PHILIPS

SERVICE MANUAL

Nordic Mobile Telephone

ap4111

This service manual is for the maintenance of ap4111 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.

CPH870601/0

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General information

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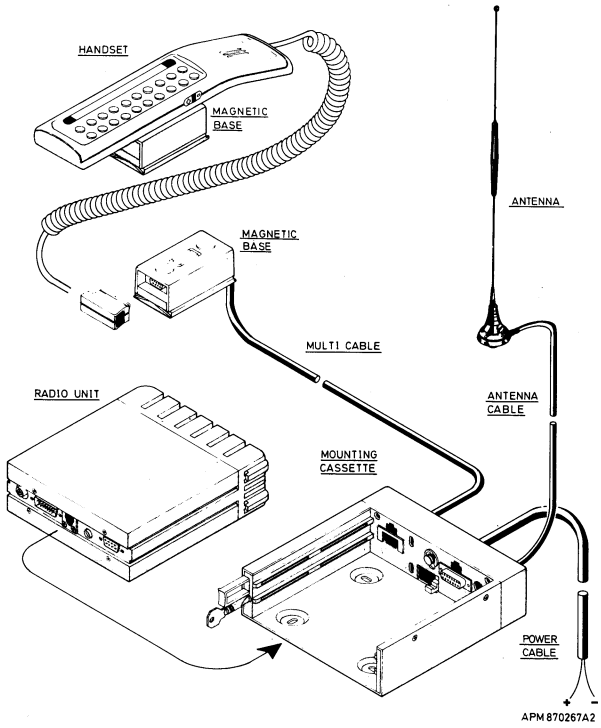
Introduction

MOBILE INSTALLATION



PORTABLE VERSION

APM860927A4

The mobile telephone ap4111 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 ap4111 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	: 453.000MHz to 457.475MHz
	Receiver	: 463.000MHz to 467.475MHz
Principle		: Digital frequency synthesizer
RF - Bandwidth		: Max. 4.5MHz
Channel spacing		: 180 channels/25kHz spacing
Channel switching time		: ≤22ms for 180 channels ≤8ms for 1 channel
Mode of operation		: Duplex, internal filter
Duplex separation		: 10MHz with 4.5MHz RF - bandwidth.
Operation temperature		: -25°C to +55°C -30°C to +60°C but specifications not guaranteed.
Frequency stability		: Better than ±5ppm for the specified temperature and supply voltage variations.
Vibration test		: According to the IEC publication 68-2-6.
Supply voltage		: 12V DC chassis neg. nom. 13.2V
Supply voltage variations		: 10.8 to 15.6V
Power consumption for NMT		: Standby: 13.2V ≤0.15A Tx 15W : 13.2V ≤5A
Antenna impedance		: 50ohms
Line input		: $75mV_{rms}$ for ±3kHz dev. at 1kHz
Line output		: $450mV_{rms}$ for ±3kHz dev. at 1kHz received
Mic. input		: $100mV_{rms}$ for ±3kHz dev. at 1kHz

2. FOR "SEMI-HANDSFREE" 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	: Nominal 92dB above $2x10^{-5}$ Pascal at 1kHz tone ±3kHz deviation
Vol. regulated from handset (nominal level adjusted internally in radio)	: -10dB and +15dB from nominal level.
Earpiece level from radio unit	: 260mV RMS at 1kHz tone ±3kHz deviation 1000mV RMS at max. vol. 75mV RMS at min. volume

The De-emphasis is located in the radio unit.

Handset microphone sensitivity	: 94dB above $2x10^{-5}$
(1kHz condenser microphone with amplifier and filter)	: Pascal free field sound pressure at 1kHz will produce a Tx deviation between ±3 and ±4.5kHz.
Line level from handset	: 100mV RMS at 1kHz tone ±3kHz deviation on transmitter.

The pre-emphasis is located in the radio unit.
A 5ohm loudspeaker is located in the handset

4. RECEIVER

Sensitivity		: Typ 0.6uV for 20dB sinad psophometric
Squelch level adjusted internally		: 0.8uV
Co-channel rejection	: Cept method	: -5dB
	: NMT method	: -5dB
Adjacent channel rej.	: Cept method	: 72dB normal test conditions
	: NMT method	: 74dB normal test conditions

Spurious and image rej.	: Cept method	: >70dB in duplex. Image 90dB
	: NMT method	: >72dB in duplex. Image 90dB
Intermodulation rej.	: Cept method	: >70dB
	: NMT method	: >72dB
Blocking	: Cept method	: >100dB
	: NMT method	: >100dB
Spurious emissions	: Antenna	: <10P
	: Cabinet	: <2nW
De-emphasis		: Following 6dB per octave curve from 0.3 to 3kHz within +1-3dB relative level at 1kHz
Harmonic distortion		: NMT method: 2%

Audio frequency

Intermodulation	: NMT method: -25dB
Hum and noise	: Cept method: -50dB RMS Psophometric NMT method: -50dB RMS Psophometric NMT method: -35dB Peak
AM suppression	: NMT method: 32dB
Function	: NMT method: <0.5dB

5. TRANSMITTER

Power output	: 15W ±1.5dB nominal between 10.8 and 15.6V : 15W ±3dB from -25^{0}C to +55^{0}C
Power reduction for ap4171	: Power reduced to 1.5W ±3dB Power reduced to 0.15W ±3dB
Carrier rise time	: 1-3ms
Carrier fall time	: <1ms
Spurious emissions : Antenna	: <25nW
Cabinet	: <2.5uW

Adjacent channel power		: 78dB below carrier power at ±25kHz
Frequency deviation		: Max. ±4.7kHz (supervisory ±300Hz)
Pre-emphasis		: Following 6dB per octave curve from 0.3 to 3kHz within +1-3dB relative level at 1kHz
Harmonic distortion		: <2% at ±3kHz deviation and 1kHz mod. frequency
Audio intermodulation	: NMT method	: -50dB RMS psophometric : -24dB peak
Hum and noise in "handset" operation		
(residual mod.)	: Cept method	: -48dB RMS Psophometric
	: NMT method	: -48dB RMS Psophometric
	: NMT method	: -24dB Peak

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 other 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. Teleteknik, 1982, No. 1
2. NMT DOC. 1-4

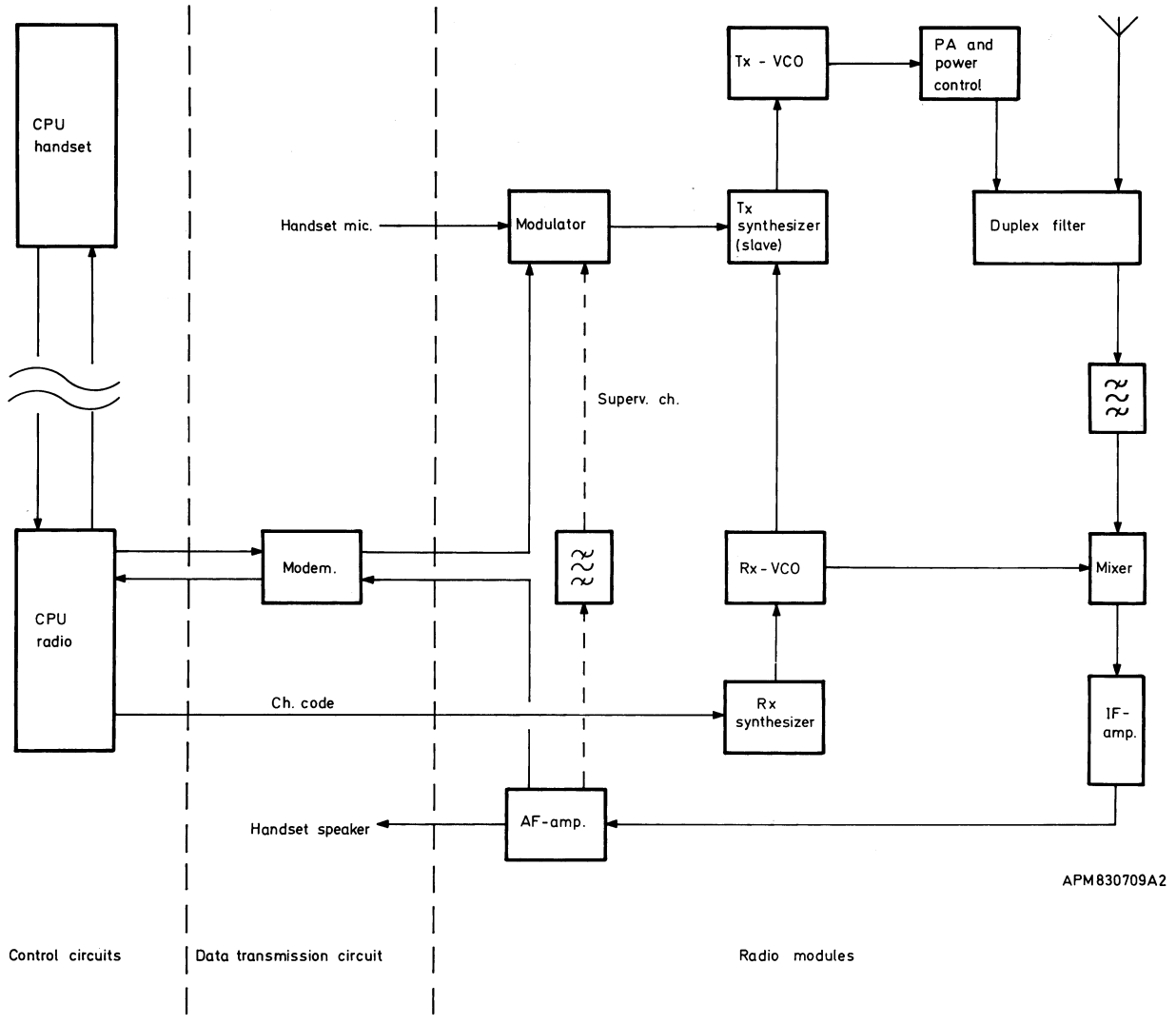


Fig. 1 Simplified block diagram

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:

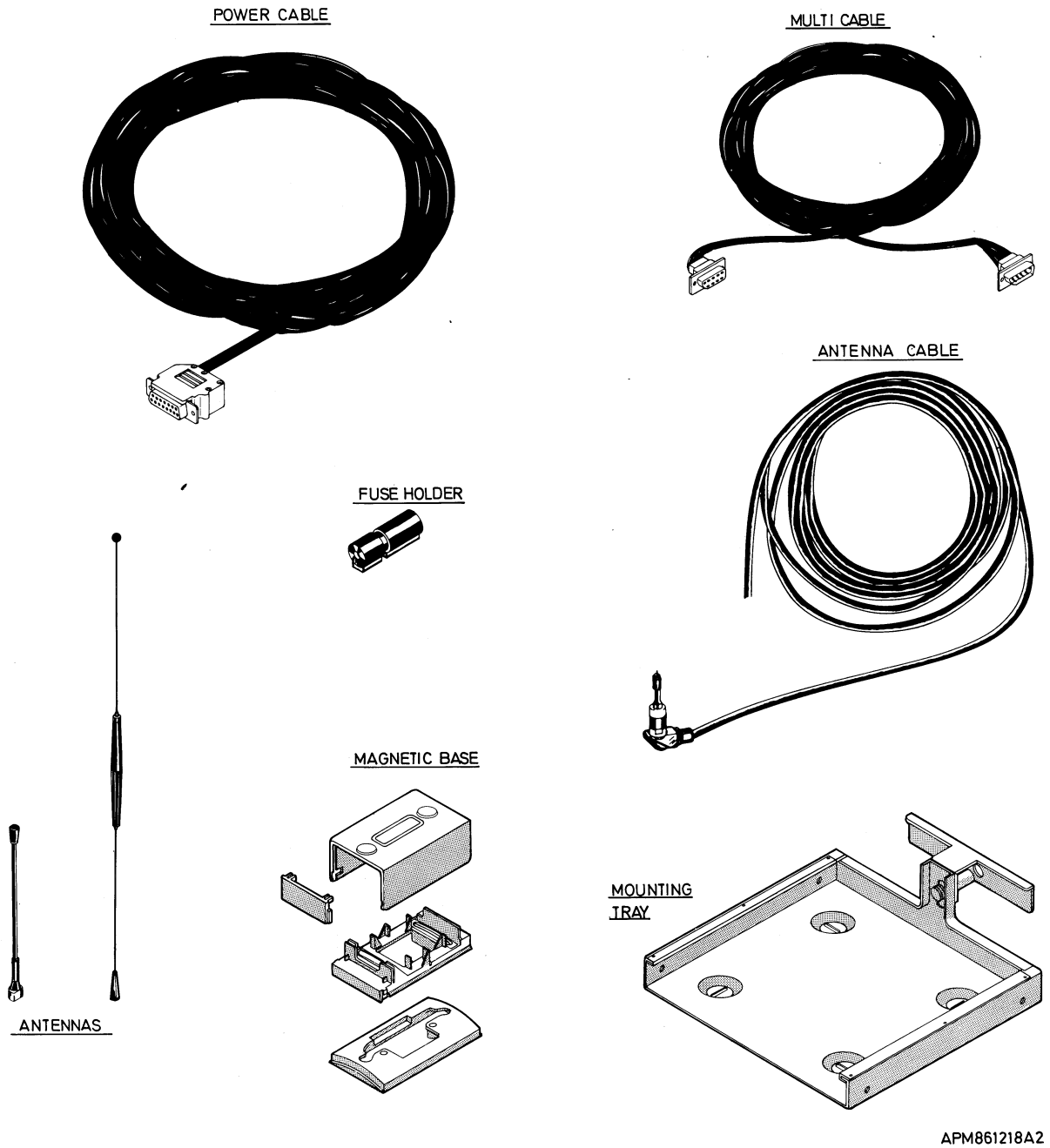

Fig. 1 Mounting tray kit

The kit furthermore includes:

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

2. MOUNTING CASSETTE KIT:

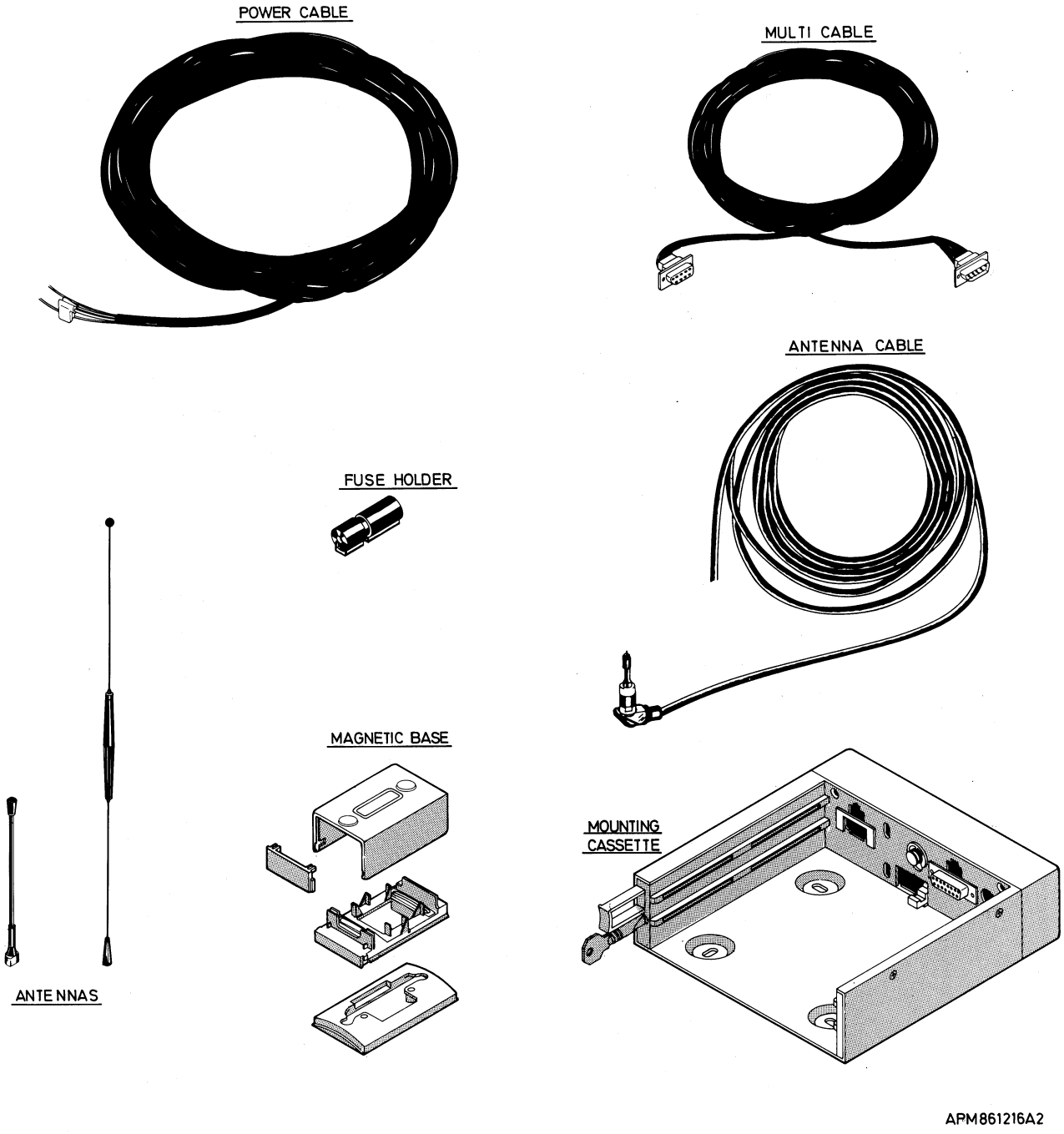

Fig. 2 Mounting cassette kit

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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.

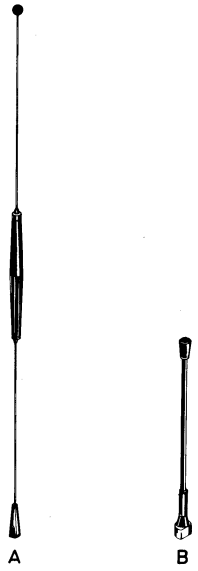

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Fig. 3 Antenna survey

Type A delivers +4dB more than type B.

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

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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:

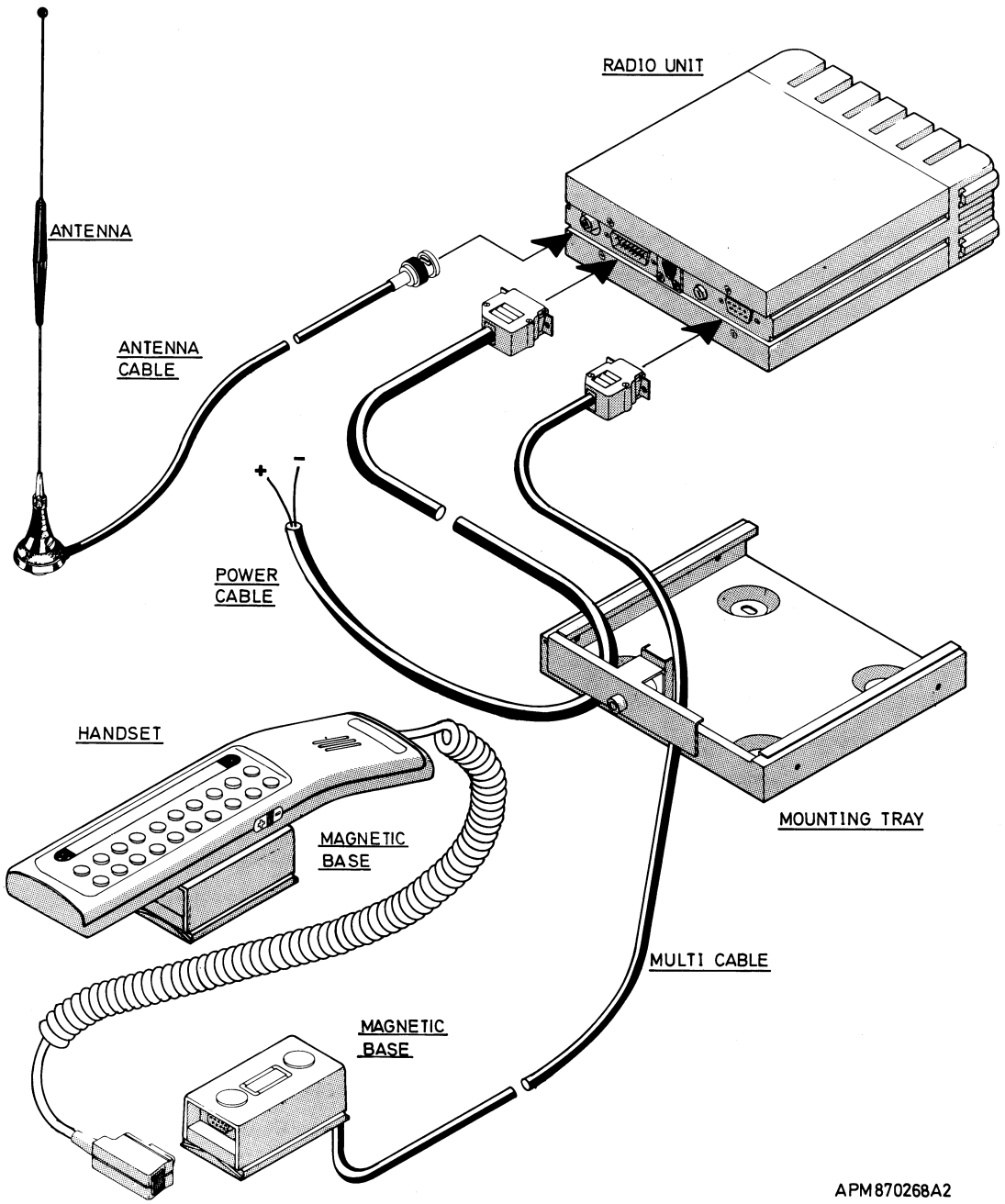

Fig. 5 Cable connections, mounting tray kit

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:

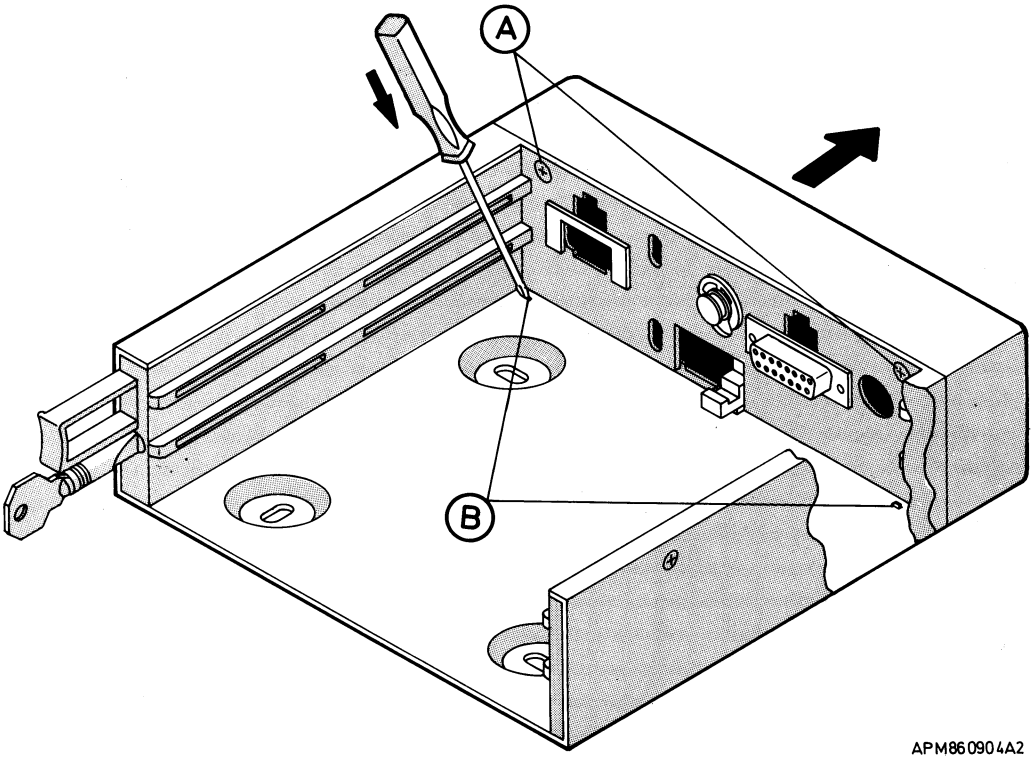

Fig. 6 Removal of the rear cover

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:

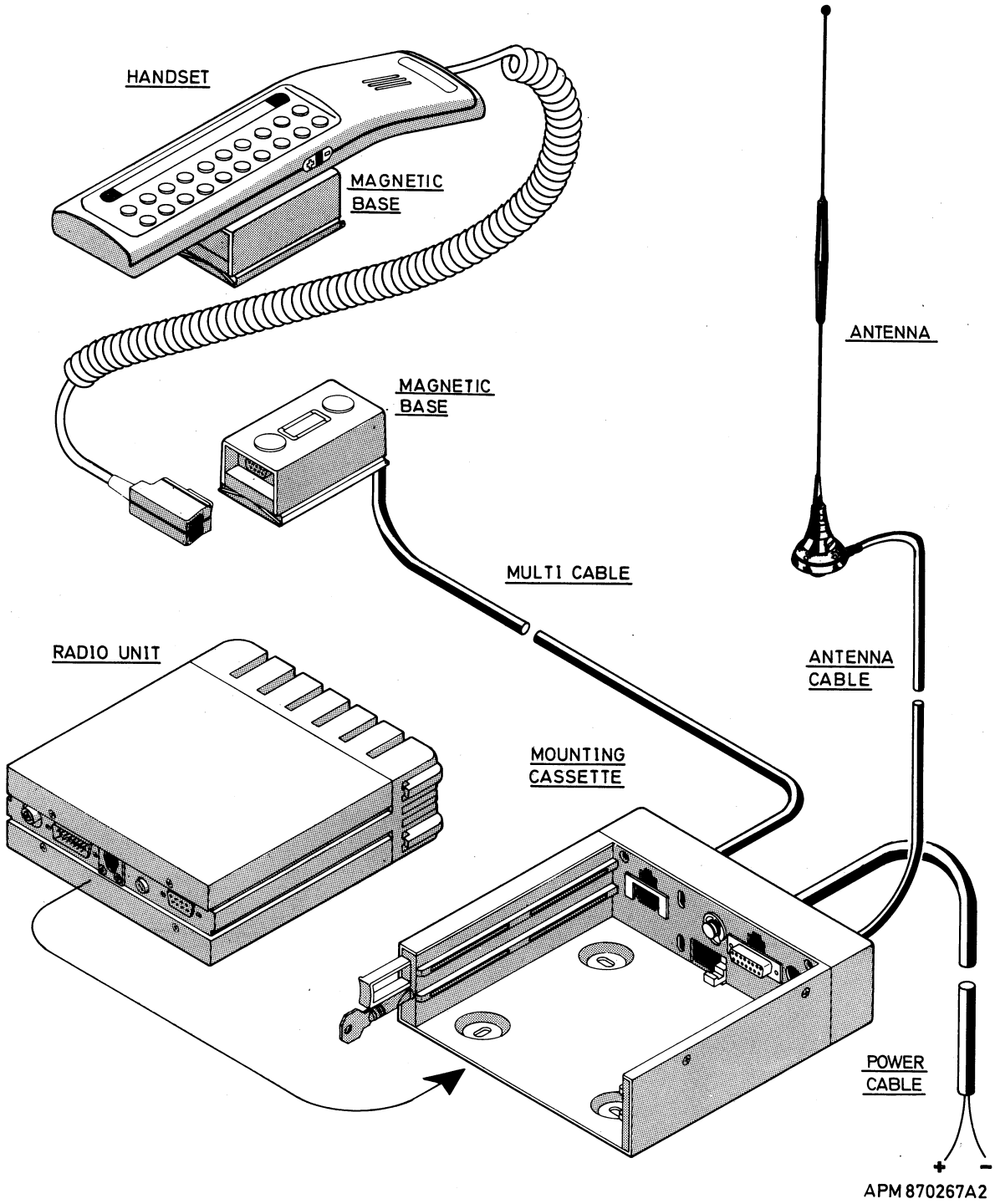

Fig. 7a Cable connections, mounting cassette

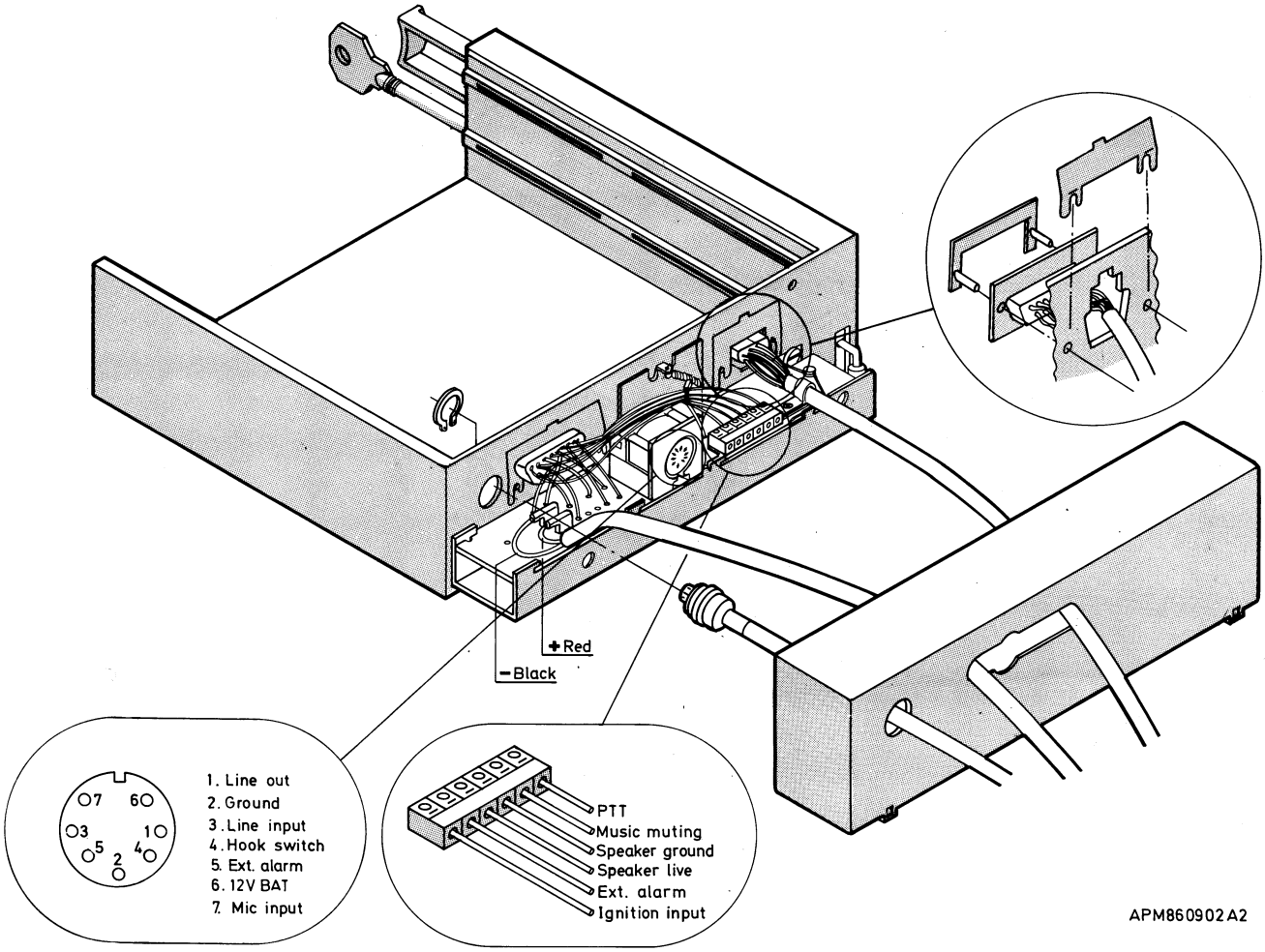

Fig. 7b Cable connections, rear view of the mounting cassette

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.

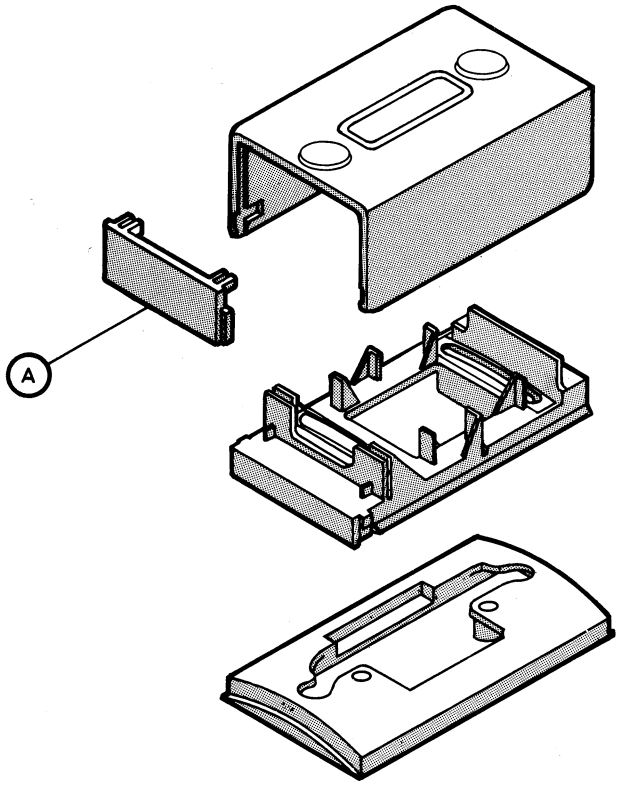

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Fig. 8 Magnetic base

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.

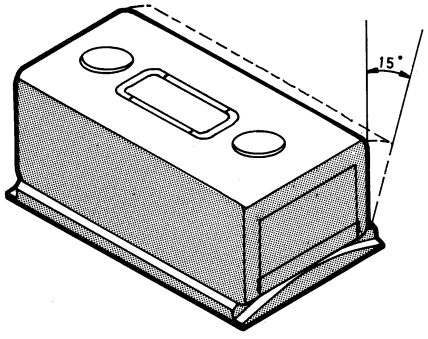

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Fig. 9 Mounting positions, magnetic base

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

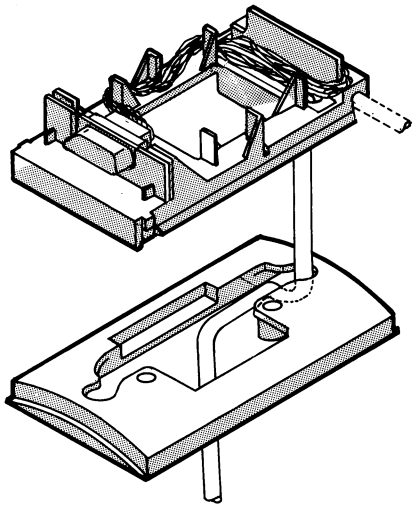

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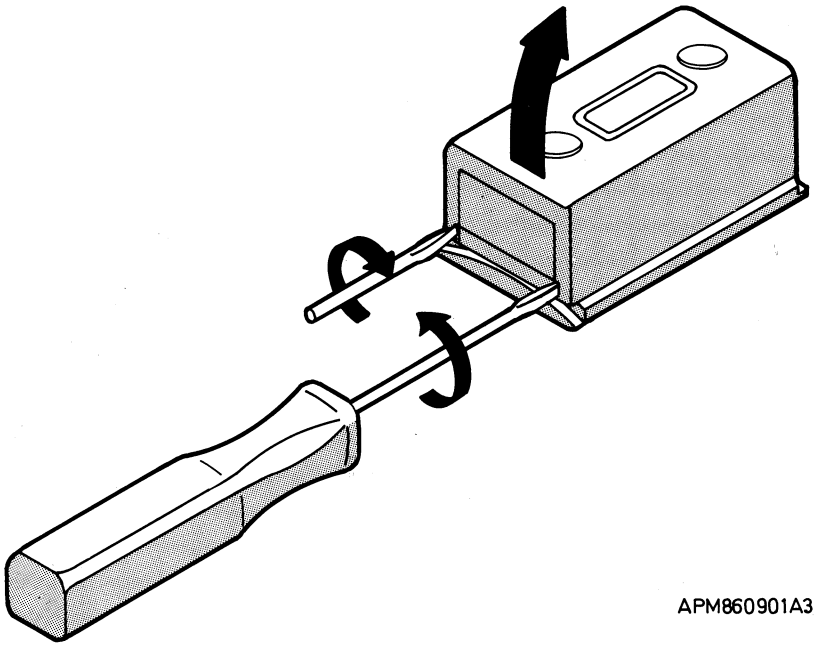
Fig. 10 Strain relief in magnetic base

Disassembling of the magnetic base:

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



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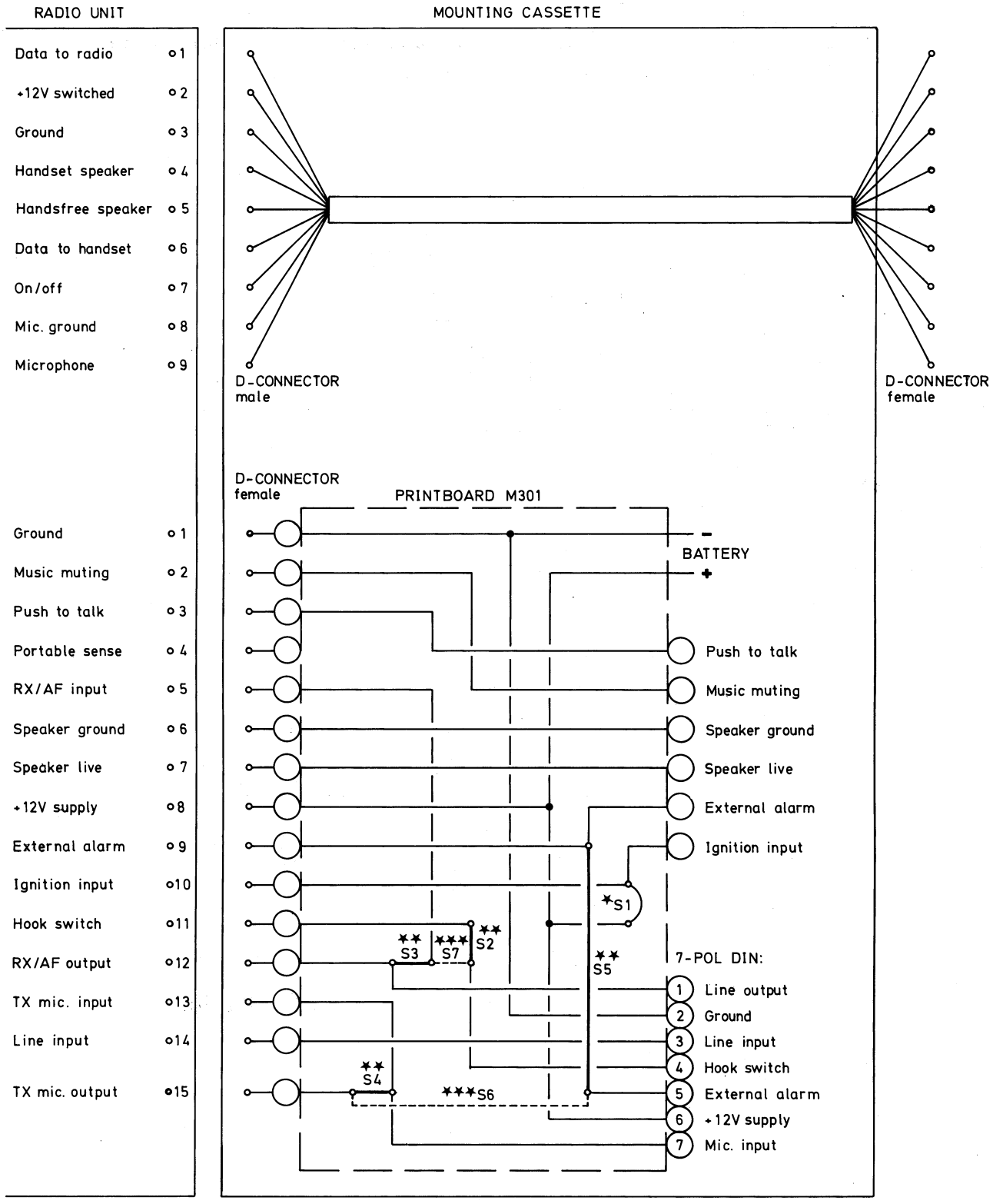
- lift up the cover.

Wiring diagram



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

OPTION: ***Wire strap mounted when scrambler is used

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Fig. 13 Wiring diagram

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Connections of options

1. External alarm (Horn alarm):

The active status of the external alarm output is LOW. The horn relay should therefore be coupled in one of the following ways depending on the car's installation.

FIGUR X

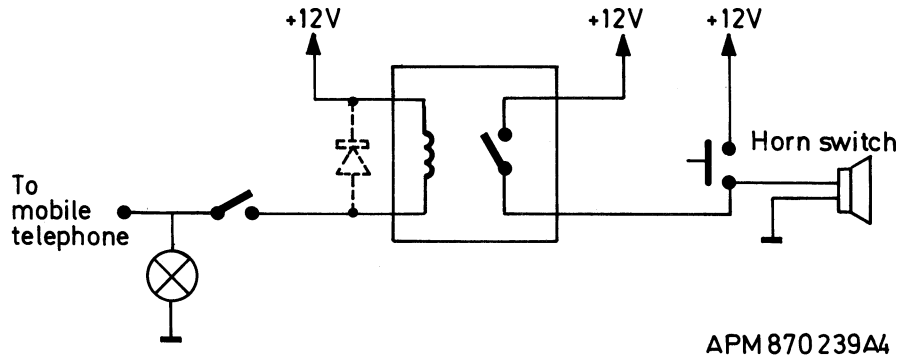

Fig. 14 Horn relay connections I

FIGUR Y

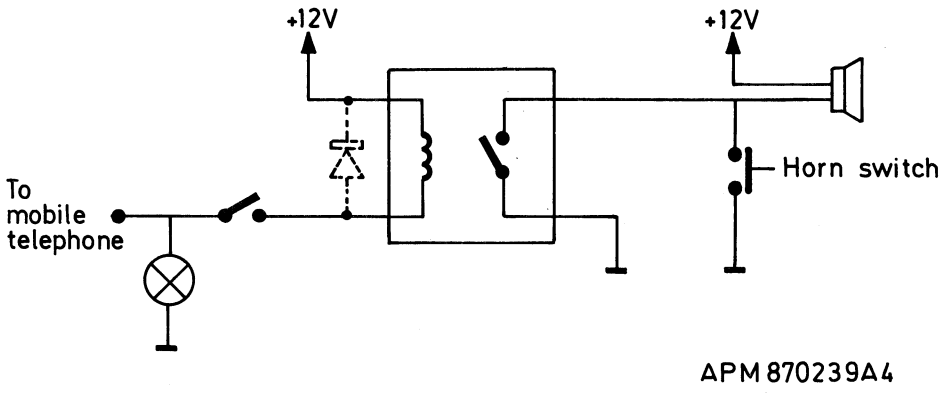

Fig. 15 Horn relay connections II

2. Music muting:

The active status of the music muting output is LOW. The music muting relay should therefore be coupled as follows:

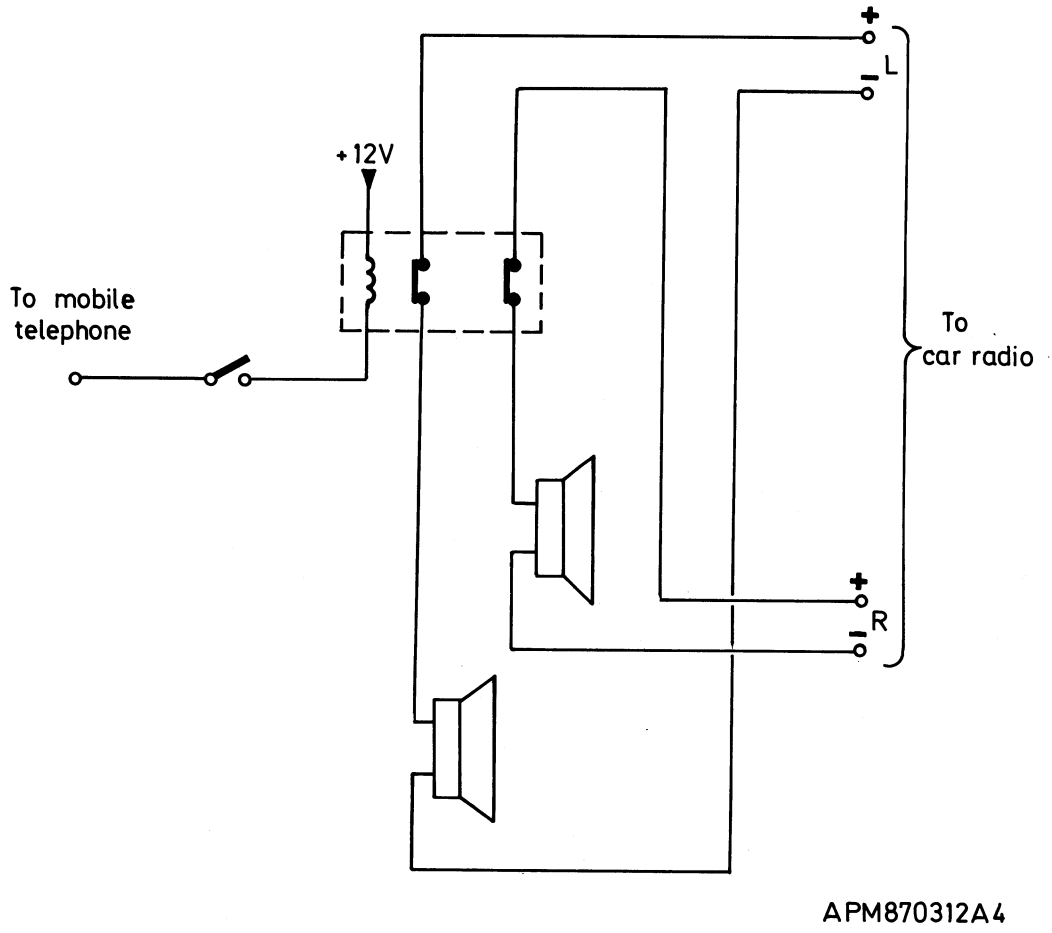

Fig. 16 Music muting relay connections

3. Ignition time-out:

To use the ignition time-out facility the ignition input terminal should be provided with +12V from the ignition key (position: motor switched ON).

NOTE: If the mobile telephone is mounted in a mounting cassette remember then to remove the wire strap S1 on the mounting cassette print.

Detailed operation instructions ap4111

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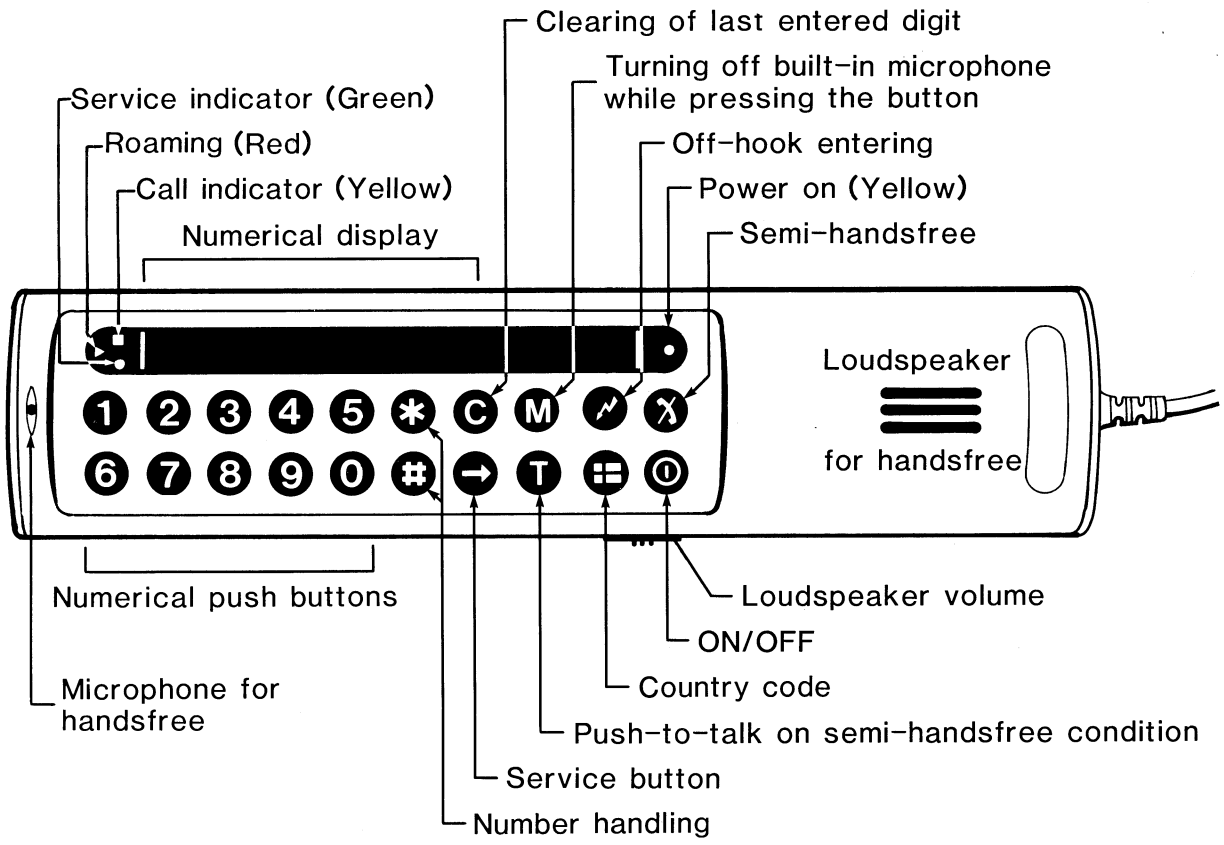
1. KEYS AND DISPLAY

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.

Refer in all cases to this drawing:



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2. TURNING ON THE SET

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

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

When power has been turned on, the yellow "ON" lamp below the 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.

3. SERVICE INDICATORS

Three indicator lamps are located below the display.

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.

4. 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 eigth 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.

5. MAKING A CALL

Turn the set on. The Power ON lamp will be lit.

Before initiating the call, check the indicator lamps below the display.

A green light (service indicator) 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 maybe necessary.

A red light (roaming) indicates that the radio is not in proper contact with the base station. (For further details, see section 3, "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 pressing ⊟ .

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

Enter the subscriber number (max 22 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 Ⓜ 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 3 "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 3 "service indicators).

D. Clearing an incorrect number or digit

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

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. The yellow LED (call indicator) will be flashing.

The green service indicator lamp will switch off when your set has been called.

To answer the call, simply lift the handset from its magnetic base, and both the alternation tone and the yellow (call) indicator 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 call indicator 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 ⏻ .
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 T 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.

Switch from normal conversation to semi-handsfree conversation is made by pressing ⌥ with the handset off the magnetic base.
Switch from semi-handsfree mode to normal conversation is made by pressing ⌥ with the handset off the magnetic base.

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 98 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 22 digits. The full number is retrieved from the memory by a 2-digit abbreviated code, running from 01 to 98.

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

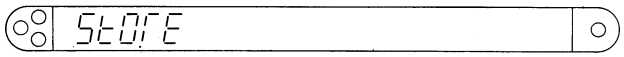
The short number "00" is reserved for entering a new phone number during conversation.
The procedure for this feature is included in article G of this section (subscriber procedure).

B. Storing a number in the memory

EXAMPLE I

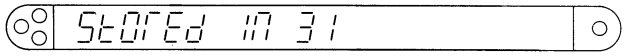
Enter the subscriber number 01324678 and press → , 1 .

The display now shows:

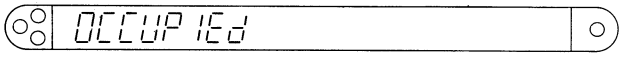


Enter the short number e.g. 31 # .

The display now shows:



If the location was occupied
The display shows:

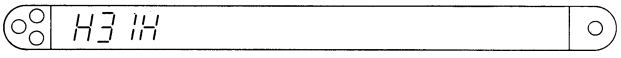


Press C for entering the new number in another location or press # and the subscriber number 01324678 will replace the previously stored number. The whole number or part of it can be stored, e.g. country and area code, whereas you enter the rest of the number.

EXAMPLE II (Another way of storing a number).

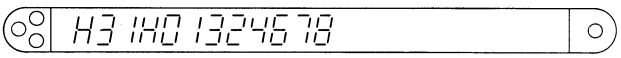
Enter the Short number by pressing * 31 * .

The display will now show:



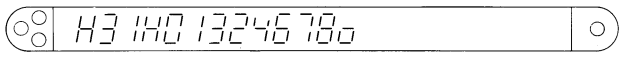
Enter the subscriber number 01324678 by using the keyboard.

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 #.

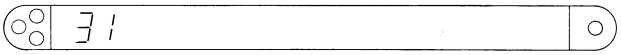
If a subscriber number contains more than 12 digits, the code indication shown (H31H in the example above) will disappear from the display, digit by digit, to accommodate the full subscriber number up to 22 digits. Press M to see the remaining part of the number.

C. Recalling a stored number by entering an abbreviated number

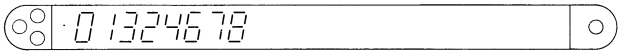
Once again the subscriber number 01324678 and associated code number 31 are taken as examples.

EXAMPLE

Enter 31 by the keyboard.
The display will show:



Press the button marked # .
The display now shows:



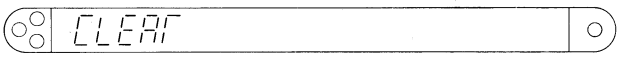
The associated subscriber number has now appeared on the display, allowing you to check the number for accuracy before lifting the handset to transmit.
In addition to storing complete subscriber numbers, the abbreviated entering facility may also be used to store other pieces of information such as frequently 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

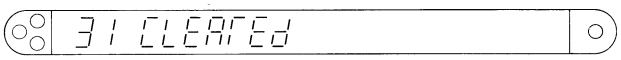
EXAMPLE I

The subscriber number can be cancelled by → , 1 being pressed.

The display now shows:



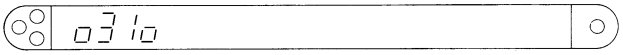
Press 31 # .
The display now shows:



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

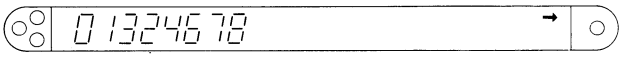
You may wish to check the memory for many reasons:

To determine whether a particular subscriber number is correct.
To check whether a certain short number is free, etc.

EXAMPLE

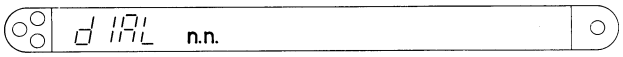
Check the memory contents for abbreviated number 31:

Enter 31 → , # .
The display now shows:

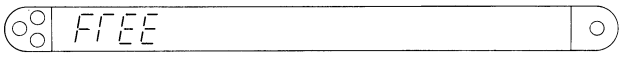


The arrow is flashing on the display.
You can now step forward through the memory by pressing * to check the next abbreviated number or backward by pressing # .

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:



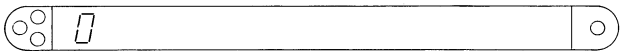
F. Recalling the last called number

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 ↗ being pressed).

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.

H. Call transfer (Special PTT service)

Call transfer is activated when * nn * s....s # , ↗ are being pressed.
This activates the function, and the telephone number s....s, to which the calls are to be transferred, is transmitted to the PTT.
The subscriber number to which the calls are transferred is stored as the short dial number 98.
* nn # , ↗ activates call transferring to a previously agreed number.
* , # nn # , ↗ is a check whether the call transferring function is activated or not.
nn can be 21, 23, or 63 depending on which service you want.
An → is shown in the display when the call transfer function is selected.

9. PROGRAMMING OF RINGING, ALARM AND LIGHT

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

1. Changing the ringing signal.
   Enter 0 ➔ 3 = Low ringing signal.
   Enter 1 ➔ 3 = Twice a low ringing and after that a high ringing signal.
   Enter 2 ➔ 3 = High ringing signal.

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

2. External alarm.
   Enter 3 ➔ 3 = No external alarm connected.
   Enter 4 ➔ 3 = Twice ringing signals without the external alarm connected and after that the external alarm connected.
   Enter 5 ➔ 3 = External alarm connected.

When the mobile telephone has been switched OFF/ON, it automatically returns to "No external alarm connected"(3).

3. Keyboard beeper.
   Enter 6 ➔ 3 = Keyboard beep connected.
   Enter 7 ➔ 3 = Keyboard disconnected.

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

4. Illumination light in mobile installations.
   Enter 8 ➔ 3 = Light AUT. (Light in display for 30 seconds when a button is pressed or a call is received.
   Enter 9 ➔ 3 = Light ON.

When the mobile telephone has been switched OFF/ON, it automatically returns to "Light AUT." (8).

5. Illumination light in portable installations.
   Enter 8 ➔ 3 = Light OFF.
   Enter 9 ➔ 3 = Light AUT.

When the mobile telephone has been switched OFF/ON, it automatically returns to "Light OFF". (8).

With empty display: the handset status can be shown on the display for ten seconds when ➔ 3 are being pressed.

10. COUNT THE TIME YOU CALL

The mobile telephone has two counters to count the call time. These will be shown when → , 5 are being 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.

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

B. Locking level 2

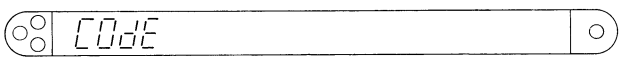
This level allows only emergency calls and the short numbers from 0 to 9.
Emergency numbers which are allowed:
Denmark and
Finland : 000
Sweden : 90000 and 90XYZ
Norway : Numbers which begins with 000,001,002 or 003.

LOCK FUNCTION

The lock function at level 1 is activated when you press 1 , → , 6 , 6 , 6 .
An L is displayed when the first two 6 's are pressed indicating that lock is in progress.
When the last 6 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 2 , → , 6 , 6 , 6 .
A key on the display indicates that the telephone is locked at level 2.

To unlock

With ⊸0 on the display, press → and 6 . On the display is shown:



Now you enter your personal 4-digit keyword and, if correct, the ⊸0 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 telephone remains locked and the sign ⊸0 is still shown on the display.

12. 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 → , T . When → , T 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.

13. FIELD STRENGTH DISPLAY

There is often a great 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 → , 0 . 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.

14. 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.

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 ➔ , Ⓜ to initiate the MFT situation. The yellow indicator (CALL) 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 ➔ , Ⓜ 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 ➔ , Ⓜ .

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.

15. 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 16 hours.

16. LIST OF SERVICE KEY FUNCTIONS

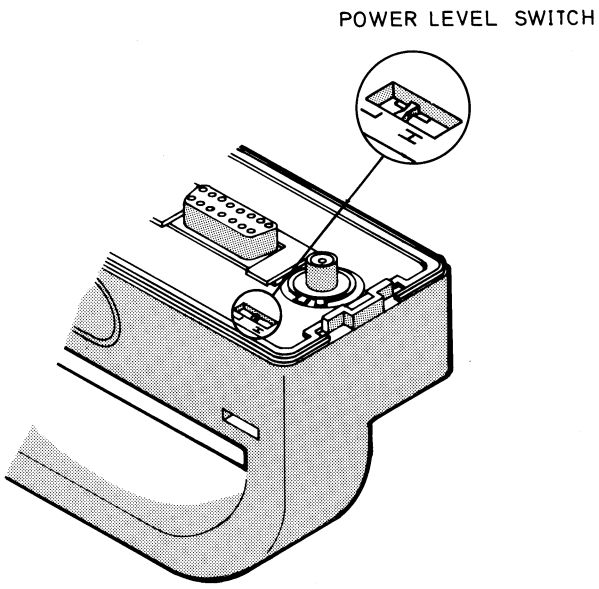
All the functions mentioned below have already been discussed earlier in this chapter in detail. This serves as a listing of the functions.
All these functions are activated by → (service key) being pressed first, and then some other key. When the service key is pressed, an arrow begins to flash on the 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 C 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:

→ , 0 = Field strength display
→ , 1 = Short dial number function
→ , 2 =
→ , 3 = Status line (acoustic signals and light)
→ , 4 =
→ , 5 = Time counter
→ , 6 = Locking function
→ , 7 =
→ , 8 = Zeroing time counters
→ , 9 =
→ , C = Erase line
→ , M = MFT signalling
→ , T = Light
→ , # = Scrolling through short dial numbers downwards
→ , * = Scrolling through short dial numbers upwards

17. PORTABLE KIT

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



This switch controls the output power from the radio when it is used as a portable radio.

Position "H": Allows the radio unit to use all three power levels.

Position "L": Allows the radio unit only to use the Low and Medium output power levels.
(This is to save battery power).

NOTE: When the portable mobile telephone is used with an external power supply, the telephone automatically shifts from Low power output to High power output, while the external power supply is used.
However, the display still reads low power output.

The transceiver

CONTENTS **PAGE**

Disassembling of the transceiver

1. Removing of the cover

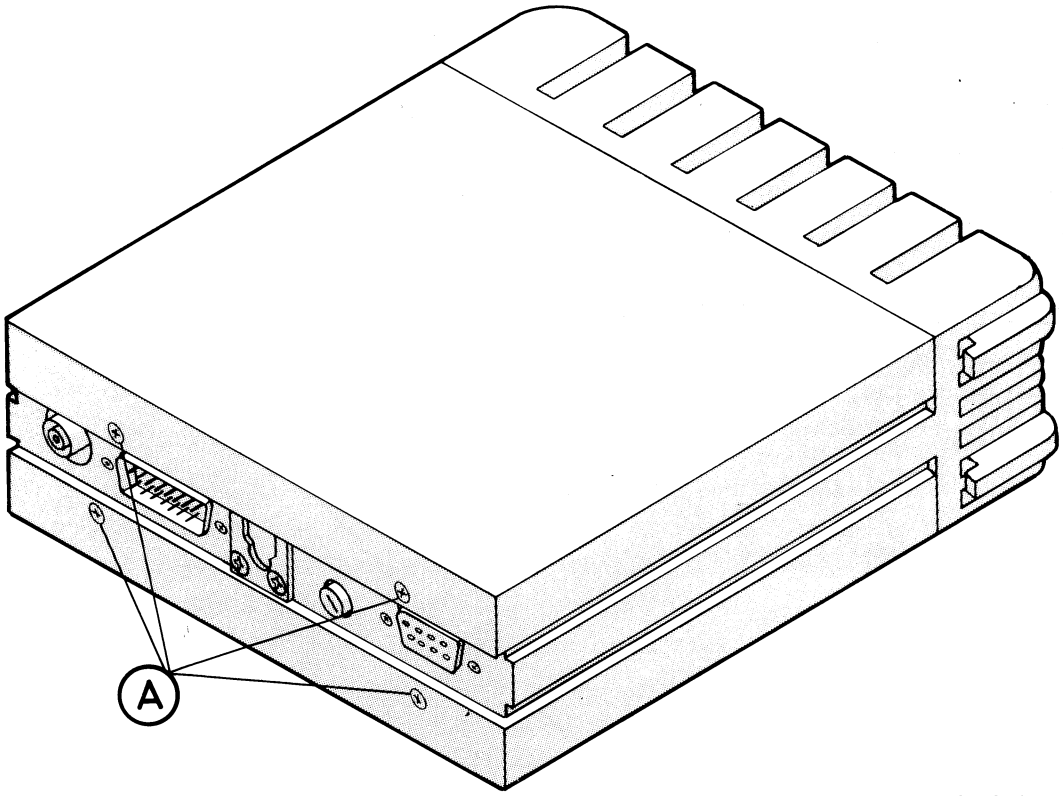


Fig. 1 Transceiver

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

2. Replacement of the transceiver part U2, 3 and 4

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, 3 and 4 can now be lifted 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 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) .

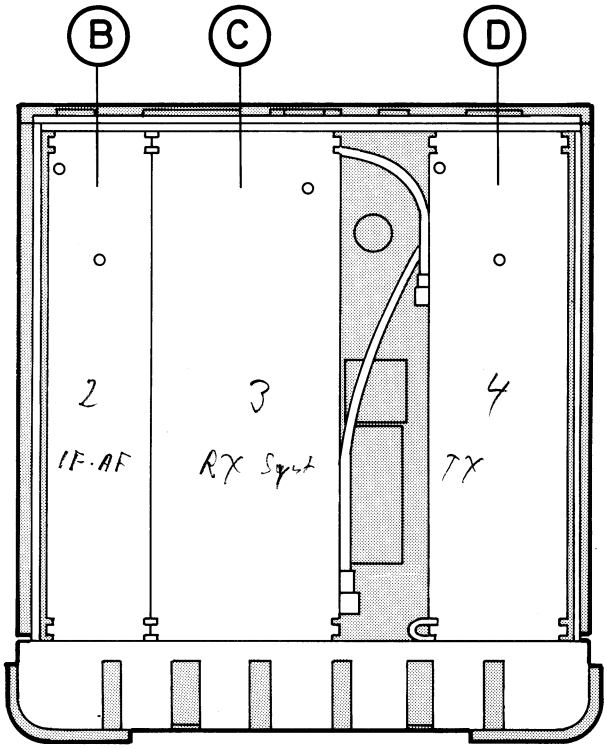


Fig. 2

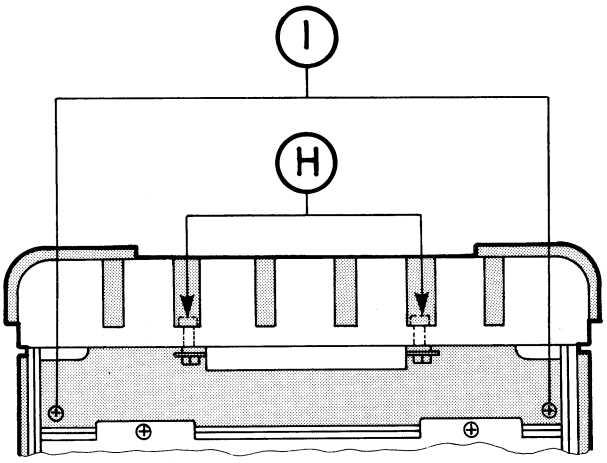


Fig. 4

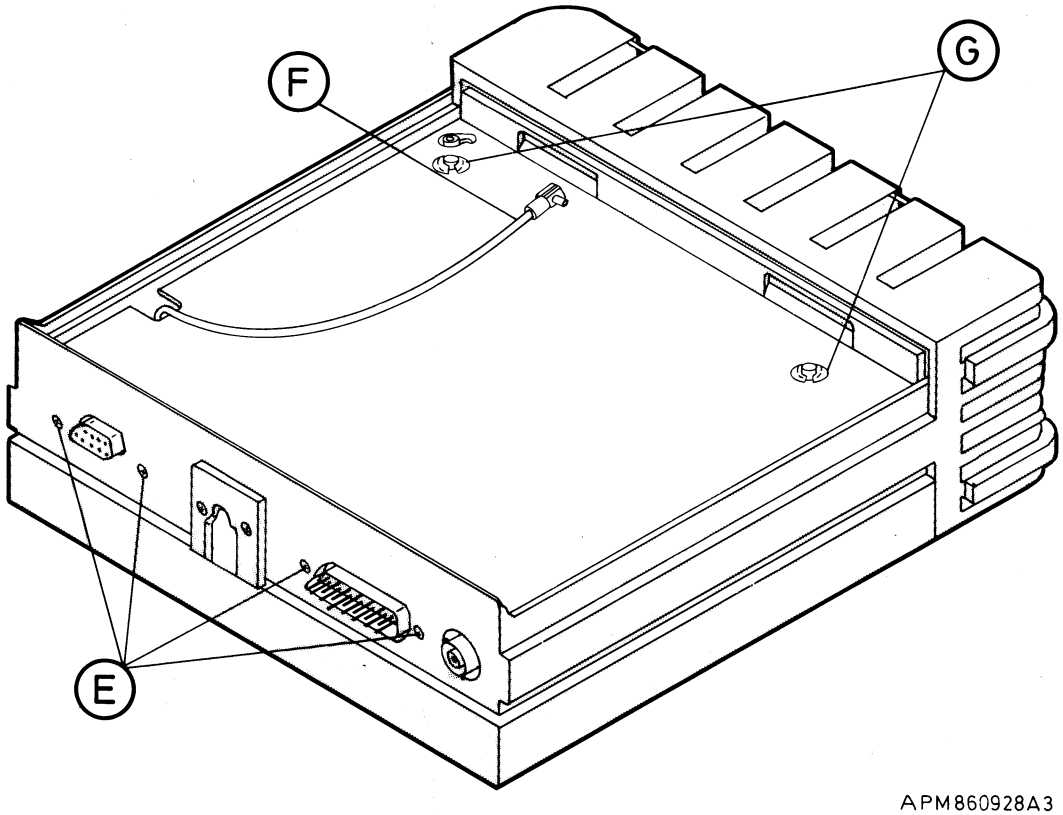


Fig. 3

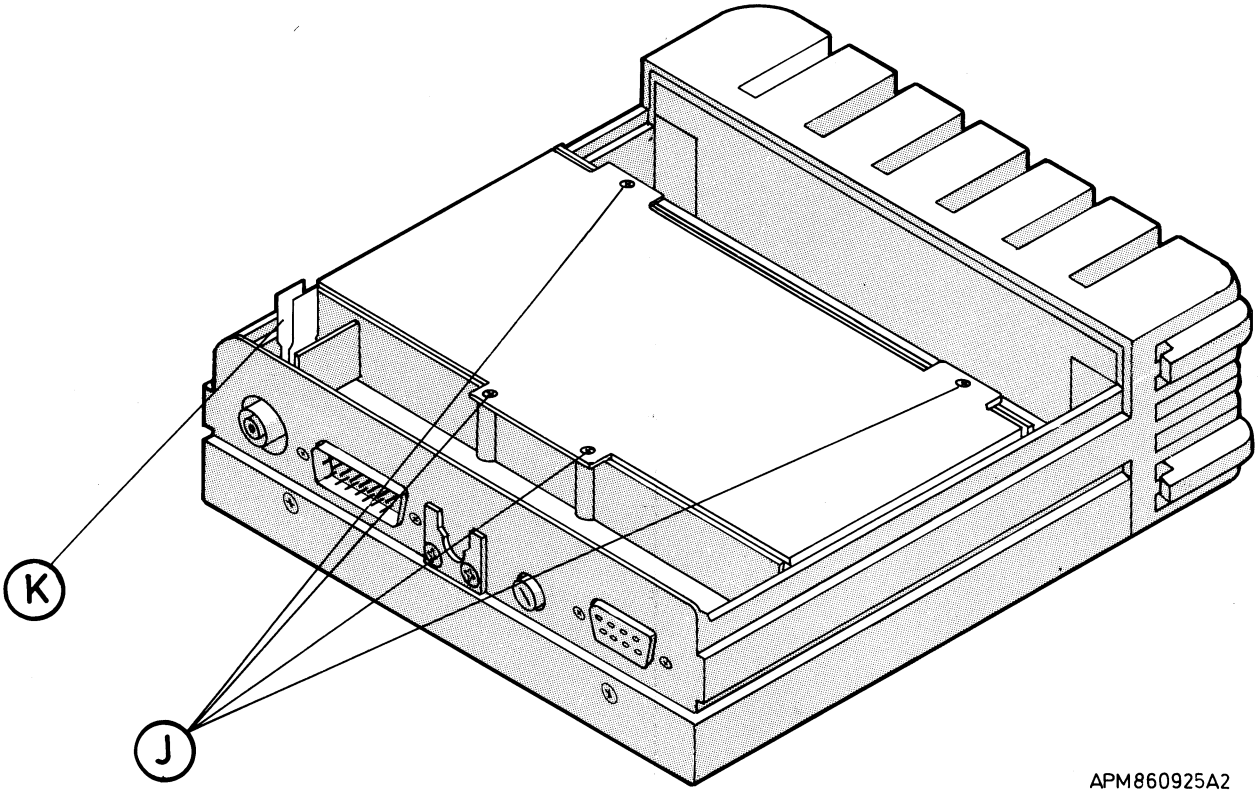


Fig. 4

Description of the transceiver

In the following chapters the block diagram of the transceiver will be explained.
Please remember the following notes:

- The battery voltage is shown as +13.2V.
  The reason is that 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, and the main signal paths are indicated by heavy lines. 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 a 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).

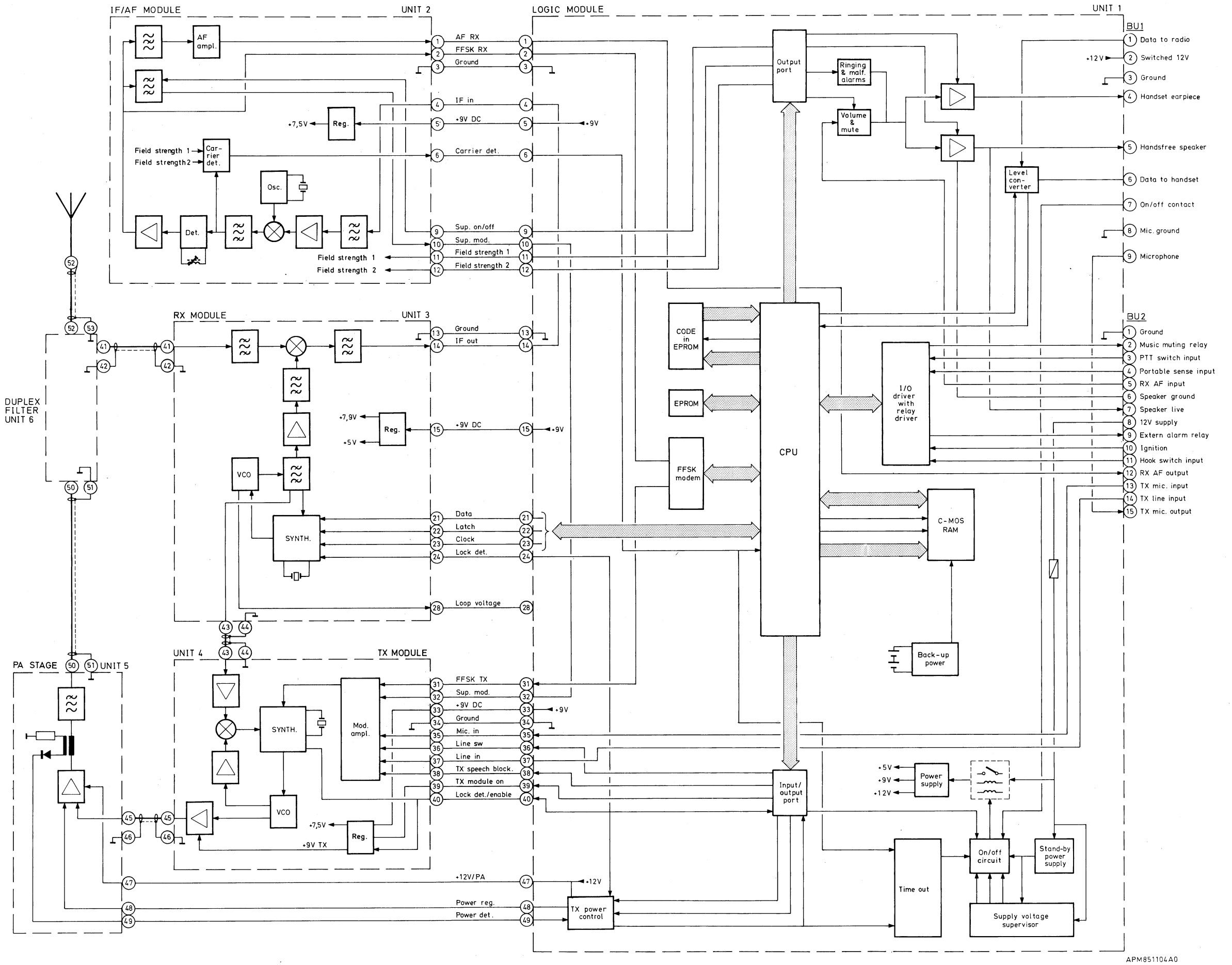
CAUTION: When a module has to be repaired, the requirement for SMD-handling must be observed.

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.

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 received antenna signal is fed through the duplex filter to the RX-synthesizer unit 3. Here it is converted to an IF-signal at 70MHz. The synthesizer is controlling the RX-VCO which works in the area 393.000MHz to 397.475MHz. As a reference the RX-synthesizer IC is provided with a 2.1MHz 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 which runs with a frequency at 453.000MHz to 457.500MHz. 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 TX-frequency always is fixed 60MHz above the RX-VCO frequency (gives 10MHz duplex separation).
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.



CPH870604/0

Fig. 5 Block diagram, transceiver

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 full-filled. The supply voltage must be above 10V (monitored by IC7/1) and below 17V (monitored by IC6/2), since all inputs on IC5/1 must be low to switch ON the radio. R19/C13 secures that the switch ON function can not 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 happens 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 is 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 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 monitores 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 to intefere 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 12.096MHz. 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.
Telephone number and lock code can be placed as a code in the EEPROM.
The modem is completely integrated with a clock frequency of 1.008MHz, derived from the microprocessor's clock.
The serial link to the handsets 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 wil 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 of 1.008MHz 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 received audio 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 changes between 700 and 1300Hz.
The sum of the received audio 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 35.

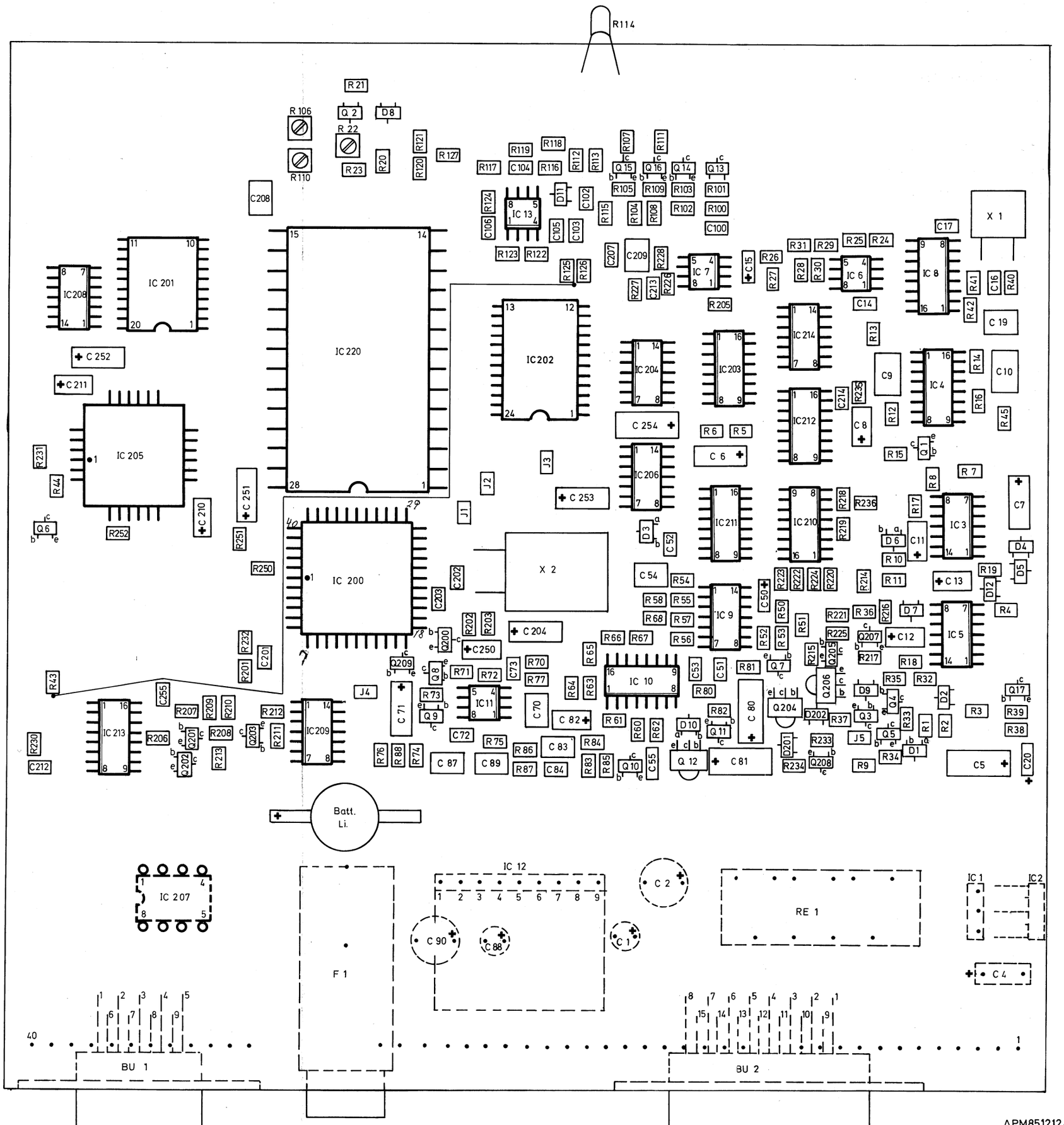


Fig. 6 Component location, system board, unit 1

CPH870604/0

Relæ RE1 skal have 6 V for at trække, men kun 2 V for at sluttede, ellers slår relæet straks til igen og bliver hængende. Begrænsning i slutspænding styres af diode D9

Hornophold styret af ringesignal
IC 9 ben 9 forbindes t/C R 216.
IC 212 ben 6 fralodder

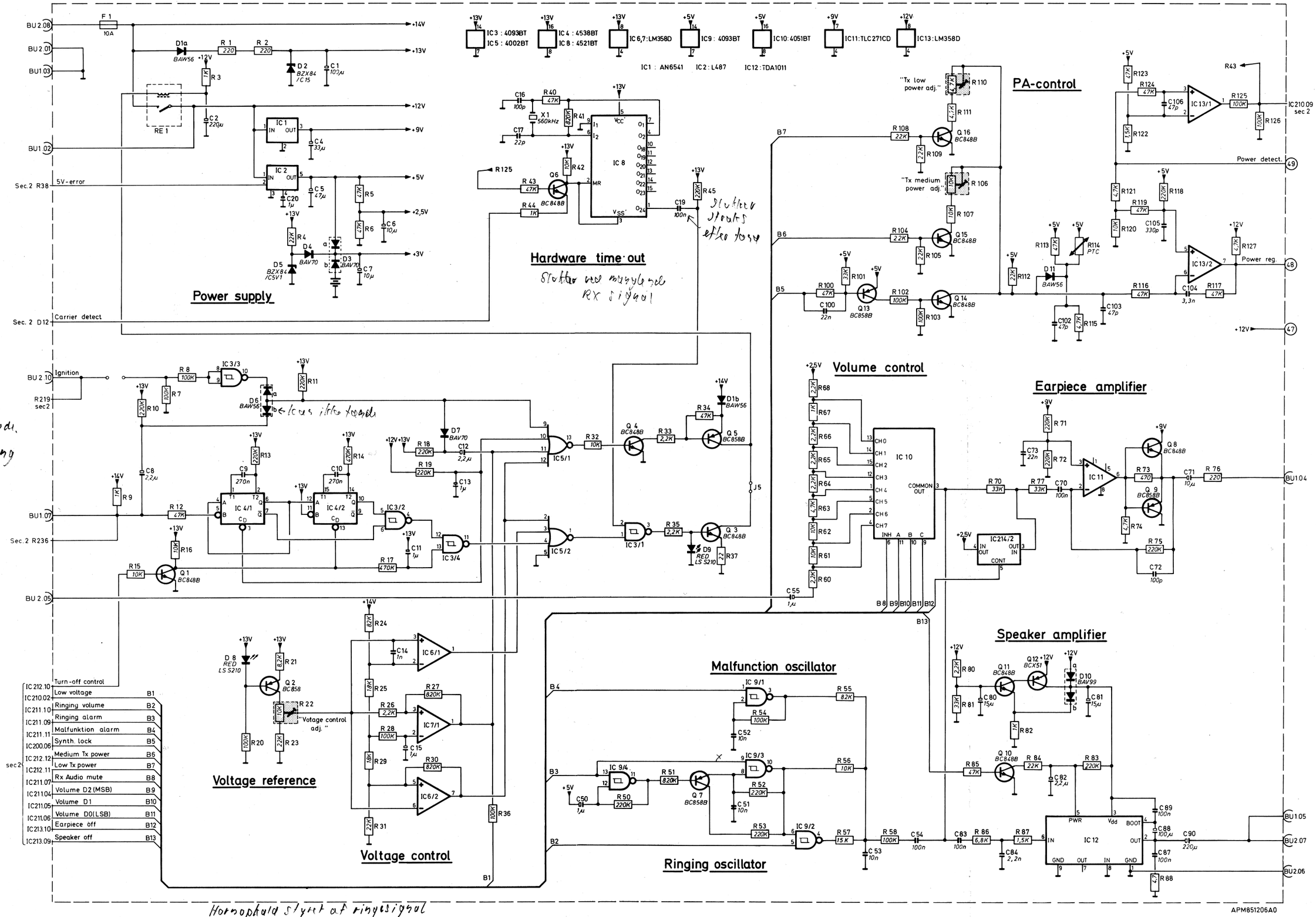


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Fig. 7 Circuit diagram, system board, unit 1 sect. 1

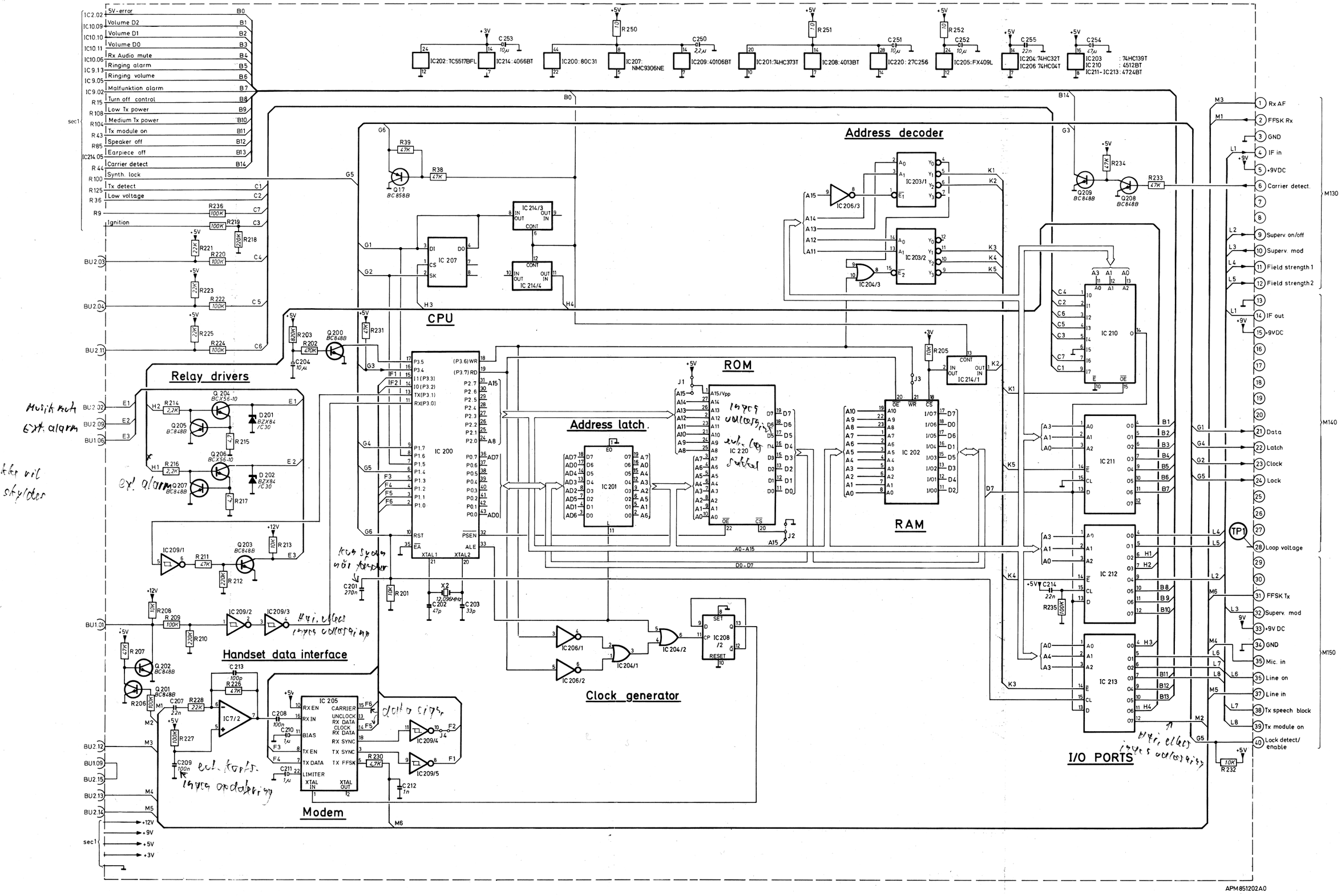

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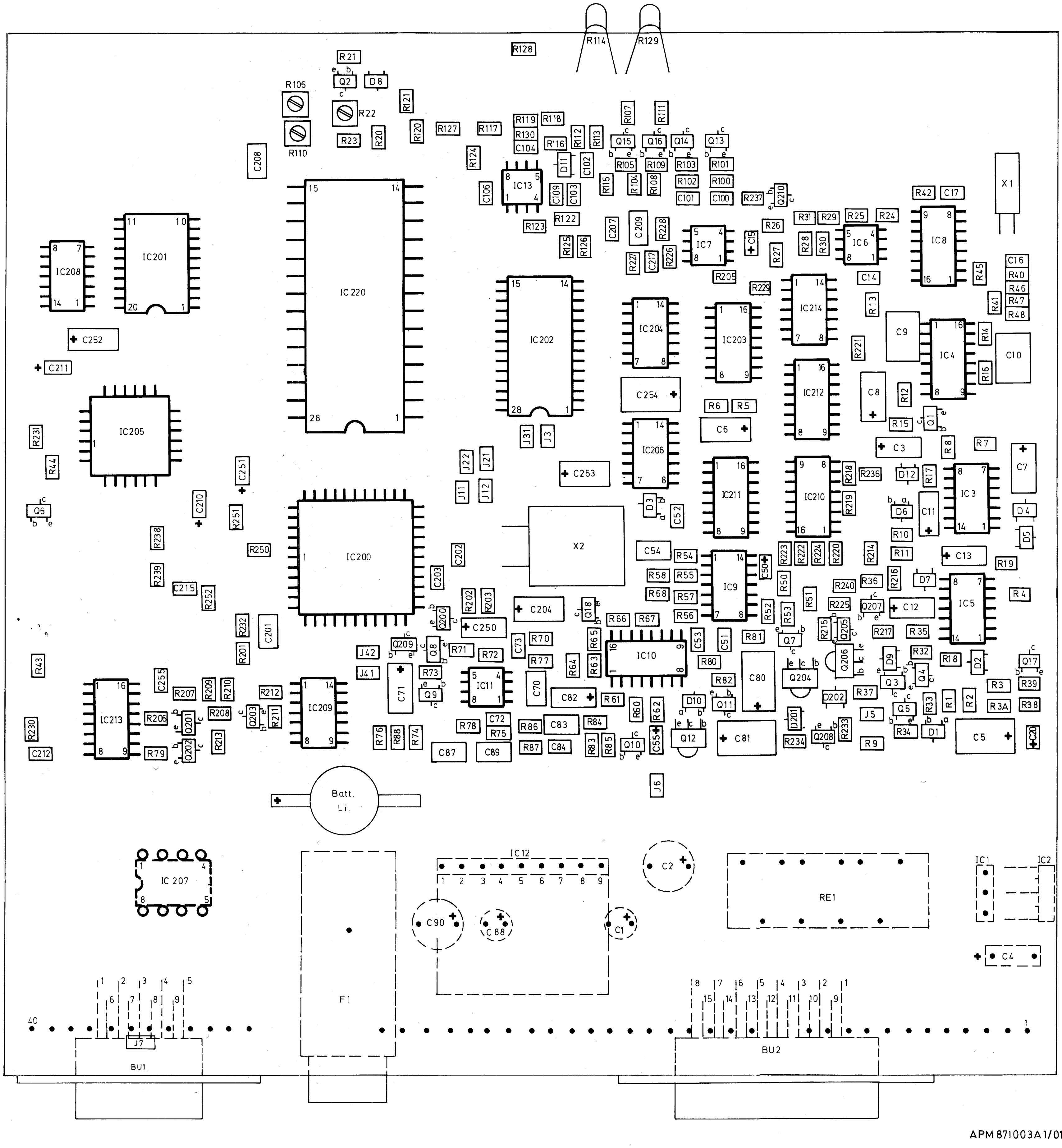
Fig. 8 Circuit diagram, system board, unit 1 sect. 2



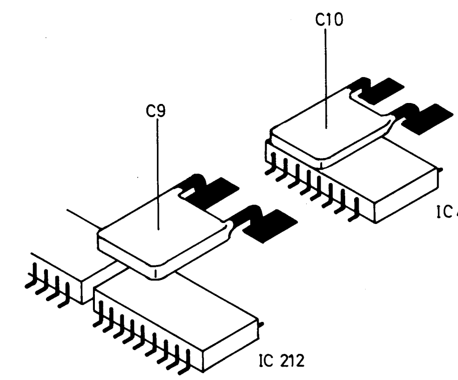


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Fig. 8a Component location, system board, unit 1
Marked 3508 101 6124X

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IC1 : AN6541 IC2 : L487 IC12 : TDA1011

IC3 : 4093BT IC5 : 4002BT
IC4 : 4538BT IC8 : 4521BT
IC6,7 : LM358D
IC9 : 4093BT
IC10 : 4051BT
IC11 : ML1776CD
IC13 : LM358D

Power supply

PA-control

Volume control

Earpiece amplifier

Voltage reference

Voltage control

Malfunction oscillator

Ringing oscillator

Speaker amplifier

*R75 : 220K
C72 : 100p
IN M120-A: 3508 102 22180

R75 : 470K
C72 : 47p
IN M120-B: 3508 102 22400
M120-C: 3508 102 22410

** C3 :
Only in M120-C
3508 102 22410

APM871005A0

Fig. 8b Circuit diagram, system board, unit 1 sect. 1
Marked 3508 101 6124X

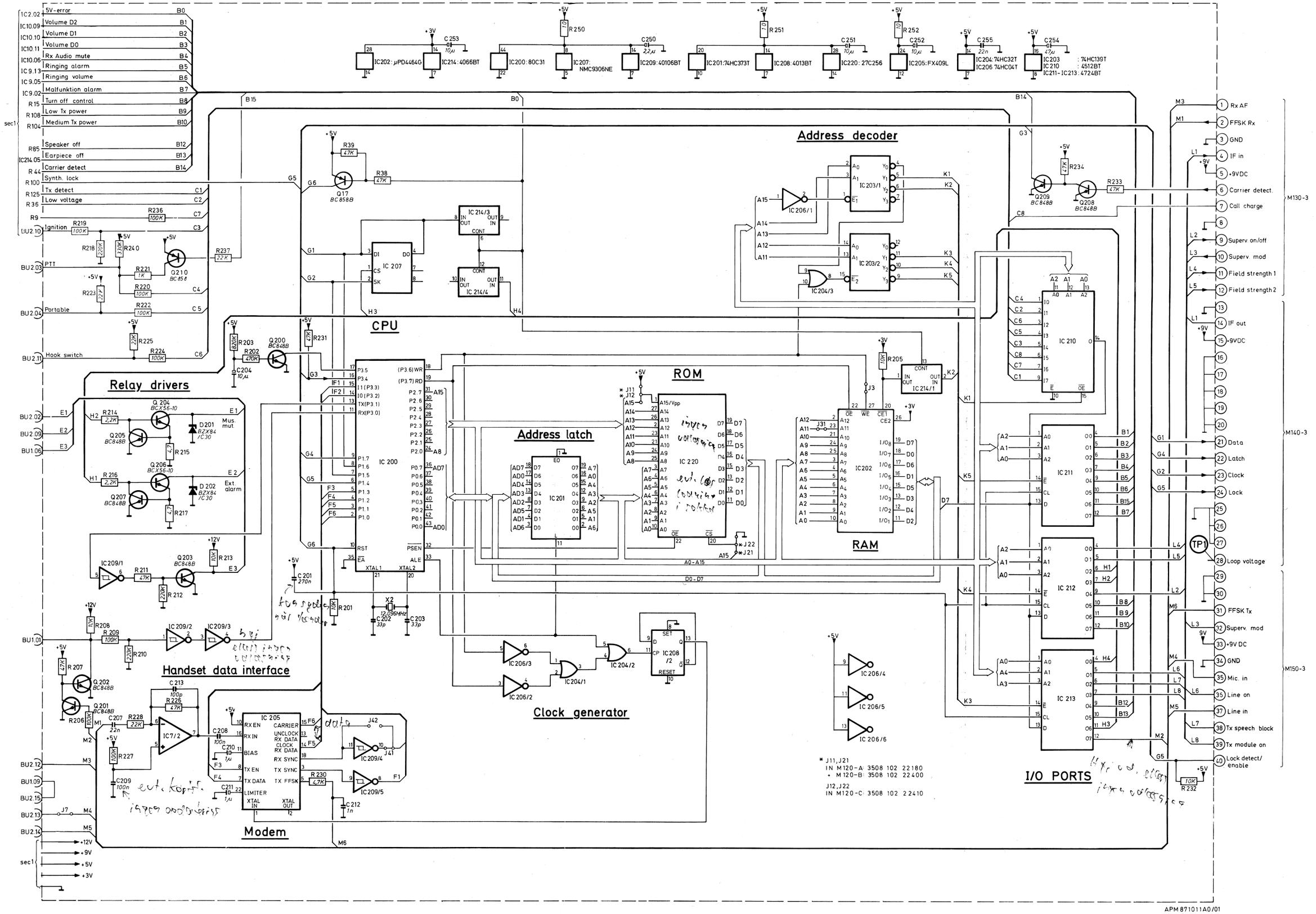

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Fig. 8c Circuit diagram, system board, unit 1 sect. 2
Marked 3508 101 6124X

Description of unit 2, IF- and AF-amplifier

IF-amplifier: The IF-signal is fed through a 70MHz crystalfilter to the first IF-amplifier Q4 and Q5. From this amplifier the signal is fed to the mixer Q6 where it is mixed with an oscillator signal from Q7 at 70.455MHz. The output of the mixer is fed via a 455kHz filter to the second IF-amplifier IC1. IC1 consists of a limiting amplifier with balanced detector and an audio pre-amplifier.
The AF signal is fed from IC1 through a 250Hz high pass filter and through a 4000Hz notch filter, which removes the supervisory tone from the AF signal, and via a de-emphasis circuit to the output connector.

Field strength amplifier: The 455kHz IF-signal is also fed to the field strength amplifier, Q12 to Q16. The amplifier is followed by a detector Q17/D6/IC6. The gain is selected and controlled by the CPU on unit 1 to ensure a small and linear working area of the detector.
During the first scanning the CPU selects a high level (20dBuV) and if no carrier is present (found) it shifts to the low level (10dBuV). The squelch level is set by R75.

Supervisory filter: The output of IC1 is fed to two stagger tuned state variable filters, one on 4154Hz and one on 3860Hz. The output is fed to the TX amplifier, unit 4.

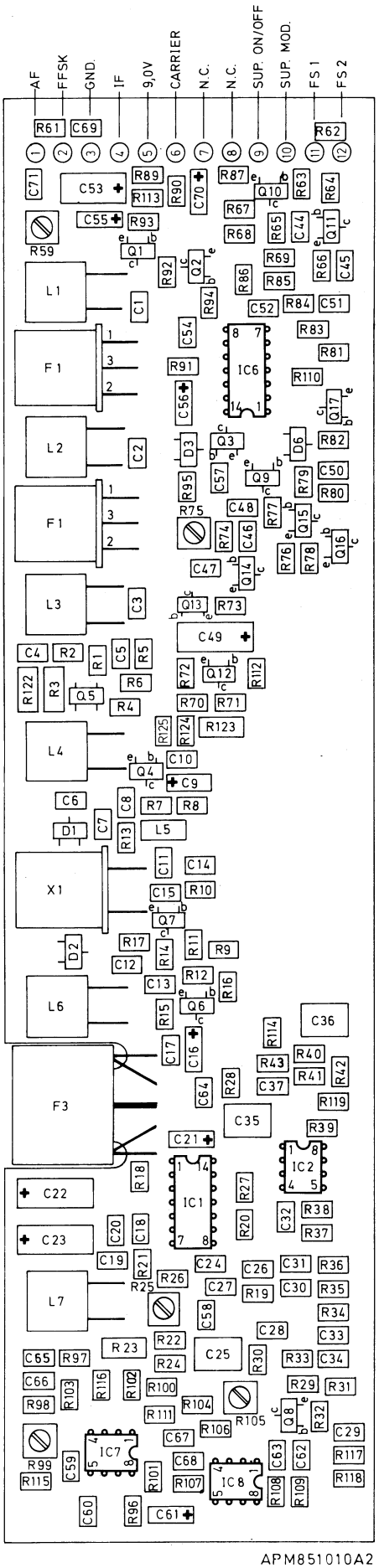

Fig. 9 Component location, IF- and AF-amplifier, unit 2

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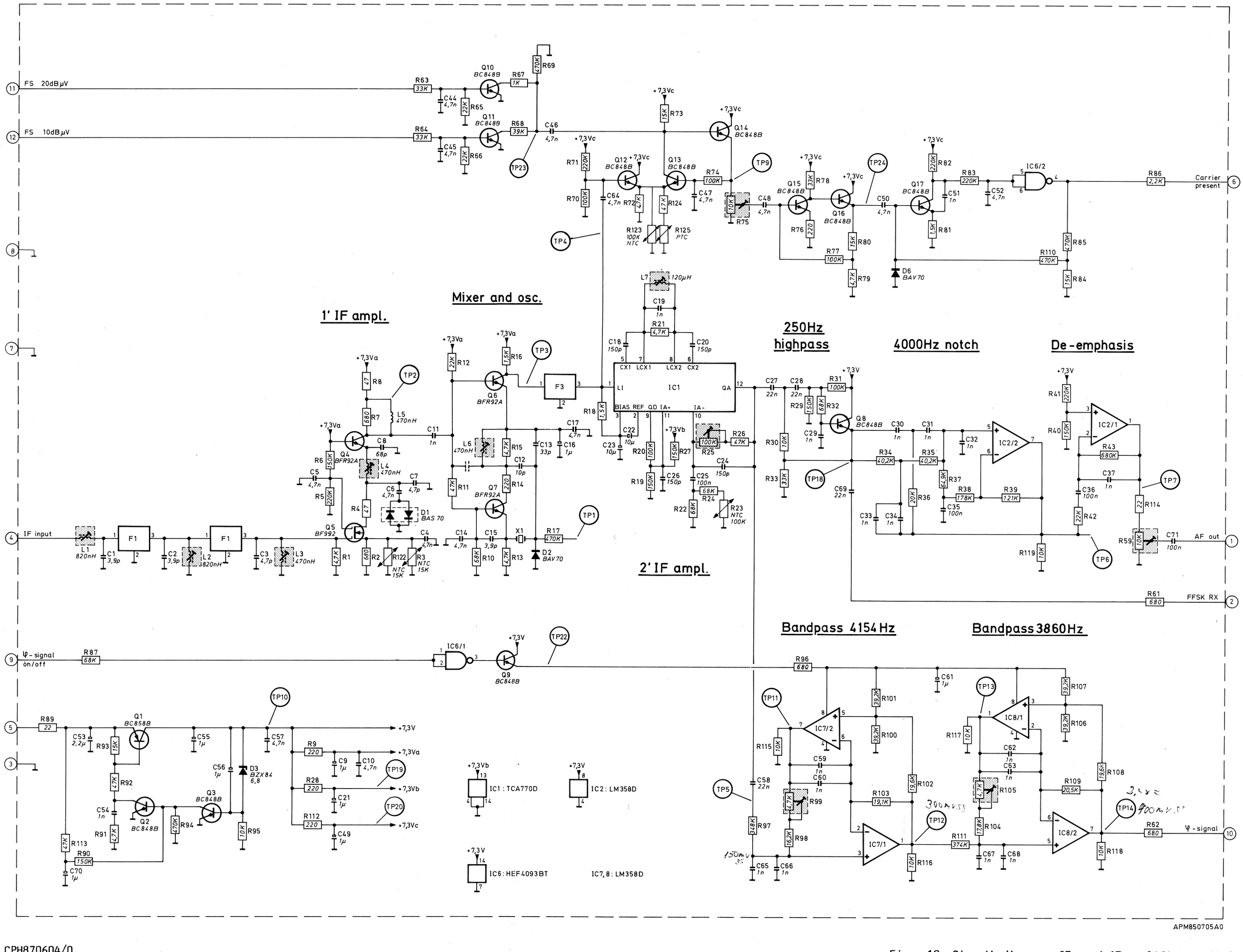

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Fig. 10 Circuit diagram, IF- and AF-amplifier, unit 2

Description of unit 3, RX synthesizer

The RX synthesizer unit can be divided into three parts: 1. Synthesizer with VCO.
2. Front end circuit.
3. Voltage regulators.

1. Synthesizer

The heart of the unit is the VCO running at 393.000-397.475MHz. The VCO signal is via the first buffer fed to the second buffer, the TX-synthesizer on unit 4, and via a prescaler to the RX synthesizer IC (IC3). The prescaler divides the VCO signal by either 64 or 65 controlled by the synthesizer. (IC3, pin 21: Low=65, Hig=64). The synthesizer is provided with a reference oscillator running at 2.1MHz. Data information about the channel number is fed from the CPU on unit 1 to the synthesizer IC. The synthesizer IC then compares the VCO frequency and the ref. osc frequency and sends out correction signals on pin 1 and 2. (For further information about the synthesizer IC, please refer to the Plessey data handbook). The output of the synthesizer IC is fed via the loop amplifier and a 25kHz notch filter back to the VCO for adjustment of the frequency. Furthermore a signal (LOCK) is send to the CPU and PA-stage control circuit on unit 1 informing about whether the synthesizer VCO loop is locked or not.

2. Frontend

The frontend consist of a mixer Q1. It mixes the RX-signal from the duplex filter with the VCO signal. Before the VCO signal from the 2. buffer stage reaches the mixer it is fed through two coupled stripline resonators which removes broadband noise at 465MHz.
The output of the mixer is the IF-signal at 70MHz.

3. Voltage regulators

Three voltage regulators are provided. The 7.9V regulator supplies the whole module. The 5V regulator supplies IC2-4 and the reference oscillator.
The voltage doubler consists of an astable multivibrator (IC1) which provides a square-wave output at approximate 6kHz. The output of IC1 is rectified by D2 and filtered by R30/C34 before it is fed to the loop amplifier IC5.

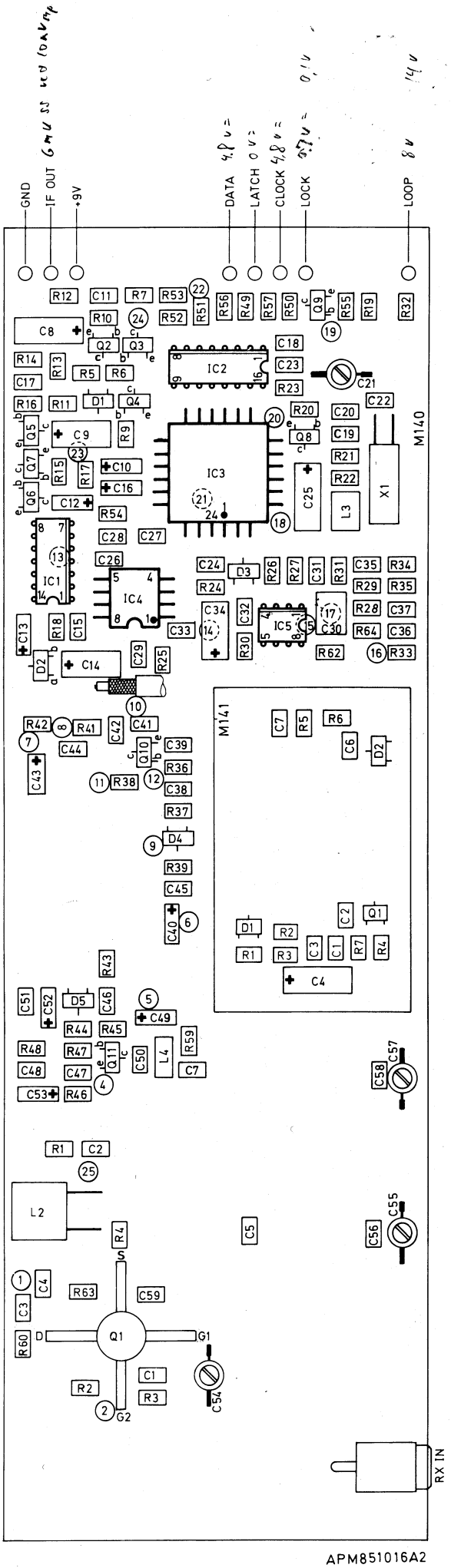

Fig. 11 Component location, RX synthesizer, unit 3

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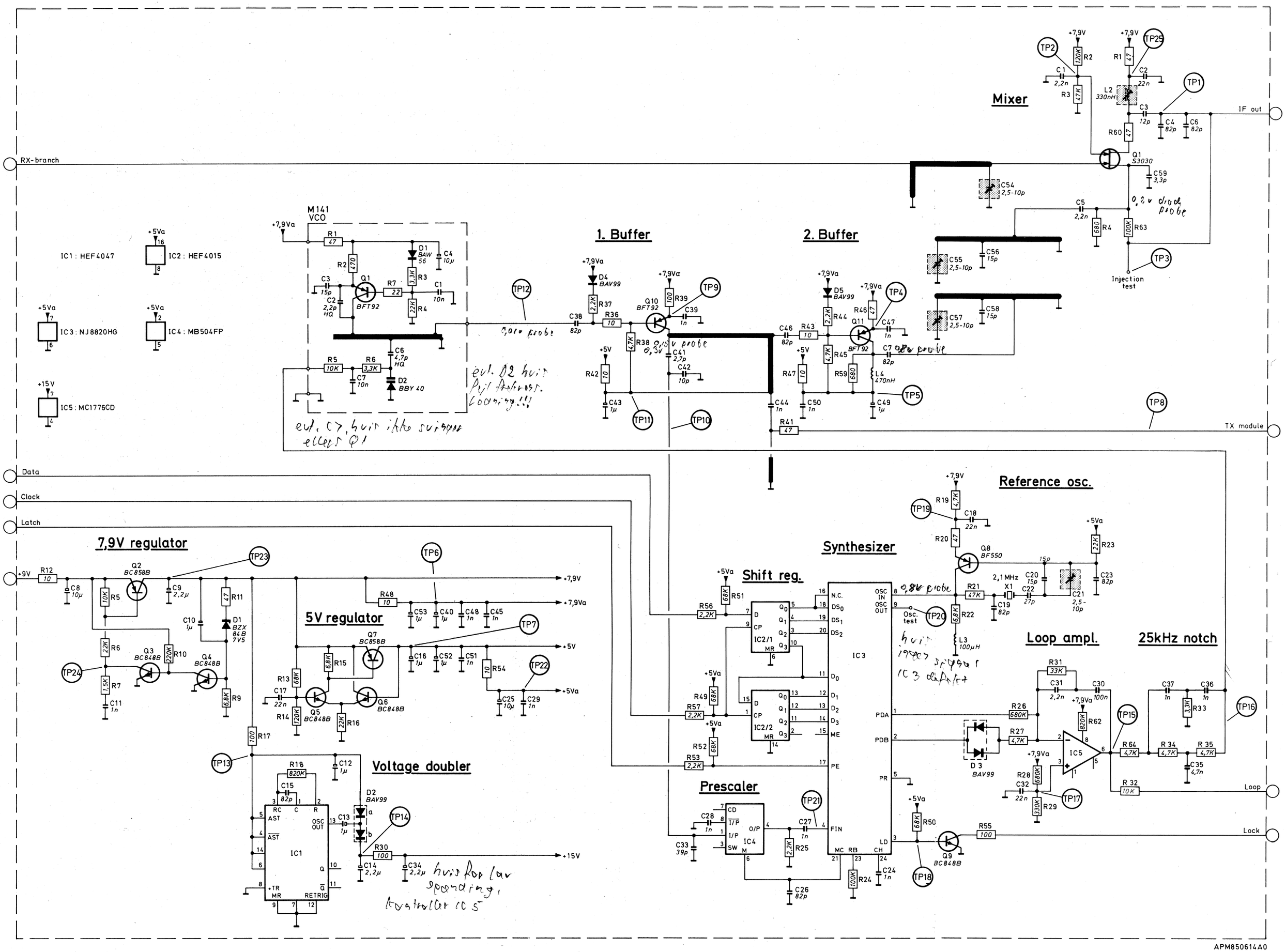

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Fig. 12 Circuit diagram, RX synthesizer, unit 3

Description of unit 4, TX/AF amplifier

The audio modulation input select and speech-block circuit, is controlled by the microprocessor on unit 1. The AGC circuit contains a comparator IC SA 571D, which contains two identical circuits each consisting of: An operational amplifier, a voltage to current converter, and a current-controlled gain cell circuit.
IC2/1 and Q15 are coupled as a voltage controlled resistor which together with the operational amplifier IC2/2 determines the gain. The AGC circuit is a relatively slow loop with a small regulation band width. Because the AGC circuit is not fast enough to prevent too high peak modulation, it is followed by a diode limiter circuit, which sets the absolute max. deviation level.
The modulation amplifier is implemented by means of two operational amplifier circuits.
The FFSK signal is coupled into the modulation amplifier next to the limiter.
The supervisory signal is coupled into the active low pass filter at the end of the modulation amplifier.
The reference oscillator is a balanced frequency doubler crystal oscillator. The transmitter carrier deviation is made by modulating the 15MHz crystal (X1).
The transmitter loop is locked to the receiver synthesizer loop. The transmitter frequency is fixed 60MHz above the RX-VCO frequency.
The synthesizer IC OM843 (IC3) contains a high speed divide-by-two circuit, phase detector, lock detector, search oscillator, and loop filter amplifier circuit. The phase detector controls the lock detector and the search oscillator. The search oscillator is blocked, when the reference oscillator and the synthesizer frequency divided-by-two are in phase.
The temperature compensated VCO contains a single bipolar transistor and a spiralex resonator.
The receiver injection buffer is a two-stage DC-coupled wideband bipolar transistor amplifier. It feeds the synthesizer mixer. In the mixer the buffered RX-frequency and the buffered TX-VCO frequency are mixed and a fixed 60MHz synthesizer frequency is generated.
The PA-buffer contains a three-stage bipolar transistor amplifier. The supply voltage of the last two stages is switchable and controlled by the TX lock detector and RX lock detector coupled together in order to prevent transmitting when one of the loops is out of lock.

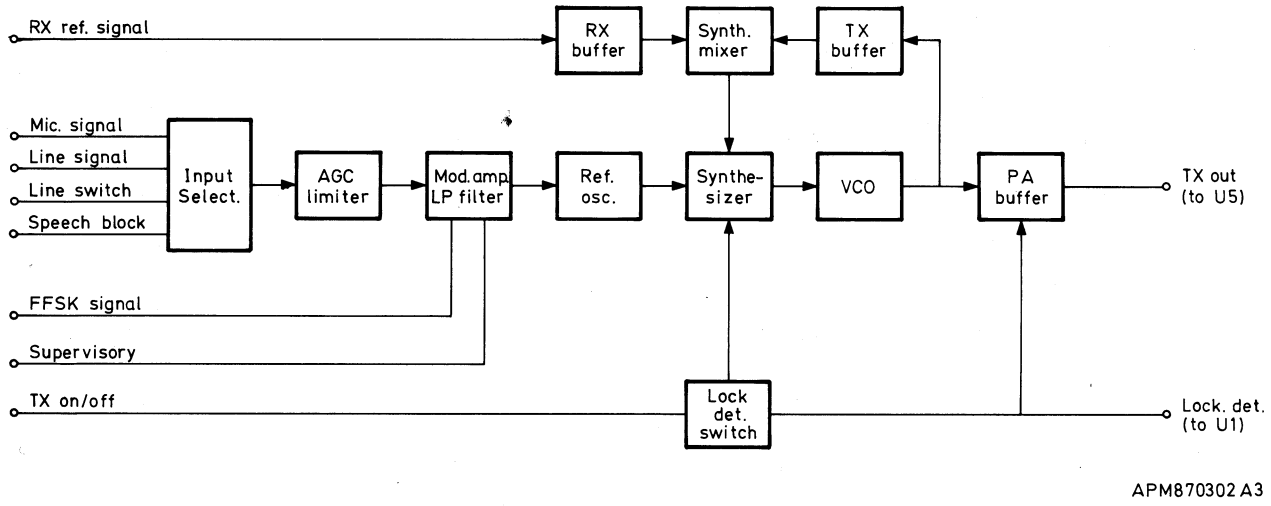

Fig. 13 Schematic block diagram, TX/AF amplifier, unit 4

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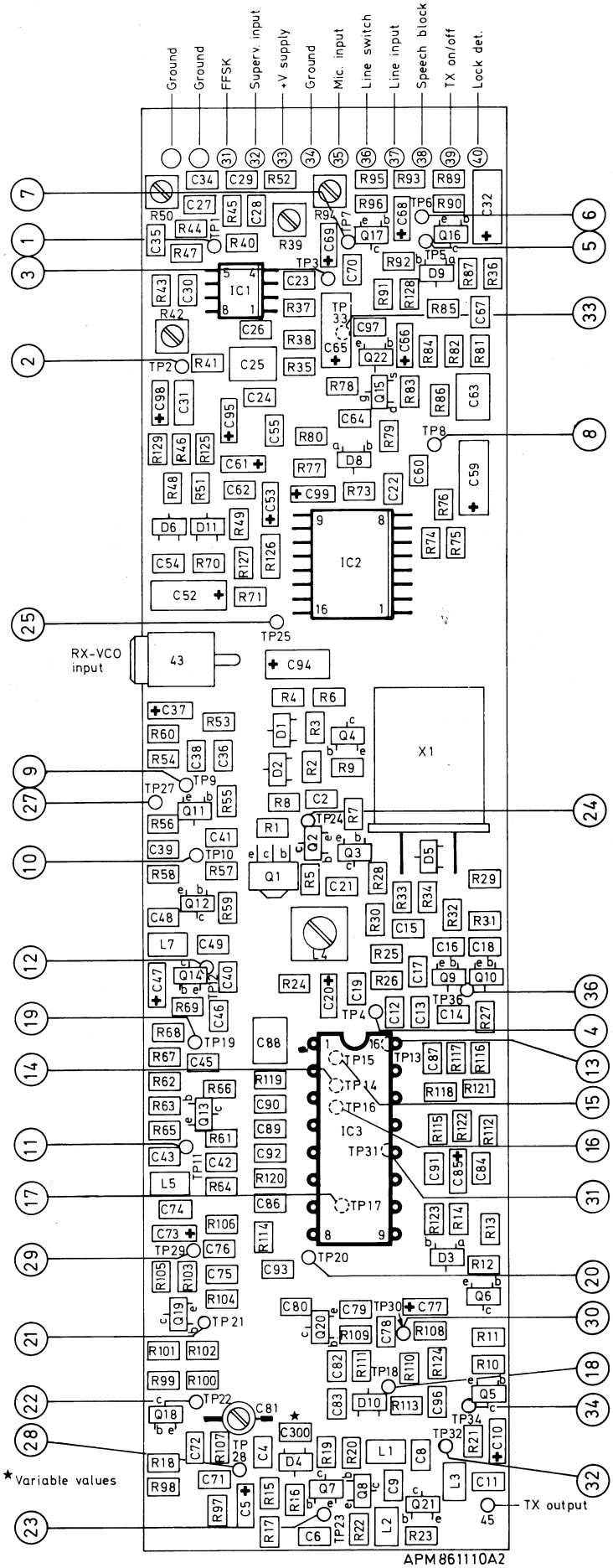

Fig. 14 Component location, TX/AF amplifier, unit 4

CPH870604/0

Reference oscillator

Modulation amplifier

Automatic gain control

Synthesizer

RX buffer

Synthesizer mixer

VCO

TX buffer

PA buffer

Lock detector switch

★ Variable values

IC1 : LM358D

IC2 : SA571D.

IC3 : OM843

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Fig. 15 Circuit diagram, TX/AF amplifier, unit 4

Description of unit 5, PA-stage

R1, R9, R10 is an approx. 3.5dB input attenuator giving a well defined input impedance on 50ohms.

R2, R3, D1 are biasing the buffer amplifier Q1 which also serves as power gain regulator by varying the collector current. This is done by the power regulating voltage on the base of Q2, supplied from the power control circuit situated on systemboard unit 1. The buffer output signal feeds the RF input on the PA-stage IC1.

A microstripline coupler on the RF output from IC1 creates through the voltage doubler D2 the power detection voltage, adjustable by R8 which sets the high power level. The detection voltage is used for the power regulating loop via the power control circuit on unit 1, where you also find the medium and low power adjustment potentiometers.

In standby mode the power regulating voltage input is driven to supply voltage level, turning Q2 and Q3 off. As the input stage of IC1 is disabled and the output stage is operating in class C, quiescent current drops to zero.

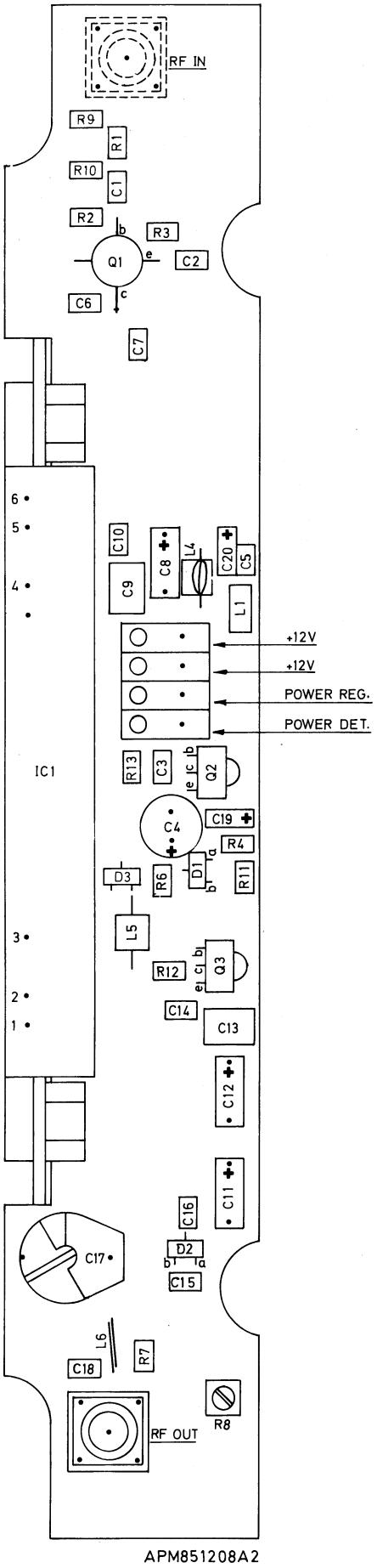

Fig. 16 Component location, PA-stage, unit 5

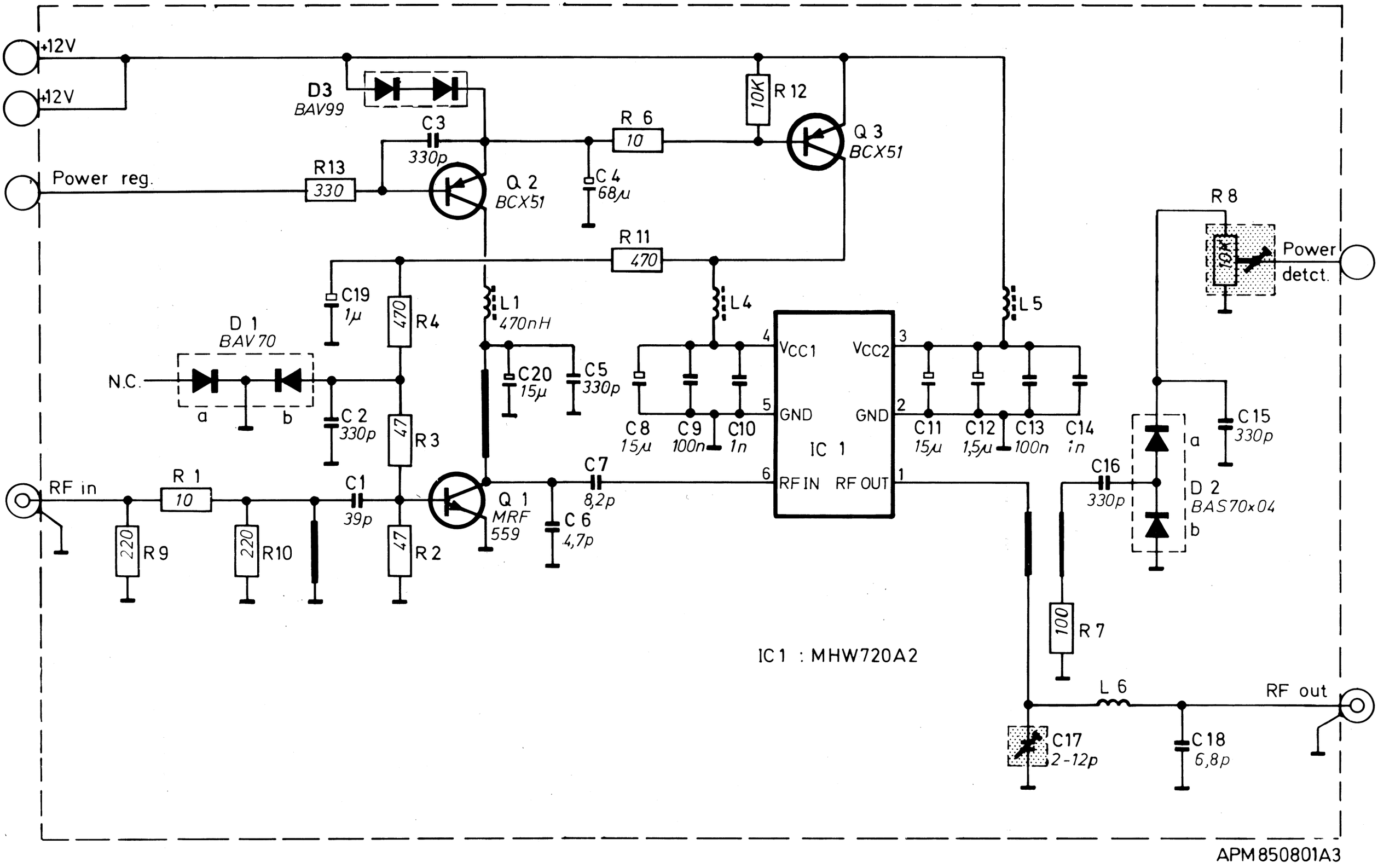

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Fig. 17 Circuit diagram, PA-stage, unit 5

Service instructions

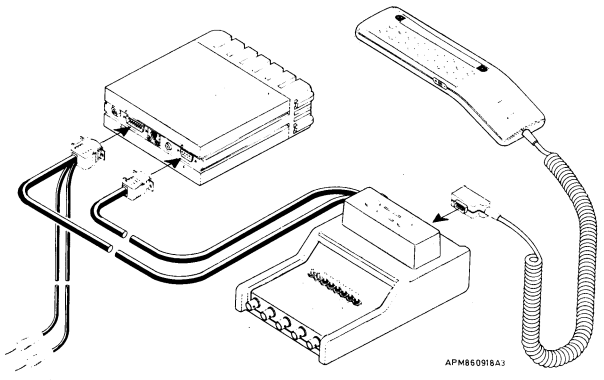
1. GENERAL INFORMATION

In this transceiver the SMD technology has been introduced. This means that repairs at components level is not allowed without the use of special tools. If any of the modules has been exchanged then make a performance test. Has any components been exchanged then follow the "Detailed module adjustments instruction" first and the performance check afterwards.
New modules as well as replacement modules have been testet 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 transceiver and connect the handset to the SIU.
Connect the black and red powercables to the power supply and set the voltage to 13.2V DC.
This is the set-up for tests and service of this 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 into standby.
Push the button ⓪ on the handset. The telephone number and the software version will be shown on the display.
To get access to the software you use these keys on the handset keyboard ➡, 0 ; look at them as a key and a keyhole. Now, what you have to do is simply to select which key you want to unlock the keyhole with. You have nine different keys, from 0 to 8.
This is the way you select the part of the software that you need:

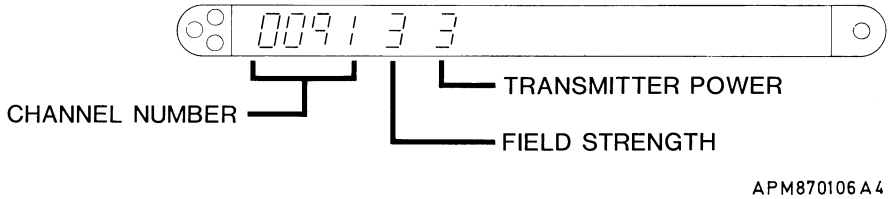
Press	and	you are in this mode
" 0 " ➡ " 0 "		Normal operation.
" 1 " ➡ " 0 "		PTT mode.
" 2 " ➡ " 0 "		Test of call probability.
" 3 " ➡ " 0 "		CPU manual control.
" 4 " ➡ " 0 "		Programming the telephone number.
" 5 " ➡ " 0 "		Programming the lock code.
" 6 " ➡ " 0 "		Resetting all abbreviated numbers.
" 7 " ➡ " 0 "		Resetting all time counters.
" 8 " ➡ " 0 "		Display software version.

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

" 0 " ➡ " 0 ":
This is the normal operation mode of the mobile telephone, it will work just as if no selection has been made.

" 1 " ➡ " 0 ":
This is the PTT mode, which is a monitoring mode. The indication on the display will show:



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A flashing of the display indicates constant updating of the information.
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 to make a call.
The parameters to be used are:

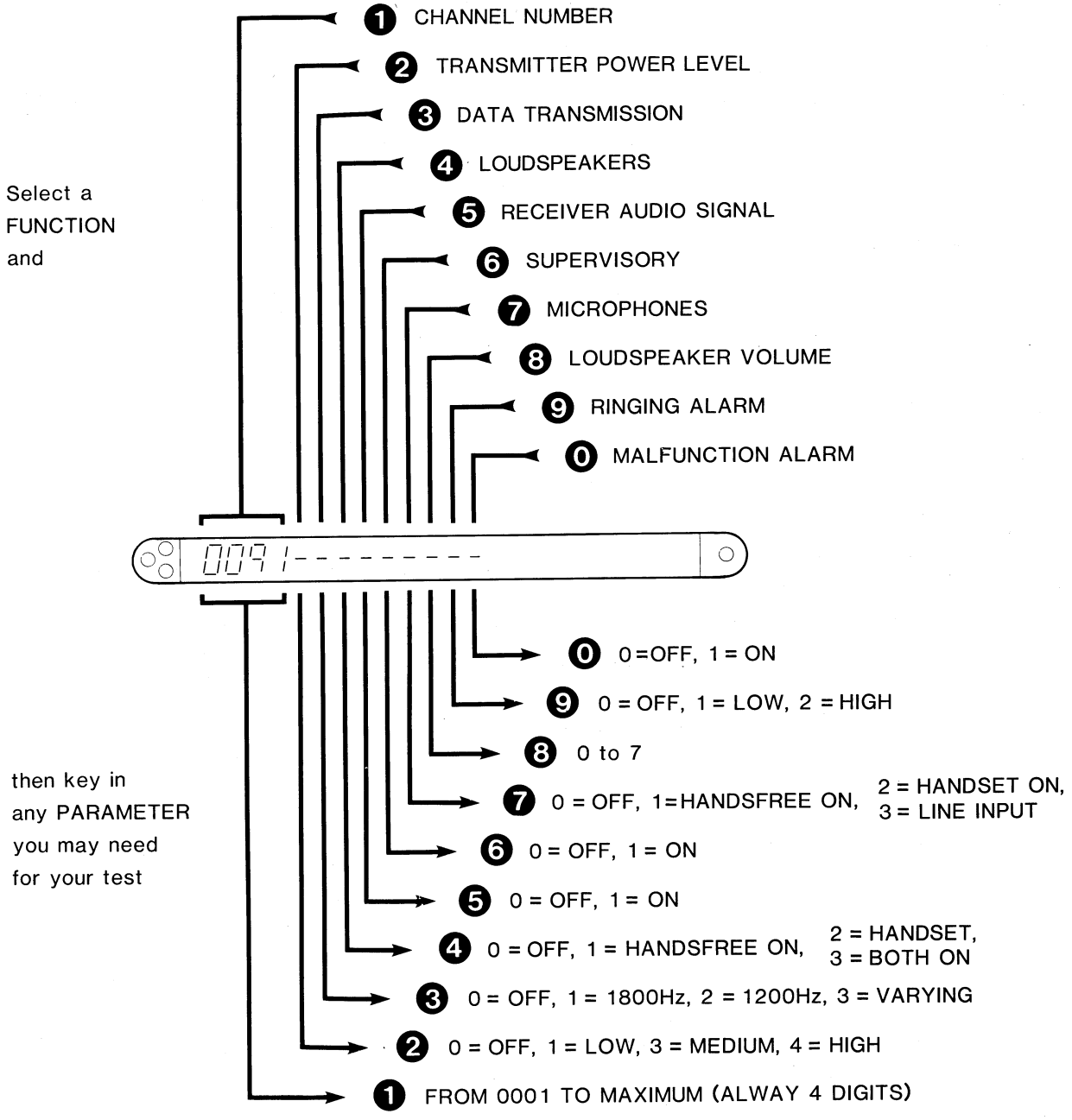
Field strenght : 0 = less than -2dBuV (<0.8uV EMK)
1 = -2dBuv to 10dBuV (0.8uV to 3.16uV EMK)
2 = 10dBuv to 20dBuV (3.16uV to 10uV EMK)
3 = more than 20dBuV (>10uV EMK)

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

" ❷ " ➔ " ⓪ ":
This is the test of call probability. This is a request from the PTT.
It enables the radio to start its scanning on max. sensivity. The display will only show 2.

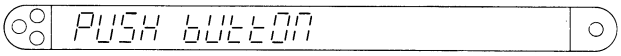
" ❸ " ➔ " ⓪ ":
This is the test and service mode of operation. In this mode the CPU allows the radio to be controlled by the handset keyboard.
The operator can select one or more functions of the radio to be performed simply by selecting one or more of the 10 functions and write in the parameters needed 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.

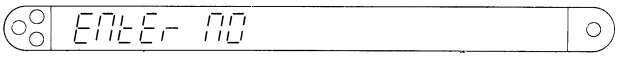


NOTE: If you have used the manual control for the CPU, the only way you can return to normal operation is to turn the radio OFF and then ON again.

" 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:

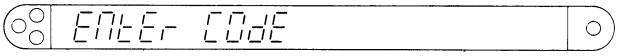


Now, press the button marked "PROG" on the SIU. The display will now show:



You can now enter the telephone number (7 digits). The word ACCEPTED will be displayed together with the entered number for a few seconds.

" 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.

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 ( ) refers to the keys on the handset keyboard.
For the location of adjusting elements and testpoints on the units refer in all cases to fig. 18 and fig. 19 on pages 40 and 42.
Before you make any test, you have to make sure that the voltage reference is correct.

VOLTAGE REFERENCE ADJUSTMENT

- Supply +13.2V to the transceiver and switch it ON.
- Check that the transceiver switches OFF when the power supply is lower than +8.2V.
- Check that the transceiver switches OFF when the power supply is above +19V.
- Adjust the power supply voltage to +10.4V ±0.1V.
- Turn R22 on unit 1 completely counter clockwise. The radio should now be in OFF mode.
- Adjust R22 to the point where the relay in the transceiver clicks.

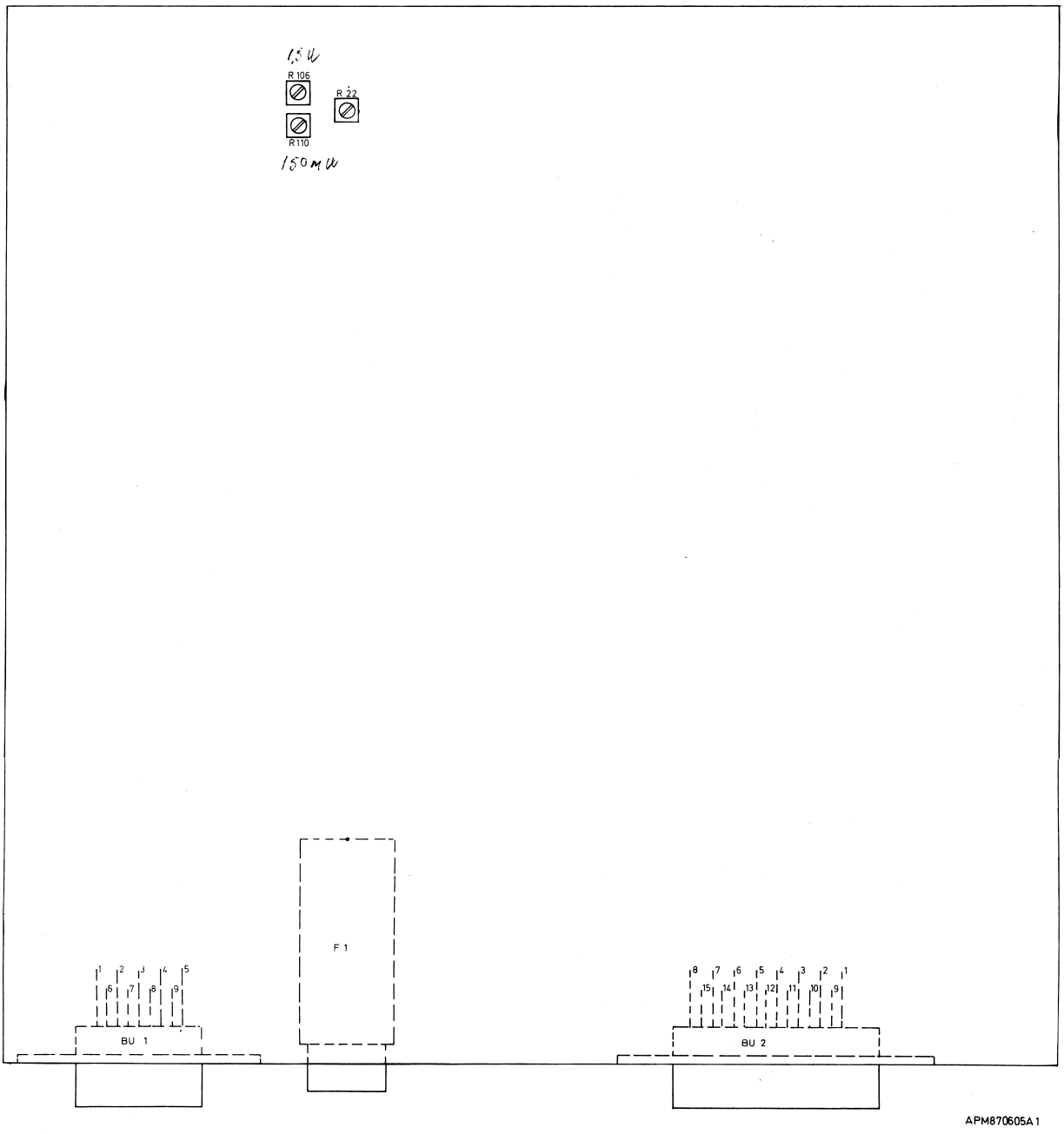
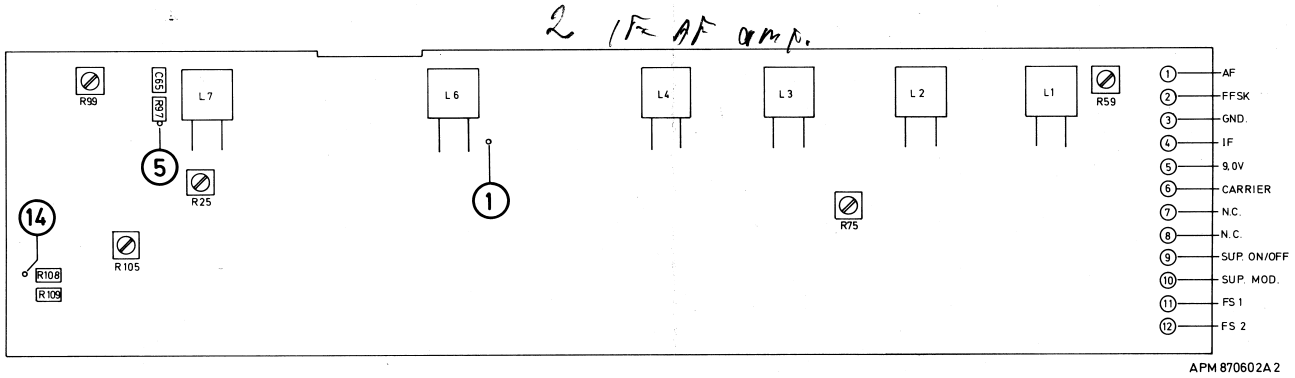
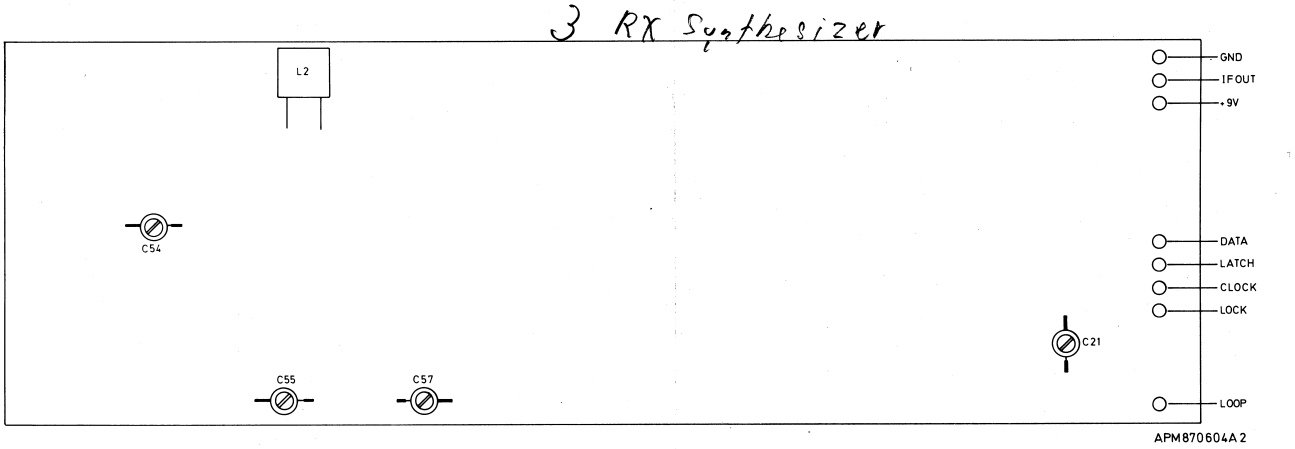
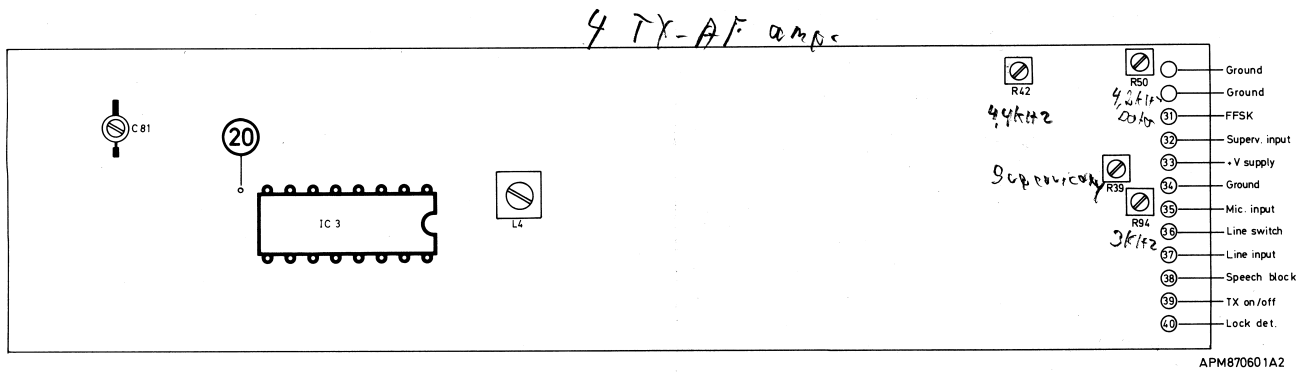


Fig. 18 Adjustment locations







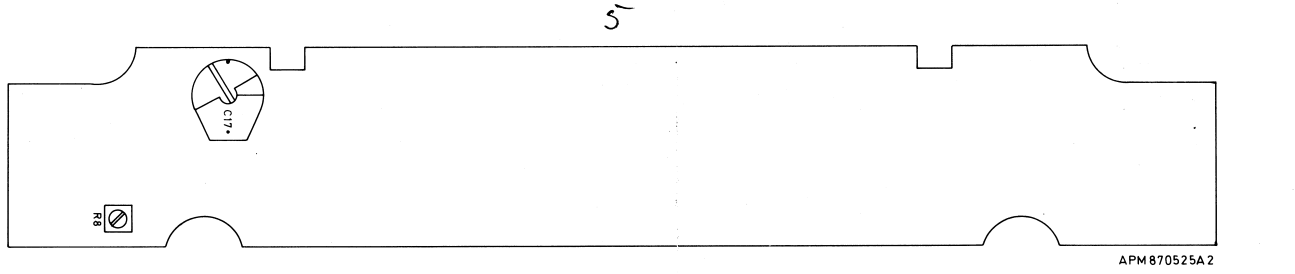


Fig. 19 Adjustment locations

Test and adjustments - unit 1

Three adjustments are located on unit 1.
The voltage reference adjustment which is already described, and the power out adjustments which are described in the transmitter performance test.

Detailed adjustment procedure for unit 2

NOTE: Before any adjustment is carried out on unit 2, unit 4 should be removed.

Crystal filter

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

Mixer and oscillator

- Remove unit 3 (RX synthesizer).
- Connect a voltmeter to TP1.
- Select supervisory on (6 1).
- Adjust L6 for maximum DC voltage (approx. 200mV).
- Replace unit 3.

AF output adjustment

- Connect an RF signal generator to the antenna input and provide a signal of 465.250MHz, 3kHz deviation, 1kHz modulation, and a level of 1.4uV EMF (-110dBm).
- Select channel 91 (1 0091).
- Select supervisory ON (6 1).
- Connect a millivoltmeter to TP5.
- Adjust L7 for maximum voltage.
- Connect the millivoltmeter to the FFSK RX output (pin 2).
- Check that the voltage is 180mV.
- If not, adjust R25.
- Connect the millivoltmeter to the line out BNC on the SIU.
- Check that the level is approximately 450mV.
- If not, adjust R59.

Supervisory filter adjustment

- Connect an RF signal generator to the antenna input and provide a signal of 465.250MHz, 1kHz deviation, and a level of 1.4uV EMF (-110dBm).
- Connect an LF-generator to the RF-signal generator and modulate the RF-signal with 4154Hz.

- Connect a millivoltmeter to TP14.
- Select channel 91 (1 0091).
- Select supervisory ON (6 1).
- Adjust R99 for maximum output at TP14.
- Change the LF-modulation signal to 3860Hz.
- Adjust R105 for maximum output at TP14.

Continue the adjustment procedure by making a performance test.

Detailed adjustment procedure for unit 3

A cover with holes for access to the trimming capacitors must be mounted on the unit when the adjustments are carried out.

Reference oscillator
- Connect a frequency counter to the output connector for the TX-synthesizer (unit 4).
- Select channel No. 91 (1 0091).
- Check that the frequency is 395.250MHz ±100Hz.
- If not, adjust C21 on unit 3.

Bandpass filters
- No antenna or signal generator should be connected to the RX-input (or the antenna connector.
- Connect a DC-voltmeter to TP3 (IF out).
- Adjust C55 and C57 for maximum DC-voltage (approx 0.6V).

Mixer gain
- Connect an RF signal generator to the antenna input and provide a signal with a frequency of 465.250MHz and a level of 1.4mV EMF (-50dBm).
- Select channel 91 (1 0091).
- Connect a voltmeter with an RF-probe terminated with 50ohms to TP3 (IF-output). (Alternatively you can use a 100MHz oscilloscope terminated with 50ohms).
- Adjust C54 and L2 for maximum output (minimum gain is 15dB).
- Note down the output level at the IF-output.
- Change the frequency of the RF signal generator to 463.000MHz.
- Select channel 1 (1 0001).
- Note down the output level at the IF-output.
- Change the frequency of the RF-signal generator to 467.~~500~~475MHz.
- Select channel 180 (1 0180).
- Note down the output level at the IF-output.
- If the level difference between channel 91 and channel 1/180 exceeds 50mV readjust the bandpass filters on this unit.

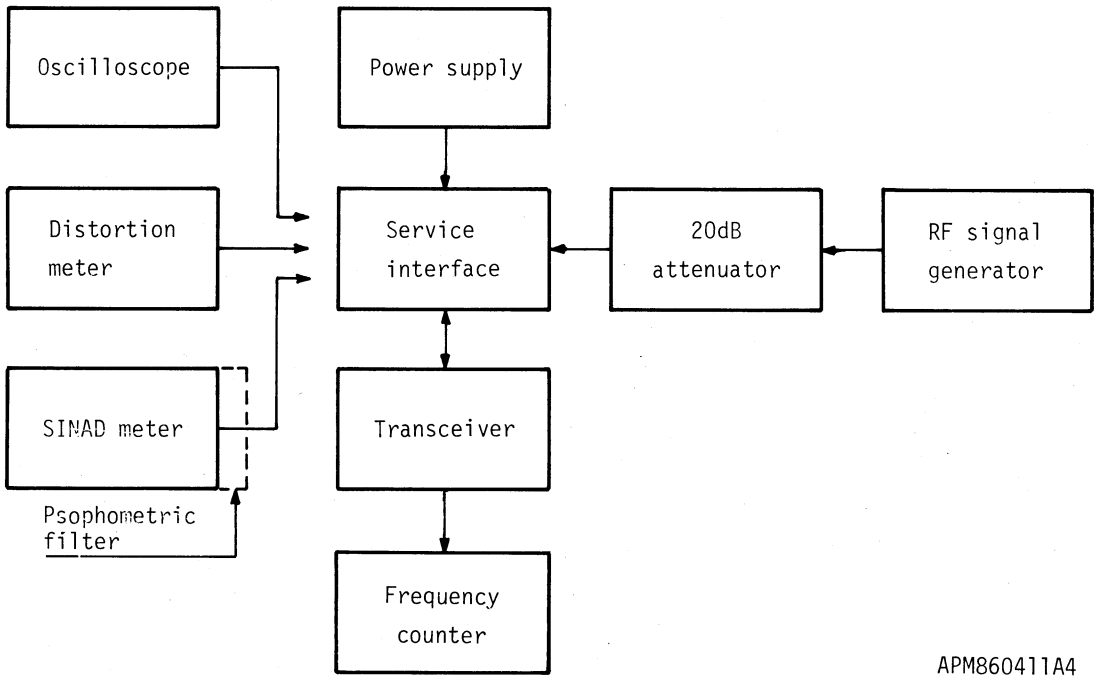
Continue the adjustment procedure by making a performance test.

Receiver performance test

The receiver performance test is devided into four steps:

1. Sensitivity.
2. Field strength.
3. Distortion.
4. AF level.

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



Step 1: Sensitivity

- Select channel 91 (1 0091).
- Select handset loudspeakers (4 3).
- Select loudspeaker volume 4 (8 4).
- Select receiver AF signal ON (5 1).
- Set the RF signal generator to 465.250MHz (channel 91), with a modulation frequency of 1kHz and a deviation of ±3kHz.
- Connect the SINAD meter to the SIU BNC marked with a small loudspeaker.
- Adjust the RF signal generator outut level until you have audio in the loudspeaker, then reduce the signal level until it reaches 20dB SINAD.
- The level should now be <0.8uV $_{emf}$ with (-115dBm) with psophometric filter and <1.0uV$_{emf}$ (-113dBm) without psophometric filter.

- If not, adjust C54 on the receiver synthesizer (unit 3).
- Select channel 1 (1 0001).
- Select channel 180 (1 0180).
- Check that the level of these extreme channels is <0.9uV$_{emf}$ (-114dBm) with psophometric filter and <1.1uV$_{emf}$ (-112dBm) without psophometric filter. - If none of the channels can be adjusted change or repair the IF/AF amplifier (unit 2).
- If only one of the extreme channels is failing, change or repair the receiver synthesizer (unit 3).
- If any of the modules has been changed, repeat the procedure and adjust C54 on the receiver synthesizer (unit 3).

Step 2: Field strength

- Check the field-strength by using the two switches Hook and Port on the SIU.
- Select HOOK ON and PORT ON.
- Set the RF signal generator to a level of 0.8uV$_{emf}$ (-115dBm).
- Adjust R75 on the IF/AF amplifier (unit 2) until the external alarm lamp on the SIU just illuminates.
- Select HOOK ON and PORT OFF.
- Adjust the RF signal generator until the external lamps, at the SIU, turns on.
- Increase the output level of the RF signal generator until the external lamp just illuminates.
- The output level of the RF signal generator should now be between 0.8uV (-115dBm) and 3.2uV$_{emf}$ (-103dBm).
- Select HOOK OFF and PORT ON.
- Adjust the RF signal generator until the external lamps at the SIU turns on.
- Increase the output level of the RF signal generator until the external lamp just illuminates.
- The output level of the RF signal generator should now be between 3.2uV$_{emf}$ (-103dBm) and 10uV$_{emf}$ (-93dBm).
- Select HOOK OFF and PORT OFF.
- Adjust the RF signal generator until the external lamps at the SIU turns on.
- Increase the output level of the RF signal generator until the external lamp just illuminates.
- The output level of the RF signal generator should now be at a level above 10uV$_{emf}$ (-93dBm).

Step 3: Distortion

- Check the distortion. Leaving the input from the RF signal generator at 20uV$_{emf}$ (-83dBm), the distortion must be less than 5%.

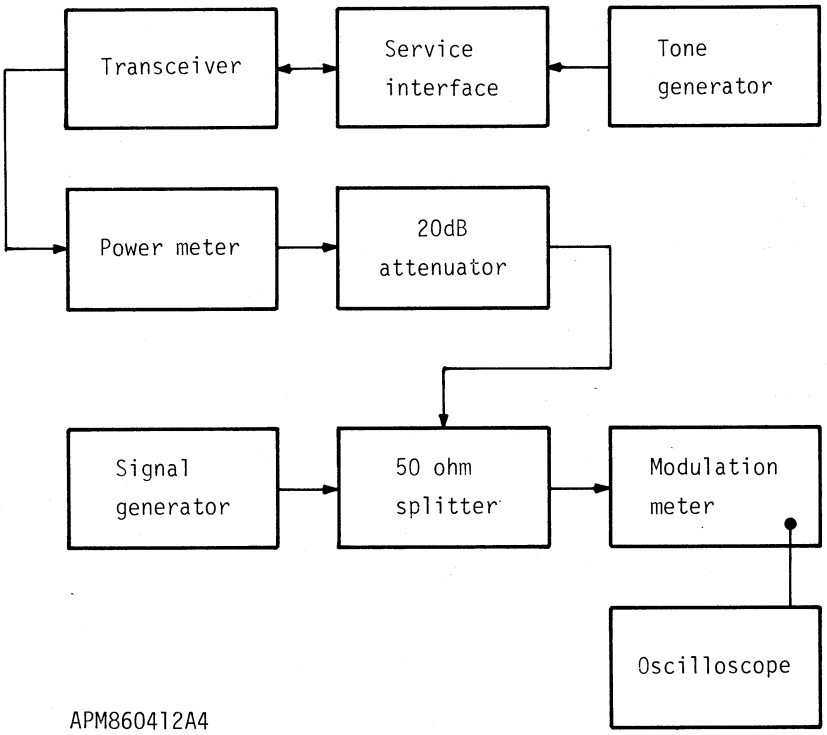
Step 4: AF level

- Select volume 3 (8 3).
- Connect the millivoltmeter to the SIU BNC marked with a small loudspeaker.
- Select (4 2).
- The level should be 240mV RMS.
- Disconnect the meter from the BNC, marked with a small loudspeaker, and connect it to the line out BNC.
- Check that the level is approximately 450mV.
- If not, adjust R59 on the IF/AF amplifier (unit 2).

Transmitter performance test

1. Transmitter power level.
2. Reference oscillator and TX-VCO frequency.
3. Modulation levels.

Test set-up for transmitter performance:



APM860412A4

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

Step 1: Transmitter power level

- Select channel 91 (1 0091).
- Provide a signal from the signal generator at 465.250MHz. The output level from the signal generator should be at a level which is able to provide a noiseless signal from the receiver of the transceiver. (The power level can be tested without the receiver receiving a signal, but then the transceiver will switch itself off after 30 seconds).
- Select transmitter high power (2 4).
- The wattmeter will show an indication between 11 and 14.5 watt.
- Adjust R8 for 12.5 watt output power on the PA-stage (unit 5).
- Select transmitter medium power (2 3).
- The medium power level should be 1.5 watt. If not, adjust R106, on the system board (unit 1).
- Select transmitter low power (2 1).
- The low power level should be 150mWatt. If not, adjust R110, on the system board (unit 1).
- Check the power on the extreme channels 1 and 180.

- Check channel 1 (1 0001).
- Check channel 180 (1 0180).
- If the power output is failing in any of these channels, try the following adjustments on the PA-stage and power control (unit 5).
- Select high power (2 4).
- Adjust R8 to max.
- Adjust C17 to max.
- Readjust R8 to 12.5 watts.
- If you have changed or repaired a defect power module, you have to make the same adjustments (R8+C17).

Step 2: Reference oscillator and TX-VCO frequency

- Select channel 91 (1 0091).
- Select receive audio signal on (5 1).
- Check that the reference oscillator frequency at TP4 on unit 4 is 30MHz.
- If not, adjust L4.
- Check that the VCO voltage at TP20 is 4V.
- If not, adjust C81.
- Select power level low (2 1).
- Check that the transmitter output frequency is 455.250MHz ±500Hz.
- If not, there could be a problem located in the RX-synthesizer (unit 3).

Step 3: Modulations

- Select channel 91 (1 0091).
- Select receive audio signal on (5 1).
- Select handsfree loudspeaker on (4 1).
- Select line input on (7 3).
- Select data transmission off (3 0).
- Select supervisory off (6 0).
- Connect the tone generator to the line input at the SIU, and set the tone generator to 3kHz and the level to 1V RMS.
- Select transmitter on (2 1).
- Check that the transmitter deviation is ±4.4kHz.
- If not, adjust R42 on the TX/AF module (unit 4).
- Select transmitter off (2 0).
- Connect the tone generator to the mic. input at the SIU, and set tone generator to 1kHz and the level to 100mV RMS.
- Select microphone off (7 0).
- Select transmitter on (2 1).
- Select microphone on (7 1).
- Check that the transmitter deviation is ±3kHz.
- If not, adjust R94 on the TX/AF module (unit 4).
- Select transmitter off (2 0).
- Remove the tone generator from the SIU.
- Select microphone off (7 0).
- Select data transmission on, 1800Hz (3 1).
- Select transmitter on (2 1).

- Check that the transmitter deviation is ±4.2kHz.
- If not, adjust R50 on the TX/AF module (unit 4).
- Select transmitter off (2 0).
- Select data transmission off (3 0).
- Connect the tone generator to the RF signal generator and modulate the signal by 4kHz and a deviation of ±1kHz. Increase the output level of the RF signal generator, until the signal is received without noise, by the transceiver.
- Select supervisory on (6 1).
- Select transmitter on (2 1).
- Check that the transmitter deviation is ±1kHz.
- If not, adjust R39 on the TX/AF module (unit 4).

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
11.	Top cover for unit 2,4	2	3508 101 01680
12.	Top cover for unit 3	1	3508 101 01730
13.	Spring for motherboard/IC	1	3508 101 01660
14.	Spring for grounding	2	3508 101 21500
	Fuse, 10A	1	2422 086 01161

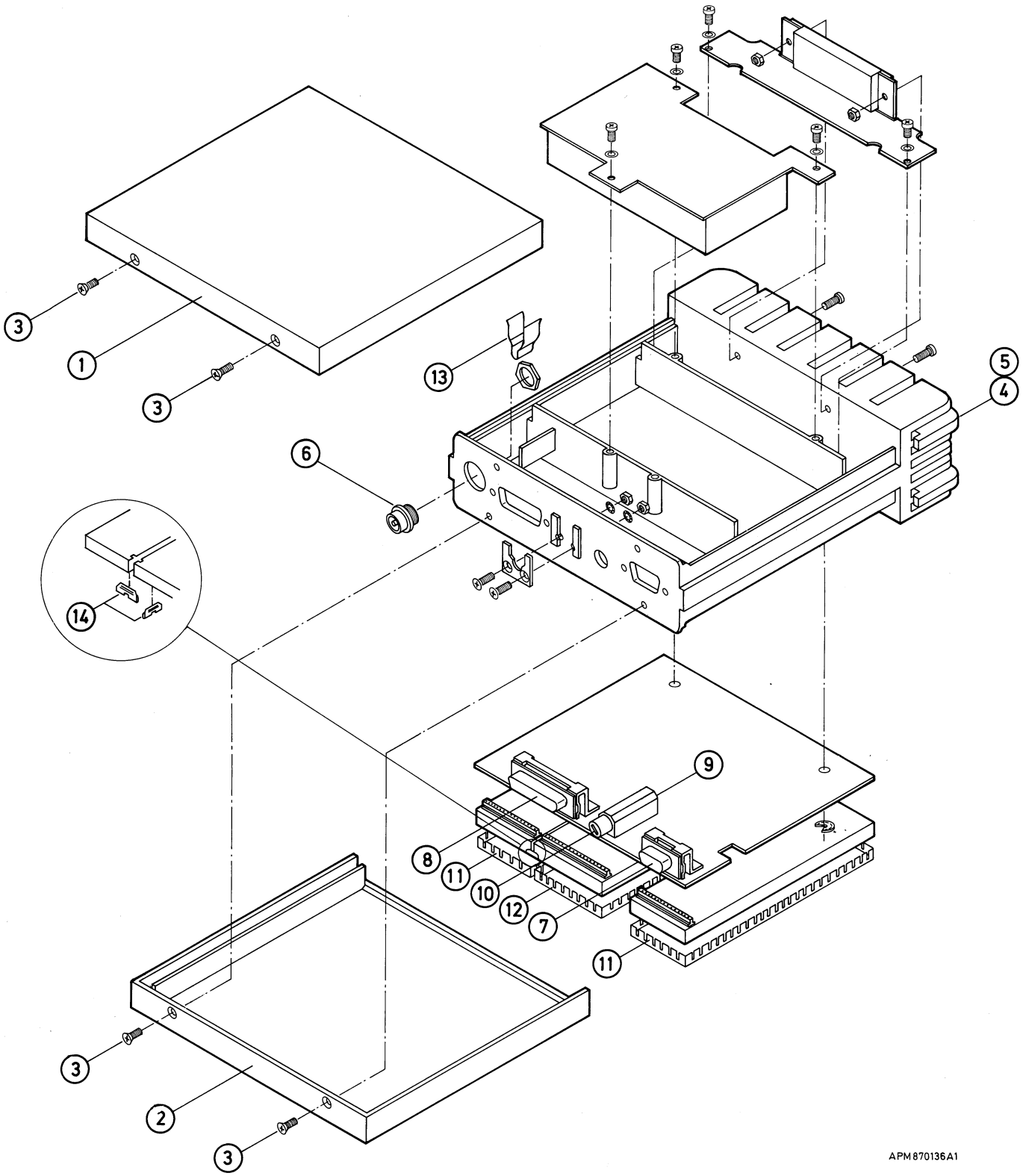


Fig. 20 Exploded view, transceiver

Electrical parts

UNIT NO	DESCRIPTION	ORDERING NUMBER
1	Systemboard, unit 1, print board marked 3508 101 6045X	8208 244 00011
1	Systemboard, unit 1, print board marked 3508 101 6124X	8208 244 00211
2	IF/AF-amplifier, unit 2	8208 244 00021
3	RX and synthesizer, unit 3	8208 244 00031
4	TX/AF amplifier, unit4	8208 244 00041
5	PA-stage, unit 5	8208 244 00051
6	Duplex filter	8208 244 00061

UNIT 1 - SYSTEMBOARD, Print board marked 3508 101 6045X

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	9335 716 80602	LM358D
IC8	9334 067 70112	HEF4521BT
IC10	9333 729 40112	HEF4051BT
IC11	3508 100 16120	TLC271CD
IC12	9335 871 80112	TDA1011
IC200	3508 100 16240	80C31
IC201	9337 154 70112	74HC373T
IC202	3508 100 16100	TC5517BFL20
IC203	9337 135 00112	74HC139T
IC204	9337 143 10112	74HC32T
IC205	3508 100 16070	FX409L
IC206	9337 142 60112	74HC04T
IC207	8208 244 01620	NMC9306NE
IC208	9333 726 60112	HEF4013BT
IC209	9334 069 60112	HEF40106BT
IC210	9333 731 90112	HEF4512BT
IC211-213	9333 733 70112	HEF4724BT
IC214	9333 729 70112	HEF4066BT
IC220	8208 244 00131	Coded EPROM

NUMBER	ORDERING NUMBER	TYPE
TRANSISTORS		
Q1,3-4,6,8,10-11, 14-16,200-203, 205,207-209	9335 896 30215	BC848B
Q2,5,7,9,13,17	9335 897 90215	BC858B
Q12	9332 722 80115	BCX51
Q204,206	9336 630 90115	BCX56-10
DIODES		
D1,6,11	9330 989 90215	BAW56
D2	9333 882 60215	BZX84-C15
D3-4,7	9331 849 10215	BAV70
D5	9331 373 90215	BZX84-C5V1
D8-9	3508 100 10180	LED RED
D10	9332 153 70215	BAV99
D201-202	9333 883 30215	BZX84-C30
RELAY		
RE1	3508 100 60050	6V 1 shiftset
CRYSTALS		
X1	3508 100 50220	Resonator 560KC
X2	3508 100 50000	12.096MHz
MISCELLANEOUS		
	3508 100 55300	Pin for unit connectors
	3508 100 55710	Guiding pin for units
	8208 205 08200	Lithiumcelle for system board

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
C5,254	3508 100 30130	47U	20%	6.3V	Tantal
C6,7,71,204, 251-253	3508 100 30120	10U	20%	10V	Tantal

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
CAPACITORS					
C8,12,82,250	3508 100 30110	2U2	20%	16V	Tantal
C9-10,201	3508 100 30820	270N	10%		Ceramic
C11,13	3508 100 30730	1U0	20%	35V	Tantal
C14,212	2222 590 16614	1N0	10%		Ceramic
C15,20,50,55, 210-211	3508 100 30100	1U0	20%	10V	Tantal
C16,72,213	2222 861 12101	100P	5%		Ceramic
C17	2222 861 12229	22P	5%		Ceramic
C19,54,70,83, 87,89,208-209	3508 100 30740	100N	10%		Ceramic
C51-53	2222 590 16627	10N	10%		Ceramic
C73,100,207, 214,255	2222 590 16632	22N	10%		Ceramic
C80-81	3508 100 30320	15U	20%	16V	Tantal
C84	2222 590 16618	2N2	10%		Ceramic
C102-103,106,202	2222 861 12479	47P	5%		Ceramic
C104	2222 590 16621	3N3	10%		Ceramic
C105	2222 861 12331	330P	5%		Ceramic
C203	2222 861 12339	33P	5%		Ceramic
RESISTORS					
R1,2,76	3508 100 20170	220	5%	0.1W	
R3,9,44,67,82	3508 100 20250	1K0	5%	0.1W	
R4,23,31,84,104-105,108-109,112, 221,223,225,228	3508 100 20410	22K	5%	0.1W	
R5-6,12,34,38-40, 43,85,100,113,116-117,119,123-124, 207,211,226,231, 233-234	3508 100 20450	47K	5%	0.1W	
R7-8,20,28,36, 54,58,102-103, 125-126,206,209, 219-220,222,224, 227,235-236	3508 100 20490	100K	5%	0.1W	
R10-11,13,18-19, 45,50,52-53,71-72,75,83,118,210, 212,218	3508 100 20530	220K	5%	0.1W	

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
R14,17,202	3508 100 20570	470K	5%	0.1W	
R15-16,32,42,56, 61-62,107,120,201, 205,208,213,232	3508 100 20370	10K	5%	0.1W	
R21	3508 100 20360	8K2	5%	0.1W	
R22,106	3508 100 22090	10K			Trim potm.
R24	3508 100 20480	82K	5%	0.1W	
R25,29	3508 100 20400	18K	5%	0.1W	
R26,33,35,60,64- 66,68,80,214,216	3508 100 20290	2K2	5%	0.1W	
R27,30,41,51,203	3508 100 20600	820K	5%	0.1W	
R37	3508 100 20050	22	5%	0.1W	
R55	3508 100 20480	82K	5%	0.1W	
R57	3508 100 20390	15K	5%	0.1W	
R63,74,111,115, 121,127,230	3508 100 20330	4K7	5%	0.1W	
R70,77,81,101	3508 100 20430	33K	5%	0.1W	
R73	3508 100 20210	470	5%	0.1W	
R86	3508 100 20350	6K8	5%	0.1W	
R87,122	3508 100 20270	1K5	5%	0.1W	
R88,215,217	3508 100 20690	4R7	5%	0.1W	
R110	3508 100 22130	4K7			Trim potm.
R114	3508 100 21380	350			PTC
R250-252	3508 100 20010	10	5%	0.1W	

UNIT 2 - IF/AF AMPLIFIER

NUMBER	ORDERING NUMBER	TYPE
Miscellaneous	5322 157 60638	
INTEGRATED CIRCUITS		
IC1	9333 321 00112	TCA770D
IC2,7-8	9335 716 80602	LM358D
IC6	9333 731 30112	HEF4093BT
TRANSISTORS		
Q1	9335 897 90215	BC858B
Q2-3,8-17	9335 896 30215	BC848B
Q4,6-7	9335 515 60215	BFR92A
Q5	9336 150 00115	BF992

NUMBER	ORDERING NUMBER	TYPE
DIODES		
D1	3508 100 10050	BAS70-04
D2,6	9331 849 10215	BAV70
D3	9336 711 30215	BZX84-B6V8
COILS		
L1-2	3508 100 40050	820NH
L3-4,6	3508 100 40060	470NH
L5	3508 100 40190	470NH
L7	3508 100 40070	120UH
CRYSTAL		
X1	3508 100 50160	70.455MHz

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
CAPACITORS					
C1,2,15	2222 861 12398	3P9	0.25		Ceramic
C3,7	2222 861 12478	4P7	5%		Ceramic
C4-6,10,14,17, 44-48,50,52, 57,64	2222 590 16623	4N7	10%		Ceramic
C8	2222 861 12689	68P	5%		Ceramic
C9,16,21,55-56, 61,70	3508 100 30100	1U0	20%	10V	Tantal
C11,19,29,37, 51,54	3508 100 30420	1N0	5%		Ceramic
C12	2222 861 12109	10P	5%		Ceramic
C13	2222 861 12339	33P	5%		Ceramic
C18,20,24,26	2222 861 12151	150P	5%		Ceramic
C22-23,49	3508 100 30120	10U	20%	10V	Tantal
C25,35-36,71	3508 100 30740	100N	10%		Ceramic
C27-28,58,69	2222 590 16632	22N	10%		Ceramic
C30-34,59-60, 62-63,65-68	3508 100 30010	1N0	1%		Ceramic
C53	3508 100 30110	2U2	20%	16V	Tantal

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
RESISTORS					
R1,13,15,21, 72,79,91	3508 100 20330	4K7	5%	0.1W	
R2,7,61,62,96	3508 100 20230	680	5%	0.1W	
R3,122	3508 100 21330	15K	20%		NTC
R4,8	3508 100 20090	47	5%	0.1W	
R5,41,71,82-83	3508 100 20530	220K	5%	0.1W	
R6,19,27,29,40,90	3508 100 20510	150K	5%	0.1W	
R9,14,28,76,112	3508 100 20170	220	5%	0.1W	
R10,22,24,32,87	3508 100 20470	68K	5%	0.1W	
R11,26,92,113,124	3508 100 20450	47K	5%	0.1W	
R12,42,65-66	3508 100 20410	22K	5%	0.1W	
R16,18,81	3508 100 20270	1K5	5%	0.1W	
R17,69,85,94,110	3508 100 20570	470K	5%	0.1W	
R20,31,70,74,77	3508 100 20490	100K	5%	0.1W	
R23,123	3508 100 21340	100K	20%		NTC
R25	3508 100 22110	100K			Trim potm.
R30,95,115-119	3508 100 20370	10K	5%	0.1W	
R33,63-64,78	3508 100 20430	33K	5%	0.1W	
R34-35	3508 100 21160	40K2	1%		
R36	3508 100 21040	20K	1%		
R37	3508 100 21070	64K9	1%		
R38	3508 100 21100	178K	1%		
R39	3508 100 21090	121K	1%		
R43	3508 100 20590	680K	5%	0.1W	
R59,75	3508 100 22090	10K			Trim potm.
R67	3508 100 20250	1K0	5%	0.1W	
R68	3508 100 20320	3K9	5%	0.1W	
R73,80,84,93	3508 100 20390	15K	5%	0.1W	
R86	3508 100 20290	2K2	5%	0.1W	
R89,114	3508 100 20050	22	5%	0.1W	
R97	3508 100 21110	348K	1%		
R98	3508 100 21150	16K2	1%		
R99,105	3508 100 22130	4K7			Trim potm.
R100-101,106-107	3508 100 21060	39K2	1%		
R102,108	3508 100 21030	19K6	1%		
R103	3508 100 21020	19K1	1%		
R104	3508 100 21010	17K8	1%		
R109	3508 100 21050	20K5	1%		
R111	3508 100 21120	374K	1%		
R125	2112 660 00004				PTC

NUMBER	ORDERING NUMBER	TYPE
DIODES		
D1	3508 100 10050	BAS70-04
D2,6	9331 849 10215	BAV70
D3	9336 711 30215	BZX84-B6V8
COILS		
L1-2	3508 100 40050	820NH
L3-4,6	3508 100 40060	470NH
L5	3508 100 40190	470NH
L7	3508 100 40070	120UH
CRYSTAL		
X1	3508 100 50160	70.455MHz

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
CAPACITORS					
C1,2,15	2222 861 12398	3P9	0.25		Ceramic
C3,7	2222 861 12478	4P7	5%		Ceramic
C4-6,10,14,17, 44-48,50,52, 57,64	2222 590 16623	4N7	10%		Ceramic
C8	2222 861 12689	68P	5%		Ceramic
C9,16,21,55-56, 61,70	3508 100 30100	1U0	20%	10V	Tantal
C11,19,29,37, 51,54	3508 100 30420	1N0	5%		Ceramic
C12	2222 861 12109	10P	5%		Ceramic
C13	2222 861 12339	33P	5%		Ceramic
C18,20,24,26	2222 861 12151	150P	5%		Ceramic
C22-23,49	3508 100 30120	10U	20%	10V	Tantal
C25,35-36,71	3508 100 30740	100N	10%		Ceramic
C27-28,58,69	2222 590 16632	22N	10%		Ceramic
C30-34,59-60, 62-63,65-68	3508 100 30010	1N0	1%		Ceramic
C53	3508 100 30110	2U2	20%	16V	Tantal

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
RESISTORS					
R1,13,15,21, 72,79,91	3508 100 20330	4K7	5%	0.1W	
R2,7,61,62,96	3508 100 20230	680	5%	0.1W	
R3,122	3508 100 21330	15K	20%		NTC
R4,8	3508 100 20090	47	5%	0.1W	
R5,41,71,82-83	3508 100 20530	220K	5%	0.1W	
R6,19,27,29,40,90	3508 100 20510	150K	5%	0.1W	
R9,14,28,76,112	3508 100 20170	220	5%	0.1W	
R10,22,24,32,87	3508 100 20470	68K	5%	0.1W	
R11,26,92,113,124	3508 100 20450	47K	5%	0.1W	
R12,42,65-66	3508 100 20410	22K	5%	0.1W	
R16,18,81	3508 100 20270	1K5	5%	0.1W	
R17,69,85,94,110	3508 100 20570	470K	5%	0.1W	
R20,31,70,74,77	3508 100 20490	100K	5%	0.1W	
R23,123	3508 100 21340	100K	20%		NTC
R25	3508 100 22110	100K			Trim potm.
R30,95,115-119	3508 100 20370	10K	5%	0.1W	
R33,63-64,78	3508 100 20430	33K	5%	0.1W	
R34-35	3508 100 21160	40K2	1%		
R36	3508 100 21040	20K	1%		
R37	3508 100 21070	64K9	1%		
R38	3508 100 21100	178K	1%		
R39	3508 100 21090	121K	1%		
R43	3508 100 20590	680K	5%	0.1W	
R59,75	3508 100 22090	10K			Trim potm.
R67	3508 100 20250	1K0	5%	0.1W	
R68	3508 100 20320	3K9	5%	0.1W	
R73,80,84,93	3508 100 20390	15K	5%	0.1W	
R86	3508 100 20290	2K2	5%	0.1W	
R89,114	3508 100 20050	22	5%	0.1W	
R97	3508 100 21110	348K	1%		
R98	3508 100 21150	16K2	1%		
R99,105	3508 100 22130	4K7			Trim potm.
R100-101,106-107	3508 100 21060	39K2	1%		
R102,108	3508 100 21030	19K6	1%		
R103	3508 100 21020	19K1	1%		
R104	3508 100 21010	17K8	1%		
R109	3508 100 21050	20K5	1%		
R111	3508 100 21120	374K	1%		
R125	2112 660 00004				PTC

UNIT 3 - RX SYNTHESIZER

NUMBER	ORDERING NUMBER	TYPE
Filterconnector	5322-157-60239	
INTEGRATED CIRCUITS		
IC1	9333 729 10112	HEF4047BT
IC2	9333 726 80602	HEF4015BT
IC3	3508 100 16560	NJ8821HG
IC4	3508 100 16160	MB504FP
IC5	3508 100 16280	MC1776CD
TRANSISTORS		
Q1	3508 100 11100	CF300C
Q2,7	9335 897 90215	BC858B
Q3-6,9	9335 896 30215	BC848B
Q8	9334 509 00215	BF550
Q10-11	9333 477 30215	BFT92
DIODES		
D1	9336 960 10215	BZX84-B7V5
D2-5	9332 153 70215	BAV99
COILS		
L2	3508 100 40090	0.330UH
L3	3508 100 40040	100UH
L4	3508 100 40190	470NH
CRYSTAL		
X1	3508 102 11320	2.1MHz

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
CAPACITORS					
C1,5,31	2222 590 16618	2N2	10%		Ceramic
C2,17-18,32	2222 590 16632	22N	10%		Ceramic
C3	2222 590 14106	12P	5%		N750
C4,7,15,19, 23,26,38,46	2222 861 12829	82P	5%		Ceramic
C8,25	3508 100 30120	10U	20%	10V	Tantal

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
C9,14,34	3508 100 30110	2U2	20%	16V	Tantal
C10,12-13,16,40, 43,49,52-53	3508 100 30100	1U0	20%	10V	Tantal
C11,27-29,39, 44-45,47-48, 50-51	2222 590 16614	1N0	10%		Ceramic
C20,56,58	2222 861 12159	15P	5%		Ceramic
C21,54-55,57	3508 100 30300	2-12P			Trim cap
C22	2222 861 12279	27P	5%		Ceramic
C24,36-37	3508 100 30420	1N0	5%		Ceramic
C30	3508 100 30740	100N	10%		Ceramic
C33	2222 861 12399	39P	5%		Ceramic
C35	2222 590 16623	4N7	10%		Ceramic
C41	2222 861 12278	2P7	0.25		Ceramic
C42	2222 861 12109	10P	5%		Ceramic
C59	2222 861 12338	3P3	0.25		Ceramic
RESISTORS					
R1,11,20,41, 46,60	3508 100 20090	47	5%	0.1W	
R2,14	3508 100 20500	120K	5%	0.1W	
R3,21	3508 100 20450	47K	5%	0.1W	
R4	3508 100 20250	1K0	5%	0.1W	
R5,32	3508 100 20370	10K	5%	0.1W	
R6,16,23	3508 100 20410	22K	5%	0.1W	
R7	3508 100 20270	1K5	5%	0.1W	
R9,15,22	3508 100 20350	6K8	5%	0.1W	
R10	3508 100 20530	220K	5%	0.1W	
R12,36,42-43, 47-48,54	3508 100 20010	10	5%	0.1W	
R13,49-52	3508 100 20470	68K	5%	0.1W	
R17,30,39,55	3508 100 20130	100	5%	0.1W	
R18,62	3508 100 20600	820K	5%	0.1W	
R19,27,34-35, 38,45,64	3508 100 20330	4K7	5%	0.1W	
R24,63	3508 100 20490	100K	5%	0.1W	
R25,37,44, 53,56-57	3508 100 20290	2K2	5%	0.1W	
R26,28	3508 100 20590	680K	5%	0.1W	
R29	3508 100 20550	330K	5%	0.1W	
R31	3508 100 20430	33K	5%	0.1W	
R33	3508 100 20310	3K3	5%	0.1W	
R59	3508 100 20230	680	5%	0.1W	

UNIT 4 - TX/AF AMPLIFIER

NUMBER	ORDERING NUMBER	TYPE
Filtercombi	5322-157-60241	
INTEGRATED CIRCUITS		
IC1	9335 716 80602	LM358D
IC2	9337 725 30602	SA571D
IC3	3508 100 16110	OM843
TRANSISTORS		
Q1	9332 722 80115	BCX51
Q2-4,6,16-17,22	9335 896 30215	BC848B
Q5	9335 897 90215	BC858B
Q7,11,13,18,20	9333 477 30215	BFT92
Q8,12,19,21	9335 515 60215	BFR92A
Q9-10,14	9334 509 00215	BF550
Q15	9331 634 90215	BFR31
DIODES		
D1,4	9331 849 10215	BAV70
D2	9336 711 30215	BZX84-B6V8
D3,8	9332 153 70215	BAV99
D5,10	9335 053 10215	BBY40
D6,11	9334 107 10215	BAT18
D9	9330 989 90215	BAW56
COILS		
L1,3,5,7	3508 100 40180	33NH
L2	3508 100 40190	470NH
L4	3508 100 40150	8.2UH
CRYSTAL		
X1	3508 100 50050	15MHz

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
CAPACITORS					
C2,22,26-28,35,62, 64,70,91-93,97	2222 590 16632	22N	10%		Ceramic

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
C4,8,15,30,39,45,49 67,74,76,78,82,84	2222 590 16614	1N0	10%		Ceramic
C5,10,20,37,47,53, 61,66,68-69,73,77, 85,95,98-99	3508 100 30100	1U0	20%	10V	Tantal
C6,16,18,90	2222 861 12101	100P	5%		Ceramic
C9	2222 861 12398	3P9	0.25		Ceramic
C11	2222 861 12478	4P7	5%		Ceramic
C12-13,38,41,89	2222 861 12479	47P	5%		Ceramic
C14	2222 861 12109	10P	5%		Ceramic
C17	3508 100 30800	47P	5%		N1500
C19,43,46,54, 86-87	2222 590 16623	4N7	10%		Ceramic
C21,23,48	2222 861 12151	150P	5%		Ceramic
C24	2222 590 16627	10N	10%		Ceramic
C25,63,88	3508 100 30740	100N	10%		Ceramic
C29	2222 861 12471	470P	5%		Ceramic
C31	2222 591 16636	47N	10%		Ceramic
C32,52,59,65	3508 100 30120	10U	20%	10V	Tantal
C34	2222 590 16618	2N2	10%		Ceramic
C36,40	2222 861 12338	3P3	0.25		Ceramic
C42,55,60,96	2222 861 12221	220P	5%		Ceramic
C71-72,75	2222 861 12688	6P8	5%		Ceramic
C79	2222 861 12828	8P2	5%		Ceramic
C80	3508 100 30810	4P7	0.25		N1500
C81	3508 100 30300	2-12P			Trim cap
C83	3508 100 31040	5P6	0.1		High Q
C94	3508 100 30110	2U2	20%	16V	Tantal

RESISTORS

R1,4,10,47,52, 75-76,81,86, 111,115-116	3508 100 20410	22K	5%	0.1W	
R2,46,55,64,68	3508 100 20430	33K	5%	0.1W	
R3,6,13,29,33, 38,40,43,45,78- 79,89-90,93,95- 96,128	3508 100 20490	100K	5%	0.1W	
R5,119	3508 100 20310	3K3	5%	0.1W	
R7,27,58,103,109	3508 100 20210	470	5%	0.1W	
R8	3508 100 20350	6K8	5%	0.1W	
R9,12,123	3508 100 20290	2K2	5%	0.1W	
R11,17,35,85,87, 91-92,121-122,127	3508 100 20330	4K7	5%	0.1W	

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
R14	3508 100 20530	220K	5%	0.1W	
R15,18,21,24, 60,70,105	3508 100 20050	22	5%	0.1W	
R16	3508 100 20230	680	5%	0.1W	
R19,23,36,98, 108,125,129	3508 100 20090	47	5%	0.1W	
R20	3508 100 20150	150	5%	0.1W	
R22	3508 100 20110	68	5%	0.1W	
R25-26,77	3508 100 20270	1K5	5%	0.1W	
R28,30-32,34, 67,110	3508 100 20370	10K	5%	0.1W	
R37,54,63,99	3508 100 20390	15K	5%	0.1W	
R39,50	3508 100 22090	10K			Trim. potm.
R41,84	3508 100 20420	27K	5%	0.1W	
R42,94	3508 100 22130	4K7			Trim. potm.
R44,82	3508 100 20510	150K	5%	0.1W	
R48,51	3508 100 20300	2K7	5%	0.1W	
R49	3508 100 20400	18K	5%	0.1W	
R53,56,61,65-66, 69,97,101,106	3508 100 20130	100	5%	0.1W	
R57,102	3508 100 20240	820	5%	0.1W	
R59,104,107	3508 100 20170	220	5%	0.1W	
R62,112	3508 100 20010	10	5%	0.1W	
R71,83,100	3508 100 20450	47K	5%	0.1W	
R73	3508 100 20520	180K	5%	0.1W	
R74	3508 100 20580	560K	5%	0.1W	
R80	3508 100 20590	680K	5%	0.1W	
R113-114,117-118,120,124	3508 100 20250	1K0	5%	0.1W	
R126	3508 100 21400	6K8	20%		NTC

UNIT 5 - PA STAGE

NUMBER	ORDERING NUMBER	TYPE
INTEGRATED CIRCUIT		
IC1	3508 100 16200	MHW720A-2
TRANSISTORS		
Q1	3508 100 11070	MRF559
Q2-3	9332 722 80115	BCX51

NUMBER	ORDERING NUMBER	TYPE
DIODES		
D1	9331 849 10215	BAV70
D2	3508 100 10050	BAS70-04
D3	9332 153 70215	BAV99
COILS		
L1	3508 100 40190	470NH
L4	3508 102 51050	Choke
L5	3508 102 51090	Choke
L6	3508 102 51080	

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
CAPACITORS					
C1	2222 861 12399	39P	5%		Ceramic
C2-3,5,15-16	2222 590 16607	330P	10%		Ceramic
C4	2222 116 55689	68U	+-20%	16V	Electrolytic
C6	2222 861 12478	4P7	5%		Ceramic
C7	2222 861 12828	8P2	5%		Ceramic
C8,11,20	2222 122 55159	15U	+-20%	16V	Electrolytic
C9,13	3508 100 30740	100N	10%		Ceramic
C10,14	2222 590 16614	1N0	10%		Ceramic
C12	2222 122 46158	1U5	+-10%	25V	Electrolytic
C17	3508 100 30490	1.6-11,4P			Trimmer
C18	3508 100 30210	6P8	0.25		High Q
C19	3508 100 30100	1U0	20%	10V	Tantal
RESISTORS					
R1,6	3508 100 20010	10	5%	0.1W	
R2-3	3508 100 20090	47	5%	0.1W	
R4,11	3508 100 20210	470	5%	0.1W	
R7	3508 100 20130	100	5%	0.1W	
R8	3508 100 22090	10K			Trim. potm.
R9-10	3508 100 20170	220	5%	0.1W	
R12	3508 100 20370	10K	5%	0.1W	
R13	3508 100 20190	330	5%	0.1W	

UNIT 1 - SYSTEMBOARD, marked 3508 101 6124X

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	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
IC201	9337 154 70112	74HC373T
IC202	3508 100 16100	TC5517BFL20
IC203	9337 135 00112	74HC139T
IC204	9337 143 10112	74HC32T
IC205	3508 100 16070	FX409L
IC206	9337 142 60112	74HC04T
IC207	8208 244 01620	NMC9306NE
IC208	9333 726 60112	HEF4013BT
IC209	9334 069 60112	HEF40106BT
IC210	9333 731 90112	HEF4512BT
IC211-213	9333 733 70112	HEF4724BT
IC214	9333 729 70112	HEF4066BT
IC220	8208 244 00131	Coded EPROM
TRANSISTORS		
Q1,3-4,6,8,10-11, 14-16,18,200-203, 205,207-209	9335 896 30215	BC848B
Q2,5,7,9,13,17,210	9335 897 90215	BC858B
Q12	9332 722 80115	BCX51
Q204,206	9336 630 90115	BCX56-10
DIODES		
D1,6,11	9330 989 90215	BAW56
D2	9333 882 60215	BZX84-C15
D3-4,7,12	9331 849 10215	BAV70
D5	9331 373 90215	BZX84-C5V1

NUMBER	ORDERING NUMBER	TYPE
D8-9	3508 100 10340	LED SLM13YW
D10	9332 153 70215	BAV99
D201-202	9333 883 30215	BZX84-C30
RELAY		
RE1	3508 100 60050	6V 1 shiftset
CRYSTALS		
X1	4008 103 01070	32.768kHz
X2	3508 100 50000	12.096MHz
MISCELLANEOUS		
	3508 100 55300	Pin for unit connectors
	3508 100 55710	Guiding pin for units
	8208 205 08200	Lithiumcelle for system board

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
C5,254	3508 100 30130	47U	20%	6.3V	Tantal
C6,7,71,204, 251-253	3508 100 30120	10U	20%	10V	Tantal
C8,12,82,250	3508 100 30110	2U2	20%	16V	Tantal
C9-10,201	3508 100 30820	270N	10%		Ceramic
C11,13	3508 100 30730	1U0	20%	35V	Tantal
C14,212	2222 590 16614	1N0	10%		Ceramic
C15,20,50,55, 210-211	3508 100 30100	1U0	20%	10V	Tantal
C16,102-103, 106,202	2222 861 12479	47P	5%		Ceramic
C17	2222 861 12109	10P	5%		Ceramic
C19,54,70,83, 87,89,208-209	3508 100 30740	100N	10%		Ceramic
C51-53	2222 590 16627	10N	10%		Ceramic
C72,213	2222 861 12101	100P	5%		Ceramic
C73,100,207, 214,255	2222 590 16632	22N	10%		Ceramic

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
C80-81	3508 100 30320	15U	20%	16V	Tantal
C84	2222 590 16618	2N2	10%		Ceramic
C104	2222 590 16621	3N3	10%		Ceramic
C105	2222 861 12331	330P	5%		Ceramic
C203	2222 861 12339	33P	5%		Ceramic
RESISTORS					
R1,2,76	3508 100 20170	220	5%	0.1W	
R3,9,44,67,82,221	3508 100 20250	1K0	5%	0.1W	
R4,23,31,84,104-105,108-109,112,223,225,228,237	3508 100 20410	22K	5%	0.1W	
R5,70,77,81,101	3508 100 20430	33K	5%	0.1W	
R6	3508 100 20420	27K	5%	0.1W	
R7-8,20,28,36,54,58,102-103,125-126,206,209,219-220,222,224,227,235-236	3508 100 20490	100K	5%	0.1W	
R10-11,13,18-19,40,50,52-53,71-72,75,83,118,210,212,218	3508 100 20530	220K	5%	0.1W	
R12,34,38-39,41,43,45,79,85,100,116-117,119,123-124,128,207,211,226,231,233,234	3508 100 20450	47K	5%	0.1W	
R14,17,202,78	3508 100 20570	470K	5%	0.1W	
R15-16,32,42,56,61-62,107,120,201,205,208,213,232	3508 100 20370	10K	5%	0.1W	
R21	3508 100 20360	8K2	5%	0.1W	
R22,106	3508 100 22090	10K			
R24	3508 100 20480	82K	5%	0.1W	
R25,29	3508 100 20400	18K	5%	0.1W	
R26,33,35,60,64-66,68,80,214,216	3508 100 20290	2K2	5%	0.1W	
R27,30,46-48,51,203	3508 100 20600	820K	5%	0.1W	
R37	3508 100 20050	22	5%	0.1W	
R55	3508 100 20480	82K	5%	0.1W	
R57	3508 100 20390	15K	5%	0.1W	

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
R63,74,111,115, 121,127,230	3508 100 20330	4K7	5%	0.1W	
R73	3508 100 20210	470	5%	0.1W	
R86	3508 100 20350	6K8	5%	0.1W	
R87,122	3508 100 20270	1K5	5%	0.1W	
R88,215,217	3508 100 20690	4R7	5%	0.1W	
R110	3508 100 22130	4K7			Trim potm.
R113	3508 100 20270	1K5	5%	0.1W	
R114	3508 100 21380	350			PTC
R240	3508 100 20550	330K	5%	0.1W	
R250-252	3508 100 20010	10	5%	0.1W	

Handset

CONTENTS PAGE

Disassembling of the handset

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

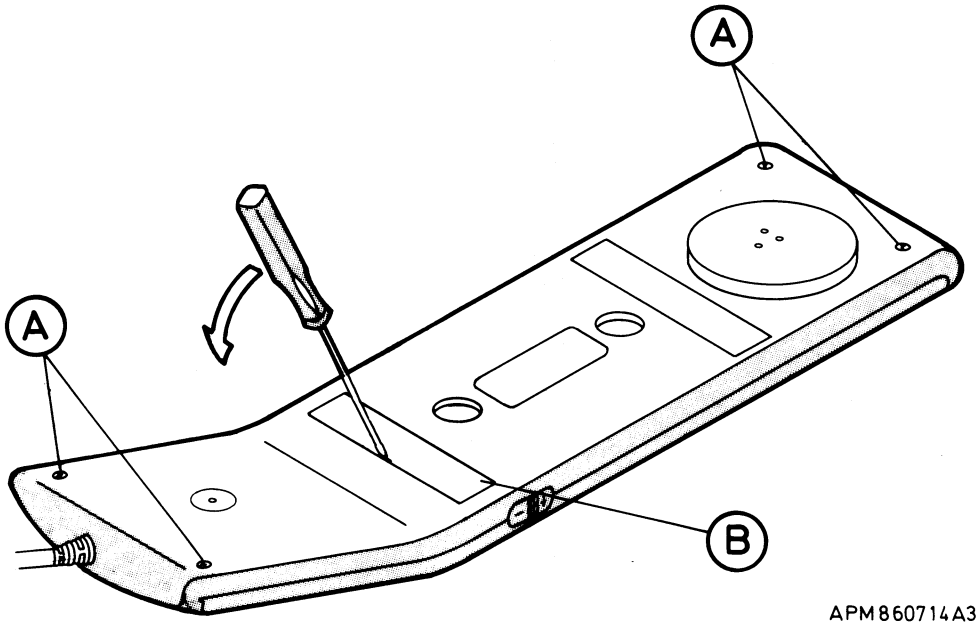


Fig. 1

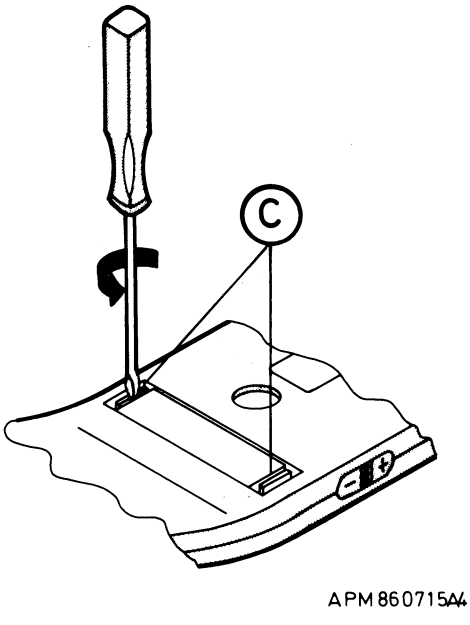


Fig. 2

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

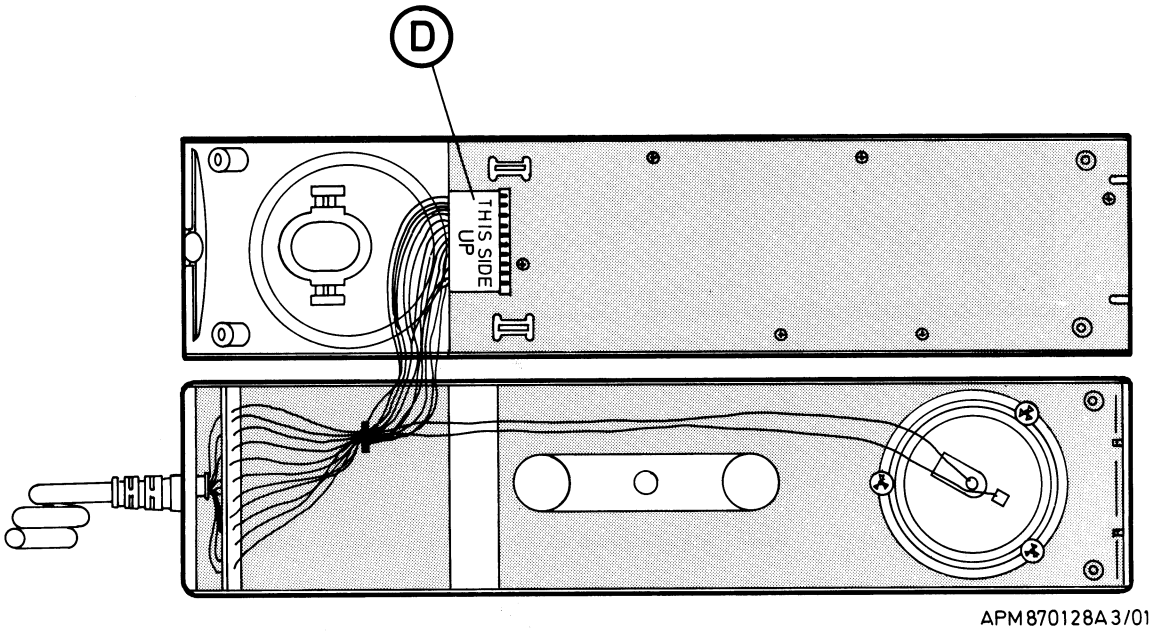


Fig. 3

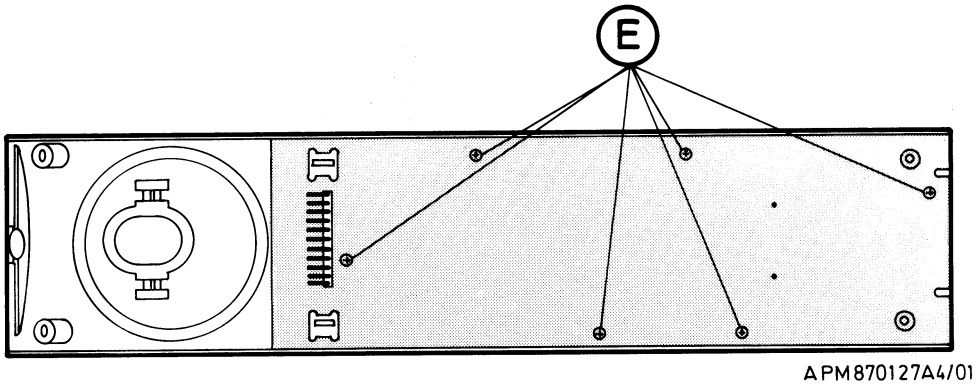


Fig. 4

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.

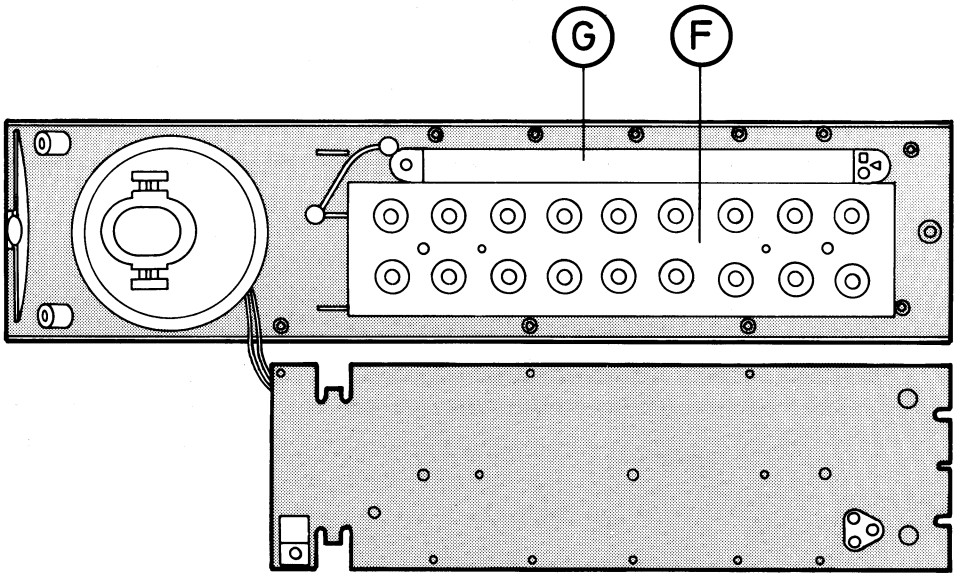


Fig. 5

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 semi-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 level is remembered after switching the mobile telephone off. 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 "-".

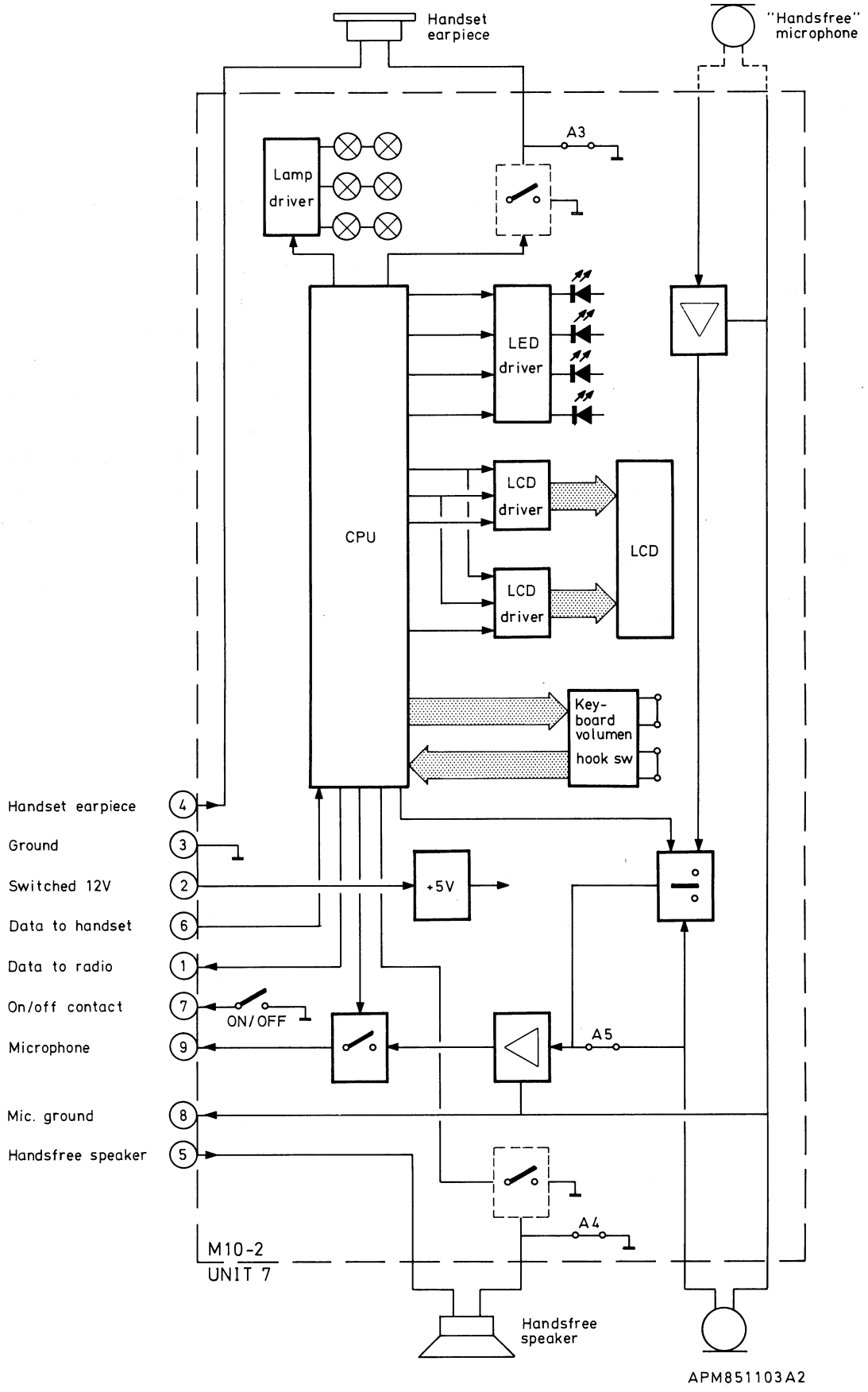


Fig. 4 Block diagram, handset

CPH870605/0

KEYBOARD TEST:

Press the keys one by one, from left to right, starting with the top row.
The display will show two states of each key, one when pressed and one when released.
The keys and their corresponding indications are listed in the table.

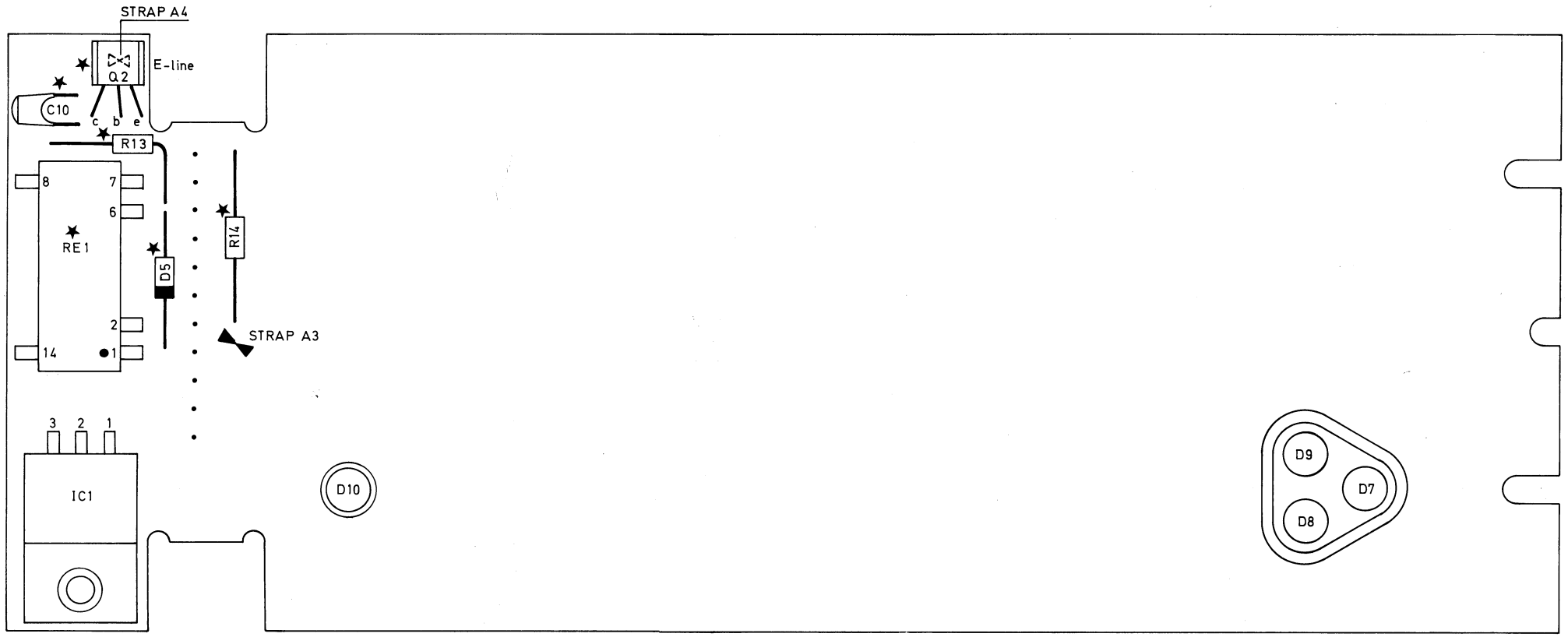
KEY	INDICATION	KEY	INDICATION
1	1-d 1-U	8	13-d 13-U
2	2-d 2-U	9	14-d 14-U
3	3-d 3-U	0	15-d 15-U
4	4-d 4-U	#	16-d 16-U
5	5-d 5-U	→	17-d 17-U
*	6-d 6-U	T	18-d 18-U
C	7-d 7-U	⇄	19-d 19-U
M	8-d 8-U	⏻	ON-OFF
↗	9-d 9-U	Volume +	24-d 24-U
↖	10-d 10-U	Volume -	25-d 25-U
6	11-d 11-U	Off cradle	26U
7	12-d 12-U	On cradle	26-d

HANDSET LOUDSPEAKER AND MICROPHONE.

The tests 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 small speaker BNC to the large speaker BNC, then the tone should be audible in the semi-handsfree speaker.
The handset microphone 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 semi-handsfree microphone can only be tested with a transceiver being used. If you want to mute the microphone, 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

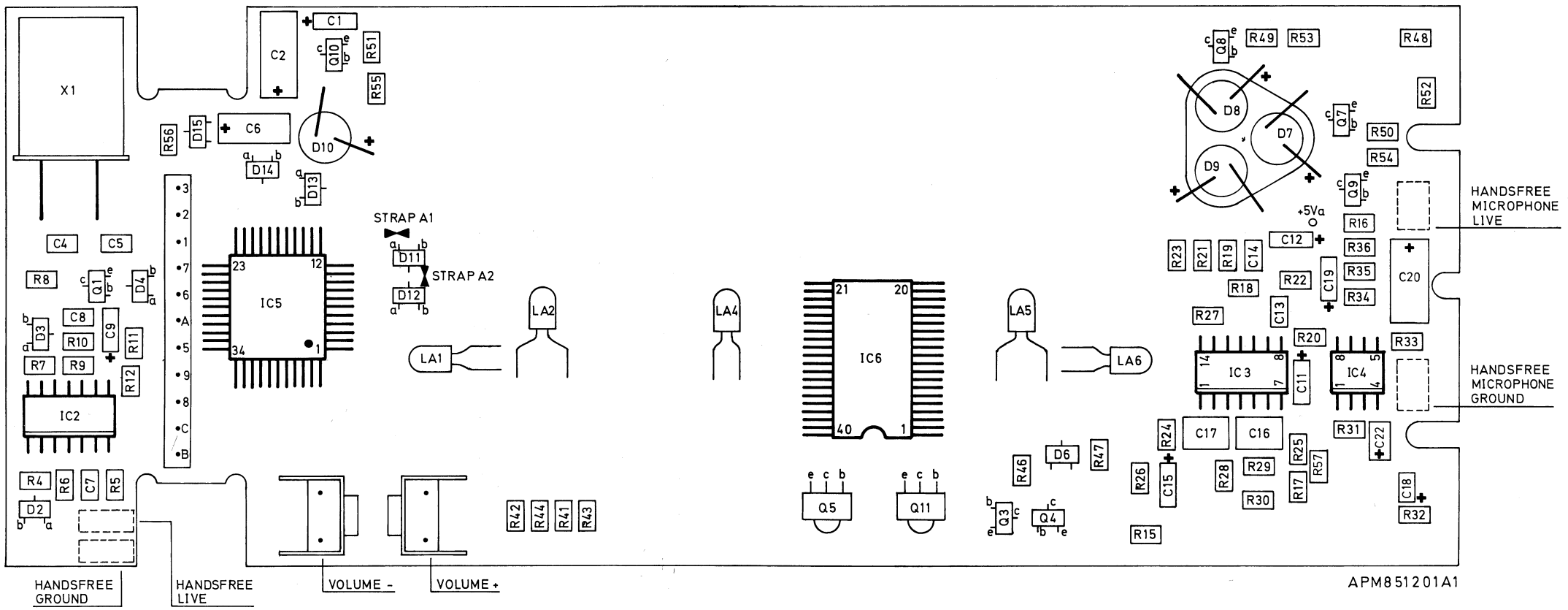


Fig. 5 Component location, handset

CPH870605/0

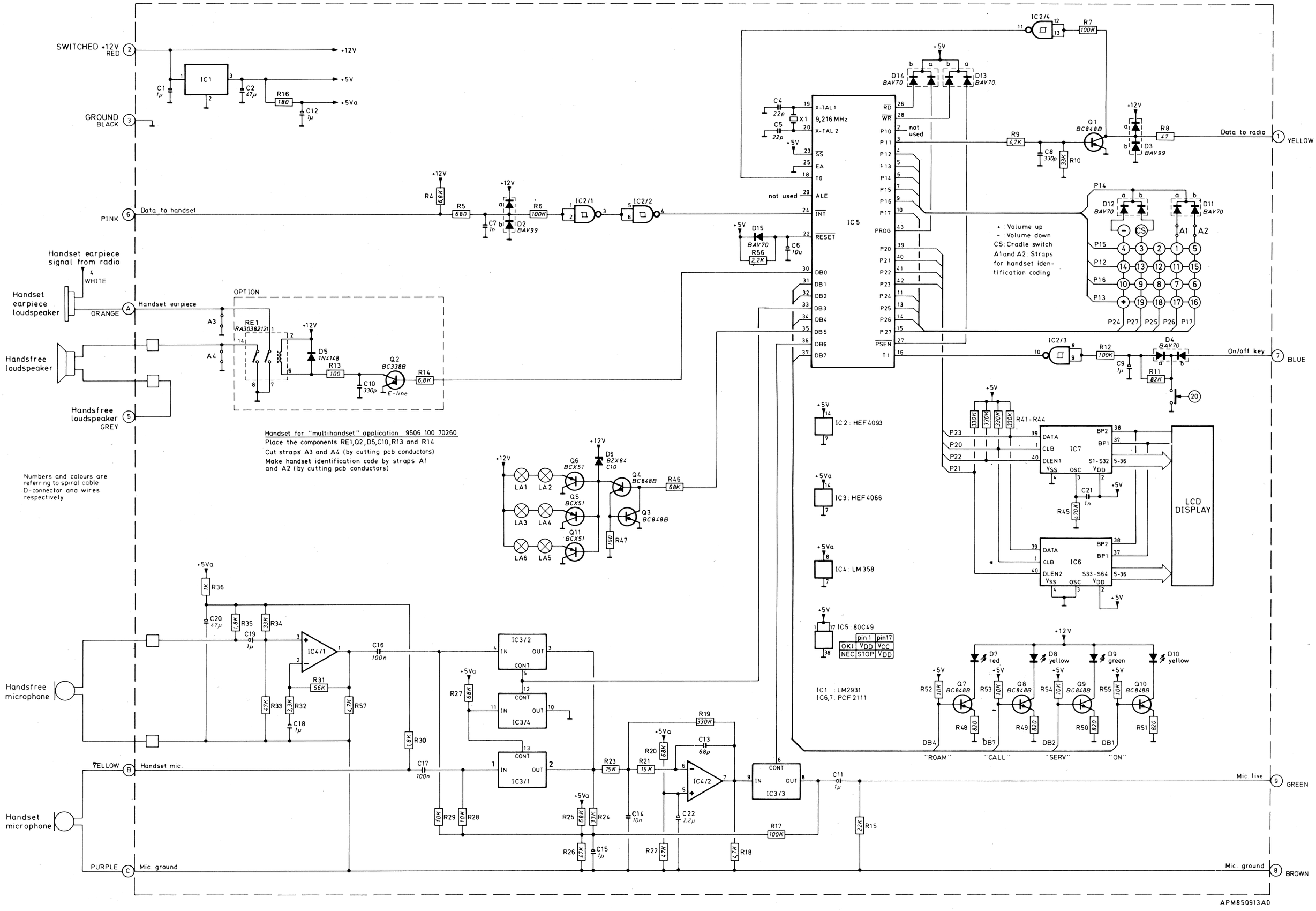


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Fig. 6 Circuit diagram, handset

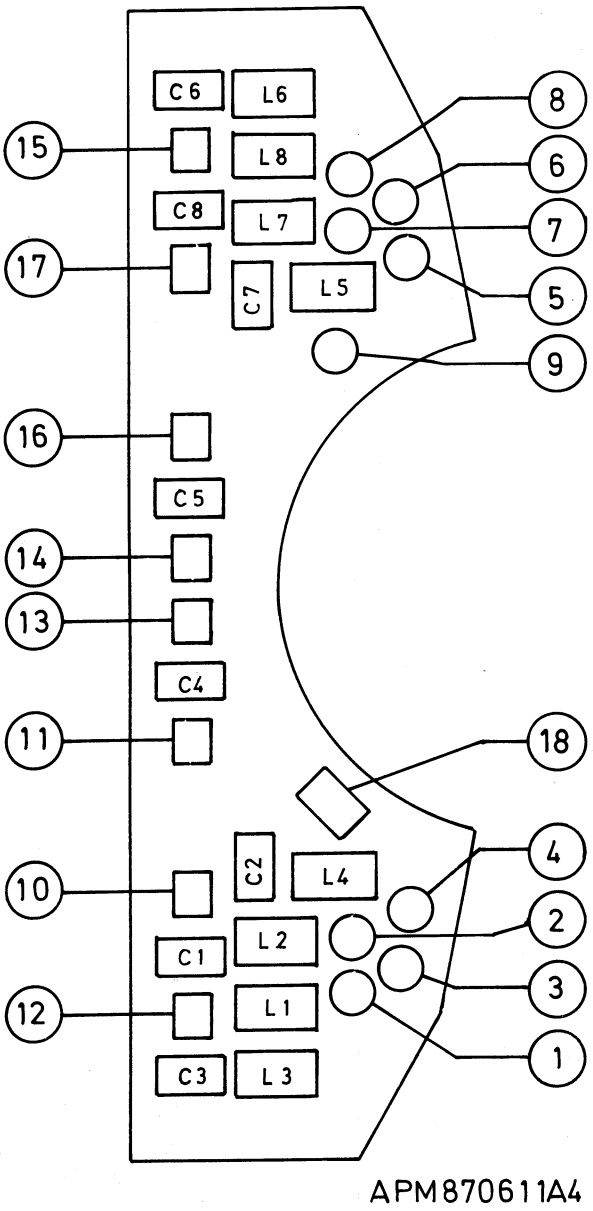

Fig. 7 Component location, RF-filter

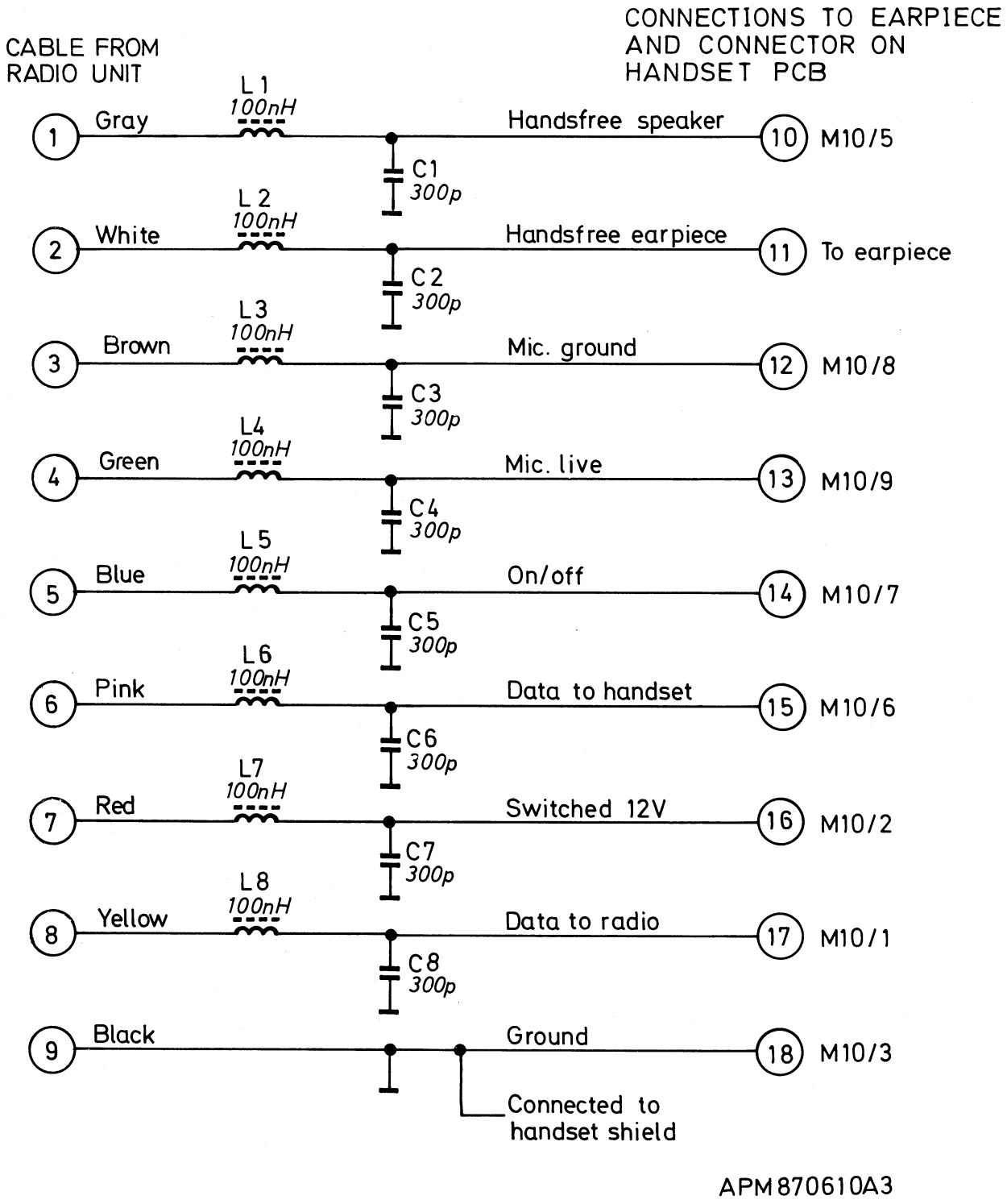

Fig. 8 Circuit diagram, RF-filter

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Mechanical parts

ITEM	DESCRIPTION	QUANTITY	ORDERING NUMBER
1.	Top cover, black with ap logo	1	3508 101 51640
1.	Top cover, white with ap logo	1	3508 101 51650
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 10850
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 00141
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
20.	RF-filter	1	3508 102 21150

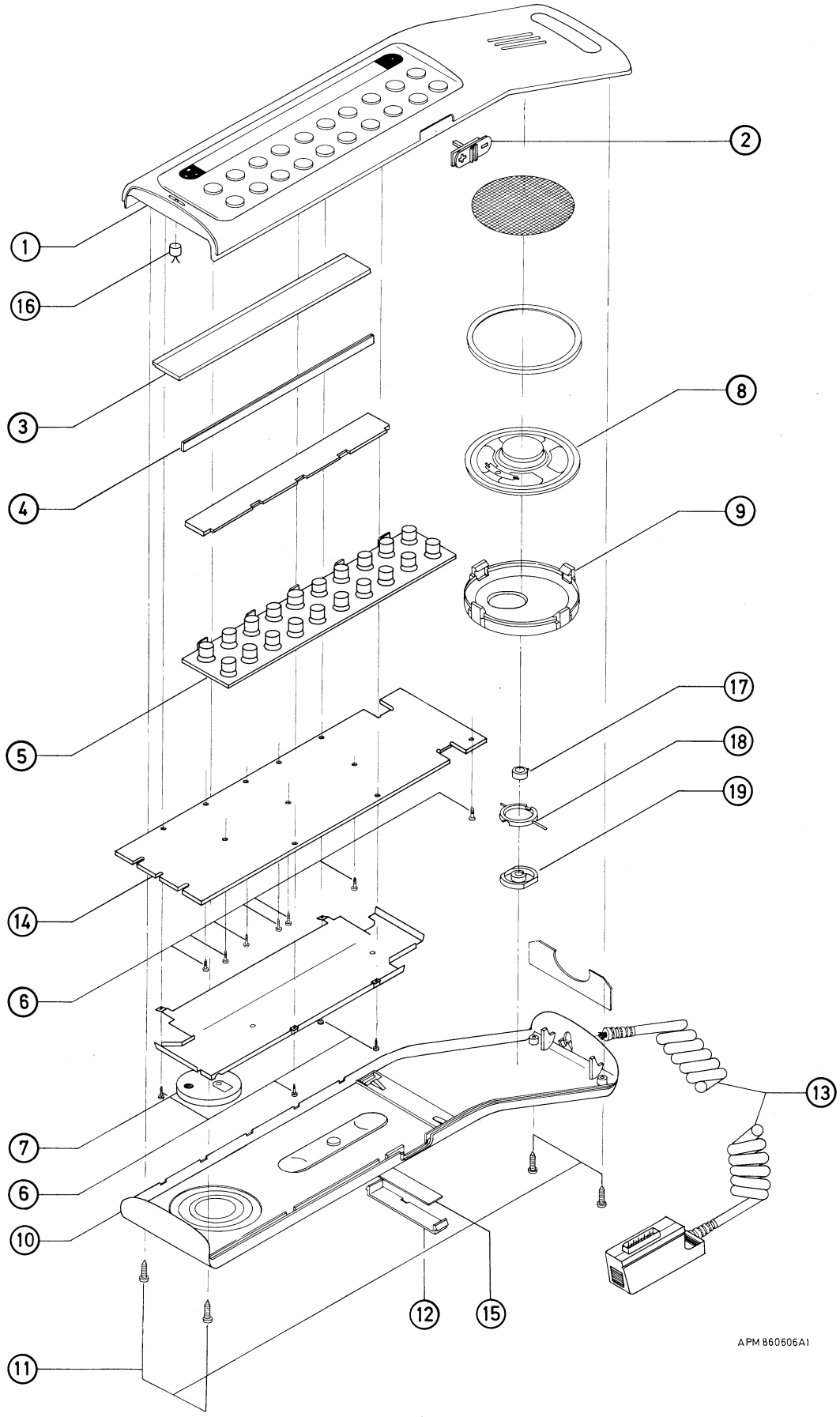

Fig. 9 Exploded view, handset

CPH870605/0

Electrical parts

NUMBER	ORDERING NUMBER	TYPE
INTEGRATED CIRCUITS		
IC1	9336 534 20682	LM2931AT
IC2	9333 731 30112	HEF4093BT
IC3	9333 729 70112	HEF4066BT
IC4	9335 716 80602	LM358D
IC5	3508 102 70800	80C49 PROG. CPU
IC6-7	9336 051 40112	PCF2111T
TRANSISTORS		
Q1,3-4,7-10	9335 896 30215	BC848B
Q5-6,11	9332 722 80115	BCX51
DIODES		
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
CRYSTAL		
X1	3508 100 50150	9.216MHz
LAMPS		
LA1-6	2422 533 00298	5V/60mA
SWITCHES		
Cradle switches	9300 885 80112	Reed contact RI-22AAA
Volume up/down	3508 100 65030	KHH15952

Portable kit - ap4000 series

CONTENTS **PAGE**

RF-Filter f/handset

NUMBER	ORDERING NUMBER	TYPE
COILS		
L1-8	3508 100 40320	100NH

NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
CAPACITORS					
C1-8	2222 580 16607	N33	10%		Ceramic

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The Portable for the ap4000 series is built-up by four major modules: Portable cassette
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This chapter only deals with the portable cassette and the battery pack.

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a. Handle for the ap4000 series portable.
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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 extern power supply, while the green LED is used as zenerdiode in connection with Q4, and has no indicator function.

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 $0^{0}C$, as this can shorten battery life, unless the charging current is accurately controlled as in the case with the cigarette lighter-cord 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.

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.

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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.

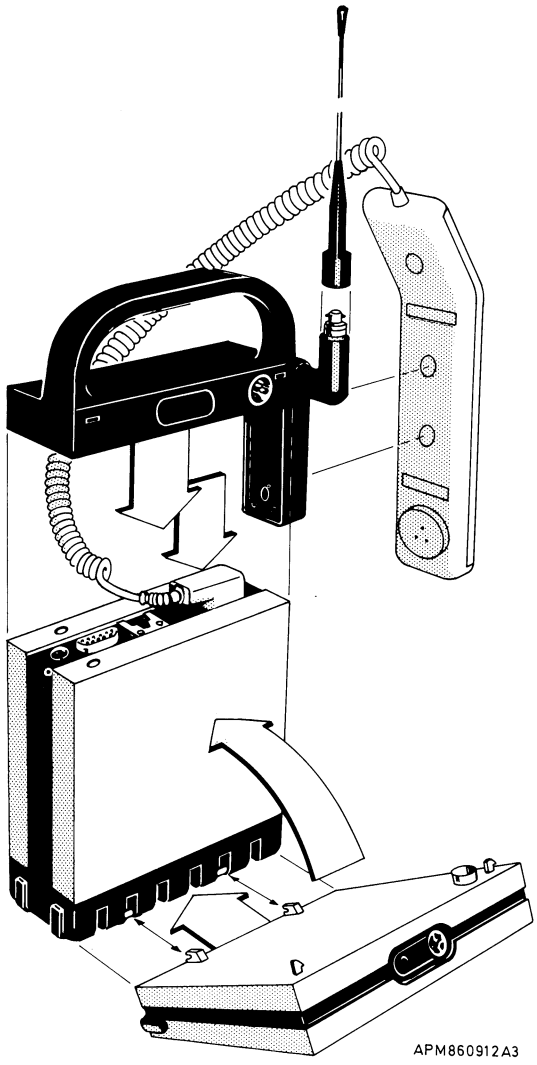

Fig. 1 Assembling of ap4000 portable

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.

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) .

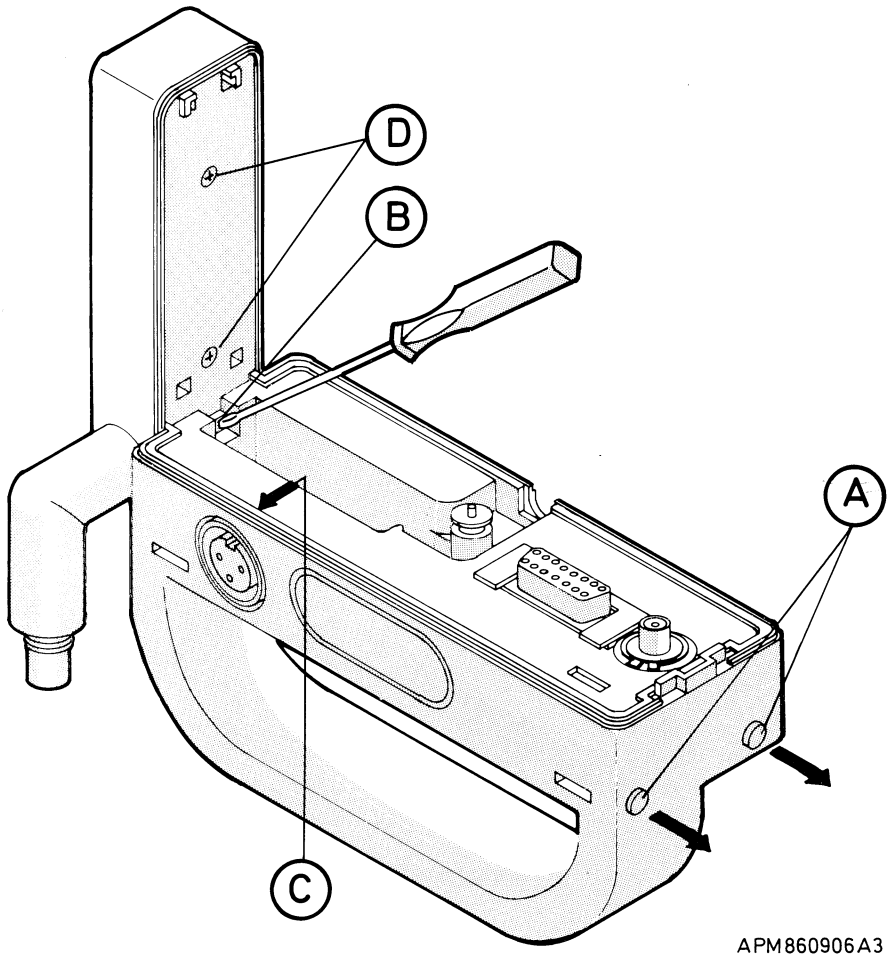

Fig. 2 Disassembling of the portable cassette

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 insulalating washer between the transistors Q2/Q3 and the metal cover.

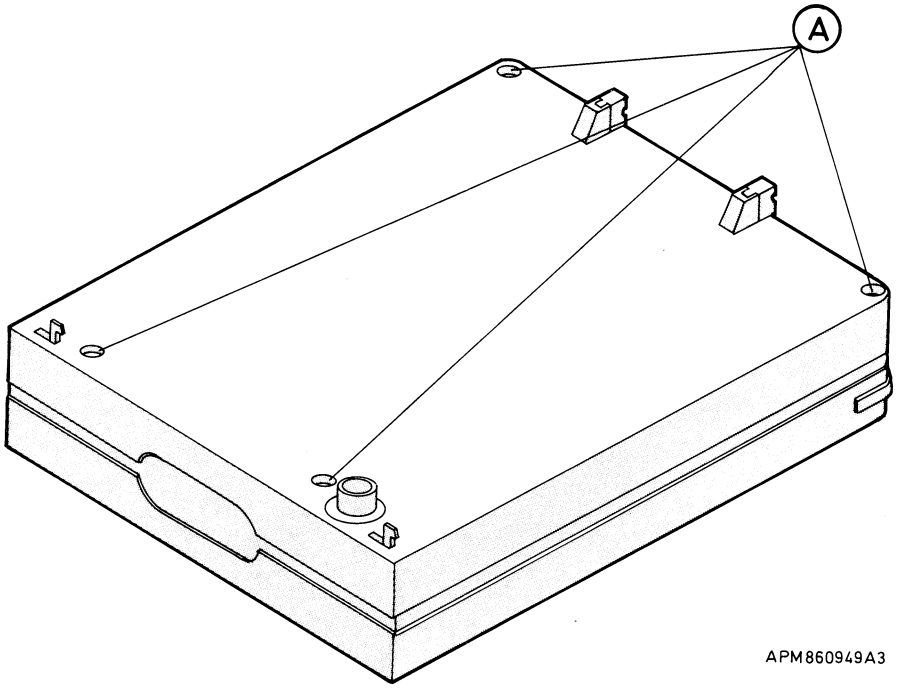

Fig. 3 Disassembling of the battery pack

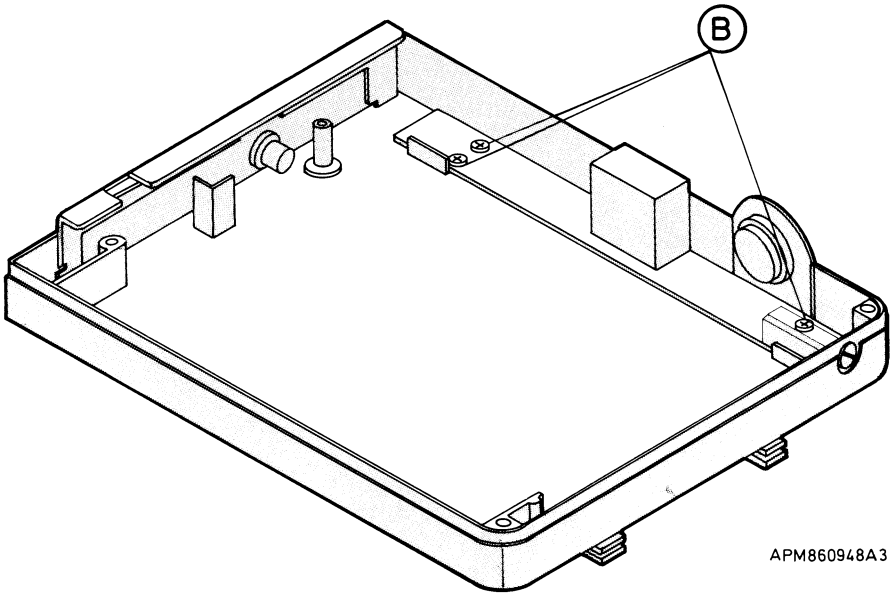

Fig. 4 Removing the charging circuit

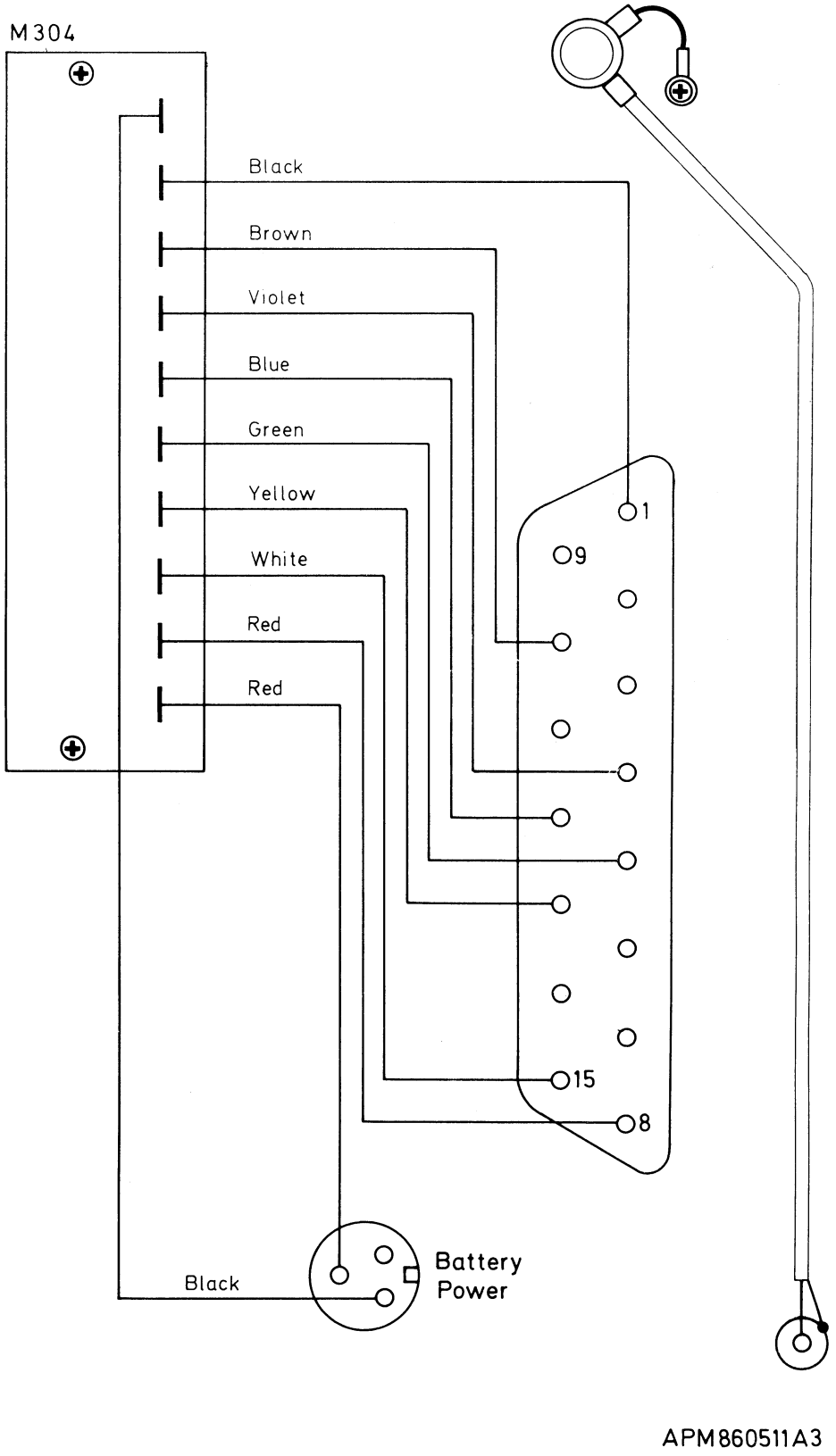

Fig. 5 Wiring diagram, portable cassette

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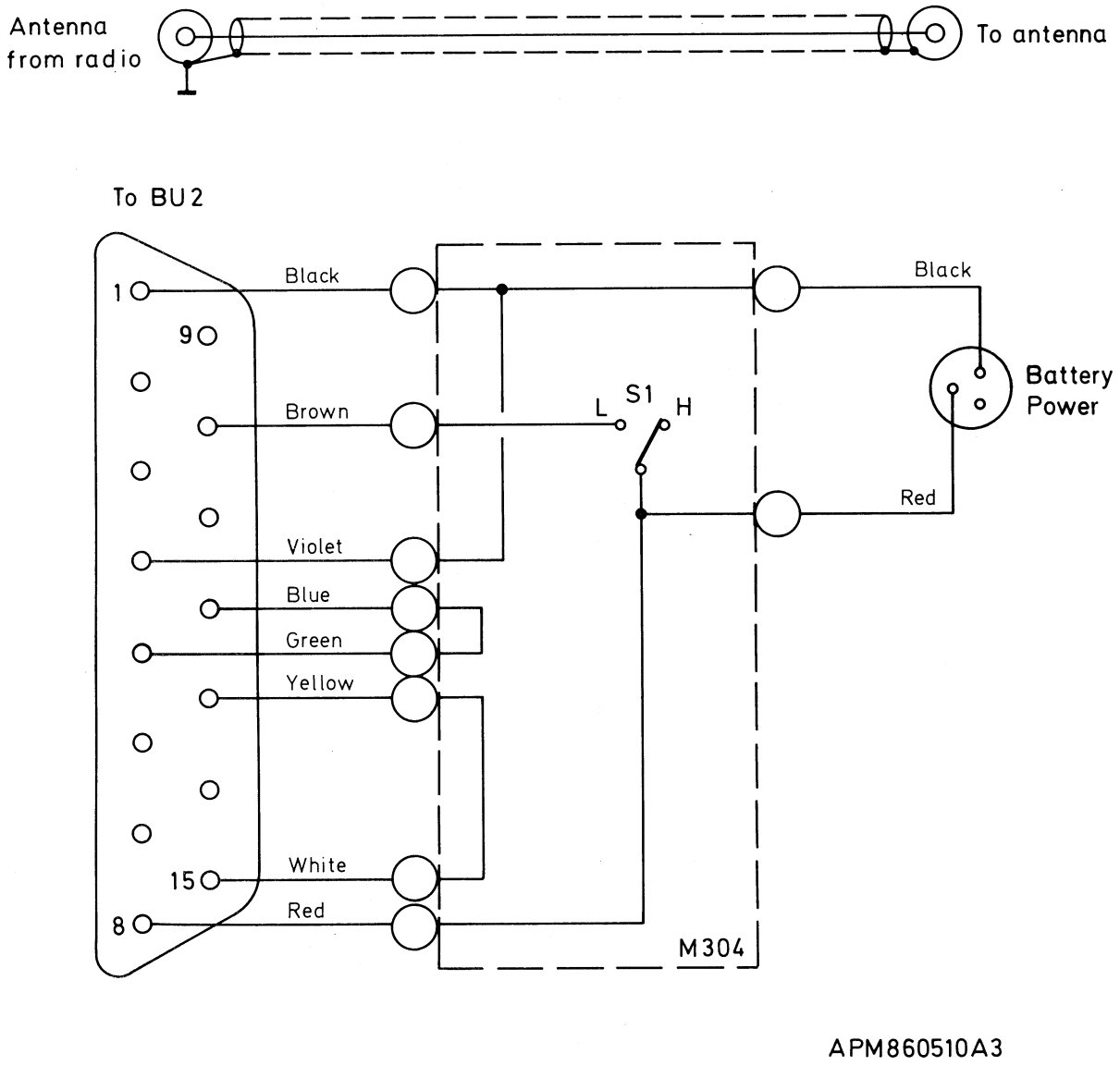

Fig. 6 Circuit diagram, portable cassette

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CHARGER / SUPPLY CONNECTOR :

1. CURRENT CHARGER NOM. 400mA
2. EXT. SUPPLY NOM. 12V 4,6A
3. GROUND

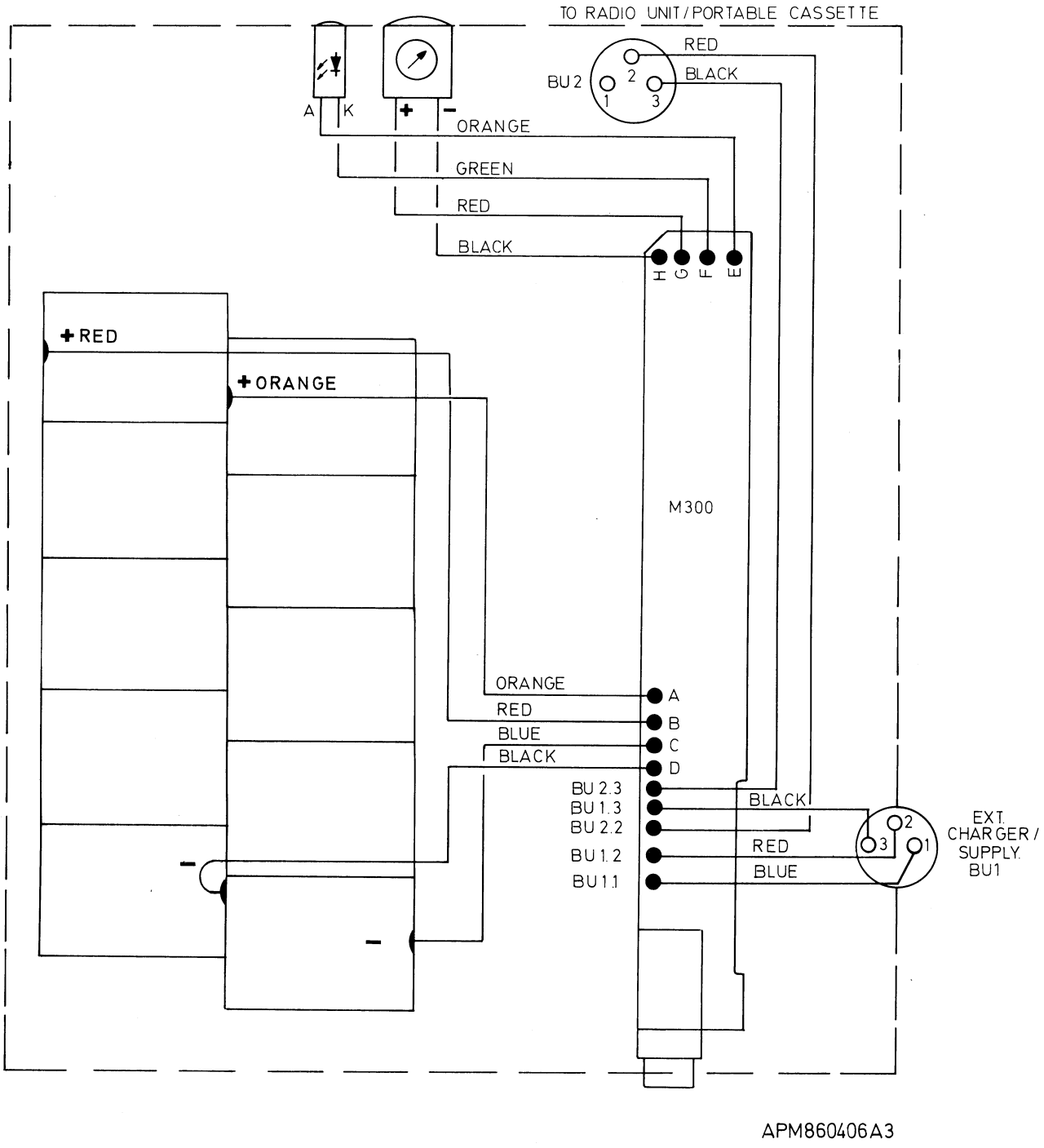

Fig. 7 Wiring diagram, battery pack

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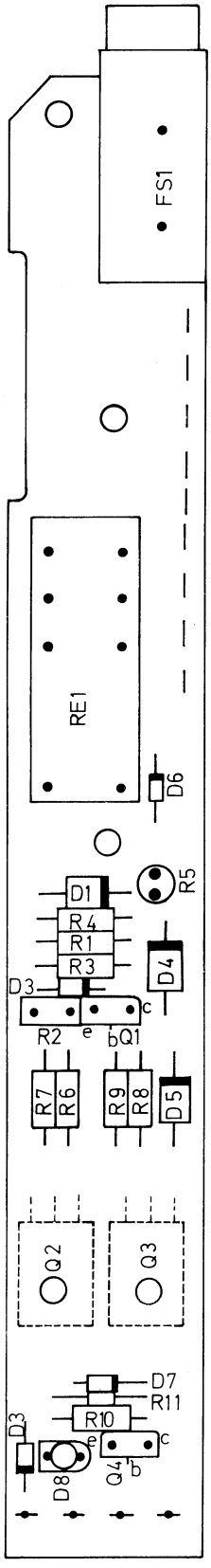

Fig. 8 Component location, charging circuit

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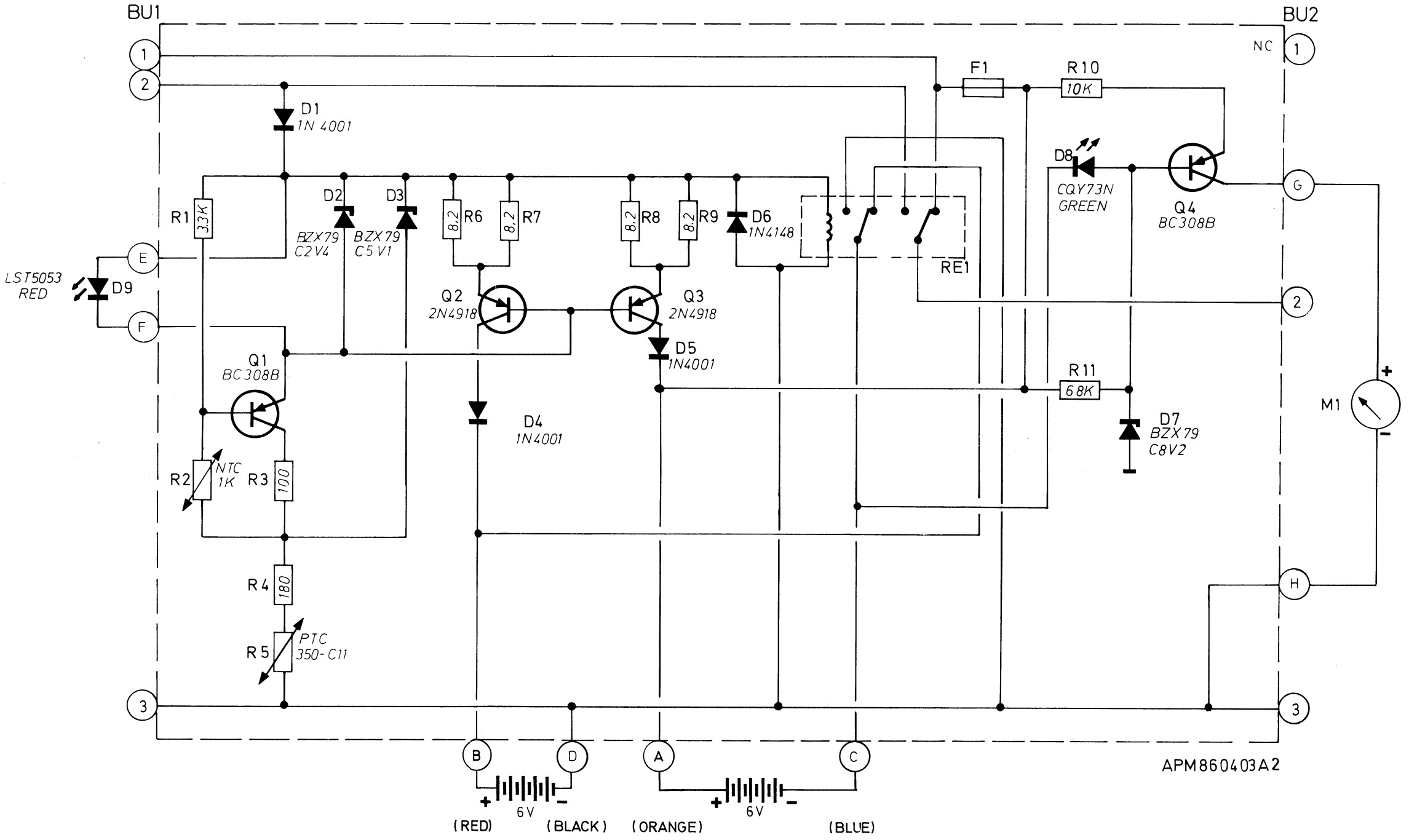

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Fig. 9 Circuit diagram, charging circuit

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

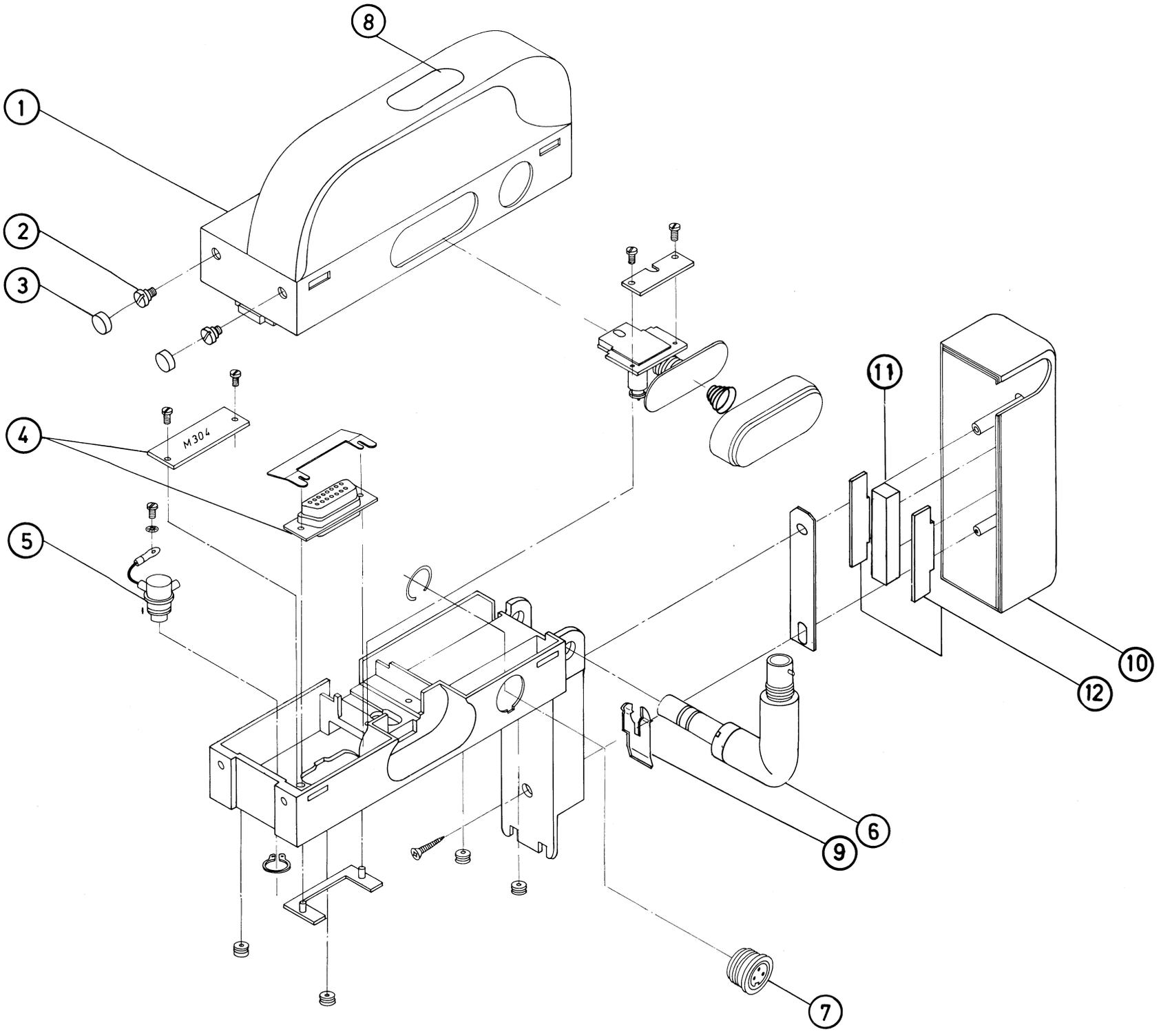

Fig. 10 Exploded view, portable cassette

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 ~~51150~~ 52300
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 $-25^{0}C$ and $+55^{0}C$.

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

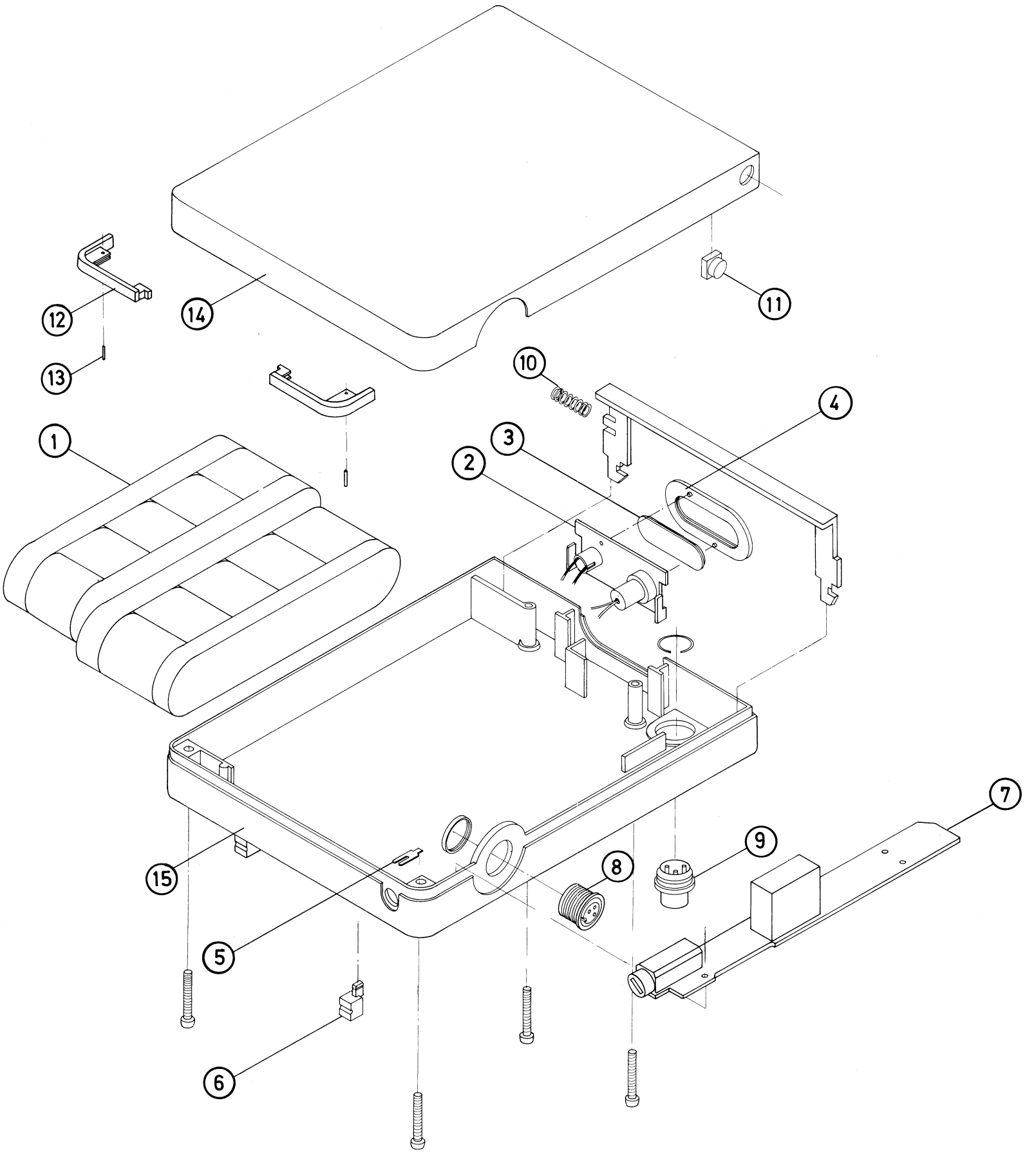

Fig. 11 Exploded view, battery pack

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
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	

Portable kit, version 2 - ap4000 series

CONTENTS **PAGE**

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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 extern power supply, while the green LED is used as zenerdiode in connection with Q4, and has no indicator function.

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

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

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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.

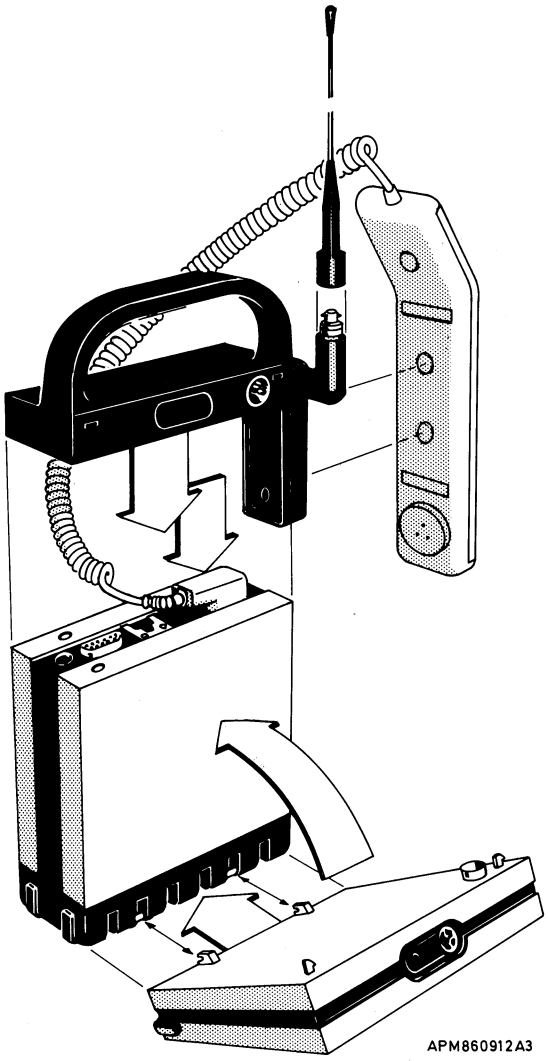


Fig. 1 Assembling of ap4000 portable

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) .

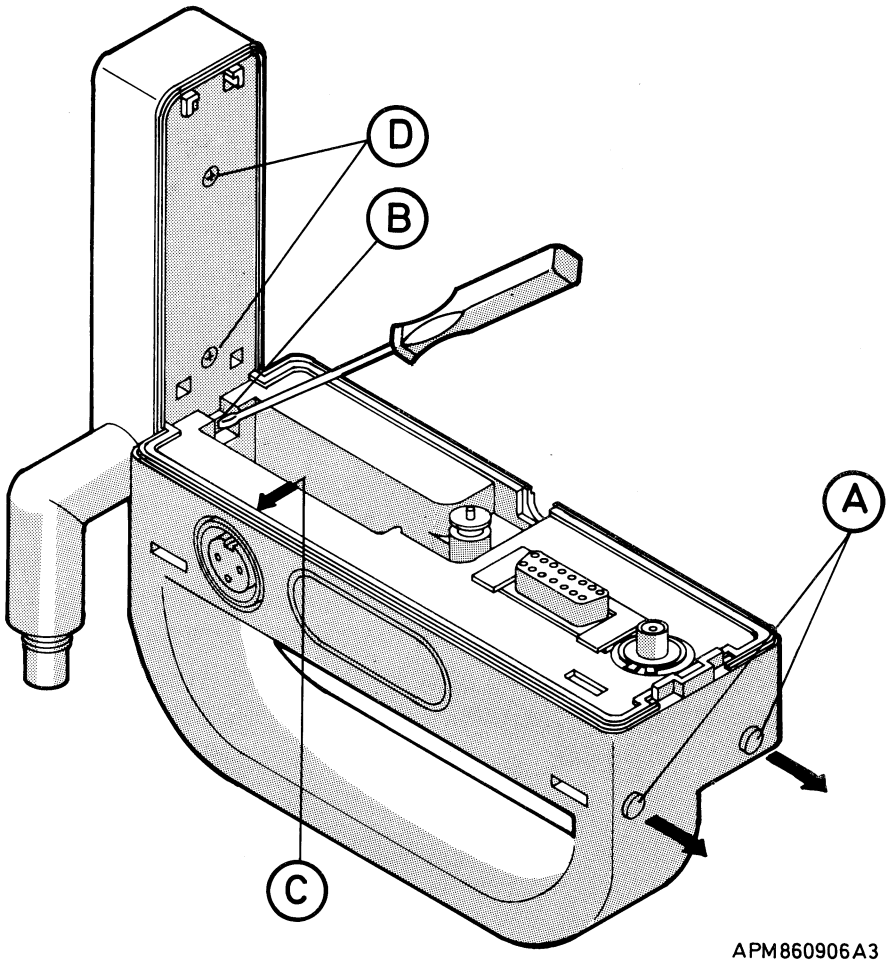


Fig. 2 Disassembling of the portable cassette

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.

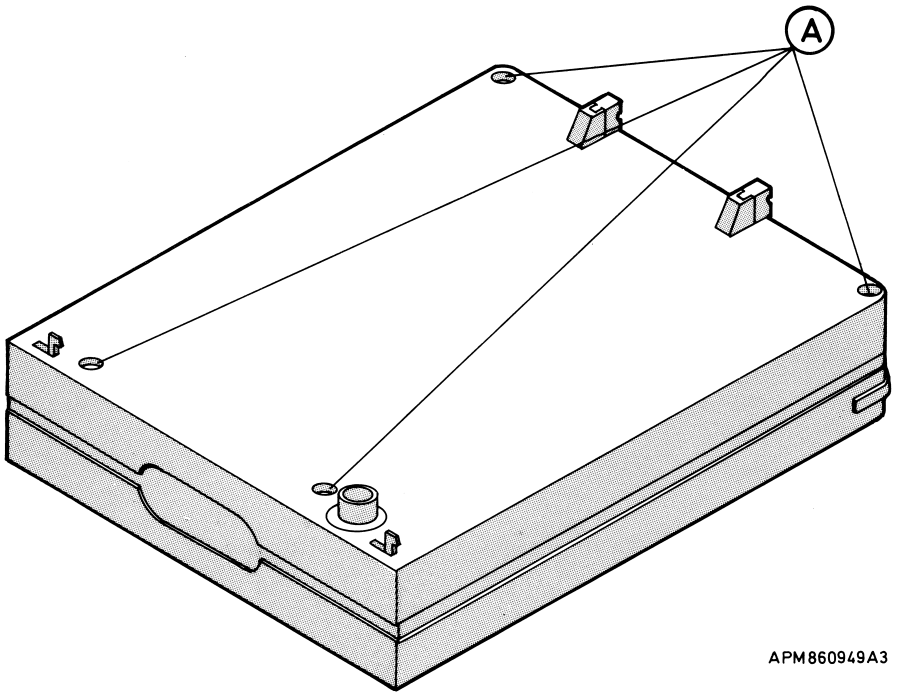


Fig. 3 Disassembling of the battery pack

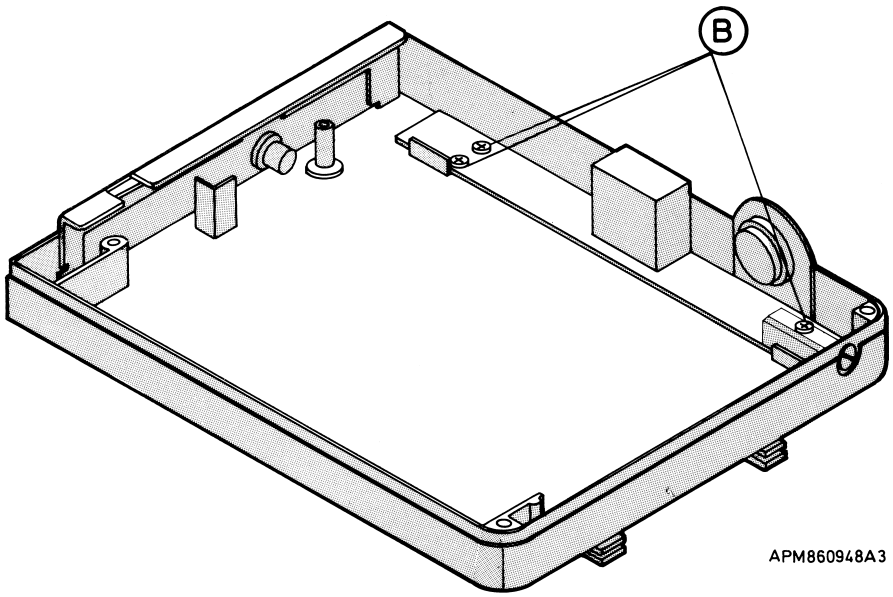


Fig. 4 Removing the charging circuit

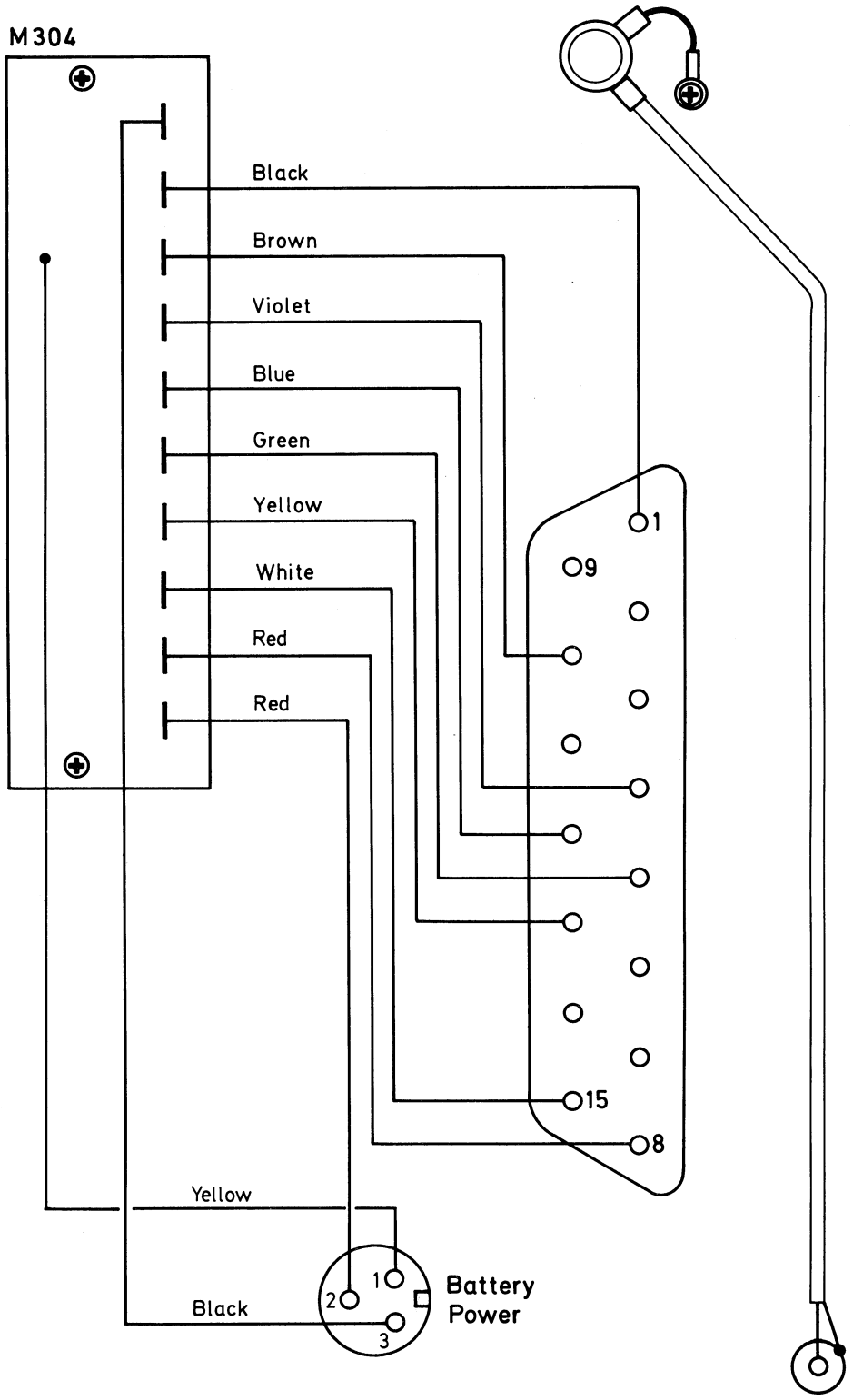


Fig. 5 Wiring diagram, portable cassette, version 2

CPH861206/0

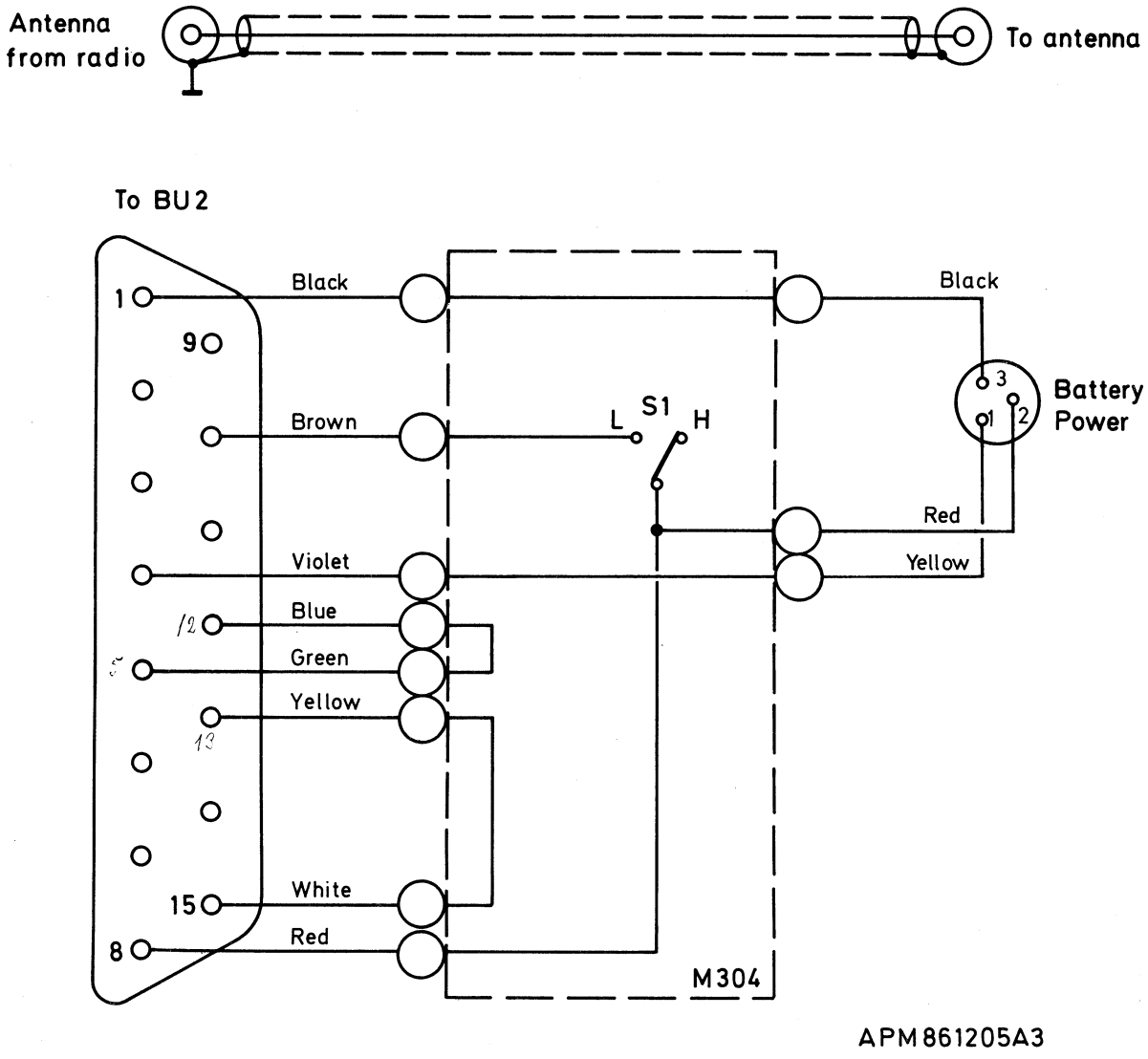


Fig. 6 Circuit diagram, portable cassette, version 2

CPH861206/0

CHARGER / SUPPLY CONNECTOR:

1. CURRENT CHARGER NOM. 400mA
2. EXT. SUPPLY NOM. 12V 4,6A
3. GROUND

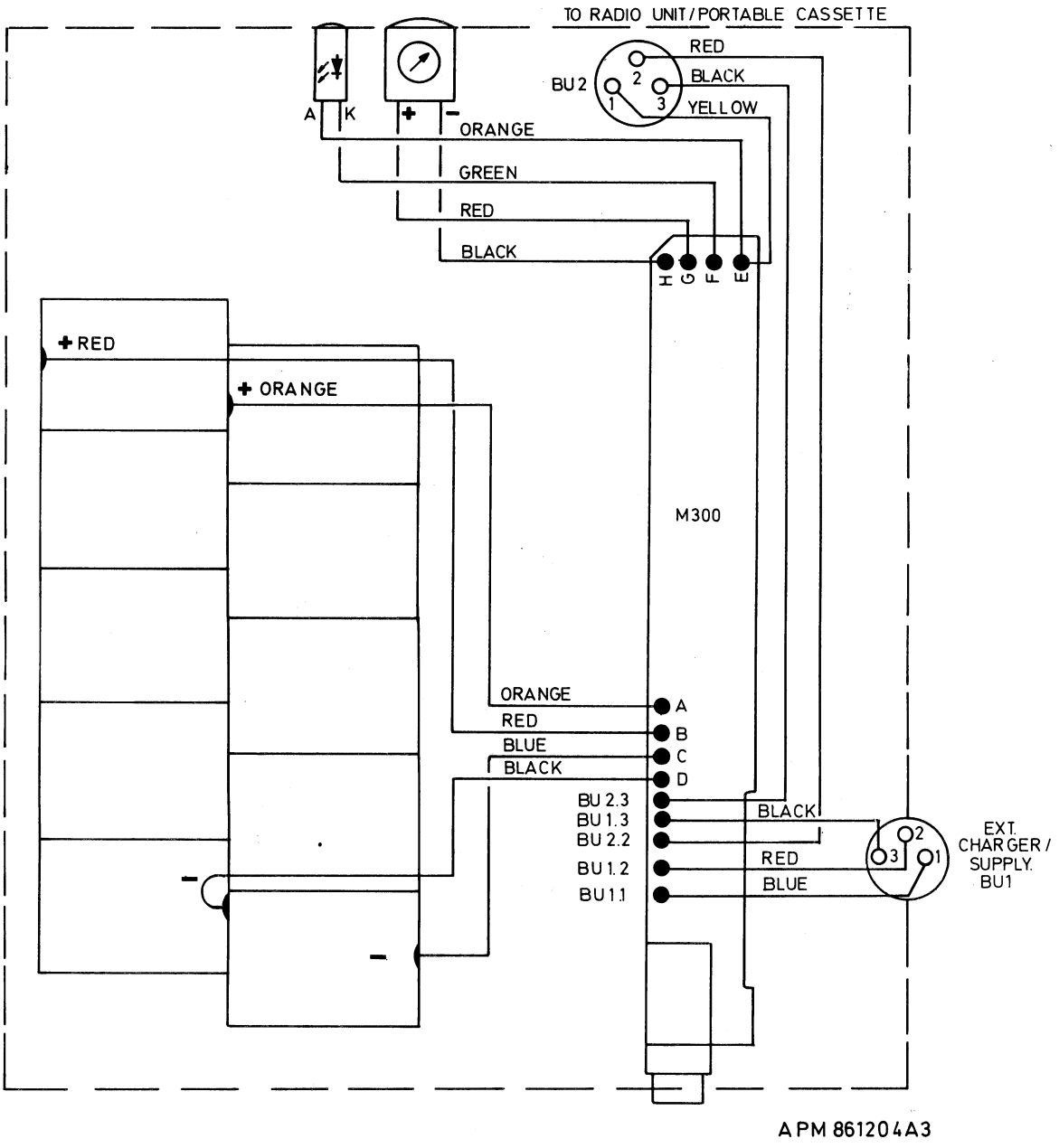


Fig. 7 Wiring diagram, battery pack, version 2

CPH861206/1

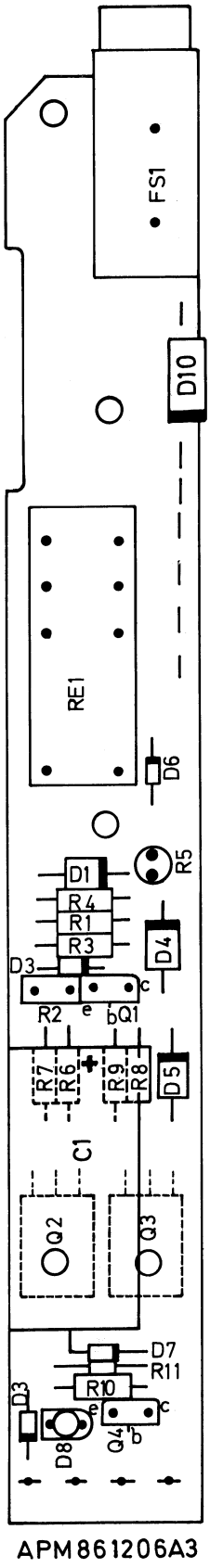
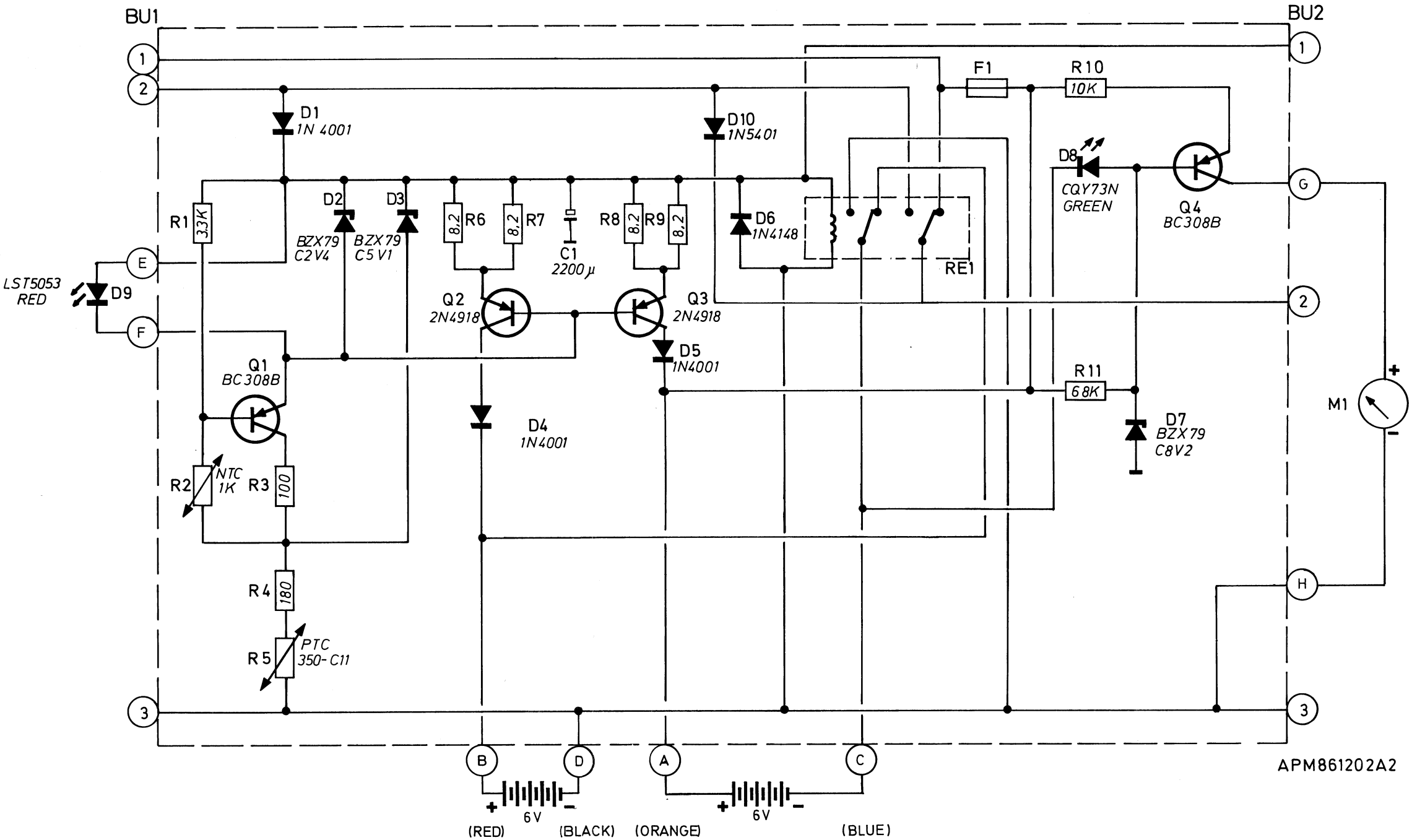


Fig. 8 Component location, charging circuit, version 2

CPH861206/0



CPH861206/1

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

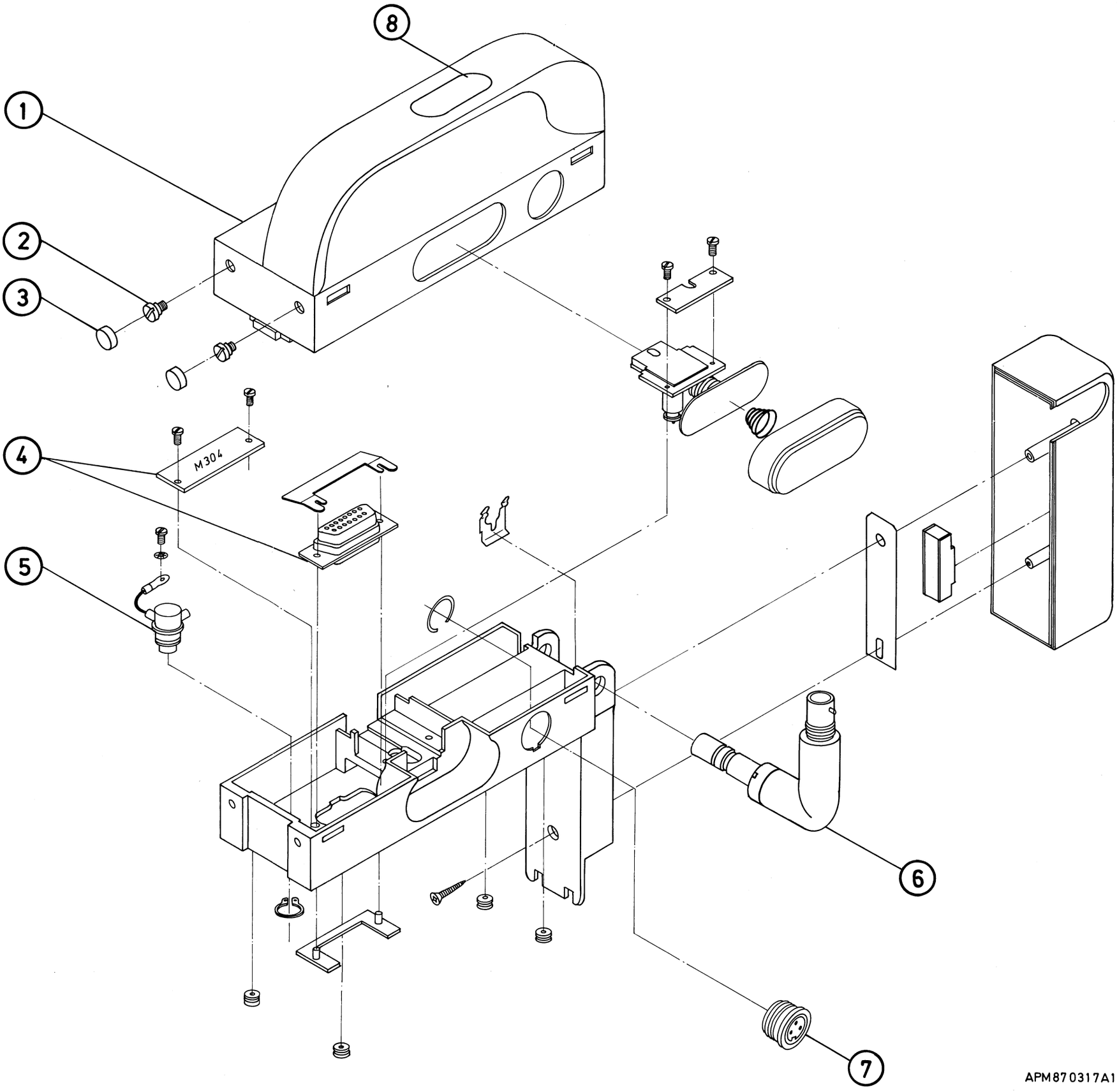


Fig. 10 Exploded view, portable cassette

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 $-25^{0}C$ and $+55^{0}C$.

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

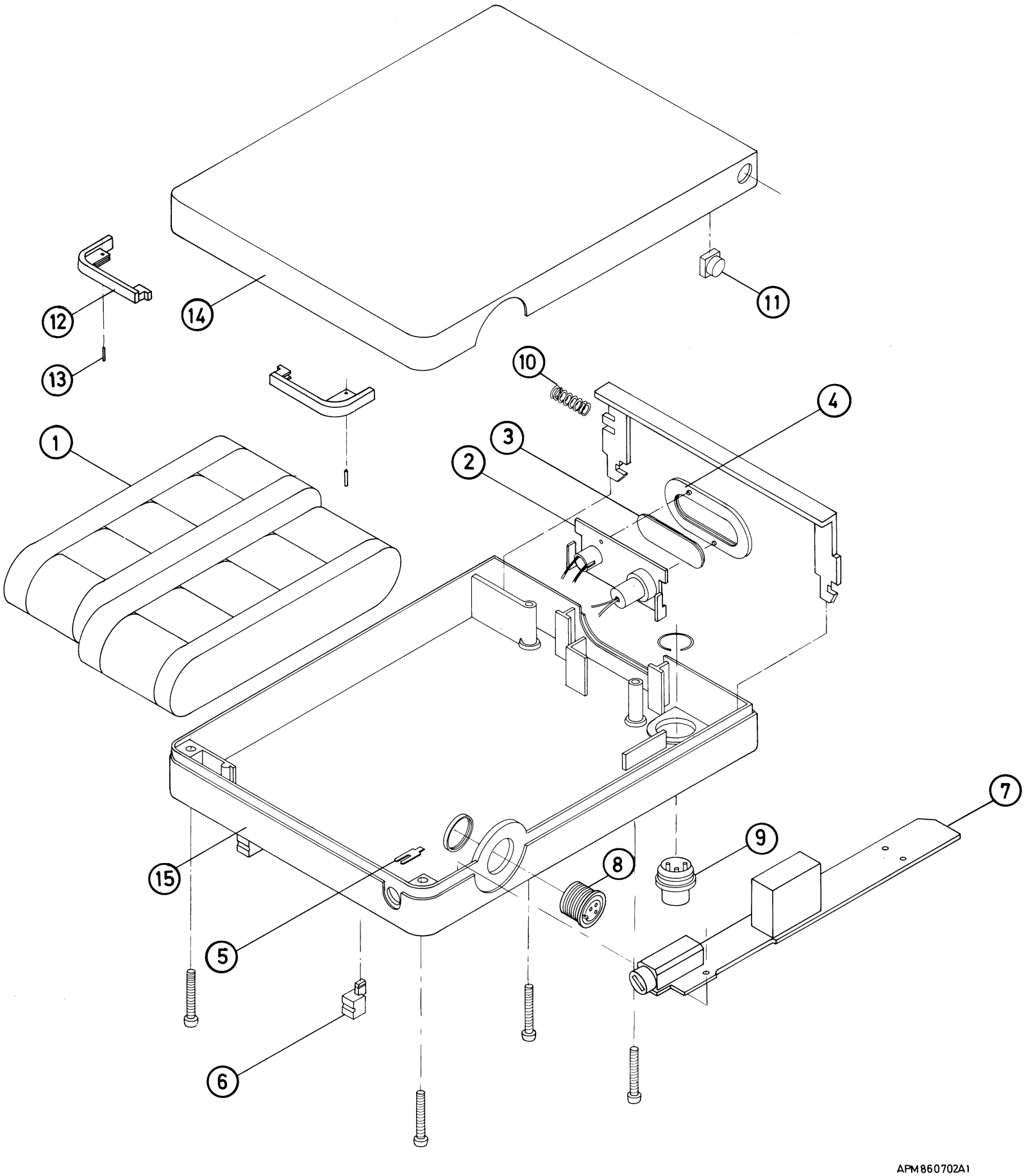


Fig. 11 Exploded view, battery pack

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

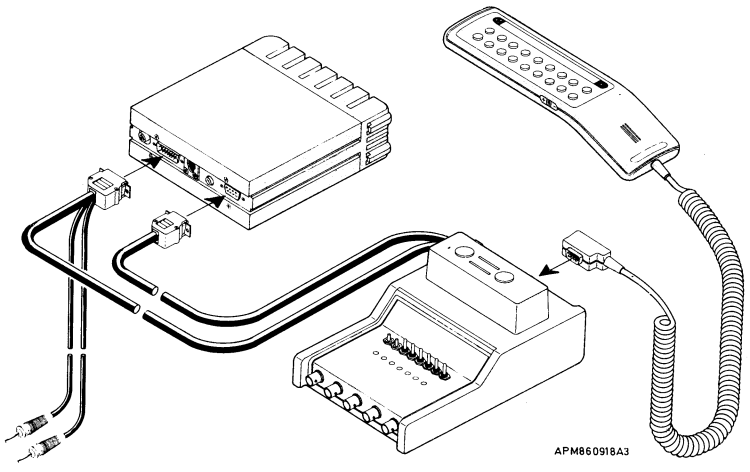
NUMBER	ORDERING NUMBER	VALUE	TOL(%)	VOLT/WATT	DESCRIPTION
CAPACITORS					
C1	2222 032 15222	2200U	5%	16V	Electrolytic
RESISTORS					
R1	2322 186 13332	3K3	5%	0.4W	
R2	2322 642 62102	1KO	10%	0.5W	NTC
R3	2322 186 13101	100	5%	0.4W	
R4	2322 186 13181	180	5%	0.4W	
R5	3508 100 21380	350			PTC
R6-9	2322 186 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 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 tree 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.



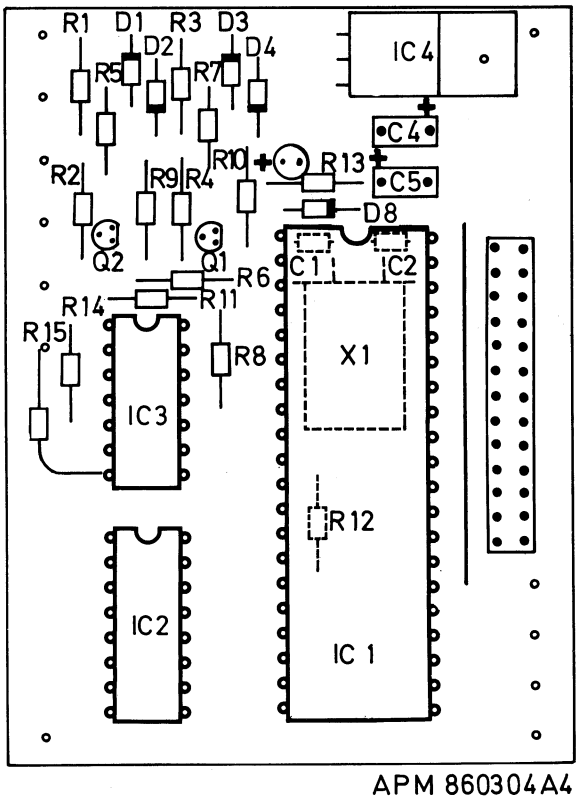
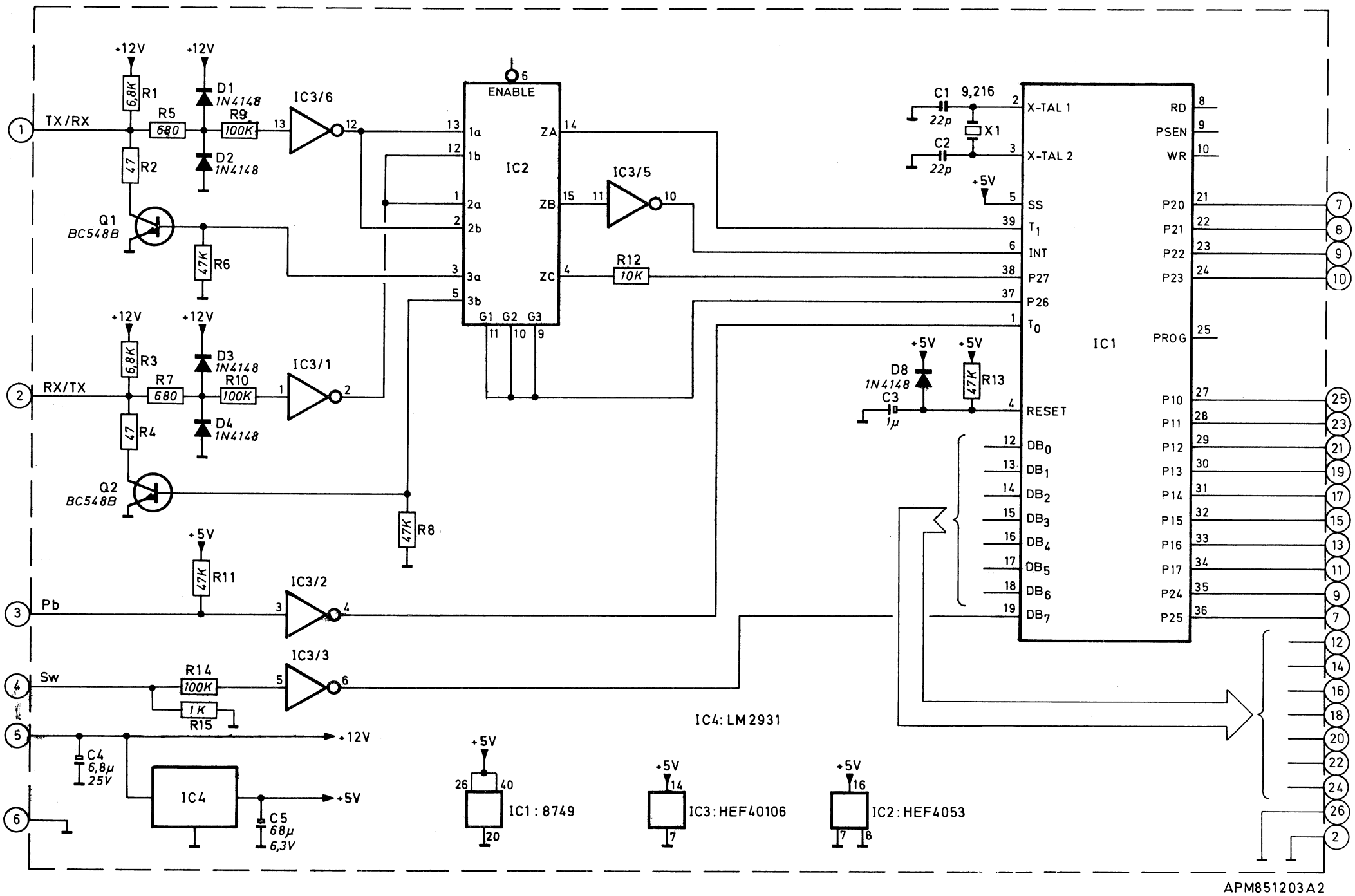


Fig. 1 Component location, test adaptor



CPH860907/0

Fig. 2 Circuit diagram, test adaptor

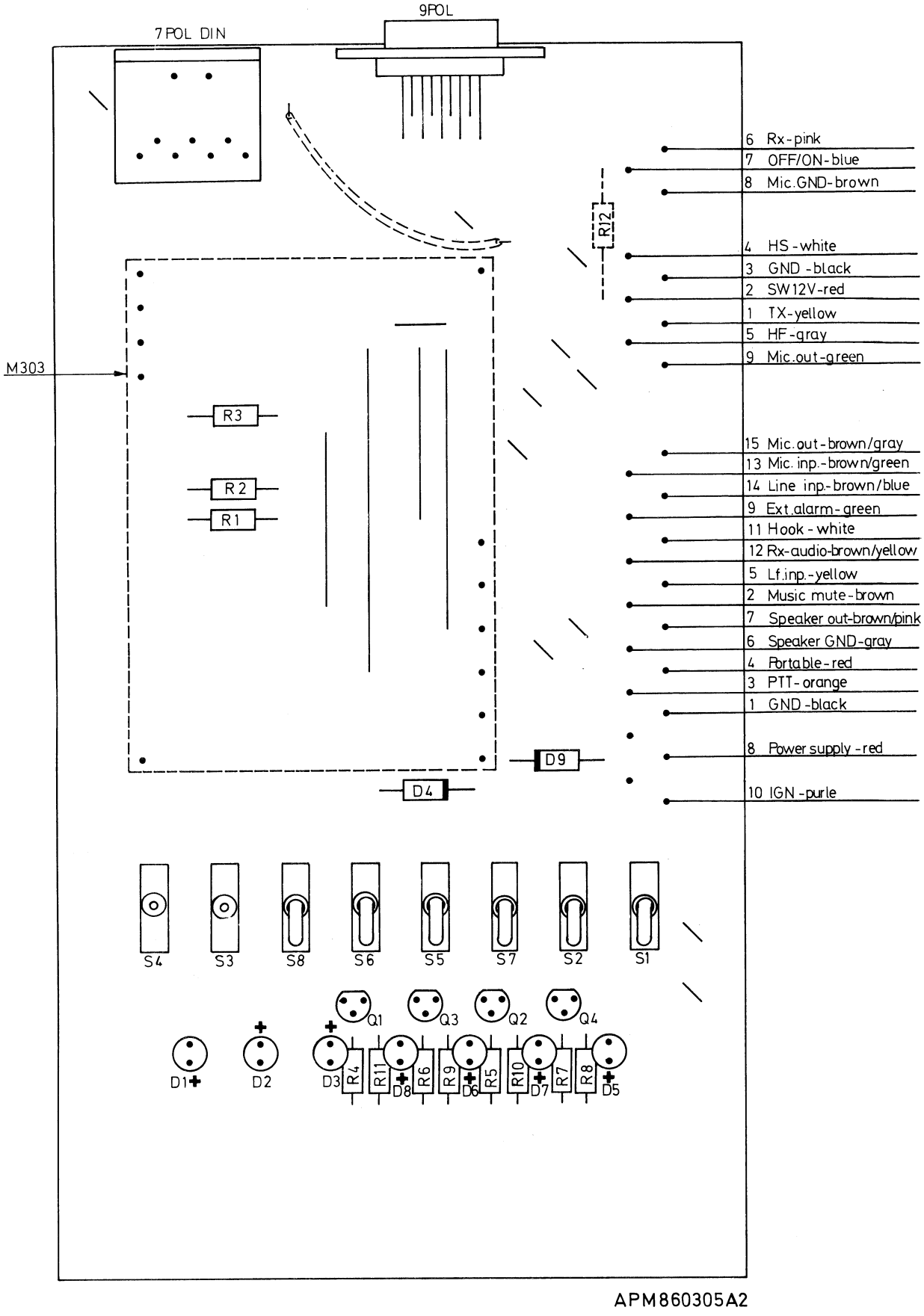
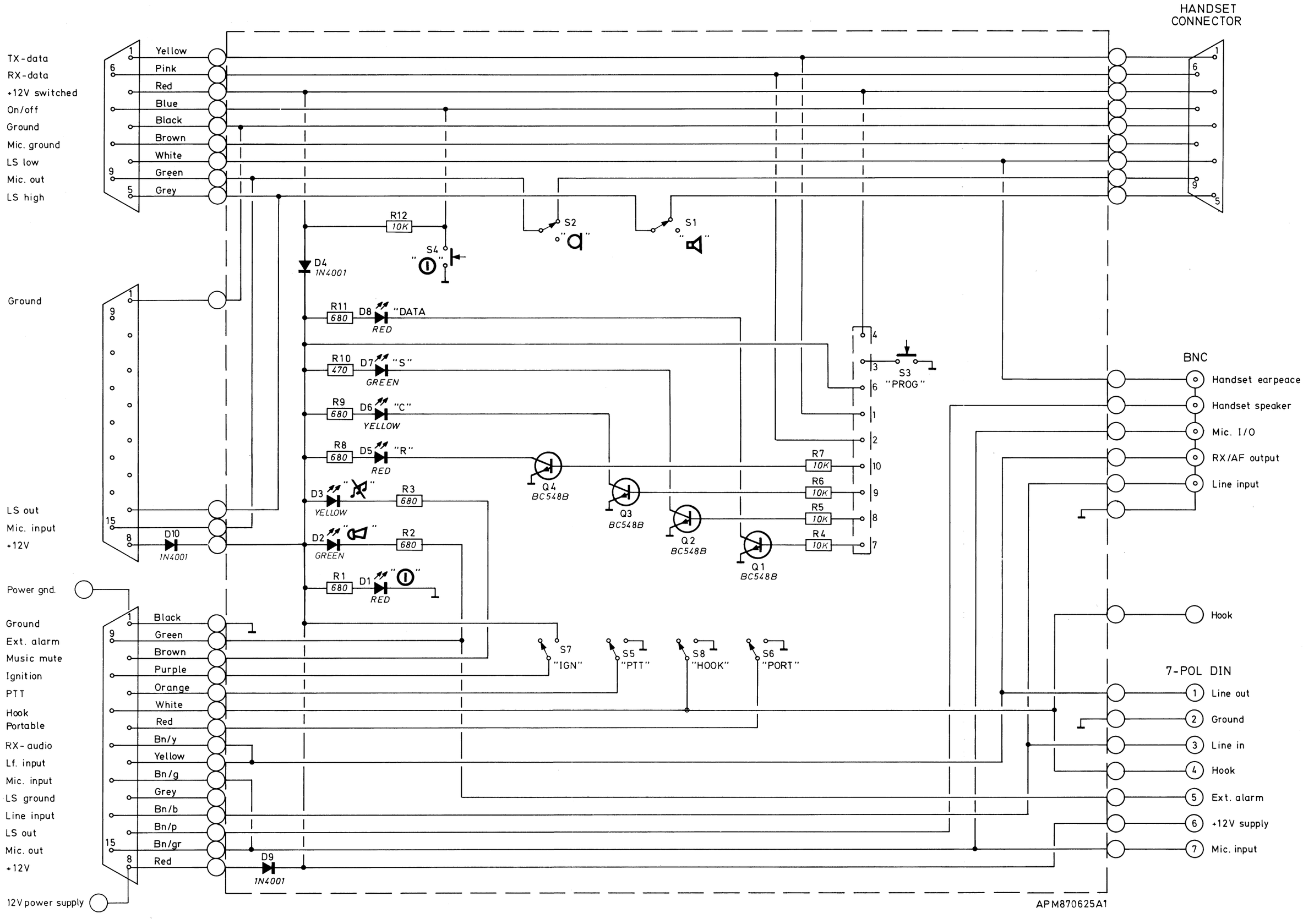


Fig. 3 Component location, test board

CPH860907/0



CPH860907/0

Fig. 4 Circuit diagram, test board, marked with KFT NO. lower than 4359

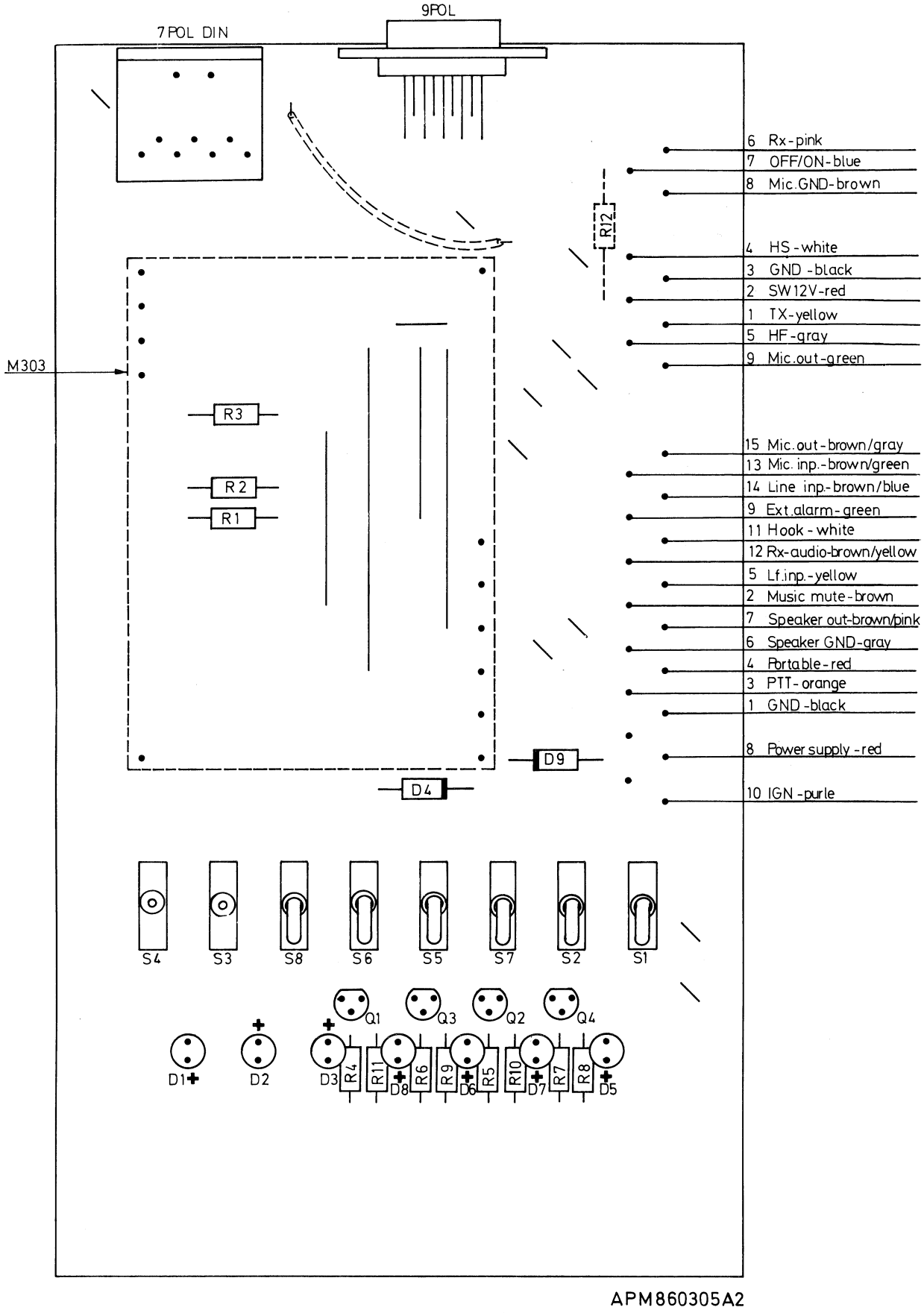
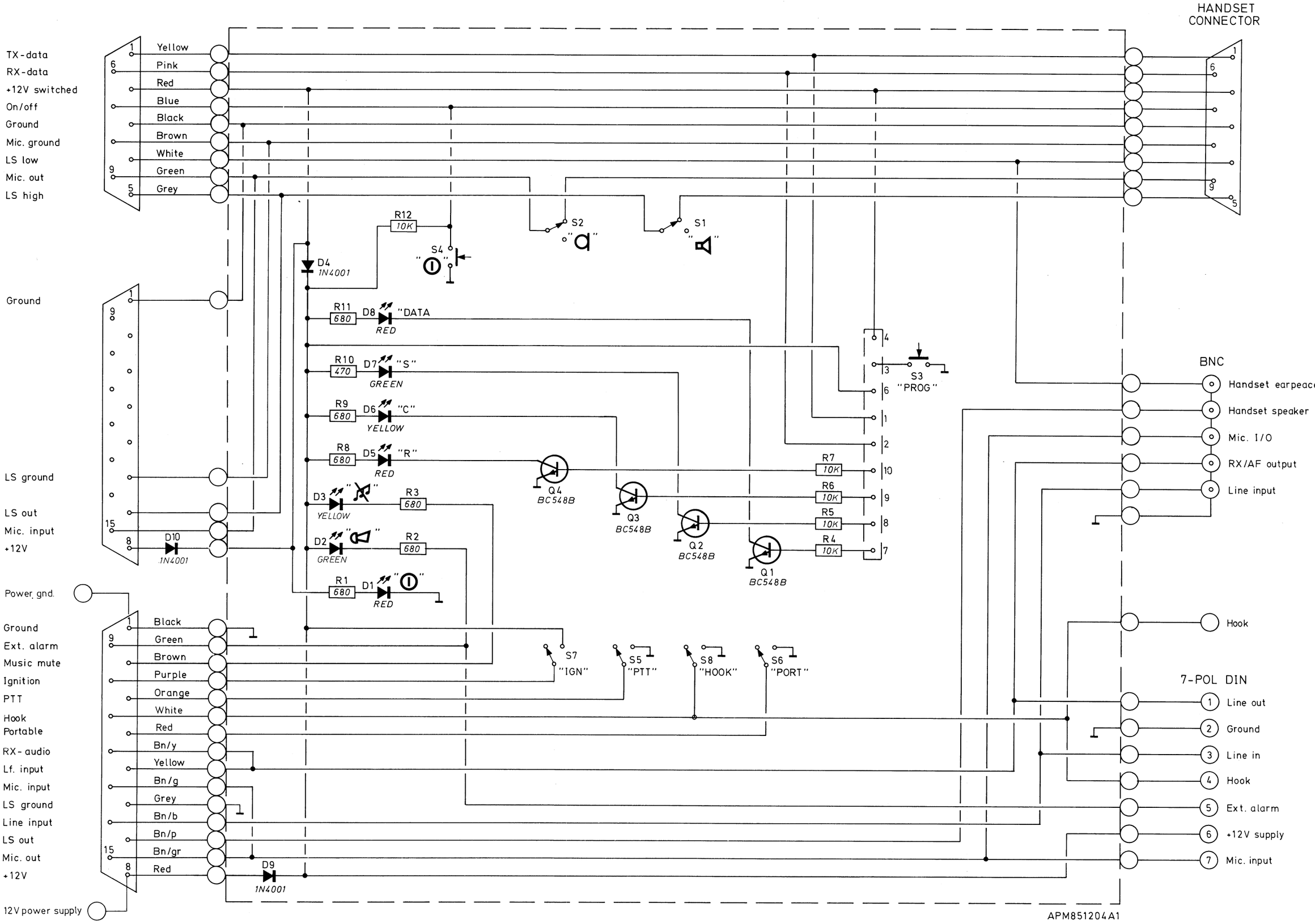


Fig. 5 Component location, test board

CPH860907/0



CPH860907/2

Fig. 6 Circuit diagram, test board, marked with KFT NO. 4359 and higher

Mounting cassettes

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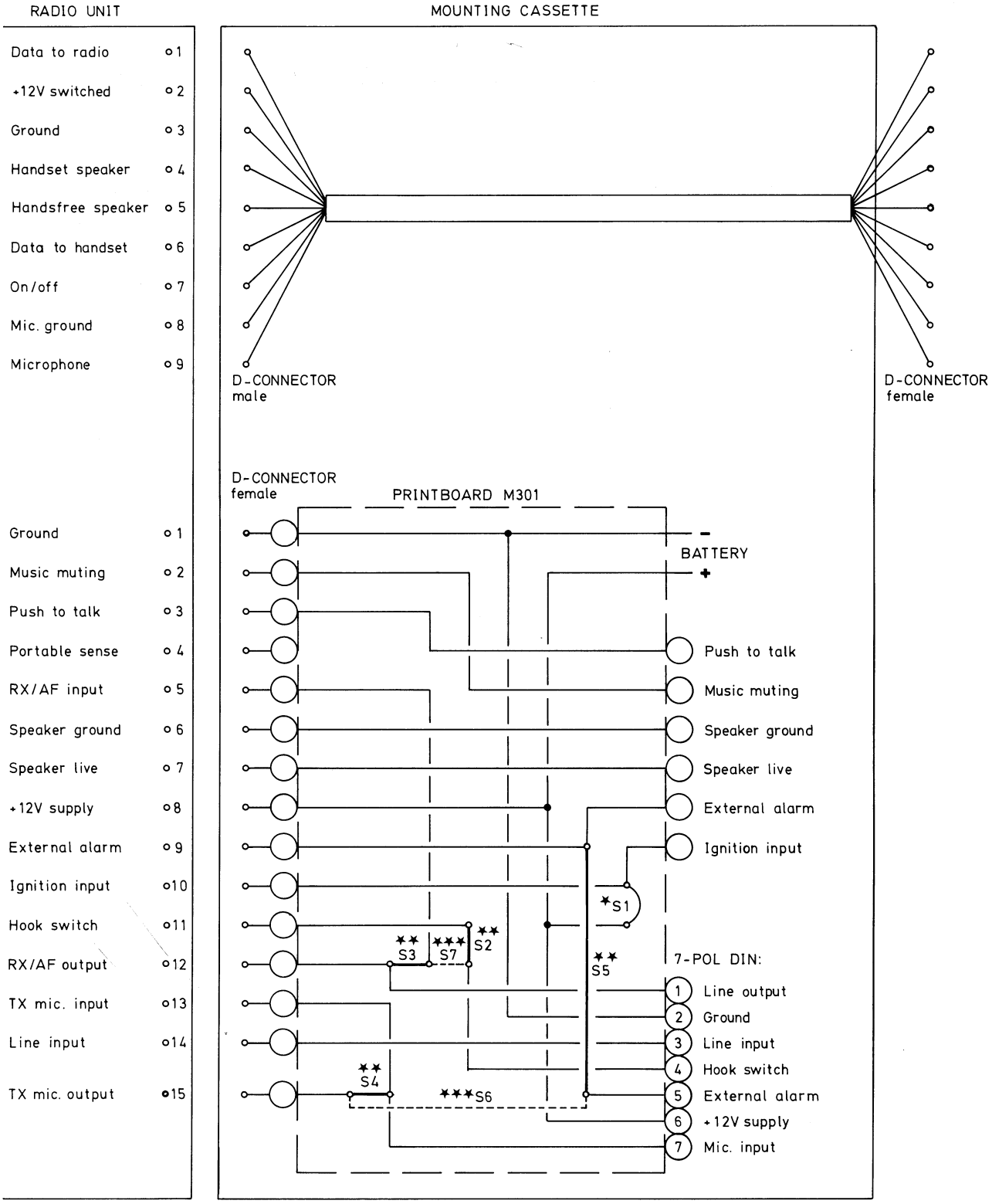


STANDARD CASSETTE: *Wire strap (removed when ignition key is connected)
**Print strap (removed when scrambler is used)

OPTION: ***Wire strap mounted when scrambler is used

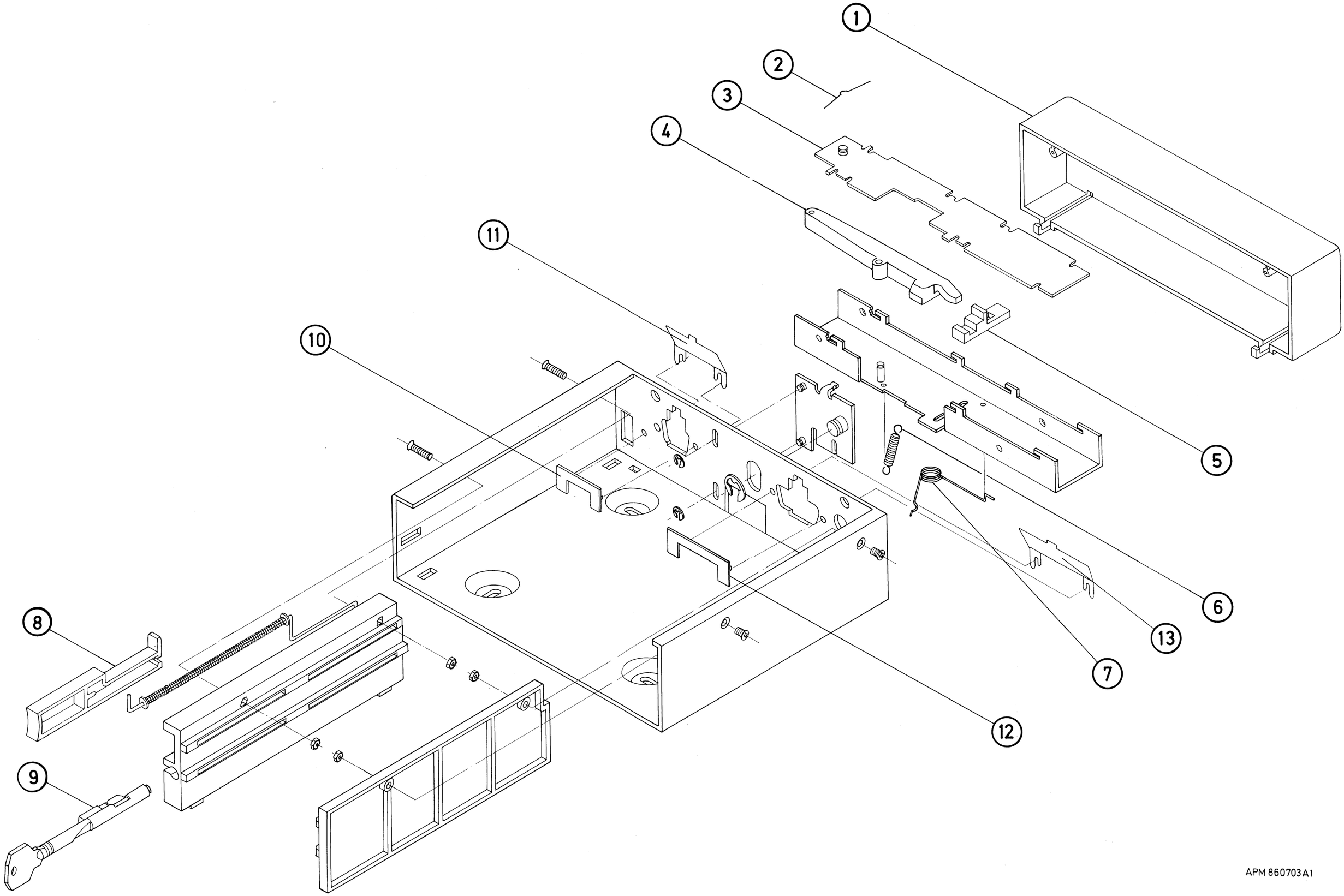
APM851205A2

Fig. 1 Wiring diagram

CPH860908/1

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



CPH860908/1

Fig. 2 Exploded view, mounting cassette

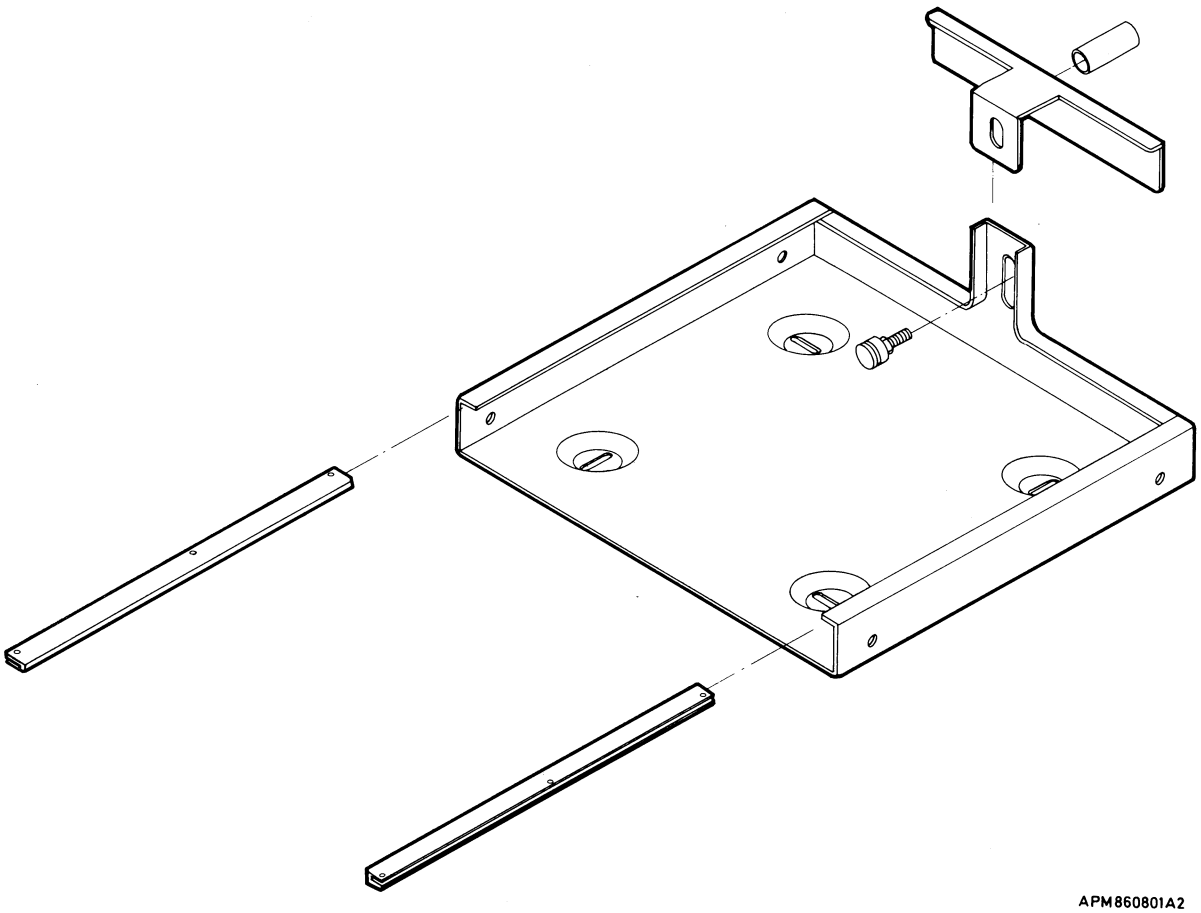


Fig. 3 Exploded view, mounting tray

CPH860908/1

AP 4016 Voice Operated Handsfree

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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.

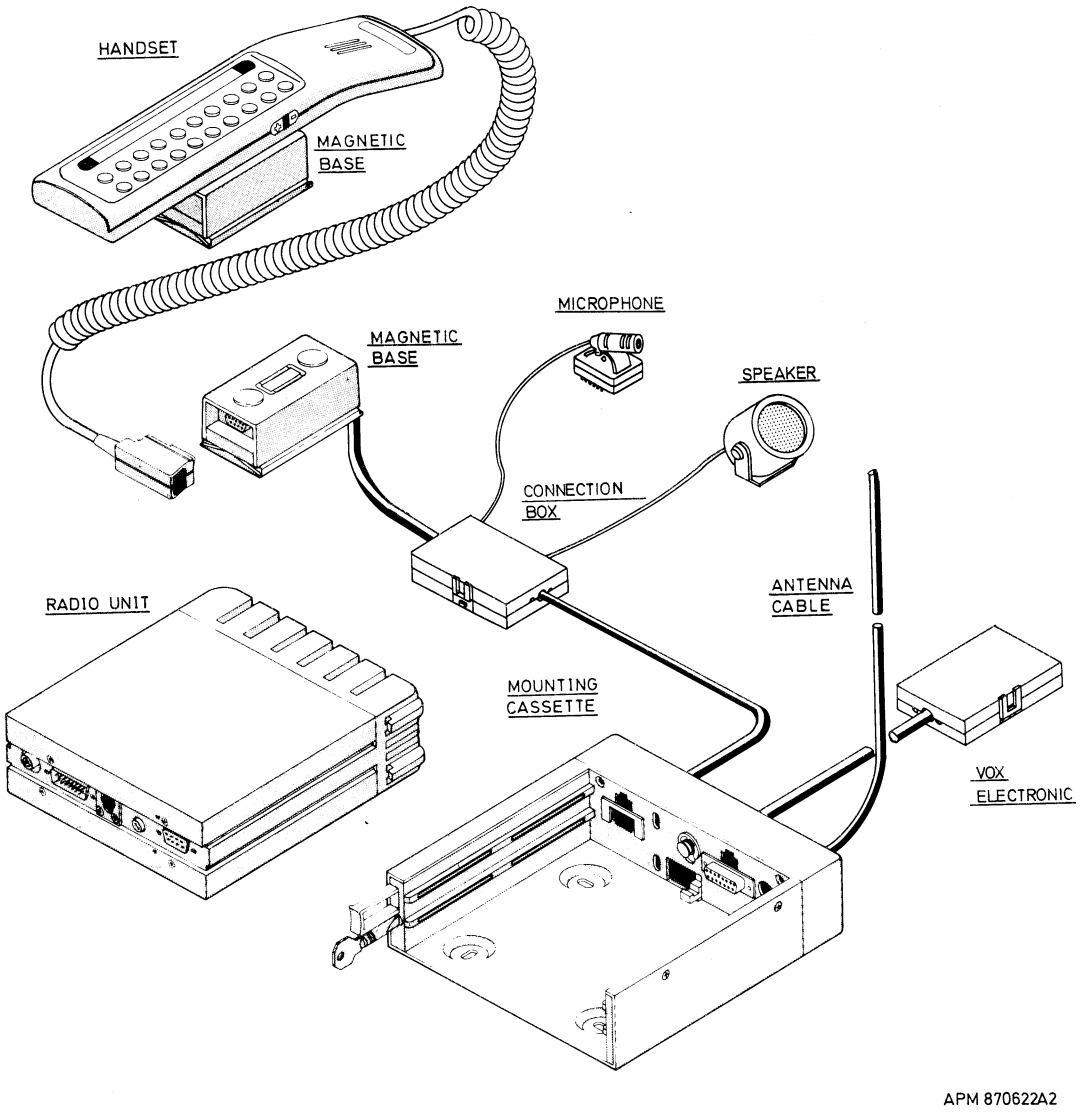


Fig. 1 Survey of the mobile telephone with VOX kit

Installation instructions

INSTALLATION OF THE INTERFACE UNIT

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

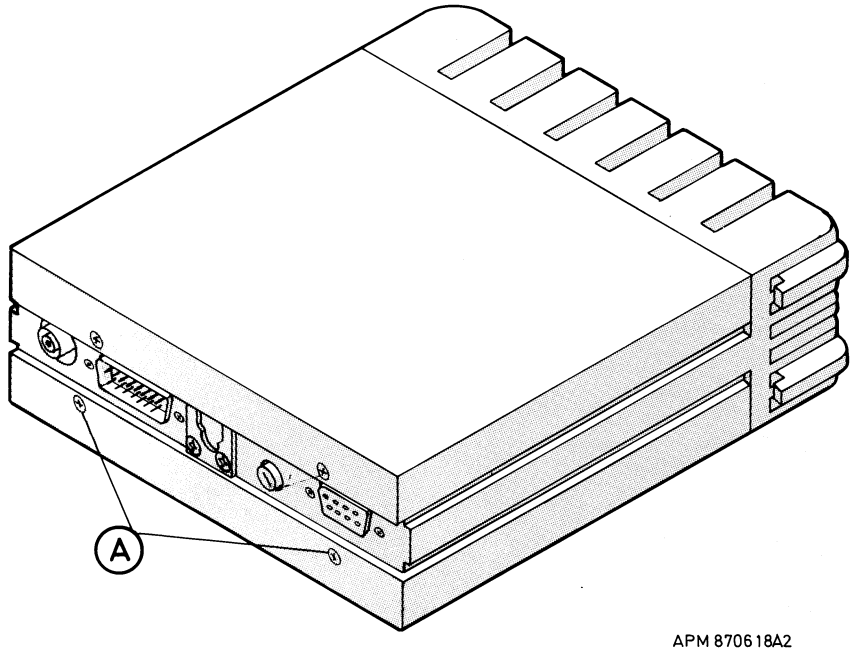


Fig. 2 Transceiver

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

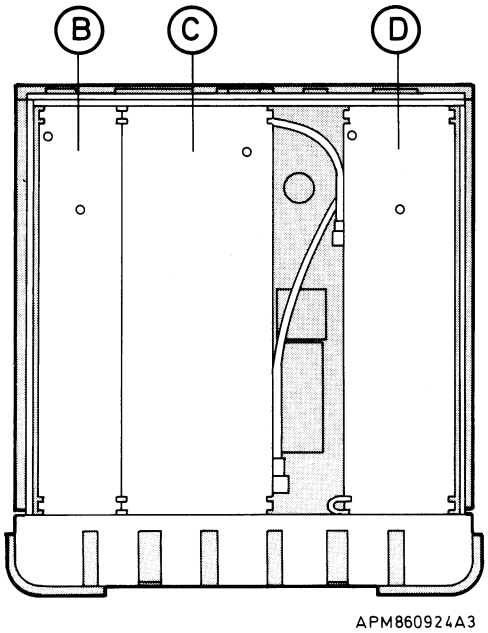


Fig. 3 Unit location

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

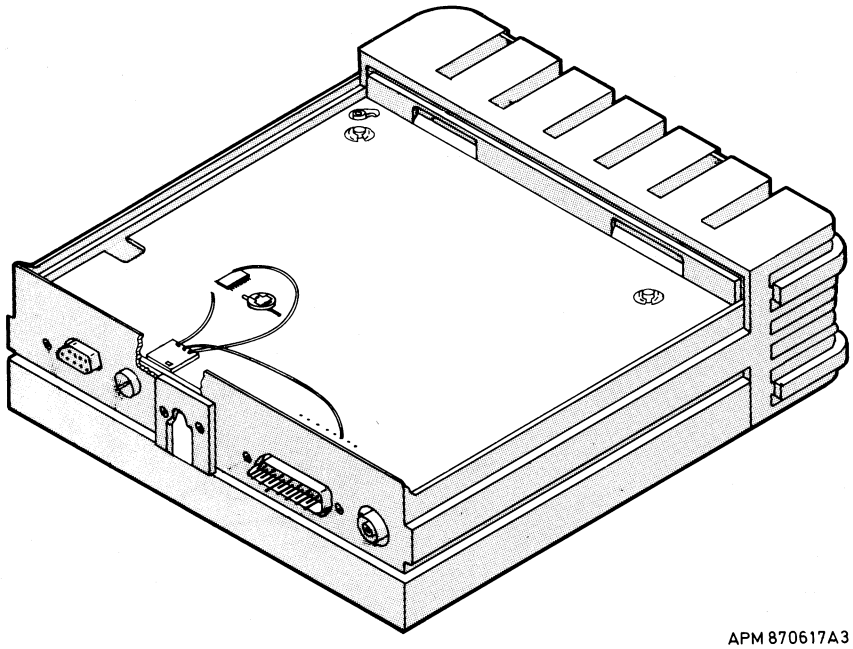


Fig. 4 Placing the interface unit

450MHz telephones:

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

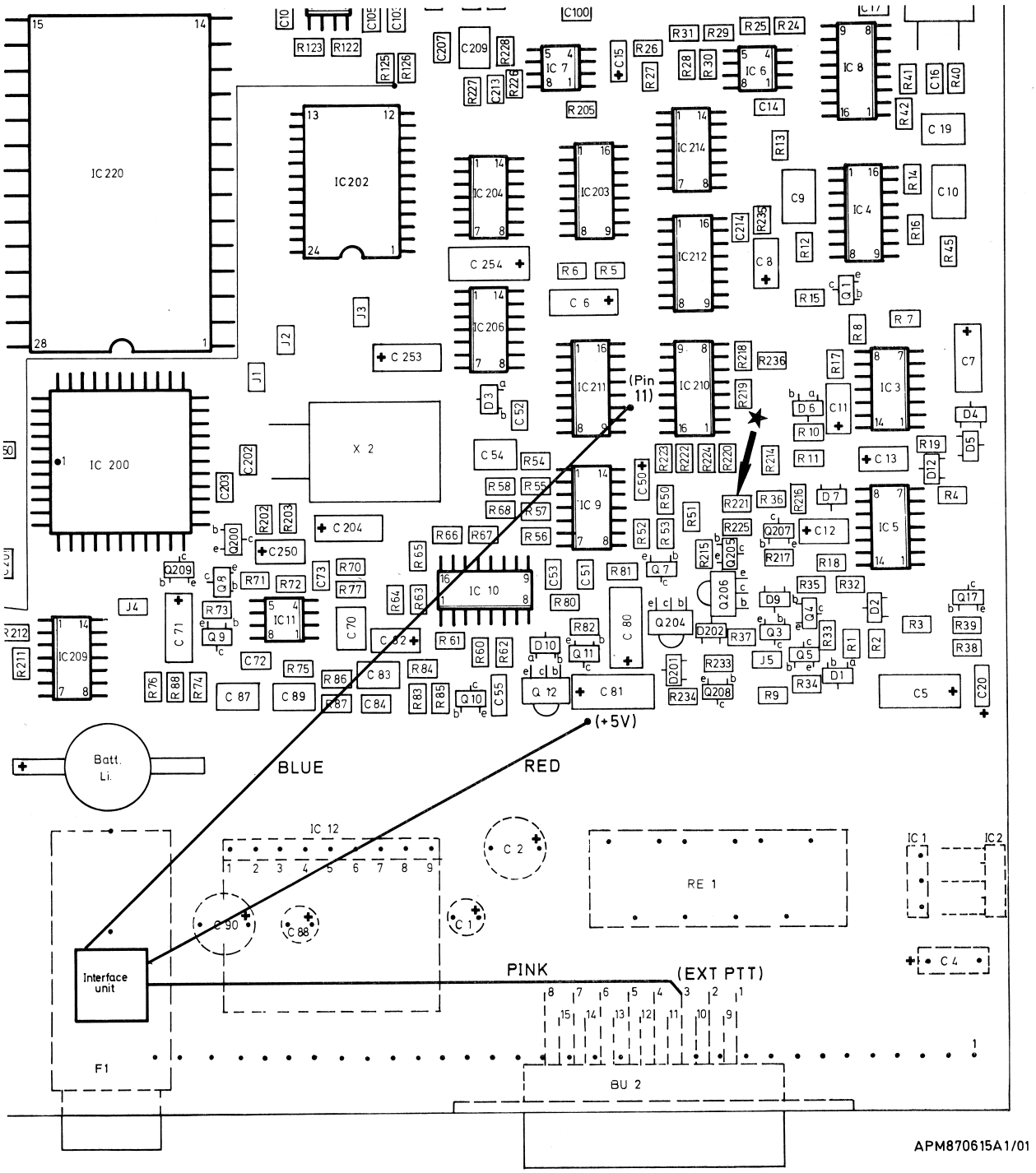
900MHz telephones:

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

Later software versions for the above mentioned telephones will contain the cahnges 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.

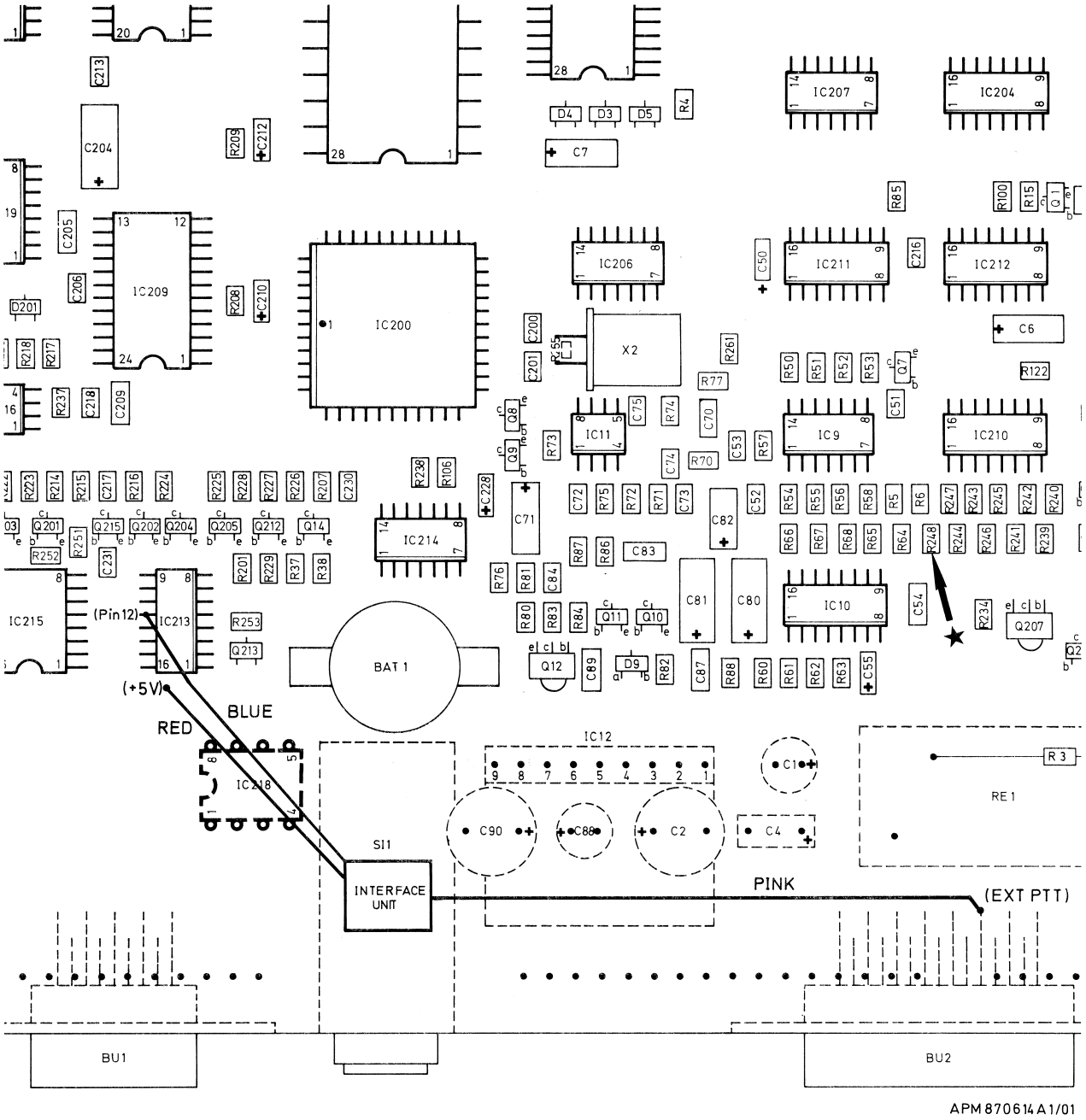
* If the systemboard's printboard for the 450MHz telephones is marked 3508 101 6124.X the VOX interface unit should not be mounted. Nor should R221 be removed. The printboard's number is found underneath the TX-synthesizer (unit 4).



★R221 must be removed when the VOX kit is mounted

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

CPH870901/0



★R248 must be removed when the VOX kit is mounted

Fig. 6 Component location, system board, unit 1, AP 4112 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.

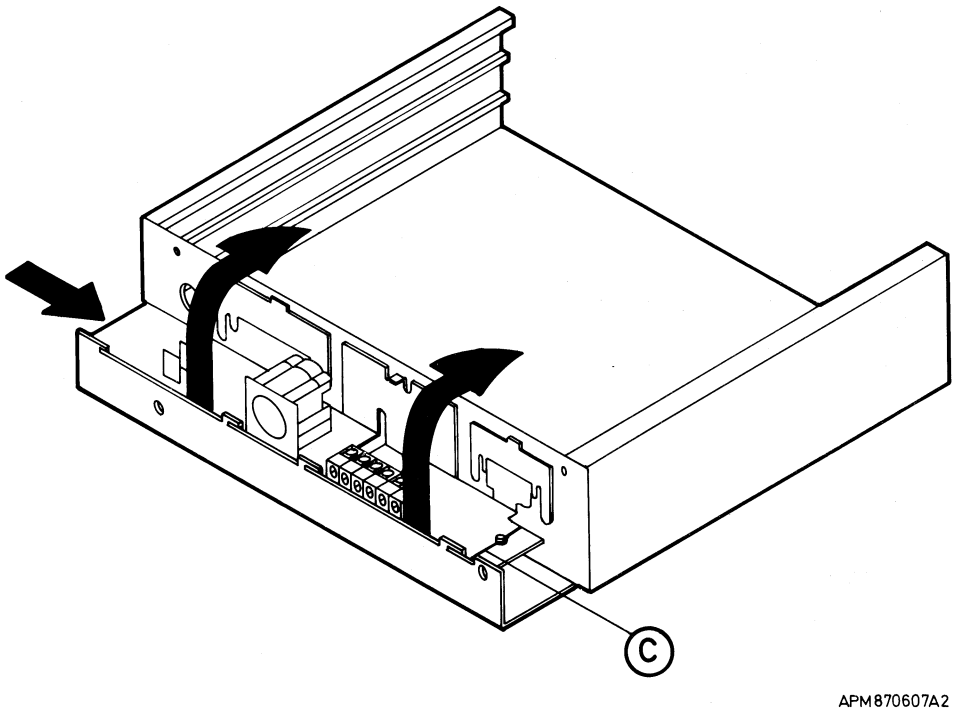
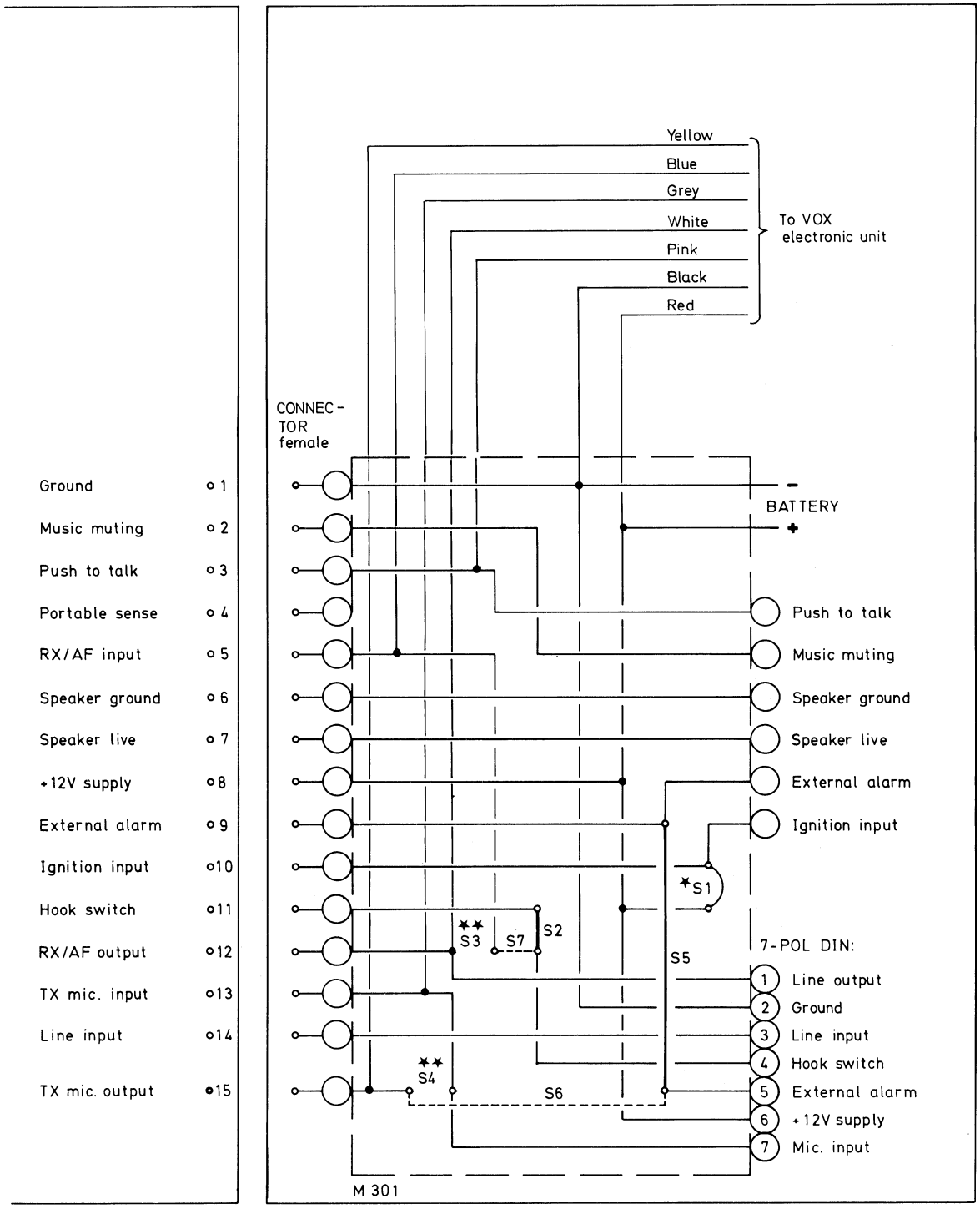


Fig. 7 Removal of the print M-301

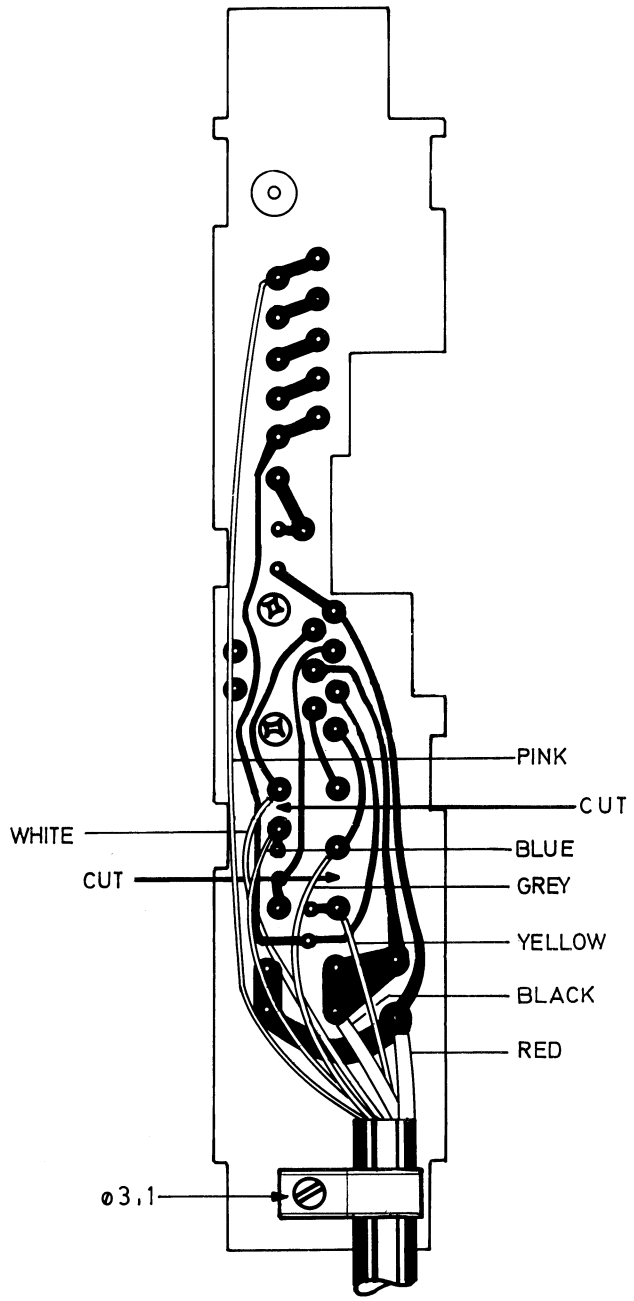


STANDARD CASSETTE: *Wire strap (removed when ignition key is connected)
**Print strap (removed when VOX is used)

APM870613A2/01

Fig. 8 Wiring diagram

CPH870901/0



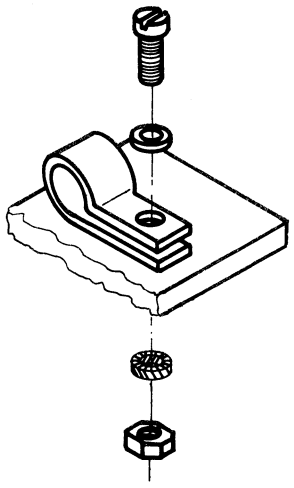


Fig. 9 Connections from the VOX electronic unit to the mounting cassette CPH870901/0

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 acustic 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 <u>on</u> 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 <u>off</u> the magnetic base. The mobile telephone returns to normal handset conversation mode (one more press on Ⓧ gives VOX-mode).
- The call is terminated.

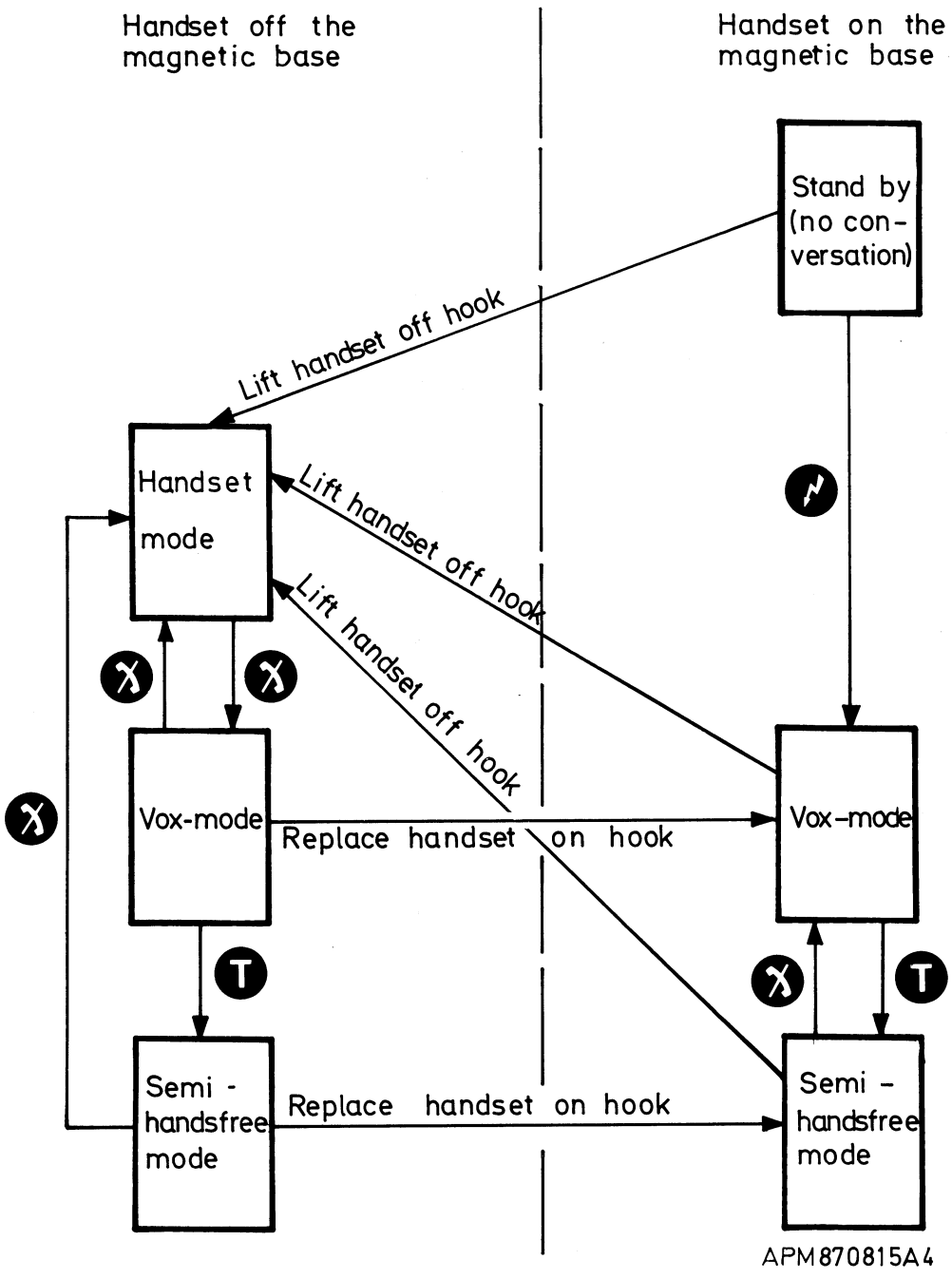

Handset off the magnetic base
Handset on the magnetic base
Stand by (no con-versation)
Lift handset off hook
Handset mode
Lift handset off hook
Lift handset off hook
Vox-mode
Replace handset on hook
Vox-mode
Semi - handsfree mode
Replace handset on hook
Semi - handsfree mode
APM870815A4

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 acustic 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.

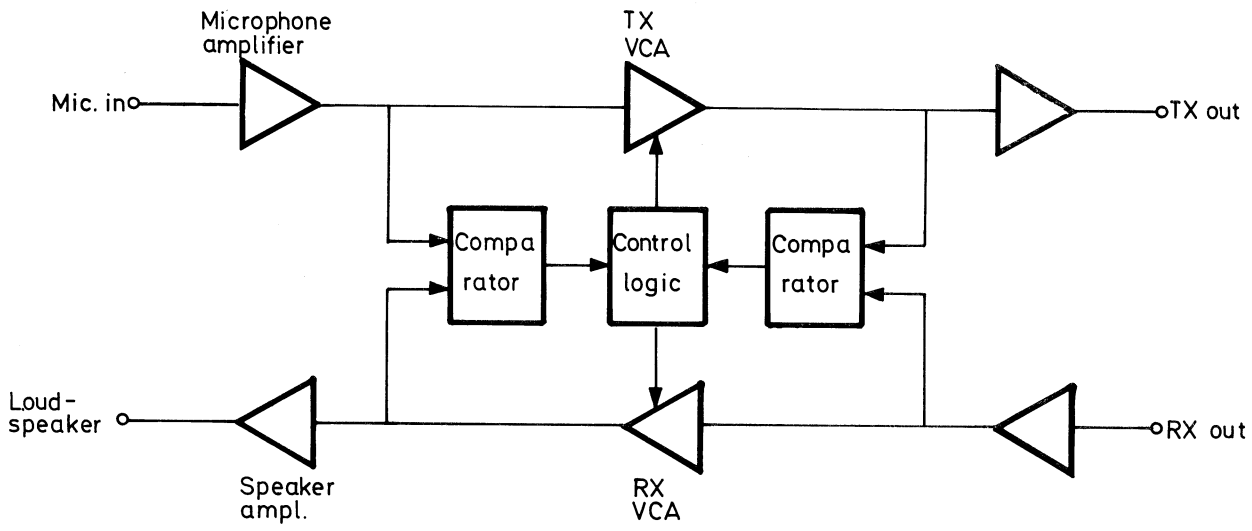


Fig. 11 Schematic block diagram

CPH870901/0

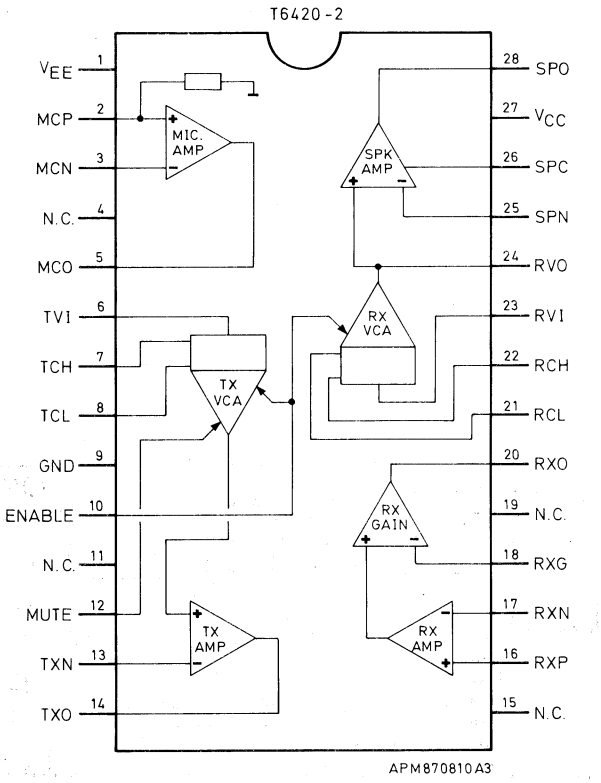


Fig. 12 T6420-2 internal block diagram

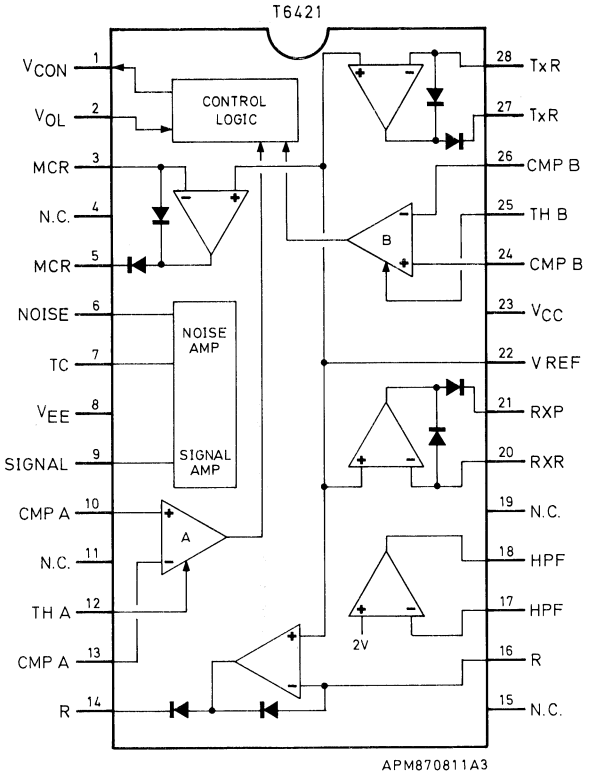


Fig. 13 T6421 internal block diagram

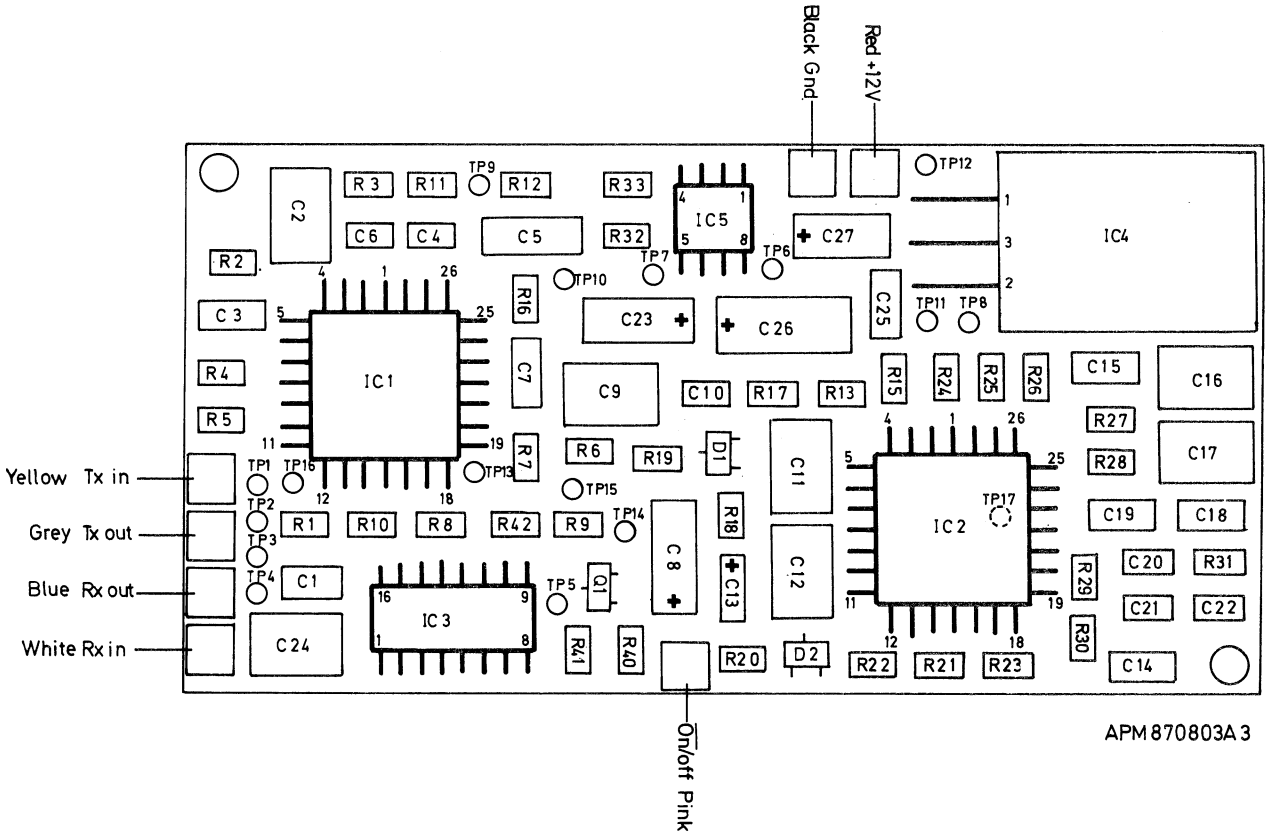
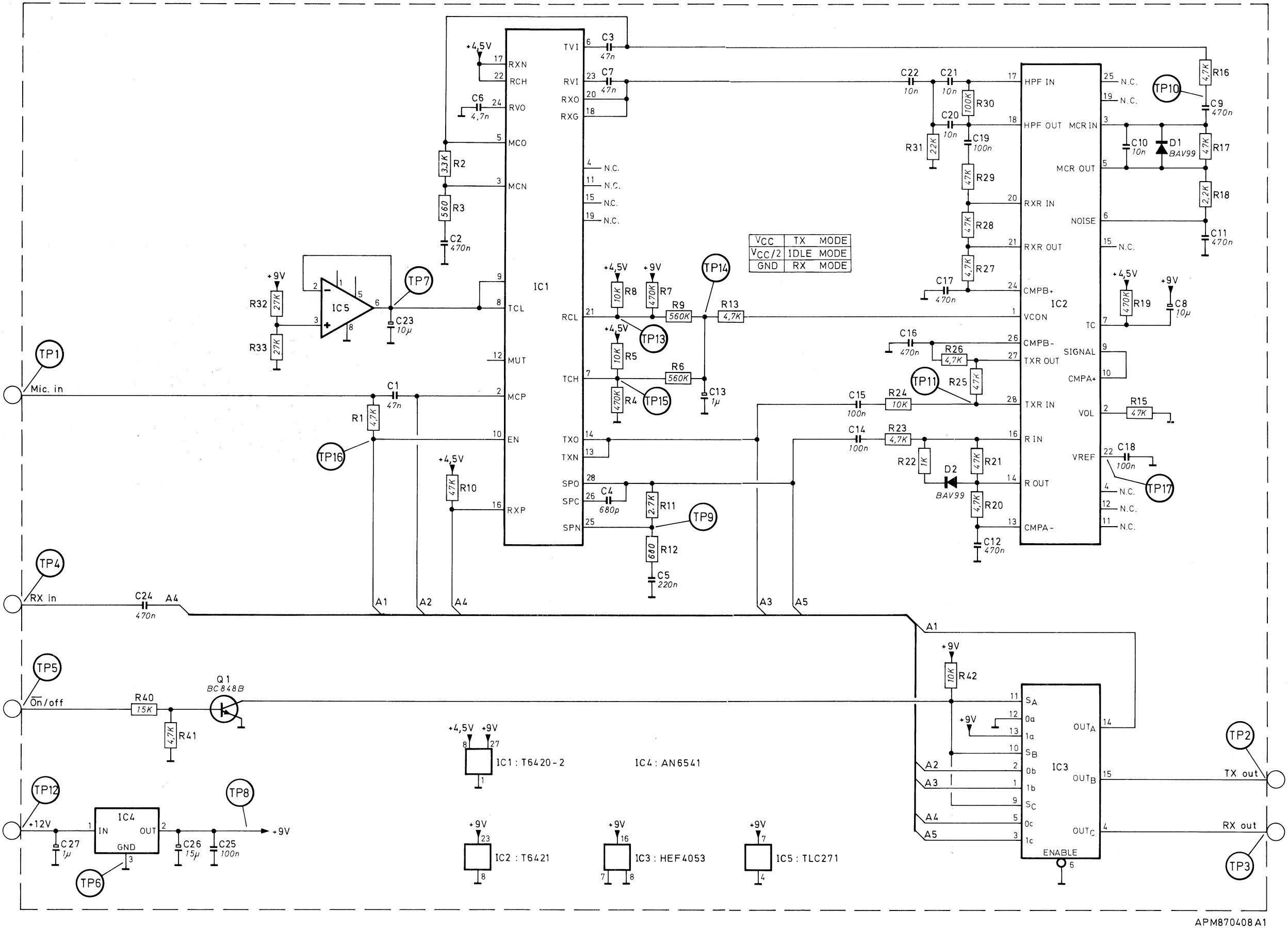


Fig. 14 Component location, VOX electronic unit

CPH870901/0



CPH870901/0

Fig. 15 Circuit diagram, VOX electronic unit

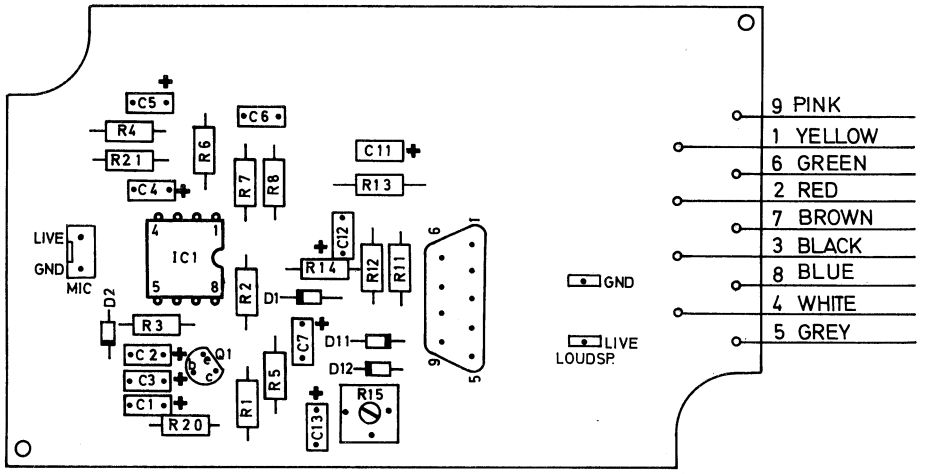
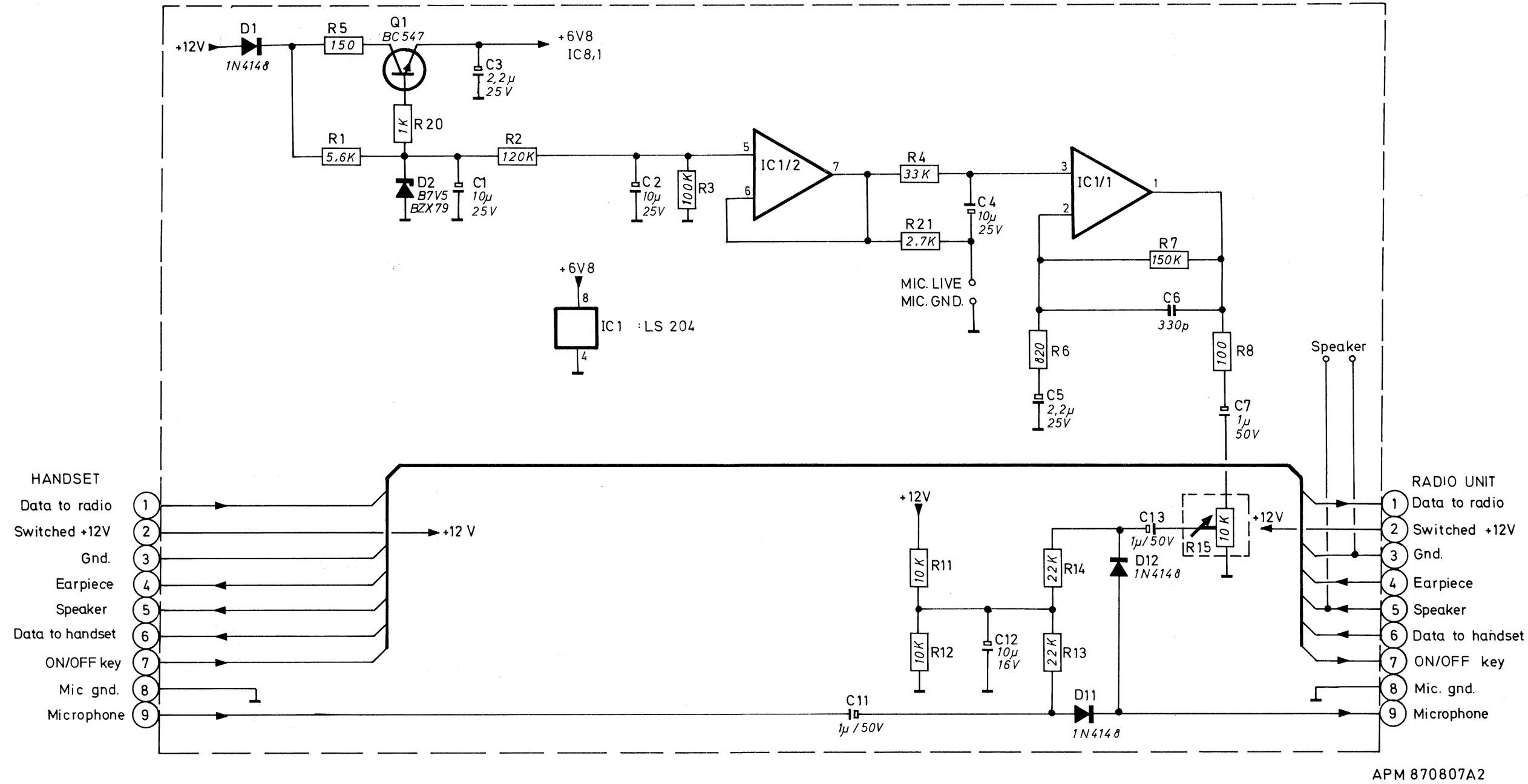


Fig. 16 Component location, connection unit

CPH870901/0



CPH870901/0

Fig. 17 Circuit diagram, connection unit

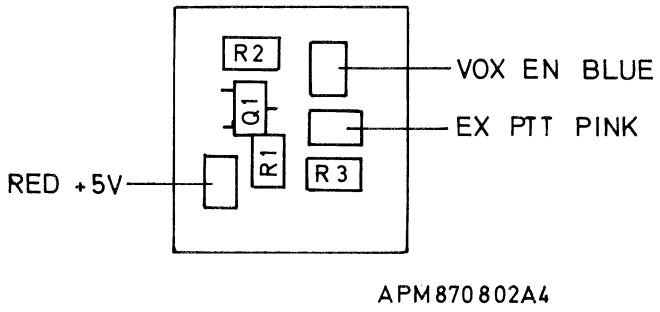


Fig. 18 Component location, interface unit

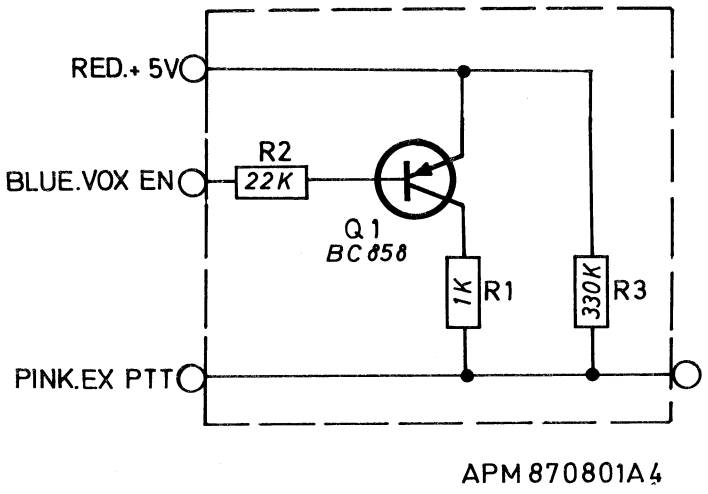


Fig. 19 Circuit diagram, interface unit

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	1KO	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	1KO	5%	0.1W	SMD
R2	3508 100 20410	22K	5%	0.1W	SMD
R3	3508 100 20550	330K	5%	0.1W	SMD

PHILIPS

SERVICE INFORMATION

PRCS-Service

Philips Radio Communication Systems (Copenhagen)

Concerning: **AP4111** **90.09**

This serviceinformation deals with information to service manual, 12 NC 9506 100 80380, for AP4111.

The new software version 8, 12 NC 5322 209 11955, will be introduced in transceivers with serial number 043997 and succeding higher serial numbers.

9506 100 82700

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SERVICE INFORMATION

PRCS-Service

Philips Radio Communication Systems (Copenhagen)

Concerning: **AP4111** **90.09**

This serviceinformation deals with information to servicemanual for AP4111, 9506 100 80380. The service information concerns information about new software, version 8.

The cause for a new software is as follows:
On a few AP4111, approximately 2%, the information on address 00 in the EE-prom suddenly disappears. As known the telephone number is programmed into address 00 and 01 in the EE-prom, and because of that, the telephone number then will be lost in some cases. To avoid loosing the telephone number in those few cases, a new software is introduced. With the new software, the telephone number is placed on address 09 and 10 in the EE-prom.

When changing software from version 5 to version 8, you must change the digit on the typeplate from 5 to 8. This is to be done by making a cross, by engraving, over the digit 5 and then making a digit 8, by engraving, in the next free area on the typeplate (see drawing below).

The new software, version 8, replaces the old software, version 5.
AP4111 delivered from the factory with version 8 software will be introduced by a serviceinformation later on.

The version 8 software is named as:

7037.8
89-51.

Ordering number for software version 8: 5322 209 11955.

PHILIPS

SERVICE INFORMATION

PRCS-Service

Philips Radio Communication Systems (Copenhagen)

Concerning: **AP4111/AP4171.** **89.11**

Ordering the system-module M120, please notice correction of the ordering number.

New ordering number for M120: 12 NC 5322 216 80186.

Please make correction in the servicemanual!

9506 100 82180.

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SERVICE INFORMATION

PRCS-Service

Philips Radio Communication Systems (Copenhagen)

Concerning **AP41X1** **89.05**

When adjusting the RX-synthesizer be aware that the adjustable capacitor C54 is to be adjusted max. 5 times.
If adjusted more than 5 times it may be necessary to exchange the capacitor.

9506 100 81770

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SERVICE INFORMATION

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Philips Radio Communication Systems (Copenhagen)

Concerning **AP 41x1** **89.05**

If the received signal is very noisy, weak, or there is no received signal at all. The problem may be a leaking capacitor, either C24, C30, C36, or C37.
At pin 24 of IC3, 2.6V is OK while a lower voltage may indicate a leaking C24. A voltage drop across R31 may indicate a leaking C30.
The voltages at TP15 and TP16 should be equal and the voltage between C36 and C37 should be 0V. If this is not the case C36 or C37 may be leaking.

Notice that on new M120 systemboards C9, C10, and C201 are SMD components. The manufacturer of this capacitor has been changed.
The order number for the capacitor is: 3508 100 30820.

The PA-module is now being fastened inside the radio unit by means of a "Super Clip" instead of the four screws.
The order number for the "Super Clip" is: 3508 101 03020.

9506 100 81800

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Philips Radio Communication Systems (Copenhagen)

CONCERNING **AP 4111** **88.08**

A new software (version 5) for AP 4111 has been introduced.
Ordering number for the E-PROM service kit is 8208 244 00130.
Following improvements have been made in version 5 software marked 7037.5 week code 8810:

1. VOX control.
2. Asterisks in display with vertical handset.
3. Call transfer code 61 is implemented, and the whole transfer sequence is stored in short dial number 98.
4. When call transfer is terminated, the transfer arrow in the handset will be removed by forced clearing from the MTX.
5. Push country code 0.5 sec. when change country on handset.

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PHILIPS

SERVICE INFORMATION

PRCS-Service

Philips Radio Communication Systems (Copenhagen)

CONCERNING **AP 4111** **88.07**

For some time the "Power detect" connection between the system board and the PA-stage has been soldered in order to make a better connection.
This has been changed, so both the system board and the PA-stage will, from week 8824, be produced only with the gold plated connections instead of the tin plated.
When changing either of the modules, don't ever mix gold plated and tin plated connector. Use only tin plated together with tin plated and gold plated with gold plated.

Ordering number for system board (unit 1) with tin plated connection pins:

System board, unit 1, version 1	8208 244 00011
System board, unit 1, version 2	8208 244 00211

Ordering number for PA-stage (unit 5) with tin plated connector:

PA-stage, unit 5	8208 244 00051

Ordering number for system board (unit 1) with gold plated connection pins:

System board, unit 1, version 2	8208 244 00311

Ordering number for PA-stage (unit 5) with gold plated connector:

PA-stage, unit 5	8208 244 00251

Ordering number for gold plated pins for unit connectors for the system board: 3508 100 56190

Ordering number for female 4-pole gold plated connector for the PA-stage: 3508 100 56200

If having problems with the "Power detect" signal the solution might be to change the connector pins on the system board and the connector on the PA-stage to the gold plated type, which are available in a repair kit, ordering number: - 8208 244 00231

WARNING ! ! !
Do not ever connect gold plated connector pins into a tin plated connector or vice versa.

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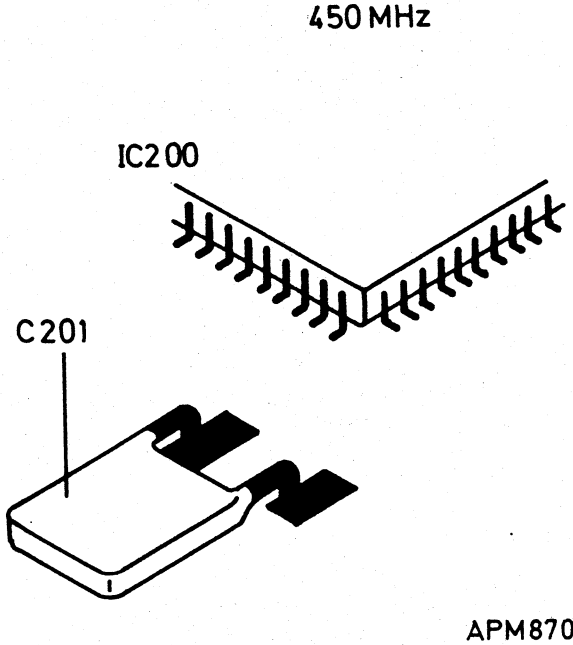
Philips Radio Communication Systems (Copenhagen)

CONCERNING **apA111/4151/4171/4181** **87.09**

This is an addition to the service information 9506 100 80600 dealing with a problem around C9/C10 on the system board.

In the 450MHz mobile telephones it is recommendable also to shift C201 on the system board. This capacitor (CPU reset) may cause a fault identical to the fault caused by C9/C10.
The new capacitor should be of type 3508 100 31250 (270N) alternatively 3508 100 31240 (220N) or 3508 100 31260 (330N).

The new capacitor should be mounted as shown on the figure.



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ap
radiotelefo

HORNOPKALD AP 4111 BÆRBAR

1 Strømstik i bærehåndtag udskiftes til 5 polet
ben 1 og ben 4 kortsluttes og forbindes til
ben 9 i 15 polet d connector
NB. open collector udgang husk diode over relæ!
ben 2 +12V
ben 3 stel

2 Strømstik i batteri udskiftes til 5 polet
ben 1 lader 220v
ben 4 horn
ben 2 +12v
ben 3 stel

3 3 polet hanstik i batteri
ben 1 forbindes til ben 4 i strømstik

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CONCERNING **apA111/4151/4171/4181** **87.06**

---

1. Fault : ON/OFF circuit fails.

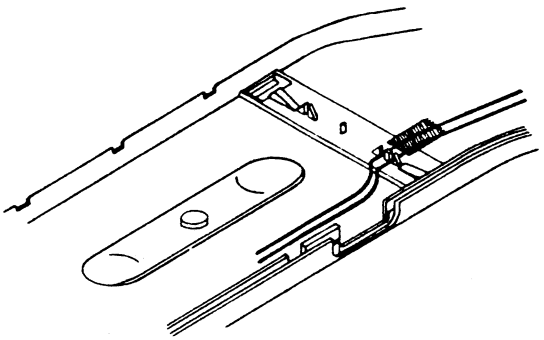
   Troubleshooting: Small pieces of solder waste may be left around or under C9 and C10 on the systemboard, unit 1.

   Repair : Remove C9 and C10 and clean both the print and the bottom part of the capacitors for solder and flux remnants. Replace the capacitors.

2. Fault : No sound in the handset loudspeaker.

   Troubleshooting: The wires for the handset loudspeaker may have been squeezed with a shortcircuiting between the shielded underpart and the loudspeaker wire as a result.

   Repair : Shift the wires for the loudspeaker and place a small piece of isolating tape on the bottom part of the handset as shown on the figure.



APM870616A4

NOTE: The introduction of the above shown change is recommended to be made in all handsets handed in for repair at the service shop. The change has been introduced in the factory from handset No. 25601.

9506 100 80410 Printed in Denmark

ap radiotelefon

SERVICE MANUAL

Nordic Mobile Telephone

ap4111

This service manual is for the maintenance of ap4111 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.

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 ar 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 build-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

Printed in Denmark March 1986 Ordering number: 296-322

SERVICE INFORMATION FRA PRCS

Vedr. ap 4111.

I brugervejledningen oplyses om, at på kortnummer 13 er lagret service telefonnummeret. Det vil derfor være naturligt, at samtidig med klargøring af mobil telefonen - programering af telefonnummer m.v. - at det lokale service værksteds telefonnummer bliver lagt ind på kortnummer 13.

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SERVICE INFORMATION

Vedr. 4111 tilbehør. (Bestillingsnumre: E-pakke 9506 100 10540
F-pakke 9506 100 10730).

Denne service information omhandler en fejl, der er fundet i nogle af håndtagene leveret i de ovenfor nævnte tilbehørspakker, mærket med en af følgende ugekoder: 625, 626, 627 eller 631.

Fejlen viser sig som støj under samtale, i særlig grad hvis antennevinklen drejes under samtale. Fejlen skyldes dårlig lodning af antennekablets skærm.

Fejlbehæftede moduler (håndtag) skal sendes til Philips Service for ombytning.

I den periode, hvor ombytningen finder sted, vil håndtagene uden denne fejl være forsynet med en rund mærkat af blåviolet farve.

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SERVICE INFORMATION

DENNE api ER EN DELVIS OVERSÆTTELSE AF DEN ENGELSK SPROGEDE VERSION, SOM ER VEDLAGT:

Vedr. ap 4111.

Denne service information udgør et supplement til servicemanualen til ap 4111 (bestillingsnummer 296-322). Den indeholder korrektioner og tilføjelser til manualen, samt service tips. Endvidere vedlægges en reservedelsliste for mekaniske dele. Denne reservedelsliste skal indsættes i manualens afsnit 12.

Korrektioner og tilføjelser, se vedl. engelsk sprogede version.

SERVICE TIP:

Der er fundet en fejl i nogle radiotelefoner.
Fejlen består i, at hardware time out pludselig slukker for radiotelefonen. For at afhjælpe denne fejl, er det nødvendigt at ændre signalet fra "TX module on" til "TX detec" på IC210, pin 9.
Denne ændring er indført på fabrikken fra og med serienummer 02615.

Følgende ændring skal indføres på Unit 1 (system board):

1. Kredsløbet fra IC213, pin 7, skal skæres, som vist på fig. 1.
2. Med en strap forbindes R125/R126 til R43, som vist på fig. 2. Denne forbindelse skal fastgøres til printet.

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SERVICE INFORMATION

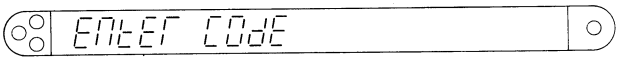
CONCERNING: ap4111

This service information is a supplement to the service manual for ap4111 (ordering number 296-322). It contains corrections and additions to the service manual, and service hints. Furthermore a mechanical spare parts list is enclosed with this service information. The mechanical parts list is to be placed as chapter 12 of the service manual.

CORRECTIONS TO THE MANUAL

Page 10-4: Function no 6 (supervisory):
The parameters should be: 0 = OFF
1 = HANDSFREE ON
2 = HANDSET ON
3 = LINE INPUT

Page 10-5: Software key 5. This section should be as follows:
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 code (4 digits).
The word ACCEPTED and the code just entered will be displayed for a few seconds.

Page 13-2: Integrated circuit:
Please add: IC120 27C256 coded EPROM ordering number 8208 244 00131.

Page 13-6: Coils should be as follows:

L4	choke coil	3508 102 51050
L5	choke coil	3508 102 51090
L6	choke coil	3508 102 51080

SERVICE HINT:

A fault has been discovered in some radios. The problem is that hardware time out suddenly turns the radio off. To remedy this problem it is necessary to change the signal from "TX module on" to "TX detect" on IC210, pin 9. This change has been introduced in the factory from serial no. 02615.
The following things must be changed on unit 1 (system board):
1. The printed wire from IC213, pin 7 has to be cut, as shown on fig. 1.
2. Connect with a strap R125/R126 to R43 as shown on fig. 2

The connection should be fixed to the print.

radiotelefon a/s

JENAGADE 22 · DK-2300 KØBENHAVN S · TLF.: (01) *54 77 77

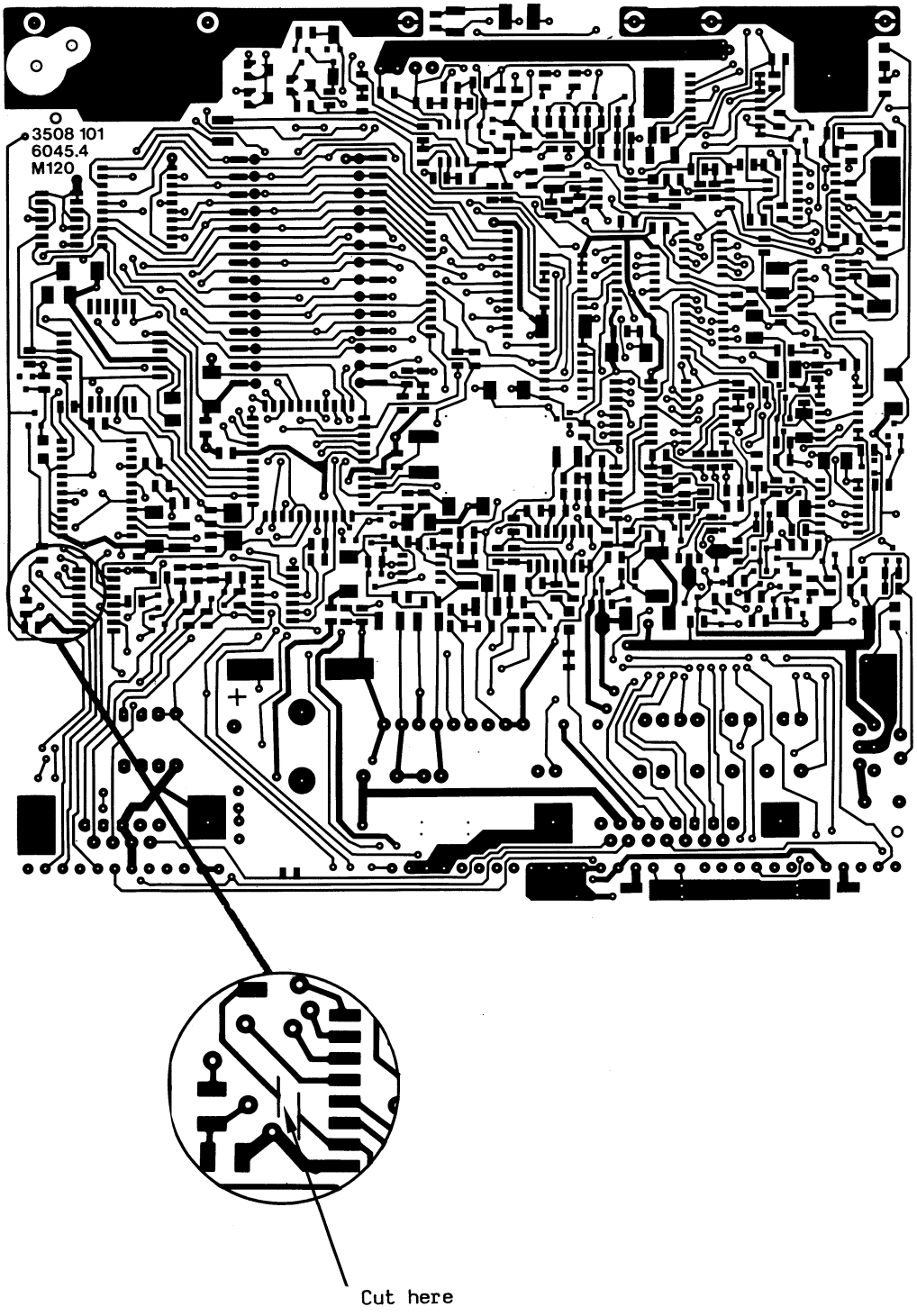


Fig. 1

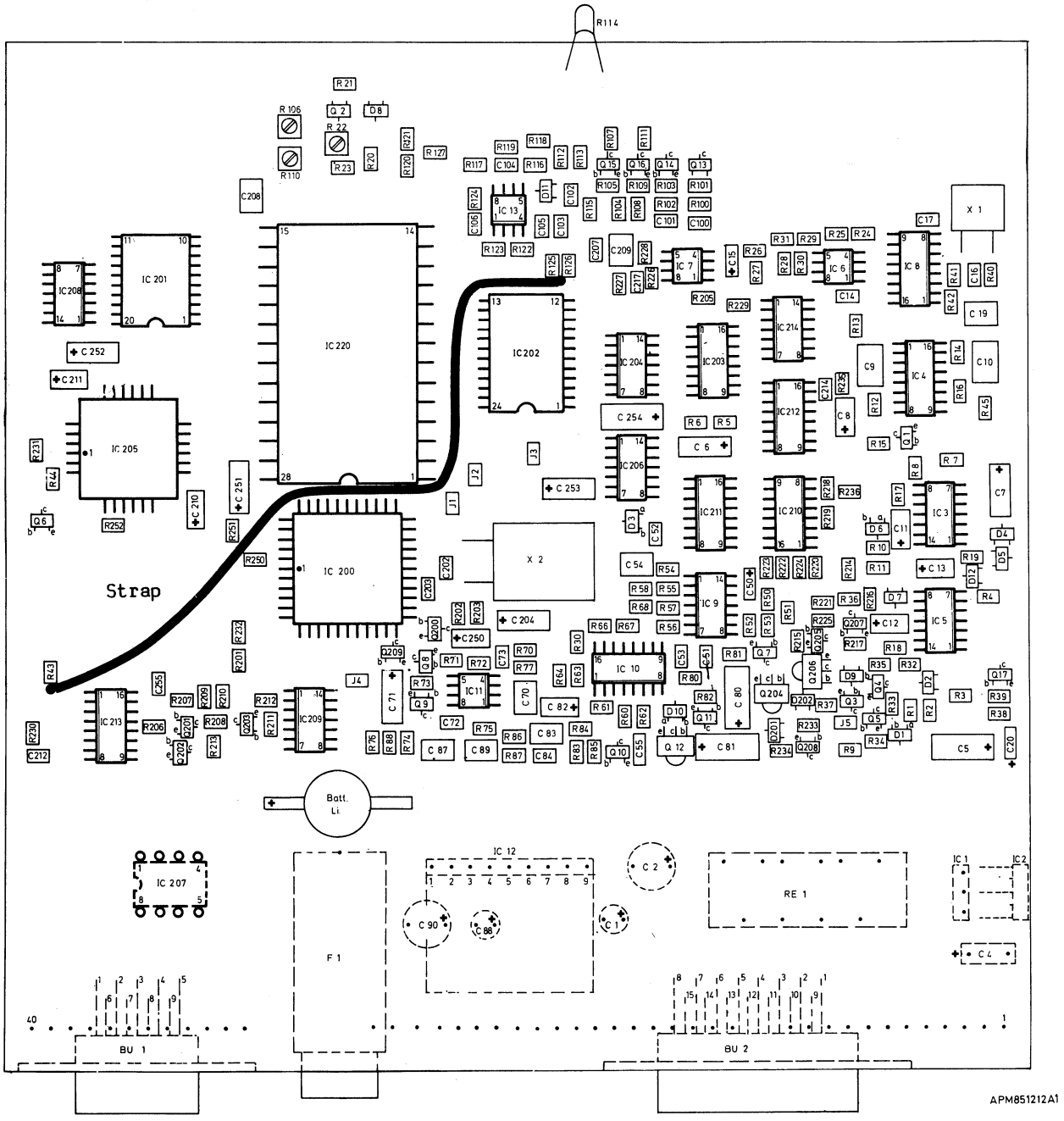


Fig. 2