radiotelefon

SERVICE MANUAL

Nordic Mobile Telephone

AP3733

Stock number: 296-303

Contents

GENERAL INFORMATION

CONFIGURATION AND INSTALLATION

SERVICE INSTRUCTIONS

ACCESSORIES

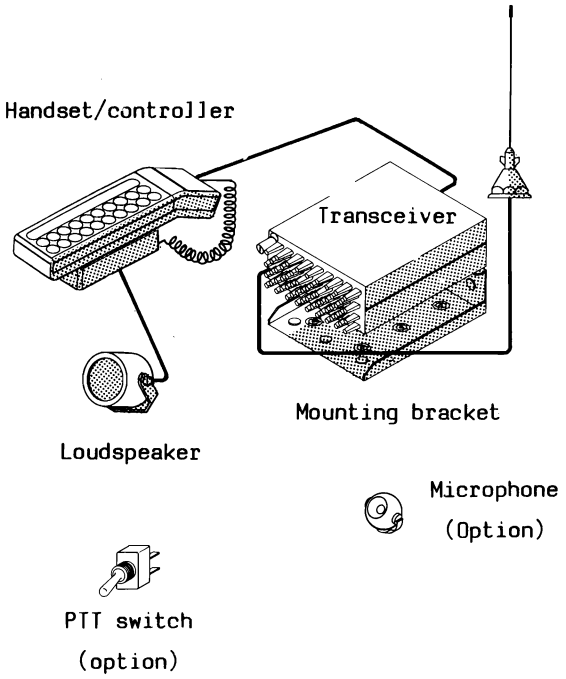
SPARE PARTS LIST

List of figures

AP3733
General information

1. Introduction

A. Mobile installation



B. Portaphone

Not yet issued

The mobile telephone AP3733 is designed for maximum operating convenience. Thereby the operator can concentrate on the driving. To increase driving safety further, the mobile installation can be provided with an optional microphone for hands-free operation.
Push-to-talk (PTT) is then done with an external switch mounted on e.g. the steering wheel.
When lifting the hand-set, the hands-free mode is automatically switched off. Going back to hands-free mode is done by pushing the appropriate button on the controller.
A portaphone kit, which contains the carrying case and the antenna (See fig. B), is available. Switching from mobile to totally portable operation is easy as the transceiver is fixed to the mounting bracket with a snap-lock.
Connections are made with one multipin plug and a BNC connector for the antenna. In addition the handset can also be unplugged and moved to the portaphone.
The portaphone has built-in battery and charger/mains power supply.
If cordless operation is not requested, the battery can be omitted.

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 a mother board or via plug terminated cables. Thereby service, if needed, is simplified.

It is possible to provide the mobile telephone with music muting and external calling indication. In addition, the ignition switch can be connected. Then the mobile telephone automatically switches off 10 hours after the ignition switch is turned off. Thereby start problems caused by leaving the car with the mobile telephone "on" is avoided.

2. Technical data

A. General

Frequency range	: Transmitter	: 453.000MHz to 457.500MHz
	Receiver	: 463.000MHz to 467.500MHz
Principle		: Digital frequency synthesizer
RF - Bandwidth		: Max. 4.5MHz
Channel spacing		: 180 channels/25kHz spacing
Channel switching time		: 3.6s for 180 channels
Mode of operation		: Duplex, internal filter
Duplex separation		: 10MHz with 4.5MHz RF - bandwidth.
Operation temperature		: -25^{0}C to $+55^{0}$C -30^{0}C to $+60^{0}$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 0.5A Tx 15W : 13.2V 7A
Antenna impedance		: 50ohms

B. For "hands free" operation

Loudspeaker	: external 4ohms
Audio output (regulated from control unit)	: Max. 3.5W at 5% distortion, 13.2V supply voltage.

Microphone	: 1kohm condenser microphone.
Input level	: 2mV RMS for ±3kHz dev. at 1kHz tone.

C. For "handset" operation

Output from handset receiver (25ohms with built in amplifier and filter)	: Max. 115dB above $2x10^{-5}$ Pascal at 1kHz tone ±3kHz deviation. Nominal 90dB above $2x10^{-5}$. Pascal at 1kHz tone ±3kHz deviation.
Vol. regulated from handset (nominal level adjusted internal in radio)	: -10dB and +15dB from nominal level.
Line level from radio unit	: 200mV RMS at 1kHz tone ±3kHz deviation 560mV RMS at max. vol.

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

D. Receiver

Sensitivity		: Typ 0.3uV (1/2 EMF) for 20dB sinad psophometric
Squelch level internal adjusted		: 0.4uV (1/2 EMF)
Co-channel rejection	: Cept method	: -7.5dB
	: NMT method	: -6.5dB
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	: >70dB in duplex. Image 90dB
Intermodulation rej.	: Cept method	: >70dB
	: NMT method	: >67dB
Blocking	: Cept method	: >100dB
	: NMT method	: >100dB
Spurious emissions	: Antenna	: <2nW
	: 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: -30dB Peak
AM suppression	: NMT method: 34dB
Function	: NMT method: <0.5dB

E. Transmitter

Power output		: 15W ±1dB from -25^{0}C to +55^{0}C between 10.8 and 15.6V
Power reduction for NMT		: Power reduced to 1.5W ±3dB Power reduced to 0.15W ±3dB
Carrier rise time		: <1ms
Carrier fall time		: <1ms
Spurious emissions	: Antenna	: <0.25uW
	Cabinet	: <2.5uW

Adjacent channel power		: 76dB 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	: -24dB
Hum and noise in "handset" operation		
(residual mod.)	: Cept method	: -48dB RMS Psophometric
	: NMT method	: -48dB RMS Psophometric
	: NMT method	: -24dB Peak

3. Description of the simplified block diagram

The radio contains a full duplex transmitter/receiver, a data modem and a CPU.
The CPU communicates with the base station via the modem which converts digital information to an FFSK (Fast Frequency Shift Keying) signal and reverse. It also communicates with a uP in the handset and with circuits in the radio.
When a call has been established the base station transmits a 4kHz supervisory (pilot) signal together with the speech. The tone is looped back by the mobile radio. At the Base Station (BS) the received tone is evaluated. A poor signal/noise ratio gives automatic switching to a more close BS or in the worst case disconnection of the call.

References

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

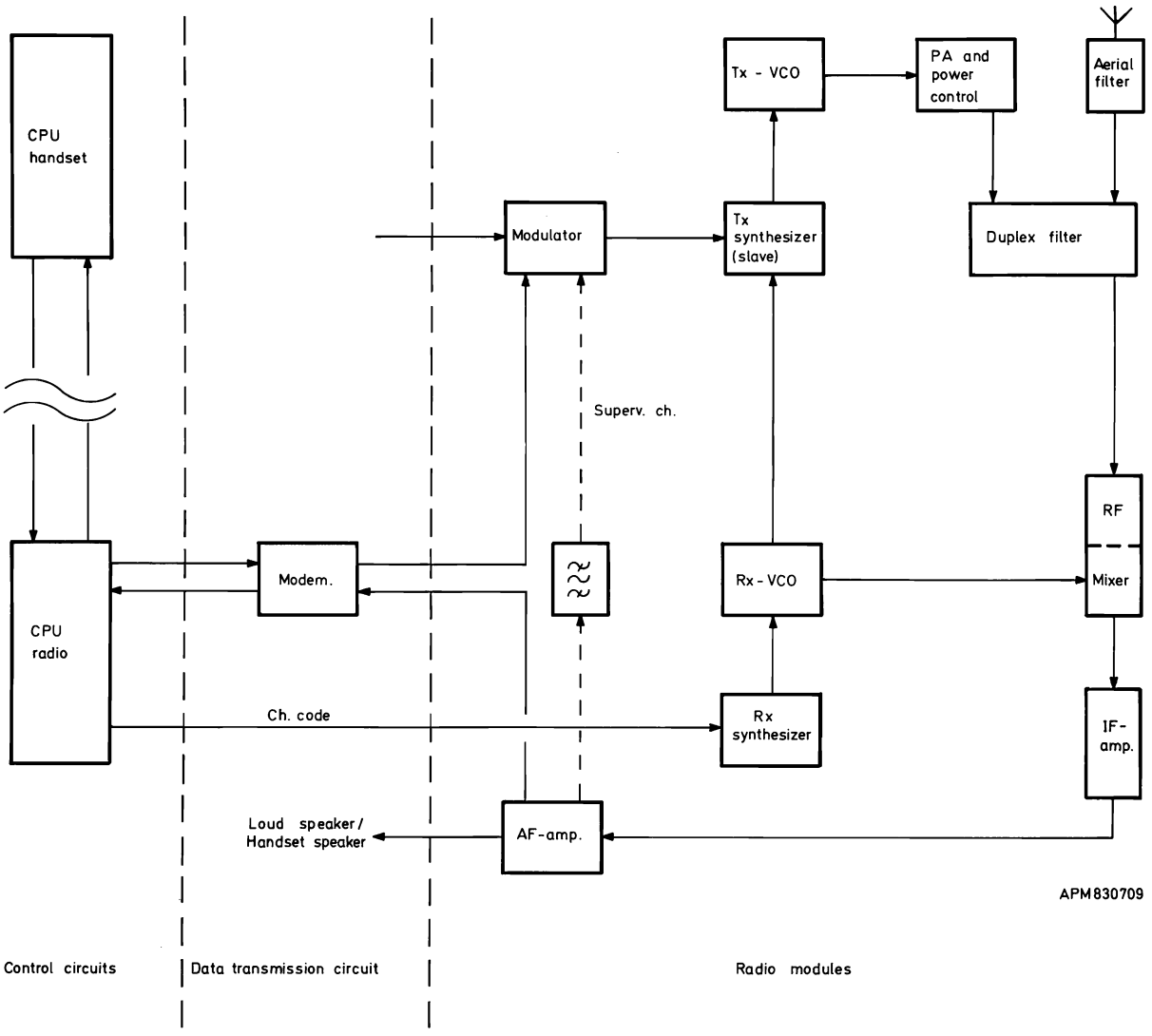
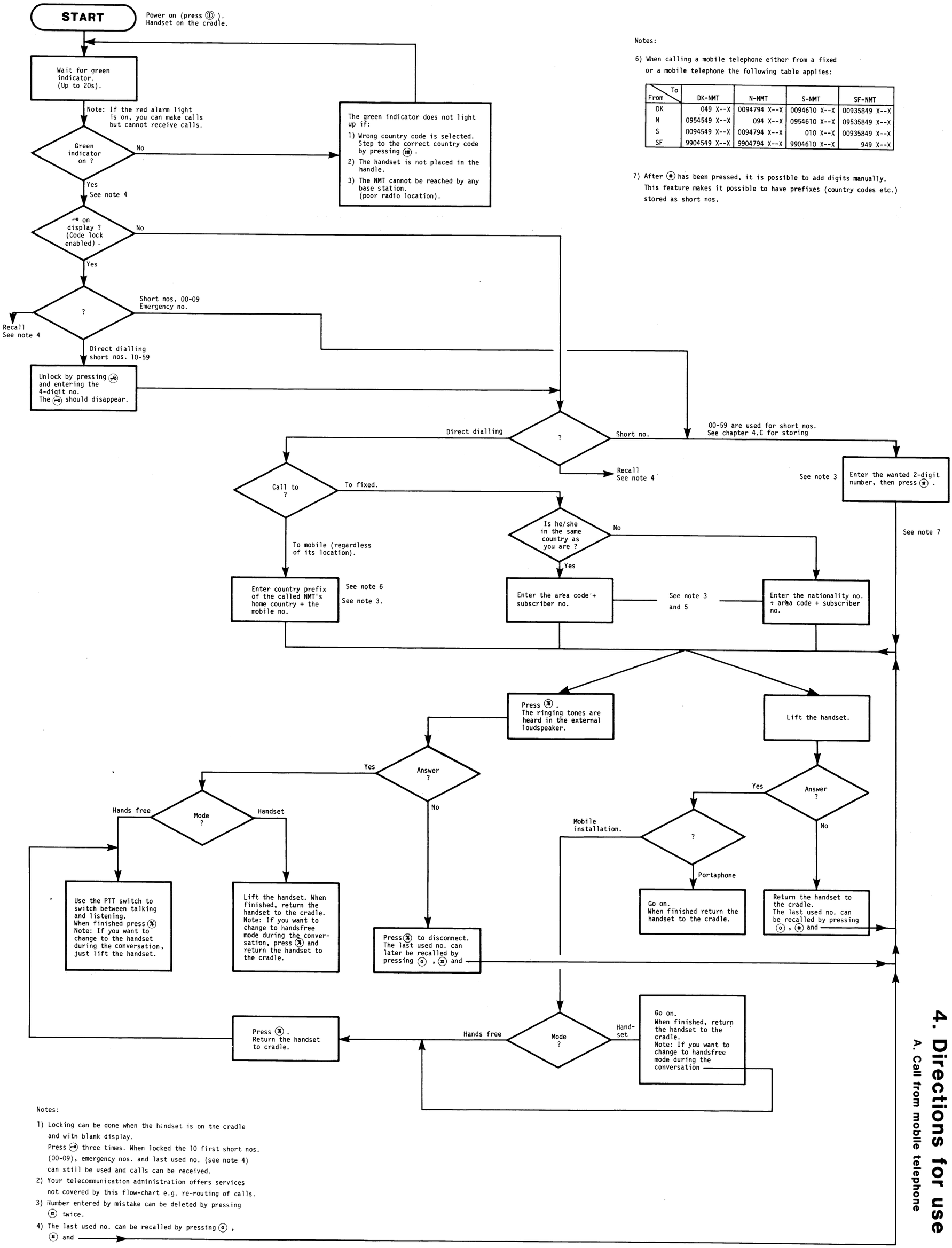


Fig. 3-1 Simplified block diagram

Call from mobile telephone



Notes:

6) When calling a mobile telephone either from a fixed or a mobile telephone the following table applies:

From \ To	DK-NMT	N-NMT	S-NMT	SF-NMT
DK	049 X--X	0094794 X--X	0094610 X--X	00935849 X--X
N	0954549 X--X	094 X--X	0954610 X--X	09535849 X--X
S	0094549 X--X	0094794 X--X	010 X--X	00935849 X--X
SF	9904549 X--X	9904794 X--X	9904610 X--X	949 X--X

7) After ⊠ has been pressed, it is possible to add digits manually. This feature makes it possible to have prefixes (country codes etc.) stored as short nos.

Notes:

1) Locking can be done when the handset is on the cradle and with blank display. Press ⊸ three times. When locked the 10 first short nos. (00-09), emergency nos. and last used no. (see note 4) can still be used and calls can be received.
2) Your telecommunication administration offers services not covered by this flow-chart e.g. re-routing of calls.
3) Number entered by mistake can be deleted by pressing ⊠ twice.
4) The last used no. can be recalled by pressing ⓪ , ⊠ and →

5) The same number as when a fixed telephone is used.

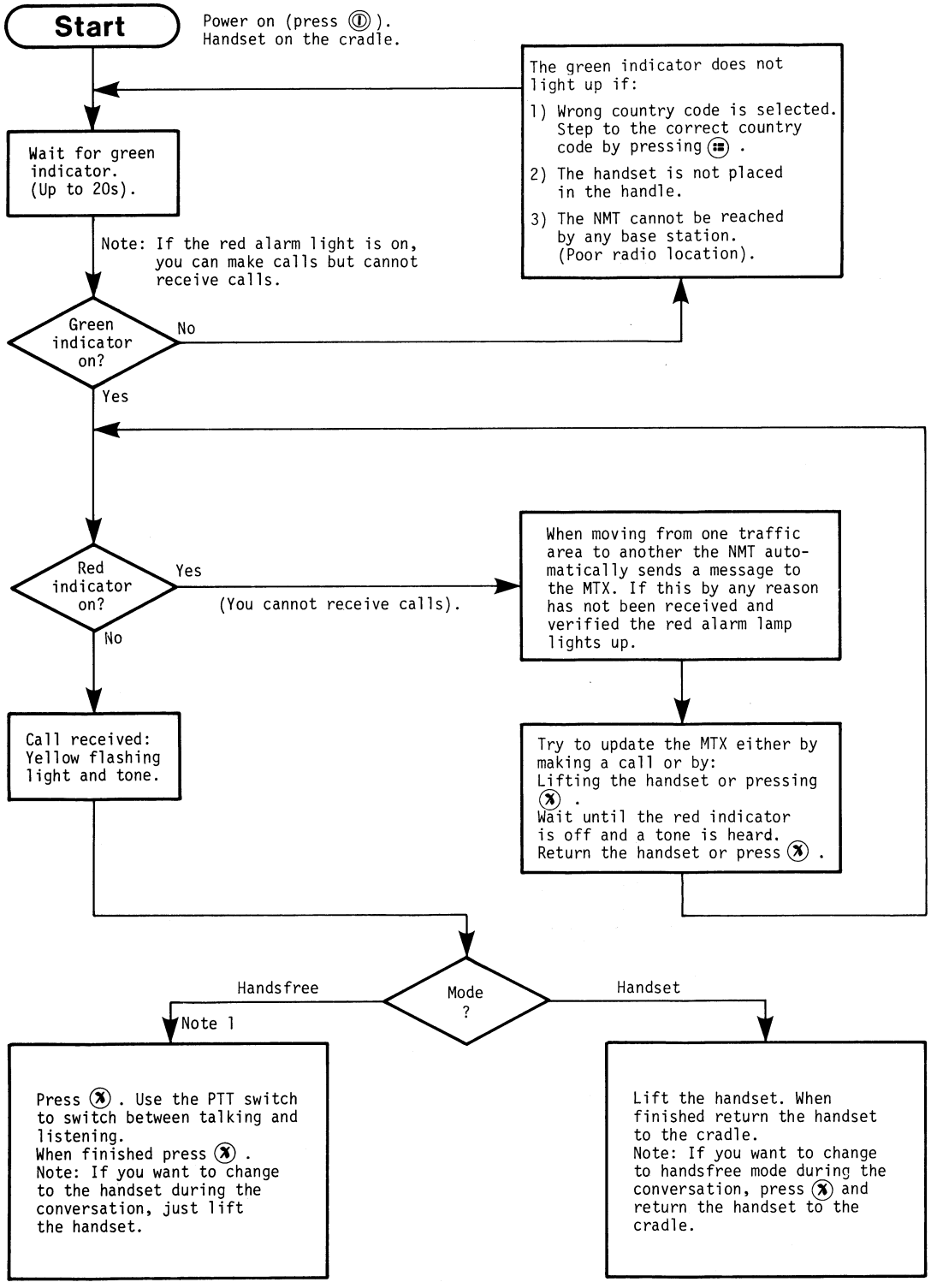
Fig. 4-1 Call from mobile telephone

APM 830502 A1

4. Directions for use

A. Call from mobile telephone

B. Receiving calls



Note 1: When using the portaphone, you can only use the handsfree mode when waiting for answer or when contacting the weather report, news service etc. as the handset microphone cannot be used.

APM830605

Fig. 4-2 Receiving calls

C. Storing short numbers

It is possible to store up to 60 telephone numbers. They can thereafter be recalled by entering a short number (two digits 00-59). The design is such that the first ten numbers (00-09) can be used also if the code lock is enabled.

In addition to storing digits it is possible to store # and * . This feature is useful for storing the sequences for special services offered by the P&T.
is displayed as a □ while a * is displayed as an H.

Storing telephone numbers

- The display must be blank (unlocked condition).
- Press (*). H is displayed.
- Enter the short number (00-59).
- Press (*). H xx H is displayed.
- Enter the telephone number (including eventual prefixes).
- Press (#) and then (*) (Blank display).

Deleting a stored telephone number

- The display must be blank (unlocked condition).
- Press (#).
- Enter the short number.
- Press (#) and then (*).

Checking which number is stored

- Enter the short number.
- Press (#). The corresponding telephone number is shown.
- Press (#).

AP3733
Configuration and installation

5. Configuration

A. Telephone number coding

The coding is done by programming a PROM on the CPU-board U11. For this purpose a programming box is used.
The telephone number is built up with 7 digits of which the 1st is the country code (Z).

Use the following procedure:

1) Turn the power on by the "ON" button.
   The display will show "E".

2) Insert the PROM into the socket.
   The socket is provided with a lever lock.
   Thereby the PROM can be inserted without using force.

3) Set the left rotary switch to position Z and the right rotary switch to the wanted country code: Denmark = 5
   Sweden = 6
   Norway = 7
   Finland = 8

Fig. 5-1 Front of the programming box

4) Check that an "F" is displayed. Press the "Program" button.

5) Check on the display that the correct digit has been programmed.

6) Turn the left switch to the X1 position and the right switch to the 1st digit in the subscriber no. Perform steps 4) and 5).

7) Continue using the described procedure until the complete subscriber no. is programmed.

NOTE 1: "E" on the display stands for "error".
An "E" will be obtained when the socket is empty and if the "Digit"-switch is set to unused positions.

NOTE 2: An empty PROM can be checked before the programming takes place.
Check that an "F" is displayed with all combinations of the switches.

B. Code lock

The code lock no. is stored in the handset memory.

When delivered all NMT's have been given the code 1,2,3,4.

This can be changed according to customer requirements with the following procedure:

Connect the handset to the test cradle and follow the flow-chart.

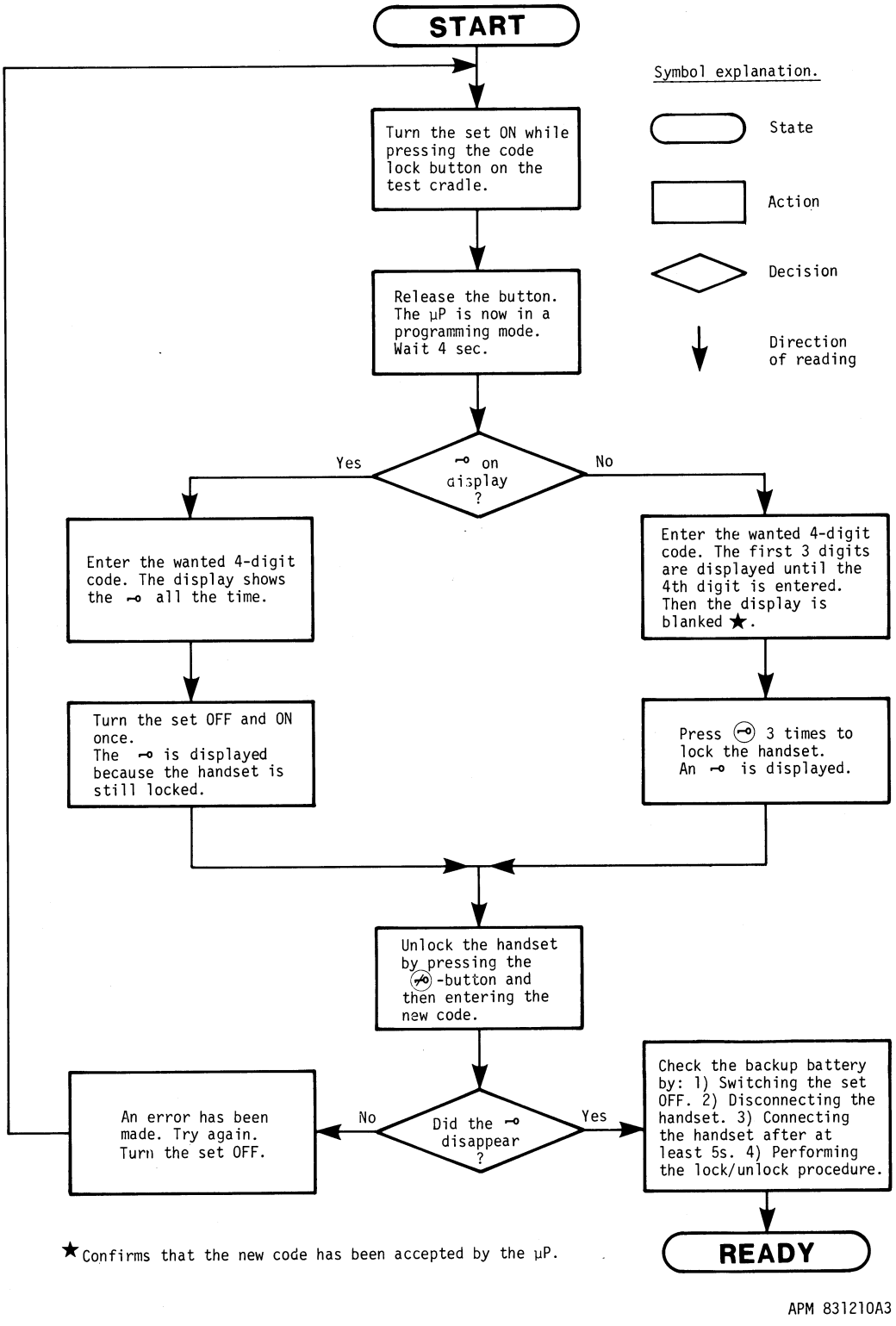


Fig. 5-2 Code lock programming

6. Installation instructions

For connection, see fig. 6-2

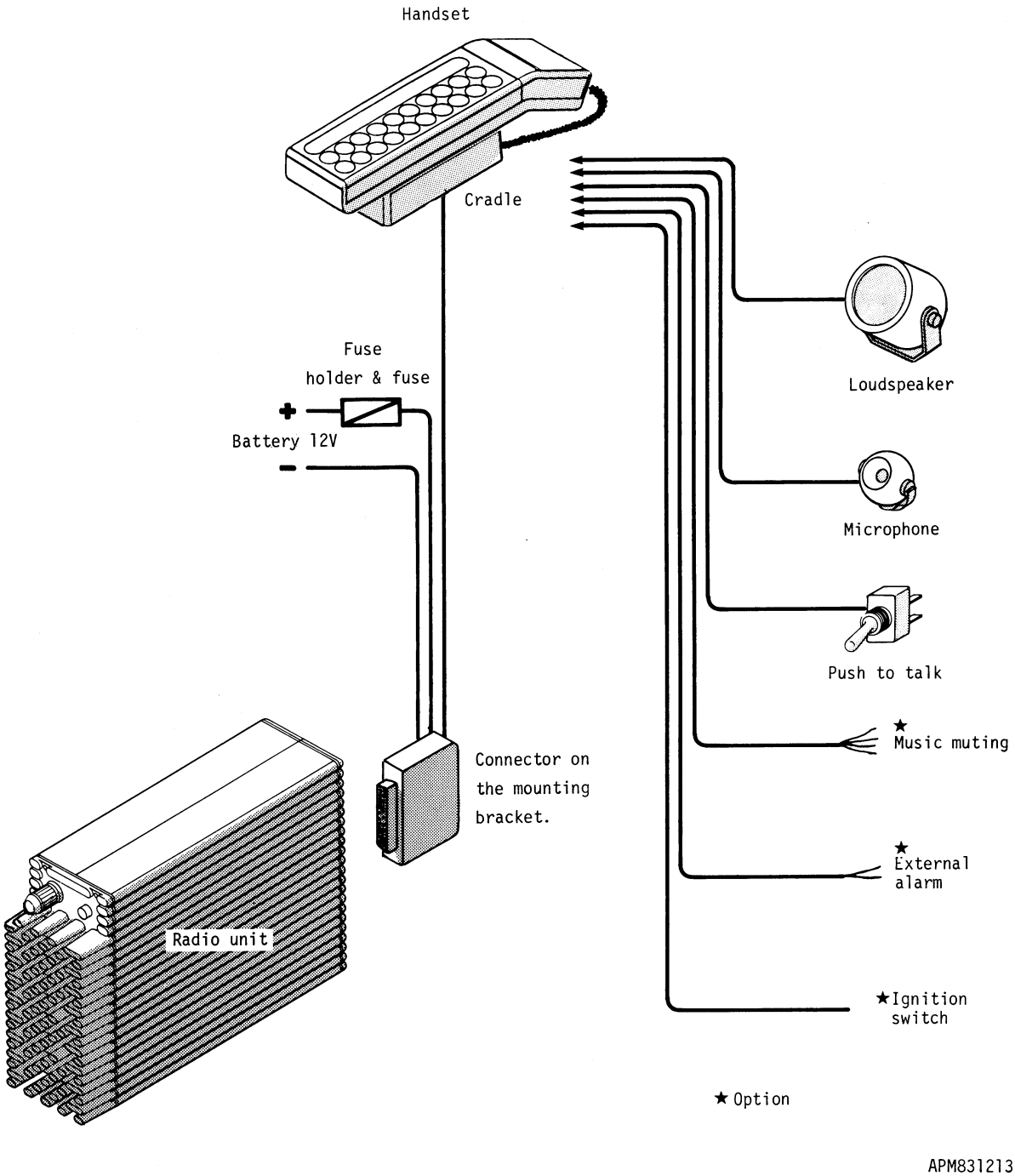
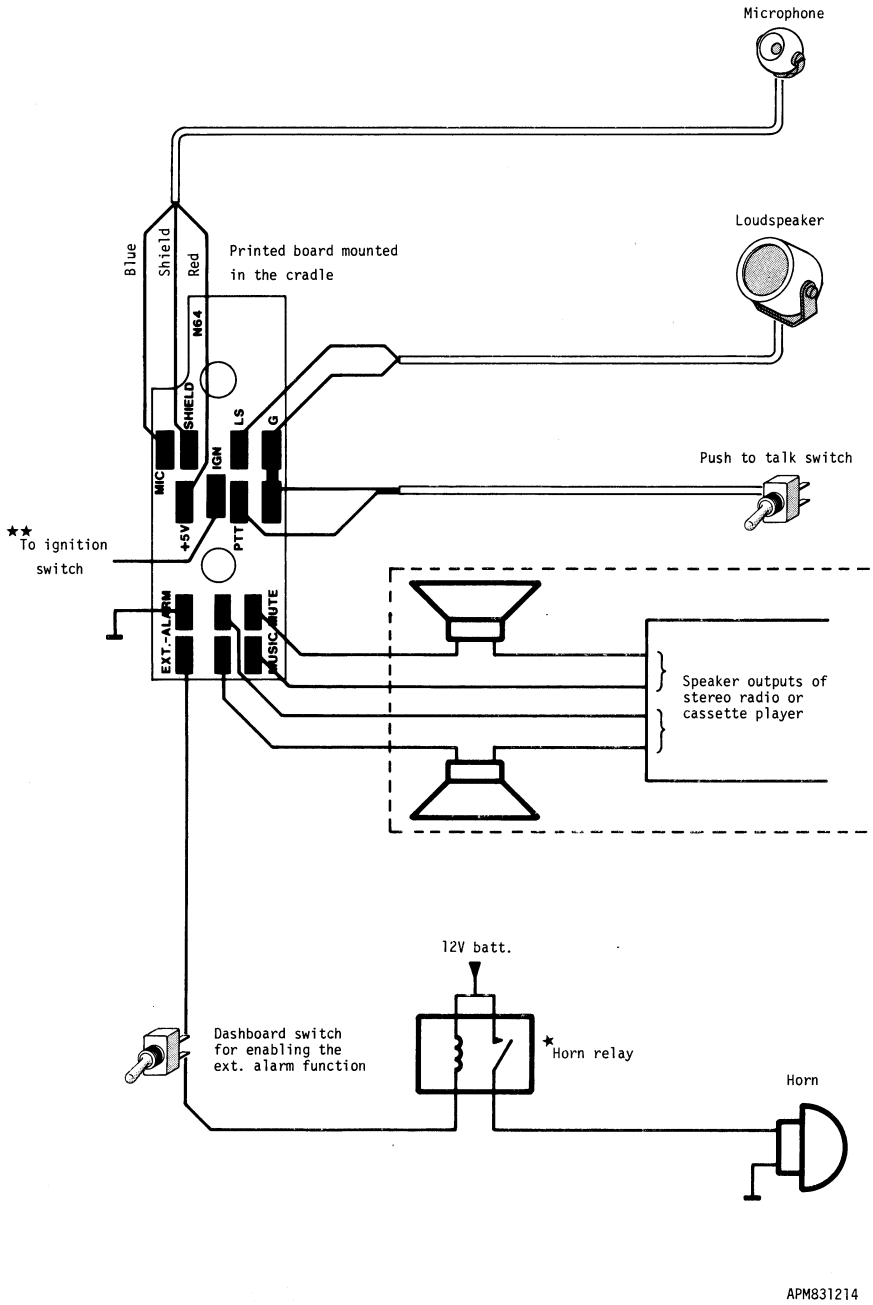


Fig. 6-1 Installation

See fig. 6-1.

IMPORTANT:
The music muting feature require mounting of some components in the cradle. See the component location drawing (page 8-4).
When the 10h timer feature (ignition switch) is used, a strap on the cradle print must be removed. See the component location drawing (page 8-4).



★ The horn relay is necessary in most cases because the relay unit can only handle 2A.

★★ The cradle must be provided with +12V when the key is turned clock-wise. If the mobile telephone is left "on" and the key is removed, the mobile telephone is automatically switched off after 10 hours.

Fig. 6-2 Connection of accessories

AP3733
Service instructions

7. Description of the radio unit

Introduction

In the following chapters the circuitry of the units will be explained.
The description of the handset and accessories and the tuning instructions are not covered here as they have separate sections.
Please remember the following notes:

- The diagrams are provided with figures for reference; [2] in the diagram for example, refers to oscillogram no. 2 (TP2) in the diagram, for example, refers to the test point 2 on the printed wiring board.
- The logic levels are indicated by the signal names $\overline{\text{TX}}$ on/off means that a high level (+5V) gives TX off condition while a low level gives TX on condition.
- The battery voltage is shown as +13.2V.
  The reason is that this voltage is the one which is used during checking and adjusting.
- The units have been given unit numbers U1, U2 etc.
  See the wiring diagrams for the location of the units.
- Most interconnections are made via the motherboards U1 and U8. These interconnections are shown in the wiring diagrams. In addition U8 has a circuit diagram and a component location drawing.

The block diagram is, to a large extent, selfexplanatory. 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 three main sections:
Transmitter, receiver and common circuits.

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 the radio is completely remote controlled. All these functions are controlled by a built in microprocessor. This is mounted on the CPU. The CPU can be regarded as a "black box" which is fed with information from the handset, the radio and the MTX (telephone exchange for NMT). The information is treated according to a program stored in a PROM. 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).

Receiver

RF, mixer, IF and detector U3 & U2

The received signal is via the duplex filter fed to U3.01. The RF amplifier consists of two cascade coupled transistors Q1,2. Six tuned helical coils are tuned for a passband about 463-468MHz. The mixer Q3 is fed by a local oscillator at 21.4MHz above the received frequency. The oscillator injection affects the DC level at TP2.
The 21.4MHz crystal filter has a bandwidth of about 25kHz. The 21.4MHz IF is converted to a 2nd IF of 455kHz. The 455kHz IF signal is fed to the quadrature detector IC1.
The detector phase shift is adjustable with L1. The 455kHz IF is also fed to the AGC amplifier on a daughter board. The output on U2.04 is a DC voltage in the range 0-3V depending on the field strength. A high dynamic range is obtained by regulating IC2 with the output voltage.

AF amplifier U9

The AF amplifier is mounted on the same board as the modulation amplifier. The AF from U2 is fed to IC1/4 which removes very low frequencies. The output of IC1/4 is fed to the AF amplifier, the squelch circuit and to the supervisory signal circuit. IC3 forms a notch filter which prevents the supervisory tone from being audible. IC4 is a variable gain amplifier controlled by the CPU. Gain is controlled by the voltage to U9.04. The CPU controls blocking of either the complete speech path (U9.05) or the loudspeaker output only (U9.06). Q1 and Q2 interrupts the signal path when U9.05 and U9.06, respectively, are grounded. After the transistor switches Q1 and Q2, the outputs from a ringing signal oscillator and a malfunction oscillator are added to the speech path. The oscillators are enabled by commands from the CPU. The supervisory signal circuit picks out the 4kHz supervisory tone with two stagger tuned BP filters. These are tuned to 3855Hz and 4145Hz respectively. When the supervisory tone is received it will be re-transmitted by the radio, provided that U9.12 is high. I.e. the supervisory tone is fed to the modulation amplifier. Q3,4 from an HP filter which picks out the noise obtained when the received signal (if any) is weak. The noise is detected and in IC6/2 the resulting DC is compared with the level set by R52 "Squelch adj.".

Receiver synthesizer loop U5 & U4

The receiver synthesizer loop contains the units U5 and U4. The circuit gives a signal in the range of 484.4 to 488.875MHz and in 25kHz steps. This corresponds to the received frequency of +21.4MHz. The frequency is determined by a channel code from the CPU. The output is used as receiver local oscillator and as a control signal for the transmitter synthesizer loop. For the PLL the VCO signal at U4.03 is fed back to U5.03. In IC1 and IC2 it is divided with a ratio determined by a 16-bit number. The 4 most significant bits are obtained from an internal switch (always the same setting in NMT). The other 12 bits are obtained from the CPU. The 16 bits are fed to the programmable divider IC2 over 4 lines only. This is possible because IC2 has a latch circuit and the multiplexers IC3 and IC4 send in sequence 4 bits at a time.
This is done on command from IC2 with the data select lines.

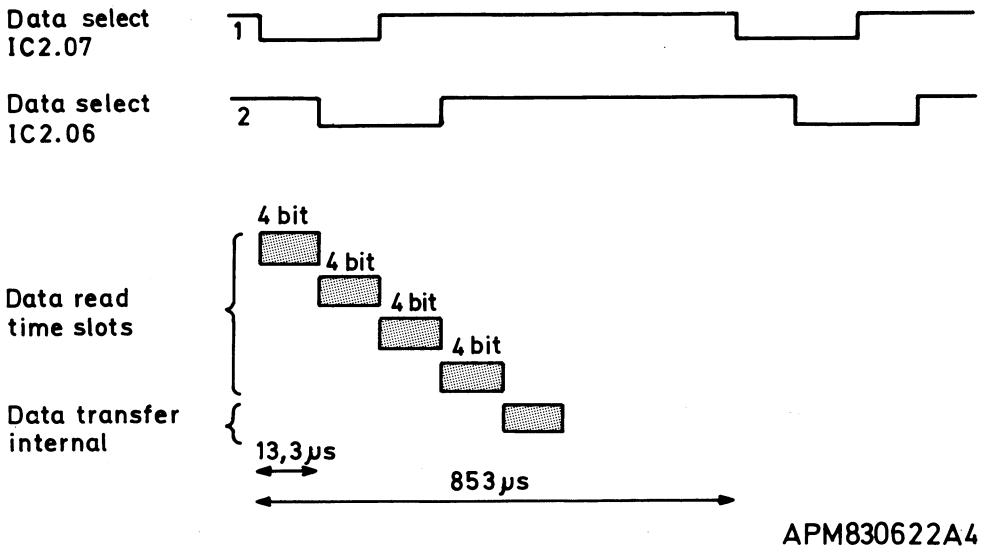


Fig. 7-1 Multiplexing the channel number

To divide fvco down to 25kHz it is necessary to have a programmable divider which can divide by fractions of units. This is performed by IC1 and IC2 in co-operation.
The internal programmable divider in IC2 (set by the channel code) gives the coarse division ratio, while the fine division ratio is obtained with IC1. This is a 4-modules counter which divides according to the control A and B inputs (see fig. 7-2).

Control A	Control B	Ratio
1	1	256
0	1	255
1	0	240
0	0	239

Fig. 7-2 Division ratios of U5/IC1

The division ratio of IC1 is 256 most of the time. To get the "fine" division ratio this is occationally changed to 239, 240 or 255. This is controlled by IC2.
The following equation applies for the synthesizer:

$$N = \frac{fvco}{0.025} - 3840$$

N = channel code (decimal) from CPU + 49152 (fixed from S1)
Fvco = output frequency (Mhz) of U4.

Transmitter

Modulation amplifier U9

The modulation amplifier is mounted on the same board as the AF amplifier.
The transmitter can be modulated with the handset microphone (mic. 2), the handsfree microphone (mic. 1), the modem and the supervisory tone. The CPU selects which source shall be connected. With the control signal to U9.15 either the handset or the handsfree microphone is selected. The pre-emphasis of the selected microphone signal is done with C53. IC8 forms together with Q8-10 a compressor which keeps the modulation constant. Q8 is a voltage controlled attenuator. This is via the loop amplifier Q9,10 controlled by the output of IC8/2. The microphone(s) can be disconnected by the CPU. This is done by disabling IC8/3 (U9.02 LOW).

Transmitter synthesizer loop U6 & U7

The transmitter synthesizer loop contains the units U6 and U7. The VCO in U7 operates as a slave oscillator with an output of 31.4MHz below the RX VCO. This is the wanted transmitter frequency and corresponds to 10MHz duplex separation (31.4-21.4MHz = 10MHz). After the mixer U6/Q2 the difference frequency (RX VCO - TX VCO) is obtained. This frequency (31.4MHz when locked) divided by 4 in IC1 gives 7.85MHz.
IC1 also contains a phase comparator. It compares the down divided difference frequency with 7.85MHz obtained from the VCXO (Voltage Controlled X-tal Oscillator).
In addition to providing the reference frequency, the VCXO is the modulated stage.
The modulation signal is obtained from U9.19. The modulation amplifier IC2 operates in push-pull mode. Thereby maximum voltage variation is obtained across the capacitance diode D2.

PA and power control U13

This unit contains four tuned amplifiers. The output power is blocked if either the TX or RX synthesizer pulls U13.02 low. This happens when the synthesizer loops are not locked. The settling time for the stabilizing loop is less than 0.5ms. Total bandwidth of the amplifier is about 10MHz. The PA (Power Amplifier) is by the CPU switched to either low, medium or high output power. The medium and high levels are adjusted with trimpotentiometers.

Common circuits

CPU U11

The CPU (Central Processing Unit) can be regarded as a "black box" which is fed with status information (high or low) to input ports, e.g. squelch condition.

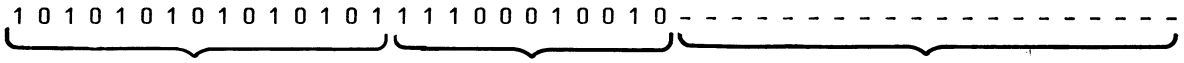
One of the inputs, U11.03, is fed with an analog signal. This is the field strength signal from the IF amplifier. The analog signal is converted to a high or low level with the comparator IC4/2. The switch level is adjustable with the trimpotentiometer R46.
Via terminal U11.27 the CPU is fed with data from the modem. This serial data is arranged in frames so that the CPU can separate different information, e.g. channel number, call etc. Via terminal U11.18 the CPU receives information from the handset (abbreviated HS in some signal names). All information received is processed according to programmes stored in the PROM IC2. The resulting output information is fed to the output ports. One of the outputs U11.35 has a DC level which can take one of 8 values (volume control). The level can by the (🔊)/(🔉)-buttons on the handset be stepped up (three steps) or down (4 steps) from a mean volume set with R9. The selected volume is remembered as long as the power is on. The volume is remembered independently for the handset and for the loudspeaker.
The digital-to-analog conversion takes place in IC4/1 set.
The CPU also has serial data outputs to the modem and to the handset. IC5/7 are expanders that make it possible for the microprocessor IC1 to have more inputs and outputs than the number of pins otherwise would allow.
During checking and adjusting the function of the CPU is taken over by a test box which is connected to the CPU. When the power is switched on, the CPU is kept passive by a low level to IC41.04 from the handset. After a delay the handset uP releases the reset i.e. IC1.04 goes high and the programme execution starts. The uP starts by setting the output of the unit to certain conditions. Then the telephone number which is set by the PROM IC16 is read and stored in the RAM. Now the uP starts channel scanning. In order to distribute call attempts evenly among all free marked traffic channels, the scanning starts from a channel selected at random. A random number is taken from IC10 which is a binary divider clocked by the down-divided crystal frequency. The random number is by the uP converted to a random channel number which is fed to the receiver synthesizer. The scanning stops when a base station with an FFSK signal is found with sufficient field strength. Checking of field strength is done with the "Field strength" input U11.03. If the field strength is too low the scanning continues, otherwise the FFSK is checked with the "RX data present" signal U11.26. If the received signal disappears during conversation (squelch off), the radio is switched off after about 30s.
This can happen, e.g. when driving through a tunnel, into a garage etc. This function is called "Time out". IC11 is clocked by the lowest frequency output of IC10. The output of IC11 is normally low, as the uP now and then resets IC11 and thus prevents IC11 to count the whole cycle. If the uP does not detect squelch during conversation the resetting of IC11 stops. Thereby IC11.12 goes high and the power is switched off (see handset).
NOTE: Carrier bursts shorter than 1 second does not count as steady carrier.

Modem U10

The modem (modulator/demodulator) is the interface between the CPU and the transmitter/receiver. Thereby full duplex data communication between the CPU and the base station/MTX is possible.

Demodulator

The audio from the receiver is fed to U10.08. Noise is removed with the BP filter IC1 which forms an HP and an LP filter in series. Demodulation takes place in the PLL circuit of IC2. This IC contains a VCO which is adjusted by means of R1.
A full period of 1200Hz gives a "1" while 1 1/2 period of 1800Hz give a "0" (same duration). When the PLL is locked, IC2.05 is low. Via the inverter IC14/1 this gives a high level at U10.11. R20 and C8 suppress noise which could otherwise give a false "Data present" signal. The data transmitted from the base station is arranged in frames of 166 bits, see fig. 7-3. Every other bit in the encoded message is a parity bit. The feature of this system is that error correction can be made (by inverting an erronous "1" to "0" and reverse). In order to separate the encoded message from the bit and frame sync, the decoder delivers data output only when the frame sync word is detected. The true frame sync detect pulse is obtained at IC13.13 and is fed to the clock input of IC8/2. The circuit with IC26 and IC9 gives a synthetic frame sync detect pulse if the received frame sync bits are disturbed. This signal is taken out by the diode matrix D9, 10, 13 & 15 from the shift register IC9 which is clocked by the 1200Hz regenerated clock. An "end of frame" pulse is taken out via the diode matrix D11, 12 & 14. The events are synchronized by a regenerated clock signal derived from the incoming data stream.



Bit sync 15 bits Frame sync 11 bits Encoded message 140 bits

Fig. 7-3 Frame structure

The 1200Hz regenerated clock is obtained by dividing the 144kHz from the modem receiver. This is done in two steps. IC6 has a nominal division ratio of 12 and IC5 divides by 10. IC6 is programmable with the levels to pins 5, 11, 14 & 2.
The D flip-flop IC8/1 measures the phase difference between the regenerated clock on TP5 and the data transitions. Thereby it can change the division ratio of IC6 to 11 or 13 in order to obtain synchronization. The regenerated clock frequency is twice the data frequency in order to obtain reading of data in the expected middle of the bits.

Modulator

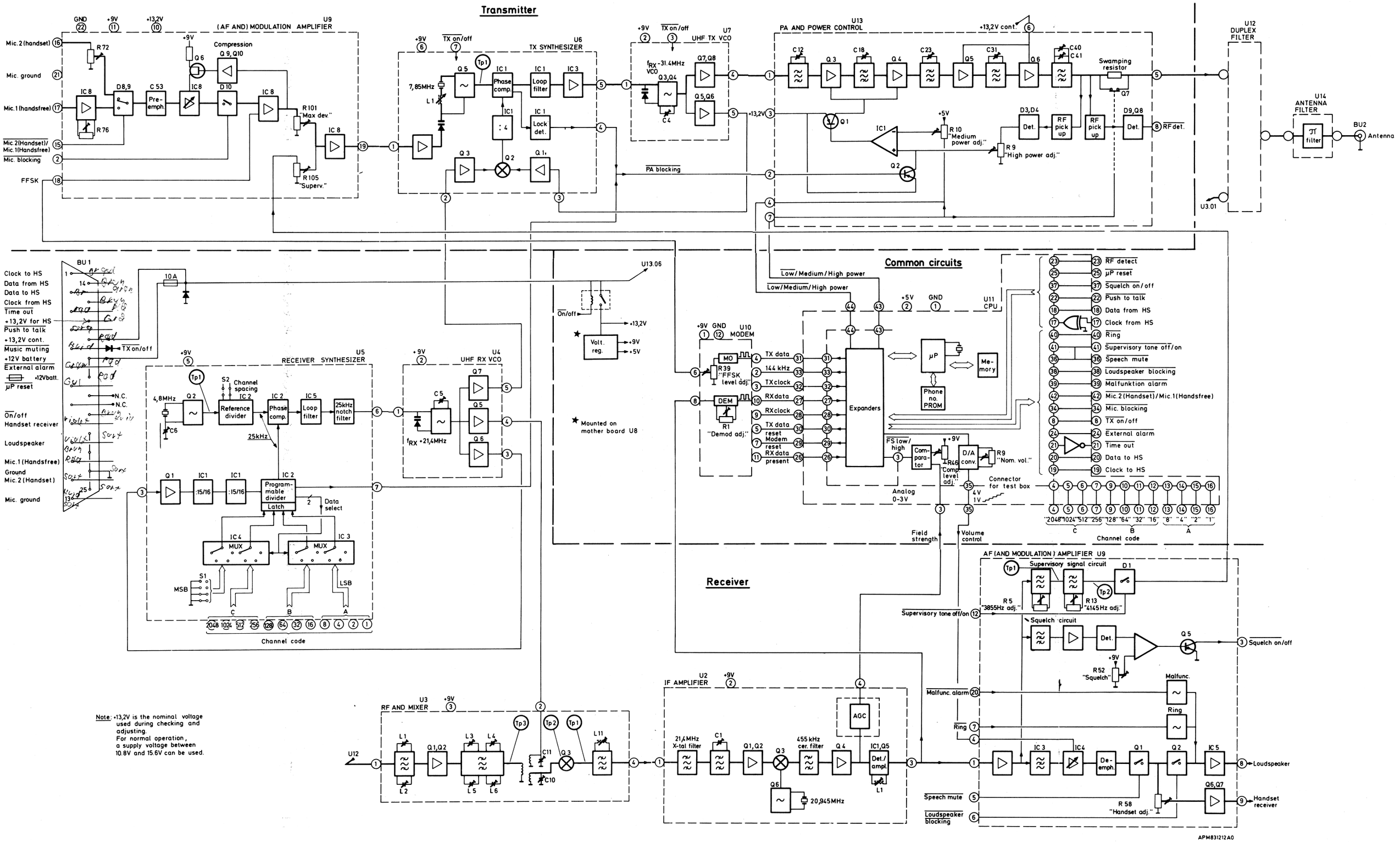
The data from the CPU is already coded with every second bit a parity bit. The modulator just converts the 1200 baud signal to an FFSK signal (fast frequency shift keying). A "1" gives a full period of 1200Hz while a "0" gives a 1 1/2 period of 1800Hz. The microprocessor initiates a data transmission by pulling the "TX data reset" line low. Thereby the frequency divider IC23 delivers 18kHz and 72kHz. The 18kHz signal is via IC25/2 used to clock the decimal

counter IC21. The 72kHz signal is divided by 3 in IC22/1 to give 24kHz. The other half, IC22/2, is clocked by the 24kHz signal and delivers 12kHz to the decimal counter IC21.

IC25/1 detects when IC22/2 reaches the zero state. Then IC25/1 feeds pulses with a 2.4kHz repetition frequency to the clock input of IC20/01 which divides by 2. The positive flanks of the resulting 1200Hz signal (TX clock) are used by the CPU which presents new data bit by bit. The synthetic sine-wave signal is filtered so that a clean sine-wave signal is obtained.

Motherboard U8

In addition to performing various interconnections the motherboard contains a power on/off relay. The relay is controlled by a S/R-flip-flop in the handset. The switched voltage is regulated to +5V and +9V. The battery voltage is routed via the relay to many units. The power for the two final transistors in PA U13 is taken out before the relay. As they operate in class C they do not consume power when the power is switched off. The reason for this arrangement is to avoid the high relay switching current which would be caused by accidental "power of" during conversation.



84.02

Fig. 7-4 Block diagram, radio unit

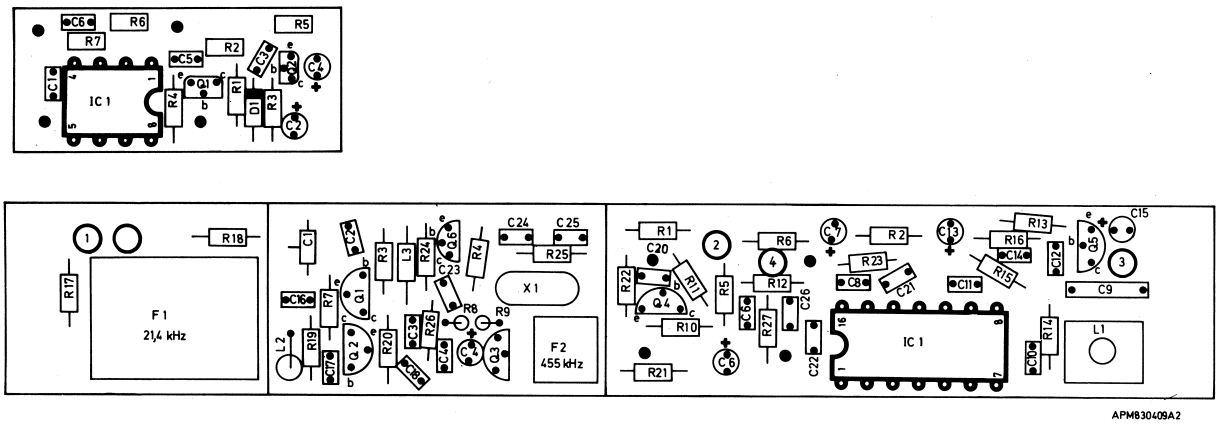


Fig. 7-5 Component location, IF amplifier, unit 2

U08 (2)
+9V
+9Va
+9Vb
+9Vc
+9Vd
R1 47
C7 1µ
C2 1µ
R4 1,5K
R5 47
R2 22
C13 4,7µ

+9Vd
11
IC1 = TBA120S
4

+9V
R6 47
+9Va
C2 1µ
+9Va
8
IC1 = MC3340
3
+9Va
R1 2,7K
R2 680K
C1 1n
IC1
1
7
6
2
C5 2,2n
Q1 BC238B
C3 2,2n
R3 100K
D1 1N4148
Q2 BC238B
+9Va
+9Va
C4 4,7µ
R6 10K
R5 2,2K
R27 1K
Field strength
(4) U11.03
C6 0,1µ
R7 8,2K
AGC amplifier

L1
"LF max. adj."
C9 2,2p
C10 150p
R14 3,9K
C11 150p
6
7
9
10
14
13
IC1
2
1
3
12
8
C8 330p
R23 1K
C26 0,1µ
C22 0,1µ
C21 0,1µ
Detector
R15 18K
R16 68K
+9Vd
C12 100p
C14 1n
+9Vd
Q5 BC238B
C15 1µ
4,7K R13
AF
(3) U09.01 U10.08

2nd mix
+9Vb
R9 220K
R8 680
C4 1µ
C19 47p
+9Va
+9Va
R3 1,5K
L3
+9Va
+9Va
R7 22K
R19 15K
Q1 BF495
Q2 BF495
R20 1K
C18 2,2n
C3 33p
+9Vb
Q3 ZTX326
Ceramic filter F2 CFU155D
+9Vc
R10 12K
R21 1,8K
+9Vc
R11 2,2K
R22 330
Q4 BC238B
C6 2,2n
R12 2,2K

X-tal osc.
C23 1,5p
+9Va
R24 47K
Q6 BC238B
+9Va
X1 20.945MHz
C24 68p
R26 47K
R25 2,2K
C25 33p

(1) U03.04 1st mix output
R17 680
X-tal filter F1 21.4MHz
R18 3,3K
L2
C1 9p
"Min. dist. adj."
C16 27p
C17 39p

APM830406A0

Fig. 7-6 Circuit diagram, IF amplifier, unit 2

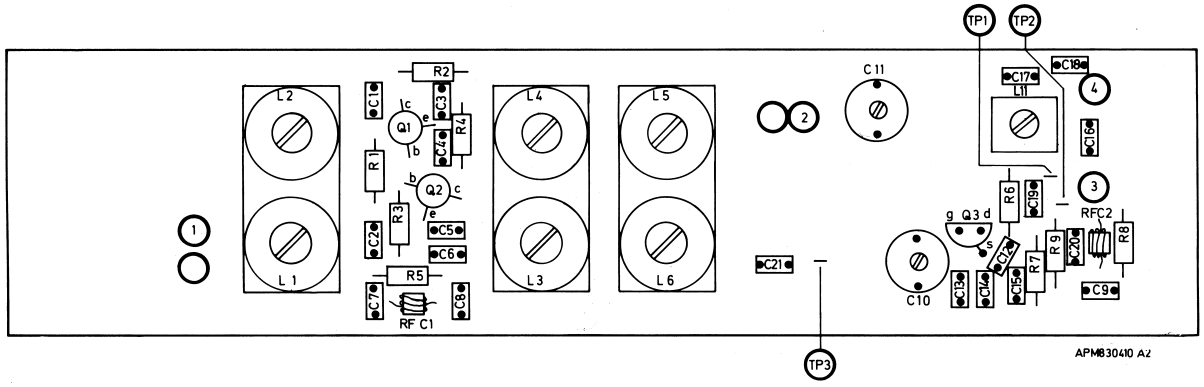
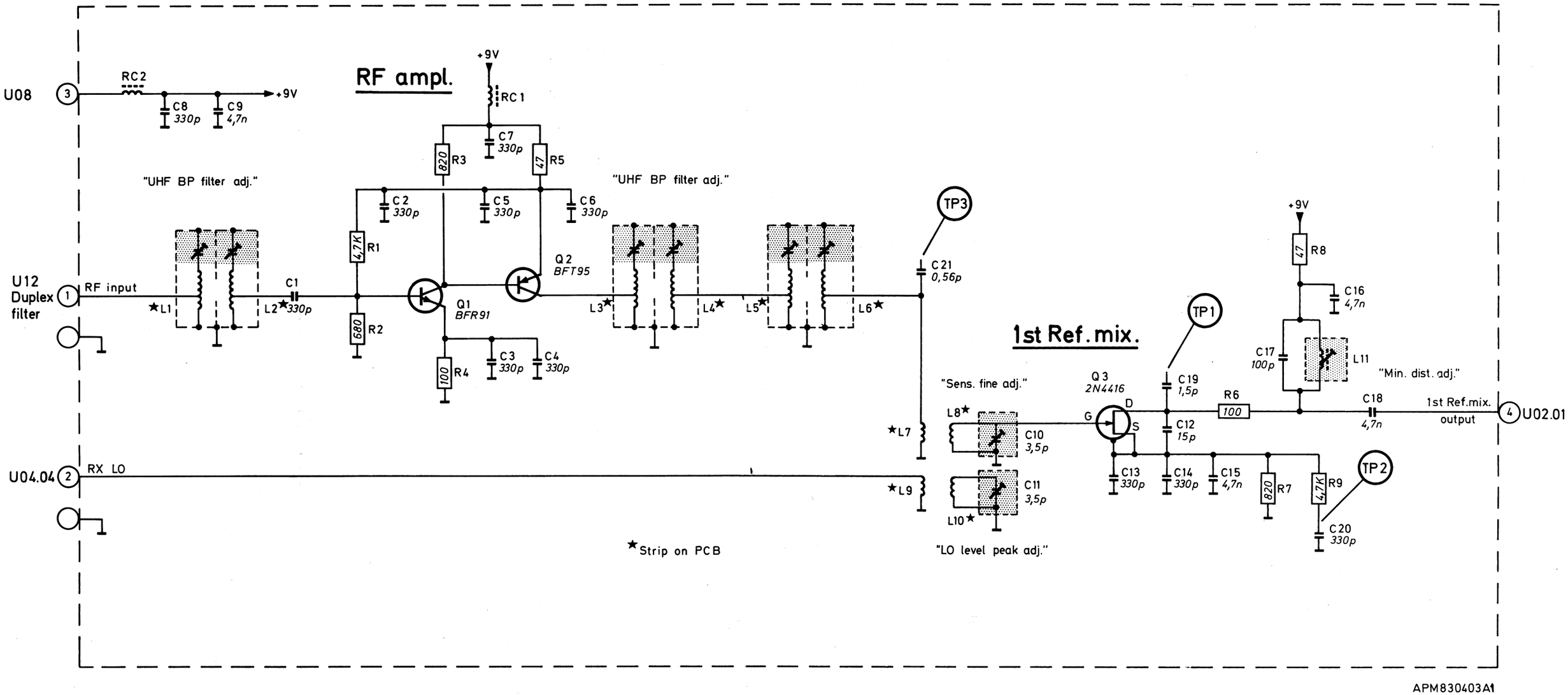
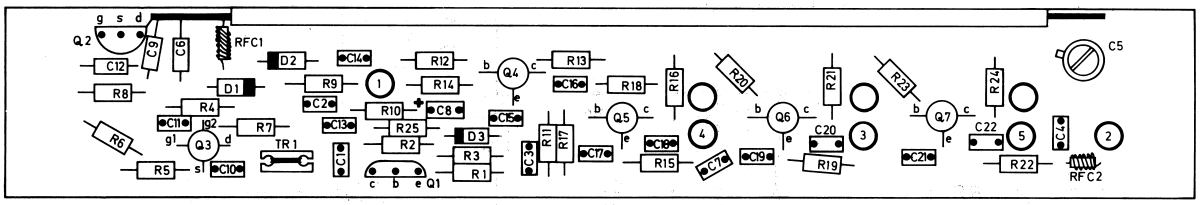


Fig. 7-7 Component location, RF and mixer, unit 3



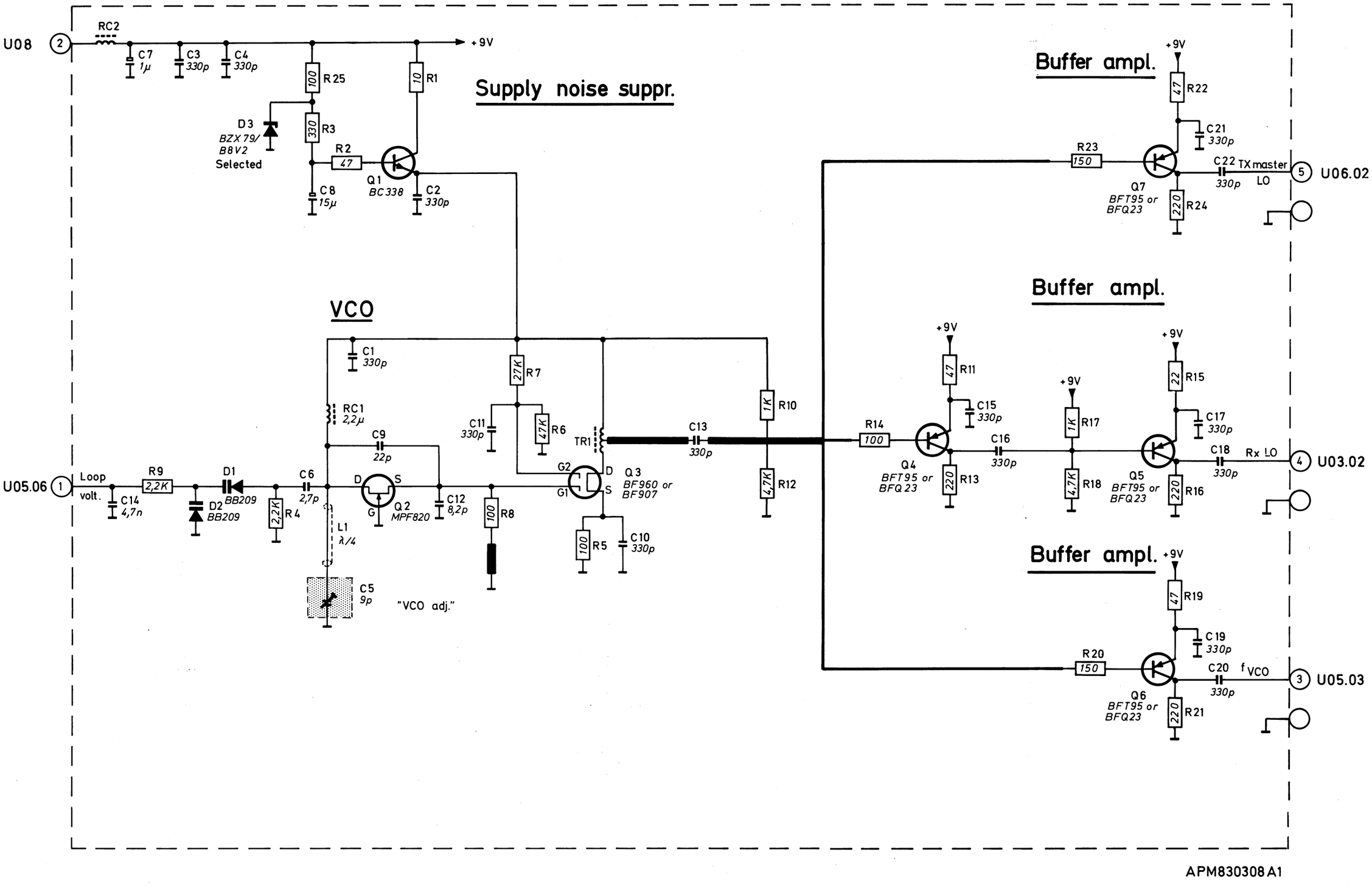
84.02

Fig. 7-8 Circuit diagram, RF and mixer, unit 3



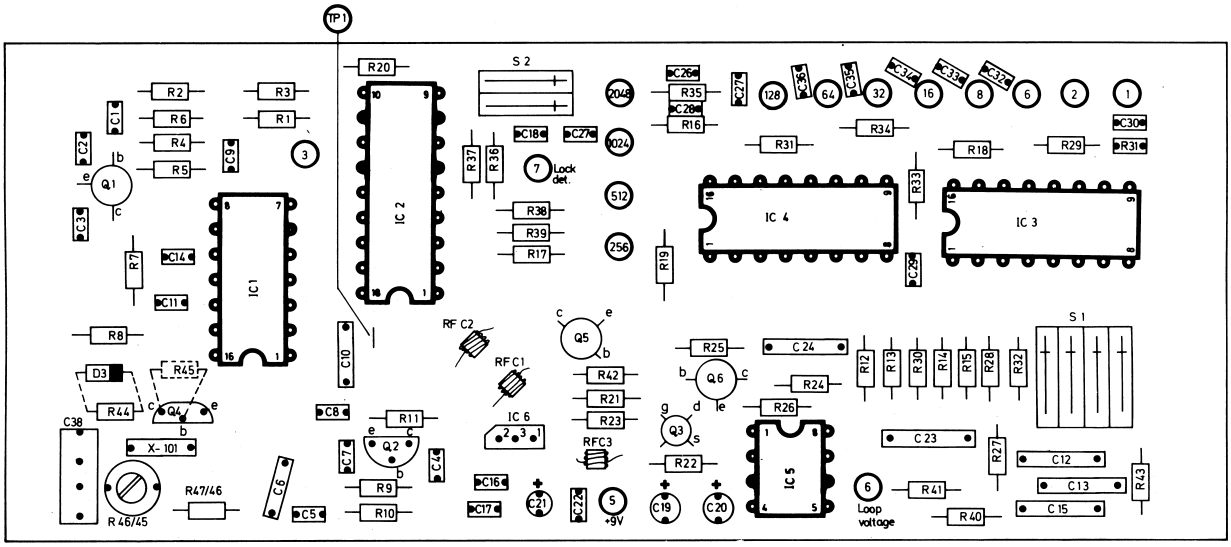
APM830408A2

Fig. 7-9 Component location, UHF RX VCO, unit 4



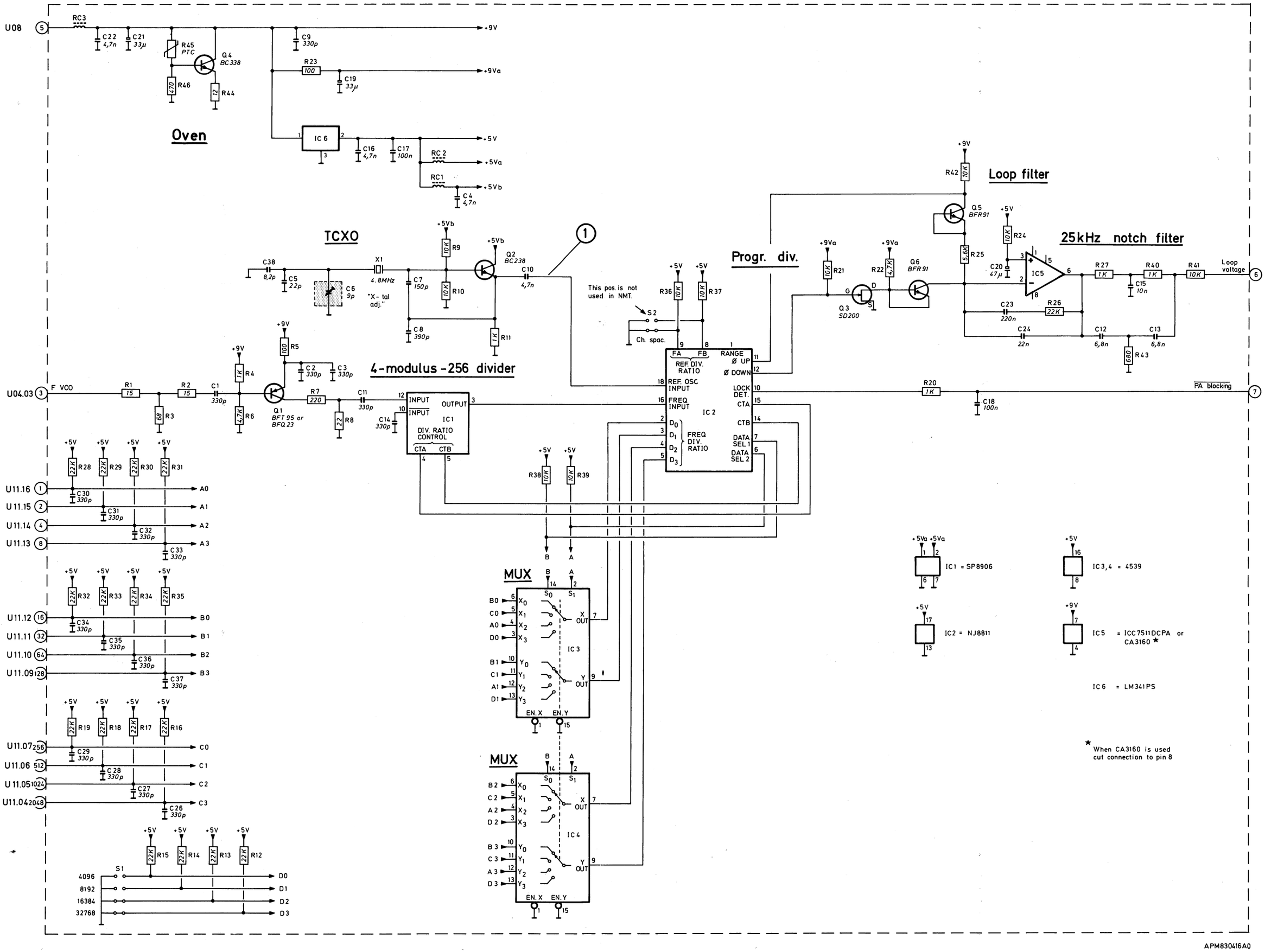
84.02

Fig. 7-10 Circuit diagram, UHF RX VCO, unit 4



APM830415A2

Fig. 7-11 Component location, RX synthesizer, unit 5



84.02

Fig. 7-12 Circuit diagram, RX synthesizer, unit 5

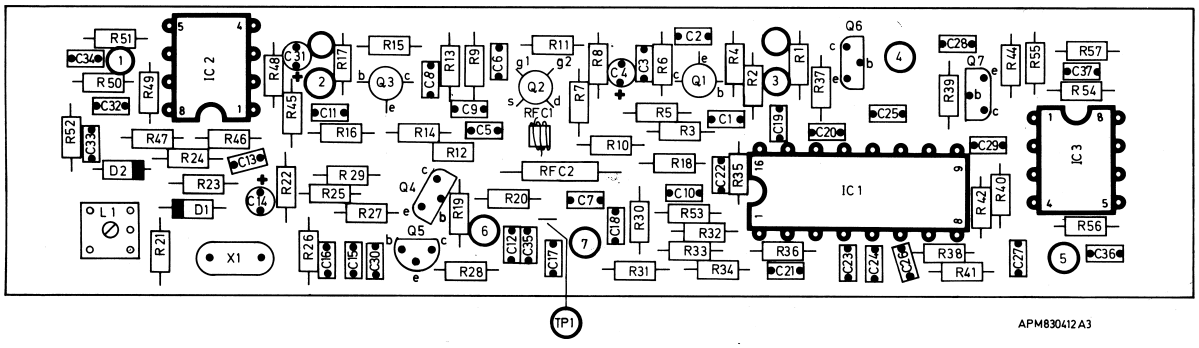
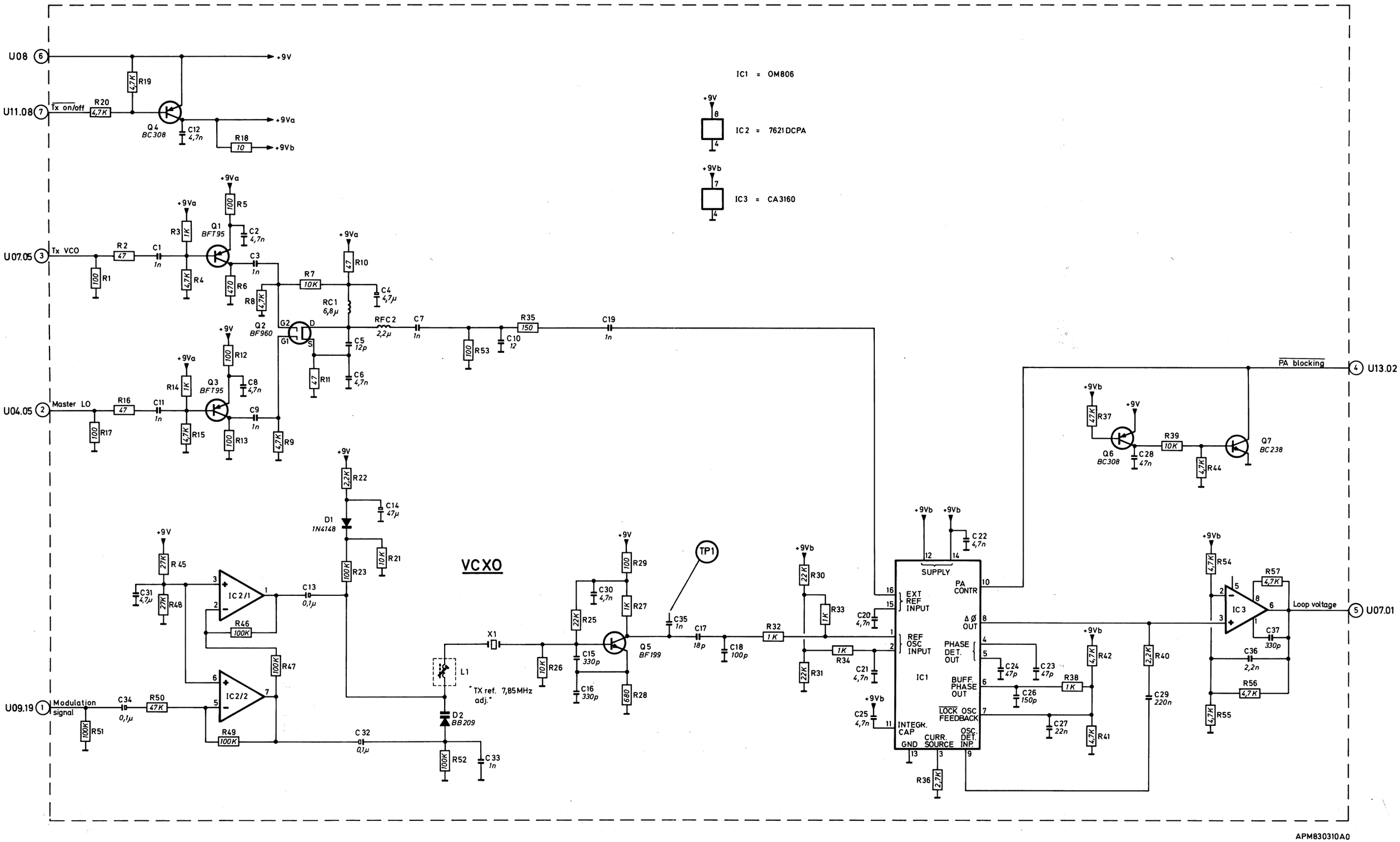


Fig. 7-13 Component location, TX synthesizer, unit 6



84.02

Fig. 7-14 Circuit diagram, TX synthesizer, unit 6

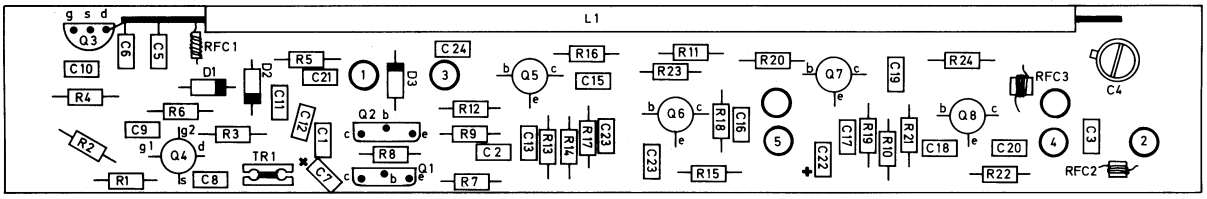
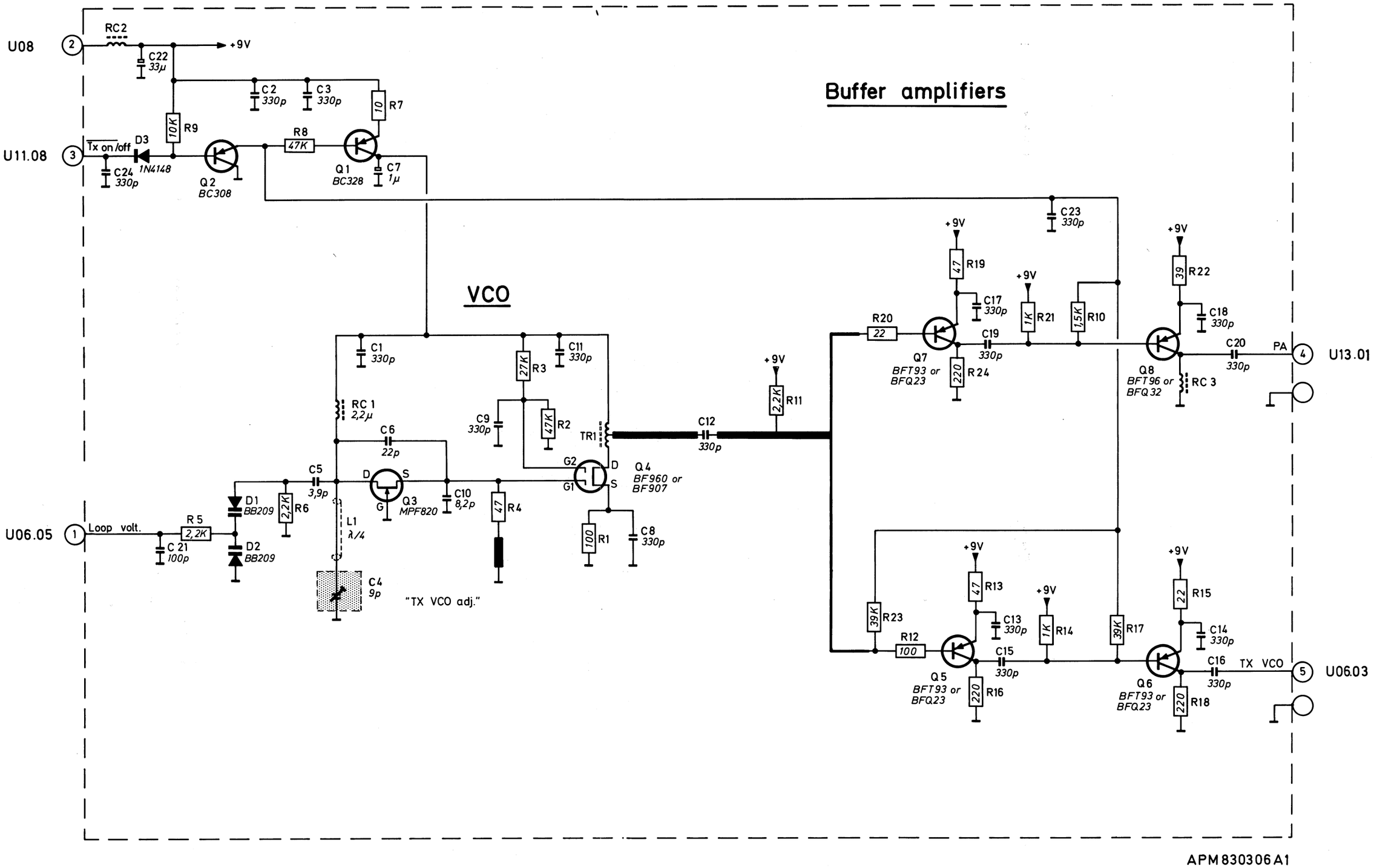


Fig. 7-15 Component location, UHF TX VCO, unit 7



84.02

Fig. 7-16 Circuit diagram, UHF TX VCO, unit 7

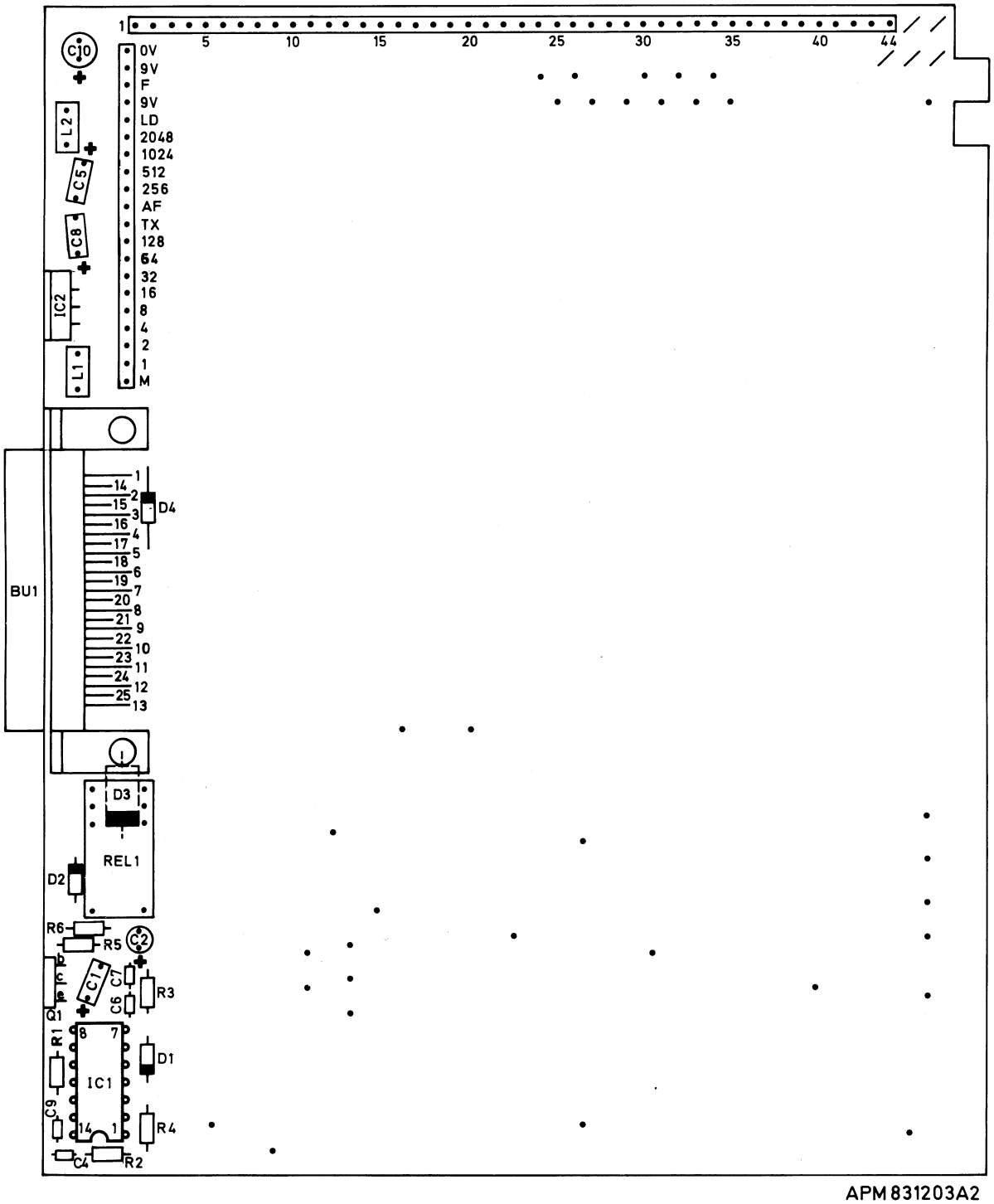


Fig. 7-17 Component location, mother board, unit 8

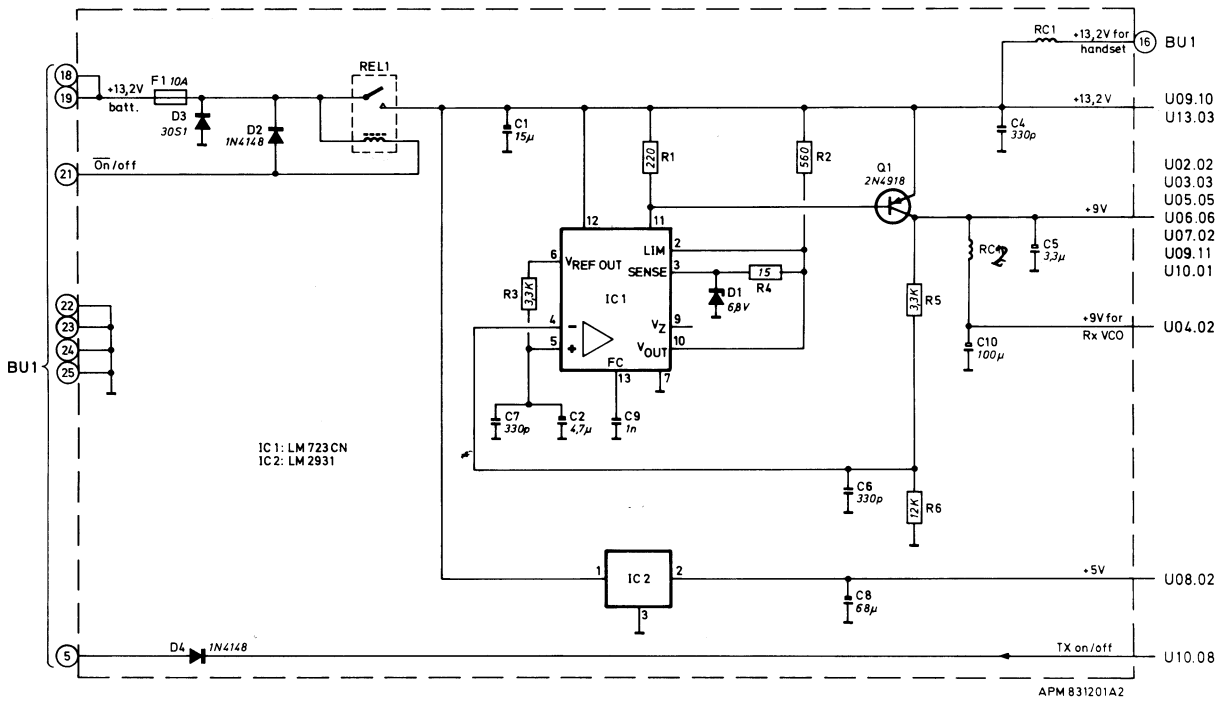


Fig. 7-18 Circuit diagram, mother board, unit 8

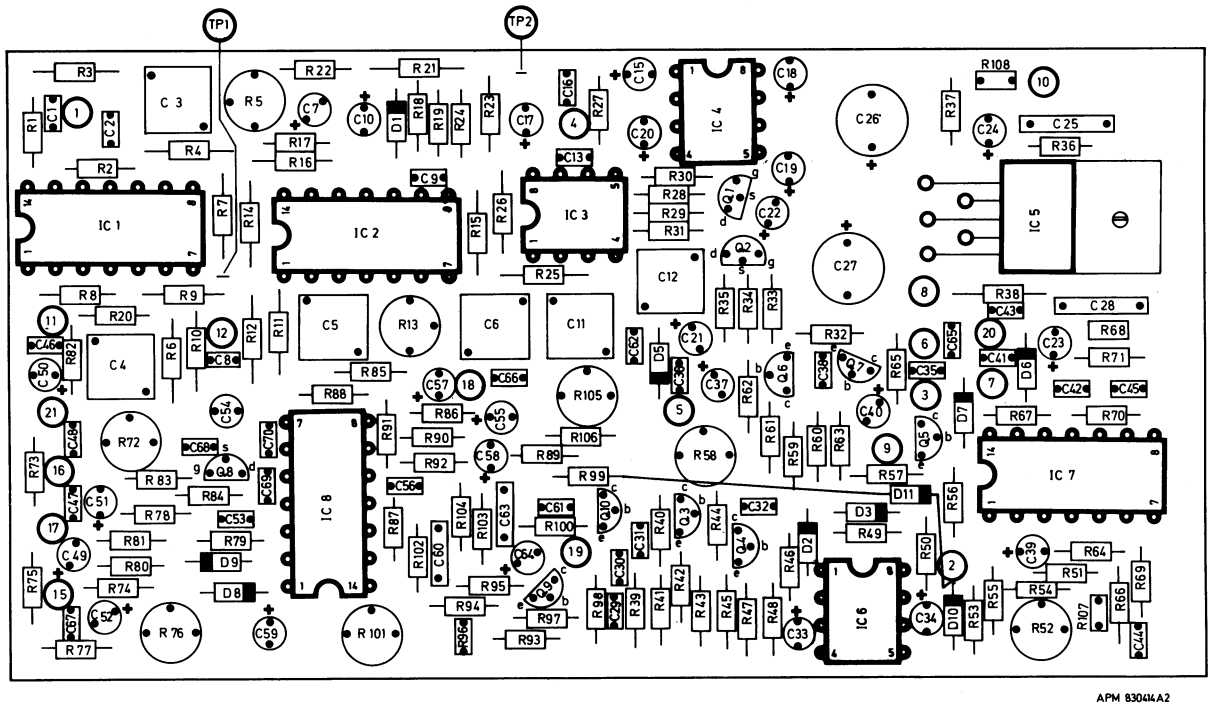
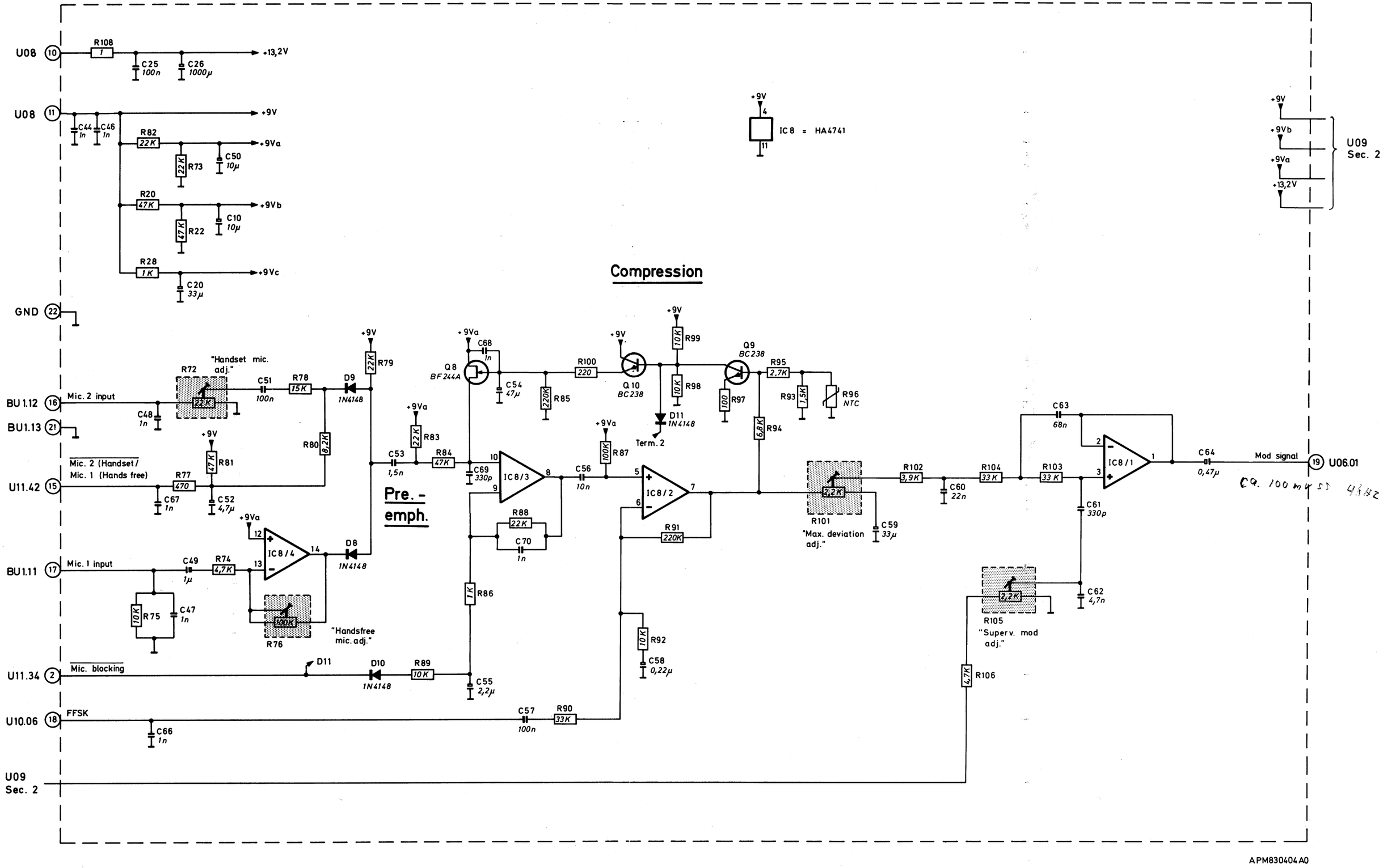


Fig. 7-19 Component location, AF and modulation amplifier, unit 9 sect. 1

84.02



84.02

Fig. 7-20 Circuit diagram, AF and modulation amplifier, unit 9 sect. 1

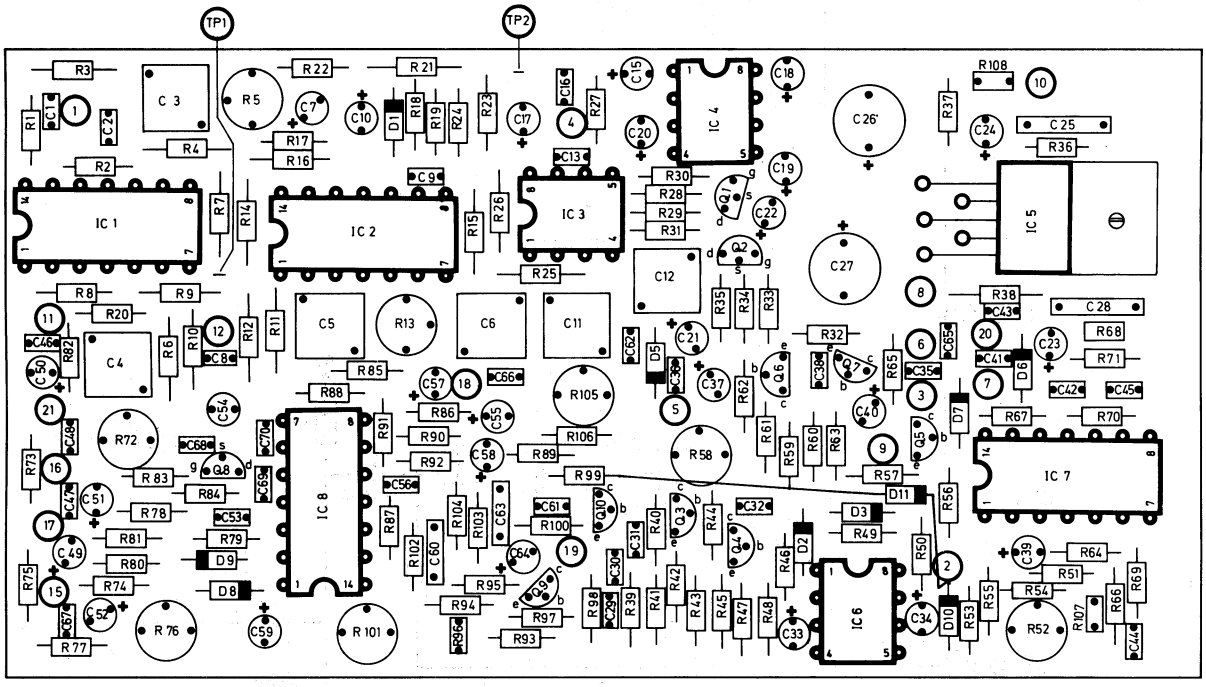
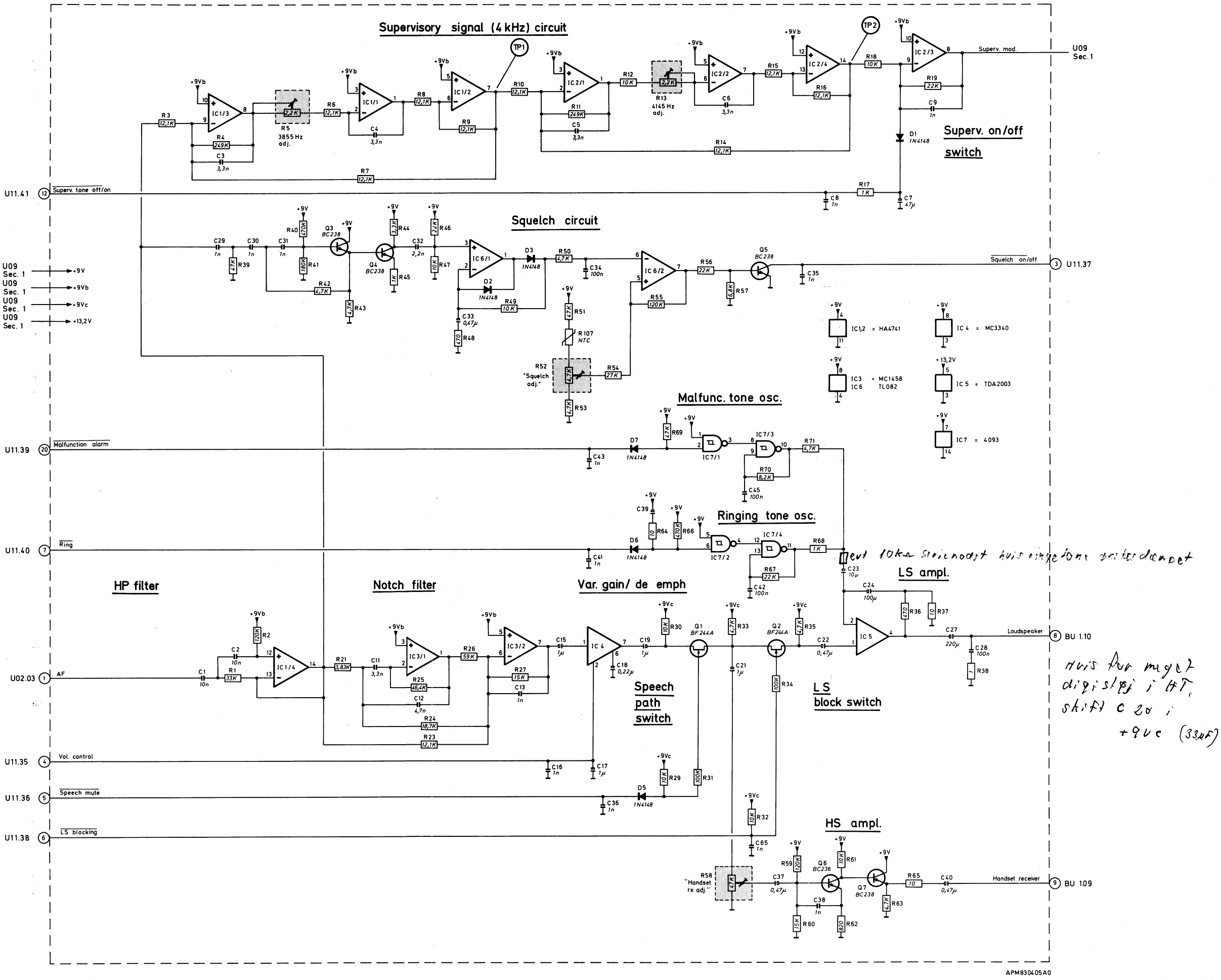


Fig. 7-21 Component location, AF and modulation amplifier, unit 9 sect. 2



84.02

Fig. 7-22 Circuit diagram, AF and modulation amplifier, unit 9 sect. 2

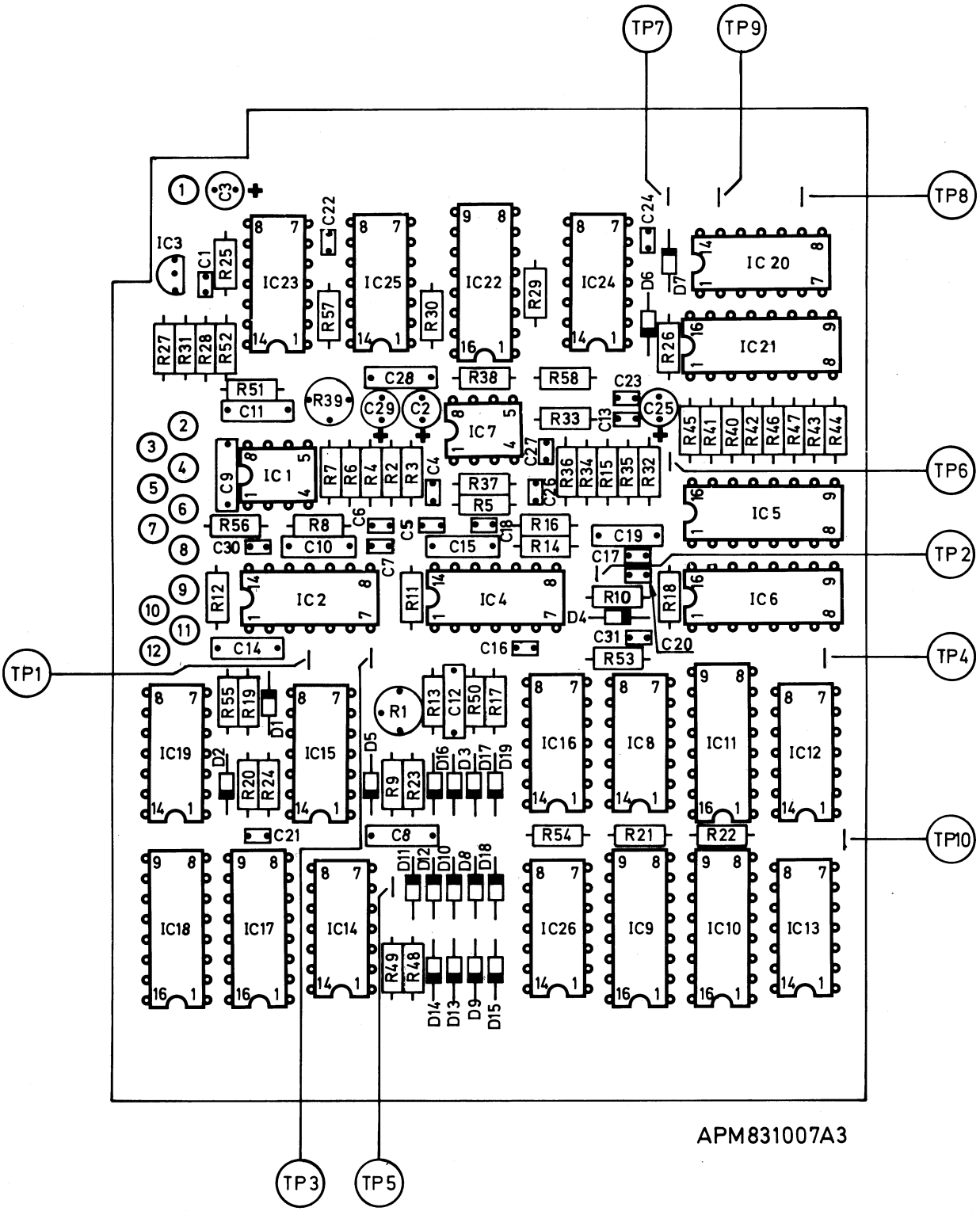


Fig. 7-23 Component location, modem, unit 10 sect. 1

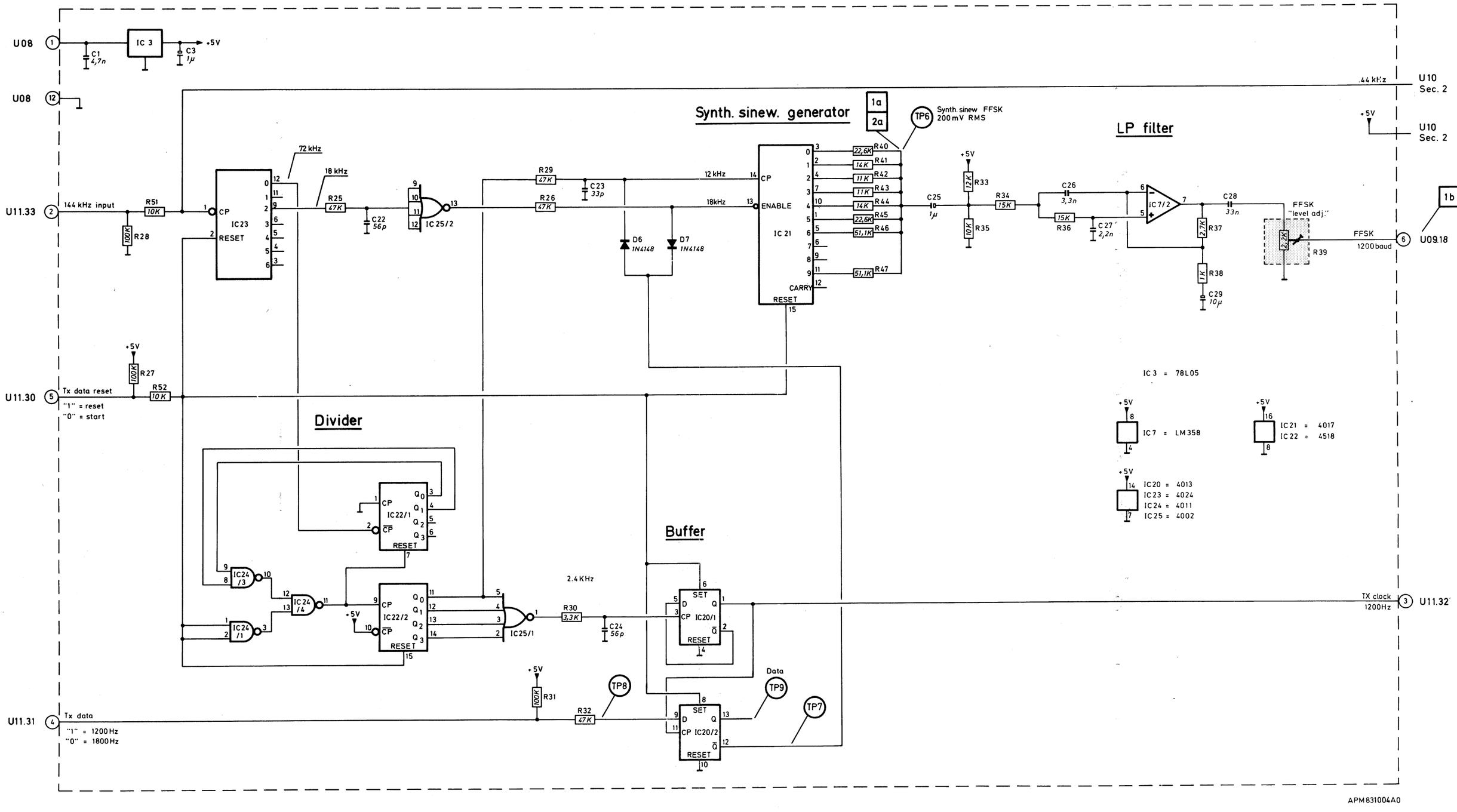


Fig. 7-24 Circuit diagram, modem, unit 10 sect. 1

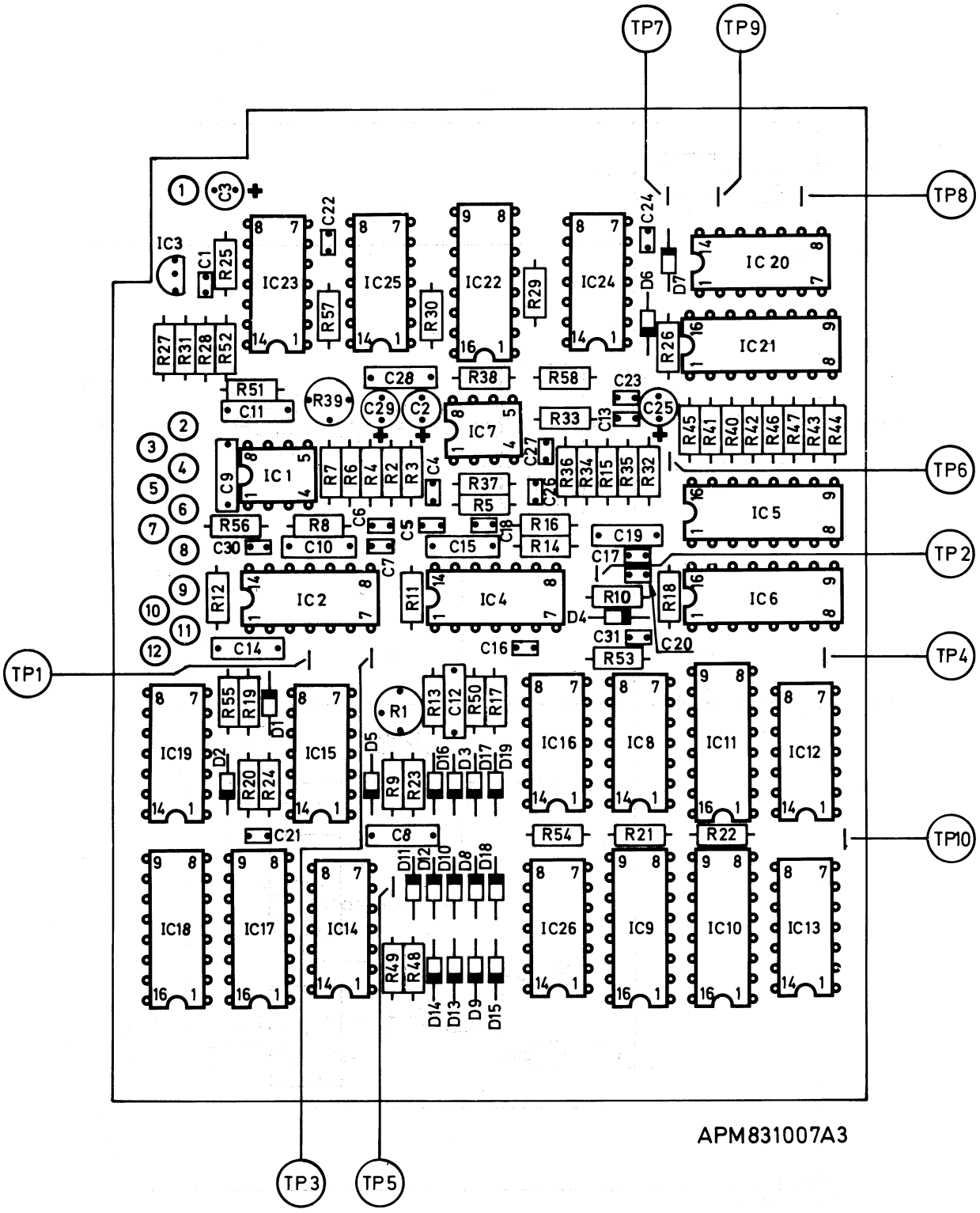


Fig. 7-25 Component location, modem, unit 10 sect. 2

BP-filter

Demodulator

Convolutional decoder

Clock regenerator

Frame sync. detector

End of frame detector

U02.03 (8) AF

U10 Sec. 1 → +5V

U10 Sec. 1 144 kHz

U11.29 (7) Modem. reset

Rx data 600 baud (10) U11.27

Rx clock 600 Hz (9) U11.28

RX data present (11) U11.26

Low when no error correction.

"Demod adj."

Clock Reg. 1200Hz

Normal 12KHz

Data.

End of frame

4 x 1N4148

6 x 1N4148

IC 1	=	LM358
IC 2	=	XR2211
IC 4, 19	=	4030
IC 8, 15, 16, 26	=	4013
IC 12	=	4068
IC 13	=	4078
IC 14	=	4093
IC 5	=	4017
IC 6	=	4526
IC 9	=	4520
IC 10, 11, 17, 18	=	4015

APM831003A0

Fig. 7-26 Circuit diagram, modem, unit 10 sect. 2

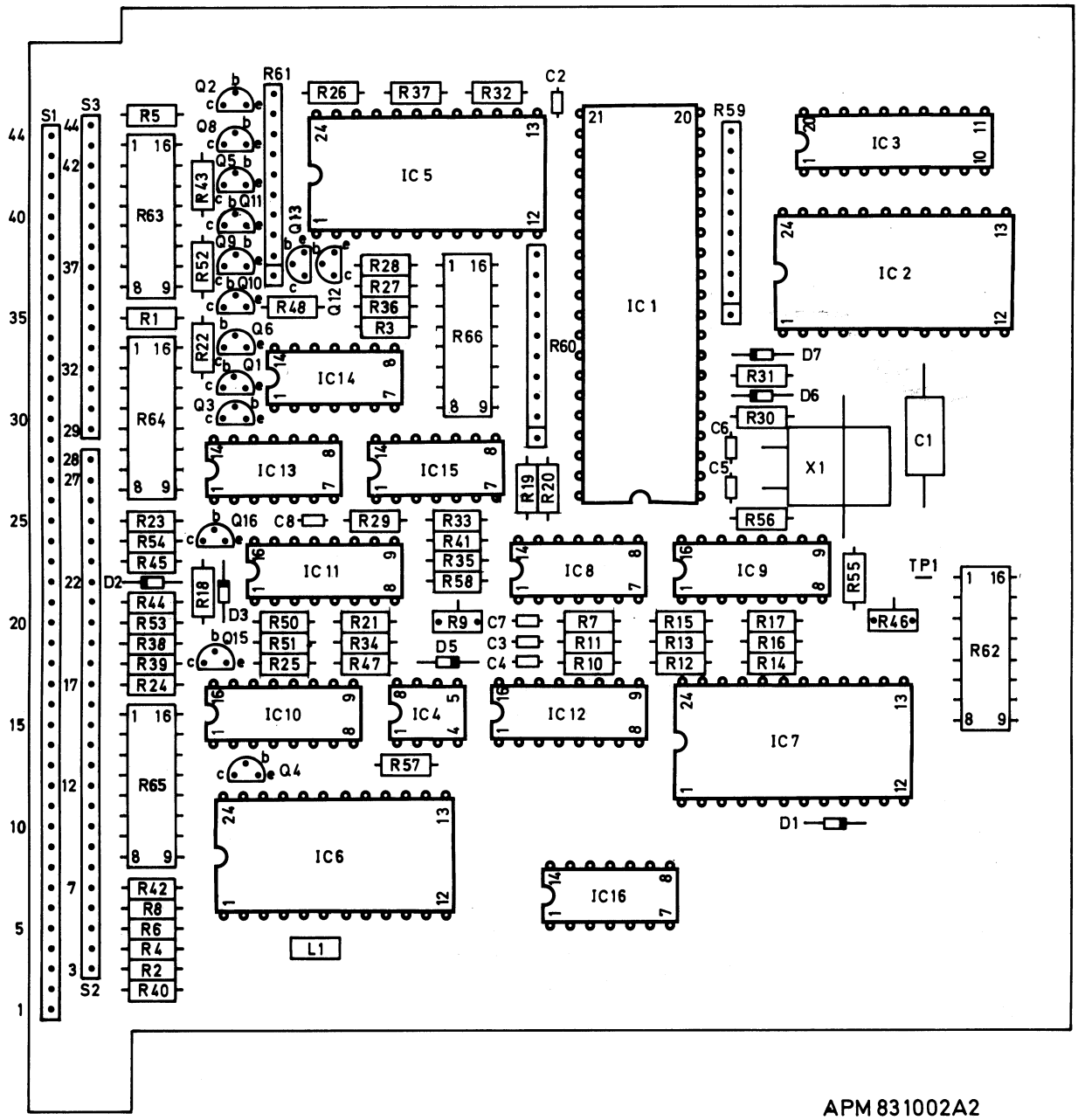
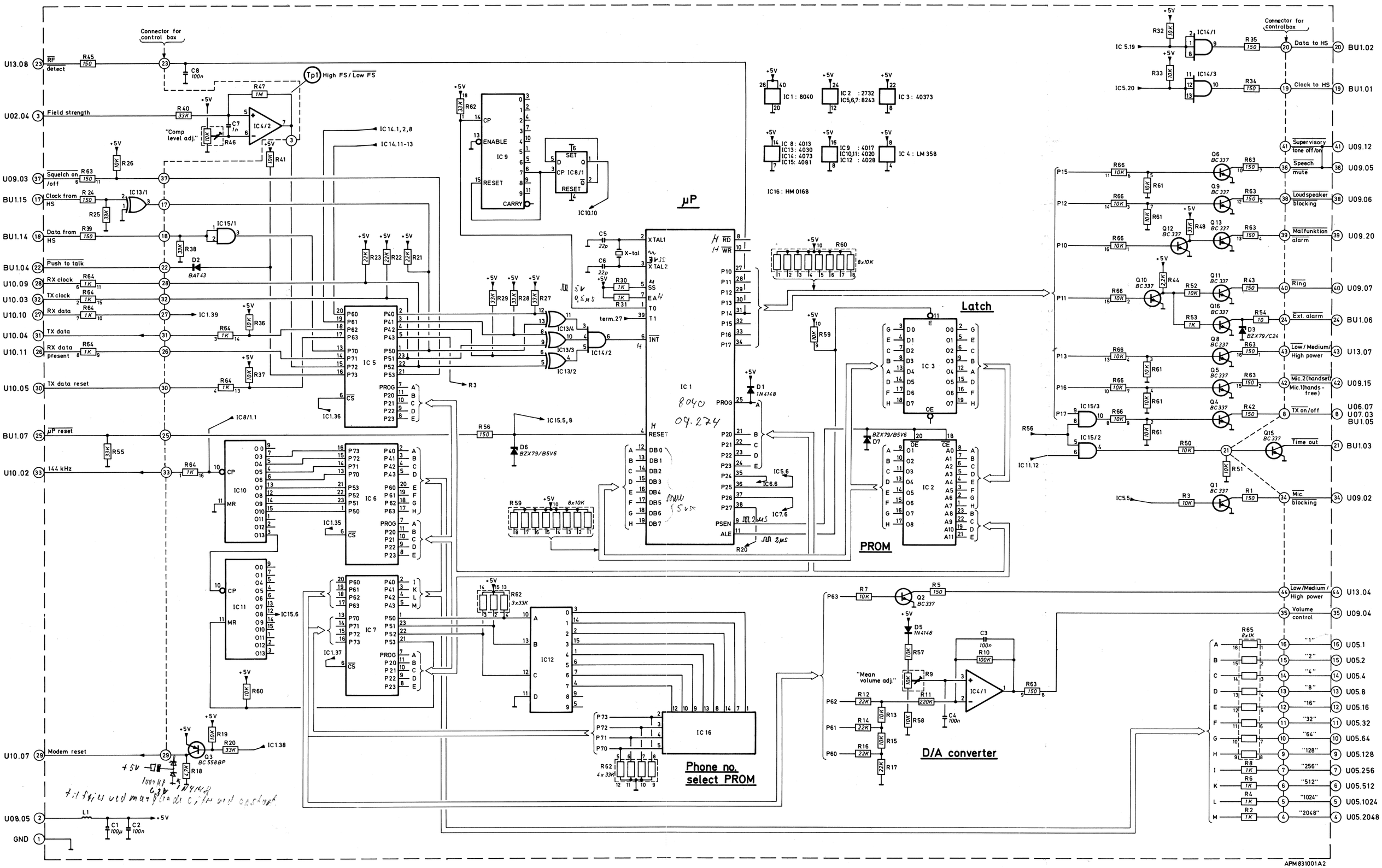


Fig. 7-27 Component location, CPU, unit 11



84.02

Fig. 7-28 Circuit diagram, unit 11

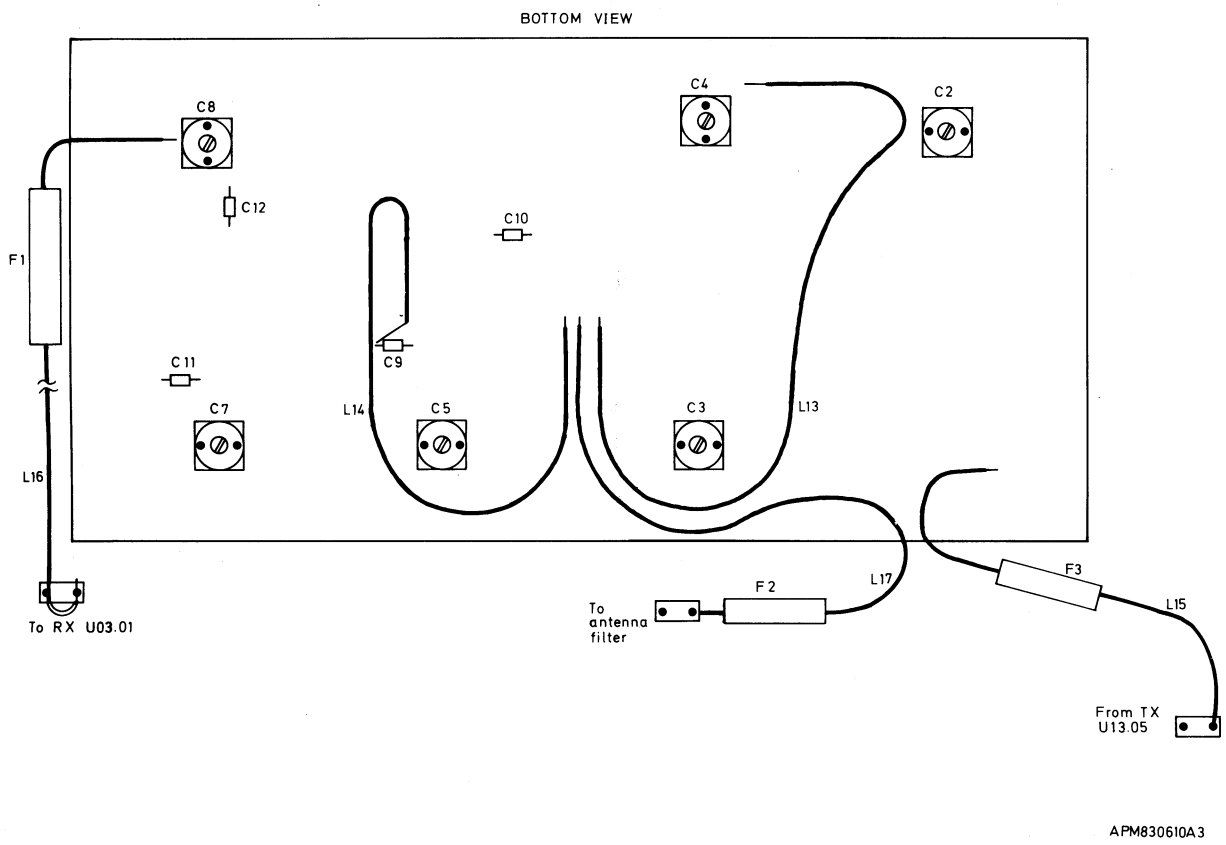


Fig. 7-29 Component location, duplex filter, unit 12

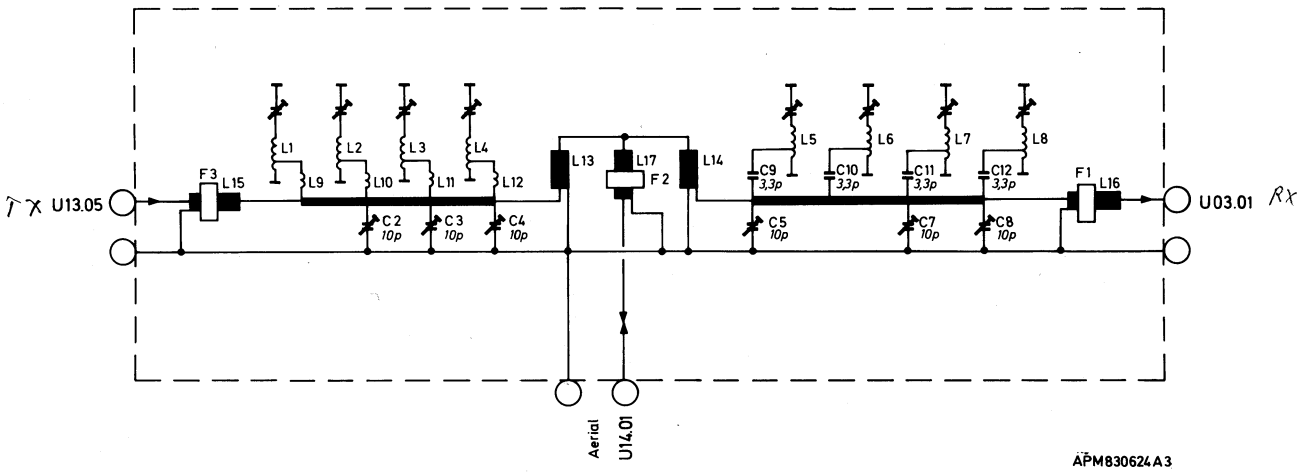


Fig. 7-30 Circuit diagram, duplex filter, unit 12

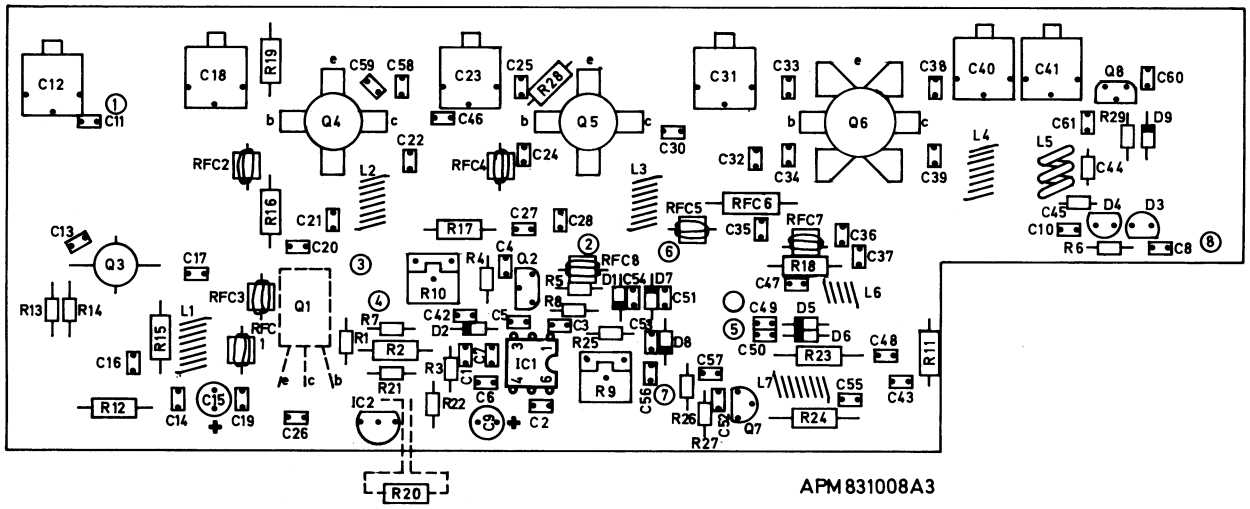
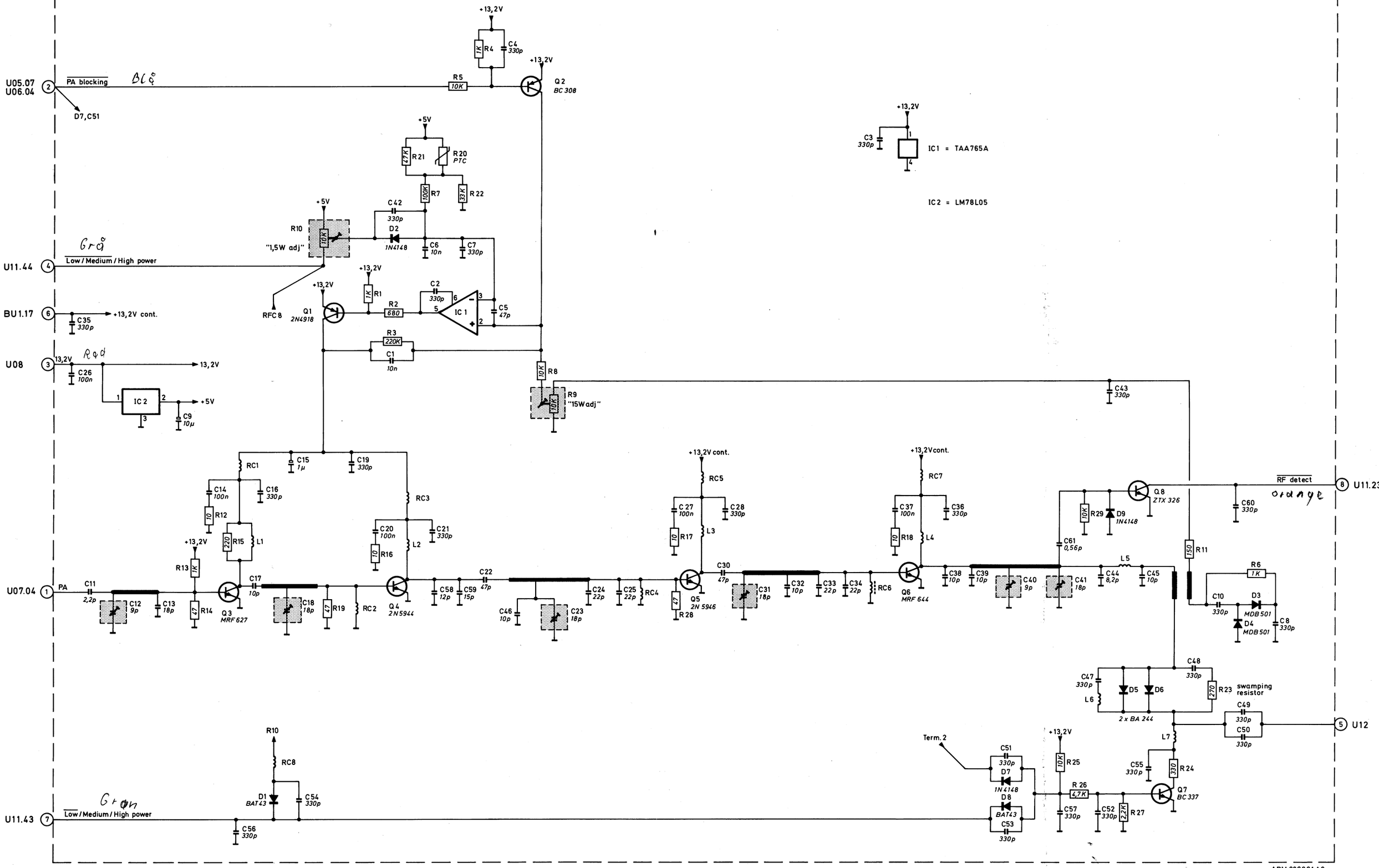


Fig. 7-31 Component location, PA and power control, unit 13



84.02

Fig. 7-32 Circuit diagram, PA and power control, unit 13

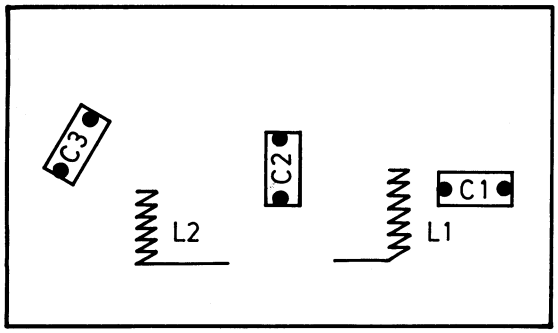


Fig. 7-33 Component location, antenna filter, unit 14

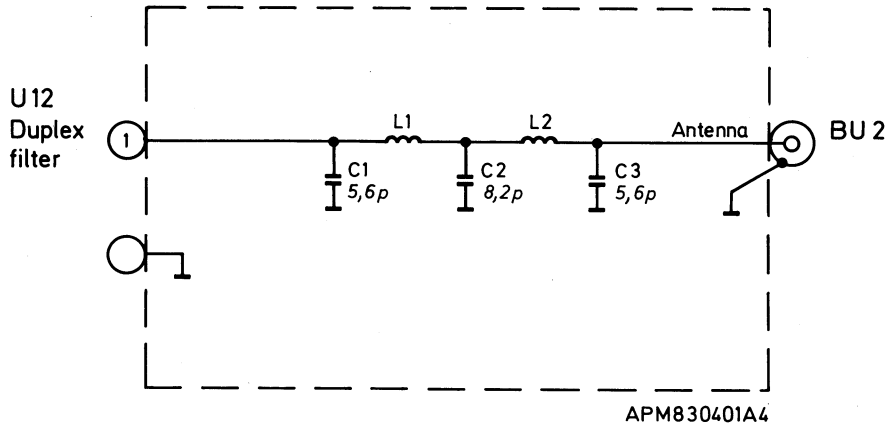


Fig. 7-34 Circuit diagram, antenna filter, unit 14

8. Description of the handset and cradle

Handset

The handset contains a microphone and receiver as well as a control part with keyboard and display. It also contains a reed switch which is operated by a permanent magnet in the cradle. Thereby "off hook" is detected.
The handset is built up with a main unit U16 and a keyboard/display unit U17.
The control part in U16 is provided with a microprocessor. The RAM IC11 stores among other things short nos. These are also kept when disconnecting the handset or power off, thanks to a back-up battery.
The microprocessor IC3 communicates with the CPU in the radio, the keyboard and with the display. This communication is done with the ports P10-P27 either directly or via the expander IC14. Some ports are devoted entirely to a specific purpose while others have a double function.

Power on/off circuit

The power on/off circuit consists of a power relay in the radio unit and control circuits in the handset.
One terminal of the relay coil is connected to the battery voltage while the other terminal is grounded in the handset during power on. This takes place in Q17 during the initial moment but is then taken over by Q18 in order to save power. Q18 is provided with an emitter resistor.
Q18 is directly controlled by IC9/1.
When the power is off and the ⏻-button is pressed IC9/2.13 goes high and IC9/2.12 goes low.
IC9/2.12 makes via IC7/1 and IC6/6 the transistor Q17 conducting.
This energizes the relay in the radio.
Q18 is also conducting as IC9/2.13 is high. When the switched +12V voltage is built up, Q17 is switched off by a high level at IC7/1.1.

Power off can be initialized by several conditions:
1) By the uP IC3.31.
2) If the supply voltage is below 6.2V.
3) If the supply voltage is above 16V.
4) If the temperature is above approx. $85^{0}C$.
5) System failure. Time out.

Pressing the ⏻-button in order to switch the power off is only a request which must be accepted by the uP.
Thereby a pressing of the ⏻-button during conversation (handset mode) or during BS-MS data exchange is ignored. In handsfree mode, a clearing message is sent before the pressing of the ⏻-button is accepted.
The voltage at the R60/61 connection is pulled low by conditions 1)3)4)5) and thus switching the power off. The condition 2) brings via C27 the power off.

Keyboard and display

The keyboard and display are via the expander IC14 communicating with the uP.
Repair of unit 17 is not considered practical, i.e. in case of failure the complete keyboard/display unit is replaced. However, replacement of the illumination lamps is possible.

Ignition switch

A 10 hour software timer prevents discharging of the car battery by the mobile telephone when being left with the power on. Terminal J shall be 12V when the key is turned. When the key is removed, the mobile telephone is switched off when 10 hours have elapsed.
If the mobile telephone is used during this period the timer starts again.

Illumination switch & LED dimmer

The illumination switch IC4/2 turns the illumination lamps on when there is not enough ambient light. The ambient light is detected by the photo transistor Q1 and converted to a proportional voltage at IC4/1.1. This voltage controls via Q5-9 the current through the LED's D1-4. In addition the voltage is fed to the illumination switch IC4/2 which is a comparator. When a certain darkness is reached (determined mainly by R22,23), the illumination lamps are turned on. The transistors Q2,3 form a constant current regulator which together with the zener diode D2 holds the voltage across the lamps constant.
When the illumination lamps are on, they can be switched off by pressing the ⑦⓪-button three times. This gives a low level at IC3.29. Pressing the ⑦⓪-button again three times, switches the lamps on.

Reset

When switching on the radio the microprocessor is being reset (IC3.4) by a delayed (about 100ms) positive voltage coming from D9-Q12-Q13-IC6/3-IC6/1.

Even a very short drop in supply voltage will reset both the handset processor IC3 and via IC6/2 the main microprocessor in the radio.

RAM protection

To prevent nonsense from the CPU to enter the RAM, during the switching ON/OFF process, the Q15 and Q16 are formed as a switchable buffer. If the "12V switched" becomes low, the reset voltage goes low and thereby cutting off the current in Q15 and Q16.

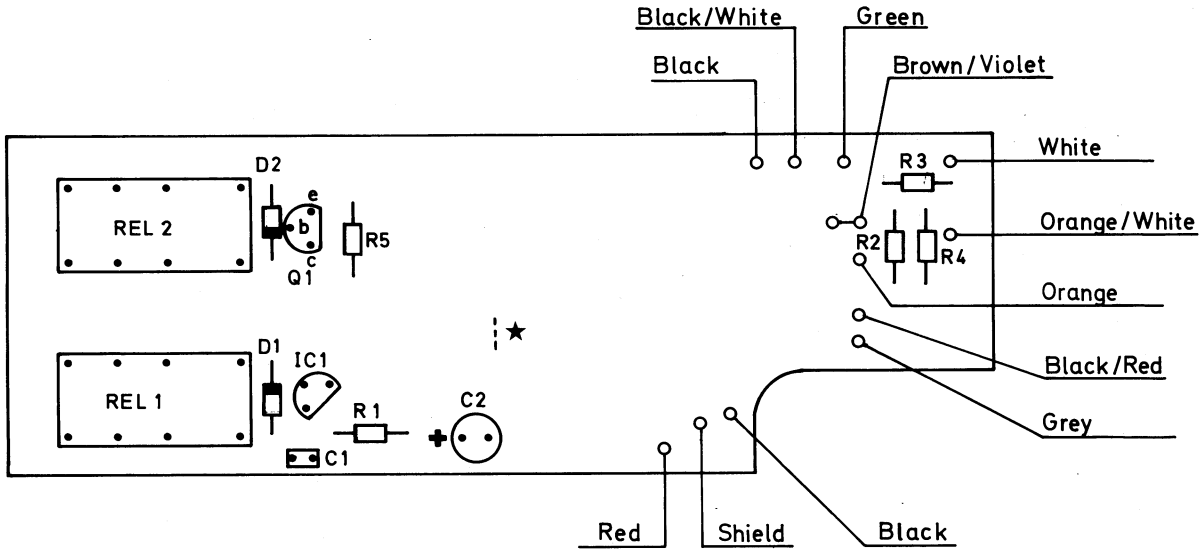
Touch-tone

Each time a push-button is pressed an accoustic signal is heard from the speaker. The uP IC3 gives a short burst of pulses (1200Hz) on IC3.33 which is amplified by Q11 and IC5.

Cradle U15

The cradle serves the following purposes:

1) Holds the handset when not in use.
2) Provides connection of handset, loudspeaker, handsfree microphone, push to talk switch, music muting, external alarm and ignition switch.
3) Contains relays for the music muting and external alarm. The relays (and associated components) are mounted when these features are requested.



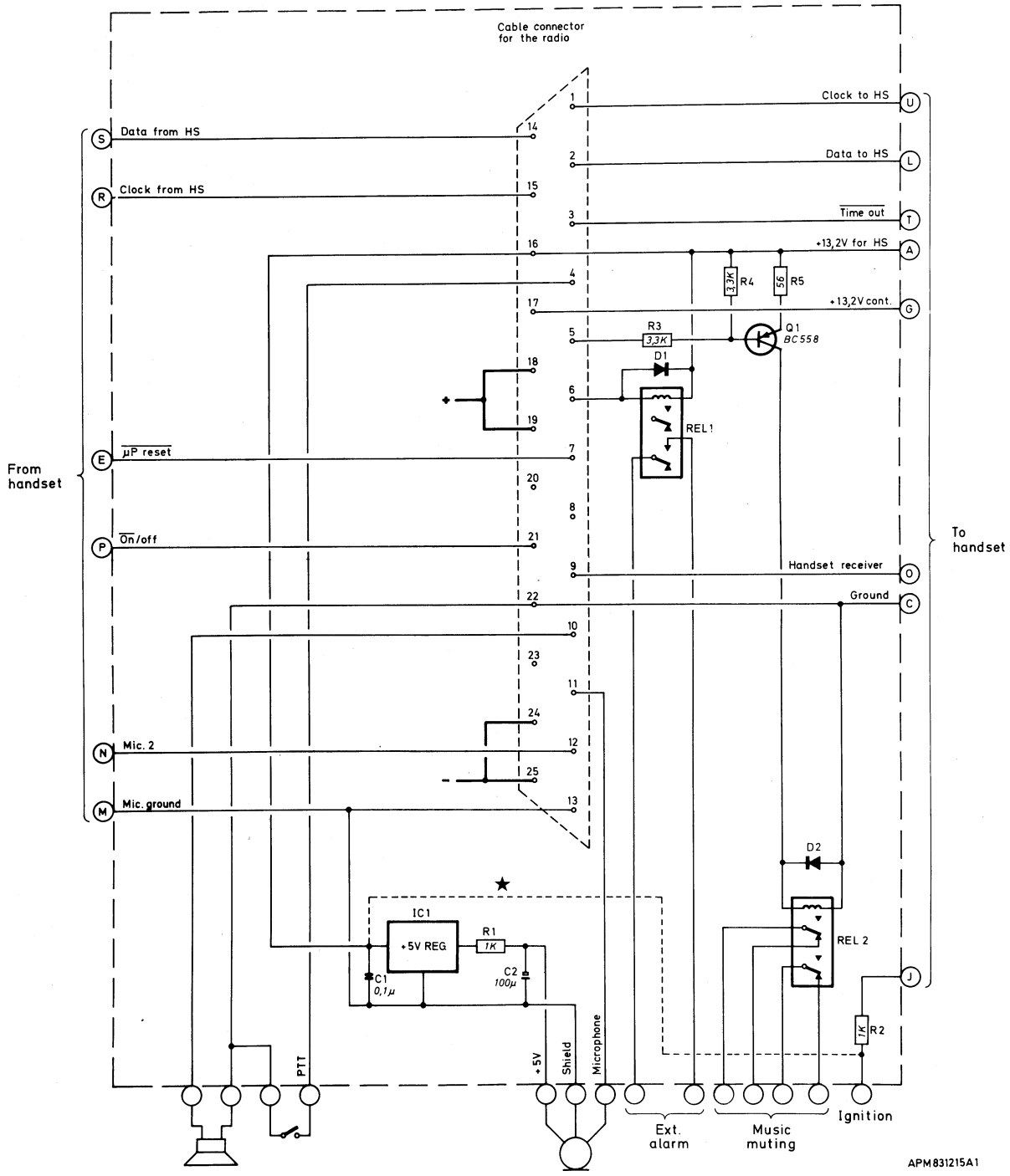
Note 1:

From the factory the cradle is delivered without REL2, D2, Q1, R3 and R4. These components must be mounted for the music muting feature.

Note 2:

When the 10h timer feature (ignition switch) is wanted, break the strap ★ .

Fig. 8-1 Component location, cradle, unit 15



3739

★ See the notes for the fig. 8-1.

Fig. 8-2 Circuit diagram, cradle, unit 15

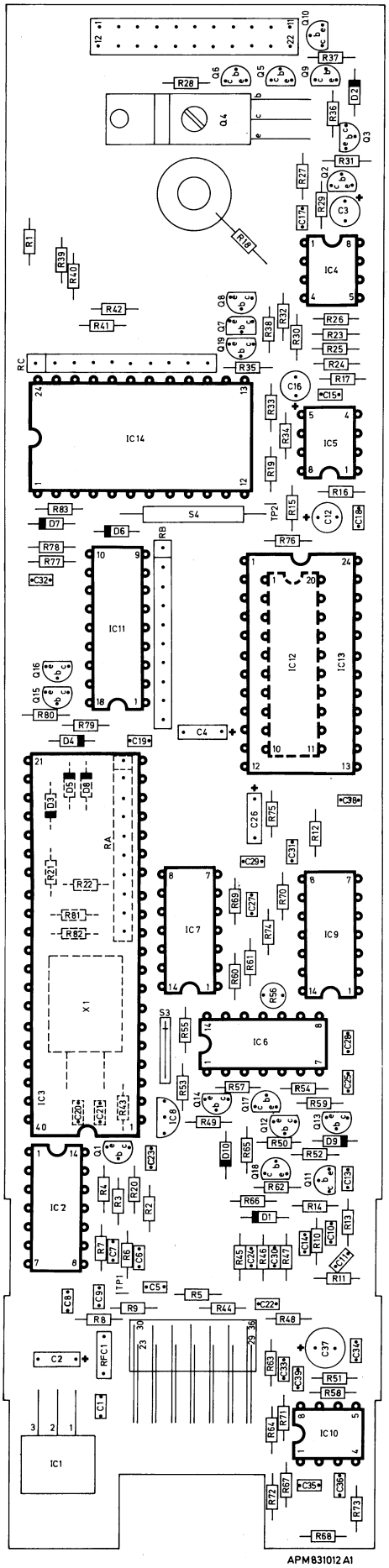


Fig. 8-3 Component location, handset, unit 16 N 5981

84.02

Fig. 8-4 Circuit diagram, handset, unit 16, unit 17

9. Disassembling and wiring diagram

A. Disassembling of the radio unit

1. Removing the cover

- Remove the screws (A) and remove the cover.

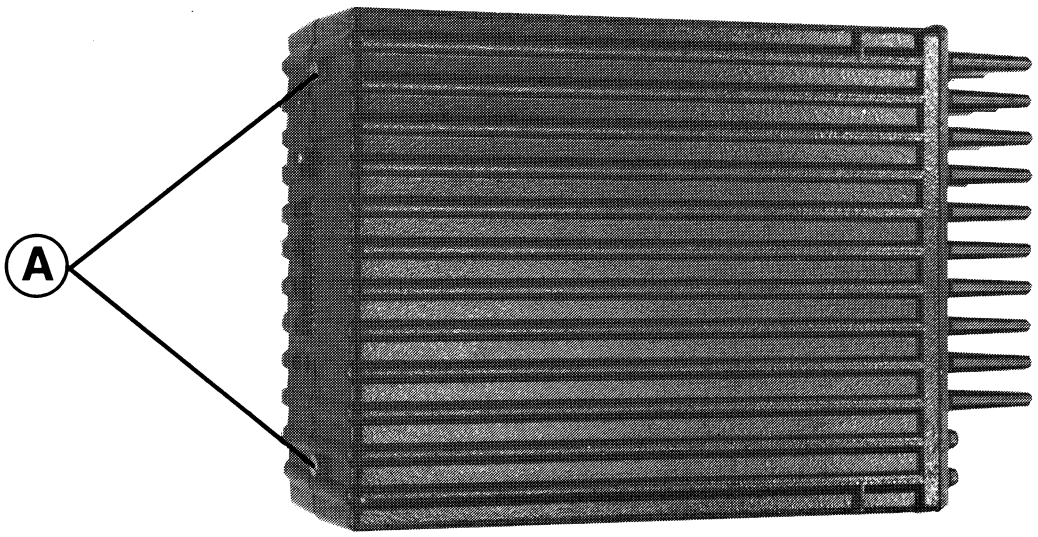


Fig. 9-1

2. Access to the units, RF side

Each unit is provided with a metal lid.
After removal of the lid the component side of the unit in question is accessible.

3. Replacement of the units, RF side

The units are provided with connector sockets for direct plug in connection to the motherboard U1.
Each unit can be removed after removal of 4 screws (A).
Note 1: Before removing U7 and U3, remove the lid and the coaxial cables.
Note 2: Before mounting a unit, observe the location of the connector pins in order to turn the unit properly.

4. Removing the PA U13

- Remove the lid (J) (see fig. 9-5) by lifting slighly at the edge (J) and, sliding the lid towards the heat sink. Now the lid can be removed.
- Remove the screws (B) .
- Now the PA can be pulled free for access to the component side.
- Remove the two nuts on the heat sink (between the cooling flanges).
- Unsolder the various cables.
- Remove the screws (D) .

5. Removing the antenna filter U14

- Remove the lid (E) .
- Remove the three screws inside the screened compartment.
- Unsolder the coaxial cable.
- Unsolder the antenna connector.

6. Removing the motherboard U1

- Remove the two metal bars by removing the screws (F) . Now U1 can be pulled out.
  Note: When mounting U1, observe that the interconnection U1-U8 is made without damage.

7. Removing the CPU U11

- Remove the screws (G) . Now the unit can be swinged out for access to the component side. For removal of the unit, the hinge (H) must also be removed.
- Unplug the flex strips on motherboard U8.
  Note: When mounting, plug each flex strip into the corresponding sockets with a pair of pliers.

8. Removing the modem U10

- Remove the four screws (K) and pull the string (N) .
  Note: When mounting, observe that the connection with motherboard U1 is made without damage.

9. Removing the AF and modulation amplifier U9

- Remove the distance pieces (L) and the screws (M) .
  Note: When mounting, observe that the connection with motherboard U1 is made without damage.

10. Removing the motherboard U8

- Motherboard U1 must be removed first.
- Unsolder the three wires (R) .
- Unsolder the wire (C) (see fig. 9-2).
- Remove the two metal bars by removing the screws (Q) .
- Remove the two screws (O) for the multiplier connector.
- Remove the two screws (P) . Now U8 can be removed.

11. Removing the duplex filter U12

- Disconnect the coax cables at U13, U3 and U14.
- Remove the screws (S) .

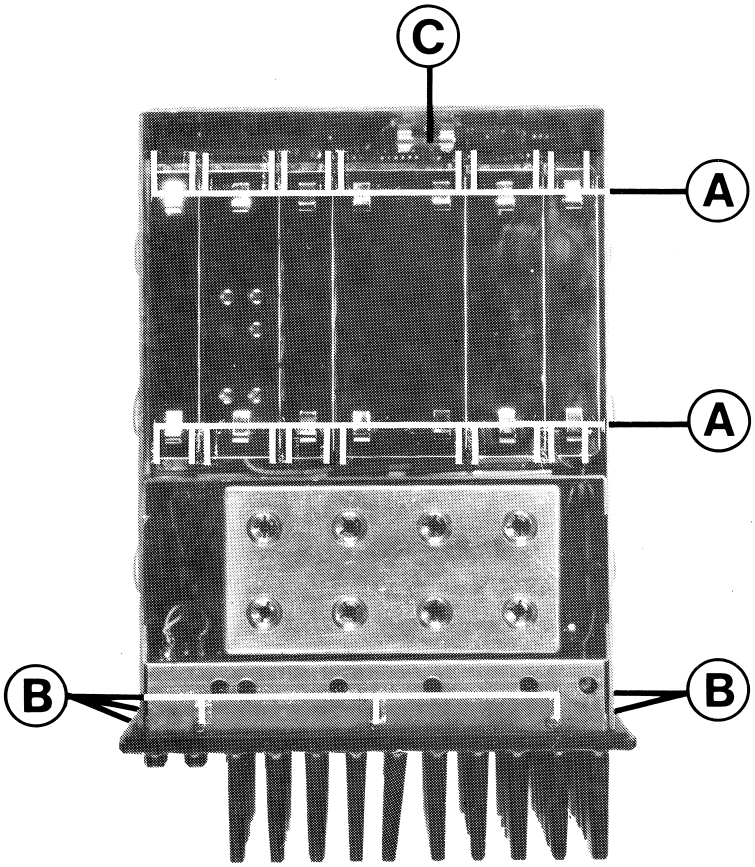


Fig. 9-2

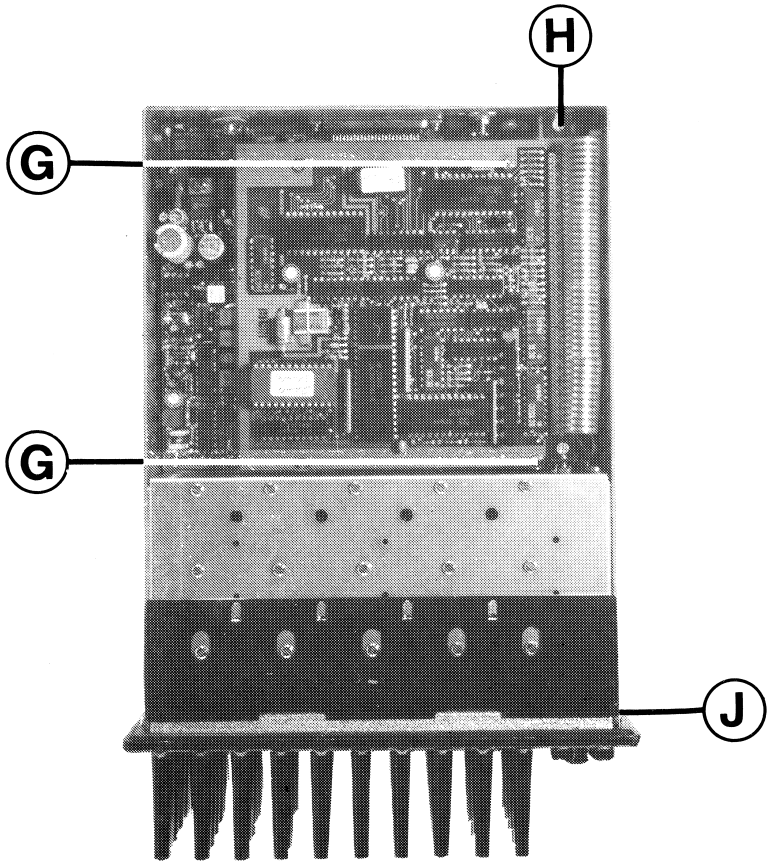


Fig. 9-5

Screens between units

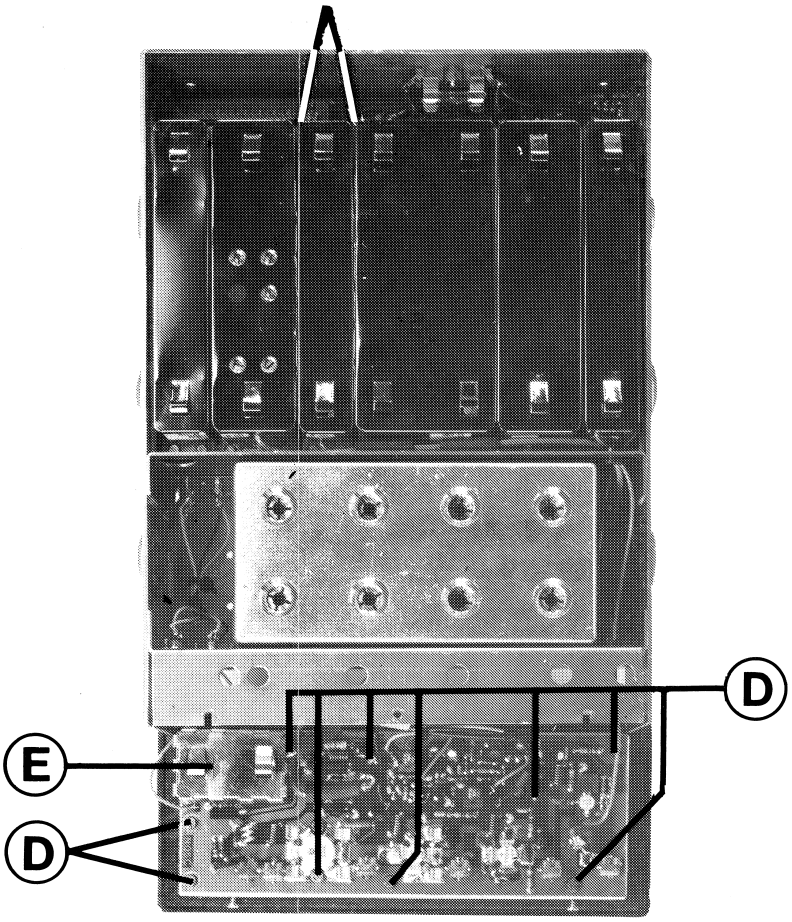


Fig. 9-3

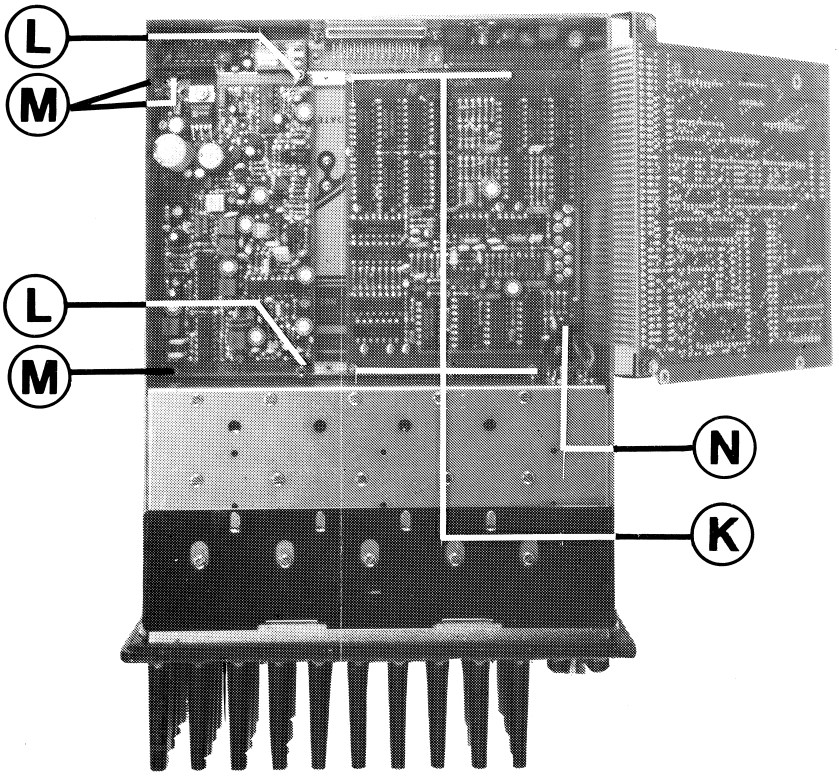


Fig. 9-6

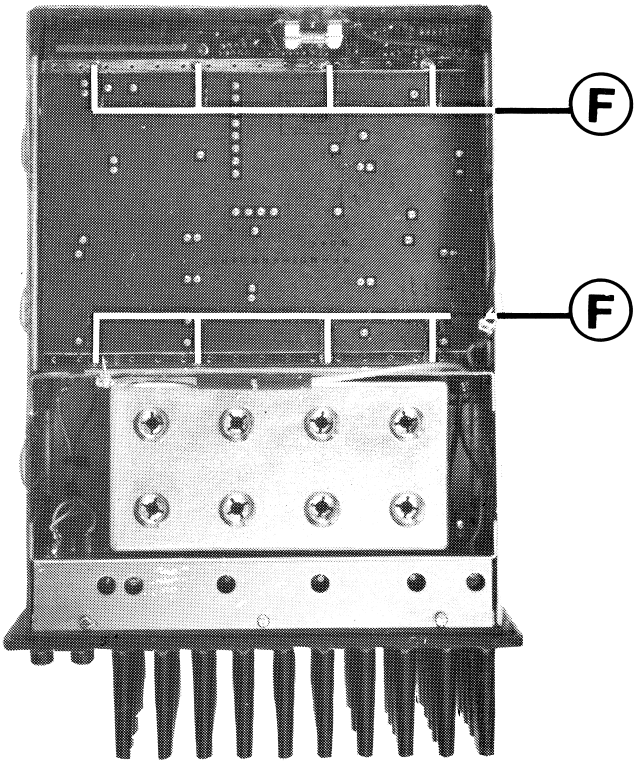


Fig. 9-4

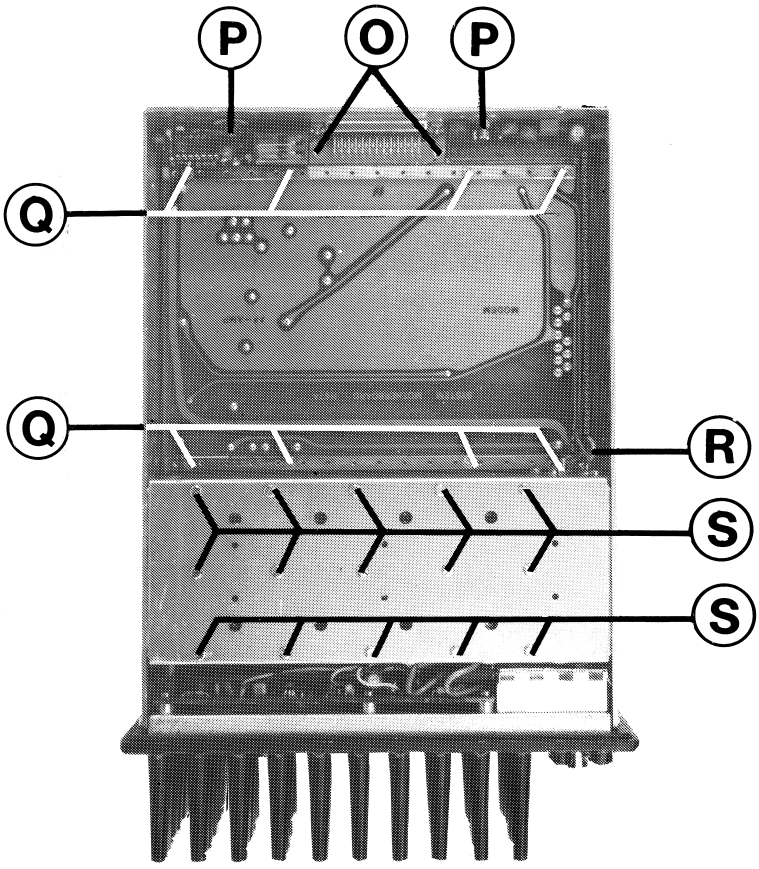


Fig. 9-7

B. Disassembling of the handset

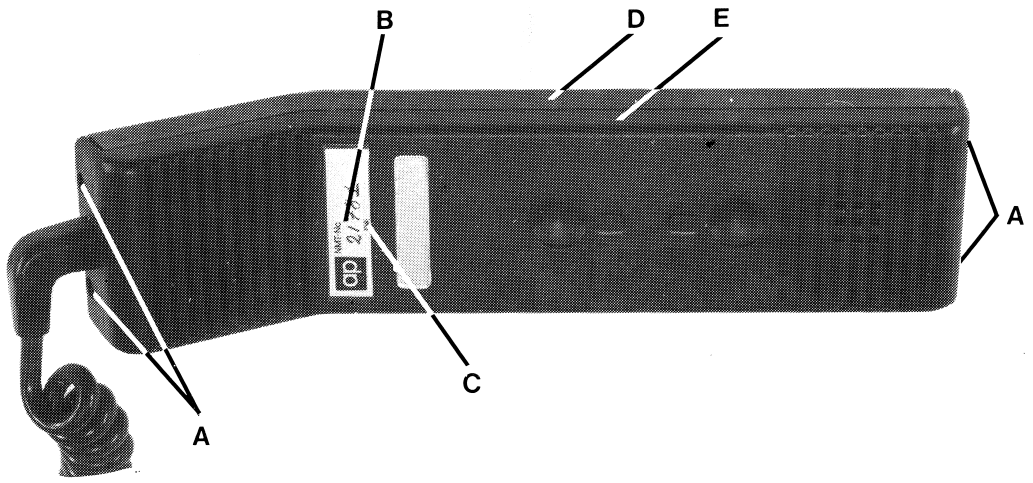


Fig. 9-8

1. Opening the handset

- Remove the four plastic plugs (A) and the screws hidden by these.
- With a pointer (e.g. small screwdriver or pincette) applied at point (B), remove the plastic screwcover.
- Remove the screw (C).
- Separate gently the two halves (D) and (E) (they are interconnected with a plug/socket).

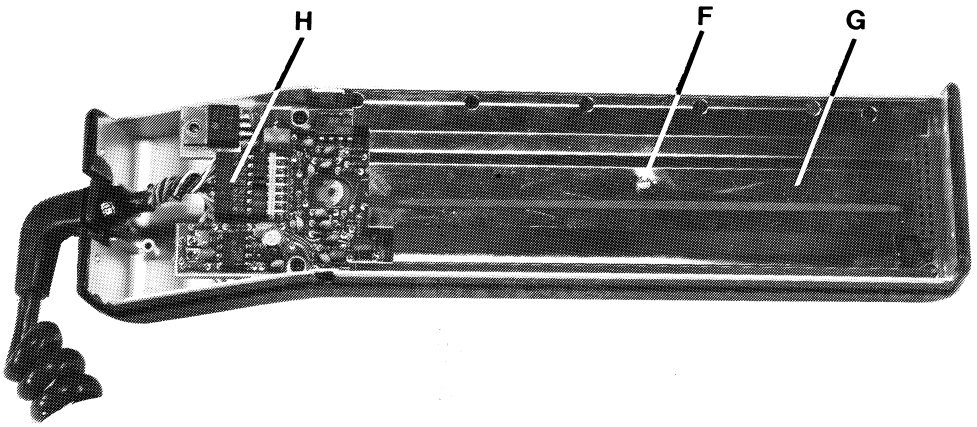


Fig. 9-9

2. Access to and replacement of U16

- Perform step 1.
- Remove the screw (F) .
- Remove gently the metal cover (G) . There is now access to the component side.
- Remove the plug (H) . The multiwire cable can now be removed.
- Unsolder the two wires for the microphone.
- Remove the 8 screws (I) .

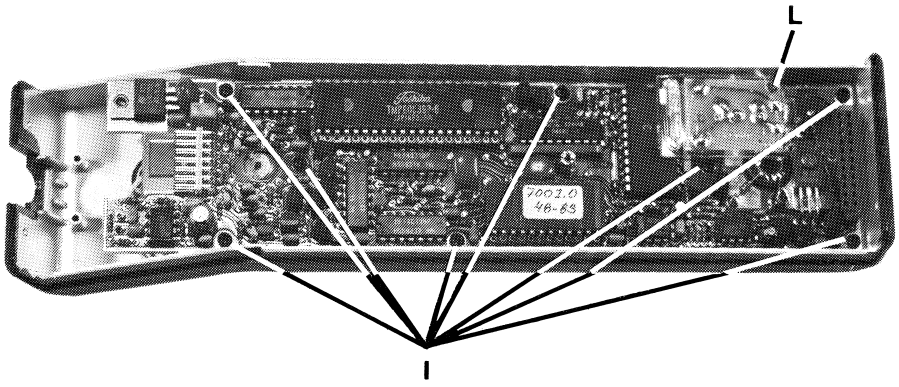


Fig. 9-10

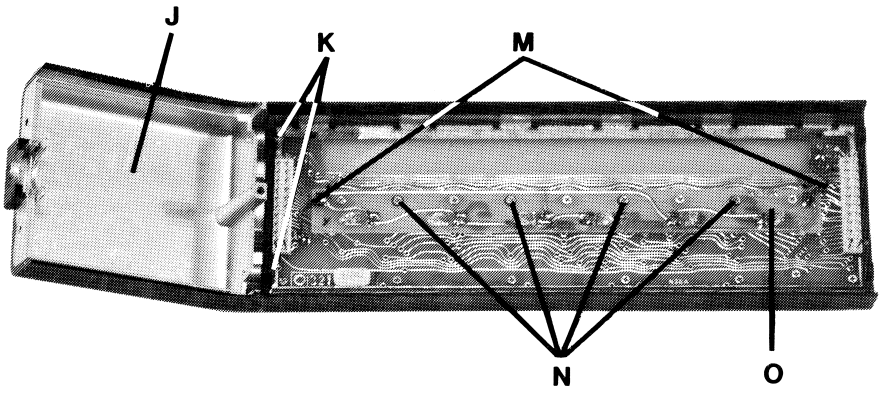


Fig. 9-11

3. Turning the U17 (for left-handed people)

- Perform step 1.
- Remove the two screws (K) . The plastic cover part called (J) , can now be moved to the other end of U17, where holes are fit for the screws (K) .
- Turn the multicable so that it fits with the new position in the holder.

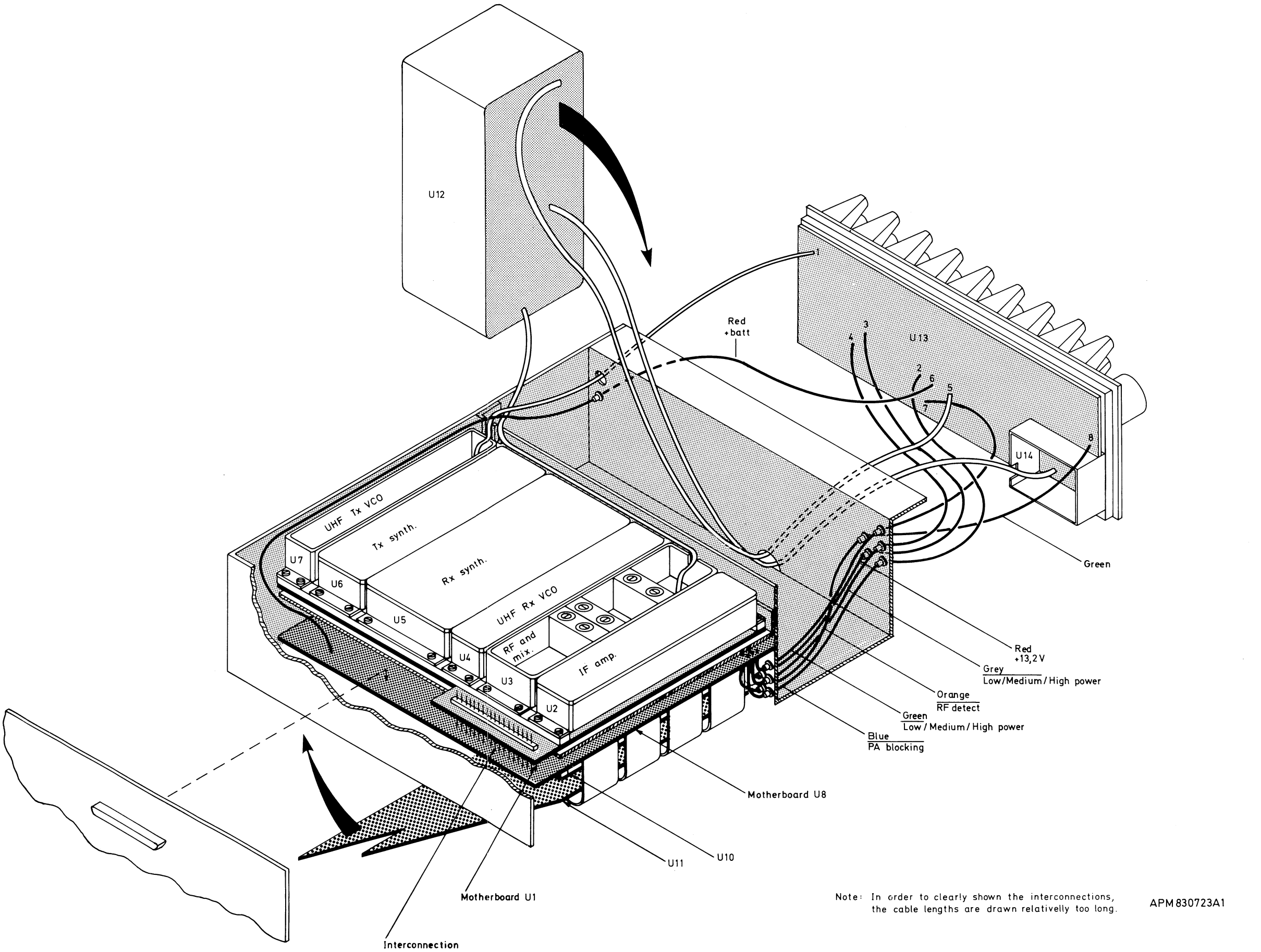
4. Replacement of memory backup battery

- Perform step 1.
- Remove the screw (F) (see fig. 9-9).
- Remove gently the metal cover (G) . There is now access to the component side of U16.
- By removing the screw (L) (see fig. 9-10), the battery can be replaced.

During battery replacement it is recommended to have the handset connected to the radio (or handset test box) with power on. Other-wise all stored numbers and the code lock number must be entered again.

5. Replacement of the illumination lamps

- Perform step 1.
- Unsolder the two wires (M) (see fig. 9-11).
- Remove the screws (N) .
- Lift gently the printboard (O) .



84.02

Fig. 9-12 Wiring survey of the radio unit

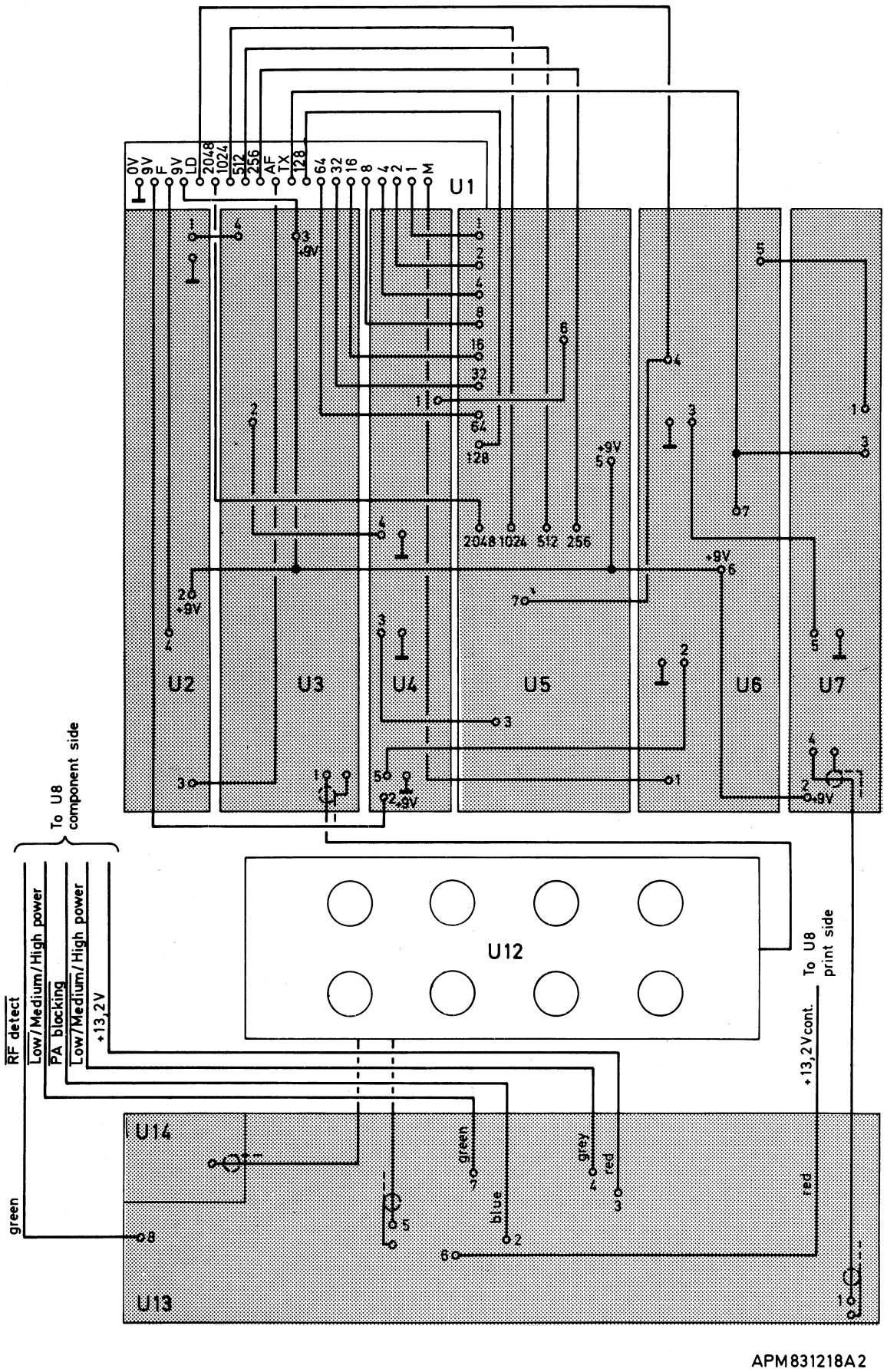


Fig. 9-13 Wiring diagram, radio unit ("RF side")

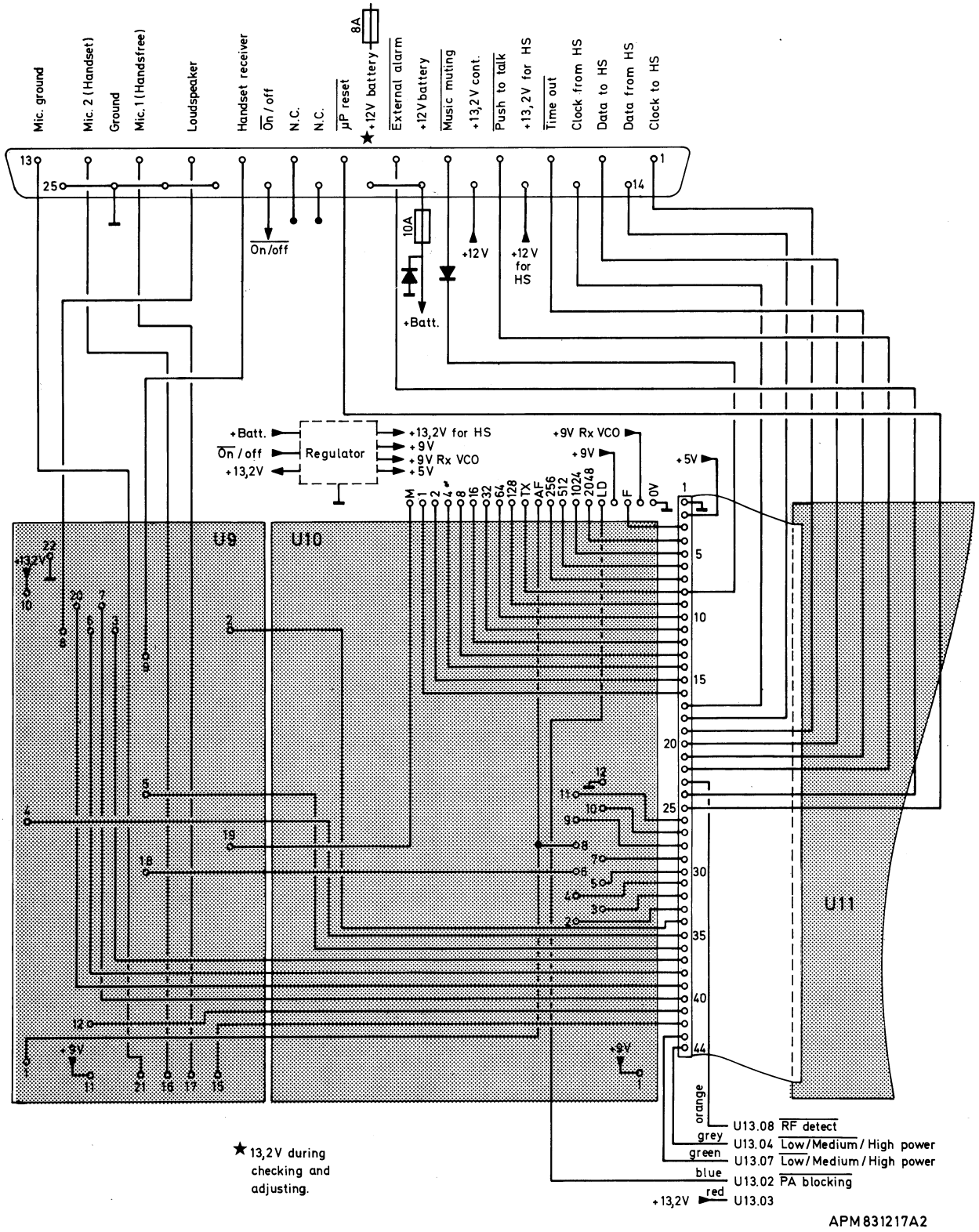
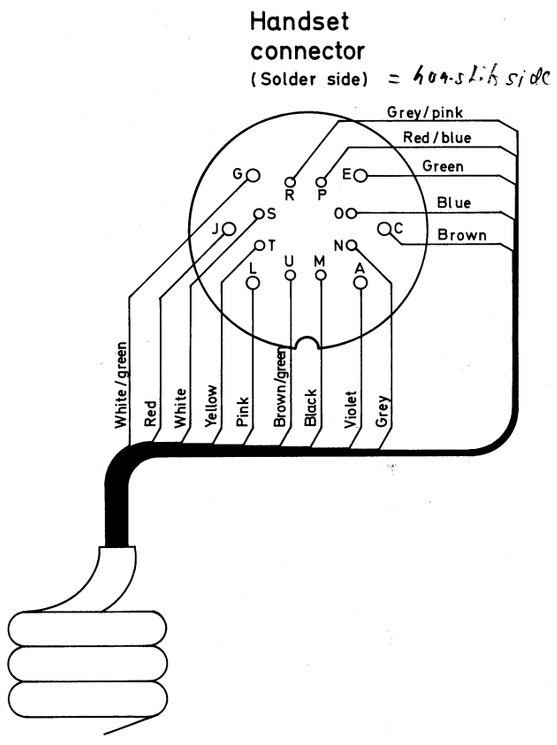
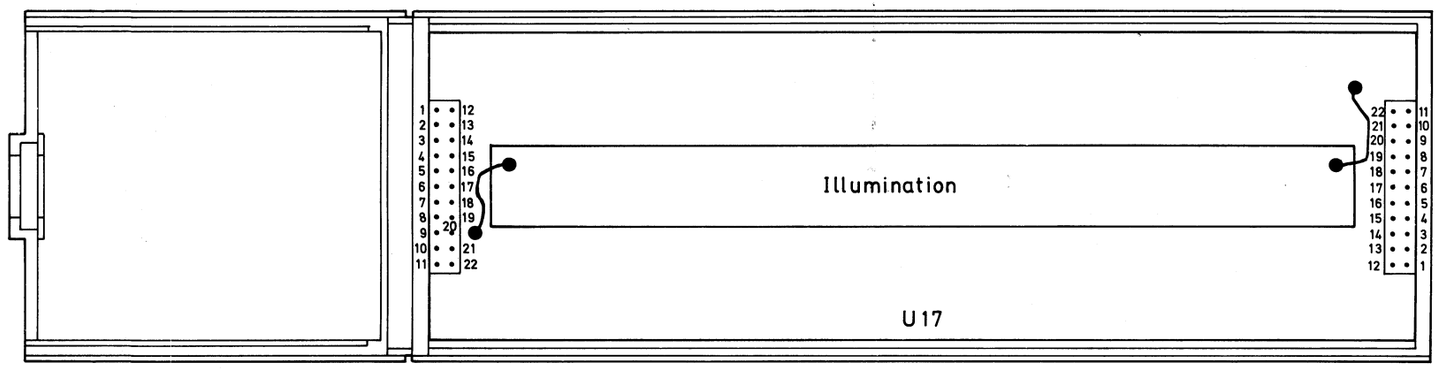
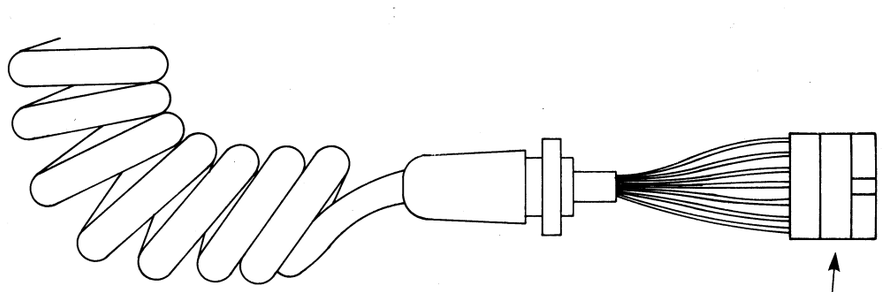
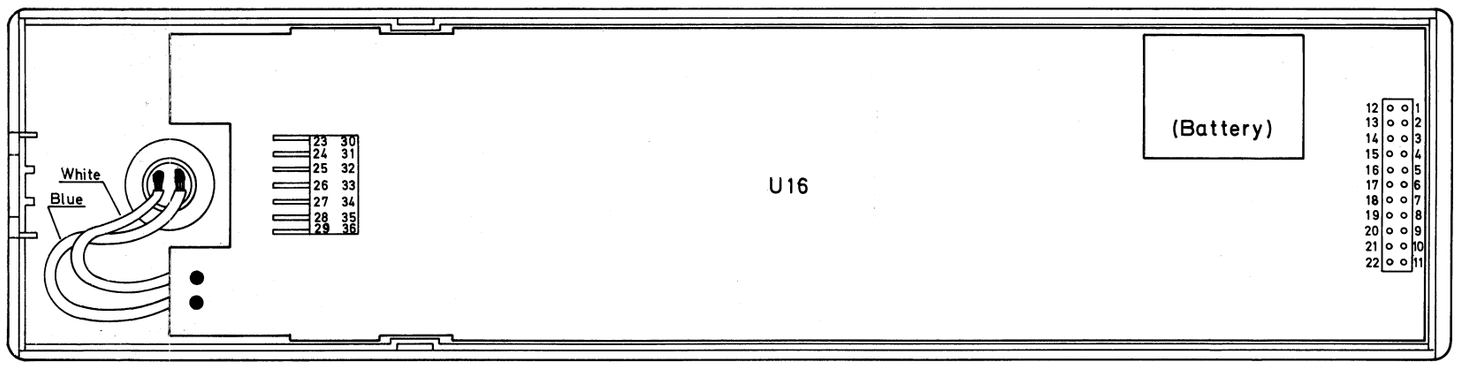


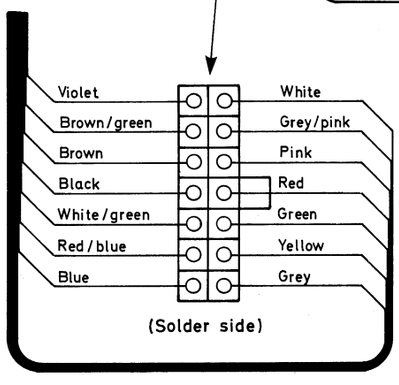
Fig. 9-14 Wiring diagram, radio unit ("CPU side")











APM831010A1

Fig. 9-15 Wiring diagram, active handset

10. Checking and adjusting

1. General information

Measuring instruments:

Test box	: AP accessory
Handset test box	: AP accessory
Power meter	
Dummy load 50ohm/25W	
Attenuator 30-40dB/50ohm/20W	
Attenuator 20dB/50ohm/20W	
Deviation meter	
Tone generator	
RF signal generator with attenuator	
Distortion meter	
Oscilloscope	
Modulation meter	
Frequency counter	
Power supply 13.2V/6A	

In the following instructions adjusting elements are indicated with the unit no. and the component no. e.g. U13/R10. The same principle is also used for indication of test points, e.g. U10/TP5 indicates unit U10 test point 5. U10.04 indicates unit U10 terminal 4. The location of test points, adjusting elements etc. is shown in fig. 10-9 and fig. 10-10.

We presume that the technician performing the adjusting is familiar with the test box and the test cradle. Before checking and adjusting, the uP must be reset by temporarily setting S9 in position "uP OPERATE".

2. Connecting the test box and test cradle

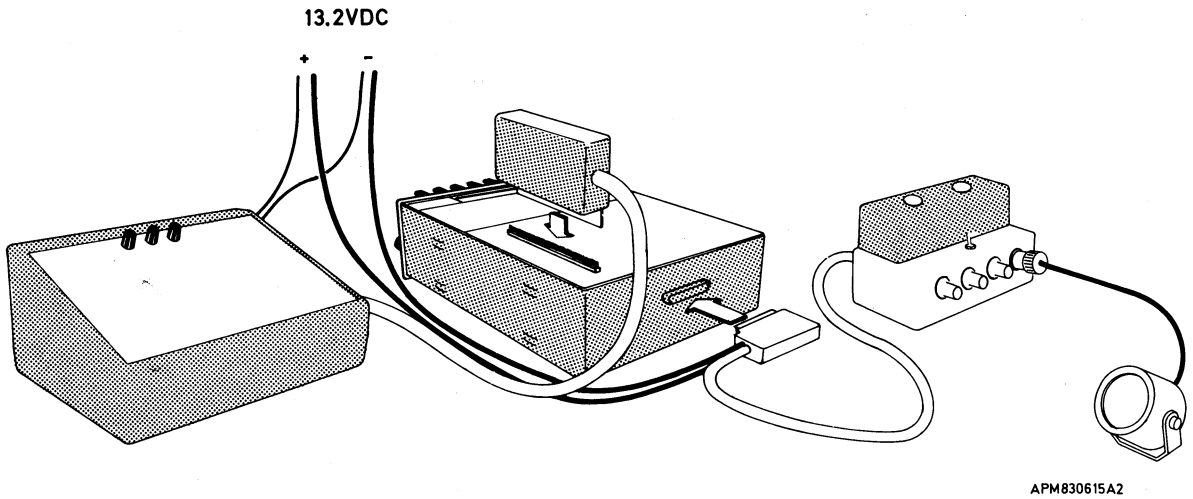
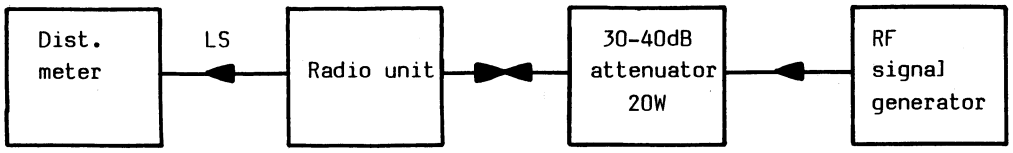


Fig. 10-1 Connection of the test box and the handset box

3. Quick functional test

The following test is not complete, but it gives an indication of the transmitter/receiver performance.

- By using e.g. the set-up in fig. 10-2, check the receiver sensitivity at the channels 1, 91 and 180 while transmitting with high power.
  Requirement: ⩽ 1uV EMF for 20dB SINAD, psophometric
  ⩽1.2V EMF for 20dB SINAD, linear.



TX ON, HI power

f = 463.000MHz for ch. 1
f = 465.250MHz for ch. 91
f = 467.475MHz for ch. 180

Note: The exact value of the att. is not important but must be known in order to determine the sensitivity.

Fig. 10-2 Test set-up for quick functional test

4. Adjusting the RX synthesizer loop

- Set the test box rotary switches to channel 91.
- Check that 5V DC is obtained on U5.06.
- If not, adjust U4/C5.

5. Adjusting the TX synthesizer loop and frequencies

- It is assumed that the RX synthesizer loop works OK, see point 4.
- Set the test box rotary switches to channel 91.
- Check that 7.850MHz ±100Hz is obtained at U6/TP1.
- If not, adjust U6/L1.
- With a dummy load connected, activate the transmitter with the test box.
- Check that the loop voltage on U7.01 is 4.5 ±0.5V DC.
- If not, adjust U7/C4.
- Check that 455.250MHz ±1kHz is obtained at U7.04 (or at the antenna connector).
- If not, adjust U5/C6.
- When the loop is locked, U6.04 will be high (approx. 12V).

Note: When U6/L1 has been adjusted, the modulation amplifier must also be adjusted. See para. 7.

6. Adjusting the PA and power control

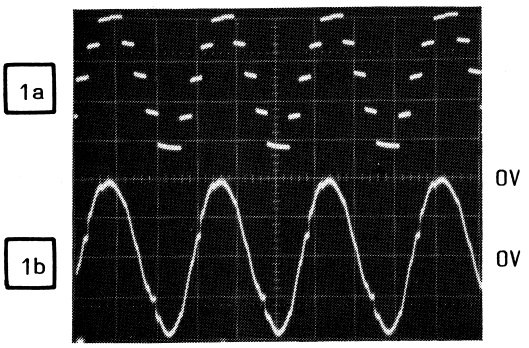
- Connect a 50ohm/25W dummy load via a power meter to the antenna connector.
- As it is important that the PA is terminated with 50ohms, it is assumed that the duplex filter is OK.
- Still using channel 91, enable a high power transmission without modulation with the test box.
- Adjust all the trim capacitors in unit U13 for maximum output (critical adjustment).
- Adjust U13/R9 for 15W output power.
- Check that the output power at channels 1 and 180 is minimum 12W.
- If not, suspect the duplex filter.
- Enable a medium power transmission on channel 91.
- Adjust U13/R10 for 2W output power. Adjustment is made to this level in order to fulfill the specification 1.5W ±3dB across the temperature range.
- Enable a low power transmission on channel 91.
- Check that the output power is 0.1-0.4W.
- Check that pin U13.08 is low during transmission.

7. Adjusting the modulation amplifier

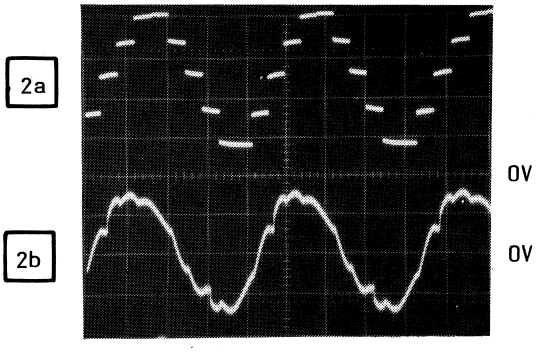
- Connect a deviation meter to U7.04 or via a power attenuator to the antenna connector.
- Connect a tone generator to the "MIC 1" connector at the test cradle.
- Connect an oscilloscope to the AF output of the modulation meter for checking of the modulation.
- Set S17 to "MIC 1" position, S10 to "OPEN" position, S20 to "SUPERVISORY OFF" and S6 in "RESET" position.
- With 1000Hz/10mV RMS from the tone generator check that ±4.5kHz deviation is obtained.
- If not, adjust U9/R101.
- With an output 20dB less (1mV output), check that ±3kHz deviation is obtained.
- If not, adjust U9/R76.
- Repeat the procedure once.
- Connect the tone generator to the "MIC 2" connector at the test cradle.
- Set S17 to "MIC 2" position.
- With 1000Hz/100mV RMS from the tone generator, check that ±3kHz deviation is obtained.
- If not, adjust U9/R72.

8. Checking the modem

Some checking of the modem can be made without sophisticated test equipment.
The modulator can be forced to transmit 1800Hz or 1200Hz by connecting U10/TP8 to ground or +5V respectively.



a: U10/TP6 0.2V/div. 0.2ms/div.
b: U10.06 0.2V/div.
Note: U10/TP8 grounded

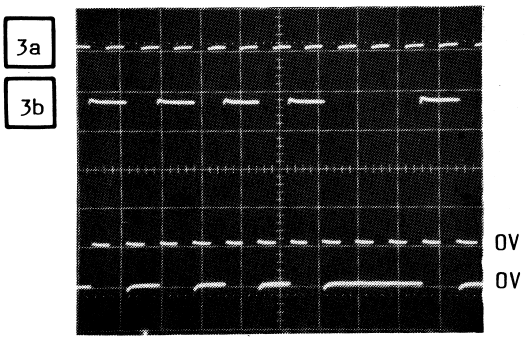


a: U10/TP6 0.2V/div. 0.2ms/div.
b: U10.06 0.2V/div.
Note: U10/TP8 to +5V

Fig. 10-3 Modem TX test

The receiver can be checked with the signal transmitted from the base station. If the modem receiver is defect, the base station must first be found with another radio unit (which is OK) connected to the test box. When the channel is noted, the defect radio can be forced to this channel.
Now the following should be checked:

a) Regenerated clock
b) Data on U10/TP3
c) Received data
d) RX clock (transition in the middle of data bits).



a: U10/TP5 1V/div. 1ms/div.
b: U10/TP3 1V/div.
Note: Ext. trig from U10/TP4.
The picture is taken with overlapping curves.

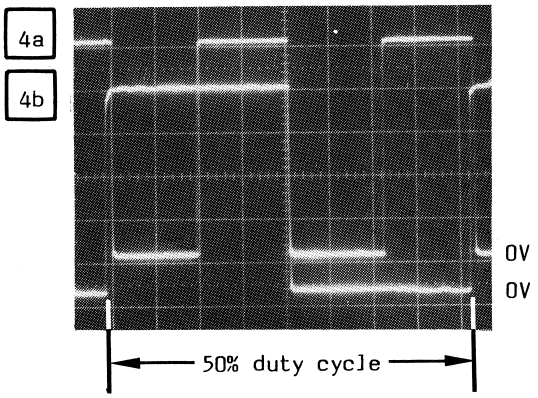
Fig. 10-4 Modem RX test

9. Adjusting the modem-TX

- With the switch S10 in "MIC BL" position and S6 in "TRANS" position, check that ±4.2kHz deviation is obtained.
- If not, adjust U10/R39.

10. Adjusting the modem-RX

Point 8 shows how the modem receiver can be checked. It is important that the duty cycle is 50 ±3% (when receiving 01010 etc).
This can be adjusted with U10/R1. Adjustment is normally required after replacing IC2.



a: U10/TP5 1V/div. 0.2ms/div.
b: U10/TP3 1V/div.
Note: Ext. trig from U3/TP4. The picture is the same as oscillogram 3a,b but is obtained with a storage oscilloscope.

Fig. 10-5 Modem RX test

11. Adjusting the IF amplifier

- If the RF and mixer unit is working you can connect the signal generator to the antenna connector. Then perform the measurement at 465.250MHz. You can "by-pass" the RF and mixer unit by connecting the signal generator to U3/TP1 instead. In this case the measurement is performed at 21.4MHz.
- Connect the distortion meter to the handset speaker output on the test cradle.
- Modulate the signal generator with 1kHz to ±3kHz deviation.
- Adjust U2/L1 for maximum LF output and U3/L11 and U2/C1 for minimum distortion.

12. Adjusting the RF amplifier

The adjustment of U3/L11 is described together with the IF amplifier.
- Set the radio to channel 91.

- Adjust U3/C11 for max. DC voltage at U3/TP2 (approx. 1.5 to 2.5V DC).
- Adjustment of the RF filter should be avoided unless e.g. a sweep generator provided with a logarithmic horizontal amplifier (min. 40dB dynamic range) is available.
- If the required instrument is available the specifications in fig. 10-3 can be checked. The generator is connected directly to U3.01 input and the RF probe to U3/TP3.
- If necessary, adjust with U3/L1-L6.
- With U3/C10 and U3/L1,2 the sensitivity can be fine-tuned (on ch. 91).
- Perform step 3.

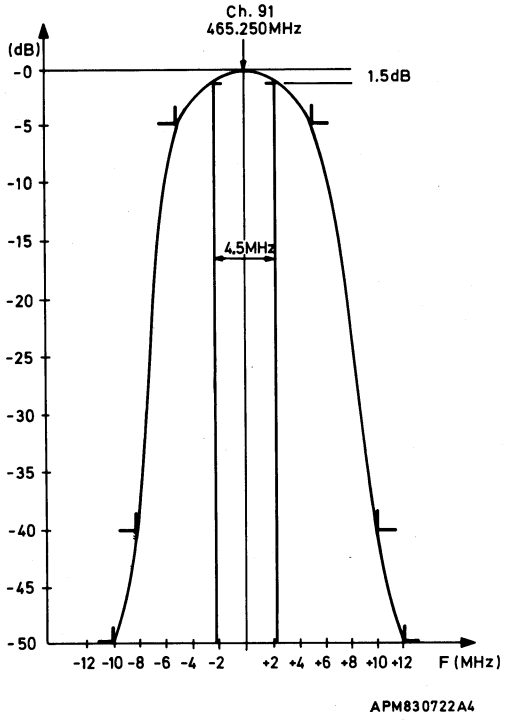


Fig. 10-6 Receiver RF filter (without duplex filter)

13. Adjusting squelch, handset output and field strength controls

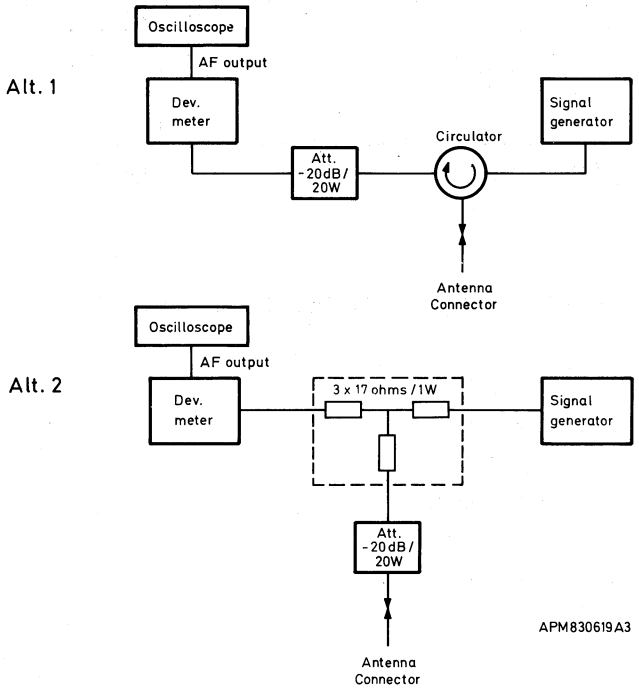
- Disable the transmitter by setting S13 in position "OFF".
- Disable the loudspeaker with S15 in position "LSPK BLOCK".
- Connect the RF signal generator to the antenna input and an oscilloscope to the handset connector of the test cradle.
- Set the RF signal generator to 465.250MHz, modulation 1000Hz tone / ±3kHz deviation and the output level for 20dB SINAD measured with a psophometric filter (=14dB SINAD measured without psophometric filter).
- Adjust U9/R52 until the "SQUELCH" lamp D19 just lights up.
- Reduce the RF signal generator output with 4dB.
- Check that the "SQUELCH" lamp is off.
- Readjust the RF signal generator to 10uV EMF.
- Adjust U11/R46 so that the "FIELD STRENGTH" lamp D20 just lights up.
- Set the receiver for maximum volume by setting S12 in position "MAN" and turning the "VOLUME" control P1 fully clock-wise.

- Check that 560mV RMS without limiting/distortion is obtained at the handset output.
- If not, adjust U9/R58.
- Set S12 in position "NOM".
- Check that 200mV RMS is obtained at the handset output.
- If not, adjust U11/R9.

14. Adjusting the supervisory filters

- Connect an RF signal generator to the antenna input (10uV EMF).
- Modulate with 3855Hz (±0.1%), ±500Hz deviation.
- Adjust U9/R5 for max. AC voltage at U9/TP1.
- Modulate the RF generator with 4145Hz (±0.1%), ±500Hz deviation.
- Adjust U9/R13 for max. AC voltage at U9/TP2.

15. Adjusting the supervisory modulation level



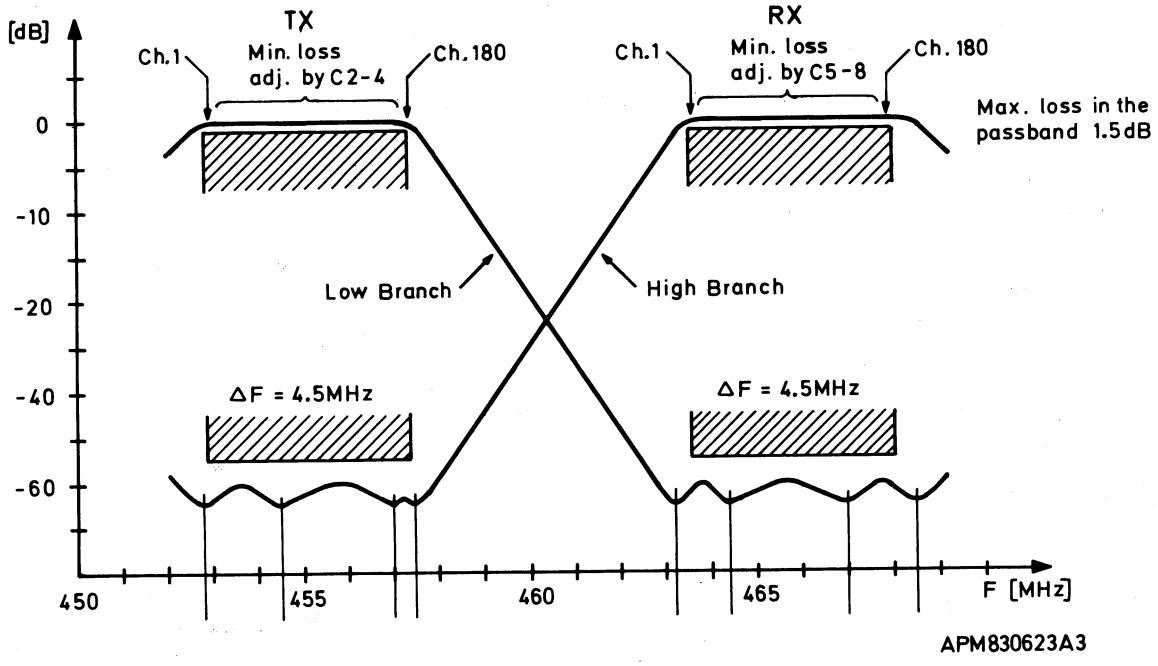
Note: The oscilloscope is used for visual checking of the signal.

Fig. 10-7 Test set-up. Supervisory modulation level

- Set the RF signal generator to the receiver frequency.
- Modulate the RF signal generator with 4000Hz to ±500Hz deviation (10uV EMF).
- Open the supervisory path (S20) and reset the TX data (S6).
- Enable the transmitter with S13.
- Check that the transmitter deviation is ±550Hz.
- If not, adjust U9/R105.

16. Adjusting of the duplex filter

Note: We recommend that adjustment of the duplex filter is made in the factory only.
Not only are expensive instruments necessary but the test set-up is also critical.
For fault-isolation we recommend that a duplex filter is kept in the work-shop.
For adjustment a network analyser or a "Polyskop" with minimum 60dB dynamic range is required.



Suggested adjustment frequencies for fulfilling the requirements:

L1:	468.5MHz	L5:	457.5MHz
L2:	464.4MHz	L6:	452.8MHz
L3:	467.0MHz	L7:	457.0MHz
L4:	463.2MHz	L8:	454.5MHz

Fig. 10-8 Duplex filter characteristics

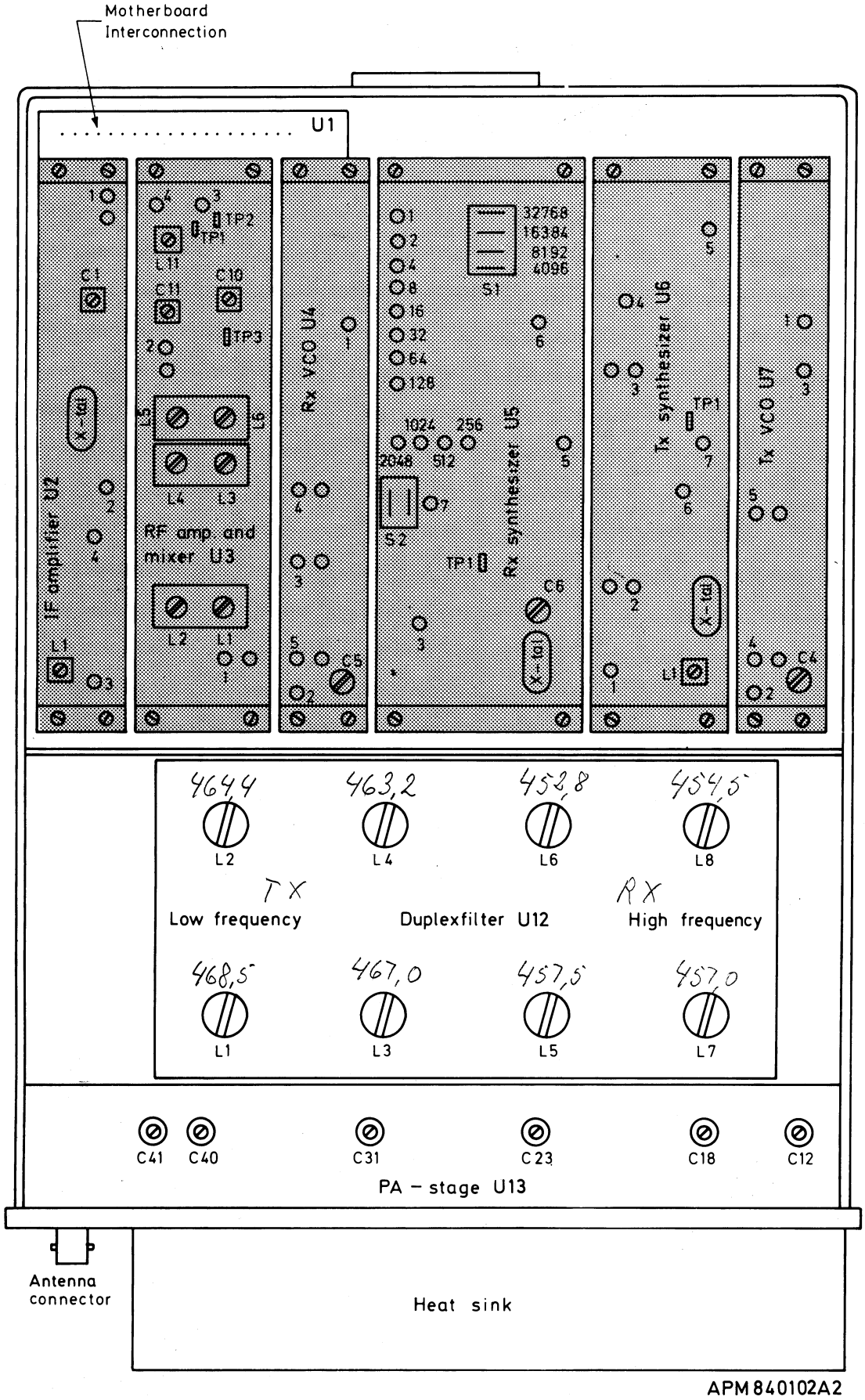


Fig. 10-9 Location of adjusting elements, test points and terminals. "RF side"

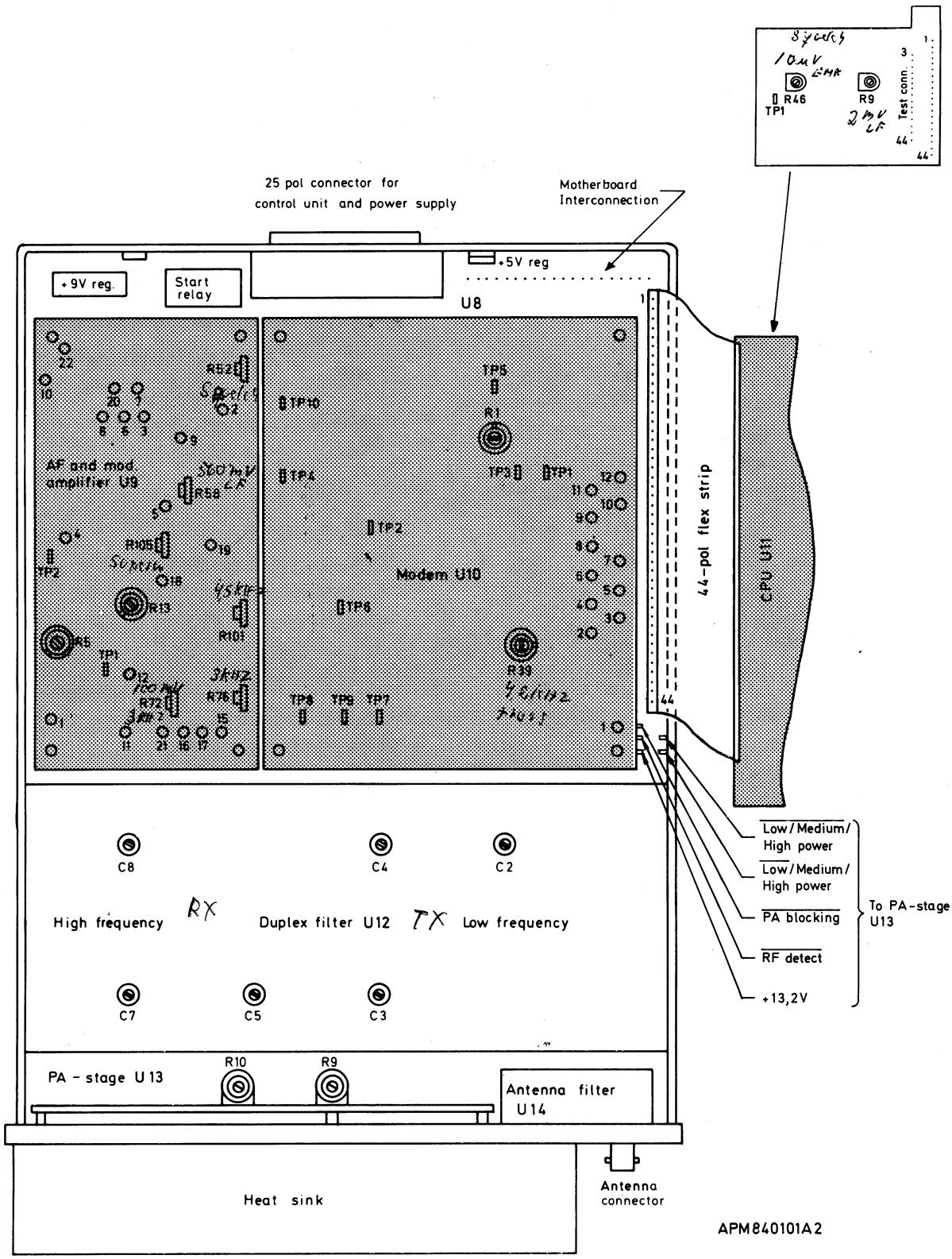


Fig. 10-10 Location of adjusting elements, test points and terminals. "CPU side" 84.02

Channel	1	0	1011	0000	463.000MHz	Channel	46	0	1101 1101 464.125MHz
"	2	0	1011	0001	463.025 "	"	47	0	1101 1110 464.150 "
"	3	0	1011	0010	463.050 "	"	48	0	1101 1111 464.175 "
"	4	0	1011	0011	463.075 "	"	49	0	1110 0000 464.200 "
"	5	0	1011	0100	463.100 "	"	50	0	1110 0001 464.225 "
"	6	0	1011	0101	463.125 "	"	51	0	1110 0010 464.250 "
"	7	0	1011	0110	463.150 "	"	52	0	1110 0011 464.275 "
"	8	0	1011	0111	463.175 "	"	53	0	1110 0100 464.300 "
"	9	0	1011	1000	463.200 "	"	54	0	1110 0101 464.325 "
"	10	0	1011	1001	463.225 "	"	55	0	1110 0110 464.350 "
"	11	0	1011	1010	463.250 "	"	56	0	1110 0111 464.375 "
"	12	0	1011	1011	463.275 "	"	57	0	1110 1000 464.400 "
"	13	0	1011	1100	463.300 "	"	58	0	1110 1001 464.425 "
"	14	0	1011	1101	463.325 "	"	59	0	1110 1010 464.450 "
"	15	0	1011	1110	463.350 "	"	60	0	1110 1011 464.475 "
"	16	0	1011	1111	463.375 "	"	61	0	1110 1100 464.500 "
"	17	0	1100	0000	463.400 "	"	62	0	1110 1101 464.525 "
"	18	0	1100	0001	463.425 "	"	63	0	1110 1110 464.550 "
"	19	0	1100	0010	463.450 "	"	64	0	1110 1111 464.575 "
"	20	0	1100	0011	463.475 "	"	65	0	1111 0000 464.600 "
"	21	0	1100	0100	463.500 "	"	66	0	1111 0001 464.625 "
"	22	0	1100	0101	463.525 "	"	67	0	1111 0010 464.650 "
"	23	0	1100	0110	463.550 "	"	68	0	1111 0011 464.675 "
"	24	0	1100	0111	463.575 "	"	69	0	1111 0100 464.700 "
"	25	0	1100	1000	463.600 "	"	70	0	1111 0101 464.725 "
"	26	0	1100	1001	463.625 "	"	71	0	1111 0110 464.750 "
"	27	0	1100	1010	463.650 "	"	72	0	1111 0111 464.775 "
"	28	0	1100	1011	463.675 "	"	73	0	1111 1000 464.800 "
"	29	0	1100	1100	463.700 "	"	74	0	1111 1001 464.825 "
"	30	0	1100	1101	463.725 "	"	75	0	1111 1010 464.850 "
"	31	0	1100	1110	463.750 "	"	76	0	1111 1011 464.875 "
"	32	0	1100	1111	463.775 "	"	77	0	1111 1100 464.900 "
"	33	0	1101	0000	463.800 "	"	78	0	1111 1101 464.925 "
"	34	0	1101	0001	463.825 "	"	79	0	1111 1110 464.950 "
"	35	0	1101	0010	463.850 "	"	80	0	1111 1111 464.975 "
"	36	0	1101	0011	463.875 "	"	81	1	0000 0000 465.000 "
"	37	0	1101	0100	463.900 "	"	82	1	0000 0001 465.025 "
"	38	0	1101	0101	463.925 "	"	83	1	0000 0010 465.050 "
"	39	0	1101	0110	463.950 "	"	84	1	0000 0011 465.075 "
"	40	0	1101	0111	463.975 "	"	85	1	0000 0100 465.100 "
"	41	0	1101	1000	464.000 "	"	86	1	0000 0101 465.125 "
"	42	0	1101	1001	464.025 "	"	87	1	0000 0110 465.150 "
"	43	0	1101	1010	464.050 "	"	88	1	0000 0111 465.175 "
"	44	0	1101	1011	464.075 "	"	89	1	0000 1000 465.200 "
"	45	0	1101	1100	464.100 "	"	90	1	0000 1001 465.225 "

Fig. 10-11 RX frequency list (1 of 2)

Channel	91	1 0000 1010	465.250MHz		Channel	136	1 0011 0111	466.375MHz	
"	92	1 0000 1011	465.275	"	"	137	1 0011 1000	466.400	"
"	93	1 0000 1100	465.300	"	"	138	1 0011 1001	466.425	"
"	94	1 0000 1101	465.325	"	"	139	1 0011 1010	466.450	"
"	95	1 0000 1110	465.350	"	"	140	1 0011 1011	466.475	"
"	96	1 0000 1111	465.375	"	"	141	1 0011 1100	466.500	"
"	97	1 0001 0000	465.400	"	"	142	1 0011 1101	466.525	"
"	98	1 0001 0001	465.425	"	"	143	1 0011 1110	466.550	"
"	99	1 0001 0010	465.450	"	"	144	1 0011 1111	466.575	"
"	100	1 0001 0011	465.475	"	"	145	1 0100 0000	466.600	"
"	101	1 0001 0100	465.500	"	"	146	1 0100 0001	466.625	"
"	102	1 0001 0101	465.525	"	"	147	1 0100 0010	466.650	"
"	103	1 0001 0110	465.550	"	"	148	1 0100 0011	466.675	"
"	104	1 0001 0111	465.575	"	"	149	1 0100 0100	466.700	"
"	105	1 0001 1000	465.600	"	"	150	1 0100 0101	466.725	"
"	106	1 0001 1001	465.625	"	"	151	1 0100 0110	466.750	"
"	107	1 0001 1010	465.650	"	"	152	1 0100 0111	466.775	"
"	108	1 0001 1011	465.675	"	"	153	1 0100 1000	466.800	"
"	109	1 0001 1100	465.700	"	"	154	1 0100 1001	466.825	"
"	110	1 0001 1101	465.725	"	"	155	1 0100 1010	466.850	"
"	111	1 0001 1110	465.750	"	"	156	1 0100 1011	466.875	"
"	112	1 0001 1111	465.775	"	"	157	1 0100 1100	466.900	"
"	113	1 0010 0000	465.800	"	"	158	1 0100 1101	466.925	"
"	114	1 0010 0001	465.825	"	"	159	1 0100 1110	466.950	"
"	115	1 0010 0010	465.850	"	"	160	1 0100 1111	466.975	"
"	116	1 0010 0011	465.875	"	"	161	1 0101 0000	467.000	"
"	117	1 0010 0100	465.900	"	"	162	1 0101 0001	467.025	"
"	118	1 0010 0101	465.925	"	"	163	1 0101 0010	467.050	"
"	119	1 0010 0110	465.950	"	"	164	1 0101 0011	467.075	"
"	120	1 0010 0111	465.975	"	"	165	1 0101 0100	467.100	"
"	121	1 0010 1000	466.000	"	"	166	1 0101 0101	467.125	"
"	122	1 0010 1001	466.025	"	"	167	1 0101 0110	467.150	"
"	123	1 0010 1010	466.050	"	"	168	1 0101 0111	467.175	"
"	124	1 0010 1011	466.075	"	"	169	1 0101 1000	467.200	"
"	125	1 0010 1100	466.100	"	"	170	1 0101 1001	467.225	"
"	126	1 0010 1101	466.125	"	"	171	1 0101 1010	467.250	"
"	127	1 0010 1110	466.150	"	"	172	1 0101 1011	467.275	"
"	128	1 0010 1111	466.175	"	"	173	1 0101 1100	467.300	"
"	129	1 0011 0000	466.200	"	"	174	1 0101 1101	467.325	"
"	130	1 0011 0001	466.225	"	"	175	1 0101 1110	467.350	"
"	131	1 0011 0010	466.250	"	"	176	1 0101 1111	467.375	"
"	132	1 0011 0011	466.275	"	"	177	1 0110 0000	467.400	"
"	133	1 0011 0100	466.300	"	"	178	1 0110 0001	467.425	"
"	134	1 0011 0101	466.325	"	"	179	1 0110 0010	467.450	"
"	135	1 0011 0110	466.350	"	"	180	1 0110 0011	467.475	"

Fig. 10-11 RX frequency list (2 of 2)

AP3733
Accessories

11. Test box and test cradle

A. Introduction

The test box is used in conjunction with a test cradle during checking and adjusting (see chapter 10). The box is provided with a cable which is plugged into a test connector on the CPU U11. With the switches and the potentiometer, many functions can now be manually controlled.

B. Survey of controls

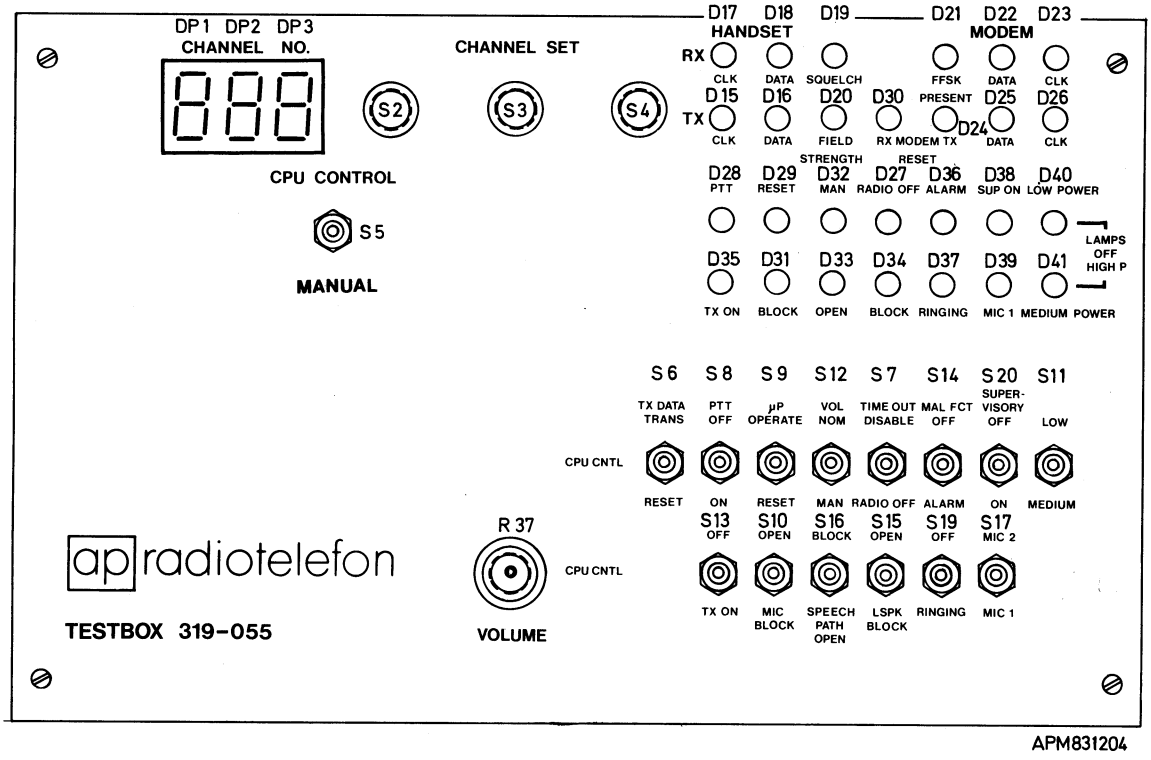


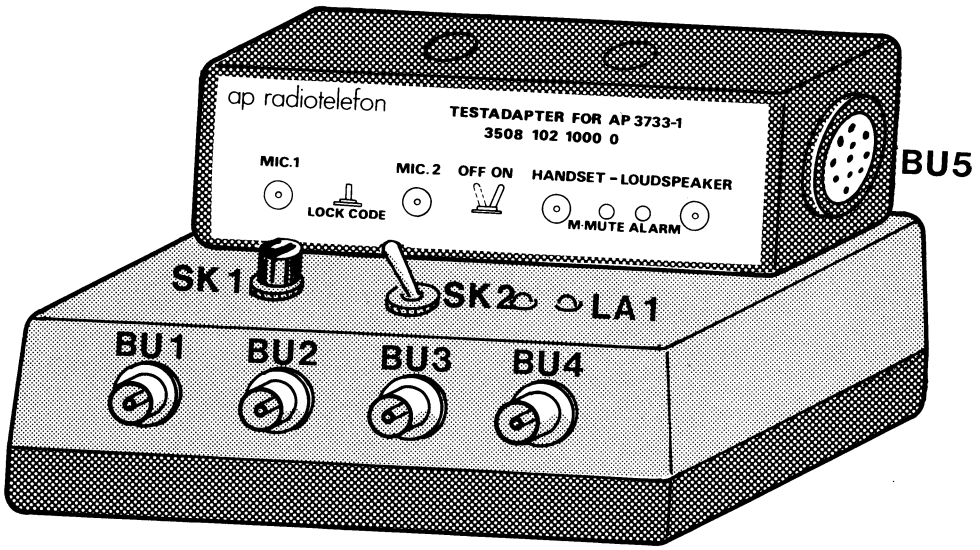
Fig. 11-1 Test box

DP1,2,3 "CHANNEL NO."
LED display which indicates the channel number chosen with S2-3 in the manual mode or the channel set by the CPU.
An irrelevant channel code is indicated with "E" (error) on the display.

D17-D41 LED's indicating status on the CPU terminals:

Signal name on diagrams

D17	Clock to HS
D18	Data to HS
D19	$\overline{\text{Squelch on/off}}$
D20	$\overline{\text{FS low}}$/high
D21	RX data present
D22	RX data
D23	RX clock
D24	TX data reset
D25	TX data
D26	TX clock
D27	$\overline{\text{Time out}}$
D28	$\overline{\text{Push to talk}}$
D29	$\overline{\text{uP reset}}$
D30	Modem reset
D31	$\overline{\text{Mic. blocking}}$
D32	(When on, the LED indicates that the volume is controlled by R37 "VOLUME" i.e. the switch S12 in pos. "MAN".
D33	$\overline{\text{Speech mute}}$
D34	$\overline{\text{Loudspeaker blocking}}$
D35	$\overline{\text{TX on}}$/off
D36	$\overline{\text{Malfunction alarm}}$
D37	$\overline{\text{Ring}}$
D38	$\overline{\text{Supervisory tone off}}$/on
D39	$\overline{\text{Mic. 2 (Handset)}}$/Mic. 1 (Handsfree)
D40	$\overline{\text{Low/Medium}}$/high power
D41	$\overline{\text{Low}}$/Medium/High power
S2-S4	"CHANNEL SET" Switches for controlling the channel selection manually (if the switch S5 is in position "MANUAL".
S5	"MANUAL" When the switch is set in the upper position the CPU controls the radio. When in the "MANUAL" position, the control is taken over by the control box switches and volume control.
S6-S17	The switches (except S12) have three positions. In the middle position the corresponding CPU control line is controlled by the CPU. In the other two positions the switches override the CPU according to the front labelling. Notes: When the switch S11 is in mid-position, the PA is set to high power.



APM831216

Fig. 11-2 Test cradle

SK1 "LOCK CODE"
The push button switch is used for programming of the code lock number.
See page 5-3.

SK2 "OFF/ON"
With this switch the radio unit and the handset can be switched on. This switch is useful if the power on circuit in the handset is defect.

LA1 "ALARM"
Yellow LED which corresponds to the calling indicator on the handset.

BU1 "MIC. 1"
BNC connector for connecting an AF generator to the external microphone input.

BU2 "MIC. 2"
BNC connector for connecting an AF generator to the handset microphone input.

BU3 "HANDSET"
BNC connector which is connected across the handset receiver.

BU4 "LOUDSPEAKER"
BNC connector for connecting an external loudspeaker.

BU5 Handset connector.

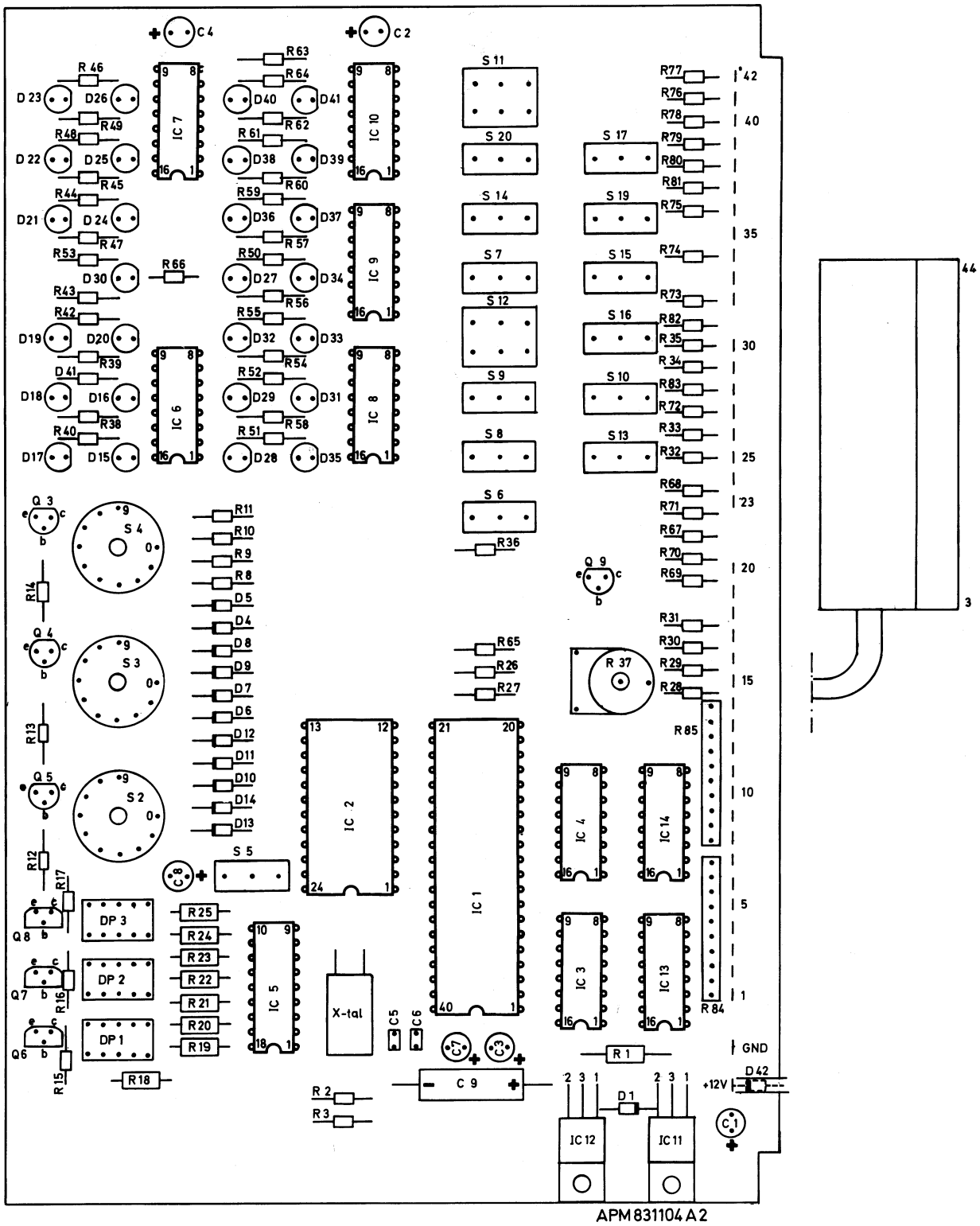


Fig. 11-3 Component location, test box

Cable connector

Data from HS/CU

IC 6 IC 7 IC 8 IC 9 IC 10

HAND-SET: D15 Red TX CLK; D16 Green TX DATA; D17 Red RX CLK; D18 Green RX DATA; D19 Yellow SQUELCH; D20 Yellow FIELD STRENGTH

MODEM: D21 Yellow RX FFSK PRESENT; D22 Green RX DATA; D23 Red RX CLOCK; D24 Yellow TX MODEM RESET; D25 Green TX DATA; D26 Red TX CLK; D27 Red RADIO OFF; D28 Red PTT; D29 Red RESET; D30 Red RX MODEM RESET; D31 Red BLOCK; D32 Red MAN; D33 Red OPEN; D34 Red BLOCK; D35 Red TX ON; D36 Red ALARM; D37 Red RINGING; D38 Red SUP ON; D39 Red MIC 1; D40 Red LOW POWER; D41 Red MEDIUM POWER

S6 RESET; TX DATA TRANS

S9 µP OPERATE; RESET

S7 RADIO OFF; TIME OUT DISABLE

S16 BLOCK; SPEECH PATH OPEN

S8 ON; PTT OFF

S10 OPEN; MIC BLOCK

S13 OFF; TX ON

S15 OPEN; LSPK BLOCK

S14 MAL FCT OFF; ALARM

S19 OFF; RINGING

S20 ON; SUPER VISORY OFF

S17 MIC 2; MIC 1

S11 MEDIUM; HIGH; LOW

S12 VOL NOM; MAN

R 37 4,7K "VOLUME"

S 2 "100"; S 3 "10"; S 4 "1"

IC 1 8748; IC 2 8243; IC 3,4,6-10,13,14 40097 BP; IC 5 2981

IC 1 X-TAL; X-TAL; SS; EA; T0; T1; INT; RESET; DB0 DB1 DB2 DB3 DB4 DB5 DB6 DB7; RD WR P10 P11 P12 P13 P14 P15 P16 P17 PROG P20 P21 P22 P23 PSEN ALE

IC 2 PROG P20 P21 P22 P23 P40 P41 P42 P43 CS; P50 P51 P52 P53 P60 P61 P62 P63 P70 P71 P72 P73

IC 3 IC 4 IC13 IC14

IC 5 R18 - 390

DP 1 DP 2 DP 3

Q 3 BC337; Q 4 BC 337; Q 5 BC337; Q 6 BCX38B; Q 7 BCX38B; Q 8 BCX38B; Q 9 BC337

R 1 3,3; C 9 470µ; D 42 3051; IC 11; IC12; C1 33µ; C2 33µ; C3 100µ; C4 100µ; D1 BZX83 /C4V3

IC11,12 - 7805CT

DP1-3 - HDSP7303

Cable connector

term.8 R85 7x33K

term.7,5,4,2,3 R84 4x33K

IAPM831103A0

Fig. 11-4 Circuit diagram, test box

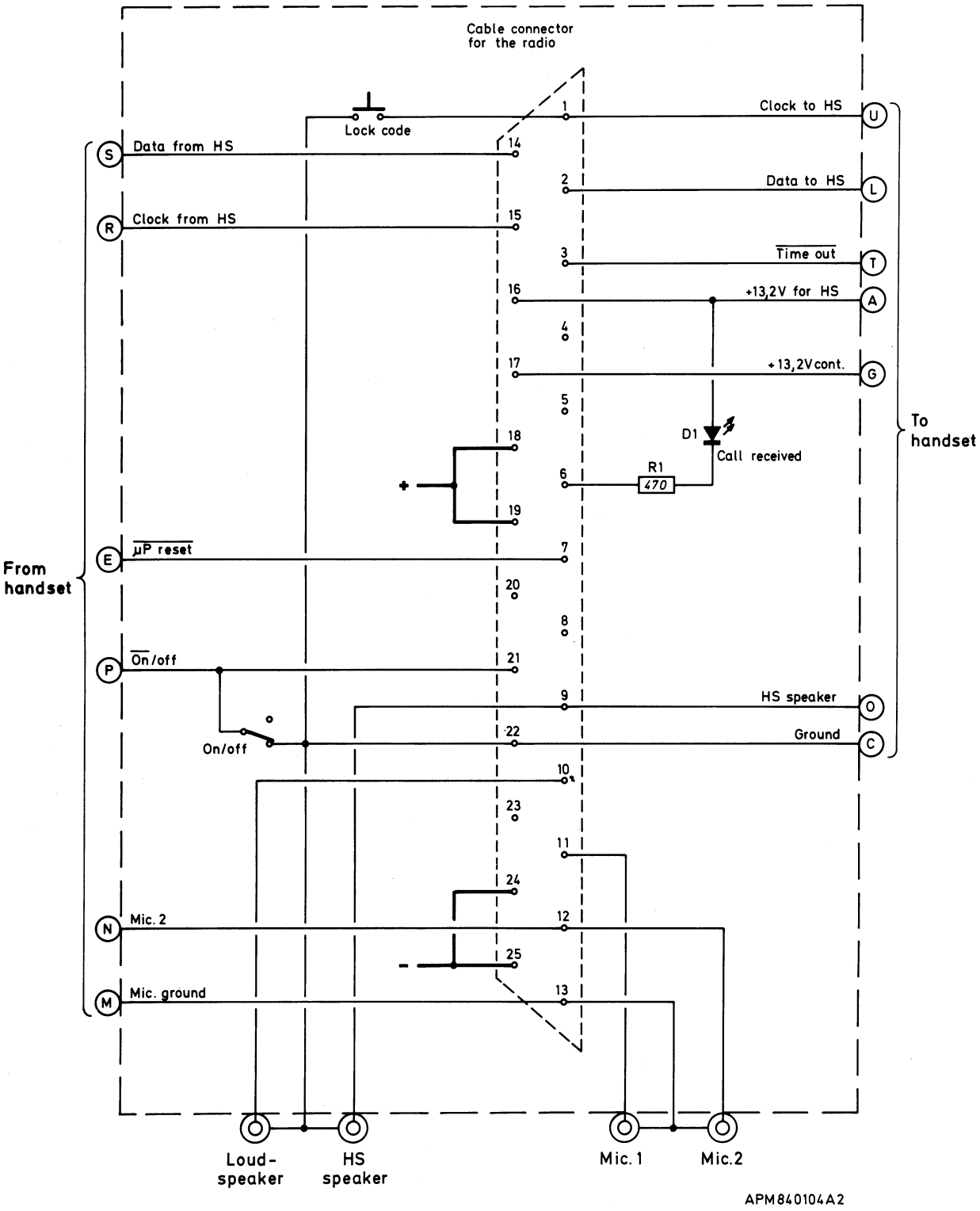


Fig. 11-5 Circuit diagram, test cradle

AP3733
Spare parts list

12. List of electrical parts

Unit no.	Description	Ordering number
1	Mother board, RF side	N04C1
2	IF amplifier	N12C1
3	RF and mixer	N10B1
4	UHF RX VCO	3508 102 20000
5	RX synthesizer	N03F1
6	TX synthesizer	N18E1
7	UHF TX VCO	N07C1
8	Mother board, CPU side	3508 102 20020
9	AF and modulation amplifier	3508 102 40020
10	Modem	N14F1
11	CPU	N61A1
12	Duplex filter	304-001
13	PA and power control	3508 102 40110
14	Harmonic filter	N21A1
15	Cradle, complete	3508 102 10350
15	Cradle, black, complete	3508 102 10170
16	Handset, main board	N59B1
17	Display and key board, black	319-007
17	Display and key board, white	319-008

Item	Type	Ordering number
Printed board	Cable connection cardle N64	3508 102 20010

Components mounted on the print board

Integrated circuit

IC1	ICLM78L/5ACZ	9335 499 00682

Diode

D1	1N4148	9330 869 90113

Item	Value	Volt/Watt	Description	Ordering number
Capacitors				
C1	100nF		Ceramic	2022 552 02334
C2	100uF		Elco	2020 002 90567
Resistors				
R1-2	1K			2322 280 13102
Relay				
RE1	RD2-2	12VDC/50MA		17-065

Item	Type	Ordering number
Printed board	Aerial filter N21A1	N21-1

Components mounted on the print board

Coils

L1-2	80054-4E2	25-087

Item	Value	Volt/Watt	Description	Ordering number
Capacitors				
C1,3	5.6pF		Ceramic	2008 554 00028
C2	8.2pF		Ceramic	2008 554 00029

Item	Type	Ordering number
Printed board	PA stage and power control NO5	3508 102 40110

Integrated circuits

IC1	TAA765A	9332 441 30682
IC2	78L05A	9335 449 00682

Transistors

Q1	2N4918	9331 234 20682
Q2	BC558B	3508 100 11000
Q3	MFR627	19-123
Q4	2N5944	19-162
Q5	2N5946	19-163
Q6	MFR644	19-177
Q7	BC337	3508 100 11010
Q8	ZTX326L	19-115

Diodes

D1,8	BAT43	9335 520 30682
D2,7,9	1N4148	9330 839 90113
D3-4	MBD501	9332 501 90682
D5-6	BA244	9332 076 30113

Coils

RFC1-5,7-8	72290-4E2	25-009
RFC6	2.2uH	4322 057 02280
L1-4,7	80053-4E2	25-086
L5	80054-4E2	25-087
L6	82001-4E2	25-096

Item	Value	Volt/Watt	Description	Ordering number
Capacitors				
C1,6	10nF	50V	Ceramic	2012 557 02012
C2-4,7-8,10,16,19 21,28,35-36,42-43, 47,57,60	330pF		Ceramic	2222 630 01331
C5,22,30	47pF		Ceramic	2222 631 34469
C9	10uF	16V	Electrolytic	2020 002 90262
C11	2.2pF		Ceramic NPO	2222 631 09228
C12,40	9pF		Trim	2012 801 10022
C13	18pF		Ceramic	2222 631 34189
C14,20,26-27,37	0.1uF	50V	Ceramic	2022 552 02334

Item	Value	Volt/Watt	Description	Ordering number
C15	1uF	50V	Electrolytic	2020 002 90256
C17,32,46	10pF		Ceramic	2222 631 34109
C18,23,31,41	18pF		Trim	2012 801 10023
C24-25,33-34	22pF		Ceramic, chip	2012 754 01026
C38-39	10pF		Ceramic, chip	2012 754 01025
C44	8.2pF		Ceramic N150	2008 554 00029
C45	10pF	400V	N750	2008 554 00017
C58	12pF	100V	N150	2222 631 34129
C50	15pF	100V	N150	2222 631 34159
C61	56pF	100V		2222 631 03567

Resistors

R23	270	1.6W	PR37	2322 191 32701
R24	330	1.2W	CR37	2322 212 13331

Item	Type	Ordering number
Printed board	AF and modulation amplifier N02	3508 102 40020

Components mounted on the print board

Integrated circuits

IC1-2,8	A1-4741-5	9336 351 10682
IC3	MC1458CP	9332 911 80682
IC4	MC3340D	9335 482 70682
IC5	TDA2003H	9336 351 00682
IC6	TL082CP	09-242
IC7	HEF4093B	9333 242 90112

Transistors

Q1-2,8	BF244A	19-106
Q3-7,9-10	BC548	9335 101 60682

Diodes

D1-3,5-11	1N4148	9330 839 90113

Item	Value	Volt/Watt	Description	Ordering number
Capacitors				
C1-2,56	10nF		Poly	2020 300 90249
C3-6,11	3.3nF	1%	Styroflex	2012 321 00017
C7,52	4.7uF	35V	Electrolytic	2020 002 90261
C8-9,13,16,29-31, 35-36,38,41,43-44, 46-48,65-68,70	1nF		Ceramic	2222 630 07102
C10,23,50	10uF	16V	Electrolytic	2020 002 90262
C12	4.7uF	1%	Styroflex	2012 321 00018
C15,17,19,21,49	1uF	50V	Electrolytic	2020 002 90256
C32	2.2uF		Ceramic	2222 630 07222
C18,58	0.22uF	35V	Tantal	11-513
C20,59	33uF	16V	Electrolytic	05-048
C22,33,37,40,64	0.47uF	50V	Electrolytic	2020 002 90255
C24	100uF	3V	Electrolytic	2020 002 90567
C25,28	100nF	16V	MKT	11-490
C26	1000uF	16V	Electrolytic	2020 002 90566
C27	220uF	16V	Electrolytic	05-024
C34,42,45,51,57	0.1uF		Ceramic	2022 552 02334
C39,55	2.2uF	25V	Electrolytic	2020 002 90258
C53	1.5nF		Poly	2020 300 90245
C54	47uF	25V	Electrolytic	05-049

Item	Value	Volt/Watt	Description	Ordering number
C60	22nF		Poly	2020 300 90251
C61	330pF		Ceramic N750	2222 631 58331
C62	4.7nF	16V	Ceramic	2222 630 07472
C63	6.8nF		Poly	2020 300 90248
C69	330pF	16V	Ceramic	2222 630 07331

Resistors

R3,6-9,14-16,23	12.1k	1%	MR25	2322 151 51213
R4,11	249k	1%	MR25	2322 151 52494
R5,13,101,105	2.2k		TRIM T7YA	2111 369 00083
R10	121k	1%	MR25	2322 151 51214
R12	10k	1%	MR25	2322 151 51003
R21	3.83k	1%	MR25	2322 151 53832
R24	18.7k	1%	MR25	2322 151 51873
R25	46.4k	1%	MR25	2322 151 54643
R26	59k	1%	MR25	2322 151 55903
R52	4.7k		TRIM T7YA	2111 369 00084
R58	47k		TRIM T7YA	2111 369 00087
R72	22k		TRIM T7YA	2111 369 00086
R76	100k		TRIM T7YA	19-273
R96	1k		NTC	2322 642 1202
R107	150		NTC	2322 642 62151
R108	1	1/2W	CR37	2322 212 13108

Item	Type	Ordering number
Printed board	UHF RX voltage controlled oscillator N08	3508 102 20000

Components mounted on the print board

Transistors

Q1	BC338B E-line	19-085
Q2	TM00085-1	19-140
Q3	BF960/BF907	9335 105 20113
Q4-7	BFT95/BF023	9335 217 80112

Diodes

D1-2	BB209	9335 411 60682
D3	04-043/8.3V Zener	04-055

Coils

L1	80049-4E2	25-089
RFC1	2.2uH	2422 535 98462
RFC2	75290-4E2	25-009
TR1	80048-4E2	25-088

Item	Value	Volt/Watt	Description	Ordering number
Capacitors				
C1-4,10-11,13 15-22	33nF		Ceramic	2222 630 01331
C5	9pF		Trim Type Tec.	2022 801 00059
C6	2.7pF	500V	N750	2222 650 57278
C7	1uF	50V	Electrolytic	2020 002 90256
C8	15uF	16V	Electrolytic	2222 122 55159
C9	2.2pF	400V	NP0	2008 554 00026
C12	8.2pF	400V	N750	2008 554 00022
C14	4.7nF		Ceramic	2222 630 01472

Item	Type	Ordering number
Printed board	CPU radio control unit N61A1	3508 102 40000

Components mounted on the print board

Integrated circuits

IC1	8040	09-274
IC2	2732	3508 102 70000
IC3	HEF40373	9335 672 10112
IC4	LM358	09-080
IC5-7	8243	09-234
IC8	HEF4013	9332 776 10112
IC9	HEF4017	9332 776 20112
IC10-11	4020	9332 827 10112
IC12	4028B	9332 827 30112
IC13	4030	9332 827 40112
IC14	HEF4073B	9333 242 70112
IC15	HEF4081B	9332 826 80112
IC16	HM-0168-5	9333 878 00682

Transistors

Q1-2,4-16	BC337	3508 100 11010
Q3	BC558	3508 100 11000

Diodes

D1,5	1N4148	9330 839 90113
D2	BAT43	9335 520 30682
D3	BZX79 24VZener	9331 178 80113
D6,7	BZX79 5.6Zener	9331 668 20113

Coil

L1	100uH	2412 541 00195

Crystal

X1	6.048MHz AP27	11-822

Item	Value	Volt/Watt	Description	Ordering number
Capacitors				
C1	100uF		Electrolytic	2222 030 34101
C2-4,8	100nF		Ceramic	2022 552 02334
C5-6	22pF		N150	2222 631 34229
C7	1nF		Plate	2222 630 07102
Resistors				
R9,46	10k	1/2W	Trim	2111 369 00085
R59-61	10k		Single in line	2120 108 90167
R62	33k		Single in line	13-712
R63	150		Single in line	13-709
R64-65	1k		Single in line	13-710
R66	10k		Single in line	13-711

Item	Type	Ordering number
Printed board	Transmiter (TX) synthesizer N18E1	N18-1

Components mounted on the print board

Integrated circuits

IC1	OM806	9333 922 30112
IC2	7621DCPA	9335 271 40682
IC3	CA3160	9336 339 50682

Transistors

Q1,3	BFQ23/02	9335 219 80112
Q2	BF960	9335 105 20113
Q4,6	BC308	
Q5	BF199	9330 634 20112
Q7	BC548	9335 101 60682

Diodes

D1	1N4148	9330 839 90113
D2	BB209	9335 411 60682

Coils

RFC1	6.8uH	04-114
RFC2	2.2uH	4322 057 02280
L1	80052-4E2	25-091

Crystal

X1	7.85MHz AP37	11-821

Item	Value	Volt/Watt	Description	Ordering number
C1,3,7,9,11,19				
33,35	1nF		Ceramic	2222 630 01102
C2,21	4.7nF		Ceramic	2222 630 01472
C4,14,31	4.7uF	25V	Tantal	2022 019 00157
C5,10	12pF		Ceramic	2222 631 34129
C6,8,12,20,22,30	4.7nF		Ceramic 2mod.	2222 630 03472
C13,32 34	0.1uF	50V	Ceramic	2022 552 02334
C15-16	330pF		Ceramic	2222 631 58331

Item	Value	Volt/Watt	Description	Ordering number
C17	18pF		Ceramic	2222 631 34189
C18	100pF		Ceramic	2222 631 34101
C23-24	47pF		Ceramic	2222 631 34479
C25-28	47nF		Poly	2020 300 90179
C26	150pF		Ceramic	2222 631 34151
C27,29	22nF		Poly	2020 300 90251
C36	2.2nF		Ceramic	2222 630 01222
C37	330pF		Ceramic	2222 630 01331

Item	Type	Ordering number
Printed board	Modem N14F1	N14-1

Components mounted on the print board

Integrated circuits

IC1,7	LM358	09-080
IC2	XR2211	9335 159 90682
IC3	78L05A	9335 499 00682
IC4,19	HEF4030	9332 827 40112
IC5,21	HEF4017	9332 776 20112
IC6	HEF4526	9334 068 30112
IC8,15-16,20,26	HEF4013	9332 776 10112
IC9	HEF4520	9332 824 60112
IC10-11,17-18	HEF4015	9332 824 00112
IC12	HEF4068	9332 824 40112
IC13	HEF4078	9335 694 70682
IC14	HEF4093	9333 242 90112
IC22	HEF4518	9332 776 60112
IC23	HEF4024	9332 826 30112
IC24	HEF4011	9332 775 90112
IC25	HEF4002	9334 537 70682

Diodes

D1-19	1N4148	9330 839 90113

Item	Value	Volt/Watt	Description	Ordering number
Capacitors				
C1,4-6,21,30	4.7nF		Ceramic	2222 630 07072
C2,3,25	1uF	50V	Electrolytic	2020 002 90256
C7,26	3.3nF		Ceramic	2220 630 07332
C8	10nF		MKT	11-495
C9	47nF		MKT	11-493
C10,28	22nF		MKT	11-489
C11-12	100nF		MKT	11-490
C13,18,27	2.2nF		Ceramic	2222 630 07222
C14	33nF		MKT	11-498
C15,19	6.8nF		MKT	11-488
C16	150pF		Ceramic	2222 631 58151
C17,20	1.0nF		Ceramic	2222 630 07102
C22,24	56pF		Ceramic	2222 631 34569
C23	33pF		Ceramic	2222 631 34339
C29	10uF	16V	Electrolytic	2020 002 90262
C31	22pF		Ceramic	2222 631 34229

Item	Value	Volt/Watt	Description	Ordering number
Resistors				
R39	2.2k		Trim	2111 369 00083
R40,45	22.6k		MR16	2322 150 52263
R41,44	14k		MR16	2322 150 51403
R42-43	11k		MR16	2322 150 51103
R46-47	51.1k		MR16	2322 150 55113

Item	Type	Ordering number
Printed board	IF amplifier N12C1	N12-1
	AGC amplifier N09B1	N09-1

Note: In stock no. N12-1 is print board N09B1 included

Components mounted on the print board

N12C1

Integrated circuit

IC1	SO41P	9336 340 10682

Transistors

Q1-2	BF495	9331 987 80112
Q3-6	BC238B E-line	19-117

Coils

L1	75279-4E2	25-001
L2-3	2.2uH	2422 535 98462

Crystal

X1	20.945MHz AP22	11-815

Crystal filters

F1	24.4MHz	11-854
F2	CFU455D	2422 549 03542

Item	Value	Volt/Watt	Description	Ordering number
Capacitors				
C1	8uF		Trim. Dau	2012 801 10019
C2,4-5,7,15	1uF	35V	Tantal	2022 019 00159
C3,25	33pF		Ceramic	2222 631 34339
C6,18	2.2nF		Ceramic	2222 630 01222
C8,20	330pF		Ceramic	2222 630 01331
C9	2.2nF		MKM	11-486
C10-11	150pF		Ceramic N750	2222 631 58151
C12	100pF		Ceramic	2222 631 34101
C13	4.7uF	25V	Tantal	2022 019 00157

Item	Value	Volt/Watt	Description	Ordering number
C14	1uF		Ceramic	2222 630 07102
C16	27pF		Ceramic	2222 631 34279
C17	39pF		Ceramic	2222 631 34399
C19	47pF		Ceramic	2222 631 34479
C21,22,26	0.1uF	50V	Ceramic	2022 552 02334
C23	1.5pF		Ceramic	2222 631 03158
C24	68pF		Ceramic	2222 631 34687

Components mounted on the print board

N09B1

Item	Type	Ordering number
Integrated circuit		
IC1	MC3340P	9335 482 70682
Transistors		
Q1-2	BC238B E-line	19-117
Diode		
D1	1N4148	9330 839 90113

Item	Value	Volt/Watt	Description	Ordering number
Capacitors				
C1	1nF		Ceramic	2222 630 08102
C2	1uF	35V	Tantal	2022 019 00159
C3,5	2.2nF		Ceramic	2222 630 08222
C4	4.7uF	10V	Tantal	2022 019 00154
C6	0.1uF	35V	Tantal	11-500
Resistors				
R1	2.7k	1/8W	CR16	2322 180 13272
R2	680k	1/8W	CR16	2322 180 13684
R3	100k	1/8W	CR16	2322 180 13104
R4	22	1/8W	CR16	2322 180 13229
R5	2.2k	1/8W	CR16	2322 180 13222
R6	10k	1/8W	CR16	2322 180 13103
R7	8.2k	1/8W	CR16	2322 180 13822

Item	Type	Ordering number
Printed board	RF amplifier and mixer N10B1	N10-1

Components mounted on the print board

Transistors

Q1	BFR91, Mot.	19-147
Q2	BFT95	19-138
Q3	2N4416	19-089

Coils

L1-6	Helix coil 80089-4E2	25-083
L11	75293-4E2	25-012
RFC1-2	RFC	25-009

Item	Value	Volt/Watt	Description	Ordering number

Capacitors

C1-8,13-14,20	330pF		Ceramic	2222 630 01331
C9,15-16,18	4.7nF		Ceramic	2222 630 07422
C10-11	3.5pF		Trim	2222 809 05001
C12	15pF		Ceramic	2222 631 34159
C17	100pF		Ceramic	2222 631 34101
C19	1.5pF		Ceramic	2222 631 03158
C21	0.47pF		Ceramic	2222 631 03567

Item	Type	Ordering number
Printed board	Transmitter voltage controlled osc. NO7C1	NO7-1

Components mounted on the print board

Transistors

Q1	BC328B E-line	19-082
Q2	BC308B E-line	19-084
Q3	TM00085-1	19-140
Q4	BF960/BF907	9335 105 20113
Q5-7	BFT95/BFQ23	9332 219 80112
Q8	BFT96/BFQ32	9335 219 90112

Diodes

D1-2	BB209	9335 411 60682
D3	1N4148	9330 839 90113

Coils

L1	80049-4E2	25-089
RFC1	74016-4, 2.2uH	2422 535 98462
RFC2-3	75290-4E2	25-009
TR1	80048-4E2	25-088

Item	Value	Volt/Watt	Description	Ordering number
Capacitors				
C1,2,3,8,9,11-20				
23-24	330pF		Ceramic	2222 630 01331
C4	9pF		Trim Type Tec.	2022 801 00059
C5	3.9pF	500V	N750	2222 650 67398
C6	2.2pF	400V	NPO	2008 554 00026
C7	1U0 20%	50V	Electrolytic	2020 002 90256
C10	8.2pF	400V	N750	2008 554 00022
C21	100pF		N150	2222 631 34101
C22	33uF	16V	Electrolytic	2020 002 00261

Item	Type	Ordering number
Printed board	Receiver (RX) synthesizer N03F1	N03-1

Components mounted on the print board

Integrated circuits

IC1	SP8906	9336 350 90682
IC2	NJ8811	09-220
IC3-4	HEF4539BP	9332 824 70112
IC5	ICL7611DCPA	9336 339 80682
IC6	LM341-P5	9335 935 00682

Transistors

Q1	BFT95/BFQ23	9332 210 80112
Q2	BC548B	9335 101 60682
Q3	SD200	9335 370 40602
Q4	BC338B	19-085
Q5-6	BFR91/02	9335 219 30112

Coils

RFC1,2,3	10uH	2412 541 00194

Crystals

X-tal	4.8MHz AP38	11-805

Switches

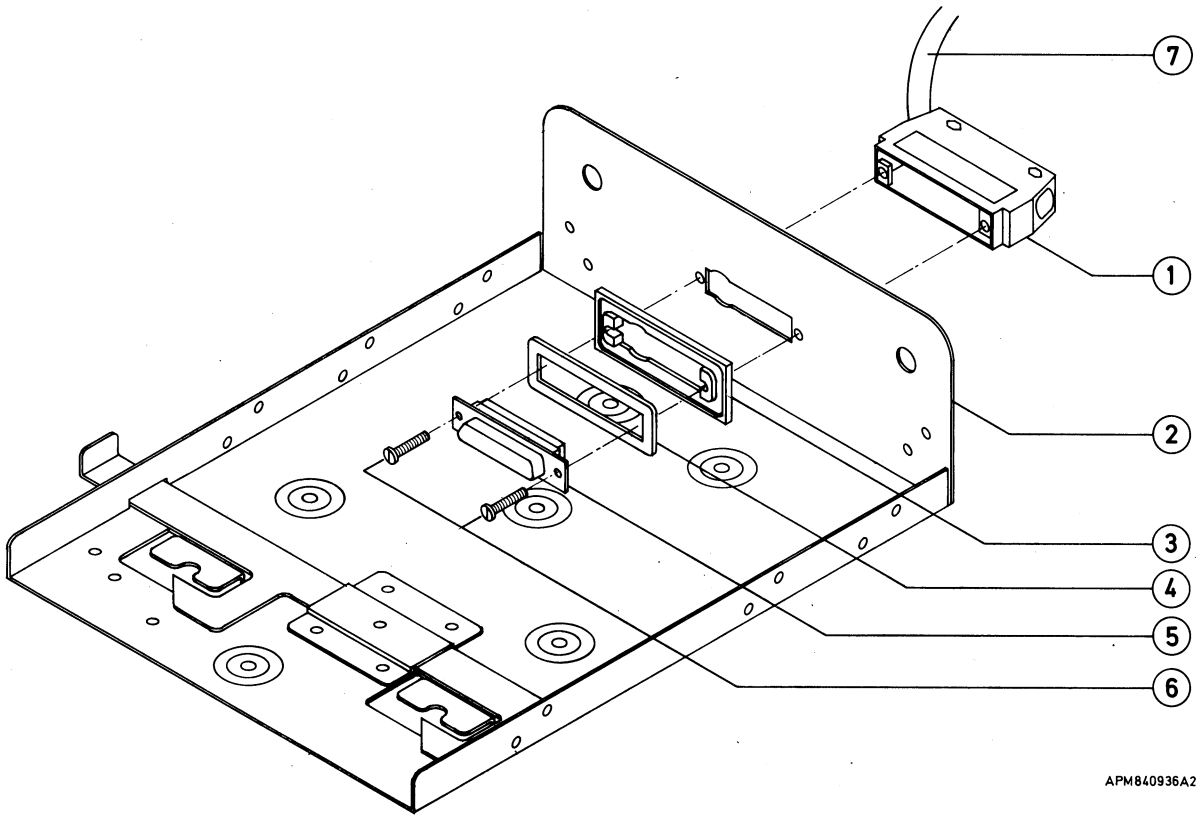
S1,2	4xswitch, 2xswitch

Item	Value	Volt/Watt	Description	Ordering number
Capacitors				
C1,2,3,9,11,14	330pF		Ceramic	2222 630 01331
C4,16,22	4.7nF		Ceramic	2222 630 07472
C5	22pF		Ceramic N750	2222 631 58229
C6	9pF		Trim Type Tec.	2022 801 00059

Item	Value	Volt/Watt	Description	Ordering number
C7	150pF		Ceramic	2222 631 34151
C8	390pF		Ceramic N1500	2222 631 70391
C10	4.7nF		Ceramic 2mod.	2222 630 03472
C12-13	6.8nF		MKH	11-488
C15	10nF		MKH	11-495
C17-18	0.1uF	50V	Ceramic	2022 552 02334
C19-21	33uF	16V	Electrolytic	2020 002 90568
C20	4.7nF	35V	Electrolytic	2020 002 90261
C23	0.22uF		MKH	11-497
C24	22nF		MKH	11-489
C26-37	330pF		Ceramic	2222 630 07331
C38	8.2pF		Ceramic N750	2008 554 00022

AP3733
Additions and alterations

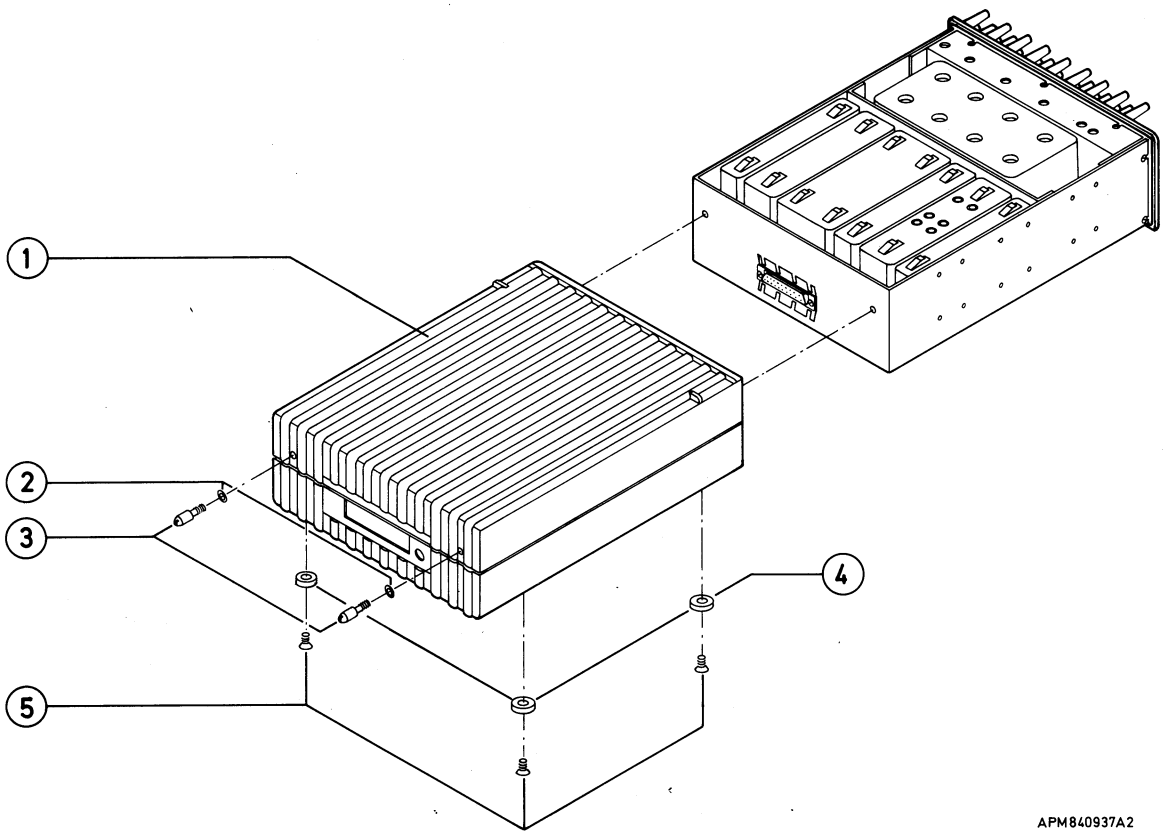
13. List of mechanical parts



AP 3733-01	Mounting bracket	**Date:** 1984.12.01
	ap radiotelefon a/s	**Page:** 13-2

List of mechanical parts

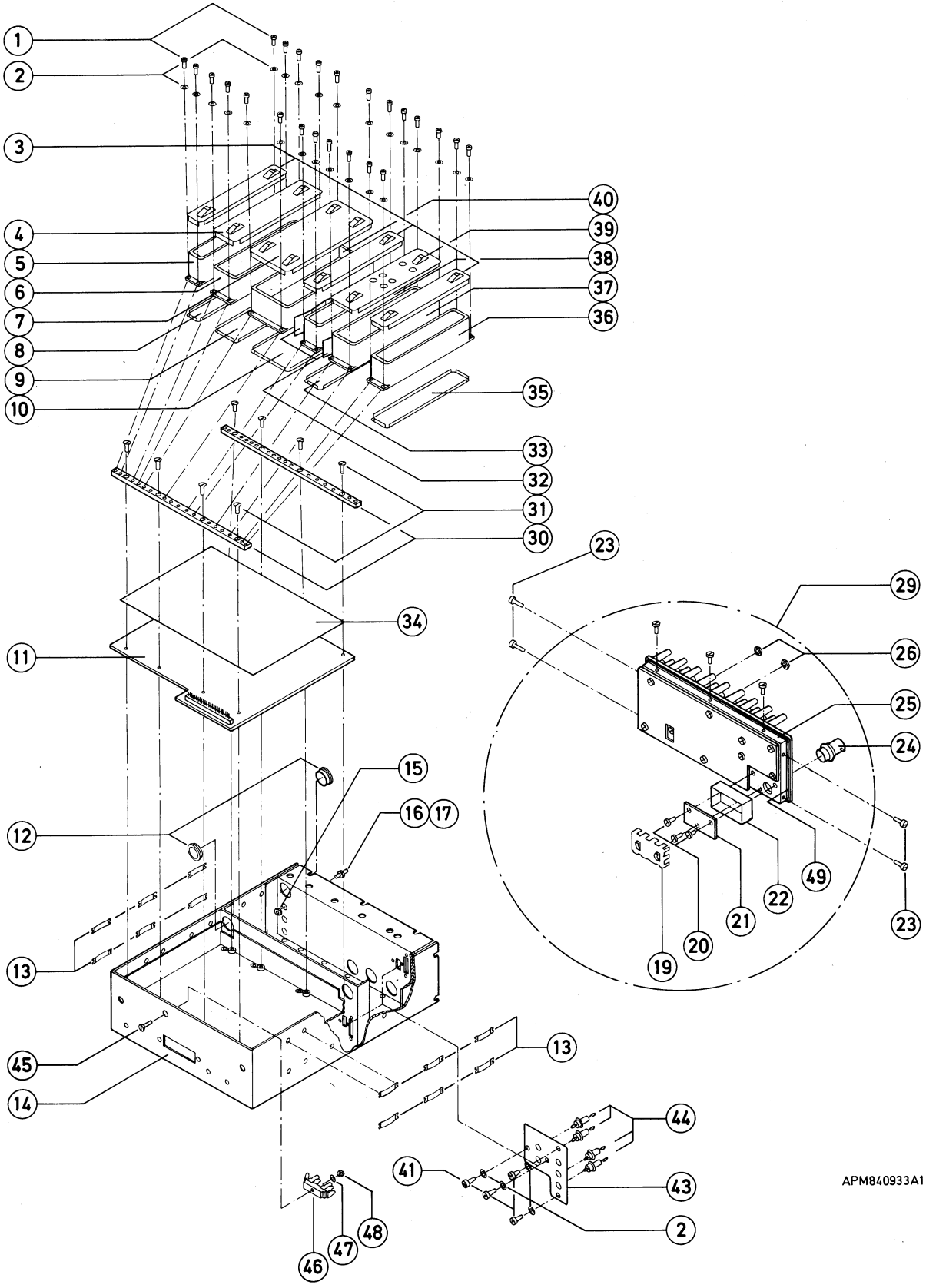
Item	Description	Ordering number
1	Connector housing 25 pol.	2432 069 00091
2	Mounting bracket for radio	3508 102 00010
3	Mounting plate	3508 101 50090
4	Washer	16-076
5	Socket 25 pol.	2422 034 10552
	Socket terminal (10pcs)	2422 034 00051
	Socket teminal, crimped (12 pcs)	2422 034 16014
6	Topscrew 4x5/8" B.Panh.	2522 123 47006
7	Cable	8208 213 01200



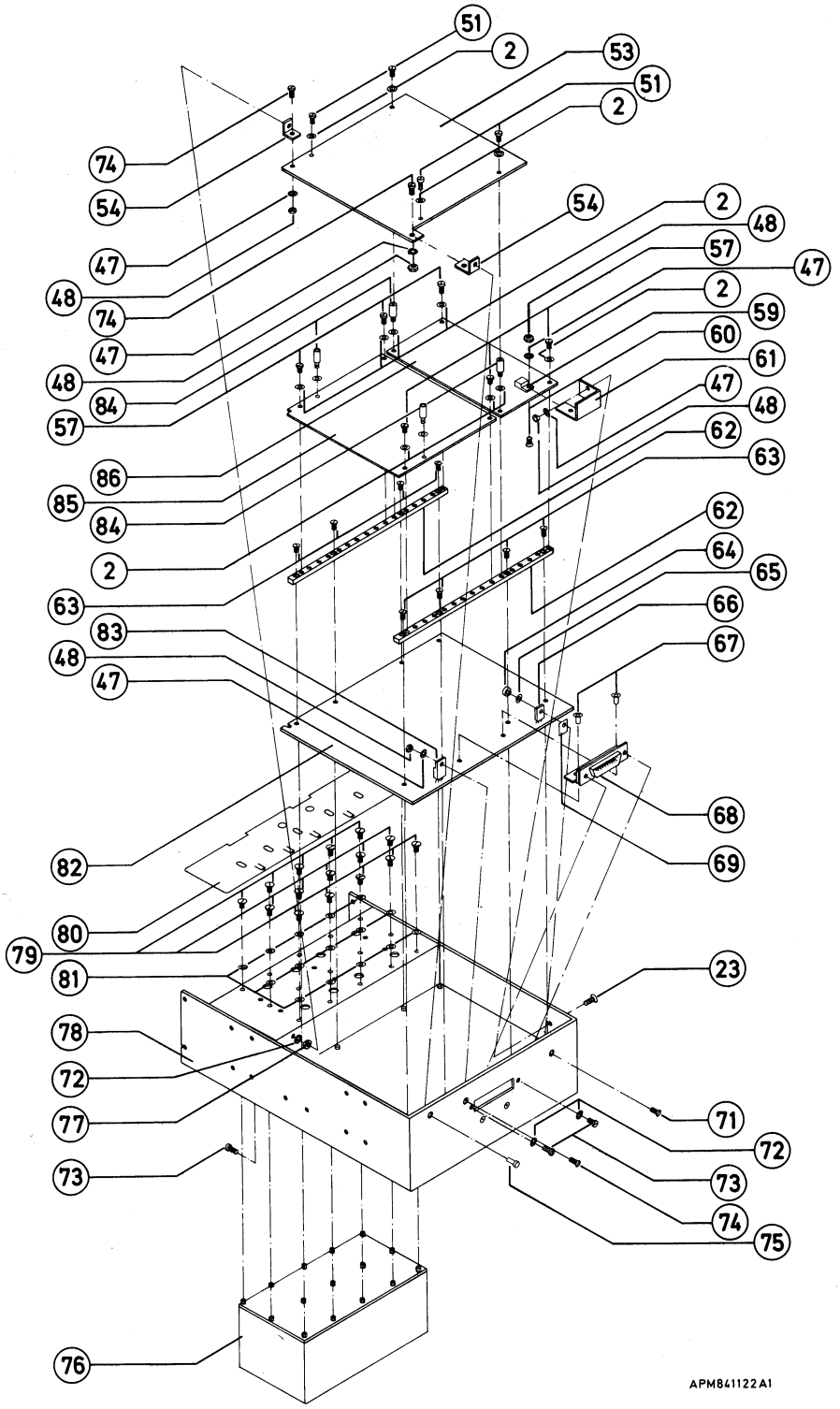
AP 3733-01	Cover	**Date:** 1984.12.01
	ap radiotelefon a/s	**Page:** 13-4

List of mechanical parts

Item	Description	Ordering number
1	Cover	3508 101 20130
2	Spring washer	2522 613 24013
3	Spacing screw	3508 101 20110
4	Spacer block	3508 101 50190
5	Screw M4x10mm UHJ	8208 130 00030



AP 3733-01	Radio unit	**Date:** 1984.12.01
	ap radiotelefon a/s	**Page:** 13-6



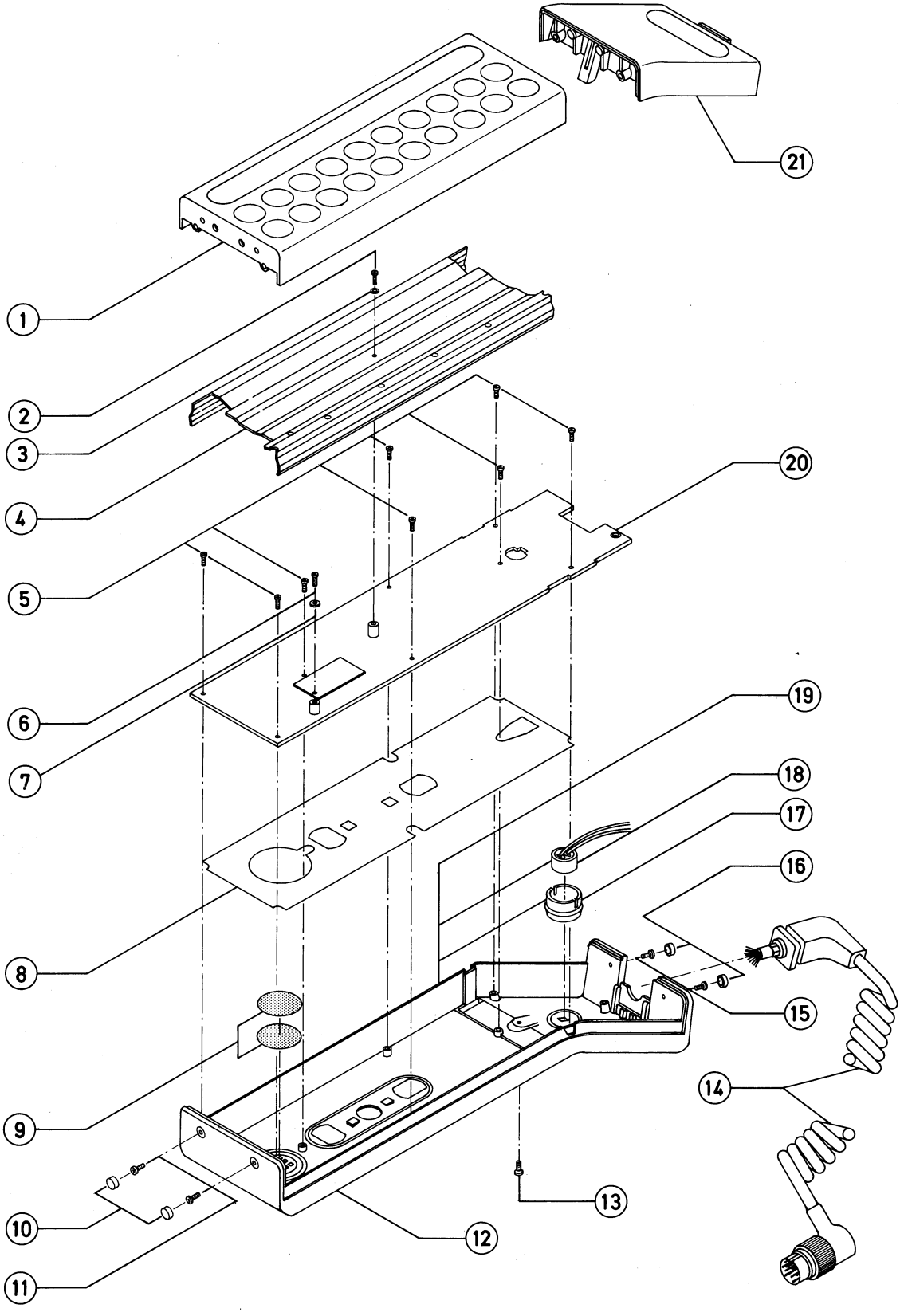
AP 3733-01	Radio unit	**Date:** 1984.12.01
	ap radiotelefon a/s	**Page:** 13-7

List of mechanical parts

Item	Description	Ordering number
1	Screw, swageform M2X6mm, PHJ	8208 130 00020
2	Curved washer M2	18-141
3	Cover, 18mm	22-737
4	Cover, 28mm	27-738
5	TX-VCO	N07C1
6	TX-synthesizer	N18E1
7	Cover, 48mm	22-739
8	Bottomshield, 18mm	22-652
9	Bottomshield, 28mm	22-650
10	Bottomshield, 48mm	22-658
11	RF-motherboard	N04C1
12	Insolating bush	16-066
13	Spring	06-049
14	Chassis	3508 101 20010
15	Nut for feed-throught	24-327
16	Feed-throught 1.2nF	2012 551 01056
17	Bushing for feed-throught	02-066
19	Cover, Aerial filter	22-787
20	Screw M2,5x12mm, UHJ	24-027
21	Aevial filter	N21A1
22	Box for aerial filter	22-671
23	Screw M2,5x6mm, PHJ	24-270
23	Screw M2.5x6mm PHJ	24-270
24	Coax socket	03-031
25	Heat sink	3508 101 20210
26	Nut for transistor	24-332
29	PA-trin (N05-2) complete	3508 102 40120
30	Rail nickel, RF-side	3508 101 20150
31	Screw, M2.5x10 UHJ	24-037
32	Spring	22-704
33	Bottomshield, 18mm	22-653
34	Isolating plate	04-184
35	Bottomshield, 18mm	22-708
36	IF-amplifier	N12C1
37	RF and mixer	N10B1
38	RX-VCO	3508 102 20000
39	Cover, 28mm (N10)	22-709
40	RX-synthesizer	N03F1
41	Screw 3/16" nr. 2	24-202
43	Mounting plate for feed-throught	3508 101 20000
44	Feed-throught 1nF	2012 551 01057
45	Screw, 142.5x8mm, UHJ	24-024
46	Fuse holder	18-296
47	Lock wash 2.5mm	19-500
48	Nut M2.5x5x2mm	24-303
49	Mesh strip	3508 100 07030
51	Screw, swageform, M2x6mm, PHJ	8208 130 00020

List of mechanical parts

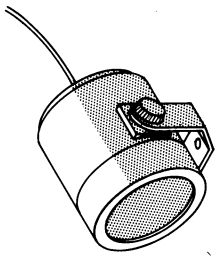
Item	Description	Ordering number
53	CPU kort	N61A1
54	Angle	22-689
55	Curved washer M2	18-141
56	Nut M2,5x5x2mm	24-303
57	Screw, swageform M2x6mm, PHJ	8208 130 00020
58	Lockwash 2.5mm	19-500
59	IC TDA2003H	09-210
60	Screw M2.5x8mm, LHM	24-247
61	Heatsink	22-669
62	Rail, nickel, sys.side	3508 101 20160
63	Screw M2.5x10mm, UHJ	24-037
64	Thread bush	07-061
65	Curved washer M3	18-143
66	Transistor 2N 4918	19-176
67	Rivet brass, 3.0x0.2x4.5x5.0mm	3508 100 00030
68	Connector 25pol	13-217
69	Insulating plate SIL-33	09-131
70	Screw M2.5x6mm, PHJ	24-270
71	Screw M2x8mm, UHJ	24-015
72	Lock washer 3.2mm	19-501
73	Screw M3x8mm, PHJ	24-271
74	Screw M2.5x8mm,UHJ	24-024
75	Buttomplug	8208 130 00010
76	Duplexfilter	3508 102 10610
77	Nut M3x5x2mm	24-305
78	Chassis	3508 101 20010
79	Screw M2.5x4mm, PHJ	24-269
80	Shield for PA-trin	22-914
81	Curved washer, M2.5	18-142
82	System motherboard	3508 102 20020
84	Threadstay	07-054
85	Modem	N14F1
86	AF and modulat. amplifier. N02	3508 102 40020



AP 3733-01	Handset	**Date:** 1984.12.01
	ap radiotelefon a/s	**Page:** 13-10

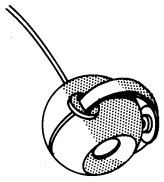
List of mechanical parts

Item	Description	Ordering number
1	Key board complete	319-007
2	Screw M2x5mm CH	24-104
3	Washer 2.4x6.3x0.5mm	4008 108 02650
4	RF shield for microphone	22-879
5	Screw 3/16" nr. 2 Black	24-202
6	Screw M2x5mm CH	24-104
7	Washer M2	18-141
8	Isolating plate	09-140
9	Gloth for speaker	82-177
10	Dækprop sort	13-024
11	Screw, plate 3/16 inch.	24-202
12	Case	3508 101 50230
13	Screw, plate 1/4 inch.	24-216
14	Coiled cable, out of stock, when store is empty	18-481
14	Coiled cable	3508 102 60150
15	Screw, plate 3/16 inch.	24-202
16	Dækprop sort	13-024
17	Bush for microphone	13-058
18	Microphone	13-107
19	Mounted bottom part, complete	313-010
20	Print board N59B1	8208 243 05921
21	Microphone cover	13-031

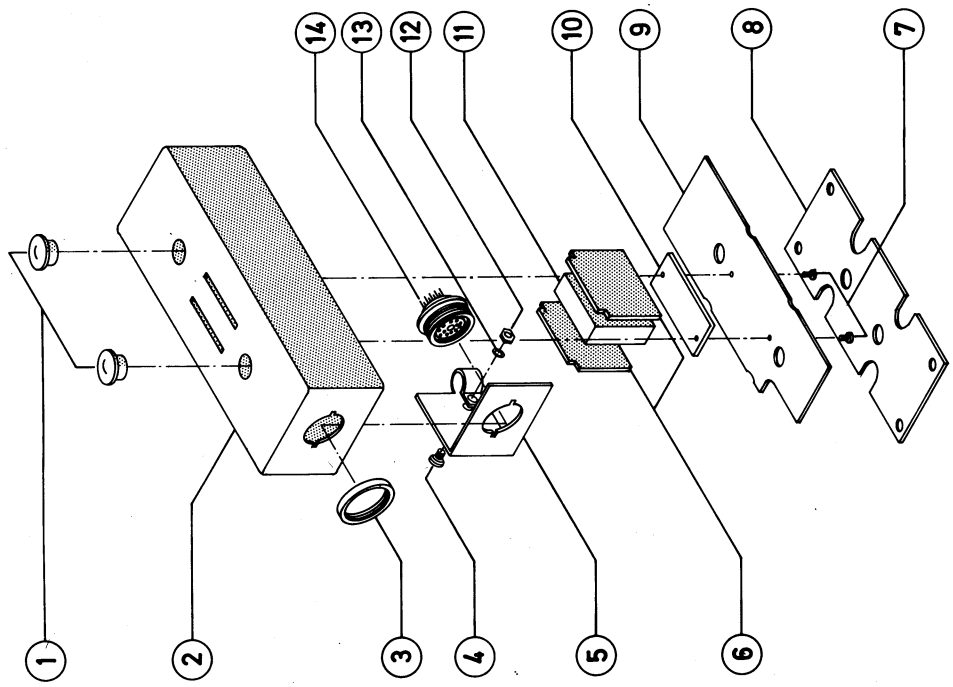


Loud speaker

APM840509A3



Microphone



Magnetic cradle for handset controller
incl. multiwire cable and connector.
Stock no. 3508 102 10170.

APM841004A2

AP 3733-01	Cradle, Microphone, Loudspeaker	**Date:** 1984.12.01
	ap radiotelefon a/s	**Page:** 13-12

List of mechanical parts

Item	Description	Ordering number
1	Holeplug for hangeup	13-128
2	Case with hole	13-116
3	Nut for multisocket	3508 100 00010
4	Screw 3x8mm	24-036
5	Bracket	22-852
6	Magnet plate	22-698
7	Screw 5/16" nr. 2	24-204
8	Base plate	22-695
9	Print board (N64)	3508 102 20010
10	Isolating plate	09-136
11	Magnetic catch	13-125
12	Nut 3x5x2mm	24-305
13	Washer 3.2mm	19-501
14	Multi socket 14 way	3508 100 55020

List of mechanical parts

Item	Description	Ordering number
	Microphone complete	213-023
	Loudspeaker complete	208-002