STORNOPHONE 6000

MAINTENANCE MANUAL

ADJUSTMENT AND SOFTWARE

OCTOBER 1990

PUBLICATION NO: 68P84836D15-D

STORNOPHPONE 6000
MAINTENANCE MANUAL FOR ADJUSTMENT AND SOFTWARE

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CHAPTER 1

SERVICE MODE

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CQM6000/MC SPECTRO - EF Software

CQM6000/MC SPECTRO - EL Software

SERVICE MODE

CQM6000 - EF SOFTWARE

1. GENERAL

This is a users guide to the service mode used in CQM6000, EF version.

The basic idea in this service mode is that all functions are accessed via a 3 digit function code. The three digits represent the following:

Function code:

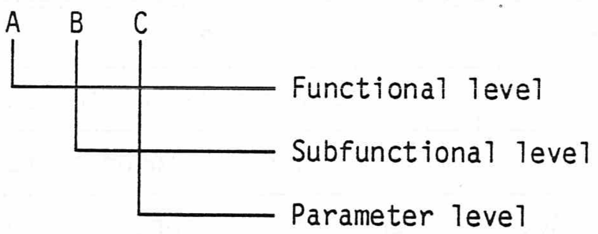


Fig. 1.1 Function code syntax.

After the function code it may be necessary to enter further data, e.g. channel number etc.

The function codes can either be entered manually by using the buttons on the control box or by simulating the key entries by an automatic test equipment.

1.1. KEY ENTRIES

In service mode the values of the keys on the control box are strictly related to their position on the control box and NOT to the values labeled on the keys. The keys have the following values:

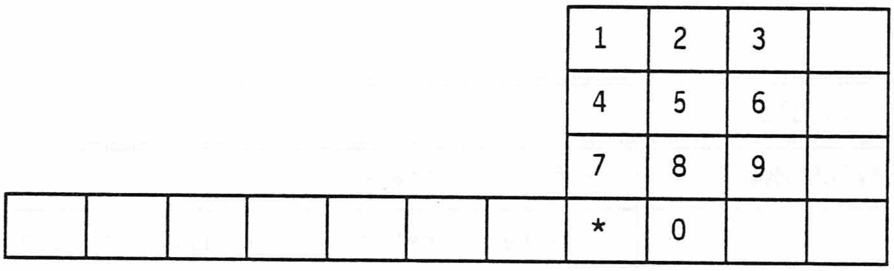


Fig. 1.2 Keyboard lay-out.

All "blank" keys in the above figure are not used but may be used similar to the *-key. One exception is the on/off key.

Entry of a function code is done by entering 3 digits which are then evaluated. If the function code does not exist, the display flashes, and an error sound is given in the loudspeaker. You can now reenter the function code or enter a completely new one.

If you regret while entering a function code, press the asterisk (*) and the function code will be considered illegal.

Note: In all the examples the # is a symbol for the cursor. When necessary the ˆ under the display indicates the cursor position.

3 examples of function code entry:

Entry	Display	
	SERVICE MODE	- initial state
0	0#	- enter first cipher in function code
0	00#	- enter second cipher in function code
0	000 001 001 400	- enter third cipher in function code

Fig. 1.3 Entry of 000 (clear all).

Entry	Display	
	SERVICE MODE	- initial state
0	0#	- enter first cipher in function code
0	00#	- enter second cipher in function code
2	002 (flashing)	- enter third cipher in function code

Fig. 1.4 Illegal function code entry.

Entry	Display	
	SERVICE MODE	- initial state
0	0#	- enter first cipher in function code
*	I (flashing)	- regret with an asterisk

Fig. 1.5 Terminating function code entry with an asterisk.

2. HOW TO ENTER SERVICE MODE

The radio can be switched into service mode in three ways:

1. Insertion of a special programmed service code plug in the control box.
2. Before starting up, pin 3 and pin 16 are connected to each other and to batt + (12V) via a 1 Kohm pull-up resistor.
3. Personality Prom filled with 00 hex.

A code plug is a service code plug if word 0 in the NMC 9306 serial EEPROM is XX1X hex. Hence if the H-bus reads a service code plug the second byte is equal 1X hex (X = don't care).

If insertion of a service code plug shall be simulated by test equipment, the test equipment must follow this procedure:

1. Generate the code plug insert message code plug IN.
2. Wait for the reception of the message code plug READ.
3. Respond to the read request by issuing a DATA FROM code plug message with the required number of data bytes.
4. Repeat step 2 and 3 until the whole code plug is transferred.

3. FUNCTION CODES

3.1. OVERVIEW

The following is a brief listing of all the function codes and their meaning.

000		Clear all (calls all other clear functions)
001		Display the software package number
100		Clear channel functions
110	<channel>	Select Rx-channel from channel-group 0
111	<channel>	Select Rx-channel from channel-group 1
112	<channel>	Select Rx-channel from channel-group 2
113	<channel>	Select Rx-channel from channel-group 3
120	<channel>	Select Tx-channel from channel-group 0
121	<channel>	Select Tx-channel from channel-group 1
122	<channel>	Select Tx-channel from channel-group 2
123	<channel>	Select Tx-channel from channel-group 3
131	<adjust>	Rx = 66.510, Tx = 66.460 MHz
132	<adjust>	Rx = 74.520, Tx = 74.040 MHz
133	<adjust>	Rx = 87.060, Tx = 86.970 MHz
134	<adjust>	Rx = 77.000, Tx = 77.000 MHz
141	<adjust>	Rx = 136.900, Tx = 136.900 MHz
142	<adjust>	Rx = 151.150, Tx = 150.400 MHz
143	<adjust>	Rx = 172.450, Tx = 172.300 MHz
144	<adjust>	Rx = 155.000, Tx = 155.000 MHz

161	<adjust>	Rx = 404.600, Tx = 404.700 MHz
162	<adjust>	Rx = 430.200, Tx = 430.700 MHz
163	<adjust>	Rx = 467.300, Tx = 467.400 MHz
164	<adjust>	Rx = 436.500, Tx = 436.500 MHz
165	<adjust>	Rx = 404.600, Tx = 404.700 MHz *
166	<adjust>	Rx = 430.200, Tx = 430.700 MHz * 12.5 kHz
167	<adjust>	Rx = 467.300, Tx = 467.400 MHz * only
168	<adjust>	Rx = 436.500, Tx = 436.500 MHz *
171	<adjust>	Rx = 174.900, Tx = 174.900 MHz
172	<adjust>	Rx = 188.900, Tx = 188.400 MHz
173	<adjust>	Rx = 208.600, Tx = 208.600 MHz
174	<adjust>	Rx = 192.000, Tx = 192.000 MHz
175	<adjust>	Rx = 190.900, Tx = 190.900 MHz
176	<adjust>	Rx = 204.560, Tx = 204.300 MHz
177	<adjust>	Rx = 223.650, Tx = 223.600 MHz
178	<adjust>	Rx = 207.500, Tx = 207.500 MHz
200		Clear Tx functions
300		Clear Rx functions
400		Clear audio functions
410		Volume level 0
411		Volume level 1
412		Volume level 2
413		Volume level 3
414		Volume level 4
415		Volume level 5
416		Volume level 6
417		Volume level 7
430		Squelch bypass off
431		Squelch bypass on
500		Clear signalling
521		Enable decoding
522	<system>	Select signalling system for decoder
523	<digits>	Select number of digits in received telegrams
531		Send a telegram
532	<system>	Select signalling system for encoder
533	<digits>	Select number of digits in send telegrams
534	<telegram>	Enter telegram for transmitter
700		Clear programming
710	<addr>	Read from program code (0000 < addr < BFFF)
720	<addr>	Read from personality prom (C000 < addr < C7FF)
730	<addr><data>	Write to personality prom (C000 < addr < C7FF)
740	<addr>	Read from code plug (00 < addr < ?)
750	<addr><data>	Write to code plug (02 < addr < ?)
760	<addr>	Select code plug-device address (20 - 2A)

3.2. FUNCTION CODE 0xx - SPECIAL FUNCTIONS.

All function codes in this group are used for special purposes which are normally non general functions unique to the specific radio. There is one exception, and that is function code 000 which is a general clear.

3.2.1. 000 - general clear.

This code activates all clear functions in the other function groups, i.e. 100, 200, ... The display in the control box is switched to the standard display format:

Display:

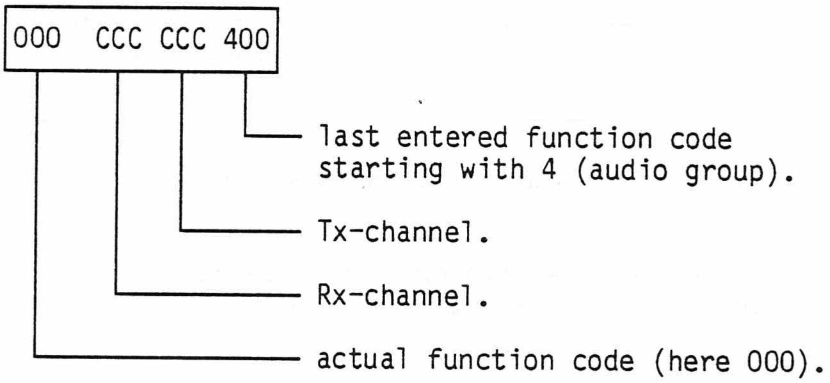


Fig. 3.1 Standard display format.

After a general clear, the radio has the following defaults:

Volume	4
Rx-channel	The first available channel
Tx-channel	The first available channel
Encoder system	CCIR sequential tones
Decoder system	CCIR sequential tones
Number of digits in a received telegram	5
Number of digits in a transmitted telegram	5
Decoding	Disabled
Telegram to send	1 2 3 4 5 6 7 8 9 A B C
Squelch bypass	OFF
code plug device addr	20

Fig. 3.2 Default values.

3.2.2. 001 - display the software package number

This function displays the software package number including the revision no.

Display :

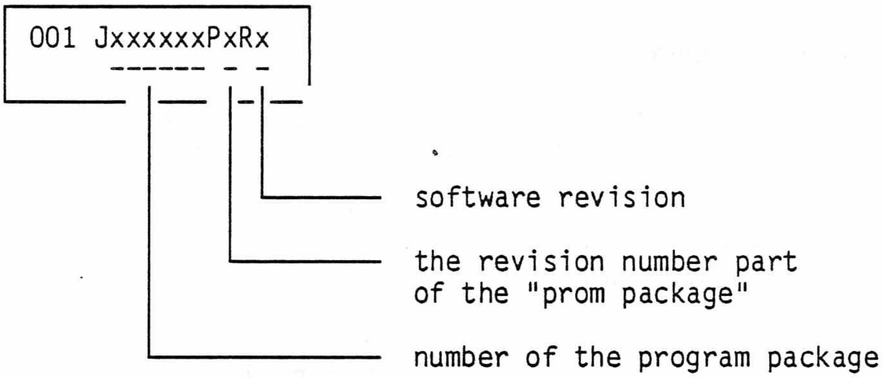


Fig. 3.3 Syntax of software package number

The software package number is placed at address 100 hexadecimal and forward. If no radio is available use prom burner to display the software package number.

3.3. FUNCTION CODE 1xx. - CHANNEL FUNCTIONS

Function codes in this group are used to select receiver (Rx) and transmitter (Tx) channels. These can be selected independently of each other.

The channels can be selected arbitrarily among the defined channels in all 4 channel groups. The channels are referred to by their logical number.

The general syntax for function codes in this group is as follows:

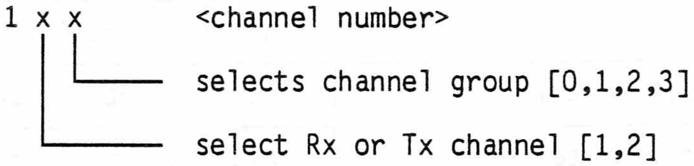


Fig. 3.4 Syntax of function code 1xx.

The second cipher in the function code specify the following:
1 = Select Rx-channel.
2 = Select Tx-channel.

The third cipher points out the channel group, i.e. group 0 to group 3.

When the function code is entered, the radio waits for a 3 digit channel number before searching in the channel table.

An attempt to select an illegal (undefined) channel will result in an error sound in the loudspeaker and the channel will remain unchanged.

3.3.1. 100 - clear channel functions.

Function code 100 is used to clear all channel functions, i.e. to select the default channels:

Rx-channel is the same as Tx-channel, which is selected as the first available channel. Channel group 0 is examined before channel group 1 etc.

The display layout is the general display format (see fig. 3.1).

3.3.2. 11x - select receiver channel.

x selects the channel group which can be group 0 to 3.

An example of selection of a receiver channel is shown below. It is assumed that the Rx- and Tx-channels are both 001 and you want to select receiver channel 004. "#" is the cursor.

Entry	Display	Comments
	#00 001 001 400	- initial state.
1	1# 001 001 400	- enter first cipher in function code.
1	11# 001 001 400	- enter second cipher in function code.
0	110 #01 001 400	- function code now entered.
0	110 0#1 001 400	- enter first cipher in channel number
*	110 0#1 001 400	- enter a wrong key by accident.
0	110 00# 001 400	- enter second cipher in channel number.
4	#10 004 001 400	- enter third cipher in channel number.

Fig. 3.5 **Entry of Rx-channel.**

When a channel number is fully entered (3 digits) the specified channel is selected, if it exists, and the cursor is positioned at the first cipher in the function code ready to receive a new function code. If an illegal channel number is entered, an error sound is given, and the channel is not changed which is indicated by displaying the standard display format with the original channel.

3.3.3. 12x - select transmitter channel.

x selects the channel group which can be group 0 to 3.

An example of selection of a transmitter channel is shown below. It is assumed that the Rx- and Tx-channels are both 001 and you want to select transmitter channel 007. "#" is the cursor.

Entry	Display	Comments
	#00 001 001 400	- initial state.
1	1# 001 001 400	- enter first cipher in function code.
2	12# 001 001 400	- enter second cipher in function code.
3	123 001 #01 400	- function code now entered.
0	110 001 0#1 400	- enter first cipher in channel number
0	110 001 00# 400	- enter second cipher in channel number.
7	#10 001 007 400	- enter third cipher in channel number.

Fig 3.6 Entry of Tx-channel.

When a channel number is fully entered (3 digits) the specified channel is selected, if it exists, and the cursor is positioned at the first cipher in the function code ready to receive a new function code. If an illegal channel number is entered, an error sound is given, and the channel is not changed which is indicated by displaying the standard display format with the original channel.

3.4. FUNCTION CODE 4xx - AUDIO FUNCTIONS.

This group contains the audio functions. The general syntax is:

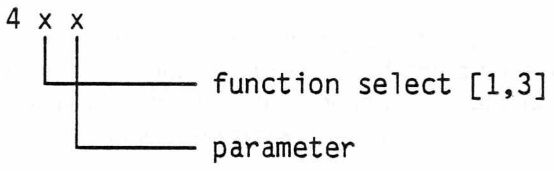


Fig. 3.7 Syntax of function code 4xx.

The functions implemented are:

function select	function	parameter
1	select volume	volume level
3	squelch bypass	on/off

Fig. 3.8 Audio default values.

3.4.1. 400 - clear audio functions.

The function code 400 is used to select the default values for the audio functions. The default values are:

- Volume level 4.
- Squelch bypass off.

The display layout is the standard display format, e.g.:

```
400  001 001 400
```

Fig. 3.9 Audio display format.

3.4.2. 41x - select volume level.

41x are used to select volume according to the third cipher in the function code, e.g. 413 selects volume level 3. The legal range for the volume is 0 - 7.

```
4 1 x
    |
    |______      volume level [0-7]
```

Fig. 3.10 Syntax for volume select.

When a new volume is entered the radio changes the volume and gives a short beep in the loudspeaker with the new volume. This beep comes immediately after the key-press beep.

The display layout is the standard display format, e.g.:

```
414  001 001 400
```

Fig. 3.11 Display format when selecting volume.

3.4.3. 43x - squelch bypass on/off.

431 is used to open the LF-way from the receiver to the loudspeaker regardless of carrier detection. This is what is called squelch bypass.

430 is used to clear this function, thus the loudspeaker follows the carrier detection, i.e. when carrier is detected, the loudspeaker is enabled.

The display layout is the standard display format, e.g.:

```
431  001 001 400
```

Fig. 3.12 Display format using function code 43x.

3.5. FUNCTION CODE 5xx - SIGNALLING FUNCTIONS.

Function codes in this group are all used for signalling purposes which are mostly to drive the 7720 signal processor.

The general syntax for this group is:

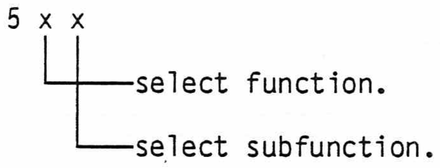


Fig. 3.13 Syntax for function code 5xx.

The second cipher in the function code is used to determine which part of the signalling function is selected:

1. 0. Clear signalling.
2. 1. Not used
3. 2. Decoder functions.
4. 3. Encoder functions

The third cipher has the same subfunction for the two latter groups:

1. 0. Not used.
2. 1. Enable decoding/encoding (send/receive).
3. 2. Select signalling system.
4. 3. Select number of digits in the telegram.
5. 4. Enter telegram (for the encoder only).

3.5.1. 500 - clear signalling functions.

500 selects the default signalling parameters:

Encoder system	CCIR sequential tones
Decoder system	CCIR sequential tones
Number of digits in a received telegram	5
Number of digits in a transmitted telegram	5
Decoding	Disabled
Telegram to send:	1 2 3 4 5 6 7 8 9 A B C

Fig. 3.14 Default signalling values.

3.5.2. 521 Enable decoding.

521 enables decoding which have the effect that each time a telegram of the specified type and the specified number of digits is received, the square lamp in the control box will be lit, and the telegram will be read out in the display.

Note: If a function code from any other function group than 5xx is activated only the square lamp will be lit. The telegram will NOT be shown in the display.

The decoding will remain enabled until a clear signalling command (500) has been executed.

To turn off the square lamp use the 521 command again.

If more telegrams are sent immediately after each other there can be a problem with detection of the 2nd and the following telegrams due to the fact that it takes a finite time to set up the decoder.

Entry	Display	Comments
	#00 001 001 400	- initial state.
5	5# 001 001 400	- enter first cipher in function code.
2	52# 001 001 400	- enter second cipher in function code.
1	#21	- function code now entered. Waiting for a telegram or a new function code.

Upon reception of the telegram "12345" the display will show the telegram:

#21 12345

Fig. 3.15 Enable decoding.

3.5.3. 522 - select decoder system.

522 selects signalling system for the decoder according to the following table:

Code Signalling system

00 = reserved.
01 = ZVEI 1
02 = ZVEI 2
03 = ZVEI 3
04 = CCIR
05 = EEA
06 = VDEW (not implemented yet)
07 = DTMF (not implemented yet)
08 = not used
09 = Binary ZVEI 1200 baud
10 = Binary ZVEI 2400 baud
11 = Binary EEA 1200 baud
12 = Binary EEA 2400 baud
13 = not used
14 = Type approval
15 = Special tone system (see personality prom)

Fig. 3.16 Signalling systems.

Note that the above values are the same as the values used when specifying the personality data.

Example on how to select decoder system ZVEI 1:

Entry	Display	Comments
	#00 001 001 400	- initial state.
5	5# 001 001 400	- enter first cipher in function code.
2	52# 001 001 400	- enter second cipher in function code.
2	522 SYSTEM:#	- function code now entered.
0	522 SYSTEM:0#	- enter first cipher in decoder system.
1	#22 SYSTEM:01	- enter second cipher in decoder system.

Fig. 3.17 Selection of decoder system.

3.5.4. 523 - select number of digits in received telegrams.

523 selects number of digits the radio must receive before it is considered as a telegram. The legal range is 01 to 12 and it is always necessary to enter two digits, i.e. four is entered as 04.

Below is an example on selecting telegrams with 4 digits.

Entry	Display	Comments
	#00 001 001 400	- initial state.
5	5# 001 001 400	- enter first cipher in function code.
2	52# 001 001 400	- enter second cipher in function code.
3	523 DIGITS:#	- function code now entered.
0	523 DIGITS:0#	- enter first cipher in number of digits.
4	#23 DIGITS:04	- enter second cipher in number of digits.

Fig. 3.18 Entry of number of digits in a received telegram.

3.5.5. 531 send one telegram.

531 causes a telegram of the specified type to be sent. Note that if the synthesizer does not lock on the Tx-channel the telegram is not sent.

3.5.6. 532 - select encoder system.

532 Selects encoder system according to the previously shown table. The transmitter inserts repeat tones automatically when necessary.
Example on how to select encoder system to binary EEA 1200 baud.

Entry	Display	Comments
	#00 001 001 400	- initial state.
5	5# 001 001 400	- enter first cipher in function code.
3	53# 001 001 400	- enter second cipher in function code.
2	532 SYSTEM:#	- function code now entered.
1	532 SYSTEM:1#	- enter first cipher in encoder system.
1	#32 SYSTEM:11	- enter second cipher in encoder system.

Fig. 3.19 Selection of encoder system.

3.5.7. 533 - select number of digits in transmitted telegrams.

533 Selects number of digits in the transmitted telegram. The legal range is 00 to 12 and it is always necessary to enter two digits, i.e. 6 is entered as 06.

Below is an example on selecting telegrams with 10 digits.

Entry	Display	Comments
	#00 001 001 400	- initial state.
5	5# 001 001 400	- enter first cipher in function code.
3	53# 001 001 400	- enter second cipher in function code.
3	533 DIGITS:#	- function code now entered.
1	533 DIGITS:1#	- enter first cipher in number of digits.
0	#33 DIGITS:10	- enter second cipher in number of digits.

Fig. 3.20 Entry of number of digits in a send telegram.

3.5.8. 534 - select encoder telegram.

534 selects the actual digits in the transmitted telegram. The digits are entered as hexadecimal digits in the form shown in the table below.

Key sequence	Display
00	0
01	1
02	2
03	3
04	4
05	5
06	6
07	7
08	8
09	9
10	A
11	B
12	C
13	D
14	E
15	F

Fig 3.21 Entry of hexadecimal numbers.

A sequence which requires data is terminated by activating the asterisk (*).

	Telegram buffer
1. The default telegram buffer is: The number of digits is 5:	123456789ABC ^——^
2. You enter 5 new digits 57680 :	576806789ABC ^——^
3. You selects number of digits in the telegram to 8:	576806789ABC ^————^
4. You send the telegram:	57680678

Fig. 3.22 Entry of a telegram to send.

The next example shows entry of a telegram when number of digits in the telegram is specified to 3. Assume the telegram to be entered is 6A1.

Entry	Display	Comments
	#00 001 001 400	- initial state.
5	5# 001 001 400	- enter first cipher in function code.
3	53# 001 001 400	- enter second cipher in function code.
4	534 #	- function code now entered.
0	534 #	- enter first cipher of telegram.
6	534 6#	- enter first cipher of telegram.
1	534 6#	- enter second cipher of telegram.
0	534 6A#	- enter second cipher of telegram.
0	534 6A#	- enter third cipher of telegram.
1	#34 6A1	- enter third cipher of telegram.

The telegram is now entered and the cursor is positioned at the first cipher in the function code ready to receive a new function code.

Fig. 3.23 Entry of the digits in a telegram to send.

3.6. FUNCTION CODE 7xx - PROGRAMMING.

This function group is used for programming purposes and to show the contents of the different storage devices in the radio (i.e. personality prom, program prom and code plug).

The general syntax for this group is as follows:

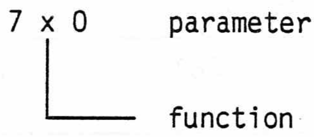


Fig. 3.24 Syntax of function code 7xx.

The functions implemented are:

function	description	parameter
0	Clear programming.	none
1	Read from program code.	addr [step...step] *
2	Read from personality data.	addr [step...step] *
3	Write into personality data.	addr [data...data] *
4	Read from code plug.	addr [step...step] *
5	Write to code plug.	addr [data...data] *
6	Select code plug-device addr	addr

Fig. 3.25 Programming functions.

The address and data are entered as decimal values for the corresponding hexadecimal ciphers and are shown in the display as the hexadecimal values. This means that a 4 digit hexadecimal number requires 8 key activations. The hexadecimal ciphers are entered as shown below:

Key sequence	Display
00	0
01	1
02	2
03	3
04	4
05	5
06	6
07	7
08	8
09	9
10	A
11	B
12	C
13	D
14	E
15	F

Fig. 3.26 Entry of hexadecimal numbers.

Any other combination of numerical keys are ignored apart from an error sound which is given in the loudspeaker.

A sequence which requires data is terminated by activating the asterisk (*).

3.6.1. 700 - Clear programming.

This function code initializes everything used in the programming functions to the original state as if the service mode was just entered.

Entry	Display	Comments
	#00 001 001 400	- initial state.
7	7# 001 001 400	- enter first cipher in function code.
0	70# 001 001 400	- enter second cipher in function code.
0	700	- function code entered.

Fig. 3.27 Clear programming.

3.6.2. 720 read personality prom.

Reads and displays the contents of the personality data at a specified address. The routine expects a correct address in the range C000-C7FF. If an illegal address is entered, an error sound will be given, and the cursor will be positioned at the first digit in the address ready to receive a correct address.
When the address is entered, and the data shown in the display, it is possible to step through the prom by activating the key corresponding to the number of steps wanted, i.e. if you want to step to the following byte press key 1.
To exit from this mode activate the asterisk (*), though it will be considered as an illegal entry.

An example where the personality data at address C010 and further contains C0, A0, C7, 00, C7, C0, FF, FF.

Entry	Display	Comments
	#00 01 001 400	- initial state.
7 2 0	720 A:#	- function code entered ready to addr entry.
1 2	720 A:C	- enter first digit of the address.
0 0	720 A:C0	- enter second digit of the address.
0 1	720 A:C01	- enter third digit of the address.
0 0	720 A:C010 D:C0	- enter fourth digit of the address.
1	720 A:C011 D:A0	- enter step forward
2	720 A:C013 D:00	- enter step forward
*	#20 A:C013 D:00	- exit from this mode

Fig. 3.28 Read from personality prom.

3.6.3. 730 - write into personality data.

Writes bytes into the personality area at a specified address. The routine expects a correct address in the range C000-C7FF. If an illegal address is entered an error sound will be given and the cursor will be positioned at the first digit in the address ready to receive a correct address.

When the address is entered, the data is shown in the display, then the new data must be entered. If the data should not be changed it is necessary to write the same data as shown in the display.

When a byte is written (8 digits entered), the address is incremented by 1, and the radio is ready to receive new data to this address.

To exit from this mode press the asterisk (*).

If there is no EEPROM but an UV-prom in the radio, the radio writes "NO EEPROM" in the display. The prom is considered as a EEPROM if the cell C000H (the first byte in the personality prom) contains 00.

An example where you want to change the contents of address C1F0 from FF, 03, A5 to 04, 03, C0.

Entry	Display	Comments
	#00 001 001 400	- initial state.
7 3 0	730 A:#	- function code entered ready to addr entry.
1 2	730 A:C	- enter first digit of the address.
0 1	730 A:C1	- enter second digit of the address.
1 5	730 A:C1F	- enter third digit of the address.
0 0	730 A:C1F0 D:FF	- enter fourth digit of the address.
0 0	730 A:C1F0 D:0F	- enter first cipher in data.
0 4	730 A:C1F0 D:04	- enter second cipher in data.
	730 A:C1F1 D:03	- the byte is written
0 0	730 A:C1F1 D:03	- enter first cipher in data.
0 3	730 A:C1F1 D:03	- enter second cipher in data.
	730 A:C1F2 D:A5	- the byte is written
1 2	730 A:C1F2 D:C5	- enter first cipher in data.
0 0	730 A:C1F2 D:C0	- enter second cipher in data.
	730 A:C1F3 D:FF	- the byte is written
*	#30 A:C1F3 D:FF	- exit from this mode

Fig. 3.29 Write to personality prom.

3.6.4. 740 - read from code plug.

Reads and displays the contents of the code plug at a specified address. The routine expects a correct address in the range 00-1F (for the small code plug). If an illegal address is entered, an error sound will be given and the cursor will be positioned at the first digit in the address ready to receive a correct address.

If no code plug is present then "NO code plug" is written in the display.

When the address is entered and the data is shown in the display, it is possible to step through the code plug by activating the key corresponding to the number of steps wanted, i.e. if you want to step to the following byte press key 1.

To exit from this mode activate the asterisk (*), though it will be considered as an illegal entry.

An example where the code plug data at address 05 and further contains 12, A0, 3D, 00.

Entry	Display	Comments
	#00 001 001 400	- initial state.
7 4 0	740 A:#	- function code entered ready to addr enter
0 0	740 A:0	- enter first digit of the address.
0 5	740 A:05 D:12	- enter second digit of the address.
1	740 A:06 D:A0	- enter step forward
2	740 A:08 D:00	- enter step forward
*	#40 A:08 D:00	- exit from this mode

Fig. 3.30 Read code plug prom.

3.6.5. 750 - write into code plug.

Writes bytes into the code plug at specified address. The routine expects a correct address, i.e. in the range 00-1F. If an illegal address is entered, an error sound will be given and the cursor will be positioned at the first digit in the address ready to receive a correct address.

If no code plug is present, "NO code plug" is written in the display.

When the address is entered, the data is shown in the display, then the new data must be entered. If the data should not be changed, it is necessary to write the same data as shown in the display.

When a byte is written (4 digits entered), the address is incremented by 1, and the radio is ready to receive new data to this address.

To exit from this mode, just press the asterisk (*).

Note: It is not possible to program the first two bytes in the code plug, though the service-mode does not check if it is tried out.

An example where you want to change the contents of address 13 from FF to 04.

Entry	Display	Comments
	#00 001 001 400	- initial state.
7 5 0	750 A:#	- function code entered ready to addr entry.
0 1	750 A:1#	- enter first digit of the address.
0 3	750 A:13 D:FF	- enter second digit of the address.
0 0	750 A:13 D:0F	- enter first cipher in data.
0 4	750 A:13 D:04	- enter second cipher in data.
	750 A:14 D:FF	- the byte is written
*	#50 A:C1F3 D:FF	- exit from this mode

Fig. 3.31 Write to code plug

SERVICE MODE

CQM6000 - EF SOFTWARE

1. GENERAL

This is a users guide to the service mode used in CQM6000, EF version.

The basic idea in this service mode is that all functions are accessed via a 3 digit function code. The three digits represent the following:

Function code:

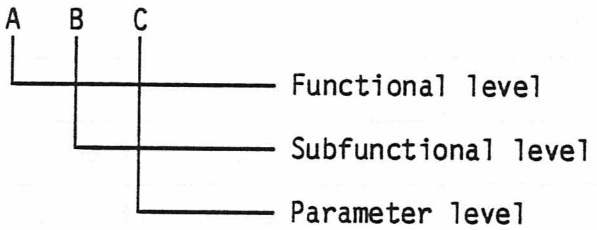


Fig. 1.1 **Function code syntax.**

After the function code it may be necessary to enter further data, e.g. channel number etc.

The function codes can either be entered manually by using the buttons on the control box or by simulating the key entries by an automatic test equipment.

1.1. KEY ENTRIES

In service mode the values of the keys on the control box are strictly related to their position on the control box and NOT to the values labeled on the keys. The keys have the following values:

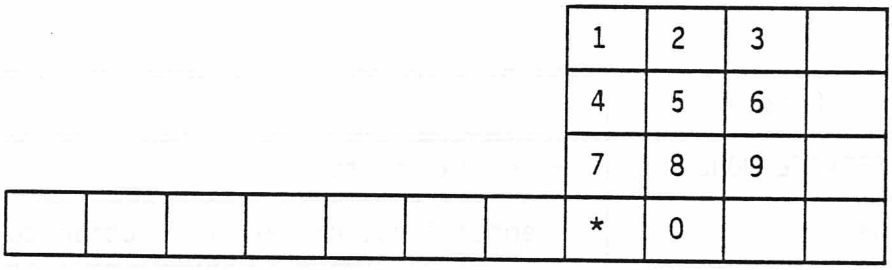


Fig. 1.2 **Keyboard lay-out.**

All "blank" keys in the above figure are not used but may be used similar to the *-key. One exception is the on/off key.

Entry of a function code is done by entering 3 digits which are then evaluated. If the function code does not exist, the display flashes, and an error sound is given in the loudspeaker. You can now reenter the function code or enter a completely new one.

If you regret while entering a function code, press the asterisk (*) and the function code will be considered illegal.

Note: In all the examples the # is a symbol for the cursor. When necessary the ˆ under the display indicates the cursor position.

3 examples of function code entry:

Entry	Display	
	SERVICE MODE	- initial state
0	0#	- enter first ciffer in function code
0	00#	- enter second ciffer in function code
0	000 001 001 400	- enter third ciffer in function code

Fig. 1.3 Entry of 000 (clear all).

Entry	Display	
	SERVICE MODE	- initial state
0	0#	- enter first ciffer in function code
0	00#	- enter second ciffer in function code
1	001 (flashing)	- enter third ciffer in function code

Fig. 1.4 Illegal function code entry.

Entry	Display	
	SERVICE MODE	- initial state
0	0#	- enter first ciffer in function code
*	I (flashing)	- regret with an asterisk

Fig. 1.5 Terminating function code entry with an asterisk.

2. HOW TO ENTER SERVICE MODE

The radio can be switched into service mode in three ways:

1. Insertion of a special programmed service code plug in the control box.
2. Before starting up, pin 3 and pin 16 are connected to each other and to batt + (12V) via a 1 Kohm pull-up resistor.
3. Personality Prom filled with 00 hex.

A code plug is a service code plug if word 0 in the NMC 9306 serial EEPROM is XX1X hex. Hence if the H-bus reads a service code plug the second byte is equal 1X hex (X = don't care).

If insertion of a service code plug shall be simulated by test equipment, the test equipment must follow this procedure:

1. Generate the code plug insert message code plug IN.
2. Wait for the reception of the message code plug READ.
3. Respond to the read request by issuing a DATA FROM code plug message with the required number of data bytes.
4. Repeat step 2 and 3 until the whole code plug is transferred.

3. FUNCTION CODES

3.1. OVERVIEW

The following is a brief listing of all the function codes and their meaning.

000		Clear all (calls all other clear functions)
001		Display the software package number
100		Clear channel functions
110	<channel>	Select Rx-channel from channel-group 0
111	<channel>	Select Rx-channel from channel-group 1
112	<channel>	Select Rx-channel from channel-group 2
113	<channel>	Select Rx-channel from channel-group 3
120	<channel>	Select Tx-channel from channel-group 0
121	<channel>	Select Tx-channel from channel-group 1
122	<channel>	Select Tx-channel from channel-group 2
123	<channel>	Select Tx-channel from channel-group 3
131	<adjust>	Rx = 66.510, Tx = 66.460 MHz
132	<adjust>	Rx = 74.520, Tx = 74.040 MHz
133	<adjust>	Rx = 87.060, Tx = 86.970 MHz
134	<adjust>	Rx = 77.000, Tx = 77.000 MHz
141	<adjust>	Rx = 136.900, Tx = 136.900 MHz
142	<adjust>	Rx = 151.150, Tx = 150.400 MHz
143	<adjust>	Rx = 172.450, Tx = 172.300 MHz
144	<adjust>	Rx = 155.000, Tx = 155.000 MHz
161	<adjust>	Rx = 404.600, Tx = 404.700 MHz
162	<adjust>	Rx = 430.200, Tx = 430.700 MHz
163	<adjust>	Rx = 467.300, Tx = 467.400 MHz
164	<adjust>	Rx = 436.500, Tx = 436.500 MHz

165	<adjust>	Rx = 404.600, Tx = 404.700 MHz *
166	<adjust>	Rx = 430.200, Tx = 430.700 MHz * 12.5 kHz
167	<adjust>	Rx = 467.300, Tx = 467.400 MHz * only
168	<adjust>	Rx = 436.500, Tx = 436.500 MHz *
171	<adjust>	Rx = 174.900, Tx = 174.900 MHz
172	<adjust>	Rx = 188.900, Tx = 188.400 MHz
173	<adjust>	Rx = 208.600, Tx = 208.600 MHz
174	<adjust>	Rx = 192.000, Tx = 192.000 MHz
175	<adjust>	Rx = 190.900, Tx = 190.900 MHz
176	<adjust>	Rx = 204.560, Tx = 204.300 MHz
177	<adjust>	Rx = 223.650, Tx = 223.600 MHz
178	<adjust>	Rx = 207.500, Tx = 207.500 MHz
200		Clear Tx functions
300		Clear Rx functions
400		Clear audio functions
410		Volume level 0
411		Volume level 1
412		Volume level 2
413		Volume level 3
414		Volume level 4
415		Volume level 5
416		Volume level 6
417		Volume level 7
430		Squelch bypass off
431		Squelch bypass on
500		Clear signalling
521		Enable decoding
522	<system>	Select signalling system for decoder
523	<digits>	Select number of digits in received telegrams
531		Send a telegram
532	<system>	Select signalling system for encoder
533	<digits>	Select number of digits in send telegrams
534	<telegram>	Enter telegram for transmitter
610		Rear connector read
611	<pinnumber>	Rear connector reset pin number
612	<pinnumber>	Rear connector set pin number
613	<p1>...<*>	Rear connector change pin numbers when activated
620		Output expander 0 read
621	<pinnumber>	Output expander 0 reset pin number
622	<pinnumber>	Output expander 0 set pin number
623	<p1>...<*>	Output expander 0 change pin numbers when activated
630		Output expander 1 read
631	<pinnumber>	Output expander 1 reset pin number
632	<pinnumber>	Output expander 1 set pin number
633	<p1>...<*>	Output expander 1 change pin numbers when activated
640		Input expander 0 read
650		Internal port 1 read
700		Clear programming
710	<addr>	Read from program code (0000 < addr < BFFF)
720	<addr>	Read from personality prom (C000 < addr < C7FF)
730	<addr><data>	Write to personality prom (C000 < addr < C7FF)
740	<addr>	Read from code plug (00 < addr < ?)
750	<addr><data>	Write to code plug (02 < addr < ?)
760	<addr>	Select code plug-device address (20 - 2A)

3.2. FUNCTION CODE 0xx - SPECIAL FUNCTIONS.

All function codes in this group are used for special purposes which are normally non general functions unique to the specific radio. There is one exception, and that is function code 000 which is a general clear.

3.2.1. 000 - general clear.

This code activates all clear functions in the other function groups, i.e. 100, 200, ... The display in the control box is switched to the standard display format:

Display:

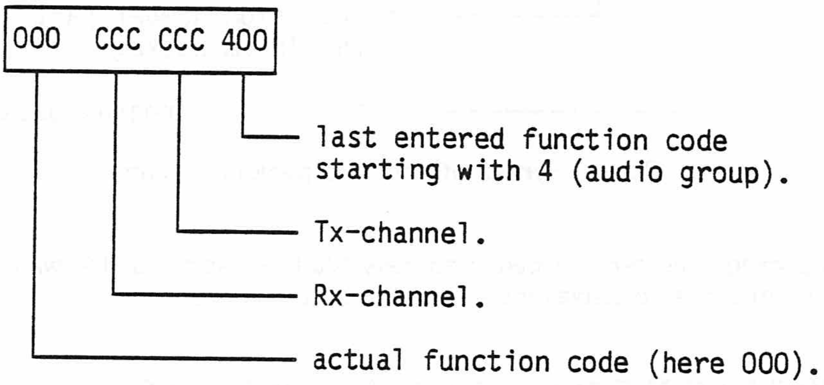


Fig. 3.1 Standard display format.

After a general clear, the radio has the following defaults:

Volume	4
Rx-channel	The first available channel
Tx-channel	The first available channel
Encoder system	CCIR sequential tones
Decoder system	CCIR sequential tones
Number of digits in a received telegram	5
Number of digits in a transmitted telegram	5
Decoding	Disabled
Telegram to send	1 2 3 4 5 6 7 8 9 A B C
Squelch bypass	OFF
code plug device addr	20

Fig. 3.2 Default values.

3.2.2. 001 - display the software package number

This function displays the software package number including the revision no.

Display :

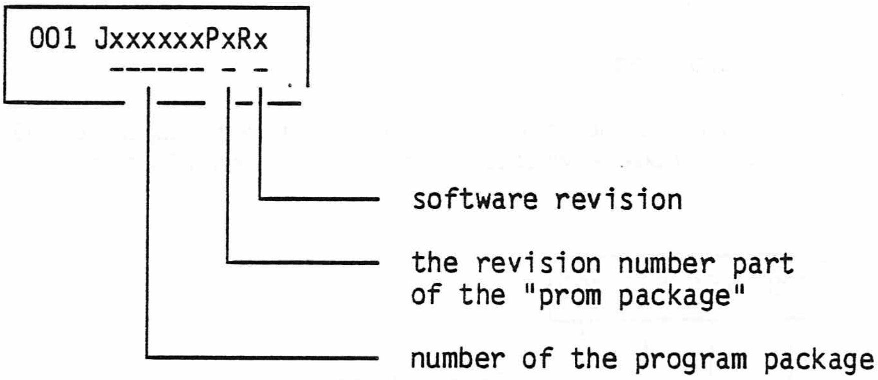


Fig. 3.3 Syntax of software package number

The software package number is placed at address 100 hexadecimal and forward. If no radio is available use prom burner to display the software package number.

3.3. FUNCTION CODE 1xx. - CHANNEL FUNCTIONS

Function codes in this group are used to select receiver (Rx) and transmitter (Tx) channels. These can be selected independently of each other.

The channels can be selected arbitrarily among the defined channels in all 4 channel groups. The channels are referred to by their logical number.

The general syntax for function codes in this group is as follows:

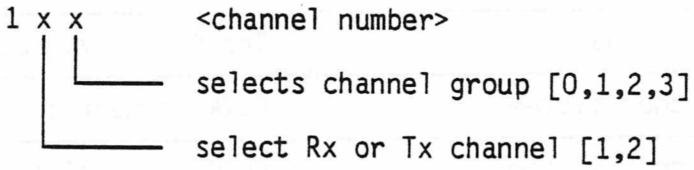


Fig. 3.4 Syntax of function code 1xx.

The second ciffer in the function code specify the following:
  1 = Select Rx-channel.
  2 = Select Tx-channel.

The third ciffer points out the channel group, i.e. group 0 to group 3.

When the function code is entered, the radio waits for a 3 digit channel number before searching in the channel table.

An attempt to select an illegal (undefined) channel will result in an error sound in the loudspeaker and the channel will remain unchanged.

3.3.1. 100 - clear channel functions.

Function code 100 is used to clear all channel functions, i.e. to select the default channels:

Rx-channel is the same as Tx-channel, which is selected as the first available channel. Channel group 0 is examined before channel group 1 etc.

The display layout is the general display format (see fig. 3.1).

3.3.2. 11x - select receiver channel.

x selects the channel group which can be group 0 to 3.

An example of selection of a receiver channel is shown below. It is assumed that the Rx- and Tx-channels are both 001 and you want to select receiver channel 004. "#" is the cursor.

Entry	Display	Comments
	#00 001 001 400	- initial state.
1	1# 001 001 400	- enter first ciffer in function code.
1	11# 001 001 400	- enter second ciffer in function code.
0	110 #01 001 400	- function code now entered.
0	110 0#1 001 400	- enter first ciffer in channel number
*	110 0#1 001 400	- enter a wrong key by accident.
0	110 00# 001 400	- enter second ciffer in channel number.
4	#10 004 001 400	- enter third ciffer in channel number.

Fig. 3.5 Entry of Rx-channel.

When a channel number is fully entered (3 digits) the specified channel is selected, if it exists, and the cursor is positioned at the first ciffer in the function code ready to receive a new function code. If an illegal channel number is entered, an error sound is given, and the channel is not changed which is indicated by displaying the standard display format with the original channel.

3.3.3. 12x - select transmitter channel.

x selects the channel group which can be group 0 to 3.

An example of selection of a transmitter channel is shown below. It is assumed that the Rx- and Tx-channels are both 001 and you want to select transmitter channel 007. "#" is the cursor.

Entry	Display	Comments
	#00 001 001 400	- initial state.
1	1# 001 001 400	- enter first ciffer in function code.
2	12# 001 001 400	- enter second ciffer in function code.
3	123 001 #01 400	- function code now entered.
0	110 001 0#1 400	- enter first ciffer in channel number
0	110 001 00# 400	- enter second ciffer in channel number.
7	#10 001 007 400	- enter third ciffer in channel number.

Fig 3.6 Entry of Tx-channel.

When a channel number is fully entered (3 digits) the specified channel is selected, if it exists, and the cursor is positioned at the first ciffer in the function code ready to receive a new function code. If an illegal channel number is entered, an error sound is given, and the channel is not changed which is indicated by displaying the standard display format with the original channel.

3.4. FUNCTION CODE 4xx - AUDIO FUNCTIONS.

This group contains the audio functions. The general syntax is:

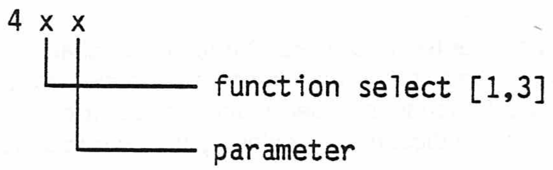


Fig. 3.7 Syntax of function code 4xx.

The functions implemented are:

function select	function	parameter
1	select volume	volume level
3	squelch bypass	on/off

Fig. 3.8 Audio default values.

3.4.1. 400 - clear audio functions.

The function code 400 is used to select the default values for the audio functions. The default values are:

- Volume level 4.
- Squelch bypass off.

The display layout is the standard display format, e.g.:

```
400  001 001 400
```

Fig. 3.9 Audio display format.

3.4.2. 41x - select volume level.

41x are used to select volume according to the third ciffer in the function code, e.g. 413 selects volume level 3. The legal range for the volume is 0 - 7.

```
4 1 x
    |
    |______     volume level [0-7]
```

Fig. 3.10 Syntax for volume select.

When a new volume is entered the radio changes the volume and gives a short beep in the loudspeaker with the new volume. This beep comes immediately after the key-press beep.

The display layout is the standard display format, e.g.:

```
414  001 001 400
```

Fig. 3.11 Display format when selecting volume.

3.4.3. 43x - squelch bypass on/off.

431 is used to open the LF-way from the receiver to the loudspeaker regardless of carrier detection. This is what is called squelch bypass.

430 is used to clear this function, thus the loudspeaker follows the carrier detection, i.e. when carrier is detected, the loudspeaker is enabled.

The display layout is the standard display format, e.g.:

```
431  001 001 400
```

Fig. 3.12 Display format using function code 43x.

3.5. FUNCTION CODE 5xx - SIGNALLING FUNCTIONS.

Function codes in this group are all used for signalling purposes which are mostly to drive the 7720 signal processor.

The general syntax for this group is:

```
5 x x
  | |
  |_|____select function.
    |
    |____select subfunction.
```

Fig. 3.13 Syntax for function code 5xx.

The second ciffer in the function code is used to determine which part of the signalling function is selected:

1. 0. Clear signalling.
2. 1. Not used
3. 2. Decoder functions.
4. 3. Encoder functions

The third ciffer has the same subfunction for the two latter groups:

1. 0. Not used.
2. 1. Enable decoding/encoding (send/receive).
3. 2. Select signalling system.
4. 3. Select number of digits in the telegram.
5. 4. Enter telegram (for the encoder only).

3.5.1. 500 - clear signalling functions.

500 selects the default signalling parameters:

Encoder system	CCIR sequential tones
Decoder system	CCIR sequential tones
Number of digits in a received telegram	5
Number of digits in a transmitted telegram	5
Decoding	Disabled
Telegram to send:	1 2 3 4 5 6 7 8 9 A B C

Fig. 3.14 Default signalling values.

3.5.2. 521 Enable decoding.

521 enables decoding which have the effect that each time a telegram of the specified type and the specified number of digits is received, the square lamp in the control box will be lit, and the telegram will be read out in the display.

Note: If a function code from any other function group than 5xx is activated only the square lamp will be lit. The telegram will NOT be shown in the display.

The decoding will remain enabled until a clear signalling command (500) has been executed.

To turn off the square lamp use the 521 command again.

If more telegrams are sent immediately after each other there can be a problem with detection of the 2nd and the following telegrams due to the fact that it takes a finite time to set up the decoder.

Entry	Display	Comments
	#00 001 001 400	- initial state.
5	5# 001 001 400	- enter first ciffer in function code.
2	52# 001 001 400	- enter second ciffer in function code.
1	#21	- function code now entered. Waiting for a telegram or a new function code.

Upon reception of the telegram "12345" the display will show the telegram:

```
#21 12345
```

Fig. 3.15 Enable decoding.

3.5.3. 522 - select decoder system.

522 selects signalling system for the decoder according to the following table:

Code Signalling system

00 = reserved.
01 = ZVEI 1
02 = ZVEI 2
03 = ZVEI 3
04 = CCIR
05 = EEA
06 = VDEW (not implemented yet)
07 = DTMF (not implemented yet)
08 = not used
09 = Binary ZVEI 1200 baud
10 = Binary ZVEI 2400 baud
11 = Binary EEA 1200 baud
12 = Binary EEA 2400 baud
13 = not used
14 = Type approval
15 = Special tone system (see personality prom)

Fig. 3.16 Signalling systems.

Note that the above values are the same as the values used when specifying the personality data.

Example on how to select decoder system ZVEI 1:

Entry	Display	Comments
	#00 001 001 400	- initial state.
5	5# 001 001 400	- enter first ciffer in function code.
2	52# 001 001 400	- enter second ciffer in function code.
2	522 SYSTEM:#	- function code now entered.
0	522 SYSTEM:0#	- enter first ciffer in decoder system.
1	#22 SYSTEM:01	- enter second ciffer in decoder system.

Fig. 3.17 Selection of decoder system.

3.5.4. 523 - select number of digits in received telegrams.

523 selects number of digits the radio must receive before it is considered as a telegram. The legal range is 01 to 12 and it is always necessary to enter two digits, i.e. four is entered as 04.

Below is an example on selecting telegrams with 4 digits.

Entry	Display	Comments
	#00 001 001 400	- initial state.
5	5# 001 001 400	- enter first ciffer in function code.
2	52# 001 001 400	- enter second ciffer in function code.
3	523 DIGITS:#	- function code now entered.
0	523 DIGITS:0#	- enter first ciffer in number of digits.
4	#23 DIGITS:04	- enter second ciffer in number of digits.

Fig. 3.18 Entry of number of digits in a received telegram.

3.5.5. 531 send one telegram.

531 causes a telegram of the specified type to be sent. Note that if the synthesizer does not lock on the Tx-channel the telegram is not sent.

3.5.6. 532 - select encoder system.

532 Selects encoder system according to the previously shown table. The transmitter inserts repeat tones automatically when necessary.
Example on how to select encoder system to binary EEA 1200 baud.

Entry	Display	Comments
	#00 001 001 400	- initial state.
5	5# 001 001 400	- enter first ciffer in function code.
3	53# 001 001 400	- enter second ciffer in function code.
2	532 SYSTEM:#	- function code now entered.
1	532 SYSTEM:1#	- enter first ciffer in decoder system.
1	#32 SYSTEM:11	- enter second ciffer in decoder system.

Fig. 3.19 Selection of encoder system.

3.5.7. 533 - select number of digits in transmitted telegrams.

533 Selects number of digits in the transmitted telegram. The legal range is 00 to 12 and it is always necessary to enter two digits, i.e. digits is entered as 06.

Below is an example on selecting telegrams with 10 digits.

Entry	Display	Comments
	#00 001 001 400	- initial state.
5	5# 001 001 400	- enter first ciffer in function code.
2	52# 001 001 400	- enter second ciffer in function code.
3	533 DIGITS:#	- function code now entered.
1	533 DIGITS:1#	- enter first ciffer in number of digits.
0	#33 DIGITS:10	- enter second ciffer in number of digits.

Fig. 3.20 Entry of number of digits in a send telegram.

3.5.8. 534 - select encoder telegram.

534 selects the actual digits in the transmitted telegram. The digits are entered as hexadecimal digits in the form shown in the table below.

Key sequence	Display
00	0
01	1
02	2
03	3
04	4
05	5
06	6
07	7
08	8
09	9
10	A
11	B
12	C
13	D
14	E
15	F

Fig 3.21 Entry of hexadecimal numbers.

Any other combination of numerical keys are ignored, apart from an error sound which ise given in the loudspeaker.

The radio only requires as many digits as specified in the telegram length (533). This means if the number of digits are changed to a larger number, the rest of the digits will be taken from the previous telegram.

A sequence which requires data is terminated by activating the asterisk (*).

	Telegram buffer
1. The default telegram buffer is: The number of digits is 5:	123456789ABC ^——^
2. You enter 5 new digits 57680 :	576806789ABC ^——^
3. You selects number of digits in the telegram to 8:	576806789ABC ^————^
4. You send the telegram:	57680678

Fig. 3.22 Entry of a telegram to send.

The next example shows entry of a telegram when number of digits in the telegram is specified to 3. Assume the telegram to be entered is 6A1.

Entry	Display	Comments
	#00 001 001 400	- initial state.
5	5# 001 001 400	- enter first ciffer in function code.
3	53# 001 001 400	- enter second ciffer in function code.
4	534 #	- function code now entered.
0	534 #	- enter first ciffer of telegram.
6	534 6#	- enter first ciffer of telegram.
1	534 6#	- enter second ciffer of telegram.
0	534 6A#	- enter second ciffer of telegram.
0	534 6A#	- enter third ciffer of telegram.
1	#34 6A1	- enter third ciffer of telegram.

The telegram is now entered and the cursor is positioned at the first ciffer in the function code ready to receive a new function code.

Fig. 3.23 Entry of the digits in a telegram to send.

3.6. FUNCTION CODE 7xx - PROGRAMMING.

This function group is used for programming purposes and to show the contents of the different storage devices in the radio (i.e. personality prom, program prom and code plug).

The general syntax for this group is as follows:

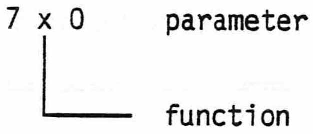


Fig. 3.24 Syntax of function code 7xx.

The functions implemented are:

function	description	parameter
0	Clear programming.	none
1	Read from program code.	addr [step...step] *
2	Read from personality data.	addr [step...step] *
3	Write into personality data.	addr [data...data] *
4	Read from code plug.	addr [step...step] *
5	Write to code plug.	addr [data...data] *
6	Select code plug-device addr	addr

Fig. 3.25 Programming functions.

The address and data are entered as decimal values for the corresponding hexadecimal ciffers and are shown in the display as the hexadecimal values. This means that a 4 digit hexadecimal number requires 8 key activations. The hexadecimal ciffers are entered as shown below:

Key sequence	Display
00	0
01	1
02	2
03	3
04	4
05	5
06	6
07	7
08	8
09	9
10	A
11	B
12	C
13	D
14	E
15	F

Fig. 3.26 Entry of hexadecimal numbers.

Any other combination of numerical keys are ignored apart from an error sound which is given in the loudspeaker.

A sequence which requires data is terminated by activating the asterisk (*).

3.6.1. 700 - Clear programming.

This function code initializes everything used in the programming functions to the original state as if the service mode was just entered.

Entry	Display	Comments
	#00 001 001 400	- initial state.
7	7# 001 001 400	- enter first ciffer in function code.
0	70# 001 001 400	- enter second ciffer in function code.
0	700	- function code entered.

Fig. 3.27 Clear programming.

3.6.2. 720 read personality prom.

Reads and displays the contents of the personality data at a specified address. The routine expects a correct address in the range C000-C7FF. If an illegal address is entered, an error sound will be given, and the cursor will be positioned at the first digit in the address ready to receive a correct address.
When the address is entered, and the data shown in the display, it is possible to step through the prom by activating the key corresponding to the number of steps wanted, i.e. if you want to step to the following byte press key 1.
To exit from this mode activate the asterisk (*), though it will be considered as an illegal entry.

An example where the personality data at address C010 and further contains C0, A0, C7, 00, C7, C0, FF, FF.

Entry	Display	Comments
	#00 01 001 400	- initial state.
7 2 0	720 A:#	- function code entered ready to addr entry.
1 2	720 A:C	- enter first digit of the address.
0 0	720 A:C0	- enter second digit of the address.
0 1	720 A:C01	- enter third digit of the address.
0 0	720 A:C010 D:C0	- enter fourth digit of the address.
1	720 A:C011 D:A0	- enter step forward
2	720 A:C013 D:00	- enter step forward
*	#20 A:C013 D:00	- exit from this mode

Fig. 3.28 Read from personality prom.

3.6.3. 730 - write into personality data.

Writes bytes into the personality area at a specified address. The routine expects a correct address in the range C000-C7FF. If an illegal address is entered an error sound will be given and the cursor will be positioned at the first digit in the address ready to receive a correct address.

When the address is entered, the data is shown in the display, then the new data must be entered. If the data should not be changed it is necessary to write the same data as shown in the display.

When a byte is written (8 digits entered), the address is incremented by 1, and the radio is ready to receive new data to this address.

To exit from this mode press the asterisk (*).

If there is no EEPROM but an UV-prom in the radio, the radio writes "NO EEPROM" in the display. The prom is considered as a EEPROM if the cell C000H (the first byte in the personality prom) contains 00.

An example where you want to change the contents of address C1F0 from FF, 03, A5 to 04, 03, C0.

Entry	Display	Comments
	#00 001 001 400	- initial state.
7 3 0	730 A:#	- function code entered ready to addr entry.
1 2	730 A:C	- enter first digit of the address.
0 1	730 A:C1	- enter second digit of the address.
1 5	730 A:C1F	- enter third digit of the address.
0 0	730 A:C1F0 D:FF	- enter fourth digit of the address.
0 0	730 A:C1F0 D:0F	- enter first ciffer in data.
0 4	730 A:C1F0 D:04	- enter second ciffer in data.
	730 A:C1F1 D:03	- the byte is written
0 0	730 A:C1F1 D:03	- enter first ciffer in data.
0 3	730 A:C1F1 D:03	- enter second ciffer in data.
	730 A:C1F2 D:A5	- the byte is written
1 2	730 A:C1F2 D:C5	- enter first ciffer in data.
0 0	730 A:C1F2 D:C0	- enter second ciffer in data.
	730 A:C1F3 D:FF	- the byte is written
*	#30 A:C1F3 D:FF	- exit from this mode

Fig. 3.29 Write to personality prom.

3.6.4. 740 - read from code plug.

Reads and displays the contents of the code plug at a specified address. The routine expects a correct address in the range 00-1F (for the small code plug). If an illegal address is entered, an error sound will be given and the cursor will be positioned at the first digit in the address ready to receive a correct address.

If no code plug is present then "NO code plug" is written in the display.

When the address is entered and the data is shown in the display, it is possible to step through the code plug by activating the key corresponding to the number of steps wanted, i.e. if you want to step to the following byte press key 1.

To exit from this mode activate the asterisk (*), though it will be considered as an illegal entry.

An example where the code plug data at address 05 and further contains 12, A0, 3D, 00.

Entry	Display	Comments
	#00 001 001 400	- initial state.
7 4 0	740 A:#	- function code entered ready to addr enter
0 0	740 A:0	- enter first digit of the address.
0 5	740 A:05 D:12	- enter second digit of the address.
1	740 A:06 D:A0	- enter step forward
2	740 A:08 D:00	- enter step forward
*	#40 A:08 D:00	- exit from this mode

Fig. 3.30 Read code plug prom.

3.6.5. 730 - write into code plug.

Writes bytes into the code plug at specified address. The routine expects a correct address, i.e. in the range 00-1F. If an illegal address is entered, an error sound will be given and the cursor will be positioned at the first digit in the address ready to receive a correct address.

If no code plug is present, "NO code plug" is written in the display.

When the address is entered, the data is shown in the display, then the new data must be entered. If the data should not be changed, it is necessary to write the same data as shown in the display.

When a byte is written (4 digits entered), the address is incremented by 1, and the radio is ready to receive new data to this address.

To exit from this mode, just press the asterisk (*).

Note: It is not possible to program the first two bytes in the code plug, though the service-mode does not check if it is tried out.

An example where you want to change the contents of address 13 from FF to 04.

Entry	Display	Comments
	#00 001 001 400	- initial state.
7 4 0	740 A:#	- function code entered ready to addr entry.
0 1	740 A:1#	- enter first digit of the address.
0 3	740 A:13 D:FF	- enter second digit of the address.
0 0	740 A:13 D:0F	- enter first ciffer in data.
0 4	740 A:13 D:04	- enter second ciffer in data.
	740 A:14 D:FF	- the byte is written
*	#40 A:C1F3 D:FF	- exit from this mode

Fig. 3.31 Write to code plug

CHAPTER 1

SERVICE MODE

SERVICE MODE

CQM6000/MC SPECTRO - EF Software

CQM6000/MC SPECTRO - EL Software

SERVICE MODE

CQM6000/MC spectro - EL SOFTWARE

1. GENERAL

This is a users guide to the service mode used in CQM6000/MC spectro, EL version.

The basic idea in this service mode is that all functions are accessed via a 3 digit function code. The three digits represent the following:

Function code:

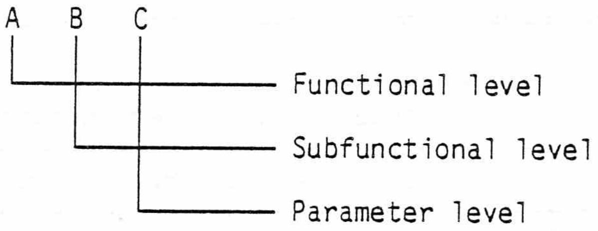


Fig. 1.1 Function code syntax.

After the function code it may be necessary to enter further data, e.g. channel number etc.

The function codes can either be entered manually by using the buttons on the control box or by simulating the key entries by an automatic test equipment.

1.1. KEY ENTRIES

In service mode the values of the keys on the control box are strictly related to their position on the control box and NOT to the values labeled on the keys. The keys have the following values:

							1	2	3	
							4	5	6	
							7	8	9	
							*	0		

Fig. 1.2 Keyboard lay-out.

All "blank" keys in the above figure are not used but may be used similar to the *-key. One exception is the on/off key.

Entry of a function code is done by entering 3 digits which are then evaluated. If the function code does not exist, the display flashes, and an error sound is given in the loudspeaker. You can now reenter the function code or enter a completely new one.

If you regret while entering a function code, press the asterisk (*) and the function code will be considered illegal.

Note: In all the examples the # is a symbol for the cursor. When necessary the underscore (_) under the display indicates the cursor position.

3 examples of function code entry:

Entry	Display	
	SERVICE MODE	- initial state
0	0#	- enter first cipher in function code
0	00#	- enter second cipher in function code
0	000 001 001 400	- enter third cipher in function code

Fig. 1.3 Entry of 000 (clear all).

Entry	Display	
	SERVICE MODE	- initial state
0	0#	- enter first cipher in function code
0	00#	- enter second cipher in function code
3	003 (flashing)	- enter third cipher in function code

Fig. 1.4 Illegal function code entry.

Entry	Display	
	SERVICE MODE	- initial state
0	0#	- enter first cipher in function code
*	I (flashing)	- regret with an asterisk

Fig. 1.5 Terminating function code entry with an asterisk.

2. HOW TO ENTER SERVICE MODE

The radio can be switched into service mode in two ways:

1. Insertion of a special programmed service code plug in the control box.
2. Before starting up, pin 3 and pin 16 are connected to each other. A wire is connected from pin 16 to +5 volt (pin9) via a 220 ohm pull-up resistor.

A code plug is a service code plug if word 0 in the NMC 9306 serial EEPROM is XX1X hex. Hence if the H-bus reads a service code plug the second byte is equal 1X hex (X = don't care).

If insertion of a service code plug shall be simulated by test equipment, the test equipment must follow this procedure:

1. Generate the code plug insert message code plug IN.
2. Wait for the reception of the message code plug READ.
3. Respond to the read request by issuing a DATA FROM code plug message with the required number of data bytes.
4. Repeat step 2 and 3 until the whole code plug is transferred.

3. FUNCTION CODES

3.1. OVERVIEW

The following is a brief listing of all the function codes and their meaning.

000		Clear all (calls all other clear functions)
001		Display the software package number
004		Erase the encryption key(s)
100		Clear channel functions
110	<channel>	Select Rx-channel from channel-group 0
111	<channel>	Select Rx-channel from channel-group 1
112	<channel>	Select Rx-channel from channel-group 2
113	<channel>	Select Rx-channel from channel-group 3
120	<channel>	Select Tx-channel from channel-group 0
121	<channel>	Select Tx-channel from channel-group 1
122	<channel>	Select Tx-channel from channel-group 2
123	<channel>	Select Tx-channel from channel-group 3
131	<adjust>	Rx = 66.510, Tx = 66.460 MHz
132	<adjust>	Rx = 74.520, Tx = 74.040 MHz
133	<adjust>	Rx = 87.060, Tx = 86.970 MHz
134	<adjust>	Rx = 77.000, Tx = 77.000 MHz
141	<adjust>	Rx = 136.900, Tx = 136.900 MHz
142	<adjust>	Rx = 151.150, Tx = 150.400 MHz
143	<adjust>	Rx = 172.450, Tx = 172.300 MHz
144	<adjust>	Rx = 155.000, Tx = 155.000 MHz

161	<adjust>	Rx = 404.600, Tx = 404.700 MHz
162	<adjust>	Rx = 430.200, Tx = 430.700 MHz
163	<adjust>	Rx = 467.300, Tx = 467.400 MHz
164	<adjust>	Rx = 436.500, Tx = 436.500 MHz
165	<adjust>	Rx = 404.600, Tx = 404.700 MHz *
166	<adjust>	Rx = 430.200, Tx = 430.700 MHz * 12.5 kHz
167	<adjust>	Rx = 467.300, Tx = 467.400 MHz * only
168	<adjust>	Rx = 436.500, Tx = 436.500 MHz *
171	<adjust>	Rx = 174.900, Tx = 174.900 MHz
172	<adjust>	Rx = 188.900, Tx = 188.400 MHz
173	<adjust>	Rx = 208.600, Tx = 208.600 MHz
174	<adjust>	Rx = 192.000, Tx = 192.000 MHz
175	<adjust>	Rx = 190.900, Tx = 190.900 MHz
176	<adjust>	Rx = 204.560, Tx = 204.300 MHz
177	<adjust>	Rx = 223.650, Tx = 223.600 MHz
178	<adjust>	Rx = 207.500, Tx = 207.500 MHz
200		Clear Tx functions
211		Select high Tx power
212		Select low Tx power
220		Select speech transmission in clear voice
221		Select speech transmission in secure voice
230		Select normal range (REX off)
231		Select extended range (REX on)
300		Clear Rx functions
400		Clear audio functions
410		Volume level 0
411		Volume level 1
412		Volume level 2
413		Volume level 3
414		Volume level 4
415		Volume level 5
416		Volume level 6
417		Volume level 7
430		Squelch bypass off
431		Squelch bypass on
440		Select audio through DCAP
441		Select standard audio paths
500		Clear signalling
521		Enable decoding
522	<system>	Select signalling system for decoder
523	<digits>	Select number of digits in received telegrams
531		Send a telegram
532	<system>	Select signalling system for encoder
533	<digits>	Select number of digits in send telegrams
534	<telegram>	Enter telegram for transmitter
540		Optional channel guard encoder
541		Optional channel guard decoder
700		Clear programming
710	<addr>	Read from program code (0000 ≤ addr ≤ FFFF)
720	<addr>	Read from personality prom (C000 ≤ addr ≤ C7FF)
730	<addr><data>	Write to personality prom (C000 ≤ addr ≤ C7FF)
740	<addr>	Read from code plug (00 ≤ addr ≤ 1F)
750	<addr><data>	Write to code plug (02 ≤ addr ≤ 1F)
760	<addr>	Select code plug-device address (20 - 2A)

3.2. FUNCTION CODE 0xx - SPECIAL FUNCTIONS.

All function codes in this group are used for special purposes which are normally non-general functions unique to the specific radio. There is one exception, and that is function code 000 which is a general clear.

3.2.1. 000 - general clear.

This code activates all clear functions in the other function groups, i.e. 100, 200, ... The display in the control box is switched to the standard display format:

Display:

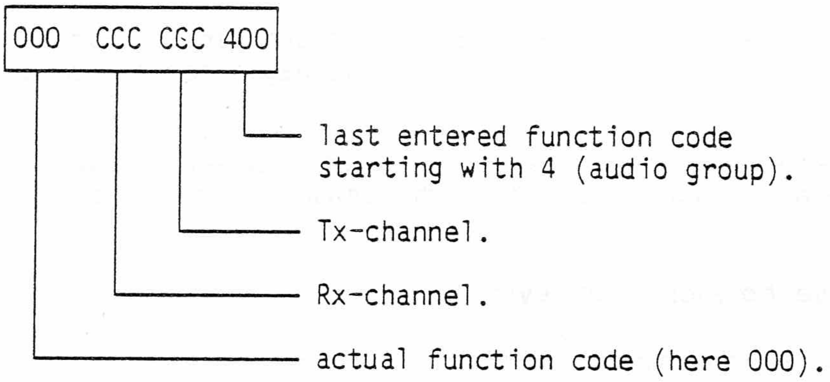


Fig. 3.1 Standard display format.

After a general clear, the radio has the following defaults:

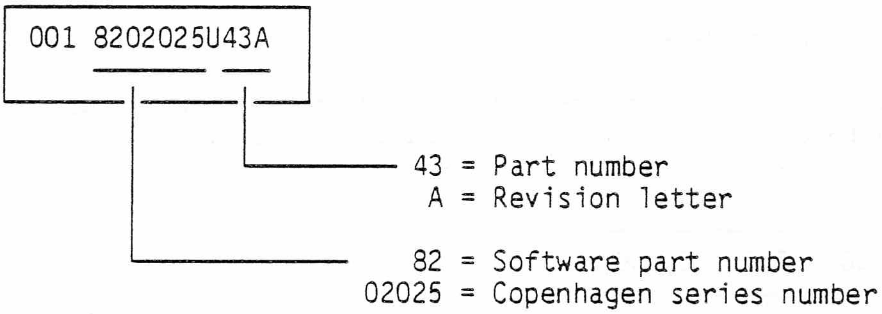
Volume	4
Rx-channel	The first available channel
Tx-channel	The first available channel
Encryption	OFF (= clear voice)
Encoder system	CCIR sequential tones
Decoder system	CCIR sequential tones
Number of digits in a received telegram	5
Number of digits in a transmitted telegram	5
Decoding	Disabled
Telegram to send	1 2 3 4 5 6 7 8 9 A B C
Squelch bypass	OFF
code plug device addr	20

Fig. 3.2 Default values.

3.2.2. 001 - display the software package number

This function displays the software package number including the revision no.

Display :



The software package number in the code PROM is placed at address 100 hexadecimal and forward. If no radio is available use prom burner to display the software package number.

3.2.3. 004 - erase the encryption key(s)

The encryption key(s) in the encryption module is/are cleared by entering function code 004. A key loader is needed to load the key(s) again.

Code 0-0-4 Erase encryption key.

Entry	Display	Comments
	#00 001 001 400	- initial state.
0	0# 001 001 400	- enter first cipher in function code.
0	00# 001 001 400	- enter second cipher in function code.
4	004 KEY ERASED	- function code now entered.

Fig. 3.3 How te erase the encryption key(s)

When function code 004 is entered, the radio performs the same tests as when function code 221 (select secure voice) is entered, except that the encryption key is not tested. If a test fails, the radio behaves as described in the section on function codes 22x, except that "004" is shown instead of "221".

3.3. FUNCTION CODE 1xx. - CHANNEL FUNCTIONS

Function codes in this group are used to select receiver (Rx) and transmitter (Tx) channels. These can be selected independently of each other.

The channels can be selected arbitrarily among the defined channels in all 4 channel groups. The channels are referred to by their logical number.

The general syntax for function codes in this group is as follows:

```
1 x x        <channel number>
  | |
  | |_____   selects channel group [0,1,2,3]
  |
  |_______   selects Rx or Tx channel [1,2]
```

Fig. 3.4 Syntax of function code 1xx.

The second cipher in the function code specifies the following:

1 = Select Rx-channel.
2 = Select Tx-channel.

The third cipher points out the channel group, i.e. group 0 to group 3.

When the function code is entered, the radio waits for a 3 digit channel number before searching in the channel table.

An attempt to select an illegal (undefined) channel will result in an error sound in the loudspeaker and the channel will remain unchanged.

3.3.1. 100 - clear channel functions.

Function code 100 is used to clear all channel functions, i.e. to select the default channels:

Rx-channel is the same as Tx-channel, which is selected as the first available channel. Channel group 0 is examined before channel group 1 etc.

The display layout is the general display format (see fig. 3.1).

3.3.2. 11x - select receiver channel.

x selects the channel group which can be group 0 to 3.

An example of selection of a receiver channel is shown below. It is assumed that the Rx- and Tx-channels are both 001 and that you want to select receiver channel 004. "#" is the cursor.

Entry	Display	Comments
	#00 001 001 400	- initial state.
1	1# 001 001 400	- enter first cipher in function code.
1	11# 001 001 400	- enter second cipher in function code.
0	110 #01 001 400	- function code now entered.
0	110 0#1 001 400	- enter first cipher in channel number
*	110 0#1 001 400	- enter a wrong key by accident.
0	110 00# 001 400	- enter second cipher in channel number.
4	#10 004 001 400	- enter third cipher in channel number.

Fig. 3.5 Entry of Rx-channel

When a channel number is fully entered (3 digits) the specified channel, if it exists, is selected and the cursor is positioned at the first cipher in the function code ready to receive a new function code. If an illegal channel number is entered, an error sound is given, and the channel is not changed. This is indicated by displaying the standard display format with the original channel.

3.3.3. 12x - select transmitter channel.

x selects the channel group which can be group 0 to 3.

An example of selection of a transmitter channel is shown below. It is assumed that the Rx- and Tx-channels are both 001 and that you want to select transmitter channel 007. "#" is the cursor.

Entry	Display	Comments
	#00 001 001 400	- initial state.
1	1# 001 001 400	- enter first cipher in function code.
2	12# 001 001 400	- enter second cipher in function code.
3	123 001 #01 400	- function code now entered.
0	110 001 0#1 400	- enter first cipher in channel number
0	110 001 00# 400	- enter second cipher in channel number.
7	#10 001 007 400	- enter third cipher in channel number.

Fig 3.6 Entry of Tx-channel.

When a channel number is fully entered (3 digits) the specified channel, if it exists, is selected, and the cursor is positioned at the first cipher in the function code ready to receive a new function code. If an illegal channel number is entered, an error sound is given, and the channel is not changed. This is indicated by displaying the standard display format with the original channel.

3.3.4. 1xy - adjust frequencies.

For each frequency band the following four adjust frequncies are available: center frequency in low window, center frequency in the middle window, center frequency in the high window, and the center band frequency. Low Tx-power is default setting and the setting is without channel guard tone.

x selects the frequency band which can be 3, 4, 6, and 7

3 = adjust frequencies in band 66-88 MHz
4 = adjust frequencies in band 136-174 MHz
6 = adjust frequencies in band 403-470 MHz
7 = adjust frequencies in band 174-225 MHz

y selects the adjust window or center band frequency.

1 = 5 = center frequency in the low window
2 = 6 = center frequency in the middle window
3 = 7 = center frequency in the high window
4 = 8 = center band frequency

An example of selection of Tx/Rx adjust frequencies on a CQM633x for center frequency in the low window.

Entry	Display	Comments
	#00 001 001 400	- initial state.
1	1# 001 001 400	- enter first cipher in function code.
3	13# 001 001 400	- enter second cipher in function code.
1	131 131 131 400	- function code now entered.

Fig 3.7 Entry of adjust frequency.

When the function code is completely entered (3 digits) the specified Tx and Rx frequency is selected. The cursor is positioned at the first cipher in function code ready to receive a new function code. If an illegal function code is entered, an error sound is given.

3.4. FUNCTION CODE 2xx - TX-FUNCTIONS

3.4.1. 200 - clear Tx-functions

Function code 200 is used to clear all Tx-functions

3.4.2. 21x - optional Tx power

The high Tx power setting and the low Tx power setting are respectively invoked with code 211 and code 212.

Low power is the range from from 0.6 Watt to 2.5 Watt. High power is the range from 6 Watt to 2.5 Watt. The state is maintained one PTT period.

Code	2-1-1	Select high Tx power
Code	2-1-2	Select low Tx power

Entry	Display	Comments
	#00 001 001 400	- initial state.
2	2# 001 001 400	- enter first cipher in function code.
1	21# 001 001 400	- enter second cipher in function code.
1	211 HIGH TX-POW.	- function code now entered.

Fig 3.8 How to select high Tx- power.

3.4.3. 22x - secure voice on/off

The following speech transmissions are in clear/secure mode respectively. The mode is unchanged until a new 22x function code is entered, or until clear mode is selected by function code 200 or 000. The current mode is indicated by the ø-indicator of the CB's supporting encryption. The ø-indicator is lit when the radio is in secure mode.

Code	2-2-0	Select clear voice
Code	2-2-1	Select secure voice

Entry	Display	Comments
	#00 001 001 400	- initial state.
2	2# 001 001 400	- enter first cipher in function code.
2	22# 001 001 400	- enter second cipher in function code.
1	221 SECURE VOICE	- function code now entered.

Fig 3.9 How to select secure voice.

When function code 221 is entered, the radio checks that a crypto module is present and working and that the encryption key is OK. This function therefore can also be used to test for proper operation of the encryption hardware. The following table shows which tests are made and the resulting display if a test fails. The tests are performed in the order below. If a test fails, the radio further stays in clear mode and an error sound is heard in the loudspeaker.

Test for	Display, if test fails:
Personality PROM specifies a valid encryption module type installed in radio.	221 NO ENCR PROG
UART device is operating properly.	221 UART ERROR
Encryption module is operating properly	221 BAD ENCR MOD
Key is OK	221 KEY FAILED

Fig. 3.10 Error checks in function code 221.

Note: If signalling is transmitted during transmission of secure voice, the signalling will be encrypted.

3.4.4. 23x - range extension on/off.

Following secure voice, transmissions are transmitted with the range extension feature switched off or on by the function codes 230 and 231 respectively. The setting is unchanged until a new 23x function code is entered.

Code	2-3-0	Select range extension off.
Code	2-3-1	Select range extension on.

Entry	Display	Comments
	#00 001 001 400	- initial state.
2	2# 001 001 400	- enter first cipher in function code.
3	23# 001 001 400	- enter second cipher in function code.
1	231 RANGE EXTEND	- function code now entered.

Fig 3.11 How to select range extension on.

When function code 230 or 231 is entered the radio performs the same tests as when function code 221 (select secure voice) is entered, except that the encryption key is not tested. If a test fails, the radio behaves as described in the section on function codes 22x, except that the current function code is shown instead of "221".

3.5. FUNCTION CODE 3xx - RX-FUNCTIONS.

The only function code in this group is 300 which is used to clear all Rx-functions.

3.6. FUNCTION CODE 4xx - AUDIO FUNCTIONS:

This group contains the audio functions. The general syntax is:

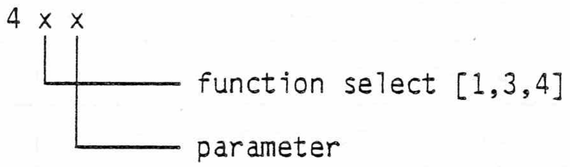


Fig. 3.12 Syntax of function code 4xx.

The functions implemented are:

function select	function	parameter
1	select volume	volume level [0-8]
3	squelch bypass	on/off
4	DCAP audio	on/off

Fig. 3.13 Possible audio settings.

3.6.1. 400 - clear audio functions.

The function code 400 is used to select the default values for the audio functions. The default values are:

- Volume level 4.
- Squelch bypass off.

The display layout is the standard display format, e.g.:

```
400  001 001 400
```

Fig. 3.14 Audio display format.

3.6.2. 41x - select volume level.

41x is used to select volume according to the third cipher in the function code, e.g. 413 selects volume level 3. The legal range for the volume is 0 - 7.

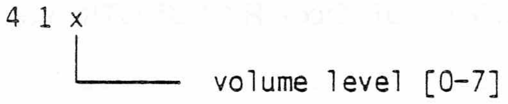


Fig. 3.15 Syntax for volume select.

When a new volume is entered the radio changes the volume and gives a short beep in the loudspeaker with the new volume. This beep comes immediately after the key-press beep.

The display layout is the standard display format, e.g.:

```
414  001 001 400
```

Fig. 3.16 **Display format when selecting volume.**

3.6.3. 43x - squelch bypass on/off.

431 is used to open the LF-way from the receiver to the loudspeaker regardless of carrier detection. This is what is called squelch bypass.

430 is used to clear this function, thus the loudspeaker follows the carrier detection, i.e. when carrier is detected, the loudspeaker is enabled.

The display layout is the standard display format, e.g.:

```
431  001 001 400
```

Fig. 3.17 **Display format using function code 43x.**

3.6.4. 44x - DCAP audio on/off.

440 is used to guide audio respectively through CG-reject filter and through the CODEC. The 440 function is maintained until disabled by 441 function.

The display layout is the standard display format, e.g.:

```
440  DCAP AUDIO
```

Fig. 3.18 **Display format using function code 440.**

441 is used to toggle the 4440 setting in order to obtain default setting.

3.7. FUNCTION CODE 5xx - SIGNALLING FUNCTIONS.

Function codes in this group are all used for signalling purposes which are mostly to drive the 7720 signal processor.

The general syntax for this group is:

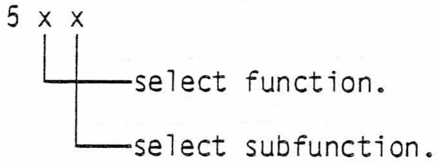


Fig. 3.19 Syntax for function code 5xx.

The second cipher in the function code is used to determine which part of the signalling function is selected:

1. 0. Clear signalling.
2. 1. Not used
3. 2. Decoder functions.
4. 3. Encoder functions

The third cipher has the same subfunction for the two latter groups:

1. 0. Not used.
2. 1. Enable decoding/encoding (send/receive).
3. 2. Select signalling system.
4. 3. Select number of digits in the telegram.
5. 4. Enter telegram (for the encoder only).

3.7.1. 500 - clear signalling functions.

500 selects the default signalling parameters:

Encoder system	CCIR sequential tones
Decoder system	CCIR sequential tones
Number of digits in a received telegram	5
Number of digits in a transmitted telegram	5
Decoding	Disabled
Telegram to send:	1 2 3 4 5 6 7 8 9 A B C

Fig. 3.20 Default signalling values.

3.7.2. 521 - enable decoding.

521 enables decoding the effect of which is that each time a telegram of the specified type and the specified number of digits is received, the square lamp in the control box will be lit, and the telegram will be read out in the display.

Note: If a function code from any other function group than 5xx is activated, only the square lamp will be lit. The telegram will NOT be shown in the display.

The decoding will remain enabled until a clear signalling command (500) has been executed.

To turn off the square lamp use the 521 command again.

If more telegrams are sent immediately after each other there can be a problem with detection of the 2nd and the following telegrams due to the fact that it takes a finite time to set up the decoder.

Entry	Display	Comments
	#00 001 001 400	- initial state.
5	5# 001 001 400	- enter first cipher in function code.
2	52# 001 001 400	- enter second cipher in function code.
1	#21	- function code now entered. Waiting for a telegram or a new function code.

Upon reception of the telegram "12345" the display will show the telegram:

```
#21 12345
```

Fig. 3.21 Enable decoding.

3.7.3. 522 - select decoder system.

522 selects signalling system for the decoder according to the following table:

Code Signalling system

00 = reserved.
01 = ZVEI 1
02 = ZVEI 2
03 = ZVEI 3
04 = CCIR
05 = EEA
06 = VDEW (not yet implemented)
07 = not used
08 = not used
09 = Binary ZVEI 1200 baud
10 = not used
11 = Binary EEA 1200 baud
12 = not used
13 = not used
14 = Type approval
15 = Special tone system (see personality prom)

Fig. 3.22 Signalling systems.

Note that the above values are the same as the values used when specifying the personality data.

Example on how to select decoder system ZVEI 1:

Entry	Display	Comments
	#00 001 001 400	- initial state.
5	5# 001 001 400	- enter first cipher in function code.
2	52# 001 001 400	- enter second cipher in function code.
2	522 SYSTEM:#	- function code now entered.
0	522 SYSTEM:0#	- enter first cipher in decoder system.
1	#22 SYSTEM:01	- enter second cipher in decoder system.

Fig. 3.23 Selection of decoder system.

3.7.4. 523 - select number of digits in received telegrams.

523 selects number of digits the radio must receive before it is considered as a telegram. The legal range is 01 to 12 and it is always necessary to enter two digits, i.e. four is entered as 04.

Below is an example on selecting telegrams with 4 digits.

Entry	Display	Comments
	#00 001 001 400	- initial state.
5	5# 001 001 400	- enter first cipher in function code.
2	52# 001 001 400	- enter second cipher in function code.
3	523 DIGITS:#	- function code now entered.
0	523 DIGITS:0#	- enter first cipher in number of digits.
4	#23 DIGITS:04	- enter second cipher in number of digits.

Fig. 3.24 Entry of number of digits in a received telegram.

3.7.5. 531 send one telegram.

531 causes a telegram of the specified type to be sent. Note that if the synthesizer does not lock on the Tx-channel the telegram is not sent.

3.7.6. 532 - select encoder system.

532 selects encoder system according to the previously shown table. The transmitter inserts repeat tones automatically when necessary.

Example on how to select encoder system to binary EEA 1200 baud.

Entry	Display	Comments
	#00 001 001 400	- initial state.
5	5# 001 001 400	- enter first cipher in function code.
3	53# 001 001 400	- enter second cipher in function code.
2	532 SYSTEM:#	- function code now entered.
1	532 SYSTEM:1#	- enter first cipher in decoder system.
1	#32 SYSTEM:11	- enter second cipher in decoder system.

Fig. 3.25 Selection of encoder system.

3.7.7. 533 - select number of digits in transmitted telegrams.

533 selects number of digits in the transmitted telegram. The legal range is 00 to 12 and it is always necessary to enter two digits, i.e. digits is entered as 06.

Below is an example on selecting telegrams with 10 digits.

Entry	Display	Comments
	#00 001 001 400	- initial state.
5	5# 001 001 400	- enter first cipher in function code.
2	52# 001 001 400	- enter second cipher in function code.
3	533 DIGITS:#	- function code now entered.
1	533 DIGITS:1#	- enter first cipher in number of digits.
0	#33 DIGITS:10	- enter second cipher in number of digits.

Fig. 3.26 Entry of number of digits in a send telegram.

3.7.8. 534 - select encoder telegram.

534 selects the actual digits in the transmitted telegram. The digits are entered as hexadecimal digits in the form shown in the table below.

Key sequence	Display
00	0
01	1
02	2
03	3
04	4
05	5
06	6
07	7
08	8
09	9
10	A
11	B
12	C
13	D
14	E
15	F

Fig 3.27 Entry of hexadecimal numbers.

Any other combination of numerical keys is ignored, apart from an error sound which is given in the loudspeaker.

A sequence which data is terminated by activating the asterisk (*).

	Telegram buffer
1. The default telegram buffer is: The number of digits is 5:	123456789ABC ^———^
2. You enter 5 new digits 57680 :	576806789ABC ^———^
3. You select number of digits in the telegram to 8:	576806789ABC ^—————^
4. You send the telegram:	57680678

Fig. 3.28 Entry of a telegram to send.

The next example shows entry of a telegram when the number of digits in the telegram is specified to 3. Assume that the telegram to be entered is 6A1.

Entry	Display	Comments
	#00 001 001 400	- initial state.
5	5# 001 001 400	- enter first cipher in function code.
3	53# 001 001 400	- enter second cipher in function code.
4	534 #	- function code now entered.
0	534 #	- enter first cipher of telegram.
6	534 6#	- enter first cipher of telegram.
1	534 6#	- enter second cipher of telegram.
0	534 6A#	- enter second cipher of telegram.
0	534 6A#	- enter third cipher of telegram.
1	#34 6A1	- enter third cipher of telegram.

The telegram is now entered and the cursor is positioned at the first cipher in the function code ready to receive a new function code.

Fig. 3.29 Entry of the digits in a telegram to send.

3.7.9. 540 - optional channel guard encoder.

The CG-tones are in accordance with the EIA standard RS-220-A.

To select a channel guard encode tone press 5-4-0 followed by a subcode from the table below.

The digit "F" resets the channel guard encoder. The state is maintained one PTT period.

Subcode	0-0	Channel guard enc. generate	67 Hz
Subcode	0-1	Channel guard enc. generate	77 Hz
Subcode	0-2	Channel guard enc. generate	88.5 Hz
Subcode	0-3	Channel guard enc. generate	100 Hz
Subcode	0-4	Channel guard enc. generate	107.2 Hz
Subcode	0-5	Channel guard enc. generate	114.8 Hz
Subcode	0-6	Channel guard enc. generate	123 Hz
Subcode	0-7	Channel guard enc. generate	131.8 Hz
Subcode	0-8	Channel guard enc. generate	141.3 Hz
Subcode	0-9	Channel guard enc. generate	151.4 Hz
Subcode	1-0	Channel guard enc. generate	162.2 Hz
Subcode	1-1	Channel guard enc. generate	173.8 Hz
Subcode	1-2	Channel guard enc. generate	186.2 Hz
Subcode	1-3	Channel guard enc. generate	203.5 Hz
Subcode	1-4	Channel guard enc. generate	218.1 Hz
Subcode	1-5	Channel guard encode is disabled.	

Example of how to select CG-encoder 141.3 Hz tone.

Entry	Display	Comments
	#00 001 001 400	- initial state.
5	5# 001 001 400	- enter first cipher in function code.
4	54# 001 001 400	- enter second cipher in function code.
0	540 CG ENC TON:#	- function code now entered.
0	540 CG ENC TON:#	- enter first cipher in cg subcode
8	#40 CG ENC TON:8	- enter first cipher in cg subcode

Fig. 3.30 Selection of CG-encode tone.

3.7.10. 541 - optional channel guard decoder.

The CG-tones are in accordance with the EIA standard RS-220-A.

To select a channel guard encode tone press 5-4-1 followed by a subcode from the table below.

The state is maintained until another tone is selected.

When the CG. tone is detected the triangle indicator is lit.

Subcode	0-0	Load the CG6001 module with	67 Hz
Subcode	0-1	Load the CG6001 module with	77 Hz
Subcode	0-2	Load the CG6001 module with	88.5 Hz

Subcode	0-3	Load the CG6001 module with	100 Hz
Subcode	0-4	Load the CG6001 module with	107.2 Hz
Subcode	0-5	Load the CG6001 module with	114.8 Hz
Subcode	0-6	Load the CG6001 module with	123 Hz
Subcode	0-7	Load the CG6001 module with	131.8 Hz
Subcode	0-8	Load the CG6001 module with	141.3 Hz
Subcode	0-9	Load the CG6001 module with	151.4 Hz
Subcode	1-0	Load the CG6001 module with	162.2 Hz
Subcode	1-1	Load the CG6001 module with	173.8 Hz
Subcode	1-2	Load the CG6001 module with	186.2 Hz
Subcode	1-3	Load the CG6001 module with	203.5 Hz

Example of how to load the CG6001 module to match with CG-decoder tone equal 173.8 Hz.

Entry	Display	Comments
	#00 001 001 400	- initial state.
5	5# 001 001 400	- enter first cipher in function code.
4	54# 001 001 400	- enter second cipher in function code.
1	541 CG DEC TON:#	- function code now entered.
1	541 CG DEC TON:#	- enter first cipher in cg subcode
1	#41 CG DEC TON:B	- enter first cipher in cg subcode

Fig. 3.31 Selection of CG-decoder tone.

3.8. FUNCTION CODE 6xx - I/O FUNCTIONS.

Function codes from this function group are used to monitor and manipulate the input and output ports which are available to the user.

The general syntax for this function group is as follows:

```
6 x x  [port pin number] <*>
  | |
  |_|______ select port
    |
    |______ select function
```

Fig. 3.32 Syntax of function codes 6xx.

The second cipher in the function code is used to select the ports:

1. Select the rear connector.
2. Select output expander 0.
3. Select output expander 1.
4. Select input expander 1.
5. Select internal port 1.
6. Select internal port 3.
7. Select output expander 2.

The third cipher selects the function where it is relevant, e.g. it is not possible to write to a input port.

0. Read port pins.
1. Reset specified port pin number.
2. Set specified port pin number.
3. Change specified port pin number.

Each function can be used in conjunction with any relevant port, but it is the same function irrespective of the port. Therefore the functions are only described once and not separately for each port.

The port pins are numbered from 0 to 7 and are shown in the display with pin number 7 as most the significant bit. Thus a port pin is referred to by its number.

All the functions in this group are terminated by activating the asterisk (*) on the control box.

3.8.1. 6x0 - read function.

All accessible pins for the selected port are shown in the display as 1 if they are logical 1 and 0 if they are logical 0. If a port pin is inaccessible it is shown as a ("-").

The display is only updated from the port every 50 mS which means that a very fast "double change" may not be shown in the display.

The monitoring is stopped by pressing the asterisk (*) on the control box. All numerial keys are inactive.

Entry	Display	Comments
	#00 001 001 400	- initial state.
6	6# 001 001 400	- enter first cipher in function code.
2	62# 001 001 400	- enter second cipher in function code.
0	620 10011100	- function code now entered and the port is monitored until termination.
*	#20	- ready to receive a new function code.

Fig. 3.33 Read a port.

3.8.2. 6x1 - reset function.

When a function code is entered the actual port is shown in the display and the radio asks for the pin number which has to be reset, i.e. set to 0.

If an illegal pin number is entered , the radio writes an "X" until a legal pin number is entered.

The port specified will remain monitored and shown in the display until an asterisk (*) is activated. It is possible to enter addtional port pin numbers until the function is terminated.

NOTE: The radio can cause a port pin to change. Thus a port pin may be set immediately after a reset command, e.g. the volume level is changed because of an alert.

Entry	Display	Comments
	#00 001 001 400	- initial state.
6	6# 001 001 400	- enter first cipher in function code.
1	61# 001 001 400	- enter second cipher in function code.
1	611 P:# 111-0101	- function code is entered and waiting for pin number.
0	611 P:X̲ 111-0101	- attempt to write to an input pin.
2	611 P:2̲ 111-0101	- clear pin 2
*	#11	- termination

Fig. 3.34 Reset a port pin

Note that the underscore means that the cursor is in that position.

3.8.3. 6x2 - set function.

When a function code is entered the actual port is shown in the display and the radio asks for the pin number which has to be set, i.e. set to 1.

If an illegal pin number is entered, the radio writes an"X" until a legal pin number is entered.

The port specified will remain monitored and shown in the display until an asterisk (*) is activated. It is possible to enter additional port pin numbers until the function is terminated.

NOTE: The radio can cause a port pin to change. Thus a port pin may be set immediately after a reset command, e.g. the volume level is changed because of an alert.

Entry	Display	Comments
	#00 001 001 400	- initial state.
6	6# 001 001 400	- enter first cipher in function code.
1	61# 001 001 400	- enter second cipher in function code.
2	612 P:# 111-0101	- function code is entered and waiting for pin number.
0	612 P:X 111-0101	- attempt to write to an input pin.
1	612 P:2 111-0101	- set pin 1.
*	#12	- termination

Fig. 3.35 Set a port pin

3.8.4. 6x3 - change function.

When a function code is entered the actual port is shown in the display and the radio asks for the pin number the status of which has to be changed, i.e. 0 -> 1 or 1 -> 0.

As long as the key corresponding to the actual port pin number is depressed the pin will remain changed.

If an illegal pin number is entered, the radio writes an "X" until the key is released.

The port specified will remain monitored and shown in the display until an asterisk (*) is activated. It is possible to enter additional port pin numbers until the function is terminated.

An example:

Entry	Display	Comments
	#00 001 001 400	- initial state.
6	6# 001 001 400	- enter first cipher in function code.
1	61# 001 001 400	- enter second cipher in function code.
3	613 P:# 111-0101	- function code is entered and waiting for pin number.
press 2	613 P:2 111-0001	- change pin 2.
release 2	613 P:# 111-0101	- restore pin 2
press 7	613 P:X 111-0101	- attempt to write to an input pin
release 7	613 P:# 111-0001	- attempt to write to an input pin.
*	#13	- termination.

Fig. 3.36 Change port pins

3.9. Format of the port images.

The format of the port-image in the display is as follows:

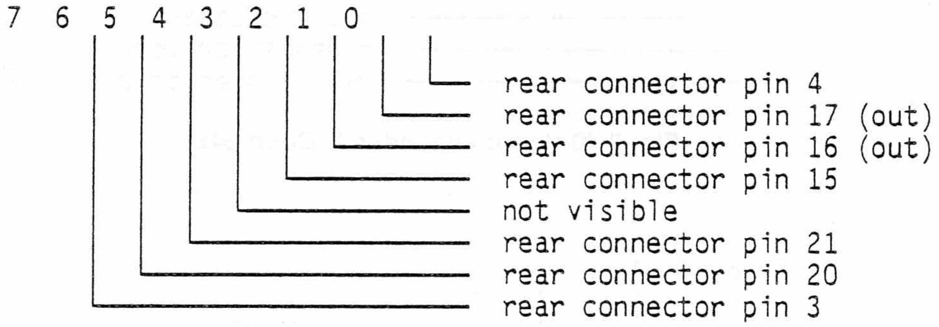


Fig. 3.37 Rear connector. Code 61x.

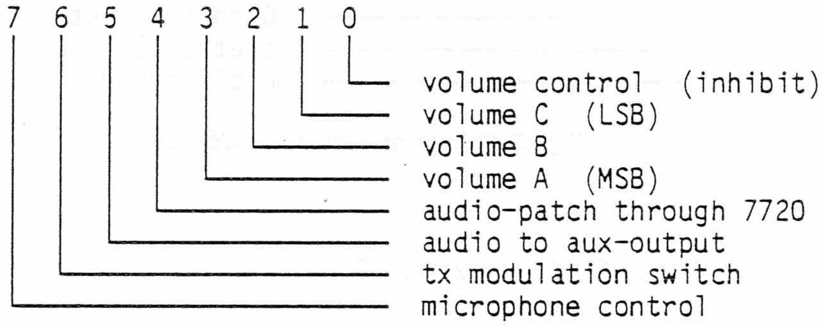


Fig. 3.38 Output expander 0. Code 62x.

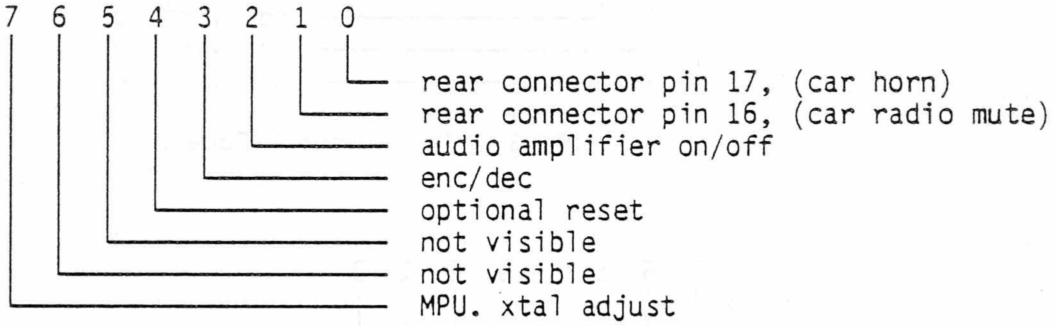


Fig. 3.39 Output expander 1. Code 63x.

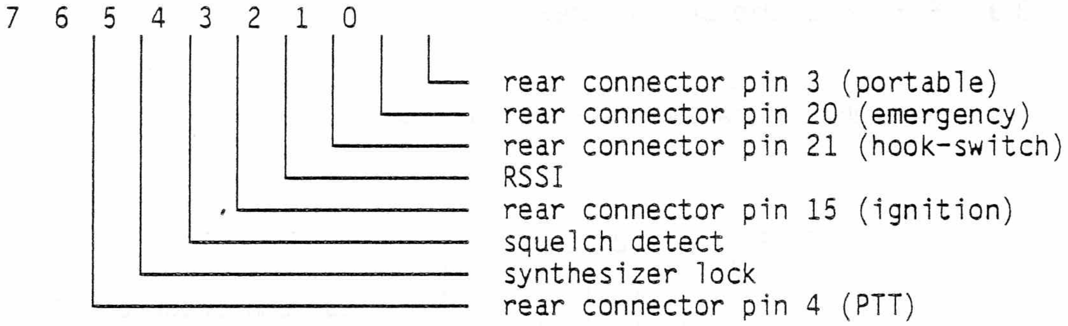


Fig. 3.40 Input expander 0. Code 64x

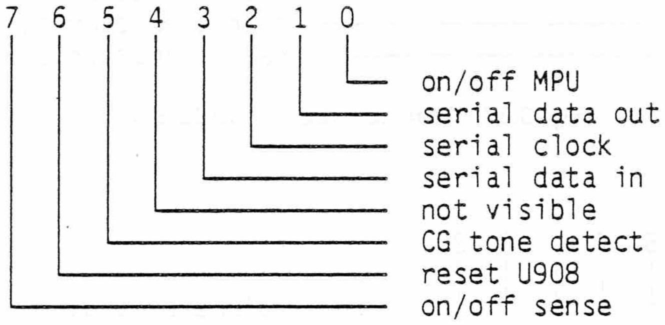


Fig. 3.41 Internal port 1. Code 65x.

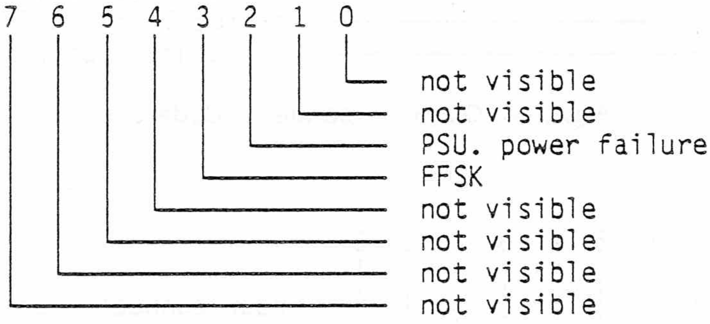


Fig. 3.42 Internal port 3. Code 66x.

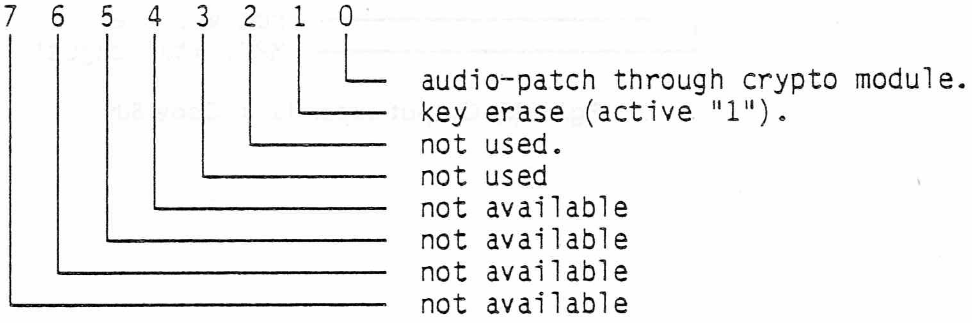


Fig. 3.43 Output expander 2. Code 67x.

3.10. FUNCTION CODE 7xx - PROGRAMMING.

This function group is used for programming purposes and to show the contents of the different storage devices in the radio (i.e. personality prom, program prom and code plug).

The general syntax for this group is as follows:

```
7 x 0     parameter
  |
  |
  └─────  function
```

Fig. 3.44 Syntax of function code 7xx.

The functions implemented are:

function	description	parameter
0	Clear programming.	none
1	Read from program code.	addr [step...step] *
2	Read from personality data.	addr [step...step] *
3	Write into personality data.	addr [data...data] *
4	Read from code plug.	addr [step...step] *
5	Write to code plug.	addr [data...data] *
6	Select code plug-device addr	addr

Fig. 3.45 Programming functions.

The address and data are entered as decimal values for the corresponding hexadecimal ciphers and are shown in the display as the hexadecimal values. This means that a 4 digit hexadecimal number requires 8 key activations. The hexadecimal ciphers are entered as shown below:

Key sequence	Display
00	0
01	1
02	2
03	3
04	4
05	5
06	6
07	7
08	8
09	9
10	A
11	B
12	C
13	D
14	E
15	F

Fig. 3.46 Entry of hexadecimal numbers.

Any other combination of numerical keys is ignored apart from an error sound which is given in the loudspeaker.

A sequence which requires data is terminated by activating the asterisk (*).

3.10.1. 700 - Clear programming.

This function code initializes everything used in the programming functions to the original state as if the service mode was just entered.

Entry	Display	Comments
	#00 001 001 400	- initial state.
7	7# 001 001 400	- enter first cipher in function code.
0	70# 001 001 400	- enter second cipher in function code.
0	700	- function code entered.

Fig. 3.47 Clear programming.

3.10.2. 710 - read program prom.

Reads and displays the contents of the program prom at a specified address.

When the address is entered, and the data shown in the display, it is possible to step forward through the prom by activating the key correspoding to the number of steps wanted, i.e. if you want to step to following byte press key 1.

To exit from this mode just activate the asterisk (*) though it will be considered as an illegal entry.

An example where the prom cell at address 3C0F and further contains 5E, 00, E4, FF, 01, 44, A4, 7C.

Entry	Display	Comments
	#00 001 001 400	- initial state.
7	7# 001 001 400	- enter first cipher in function code.
1	71# 001 001 400	- enter second cipher in function code.
0	710 A:#	- function code entered ready to addr entry.
0	710 A:#	- enter first digit of the address.
3	710 A:3#	- enter first digit of the address.
1	710 A:3#	- enter second digit of the address
2	710 A:3C	- enter second digit of the address
0	710 A:3C#	- enter third digit of the address

continued

Entry	Display	Comments
0	710 A:3C0#	- enter third digit of the address.
1	710 A:3C0#	- enter fourth digit of the address.
5	710 A:3C0F D:5E	- enter fourth digit of the address.
1	710 A:3C10 D:00	- enter step forward.
3	710 A:3C13 D:FF	- enter step forward.
5	710 A:3C18 D:7C	- enter step forward.
*	#10 A:3C18 D:7C	- exit from this mode.

Fig. 3.48 Read from program prom.

3.10.3. 720 read personality prom.

Reads and displays the contents of the personality data at a specified address. The routine expects a correct address in the range C000-C7FF. If an illegal address is entered, an error sound will be given, and the cursor will be positioned at the first digit in the address ready to receive a correct address.
When the address is entered, and the data shown in the display, it is possible to step through the prom by activating the key corresponding to the number of steps wanted, i.e. if you want to step to the following byte press key 1.
To exit from this mode activate the asterisk (*), though it will be considered as an illegal entry.

An example where the personality data at address C010 and further contains C0, A0, C7, 00, C7, C0, FF, FF.

Entry	Display	Comments
	#00 01 001 400	- initial state.
7 2 0	720 A:#	- function code entered ready to addr entry.
1 2	720 A:C	- enter first digit of the address.
0 0	720 A:C0	- enter second digit of the address.
0 1	720 A:C01	- enter third digit of the address.
0 0	720 A:C010 D:C0	- enter fourth digit of the address.
1	720 A:C011 D:A0	- enter step forward
2	720 A:C013 D:00	- enter step forward
*	#20 A:C013 D:00	- exit from this mode

Fig. 3.49 Read from personality prom.

3.10.4. 730 - write into personality data.

Writes bytes into the personality area at a specified address. The routine expects a correct address in the range C000-C7FF. If an illegal address is entered, an error sound will be given and the cursor will be positioned at the first digit in the address ready to receive a correct address.

When the address is entered the data is shown in the display, then the new data must be entered. If the data should not be changed it is necessary to write the same data as shown in the display.

When a byte is written (8 digits entered), the address is incremented by 1, and the radio is ready to receive new data to this address.

To exit from this mode press the asterisk (*).

If there is no EEPROM but an UV-prom in the radio, the radio writes "NO EEPROM" in the display. The prom is considered as an EEPROM if the cell C000H (the first byte in the personality prom) contains 00.

An example where you want to change the contents of address C1F0 from FF, 03, A5 to 04, 03, C0.

Entry	Display	Comments
	#00 001 001 400	- initial state.
7 3 0	730 A:#	- function code entered ready to addr entry.
1 2	730 A:C	- enter first digit of the address.
0 1	730 A:C1	- enter second digit of the address.
1 5	730 A:C1F	- enter third digit of the address.
0 0	730 A:C1F0 D:FF	- enter fourth digit of the address.
0 0	730 A:C1F0 D:0F	- enter first cipher in data.
0 4	730 A:C1F0 D:04	- enter second cipher in data.
	730 A:C1F1 D:03	- the byte is written
0 0	730 A:C1F1 D:03	- enter first cipher in data.
0 3	730 A:C1F1 D:03	- enter second cipher in data.
	730 A:C1F2 D:A5	- the byte is written
1 2	730 A:C1F2 D:C5	- enter first cipher in data.
0 0	730 A:C1F2 D:C0	- enter second cipher in data.
	730 A:C1F3 D:FF	- the byte is written
*	#30 A:C1F3 D:FF	- exit from this mode

Fig. 3.50 Write to personality prom.

3.10.5. 740 - read from code plug.

Reads and displays the contents of the code plug at a specified address. The routine expects a correct address in the range 00-1F (for the small code plug). If an illegal address is entered, an error sound will be given and the cursor will be positioned at the first digit in the address ready to receive a correct address.

If no code plug is present "NO code plug" is written in the display.

When the address is entered and the data is shown in the display, it is possible to step through the code plug by activating the key corresponding to the number of steps wanted, i.e. if you want to step to the following byte press key 1.

To exit from this mode activate the asterisk (*), though it will be considered as an illegal entry.

An example of where the code plug data at address 05 and further contains 12, A0, 3D, 00.

Entry	Display	Comments
	#00 001 001 400	- initial state.
7 4 0	740 A:#	- function code entered ready to addr enter
0 0	740 A:0	- enter first digit of the address.
0 5	740 A:05 D:12	- enter second digit of the address.
1	740 A:06 D:A0	- enter step forward
2	740 A:08 D:00	- enter step forward
*	#40 A:08 D:00	- exit from this mode

Fig. 3.51 Read code plug prom.

3.10.6. 750 - write into code plug.

Writes bytes into the code plug at specified address. The routine expects a correct address, i.e. in the range 00-1F. If an illegal address is entered, an error sound will be given and the cursor will be positioned at the first digit in the address ready to receive a correct address.

If no code plug is present, "NO code plug" is written in the display.

When the address is entered the data is shown in the display and the new data must be entered. If the data should not be changed, it is necessary to write the same data as shown in the display.

When a byte is written (4 digits entered), the address is incremented by 1, and the radio is ready to receive new data to this address.

To exit from this mode, just press the asterisk (*).

Note: It is not possible to program the first two bytes in the code plug, though the service-mode does not check if it is tried out.

An example of where you want to change the contents of address 13 from FF to 04.

Entry	Display	Comments
	#00 001 001 400	- initial state.
7 5 0	750 A:#	- function code entered ready to addr entry.
0 1	750 A:1#	- enter first digit of the address.
0 3	750 A:13 D:FF	- enter second digit of the address.
0 0	750 A:13 D:0F	- enter first cipher in data.
0 4	750 A:13 D:04	- enter second cipher in data.
	750 A:14 D:FF	- the byte is written
*	#50 A:C1F3 D:FF	- exit from this mode

Fig. 3.52 Write to code plug

3.10.7. 760 - select codeplug-device address.

This function code is used to change the H-bus address of the device in which the codeplug is located. The default address is the same as the default service-CB address, which is 20H.

The legal addresses are in the range 20H to 2AH. For this reason only the latter ciffer has to be entered.

When the function code is entered the previous address is shown, and the cursor points at the less significant ciffer.

The address is entered as a hexidecimal value.

An example where you want to specify the H-bus address to be 2A.

Entry	Display	Comments
	#00 001 001 400	- initial state.
7 6 0	760 CP-ADDR:2Q	- function code entered ready to addr entry.
10	#60 CP-ADDR:2A	- address is entered.

Fig. 3.53 Select H-bus address for codeplug.

CHAPTER 2

ADJUSTMENT

ADJUSTMENT

- General adjustment procedure
- General adjustment procedure encryption version
- Test prom
- Receiver test set-up
- Transmitter test set-up
- Adjustable components and test points CF6001

a) RF611x/RF677x

b) RF633x

c) RF666x

ADJUSTMENT PROCEDURE

CQM6000/MC spectro

136 - 174 MHz AND 174 - 225 MHz L/H

INSTRUMENTS

The following instruments are necessary in order to perform a complete adjustment of the radiotelephone.

AF Voltmeter	Zi ≥1 Mohm
DC Voltmeter	Ri ≥1 Mohm
DC Amperemeter	0 - 1/0 - 10 A
RF Generator	10 - 470 MHz
RF Wattmeter	68 - 470 MHz
Deviationmeter	68 - 470 MHz
Frequency counter	0.4 - 512 MHz
Distortionmeter	Psophometric
AF Generator	0.1 - 10 kHz
DC Power Supply	10 - 20 V/0 - 10 A
RF Probe	Part no. 95.0059-00
Trimming Tool	Part no. 17.0053-00
Interface Box SE6002	Part no. 95D5014-00
Service Prom M6000	Part no. 95D5015-01

GENERAL NOTES

During test and adjustment DC power (13.2 V) must be connected and the radio turned on.
The personality prom U904 must be replaced by a test prom.

VOLTAGE REGULATOR

Connect the DC power supply to the radio and set the voltage to 13.2 V.
Turn the radio on.
Read the current drain.
Requirement: I>250 mA.
Connect a DC voltmeter to the negative terminal C707.
Adjust R707 for -5 V ±0.1 V.
Connect a voltmeter to P902 pin 2.
Adjust R719 for -24 V ±0.1 V.

LOW BATTERY THRESHOLD ADJUSTMENT.

Turn R722 completely clockwise.
Set voltage supply to 10V ±1mV.
Check the voltage on pin 14 of U905 for being high (>5V).
Adjust R722 anticlockwise until the voltage on pin 14 of U905 just goes low.
Adjust the supply voltage up and down to veryfy that the voltage on U905 pin 14 switches from high to low when the battery voltage is between 10-10.5V.

Note: Readjustment of R719 requires readjustment of the receiver.

TRANSMITTER ADJUSTMENT

During adjustment the transmitter must be connected to an RF wattmeter and keyed.
Connect a voltmeter to P102 pin 9. (LOCK)
Check that the lock signal is 0 V (Low).

TRANSMITTER OUTPUT POWER

Adjust R133 for rated RF power.
Select a channel with reduced power, if used.
Adjust R132 for rated reduced power.

TRANSMITTER FREQUENCY

Connect a frequency counter to the antenna output through a suitable attenuator.
Adjust L701 for nominal transmitter frequency.
Requirement: F_{nom} ± 0.2 p.p.m. (parts per million).

TRANSMITTER MODULATION

Connect an AF generator to P102 pin 3-(4 = GND).
Connect a deviation meter to the antenna output through a suitable attenuator.
Set the generator frequency to 1 kHz and the output to 1.66 V r.m.s.
Set R677 to its center position.
Select the center channel in the high frequency window:

136-174 MHz band:	172.3 MHz
174-210 MHz (Low band):	208.6 MHz
190-225 MHz (High band):	223.6 MHz

Adjust R675 for maximum deviation (all bands):

Channel spacing 25 kHz:	±5 kHz +0/-100 Hz
Channel spacing 20 kHz:	±4 kHz +0/-100 Hz
Channel spacing 12.5 kHz:	±2.5 kHz +0/-100 Hz

Select the center channel in the low frequency window:

136-174 MHz band:	136.9 MHz
174-210 MHz (Low band):	174.9 MHz
174-210 MHz (High band):	190.9 MHz

Adjust R680 for maximum deviation (all bands):

Channel spacing 25 kHz:	±5 kHz +0/-100 Hz
Channel spacing 20 kHz:	±4 kHz +0/-100 Hz
Channel spacing 12.5 kHz:	±2.5 kHz +0/-100 Hz

Select the center channel in the middle frequency window:

136-174 MHz band:	150.4 MHz
174-210 MHz (Low band):	188.4 MHz
190-225 MHz (High band):	204.56 MHz

Set the AF generator output to 1.66 V r.m.s.
Alternately set the generator frequency to 1 kHz and 20 Hz.
Adjust R677 for the same deviation at both modulation frequencies (±100 Hz).
Check and if necessary readjust R675 for maximum deviation (+0/-100 Hz).
Connect the AF generator to J901 pin 22 (TX LINE).

Adjust the generator output to obtain 60% of maximum deviation (all bands):

Channel spacing 25 kHz:	±3.0 kHz
Channel spacing 20 kHz:	±2.4 kHz
Channel spacing 12.5 kHz:	±1.75 kHz

Requirement: AF input 100 mV ±3 dB.

RECEIVER ADJUSTMENT

RECEIVER FRONT END

Select the center channel of the low RX frequency window:

136-174 MHz band:	136.9 MHz
174-210 MHz (Low band):	174.9 MHz
190-225 MHz (High band):	190.9 MHz

Connect a diode probe and DC-Voltmeter to TP7.

Connect a signal generator to the antenna input and set its frequency to the channel frequency.
Set the generator to 0 dB (225 mV - 1/2 e.m.f.).
Adjust L301, L302 and L304 for maximum voltmeter reading.

Adjust L306 for minimum reading, L308 for minimum reading and L310 for maximum reading.
Repeat the adjustments until no further improvements in minimums and maximums are possible.

Connect the diode probe and voltmeter to TP3.
Adjust L313 and L314 for maximum voltmeter reading.

Select the center channel of the high RX frequency window:

136-174 MHz band:	172.45 MHz
174-210 MHz (Low band):	208.6 MHz
190-225 MHz (High band):	255.65 MHz

Set the signal generator frequency to the channel frequency.
Connect a distortion meter to P102 pin 10 (RX LINE).
Adjust R663 for best sensitivity (SINAD).

The radio can now cover the entire frequency band without readjustment.

ALTERNATIVE METHOD

If the RX window is less than 10 MHz:

Connect a voltmeter to TP12.
Adjust R633 for a voltage reading according to the graph (±50 mV).
Connect a diode probe and voltmeter to TP3.

Adjust L313 and L314 for maximum reading.
Connect a RF signal generator to the antenna input.
Set the generator frequency to the center channel frequency and the modulation frequency to 1 kHz and 60% deviation.

Adjust the following capacitors for best sensitivity (SINAD).
L301, L302, L304, L306, L308, L310, L312.

45 MHz IF AMPLIFIER

Connect a signal generator to the antenna input.
Set the generator frequency to the channel frequency.
Set the generator output to 15 mV (10 - 20 mV) unmodulated.

Connect a spectrum analyzer to TP5.
Adjust L403 and L405 for maximum.
Modulate the signal generator with 1 kHz to ±30 - 50 kHz.
Adjust L404 for symetrical curve.
Set the generator output to 1 mV unmodulated.

Connect a frequency counter to TP6.
Connect a distortionmeter and an oscilloscope to P102 pin 10 (RX LINE).
Adjust L408 for 455 kHz.

Alternative: Adjust L408 for minimum distortion with 100% modulation. The decrease in distortion is small (approx. 1%).
Set the generator modulation to 1 kHz and 60% deviation.
Adjust L406 and L409 for minimum distortion.
Adjust L410 for best demodulated/recovered audio signal on the oscilloscope.
Adjust R426 for 110 mV (RX LINE).

RECEIVER SENSITIVITY

Measure the 20 dB psophometric SINAD on all channels.

Typical sensitivity:

136-174 MHz Band:	Channel spacing 25 kHz:	0.7 uV
	Channel spacing 20 kHz:	0.7 uV
	Channel spacing 12.5 kHz:	1.0 uV
174-210/190-225 MHz Band:		1.15 uV

SQUELCH

Connect a signal generator to the antenna input.
Set the generator frequency to the channel frequency. Set the modulation to 1 kHz and 60% deviation.

Connect a distortion meter to J102 pin 10.
Connect a voltmeter to P102 pin 11.
Adjust the generator output to obtain 10 - 12 dB SINAD.
Adjust R442 so that the squelch just opens.

Squelch open: ≤1 V.
Squlech closed: ≥3 V.

CURRENT CONSUMPTION

Measure the current consumption in off state, receive and transmit mode:

Band:	**136-174 MHz**	**174-210/190-225 MHz**
OFF:	27 mA	17 mA
Receive Stand-by:	<720 mA	<720 mA
Transmit (25 W):	6.52 A	7.02 A

Values are typical and may only be used for reference.

ADJUSTMENT PROCEDURE

CQM6110 - CQM6770L/H

INSTRUMENTS

The following instruments are necessary in order to perform a complete adjustment of a Stornophone 6000 radiotelephone.

AF Voltmeter	Zi ≥ 1 Mohm
DC Voltmeter	Ri ≥ 1 Mohm
DC Amperemeter	0 - 1/0 - 10 A
RF Generator	10 - 470 MHz
RF Wattmeter	68 - 470 MHz
Deviationmeter	68 - 470 MHz
Frequency counter	0.4 - 512 MHz
Distortionmeter	Psophometric
AF Generator	0.1 - 10 kHz
DC Power Supply	10 - 20 V/O - 10 A
RF Probe	Part no. 95.0059-00
Trimming Tool	Part no. 17.0053-00
Interface Box SE6002	Part no. 95D5014-00
Service Prom M6000	Part no. 95D5015-01

GENERAL NOTES

During test and adjustment DC power (13.2 V) must be connected and the radio turned on.
The personality prom U904 must be replaced by a test prom.

VOLTAGE REGULATOR

Connect the DC power supply to the radio and set the voltage to 13.2 V.
Turn the radio on.
Read the current drain.
Requirement:1 > 250 mA.
Connect a DC voltmeter to R716.
Adjust R709 for 5 V ±0.1 V.

WARNING!

Never set the +5 V supply to be higher than +6 V, even for a short period, as overvoltage can destroy the circuitry.
Connect a volmeter to P102 pin 2.
Adjust R719 for -24 V ±0.1 V.

Note: Readjustment of R719 requires readjustment of the receiver.

TRANSMITTER ADJUSTMENT

During adjustment the transmitter must be connected to an RF wattmeter and keyed.
Connect a voltmeter to P102 pin 9. (LOCK)
Check that the lock signal is 0 V (LOW).

TRANSMITTER OUTPUT POWER

Adjust R133 for rated RF power.
Select a channel with reduced power, if used.
Adjust R132 for rated reduced power.

TRANSMITTER FREQUENCY

Connect a frequency counter to the antenna output through a suitable attenuator.
Adjust L701 for nominal transmitter frequency.
Requirement:F_{nom} ± 0.2 p.p.m.(parts per million).

TRANSMITTER MODULATION

Connect an AF generator to P102 pin 3-(4 = GND).
Connect a deviationmeter to the antenna output through a suitable attenuator.
Set the generator frequency to 1 kHz and the output to 1.66 V r.m.s.
Set R677 to its center position.
Select the center channel in the high frequency window:

CQM6110:	172.3 MHz
CQM6770L:	208.6 MHz
CQM6770H:	223.6 MHz

Adjust R675 for maximum diviation (all bands):

CQM6XX:	±5 kHz + 0/-100 Hz
CQM6XX3	±4 kHz + 0/-100 Hz
CQM6XX4	±2.5 kHz + 0/-100 Hz

Select the center channel in the low frequency window:

CQM6110:	136.9 MHz
CQM6770L:	174.9 MHz
CQM6770H:	190.9 MHz

Adjust R680 for maximum deviation (all bands):

CQM6XX2:	±5 kHz + 0/-100 Hz
CQM6XX3:	±4 kHz + 0/-100 Hz
CQM6XX4	±2.5 kHz + 0/-100 Hz

Select the center channel in the middle frequency window:

CQM6110:	150.4 MHz
CQM6770L:	188.4 MHz
CQM6770H:	204.56 MHz

Set the AF generator output to 1.66 V r.m.s.
Alternately set the generator frequency to 1 kHz and 20 Hz.
Adjust R677 for the same deviation at both modulation frequencies (±100 Hz).
Connect the AF generator to J901 pin 22 (TX LINE).

Adjust the generator output to obtain 60% of maximum deviation (all bands):

CQM6XX2:	±3.0 kHz
CQM6XX3:	±2.4 kHz
CQM6XX4:	±1.75 kHz

Requirement: AF input 100 mV ±3 dB.

RECEIVER ADJUSTMENT

RECEIVER FRONT END

Select the center of the low RX frequency window:

CQM6110:	136.9 MHz
CQM6770L:	174.9 MHz
CQM6770H:	190.9 MHz

Connect a diode probe and DC-Voltmeter to TP7.

Connect a signal generator to the antenna input and set its frequency to the channel frequency.
Set the generator to 0 dB (225 mV - 1/2 e.m.f.).
Adjust L301, L302 and L304 for maximum voltmeter reading.

Adjust L306 for minimum reading, L308 for minimum reading and L310 for maximum reading.
Repeat the adjustments until no further improvements in minimums and maximums are possible.

Connect the diode probe and voltmeter to TP3.
Adjust L313 and L314 for maximum voltmeter reading.

select the center channel of the high RX frequency window:

CQM6110:	172.45 MHz
CQM6770L:	208.6 MHz
CQM6770H:	255.65 MHz

Set the signal generator frequency to the channel frequency.
Connect a distortionmeter to P102 pin 10 (RX LINE).
Adjust R663 for best sensitivity (SINAD).

The radio can now cover the entire frequency band without readjustment.

ALTERNATIVE METHOD

If the RX window is less than 10 MHz:

Connect a voltmeter to TP12.
Adjust R633 for a voltage reading according to the graph (±50 mV).
Connect a diode probe and voltmeter to TP3.

Adjust L313 and L314 for maximum reading.
Connect a RF signal generator to the antenna input.
Set the generator frequency and the modulation frequency to 1 kHz and 60% deviation.

Adjust the following capacitors for best sensitivity (SINAD).
L301, L302, L304, L306, L308, L310, L312.

45 MHz IF AMPLIFIER

Connect a signal generator to the antenna input.
Set the generator frequency to the channel frequency.
Set the generator output to 15 mV (10 - 20mV) unmodulated.

Connect a spectrum analyzer to TP5.
Adjust L403 and L405 for maximum.
Modulate the signal generator with 1 kHz to ±30 - 50 kHz.
Adjust L404 for symetrical curve.
Set the generator output to 1 mV unmodulated.

Connect a frequency counter to TP6.
Connect a distortionmeter and an oscilloscope to P102 pin 10 (RX LINE).
Adjust L408 for 455 kHz.

ALTERNATIVE

Adjust L408 for minimum distortion with 100% modulation. The decrease in distortion is small (approx. 1%).
Set the generator modulation to 1 kHz and 60% divation.
Adjust L406 and L409 for minimum distortion.
Adjust L410 for best demodulated/recovered audio signal on the oscilloscope.
Adjust R426 for 110 mV (RX LINE).

RECEIVER SENSITIVITY

Measure the 20 dB psophometric SINAD on all channels.

Typical sensitivity:

CQM6112:	0.7 uV
CQM6113:	0.7 uV
CQM6114:	1.0 uV
CQM6770:	1.15 uV

SQUELCH

Connect a signal generator to the antenna input.
Set the generator frequency to the channel frequency.
Set the modulation to 1 kHz and 60% deviation.

Connect a distortionmeter to J102 pin 10.
Connect a voltmeter to P102 pin 11.
Adjust the generator output to obtain 10 - 12 dB SINAD.
Adjust R442 so that the squelch just opens.

Squelch open: $\leq$1 V.
Squelch closed: $\geq$3 V.

CURRENT CONSUMPTION.

Measure the current consumption in off state, receive and transmit mode:

Band:	CQM6110	CQM6770
OFF:	27 mA	17 mA
Receiver Stand-by:	<720 mA	<720 mA
Transmit (25 W):	6.52 A	7.02 A

Values are typical and may only be used for reference.

ADJUSTMENT PROCEDURE

CQM6000/MCspectro

66 - 88 MHz

INSTRUMENTS

The following instruments are necessary in order to perform a complete adjustment of the radiotelephone.

AF Voltmeter	Zi ≥1 Mohm
DC Voltmeter	Ri ≥1 Mohm
DC Amperemeter	0 - 1/0 - 10 A
RF Generator	10 - 470 MHz
RF Wattmeter	68 - 470 MHz
Deviationmeter	68 - 470 MHz
Frequency counter	0.4 - 512 MHz
Distortionmeter	Psophometric
AF Generator	0.1 - 10 kHz
DC Power Supply	10 - 20 V/0 - 10 A
RF Probe	Part no. 95.0059-00
Trimming Tool	Part no. 17.0053-00
Interface Box SE6002	Part no. 95D5014-00
Service Prom M6000	Part no. 95D5015-01

GENERAL NOTES

During test and adjustment DC power (13.2 V) must be connected and the radio turned on.
The personality prom U904 must be replaced by a test prom.

VOLTAGE REGULATOR

Connect the DC power supply to the radio and set the voltage to 13.2 V.
Turn the radio on.
Read the current drain.
Requirement: I>250 mA.
Connect a DC voltmeter to the negative terminal C707.
Adjust R707 for -5 V ±0.1 V.
Connect a voltmeter to P902 pin 2.
Adjust R719 for -24 V ±0.1 V.

LOW BATTERY THRESHOLD ADJUSTMENT.

Turn R722 completely clockwise.
Set voltage supply to 10V ±1mV.
Check the voltage on pin 14 of U905 for being high (>5V).
Adjust R722 anticlockwise until the voltage on pin 14 of U905 just goes low.
Adjust slowly the supply voltage from 10.5 V down to 10 V.
Verify that the voltage on U905 pin 14 switches from high to low
at a battery voltage level: 10 V ±50mV.

Note: Readjustment of R719 requires readjustment of the receiver.

TRANSMITTER ADJUSTMENT

During adjustment the transmitter must be connected to an RF wattmeter and keyed.
Connect a voltmeter to P102 pin 9. (LOCK)
Check that the lock signal is 0 V (Low).

TRANSMITTER OUTPUT POWER

Adjust R133 for rated RF power.
Select a channel with reduced power, if used.
Adjust R132 for rated reduced power.

TRANSMITTER FREQUENCY

Connect a frequency counter to the antenna output through a suitable attenuator.
Adjust L701 for nominal transmitter frequency.
Requirement: F_{nom} ± 0.2 p.p.m. (parts per million).

TRANSMITTER MODULATION

Connect an AF generator to P102 pin 3-(4 = GND).
Connect a deviation meter to the antenna output through a suitable attenuator.
Set the generator frequency to 1 kHz and the output to 1.66 V r.m.s.
Set R677 to its center position.
Select the center channel in the high frequency window: 86.970 MHz.

Adjust R675 for maximum deviation:

Channel spacing 25 kHz:	±5 kHz +0/-100 Hz
Channel spacing 20 kHz:	±4 kHz +0/-100 Hz
Channel spacing 12.5 kHz:	±2.5 kHz +0/-100 Hz

Select the center channel in the low frequency window: 66.46 MHz.

Adjust R680 for maximum deviation:

Channel spacing 25 kHz:	±5 kHz +0/-100 Hz
Channel spacing 20 kHz:	±4 kHz +0/-100 Hz
Channel spacing 12.5 kHz:	±2.5 kHz +0/-100 Hz

Select the center channel in the middle frequency window: 74.040 MHz.

Set the AF generator output to 1.66 V r.m.s.
Alternately set the generator frequency to 1 kHz and 20 Hz.
Adjust R677 for the same deviation at both modulation frequencies (± 100 Hz).
Check and if necessary readjust R675 for maximum deviation (+ 0/-100 Hz).
Connect the AF generator to J901 pin 22 (TX LINE).

Adjust the generator output to obtain 60% of maximum deviation:

Channel spacing 25 kHz:	±3.0 kHz
Channel spacing 20 kHz:	±2.4 kHz
Channel spacing 12.5 kHz:	±1.75 kHz

Requirement: AF input 100 mV ±3 dB.

RECEIVER ADJUSTMENT

RECEIVER FRONT END

Select the center channel of the low RX frequency window: 66.510 MHz.

Connect a diode probe and DC-Voltmeter to TP7.

Connect a signal generator to the antenna input and set its frequency to the channel frequency.
Set the generator to 0 dB (225 mV - 1/2 e.m.f.).
Adjust L301, L302 and L304 for maximum voltmeter reading.

Adjust L306 for maximum reading, L308 for maximum reading and L310 for minimum reading.
Repeat the adjustments until no further improvements in minimums and maximums are possible.

Connect the diode probe and voltmeter to TP3.
Adjust L313 and L314 for maximum voltmeter reading.

Select the center channel of the high RX frequency window: 87.060 MHz.

Set the signal generator frequency to the channel frequency.
Connect a distortion meter to P102 pin 10 (RX LINE).
Adjust R663 for best sensitivity (SINAD).

The radio can now cover the entire frequency band without readjustment.

ALTERNATIVE METHOD

If the RX window is less than 10 MHz:

Connect a voltmeter to TP12.
Adjust R633 for a voltage reading according to the graph (±50 mV).
Connect a diode probe and voltmeter to TP3.

Adjust L313 and L314 for maximum reading.
Connect a RF signal generator to the antenna input.
Set the generator frequency to the center channel frequency and the modulation frequency to 1 kHz and 60% deviation.

Adjust the following capacitors for best sensitivity (SINAD).
L301, L302, L304, L306, L308, L310, L312.

21.4 MHz IF AMPLIFIER

Connect a signal generator to the antenna input.
Set the generator frequency to the channel frequency.
Set the generator output to 15 mV (10 - 20 mV) unmodulated.

Connect a diode probe to TP5.
Adjust L403 and L405 for maximum.
Set the generator output to 1 mV unmodulated.

Connect a frequency counter to TP6.
Connect a distortionmeter and an oscilloscope to P102 pin 10 (RX LINE).
Adjust L408 for 455 kHz.

Alternative: Adjust L408 for minimum distortion with 100% modulation. The decrease in distortion is small (approx. 1%).
Set the generator modulation to 1 kHz and 60% deviation.
Adjust L406 and L409 for minimum distortion.
Adjust L410 for best demodulated/recovered audio signal on the oscilloscope.
Adjust R426 for 110 mV (RX LINE).

RECEIVER SENSITIVITY

Measure the 20 dB psophometric SINAD on all channels.

Typical sensitivity:

Channel spacing 25 kHz:	0.7 uV
Channel spacing 20 kHz:	0.7 uV
Channel spacing 12.5 kHz:	1.0 uV

SQUELCH

Connect a signal generator to the antenna input.
Set the generator frequency to the channel frequency. Set the modulation to 1 kHz and 60% deviation.

Connect a distortion meter to J102 pin 10.
Connect a voltmeter to P102 pin 11.
Adjust the generator output to obtain 10 - 12 dB SINAD.
Adjust R442 so that the squelch just opens.

Squelch open: ≤1 V.
Squlech closed: ≥3 V.

CURRENT CONSUMPTION

Measure the current consumption in off state, receive and transmit mode:

OFF:	27 mA
Receive Stand-by:	<720 mA
Transmit (25 W):	6.52 A

Values are typical and may only be used for reference.

ADJUSTMENT PROCEDURE

CQM6330

INSTRUMENTS

The following instruments are necessary in order to perform a complete adjustment of a Stornophone 6000 radiotelephone.

AF Voltmeter	Zi ≥1 Mohm
DC Voltmeter	Ri ≥1 Mohm
DC Amperemeter	0 - 1/0 - 10 A
RF Generator	10 - 470 MHz
RF Wattmeter	68 - 470 MHz
Deviationmeter	68 - 470 MHz
Frequency counter	0.4 - 512 MHz
Distortionmeter	Psophometric
AF Generator	0.1 - 10 kHz
DC Power Supply	10 - 20 V/0 - 10 A
RF Probe	Part no. 95.0059-00
Trimming Tool	Part no. 17.0053-00
Interface Box SE6002	Part no. 95D5014-00
Service Prom M6000	Part no. 95D5015-01

GENERAL NOTES

During test and adjustment DC power (13.2 V) must be connected and the radio turned on.
The personality prom U904 must be replaced by a test prom.

VOLTAGE REGULATOR

Connect the DC power supply to the radio and set the voltage to 13.2 V.
Turn the radio on.
Read the current drain.
Requirement: I>250 mA.
Connect a DC voltmeter to R716.
Adjust R709 for 5 V ±0.1 V.

WARNING

Never set the +5 V supply to be higher than +6 V, even for a short period, as overvoltage can destroy the circuitry.
Connect a voltmeter to P102 pin 2.
Adjust R719 for -24 V ±0.1 V.

Note: Readjustment of R719 requires readjustment of the receiver.

TRANSMITTER ADJUSTMENT

During adjustment the transmitter must be connected to an RF wattmeter and keyed.
Connect a voltmeter to P102 pin 9. (LOCK)
Check that the lock signal is 0 V (Low).

TRANSMITTER OUTPUT POWER

Adjust R133 for rated RF power.
Select a channel with reduced power, if used.
Adjust R132 for rated reduced power.

TRANSMITTER FREQUENCY

Connect a frequency counter to the antenna output through a suitable attenuator.
Adjust L1 in L701 for nominal transmitter frequency.
Requirement: F_{nom} ± 0.2 p.p.m. (parts per million).

TRANSMITTER MODULATION

Connect an AF generator to P102 pin 3-(4 = GND).
Connect a deviation meter to the antenna output through a suitable attenuator.
Set the generator frequency to 1 kHz and the output to 1.66 V r.m.s.
Set R677 to its center position.
Select the center channel in the high frequency window: 86.970 MHz.

Adjust R675 for maximum deviation:

CQM6xx2:	± 5 kHz	+ 0/-100 Hz
CQM6xx3:	± 4 kHz	+ 0/-100 Hz
CQM6xx4:	± 2.5 kHz	+ 0/-100 Hz

Select the center channel in the low frequency window: 66.46 MHz.

Adjust R680 for maximum deviation:

CQM6xx2:	± 5 kHz	+ 0/-100 Hz
CQM6xx3:	± 4 kHz	+ 0/-100 Hz
CQM6xx4:	± 2.5 kHz	+ 0/-100 Hz

Select the center channel in the middle frequency window: 74.040 MHz.

Set the AF generator output to 1.66 V r.m.s.
Alternately set the generator frequency to 1 kHz and 20 Hz.
Adjust R677 for the same deviation at both modulation frequencies (± 100 Hz).
Check and if necessary readjust R675 for maximum deviation (+ 0/-100 Hz).
Connect the AF generator to J901 pin 22 (TX LINE).

Adjust the generator output to obtain 60% of maximum deviation:

CQM6xx2: ±3.0 kHz
CQM6xx3: ±2.4 kHz
CQM6xx4: ±1.75 kHz

Requirement: AF input 100 mV ±3 dB.

RECEIVER ADJUSTMENT

RECEIVER FRONT END

Select the center channel of the low RX frequency window: 66.510 MHz.

Connect a diode probe and DC-Voltmeter to TP7.

Connect a signal generator to the antenna input and set its frequency to the channel frequency.
Set the generator to 0 dB (225 mV - 1/2 e.m.f.).
Adjust L301, L302 and L304 for maximum voltmeter reading.

Adjust L306 for maximum reading, L308 for maximum reading and L310 for minimum reading.
Repeat the adjustments until no further improvements in minimums and maximums are possible.

Connect the diode probe and voltmeter to TP3.
Adjust L313 and L314 for maximum voltmeter reading.

Select the center channel of the high RX frequency window: 87.060 MHz.

Set the signal generator frequency to the channel frequency.
Connect a distortion meter to P102 pin 10 (RX LINE).
Adjust R663 for best sensitivity (SINAD).

The radio can now cover the entire frequency band without readjustment.

ALTERNATIVE METHOD

If the RX window is less than 10 MHz:

Connect a voltmeter to TP12.
Adjust R633 for a voltage reading according to the graph (±50 mV).
Connect a diode probe and voltmeter to TP3.

Adjust L313 and L314 for maximum reading.
Connect a RF signal generator to the antenna input.
Set the generator frequency to the center channel frequency and the modulation frequency to 1 kHz and 60% deviation.

Adjust the following capacitors for best sensitivity (SINAD).
L301, L302, L304, L306, L308, L310, L312.

21.4 MHz IF AMPLIFIER

Connect a signal generator to the antenna input.
Set the generator frequency to the channel frequency.
Set the generator output to 15 mV (10 - 20 mV) unmodulated.

Connect a diode probe to TP5.
Adjust L403 and L405 for maximum.
Set the generator output to 1 mV unmodulated.

Connect a frequency counter to TP6.
Connect a distortionmeter and an oscilloscope to P102 pin 10 (RX LINE).
Adjust L408 for 455 kHz.
Alternative: Adjust L408 for minimum distortion with 100% modulation. The decrease in distortion is small (approx. 1%).

Set the generator modulation to 1 kHz and 60% deviation.
Adjust L406 and L409 for minimum distortion.
Adjust L410 for best demodulated/recovered audio signal on the oscilloscope.
Adjust R426 for 110 mV (RX LINE).

RECEIVER SENSITIVITY

Measure the 20 dB psophometric SINAD on all channels.

Typical sensitivity:
CQM6662: 0.7 uV
CQM6663: 0.7 uV
CQM6664: 1.0 uV

SQUELCH

Connect a signal generator to the antenna input.
Set the generator frequency to the channel frequency. Set the modulation to 1 kHz and 60% deviation.

Connect a distortion meter to J102 pin 10.
Connect a voltmeter to P102 pin 11.
Adjust the generator output to obtain 10 - 12 dB SINAD.
Adjust R442 so that the squelch just opens.

Squelch open: ≤1 V.
Squelch closed: ≥3 V.

CURRENT CONSUMPTION

Measure the current consumption in off state, receive and transmit mode:

OFF:	27 mA
Receive Stand-by:	<720 mA
Transmit (25 W):	6.52 A

Values are typical and may only be used for reference.

ADJUSTMENT PROCEDURE

CQM6000/MC spectro

403 - 470 MHz

INSTRUMENTS

The following instruments are necessary in order to perform a complete adjustment of the radiotelephone.

AF Voltmeter	Zi $\geq$1 Mohm
DC Voltmeter	Ri $\geq$1 Mohm
DC Amperemeter	0 - 1/0 - 10 A
RF Generator	10 - 470 MHz
RF Wattmeter	68 - 470 MHz
Deviationmeter	68 - 470 MHz
Frequency counter	0.4 - 512 MHz
Distortionmeter	Psophometric
AF Generator	0.1 - 10 kHz
DC Power Supply	10 - 20 V/0 - 10 A
RF Probe	Part no. 95.0059-00
Trimming Tool	Part no. 17.0053-00
Interface Box SE6002	Part no. 95D5014-00
Service Prom M6000	Part no. 95D5015-01

GENERAL NOTES

During test and adjustment DC power (13.2 V) must be connected and the radio turned on.
The personality prom U904 must be replaced by a test prom.

VOLTAGE REGULATOR

Connect the DC power supply to the radio and set the voltage to 13.2 V.
Turn the radio on.
Read the current drain.
Requirement: I>250 mA.
Connect a DC voltmeter to the negative terminal C707.
Adjust R707 for -5 V ±0.1 V.
Connect a voltmeter to P902 pin 2.
Adjust R719 for -24 V ±0.1 V.

LOW BATTERY THRESHOLD ADJUSTMENT.

Turn R722 completely clockwise.
Set voltage supply to 10V ±1mV.
Check the voltage on pin 14 of U905 for being high (>5V).
Adjust R722 anticlockwise until the voltage on pin 14 of U905 just goes low.
Adjust the supply voltage up and down to veryfy that the voltage on U905 pin 14 switches from high to low when the battery voltage is between 10-10.5V.

Note: Readjustment of R719 requires readjustment of the receiver.

TRANSMITTER ADJUSTMENT

During adjustment the transmitter must be connected to an RF wattmeter and keyed.
Connect a voltmeter to P102 pin 9. (LOCK)
Check that the lock signal is 0 V (Low).

TX VCO DOUBLER

Select the center channel in the low frequency window: 404.700 MHz.
Connect a diode probe and voltmeter to TP9.
Adjust C529 and 533 for maximum voltmeter reading.

TRANSMITTER OUTPUT POWER

Adjust R133 for rated RF power.
Select a channel with reduced power, if used.
Adjust R132 for rated reduced power.

TRANSMITTER FREQUENCY

Connect a frequency counter to the antenna output through a suitable attenuator.
Adjust L1 in U611 for nominal transmitter frequency.
Requirement: F_{nom} ± 0.2 p.p.m. (parts per million).

TRANSMITTER MODULATION

Connect an AF generator to P102 pin 3-(4 = GND).
Connect a deviation meter to the antenna output through a suitable attenuator.
Set the generator frequency to 1 kHz and the output to 1.66 V r.m.s.
Set R677 to its center position.
Select the center channel in the high frequency window: 467.400 MHz.

Adjust R675 for maximum deviation:

Channel spacing 25 kHz:	±5 kHz +0/-100 Hz
Channel spacing 20 kHz:	±4 kHz +0/-100 Hz
Channel spacing 12.5 kHz:	±2.5 kHz +0/-100 Hz

Select the center channel in the low frequency window: 404.700 MHz.

Adjust R680 for maximum deviation:

Channel spacing 25 kHz:	±5 kHz +0/-100 Hz
Channel spacing 20 kHz:	±4 kHz +0/-100 Hz
Channel spacing 12.5 kHz:	±2.5 kHz +0/-100 Hz

Select the center channel in the middle frequency window: 430.700 MHz.

Set the AF generator output to 1.66 V r.m.s.
Alternately set the generator frequency to 1 kHz and 20 Hz.
Adjust R677 for the same deviation at both modulation frequencies (± 100 Hz).
Check and if necessary readjust R675 for maximum deviation (+ 0/-100 Hz).
Connect the AF generator to J901 pin 22 (TX LINE).

Adjust the generator output to obtain 60% of maximum deviation:

Channel spacing 25 kHz:	±3.0 kHz
Channel spacing 20 kHz:	±2.4 kHz
Channel spacing 12.5 kHz:	±1.75 kHz

Requirement: AF input 100 mV ±3 dB.

RECEIVER ADJUSTMENT

RECEIVER FRONT END

Select the center channel of the low RX frequency window: 404.600 MHz.

Connect a diode probe and DC-Voltmeter to R309.

Connect a signal generator to the antenna input and set its frequency to the channel frequency.
Set the generator to 0 dB (225 mV - 1/2 e.m.f.).
Adjust C304, C309 and C316 for maximum voltmeter reading.

Adjust C321 for minimum reading, C326 for maximum reading, C330 for minimum reading and C336 for maximum reading.
Repeat the adjustments until no further improvements in minimums and maximums are possible.

Connect the diode probe and voltmeter to TP3.
Adjust C332 and C342 for maximum voltmeter reading.

Select the center channel of the high RX frequency window: 467.300 MHz.

Set the signal generator frequency to the channel frequency.
Connect a distortion meter to P102 pin 10 (RX LINE).
Adjust R663 for best sensitivity (SINAD).

The radio can now cover the entire frequency band without readjustment.

ALTERNATIVE METHOD

If the RX window is less than 10 MHz:

Connect a voltmeter to TP12.
Adjust R633 for a voltage reading according to the graph (±50 mV).
Connect a diode probe and voltmeter to TP3.

Adjust C332 and C342 for maximum reading.
Connect a RF signal generator to the antenna input.
Set the generator frequency to the center channel frequency and the modulation frequency to 1 kHz and 60% deviation.

Adjust the following capacitors for best sensitivity (SINAD).
C304, C309, C316, C321, C326, C330, C336.

45 MHz IF AMPLIFIER

Connect a signal generator to the antenna input.
Set the generator frequency to the channel frequency.
Set the generator output to 15 mV (10 - 20 mV) unmodulated.

Connect a spectrum analyzer to TP5.
Adjust L403 and L405 for maximum.
Modulate the signal generator with 1 kHz to ±30 - 50 kHz.
Adjust L404 for symetrical curve.
Set the generator output to 1 mV unmodulated.

Connect a frequency counter to TP6.
Connect a distortionmeter and an oscilloscope to P102 pin 10 (RX LINE).
Adjust L408 for 455 kHz.

Alternative: Adjust L408 for minimum distortion with 100% modulation. The decrease in distortion is small (approx. 1%).
Set the generator modulation to 1 kHz and 60% deviation.
Adjust L406 and L409 for minimum distortion.
Adjust L410 for best demodulated/recovered audio signal on the oscilloscope.
Adjust R426 for 110 mV (RX LINE).

RECEIVER SENSITIVITY

Measure the 20 dB psophometric SINAD on all channels.

Typical sensitivity:

Channel spacing 25 kHz:	0.7 uV
Channel spacing 20 kHz:	0.8 uV
Channel spacing 12.5 kHz:	1.2 uV

SQUELCH

Connect a signal generator to the antenna input.
Set the generator frequency to the channel frequency. Set the modulation to 1 kHz and 60% deviation.

Connect a distortion meter to J102 pin 10.
Connect a voltmeter to P102 pin 11.
Adjust the generator output to obtain 10 - 12 dB SINAD.
Adjust R442 so that the squelch just opens.

Squelch open: ≤1 V.
Squlech closed: ≥3 V.

CURRENT CONSUMPTION

Measure the current consumption in off state, receive and transmit mode:

OFF:	10 mA
Receive Stand-by:	<720 mA
Transmit (25 W):	6.52 A

Values are typical and may only be used for reference.

ADJUSTMENT PROCEDURE

ENCRYPTION

NOTE

Before starting the encryption test, be sure that all points are adjusted as specified in the adjustment procedures for the CQM6xxx, and MC spectro manuals.
Measure and note the input signal for 20 dB SINAD

KEY-LOAD

Load the key using the KEYLOADER to the actual encryption module.

BIT ERROR RATE

Load the encryption test box using the KEYLOADER to the actual encryption module.
Connect the Bit Error Analyzer to the encryption test box.
Connect the radio to the encryption test box.
Modulate the RF-signal generator with the TX output from the test box. Adjust the deviation to 3 kHz.
Locate P112 pin 2 at the EC6001 board and connect the point to the test box LINE input connector.

Adjust the output from the RF-signal generator according to the table below:

dB relative to 20 dB SINAD

	Fo	Fo +2 kHz	Fo -2 kHz
CQM6112	4	6	6
CQM6113	N.Y.R.	N.Y.R.	N.Y.R.
CQM6332	4	6	6
CQM6333	N.Y.R.	N.Y.R.	N.Y.R.
CQM6662	7	9	9
CQM6663	N.Y.R.	N.Y.R.	N.Y.R.

Measure the BIT ERROR RATE:
Requirement: BIT ERROR RATE < 1%

Rise the Output from the RF-generator to 0 dBm and measure the BIT ERROR RATE.
Requirement: NO BIT ERROR RATE.

PROPER CODE DETECT

Set the test box to internal bit generator (encrypted signal).
Using the output level from the RF-generator as shown in the table above (Only Fo, it is not necessary to measure at ±2 kHz).
Check that the Proper Code LED at CB6xxx has start flashing.
Rise the output from the RF-generator to 0 dBm.
The Proper Code LED should still be flashing.

TALK TEST AND ENCRYPTED LINE ADJUSTMENT

Adjust the RF-generator output to -47 dBm (1 mV).
Connect the loudspeaker to the radio.
Set the test box to external microphone. Talk to the microphone and switch between "Analog" and encrypted mode. Adjust R326 until the volume in both "Analog" and encrypted modes appears to be the same.

TX MODULATION ADJUST

Set the radio in encrypted mode and key the TX.
Measure the adjacent channel power.
Adjust R304 for -70 dB adjacent channel power.
Requirement: -70 dB, +0 -2 dB.

CHECK OF PROPER CODE DETECT

Connect the TX to the test box using the power attenuator. Key the TX and check that the Proper Code LED has start flashing.

ADJUSTMENT PROCEDURE

STORNOPHONE 6000

The following instruments are required for adjustment and measuring performance data of a STORNOPHONE 6000 radiotelephone.

RF Signal generator	10-470 MHz
Deviation meter	10-470 MHz
RF Watt meter	10-470 MHz/0-30 W
RF attenuator	10-470 MHz/20 dB/40 dB
Distortion meter	SINAD/Psophometric
Frequency counter	0.1-470 MHz
AF Generator	10 Hz-10 kHz

The above mentioned instruments can be replaced with a radiotelephone test set e.g.

Stabilock/Slumberger 4040

DC Power supply	0-20 V/0-10 A
Oscilloscope	DC-15 MHz
AC voltmeter	Zi= 1 Mohm/1 mV
DC voltmeter	Ri= 20 Kohm/V
DC voltmeter	Ri= 1 Mohm

TRIMMING TOOLS

Trimming tool	17.0053-00
RF probe	95.0059-00

ADJUSTMENT PROCEDURE

The adjustment procedure is divided into four section:
Transmitter RF circuits
Transmitter Modulation circuits
Receiver RF circuits
Receiver AF circuits

Before the alignment or adjustment of any circuits the radiotelephone should be connected to a test setup as shown on D404.344 (Transmitter) or D404.345 (Receiver).

VOLTAGE REGULATOR

Connect the radiotelephone to a DC power supply and set the voltage to 13.2 volt.

Turn the radio on.
Check the currect drain, approx. 0.25 A.
Connect a voltmeter to TP13.
Read the voltage, 8.5 V.
Connect a voltmeter to P102 pin 2.
Read the voltage, -24 V.
Connect a voltmeter to the rear connector, J901 pin 9.
Read the voltage +5 V.

TRANSMITTER ADJUSTMENT

All transmitter adjustments are performed with the transmitter keyed unless otherwise noted.

Connect the antenna output to a wattmeter.
Adjust R133 for rated power, 25 W or 10 W.
If the radio has channels with reduced power select a channel programmed with reduced power.
Adjust R132 for rated reduced power.
Connect a frequency counter to the antenna output through a suitable attenuator.

Adjust L701 for nominal transmitter frequency.

CQM666x only

Adjust L1 in U611 oscillator for nominal transmitter frequency.

Frequency adjustment accuracy:

F_{nom} ±0.2 p.p.m. (parts per million)

e.g. F_{nom}= 445.125 MHz

tolerance= 445.1161 MHz - 455.1339 MHz

TRANSMITTER MODULATION

Connect a deviation meter to the antenna connector through a suitable attenuator.

Connect an AF Generator to J904 pin 4.
Set the generator output to 1 V.
Key transmitter.
Vary AF generator frequency between 100 Hz and 3000 Hz to find the frequency which produce the highest frequency deviation. Check both + and - modulation.
At the AF frequency giving peak deviation adjust R675 for maximum permissible frequency deviation:

CQM6xx2=	±5 kHz
CQM6xx3=	±4 kHz
CQM6xx4=	±2.5 kHz

RECEIVER ADJUSTMENT

RECEIVER SENSITIVITY

Connect an RF generator to the antenna connector.
Set the signal generator to the channel frequency.
Set the generator modulation frequency to 1 kHz.

Adjust the frequency deviation to:

CQM6xx2=	±3 kHz
CQM6xx3=	±2.4 kHz
CQM6xx4=	±1.5 kHz

Measure 20 dB psophometric SINAD on all channels:

Typical Sensitivity:

CQM6112=	0.7 uV
CQM6113=	0.7 uV
CQM6114=	1.0 uV
CQM6332=	0.7 uV
CQM6333=	0.7 uV
CQM6334=	1.0 uV
CQM6662=	0.8 uV
CQM6663=	0.8 uV
CQM6664=	1.15 uV
CQM6774=	1.15 uV

Values are e.m.f.

AF LINE LEVEL

Connect the RF Generator to the antenna connector.
Set the generator frequency to the channel frequency.
Set the generator output to 1 mV.

Set the frequency deviation to:

CQM6xx2=	±3 kHz
CQM6xx3=	±2.4 kHz
CQM6xx4=	±1.5 kHz

Connect an AF voltmeter to P102 pin 10.
Adjust R424 for 110 mV ±5 mV.

RECEIVER SQUELCH ADJUSTMENT

Connect a psophometric distortion meter to the AF output.
Adjust the signal generator output for 10 dB SINAD.
Connect a voltmeter (10 V) to P102 pin 11.
Adjust R442 so that the squelch just opens.
Squelch open= $\leq$1 V
Squelch closed= $\geq$3 V

Vary the RF generator output to find the points of squelch open and squelch closed (Squelch hysteresis).

Typical squelch hysteresis= 1-4 dB

CURRENT CONSUMPTION

Measure the current consumption in off, transmit and receive mode:

	CQM611x/633x	CQM666x/6774
OFF	27 mA	17 mA
RX standby	720 mA	720 mA
TX (25 W)	6520 mA	7020 mA

TEST PROM

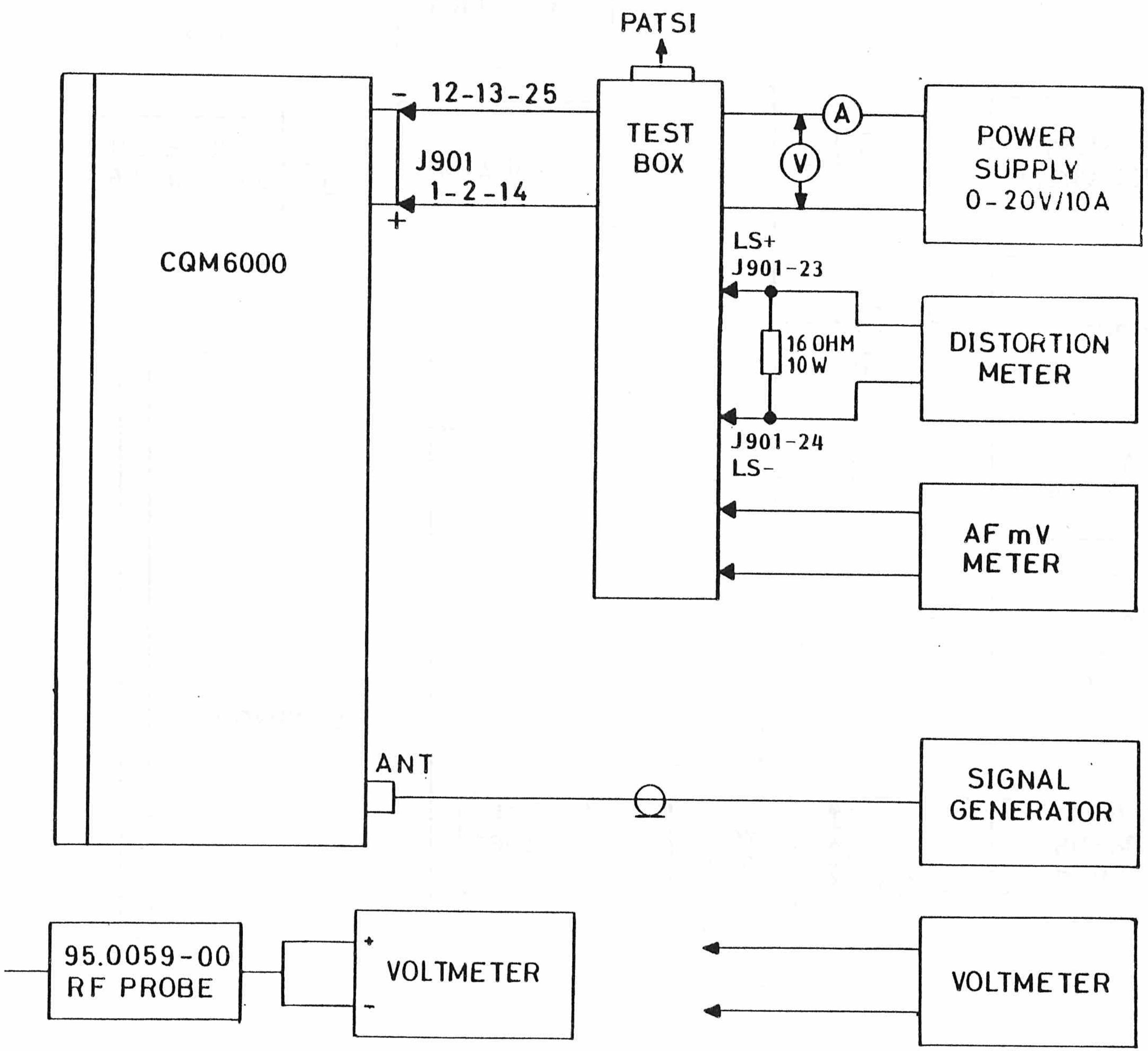
CQM6xxx

Part no. 95D5015-00

CHANNEL	RADIO	RX-FREQENCY	TX-FREQUENCY	POWER
11	611x	136.900	136.900	Full
12	611x	151.150	150.400	Full
13	611x	172.450	172.300	Full
14	611x	155.000	155.000	Redu.
31	633x	66.510	66.460	Full
32	633x	74.520	74.040	Full
33	633x	87.060	86.970	Full
34	633x	77.000	77.000	Redu.
61	666x	404.600	404.700	Full
62	666x	430.200	430.700	Full
63	666x	467.300	467.400	Full
64	666x	436.500	436.500	Redu.
71	677xL	174.900	174.900	Full
72	677xL	188.900	188.400	Full
73	677xL	208.600	208.600	Full
74	677xL	192.000	192.000	Redu.
75	677xH	190.900	190.900	Full
76	677xH	204.560	204.300	Full
77	677xH	223.650	223.600	Full
78	677xH	207.500	207.500	Redu.

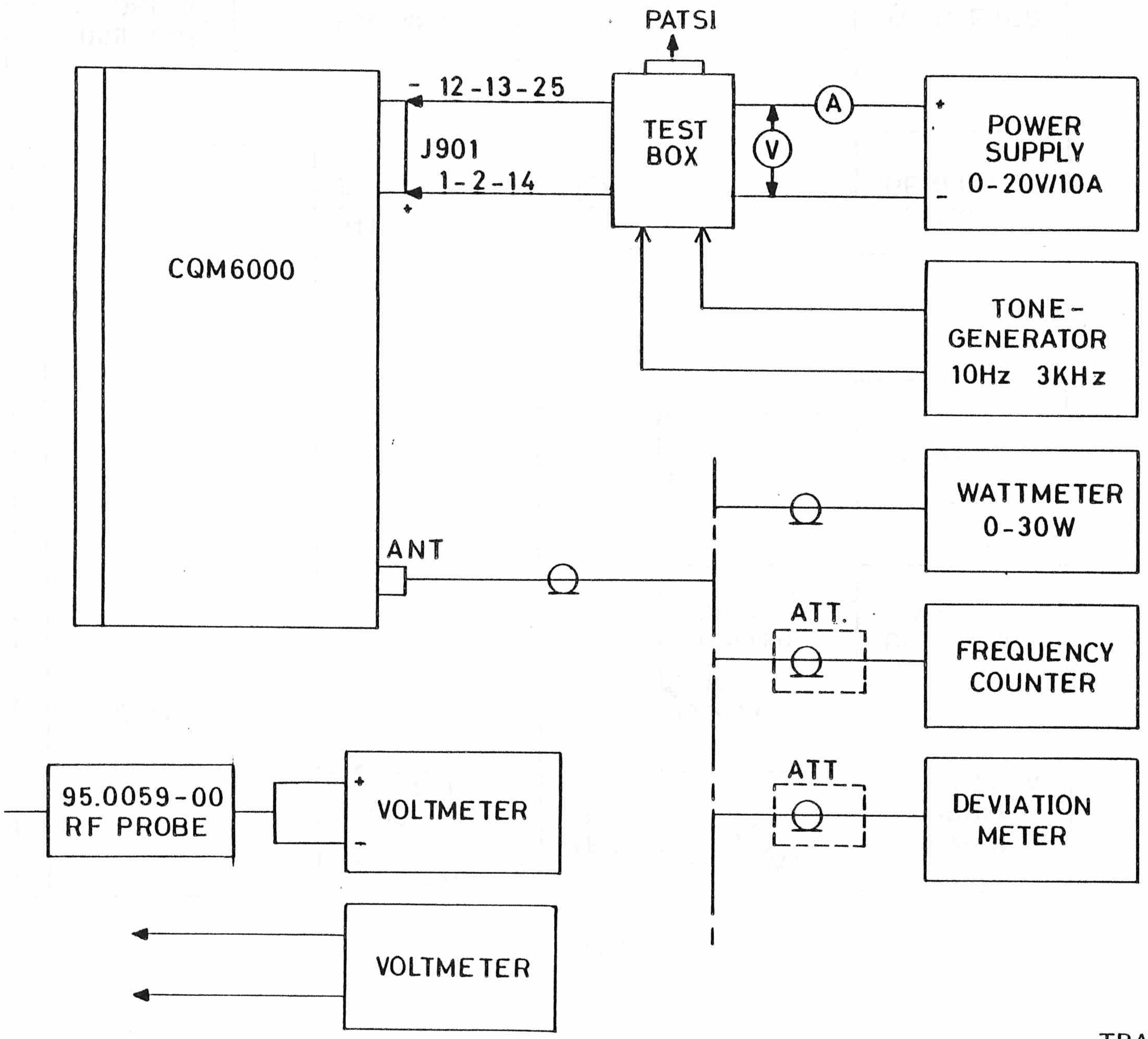
TON	ZVEI I
Enc ( )	(1A, 2A, 3A, 4A, 5A)
SNC (S)	(1,) DUR 2.5 sec.
DEC	(1, 2, 3, 4, 5) ACK = DEC

QUEUE for 5 sec. + "2718" = Servicemode.
"730" = Write in EE PROM
"720" = Read in EE PROM



STORNOPHONE 6000
RECEIVER TEST SETUP

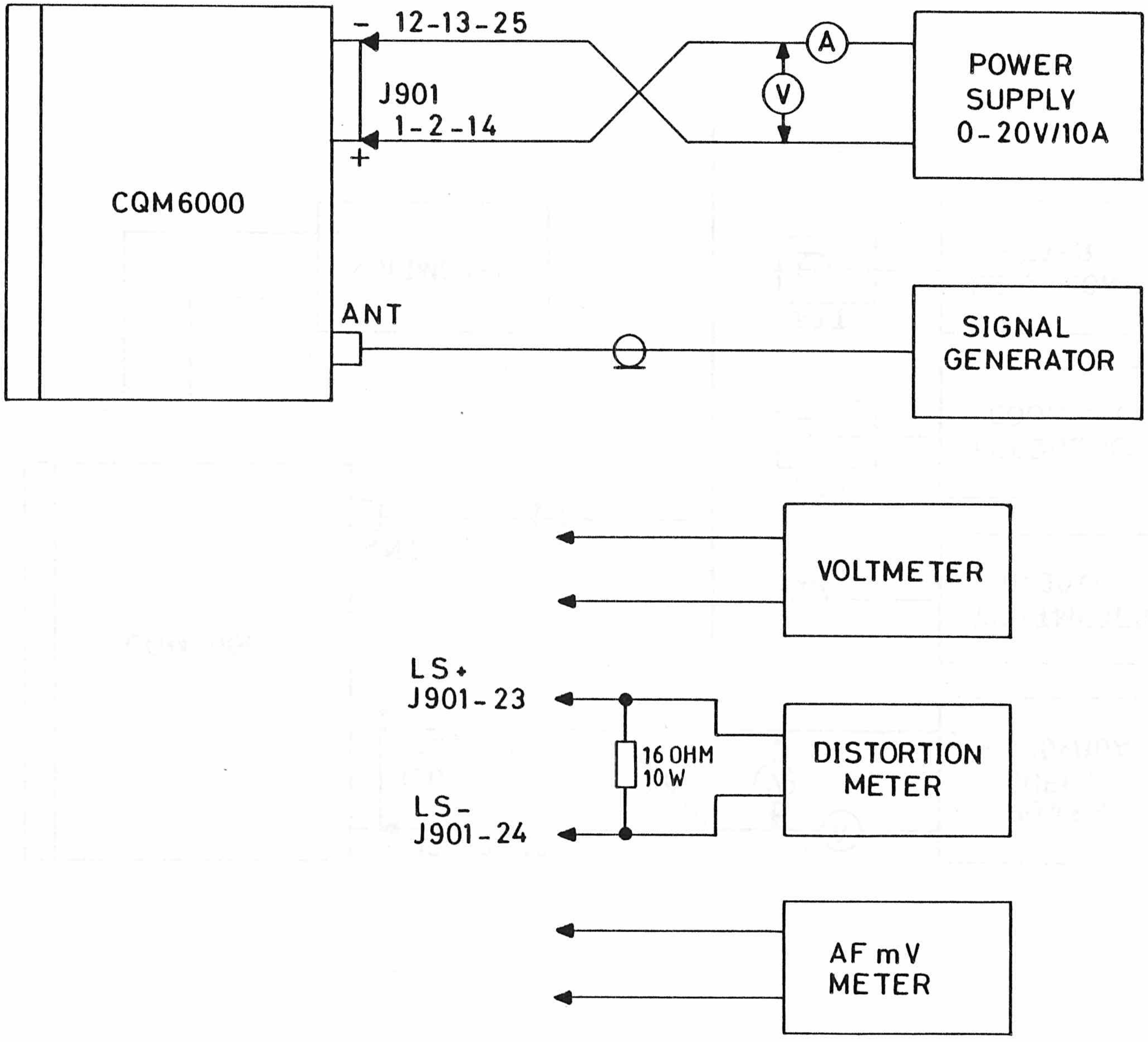
D404.345/2



STORNOPHONE 6000

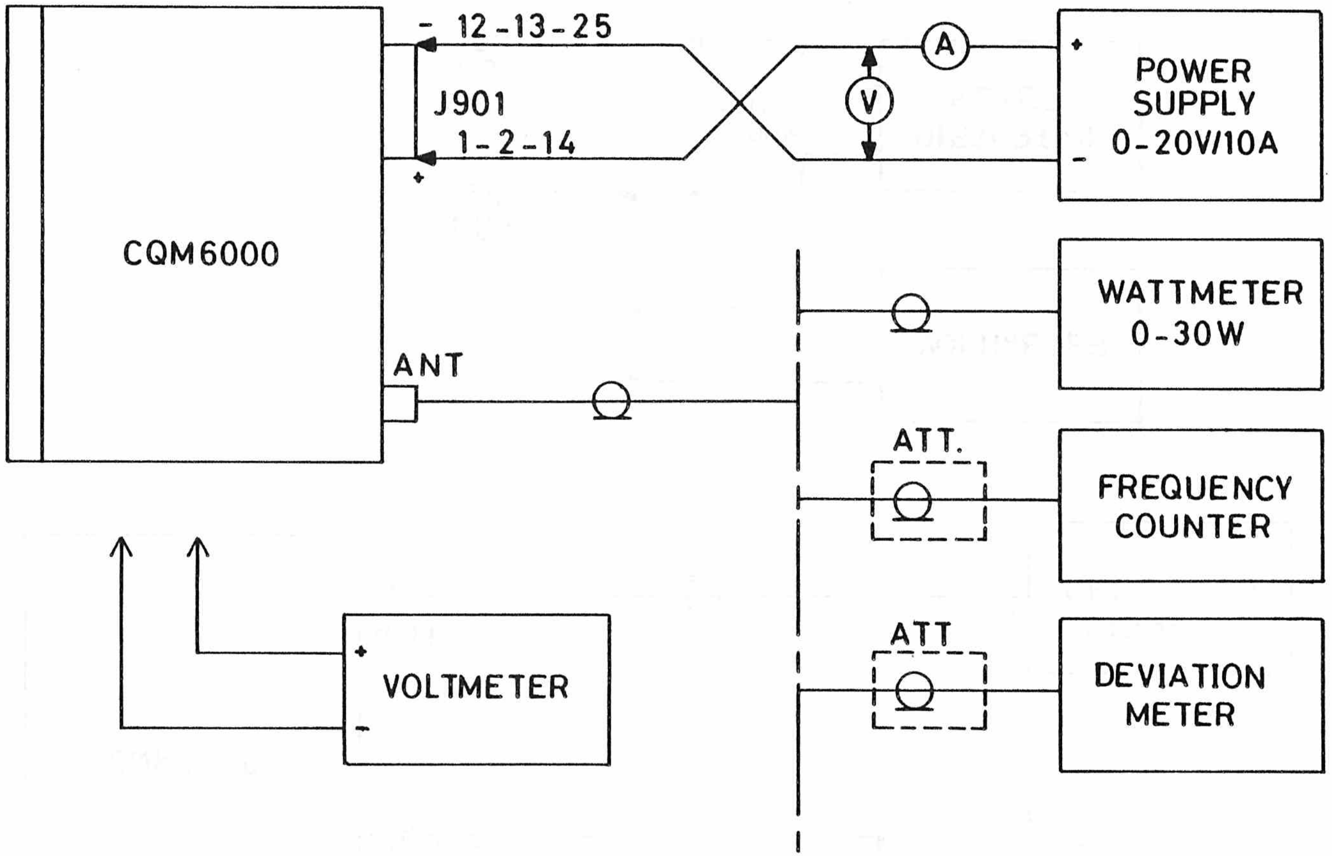
TRANSMITTER TEST SETUP

D40 44/2



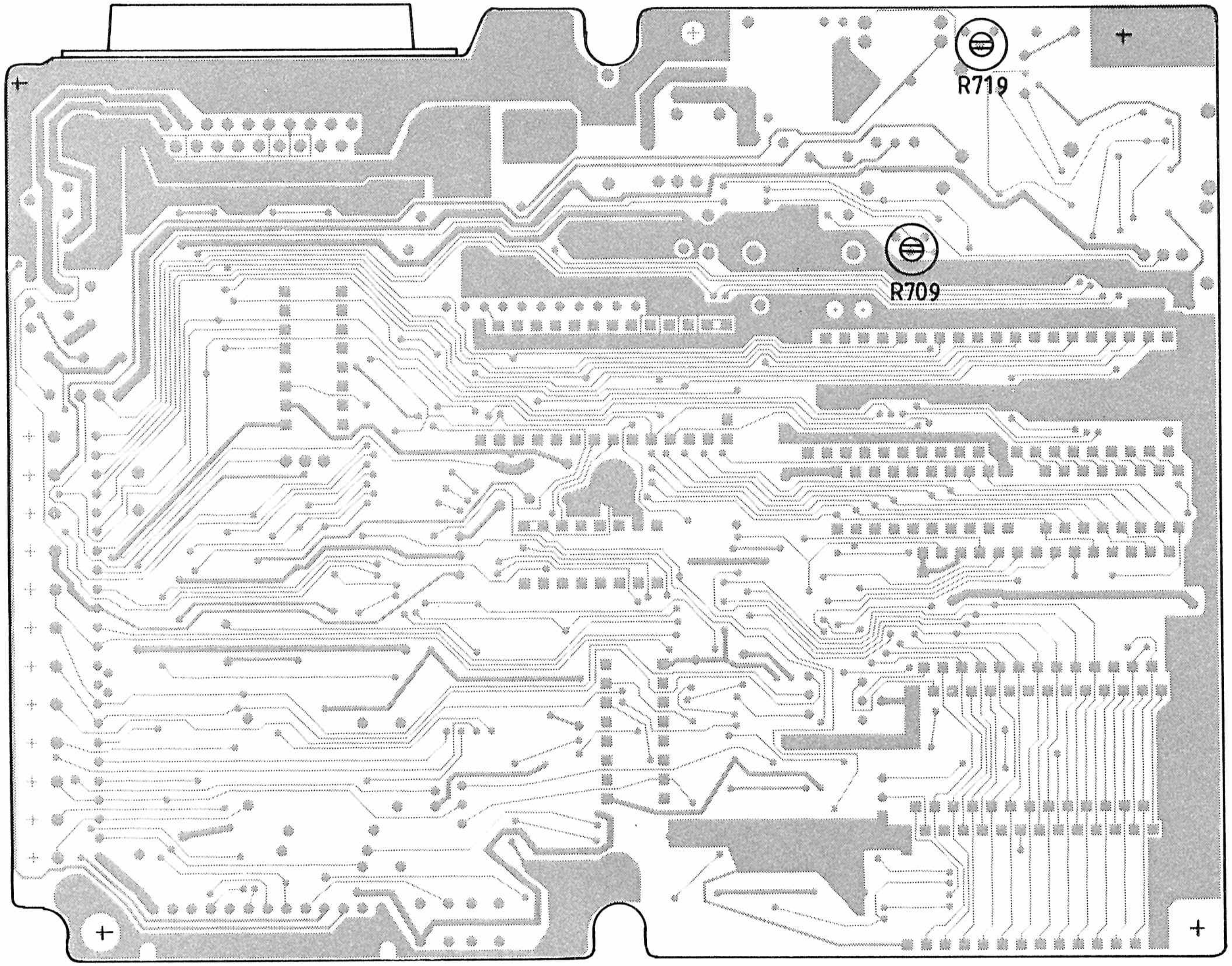
STORNOPHONE 6000
RECEIVER TEST SETUP

D404.345



STORNOPHONE 6000
TRANSMITTER TEST SETUP

D404.344



ADJUSTABLE COMPONENTS AND TEST POINTS
COMMON FUNCTION BOARD CF6001

RF611x/RF677x

- Adjustment procedure
- Test points
- Tuning voltages

ADJUSTMENT PROCEDURE

CQM6110 - CQM6770L/H

INSTRUMENTS

The following instruments are necessary in order to perform a complete adjustment of a Stornophone 6000 radiotelephone.

AF Voltmeter	Zi ≥1 Mohm
DC Voltmeter	Ri ≥1 Mohm
DC Amperemeter	0 - 1/0 - 10 A
RF Generator	10 - 470 MHz
RF Wattmeter	68 - 470 MHz
Deviationmeter	68 - 470 MHz
Frequency counter	0.4 - 512 MHz
Distortionmeter	Psophometric
AF Generator	0.1 - 10 kHz
DC Power Supply	10 - 20 V/0 - 10 A
RF Probe	Part no. 95.0059-00
Trimming Tool	Part no. 17.0053-00
Interface Box SE6002	Part no. 95D5014-00
Service Prom M6000	Part no. 95D5015-00
Service Box S/SF	Part no. J709551P2

GENERAL NOTES

During test and adjustment DC power (13.2 V) must be connected and the radio turned on.
The personality prom U904 must be replaced by a test prom.

VOLTAGE REGULATOR

Connect the DC power supply to the radio and set the voltage to 13.2 V.
Turn the radio on.
Read the current drain.
Requirement: I>250 mA.
Connect a DC voltmeter to R716.
Adjust R709 for 5 V ±0.1 V.

WARNING!
Never set the +5 V supply to be higher than +6 V, even for a short period, as overvoltage can destroy the circuitry.
Connect a voltmeter to P102 pin 2.
Adjust R719 for -24 V ±0.1 V.

Note: Readjustment of R719 requires readjustment of the receiver.

TRANSMITTER ADJUSTMENT

During adjustment the transmitter must be connected to an RF wattmeter and keyed.
Connect a voltmeter to P102 pin 9. (LOCK)
Check that the lock signal is 0 V (Low).

TRANSMITTER OUTPUT POWER

Adjust R133 for rated RF power.
Select a channel with reduced power, if used.
Adjust R132 for rated reduced power.

TRANSMITTER FREQUENCY

Connect a frequency counter to the antenna output through a suitable attenuator.
Adjust L1 in L701 for nominal transmitter frequency.
Requirement: F_{nom} ±0.2 p.p.m. (parts per million).

TRANSMITTER MODULATION

Connect an AF generator to P102 pin 3-(4 = GND).
Connect a deviation meter to the antenna output through a suitable attenuator.
Set the generator frequency to 1 kHz and the output to 1.66 V r.m.s.
Set R677 to its center position.
Select the center channel in the high frequency window:

CQM6110:	172.3 MHz
CQM6770L:	208.6 MHz
CQM6770H:	223.6 MHz

Adjust R675 for maximum deviation (all bands):

CQM6XX2:	±5 kHz +0/-100 Hz
CQM6XX3:	±4 kHz +0/-100 Hz
CQM6XX4:	±2.5 kHz +0/-100 Hz

Select the center channel in the low frequency window:

CQM6110:	136.9 MHz
CQM6770L:	174.9 MHz
CQM6770H:	190.9 MHz

Adjust R680 for maximum deviation (all bands):

CQM6XX2:	±5 kHz +0/-100 Hz
CQM6XX3:	±4 kHz +0/-100 Hz
CQM6XX4:	±2.5 kHz +0/-100 Hz

Select the center channel in the middle frequency window:

CQM6110:	150.4 MHz
CQM6770L:	188.4 MHz
CQM6770H:	204.56 MHz

Set the AF generator output to 1.66 V r.m.s.
Alternately set the generator frequency to 1 kHz and 20 Hz.
Adjust R677 for the same deviation at both modulation frequencies (±100 Hz).
Check and if necessary readjust R675 for maximum deviation (+0/-100 Hz).
Connect the AF generator to J901 pin 22 (TX LINE).

Adjust the generator output to obtain 60% of maximum deviation (all bands):

CQM6XX2:	±3.0 kHz
CQM6XX3:	±2.4 kHz
CQM6XX4:	±1.75 kHz

Requirement: AF input 100 mV ±3 dB.

RECEIVER ADJUSTMENT

RECEIVER FRONT END

Select the center channel of the low RX frequency window:

CQM6110:	136.9 MHz
CQM6770L:	174.9 MHz
CQM6770H:	190.9 MHz

Connect a diode probe and DC-Voltmeter to TP7.

Connect a signal generator to the antenna input and set its frequency to the channel frequency.
Set the generator to 0 dB (225 mV - 1/2 e.m.f.).
Adjust L301, L302 and L304 for maximum voltmeter reading.

Adjust L306 for minimum reading, L308 for minimum reading and L310 for maximum reading.
Repeat the adjustments until no further improvements in minimums and maximums are possible.

Connect the diode probe and voltmeter to TP3.
Adjust L313 and L314 for maximum voltmeter reading.

Select the center channel of the high RX frequency window:

CQM6110:	172.45 MHz
CQM6770L:	208.6 MHz
CQM6770H:	255.65 MHz

Set the signal generator frequency to the channel frequency.
Connect a distortion meter to P102 pin 10 (RX LINE).
Adjust R663 for best sensitivity (SINAD).

The radio can now cover the entire frequency band without readjustment.

ALTERNATIVE METHOD

If the RX window is less than 10 MHz:

Connect a voltmeter to TP12.
Adjust R633 for a voltage reading according to the graph (±50 mV).
Connect a diode probe and voltmeter to TP3.

Adjust L313 and L314 for maximum reading.
Connect a RF signal generator to the antenna input.
Set the generator frequency to the center channel frequency and the modulation frequency to 1 kHz and 60% deviation.

Adjust the following capacitors for best sensitivity (SINAD).
L301, L302, L304, L306, L308, L310, L312.

45 MHz IF AMPLIFIER

Connect a signal generator to the antenna input.
Set the generator frequency to the channel frequency.
Set the generator output to 15 mV (10 - 20 mV) unmodulated.

Connect a spectrum analyzer to TP5.
Adjust L403 and L405 for maximum.
Modulate the signal generator with 1 kHz to ±30 - 50 kHz.
Adjust L404 for symetrical curve.
Set the generator output to 1 mV unmodulated.

Connect a frequency counter to TP6.
Connect a distortionmeter and an oscilloscope to P102 pin 10 (RX LINE).
Adjust L408 for 455 kHz.
Alternative: Adjust L408 for minimum distortion with 100% modulation. The decrease in distortion is small (approx. 1%).

Set the generator modulation to 1 kHz and 60% deviation.
Adjust L406 and L409 for minimum distortion.
Adjust L410 for best demodulated/recovered audio signal on the oscilloscope.
Adjust R426 for 110 mV (RX LINE).

RECEIVER SENSITIVITY

Measure the 20 dB psophometric SINAD on all channels.

Typical sensitivity:

CQM6112:	0.7 uV
CQM6113:	0.7 uV
CQM6114:	1.0 uV
CQM6770:	1.15 uV

SQUELCH

Connect a signal generator to the antenna input.
Set the generator frequency to the channel frequency. Set the modulation to 1 kHz and 60% deviation.

Connect a distortion meter to J102 pin 10.
Connect a voltmeter to P102 pin 11.
Adjust the generator output to obtain 10 - 12 dB SINAD.
Adjust R442 so that the squelch just opens.

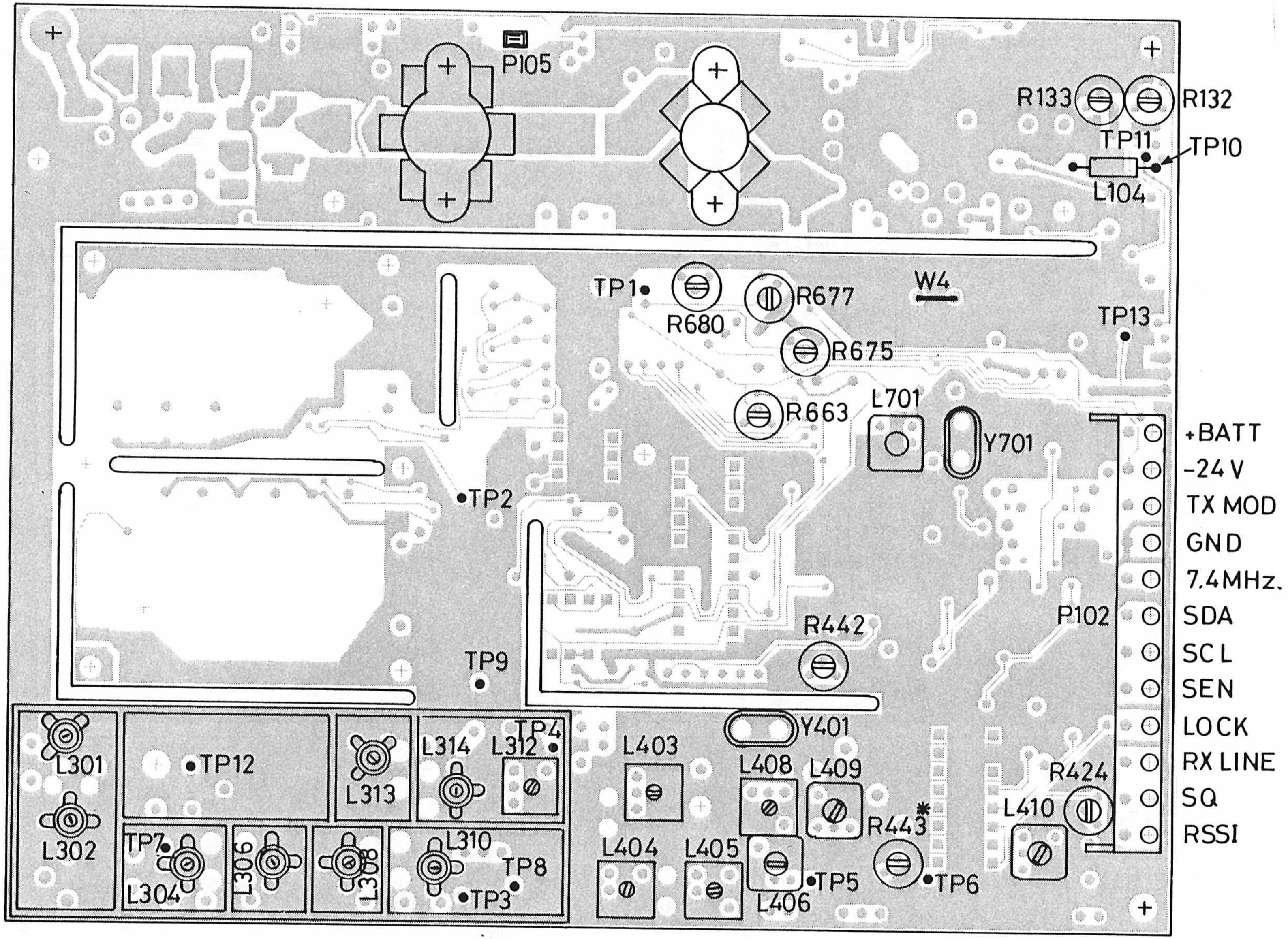
Squelch open: ≤1 V.
Squelch closed: ≥3 V.

CURRENT CONSUMPTION

Measure the current consumption in off state, receive and transmit mode:

Band:	CQM6110	CQM6770
OFF:	27 mA	17 mA
Receive Stand-by:	<720 mA	<720 mA
Transmit (25 W):	6.52 A	7.02 A

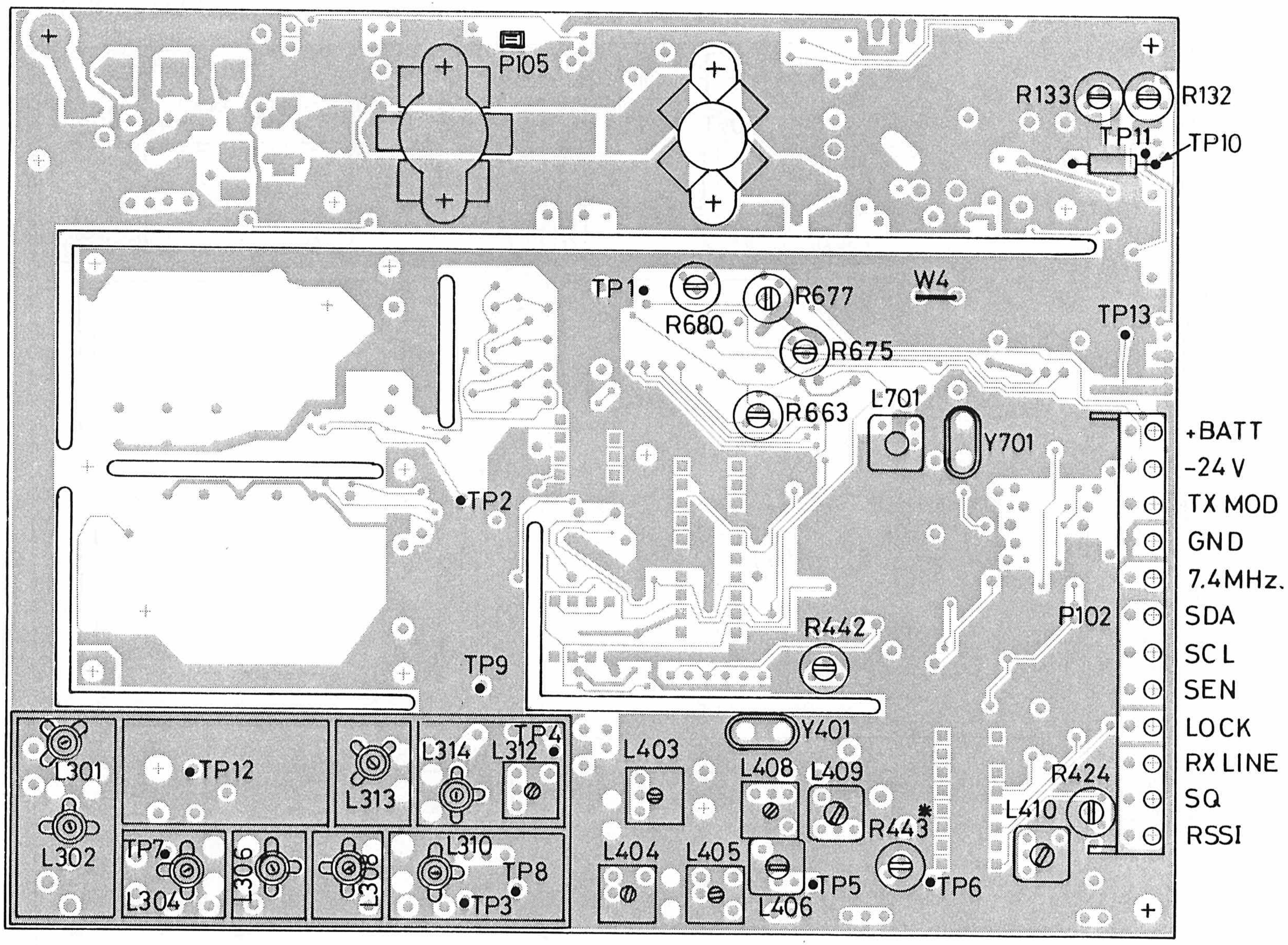
Values are typical and may only be used for reference.



* ONLY FOR RSSI

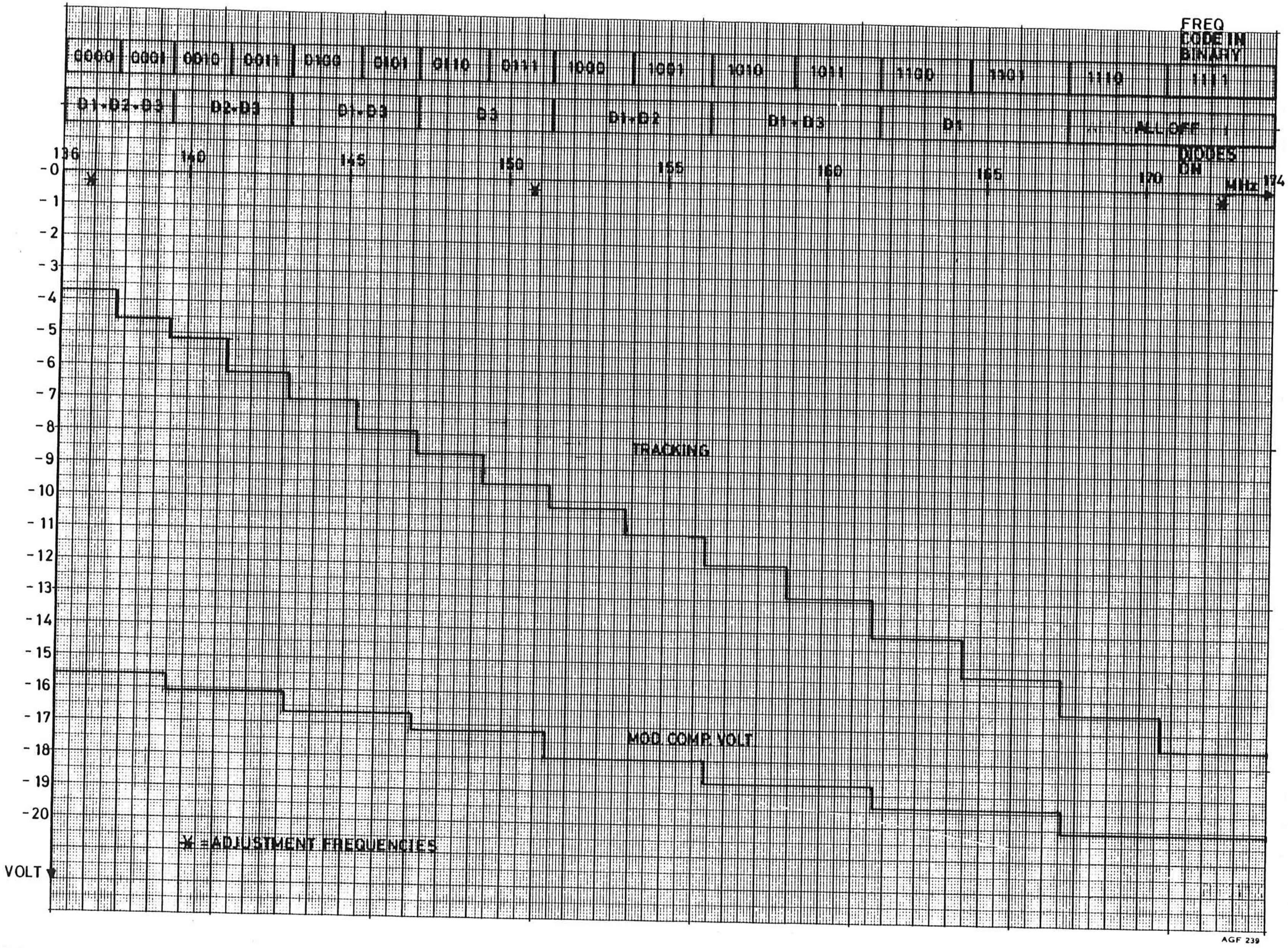
ADJUSTABLE COMPONENTS AND TEST POINTS
RF BOARD 6110 L

M405. 284/2



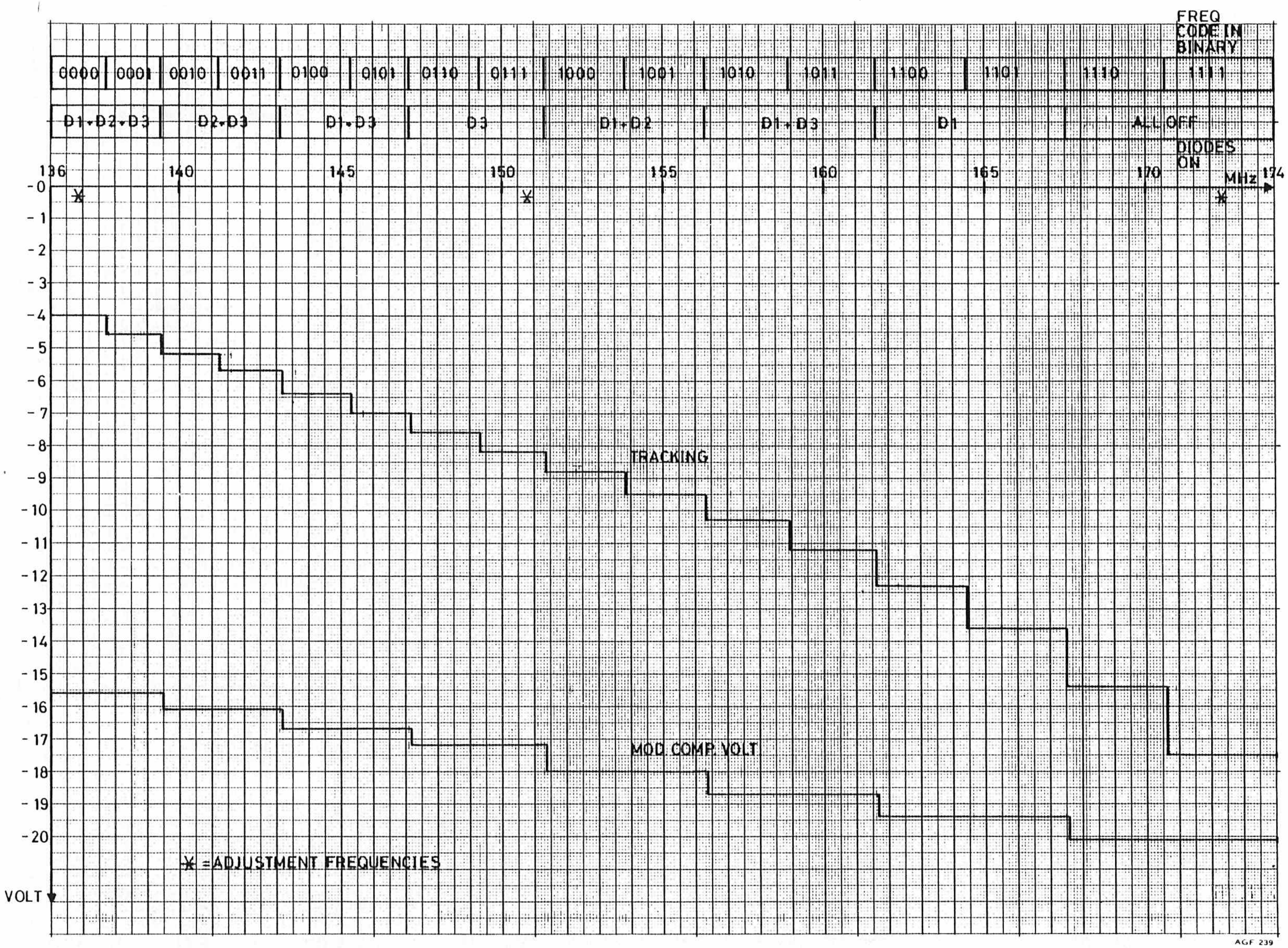
* ONLY FOR RSSI

ADJUSTABLE COMPONENTS AND TEST POINTS
RF BOARD 6110 L



TUNING VOLTAGES ON RF BOARD RF611X

D404.422/2



TUNING VOLTAGES ON RF BOARD RF611X

ADJUSTMENT PROCEDURE

CQM6330

INSTRUMENTS

The following instruments are necessary in order to perform a complete adjustment of a Stornophone 6000 radiotelephone.

AF Voltmeter	Zi ≥1 Mohm
DC Voltmeter	Ri ≥1 Mohm
DC Amperemeter	0 - 1/0 - 10 A
RF Generator	10 - 470 MHz
RF Wattmeter	68 - 470 MHz
Deviationmeter	68 - 470 MHz
Frequency counter	0.4 - 512 MHz
Distortionmeter	Psophometric
AF Generator	0.1 - 10 kHz
DC Power Supply	10 - 20 V/0 - 10 A
RF Probe	Part no. 95.0059-00
Trimming Tool	Part no. 17.0053-00
Interface Box SE6002	Part no. 95D5014-00
Service Prom M6000	Part no. 95D5015-00
Service Box DK/N	Part no. J709551P1
Service Box S/SF	Part no. J709551P2

GENERAL NOTES

During test and adjustment DC power (13.2 V) must be connected and the radio turned on.
The personality prom U904 must be replaced by a test prom.

VOLTAGE REGULATOR

Connect the DC power supply to the radio and set the voltage to 13.2 V.
Turn the radio on.
Read the current drain.
Requirement: I>250 mA.
Connect a DC voltmeter to R716.
Adjust R709 for 5 V ±0.1 V.

WARNING

Never set the +5 V supply to be higher than +6 V, even for a short period, as overvoltage can destroy the circuitry.
Connect a voltmeter to P102 pin 2.
Adjust R719 for -24 V ±0.1 V.

Note: Readjustment of R719 requires readjustment of the receiver.

TRANSMITTER ADJUSTMENT

During adjustment the transmitter must be connected to an RF wattmeter and keyed.
Connect a voltmeter to P102 pin 9. (LOCK)
Check that the lock signal is 0 V (Low).

TRANSMITTER OUTPUT POWER

Adjust R133 for rated RF power.
Select a channel with reduced power, if used.
Adjust R132 for rated reduced power.

TRANSMITTER FREQUENCY

Connect a frequency counter to the antenna output through a suitable attenuator.
Adjust L1 in L701 for nominal transmitter frequency.
Requirement: F_{nom} ± 0.2 p.p.m. (parts per million).

TRANSMITTER MODULATION

Connect an AF generator to P102 pin 3-(4 = GND).
Connect a deviation meter to the antenna output through a suitable attenuator.
Set the generator frequency to 1 kHz and the output to 1.66 V r.m.s.
Set R677 to its center position.
Select the center channel in the high frequency window: 86.970 MHz.

Adjust R675 for maximum deviation:

CQM6xx2: ± 5 kHz + 0/-100 Hz
CQM6xx3: ± 4 kHz + 0/-100 Hz
CQM6xx4: ± 2.5 kHz + 0/-100 Hz

Select the center channel in the low frequency window: 66.46 MHz.

Adjust R680 for maximum deviation:

CQM6xx2: ± 5 kHz + 0/-100 Hz
CQM6xx3: ± 4 kHz + 0/-100 Hz
CQM6xx4: ± 2.5 kHz + 0/-100 Hz

Select the center channel in the middle frequency window: 74.040 MHz.

Set the AF generator output to 1.66 V r.m.s.
Alternately set the generator frequency to 1 kHz and 20 Hz.
Adjust R677 for the same deviation at both modulation frequencies (± 100 Hz).
Check and if necessary readjust R675 for maximum deviation (+ 0/-100 Hz).
Connect the AF generator to J901 pin 22 (TX LINE).

Adjust the generator output to obtain 60% of maximum deviation:

CQM6xx2: ±3.0 kHz
CQM6xx3: ±2.4 kHz
CQM6xx4: ±1.75 kHz

Requirement: AF input 100 mV ±3 dB.

RECEIVER ADJUSTMENT

RECEIVER FRONT END

Select the center channel of the low RX frequency window: 66.510 MHz.

Connect a diode probe and DC-Voltmeter to TP7.

Connect a signal generator to the antenna input and set its frequency to the channel frequency.
Set the generator to 0 dB (225 mV - 1/2 e.m.f.).
Adjust L301, L302 and L304 for maximum voltmeter reading.

Adjust L306 for maximum reading, L308 for maximum reading and L310 for minimum reading.
Repeat the adjustments until no further improvements in minimums and maximums are possible.

Connect the diode probe and voltmeter to TP3.
Adjust L313 and L314 for maximum voltmeter reading.

Select the center channel of the high RX frequency window: 87.060 MHz.

Set the signal generator frequency to the channel frequency.
Connect a distortion meter to P102 pin 10 (RX LINE).
Adjust R663 for best sensitivity (SINAD).

The radio can now cover the entire frequency band without readjustment.

ALTERNATIVE METHOD

If the RX window is less than 10 MHz:

Connect a voltmeter to TP12.
Adjust R633 for a voltage reading according to the graph (±50 mV).
Connect a diode probe and voltmeter to TP3.

Adjust L313 and L314 for maximum reading.
Connect a RF signal generator to the antenna input.
Set the generator frequency to the center channel frequency and the modulation frequency to 1 kHz and 60% deviation.

Adjust the following capacitors for best sensitivity (SINAD).
L301, L302, L304, L306, L308, L310, L312.

21.4 MHz IF AMPLIFIER

Connect a signal generator to the antenna input.
Set the generator frequency to the channel frequency.
Set the generator output to 15 mV (10 - 20 mV) unmodulated.

Connect a diode probe to TP5.
Adjust L403 and L405 for maximum.
Set the generator output to 1 mV unmodulated.

Connect a frequency counter to TP6.
Connect a distortionmeter and an oscilloscope to P102 pin 10 (RX LINE).
Adjust L408 for 455 kHz.
Alternative: Adjust L408 for minimum distortion with 100% modulation. The decrease in distortion is small (approx. 1%).

Set the generator modulation to 1 kHz and 60% deviation.
Adjust L406 and L409 for minimum distortion.
Adjust L410 for best demodulated/recovered audio signal on the oscilloscope.
Adjust R426 for 110 mV (RX LINE).

RECEIVER SENSITIVITY

Measure the 20 dB psophometric SINAD on all channels.

Typical sensitiviiy:

CQM6662: 0.7 uV
CQM6663: 0.7 uV
CQM6664: 1.0 uV

SQUELCH

Connect a signal generator to the antenna input.
Set the generator frequency to the channel frequency. Set the modulation to 1 kHz and 60% deviation.

Connect a distortion meter to J102 pin 10.
Connect a voltmeter to P102 pin 11.
Adjust the generator output to obtain 10 - 12 dB SINAD.
Adjust R442 so that the squelch just opens.

Squelch open: $\leq$1 V.
Squelch closed: $\geq$3 V.

CURRENT CONSUMPTION

Measure the current consumption in off state, receive and transmit mode:

OFF:	27 mA
Receive Stand-by:	<720 mA
Transmit (25 W):	6.52 A

Values are typical and may only be used for reference.

ADJUSTMENT PROCEDURE

CQM6660

INSTRUMENTS

The following instruments are necessary in order to perform a complete adjustment of a Stornophone 6000 radiotelephone.

AF Voltmeter	Zi ≥1 Mohm
DC Voltmeter	Ri ≥1 Mohm
DC Amperemeter	0 - 1/0 - 10 A
RF Generator	10 - 470 MHz
RF Wattmeter	68 - 470 MHz
Deviationmeter	68 - 470 MHz
Frequency counter	0.4 - 512 MHz
Distortionmeter	Psophometric
AF Generator	0.1 - 10 kHz
DC Power Supply	10 - 20 V/0 - 10 A
RF Probe	Part no. 95.0059-00
Trimming Tool	Part no. 17.0053-00
Interface Box SE6002	Part no. 95D5014-00
Service Prom M6000	Part no. 95D5015-00
Service Box DK/N	Part no. J709551P1
Service Box S/SF	Part no. J709551P2

GENERAL NOTES

During test and adjustment DC power (13.2 V) must be connected and the radio turned on.
The personality prom U904 must be replaced by a test prom.

VOLTAGE REGULATOR

Connect the DC power supply to the radio and set the voltage to 13.2 V.
Turn the radio on.
Read the current drain.
Requirement: I>250 mA.
Connect a DC voltmeter to R716.
Adjust R709 for 5 V ±0.1 V.

WARNING!
Never set the +5 V supply to be higher than +6 V, even for a short period, as overvoltage can destroy the circuitry.

Connect a voltmeter to P102 pin 2.
Adjust R719 for -24 V ±0.1 V.

Note: Readjustment of R719 requires readjustment of the receiver.

TRANSMITTER ADJUSTMENT

During adjustment the transmitter must be connected to an RF wattmeter and keyed.
Connect a voltmeter to P102 pin 9. (LOCK)
Check that the lock signal is 0 V (Low).

TX VCO DOUBLER

Select the center channel in the low frequency window: 404.700 MHz.
Connect a diode probe and voltmeter to TP9.
Adjust C529 and 533 for maximum voltmeter reading.

TRANSMITTER OUTPUT POWER

Adjust R133 for rated RF power.
Select a channel with reduced power, if used.
Adjust R132 for rated reduced power.

TRANSMITTER FREQUENCY

Connect a frequency counter to the antenna output through a suitable attenuator.
Adjust L1 in U611 for nominal transmitter frequency.
Requirement: F_{nom} ±0.2 p.p.m. (parts per million).

TRANSMITTER MODULATION

Connect an AF generator to P102 pin 3-(4 = GND).
Connect a deviation meter to the antenna output through a suitable attenuator.
Set the generator frequency to 1 kHz and the output to 1.66 V r.m.s.
Set R677 to its center position.
Select the center channel in the high frequency window: 467.400 MHz.
Adjust R675 for maximum deviation:

CQM6xx2: ±5 kHz +0/-100 Hz
CQM6xx3: ±4 kHz +0/-100 Hz
CQM6xx4: ±2.5 kHz +0/-100 Hz

Select the center channel in the low frequency window: 404.700 MHz.
Adjust R680 for maximum deviation:

CQM6xx2: ±5 kHz +0/-100 Hz
CQM6xx3: ±4 kHz +0/-100 Hz
CQM6xx4: ±2.5 kHz +0/-100 Hz

Select the center channel in the middle frequency window: 430.700 MHz.
Set the AF generator output to 1.66 V r.m.s.
Alternately set the generator frequency to 1 kHz and 20 Hz.
Adjust R677 for the same deviation at both modulation frequencies (±100 Hz).
Check and if necessary readjust R675 for maximum deviation (+0/-100 Hz).
Connect the AF generator to J901 pin 22 (TX LINE).

Adjust the generator output to obtain 60% of maximum deviation:

CQM6xx2: ±3.0 kHz
CQM6xx3: ±2.4 kHz
CQM6xx4: ±1.75 kHz

Requirement: AF input 100 mV ±3 dB.

RECEIVER ADJUSTMENT

RECEIVER FRONT END

Select the center channel of the low RX frequency window: 404.600 MHz.

Connect a diode probe and DC-Voltmeter to R309.

Connect a signal generator to the antenna input and set its frequency to the channel frequency.
Set the generator to 0 dB (225 mV - 1/2 e.m.f.).
Adjust C304, C309 and C316 for maximum voltmeter reading.
Adjust C321 for minimum reading, C326 for maximum reading, C330 for minimum reading and C336 for maximum reading.
Repeat the adjustments until no further improvements in minimums and maximums are possible.

Connect the diode probe and voltmeter to TP3.
Adjust C332 and C342 for maximum voltmeter reading.

Select the center channel of the high RX frequency window: 467.300 MHz.

Set the signal generator frequency to the channel frequency.
Connect a distortion meter to P102 pin 10 (RX LINE).
Adjust R663 for best sensitivity (SINAD).

The radio can now cover the entire frequency band without readjustment.

ALTERNATIVE METHOD

If the RX window is less than 10 MHz:

Connect a voltmeter to TP12.
Adjust R633 for a voltage reading according to the graph (±50 mV).
Connect a diode probe and voltmeter to TP3.

Adjust C332 and C342 for maximum reading.
Connect a RF signal generator to the antenna input.
Set the generator frequency to the center channel frequency and the modulation frequency to 1 kHz and 60% deviation.

Adjust the following capacitors for best sensitivity (SINAD).
C304, C309, C316, C321, C326, C330, C336.

45 MHz IF AMPLIFIER

Connect a signal generator to the antenna input.
Set the generator frequency to the channel frequency.
Set the generator output to 15 mV (10 - 20 mV) unmodulated.

Connect a spectrum analyzer to TP5.
Adjust L403 and L405 for maximum.
Modulate the signal generator with 1 kHz to ±30 - 50 kHz.
Adjust L404 for symetrical curve.
Set the generator output to 1 mV unmodulated.
Connect a frequency counter to TP6.
Connect a distortionmeter and an oscilloscope to P102 pin 10 (RX LINE).
Adjust L408 for 455 kHz.
Alternative: Adjust L408 for minimum distortion with 100% modulation. The decrease in distortion is small (approx. 1%).

Set the generator modulation to 1 kHz and 60% deviation.
Adjust L406 and L409 for minimum distortion.
Adjust L410 for best demodulated/recovered audio signal on the oscilloscope.
Adjust R426 for 110 mV (RX LINE).

RECEIVER SENSITIVITY

Measure the 20 dB psophometric SINAD on all channels.

Typical sensitivity:

CQM6662: 0.7 uV
CQM6663: 0.8 uV
CQM6664: 1.2 uV

SQUELCH

Connect a signal generator to the antenna input.
Set the generator frequency to the channel frequency. Set the modulation to 1 kHz and 60% deviation.

Connect a distortion meter to J102 pin 10.
Connect a voltmeter to P102 pin 11.
Adjust the generator output to obtain 10 - 12 dB SINAD.
Adjust R442 so that the squelch just opens.

Squelch open: ≤1 V.
Squelch closed: ≥3 V.

CURRENT CONSUMPTION

Measure the current consumption in off state, receive and transmit mode:

OFF:	10 mA
Receive Stand-by:	<720 mA
Transmit (25 W):	6.52 A

Values are typical and may only be used for reference.

ADJUSTMENT PROCEDURE

CQM6110 - CQM6770L/M

INSTRUMENTS

The following instruments are necessary in order to perform a complete adjustment of a Stornophone 6000 radiotelephone.

AF Voltmeter	Zi ≥ 1 Mohm
DC Voltmeter	Ri ≥ 1 Mohm
DC Amperemeter	0 - 1/0 - 10 A
RF Generator	10 - 470 MHz
RF Wattmeter	68 - 470 MHz
Deviationmeter	68 - 470 MHz
Frequency counter	0.4 - 512 MHz
Distortionmeter	Psophometric
AF Generator	0.1 - 10 kHz
DC Power Supply	10 - 20 V/0-10 A
RF Probe	Part no. 95.0059-00
Trimming Tool	Part no. 17.0053-00
Interface Box SE6002	Part no. 95D5014-00
Service Prom M6000	Part no. 95D5015-00
Service Box DK/N	Part no. J709551P1
Service Box S/SF	Part no. J709551P2

GENERAL NOTES

During test and adjustment DC power (13.2 V) must be connected and the radio turned on.

The personality prom U904 must be replaced by a test prom.

VOLTAGE REGULATOR

Connect the DC power supply to the radio and set the voltage to 13.2 V
Turn the radio on.
Read the current drain.
Requirement: I>250 mA
Connect a DC voltmeter to R716.
Adjust R709 for 5 V ±0.1 V.

WARNING
Never set the +5 V supply to be higher than +6 V, even for a short period, as overvoltage can destroy the circuitry.

Connect a voltmeter to P102 pin 2.
Adjust R719 for -24 V ±0.1 V.

Note: Readjustment of R719 requires readjustment of the receiver.

TRANSMITTER ADJUSTMENT

During adjustment the transmitter must be connected to an RF wattmeter and keyed.
Connect a voltmeter to P102 pin 9. (LOCK)
Check that the lock signal is 0V (Low).
Adjust R133 for rated RF power.
Select a channel with reduced power, if used.
Adjust R132 for rated reduced power.

TRANSMITTER FREQUENCY

Connect a frequency counter to the antenna output through a suitable attenuator.
Adjust L701 for nominal transmitter frequency.
Requirement: F_{nom} ±0.2 p.p.m. (parts per million)

TRANSMITTER MODULATION

Connect an AF generator to P102 pin 3-(4= GND). Connect a deviation meter to the antenna output through a suitable attenuator.

Set the generator frequency to 1 kHz and the output to 1.66 V r.m.s.
Set R 677 to its center position.

Select the center channel in the high frequency window:
CQM6110 = 172.3 MHz
CQM6770L = 208.6 MHz
CQM6770H = 223.6 MHz
Adjust R675 for maximum deviation:
CQM6xx2: ±5 kHz +0/-100 Hz
CQM6xx3: ±4 kHz +0-/100 Hz
CQM6xx3: ±2.5 kHz +0/-100 Hz

Select the center channel in the low frequency window:
CQM6110 = 136.9 MHz
CQM6770L = 174.9 MHz
CQM6770H = 190.9 MHz

Adjust R680 for maximum deviation:
CQM6xx2: ±5 kHz +0/-100 Hz
CQM6xx3: ±4 kHz +0/-100 Hz
CQM6xx4: ±2.5 kHz +0-/100 Hz

Select the center channel in the middle frequency window:
CQM6110 = 150.4 MHz
CQM6770L = 188.4 MHz
CQM6770H = 204.56 MHz

Set the AF generator output to 1.66 V r.m.s.
Alternately set the generator frequency to 1 kHz and 20 Hz.
Adjust R677 for the same deviation at both modulation frequencies (±100Hz).
Check and if necessary readjust R677 for maximum deviation (+0/-100Hz).
Connect the AF generator to J901 pin 22 (TX LINE).
Adjust the generator output to obtain 60% of maximum deviation:
CQM6xx2: ±3.0 kHz
CQM6xx3: ±2.4 kHz
CQM6xx4: ±1.75 kHz

Requirement: AF input 100 mV ±3 dB.

RECEIVER ADJUSTMENT

RECEIVER FRONT END

Select the center channel of the low RX frequency window.
CQM6110: 136.9 MHz
CQM6770L: 174.9 MHz
CQM6770H: 190.9 MHz

Connect a diode probe and DC-Voltmeter to TP7.

Connect a signal generator to the antenna input and set its frequency to the channel frequency.
Set the generator to 0 dB (225 mV - ½ e.m.f.).
Adjust L301, L302 and L304 for maximum voltmeter reading.

Adjust L306 for minimum reading, L308 for minimum reading and L310 for maximum reading.
Repeat the adjustments until no further improvements in mimimums and maximums are possible.

Connect the diode probe and voltmeter to TP3.
Adjust L313 and L314 for maximum voltmeter reading.

Select the center channel of the high RX frequency window.
CQM6110: 172.45 MHz
CQM6770L: 208.6 MHz
CQM6770H: 255.65 MHz

ADJUSTMENT PROCEDURE

CQM6110 - CQM6770L/M

INSTRUMENTS

The following instruments are necessary in order to perform a complete adjustment of a Stornophone 6000 radiotelephone.

AF Voltmeter	Zi $\geq$ 1 Mohm
DC Voltmeter	Ri $\geq$ 1 Mohm
DC Amperemeter	0 - 1/0 - 10 A
RF Generator	10 - 470 MHz
RF Wattmeter	68 - 470 MHz
Deviationmeter	68 - 470 MHz
Frequency counter	0.4 - 512 MHz
Distortionmeter	Psophometric
AF Generator	0.1 - 10 kHz
DC Power Supply	10 - 20 V/0-10 A
RF Probe	Part no. 95.0059-00
Trimming Tool	Part no. 17.0053-00
6000 Service Box	Part no. 95D5014-00
Service Prom M6000	Part no. 95D5015-00

GENERAL NOTES

During test and adjustment DC power (13.2 V) must be connected and the radio turned on.

The personality prom U904 must be replaced by a test prom.

VOLTAGE REGULATOR

Connect the DC power supply to the radio and set the voltage to 13.2 V
Turn the radio on.
Read the current drain.
Requirement: I>250 mA
Connect a DC voltmeter to R716.
Adjust R709 for 5 V ±0.1 V.

WARNING
Never set the +5 V supply to be higher than +6 V, even for a short period, as overvoltage can destroy the circuitry.

Connect a voltmeter to P102 pin 2.
Adjust R719 for -24 V ±0.1 V.

Note: Readjustment of R719 requires readjustment of the receiver.

TRANSMITTER ADJUSTMENT

During adjustment the transmitter must be connected to an RF wattmeter and keyed.
Connect a voltmeter to P102 pin 9. (LOCK)
Check that the lock signal is 0V (Low).
Adjust R133 for rated RF power.
Select a channel with reduced power, if used.
Adjust R132 for rated reduced power.

TRANSMITTER FREQUENCY

Connect a frequency counter to the antenna output through a suitable attenuator.
Adjust L701 for nominal transmitter frequency.
Requirement: F_{nom} ±0.2 p.p.m. (parts per million)

TRANSMITTER MODULATION

Connect an AF generator to P102 pin 3-(4= GND). Connect a deviation meter to the antenna output through a suitable attenuator.

Set the generator frequency to 1 kHz and the output to 1.66 V r.m.s.
Set R 677 to its center position.

Select the center channel in the high frequency window:
CQM6110 = 172.3 MHz
CQM6770L = 208.6 MHz
CQM6770H = 223.6 MHz
Adjust R675 for maximum deviation:
CQM6xx2: ±5 kHz +0/-100 Hz
CQM6xx3: ±4 kHz +0-/100 Hz
CQM6xx3: ±2.5 kHz +0/-100 Hz

Select the center channel in the low frequency window:
CQM6110 = 136.9 MHz
CQM6770L = 174.9 MHz
CQM6770H = 190.9 MHz

Adjust R680 for maximum deviation:
CQM6xx2: ±5 kHz +0/-100 Hz
CQM6xx3: ±4 kHz +0/-100 Hz
CQM6xx4: ±2.5 kHz +0-/100 Hz

Select the center channel in the middle frequency window:
CQM6110 = 150.4 MHz
CQM6770L = 188.4 MHz
CQM6770H = 204.56 MHz

Set the AF generator output to 1.66 V r.m.s.
Alternately set the generator frequency to 1 kHz and 20 Hz.
Adjust R677 for the same deviation at both modulation frequencies (±100Hz).
Check and if necessary readjust R677 for maximum deviation (+0/-100Hz).
Connect the AF generator to J901 pin 22 (TX LINE).
Adjust the generator output to obtain 60% of maximum deviation:
CQM6xx2: ±3.0 kHz
CQM6xx3: ±2.4 kHz
CQM6xx4: ±1.75 kHz

Requirement: AF input 100 mV ±3 dB.

RECEIVER ADJUSTMENT

RECEIVER FRONT END

Select the center channel of the low RX frequency window.
CQM6110: 136.9 MHz
CQM6770L: 174.9 MHz
CQM6770H: 190.9 MHz

Connect a diode probe and DC-Voltmeter to TP7.

Connect a signal generator to the antenna input and set its frequency to the channel frequency.
Set the generator to 0 dB (225 mV - ½ e.m.f.).
Adjust L301, L302 and L304 for maximum voltmeter reading.

Adjust L306 for minimum reading, L308 for minimum reading and L310 for maximum reading.
Repeat the adjustments until no further improvements in mimimums and maximums are possible.

Connect the diode probe and voltmeter to TP3.
Adjust L313 and L314 for maximum voltmeter reading.

Select the center channel of the high RX frequency window.
CQM6110: 172.45 MHz
CQM6770L: 208.6 MHz
CQM6770H: 255.65 MHz

Set the signal generator frequency to the channel frequency.

Connect a distortion meter to P102 pin 10 (RX LINE)

Adjust R663 for best sensitivity (SINAD)

The radio can now cover the entire frequency band without readjustment.

ALTERNATIVE METHOD

If the RX window is less than 10 MHz:

Connect a voltmeter to TP12.

Adjust R633 for a voltage reading according to the graph (±50 mV).

Connect a diode probe and voltmeter to TP3.

Adjust L313 and L314 for maximum reading.

Connect a RF signal generator to the antenna input.

Set the generator frequency to the center channel frequency and the modulation frequency to 1 kHz and 60% deviation.

Adjust the following coils for best sensitivity (SINAD).

L301, L302, L304, L306, L308, L310, L312.

45 MHz IF AMPLIFIER

Connect a signal generator to the antenna input.

Set the generator frequency to the channel frequency.

Set the generator output to 15 mV (10 - 20 mV) unmodulated.

Connect a spectrum analyzer to TP5.

Adjust L403 and L405 for maximum.

Modulate the signal generator with 1 kHz to ±30 - 50 kHz.

Adjust L404 for symetrical curve.

Set the generator output to 1 mV unmodulated.

Connect a frequency counter to TP6.

Connect a distortionmeter and an oscilloscope to P102 pin 10 (RX LINE).

Adjust L408 for 455 kHz.

Alternative: Adjust L408 for minimum distortion with 100% modulation. The decrease in distortion is small (approx. 1%).

Set the generator modulation to 1 kHz and 60% deviation.

Adjust L406 and L409 for minimum distortion.

Adjust L410 for best demodulated/recovered audio signal on the oscilloscope.

Adjust R426 for 110 mV (RX LINE).

RECEIVER SENSITIVITY.

Measure the 20 dB psophometric SINAD on all channels.

Typical sensitivity:

CQM6112: 0.7 uV

CQM6113: 0.7 uV

CQM6114: 1.0 uV

CQM6770: 1.15uV

SQUELCH

Connect a signal generator to the antenna input.

Set the generator frequency to the channel frequency. Set the modulation to 1 kHz and 60% deviation.

Connect a distortion meter to J102 pin 10.

Connect a voltmeter to P102 pin 11.

Adjust the generator output to obtain 10 - 12 dB SINAD.

Adjust R442 so that the squelch just opens.

Squelch open: ≤1 V

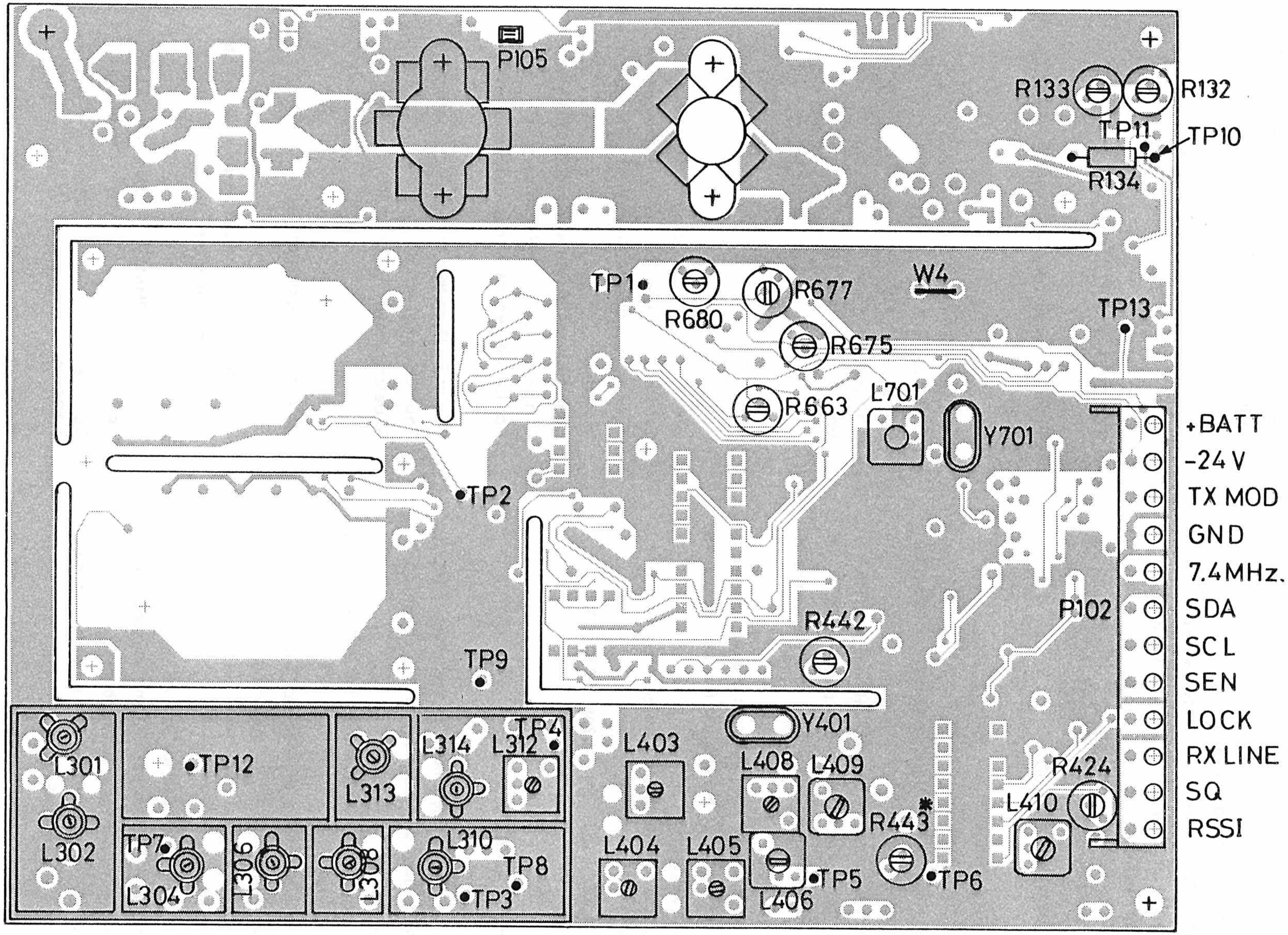
Squelch closed: ≥3 V

CURRENT CONSUMPTION

Measure the current consumption in off state, receive and transmit mode.

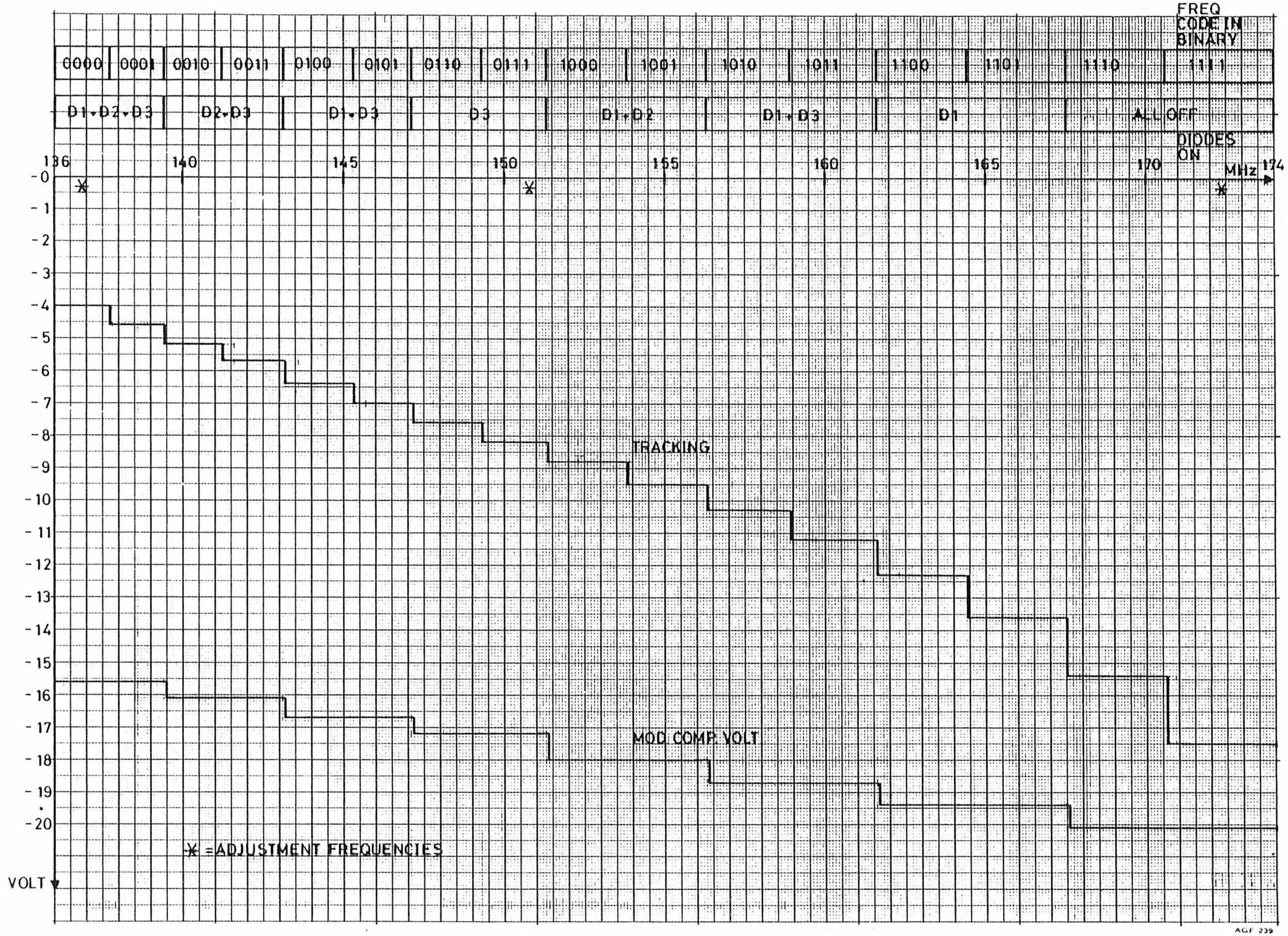
	CQM6110	CQM6770	
OFF	27	17	mA
Receive Stand-by	720	720	mA
Transmit (25 W)	6.52	7.02	A

Values are typical and may only be used for reference.



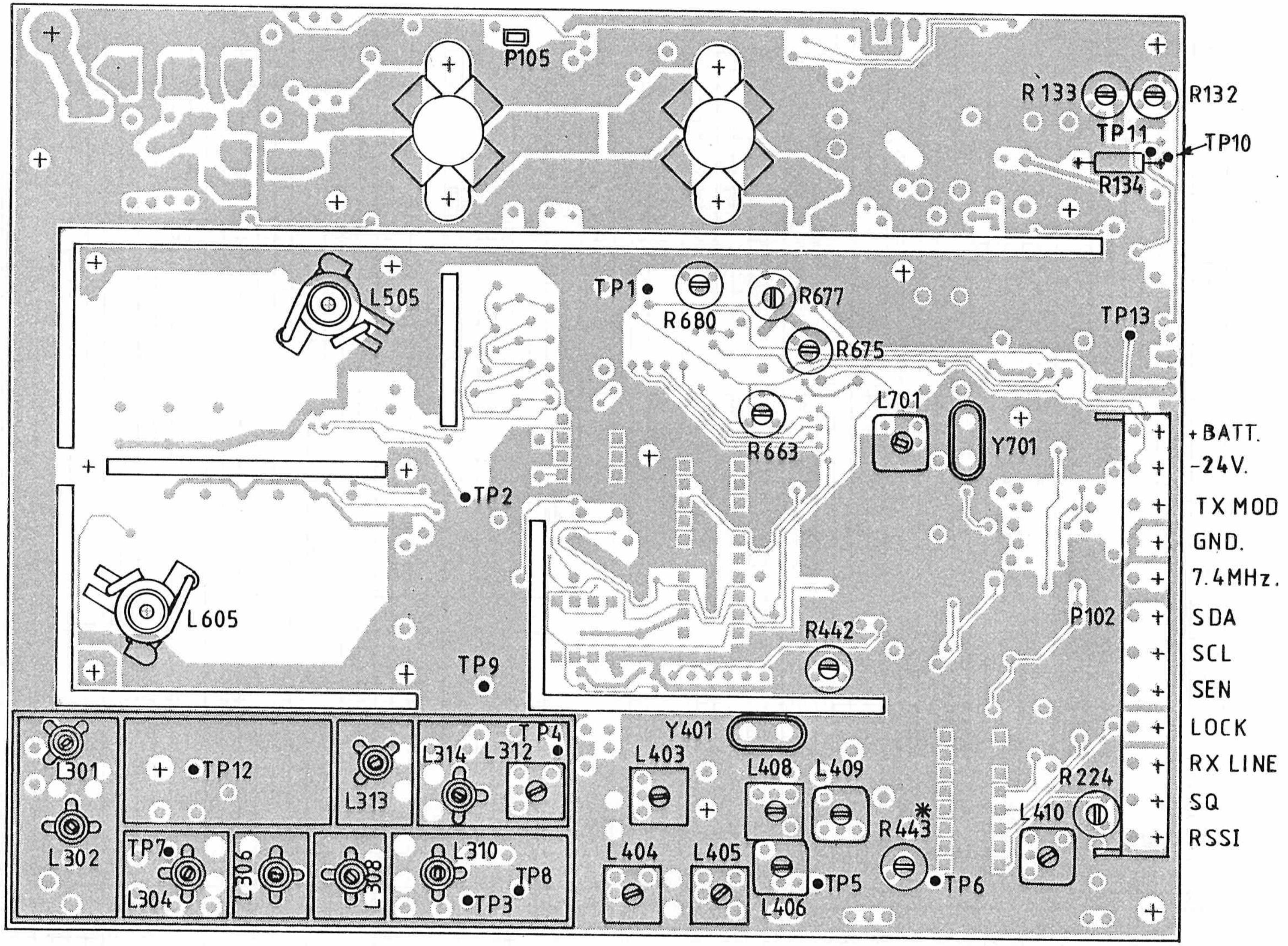
✳ ONLY FOR RSSI

ADJUSTABLE COMPONENTS AND TEST POINTS
RF BOARD 6110 L



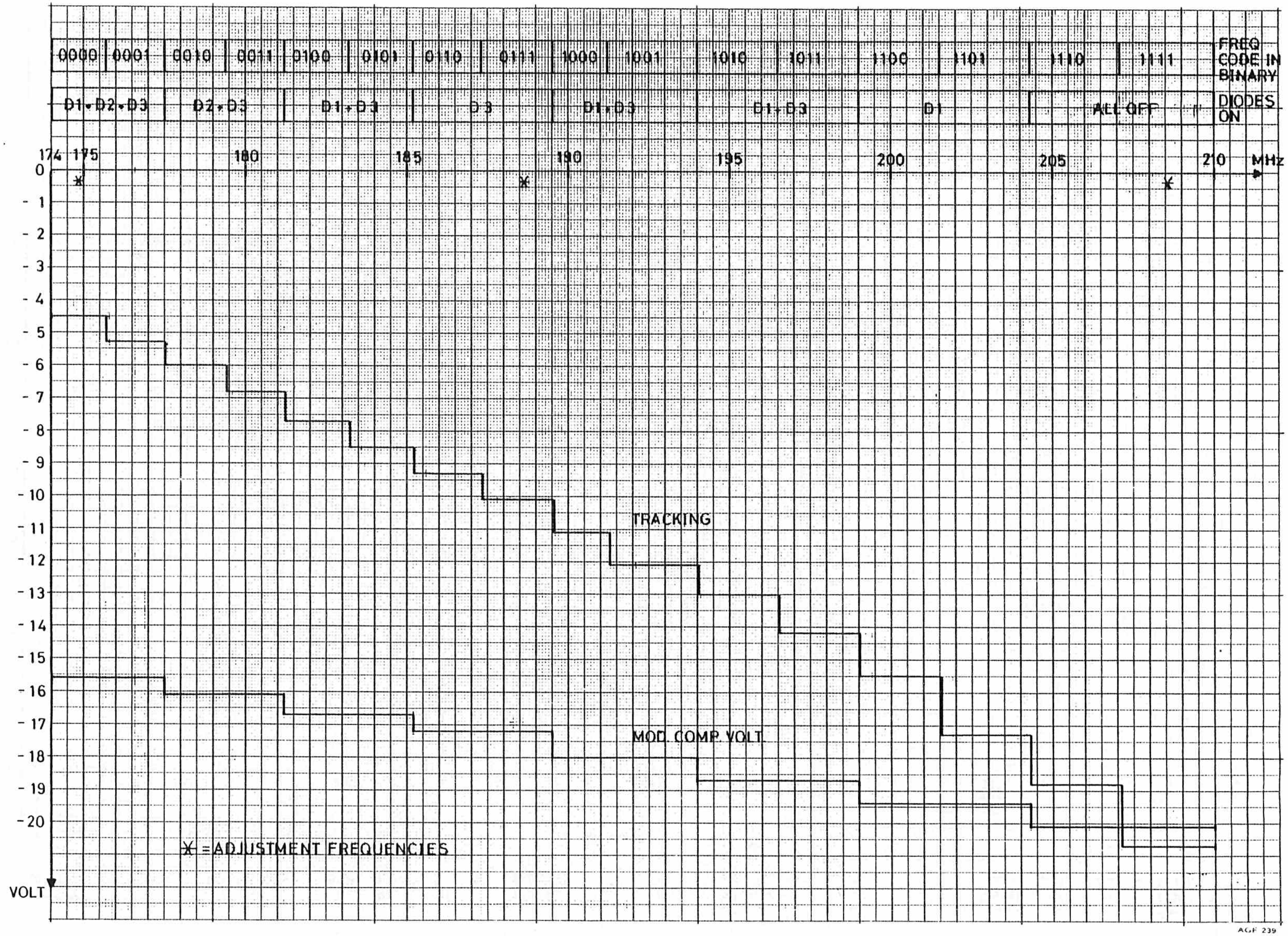
TUNING VOLTAGES ON RF BOARD RF611X

D404.422



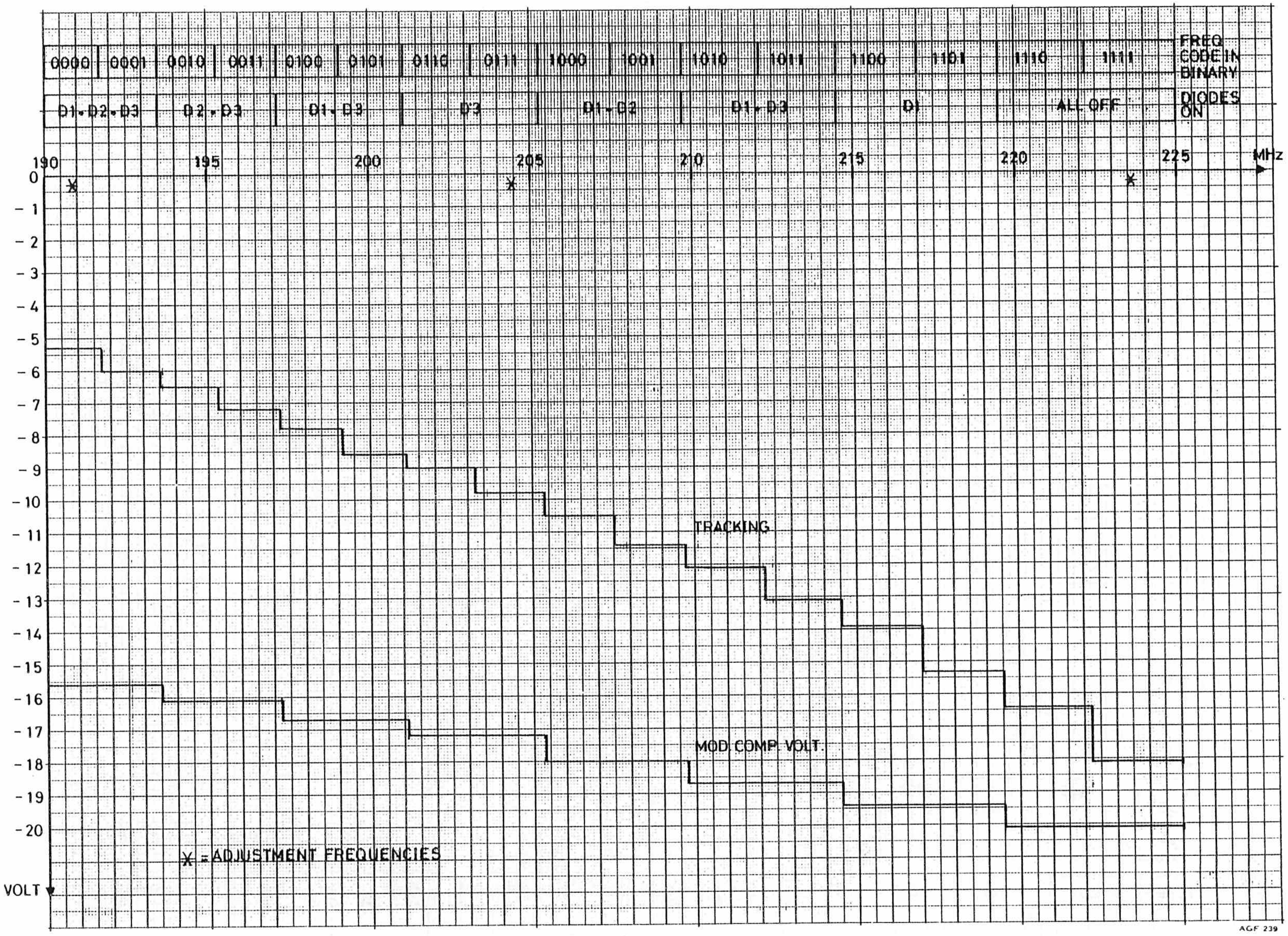
✱ ONLY FOR RSSI

ADJUSTABLE COMPONENTS AND TEST POINTS
RF BOARD 677X L & RF677X H



TUNING VOLTAGES ON RF BOARD RF677XL

D404.419



TUNING VOLTAGES ON RF BOARD RF677XH

D404.418

RF633x

- Adjustment procedure
- Test points
- Tuning voltages

ADJUSTMENT PROCEDURE

CQM6330

INSTRUMENTS

The following instruments are necessary in order to perform a complete adjustment of a Stornophone 6000 radiotelephone.

AF Voltmeter	Zi $\geq$ 1 Mohm
DC Voltmeter	Ri $\geq$ 1 Mohm
DC Amperemeter	0 - 1/0 - 10 A
RF Generator	10 - 470 MHz
RF Wattmeter	68 - 470 MHz
Deviationmeter	68 - 470 MHz
Frequency counter	0.4 - 512 MHz
Distortionmeter	Psophometric
AF Generator	0.1 - 10 kHz
DC Power Supply	10 - 20 V/0-10 A
RF Probe	Part no. 95.0059-00
Trimming Tool	Part no. 17.0053-00
Interface Box SE6002	Part no. 95D5014-00
Service Prom M6000	Part no. 95D5015-00
Service Box DK/N	Part no. J709551P1
Service Box S/SF	Part no. J709551P2

GENERAL NOTES

During test and adjustment DC power (13.2 V) must be connected and the radio turned on.

The personality prom U904 must be replaced by a test prom.

VOLTAGE REGULATOR

Connect the DC power supply to the radio and set the voltage to 13.2 V
Turn the radio on.
Read the current drain.
Requirement: I>250 mA
Connect a DC voltmeter to R716.
Adjust R709 for 5 V ±0.1 V.

WARNING
Never set the +5 V supply to be higher than +6 V, even for a short period, as overvoltage can destroy the circuitry.

Connect a voltmeter to P102 pin 2.
Adjust R719 for -24 V ±0.1 V.

Note: Readjustment of R719 requires readjustment of the receiver.

TRANSMITTER ADJUSTMENT

During adjustment the transmitter must be connected to an RF wattmeter and keyed.
Connect a voltmeter to P102 pin 9. (LOCK)
Check that the lock signal is 0 V (Low).
Adjust R133 for rated RF power.
Select a channel with reduced power, if used.
Adjust R132 for rated reduced power.

TRANSMITTER FREQUENCY

Connect a frequency counter to the antenna output through a suitable attenuator.
Adjust L701 for nominal transmitter frequency.
Requirement: F_{nom} ±0.2 p.p.m. (parts per million)

TRANSMITTER MODULATION

Connect an AF generator to P102 pin 3-(4= GND). Connect a deviation meter to the antenna output through a suitable attenuator.

Set the generator frequency to 1 kHz and the output to 1.66 V r.m.s.
Set R 677 to its center position.

Select the center channel in the high frequency window: 86.970 MHz

Adjust R675 for maximum deviation:
CQM6xx2: ±5 kHz +0/-100 Hz
CQM6xx3: ±4 kHz +0/-100 Hz
CQM6xx3: ±2.5 kHz +0/-100 Hz

Select the center channel in the low frequency window: 66.46 MHz

Adjust R680 for maximum deviation:
CQM6xx2: ±5 kHz +0/-100 Hz
CQM6xx3: ±4 kHz +0/-100 Hz
CQM6xx4: ±2.5 kHz +0/-100 Hz

Select the center channel in the middle frequency window: 74.040 MHz

Set the AF generator output to 1.66 V r.m.s.
Alternately set the generator frequency to 1 kHz and 20 Hz.
Adjust R677 for the same deviation at both modulation frequencies (±100Hz).
Check and if necessary readjust R677 for maximum deviation (+0/-100Hz).
Connect the AF generator to J901 pin 22 (TX LINE).
Adjust the generator output to obtain 60% of maximum deviation:
Requirement: AF input 100 mV ±3 dB.

RECEIVER ADJUSTMENT

RECEIVER FRONT END

Select the center channel of the low RX frequency window: 66.510 MHz

Connect a diode probe and DC-Voltmeter to TP7.

Connect a signal generator to the antenna input and set its frequency to the channel frequency.
Set the generator to 0 dB (225 mV - ½ e.m.f.).
Adjust L301, L302 and L304 for maximum voltmeter reading.
Adjust L306 for maximum reading, L308 for maximum reading and L310 for minimum reading.
Repeat the adjustments until no further improvements in minimums and maximums are possible.

Connect the diode probe and voltmeter to TP3.
Adjust L313 and L314 for maximum voltmeter reading.

Select the center channel of the high RX frequency window: 87.060 MHz

Set the signal generator frequency to the channel frequency.
Connect a distortion meter to P102 pin 10 (RX LINE).
Adjust R663 for best sensitivity (SINAD).
The radio can now cover the entire frequency band without readjustment.

ALTERNATIVE METHOD

If the RX window is less than 10 MHz:
Connect a voltmeter to TP12.
Adjust R633 for a voltage reading according to the graph (±50 mV).
Connect a diode probe and voltmeter to TP3.
Adjust L313 and L314 for maximum reading.
Connect a RF signal generator to the antenna input.
Set the generator frequency to the center channel frequency and the modulation frequency to 1 kHz and 60% deviation.
Adjust the following coils for best sensitivity (SINAD).
L301, L302, L304, L306, L308, L310, L312.

ADJUSTMENT PROCEDURE

CQM6330

INSTRUMENTS

The following instruments are necessary in order to perform a complete adjustment of a Stornophone 6000 radiotelephone.

AF Voltmeter	Zi $\geq$ 1 Mohm
DC Voltmeter	Ri $\geq$ 1 Mohm
DC Amperemeter	0 - 1/0 - 10 A
RF Generator	10 - 470 MHz
RF Wattmeter	68 - 470 MHz
Deviationmeter	68 - 470 MHz
Frequency counter	0.4 - 512 MHz
Distortionmeter	Psophometric
AF Generator	0.1 - 10 kHz
DC Power Supply	10 - 20 V/0-10 A
RF Probe	Part no. 95.0059-00
Trimming Tool	Part no. 17.0053-00
6000 Service Box	Part no. 95D5014-00
Service Prom M6000	Part no. 95D5015-00

GENERAL NOTES

During test and adjustment DC power (13.2 V) must be connected and the radio turned on.

The personality prom U904 must be replaced by a test prom.

VOLTAGE REGULATOR

Connect the DC power supply to the radio and set the voltage to 13.2 V
Turn the radio on.
Read the current drain.
Requirement: I>250 mA
Connect a DC voltmeter to R716.
Adjust R709 for 5 V ±0.1 V.

WARNING
Never set the +5 V supply to be higher than +6 V, even for a short period, as overvoltage can destroy the circuitry.

Connect a voltmeter to P102 pin 2.
Adjust R719 for -24 V ±0.1 V.

Note: Readjustment of R719 requires readjustment of the receiver.

TRANSMITTER ADJUSTMENT

During adjustment the transmitter must be connected to an RF wattmeter and keyed.
Connect a voltmeter to P102 pin 9. (LOCK)
Check that the lock signal is 0 V (Low).
Adjust R133 for rated RF power.
Select a channel with reduced power, if used.
Adjust R132 for rated reduced power.

TRANSMITTER FREQUENCY

Connect a frequency counter to the antenna output through a suitable attenuator.
Adjust L701 for nominal transmitter frequency.
Requirement: F_{nom} ±0.2 p.p.m. (parts per million)

TRANSMITTER MODULATION

Connect an AF generator to P102 pin 3-(4= GND).
Connect a deviation meter to the antenna output through a suitable attenuator.

Set the generator frequency to 1 kHz and the output to 1.66 V r.m.s.
Set R 677 to its center position.

Select the center channel in the high frequency window: 86.970 MHz

Adjust R675 for maximum deviation:
CQM6xx2: ±5 kHz +0/-100 Hz
CQM6xx3: ±4 kHz +0/-100 Hz
CQM6xx3: ±2.5 kHz +0/-100 Hz

Select the center channel in the low frequency window: 66.46 MHz

Adjust R680 for maximum deviation:
CQM6xx2: ±5 kHz +0/-100 Hz
CQM6xx3: ±4 kHz +0/-100 Hz
CQM6xx4: ±2.5 kHz +0/-100 Hz

Select the center channel in the middle frequency window: 74.040 MHz

Set the AF generator output to 1.66 V r.m.s.
Alternately set the generator frequency to 1 kHz and 20 Hz.
Adjust R677 for the same deviation at both modulation frequencies (±100Hz).
Check and if necessary readjust R677 for maximum deviation (+0/-100Hz).
Connect the AF generator to J901 pin 22 (TX LINE).
Adjust the generator output to obtain 60% of maximum deviation:
Requirement: AF input 100 mV ±3 dB.

RECEIVER ADJUSTMENT

RECEIVER FRONT END

Select the center channel of the low RX frequency window: 66.510 MHz

Connect a diode probe and DC-Voltmeter to TP7.

Connect a signal generator to the antenna input and set its frequency to the channel frequency.
Set the generator to 0 dB (225 mV - ½ e.m.f.).
Adjust L301, L302 and L304 for maximum voltmeter reading.
Adjust L306 for maximum reading, L308 for maximum reading and L310 for minimum reading.
Repeat the adjustments until no further improvements in minimums and maximums are possible.

Connect the diode probe and voltmeter to TP3.
Adjust L313 and L314 for maximum voltmeter reading.

Select the center channel of the high RX frequency window: 87.060 MHz

Set the signal generator frequency to the channel frequency.
Connect a distortion meter to P102 pin 10 (RX LINE).
Adjust R663 for best sensitivity (SINAD).
The radio can now cover the entire frequency band without readjustment.

ALTERNATIVE METHOD

If the RX window is less than 10 MHz:
Connect a voltmeter to TP12.
Adjust R633 for a voltage reading according to the graph (±50 mV).
Connect a diode probe and voltmeter to TP3.
Adjust L313 and L314 for maximum reading.
Connect a RF signal generator to the antenna input.
Set the generator frequency to the center channel frequency and the modulation frequency to 1 kHz and 60% deviation.
Adjust the following coils for best sensitivity (SINAD).
L301, L302, L304, L306, L308, L310, L312.

21.4 MHz IF AMPLIFIER

Connect a signal generator to the antenna input.
Set the generator frequency to the channel frequency.
Set the generator output to 15 mV (10 - 20 mV) unmodulated.
Connect a diode probe to TP5.
Adjust L403 and L405 for maximum.
Set the generator output to 1 mV unmodulated.
Connect a frequency counter to TP6.
Connect a distortionmeter and an oscilloscope to P102 pin 10 (RX LINE).
Adjust L408 for 455 kHz.
Alternative: Adjust L408 for minimum distortion with 100% modulation. The decrease in distortion is small (approx. 1%).
Set the generator modulation to 1 kHz and 60% deviation.
Adjust L406 and L409 for minimum distortion.
Adjust L410 for best demodulated/recovered audio signal on the oscilloscope.
Adjust R426 for 110 mV (RX LINE).

RECEIVER SENSITIVITY.

Measure the 20 dB psophometric SINAD on all channels.

Typical sensitivity:
CQM6332: 0.7 uV
CQM6333: 0.7 uV
CQM6334: 1.0 uV

SQUELCH

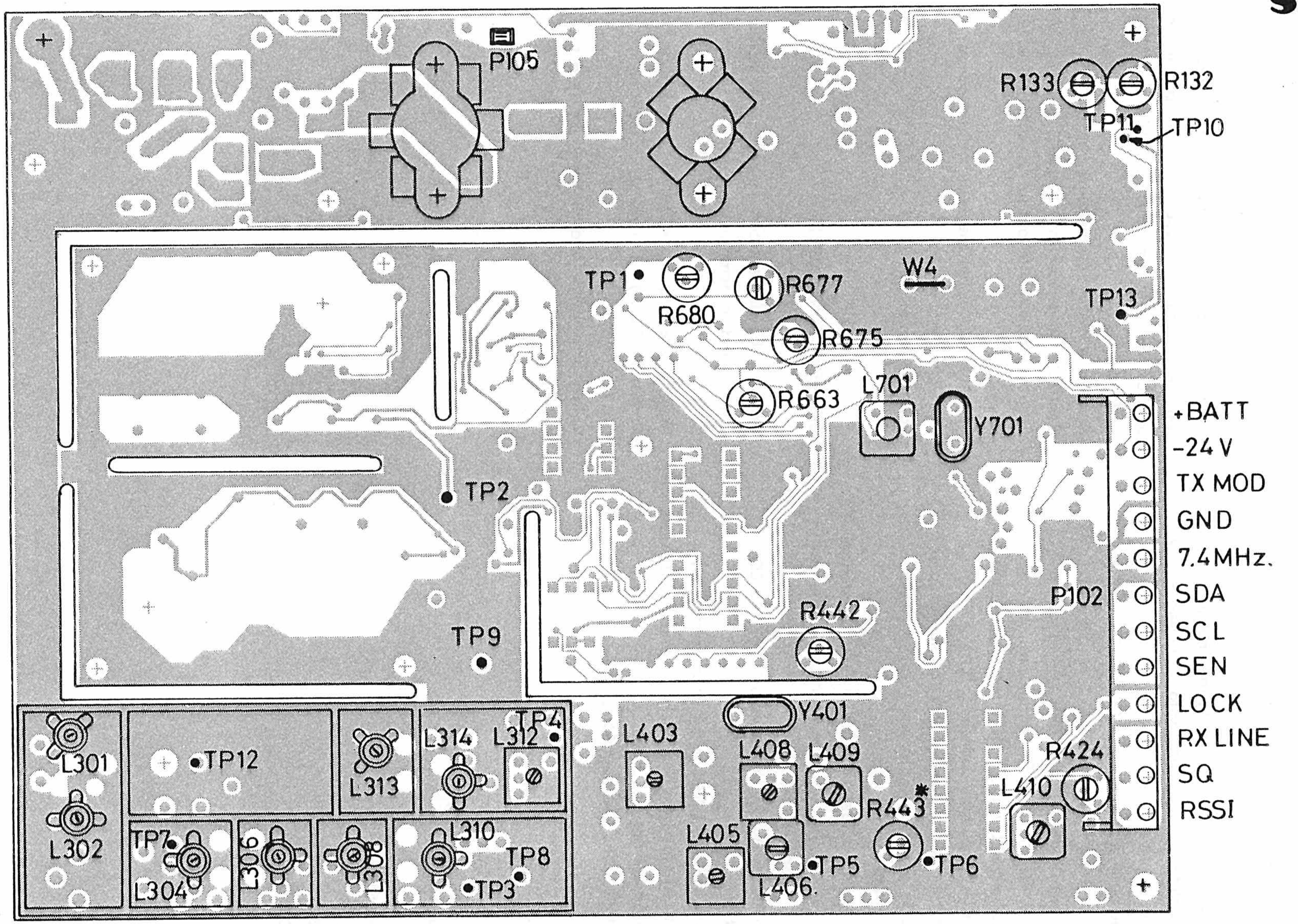
Connect a signal generator to the antenna input.
Set the generator frequency to the channel frequency. Set the modulation to 1 kHz and 60% deviation.
Connect a distortion meter to J102 pin 10.
Connect a voltmeter to P102 pin 11.
Adjust the generator output to obtain 10 - 12 dB SINAD.
Adjust R442 so that the squelch just opens.
Squelch open: ≤1 V
Squelch closed: ≥3 V

CURRENT CONSUMPTION

Measure the current consumption in off state, receive and transmit mode:

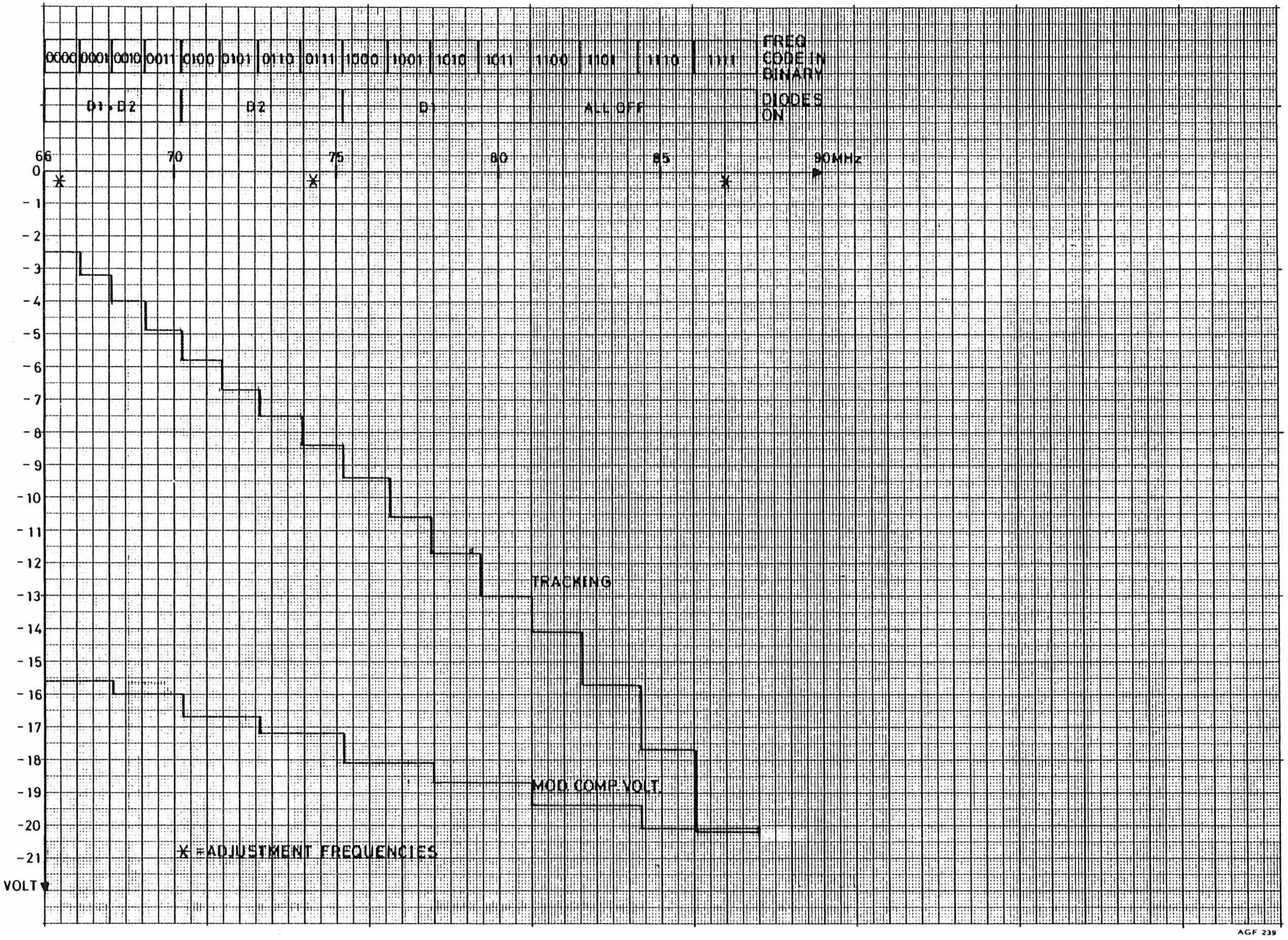
OFF:	27 mA
Receive Stand-by:	<750 mA
Transmit (25 W):	6.52 A

Values are typical and may only be used for reference.



* ONLY FOR RSSI

ADJUSTABLE COPMONENTS AND TEST POINTS
RF BOARD 6330L



TUNING VOLTAGES ON RF BOARD RF633X

D404.421

RF666x

- Adjustment procedure
- Test points
- Tuning voltages

ADJUSTMENT PROCEDURE

CQM6660

INSTRUMENTS

The following instruments are necessary in order to perform a complete adjustment of a Stornophone 6000 radiotelephone.

AF Voltmeter	Zi $\geq$ 1 Mohm
DC Voltmeter	Ri $\geq$ 1 Mohm
DC Amperemeter	0 - 1/0 - 10 A
RF Generator	10 - 470 MHz
RF Wattmeter	68 - 470 MHz
Deviationmeter	68 - 470 MHz
Frequency counter	0.4 - 512 MHz
Distortionmeter	Psophometric
AF Generator	0.1 - 10 kHz
DC Power Supply	10 - 20 V/0-10 A
RF Probe	Part no. 95.0059-00
Trimming Tool	Part no. 17.0053-00
Interface Box SE6002	Part no. 95D5014-00
Service Prom M6000	Part no. 95D5015-00
Service Box DK/N	Part no. J709551P1
Service Box S/SF	Part no. J709551P2

GENERAL NOTES

During test and adjustment DC power (13.2 V) must be connected and the radio turned on.

The personality prom U904 must be replaced by a test prom.

VOLTAGE REGULATOR

Connect the DC power supply to the radio and set the voltage to 13.2 V
Turn the radio on.
Read the current drain.
Requirement: I>250 mA
Connect a DC voltmeter to R716.
Adjust R709 for 5 V ±0.1 V.

WARNING

Never set the +5 V supply to be higher than +6 V, even for a short period, as overvoltage can destroy the circuitry.

Connect a voltmeter to P102 pin 2.
Adjust R719 for -24 V ±0.1 V.

Note: Readjustment of R719 requires readjustment of the receiver.

TRANSMITTER ADJUSTMENT

During adjustment the transmitter must be connected to an RF wattmeter and keyed.
Connect a voltmeter to P102 pin 9. (LOCK)
Check that the lock signal is 0V (Low).

TX VCO DOUBLER

Select the center channel in the low frequency window: 404.700 MHz.
Connect a diode probe and voltmeter to TP9.
Adjust C529 and 533 for maximum volmeter reading.

TRANSMITTER OUTPUT POWER

Adjust R133 for rated RF power.
Select a channel with reduced power, if used.
Adjust R132 for rated reduced power.

TRANSMITTER FREQUENCY

Connect a frequency counter to the antenna output through a suitable attenuator.
Adjust L1 in U601 for nominal transmitter frequency.
Requirement: F_{nom} ±0.2 p.p.m. (parts per million)

TRANSMITTER MODULATION

Connect an AF generator to P102 pin 3-(4= GND).
Connect a deviation meter to the antenna output through a suitable attenuator.

Set the generator frequency to 1 kHz and the output to 1.66 V r.m.s.
Set R 677 to its center position.
Select the center channel in the high frequency window: 467.400 MHz
Adjust R675 for maximum deviation:
CQM6xx2: ±5 kHz +0/-100 Hz
CQM6xx3: ±4 kHz +0-/100 Hz
CQM6xx3: ±2.5 kHz +0/-100 Hz

Select the center channel in the low frequency window: 404.700 MHz

Adjust R680 for maximum deviation:
CQM6xx2: ±5 kHz +0/-100 Hz
CQM6xx3: ±4 kHz +0/-100 Hz
CQM6xx4: ±2.5 kHz +0-/100 Hz

Select the center channel in the middle frequency window: 430.700 MHz

Set the AF generator output to 1.66 V r.m.s.
Alternately set the generator frequency to 1 kHz and 20 Hz.
Adjust R677 for the same deviation at both modulation frequencies (±100Hz).
Check and if necessary readjust R675 for maximum deviation (+0/-100Hz).
Connect the AF generator to J901 pin 22 (TX LINE).
Adjust the generator output to obtain 60% of maximum deviation:
CQM6xx2: ±3.0 kHz
CQM6xx3: ±2.4 kHz
CQM6xx4: ±1.75 kHz

Requirement: AF input 100 mV ±3 dB.

RECEIVER ADJUSTMENT

RECEIVER FRONT END

Select the center channel of the low RX frequency window: 404.600 MHz.

Connect a diode probe and DC-Voltmeter to R309.

Connect a signal generator to the antenna input and set its frequency to the channel frequency.
Set the generator to 0 dB (225 mV - ½ e.m.f.).
Adjust C304, C309 and C316 for maximum voltmeter reading.
Adjust C321 for minimum reading, C326 for maximum reading, C330 for minimum reading and C336 for maximum reading.
Repeat the adjustments until no further improvements in minimums and maximums are possible.

Connect the diode probe and voltmeter to TP3.
Adjust C332 and C342 for maximum voltmeter reading.

Select the center channel of the high RX frequency window: 467.300MHz.

Set the signal generator frequency to the channel frequency.
Connect a distortion meter to P102 pin 10 (RX LINE)
Adjust R663 for best sensitivity (SINAD)
The radio can now cover the entire frequency band without readjustment.

ALTERNATIVE METHOD

If the RX window is less than 10 MHz:
Connect a voltmeter to TP12.

Adjust R633 for a voltage reading according to the graph (±50 mV).
Connect a diode probe and voltmeter to TP3.
Adjust C332 and C342 for maximum reading.
Connect a RF signal generator to the antenna input.
Set the generator frequency to the center channel frequency and the modulation frequency to 1 kHz and 60% deviation.
Adjust the following capacitors for best sensitivity (SINAD).
C304, C309, C316, C321, C326, C330, C336.

45 MHz IF AMPLIFIER

Connect a signal generator to the antenna input.
Set the generator frequency to the channel frequency.
Set the generator output to 15 mV (10 - 20 mV) unmodulated.
Connect a spectrum analyzer to TP5.
Adjust L403 and L405 for maximum.
Modulate the signal generator with 1 kHz to ±30 - 50 kHz.
Adjust L404 for symetrical curve.
Set the generator output to 1 mV unmodulated.
Connect a frequency counter to TP6.
Connect a distortionmeter and an oscilloscope to P102 pin 10 (RX LINE).
Adjust L408 for 455 kHz.
Alternative: Adjust L408 for minimum distortion with 100% modulation. The decrease in distortion is small (approx. 1%).
Set the generator modulation to 1 kHz and 60% deviation.
Adjust L406 and L409 for minimum distortion.
Adjust L410 for best demodulated/recovered audio signal on the oscilloscope.
Adjust R426 for 110 mV (RX LINE).

RECEIVER SENSITIVITY.

Measure the 20 dB psophometric SINAD on all channels.

Typical sensitivity:
CQM6662: 0.7 uV
CQM6663: 0.8 uV
CQM6664: 1.2 uV

SQUELCH

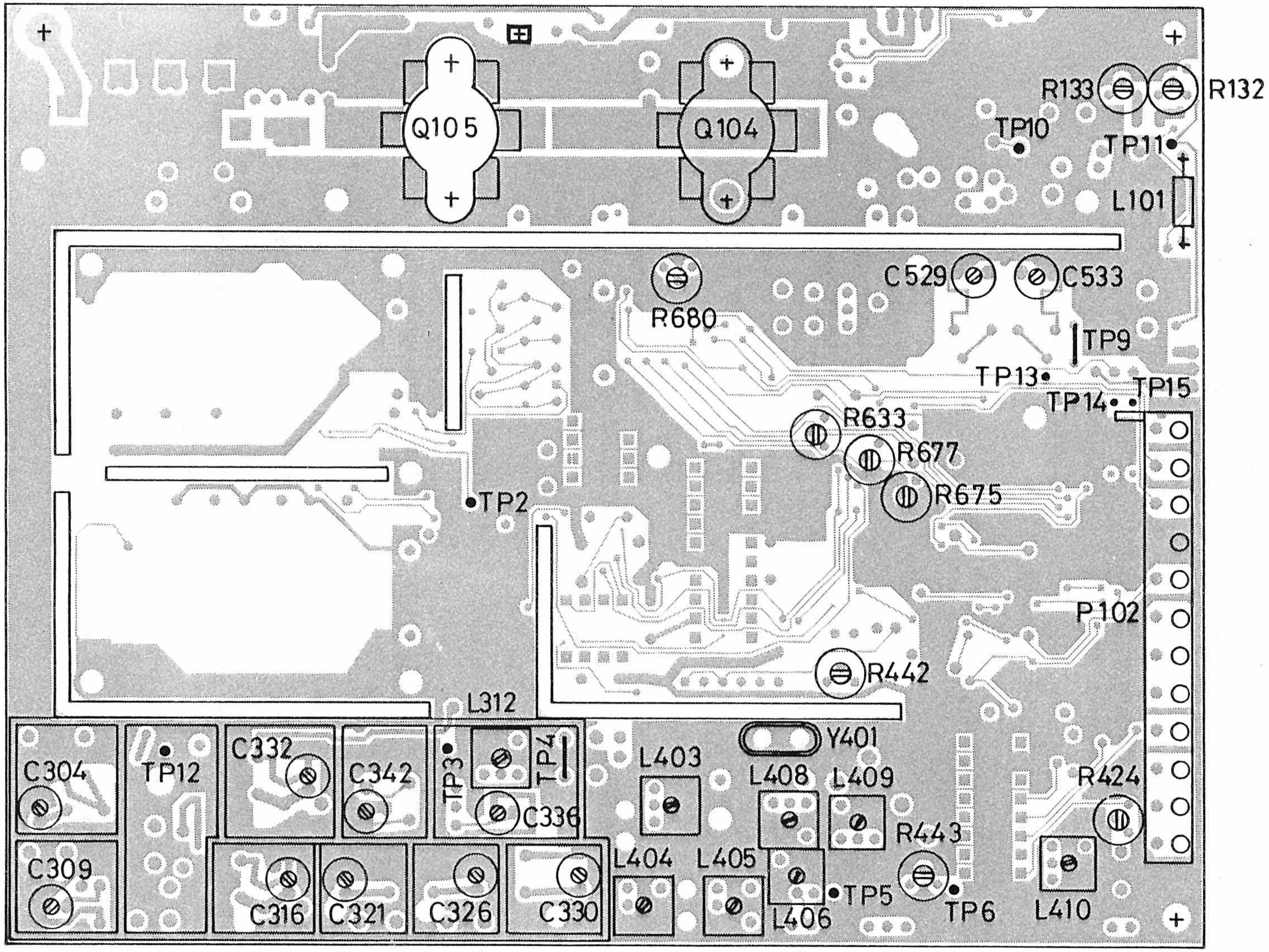
Connect a signal generator to the antenna input.
Set the generator frequency to the channel frequency. Set the modulation to 1 kHz and 60% deviation.
Connect a distortion meter to J102 pin 10.
Connect a voltmeter to P102 pin 11.
Adjust the generator output to obtain 10 - 12 dB SINAD.
Adjust R442 so that the squelch just opens.
Squelch open: ≤1 V
Squelch closed: ≥3 V

CURRENT CONSUMPTION

Measure the current consumption in off state, receive and transmit mode:

OFF:	10 mA
Receive Stand-by:	<720 mA
Transmit (25 W):	6.52 A

Values are typical and may only be used for reference.



ADJUSTABLE COPMONENTS AND TEST POINTS
RF BOARD 6660L

ADJUSTMENT PROCEDURE

CQM6660

INSTRUMENTS

The following instruments are necessary in order to perform a complete adjustment of a Stornophone 6000 radiotelephone.

AF Voltmeter	Zi ≥ 1 Mohm
DC Voltmeter	Ri ≥ 1 Mohm
DC Amperemeter	0 - 1/0 - 10 A
RF Generator	10 - 470 MHz
RF Wattmeter	68 - 470 MHz
Deviationmeter	68 - 470 MHz
Frequency counter	0.4 - 512 MHz
Distortionmeter	Psophometric
AF Generator	0.1 - 10 kHz
DC Power Supply	10 - 20 V/0-10 A
RF Probe	Part no. 95.0059-00
Trimming Tool	Part no. 17.0053-00
6000 Service Box	Part no. 95D5014-00
Service Prom M6000	Part no. 95D5015-00

GENERAL NOTES

During test and adjustment DC power (13.2 V) must be connected and the radio turned on.

The personality prom U904 must be replaced by a test prom.

VOLTAGE REGULATOR

Connect the DC power supply to the radio and set the voltage to 13.2 V
Turn the radio on.
Read the current drain.
Requirement: I>250 mA
Connect a DC voltmeter to R716.
Adjust R709 for 5 V ±0.1 V.

WARNING

Never set the +5 V supply to be higher than +6 V, even for a short period, as overvoltage can destroy the circuitry.

Connect a voltmeter to P102 pin 2.
Adjust R719 for -24 V ±0.1 V.

Note: Readjustment of R719 requires readjustment of the receiver.

TRANSMITTER ADJUSTMENT

During adjustment the transmitter must be connected to an RF wattmeter and keyed.
Connect a voltmeter to P102 pin 9. (LOCK)
Check that the lock signal is 0V (Low).

TX VCO DOUBLER

Select the center channel in the low frequency window: 404.700 MHz.
Connect a diode probe and voltmeter to TP9.
Adjust C529 and 533 for maximum volmeter reading.

TRANSMITTER OUTPUT POWER

Adjust R133 for rated RF power.
Select a channel with reduced power, if used.
Adjust R132 for rated reduced power.

TRANSMITTER FREQUENCY

Connect a frequency counter to the antenna output through a suitable attenuator.
Adjust L1 in U601 for nominal transmitter frequency.
Requirement: F_{nom} ±0.2 p.p.m. (parts per million)

TRANSMITTER MODULATION

Connect an AF generator to P102 pin 3-(4= GND). Connect a deviation meter to the antenna output through a suitable attenuator.

Set the generator frequency to 1 kHz and the output to 1.66 V r.m.s.
Set R 677 to its center position.
Select the center channel in the high frequency window: 467.400 MHz
Adjust R675 for maximum deviation:
CQM6xx2: ±5 kHz +0/-100 Hz
CQM6xx3: ±4 kHz +0-/100 Hz
CQM6xx3: ±2.5 kHz +0/-100 Hz

Select the center channel in the low frequency window: 404.700 MHz

Adjust R680 for maximum deviation:
CQM6xx2: ±5 kHz +0/-100 Hz
CQM6xx3: ±4 kHz +0/-100 Hz
CQM6xx4: ±2.5 kHz +0-/100 Hz

Select the center channel in the middle frequency window: 430.700 MHz

Set the AF generator output to 1.66 V r.m.s.
Alternately set the generator frequency to 1 kHz and 20 Hz.
Adjust R677 for the same deviation at both modulation frequencies (±100Hz).
Check and if necessary readjust R675 for maximum deviation (+0/-100Hz).
Connect the AF generator to J901 pin 22 (TX LINE).
Adjust the generator output to obtain 60% of maximum deviation:
CQM6xx2: ±3.0 kHz
CQM6xx3: ±2.4 kHz
CQM6xx4: ±1.75 kHz

Requirement: AF input 100 mV ±3 dB.

RECEIVER ADJUSTMENT

RECEIVER FRONT END

Select the center channel of the low RX frequency window: 404.600 MHz.

Connect a diode probe and DC-Voltmeter to R309.

Connect a signal generator to the antenna input and set its frequency to the channel frequency.
Set the generator to 0 dB (225 mV - ½ e.m.f.).
Adjust C304, C309 and C316 for maximum voltmeter reading.
Adjust C321 for minimum reading, C326 for maximum reading, C330 for minimum reading and C336 for maximum reading.
Repeat the adjustments until no further improvements in minimums and maximums are possible.

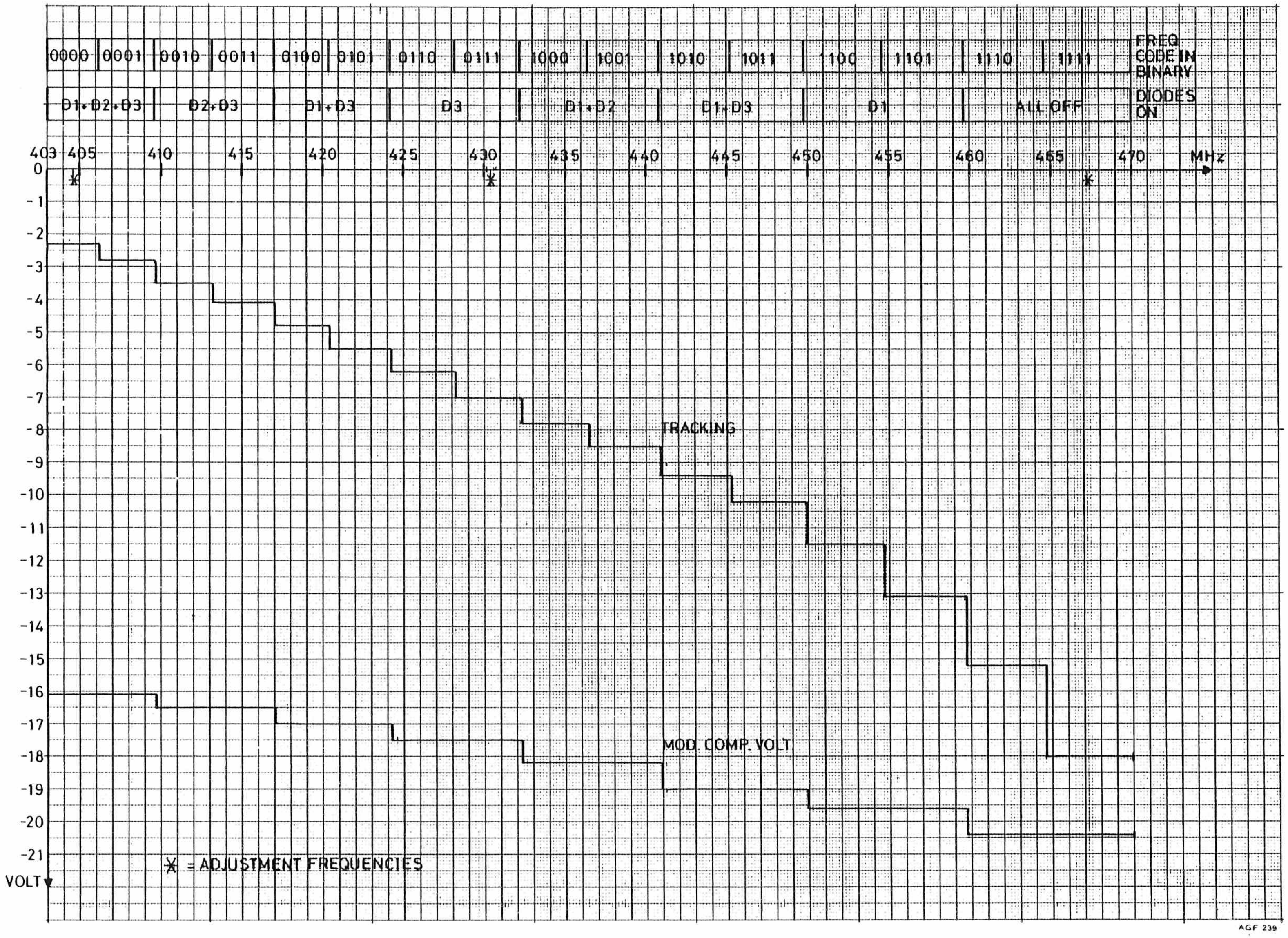
Connect the diode probe and voltmeter to TP3.
Adjust C332 and C342 for maximum voltmeter reading.

Select the center channel of the high RX frequency window: 467.300MHz.

Set the signal generator frequency to the channel frequency.
Connect a distortion meter to P102 pin 10 (RX LINE)
Adjust R663 for best sensitivity (SINAD)
The radio can now cover the entire frequency band without readjustment.

ALTERNATIVE METHOD

If the RX window is less than 10 MHz:
Connect a voltmeter to TP12.

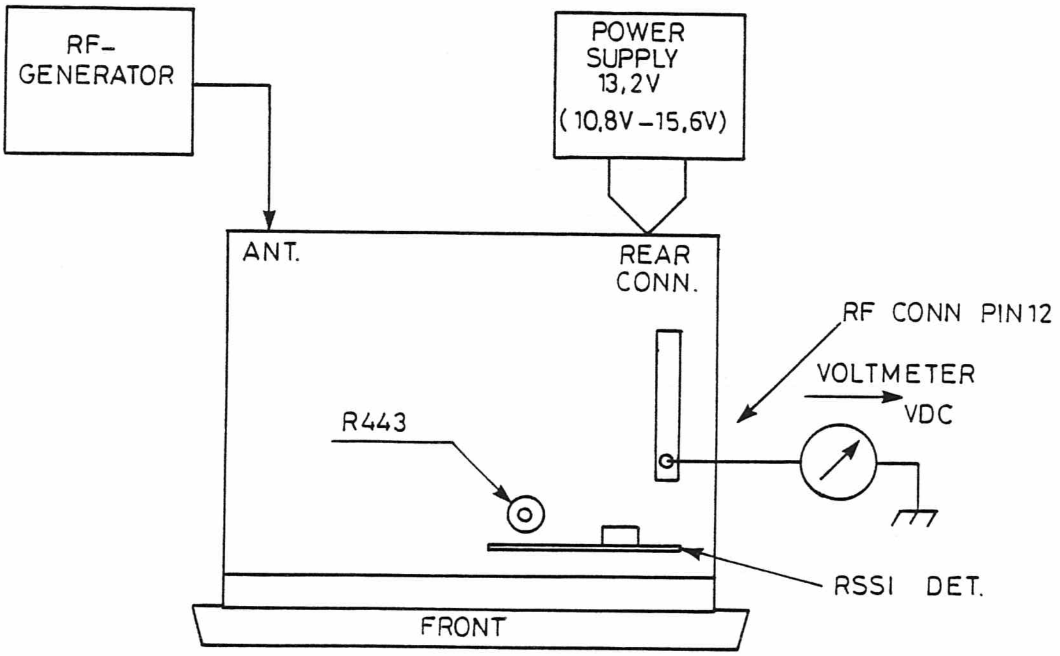


TUNING VOLTAGES ON RF BOARD RF666X

D404.420

IU6001 AND RA6004/RA6005

ALIGNMENT OF THE RSSI CIRCUITRY



D404.836

REQUIRED EQUIPMENT

1. Power supply, 13.2 V (10.8 V to 15.6 V)
1. RF-generator, freq. = channel freq. -93 dBm, Zo = 50 ohm
1. Voltmeter, 0 - 5 V, Ri >10 Mohm

ADJUSTMENT

Switch on the radio.
Select an appropriate channel.
Set the RF-generator to the receiver frequency.
Adjust the level of the generator to -93 dBm.
Adjust R443 on the RF-board to reading of 1.5 volt ±2% on the voltmeter.

TEST PROM

CQM6xxx

Part no. 95D5015-00

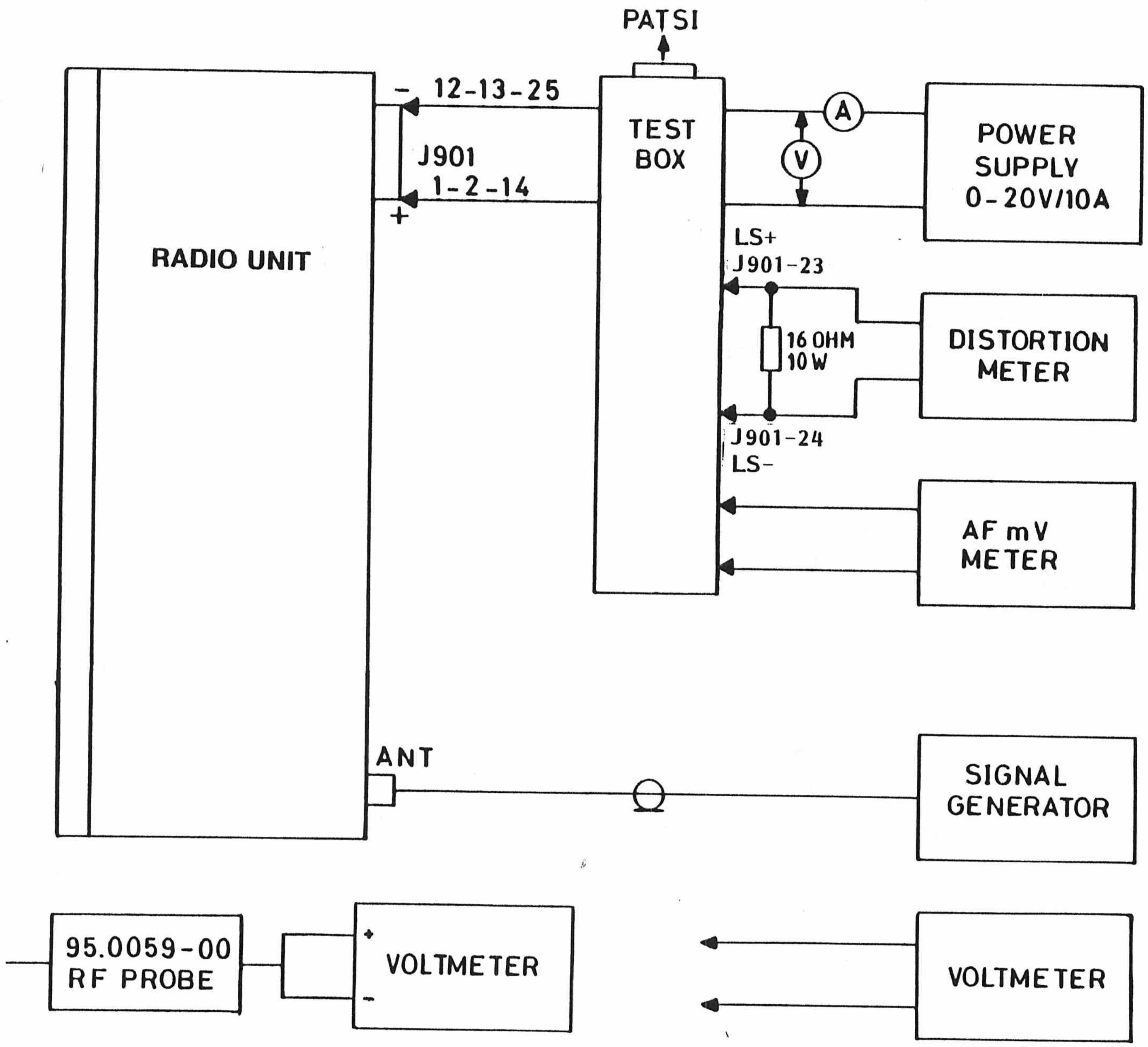
CHANNEL	RADIO	RX-FREQENCY	TX-FREQUENCY	POWER
11	611x	136.900	136.900	Full
12	611x	151.150	150.400	Full
13	611x	172.450	172.300	Full
14	611x	155.000	155.000	Redu.
31	633x	66.510	66.460	Full
32	633x	74.520	74.040	Full
33	633x	87.060	86.970	Full
34	633x	77.000	77.000	Redu.
61	666x	404.600	404.700	Full
62	666x	430.200	430.700	Full
63	666x	467.300	467.400	Full
64	666x	436.500	436.500	Redu.
71	677xL	174.900	174.900	Full
72	677xL	188.900	188.400	Full
73	677xL	208.600	208.600	Full
74	677xL	192.000	192.000	Redu.
75	677xH	190.900	190.900	Full
76	677xH	204.560	204.300	Full
77	677xH	223.650	223.600	Full
78	677xH	207.500	207.500	Redu.

TON	ZVEI I
Enc ( )	(1A, 2A, 3A, 4A, 5A)
SNC (S)	(1,) DUR 2.5 sec.
DEC	(1, 2, 3, 4, 5) ACK = DEC

QUEUE for 5 sec. + "2718" = Servicemode.

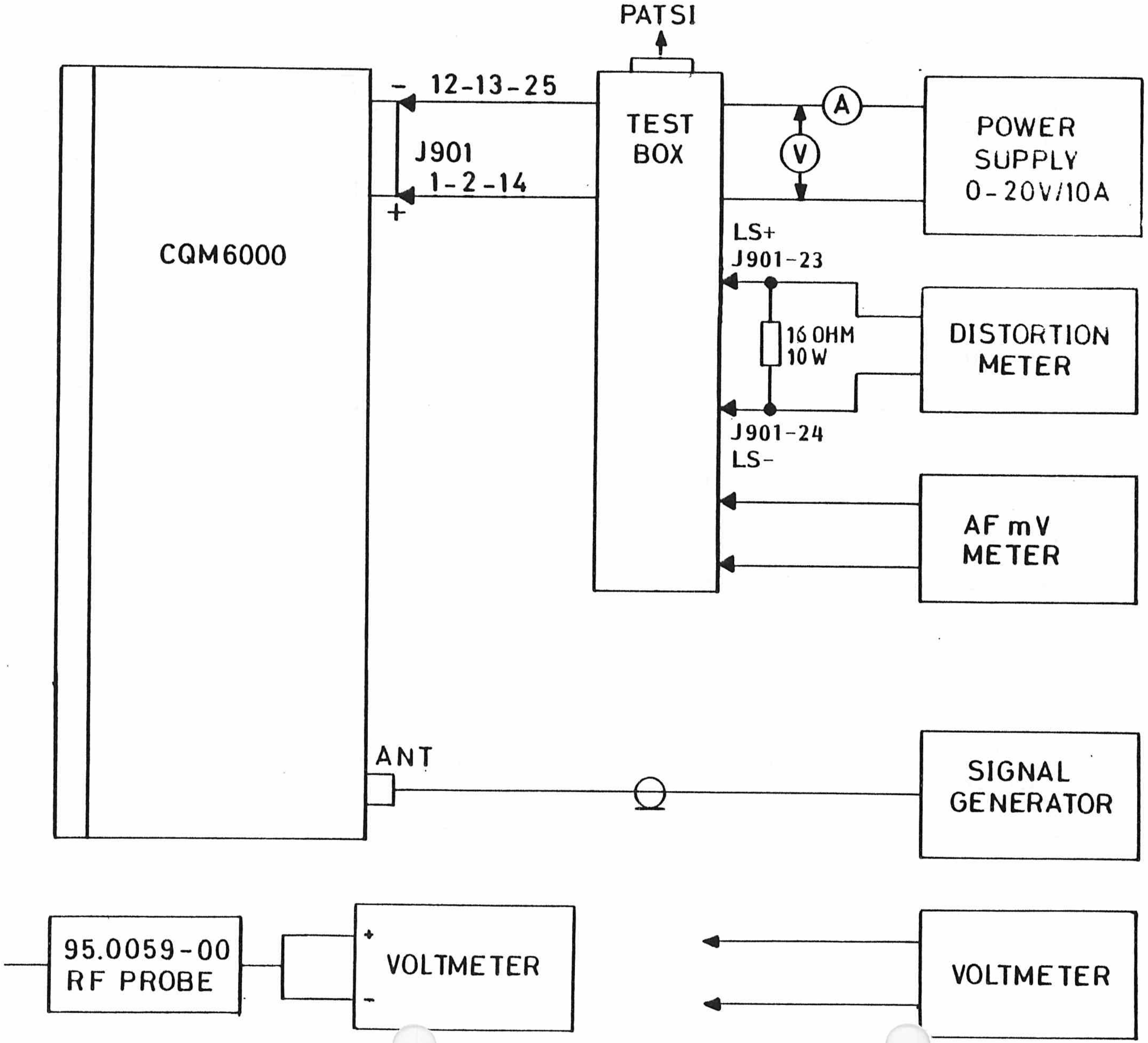
"730" = Write in EE PROM

"720" = Read in EE PROM



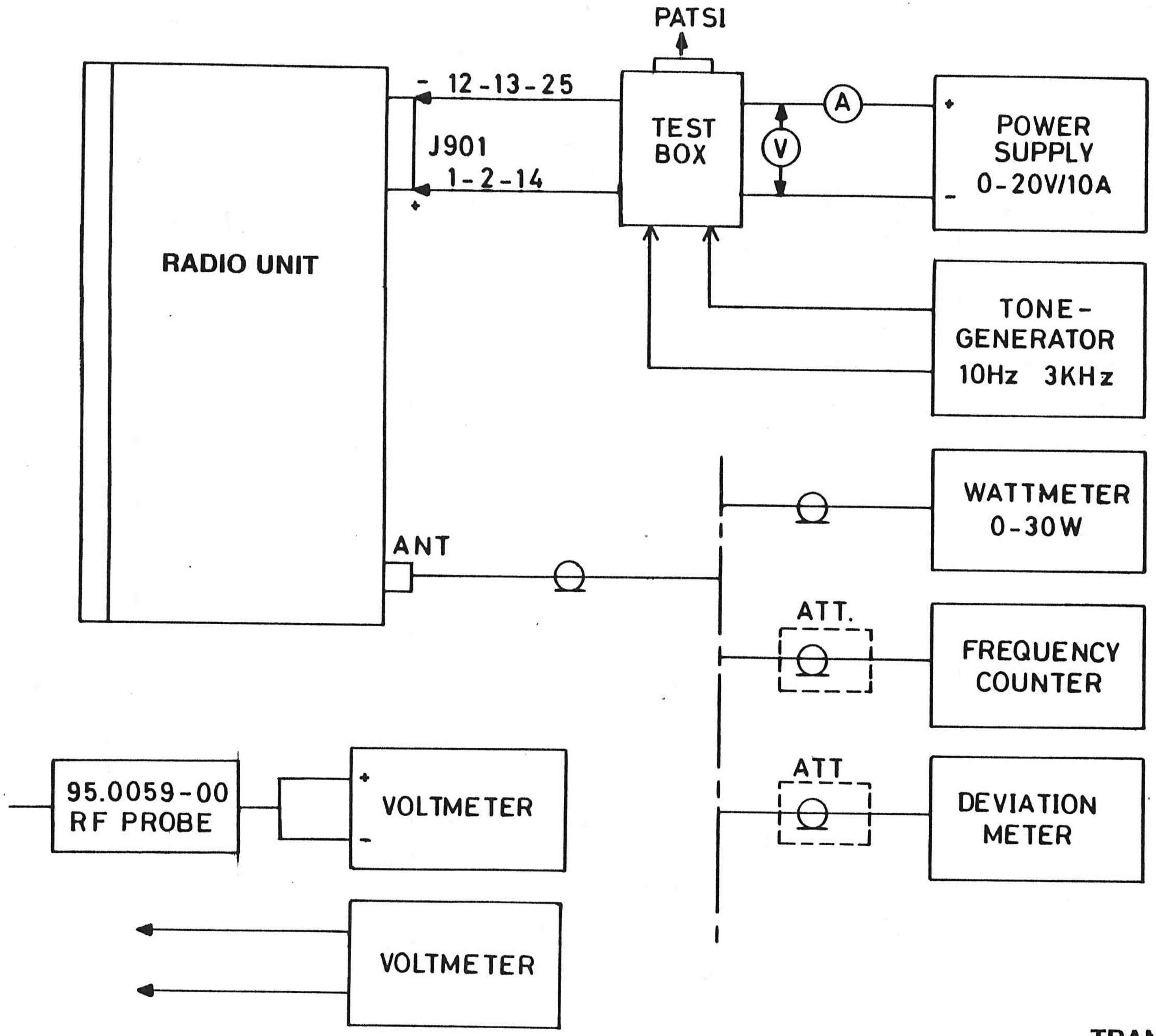
RECEIVER TEST SETUP

D404.345/3



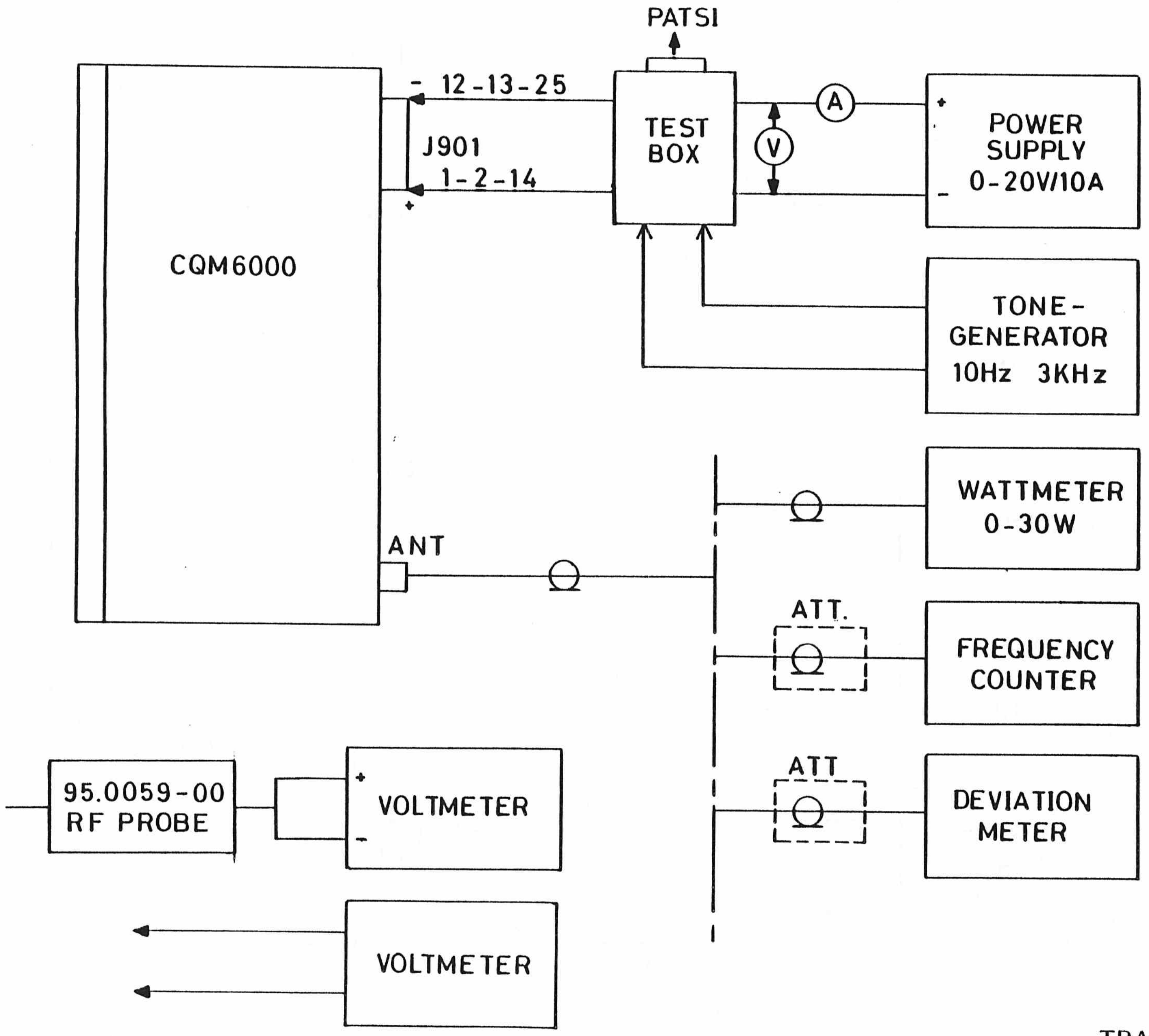
STORNOPHONE 6000
RECEIVER TEST SETUP

D404 5/2



TRANSMITTER TEST SETUP

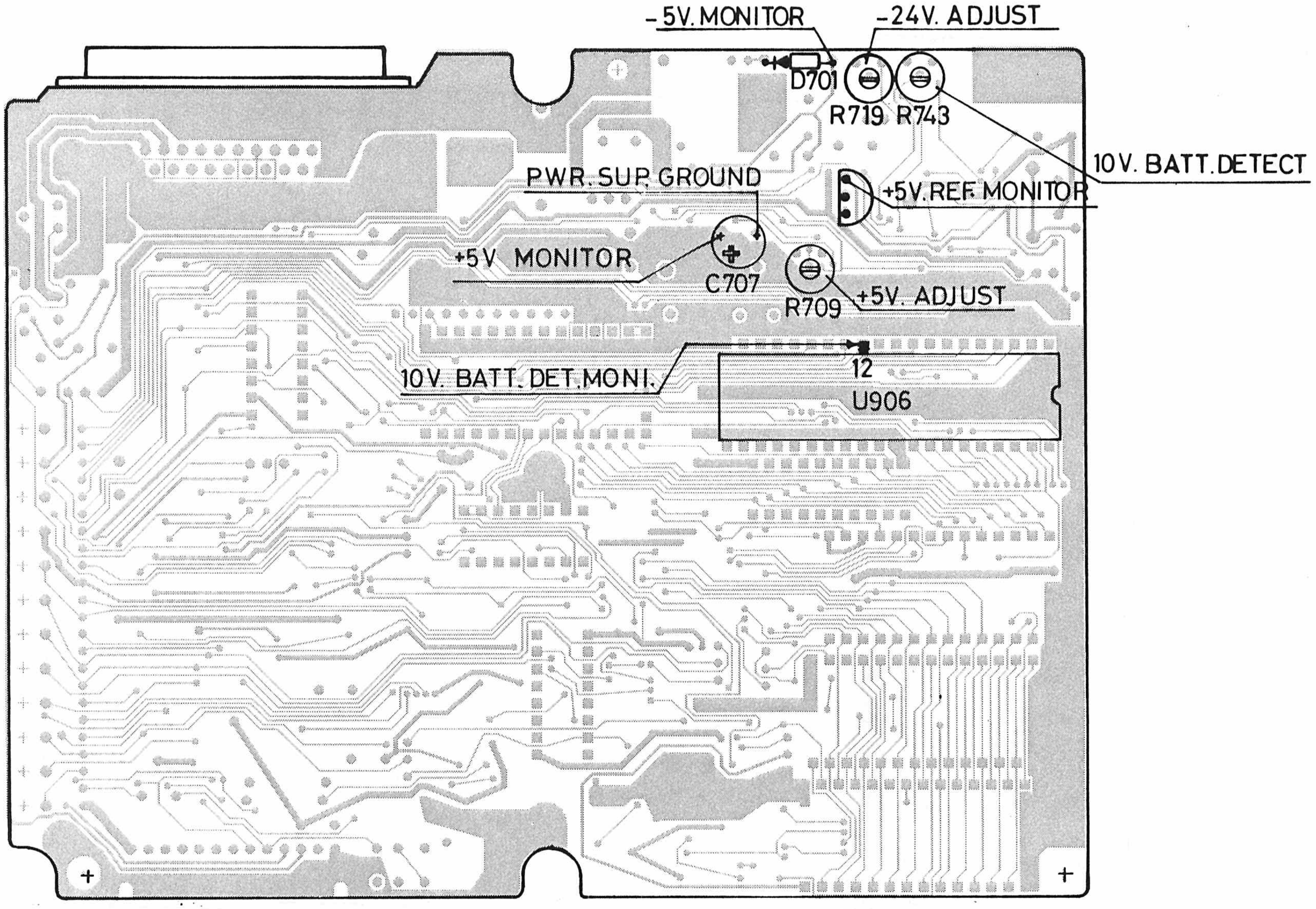
D404.344/3



STORNOPHONE 6000

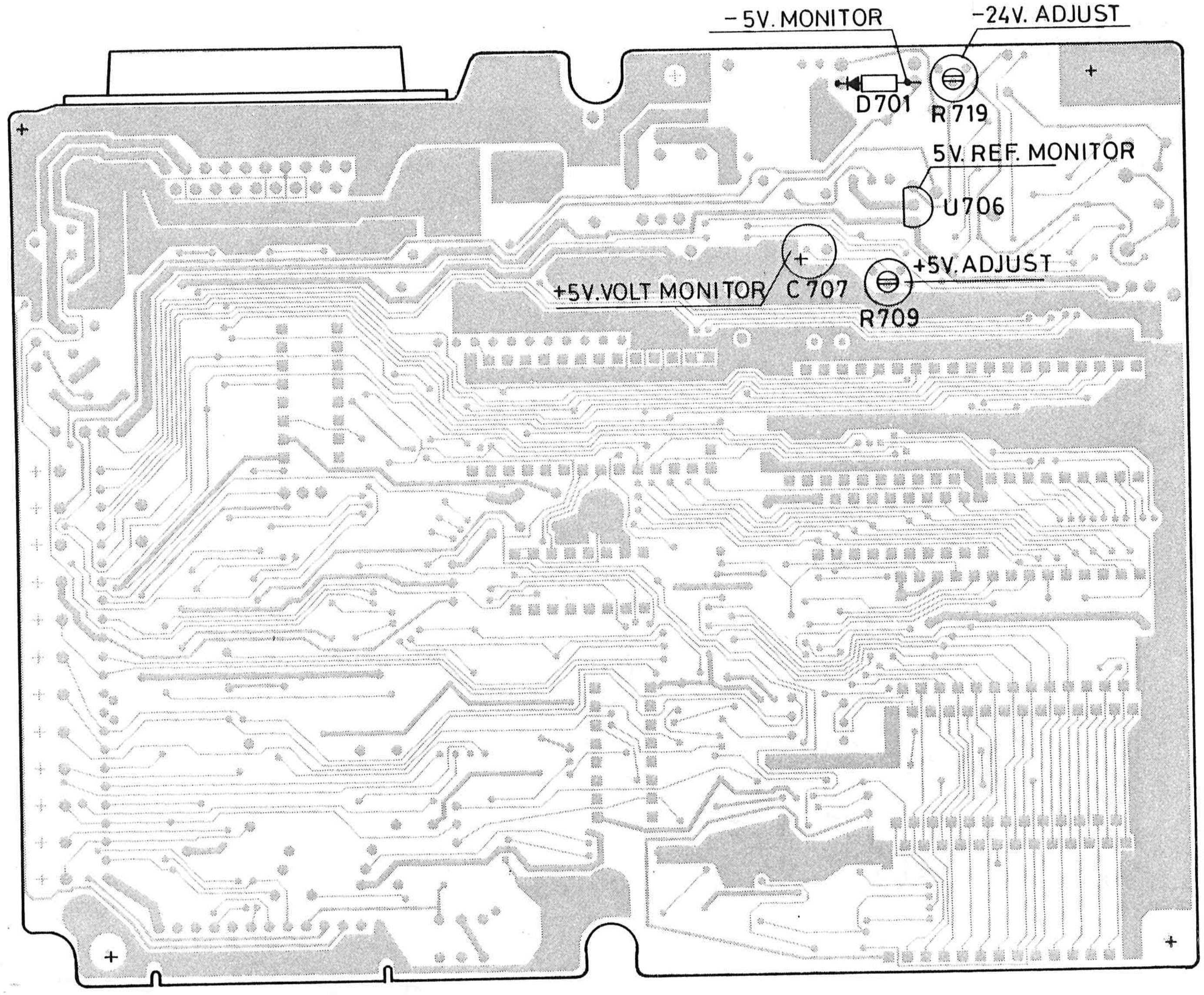
TRANSMITTER TEST SETUP

D40 44/2



ADJUSTABLE COMPONENTS & TEST POINTS
COMMON FUNCTION BOARD CF6001
PWB REV.4

M405.254/4



ADJUSTABLE COMPONENTS AND TEST POINTS
COMMON FUNCTION BOARD CF6001
PWB REV. 3 M405 254/3

SERVICE MODE

CQM6xxx

The Stornophone 6000 has an inherent service mode which can be involved with a jumper on the rear connector or by using SE6001 (PATSI).

The service mode has facilities for:

- Channel select
- Volume select
- Tone signalling select
- Memory read/programming of the EE prom if installed.

These functions are called by entering a 3-digit code for the wanted function. Some functions also require that parameters and data are entered.

Channel Select (1xx)

The channel select mode is function group 1 and the syntax is:

1 + channel group (0-3).
100= clear channel select mode

Volume Select (4xx)

The volume select mode is function group 4 and the syntax is:

4 + 1 volume level
400= clear volume select mode

Tone Signalling Select (5xx)

The tone signalling select mode is group 5 and the codes are:

Code	Parameter	Description
521	None	Enable decoding
522	System	Select decoder system
523	Digits	Number of digits in decoder
531	None	Send telegram
532	System	Select encoder system
533	Digits	Select number of digits in encoder
534	Telegram	Tone telegram for encoder
500		Clear tone signalling

Programming Mode (7xx)

The programming mode is used to display the contents of the different memory devices in the radio and provided that an EE-Prom is used also to program personality data. However, due to the complexity of the data structure in the personality prom care must be taken not to alter data which may be dependent on other data or pointers in the system. It must also be stressed that data can be overwritten only if they match the available space exactly. It is f.ex. not possible to change the number of tones in the encoder to a new value without upsetting the data flow in the radio.

The syntax of the programming mode is:

Function code + address + (data, data, data - - -)

Code	Paramerer(s)	Description
710	Address	Read Program memory Address 00_H - $BFFF_H$
720	Address	Read personality prom Address C000 - C7FF
730	Address + data	Write to personality prom
700		Clear programming

Addresses and data are entered in decimal form and corresponding to Hexadecimal as follows:

ENTER	HEX
0 + 0 (00)	0
0 + 1 01	1
0 + 2 02	2
0 + 3 03	3
0 + 4 04	4
0 + 5 05	5
0 + 6 06	6
0 + 7 07	7
0 + 8 08	8
0 + 9 09	9
1 + 0 10	A
1 + 1 11	B
1 + 2 12	C
1 + 3 13	D
1 + 4 14	E
1 + 5 15	F

Any other key entry is not valid and ignored with an error tone being emitted

Any sequence requiring data entry is terminated by pressing $\boxed{*}$.

Example

Display the contents of the personality prom at address: C304

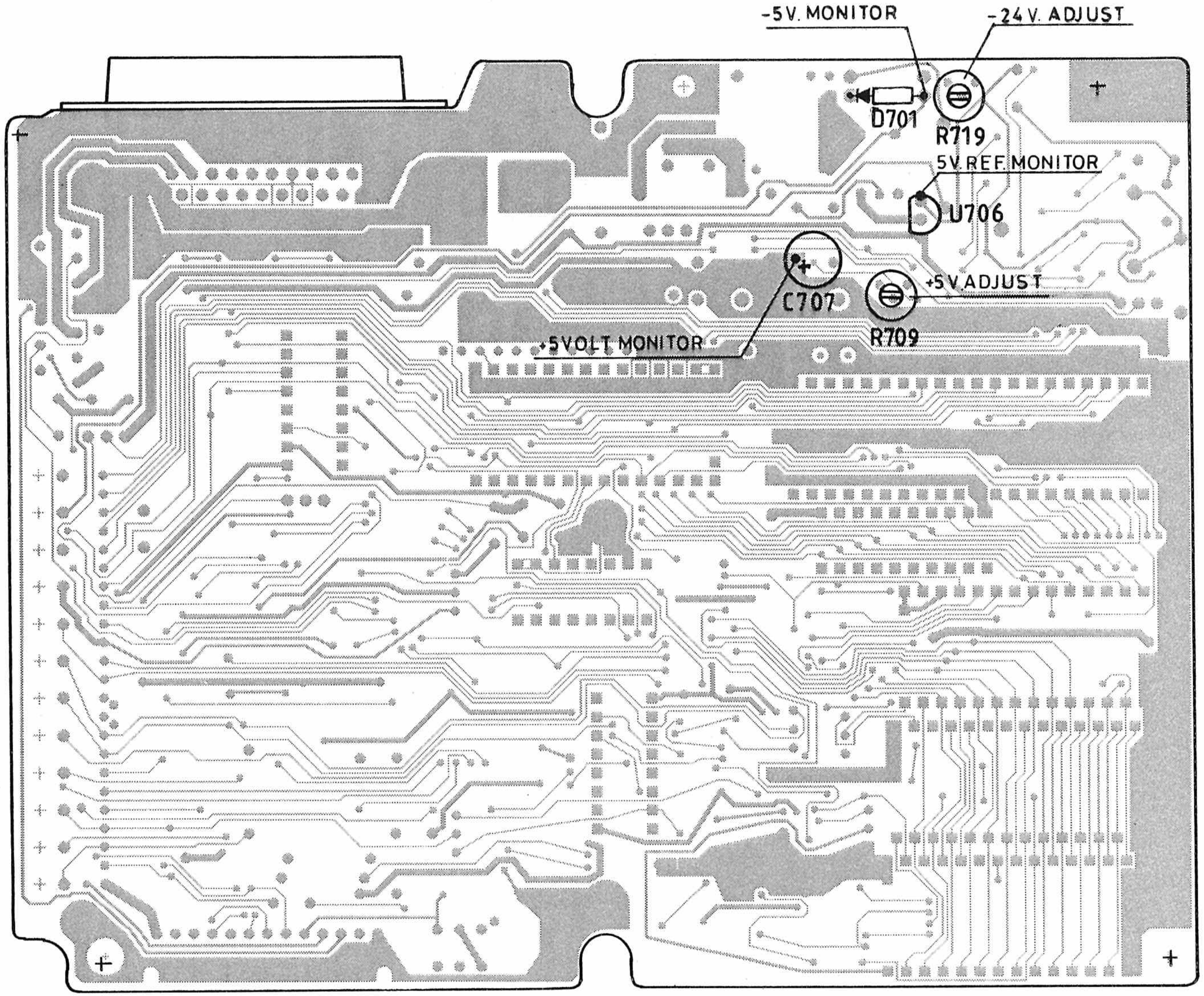
ENTER	DISPLAY
720	720 A =
12	720 A = C
03	720 A = C3
00	720 A = C30
04	720 A = C304 D = 39

Pressing numeric key (1-9) steps the address forward corresponding to the pressed key.

01	720 A = C305 D = C7
04	720 A = C309 D = 35

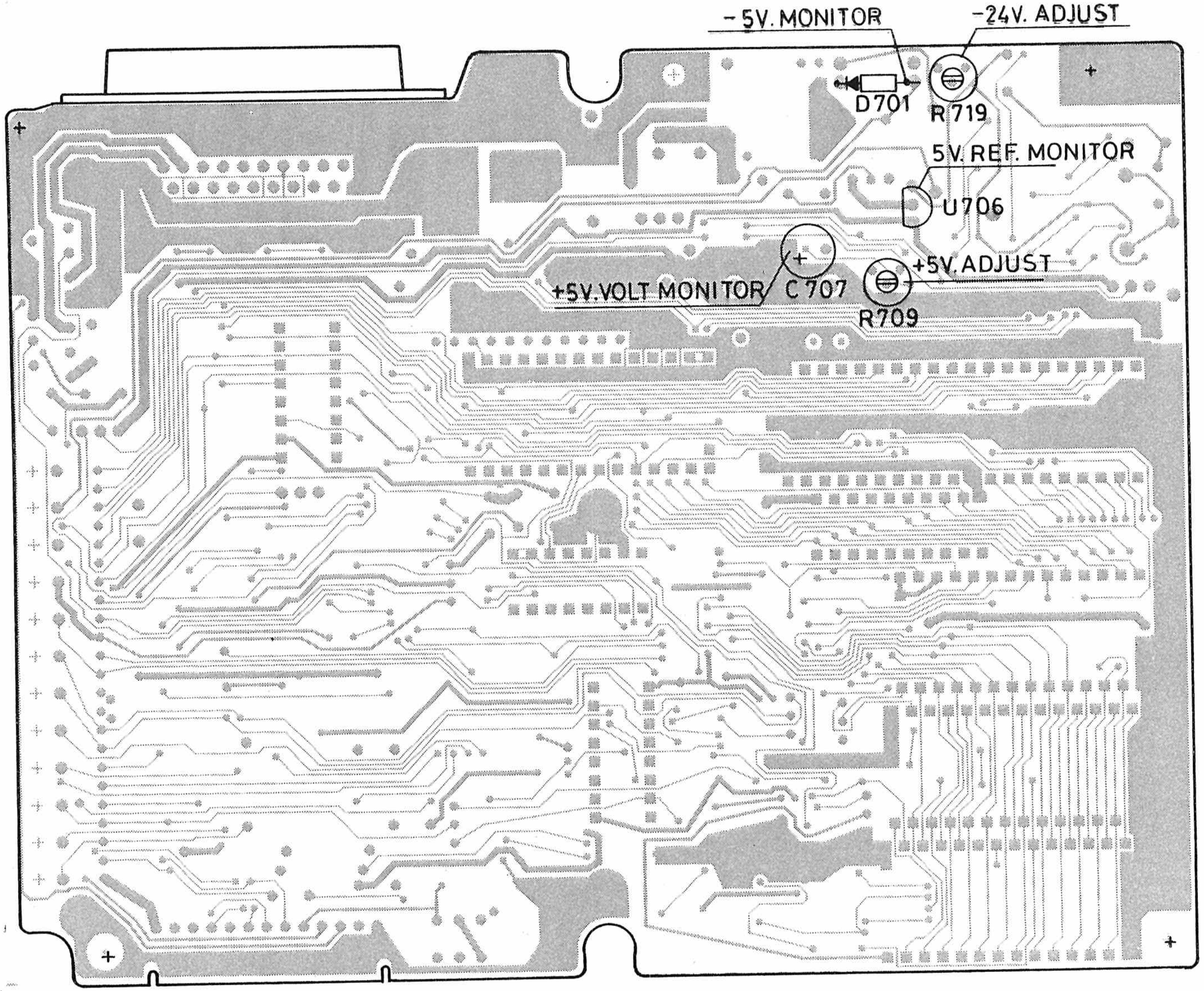
The 000 Code

At any time when in service mode entering 0-0-0 causes the radio to revert to the initial state of service mode. (CLEAR ALL)

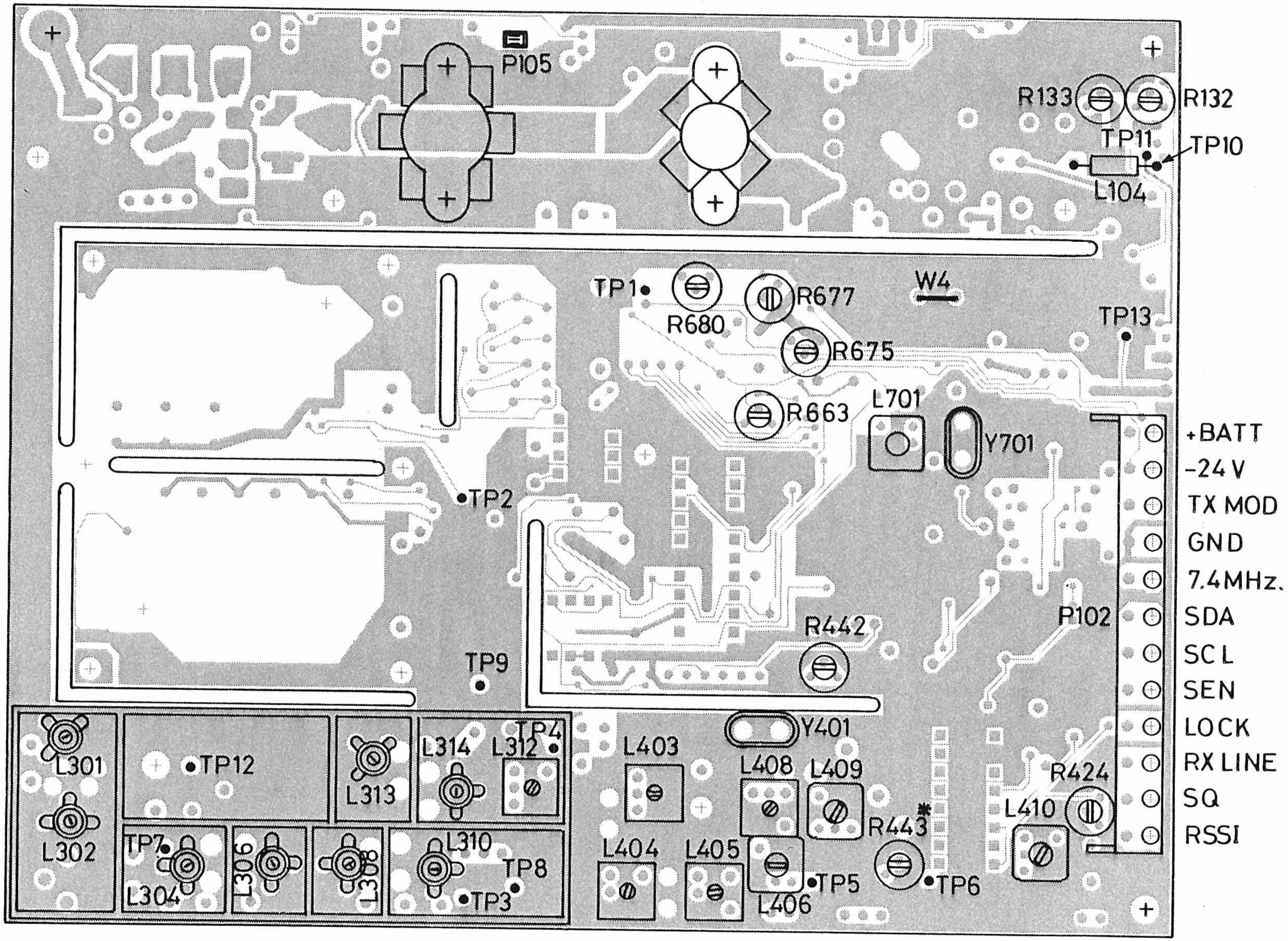


ADJUSTABLE COMPONENTS AND TEST POINTS
COMMON FUNCTION BOARD CF6001

PWB REV. 2



ADJUSTABLE COMPONENTS AND TEST POINTS
COMMON FUNCTION BOARD CF6001
PWB REV. 3



✱ ONLY FOR RSSI

ADJUSTABLE COMPONENTS AND TEST POINTS
RF BOARD 6110 L

CHAPTER 3

SOFTWARE

SOFTWARE

EF SOFTWARE

INFORMATION

The new EF SOFTWARE for programming the CQM6000 module station is not described in this manual.

All information concerning the EF SOFTWARE PROGRAMMING is contained in the Field Programmer 6000, Publications no. 8311.6006-00, which can be ordered together with the programming disk by licence at:

STORNO A/S
Publications Services - 1443
Midtager 20
DK-2605 Brøndby

The Field Programmer manual is automatically updated.

FEATURES

FEATURES

CQM6xxx

- 99 CHANNELS

  Up to 15 channels with related channel guard encoder and for decoder.

  Power reduction facility on all channels

- DISPLAY CONFIGURATION

Channel field	0-99 channels
Address field	0-7 digits
Status field	0-2 digits

- TONE SIGNALLING

ZVEI 1, 2, 3 CCIR, EEA, VDEW	Sequential
ZVEI, EEA	Binary

- GROUP CALL/ALL CALL
- TWO ENCODER TELEGRAMS (ENC, SNC)
- TWO DECODER TELEGRAMS (DEC, ADE)
- THREE TONE FORMATS
- PRIVACY
- MIXED TONE SYSTEMS
- IDENTIFICATION
- ACKNOWLEDGE
- TIMER OFF (1-42 h)
- ON/OFF DISABLE
- VOLUME SPECIFICATION

SOFTWARE SPECIFICATION

STORNOPHONE 6000

SOFTWARE SPECIFICATION

The Stornophone 6000 software consists of a fixed program stored in a 64 kB ROM and the personality data stored in a 2 kB EE prom or E prom.

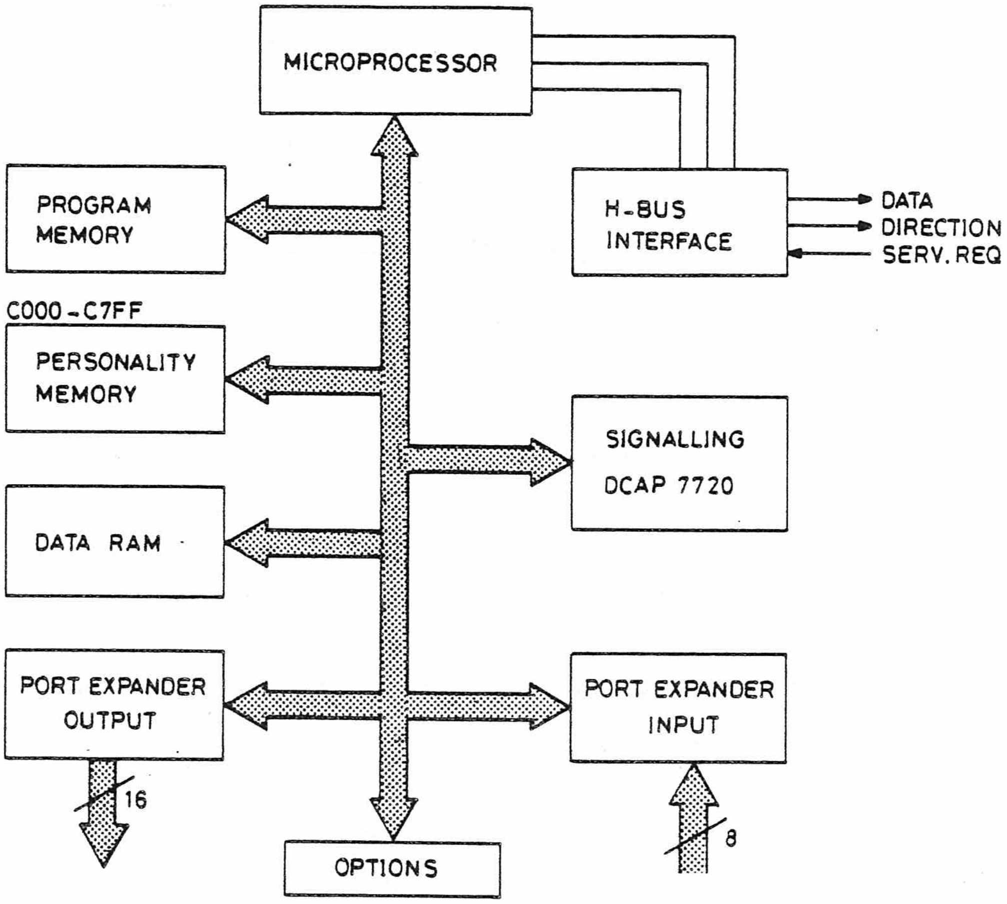
The address range for the memory is 0000_H-CFFF.

The personality data is specified by stating the values for the wanted functions and subfunctions.

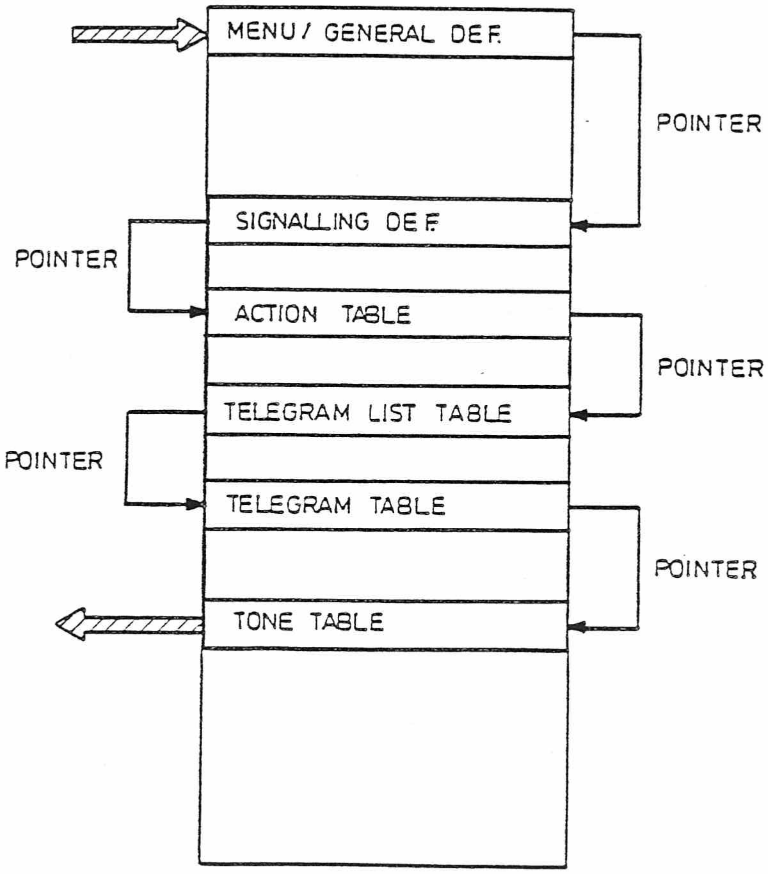
A function is an identifier that states that a specific software facility is wanted and in some cases there are several values to choose from. When a function has been selected as wanted it is often possible to further specify subfunctions which in details describe exactly how the main function is going to operate.

The personality data can only be calculated and stored in the EE prom or the E prom by mean of a computer and in the case of an E prom a programming equipment.

The personality data specification for the sales package is explained in the following chapters but to fully understand the complex structure of the personality data calculation a brief description is given.



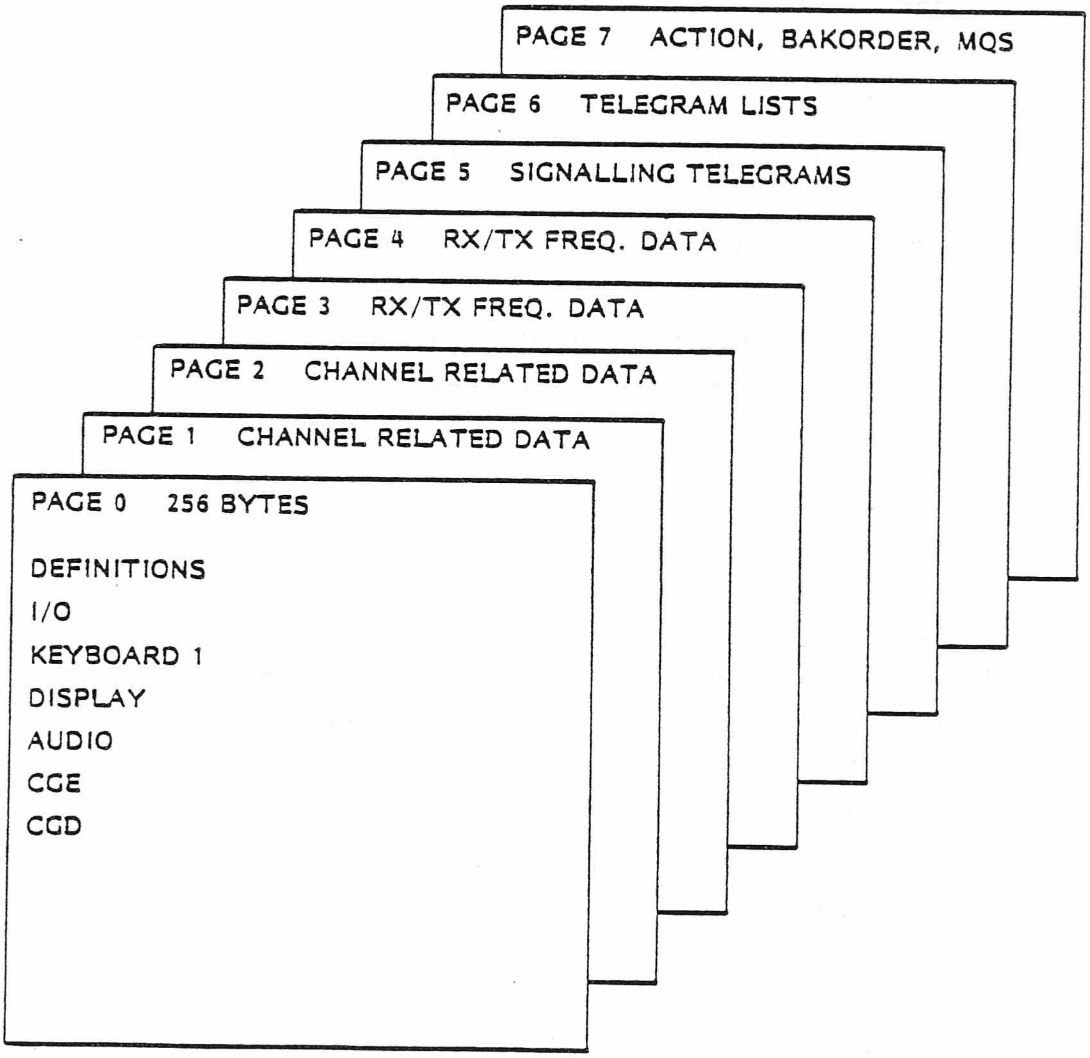
LOGIC CIRCUITS BLOCK DIAGRAM



BASIC ENTRY-PRINCIPLE TO PPROM

The personality prom is organized as 8 pages each consisting of 256 bytes.

Page 0 = Radio environment definition
Page 1 =
Page 2 = RF channel data and channel related data
Page 3 =
Page 4 =
Page 5 = Tone signalling telegrams
Page 6 = Tone telegram lists
Page 7 = Action descriptors, Bak orders, identity, Manufacturing/Service data.



STORNOPHONE 6000 PERSONALITY PROM

Page 0 at the top has pointers to the areas where the different parts of the personality data are located and then again on the specific page are new pointers to data tables, action tables, frequency tables etc..

Each list of data can be either of fixed length or a byte at the beginning may specify the length of the data table.

The Personality data program for the M24 Olivetti PC stricktly follows the software nomenclature as specified by the marketing organisation and data should be entered exactly as described. However, in order to ease programming and data calculation some extra prompts request the operator to answer questions such as f.ex. whether there are tone signalling or not. If a function is not used the remaining part and its subfunctions are skipped.

The personality data program is linked to either a data I/O programming equipment or preferably a SE6001 (PATSI) with Prom programmer.

Also the operator must know the nomenclature of the radio and its options and also it is an advantage to know if one of the receiver frequencies are subject to selfquieting in which case the reference crystal should be changed to the alternative value. However, the Stornophone 6000 receiver only has a few frequencies for which this procedure must be used.

REPROGRAMMING

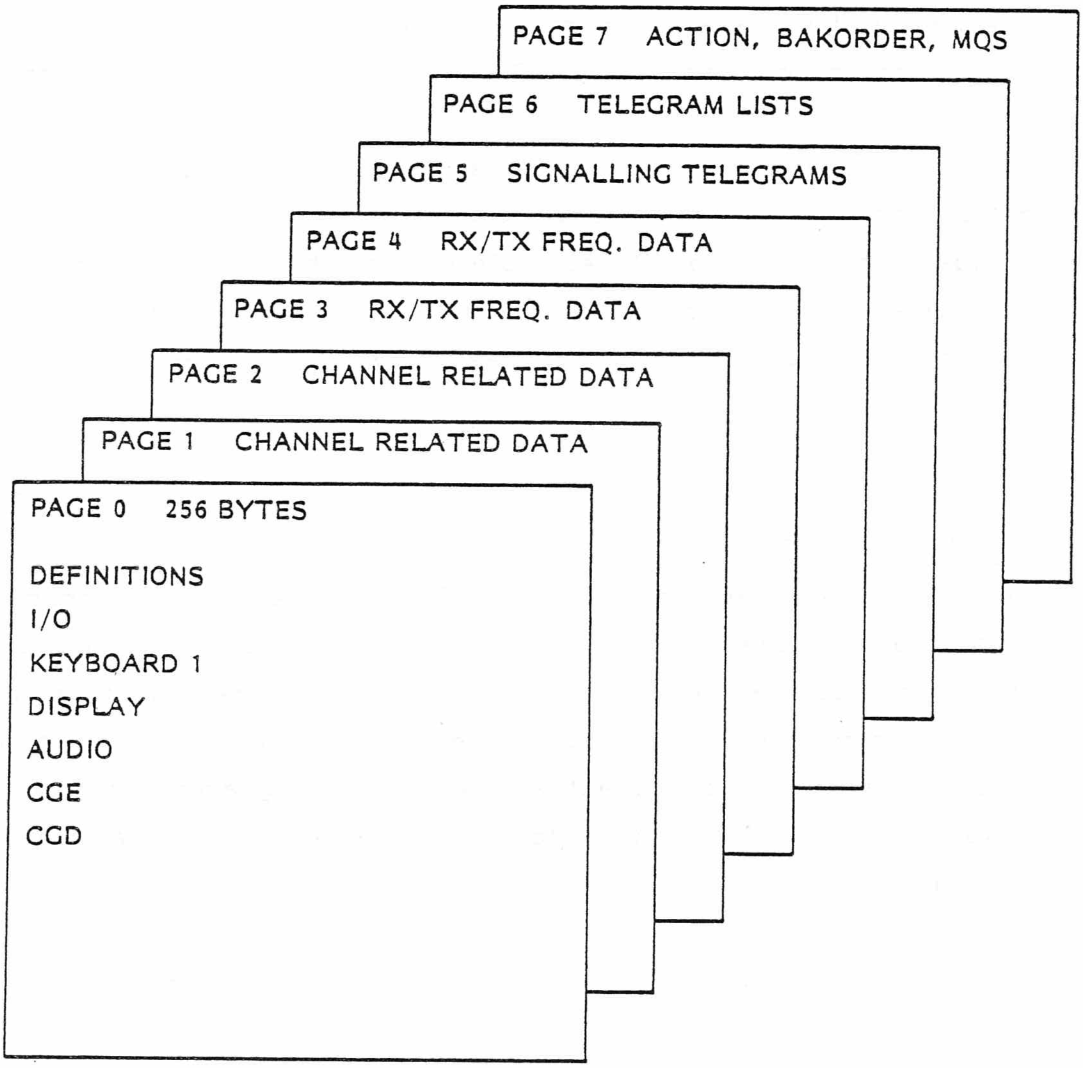
An already programmed radio with EE prom may be reprogrammed in service mode provided that only few specific parameters are subject to alteration and that the new data exactly has the same format as the old data. It requires, however that the operator has access to a print out of the prom and knows exactly how it was programmed and with which data. The procedure is then to calculate the new data and overwrite the old data.

In cases of radios with E proms the data may be loaded into a programmer and edited. Then a new prom can be programmed and inserted in the equipment.

Prom pages

In order to arrange the data in a logic form the personality prom has been divided into 8 pages, (each page is 256 bytes) which are used as follows:

Page 0 = Radio environment definition
Page 1 =
Page 2 =
Page 3 = Channel data
Page 4 =
Page 5 = Tone signalling telegrams
Page 6 = Tone telegram lists
Page 7 = Action descriptors/Bak orders/ ID and MFG



STORNOPHONE 6000 PERSONALITY PROM

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In cases of radios with E proms the data may be loaded into a programmer and edited. Then a new prom can be programmed and inserted in the equipment.

TONE SIGNALLING

The Stornophone 6000 Software supports all tone signalling systems including channel guard and Binary Signalling.

If a default tone system is specified all telegrams for which another system is not specified will refer to the default system. If required up to three different tone formats can be specified each with its own specification and used indiscriminately with all specified systems. Tone encoder telegrams can be specified to be followed by new telegrams either in the same format or in a different format. This makes it possible to construct very complex tone systems which use different lengths of telegrams, use variable tones entered as address and or status from the keyboard and display.

As an example it is possible to have the ENCODER refering to ZVEI1 system as default with two fixed and three variable tones for address and then specify the ENCODER to be followed by a second telegram format with 7 tones in the CCIR system. The two telegrams may be either linked together or separated as two independent telegrams.

Normally one encoder telegram is assigned to the button and, if used, a second encoder telegram is assigned to the button.

CHAPTER 3c
SOFTWARE/SUB

SOFTWARE NOMENCLATURE

STORNO
PHONE
6000

CQM6000 OPUS

Rev. March 13. 1986

TERM IDENTIFIER		TERM	ASSIGNMENT VALUE	DEFAULT VALUE	REMARKS
MAIN	SUB				
PAK		Sales package	OPUS		Requires radio unit structured option EC
ODA		On/Off key disable	0 = ON/OFF key disabled 1 = ON/OFF key enabled	1	If ODA=0, the radio will be ON if connected to a power supply.
	,TIO	Time off timer	N = No timer = 1 - 254 h in one hour steps.	10	Timer controlling automatic switch off counted from the instant the radio is turned on. Timer can be disabled while ignition key is ON by ordering the cable kit CC 6006.
RPL		Reduced power level	N=No 0.6 - 25 Watts	N	Minimum value is 10% of nominal power output. See Appendix 5
MIV		Min volume	0 - 8	0	Minimum loudspeaker volume Note that MIV = 0 does not turn the loudspeaker off.
MAV		Max volume	MIV - 8	8	Maximum loudspeaker volume.
ACA		Acoustic alert volume	0 - 8 N = None	4	Calling signal volume.
AFB		Acoustic feedback	Y = Yes N = No	Y	Keystroke accepted/rejected signal.

STORNO-
PHONE
6000

CQM6000 OPUS

Rev. March 13. 1986

The assignments in the subsequent frame must be corroborated once for each channel. A maximum of 99 channels are available. Each channel can be chosen as either one- or two-frequency simplex.

TERM IDENTIFIER		TERM	ASSIGNMENT VALUE	DEFAULT VALUE	REMARKS
MAIN	SUB				
CHF		Channel number	01 - 99/ 1 - 9	-	All channel numbers must be specified in the two-digit range from 01 to 99 or in the single digit range from 1 to 9.
	,TXF	Transmit frequency	frequency in MHz; up to 6 decimal digits.	-	Must correspond to frequency band stated in the radio unit hardware nomenclature.
	,RXF	Receive frequency	frequency in MHz; up to 6 decimal digits.	-	Must correspond to frequency band stated in the radio unit hardware nomenclature.
	,CGD	CTCSS decoder	67.0 - 210.7 (Hz) max. 1 decimal digit N = None	N	Requires radio unit structured option CD. Up to 15 different decoder frequencies can be assigned.
	,CGE	CTCSS encoder	67.0 - 210.7 (Hz) max. 1 decimal digit N = None	N	Up to 15 different encoder frequencies can be assigned.
	,PWR	Power reduction	N = No Y = Yes	N	If ,PWR = Y, the value assigned to RPL will apply to this channel.
	,CDI	Number of channel digits in display	1/2	2	For single-digit channel numbers, ,CDI = 1. For two-digit channel numbers, ,CDI = 2.
	,ADI	Number of address digits.	0 - 7	5	,ADI = 0 deletes the address field in the display. The number of address digits to appear on the display must be equal to the number of referenced digits in the address.
	,SDI	Number of status digits	0/1/2	2	,SDI = 0 deletes the status field in the display. If single status digit, ,SDI = 1. For two status digits, ,SDI = 2.

STORNO
PHONE
6000

CQM6000 OPUS

Rev. March 13. 1986

TERM IDENTIFIER MAIN	SUB	TERM	ASSIGNMENT VALUE	DEFAULT VALUE	REMARKS
PRI		Privacy	N = No / Y = Yes	N	PRI = Y disables the 🔈 button.
	,BDT	Break down time	N=No automatic switch off/ 0 - 254 sec in one sec steps.	3	Time from carrier disappearance to automatic LS switch off.
	,MAT	Monitoring after telegram transmission	N = No / Y = Yes	Y	If ,MAT = N, then operating either the PTT-device, pressing the ♪ button, or pressing the ᗩ button will close the loudspeaker upon telegram transmission.
	,MAC	Monitoring after channel shift	N = No / Y = Yes	N	If ,MAC = N, the loudspeaker will close when a new channel is selected.
PTA		Push to talk admit	N = PTT totally blocked 0 = LS open or channel free 1 = Channel free 2 = LS open 3 = No limitation	0	Transmission rule to be associated with the PTT-device. If PTA = 1 , the channel must be free prior to transmission whenever the PTT-device is pushed.
TKA		Tone key admit	N = Tone key totally blocked 0 = LS open or channel free 1 = Channel free 2 = LS open 3 = No limitation	0	Transmission rule to be associated with the ♪ button. If TKA = 1 , the channel must be free prior to transmission whenever the ♪ button is pressed.
SKA		Second tone key admit.	N = Tone key totally blocked 0 = LS open or channel free 1 = Channel free 2 = LS open 3 = No limitation	0	Transmission rule to be associated with the ᗩ button. If SKA = 1 , the channel must be free prior to transmission whenever the ᗩ button is pressed.
CCT		Carrier control timer	N = No timer/ 1 - 254 sec in one sec steps	N	Maximum duration of each transmission period. Prior to timeout, a warning signal will be issued.

CQM6000 OPUS

Rev. March 13. 1986

The assignments in the subsequent frame will constitute the default values for all telegrams.

TERM IDENTIFIER		TERM	ASSIGNMENT VALUE	DEFAULT VALUE	REMARKS
MAIN	SUB				
TON		Tone system	ZV1/ZV2/ZV3/CCI/ VDE/EEA/BZV/BEE/ N=No tone system	N	For an elaborate account of signalling systems, see Appendices. Seq. tone systems: Appendix 1 Binary ZVEI: Appendix 2 Binary EEA: Appendix 3 Mixed systems: Appendix 4
	,BAS	Base station	N = No / Y = Yes	N	This piece of information is only meaningful if TON = BZV. For details, see Appendix 2.
	,PRE	Preamble time	For sequential tone systems: 10 - 2540 msec in 10 msec steps/ S = Standard N = No preamble time For binary systems: see Appendix 2 and 3. S = Standard	S	Standard as defined by the tone system. For details, see Appendix 1, 2 or 3
	,DUR	Duration	10 - 2540 mSec in 10 mSec increments./ S = Standard	S	Only defined in sequential tone systems. Standard as defined by the tone system. For details, see Appendix 1.
GRP		Group digit	Digit according to tone table / N = Nil	N	Digit used for identification of group calls. For valid digits see Appendix 1, 2 and 3.
	,POS	Position of group call digit	If sequential tone system: any combination of one or more of the positions: 1 2 3 4 5 6 7 /N = All positions If TON = BZV: position 6/7/8 If TON = BEE: position 3/4/5	N	An elaborate account of group calls can be found in Appendix 1, Appendix 2, and Appendix 3.
	,BDT	Break down time	N = No break down timer/ 0 - 254 sec in one sec steps.	3	Time from carrier disappeareance to loudspeaker switch off.

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TERM IDENTIFIER MAIN	SUB	TERM	ASSIGNMENT VALUE	DEFAULT VALUE	REMARKS
ENC		Encoder	If sequential tone system: see Appendix 1 If TON = BZV: see Appendix 2 If TON = BEE: see Appendix 3 / N = None	N	Telegram transmitted when pressing the ♪ button provided that the criterion as assigned to TKA is satisfied. Following telegrams are optional, see the appendices.
SNC		Second encoder	If sequential tone system: see Appendix 1 If TON = BZV: see Appendix 2 If TON = BEE: see Appendix 3 / N = None	N	Telegram transmitted when pressing the ⊓ button provided that the admit criterion as assigned to SKA is satisfied. Following telegrams are optional, see the appendices.
TOF		Transmission on first PTT	If sequential tone system: see Appendix 1 If TON = BZV: see Appendix 2 If TON = BEE: see Appendix 3 / N = None	N	Telegram transmitted at the first push of the PTT device provided that the admit criterion as assigned to PTA is satisfied. Following telegrams are optional, see the appendices. If a telegram is assigned to TOF then TOE = N
TOE		Transmission on every PTT	If sequential tone system: see Appendix 1 If TON = BZV: see Appendix 2 If TON = BEE: see Appendix 3 / N = None	N	Telegram transmitted at every push of the PTT device. Following telegrams are optional, see the appendices. If a telegram is assigned to TOE, then TOF = N
	,IDT	Identification	1 to 254 sec in 1 sec step / N = No identification	N	The identification timer causes the telegram(s) assigned to TOE to be transmitted at regular intervals when the PTT device is kept depressed.

CQM6000 OPUS

Rev. March 13. 1986

TERM IDENTIFIER MAIN SUB	TERM	ASSIGNMENT VALUE	DEFAULT VALUE	REMARKS
AC1	Acknowledge for DEC	If sequential tone system: see Appendix 1 If TON = BZV: see Appendix 2 If TON = BEE: see Appendix 3 / N = None	N	Transmitted when decoding the DEC telegram. Following telegrams are optional, see the appendices.
STF	Second telegram format	If sequential tone system: see Appendix 1 If TON = BZV see Appendix 2 If TON = BEE see Appendix 3 / N = None	N	Auxiliary telegram, must always be preceded by a functional telegram.
TTF	Third telegram format	If sequential tone system: see Appendix 1 If TON = BZV see Appendix 2 If TON = BEE see Appendix 3 / N = None	N	Auxiliary telegram, must always be preceded by a functional telegram.
DEC	Decoder	If sequential tone system: see Appendix 1 If TON = BZV see Appendix 2 If TON = BEE see Appendix 3 / N = None	N	

CQM6000 OPUS

Rev. March 13. 1986

TERM IDENTIFIER MAIN	SUB	TERM	ASSIGNMENT VALUE	DEFAULT VALUE	REMARKS
ADE		Acknowledge decoder	If sequential tone system: see Appendix 1 If TON = BZV see Appendix 2 If TON = BEE see Appendix 3 / N = None	N	Acknowledge decoder for ENC, SNC, TOF, TOE.
	,ACE	Acknowledge expected	Any combination of one or more of the digits 1 2 4 5 where 1 = On ENC 2 = On SNC 4 = On TOF 5 = On TOE / N = None	N	If an acknowledge telegram is assigned to ADE, the assignment made here specifies on which actions the acknowledge telegram is to be expected. ENC: pressing the ♪ button SNC: pressing the ⊓ button TOF: first push of the PTT-device TOE: every push of the PTT-device
	,REP	Repetitions	0 - 15	0	Number of retry's if no acceptable acknowledge is received.
	,RTI	Repetition time	0 - 25.4 sec in 0.1 sec increments	1	Time before retry. Repetition time must at least be PRE + DUR + telegramlength

CHAPTER 3d
SOFTWARE/SUB

SEQUENTIAL TONE SYSTEMS

APPENDIX 1

SEQUENTIAL TONE SYSTEMS

The circuitry which takes care of sequential tone signalling is an integrated part of the Stornophone 6000. Accordingly, no supplementary hardware modules have to be ordered, and all information concerning the signalling set-up can be stated using the software nomenclature.
In the following we will demonstrate how to apply the software nomenclature when specifying the signalling set-up of the radio.

Assignment of Tone System

In the Stornophone 6000, six different tone systems are available:

TON = ZV1: ZVEI1 Recommendation
TON = ZV2: ZVEI2 Recommendation
TON = ZV3: ZVEI3 Recommendation
TON = CCI: CCIR Recommendation
TON = EEA: EEA Recommendation
TON = VDE: VDEW Recommendation

In the table at the end of this appendix you will find the tone specifications for the systems mentioned above.

Preamble Time

The preamble time ("Wake-up time") is the duration of the period from the instant the transmitter is activated to the moment the tone telegram is transmitted, see fig. A1-1 below.

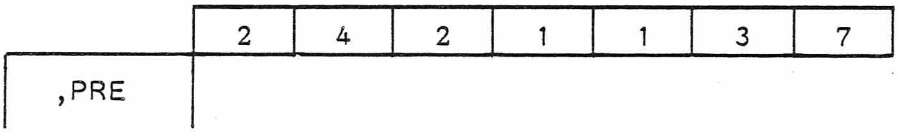


fig. A1-1

The preamble time is assigned by writing

,PRE = (value in milliseconds)

e.g. ,PRE = 300. If no value is assigned, the preamble time assumes the default value as specified in the assigned tone system, see table 1.

Duration

Duration is the duration of the first tone in the telegram.

1. All tones of equal duration:

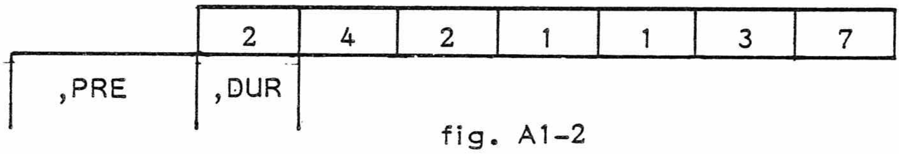


fig. A1-2

2. First tone of longer duration:

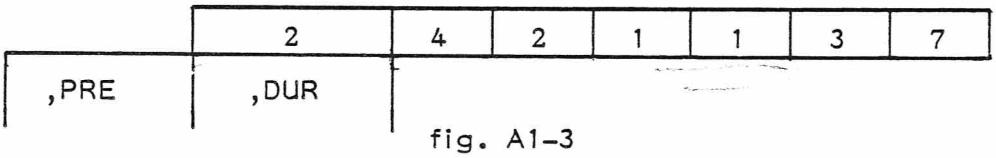


fig. A1-3

3. First tone of shorter duration:

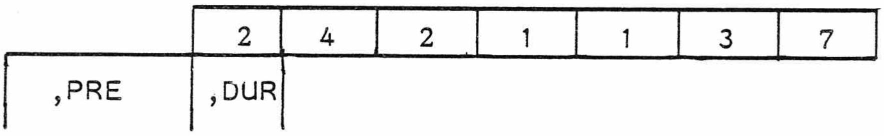


fig. A1-4

The duration of the first tone is assigned by writing ,DUR = (value in milliseconds) for instance, ,DUR = 200.
If no value is assigned, the duration of the first tone will be equal to the duration of the remaining tones of the telegram.

Telegram Size

All telegrams can contain up to 7 positions. If a single telegram cannot accomodate the requested information, you can append extra telegrams as described in "Auxiliary Telegrams", this appendix.

Telegram Specification

A telegram can either be assigned:

a) a string of telegram positions, separated by ".", where each position is occupied by either a fixed digit, (0/1/2/3/4/5/6/7/8/9/A/B/C/D) or a reference to a digit, (1A/2A/3A/4A/5A/6A/7A/1S/2S) in the display, see fig. A1-5.

b) by reference to another telegram.

Examples:

ENC = 1.5.7.1A.2A

AC1 = DEC

Referenced Digits

A referenced digit is a digit in the display. The references indicate the positions in the display as shown in fig. A1-5 below.

C	▨	▨		A	3	4	5	6	7	8	9		S	0	9	
					1A	2A	3A	4A	5A	6A	7A			1S	2S	Reference

fig. A1-5

Note that the two digits in the positions next to the "C" cannot be referenced.

Writing

ENC = 4.6.1A.8.2A

will instruct the radio to transmit the telegram corresponding to the string 4.6.3.8.4 when pressing the ♪ button if the display is as shown in fig. A1-5 at the instant of transmission.

Telegram Types

The OPUS Sales Package contains nine telegrams which fall into three categories:

- Functional telegrams
- Decoder telegrams
- Auxiliary telegrams

Functional Telegrams

A functional telegram is transmitted upon some action. The OPUS Sales Package comprises five such telegrams:

TELEGRAM	ACTION		
ENC	Pressing the	♪	button
SNC	Pressing the	A	button
TOF	Pressing the	ϟ	device; loudspeaker closed
TOE	Pressing the	ϟ	device
AC1	Decoding DEC		

Decoder Telegrams

A decoder telegram is a telegram which can be decoded ("understood") by the radio. The OPUS Sales Package comprises two decoder telegrams, DEC and ADE.

The DEC is the radio's identity in the system; i.e. the "telephone number" of the radio as seen from the system's point of view (Not necessarily from the user's point of view).

ADE is a decoder which becomes alive upon transmitting a telegram requesting an acknowledgement. If an acknowledgement is not received within the time limit assigned to ,RTI, the requesting telegram will be retransmitted. This cycle will repeat itself until either an acknowledgement is received or the number of cycles becomes equal to the value assigned to ,REP.

Auxiliary Telegrams

Auxiliary telegrams are telegrams which can be appended to a functional telegram. Note that auxiliary telegrams cannot "leave the house unless accompanied by a parent", i.e. a functional telegram.
Two telegrams, denoted by the identifiers STF and TTF are avalilable.

Examples: Consider the telegram sequence in fig. A1-6 below.

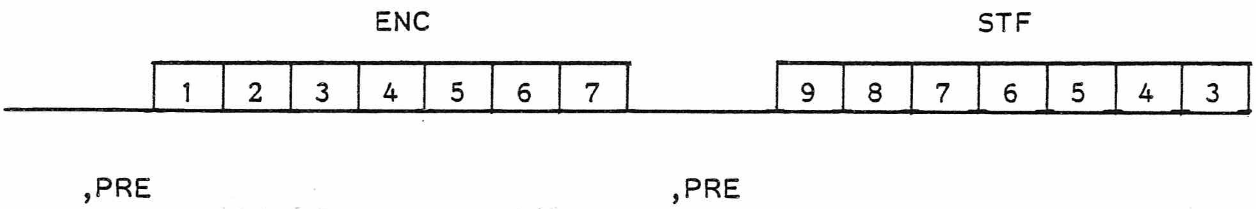


fig. A1-6

This sequence is assigned when writing

```
 ,BDT = xx
ENC = 1.2.3.4.5.6.7
 ,FOL = STF
SNC = z.z.z.z.z.z.z
...................
STF = 9.8.7.6.5.4.3.
```

If the message cannot be accommodated in a single telegram, two or more telegrams can be "packed" into a single telegram, see fig. A1-7 below.

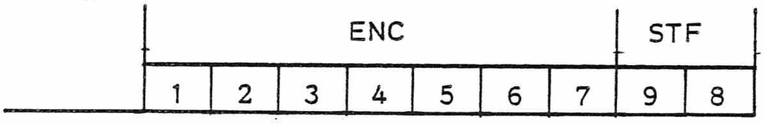


fig. A1-7

This "packing" can be done by appending ,PRE = 0 to the auxiliary telegram STF:

```
 ,BDT = 2
ENC = 1.2.3.4.5.6.7
 ,FOL = STF
 ,PRE = 0
SNC = 1.3.5.7.9.1.3
.........................
STF = 9.8
```

Prolonging the first tone of the auxiliary telegram can be carried out by writing, say, ,DUR = 140, where ,DUR refers to STF, see fig. A1-8 below.

```
,BDT = 2
ENC = 1.2.3.4.5.6.7
 ,FOL = STF
 ,PRE = 0
 ,DUR = 140
SNC = 1.3.5.7.9.1.3
........................
STF = 9.8
```

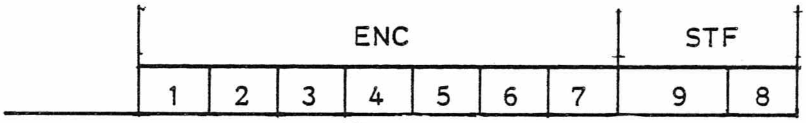


fig. A1-8

Group Calls

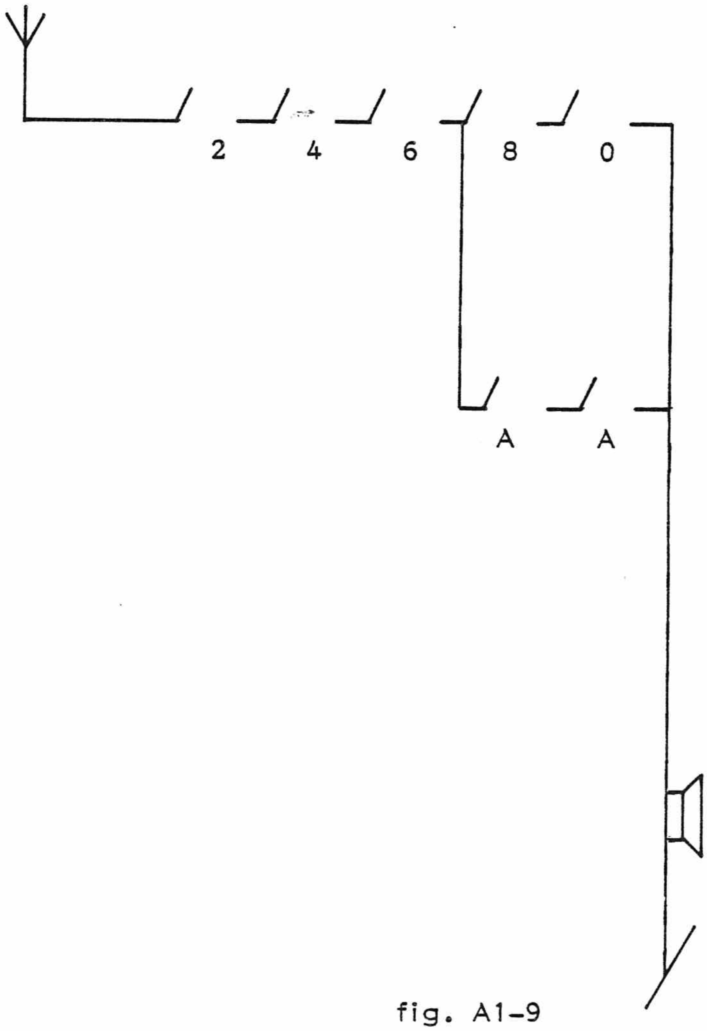
When designing a group call scheme for the radio, you start by assigning a group digit to GRP, e.g. GRP = A. You may assign another digit if you like, e.g. GRP = 0. If this is the case, the digit "0" is reserved for group calls and cannot sensibly be used for other purposes.
Next, you decide which positions in the decoder telegram the group tone is to be inserted. For illustration, consider the four examples given below.

Example 1:

Suppose we write

DEC = 2.4.6.8.0
GRP = A
,POS = 4

we get the set-up



Loudspeaker will open upon receiving

2 4 6 8 0

2 4 6 A A

fig. A1-9

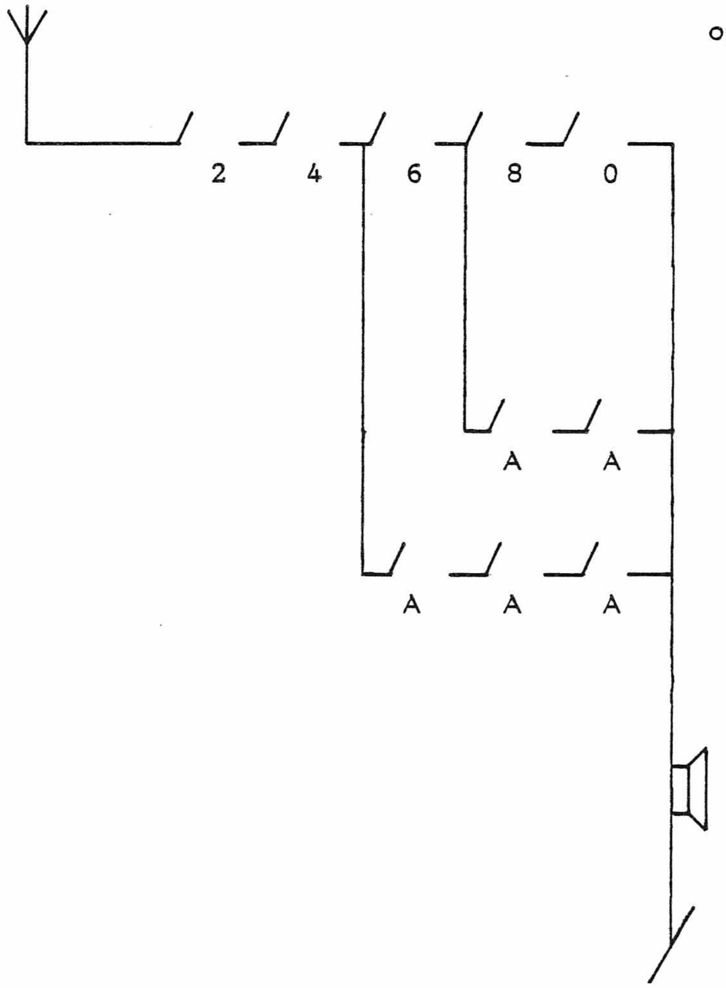
The assignment ,POS = 4 thus establishes a "shunt" between the switch in position 4 and the loudspeaker.

Example 2:

You are allowed to put extra "shunts" into the decoder. If you replace ,POS = 4 with ,POS = 3.4 in the statements in example 1, i.e., writing

DEC = 2.4.6.8.0
GRP = A
,POS = 3.4

you will get



Loudspeaker will
open upon receiving

2 4 6 8 0

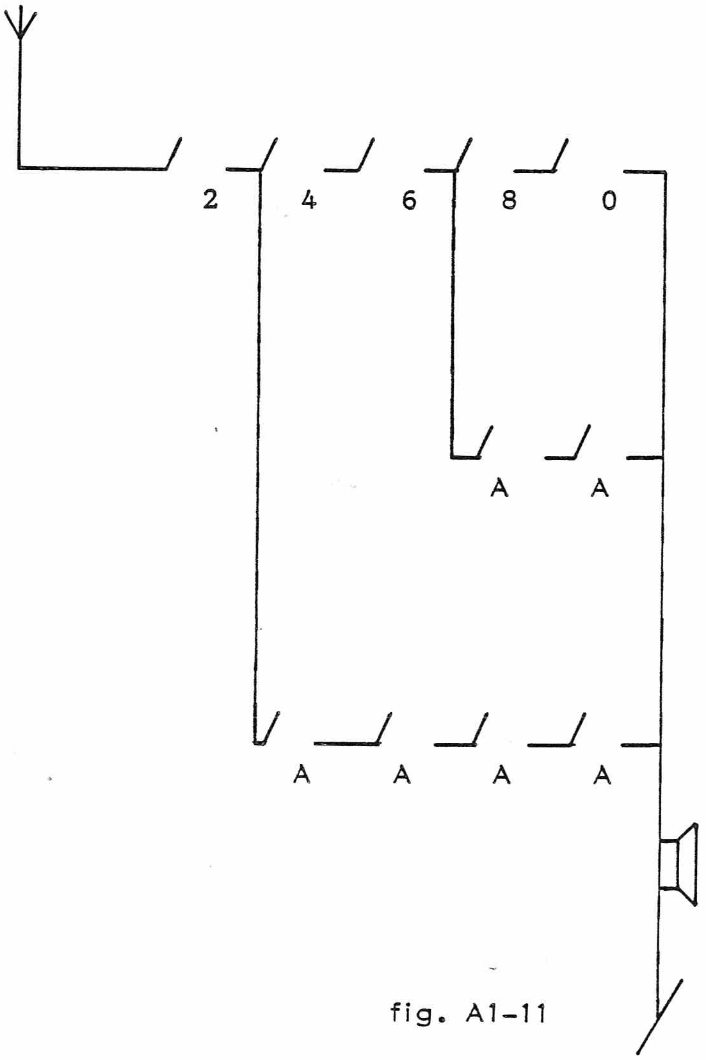
2 4 6 A A

2 4 A A A

fig. A1-10

Example 3

If you want the setup



Loudspeaker will
open upon receiving

2 4 6 8 0

2 4 6 A A

2 A A A A

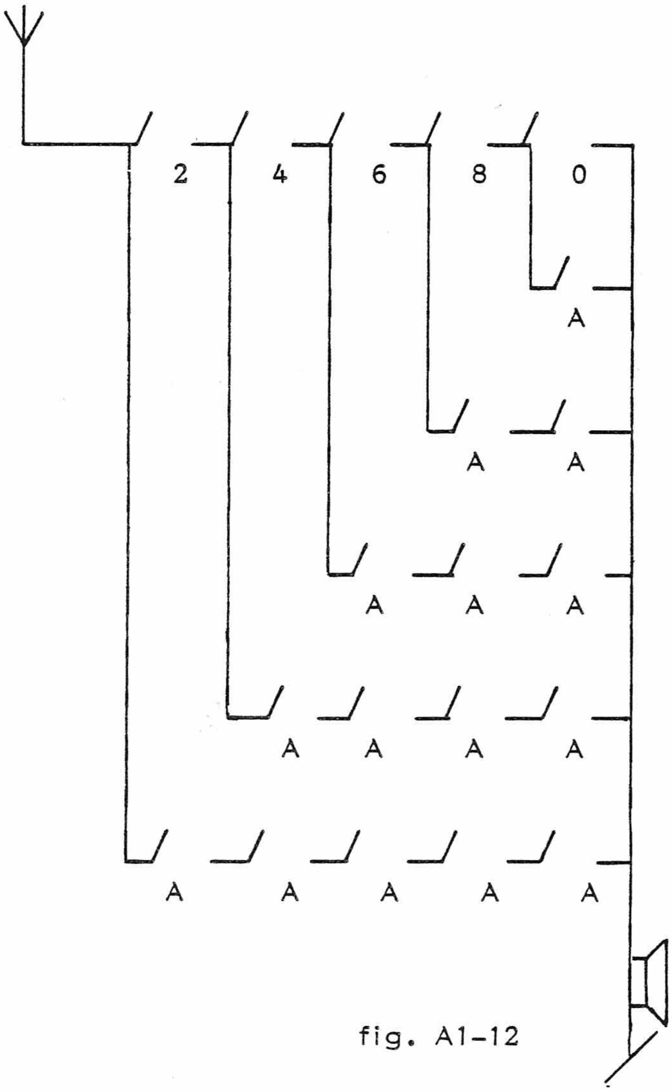
fig. A1-11

You write

DEC = 2.4.6.8.0
GRP = A
,POS = 2.4

Example 4

If you want a complete hierarchial group call set-up for the radio, that is,



Loudspeaker will
open upon receiving

2 4 6 8 0

2 4 6 8 A

2 4 6 A A

2 4 A A A

2 A A A A

A A A A A
(All Call)

fig. A1-12

you write

DEC = 2.4.6.8.0
GRP = A
,POS = N

Summarizing these examples we state that every position in DEC can be "shunted" at will. The positions to be shunted is indicated by writing the requested positions separated by a "." .

SEQUENTIAL SIGNALLING TONETABLE

TABLE 1

TON =	ZV1	ZV2	ZV3	CCI	EEA	VDE	Remarks
Tone	Frequency (Hz)						
0	2400	2400	2200	1981	1981	825	Normal Tones
1	1060	1060	970	1124	1124	1010	
2	1160	1160	1060	1197	1197	1240	
3	1270	1270	1160	1275	1275	1435	
4	1400	1400	1270	1358	1358	1520	
5	1530	1530	1400	1446	1446	1750	
6	1670	1670	1530	1540	1540	1860	
7	1830	1830	1670	1640	1640	1980	
8	2000	2000	1830	1747	1747	2000	
9	2200	2200	2000	1860	1860	2135	
A	2800	885	885	2400	1055	2280	Group Tone
B	810	810	2800	930	930	2450	Special Tones
C	970	2800	810	2247	2247	2800	
D	885	2600	2600	991	991	675	
E	2600	970	2400	2110	2110	450	Repeat Tone

Tone Length *)	70 msec	100 msec	40 msec		Default
Pre-amble **)	140 msec	200 msec	100 msec		Default

*) Measured at 90% of rated deviation (amplitude)

**) Starting at 90% of rated carrier output power.

BINARY SIGNALLING ACCORDING TO ZVEI

APPENDIX 2

BINARY SIGNALLING ACCORDING TO ZVEI

The circuitry which takes care of binary signalling is an integrated part of the Stornophone 6000. Accordingly, no supplementary hardware modules have to be ordered, and all information concerning the signalling set-up can be stated using the software nomenclature.
In the following we will demonstrate how to apply the software nomenclature when specifying the signalling set-up of the radio.

Assignment of Signalling System

The binary signalling system according to ZVEI is assigned by writing

TON = BZV

The Binary ZVEI Telegram

In contradistinction to sequential tone systems, the binary systems only use two frequencies representing the binary digits 0 and 1. Using binary signalling increases the amount of information to be transmitted per unit time tenfold.
A binary ZVEI telegram is represented as a string of bits (bit = binary digit), typically 71 bits long. The telegram is divided into five blocks: the Header, the Preamble, the Block Syncronization, the Message, and the Error Check, see fig. A2-1. below:

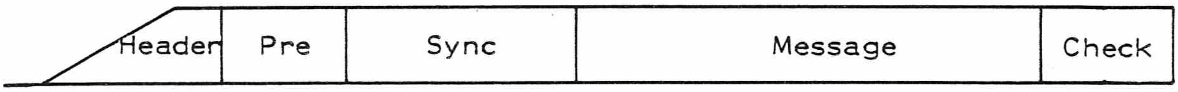


fig. A2 - 1

The Preamble, the Syncronization block, and the Error check are fixed bit patterns and cannot be accessed from the nomenclature. Note that the Preamble of binary ZVEI telegrams has nothing to do with the preamble used in sequential signalling.

The Header Block

The transmission of a binary ZVEI telegram starts with a header, which is an unmodulated carrier gradually changing into a pattern of alternating "0"'s and "1"'s. The header lasts for a period of not less than 25 ms, and the alternating bit string lasts for a period not less than 5.8 ms.

If desired, the length of the header can be increased by appending a number of extra alternating bits.
Writing, for example, ,PRE = 2 will add two extra bits at the end, making the total length of the header 26.6 ms.

The Message Block

This block contains the intrinsic information conveyed by the telegram. This information is represented in the software nomenclature as a string of 8 positions, separated by ".", where each position contains either a fixed digit or a reference to a digit in the display. Each position has a definite interpretation, see fig. A2-2 below.

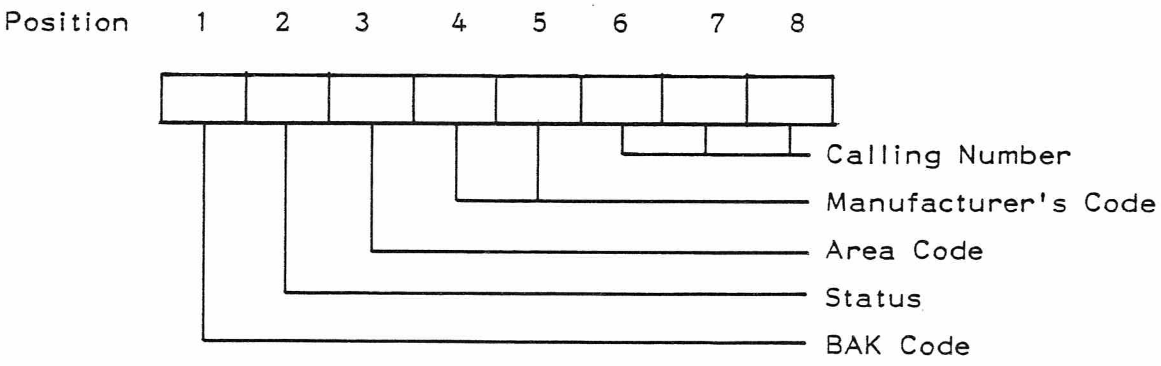


fig. A2 - 2

Position 1: BAK code

The socalled BAK code is a tag which indicates the current function of the telegram. Since the current function of the remaining telegram depends on the current context in which the remaining telegram is used, we write the capital letter "Z" in the first position, that is

ENC = Z. . . . . . .

A "Z" in the first position will instruct the radio to evaluate the current function of telegram automatically and insert the correct BAK code. For the sake of completeness, we have shown the various BAK codes in the table below:

BAK code	Telegram type	
0	At free disposal	
1	Call to Mobile	*)
2	Call to Base	*)
3	Identification	
4	Acknowledge	
5	Following Telegram	
6	Disconnect Command	*)
7	Reserved	
8	Priority Call	*)
9	Status Request	*)
A	Reserved	
B	Reserved	
C	Reserved	
D	At free disposal	
E	At free disposal	
F	Emergency Call	

*) Acknowledge required

Note that the assignment of anything different from "Z" in position 1 is illegal within the OPUS Sales Package.

Position 2: Status

The element in position two can be assigned either :

a fixed digit, that is, 0/1/2/3/4/5/6/7/8/9/A/B/C/D/E/X, where "X" is the "Don't care"-digit.

or

a reference to a digit in the status field on the display, that is, 1S/2S, where 1S refers to the current digit in position 1 of the status field, and 2S refers to the current digit in position 2 of the status field, see fig. A2-3 below.

C	▨	▨		A	▨	▨	▨	▨	▨	▨	▨		S	0	9

1S 2S Reference

fig. A2 - 3

Hence you may write

ENC = Z.1. . . . . .

which will instruct the radio to insert the binary code corresponding to "1" in the telegram to be transmitted when pressing the ♪ button.

If the status is to be ignored, you simply write

ENC = Z.X. . . . . .

Writing

ENC = Z.2S. . . . . .

will command the radio to insert the binary code corresponding to "9" in the telegram to be transmitted when pressing the ♪ button, provided that the display looks as in fig. A2-3 at the instant of transmission.

Position 3: Area Code

The Area Code is used to indicate the geographical location of the base station. The position contains one of the values

0/1/2/3/4/5/6/7/8/9/A/B/C/D/E

For instance,

ENC = Z.2S.9. . . .

Position 4 and 5: Manufacturer Code

These positions are used to indicate the manufacturer's identity. The code is prescribed by the national electronics industries association, for instance,

ENC = Z.2S.9.8.8. . .

Position 6, 7, and 8: Calling Number

The calling number occupies precisely three positions where each position contains either

a fixed digit, that is, 0/1/2/3/4/5/6/7/8/9/A/B/C/D/E/X, where "X" is the Don't care digit.

or

a reference to the current digit in a position in the address field of the display, that is, 1A/2A/3A/4A/5A/6A/7A, where 1A refers to the current digit in position 1 of the address field, and 2A refers to the current digit in position 2 of the address field, etc., see fig.A2 - 4.

C	▨	▨		A	2	4	6	8	0	2	4		S	▨	▨	
					1A	2A	3A	4A	5A	6A	7A					Reference

fig. A2 - 4

Hence you may write

ENC = Z.2S.9.8.8.1.2.3

which will instruct the radio to insert the binary code corresponding to the string "1 2 3" in the telegram to be transmitted when pressing the ♪ button.

If you do not care about the digit in, say, position 8 you merely write

ENC = Z.2S.9.8.8.1A.2A.X

Writing

ENC = Z.2S.9.8.8.1A.2A.3A

will order the radio to insert the binary code corresponding to the string "2 4 6" in the telegram to be transmitted when pressing the ♪ button, provided that the display looks as in fig. A2-4 at the instant of transmission.

Assigning by Reference

A telegram may be assigned by reference by writing, for instance,

AC1 = DEC

If DEC = Z.2S.9.8.8.1.2.3, then AC1= DEC implies AC1 = Z.2S.9.8.8.1.2.3

Telegram Types

The OPUS Sales Package contains nine telegrams which fall into three categories:

Functional telegrams
Decoder telegrams
Auxiliary telegrams

Functional Telegrams

A functional telegram is transmitted upon some action. The OPUS Sales Package comprises five such telegrams:

TELEGRAM	ACTION
ENC	Pressing the ♪ button
SNC	Pressing the A button
TOF	Pressing the ϟ device; loudspeaker closed
TOE	Pressing the ϟ device
AC1	Decoding DEC

Decoder Telegrams

A decoder telegram is a telegram which can be decoded ("understood") by the radio. The OPUS Sales Package comprises two decoder telegrams, DEC and ADE. The DEC is the radio's identity in the system; i.e. the "telephone number" of the radio as seen from the system's point of view (Not necessarily from the user's point of view).

ADE is a decoder which becomes alive upon transmitting a telegram requesting an acknowledgement. If an acknowledgement is not received within the time limit assigned to ,RTI, the requesting telegram will be retransmitted. This cycle will repeat itself until either an acknowledgement is received or the number of cycles becomes equal to the value assigned to ,REP.

Stornophone 6000 as a Base Station

Writing

BAS = Y

will enable the radio to function as a base station. Having specified BAS = Y enables a keystroke procedure to change the function of the radio from being mobile to base.

Auxiliary Telegrams

Auxiliary telegrams are telegrams which can be appended to a functional telegram. Note that auxiliary telegrams cannot "leave the house unless accompanied by a parent", i.e. a functional telegram.
Two telegrams, denoted by the identifiers STF and TTF are avalilable.

Examples: Consider the telegram sequence in fig. A2-5 below.

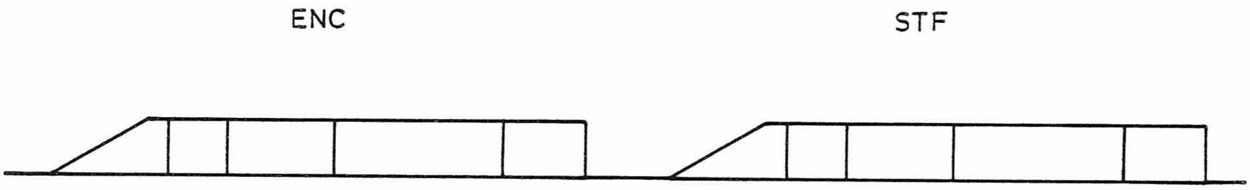


fig. A2 - 5

This sequence is assigned when writing

```
    ,BDT = xx
ENC = Z.X.0.1.1.6.7.8
    ,FOL = STF
SNC = Z.1S.0.1.1.X.X.X
...................
STF = Z.X.0.1.1.8.9.X
```

Group Calls

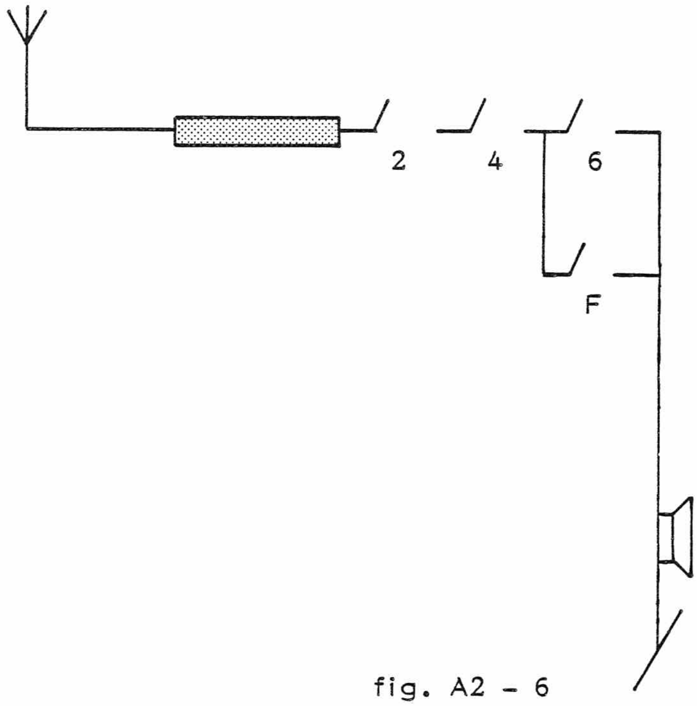
When designing a group call scheme for the radio, you start by assigning the group digit "F" to GRP, that is GRP = F.
Next, you decide which position in the decoder telegram the group tone is to be assigned. There are precisely three possible ways in which a group call set-up can be made. See the examples given below.

Example 1, ten group

Suppose we write

DEC = ...2.4.6
GRP = F
,POS = 8

we get the set-up in fig. A2-6, below.



Loudspeaker will open upon receiving

2 4 6

2 4 F

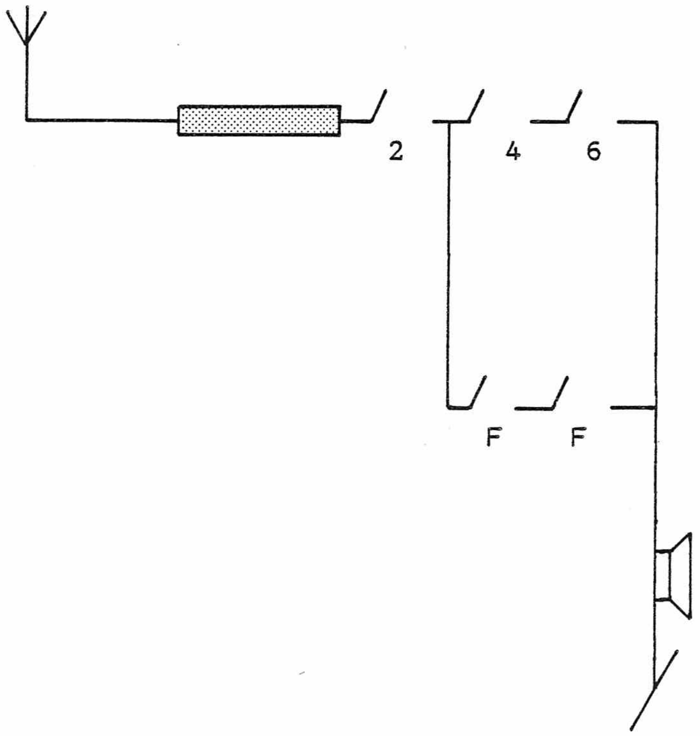
fig. A2 - 6

The assignment ,POS = 8 thus establishes a "shunt" between the switch in position 4 and the loudspeaker.

Example 2, Hundred Group

DEC = ...2.4.6
GRP = F
,POS = 7

we get the set-up in fig. A2-7 below.



Loudspeaker will open upon receiving

2 4 6

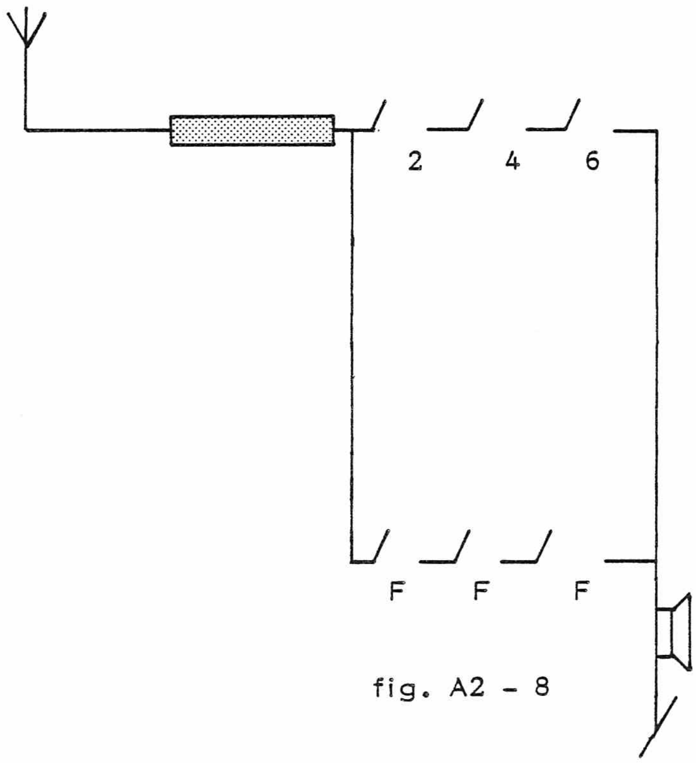
2 F F

fig. A2 - 7

Example 3, All Call

DEC = ...2.4.6
GRP = F
,POS = 6

we get the set-up shown in fig. A2-8 below.



Loudspeaker will open upon receiving

2 4 6

F F F

fig. A2 - 8

ZVEI BINARY CODE TABLE

DIGIT	TRANSMITTED AS	REMARKS
0	0000	Normal digit
1	0001	Normal digit
2	0010	Normal digit
3	0011	Normal digit
4	0100	Normal digit
5	0101	Normal digit
6	0110	Normal digit
7	0111	Normal digit
8	1000	Normal digit
9	1001	Normal digit
A	1010	Special digit
B	1011	Special digit
C	1100	Special digit
D	1101	Special digit
E	1110	Special digit
F	1111	Group digit

Digit length: 4 bits

Preamble: 9 bits

BINARY SIGNALLING ACCORDING TO EEA

APPENDIX 3

BINARY SIGNALLING ACCORDING TO EEA

The circuitry which takes care of binary signalling is an integrated part of the Stornophone 6000. Accordingly, all the information pertinent to the signalling set-up can be stated using the rules and terms of the software nomenclature.
In the following we will demonstrate how to apply the software nomenclature when specifying the signalling set-up of the radio.

Assignment of Signalling System

The binary signalling system according to EEA is assigned by writing

TON = BEE

The Binary EEA Telegram

In contradistinction to sequential tone systems, the binary systems only use two frequencies representing the binary digits 0 and 1. Using binary signalling increases the amount of information to be transmitted per unit time tenfold.
A binary EEA telegram is represented as a string of bits (bit = binary digit), 96 bits long. The telegram is divided into four blocks: the Preamble, the Block Syncronization, the Message, and the Error Check, see fig. A3-1 below:

Preamble	Sync	Message	Check

fig. A3-1

The Block Syncronization block and the Error check are fixed bit patterns and cannot be accessed from the nomenclature.

The Preamble

The transmission of a binary EEA telegram starts with a preamble, which is a string of alternating "0"'s and "1"'s, 16 bits long.

If desired, the length of the Preamble can be increased by appending a number of extra alternating bits.
Writing, for example, ,PRE = 2 will add two extra bits at the end, making the total length of the Preamble 18 bits.

The Message Block

This block contains the intrinsic information conveyed by the telegram. This information is represented in the software nomenclature as a string of 12 positions, separated by ".", where each position contains either a fixed digit or a reference to a digit in the display. Each position has a definite interpretation according to whether the telegram is:

a functional telegram (A telegram to be transmitted upon an action)
a decoder telegram (A telegram that the radio can "understand")
an auxiliary telegram (A telegram which can be appended to a functional telegram).

Functional and Decoder Telegrams

For telegrams belonging to these categories, the 12 positions have the following interpretation, see fig. A3-2 below.

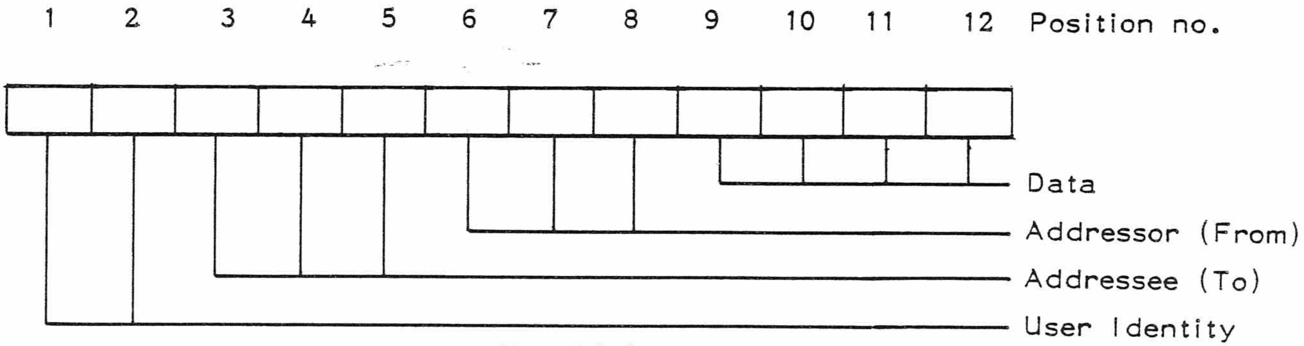


fig. A3-2

Position 1 and 2 : User Identity

Position 1 contains one of the value
8/9/A/B/C/D/E

while position 2 contains one of the values
0/1/2/3/4/5/6/7/8/9/A/B/C/D/E

Example: ENC = 9.1. . . . .

Position 3, 4, and 5: Addressee (To)

These positions are used to indicate the identity of the receiving party. Each position can be occupied by either

> a fixed digit, that is, 0/1/2/3/4/5/6/7/8/9/A/B/C/D/E/X, where "X" is the "Don't care" digit

or

> a reference to a digit in the address field in the display, that is, 1A/2A/3A/4A/5A/6A/7A , where 1A refers to the current digit in position 1 of the adress field, 2A refers to the current digit in position 2 of the adress field, etc., see fig. A3-3.

C	▨	▨		A	7	6	5	4	3	2	1		S	▨	▨	
					1A	2A	3A	4A	5A	6A	7A					Reference

fig. A3-3

Using only fixed digits, you may write
ENC = 9.1.2.4.6. . . . . . .

which will instruct the radio to insert the binary code corresponding to "2 4 6" in the telegram to be transmitted when pressing the ♪ Button.

If, for instance, position 3 is to be ignored, you simply write

ENC = 9.1.X.1A.2A. . . . . . .

Writing

ENC = 9.1.2.1A.2A. . . . . . .

will command the radio to insert the binary code corresponding to "2 7 6" in the telegram to be transmitted when pressing the ♪ button, provided that the display looks as in fig. A3-3 at the instant of transmission.

Position 6, 7, and 8: Addressor (From)

These posisitons are used to indicate the identity of the radio as seen from the system point of view (not necessarily the user's point of view). Each position can be occupied by a fixed digit, that is

0/1/2/3/4/5/6/7/8/9/A/B/C/D/E/X
where "X" is the "Don't care" digit.

Hence you may write

ENC = 9.1.2.1A.2A.3.5.7. . . . .

which will instruct the radio to insert the binary code corresponding to "3 5 7" in the telegram to be transmitted when pressing the ♪ button.

Position 9, 10, 11, 12: Data

These posisitons are used to convey more information. Each position can be occupied by either

a fixed digit, that is
0/1/2/3/4/5/6/7/8/9/A/B/C/D/E/X
where "X" is the "Don't care" digit.

or

a reference to a digit in the address field or status field in the display, that is,

1A/2A/3A/4A/5A/6A/7A/1S/2S

where 1A refers to the current digit in position 1 of the address field, 2A refers to the current digit in position 2 of the address field, etc., see fig. A3-4.

C	▨	▨		A	7	6	5	4	3	2	1		S	9	8	
					1A	2A	3A	4A	5A	6A	7A			1S	2S	Reference

fig. A3-4

Accordingly, you are allowed to write

ENC = 9.1.2.1A.2A.X.5.7.1S.2S.7A.5A

which will command the radio to insert the binary code corresponding to "9 8 1 3" in the telegram to be transmitted when pressing the ♪ button, provided that the display looks as in fig. A3-4 at the instant of transmission.

Auxiliary Telegrams

An auxiliary telegram is used to convey extra information. Note that an auxiliary telegram must be preceded by a functional telegram.

Position 1:

The range of digit values which can be put into position 1 is restricted to

0/1/2/3/4/5/6/7

Positions 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12:

Each position can be occupied by either

a fixed digit, that is
0/1/2/3/4/5/6/7/8/9/A/B/C/D/E/X
where "X" is the "Don't care" digit

or

a reference to a digit in the address field or the status field in the display, that is,
1A/2A/3A/4A/5A/6A/7A/1S/2S
where 1A refers to the current digit in position 1 of the address field, 2A refers to the current digit in position 2 of the address field, etc., see fig. A3-5.

C	▨	▨		A	7	6	5	4	3	2	1		S	9	8	
					1A	2A	3A	4A	5A	6A	7A			1S	2S	Reference

fig. A3-5

Hence you may write

STF = 0.1.2.1A.2A.4A.5A.7A.1S.2S.7A.5A

which will command the radio to compose the binary code corresponding to "0 1 2 7 6 4 3 1 9 8 1 3" in the auxiliary telegram to be transmitted provided that the display looks as in fig. A3-5 at the instant of transmission.

Assigning by Reference

A telegram may be assigned by reference by writing, for instance,

AC1 = DEC

If DEC = 9.1.2.3.4.5.6.7.8.9.0.2, then AC1 = DEC implies
AC1 = 9.1.2.3.4.5.6.7.8.9.0.2

Telegram Types

The OPUS Sales Package contains nine telegrams which fall into three categories:

Functional telegrams
Decoder telegrams
Auxiliary telegrams

Functional Telegrams

A functional telegram is transmitted upon some action. The OPUS Sales Package comprises five such telegrams:

TELEGRAM	**ACTION**
ENC	Pressing the ♪ button
SNC	Pressing the Ħ button
TOF	Pressing the ϟ device; loudspeaker closed
TOE	Pressing the ϟ device
AC1	Decoding DEC

Decoder Telegrams

A decoder telegram is a telegram which can be decoded ("understood") by the radio. The OPUS Sales Package comprises two decoder telegrams, DEC and ADE. The DEC is the radio's identity in the system; i.e. the "telephone number" of the radio as seen from the system's point of view (Not necessarily from the user's point of view).
ADE is a decoder which becomes alive upon transmitting a telegram requesting an acknowledgement. If an acknowledgement is not received within the time limit assigned to ,RTI, the requesting telegram will be retransmitted. This cycle will repeat itself until either an acknowledgement is received or the number of cycles becomes equal to the value assigned to ,REP.

Auxiliary Telegrams

Auxiliary telegrams are telegrams which can be appended to a functional telegram. Note that auxiliary telegrams cannot "leave the house unless accompanied by a parent", i.e. a functional telegram.
Two telegrams, denoted by the identifiers STF and TTF are avalilable.

Examples: Consider the telegram sequence shown in fig. A3-6 below.

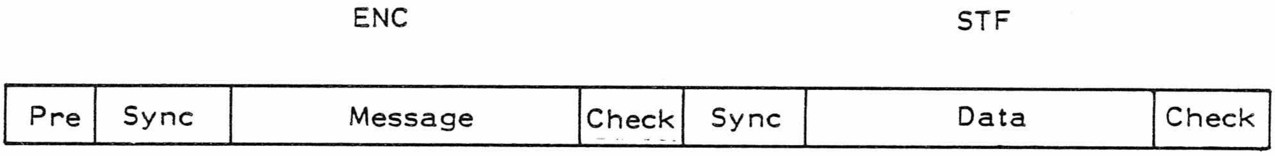


fig. A3-6

This sequence is assigned when writing

```
        ,BDT = xx
                ENC = 9.1.2.1A.2A.X.5.7.1S.2S.7A.5A
                   ,FOL = STF
                SNC = 8.0.1.2A.3A.X.X.X.X.X.1A.2A
                ..................
                STF = 0.1.2.1A.2A.4A.5A.7A.1S.2S.7A.5A
```

Group Calls

When designing a group call scheme for the radio, you start by assigning the group digit "F" to GRP, that is GRP = F.
Next, you decide which position in the decoder telegram the group tone is to be inserted. There are precisely three possible ways in which a group call set-up can be made. See the examples given below.

Example 1, ten group

Suppose we write

DEC = . .2.4.6. . . . . . .

GRP = F

,POS = 5

we get the set-up shown in fig. A3-7 below.

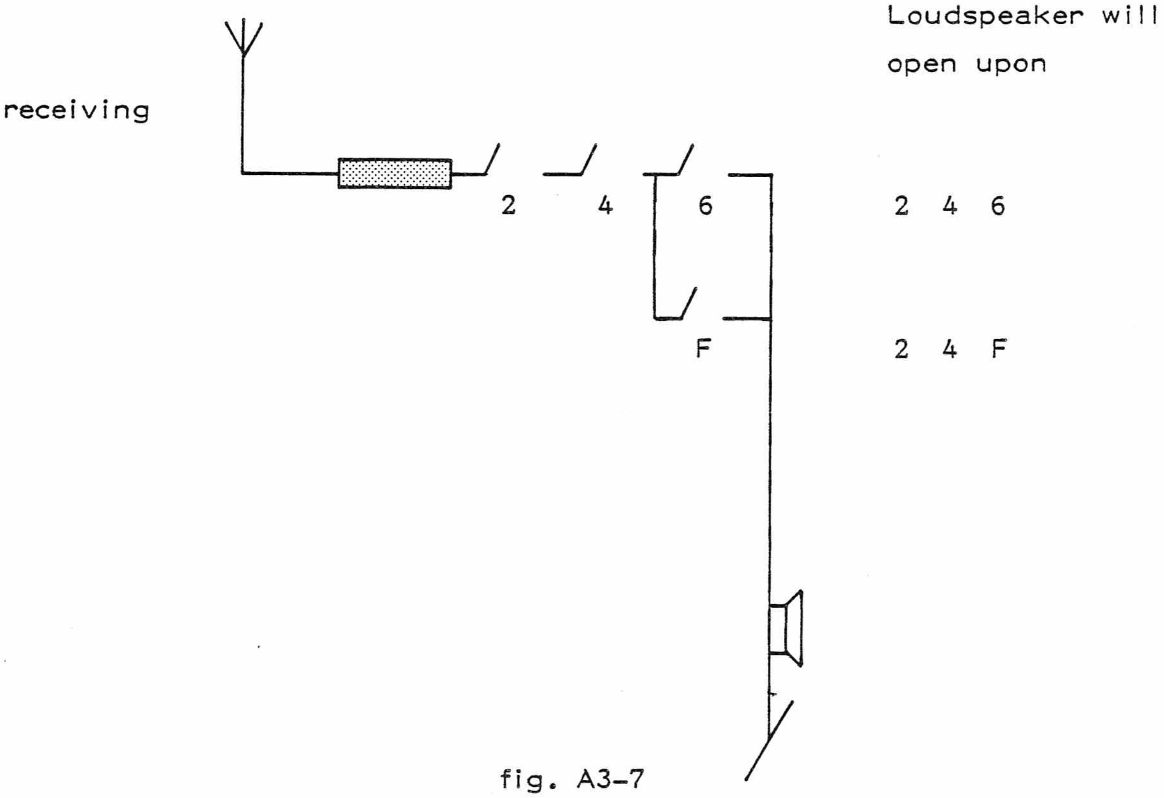


fig. A3-7

The assignment ,POS = 5 thus establishes a "shunt" in position 5.

Example 2, Hundred Group

DEC = . .2.4.6. . . . . . .

GRP = F

,POS = 4

we get the set-up shown in fig. A3-8 below.

receiving

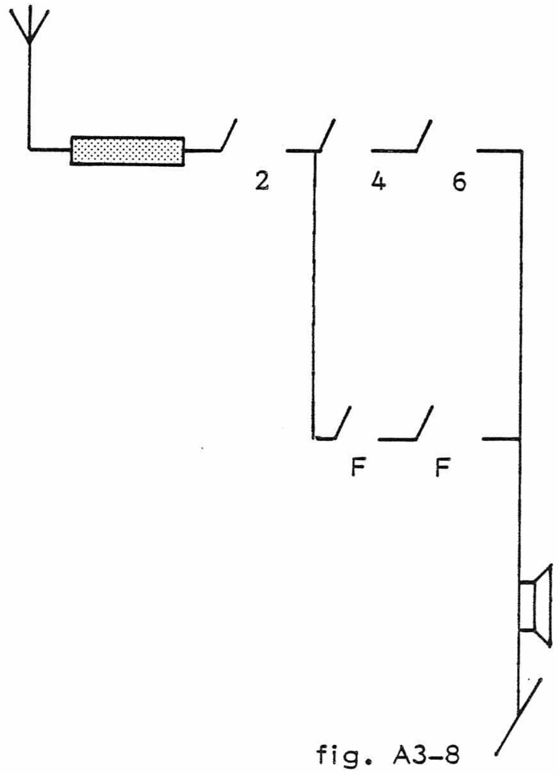


fig. A3-8

Loudspeaker will open upon

2 4 6

2 F F

Example 3, All Call

DEC = . .2.4.6. . . . . . .

GRP = F

,POS = 3

we get the set-up shown in fig. A3-9 below.

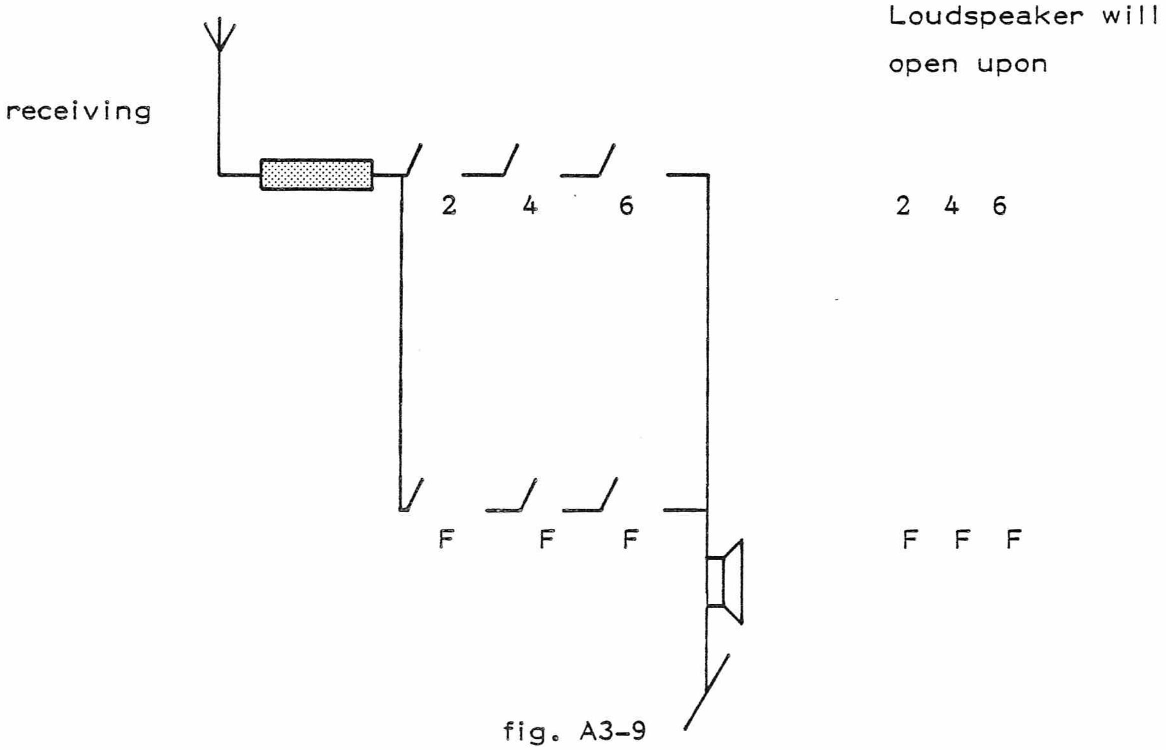


fig. A3-9

EEA Binary Code Table

DIGIT	TRANSMITTED AS	REMARKS
0	0000	Normal digit
1	0001	Normal digit
2	0010	Normal digit
3	0011	Normal digit
4	0100	Normal digit
5	0101	Normal digit
6	0110	Normal digit
7	0111	Normal digit
8	1000	Normal digit
9	1001	Normal digit
A	1010	Special digit
B	1011	Special digit
C	1100	Special digit
D	1101	Special digit
E	1110	Special digit
F	1111	Group digit

Digit length: 4 bits

Preamble: 16 bits

MIXED TONE SIGNALLING SYSTEMS

APPENDIX 4

MIXED TONE SIGNALLING SYSTEMS

The OPUS Sales Package provides the option of assigning a tone system specific to a functional or an auxiliary telegram by using the telegram's subterm identifier ,TON.

If you have assigned a default tone system to the main term identifier TON, all telegrams will use the default tone system except for the telegrams which are assigned otherwise by their subterm identifier ,TON.

Note that the telegram format for every telegram must obey the rules specific to the signalling system chosen for that telegram.

Note also that you cannot change the signalling system for decoder telegrams. The decoder telegrams always use the default signalling system assigned to TON.

Example 1:

Suppose that you have chosen ZVEI 1 as the default tone system by writing

TON = ZV1 and that you want the second encoder telegram

SNC = 1.2.3.4.1A.2A to be transmitted in ZVEI 3:

```
..........................
SNC = 1.2.3.4.1A.2A
 ,TON = ZV3
..........................
```

Example 2:

Assume that the unit must have its decoder code in the ZVEI 1 signalling system. Furthermore, we want the ZVEI 1 telegram 2.4.1A.2A.3A to be transmitted when pressing the ♪ button and the Binary ZVEI telegram Z.2S.9.8.8.1.2.3 when pressing the A button.
This set-up is written as

```
.........................
TON = ZV1
ENC = 2.4.1A.2A.3A
SNC = Z.2S.9.8.8.1.2.3
 ,TON = BZV
.........................
```

Example 3:

We want a unit with the Binary ZVEI decoder code Z.2S.9.8.8.4.5.6. Pressing the ♪ button we want to transmit the Binary ZVEI telegram Z.2S.9.8.8.1.2.3 via a repeater requiring the ZVEI 1 telegram 2.4.6.8.0 in order to open. This is done in the following way:

```
.........................
TON = BZV
ENC = 2.4.6.8.0
 ,TON = ZV1
 ,FOL = STF
.........................
STF = Z.2S.9.8.8.1.2.3
DEC = Z.2S.9.8.8.4.5.6
.........................
```

Note that the assignment ,TON = ZV1 applies to ENC only.

MINIMUM VALUES FOR REDUCED POWER LEVEL

APPENDIX 5

MINIMUM VALUES FOR REDUCED POWER LEVEL

Identifier: RPL

	Minimum Value in Watts for RPL at:				
Nominal Value	80 MHz	160 MHz	200 MHz	370 MHz	450 MHz
1 Watt	1.0	0.6			0.6
6 Watt	1.0	0.6	2.5		0.6
10 Watt	1.0	2.5	2.5		2.5
15 Watt	2.5	2.5	2.5		2.5
25 Watt	2.5	2.5	2.5		2.5

Example:

A 160 MHz radio unit is ordered with a nominal output of 10 Watts. According to the table above, the minimum value is equal to 2.5 Watts, that is, RPL can be assigned a value in the range from 10.0 downto 2.5 Watts.

Writing

```
RPL = 3.6

 ...............
CHF = 01

 ...............
 ,PWR = Y


CHF = 02

 ...............
 ,PWR = Y


CHF = 43

 ...............
 ,PWR = N
```

you will order a radio which transmits at a level of 3.6 Watts on channels 01 and channel 02, while on channel 43, the output power is 10 Watts.

NOMENCLATURE CHECKLIST

APPENDIX 6

CHECKLIST

STORNOPHONE 6000 OPUS SALES PACKAGE

			DEFAULT
PAK	=	O P U S	☐
ODA	=	☐	1
,TIO	=	☐ ☐ ☐	1 0
RPL	=	☐ ☐	N
MIV	=	☐	0
MAV	=	☐	8
ACA	=	☐	4
AFB	=	☐	Y

APPENDIX 6

CHECKLIST

STORNOPHONE 6000 OPUS SALES PACKAGE

DEFAULT

THIS PAGE OF THE CHECKLIST MUST BE FILLED IN ONCE FOR EACH CHANNEL

TOTAL NUMBER OF CHANNELS:

CHF	=	☐☐	☐
,TXF	=	☐☐☐☐☐☐☐☐☐	☐
,RXF	=	☐☐☐☐☐☐☐☐☐	☐
,CGD	=	☐☐☐☐	N
,CGE	=	☐☐☐☐	N
,PWR	=	☐	N

APPENDIX 6

CHECKLIST

STORNOPHONE 6000 OPUS SALES PACKAGE

			DEFAULT
,CDI	=	☐	2
,ADI	=	☐	5
,SDI	=	☐	2
PRI	=	☐	N
,BDT	=	☐☐☐	3
,MAT	=	☐	Y
,MAC	=	☐	N
PTA	=	☐	0
TKA	=	☐	0
SKA	=	☐	0
CCT	=	☐☐☐	N

APPENDIX 6

CHECKLIST

STORNOPHONE 6000 OPUS SALES PACKAGE

			DEFAULT
TON	=	☐☐☐	N
,BAS	=	☐	N
,PRE	=	☐☐☐	S
,DUR	=	☐☐☐	S
GRP	=	☐	N
,POS	=	☐☐☐☐☐☐	N
		Sequential tone systems: from 1 to 6 positions Binary systems: 1 position	
,BDT	=	☐☐☐	3

APPENDIX 6

CHECKLIST

STORNOPHONE 6000 OPUS SALES PACKAGE

			DEFAULT
ENC	=	☐☐☐☐☐☐☐☐☐☐☐☐ Sequential tone systems: from 1 to 7 positions Binary ZVEI: Always 8 positions Binary EEA: Always 12 positions	N
,TON	=	☐☐☐	*
,PRE	=	☐☐☐	*
,DUR	=	☐☐☐	*
,FOL	=	☐☐☐	N
,PRE	=	☐☐☐	*
,DUR	=	☐☐☐	*
,FOL	=	☐☐☐	N
,PRE	=	☐☐☐	*
,DUR	=	☐☐☐	*

* = Value as assigned to the corresponding main term identifier on page Appendix 6-4

APPENDIX 6

CHECKLIST

STORNOPHONE 6000 OPUS SALES PACKAGE

			DEFAULT
SNC	=	☐☐☐☐☐☐☐☐☐☐☐☐ Sequential tone systems: from 1 to 7 positions Binary ZVEI: Always 8 positions Binary EEA: Always 12 positions	N
,TON	=	☐☐☐	*
,PRE	=	☐☐☐	*
,DUR	=	☐☐☐	*
,FOL	=	☐☐☐	N
,PRE	=	☐☐☐	*
,DUR	=	☐☐☐	*
,FOL	=	☐☐☐	N
,PRE	=	☐☐☐	*
,DUR	=	☐☐☐	*

* = Value as assigned to the corresponding main term identifier on page Appendix 6-4

APPENDIX 6

CHECKLIST

STORNOPHONE 6000 OPUS SALES PACKAGE

			DEFAULT
TOF	=	☐☐☐☐☐☐☐☐☐☐☐☐ Sequential tone systems: from 1 to 7 positions Binary ZVEI: Always 8 positions Binary EEA: Always 12 positions	N
,TON	=	☐☐☐	*
,PRE	=	☐☐☐	*
,DUR	=	☐☐☐	*
,FOL	=	☐☐☐	N
,PRE	=	☐☐☐	*
,DUR	=	☐☐☐	*
,FOL	=	☐☐☐	N
,PRE	=	☐☐☐	*
,DUR	=	☐☐☐	*

* = Value as assigned to the corresponding main term identifier on page Appendix 6-4

APPENDIX 6

CHECKLIST

STORNOPHONE 6000 OPUS SALES PACKAGE

			DEFAULT
TOE	=	☐☐☐☐☐☐☐☐☐☐☐☐ Sequential tone systems: from 1 to 7 positions Binary ZVEI: Always 8 positions Binary EEA: Always 12 positions	N
,TON	=	☐☐☐	*
,PRE	=	☐☐☐	*
,DUR	=	☐☐☐	*
,FOL	=	☐☐☐	N
,PRE	=	☐☐☐	*
,DUR	=	☐☐☐	*
,FOL	=	☐☐☐	N
,PRE	=	☐☐☐	*
,DUR	=	☐☐☐	*
,IDT	=	☐☐☐	N

* = Value as assigned to the corresponding main term identifier on page Appendix 6-4

APPENDIX 6

CHECKLIST

STORNOPHONE 6000 OPUS SALES PACKAGE

			DEFAULT
AC1	=	☐☐☐☐☐☐☐☐☐☐☐☐ Sequential tone systems: from 1 to 7 positions Binary ZVEI: Always 8 positions Binary EEA: Always 12 positions	N
,TON	=	☐☐☐	*
,PRE	=	☐☐☐	*
,DUR	=	☐☐☐	*
,FOL	=	☐☐☐	N
,PRE	=	☐☐☐	*
,DUR	=	☐☐☐	*
,FOL	=	☐☐☐	N
,PRE	=	☐☐☐	*
,DUR	=	☐☐☐	*

* = Value as assigned to the corresponding main term identifier on page Appendix 6-4

APPENDIX 6

CHECKLIST

STORNOPHONE 6000 OPUS SALES PACKAGE

DEFAULT

STF = ☐☐☐☐☐☐☐☐☐☐☐☐ N

Sequential tone systems: from 1 to 7 positions
Binary ZVEI: Always 8 positions
Binary EEA: Always 12 positions

,TON = ☐☐☐ *

TTF = ☐☐☐☐☐☐☐☐☐☐☐☐ N

Sequential tone systems: from 1 to 7 positions
Binary ZVEI: Always 8 positions
Binary EEA: Always 12 positions

,TON = ☐☐☐ *

DEC = ☐☐☐☐☐☐☐☐☐☐☐☐ N

Sequential tone systems: from 1 to 7 positions
Binary ZVEI: Always 8 positions
Binary EEA: Always 12 positions

ADE = ☐☐☐☐☐☐☐☐☐☐☐☐ N

Sequential tone systems: from 1 to 7 positions
Binary ZVEI: Always 8 positions
Binary EEA: Always 12 positions

,ACE = ☐☐☐ N

,REP = ☐☐ 0

,RTI = ☐☐☐ 1