Communication
Systems

PHILIPS

FM91 MK2 SERIES
VHF/UHF MOBILE RADIO TELEPHONE

WARNING

The transistors used in the transmitter power amplifier contain beryllium oxide, the dust of which is toxic.

No danger can arise from normal handling, but no attempt should be made to tamper with the encapsulation of these devices. They must not be discarded with industrial or domestic waste.

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AMENDMENT LIST

Changes made to the equipment described in this manual are published as amendments which are dated and consecutively numbered. This sheet is to be used to record the incorporation of all amendments.

Reprints of the manual will incorporate all amendments to date and an entry to this effect will be recorded on the amendment list below.

Amendment No.	Subject	Date Change Completed	Initials

The usefulness of this manual depends upon its accuracy. Whilst every endeavour has been made to minimise errors, some may exist. It is therefore requested that any errors or omissions noted be advised as follows:

Please quote:
a) Publication Title
b) Publication Ref. No. and Issue Date
c) Latest amendment received
d) Details of error

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VEHICLE CARE

With advancing technology there is a trend by motor vehicle manufacturers to introduce the use of electronic circuitry in the control of the vehicles. Proper design, care and maintenance of these vehicle electronics will avoid the remote possibility of malfunction from radio frequency interference from adjacent or installed two way radio transmitters.

The following information is supplied to ensure that there is no radio frequency interference effect on the vehicle's electronic systems.

To prevent interference with any other electronic systems in the vehicle, e.g. ignition, anti-skid devices etc., the radiotelephone and antenna should be mounted as far away as possible from these units and their associated cables. Reference should be made to the vehicle manufacturer's handbook for the location of these items.

Finally, the following checks should be carried out if the vehicle is equipped with electronic anti-skid and/or electronic ignition systems.

NOTES:

1. The transmitter should be keyed only for the time required to make an observation.
2. An assistant will be required for the following checks.

RF COMPATIBILITY CHECKS

1. With vehicle stationary and the engine running at fast idle, key the transmitter and check that the brake lights do not illuminate, and the engine continues to run normally.
2. Operate brake pedal, key the transmitter and check that the brake lights do not extinguish.
3. Put the vehicle into motion at a moderate speed (15-20kph), key the transmitter and operate the brake pedal simultaneously. Check that the braking action is normal, and that the engine does not surge or cut out.

CAUTION

In the event of an apparent malfunction in the braking or ignition systems during the above checks, the radio installation should be rendered inoperative and the vehicle manufacturer should be contacted before any further use is made of the radio installation.

FM91 SERIES VHF/UHF MOBILE RADIOTELEPHONE

Publication 9585 666 91000 Issue 4

PART 1

PART 2

Communication
Systems

PHILIPS

FM91 Series
VHF/UHF
Mobile Radiotelephones

Philips Communication Systems Limited

PART 1

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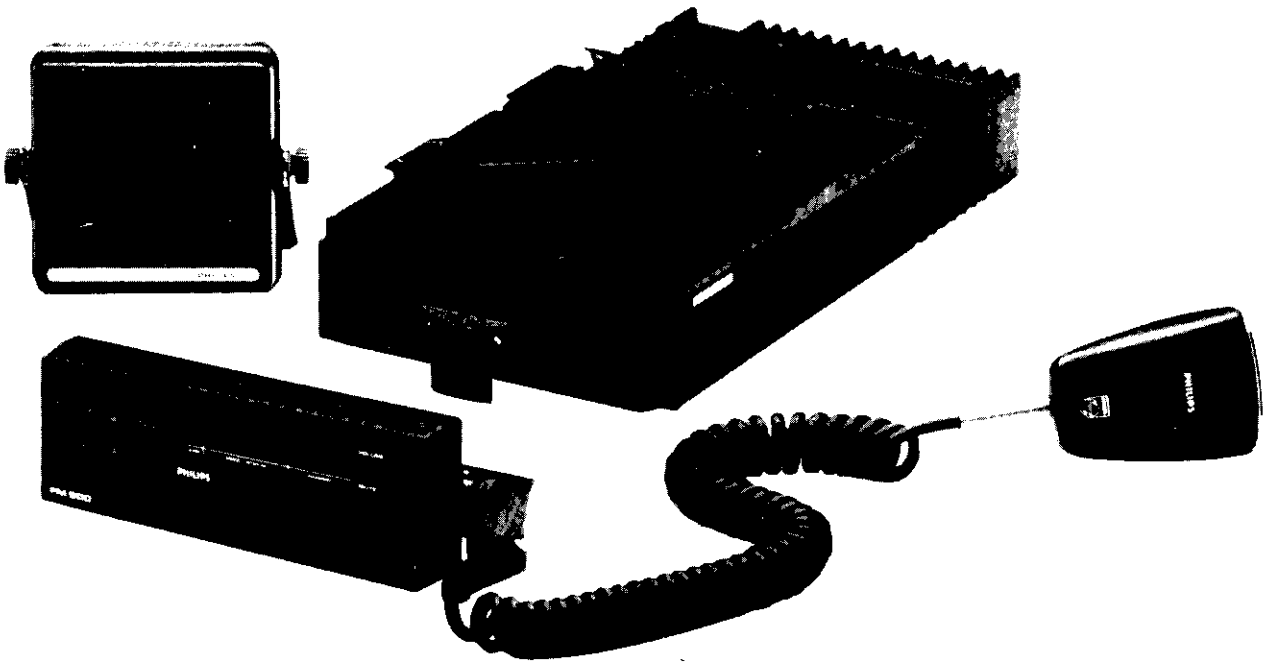
PART 1

FM91 MOBILE RADIOTELEPHONE

SECTION 1 INTRODUCTION

1.1 GENERAL



The FM91 Mk2 series is a trunk mount, flexible, system oriented, computer controlled frequency synthesised mobile designed for use in the land mobile radio service.

The design concept is based on a combination of high performance RF circuitry, a rugged mechanical design, a microcomputer (controlling a single loop frequency synthesiser and other prime functions and options) and the use of advanced LSI, custom integrated circuits and hybrid thick film technology.

A range of options is available to suit customer or system requirements.

A full description of these features is contained in Part 2 of this handbook.

1.4.4 MUTUAL EXCLUSIONS

A number of options available in the 900 mobile are mutually exclusive, or are not available together but may be independently accessible on different channels. The following chart details the exclusivity of the available options.

	CHAN DISPLAY TIMED OR CONTINUOUS	MUTE FIXED OR VARIABLE	TX TIMER	TX INHIBIT	TX O/P POWER PROP TO RX SIG (91 DUPLEX)	SCAN	VOTING	CTCSS	SELCALL	ECONOMISER	A.N.I.	STATUS (91)	8 HOUR TIMER	DUPLEX (91)	TALKTHRU (91)
IS I/O EXPANDER KIT REQUIRED 92 ONLY ?	NO	NO	NO	NO		NO	NO	YES	YES	NO	YES		NO		
IS ADDITIONAL HARDWEAR REQUIRED ? 91 / 92	N / N	N / N	N / N	N / N	N	N / N	N / N	Y / Y	Y / Y	N / N	Y / Y	Y	N / N	Y	Y
EPROM SIZE REQUIRED 92 (91 - 8K STND)	4K	4K	4K	4K		8K	4K	4K	8K	4K	8K		8K	8K	8K
CHAN DISPLAY TIMED OR CONTINUOUS	✓	✓	✓	N/A	✓	✓	✓	✓ [6]	✓	✓	✓	✓	✓	✓	
MUTE FIXED OR VARIABLE	✓	✓	N/A	✓	✓ [3]	✓	✓	✓	✓ [7]	✓	✓	✓	✓	✓ [5]	
TX TIMER	✓	N/A	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
TX INHIBIT		N/A	✓	✓	✓ [4]	✓	✓	✓	✓	✓	✓	✓	✓		
TX O/P POWER PROP TO RX SIG.(91 DUPLEX)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SCAN	N/A [1]	✓	[5] N/A [1]	N/A [2]	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
VOTING	✓	✓	✓	N/A [1]	✓	✓	✓	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
CTCSS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
SELCALL	✓	✓	✓	N/A [1]	✓	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	
ECONOMISER	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
A.N.I.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	
STATUS (91)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	N/A	N/A	
8 HOUR TIMER	✓	✓	✓	✓	✓	✓	✓	✓	N/A	✓	✓	N/A	N/A	N/A	
DUPLEX	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	

LEGEND

✓	Valid option combination
N/A	Not available together
▨	Not applicable

Combinations of more than one option should be checked individually.
e.g. if the combinations "Selcall, Economiser and CTCSS" are required together, then the following combinations should be checked:

(1) Selcall, Economiser
(2) Selcall, CTCSS
(3) Economiser, CTCSS

NOTES:

1. These options are mutually exclusive, i.e. they cannot exist together on the one channel. They are, however, available in different channels in the one radio. Therefore, if you require scanning and selcall for example, it would be necessary to list your frequencies with selcall and then duplicate the frequency list with scanning.

2. Scanning and Economiser are operationally mutually exclusive, but they are available as options together on the one channel. If the radio is operating in the economise mode and the scanning is activated (via "AUX" or "SCAN" button) the economiser will be defeated.

3. Mute level is always fixed on voting channels.

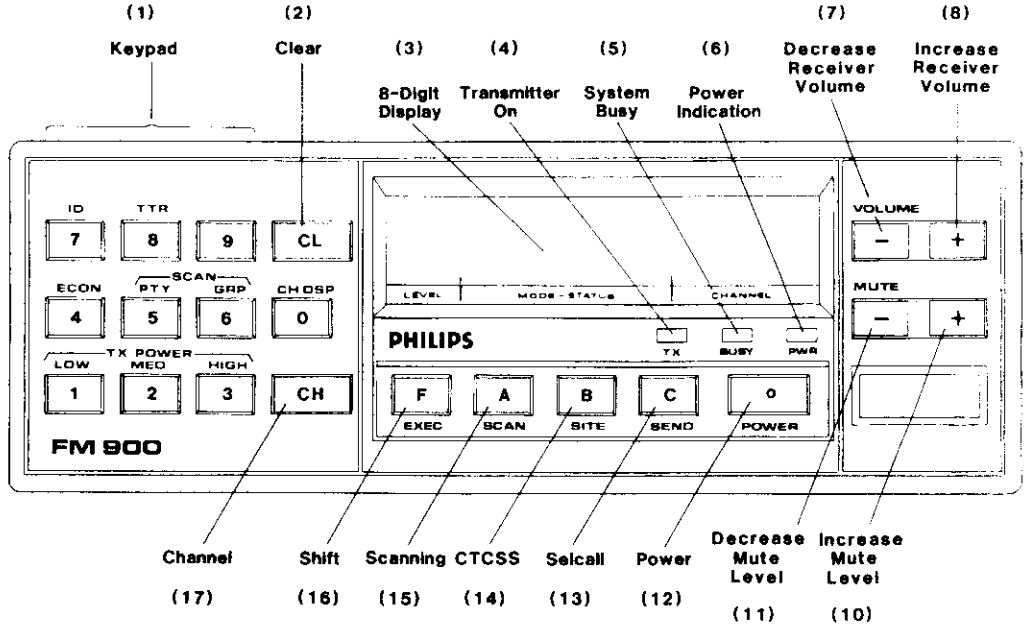
4. Tx inhibit feature is exclusive with CTCSS community repeater option.

5. Mobiles fitted with "mobile to mobile" Selcall option cannot have scanning option.

6. Mobiles fitted with "mobile to mobile" Selcall option cannot have the timed display option.

7. Mute defeat and economiser. When mute is defeated economiser stops.

1.5 OPERATING INSTRUCTIONS AND FEATURES



1.5.1 INDICATORS AND DISPLAY

1.5.1.1 TX Indicator

The red TX LED is illuminated continuously when the transmitter is operating, and flashes when a call has been queued by a selcall request. (See Section 1.5.4.12).

1.5.1.2 Busy Indicator

The amber LED is illuminated continuously whenever a signal is detected or the mute level has been reduced to zero. This LED will also flash if the economiser is active. (See Section 1.5.4.4).

1.5.1.3 Power-on Indicator

This is a green LED which is illuminated when the radio is turned on.

1.5.1.4 Eight Digit LED Display

This display is divided into three main sections as described below.

a) Channel

The righthand section of the display is used to display channel number information.

b) Mode-Status

This section of the display is used for special messages including current mode of operation of the mobile, selcall codes, scan information and error message.

c) Level

This section of the display is reserved entirely for the display of mute level (see Section 1.5.2.1.3), transmitter RF power level (see Section 1.5.4.7) or the keyboard shift indicator (see Section 1.5.2).

1.5.2 **CONTROLS**

The controls can be divided into two major groups. Group 1 includes all controls responsible for operation of basic radio functions. Group 2 covers controls which provide selection of special functions.

Secondary (Shifted) Functions

It should be noted that some keys have a dual function which enables them to be used in both groups. The functions executed by these keys are accessed by use of the shift key "F" (16). This key will toggle the keyboard between the normal mode and shifted mode. The shifted mode is indicated by a minus sign (" - ") in the "level" section of the display(3).

Keypad (1)

A number of functions require data to be entered before operating a particular function key. This data is entered using the keys 0-9 of the keypad.

When the first numeric key is pressed, the display will automatically be cleared and the selected digit will appear flashing in the rightmost display position. As further digits are entered, the contents of the display will scroll to the left and the new digit will be appended to the right of the number.

1.5.2.1 **Group 1 Controls**

1.5.2.1.1 **Power On/Off Key** (12)

This key switches the mobile on and off with alternate operations. The green power indicator LED (6) is illuminated when the transceiver is on.

1.5.2.1.2 **Volume Controls** (7 and 8)

Pressing the volume "+" key (8) will result in increased audio level from the loudspeaker.

Pressing the volume "-" key (7) decreases the audio level.

Volume may be adjusted in 16 discrete levels of approximately 4dB each. If the receiver is muted when the volume is adjusted, the mute will automatically open to permit setting of the audio level to a comfortable listening level.

1.5.2.1.3 **Mute Controls** (10 and 11)

Pressing the mute "+" key (10) increases the signal threshold level of the receiver (i.e. increases the received signal level required to unmute the receiver) and display the new mute setting.

Pressing the mute "-" key (11) decreases the signal threshold level.

The mute may be adjusted in 8 discrete levels. As the mute is being adjusted, the level will appear in the "level" section of the display. (0 = minimum level). The level is displayed for approximately 2 seconds before clearing.

If the mobile is fitted with fixed mute, pressing either mute key will display, but not alter, the pre-programmed level.

If the talk-through option is fitted and active, pressing either mute key will display, but not alter, the power-on mute level (see also Section 1.5.4.11).

1.5.2.1.4 **Clear Display Control** (2)

Pressing the "CL" key (2) will clear the entire 8 digit display (3). This is useful for cancelling any data incorrectly entered from the keypad (1).

1.5.2.1.5 **Channel Selection** (17)

Select the required channel number by pressing the appropriate digit keys on the keypad (1). Pressing the "CH" (17) key completes the channel selection procedure and the selected channel will appear continuously in the "Channel" section of the display.

Any attempt to select an invalid or unavailable channel, or to change channels while on transmit or while scanning is active will be indicated by a series of beeps and the word **"Error"** will temporarily appear in the display. The radio will then revert to the last selected channel.

Pressing the "CH" key without entering a channel number from the keypad will re-display the currently selected channel or mode of operation of the mobile. (e.g. scanning).

1.5.2.2 **Group 2 Controls**

These keys provide operational control of a number of special facilities and options:

The correct operation of these keys to control special options is described in detail under the appropriate heading in the "options" section 1.5.4. These options include:

a) Transmitter power level (See Section 1.5.4.7)
b) Manual economiser (See Section 1.5.4.4)
c) C.T.C.S.S. (See Section 1.5.4.10)
d) Channel scanning (See Section 1.5.4.8)
e) Selective call (See Section 1.5.4.12)

1.5.3 **STANDARD FACILITIES AND FEATURES**

The following facilities are provided as standard on all 91 mobiles.

1.5.3.1 **Mute Defeat**

The mute may be defeated by operation of the "F"(16) key then the "mute +"(10) key. To return to normal mute operation press the "F"(16) key then the "Mute -"(11) key.

This function will be inactive if a community repeater channel is selected.

The mute defeat function may not be fitted on all mobiles, and if omitted the above operations will result in an **"Error"** indication.

1.5.3.2 **Mobile Channel Display**

The operator may determine which channels have been installed in the mobile by entering the following key sequence -

a) Press the shift key "F" (16)
b) Press the key with the designated secondary function "CH DISP" (digit 0 of the keypad (1)).

The above operation will sequentially display every valid channel in the "channel" section of the display (3) at a rate of approximately 1 channel per second. In addition the characters **"CH"** will appear in the "mode-status" section of the display.

Pressing any key while the sequential display is active will terminate the display process. If the key does not normally alter the "mode-status" or "channel" sections of the display (i.e. volume, mute, shift or send keys) the display will remain frozen on the last value displayed.

NOTES:-

1) This function does not change the current channel of the mobile, or in any other way alter the mode of the mobile.

2) This function may not be selected when the economiser is active or scanning is enabled. Any such attempt will result in an error response.

3) An error message will result if Channel Display is attempted with preceding data.

1.5.3.3 **Fault Display**

A number of parameters are continually monitored by the mobile to ensure correct operation. If a fault condition is detected, a fault code is saved. This code may be displayed by entering the following key sequence.

a) Press the shift key "F" (16)
b) Press digit 9 on the keypad (1)

If no fault has been detected, the display will not change. If a fault is detected, the fault code will be displayed as a four digit number preceded by the character **"F"**, and the code will be cleared. The last digit of fault code refers to software errors while the second last digit represents hardware errors. The remaining two digits will always be zero. The cause of the fault condition is determined from the table on the following page.

If a "TX Power Range/SWR" error is detected a decimal point will appear in the righthand side of the display to warn the operator that a problem may exist which is causing an excessive SWR. The decimal point will disappear when the fault code has been displayed and the fault condition no longer exists.

NOTE:- Fault codes do NOT necessarily indicate that a fault exists in the mobile but rather should ONLY be used as a relative indication of system operation as the program is designed to minimise or eliminate the effect of these faults on the performance of the mobile.

FAULT CONDITION TABLE

Disp Value	TX Power Range/SWR	10V Reg. Supply	PLL VCO Range	Out of Lock
0				
1				•
2			•	
3			•	•
4		•		
5		•		•
6		•	•	
7		•	•	•
8	•			
9	•			•
A	•		•	
b	•		•	•
C	•	•		
d	•	•		•
E	•	•	•	
F	•	•	•	•

HARDWARE CODE

Disp Value	Stack Underflow	A/D Conv. Overflow	Buffer Full	Invalid Command
0				
1				•
2			•	
3			•	•
4		•		
5		•		•
6		•	•	
7		•	•	•
8	•			
9	•			•
A	•		•	
b	•		•	•
C	•	•		
d	•	•		•
E	•	•	•	
F	•	•	•	•

SOFTWARE CODE

1.5.3.4 **Mobile Self Test**

In addition to the parameters checked by the mobile and displayed as described above, a number of additional self test facilities have been included. The response by the mobile as a result of these tests under fail conditions will vary in accordance with the severity of the fault.

1.5.3.5 **Promcheck**

A number of checks are carried out continually to ensure the validity of the information programmed into the EPROM. Should the contents of the EPROM be considered incorrect at any time, the mobile will immediately switch off and may not be switched on again until the faulty EPROM has been replaced.

1.5.3.6 **RAM Integrity**

The RAM in the central control processor is continually checked, and if found to be invalid the mobile will be switched off and all the RAM data will be re-initialised to the initial power up state.

If this occurs, all previously set data (i.e. channel, volume, mute, power, scan groups, CTCSS tones and selcall codes) will be lost, and default power up conditions will apply when next switched on.

1.5.3.7 **Control Head Test**

While the mobile is switched on, a command is continually sent to the control head approximately every 500mS to ensure that serial data is not being corrupted and that the control head is functioning correctly. If the central control processor fails to receive two successive acknowledges from the control head the mobile will switch off.

Note that data will not be lost as is the case with the RAM check when the mobile is again switched on.

1.5.3.8 **RF Power Output on Receive**

If any RF power is detected from the transmitter while in the receive mode on a simplex mobile, the mobile will immediately be switched off to prevent possible damage or interference to other users.

To assist in maintenance, a square wave of approximately 500Hz will appear on pin 10 of the control processor when the mobile is switched off as a result of this fault.

1.5.4 **CUSTOMER OPTIONS**

The facilities described in this section are optionally enabled and characterised when the mobile is ordered.

1.5.4.1 **Channel Display**

The user has the option of specifying continuous or intermittent channel display. If intermittent option is selected, the display will automatically clear approximately 5 seconds after the display was last changed. In the continuous mode, the display may only be cleared manually.

1.5.4.2 **8 Hour Timer**

If this option is selected an 8 hour "switch off" timer will be enabled. When the timer expires a short audible tone will be emitted as a warning to the operator. If no action is taken the mobile will then automatically switch off after a further 20 seconds.

This timer function will be suspended while the mobile is transmitting, and will automatically reset to 8 hours at the end of each operator initiated transmission, (i.e. operating the transmit switch on the microphone, or generating a selcall transmission with the SEND key). An automatic acknowledge transmission following reception of a selcall address code does not reset the 8 hour timer.

1.5.4.3 **Fixed/Variable Mute**

The mobile may be ordered with either fixed or variable mute. In both cases the mute level may be displayed (see section 1.5.2.1.3) and the mute may also be defeated (see section 1.5.3.1).

The mute will automatically revert to fixed level when the talk-through option is active (see Section 1.5.4.11).

1.5.4.4 **Economiser**

This option provides a method of reducing the average current consumption during periods when the channel is inactive (no signal present) and the

microphone is on the cradle. This is achieved by switching the internal 10V regulated supply at a rate of approximately 100mS on and 400mS off.

If the economiser is active, it will be temporarily disabled when either the following conditions occurs:-

a) The microphone is removed from the cradle
b) A signal is received.
c) PTT is activated.
d) Mute is disabled.

Approximately 3 seconds after these conditions cease to exist the economiser will resume operation.

The economiser may be activated as described below depending on the mode selected when ordering. When the economiser is active the amber "BUSY" indicator (5) will flash.

Per Channel

In this mode the economiser will automatically be activated when a channel is selected which includes the economise option. When a channel is selected which does not include this option, the economiser will be disabled.

All Channels

This is a special case of the per-channel mode described above where all channels in the mobile include the economise option.

Operator Selectable

In this mode, the operator may manually enable and disable the economiser on channels which include this option. This is achieved by entering the following key sequence.

NOTE: ENSURE SCAN FUNCTION IS OFF BEFORE ATTEMPTING TO ENABLE THE ECONOMISER.

a) Press the shift key "F" (16)
b) Press the key with the designated secondary function "ECON" (digit 4 of the keypad (1)).

This operation will switch the economiser on or off.

NOTES:

1) The economiser can not be switched on while scanning is active or while on a voting channel.

2) When the economiser is active, the channel display function (section 1.5.4.1) and scan channel display functions (section 1.5.4.8.3) are inoperative.

1.5.4.5 **Transmit Limit Timer**

When this facility is included, all transmissions from the mobile will be limited to a pre-determined time which is programmed into the mobile before delivery, typically 1,3,5 or 10 minutes.

If the PTT switch on top of the microphone is depressed for longer than the programmed time the transmission will be terminated and the following warnings are given.

a) **Visual Warning**
The "TX" indicator is extinguished.

b) **Audible Alarm**
While the switch on top of the microphone is depressed after the transmit limit timer has expired, a continuous audible tone is emitted from the speaker.

Associated with the transmit limit timer is an optional Re-PTT timer which is started on release of the PTT switch if the transmit limit timer has expired.

While this timer is operating an audible alarm will sound if the PTT switch is operated and the transmitter will not be activated. This prevents re-transmission for a fixed period immediately following the transmit limit period. A short audible indication will be given when the Re-PTT timer expires.

Note that the Re-PTT timer function will be disabled if the timer value is set to zero (the normal case).

1.5.4.6 **Transmit Inhibit**

This option prevents the transmitter from operating if the receiver mute is opened either manually or due to the presence of carrier on the receive frequency.

If the PTT switch is operated while this condition exists, an audible alarm will be emitted to warn that no transmission is taking place. (This alarm tone will not be emitted if the scan mode is active and a signal is being received but the transmitter will still be inhibited).

Note: This TX inhibit option is independent of a similar inhibit which applies to manual selective call transmission (see section 1.5.4.12).

1.5.4.7 **Transmit Power**

Transmitter power level may be set to either low, medium and high power in a number of ways depending on the option selected.

Per Channel

If this option is ordered, the power level may be defined for each channel in the mobile. In this case the power level will be set to the required value whenever the channel is changed (either manually via the Channel key, or automatically as in scanning or voting). If no power level is defined for the new channel the power level will remain unaltered.

Low, Medium and High Power Fixed

If this option is selected the transmitter power level will be fixed at the specified value under all conditions.

Operator Selectable

When this option is enabled, the power level may be altered by the operator at any time by entering the following key sequences -

a) Press the shift key "F" (16)
b) Press the key with the designated secondary function corresponding to the power level "LOW", "MED" or "HIGH" as required. (digits 1,2 and 3 of the keypad (1) respectively).

The specified power level will remain selected until either manually altered again, or a channel is selected which has a defined "Per Channel" power level.

When setting the transmitter power, the defined level (1,2 or 3) will appear in the "level" section of the display. The power level will also be displayed while on transmit.

An **Error** display will result if data is entered immediately prior to the power level function.

Proportional to Received Signal

This option may only be enabled on duplex mobiles and will automatically adjust the transmitter power level to minimise current consumption, and reduce possible intermodulation problems while still maintaining an acceptable signal level at the base end. A degree of hysterisis is built into the switching points to prevent chopping.

1.5.4.8 **Scanning**

This option allows a number of channels to be combined together into groups which may then be continually monitored for traffic.

A maximum of 5 independent scan groups may exist numbered 1 to 5.

Each scan group may contain from 1 to 10 "basic" channels plus one optional "priority" channel.

Groups 1,2 and 3 are fixed (ROM based) and the channels required in any of these groups must be specified when ordering. Groups 4 and 5 are operator configurable (RAM based). The channels for these groups may be defined, altered or deleted by the operator from the keypad (1).

Only one scan group may be selected at any time. The selected group is called the "current" group and all scan commands refer to that group.

A scan group is considered empty if there are no basic channels defined (although a priority channel may exist).

Voting channels can not form a part of a scan group.

1.5.4.8.1 **Operating Modes**

Scanning is capable of operating in two modes as described below. The required mode must be specified when ordering.

1.2 ELECTRICAL

1.2.1 GENERAL

The mobile equipment can be divided into three main parts, i.e., RF Section (including audio processing), Central Control and Signalling. A block diagram of the mobile unit is given below in figure 1.1.

The RF section consists of a receiver, synthesiser and a transmitter. The synthesiser provides the receiver local oscillator signal and the transmitter modulated drive signal.

The central control unit contains all the logic and memory storage necessary to execute the required signalling sequences and control of the mobile.

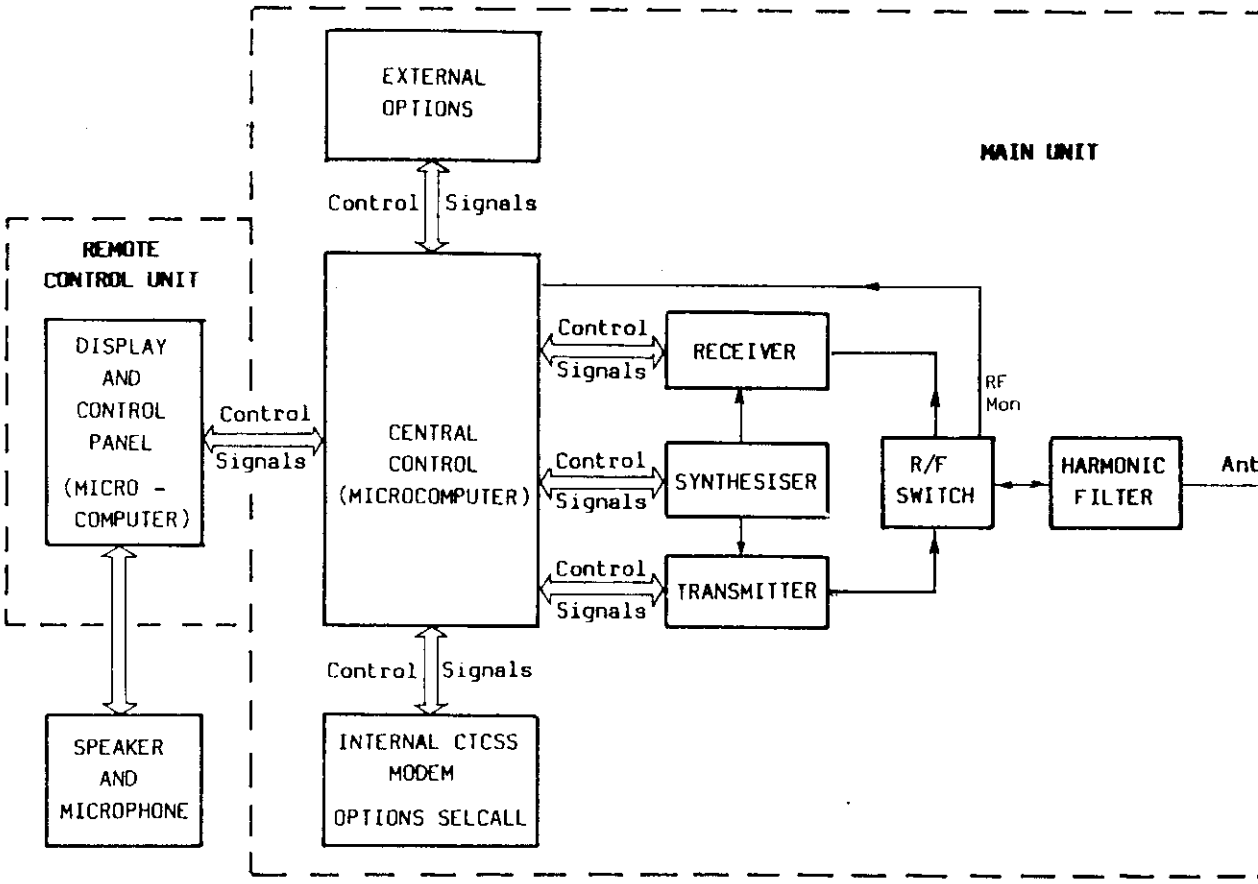


Figure 1.1 Mobile Unit Block Diagram

Occupied Channel Mode

In this mode the mobile will scan all channels in the current scan group until either of the following test conditions occur -

a) A signal is found on a basic channel (with the correct C.T.C.S.S. tone if applicable), or
b) A signal is found on the priority channel (with the correct C.T.C.S.S. tone if applicable).

Vacant Channel Mode

In this mode the mobile will scan for either of the following conditions.

a) A basic channel is found with no signal, or
b) A signal is found on the priority channel (with the correct C.T.C.S.S. tone if applicable).

1.5.4.8.2 **Priority Channel**

One channel may optionally be included in each scan group as a priority channel, in addition to the ten basic channels.

This channel differs from the basic channels in the following respects.

a) In receive, the priority channel is always tested for the presence of a signal, and C.T.C.S.S. tone if applicable, irrespective which operating mode is enabled.

b) While scanning, the priority channel is examined between each basic channel.

c) When scanning has stopped on a basic channel and the microphone is on the cradle, the priority channel is periodically checked approximately every 2 seconds. If a signal is found on the priority channel, with the correct C.T.C.S.S. tone if applicable, the receiver will leave the basic channel and switch to the priority channel. When this occurs, a short tone will be emitted.

d) When the microphone is removed from the cradle while scanning the priority channel will be selected.

1.5.4.8.3 **Operation**

Scanning will only be active if the microphone is in the cradle and the test conditions specified above (see section 1.5.4.8.1) do not exist.

The mobile will stop on a channel when any of the above conditions are detected. Scanning will then recommence approximately 3.5 seconds after the test condition disappears.

If the microphone is removed from the cradle when scanning has stopped on a channel, the mobile will remain on that channel. Should no activity occur for approximately 30 seconds in this state (i.e. no transmission or test condition) a continuous tone will be emitted. If this occurs, scanning will resume immediately the microphone is returned to the cradle. Scanning will resume approximately 3.5 seconds after the microphone is returned to the cradle if the continuous tone has not commenced.

If scanning is active when the microphone is removed from the cradle the mobile will stop on either -

a) The priority channel (if one is defined for the current scan group), or
b) If no priority channel exists, the channel selected by the operator immediately prior to scanning.

1.5.4.8.4 **Scanning Control**

The following functions control the operation of the scan option.

NOTE: Scan functions 2-10 below cannot be executed while on Tx.

1) **Scanning Off/On:**

a) TO INITIATE THE SCAN FUNCTION - Press the "SCAN" key (15).
The scan function is now initiated. This will be indicated by **"SC-"** followed by the group number. e.g. **"SC-1".**
If the selected scan group is empty two dashes will be displayed (i.e. " -- ") and scanning will not be started.
Notes: 1) Scanning cannot be started if the mobile is currently on a voting channel, on transmit, or if talk-through is active.
2) If the economiser is operating when scanning is activated, the economiser will be switched off.

b) TO TERMINATE THE SCAN FUNCTION - Press the "SCAN" key (15).
The mobile will automatically revert to the last selected channel.

2) **To Display The Current Scan Group:**

NOTE: ENSURE SCAN AND ECONOMISER FUNCTIONS ARE OFF BEFORE PROCEEDING.
a) Press the shift key "F" (16).
b) Press the key with the designated secondary function "GRP" (digit 6 of the keypad (1)).
The current scan group will now appear in the display e.g. **"G-1"** showing group 1 is the current group.

3) **To Change the Current Scan Group:**

NOTE: ENSURE SCAN AND ECONOMISER FUNCTIONS ARE OFF BEFORE PROCEEDING.
a) Enter the required group number by depressing the corresponding key number on the keypad (1).
b) Press the shift key "F" (16).
c) Press the key with the designated secondary function "GRP" (digit 6 of the keypad (1)).
The required scanning group has now been selected and will become the current scan group.

4) **To Display Channels In Current Scan Group:**

NOTE: ENSURE SCAN AND ECONOMISER FUNCTIONS ARE OFF BEFORE PROCEEDING.
a) Press the shift key "F" (16).
b) Press the "SCAN" key (15).
c) All channels in the current scan group will be displayed consecutively e.g. for scan group one, **"S-1"** will appear in the "mode-status" section of the display while the channels in that group will appear in the channel section of the display at a rate of 0.5 - 1.0 second per channel.

5) **To Enter A Channel In The Current Scan Group:**

NOTE: ENSURE SCAN AND ECONOMISER FUNCTIONS ARE OFF BEFORE PROCEEDING
a) Enter the required channel via the keypad(1)
b) Press the "SCAN" Key (15).
c) If the channel number disappears from the display the channel has been accepted into the memory of the current scan group.
d) If **"FULL"** appears in the display it indicates that the memory is full for this group and the entry has been rejected. If it is still required to add the channel to the memory for this group an existing channel must be deleted. Refer 4) above for displaying channels in current group. Then to delete unwanted channel proceed as per 6) below.
e) If **"GroUP"** appears in the display it indicates that the current group is a fixed programme group and cannot be altered by the user. Thus the required channel entry has been rejected.

6) **To Delete A Channel From The Current Scan Group:**

NOTE: ENSURE THE SCAN AND ECONOMISER FUNCTIONS ARE OFF BEFORE PROCEEDING.
a) Enter the number of the channel to be deleted on the keypad (1).
b) Press the shift key "F" (16).
c) Press the "SCAN" key (15).
d) If the number of the channel disappears from the display the deletion has been accepted.
e) If **"GroUP"** appears in the display, it indicates that the group is a fixed programme group and cannot be altered by the user. The deletion has been ignored.

7) **To Clear All Channels From The Current Scan Group:**

NOTE: ENSURE THE SCAN AND ECONOMISER FUNCTIONS ARE OFF BEFORE PROCEEDING.
a) Enter the number "0" from the keypad (1).
b) Press the shift key "F" (16).
c) Press the "SCAN" key (15).
d) If the "0" disappears from the display then all channels in the current scan group (with the exception of the priority channel) have been deleted.
e) If **"GroUP"** appears in the display, it indicates that the group is a fixed programme group and cannot be altered by the user. The deletion has been ignored.

8) **To Display the Priority Channel In Current Scan Group:**

NOTE: ENSURE SCAN AND ECONOMISER FUNCTIONS ARE OFF BEFORE PROCEEDING
a) Press the Shift key "F" (16).
b) Press the key with the designated secondary function "PTY" (digit 5 of the keypad (1)).
c) The priority channel of the current scan group will now be displayed e.g. **"P-1 12"** indicates channel 12 is the priority channel of group 1.

9) **To Enter Or Alter The Priority Channel Of The Current Group:**

NOTE: ENSURE THE SCAN AND ECONOMISER FUNCTIONS ARE OFF BEFORE PROCEEDING.
a) Enter the number of the required priority channel on the keypad (1).
b) Press the shift key "F"(16).
c) Press the key with the designated secondary function "PTY" (digit 5 of the keypad (1)).

d) If the channel number disappears from the display the entry has been accepted into the memory.
e) If **"GroUP"** appears in the display it indicates that the group is a fixed programme group and cannot be altered by the user. The entry has been rejected.

10) **To Delete The Priority Channel:**

NOTE: ENSURE THE SCAN AND ECONOMISER FUNCTIONS ARE OFF BEFORE PROCEEDING.
a) Enter the number "0" from the keypad (1).
b) Press the shift key "F"(16).
c) Press the key with the designated secondary function "PTY" (digit 5 of the of the keypad (1)).
d) If the "0" disappears from the display the priority channel has been deleted from the current scan group.
e) If **"GroUP"** appears in the display, it indicates that the group is a fixed programme group and cannot be altered by the user. The deletion has been ignored.

1.5.4.8.5 **Scanning Displays**

The following messages related to scanning may appear in the "mode-status" section of the display.

"SC-g"	Scanning is active. "g" is the current group number (1 to 5)
"-----n"	Scanning has stopped on a channel. (The channel number 'n' will appear in the "channel" section of the display).
"P----n"	Scanning has stopped on the priority channel. (The channel number 'n' will appear in the "channel" section of the display).
" — "	The current scan group is empty (no basic channels exist) or the priority channel does not exist.
"GroUP"	This message indicates that the operator has attempted to alter a fixed scan group by inserting or deleting channels (ie. the current group is 1,2 or 3).
"FULL"	An attempt was made to enter a new channel into the current (user definable) group which already contains 10 channels.
"S-g"	The current scan group "g" (1 to 5) contains the channel shown in the "channel" section of the display.
"P-g"	The priority channel of the current scan group "g" (1 to 5) is displayed in the "channel" section of the display.
"G-g"	Group number "g" (1-5) is defined as the current scan group.

1.5.4.9 **Voting**

A number of frequencies may be combined onto a single channel to generate a "Voting Channel".

The word "channel" is used here to indicate the channel selected by the operator as shown on the display, and does not indicate the frequency selected by the voting system.

The minimum number of frequencies associated with a voting channel is two, while the maximum number is equal to the number of single frequency channels normally available.

Each frequency included in a voting channel will decrease the number of available channels in the mobile by one.

Voting is activated automatically when a "voting" channel is selected.

Receiver Operation

In the receive mode and when no carrier is present, the receiver will continuously scan all the frequencies associated with the voting channel until a carrier is detected.

When a carrier is detected each frequency will be checked once more and then the frequency on which the highest signal strength was recorded will be permanently selected.

The scanning operation will recommence when the carrier vanishes.

The "variable hang time" (refer mute operation Section 3.1.4.1) is not engaged in the voting mode, and is limited to approximately 50 msecs maximum. This reduces time delays during voting operation.

Transmit Operation

When the PTT button is activated, the transmitter will be programmed as follows:-

a) To the transmit frequency corresponding to the receive frequency on which the last highest signal strength was recorded,

or, if no signal has been received since selecting a voting channel,

b) to the transmit frequency nominated with the first channel in the voting group of channels.

NOTES:

1. While voting and scanning may appear in the same mobile, a voting channel cannot be a member of a scan group.
   If required, the individual frequencies of the voting channel may also appear as separate channels which may be included in a scan group.
2. Voting and Economiser are mutually exclusive as the economiser is switching the radio receiver on and off, thereby not allowing the radio to vote. However, again it is quite practical to have these options together in the same radio on different channels.

1.5.4.10 C.T.C.S.S. and Community Repeater

This option allows for a sub-audible tone to be used in a number of combinations to provide "quiet mobile/quiet base" operation. C.T.C.S.S. may be enabled in the following forms -

a) C.T.C.S.S. Encode only
b) C.T.C.S.S. Encode with Reverse Tone Burst (RTB)
c) C.T.C.S.S. Encode and decode
d) C.T.C.S.S. Encode and decode with RTB
e) Community Repeater

This option is enabled on a per-channel basis, however, the operating mode will be identical for each C.T.C.S.S. channel. A table of the available C.T.C.S.S. tones is given in part 2 of the handbook, section 3.3.4.

C.T.C.S.S. Encode Operation

When the microphone is removed from the cradle and the PTT switch is operated, the sub-audible tone specified for that channel will modulate the transmitter in addition to the normal audio.

If the PTT switch is operated prior to removing the microphone from the cradle, the encode function will be inhibited. This feature is provided as a test facility.

Note that if a selcall transmission is generated on a C.T.C.S.S. channel, the C.T.C.S.S. tone will be transmitted for the duration of the selcall tone burst irrespective of the condition of the microphone.

C.T.C.S.S. Decode

If the microphone is on the cradle and a carrier is received, the "BUSY" LED will turn on but the receiver will remain muted until the correct sub-audible tone is detected.

If the microphone is off the cradle, the C.T.C.S.S. decode function will be disabled and the receiver will unmute on carrier in the normal manner. The exception to this is when community repeater option is in use.

RTB

If this option is fitted and the C.T.C.S.S. tone is being transmitted, the transmitter will remain active for a short period (typically 150mS) before the tone is disabled (ie. on release of PTT, or the end of the selcall transmission when the microphone is in the cradle). During this period, the C.T.C.S.S. tone will continue to be sent with a phase shift of 120 degrees.

This facility is provided to maintain compatibility with existing equipment.

Community Repeater

This option is a variation of the C.T.C.S.S. facility with the following operational characteristics:

a) The receiver will remain muted unless a signal is received with the correct C.T.C.S.S. tone (irrespective of the state of the microphone).

b) A continuous audible alarm tone will be emitted from the speaker if the operator attempts to transmit while a carrier is being received with the incorrect, or no C.T.C.S.S. tone.

c) The mute defeat facility will be inoperative on community repeater channels and will automatically be disabled if active when the community repeater channel is selected. (See Section 1.5.3.1.)

d) If selcall send is available on the community repeater channel, the call send will be inhibited if the channel is occupied. (Error alarm will be indicated).

C.T.C.S.S. Tone Change/Display

The current C.T.C.S.S. tone code may be displayed and optionally altered from the keypad. In addition the C.T.C.S.S./Community Repeater option may be temporarily disabled on the current channel.

1. **To Display the Current C.T.C.S.S. Tone Code**

a) Press the "SITE" key (14)
b) The message **"SItE"** will appear in the "mode-status" section of the display with the tone code number in the "channel" section of the display. (See table in Part 2 of this handbook, Section 3.3.4).

If the mobile is not on a C.T.C.S.S channel or is on transmit an **Error** message will appear in the display.

2. **To Change the C.T.C.S.S. Tone Code**

a) Enter the code number of the required tone (1-37) from the keypad (1)
b) Press the "SITE" key (14)
c) The C.T.C.S.S. tone of the current channel will be changed and the new code will be displayed. The selected tone will remain valid until it is either changed using the above procedure, or a different radio channel is selected.
An **Error** message will result if the mobile is not on a C.T.C.S.S. channel, is on transmit, the variable via keypad option is not selected, or C.T.C.S.S. was previously disabled.

3. **To Disable C.T.C.S.S. on the Current Channel**

a) Enter the number "0" from the keypad (1).
b) Press the "SITE" key (14)
c) C.T.C.S.S. will temporarily be disabled on the current channel and the code "0" will be displayed.
An **Error** message will result if the mobile is not on a C.T.C.S.S. channel, is on transmit, the variable via keypad option is not selected, or C.T.C.S.S. was previously disabled.

NOTE- C.T.C.S.S. may only be re-enabled on this channel by re-selecting the channel.

1.5.4.11 **Mode**

The mobile may be ordered to operate in any one of three modes as described below.

Simplex

In this mode of operation the mobile may not transmit and receive simultaneously (ie. when the PTT switch is operated the receiver will be disabled and the transmitter will be enabled).

Duplex

If this mode is selected, a second VCO will be included in the mobile. This option will not disable the receiver when the PTT switch is operated allowing simultaneous transmit and receive operations on different frequencies.

Talk-Through

In the talk-through mode the mobile operates in a duplex mode and the transmitter will automatically be activated when a signal is detected (with the correct C.T.C.S.S. tone if applicable) which is above the mute threshold. When the signal disappears, the transmitter will remain active for a further 750mS.

The talk-through mode may be enabled or disabled by the operator by entering the following key sequence-

a) Press the shift key "F"(16)
b) Press the key with the designated secondary function "TTR" (digit 8 of the keypad (1)).

While in the talk-through mode the message **"t-t"** will appear in the "mode-status" section of the display and the mute will revert to fixed level (if variable mute option is selected). When talk-through is de-activated, the original mute level will be restored.

While talk-through is active, all talk-through traffic may be monitored by the operator of the mobile, however, the PTT function will be disabled.

NOTES:

1) Scanning is not available with Talk-Through.

2) If C.T.C.S.S. is selected on a talk-through channel, it will operate as described in Section 1.5.4.10 and will not operate in a duplex encode/decode mode. C.T.C.S.S. is available in either Encode Only or Decode Only for Duplex and Talk-Through versions.

1.5.4.12 **Selcall**

This option allows the mobile to be used in tone sequential signalling systems employing a number of signalling formats. Either CCIR, EEA or ZVEI tone sets may be specified. Various combinations of the following facilities are offered:-

a) Standard Call Decode - Fixed Code
   - Variable Code
b) Urgent Call Decode
c) Alarm Decode - Alarm on, Alarm off, or
   - Timed Alarm
d) Group decode for Standard or Urgent Call.
e) Automatic Number Identification - Pre transmit
   - Post transmit
f) Status - Memory
g) Base Call - Fixed Code
   - Variable Code
h) 5 or 7 tone encode (5 tone decode)

The combination of facilities required is specified by digits 12 to 15 of the software code (see Section 1.4.2). The tone period is specified by digit 10.

1.5.4.12.1 **Standard Call Decode**

When the mobile is on a selcall channel and the microphone is on the cradle, the "BUSY" indicator will be illuminated when a signal is received but the audio will remain muted until the standard call code is detected. When this occurs, the mute will open, a short audible alarm will sound, and the message **"CALL"** will appear in the "mode-status" section of the display. The call message will remain in the display until either the microphone is removed from the cradle or it is manually cleared.

After the code has been detected, the mute will operate as normal until the microphone is removed from the cradle and replaced, at which point the mobile will again return to the quiet mode.

If the standard call code is detected while the microphone is off the cradle, the audible alarm will sound; and the "CALL" message will re-appear in the display.

The standard call is always a 5-tone sequence irrespective of whether the system is 5- or 7-tones.

1.5.4.12.2 **Urgent Call Decode**

The operation of the urgent call facility is identical to the standard call decode described above with the following exceptions -

a) If the urgent call code is received while the microphone is on the cradle, continuous alarm tones will be emitted until the microphone is removed from the cradle. If the microphone is off the cradle, a short tone will be emitted.

b) The message **"UrGEnt"** is displayed in place of the word **"CALL"**, and the channel number is cleared from the display.
The urgent call code is a 5-tone sequence irrespective of the type of system (5- or 7-tones).

1.5.4.12.3 **External Alarm**

An external alarm output is also provided from the selcall hybrid. This output is TTL compatible and will drive one standard TTL load.

This Alarm output may operate in either an Alarm On/Off mode or an Alarm-timed mode. In both cases the output is controlled by special selcall codes.

Alarm-Timed Mode

In this mode, the alarm output will go to logic 1 when the selcall "Alarm-On" code is detected, and a 15 second timer will be started. The alarm output will return to logic 0 when either the 15 second timer expires, or the microphone is removed from the cradle.

Alarm On/Off mode

The alarm output will go to logic 1 when the selcall "Alarm-On" code is detected as for the timed alarm, however, in this mode the output will remain at this level until either an "Alarm-Off" code is detected, or the mobile is switched off at which point it will return to logic 0.

1.5.4.12.4 **Group Decode**

If the Group call option is enabled, both the Standard call and, where enabled the Urgent call facilities will respond to the group call tone "A", as a valid match to the expected tone.

The Group call code will not be accepted as part of either the Alarm-On or Alarm-Off codes and will be treated as an invalid decode.

1.5.4.12.5 **Automatic Number Identification (ANI)**

When selcall is enabled, the mobile I.D. (Standard call code) will be automatically transmitted every time the operator operates the PTT switch. The code may optionally be sent at either the beginning or the end of the transmission, and in the case of 7-tone systems, the last tone is always the status tone.

1.5.4.12.6 **Automatic Acknowledge**

If either a Standard call or an Urgent call code is received, this code will be re-transmitted immediately in response to the call without operator intervention.

In the case of 7-tone systems, the acknowledge to the standard and urgent call will also be followed by the status tone.

No acknowledge is sent in response to Alarm-On or Alarm-Off codes.

1.5.4.12.7 **Status**

The status option allows the user to alter the last tone of a 7-tone system to any value from 0 to 9. Status operates in a Memory mode and applies only to codes transmitted from the mobile.

The Status code may be changed by entering the following key sequence -

a) Enter the new status value required (0 to 9) from the keypad(1).
b) Press the "SEND" Key(13).
c) The status code will be permanently changed.

Memory mode

In this mode, the status digit entered with the above procedure will be stored in memory, and sent with all subsequent ANI and auto acknowledge code transmissions.

The status can not be transmitted when scanning is active.

1.5.4.12.8 **Mobile to Base calls**

On mobiles fitted with selcall, pressing the "SEND" key(13) without entering any data from the keypad will cause the mobile transmit (base call) code to be sent. This facility will operate on all channels (including non-selcall channels).

1.2.2 THE RECEIVER

The FM900 receiver is a double conversion superhetrodyne design with Intermediate Frequencies of 21.4MHz and 455kHz.

The receiver can operate with channel separations of 12.5kHz, 20kHz, 25kHz or 30kHz.

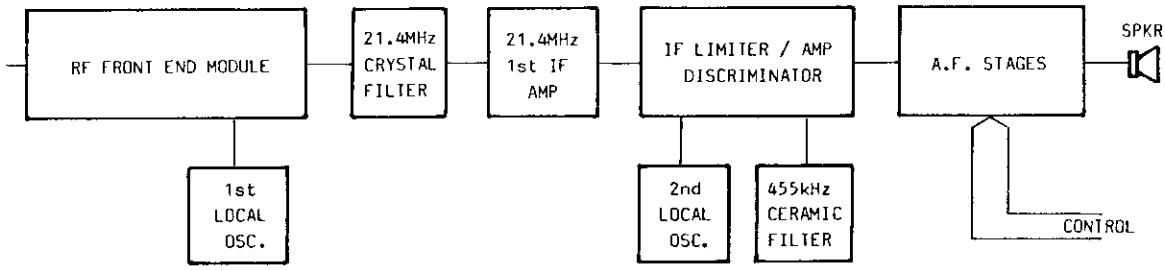


Figure 1.2 Receiver Simplified Block Diagram.

1.2.3 THE SYNTHESISER

A single loop frequency synthesiser is used to generate transmitter carrier frequencies and receiver first local oscillator frequencies.

A programmable divider is controlled by the central control microcomputer to phase lock a voltage controlled oscillator to an accurate crystal oscillator reference.

The synthesiser has a fast response time with extremely low noise and spurious components.

A failsafe lock detector is provided to enable the central control to monitor the status of the synthesiser. This ensures that no transmissions of spurious or unlocked signals will occur.

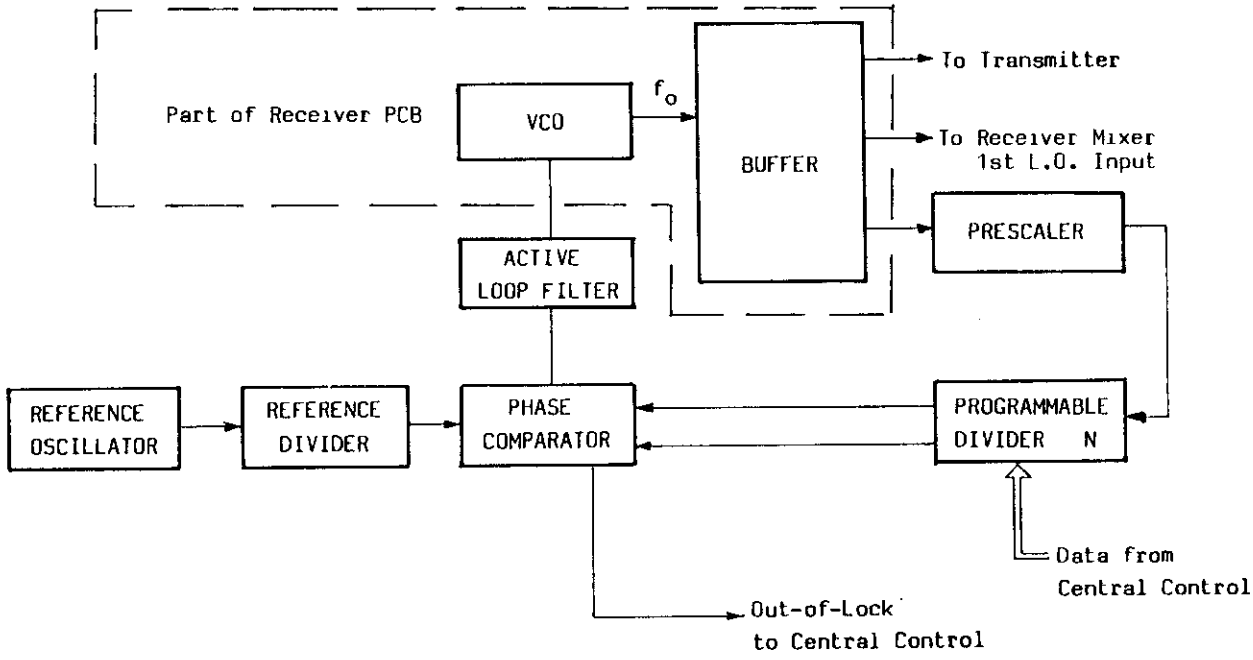


Figure 1.3 Frequency Synthesiser Block Diagram

If the "BUSY" indicator is on when the call is initiated (i.e. a signal is present or the mute level has been reduced to zero), the call request will be queued and the "TX" indicator will flash to indicate that the call is waiting to be sent. (This is independent of the transmit inhibit option described in section 1.5.4.6).

When the above condition disappears, the transmitter will activate and send the code in the normal manner.

Once the call has been sent, the "SEND" key will be ignored for approximately 10 seconds.

If a base call is attempted while scanning is active an **Error** message will be displayed and the request will be ignored.

1.5.4.12.9 **Mobile to Mobile calls (variable send code)**

If variable send code is selected the operator may temporarily alter the transmit code to enable other mobiles to be called. This is achieved by entering the following key sequence -

a) Enter the code of the mobile to be called (1 to 5 digits) on the keyboard(1)
b) Press the Shift key "F" (16)
c) Press the "SEND" key (13)

The digits entered progressively replace the last digits of the existing transmit code before the code is sent. If the "BUSY" indicator is on when the call is initiated the "TX" indicator will flash and the call will be queued as for mobile to base calls described above. After the transmission the transmit code will revert to the original code (e.g. If the transmit code was originally 12345, entering the sequence "9 8 F SEND" will send the new code 12398 after which the code will return to 12345).

Preceding zeros entered with the new code will be ignored by this function, so entering 00098 will have the same effect as entering 98 in the above example.

If a call attempt is made while scanning is active an **Error** message will be displayed and the request will be ignored.

1.5.4.12.10 **Variable I.D. (standard call) code**

If the variable standard call option is selected, the operator may permanently modify the I.D. (standard call) code by entering the following key sequence -

a) Enter the required new code (1 to 5 digits) from the keypad(1)
b) Press the Shift key "F" (16)
c) Press the key with the designated secondary function "ID" (digit 7 of the keypad(1)).

The entered value will completely replace the old code. If less than 5 digits are entered the new code will be completed with preceding zeros. (e.g. if the I.D. code was 12345, entering the sequence "9 8 F ID" will permanently alter the code to 00098).

1.5.4.12.11 **Display Base call code**

The base call code may be displayed by entering the following key sequence -

a) Press the Shift key "F" (16)
b) Press the "SEND" key (13)

The first five digits of the base call code will be displayed with leading zero's suppressed. The characters **"St"** will also appear in the "mode-status" section of the display.

1.5.4.12.12 **Display I.D. (Standard call) code**

The current I.D. code may be displayed by entering the following key sequence -

a) Press the Shift key "F" (16)
b) Press the key with the designated secondary function "ID" (digit 7 of the keypad (1))

The five digits of the I.D. code will be displayed with leading zeros suppressed. The characters **"Sr"** will also appear in the "mode-status" section of the display.

1.2.4 THE TRANSMITTER

The transmitter including the antenna change-over switch is fully solid state, delivering up to 25W c.w.

The transmitter power amplifier consists of a driver stage, the main output stage and harmonic filter.

A closed loop power control circuit maintains constant RF drive power to the output stage.

In the event of excessive temperature rise in the PA heatsink a temperature sensor is used to provide gradual power reduction to ensure safe operating levels.

Three preset dc controls are provided to enable setting of power to required output levels.

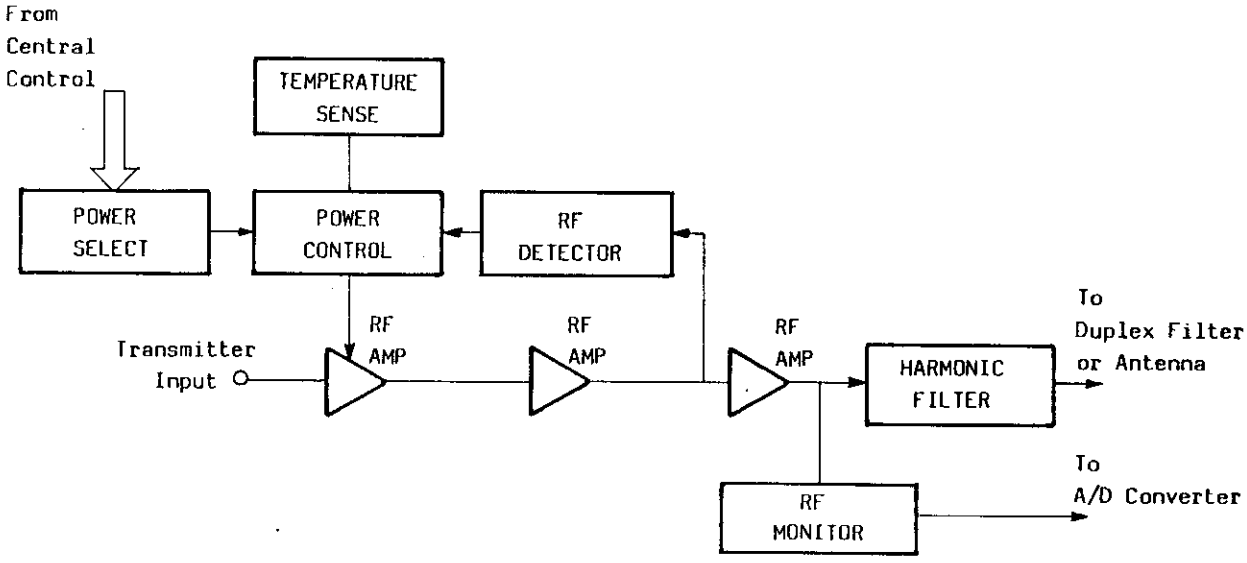


Figure 1.4 Transmitter PA Simplified Block Diagram

1.2.5 THE CENTRAL CONTROL

The central control is responsible for all logic sequences required by the system and so must interface with all appropriate sections of the equipment (refer figure 1.5). The control logic is provided by an 8-bit microcomputer. It is possible to update the control logic to cater for further facilities by simple reprogramming.

The transceiver communicates with the control unit via a half-duplex serial data link. The analogue to digital converter allows the central control logic to monitor six different analogue parameters within the equipment as shown in the diagram.

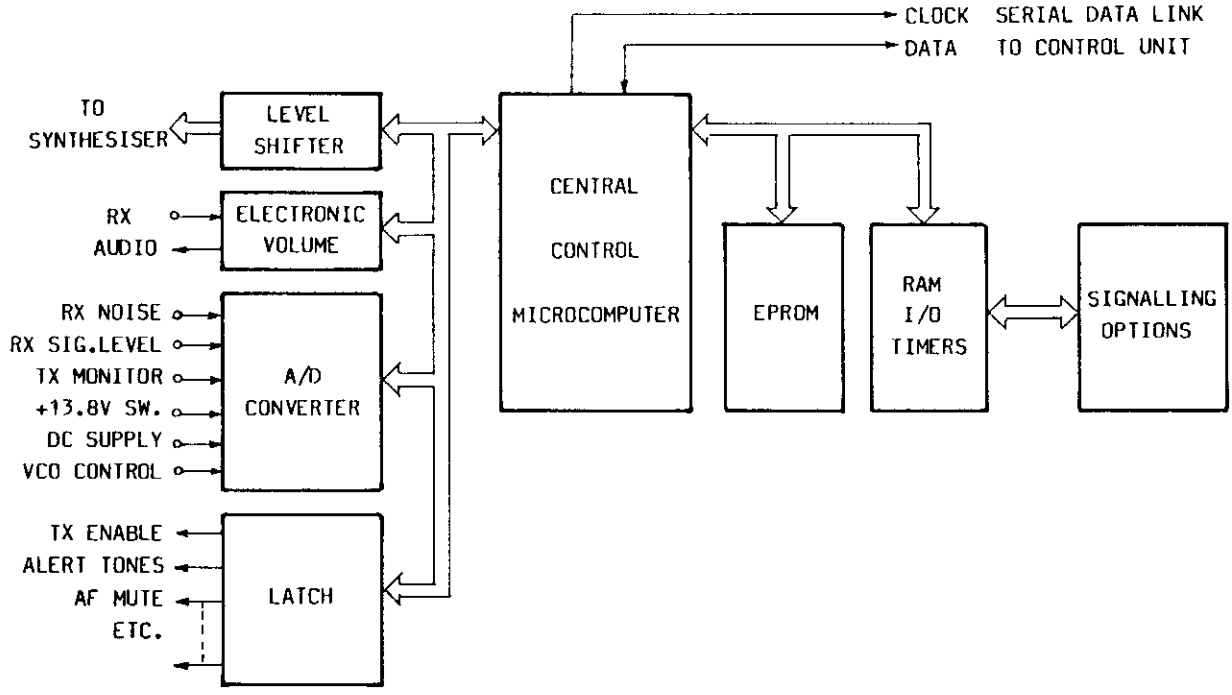


Figure 1.5 Block Diagram of Central and Data Control

1.3 MECHANICAL DESCRIPTION

1.3.1 THE MAIN MOBILE UNIT

The main mobile unit consists of a pressure diecast chassis containing 4 printed circuit board assemblies on two levels. These consist of the following functions:

(a) Receiver RF, receiver IF, receiver audio processing, power supply and synthesiser VCO.

(b) Central control logic, synthesiser, transmitter audio processing, A/D converter.

(c) Transmitter PA, antenna changeover, harmonic filter.

(d) Front panel remote interface.

The main chassis contains a central dividing shield which provides isolation between the synthesiser/central control logic and the receiver. The receiver and the control/synthesiser printed circuit boards are hinged to allow easy access for servicing.

Flexible flat cables are used to interconnect all the printed circuit assemblies. A locking 15-way connector is used to interconnect the main unit with the remote mobile control unit while a BNC connector is used for the mobile antenna connection.

A mounting fixture is provided which enables the main unit to be locked into position. It is then removable only with the aid of a special key.

1.4 CODING AND PROGRAMMING

The 900 mobile is characterised by a 12-digit hardware code and a 15-digit software code. These codes define the operating features and facilities of the mobile.

Each unit is programmed and tested with the customers requirements in accordance with the information specified by these codes prior to shipment from the factory.

NOTE: The information and tables presented in this section of the manual indicate possible operating combinations which may be installed in the mobile.
Availability of any required option should be confirmed with a Philips Radio Communication Systems sales branch prior to ordering.

1.4.1 HARDWARE PRODUCT CODE

A 12-digit product code is derived from the chart below. The first four digits (9502) are fixed and denote Australian manufacture. The remaining eight digits of the code detail the mobile type and frequency band (centre three digits), and optional hardware facilities (last five digits).

1	2	3	4
9	5	0	2

HARDWARE CODE TABLE

	5	6	7	8	9	10	11	12
	SERIES	MODEL	FREQ. BAND	CHANNEL SPACING	TEMP RANGE & STABILITY WATERPROOF KIT	SIGNALLING HARDWARE	SELCALL SYSTEM	OPTION
0		DUPLEX			10PPM -10°to+60° (STANDARD)	STD (NONE)	STD (LESS SELCALL)	STD
1		SIMPLEX			5PPM -30°to+60° (XTAL HTR. KIT)	CTCSS ENC ONLY	CCIR SELCALL	REV TONE BURST
2			E		WATERPROOF KIT	CTCSS ENC/DEC	ZVEI SELCALL	TALK THROUGH
3			B		WATERPROOF & XTAL HTR. KITS	SELCALL TYPE 1 NO CTCSS	EEA SELCALL	
4			A	25kHz		CTCSS ENC ONLY & SELCALL TYPE 1	EIA SELCALL	IGNITION BLANKER
5			T		2.5PPM -30°to+60° (TCXO KIT)	CTCSS ENC/DEC & SELCALL TYPE 1		
6			U			SELCALL TYPE 2 NO CTCSS	CCIR TYPE 2 ENC. ONLY	
7			W1		WATERPROOF & TXCO KITS	CTCSS ENC ONLY & SELCALL TYPE 2	ZVEI TYPE 2 ENC. ONLY	
8			W2	12.5kHz		CTCSS ENC/DEC & SELCALL TYPE 2	EEA TYPE 2 ENC. ONLY	
9	MOBILE						EIA TYPE 2 ENC. ONLY	

1.4.2 SOFTWARE OPTIONS CODE

The options fitted to the mobile are characterised by a 15-digit software code specified by the table on the following page. (For a detailed description of these options see Section 1.5).

SOFTWARE OPTION CODE TABLE

	1	2	3	4	5	6	7	8	9	10	11	12/13	14/15
	CHANNEL DISPLAY	MUTE	ECON.	Tx TIMER	Tx INH.	Tx POWER	SCAN	VOTING	CTCSS	TONE PERIOD	MODE	SELCALL ENCODE	SELCALL DECODE
0	INTERMITTENT	FIXED	N/R	N/R	N/R	25W	N/R	N/R	N/R	N/R	SIMPLEX		
1	CONTINUOUS	VARIABLE	REQ. ALL CHANNELS	1min	REQ. ALL CHANNELS	5W	VACANT, PRE-PROG. BLOCKS	REQ.	VARIABLE PER CHANNEL	100mS	DUPLEX		
2	INTERMITTENT & 8 HR TIMER		OPERATOR SELECT	3min		1W	OCCUPIED PRE-PROG BLOCKS		VARIABLE VIA KEY PAD	40mS	TALK THROUGH		
3	CONTINUOUS & 8 HR TIMER		PER CHANNEL	5min		OPERATOR SELECT	OCCUPIED, OPER SELECT PRE-PROG. BLOCKS		VARIABLE PER CHANNEL & R.T.B.	70mS			
4				10min		PER CHANNEL			VARIABLE VIA KEYPAD & R.T.B.	20mS		SEE TABLES	SEE TABLES
5									COMMUNITY RPTR. PER CHANNEL				
6						5-25W FIX. ALL CH.			VARIABLE VIA KEYPAD & COM.RPTR				
7													
8													

▨ these options are not available with Duplex or Talk-Through versions.

▨ This option is only available with Selcall Type 1

TYPE 1 & TYPE 2 SELCALL ENCODE FUNCTION (AUSTRALIA ONLY) - Col.12/13

SOFTWARE CODE NO.	STATUS	ANI CODE POSITION	SEND CODE	STATUS MEMORY	TONES PER CODE	DECODE
00	N	NA	V	NA	5	Y
01	N	S	F	NA	5	N
02	N	NA	F	NA	5	Y
03	N	S	F	NA	7	N
04	N	S	F	NA	7	Y
05	N	E	F	NA	5	N
07	N	E	F	NA	7	N
08	N	E	F	NA	7	Y
09	N	NA	F	NA	5	N
11	N	S	V	NA	7	N
12	N	S	V	NA	7	Y
15	N	E	V	NA	7	N
16	N	E	V	NA	7	Y
27	Y	S	F	Y	7	N
28	Y	S	F	Y	7	Y
35	Y	E	F	Y	7	N
36	Y	E	F	Y	7	Y
43	Y	S	V	Y	7	N
44	Y	S	V	Y	7	Y
51	Y	E	V	Y	7	N
52	Y	E	V	Y	7	Y
53	N	NA	V	NA	5	N

TYPE 1 SELCALL DECODE FUNCTION (AUSTRALIA ONLY) - Col.14/15

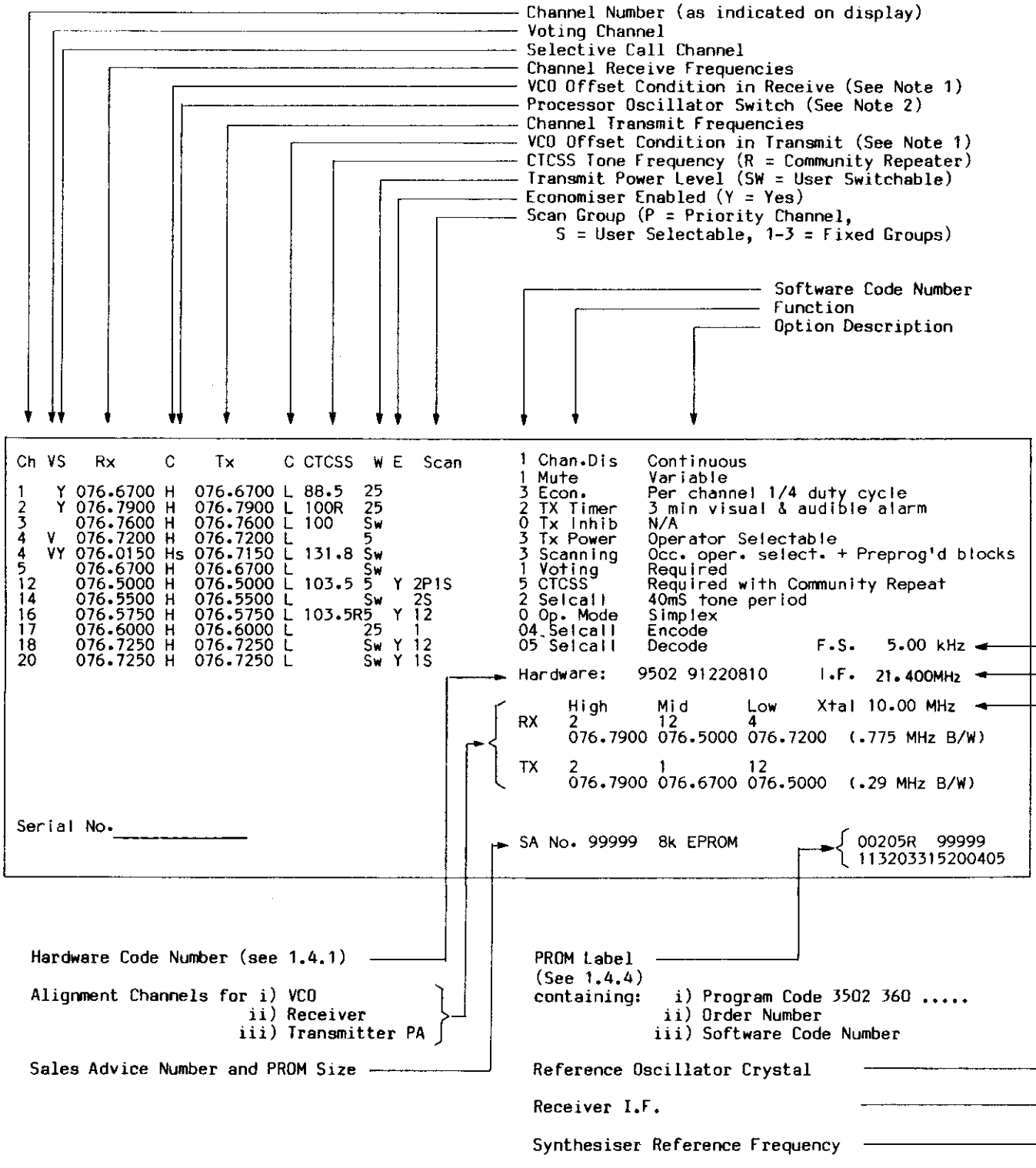
SOFTWARE CODE NO.	STANDARD CALL ONLY	STANDARD CALL WITH URGENT BEEP	GROUP CALL	STANDARD CALL WITH ALARM TIMED	STANDARD CALL WITH URGENT BEEP & ALARM TIMED
00	N	N	N	N	N
31	F	N	N	N	N
32	F	N	Y	N	N
33	N	F	N	N	N
34	N	F	Y	N	N
35	N	N	N	F	N
36	N	N	Y	F	N
37	N	N	N	N	F
38	N	N	Y	N	F
39	V	N	N	N	N
40	V	N	Y	N	N
41	N	V	N	N	N
42	N	V	Y	N	N
43	N	N	N	V	N
44	N	N	Y	V	N
45	N	N	N	N	V
46	N	N	Y	N	V

TYPE 2 SELCALL DECODE FUNCTION (AUSTRALIA ONLY) - Col.14/15

SOFTWARE CODE NO.	STANDARD CALL ONLY	URGENT CALL	GROUP CALL	ALARM TIMED	ALARM ON & OFF
00	N	N	N	N	N
01	F	N	N	N	N
02	F	N	Y	N	N
03	F	Y	N	N	N
04	F	Y	Y	N	N
05	F	N	N	N	Y
06	F	Y	N	N	Y
07	F	N	Y	N	Y
08	F	Y	Y	N	Y
09	F	N	Y	Y	N
10	V	N	N	N	N
11	V	N	Y	N	N
12	V	N	Y	Y	N
13	V	Y	N	N	N
14	V	Y	Y	N	N
15	V	N	N	N	Y
16	V	Y	N	N	Y
17	V	N	Y	N	Y
18	V	Y	Y	N	Y

LEGEND:

N = Not Required
E = End of Transmission
F = Fixed Code
S = Start of Transmission
Y = Required
NA = Not Applicable
V = Variable Code



Notes:

1) The VCO offset condition refers to the voltage measured on the offset control latch output, IC405 pin 5 (H = High, L = Low). (For details see Section 3.3.3.5).

2) The processor oscillator switch condition refers to a logic high on the processor oscillator control output (see Section 3.4.3.1 for details).

Figure 1.6 Mobile Information Label

1.4.3 IDENTIFICATION LABELS

A Serial Number plate is fitted externally to the mobile. For the Mk2 this has silver lettering on a black background and the Ser.No. is a six-digit number which always commences with digit 1.

Programming labels giving details of hardware and software facilities associated with the mobile are fixed to the inside covers of the unit as well as to the packing box for easy identification. One or two labels are also attached to the PROM depending on the options selected.

1.4.3.1 Mobile Labels

Two or more large labels will be included with each mobile. One lists the software and hardware codes with further information for alignment purposes, while the remainder list selcall information if applicable, and all the frequencies and channel dependent information for each radio channel.

Figure 1.6 on the facing page describes the information printed on these labels relating to software and hardware codes plus channel dependent information.

The label shown in Figure 1.7 is only fitted to mobiles which include selective call options.

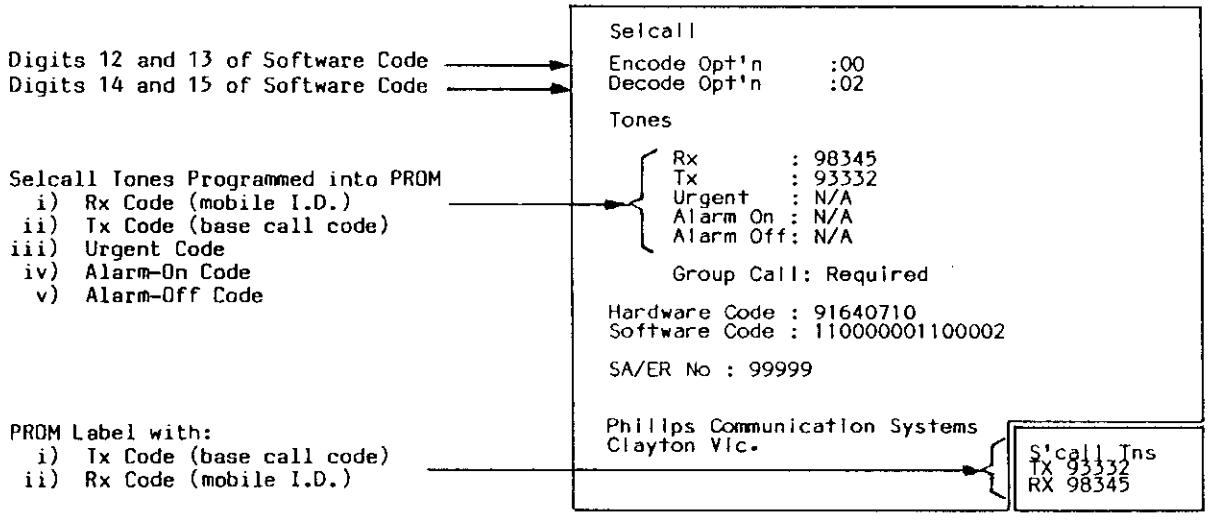


Figure 1.7 Selcall Option Label

1.4.3.2 PROM Label

A label will also be fixed to the PROM containing the following information.

a) The last five digits of the 12-digit program code (the first seven digits being fixed as 3502 360), followed by an "L" or "R" to identify the mobile type as local or remote respectively. The last digit of this number represents the software release number.

b) The Sales Advice (SA) number against which the mobile was ordered.

c) The 15-digit software option code.

If the mobile is ordered with selective call, the label described above will be placed on the bottom of the PROM, and a label specifying the selcall Tx (base call) code and the standard receive code (mobile I.D.) will be fixed to the top of the PROM.

SECTION 2 TECHNICAL SPECIFICATIONS

Performance figures indicate minimum guaranteed values related to unit operated at 13.8 volts dc at 25°C.

2.1 SIMPLEX

2.1.1 GENERAL

Operating Voltage: 13.8V dc negative earth.

Current Consumption: Receive:

	VHF	UHF
Standby	⩽695mA	⩽750mA
Economiser mode	⩽450mA	⩽480mA
Full Audio	1.125A	1.125A

Transmit:

Power O/P:	VHF E-Band	VHF A/B-Band	UHF
25W	⩽5.0A	⩽5.3A	⩽6.5A
5W	⩽3.0A	⩽3.0A	⩽3.5A
1W	⩽1.5A	⩽1.5A	⩽2.0A

Frequency Bands:

VHF	UHF
68- 88MHz (E)	403-420MHz (T)
132-153MHz (B)	440-470MHz (U)
148-174MHz (A)	470-500MHz (W1)
	500-520MHz (W2)

Switching Bandwidth: Receive: (1dB RF Sensitivity Points)

E Band	⩾3MHz
B Band	⩾5.5MHz
A Band	⩾6MHz
UHF Bands	⩾10MHz

Note: Dual front-end versions available on special application.

Transmit: (< 0.5dB power output drop):

E Band	⩾5MHz
B,A Bands	⩾6MHz
UHF Bands	⩾10MHz

SIMPLEX MOBILE RX & TX BANDWIDTH, AND MAXIMUM SEPARATION SPECIFICATIONS

COL.1	2	3	4	5	6	7	8	9	10	11	COPPER SLUGS 12	13
BAND	FREQY RANGE MHz	RX L.O. OFFSET MHz	Rx BANDWIDTH ⩽ MHz SENSITIVITY <1dB STAND.	<3dB SPECIAL	Rx VCO ELECTRO. TUNING LIMIT	Tx BANDWIDTH ⩽ MHz POWER <0.5dB STAND.	ELECTRO. TUN.LIM. SPECIAL	1) MAX.FREQY. MINUS MIN. FREQUENCY < MHz	2) EXTENDED TX-RX SPACING IF PREVIOUS CHECK IN COLUMN 9 FAILS	⩽ MHz	3) EXTENDED TX-RX SPACING IF PREVIOUS CHECKS IN COL.9,10 & 11 FAILS. SPEC.MUST BE CHECKED ON ALL CHANNELS.	FIT COPPER SLUG TO VCO OFFSET COIL (See Note D) MHz
E	68-88	+21.4	3	3.75	5	5	5	9	IF TX MAX < RX MAX THEN RX MAX-TX MIN	15	IF TX MIN > RX MIN THEN TX-RX	> 9, < 18
A	148-174	-21.4	6	7	7	6	8	8	IF TX MIN > RX MIN THEN TX MAX-RX MIN	20	IF TX MAX < RX MAX THEN RX-TX	> 8, < 15
B	132-153	+21.4	5.5	6.25	8	6	8	7	IF TX MAX < RX MAX THEN RX MAX-TX MIN	11	IF TX MIN > RX MIN THEN TX-RX	> 10, < 14
T	403-420	+21.4	10	18A	11	10	11	17	IF TX MIN < RX MIN THEN RX MAX-TX MIN	20		
U	440-470	+21.4	10	11.5	11.5	10	11	28	IF TX MIN < RX MIN THEN RX MAX-TX MIN	30		
W1	470-500	-21.4	10	18A	12	10	11	30	NO EXTENSION NEEDED	-		
W2	500-520	-21.4	10	18A	13	10	12	17	IF TX MIN > RX MIN THEN TX MAX-RX MIN	20		

NOTE: A. To use chart: i) Select required band, Rx front end B/W
ii) Check Rx B/W and Tx B/W. i.e. Rx Max. - Rx Min. Column 4
Tx Max. - Tx Min. Column 7
iii) Check total separation of extreme frequencies (either Tx or Rx)
$f_{Max.} - f_{Min.} \leqslant$ Column 9
iv) If the above calculation is not satisfied then check Columns 10 and 12 calculations which must satisfy the figures in Columns 11 and 13 respectively.

B. Rx and Tx Bandwidth figures under "Special" columns (columns 5 & 8) are for special applications only.
C. Rx or Tx bandwidth cannot exceed VCO electronic tuning range.
D. Copper slug (P/N 3502 319 91880) should be fitted to VCO offset coil only and VCO alignment should be carried out to procedure 9502 912 20000 or handbook.

Channel Spacing:

VHF	UHF
12.5kHz	12.5kHz
20kHz	25kHz
25kHz	
30kHz	

Channel Capacity: 1-120 channels
Higher channel capacity available on special application.

Frequency Stability:

VHF:		
(Standard)	±10ppm	-10° to +60°C
(Ext. Temp. Range with Xtal Heater)	±5ppm	-30° to +60°C
UHF:		
(Standard)	±5ppm	-10° to +60°C
(Ext. Temp. Range with Xtal Heater)	±5ppm	-30° to +60°C
(Ext.Temp. Range with TCXO)	±2.5ppm	-30° to +60°C

Operating Temperature: Standard: -10° to +60°C (functional -20° to +60°C)

Ext. Temp.Range: -30° to +60°C

Duty Cycle: Continuous transmission.

Dimensions:

Main Unit	339mm(L) x 175mm(W) x 52mm(H)
Remote Control Unit	40mm(L) x 187mm(W) x 65mm(H) (excluding mating plugs or cradle projections).

Weight:

Main Unit	3.4kg (approx.) (3.9kg with cradle)
Remote Control Unit	270g (approx.) (430g with cradle)

Finish: Semi-gloss black with splatter texture paint.

2.1.2 **RECEIVER**

Audio Output: ⩾3.5W into 4 Ohms
⩾5.5W into 2 Ohms
(Measured at 10% distortion at 1kHz)

Audio Distortion: ⩽3% at 300mW into 4 ohms.

Audio Frequency Response: Within +1dB to -3dB of 6dB/octave de-emphasis over frequency range as follows:

	20/25/30kHz	12.5kHz
(a) Standard & including CTCSS:	450Hz to 3000Hz	450Hz to 2550Hz
(b) Optional * :	300Hz to 3000Hz	300Hz to 2550Hz

* CTCSS tones below 167.9Hz may be used with this response.

AF Regulation: ⩽2dB for an RF Input variation from 1uV to 100mVpd.

Hum and Noise:

	25kHz	20kHz	12.5kHz
VHF:	⩾47dB	⩾45dB	⩾40dB
UHF:	⩾42dB	N.A.	⩾40dB

Sensitivity:

		25kHz/20kHz	12.5kHz
12dB Sinad:	VHF:	⩽ 0.35uVpd	⩽ 0.35uVpd
	UHF:	⩽ 0.3uVpd	⩽ 0.3uVpd
Quieting:	VHF:	⩾18dB	⩾13dB
(for 0.5uVpd)	UHF:	⩾18dB	⩾13dB

Selectivity:
(2 signal method EIA) Adjacent Channel

	25kHz	20kHz	12.5kHz
VHF:	⩾ 80dB	⩾ 75dB	⩾ 70dB
UHF:	⩾ 76dB	N.A.	⩾ 66dB

Intermodulation:
(3 generator method)

	@ ±100, ±200kHz	@ ±25, ±50kz
VHF:	⩾ 78dB	⩾ 75dB
UHF:	⩾ 76dB	⩾ 73dB

Spurious Rejection:

Frequency	
68- 88MHz	⩾ 90dB
132-153MHz	⩾ 85dB
148-175MHz	⩾ 85dB
403-520MHz	⩾ 70dB

Image Response:

Frequency	
68-88MHz	⩾ 95dB
132-157MHz	⩾ 95dB
148-175MHz	⩾ 95dB
403-520MHz	⩾ 75dB

Intermediate Frequencies: 1st IF: 21.4MHz
2nd IF: 455kHz

2nd Local Oscillator Frequency: 20.945MHz (Alternative 21.855MHz)

The alternative 2nd IF frequency is only used when the receiver carrier frequency lies within bands shown in the table.

		Freq. Band MHz
VHF	E	83.761 - 83.799
	B	146.591 - 146.639
	A	167.531 - 167.589
UHF	T	418.869 - 418.931
	U	460.751 - 460.829
	W1	481.696 - 481.774
	W2	502.624 - 502-724

Blocking: VHF: ⩾ 95dB at ± 150kHz frequency distance
UHF: ⩾ 95dB at ± 200kHz frequency distance

Mute Delay: ⩽ 35mSec to open at 20dB SINAD

Modulation Acceptance: ⩾ ±8.5kHz(25kHz) ⩾ ±4.75kHz(12.5kHz)

Antenna Radiation: < 2n Watt

Mute Range :

	12.5kHz/20kHz	25kHz
Mute Maximum :	⩾18dB	⩾20dB SINAD
Mute Minimum :	⩽12dB	⩽12dB SINAD

Voting Parameters

'Voting On-Channel' Time (V):	49mSecs ±0.42mSecs
Voting Attack Time: (Time required for receiver to perform voting process after carrier has been detected)	V(n + 1) + 40mSecs (n = number of channels voted)
Voting Decay Time: (Time required for receiver to recommence scanning after cessation of carrier)	49mSecs ±0.42mSecs
Mute Open Response Time: (Time required for mute to open after carrier is presented to the receiver -excluding signalling delays e.g. CTCSS, Selcall.)	V(n - 1) + V(n + 1) + 40mSecs (worst possible case)
Minimum Vote Detect Level: (Fixed for all voting channels)	15dB Sinad threshold

Dynamic Range Carrier Level Detector (Voting):

Minimum:	⩽ 0.3uV
Maximum:	⩾ 200uV

2.1.3 **TRANSMITTER**

Power Output: 25W +1dB -0dB
Internally adjustable to 1W

Spurious Emission: ⩽ 0.25uW(⩾ 80dB)

FM Noise:

	Max Devn.	VHF	UHF
30kHz:	±5kHz	> 50dB	N.A.
25kHz:	±5kHz	> 50dB	> 45dB
20kHz:	±4kHz	> 48dB	N.A.
12.5kHz:	±2.5kHz	> 45dB	> 40dB

(Measured in a 300-3000Hz bandwidth)

Audio Sensitivity: < 40mV at 1kHz for 60% deviation.

AF Distortion: < 3% at 1kHz for 60% deviation

Audio Frequency Response: Within +1dB to -3dB of 6dB/octave pre-emphasis curve over 300 to 3000Hz, relative to 1kHz modulation at 20% of maximum deviation.
(300 to 2550Hz for 12.5kHz).

Tx Rise Time: < 60mSecs from operation of PTT to achieve 70% of output power.

Group Delay:

< 20uSecs	900 to 2100Hz
< 50uSecs	300 to 3000Hz

2.1.4 VARIATIONS OVER TEMPERATURE AND SUPPLY VOLTAGE

2.1.4.1 Supply Voltage Variations (Over 10.8V to 16.2V Range)

Receiver Audio Power Output: < ±0.25dB wrt 1 watt at 13.8Vdc

Transmitter Power Output: < +2, -3dB wrt 25 watt ouput at 13.8Vdc

2.1.4.2 Temperature Variations (Over -10°C to +60°C Range)

Receiver Sensitivity: < ±3dB for 12dB Sinad, wrt rated sensitivity.

AF Power: < ±2dB wrt 300mW output into 4 ohms.

Mute Sensitivity: < ±3dB RF I/P variation from reference Sinad at +25°C.

Transmitter Output Power: < ±0.5dB wrt 25W output at ambient.

2.2 DUPLEX

The FM900 duplex version is derived from a standard FM91 unit by the addition of a duplex offset PLL to generate the Tx frequency, and the addition of Rx-antenna socket to the unit. Also the Tx/Rx changeover circuitry is deleted from the Tx-PA pcb. The unit can be controlled by handset type HS765/9D. Automatic loudspeaker muting takes place when the handset is lifted from the cradle. The transmitter is normally operated by the PTT control on the handset.

In Talk-Through versions, the unit can be switched to talk-through operation by operating the nominated push button on the remote control unit. In this mode the audio signal from the receiver is fed into the transmitter modulator, and the audio signal from the microphone/handset (if connected) is automatically disconnected when in the talkthrough mode. The transmitter is turned on when a carrier is being received, and is turned off on cessation of received carrier after a short time delay of approximately 0.75 seconds.

Addition Loop Crystal Frequency: The addition loop crystal frequency is determined by the following formula:

$$f_{xtal} = \frac{21.4 + \text{Rx/Tx SEPARATION}}{4} \quad (\text{MHz})$$

The crystal specification: 3502 414 88490

Maximum Separation: 10MHz

Minimum Separation: 4MHz 25kHz channel spacing
2MHz 12.5kHz channel spacing
0.6MHz minimum spacing available on special order.

Switching Bandwidth: (NB: dependent on duplex filter also)

UHF-Band: < 3MHz

Channel Spacing:

UHF: 12.5/ 25kHz

Spurious Emissions: < 70dB.

Frequency Stability (-30°C to +60°C):
(±5ppm Synthesiser)

DOC Test Method: Receiver: ±5 ppm
Transmitter: U,T,W1,W2 Bands: ±6ppm

Continuous Tx Operation (EIA Test Method):
Receiver: ±10ppm (Note: Rx Frequency Stability not measured in EIA Specification)
Transmitter: U,T,W1,W2 Bands: ±10ppm

Duplex Receiver Desensitization: < 1dB
(assuming perfect duplexer)

Transmitter Audio Characteristics:

25kHz Spacing

Max. Deviation: ±5kHz
Distortion at ±3kHz deviation: < 5% measured at 1kHz modulation frequency.
Hum and Noise: As per simplex specification.

12.5kHz Spacing

Max. Deviation: ±2.5kHz
Distortion at ±1.5kHz deviation: < 3% measured at 1kHz modulation frequency.
Hum and Noise: As per simplex specification.

Duplexer Requirements:

The minimum required isolation for both Tx and Rx is 60dB at 4.5MHz Tx/Rx separation. A duplexer which provides this attenuation will give receiver desensitization of 1dB SINAD.

For Tx/Rx separations greater than 4.5MHz and/or for operation on VHF at 4.5MHz or more, the minimum required isolation is theoretically smaller, however for standardisation reasons the general recommendation is to always provide 60dB isolation as a minimum.

Frequency Limitations and VCO Requirements:

BAND	Rx/Tx SIDE	Rx VCO CODE NUMBER	Tx VCO CODE NUMBER	Rx VCO OFFSET LOGIC LEVEL	LK801
T 403-420	Rx ≷ Tx	3502 358 00160 H11A	3502 358 00590 H11E	HIGH	OUT
U 450-470	Rx ≷ Tx	3502 358 00170 H11B	3502 358 00600 H11F	HIGH	OUT
W1 470-500	Rx < Tx Tx < Rx < 480MHz Tx < Rx > 480MHz	3502 358 00170 H11B 3502 358 00170 H11B 3502 358 00180 H11C	3502 358 00600 H11F	HIGH HIGH HIGH	OUT
W2 500-520	Rx ≷ Tx	3502 358 00180 H11C	3502 358 00610 H11G	HIGH	OUT

NOTE: It is necessary (to avoid spurious response beats on receive), to ensure that the main synthesiser reference crystal frequency is not equal to the Tx/Rx spacing. Alternative reference crystals include 9MHz and 11.25MHz.

2.3 TALKTHROUGH OPERATION

Operation:

Carrier Operated: The unit re-transmits a received signal if it opens the mute. Standard mute preset adjustment is nominally 12dB SINAD.

Tone (CTCSS) Operated: As for Carrier Operated but in this case a tone of the correct frequency must also be present. Can be programmed on a "per channel" basis. This is effectively a CTCSS "decode only" feature.

Retransmission of CTCSS: Retransmission of CTCSS tones is not possible in the standard unit. With special software a CTCSS tone equal or different from the received tone can be retransmitted, programmed on a per channel basis. Note that this is not a standard feature.

Encode only of CTCSS in Duplex and Talkthrough Repeater mode is available as standard.

Frequency Response Overall:

Carrier Operated Version:
(with respect to 1kHz 0dB)
300Hz ±2.5dB
3000Hz +1/-4dB

CTCSS Operated Version:
(with respect to 1kHz 0dB)
500Hz +2/-6dB
3000Hz +0.5/-6dB

Transmitter Hang Time:
(Talkthrough mode)
Standard 750mSecs.
Can be varied by software to 250, 500mS, 1 and 2 Secs.

Repeater Hum and Noise Overall:
(w.r.t. 1kHz/±3kHz Tx deviation)

Carrier Operated	CTCSS Operated
UHF > 36dB	> 38dB

Measured with de-emphasis and a bandwidth of 15kHz. Rx input level 1mVPD.

SECTION 3 TECHNICAL DESCRIPTION

3.1 RECEIVER (Circuit Diagrams 7.2 and 7.3)

3.1.1 GENERAL

The FM900 Mk2 series receiver is a double conversion superheterodyne with intermediate frequencies of 21.4MHz and 455kHz.

The receiver consists of four main modules; RF front end, IF amplifier with a high dynamic range Receive Signal Strength Indicator for extended voting capability, limiter/discriminator, and enhanced audio processing for use with CTCSS signalling.

The basic receiver sections are described in the following sub-sections.

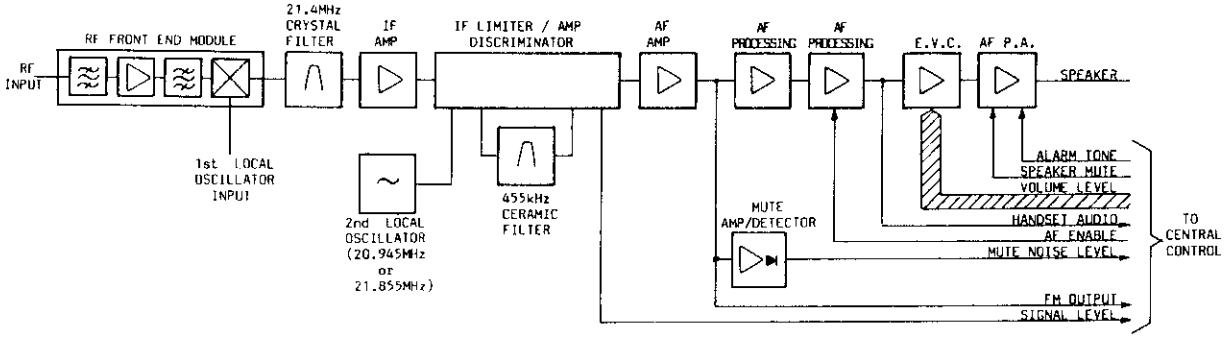


Figure 3.1 Receiver Block Diagram

3.1.2 FRONT-END

The receiver front-end consists of a single module U201, comprising six helical resonators, an RF preamplifier hybrid and a combined mixer IF preamplifier hybrid. These components are contained in a single discrete housing to form the complete front-end module U201. This module may be aligned for narrow or wideband operation depending on customer requirements. (Refer Section 4.12, 4.13 Test and Alignment Procedure). The input signal passes via a two resonator bandpass filter to the RF preamp. Further filtering is then provided by an RF bandpass filter, comprising four helical resonators. The signal is then coupled to a balanced active FET mixer where it is mixed with the LO signal from the frequency synthesiser. The mixer output is amplified by a FET IF preamplifier contained on the same hybrid as the mixer.

If during service the front end module is found to be faulty it should be replaced as a complete unit. On no account should the sideplates be removed as special techniques are required for re-assembly.

3.1.3 IF SECTION

The IF section provides the necessary receiver adjacent channel selectivity, as well as the majority of the gain required to amplify the low level input signals to levels suitable for audio processing after detection. There are two versions of the IF, one for 12.5kHz channel spacing , the second for 20kHz, 25kHz and 30kHz systems.

The front-end output passes to the 6-pole monolithic crystal filter FL201, which blocks all but the wanted signal.

The output of the filter is matched into the gate of a FET source follower then amplified by a discrete transistor stage into the input of IC202. IC202 is a high performance I.F. limiter amplifier and discriminator.

The IC contains amplification at 21.4MHz which is mixed with a signal from the external second local oscillator to produce 455kHz. The 2nd L.O. operates at 20.945MHz, however this frequency can change to 21.855MHz depending on the operating carrier frequency. A list of the relevant frequencies is given in Section 2, Sub-section 2.1.2.

Additional selectivity is provided by a 455kHz ceramic filter before further amplification and audio detection by a quadrature detector. A damping resistor in parallel with the quadrature detector tuned circuit is used to ensure the same recovered audio signal levels for both versions of the I.F.

3.1.4 RECEIVER AUDIO PROCESSING

The receive audio processing circuit consists of a series of low-pass and high-pass active filters.

A high performance dual operational amplifier (IC204) and a quad operational amplifier (IC205) are combined to provide the required gain, de-emphasis and filter characteristics.
The filtering is designed to provide adequate rejection of CTCSS tones up to 250Hz while minimising the affect on the in-band frequency response. Refer to Figure 3.2.

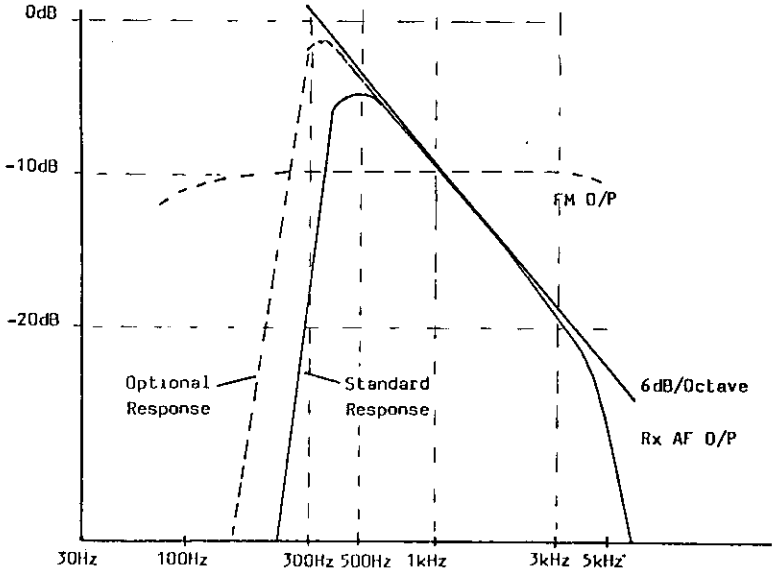


Figure 3.2 Audio Processor Response Curve

An optional filter configuration can provide full 300Hz to 3000Hz response with sufficient rejection of CTCSS tones up to 167.9Hz.

An ac coupled mute gate (TR214) controls the low level audio signal for handset operation.

Unprocessed audio provides a buffered broadband unde-emphasised output which is used for signalling options.

The output level is typically 500mV for standard deviation.

One half of IC204 is used as a bandpass filter for the mute noise amplifier with a diode detector and passive integrator to provide a dc output proportional to the input noise. This signal is connected to the analogue to digital converter in the central control for further digital processing.

3.1.4.1 Mute Hangtime

Digital processing of the mute noise detector voltage is used to set the mute open and close thresholds.

The central control also uses the information to set the mute hangtime dynamically, according to the received signal strength. In areas where the signal level is variable about the mute close point, a variable hangtime is inserted to carry through over signal troughs and fading. This prevents mute chopping and greatly improves speech intelligibility under fade conditions. In areas where signal levels are high, minimum mute hangtime is applied and so gives a clean mute cut-off at the end of transmission.

The hangtime is applied in 6 levels from 66mSec to 396mSec.

Figure 3.3 provides details of the detected noise voltage level versus signal level over the mute control range. The corresponding mute settings are also shown.

The muting functions, Rx AF enable and speaker enable, are generally applied simultaneously, however with handset operation the loudspeaker and earpiece muting can be operated independently under software control.

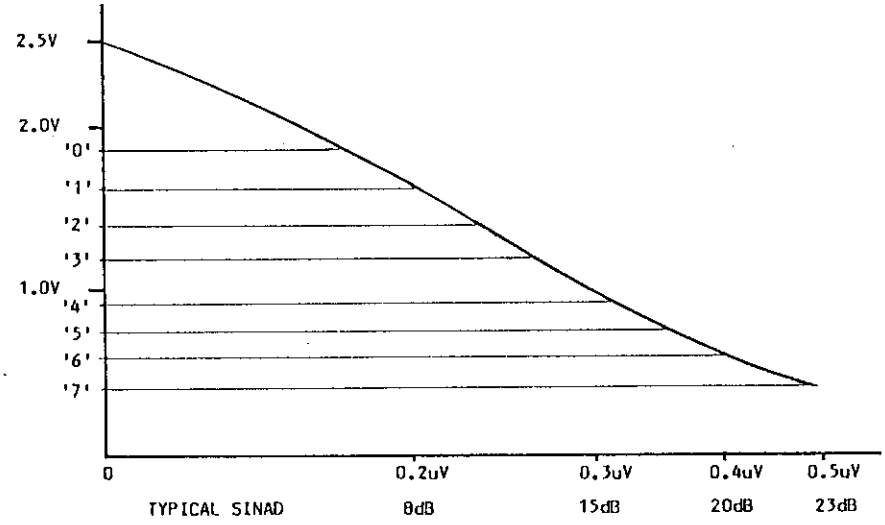
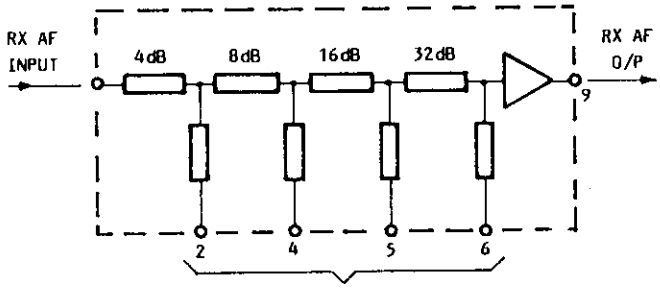


Figure 3.3 Mute Noise Detector Output

3.1.5 AUDIO POWER AMPLIFIER

The audio output from the audio processing stage is connected to the volume control consisting of an electronic attenuator hybrid U401 with 16 steps under central control.



ATTENUATOR STEP

VOL LEVEL		4dB	8dB	16dB	32dB
(MIN)	0	1	1	1	1
	1	0	1	1	1
	2	1	0	1	1
	3	0	0	1	1
	4	1	1	0	1
(MAX)	16	0	0	0	0

Figure 3.4 Electronic Attenuator Hybrid

The signal is then fed back to the receiver board where it is gated by TR213 (which provides transient free muting) and then amplified in IC203. IC203 provides up to 3.5 watts into 4 ohms or 5.5 watts into 2 ohms and is protected against thermal overload and ac coupled short circuits at its output.

The alarm tone, which is generated as required by the central controller, is fed into the power amplifier stage of IC203 and is independent of the volume control setting and mute status.

3.2 TRANSMITTER

3.2.1 TRANSMITTER (UHF) (Circuit Diagram 7.4)

3.2.1.1 General

The UHF transmitter PA is based on a two stage line up, utilizing a discrete transistor output stage driven by a hybrid power module driver stage. The power module IC102 receives an input drive level of 150mW and delivers typically 8 Watts to TR102 output stage. TR102 provides 5.5dB gain to deliver 25W output into 50 ohms.

Broadband impedance matching at the input and output to TR102 is realised with a printed circuit microstrip. C111 and C124 are trimmed for maximum power output. IC102 is internally matched for 50ohms input and output impedance.

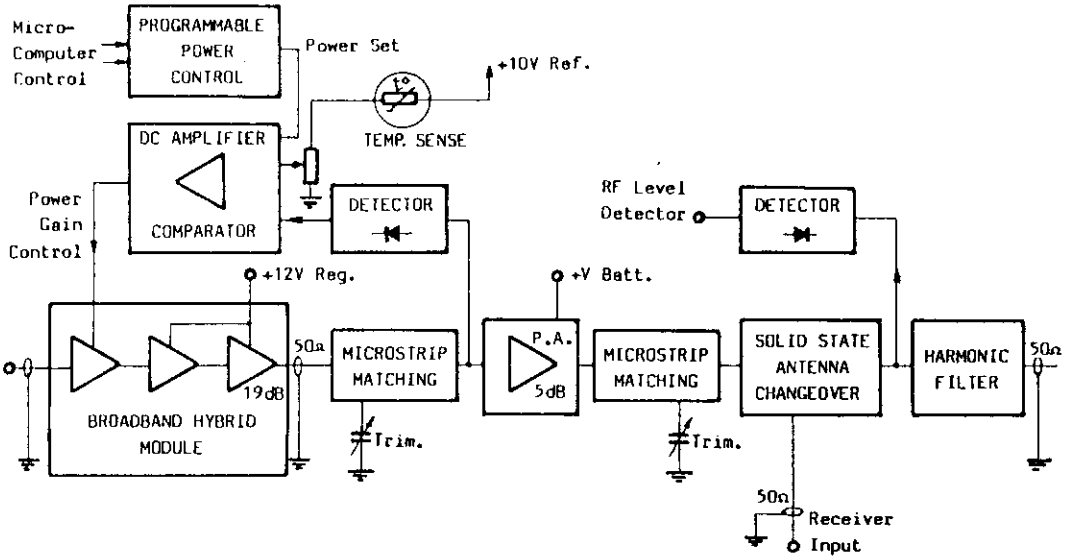


Figure 3.5 UHF Transmitter PA Block Diagram

3.2.1.2 Power Stabilization

Output power level is stabilized with a power control loop. RF at TR102 input is rectified by Diode D102 and a dc voltage is fed back to the inverting input of IC101 operational amplifier. This feedback voltage is compared to the reference voltage as set on R102 the power output setting pot. The output voltage of IC101 controls the bias on TR101 which in turn adjusts the supply level to the first transistor stage of the power module. Adjustment of this voltage controls the gain of the power module. The action of the control loop is to stabilize the power input level to TR102. At low power settings of R102, stabistor D101 helps to stabilize the transmitter output power at low temperatures by providing a negative temperature coefficient on the reference voltage.

The PTC R106 senses the Tx PA internal temperature. In the event of a temperature rise above 100°C the PTC resistance will increase. This will cause a reduction of the control loop reference voltage and will therefore reduce the transmitter output power. The transmitter output power is externally adjusted by varying the +10V PA input to the control loop reference voltage. Link LK101 is opened to disable the control loop for Tx PA tuning.

3.2.1.3 RF Power Output

RF output from TR102 is coupled to the antenna socket via the solid state antenna changeover circuit. In the transmit mode +10V Tx biasses PIN Diode D103 on and couples the output power to the antenna socket. The bias current for D103 flows into D104 and D105 via a quarter wave length line. D104 and D105 when biassed on, form a short circuit across the receiver input to achieve isolation from the transmitter. This short circuit is transformed to an effective open circuit at the other end of the quarter wavelength line, and therefore does not load the transmitter output. In receive mode, bias to D103/D104 and D105 is removed and the receiver input is coupled to the antenna socket. With D103 off the transmitter output does not load the receiver input.

Between the antenna socket and the solid state change over circuit is the antenna filter. The function of this filter is to reject harmonic emissions from the transmitter output.

At the output of the antenna changeover circuit D106 is loosely coupled to the signal path to rectify the RF output power. The DC voltage (2V for 25W output) is sent to the microcomputer for monitoring of the transmitter power. If the transmitter power is out of the recommended range an error indication will be displayed, by a decimal point in the righthand segment of the control unit display.

3.2.2 TRANSMITTER (VHF) (Circuit Diagram 7.5)

The following description refers to the A, B and E Band transmitter circuits. Component designation may vary between bands, therefore the description is primarily for A and B Bands with E Band designation entered in parenthesis where a variation exists.

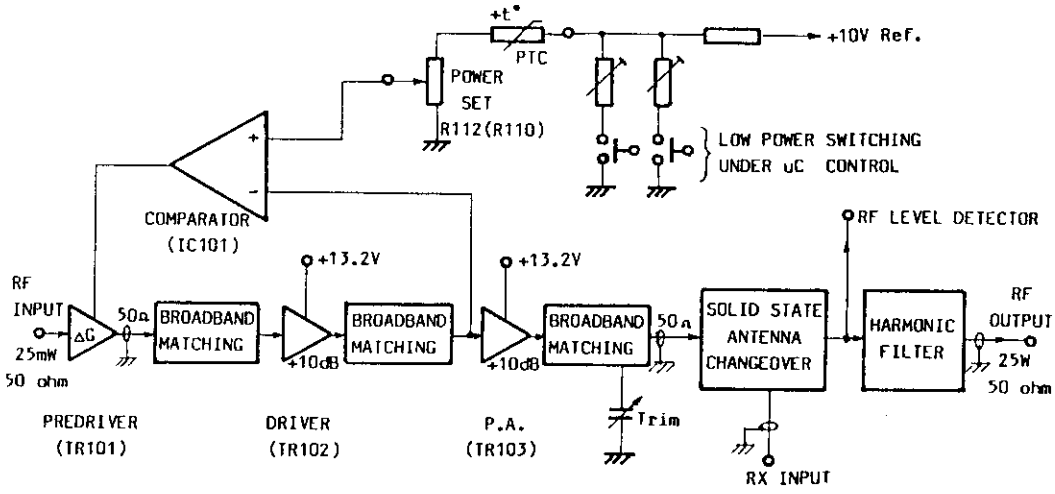


Figure 3.6 VHF Transmitter PA Block Diagram

3.2.2.1 General

The transmitter PA is based on a three stage line-up utilising discrete transistors in each stage. The first, predriver stage TR101, receives an

input drive level of 25mW and delivers typically 250mW to the second stage, driver TR102. A drive level of typically 3W is then fed into the PA stage TR103, which provides a further 9.5dB gain to produce an output of 25 Watts into 50 ohms.

Broadband impedance matching is employed between all stages and at the input and output to the line-up. A 50 ohm impedance point is available between the predriver and driver stages at the junction of R108 and C111 (R109 and C110).

3.2.2.2 Power Stabilisation

Stabilisation of the output level is provided by a power control loop. RF at the input to the PA stage TR103 is rectified by diodes D103 and D104 and the resultant dc voltage is fed back to the inverting input of IC101, an operational amplifier. This feedback voltage is compared to the reference voltage set by R112 (R110), the output power setting control.

The output voltage of IC101 is then applied as bias on the base of TR101, subsequently, adjustment of this bias controls the gain of the predriver stage. The action of the power control loop is to stabilise the power input level to TR103.

At low power settings of R112 (R110), diode D102 helps to stabilise the transmitter output power at low temperatures by providing a negative temperature coefficient in the reference voltage. The PTC resistor R111 (R107) senses the Tx PA internal temperature. In the event of a temperature rise above 100°C the PTC resistance will increase and thus cause a reduction of the loop reference voltage to subsequently reduce the transmitter output power.

The transmitter output power may be externally adjusted by varying the +10V PA input voltage at pin 4.

Link LK101 is opened to disable the control loop for normal PA tuning.

3.2.2.3 RF Output and Antenna Changeover

The RF output from TR103 is coupled to the antenna socket via a solid state antenna changeover circuit and harmonic filter.

In the receive mode, diode D105 is "off", therefore diodes D106 and D107 are also "off" and the antenna socket is coupled directly to the receiver input. D105 "off" ensures that the transmitter output circuit does not load the receiver input.

In the transmit mode, +10V TX at pin 7 biases D105 "on" and couples the output power to the antenna socket. The bias current for D105 flows into D106 and D107 via a Pi section equivalent quarterwave length line. D106 and D107 are biased "on" and form a short circuit across the receiver input to achieve isolation from the transmitter.

This short circuit is transformed to an effective open circuit at the other end of the Pi section, and therefore does not load the transmitter output.

An antenna filter is inserted between the changeover circuit and the antenna socket to reject any harmonic emissions from the transmitter output.

At the output of the antenna changeover circuit, diode D108 is loosely coupled to the signal path to rectify a sample of the RF output power. The dc voltage produced (2 volts for 25W output) is sent to the microcomputer via pin 8 for monitoring of the transmitter power. If the transmitter power is out of the recommended range an error indication will be displayed, decimal point on righthand segment.

3.3 SYNTHESISER (Circuit Diagram 7.6)

3.3.1 GENERAL

The synthesiser is an important subsystem within the equipment since it is responsible for generating both the receiver local oscillator signal and the modulated RF input to the transmitter power amplifier. The synthesiser must therefore produce an output of high spectral purity and low sideband phase noise if satisfactory levels of receiver and transmitter performance are to be achieved. In order to achieve these objectives a synthesiser based on a single phase locked loop employing a high gain sample and hold type phase comparator and a low noise VCO, has been used. To ensure consistent and reliable performance, extensive use has been made of L.S.I. and hybrid circuits.

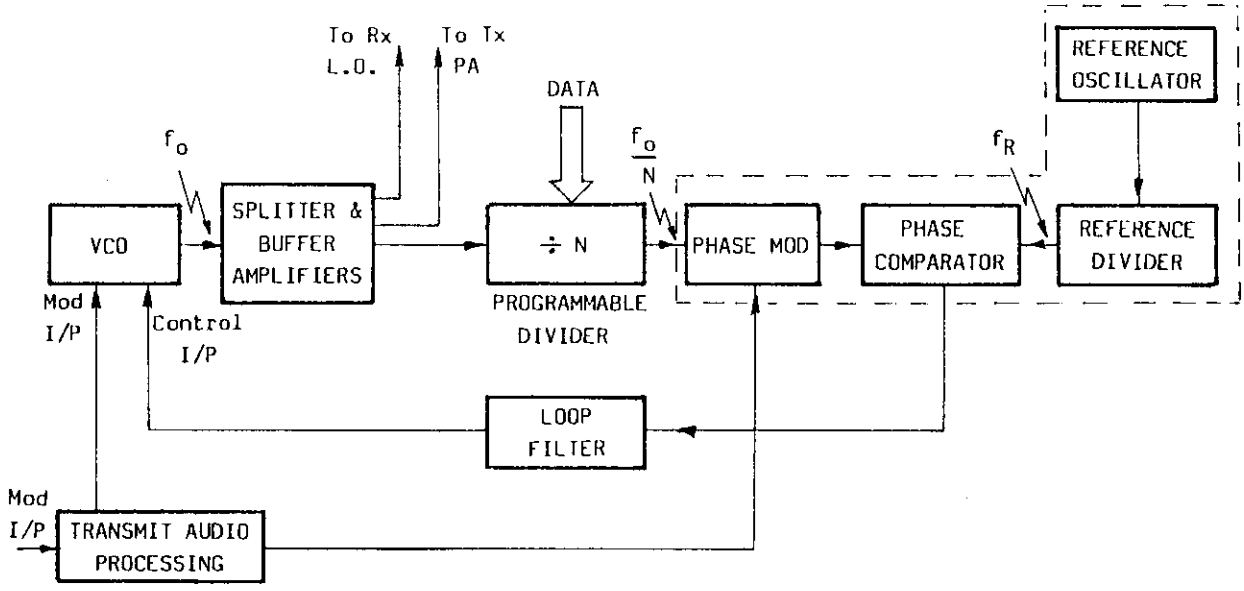


Figure 3.7 Synthesiser Simplified Block Diagram

3.3.2 THE BASIC PHASE LOCKED LOOP SYNTHESISER

Refer simplified block diagram in Figure 3.7.

A voltage controlled oscillator (VCO) provides an output signal at frequency fo, which is divided down to fo/N by a programmable divider. A reference oscillator is also provided, the output frequency of which is reduced to a suitable incremental value fR by a fixed reference divider. Signals fo/N and fR are coupled to a phase comparator which produces an output voltage proportional to the phase error between these two inputs. This error signal is connected via the loop filter back to the control input of the VCO which causes the VCO frequency to be modified so that only a small phase difference exists between the two phase comparator inputs. The loop is then said to be locked and fo/N = fR. Thus if the value of N is increased by 1 to N+1 we will have fo'/N+1 = fR = fo'/N where fo' is the new VCO frequency. Thus it is easily shown that fo' = fo + fR. Therefore if fR = channel spacing it is possible to select a particular channel by choosing the appropriate value for N providing that the required frequency is within the electronic control range of the VCO.

When used as the transmitter exciter, the synthesiser must also be modulated by the transmit audio. This is achieved by directly modulating the VCO by the processed audio. A phase modulator between the divider and the phase comparator prevents the modulation appearing as a phase error at the phase comparator.

The modulation is effectively cancelled by the phase modulator provided an audio signal of the correct amplitude and phase is applied. When this is done no phase error due to modulation of the VCO is detected by the phase comparator and hence no correction is sent back to the VCO. Thus the modulation characteristic of the VCO is the same as if it were being modulated with the phase comparator disconnected.

3.3.3 DETAILED TECHNICAL DESCRIPTION

Refer detailed block diagram in Figure 3.8.

3.3.3.1 Prescalers and Programmable Divider

The output of the VCO buffer is connected to the synthesizer input via coaxial cable, since these sections are on separate circuit boards. An ECL prescaler (IC301) then divides the input frequency by 4 for UHF or by 2 for A/B bands. This prescaler is not used for E band.

The signal is then further reduced in frequency by an ECL 10/11 prescaler IC303. Since this device operates from a 5 volt supply, whereas the following programmable divider IC304 operates from a 10 volt supply, it is necessary to provide a dc level shift between the two devices. This is achieved by setting the earth reference of IC303 to +5V, and using a high speed PNP transistor TR301 to produce an output level which switches between 0 and +9V, suitable for clocking IC304.

The +5V level is provided by negative regulator IC302, which operates as a current sink. The correct voltage relationships for the device are established by connnecting the common terminal to +10V and grounding the input.

Data for the programmable divider is clocked into IC304 by the central control as required. The data consists of seven 4-bit BCD numbers, clocked one number at a time onto the data input lines $\overline{A0}$ to $\overline{A3}$ using the program clock and enable control lines PC and PE. Note that the data entered is active low while the program enable line is active high. The synthesiser is programmed every time the channel is changed, the mobile goes to transmit (simplex only), or at a 50mSec rate if the synthesiser is out of lock (except duplex transmit).

IC304 also produces a feedback control signal $\overline{FB}$ to control the dual modulus prescaler IC303. This signal determines which of the two divisional ratios the prescaler must be set to at any given instant, to provide the required overall division ratio. This control signal is not necessarily fixed for a given division ratio, but may be rapidly changing states. To ensure exact timing of the transitions, a separate synchronising signal $\overline{SY}$ is also produced by IC304. An RC network provides the necessary interface for the control signals $\overline{FB}$ and $\overline{SY}$ passing between IC303 and IC304.

The divider circuit IC304 produces two output signals FF and FS, the first being referred to as the fast output and the second, the slow output. The two are always related by FF = 10 FS in terms of frequency.

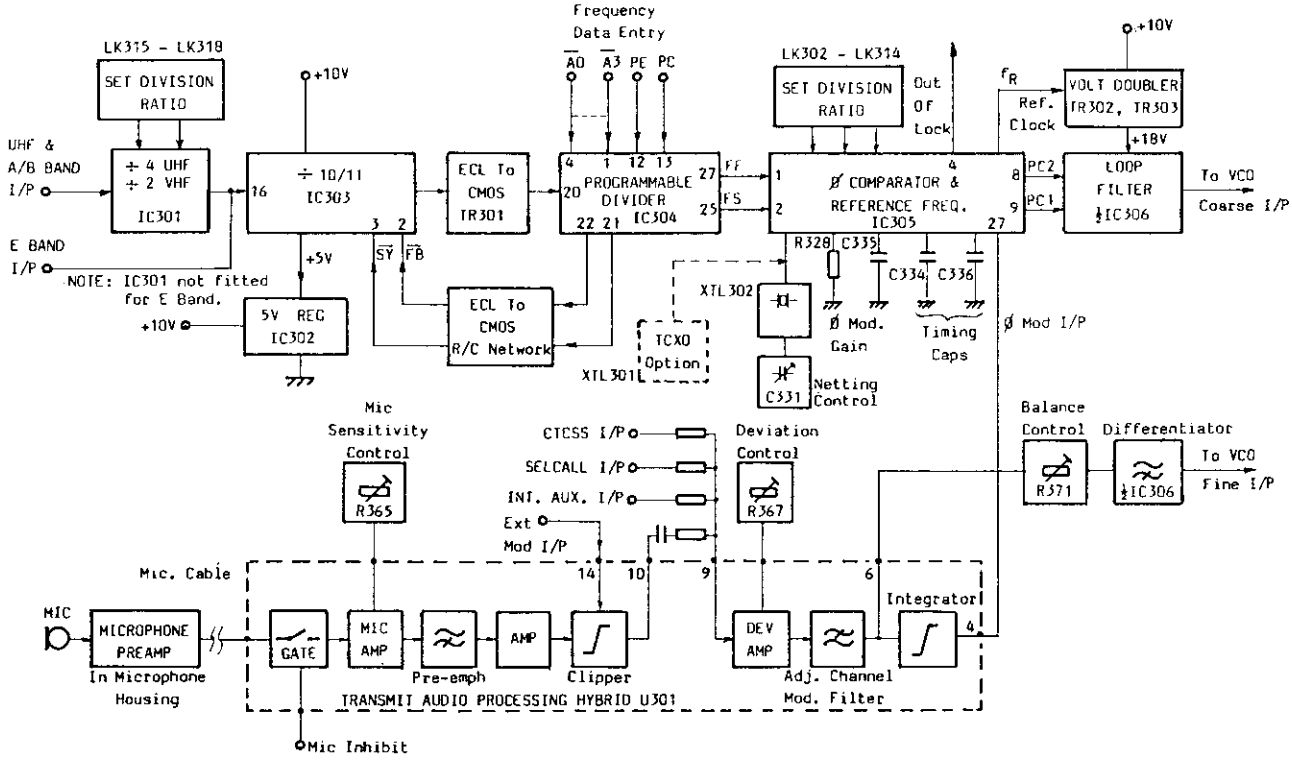


Figure 3.8 Synthesiser Detailed Block Diagram

3.3.3.2 Phase Comparator and Reference Signal

The programmable divider outputs FF and FS are connected to a high gain phase comparator contained in IC 305. The FF signal is also connected to an auxiliary digital phase/frequency comparator which is needed to bring the VCO within the narrow capture range of the high gain phase comparator. As soon as the high gain phase comparator phase locks the VCO to the reference then the digital comparator is switched off.

This is simply achieved since tri-state logic is used. At the instant the out-of-lock indicator goes low, the VCO will not be exactly on frequency until the loop settling time has elapsed, so the radio operation is inhibited during this settling period.

IC305 also contains the reference oscillator which utilises an external high stability 10MHz crystal. Netting of the oscillator is achieved via trimmer capacitor C331. For very high stability requirements a TXCO can be fitted as an option. On VHF versions where receiver channels occur on direct multiple harmonics of 10.0MHz, either 9.0, 11.25 or 12.5MHz reference crystal is used. This is done to avoid the possibility of receiver desensitisation caused by reference oscillator harmonics, and must be accompanied by the appropriate selection of links LK302 - 314. These links enable various division ratios from 160 to 500 to be selected (160 to 360 in early versions). The division ratio required equals the crystal frequency divided by the reference frequency (FR) which on UHF is 62.5kHz, on E band is 50 or 62.5kHz (depending on channel spacing), and on A and B bands is 25 or 31.5kHz (50 or 62.5kH in early versions). Link information is given in Part 2, Section 1, Sub-section 1.3.

When the loop is locked FR = FF = 10FS. The synthesiser can change frequency in increments of FS on E band, 2FS on A/B bands, and 4FS on UHF since the phase comparator incorporates a sample and hold circuit operating at FS. Thus at VHF any frequency which is a multiple of 12.5, 20, 25 or 30kHz can be generated and at UHF any frequency which is a multiple of 12.5kHz or 25kHz can be generated. Note that it is possible to have only one type of channel spacing for all the channels in the radio once the division ratio is set.

The gain of the phase comparator is set by the current source resistor R328 and the timing capacitors C334 and C336. The digital phase comparator output, PC2 will be switching between ground and supply with a duty cycle automatically adjusted to bring the VCO into lock. When the high gain comparator output PC1 begins controlling the VCO, PC2 goes into a high impedance mode and its voltage is then determined by the bias of the loop filter. The main output (PC1) is an analogue dc voltage which will vary slightly about the bias voltage of the loop filter which has very high dc gain so that only a small shift in PC1 will cause a large shift in the VCO control voltage.

3.3.3.3 Loop Filter

The main and auxiliary phase comparator outputs PC1 and PC2 are combined in the loop filter comprising the low noise bifet operational amplifier IC306. The loop filter determines the order of the loop and also sets the desired cut off frequency and damping factor. The loop filter can be relatively simple since it is primarily used to set the loop dynamics and not for the suppression of sideband reference products as would be the case for a digital phase comparator.

The dc supply for the loop filter operational amplifier IC306 is produced by a voltage doubler circuit comprising switching transistors TR302 and TR303 and rectifier diodes D303 and D304. The transistors are driven by the reference frequency signal fR which enables simple filtering of the loop filter supply due to the relatively high value of fR.

The purpose of this arrangement is to increase the available output voltage swing from the loop filter which results in an increase in the VCO electronic tuning range. Increasing the gain of the VCO to give the same tuning range would increase its susceptibility to modulation by spurious signals. In addition there are limitations on how far the gain of a VCO may be increased without sacrificing performance.

3.3.3.4 Transmit Audio Processing and Loop Modulation

All the transmit audio processing functions are contained on a single hybrid module U301. The microphone input has relatively low sensitivity to avoid extraneous signal pick up when long leads are employed as in remote control versions. For this reason, the microphone contains an inbuilt preamplifier to boost the low level microphone signal to the required level. The audio processing hybrid U301 contains a microphone inhibit circuit which is used to prevent microphone audio from disturbing selective call signals as well as in other special systems applications. The hybrid also contains a microphone amplifier with external variable gain control R365 to set the desired microphone sensitivity level. A pre-emphasis network and peak level clipper are also included. In addition a deviation amplifier with external gain control R367 to set the required peak deviation level is provided. Finally, a multi-pole active low pass adjacent channel modulation reject filter and an active integrator complete the hybrid circuit. Additional inputs allow for external modulation and internal signalling requirements such as CTCSS (tone squelch) and selective call.

The clipper output is linked externally to the deviation amplifier, thus allowing special circuitry to be inserted when needed for systems applications.

The integrator is required to provide the necessary signal characteristics for the phase modulator in IC305 to ensure correct operation of the two point modulation method (described in section 2) over the complete range of modulating signals including sub-audible tones.

The main modulation path passes via attenuator R371, which acts as the balance control for the two point modulation system, to the active differentiator comprising ½IC306 whose output is used to directly modulate the VCO via its fine input control line. The modulation balance is simply set by adjusting R371 so that the level of modulation signal present at the phase comparator output PC1 is a minimum since this represents the condition where the modulation effects of the VCO are being best cancelled by the phase modulator in IC305.

3.3.3.5 **The VCO and Buffer Amplifiers**

The VCO is contained on a single hybrid module located on the receiver board. The hybrid is rigidly attached to the diecast metal housing which in turn is securely fastened to the main chassis. This results in a fully screened oscillator with a high immunity to microphony and therefore well suited to mobile use. The VCO is provided with both coarse and fine control inputs to allow the loop control to be independent of the modulation. The main reason for this is to allow separate control of the VCO fine input bias voltage which is automatically varied as the coarse control voltage changes.

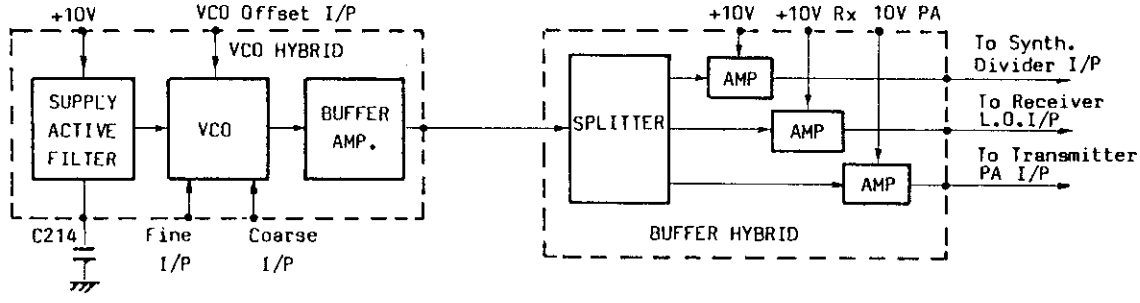


Figure 3.9 VCO and Buffer Block Diagram

Without this compensation the VCO fine input gain would vary over the VCO holding range resulting in a change to the deviation level. This compensation is carried out by coupling the VCO coarse control voltage to the bias network of the active differentiator ½IC306 via resistor R349.

In addition to the coarse and fine control inputs, an offset control input is also provided to enable the VCO to be coarse switched between the transmit and receiver local oscillator frequencies. For the UHF VCO the offset is switched on when the control input is connected to ground and for the VHF VCO the offset is switched on when the control input is connected to the +10V supply or open circuited since the hybrid contains an internal pull up resistor.

The offset off condition in a receive mode generally implies a receiver local oscillator injection on the high side of receive frequency. Similarly, if offset is on in receive this generally implies local oscillator injection on the low side of the receive frequency. See the Test and Alignment Procedure Section 4 for further offset details.

The hybrid also contains an active filter on the VCO supply to suppress hum and noise signals which may be present on the regulated +10-volt supply.

The VCO is provided with two adjustments to allow mechanical tuning, the first is used to set the frequency with the offset off and the second to adjust the amount of offset required with the offset switched on.

A buffer amplifier is also incorporated on the VCO hybrid to provide isolation between the VCO and the hybrid output as well as providing a reasonably high output level which minimises the gain requirements of the buffer amplifier hybrid.

The buffer hybrid is also located on the receiver board next to the VCO hybrid. It contains a passive splitter which also provides broadband isolation between its three outputs.

These outputs are connected to three independent broadband amplifiers each with its own supply input. The first buffer amplifier provides a relatively low output level of 1 to 2mW which is used to drive the synthesiser divider and hence its supply is connected to +10V permanent. The second amplifier supplies the receiver local oscillator signal at a level of about 10mW and only operates during receive so its supply is connected to +10V Rx.

Finally the third buffer amplifier provides drive to the transmitter power amplifier at a level of approximately 30mW at VHF and 150mW at UHF. This amplifier is powered via a separate +10V PA supply which is only present when:

i) The radio is set to transmit.
ii) The out-of-lock signal is low.
iii) The synthesiser has had sufficient time to settle to the required frequency. This is achieved by a time delay, determined by the regulator and switching integrated circuit, IC201.

In the Duplex mode of operation the receiver local oscillator buffer is powered by the unswitched +10V supply, (link LK201 must be fitted). With this provision it is possible to have all three buffers operating simultaneously.

3.3.4 **DUPLEX FREQUENCY OFFSET LOOP** (Circuit Diagram 7.17).

3.3.4.1 Introduction

The duplex offset loop is used to generate the mobile transmitter frequency. This is achieved by phase locking the Tx VCO to the Rx local oscillator VCO separated by the duplex offset frequency. The separation frequency is determined by the offset loop crystal reference and the Rx IF frequency - refer crystal calculation and other duplex details in the Specification Section. A block diagram of the duplex offset loop is given in Figure 3.10 with a description of circuit operation below.

3.3.4.2 Transmitter Carrier Frequency Generation - Duplex

The receiver local oscillator signal from the main synthesiser is taken from Buffer hybrid U202 at a level of +8dBm and fed to Gate 2 of TR803 mixer FET. Gate 1 is driven by a signal from the transmitter VCO U801 driving the buffer U802. The resultant difference frequency from the mixer is then filtered through the drain load components L804, C835 and C833 to the divide-by-4 input (pin 16) of Phase Comparator IC802. At this point (TP802) a signal of about 150mV p-p at a frequency of around 20 to 30MHz should be present.

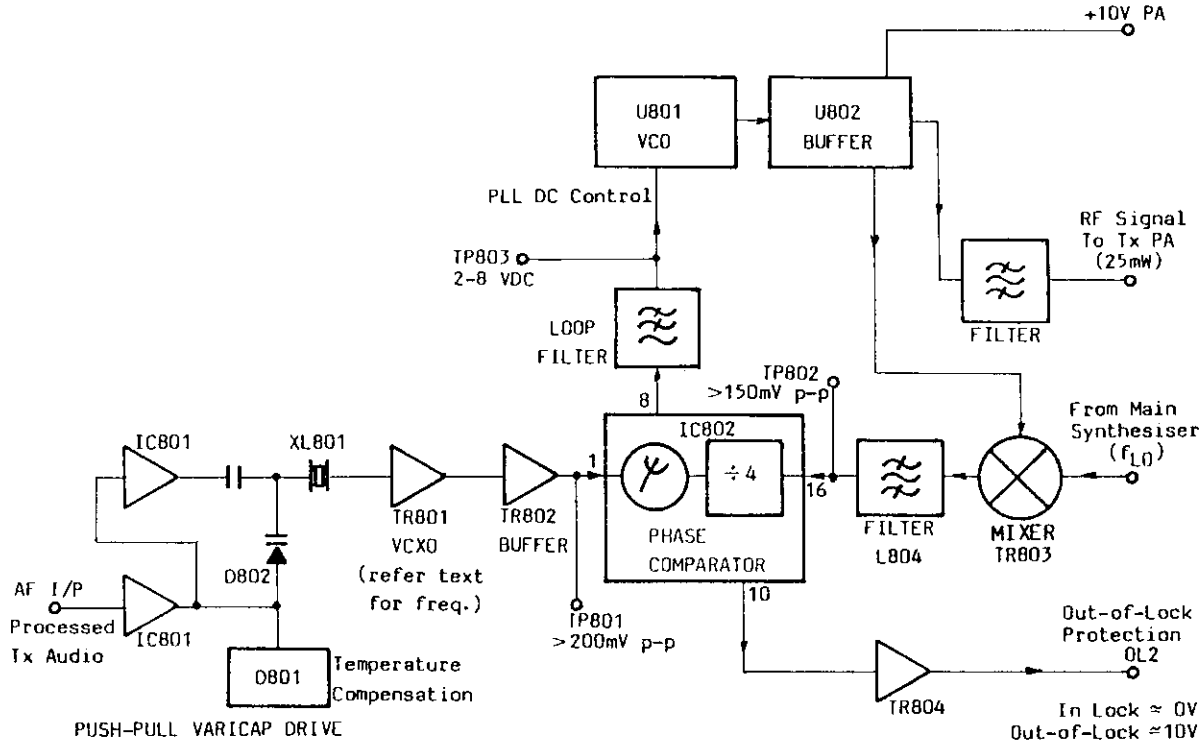


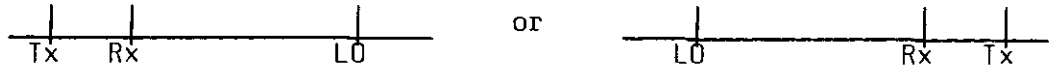
Figure 3.10 Duplex Frequency Addition Loop Block Diagram

The VCXO (TR801) provides the reference frequency input to the phase comparator at the required Xtal frequency (determined by the actual Tx/Rx separation). The oscillator is a modified Colpitts which uses a series varicap diode D802 to provide frequency modulation of the transmitter carrier. The oscillator output is buffered through TR802, then filtered and matched to the input of the phase comparator by L802, C822 and C823.

During lock acquisition the phase comparator IC802 applies a 3kHz sinusoidal signal to the VCO control line through R845. This signal sweeps the frequency of VCO D801 over approximately 4MHz, which is translated to the difference frequency at IC802 pin 16.

When the difference frequency divided by 4 equals the VCXO Xtal frequency, the loop will phase lock and the 3kHz sweep waveform will be removed from the VCO control line. Thus the VCO U801 will be locked to (f_{LO} - $4f_{VCO}$).The Tx frequency will now follow the Rx frequency by a constant separation.

To minimise the potential of spurious products appearing on the transmitter, the receiver local oscillator frequency is always set so that the maximum separation between Tx and Rx L.O. frequencies is achieved:



This means that if the Tx frequencies are above the Rx frequencies, local oscillator injection will be 21.4MHz below the Rx frequency. Conversely, if the Tx frequencies are below the Rx frequencies the local oscillator injection is 21.4MHz above the Rx frequency.

3.3.4.3 Transmitter Frequency Modulation - Duplex

Transmitter frequency modulation is obtained by applying processed signals to the duplex loop VCXO varicap via a push pull amplifier (ie. differential voltage drive to the VCXO). Frequency deviation is controlled as per simplex and should be aligned accordingly. Note that the resultant transmitter frequency deviation is 4 times the VCXO deviation due to the divide-by-4 prescaler preceding the phase comparator within IC802.

3.3.4.4 Netting - Duplex

Frequency netting of the transmitter is affected directly by the receiver synthesiser netting. Before adjusting the VCXO netting coil L801, first check the receiver netting using known accurate frequency sources. When the receive netting has been checked, L801 may then be adjusted for the correct transmitter frequency.

3.3.4.5 Out-of-Lock - Duplex

The phase comparator IC802 has an internal out-of-lock protection circuit. If a fault occurs in the loop or the reference signal is lost or out of range, a LOW voltage will occur at pin 10. This will switch on TR804 and produce a HIGH voltage which is coupled directly to IC201 and to the central control. IC201 will then immediately disable the transmitter (remove +10V PA).

3.3.4.6 Mode Change (Tx On)

When the mobile unit is set to transmit, the "TX ENABLE" line to IC201 goes LOW enabling the +10V Tx switch. The +10V Tx line provides supply to all duplex loop circuits except the VHF buffer output amplifier, which is supplied from the +10V PA line (this line has software and hardware delays to allow for synthesiser programming and VCO settling times). The duplex loop will lock typically within 7mS of the "TX ENABLE" command. When both the synthesiser loop and the duplex frequency addition loop are established the +10V PA will be enabled and RF drive signal will be applied to the transmitter PA. The delay for the +10V PA line to be enabled is approximately 18mS from the "TX ENABLE" command.

3.4 CENTRAL CONTROL (CONTROL/SYNTHESISER PCB) (Circuit Diagram 7.7)

3.4.1 GENERAL

The FM900 central control provides logic control of the following transceiver functions:

- On/Off and supply transient protection.
- Synthesiser programming.
- Mute control.
- Receiver/transmitter control.
- Transmit power control.
- Auto-test.
- Signalling options.
- Operating interface (via control unit).

The main logic control element is an 8-bit CMOS microcomputer (146805E2) with external program memory. Interface to the transceiver is via I/O ports on the microcomputer with expansion via three hex latches and a six-channel A/D converter. Additional I/O and RAM is provided by an RAM, I/O, Timer I/C (NSC810) for signalling options and systems control.

The actual logic operations (program flow) is controlled by a program contained in the EPROM. This program is the key to all facilities provided by the transceiver.

Essentially, the program flow of the central control can be divided into two main areas, foreground real time tasks, such as mute control, and background non-real time tasks, such as synthesiser programming on channel change.

3.4.2 MICROCOMPUTER POWER SUPPLY AND POWER FAIL RESET CIRCUITRY

3.4.2.1 Permanent 5-Volt Regulator

The permanent 5-volt regulator is used to maintain supply to all critical CMOS circuit elements including the microcomputer (IC408), on/off and power up reset circuits (IC407), peripheral control latches (IC's 404, 405 and 406), A/D converter (IC402) and the RAM, I/O, Timer (IC415).

When the mobile is connected to the battery and switched off, all microcomputer internal clocks will be stopped, reducing current consumption to leakage currents of the above elements, plus the quiescent current of the permanent 5-volt regulator (IC401). In the case of VHF mobiles which employ a discrete oscillator, standby current is also supplied to this circuit.

The permanent 5-volt regulator is connected to the unswitched 13.6-volt supply via the reverse polarity protection diode D402, and transient suppression circuit R404 and C401. Capacitors C413, C449, C450 and C454 also serve to maintain supply to the above circuits whenever transients occur on the input supply, preventing loss of data and ensuring an orderly recovery from dropouts.

3.4.2.2 Switched 5-Volt Regulator

The switched 5-volt regulator is used to supply all non critical circuit elements. These include the PROM (IC412), address latch (IC409), address decoder logic (IC's 410, 413 and 414) and option hybrids (U402 to U405), although link options are provided to operate these hybrids from the permanent 5-volt regulator for special applications.

When the mobile is connected to the battery and switched off, the address strobe line (AS) out of the microcomputer will be held at logic zero. This output is applied to the base of the emitter follower TR404 causing the emitter to be grounded and, therefore, turning off the switch transistors TR406 and TR405, removing the input from the switched 5-volt regulator.

When the set is switched on, a pulse of approximately 3ms will occur at the reset pin of the microcomputer, causing the internal clocks to start (i.e. data strobe, address strobe and the 5MHz oscillator for UHF mobiles). At this point, the processor will wait for 1920 address strobe cycles before commencing to execute instructions (i.e. allowing approximately 2ms for the 5-volt switched supply to stabilise).

The address strobe pulses appear at the output of the emitter follower TR404 and are applied to the base of the switch TR406 through the integration network R443 and C423. Following the third or fourth address strobe pulse, TR406 will be switched on, turning on TR405, and supplying approximately 12.5-volts to the input of the switched 5-volt regulator IC411, through protection diode D402 and resistor R441. The total switching time for the 5-volt switched supply is dominated primarily by the stabilisation time of the regulator IC411, this being as high as 50us.

3.4.2.3 Power On/Off Switch

The power on/off circuit consists of IC407 configured as a monostable and schmitt trigger. The on/off switch is connected directly to the monstable input via the key debounce circuit R426 and C408. When the switch is depressed, pin 10 of IC407 will go to logic 1 for the period that the switch is depressed. This level is applied to the PA5 input of the microcomputer, via isolation resistor R425, where it is sampled approximately 25mS after the program commences execution. The logic level at this input identifies the reset pulse being due to an on/off request and not a supply transient.

When pin 10 of IC407 goes high, pins 12 and 13 will also be forced high, via capacitor C407, taking pin 11 low. As C407 charges through R422, the voltage at pins 12 and 13 of IC407 drops, causing pin 11 to again return high, approximately 3ms later.

Pin 1 of IC407 will be at logic 1 under normal operating conditions, allowing the negative pulse generated by the on/off key to be applied to the reset pin of the microcomputer, and to the reset input of latch IC406. This second function will immediately result in the supply switch relay being turned off, removing power from the remainder of the circuit.

The on/off switch is programmed as a toggle function, therefore, if the mobile was in the "on" condition, a switch off sequence will be initiated, which will return all lines to either safe or low current conditions, the relay will be held in the off state and, finally, the microcomputer will stop, turning off all internal clocks and removing the switched 5-volts, as previously described (see Section 3.4.2.2). If the mobile was already switched off, then an initialization sequence will be executed, which will return the latch IC406 to the active state, turning on the supply relay and therefore applying power to the remaining circuits.

3.4.2.4 Supply Reset Sequence

While the mobile is designed to operate over the supply voltage range of 10.8 to 16.5-volts it will still function correctly to lower supply levels. In order to protect the set against incorrect operation or corruption of data at low supply levels, due to possible execution of invalid program instructions below the level of the voltage regulator dropout points, the microcomputer is forced into the reset state before this condition is reached.

The point at which the low supply level reset condition occurs is determined by threshold detector comprising of R458, R459, R473 and TR408, plus the schmitt trigger circuit comprising of TR408 and IC407, and the hysteresis network R423 and R460.

As the I/P voltage reduces, the level at the emitter of TR408 begins to approach the point where the transistor will begin to turn off. As the transistor switches off the voltage at IC407 pin 1 reduces causing pin 3 to go high. This signal is fed back to the base of TR408 by the hysteresis network, causing the base-emitter voltage to further reduce. When pin 3 of IC407 is high the voltage at the base of TR408 will be higher than the normal operating voltage at this point, therefore, the supply voltage must be increased significantly to restore this level to the switching point before pin 3 may again return low.

The point at which pin 4 of IC407 will switch is between 8 and 10-volts, with sufficient hysteresis to protect against line switching transients.

To protect against both receive and transmit lockup conditions, which could result from the microcomputer being forced into the reset condition and therefore preventing the mobile from being switched off, pin 4 of IC407 is also connected to the reset input of latch IC406. This turns off the relay removing power from the remainder of the circuits under such conditions. When the supply reset condition is removed, the computer will continue operation as if the set had just been switched "on" from the off condition.

3.4.3 MICROCOMPUTER ADDRESS, DATA, CONTROL BUS AND CLOCK

3.4.3.1 Clock

The basic clock frequency for all microprocessor operations is 1MHz, giving an instruction cycle time of 1uS. This frequency is derived by internally dividing the signal at the oscillator input by 5.

An internal, timer-counter in the microcomputer further divides the basic clock by 416 and activates a timer interrupt. This interrupt forms the basis of the real time foreground processing section of the program.

For UHF mobiles the microprocessor oscillator signal is derived by use of a 5MHz parallel resonant 5MHz crystal in conjunction with the internal clock oscillator circuit of the 146805E2.

In the case of VHF mobiles the oscillator input signal is obtained from an external 5MHz switched crystal oscillator (TR409). The frequency of this oscillator can be shifted by approximately +500ppm by switching the crystal capacitance to a lower value. This is achieved by switching on TR411 with a logic high from the microprocessor. This in turn switches off TR410. The switching rate is controlled by R467, R466 and C445 to prevent phase transients or oscillator damping. Frequency switching is controlled on a per channel basis from IC404 pin 10 in 92 mobiles, and from IC415 pin 2 in 91 mobiles. Switching control of this oscillator is employed on VHF bands to reduce possibility of receiver internal interference from signals in the control area. These signals are generally related to the processor clock and may have high energy outputs on channels near 1MHz boundaries. Channels on which the oscillator is switched are indicated by an "s" following the receiver frequency on the mobile option label.

3.4.3.2 Bus Description

The main items on the bus of the microcomputer are the octal latch (IC409), 8K byte NMOS UV eraseable PROM (IC412), RAM-I/O-Timer (IC415) and several gates.

The EPROM (IC412) is an 8K byte 28-pin I.C. which must be factory programmed for correct operation of the transceiver (NB: correct programming of the PROM is checked by the uC at switch-on, refer Section 1.5.3.5).

The address/data bus of the MC146805E2 is a multiplexed bus with a basic machine cycle time of 1us. Address information (low order, A0-A7) is latched by the octal latch (IC409) on the falling edge of the address strobe (AS). High order address lines A8 to A12 are decoded (these lines are not multiplexed) and gated with the appropriate control bus signals (AS, DS and R/$\overline{W}$) to locate the various devices placed on the bus in the required position in the processor memory map.

Data is written, or read, onto the AD0 to AD7 lines during the data strobe cycle (DS). The DS line is gated with R/W to bring data on to the bus during the correct time slot only (for bus timing details refer to the 146805E2 manufacturer's data sheet).

3.4.3.3 Decoding/Gating of Bus

Control bus gating is performed by IC410 for the EPROM, where R/W and DS are gated to form an active low enable into the $\overline{OE}$ pin of the EPROM. Additional chip selection control of the EPROM is provided by IC410 (for 4K EPROM's only) and IC413 (pin 5).

The purpose of IC413 (5 input NOR gate) is to disable the EPROM on addresses below 256 decimal (100 hex); when all inputs to this gate are low (i.e. A8 to A12 are logic 0) the output of IC413 pin 5 is high, causing the $\overline{CE}$ of the EPROM to be disabled.

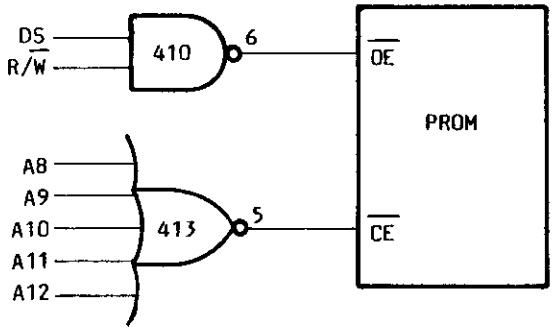


Figure 3.11 Diagram showing $\overline{CE}$ & $\overline{OE}$ of 8K Prom

Address and control decoding for the RAM-I/O-timer (IC415) is provided by IC414 and the second half of IC413. IC414 inverts the R/$\overline{W}$ signal to give $\overline{R/W}$, this is in turn gated with DS to give a write enable (active low) to pin 10 of IC415.

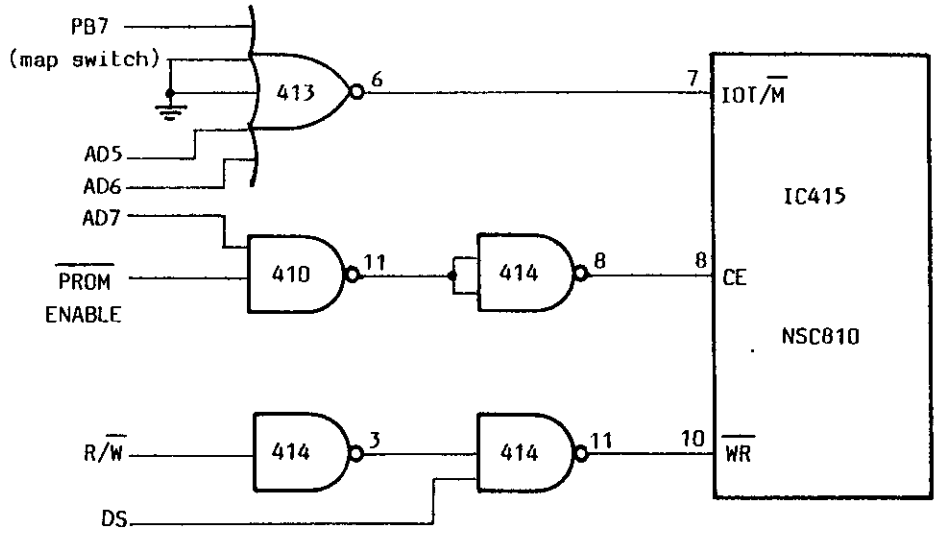


Figure 3.12 Diagram showing address Decoding/enabling of RAM I/O Timer (IC415)

The IOT/$\overline{M}$ input of IC415 controls access to the I/O, Timer registers or RAM memory of this IC. Control of this input is not only a function of the address bus but, also, PB7. This allows a form of address Map switching to gain access to additional RAM locations within the RAM-I/O Timer IC.

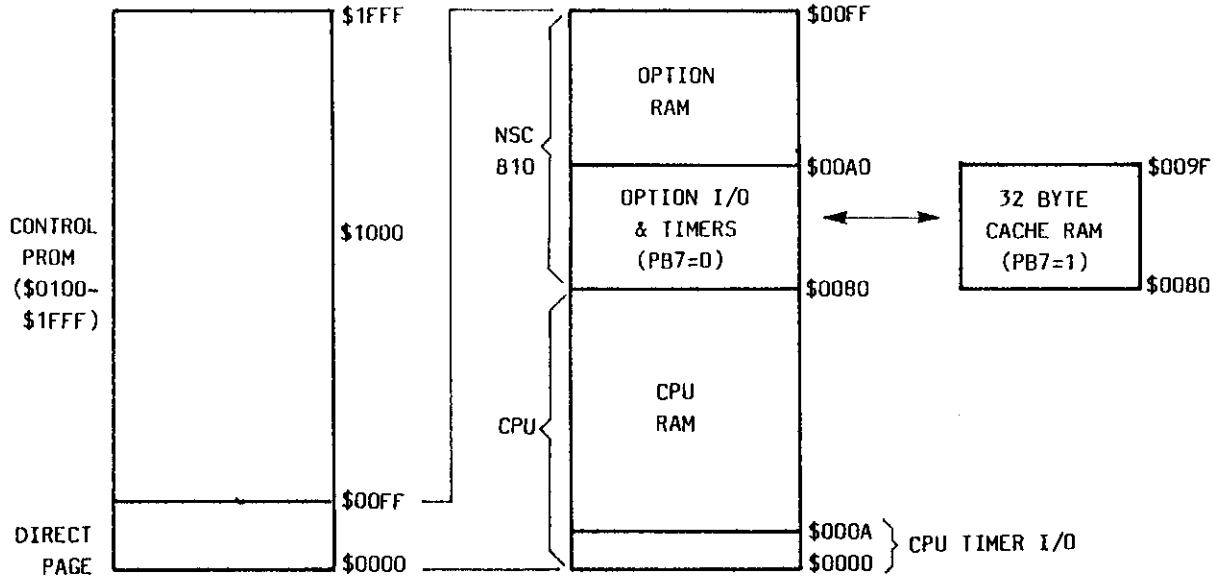


Figure 3.13 Memory Map

3.4.4 RADIO INTERFACE FROM/TO MICROCOMPUTER

3.4.4.1 Microcomputer Port Lines

All interfacing to the radio system is indirectly handled by the microcomputer through the two inbuilt 8-bit bidirectional I/O ports (PA0 to PA7 and PB0 to PB7). Generally, port A lines PA0 to PA5 are used as outputs only (except during the on/off sequence when PA5 is temporarily converted to an input) and are written to with paralled data. This data is applied to interface latches (IC404, IC405 and IC406) plus level buffer (IC403). The lines of port B all perform individual dedicated functions, and are programmed in the bit mode as follows:

PB0 - Serial data
PB1 - Serial clock
PB2 - Latch 3 strobe
PB3 - Latch 2 strobe
PB4 - Latch 1 strobe
PB5 - Synthesiser program clock
PB6 - Synthesiser program enable
PB7 - Memory map switch.

Lines PB0 and PB1 are used for communication with the control head (see Section 3.6). Lines PB2 to PB4 clock the parallel data from port lines PA0 to PA5 into the interface latches IC406 to IC404, respectively, at fixed rates. The length of the pulses on PB3 and PB4 will generally be 5us and will occur every 833us and 13.3ms, respectively. The pulses on PB2 will vary in width in accordance with the voltage at the input of the A/D converter channel, which is addressed by inputs A0-A2 of IC402 while PB2 is high. The pulses on PB2 will repeat at a rate of four pulses every 13.3ms.

Lines PB5 and PB6 are dedicated to synthesiser frequency programming, PB5 normally being held in logic 1 state and PB6 being held at logic 0.

Line PB7 is used only to select the 32 byte cache RAM in place of the option I/O and timer locations within IC415. This line will be held low during normal operation (use of this RAM is limited to special options).

3.4.4.2 Synthesiser Programming Interface

The synthesiser is programmed under control of the six data lines PA0-PA3, PB5 (clock) and PB6 (enable). When not being used for synthesiser programming, line PB5 will be held high, PB6 will be low and data lines PA0-PA3 will be shared by other functions and will contain random information. When the synthesiser is to be programmed, the synthesiser clock line (PB5) will pulse low, after which the enable line will be taken high. A further nine clock pulses will occur as data is clocked in, after which the enable line will return low. Synthesiser programming information is presented in inverse BCD on data lines PA0-PA3 and is valid and stable only while the clock line PB5 is low.

As the synthesiser circuit operates on 10 volts, the six programming lines are applied to a level buffer (IC403) to translate the TTL logic levels from the microcomputer ports to 10-volt pulses for the synthesiser inputs.

3.4.4.3 Volume and RF Power Level Control

Both the E.V.C. (Electronic Volume Control) and the RF power level control circuits are driven from latch IC404. Data is written to this latch once every 13.3ms. The level of the volume control is defined by the inverted 4-bit binary value on input pins V0-V3 of hybrid module U401 (all logic high's representing minimum volume).

RF power level is selected by the pin 10 and pin 12 outputs of IC404, according to the following table.

Pin 10	Pin 12	
0	0	High Power
0	1	Medium Power
1	0	Low Power
1	1	Illegal State (Unused)

The above logic conditions are applied to the bases of switch transistors TR401 and TR402 which, in turn, switch in R402 or R403, respectively, therefore altering the reference voltage to the power control circuit located on the PA board.

3.4.4.4 TX/RX Control Lines

Transmit and receive control lines are handled primarily through latch 2 (IC405). Data is written to this latch every 833us. Lines controlled through this latch are as follows.

1. Transmit enable.
2. VCO offset.
3. Rx AF enable.
4. Microphone inhibit.
5. Alarm tone.
6. Speaker enable.

a) Transmit Enable (Pin 7) This line is an active low and is applied directly to pin 9 of the OM815 voltage regulator (IC201). The low condition will cause power to be applied to the transmitter circuits following a hardware delay and, if not in the duplex mode, the receiver will be switched off. (See also Section 3.5).

b) VCO Off Set (Pin 5) This line may be high on either Tx or Rx (or both), depending on the per channel transmit/receive frequency channel allocations. A high level on this line will turn on TR403, causing the VCO off set input to the VCO hybrid (U203) to be grounded. (For a description of the operation of this line on the VCO see Sections 3.3.3.5 and 4.5).

c) Rx AF Enable (Pin2) This line is a direct input to the Rx Audio processing hybrid module and operates as an audio gate, disabling all receiver audio outputs when high (both speaker and handset).

d) Microphone Inhibit (Pin 15) This line is a direct input to hybrid module U301 and is used to disable the microphone input to the transmitter in such conditions as selective call signalling periods, to prevent transmitter over deviation.

e) Alarm Tone (Pin 12) This line is not a control line but an input to the receiver audio stage, and contains the computer generated alarm tone. When not active, this line will be at logic low.

f) Speaker Enable (Pin 10) This line switches the receiver audio output to the receiver audio PA, and effectively mutes the speaker. The handset output is not effected by this control line.

3.4.5 A/D CONVERTER

The A/D converter (IC402) is an 8 channel single ramp CMOS IC, which operates under control of the microcomputer, through latch 3 (IC406) and the interrupt request line ($\overline{IRQ}$). Channels 0 and 7 are internally connected, while channels 1 to 6 are used to monitor the following points within the mobile.

Ch 1 - Mute noise detect output.
Ch 2 - Receiver signal level.
Ch 3 - PLL feedback voltage.
Ch 4 - 10 volt regulated supply.
Ch 5 - 13.6V unregulated supply.
Ch 6 - Tx RF monitor.

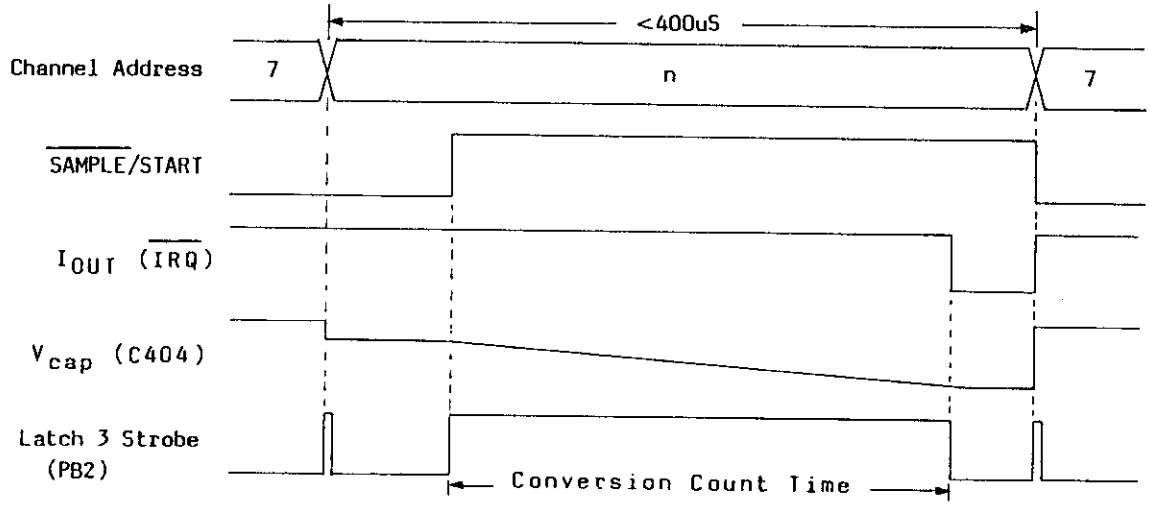


Figure 3.14 A/D Converter Timing Waveforms

The measurable input voltage range of the converter is from approximately 50mV to 2.5 volts.

In the standby mode, the $\overline{SAMPLE}$/START input is held at logic 0 condition (SAMPLE mode), while the address lines are held on channel 7 (internal reference voltage). When a reading is about to be taken, the required channel is addressed and the capacitor (C404) is charged to the input voltage of that channel (i.e. the channel is sampled). This condition is maintained for 29us, after which the $\overline{SAMPLE}$/START line is taken high. At this point, the capacitor is isolated from the input channel and discharged through a constant current reference.

When this voltage reaches the comparator threshold voltage, the comparator output (pin 7) goes to logic 0, initiating an interrupt (IRQ) sequence within the microcomputer, allowing the capacitor discharge time to be measured and, hence, the input voltage to be determined. After the interrupt has been generated, the SAMPLE/START line will be returned low and channel 7 will be selected until the next measurement is started. Four A/D converter readings are taken every 13.3ms. Timing of the A/D converter is shown in figure 3.14.

3.4.6 SIGNALLING INTERFACE

Several product options require additional hardware hybrid modules (U402 to U405) which are controlled by the microcomputer through memory mapped port lines of the RAM-I/O - timer (IC415). These lines are TTL level compatible and may be configured as inputs or outputs, as required by the selected option. Details of modules U402 and U405 are described in Part 2 of this manual.

3.4.6.1 Selective Call (Type 2)

Selective calling is implemented by the hybrid circuit module U402, connected to port A of IC415. The first four lines of this port (PA0-PA3) define the current code of the tone code sequence which is being sent or received and will be configured as either an output or an input, depending on whether the module is in the Encode or Decode mode respectively. The fifth line (PA4) is always an output and is high to select encode and low for decode. Line six (PA5) is an output to the external alarm pin on the hybrid. The seventh line (PA6) is configured as an input or output in sympathy with lines PA0 to PA3, and is used to strobe data into the hybrid on encode, and to indicate that data has been detected in decode. The last line of the port (PA7) is always configured as an output, whose function is defined by PA4. In encode, this line selects the code format, while on decode it is used as a data hold in conjunction with PA6.

When switching from encode to decode, lines PA0 to PA3 and PA6 are always changed to inputs, prior to PA4 changing state, while the reverse sequence is maintained when switching back to encode.

The timing for type 2 selcall is shown in figure 3.15.

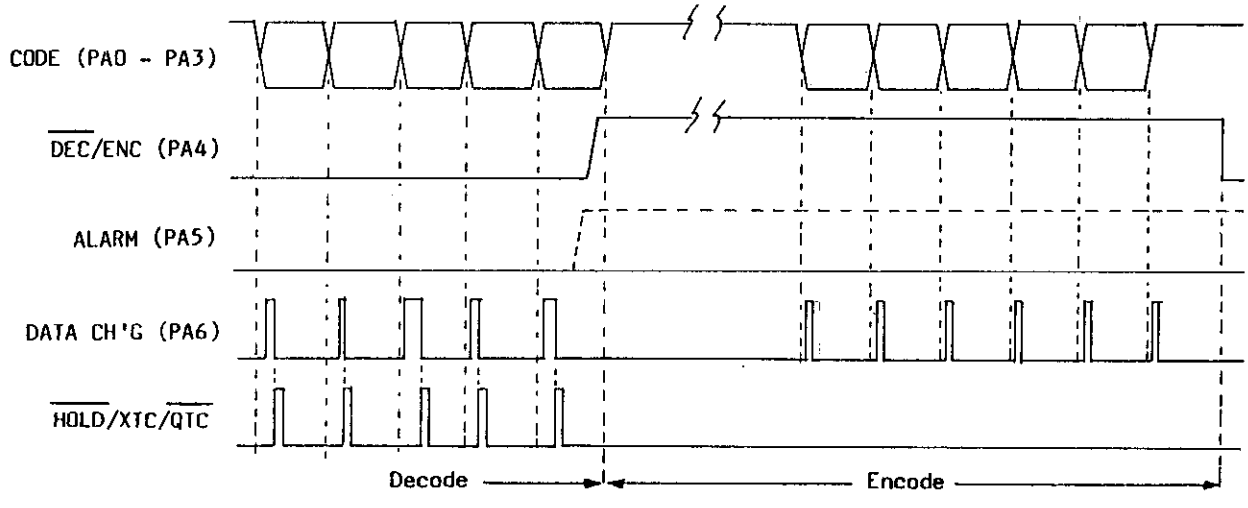


Figure 3.15 Type 2 Selcall Timing (Decode & Auto-Acknowledge Sequence)

3.4.6.2 CTCSS

CTCSS option is implemented by module U405. This module is interfaced to port B lines PB0 to PB6 and port C lines PC1 and PC2. Lines PB0 to PB5 are always configured as outputs and contain the code of the required tone (see Section 3.3.4 of Part 2). The third line of port C (PC2) is configured as an input and is used to detect the presence of tone in the decode mode.

The first line of port C (PC1) is an output which selects either the encode or decode mode, a low state defining encode.

The seventh line of Port B (PB6) is an output and is used to activate Reverse Tone Burst.

Timing of C.T.C.S.S. is shown in figure 3.16.

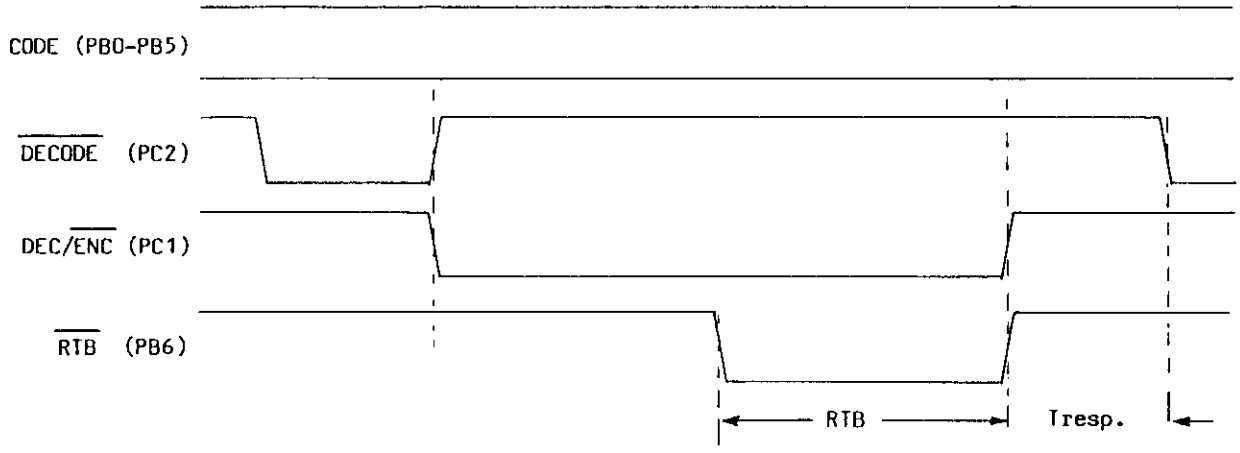


Figure 3.16 C.T.C.S.S. Encode/Decode Timing

3.5 POWER SUPPLY (Circuit Diagram 7.2 or 7.3)

3.5.1 GENERAL

The power supply consists of five sections -

(a) The main battery supply filter and on/off switching.
(b) +10V Regulator.
(c) +12V Regulator.
(d) +9V Supply to Remote Control Unit.
(e) Transmit/Receive Switching.

A single integrated circuit provides the logic control for all the transmit/receive switching, as well as control for the +10V and +12V regulators. The +9V remote control unit supply is referred to the +10V supply.

Note that +12V regulator TR210 is used only with UHF and is bypassed for VHF versions.

3.5.2 SUPPLY FILTERING AND ON/OFF SWITCHING

The battery supply is provided with RF filter L201, C203, C206, as well as impulse suppressor diode D203. Battery isolation is provided by relay RL201 with non destructive reverse polarity protection provided by D201. The relay driver TR202 is controlled by the central control microcomputer.

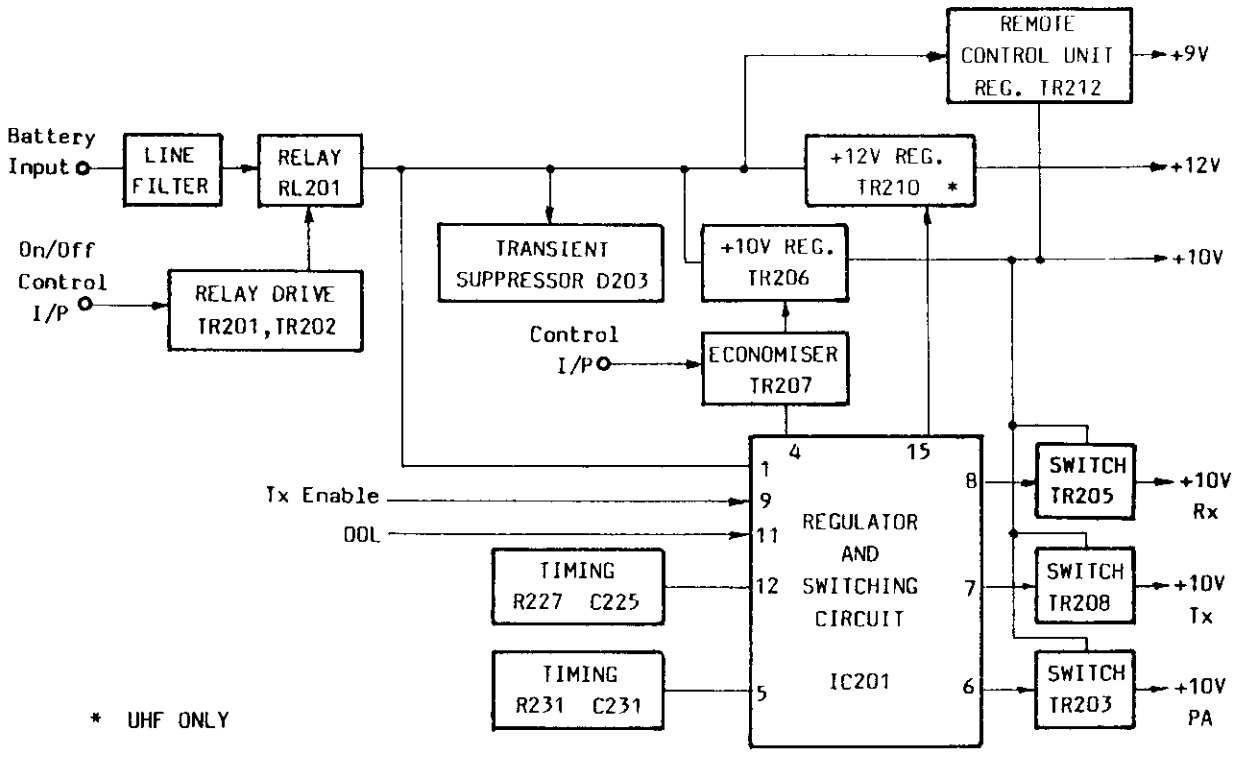


Figure 3.17 Power Supply Simplified Block Diagram

3.5.3 REGULATORS

Three regulators are provided, which supply +10V to synthesiser and receiver, +12V to the transmitter power amplifier (VHF transmitter power amplifier is supplied with 13.2V unregulated) and +9V to the remote control unit. The +10V and +12V regulators are contained in integrated circuit IC201, which controls the external series pass PNP power transistors TR206 and TR210. Current sensing, provided by series resistors, allows controlled current foldback during short circuits, thus protecting the series pass transistors against excessive dissipation.

An economiser switch, TR207, allows central control of the +10V regulator.

The +9V regulator TR212 is referenced to +10V and acts as a simple emitter follower.

3.5.4 SWITCHES

Three switching transistors, TR203, TR205 and TR208, provide the necessary transmit/receive changeover switching voltages +10VPA, +10VRx and +10VTx. There are in-built logic time delays to allow for synthesiser settling and these delays are provided by the RC time constants R227, C225 and R231, C231. All control for the switches is contained in IC201. An inhibit input prevents +10VPA from switching, whenever the out-of-lock line on the synthesiser is high.

3.6 91 REMOTE CONTROL UNIT (Circuit Diagram 7.9)

3.6.1 GENERAL

The Control Unit for the 91 mobiles consists of two printed circuit boards. The first board contains the display and keyboard section and is interfaced to the second board containing an 8748 microprocessor or a masked 8048 controller and drivers via a 36 way flexible connector. Interfacing to the mobile is via a 15 way D-type connector (SK501) mounted at the rear of the control unit and connecting to the keypad and display board. A phone jack socket (SK601) and 8-pin DIN Socket (SK502) and provided at the rear for connection to the loudspeaker and microphone respectively.

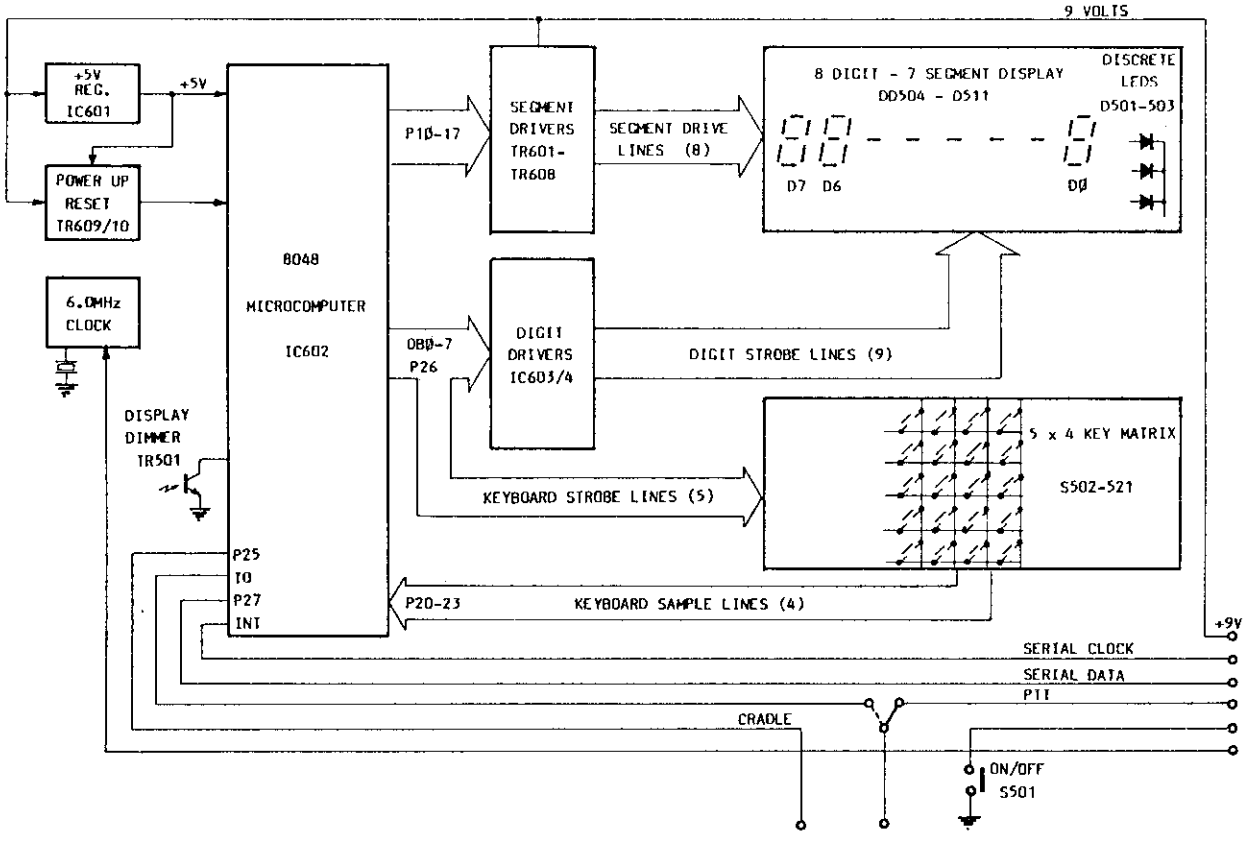


Figure 3.18 Simplified Block Diagram of Control Unit

3.6.2 TECHNICAL DESCRIPTION

In this description both circuit boards comprising the Control Unit will be treated as one integral module although either may be used independently for special applications. The block diagram in Figure 3.18 may also be useful in identifying the individual functions of the circuit.

Supply to the microprocessor is derived from the 9 volt input of SK501 via protection diode D601 and filter network C601 and C602. With capacitor C603, this network will also maintain supply to the processor during short supply drop outs, or glitches allowing continuous uninterrupted operation during very short pulses, and providing a controlled reset sequence via the reset circuit during slightly longer pulses.

3.6.2.1 **Reset**

The reset circuit consists of D602, TR609, TR610 and associated components. Under normal conditions TR610 will be saturated due to the base current provided via D602 and R606, turning off TR609 and allowing the reset line to be pulled high by R649 in parallel with an internal 200K resistor. During power up, the above conditions will be established immediately with the exception that the processor $\overline{R}$ input (pin 4) will be held low by capacitor C609 for approximately 50mS until charged by R649 and the internal 200k resistor at pin 4.

The reset circuit should provide a controlled reset under both low voltage conditions and supply transients. In the first case the current to the base of TR610 will decrease as the supply voltage reduces until it will no longer remain in saturation allowing TR609 to turn on reducing the voltage at the processor reset pin. This voltage is also fed back to the base of TR610 which causes further reduction in base current causing TR609 to further turn on. The effect of this schmitt trigger circuit is to provide a sharp reset at a predefined supply level. The reset point is set at approximately 7.5 volts to ensure that the control unit will not reset before the central control processor in the mobile (the reset point for this processor being approximately 9 volts). The hysteresis provided by R643 also prevents the reset line from returning high until the supply reaches approximately 8.2 volts. Control Unit resets are handled entirely by the Central Control reset circuit for slow supply changes, however, in the case of transients induced in cabling, the Control Unit will operate as described above.

3.6.2.2 **Control Head Processor**

The Control Unit microprocessor handles all functions related to display multiplexing keyboard strobing, data interfacing and display intensity control. These functions are described below.

a) Data Interfacing

All data interfacing to the mobile is handled over the serial clock and serial data lines. These lines are both protected and TTL level compatible. The clock line is an input only to the control head and provides all the timing required by the Control Unit for data transmission, display and keyboard driver routines. The data line is bi-directional and in the idle state is configured as an input (at both the control head and the mobile) and will be floating at logic 1 (+5V). Data is sent at a rate of 1200 baud using one start bit, 8 data bits, one parity bit and one stop bit. To provide this data rate the clock line contains a square wave of 1200Hz. To synchronize the control head to the mobile and to enable internal timing to be accurately derived the clock line is applied to the interrupt input of the processor.

b) Display Multiplexing

The 8 seven segment displays and 3 discrete LEDs are multiplexed directly from the microprocessor. Each digit is illuminated in turn for one time slot (2 in the case of the discrete LEDs), each slot being 833uS. This results in 10 slots per display scan and producing a display refresh rate of 120Hz.

The segment strobe pulses are derived from the Data bus outputs to provide sufficient drive capability for the digit driver buffers IC603 and IC604. These IC's invert the digit drive pulses and provide sufficient current sink capability for all segments of the displayed digit. During each digit strobe pulse, the data for the addressed display appears across the segment driver outputs from port lines P10 to P17. The current for each segment is supplied from the constant current network consisting of R633 to R640 in conjunction with transistors TR601 to TR608 in order to maintain constant display intensity. Resistors R625-R632 are included to provide sufficient drive capacity to the segment driver transistors in the logic one state. The timing diagram Figure 3.19 shows the waveforms associated with the display multiplexing and keyboard strobing.

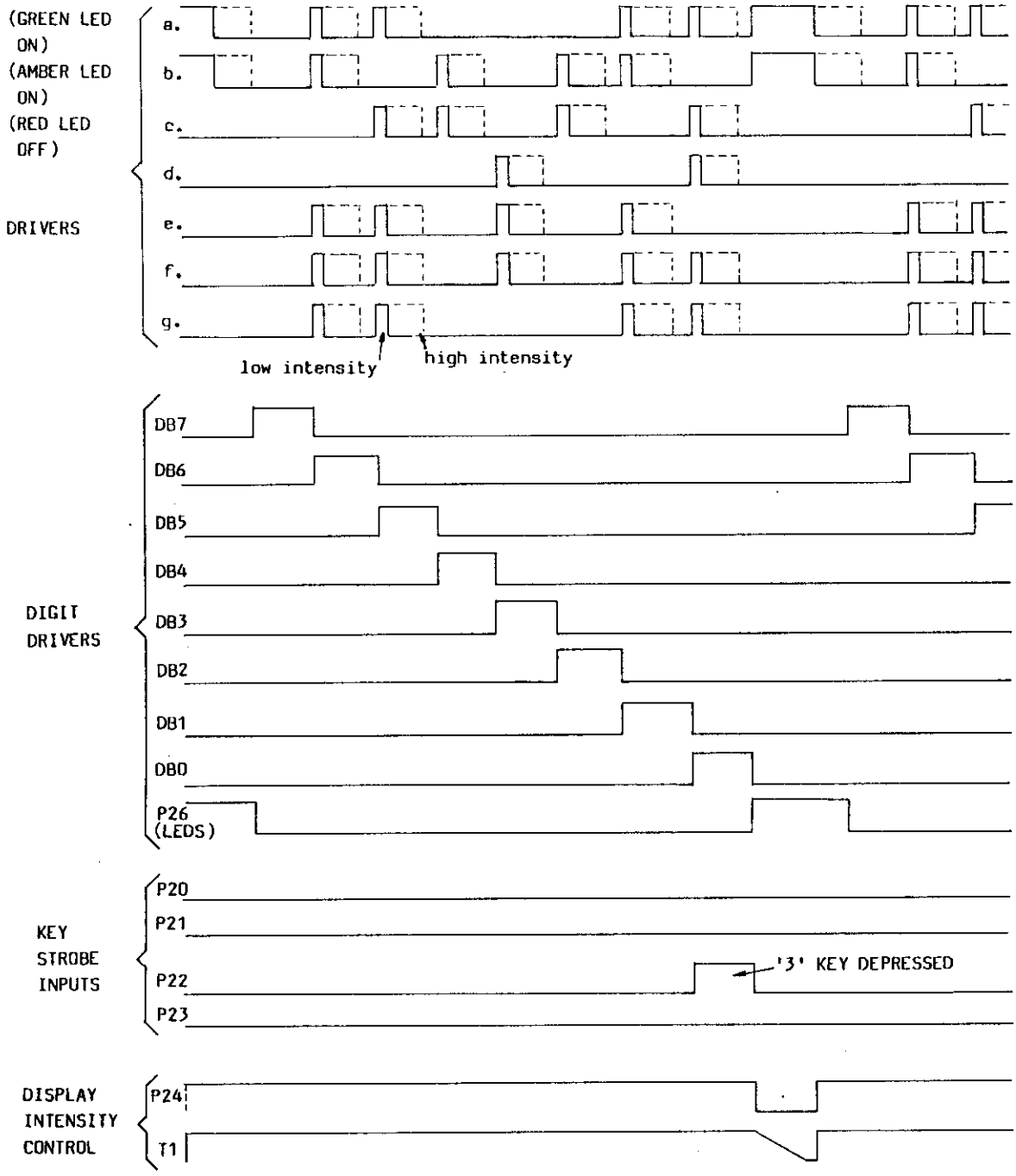


Figure 3.19 Control Head Timing Waveforms

c) Display Intensity

The display intensity is controlled by the microprocesssor in association with the photo transistor TR501 diode D608 and integrating capacitor C615. The waveforms associated with this section are shown in Figure 3.20.

The display intensity is controlled by varying the pulse width of the segment driver pulses in five discrete steps in accordance with the discharge time of capacitor C615. This capacitor is normally held in the charged state and, during the first of the two digit driver pulses for the discrete LED displays the charging pulse is removed allowing the capacitor to be discharged by the phototransistor TR501. The higher the ambient light level the faster the capacitor discharges and the wider the segment driver pulses are made for the next display scan thus increasing the display intensity.

d) Keyboard Scanning

The keyboard is wired in a 4 x 5 matrix and is driven from the first 5 lines of the data bus of the processor (digit driver outputs) allowing each of the four rows of keys to be sampled once per display scan. When a key is depressed the digit driver pulse is detected on port lines P20 - P23 allowing the key to be decoded. (These port lines are normally held at logic low by resistors R612 thru R615.

On control heads using NMOS 8748 processors, transistors TR502 to TR506 are provided to supply the current necessary to pull up the inputs P20-P23 without detracting significantly from the current available to drive the digit drivers IC603 and IC604 (This is required due to the excessive leakage currents associated with this component). These transistors also prevent multiple key closures from generating erroneous displays due to digit drive pulses being applied simultaneously to two or more drivers. On control heads using masked CMOS 8048 processors, the leakage current is significantly lower, allowing these transistors to be replaced with diodes to prevent the erroneous display condition.

e) Clock

The clock for the microprocessor operates at 6MHz and is internally divided by 15 to give an instruction cycle time of 2.5uS. The 6MHz signal is derived from an external switched crystal oscillator (TR613). The frequency of this oscillator can be shifted by approximately +500ppm by switching the crystal capacitance via transistors TR611 and TR612, the switching rate being controlled by R653, R654 and C620. Control of the switching is achieved from the central control microprocessor on a per channel basis through pin 11 of SK501. Oscillator switching is provided on VHF bands only, to reduce possible local receiver desensitisation due to harmonics from the 6MHz clock. Channels on which the oscillator is switched are indicated by the character "S" following the receiver frequency on the mobile option label. (See also Section 3.4.3.1).

3.6.2.3 Speaker Socket

Both speaker active and speaker ground lines are wired directly from the speaker socket (SK601) on the rear of the control unit to the interface socket SK501 where each is individually routed back to the mobile to reduce any possible interference problems which may be generated using a common ground return.

3.6.2.4 **Microphone Socket**

The microphone socket (SK502) on the front panel contains individual connections to the microphone active and ground each being wired independently back to the mobile from the interface connector (SK501). In addition, this socket contains connections for both Cradle and Push-to-Talk input. The PTT input may be routed either directly to the interface socket or to the microprocessor (the normal case) where the PTT command will be transmitted to the mobile via the serial data line. The cradle input is connected permanently to the processor and is always transmitted as a "Serial Cradle" command.

3.6.2.5 **On/Off Switch**

The on/off switch is identical to all other keys on the control unit, however, it is wired directly to the interface socket (SK501) as the on/off function is controlled by the microcomputer in the central control section of the mobile. The operation of this switch provides a momentary ground to the central control circuits.

3.6.2.6 **Auto Key Repeat**

All keys on the control unit (with the exception of the on/off key) will cause a unique one byte code to be transmitted to the mobile via the serial data line. If a key is held down for longer than about 670ms the code will be repeated on the serial data line every 168ms until the key is released.

3.6.2.7 **Keyboard Illumination**

Each key of the control unit is illuminated with an integral LED indicator. The current through each LED is nominally set to 6.0mA, which provides sufficient back lighting in dull conditions to enable the keys to be easily located and identified. The LED behind the on/off switch is designed for a higher current of about 20mA, so that it will show up in brighter conditions.

4.19.4 **RECEIVER ALIGNMENT** (Cont'd)

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
4	A.F. wattmeter	Speaker output socket	Switch RF sig. gen. output on and set output level	Approx. 25dB Rx noise quieting	
5	C.R.O.	Speaker output socket	C331 (synthesiser-control PCB)	Zero beat frequency <100Hz	Lightly couple a 21.4MHz marker oscillator into receiver I.F.
6			RF sig. gen.	1kHz modulation	Set sig. gen. modulation to 1kHz frequency and:- ±3kHz (25kHz) ±2.4kHz (20kHz) ±1.5kHz (12.5kHz) Deviation
7	C.R.O.	Speaker output socket	RF sig. gen. output level	Approx. 300mW of 1kHz tone	Set RF gen. output level to give approx. 20% noise on waveform
8	AVO 3V DC range	Signal strength test point S	L1 to L6 front end cores	Maximum voltage	Noise on waveform should reduce. Reduce RF level if voltage no longer increases maintain approx. 20% noise on waveform
9	AVO 3V DC range	Signal strength test point S	L1 to L6 front end cores	Maximum voltage	Repeat steps 8 & 9 until no further peaking of S voltage is possible
10	N & D Meter	Speaker output socket	RF gen. level to 0.30uV ±0.01uVPD (UHF)	> 12dB SINAD	
11			Mobile channel for Rx **LOW** frequency		See channel frequency label
12			RF sig. gen. frequency for Rx **LOW** channel		
13	N & D Meter	Speaker output socket		> 12dB SINAD	
14			Mobile for Rx **HIGH** frequency		See channel frequency label
15			RF sig. gen. frequency for Rx **HIGH** channel		
16	N & D Meter	Speaker output socket		> 12dB SINAD	

4.19.4 **RECEIVER ALIGNMENT**

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
NOTE: DETERMINE ON WHICH SIDE OF THE RECEIVER FREQUENCY THE TRANSMITTER CHANNEL IS LOCATED (SEE THE CHANNEL FREQUENCY LABEL). IF THE TRANSMIT FREQUENCY IS ABOVE THE RECEIVE FOLLOW PROCEDURE STEPS 17 TO 27, IF THE TRANSMIT FREQUENCY IS BELOW THE RECEIVE FOLLOW STEPS 28 to 38.					
17			Mobile channel Rx **HIGH** frequency		See channel frequency label
18			RF sig. gen. frequency for Rx **HIGH** channel		
19	N & D Meter	Speaker socket	RF sig. gen. output level	18dB ±2dB SINAD	
20	N & D Meter	Speaker socket	L1 to L6 front end cores	See note below	
NOTE: INDIVIDUALLY ADJUST EACH CORE FURTHER INTO THE FRONT END HOUSING SO THAT A SLIGHT DEGRADATION IN SINAD IS MEASURED (-1dB). BACK OFF THE ADJUSTMENT SLIGHTLY SO THAT NO DEGRADATION IN SINAD IS DETECTED AND LEAVE CORE IN THAT POSITION.					
21			RF sig. gen. output level 0.30uV ±0.01uVPD (UHF)	> 12dB SINAD	Repeat steps 19 & 20 If greater than 12dB is not achieved, and back off core position slightly further
22			Mobile channel for Rx **MID** frequency		See channel frequency level
23			RF sig. gen. frequency for Rx **MID** channel		
24	N & D Meter	Speaker output socket		> 12dB SINAD	
25			Mobile channel for Rx **LOW** frequency		See channel frequency label
26			RF sig. gen. frequency for Rx **LOW** frequency		See channel frequency label
27	N & D Meter	Speaker output socket		> 12dB SINAD	
NOTE: IF SENSITIVITY CANNOT BE MET AT **LOW**, AND **MID** RX CHANNELS REPEAT FRONT END ALIGNMENT PROCEDURE STEPS 1 TO 16 AND REPEAT STEPS 17 TO 20 MORE CAREFULLY					
28			Mobile channel for Rx **LOW** frequency		See channel frequency label
29			RF sig. gen. frequency for Rx **LOW** frequency		

4.19.4 RECEIVER ALIGNMENT

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
30	N & D Meter	Speaker output socket	RF sig. gen. output level	18dB ±2dB SINAD	
31	N & D Meter	Speaker output socket	L1 to L6 front end cores	See note below	
NOTE:	INDIVIDUALLY ADJUST EACH CORE FURTHER OUT OF THE FRONT END HOUSING SO THAT A SLIGHT DEGRADATION IN SINAD IS MEASURED (-1dB). BACK OFF THE ADJUSTMENT SLIGHTLY (SET CORE INTO THE HOUSING) SO THAT NO DEGRADATION IN SINAD IS DETECTED AND LEAVE CORE IN THAT POSITION.				
32			RF sig. gen. output level 0.30uV ±0.01uVPD (UHF)	> 12dB SINAD	Repeat steps 30 & 31 if greater than 12dB not achieved and back off core position slightly further
33			Mobile channel for Rx **MID** frequency		See channel frequency label
34			RF sig. gen. frequency for Rx **MID** channel		
35	N & D Meter	Speaker output socket		> 12dB SINAD	
36			Mobile channel for Rx **HIGH** frequency		See channel frequency label
37			RF sig. gen. frequency for Rx **HIGH** channel		
38	N & D Meter	Speaker output socket		> 12dB SINAD	
NOTE:	IF SENSITIVITY CANNOT BE MET AT **HIGH**, AND **MID** RX CHANNELS, REPEAT FRONT END ALIGNMENT PROCEDURE STEPS 1 TO 16 AND REPEAT STEPS 28 TO 31 MORE CAREFULLY.				

4.19.5 MUTE ALIGNMENT

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1	DVM	Pin 18 SK203 (Top of R263)	R258	2.5V ±0.1V	Ensure uP section cover is fitted. Fasten all screws of Rx PCB to chassis.

4.19.6 RECEIVER MODULATION PERFORMANCE

As the alignment requirement is the same as for simplex operation the procedure detailed in Section 4.14 is to be followed.

4.19.7 MUTE PERFORMANCE

As the alignment requirement is the same as for simplex operation the procedure detailed in Section 4.15 is to be followed.

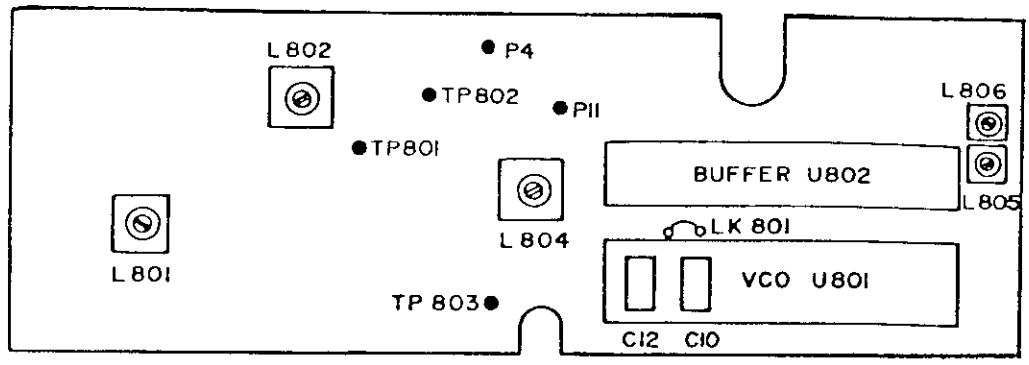


Figure 4.11 UHF Duplex PCB Layout and Test Points

4.19.8 **TRANSMITTER ALIGNMENT - UHF**

NOTE: USE EQUIPMENT SET UP AS SHOWN IN FIGURE 4.3

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1			Mobile channel for Tx **HIGH** frequency		See channel frequency label
2		Duplex PCB	Fit link from OL2 (Pin 4) to chassis		
3	RF voltmeter	TP801 Duplex PCB	Activate PTT adjust L802	> 80mV rms	Adjust L802 for maximum reading
4	RF Sig. Gen.	Pin 11 Duplex PCB	RF sig. gen. frequency (Set RF output level to 0dBm)	See notes column	Connect RF sig. gen. output to Pin 11 and set generator frequency to "DUPLEX SEPARATION" plus 21.4MHz. Example: UHF typically 9.5 + 21.4 = 30.9MHz
5	RF Voltmeter	TP802 Duplex PCB	L804	> 50mV rms	Set L804 for maximum reading
6			Disconnect RF sig. gen. from Pin 11		
7	C.R.O. & A.V.O. 10V DC Range	TP803	C12	6V ±0.25V	C12 is located on U801 module-duplex PCB. Ensure no ripple is observed on C.R.O. (Loop is locked)

NOTE: IF 6V CANNOT BE SET BY ADJUSTMENT OF C12, ADJUST BOTH C12 AND C10 ON U801 MODULE USE FREQUENCY COUNTER TO ENSURE VCO IS ON REQUIRED TX FREQUENCY.

4.19.8 **TRANSMITTER ALIGNMENT - UHF** (Cont'd)

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
8	C.R.O. & AVO 10V DC range	TP803	C12 (& C10 if required)	1.7 to 8.3V DC	No ripple should be observed on CRO, checks loop holding range
9	C.R.O. & AVO 10V DC range	TP803	C12 (& C10 if required)	6V ±0.25V	
10			Disable PTT adjust Mobile Channel for Tx **LOW** frequency		See channel frequency label
11	C.R.O. & AVO 10V DC range	TP803	Activate PTT	> 3V	No ripple should be observed on CRO.
12			Remove link from Pin 4 to -ve disable PTT		
13			Mobile channel for Tx **MID** frequency		See channel frequency label
NOTE: IF 25W IS NOT ENABLED ON EITHER TX **MID, LOW** OR **HIGH** FREQUENCY CHANNELS, PLACE A LINK FROM BASE OF TR401 AND TR402 TO CHASSIS TO OVERRIDE LOW POWER CONTROL.					
14	Wattmeter 25W range	Tx output socket	Activate PTT adjust R102	15W ±5W	Adjust pot slowly clockwise. If 15W not possible set pot to ½ max. and go to step 15
15	Wattmeter 25W range	Tx output socket	L805 and L806	Max Tx output power	Keep power below 25W by resetting R102 if necessary
16	Wattmeter 25W range	Tx output socket	R102	25W ±3W	If 25W not possible set pot to ¾ max. and go to step 13
17	Wattmeter 25W range AVO 10A DC range	Tx output socket In series with +ve supply lead	C111 & C124	Max power at best efficiency	Total supply current should be less than 6.9A
18	Wattmeter 25W range	Tx output socket	R102	25W ±1W	Ensure link LK101 is still open
19	DVM 10V DC range	RF monitor PA feed through		2V ±0.4V	Monitor voltage for 25W
20	Frequency counter	Via sampling pad at wattmeter	L801	Correct Tx frequency ±500Hz	
21	Wattmeter 25W range	Tx output socket	Fit link from XL801 to negative	0W	Checks duplex out-of-lock detect

4.19.8 **TRANSMITTER ALIGNMENT - UHF**

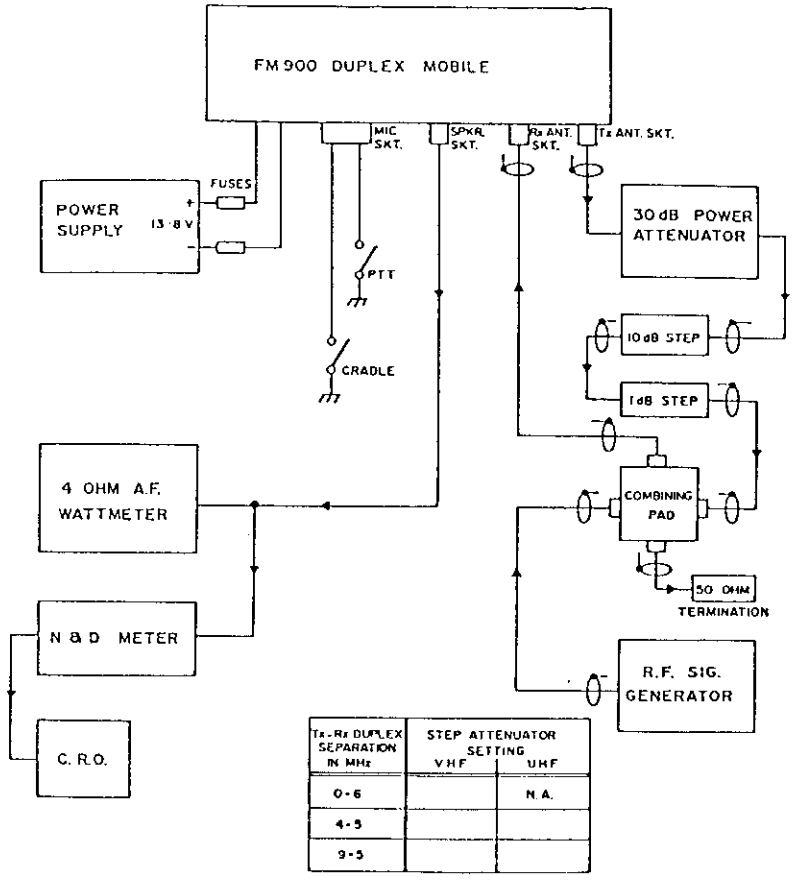
STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
22			Remove link disable PTT adjust mobile channel for Tx **HIGH** frequency		
23	Wattmeter 25W range	Tx output socket	Activate PTT adjust L806	Max. Tx Output Power	Peak L806 at Tx **HIGH** channel. Ensure LK101 is open.
24			Disable PTT adjust mobile channel for Tx **LOW** frequency		
25	Wattmeter 25W range	Tx output socket	Activate PTT adjust L805	Max. Tx Output Power	
NOTE: REPEAT STEPS 14 TO 19 TO ACCOUNT FOR ANY INTERACTION					
26			Disable PTT adjust mobile channel for Tx **MID** frequency		
27	Wattmeter 25W range	Tx output socket	Activate PTT Adjust R102	25W ±1W	
28			Disable PTT adjust mobile for Tx **LOW** frequency		
29	Wattmeter 25W range	Tx output socket	Activate PTT	25W ±2W	
30			Disable PTT adjust mobile for Tx **HIGH** frequency		
31	Wattmeter 25W range	Tx output socket	Activate PTT	25W ±2W	
NOTE: IF SPECIFICATION IN STEPS 29 AND 31 CANNOT BE MET REPEAT STEPS 22 TO 31. IF PROBLEMS ARE STILL ENCOUNTERED, OPTIMIZE TX PA TUNING C111 & C124 FOR BEST OPEN LOOP TRANSMITTER POWER RESPONSE ACROSS LOW TO HIGH TX CHANNELS.					
32			Disable PTT adjust mobile channel for Tx **MID** frequency		
33	Wattmeter	Tx output socket	Activate PTT adjust R102	25W +3W,-0W	Close link LK101 before setting R102
34			Disconnect link which overrides **LOW** power option control (if fitted)		If low power option is programmed go directly to procedure 4.17

4.19.9 **TX MODULATION PERFORMANCE**

As the alignment requirement is the same as for simplex operation the procedure detailed in Section 4.10 is to be followed.

4.19.10 **DUPLEX OPERATION**

Connect mobile to test equipment set up as shown in Figure 4.12



NOTE: Combing pad has approx. 9.5dB loss.

Figure 4.12 Duplex Operation Test Equipment Set-Up

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1			Mobile channel to Rx **LOW** frequency		See channel frequency label
2			RF signal generator to Rx **LOW** channel		Modulate generator with 1kHz frequency and:- ±3kHz (25kHz version) ±2.4kHz (20kHz version) ±1.5kHz(12.5kHz version) deviation
3	N & D Meter	Speaker output socket	RF sig. gen. output level	20dB ±1dB SINAD	

4.19.10 **DUPLEX OPERATION** (Cont'd)

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
4	Wattmeter 25W range	Tx output socket	Activate PTT	25W +3W -0W	(If low power option programmed override low power control to achieve 25W)
5	N & D Meter	Speaker output socket		SINAD degradation should be < 1dB	Attenuator settings should be as shown in Table (Figure 4.12)
6			Disable PTT		
7			Mobile channel for Rx **HIGH** frequency		See channel frequency label
8			RF signal generator frequency to Rx **HIGH** channel		
9	N & D Meter	Speaker output socket	RF signal generator output level	20dB ±1dB SINAD	
10	Wattmeter 25W range	Tx output socket	Activate PTT	25W +3W -0W	(If low power option programmed override low power control to achieve 25W)
11	N & D Meter	Speaker output socket		SINAD degratation should be < 1dB	
12			Disable PTT		

4.19.11 **DUPLEX A.F. ISOLATION**

Connect mobile test equipment set up in Figure 4.13.

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1			Mobile channel to Tx **MID** frequency		See channel frequency label
2			RF signal generator to Rx frequency		Modulate generator with 1kHz frequency and:- ±3kHz (25kHz Version) ±2.4kHz (20kHz version) ±1.5kHz(12.5kHz Version) deviation. Switch modulation Off.

4.19.11 **DUPLEX A.F. ISOLATION** (Cont'd)

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
3			AF signal generator output	1kHz frequency 40mV rms ±4mV	
4	N & D Meter	Output of deviation monitor	Activate PTT set N & D Meter reference level	0dBr	
5	N & D Meter	Output of deviation monitor	Switch off A.F. signal generator output	Hum and Noise measurement	Record hum and noise result
6	A.F. Power meter	Speaker output socket	Switch RF signal generator modulation on and adjust receiver volume control	3.5W	
7	N & D Meter	Output of deviation monitor		< 4dB	Degradation on hum and noise measurement Step 5

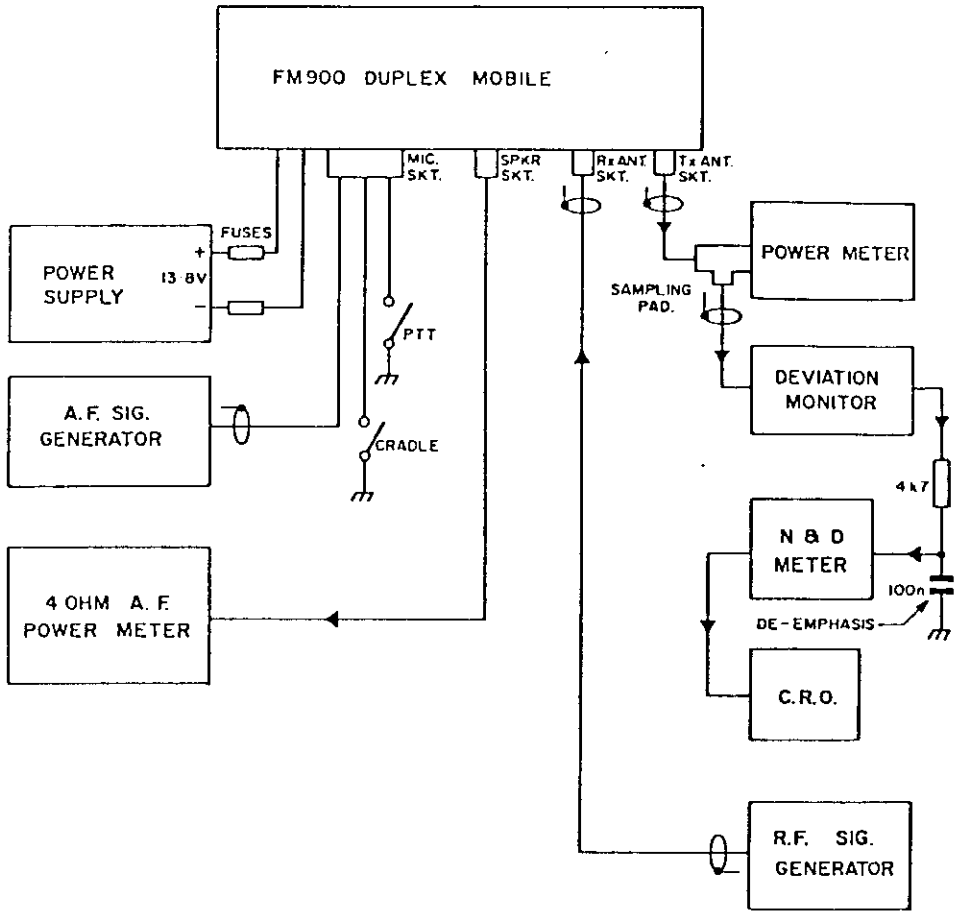


Figure 4.13 Duplex AF Isolation Test Equipment Set-Up

4.20 ECONOMISER CHECK

(Option enabled on either a per channel basis or is operator selectable).

4.20.1 PER CHANNEL

STEP	CHECK
1	Connect FM900 mobile to power supply at 13.8V and to test equipment set up. Ensure mic is in cradle. See Figure 4.8.
2	Switch set on. If economiser is programmed for power-up channel ensure that green "Power-On" LED is on and that amber "Rx-Busy" LED is flashing. Economise rate is 100ms on, 400ms off, the Rx LED will flash 400ms on and 100ms off. Ensure that channel number is not displayed.
3	If "Power-Up" channel is not an economise channel, use channel up/down to select a channel programmed for economise operation. (See labels for information). When economise channel is selected display will blank and operation as described in Step 2 will occur.
4	Remove mic from cradle. Ensure that amber Rx LED is extinguished and channel number is then displayed. (If the timed display is also fitted, the display will time out after approximately 5 seconds).
5	Replace mic in cradle and ensure economise operation is returned after approximately 2 seconds.
6	Connect antenna socket to RF signal generator output and adjust signal generator frequency to receiver frequency on economiser channel. Set generator level to 100uV PD output. Ensure that economise operation stops and amber Rx LED is on continuously. Ensure that channel number is displayed (again if timed display option is programmed the display number will time out after approximately 5 secs).
7	Remove receiver input signal and ensure that the economiser operation is returned after approximately 2 seconds.

4.20.2 OPERATOR SELECTABLE

STEP	CHECK
1	Connect mobile to test equipment set up. Ensure mic is in cradle.
2	Switch mobile on and ensure green "Power-On" LED is on. Check that display indicates channel number. (This may time out if timed display option is fitted). Ensure also that Rx amber LED is off.
3	Enable economise mode by pressing [F] [4]. If an "ERROR" message occurs ensure that the channel is not a Voting Channel or a selective call channel. Choose a channel which has been programmed for economise selection and enable economise. Once economise is enabled check that display is blanked and Rx amber LED flashes 400ms On, 100ms Off.

4.20.2 **OPERATOR SELECTABLE** (Cont'd)

STEP	CHECK
4	Remove mic from cradle and check that economiser operation stops. (Channel number will be displayed and Rx LED is Off).
5	Replace mic on cradle and ensure economiser operation continues after approximately 2 seconds.
6	Connect RF Generator at input to receiver antenna socket and set to 100uV PD at receive frequency. Ensure that economiser stops and channel display is on, Rx LED also on.
7	Remove RF Input from receiver and ensure economiser operation is returned after approximately 2 seconds.
8	Press [F] → [4] and check that economiser operation is disabled.

4.21 **SCANNING**

4.21.1 **FM91 (Occupied Pre-Programmed Blocks)**

STEP	CHECK
1	Connect mobile to test equipment set up. Ensure mic is in cradle.
2	Switch mobile on and enable scan group 1 by pressing Button [A] . (Ensure scan mode is not enabled while on a voting channel). When the scan mode is selected, the display will show [SC-1] .
3	Disable scan mode by pressing [A] again, the display should show previous channel again.
4	Press [F] → [A] and display the channels of the scan group 1. Verify that the correct channels have been programmed. If a priority channel is programmed press [F] → [5] and verify priority channel.
5	Enable scan mode by pressing button [A]. Remove mic from cradle and ensure that a channel number is displayed. This channel must be the previous programmed channel before scan was enabled, or if the priority channel is programmed ensure [P NN] is displayed where NN is priority channel number. Ensure that if the mic is left out of the cradle for more than 20 seconds, an alarm is emitted from the speaker. The alarm should be defeated and the scan mode re-enabled when the mic is replaced in the cradle.

4.21.1 FM91 (Occupied Pre-Programmed Blocks)

STEP	CHECK
6	Connect a RF signal generator to the receiver antenna socket and adjust the frequency to a channel in the scan group. Set the level to 100uV PD and check that the scanning stops and the display shows the channel number. The receiver should also unmute (IF CTCSSS is required to unmute the receiver, the receiver will stop momentarily on the channel but then return to the scan mode. The receiver will then toggle back and forth to the channel but will only stop there continuously and open the mute, if the CTCSS tone is present). If a receiver is stopped on a non-priority channel the receiver scans back to the priority channel every 2 seconds.
7	Remove the mic from the cradle and ensure that the receiver no longer scans and stops on the channel of the incoming carrier. Activate PTT and measure the transmitter frequency, ensure that the frequency corresponds to the channel number
8	Switch off PTT and disconnect the RF signal generator from the receiver. Replace the mic on the cradle and ensure that after approximately 2 seconds the receiver returns to the scan mode.
9	If further scan groups are programmed, press button [A] to disable scan mode. Select second scan group by pressing [2] → [F] → [6]. Repeat Steps 4 to 8 for scan group 2.
10	If a further scan group is defined, repeat Steps 4 to 8 for scan group 3.

4.21.2 FM91 SCANNING (Vacant Pre-Programmed Blocks)

STEP	CHECK
1	Connect mobile to test equipment set up. Ensure mic is in cradle.
2	Switch mobile on and enable the scan group 1 by pressing button [A] . (Ensure scan mode is not selected while on a voting channel). When the scan mode is selected the display will show [- NN], where NN is a channel number of one of the channels in the scan group. (This is generally the lowest channel number in the group).
3	Couple a marker oscillator into the IF of the receiver. (This will simulate all channels occupied). After approximately 2 seconds. The display should indicate [SC-1] . If the priority channel is programmed, ensure that the scan group number is briefly displayed and then the priority channel will be displayed as [P NN] where NN is the priority channel number. The mute should open on this priority channel (unless CTCSS is also required to open the mute. In the absence of the tone the receiver will return to the scan mode momentarily only to toggle back to the priority channel again. This will continue back and forth).
4	Remove mic from the cradle. Ensure that if the mic is left out of the cradle for 20 seconds that an alarm is emitted from the speaker and is defeated when the mic is placed back in the cradle.

4.21.2 **FM91 SCANNING (Vacant Pre-Programmed Blocks)**

STEP	CHECK
5	With mic in cradle, switch off the marker oscillator and ensure that a channel number is displayed [- NN] . This should be any one of the channels in the scan group, but not the priority.
6	Connect an RF signal generator into the receiver antenna socket at the frequency of the channel displayed. Set the generator level to 1mV PD and ensure after approximately 2 seconds the receiver mutes and selects another channel in the scan group. (Use a power attenuator or sampling pad between the Antenna socket and the signal generator).
7	Activate PTT and measure transmitter frequency. Ensure that frequency corresponds to channel that is displayed in scan mode.
8	From receive mode press scan button [A] and disable scan mode. If a second or third scan group is programmed, select the next scan group by pressing [N] → [F] → [6] (N is scan group number) then press [A] to enable next scan group and repeat Steps 2 to 7.

4.21.3 **FM91 SCANNING (Operator Selectable Groups)**

STEP	CHECK
1	Connect mobile to test equipment set up. Ensure mic is in cradle.
2	Test occupied pre-programmed scan groups if fitted, by the appropriate test procedure.
3	Program one of the user definable scan groups (4 or 5) by pressing [N] → [F] → [6] where N is either 4 or 5. (This must be done with receiver not in a scan mode).
4	Enter a small group of channels (Use 2) into the scan group by pressing the channel number followed by [A] . Add the priority channel as a third channel by pressing the channel number followed by [F] → [5] .
5	Verify the channels in the scan group by pressing [F] → [A] . The display will indicate [S N] where N will step through the scan group channel numbers. Verify the priority channel by pressing [F] → [5], the display will show [P N] where N is the priority channel number.
6	Enable the programmed scan group by pressing [A] and follow Test Procedure - occupied pre-programmed blocks to verify scan group operation (4.21.1).
7	Disable scan mode and delete all channels in the scan group by pressing [0] → [F] → [A] .
8	Attempt to enable the scan group by pressing [A] and ensure that the display indicates two hyphens [- -] .

4.22 VOTING

STEP	CHECK
1	Connect mobile to test equipment set up.
2	Switch mobile on and set channel to voting channel as shown on channel frequency label. Ensure receiver mute is closed and Rx LED is Off, mic is in cradle.
3	Place a power attenuator or sampling pad between the antenna socket and the signal generator. Connect RF generator to receiver antenna input and set output to 1mV PD. Adjust generator frequency to each of the receive channel frequencies in the voting group and ensure that mute opens for each channel. (If CTCSS to is also included on the voting channel, the receiver will stop on that channel but the mute will not open unless the CTCSS tone is present. The mute will open if the mic is out of cradle).
4	At each receive channel checked, activate PTT and measure transmit frequency. Ensure the transmit frequency corresponds to the same channel as the last received frequency. (If other options such as per channel CTCSS and per channel Tx power is also included on the voting channels, ensure that these options are correct for the transmit condition on each voting channel).
5	Connect DVM +ve lead to "S" test point on receiver PCB and -ve to chassis. Switch RF signal generator output Off and ensure "S" reading is 0.6V ±0.15V. Set RF signal generator level to 1.0uV and ensure "S" point reading is 1.0V ±0.2V Set RF signal generator level to 300uV and ensure "S" point reading is 2.0V ±0.1V

4.23 PTT INHIBIT

STEP	CHECK
1	Connect mobile to test equipment set up. Ensure mic is in cradle.
2	Connect RF signal generator to receiver antenna socket input via a power attenuator (or via a sampling pad at a Wattmeter). Set generator output to 1mV PD at the receiver frequency and ensure Rx amber LED is on.
3	Activate PTT and ensure that the mobile transceiver does not transmit and that an audible alarm is sounded in the speaker for as long as the PTT is activated. The alarm should cease when the PTT is disabled.
4	Remove RF signal generator input from receiver and ensure that PTT can be activated.

4.24 COMMUNITY REPEATER CHECK

STEP	CHECK
1	Connect mobile to test equipment set up as shown in Figure 4.8. Ensure cradle switch is closed and PTT is disabled. Set mute to mid position.
2	Connect RF signal generator to receiver antenna socket input via a power attenuator (or via a sampling pad at wattmeter). Set generator output to 50uV PD at the receiver frequency and switch generator modulation Off.
3	Switch mobile on and ensure Rx amber LED is On. Activate PTT and ensure PTT is inhibited. An alarm tone should appear at speaker socket output. Disable PTT.
4	Modulate signal generator with 1kHz ±1.5kHz deviation and ensure no A.F. output occurs in speaker output. (Adjust Rx volume control and observe output on C.R.O. via N & D Meter).
5	Open cradle switch and ensure no A.F. output appears at speaker output.
6	Modulate signal generator with CTCSS tone at ±500Hz deviation. (Check channel frequency label for CTCSS tone frequency programmed on Rx channel). Ensure Rx mute opens and audio appears at speaker socket (noise residual may be seen on C.R.O.
7	Activate PTT and ensure PTT is not inhibited and RED Tx LED is illuminated. Disable PTT.
8	Switch Off RF output from signal generator. Activate PTT and ensure PTT is not inhibited and RED Tx LED is illuminated. Disable PTT.

SECTION 4 TEST AND ALIGNMENT PROCEDURE

NOTES:

1. This test and alignment procedure is applicable to all versions of the FM91 Mk2 Series mobile, with the exception of mobiles fitted with signalling or special options. Refer to the documentation on the appropriate option for any additional test and alignment instructions.

2. The test and alignment procedures given, follow a logical sequence and it is therefore recommended that each step be completed before proceeding to the next.

3. The Synthesiser and Receiver PC Boards are held in the servicing position by the PC Board Support Spring. This spring must be released to allow the cam on the board attachment to pass freely, or damage to the spring may result.

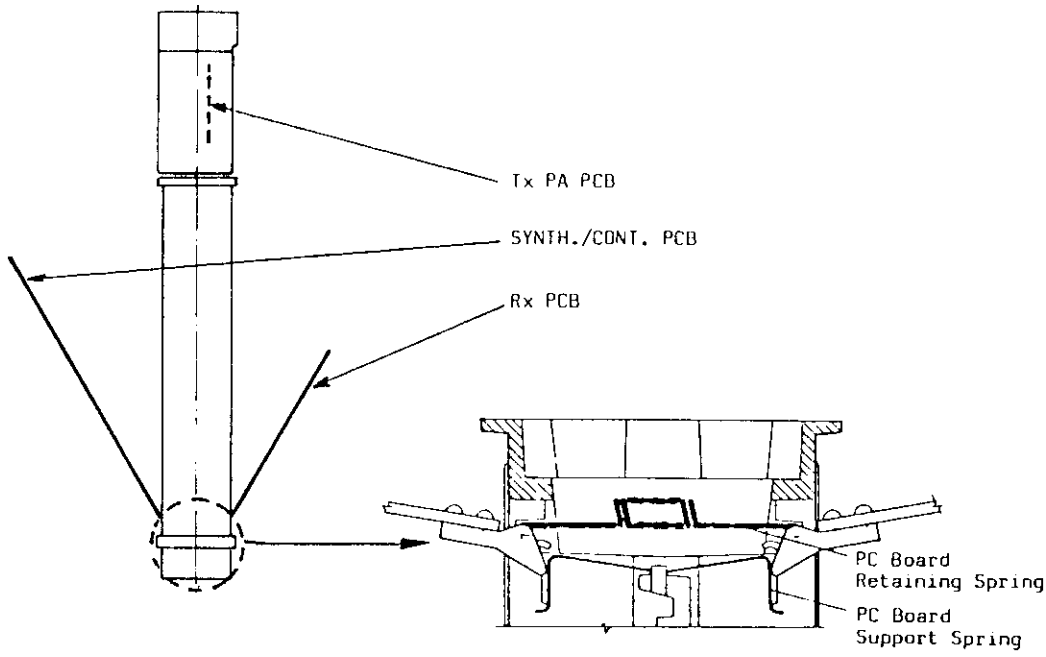


Figure 4.1 FM91 Series - Chassis with Sectional Side View showing PCB Support and Retaining Springs

4. Re-fitting of Screws:
To ensure no 'second starting' occurs the following procedure is to be followed.

   a) Locate screw in hole
   b) Press down lightly on screw, turning anti-clockwise until a click is felt.
   c) Turn clockwise to drive screw home in normal manner.
   d) Re-fitting torque for M2.5 screws - .65 to .75Nm
      for M3.5 screws - 2.0 to 2.2Nm

   Torque tighten VHF Stud Device nut - .40 to .50Nm.

5. On the Receiver PC Board assembly, the front-end module and the discriminator module are soldered at selected locations to the earth plane of the PCB. When either of these modules require replacement ensure that the module is resoldered in the correct manner.

   Low melting point solder must be used.

KEY CODES AND DISPLAYS

This section shows the displays which may appear in the 91 mobile with associated keystrokes which may be associated with these displays.

In the diagram the following legend applies.

nnn	-	indicates user entered data when it appears ahead of the keystrokes, or general display information when shown in the display section.
n	-	indicates a single digit value.
ccc	-	indicates a 1 to 3 digit channel number.
nnnnn	-	indicates a selcall code display (1 to 5 digits)
(nnn)	-	when preceding a key sequence indicates that the data is optional.
nn	-	indicates a 1 or 2 digit CTCSS code, key code or fault code.

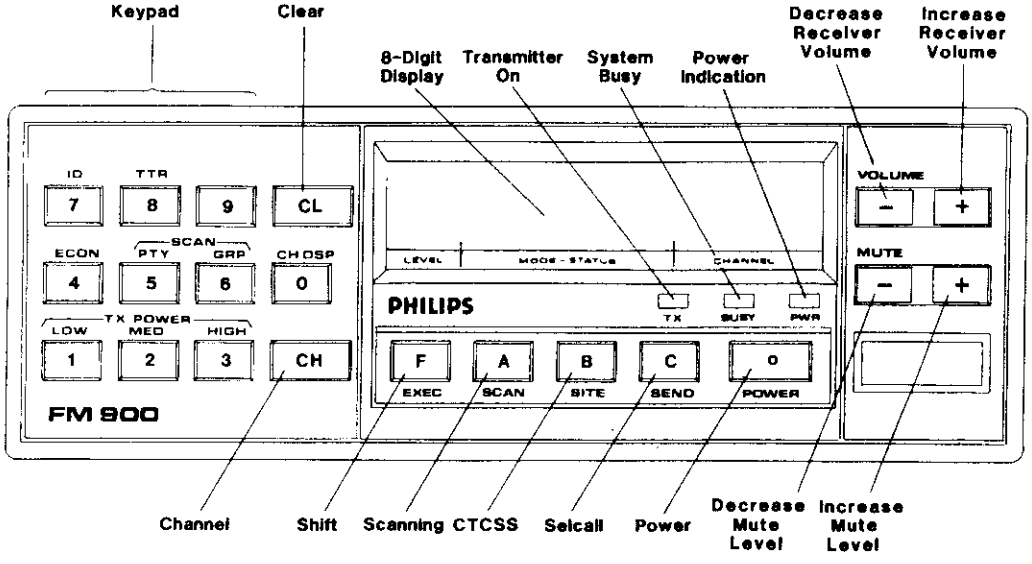
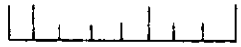
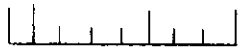
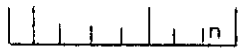


Figure 4.2 Remote Control Front Panel

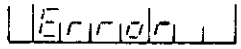
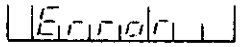
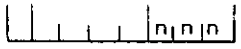
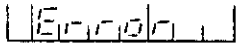
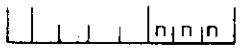
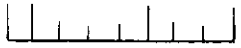
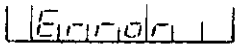
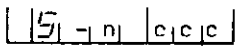
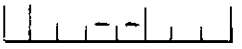
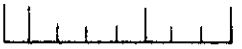
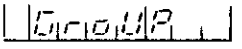
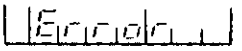
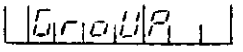
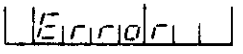
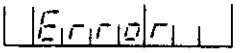
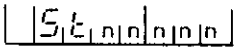
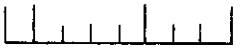
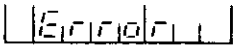
PRIMARY FUNCTIONS

Keystrokes	Display	Operation
Volume +		Increase volume
nnn Volume +	nnn	Increase volume (display unaffected)
Volume -		Decrease volume
nnn Volume -	nnn	Decrease volume (display unaffected)
Mute +	n	Increase mute level (n = 0-7)
nnn Mute +	n nnn	Increase mute level (display unaffected) (n = 0-7)
Mute -	n	Decrease mute level (n = 0-7)
nnn Mute -	n nnn	Decrease mute level (display unaffected) (n = 0-7)
CL		Clears entire display
nnn CL		Clears entire display
CH	ccc	Display current channel (ccc = 1-120)
	Error	Invalid while scanning
nnn CH	ccc	Enter and display new channel
	Error	Invalid while on Tx or scanning, or invalid channel number
A Scan	SCAn	Start scanning group "n" (n = 1-5)
	ccc	Stop scanning & display current channel
	---	Tried to scan empty group
	Error	Scanning not fitted or current channel is a voting channel
nnn A Scan	ccc	Enter channel "nnn" in variable scan group
	FULL	Current variable scan group is full
	GrOUP	Illegal (current group is fixed)
	Error	Scanning not fitted or illegal channel # or channel not allowed
B Site	SitE nn	Display CTCSS site number of current channel
	Error	CTCSS not defined for current channel
nn B Site	SitE nn	Change CTCSS site number of current channel (n = 1-37)
	Error	CTCSS not defined for current channel

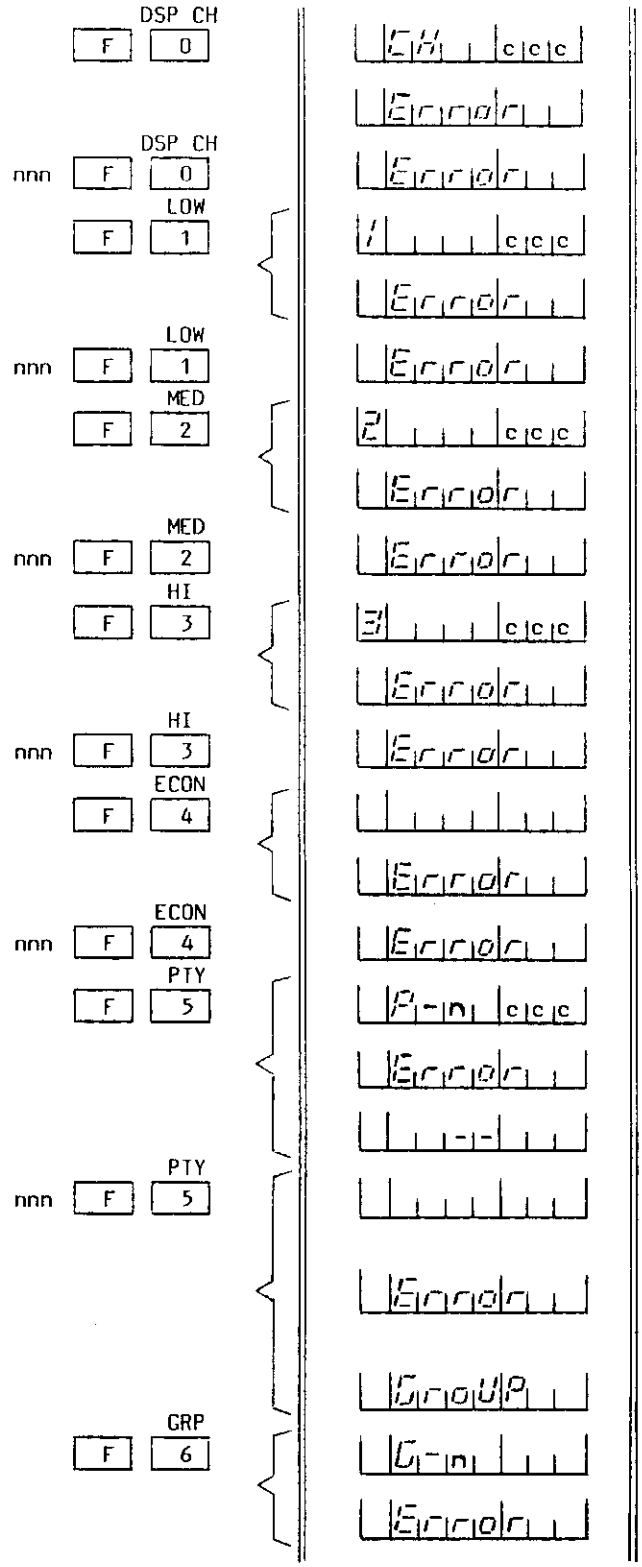
PRIMARY FUNCTIONS (Continued)

Keystrokes	Display	Operation
o(oo...) [B] Site		Cancel CTCSS on current channel
[C] Send		Send selcall code (I.D.)
n [C] Send		Send call & status "n", or change status
1,2,3.....9		Enter digit(s) (data). First digit clears display

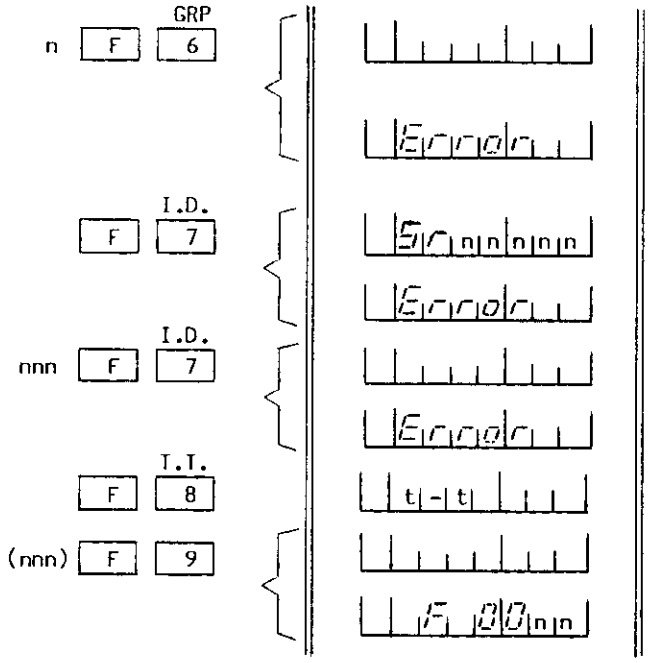
SECONDARY FUNCTIONS (Normal Mode)

(nnn) [F] [Volume +]		Invalid command
(nnn) [F] [Volume -]		Invalid command
(nnn) [F] [Mute +]		Defeat mute (display unaffected)
		Mute defeat not fitted
(nnn) [F] [Mute -]		Cancel mute defeat (display unaffected)
(nnn) [F] [CL]		Clears entire display.
(nnn) [F] [CH]		Invalid command
[F] [A] Scan		Display channels in current scan group (n)
		Current scan group empty
nnn [F] [A] Scan		Delete channel "nnn" from current scan group
		Current group is not user definable
		Scanning not fitted
0 [F] [A] Scan		Delete ALL channels from current scan group
		Current group is not user definable
		Scanning not fitted
(nnn) [F] [B] Site		Invalid command
[F] [C] Send		Display selcall base call code
nnn [F] [C] Send		Send the entered selcall code
		Selcall not fitted or variable Tx code not allowed

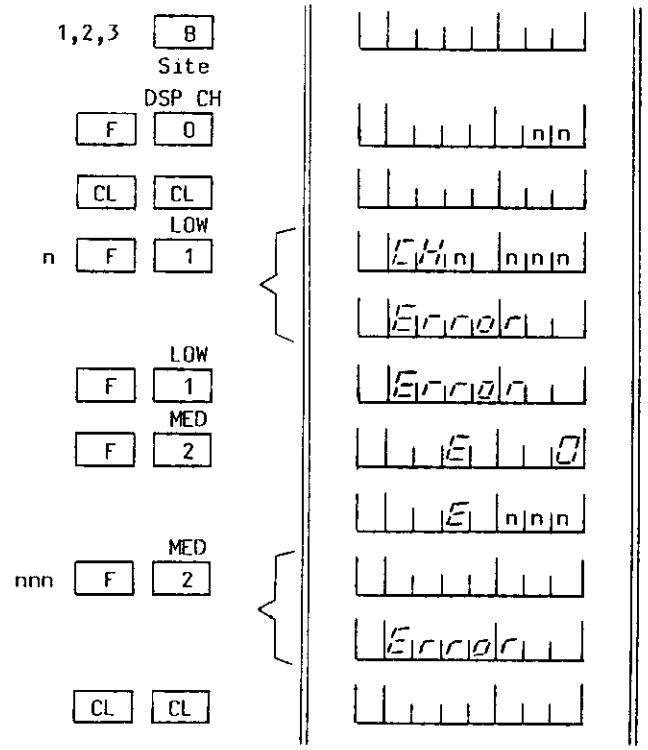
SECONDARY FUNCTIONS (Normal Mode) (Continued)



SECONDARY FUNCTIONS (Normal Mode) (Continued)



SECONDARY FUNCTIONS (Test Mode) Not Standard Programme



4.1 TEST EQUIPMENT

a) RF Signal Generator HP8640B.)
b) Noise and Distortion Meter HP331A.)
c) RF Power Meter Bird Model 6154) ALTERNATIVE TEST UNIT:
d) Sampling Pad (-40dB)) ROHDE & SCHWARTZ MODEL
e) Deviation Monitor Marconi TF2300B) SMFP
f) AF Signal Generator HP208A)
g) Power Supply PS775
h) C.R.O. BWD 539D
i) A.F. Power Meter.
j) AVO
k) DVM

4.2 GENERAL INSTRUCTIONS

a) Channel and option information is located on the underside of the main chassis covers of the set. To aid alignment, highest, mid, and lowest frequencies for Tx and Rx are listed.

b) A non-metallic tuning tool should be used for all tuning coil adjustments, and an insulated tool for all other adjustments where short circuits could occur.

c) The negative lead of all test equipment should be connected to the FM900 chassis unless stated otherwise.

4.3 PRELIMINARY ADJUSTMENTS FOR TX PA AND SYNTHESISER

a) Fit EPROM (with customer programme) to control section and fit shield.

b) If signalling option required ensure module is fitted and PCB links are correctly configured. Disable Tx encode and Rx mute for normal mobile alignment.

c) Preset VCO trimming components for mid tuning position.

d) Preset modulation balance to mid position (R371).

e) Preset microphone sensitivity fully clockwise (R365).

f) Preset deviation fully clockwise (R367).

g) Preset "RSSI Calibrate" to mid position (R257)

h) Preset "Mute Calibrate" to fully clockwise position (R258)

i) OPEN link LK101 in PA. Adjust PA trimmers to mid tuning position. (C111 and C124 for UHF, C12 E-Band, C136 A and B-Band).

j) Adjust PA power setting pot to fully counter clockwise (R102 UHF, R110 E-Band R112 A and B-Band).

4.4 POWER SUPPLY CHECK

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1	AVO 1A DC Range	In series with +ve supply lead	Activate Power On	750mA	Green "Power on" LED ON
2	AVO + 10V DC Range	Collector of TR206		+9.8V ±0.1V	Checks +10V regulator output.
3	"	Collector of TR205		+9.7V ±0.1V	Checks +10V Rx output.
4	AVO +30V DC Range	Collector of TR210		+12V ±0.5V	Checks +12V regulator output. UHF VERSION ONLY
5	AVO +10V DC Range	Collector of TR208	Activate PTT	+9.7V ±0.1V	Checks +10V Tx output. (VCO must be in lock)

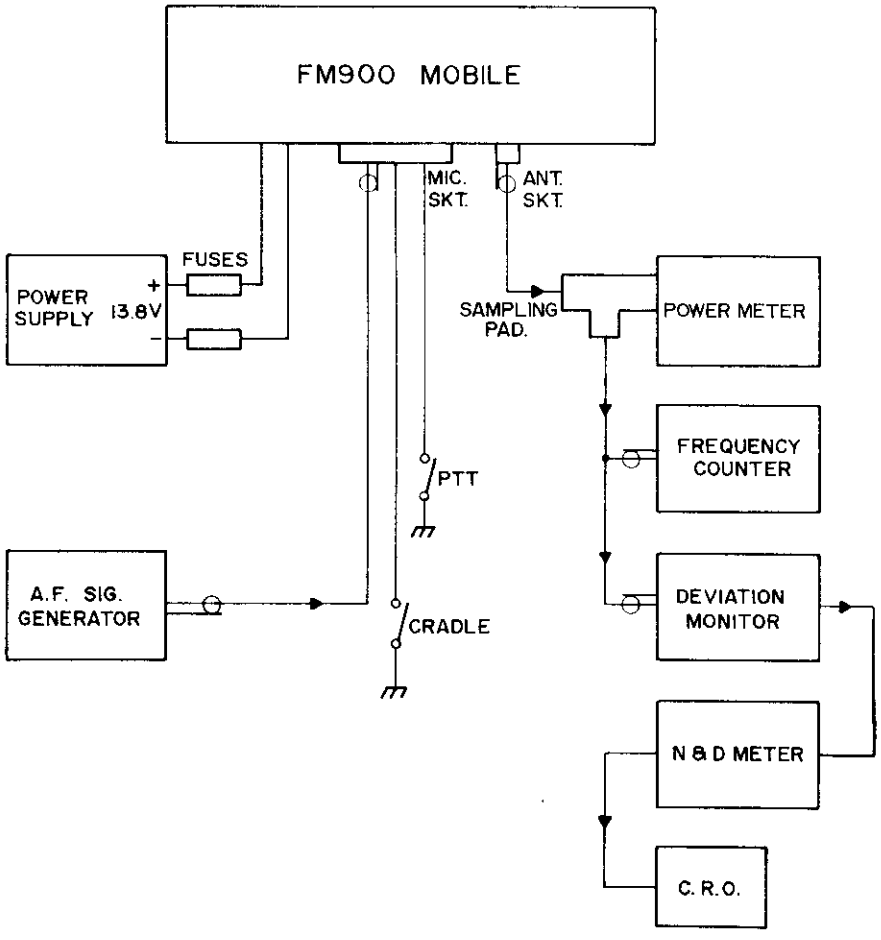


Figure 4.3 Synthesiser and Transmitter Alignment Equipment Set-Up

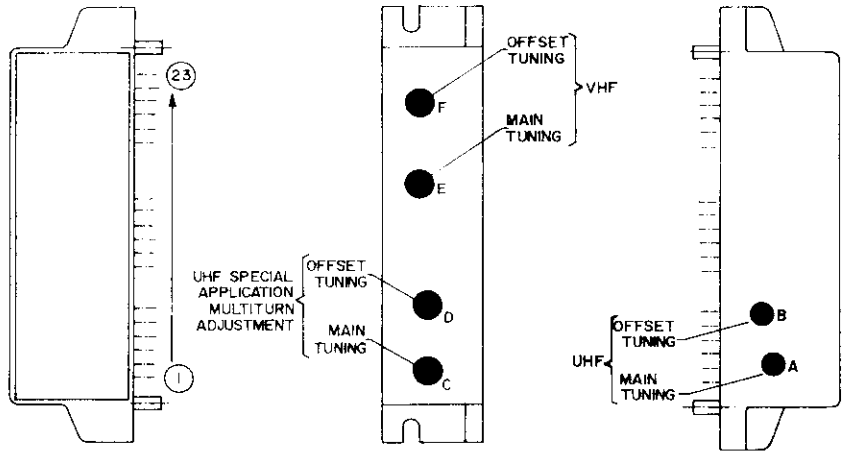


Figure 4.4 VCO Tuning Access Hole Location

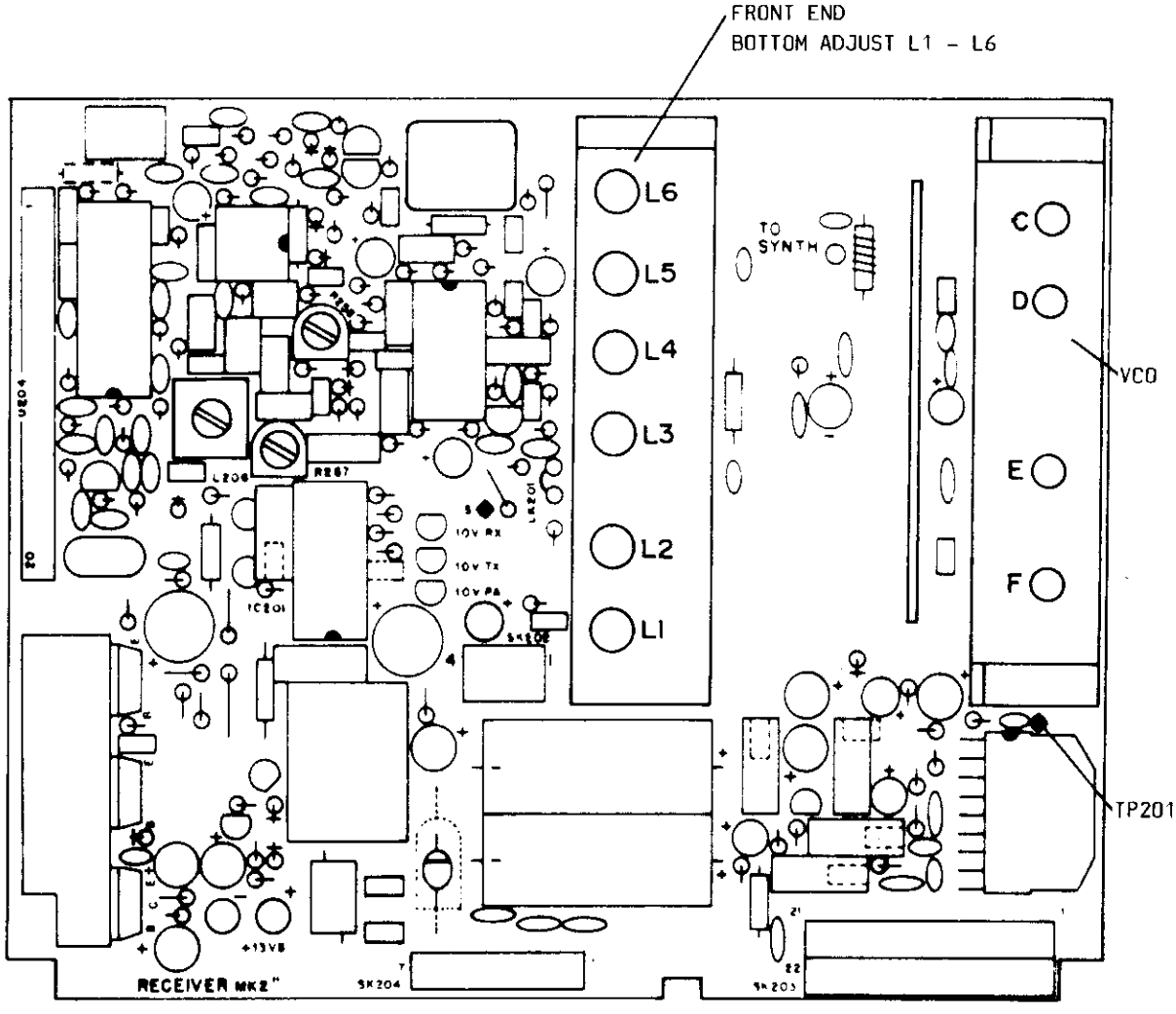


Figure 4.5 Receiver Board Layout and Test Point Location

4.5 VCO OFFSET TABLE

FREQUENCY BAND	Voltage on IC405 pin 5 for **OFFSET OFF**	Corresponding mobile mode (See note 3)
E (68- 88MHz)	LOW	RECEIVE
B (132-153MHz)	LOW	RECEIVE
A (148-174MHz)	LOW	TRANSMIT
T (403-420MHz)	HIGH	RECEIVE
U (440-470MHz)	HIGH	RECEIVE
W1 (470-500MHz)	HIGH	TRANSMIT
W2 (500-520MHz)	HIGH	TRANSMIT

Notes:

1. Switching from OFFSET OFF to OFFSET ON lowers VCO frequency.
2. Receiver local oscillator is normally on the high side for bands E, B, T, U and on the low side for bands A, W1, W2.
3. On VHF, software is occasionally fitted to shift the receiver L.O. to the other side. If in doubt about the mobile mode for OFFSET OFF check the voltage on IC405 pin 5.

4.6 VCO ALIGNMENT (See Figure 4.4)

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1			Select channel with highest frequency for **OFFSET OFF** Condition		See channel frequency label and above table.
2			Set mobile to **OFFSET OFF** Condition		See offset table.
3	AVO 30V DC Range	TP201	VCO main tuning.	12V ± 0.5V	
4			Select channel with highest frequency for **OFFSET ON** Condition.		
5			Set mobile to **OFFSET ON** Condition		Refer to above table.
6	AVO 30V DC Range	TP201	VCO offset tuning.	12V ± 0.5V	If voltage cannot be adjusted below 13V go to Special Procedure No. 1. If voltage cannot be adjusted above 11V go to Special Procedure No. 2.
NOTE: STEPS 1 TO 6 SHOULD BE REPEATED TO ACCOUNT FOR ANY INTERACTION IN THE TUNING.					
7	AVO 30V DC Range	TP201	Select channel for lowest Receive Frequency.	> 4V	See channel frequency label.
8	AVO 30V DC Range	TP201	Select channel for lowest transmit freq. & Activate PTT.	> 4V	See channel frequency label.

4.6.1 **VCO SPECIAL ALIGNMENT PROCEDURE NO. 1** (Continued from 4.6/step 6)

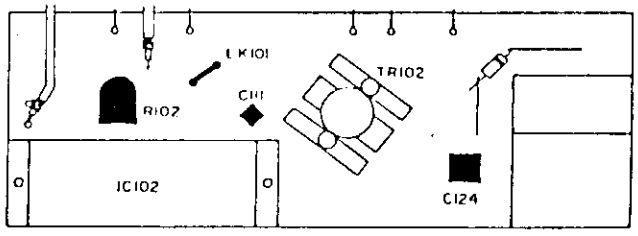
STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
7			VCO offset tuning.	Minimum capacitance or Inductance.	In VHF do not adjust slug past the top face of the VCO housing.
8	AVO 30V DC Range	TP201	VCO main tuning.	13V ±0.2V	Offset should still be on.
9	"	"	VCO offset tuning.	Minimum voltage	In VHF keep top of slug below the Top face of the VCO housing.
10	"	"	VCO main tuning.	13V ±0.2V	Accounts for interaction in tuning.
11			Select channel for highest frequency for **OFFSET OFF** condition.		
12	AVO 30V DC Range	TP201	Set mobile to **OFFSET OFF** Condition	> 5V	
13	"	"	Select channel for lowest Receive frequency.	> 4V	See channel frequency label.
14	"	"	Select channel for lowest transmit frequency. Activate PTT.	> 4V	See channel frequency label.

4.6.2 **VCO SPECIAL ALIGNMENT PROCEDURE NO. 2** (Continued from 4.6/step 6)

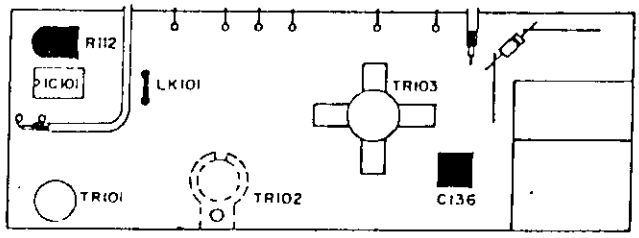
STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
7			Select channel with highest frequency for **OFFSET OFF** condition		
8			Set mobile to **OFFSET OFF** condition.		
9	AVO 30V DC Range	TP201	VCO main tuning.	13V ±0.2V	
10			Set mobile to **OFFSET ON** Condition		

4.6.2 **VCO SPECIAL ALIGNMENT PROCEDURE NO.2** (Cont'd)

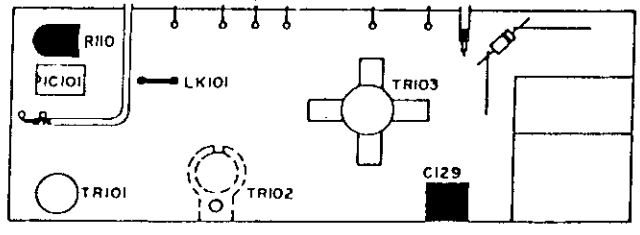
STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
11	AVO 30V DC Range	TP201	VCO offset tuning.	Maximum voltage.	
NOTE: Repeat steps 1 to 6 to account for any interaction in the tuning.					
12	AVO 30V DC Range	TP201	Select channel for lowest Receive frequency.	> 4V	See channel frequency label.
13	"	"	Select channel for lowest Transmit freq. & Activate PTT.	> 4V	See channel frequency label.



UHF



A BAND



E BAND

Figure 4.6 Tx PA Board Layout and Test Point Location

4.7 TX PA ALIGNMENT: UHF

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1			Mobile channel for Tx **MID** frequency.		See channel frequency label.
NOTE: IF 25W IS NOT ENABLED ON **MID** Tx FREQUENCY CHANNEL, PLACE A LINK FROM BASE OF TR401 AND TR402 TO CHASSIS TO OVERRIDE LOW POWER CONTROL.					
2	Wattmeter 25W Range.	Ant. Skt.	Activate PTT adjust R102.	25W ±3W	Adjust Pot slowly clockwise. If 25W not possible set Pot to ¾ max. and go to Step 3.
3	Wattmeter 25W Range. AVO 10A DC Range.	Ant. Skt. In series with +ve supply lead.	C111 and C124.	Max. power at best efficiency.	Total supply current should be less than 6.9A.
4	Wattmeter 25W Range.	Ant. Skt.	R102.	25W ±3W -0W	Close link LK101. Before setting R102.
5	AVO 10V DC Range.	RF monitor PA feedthru		2V ± 0.4V	Monitor Voltage for 25 Watt.
6			Disconnect link which overrides low power option control (if fitted)		If low power option is programmed, go directly to procedure 4.17 for low power alignment.

4.8 TX PA ALIGNMENT: VHF

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1			Mobile channel for Tx mid frequency.		See channel frequency label.
NOTE: IF 25W IS NOT ENABLED ON **MID** Tx FREQUENCY CHANNEL, PLACE A LINK FROM BASE OF TR401 AND TR402 TO CHASSIS TO OVERRIDE LOW POWER CONTROL.					
2	Wattmeter 25W Range.	Ant. Skt.	Activate PTT adjust R110 (E-Band) R112 (A-Band)	25W ±3W	Adjust Pot slowly clockwise. If 25W not possible set Pot to
3	Wattmeter 25W Range. AVO 10A DC Range.	Ant. Skt. In series with +ve supply lead.	C129 (E-Band) C136 (A-Band & B-Band)	Max. power at best efficiency.	Total supply current should be less that 5.3A
4	Wattmeter 25W Range.	Ant. Skt.	R110 (E-Band) R112 (A-Band)	25W ±3W -0W	Close link LK101. Before setting R102.

4.8 TX PA ALIGNMENT: VHF

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
5	AVO 10V DC Range.	RF monitor PA feedthru		2V ± 0.4V	Monitor Voltage for 25 Watt.
6			Disconnect link which overrides low power option control (if fitted)		If low power option is programmed, go directly to procedure 4.17 for low power alignment

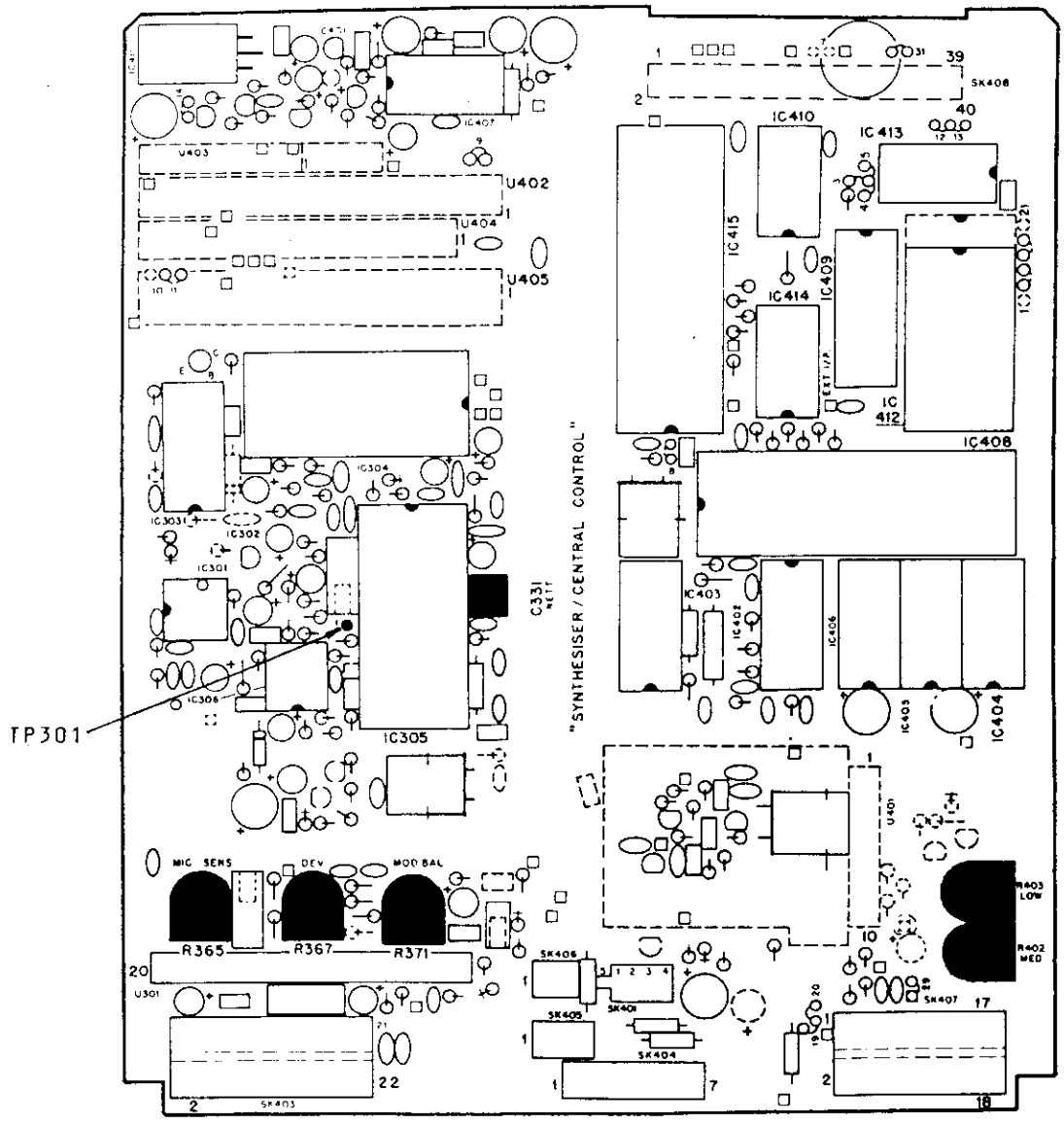


Figure 4.7 Synthesiser and Control Board Layout and Test Point Location

4.9 SYNTHESISER NETTING:

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1			Mobile channel for Tx mid frequency.		See channel frequency label.
2	Frequency Counter	Via sampling pad at wattmeter.	Active PTT Adjust C331.	Correct Freq.±100Hz	A dummy chassis cover should be fitted.
NOTE: WHEN TCXO OPTION FITTED ADJUST TRIMMER R4 ON TCXO (C331 NOT FITTED).					

4.9.1 LOW TEMPERATURE HEATER (If fitted)

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1	AVO 1Amp Range	Power Supply Lead	Spray instant freeze onto crystal heater and note supply current.	Supply increases by 300mA.	Checks crystal heater operation.
2			Stop spray and note current returns to original value.	Current reduces to original value in < 40Seconds	

4.10 TX MODULATION ALIGNMENT

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1			Mobile channel for Tx mid frequency.		See channel frequency label.
2		Microphone Input Socket	AF Sig. Gen. Output.	1KHz/400mV rms. ±20mV	
3	C.R.O. AC Voltmeter 30mv range.	TP301	Activate PTT Adjust R371	null in amplitude.	Sets modulation balance. Modulate mobile with 1KHz/400mVrms.
4	Deviation Monitor	via sampling pad at wattmeter.		> ± 6.0kHz	Checks max. deviation.
5	"	"	AF Gen. output level.	± 3KHz AF level < 30mV rms	Checks deviation sensitivity.
6			AF Gen. output level.	400mV ±40mV rms	
7	Deviation monitor	via sampling pad at wattmeter.	R367	A ±4.8kHz B ±3.8kHz C ±2.4kHz +0, -0.5dB	sets maximum deviation. A = 25kHz version B = 20kHz version C = 12.5kHz version

4.10 TX MODULATION ALIGNMENT

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
8			AF Gen. output level.	40mV ±4mV rms	1kHz modulating freq.
9	Deviation monitor	via sampling pad at wattmeter.	R365	A ±3kHz B ±2.4kHz C ±1.5kHz ±1dB	sets standard modulation level. A = 25kHz version B = 20kHz version C = 12.5kHz version
10			AF Gen. output level.	400mV ±40mV rms	1kHz modulating frequ y
11	Deviation monitor	via sampling pad at wattmeter.	AF Gen. Freq.	A ±5.0kHz B ±4.0kHz C ±2.5kHz	Check for frequency range 300 to 3kHz A = 25kHz version B = 20kHz version C = 12.5kHz version
NOTE: FOR MULTI CHANNEL VERSIONS REPEAT STEP 11 FOR HIGHEST AND LOWEST Tx FREQUENCY					

4.10.1 TX MODULATION PERFORMANCE

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1			Mobile channel for Tx **MID** Frequency		See channel frequency label
2			Activate PTT		Ensure cradle switch is closed to disable CTCSS encoder if option is fitted.
3	Deviation Monitor	Via sampling pad at watt meter	Microphone input level	±500Hz deviation	Microphone input signal frequency = 1kHz.
4	N & D Meter	Output of Deviation Monitor	Reference of N & D Meter	0dB ref.	
5	N & D Meter	Output of Deviation Monitor	Microphone input signal frequency to 300Hz	-9.5 to -13.5dB	Ideal result is -10.5dB
6	N & D Meter	Output of Deviation Monitor	Microphone input signal frequency to A 3kHz B 2.55kHz	A +6.5 to +10.5dB B +5.2 to +9.2dB	A = 20/25kHz version B = 12.5kHz version
7	N & D Meter	Output of Deviation Monitor	Microphone input signal frequency to 3kHz	+5.5dB to +1.5dB	12.5kHz out of band response
8	Deviation Monitor	Via sampling Pad at Watt meter	Microphone input signal frequency to 1kHz and set level.	A ±3kHz B ±2.4kHz C ±1.5kHz	A = 25kHz version B = 20kHz version C = 12.5kHz version

4.10.1 TX MODULATION PERFORMANCE

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
9	N & D	Output of Deviation Monitor	Distortion meter	< 3% THD	
10	Deviation Monitor	Via sampling pad at watt meter	Microphone input level	A ±5kHz B ±4kHz C ±2.5kHz +0, -0.5dB	AS ABOVE
11	N & D Meter	Output of deviation monitor	N & D Meter Calibrate	0dB	
12	N & D Meter	Output of deviation monitor	Switch off microphone Input Signal	A >50dB B >48dB C >45dB D >45dB E 40dB	Measures Hum and Noise Ratio: A = VHF 25kHz version B = VHF 20kHz version C = VHF 12.5kHz version D = UHF 25kHz version E = VHF 12.5kHz version

4.11 PRELIMINARY ADJUSTMENTS FOR RECEIVER

a. Adjust volume control fully minimum.
b. Adjust mute control fully minimum.
c. Preset Front-end tuning cores flush with the level of the PCB
d. Adjust R258 mute adjust to mid position.

NOTE: If receiver bandwidth is > 1MHz/VHF or > 3MHz/UHF wideband performances alignment should be carrie out.

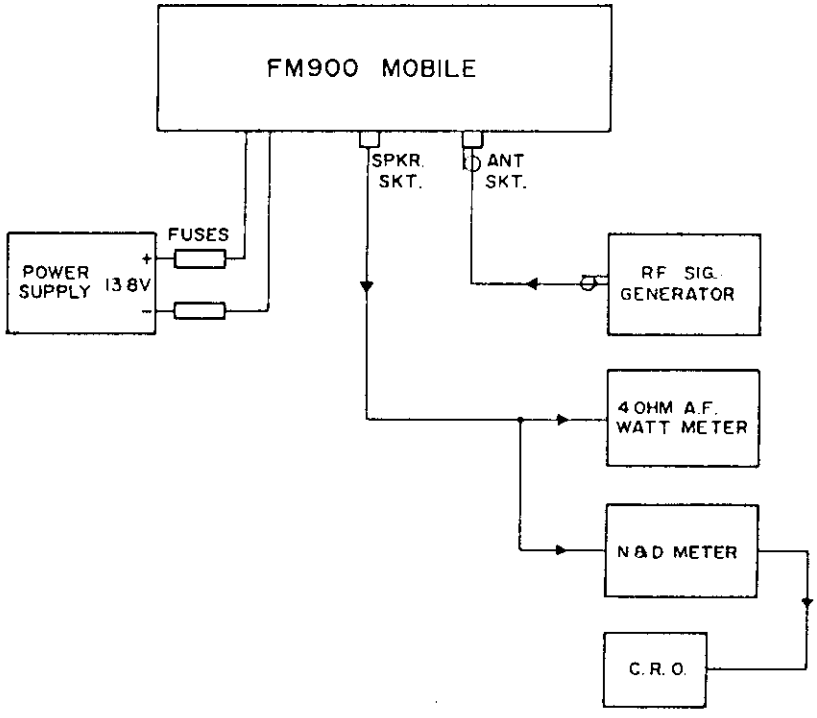


Figure 4.8 Receiver Alignment Equipment Test Set-Up

4.12 RECEIVER ALIGNMENT FOR NARROWBAND PERFORMANCE

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1			Mobile channel for Rx **MID** Frequency.		See channel frequency label.
2			RF Sig. Gen. Frequency for Rx **MID** channel.		Modulate generator with 1KHz frequency and ±3kHz (25kHz) ±2.4kHz (20kHz) ±1.5kHz (12.5kHz) Deviation. Switch RF output Off.
3	A.F. Watt Meter	Speaker output socket.	Volume Control	Approx. 300mW of noise output.	
4	N&D Meter	"	Switch RF Gen. output on and set level to 1mV.	Approx. 300mW of 1KHz tone.	
5	AF Watt Meter	"	L206	Maximum 1kHz tone	
6	AVO 3V DC Range.	Signal strength test point S.	L1 to L6 front end cores.	Maximum Voltage.	Noise on waveform should reduce. Reduce RF level if voltage no longer increases.
7	"	"	Reduce RF gen. output level.	S voltage < 0.7V	More noise should appear on waveform.
8	"	"	L1 to L6 front end cores.	maximum voltage.	Repeat Steps 6 to 8 until no further peaking of S voltage is possible
9	N&D Meter.	Speaker output socket.	RF Gen. level to 0.35uV ±0.01uVPD (VHF) 0.30uV ±0.01uVPD (UHF)	> 12dB SINAD	
10	"	"	RF gen. level to 0.5uV ±0.01uVPD	A > 20dB B > 13dB Quieting	A = 25kHz version B = 12.5kHz version No modulation on RF sig. generator
11			Mobile channel for RX **LOW** frequency.		See channel frequency label.
12			RF Sig. Gen. Frequency for Rx **LOW** channel.		Modulate generator with 1KHz Frequency and - ±3kHz (25kHz) ±2.4kHz (20kHz) ±1.5kHz (12.5kHz) Deviation.

4.12 RECEIVER ALIGNMENT FOR NARROWBAND PERFORMANCE

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
13	N&D Meter	Speaker output socket.	RF Sig. Gen. Output level to 0.39uV (VHF) 0.34uV (UHF) ±0.01uV PD	> 12dB SINAD	
14			Mobile channel for Rx **HIGH** frequency.		See channel frequency label.
15	N&D Meter	Speaker output socket	RF Sig. Gen. frequency for Rx **HIGH** channel	> 12dB SINAD	
NOTE: IF SENSITIVITY SPECIFICATION CANNOT BE MET AT EXTREMES OF SWITCHING RANGE, THE FRONT END TUNING MUST BE DONE USING A SWEEP ANALYSIS METHOD TO OBTAIN THE REQUIRED BANDWIDTH AMPLITUDE RESPONSE. SEE RECEIVER FRONT END ALIGNMENT - WIDEBAND.					
MUTE ALIGNMENT					
16			Switch RF Sig. Gen. Output Off.		
17	DVM 10V Range	Pin 18 of SK203 (Top of R263)	R258	2.5V ±0.1V	Ensure uP section cover is fitted. Fasten all screws of Rx pcb to chassis.
18	DVM 10V Range	T.P.S	RF Gen level to 1mV		
19	DVM 10V Range	T.P.S.	R257	2.0V ±0.1V	RSSI calibration
20	DVM 10V Range	T.P.S.	RF Gen Level to zero	0.6V ±0.15V	

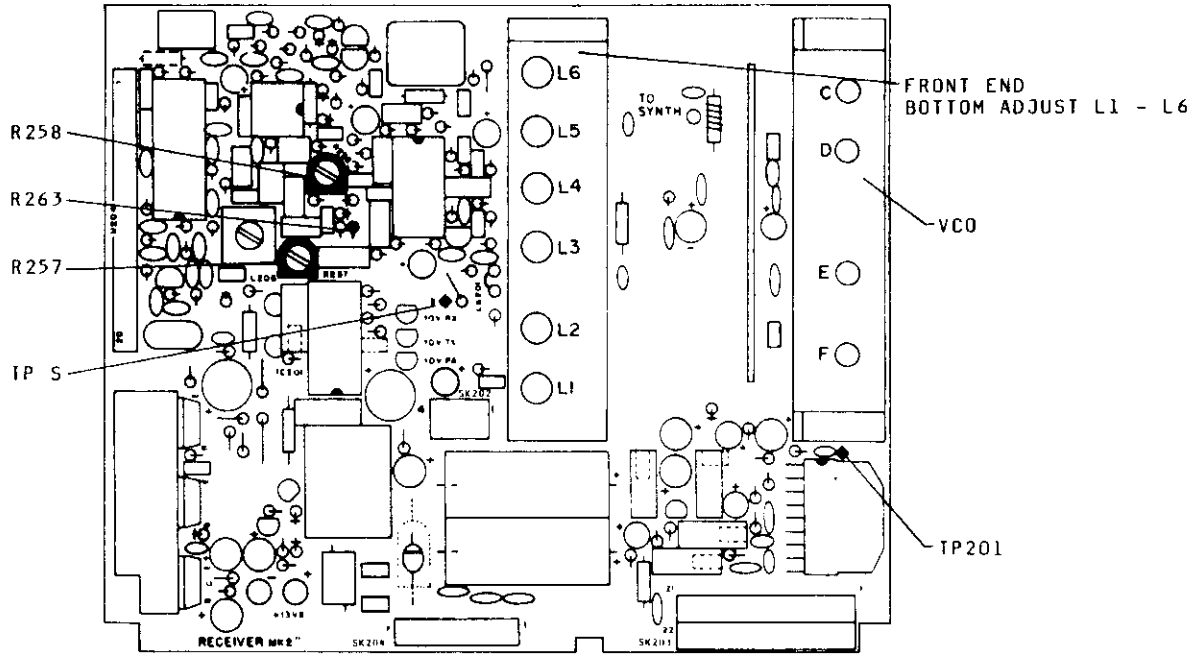


Figure 4.9 Receiver Board Layout and Test Point Location

4.13 RECEIVER FRONT-END ALIGNMENT FOR WIDEBAND PERFORMANCE (FACTORYFIELD PROCEDURE)

Additional Test Equipment Required:

Frontend Alignment Unit
CRO (with x-y facility)

*UHF Pin 1
VHF Pin 5

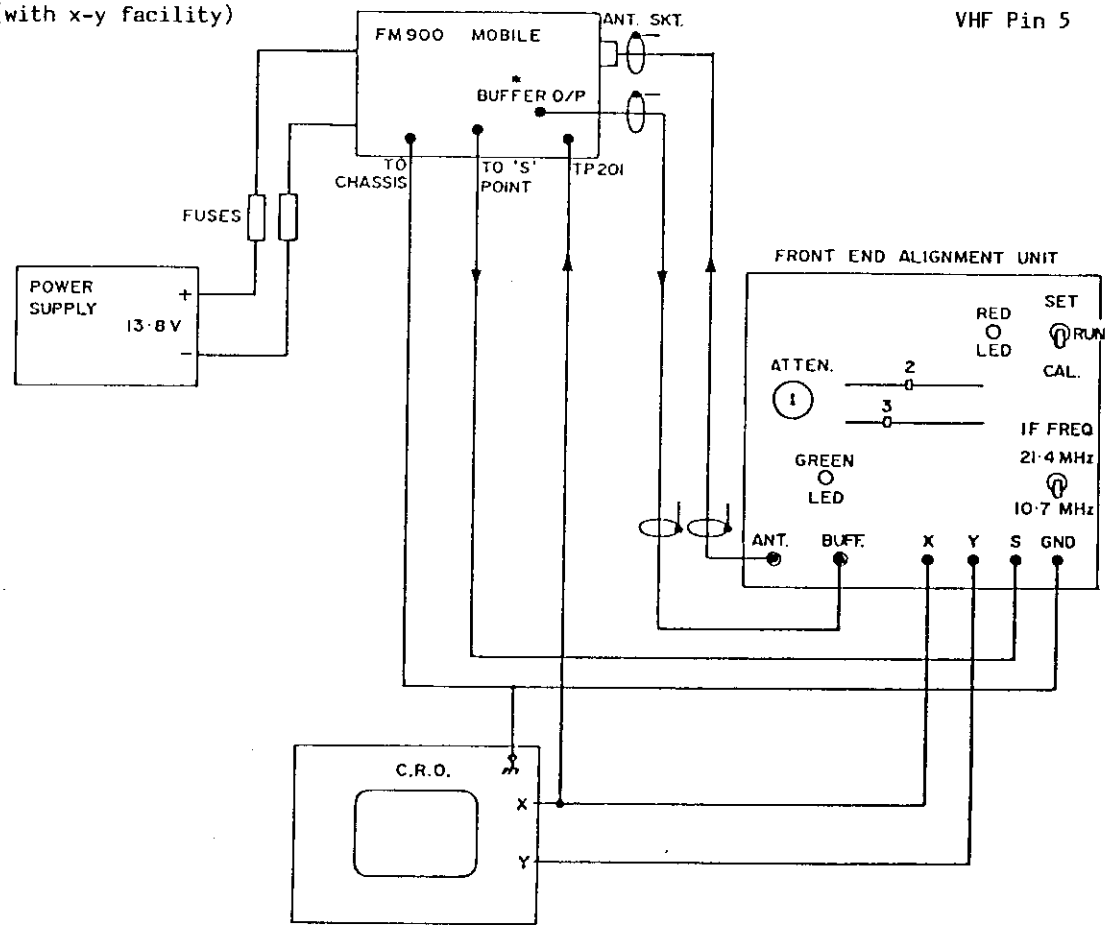


Figure 4.10 Equipment Set-Up

NOTE: 1. CRO must have x-y facility
2. Set y deflection to .1V/cm and x deflection 1V/cm AC.
3. For coax connection to buffer output* the braid goes to the nearest earth.

NOTE: PERFORM PROCEDURE 4.12 TO OBTAIN A COARSE ALIGNMENT OF FRONT END, BEFORE PROCEEDING WITH WIDE BAND ALIGNMENT.

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1		FM900 Mobile	Mobile channel for Rx **HIGHEST** frequency		Channel shown in channel frequency label
2		Front end alignment unit	Mode switch to **SET** position. Select the IF type position		The I.F.type switch must be set to 21.4kHz
3	Red LED	Front end alignment unit	Number 2 slide pot	LED just illuminated	Set the slide pot to position where the LED just lights

4.13 **RECEIVER FRONT-END ALIGNMENT FOR WIDEBAND PERFORMANCE)** (Cont'd)

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
4		FM900 Mobile	Mobile channel for Rx **LOWEST** frequency		Channel shown on channel frequency label
5	Green LED	Front end alignment unit	Number 3 slide pot	LED just illuminated	Set the slide pot to position where the LED just lights
NOTE: STEPS 1 TO 5 SHOULD BE REPEATED TO ACCOUNT FOR ANY INTERACTION					
6		Front end alignment unit	Mode switch to **RUN** position		
7	C.R.O. Trace	C.R.O.	X Gain and X position	Trace to occupy approx. 6cm of screen and central	
8	C.R.O. Trace	C.R.O.	Number 1 Pot (RF Attenuator)	See Note Below	Number 1 pot sets RF level into front end
NOTE: 1. ROTATE THE ATTENUATOR CONTROL FULLY CLOCKWISE AND SET AN UPPER DEFLECTION LIMIT ON CRO AT TOP GRATICULE ON SCREEN. THEN ROTATE THE ATTENUATOR CONTROL COUNTER CLOCKWISE SO THAT PEAK OF TRACE IS TWO CENTIMETERS FROM TOP GRATICULE OF SCREEN. 2. IT IS NECESSARY THAT DURING THE FRONT END ALIGNMENT THE ATTENUATOR (NUMBER 1 POT) MUST BE ADJUSTED PERIODICALLY TO MAINTAIN THE POSITION OF THE CRO TRACE BELOW TWO CENTIMETERS OF THE TOP GRATICULE.					
9	C.R.O. Trace	C.R.O.	L1 to L6 FM900 front end module.	Maximum vertical deflection of trace and optimum flatness	Ensure Note 2 above is kept in mind when aligning for maximum vertical deflection of CRO trace
NOTE: L1 AND L2 SHOULD BE ALIGNED FOR MAXIMUM RESPONSE AT CENTRE OF TRACE. L4 AND L5 SHOULD BE ALIGNED FOR BEST BANDWIDTH. L3 AND L6 SHOULD BE ALIGNED FOR BEST FLATNESS REPEAT STEP 9 UNTIL NO FURTHER IMPROVEMENT IS ACHIEVED.					
10	C.R.O. Trace	Front end alignment unit	Mode switch to **CALIBRATE** position	Two traces appear on C.R.O.	
11	C.R.O. Trace	C.R.O.	Y Position	See Notes Column	Adjust trace so that the **X** centre graticule is positioned between the two traces. NEITHER TRACE SHOULD CROSS THE CENTRE X AXIS
NOTE: REPEAT STEPS 9 TO 11 TO OBTAIN A TRACE WHICH HAS OVERALL BEST FLATNESS AND ENSURE THAT THE CALIBRATION TEST STEP 11 IS PASSED					

4.13 **RECEIVER FRONT-END ALIGNMENT FOR WIDEBAND PERFORMANCE)** (Cont'd)

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
12	Disconnect front end alignment equipment set up and connect FM900 mobile to equipment set up shown in Figure 4.8.				
13		FM900 Mobile	Mobile for Rx **MID** frequency channel		See channel frequency label.
14			RF Sig. Gen. frequency for Rx **MID** channel		
15			RF Sig. Gen. output level	A. 0.35uV B. 0.3uV ±0.01uV pd	A = VHF version B = UHF version Modulate Sig. Gen. with 1kHz and 60% of maximum system deviation
16	A.F. Watt meter	Speaker output	Volume Control	300mW ±5mW rms	
17	N & D Meter	Speaker output		> 12dB SINAD	
18			Mobile channel for Rx **LOW** frequency		
19	N & D Meter	Speaker output	RF Sig. Gen. frequency for Rx **LOW** alignment channel, set RF output level to A 0.39uV ±0.01uV pd B 0.34uV ±0.02uV pd	> 12dB SINAD	A = VHF version B = UHF version
20			Mobile channel for Rx **HIGH** frequency		
21	N & D Meter	Speaker output	RF Sig. Gen. frequency for Rx **HIGH** frequency	> 12dB SINAD	
NOTE: IF THE SENSITIVITY SPECIFICATION CANNOT BE MET FOR STEPS 17, 19, 21, A FURTHER MORE-CAREFUL TUNING OF L1 TO L6 FRONT END CORES WILL BE NECESSARY.					
22			Switch RF Sig. Gen. output Off		
23	DVM 10V range	Pin 18 of SK203 (Top of R263)	R258	2.5V ±0.1V	Ensure uP section cover is fitted. Fasten all screws of Rx PCB to chassis.
24	DVM 10V Range	Pin 14 of SK203 (T.P. S)	RF Gen level to 1mV	2.0V ±0.1V	RSSI calibration
25	DVM 10V Range	Pin 14 of SK203 (T.P. S)	RF Gen level to zero	0.6V ±0.15V	

4.14 RECEIVER MODULATION PERFORMANCE

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1			Mobile Channel for RX **MID** frequency.		See channel frequency label.
2			RF Sig. Gen. Frequency for Rx **MID** channel.		
3			RF Gen. output level.	100uV pd ±10uV	Modulate generator with 1KHz deviation and - ±3kHz (25kHz) ±2.4kHz (20kHz) ±1.5kHz (12.5kHz) Deviation
4	A.F. watt meter	Speaker output	Volume Control	300mW ±2dB	
5	N&D Meter	Speaker output		3% THD	
6			RF Sig. Gen. deviation	A ±5kHz B ±4kHz C ±2.5kHz	A = 25kHz version B = 20kHz version C = 12.5kHz version
7	N&D Meter	Speaker output	N&D meter for 0dB reference level.	0dB	
8	N&D Meter	Speaker output	Switch on RF Sig. Gen. modulation.	A > 45dB B > 42dB C > 40dB D > 42dB E > 40dB	Measures hum and noise ratio. A = VHF 25kHz version B = VHF 20kHz version C = VHF 12.5kHz version D = UHF 25kHz version E = UHF 12.5kHz version
9			Switch on RF Sig. Gen. modulation		Set modulation to ±500Hz deviation.
10	A.F. watt meter	Speaker output	Volume Control	100mW ±2dB	
11	N&D meter	Speaker output	N&D meter for 0dB reference.	0dB	
12	N&D meter	Speaker output	RF Sig. Gen. modulation to 450Hz.	6.9 +1dB -3dB	
13	N&D meter	Speaker output	RF Sig. Gen. modulation to A 3kHz B 2.55kHz	A -9.5 +1dB -3dB B -8.2 +1dB -3dB	A = 20/25kHz version B = 12.5kHz version
14	N&D meter	Speaker output	RF Sig. Gen. modulation to 250kHz	<-18dB	
15			RF Sig Gen modulation to 1kHz		

4.14 RECEIVER MODULATION PERFORMANCE

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
16			Volume control to maximum.		
17	A.F. watt meter	Speaker output	RF Sig. Gen. deviation	3.5W ±0.2W	Deviation should be < ±2kHz for 20/25kHz version < ±1kHz for 12.5kHz version

4.15 MUTE PERFORMANCE

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1			RF Sig. Gen. output level	100uVPD ±10uV	Modulate generator with 1kHz frequency and- ±3kHz (25kHz) ±2.4kHz (20kHz) ±1.5kHz(12.5kHz) Dev.
2	A.F. watt meter	Speaker output	Volume control	300mW ±2dB	
3			Switch off RF signal gen. output.		
4			Mute control to min.	Receiver unmuted	Yellow Rx LED should turn On.
5			Mute control	Receiver muted	Sets mute to min. threshold. Yellow LED should be Off.
6			Increase RF Sig. Gen. output from minimum.	Receiver unmuted.	Set RF Sig. Gen. at mute threshold.
7	N&D meter.	Speaker output.		< 12dB SINAD	
8			Mute control to maximum	Receiver mutes.	
9			Increase RF Sig. Gen. output level slowly.	Receiver unmutes.	Set RF Sig. Gen. at mute max.
10	N&D meter.	Speaker output.		A > 20dB B > 18dB SINAD	A = 25kHz version B = 12.5/20kHz version
11			Reduce RF Sig. Gen. output slowly.	Receiver mutes	Check hysteresis 10dB ± 2dB.

4.16 LOW SUPPLY CHECK

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1	AVO 10V DC Range	DC input to mobile	Reduce supply voltage.	10.6V ±0.1V	
2			Power ON/OFF button.	ON/OFF Button Responds	Ensure that ON/OFF button responds at 10.5V
3	AVO 10V DC Range	DC input to mobile	Reduce supply voltage	Mobile Switches OFF.	Voltage at which mobile switches off should be in range 8V to 10V.
4	AVO 10V DC Range	DC input to mobile	Reduce supply voltage	6V ±0.5V	
5	AVO 10V DC Range	DC input to mobile	Increase supply voltage	13.8V ±0.4V	Switch mobile Power on and ensure that last programmed channel is still set. (Do this test with the mobile initially programmed on a channel other than the power up channel.)

4.17 LOW POWER OPTION ALIGNMENT CHANNEL ENTRY SELECTED

NOTE: ENSURE TX PA IS ALIGNED AT 25W FIRST. PERFORM PROCEDURE 4.7/4.8 FIRST.

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1			Select channel for which medium power is required.		See channel frequency label.
2	Wattmeter 10W range.	ANT. SKT.	Activate PTT adjust R402 clockwise.	5 Watt ±1 Watt	R402 located on synthesiser/control PCB.
3			Disable PTT		
4			Select channel for which low power is required.		See channel frequency label.
5	Wattmeter 5W Range.	ANT. SKT.	Activate PTT adjust R403 clockwise.	1 Watt -0.25 Watt +0.5 Watt	R403 locted on synthesiser/control PCB.
6			Disable PTT.		

4.17.1 5W-25W ADJUSTABLE ALL VERSIONS

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1	Wattmeter 25W range	ANT. SKT.	Activate PTT and Align Tx PA for 25W	25W	See procedure 4.7/4.8
2	Wattmeter 25W range	ANT. SKT.	R110 (E-Band) R112 (A/B-Band) R102 (UHF)	5-25W	Set power to level as shown on channel frequency label.
3			Disable PTT		

4.17.2 CHANNEL ENTRY SELECTED 25W-10W

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1			Select channel for which 10W is selected		See channel frequency label.
2			Place link between base of TR401 and chassis		TR401 located on synthesiser-control PCB
3	Wattmeter 25W range	ANT. SKT.	Activate PTT and perform Tx PA alignment at 25W	25W	See procedure 4.7/4.8
4			Remove link from base of TR401 and chassis		
5	Wattmeter 25W range	ANT. SKT.	R402	10W ±2W	R402 located on synthesiser-control PCB
6			Disable PTT		

4.17.3 OPERATOR SELECTABLE

NOTE: ENSURE TX PA IS ALIGNED AT 25W FIRST. PERFORM PROCEDURE 4.7/4.8 FIRST.

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1			Mobile channel for TX **MID** frequency.		See channel frequency label.
2			Select medium power level by keypad entry.		See FM91 Operating Instructions for keypad entry procedure.

4.17.3 **OPERATOR SELECTABLE** (Cont'd)

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
3	Wattmeter 10W Range.	ANT. SKT.	Activate PTT adjust R402	5 Watt ±1 Watt	R402 located at synthesiser/control PCB
4			Disable PTT		
5			Select low power level by keypad entry.		See FM91 Operating Instructions for keypad entry procedure.
6	Wattmeter 5W Range.	ANT. SKT.	Activate PTT adjust R403 clockwise.	1 Watt -0.25 +0.5W	
7			Disable PTT		

4.17.4 **OPERATOR SELECTABLE - 10W MEDIUM POWER**

NOTE: ENSURE TX PA IS ALIGNED AT 25W FIRST. PERFORM PROCEDURE 4.7/4.8 FIRST

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1			Mobile channel for Tx **MID** frequency		See channel frequency label
2			Select medium power level by Keypad entry		See FM91 Operating Instructions for keypad entry procedure
3	Wattmeter 25W range	ANT. SKT.	Activate PTT adjust R402	10W ±2W	R402 located on synthesiser-control PCB
4			Select low power level by keypad entry		
5	Wattmeter 5W range	ANT. SKT.	R403	1 Watt -0.25 +0.5W	
6			Disable PTT		

4.18 MISCELLANEOUS

4.18.1 TX LIMIT TIMER CHECK

Transmit limit options: 1, 3, 5, 10 minute. (See mobile label)
Retransmit time : 0 seconds.
Additional test equipment required: Stop watch.
Loud speaker.

NOTE: READ THIS PROCEDURE BEFORE MAKING THE TEST

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1			Mobile Channel for TX Mid Frequency.		See channel frequency label.
2			Connect loudspeaker to mobile.		Loudspeaker socket located at rear of mobile
3			Reset stop watch to zero.		
4	Wattmeter 25W range.	ANT. SKT.	Activate PTT and start stop watch.	25Watt	PTT and stop watch should begin simultaneously.
5	Wattmeter Stop watch.	ANT. SKT. Time out period.		0 Watt Limit time + 5 secs.	At transmit time out, a continuous tone alarm should be heard from loudspeaker. Tx LED should go out.
6			Release PTT and then reactivate PTT	25Watt	Transmitter should become active again.
7			Disable PTT		

4.18.2 VHF PROCESSOR CRYSTAL FREQUENCY STEERING

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1	Frequency Counter	IC408 pin 6 on Synth/Control PCB	Select channel with no crystal steering offset	1MHz ±50Hz	See channel frequency label.
2	Frequency Counter	IC602 pin 11 on Remote Control Head		400kHz±20Hz	
3	Frequency Counter	IC408 pin 6	Select channel with crystal steering offset	1MHz +500Hz +600Hz	See channel frequency label.
4	Frequency Counter	IC602 pin 11		400kHz +200Hz +250Hz	

4.19 DUPLEX ALIGNMENT

4.19.1 PRELIMINARY ADJUSTMENTS

a) Read carefully the general instructions stated in Section 4.2. Ensure that the preliminary adjustments specified in Section 4.3 are carried out.

b) Connect mobile to test equipment set up as shown in Figure 4.13. Connect RF Sig. Gen. to Rx antenna socket.

4.19.2 POWER SUPPLY CHECK

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1	AVO 1A DC range	In series with +ve supply lead	Activate power on	< 750mA	Green "POWER ON" LED on
2	DVM	Collector of TR206		+9.8V ±0.1V	Checks +10V Regulator output
3	DVM	Collector if TR205		+9.7V ±0.1V	Checks +10V Rx output

4.19.3 VCO ALIGNMENT - RECEIVER

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1			Mobile channel for Rx **HIGH** frequency		See channel frequency label.
2	AVO 30V DC range	U203 Pin 10 (VHF) Pin 23 (UHF)	VCO main tuning	12V ±0.5V	If 12V cannot be set by main tuning, adjustment of both main and offset tuning may be necessary
3			Mobile channel for Rx **LOW** frequency		See channel frequency label
4	AVO 30V DC range	U203 Pin 10 (VHF) Pin 23 (UHF)		> 8V	

4.19.4 RECEIVER ALIGNMENT

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1			Mobile channel for Rx **MID** frequency		See channel frequency label
2			RF signal generator frequency to Rx **MID** channel		Switch RF output Off
3	A.F. wattmeter	Speaker output socket	Volume control	300mW ±2dB noise output	

SECTION 5 INSTALLATION

NOTE: REFER ALSO TO "VEHICLE CARE" PAGE AT FRONT OF HANDBOOK

5.1 GENERAL INFORMATION

The mobile radio unit(s) must be fitted in a position such that the operator has easy access to the controls and microphone when wearing the seat belt. The controls must also be situated so that the driver can see them within his normal field of vision.

Caution should be exercised before drilling holes through bulkheads to ascertain if safe to do so. i.e. fuel tank, fuel line, brake line, battery, cable loom etc.

5.2 VEHICLES FITTED WITH ELECTRONIC DEVICES

An additional precaution is necessary in relation to vehicles fitted with Electronic Ignition, Fuel Injection, Anti-skid Brakes or any other electronic device where temporary loss of service could be hazardous.

In theory, any of the above systems could be affected by the presence of an RF field of sufficient intensity, which when detected may cause the device to malfunction. The source of RF may be a mobile radio installed in the vehicle itself or a transmitter operating in another vehicle alongside. If interaction did occur, loss of control could result for the duration of the mobile transmission.

In the interests of safety, the user must be asked to test the vehicle when the installation is complete.

If a problem is found the owner should take the vehicle to an automobile specialist to resolve the problem. Unqualified persons should not attempt to modify these units in any way, the work should be done by a qualified automobile electrician.

5.3 SPECIALISED VEHICLES

The installation on certain specialised vehicles, such as Petrol Tankers and Fire Appliances, may be subject to safety regulations which must be closely observed.

Prior to commencing an installation on such a vehicle, be sure that any relevant safety regulations are fully understood.

5.4 DASH MOUNTED EQUIPMENT

Conditions in Section 5.1 must be complied with when positioning equipment.

Fitting positions above the driver's or passenger's head must be avoided. Care should be taken to ensure that the microphone/handset lead is not installed such that the lead can interfere with the vehicle controls, and in particular the driver's feet.

The microphone/handset clip should be fitted such that the microphone/handset is easily accessible. In the case of a loudspeaker it is necessary for the loudspeaker grill to face the operator when mounted.

The FM900 series has been designed with safety in mind, e.g. non-reflective surface, no protrusions or sharp corners. Care must be taken when installing these, to ensure that any additional metalwork necessary to fix the units into the vehicle conforms to the same requirement.

Refer to Section 5.6 for mounting cradle and transceiver fitment.

5.5 REMOTE (EXTENDED CONTROL) EQUIPMENT

The information contained in Section 5.4 also applies for the positioning and mounting of the remote (extended) control unit and loudspeaker.

When fitting the main unit in the luggage compartment of a vehicle, always attempt to mount in a vertical position rather than in a horizontal position on the floor. This will lessen the possibility of the unit being covered and cause overheating. If the unit must be floor mounted, it is preferable to mount the cradle on the carpet rather than lift the carpet to mount directly to the metal floor.

5.5.1 PETROL POWERED VEHICLES

Ensure there are no petrol leaks before commencing installation with the use of electric tools, these can produce sparks.

Ensure no damage to petrol tank or fuel lines occurs when drilling holes.

5.5.2 GAS POWERED VEHICLES

Before installation starts:

Establish if there are any gas leaks. DO NOT USE A FLAME. Butane and Propane are heavier than air. If there is a leak, the gas may lay on the floor of the boot and is detectable by its characteristic smell. The point of escaping gas may show signs of frosting.

The vehicle owner should arrange for the leak to be repaired before the installation can commence.

Ensure no damage to gas tank or gas lines occurs when drilling holes.

LT cables should be run if possible on the opposite side of the vehicle to the gas fuel pipe.

5.6 MAIN UNIT FITMENT

5.6.1 CRADLE AND TRANSCEIVER FITMENT

Fit the transceiver cradle into the required position in the vehicle using the four slotted holes which provide forward and backward adjustment of the cradle if required. Ensure cradle positioned to allow release key to be inserted for removal as per 5.6.2.

The transceiver can now be easily fitted into the cradle.

Position the unit with lip (a) on the cover casting so that it enters recess (c) of the cradle. Lip (b) on the cover can then be inserted into the front of the cradle channel (d) by applying slight upward pressure. The transceiver is then pushed into the cradle until two distinct "clicks" are heard, the unit is then locked into position.

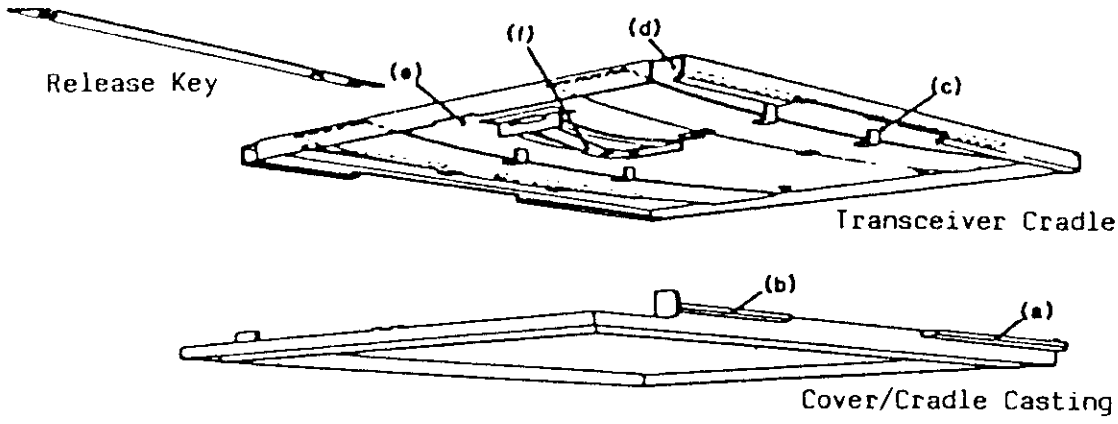


Figure 5.1 FM900 Cradle and Cover

5.6.2 TRANSCEIVER REMOVAL

The unit cannot be removed from the cradle without a special "Release Key". This key is inserted between the transceiver and the cradle at point (e) and pushed fully into position to release spring (f). The transceiver can now be removed by pulling the unit forward to the point of release.

5.7 ANTENNA INSTALLATION

For best all round performance of the radiotelephone the antenna should be mounted on the centre of the vehicle roof. Alternative positions, such as guard mounted will give degraded performance.

The coaxial feeder should be secured along its length to eliminate any possibility of damage by sharp edges or moving parts. Check the feeder for insulation and continuity.

5.8 DC SUPPLY CONNECTION

The radio supply should be connected to the vehicle battery as a continuous unbroken run, with the earth lead connected to the chassis end of the battery earth braid. This is to protect the radio equipment in the event of the battery earth becoming disconnected.

The leads contain in-line fuse holders and fuses of the correct rating must be fitted.

In the case of 24 volt dc supply vehicles, an approved 24V/12V converter must be used. The supply should not be taken from a 12 volt tap on the battery supply.

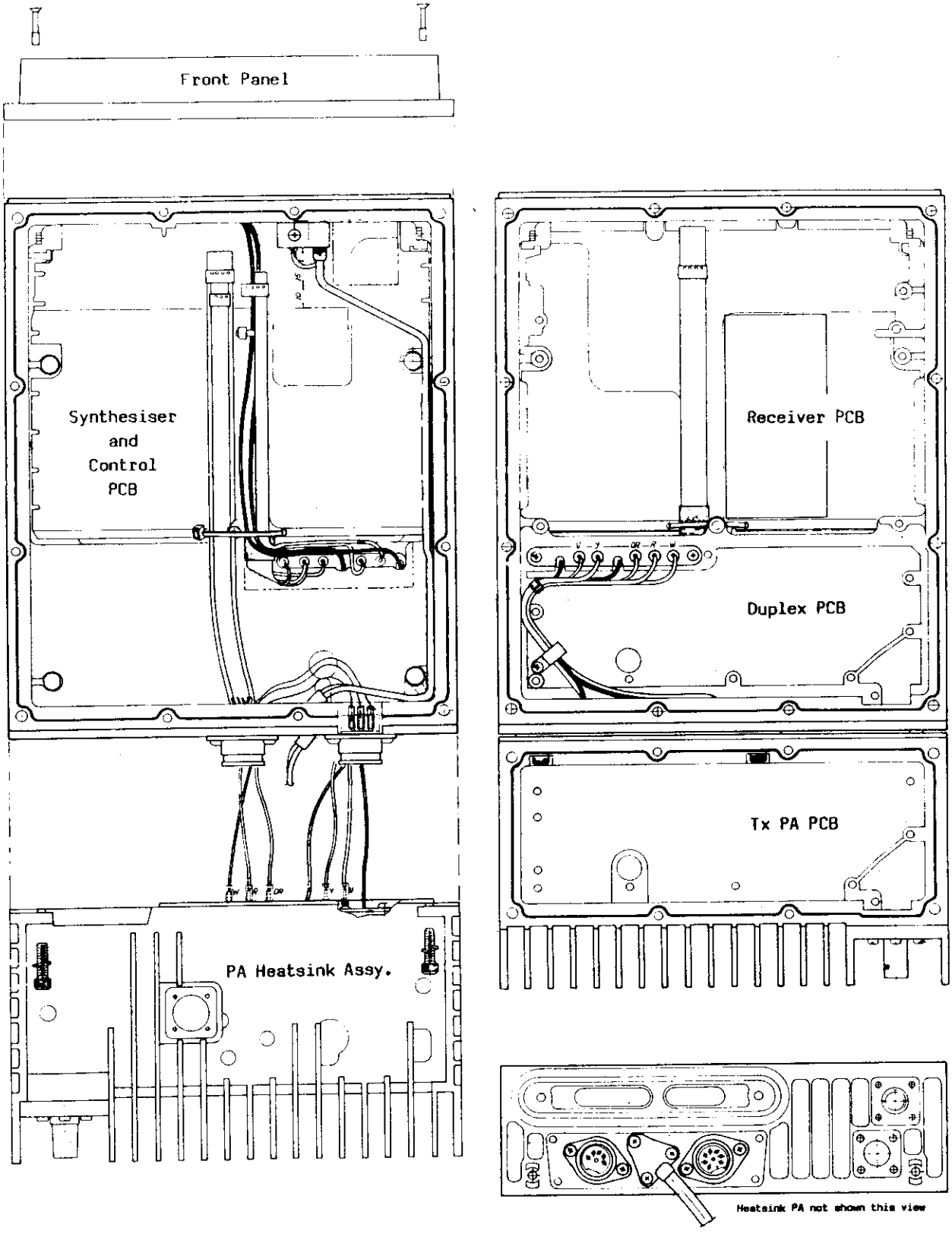


Figure 6.1 Main Unit Internal view (Top and Bottom)

SECTION 6 PARTS LIST

6.1 VHF MOBILE UNIT MAIN CODES (SIMPLEX)

6.1.1 PCB CODES (25kHz CH.SP.)

PC BOARD	E BAND 9502 912 40000	B BAND 9502 913 40000	A BAND 9502 914 40000
Tx PA PC Board	3502 349 71020	3502 349 71130	3502 349 71140
Receiver PC Board Mk2	3502 349 72160	3502 349 72170	3502 349 72180
Synth/Control PC Brd	3502 349 73250	3502 349 73550	3502 349 73550
Remote Interface PC Board	3502 349 77000	3502 349 77000	3502 349 77000

6.1.2 PCB CODES (12.5kHz CH.SP.)

PC BOARD	E BAND 9502 912 80000	B BAND 9502 913 80000	A BAND 9502 914 80000
Tx PA PC Board	3502 349 71020	3502 349 71130	3502 349 71140
Receiver PC Board Mk2	3502 349 72360	3502 349 72370	3502 349 72380
Synth/Control PC Brd	3502 349 73270	3502 349 73570	3502 349 73570
Remote Interface PC Board	3502 349 77000	3502 349 77000	3502 349 77000

6.1.3 VHF MOBILES (COMMON PARTS)

Chassis Assy 91	3502 330 06740	Insulator Assy. Control/Synth	3502 330 08090
Lid, Cradle Mtg 900	3502 319 90190	Cable Assy Insul/Displmnt	3502 350 03100
Lid, Main Chassis	3502 319 90200	Connector Sub-assy 91/92	3502 330 06870
Spring, PCB Retaining	3502 319 91170	Connector, Coax 31-202 AMP	2422 031 00002
Spring, PCB Support	3502 319 91160	Assy Ribbon Cable 4 way	3502 350 03340
Plate DC Cable Clamp	3502 319 90310	L.T. Cable Assy	3502 350 03090
Plate Heatsink	3502 319 92740	L.T. Lead Assy. (Long)	3502 330 05860
Lid, Heatsink P.A. 914/6	3502 319 90340	Socket 5-Pin DIN Ster.Lock.(SK1)	2412 026 15012
Panel, Remote Front	3504 319 90250	Socket BNC Fem. AMP.114375 (SK3)	2422 031 10301
Cradle, Plinth 900 (plas/blk)	3502 319 91000	Fuse 10A L1055 or 3AG (FS1/FS2)	2413 086 00168
Spring, Cradle Mtg 900	3502 319 91010	Feedthru Strip Assy.	3502 350 03070
Spring Latch, Split Cradle	3502 319 91020	Assy. F/Thru Strip 91	3502 350 03080
Guide, Cradle Cover	3502 319 90820	Heatsink PA VHF	3502 319 90330
Key Cradle, 900 Rumbled	3502 319 91030	Heatsink TO-5 PA	3502 319 90370
Label, Serial No	3502 319 91740	Coax Link, Rx-PA T/R Sw	3502 319 91570
Label, Type	3502 319 94140	Coax Link, Rx-PA Input	3502 319 91560

References for mechanical hardware are presented pictorially in Section 9 to provide easy and quick recognition of the required parts.

6.2 UHF MOBILE UNIT MAIN CODES (SIMPLEX)

6.2.1 PCB CODES

6.2.1.1 PCB Codes (25kHz Ch.Sp.)

SUB-UNIT	T - BAND 25kHz Ch. Sp. 9502 915 40000	U - BAND 25kHz Ch. Sp. 9502 916 40000	W1 - BAND 25kHz Ch. Sp. 9502 917 40000	W2 - BAND 25kHz Ch.Sp. 9502 918 40000
Tx PA PC Board	3502 349 81050	3502 349 81060	3502 349 81070	3502 349 81080
Receiver PC Board Mk2	3502 349 82110	3502 349 82120	3502 349 82130	3502 349 82140
Synth/Control PC Board	3502 349 83250	3502 349 83250	3502 349 83250	3502 349 83250
Remote Interface PC Board	3502 349 77000	3502 349 77000	3502 349 77000	3502 349 77000

6.2.1.2 PCB Codes (12.5kHz Ch.Sp.)

SUB-UNIT	T - BAND 12.5kHz Ch.Sp. 9502 915 81000	U - BAND 12.5kHz Ch.Sp. 9502 916 81000	W1 - BAND 12.5kHz Ch.Sp. 9502 917 81000	W2 - BAND 12.5kHz Ch.Sp. 9502 918 81000
Tx PA PC Board	3502 349 81050	3502 349 81060	3502 349 81070	3502 349 81080
Receiver PC Board Mk2	3502 349 82410	3502 349 82420	3502 349 82430	3502 349 82480
Synth/Control PC Board	3502 349 83260	3502 349 83260	3502 349 83260	3502 349 83260
Remote Interface PC Board	3502 349 77000	3502 349 77000	3502 349 77000	3502 349 77000

6.2.2 UHF MOBILES (COMMON PARTS)

Chassis Assy 91	3502 330 06740	Insulator Assy Synth/Cont	3502 330 08090
Lid, Cradle Mtg 900	3502 319 90190	Assy Ribbon Cable 4 way	3502 350 03340
Lid, Main Chassis	3502 319 90200	Cable Assy Insul/Displmnt	3502 350 03100
Spring, PCB Retaining	3502 319 91170	Connector Sub-assy 91/92	3502 330 06870
Spring, PCB Support	3502 319 91160	Connector, Coax 31-202 AMP	2422 031 00002
Plate DC Cable Clamp	3502 319 90310	L.T. Cable Assy	3502 350 03090
Plate Heatsink	3502 319 92740	L.T. Lead Assy. (Long)	3502 330 05860
Lid, Heatsink P.A. 914/6	3502 319 90340	Socket 5-Pin DIN Ster.Lock.(SK1)	2412 026 15012
Panel, Remote Front	3504 319 90250	Socket BNC Fem. AMP.114375 (SK3)	2422 031 10301
Cradle, Plinth 900 (plas/blk)	3502 319 91000	Fuse 10A L1055 or 3AG (FS1/FS2)	2413 086 00168
Spring, Cradle Mtg 900	3502 319 91010	Assy. F/Thru Strip Chassis	3502 350 03480
Spring Latch, Split Cradle	3502 319 91020	Assy. F/Thru Strip 91 PA	3502 350 03470
Guide, Cradle Cover	3502 319 90820	Heatsink PA UHF	3502 319 90320
Key Cradle, 900 Rumbled	3502 319 91030	Coax Link, Rx-PA T/R Sw	3502 319 91520
Insulator, Front End	3502 319 94100	Coax Link, Rx-PA Input	3502 319 91510
Label, Serial Number	3502 319 91740	Packing Piece, PA Module	3502 319 92750
Label, Type	3502 319 94140	Washer, Mica TO-220	3502 319 91150

References for mechanical hardware are presented pictorially in Section 9 to provide easy and quick recognition of the required parts.

6.3 TRANSMITTER PA PC BOARDS

6.3.1 VHF TRANSMITTER PC BOARDS

6.3.1.1 Tx PA PC Board (E-Band)(3502 349 71020)

	PCB Tx PA (E Band)	3502 309 71020
	Heatsink PA Diode (x2)	3502 319 91070
	Shield Aerial Filter	3502 319 91100
	Partition Aerial Filter	3502 319 91110
	Spacer PCB Support	3502 319 91860
R101	Res Carb F 10E 5% ¼W	2120 101 46109
R102	Res Carb F 1k5 5% ¼W	2120 101 46152
R103	Res Carb F 470E 5% ¼W	2120 101 46471
R104	Res Carb F 330k 5% ¼W	2120 101 46334
R105	Res Carb F 10E 5% ½W	2322 212 13109
R106	Res Carb F 180E 5% ¼W	2120 101 46181
R107	Thermistor PTC 90C with leads	2322 672 91004
R108	Res Carb F 3k3 5% ¼W	2120 101 46332
R109	Res Carb F 2E2 5% ¼W	2120 101 46228
R110	Pot Cermet 5k 10% 1W	2113 391 00506
R111	Res Carb F 3k3 5% ¼W	2120 101 46332
R112	Res Carb F 100E 5% ¼W	2120 101 46101
R113	Res Carb F 39k 5% ¼W	2120 101 46393
R114	Res Carb F 470E 5% ½W	2322 186 13471
R115	Res Carb F 10E 5% ¼W	2120 101 46109
R116	Res Carb F 10E 5% ½W	2322 212 16109
R117	Res Carb F 10E 5% ¼W	2120 101 46109
R118	Res Carb F 470E 5% ½W	2322 186 13471
R119	Res Carb F 18k 5% ¼W	2120 101 46183
R120	Res Carb F 22E 5% ½W	2322 212 13229
R121	Res Carb F 10E 5% ½W	2322 186 16109
R122	Res Carb F 47E 5% ¼W	2120 101 46479
R123	Res Carb F 100E 5% ¼W	2120 101 46101
R124	Res Carb F 10k 5% ¼W	2120 101 46103
R125	Res Carb F 22k 5% ¼W	2120 101 46223
R126	Res Carb F 68k 5% ¼W	2120 101 46683
R127	Res Carb F 22E 5% ¼W	2120 101 46229
C101	Cap Cer Pl 220p 2% 100V N750	2222 680 58221
C102	Cap Cer Pl 68p 2% 100V NPO	2222 680 10689
C103	Cap Cer D/M 100n 20% 50V X7R	2022 552 01751
C104	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C105	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C106	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C107	Cap Cer Pl 100p 2% 100V NPO	2222 680 10101
C108	Cap Cer Pl 82p 2% 100V NPO	2222 680 10829
C109	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C110	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C111	Cap Cer Pl 68p 2% 100V NPO	2222 680 10689
C112	Cap Cer Pl 82p 2% 100V NPO	2222 680 10829
C113	Cap Elec S/AL 3u3 -20+40% 63V	2222 122 56338
C114	Cap Cer D/M 100n 20% 50V X7R	2022 552 01751
C115	Cap Cer D/M 100n 20% 50V X7R	2022 552 01751
C116	Cap Cer Pl 270p 10% 100V	2222 630 08271
C117	Cap Cer Pl 47p 2% 100V NPO	2222 680 10479
C118	Cap Cer Pl 180p 10% 100V	2222 630 08181
C119	Cap Cer Pl 68p 2% 100V NPO	2222 680 10689
C120	Cap Cer Pl 5p6 p25 100V NPO	2222 680 09568
C121	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C122	Cap Mica 300p 5% 350V	2022 751 00029
C123	Cap Mica 300p 5% 350V	2022 751 00029
C124	Cap Elec S/AL 4u7 -20+40% 25V	2222 122 56478
C125	Cap Cer D/M 100n 20% 50V	2022 552 01751
C126	Cap Cer Pl 47p 2% 500V NPO	2222 650 10479
C127	Cap Cer Pl 270p 10% 100V	2222 630 08271
C128	Cap Mica 250p 5% 350V	2022 751 00032
C129	Cap Trim Film H/T 4p-40p	2222 809 08002
C130	Cap Cer Pl 27p 2% 500V NPO	2222 650 10279
C131	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C132	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C133	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C134	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C135	Cap Cer Pl 39p 2% 100V NPO	2222 680 10399
C136	Cap Cer Pl 39p 2% 500V NPO	2222 650 10399
C137	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C138	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C139	Cap Cer Pl 27p 2% 500V NPO	2222 650 10279
C140	Cap Cer Pl 47p 2% 500V NPO	2222 650 10479
C141	Cap Cer Pl 15p 2% 500V NPO	2222 650 10159
C142	Cap Cer Pl 47p 2% 500V NPO	2222 650 10479
C143	Cap Cer Pl 27p 2% 500V NPO	2222 650 10279
C144	Cap Cer Pl 470p 10% 100V	2222 630 08471
IC101	Intgrd Circt LM358N	9333 935 10112
D101	Diode BA482	9334 632 90113
D102	Diode 1N4148	9330 839 90112
D103	Diode 1N4148	9330 839 90112
D104	Diode 1N4148	9330 839 90112
D105	Diode M1407	9338 550 70682
D106	Diode MA858	9338 718 80682
D107	Diode MA858	9338 718 80682
D108	Diode 1N4148	9330 839 90112
TR101	Transistor MRF629	9334 397 90112
TR102	Transistor MRF237	9335 681 60682
TR103	Transistor SRF1800	9337 983 40682
L101	Coil C/W Tx pa 'E'	3502 382 90140
L102	Choke 0.47uH 10% AXL SS-070-9	2422 535 97094
L103	Coil A/W Tx PA 'E'	3502 382 90150
L104	Coil A/W Tx PA 'E'	3502 382 90160
L105	Coil A/W Tx PA 'E'	3502 382 90170
L106	Choke 0.47uH 10% AXL SS-070-9	2422 535 97094
L107	Choke wide band RF	4312 020 36640
L108	Coil A/W Tx PA 'E'	3502 382 90180
L109	Coil A/W Tx PA 'E'	3502 382 90190
L110	Coil A/W Tx PA 'E'	3502 382 90200
L112	Choke wide band RF	4312 020 36640
L113	Choke wide band RF	4312 020 36640
L114	Coil A/W Tx PA 'E'	3502 382 90210
L115	Coil A/W Tx PA 'E'	3502 382 90220
L116	Coil A/W Tx PA 'E'	3502 382 90230
L117	Choke 2.2uH 5% AXL SS-070-17	2422 535 97095
L118	Coil A/W Tx PA 'E'	3502 382 90240
L119	Coil A/W Tx PA 'E'	3502 382 90250
L120	Coil A/W Tx PA 'E'	3502 382 90260
L121	Coil A/W Tx PA 'E'	3502 382 90250
L122	Coil A/W Tx PA 'E'	3502 382 90420

6.3.1.2 Tx PA PC Board (B-Band) (3502 349 71130)

	PCB Tx PA (B-Band)	3502 349 71100	C131	Cap Mica 390p 10% 350V	2022 751 00037
R116	Res Carb F 100k 5% ¼W	2120 101 46104	C134	Cap Mica 150p 10% 350V	2022 751 00038
R119	Res Carb F 470E 5% ½W	2322 186 13471	C135	Cap Mica 47p 5% 250V	2022 751 00017
C102	Cap Cer Pl 47p 2% 100V NPO	2222 680 10479	C137	Cap Cer Pl 33p 2% 500V NPO	2222 650 10339
C107	Cap Cer Pl 33p 2% 100V NPO	2222 680 10339	C143	Cap Cer Pl 22p 2% 100V NPO	2222 680 10229
C108	Cap Cer Pl 33p 2% 100V NPO	2222 680 10339	C144	Cap Cer Pl 22p 2% 500V NPO	2222 650 10229
C112	Cap Cer Pl 47p 2% 100V NPO	2222 680 10479	C147	Cap Cer Pl 18p 2% 500V NPO	2222 650 10189
C113	Cap Cer Pl 100p 2% 100V NPO	2222 680 10101	C152	Cap Cer Pl 18p 2% 500V NPO	2222 650 10189
C118	Cap Cer Pl 33p 2% 100V NPO	2222 680 10339	L104	Coil A/W Tx PA 'A'	3502 382 90280
C119	Cap Cer Pl 220p 10% 100V	2222 630 08221	L114	Coil A/W 900	3502 382 90590
C120	Cap Cer Pl 33p 2% 100V NPO	2222 680 10339	L120	Coil A/W 900	3502 382 90580
C122	Cap Mica 130p 5% 350V	2022 751 00025	L121	Coil A/W 900	3502 382 90600
C128	Cap Mica 390p 10% 350V	2022 751 00037	L122	Coil A/W 900	3502 382 90580

6.3.1.3 Tx PA PC Board (A-Band) (3502 349 71140)

	PCB Tx PA (A-Band)	3502 349 71100	C131	Cap Sl/Mic 350p 10% 350V	2022 751 00036
R116	Res Carb F 39k 5% ¼W	2120 101 46393	C134	Cap Mica 130p 5% 350V	2022 751 00025
R119	Res Carb F 220E 5% ½W	2322 186 13221	C135	Cap Mica 22pF 5% 250V	2022 751 00018
C102	Cap Cer Pl 39p 2% 100V NPO	2222 680 10399	C137	Cap Cer Pl 27p 2% 500V NPO	2222 650 10279
C107	Cap Cer Pl 27p 2% 100V NPO	2222 680 10279	C143	Cap Cer Pl 18p 2% 100V NPO	2222 680 10189
C108	Cap Cer Pl 39p 2% 100V NPO	2222 680 10399	C144	Cap Cer Pl 18p 2% 500V NPO	2222 650 10189
C112	Cap Cer Pl 27p 2% 100V NPO	2222 680 10279	C147	Cap Cer Pl 15p 2% 500V NPO	2222 650 10159
C113	Cap Cer Pl 120p 2% 100V NPO	2222 680 10121	C152	Cap Cer Pl 15p 2% 500V NPO	2222 650 10159
C118	Cap Cer Pl 22p 2% 100V NPO	2222 680 10229	L104	Coil A/W Tx PA 'A'	3502 382 90520
C119	Cap Cer Pl 180p 10% 100V	2222 630 08181	L114	Coil A/W Tx PA 'A'	3502 382 90280
C120	Cap Cer Pl 27p 2% 100V NPO	2222 680 10279	L120	Coil A/W Tx PA 'A'	3502 382 90330
C122	Cap Sl/Mic 100p 5% 350V	2022 751 00033	L121	Coil A/W Tx PA 'A'	3502 382 90340
C124	Cap Sl/Mic 80p 10% 350V	2022 751 00035	L122	Coil A/W Tx PA 'A'	3502 382 90330
C128	Cap Sl/Mic 350p 10% 350V	2022 751 00036			

6.3.1.4 Tx PA PC Board (A & B Band) Basic (3502 349 71100)

	PCB Tx PA (A Band)	3502 309 71100	R124	Res Carb F 10E 5% ½W	2120 101 16109
	Heatsink PA Diode (x2)	3502 319 91070	R125	Res Carb F 10E 5% ½W	2322 101 16109
	Shield Aerial Filter	3502 319 91100	R126	Res Carb F 47E 5% ¼W	2120 101 46479
	Partition Aerial Filter	3502 319 91110	R127	Res Carb F 100E 5% ¼W	2120 101 46101
	Spacer PCB Support	3502 319 91860	R128	Res Carb F 10k 5% ¼W	2120 101 46103
R102	Res Carb F 10E 5% ¼W	2120 101 46109	R129	Res Carb F 68k 5% ¼W	2120 101 46683
R103	Res Carb F 1k5 5% ¼W	2120 101 46152	R130	Res Carb F 10E 5% ½W	2322 101 16109
R104	Res Carb F 470E 5% ¼W	2120 101 46471	R131	Res Carb F 68k 5% ¼W	2120 101 46683
R105	Res Carb F 330k 5% ¼W	2120 101 46334	C101	Cap Cer Pl 68p 2% 100V NPO	2222 680 10689
R106	Res Carb F 10E 5% ½W	2322 212 16109	C103	Cap Cer Pl 4n7 10% 100V	2222 630 08472
R107	Res Carb F 180E 5% ¼W	2120 101 46181	C104	Cap Cer D/M 100n 20% 50V X7R	2022 552 01751
R108	Res Carb F 2E2 5% ¼W	2120 101 46228	C105	Cap Cer Pl 4n7 10% 100V	2222 630 08472
R109	Res Carb F 3k3 5% ¼W	2120 101 46332	C106	Cap Cer Pl 1n0 10% 100V	2222 630 08102
R110	Res Carb F 470E 5% ¼W	2120 101 46471	C109	Cap Cer Pl 1n0 10% 100V	2222 630 08102
R111	Thermistor PTC 90C with leads	2322 672 91004	C111	Cap Cer Pl 1n0 10% 100V	2222 630 08102
R112	Pot Cermet 2k 10% 1W	2113 391 00505	C114	Cap Elec S/AL 3u3 -20+40% 63V	2222 122 56338
R113	Res Carb F 3k3 5% ¼W	2120 101 46332	C115	Cap Cer D/M 100n 20% 50V X7R	2022 552 01751
R114	Res Carb F 22E 5% ¼W	2120 101 46229	C116	Cap Cer D/M 100n 20% 50V X7R	2022 552 01751
R117	Res Carb F 10E 5% ¼W	2120 101 46109	C117	Cap Cer Pl 180p 10% 100V	2222 630 08181
R118	Res Carb F 10E 5% ½W	2322 101 16109	C121	Cap Cer Pl 39p 2% 100V NPO	2222 680 10399
R123	Res Carb F 10k 5% ¼W	2120 101 46103	C123	Cap Cer Pl 1n0 10% 100V	2222 630 08102

6.3.1.4 Tx PA PC Board (A & B-Band) Basic (Cont'd)

C125	Cap Cer Pl 6p8 p25, 100V NPO	2022 680 09688	D102	Diode 1N4148	9330 839 901
C129	Cap Cer Pl 220p 10% 100V	2222 630 08221	D103	Diode 1N4148	9330 839 901
C130	Cap Cer Pl 180p 2% 100V N750	2222 680 58181	D104	Diode 1N4148	9330 839 901
C132	Cap Elec S/AL 4u7 -20+40% 25V	2222 122 56478	D105	Diode M1407	9338 550 706
C133	Cap Cer D/M 100n 20% 50V X7R	2022 552 01751	D106	Diode MA858	9338 718 806
C136	Cap Trim Flm 3H/T 2P-18P 300V	2222 809 09003	D107	Diode MA858	9338 718 806
C138	Cap Cer Pl 1n0 10% 100V	2222 630 08102	D108	Diode 1N4148	9330 839 901
C139	Cap Cer Pl 1n0 10% 100V	2222 630 08102	L101	Coil A/W Tx PA 'A'	3502 382 902
C141	Cap Cer Pl 1n0 10% 100V	2222 630 08102	L102	Choke 0.22uH 10% AXL SS-070-5	2402 535 970
C142	Cap Cer Pl 1n0 10% 100V	2222 630 08102	L103	Coil A/W Tx PA 'A'	3502 382 902
C145	Cap Cer Pl 1n0 10% 100V	2222 630 08102	L106	Coil A/W Tx PA 'A'	3502 382 902
C146	Cap Cer Pl 1n0 10% 100V	2222 630 08102	L107	Choke Wide Band RF	4312 020 366
C148	Cap Cer Pl 27p 2% 500V NPO	2222 650 10279	L108	Choke Tx PA A Band	3502 389 903
C149	Cap Cer Pl 6p8 p25 500V NPO	2222 650 09688	L111	Coil A/W Tx PA 'A'	3502 382 902
C151	Cap Cer Pl 27p 2% 500V NPO	2222 650 10279	L112	Choke Wide Band RF	4312 020 366
IC101	Intgrd Circt LM358N	9333 935 10112	L113	Choke Wide Band RF	4312 020 366
TR101	Transistor MRF629	9334 397 90112	L116	Coil A/W Tx PA 'A'	3502 382 902
TR102	Transistor MRF237	9336 681 60682	L118	Coil A/W Tx PA 'A'	3502 382 903
TR103	Transistor SRF1581-1	9337 983 50682	L119	Coil A/W Tx PA 'A'	3502 382 903
D101	Diode BA482	9334 632 90113			

6.3.2 UHF TRANSMITTER PC BOARDS

6.3.2.1 Tx PA PC Board T-Band (3502 349 81050)

	Tx PA Brd UHF Basic	3502 349 81000	C122	Cap Mica 6p8 5% 250V	2022 900 000
	Heatsink PA Diode (x2)	3502 319 91070	C123	Cap Cer Pl 8p2 p25 500V NPO	2222 650 098
	Coax ¼ Wave Line	3502 319 91500	C125	Cap Cer Pl 470p 10% 100V	2222 630 084
R113	Res Carb F 100E 5% ½W	2120 101 46101	C127	Cap Cer Pl 470p 10% 100V	2222 630 084
R114	Res Carb F 100E 5% ½W	2120 101 46101	IC102	Intgrd Circt MHW709-1	9334 497 601
R116	Res Carb F 18k 5% ½W	2120 101 46183	D103	Diode M1407	9338 550 706
R121	Res Carb F 1K 5% ½W	2120 101 46102	D104	Diode MA858	9338 718 806
C114	Cap Mica 27p 5% 250V	2022 751 00016	D105	Diode MA858	9338 718 806
C115	Cap Mica 39p 5% 250V	2022 751 00019	L105	Coil A/W Tx PA U,T,W1	3502 382 900
C118	Cap Mica 39p 5% 250V	2022 751 00019	L106	Choke Tx PA T Bnd	3502 389 903
C119	Cap Mica 47p 5% 250V	2022 751 00017	L108	Coil A/W Tx PA UHF	3502 382 900

6.3.2.2 Tx PA PC Board U-Band (3502 349 81060)

	Tx PA Brd UHF Basic	3502 349 81000	C122	Cap Mica 6p8 5% 250V	2022 900 000
	Heatsink PA Diode (x2)	3502 319 91070	C123	Cap Cer Pl 5p6 p25 500V	2222 650 095
	Coax ¼ Wave Line	3502 319 91500	C125	Cap Cer Pl 470p 10% 100V	2222 630 084
R113	Res Carb F 100E 5% ½W	2120 101 46101	C127	Cap Cer Pl 470p 10% 100V	2222 630 084
R114	Res Carb F 100E 5% ½W	2120 101 46101	IC102	Intgrd Circt MHW709-2	9334 497 701
R116	Res Carb F 18k 5% ½W	2120 101 46183	D103	Diode M1407	9338 550 706
R121	Res Carb F 1K 5% ½W	2120 101 46102	D104	Diode MA858	9338 718 806
C114	Cap Mica 22pF 5% 250V	2022 751 00018	D105	Diode MA858	9338 718 806
C115	Cap Mica 27p 5% 250V	2022 751 00016	L105	Coil A/W Tx PA "U,T,W1"	3502 382 900
C118	Cap Mica 33p 5% 250V	2022 751 00015	L106	Choke Tx PA U Band	3502 389 903
C119	Cap Mica 47p 5% 250V	2022 751 00017	L108	Coil A/W Tx PA UHF	3502 382 900

6.3.2.3 Tx PA PC Board W1 Band (3502 349 81070)

	Tx PA Brd UHF Basic	3502 349 81000
	Heatsink PA Diode (x2)	3502 319 91070
	Coax ¼ Wave Line	3502 319 91500
R113	Res Carb F 100E 5% ¼W	2120 101 46101
R114	Res Carb F 100E 5% ¼W	2120 101 46101
R116	Res Carb F 22k 5% ¼W	2120 101 46223
R121	Res Carb F 1k 5% ¼W	2120 101 46102
C114	Cap Mica 22pF 5% 250V	2022 751 00018
C115	Cap Mica 22pF 5% 250V	2022 751 00018
C118	Cap Mica 33p 5% 250V	2022 751 00015
C119	Cap Mica 47p 5% 250V	2022 751 00017
C122	Cap Mica 6p8 5% 250V	2022 900 00095
C123	Cap Cer P1 4p7 p25 500V	2222 650 09478
C125	Cap Cer P1 470p 10% 100V	2222 630 08471
C127	Cap Cer P1 470p 10% 100V	2222 630 08471
IC102	Intgrd Circt MHW709-3	9334 497 80112
D103	Diode M1407	9338 550 70682
D104	Diode MA858	9338 718 80682
D105	Diode MA858	9338 718 80682
L105	Coil A/W Tx PA U,T,W1	3502 382 90010
L106	Choke Tx PA W1-W2 Bnd	3502 389 90330
L108	Coil A/W Tx PA UHF	3502 382 90030

6.3.2.4 Tx PA PC Board W2 Band (3502 349 81080)

	Tx PA Brd UHF Basic	3502 349 81000
	Heatsink PA Diode (x2)	3502 319 91070
	Coax ¼ Wave Line	3502 319 91500
R113	Res Carb F 100E 5% ¼W	2120 101 46101
R114	Res Carb F 100E 5% ¼W	2120 101 46101
R116	Res Carb F 22k 5% ¼W	2120 101 46223
R121	Res Carb F 1k 5% ¼W	2120 101 46102
C114	Cap Mica 22pF 5% 250V	2022 751 00018
C115	Cap Mica 22pF 5% 250V	2022 751 00018
C118	Cap Mica 27p 5% 250V	2022 751 00016
C119	Cap Mica 39p 5% 250V	2022 751 00019
C123	Cap Cer P1 4p7 p25 500V	2222 650 09478
C125	Cap Cer P1 470p 10% 100V	2222 630 08471
C127	Cap Cer P1 470p 10% 100V	2222 630 08471
IC102	Intgrd Circt MHW709-3	9334 497 80112
D103	Diode M1407	9338 550 70682
D104	Diode MA858	9338 718 80682
D105	Diode MA858	9338 718 80682
L105	Coil A/W Tx PA W2 L5	3502 382 90020
L106	Choke Tx PA W1-W2 bnd L7	3502 389 90330
L108	Coil A/W Tx PA UHF	3502 382 90030

6.3.2.5 Tx PA PC Board UHF Basic (3502 349 81000)

	PCB Tx PA 25W Basic	3502 309 81000
	Shield Aerial Filter	3502 319 91100
	Partition Aerial Filter	3502 319 91110
	Bead Ferrite	4332 020 34400
R101	Res Carb F 2k7 5% ¼W	2120 101 46272
R102	Pot Cermet 10k 10% 1W	2113 391 00507
R103	Res Carb F 1k0 5% ¼W	2120 101 46102
R104	Res Carb F 470k 5% ¼W	2120 101 46474
R105	Res Carb F 100E 5% ¼W	2120 101 46101
R106	Thermistor PTC 90C with Leads	2322 672 91004
R108	Res Carb F 10E 5% ¼W	2120 101 46109
R109	Res Carb F 10k 5% ¼W	2120 101 46103
R110	Res Carb F 10k 5% ¼W	2120 101 46103
R111	Res Carb F 33k 5% ¼W	2120 101 46333
R112	Res Carb F 4E7 5% ½W	2322 186 13478
R115	Res Carb F 10k 5% ¼W	2120 101 46103
R117	Res Carb F 68k 5% ¼W	2120 101 46683
R118	Res Carb F 10E 5% ¼W	2120 101 46109
R119	Res Carb F 3k3 5% ¼W	2120 101 46332
C101	Cap Cer D/M 100n 20% 50V X7R	2022 552 01750
C102	Cap Cer P1 470p 10% 100V	2222 630 08471
C103	Cap Cer P1 4n7 10% 100V	2222 630 08472
C104	Cap Elec S/Al 3u3 -20+40% 16V	2222 122 55338
C105	Cap Cer D/M 100n 20% 50V X7R	2022 552 01751
C106	Cap Elec S/AL 3u3 -20+40% 16V	2222 122 55338
C107	Cap Cer D/M 100n 20% 50V X7R	2022 552 01751
C108	Cap Cer P1 220p 10% 100V	2222 630 08221
C109	Cap Elec S/AL 3u3 -20+40% 16V	2222 122 55338
C110	Cap Cer P1 47p 2% 100V NPO	2222 632 10479
C111	Cap Trim Film H/T 1p8-10p 300V	2222 809 05002
C112	Cap Cer P1 220p 10% 100V	2222 630 08221
C113	Cap Cer P1 2p2 p25 100V NPO	2222 632 09228
C116	Cap Elec S/AL 4u7 -20+40% 25V	2222 122 56478
C117	Cap Cer P1 120p 2% 500V N750	2222 650 58121
C120	Cer D/M 100n 20% 50V X7R	2022 552 01751
C121	Cap Cer P1 2n2 10% 100V	2222 630 08222
C124	Cap Trim Film 3H/T 2p-9p 300V	2222 809 09002
C126	Cap Cer P1 120p 2% 500V N750	2222 650 58121
C128	Cap Cer P1 120p 2% 500V N750	2222 650 58121
C129	Cap Cer P1 1n0 10% 100V	2222 630 08102
C130	Cap Cer P1 4p7 p25 500V NPO	2222 650 09478
C131	Cap Cer P1 10p 2% 500V NPO	2222 650 10109
C132	Cap Cer P1 1p8 p25 500V NPO	2222 650 09188
C133	Cap Cer P1 10p 2% 500V NPO	2222 650 10109
C134	Cap Mica 5p6 5% 250V	2022 900 00094
C135	Cap Cer P1 2p2 p25 100V NPO	2222 632 09228
IC101	Intgrd Circt LM358N	9333 935 10112
TR101	Transistor BD945	9333 481 20112
TR102	Transistor MRF646	9333 928 70112
D101	Diode BZV46-2V0	9334 339 40112
D102	Diode 1N4148	9330 839 90112
D106	Diode 1N4148	9330 839 90112
L101	Choke RF 2.5turn 4B	4312 020 36700
L103	Coil A/W Tx PA UHF	3502 382 90000
L104	Choke RF 2.5turn 4B	4312 020 36700
L110	Coil A/W Tx PA UHF	3502 382 90040
L111	Coil A/W Tx PA UHF	3502 382 90050
L112	Coil A/W Tx PA UHF	3502 382 90060

6.4 RECEIVER PC BOARDS

6.4.1 VHF RECEIVER PC BOARDS

6.4.1.1 Receiver PC Board E-Band 25kHz (3502 349 72160)

	Rx Brd (Basic) VHF 25kHz	3502 349 72050	R239	Res Carb F 27k 5% ¼W	2120 101 46273
U201	F/End Module E Bnd 21.4MHz	3502 357 90210	R247	Res Carb F 1k5 5% ¼W	2120 101 46152
U202	Hybrid H9	3502 358 00140	R251	Res Carb F 1k5 5% ¼W	2120 101 46152
U203	VCO Module Assy 'E' (21.4MHz)	3502 357 90180	R263	Res Carb F 47k 5% ¼W	2120 101 46473
FL201	Xtal Filt. Mnlthic 21.4 21F15C	2722 172 90032	R264	Res Carb F 5k6 5% ¼W	2120 101 46562
FL202	Filter Cer. 455kHz CFW455D	2422 549 03635	C263	Cap Pest 6n8 10% 100V AMX	2020 300 85682
SK202	Pin Header 4P Molex M7812-4A	2422 021 98145	C265	Cap Pest 4n7 10% 100V AMX	2020 300 85472
			C277	Cap Pest 3n9 10% 100V AMX	2020 300 85392

6.4.1.2 Receiver PC Board E-Band 12.5kHz (3502 349 72360)

	Rx Brd (Basic) VHF 25kHz	3502 349 72050	R239	Res Carb F 68k 5% ¼W	2120 101 46683
U201	F/End Module E Bnd 21.4MHz	3502 357 90210	R247	Res Carb F 2k2 5% ¼W	2120 101 46222
U202	Hybrid H9	3502 358 00140	R251	Res Carb F 2k2 5% ¼W	2120 101 46222
U203	VCO Module Assy 'E' (21.4MHz)	3502 357 90180	R263	Res Carb F 27k 5% ¼W	2120 101 46273
FL201	Xtal Filt. Mnlthic 6P 21F7.5CK	2722 172 90037	R264	Res Carb F 2k7 5% ¼W	2120 101 46272
FL202	Filter Cer. 455kHz CFW455F	2422 549 03637	C263	Cap Pest 15n 10% 100V AMX	2020 300 85153
SK202	Pin Header 4P Molex M7812-4A	2422 021 98145	C265	Cap Pest 22n 10% 100V AMX	2020 300 85223
			C277	Cap Pest 15n 10% 100V AMX	2020 300 85153

6.4.1.3 Receiver PC Board B-Band 25kHz (3502 349 72170)

	Rx Brd (Basic) VHF 25kHz	3502 349 72050	R239	Res Carb F 27k 5% ¼W	2120 101 46273
U201	F/End Module B Bnd WDE z	3502 357 90340	R247	Res Carb F 1k5 5% ¼W	2120 101 46152
U202	Buffer B-Band Duplex H10E	3502 358 00670	R251	Res Carb F 1k5 5% ¼W	2120 101 46152
U203	VCO Module Assy B Bnd	3502 357 90350	R263	Res Carb F 47k 5% ¼W	2120 101 46473
FL201	Xtal Filt. Mnlthic 21.4 21F15C	2722 172 90032	R264	Res Carb F 5k6 5% ¼W	2120 101 46562
FL202	Filter Cer. 455kHz CFW455D	2422 549 03635	C263	Cap Pest 6n8 10% 100V AMX	2020 300 85682
SK202	Pin Header 4P Molex M7812-4A	2422 021 98145	C265	Cap Pest 4n7 10% 100V AMX	2020 300 85472
C208	Cap Cer Pl 33p 2% 100V NPO	2222 680 10339	C277	Cap Pest 3n9 10% 100V AMX	2020 300 85392

6.4.1.4 Receiver PC Board B-Band 12.5kHz (3502 349 72370)

	Rx Brd (Basic) VHF 25kHz	3502 349 72050	R239	Res Carb F 68k 5% ¼W	2120 101 46683
U201	F/End Module B Bnd	3502 357 90340	R247	Res Carb F 2k2 5% ¼W	2120 101 46222
U202	Buffer B-Band Duplex H10E	3502 358 00670	R251	Res Carb F 2k2 5% ¼W	2120 101 46222
U203	VCO Module Assy B Bnd	3502 357 90350	R263	Res Carb F 27k 5% ¼W	2120 101 46273
FL201	Xtal Filt. Mnlthic 6P 21F7.5CK	2722 172 90037	R264	Res Carb F 2k7 5% ¼W	2120 101 46272
FL202	Filter Cer. 455kHz CFW455F	2422 549 03637	C263	Cap Pest 15n 10% 100V AMX	2020 300 85153
SK202	Pin Header 4P Molex M7812-4A	2422 021 98145	C265	Cap Pest 22n 10% 100V AMX	2020 300 85223
C208	Cap Cer Pl 33p 2% 100V NPO	2222 680 10339	C277	Cap Pest 15n 10% 100V AMX	2020 300 85153

6.4.1.5 Receiver PC Board A-Band 25kHz (3502 349 72180)

	Rx Brd (Basic) VHF 25kHz	3502 349 72050	R239	Res Carb F 27k 5% ¼W	2120 101 46273
U201	F/End Module A Bnd WDE	3502 357 90030	R247	Res Carb F 1k5 5% ¼W	2120 101 46152
U202	Hybrid $H_1$0A	3502 358 00150	R251	Res Carb F 1k5 5% ¼W	2120 101 46152
U203	VCO Module Assy 'A' (21.4MHz)	3502 357 90190	R263	Res Carb F 47k 5% ¼W	2120 101 46473
FL201	Xtal Filt. Mnlthic 21.4 21F15C	2722 172 90032	R264	Res Carb F 5k6 5% ¼W	2120 101 46562
FL202	Filter Cer. 455kHz CFW455D	2422 549 03635	C263	Cap Pest 6n8 10% 100V AMX	2020 300 85682
SK202	Pin Header 4P Molex M7812-4A	2422 021 98145	C265	Cap Pest 4n7 10% 100V AMX	2020 300 85472
C208	Cap Cer Pl 33p 2% 100V NPO	2222 680 10339	C277	Cap Pest 3n9 10% 100V AMX	2020 300 85392

6.4.1.6 Receiver PC Board A-Band 12.5kHz (3502 349 72380)

	Rx Brd (Basic) Mk2	3502 349 72050	R239	Res Carb F 68k 5% ¼W	2120 101 46683
U201	F/End Module A Bnd WDE	3502 357 90030	R247	Res Carb F 2k2 5% ¼W	2120 101 46222
U202	Hybrid H10A	3502 358 00150	R251	Res Carb F 2k2 5% ¼W	2120 101 46222
U203	VCO Module Assy A Bnd	3502 357 90170	R263	Res Carb F 27k 5% ¼W	2120 101 46273
FL201	Xtal Filt. Mnlthic 6P 21F7.5CK	2722 172 90037	R264	Res Carb F 2k7 5% ¼W	2120 101 46272
FL202	Filter Cer. 455kHz CFW455F	2422 549 03637	C263	Cap Pest 15n 10% 100V AMX	2020 300 85153
SK202	Pin Header 4P Molex M7812-4A	2422 021 98145	C265	Cap Pest 22n 10% 100V AMX	2020 300 85223
C208	Cap Cer P1 33p 2% 100V NPO	2222 680 10339	C277	Cap Pest 15n 10% 100V AMX	2020 300 85153

6.4.1.7 Receiver PC Board (Basic) VHF (3502 349 72050)

	PCB Brd Rx Basic VHF	3502 309 72050	R245	Res Carb F 15k 5% ¼W	2120 101 46153
	Bracket TO-220 MTG	3502 319 92730	R246	Res Carb F 820E 5% ¼W	2120 101 46821
	Hinge Block LH	3502 319 90290	R249	Res Carb F 330k 5% ¼W	2120 101 46334
	Hinge Block RH	3502 319 90300	R250	Res Carb F 5k6 5% ¼W	2120 101 46562
	Jumper Assy 11-way AMP	2422 011 00775	R252	Res Carb F 4E7 5% ¼W	2120 101 46478
	Jumper Assy 11-way AMP	2422 011 00776	R253	Res Carb F 220E 5% ¼W	2120 101 46221
	Jumper Assy 7-Way AMP	2422 011 00777	R254	Res Carb F 1M5 5% ¼W	2120 101 46155
R201	Res Carb F 47k 5% ¼W	2120 101 46473	R255	Res Carb F 1k2 5% ¼W	2120 101 46122
R202	Res Carb F 100k 5% ¼W	2120 101 46104	R256	Res Carb F 10E 5% ¼W	2120 101 46109
R203	Res Carb F Ik0 5% ¼W	2120 101 46102	R257	Trim Pot Cermet 20k 30% Lin	2102 410 05018
R205	Res Carb F 100E 5% ¼W	2120 101 46101	R258	Trim Pot Cermet 2k0 30% Lin	2102 410 05022
R206	Res Carb F Ik5 5% ¼W	2120 101 46152	R259	Res Carb F 33k 5% ¼W	2120 101 46333
R207	Res Carb F 47E 5% ¼W	2120 101 46479	R260	Res Carb F 180k 5% ¼W	2120 101 46184
R208	Res Carb F 22k 5% ¼W	2120 101 46223	R261	Res Carb F 33k 5% ¼W	2120 101 46333
R210	Res Carb F 1E0 5% ¼W	2120 101 46108	R262	Res Carb F 10E 5% ¼W	2120 101 46109
R211	Res Carb F 10k 5% ¼W	2120 101 46103	R265	Res Carb F 220k 5% ¼W	2120 101 46224
R212	Res Carb F 1k2 5% ¼W	2120 101 46122	R266	Res Metal F 47k 1% 0.6W MRS25	2322 156 14703
R213	Res Carb F 1E0 5% ¼W	2120 101 46108	R267	Res Metal F 220k 1% 0.6W MRS25	2322 156 12204
R214	Res Carb F 1E0 5% ¼W	2120 101 46108	R268	Res Metal F 27k 1% 0.6W MRS25	2322 156 12703
R215	Res Carb F 15k 5% ¼W	2120 101 46153	R269	Res Metal F 39k 1% 0.6W MRS25	2322 156 13903
R216	Res Carb F 4k7 5% ¼W	2120 101 46472	R270	Res Carb F 6k8 5% ¼W	2120 101 46682
R217	Res Carb F 1k5 5% ¼W	2120 101 46152	R271	Res Metal F 82k 1% 0.6W MRS25	2322 156 18203
R218	Res Carb F 1k5 5% ¼W	2120 101 46152	R272	Res Metal F 27k 1% 0.6W MRS25	2322 156 12703
R219	Res Carb F 150E 5% ¼W	2120 101 46151	R273	Res Metal F 47k 1% 0.6W MRS25	2322 156 14703
R220	Res Carb F 270E 5% ¼W	2120 101 46271	R274	Res Metal F 220k 1% 0.6W MRS25	2322 156 12204
R221	Res Carb F 820E 5% ¼W	2120 101 46821	R275	Res Metal F 82k 1% 0.6W MRS25	2322 156 18203
R222	Res Carb F 1k8 5% ¼W	2120 101 46182	R276	Res Carb F 10k 5% ¼W	2120 101 46103
R223	Res Carb F 15k 5% ¼W	2120 101 46153	R277	Res Carb F 18k 5% ¼W	2120 101 46183
R224	Res Carb F 47E 5% ¼W	2120 101 46479	R278	Res Carb F 10E 5% ¼W	2120 101 46109
R225	Res Carb F 470E 5% ¼W	2120 101 46471	R279	Res Metal F 22k 1% 0.6W MRS25	2322 156 12203
R226	Res Carb F 330E 5% ¼W	2120 101 46331	R280	Res Carb F 56k 5% ¼W	2120 101 46563
R227	Res Carb F 270k 5% ¼W	2120 101 46274	R281	Res Carb F 56k 5% ¼W	2120 101 46563
R229	Res Carb F 56E 5% ¼W	2120 101 46569	R282	Res Carb F 47k 5% ¼W	2120 101 46473
R231	Res Carb F 22k 5% ¼W	2120 101 46223	R283	Res Carb F 220k 5% ¼W	2120 101 46224
R233	Res Carb F 10k 5% ¼W	2120 101 46103	R284	Res Carb F 22k 5% ¼W	2120 101 46223
R234	Res Carb F 10k 5% ¼W	2120 101 46103	R285	Res Carb F 15k 5% ¼W	2120 101 46153
R235	Res Carb F 1E0 5% ¼W	2120 101 46108	R286	Res Carb F 220k 5% ¼W	2120 101 46224
R236	Res Carb F 470E 5% ¼W	2120 101 46471	R288	Thermistor NTC 470E 10% 0.5W	2322 642 62471
R237	Res Carb F 1k0 5% ¼W	2120 101 46102	R289	Thermistor NTC 100k 10% 0.6W	2322 642 62104
R238	Res Carb F 560E 5% ¼W	2120 101 46561	R290	Res Carb F 82k 5% ¼W	2120 101 46823
R240	Res Carb F 470E 5% ¼W	2120 101 46471	R291	Res Carb F 10k 5% ¼W	2120 101 46103
R241	Res Carb F 22k 5% ¼W	2120 101 46223	R292	Res Carb F 390E 5% ¼W	2120 101 46391
R242	Res Carb F 47k 5% ¼W	2120 101 46473	R293	Res Carb F 2k2 5% ¼W	2120 101 46222
R243	Res Carb F 10k 5% ¼W	2120 101 46103	R294	Res Carb F 2k2 5% ¼W	2120 101 46222
R244	Res Carb F 56k 5% ¼W	2120 101 46563			

6.4.1.7 Receiver PC Board (Basic) VHF (3502 349 72050) (Cont'd)

C200	Cap Con/Ml Cer 10n 10% 50V X7R	2022 552 02495
C201	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C202	Cap Tant 22u 20% 16V	2020 004 90041
C203	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02482
C204	Cap Tant 22u 20% 16V	2020 004 90041
C206	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02482
C207	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02482
C209	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C210	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C211	Cap Al Elec 47u -10+50% 25V	2222 035 56479
C212	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C213	Cap Al Elec 100u -10+50% 25V	2222 035 56101
C215	Cap Al Elec 47u -10+50% 25V	2222 035 56479
C216	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C218	Cap Al Elec 10u -10+50% 50V	2222 035 90008
C219	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C220	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C221	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C222	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C223	Cap Al Elec 100u -10+50% 25V	2222 035 56101
C224	Cer Cer D/M 100n 20% 50V Z5U	2022 552 02482
C225	Cap Pcar 100n 10% 100V	2222 344 21104
C226	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C228	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C230	Cap Cer Pl 33p 2% 100V NPO	2222 680 10339
C231	Cap Pcar 100n 10% 100V	2222 344 21104
C232	Cap Cer Pl 22p 2% 100V NPO	2222 680 10229
C233	Cap Cer Pl 120p 2% 100V N750	2222 680 58121
C234	Cap Cer Pl 82p 2% 100V NPO	2222 680 10829
C235	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C236	Cap Al Elec 4u7 -10+50% 63V	2222 035 58478
C237	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C238	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C239	Cap Al Elec 47u -10+50% 25V	2222 035 56479
C240	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C241	Cap Cer Pl 68p 2% 100V NPO	2222 680 10689
C242	Cap Cer Pl 10p 2% 100V NPO	2222 680 10109
C243	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C244	Cap Al Elec 47u -10+50% 25V	2222 035 56479
C245	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C246	Cap Al Elec 10u -10+50% 50V	2222 035 90008
C247	Cap Pcar 100n 10% 100V	2222 344 21104
C248	Cap Pest 1n5 10% 100V AMX	2020 300 85152
C249	Cap Al Elec 1u -10+50% 100V	2222 035 59108
C250	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C251	Cap Pcar 100n 10% 100V	2222 344 21104
C252	Cap Al Elec 47u -10+50% 25V	2222 035 56479
C253	Cap Pcar 100n 10% 100V	2222 344 21104
C254	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C255	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C256	Cap Al Elec 33u -10+50% 16V	2222 035 55339
C257	Cap Cer Pl 10p 2% 100V NPO	2222 680 10109
C258	Cap Con/Ml Cer 220n 10% 50V	2022 552 02379
C259	Cap Con/Ml Cer 220 10% 50V	2022 552 02379
C260	Cap Pcar 100n 10% 100V	2222 344 21104
C261	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C262	Cap Al Elec 47u -10+50% 25V	2222 035 56479
C264	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C266	Cap Al Elec 470u -10+50% 16V	2222 031 35471
C267	Cap Al Elec 470u -10+50% 16V	2222 031 35471
C268	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C269	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C270	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C271	Cap Con/Ml Cer 220n 10% 50V	2022 552 02379
C272	Cap Cer Pl 150p 2% 100V N750	2222 680 58151
C273	Cap Cer Pl 8p2 p25 100V NPO	2222 680 09828
C274	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C275	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C276	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C278	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C279	Cap Pest Stkd 10n 5% 100V	2011 301 40251
C280	Cap Pest Stkd 10n 5% 100V	2011 301 40251
C281	Cap Al Elec 10u -10+50% 50V	2222 035 90008
C282	Cap Con/Ml Cer 220n 10% 50V	2022 552 02379
C283	Cap Cer Dp/Ml 3n3 5% 50V NPO	2011 557 25591
C284	Cap Cer Dp/Ml 3n3 5% 50V NPO	2011 557 25591
C285	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C286	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C287	Cap Al Elec 10u -10+50% 50V	2222 035 90008
C288	Cap Pest Stkd 10n 5% 100V	2011 301 40251
C289	Cap Cer Pl 470p 10% 100V	2222 630 08471
C290	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C291	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C292	Cap Cer Pl 150p 2% 100V N750	2222 680 58151
C293	Cap Pest 10n 10% 100V	2020 300 85103
C294	Cap Al Elec 4u7 -10+50% 25V	2222 035 56478
C298	Cap Al Elec 4u7 -10+50% 25V	2222 035 56478
TR201	Transistor BC548C	9331 976 70112
TR202	Transistor BC337	9331 492 00112
TR203	Transistor BC328	9331 491 90112
TR204	Transistor BC548C	9331 976 70112
TR205	Transistor BC328	9331 491 90112
TR206	Transistor BD946	9334 481 30112
TR207	Transistor BC548C	9331 976 70112
TR208	Transistor BC328	9331 491 90112
TR209	Transistor BF256B	9331 905 30112
TR211	Transistor BF494	9331 987 70112
TR212	Transistor BD945	9334 481 20112
TR213	Transistor BC548C	9331 976 70112
TR214	Transistor BC548C	9331 976 70112
TR215	Transistor BF494	9331 987 70112
D201	Diode 1N4148	9330 839 90112
D202	Diode 1N4148	9330 839 90112
D203	Diode BZT03-C20	9336 015 80112
D204	Diode 1N4148	9330 839 90112
D205	Diode 1N4148	9330 839 90112
D206	Diode 1N4148	9330 839 90112
D207	Diode BZX79-C10	9331 177 90112
D208	Diode BZX79-C6V8	9331 177 50112
D209	Diode 1N4148	9330 839 90112
D210	Diode 1N4148	9330 839 90112
D211	Diode 1N4148	9330 839 90112
D212	Diode 1N4148	9330 839 90112

6.4.1.7 Receiver PC Board (Basic) VHF (3502 349 72050) (cont'd)

IC201	Intgrd Circt OM815	3502 319 91350		L201	Choke Wide Band RF	4312 020 36640	
IC202	Intgrd Circt SL6652DG-20	9338 300 40682		L203	Choke Sub-Min HF 0.15uH	3522 020 61930	
IC203	Intgrd Circt TDA1010	9333 849 50112		L205	Choke RF 1.5uH 10% DL1025-24	2422 535 98002	
IC204	Intgrd Circt MC34082P	9338 734 30682		L206	Coil, Disdr, Toko RMC-2A6597HM	2422 549 18111	
IC205	Intgrd Circt LM348N	9333 705 60682		L207	Choke 6.8mH EL0607SK1-682J	2422 535 97062	
RL201	Relay, Min 10Amp 12V	2402 132 00015		L208	Choke RF 0.33uH 10% DL1025-08	2422 535 98001	
XL201	Crystal 20.94MHz 2nd L.Osc	3502 413 48410					

6.4.2 UHF RECEIVER PC BOARDS

6.4.2.1 Receiver PC Board T-Band 25kHz (3502 349 82110)

	Rx Brd UHF 25kHz Basic	3502 349 82090		C204	Cap Cer Pl 1n0 10% 100V	2222 630 08102	
U201	Front-End Module Assy 'T' Wde	3502 357 90050		C263	Cap Pest 6n8 10% 100V AMX	2020 300 85682	
U202	Hybrid H12	3502 358 00190		C265	Cap Pest 4n7 10% 100V AMX	2020 300 85472	
U203	VCO Module Assy 'T'	3502 357 90120		C277	Cap Pest 3n9 10% 100V AMX	2020 300 85392	
R239	Res Carb F 27k 5% ¼W	2120 101 46273		FL201	Xtal Filt Mnlthic 21.4(21F15C)	2722 172 90032	
R247	Res Carb F 1k5 5% ¼W	2120 101 46152		FL202	Filter Cer. 455kHz CFW455D	2422 549 03635	
R251	Res Carb F 1k5 5% ¼W	2120 101 46152		L202	Choke 6.8uH 10% AXL 070-23	2422 535 97559	
R263	Res Carb F 82k 5% ¼W	2120 101 46823		L203	Coil Assy Rx Mixer Input	3502 389 90410	
R264	Res Carb F 6k8 5% ¼W	2120 101 46682		SK202	Pin Header 4P Molex M7812-4A	2422 021 98145	

6.4.2.2 Receiver PC Board U-Band 25kHz (3502 349 82120)

	Rx Brd UHF 25kHz Basic	3502 349 82090		C204	Cap Cer Pl 1n0 10% 100V	2222 630 08102	
U201	Front-End Module Assy 'U' Wde	3502 357 90070		C263	Cap Pest 6n8 10% 100V AMX	2020 300 85682	
U202	Hybrid H12	3502 358 00190		C265	Cap Pest 4n7 10% 100V AMX	2020 300 85472	
U203	VCO Module Assy 'U'	3502 357 90130		C277	Cap Pest 3n9 10% 100V AMX	2020 300 85392	
R239	Res Carb F 27k 5% ¼W	2120 101 46273		FL201	Xtal Filt Mnlthic 21.4(21F15C)	2722 172 90032	
R247	Res Carb F 1k5 5% ¼W	2120 101 46152		FL202	Filter Cer. 455kHz CFW455D	2422 549 03635	
R251	Res Carb F 1k5 5% ¼W	2120 101 46152		L202	Choke 6.8uH 10% AXL 070-23	2422 535 97559	
R263	Res Carb F 82k 5% ¼W	2120 101 46823		L203	Coil Assy Rx Mixer Input	3502 389 90410	
R264	Res Carb F 6k8 5% ¼W	2120 101 46682		SK202	Pin Header 4P Molex M7812-4A	2422 021 98145	

6.4.2.3 Receiver PC Board W1 Band 25kHz (3502 349 82130)

	Rx Brd UHF 25kHz Basic	3502 349 82090		C204	Cap Cer Pl 1n0 10% 100V	2222 630 08102	
U201	Front-End Module Assy 'W' Wde	3502 357 90080		C263	Cap Pest 6n8 10% 100V AMX	2020 300 85682	
U202	Hybrid H12B Buffer Duplex	3502 358 00620		C265	Cap Pest 4n7 10% 100V AMX	2020 300 85472	
U203	VCO Module Assy 'W'	3502 357 90140		C277	Cap Pest 3n9 10% 100V AMX	2020 300 85392	
R239	Res Carb F 27k 5% ¼W	2120 101 46273		FL201	Xtal Filt Mnlthic 21.4(21F15C)	2722 172 90032	
R247	Res Carb F 1k5 5% ¼W	2120 101 46152		FL202	Filter Cer. 455kHz CFW455D	2422 549 03635	
R251	Res Carb F 1k5 5% ¼W	2120 101 46152		L202	Choke 6.8uH 10% AXL 070-23	2422 535 97559	
R263	Res Carb F 82k 5% ¼W	2120 101 46823		L203	Coil Assy Rx Mixer Input	3502 389 90410	
R264	Res Carb F 6k8 5% ¼W	2120 101 46682		SK202	Pin Header 4P Molex M7812-4A	2422 021 98145	

6.4.2.4 Receiver PC Board W2 Band 25kHz (3502 349 82140)

	Rx Brd UHF 25kHz Basic	3502 349 82090		R264	Res Carb F 6k8 5% ¼W	2120 101 46682	
U201	Front-End Module Assy 'W2' Wde	3502 357 90230		C204	Cap Cer Pl 1n0 10% 100V	2222 630 08102	
U203	Hybrid H12B Buffer Duplex	3502 358 00620		C263	Cap Pest 6n8 10% 100V AMX	2020 300 85682	
U204	VCO Module Assy 'W2'	3502 357 90150		C265	Cap Pest 4n7 10% 100V AMX	2020 300 85472	
R204	Res Carb F 10E 5% ¼W	2120 101 46109		C277	Cap Pest 3n9 10% 100V AMX	2020 300 85392	
R239	Res Carb F 27k 5% ¼W	2120 101 46273		FL201	Xtal Filt Mnlthic 21.4(21F15C)	2722 172 90032	
R247	Res Carb F 1k5 5% ¼W	2120 101 46152		FL202	Filter Cer. 455kHz CFW455D	2422 549 03635	
R251	Res Carb F 1k5 5% ¼W	2120 101 46152		L203	Coil L201 Rx PCB W2	3502 389 90470	
R263	Res Carb F 82k 5% ¼W	2120 101 46823		SK202	Pin Header 4P Molex M7812-4A	2422 021 98145	

6.4.2.5 Receiver PC Board T Band 12.5kHz (3502 349 82410)

	Rx Brd UHF 25kHz Basic	3502 349 82090	C204	Cap Cer Pl 1n0 10% 100V	2222 630 08102
U201	Front-End Module Assy 'T' Wde	3502 357 90050	C263	Cap Pest 15n 10% 100V AMX	2020 300 85153
U202	Hybrid H12	3502 358 00190	C265	Cap Pest 22n 10% 100V AMX	2020 300 85223
U203	VCO Module Assy 'T'	3502 357 90120	C277	Cap Pest 15n 10% 100V AMX	2020 300 85153
R239	Res Carb F 68k 5% ¼W	2120 101 46683	FL201	Xtal Filt Mnlthic 6P (21F7.5C)	2722 172 90037
R247	Res Carb F 2k2 5% ¼W	2120 101 46222	FL202	Filter Cer. 455kHz CFW455F	2422 549 03637
R512	Res Carb F 2k2 5% ¼W	2120 101 46222	L202	Choke 6.8uH 10% AXL 070-23	2422 535 97559
R263	Res Carb F 27k 5% ¼W	2120 101 46273	L203	Coil Assy Rx Mixer Input	3502 389 90410
R264	Res Carb F 2k7 5% ¼W	2120 101 46272	SK202	Pin Header 4P Molex M7812-4A	2422 021 98145

6.4.2.6 Receiver PC Board U Band 12.5kHz (3502 349 82420)

	Rx Brd UHF 25kHz Basic	3502 349 82090	C204	Cap Cer Pl 1n0 10% 100V	2222 630 08102
U201	Front-End Module Assy 'U' Wde	3502 357 90070	C263	Cap Pest 15n 10% 100V AMX	2020 300 85153
U202	Hybrid H12	3502 358 00190	C265	Cap Pest 22n 10% 100V AMX	2020 300 85223
U203	VCO Module Assy 'U'	3502 357 90130	C277	Cap Pest 15n 10% 100V AMX	2020 300 85153
R239	Res Carb F 68k 5% ¼W	2120 101 46683	FL201	Xtal Filt Mnlthic 6P (21F7.5C)	2722 172 90037
R247	Res Carb F 2k2 5% ¼W	2120 101 46222	FL202	Filter Cer. 455kHz CFW455F	2422 549 03637
R512	Res Carb F 2k2 5% ¼W	2120 101 46222	L202	Choke 6.8uH 10% AXL 070-23	2422 535 97559
R263	Res Carb F 27k 5% ¼W	2120 101 46273	L203	Coil Assy Rx Mixer Input	3502 389 90410
R264	Res Carb F 2k7 5% ¼W	2120 101 46272	SK202	Pin Header 4P Molex M7812-4A	2422 021 98145

6.4.2.7 Receiver PC Board W Band 12.5kHz (3502 349 82430)

	Rx Brd UHF 25kHz Basic	3502 349 82090	C204	Cap Cer Pl 1n0 10% 100V	2222 630 08102
U201	Front-End Module Assy 'W1' Wde	3502 357 90080	C263	Cap Pest 15n 10% 100V AMX	2020 300 85153
U202	Hybrid H12B Buffer Duplex	3502 358 00620	C265	Cap Pest 22n 10% 100V AMX	2020 300 85223
U203	VCO Module Assy 'W'	3502 357 90140	C277	Cap Pest 15n 10% 100V AMX	2020 300 85153
R239	Res Carb F 68k 5% ¼W	2120 101 46683	FL201	Xtal Filt Mnlthic 6P (21F7.5C)	2722 172 90037
R247	Res Carb F 2k2 5% ¼W	2120 101 46222	FL202	Filter Cer. 455kHz CFW455F	2422 549 03637
R512	Res Carb F 2k2 5% ¼W	2120 101 46222	L202	Choke 6.8uH 10% AXL 070-23	2422 535 97559
R263	Res Carb F 27k 5% ¼W	2120 101 46273	L203	Coil Assy Rx Mixer Input	3502 389 90410
R264	Res Carb F 2k7 5% ¼W	2120 101 46272	SK202	Pin Header 4P Molex M7812-4A	2422 021 98145

6.4.2.8 Receiver PC Board W2 Band 12.5kHz (3502 349 82440)

	Rx Brd UHF 25kHz Basic	3502 349 82090	R264	Res Carb F 2k7 5% ¼W	2120 101 46272
U201	Front-End Module Assy 'W2' Wde	3502 357 90230	C204	Cap Cer Pl 1n0 10% 100V	2222 630 08102
U202	Hybrid H12B Buffer Duplex	3502 358 00620	C263	Cap Pest 15n 10% 100V AMX	2020 300 85153
U203	VCO Module Assy 'W2'	3502 357 90150	C265	Cap Pest 22n 10% 100V AMX	2020 300 85223
R204	Res Carb F 10E 5% ¼W	2120 101 46109	C277	Cap Pest 15n 10% 100V AMX	2020 300 85153
R239	Res Carb F 68k 5% ¼W	2120 101 46683	FL201	Xtal Filt Mnlthic 6P (21F7.5C)	2722 172 90037
R247	Res Carb F 2k2 5% ¼W	2120 101 46222	FL202	Filter Cer. 455kHz CFW455F	2422 549 03637
R512	Res Carb F 2k2 5% ¼W	2120 101 46222	L203	Coil L201 Rx PCB W2	3502 389 90470
R263	Res Carb F 27k 5% ¼W	2120 101 46273	SK202	Pin Header 4P Molex M7812-4A	2422 021 98145

6.4.2.9 Receiver PC Board Basic (UHF) (3502 349 82090)

PCB Rx UHF 25KHz	3502 309 82090	R201	Res Carb F 47k 5% ¼W	2120 101 46473
Bracket TO-220 MTG	3502 319 92730	R202	Res Carb F 100k 5% ¼W	2120 101 46104
Hinge Block LH	3502 319 90290	R203	Res Carb F 1k0 5% ¼W	2120 101 46102
Hinge Block RH	3502 319 90300	R205	Res Carb F 100E 5% ¼W	2120 101 46101
Insulator Rx VCO	3502 319 94370	R206	Res Carb F 1k5 5% ¼W	2120 101 46152
Jumper Assy 11-way AMP	2422 011 00775	R207	Res Carb F 47E 5% ¼W	2120 101 46479
Jumper Assy 11-way AMP	2422 011 00776	R208	Res Carb F 22k 5% ¼W	2120 101 46223
Jumper Assy 7-way AMP	2422 011 00777	R209	Res Carb F 10E 5% ¼W	2120 101 46109

6.4.2.9 **Receiver PC Board (Basic) UHF (3502 349 82090)** (Cont'd)

R210	Res Carb F 1E0 5% ¼W	2120 101 46108	R268	Res Metal F 27k 1% 0.6W MRS25	2322 156 12703
R211	Res Carb F 10k 5% ¼W	2120 101 46103	R269	Res Metal F 39k 1% 0.6W MRS25	2322 156 13903
R212	Res Carb F 1k2 5% ¼W	2120 101 46122	R270	Res Carb F 6k8 5% ¼W	2120 101 46682
R213	Res Carb F 1E0 5% ¼W	2120 101 46108	R271	Res Metal F 82k 1% 0.6W MRS25	2322 156 18203
R214	Res Carb F 1E0 5% ¼W	2120 101 46108	R272	Res Metal F 27k 1% 0.6W MRS25	2322 156 12703
R215	Res Carb F 15k 5% ¼W	2120 101 46153	R273	Res Metal F 47k 1% 0.6W MRS25	2322 156 14703
R217	Res Carb F 1k5 5% ¼W	2120 101 46152	R274	Res Metal F 220k 1% 0.6W MRS25	2322 156 12204
R218	Res Carb F 1k5 5% ¼W	2120 101 46152	R275	Res Metal F 82k 1% 0.6W MRS25	2322 156 18203
R219	Res Carb F 1k0 5% ¼W	2120 101 46102	R276	Res Carb F 10k 5% ¼W	2120 101 46103
R220	Res Carb F 270E 5% ¼W	2120 101 46271	R277	Res Carb F 18k 5% ¼W	2120 101 46183
R217	Res Carb F 1k5 5% ¼W	2120 101 46152	R278	Res Carb F 10E 5% ¼W	2120 101 46109
R218	Res Carb F 1k5 5% ¼W	2120 101 46152	R279	Res Metal F 22k 1% 0.6W MRS25	2322 156 12203
R219	Res Carb F 1k0 5% ¼W	2120 101 46102	R280	Res Carb F 56k 5% ¼W	2120 101 46563
R220	Res Carb F 270E 5% ¼W	2120 101 46271	R281	Res Carb F 56k 5% ¼W	2120 101 46563
R221	Res Carb F 820E 5% ¼W	2120 101 46821	R282	Res Carb F 47k 5% ¼W	2120 101 46473
R222	Res Carb F 1k8 5% ¼W	2120 101 46182	R283	Res Carb F 220k 5% ¼W	2120 101 46224
R223	Res Carb F 15k 5% ¼W	2120 101 46153	R284	Res Carb F 22k 5% ¼W	2120 101 46223
R224	Res Carb F 47E 5% ¼W	2120 101 46479	R285	Res Carb F 15k 5% ¼W	2120 101 46153
R225	Res Carb F 470E 5% ¼W	2120 101 46471	R286	Res Carb F 220k 5% ¼W	2120 101 46224
R226	Res Carb F 330E 5% ¼W	2120 101 46331	R289	Thermistor NTC 100k 10% 0.6W	2322 642 62104
R227	Res Carb F 180k 5% ¼W	2120 101 46184	R290	Res Carb F 82k 5% ¼W	2120 101 46823
R228	Res Carb F 220E 5% ¼W	2120 101 46221	R291	Res Carb F 10k 5% ¼W	2120 101 46103
R229	Res Carb F 56E 5% ¼W	2120 101 46569	R292	Res Carb F 100E 5% ¼W	2120 101 46101
R230	Res Carb F 3k9 5% ¼W	2120 101 46392	R293	Res Carb F 2k2 5% ¼W	2120 101 46222
R231	Res Carb F 22k 5% ¼W	2120 101 46223	R294	Res Carb F 2k2 5% ¼W	2120 101 46222
R232	Res Carb F 6k8 5% ¼W	2120 101 46682	C200	Cap Con/Ml Cer 10n 10% 50V X7R	2022 552 02495
R233	Res Carb F 10k 5% ¼W	2120 101 46103	C201	Cap Cer Pl 1n0 10% 100V	2222 630 08102
R234	Res Carb F 10k 5% ¼W	2120 101 46103	C202	Cap Cer Pl 1n0 10% 100V	2222 630 08102
R235	Res Carb F 1E0 5% ¼W	2120 101 46108	C203	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02482
R236	Res Carb F 470E 5% ¼W	2120 101 46471	C205	Cap Cer Pl 1n0 10% 100V	2222 630 08102
R237	Res Carb F 1k0 5% ¼W	2120 101 46471	C206	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02482
R238	Res Carb F 560E 5% ¼W	2120 101 46561	C207	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02482
R240	Res Carb F 470E 5% ¼W	2120 101 46471	C208	Cap Cer Pl 33p 2% 100V NPO	2222 680 10339
R241	Res Carb F 22k 5% ¼W	2120 101 46223	C209	Cap Cer Pl 4n7 10% 100V	2222 630 08472
R242	Res Carb F 47k 5% ¼W	2120 101 46473	C210	Cap Cer Pl 4n7 10% 100V	2222 630 08472
R243	Res Carb F 10k 5% ¼W	2120 101 46103	C211	Cap Al Elec 47u -10+50% 25V	2222 035 56479
R244	Res Carb F 56k 5% ¼W	2120 101 46563	C212	Cap Cer Pl 4n7 10% 100V	2222 630 08472
R245	Res Carb F 15k 5% ¼W	2120 101 46153	C213	Cap Al Elec 100u -10+50% 25V	2222 035 56101
R246	Res Carb F 820E 5% ¼W	2120 101 46821	C214	Cap Cer Pl 4n7 10% 100V	2222 630 08472
R249	Res Carb F 330k 5% ¼W	2120 101 46334	C215	Cap Al Elec 47u -10+50% 25V	2222 035 56479
R250	Res Carb F 5k6 5% ¼W	2120 101 46562	C216	Cap Cer Pl 1n0 10% 100V	2222 630 08102
R252	Res Carb F 4E7 5% ¼W	2120 101 46478	C217	Cap Al Elec 22u -10+50% 50V	2222 035 90003
R253	Res Carb F 220E 5% ¼W	2120 101 46221	C218	Cap Al Elec 10u -10+50% 50V	2222 035 90008
R254	Res Carb F 1M5 5% ¼W	2120 101 46155	C219	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
R255	Res Carb F 1k2 5% ¼W	2120 101 46122	C220	Cap Cer Pl 1n0 10% 100V	2222 630 08102
R256	Res Carb F 10E 5% ¼W	2120 101 46109	C221	Cap Cer Pl 1n0 10% 100V	2222 630 08102
R257	Trim Pot Cermet 20k 30% Lin	2102 410 05018	C222	Cap Cer Pl 4n7 10% 100V	2222 630 08472
R258	Trim Pot Cermet 2k0 30% Lin	2102 410 05022	C223	Cap Al Elec 100u -10+50% 25V	2222 035 56101
R259	Res Carb F 33k 5% ¼W	2120 101 46333	C224	Cap Cer Pl 4n7 10% 100V	2222 630 08472
R260	Res Carb F 180k 5% ¼W	2120 101 46184	C225	Cap Pcar 100n 10% 100V	2222 344 21104
R261	Res Carb F 33k 5% ¼W	2120 101 46333	C226	Cap Cer Pl 1n0 10% 100V	2222 630 08102
R262	Res Carb F 10E 5% ¼W	2120 101 46109	C227	Cap Cer Pl 22n 20% 50V X7R	2022 552 02019
R263	Res Carb F 6k8 5% ¼W	2120 101 46682	C228	Cap Cer Pl 4n7 10% 100V	2222 630 08472
R265	Res Carb F 220k 5% ¼W	2120 101 46224	C229	Cap Al Elec 47u -10+50% 25V	2222 035 56479
R266	Res Metal F 47k 1% 0.6W MRS25	2322 156 14703	C230	Cap Cer Pl 33p 2% 100V NPO	2222 680 10339
R267	Res Metal F 220k 1% 0.6W MRS25	2322 156 12204	C231	Cap Pcar 100n 10% 100V	2222 344 21104

6.4.2.9 Receiver PC Board (Basic) UHF (3502 349 82090) (Cont'd)

C232	Cap Cer Pl 27p 2% 100V NPO	2222 680 10279
C233	Cap Cer Pl 120p 2% 100V N750	2222 680 58121
C234	Cap Cer Pl 82p 2% 100V NPO	2222 680 10829
C235	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C236	Cap Al Elec 4u7 -10+50% 63V	2222 035 58478
C237	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C238	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C239	Cap Al Elec 47u -10+50% 25V	2222 035 56479
C240	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C241	Cap Cer Pl 68p 2% 100V NPO	2222 680 10689
C242	Cap Cer Pl 10p 2% 100V NPO	2222 680 10109
C243	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C244	Cap Al Elec 47u -10+50% 25V	2222 035 56479
C245	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C246	Cap Al Elec 10u -10+50% 50V	2222 035 90008
C247	Cap Pcar 100n 10% 100V	2222 344 21104
C248	Cap Pest 1n5 10% 100V AMX	2020 300 85152
C249	Cap Al Elec 1u -10+50% 100V	2222 035 59108
C250	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C251	Cap Pcar 100n 10% 100V	2222 344 21104
C252	Cap Al Elec 47u -10+50% 25V	2222 035 56479
C253	Cap Pcar 100n 10% 100V	2222 344 21104
C254	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C255	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C256	Cap Al Elec 33u -10+50% 16V	2222 035 55339
C257	Cap Cer Pl 10p 2% 100V NPO	2222 680 10109
C258	Cap Con/Ml Cer 220n 10% 50V	2022 552 02379
C259	Cap Con/Ml Cer 220 10% 50V	2022 552 02379
C260	Cap Pcar 100n 10% 100V	2222 344 21104
C261	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C262	Cap Al Elec 47u -10+50% 25V	2222 035 56479
C264	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C266	Cap Al Elec 470u -10+50% 16V	2222 031 35471
C267	Cap Al Elec 470u -10+50% 16V	2222 031 35471
C268	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C269	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C270	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C271	Cap Con/Ml Cer 220n 10% 50V	2022 552 02379
C272	Cap Cer Pl 150p 2% 100V N750	2222 680 58151
C273	Cap Cer Pl 8p2 p25 100V NPO	2222 680 09828
C274	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C275	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C276	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C278	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C279	Cap Pest Stkd 10n 5% 100V	2011 301 40251
C280	Cap Pest Stkd 10n 5% 100V	2011 301 40251
C281	Cap Al Elec 10u -10+50% 50V	2222 035 90008
C282	Cap Con/Ml Cer 220n 10% 50V	2022 552 02379
C283	Cap Cer Dp/Ml 3n3 5% 50V NPO	2011 557 25591
C284	Cap Cer Dp/Ml 3n3 5% 50V NPO	2011 557 25591
C285	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C286	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C287	Cap Al Elec 10u -10+50% 50V	2222 035 90008
C288	Cap Pest Stkd 10n 5% 100V	2011 301 40251
C289	Cap Cer Pl 470p 10% 100V	2222 630 08471
C290	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C291	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C292	Cap Cer Pl 150p 2% 100V N750	2222 680 58151
C293	Cap Pest 10n 10% 100V	2020 300 85103
C294	Cap Al Elec 4u7 -10+50% 25V	2222 035 56478
C298	Cap Al Elec 4u7 -10+50% 25V	2222 035 56478
C299	Cap Cer Pl 1n0 10% 100V	2222 630 08102
TR201	Transistor BC548C	9331 976 70112
TR202	Transistor BC337	9331 492 00112
TR203	Transistor BC328	9331 491 90112
TR204	Transistor BC548C	9331 976 70112
TR205	Transistor BC328	9331 491 90112
TR206	Transistor BD946	9334 481 30112
TR207	Transistor BC548C	9331 976 70112
TR208	Transistor BC328	9331 491 90112
TR209	Transistor BF256B	9331 905 30112
TR210	Transistor BD946	9334 481 30112
TR211	Transistor BF494	9331 987 70112
TR212	Transistor BD945	9334 481 20112
TR213	Transistor BC548C	9331 976 70112
TR214	Transistor BC548C	9331 976 70112
TR215	Transistor BF494	9331 987 70112
D201	Diode 1N4148	9330 839 90112
D202	Diode 1N4148	9330 839 90112
D203	Diode BZT03-C20	9336 015 80112
D204	Diode 1N4148	9330 839 90112
D205	Diode 1N4148	9330 839 90112
D206	Diode 1N4148	9330 839 90112
D207	Diode BZX79-C10	9331 177 90112
D208	Diode BZX79-C6V8	9331 177 50112
D209	Diode 1N4148	9330 839 90112
D210	Diode 1N4148	9330 839 90112
D211	Diode 1N4148	9330 839 90112
D212	Diode 1N4148	9330 839 90112
IC201	Intgrd Circt OM815	3502 319 91350
IC202	Intgrd Circt SL6652DG-20	9338 300 40682
IC203	Intgrd Circt TDA1010	9333 849 50112
IC204	Intgrd Circt MC34082P	9338 734 30682
IC205	Intgrd Circt LM348N	9333 705 60682
L201	Choke Wide Band RF	4312 020 36640
L205	Choke RF 1.5uH 10% DL1025-24	2422 535 98002
L206	Coil, Disdr, Toko RMC-2A6597HM	2422 549 18111
L207	Choke 6.8mH EL0607SK1-682J	2422 535 97062
L208	Choke RF 0.33uH 10% DL1025-08	2422 535 98001
RL201	Relay, Min 10Amp 12V	2402 132 00015
XL201	Crystal 20.94MHz 2nd L.Osc	3502 413 48410

6.5 SYNTHESISER/CONTROL PC BOARDS

6.5.1 VHF SYNTHESISTER/CONTROL PC BOARDS

6.5.1.1 Synth/Control PC Board E Band 25kHz (3502 349 73250)

	Synth/Cont BRD E 25kHz 91	3502 349 73150	R413	Res Carb F 47k 5% ¼W	2120 101 46473
R403	Pot Preset 470E 30% Lin	2120 357 01471	IC415	Intgrd Circt NSC810AN	9337 507 50682
R407	Res Carb F 390k 5% ¼W	2120 101 46394	TR402	Transistor BC548C	9331 976 70112
R412	Res Carb F 22k 5% ¼W	2120 101 46223	U401	Hybrid H6P	3502 358 00100

6.5.1.2 Synth/Control PC Board E Band 25kHz (91-92) (3502 349 73150)

	PCB Synth/Control Basic	3502 349 73050	C315	Cap Cer P1 27p 2% 100V NPO	2222 680 10279
	Coax Link	3502 319 93280	C319	Cap Al Elect 10u -10+50% 50V	2222 035 90008
	Coax Link Rx-Synth/Control	3502 319 93590	C332	Cap Cer P1 8p2 p25 100V NPO	2222 680 09828
	Bead Ferrite	2413 545 00249	C333	Cap Cer P1 100p 2% 100V NPO	2222 680 10101
	Shield Synth Circuit	3502 319 90390	C335	Cap Cer P1 1n0 10% 100V	2222 630 08102
U301	Hybrid H13	3502 358 00200	C339	Cap Cer P1 4n7 10% 100V	2222 630 08472
R305	Res Carb F 82E 5% ¼W	2120 101 46829	C341	Cap Pcar 220n 10% 100V	2222 344 21224
R313	Res Carb F 680E 5% ¼W	2120 101 46681	C345	Cap Cer D/M 100n 20%50V X7R	2022 552 01751
R328	Res Carb F 15k 5% ¼W	2120 101 46153	C346	Cap Al Elect 47u -10+50% 25V	2222 035 56479
R340	Res Carb F 27k 5% ¼W	2120 101 46273	C347	Cap Cer P1 2n2 10% 100V	2222 680 08222
R341	Res Carb F 1M0 5% ¼W	2120 101 46105	C354	Cap Cer P1 4n7 10% 100V	2222 630 08472
R345	Res Carb F 27k 5% ¼W	2120 101 46273	C362	Cap Pcarb 33n 10% 400V	2222 344 51333
R346	Res Carb F 8k2 5% ¼W	2120 101 46822	C365	Cap Pest 33n 10% 100V AMX	2020 300 85333
R347	Res Carb F 22k 5% ¼W	2120 101 46223	C366	Cap Al Elec 4u7 -10+50% 63V	2222 035 58478
R349	Res Carb F 15k 5% ¼W	2120 101 46153	C370	Cap Cer P1 33p 2% 100V NPO	2222 680 10339
R355	Res Carb F 220k 5% ¼W	2120 101 46224	C371	Cap Cer P1 220p 10% 100V	2222 630 08221
R356	Res Carb F 82k 5% ¼W	2120 101 46823	C418	Cap Cer P1 12p 2% 100V NPO	2222 680 10129
R357	Res Carb F 470k 5% ¼W	2120 101 46474	C437	Cap Cer P1 220p 10% 100V	2222 630 08221
R364	Res Carb F 4k7 5% ¼W	2120 101 46472	C438	Cap Cer P1 220p 10% 100V	2222 630 08221
R366	Res Carb F 220k 5% ¼W	2120 101 46224	C439	Cap Cer P1 220p 10% 100V	2222 630 08221
R367	Pot Preset Carb 47k 30% Lin	2120 357 01473	C440	Cap Cer P1 27p 2% 100V NPO	2222 680 10279
R368	Res Carb F 10k 5% ¼W	2120 101 46103	C441	Cap Cer P1 220p 2% 100V N750	2222 680 58221
R369	Res Carb F 22k 5% ¼W	2120 101 46223	C442	Cap Cer P1 220p 2% 100V N750	2222 680 58221
R370	Res Carb F 18k 5% ¼W	2120 101 46183	C443	Cap Cer P1 3p9 p25 100V NPO	2222 680 09398
R371	Pot Preset Carb 4k7 30% Lin	2120 357 01472	C444	Cap Cer D/M 100n 20% 50V X7R	2022 552 01751
R372	Res Carb F 680E 5% 1/4W	2120 101 46681	C445	Cap Cer D/M 22n 20% 50V X7R	2022 552 02019
R402	Pot Preset Carb 1k0 30% Lin	2120 357 01102	C446	Cap Cer D/M 100n 20% 50V X7R	2022 552 01751
R462	Res Carb F 3k9 5% ¼W	2120 101 46392	C447	Cap Al Elec 100u -10+50% 25V	2222 035 56101
R463	Res Carb F 82k 5% ¼W	2120 101 46823	XL302	Crystal 10000kHz, Holder	3502 414 98990
R464	Res Carb F 15k 5% ¼W	2120 101 46153	XL402	Crystal 5MHz Daiwa	2422 543 00051
R465	Res Carb F 470E 5% ¼W	2120 101 46471	TR409	Transistor BF324	9331 677 30112
R466	Res Carb F 1k2 5% ¼W	2120 101 46122	TR410	Transistor BF256B	9331 905 30112
R467	Res Carb F 22k 5% ¼W	2120 101 46223	TR411	Transistor BC548C	9331 976 70112
R468	Res Carb F 15k 5% ¼W	2120 101 46153	D305	Diode 1N4148	9330 839 90112
R469	Res Carb F 22k 5% ¼W	2120 101 46223	D401	Diode 1N4148	9330 839 90112
R470	Res Carb F 470E 5% ¼W	2120 101 46471	D405	Diode BAV21	9331 892 10113
R471	Res Carb F 6E8 5% ¼W	2120 101 46688	SK401	Pin Header 4p Molex M7812 4A	2422 021 98145
			IC303	Intgrd Circuit 11C90DC	9333 255 90682

6.5.1.3 Synth/Control Board E Band 12.5kHz (3502 349 73270)

	Synth/Cont BRD E 12.5kHz 91-92	3502 349 73170	R413	Res Carb F 47k 5% ¼W	2120 101 46473
R403	Pot Preset Carb 470E 30% Lin	2120 357 01471	IC415	Intgrd Circt NSC810AN	9337 507 50682
R407	Res Carb F 390K 5% ¼W	2120 101 46394	TR402	Transistor BC548C	9331 976 70112
R412	Res Carb F 22k 5% ¼W	2120 101 46223	U401	Hybrid H6P	3502 358 00100

6.5.1.4 Synth/Control PC Board E Band 12.5kHz (3502 349 73170)

	Synth/Control BRD Basic	3502 349 73050	C315	Cap Cer Pl 27p 2% 100V NPO	2222 680 10279
	Coax Link	3502 319 93280	C319	Cap Al Elect 10u -10+50% 50V	2222 035 90008
	Coax Link, Rx Synth/Control	3502 319 93590	C332	Cap Cer Pl 8p2 p25 100V NPO	2222 680 09828
	Shield, Synth Circuit	3502 319 90390	C333	Cap Cer Pl 100p 2% 100V NPO	2222 680 10101
	Bead Ferrite	2413 545 00249	C335	Cap Cer Pl 1n0 10% 100V	2222 630 08102
U301	Hybrid H13C	3502 358 00220	C339	Cap Cer Pl 4n7 10% 100V	2222 630 08472
R305	Res Carb F 82E 5% ¼W	2120 101 46829	C341	Cap Pcar 220n 10% 100V	2222 344 21224
R313	Res Carb F 680E 5% ¼W	2120 101 46681	C345	Cap Cer D/M 100n 20% 50V X7R	2022 555 01751
R328	Res Carb F 15k 5% ¼W	2120 101 46153	C346	Cap Al Elec 47u -10+50% 25V	2222 035 56479
R340	Res Carb F 27k 5% ¼W	2120 101 46273	C347	Cap Cer Pl 2n2 10% 100V	2222 630 08222
R341	Res Carb F 1MO 5% ¼W	2120 101 46105	C354	Cap Cer Pl 4n7 10% 100V	2222 630 08472
R345	Res Carb F 27k 5% ¼W	2120 101 46273	C362	Cap Pcarb 33n 10% 400V	2222 344 51333
R346	Res Carb F 8k2 5% ¼W	2120 101 46822	C365	Cap Pest 33n 10% 100V AMX	2020 300 85333
R347	Res Carb F 22k 5% ¼W	2120 101 46223	C366	Cap Al Elec 4u7 -10+50% 63V	2222 035 58478
R349	Res Carb F 15k 5% ¼W	2120 101 46153	C370	Cap Cer Pl 33p 2% 100V NPO	2222 680 10339
R355	Res Carb F 220k 5% ¼W	2120 101 46224	C371	Cap Cer Pl 220p 10% 100V	2222 630 08221
R356	Res Carb F 180k 5% ¼W	2120 101 46184	C418	Cap Cer Pl 12p 2% 100V NPO	2222 680 10129
R357	Res Carb F 470k 5% ¼W	2120 101 46474	C437	Cap Cer Pl 220p 10% 100V	2222 630 08221
R364	Res Carb F 4k7 5% ¼W	2120 101 46472	C438	Cap Cer Pl 220p 10% 100V	2222 630 08221
R366	Res Carb F 220k 5% ¼W	2120 101 46224	C439	Cap Cer Pl 220p 10% 100V	2222 630 08221
R367	Pot Preset Carb 22k 30% Lin	2120 357 01223	C440	Cap Cer Pl 27p 2% 100V NPO	2222 680 10279
R368	Res Carb F 5k6 5% ¼W	2120 101 46562	C441	Cap Cer Pl 220p 2% 100V N750	2222 680 58221
R369	Res Carb F 22k 5% ¼W	2120 101 46223	C442	Cap Cer Pl 220p 2% 100V N750	2222 680 58221
R370	Res Carb F 18k 5% ¼W	2120 101 46183	C443	Cap Cer Pl 3p9 p25 100V NPO	2222 680 09398
R371	Pot Preset Carb 4k7 30% Lin	2120 357 01472	C444	Cap Cer D/M 100n 20% 50V X7R	2022 552 01751
R372	Res Carb F 680E 5% ¼W	2120 101 46681	C445	Cap Cer D/M 22n 20% 50V X7R	2022 552 02019
R402	Pot Preset Carb 1kO 30% Lin	2120 357 01102	C446	Cap Cer D/M 100n 20% 50V X7R	2022 552 01751
R462	Res Carb F 3k9 5% ¼W	2120 101 46392	C447	Cap Al Elec 100u -10+50% 25V	2222 035 56101
R463	Res Carb F 82k 5% ¼W	2120 101 46823	XL302	Crystal 10000kHz, Holder	3502 414 98930
R464	Res Carb F 15k 5% ¼W	2120 101 46153	XL402	Crystal 5MHz Daiwa	2422 543 00051
R465	Res Carb F 470E 5% ¼W	2120 101 46471	TR409	Transistor BF324	9331 677 30112
R466	Res Carb F 1k2 5% ¼W	2120 101 46122	TR410	Transistor BF256B	9331 905 30112
R467	Res Carb F 22k 5% ¼W	2120 101 46223	TR411	Transistor BC548C	9331 976 70112
R468	Res Carb F 15k 5% ¼W	2120 101 46153	D305	Diode 1N4148	9330 839 90112
R469	Res Carb F 22k 5% ¼W	2120 101 46223	D401	Diode 1N4148	9330 839 90112
R470	Res Carb F 470E 5% ¼W	2120 101 46471	D405	Diode BAV21	9331 892 10113
R471	Res Carb F 6E8 5% ¼W	2120 101 46688	IC303	Intgrd Circuit 11C90DC	9333 255 90682
			SK401	Pin Header 4p Molex	2422 021 98145

6.5.1.5 Synth/Control PC Board A/B Band 25kHz (3502 349 73550)

	Synth/Cont Brd A/B 25kHz 91	3502 349 73450	R413	Res Carb F 47k 5% ¼W	2120 101 46473
R403	Pot Preset 470E 30% ¼W	2120 357 01471	IC415	Intgrd Circt NSC810AN	9337 507 50682
R407	Res Carb F 390k 5% ¼W	2120 101 46394	TR402	Transistor BC548C	9331 976 70112
R412	Res Carb F 22k 5% ¼W	2120 101 46223	U401	Hybrid H6P	3502 358 00100

6.5.1.6 Synth/Control PC Board A Band 25kHz (3502 349 73450)

	PCB Synth/Control Basic	3502 309 73060	R341	Res Carb F 1MO 5% ¼W	2120 101 46105
	Coax Link	3502 319 93280	R345	Res Carb F 27k 5% ¼W	2120 101 46273
	Bead Ferrite F14	2413 545 00249	R346	Res Carb F 6k8 5% ¼W	2120 101 46682
	Shield, Synth Circuit	3502 319 90390	R347	Res Carb F 10k 5% ¼W	2120 101 46103
R313	Res Carb F 680E 5% ¼W	2120 101 46681	R349	Res Carb F 15k 5% ¼W	2120 101 46153
R328	Res Carb F 15k 5% ¼W	2120 101 46153	R355	Res Carb F 220k 5% ¼W	2120 101 46224
R340	Res Carb F 8k2 5% ¼W	2120 101 46822	R356	Res Carb F 82k 5% ¼W	2120 101 46823

6.5.1.6 Synth/Control PC Board A Band 25kHz (3502 349 73450) (Cont'd)

R357	Res Carb F 470k 5% ¼W	2120 101 46474	C354	Cap Cer Pl 4n7 10% 100V	2222 630 08472
R364	Res Carb F 4k7 5% ¼W	2120 101 46472	C362	Cap Pcar 33n 10% 400V	2222 344 51333
R366	Res Carb F 220k 5% ¼W	2120 101 46224	C365	Cap Pest 33n 10% 100V	2020 300 85333
R367	Res Carb F 47k 5% ¼W	2120 101 46473	C366	Cap Al Elec 4u7 -10+50% 63V	2222 035 58478
R368	Res Carb F 10k 5% ¼W	2120 101 46103	C370	Cap Cer Pl 33p 2% 100V NPO	2222 680 10339
R369	Res Carb F 22k 5% ¼W	2120 101 46223	C371	Cap Cer Pl 220p 10% 100V	2222 630 08221
R370	Res Carb F 18k 5% ¼W	2120 101 46183	C418	Cap Cer Pl 12p 2% 100V NPO	2222 680 10129
R371	Pot Preset Carb 4k7 30% Lin	2120 357 01472	C437	Cap Cer Pl 220p 10% 100V	2222 630 08221
R372	Res Carb F 680E 5% ¼W	2120 101 46681	C438	Cap Cer Pl 220p 10% 100V	2222 630 08221
R402	Pot Preset Carb 1k0 30% Lin	2120 357 01102	C439	Cap Cer Pl 220p 10% 100V	2222 630 08221
R462	Res Carb F 3k9 5% ¼W	2120 101 46392	C440	Cap Cer Pl 27p 2% 100V NPO	2222 680 10279
R463	Res Carb F 82k 5% ¼W	2120 101 46823	C441	Cap Cer Pl 220p 2% 100V N750	2222 680 58221
R464	Res Carb F 15k 5% ¼W	2120 101 46153	C442	Cap Cer Pl 220p 2% 100V N750	2222 680 58221
R465	Res Carb F 470E 5% ¼W	2120 101 46471	C443	Cap Cer Pl 3p9 p25 100V NPO	2222 680 09398
R466	Res Carb F 1k2 5% ¼W	2120 101 46122	C444	Cap Cer D/M 100n 20% 50V X7R	2222 552 02876
R467	Res Carb F 22k 5% ¼W	2120 101 46223	C445	Cap Cer D/M 22n 20% 50V X7R	2022 552 02019
R468	Res Carb F 15k 5% ¼W	2120 101 46153	C446	Cap Cer D/M 100n 20% 50V X7R	2022 552 02876
R469	Res Carb F 22k 5% ¼W	2120 101 46223	C447	Cap Al Elec 100u -10+50% 25V	2222 035 56101
R470	Res Carb F 470E 5% ¼W	2120 101 46471	XL302	Crystal 10000kHz, Holder	3502 414 98990
R471	Res Carb F 6E8 5% ¼W	2120 101 46688	XL402	Crystal 5MHz Daiwa	2422 543 00051
C315	Cap Cer Pl 27p 2% 100V NPO	2222 680 10279	TR409	Transistor BF324	9331 677 30112
C319	Cap Al Elect 10u -10+50% 50V	2222 035 90008	TR410	Transistor BF256B	9331 905 30112
C332	Cap Cer Pl 8p2 p25 100V NPO	2222 680 09828	TR411	Transistor BC548C	9331 976 70112
C333	Cap Cer Pl 100p 2% 100V NPO	2222 680 10101	D305	Diode 1N4148	9330 839 90112
C335	Cap Cer Pl 1n0 10% 100V	2222 630 08102	D401	Diode 1N4148	9330 839 90112
C339	Cap Cer Pl 4n7 10% 100V	2222 630 08472	D405	Diode BAV21	9331 892 10113
C341	Cap Pcar 220n 10% 100V	2222 344 21224	U301	Hybrid H13	3502 358 00200
C345	Cap Con/ML Ces 220n 10% 50V	2022 552 02379	IC303	Intgrd Circuit 11C90DC	9333 255 90682
C346	Cap Al Elec 47u -10+50% 25V	2222 035 56479	SK401	Pin Header 4p Molex M7812-4A	2422 021 98145
C347	Cap Cer P1 4n7 10% 100V	2222 630 08472			

6.5.1.7 Synth/Control PC Board A Band 12.5kHz (3502 349 73570)

	Synth/Cont Brd A 12.5kHz 91	3502 349 73470	R413	Res Carb F 47k 5% ¼W	2120 101 46473
R403	Pot Preset Carb 470E 30% Lin	2120 357 01471	IC415	Intgrd Circt NSC810AN	9337 507 50682
R407	Res Carb F 390k 5% ¼W	2120 101 46394	TR402	Transistor BC548C	9331 976 70112
R412	Res Carb F 22k 5% ¼W	2120 101 46223	U401	Hybrid H6P	3502 358 00100

6.5.1.8 Synth/Control PC Board A/B Band 12.5kHz (91-92) (3102 349 73470)

	Synth/Control BRD Basic	3502 349 73060	R357	Res Carb F 470k 5% ¼W	2120 101 46474
	Coax Link	3502 319 93280	R364	Res Carb F 4k7 5% ¼W	2120 101 46472
	Bead Ferrite F14	2413 545 00249	R366	Res Carb F 220k 5% ¼W	2120 101 46224
	Shield, Synth Circuit	3502 319 90390	R367	Pot Preset Carb 22k 30% Lin	2120 357 01223
R313	Res Carb F 680E 5% ¼W	2120 101 46681	R368	Res Carb F 15k 5% ¼W	2120 101 46153
R328	Res Carb F 15k 5% ¼W	2120 101 46153	R369	Res Carb F 22k 5% ¼W	2120 101 46223
R340	Res Carb F 8k2 5% ¼W	2120 101 46822	R370	Res Carb F 18k 5% ¼W	2120 101 46183
R341	Res Carb F 1M0 5% ¼W	2120 101 46105	R371	Pot Preset Carb 4k7 30% Lin	2120 357 01472
R345	Res Carb F 27k 5% ¼W	2120 101 46273	R372	Res Carb F 680E 5% ¼W	2120 101 46681
R346	Res Carb F 6k8 5% ¼W	2120 101 46682	R402	Pot Preset Carb 1k0 30% Lin	2120 357 01102
R347	Res Carb F 10k 5% ¼W	2120 101 46103	R462	Res Carb F 3k9 5% ¼W	2120 101 46392
R349	Res Carb F 15k 5% ¼W	2120 101 46153	R463	Res Carb F 82k 5% ¼W	2120 101 46823
R355	Res Carb F 220k 5% ¼W	2120 101 46224	R464	Res Carb F 15k 5% ¼W	2120 101 46153
R356	Res Carb F 180k 5% ¼W	2120 101 46184	R465	Res Carb F 470E 5% ¼W	2120 101 46471

6.5.1.8 Synth/Control PC Board A/B Band 12.5kHz (91-92) (3102 349 73470) (Cont'd)

R466	Res Carb F 1k2 5% ¼W	2120 101 46122	C437	Cap Cer Pl 220p 10% 100V	2222 630 08221
R467	Res Carb F 22k 5% ¼W	2120 101 46223	C438	Cap Cer Pl 220p 10% 100V	2222 630 08221
R468	Res Carb F 15k 5% ¼W	2120 101 46153	C439	Cap Cer Pl 220p 10% 100V	2222 630 08221
R469	Res Carb F 22k 5% ¼W	2120 101 46223	C440	Cap Cer Pl 27p 2% 100V NPO	2222 680 10279
R470	Res Carb F 470E 5% ¼W	2120 101 46471	C441	Cap Cer Pl 220p 2% 100V N750	2222 680 58221
R471	Res Carb F 6E8 5% ¼W	2120 101 46688	C442	Cap Cer Pl 220p 2% 100V N750	2222 680 58221
C315	Cap Cer Pl 27p 2% 100V NPO	2222 680 10279	C443	Cap Cer Pl 3p9 p25 100V NPO	2222 680 09398
C319	Cap Al Elect 10u -10+50% 50V	2222 035 90008	C444	Cap Cer D/M 100n 20% 50V X7R	2022 552 02876
C332	Cap Cer Pl 8p2 p25 100V NPO	2222 680 09828	C445	Cap Cer D/M 22n 20% 50V X7R	2022 552 02019
C333	Cap Cer Pl 100p 2% 100V NPO	2222 680 10101	C446	Cap Cer D/M 100n 20% 50V X7R	2022 552 02876
C335	Cap Cer Pl 470p 10% 100V	2222 630 08471	C447	Cap Al Elec 100u -10+50% 25V	2222 035 56101
C339	Cap Cer Pl 4n7 10% 100V	2222 630 08472	XL302	Crystal 10000kHz, Holder RW-43	3502 414 98930
C341	Cap Pcar 220n 10% 100V	2222 344 21224	XL402	Crystal 5MHz Daiwa	2422 543 00051
C345	Cap Con/ML Cer 220n 10% 50V	2022 552 02379	TR409	Transistor BF324	9331 677 30112
C346	Cap Al Elec 47u -10+50% 25V	2222 035 56479	TR410	Transistor BF256B	9331 905 30112
C347	Cap Cer Pl 4n7 10% 100V	2222 630 08472	TR411	Transistor BC548C	9331 976 70112
C354	Cap Cer Pl 4n7 10% 100V	2222 630 08472	D305	Diode 1N4148	9330 839 90112
C362	Cap Pcar 33n 10% 400V	2222 344 51333	D401	Diode 1N4148	9330 839 90112
C365	Cap Pest 33n 10% 100V AMX	2020 300 85333	D405	Diode BAV21	9331 892 10113
C366	Cap Al Elec 4u7 -10+50% 63V	2222 035 58478	U301	Hybrid H13C	3502 354 00220
C370	Cap Cer Pl 33p 2% 100V NPO	2222 680 10339	IC303	Intgrd Circuit 11C90DC	9333 255 90682
C371	Cap Cer Pl 220p 10% 100V	2222 630 08221	SK401	Pin Header 4p Molex	2422 021 98145
C418	Cap Cer Pl 12p 2% 100V NPO	2222 680 10129			

6.5.1.9 Synth/Control PC Board A/B/UHF Basic (3502 349 73060)

	PCB Synthesiser Control	3502 349 73050	C301	Cap Cer Pl 220p 10% 100V	2222 630 08221
	Coax Link Rx-Cont/Synth	3502 319 91530	C302	Cap Cer Pl 1N0 10% 100V	2222 630 08102
IC301	Intgrd Circt UPB565C	9337 962 90682	C303	Cap Cer Pl 1N0 10% 100V	2222 630 08102
R301	Res Carb F S6E 5% ¼W	2120 101 46569	C304	Cap Cer Pl 1N0 10% 100V	2222 630 08102
R302	Res Carb F 150E 5% ¼W	2120 101 46151	C305	Cap Cer Pl 1N0 10% 100V	2222 630 08102
R303	Res Carb F 180E 5% ¼W	2120 101 46181	D307	Diode BZX79-C5V1	9331 177 20012

6.5.1.10 Synth/Control PC Board Basic (3502 349 73050)

	PCB Synthesiser Control	3502 309 73050	R335	Res Carb F 22k 5% ¼W	2120 101 46223
	Shield Cont. Circuit	3502 319 90400	R336	Res Carb F 6k8 5% ¼W	2120 101 46682
	Shield Voltage Doubler	3502 319 91400	R337	Res Carb F 100E 5% ¼W	2120 101 46101
	Hinge Block LH	3502 319 90290	R338	Res Carb F 22k 5% ¼W	2120 101 46223
	Hinge Block RH	3502 319 90300	R339	Res Carb F 1k5 5% ¼W	2120 101 46152
	Socket 28P D/I/LN(x3)	2422 549 13511	R342	Res Carb F 10k 5% ¼W	2120 101 46103
	Socket 40P D/I/LN(x2)	2422 549 13572	R343	Res Carb F 18k 5% ¼W	2120 101 46183
R311	Res Carb F 120E 5% ¼W	2120 101 46121	R344	Res Carb F 10k 5% ¼W	2120 101 46103
R314	Res Carb F 100E 5% ¼W	2120 101 46101	R348	Res Carb F 10k 5% ¼W	2120 101 46103
R315	Res Carb F 1k0 5% ¼W	2120 101 46102	R350	Res Carb F 22E 5% ¼W	2120 101 46229
R316	Res Carb F 180E 5% ¼W	2120 101 46181	R351	Res Carb F 12k 5% ¼W	2120 101 46123
R317	Res Carb F 22E 5% ¼W	2120 101 46229	R352	Res Carb F 1k8 5% ¼W	2120 101 46182
R318	Res Carb F 1k0 5% ¼W	2120 101 46102	R353	Res Carb F 47E 5% ¼W	2120 101 46479
R319	Res Carb F 180E 5% ¼W	2120 101 46181	R354	Res Carb F 220E 5% ¼W	2120 101 46221
R323	Res Carb F 47E 5% ¼W	2120 101 46479	R361	Res Carb F 1k0 5% ¼W	2120 101 46102
R324	Res Carb F 47E 5% ¼W	2120 101 46479	R365	Pot Preset Carb 10k 30% Lin	2120 357 01103
R326	Res Carb F 1M0 5% ¼W	2120 101 46105	R373	Res Carb F 180E 5% ¼W	2120 101 46181
R327	Res Carb F 1k0 5% ¼W	2120 101 46102	R374	Res Carb F 180E 5% ¼W	2120 101 46181
R330	Res Carb F 4k7 5% ¼W	2120 101 46472	R401	Res Carb F 2k2 5% ¼W	2120 101 46222
R331	Res Carb F 4k7 5% ¼W	2120 101 46472	R404	Res Carb F 10E 5% ¼W	2120 101 46109

6.5.1.10 **Synth/Control PC Board Basic (3502 349 73050)** (Cont'd)

R405	Res Carb F 180k 5% ¼W	2120 101 46184
R406	Res Carb F 47k 5% ¼W	2120 101 46473
R408	Res Carb F 22k 5% ¼W	2120 101 46223
R409	Res Carb F 1E0 5% ¼W	2120 101 46108
R410	Res Carb F 1E0 5% ¼W	2120 101 46108
R411	Res Carb F 22k 5% ¼W	2120 101 46223
R414	Res Carb F 100k 5% ¼W	2120 101 46104
R415	Res Carb F 100k 5% ¼W	2120 101 46104
R416	Res Carb F 22k 5% ¼W	2120 101 46223
R417	Res Carb F 390k 5% ¼W	2120 101 46394
R418	Res Carb F 47k 5% ¼W	2120 101 46473
R421	Res Carb F 47k 5% ¼W	2120 101 46473
R422	Res Carb F 220k 5% ¼W	2120 101 46224
R423	Res Carb F 15k 5% ¼W	2120 101 46153
R424	Res Carb F 4k7 5% ¼W	2120 101 46472
R425	Res Carb F 10k 5% ¼W	2120 101 46103
R426	Res Carb F 100k 5% ¼W	2120 101 46104
R427	Res Carb F 100k 5% ¼W	2120 101 46104
R428	Res Carb F 100k 5% ¼W	2120 101 46104
R429	Res Carb F 47k 5% ¼W	2120 101 46473
R430	Res Carb F 47k 5% ¼W	2120 101 46473
R431	Res Carb F 47k 5% ¼W	2120 101 46473
R432	Res Carb F 47k 5% ¼W	2120 101 46473
R433	Res Carb F 10k 5% ¼W	2120 101 46103
R434	Res Carb F 47k 5% ¼W	2120 101 46473
R435	Res Carb F 4k7 5% ¼W	2120 101 46472
R436	Res Carb F 4k7 5% ¼W	2120 101 46472
R437	Res Carb F 10k 5% ¼W	2120 101 46103
R439	Res Carb F 47k 5% ¼W	2120 101 46473
R441	Res Carb F 10E 5% ¼W	2120 101 46109
R442	Res Carb F 10k 5% ¼W	2120 101 46103
R443	Res Carb F 4k7 5% ¼W	2120 101 46472
R444	Res Carb F 2k2 5% ¼W	2120 101 46222
R446	Res Carb F 4k7 5% ¼W	2120 101 46472
R447	Res Carb F 4k7 5% ¼W	2120 101 46472
R448	Res Carb F 4k7 5% ¼W	2120 101 46472
R449	Res Carb F 4k7 5% ¼W	2120 101 46472
R451	Res Carb F 1k0 5% ¼W	2120 101 46102
R452	Res Carb F 10k 5% ¼W	2120 101 46103
R454	Res Carb F 10E 5% 0.2W	2322 210 13109
R458	Res Metal F 22k 2% 0.4W	2322 151 42203
R459	Res Metal F 27k 2% 0.4W	2322 151 42703
R460	Res Carb F 1k0 5% ¼W	2120 101 46102
R473	Res Carb F 4k7 5% ¼W	2120 101 46472
C309	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C310	Cap Al Elec 1u0 -10%+50% 100V	2222 035 59108
C311	Cap Al Elec 1u0 -10+50% 100V	2222 035 59108
C313	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C314	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C316	Cap Al Elec 4u7 -10+50% 63V	2222 035 58478
C317	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C318	Cap Cer Pl 4p7 p25 100V NPO	2222 680 09478
C320	Cap Cer Pl 4p7 p25 100V NPO	2222 680 09478
C321	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02875
C322	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C326	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C327	Cap Al Elec 10u -10+50% 50V	2222 035 90008
C328	Cap Al Elec 10u -10+50% 50V	2222 035 90008
C329	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C331	Cap Trim Film H/T 2P-18P 300V	2222 809 05003
C334	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C336	Cap Pcar 33n 10% 400V	2222 344 51333
C340	Cap Al Elec 10u -10+50% 50V	2222 035 90008
C342	Cap Al Elec 10u -10+50% 50V	2222 035 90008
C344	Cap Al Elec 4u7 -10+50% 63V	2222 035 58478
C348	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02875
C349	Cap Al Elec 10u -10+50%	2222 035 90008
C350	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02875
C351	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02875
C352	Cap Al Elec 10u -10+50% 50V	2222 035 90008
C353	Cap Al Elec 1u0 -10+50% 100V	2222 035 59108
C355	Cap Cer Pl 330p 10% 100V	2222 630 08331
C356	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02875
C363	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02875
C364	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02875
C367	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C368	Cap Cer Pl 10p 2% 100V NPO	2222 680 10109
C401	Cap Al Elec 22u -10+50% 35V	2222 035 90003
C402	Cap Al Elec 22u -10+50% 35V	2222 035 90003
C403	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C404	Cap Psty 330p 1% 630V	2222 427 43301
C405	Cap Tant 1u0 20% 35V	2020 004 90037
C406	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C407	Cap Cer D/M 100n 20% 50V X7R	2022 552 02876
C408	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02875
C412	Cap Al Elec 100u -10+50% 25V	2222 035 56101
C413	Cap Al Elec 100u -10+50% 25V	2222 035 56101
C414	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C415	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C416	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C417	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02875
C419	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C420	Cap Cer Pl 47p 2% 100V NPO	2222 680 10479
C422	Cap Al Elec 100u -10+50% 25V	2222 035 56101
C423	Cap Cer Pl 100p 2% 100V NPO	2222 680 10101
C424	Cap Cer Pl 47p 2% 100V NPO	2222 680 10479
C425	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02875
C426	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02875
C429	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C430	Cap Cer Pl 220p 10% 100V	2222 630 08221
C431	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C432	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C448	Cap Pest 22n 10% 100V AMX	2020 300 85223
C449	Cap Al Elec 47u -10+50% 25V	2222 035 56479
C450	Cap Al Elec 47u -10+50% 25V	2222 035 56479
C451	Cap Al Elec 100u -10+50% 25V	2222 035 56101
C452	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C453	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C454	Cap Elec 47000uF +80-20% NEC	2020 900 00002
C460	Cap Cer Pl 39p 2% 500V NPO	2222 650 10399
SK405	Pin Header 4P Molex M7812-4A	2422 021 98145
SK406	Pin Header 3P M7812-3A	2422 021 98158

6.5.1.10 **Synth/Control PC Board Basic (3502 349 73050)** (Cont'd)

IC302	Intgrd Circt MC79L05ACP	9335 330 20682	IC414	Intgrd Circt 74LS00PC	9332 897 71682
IC304	Intgrd Circt HEF4751VD	9335 202 00682	TR301	Transistor 2N5771	9333 885 90682
IC305	Intgrd Circt HEF4750VD	9335 201 80682	TR302	Transistor BC558	9331 977 30112
IC306	Intgrd Circt TL072CP-00	9335 327 60682	TR303	Transistor BC548C	9331 976 70112
IC401	Intgrd Circt MC78L05ACP	9335 107 20682	TR401	Transistor BC548C	9331 976 70112
IC402	Intgrd Circt MC14443P	9335 635 90682	TR403	Transistor BC548C	9331 976 70112
IC403	Intgrd Circt MC14504BCP	9335 635 80682	TR404	Transistor BC548C	9331 976 70112
IC404	Intgrd Circt MC14174BCP	9335 145 90682	TR405	Transistor BC328	9331 491 90112
IC405	Intgrd Circt MC14174BCP	9335 145 90682	TR406	Transistor BC548C	9331 976 70112
IC406	Intgrd Circt MC14174BCP	9335 145 90682	TR408	Transistor BC558	9331 977 30112
IC407	Intgrd Circt HEF4011BP	9332 775 90112	D302	Diode 1N4148	9330 839 90112
IC408	Micro Pro Unit MC146805E2P	9336 237 50682	D303	Diode 1N4148	9330 839 90112
IC409	Intgrd Circt N74LS373N	9334 555 00112	D304	Diode 1N4148	9330 839 90112
IC410	Intgrd Circt 74LS00PC	9332 897 71682	D306	Diode 1N4148	9330 839 90112
IC411	Intgrd Circt LM340-T5T	9334 006 00682	D402	Diode BAV21	9331 892 10113
IC413	Intgrd Circt MC74LS260PC	9336 355 20682	D403	Diode BAV21	9331 892 10113

6.5.2 UHF SYNTHESISER/CONTROL PC BOARDS

6.5.2.1 Synth/Control PC Board 91 UHF (25kHz) (3502 349 83250)

	Synth/Cont BRD A 25kHz	3502 349 83150	IC415	Intgrd Circt NSC810AN	9337 507 50682
R407	Res Carb F 390k 5% ¼W	2120 101 46394	U401	Hybrid H6P	3502 358 00100
R413	Res Carb F 47k 5% ¼W	2120 101 46473			

6.5.2.2 Synth/Control PC Board UHF (25kHz) (3502 349 83150)

	PCB Synth/Control Basic	3502 349 73060	C319	Cap Al Elect 10u -10+50% 50V	2222 035 90008
R313	Res Carb F 470E 5% ¼W	2120 101 46471	C332	Cap Cer Pl 8p2 p25 100V NP0	2222 680 09828
R328	Res Carb F 68k 5% ¼W	2120 101 46683	C333	Cap Cer Pl 100p 2% 100V NP0	2222 680 10101
R340	Res Carb F 3k3 5% ¼W	2120 101 46332	C335	Cap Cer Pl 47p 2% 100V NP0	2222 680 10479
R341	Res Carb F 560k 5% ¼W	2120 101 46564	C341	Cap Pcar 220n 10% 100V	2222 344 21224
R345	Res Carb F 39k 5% ¼W	2120 101 46393	C345	Cap Cer D/M 100n 20% 50V X7R	2022 552 01751
R346	Res Carb F 15k 5% ¼W	2120 101 46153	C346	Cap Al Elect 47u -10+50% 25V	2222 035 56479
R347	Res Carb F 22k 5% ¼W	2120 101 46223	C347	Cap Cer Pl 2n2 10% 100V	2222 630 08222
R349	Res Carb F 22k 5% ¼W	2120 101 46223	C354	Cap Cer Pl 4n7 10% 100V	2222 630 08472
R355	Res Carb F 220k 5% ¼W	2120 101 46224	C362	Cap Pcar 33n 10% 400V	2222 344 51333
R356	Res Carb F 82k 5% ¼W	2120 101 46823	C365	Cap Pest 33n 10% 100V AMX	2020 300 85333
R357	Res Carb F 470k 5% ¼W	2120 101 46474	C366	Cap Al Elec 4u7 -10+50% 63V	2222 035 58478
R364	Res Carb F 4k7 5% ¼W	2120 101 46472	C418	Cap Cer Pl 18p 2% 100V NP0	2222 680 10189
R366	Res Carb F 220k 5% ¼W	2120 101 46224	C421	Cap Cer Pl 18p 2% 100V NP0	2222 680 10189
R367	Pot Preset Carb 47k 30% Lin	2120 357 01473	IC303	Intgrd Circt 11C90DC	9333 255 90682
R368	Res Carb F 10k 5% ¼W	2120 101 46103	U301	Hybrid H13	3502 358 00200
R369	Res Carb F 22k 5% ¼W	2120 101 46223	TR402	Transistor BC548C	9331 976 70112
R370	Res Carb F 18k 5% ¼W	2120 101 46183	D305	Diode 1N4148	9330 839 90112
R371	Pot Preset Carb 4k7 30% Lin	2120 357 01472	D401	Diode BZV46-2V0	9334 339 40112
R372	Res Carb F 1k0 5% ¼W	2120 101 46102	XL302	Crystal 10000kHz Holder	3502 414 98930
R402	Pot Preset Carb 2k2 30% Lin	2120 357 01222	XL401	Crystal 5MHz Daiwa	2422 543 00051
R403	Pot Preset Carb 470E 30% Lin	2120 357 01471	SK401	Pin header 4p Molex M7812-4A	2422 021 98145
R412	Res Carb F 22k 5% ¼W	2120 101 46223			
R438	Res Carb F 10M 10% .33W	2322 211 12106			

6.5.2.3 Synth/Control PC Board 91 UHF (12.5kHz) (3502 349 83260)

	Synth/Cont BRD 12.5kHz 91-92	3502 349 83160	IC415	Intgrd Circt NSC810AN	9337 507 50682
R407	Res Carb F 390k 5% ¼W	2120 101 46394	U401	Hybrid H6P	3502 358 00100
R413	Res Carb F 47k 5% ¼W	2120 101 46473			

6.5.2.4 Synth/Control PC Board UHF (12.5kHz) (3502 349 83160)

	PCB Synth/Control Basic	3502 349 73060	C319	Cap Al Elec 10u -10+50% 50V	2222 035 90008
	Low Temp. Heater Brd. 10MHz	3502 349 98640	C332	Cap Cer Pl 8p2 p25 100V NP0	2222 680 09828
R313	Res Carb F 470E 5% ¼W	2120 101 46471	C333	Cap Cer Pl 100p 2% 100V N70	2222 680 58101
R328	Res Carb F 68k 5% ¼W	2120 101 46683	C335	Cap Cer Pl 47p 2% 100V NP0	2222 680 10479
R340	Res Carb F 3k3 5% ¼W	2120 101 46332	C341	Cap Pcar 220n 10% 100V	2222 344 21224
R341	Res Carb F 1M0 5% ¼W	2120 101 46105	C345	Cap Cer D/M 100n 20% 50V X7R	2022 552 01751
R345	Res Carb F 39k 5% ¼W	2120 101 46393	C346	Cap Al Elec 47u -10+50% 25V	2222 035 56479
R346	Res Carb F 15k 5% ¼W	2120 101 46153	C347	Cap Cer Pl 2n2 10% 100V	2222 630 08222
R347	Res Carb F 22k 5% ¼W	2120 101 46223	C354	Cap Cer Pl 4n7 10% 100V	2222 630 08472
R349	Res Carb F 22k 5% ¼W	2120 101 46223	C362	Cap Pcar 33n 10% 400V	2222 344 51333
R355	Res Carb F 220k 5% ¼W	2120 101 46224	C365	Cap Pest 33n 10% 100V AMX	2020 300 85333
R356	Res Carb F 82k 5% ¼W	2120 101 46823	C366	Cap Al Elec 4u7 -10+50% 63V	2222 035 58478
R357	Res Carb F 470k 5% ¼W	2120 101 46474	C418	Cap Cer Pl 18p 2% 100V NP0	2222 680 10189
R364	Res Carb F 4k7 5% ¼W	2120 101 46472	C421	Cap Cer Pl 18p 2% 100V NP0	2222 680 10189
R366	Res Carb F 220k 5% ¼W	2120 101 46224	IC303	Intgrd Circuit 11C90DC	9333 255 90682
R367	Pot Preset Carb 22k 30% Lin	2120 357 01223	TR402	Transistor BC548C	9331 976 70112
R368	Res Carb F 5k6 5% ¼W	2120 101 46562	D305	Diode 1N4148	9330 839 90112
R369	Res Carb F 22k 5% ¼W	2120 101 46223	D401	Diode BZV46-2V0	9334 339 40112
R370	Res Carb F 18k 5% ¼W	2120 101 46183	U301	Hybrid H13C	3502 358 00220
R371	Pot Preset Carb 4k7 30% Lin	2120 357 01472	XL302	Crystal 10000kHz Holder	3502 414 98930
R372	Res Carb F 1k0 5% ¼W	2120 101 46102	XL401	Crystal 5MHz Daiwa	2422 543 00051
R402	Pot Preset Carb 2k2 30% Lin	2120 357 01222	SK401	Pin header 4p Molex M7812-4A	2422 021 98145
R403	Pot Preset Carb 470E 30% Lin	2120 357 01471			
R412	Res Carb F 22k 5% ¼W	2120 101 46223			
R438	Res Carb F 10M 10% .33W	2322 211 12106			

6.5.2.5 Low Temp. Heater Brd 10MHz (3502 349 98640)

	PCB Low Temp Heater	3502 309 97140	R8	Res Carb F 1k8 5% 0.2W	2322 210 13182
R1	Res Carb F 12E 5% ¼W	2120 101 46129	R9	Res Carb F 680E 5% ¼W	2120 101 46681
R2	Posistor PTC 33E	2120 660 90006	C2	Cap Cer Pl 220p 10% 100V	2222 630 08221
R3	Res Carb F 12E 5% ¼W	2120 101 46129	D1	Diode BZX79-C6V2	9331 177 40112
R4	Res Carb F 1k0 5% 0.2W	2322 210 13102	TR1	Transistor BC328	9331 491 90112
R5	Res Carb F 3k3 5% 0.2W	2322 210 13332	TR2	Transistor BC548	9331 976 40112
R7	Thermistor NTC 470E 10% 0.6W	2322 642 61471	XL1	Crystal 10000kHz, Holder	3502 414 98930

6.6 REMOTE INTERFACE PC BOARD (3502 349 77000)

	PCB Remote Interface	3502 309 77000	R701	Res Carb F 100E 5% ¼W	2120 101 46101
C701	Cap Cer Pl 470p 10% 100V	2222 630 08471	R703	Res Carb F 100E 5% ¼W	2120 101 46101
C703	Cap Cer Pl 470p 10% 100V	2222 630 08471		Jumper Assy.9-Way AMP 86942-8	2422 011 00778
C705	Cap Cer Pl 470p 10% 100V	2222 630 08471	SK703	Connector 15 Way F15S4K49	2412 033 03029

6.7 FM91 REMOTE CONTROL UNIT

6.7.1 FM91 REMOTE CONTROL UNIT (9585 900 11600)

Assy PC Boards(C-MOS)91	3502 350 05000	Button Cap,(Small),Amber(XII)	3502 319 90550
Front Panel Screened 91 CU	3502 319 91380	Button Cap,(Large) Red (X3)	3502 319 90590
Back Panel Assy	3502 330 11150	Button Cap,(Small) Green (X7)	3502 319 90580
Spacer PCB 916	3502 319 90750	Button Base (Large) (X3)	3502 319 90570
Support,Cont Unit Cradle(X2)	3502 319 90380	Button Base (Small) (x18)	3502 319 90560
Cradle,Cont Unit(Blk P/Coat)	3502 319 91220	Frame, Lens Mounting 900	3502 319 90900
Screw, Thumb Pld Bzn	3502 319 91750	Lens, Screened 91 CU	3502 319 91370
Label, Cont Unit 91	3502 319 91480	Label Button Cap	3502 319 91410
Remote Control Cable 900	3502 330 06990	Blank Plate, 91 F/Panel	3502 319 94110

6.8 ASSY,PC BOARDS FM91 CONTROL UNIT (C-MOS) (3502 350 05000)

Microprocessor Brd 91 "C-MOS	3502 349 98670
Contr/Display Brd 91A "C-MOS	3502 349 75110
Flexistrip 12 Cond FST-21A-12	2422 024 00289

6.8.1 MICROPROCESSOR PC BOARD (Basic) (3502 349 98670)

	PC Board Microprocessor CU91	3502 309 76000	R628	Res Carb F 4k7 5% ¼W	2120 101 46472
	Socket 40p D/I/LN	2422 549 13512	R629	Res Carb F 4k7 5% ¼W	2120 101 46472
	Wire Link 112mm	3502 319 91670	R630	Res Carb F 4k7 5% ¼W	2120 101 46472
	Wire Link 127mm	3502 319 91700	R631	Res Carb F 4k7 5% ¼W	2120 101 46472
	Wire Link 96mm	3502 319 91710	R632	Res Carb F 4k7 5% ¼W	2120 101 46472
	Wire Link 76mm	3502 319 91720	R633	Res Carb F 220E 5% ¼W	2120 101 46221
	Wire Link Slate	3502 319 93160	R634	Res Carb F 220E 5% ¼W	2120 101 46221
	Coax Link 125mm	3502 319 93260	R635	Res Carb F 220E 5% ¼W	2120 101 46221
R601	Res Carb F 100E 5% ¼W	2120 101 46101	R636	Res Carb F 220E 5% ¼W	2120 101 46221
R602	Res Carb F 100E 5% ¼W	2120 101 46101	R637	Res Carb F 220E 5% ¼W	2120 101 46221
R603	Res Carb F 10k 5% ¼W	2120 101 46103	R638	Res Carb F 220E 5% ¼W	2120 101 46221
R604	Res Carb F 10k 5% ¼W	2120 101 46103	R639	Res Carb F 220E 5% ¼W	2120 101 46221
R605	Res Carb F 4k7 5% ¼W	2120 101 46472	R640	Res Carb F 220E 5% ¼W	2120 101 46221
R606	Res Carb F 4k7 5% ¼W	2120 101 46472	R641	Res Carb F 1k0 5% ¼W	2120 101 46102
R607	Res Carb F 4k7 5% ¼W	2120 101 46472	R642	Res Carb F 390E 5% ¼W	2120 101 46391
R608	Res Carb F 100E 5% ¼W	2120 101 46101	R643	Res Carb F 100k 5% ¼W	2120 101 46104
R609	Res Carb F 100E 5% ¼W	2120 101 46101	R649	Res Carb F 47k 5% ¼W	2120 101 46473
R610	Res Carb F 4k7 5% ¼W	2120 101 46472	R650	Res Carb F 470E 5% ¼W	2120 101 46471
R611	Res Carb F 4k7 5% ¼W	2120 101 46472	R651	Res Carb F 3k9 5% ¼W	2120 101 46392
R612	Res Carb F 22k 5% ¼W	2120 101 46223	R652	Res Carb F 82k 5% ¼W	2120 101 46823
R613	Res Carb F 22k 5% ¼W	2120 101 46223	R653	Res Carb F 1k2 5% ¼W	2120 101 46122
R614	Res Carb F 22k 5% ¼W	2120 101 46223	R654	Res Carb F 4k7 5% ¼W	2120 101 46472
R615	Res Carb F 22k 5% ¼W	2120 101 46223	R655	Res Carb F 15k 5% ¼W	2120 101 46153
R616	Res Carb F 10k 5% ¼W	2120 101 46103	R656	Res Carb F 15k 5% ¼W	2120 101 46153
R617	Res Carb F 10k 5% ¼W	2120 101 46103	R657	Res Carb F 22k 5% ¼W	2120 101 46223
R618	Res Carb F 10k 5% ¼W	2120 101 46103	C601	Cap Al Elec 47u -10+50% 25V	2222 030 26479
R619	Res Carb F 10k 5% ¼W	2120 101 46103	C602	Cap Al Elec 10u -10+50% 63V	2222 030 28109
R620	Res Carb F 10k 5% ¼W	2120 101 46103	C603	Cap Al Elec 10u -10+50% 63V	2222 030 28109
R621	Res Carb F 10k 5% ¼W	2120 101 46103	C604	Cap Cer D/M 100n 20% Z5U	2022 552 02482
R622	Res Carb F 10k 5% ¼W	2120 101 46103	C605	Cap Cer Pl 1n0 10% 100V	2222 630 08102
R623	Res Carb F 10k 5% ¼W	2120 101 46103	C606	Cap Cer Pl 1n0 10% 100V	2222 630 08102
R624	Res Carb F 10k 5% ¼W	2120 101 46103	C607	Cap Cer Pl 22p 2% 100V NPO	2222 680 10229
R625	Res Carb F 4k7 5% ¼W	2120 101 46472	C608	Cap Cer Pl 5p6 p25 100V NPO	2222 680 09568
R626	Res Carb F 4k7 5% ¼W	2120 101 46472	C609	Cap AL Elec 2u2 -10+50% 63V	2222 030 28228
R627	Res Carb F 4k7 5% ¼W	2120 101 46472	C610	Cap Cer Pl 10n -20+80% 63V	2222 629 08103

6.8.1 MICROPROCESSOR PC BOARD (Basic) (3502 349 98670) (Cont'd)

C611	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C612	Cap Cer D/M 100n 20% 50V	2022 552 02482
C613	Cap Cer Pl 10n -20+80% 63V	2222 629 08103
C614	Cap AL Elect 10u -10+50% 63V	2222 030 28109
C615	Cap Cer Pl 330p 10% 100V	2222 630 08331
C616	Cap Cer D/M 100n 20% 50V X7R	2022 552 01751
C617	Cap Cer Tant 22u 20% 16V	2020 004 90041
C618	Cap Cer Pl 220p 2% 100V N750	2222 680 58221
C619	Cap Cer Pl 220p 2% 100V N750	2222 680 58221
C620	Cap Cer D/M 22n 10% 50V X7R	2022 552 02019
C621	Cap Cer Pl 27p 2% 100V NPO	2222 680 10279
C622	Cap Cer Pl 2p7 p25 100V NPO	2222 680 09278
D601	Diode BAV21	9331 892 10113
D602	Diode BZX79-C6V2	9331 177 40112
D603	Diode 1N4148	9330 839 90112
D604	Diode 1N4148	9330 839 90112
D605	Diode 1N4148	9330 839 90112
D606	Diode 1N4148	9330 839 90112
D607	Diode 1N4148	9330 839 90112
D608	Diode 1N4148	9330 839 90112
TR601	Transistor BC337	9331 492 00112
TR602	Transistor BC337	9331 492 00112
TR603	Transistor BC337	9331 492 00112
TR604	Transistor BC337	9331 492 00112
TR605	Transistor BC337	9331 492 00112
TR606	Transistor BC337	9331 492 00112
TR607	Transistor BC337	9331 492 00112
TR608	Transistor BC337	9331 492 00112
TR609	Transistor BC548C	9331 976 70112
TR610	Transistor BC548C	9331 976 70112
TR611	Transistor BF256B	9331 905 30112
TR612	Transistor BC548C	9331 976 70112
TR613	Transistor BF324	9331 677 30112
IC601	Intgrd Circt LM340-T5	9333 006 00682
IC602	ROM Processor Cont/Hd (80C48)	3502 362 00540
IC603	Intgrd Circt LED MC75492P	9334 527 10682
IC604	Intgrd Circt LED MC75492P	9334 527 10682
XL601	Crystal 6MHz Daiwa KDS	2422 543 00052

6.8.2 CONTROL DISPLAY PC BOARD FM91A (C-MOS) (3502 349 75110)

	Contr/Display Brd 91 C-MOS	3502 349 75010
S501	Switch (Tact) SP Red 11903	2422 128 02027
S502	Switch (Tact) SP Red 11903	2422 128 02027
S503	Switch (Tact) SP Amber 11906	2422 128 02029
S504	Switch (Tact) SP Green 11904	2422 128 02028
S505	Switch (Tact) SP Green 11904	2422 128 02028
S506	Switch (Tact) SP Amber 11906	2422 128 02029
S507	Switch (Tact) SP Amber 11906	2422 128 02029
S508	Switch (Tact) SP Green 11904	2422 128 02028
S509	Switch (Tact) SP Green 11904	2422 128 02028
S510	Switch (Tact) SP Amber 11906	2422 128 02029
S511	Switch (Tact) SP Amber 11906	2422 128 02029
S512	Switch (Tact) SP Amber 11906	2422 128 02029
S513	Switch (Tact) SP Green 11904	2422 128 02028
S514	Switch (Tact) SP Amber 11906	2422 128 02029
S515	Switch (Tact) SP Amber 11906	2422 128 02029
S516	Switch (Tact) SP Red 11903	2422 128 02027
S517	Switch (Tact) SP Green 1904	2422 128 02028
S518	Switch (Tact) SP Amber 11906	2422 128 02029
S519	Switch (Tact) SP Amber 11906	2422 128 02029
S520	Switch (Tact) SP Amber 11906	2422 128 02029
S521	Switch (Tact) SP Green 11904	2422 128 02028

6.8.2.1 Control Display PC Board 91 (C-MOS) (3502 349 75010)

Contr/Display Brd Basic	3502 349 75000
Wire Tn.Cu. 0.50mm	0322 042 00013

6.8.2.2 Control/Display PC Board (Basic) (3502 349 75000)

	PCB Display Control Unit	3502 309 75000
	Assy. Microphone Socket	3502 330 09610
	Connector 15W D Male FI5P4K49	2412 033 02027
R501	Res Carb F 390E 5% ¼W	2120 101 46391
R502	Res Carb F 470E 5% ¼W	2120 101 46471
R503	Res Carb F 470E 5% ¼W	2120 101 46471
R504	Res Carb F 470E 5% ¼W	2120 101 46471
R505	Res Carb F 470E 5% ¼W	2120 101 46471
R506	Res Carb F 470E 5% ¼W	2120 101 46471
R507	Res Carb F 680E 5% ¼W	2120 101 46681
TR501	Transistor XC500E	9338 487 30682
D501	LED Red CQV36-5	9336 216 80682
D502	LED Yellow CQV38-5	9336 216 90682
D503	LED Green CQV39-5	9336 217 00682
D504	LED HDSP-3533	9335 456 60682
D505	LED HDSP-3533	9335 456 60682
D506	LED HDSP-3533	9335 456 60682
D507	LED HDSP-3533	9335 456 60682
D508	LED HDSP-3533	9335 456 60682
D509	LED HDSP-3533	9335 456 60682
D510	LED HDSP-3533	9335 456 60682
D511	LED HDSP-3533	9335 456 60682

6.8.3 REMOTE CONTROL CABLE (3502 330 06990)

Shell, Rear Shroud	3502 319 90880	Screw ST CSK NO4x.375	2522 164 22004
Shell, Front Shroud	3502 319 90870	Tie, Cable	2413 015 00033
Screw, CH/HD Shroud	3502 319 91930	Sub Assy, Remote Contr Cable	3502 330 06980

6.8.3.1 Sub Assy, Remote Control Cable (3502 330 06980)

Remote Control 91/92	3502 319 93020	Contact, Female (x15)	2422 034 17533
Socket 15W D Female	2422 025 04409	Contact, Male (x15)	2422 034 17505
Plug, 15W D Male	2422 025 04411	Sleeving HTSH 3mm Blk	0813 011 95056
Sleeving HTS4 10mm Blk	0813 011 95054		

6.9 FIST MICROPHONE

6.9.1 FIST MICROPHONE 900 REMOTE (Moulded Plug) (9585 000 00620)

Microphone Pre Amp Board	3502 349 96360	Spring, PTT Actuator	3502 319 94030
Assy, Mic Cable (Tinsel)(Mld)	3502 330 09750	Switch, Micro QAS-1229-4	2422 127 00182
Insert, Microphone 500ohm	2422 549 12009	Assy. Rear Shell (900 Mic)	3502 330 09330
Press Button, Fist Mic	3502 319 90850	Assy. Front Shell (900 Mic)	3502 330 09350

6.9.2 FIST MICROPHONE 900 LOCAL (DIN Plug) (9585 000 00610)

Microphone Pre Amp Board	3502 349 96360	Spring, PTT Actuator	3502 319 94030
Assy, Mic Cable (Tinsel)(DIN)	3502 330 09740	Switch, Micro QAS-1229-4	2422 127 00182
Insert, Microphone 500ohm	2422 549 12009	Assy. Rear Shell (900 Mic)	3502 330 09330
Press Button, Fist Mic	3502 319 90850	Assy. Front Shell (900 Mic)	3502 330 09350

6.9.3 MICROPHONE PREAMP PC BOARD (3502 349 96360)

	PCB Mic Preamp 900	3502 309 96360	C3	Cap A1 Elec 4u7 -10+50% 63V	2222 035 58478
R1	Res Carb F 150k 5% ¼W	2120 101 46154	C4	Cap Cer P1 1n5 10% 100V	2222 630 08152
R2	Res Carb F 47E 5% ¼W	2120 101 46479	C5	Cap Cer P1 1no 10% 100LV	2222 630 08102
C1	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02482	TR1	Transistor BC549	9331 976 80112
C2	Cap Cer P1 1n0 10% 100V	2222 630 08102	SW1	Switch Reed Modified	3502 319 92270

6.10 HANDSET 900 SIMPLEX (9585 765 90110)

	Assy Handset Holder	3502 330 07950		Mic Pre-Amp Brd 765 H/Set	3502 349 96870
	Assy Lead H/Set	3502 330 07960	S2	Switch Tumbler Ring Grip MS1	450 765 028
	Assy Speaker Box Bottom	3502 330 07940	S3	Switch PB Low/Frce Sub/Min	2422 128 02180
	Assy Handset & Lead	3502 330 07930	LS1	Speaker 5 ohms MAGNAVOX	2402 264 03009

6.10.1 MICROPHONE PRE-AMP BOARD 765 HANDSET (3502 349 96870)

	PC Board Mic Pre-amp H/Set	3502 309 96870	C1	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02483
	Lug Quick Connect BR H1124(6)	2402 015 01108	C2	Cap Cer P1 1n0 10% 100V	2222 630 08103
	Lug Solder PT NO 6000-04-01(4)	3502 310 30110	C3	Cap Al Elec 4u7 -10+50% 63V	2222 035 58470
R1	Res Carb.F.150k 5% ¼W	2120 101 46154	C4	Cap Cer P1 1n5 10% 100V	2222 630 08152
R2	Res Carb.F.47E 5% ¼W	2120 101 46479	C5	Cap Cer P1 1n0 10% 100V	2222 630 08102
R3	Res Carb.F.1k5 5% ¼W	2120 101 46152	TR1	Transistor BC549	9331 976 80112

6.11 UHF MOBILE UNIT MAIN CODES (DUPLEX)

6.11.1 PCB CODES (25kHz CH.SP.)

SUB-UNIT	T - BAND	U - BAND	W1 BAND LOW (LOW SIDE Rx LO)	W1 BAND HIGH HIGH SIDE Rx LO)	W2 - BAND
	25kHz Ch. Sp.	25kHz Ch. Sp.	25kHz Ch. Sp.	25kHz Ch. Sp.	25kHz Ch. Sp.
	9502 905 40000	9502 906 40000	9502 907 40000	9502 908 40000	9502 909 40000
Tx PA PC Board	3502 349 81650	3502 349 81660	3502 349 81670	3502 349 81670	3502 349 81680
Receiver PC Board Mk2	3502 349 82210	3502 349 82220	3502 349 82230	3502 349 82330	3502 349 82240
Synth/Control PC Board	3502 349 83350	3502 349 83350	3502 349 83350	3502 349 83350	3502 349 83350
Duplex PC Board	3502 349 81350	3502 349 81360	3502 349 81370	3502 349 81370	3502 349 81380
Remote Interface PC Board	3502 349 77000	3502 349 77000	3502 349 77000	3502 349 77000	3502 349 77000

6.11.2 UHF MOBILES (COMMON PARTS)

Chassis Assy Duplex	3502 330 06960	Cable Assy Insul/Displmnt	3502 350 03100
Lid, cradle mtg 900	3502 319 90190	Cable, Cont/Synth Duplex	3502 319 93450
Lid, Main Chassis	3502 319 90200	Cable, Rx-Duplex UHF	3502 319 94130
Spring, PCB retaining	3502 319 91170	Connector Sub-assy 91/92	3502 330 06870
Spring, PCB support	3502 319 91160	Connector, Coax 31-202 AMP	2422 031 00002
Plate DC cable clamp	3502 319 90310	Connector, Coax, Modfd Dplx. (SK4)	3502 310 36520
Plate heatsink	3502 319 92740	L.T. Cable Assy	3502 350 03090
Lid, heatsink P.A. 914/6	3502 319 90340	L.T. Lead Assy. (Long)	3502 330 05860
Panel, remote front	3504 319 90250	Socket 5-Pin DIN Ster.Lock.(SK1)	2412 026 15012
Cradle, plinth 900 (plas/blk)	3502 319 91000	Socket BNC fem. amp.114375 (SK3)	2422 031 10301
Spring, cradle Mtg 900	3502 319 91010	Fuse 10A L1055 or 3AG (FS1/FS2)	2413 086 00168
Spring latch, split cradle	3502 319 91020	Assy. F/Thru Strip Chassis	3502 350 03480
Guide, cradle cover	3502 319 90820	Assy. F/Thru Strip 91 PA	3502 350 03470
Key cradle 900 rumbled	3502 319 91030	Heatsink PA UHF	3502 319 90320
PCB, Duplex Wiring	3502 309 96940	Packing Piece, PA Module	3502 319 92750
Shield Duplex Loop	3502 319 93410	Screw, PA Shield Mtg	3502 319 91780
Label, Duplex Tx-Rx	3502 319 35610	Coax Link, Rx-Cont/Syn	3502 319 91530
Insulator Assy Cont/Synth	3502 330 08090	Coax Link, Rx-PA T/R Sw	3502 319 91520
Insulator Front End	3502 319 94100	Coax Link, Rx-PA Input	3502 319 91510
Cap Cer.Pl. 470p 10% 100V (C1)	2222 630 08471	Coax Link, Rx Mix/Rx Ant	3502 319 93550
Cap Cer.Pl. 470p 10% 100V (C2)	2222 630 08471	Coax Link, Rx VCO/Cont.Synth	3502 319 93540
(*) Bead, Ferrite	2413 545 00249	Coax Link, Dplx/Tx PA	3502 319 93560
Assy Ribbon Cable 4 way	3502 350 03340	Coax Link, Rx Buff/Dplx	3502 319 93570

Note (*) This item not fitted for W1 High Band.

References for mechanical hardware are presented pictorially in Section 9 to provde easy and quick recognition of the required parts.

6.12. TRANSMITTER PA PC BOARDS (DUPLEX) UHF

6.12.1 TX PA PC BOARD T-BAND (DUPLEX) (3502 349 81650)

	Tx PA Brd UHF Basic	3502 349 81000	C122	Cap Mica 6p8 5% 250V	2022 900 00095
R116	Res Carb F 18k 5% ¼W	2120 101 46183	C123	Cap Cer Pl 8p2 p25 500V NPO	2222 650 09828
C114	Cap Mica 27p 5% 250V	2022 751 00016	IC102	Intgrd Circt MHW709-1	9334 497 60112
C115	Cap Mica 39p 5% 250V	2022 751 00019	LK102	Wire Link	3502 319 93210
C118	Cap Mica 39p 5% 250V	2022 751 00019	L105	Coil A/W Tx PA U,T,W1	3502 382 90010
C119	Cap Mica 47p 5% 250V	2022 751 00017	L106	Choke Tx PA T Bnd	3502 389 90310

6.12.2 TX PA PC BOARD U-BAND (DUPLEX) (3502 349 81660)

	Tx PA Brd UHF Basic	3502 349 81000	C122	Cap Mica 6p8 5% 250V	2022 900 00095
R116	Res Carb F 18k 5% ¼W	2120 101 46183	C123	Cap Cer Pl 5p6 p25 500V NPO	2222 650 09568
C114	Cap Mica 22pF 5% 250V	2022 751 00018	IC102	Intgrd Circt MHW709-2	9334 497 70112
C115	Cap Mica 27p 5% 250V	2022 751 00016	LK102	Wire Link	3502 319 93210
C118	Cap Mica 33p 5% 250V	2022 751 00015	L105	Coil A/W Tx PA "U,T,W1"	3502 382 90010
C119	Cap Mica 47p 5% 250V	2022 751 00017	L106	Choke Tx PA U Band	3502 389 90320

6.12.3 TX PA PC BOARD W1 BAND (DUPLEX) (3502 349 81670)

	Tx PA Brd UHF Basic	3502 349 81000	C122	Cap Mica 6p8 5% 250V	2022 900 00095
R116	Res Carb F 22k 5% ¼W	2120 101 46223	C123	Cap Cer Pl 4p7 p25 500V NPO	2222 650 09478
C114	Cap Mica 22pF 5% 250V	2022 751 00018	IC102	Intgrd Circt MHW709-3	9334 497 80111
C115	Cap Mica 22pF 5% 250V	2022 751 00018	LK102	Wire Link	3502 319 93210
C118	Cap Mica 33p 5% 250V	2022 751 00015	L105	Coil A/W Tx PA U,T,W1	3502 382 90010
C119	Cap Mica 47p 5% 250V	2022 751 00017	L106	Choke Tx PA W1-W2 Bnd	3502 389 90330

6.12.4 TX PA PC BOARD W2 BAND (DUPLEX) (3502 349 81680)

	Tx PA Brd UHF Basic	3502 349 81000	C123	Cap Cer Pl 4p7 p25 500V NPO	2222 650 0947
R116	Res Carb F 22k 5% ¼W	2120 101 46223	IC102	Intgrd Circt MHW709-3	9334 497 8011
C114	Cap Mica 22pF 5% 250V	2022 751 00018	LK102	Wire Link	3502 319 9321
C115	Cap Mica 22pF 5% 250V	2022 751 00018	L105	Coil A/W Tx PA W2 L5	3502 382 9002
C118	Cap Mica 27p 5% 250V	2022 751 00016	L106	Choke Tx PA W1-W2 bnd L7	3502 389 9033
C119	Cap Mica 39p 5% 250V	2022 751 00019			

6.12.5 TX PA PC BOARD UHF BASIC (3502 349 81000)

	PCB Tx PA 25W Basic	3502 309 81000	R115	Res Carb F 10k 5% ¼W	2120 101 4610
	Shield, Aerial Filter	3502 319 91100	R117	Res Carb F 68k 5% ¼W	2120 101 4668
	Partition, Aerial Filter	3502 319 91110	R118	Res Carb F 10E 5% ¼W	2120 101 4610
	Bead, Ferrite	4322 020 34400	R119	Res Carb F 3k3 5% ¼W	2120 101 4633
R101	Res Carb F 2k7 5% ¼W	2120 101 46272	C101	Cap Cer D/M 100n 20% 50V X7R	2022 552 0175
R102	Pot Cermet 10k 10% 1W	2113 391 00507	C102	Cap Cer Pl 470p 10% 100V	2222 630 0847
R103	Res Carb F 1kO 5% ¼W	2120 101 46102	C103	Cap Cer Pl 4n7 10% 100V	2222 630 0847
R104	Res Carb F 470k 5% ¼W	2120 101 46474	C104	Cap Elec S/Al 3u3 -20+40% 16V	2222 122 5533
R105	Res Carb F 100E 5% ¼W	2120 101 46101	C105	Cap Cer D/M 100n 20% 50V X7R	2022 552 0175
R106	Thermistor PTC 90C with Lead	2322 672 91004	C106	Cap Elec S/AL 3u3 -20+40% 16V	2222 122 5533
R108	Res Carb F 10E 5% ¼W	2120 101 46109	C107	Cap Cer D/M 100n 20% 50V X7R	2022 552 0175
R109	Res Carb F 10k 5% ¼W	2120 101 46103	C108	Cap Cer Pl 220p 10% 100V	2222 630 0822
R110	Res Carb F 10k 5% ¼W	2120 101 46103	C109	Cap Elec S/AL 3u3 -20+40% 16V	2222 122 5533
R111	Res Carb F 33k 5% ¼W	2120 101 46333	C110	Cap Cer Pl 47p 2% 100V NPO	2222 680 1047
R112	Res Metal F 4E7 5% ½w	2322 186 13478	C111	Cap Trim Film H/T 1p8-10p 300V	2222 809 0500

6.12.5 **TX PA PC BOARD UHF BASIC** (Cont'd)
(3502 349 81000)

C112	Cap Cer Pl 220p 10% 100V	2222 630 08221	C134	Cap Mica 5p6 5% 250V	2022 900 00094
C113	Cap Cer Pl 2p2 p25 10% 100V	2222 680 09228	C135	Cap Cer Pl 2p2 p25 100V NP0	2222 680 09228
C116	Cap Elec S/AL 4u7 -20+40% 25V	2222 122 56478	IC101	Intgrd Circt LM358N	9333 935 10112
C117	Cap Cer Pl 120p 2% 500V N750	2222 650 58121	TR101	Transistor BD945	9333 481 20112
C120	Cer D/M 100n 20% 50V X7R	2022 552 01751	TR102	Transistor MRF646	9333 928 70112
C121	Cap Cer Pl 2n2 10% 100V	2222 630 08222	D101	Diode BZV46-2V0	9334 339 40112
C124	Cap Trim Film 3H/T 2p-9p 300V	2222 809 09002	D102	Diode 1N4148	9330 839 90112
C126	Cap Cer Pl 120p 2% 500V N750	2222 650 58121	D106	Diode 1N4148	9330 839 90112
C128	Cap Cer Pl 120p 2% 500V N750	2222 650 58121	L101	Choke RF 2.5turn 4B	4312 020 36700
C129	Cap Cer Pl 1n0 10% 100V	2222 630 08102	L103	Coil A/W Tx PA UHF	3502 382 90000
C130	Cap Cer Pl 4p7 p25 500V NP0	2222 650 09478	L104	Choke RF 2.5turn 4B	4312 020 36700
C131	Cap Cer Pl 10p 2% 500V NP0	2222 650 10109	L110	Coil A/W Tx PA UHF	3502 382 90040
C132	Cap Cer Pl 1p8 p25 500V NP0	2222 650 09188	L111	Coil A/W Tx PA UHF	3502 382 90050
C133	Cap Cer Pl 10p 2% 500V NP0	2222 650 10109	L112	Coil A/W Tx PA UHF	3502 382 90060

6.13 **RECEIVER PC BOARDS (DUPLEX) UHF**

6.13.1 **RECEIVER PC BOARD T-BAND 25KHZ DUPLEX MK2**
(3502 349 82210)

	Rx Brd UHF 25kHz Basic	3502 349 82090	C204	Cap Cer D/M 100n 20% 50v X7R	2022 552 01751
R239	Res Carb F 27k 5% ¼W	2120 101 46273	C263	Cap Pest 6n8 10% 100V AMX	2020 300 85682
R247	Res Carb F 1k5 5% ¼W	2120 101 46152	C265	Cap Pest 4n7 10% 100V AMX	2020 300 85472
R251	Res Carb F 1k5 5% ¼W	2120 101 46152	C277	Cap Pest 3n9 10% 100V AMX	2020 300 85392
R263	Res Carb F 82k 5% ¼W	2120 101 46823	C295	Cap Cer D/M 100n 20% 50v X7R	2022 552 01751
R287	Res Carb F 330E 5% ¼W	2120 101 46331	C296	Cap Cer D/M 100n 20% 50v X7R	2022 552 01751
FL201	Xtal Filt Mnlthic 21.4(21F15C)	2722 172 90032	C297	Cap Cer Pl 1n0 10% 100V	2222 630 08102
FL202	Filter Cer. 455kHz CFW455D	2422 549 03635	U201	Front-End Module Assy 'T' Wde	3502 357 90050
L202	Choke 6.8uH 10% AXL 070-23	2422 535 97559	U202	Hybrid H12	3502 358 00190
L203	Coil Assy Rx Mixer Input	3502 389 90410	U203	VCO Module Assy 'T'	3502 357 90120

6.13.2 **RECEIVER PC BOARD U-BAND 25KHZ DUPLEX MK2**
(3502 349 82220)

	Rx Brd UHF 25kHz Basic	3502 349 82090	C204	Cap Cer D/M 100n 20% 50v X7R	2022 552 01751
R239	Res Carb F 27k 5% ¼W	2120 101 46273	C263	Cap Pest 6n8 10% 100V AMX	2020 300 85682
R247	Res Carb F 1k5 5% ¼W	2120 101 46152	C265	Cap Pest 4n7 10% 100V AMX	2020 300 85472
R251	Res Carb F 1k5 5% ¼W	2120 101 46152	C277	Cap Pest 3n9 10% 100V AMX	2020 300 85392
R263	Res Carb F 82k 5% ¼W	2120 101 46823	C295	Cap Cer D/M 100n 20% 50v X7R	2022 552 01751
R287	Res Carb F 330E 5% ¼W	2120 101 46331	C296	Cap Cer D/M 100n 20% 50v X7R	2022 552 01751
FL201	Xtal Filt Mnlthic 21.4(21F15C)	2722 172 90032	C297	Cap Cer Pl 1n0 10% 100V	2222 630 08102
FL202	Filter Cer. 455kHz CFW455D	2422 549 03635	U201	Front-End Module Assy 'U' Wde	3502 357 90070
L202	Choke 6.8uH 10% AXL 070-23	2422 535 97559	U202	Hybrid H12	3502 358 00190
L203	Coil Assy Rx Mixer Input	3502 389 90410	U203	VCO Module Assy 'U'	3502 357 90130

6.13.3 **RECEIVER PC BOARD W1 BAND 25KHZ DUPLEX MK2**
(3502 349 82230)

	Rx Brd UHF 25kHz Basic	3502 349 82090	C204	Cap Cer D/M 100n 20% 50v X7R	2022 552 01751
R239	Res Carb F 27k 5% ¼W	2120 101 46273	C263	Cap Pest 6n8 10% 100V AMX	2020 300 85682
R247	Res Carb F 1k5 5% ¼W	2120 101 46152	C265	Cap Pest 4n7 10% 100V AMX	2020 300 85472
R251	Res Carb F 1k5 5% ¼W	2120 101 46152	C277	Cap Pest 3n9 10% 100V AMX	2020 300 85392
R263	Res Carb F 82k 5% ¼W	2120 101 46823	C295	Cap Cer D/M 100n 20% 50v X7R	2022 552 01751
R287	Res Carb F 330E 5% ¼W	2120 101 46331	C296	Cap Cer D/M 100n 20% 50v X7R	2022 552 01751
FL201	Xtal Filt Mnlthic 21.4(21F15C)	2722 172 90032	C297	Cap Cer Pl 1n0 10% 100V	2222 630 08102
FL202	Filter Cer. 455kHz CFW455D	2422 549 03635	U201	Front-End Module Assy 'W' Wde	3502 357 90080
L202	Choke 6.8uH 10% AXL 070-23	2422 535 97559	U202	Hybrid H12B Buffer DPLX	3502 358 00620
L203	Coil Assy Rx Mixer Input	3502 389 90410	U203	VCO Module Assy 'U'	3502 357 90130

6.13.4 RECEIVER PC BOARD W2 BAND 25KHZ DUPLEX MK2 (3502 349 82240)

	Rx Brd UHF 25kHz Basic	3502 349 82090
R204	Res Carb F 10E 5% ¼W	2120 101 46109
R239	Res Carb F 27k 5% ¼W	2120 101 46273
R247	Res Carb F 1k5 5% ¼W	2120 101 46152
R251	Res Carb F 1k5 5% ¼W	2120 101 46152
R263	Res Carb F 82k 5% ¼W	2120 101 46823
R287	Res Carb F 330E 5% ¼W	2120 101 46331
FL201	Xtal Filt Mnlthic 21.4(21F15C)	2722 172 90032
FL202	Filter Cer. 455kHz CFW455D	2422 549 03635
L203	Coil L201 Rx PCB W2	3502 382 90470
C204	Cap Cer D/M 100n 20% 50v X7R	2022 552 01751
C263	Cap Pest 6n8 10% 100V AMX	2020 300 85682
C265	Cap Pest 4n7 10% 100V AMX	2020 300 85472
C277	Cap Pest 3n9 10% 100V AMX	2020 300 85392
C295	Cap Cer D/M 100n 20% 50v X7R	2022 552 01751
C296	Cap Cer D/M 100n 20% 50v X7R	2022 552 01751
C297	Cap Cer Pl 1n0 10% 100V	2222 630 08102
U201	Front-End Module Assy 'W2' Wde	3502 357 90230
U202	Hybrid H12B Buffer DPLX	3502 358 00620
U203	VCO Module Assy 'W2'	3502 357 90150

6.13.5 RECEIVER PC BOARD BASIC (UHF) (3502 349 82090)

	PCB Rx UHF 25KHz	3502 309 82090
	Bracket TO-220 MTG	3502 319 92730
	Hinge Block LH	3502 319 90290
	Hinge Block RH	3502 319 90300
	Insulator Rx VCO	3502 319 94370
	Jumper Assy 11-way AMP	2422 011 00775
	Jumper Assy 11-way AMP	2422 011 00776
	Jumper Assy 7-way AMP	2422 011 00777
R201	Res Carb F 47k 5% ¼W	2120 101 46473
R202	Res Carb F 100k 5% ¼W	2120 101 46104
R203	Res Carb F 1k0 5% ¼W	2120 101 46102
R205	Res Carb F 100E 5% ¼W	2120 101 46101
R206	Res Carb F 1k5 5% ¼W	2120 101 46152
R207	Res Carb F 47E 5% ¼W	2120 101 46479
R208	Res Carb F 22k 5% ¼W	2120 101 46223
R209	Res Carb F 10E 5% ¼W	2120 101 46109
R210	Res Carb F 1E0 5% ¼W	2120 101 46108
R211	Res Carb F 10k 5% ¼W	2120 101 46103
R212	Res Carb F 1k2 5% ¼W	2120 101 46122
R213	Res Carb F 1E0 5% ¼W	2120 101 46108
R214	Res Carb F 1E0 5% ¼W	2120 101 46108
R215	Res Carb F 15k 5% ¼W	2120 101 46153
R217	Res Carb F 1k5 5% ¼W	2120 101 46152
R218	Res Carb F 1k5 5% ¼W	2120 101 46152
R219	Res Carb F 1k0 5% ¼W	2120 101 46102
R220	Res Carb F 270E 5% ¼W	2120 101 46271
R217	Res Carb F 1k5 5% ¼W	2120 101 46152
R218	Res Carb F 1k5 5% ¼W	2120 101 46152
R219	Res Carb F 1k0 5% ¼W	2120 101 46102
R220	Res Carb F 270E 5% ¼W	2120 101 46271
R221	Res Carb F 820E 5% ¼W	2120 101 46821
R222	Res Carb F 1k8 5% ¼W	2120 101 46182
R223	Res Carb F 15k 5% ¼W	2120 101 46153
R224	Res Carb F 47E 5% ¼W	2120 101 46479
R225	Res Carb F 470E 5% ¼W	2120 101 46471
R226	Res Carb F 330E 5% ¼W	2120 101 46331
R227	Res Carb F 180k 5% ¼W	2120 101 46184
R228	Res Carb F 220E 5% ¼W	2120 101 46221
R229	Res Carb F 56E 5% ¼W	2120 101 46569
R230	Res Carb F 3k9 5% ¼W	2120 101 46392
R231	Res Carb F 22k 5% ¼W	2120 101 46223
R232	Res Carb F 6k8 5% ¼W	2120 101 46682
R233	Res Carb F 10k 5% ¼W	2120 101 46103
R234	Res Carb F 10k 5% ¼W	2120 101 46103
R235	Res Carb F 1E0 5% ¼W	2120 101 46108
R236	Res Carb F 470E 5% ¼W	2120 101 46471
R237	Res Carb F 1k0 5% ¼W	2120 101 46471
R238	Res Carb F 560E 5% ¼W	2120 101 46561
R240	Res Carb F 470E 5% ¼W	2120 101 46471
R241	Res Carb F 22k 5% ¼W	2120 101 46223
R242	Res Carb F 47k 5% ¼W	2120 101 46473
R243	Res Carb F 10k 5% ¼W	2120 101 46103
R244	Res Carb F 56k 5% ¼W	2120 101 46563
R245	Res Carb F 15k 5% ¼W	2120 101 46153
R246	Res Carb F 820E 5% ¼W	2120 101 46821
R249	Res Carb F 330k 5% ¼W	2120 101 46334
R250	Res Carb F 5k6 5% ¼W	2120 101 46562
R252	Res Carb F 4E7 5% ¼W	2120 101 46478
R253	Res Carb F 220E 5% ¼W	2120 101 46221
R254	Res Carb F 1M5 5% ¼W	2120 101 46155
R255	Res Carb F 1k2 5% ¼W	2120 101 46122
R256	Res Carb F 10E 5% ¼W	2120 101 46109
R257	Trim Pot Cermet 20k 30% Lin	2102 410 05018
R258	Trim Pot Cermet 2k0 30% Lin	2102 410 05022
R259	Res Carb F 33k 5% ¼W	2120 101 46333
R260	Res Carb F 180k 5% ¼W	2120 101 46184
R261	Res Carb F 33k 5% ¼W	2120 101 46333
R262	Res Carb F 10E 5% ¼W	2120 101 46109
R263	Res Carb F 6k8 5% ¼W	2120 101 46682
R265	Res Carb F 220k 5% ¼W	2120 101 46224
R266	Res Metal F 47k 1% 0.6W MRS25	2322 156 14703
R267	Res Metal F 220k 1% 0.6W MRS25	2322 156 12204
R268	Res Metal F 27k 1% 0.6W MRS25	2322 156 12703
R269	Res Metal F 39k 1% 0.6W MRS25	2322 156 13903
R270	Res Carb F 6k8 5% ¼W	2120 101 46682
R271	Res Metal F 82k 1% 0.6W MRS25	2322 156 18203
R272	Res Metal F 27k 1% 0.6W MRS25	2322 156 12703
R273	Res Metal F 47k 1% 0.6W MRS25	2322 156 14703
R274	Res Metal F 220k 1% 0.6W MRS25	2322 156 12204
R275	Res Metal F 82k 1% 0.6W MRS25	2322 156 18203
R276	Res Carb F 10k 5% ¼W	2120 101 46103
R277	Res Carb F 18k 5% ¼W	2120 101 46183
R278	Res Carb F 10E 5% ¼W	2120 101 46109
R279	Res Metal F 22k 1% 0.6W MRS25	2322 156 12203

6.13.5 **RECEIVER PC BOARD BASIC (UHF)** (Cont'd)
(3502 349 82090)

R280	Res Carb F 56k 5% ¼W	2120 101 46563
R281	Res Carb F 56k 5% ¼W	2120 101 46563
R282	Res Carb F 47k 5% ¼W	2120 101 46473
R283	Res Carb F 220k 5% ¼W	2120 101 46224
R284	Res Carb F 22k 5% ¼W	2120 101 46223
R285	Res Carb F 15k 5% ¼W	2120 101 46153
R286	Res Carb F 220k 5% ¼W	2120 101 46224
R289	Thermistor NTC 100k 10% 0.6W	2322 642 62104
R290	Res Carb F 82k 5% ¼W	2120 101 46823
R291	Res Carb F 10k 5% ¼W	2120 101 46103
R292	Res Carb F 100E 5% ¼W	2120 101 46101
R293	Res Carb F 2k2 5% ¼W	2120 101 46222
R294	Res Carb F 2k2 5% ¼W	2120 101 46222
C200	Cap Con/Ml Cer 10n 10% 50V X7R	2022 552 02495
C201	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C202	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C203	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02482
C205	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C206	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02482
C207	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02482
C208	Cap Cer Pl 33p 2% 100V NPO	2222 680 10339
C209	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C210	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C211	Cap Al Elec 47u -10+50% 25V	2222 035 56479
C212	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C213	Cap Al Elec 100u -10+50% 25V	2222 035 56101
C214	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C215	Cap Al Elec 47u -10+50% 25V	2222 035 56479
C216	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C217	Cap Al Elec 22u -10+50% 50V	2222 035 90003
C218	Cap Al Elec 10u -10+50% 50V	2222 035 90008
C219	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C220	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C221	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C222	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C223	Cap Al Elec 100u -10+50% 25V	2222 035 56101
C224	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C225	Cap Pcar 100n 10% 100V	2222 344 21104
C226	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C227	Cap Cer Pl 22n 20% 50V X7R	2022 552 02019
C228	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C229	Cap Al Elec 47u -10+50% 25V	2222 035 56479
C230	Cap Cer Pl 33p 2% 100V NPO	2222 680 10339
C231	Cap Pcar 100n 10% 100V	2222 344 21104
C232	Cap Cer Pl 27p 2% 100V NPO	2222 680 10279
C233	Cap Cer Pl 120p 2% 100V N750	2222 680 58121
C234	Cap Cer Pl 82p 2% 100V NPO	2222 680 10829
C235	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C236	Cap Al Elec 4u7 -10+50% 63V	2222 035 58478
C237	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C238	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C239	Cap Al Elec 47u -10+50% 25V	2222 035 56479
C240	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C241	Cap Cer Pl 68p 2% 100V NPO	2222 680 10689
C242	Cap Cer Pl 10p 2% 100V NPO	2222 680 10109
C243	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C244	Cap Al Elec 47u -10+50% 25V	2222 035 56479
C245	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C246	Cap Al Elec 10u -10+50% 50V	2222 035 90008
C247	Cap Pcar 100n 10% 100V	2222 344 21104
C248	Cap Pest 1n5 10% 100V AMX	2020 300 85152
C249	Cap Al Elec 1u -10+50% 100V	2222 035 59108
C250	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C251	Cap Pcar 100n 10% 100V	2222 344 21104
C252	Cap Al Elec 47u -10+50% 25V	2222 035 56479
C253	Cap Pcar 100n 10% 100V	2222 344 21104
C254	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C255	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C256	Cap Al Elec 33u -10+50% 16V	2222 035 55339
C257	Cap Cer Pl 10p 2% 100V NPO	2222 680 10109
C258	Cap Con/Ml Cer 220n 10% 50V	2022 552 02379
C259	Cap Con/Ml Cer 220 10% 50V	2022 552 02379
C260	Cap Pcar 100n 10% 100V	2222 344 21104
C261	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C262	Cap Al Elec 47u -10+50% 25V	2222 035 56479
C264	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C266	Cap Al Elec 470u -10+50% 16V	2222 031 35471
C267	Cap Al Elec 470u -10+50% 16V	2222 031 35471
C268	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C269	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C270	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C271	Cap Con/Ml Cer 220n 10% 50V	2022 552 02379
C272	Cap Cer Pl 150p 2% 100V N750	2222 680 58151
C273	Cap Cer Pl 8p2 p25 100V NPO	2222 680 09828
C274	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C275	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C276	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C278	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C279	Cap Pest Stkd 10n 5% 100V	2011 301 40251
C280	Cap Pest Stkd 10n 5% 100V	2011 301 40251
C281	Cap Al Elec 10u -10+50% 50V	2222 035 90008
C282	Cap Con/Ml Cer 220n 10% 50V	2022 552 02379
C284	Cap Cer Dp/Ml 3n3 5% 50V NPO	2011 557 25591
C285	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C286	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C287	Cap Al Elec 10u -10+50% 50V	2222 035 90008
C288	Cap Pest Stkd 10n 5% 100V	2011 301 40251
C289	Cap Cer Pl 470p 10% 100V	2222 630 08471
C290	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C291	Cer Cer D/M 100n 20% 50V X7R	2022 552 01751
C292	Cap Cer Pl 150p 2% 100V N750	2222 680 58151
C293	Cap Pest 10n 10% 100V	2020 300 85103
C294	Cap Al Elec 4u7 -10+50% 25V	2222 035 56478
C298	Cap Al Elec 4u7 -10+50% 25V	2222 035 56478
C299	Cap Cer Pl 1n0 10% 100V	2222 630 08102
TR201	Transistor BC548C	9331 976 70112
TR202	Transistor BC337	9331 492 00112
TR203	Transistor BC328	9331 491 90112
TR204	Transistor BC548C	9331 976 70112
TR205	Transistor BC328	9331 491 90112

6.13.5 RECEIVER PC BOARD (BASIC) UHF (Cont'd)

TR206	Transistor	BD946	9334 481 30112	D208	Diode	BZX79-C6V8	9331 177 50112
TR207	Transistor	BC548C	9331 976 70112	D209	Diode	1N4148	9330 839 90112
TR208	Transistor	BC328	9331 491 90112	D210	Diode	1N4148	9330 839 90112
TR209	Transistor	BF256B	9331 905 30112	D211	Diode	1N4148	9330 839 90112
TR210	Transistor	BD946	9334 481 30112	D212	Diode	1N4148	9330 839 90112
TR211	Transistor	BF494	9331 987 70112	IC201	Intgrd Circt	OM815	3502 319 91350
TR212	Transistor	BD945	9334 481 20112	IC202	Intgrd Circt	SL6652DG-20	9338 300 40682
TR213	Transistor	BC548C	9331 976 70112	IC203	Intgrd Circt	TDA1010	9333 849 50112
TR214	Transistor	BC548C	9331 976 70112	IC204	Intgrd Circt	MC34082P	9338 734 30682
TR215	Transistor	BF494	9331 987 70112	IC205	Intgrd Circt	LM348N	9333 705 60682
D201	Diode	1N4148	9330 839 90112	L201	Choke	Wide Band RF	4312 020 36640
D202	Diode	1N4148	9330 839 90112	L205	Choke	RF 1.5uH 10% DL1025-24	2422 535 98002
D203	Diode	BZT03-C20	9336 015 80112	L206	Coil, Disdr,	Toko RMC-2A6597HM	2422 549 18111
D204	Diode	1N4148	9330 839 90112	L207	Choke	6.8mH EL0607SK1-682J	2422 535 97062
D205	Diode	1N4148	9330 839 90112	L208	Choke	RF 0.33uH 10% DL1025-08	2422 535 98001
D206	Diode	1N4148	9330 839 90112	RL201	Relay,	Min 10Amp 12V	2402 132 00015
D207	Diode	BZX79-C10	9331 177 90112	XL201	Crystal	20.94MHz 2nd L.Osc	3502 413 48410

6.14 SYNTHESISER/CONTROL PC BOARDS (DUPLEX) UHF

6.14.1 SYNTH/CONTROL PC BOARD UHF DPLX (3502 349 83350)

	Synth/Cont	A/B/UHF Basic	3502 349 73060	R438	Res Carb F	10M 10%, .33W	2322 211 12106
R313	Res Carb F	470E 5%, ¼W	2120 101 46471	C319	Cap Al Elect	10u -10+50% 50V	2222 035 90008
R328	Res Carb F	68k 5%, ¼W	2120 101 46683	C332	Cap Cer Pl	8p2 p25 100V NPO	2222 680 09828
R340	Res Carb F	3k3 5%, ¼W	2120 101 46332	C333	Cap Cer Pl	100p 2% 100V NPO	2222 680 10101
R341	Res Carb F	560k 5%, ¼W	2120 101 46564	C335	Cap Cer Pl	47p 2% 100V NPO	2222 680 10479
R346	Res Carb F	15k 5%, ¼W	2120 101 46153	C345	Cap Cer D/M	100n 20% 50V X7R	2022 552 01751
R347	Res Carb F	22k 5%, ¼W	2120 101 46223	C346	Cap Al Elect	47u -10+50% 25V	2222 035 56479
R349	Res Carb F	22k 5%, ¼W	2120 101 46223	C347	Cap Cer Pl	2n2 10% 100V	2222 630 08222
R355	Res Carb F	220k 5%, ¼W	2120 101 46224	C362	Cap Cer D/M	100n 20% 50V X7R	2022 552 01751
R356	Res Carb F	27k 5%, ¼W	2120 101 46273	C418	Cap Cer Pl	18p 2% 100V NPO	2222 680 10189
R357	Res Carb F	180k 5%, ¼W	2120 101 46184	C421	Cap Cer Pl	18p 2% 100V NPO	2222 680 10189
R366	Res Carb F	68k 5%, ¼W	2120 101 46683	IC303	Intgrd Circt	11C90DC	9333 255 90682
R367	Pot Preset Carb	47k 30% Lin H	2120 357 01473	IC415	Intgrd Circt	NSC810AN	9337 507 50682
R368	Res Carb F	10k 5%, ¼W	2120 101 46103	U301	Hybrid	H13	3502 358 00200
R372	Res Carb F	18k 5%, ¼W	2120 101 46183	U401	Hybrid	H6P	3502 358 00100
R402	Pot Preset Carb	2k2 30% Lin H	2120 357 01222	TR402	Transistor	BC548C	9331 976 70112
R403	Pot Preset Carb	470E 30% Lin H	2120 357 01471	D305	Diode	1N4148	9330 839 90112
R407	Res Carb F	390k 5%, ¼W	2120 101 46394	D401	Diode	BZV46-2V0	9334 339 40112
R412	Res Carb F	22k 5%, ¼W	2120 101 46223	XL302	Crystal	10000kHz Holder	3502 414 98930
R413	Res Carb F	47k 5%, ¼W	2120 101 46473	XL401	Crystal	5.006MHz	2422 413 60020

6.14.2 SYTH/CONTROL PC BOARDS (DUPLEX) BASIC

6.14.2.1 Synth/Control PC Board A/B/UHF Basic (3502 349 73060)

	PCB	Synthesiser Control	3502 349 73050	C301	Cap Cer Pl	220p 10% 100V	2222 630 08221
	Coax Link	Rx-Cont/Synth	3502 319 91530	C302	Cap Cer Pl	1N0 10% 100V	2222 630 08102
IC301	Intgrd Circt	UPB565C	9337 962 90682	C303	Cap Cer Pl	1N0 10% 100V	2222 630 08102
R301	Res Carb F	56E 5% ¼W	2120 101 46569	C304	Cap Cer Pl	1N0 10% 100V	2222 630 08102
R302	Res Carb F	150E 5% ¼W	2120 101 46151	C305	Cap Cer Pl	1N0 10% 100V	2222 630 08102
R303	Res Carb F	180E 5% ¼W	2120 101 46181	D307	Diode	BZX79-C5V1	9331 177 20012

6.14.2.2 Synth/Control PC Board Basic (3502 349 73050)

	PCB Synthesiser Control	3502 309 73050
	Shield Cont. Circuit	3502 319 90400
	Shield Voltage Doubler	3502 319 91400
	Hinge Block LH	3502 319 90290
	Hinge Block RH	3502 319 90300
	Socket 28P D/I/LN(x3)	2422 549 13511
	Socket 40P D/I/LN(x2)	2422 549 13572
R311	Res Carb F 120E 5% ¼W	2120 101 46121
R314	Res Carb F 100E 5% ¼W	2120 101 46101
R315	Res Carb F 1k0 5% ¼W	2120 101 46102
R316	Res Carb F 180E 5% ¼W	2120 101 46181
R317	Res Carb F 22E 5% ¼W	2120 101 46229
R318	Res Carb F 1k0 5% ¼W	2120 101 46102
R319	Res Carb F 180E 5% ¼W	2120 101 46181
R323	Res Carb F 47E 5% ¼W	2120 101 46479
R324	Res Carb F 47E 5% ¼W	2120 101 46479
R326	Res Carb F 1M0 5% ¼W	2120 101 46105
R327	Res Carb F 1k0 5% ¼W	2120 101 46102
R330	Res Carb F 4k7 5% ¼W	2120 101 46472
R331	Res Carb F 4k7 5% ¼W	2120 101 46472
R335	Res Carb F 22k 5% ¼W	2120 101 46223
R336	Res Carb F 6k8 5% ¼W	2120 101 46682
R337	Res Carb F 100E 5% ¼W	2120 101 46101
R338	Res Carb F 22k 5% ¼W	2120 101 46223
R339	Res Carb F 1k5 5% ¼W	2120 101 46152
R342	Res Carb F 10k 5% ¼W	2120 101 46103
R343	Res Carb F 18k 5% ¼W	2120 101 46183
R344	Res Carb F 10k 5% ¼W	2120 101 46103
R348	Res Carb F 10k 5% ¼W	2120 101 46103
R350	Res Carb F 22E 5% ¼W	2120 101 46229
R351	Res Carb F 12k 5% ¼W	2120 101 46123
R352	Res Carb F 1k8 5% ¼W	2120 101 46182
R353	Res Carb F 47E 5% ¼W	2120 101 46479
R354	Res Carb F 220E 5% ¼W	2120 101 46221
R361	Res Carb F 1k0 5% ¼W	2120 101 46102
R365	Pot Preset Carb 10k 30% Lin	2120 357 01103
R373	Res Carb F 180E 5% ¼W	2120 101 46181
R374	Res Carb F 180E 5% ¼W	2120 101 46181
R401	Res Carb F 2k2 5% ¼W	2120 101 46222
R404	Res Carb F 10E 5% ¼W	2120 101 46109
R405	Res Carb F 180k 5% ¼W	2120 101 46184
R406	Res Carb F 47k 5% ¼W	2120 101 46473
R408	Res Carb F 22k 5% ¼W	2120 101 46223
R409	Res Carb F 1E0 5% ¼W	2120 101 46108
R410	Res Carb F 1E0 5% ¼W	2120 101 46108
R411	Res Carb F 22k 5% ¼W	2120 101 46223
R414	Res Carb F 100k 5% ¼W	2120 101 46104
R415	Res Carb F 100k 5% ¼W	2120 101 46104
R416	Res Carb F 22k 5% ¼W	2120 101 46223
R417	Res Carb F 390k 5% ¼W	2120 101 46394
R418	Res Carb F 47k 5% ¼W	2120 101 46473
R421	Res Carb F 47k 5% ¼W	2120 101 46473
R422	Res Carb F 220k 5% ¼W	2120 101 46224
R423	Res Carb F 15k 5% ¼W	2120 101 46153
R424	Res Carb F 4k7 5% ¼W	2120 101 46472
R425	Res Carb F 10k 5% ¼W	2120 101 46103
R426	Res Carb F 100k 5% ¼W	2120 101 46104
R427	Res Carb F 100k 5% ¼W	2120 101 46104
R428	Res Carb F 100k 5% ¼W	2120 101 46104
R429	Res Carb F 47k 5% ¼W	2120 101 46473
R430	Res Carb F 47k 5% ¼W	2120 101 46473
R431	Res Carb F 47k 5% ¼W	2120 101 46473
R432	Res Carb F 47k 5% ¼W	2120 101 46473
R433	Res Carb F 10k 5% ¼W	2120 101 46103
R434	Res Carb F 47k 5% ¼W	2120 101 46473
R435	Res Carb F 4k7 5% ¼W	2120 101 46472
R436	Res Carb F 4k7 5% ¼W	2120 101 46472
R437	Res Carb F 10k 5% ¼W	2120 101 46103
R439	Res Carb F 47k 5% ¼W	2120 101 46473
R441	Res Carb F 10E 5% ¼W	2120 101 46109
R442	Res Carb F 10k 5% ¼W	2120 101 46103
R443	Res Carb F 4k7 5% ¼W	2120 101 46472
R444	Res Carb F 2k2 5% ¼W	2120 101 46222
R446	Res Carb F 4k7 5% ¼W	2120 101 46472
R447	Res Carb F 4k7 5% ¼W	2120 101 46472
R448	Res Carb F 4k7 5% ¼W	2120 101 46472
R449	Res Carb F 4k7 5% ¼W	2120 101 46472
R451	Res Carb F 1k0 5% ¼W	2120 101 46102
R452	Res Carb F 10k 5% ¼W	2120 101 46103
R454	Res Carb F 10E 5% 0.2W	2322 210 13109
R458	Res Metal F 22k 2% 0.4W	2322 151 42203
R459	Res Metal F 27k 2% 0.4W	2322 151 42703
R460	Res Carb F 1k0 5% ¼W	2120 101 46102
R473	Res Carb F 4k7 5% ¼W	2120 101 46472
C309	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C310	Cap Al Elec 1u0 -10%+50% 100V	2222 035 59108
C311	Cap Al Elec 1u0 -10+50% 100V	2222 035 59108
C313	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C314	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C316	Cap Al Elec 4u7 -10+50% 63V	2222 035 58478
C317	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C318	Cap Cer Pl 4p7 p25 100V NPO	2222 680 09478
C320	Cap Cer Pl 4p7 p25 100V NPO	2222 680 09478
C321	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02875
C322	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C326	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C327	Cap Al Elec 10u -10+50% 50V	2222 035 90008
C328	Cap Al Elec 10u -10+50% 50V	2222 035 90008
C329	Cap Cer Pl 4n7 10% 100V	2222 630 08472
C331	Cap Trim Film H/T 2P-18P 300V	2222 809 05003
C334	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C336	Cap Pcar 33n 10% 400V	2222 344 51333
C340	Cap Al Elec 10u -10+50% 50V	2222 035 90008
C342	Cap Al Elec 10u -10+50% 50V	2222 035 90008
C344	Cap Al Elec 4u7 -10+50% 63V	2222 035 58478
C348	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02875
C349	Cap Al Elec 10u -10+50%	2222 035 90008
C350	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02875
C351	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02875
C352	Cap Al Elec 10u -10+50% 50V	2222 035 90008

6.14.2.2 **Synth/Control PC Board Basic** (Cont'd)
(3502 349 73050)

C353	Cap Al Elec 1u0 -10+50% 100V	2222 035 59108	C453	Cap Cer Pl 1n0 10% 100V	2222 630 08102
C355	Cap Cer Pl 330p 10% 100V	2222 630 08331	C454	Cap Elec 47000uF +80-20% NEC	2020 900 00002
C356	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02875	C460	Cap Cer Pl 39p 2% 500V NPO	2222 650 10399
C363	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02875	IC302	Intgrd Circt MC79L05ACP	9335 330 20682
C364	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02875	IC304	Intgrd Circt HEF4751VD	9335 202 00682
C367	Cap Cer Pl 1n0 10% 100V	2222 630 08102	IC305	Intgrd Circt HEF4750VD	9335 201 80682
C368	Cap Cer Pl 10p 2% 100V NPO	2222 680 10109	IC306	Intgrd Circt TL072CP-00	9335 327 60682
C401	Cap Al Elec 22u -10+50% 35V	2222 035 90003	IC401	Intgrd Circt MC78L05ACP	9335 107 20682
C402	Cap Al Elec 22u -10+50% 35V	2222 035 90003	IC402	Intgrd Circt MC14443P	9335 635 90682
C403	Cap Cer Pl 4n7 10% 100V	2222 630 08472	IC403	Intgrd Circt MC14504BCP	9335 635 80682
C404	Cap Psty 330p 1% 630V	2222 427 43301	IC404	Intgrd Circt MC14174BCP	9335 145 90682
C405	Cap Tant 1u0 20% 35V	2020 004 90037	IC405	Intgrd Circt MC14174BCP	9335 145 90682
C406	Cap Cer Pl 4n7 10% 100V	2222 630 08472	IC406	Intgrd Circt MC14174BCP	9335 145 90682
C407	Cap Cer D/M 100n 20% 50V X7R	2022 552 02876	IC407	Intgrd Circt HEF4011BP	9332 775 90112
C408	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02875	IC408	Micro Pro Unit MC146805E2P	9336 237 50682
C412	Cap Al Elec 100u -10+50% 25V	2222 035 56101	IC409	Intgrd Circt N74LS373N	9334 555 00112
C413	Cap Al Elec 100u -10+50% 25V	2222 035 56101	IC410	Intgrd Circt 74LS00PC	9332 897 71682
C414	Cap Cer Pl 4n7 10% 100V	2222 630 08472	IC411	Intgrd Circt LM340-T5T	9334 006 00682
C415	Cap Cer Pl 1n0 10% 100V	2222 630 08102	IC413	Intgrd Circt MC74LS260PC	9336 355 20682
C416	Cap Cer Pl 1n0 10% 100V	2222 630 08102	IC414	Intgrd Circt 74LS00PC	9332 897 71682
C417	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02875	TR301	Transistor 2N5771	9333 885 90682
C419	Cap Cer Pl 4n7 10% 100V	2222 630 08472	TR302	Transistor BC558	9331 977 30112
C420	Cap Cer Pl 47p 2% 100V NPO	2222 680 10479	TR303	Transistor BC548C	9331 976 70112
C422	Cap Al Elec 100u -10+50% 25V	2222 035 56101	TR401	Transistor BC548C	9331 976 70112
C423	Cap Cer Pl 100p 2% 100V NPO	2222 680 10101	TR403	Transistor BC548C	9331 976 70112
C424	Cap Cer Pl 47p 2% 100V NPO	2222 680 10479	TR404	Transistor BC548C	9331 976 70112
C425	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02875	TR405	Transistor BC328	9331 491 90112
C426	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02875	TR406	Transistor BC548C	9331 976 70112
C429	Cap Cer Pl 4n7 10% 100V	2222 630 08472	TR408	Transistor BC558	9331 977 30112
C430	Cap Cer Pl 220p 10% 100V	2222 630 08221	D302	Diode 1N4148	9330 839 90112
C431	Cap Cer Pl 1n0 10% 100V	2222 630 08102	D303	Diode 1N4148	9330 839 90112
C432	Cap Cer Pl 1n0 10% 100V	2222 630 08102	D304	Diode 1N4148	9330 839 90112
C448	Cap Pest 22n 10% 100V AMX	2020 300 85223	D306	Diode 1N4148	9330 839 90112
C449	Cap Al Elec 47u -10+50% 25V	2222 035 56479	D402	Diode BAV21	9331 892 10113
C450	Cap Al Elec 47u -10+50% 25V	2222 035 56479	D403	Diode BAV21	9331 892 10113
C451	Cap Al Elec 100u -10+50% 25V	2222 035 56101	SK405	Pin Header 4P Molex M7812-4A	2422 021 98145
C452	Cap Cer Pl 1n0 10% 100V	2222 630 08102	SK406	Pin Header 3P M7812-3A	2422 021 98158

6.15 UHF DUPLEX PC BOARD

6.15.1 DUPLEX PC BOARD T-BAND (3502 349 81350)

	PCB Duplex Brd Basic	3502 349 81300	U801	Hybrid H11E VCO	3502 358 00590
L805	Coil HEL/RES 828 T L1,3	3502 383 00920	U802	Hybrid H12	3502 358 00190
L806	Coil HEL/RES 828 T L1,3	3502 383 00920			

6.15.2 DUPLEX PC BOARD U-BAND (3502 349 81360)

	PCB Duplex Brd Basic	3502 349 81300	U801	Hybrid H11 VCO	3502 358 00600
L805	Coil HEL/RES 828 URX L1,3	3502 383 00640	U802	Hybrid H12	3502 358 00190
L806	Coil HEL/RES 828 URX L1,3	3502 383 00640			

6.15.3 DUPLEX PC BOARD W1-BAND (3502 349 81370)

	PCB Duplex Brd Basic	3502 349 81300	U801	Hybrid H11 VCO	3502 358 00600
L805	Coil HEL/RES 828 W1RX L1,3	3502 383 00780	U802	Hybrid H12B Buffer	3502 358 00620
L806	Coil HEL/RES 828 W1RX L1,3	3502 383 00780			

6.15.4 DUPLEX PC BOARD W2-BAND (3502 349 81380)

	PCB Duplex Brd Basic	3502 349 81300	U801	Hybrid H11G VCO	3502 358 00610
L805	Coil HEL/RES 828 W2RX L1,3	3502 383 00870	U802	Hybrid H12B Buffer	3502 358 00620
L806	Coil HEL/RES 828 W2RX L1,3	3502 383 00870			

6.15.5 DUPLEX PC BRD BASIC UHF (3502 349 81300)

	PCB Duplex Brd UHF	3502 309 81300	R862	Res Carb F 12E 5% ¼W	2120 101 46129
	Spacer, PCB Support	3502 319 91860	R863	Positor PTC 33 ohm	2120 660 90006
R801	Res Carb F 47k 5% ¼W	2120 101 46473	R864	Res Carb F 1k0 5% ¼W	2120 101 46102
R802	Res Carb F 27k 5% ¼W	2120 101 46273	R865	Res Carb F 3k3 5% ¼W	2120 101 46332
R803	Res Carb F 27k 5% ¼W	2120 101 46273	R866	Res Carb F 47k 5% ¼W	2120 101 46473
R804	Res Carb F 10E 5% ¼W	2120 101 46109	R867	Thermistor NTC 470E 10% 0.6W	2322 642 61471
R805	Res Carb F 100k 5% ¼W	2120 101 46104	R868	Res Carb F 12k 5% ¼W	2120 101 46123
R806	Res Carb F 100k 5% ¼W	2120 101 46104	R869	Res Carb F 1k8 5% ¼W	2120 101 46182
R807	Res Carb F 100k 5% ¼W	2120 101 46104	C801	Cap Al Elect 47u -10+50% 25V	2222 035 56479
R808	Res Carb F 33E 5% ¼W	2120 101 46339	C802	Cap Petp 100n 10% 100V	2222 344 27104
R809	Res Carb F 100k 5% ¼W	2120 101 46104	C803	Cap Cer Pl 4n7 10% 100V	2222 630 08472
R810	Res Carb F 6k8 5% ¼W	2120 101 46682	C804	Cap Al Elec 47u -10+50% 25V	2222 035 56479
R811	Res Carb F 100k 5% ¼W	2120 101 46104	C805	Cap Tant 0u1 20% 35V	2020 004 90037
R812	Res Carb F 100k 5% ¼W	2120 101 46104	C806	Cap Al Elec 47u -10+50% 25V	2222 035 56479
R813	Res Carb F 1k0 5% ¼W	2120 101 46102	C807	Cap Cer Pl 100p 2% 100V N750	2222 680 58101
R814	Res Carb F 10k 5% ¼W	2120 101 46103	C808	Cap Cer Pl 1n0 10% 100V	2222 630 08102
R815	Res Carb F 22k 5% ¼W	2120 101 46223	C809	Cap Cer Pl 4n7 10% 100V	2222 630 08472
R816	Res Carb F 680E 5% ¼W	2120 101 46681	C810	Cap Cer Pl 4n7 10% 100V	2222 630 08472
R817	Res Carb F 47E 5% ¼W	2120 101 46479	C811	Cap Pcar 47n 10% 250V	2222 344 45473
R818	Res Carb F 390E 5% ¼W	2120 101 46391	C812	Cap Pcar 47n 10% 250V	2222 344 45473
R819	Res Carb F 1E0 5% ¼W	2120 101 46108	C813	Cap Al Elec 47u -10+50% 25V	2222 035 56479
R820	Res Carb F 15k 5% ¼W	2120 101 46153	C814	Cap Cer Pl 2n2 10% 100V	2222 630 08222
R821	Res Carb F 47E 5% ¼W	2120 101 46479	C815	Cap Tant 0u47 20% 35V	2020 004 90036
R822	Res Carb F 1k0 5% ¼W	2120 101 46102	C816	Cap Cer Pl 4n7 10% 100V	2222 630 08472
R823	Res Carb F 22k 5% ¼W	2120 101 46223	C817	Cap Cer Pl 4n7 10% 100V	2222 630 08472
R824	Res Carb F 47E 5% ¼W	2120 101 46479	C818	Cap Cer D/M 100n 20% 50V Z5U	2022 552 02482
R825	Res Carb F 4k7 5% ¼W	2120 101 46472	C819	Cap Cer Pl 330p 2% 100V N750	2222 680 58331
R826	Res Carb F 1k0 5% ¼W	2120 101 46102	C820	Cap Al Elec 4u7 -10+50% 63V	2222 035 58478
R827	Res Carb F 4k7 5% ¼W	2120 101 46472	C821	Cap Cer Pl 330p 2% 100V N750	2222 680 58331
R828	Res Carb F 22k 5% ¼W	2120 101 46223	C822	Cap Pest 3n3 10% 100V AMX	2020 300 85332
R829	Res Carb F 1k0 5% ¼W	2120 101 46102	C823	Cap Pest 1n5 10% 100V AMX	2020 300 85152
R830	Res Carb F 33k 5% ¼W	2120 101 46333	C824	Cap Cer Pl 1n0 10% 100V	2222 630 08102
R831	Res Carb F 1E0 5% ¼W	2120 101 46108	C825	Cap Cer Pl 4n7 10% 100V	2222 630 08472
R832	Res Carb F 2k7 5% ¼W	2120 101 46272	C826	Cap Cer Pl 1n0 10% 100V	2222 630 08102
R833	Res Carb F 47E 5% ¼W	2120 101 46479	C827	Cap Cer Pl 47p 2% 100V NP0	2222 680 10479
R834	Res Carb F 10k 5% ¼W	2120 101 46103	C828	Cap Cer Pl 1n0 10% 100V	2222 630 08102
R835	Res Carb F 820E 5% ¼W	2120 101 46821	C829	Cap Tant 0u1 20% 35V	2020 004 90034
R836	Res Carb F 150E 5% ¼W	2120 101 46151	C830	Cap Cer Pl 4n7 10% 100V	2222 630 08472
R837	Res Carb F 1k0 5% ¼W	2120 101 46102	C831	Cap Cer Pl 47p 2% 100V NP0	2222 680 10479
R838	Res Carb F 10k 5% ¼W	2120 101 46103	C832	Cap Cer Pl 22p 2% 100V NP0	2222 680 10229
R839	Res Carb F 100k 5% ¼W	2120 101 46104	C833	Cap Cer Pl 22p 2% 100V NP0	2222 680 10229
R841	Res Carb F 47E 5% ¼W	2120 101 46479	C834	Cap Cer Pl 47p 2% 100V NP0	2222 680 10479
R842	Res Carb F 4k7 5% ¼W	2120 101 46472	C835	Cap Cer Pl 220p 10% 100V	2222 630 08221
R843	Res Carb F 4k7 5% ¼W	2120 101 46472	C836	Cap Cer Pl 220p 10% 100V	2222 630 08221
R844	Res Carb F 2k2 5% ¼W	2120 101 46222	C837	Cap Cer Pl 150p 2% 100V N750	2222 680 58151
R845	Res Carb F 2k7 5% ¼W	2120 101 46272	C838	Cap Cer D/M 22n 20% 50V X7R	2022 552 02019
R846	Res Carb F 820E 5% ¼W	2120 101 46821	C839	Cap Al Elec 4u7 -10+50% 63V	2222 035 58478
R847	Res Carb F 3k3 5% ¼W	2120 101 46332	C841	Cap Pcar 22n 10% 400V	2222 344 51223
R848	Res Carb F 1k0 5% ¼W	2120 101 46102	C842	Cap Cer D/M 22n 20% 50V X7R	2022 552 02019
R849	Res Carb F 33k 5% ¼W	2120 101 46333	C843	Cap Pest 2n2 10% 100V	2020 300 85222
R861	Res Carb F 12E 5% ¼W	2120 101 46129	C844	Cap Cer Pl 4n7 10% 100V	2222 630 08472

6.15.5 **DUPLEX PC BOARD UHF BASIC** (Cont'd)
(3502 349 81300)

C845	Cap Cer D/M 100n 20% 50V	2022 552 02482		TR803	Transistor	BF960	9335 105 20112
C850	Cap Cer Pl 22p 2% 100V NPO	2222 680 10229		TR804	Transistor	BC558	9331 977 30112
C861	Cap Cer D/M 100n 20% 50V	2022 552 02482		TR811	Transistor	BC328	9331 491 90112
D801	Diode BZV46-2V0	9334 339 40112		TR812	Transistor	BC548C	9331 976 70112
D802	Diode BB609B	9337 403 80682		IC801	Intgrd Circt	TL72CP-00	9333 327 60682
D803	Diode 1N4148	9330 839 90112		IC802	Intgrd Circt	OM806	9333 922 30112
D804	Diode 1N4148	9330 839 90112		L801	Coil Assy		3502 389 90840
D811	Diode BZX79-C6V2	9331 177 40112		L802	Coil Assy		3502 389 90500
TR801	Transistor BF495	9331 987 80112		L803	Choke 6.8uH 10% Axial 70-223		2422 535 97559
TR802	Transistor BF495	9331 987 80112		L804	Coil Assy		3502 389 90560

6.16 **HANDSET 900 DUPLEX (9585 765 90100)**

	Assy. Handset Holder Duplex	3502 330 07970		Mic Pre-amp Brd 765 H/Set	3502 349 96870
	Assy. Lead H/Set	3502 330 07960	S2	Switch PB Low/Frce Sub/Min	2422 128 02186
	Assy. Speaker Box Bottom	3502 330 07940	S3	Switch PB Low/Frce Sub/Min	2422 128 02186
	Assy. Handset & Lead	3502 330 07930	LS1	Speaker 5 Ohms MAGNAVOX 3T/5	2402 264 03009

6.16.1 **MICROPHONE PRE-AMP BOARD 765 HANDSET**
(3502 349 96870)

	PC Board Mic Pre-amp H/Set	3502 309 96870	C1	Cap Cer D/M 100n 20% Z5U	2022 552 02482
	Lug Quick Connect BR H1124 6	2402 015 01108	C2	Cap Cer Pl 1n0 10% 100V	2222 630 08102
	Lug Solder PT NO 6000-04-01 4	3502 310 30110	C3	Cap Al Elec 4u7 -10+50% 63V	2222 035 58478
R1	Res Carb.F.150k 5% ¼W	2120 101 46154	C4	Cap Cer Pl 1n5 10% 100V	2222 630 08152
R2	Res Carb.F.47E 5% ¼W	2120 101 46479	C5	Cap Cer Pl 1n0 10% 100V	2222 630 08102
R3	Res Carb.F.1k5 5% ¼W	2120 101 46152	TR1	Transistor BC549	9331 976 80112

SECTION 8 FAULT FINDING

The following section is intended as an aid to servicing the radio. It is recommended that if a fault fits into the categories listed below, the relevant technical description section should be read and comprehended.

FAULT CONDITIONS

ANCILLARY INFORMATION

8.1.1 **RADIO FAILS TO SWITCH ON** (Refer to Section 3.4.2)

a) Check 5VP supply. (IC408 pin 40).
b) Check 1mSec LOW reset pulse at IC408 pin 1, when ON/OFF key activated.
c) Check IC406 pin 10 (HIGH to enable relay driver circuit).
d) Check 5MHz microprocessor clock. (IC402 pin 38).
e) Check IC408 pin 6 A.S for 1MHz/5v p.p.
f) Check 5VS supply. (Refer section 3.4.2.2).
g) Check address lines to address latch IC409 for correct data.
h) Check address lines to EPROM IC412 for correct data.
i) Check IC408 pin 34 for strobe pulses.
j) * Initial Checksum of EPROM IC412 failure.
k) * Initial Checksum of microprocessor RAM failure.

8.1.2 **RADIO SWITCHES ON BUT SWITCHES OFF AGAIN AFTER A SHORT PERIOD**

a) Check microprocessor, pin 10 for 500Hz 5v p.p. squarewave. If this is present, voltage on the RF monitor when in receive (e.g. from external transmitter) caused automatic switch off.
b) Control-to-handset "AHOY" signal not answered. Check the mobile using a known operational handset.
c) Check serial data line to/from handset.
d) Check serial clock line to handset (1200Hz/5v p.p).
e) * Subsequent Checksum of EPROM IC412 failure.
f) * Subsequent Checksum of microprocessor RAM failure.

* The probability of these routines failing after the EPROM has been in service is small, however on installation of a new EPROM this fault condition should not be overlooked.

8.1.3 **NO CARRIER RECEIVED**

a) If a faint intermittent clicking is audible, the synthesiser is out-of-lock.
Check PLL in-lock, TP201 in range 4V to 13V. If outside this range, refer to synthesiser out-of-lock procedure.
b) Check mute noise detector O/P SK203/403 pin 18. Increase Rx RF signal until detector O/P falls to less than 0.1V. The RF level should be less than 2uV pd.
c) Check gain of front end. (A high impedance RF millivoltmeter is required, 10k, 1pF input).
Set RF generator to 20mV pd at receiver frequency. Check level at pin 3 of U201 is greater than 500mV rms.
Note: This represents greater than 28dB conversion gain at the mixer U201.
Check that the local oscillator level at U201 pin 7 is greater than 600mV rms.
Check that the oscillator output level at U203 pin 14 (UHF), or pin 5 (VHF), is greater than 800mV rms

8.1.4 **NO RECEIVER AF OUTPUT**

Check central control latch outputs, Rx AF enable SK203/403 pin 4 and speaker enable SK203/403 pin 13. Lines should be low for Rx audio. If lines are +5V, check - Cradle line is +5V
- Community repeater option fitted.

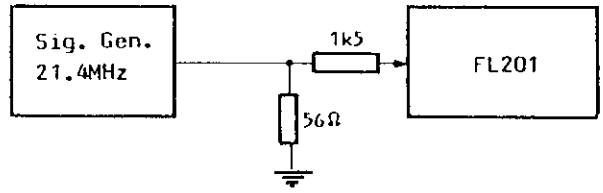
To override community repeater option, ground pin 39 IC415.

8.1.5 LOW RECEIVER SENSITIVITY

a) Confirm that the receiver is correctly aligned, see Test and Alignment Procedure, Section 4.

b) Check I.F. sensitivity

Remove R205, R206



Sensitivity should be less than 8uV pd for 12dB SINAD

8.1.6 LOW RECEIVER AF LEVEL

Connect RF signal generator to receiver input at 100uV pd level and standard modulation conditions:

25kHz Version - 1kHz ±3kHz
12.5kHz Version - 1kHz ±1.5kHz

Use a high input impedance ac millivoltmeter for the following tests:-

Check AF level at:-

(i)	IC202 pin 4	120mV rms
(ii)	IC204 pin 1	900mV rms
(iii)	IC205 pin 1	500mV rms
(iv)	IC205 pin 14	500mV rms
(v)	IC205 pin 8	750mV rms
(vi)	IC205 pin7	750mV rms

To achieve an AF output level of 3W into 4 ohms, the level at SK203 pin 8 should 150mV rms. Adjust the volume control to check this.

8.1.7 SYNTHESISER OUT-OF-LOCK

Check TP201 voltage.

Note: +16V indicates that VCO frequency is too low for phase-lock.
+1.5V indicates that VCO frequency is too high for phase-lock.

No Tx power, No Rx Audio, amber LED flickers.

8.1.7.1 DC Tests

a) Check IC306 pin 8 to be approximately +17V

b) Check IC306 pin 3 to be approximately +5V

c) Check IC303 pin 1 to be approximately +5V

d) Check dc voltages on VCO pins, Vcoase, Vfine and offset

8.1.7.2 **AC Tests**

a) Check IC305 pin 27 for 25/31.25/50/62.5kHz squarewave 9V p.p.

b) Check IC305 pin 1 for identical signal.
Note: Signals a) and b) constitute the 2 inputs to the phase comparators. Tuning VCO should change frequency a).

c) Attempt synthesiser re-alignment as per test procedure.

d) If tuning VCO does not change frequency c), check VCO frequency with a counter.
Note: ECL dividers can give an O/P with no I/P.

e) Check IC301 and IC303 outputs with a counter.

f) Check IC304 A0 to A3 programming lines for data.
Note: Whilst out-of-lock, synthesiser is repeatedly re-programmed. On non auto economise non voting channels. Scanning Off.

g) Check IC304 PE line for pulses (out-of-lock re-programmable).

h) Check IC304 PC line for pulses (re-programming clock).

If frequencies a) and b) can be tuned above and below each other without phase locking, check IC306 pin 1 swings between 16V and 1.5V.

8.1.8 NO TRANSMITTER POWER OUTPUT

Check that PTT command is successful, red LED should be illuminated. IF alarm tone is present during transmit, ensure mute is closed (amber LED is Off) and cradle switch is open.

Check that red LED remains illuminated when PTT switch is closed. If transmit is cancelled (red LED is extinguished), check +10V regulator.

Check synthesiser is in-lock, TP201 voltage in range 4V to 13V. Check duration of OL1, SK403 pin 16. Pulse should be +5V for less than 12mSec after PTT activated.

Check 10V Tx and 10V PA at feed-through connection of PA. If the synthesiser is locked and Tx enable (SK203 pin 6) is low (less than 0.1V), both 10V Tx and 10V PA should be present.

Check the drive level to the PA, VHF less than 20mW, UHF less than 120mW.

8.1.9 DECIMAL POINT DISPLAYED IN LOWER RIGHT HAND SEGMENT

TEST: Switch set off then on again and activate PTT.

A decimal point appearing in display indicates the transmitter power is out-of-range, as measured by the RF monitor. Check the power output.

Check RF monitor pin 3 of SK401. Voltage should be 2 ±0.4V for 25W.

Valid ranges are:- 0.85V to 2.5V for 25W
0.25V to 1.6V for 5W
0.0V to 0.65V for 1W

A further aid in diagnosing a fault condition ia available via the fault report command. In the receive mode, the keypad sequence [F] → [9] will display a four digit number in the right hand portion of the display, preceeded by a character F.
The two least significant digits are coded in a hexadecimal format to indicate both possible software or hardware faults.

	FAULT	DISPLAY	
Digit 1.	(1) Tx Power out of range	F0080	
	(2) 10V Supply out of range	F0040	Hardware
	(3) PLL Control Voltage out of range	F0020	Fault
	(4) PLL out of lock	F0010	
Digit 0	(1) Software stack overflow	F0008	
	(2) ADC range overflow	F0004	Software
	(3) Serial communication stack overflow	F0002	Fault
	(4) Invalid command	F0001	

If two or more errors exist when Report Fault is requested the display will indicate the hexadecimal sum of the two faults, e.g. 10V supply range and PLL control voltage out of range will show F0060 (i.e. F0040 + F0020) or Tx power out of range and 10V supply out of range will show F00C0 (i.e. F0080 + F0040).

8.1.10 **DECIMAL POINT DISPLAYED IN LEFT HAND SEGMENT**

Mobiles programmed to permit user entry via the keypad of software codes, or channels in scan groups, are provided with an additional fault reporting indicator. In the event of the user entered selcall code becoming altered in any way other than operator selection, due to memory corruption under a power fail transient for example, the corrupted data is cleared and the default selcall code from ROM is overwritten into the RAM. Similarly, if corruption occurs on a user entered scan group, the group is cleared of all channels.

When either of these faults occur a decimal point will appear in the left hand segmant of the display. The decimal point is cleared by re-entering the lost data manually via the keypad.

8.1.11 **LOW TRANSMIT DEVIATION**

Check mic inhibit U301 pin 17. Should be less than 0.1V for mic enable.

Operate PTT and connect audio signal generator at 40mV rms/1kHz to mic socket.

Check AF level at U301 pin 10. Should be 1.4V ±0.3V.

Check AF level at U301 pin 6,
25kHz Version - 150 ±50mV
12.5kHz Version - 75 ±25mV

Check DC voltage and AF level on IC305 pin 27. DC voltage approx. 5V.

AF level:
25kHz Version - 35mV ±15mV
12.5kHz Version - 18mV ± 8mV

Check AF level on VCO, U203 pin 22 (UHF)/pin 9 (VHF).

25kHz Version - 12mV
12.5kHz Version - 6mV

Check that there is a residual deviation when the wiper of trimpot R371 is grounded to chassis. (This checks modulation path through IC305).

8.2 ANCILLARY INFORMATION

8.2.1 SCANNING, VOTING AND ECONOMISE INFORMATION

All these options rely on fast synthesiser programming and locking. Every channel programmed in the mobile must be in lock and TP201 voltage in the range 4-13V. The cradle switch must be closed for scanning and economise options to operate.

To check synthesiser locking time, disable scanning/economiser, check IC305 pin 4 pulses to +9.7V for less than 12mSec as PTT is operated and released.

During economise, check SK404 pin 1 duty cycle. +9.7V for 100mSec and 0V for 400mSec. Check IC305 pin 4 pulses to +9.7V for less than 30mSec.

During scanning, check IC305 pin 4 pulses to +9.7V for less than 12mSec every 50mSec.

Economise, scanning and voting with cradle switch closed, are all interrupted by a drop in the mute noise voltage. The mute control setting determines the voltage threshold at which the interruption occurs. In voting, the received signal strength pin 14 SK203, is also used to decide which channel the receiver will be stopped on.

8.2.2 MICROPROCESSOR INTERFACE WITH ANALOGUE FUNCTIONS

A large part of the microprocessor program deals with information from the A/D converter. To assist in fault-finding, listed below is the effect of each A/D channel on the central control program.

CHANNEL 1 PIN 15 IC402

Mute Noise Detector (O/P from Receiver)
Used for:
- Normal muting decisions
- Stops scanning, stops voting
- Operates the Tx inhibit option
- Operates the community repeater option
- Stops the economiser

CHANNEL 2 PIN 13

Rx Signal Level (O/P from Receiver)
Used for:
- Voting decisions
- Duplex variable Tx power option

CHANNEL 3 PIN 12

PLL (Coarse control voltage from PLL)
Used for:
- Stopping transmitter prior to loss of synthesiser lock.
- Tx error message if control voltage below 3V or above 13V.

CHANNEL 4 PIN 11

10V (Monitors 10V regulator voltage)
Used for: - Stopping transmitter with loss of 10V regulation.

CHANNEL 5 PIN 10

13.8V (Monitors mobile supply voltage FM91 only)
Used for: - "LOW BATTERY" and "HI BATTERY" display.

CHANNEL 6 PIN 9

RF Monitor (Monitors RF output power)
Used for: - Checking RF power in correct range. (Decimal point)
- Switching mobile off if Tx during Rx mode (Simplex only)

OL1 PIN 10 IC408 (Direct connection to microprocessor PA4)
Used for: - Stopping Tx enable
- Disabling all audio mutes
- Initiates synthesiser re-program

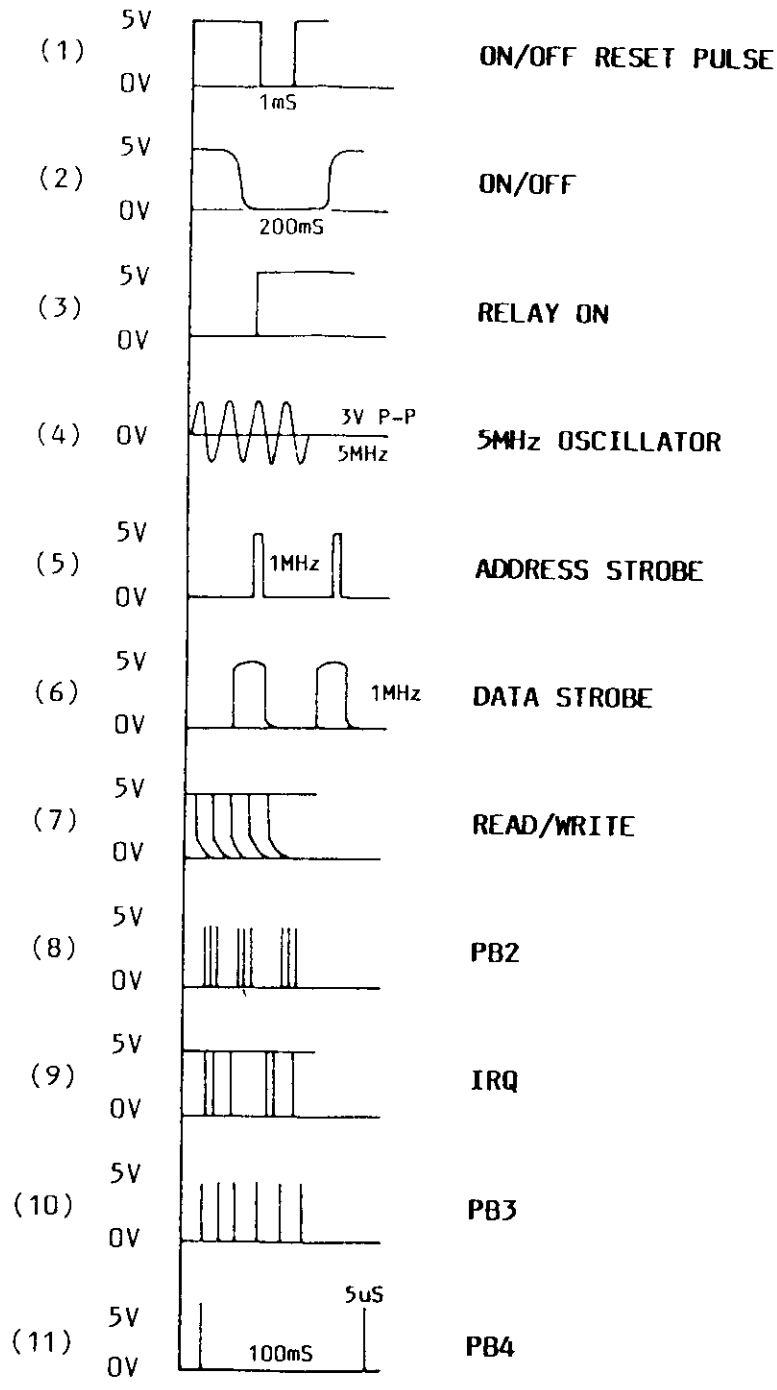
8.2.3 DC VOLTAGES

PIN IC	IC201 RX	IC201 TX	TDA1010 IC203	IC202	IC204	IC205	PRESCALER IC301	10/11 PRESCALER IC303	UNIVERSAL DIVIDER IC304	PHASE COMP. & REF OSC.IC305 RX	PHASE COMP. & REF OSC.IC305 TX	LOOP FILTER IC306
1	13.8	13.44	0	5.65	5.0	5.0	5.1	4.67	6.24	4.8		12.2
2	0	0	6.94	6.9	5.0	5.0	3.3	8.47	9.65	9.09		4.84
3	13.62	13.24	13.8	1.2	5.0	5.0	3.3	9.47	0.3	0.45		4.84
4	12.27	11.79	13.4	1.5	0	9.69	0	9.74	9.71	0		0
5	0.94	3.95	13.15	6.8	1.8	5.0	4.0	9.74	9.56	4.55		6.08
6	9.26	0.09	1.42	0	1.85	5.0	4.0	8.47	9.56	4.6		6.08
7	9.25	0.08	0.57	0.7	1.85	5.0	*	9.47	9.56	4.84		6.08
8	0.08	9.25	0.82	1.2	9.68	5.0	*	8.7	9.56	4.84		17.1
9	5.17	0	0	6.2		5.0		8.32	9.56	4.84		
10	9.76	9.77		6.2		5.0		8.76	9.56	*		
11	0			2.1		0		8.79	9.56	*		
12	4.3	1.03		5.7		5.0		4.67	0	*		
13	9.77			5.7		5.0		9.18	9.75	*		
14	1.35			5.7		5.0		4.67	0	0		
15	0			0				8.45	0	*		
16	0			0				8.50	9.56	*		
17				0					9.56	0		
18				0					9.75	0		
19				1.15					9.75	0		
20				1.15					5.7	0		
21									9.17	4.5		
22									2.31	4.32		
23									6.73	0		
24									9.56	8.9		
25									9.08	4.28		
26									9.75	4.28		
27									4.8	7.71	5.7	
28									9.56	8.9		

*: Depends on link setting

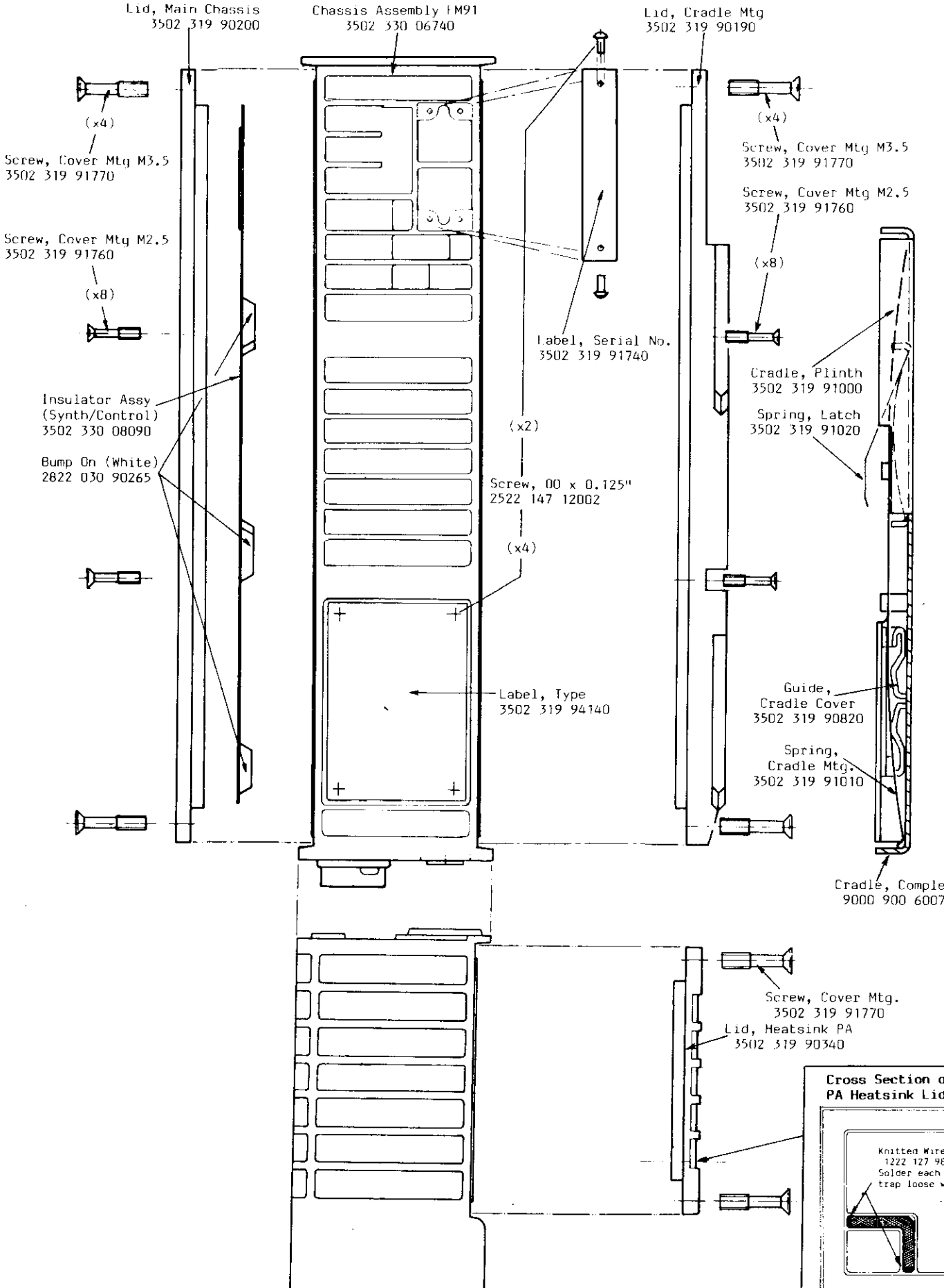
NOTE: Receiver voltages measured with 1mV CW RF input.

8.2.4 MICROPROCESSOR WAVEFORMS

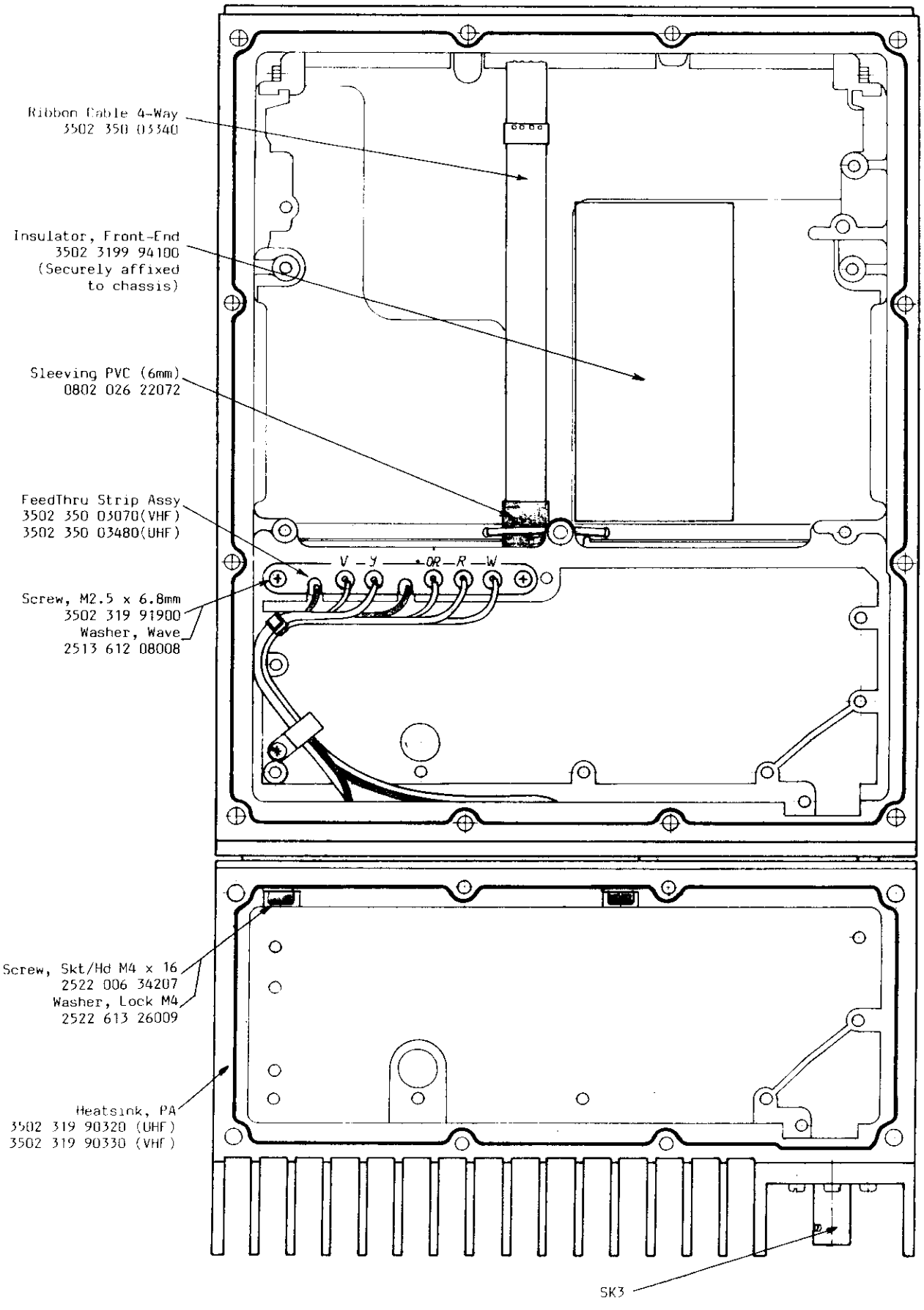


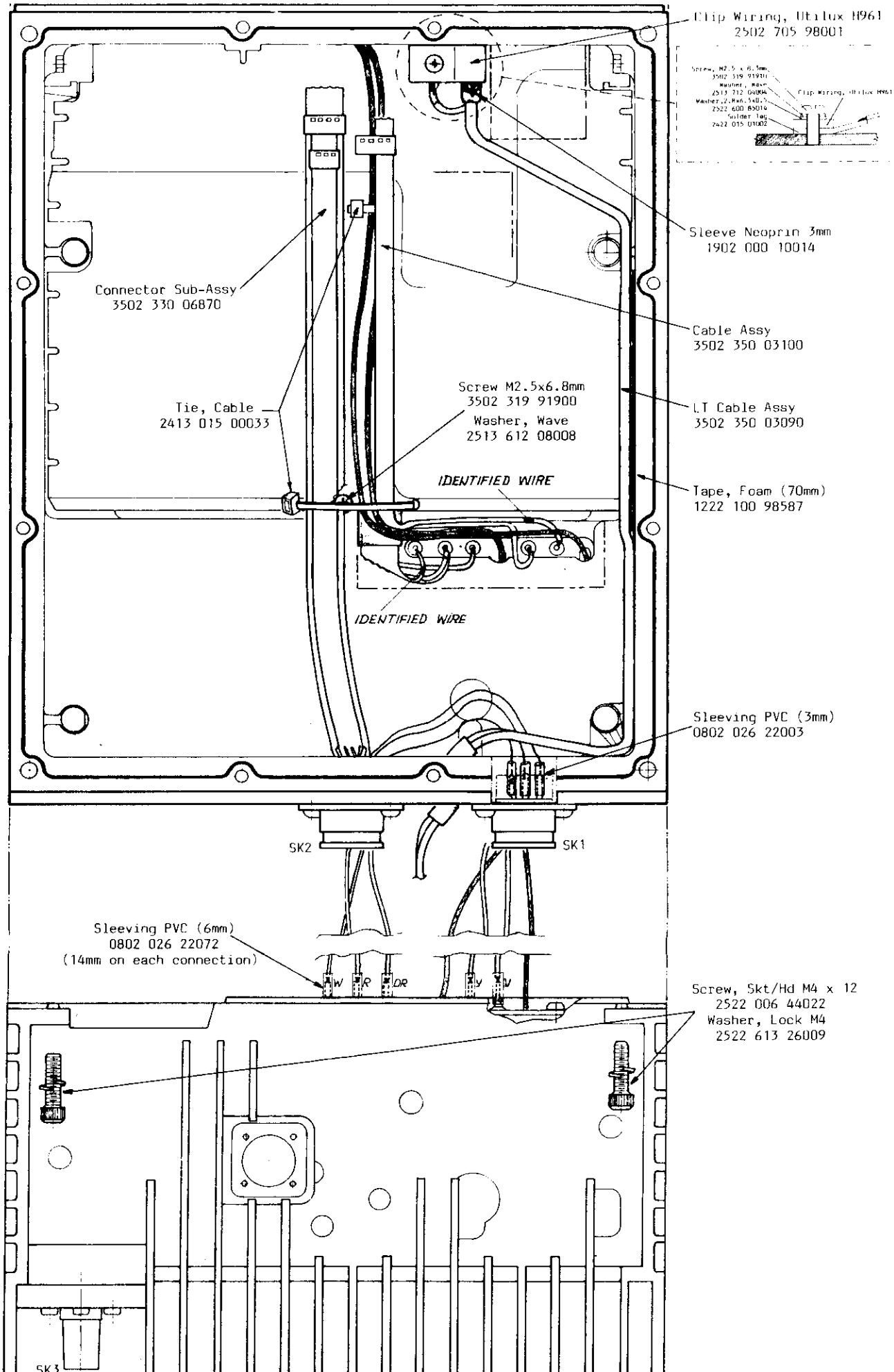
SECTION 9 MECHANICAL QUICK REFERENCE

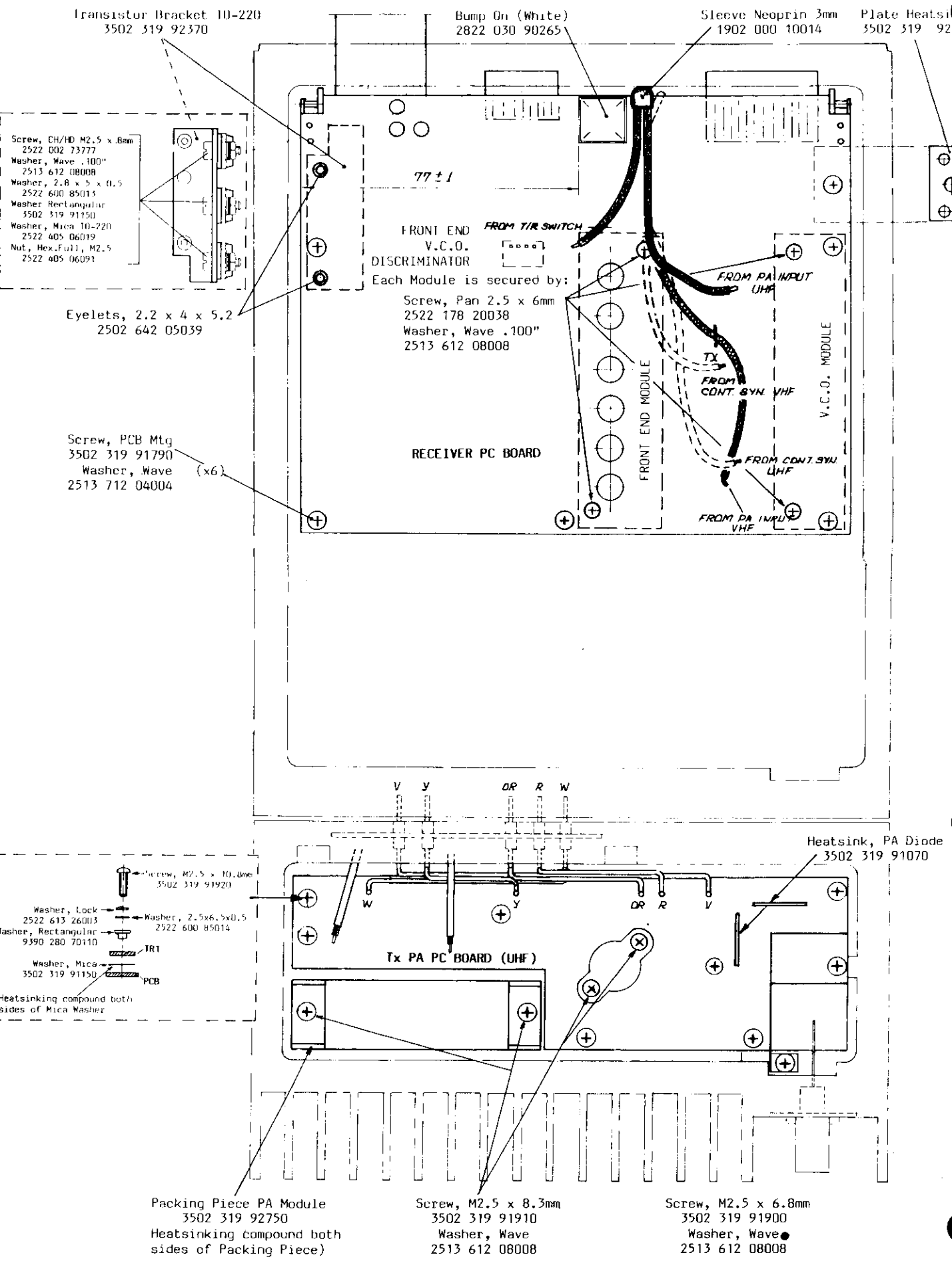
9.1 COVERS

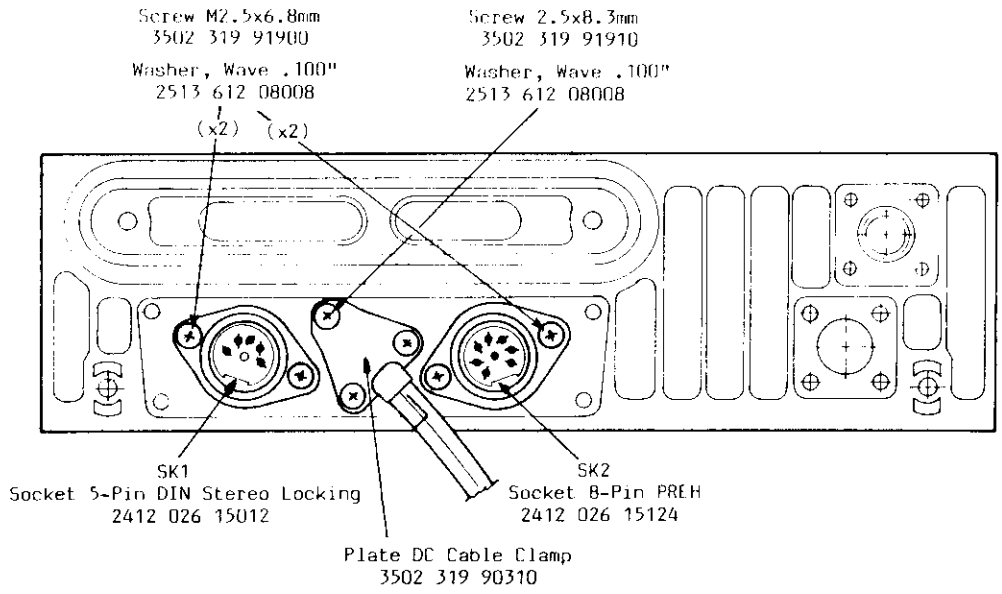


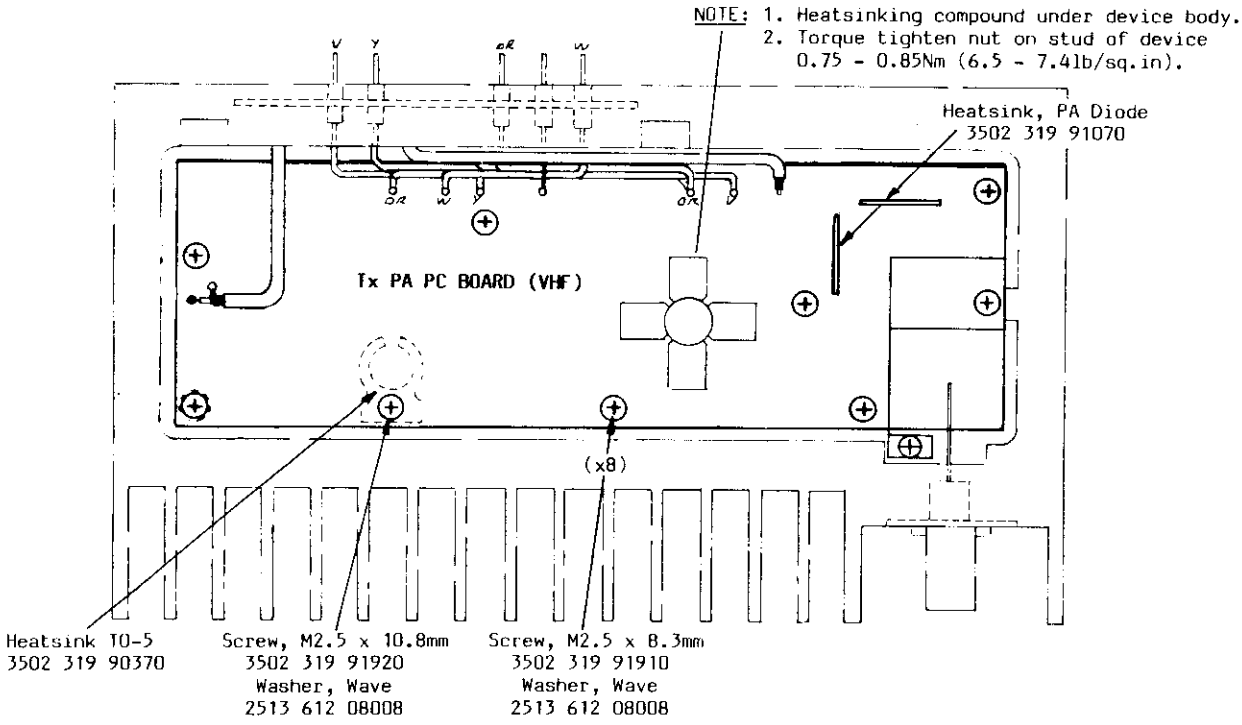
9.2 CHASSIS FM91 SIMPLEX

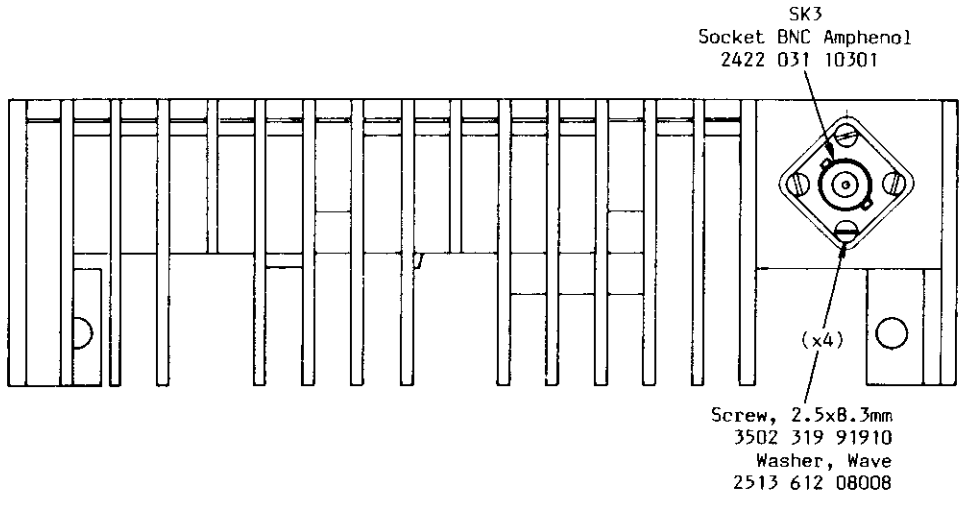


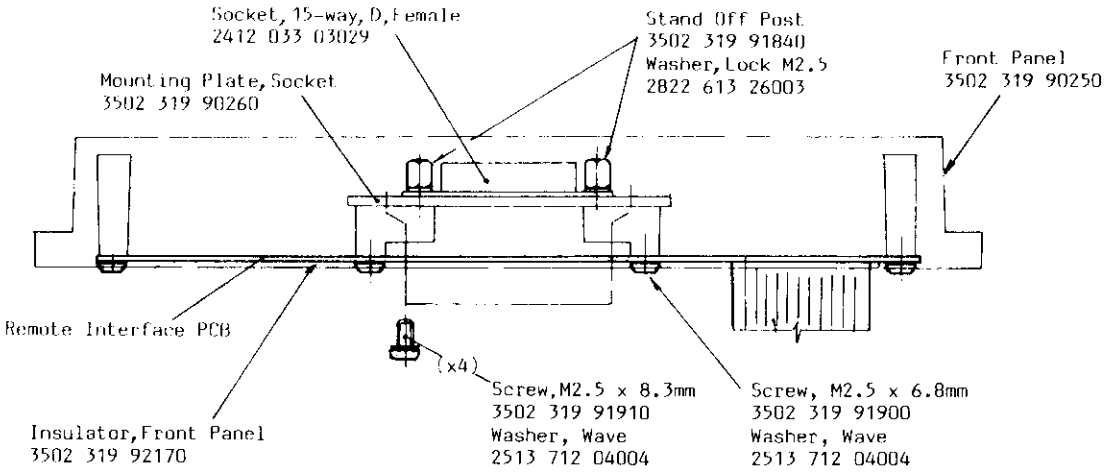

Clip Wiring, Utilux H961
2502 705 98001
Sleeve Neoprin 3mm
1902 000 10014
Connector Sub-Assy
3502 330 06870
Cable Assy
3502 350 03100
Screw M2.5x6.8mm
3502 319 91900
Washer, Wave
2513 612 08008
Tie, Cable
2413 015 00033
LT Cable Assy
3502 350 03090
IDENTIFIED WIRE
Tape, Foam (70mm)
1222 100 98587
IDENTIFIED WIRE
Sleeving PVC (3mm)
0802 026 22003
SK2
SK1
Sleeving PVC (6mm)
0802 026 22072
(14mm on each connection)
W
R
DR
V
V
Screw, Skt/Hd M4 x 12
2522 006 44022
Washer, Lock M4
2522 613 26009
SK3

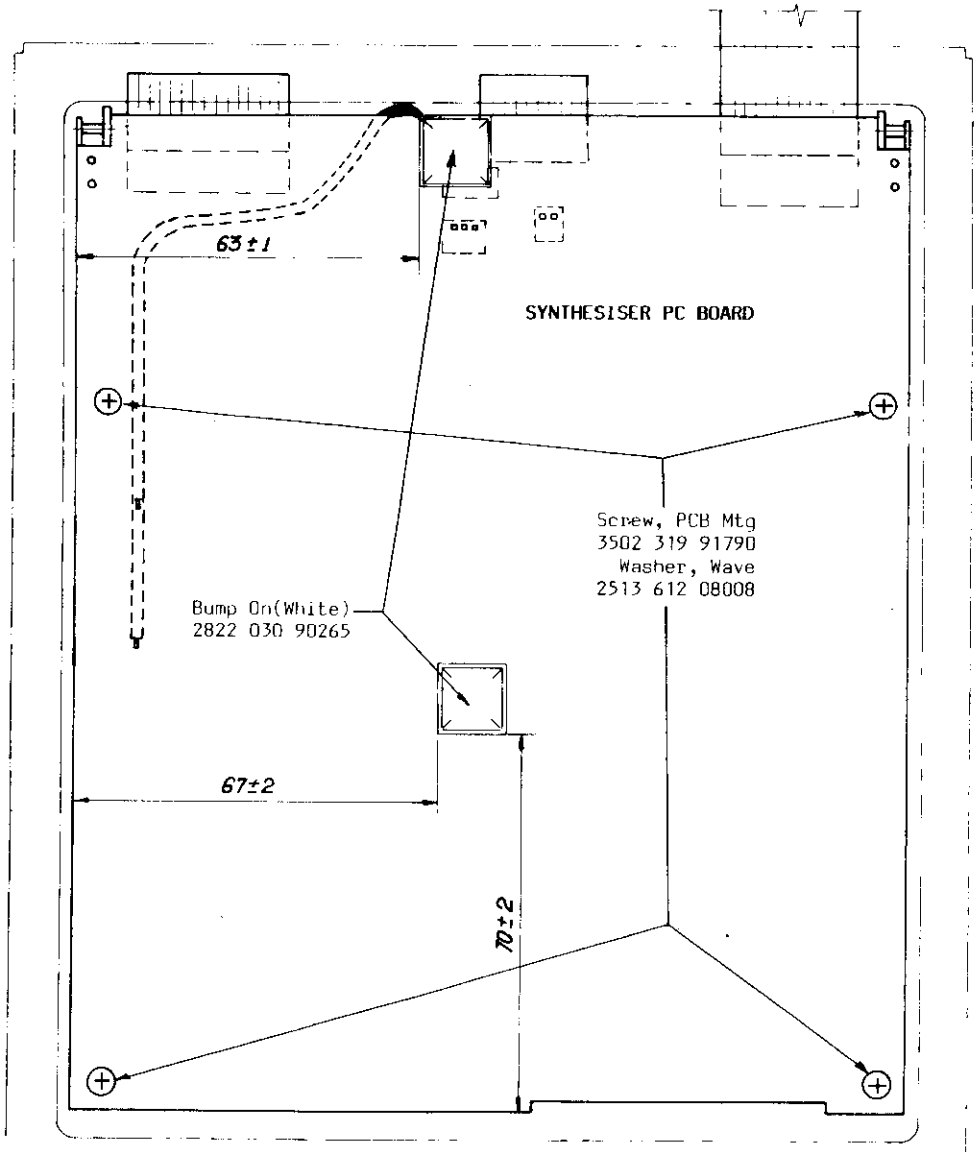

Transistor Bracket TO-220
3502 319 92370
Bump On (White)
2822 030 90265
Sleeve Neoprin 3mm
1902 000 10014
Plate Heatsi
3502 319 92
Screw, CH/HD M2.5 x .8mm
2522 002 73777
Washer, Wave .100"
2513 612 08008
Washer, 2.8 x 5 x 0.5
2522 600 85013
Washer Rectangular
3502 319 91150
Washer, Mica TO-220
2522 405 06019
Nut, Hex.Full, M2.5
2522 405 06091
77 ± 1
FRONT END
V.C.O.
DISCRIMINATOR
Each Module is secured by:
Screw, Pan 2.5 x 6mm
2522 178 20038
Washer, Wave .100"
2513 612 08008
FROM T/R SWITCH
FROM PA INPUT UHF
TX
FROM CONT. SYN. VHF
FRONT END MODULE
V.C.O. MODULE
RECEIVER PC BOARD
FROM CONT.SYN. UHF
FROM PA INPUT VHF
Eyelets, 2.2 x 4 x 5.2
2502 642 05039
Screw, PCB Mtg
3502 319 91790 (x6)
Washer, Wave
2513 712 04004
V
Y
OR
R
W
Heatsink, PA Diode
3502 319 91070
Screw, M2.5 x 10.8mm
3502 319 91920
Washer, Lock
2522 613 26003
Washer, 2.5x6.5x0.5
2522 600 85014
Washer, Rectangular
9390 280 70110
TRT
Washer, Mica
3502 319 91150
PCB
Heatsinking compound both sides of Mica Washer
Tx PA PC BOARD (UHF)
Packing Piece PA Module
3502 319 92750
Heatsinking compound both sides of Packing Piece)
Screw, M2.5 x 8.3mm
3502 319 91910
Washer, Wave
2513 612 08008
Screw, M2.5 x 6.8mm
3502 319 91900
Washer, Wave
2513 612 08008

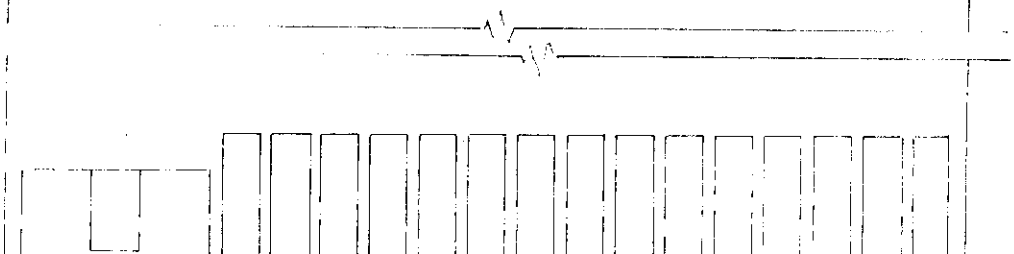

Screw M2.5x6.8mm
3502 319 91900
Washer, Wave .100"
2513 612 08008
(x2)
(x2)
Screw 2.5x8.3mm
3502 319 91910
Washer, Wave .100"
2513 612 08008
SK1
Socket 5-Pin DIN Stereo Locking
2412 026 15012
SK2
Socket 8-Pin PREH
2412 026 15124
Plate DC Cable Clamp
3502 319 90310


NOTE: 1. Heatsinking compound under device body.
2. Torque tighten nut on stud of device
0.75 - 0.85Nm (6.5 - 7.4lb/sq.in).
Heatsink, PA Diode
3502 319 91070
Tx PA PC BOARD (VHF)
(x8)
Heatsink TO-5
3502 319 90370
Screw, M2.5 x 10.8mm
3502 319 91920
Washer, Wave
2513 612 08008
Screw, M2.5 x 8.3mm
3502 319 91910
Washer, Wave
2513 612 08008

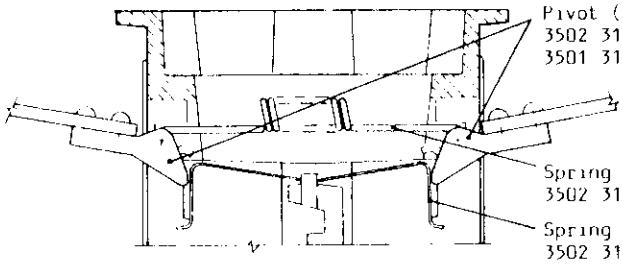

SK3
Socket BNC Amphenol
2422 031 10301
(x4)
Screw, 2.5x8.3mm
3502 319 91910
Washer, Wave
2513 612 08008

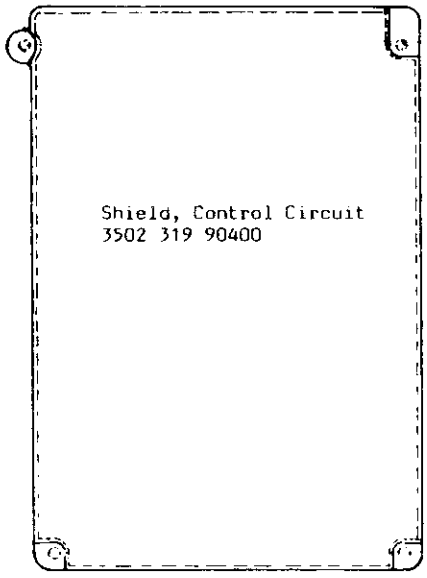

Socket, 15-way, D, Female
2412 033 03029
Stand Off Post
3502 319 91840
Washer, Lock M2.5
2822 613 26003
Front Panel
3502 319 90250
Mounting Plate, Socket
3502 319 90260
Remote Interface PCB
(x4)
Screw, M2.5 x 8.3mm
3502 319 91910
Washer, Wave
2513 712 04004
Screw, M2.5 x 6.8mm
3502 319 91900
Washer, Wave
2513 712 04004
Insulator, Front Panel
3502 319 92170

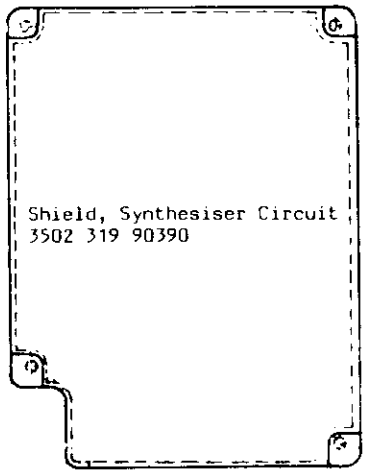

63±1
SYNTHESISER PC BOARD
Screw, PCB Mtg
3502 319 91790
Washer, Wave
2513 612 08008
Bump On(White)
2822 030 90265
67±2
70±2



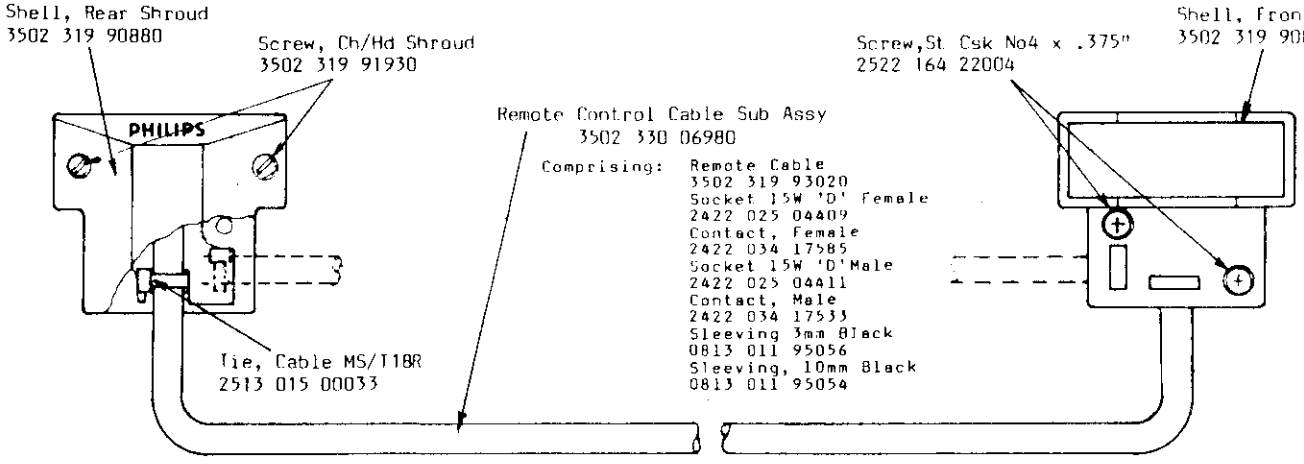
9.3 ANCILLARY ITEMS



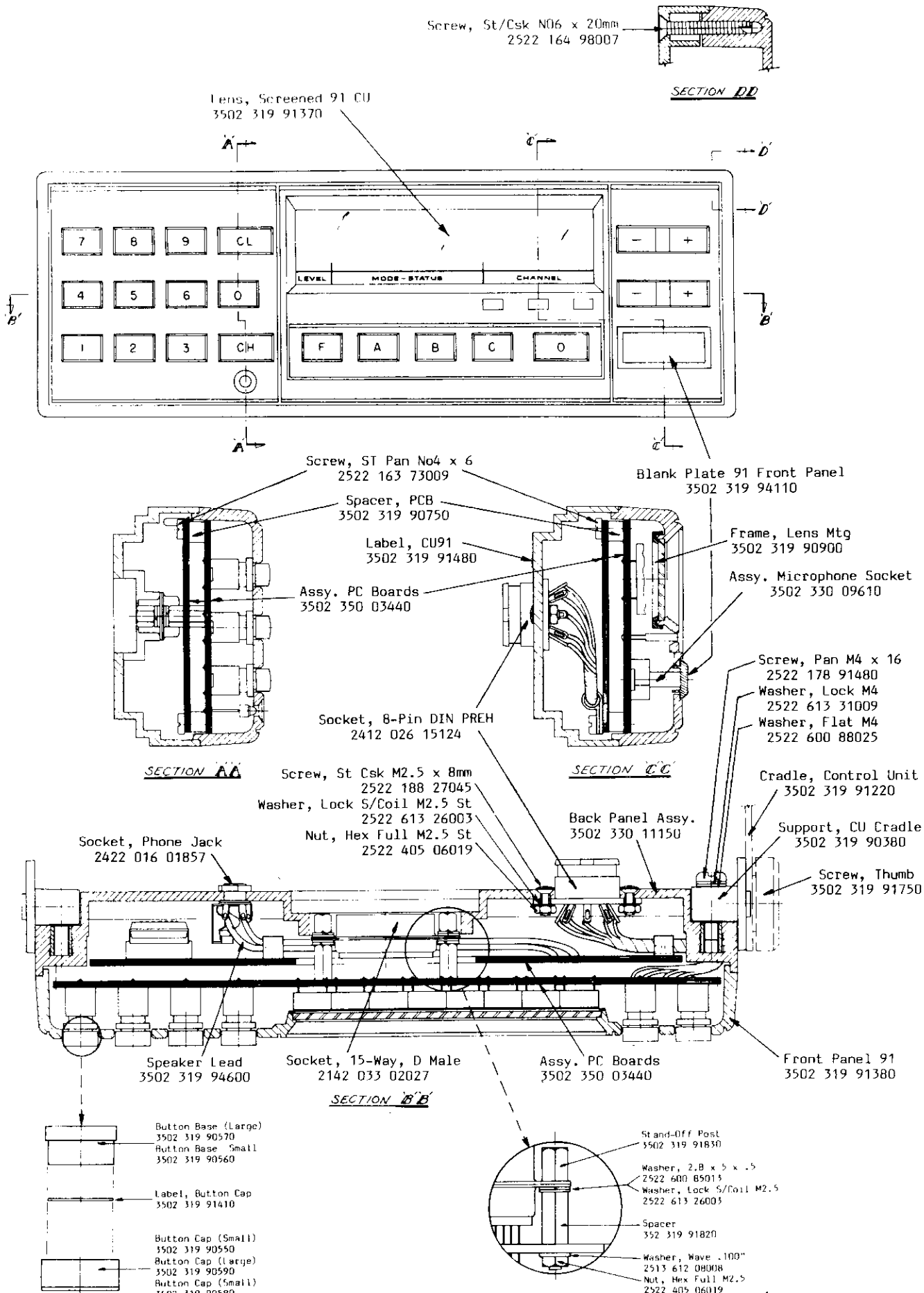




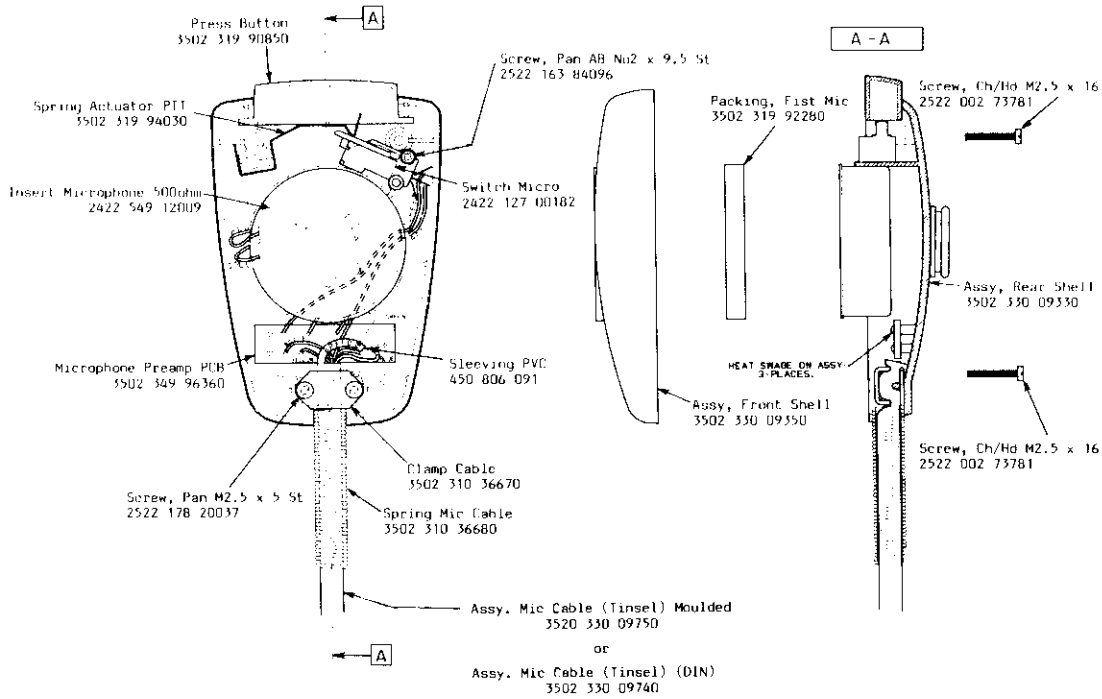
Circuit Shields attached by:
Screw, M2.5 x 6.8mm
3502 319 91900
Washer, Wave .100" (fitted under screw head)
2513 612 08008
Washer, Insulating
3502 319 93730



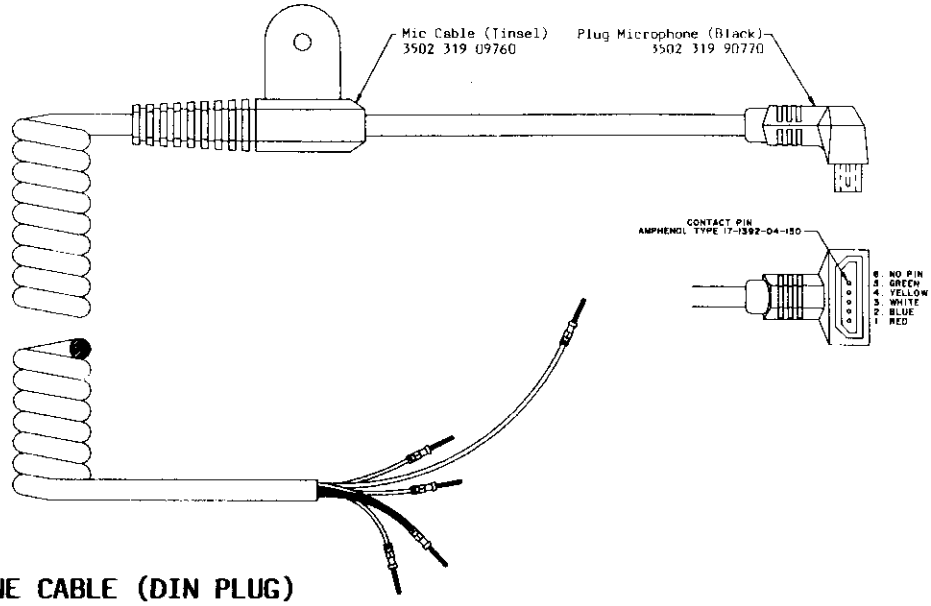
9.4 CONTROL UNIT FM91



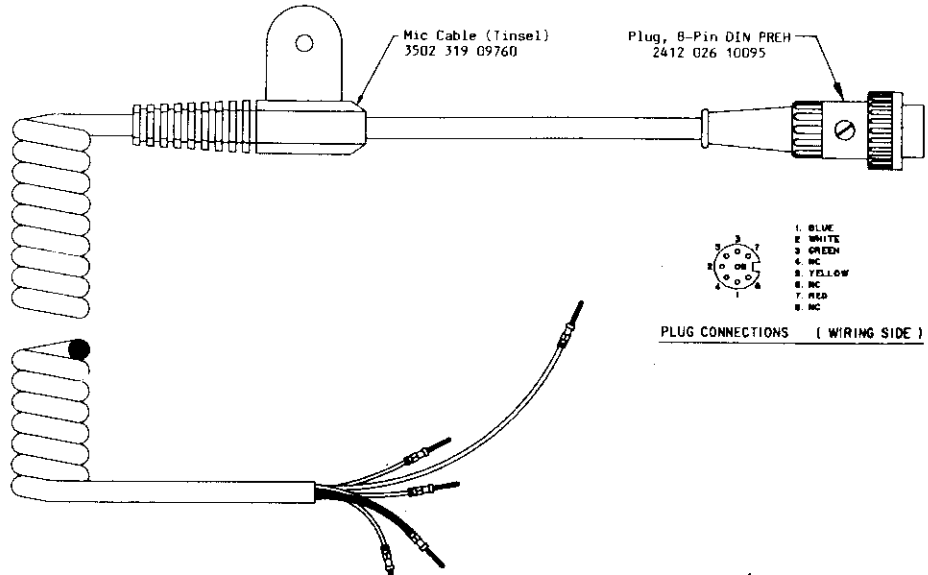
9.5 FIST MICROPHONE



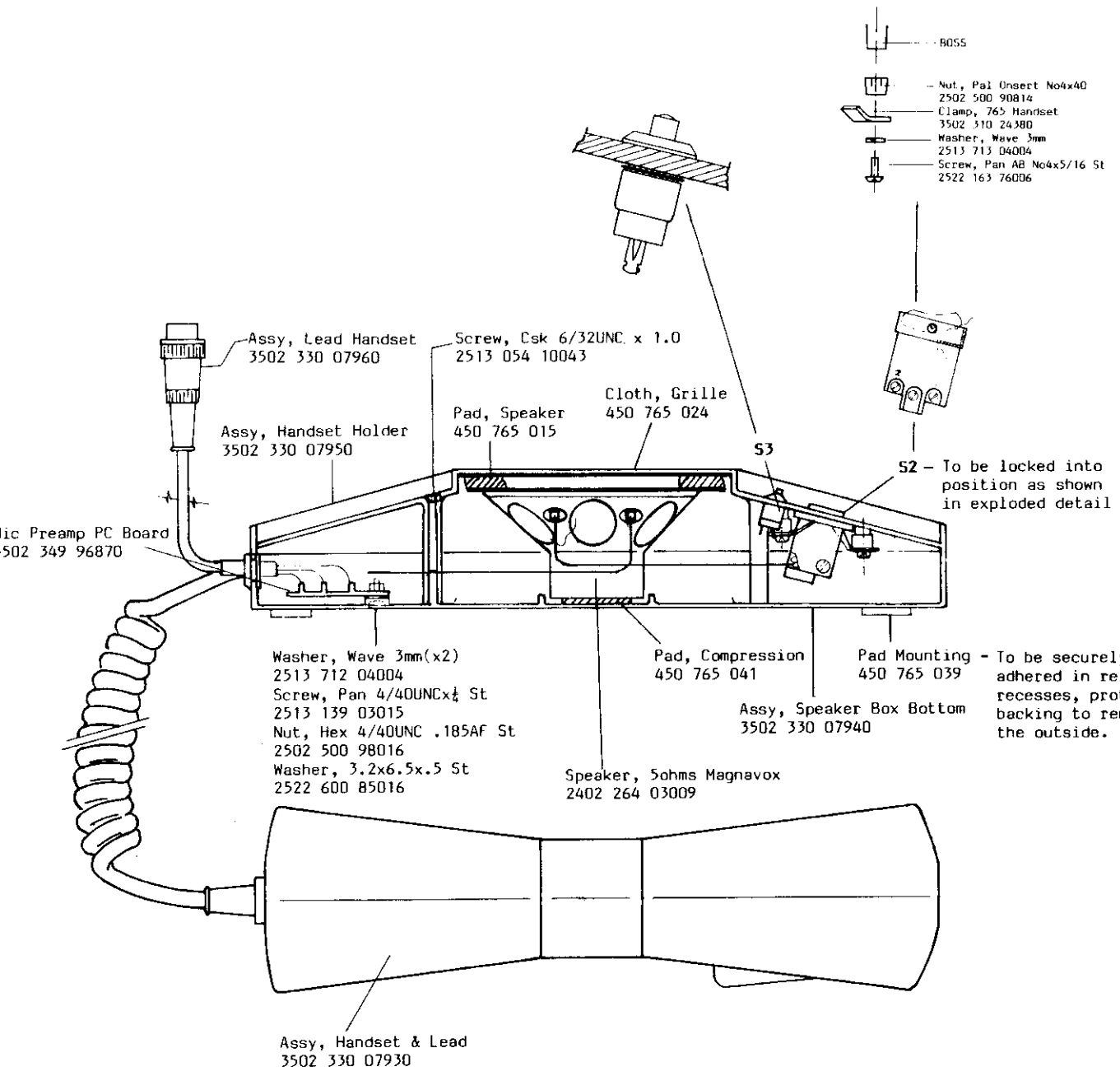
9.5.1 MICROPHONE CABLE (MOULDED PLUG)



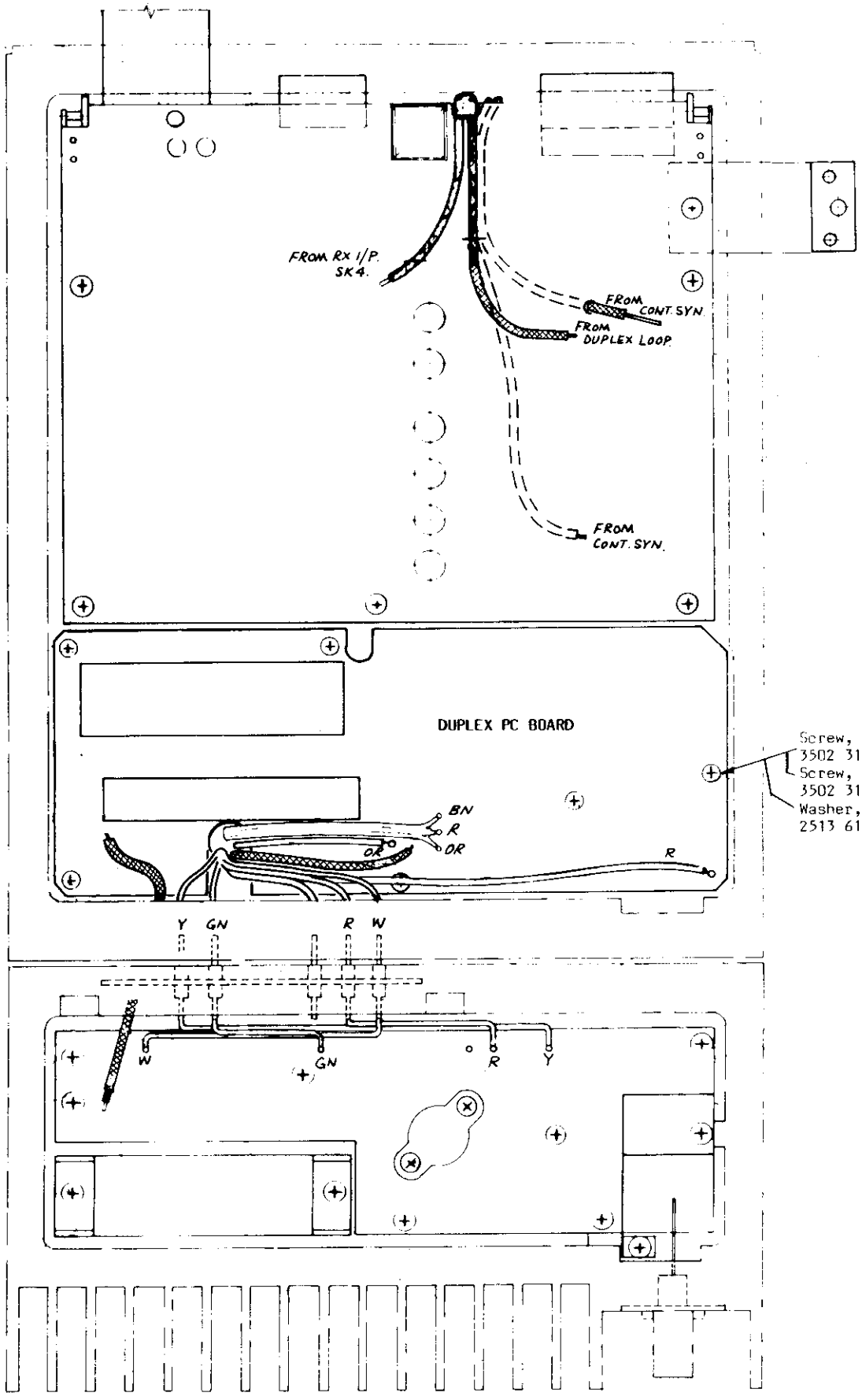
9.5.2 MICROPHONE CABLE (DIN PLUG)

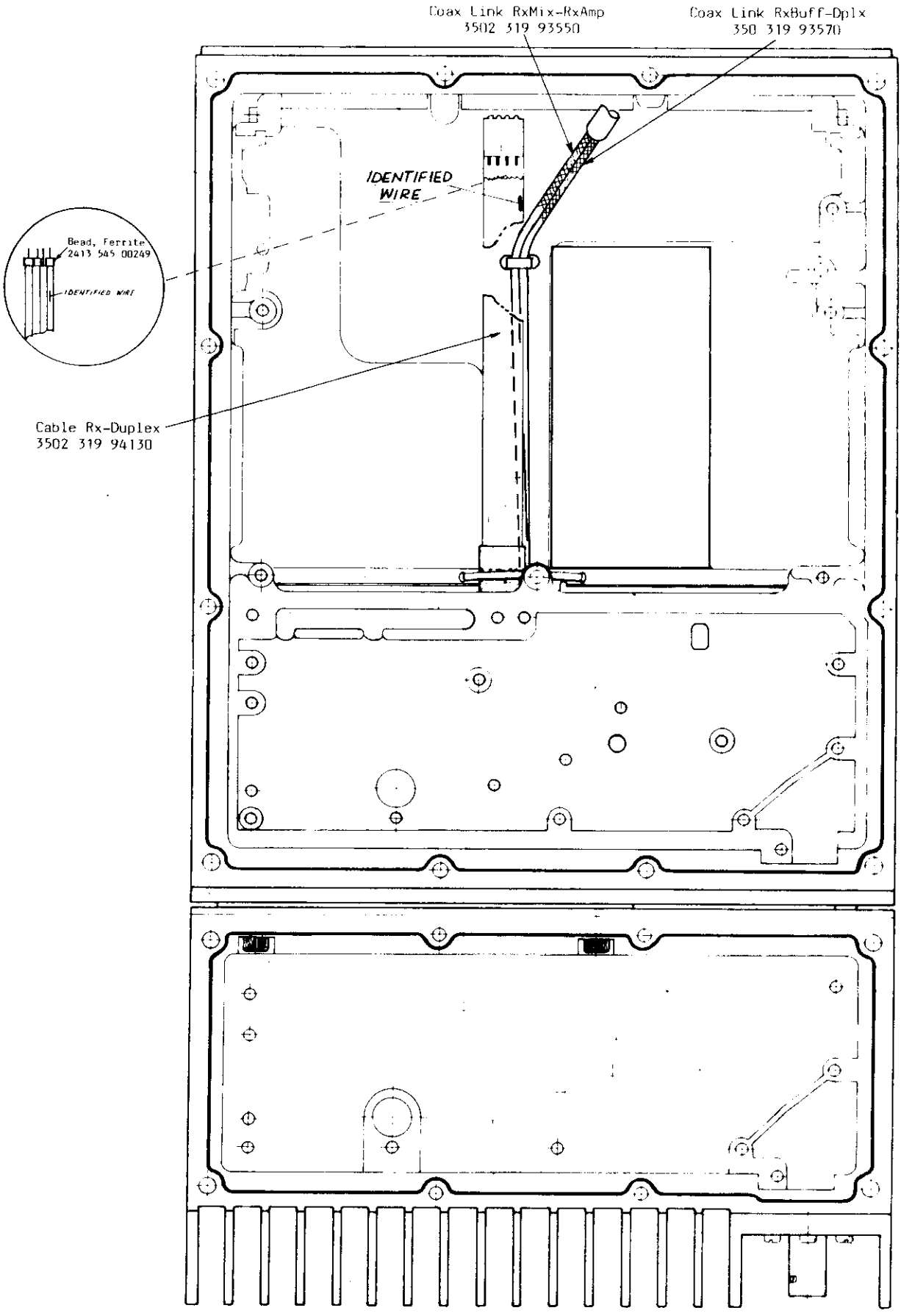


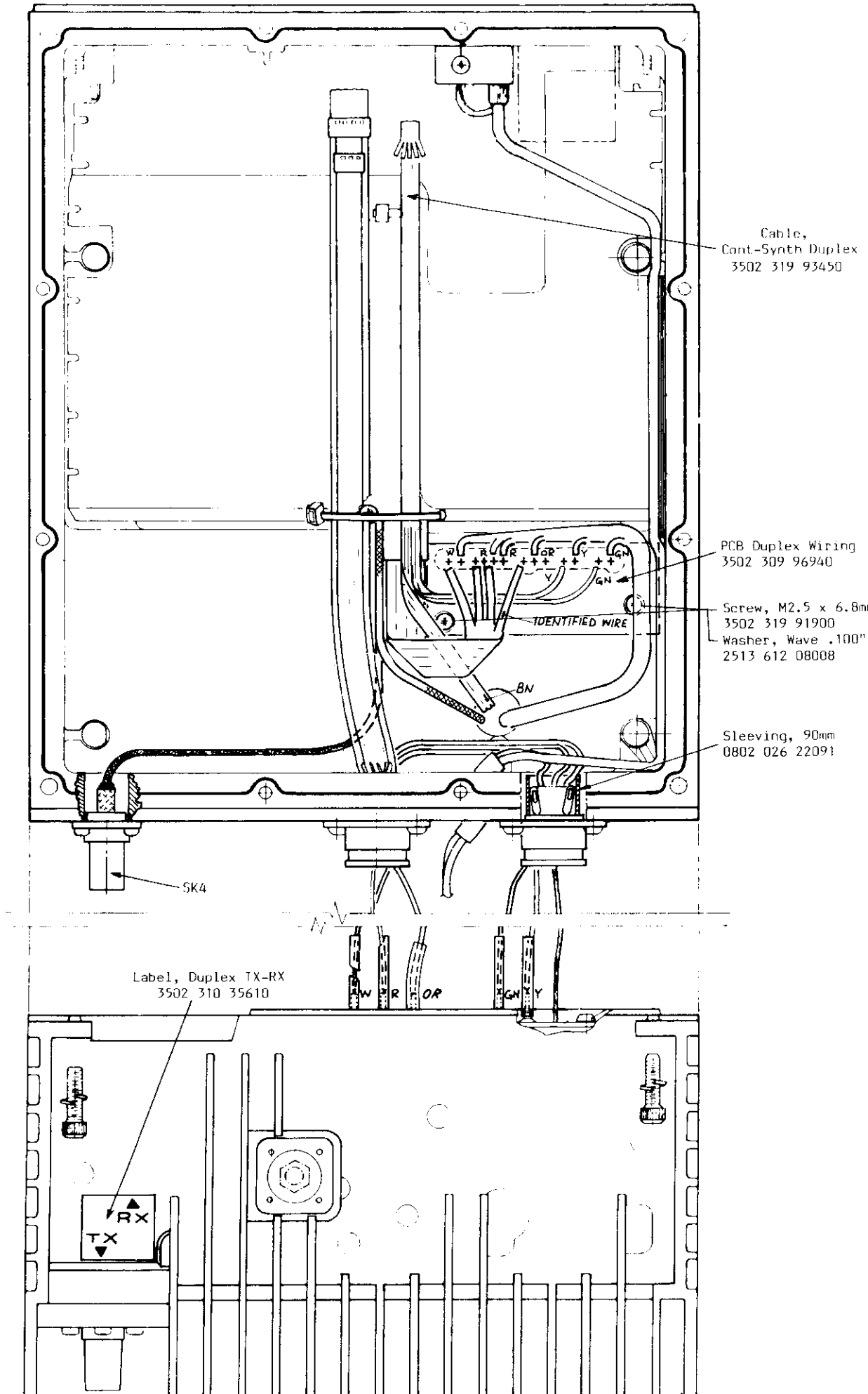
9.6 SIMPLEX HANDSET HS765



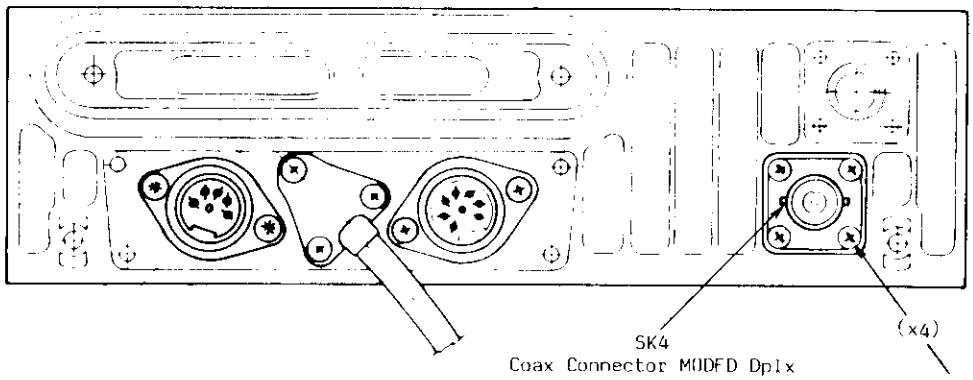
9.7 CHASSIS FM91 DUPLEX



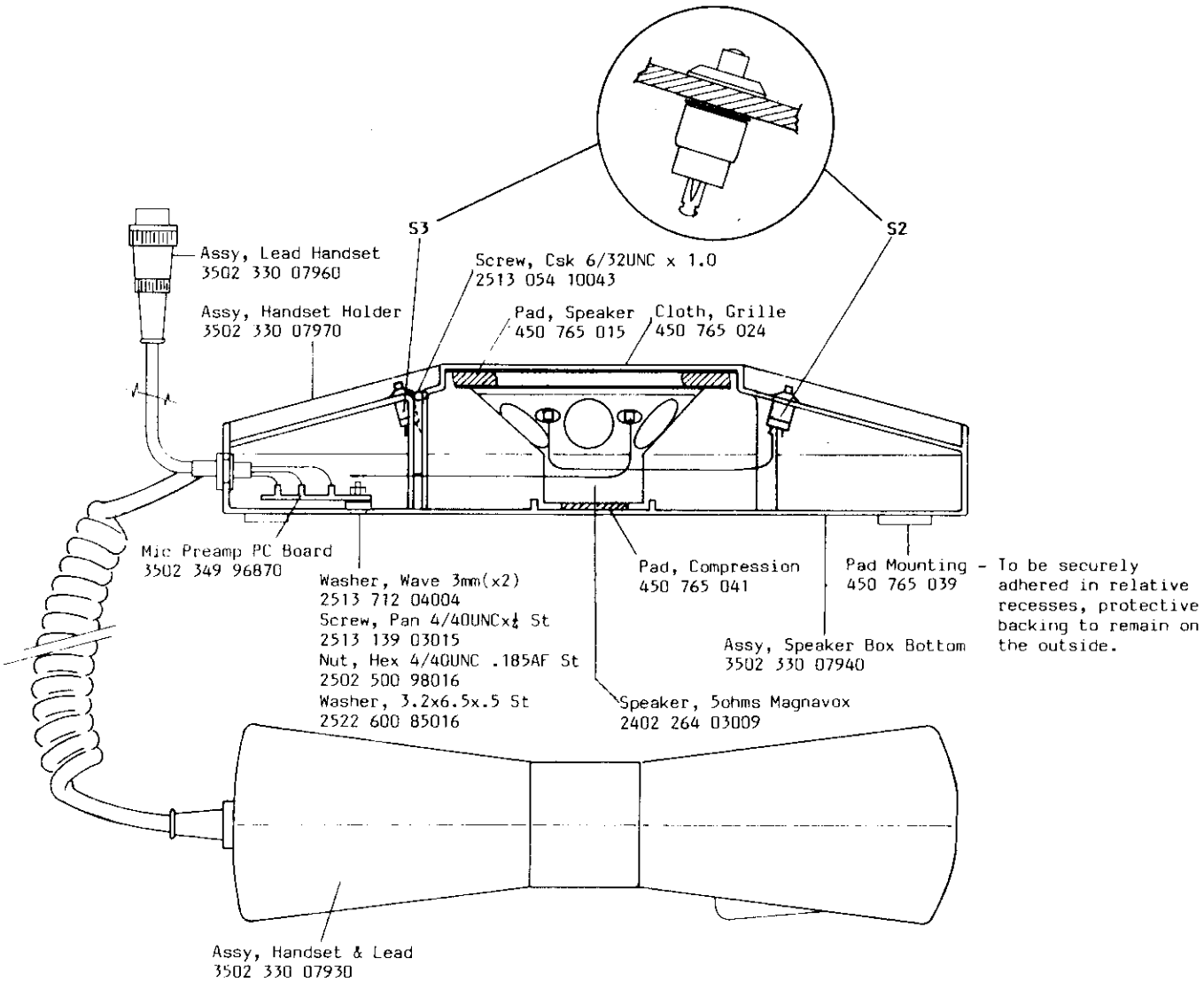

Coax Link RxMix-RxAmp
3502 319 93550
Coax Link RxBuff-Dplx
350 319 93570
IDENTIFIED WIRE
Bead, Ferrite
2413 545 00249
IDENTIFIED WIRE
Cable Rx-Duplex
3502 319 94130


Cable,
Cont-Synth Duplex
3502 319 93450
PCB Duplex Wiring
3502 309 96940
Screw, M2.5 x 6.8mm
3502 319 91900
Washer, Wave .100"
2513 612 08008
Sleeving, 90mm
0802 026 22091
W
R
R
OR
Y
GN
IDENTIFIED WIRE
BN
SK4
Label, Duplex TX-RX
3502 310 35610
RX
TX

9.8 CHASSIS BACK PANEL FM91 DUPLEX



9.9 DUPLEX HANDSET HS765



SECTION 10 WATERPROOF KIT

10.1 APPLICATION

The waterproof kit provides sealing of all surfaces as shown in the drawing with the parts listed. The repair kit listed provides the gaskets necessary to ensure covers required to be removed during normal routine servicing can be replaced.

10.2 FITMENT

10.2.1 GENERAL INSTRUCTIONS

a) All external joints and interfaces are protected by a gasket, some with an adhesive surface.

b) When dis-assembling any interface, care must be taken to ensure that no damage occurs to the gasket or mating surface.

c) On interfaces where a raised bead is present on the casting, the mating component with the gasket must be re-assembled in the same orientation. For the chassis covers, a label specifying side and orientation is attached on their internal surface.

d) Gasket Repair Kit 3502 330 06930 comprises the four adhesive coated gaskets used at the major interfaces.

10.2.2 FITMENT OF ADHESIVE COATED GASKETS

a) Prior to fitting gaskets to the front panel and covers ensure that the surfaces are clean, free from dust, oil and grease etc..

b) Remove protective backing paper taking care not to contaminate the adhesive coating.

c) Location of the adhesive coating to be on the side indicated by the broken line.

d) Position the gasket as close as possible to and parallel with the outer gasket retaining lip, then press into place.

10.2.3 FITMENT OF PLAIN GASKETS

a) Ensure that castings are clean, free from dust and burrs etc..

b) Carefully position the gaskets and ensure that they remain in position while the associated parts are screwed together.

10.2.4 FITMENT OF SCREWS

a) When fitting the screws ensure that they do not pick up the gaskets and tear or distort them.

Maximum recommended tightening torque for all

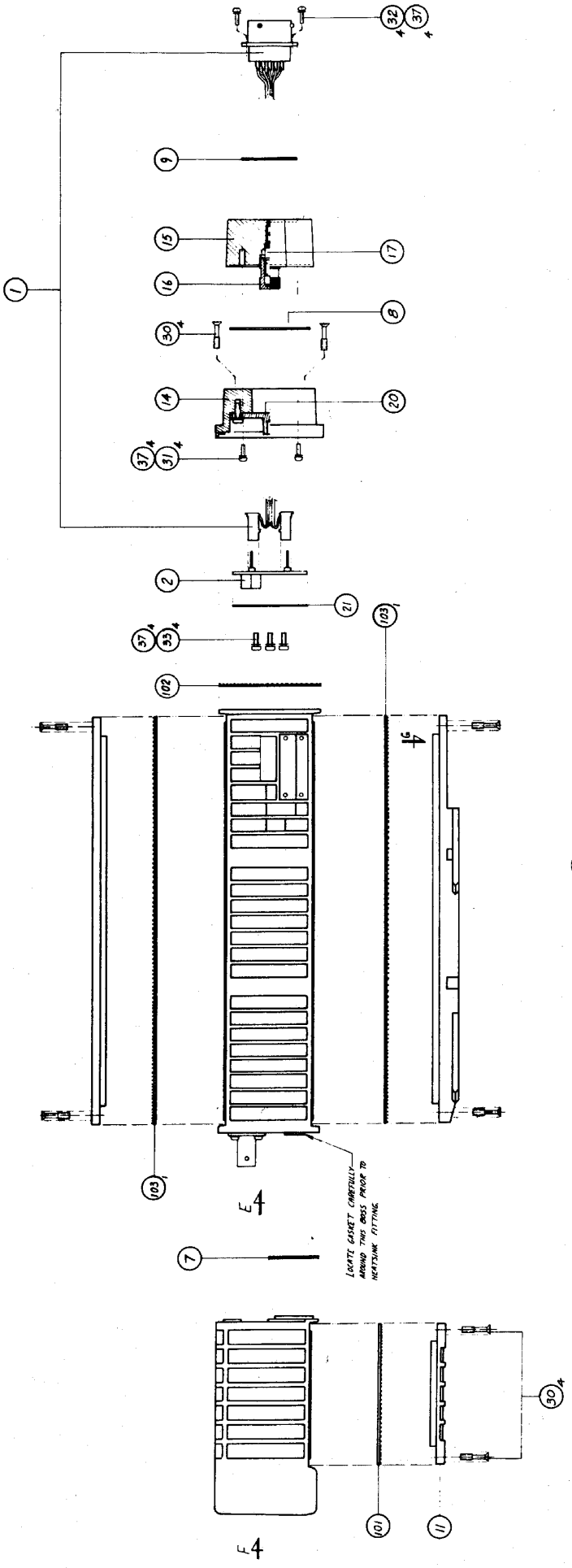
M2.5 Plastite screws .7Nm(6lb in)
M3.5 Plastite screws 2.2Nm(19lb in)

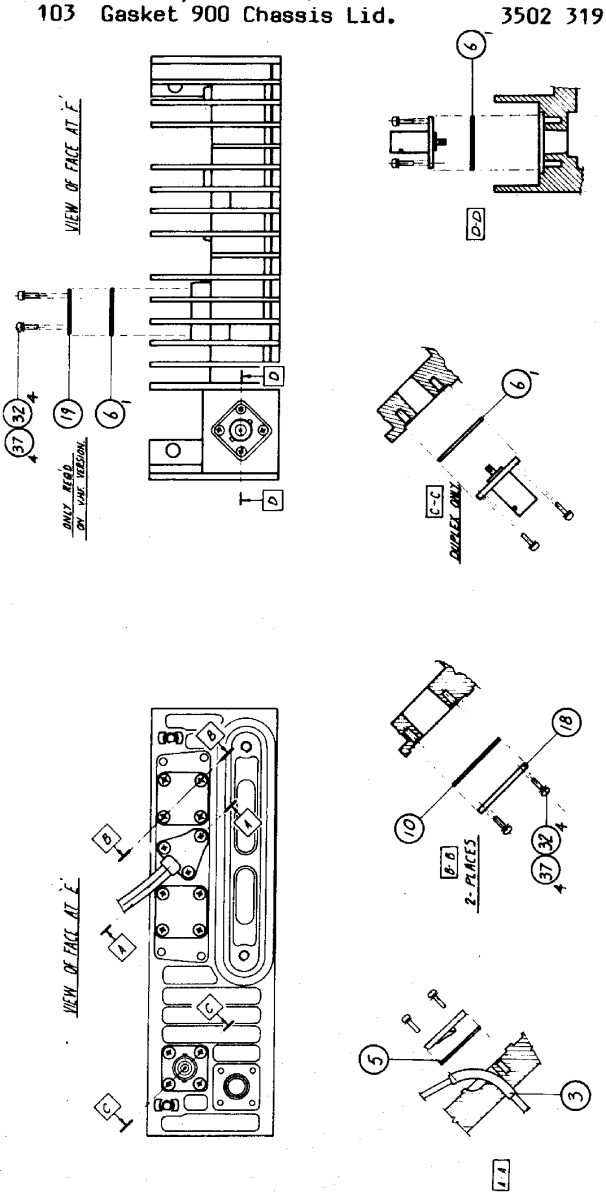
900 WATERPROOF KIT (9585 900 60050)

1	Connector Assy W/Proof	3502 350 03110
2	Remote Interface BRD W/Proof	3502 349 77010
3	Lt Cable Assy W/Proof 900	3502 330 06920
	Gasket Kit 900 Repair	3502 330 06930
5	Gasket DC Cable Clamp	3502 319 91300
6	Gasket - BNC Socket Flange	3502 319 91290
7	Gasket, PA Interface	3502 319 91280
8	Gasket, W/Proof Adapt Block	3502 319 91330
9	Gasket, W/Proof Connector	3502 319 91340
10	Gasket, Rear Cover Plates	3502 319 92700
11	Cover PA Heatsink W/Proof	3502 319 90930
14	Front Panel 900 W/Proof	3502 319 90920
15	Adaptor Block 900 W/Proof	3502 319 90280
16	Nut - Valve MTG	3502 319 90890
17	Valve (Modified)	3502 330 08060
18	Plate, Rear Cover WP/K Pntd	3502 319 92690
19	Ltd, BNC Socket Flange Pntd	3502 319 91140
20	Mtg Plate, 15WSCKT, RC Nat	3502 319 90260
21	Insulator, F/Panel PCB	3502 319 92170
30	Screw Co/Mtg M2.5 Plast Pld	3502 319 91760
31	Screw,M2.5x10.8MM,Plast Pld	3502 319 91920
32	Screw,M2.5x8.3MM, Plast Pld	3502 319 91910
33	Screw,M2.5x6.8MM, Plast Pld	3502 319 91900
37	Washr BCU Wave .100"	2513 612 04008

FM900 GASKET REPAIR KIT (3502 330 06930)

101	Gasket, 900 PA H'Sink	3502 319 91270
102	Gasket, 900 RC F/Panel	3502 319 91320
103	Gasket 900 Chassis Lid.	3502 319 91310





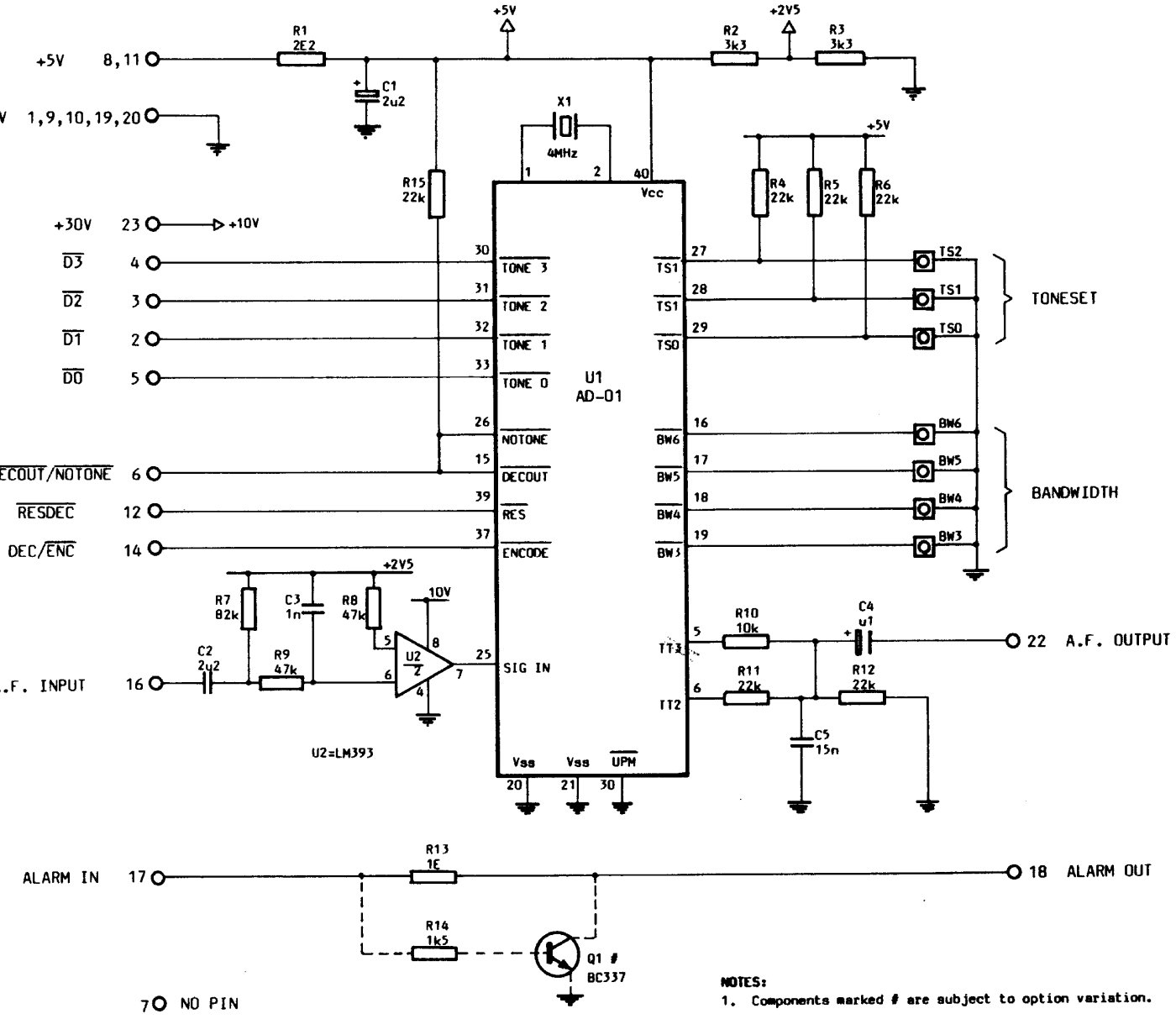


Figure 2.1 Selcall Modem Circuit Diagram

2.1.1.3 **Decoder Operation**

Once the static binary tonenumber has been placed on the $\overline{D0}$-$\overline{D3}$ inputs along with a HI on the DEC/$\overline{ENC}$ pin, $\overline{RESDEC}$ is taken LO for 10uS to reset the decoder and strobe the new tone number in.

a) **Decode Out Signal (Pin 14)**

$\overline{DECOUT}$ remains inactive HI until a decodable signal is presented at the SIGIN input of the module, at which time $\overline{DECOUT}$ becomes latched active LO until $\overline{RESDEC}$ is taken active LO again.

b) **Group Decoding**

Group decoding can be implemented using a system similar to other systems where the first 'G' tone encoded is stretched to 3tp. When decoding, if the 'NEXT' tone in a predictive sequence is not decoded during a 1.7tp gate period, the decoder is reset to look for tone 'G' for 1tp, and if found, the decoder reverts to looking for R-G-R etc., until 5 tones are decoded.

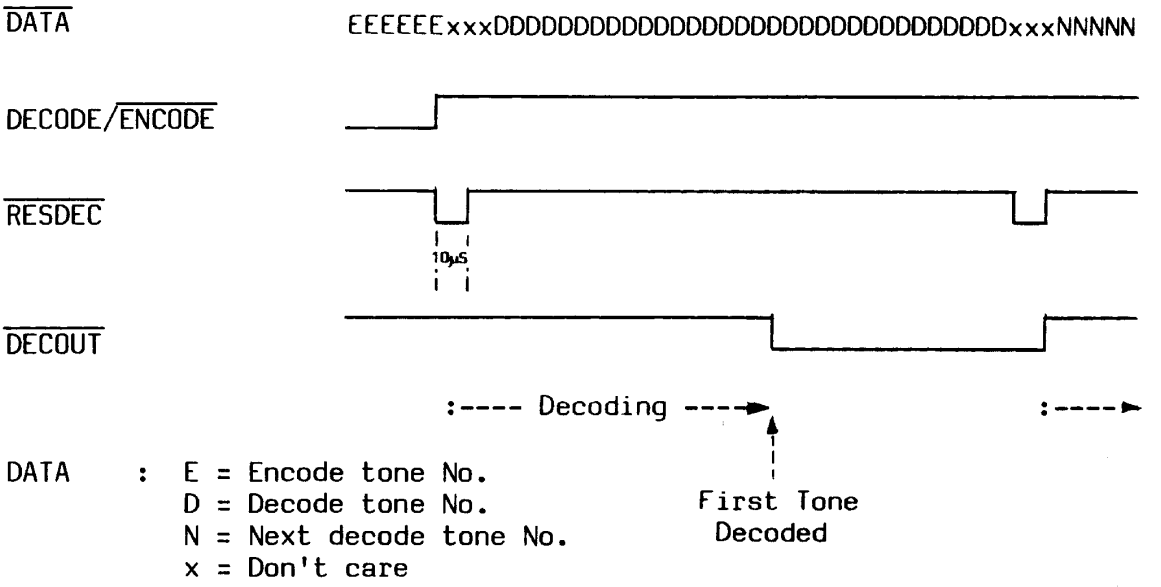


Figure 2.2 - Decoder Timing Diagram

2.1.1.4 **Encoder Operation**

To begin encoding, RESDEC is taken LO for 10uS, and upon returning HI. DEC/ENC input is taken LO. This remains LO permanently during the encoding process.

a) **Lead In Delay**

The lead in delay is set at factory standard 600mS.

b) **Encoding A Tone**

To encode a tone within the selected toneset (hardware selected), a binary (logically inverted) value is placed on D0 to D3.

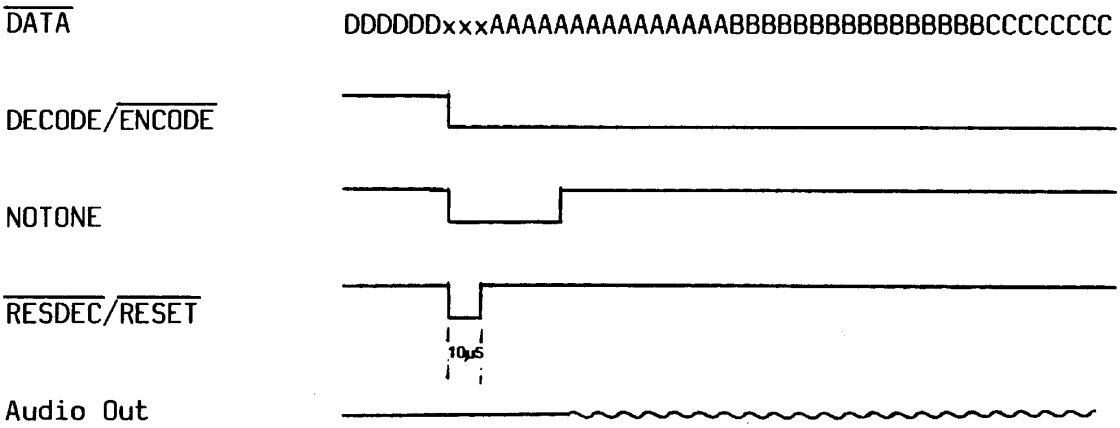
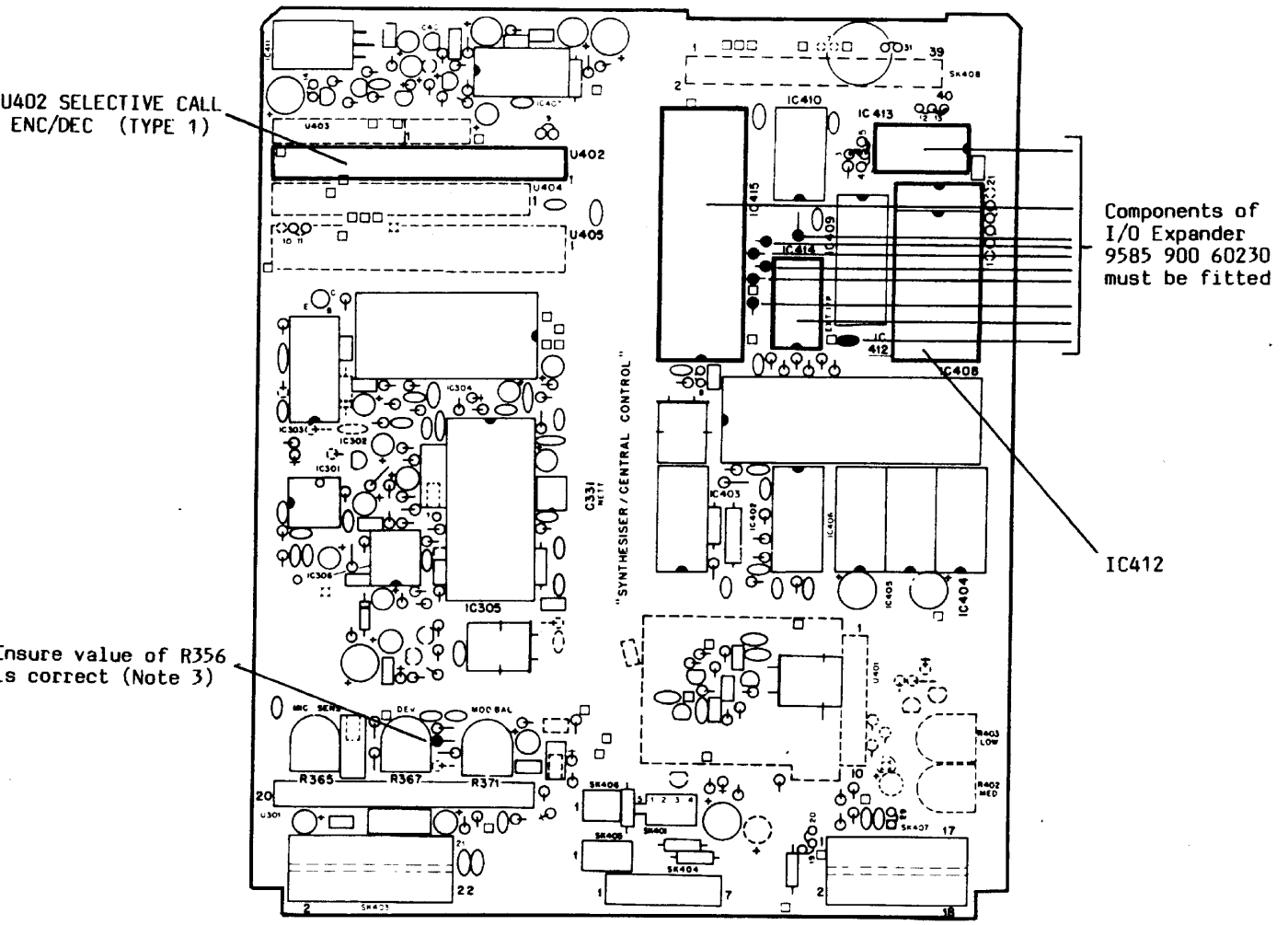


Figure 2.3 - Encoder Timing Diagram

2.1.2 **FITMENT**

SELCALL TYPE 1 KIT (9585 900 61120)



COMPONENT: U402 Module (3502 350 04180)

NOTES:

1. I/O EXPANDER KIT is standard fitment on FM91 Series.
2. EPROM IC412 must be 8k capacity with correct software.
3. R356 is 82k in 25kHz versions and 180k in 12.5kHz versions.
4. U403 cannot be fitted when Selcall Type 1 is fitted in position U402.

2.1.3 SPECIFICATIONS

2.1.3.1 Electrical

Supply Voltage:	5V ±10%
Maximum Rating On Any Pin:	-1.0V, +7.0V
Current Consumption:	< 55mA
Internal Clock Frequency:	4MHz
Tonesets Available:	CCIR, EEA, EIA, ZVEI-1,ZVEI-2,ZVEI-3, NATEL, CCRIH.
Individual Toneset Frequencies:	See Table 2.1.
Encode AF Output Level:	750mV ±150mV RMS
Encode AF Output Change vs Frequency:	±2dB wrt 750mV RMS
Encode AF Output Distortion:	< 10% THD
Encode AF Output Muting:	> 50dB
Encode Output Impedance:	< 5k ac coupled
Frequency Stability:	±0.01%
Frequency Accuracy:	±0.2%
Decode Sensitivity:	< 40mV RMS
Decode AF Input Dynamic Range:	40mV to 2V RMS
Decode AF Input Impedance:	> 100k Ohm
Decode Bandwidth: (See Note 1)	±1.5% Pass ±2.0% Stop (CCIR)
Decode Response Time: (See Note 2)	9mS for tone 5 CCIR @ 20dB SINAD
False Decode Rate (See Note 3): (Gaussian noise 6kHz BW, 5V p-p)	Zero
Alarm Output Sink Current: (Alarm transistor not normally fitted)	> 30mA Sink @ 0.2V
Logic Levels: (Internal 6k pullups on all I/O)	'1' = 2.0V to 5.8V '0' = -0.3V to +0.8V
Operating Temperature Range:	-10° to +80°C (-40° to +90°C Available)
Storage Temperature Range:	-55° to +125°C

Module Pin Connection:

Pin 1, 10, 19, 20	0V
Pin 8	+5V
Pin 5	$\overline{\text{TONE 0}}$ Input
Pin 2	$\overline{\text{TONE 1}}$ Input
Pin 3	$\overline{\text{TONE 2}}$ Input
Pin 4	$\overline{\text{TONE 3}}$ Input
Pin 12	$\overline{\text{RESDEC}}$ Input
Pin 14	DEC/$\overline{\text{DEC}}$ Input
Pin 6	$\overline{\text{DECOUT}}$/$\overline{\text{NOTONE}}$
Pin 16	AF Input
Pin 22	AF Output
Pin 17	Alarm Input
Pin 18	Alarm Output
Pin 9, 11, 13, 15, 21, 23	Not Connected
Pin 7	Not Fitted

NOTES:

1. The bandwidth of the decoder is preset (via pcb tracks) to the suggested setting for CCIR. To select another bandwidth, these tracks must be cut and the chosen bandwidth selected via the four bridge points (BW6, BW5, BW4, BW3).

BW6	BW5	BW4	BW3	Bandwidth Pass	Bandwidth Stop	
1	0	1	1	±3.6%	±4.7%	
1	0	1	0	±3.0%	±3.9%	* Recommended for EIA
1	0	0	1	±2.4%	±3.1%	
1	0	0	0	±2.1%	±2.6%	
0	1	1	1	±1.8%	±2.3%	* Recommended for ZVEI
0	1	1	0	±1.5%	±2.0%	* Recommended for CCIR
0	1	0	1	±1.2%	±1.6%	
0	1	0	0	±1.0%	±1.3%	
0	0	1	1	±0.79%	±1.0%	
0	0	1	0	±0.60%	±0.8%	

   These figures are nominally correct at 20dB Sinad, however, as the decoder has an almost 'square' passband response, they remain correct at virtually all sinads, with only a slight reduction in bandwidth as the sinad deteriorates.

2. This parameter varies with tone frequency, bandwidth and Sinad, however, as an example, the typical decode time for tone 5 in the CCIR toneset at 20dB Sinad would be around 9mS.

3. The decoder when used as a single tone device, will not respond unless the power within the passband of the decoder is greater than the total power outside the passband (0dB S/N). It therefore will NOT decode when subjected to any level of white or semi-white (300-3000Hz) noise. No decodes will occur on impulse noise unless the noise is repetitive and meets the above algorithm. As the decoder is sequenced by an external processor, false decoding can only be stated for single tones.

2.1.3.2 **Mechanical**

Size:	72mm x 19mm x 12mm (xtal extra)
Construction:	Double Sided PCB
Mounting:	The module is designed to fit in the existing U402 slot. The area allocated for U403 will also be required. However, the RTB module (U404) will not be affected.
Vibration:	Capable of withstanding vibration conditions encountered in mobile radio environment.
Moisture:	Protected from condensation (Not hermetically sealed).

2.1.4 TEST AND ALIGNMENT

This test procedure covers the testing of all FM900 mobiles fitted with "Type 1" Selcall systems. The procedure covers CCIR, ZVEI and EEA toneset systems and tone periods of 20, 40, 70 and 100mSecs. Normal transmitter and receiver alignment must be completed before Selcall testing is performed. As this is a generalised test procedure which covers a variety of Selcall systems, it will be necessary to consult the mobile's programming chart and the software code charts (refer Part 1, Section 1.4) to determine which facilities are to be tested in a particular mobile.

2.1.4.1 Test Equipment

a) Power Supply. PS775 or similar (13.8V @ 8A)

b) Rohde & Schwarz test unit model SMFP.

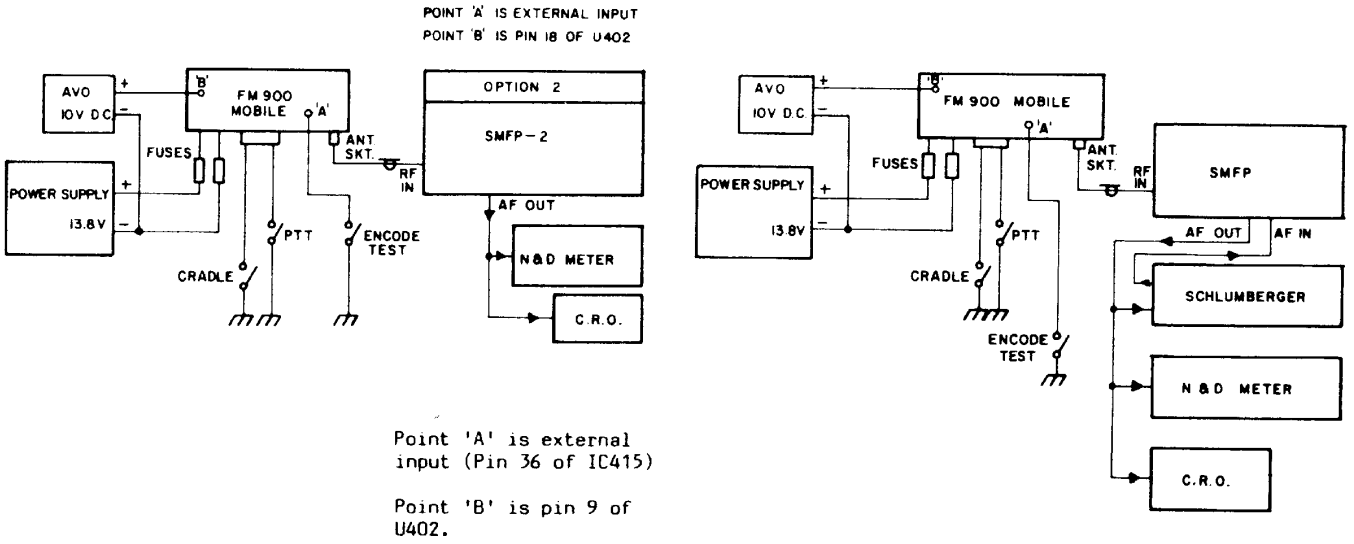
c) Selective call test unit:

i) Option-2 fitted to SMFP suitable for testing:
CCIR, ZVEI, EEA, 5 and 7-tone systems.
20, 40, 70, 100mS tone period.

ii) Schlumberger Selective Call test unit model 4920, suitable for testing:
CCIR, ZVEI, EEA, 5-tone systems.
20, 40, 70 100mS tone period.

d) Noise and distortion meter, HP331A or similar.

e) CRO BWD Model 539D or similar.



(a) Equipment Set Up Suitable For All Selcall Systems

(b) Alternative Equipment Set-up. Suitable for 5-Tone Selcall Systems Only.

NOTE: "Encode Test" switch when closed extends the tone period on selcall encode, if held closed when mobile switched on.

Figure 2.4 - Equipment Set-up for Selcall Test

2.1.4.2 **Test Procedure**

2.1.4.2.1 **Encoder Test 5-Tone Systems**

a) Select channel on mobile for which Selcall is programmed.

b) Close "encode test" switch.

c) Adjust SMFP to measure FM900 mobile's transmit deviation.

d) Press Selcall "SEND" button on FM900 mobile and check transmit deviation of all Selcall tones. (**NOTE:** Tones will be extended in length).

Ensure deviation is between ±3kHz (±1.5kHz) and ±4.9kHz (±2.4kHz).

Check the tone distortion for one of the tones (preferably the lowest frequency tone). Distortion should be less than 10% THD.

e) Open "encode test" switch.

f) Adjust Selcall test unit to decode the toneset used by the mobile's Selcall system (i.e. CCIR, ZVEI or EEA as specified in the mobile's hardware code).

Press the Selcall "SEND" button and record code as decoded by test unit. Ensure the code has the correct 5-tone address.

g) Variable Send Function (if applicable)

Reprogram the mobile's "Send" code to any arbitrary code. Press the "SEND" button and verify that the manually programmed code is correctly sent.

2.1.4.2.2 **Encoder Test, 7-Tone Systems (SEPAC Compatible)**

a) Select channel on mobile for which Selcall is programmed.

b) Close "ENCODE TEST" Switch.

c) Adjust SMFP to measure FM900 mobile's transmit deviation.

d) Press Selcall "Send" button on FM900 mobile and check transmit deviation of all Selcall tones. **(NOTE:** Tones will be extended in length).

Ensure deviation is between ±3kHz (±1.5kHz) and ±4.9kHz (±2.4kHz).

Check the tone distortion for one of the tones (preferably the lowest frequency tone). Distortion should be less than 10% THD.

e) Open "encode test" switch.

f) Adjust Selcall test unit to the toneset used by the mobile's Selcall system (i.e. CCIR, ZVEI or EEA as specified in the mobile's hardware code).

Press mobile's "SEND" button and record code as decoded by test unit. Ensure that this code has the correct 5-tone address plus the "NULL status" tone.

g) Variable Send Function (if applicable)

Reprogram the mobile's "Send" code to any arbitrary code. Press the "SEND" button and verify that the manually programmed code is correctly sent. The status digit should be unchanged.

h) ANI Function (if applicable)

Press PTT switch and release. Verify that the mobile's ident is transmitted. Verify that the ident code is correctly positioned at either the start or end of transmission in accordance with the mobile's software code.

i) Variable Status (if applicable)

Reprogram the status digit to any arbitrary code. Press the PTT switch momentarily and verify that the mobile's ident code is transmitted with the new status digit appended.

2.1.4.2.3 **Decoder Test**

a) Standard Decode

i) Ensure cradle switch is closed and "Encode Test" and PTT switches are open. In this condition, verify that the receiver mute is closed.

ii) Select channel on mobile for which Selcall decode is programmed.

iii) Adjust SMFP signal generator to mobile receive frequency and set output level to 100uV PD. Ensure the amber Rx LED is on but receiver mute is closed. Program SMFP to have fast response time on the transmit mode for demodulated audio output. (See SMFP handbook for set up procedure).

iv) Set Selcall tester to the correct tone set (either CCIR, ZVEI or EEA as specified by mobile's hardware code). Ensure test set is adjusted for correct tone period.

v) Set SMFP modulation at ±4kHz (±2kHz) deviation.

vi) Program Selcall tester with mobile's address code, and transmit this code to the mobile.

vii) Ensure the mobile gives the correct response, see Table 2.2 for appropriate decode response.

b) Variable Ident (if applicable)

Reprogram the mobile's ident to any arbitrary 5-digit code, and program this same code into the Selcall tester.

Transmit this code to the mobile and ensure that the correct decode response occurs.

c) Group Decode

i) If mobile is programmed with group decode response, a SEPAC base console encoder will be needed to generate the group encode address. The SEPAC console will produce a sequence with the first group tone having a 3-tone period length and the remainder of the sequence being repeat-group-repeat to complete the 5-tones. Connect AF output from SEPAC console to modulation input of SMFP.

ii) Send a group address to mobile (first tone must not be group tone), ensure correct response occurs. See Table 2.2.

d) Decode Bandwidth Test

i) Modulate SMFP with mobile's 5-tone decode address. Set modulation to ±4kHz deviation and offset tone frequencies by ±3.5%.

ii) Send code to mobile and ensure mobile does not respond.

iii) Offset tone frequencies by -3.5% and again modulate SMFP with Selcall code.

iv) Ensure mobile does not respond.

OPTIONAL

If facilities are available on Selcall test unit offset tone frequencies by +1.5% and -1.5% and repeat decode test.

v) Ensure mobile does respond to selcall code.

e) Decode Sensitivity Check

i) Establish a 4dB SINAD condition on receiver for 1kHz/±3kHz with 300mW into 4 ohm load. Modulate signal generator with Selcall test unit and set tone deviation to ±4kHz.

ii) Send 5-tone code to mobile and ensure mobile responds. Repeat sending Selcall code several times and ensure that the mobile responds at least 9 out of 10 times.

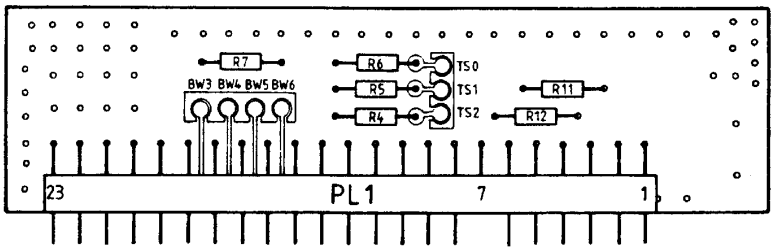
TABLE 2.2 - TYPE 1 Selcall Decode Response

	AUDIBLE ALARM	DISPLAY	RECEIVER MUTE	TIMED ALARM	AUTOMATIC ACKNOWLEDGE
STANDARD CALL	SHORT BEEP	"CALL" DISPLAYED FLASHING	OPENS CONTINUOUS	N/A	YES
STANDARD CALL WITH URGENT BEEP	CONTINUOUS BEEPING			N/A	YES
STANDARD CALL WITH ALARM TIMED	SHORT BEEP			SET FOR 10 SECONDS	YES
STANDARD CALL WITH URGENT BEEP AND ALARM TIMED	CONTINUOUS BEEPING			SET FOR 10 SECONDS	YES
ANY OF ABOVE WITH GROUP CODE	AS PER ABOVE			AS FOR ABOVE	NO
STANDARD CALL WITH SC706 COMPATIBILITY	SHORT BEEP	N/A	OPENS FOR 7 SECONDS	N/A	NO
STANDARD CALL WITH URGENT BEEP AND SC706 COMPATIBILITY	2 SECONDS OF BEEPING	N/A		SET FOR 10 SECONDS	NO

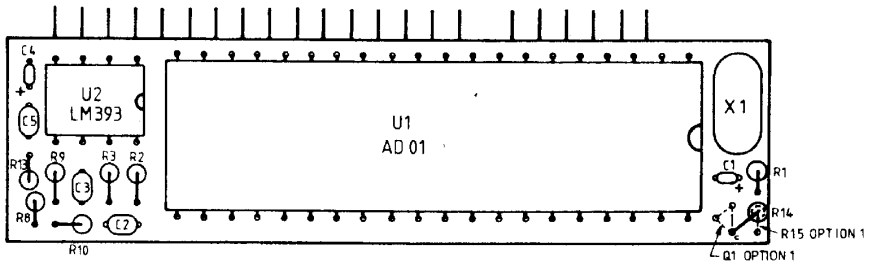
N/A = Not Applicable.

2.1.5 PC BOARD SELCALL TYPE 1 MODULE

	PCB 17-00A
U1	Integrated Circuit AD01
U2	Integrated Circuit LM393
D1	Transistor BC337
R1	Resistor 2E2/5/.25/CF
R2	Resistor 3k3/5/.125/CF
R3	Resistor 3k3/5/.125/CF
R4	Resistor 22k/5/.125/CF
R5	Resistor 22k/5/.125/CF
R6	Resistor 22k/5/.125/CF
R7	Resistor 82k/5/.125/CF
R8	Resistor 47k/5/.125/CF
R9	Resistor 47k/5/.125/CF
R10	Resistor 10k/5/.125/CF
R11	Resistor 22k/5/.125/CF
R12	Resistor 22k/5/.125/CF
R13	Resistor 1E/5/.125/CF
R14	Resistor 1k5/5/.125/CF
R15	Resistor 22k/5/.125/CF
C1	Capacitor 2u2//16/TANT
C2	Capacitor 2n2/10//CER/X7R
C3	Capacitor 1n/10/CER/X7R
C4	Capacitor u1//16/TANT
C5	Capacitor 15n/10//CER/X7R
X1	Crystal 4MHz/MC18U/QTZ
PL1	Plug 23/.1/SIL/PL



Solder Side



Component Side

Repair of this module is not recommended due to the manner in which assembly is effected.

2.2 SELCALL TYPE 2

2.2.1 GENERAL DESCRIPTION

The Selective Call encoder/decoder signalling option module, is constructed on a 60mm x 16.9mm x 0.635mm hybrid substrate. The hybrid is fitted in the U402 position on the synthesiser/control board of the FM900 series mobile. The circuit design utilizes very large scale integration CMOS technology.

The hybrid has four versions to cover CCIR, ZVEI, and EEA tone frequency standards, in both encoder/decoder and encoder only variants.

The hybrid contains a 17-tone programmable encoder, producing frequencies which conform to the appropriate standard, and a universal decoder which responds to 15 frequencies in the tone set. Both the encoder and decoder operate from a common 560kHz reference frequency which is generated by a ceramic resonator. A trimmer capacitor is provided to fine tune this clock frequency. Programming of the encoder frequency is under microcomputer control and is achieved via four bi-directional logic control inputs (D0 to D3 at Pins, 5, 2, 3 and 4 respectively) which also act as data outputs when in decode. The encoder only variant has no decode circuitry assembled on the hybrid.

An input at Pin 12 sets either the encode or decode mode and is at logic '1' for encode. A bi-directional input at Pin 14 (Data change) is used to latch-in the new encode data when encoding, and produces a positive going pulse output in decode, each time the output data has changed. A dual function input at Pin 6 is used in encode to select two alternative modes of the encoder, i.e. logic '1' sets a hexadecimal tone set format and '0' sets the quadradecimal tone set format. In decode this input is used in conjunction with the microcomputer control to hold the state of the output data for reading, this effectively establishes handshake routines for selcall decoding.

AF input to the selcall decoder is derived from the receiver unde-emphasised output and is connected to Pin 16 of the hybrid.

AF output for selcall encode is at Pin 22 and couples the selcall tones to the transmitter audio processing hybrid, U301.

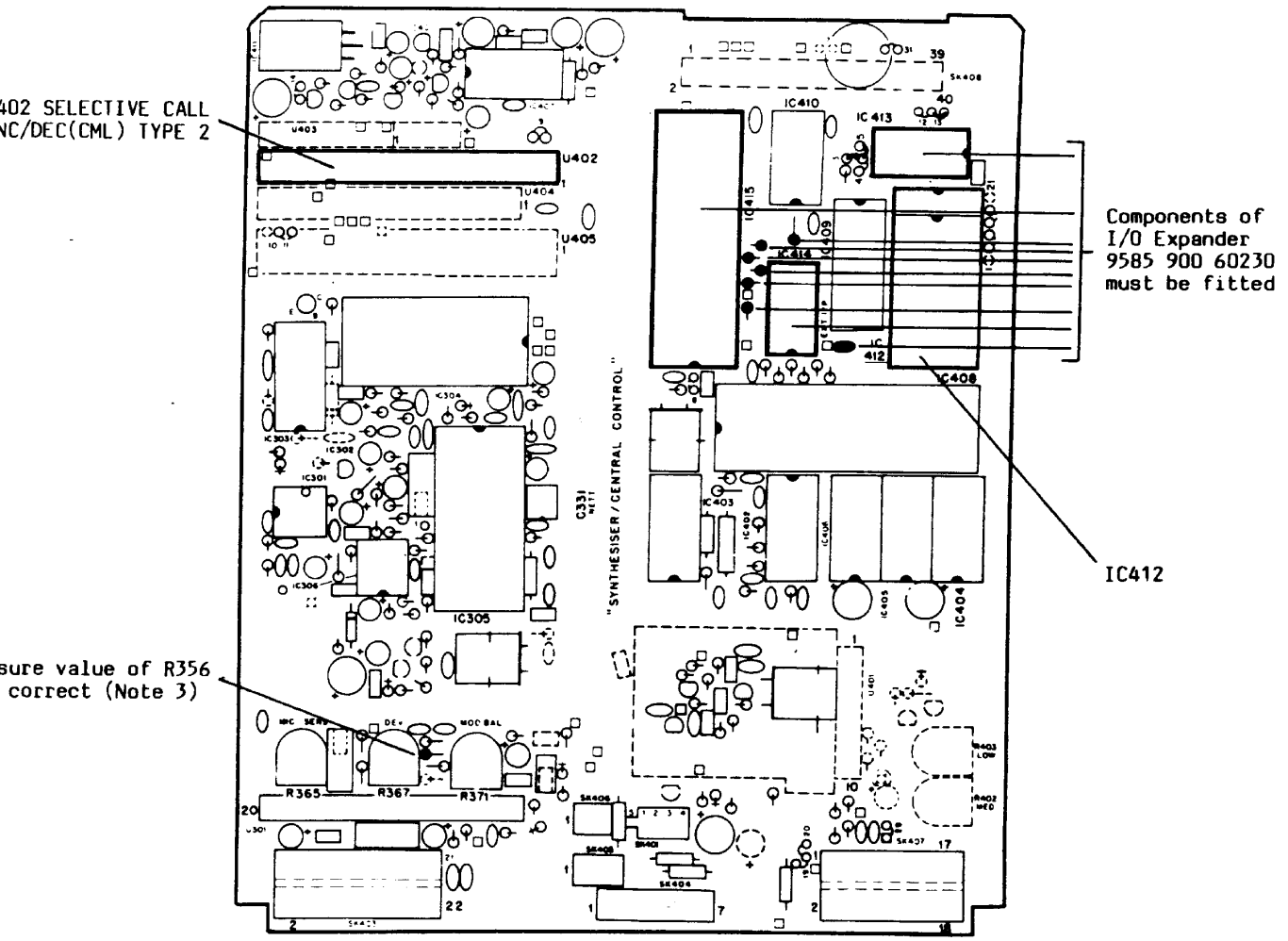
Pin 18 of the selcall hybrid is internally linked to Pin 17 and provides a connection to the mobile microcomputer. The output at this pin is provided as a logic control for selcall alarm decode options.

The selcall hybrid operates in tone sequential signalling systems under microcomputer control in the mobile. The microcomputer establishes all timing and sequencing of code patterns.

2.2.2 FITMENT

SELCALL TYPE 2 KIT

a) CCIR Encoder/Decoder (9585 900 61040)
b) CCIR Encode Only (9585 900 61100)
c) ZVEI Encoder/Decoder (9585 900 61050)
d) EEA Encoder/Decoder (9585 900 61060)



COMPONENTS: U402 Hybrid a) H40A (3502 358 00370)
b) H50A (3502 358 00430)
c) H40B (3502 358 00380)
d) H40F (3502 358 00420)

NOTES: 1. I/O EXPANDER KIT is fitted as standard on FM91 Series.

2. EPROM IC412 must be 8K capacity with correct software.

3. R356 is 82k in 25kHz versions and 180k in 12.5kHz versions.

2.2.3 SPECIFICATIONS

2.2.3.1 Encoder

a)	Tone Deviation	±3.5kHz to ±4.9kHz deviation. Nominal ±4kHz. (For 25/30kHz channel spacing).
b)	Tone Distortion	< 10% THD
c)	Frequency Standards	CCIR, ZVEI, EEA. (See Note 1)
d)	Frequency Stability	±0.3% (Over temperature range -30°C to +60°C Ambient).
e)	Tone Period Timing	40, 70, 100mSec (See Note 2) (EEA),(ZVEI),(CCIR)
f)	Tone Period Tolerance	40 ±2mSec, 70 ±2mSec, 100 ±4mSec.
g)	Lead In Delay	Adjustable, 10mSec to 2.5 Sec. in 10mSec steps. Factory preset at 600mSec.
h)	Lead Out Delay	Adjustable, 10mSec to 2.5 Sec. in 10mSec steps. Factory preset to 100mSec.
i)	Send Repeat Rate	Delay between successive calls is fixed at 10 Secs.
j)	Code Formats	i) 5-Tone consecutive address code. OR ii) 7-Tone (5-Tone consecutive address code followed by a two tone period gap followed by a two tone period "Status" tone).

NOTE: 1. A different hybrid is required for each of the tone sets.

2. The tone period for CCIR may be either 40mSec or 100mSec on request.

2.1.3.2 Decoder

a)	SINAD Sensitivity (90% decode success rate of 5-tone sequence).	⩽ 3dB SINAD (measured at loud speaker for receiver reference input of 1kHz ±3kHz deviation).
b)	Deviation Sensitivity (Min.deviation for decode, with receiver in full quieting).	⩽ ±300Hz

2.2.3.2 **Decoder** (Cont'd)

c) Decode Bandwidth

CCIR ±1% to ±3%
ZVEI ±1% to ±4.5%

EEA ±1% to ±3%

d) Tone Decode Response Time

Typically 25mSec.

e) False Decode In Noise (Gaussion Noise in 6kHz Bw) 5 Tone Sequence 100mSec.

CCIR: 1 in 10^{14} Years
ZVEI T.B.A.

Tone Period

EEA T.B.A.

f) False Decode In Speech 5 Tone Sequence

CCIR: 100mSec Tone Period
Better than once every
3 years per mobile

ZVEI: T.B.A.
EEA: T.B.A.

g) Valid Tone Period for Successful Decode (Excluding Group Tone)

	*Min.	Max.
CCIR 40mSec.	25mSec	80-106mSec
CCIR 100mSec.	25mSec	186-212mSec
ZVEI	25mSec	140-166mSec
EEA	25mSec	80-106mSec

***NOTE:** This is the typical decode response time.

h) Group Tone Decode

A successful group tone response will occur for the group tone period from a minimum of 25mSec. (typical response time) to a maximum of 3 times the tone period. Any tone of the 5 tone address may be substituted with the group tone.

i) Code Format

All decode addresses must be 5 tone consecutive.
A successful decode will occur if the correct code address is preceded with and/or followed by erroneous tones.

j) Decode Recognition

Upon receipt of correct decode address no action occurs (i.e. mute open, automatic acknowledge) until the decoder produces a change of output, i.e. reverts to a non-tone code output or any other code output.

2.2.3.3 U402 Module Pin Connections Selcall Hybrid

PIN NO.	CONNECTION
1, 10, 19, 20	0V
8	+5V
5	D0 Data Input/Output
2	D1 Data Input/Output
3	D2 Data Input/Output
4	D3 Data Input/Output
14	Data Change Input/Output
6	SEE NOTE
12	Encode/$\overline{\text{Decode}}$
16	AF Input
22	AF Output
17	Connected to Pin 18
11, 13, 15, 21, 23	Not Connected
7, 9	Not Fitted

NOTE: Pin 6 is $\overline{\text{hold}}$ on Decode and XTC/$\overline{\text{QTC}}$ on Encode.

2.2.3.4 **Character Tone Table Selcall Hybrid**

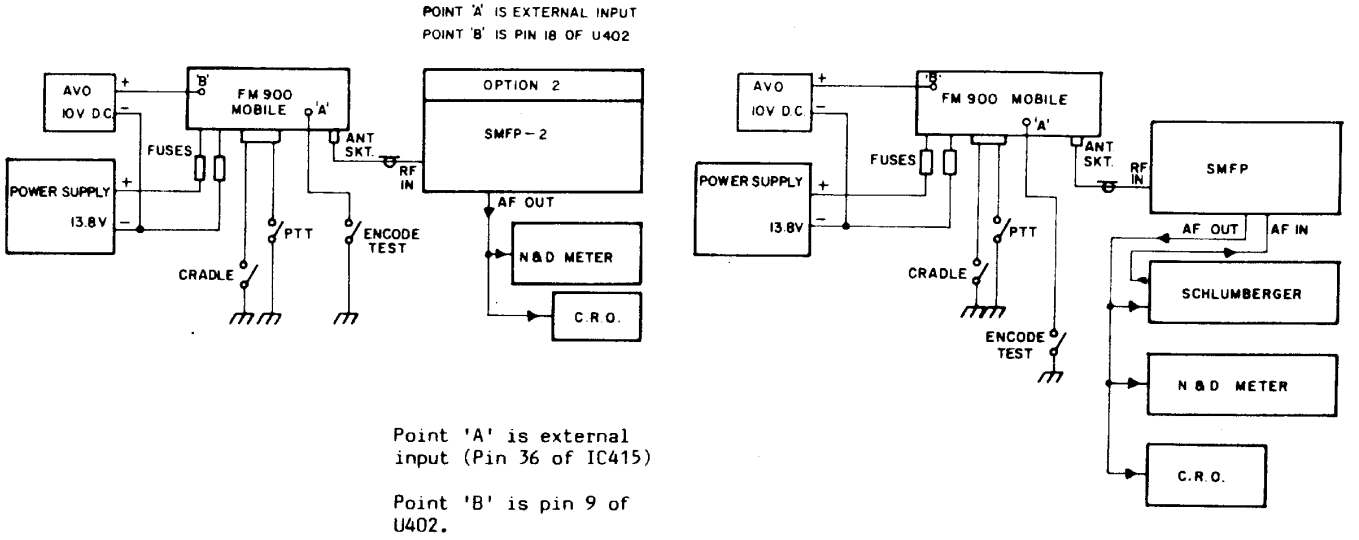
FORMAT CHARACTERS	DATA INPUTS	TONE FREQUENCY (Hz)		
QTC	D_3 D_2 D_1 D_0	CCIR	EEA	ZVEI
0	0000	1981	1981	2400
1	0001	1124	1124	1060
2	0010	1197	1197	1160
3	0011	1275	1275	1270
4	0100	1358	1358	1400
5	0101	1446	1446	1530
6	0110	1540	1540	1670
7	0111	1640	1640	1830
8	1000	1747	1747	2000
9	1001	1860	1860	2200
A(Group)	1010	2400	1055	2800
B	1011	930	930	810
C	1100	2247	2247	970
D	1101	991	991	886
E(Repeat)	1110	2110	2110	2600
F	1111	NO TONE	NO TONE	NO TONE

2.2.4 TEST & ALIGNMENT

This test and alignment procedure assumes that the normal transmitter and receiver alignment is already completed.

2.2.4.1 Test Equipment & Test Set-Up

a) Power supply, PS775 or similar. (13.8V @ 8a)
b) Rohde and Schwarz test unit model SMFP. (with Option 2)
c) Schlumberger Selective Call test unit model 4920.
This may be used with SMFP if option 2 not fitted, but will only be suitable for 5 tone system testing).
d) Noise and Distortion meter. HP331A or similar.
e) C.R.O. BWD Model 539D.
f) Frequency Counter Philips PM6668.
g) High impedance probe.



(a) Equipment Set Up Suitable For All Selcall Systems

(b) Alternative Equipment Set-up. Suitable for 5-Tone Selcall Systems Only.

NOTE: "Encode Test" switch when closed extends the tone period on selcall encode, if held closed when mobile switched on.

Figure 2.5 - Equipment Set-Up for Selcall Test

2.2.4.2 **Test Procedure**

2.2.4.1.1 **Selcall Hybrid Alignment**

a) Set "Encode Test" switch to closed position.

b) Switch FM900 mobile on and measure clock frequency on selcall hybrid at Pin 9 of Hybrid U402. Adjust frequency. 560kHz ±0.6kHz.

c) Disconnect frequency counter from hybrid.

2.2.4.1.2 **Encoder Test 5-Tone Systems**

a) Select channel on mobile for which selcall encode is programmed.

b) Adjust SMFP to measure FM900 mobile's transmit deviation.

c) Press Selcall "Send" button on FM900 mobile and check transmit deviation of all Selcall tones. (N.B. tones will be extended in length.)

Ensure deviation is between ±3.5kHz and ±4.9kHz. Check the tone distortion for one of the tones. Distortion should be less than 10% THD.

d) Open "encode test" switch.

e) Adjust Selcall test unit to decode the mobile code sent. Press mobile's "Send" button and record code as decoded by test unit. Ensure code corresponds to "base address" code as programmed for the customer. (Ensure Selcall test set is adjusted for correct tone period length).

2.2.4.1.3 **Encoder Test 7-Tone Systems (Sepac)**

a) Select channel on mobile for which Selcall encode is programmed.

b) Adjust SMFP to measure FM900 mobile's transmit deviation.

c) Press Selcall "Send" button on FM900 mobile and check transmit deviation of all Selcall tones.
(N.B. tones will be extended in length).

Ensure deviation is between ±3.5kHz and ±4.9kHz. Check the tone distortion for one of the tones. Distortion should be less than 10% THD.

d) Open "encode test" switch.

2.2.4.1.4 **Encoder Test 7-Tone Systems (Sepac)**

e) Adjust Selcall test unit to decode the mobile code sent. Press mobile's "Send" button and record code as decoded by test unit. Ensure this code has correct 5-tone address plus the "null status" tone. For Selcall plus ANI system ensure the 5-tone address corresponds to the "base address" code for the customer. For ANI only system ensure the 5-tone address corresponds to the "mobile ident" code for the customer.

f) For mobiles programmed with ident at start of transmission, activate PTT and ensure "mobile ident" code is sent at start of transmission. If mobile is programmed with ident at end of transmission, ensure correct code is sent when PTT is released. This code should have the 5-tone address plus the "null status" tone.

g) For FM91 mobiles with variable encode, programme a 5-tone code (arbitrary code) and press "SEND" button. Verify that manually programmed code is correctly sent.

2.2.4.1.5 **Decode Test**

a) Ensure cradle switch is closed and "Encode Test" and PTT switches are open. In this condition verify that the receiver mute is closed.

b) Select channel on mobile for which Selcall decode is programmed.

c) Adjust SMFP signal generator to mobile receive frequency and set output level to 100uv pd. Ensure the amber Rx LED is on but receiver mute is closed.

Programme SMFP to have fast response time on the transmit mode, for demodulated audio output. (See SMFP handbook for set up procedure.)

d) Standard Decode

i) Modulate SMFP with mobile's 5-tone standard decode address. (Set modulation at ±4kHz deviation and ensure code is sent at correct tone period length and initially sent at ±0% frequency error).

ii) Check that mobile responds in the following way:

(a) When mobile decodes corectly, an audible "beep" is produced in loudspeaker. The word "CALL" should be displayed.

(b) PTT is activated and Tx Red LED is active during transmit. Selcall code is sent. This is automatic acknowledge, measure this selcall transmission and ensure code corresponds to the mobile ident code.

(c) Receiver mute should open.

iii) Check that the "CALL" message on the display is cleared when cradle switch is opened, and that the receiver is muted when switch is closed again.

e) Urgent Decode

i) If mobile is programmed with Urgent decode response, modulate SMFP with this code at ±4kHz deviation.

ii) Check that the mobile has the following response:

a) When mobile decodes correctly, a continuously "beeping" audible alarm is produced in loud speaker. The word "URGENT" only is displayed.

b) PTT is activated and Tx Red LED is active during transmit. Selcall code is sent. This is automatic acknowledge, measure this Selcall transmission and ensure code corresponds to the "URGENT" code.

c) Receiver mute should open.

iii) Check that the "URGENT" message blanks and alarm stops when cradle switch is opened. Ensure that receiver is muted when cradle switch is closed again.

f) Group Decode

i) If mobile is programmed with group decode response, modulate SMFP with the mobile address code but substitute the group tone for any one of the 5-tones. (The sequence should still remain 5-tone.)

ii) Check that the mobile has the following response:

a) When the mobile decodes correctly, an audible "beep" is produced in loudspeaker and amber LED illuminates. (If a group response to an urgent call is programmed, the word "URGENT" is displayed. If a standard group code is sent "CALL" is displayed.

b) Receiver mute should open.

iii) Check that "CALL" (or "URGENT") display is cleared when cradle switch is opened. Ensure receiver is muted when cradle switch is closed.

g) Alarm Timed Decode

i) If mobile is programmed for alarm timed decode response, connect an AVO positive lead to Pin 18 of U402 module and negative lead to chassis. Set AVO to +10VDC range. Modulate SMFP with mobile's alarm code address.

ii) Check that mobile has the following response:

a) When mobile decodes correctly, the AVO reads between 2.4V & 5V for 15 secs. After 15 secs the AVO should read between 0V and 0.4V. No other response should occur.

h) Alarm ON/OFF Decode

i) If mobile is programmed for alarm on/off decode response, connect an AVO positive lead to Pin 18 of U402 module and negative lead to chassis. Set AVO +10Vdc range. Modulate SMFP with mobile's alarm on address code.

ii) Check that mobile has the following response:

When mobile decodes correctly, the AVO reads between 2.4V & 5V. No other response should occur.

iii) Modulate SMFP with mobile's alarm off address code and ensure that mobile responds in the following way:

The AVO reads between 0V & 0.4V.
No other response should occur.

j) Variable Ident

i) Manually reprogramme the mobile's ident code. This is done by selecting a 5-tone code on the keypad and pressing F7 to permanently change mobile's ident.

ii) Modulate SMFP with the above 5-tone code which was programmed.

iii) Ensure mobile responds in the same manner as for "standard" decode address.

k) Decode Bandwidth Test

i) Modulate SMFP with mobile's 5-tone standard decode Address. Set modulation to ±4kHz deviation and offset tone frequencies by +3.5%.

ii) Ensure mobile does not respond to Selcall code.

iii) Offset tone frequencies by -3.5% and again modulate SMFP with Selcall code.

iv) Ensure mobile does not respond to Selcall code.

v) OPTIONAL

If facilities are available on Selcall test unit, offset Selcall tone frequencies by +1.5% and -1.5% and repeat decode test.

vi) Ensure mobile does respond to Selcall code.

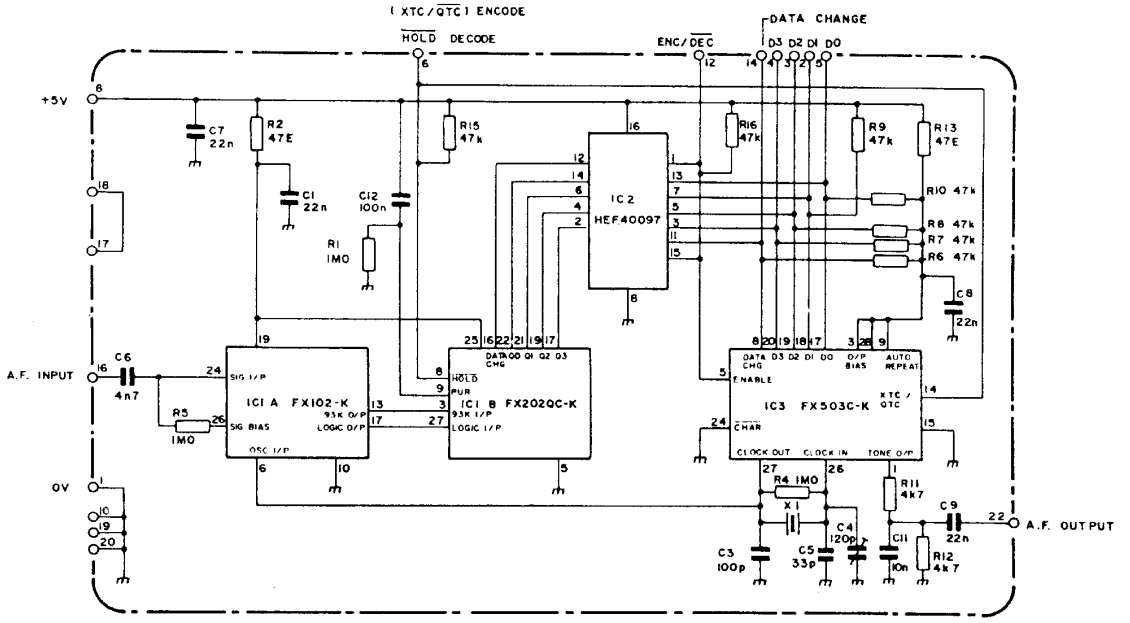
l) Decode Sensitivity Check

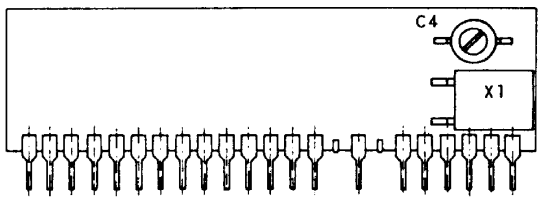
i) Establish a 4dB SINAD condition on receiver for 1kHz ±3kHz with 300mW into 4ohm load. Change SMFP modulation to Selcall code for mobile standard decode address. Modulate at ±4kHz deviation.

ii) Ensure mobile successfully decodes. Repeat sending Selcall to mobile several times and ensure that the mobile responds at least 9 out of 10 times.

2.2.5 PC BOARD SELCALL TYPE 2 MODULE

This module is a hybrid unit which cannot be serviced, therefore no parts list is provided, however, the basic Selcall circuit is produced below for information together with a diagram indicating only the crystal and tuning capacitor location.





SECTION 2 - SELECTIVE CALLING

2.1 SELCALL TYPE 1

2.1.1 GENERAL DESCRIPTION

The Type 1 Selcall signalling module is designed for operation with the FM91 series mobile and fits into the existing U402 module slot. It offers high stability encoding/decoding of one of 8 defined international tonesets. Tonesets include CCIR, EEA, EIA, ZVEI 1, ZVEI 2, ZVEI 3, NATEL and CCIRH.

When decoding, the module is capable of continuously monitoring a signal input terminal for a pre-specified tone sequence and then producing audible and visual alert for the operator.

When encoding, a synthesized tone sequence output is produced.

All interface to the central control section is at standard TTL levels with inverted logic.

2.1.1.1 Toneset Selection

A total of 8 variations of toneset can be selected by solder bridging the appropriate copper lands TS2, 1, 0 situated on the modem module.

TABLE 2.1 - Sequential Signalling Tonesets

LINK SETTING	CCIR	EEA	EIA	ZVEI-1	ZVEI-2	ZVEI-3	NATEL	CCIRH	TONE ADDRESS
TS2	H	H	H	H	L	L	L	L	
TS1	H	H	L	L	H	H	L	L	
TS0	H	L	H	L	H	L	H	L	
TONE									$\overline{D3}$ $\overline{2}$ $\overline{1}$ $\overline{0}$
0	1981	1981	600	2400	2400	2200	1633	1981	H H H H
1	1124	1124	741	1060	1060	970	631	1124	H H H L
2	1197	1197	882	1160	1160	1060	697	1197	H H L H
3	1275	1275	1023	1270	1270	1160	770	1275	H H L L
4	1358	1358	1164	1400	1400	1270	852	1358	H L H H
5	1446	1446	1305	1530	1530	1400	941	1446	H L H L
6	1540	1540	1446	1670	1670	1530	1040	1540	H L L H
7	1640	1640	1587	1830	1830	1670	1209	1640	H L L L
8	1747	1747	1728	2000	2000	1830	1336	1747	L H H H
9	1860	1860	1869	2200	2200	2000	1477	1860	L H H L
A	2110	2110	459	2600	970	2400	1805	2400	L H L H
B	2400	1055	2151	2800	885	885	1995	930	L H L L
C	(1055)	(2400)	(2600)	(741)	(741)	(741)	(1300)	2247	L L H H
D	(2247)	(2247)	(2010)	(970)	(2600)	(2600)	(1700)	991	L L H L
E	(930)	(930)	(2433)	(810)	(2800)	(2800)	(2175)	2110	L L L H
F	(991)	(991)	(2292)	(886)	(600)	(600)	(2937)	(1055)	L L L L

Tones indicated in brackets are not specifically defined in the respective International Toneset.

2.1.1.2 Tone Number Selection

Selection of the appropriate tone number from the toneset table above is achieved by placing a static (logically inverted) binary value on the $\overline{D0}$ to $\overline{D3}$ inputs of the module. See Section 2.1.1.3 and 2.1.1.4 for timing details.

SECTION 3 CTCSS
(Continuous-Tone-Controlled-Squelch-System)

3.1 GENERAL DESCRIPTION

3.1.1 CTCSS ENCODER ONLY

The CTCSS encoder only signalling option module is a discrete design constructed on a 60mm x 17mm x 0.8mm printed circuit board. The module is fitted in the U405 position on the synthesiser/control board of the FM900 series mobile. The module synthesises a low distortion tone from an external 1MHz clock input. Frequency programming control inputs to the module (D0 to D5 at Pins 7, 6, 4, 13, 22 and 14 respectively) enable selection of tone frequencies in the range 67Hz to 250Hz.

The frequencies selected conform to the EIA standard tone set. A control input to the module at Pin 15 is provided for gating of the output tone. The module control inputs interface to the mobile's central control microcomputer via the NSC810 I/O expander. The AF output of the module at Pins 20 and 23 may interface directly to the transmitter audio processing hybrid U301 or via the reverse-tone-burst module U404.

3.1.2 CTCSS ENCODER/DECODER WITH RX FILTER

The CTCSS encoder/decoder with Rx filter signalling option module, is a discrete design constructed on a 60mm x 17mm x 0.8mm printed circuit board. The module is fitted in the U405 position on the synthesiser/control board of the FM900 series mobile. The module contains two indpendent circuits. One circuit is the CTCSS encoder/decoder and the other is an active high pass AF filter.

In the encode mode the encoder/decoder circuit synthesises a low distortion tone from an external 1MHz clock input. Frequency programming control inputs to the module (D0 to D5 at Pins 7, 6, 4, 13, 22 and 14 respectively) enable selection of tone frequencies in the range 67Hz to 250Hz. The frequencies selected conform to the EIA standard tone set. The encode/decode changeover control input at Pin 15 of the module, disables the AF output tone when in the decode state. The encode AF output at Pins 20 and 23 may interface directly to the transmitter audio processing hybrid U301 or via the reverse-tone-burst module U404.

In the decode mode unde-emphasised receiver AF output from the receiver audio processing hybrid is connected to Pin 2 and processed in the module for detection of the sub-audible tone. The decoder centre frequency is programmed the same way as the encoder. A successful tone decode causes a control output at Pin 16 to go to a logic '0' state. Control inputs and outputs interface to the mobile's central control microcomputer via the NSC810 I/O expander.

The Rx Filter circuit is an active high pass filter with a 500Hz cut off frequency. This filter is not used in the FM900 Mk2 version but is fitted to maintain compatibility with the FM900 Mk1.

3.1.3 REVERSE TONE BURST GENERATOR (U404)

The reverse-tone-burst signalling option module is a discrete design constructed on a 53mm x 17mm x 0.8mm printed circuit board. The module is fitted in the U404 position on the synthesiser/control board of the FM900 series mobile. The module is used in association with either the CTCSS encoder only, or the CTCSS encoder/decoder with Rx Filter Module, fitted in the U405 position on the synthesiser/control board.

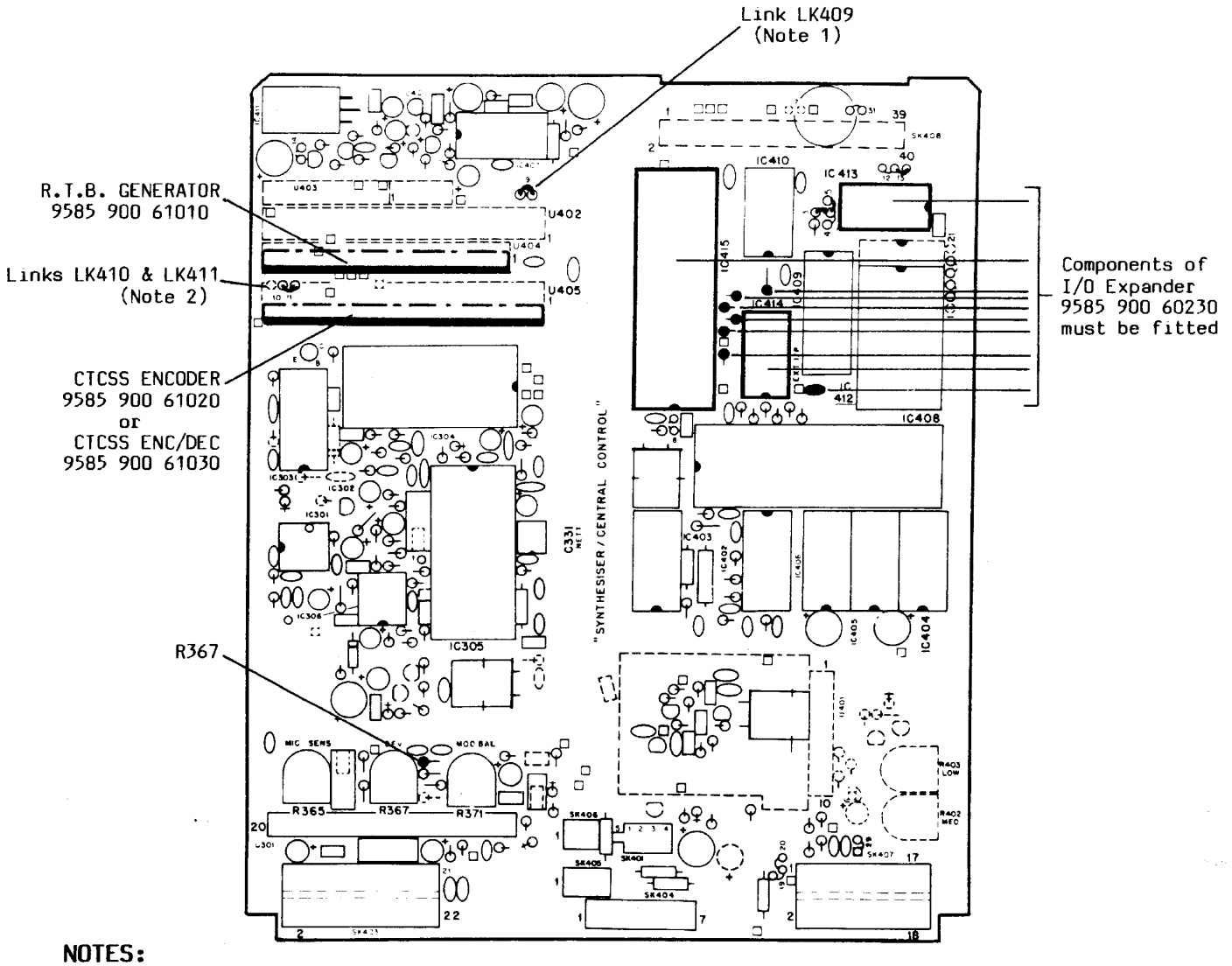
The module contains an active phase shift network producing a 120° phase lag over the frequency range 67Hz to 150Hz and an electronic single-pole-double-throw audio switch. The purpose of the R.T.B. generator is to invert the phase of the sub-audible tone at the end of transmission, for rapid squelch of vibrating reed type decoders.

The R.T.B. enable control input to the module at Pin 5, interfaces with the mobile's central control micro-computer via the NSC810 I/O expander.

AF input to the module at Pin 8 is sourced from the CTCSS encoder output, and the AF output of the module at Pin 3 interfaces directly to the transmitter audio processing hybrid U301.

3.2 FITMENT

i) CTCSS ENCODER KIT 9585 900 61020
ii) ENCODER/DECODER KIT 9585 900 61030
iii) REVERSE TONE BURST KIT 9585 900 61010



NOTES:

1) CTCSS Encoder Only-CTCSS Encoder/Decoder
Link 409 must be fitted for both encoder only and encoder/decoder.

2) Reverse Tone Burst Generator
When RTB generator is required, this module is always used, with either an encoder or encoder/decoder module.
i) Link 410 (track of PC Board) must be cut.
ii) Link 411 must be fitted.

3) I/O Expander Kit
Standard fitment on all FM91 mobiles.

COMPONENTS:

ENCODER KIT (9585 900 61020)	
CTCSS Encoder PC Board	3502 349 96430
R357 Res. Carb.F, 680k, 5% ¼W	2120 101 46684
ENCODER/DECODER KIT (9585 900 61030)	
CTCSS Encoder/Decoder PC Board	3502 349 97300
R357 Res. Carb.F, 1M2, 5% ¼W	2120 101 46125
REVERSE TONE BURST KIT (9585 900 61010)	
R.T.B. Generator PC Board	3502 349 96490

3.3 SPECIFICATIONS

3.3.1 CTCSS ENCODER ONLY

a)	Tone Deviation: (for 20/25/30kHz Chan.Spac.) (for 12.5kHz Chan.Spac.)	 ±560Hz to ±760Hz ±280Hz to ±350Hz
b)	Tone Distortion	27dB to 33dB SINAD (limited by residual noise)
c)	Frequency Range	67Hz to 250Hz (conforms to EIA tone set)
d)	Number of Tones	38 (over range 67Hz to 250Hz)
e)	Frequency Stability	±0.01% (over temperature range -30°C to 60°C ambient)
f)	Absolute Frequency Error from EIA Tone Frequency	±0.5% max.
g)	Transmitter Deviation for Standard Microphone Line Up Levels	±2.4kHz to ±2.7kHz (1kHz at 40mV rms mic. input with CTCSS tone disabled).

h) Module Pin Connections

PIN NO.	FUNCTION
1,2,9,12,16,17,18,19	Not Connected
3,10,21	0V
5,8	+5V
4	$\frac{1}{1}$
13	$\frac{1}{2}$
22	$\frac{4}{8}$
14	$\frac{}{8}$
7	X
6	Y
15	Tone Enable
20,23	Tone Output
11	Clock Input

3.3.2 CTCSS ENCODER/DECODER WITH RX FILTER

3.3.2.1 Encoder

See 3.3.1 a) to g) for Specifications

3.3.2.2 Decoder

a)	Sensitivity (mute opening Sinad)	7dB typical (11dB max.). See Note 2. (for ±500Hz receive deviation)
b)	Bandwidth	From ±0.5% to ±3% (Total)

3.3.2.2 **Decoder** (Cont'd)

c)	Response Time	For f_o > 100Hz typically 150mSec maximum 250mSec. For f_o = 67Hz max. 373mSec.
d)	Frequency Range	As per Encoder
e)	Number of Tones	As per Encoder
f)	Centre Frequency Stability	As per Encoder
g)	Absolute Centre Frequency Accuracy	As per Encoder
h)	Speech Deviation for loss of Decode	> ±5kHz Peak to Peak 350Hz to 3kHz
i)	False Decode Rate (no carrier input)	1 per minute max. (see note 4)
j)	Receiver Hum & Noise Ratio Ref. 1kHz at 3kHz deviation 300mW into 4ohms load at Speaker Ouptut	> 32dB (see note 3)
k)	Receiver Audio Response	Within +1, -3dB of a 6dB/octave de-emphasis over a frequency range of 450Hz to 3kHz standard. Optional response +1, -3dB of a 6dB/octave de-emphasis over a response of 300hZ to 3000Hz can be used with CTCSS tones up to 167.9Hz while maintaining Hum and noise figure greater than 32dB.

NOTES:

1. CTCSS encode tone output is disabled when in decode (receive) mode.

2. Mute opening threshold for carrier controlled mute at minimum. CTCSS mute and carrier controlled mute normally wired as an "AND" function.

3. This hum and noise ratio is the worse case figure with 250Hz tone. The CTCSS tone is normally of low distortion therefore the degradation to receiver hum and noise ratio is normally not noticed.

4. This false decode typically consists of a pulse 200mSec in duration and because the tone mute is wired as an "AND" function with the carrier mute, the false decode is not noticed. When a carrier is received no false decodes occur.

3.3.2.2 **Decoder** (Cont'd)

k) Module Pin Connections

PIN NO.	FUNCTION
3,10,21	0V
5,8	+5V
18	+10V
4	1
13	2
22	4
14	8
7	X
6	Y
11	Clock Input
1	Rx Filter Output
12	Rx Filter Input
2	Decoder AF Input
16	Decoder Output
23,20	Encoder AFOutput
9,17,19	Not Connected.
15	Encode/Decode

3.3.3 **CTCSS ENCODE WITH REVERSE TONE BURST**

a)	Tone Burst Duration	147 ±14mSec.
b)	Variation between normal and phase shifted tone deviation over frequency range	0dB ±2dB
c)	Phase shift over frequency range	126° ±10°, Lagging
d)	Frequency range of operation	67Hz to 150Hz
e)	Operating temperature range	-30°C to +85°C

f) Module Pin Connections

PIN NO.	FUNCTION
2,4,7,10,12,13,14, 15,16,17,19,20	Not Connected
1	+5V
11	+10V
6,9,18	0V
5	RTB Enable
8	AF Input
3	AF Output

3.3.4 FREQUENCY PROGRAMMING TABLE CTCSS U405

S.A. ORDER CHARACTERS	OPERATOR SELECTABLE TONE NUMBER	EIA FREQUENCY Hz.	PROGRAMME INPUTS U405 PINS					
			7	6	4	13	22	14
Q	17	67.0	1	1	1	1	1	1
R	18	71.9	1	0	1	1	1	1
S	19	74.4	1	1	0	1	1	1
T	20	77.0	0	0	1	1	1	1
U	21	79.7	1	1	1	0	1	1
I	9	82.5	1	0	0	1	1	1
V	22	85.4	1	1	0	0	1	1
A	1	88.5	0	0	0	1	1	1
W	23	91.5	1	1	1	1	0	1
J	10	94.8	1	0	1	0	1	1
B	2	100.0	0	0	1	0	1	1
K	11	103.5	1	0	0	0	1	1
C	3	107.2	0	0	0	0	1	1
L	12	110.9	1	0	1	1	0	1
D	4	114.8	0	0	1	1	0	1
M	13	118.8	1	0	0	1	0	1
E	5	123.0	0	0	0	1	0	1
N	14	127.3	1	0	1	0	0	1
F	6	131.8	0	0	1	0	0	1
O	15	136.5	1	0	0	0	0	1
G	7	141.3	0	0	0	0	0	1
P	16	146.2	1	0	1	1	1	0
H	8	151.4	0	0	1	1	1	0
X	24	156.7	1	0	0	1	1	0
Y	25	162.2	0	0	0	1	1	0
0	26	167.9	1	0	1	0	1	0
1	27	173.8	0	0	1	0	1	0
2	28	179.9	1	0	0	0	1	0
3	29	186.2	0	0	0	0	1	0
4	30	192.8	1	0	1	1	0	0
5	31	203.5	0	0	1	1	0	0
6	32	210.7	1	0	0	1	0	0
7	33	218.1	0	0	0	1	0	0
8	34	225.7	1	0	1	0	0	0
9	35	233.6	0	0	1	0	0	0
*	36	241.8	1	0	0	0	0	0
#	37	250.3	0	0	0	0	0	0
=	38	97.4	1	1	0	1	0	1

LOGIC '1' = +5V (VDD)
LOGIC '0' = 0V (VSS)

3.4 TEST AND ALIGNMENT

3.4.1 CTCSS ENCODER ONLY

3.4.1.1 Test Equipment and Test Set-Up

a) Noise and distortion meter. HP339A or similar.
b) Power supply PS775 or similar.
c) Frequency Counter.
d) R.F. Power Attenuator/Power Meter 25W Bird 8321
e) Sampling Pad (-40dB)
f) Deviation Monitor. Marconi TF2300B.
g) Audio Signal Generator HP208A.
h) C.R.O. BWD 539D.

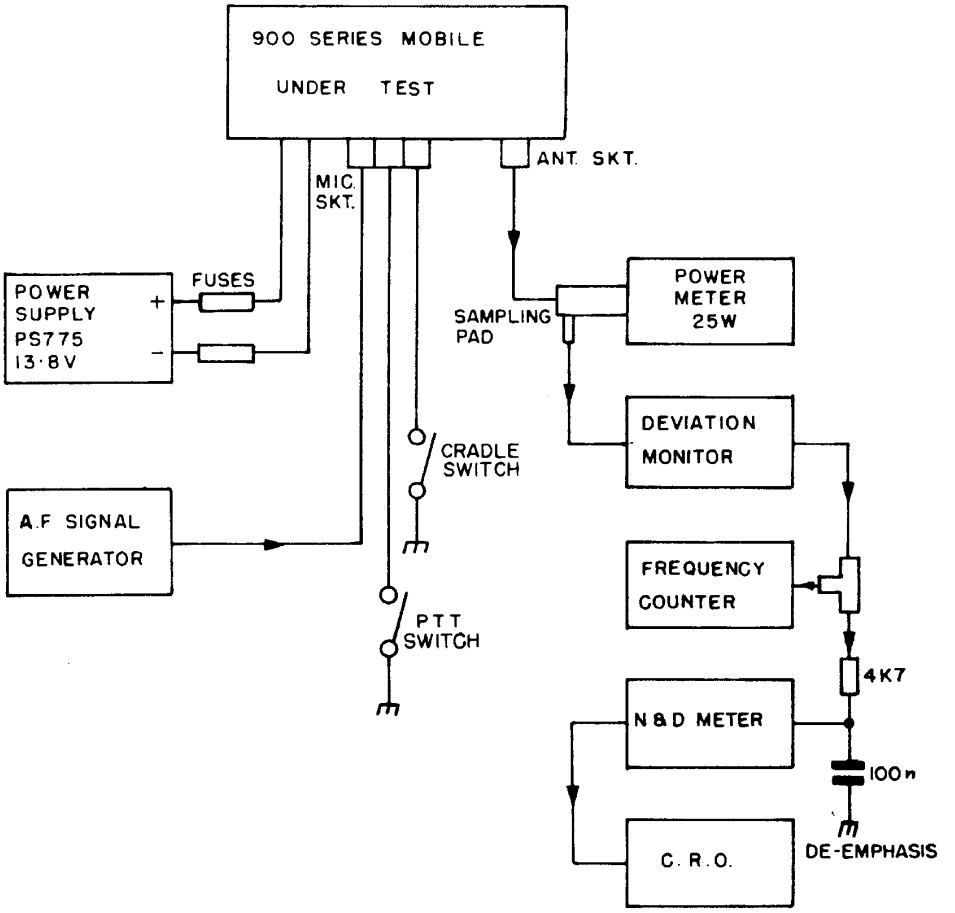


Figure 3.1. Equipment Set Up.

3.4.1.2 Preliminary Adjustments

a) Disable CTCSS tone output by closing Cradle Switch.

b) Perform normal mobile transmitter and receiver test and alignment procedure.

c) Enable CTCSS Encoder output by opening Cradle Switch.

d) Ensure R357 is fitted.

e) Deviation settings bracketed are for 12.5kHz mobiles.

3.4.1.3 Test Procedure

a) Select channel for which CTCSS is programmed.

b) Activate PTT and monitor deviation of transmitter via a sampling pad at the Wattmeter.

c) Deviation of sub-audible tone should be in the range ±560Hz(±280Hz) to ±700Hz(±350Hz). Observe waveform on CRO. Adjust R357 for result.

d) Measure frequency of tone. Frequency should be within ±0.2Hz of EIA tone frequency programmed.

e) Use N & D Meter to measure SINAD (with de-emphasis) of sub-audible tone. SINAD should be between 27dB and 33dB.

f) Connect A.F. generator to mic. input SKT and set to 1kHz/400mV rms.

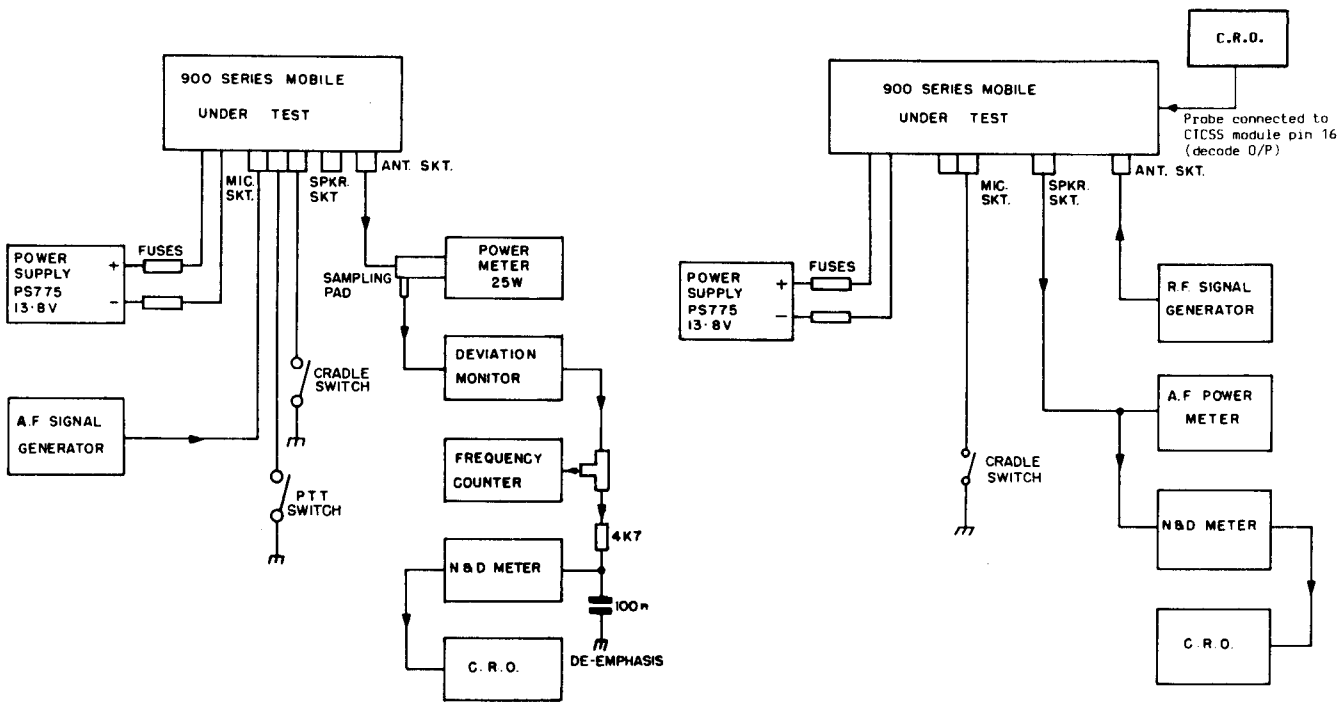
g) Measure transmitter deviation and if deviation is greater than ±5kHz slightly re-adjust deviation set pot R367 for 4.9kHz.

h) Disable PTT and disconnect equipment set up.

3.4.2 CTCSS ENCODER/DECODER WITH Rx FILTER

3.4.2.1 Test Equipment and Test Set-Up

a) Noise and Distortion Meter HP339A or similar.
b) Power Supply PS775 or similar.
c) Frequency Counter.
d) RF Power Attenuator/Power Meter 25W Bird 8321.
e) Sampling Pad (-40dB).
f) Deviation Monitor. Marconi TF2300B or similar.
g) AF Signal Generator HP208A.
h) C.R.O. BWD 539D.
j) RF Signal Generator HP8640B or similar.
k) AF Power Meter (4 Ohm Load).



(a) Encoder Set-Up (b) Decoder Set-Up

Figure 3.2 Equipment Set Up For Encoder/Decoder With Rx Filter Test

3.4.2.2 **Preliminary Operations**

a) Ensure LK409 and R357 are fitted, and that C428 is not fitted to synthesiser/control pcb.

b) Disable encoder output. (Close Cradle Switch to disable encoder output. Open Cradle Switch to disable decoder receiver mute).

c) Perform normal mobile transmitter and receiver test and alignment procedure.

d) Open Cradle Switch and re-enable CTCSS encoder output.

e) Connect mobile undertest to test equipment as shown in Figure 3.2a.

f) Deviation settings in parenthesis are for 12.5kHz mobiles.

3.4.2.3 **Encoder Test**

a) Select transmit channel for which CTCSS encode is programmed.

b) Activate PTT and monitor deviation of transmitter via a sampling pad at the Wattmeter. Ensure Cradle Switch is open.

c) The deviation of the sub-audible tone should be in the range ±560Hz to ±700Hz (±280Hz to ±350Hz). Observe waveform on C.R.O. Adjust R357 to achieve the required result.

d) Measure frequency of tone. Frequency should be within ±0.2Hz of EIA tone frequency programmed.

e) Use N & D Meter to measure SINAD (with de-emphasis) of CTCSS tone. SINAD should be between 27dB to 33dB.

f) Connect AF generator to mic input skt and set to 1kHz/400mV rms.

g) Measure transmitter deviation and if deviation is greater than ±5kHz (±2.5kHz) slightly re-adjust deviation set pot R367 for ±4.9kHz (±2.4kHz).

h) For mobiles fitted with multi-tone access option, check encode tone deviation and frequency for other channels.

j) Disable PTT.

3.4.2.4 **Decoder**

a) Connect mobile to test equipment as shown in Figure 3.2b. Disable receiver mute. (F → MUTE +).

b) Select channel for which CTCSS decode is fitted.

c) Set RF generator to mobile frequency, and modulate with 1kHz ±3kHz (1kHz ±1.5kHz).

d) Adjust RF generator level to give 6dB receiver SINAD. Switch off RF generator modulation. Do not alter RF level.

3.4.2.4 **Decoder Test** (Cont'd)

e) Enable receiver mute (F → MUTE -). Adjust receiver carrier mute to minimum. Check that the cradle switch is closed. Carrier received LED should be on but receiver AF ouput should be muted.

f) Modulate RF generator with correct CTCSS tone (for mobile decoder) at ±500Hz (±250Hz) deviation.

g) Set trimpot R14 on CTCSS module to full counter clockwise position. Rx audio should be muted. Slowly adjust R14 in clockwise direction until receiver mute opens and audio is present.

3.4.2.5 **Rx Filter Test**

a) Use equipment set up as shown in Figure 3.2. Disable receiver mute (as in Step 3.4.2.4)).

b) Set RF Signal Generator to 1mV PD and modulate with 1kHz±1kHz (±500Hz) deviation.

c) Adjust Receiver volume for 300mW AF output into 4ohm. Adjust N & D Meter for 0dB reference level.

d) Modulate Sig. Gen. with 250Hz and measure receiver output level which should be greater than 18dB below reference.

3.4.3 CTCSS ENCODE WITH REVERSE TONE BURST GENERATOR

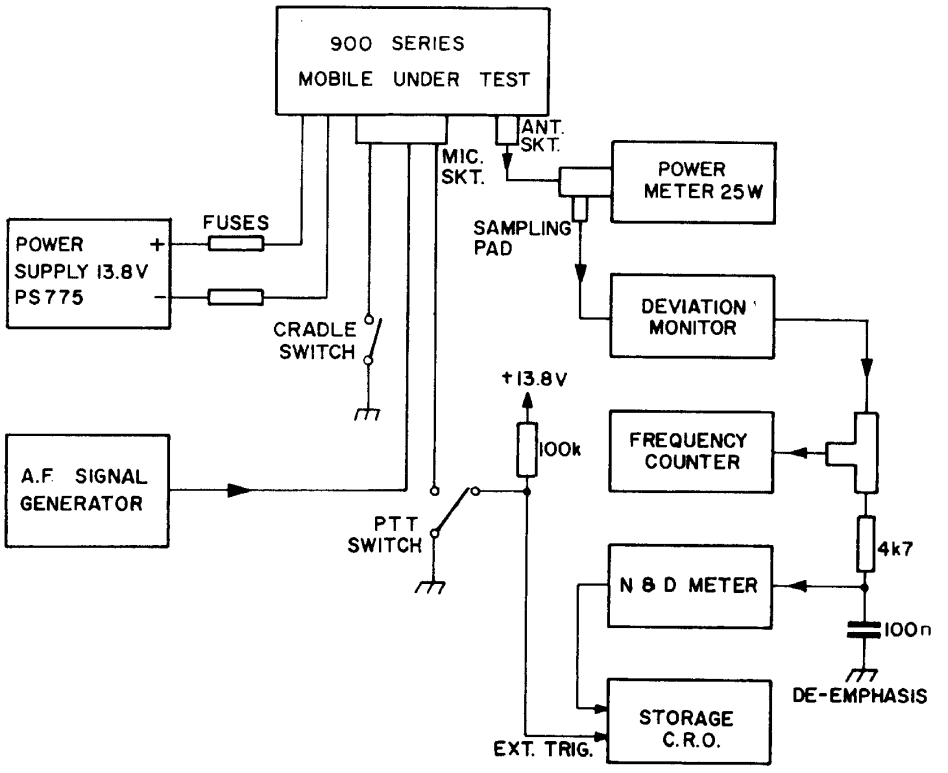


Figure 3.3. Equipment Set Up

3.4.3.1 Test Equipment

a) Power Supply PS775 or similar
b) N & D Meter HP339A or similar
c) C.R.O. with storage facility Philips PM3234 or similar
d) RF Power Meter
e) Sampling Pad (-40dB)
f) Deviation Monitor. Marconi TF2300B.

3.4.3.2 Preliminary Instructions

It is necessary to complete mobile alignment (Part 1 Section 4) and normal CTCSS (Encode only - Section 3.4.1 or Encode/Decode - Section 3.4.2) alignment before encode with RTB is tested.

Ensure that link LK410 is out and LK411 is fitted to synth/control PC board.

3.4.3.3 Test Procedure

a) Use equipment set up as shown in Figure 3.3.

b) Open Cradle Switch, activate PTT and observe CTCSS Encode Tone on CRO. Adjust vertical amplitude for 6cm. peak-to-peak.

c) Adjust storage CRO to trigger on PTT release and set horizontal sweep rate to 20ms per cm.

d) Release PTT and observe reverse-tone-burst on CRO. (See Fig. 3.4)

e) Check duration of burst 147ms±14ms. Check amplitude of burst 6cm±0.8cm peak-to-peak.

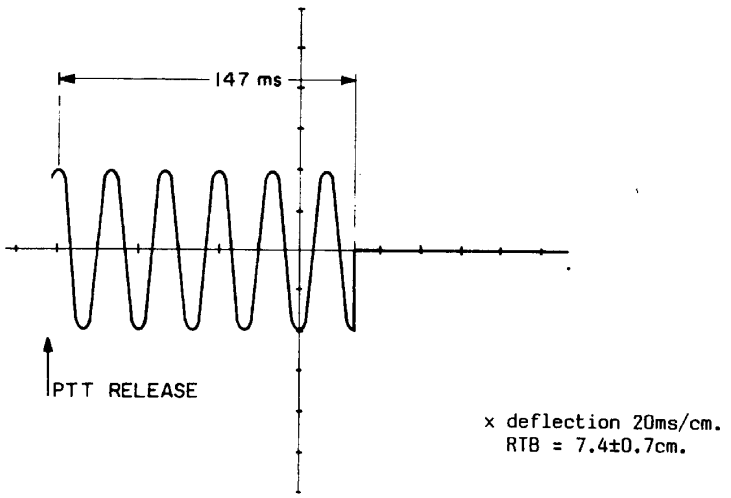
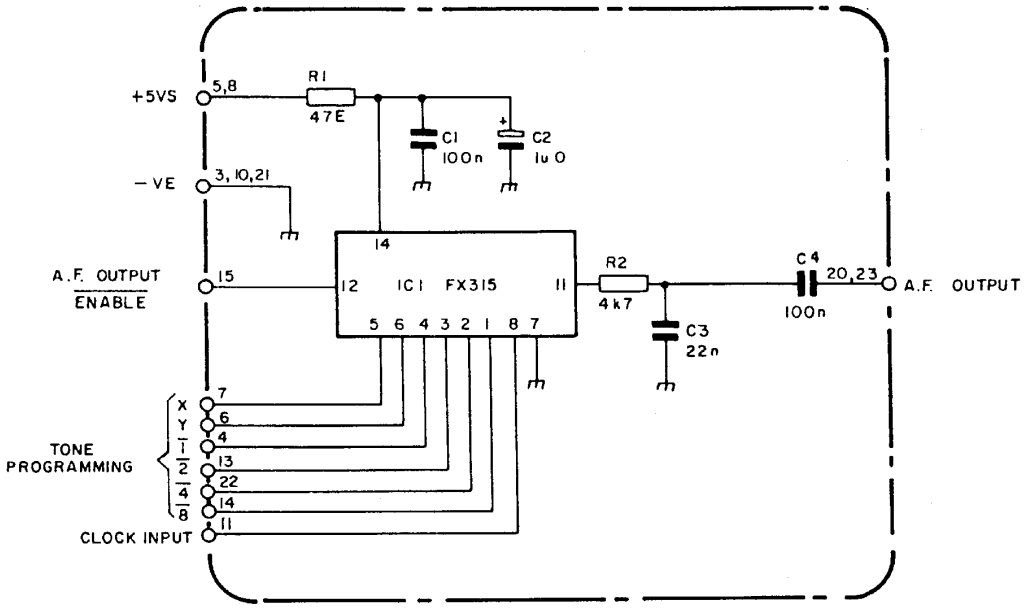


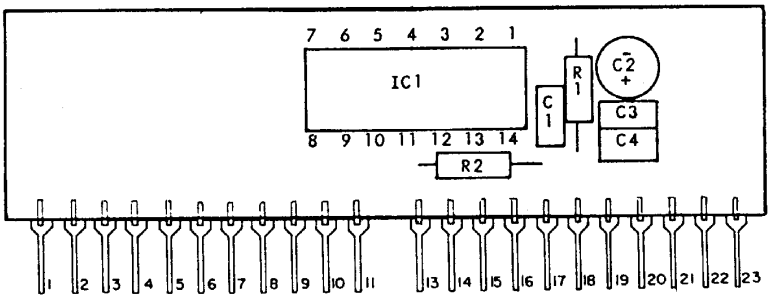
Figure 3.4 Reverse-Tone-Burst Waveform

3.5 CTCSS PC BOARDS

3.5.1 CTCSS ENCODER PC BOARD (3502 349 96430)

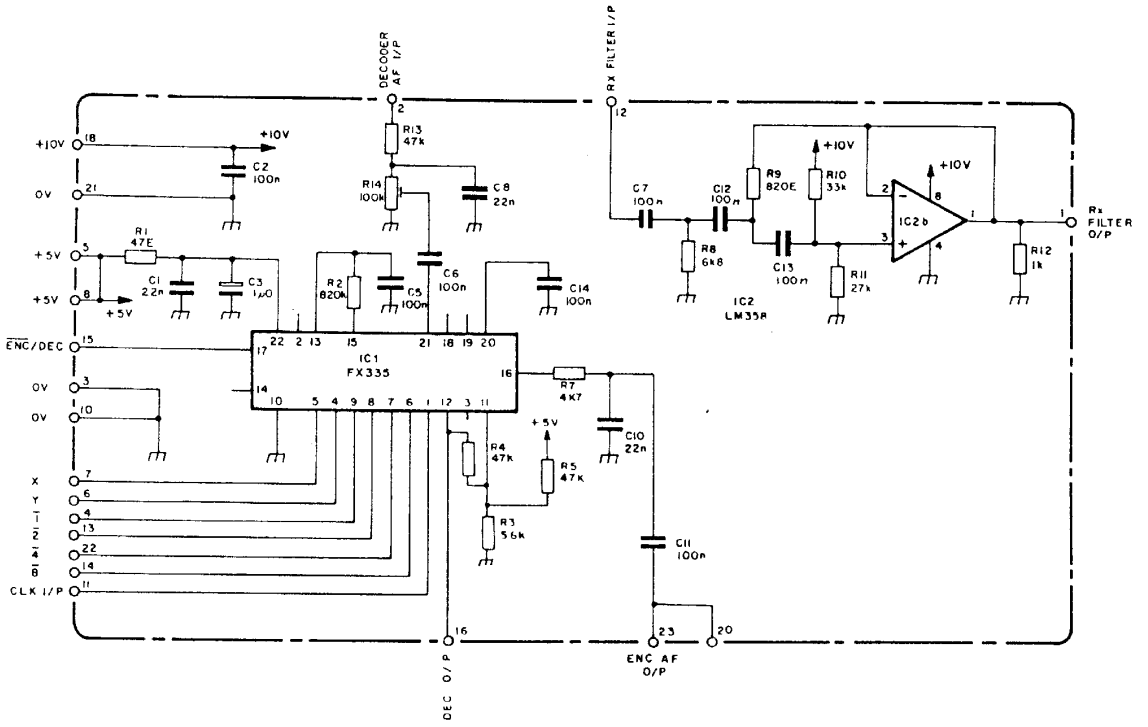
	PCB CTCSS Encoder	3502 329 96430	C1	100n,20%,50V, Cer D/M	2022 552 02482
	47E, 5%, ¼W, Carb.F.	2120 101 46479	C2	1uO, 20%,35V, Tant.	2020 004 90037
R2	4k7, 5%, ¼W, Carb.F.	2120 101 46472	C3	22n, 20%,50V, Cer D/M	2022 552 02019
			C4	100n,20%,50V, Cer D/M	2022 552 02482
IC1	Intgrd Circt FX315	9336 526 30682			

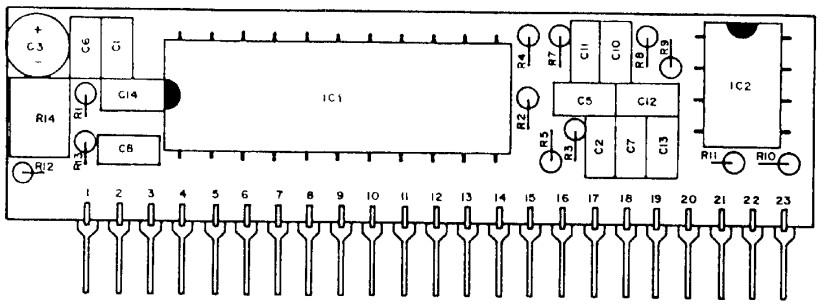




3.5.2 ENCODER/DECODER PC BOARD (3502 349 97300)

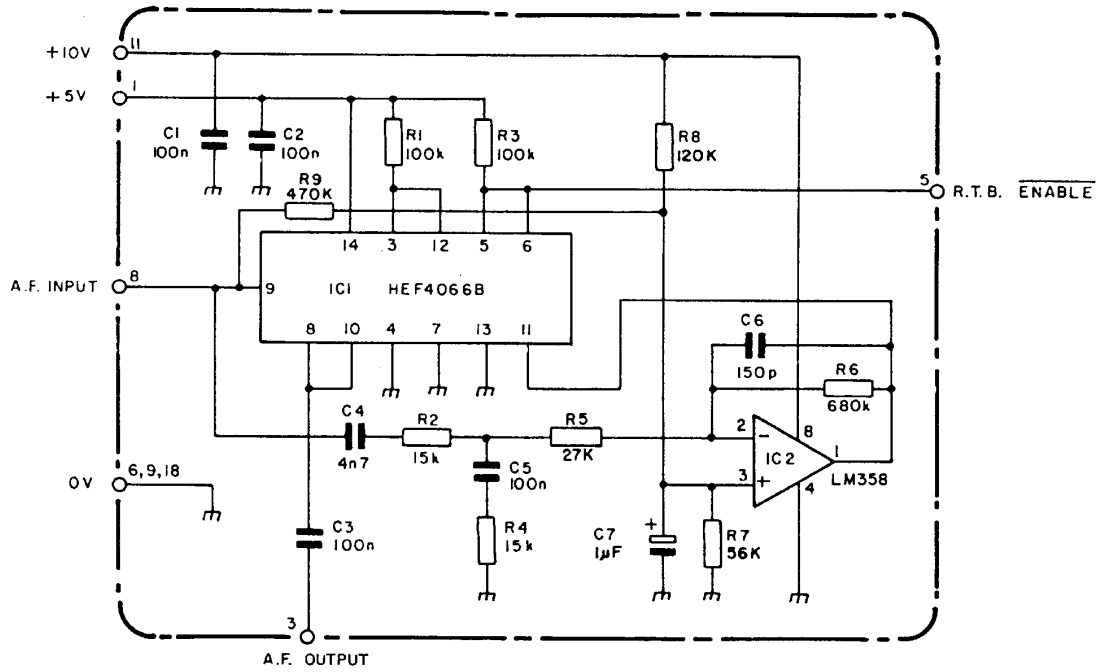
	PCB CTCSS Encoder/Decoder	3502 329 97300	C1	22n, 20%,50V, Cer D/M X7R	2022 552 02019
R1	47E, 5%, 0.2W, Carb.F.	2120 101 46479	C2	100n,20%,50V, Cer D/M Z5U	2022 552 02482
R2	820k,5%, 0.2W, Carb.F.	2120 101 46824	C3	1u,-10+50%,100V, Al Elec.	2222 035 59108
R3	56k, 5%, 0.2W, Carb.F.	2120 101 46563	C5	100n,20%,50V, Cer D/M X7R	2022 552 01751
R4	47k, 5%, 0.2W, Carb.F.	2120 101 46473	C6	100n,20%,50V, Cer D/M Z5U	2022 552 02482
R5	47k, 5%, 0.2W, Carb.F.	2120 101 46473	C7	100n,10%,50V, Cer D/M X7R	2022 552 02335
R7	4k7, 5%, 0.2W, Carb.F.	2120 101 46472	C8	22n, 20%,50V, Cer D/M X7R	2022 552 02019
R8	6k8, 5%, 0.2W, Carb.F.	2120 101 46682	C10	22n, 20%,50V, Cer D/M X7R	2022 552 02019
R9	820E,5%, 0.2W, Carb.F.	2120 101 46821	C11	100n,20%,50V, Cer D/M Z5U	2022 552 02482
R10	33k, 5%, 0.2W, Carb.F.	2120 101 46333	C12	100n,10%,50V, Cer D/M X7R	2022 552 02335
R11	27k, 5%, 0.2W, Carb.F.	2120 101 46273	C13	100n,10%,50V, Cer D/M X7R	2022 552 02335
R12	1k, 5%, 0.2W, Carb.F.	2120 101 46102	C14	100n,20%,50V, Cer D/M Z5U	2022 552 02482
R13	47k, 5%, 0.2W, Carb.F.	2120 101 46473	IC1	Intgrd Circt. FX335	9337 403 90682
R14	100k, Pot Carb. LIN	2122 350 00263	IC2	Intgrd Circt. LM358N	9333 935 10112

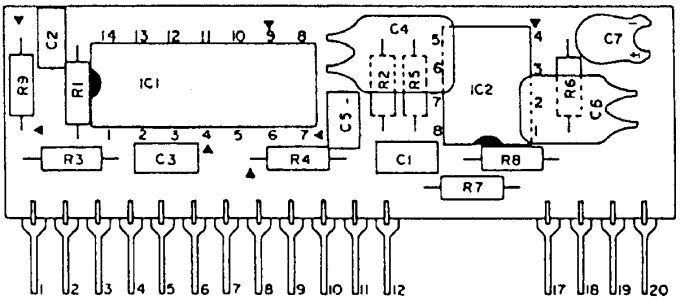




3.5.3 REVERSE TONE BURST GENERATOR PC BOARD (3502 349 96490)

	PCB RTB Generator	3502 329 96490	C1	100n, 20%,50V, Cer D/M	2022 552 02482
R1	100k,5%, 0.2W, Carb.F.	2120 101 46104	C2	100n, 20%,50V, Cer D/M	2022 552 02482
R2	15k, 5%, 0.2W, Carb.F.	2120 101 46153	C3	100n, 20%,50V, Cer D/M	2022 552 02482
R3	100k,5%, 0.2W, Carb.F.	2120 101 46104	C4	4n7, 10%,100V,Cer D/M	2022 630 01472
R4	15k, 5%, 0.2W, Carb.F.	2120 101 46153	C5	100n, 20%,50V, Cer D/M	2022 552 01751
R5	27k, 5%, 0.2W, Carb.F.	2120 101 46273	C6	150p, 2%,100V, Cer D/M	2222 632 58151
R6	680k,5%, 0.2W, Carb.F.	2120 101 46684	C7	1u, 20%, 35V, Tant.	2020 004 90037
R7	56k, 5%, 0.2W, Carb.F.	2120 101 46563			
R8	120k,5%, 0.2W, Carb.F.	2120 101 46124	IC1	Intgrd Circt HEF4066P	9332 966 50112
R9	470k,5%, 0.2W, Carb.F.	2120 101 46474	IC2	Intgrd Circt. LM358N	9332 935 10112





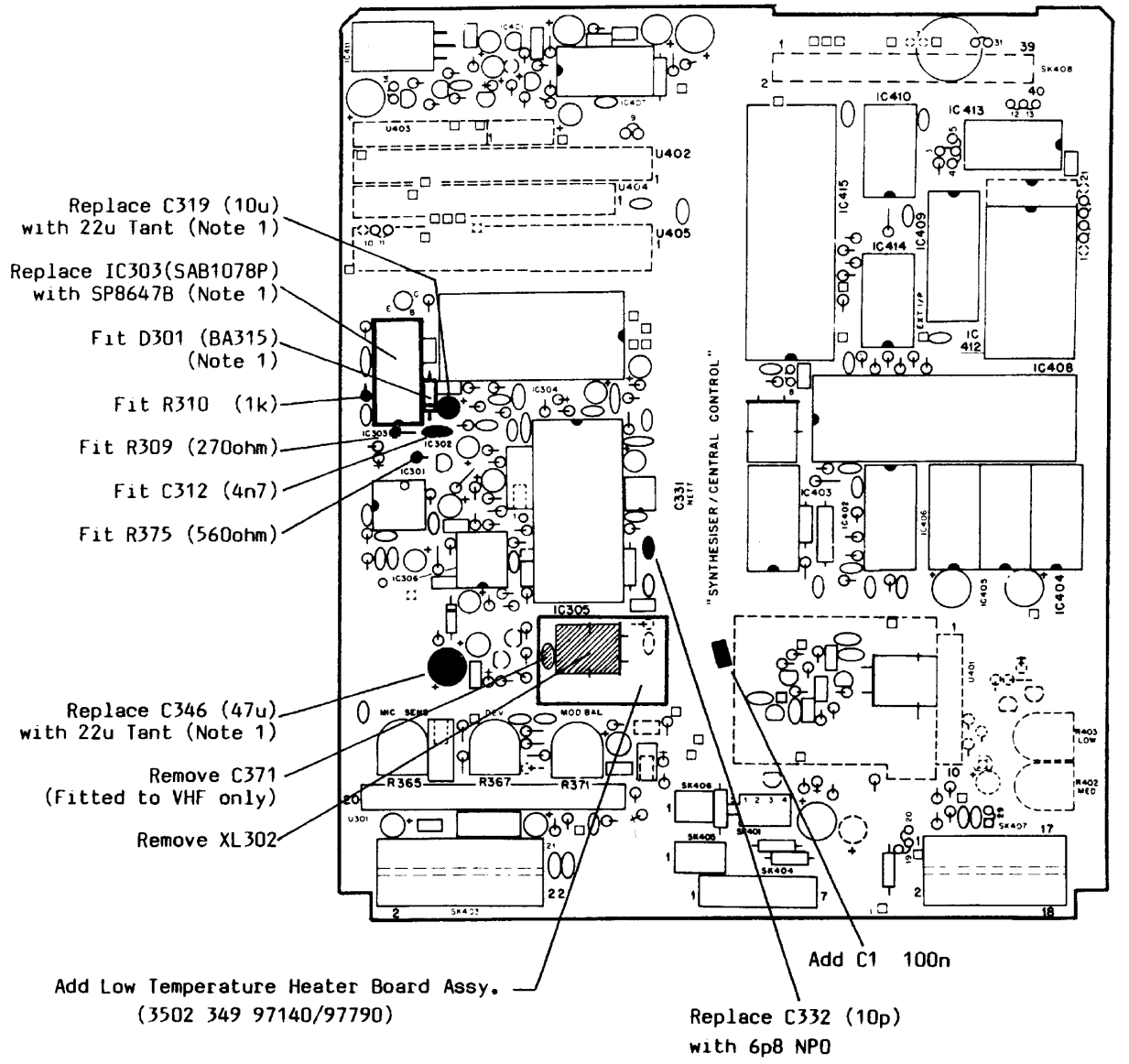
Note: Positions marked ▲ are soldered top and bottom of pc board.

SECTION 4 CRYSTAL HEATER KIT

4.1 SYNTHESISER/CONTROL PCB 3502 349 73050 (All Issues. VHF & UHF)

i) Crystal Heater Kit 10MHz (9585 900 60042)
ii) Crystal Heater Kit 9MHz (9585 900 60041)

4.1.1 FITMENT



NOTES:

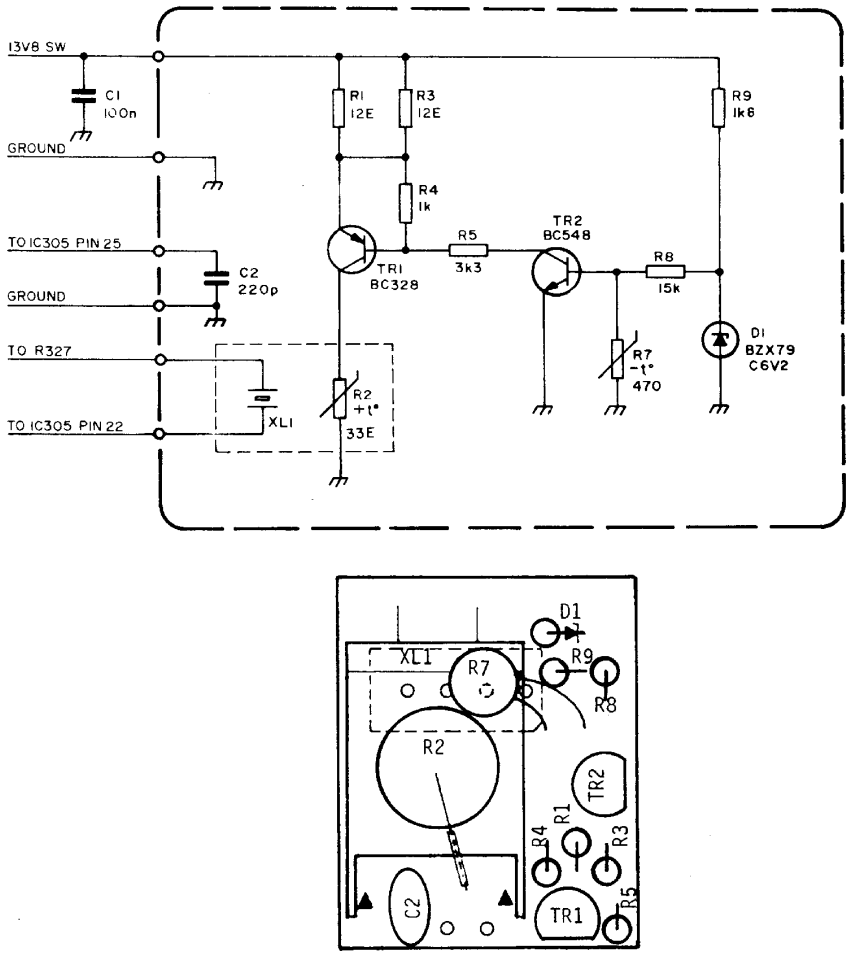
1. Orient correctly when refitting.

4.1.2 COMPONENTS

	Low Temp Htr Brd 10MHz	3502 349 97140	C1	Cap Cer D/M	100n	20% 50V Z5u	2022 552 02482
	Low Temp Htr Brd 9MHz	3502 349 97790	C312	Cap Cer Pl	4n7	10% 100V	2222 630 08472
R309	Res Met F 270E 0.6W	2322 156 22701	C319	Cap Tant	22u	20% 16V	2020 004 90041
R310	Res Met F 1kO 0.6W	2322 156 21002	C332	Cap Cer Pl	6p8	100V NPO	2222 680 09688
R375	Res Met F 56OE 0.6W	2322 156 25601	C346	Cap Tant	22u	20% 16V	2020 004 90041
IC303	Intgrd Circt SP8647B	9335 491 50682	D301	Diode BA315			9332 083 80113

4.2 CRYSTAL HEATER PC BOARD ASSEMBLY

i) Low Temp. Heater Board 10MHz (3502 349 97140)
ii) Low Temp. Heater Board 9MHz (3502 349 97790)



4.2.1 COMPONENTS

i) **Low Temperature 10MHz Assy. (3502 349 97140)**

	Low Temp. Heater PC Board	3502 309 97140
R1	Res. Carb.F. 12E 5% ¼W	2120 101 46129
R2	Res. PTC 33E	2120 660 90006
R3	Res. Carb.F. 12E 5% ¼W	2120 101 46129
R4	Res. Carb.F. 1k, 5% 0.2W	2322 210 13102
R5	Res. Carb.F. 3k3 5% 0.2W	2322 210 13332
R7	Thermistor NTC 470E 10% 0.6W	2322 642 61471
R8	Res. Carb.F. 15k 5% 0.2W	2322 210 13153
R9	Res. Carb.F. 1k8, 5% 0.2W	2322 210 13182
C1	Cap. Cer.Pl.220p 10% 100V HiK	2222 630 01221
D1	Diode BZX79-C6V2	9331 177 40112
TR1	Transistor BC328	9331 491 90112
TR2	Transistor BC548	9331 976 40112
XL1	Crystal 10MHz	3502 414 98930

ii) **Low Temperature 9MHz Assy. (3502 349 97790)**

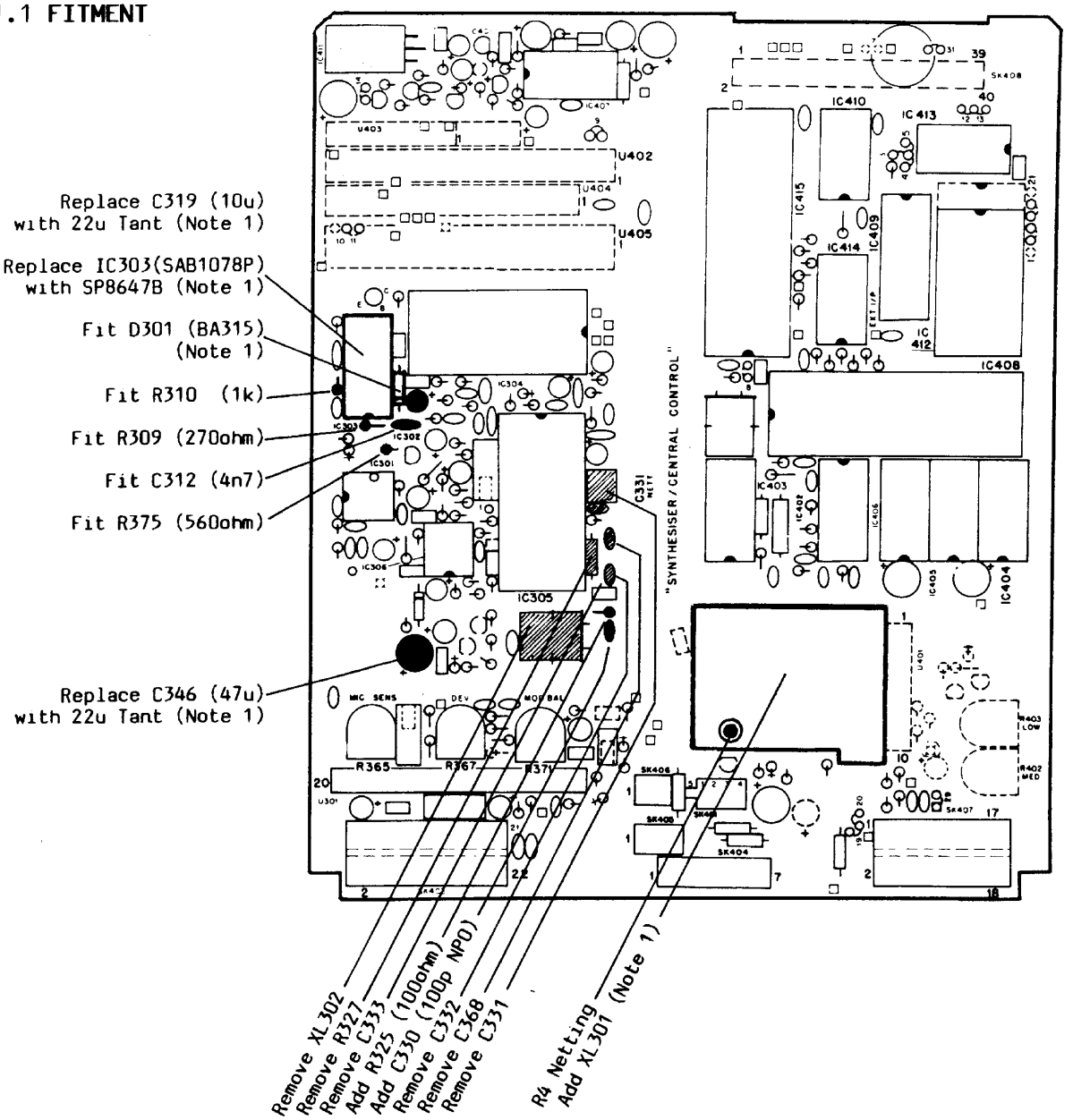
	Low Temp. Heater PC Board	3502 309 97140
R1	Res. Carb.F. 12E 5% ¼W	2120 101 46129
R2	Res. PTC 33E	2120 660 90006
R3	Res. Carb.F. 12E 5% ¼W	2120 101 46129
R4	Res. Carb.F. 1k, 5% 0.2W	2322 210 13102
R5	Res. Carb.F. 3k3 5% 0.2W	2322 210 13332
R7	Thermistor NTC 470E 10% 0.6W	2322 642 61471
R8	Res. Carb.F. 15k 5% 0.2W	2322 210 13153
R9	Res. Carb.F. 1k8, 5% 0.2W	2322 210 13182
C1	Cap. Cer.Pl.220p 10% 100V HiK	2222 630 01221
D1	Diode BZX79-C6V2	9331 177 40112
TR1	Transistor BC328	9331 491 90112
TR2	Transistor BC548	9331 976 40112
XL1	Crystal 9MHz	3502 414 98460

SECTION 5 TEMPERATURE CONTROLLED XTAL OSCILLATOR

5.1 SYNTHESISER/CONTROL PCB 3502 349 73050 (All Issues UHF only)

i) TCXO Kit 10MHz (9585 900 60092)
ii) TCXO Kit 9MHz (9585 900 60091)

5.1.1 FITMENT



NOTES:

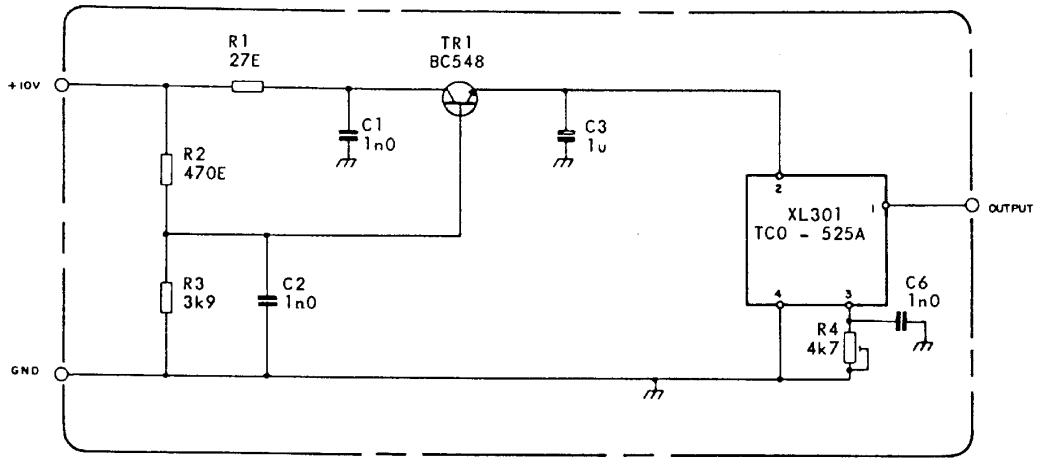
1. Place insulator 3502 319 94310 between TCXO pcb assembly and synth/control pcb.
2. Orient correctly when refitting.

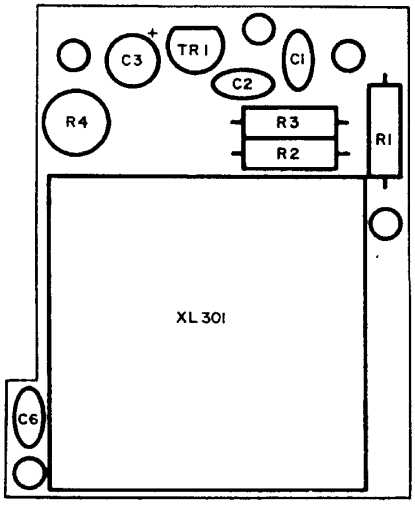
5.1.2 COMPONENTS

XL301	TCXO Board Assy 10MHz		3502 349 97660	C312	Cap Cer Pl	4n7 10% 100V	2222 630 08472
XL301	TCXO Board Assy 9MHz		3502 349 97800	C319	Cap Tant	22u 20% 16V	2020 004 90041
R309	Res Met F 270E	1% 0.6W	2322 156 22701	C330	Cap Cer Pl	100p 2% 100V	2222 632 10101
R310	Res Met F 1kO	1% 0.6W	2322 156 21002	C346	Cap Tant	22u 20% 16V	2020 004 90041
R325	Res Carb F 100E	5% ¼W	2120 101 46101	D301	Diode BA315		9332 083 80113
R375	Res Met F 560E	1% 0.6W	2322 156 25601	IC303	Intgrd Circt SP8647B		9335 491 50682

5.2 TCXO PC BOARD ASSEMBLY

i) TCXO 10MHz Board (3502 349 97660)
ii) TCXO 9MHz Board (3502 349 97800)





5.2.1 COMPONENTS

i) **TCXO 10MHz PC Board Assembly (3502 349 97660)**

	PC Board TCXO	3502 309 97660
R1	Res. Carb.F. 27E 5% ¼W	2120 101 46279
R2	Res. Carb.F. 470E 5% ¼W	2120 101 46471
R3	Res. Carb.F. 3k9 5% ¼W	2120 101 46392
R4	Pot Cermet Trim 4k7 20%	2122 358 00088
C1	Cap. Cer.Pl. 1n0 10% 100V	2222 630 01102
C2	Cap. Cer.Pl. 1n0 10% 100V	2222 630 01102
C3	Cap. Tant. 1u0 20% 35V	2020 004 90037
C6	Cap. Cer.pl. 1n0 10% 100V	2222 630 01102
TR1	Transistor BC548	9331 976 40112
XL301	Crystal Osc. 10MHz TCO525A	2722 171 08107

ii) **TCXO 9MHz PC Board Assembly (3502 349 97800)**

	PC Board TCXO	3502 309 97660
R1	Res. Carb.F. 27E 5% ¼W	2120 101 46279
R2	Res. Carb.F. 470E 5% ¼W	2120 101 46471
R3	Res. Carb.F. 3k9 5% ¼W	2120 101 46392
R4	Pot Cermet Trim 4k7 20%	2122 358 00088
C1	Cap. Cer.Pl. 1n0 10% 100V	2222 630 01102
C2	Cap. Cer.Pl. 1n0 10% 100V	2222 630 01102
C3	Cap. Tant. 1u0 20% 35V	2020 004 90037
C6	Cap. Cer.pl. 1n0 10% 100V	2222 630 01102
TR1	Transistor BC548	9331 976 40112
XL301	Crystal Osc. 9MHz TCO525A	2722 171 08121

SECTION 6 IGNITION NOISE BLANKER

6.1 GENERAL DESCRIPTION

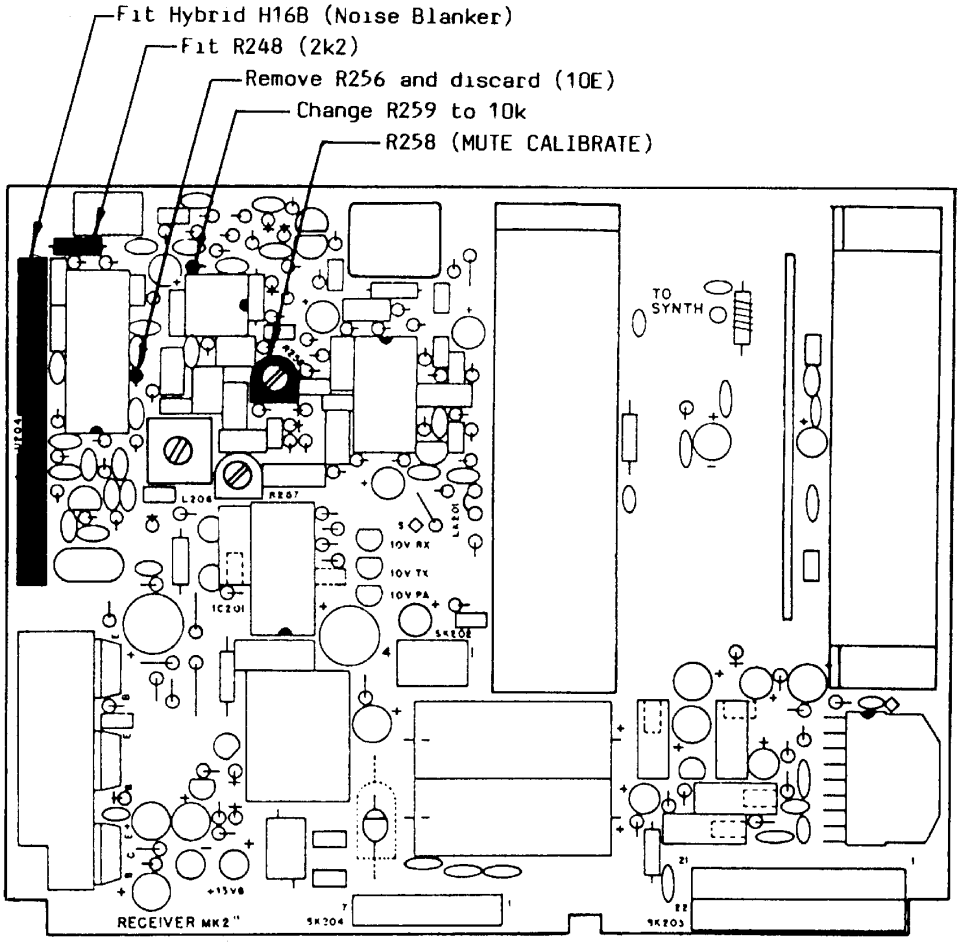
The module is fitted in the U204 position of the receiver pcb of the FM900 Mk2 series mobile.

The module contains a buffer and IF amplifier stage which samples the IF signal, including noise impulses, at the input of FL202. Pulse detector, pulse amplifier and blanking pulse generator stages then control an audio gate. The audio gate interrupts the AF output from IC202 for 1.2mSec when a high level noise impulse is received.

Blanking effectively stops the high level noise pulses from reaching the filters and de-emphasis stages. With the ignition pulses removed at this point a significant improvement is achieved in message intelligibility in the presence of high level ignition interference.

6.2 IGNITION NOISE BLANKER KIT

Applicability: All issues of FM900 Mk2 receiver pc boards (3502 349 72050 - VHF, 3502 349 82090 - UHF).



NOTE: Ignition Blanker Hybrid Type H16B (3502 358 00760) must be used with FM900 Mk2 receiver.This hybrid can also be used with FM900 Mk1 receivers

6.2.1 COMPONENTS

U204	Hybrid H16B	3502 358 00760
R248	Res.Carb F.,2k2,5%,¼W	2120 101 46222
R259	Res.Carb F.,10k,5%,¼W	2120 101 46103

R256 10ohm resistor is to be removed and discarded

6.3 TEST AND ALIGNMENT

6.3.1 TEST EQUIPMENT AND TEST SET-UP

a) Power supply PS775 or similar
b) RF Signal Generator HP8640B or similar
c) C.R.O. BWD 539D or similar.
d) Audio oscillator with squarewave output HP3311A or similar.
e) D.V.M.

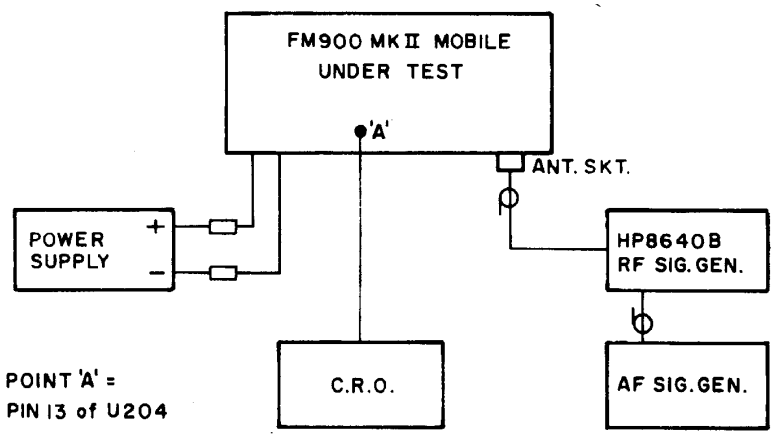


Figure 6.1 Equipment Set Up

6.3.2 PRELIMINARY ADJUSTMENTS

a) Set C.R.O. to 0.5V per cm dc vertical deflection and 1mSec per cm horizontal sweep rate. Use C.R.O. probe x10 high impedance.

b) Adjust AF signal generator to modulate RF signal with "Pulse AM" at 200Hz.

6.3.3 TEST PROCEDURE

a) Adjust RF signal generator to receiver channel frequency and set output to 1mV pd.

b) Connect C.R.O. probe to pin 13 of U204.

c) Switch on RF signal generator and adjust output for 100uV pd. Pulse amplitude modulate the generator with 200Hz frequency.

d) Observe the waveform on C.R.O. and ensure blanking period is between 1.3 and 1.76mSecs. (See figure 6.2)

e) Reduce RF generator output level to 20uV pd. and insure blanker is still operative.

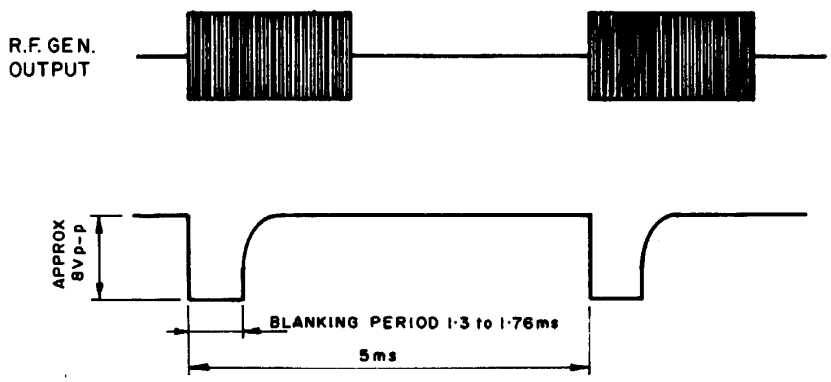


Figure 6.2 Blanking Pulse Waveforms

SECTION 7 TALK-THROUGH REPEATER KIT

7.1 GENERAL DESCRIPTION

This option module is constructed on a 27mm x 17mm x 0.60mm printed circuit board. The module is fitted into the U403 position of the synthesiser/ control board of the FM900 series mobile.

The module contains an audio gating circuit and an audio level adjustment to set transmit deviation level in talk-through mode.

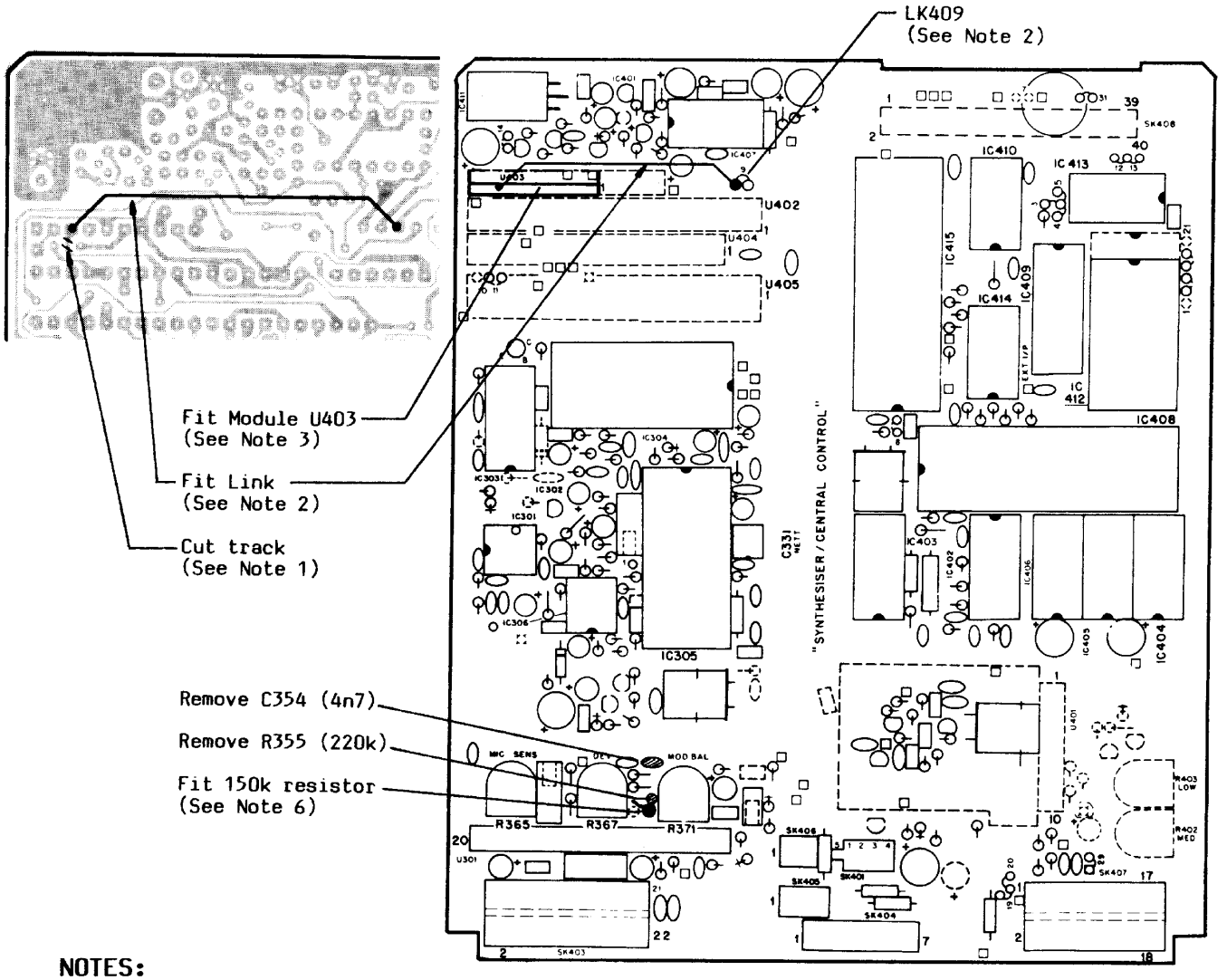
A control input at pin 7 of the module interfaces to the I/O expander IC415 and is active high (5 volts) for gating of the talk-through audio. Receiver unde-emphasised audio is connected to pin 8 at the input to the level attenuator and transmit audio after this adjustment is connected from pin 10 of the module output, to the transmit audio processing hybrid U301.

The talk-through transmit audio is activated under software control.

7.1.1 TALK-THROUGH REPEATER KIT 9585 900 60100

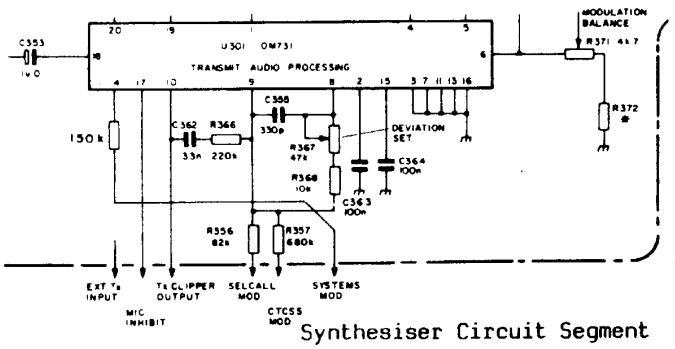
Module U403	3502 349 96960
Resistor Carb. F 150k, 5%, 1/4W	2120 101 46154

7.2 FITMENT

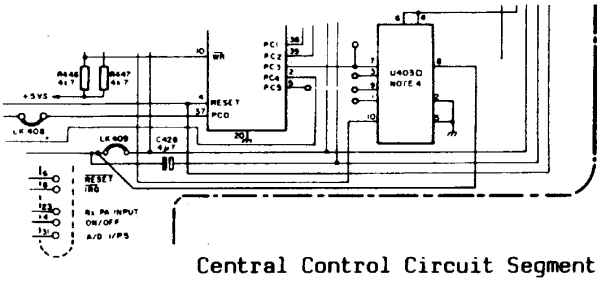


NOTES:

1. Cut track between pin 8 of U403 and pin 16 of U402
   (Note: Track on component side of pc board)
2. Fit link between pin 8 of U403 and LK409 using plated through hole nearest U403. See modified circuit segment of central control circuit.
3. Fit Module 3502 349 96960 in position allocated for U403.
   (Observe position of pin 1)
4. Remove resistor R355 (220k)
5. Remove capacitor C354 (4n7)
6. Fit 150k resistor(2120 101 46154) supplied with T/T Kit(9585 900 60100) in position shown above. See modified synthesiser circuit segment.



Synthesiser Circuit Segment



Central Control Circuit Segment

7.3 TEST AND ALIGNMENT

7.3.1 TEST EQUIPMENT AND TEST SET-UP

a) Power supply PS775 or similar
b) RF signal generator Rohde and Schwartz SMFP
c) RF power meter 25W Bird 8321 or similar
d) Sampling pad (-40dB)
e) Noise and Distortion Meter. HP339A or similar
f) Deviation monitor. Marconi RF2300B or similar
g) C.R.O. BWD 539D
h) AF Power Meter 4 ohm

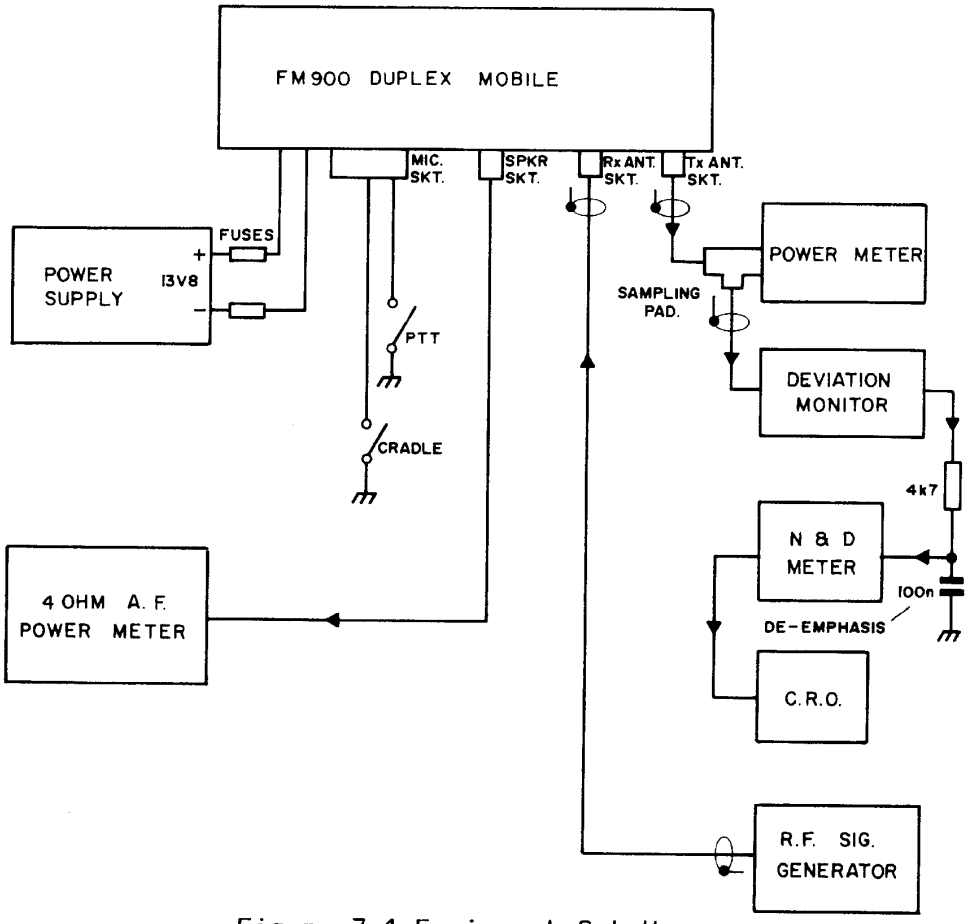


Figure 7.1 Equipment Set Up

7.3.2 PRELIMINARY ADJUSTMENTS

a) Ensure normal mobile transmitter and receiver duplex alignment is completed as per Part 1, Section 4.19.

b) Ensure talk-through audio pcb (U403) is fitted and that R355 is removed. Also ensure 150k resistor from kit is fitted on synthesiser/control pcb.

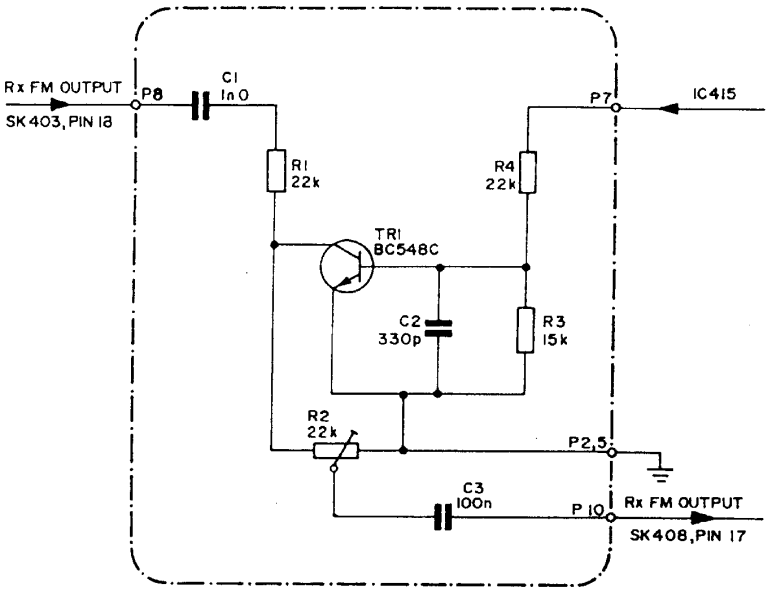
c) Connect mobile to test equipment as shown in Figure 7.1 above.

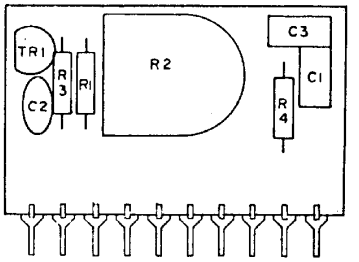
7.3.3 TEST PROCEDURE

STEP	RESULT MEASURED BY	RESULT MEASURED AT	ADJUST	RESULT	NOTES
1			RF Sig. Gen. for mobile Rx TTR frequency		See frequency on mobile channel frequency label.
2			RF Sig. Gen. output level	1mV PD	Modulate generator with 60% of system deviation at 1kHz modulating frequency
3			Fit link if applicable. See notes column		For CTCSS activated TTR. Place a link from pin 16 of U405 on synth/cont. PCB, to chassis.
4	RF Power Meter	Tx Output Socket	Enable "Talk-through" mode	Transmitter activates	Keyboard: [F] [8]
5	Deviation Monitor	Via Sampling pad at Wattmeter	"Deviation Set" trimpot on talk-through Audio PCB	60% of system deviation	Talk-through audio PCB located in signalling option area of synth/control PCB
6			RF Sig. Gen. deviation	±1kHz at 1kHz freq.	
7	Deviation Monitor	Via Sampling pad at Wattmeter		Deviation ±1kHz ±200Hz	Check Linearity in talk-through audio
8			RF Sig. Gen deviation	Maximum system deviation	±5kHz for 25kHz version. ±2.5kHz for 12.5kHz version.
9	Deviation Monitor	Via Sampling pad at Wattmeter		Deviation should be A ±5kHz B ±2.5kHz	A = 25kHz version B = 12.5kHz version
10			RF Sig. Gen. Output level to zero.	Transmitter deactivates	Disconnect link from pin 16 to chassis for tone operated TTR versions.
11			RF Sig. Gen. Modulation to CTCSS tone frequnecy		Set tone deviation to ±500Hz for 25kHz version or ±250Hz for 12.5kHz version. Switch modulation off.
12			RF Sig. Gen. Output level to 1mV	Transmitter does not activate	
13			Switch RF Sig. Gen. Modulation on	Transmitter activates	
14			Switch RF Sig. Gen. RF Output off	Transmitter deactivates after 1sec	

7.4 TALK-THROUGH REPEATER PCB (U403) (3502 349 96960)

	PCB Talk-Through	3502 329 96960	C1	1n0, 10%,100V,Cer. Pl.	2222 630 02102
R1	22k, 5%, 0.2W, Carb.F.	2120 101 46223	C2	330p,10%,100V,Cer. Pl.	2222 630 01331
R2	22k, 30%, LIN. Pot Preset	2120 357 01223	C3	100n,20%,50V, Cer D/M	2022 552 02482
R3	15k, 5%, 0.2W, Carb.F.	2120 101 46153			
R4	22k, 5%, 0.2W, Carb.F.	2120 101 46223	TR1	Transistor, BC548C	9331 976 70112



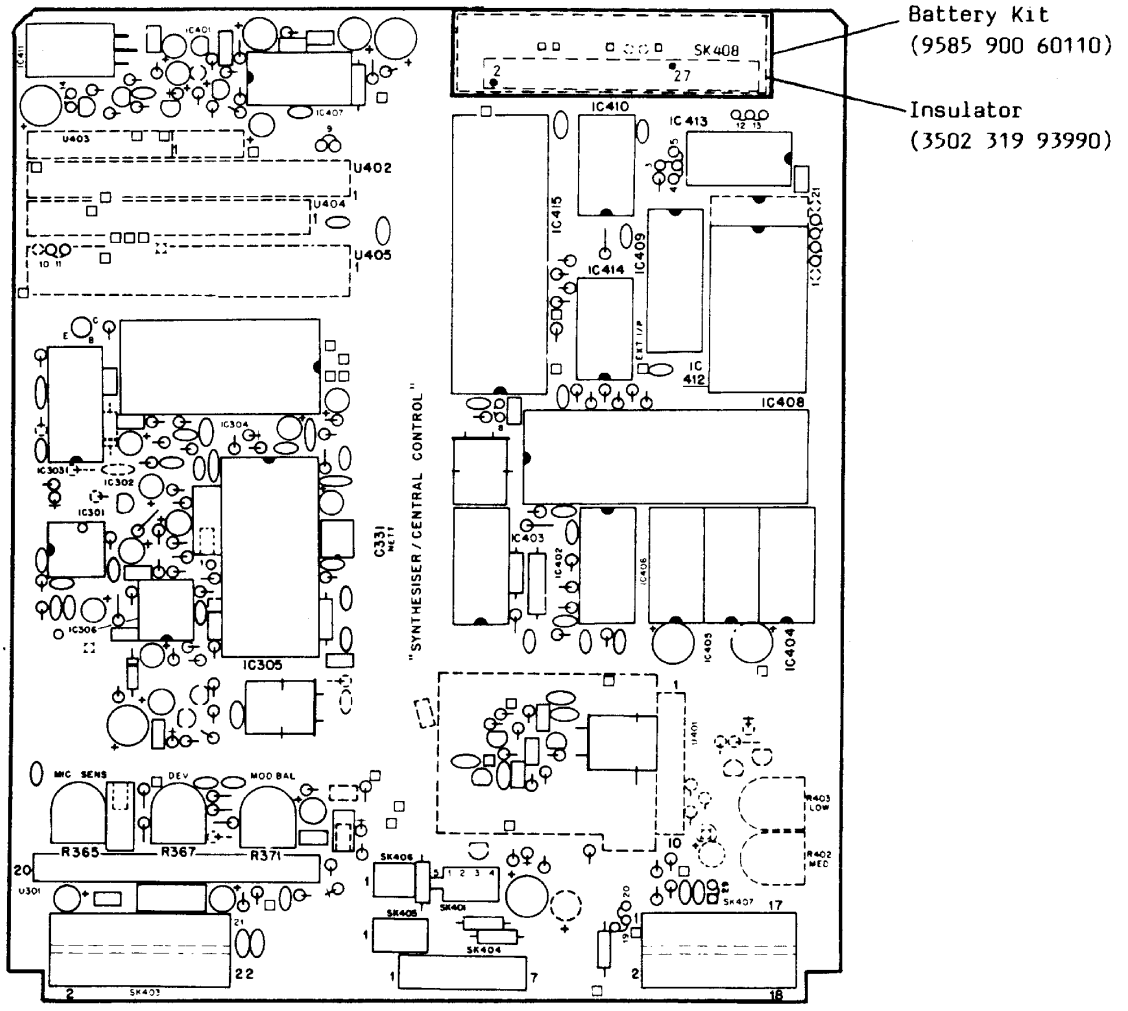


SECTION 8 BATTERY BACKUP KIT

8.1 GENERAL DESCRIPTION

This kit ensures that all volatile memory contents are protected during power disruption or disconnection. This option is recommended when the FM91 is used as a low power power base station where longer power disruptions may occur without prior warning.

8.2 FITMENT



DETAIL 'A'

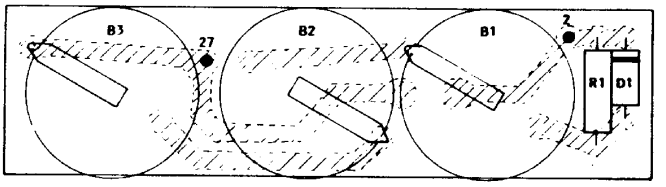
NOTES: 1. Put Mounting pins as per Detail 'A'.

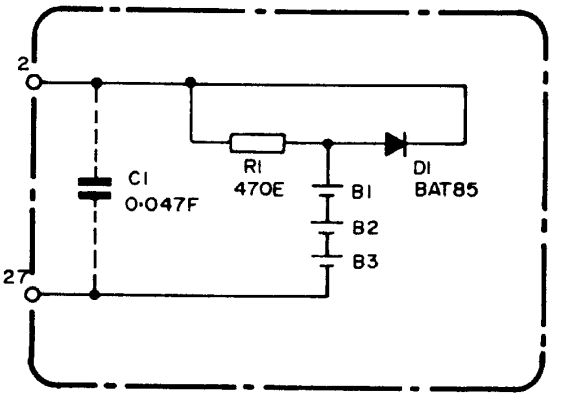
2. Ensure that pin 2 and pin 27 of the kit are fitted into pin 2 and pin 27 respectively of SK408 on the Synthesiser Control printed circuit board.

8.3 BATTERY BACKUP KIT 9585 900 60110

Battery Pack Board Assy.	3502 349 97190
Insulator, Battery PCB	3502 319 93990

8.3.1 BATTERY PACK BOARD ASSY 3502 349 97190





	PCB Battery Pack	3502 309 97190
R1	Res. Carb.F. 470E,5%,¼W	2120 101 46471
D1	Diode, BAT85	9336 247 60112
B1	Battery, Modified Type VB4	3502 319 94010
B2	Battery, Modified Type VB4	3502 319 94010
B3	Battery, Modified Type VB4	3502 319 94010

8.3.2 BATTERY KIT TEST

i) Ensure battery board is fitted in accordance with instructions in 8.2

ii) Switch mobile on.

iii) Select any channel other than power-up channel (if fitted).

iv) Allow mobile to operate for 2 - 3 minutes.

v) Remove fuse from positive supply line for 5 - 10 seconds and replace.

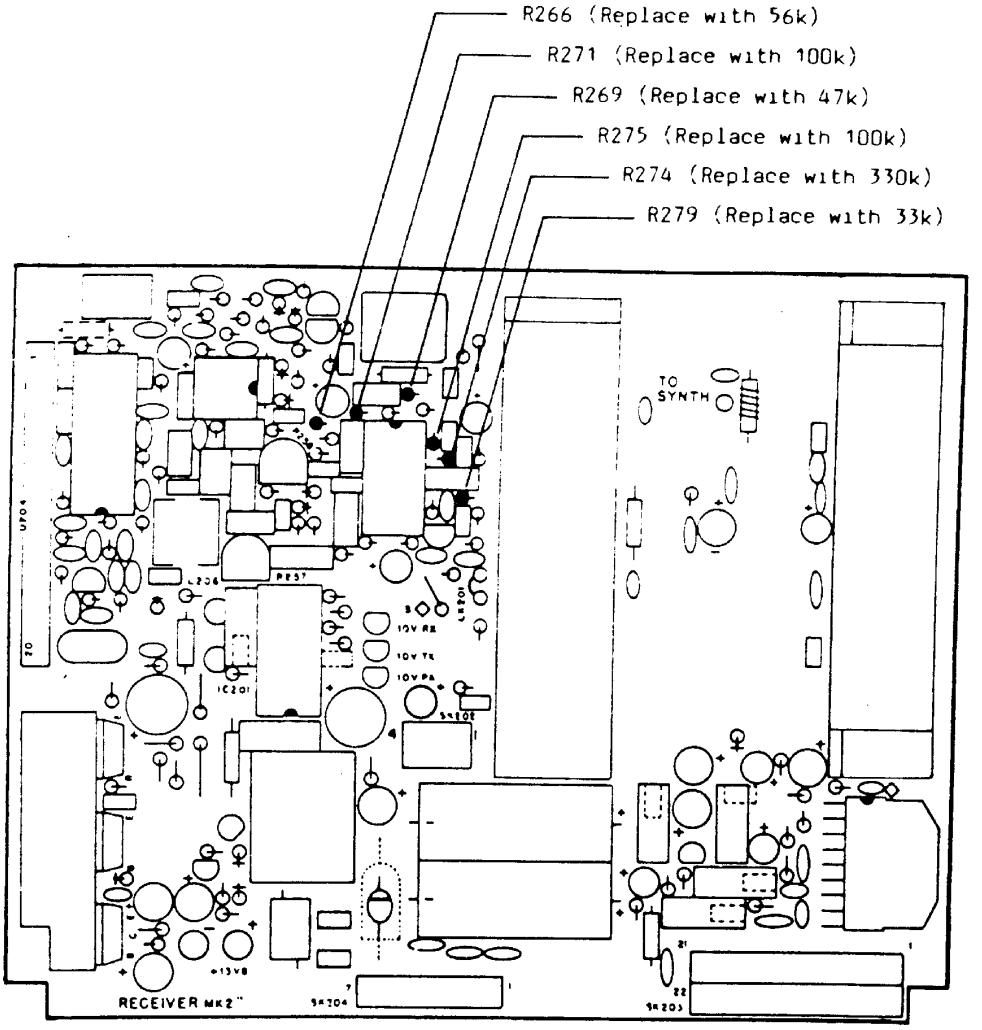
vi) Ensure mobile switches on when fuse is reconnected, and the channel has not changed.

SECTION 9 300Hz TO 3000Hz AUDIO RESPONSE

9.1 GENERAL

This option provides for the audio response of the receiver to cover the full range of 300Hz to 3000Hz.

9.2 FITMENT



9.2.1 COMPONENTS

R266	Res. Met.F. 56k, 1%, 0.6W	2322 156 15603
R269	Res. Met.F. 47k, 1%, 0.6W	2322 156 14703
R271	Res. Met.F. 100k, 1%, 0.6W	2322 156 11004
R274	Res. Met.F. 330k, 1%, 0.6W	2322 156 13304
R275	Res. Met.F. 100k, 1%, 0.6W	2322 156 11004
R279	Res. Met.F. 33k, 1%, 0.6W	2322 156 13303