PROVISIONAL

AWA

SERVICE MANUAL

VHF FM MOBILE TRANSCEIVER

MODEL M8-1540

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Ashfield Division
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560 4533	844 1631	79 6155	272 2366	271 0888	44 5155

SECTION 1
GENERAL INFORMATION

General

Frequency Range	148- 174MHz
Frequency BANDSWITCHING	26MHz without any degradation
Operation	Single and/or two frequency simplex
Modulation	Frequency (F3)
Channel Spacing	25KHz, 30KHz
No. of Channels	Up to 99 channels
Power Supply	13.8V ±10% DC negative ground
Operational Environment	The equipment is designed for operation over the temperature range -30 ℃ to +60 ℃ and meets EIA recommendations or relevant national specifications.
Frequency Stability	±0.0005%
Operator Controls	see SECTION 2
Overall Dimensions	65(H) x 190(W) x 275(L) in m/m
Weight	2.9kg (6·2lbs) approx.

Receiver

Sensitivity	0.25 μV at 12dB SINAD
Adjacent Channel Selectivity	Better than 80dB at ±25KHz
Spurious Response Attenuation	Better than 85dB
Image Rejection	Better than 85dB
Intermodulation Attenuation	Better than 70dB
Hum and Noise Level	Better than 45dB
Audio Output	5W into 4Ω with 10% THD. at 13.8V
Audio Response	Within +1dB and -3dB of a 6dB/octave de-emphasis between 300 - 3000Hz
Audio Distortion	Less than 3% at 1W output

Transmitter

Power Output	
NORMALPower	25W nominal (variable to 10W)
Low Power	15W nominal (variable to 3W)
Spurious & Harmonic Emissions	Better than 70dB below carrier
Hum and Noise Level	Better than 45dB
Modulation	Adjustable up to ±5KHz peak deviation
Modulation Response (Speech Band)	Within +1dB and -3dB of a 6dB/octave pre-emphasis between 300 - 3000Hz
Modulation Distortion	Less than 1.5% at 60% modulation

FEATURES

Dealer Programme Items	Channel Number, TX/RX Frequency, TX/RX Tone Frequency and High or Lo power in each channel, Time-out-timer
User Programmable Items	Priority channel, Scan lock-out channel(s), Scan resume time
Programming Method	Function Keys on front panel
Memory System	EEP-ROM
CTCSS Frequency	38 tones
Time-out-Timer	30 - 300 seconds (30 sec. step)
Scan Rate	25 channels per second

* The above typical figures are based on normal operating conditions.
* 12.5KHz Channel Spacing version is also available on request.

INTRODUCTION

The M8 is a synthesised VHF FM mobile transceiver. The euipment employs an advanced frequency-synthesiser circuit which is controlled by an 8 bit micro-processor and permits multiple channel operation from a single master crystal. Channel frequency information is contained within an EEP-ROM. The contains in the EEP-ROM can easily be re-programmed by a dealer without using any special instrument.

A large scale integration (LSI) processor circuit enables TX/RX frequency, channel, tone, output power, time-out-timer, priority channel, lock out channel and scan resume time selections for dealers and users with the minimum controls. Clear visual indication of operator action and equipment status are provided by a liquid crystal display (LCD) mounted on the front panel. Clock and data connections on the rear-mounted facility socket allow to transfer the contents within the memory to other M8 radios (cloning). Since the radio uses an EEP-ROM as a memory device, no extra power source for memory back-up is needed.

Transmit-receive switching is achieved by the an antenna switch. Direct frequency modulation of the transmitter is employed with very low distortion.

The M8 provides three scanning modes, such as normal scan, priority scan and scan with priority.

SUPPLIED STANDARD ACCESSORY

* Hand Microphone ..... 1 pce.
* Fused Power Cable ..... 1 pce.
* Microphone Hanger ..... 1 pce.

OPTIONAL ACCESSORY

* Hand Microphone with Up-Down buttons

SECTION 2
INSTALLATION AND OPERATION

UNPACKING

Unpack the radio container and check that no obvious damage has occurred in transit. In the event of the radio having to be repacked, ensure that all items are placed in the correct compartment.

SERVICEABILITY CHECK

Each radio set is adjusted, tested and inspected before shipment. However, it is recommended that both the transmitter and receiver sections of the radio be checked for proper operation just prior to installation.

The radio should be tested with all cables and accessories supplied with the radio connected as they will be in the final installation. The frequency, deviation and power output of the transmitter should be checked, as well as the sensitivity, squelch operation and audio quality of the receiver. Radios with signalling, such as CTCSS, should be operated in that mode to verify proper encode/decode performance.

INSTALLATION

A. General
Planning is the key to fast, easy radio installation. Before holes are drilled or wires are run, firstly inspect the vehicle and determine how and where the antenna, radio set and accessories should be fixed.

B. Antenna Mounting
The best mounting place for the antenna is in the centre of a large flat conductive surface, such as the centre of the roof. Make sure that the antenna impedance is 50 ohms and VSWR is below 1.5 at operating frequency.

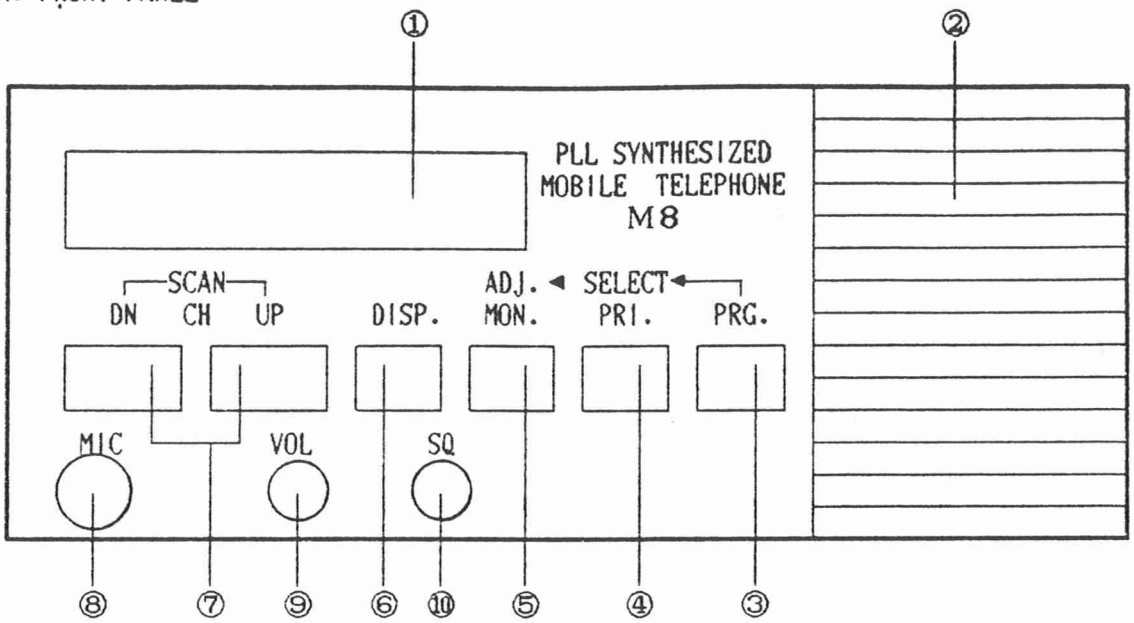
C. Radio Mounting
Make sure that the mounting surface enables to adequately support the weight of the radio and it is close enough to the vehicle operator to permit easy access to operating controls while driving. Allow sufficient space around the radio for free air flow for cooling.

D. DC Power and Wiring
This radio must be operated only from 12 volt negative ground electrical systems. Reverse polarity will not damage the radio, but the cable fuse will blow. Do not bypass the fuse in any condition.
Connect the RED power lead via fuse to the positive terminal of the battery. Connecting the red lead to any other positive voltage point in the vehicle is not recommended.
Connect the BLACK power lead to a good ground point on the vehicle chassis. Do not connect the blck lead directly to the negative side of the battery.

E. Microphone Hanger Fixing
If the microphone hanger is mounted on a plastic dashboard surface, connect a lead between the microphone hanger and vehicle ground.

CONTROL FUNCTIONS

A. FRONT PANEL



① LCD Readout
The Liquid Crystal Display indicates frequency and status information. The back-light illuminates green in receiving and red in transmitting. Details are described in the other section of this manual.

② Speaker
Signals received can be heard from this speaker.

③ [PRG.] Key
This key used for changing the radio from normal operating mode to user programming mode and viceversa (operating mode ←→ user programming mode), and also works as an entry key for user programming items.

④ [PRI.] ([SELECT]) Key
This key is used to monitor the priority channel in priority scan and scan with priority modes. In the user programming mode, this key is used for selecting user programming items.

⑤ [MON.] ([ADJ.]) Key
This key is used to monitor the channel when CTCSS is operating. The MON appears on the display when the switch is depressed and you may monitor the channel. To return to CTCSS mode, depress it again.
In the user programming mode, this key is used for setting or releasing lock-out channel(s) and scan resume time.

⑥ [DISP.] Key
The indication on the display can be changed by depressing this key, such as "CH-01"→"Frequency" →"Tone Frequency".

⑦ [UP] and [DN] ([SCAN]) Keys
These keys are used for increasing or decreasing the selected channel. In case both keys are depressed simultaneously, the radio will be in scan mode.

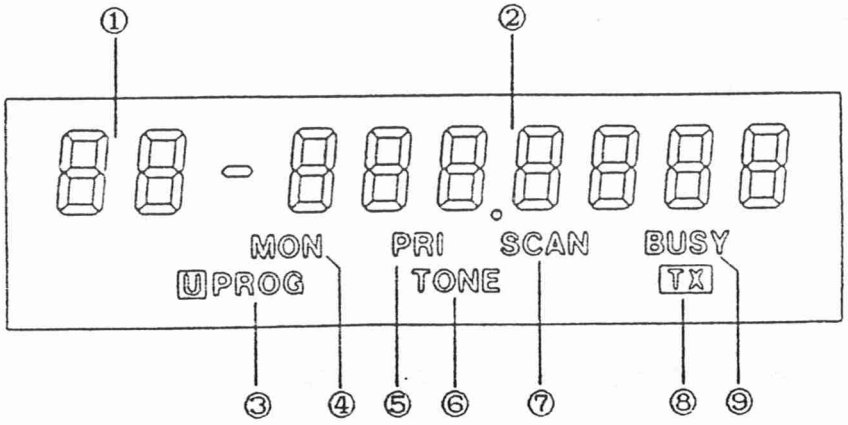
⑧ Microphone Connector
This 8-pin connector is for the supplied microphone and also for accepting the microphone with up-down buttons from the optional accessories.

⑨ Volume Control & Power ON-OFF Switch
This contol co-operates with power ON-OFF switch adjusts the receiver output level. To increase volume, the control should be turned clockwise. The fully counter-clockwise position is power off.

⑩ Squelch Control
This control is used for eliminating noise when there is no signal on the channel. The degree of the sensitivity to incoming signals is adjustable. The fully clockwise position provides maximum squelch action. This control should normally be turned clockwise until noise is eliminated or BUSY on the display disappears. At this setting, proper scan action takes place.

B.LCD READOUT

The display indicates status of the radio in normal operating and user programming modes. The status indicators in dealer programming mode are not listed on the display below.



① Channel Indicator
This section indicates "CH" (channel), and also "Sc" when scan resume time is programmed in the user programming mode.

② Channel Number & Frequency Indicator
This section indicates channel number, RF frequency, tone frequency, and scan resume time in the user programming mode.

③ User Programming Mode Indicator
While the radio is in the user programming mode, "U PROG" appears.

④ Monitor Indicator
In case the squelch is on or the microphone is hooked, "MON" appears. When CTCSS is operating, depress the [MON] key and this indicator is on and the channel can be monitored.

⑤ Priority Indicator
In scan mode, depress the [PRI] key and "PRI" appears to show that there is a priority channel among scanning channels.

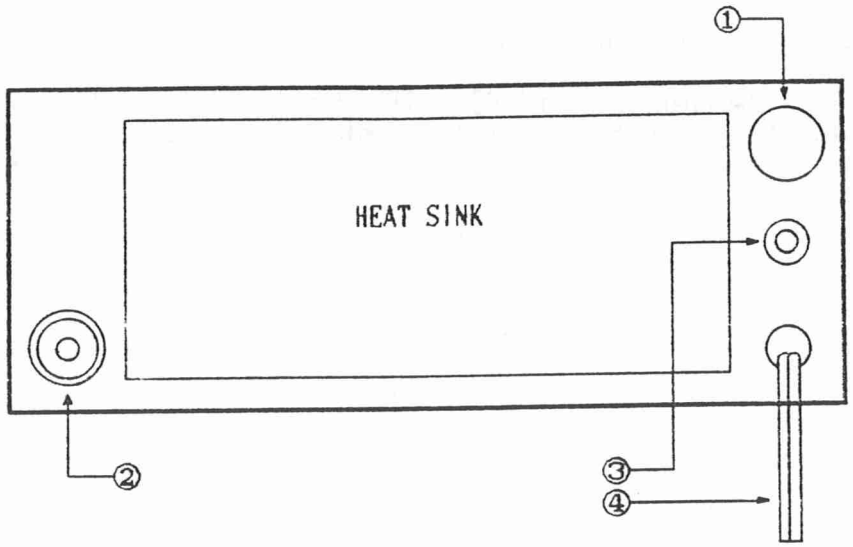
⑥ Tone Indicator
"TONE" appears when the built-in sub-audible encoder/decoder is programmed to operate on the channel. Only that receive signal accompanied by a special tone frequency is audible when this circuit is active.

⑦ Scan Indicator
"SCAN" appears when the radio is in the scan mode.

⑧ TX Indicator
"TX" appears when the radio is in the transmit mode.

⑨ Busy Indicator
"BUSY" appears when the squelch is in no action or there is a signal on the receiving channel.

C. REAR PANEL



① Clone Connector
This 7 pin DIN connector is for accepting the cable to transfer data such as frequency information, to same other model radios.

② Antenna Connector
This connector is for accepting an antenna lead-in cable with a PL-259 Plug or a UG-260 plug for the model with a BNC connector.

③ External Speaker Jack
This jack is for accepting a speaker lead-in cable with a 3.5φ phono plug (or a RCA plug) connected to a 4 ohm or an 8 ohm speaker; the internal speaker is automatically silenced (for the model with a RCA type jack, the internal speaker is not silenced).

④ DC Power Cable
The DC power of around 13.6V (or 13.2V) is supplied through this fused cable. The RED lead should be connected to the (+) side and the BLACK lead should be connected to the ground (-).

OPERATION

· Verify that the POWER switch is OFF and the microphone is in the microphone hanger which is grounded before connecting power to the radio.

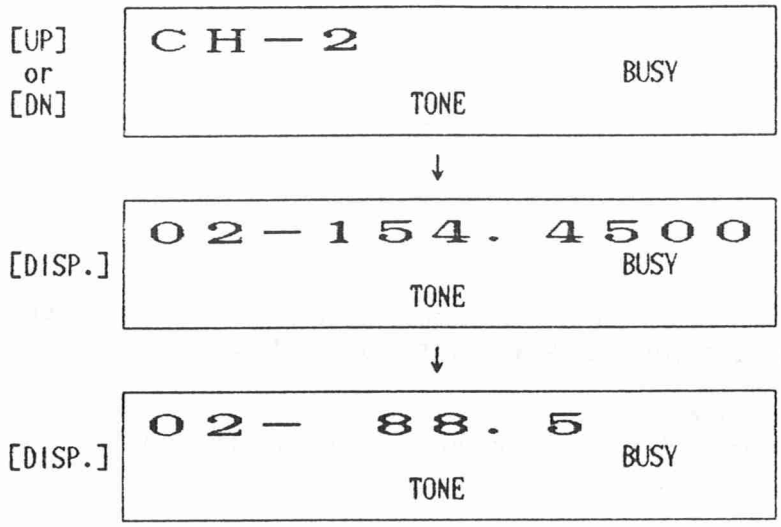
Then supply power to the radio and firstly, carry out USER PROGRAMMING in accordance with the instruction in this section.

A. RECEIVING

1. Turn the Volume Control about half-way to the right.

2. Select the channel with [UP] or [DN] key to the desired channel. Depress [DISP.] key, and the LCD readout indicates the exact receiving frequency. And then depress [DISP.] again, and CTCSS tone frequency appears.

EXAMPLE : RX Channel selected & Frequency = CH-2 & 154.450MHz
RX Tone Frequency = 88.5Hz, Squelch = off.



3. In case hissing noise is heard from the speaker ("BUSY" appears on the LCD readout); turn the Squelch Control slowly to the right until the noise fades out ("BUSY" disappears). Do not set it too high, otherwise weak signals can not be heard.

4. Adjust the Volume Control at a reasonable listening level.

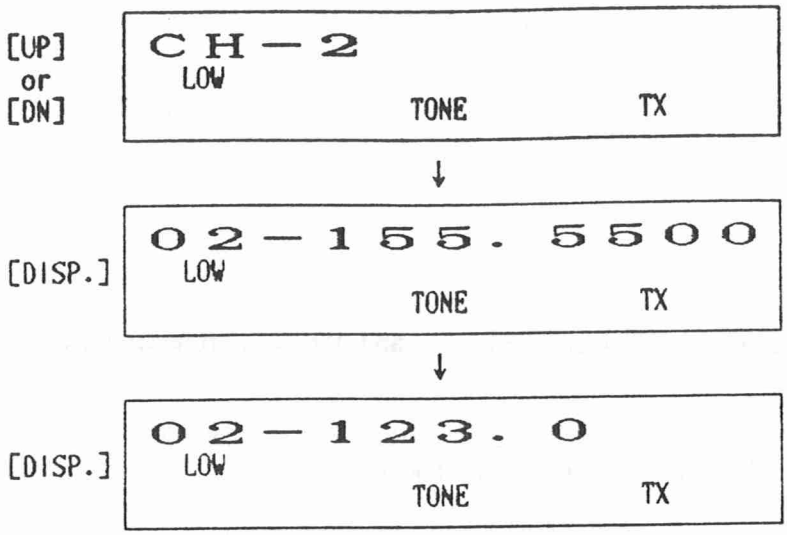
> NOTE: If no tone frequency is programmed for the channel, "TONE" does not appear on the LCD readout.

B. TRANSMITTING

1. Set the radio to the condition as instructed in "RECEIVING".

2. Depress the PTT (Push to Transmit) switch on the microphone to begin transmitting (the back-light of the LCD readout turns to RED). "TX" appears on the LCD readout to indicate a signal is being transmitted. If a tone is programmed for the channel, "TONE" also appears on the LCD. Actual TX and tone frequencies can also be indicated by depressing [DISP.] key which is the same manner as mentioned above.

EXAMPLE : TX Channel selected & Frequency = CH-2 & 155.550MHz
TX Tone Frequency = 123.0Hz, Output = Low power position



3. Speak into the microphone in a normal tone voice.

4. Release the PTT switch to receive a message.

C. SCAN FUNCTION

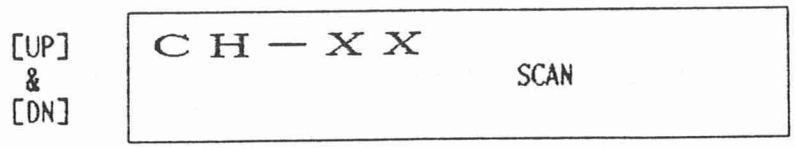
The radio is equipped with functions for three types of scan modes, such as (1) NORMAL SCAN, (2) PRIORITY SCAN and (3) SCAN WITH PRIORITY.

(1) Normal Scan

1. Verify that the microphone is hooked (the hanger terminal on the rear side of the microphone is grounded).

2. Depress [DN] & [UP] keys simultaneously and "SCAN" appears on the LCD.

EXAMPLE : Microphone = Hooked, Squelch = ON

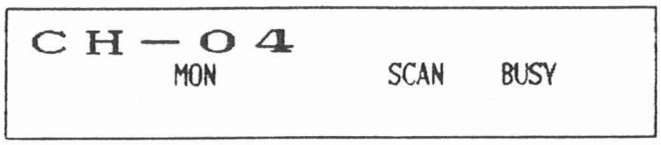


3. Scan starts to sample each of the programmed channels in a consecutive manner and stops to monitor only those channels which have communication on them.
The period of the monitoring time on the channel is related to the 'Scan Resume Time' which is described in the USER PROGRAMMING.

NOTE: On the factory, this scan function is normally programmed to work only the following conditions:
1) On NO TONE programmed channels, the scan stops by detecting CARRIER.
2) On TONE programmed channels, the scan stops by detecting the same tone as being programmed in the radio.

4. If the microphone is hooked off on a scan stopped channel, the communication on that channel can be heard until the microphone is hooked and also the operator can transmit on that channel.

EXAMPLE : Scan stopped channel = CH-04, Microphone = Hooked off



5. Depress either [DN] or [UP] key, and the scan function is released.

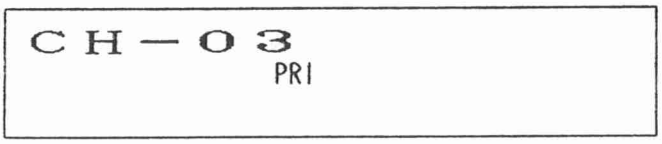
(2) Priority Scan (Dual Watch or Scan between 2 channels)

1. Verify that the microphone is hooked.

2. Depress [PRI.] key, and "PRI" appears on the LCD.

EXAMPLE : Monitoring Channel (no signal) = CH-03, Microphone = Hooked

[PRI.]



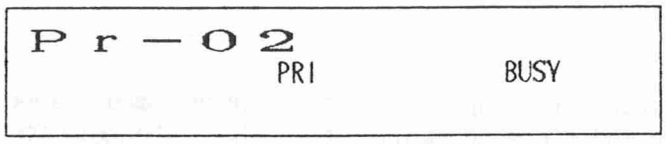
3. The scan starts so that the radio monitors the priority channel once every 3 seconds. The LCD keeps indicating the channel number or frequency the operator is presently monitoring until a signal comes in on the priority channel

4. When a signal appears on the priority channel, a beep sound is heard from the speaker and the radio is set to the priority channel, and at the same time the LCD indicates "Pr-ZZ".

ZZ = priority channel

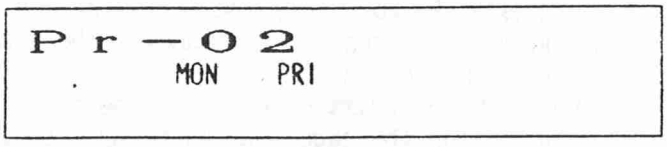
The radio keeps monitoring the priority channel until 3 seconds after the signal is disappears.

EXAMPLE : Priority Channel = CH-02, Microphone = Hooked



5. If the microphone is hooked off when the operator is monitoring other channel, the radio is set to the priority channel and at the same time "Pr-ZZ" is indicated on the LCD.

EXAMPLE : Priority Channel = CH-02, Microphone = Hooked off



6. Then 3 seconds after the microphone is hooked, the radio returns to the channel which is previously monitored.

7. Depress [PRI.] key once again, and this function is released.

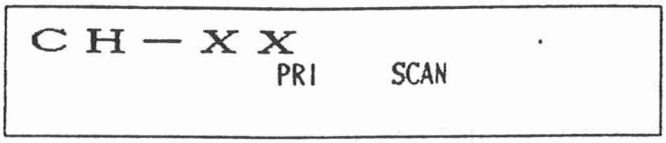
(3) Scan With Priority

1. Verify that the microphone is hooked.

2. Depress [DN] & [UP] keys simultaneousl and then depress [PRI.], and "SCAN" & "PRI" appear on the LCD.

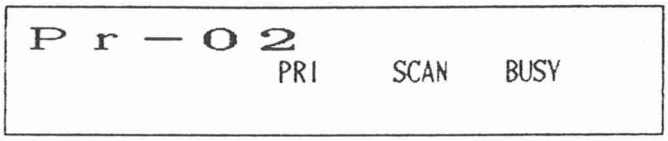
EXAMPLE : Microphone = Hooked

[UP] & [DN] then [PRI.]



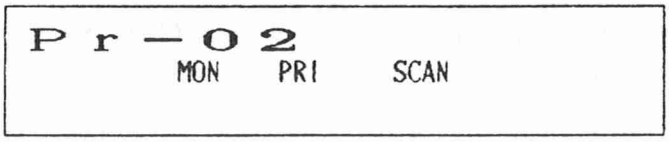
3. Scan starts so that the priority channel is monitored once every 6 seconds. As soon as a signal appears on the priority channel, a beep sound is heard from the speaker and the radio is set to the priority channel, and at the same time the LCD indicates "Pr-ZZ".
The radio keeps monitoring the priority channel until 1 second after the signal disappears.

EXAMPLE : Priority Channel = CH-02, Microphone = Hooked



4. If the microphone is hooked off during scanning, the radio is set to the priority channel and at the same time the LCD indicates "Pr-ZZ".

EXAMPLE : Priority Channel (no signal) = CH-02, Microphone = Hooked off



5. Then 1 second after the microphone is hooked, scan starts again.

6. Depress either [DN] or [UP] key and then [PRI.] key, and this function is released.

D. MONITOR FUNCTION

The monitor function allows the operator to listen to a busy channel when the microphone is hooked off regardless of which tone system , such as CTCSS, 2 TONE, 5 TONE, etc., is in use on that channel.

USER PROGRAMMING

INTRODUCTION

The operator can be programmed the PRIORITY CHANNEL, SCAN LOCK OUT CHANNEL and SCAN RESUME TIME. The M8 is set to the Priority Channel when it is powered on and also the microphone is off-hooked in the Priority Scan mode.

In case no key is depressed 8 seconds after from the last key is depressed, the user programming mode reverts to the normal operating mode and no data is programmed into the memory.

PROGRAMABLE ITEMS

A. Priority Channel
The priority channel can be chosen from any channels which are programmed into the M8 by the dealer.

B. Scan Lock Out Channel(s)
The purpose of the lock out function is to disable (skip over) specific channels, so when scanning, the M8 does not stop on these channels. The operator can be chosen any channels. But do not lock out all channels, otherwise the CPU will hang up in the scan mode. In this case, power OFF and then ON again to recover it.

C. Scan Resume Time
The purpose of this function is to delay the scanning start. The scan resume time can be chosen from 0, 3, 6 seconds and C.
In scan mode, if the operator is set to;

0: The scan will start as soon as the carrier on the channel is disappeared.

3: The scan will start 3 seconds after the carrier on the channel is detected.

6: The scan will start 6 seconds after the carrier on the channel is detected.

C: The scan will start 3 seconds after the carrier on the channel is disappeared.

> NOTE: In case the operator does not programme any User Programming Items into the radio, two of three items into the radio, two of three items are pre-set to the radio as follows;
> ‡ Priority Channel → Channel 1 (CH-01)
> ‡ Scan Resume Time → 0 (Sc-0)

KEY FUNCTION

The functions of the keys for user programming are printed in RED on the front panel except [PRG] key.

A. [PRG] Key
This key is used for changing the M8 from normal operating mode to user programming mode and viceversa. (operating mode ⟷ user programming mode) This key also works as an entry key; depress this key at the end of the programming.

B. [SELECT] ([PRI]) Key
This key is used for selecting the user programming items as mentioned in paragraph 1.2 above.

C. [ADJ.] ([MON]) Key
In case setting priority channel, do not use this key. Use [UP] or [DN] key for selecting the channel.

1. For setting Scan Lock Out Channel(s)
This key is used for setting or releasing lock out channel(s) selected by [UP] or [DN] key.

2. For setting Scan Resume Time
This key is also used for setting resume time which is chosen from 0, 3, 6 and C. The resume time effects to all channels.

PROGRAMMING PROCEDURE (REFER TO TABLE 2.1)

In user programming mode, the operator can be programmed 3 items as the following sequence; Priority Channel→ Lock Out Channel(s)→ Resume Time

STEP 1: Apply power to the radio and then depress [PRG] key. The display should show "Pr-01".
STEP 2: Select the priority channel by using [UP] or [DN] key and then depress [PRI] key.
STEP 3: The display should show "CH-XX" (XX = number) and select the lock out channel by using [UP] or [DN] key.
Depress [MON] key and the display should show CH-'YY '.
'YY ' = channel number selected with blinking
In case more lock out channels are needed to programme.
repeat the same procedure as mentioned above; depress [UP] or [DN] key to select the channel and then depress [MON] key so on.
STEP 4: Depress [PRI] key and the display should show "Sc-0".
Depress [MON] key to select resume time from 0, 3, 6 and C.
STEP 5: Depress [PRG] key to finish user programmingh mode. In this case, [PRG] key works as an entry key. The display should show "CH-ZZ". ZZ = Priority Channel number selected
The M8 is now in normal operating mode.

Table 2. 1 USER PROGRAMMING EXAMPLE

Priority Channel : CH 2
Lock Out Channel : CH 3 & CH 5
Resume Time : 6 seconds

ITEM	KEY	DISPLAY
Priority Channel	[PRG]	Pr-01 U PROG
	[UP] or [DN]	Pr-02 U PROG
Lock Out Channel	[PRI]	CH-01 U PROG
	[UP] or [DN]	CH-03 U PROG
	[MON]	CH-0'3' U PROG
	[UP] or [DN]	CH-05 U PROG
	[MON]	CH-0'5' U PROG
Resume Time	[PRI]	Sc-0 U PROG
	[MON]	Sc-6 U PROG
	[PRG]	CH-02

SECTION 3
TECHNICAL DESCRIPTION

INTRODUCTION

Frequency synthesisers employing mixer/multipler techniques have been used for a number of years in applications where the need to utilize a large number of defined channels has justified their complexity. The resulting high cost, together with limitations in respect of frequency coverage, noise performance and frequency acquisition time have, however, largely precluded their use in private radiotelephone (PMR) equipment. The approach to frequency synthesiser design has, however, changed with the advent of large scale integrated circuits which can, with a voltage controlled oscillator, generate VHF output directly, without the need of a mixer or multipler. As a result, frequency synthesis now provides a cost-effective technique which meets high standards of performance required for PMR mobile and portable equipments. In its basic form, a frequency synthesiser consists of a voltage controlled oscillator, phase comparator, ÷divider and reference oscillator interconnected as shown in Fig 3.1.

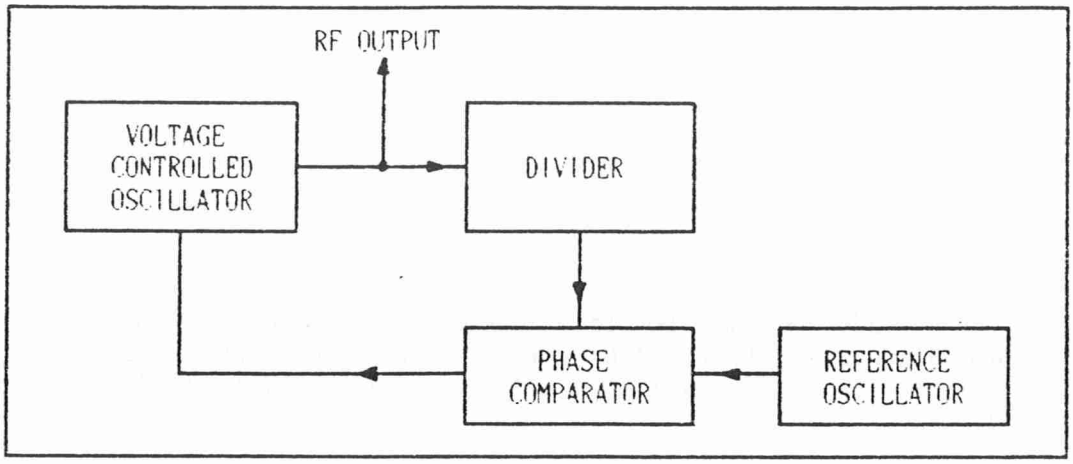


Fig.3.1 Basic Frequency Synthesiser

The phase comparator output voltage adjusts the voltage controlled oscillator (VCO) output frequency so that the outputs of the reference oscillator and the divider are at the same frequency and are phase locked. By using a programmable divider, a number of different VCO output frequencies can be obtained, their minimum spacing equalling the reference oscillator frequency.

A practical frequency synthesiser requires the use of more circuit elements than are shown in the basic arrangement above. The simplified block diagram of the multi-channel frequency synthesiser (Fig 3.2) shows where they are used.

The output of the voltage controlled oscillator through the buffer amplifier is applied to a pre-scaler which reduces the frequency to a value suitable for application to the main divider. The divider is programmed by the channel selector so that its output to the phase comparator is at the same frequency as the reference divider output when the voltage controlled oscillator is phase locked at the required channel frequency. The reference divider input is provided by a crystal controlled oscillator; the divider output providing a stable and accurate reference signal to the comparator. A control voltage for the VCO, proportional to the phase difference between the reference signal and the main divider output, is produced by the phase comparator. This control voltage, fed to the voltage controlled oscillator by way of a low pass filter, adjusts the frequency and phase of the VCO to make the two inputs to the comparator identical in frequency and in phase. The VCO is, therefore, phase

locked to the stable reference frequency. The loop filter attenuates high frequency noise and is the main element that determines the dynamic characteristics of the phase loocked loop. AF modulation is applied to the VCO.

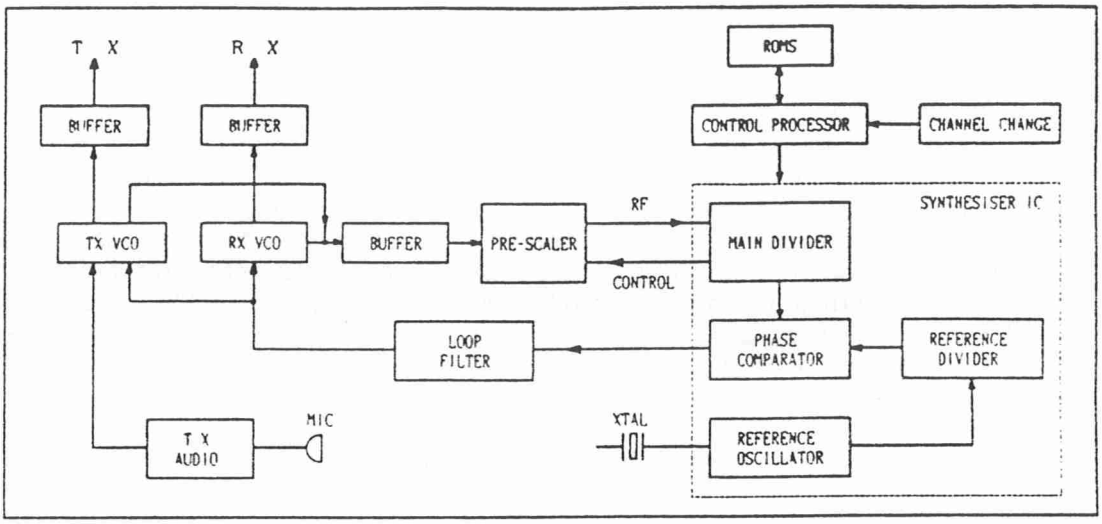


Fig.3.2 A Practical Multi-channel Frequency Synthesiser

The central synthesiser circuit elements: i.e. the main and reference dividers, and the phase comparator are contained in one IC package. The synthesiser IC is a CMOS device which operates from the supply voltage of 5V.

Channel changing is implemented by a Control Processor IC, which is prompted by operator action on the transceiver front panel controls. The Processor addresses and monitors channel information stored in an EEP-ROM. This information is sent, via data lines, to the synthesiser IC where it sets the division ratio of the dividers. Information is relayed visually to the user via a liquid crystal display.

The synthesiser output is used to provide the receiver local oscillator frequency in the receive mode and modulated RF source for the transmitter power amplifier in the transmit mode. Both signal sources are passed through buffer stages, the outputs of which are normally at the required final frequency.

The receiver stages are of double superheterodyne design with intermediate frequencies of 21.6MHz and 455KHz. Construction of the receiver is mainly of ICs, together with discrete components for the RF stages.

Transmit and receive switching is performed by the Regulator IC and timer (data from the Control Processor), with antenna switching provided by pin diodes housed within the PA PCB: this PCB also houses a low pass filter in the antenna leg.

POWER SUPPLIES AND SWITCHING

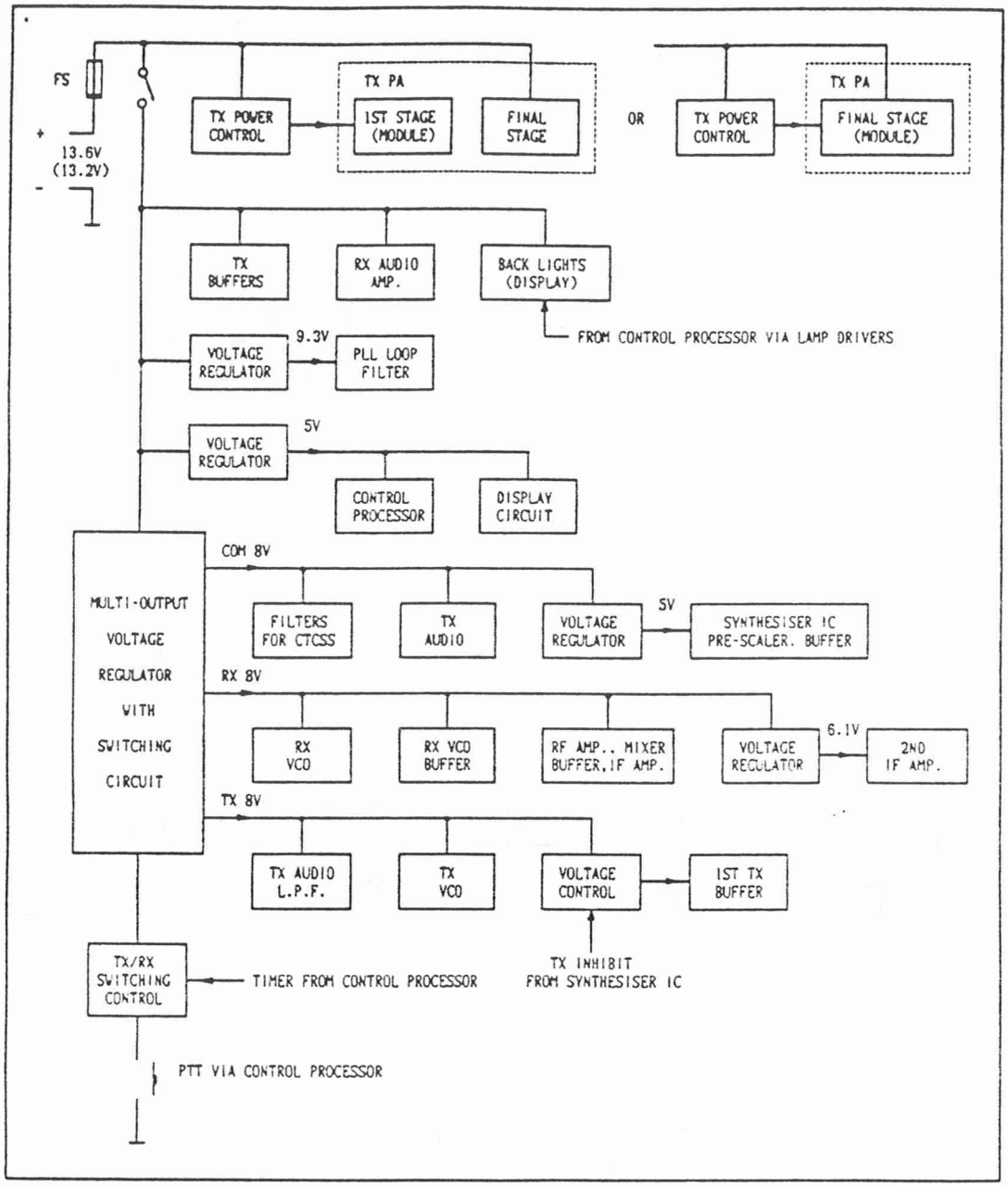


Fig.3.3 Power Supplies Block Diagram

The radio is supplied with a nominal 13.6V (or 13.2V) from a car battery via Fuse FS. This supply is applied to the transmitter power amplifier.

The supply through the ON/OFF switch is applied to the transmitter buffers, receiver audio amplifier and the display back-lights, and is also applied to three voltage regulators.

The first one 9.3V output is for the PLL loop filter circuit. The second one 5V output is for the Control and Display circuits. The third one has three outputs with a switching circuit and is for the rest of all circuits.

On receive, this module produces an 8V supply for the receiver VCO & VCO buffer on the Control P.C.B. and on the Receiver P.C.B., the RF amplifier, 1st mixer, 1st IF amplifier & 2nd IF amplifier via a 6.1V voltage regulator.

On transmit, the module provides an 8V supply for the transmitter VCO, L.P.F. for modulator and the 1st TX buffer (via a voltage controller). An output from the collector of Q317 will cut off the line if the VCO circuit of the synthesiser is out-of-lock (TX inhibit).

FREQUENCY SYNTHESISER

INTRODUCTION

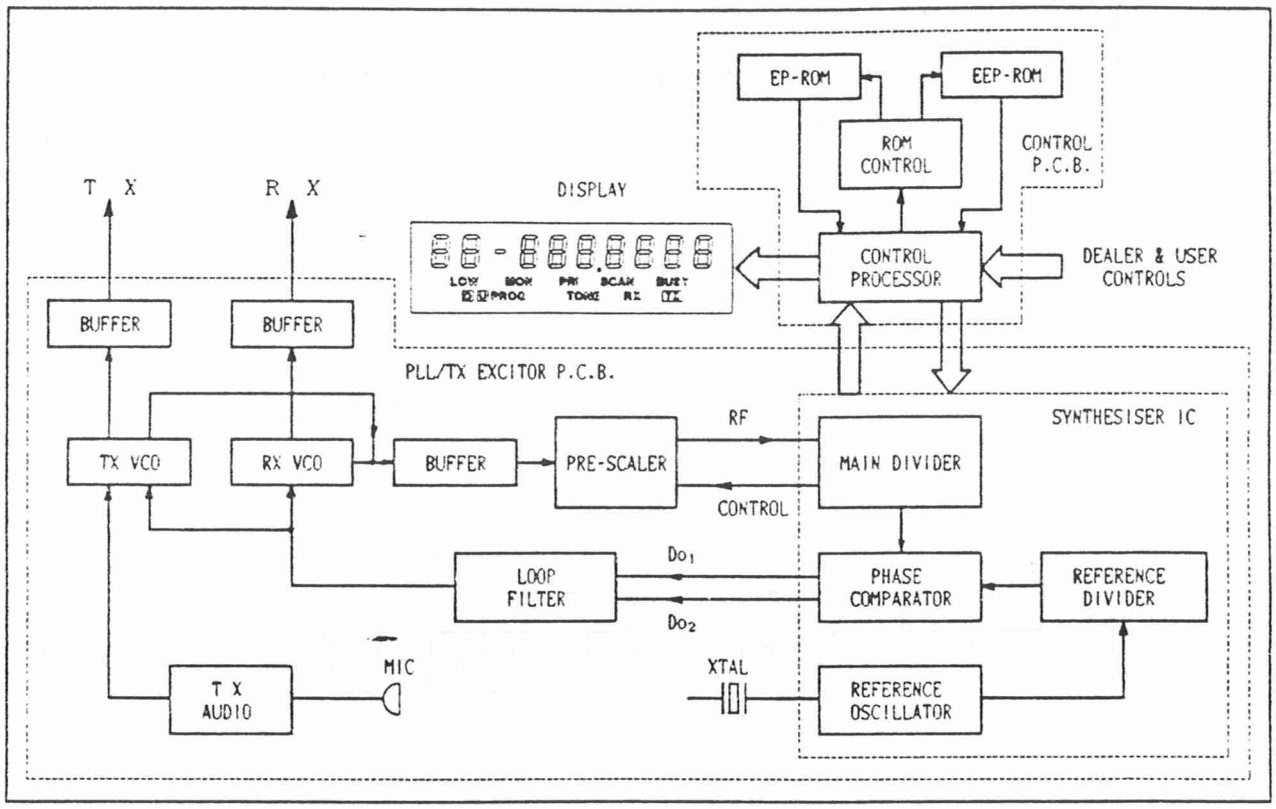


Fig.3.4 Synthesiser Block Diagram

The synthesiser is of a single-loop type with two VCO operatings, one for the transmit channel frequency and the other for receiver local oscillator injection frequency. All the transmit and receive frequencies are controlled by a single high stability crystal-controlled reference oscillator. Modulation is added directly to the VCO when transmitting. All the data required to define the radio channel frequencies is contained in an electrical erasable P-ROM.

REFERENCE FREQUENCY GENERATION

The reference frequency for the phase comparator is divided by feeding the output of a highly stable quartz crystal of 12.5MHz through the reference divider (contained in IC301). The reference crystal operates in a parallel resonance mode. Variable capacitor TC301 is used to trim the reference frequency, and hence the transmit and receive frequencies to the required values.

The Control Processor controls the division ratio of the reference divider in accordance with data stored in the EEP-ROM IC202. The reference divider ratio is determined by a group of 12 bit binary code which is supplied as a serial data from the Control Processor and programmable in the range of 5 to

4095. The ratio of 2000 is for 6.25KHz and that of 2500 is for 5KHz. Accordingly, the reference frequency input to the reference comparator (the output from the reference divider) is either 5KHz or 6.25KHz, depending upon which is a sub-multiple of the both the transmit frequency and the receiver injection frequnecy.

PHASE COMPARATOR AND LOOP FILTER

The phase comparator requires two input signals, a 5KHz or 6.25KHz signal from the reference divider and the output from the VCO programmable divider. The programmable divider, together with Pre-scaler IC302, enables the VCO output frequency to be changed in steps equal to the radio channel spacing. The phase comparator compares the phase of these two inputs.

Phase comparator output Do_1 is a high-gain sample-and-hold output which gives good noise performance but is slow to acquire lock. Phase comparator output Do_2 is a low-gain output which is able to acquire lock rapidly but is noisy. Thus, the circuit is arranged so that phase comparator output Do_2 rapidly brings the loop into the linear range of Do_1 and then goes tri-state. In this way the loop is able to acquire lock rapidly whilst maintaining the good noise performance of Do_1.

The loop filter is a convensional low-pass filter using a field-effect-transistor amplifier. The filtered output is applied to the VCOs as control voltage.

OUT OF LOCK/TRANSMIT INHIBIT

An out-of-lock signal('high') is presented at IC301 pin 13 until phase comparator output Do_2 goes tri-state. When IC301 pin 13 goes 'low' (indicating phase comparator charge-over), Q316 and then Q317 are off. The resultant 'high' on Q319 base activates the voltage line for the part of transmitter buffer.

In case IC301 pin 13 is 'high' (PLL is out-of-lock), the resultant 'low' on Q319 base switches off the line.

VCO AND BUFFER

Synthesiser performance is determined mainly by the characteristics of the VCOs, particularly with respect to their noise floor and immunity to microphony induced, for example, by acoustic feedback from the internal speaker. Use of high-Q resonant circuits, careful screening and rigid mechanical construction enable the necessary performance to be achieved.

Two separate VCOs are used, one of which is dedicated to the transmitter and the other to the receiver. Which of the two VCOs is enabled at any given time is controlled by the Control Processor IC201. Each VCO can be programmed independently to cover the frequency band.

Varicap diodes are contained in the VCOs to allow the loop control voltage to electrically-tune the oscillator to frequency. Variable inductors of L302 & L307 provide mechanical tuning of VCO Rx and VCO Tx respectively. Each VCO can be tuned over the complete frequency band of the radio and has two outputs, one for the Pre-scaler via a buffer and the other for the buffers to the transmitter and receiver.

In the transmit mode, the VCO output frequency is at the final transmit frequency. In the receive mode, the VCO output frequency is at the receiver injection frequency (receiver channel frequency - intermediate frequency). The first intermediate frequency (IF) of the radio is 21.6MHz.

The receiver buffer stage provides the RF mixer injection signal and this section has no frequency multiplication stage.

Three stages of amplication are provided within the transmitter buffer to produce around 300mW of modulated RF drive for the Power Aplifier through the Drive stage using a power module (some low power output versions are used a power module as the Power Aplifier). No frequency multiplication is applied to VCO transmitter output, with suitable input and output filtering, to provide a frequency modulated RF source at the final transmit frequency.

FREQUENCY DIVISION

A sample of each VCO output is fed to pin 2 of the Pre-scaler IC302 via Q301 buffer. The Pre-scaler is of the two-modulus type and its division ratio is controlled at pin 7 (Modulus Control input, N at 'high', N+1 at 'low') by the Synthesiser IC301.

The Pre-scaler output is divided down to the same frequency as that of the final reference frequency; the required division ratio equalling the Pre-scaler output frequency divided by the phase comparator reference frequency (5KHz or 6.25KHz).

The Pre-scaler division ratio is made variable to ensure that the channel spacing may be made equal to the reference frequency using the phase-swallowing method of division.

MODULATION

Modulation singals from a microphone is fed to the microphone amplifier of IC306. The amplifier has a frequency dependent feedback which makes it possible to obtain the wanted pre-emphasis characteristics of 6dB per octave from 300 to 3000Hz. The microphone sensitivity is adjustable with the semi-fixed resistor of VR301.

An encoded CTCSS tone from IC208 on the Control Board is fed to IC306 of the microphone amplifier through the tone deviation adjustment semi-fixed resistor of VR302.

For other singallings, such as, 2 or 5 tone selective calling system, the encoded tone from its board is also fed to IC306 of the microphone amplifier through the connector of CN303 pin 4 on the PLL/EXCITOR board.

The pre-emphasised signal from IC306 is fed to the low-pass filter of IC307 which gives a sharp cut-off for audio frequencies above 3000Hz and then to the TX VCO for modulation through the deviation adjustment semi-fixed resistor of VR303.

CONTROL PROCESSOR

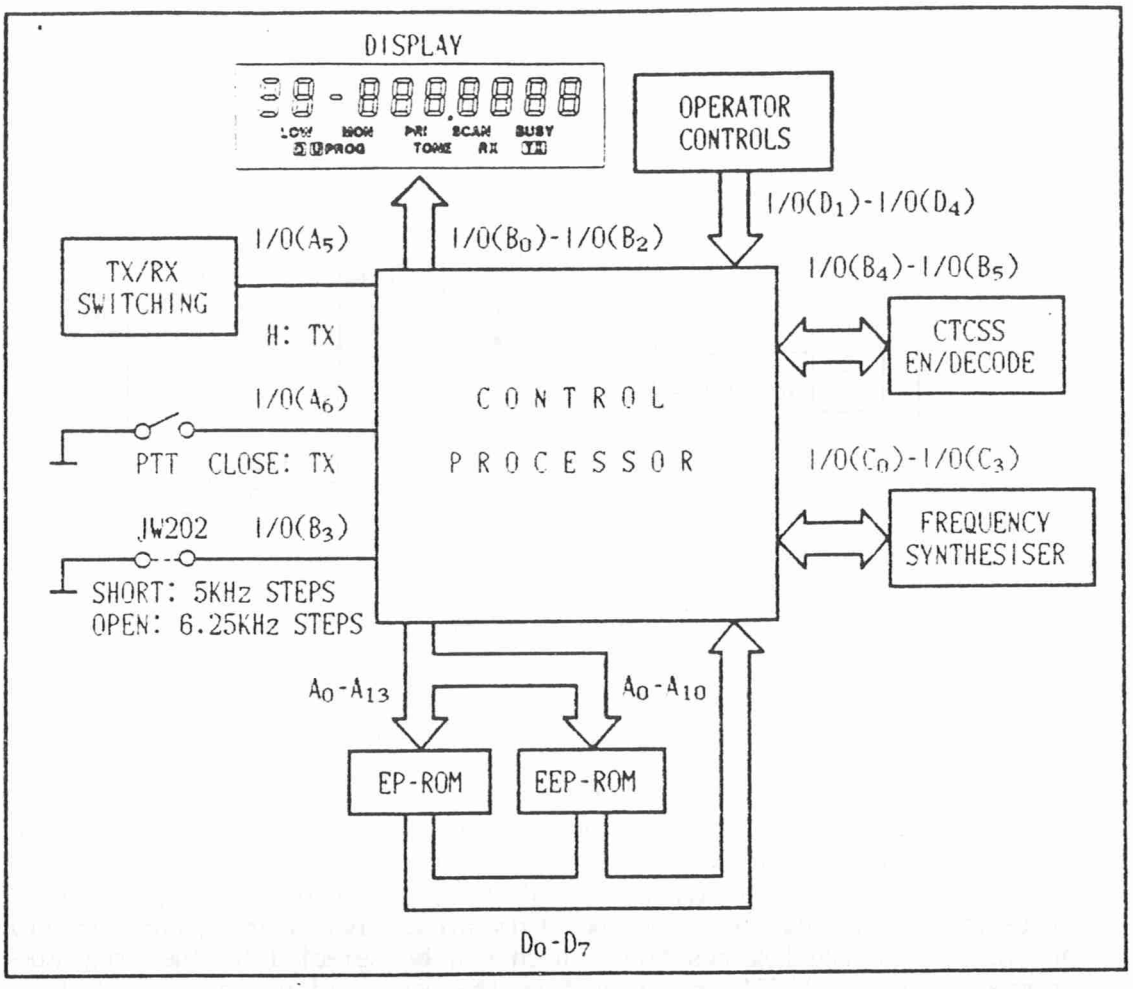


Fig.3.5 Control Processor Block Diagram

The Control Processor IC201 provides the interface between operation controls, liquid crystal display and singallings.

When changing channel, or moving from transmit to receive (or viceversa), the Control Processor receives a prompt signal from the Synthesiser and uses it to scan the EEP-ROM via address lines of A_0-A_{10}.

The interface to the Synthesiser comprises a Strobe, Data, Clock and LD lines plus a ground reference line. The reference ground, two Data and Clock lines are connected to the AUX socket CN005 allowing the radio to be controlled externally by a micro-computer and also allowing the frequency information to transfer other radio of the same model (Cloning).

PROGRAMMABLE READ-ONLY MEMORIES

Two kinds of memories are used in the radio to control; one of which is Erasable Programmable Read-Only Memory (EP-ROM) and the other is Electrically Erasable Read-Only Memory (EEP-ROM).

The main programme is contained in EP-ROM and the size of capacity is 64K which provides all necessary functions to be worked the radio. The data required to difine all the transmit and receive frequencies, and all information for the User Programmable items are contained in EEP-ROM which has 28K capacity.

TRANSMITTER

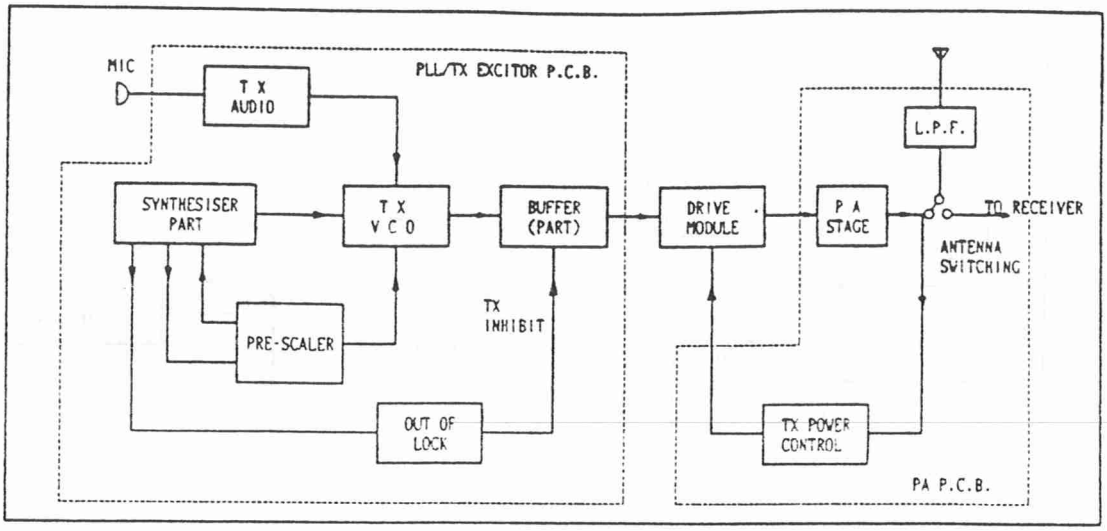


Fig.3.6 Transmitter Block Diagram

Audio is applied to the transmitter as detailed under "Modulation" in the "Frequency Synthesiser" section of this description.

In the transmit mode, the synthesiser circuits are programmed to produce an RF signal from the TX VCO. The VCO output is amplified by 3 stage buffer of Q313, Q314 & Q315 before application to the Drive module (Low Power versions are used as PA module). The transmitter PA stage amplifies the signal and provides filtering against carrier frequency harmonics. Two output power positions are provided; High and Low positions which can be selected by the programme. The trimmer capacitor VR501 is for setting the power output level at High position and VR502 is for Low power setting. This power control circuit is so-called Automatic Power Control (APC) and controls the voltage to the 1st stage of the Drive module (PA module for Low Power versions). The voltage to control the APC is picked up from the RF power output which is changed to DC voltage by the rectifier circuit.

Transmitter Power Amplifier RF output is fed to the Antenna Switching circuit where the signal is directed by diode switches to the antenna connector. Between the diode switches and the antenna connector, there are 4 stage (3 stage for Low power versions) low pass filters to further reduce harmonic radiation.

A Time-Out-Timer which disables the transmitter is provided. The time period can be programmed up to 300 seconds in 30 second steps in the Dealer programming mode.

RECEIVER

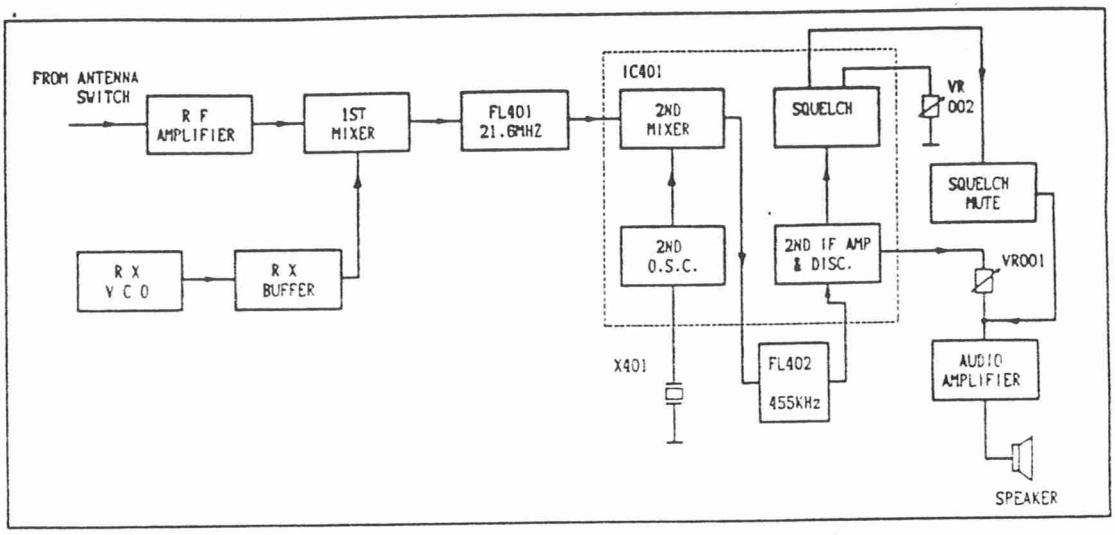


Fig.3.7 Receiver Block Diagram

In the receive mode, the synthesiser circuits are programmed to produce an output from the receiver VCO Buffer at the following injection frequency:

$$fo = fc - 21.6MHz$$

where fc = carrier frequency, in MHz, of the selected channel.

The injection signal is applied to 1st Mixer Q402 through the Buffer Q403 and 2 stage band pass filter L408 & L407 which are tuned to the frequency by varicap diodes controlled by the voltage from the Loop Filter of PLL circuit.

Received signals are fed to the Antenna Switching circuit which routes the signals to the RF Amplifier & 1st Mixer.

The RF Amp & 1st Mixer amplify the signal and provides a high degree of selectivity against unwanted signals. The 1st Mixer combines the RF signal and the oscillator output from the Buffer to provide a 21.6MHz 1st IF. The 1st IF signal is fed via suitable matching to a 6 pole Crystal Filter of FL401, which has a very sharp band-pass characteristic against adjacent channel interference.

The output from FL401 is further amplified by 1st IF Amplifier Q405 and then fed to pin 16 of IF Amplifier IC IC401. The IC401 has every function after the 1st IF stage except an audio output amplifier. The 21.6MHz signal from Q405 is fed to this IC and mixed with the 2nd oscillator of 21.145MHz in order to produce the 2nd IF of 455KHz. The 455KHz signal from pin 3 is fed to a Ceramic Filter of FL402 and then to pin 5 of the limiting amplifier input. The limiting amplifier is connected to the detector. The detector is consisted of L410 and changes FM signal to audio signal and then this audio signal appears at pin 9. The signal from pin 9 is partly filtered by L412 & C455 in order to produce noise component of off-voice frequency and then fed to pin 10 of the active filter input. A noise component from pin 11 is amplified by Q406 and then changed to DC level by the rectifier circuit of D415 & D416. This DC voltage is fed with the trigger circuit in this IC and then to a switching transistor of Q404. Pin 8 of IC402 is to "mute" the receiver by Q404 in squelch condition. The degree of squelch action is varied by the variable resistor of VR002 on the front panel.

The audio output from pin 9 of IC401 is partly fed to the audio output amplifier of IC402 through the high-pass-filter of IC403, an active filter and the volume control. The high-pass filter is for CTCSS operation and has a very sharp attenuation for audio frequencies below 300Hz in order not to be interfered in voice frequencies by CTCSS tones. The audio signal from IC403 is fed to the low pass filter consisted of R441 & C464 and gives the wanted de-emphasis of 6dB per octave. The de-emphasised audio signal is then fed with the audio output amplifier of IC402 through the volume control. In the transmit and squelch-ON conditions, Q404 is activated to ground the pin 8 of IC402.

SECTION 4
SERVICING

GENERAL INFORMATION

METAL OXIDE SEMICONDUCTOR DEVICES

The C-MOS integrated circuits used in this radio are metal oxide semiconductor devices. Because they have an extremely high input impedance, they are susceptible to damage when subjected to high transient voltages or static electricalcharges. To eliminate the possibility of damage the following precautions must be taken:

a) Device leads must always be in contact with a conductive material to avoid the build-up of static charges.

b) Soldering iron tips, tools and metal parts of test equipment used during servicing must be grounded.

c) To avoid transient voltage spikes, devices must not be inserted into, nor removed from, circuits, with power applied.

d) Signals must not be applied to integrated circuits in the absence of power supplies to the devices.

e) Use conductive foam on work surfaces.

ROUTINE FREQUENCY ADJUSTMENTS

Although the pre-aged reference oscillator quartz crystal used in this radio is extremely accurate and reliable, it is important to realise that crystal 'age' slightly and require readjustment periodically. Therefore, the REFERENCE OSCILLATOR FREQUENCY ADJUSTMENTS in this section needs to be carried out as a matter of routine at least once a year. The need for this adjustment is not affected by whether or not the radio is in use, it occurs even during careful storage and is greatest whilst the crystal is new.

COMPONENT REMOVAL

Compnents are normally fitted so that the wire-ends protrude through the printed circuit boards by 1mm. Using a solder sucking device, extract the solderto expose the wire protrusion. Cut component free from its wire-end and remove wire with pliers. Should the wire-end be too short to grasp with pliers, it canbe tapped out from the component side with a very fine drift.

SOLDERING

Soldering operations should be kept to a minimum. Ensure that the radio is switched off before soldering. Printed conductor should be kept clean before applying soldering iron. The amount of solder applied and the dwell time of the soldering iron should be kept to the minimum required for practical purposes. Avoid excessive heat by using heat shunts. Always check that the hole in the printed conductor is clean of solder before fitting a component. Wherever possible a low voltage DC soldering iron with an earthed bit should be used.

When soldering wire ends into plated-through holes in the printed board,

ensure that the solder flows through to emerge on the other side of the board. However, care must be taken to ensure that the solder flows, or leads, do not protrude more than 1mm to avoid making contact with adjacent parts leads. Do not use a permanent magnet type soldering iron in the vicinity of coils with ferrite cores.

FAULT FINDING - INTEGRATED CIRCUITS (ICs)

In the event of an apparent failure of an IC, all external associated components should be checked to prove the serviceability or otherwise of the IC before replacing it. It is essential that these checks be carried out as otherwise the original cause of the failure could still be present and destroy the replacement item.

PRINTED CIRCUIT BOARDS (PCBs)

Take particular care not to bend printed circuit boards when removing or replacing them, or when working on them. Bending can cause hairline breaks in the printed conductors and such breaks are difficult to locate. Do not connect test leads to a printed conductor.

TEST EQUIPMENT REQUIRED

ITEM	PARAMETERS
1. Stabilised Power Supply	0 - 20V Limited at 15A
2. RF Signal Generator	up to 200MHz, ±5KHz deviation capability
3. Audio Signal Generator	50 - 10000Hz, o/p imp. 600 ohms
4. Distortion Meter	True RMS-reading
5. Frequency Counter	up to 500MHz
6. Deviation Meter	up to 200MHz, ±5KHz deviation scale
7. RF Power Meter	1W & 100W, 50 ohms
8. Spectrum Analyser	up to 1.5GHz, 100dB Dynamic Range
9. Oscilloscope	up to 50MHz
10. AF Millivoltmeter	General Purpose
11. Digital Multimeter	High impedance (10 Mohms)
12. T Coupler	RF Signal Sampler with a -40dB output
13. High Pass Filter	Fc=200MHz for checking Harmonics
14. AF Dummy Load	8 ohm, 5W resistor
15. Trimming Tool	

NOTE: The above 2 - 7 may be replaced to a Radiotelephone Service Monitor from various manufacturers, such as model SMFP2 by ROHDE & SCHWARZ.

ALIGNMENT

- The Alignment Procedure described here is for M8-1540 of 148 -173.995MHz.

Preliminaries

1. Before adjustments are performed, the following functions should be programmed into the memory (EEP-ROM).

C H	TX/RX Frequency	TX Power Position	TX/RX CTCSS TONE
CH-01	149.9000MHz	High (Hi)	-
CH-02	149.9000MHz	Low (Lo)	-
CH-03	162.1000MHz	High (Hi)	-
CH-04	162.1000MHz	Low (Lo)	-
CH-05	173.9950MHz	High (Hi)	-
CH-06	173.9950MHz	Low (Lo)	-
CH-07	162.1000MHz	High (Hi)	123Hz

2. Transmitter Alignment MUST ALWAYS be completed before commencing Receiver Alignment.

Transmitter

CPU CLOCK FREQUENCY ADJUSTMENTS

1. Power ON the radio.
2. Set the channel to one of channels programmed.
3. Connect a Frequency Counter to pin 6 of IC201 on the Control PCB as shown in FIG.4.1.
4. Adjust TC201 to give a frequency of 4MHz±50Hz on the Counter.

VCO ADJUSTMENTS

1. Power ON the radio.
2. Set the channel to CH5 (the channel with the highest transmit frequency in the VCO).
3. Connect a Digital Multimeter (DC range) to TP301 on the PLL/Exciter PCB as shown in FIG.4.1.
4. Set the PTT (TRANSMIT) switch to ON.
5. Adjust L307 to give a DC voltage of the under-mentioned value on the Multimeter.

   ..... 7.0±0.05V
6. Then, change the channel to CH1 and check that voltage at TP301 should read :

   ... 1.3±0.3V

REFERENCE OSCILLATOR FREQUENCY ADJUSTMENTS

1. Power ON the radio.
2. Set the channel to CH5.
3. Connect a Frequency Counter to CN305 on the PLL/Exciter PCB through T-Counter as shown in FIG.4.1.
4. Set the PTT switch to ON.
5. Adjust TC301 to give a frequency of 173.9950MHz±100Hz on the Counter.

DRIVE STAGE OUTPUT POWER CHECK

1. Power ON the radio.
2. Connect a Power Meter (full scale 1W) to CN305 on the PLL/Exciter PCB as shown in FIG.4.1.
3. Set the PTT switch to ON.
4. Check that the output power is between 250 - 400mW on CH1, CH3 & CH5 on the Power Meter.

MAXIMUM FREQUENCY DEVIATION ADJUSTMENTS

1. Power ON the radio.
2. Set the channel to CH5.
3. Connect a Deviation Meter to CN305 on the PLL/Exciter PCB through T-Counter as shown in FIG.4.1.
4. Apply 1KHz audio frequency of 30mV RMS to pin 1 of the 8 pin microphone connector, CN001.
5. Set the PTT switch to ON.
6. Adjust VR303 to give a deviation of under-mentioned value on the Meter.
   a) For 25 and 30KHz channel spacings .... ±4.3KHz±100Hz
   b) For 20KHz channel spacing ..... ±3.3KHz±100Hz
   c) For 12.5kHz channel spacing ..... ±1.8KHz±100Hz

7. Then, decrease the audio input to the microphone connector down to 3mV RMS and adjust VR301 to give a deviation of under-mentioned value.
   a) For 25 and 30KHz channel spacings .... ±3.0KHz±100Hz
   b) For 20kHz channel spacing ..... ±2.4KHz±100Hz
   c) For 12.5KHz channel spacing ..... ±1.5kHz±100Hz
8. In case the radio is equipped with CTCSS, change the channel to CH7 and adjust VR302 to give a deviation (audio + CTCSS tone) of under-mentioned value (CTCSS tone deviation: below ±700Hz).
   a) For 25 and 30KHz channel spacings .... ±5.0KHz-100Hz/+0Hz
   b) For 20KHz channel spacing ..... ±4.0KHz-100Hz/+0Hz
   c) For 12.5KHz channel spacing ..... ±2.5kHz-100Hz/+0Hz

PA STAGE ADJUSTMENTS

25W OUTPUT VERSION (using M57741 module as PA)

NOTE: For radios of using the above PA module, the frequency separation which is originally 24MHz probably becomes narrow and the adjustment frequencies might be changed.

1. Power ON the radio.
2. Set the channel to CH5.
3. Connect a Spectrum Analyser and a Power Meter (full scale 50W) to the antenna connector as shown in FIG.4.2.
4. Set the PTT switch to ON and check that the output is more than 30W.
5. Check that the output is also more than 30W on CH1 & CH3.

6. Change the channel to CH3 and adjust VR501 to give an output of 25W.
7. Check that the output is not more than 25W on CH1 & CH5. In case the output is over 25W on a channel, once again adjust VR501 to give the output of 25W on the channel.
8. If a low output is required, change the channel to CH4 and adjust VR502 to give a desired output. In case the radio is set to 25W at the high output position, the obtainable minimum output is around 3W with VR502.
9. Check that the output is not more than the desired output on CH2 & CH6. In case the output is over the desired value, do the same manner as described in 7 above with VR502.
10. Check that conducted spurious and harmonics are better than 0.25μW on both high and low output channels.

VCO ADJUSTMENTS

1. Power ON the radio.
2. Set the channel to CH5.
3. Connect a Digital Multimeter (DC range) to TP301 on the PLL/Excitor PCB as shown in FIG.4.1.
4. Adjust L302 to give a DC voltage of the under-mentioned value.

.... 7.0±0.05V

5. Change the channel to CH1 and check that the voltage at TP301 should read :

..... 1.0 +0.5/-0.3V

FRONT END ADJUSTMENTS

1. Power ON the radio.
2. Set the channel to CH1.
3. Connect a Signal Generator (no modulation) of -47dBm output to the antenna connector and an oscilloscope of 50MHz bandwidth to TP402 on the receiver PCB as shown in FIG.4.3.

4. Adjust L401, L402, L403, L404 & L405 to give a voltage of maximum value on the Oscilloscope.

1ST LOCAL ADJUSTMENTS

1. Power ON the radio.
2. Set the channel to CH1.
3. Connect an Oscilloscope to TP402 on the receiver PCB as shown in FIG.4.3
4. Adjust L407 & L408 to give a voltage of maximum value.

1ST IF ADJUSTMENTS

1. Power ON the radio.
2. Set the channel to CH1.
3. Connect a Signal Generator (1KHz modulation & 60% deviation) of -47dBm output to the antenna connector and an Oscilloscope to TP403 as shown in FIG.4.3.
4. Adjust L406 & L413 to give a voltage of maximum value with best wave form on the Oscilloscope.

DISCRIMINATOR ADJUSTMENTS

1. Power ON the radio.
2. Set the channel to CH1.
3. Connect an Audio Millivoltmeter & Oscilloscope across an 8 ohm dummy load and also a Signal Generator (1KHz modulation & 60% deviation) of -47dBm output to the antenna connector as shown in FIG.4.3.
4. Adjust L410 to give a voltage of maximum value on the millivoltmeter and minimum distortion on the Oscilloscope.

AUDIO OUTPUT POWER AND SENSITIVITY CHECKS

1. Power ON the radio.
2. Set the channel to CH1.
3. Connect an Audio Millivoltmeter & Oscilloscope across an 8 ohm dummy load and also a Signal Generator (1KHz modulation & 60% deviation) of -47dBm output to the antenna connector as shown in FIG.4.3.
4. Check that the audio level should read more than 4V RMS at maximum volume and more than 3.4V RMS at no distortion.
5. Then, decrease the output of the Signal Generator and check that the sensitivity should be better than 0.25μV at 12dB SINAD.
   This check should also be done on CH3 & CH5 and confirm that the sensitivity should be better than 0.25μV at 12dB SINAD.

NOTE: 60% deviation means:
a) For 25 and 30KHz channel spacings ..... ±3.0KHz deviation
b) For 20kHz channel spacing ..... ±2.4KHz deviation
c) For 12.5KHz channel spacing ..... ±1.5KHz deviation

O t h e r

BEEP TONE ADJUSTMENTS

1. Power ON the radio.
2. Adjust VR401 on the receiver PCB to give a reasonable audio level when depressing one of keys on the front panel.

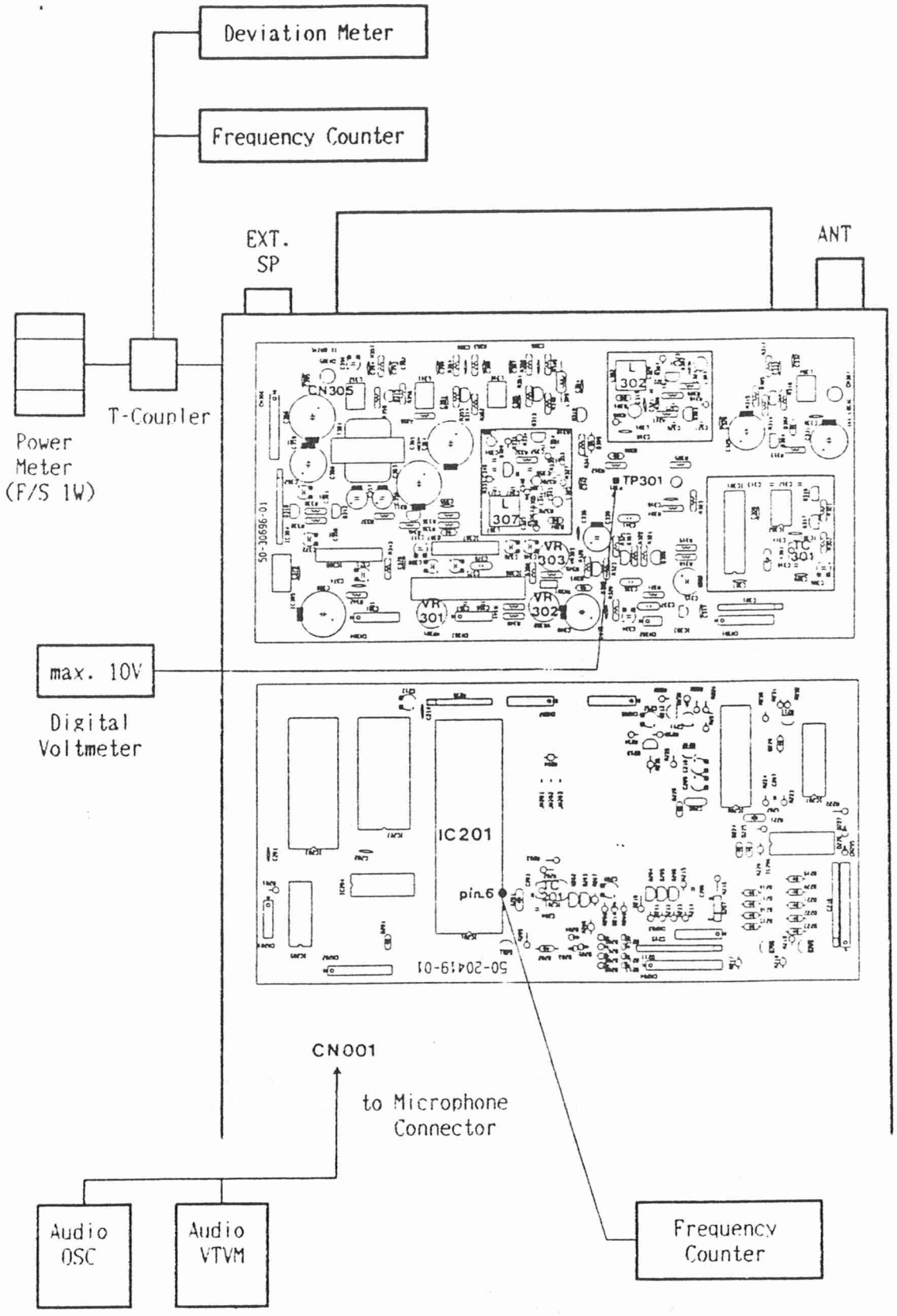

Deviation Meter
Frequency Counter
EXT.
SP
ANT
T-Coupler
Power
Meter
(F/S 1W)
CN305
TP301
VR
303
VR
301
VR
302
max. 10V
Digital
Voltmeter
IC201
pin6
CN001
to Microphone
Connector
Audio
OSC
Audio
VTVM
Frequency
Counter

Fig. 4. 1

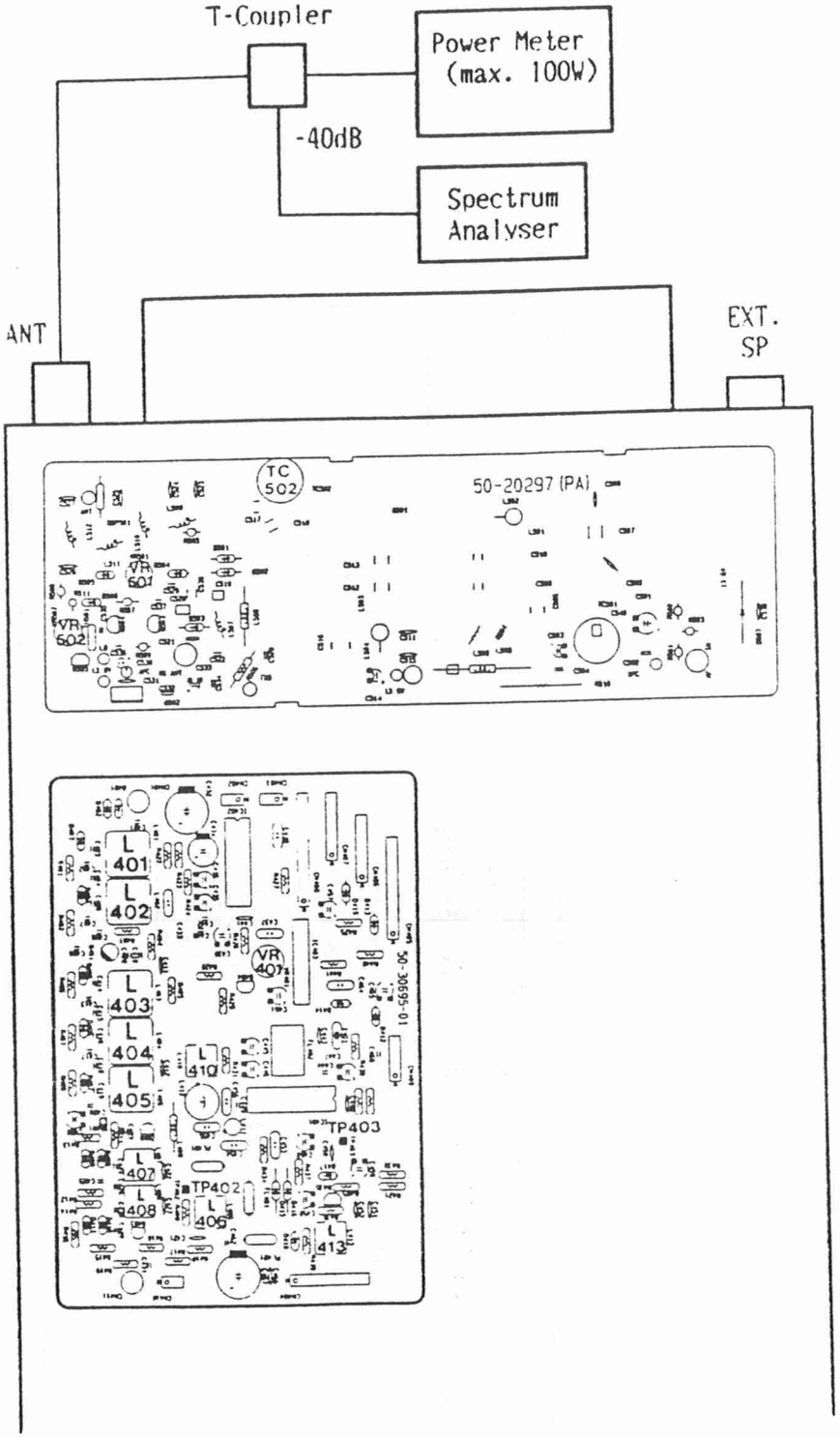

T-Coupler
Power Meter
(max. 100W)
-40dB
Spectrum
Analyser
ANT
EXT.
SP
TC
502
50-20297 (PA)
VR
602
L
401
L
402
VR
407
L
403
L
404
L
405
L
410
TP403
L
407
TP402
L
408
L
406
L
413
30-30695-10

Fig. 4. 2

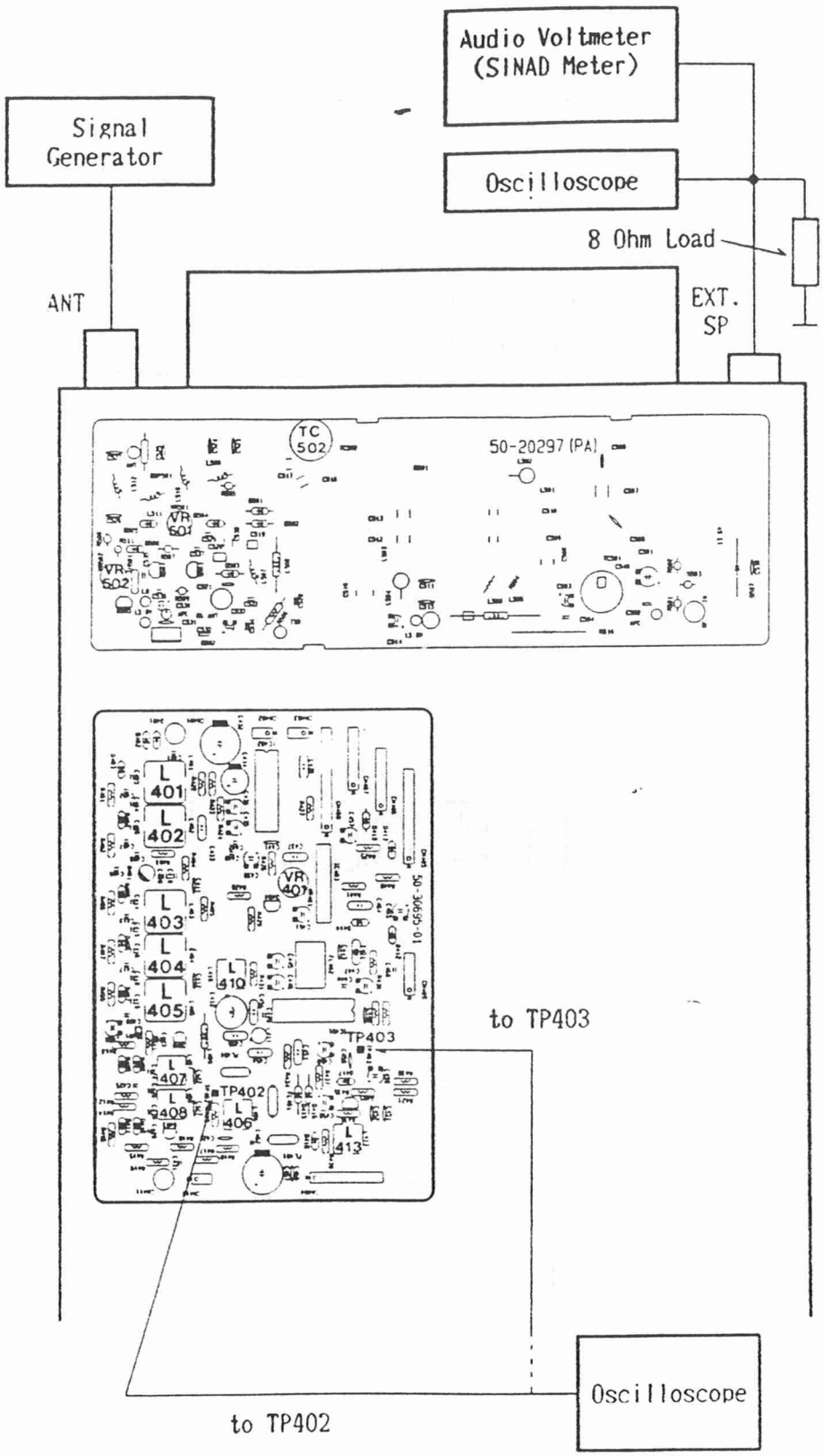

Audio Voltmeter
(SINAD Meter)
Signal
Generator
Oscilloscope
8 Ohm Load
ANT
EXT.
SP
TC
502
50-20297 (PA)
VR
501
VR
502
L
401
L
402
VR
407
L
403
L
404
L
405
L
410
TP403
L
407
TP402
L
408
L
406
L
413
to TP403
Oscilloscope
to TP402

Fig. 4. 3

CIRCUIT BOARD : 050-30695-01

ITEM : RX P.C.B. SCHEMATIC DIAGRAM :

DESCRIPTION	PART NUMBER	Q'TY	SYMBOL NUMBER
IC			
MC3361P	078-00369-01	1	IC401
TDA1905	078-00370-01	1	IC402
HIGH PASS FILTER	050-410-02	1	IC403
FET			
2SK121 GR	078-90026-01	1	Q401
2SK125	078-90018-01	1	Q402
TRANSISTOR			
2SC2026	078-32026-01	1	Q403
2SC2669 Y	078-32669-26	1	Q405
2SD1468 SS	078-41468-32	1	Q404
DIODE			
1SS133	078-50254-01	6	D401,D402,D412,D413, D417,D418
1S188	078-50010-01	2	D415,D416
HZ6C1L	078-50168-01	1	D414
1S2339	078-50059-01	5	D403,D404,D405,D406, D407
1SV50	078-50058-01	4	D408,D409,D410,D411
VARIABLE RESISTOR			
10K ohm B	050-40877-02	1	VR401
RF TRANSFORMER			
	050-40877-02	1	L401
	050-40877-03	1	L402
	050-40877-04	3	L402,L403,L404
	050-42379-01	1	L406
	050-42379-02	1	L407
IF TRANSFORMER			
	050-42380-01	1	L408
	050-42380-02	1	L413
	050-40882-01	1	L410
CRYSTAL FILTER			
21.6MHz	050-42381-01	1	FL401
CERAMIC FILTER			
KBF 455 15A	050-41205-01	1	FL402
MICROINDUCTOR			
680uH	050-40714-16	1	L411
3.3uH	050-40714-12	1	L412
10uH	050-41365-21	1	L409
CRYSTAL			
21.145MHz	050-42382-01	1	X401

CIRCUIT BOARD : 050-30695-01

ITEM : RX P.C.B. SCHEMATIC DIAGRAM :

DESCRIPTION	PART NUMBER	Q'TY	SYMBOL NUMBER
RESISTOR			
2.2 ohm RD16S	076-32202-12	1	R422
33 ohm	076-33301-12	1	R424
47 ohm	076-34701-12	1	R419
100 ohm	076-31010-12	5	R405,R410,R420,R421, R440
470 ohm	076-34710-12	2	R411,R417
1K ohm	076-31020-12	1	R416
1.5K ohm	076-31520-12	2	R404,R437
2.2K ohm	076-32220-12	2	R409,R435
4.7K ohm	076-34720-12	5	R426,R427,R429,R432, R441
8.2K ohm	076-38220-12	1	R438
10K ohm	076-31030-12	3	R403,R423,R425
22K ohm	076-32230-12	2	R418,R428
47K ohm	076-34730-12	11	R401,R402,R406,R407, R408,R412,R413,R414, R415,R430,R431
220K ohm	076-32240-12	2	R434,R436
DISC CAPACITOR			
0.5pF SL 50V		3	C415,C418,C419
1pF CK 50V	075-10031-13	3	C404,C405,C426
2pF CK 50V	075-20031-13	2	C416,C424
3pF CJ 50V	075-30031-13	1	C414
4pF CH 50V	075-40031-13	1	C403
12pF CH 50V	075-12131-13	2	C462,C463
22pF CH 50V	075-22131-13	5	C402,C413,C417,C420, C429
27pF CH 50V	075-27131-13	2	C407,C408
33pF CH 50V	075-33131-13	2	C425,C444
68pF CH 50V	075-68131-13	1	C443
0.001uF ZF 50V	075-10331-03	7	C401,C406,C409,C423, C431,C440,C442
0.01uF ZF 50V	075-10431-03	11	C410,C411,C412,C421, C422,C427,C441,C450, C451,C452,C466
0.047uF 25V	072-10445-56	1	C448
220pF YB 50V	072-22231-95	1	C410
ELECTROLYTIC CAPACITOR			
1uF 50V SRA	074-10647-61	3	C428,C458,C460
2.2uF 50V SRA	074-22647-61	2	C436,C439
10uF 16V SRA	074-10744-61	5	C435,C447,C457,C459, C465
47uF 16V SM	074-47744-61	1	C434
470uF 16V SM	074-47844-61	2	C432,C467

CIRCUIT BOARD : 050-30695-01

ITEM : RX P.C.B. SCHEMATIC DIAGRAM :

DESCRIPTION	PART NUMBER	Q'TY	SYMBOL NUMBER
MYLAR CAPACITOR			
0.001uF 50V AMZ	072-22331-54	1	C454
0.0015uF 50V AMF	072-15331-54	1	C455
0.0047uF 50V AMF	072-47331-54	1	C456
0.022uF 50V AMF	072-22431-54	1	C437
0.033uF 50V AMF	072-33431-54	1	C453
0.1uF 50V AMF	072-10531-54	1	C438
0.22uF 50V AMF	072-22531-54	2	C433,C464
CONNECTOR			
2P	002-48338-02	3	CN402,CN403,CN410
4P	002-48338-04	1	CN409
5P	002-48338-05	1	CN407
6P	002-48338-06	1	CN406
7P	002-48338-07	1	CN404
9P	002-48338-09	1	CN405
10P	002-48338-10	1	CN408
V TYPE MINI JACK			
	002-48169-01	2	CN401,CN411
TANTALUM CAPACITOR			
0.1uF 50V K	073-10534-21	2	C445,C446
TEST POINT PIN			
	050-41114-01	3	TP401,TP402,TP403

CIRCUIT BOARD : 050-30696-01

ITEM : PLL/TX EXCITOR SCHEMATIC DIAGRAM :

DESCRIPTION	PART NUMBER	Q'TY	SYMBOL NUMBER
IC			
TC9181P	078-00367-01	1	IC301
TD6128P	078-00368-01	1	IC302
NJM78L05A	078-00314-01	1	IC303
MB3756	078-00176-01	1	IC304
UA7805	078-00107-01	1	IC305
LOW PASS FILTER	050-380-01	2	IC309,IC308
LOW PASS FILTER	050-380-02	1	IC307
MIC AMP	050-383-02	1	IC306
TDA114YS	078-00371-01	2	Q319,Q317
TDC114YS	078-00372-01	2	Q318,Q316
FET			
3SK121GR	078-90026-01	1	Q301
2SK184GR	078-90049-01	1	Q306
2SK192BL	078-90050-01	2	Q302,Q307
2SK241GR	078-90051-01	2	Q303,Q310
TRANSISTOR			
2SD1468SS	078-41468-32	1	Q304
2SC2458LG	078-32458-34	1	Q307
2SA1150Y	078-11150-26	1	Q312
2SC2668 O	078-32668-16	3	Q305,Q313,Q314
2SC2053	078-32053-01	1	Q315
DIODE			
1SS133	078-50254-01	3	D302,D307,D308
HZ9C3L	078-50306-01	1	D303
HZ6A2L	078-50221-01	1	D309
1SV50	078-50058-01	2	D301,D304
1S2339	078-50059-01	1	D305
1SV71	078-50219-01	1	D306
CRYSTAL			
12.5MHz	050-42387-01	1	X301
CERAMIC TRIMMER			
20pF	050-41246-05	1	TC301
MICROINDUCTOR			
2.2uH	050-41365-13	5	L301,L303,L305,L306, L308
10uH	050-41365-21	1	L307

CIRCUIT BOARD : 050-30696-01

ITEM : PLL/TX EXCITOR SCHEMATIC DIAGRAM :

DESCRIPTION		PART NUMBER	Q'TY	SYMBOL NUMBER
VARIABLE RESISTOR				
500 ohm B		050-41199-04	1	VR301
5K ohm B		050-41199-08	1	VR303
20K ohm B		050-41199-10	1	VR302
CONDENSER BLOCK				
470pF ZF		050-41068-09	1	C301
CHOKE TRANSFORMER				
		050-40718-01	1	T301
WIDE BAND TRANSFORMER				
		050-42374-01	3	L310,L311,L312
		050-42374-02	1	L304
MYLER CAPACITOR				
0.47uF/50V		072-47521-67	1	
RESISTOR				
2.2 ohm	RD16S	076-32202-12	1	R357
4.7 ohm	RD16S	076-34702-12	1	R359
10 ohm	RD16S	076-31001-12	3	R338,R355,R358
33 ohm	RD16S	076-33301-12	1	R309
33 ohm	RD16U	076-13301-12	1	R333
47 ohm	RD16S	076-34701-12	6	R308,R312,R332,R336, R354,R356
100 ohm	RD16S	076-31010-12	7	R316,R317,R339,R342, R346,R350,R351
150 ohm	RD16S	076-31510-12	1	R322
220 ohm	RD16S	076-32210-12	1	R313
330 ohm	RD16S	076-33310-12	2	R321,R353
470 ohm	RD16S	076-34710-12	4	R303,R311,R326,R337
470 ohm	RD16U	076-14710-12	1	R335
1K ohm	RD16S	076-31020-12	2	R319,R344
1.5K ohm		076-31520-12	1	R349
1.8K ohm		076-31820-12	1	R304
2.2K ohm		076-32220-12	4	R305,R315,R325,R352
4.7K ohm		076-34720-12	4	R314,R323,R347,R348
10K ohm		076-31030-12	3	R301,R302,R343
15K ohm		076-31530-12	1	R318
18K ohm		076-31830-12	1	R324
22K ohm		076-32230-12	5	R320,R330,R340,R341, R345
22K ohm	RD16U	076-12230-12	1	R329
27K ohm	RD16S	076-32730-12	1	R360
100K ohm	RD16U	076-11040-12	2	R310,R334
150K ohm		076-11540-12	2	R307,R331

CIRCUIT BOARD :050-30696-01

ITEM :PLL/TX EXCITOR SCHEMATIC DIAGRAM :

DESCRIPTION	PART NUMBER	Q'TY	SYMBOL NUMBER
DISC CAPACITOR			
5pF CH 50V	075-50031-13	6	C323,C326,C327,C349, C353,C354
8pF CH 50V	075-80031-13	6	C320,C322,C325,C344, C348,C350
27pF CH 50V	075-27131-13	2	C343,C347
33pF CH 50V	075-33131-13	2	C310,C321
47pF CH 50V	075-47131-13	2	C309,C319
0.001uF ZF 50V	075-10331-03	13	C305,C312,C313,C345, C358,C359,C361,C367, C368,C381,C382,C383, C397
0.01uF ZF 50V	075-10431-03	29	C307,C308,C314,C316, C317,C318,C324,C328, C330,C332,C333,C335, C336,C342,C335,C365, C374,C379,C384,C385, C386,C387,C388,C389, C390,C391,C393,C394, C395
0.01uF SR 25V	072-10445-56	2	C351,C352
ELECTROLYTIC CAPACITOR			
1uF 50V	074-10647-61	3	C306,C334,C372,C376
10uF 16V	074-10744-61	9	C346,C356,C357,C362, C369,C373,C375,C377, C378
47uF 16V	074-47744-60	2	C315,C339
220uF 16V	074-22844-60	4	C329,C331,C340,C360
1000uF 16V	074-10944-60	4	C363,C364,C366,C380
MYLAR CAPACITOR			
0.022uF	072-22431-54	2	C338,C370
0.22uF	072-22531-54	1	C341
TANTALUM CAPACITOR			
10uF 16V	073-10734-21	1	
SHIELD CASE	060-41047-01	2	
SHIELD PANEL	060-42386-01	2	
SHILD CASE (A)	060-42384-01	1	
SHIELD PANEL	060-42385-01	1	

CIRCUIT BOARD : 050-30696-01

ITEM : PLL/TX EXCITOR SCHEMATIC DIAGRAM :

DESCRIPTION	PART NUMBER	Q'TY	SYMBOL NUMBER
V TYPE MINI JACK			
	002-48169-01	2	CN305,CN307
CONNECTOR			
EH 2P	002-48338-02	1	CN302
EH 4P	002-48338-04	1	CN303
EH 6P	002-48338-06	2	CN301,CN304
EH 7P	002-48338-07	1	CN306
THERMISTOR			
3.3K ohm	050-42403-02	1	TH301
TEST POINT PIN			
	050-41114-01	1	
RF COIL HV OUT			
	050-42072-01	2	

CIRCUIT BOARD : 050-20419-01

ITEM : CONTROL P.C.B. SCHEMATIC DIAGRAM :

DESCRIPTION	PART NUMBER	Q'TY	SYMBOL NUMBER
I.C.			
HD6305Y2P	078-00366-01	1	IC201
DQ2816A	078-00365-01	1	IC202
uPD27C64D	078-00364-01	1	IC203
TC4011BP	078-00119-01	1	IC204
TC40H423P	078-00362-01	1	IC205
TC4081BP	078-00185-01	1	IC206
TA7320P	078-00363-01	1	IC207
NJM2904D	078-00221-01	1	IC208
TRANSISTOR			
2SC1545	078-31545-72	1	Q206
2SA2458	078-32458-26	12	Q201,202,203,204, Q207,208,209
2SA1048	078-11048-26	1	Q205
DIODE			
1SS133	078-50254-01	24	D201 - D224
HZ4BLL	078-50120-01	1	D225
ELECTROLYTIC CAPACITOR			
2.2uF/50V	074-22647-61	2	C205,C208
10uF/16V	074-10744-61	4	C216,C207,C211,C219
22uF/6.3V	074-22742-61	1	C215
33uF/6.3V	074-33742-61	2	C209,C217
47uF/6.3V	074-47742-61	2	C210,C241
RESISTOR			
47 ohm RD16U	076-14701-12	1	R220
100 ohm RD16U	076-11010-12	1	R229
220 ohm RD16S	076-32210-12	1	R231
330 ohm RD16S	076-33310-12	1	R241
1K ohm RD16U	076-11020-12	2	R226,R230
3.9K ohm RD16U	076-13920-12	1	R228
10K ohm RD16U	076-11030-12	4	R208,R209,R210,R225
15K ohm RD16U	076-11530-12	1	R214
20K ohm RD16U	076-12030-12	4	R204,R205,R206,R207
20K ohm RD16S	076-32032-12	1	R211
22K ohm RD16U	076-12230-12	5	R202,R203,R215,R218, R219
24K ohm RD16U	076-12430-12	1	R246
33K ohm RD16S	076-33330-12	1	R245
47K ohm RD16U	076-14730-12	6	R201,R216,R217,R221, R243,R244
47K ohm RD16S	076-34730-12	6	R239,R242 others
100K ohm RD16S	076-31040-12	7	R212,R222,R223,R224, R233,R234
220K ohm RD16U	076-12240-12	1	R213
330K ohm RD16U	076-13340-12	1	R227
47oK ohm RD16U	076-14740-12	1	R240
1K ohm RN16S	076-91020-17	1	R238
1.2K ohm RN16S	076-91220-17	1	R236
22K ohm RN16S	076-91220-17	1	R232
150K ohm RN16S	076-91540-17	1	R235

CIRCUIT BOARD :050-20419-01

ITEM : CONTROL P.C.B. SCHEMATIC DIAGRAM :

DESCRIPTION	PART NUMBER	Q'TY	SYMBOL NUMBER
MYLER CAPACITOR			
0.47uF/50V	072-47321-67	2	C212,C213
CAPACITOR			
0.01uF/50V	075-10451-03	3	C201,C218,C202
0.001uF/50V	075-10351-03	1	C206
10pF/50V	075-10131-13	1	C203
18pF/50V	075-18131-13	1	C204
CONDENSER BLOCK			
0.001uF*8	050-41068-07	2	C221,C220
CERAMIC TRIMMER			
10pF	050-41246-04	1	TC201
RESISTOR BLOCK			
EXB-F7E 223J	050-41991-06	1	R247
VARIABLE RESISTOR			
200 ohm B	050-41199-02	1	VR202
10K ohm B	050-41199-09	1	VR201
CRYSTAL			
4MHz	050-42363-01	1	X201
IC SOCKET			
DICF-28C-E	050-42392-01	1	
CONNECTOR			
4P	002-48338-04	1	CN201
5P	002-48338-05	2	CN203,CN207
6P	002-48338-06	1	CN206
7P	002-48338-07	1	CN202
8P	002-48338-08	1	CN204
9P	002-48338-09	1	CN205

CIRCUIT BOARD : 50-30687-01

ITEM : DISPLAY P.C.B. SCHEMATIC DIAGRAM :

DESCRIPTION	PART NUMBER	Q'TY	SYMBOL NUMBER
I.C.			
uPD7225G	078-00215-01	1	IC101
TRANSISTOR			
2SC1545	078-31545-72	1	Q101
DIODE			
1SS133	078-50254-01	1	D101
ELECTROLYTIC CAPACITOR			
1uF/50V	074-10647-61	1	C101
SWITCH			
tact switch	050-41911-01	6	SW101,102,103,104,105 SW106
LAMP			
12V/50mA	050-40853-01	4	LMP101,102,103,104
RESISTOR			
2.7K ohm RD16S	076-31540-12	2	R107,R108
10K ohm "	076-31030-12	2	R101,R102
22K ohm "	076-32230-12	3	R103,R104,R105
150K ohm "	076-31540-12	1	R106
CONNECTOR			
7P-7P	002-30439-01	1	CN101
8P-8P	002-30440-01	1	CN102

CIRCUIT BOARD :050-20297-01

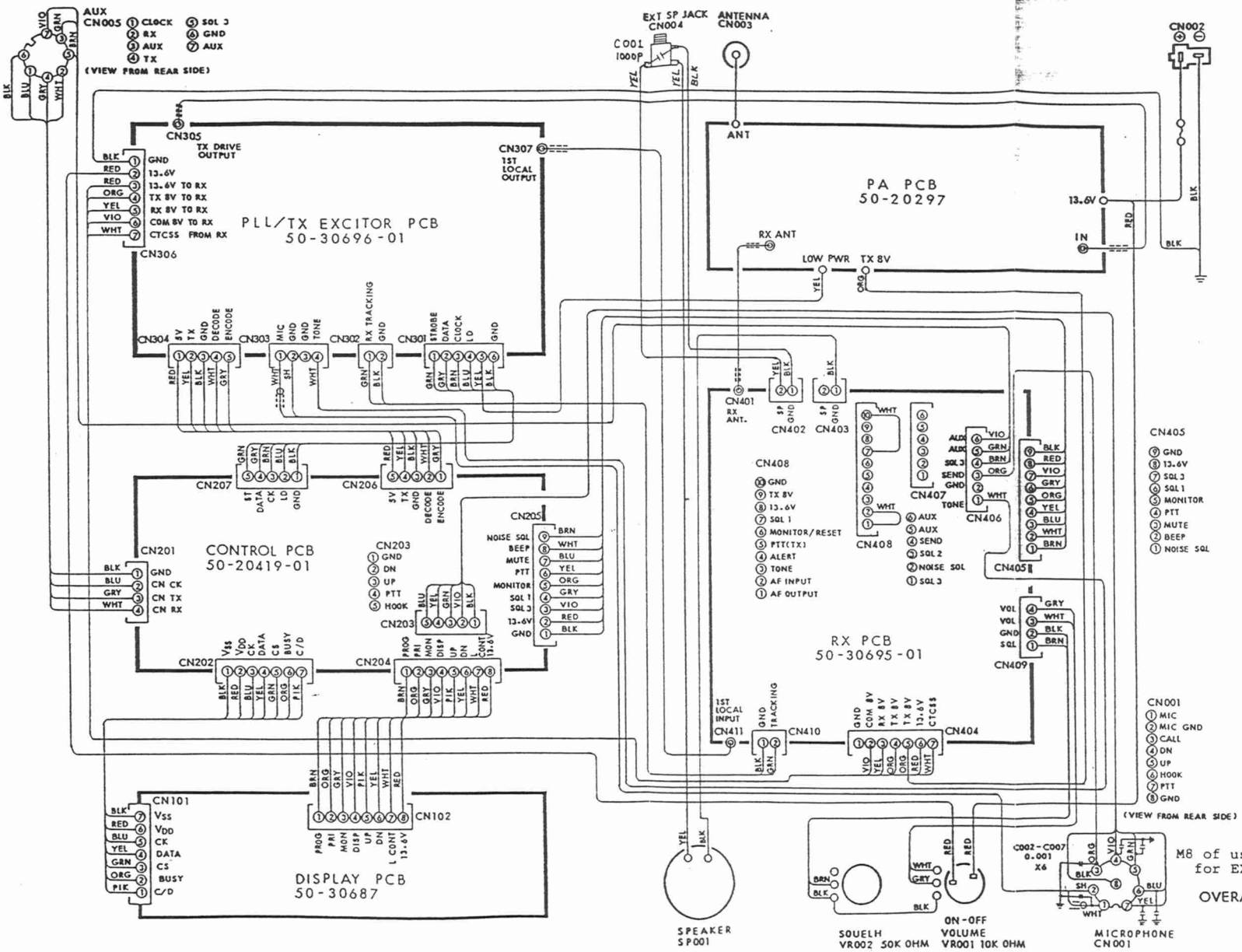
ITEM :PA P.C.B. SCHEMATIC DIAGRAM :

DESCRIPTION	PART NUMBER	Q'TY	SYMBOL NUMBER
TRANSISTER			
2SC2694	078-32694-01	1	Q501
2SC2458 Y	078-32458-26	2	Q503,Q504
2SB1015 Y	078-21015-26	1	Q502
DEGITAL TRANSISTOR			
DTC114TS	078-00322-01	1	Q505
DIODE			
MI407	078-50253-01	3	D501,D502,D503
1SS106	078-50169-01	1	D504
1SS133	078-50254-01	2	D505,D506
GP30A	078-50143-01	1	D507
DSP			
DSP-301N	050-42356-01	1	DSP501
COIL			
2.5T	050-41932-01	4	L509,L510,L512,L513
°5 2.5T	050-41292-03	2	L503,L507
°5 4.5T	050-41292-05	1	L501
MICROINDUCTOR			
	050-41933-01	2	L506,L508
FERRITE BEAD CORE			
BP53-BH30-10-040A	050-41812-01	1	L502
BL02 RN1-R62	050-42357-01	2	L504,L506
VARIABLE RESISTOR			
500 ohm B	050-41199-04	1	VR502
10K ohm B	050-41199-09	1	VR501
TRIMMER CAPACITOR			
40pF	050-41935-01	1	TC502
RESISTOR			
10 ohm 3W	050-42367-01	1	R504
390 ohm 3W	050-42367-39	1	R510
2.7 ohm RD16S	076-32702-12	2	R501,R502
47 ohm RD16S	076-34701-12	1	R505
430 ohm RD16S	076-34310-12	1	R503
62 ohm RN16S	076-96201-18	1	R511
220 ohm RN16S	076-92210-18	1	R509
470 ohm RN16S	076-94710-18	1	R508
1.8K ohm RN16S	076-91820-18	1	R507
120 ohm RD50S	076-31210-42	1	R506

CIRCUIT BOARD :050-20297-01

ITEM : PA P.C.B. SCHEMATIC DIAGRAM :

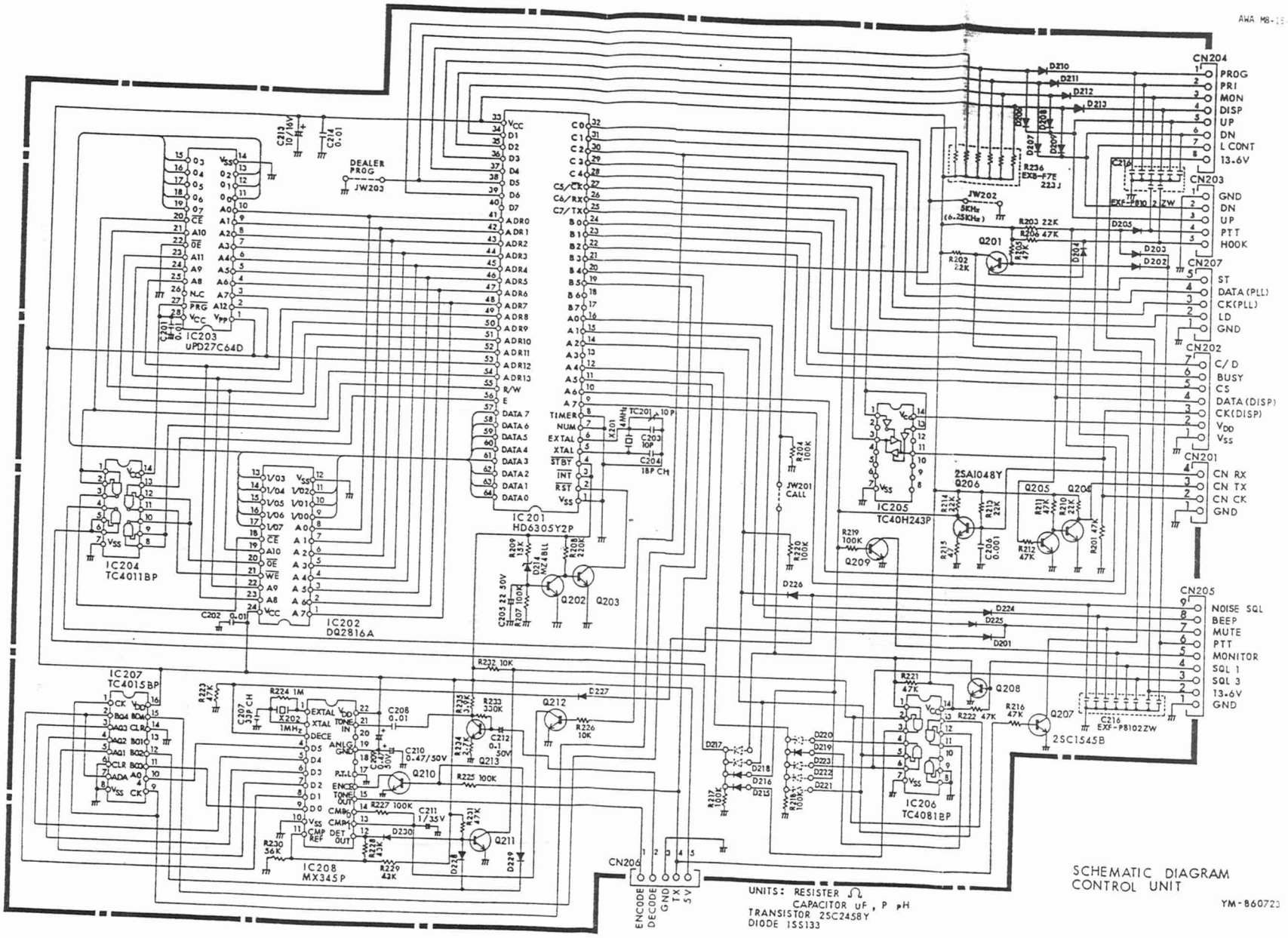
DESCRIPTION	PART NUMBER	Q'TY	SYMBOL NUMBER
DISC CAPACITOR			
12pF 50V CH	075-12131-13	1	C521
18pF 50V CH	075-18131-13	1	C505
22pF 50V CH	075-22131-13	1	C506
100pF 50V YB	075-10231-95	1	C532
0.001uF 50V ZF	075-10351-03	9	C522,C528,C529,C534, C535,C536,C537,C502, C503
0.0047uF 50V YB	075-47351-95	2	C511,C515
0.01uF 50V ZF	075-10451-03	1	C538
0.01uF 25V SR	072-10435-72	1	C531
15pF 500V CH	075-15133-13	1	C527
18pF 500V CH	075-18133-13	1	C523
22pF 500V CH	075-22133-13	1	C526
33pF 500V CH	075-33133-13	1	C524
CAPACITOR			
6pF 50V CH	175-60932-02	1	C540
27pF 50V CH	175-27032-02	1	C539
33pF 50V CH	175-33032-02	1	C507
150pF 50V PH	175-15132-02	1	C508
330pF 50V PH	175-33132-02	2	C509,C510
33pF 100V J	172-33023-01	1	C518
120pF 100V J	172-12123-02	1	C516
220pF 100V J	172-22123-02	3	C512,C513,C519
12pF 500V J	172-12025-02	1	C520
39pF 500V J	172-39025-02	1	C525
ELECTROLYTIC CAPACITOR			
10uF 25V	074-10744-61	2	C503,C533
47uF 25V	074-47744-61	1	C514
470uF 16V	074-47844-61	1	C501
TANTALUM CAPACITOR			
10uF 16V	073-10734-52	1	C530
COAXIAL PIN PLUG ASS'Y	002-48172-07	1	
COAXIAL CABLE	002-48172-04	1	
ISOLATION TUBE			
8 mm	060-40328-06	2	
6 mm	060-40328-10	3	
EARTH LUG	085-07030-21	2	
IC			
M57706	078-00351-01	1	IC501



M8 of using a 3.5Ø Ja
for EXT. SP outlet

OVERALL DIAGRAM

YM-860922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IC202 DQ2816A
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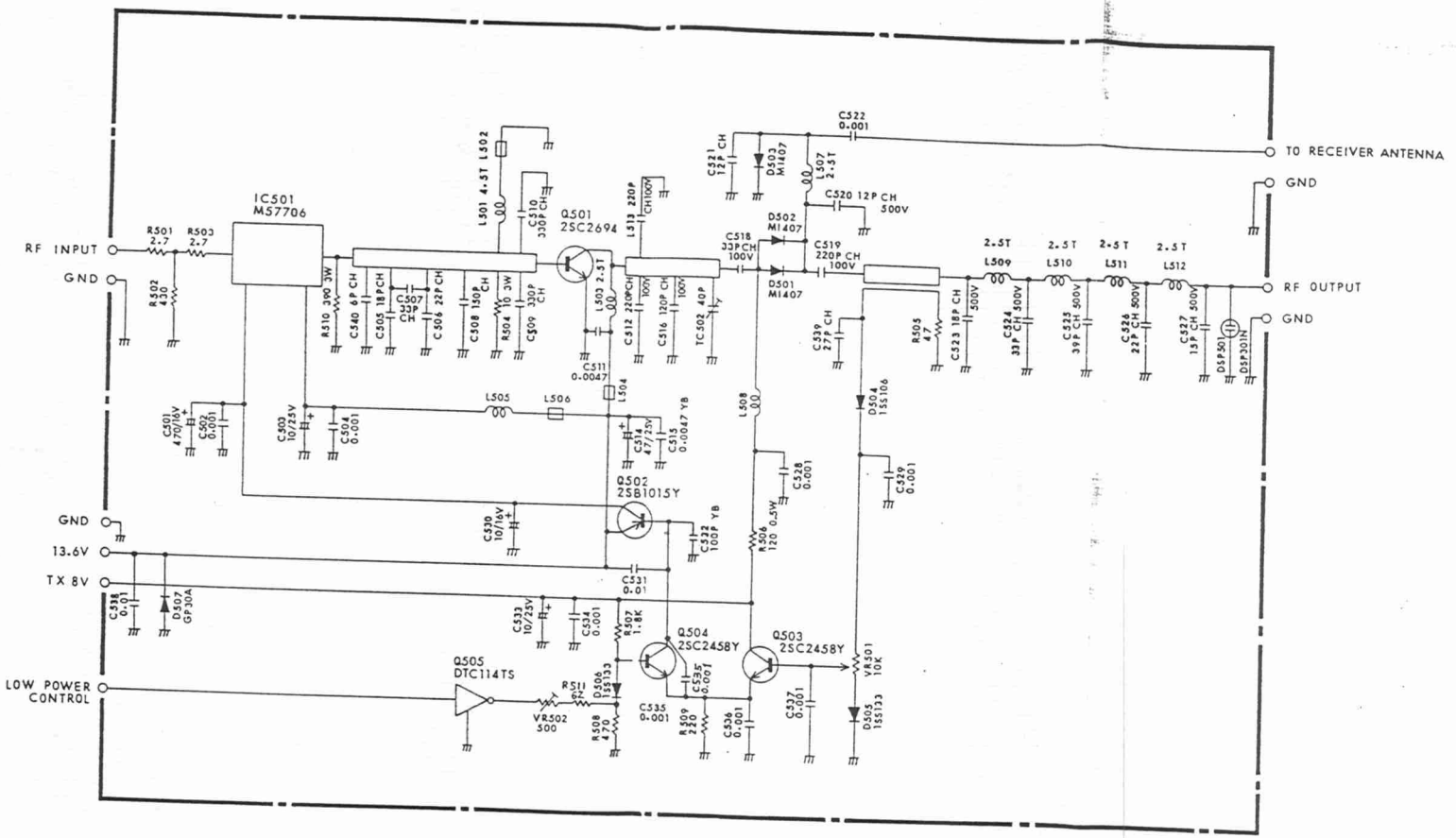
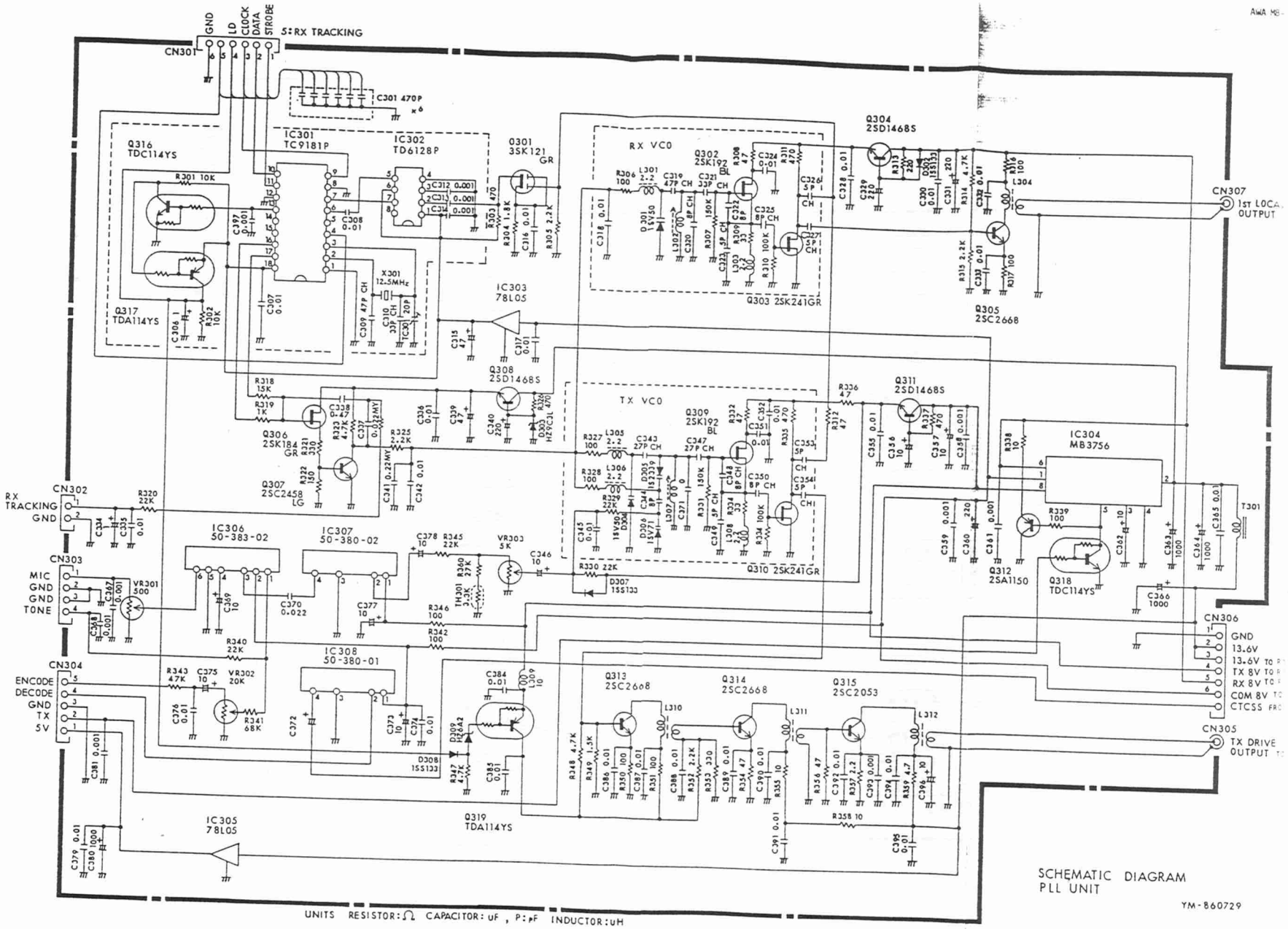
IC206 TC4081BP
IC207 TC4015BP
IC208 MX345P
Q201
Q202
Q203
Q204
Q205
Q206
Q207 2SC1545B
Q208
Q209
Q210
Q211
Q212
Q213
2SA1048Y
CN204
PROG
PRI
MON
DISP
UP
DN
L CONT
13.6V
CN203
GND
DN
UP
PTT
HOOK
CN207
ST
DATA (PLL)
CK (PLL)
LD
GND
CN202
C/D
BUSY
CS
DATA (DISP)
CK (DISP)
VDD
VSS
CN201
CN RX
CN TX
CN CK
GND
CN205
NOISE SQL
BEEP
MUTE
PTT
MONITOR
SQL 1
SQL 3
13.6V
GND
CN206
ENCODE
DECODE
GND
TX
5V
DEALER PROG
JW203
JW201 CALL
JW202
SCHEMATIC DIAGRAM
CONTROL UNIT
UNITS: RESISTER Ω
CAPACITOR uF, P pH
TRANSISTOR 2SC2458Y
DIODE 1SS133
YM-B60723

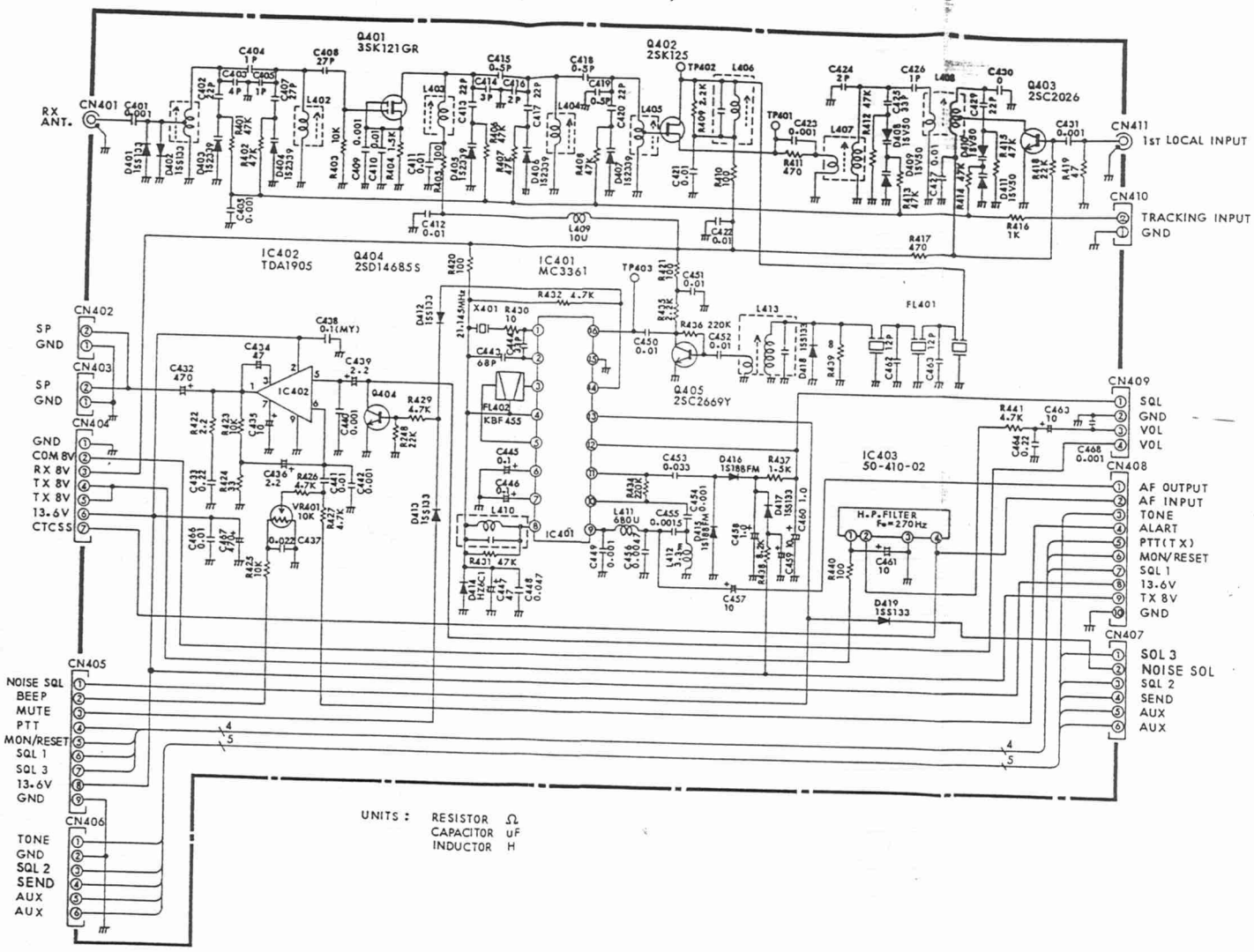


UNITS: RESISTOR Ω
CAPACITOR uF

SCHEMATIC DIAGRAM
POWER AMPLIFIER UNIT

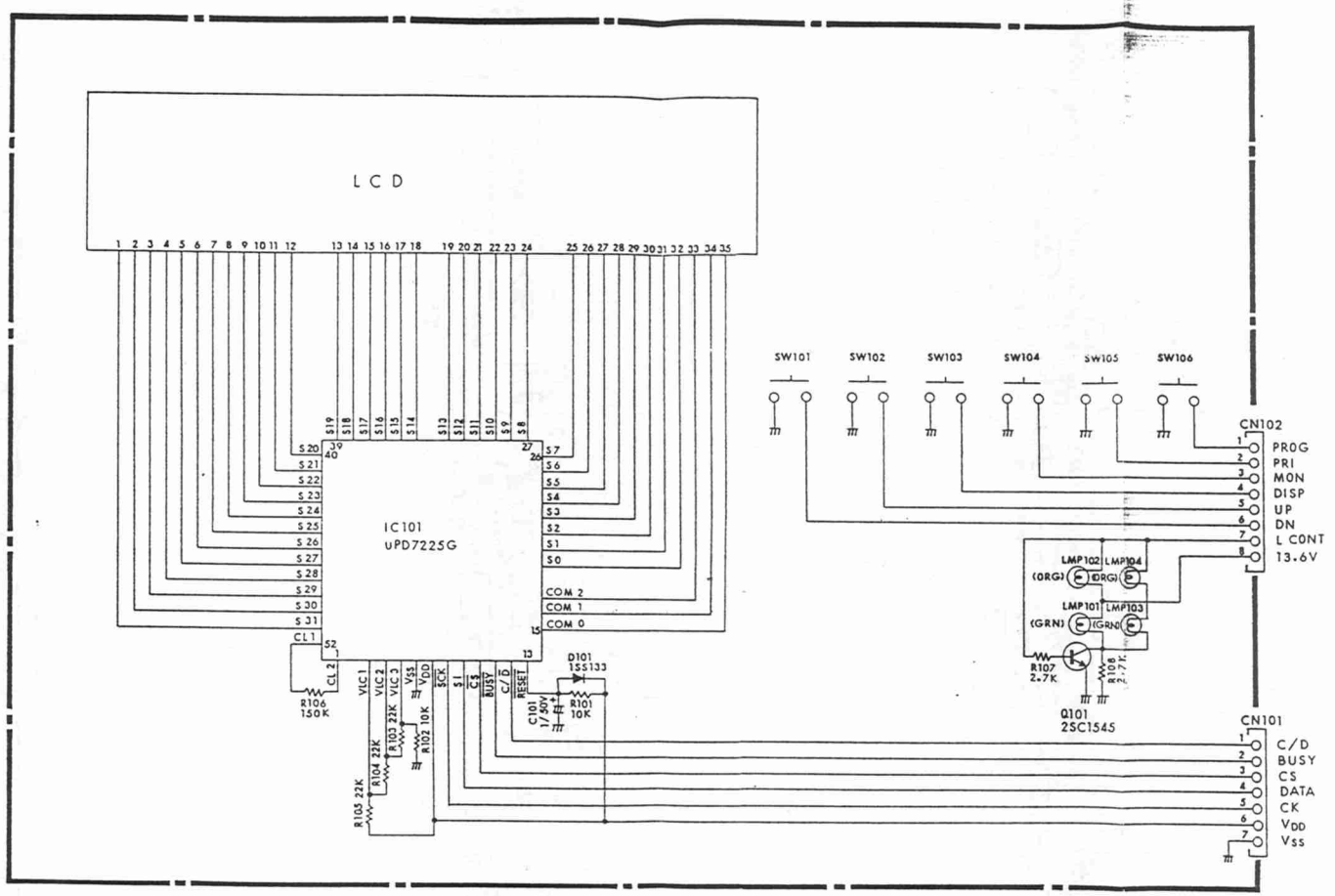
YM-860719


CN301
GND
LD
CLOCK
DATA
STROBE
5:RX TRACKING
IC301 TC9181P
IC302 TD6128P
Q316 TDC114YS
Q317 TDA114YS
X301 12.5MHz
IC303 78L05
Q301 3SK121 GR
RX VCO
Q302 2SK192 BL
Q303 2SK241GR
Q304 2SD1468S
Q305 2SC2668
CN307 1ST LOCAL OUTPUT
TX VCO
Q308 2SD1468S
Q309 2SK192 BL
Q310 2SK241GR
Q311 2SD1468S
IC304 MB3756
Q312 2SA1150
Q318 TDC114YS
T301
Q306 2SK184 GR
Q307 2SC2458 LG
CN302
RX TRACKING
GND
CN303
MIC
GND
GND
TONE
VR301 500
IC306 50-383-02
IC307 50-380-02
IC308 50-380-01
VR303 5K
VR302 20K
TH301 2.2K
CN304
ENCODE
DECODE
GND
TX
5V
IC305 78L05
Q319 TDA114YS
Q313 2SC2608
Q314 2SC2668
Q315 2SC2053
CN306
GND
13.6V
13.6V TO R
TX 8V TO R
RX 8V TO R
COM 8V TO
CTCSS FRO
CN305
TX DRIVE OUTPUT TO
SCHEMATIC DIAGRAM
PLL UNIT
YM-860729
UNITS RESISTOR: Ω CAPACITOR: uF , P: pF INDUCTOR: uH



SCHEMATIC DIAGRAM
RECEIVER UNIT

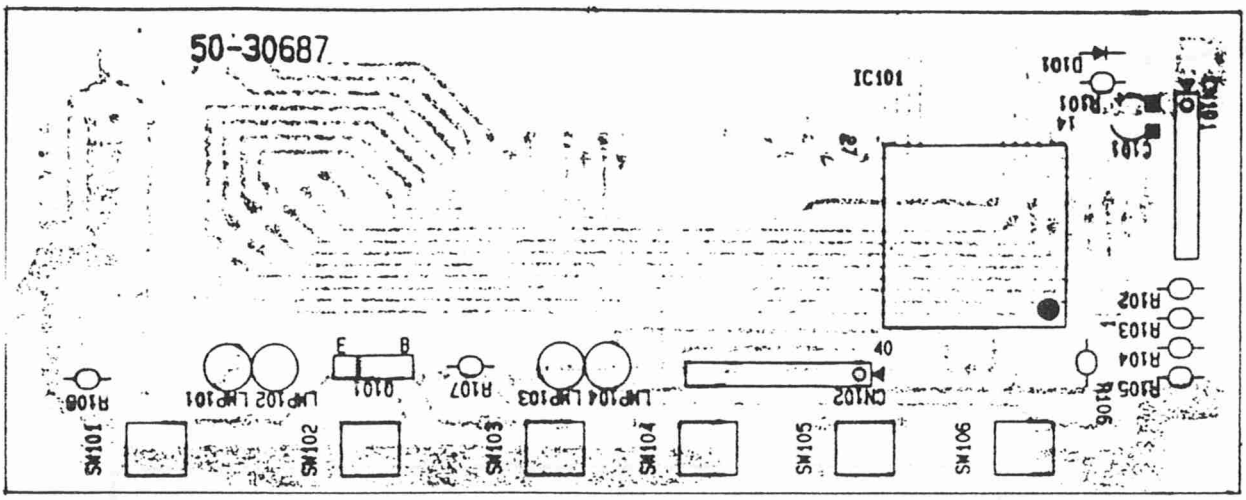
YM-860717



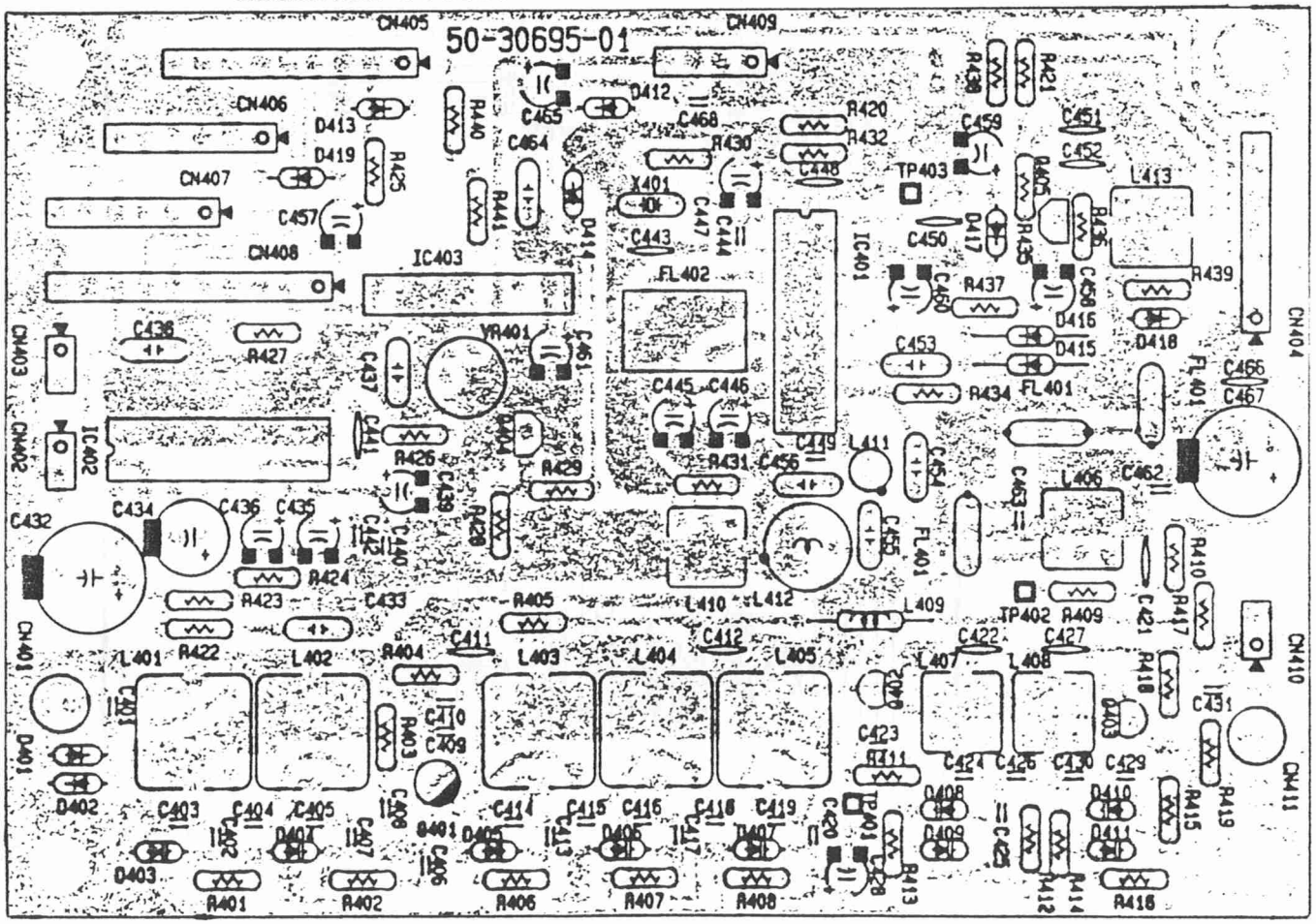
SCHEMATIC DIAGRAM
DISPLAY UNIT

YM-860720

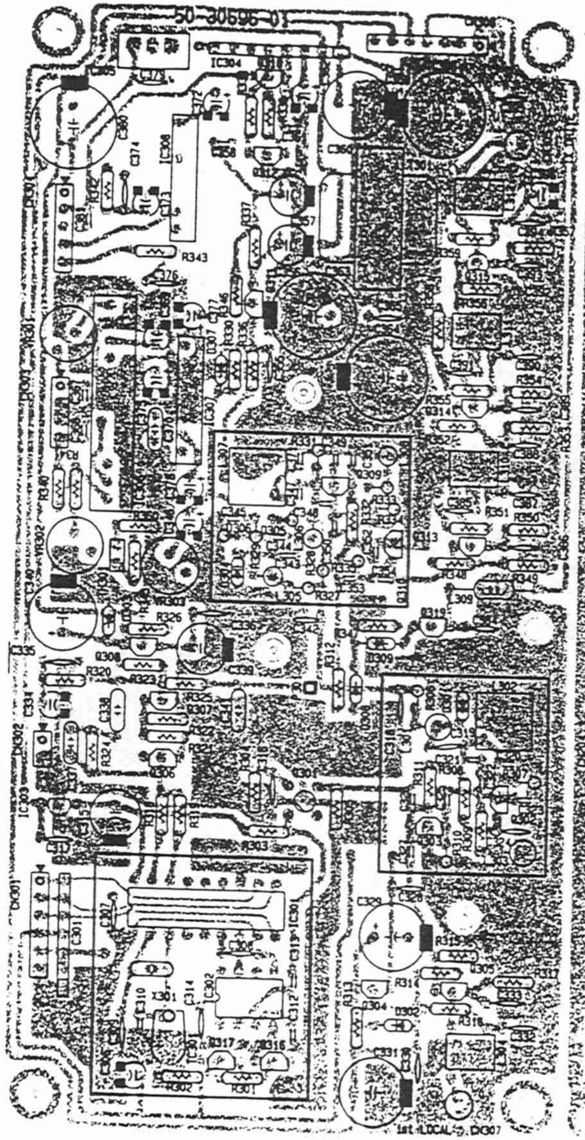
DISPLAY P.C.B.



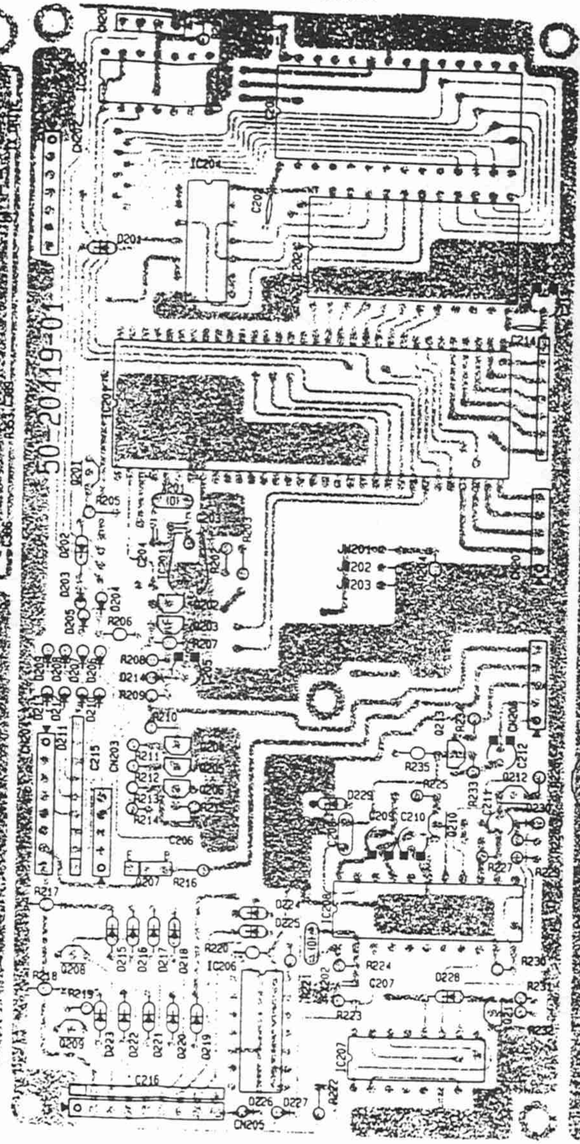
RECEIVER P.C.B.



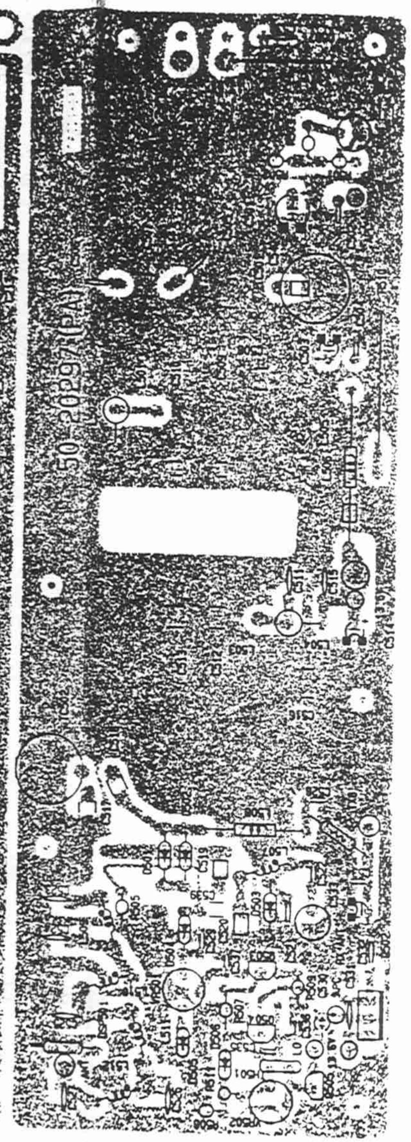
TX PLL P.C.B.



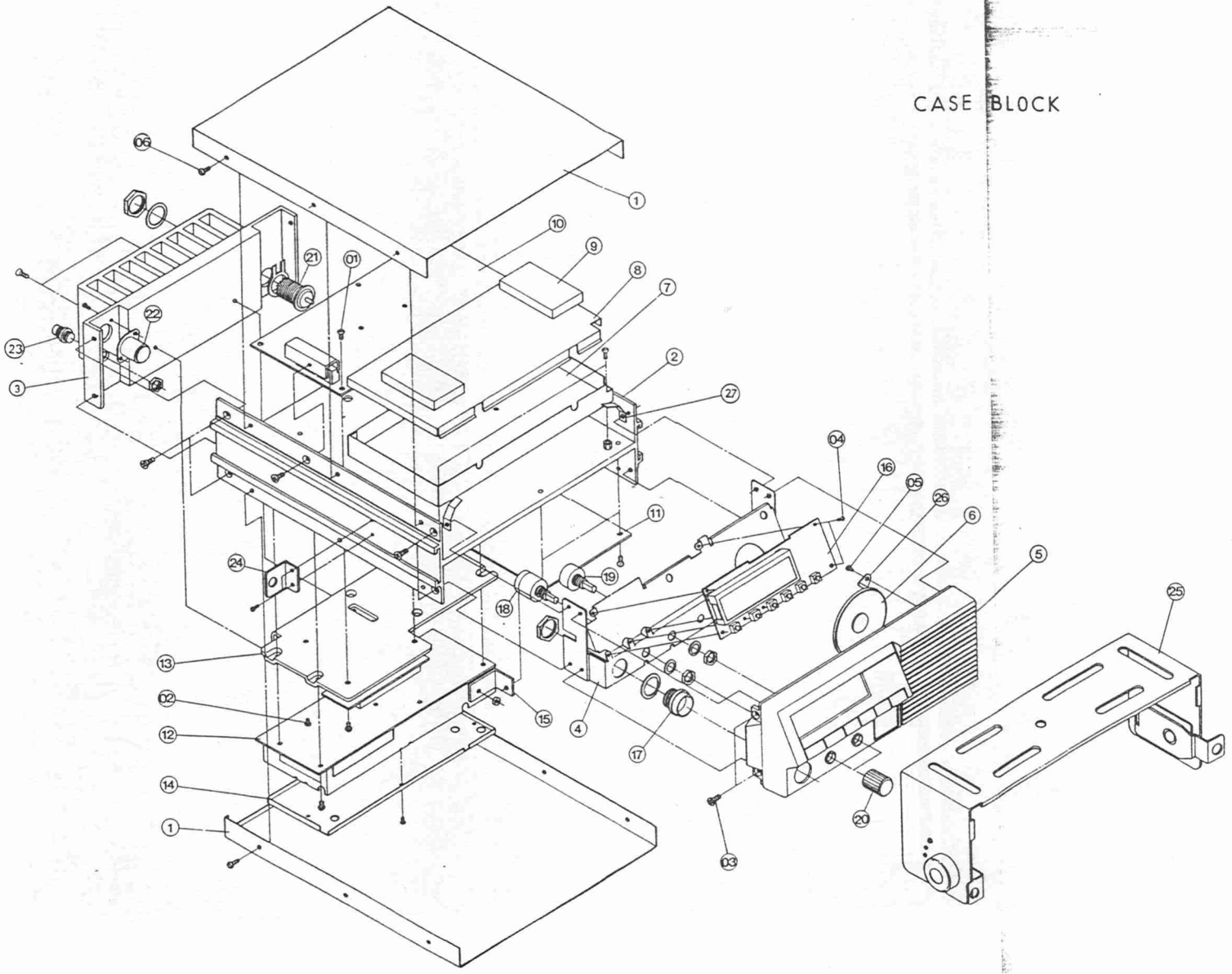
CONTROL P.C.B.



POWER AMPLIFIER



CASE BLOCK


06
1
10
9
8
7
21
01
22
23
2
3
27
04
16
05
26
6
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19
18
25
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02
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14
20
1
03

DEPARTMENT OF COMMUNICATIONS

T Y P E A P P R O V A L C E R T I F I C A T E

FOR

RADIOCOMMUNICATIONS EQUIPMENT

ISSUED TO

AMALGAMATED WIRELESS (AUSTRALASIA) LTD

ASHFIELD NSW 2131

Following tests completed on 30 June 1986 of equipment submitted for testing by the above-mentioned company and designated:

M8-1540-3

the Department certifies that the performance of the equipment met the requirements set out in specification DOC 207.

Accordingly, the Department is prepared to accept the equipment manufactured by Tad Corporation (Japan) as satisfactory for use as a mobile station operating within the frequency range 148-174 MHz in the land mobile radiocommunication service, on the understanding that all production equipment so designated possess performance characteristics not inferior to those of the unit tested.

Dated at the Department
of Communications, Canberra,
this 2nd day of
July 1986

G WARDLE
Senior Engineer
Radio Frequency Management
Division

Type Approval &
Certificate No: 2070325

DEPARTMENT OF COMMUNICATIONS

T Y P E A P P R O V A L C E R T I F I C A T E

FOR

RADIOCOMMUNICATIONS EQUIPMENT

ISSUED TO

AMALGAMATED WIRELESS (AUSTRALASIA) LTD

ASHFIELD NSW 2131

Following tests completed on 30 June 1986 of equipment submitted for testing by the above-mentioned company and designated:

M8-1540-10

the Department certifies that the performance of the equipment met the requirements set out in specification DOC 207.

Accordingly, the Department is prepared to accept the equipment manufactured by Tad Corporation (Japan) as satisfactory for use as a mobile station operating within the frequency range 148-174 MHz in the land mobile radiocommunication service, on the understanding that all production equipment so designated possess performance characteristics not inferior to those of the unit tested.

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