MIDLAND SYN-TECH™

VHF (LOW BAND)

SERVICE MANUAL

70-050

70-055

MIDLAND LMR
LAND MOBILE RADIO
1690 North Topping Avenue
Kansas City, Missouri 64120

70-300500
09-050055-SM-3/85-1M

The Midland Models 70-050A, 70-050B, 70-050C, 70-055A, 70-055B, and 70-055C are solid state VHF Low Band Land Mobile transceivers designed to operate in the 29-37 MHz (70-050A, 70-055A), 35-44 MHz (70-050B, 70-055B) and 40-54 MHz (70-050C, 70-055C) ranges.

Providing up to 80 channel capability and field programmable/ eraseable/reprogrammable frequencies and options, these SYN-TECH models are designed to provide flexible communications for a variety of applications.

The Service Manual is laid out to facilitate maintenance and service of the units. As necessary, manual supplements will be published and distributed in the following forms.

Manual Addition (MA) - Provides additional information useful in unit alignment and service or to upgrade for increased capability. Printed on BLUE paper.

Change Notice (CN) - Details circuitry changes made during production by model and serial number. Printed on YELLOW paper.

Manual Correction (MC) - Corrects manual errors not related to production changes. Printed on GREEN paper.

Technical Bulletin (TB)- Provides solutions for field problems and tips for performance improvement. Printed on PINK paper.

Careful use of the manual information will insure properly aligned, installed and maintained units. Comments or suggestions concerning areas of manual improvement are welcome.

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GENERAL SPECIFICATIONS

Nominal operating voltage:	13.6V DC (negative ground) (12.2-16V DC range)
Temperature range:	-30°C to +60°C
Antenna impedance:	50 ohms, unbalanced
Microphone:	Dynamic element, with amplifier
Speaker - internal: (70-050A/050B/050C)	8 ohms
external:	4 ohms
Frequency control:	Frequency synthesized with EPROM Programming
Frequencies of operation:	29-37 MHz (70-050A/055A) 35-44 MHz (70-050B/055B) 40-54 MHz (70-050C/055C)
Receiver and transmitter performance bandwidth without adjustment:	1.0 MHz Standard 2.0 MHz (Optional)
Maximum transmit-to-receive frequency separation:	2.0 MHz
Frequency tolerance and stability:	±5 PPM Tx and Rx (Standard) ±2.5 or 2.0 PPM Tx and Rx (Optional)
Duty cycle:	Intermittent EIA RS 152-B (1 minute Tx, 4 minutes Rx)
High humidity:	95% @ 50°C per EIA RS-152-B, sec. 13
Vibration stability:	EIA RS-152-B, sec. 14
Shock stability:	EIA RS-152-B, sec. 15
Channel capability:	Up to 80 channel transmit/receive
Current drain - Standby:	0.35 A DC
Receive:	1.00 A DC
Transmit:	8.00 A DC
Dimensions (HWD):	
Main chassis: (70-050/055)	65 x 185 x 280mm (2½" x 7¼" x 11")
Control head: (70-055)	50 x 88 x 80mm (2" x 3½" x 3 3/16")
Speaker: (70-055)	100 x 100 x 77mm (4" x 4" x 3")
Weight:	
Main chassis: (70-050/055)	3.0 kg (6.6 lb.)
Control Head: (70-055)	0.8 kg (1.8 lb.)
Speaker: (70-055)	0.71 kg (1.58 lb.)

RECEIVER SPECIFICATIONS

Refer to EIA RS-204-C and DOC RSS-119 for Method of Measurement and Standard of Performance.

Sensitivity:	12dB SINAD	0.25uV @ 50 ohm
Squelch sensitivity:	Threshold	0.2uV max or 6dB SINAD
	Tight	1.0uV min, 2.0uV max
Squelch blocking:	10dB	
Receiver attack (squelch release) time:	100ms max	
Receiver squelch closing time:	200ms max	
Modulation acceptance bandwidth:	±7.0KHz min @ 20/25/30 KHz ±4.5KHz min @ 12.5 KHz	
Adjacent channel two signal selectivity and desensitization:	90dB @ ±20KHz	
Spurious response attenuation:	90dB	
Intermodulation spurious response attenuation: (measured at useable sensitivity)	80dB (Noise Blanker off) 75dB (Noise Blanker on)	
Audio power output:	1W @ 5% THD @ 8 ohms (Internal) 5W @ 5% THD @ 3.2 ohms (External)	
Audio frequency response:	Per EIA and DOC Specifications	
Hum and noise:	Unsquelched 40dB Squelched 50dB	
Conducted suprious RF power:	200uV across 50 ohms (800pW) from DC to 1000MHz	
Intermediate Frequencies:	10.7MHz (1st) and 455KHz (2nd)	

SCAN SPECIFICATIONS

Scan speed:	20 channels/second
Channel capacity:	64 (PRI) 64 (SCAN)
Scan detection:	Carrier, tone or vacant channel
Scan resume delay:	0.3, 2.5/5 seconds or infinite

TRANSMITTER SPECIFICATIONS

Refer to EIA RS-152-B and DOC RSS-119 for Method of Measurement and Standard of Performance.

Carrier power output:	50W minimum, adjustable 25-50W (optional 1-50W)
Modulation system:	PM
Audio frequency response:	Per EIA and DOC RSS-119 Specifications
Audio frequency harmonic distortion:	3% @ 1000Hz for ±3.0KHz deviation
System deviation:	±5KHz, max
Modulation limiting:	Instantaneous peak clipping with low pass audio filter
Hum and noise:	50dB
Occupied bandwidth:	Less than 25uW adjacent channel power, ±30KHz (-60dB from carrier power)
Transmitter carrier attack time:	100ms max for 50% rated power
Conducted spurious emissions:	Less than 25uW, 1MHz to 1000MHz
Microphone input level and impedance:	-8dbm ±3dB/600 ohms

Output protection: Shall withstand for 5 minutes all VSWR around Smith Chart of 20:1 without failure or damage.

Output stability: Shall not exceed spurious emission requirements when operated into a mis-match load with 5:1 VSWR at any point on the Smith Chart.

CTCSS SPECIFICATIONS

(Optional, not supplied with unit)

Code Frequencies:	All EIA Standard from 67Hz to 241.8Hz
Modulation limits:	500 - 1000Hz
Decode sensitivity:	Less than 5dB SINAD
Receiver response time:	200ms max
Encoder Response time:	50ms max
Transmitter tone distortion:	5% max
Transmitter intermodulation distortion:	10%

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

E/PROM MODULE LOCATION AND REMOVAL

The operating frequencies and optional functions for the Midland 70-050/055 transceivers are programmed in a semiconductor-memory E/PROM module. To remove the module for programming, first remove the transceiver top cover, then locate the small printed circuit board near the front of the unit marked "Z-273". The module—is mounted on two connectors and can be separated from the main printed circuit board by simply pulling straight up.

PROGRAMMING PREPARATION

NOTE: The 70-050/055 contains the HD44840A22 or HD44840A27 microcomputer (IC901). The 70-1000 programmer used to program E/PROM modules for the 70-050/055 must be upgraded to the "E0" or later configuration.

The 70-1000 E/PROM Programmer Operator's Manual contains detailed information concerning E/PROM module programming. Be careful to observe the following precautions.

DO NOT APPLY OR REMOVE PROGRAMMER AC POWER WHILE THE E/PROM MODULE IS PLUGGED INTO THE PROGRAMMER.

IT IS NOT NECESSARY OR RECOMMENDED TO PLUG THE E/PROM MODULE INTO THE PROGRAMMER EXCEPT TO PERFORM BLANK CHECK, WRITE, VERIFY OR COPY OPERATIONS.

Apply power to the 70-1000 programmer and confirm the correct display is present.

HEADING INPUT

Input the optional heading data as described in the 70-1000 manual.

BAND SELECTION

A band selection code must be entered to program the frequency range, IF and reference frequencies, and local oscillator injection. The standard configuration 70-050/055 will accept only Band 50, which is entered as BAND CODE 0. Band 50 corresponds to a 30-50MHz frequency range, 10.7 MHz RX IF, 10.24 MHz TX IF, 5 KHz reference frequency and high side local oscillator injection.

The 70-050/055 can be converted to accept bands 5A, 5B, 5C, 5D or 5E as follows:

1. Band 5A, BAND CODE 0A, differs from Band 50 only in using low side receiver local oscillator injection instead of high side. Low side injection may be used to reduce or eliminate interference from intermodulation products. Band 5A should be programmed only if the Low Side Injection Kit 70-2175 (70-050A/055A), 70-2176 (70-050B/055B) or 70-2177 (70-050C/055C) has been installed in the radio. If a Low Side Injection Kit has been installed, Band 50 cannot be used.

2. Band 5B utilizes a 9.6 MHz TX IF, 12.5 KHz reference frequency and high side local oscillator injection. This band selection allows the programming of "splinter" frequencies at 12.5 KHz channel spacings. The 70-2132 12.5 KHz Channel Spacing Kit must be added to the radio to allow operation on these frequencies. Only those frequencies which are evenly divisible by 12.5 KHz may be programmed in Band 5B. If full specification receiver performance is required on adjacent 12.5 KHz spaced channels, the 12.5 KHz 1st/2nd IF Filter Kit 70-2135 should also be added to the transceiver.

3. Band 5C allows the programming of "splinter" frequencies with low side local oscillator injection instead of high side. To utilize this band, both the 70-2132 12.5 KHz Channel Spacing Kit and the appropriate 70-2175/2176/2177 Low Side Injection Kit must be installed in the radio. Other band selection codes may not be used after this conversion.

4. Band 5D, BAND CODE 0D, utilizes a 10.24 MHz TX IF, 2.5 KHz reference frequency and high side local oscillator injection. This band selection allows mixed programming of standard 15 KHz spaced channels and 12.5 KHz "splinter" frequencies. To utilize this band, the 70-2138 2.5 KHz Channel Spacing Kit must be installled.
NOTE: Radios containing the 70-2138 kit can be programmed only with programmers configured with "0.0" and later software.

5. Band 5E, BAND CODE 0E, allows the mixed programming of standard 15 KHz spaced channels and 12.5 KHz "splinter" frequencies with low side local oscillator injection instead of high side. The 70-2138 kit and the appropriate low side injection kit must be installed in the radio.

CHANNEL PROGRAMMING

When the band selection has been, channel frequencies and auxiliary codes can be entered as outlined in the 70-1000 Operator's Manual.

Note that Auxiliary Code "0" (tone disable) is automatically programmed for each transmit and receive channel if no other code is entered. Auxiliary data may be programmed in E/PROM even if the CTCSS option is not installed in the transceiver.

If the transceiver installation causes all power to be removed from the unit by the ignition switch, it should be noted that the powerup channel will always by the lowest numbered channel programmed. As long as power is supplied to the radio power/auxiliary connector, the channel in use at unit turn-off will be displayed at turn-on.

SCAN PROGRAMMING

Up to 64 channels can be programmed in each of 2 scan groups. Refer to the 70-1000 Operator's Manual for programming details.

FUNCTION CODE PROGRAMMING

Eight transceiver functions are programmable by function code inputs

as detailed in the 70-1000 Operator's Manual.

The Busy Channel Lockout function, if programmed, prevents inadvertent transmission on a occupied frequency and can be programmed to audibly warn the operator that transmission is not occuring. The BCLO function can be jumper selected to operate on carrier or CTCSS tone. The standard radio is configured for carrier BCLO by JP107. If tone BCLO is desired, remove JP107 and install a jumper in the JP108 position. DO NOT operate the radio with both JP107 and JP108 installed. Time Out Timer programming is selectable from 30 seconds to 210 seconds as detailed in the 70-1000 manual.

Note that for all radios programmed for either noise squelch scan or CTCSS scan, the automatic default condition should be used for function codes 3 and 4 (intervals A and B). These same default conditions should also by used if no scan channels are programmed.

PROGRAMMING THE E/PROM MODULE

Carefully check the programming data entered in the buffer RAM of the programmer for correctness by repeatedly pressing ENTER or by printing out the buffer RAM contents on the 70-1300 printer.

Prepare the E/PROM module for programming by a thorough erasure in the 70-1100 E/PROM Eraser. Plug the E/PROM module in the programmer adapter, noting the following precaution.

> MAKE SURE THE E/PROM MODULE CONNECTORS MATE PROPERLY WITH THE ADAPTER PINS AND ARE NOT OFFSET IN EITHER DIRECTION.

Remove the module at the completion of the Blank Check, Write and Verify operations. Reinstall the E/PROM module in the transceiver, again checking for proper mating of the connectors.

PLL/Synthesizer Function

The frequency synthesizer consists of two phase-locked loops. One loop (Main PLL) is controlled directly by the microcomputer and generates the receive local oscillator frequency. This loop also generates a frequency used in the second loop (Transmit PLL) for transmitter operation.

Reference Oscillator and Main PLL

A stable frequency for the entire radio is generated by a crystal oscillator composed of X101, Q701 and related components. This oscillator operates at 5.12 MHz and stability is maintained by use of a posistor crystal heater. This 5.12 MHz signal is divided by 1024 in IC701 to give the 5kHz reference frequency for the Main PLL loop consisting of IC701 (phase comparator and programmable divider), Q704-706 (loop low pass filter), D702/707 (VCO), and IC703 (pre-scaler). The VCO frequency is equal to the channel frequency plus 10.7 MHz in receive and channel frequency plus 10.24 Mhz in transmit. The VCO frequency is divided by 32/33 by pre-scaler IC703 and further divided in IC701. The division ratio of IC701 is controlled by the 8 bit code latched into the shift register IC902 from the E/PROM IC951 under control of the microcomputer IC901. The 8 bit code is sent in serial fashion from IC902 to IC701 under microcomputer control. Besides being a programmable divider, IC701 is also a phase comparator which generates an error signal for VCO control if the programmable divider output is out of phase with the 5 KHz reference frequency.

Modulator and Transmit PLL

The 5.12 MHz oscillator output is also fed to IC702 where it is divided by 8 to give 640 KHz. This signal goes directly to the transmit phase shift modulator D101/D102. Audio from the microphone is shaped and limited by IC101 (instantaneous deviation control), filtered and buffered and fed to the phase shift modulator. The modulator output becomes the reference frequency for the Transmit PLL loop consisting of IC103 (phase comparator), D104/Q108 (VCO), D108 (mixer), and IC106 (fixed divider). The VCO output is at the transmit channel frequency and is mixed at D108 with the Ftx + 10.24 MHz signal from the Main PLL loop to yield 10.24 MHz. This frequency is divided by 16 at IC106 to give 640 KHz and compared with the 640 KHz reference signal from the modulator. Thus the VCO output is forced to track the modulated reference signal, reproducing this modulation at the transmit frequency. IC102 detects any large differences between the two phase comparator inputs and generates an out-of-lock signal which biases Q111 on and prevents any transmitter signal from reaching the power amplifier stages. Q111 is also biased on during receive by a signal from the microcomputer IC901 pin 6.

Transmit Power Amplifier and APC (Automatic Power Controller)

The transmit PLL output is amplified by Q110 before being fed to the PA section. The Q110 output is amplified to rated output by Q501 (pre-driver), Q502 (driver), and the final transistor Q503. A sample of the RF output is detected by D501 and coupled to the diffential amplifier

Q505/Q506. The output of Q505 controls the conduction of Q504 which in turn controls the gain of the pre-driver Q501. Thus any changes in output power are automatically corrected by this control loop. Output power is set at alignment by RV502. Transmitter harmonics are eliminated by output low pass filtering composed of L513-L515 and C521-C527. Transmit/receive switching is accomplished by antenna relay K501.

Receiver RF/IF/Detector

The receiver front end consists of filtering by C201-C206 and L201-L203 and RF amplification by Q201. After further filtering the RF signal is mixed at the FET mixer Q202 with the local oscillator signal generated by the Main PLL loop to give the 10.7 MHz IF. The IF signal is filtered by the crystal filter FL251, amplified by Q251 and fed to the internal mixer of IC251. The 2nd local oscillator frequency of 10.245 MHz is generated by X251 and the IC251 internal oscillator and injected into the internal mixer, producing the 2nd IF of 455 KHz. The 2nd IF signal is filtered by FL252 and FL253, amplified and limited by the amplifier/limiter stage of IC251, and injected into the quadrature circuit consisting of L252 and the internal balanced mixer of IC251. The output of the balanced mixer is the detected audio signal.

Squelch and Audio Amplifier

The noise signal from the detector is amplified by Q252, detected by D253 and controlled in level by the squelch control RV301. This detected noise signal is coupled to the DC switching amplifier of IC251. Under conditions of no RF signal, the detected noise signal increases and turns on the DC switching amplifier, which in turn biases off the transceiver audio squelch gate (Q259). The detected audio signal is buffered by Q250 and passed through the squelch gate and volume control RV302 to the audio power amplifier IC252 and then to the speaker.

Microcomputer Channel Data Transfer

At unit power-up a pulse is generated by Q405, resetting the microcomputer to an auto test mode. A check is made to insure the E/PROM module is installed. If valid data is present at the E/PROM, 3 bits of address data corresponding to the selected receive channel frequency are strobed from the microcomputer IC901 to the latch IC IC952. The remaining three address bits are then strobed and latched in IC952. The E/PROM data corresponding to the selected receive channel is then strobed to the 8 bit shift register IC902 which transfers this data serially to the programmable divider IC701 under microcomputer control. IC701 divides its input signal by the correct ratio to yield the desired local oscillator frequency. IC701 outputs an out-of-lock signal which mutes the receiver until phase lock is achieved. The microcomputer strobes data corresponding to the selected channel to the latched LED display drivers IC301 and IC302 which in turn drive the channel LEDs. Brightness of the LED display is automatically adjusted to ambient light conditions by photosensor CDS301 and transistors Q301 and Q302.

Manual Channel Selection

Activation of the Up-Down channel selector switch is sensed by the microcomputer, the receive audio is muted and incrementing or decrementing of the channel display is begun. Upon release of the channel selector switch, E/PROM data corresponding to the new channel is strobed to the programmable divider. If the synthesizer lock signal is not detected after a channel change, receiver and transmitter are inhibited and the channel indicator displays the error code 95. When the PTT is depressed, the microcomputer IC901 pin 13 output switches the voltage regulator IC401 to the transmit condition, outputting 8 VDC to the transmitter and disabling the receive 8 VDC output. The microcomputer then outputs E/PROM address data corresponding to the selected transmit channel, which results in the programmable divider IC701 being reprogrammed for the correct transmit frequency.

Scan Operation

When scan operation is activated by selection of either of the front panel pushbuttons, the transmit and receive addresses of the displayed channel are stored in microcomputer memory as the priority channel. The address data corresponding to the first scan channel is then strobed to the latch IC952, resulting in the generation of the correct local oscillator frequency as previously described. After synthesizer lock is achieved, a 25 millisecond period (Interval A) is allotted for operation of the noise squelch circuitry. At the end of Interval A the microcomputer, based on the noise squelch output and E/PROM program either a) causes the SCAN sequence to resume (noise squelch closed); b) opens the audio squelch gate (noise squelch open and noise squelch scan mode programmed or noise squelch open, CTCSS scan mode programmed but no CTCSS tone programmed for the specific receive channel); or c) activates the Interval B timer (noise squelch open, CTCSS scan mode programmed and CTCSS tone programmed for the specific receive channel). Interval B is a time period (programmed to 300 ms for CTCSS operation) allotted for signalling system decoder operation. At the end of Interval B scanning resumes (no decoder output, indicated by a high level on the TSQMON line at IC901-5), or the audio squelch gate is opened (successful decode indicated by low input to IC901-5). If the receive channel corresponds to the operator-selected priority channel, a two-beep signal is generated when the squelch gate opens. After squelch closure, scan resumption is delayed by the amount of the programmable delay tinmer (RX or TX). If the priority-sampling scan mode is selected, the microcomputer automatically checks the priority channel after every fourth or eighth non-priority channel (programmable). While in a hold condition on a non-priority channel, the priority channel is sampled every second or two seconds (programmable). The priority channel sampling sequence is identical to the normal scan procedure described above.

If the priority sampling scan mode is selected, a PTT activation sensed by a high level input to IC901-30 causes the priority channel transmit address to be latched in IC952 and transmit occurs immediately on that channel.

Busy Channel Lockout and Time Out Timer

The Busy Channel Lockout function can be jumper selected by JP107 to provide lockout on either carrier or CTCSS tone. The busy channel signal, tone or carrier, is input to the microcomputer pin 28 (transmit inhibit). If the Busy Channel Lockout function is programmed in E/PROM, transmit is inhibited while the busy channel signal is present. An audio alert signal (if programmed) is generated when the transmitter is keyed to indicate the channel busy condition. The time out timer function is completely internal to the microcomputer. If the continuous transmit time exceeds the time limit programmed in E/PROM, the transmitter is disabled and an audio beep alerts the operator.

Power Supply

The 13.6 VDC input is filtered by L256 and related components and switched by K201 (trunk-mount models) or the unit on-off switch (under-dash models). This filtered 13.6 VDC is supplied directly to the PA driver and final stages and also to pin 2 of IC401, the main voltage regulator. IC401 outputs a constant 8 VDC from pin 1 as well as 8 VDC during receive from pin 8 and 8 VDC during transmit from pin 6. The receive/transmit switching signal is output from IC901 pin 13 through Q402 and Q403 to IC401 pin 5. Regulator IC402 (Tx board) provides 5 VDC for the reference oscillator, synthesizer integrated circuits and the E/PROM module. Regulator IC303 (control panel or control head) supplies 8 VDC for microphone bias and LED displays. The microcomputer IC901 is supplied 5 VDC from zener diode D402, which is powered by an unswitched 13.6 VDC source. This allows the microcomputer to retain memory of the last selected channel as long as power is connected to the radio. Other microcomputer functions are disabled at unit turn-off, since power is removed from pin 19, the standby control pin.

CTCSS Operation

The CTCSS option provides, under microcomputer control, encode and decode of 35 standard EIA CTCSS tones. At each channel change and transmit/receive transition, data corresponding to the selected channel and mode is strobed on lines D0-D4 and latched in IC1. IC1 outputs this data to IC3 for generation or detection of the correct CTCSS tone. This data is also input to IC2, which outputs a high logic level for encode/decode inhibit if all data lines are low (Aux Code 0). Encode inhibit is accomplished by holding IC3 pin 17 at a high level through D2. Decode is inhibited by biasing Q1 on through D4. As long as the collector of Q1 is low, the base of Q261 (Receiver board) is also held low. The collector of Q261, which is also connected to the gate of the squelch FET, is then under control of the noise squelch signal from IC251 pin 13. If decode is not inhibited by Aux Code 0 programming, control of the squelch FET is by IC251 pin 13 and Q261. Q261 is controlled by Q260, which is in turn switched by Q2 (CTCSS board). Q2 is normally biased on by IC1 pin 12 but is switched off when the correct tone is detected. The Monitor switch and microphone hang-up box both control the status of Q1 and thus allow or inhibit squelch gate control by the CTCSS board in the same manner as Aux Code 0 programming.

Crystal X1 generates a stable reference frequency for IC3 tone generation and detection. IC4 functions as an audio highpass filter to remove CTCSS tones from the speaker audio. Encode tone output is from IC3 pin 16 with tone modulation level adjustable by RV1.

SUGGESTED TEST INSTRUMENTS

TEST INSTRUMENT	REQUIRED SPECIFICATIONS	INSTRUMENT TYPE
DC Power Supply	13.8 VDC 10 amps	Power/Mate BPA-20F
Watt Meter	29-54 MHz	Bird Model 43 with 100A Element and 100 watt, 50 ohm load
Digital Multimeter	AC 100 mv - 10v DC 100 mv - 100v	B-K 2810
AC Voltmeter	10mv - 10v	Heath SM-5238
Speaker Load	4 ohm speaker and resistive load (switchable)	Shop Fabricated
RF Signal Generator	29-54 MHz Range Calibrated output 0.1 to 100 uV. Internal and external modulation capability with internal frequency of 1 KHz at 5 KHz deviation	Cushman CE-31A
Deviation Meter	0 - 5 KHz Deviation Range +/- Deviation Capability	Cushman CE-31A
Frequency Meter	Frequency Range 29-54 MHz Frequency tolerance of +/- .00002%	Cushman CE-31A or Heath SM-4120
Signal Generator	0-10 KHz Sine Wave 0-5V	Heath SG-5218
LMR Test Set	- - - - - - - - - - - - - - - - - -	Midland 70-E10
Sinad Meter	- - - - - - - - - - - - - - - - - -	Helper Instruments Sinadder

Fold Out →

Remove the 8 screws securing the top and bottom covers. Loosen the 4 screws securing the PA assembly and pivot the top of the PA assembly to the rear. Turn the volume control to a mid position and the squelch control fully clockwise. If the 70-E10 test set is used, the RED 5 pin test socket should be connected to CM101 for transmitter alignment and the WHITE 5 pin test socket to CM201 for receiver alignment. Both test sockets should be connected with the unused socket position toward the rear of the radio. Refer to the 70-E10 TEST PINS switch position underlined in the steps below. Supply power to the radio and connect a wattmeter and dummy load with a reduced power output for a frequency counter and modulaton meter.

* * * * * * * * * * * * * IMPORTANT NOTE * * * * * * * * * * * * *
* A "95" error code display and triple beep can be expected at *
* unit turn on if the channel frequencies programmed in the *
* E/PROM are outside the band for which the Main VCO is curen- *
* tly aligned. To eliminate this error indication, adjust L702 *
* (TX board) for 4 volts at TP701. The normal alignment proce- *
* dures can then be performed. *
* *
* Error codes "90" through "94" indicate the E/PROM module to *
* be missing, improperly inserted or incorrectly programmed. *
* Refer to the general troubleshooting chart if these error *
* conditions occur. *
* *
* *

VCO AND TRANSMITTER ALIGNMENT

1.Turn RV502 (PA) maximum counterclockwise.

MAIN VCO ALIGNMENT

2. The Main VCO should be adjusted with the radio operating on the channel and in the condition (transmit or receive) corresponding to the highest programmed frequency. If the highest frequency is a transmit frequency, select this channel, key the transmitter and adjust L702 to give 4.0 VDC at TP701. If the highest programmed frequency is a receive frequency, adjust L702 for 4.5VDC at TP701 while in the receive mode.

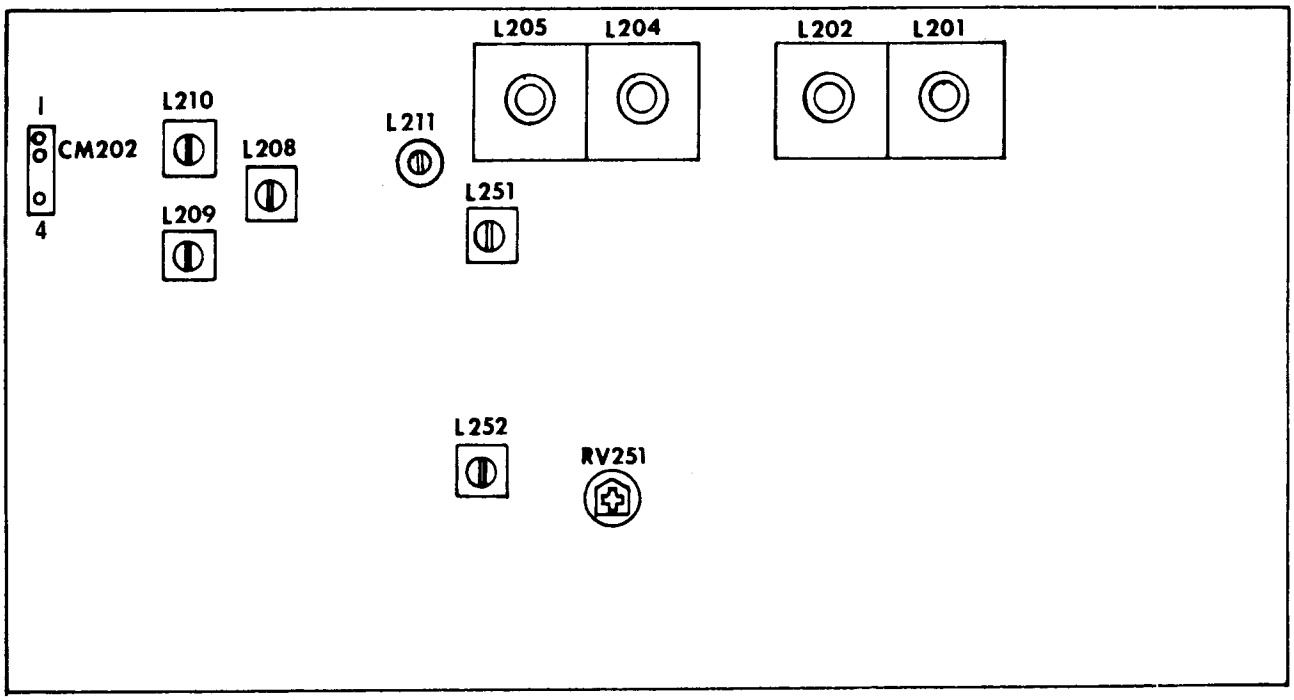
TRANSMIT VCO ALIGNMENT

3. Monitor TP101 (TX) with a DC voltmeter. Key the transmitter and adjust L107 for 4.5 VDC.

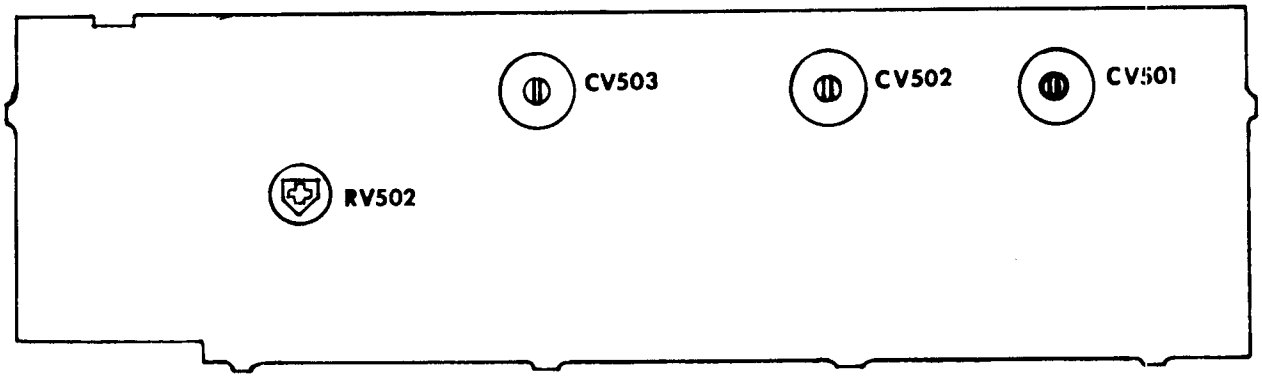
TRANSMIT DRIVER ALIGNMENT

4. Monitor CM101 Pin 2 (position 9) with a selected channel frequency near the center of the programmed frequencies. Adjust CV102 for a dip betweeen two peaks.

RECEIVER ALIGNMENT POINTS



PA BOARD ALIGNMENT POINTS



POWER AMPLIFIER ALIGNMENT

5. Adjust RV502 (PA) maximum clockwise and adjust CV501, CV502 and CV503 for maximum RF output power. Readjust RV502 for 50 watts RF output.

MODULATION ADJUSTMENT

6. If the CTCSS option is installed, select any channel programmed for CTCSS encode. Key the transmitter and adjust RV1 on the CTCSS board for the desired CTCSS modulation.

7. Input audio modulation of 2500 Hz and adjust RV101 (TX) for 5 kHz deviation. Adjust L101, L102 and L105 for maximum deviaton and balance. Vary the modulating signal level to insure deviation does not exceed ± 5 kHz.

OSCILLATOR FREQUENCY ADJUSTMENT

8. Monitor the frequency of the transmitted signal and adjust CV701 for the correct frequency.

   NOTE: RV102 and L118 are factory set and should not require field adjustment. If adjustment is necessary, see the supplementary alignment instructions.

9. Pivot the PA assembly to its original position and tighten the 4 retaining screws.

RECEIVER ALIGNMENT

L. O. AMPLIFIER ALIGNMENT

1. Select a channel with a receive frequency near the center of the programmed frequencies. Monitor CM202 Pin 1 (position 2) and adjust L209 and L210 for a maximum indication.

RF-IF ALIGNMENT

2. Connect an on-channel signal generator to the antenna connector. Adjust L201, L202, L204 and L205 for maximum indication at CM202 Pin 2 (position 3).

3. Adjust L208 and L251 for minimum audio distortion.

QUADRATURE COIL ALIGNMENT

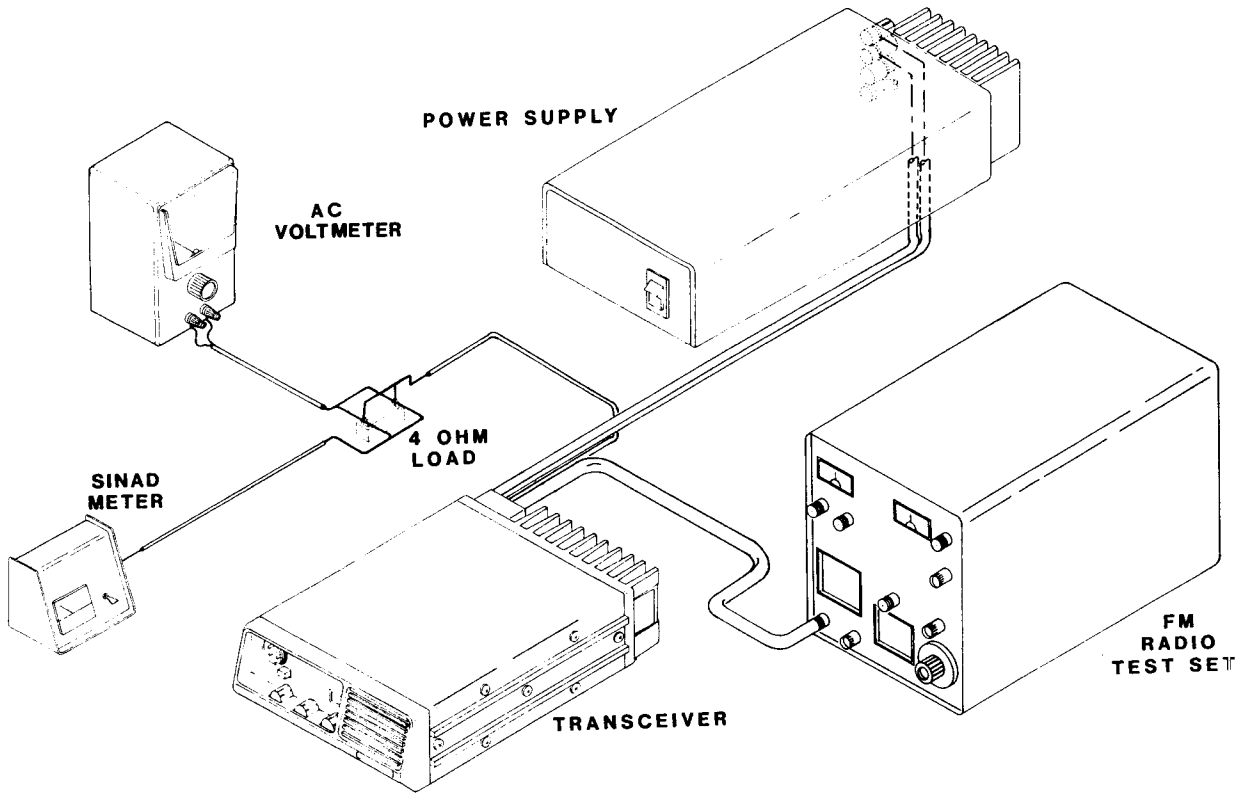
4. Adjust L252 for maximum audio output.

TIGHT SQUELCH ADJUSTMENT

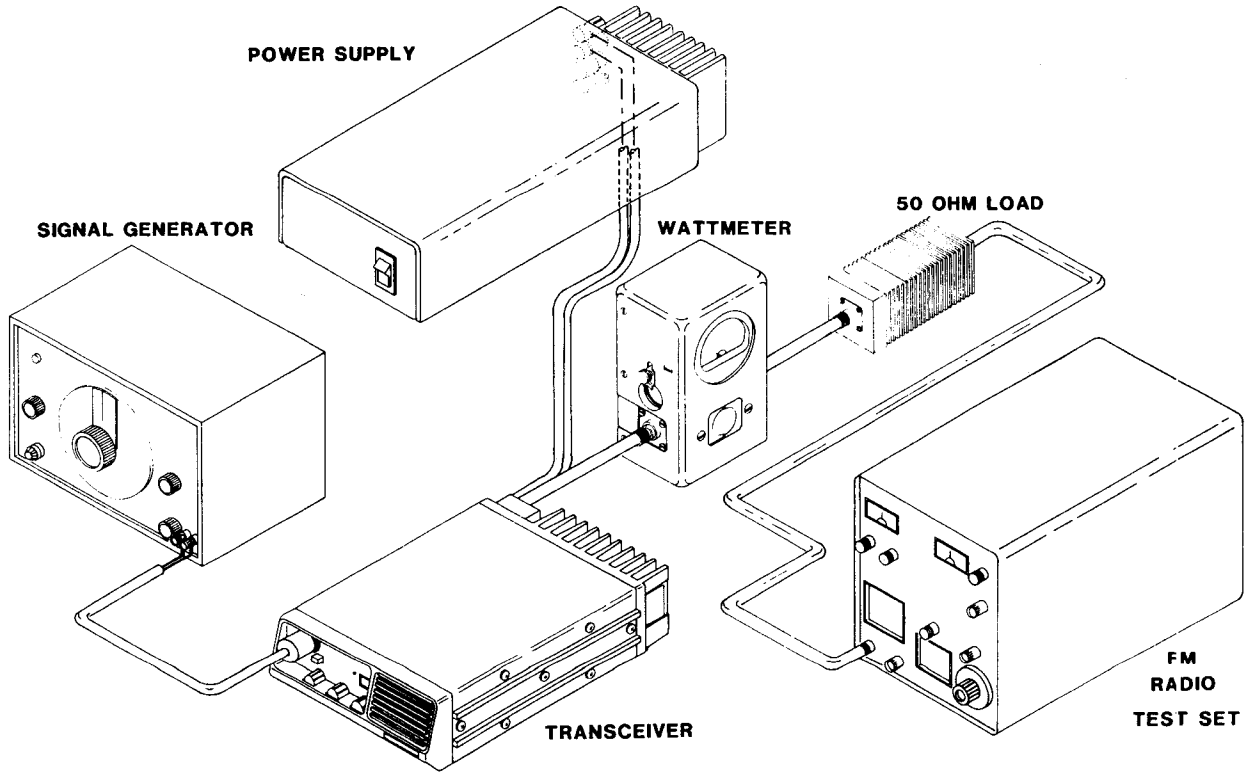
5. Adjust RV251 for the desired tight squelch sensitivity.

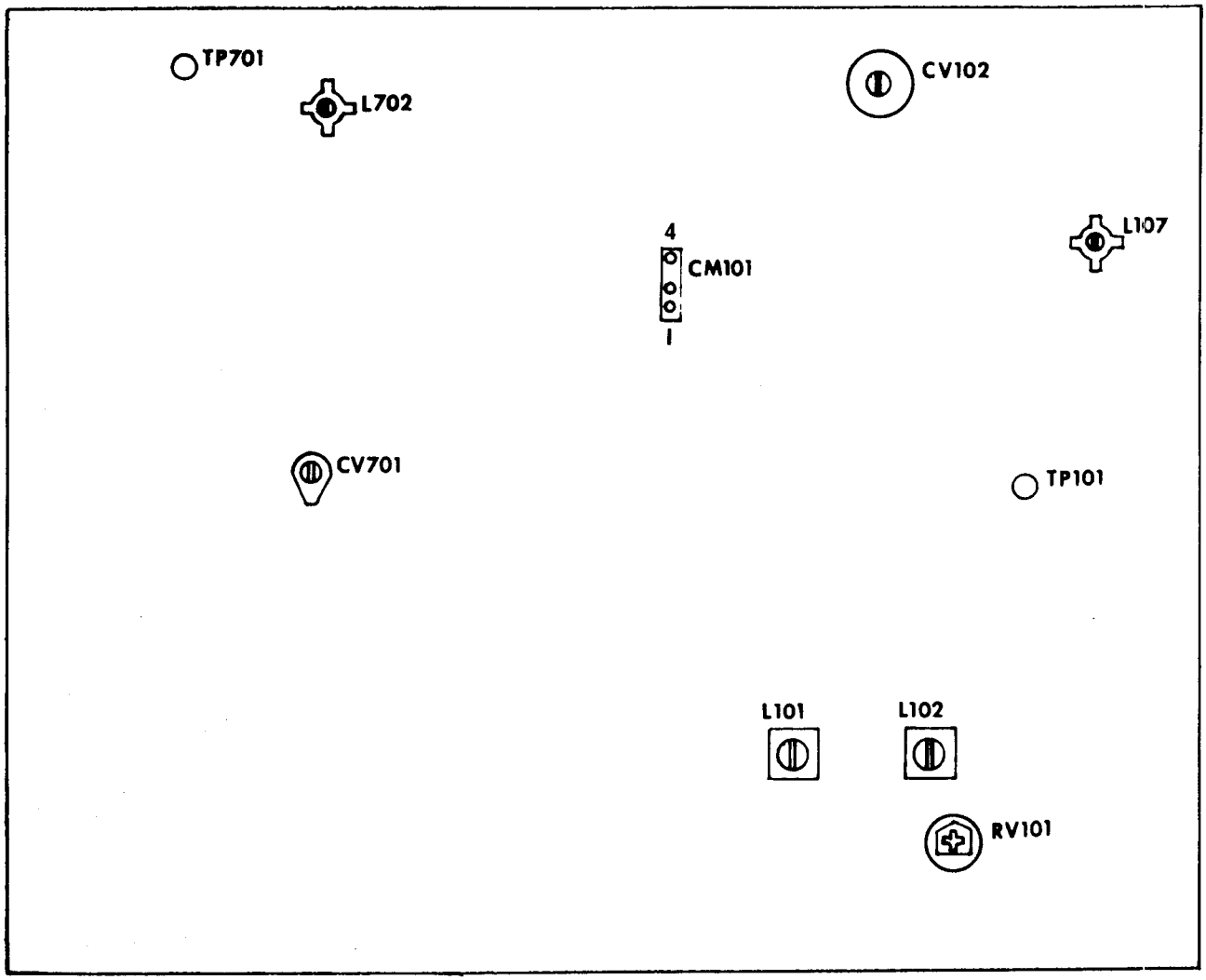
TEST EQUIPMENT SET-UP DIAGRAMS

RECEIVER TEST SET-UP



TRANSMITTER TEST SET-UP




TP701
L702
CV102
4
CM101
1
L107
CV701
TP101
L101
L102
RV101

The following points should require alignment only in case of component replacement or accidental misadjustment.

TRANSMITTER/SYNTHESIZER BOARD

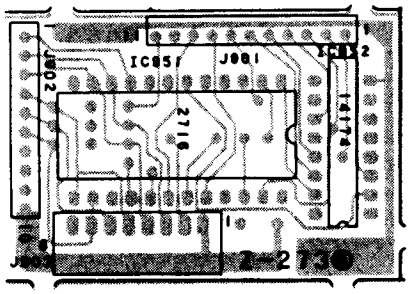
RV102 - Microphone Gain Control. Adjust near the center position and perform the standard service manual modulator alignment. Input a 150 MV RMS 1 KHz signal at the microphone audio input and adjust RV102 to give 2.5 KHz deviation on the transmitted signal.

L118 - Transmit IF. Monitor IC106 pin 14 with an RF voltmeter or oscilloscope. Adjust L118 for the maximum level of the Transmit IF signal.

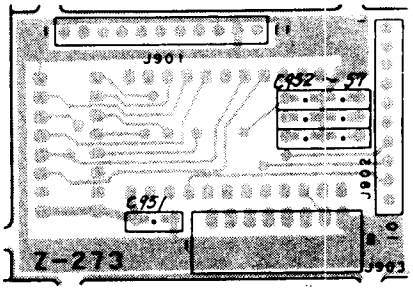
RECEIVER BOARD

RV252 - Maximum Audio Output Control. Input a standard test signal and turn the radio volume control maximum clockwise. Adjust RV252 to yield the maximum output power not exceeding 10% distortion.

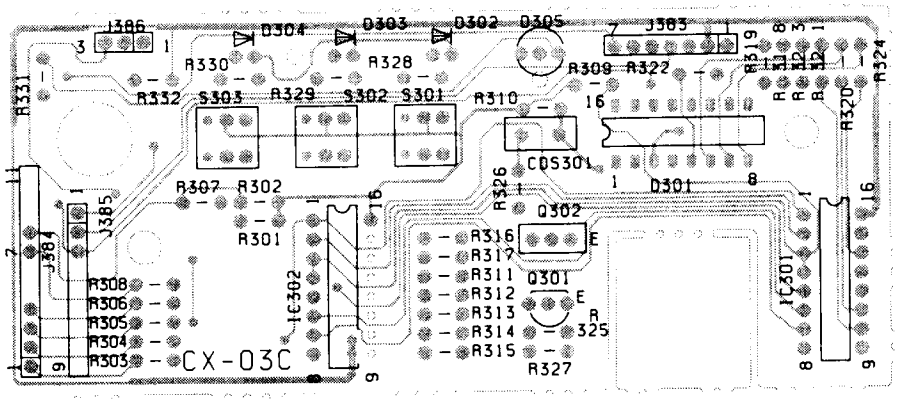
70-050/055 E/PROM MODULE
PCB (Z-273) (TOP VIEW)



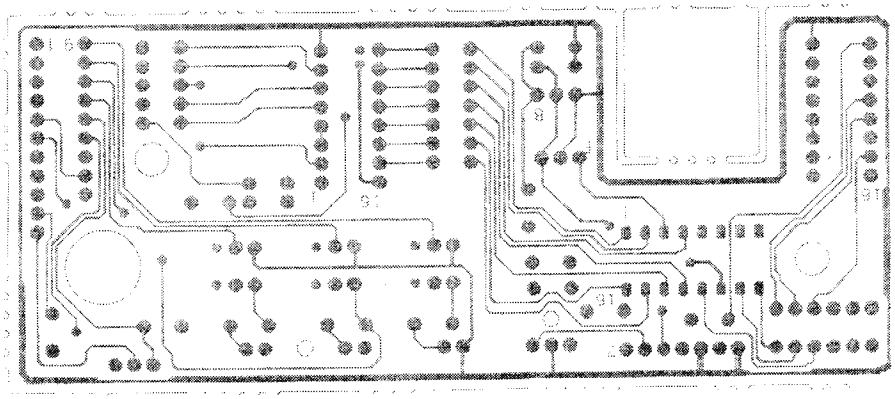
70-050/055 E/PROM MODULE
PCB (Z-273) (BOTTOM VIEW)



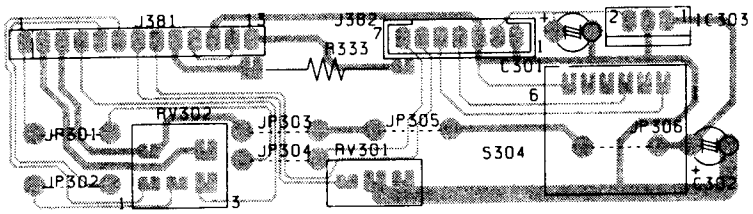
70-050 DISPLAY PCB (CX-03) (TOP VIEW)



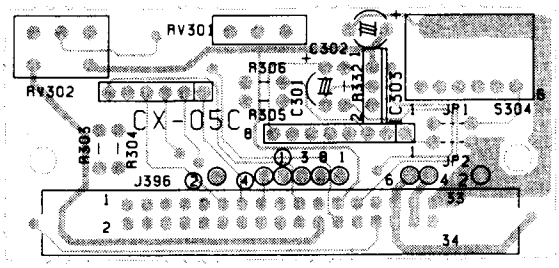
70-050 DISPLAY PCB (CX-03) (BOTTOM VIEW)



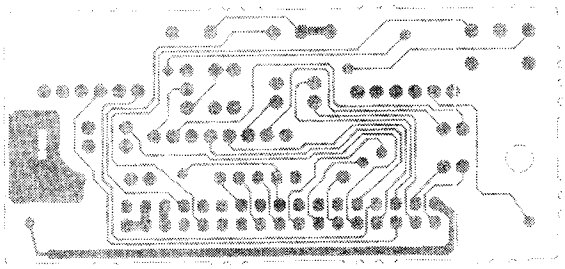
70-050 CONTROL PCB (CX-04)



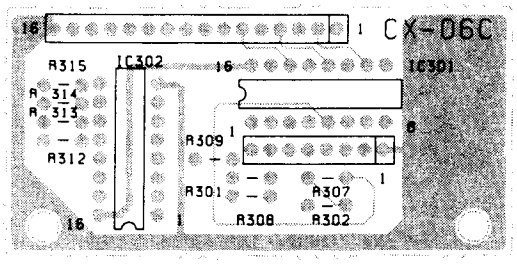
70-055 CONTROL INTERFACE PCB (CX-05) (TOP VIEW)



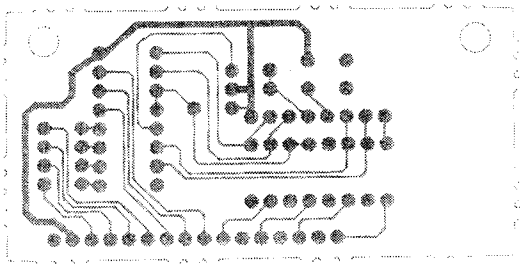
70-055 CONTROL INTERFACE PCB (CX-05) (BOTTOM VIEW)



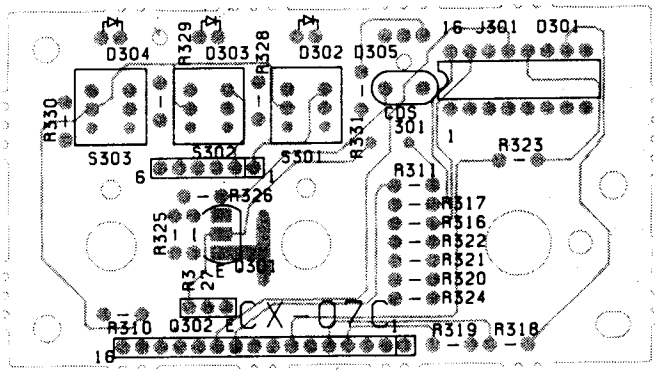
70-055 DISPLAY DRIVER PCB (CX-06) (TOP VIEW)



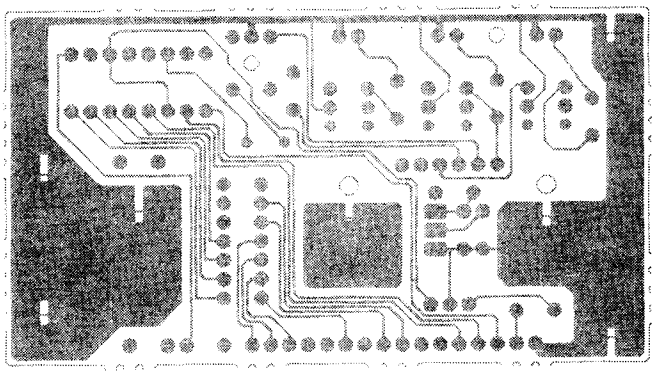
70-055 DISPLAY DRIVER PCB (CX-06) (BOTTOM VIEW)



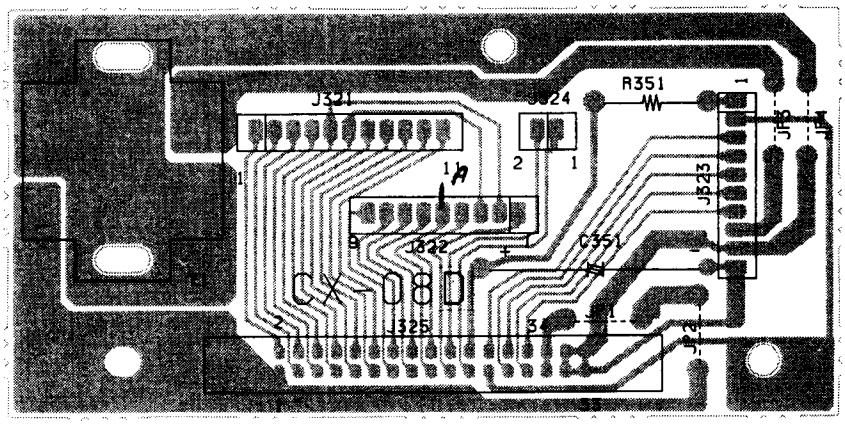
70-055 DISPLAY PCB (CX-07) (TOP VIEW)

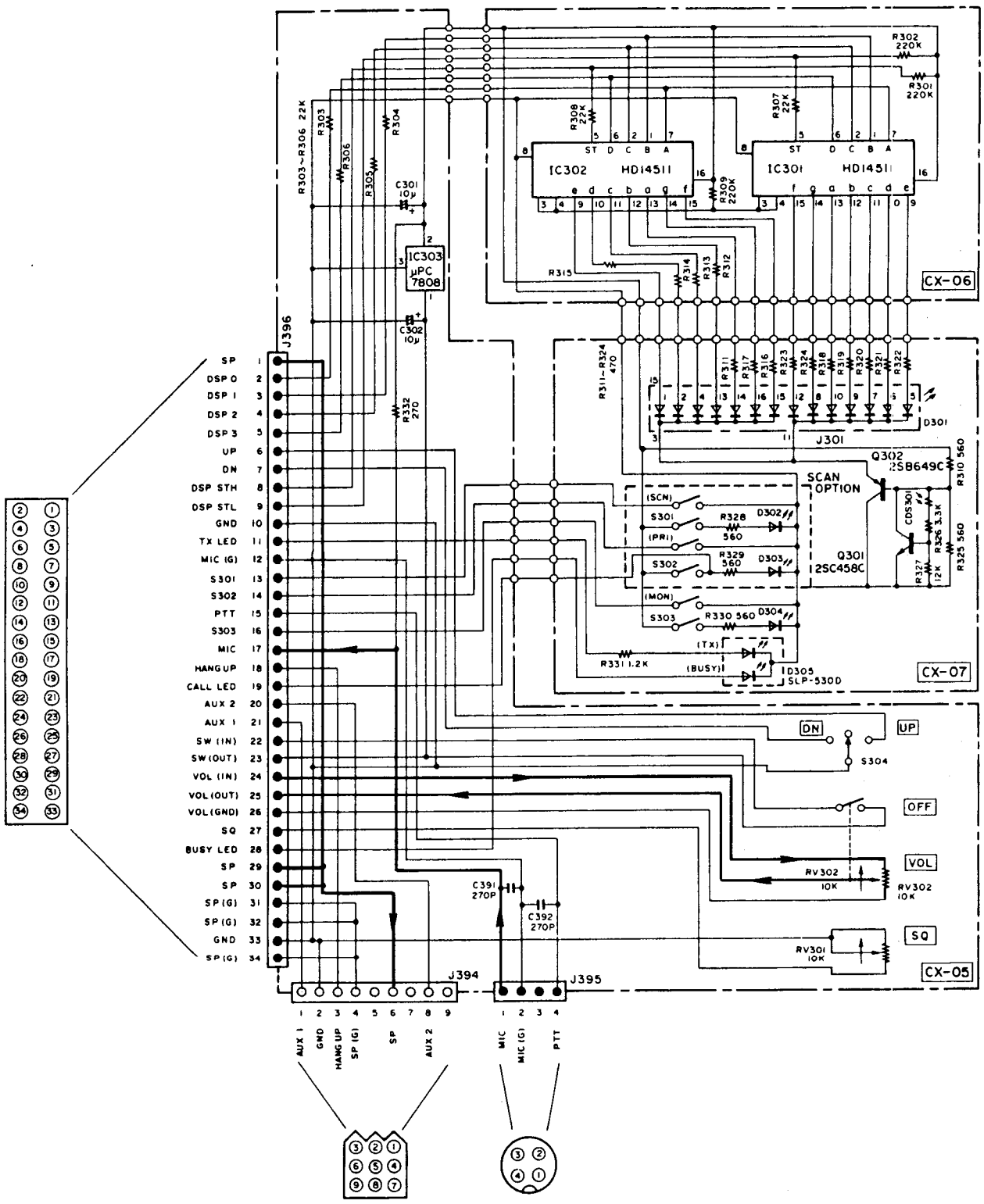


70-055 DISPLAY PCB (CX-07) (BOTTOM VIEW)

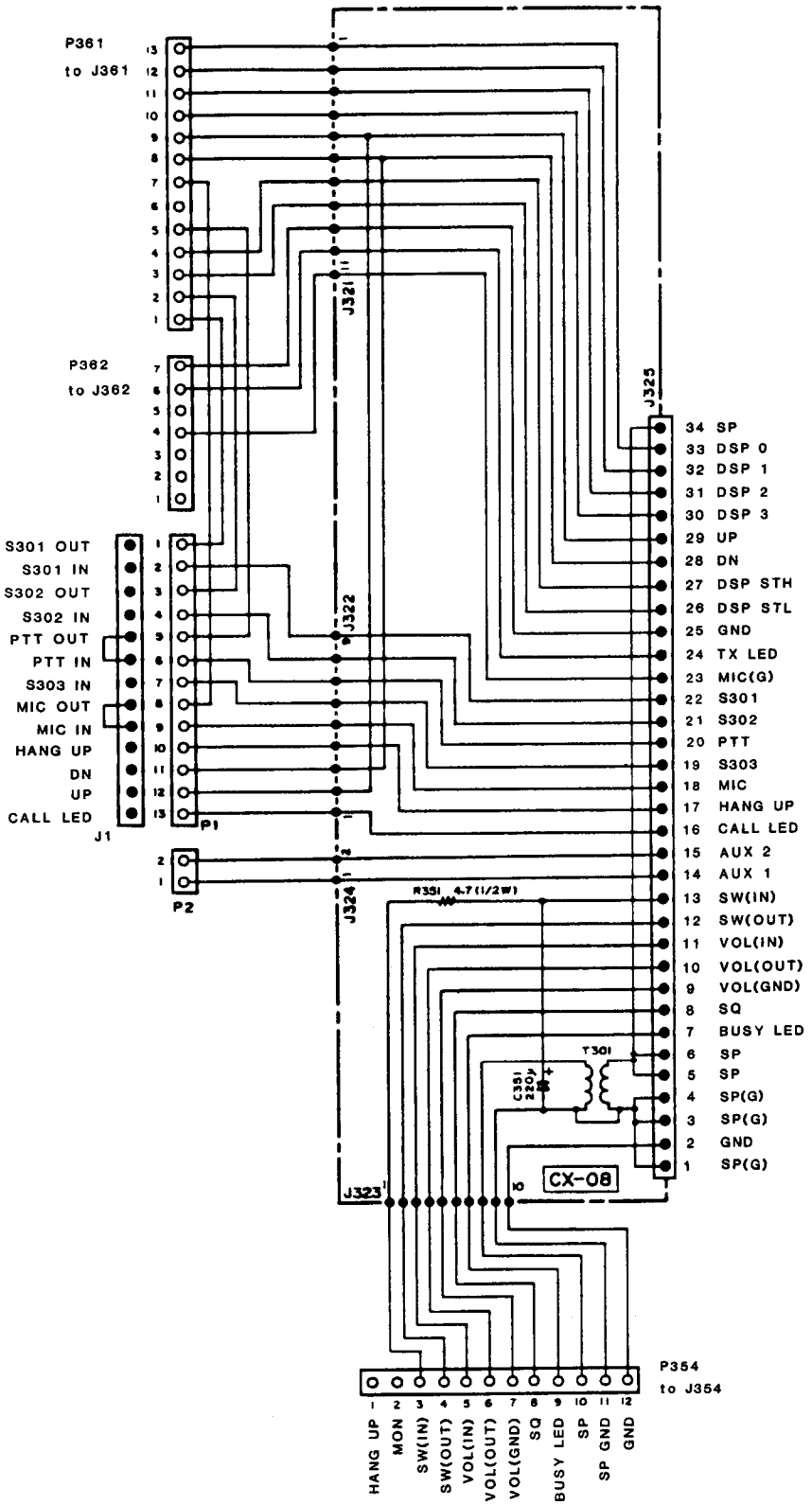


70-055 CONTROL CABLE INTERFACE PCB (CX-08)

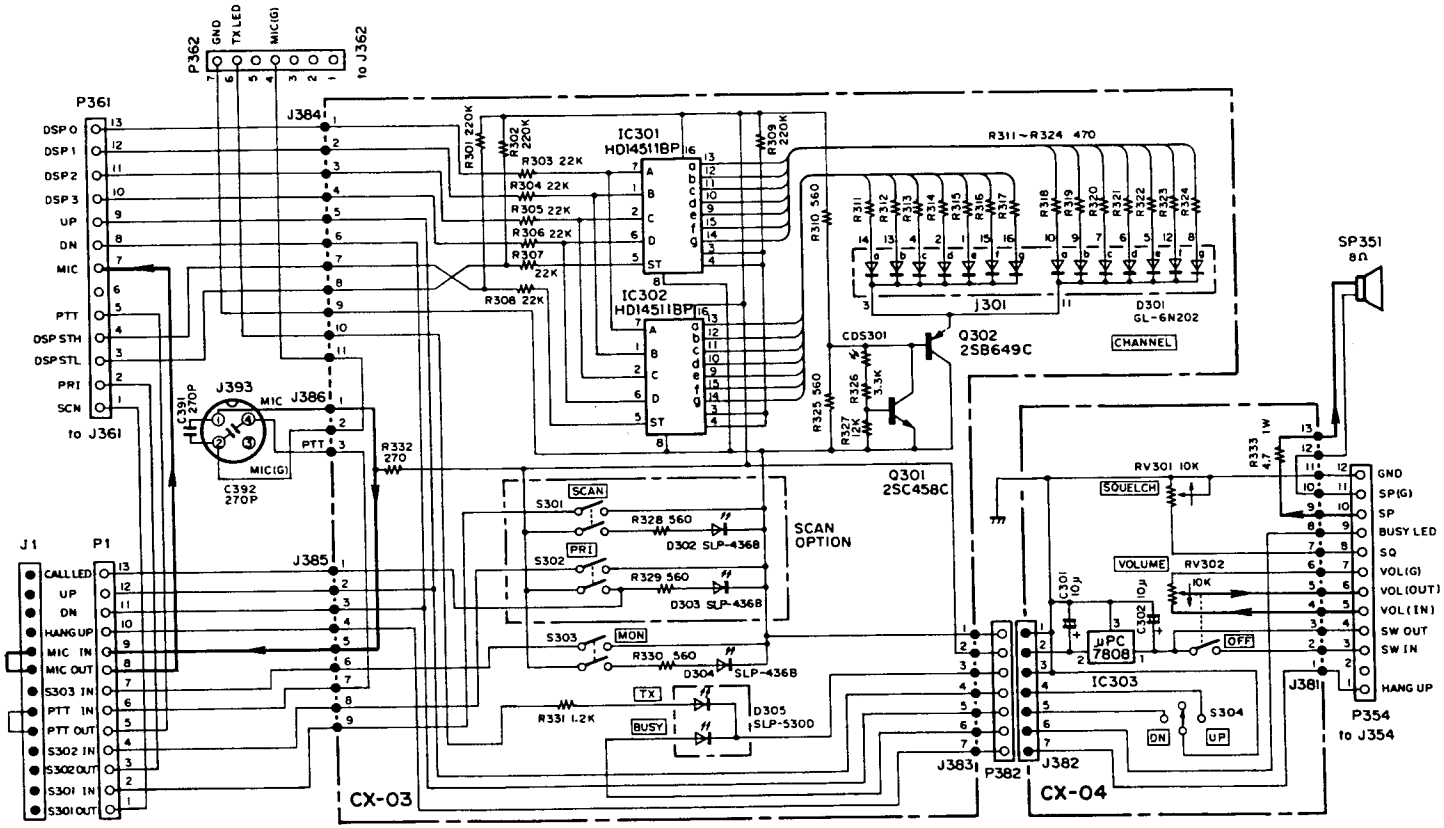



CX-06
CX-07
CX-05
IC302 HD14511
IC301 HD14511
IC303 μPC 7808
J396
J394
J395
J301
D301
SCAN OPTION
Q302 2SB649C
Q301 2SC458C
D305 SLP-530D
SP
DSP 0
DSP 1
DSP 2
DSP 3
UP
DN
DSP STH
DSP STL
GND
TX LED
MIC (G)
S301
S302
PTT
S303
MIC
HANGUP
CALL LED
AUX 2
AUX 1
SW (IN)
SW (OUT)
VOL (IN)
VOL (OUT)
VOL (GND)
SQ
BUSY LED
SP
SP
SP (G)
SP (G)
GND
SP (G)
DN
UP
S304
OFF
VOL
SQ
RV302 10K
RV301 10K
AUX 1
GND
HANG UP
SP (G)
SP
AUX 2
MIC
MIC (G)
PTT

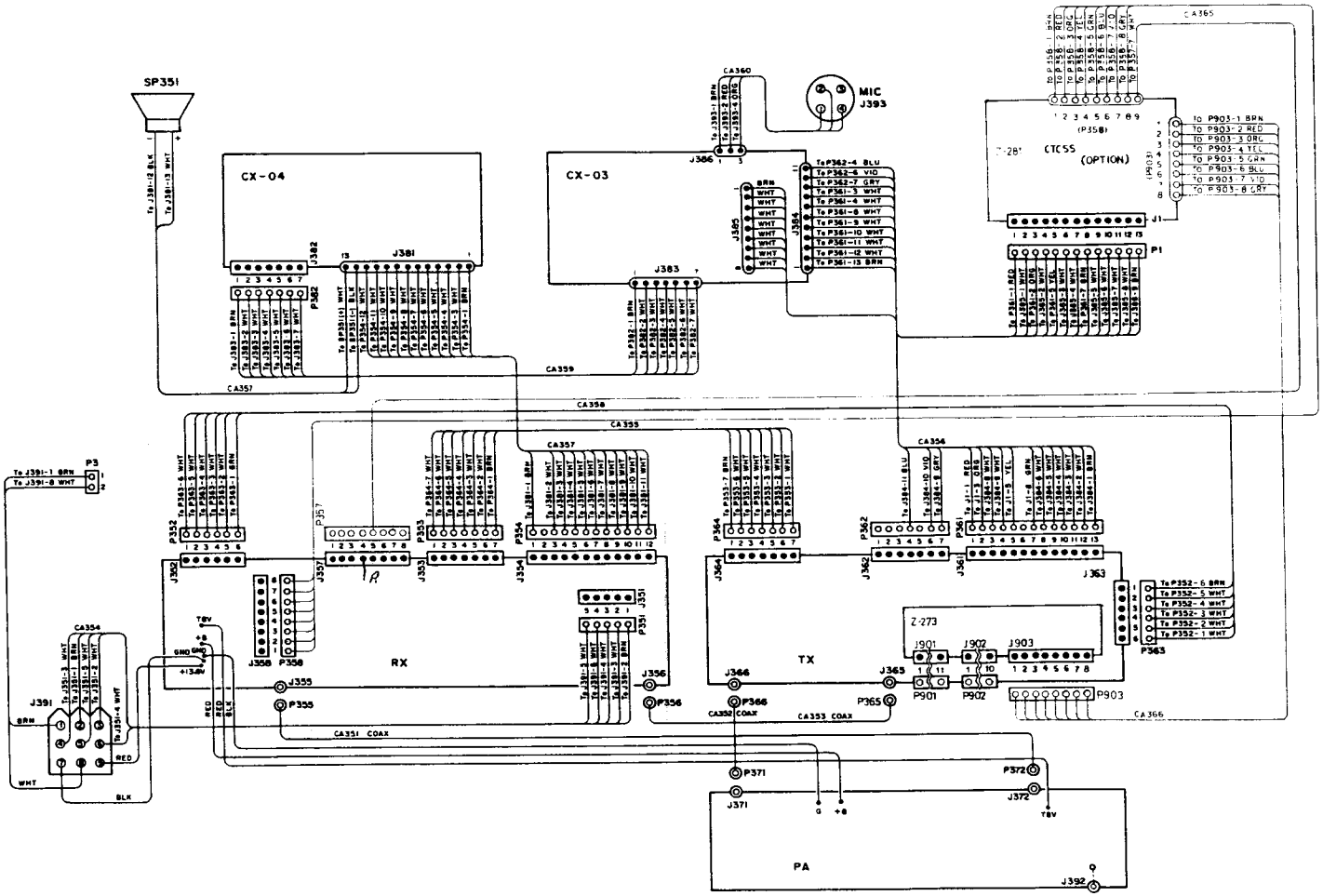
CONTROL INTERFACE SCHEMATIC DIAGRAM



CONTROL PANEL SCHEMATIC DIAGRAM

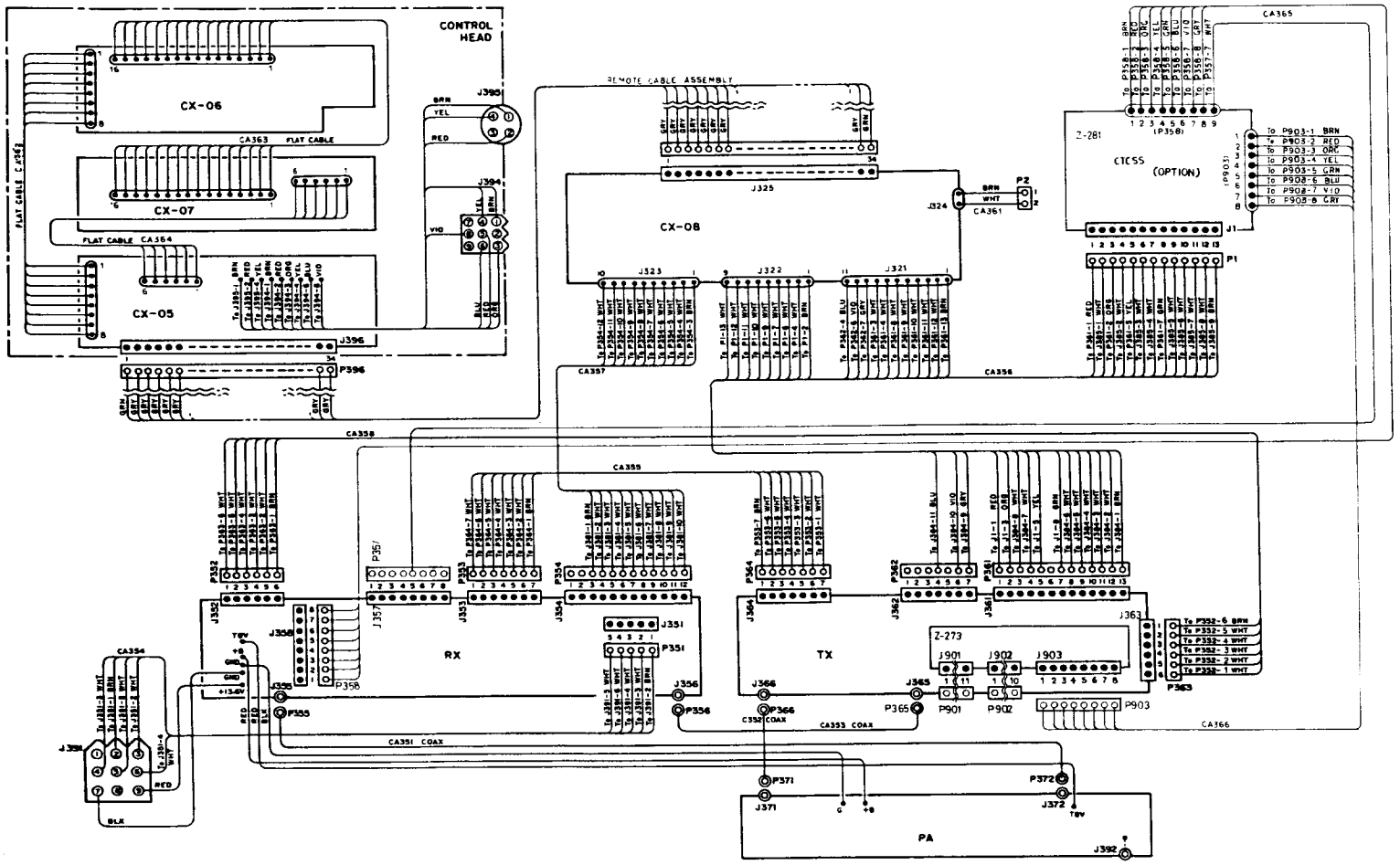


PC BOARD INTER-CONNECT DIAGRAM

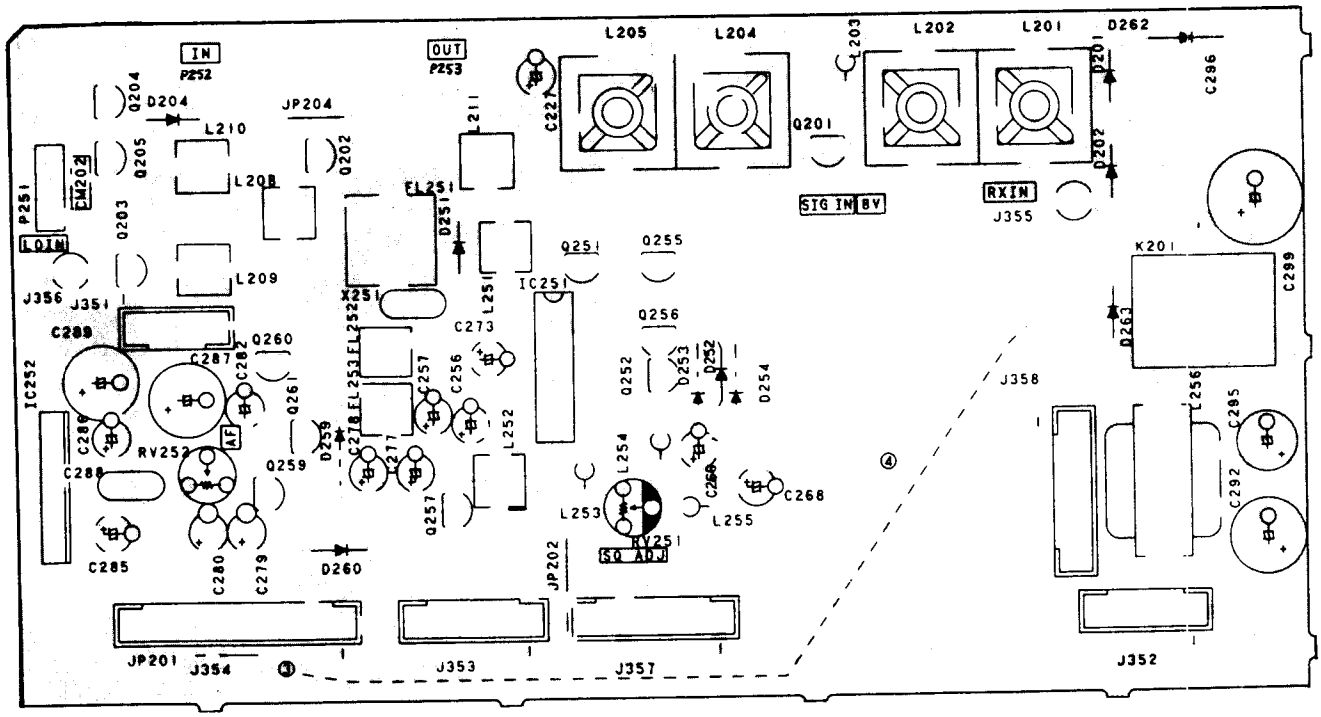


Fold Out

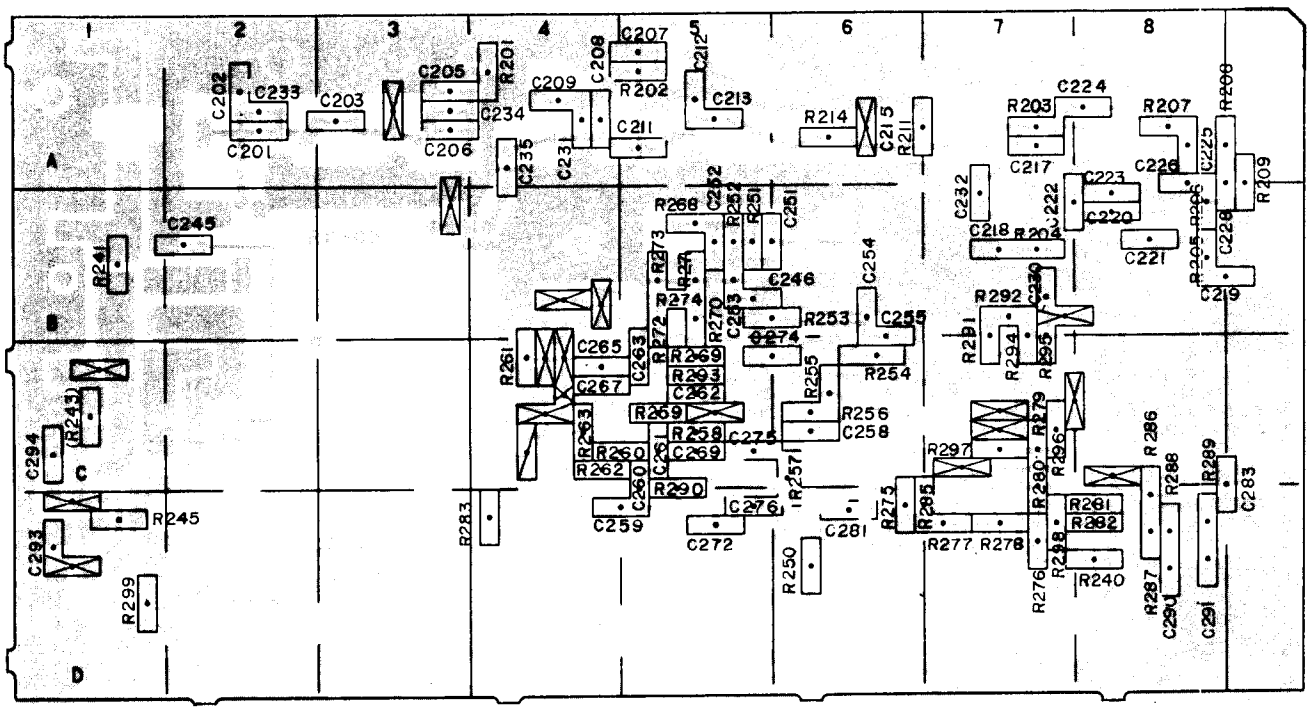
PC BOARD INTER-CONNECT DIAGRAM

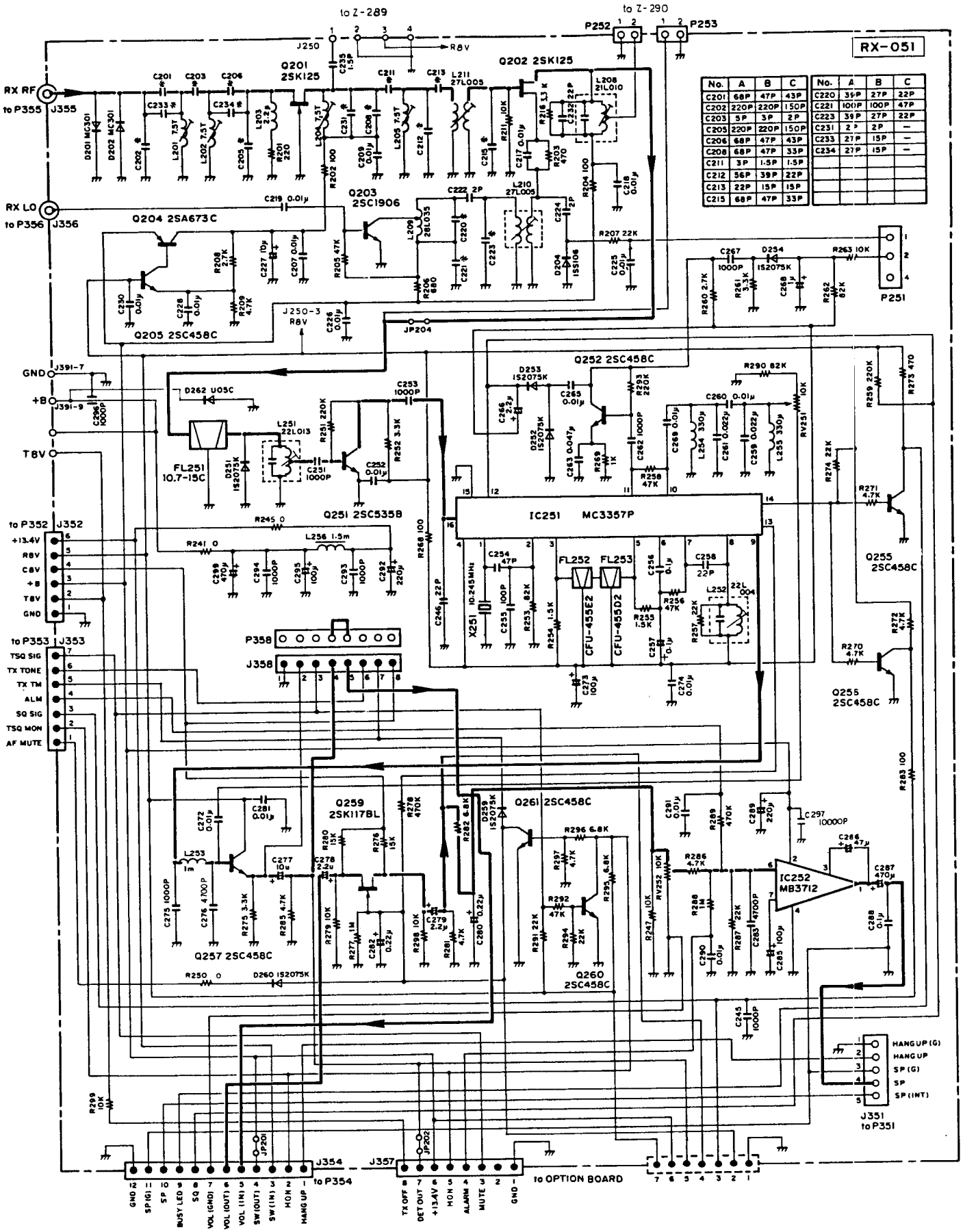


RECEIVER PC BOARD (TOP VIEW)



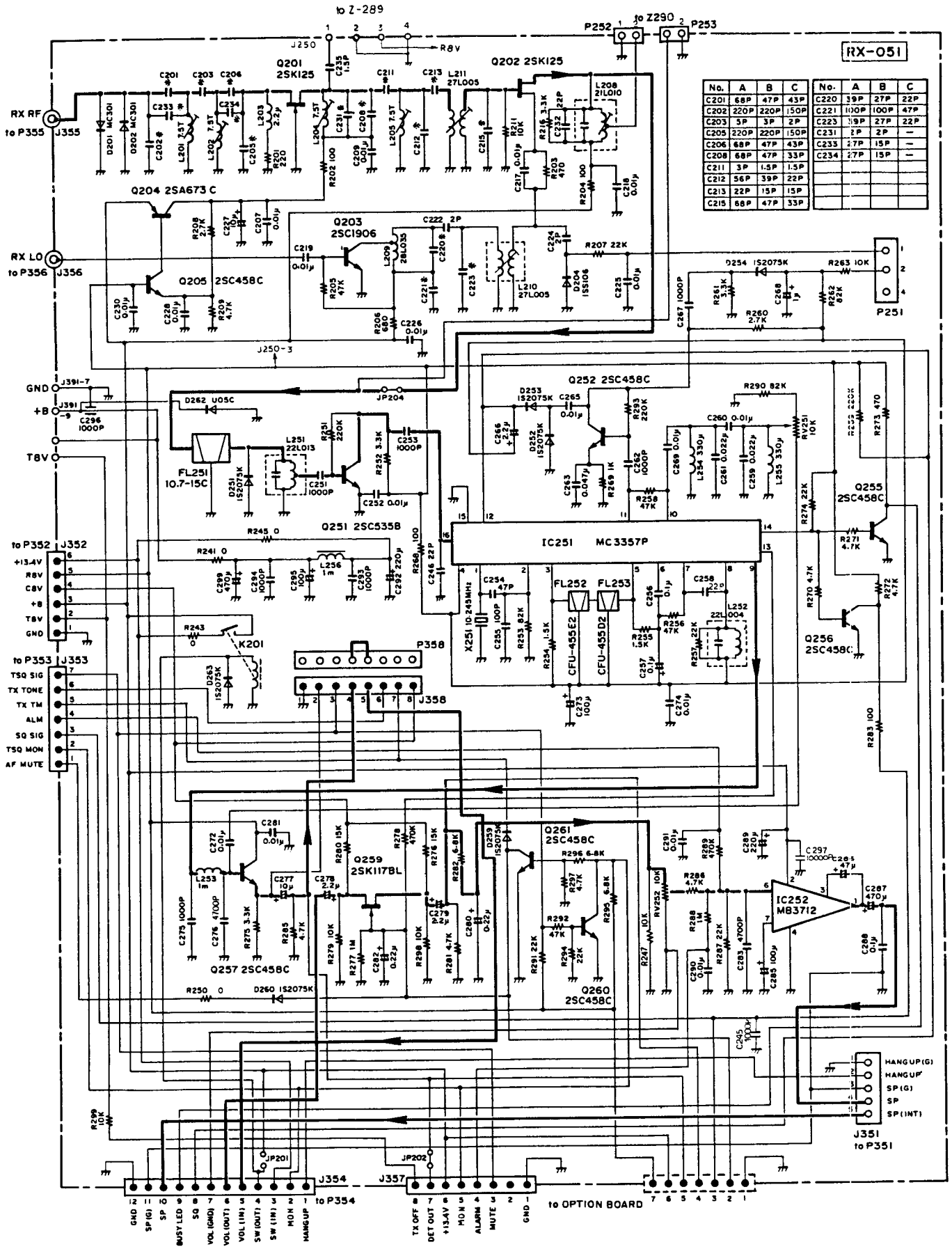
RECEIVER PC BOARD (BOTTOM VIEW)





No.	A	B	C
C201	68P	47P	43P
C202	220P	220P	150P
C203	5P	3P	2P
C205	220P	220P	150P
C206	68P	47P	43P
C208	68P	47P	33P
C211	3P	1.5P	1.5P
C212	56P	39P	22P
C213	22P	15P	15P
C215	68P	47P	33P

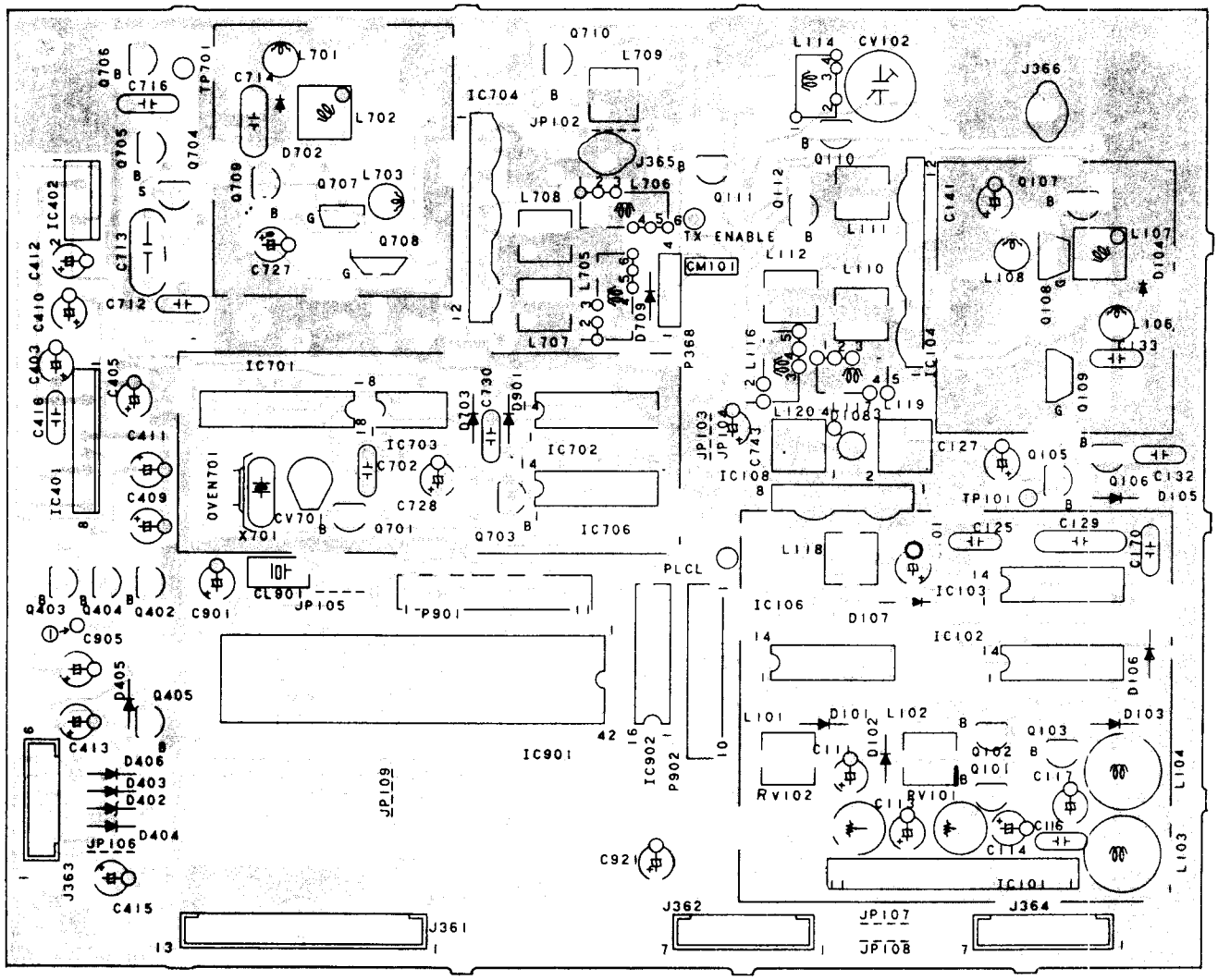
No.	A	B	C
C220	39P	27P	22P
C221	100P	100P	47P
C223	39P	27P	22P
C231	2P	2P	—
C233	21P	15P	—
C234	27P	15P	—



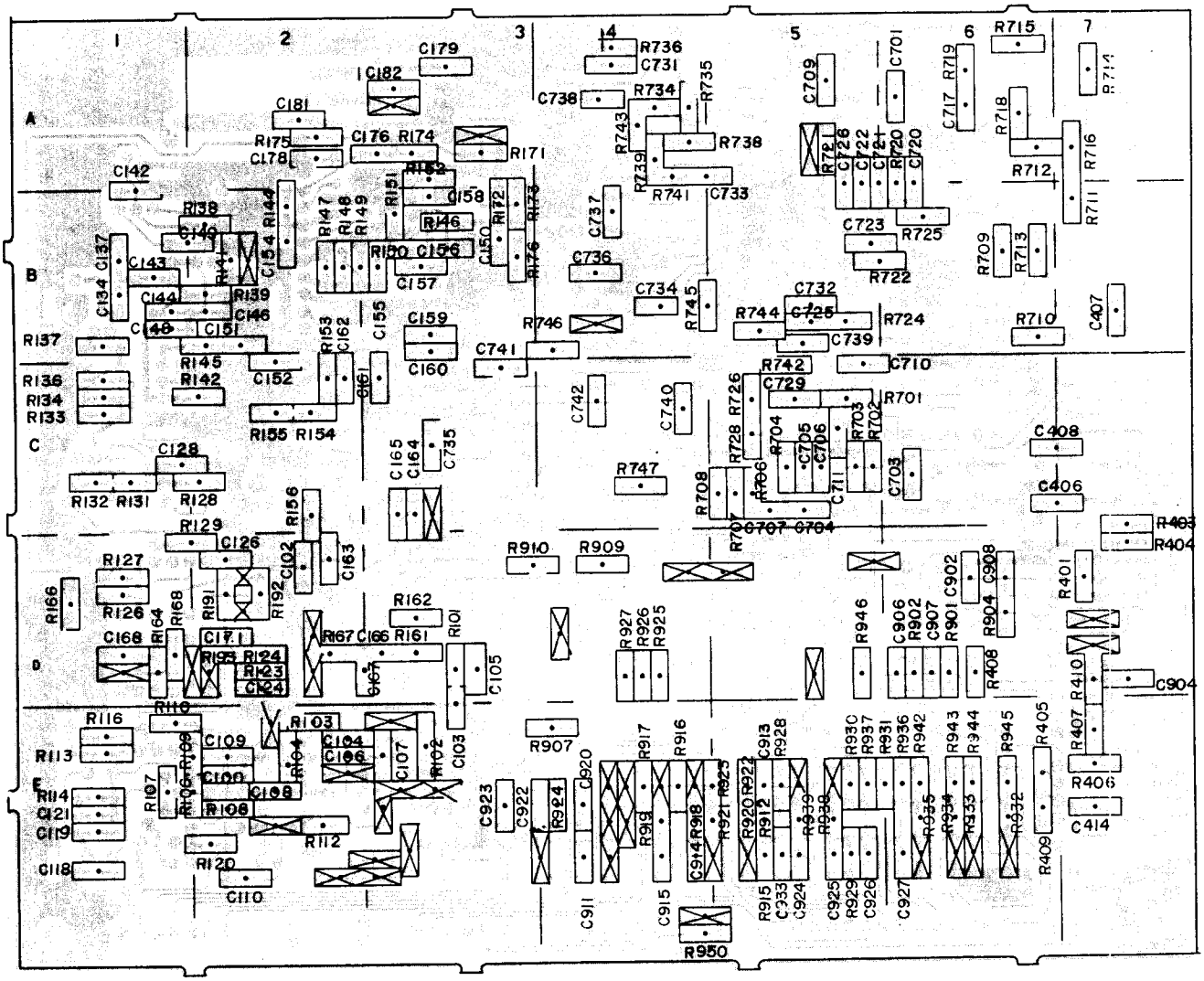
No.	A	B	C
C201	68P	47P	43P
C202	220P	220P	150P
C203	5P	3P	2P
C205	220P	220P	150P
C206	68P	47P	43P
C208	68P	47P	33P
C211	3P	1.5P	1.5P
C212	56P	39P	22P
C213	22P	15P	15P
C215	68P	47P	33P

No.	A	B	C
C220	39P	27P	22P
C221	100P	100P	47P
C223	39P	27P	22P
C231	2P	2P	—
C233	27P	15P	—
C234	47P	15P	—

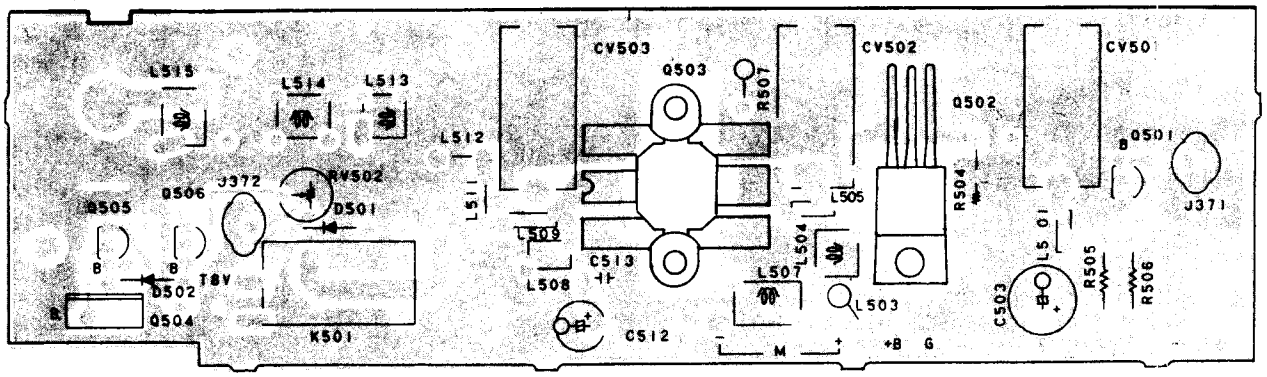
TRANSMITTER PC BOARD (TOP VIEW)



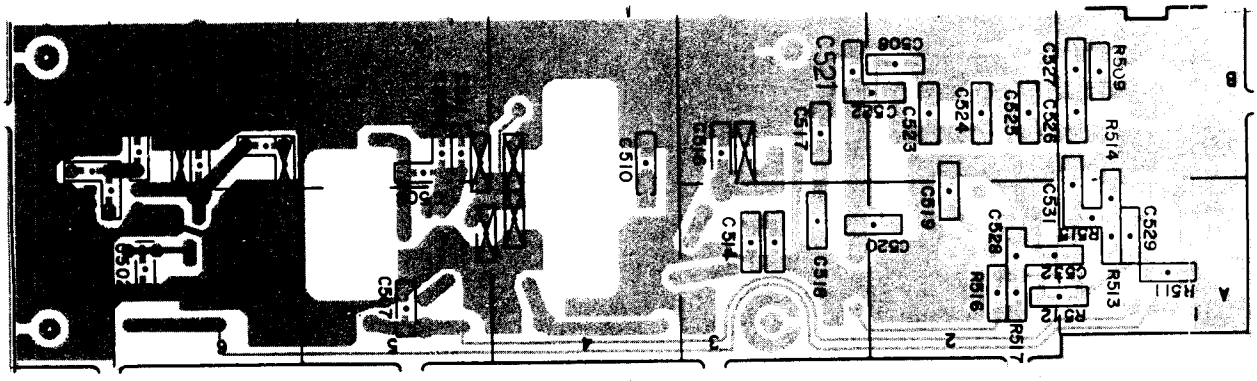
TRANSMITTER PC BOARD (BOTTOM VIEW)



PA PC BOARD (TOP VIEW)

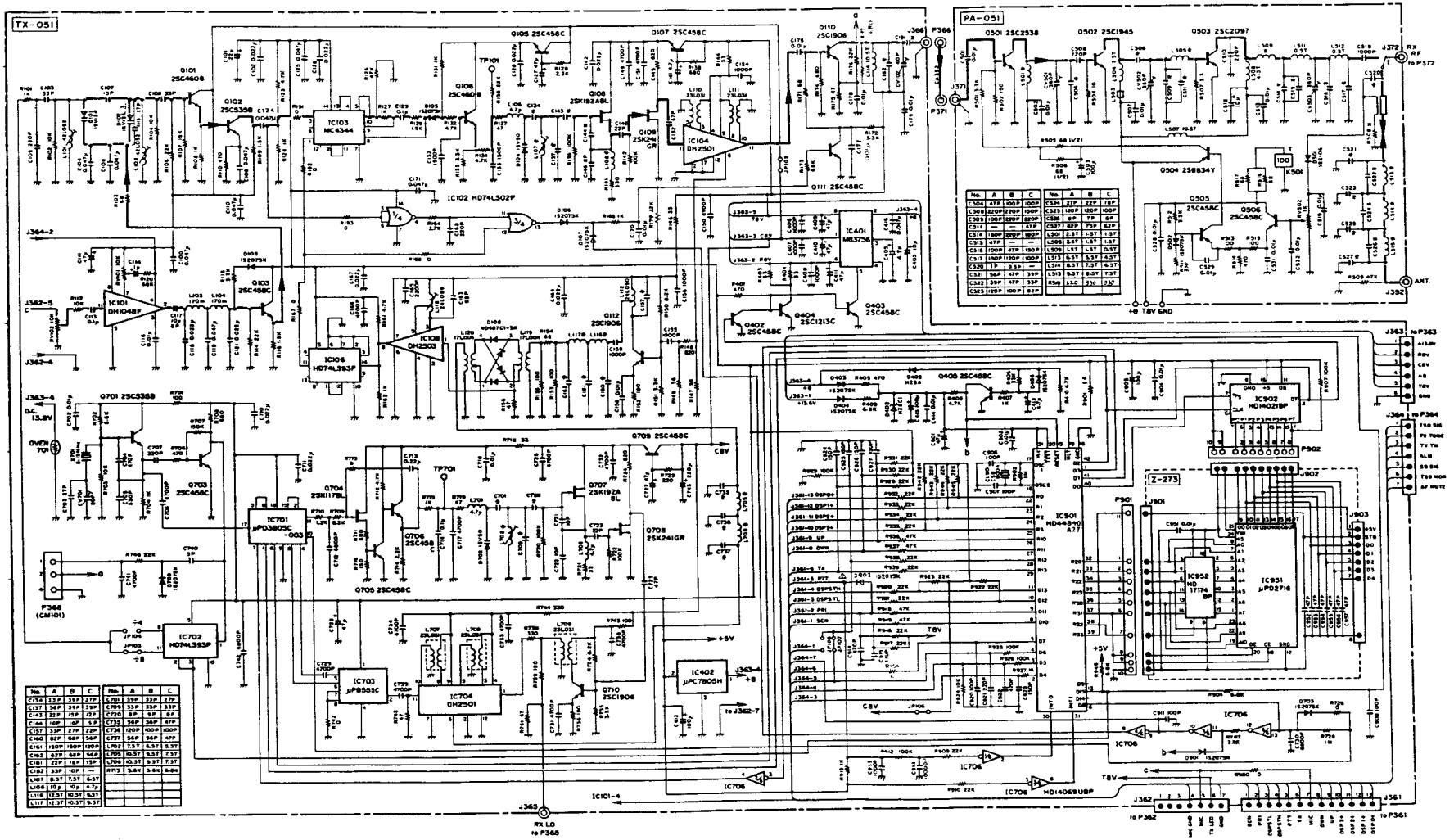


PA PC BOARD (BOTTOM VIEW)



TRANSMITTER SCHEMATIC DIAGRAM

70-050/055



TRANSISTORS

REF. NO.	DESCRIPTION	MODE	BASE	COLLECTOR	EMITTER	FUNCTION
Q101	2SC460B	TX	3.2	8.0	2.5	Buffer
Q102	2SC535B	TX	2.5	2.97	1.8	Buffer
Q103	2SC458C	TX	3.2	5.0	3.1	AF Buffer
Q105	2SC458C	TX	7.9	8.0	7.3	Power Line Filter
Q106	2SC460B	TX	2.3--7.0	7.3	1.6--6.3	Buffer
Q107	2SC458C	TX	7.9	8.0	7.3	Power Line Filter
Q110	2SC1906	TX	1.2	8.0	0.5	Pre Driver
Q111	2SC458C	TX	.143	1.3	0	Pre Driver Control
Q112	2SC1906	TX	1.9	7.6	1.4	Buffer
Q203	2SC1906	RX	0.6	6.0	0	1st Local Amplifier
Q204	2SA673C	RX	13.0	11.5	13.6	Power Regulator
Q205	2SC458C	RX	8.0	13.0	7.4	Power Control
Q251	2SC535B	RX	0.7	3.8	0	1st IF Amplifier
Q252	2SC458C SQ ON 2SC458C SQ OFF	RX RX	1.6 1.7	3.7 3.5	1.5 1.6	Noise Amplifier
Q255	2SC458C	RX	0	2.0	0	Sq. Switch
Q256	2SC458C	RX	0	7.4	0	Sq. Switch
Q257	2SC458C	RX	2.5	8.0	3.2	AF Pre Amplifier
Q260	2SC458C	RX	0.6	0.06	0	Sq. Switch
Q261	2SC458C SQ ON 2SC458C SQ OFF	RX RX	0.02 0	0 3.7	0 0	Sq. Switch
Q301	2SC458C 2SC458C	TX RX	.1 .1	4.0 4.0	0 0	Dimmer Control
Q302	2SB649C 2SB649C	TX RX	4.0 4.0	0 0	4.6 4.6	Dimmer Control
Q402	2SC458C	TX RX	.112 0.7	0.7 0	0 0	Power Control
Q403	2SC458C	TX RX	0.7 0	0 1.7	0 0	Power Switch
Q404	2SC1213C	TX RX	0.7 0	0 8	0 0	Power Control
Q405	2SC458C	TX RX	0.6 0.6	0 0	0 0	Reset (MCPU)
Q501	2SC2538	TX	0.1	3--8	0	Pre Driver
Q502	2SC1945	TX	---	13.6	0	Driver
Q503	2SC2097	TX	---	13.6	0	RF Power Amp.
Q504	2SB834Y	TX	12.9	3--9.2	13.6	APC
Q505	2SC458C	TX	1.6	12.9	1.1	APC Amp.
Q506	2SC458C	TX	1.3--1.9	8.0	1.2	APC Amp.

Fold Out

VOLTAGE CHARTS 70-050/055

Q701	2SC535B	TX RX	2.9 2.9	4.5 4.5	2.4 2.4	OSC (RX SYN)
Q703	2SC458C	TX RX	0.7 0.7	2.0 2.0	0 0	Buffer
Q705	2SC458C	TX RX	0.6 0.6	5.1 5.1	0 0	Loop Filter (RX Syn.)
Q706	2SC458C	TX RX	5.0 5.0	7.3 7.3	4.35 4.35	Loop Filter (RX Syn.)
Q709	2SC458C	TX RX	8.2 8.2	8.2 8.2	7.4 7.4	Power Line Filter
Q710	2SC1906	TX RX	1.9 1.9	7.3 7.3	1.4 1.4	Buffer

F.E.T'S

REF. NO.	DESCRIPTION	MODE	GATE	DRAIN	SOURCE	FUNCTION
Q108	2SK192A BL	TX	0	7.3	1.4	VCO (TX PLL)
Q109	2SK241GR	TX	0	1.6	0	Buffer
Q201	2SK125	RX	0	10.5	2.5	Front End Amp.
Q202	2SK125	RX	0	12.6	3.0	1st Mixer
Q259	2SK117BL SQ.OPN. 2SK117BL SQ.CLS.	RX RX	3.05 0	3.2 3.2	3.3 3.3	AF Switch
Q704	2SK117BL	TX RX	3.3 3.3	7.3 7.3	3.5 3.5	Loop Filter (RX Syn)
Q707	2SK192ABL	TX RX	0 0	7.4 7.4	0.3 0.3	VCO (RX Syn)
Q708	2SK241GR	TX RX	0 0	2.6 2.6	0.6 0.6	Buffer

DIGITAL IC

REF. NO.	DESCRIPTION	PIN NO.	+ V VOLTAGE	GND PIN NO.	FUNCTION:
IC 102	HD74LS02P	14	5	7	Nor Gates
IC 103	MC4344	14	5	7	Phase Detector
IC 106	HD74LS93P	5	5	10	4 Bit Binary Counter
IC 301	HD14511BP	16	8	8	Led Driver
IC 302	HD14511BP	16	8	8	Led Driver
IC 701	uPD5805C	18	5	9	PLL
IC 702	HD74LS93P	5	5	10	4 Bit Binary Counter
IC 703	uPB571C	1	5	4	Pre Scaler (Rx Syn)
IC 706	HD14069UBP	14	5	7	Buffer
IC 901	HD44840A27	20/21	5	16	CPU
IC 902	HD14021BP	16	5	8	Date Shifter (Rx Syn)
IC 951	uPD2716	24	5	12	Read Only Memory
IC 952	HD14174BP	16	5	8	Data Buffer