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**MAINTENANCE MANUAL
RECEIVER BOARD
CMA-257
FOR
MLSH040
TWO-WAY MOBILE RADIO COMBINATIONS**

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DESCRIPTION

The MLS FM dual conversion, super-heterodyne receiver board (CMA-257) is designed for operation in the 150.8 - 174 MHz frequency ranges and mounts in the front and bottom of the radio frame assembly as shown in Figure 1- Receiver Board Location.

A regulated 9.0 volts is provided to operate all receiver stages except the audio PA IC, which operates from the switched A+ (13.6 volts) supply.

The receiver has intermediated frequencies of 82.2 MHz and 455 KHz. Adjacent channel selectivity is obtained by using two band-pass filters: an 82.2 MHz crystal filter and a 455 KHz ceramic filter.

All of the receiver circuitry except the synthesizer, audio preamp, and audio PA are mounted on the receiver (RX) board (refer to Figure 2 - Block Diagram). The receiver consists of:

- a Front End and Mixer
- an 82.2 MHz First IF, a 455 MHz Second IF and a FM Detector
- Audio PA
- Squelch

CIRCUIT ANALYSIS

Receiver Front End

An RF signal from the antenna is coupled through the low-pass filter, antenna switch relay K1 and RF band-pass Filter FL401 to the input of RF amplifier HC401. The output of HC401 is coupled through RF band-pass filter FL402 and low-pass filter FL403 to the input of first mixer HC402. Front end selectivity is provided by the RF band-pass filters and low-pass filter.

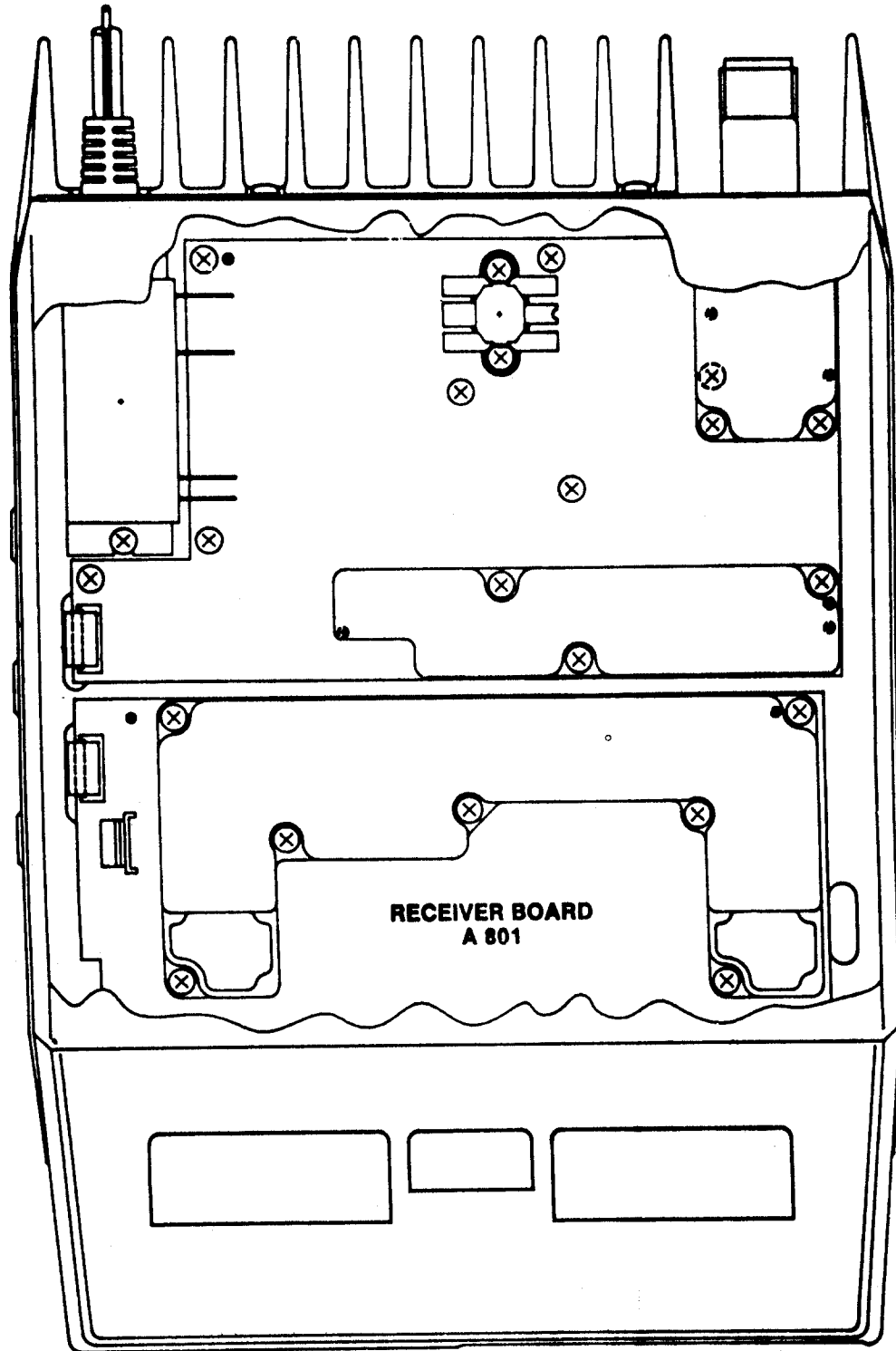
Receiver Injection

The receiver board RF injection frequency (233.0 to 256.2 MHz) from the synthesizer VCO is applied to amplifier HC403 through RX injection connector J402. The input level at J402 will be between 0.5 and 1.0 milliwatts, 0.5 milliwatts minimum. The output of amplifier HC403 is filtered by an injection filter (FL403). This filter is tuned to pass frequencies in the 233.0 - 256.2 MHz band-pass range.

First Mixer

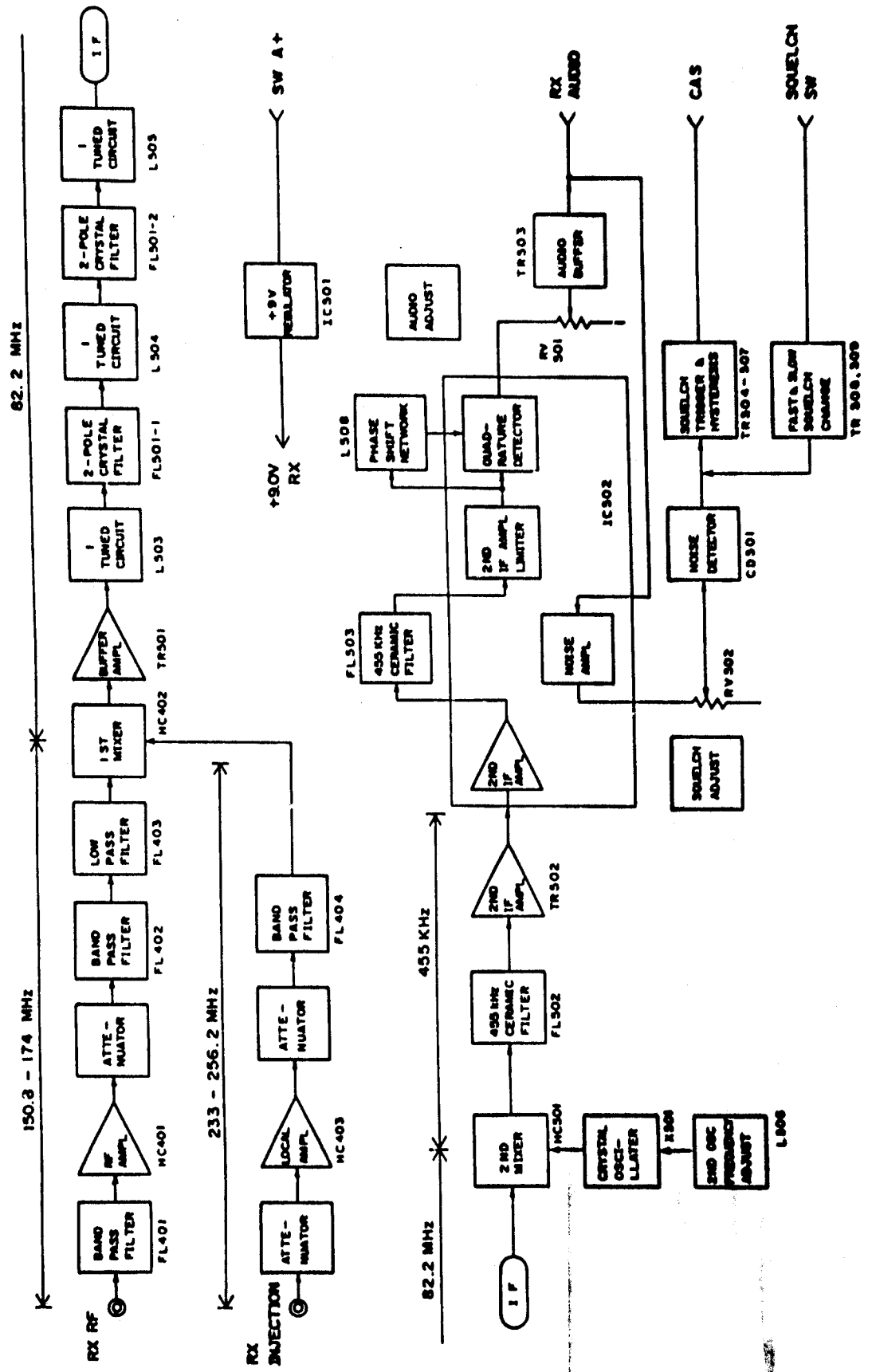
The first mixer (HC402) is a double-balanced diode mixer that converts a signal in the 150.8-174.0 MHz frequency range to the 82.2 Mhz first IF frequency.

In the mixer stage, RF from the front end RF filter is applied to an



RC-6430A

Figure 1 - Receiver Location (Bottom View)



RC-5515

Figure 2 - Block Diagram

input of the mixer. Injection voltage from the amplifier stages is applied to an input of the mixer. The 82.2 MHz mixer first IF output signal is coupled from the output of HC402 through an impedance matching network (TR501 and L503) to a 4-pole crystal filter consisting of FL501-1 and FL501-2.

First IF

The highly-selective crystal filters FL501-1 and FL501-2 provide the first portion of the receiver IF selectivity. The output to the filters is coupled through an impedance matching network consisting of inductor L505, capacitor C506 and resistor R504 to second mixer HC501.

Second Mixer

Second mixer HC501 and associated circuitry provide the second oscillator and second mixer.

The 82.2 MHz IF input is applied to Pin 7 and mixed with an 81.745 MHz frequency supplied by crystal oscillator X501. Inductor L506 sets the frequency of X501.

Second IF and Detector

The output of the second mixer is coupled to the 4-pole ceramic filter FL502, which provides the 455 KHz selectivity. The output of the ceramic filter is coupled to the base of IF amplifier transistor TR502. This transistor provides limiting for the 455 KHz IF signal (1.4 Vp-p) to prevent high level overloading of IC502 (Limited/FM Detector, Noise Amplifier).

IC502 and associated circuitry provide an IF amplifier and FM detector. The 455 KHz IF input is applied to Pin 18.

The 455 KHz IF signal is amplified and applied to 4-pole ceramic filter FL503, which provides the 455 KHz selectivity. The output of the 455 KHz filter is re-applied to IC502-5. The second IF signal is amplified and limited. Inductor L508 shifts the IF signal by 90° and reapplies it to the internal FM detector. The FM detector compares the shifted IF

signal to the internal IF signal to recover the audio modulation. The audio output of IC502 is applied to the System Control and Frequency Synthesizer board (A801) through the base of audio buffer transistor TR503.

Squelch Circuit

The squelch circuit senses the noise components contained in the FM detector audio output. The squelch input is applied to Pin 12 of IC502 from audio buffer transistor TR503. An internal circuit of IC502 provides filtering and applies received noise in the 6-8 KHz frequency band to potentiometer RV502 (Squelch Adjust). The output of the squelch adjust potentiometer is connected to the noise detector. The noise detector consists of resistor R528, capacitor C536 and diode CD501. As the noise increases in magnitude in a negative direction, negative spikes cause CD501 to conduct and charge C535 and C536 to a DC level proportional to the noise level. The output of the noise detector is applied to the input of a squelch trigger circuit consisting of transistors TR504 through TR507. The squelch trigger has approximately 3 dB of hysteresis to prevent sudden noise level changes from effecting the squelch threshold setting. Resistor R527 provides temperature compensation for the squelch circuit. The output of squelch trigger is the Carrier Activated Switch (CAS) signal. The CAS output is applied to the System Control and Frequency Synthesizer board.

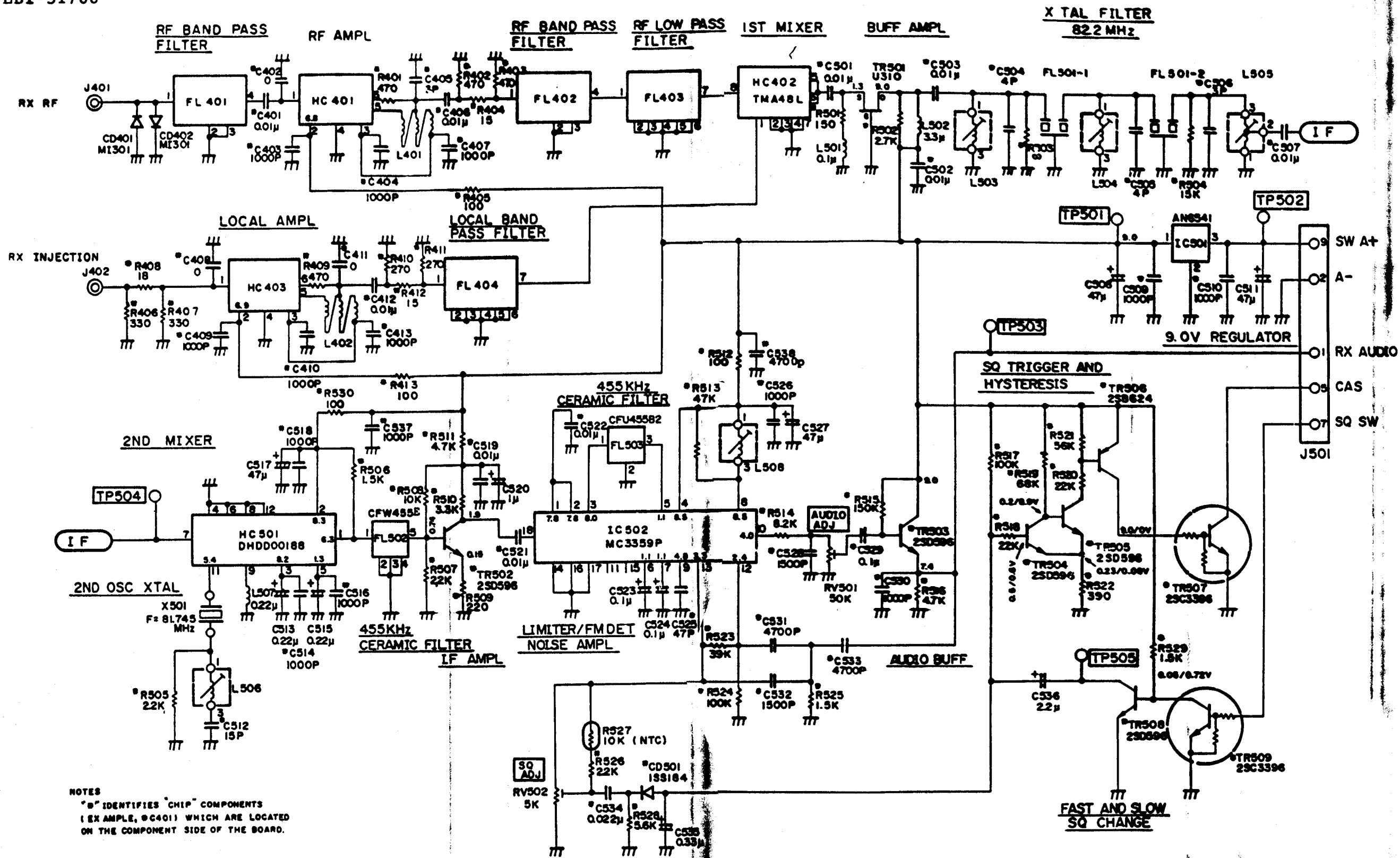
Audio Circuits

Received audio (RX AUDIO) from the FM detector is applied to the input of audio pre-amplifier IC601-A on Frequency Synthesizer Board A801 (refer to Maintenance Manual LBI-31767). The audio is then applied through Tone Reject Filter HC601, audio gate IC604-C and pre-amplifier IC601-C to the Volume Control IC602. The audio output from the Volume Control IC is applied through audio pre-amplifier IC601-C to the de-emphasis network R628, R618, capacitor C609 and C605. This enables audio amplifier IC603 which provides up to 4 watts of audio output power input to a 4-ohm speaker.

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NOTES
 * IDENTIFIES "CHIP" COMPONENTS
 (EX AMPLE, C401) WHICH ARE LOCATED
 ON THE COMPONENT SIDE OF THE BOARD.

ALL RESISTORS ARE 1/8 WATT UNLESS OTHERWISE SPECIFIED
 RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER K OR M.
 CAPACITOR VALUES IN P UNLESS FOLLOWED BY MULTIPLIER μ, n OR p.
 INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER m OR μ.

SCHEMATIC DIAGRAM

150.8-174 MHz Receiver
 DD00-CMA-257

PARTS LIST

RECEIVER BOARD
JRC/CBA-257
ISSUE 1

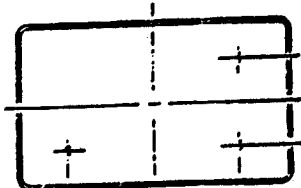
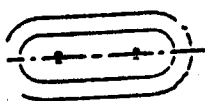
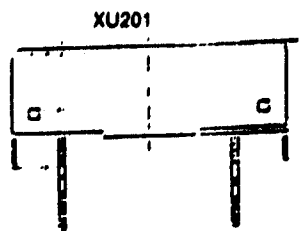
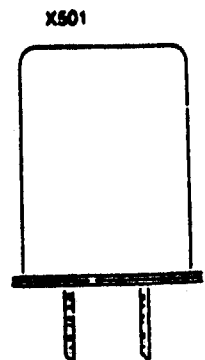
SYMBOL	PART NO.	DESCRIPTION
----- CAPACITORS -----		
C401	JRC/SCAAD00799	Ceramic: 0.01 uF ±10%, 50 VDCV, temp coef ±10%.
C403 and C404	JRC/SCAAD00792	Ceramic: 1000 pF ±5%, 50 VDCV, temp coef ±300 -1000 PPM.
C405	JRC/SCAAD00796	Ceramic: 3 pF ±0.25 pF, 50 VDCV, temp coef 0 ±200 PPM.
C406	JRC/SCAAD00799	Ceramic: 0.01 uF ±10%, 50 VDCV, temp coef ±10%.
C407	JRC/SCAAD00792	Ceramic: 1000 pF ±5%, 50 VDCV, temp coef ±300 -1000 PPM.
C409 and C410	JRC/SCAAD00792	Ceramic: 1000 pF ±5%, 50 VDCV, temp coef ±300 -1000 PPM.
C412	JRC/SCAAD00799	Ceramic: 0.01 uF ±10%, 50 VDCV, temp coef ±10%.
C413	JRC/SCAAD00792	Ceramic: 1000 pF ±5%, 50 VDCV, temp coef ±300 -1000 PPM.
C501 thru C503	JRC/SCAAD00799	Ceramic: 0.01 uF ±10%, 50 VDCV, temp coef ±10%.
C504 and C506	JRC/SCAAD00792	Ceramic: 4 pF ±0.25 pF, 50 VDCV, temp coef 0 ±200 PPM.
C508	JRC/SCAAD00796	Ceramic: 3 pF ±0.25 pF, 50 VDCV, temp coef 0 ±200 PPM.
C507	JRC/SCAAD00799	Ceramic: 0.01 uF ±10%, 50 VDCV, temp coef ±10%.
C508	JRC/SCAAD00796	Electrolytic: 47 uF ±20%, 16 VDCV.
C509 and C510	JRC/SCAAD00792	Ceramic: 1000 pF ±5%, 50 VDCV, temp coef ±300 -1000 PPM.
C511	JRC/SCAAD00796	Electrolytic: 47 uF ±20%, 25 VDCV.
C512	JRC/SCAAD00797	Ceramic: 15 pF ±5%, 50 VDCV, temp coef 0 ±200 PPM.
C513	JRC/SCAAD00799	Tantalum: 0.22 uF ±20%, 35 VDCV.
C514	JRC/SCAAD00792	Ceramic: 1000 pF ±5%, 50 VDCV, temp coef ±300 -1000 PPM.
C515	JRC/SCAAD00799	Tantalum: 0.22 uF ±20%, 35 VDCV.
C516	JRC/SCAAD00792	Ceramic: 1000 pF ±5%, 50 VDCV, temp coef ±300 -1000 PPM.
C517	JRC/SCAAD00796	Electrolytic: 47 uF ±20%, 16 VDCV.
C518	JRC/SCAAD00792	Ceramic: 1000 pF ±5%, 50 VDCV, temp coef ±300 -1000 PPM.
C519	JRC/SCAAD00799	Ceramic: 0.01 uF ±10%, 50 VDCV, temp coef ±10%.
C520	JRC/SCAAD00792	Tantalum: 1 uF ±20%, 35 VDCV.
C521	JRC/SCAAD00799	Ceramic: 0.01 uF ±10%, 50 VDCV, temp coef ±10%.
C522	JRC/SCAAD00799	Ceramic: 0.01 uF ±10%, 50 VDCV, temp coef ±10%.
C523 and C524	JRC/SCAAD00799	Tantalum: 0.1 uF ±20%, 35 VDCV.
C525	JRC/SCAAD00794	Ceramic: 47 pF ±5%, 50 VDCV, temp coef 0 ±200 PPM.
C526	JRC/SCAAD00792	Ceramic: 1000 pF ±5%, 50 VDCV, temp coef ±300 -1000 PPM.
C527	JRC/SCAAD00796	Electrolytic: 47 uF ±20%, 16 VDCV.
C528	JRC/SCAAD00791	Ceramic: 1000 pF ±5%, 50 VDCV, temp coef ±300 -1000 PPM.
C529	JRC/SCAAD00796	Ceramic: 0.1 uF ±20% -20%, 50 VDCV, temp coef ±30 -20%.
C530	JRC/SCAAD00792	Ceramic: 1000 pF ±5%, 50 VDCV, temp coef ±300 -1000 PPM.
C531	JRC/SCAAD00793	Ceramic: 4700 pF ±10%, 50 VDCV, temp coef ±10%.

SYMBOL	GE PART NO.	DESCRIPTION
CB32	JRC/SCAAD00791	Ceramic: 1000 pF ±10%, 50 VDCV, temp coef ±10%.
CB33	JRC/SCAAD00793	Ceramic: 4700 pF ±10%, 50 VDCV, temp coef ±10%.
CB34	JRC/SCAAD01109	Ceramic: 0.022 uF ±20%, 50 VDCV, temp coef ±10%.
CB35	JRC/SCSAC01181	Tantalum: 0.22 uF ±20%, 35 VDCV.
CB36	JRC/SCSAC01089	Tantalum: 2.2 uF ±20%, 35 VDCV.
CB37	JRC/SCAAD00792	Ceramic: 1000 pF ±5%, 50 VDCV, temp coef ±300 -1000 PPM.
CB38	JRC/SCAAD00793	Ceramic: 4700 pF ±10%, 50 VDCV, temp coef ±10%.
----- DIODES -----		
CD401 and CD402	JRC/STRAR0004	Silicon, RF Switching; sim to Mitsubishi.
CD801	JRC/STRAD00390	Silicon, fast recovery (2 diodes in cathode common); sim to Toshiba 1S8184.
----- FILTERS -----		
FL401	JRC/SNBAG00012	Band-pass filter; sim to Soeha BP150-174A1.
FL402	JRC/SNBAG00013	Band-pass filter; sim to Soeha BP150-174A2.
FL403	JRC/SNLAT00020	Low-pass filter; sim to Soeha LP174A1.
FL404	JRC/SNBAG00014	Band-pass filter; sim to Soeha BP232-257A1.
FL501	JRC/SXRAA00850	Crystal filter; sim to Nihon design KPJ15-2.
FL502	JRC/SXRAA00894	Ceramic filter; sim to Murata CF9455E.
FL503	JRC/SXRAA00841	Ceramic filter; sim to Murata CF9455E2.
BC401	JRC/SDHBE00005	Linear, RF Amplifier; sim to Soeha AMP-2.
BC402	JRC/SDHBE00004	Linear, DB-Mixer; sim to Touhou TM648L.
BC403	JRC/SDHBE00005	Linear, RF Amplifier; sim to Soeha AMP-2.
BC501	JRC/SDHDD00188	Linear, Mixer; sim to JRC DHD0188.
----- INTEGRATED CIRCUITS -----		
IC501	JRC/SDHAR00021	Linear, Positive Voltage Regulator; sim to Matsushita AM841.
IC502	JRC/SDHAR00074	Linear, IF Amplifier & Detector; sim to Motorola MC3368.
----- JACKS -----		
J401	JRC/5JUCLO0045	Coaxial, RF; sim to Tuba TWP-J011-A2.
J501	JRC/5JVB00178	Coaxial, 10 pins; sim to Hirose PH3-100-1.250A(6).
----- COILS -----		
L401 and L402	JRC/6LAFD01136	Coll, RF.
L401	JRC/6LAC00391	Choke coil: 0.1 uH ±10%.
L402	JRC/6LAC00160	Choke coil: 3.3 uH ±10%.
L403 thru L405	JRC/6LADD00563	Coll, RF.
L406	JRC/6LADD00554	Coll, RF.
L407	JRC/6LAC00165	Choke coil: 0.22 uH ±20%.
L408	JRC/6LAFD00877	Coll, RF.
----- RESISTORS -----		
R401 thru R403	JRC/5RDAC02163	Metal film: 470 ohms ±5%, 200 VDCV, 1/8 W.
R404	JRC/5RDAC02161	Metal film: 15 ohms ±5%, 200 VDCV, 1/8 W.
R405	JRC/5RDAC02137	Metal film: 100 ohms ±5%, 200 VDCV, 1/8 W.
R406 and R407	JRC/5RDAC02140	Metal film: 330 ohms ±5%, 200 VDCV, 1/8 W.
R408	JRC/5RDAC02146	Metal film: 18 ohms ±5%, 200 VDCV, 1/8 W.
----- TRANSISTORS -----		
TR501	JRC/5TLAG00007	Field effect (Single Gate); sim to Siliconix U310.
TR502 thru TR504	JRC/5TDAB00084	Silicon, NPN; sim to NEC 2SD506 (DV3).
TR506	JRC/5TDAB00055	Silicon, PNP; sim to NEC 2SD524 (DV3).
TR507	JRC/5TCAZ00007	Silicon, NPN; sim to Sanyo 2SC3396.
TR508	JRC/5TDAB00084	Silicon, NPN; sim to NEC 2SD506 (DV3).
TR509	JRC/5TCAZ00007	Silicon, NPN; sim to Sanyo 2SC3396.
----- CRYSTALS -----		
XC501	JRC/5XRAA00849	Quartz crystal: 65.965 MHz, KPJ15-3.
----- SOCKETS -----		
XS501-A and XS501-B	JRC/5EJDF00001	Crystal Socket; sim to Matsushita 75315-001.

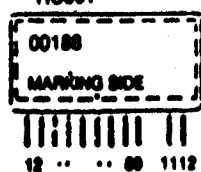
SYMBOL	PART NO.	DESCRIPTION
R409	JRC/5RDAC02153	Metal film: 470 ohms ±5%, 200 VDCV, 1/8 W.
R410 and R411	JRC/5RDAC02163	Metal film: 270 ohms ±5%, 200 VDCV, 1/8 W.
R412	JRC/5RDAC02161	Metal film: 15 ohms ±5%, 200 VDCV, 1/8 W.
R413	JRC/5RDAC02137	Metal film: 100 ohms ±5%, 200 VDCV, 1/8 W.
R501	JRC/5RDAC02135	Metal film: 150 ohms ±5%, 200 VDCV, 1/8 W.
R502	JRC/5RDAC02136	Metal film: 2.7K ohms ±5%, 200 VDCV, 1/8 W.
R504	JRC/5RDAC02160	Metal film: 15K ohms ±5%, 200 VDCV, 1/8 W.
R505	JRC/5RDAC02124	Metal film: 2.2K ohms ±5%, 200 VDCV, 1/8 W.
R506	JRC/5RDAC02133	Metal film: 1.5K ohms ±5%, 200 VDCV, 1/8 W.
R507	JRC/5RDAC02124	Metal film: 2.2K ohms ±5%, 200 VDCV, 1/8 W.
R508	JRC/5RDAC02125	Metal film: 10K ohms ±5%, 200 VDCV, 1/8 W.
R509	JRC/5RDAC02150	Metal film: 230 ohms ±5%, 200 VDCV, 1/8 W.
R510	JRC/5RDAC02147	Metal film: 3.3K ohms ±5%, 200 VDCV, 1/8 W.
R511	JRC/5RDAC02132	Metal film: 4.7K ohms ±5%, 200 VDCV, 1/8 W.
R512	JRC/5RDAC02137	Metal film: 100 ohms ±5%, 200 VDCV, 1/8 W.
R513	JRC/5RDAC02134	Metal film: 47K ohms ±5%, 200 VDCV, 1/8 W.
R514	JRC/5RDAC02158	Metal film: 8.2K ohms ±5%, 200 VDCV, 1/8 W.
R515	JRC/5RDAC02129	Metal film: 150K ohms ±5%, 200 VDCV, 1/8 W.
R516	JRC/5RDAC02132	Metal film: 4.7K ohms ±5%, 200 VDCV, 1/8 W.
R517	JRC/5RDAC02138	Metal film: 100K ohms ±5%, 200 VDCV, 1/8 W.
R518	JRC/5RDAC02140	Metal film: 22K ohms ±5%, 200 VDCV, 1/8 W.
R519	JRC/5RDAC02176	Metal film: 68K ohms ±5%, 200 VDCV, 1/8 W.
R520	JRC/5RDAC02148	Metal film: 22K ohms ±5%, 200 VDCV, 1/8 W.
R521	JRC/5RDAC02231	Metal film: 56K ohms ±5%, 200 VDCV, 1/8 W.
R522	JRC/5RDAC02443	Metal film: 390 ohms ±5%, 200 VDCV, 1/8 W.
R523	JRC/5RDAC02374	Metal film: 39K ohms ±5%, 200 VDCV, 1/8 W.
R524	JRC/5RDAC02138	Metal film: 100K ohms ±5%, 200 VDCV, 1/8 W.
R525	JRC/5RDAC02133	Metal film: 1.5K ohms ±5%, 200 VDCV, 1/8 W.
R526	JRC/5RDAC02124	Metal film: 2.2K ohms ±5%, 200 VDCV, 1/8 W.
R527	JRC/5E2E00082	Thermistor: 10K ohms ±5%, sim to TDK PTC50-4000390 103JC.
R528	JRC/5RDAC02154	Metal film: 5.6K ohms ±5%, 200 VDCV, 1/8 W.
R529	JRC/5RDAC02133	Metal film: 1.5K ohms ±5%, 200 VDCV, 1/8 W.
R530	JRC/5RDAC02137	Metal film: 100 ohms ±5%, 200 VDCV, 1/8 W.
RV501	JRC/5RVAB00317	Variable: 50K ohms ±20%, 0.1 W.
RV502	JRC/5RVAB00277	Variable: 5K ohms ±20%, 0.1 W.
----- CRYSTALS -----		
XC501	JRC/5XRAA00849	Quartz crystal: 65.965 MHz, KPJ15-3.
----- SOCKETS -----		
XS501-A and XS501-B	JRC/5EJDF00001	Crystal Socket; sim to Matsushita 75315-001.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

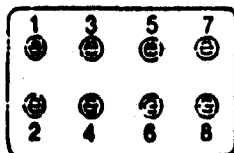
OSCILLATORS



HC501



HC402



IC DATA

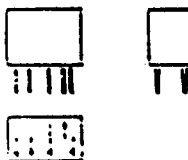
FILTERS

FL403

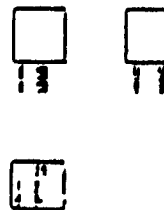


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FL502

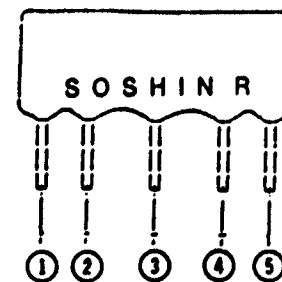


FL503



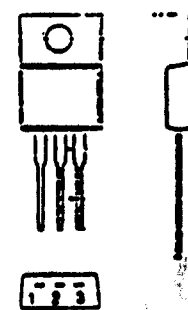
Input
Gnd
Output

FL401-FL403



9-VOLT REGULATOR

IC501



1 - Input
2 - Common
3 - Output

RC-5421