MAINTENANCE MANUAL
ORION™
136-174 MHz SYNTHESIZER/RECEIVER/EXCITER BOARD
B19/CMN-352 A/B

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DESCRIPTION

The ORION™ Synthesizer/Receiver/Exciter board provides, on one printed circuit board, circuits for the synthesizer, receiver and transmitter exciter. The synthesizer circuit generates transmit frequencies for two ranges. Range A (or Part 1) is 136-153 MHz, and range B (or Part 2) is 150-174 MHz. Receiver injection frequencies are also generated by the synthesizer of 181.1-219.1 MHz.

The receive circuit is an FM dual-conversion, superheterodyne receiver designed for operation in the 136-174 MHz frequency range. Regulated 9 Volts is supplied to all receiver stages except the audio PA integrated circuit which operates from the switched A+ supply.

The receiver has **I**ntermediate **F**requencies (**IF's**) of 82.2 MHz and 455 kHz. Adjcent channel selectivity is obtained by two band-pass filters, an 82.2 MHz crystal filter, and a 455 kHz ceramic filter.

The receiver circuit, except for the synthesizer circuit, consists of:

- Front End Mixer
- 45.1 MHz 1st IF, 455 kHz 2nd IF and FM Detector
- Audio Signal Processor (ASP) including squelch
- Audio PA

The receiver Front End and Mixer Circuits are on the Synthesizer/Receiver/Exciter board. The 82.2 MHz 1st IF and the 455 kHz 2nd IF, FM Detector, ASP and Audio PA circuits are on the System Control/IF Board (refer to Maintenance Manual LBI-38906).

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The exciter circuit consists of two wide-band amplifier stages operating over a frequency range of 136-174 MHz without any tuning. The Exciter circuit amplifies a 1 milliwatt signal generated by a **V**oltage **C**ontrolled **O**scillator (**VCO**) in the synthesizer circuit to a 400 milliwatt drive input to the power amplifier.

CIRCUIT ANALYSIS

FREQUENCY SYNTHESIZER

The frequency synthesizer receives SYNTH CLOCK, SYNTH DATA, and control information from the microcomputer and from this generates the transmit and receive RF frequencies (refer to Figure 1). The synthesizer also provides frequency-lock status to the microcomputer. The synthesizer consists of synthesizer chip IC201, low and high current buffers, loop filters, Tx and Rx **V**oltage **C**ontrolled **O**scillators (**VCO**'s), feedback amplifiers, the dual modulus prescaler and the reference oscillator. The VCO's are locked to the reference oscillator by a single direct divide synthesis loop consisting of the feedback buffer, prescaler and synthesizer. The Tx VCO operates over a frequency range of 136 MHz to 174 MHz. The Rx VCO operates over the range of 181.1 to 219.1 MHz.

Reference Oscillator

The reference oscillator consists of a 2-PPM **T**emperature **C**ompensated **X**rystal **O**scillator (**TCXO**). The standard reference oscillator frequency is 12.8 MHz. The TCXO is enclosed in an RF shielded housing. Access to the oscillator trimmer is made through a hole in the top of the housing. The TXCO is compensated by an internal temperature compensating circuit for both low and high temperatures. With no additional compensation the oscillators provide 2 PPM stability from -30°C to +60°C.

Synthesizer

Synthesizer chip IC201 contains a programmable reference oscillator divider (÷R), phase detector and programmable VCO dividers (÷N, ÷A). The reference frequency, 12.8 MHz from the reference ocillator, is divided by a fixed integer number to obtain a 6.25 kHz or 5 kHz channel reference for the synthesizer. This divide value can be changed by PROM programming. The internal phase detector compares the output of the reference divider with the output of the internal N, A counter. The N, A counter receives as an input the VCO frequency divided by the dual modulus prescaler and programmed by the microcomputer. This comparison results in a ± error voltage when the phases differ and a constant output voltage when the frequency detector inputs compare in frequency and phase.

If a phase error is detected an error voltage is developed and applied to the VCO DC offset buffer, high current buffers, and loop-filter to adjust the VCO frequency. The count of the ÷N, ÷A counters is controlled by the frequency data received on the **SYNTH CLOCK** and **SYNTH DATA** lines from the microcomputer. When a different channel is selected or when changing to the transmit or receive mode an error voltage is generated and appears at the phase detector output, **APD OUT**, causing the phase-locked-loop to acquire the new frequency.

The **SYNTH ENABLE** pulse from the microcomputer enables the synthesizer and allows frequency data to be internally stored.

Equalizer

The equalizer circuit consists of operational amplifier IC203-A, resistors R205 and R207 and capacitor C206. This circuit receives transmit audio from Loop Modulation Adjust RV201. The output of the equalizer is summed with the output signal from the Phase Detector in the Adder operational amplifier IC203-B.

DC Offset And High Current Buffers

DC offset buffer transistors TR201 and TR202 and diode CD202-A receive error voltage from the synthesizer and increase the level of this error voltage by 1.8 Vdc. This extends the operating range of the high current buffers. When the Phase-Lock-Loop (PLL) is off frequency due to a channel change or frequency drift, the error voltage from the Synthesizer (APD) rises or falls, turning TR201 either On or Off. This transistor (TR201) controls the DC offset buffer TR202. Resistor R214, diode CD202-A and transistor TR202 complete a high current rapid charge or discharge path for capacitors C210, C211 and C212. As the error voltage decreases, TR201, TR202 and CD202-A turn on, completing a discharge path for C210 through C212. When the error voltage goes positive, TR201, TR202 and CD212 are turned off, allowing C210 through C212 to charge through R214.

When a channel is changed in receive and when changing from transmit to receive, bilateral switch IC204-E, B, C, and D are turned on for 4 milliseconds. When changing from receive to transmit, bilateral switches IC204-C, E, D, and B, are turned on for 10 milliseconds.

Loop Filter

The loop filter consists of resistors R216 through R218 and capacitors C210 through C212. This filter controls the bandwidth and stability of the synthesizer loop. Bilateral switch IC204 is controlled by 9 Volt **SYNTH BANDWIDTH** pulse. When the **SYNTH BANDWIDTH** pulse is present, the bilateral switch shorts out the low-pass filter, greatly increasing the loop bandwidth to achieve the 4 millisecond channel acquisition time required for dual priority scan. The low-pass filter removes noise and other extraneous signals internal to the synthesizer chips. The output of the filter is applied to the varicaps in the transmit and receive VCO's to adjust and maintain the VCO frequency.

The use of two VCO's allows rapid independent selection of transmit and receive frequencies across the frequency split.

Receiver Voltage Controlled Oscillator

The receiver VCO consists of low-noise JFET oscillator, TR240, followed by high-gain buffer transistor TR241. Transistor TR241 prevents external loading and provides power gain. The VCO is a Colpitts oscillator circuit with the various varactors, capacitors and a high-Q resonator coil forming the tank circuit.

The VCO is switched On and Off under the control of the **T/R** line. When the **T/R** line is high, the receiver VCO is turned on (TR 242 is ON). Oscillator output is typically 0 dBm. The output is applied to the feedback buffer for VCO frequency control and as the Rx injection frequency to the receiver 1st mixer through local oscillator buffers in the receive circuit. The Rx VCO uses a high-Q coil to achieve superior noise performance. The VCO operates over a frequency range of 181.1 - 219.1 MHz. The VCO voltage need only be set once at the highest frequency of the band split, after which it operates over the entire split with no additional tuning.

Transmitter Voltage Controlled Oscillator

The transmit VCO is basically the same as the receiver VCO. The wideband VCO allows frequency separation of 17 MHz, or 24 MHz as determined by the bandsplit the radio is operating on, 136-153 MHz, or 150-174 MHz. The varactors in conjunction with the frequency segment selector circuitry (transistors TR2301-TR2303 and band-switching diodes CD285-CD290) provide a voltage controlled adjustment range that extends across the entire frequency split. VCO control switch transistor TR282 turns the transmit VCO on when the T/R line is low.

Feed Back Buffer

The buffered output of the Rx VCO and Tx VCO, from buffer transistors TR241 and TR281 respectively, are supplied to feedback buffer IC206. This, in turn, drives dual modulus prescaler IC205. The buffered VCO output also provides Rx or Tx injection drive.

Dual Modulus Prescaler

The dual modulus prescaler completes the PLL feedback path from the synthesizer to the loop-filter, to the VCO's and feedback buffers and then back to the synthesizer through the prescaler. The prescaler divides the VCO frequency by 64 or 65 under control of **M CONT** signal from the synthesizer. The output of the prescaler is applied to the synthesizer where it is divided down to 6.25 kHz or 5 kHz by an internal ÷N, A counter and compared in frequency and phase with the divided-down frequency from the reference oscillator. The result of this comparison is the error voltage used to maintain frequency lock. The ÷N, A counter is controlled by frequency data received from the microcomputer. Depending on the operating frequency, the DC voltage at Test Point TP201 should be within the range of 3.5 to 7.5 Vdc when the PLL is locked.

Lock Detect

The lock detect circuit consists of comparator IC207, diodes CD204 and CD205, and reference oscillator mute switch transistor TR203. It is used to quickly synchronize the phase relation of the divided-down VCO frequency with the reference oscillator if the loop loses lock. It also provides a fast lock-detect signal to the microcomputer to turn on the out-of-lock indicator. If a large change in frequency is required, the ramp capacitor output (**C_R**) of the synthesizer increases voltage on the LD line from the synthesizer. Thus, transistor TR203 disables the reference oscillator and allows the PLL loop to be brought back to synchronization rapidly.

If a large frequency error exists, the LD positive lead from the synthesizer carries negative spikes to the microcomputer. Transistor TR203 is turned on, thus preventing reference oscillator muting.

Loop Mod Adjust

The Loop Mod Adjust circuit automatically sets the loop modulation level applied to equalizer circuit IC202 and IC203 through Loop Mod Adjuster RV201. The loop Mod Adjust modulation circuit consists of decoder IC208, bilateral switch IC209, resistors R2001 through R2006 and RV201. The loop modulation level is controlled by turning bilateral switches IC209 On or Off (under control of IC208) to include attenuators R2001 through R2006 in the circuit. Resistors R2001 through R2006 form an adjustable voltage divider to change the loop modulation level as required. Table 1 also identifies the resistor (if applicable) used for each frequency segment.

Frequency Segment Selector

The Frequency Segment Selector, operating under control of the microcomputer, switches capacitance in and out of the Tx and Rx VCO tank circuits to select the frequency segment containing the selected channel. The Frequency Segment Selector consists of transistor packages TR2301 through TR2303 and band switching diodes CD243 through CD248 and CD285 through CD290. Capacitors C260, C261, C266, C267, C272, C273, C2104-C2107 and C2111-C2114, C2118-C2120 and C2121 are selected or deselected for operation in a given segment. Table 2 identifies the circuit conditions existing for selection of each segment and the capacitors used.

Reverse bias to turn off the band switching diodes is provided by the +8 Volt filtered supply through resistors R2303, R2306 and R2309. Forward bias for the diodes and current for the switching transistors is provided by the +8 Volts supply through resistors R2301, R2302, R2304, R2305, R2307 and R2308. When segment 3 is selected, switching transistors TR2302 and TR2303 are turned on. In the Tx VCO diodes CD287, CD288, CD289 and CD290 are reverse biased and CD285 and CD286 are turned on. Capacitors C211 and C2112, C2118 and C2119 are effectively isolated from ground and C2104 and C2105 are connected to ground through CD285 and CD286.

Similarly in the Rx VCO capacitors C266, C267, C272 and C273 are isolated from ground. Capacitor C260 and C261 are grounded through diodes CD243 and CD244.

Operation of the radio over the frequency ranges 136-153 MHz or 150-174 MHz is determined by the group number of the synthesizer board. Each frequency split is divided into four operating segments varying from 4 to 6.5 MHz wide.

RECEIVER

Receiver Front End

An RF signal from the antenna is coupled through a low-pass filter, antenna relay, high-pass filter and switchable impedance matching network to the input of RF amplifier (RF AMP) transistor TR401 (Refer to Figure 2). The RF amplifier TR401 is gain switched through a switchable attenuator (about 18 dB / 14 db) by diode CD403.

The output of TR401 is coupled through a low-pass filter and a band-pass filter to the input of 1st mixer HC441. Front end selectivity is provided by this band-pass filter.

Receiver Injection

Receiver RF injection (181.1-219.1 MHz) from the synthesizer **V**oltage **C**ontrolled **O**scillator (**VCO**) is applied to the base of receiver injection amplifier (**Rx INJ AMP**) transistor TR461. The input level of TR461 is between 1.0 and 2.0 milliwatts. The output of TR461 is coupled to the input of receiver injection amplifier (**Rx INF AMP**) transistor TR462. The output of amplifier TR462 is filtered by a low-pass filter consisting of capacitors C475, C476, C477 and inductor L465. This filter is tuned to pass frequencies in the 181.1-219.1 MHz pass band.

1st Mixer

The first mixer is a double-balanced diode mixer (HC441) that converts a signal in the 136-174 MHz frequency range to the 45.1 MHz first IF frequency. In the mixer stage, RF from the receiver front-end RF filter is applied to one input of the mixer. Injection voltage from the amplifier stage is applied to the other input of the mixer. The difference between the receiver front-end RF frequency and the injection frequency produces the 45.1 MHz first **I**ntermediate **F**requency (**IF**). The circuit analysis for the receiver is continued in maintenance manual LBI-38907 for **SYSTEMCONTROL/IF/AUDIO FREQUENCY BOARD CMF-138W.**

Exciter Circuit

The 136-174 MHz Tx injection (**TX INJ**) input from the Tx VCO is applied to the input of amplifier IC151 through an impedance matching circuit consisting of capacitor C151, inductor L151 and capacitor C152 (refer to Figure 3). The Vcc supply voltage (+5 Volts) is applied through Vcc feed network resistor R151 and inductor L152. Capacitor C153 is used to bypass the supply line. The +5 Volts is supplied by voltage regulator IC152 (3-terminal voltage regulator).

The output of IC151 drives amplifier transistor TR151 through an impedance matching circuit consisting of capacitor C154, inductor L153 and coupling capacitor C156. Resistors R153, R152 and diode CD151 set the bias voltage for TR151.

Collector voltage (+9 Volts) for TR151 is applied through the collector feed network resistor R154 and inductor L155. C158 and C159 are bypass capacitors.

The output of TR151 is coupled to connector J151 through impedance matching components consisting of inductor L156 and capacitors C160 and C161.

Table 1 - Frequency Segment Selection

	Segment	Frequency Split (MHz)	SYNTH Band 1 (INPUT TR2303)	SYNTH Band 2 (INPUT TR2301)	SYNTH Band 3 (INPUT TR2302)	Grounded Modulation Resistor
136-153 MHz	1	136-140	1	1	1	R2004
	2	140-144	0	1	1	R2003
	3	144-148	0	1	0	R2002
	4	148-153	0	0	0	R2006
150-174 MHz	1	150-155.5	1	1	1	R2004
	2	155.5-161.5	0	1	1	R2003
	3	161.5-167.5	0	1	0	R2002
	4	167.5-174	0	0	0	R2006

Table 2 - Capacitor Selection

Segment	Transistor Switch			Band Switching Diodes						Grounded Capacitors
	TR2301	TR2302	TR2303	CD243 CD244	CD245 CD246	CD247 CD248	CD285 CD286	CD287 CD288	CD289 CD290	
1	0	0	0	ON	ON	ON	ON	ON	ON	ALL
2	0	0	1	ON	ON	OFF	ON	ON	OFF	C260, C261, C266, C267, C2104, C2105, C2111, C2112
3	0	1	1	ON	OFF	OFF	ON	OFF	OFF	C260, C261, C2104, C2105
4	1	1	1	OFF	OFF	OFF	OFF	OFF	OFF	NONE

NOTE: 1 - Transistor turned ON, 0 - Transistor turned OFF

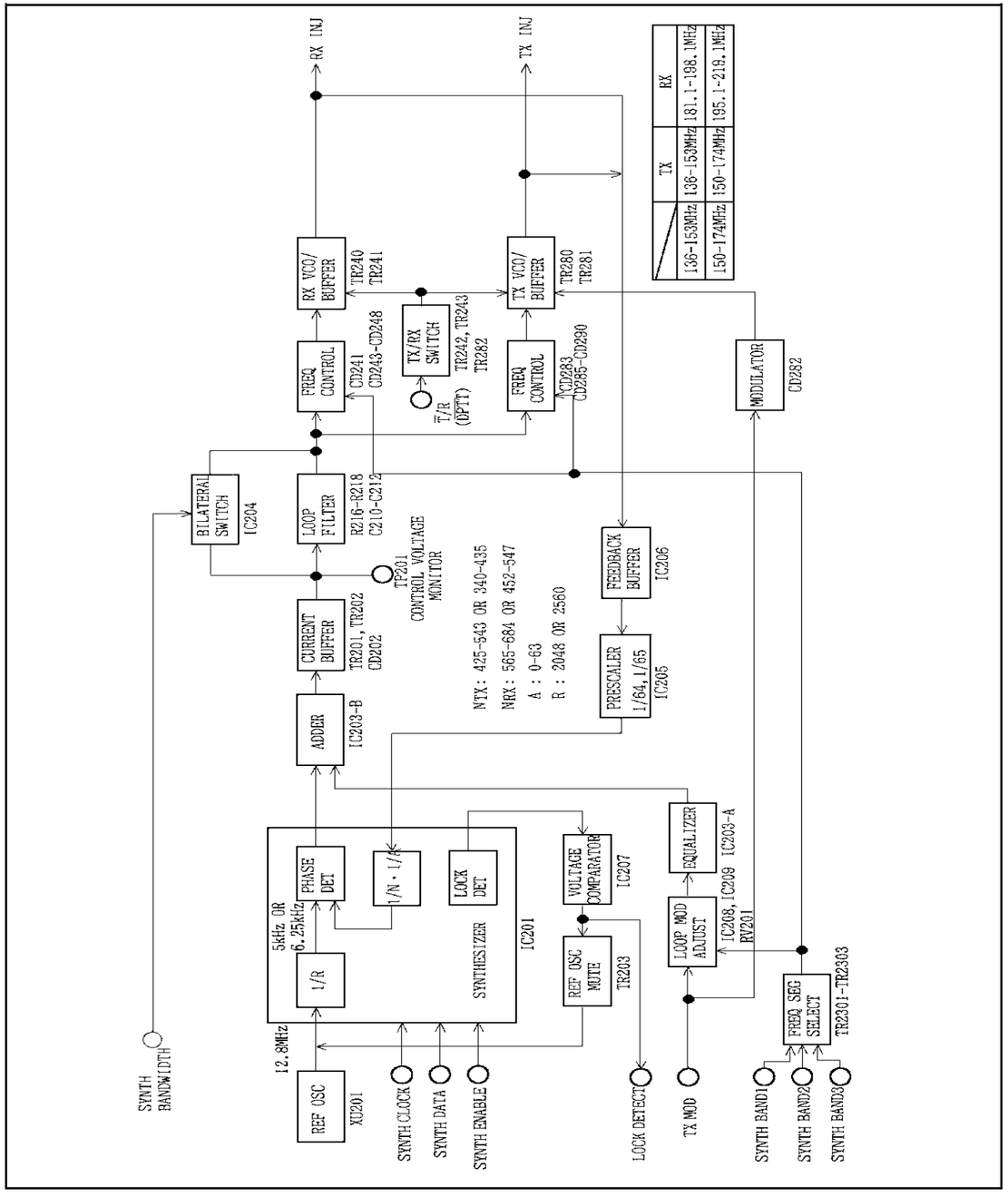


Figure 1 - Synthesizer Block Diagram

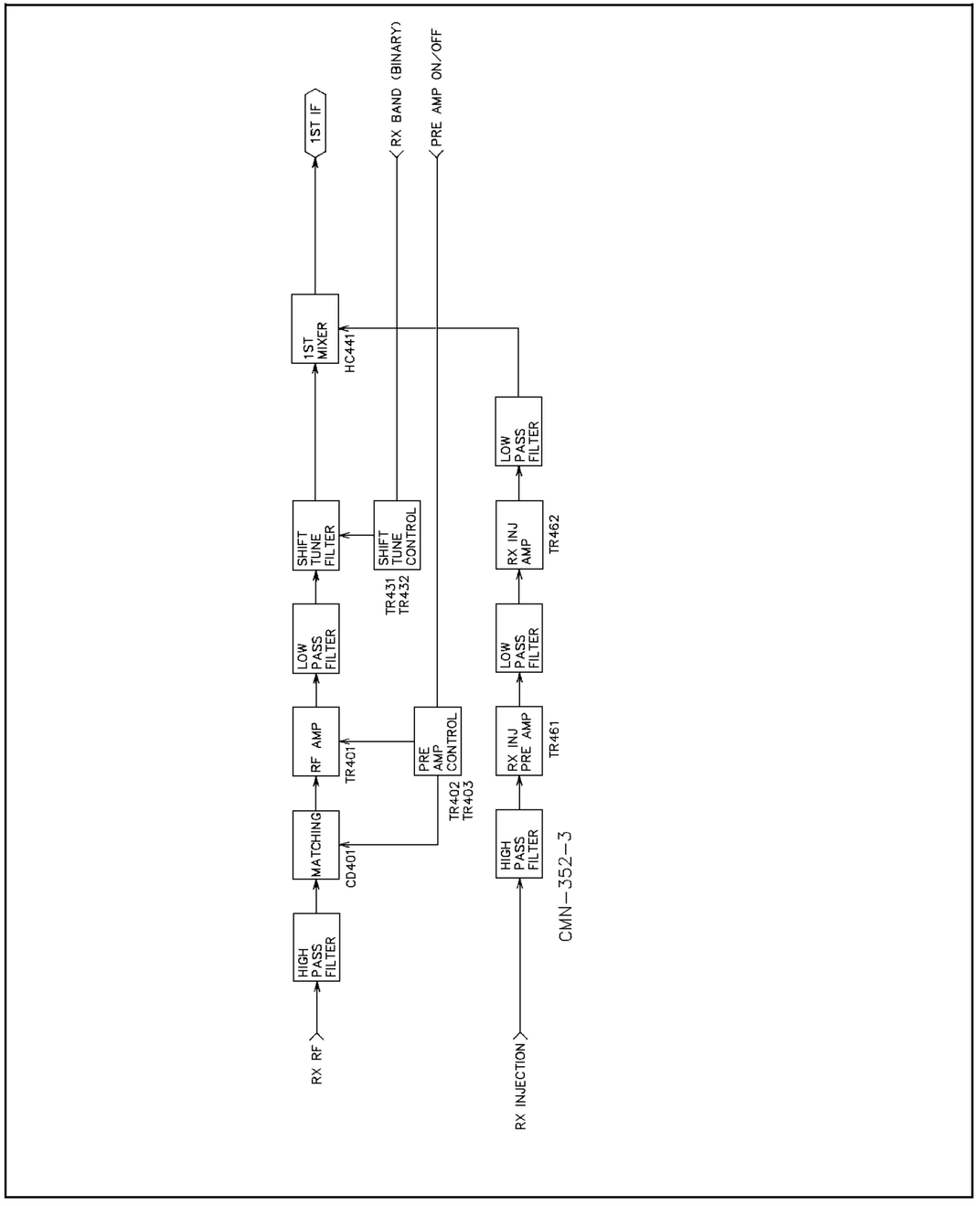


Figure 2 - Receiver Block Diagram

Resistor R155 provides negative feedback through capacitor C157 and C168 to ensure stability.

Transistor TR151 amplifies a 20 milliwatt input level to about 400 milliwatts.

Supply voltage (A+) from connector J501 is regulated to 9 Volts by regulator IC481 (3-terminal regulator). The +9 Volts regulated output on IC481, pin 3 is applied to IC152 and TR151 through Tx power switch transistor TR152. When **TX ENBL** is high (receive mode) +9 Volts is not applied. The exciter energizes when the **TX ENBL** state is made low by the microprocessor, causing TR152 to conduct and apply the regulated +9 Volts to all exciter stages. A typical emitter voltage for TR151 is 1.5 volts.

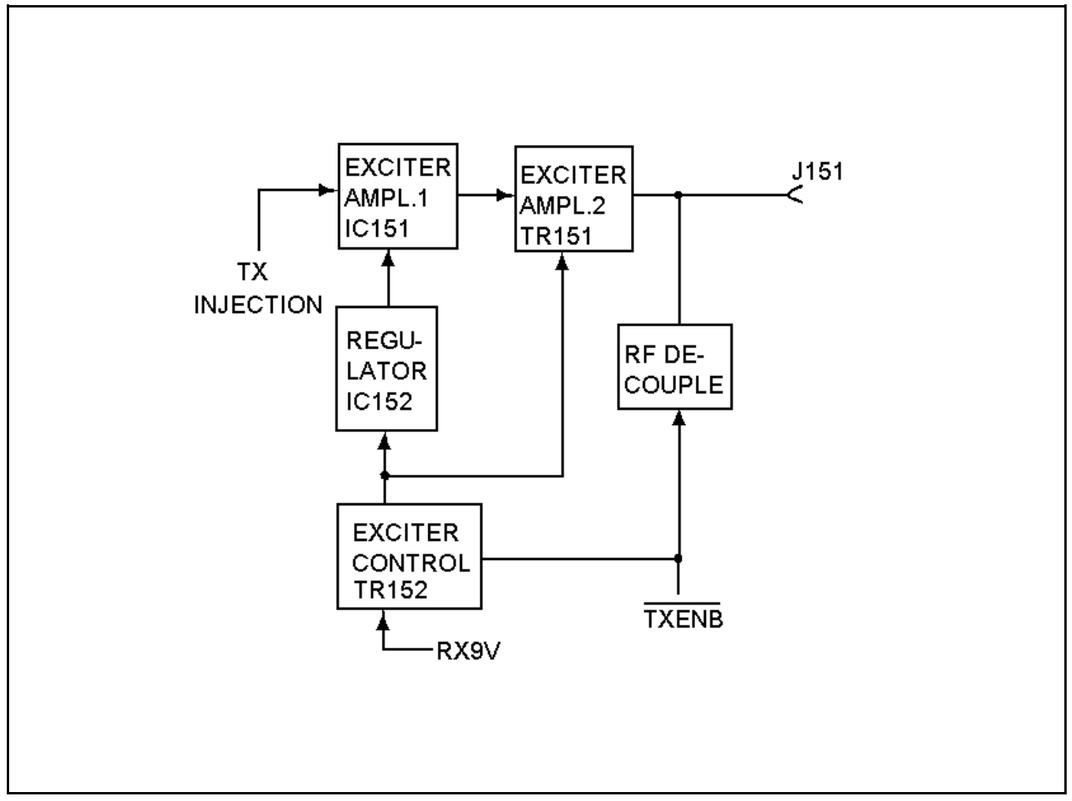
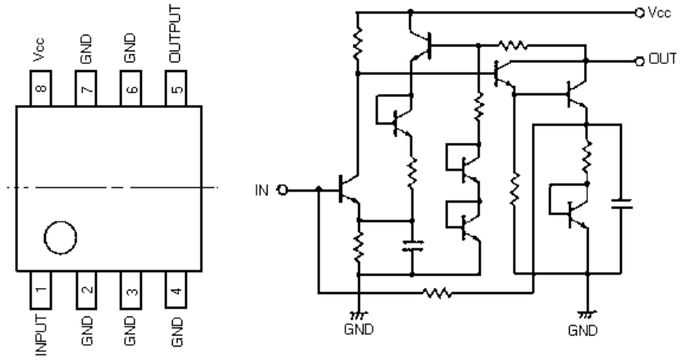
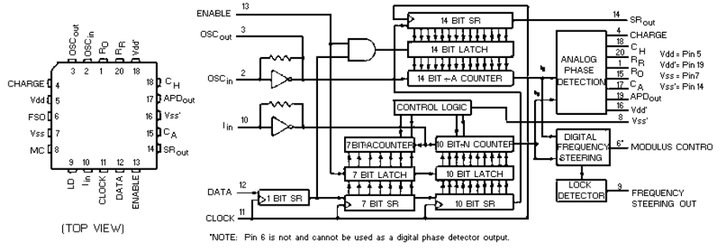


Figure 3 - Exciter Block Diagram

RF WIDE BAND AMPLIFIER IC151

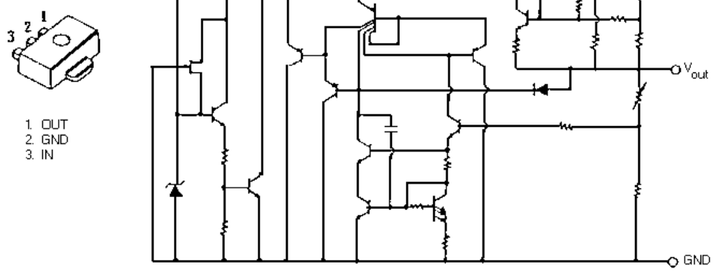


SYNTHESIZER IC201

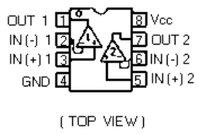


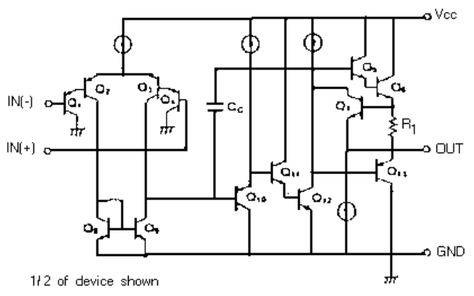
*NOTE: Pin 6 is not and cannot be used as a digital phase detector output.

POSITIVE VOLTAGE REGULATOR IC152

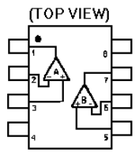


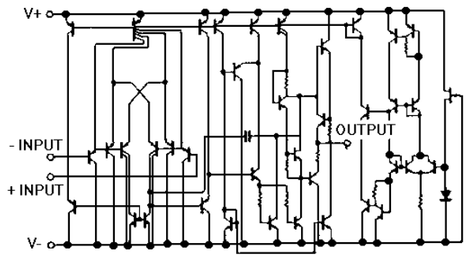
DUAL OPERATIONAL AMPLIFIER IC202



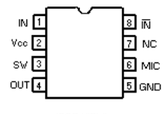


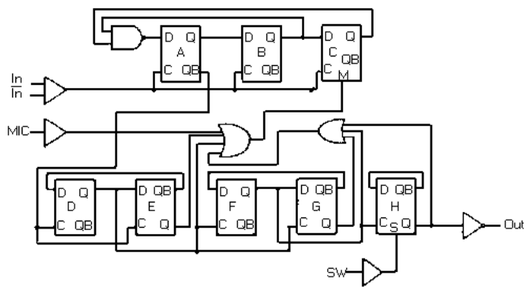
DUAL OPERATIONAL AMPLIFIER IC203



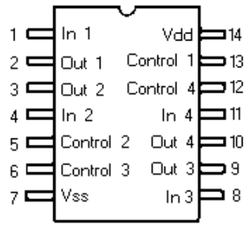


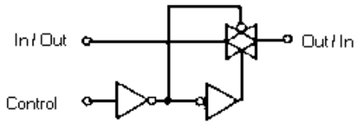
PRESCALER IC205





BILATERAL SWITCH IC204, IC209





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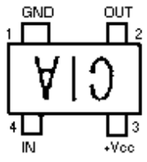
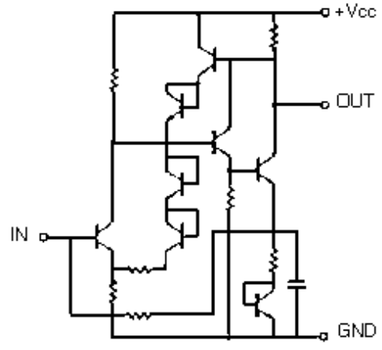
Control	Switch
0 = Vss	OFF
1 = Vdd	ON

RF WIDE BAND AMPLIFIER IC206

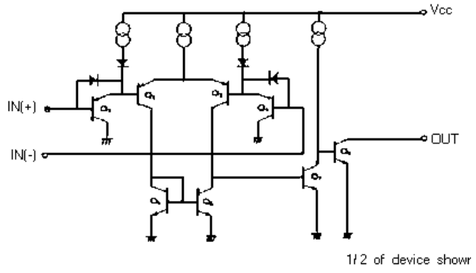


(TOP VIEW)



DUAL COMPARATOR IC207

(TOP VIEW)



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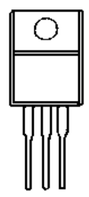
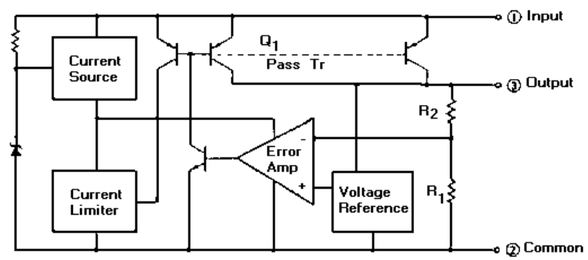
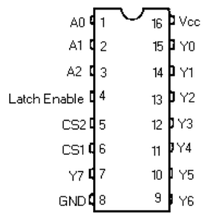
POSITIVE VOLTAGE REGULATOR IC230

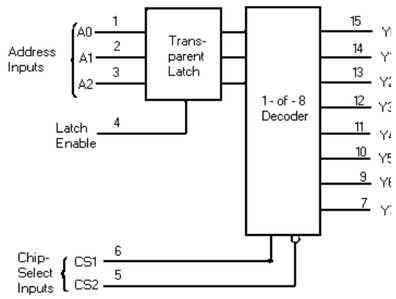


1 2 3
(Top View)

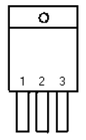


DECODER IC208

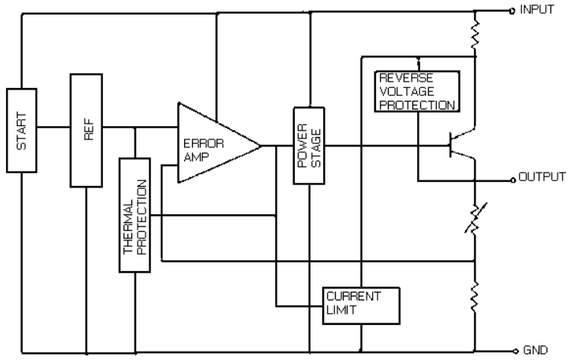




POSITIVE VOLTAGE REGULATOR IC481



1. INPUT
2. GND
3. OUTPUT



RF/EX/SYNTHESIZER BOARD
RECEIVER/EXCITER SECTION
CMN-352A (Used in P1)
CMN-352B (Used in P2)

SYMBOL	PART NO.	DESCRIPTION
	NOTE: Parts listed are for reference only. Refer to Service Section for serviceable parts.	---------- CAPACITORS ----------
C151 thru C153		Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C154		Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0±60 PPM.
C156 thru C159		Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C161		Ceramic: 5 pF ±0.25 pF, 50 VDCW, temp coef 0±60 PPM.
C162 thru C164		Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C165 and C166		Ceramic: 0.1 uF ±10%, 25 VDCW, temp coef ±15%.
C167		Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C168		Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C169		Tantalum: 22 uF ±20%, 16 VDCW.
C170		Tantalum: 1 uF ±20%, 16 VDCW.
C401 and C402		Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0±60 PPM.
C403		Ceramic: 150 pF ±5%, 50 VDCW, temp coef 0±60 PPM.
C404 thru C407		Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C408 and C409		Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C410 and C411		Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C412		Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0±60 PPM.
C413 thru C415		Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C416		Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C417		Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C431A		Ceramic: 9 pF ±0.5 pF, 50 VDCW, temp coef 0±60 PPM. (Used in A)
C431A		Ceramic: 10 pF ±0.5 pF, 50 VDCW, temp coef 0±60 PPM. (Used in B)
C432A		Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0±60 PPM.
C433A		Ceramic: 15 pF ±5%, 50 VDCW, temp coef 0±60 PPM. (Used in A)
C433A		Ceramic: 10 pF ±0.5 pF, 50 VDCW, temp coef 0±60 PPM. (Used in B)
C433B		Ceramic: 4 pF ±0.25 pF, 50 VDCW, temp coef 0±60 PPM. (Used in B)
C434A		Ceramic: 4 pF ±0.25 pF, 50 VDCW, temp coef 0±60 PPM. (Used in A)
C434A		Ceramic: 2 pF ±0.25 pF, 50 VDCW, temp coef 0±250 PPM. (Used in B)
C434B		Ceramic: 0.5 pF ±0.25 pF, 50 VDCW, temp coef 0±250 PPM. (Used in B)
C435		Ceramic: 15 pF ±5%, 50 VDCW, temp coef 0±60 PPM.
C436		Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0±60 PPM. (Used in A)
C436		Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0±60 PPM. (Used in B)
C437		Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0±60 PPM. (Used in A)
C437		Ceramic: 15 pF ±5%, 50 VDCW, temp coef 0±60 PPM. (Used in B)
C438		Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0±60 PPM.
C439		Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0±60 PPM. (Used in A)
C439		Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0±60 PPM. (Used in B)
C440		Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0±60 PPM. (Used in A)
C440		Ceramic: 15 pF ±5%, 50 VDCW, temp coef 0±60 PPM. (Used in B)
C441		Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0±60 PPM. (Used in A)
C441		Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0±60 PPM. (Used in B)
C442		Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0±60 PPM. (Used in A)
C442		Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0±60 PPM. (Used in B)
C443A		Ceramic: 6 pF ±0.5 pF, 50 VDCW, temp coef 0±60 PPM. (Used in A)
C443A		Ceramic: 5 pF ±0.25 pF, 50 VDCW, temp coef 0±60 PPM. (Used in B)
C443B		Ceramic: 3 pF ±0.25 pF, 50 VDCW, temp coef 0±120 PPM. (Used in B)
C444A		Ceramic: 5 pF ±0.25 pF, 50 VDCW, temp coef 0±60 PPM.
C444B		Ceramic: 0.5 pF ±0.25 pF, 50 VDCW, temp coef 0±250 PPM.
C445A		Ceramic: 3 pF ±0.25 pF, 50 VDCW, temp coef 0±120 PPM. (Used in A)
C445A		Ceramic: 2 pF ±0.25 pF, 50 VDCW, temp coef 0±250 PPM. (Used in B)
C445B		Ceramic: 0.75 pF ±0.25 pF, 50 VDCW, temp coef 0±250 PPM. (Used in B)
C446		Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0±60 PPM. (Used in A)
C446		Ceramic: 12 pF ±5%, 50 VDCW, temp coef 0±60 PPM. (Used in B)
C447A		Ceramic: 120 pF ±5%, 50 VDCW, temp coef 0±60 PPM.
C447B		Ceramic: 180 pF ±5%, 50 VDCW, temp coef 0±60 PPM. (Used in A)
C447B		Ceramic: 68 pF ±5%, 50 VDCW, temp coef 0±60 PPM. (Used in B)
C447C		Ceramic: 120 pF ±5%, 50 VDCW, temp coef 0±60 PPM.
C448		Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0±60 PPM. (Used in A)
C448		Ceramic: 12 pF ±5%, 50 VDCW, temp coef 0±60 PPM. (Used in B)
C449A		Ceramic: 0.75 pF ±0.25 pF, 50 VDCW, temp coef 0±250 PPM. (Used in B)
C449B		Ceramic: 3 pF ±0.25 pF, 50 VDCW, temp coef 0±120 PPM. (Used in A)
C449B		Ceramic: 2 pF ±0.25 pF, 50 VDCW, temp coef 0±250 PPM. (Used in B)
C450A		Ceramic: 0.5 pF ±0.25 pF, 50 VDCW, temp coef 0±250 PPM.
C450B		Ceramic: 5 pF ±0.25 pF, 50 VDCW, temp coef 0±60 PPM.
C451A		Ceramic: 6 pF ±0.5 pF, 50 VDCW, temp coef 0±60 PPM. (Used in A)
C451A		Ceramic: 5 pF ±0.25 pF, 50 VDCW, temp coef 0±60 PPM. (Used in B)
C454A thru C454C		Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0±60 PPM.
C455A thru C455C		Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0±60 PPM.
C456A thru C456C		Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0±60 PPM.
C457A thru C457C		Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0±60 PPM.
C461		Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C463		Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C464		Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C465		Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C467		Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0±60 PPM.
C468		Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C469 and C470		Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0±60 PPM.
C471 and C472		Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C473		Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0±60 PPM.
C474		Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
C475 and C476		Ceramic: 15 pF ±5%, 50 VDCW, temp coef 0±60 PPM.
C477		Ceramic: 4 pF ±0.25 pF, 50 VDCW, temp coef 0±60 PPM.
C480		Ceramic: 0.1 uF ±10%, 25 VDCW, temp coef ±15%.
C482		Ceramic: 0.1 uF ±10%, 25 VDCW, temp coef ±15%.
C483 and C484		Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C485		Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C486		Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C488A		Ceramic: 15 pF ±5%, 50 VDCW, temp coef 0±60 PPM. (Used in A)
C488A		Ceramic: 12 pF ±5%, 50 VDCW, temp coef 0±60 PPM. (Used in B)
C488B		Ceramic: 1 pF ±0.25 pF, 50 VDCW, temp coef 0±250 PPM. (Used in B)
C489A		Ceramic: 15 pF ±5%, 50 VDCW, temp coef 0±60 PPM. (Used in A)
C489A		Ceramic: 12 pF ±5%, 50 VDCW, temp coef 0±60 PPM. (Used in B)
C489B		Ceramic: 1 pF ±0.25 pF, 50 VDCW, temp coef 0±250 PPM. (Used in B)
C490		Ceramic: 10 pF ±0.5 pF, 50 VDCW, temp coef 0±60 PPM. (Used in A)
C490		Ceramic: 8 pF ±0.5 pF, 50 VDCW, temp coef 0±60 PPM. (Used in B)
C491		Tantalum: 22 uF ±20%, 16 VDCW.
C492 and C493		Ceramic: 0.01 uF ±10%, 50 VDCW, temp coef ±15%.
C494		Ceramic: 3 pF ±0.25 pF, 50 VDCW, temp coef 0±120 PPM.
C495		Tantalum: 22 uF ±20%, 16 VDCW.
C496		Ceramic: 1000 pF ±10%, 50 VDCW, temp coef ±15%.
CV431 and CV432		Variable: 6 pF max.
		---------- DIODES ----------
CD151		Silicon: fast recovery sim to TOSHIBA ISS352.
CD152		Silicon: fast recovery (2 diodes in cathode); sim to TOSHIBA ISS184.
CD401		Silicon: (Schottky Barrier); sim to MITSUBISHI MI809.
CD403		Silicon: (Schottky Barrier); sim to MITSUBISHI MI809.
CD431 thru CD434		Silicon: Epitaxia Planar Diode; sim to HITACHI HSU277.
		---------- FILTER ----------
FL481		EMI Filter: 1000 pF.
		---------- HYBRID CIRCUIT ----------
HC441		Double Balanced Mixer.
		---------- INTEGRATED CIRCUITS ----------
IC151		RF wide-band ampifier:sim to NEC uPC1678G.
IC152		Linear: Positive Voltage Regulator; sim to NewJRC NJM78L06UA.
IC481		Linear: Positive Voltage Regulator; sim to NEC uPC2409HF.
		---------- JACKS ----------
J151		Connector: RF.
J401		Connector: RF.
J501		Connector: 30 pins.
		---------- COILS ----------
L152		Coil: RF 0.22 uH ±10%.
L153		Coil: RF 33 nH ±10%.
L154 and L155		Coil: RF 0.22 uH ±10%.
L156		Coil: RF 19 nH ±10%.
L157		Coil: RF 1.0 uH ±20%.
L401		Coil: RF.
L402		Coil: RF 0.15 uH ±10%. (Used in A)
L402		Coil: RF 0.1 uH ±10%. (Used in B)
L403 and L404		Coil: RF 0.82 uH ±20%.
L405		Coil: RF 68 nH ±10%.
L406		Coil: RF 47 nH ±10%. (Used in A)
L406		Coil: RF 39 nH ±10%. (Used in B)
L431		Coil: RF. (Used in A)
L431		Coil: RF. (Used in B)
L432		Coil: RF. (Used in A)
L432		Coil: RF. (Used in B)
L433		Coil: RF. (Used in A)
L433		Coil: RF. (Used in B)
L434		Coil: RF.
L435		Coil: RF. (Used in A)
L435		Coil: RF. (Used in B)
L436 and L437		Coil: RF.
L461		Coil: 0.1 uH ±10%.
L462 thru L465		Coil: RF 33 nH ±10%.
L466		Coil: RF 39 uH ±20%.
		---------- RESISTORS ----------
R151		Metal film: 10 ohms ±5%, 50 VDCW, 1/16W.
R152		Metal film: 220 ohms ±5%, 50 VDCW, 1/16W.
R153		Metal film: 1.5K ohms ±5%, 50 VDCW, 1/16W.
R154		Metal film: 4.7 ohms ±10%, 200 VDCW, 1/2W.
R155		Metal film: 330 ohms ±5%, 50 VDCW, 1/16W.
R156		Metal film: 220 ohms ±5%, 100 VDCW, 1/10W.
R157		Metal film: 3.3K ohms ±5%, 50 VDCW, 1/16W.
R158		Metal film 1k ohms ±5%, 100 VDCW, 1/10W.
R159		Metal film: 15 ohms ±5%, 50 VDCW, 1/16W.
R160 thru R162		Metal film: 330 ohms ±5%, 50 VDCW, 1/16W.
R163		Metal film: 15 ohms ±5%, 50 VDCW, 1/16W.
R164		Metal film: 330 ohms ±5%, 50 VDCW, 1/16W.

SYMBOL	PART NO.	DESCRIPTION
R403		Metal film: 1.8K ohms ±5%, 50 VDCW, 1/16W.
R404		Metal film: 6.8K ohms ±5%, 50 VDCW, 1/16W.
R405		Metal film: 27 ohms ±5%, 50 VDCW, 1/16W. (Used in A).
R405		Metal film: 39 ohms ±5%, 50 VDCW, 1/16W. (Used in B).
R406		Metal film: 27 ohms ±5%, 50 VDCW, 1/16W.
R408		Metal film: 2.2K ohms ±5%, 50 VDCW, 1/16W.
R409 and R410		Metal film: 47 ohms ±5%, 50 VDCW, 1/16W.
R411		Metal film: 220 ohms ±5%, 50 VDCW, 1/16W.
R412		Metal film: 470 ohms ±5%, 50 VDCW, 1/16W.
R413		Metal film: 12 ohms ±5%, 50 VDCW, 1/16W.
R414		Metal film: 470 ohms ±5%, 50 VDCW, 1/16W.
R415		Metal film: 10K ohms ±5%, 50 VDCW, 1/16W.
R417		Metal film: 2.2K ohms ±5%, 50 VDCW, 1/16W.
R418		Metal film: 100K ohms ±5%, 50 VDCW, 1/16W.
R419 and R420		Metal film: 10K ohms ±5%, 50 VDCW, 1/16W.
R421		Metal film: 100K ohms ±5%, 50 VDCW, 1/16W.
R422		Metal film: 10K ohms ±5%, 50 VDCW, 1/16W.
R431 thru R434		Metal film: 10K ohms ±5%, 50 VDCW, 1/16W.
R435		Metal film: 0 ohms.
R438		Metal film: 0 ohms.
R445 thru R447		Metal film: 100K ohms ±5%, 50 VDCW, 1/16W.
R448 and R449		Metal film: 10K ohms ±5%, 50 VDCW, 1/16W.
R450 thru R452		Metal film: 100K ohms ±5%, 50 VDCW, 1/16W.
R453 and R454		Metal film: 10K ohms ±5%, 50 VDCW, 1/16W.
R461		Metal film: 5.6K ohms ±5%, 50 VDCW, 1/16W.
R462 and R463		Metal film: 1K ohms ±5%, 50 VDCW, 1/16W.
R464		Metal film: 10 ohms ±5%, 50 VDCW, 1/16W.
R465		Metal film: 22 ohms ±5%, 50 VDCW, 1/16W.
R466		Metal film: 5.6K ohms ±5%, 50 VDCW, 1/16W.
R467 and R468		Metal film: 1K ohms ±5%, 50 VDCW, 1/16W.
R469		Metal film: 22 ohms ±5%, 50 VDCW, 1/16W.
R470		Metal film: 10 ohms ±5%, 50 VDCW, 1/16W.
R471 and R472		Metal film: 330 ohms ±5%, 50 VDCW, 1/16W.
R473		Metal film: 15 ohms ±5%, 50 VDCW, 1/16W.
R474 and R475		Metal film: 330 ohms ±5%, 50 VDCW, 1/16W.
R476		Metal film: 15 ohms ±5%, 50 VDCW, 1/16W.
R477		Metal film: 330 ohms ±5%, 50 VDCW, 1/16W.
R478		Metal film: 15 ohms ±5%, 100 VDCW, 1/10W.
R479		Metal film: 330 ohms ±5%, 50 VDCW, 1/16W.
R480		Metal film: 2.2K ohms ±5%, 50 VDCW, 1/16W. (Used in A).
R480		Metal film: 4.7K ohms ±5%, 50 VDCW, 1/16W. (Used in B).
R498		Metal film: 0 ohms. (Used in B).
R499		Metal film: 0 ohms. (Used in A).

SYMBOL	PART NO.	DESCRIPTION
		---------- TRANSISTORS ----------
TR151		Silicon, NPN; sim to MOTOROLA MRF559.
TR152		Silicon, PNP; sim to NEC 2SB624.
TR401		Silicon, NPN; sim to NEC 2SC3357.
TR402		Silicon, NPN; sim to NEC 2SD596.
TR403		Silicon, NPN; sim to PANASONIC XN6401.
TR431 and TR432		Silicon, NPN; sim to PANASONIC XN6401.
TR461 and TR462		Silicon, NPN; sim to NEC 2SC3357.

RF/EX/SYNTHE BOARD
SYNTHESIZER SECTION
CMN-352A2W (Used in P1)
CMN-352B2W (Used in P2)

SYMBOL	PART NO.	DESCRIPTION
C201	NOTE: Parts listed are for reference only. Refer to Service Section for serviceable parts.	Ceramic: 0.047 uF ±10% 25 VDCW, temp coef ±15%.
C202		Ceramic: 470 pF ±5% 50 VDCW, temp coef +350 -1000 PPM.
C203		Electrolytic: 220 uF ±20% 10 VDCW.
C204		Ceramic: 0.047 uF ±10% 25 VDCW, temp coef ±15%.
C205		Ceramic: 0.01 uF ±10% 50 VDCW, temp coef ±15%.
C206		Polyester: 0.47 uF ±5% 50 VDCW.
C207 thru C209		Electrolytic: 47 uF ±20% 16 VDCW.
C210		Metallized Plastic: 1uF ±10%.
C211		Ceramic: 0.047 uF ±10% 25 VDCW, temp coef ±15%.
C212		Polypropylene: 0.1 uF ±5% 50 VDCW.
C213		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C214		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C215 and C216		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C217		Ceramic: 0.047 uF ±10% 25 VDCW, temp coef ±15%.
C218 thru C220		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C221		Ceramic: 0.047 uF ±10% 25 VDCW, temp coef ±15%.
C222		Ceramic: 150 pF ±5% 50 VDCW, temp coef 0±30 PPM.
C223		Ceramic: 680 pF ±5% 50 VDCW, temp coef +350 -1000 PPM.
C224		Tantalum: 10uF ±20% 10 VDCW.
C225		Tantalum: 4.7uF ±20% 16 VDCW.
C230		Polyester: 0.1 uF ±5% 50 VDCW.
C231		Electrolytic: 47 uF ±20% 16 VDCW.
C232 and C233		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C234		Electrolytic: 47 uF ±20% 16 VDCW.
C235		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C236		Electrolytic: 47 uF ±20% 16 VDCW.
C237 and C238		Ceramic: 0.047 uF ±10% 25 VDCW, temp coef ±15%.
C240		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C241		Ceramic: 18 pF ±5% 50 VDCW, temp coef -750±120 PPM (Used in A).

SYMBOL	PART NO.	DESCRIPTION
C241		Ceramic: 22 pF ±5% 50 VDCW, temp coef -750±120 PPM (Used in B).
C242		Ceramic: 39 pF ±5% 50 VDCW temp coef 0±30PPM.
C243		Ceramic: 5 pF ±0.25 pF 50 VDCW, temp coef 0±30 PPM .
C244		Ceramic: 27 pF ±5% 50 VDCW, temp coef -750±120 PPM.
C246		Ceramic: 22 pF ±5% 50 VDCW, temp coef 0±30 PPM.
C247		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C248		Ceramic: 22 pF ±5% 50 VDCW, temp coef 0±30 PPM.
C249		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C250		Ceramic: 1 pF ±0.25 pF 50 VDCW, temp coef 0±30 PPM.
C251 thru C253		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C255		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C256		Ceramic: 15 pF ±5% 50 VDCW, temp coef 0±30 PPM.
C257		Ceramic: 8 pF ±0.5pF 50 VDCW, temp coef 0±30 PPM.
C258		Ceramic: 15 pF ±5% 50 VDCW, temp coef 0±30 PPM.
C260		Ceramic: 4 pF ±0.25 pF 50 VDCW, temp coef 0±30 PPM.(Used in A).
C260		Ceramic: 6 pF ±0.5 pF 50 VDCW, temp coef 0±30 PPM.(Used in B).
C261		Ceramic: 6 pF ±0.5 pF 50 VDCW, temp coef 0±30 PPM.
C263 and C264		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C266		Ceramic: 6 pF ±0.5 pF 50 VDCW, temp coef 0±30 PPM (Used in A).
C266		Ceramic: 7 pF ±0.5 pF 50 VDCW temp coef 0±30 PPM (Used in B).
C267		Ceramic: 4 pF ±0.25 pF 50 VDCW, temp coef 0±30 PPM (Used in A).
C267		Ceramic: 8 pF ±0.5pF 50 VDCW, temp coef 0±30 PPM (Used in B).
C269 and C270		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C272		Ceramic: 6 pF ±0.5 pF 50 VDCW, temp coef 0±30 PPM (Used in A).
C272		Ceramic: 8 pF ±0.5pF 50 VDCW, temp coef 0±30 PPM (Used in B).
C273		Ceramic: 7 pF ±0.5 pF 50 VDCW, temp coef 0±30 PPM (Used in A).
C273		Ceramic: 12 pF ±5%. 50 VDCW, temp coef 0±30 PPM (Used in B).
C275 and C276		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C280		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C281		Ceramic: 1 pF ±0.25 pF 50 VDCW, temp coef 0±30 PPM.
C282		Ceramic: 4 pF ±0.25 pF 50 VDCW, temp coef 0±30 PPM (Used in A).
C282		Ceramic: 5 pF ±0.25 pF 50 VDCW, temp coef 0±30 PPM (Used in B).
C283		Ceramic: 220 pF ±5% 50 VDCW, temp coef 0±30 PPM.
C284		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C285		Ceramic: 33 pF ±5% 50 VDCW, temp coef -750±120 PPM.
C286		Ceramic: 22 pF ±5% 50 VDCW, temp coef -750±120 PPM .
C287		Ceramic: 2 pF ±0.25 pF 50 VDCW, temp coef 0±30 PPM.
C288		Ceramic: 82 pF ±5% 50 VDCW, temp coef 0±30 PPM (Used in A).
C288		Ceramic: 68 pF ±5% 50 VDCW, temp coef 0±30 PPM (Used in B).
C289		Ceramic: 7 pF ±0.5 pF 50 VDCW, temp coef 0±30 PPM (Used in B).
C290		Ceramic: 22 pF ±5% 50 VDCW, temp coef 0±30 PPM.

SYMBOL	PART NO.	DESCRIPTION
C291 and C292		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C293		Ceramic: 27 pF ±5% 50 VDCW, temp coef 0±30 PPM (Used in A).
C293		Ceramic: 18 pF ±5% 50 VDCW, temp coef 0±30 PPM (Used in B).
C294		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C295		Ceramic: 1 pF ±0.25 pF 50 VDCW, temp coef 0±30 PPM.
C296 thru C298		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C2001		Tantalun: 10uF ±20% 10 VDCW.
C2100		Ceramic: 18 pF ±5% 50 VDCW, temp coef 0±30 PPM.
C2101		Ceramic: 15 pF ±5% 50 VDCW, temp coef 0±30 PPM.
C2102		Ceramic: 18 pF ±5% 50 VDCW, temp coef 0±30 PPM.
C2104		Ceramic: 12 pF ±5% 50 VDCW, temp coef 0±30 PPM (Used in A).
C2104		Ceramic: 8 pF ±0.5 pF 50 VDCW, temp coef 0±30 PPM (Used in B).
C2105		Ceramic: 12 pF ±5% 50 VDCW, temp coef 0±30 PPM (Used in A).
C2105		Ceramic: 10 pF ±0.5 pF 50 VDCW, temp coef 0±30 PPM (Used in B).
C2106 and C2107		Ceramic: 3 pF ±0.25 pF 50 VDCW, temp coef 0±30 PPM (Used in A).
C2108 and C2109		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C2111		Ceramic: 15 pF ±5% 50 VDCW, temp coef 0±30 PPM (Used in A).
C2111		Ceramic: 12 pF ±5% 50 VDCW, temp coef 0±30 PPM (Used in B).
C2112		Ceramic: 15 pF ±5% 50 VDCW, temp coef 0±30 PPM.
C2113 and C2114		Ceramic: 3 pF ±0.25 pF 50 VDCW, temp coef 0±30 PPM (Used in A).
C2115 and C2116		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C2118		Ceramic: 27 pF ±5% 50 VDCW, temp coef 0±30 PPM (Used in A).
C2118		Ceramic: 18 pF ±5% 50 VDCW, temp coef 0±30 PPM (Used in B).
C2119		Ceramic: 27 pF ±5% 50 VDCW, temp coef 0±30 PPM.
C2120 and C2121		Ceramic: 3 pF ±0.25 pF 50 VDCW, temp coef 0±30 PPM (Used in A).
C2122 and C2123		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C2201		Ceramic: 15 pF ±5% 50 VDCW, temp coef 0±30 PPM.
C2304		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
		----------DIODES ----------
CD201		Zener: 4.0 V; sim to HITACHI HZM3.9NB2.
CD202		Silicon: fast recovery (2 diodes in series); sim to TOSHIBA 1SS226.
CD203		Zener: 3.0 V; sim to HITACHI HZK3B.
CD204		Silicon: fast recovery (2 diodes in series); sim to TOSHIBA 1SS226.
CD205		Silicon: fast recovery(2 diodes with anode common); sim to TOSHIBA 1SS181.
CD241		Silicon: Variable Capacitance Diode: sim to TOSHIBA ISV228.
CD242		Silicon: (Schottky Barrier); sim to HITACHI HSU88.
CD243 thru CD248		Silicon: Epitaxial Planer Diode: sim to ROHM 1SS318.

SYMBOL	PART NO.	DESCRIPTION
CD281		Silicon: fast recovery (2 diodes in series); sim to PANASONIC MA153A.
CD282		Silicon: Variable Capacitance Diode; sim to HITACHI HVU202.
CD283		Silicon: Variable Capacitance Diode: sim to TOSHIBA ISV228.
CD284		Silicon: (Schottky Barrier); sim to HITACHI HSU88.
CD285 thru CD290		Silicon: Epitaxial Planer Diode: sim to ROHM 1SS318.
CV240		Variable: 10 pF max.
CV280		Variable: 10 pF max.
FL204		EMI Filter:
		---------- INTEGRATED CIRCUITS ----------
IC201		Synthesizer: CMOS serial input; sim to MOTOROLA MC145159FN.
IC202		Linear: Dual OP AMP; sim to MITSUBISHI M5223FP.
IC203		Linear: Dual OP AMP; sim to New JRC NJM3404AM.
IC204		Digital: Bilateral switch sim to MOTOROLA MC14066BF.
IC205		Prescaler: sim to MOTOROLA MC12022SLAD.
IC206		RF Wide bend amplifier; sim to NEC UPC1676G.
IC207		Linear: Dual Comparator; sim to MITSUBISHI M5233FP.
IC208		Digital: Decoder; sim to MOTOROLA MC74HC237F.
IC209		Digital: Bilateral switch sim to MOTOROLA MC14066BF.
IC230		Linear: Positive Voltage Regulator; sim to PANASONIC AN6541.
		---------- COILS ----------
L201		Choke Coil: 4.7 uH ±10%.
L220		Coil RF: 33 nH ±10%.
L230		Choke Coil: 4.7 uH ±10%.
L240 and L241		Choke Coil: 0.68 uH ±10%.
L242		Coil RF (Used in A).
L242		Coil RF (Used in B).
L243		Choke Coil: 1 uH ±10%.
L244		Choke Coil: 0.68 uH ±10%.
L245		Choke Coil: 1 uH ±20%.
L246		Coil RF: 22 nH ±20%.
L247		Choke Coil: 0.82 uH ±10%.
L248 thru L252		Choke Coil: 0.82 uH ±10% (Used in A).
L248 thru L252		Choke Coil: 0.68 uH ±10% (Used in B).
L280 and L281		Choke Coil: 0.68 uH ±10%.
L282		Coil RF (Used in A).
L282		Coil RF (Used in B).
L283		Choke Coil: 0.82 uH ±10%.
L284		Choke Coil: 0.68 uH ±10%.
L285		Choke Coil: 1 uH ±20%.
L286		Coil RF: 22 nH ±20%.
L287		Choke Coil: 1 uH ±10% (Used in A).
L287		Choke Coil: 0.68 uH ±10% (Used in B).
L288		Choke Coil: 0.68 uH ±10%.
L289		Choke Coil: 1 uH ±10% (Used in A).
L289		Choke Coil: 0.68 uH ±10% (Used in B).

SYMBOL	PART NO.	DESCRIPTION
L290		Choke Coil: 0.68 uH ±10% .
L291		Choke Coil: 1 uH ±10% (Used in A).
L291		Choke Coil: 0.68 uH ±10% (Used in B).
L292		Choke Coil: 0.68 uH ±10%.
		----------RESISTORS ----------
R201		Metal film: 10K ohms ±5% 50 VDCW 1/16W.
R202		Metal film: 22 ohms ±5% 100 VDCW 1/10W.
R203		Metal film: 150K ohms ±5% 50 VDCW 1/16W.
R204		Metal film: 470K ohms ±5% 50 VDCW 1/16W.
R205		Metal film: 150K ohms ±5% 100 VDCW 1/10W.
R206		Metal film: 2.2K ohms ±5% 50 VDCW 1/16W.
R207		Metal film: 1M ohms ±5% 50 VDCW 1/16W.
R208		Metal film: 2.2K ohms ±5% 50 VDCW 1/16W.
R209		Metal film: 100 ohms ±5% 50 VDCW 1/16W.
R210		Metal film: 470K ohms ±5% 50 VDCW 1/16W.
R211		Metal film: 100K ohms ±5% 50 VDCW 1/16W.
R213		Metal film: 0 ohm.
R214		Metal film: 330 ohms ±5% 200 VDCW 1/4W.
R215		Metal film: 10K ohms ±5% 100 VDCW 1/10W.
R216		Metal film: 470K ohms ±5% 50 VDCW 1/16W.
R217		Metal film: 15K ohms ±5% 50 VDCW 1/16W.
R218		Metal film: 6.8K ohms ±5% 50 VDCW 1/16W.
R219		Metal film: 15 ohms ±5% 50 VDCW 1/16W.
R220 thru R224		Metal film: 10K ohms ±5% 50 VDCW 1/16W.
R228		Metal film: 220K ohms ±5% 50 VDCW 1/16W.
R229		Metal film: 68K ohms ±5% 50 VDCW 1/16W (Used in A).
R229		Metal film: 82K ohms ±5% 50 VDCW 1/16W (Used in B).
R230		Metal film: 3.9K ohms ±5% 50 VDCW 1/16W (Used in A).
R230		Metal film: 15K ohms ±5% 50 VDCW 1/16W (Used in B).
R231		Metal film: 22K ohms ±5% 50 VDCW 1/16W.
R232		Metal film: 1.5K ohms ±5% 50 VDCW 1/16W.
R233		Metal film: 22K ohms ±5% 50 VDCW 1/16W.
R234		Metal film: 100K ohms ±5% 50 VDCW 1/16W.
R235 and R236		Metal film: 10K ohms ±5% 50 VDCW 1/16W.
R237		Metal film: 4.7K ohms ±5% 50 VDCW 1/16W.
R238		Metal film: 5.6K ohms ±5% 50 VDCW 1/16W.
R239		Metal film: 2.2K ohms ±5% 100 VDCW 1/10W.
R241		Metal film: 15K ohms ±5% 100 VDCW 1/10W.
R242		Metal film: 68 ohms ±5% 100 VDCW 1/10W.
R243		Metal film: 5.6K ohms ±5% 100 VDCW 1/10W.
R244		Metal film: 1.5K ohms ±5% 100 VDCW 1/10W.
R245		Metal film: 120 ohms ±5% 100 VDCW 1/10W.
R246		Metal film: 220 ohms ±5% 100 VDCW 1/10W (Used in A).
R246		Metal film: 180 ohms ±5% 100 VDCW 1/10W (Used in B).
R247		Metal film: 22 ohms ±5% 100 VDCW 1/10W (Used in A).
R247		Metal film: 33 ohms ±5% 100 VDCW 1/10W (Used in B).
R248		Metal film: 220 ohms ±5% 100 VDCW 1/10W (Used in A).
R248		Metal film: 180 ohms ±5% 100 VDCW 1/10W (Used in B).
R249		Metal film: 220 ohms ±5% 100 VDCW 1/10W.
R280		Metal film: 1M ohms ±5% 100 VDCW 1/10W.
R281		Metal film: 33K ohms ±5% 100 VDCW 1/10W.

SYMBOL	PART NO.	DESCRIPTION
R282		Metal film: 22K ohms ±5% 100 VDCW 1/10W.
R283		Metal film: 47K ohms ±5% 100 VDCW 1/10W.
R284		Metal film: 27K ohms ±5% 100 VDCW 1/10W.
R286		Metal film: 15K ohms ±5% 100 VDCW 1/10W.
R287		Metal film: 270 ohms ±5% 100 VDCW 1/10W.
R288		Metal film: 5.6K ohms ±5% 100 VDCW 1/10W.
R289		Metal film: 1.5K ohms ±5% 100 VDCW 1/10W.
R290		Metal film: 120 ohms ±5% 100 VDCW 1/10W.
R291		Metal film: 270 ohms ±5% 100 VDCW 1/10W .
R292		Metal film: 15 ohms ±5% 100 VDCW 1/10W.
R293		Metal film: 270 ohms ±5% 100 VDCW 1/10W .
R294		Metal film: 220 ohms ±5% 100 VDCW 1/10W .
R295		Metal film: 100 ohms ±5% 100 VDCW 1/10W .
R296		Metal film: 10K ohms ±5% 100 VDCW 1/10W .
R2001		Metal film: 22K ohms ±5% 50 VDCW 1/16W .
R2002		Metal film: 390K ohms ±5% 50 VDCW 1/16W (Used in A).
R2002		Metal film: 560K ohms ±5% 50 VDCW 1/16W (Used in B).
R2003		Metal film: 270K ohms ±5% 50 VDCW 1/16W (Used in A).
R2003		Metal film: 180K ohms ±5% 50 VDCW 1/16W (Used in B).
R2004		Metal film: 120K ohms ±5% 50 VDCW 1/16W (Used in A).
R2004		Metal film: 82K ohms ±5% 50 VDCW 1/16W (Used in B).
R2005		Metal film: 18K ohms ±5% 50 VDCW 1/16W (Used in A).
R2005		Metal film: 47K ohms ±5% 50 VDCW 1/16W (Used in B).
R2008		Metal film: 330 ohms ±5% 50 VDCW 1/16W.
R2009		Metal film: 0 ohm.
R2011		Metal film: 1M ohms ±5% 50 VDCW 1/16W.
R2012		Metal film: 100K ohms ±5% 100 VDCW 1/10W.
R2301 and R2302		Metal film: 1K ohms ±5% 200 VDCW 1/8W.
R2303		Metal film: 4.7K ohms ±5% 100 VDCW 1/10W.
R2304 and R2305		Metal film: 1K ohms ±5% 200 VDCW 1/8W.
R2306		Metal film: 4.7K ohms ±5% 100 VDCW 1/10W.
R2307 and R2308		Metal film: 1K ohms ±5% 200 VDCW 1/8W.
R2309		Metal film: 4.7K ohms ±5% 100 VDCW 1/10W.
R2310 thru R2312		Metal film: 15K ohms ±5% 50 VDCW 1/16W.
R2313 thru R2315		Metal film: 39K ohms ±5% 50 VDCW 1/16W.
R2401		Metal film: 10K ohms ±5% 50 VDCW 1/16W.
R2402		Metal film: 100K ohms ±5% 50 VDCW 1/16W.
RV201		Variable: 20K ohms ±25% 1/10W.
		---------- TERMINAL ----------
TP202		Test terminal
		---------- - TRANSISTORS ----------
TR201 and TR202		Silicon, PNP; sim to NEC 2SB624 BV3.
TR203		Silicon, NPN; sim to PANASONIC XP1211.
TR230		Silicon, NPN; sim to NEC 2SD596 DV3.
TR240		N-channel, field effect.(Junction Singe Gate); sim to SONY 2SK125.
TR241		Silicon, NPN; sim to NEC 2SC3356.

SYMBOL	PART NO.	DESCRIPTION
TR242 and TR243		Silicon, NPN; sim to PANASONIC UN5216.
TR280		N-channel, field effect.(Junction Singe Gate);sim to SONY 2SK1577.
TR281		Silicon, NPN; sim to NEC 2SC3356.
TR282		Silicon, NPN; sim to PANASONIC XP1216TX.
TR2301 thru TR2303		Silicon, NPN; sim to PANASONIC XP1216TX.
		---------- CRYSTAL ----------
XU201		Reference Oscillator unit: 12.8MHz 2PPM.

PRODUCTION CHANGES

Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter", which is stamped after the model number on the unit. The revision stamped on the unit includes all previous revisions. Refer to the Parts List for the description of parts affected by these revisions.

REV. A - VHF TX RX 344A4577P1 & P2
Control Logic Board CMC-862
To eliminate "sneak" current path on switched outputs. Deleted diodes CD713 and CD714. Refer to Maintenance Manual LBI-39003.

REV. B - VHF TX RX 344A4577P1 & P2
Synthesizer/Receiver/Exciter Board CMN-352A/B
To improve receiver selectivity and intermodulation. Changed inductor L466 from 10 µH to 39 µH .

REV. C- VHF TX RX 344A4577P1 & P2
Control Logic Board CMC-862
To reduce TX hum and noise. Added 2.2k ohms resistor between capacitor C670 and capacitor C603. Refer to Maintenance Manual LBI-39003.

REV. D- VHF TX RX 344A4577P1 & P2
Control Logic Board CMC-862
To improve Dual Radio speaker balance, added R664 (2.2k ohms). To change EXTMIC to unbias load change R609 2.2k ohm and deleted R651. Relocated R748 to VCC1 to improve RF Type Decoding. Improve A+ reverse polarity protection by removing CD603 and adding CD606. Refer to Maintenance Manual LBI-39003.

Δ COMPONENT IDENTIFICATION CHART

SYMBOL	A 136~153MHz	B 150~174MHz
C241	18pF (UJ)	22pF (UJ)
C260	4pF	6pF
C266	6pF	7pF
C267	4pF	8pF
C272	6pF	8pF
C273	7pF	12pF
C281	2pF	1pF
C282	4pF	5pF
C288	82pF	68pF
C289	0	7pF
C293	27pF	18pF
C2104	12pF	8pF
C2105	12pF	10pF
C2106	3pF	-
C2107	3pF	-
C2111	15pF	12pF
C2113	3pF	-
C2114	3pF	-
C2118	27pF	18pF
C2120	3pF	-
C2121	3pF	-
L242	H-6LALD00171	H-6LALD00173
L248	0.82µH	0.68µH
L249	0.82µH	0.68µH
L250	0.82µH	0.68µH
L251	0.82µH	0.68µH
L252	0.82µH	0.68µH
L282	H-6LALD00170	H-6LALD00172
L287	1.0µH	0.68µH
L289	1.0µH	0.68µH
L291	1.0µH	0.68µH
R204	330kΩ	270kΩ
R229	120kΩ	180kΩ
R230	22kΩ	15kΩ
R246	220Ω	180Ω
R247	22Ω	33Ω
R248	220Ω	180Ω
R283	15kΩ	150kΩ
R2002	390kΩ	560kΩ
R2003	270kΩ	180kΩ
R2004	120kΩ	82kΩ
R2005	18kΩ	47kΩ

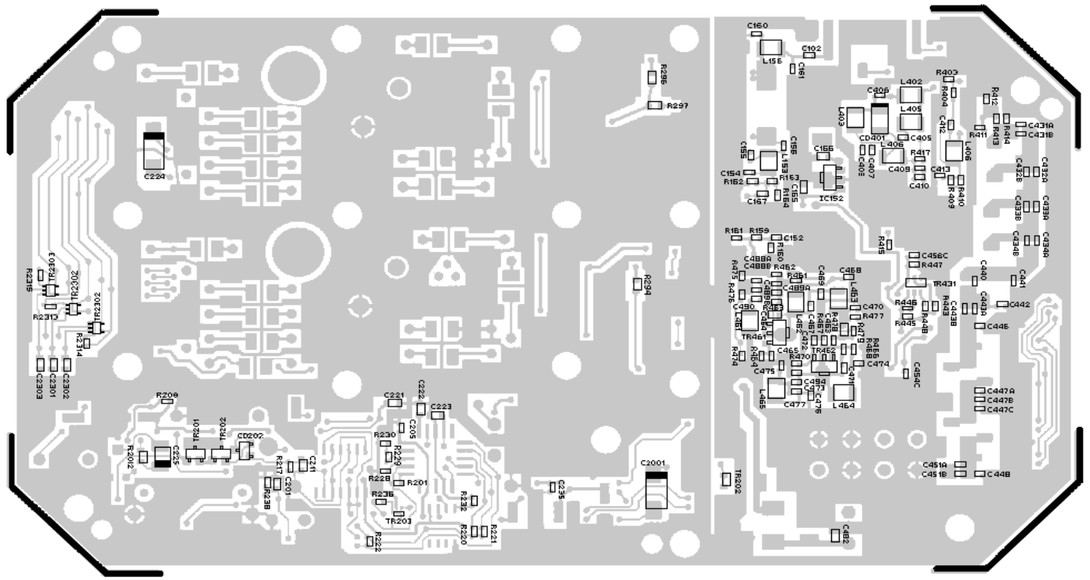
SYNTHESIZER

Δ COMPONENT IDENTIFICATION CHART

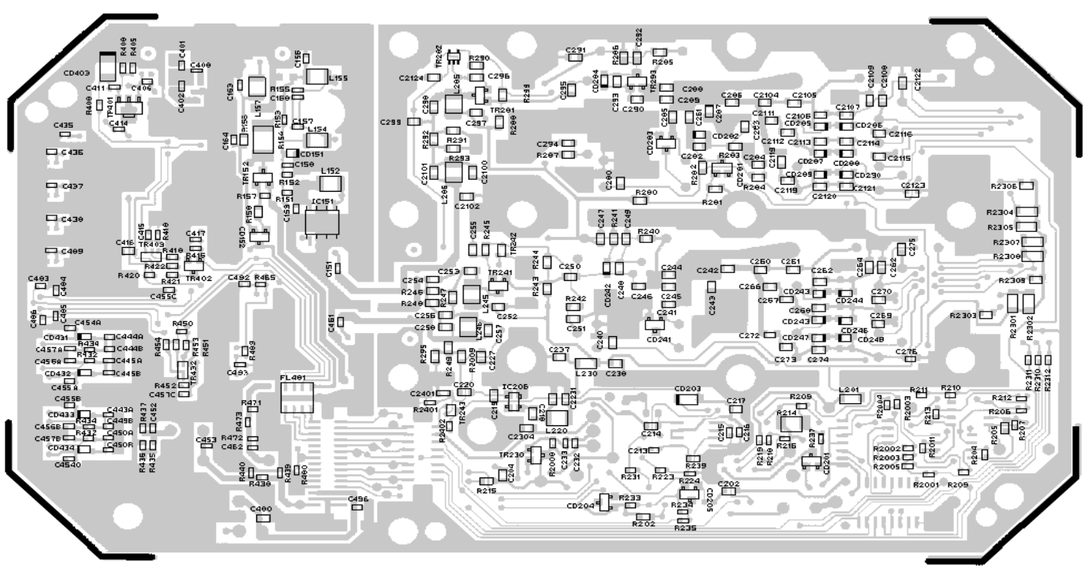
PARTS NO.	CMN-352A-1 136-153MHz	CMN-352B-1 150-174MHz
C431A	9PF	10PF
C431B	0PF	0PF
C432A	22PF	22PF
C432B	0PF	0PF
C433A	15PF	10PF
C433B	0PF	4PF
C434A	4PF	2PF
C434B	0PF	0.5PF
C435	15PF	15PF
C436	22PF	18PF
C437	18PF	15PF
C438	27PF	27PF
C439	22PF	18PF
C440	18PF	15PF
C441	22PF	18PF
C442	22PF	18PF
C443A	6PF	5PF
C443B	0PF	3PF
C444A	5PF	5PF
C444B	0.5PF	0.5PF
C445A	3PF	2PF
C445B	0PF	0.75PF
C446	18PF	12PF
C447A	120PF	120PF
C447B	180PF	68PF
C447C	120PF	120PF
C448	18PF	12PF
C449A	0PF	0.75PF
C449B	3PF	2PF
C450A	0.5PF	0.5PF
C450B	5PF	5PF
C451A	6PF	5PF
C451B	0PF	0PF
C488A	15PF	12PF
C488B	0PF	1PF
C489A	15PF	12PF
C489B	0PF	1PF
C490	10PF	8PF
L402	150nH	100nH
L406	47nH	39nH
L431	2.0 ø6T	2.0 ø5T
L432	1.8 ø5T	2.0 ø4T
L433	2.5 ø4T	2.0 ø5T
L434	2.5 ø5T	2.0 ø5T
L435	1.8 ø5T	2.0 ø4T
R405	27Ω	39Ω
R406	27Ω	27Ω
R480	1.5KΩ	3.3KΩ

RECEIVER/EXCITER

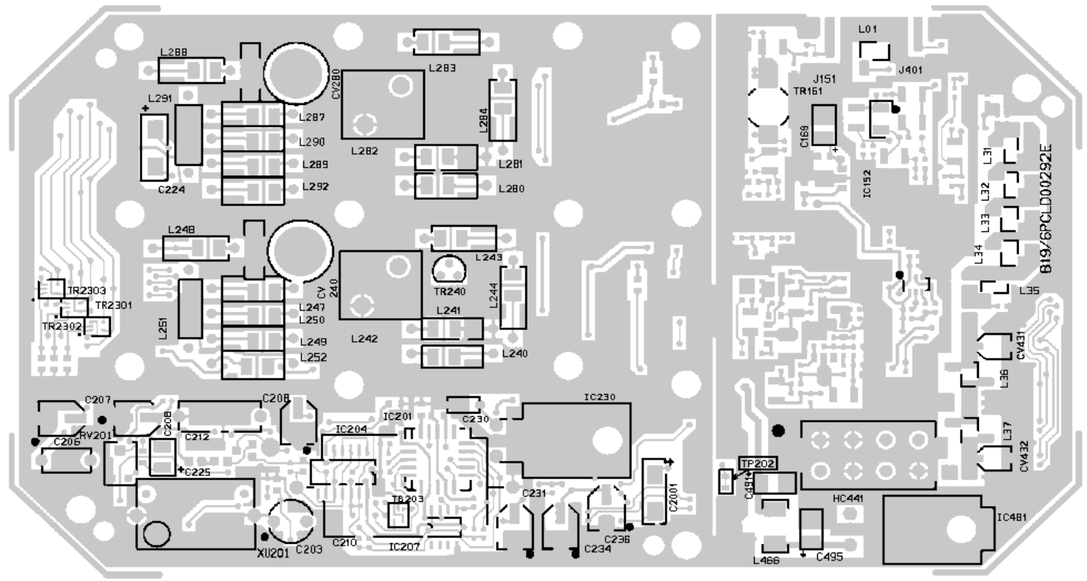
COMPONENT SIDE



SOLDER SIDE



COMPONENT SIDE



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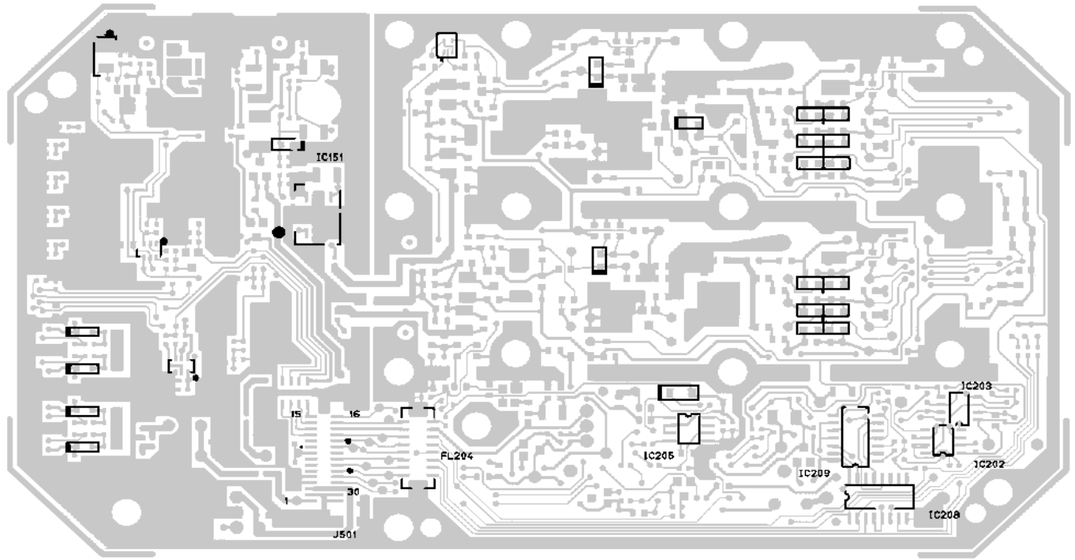
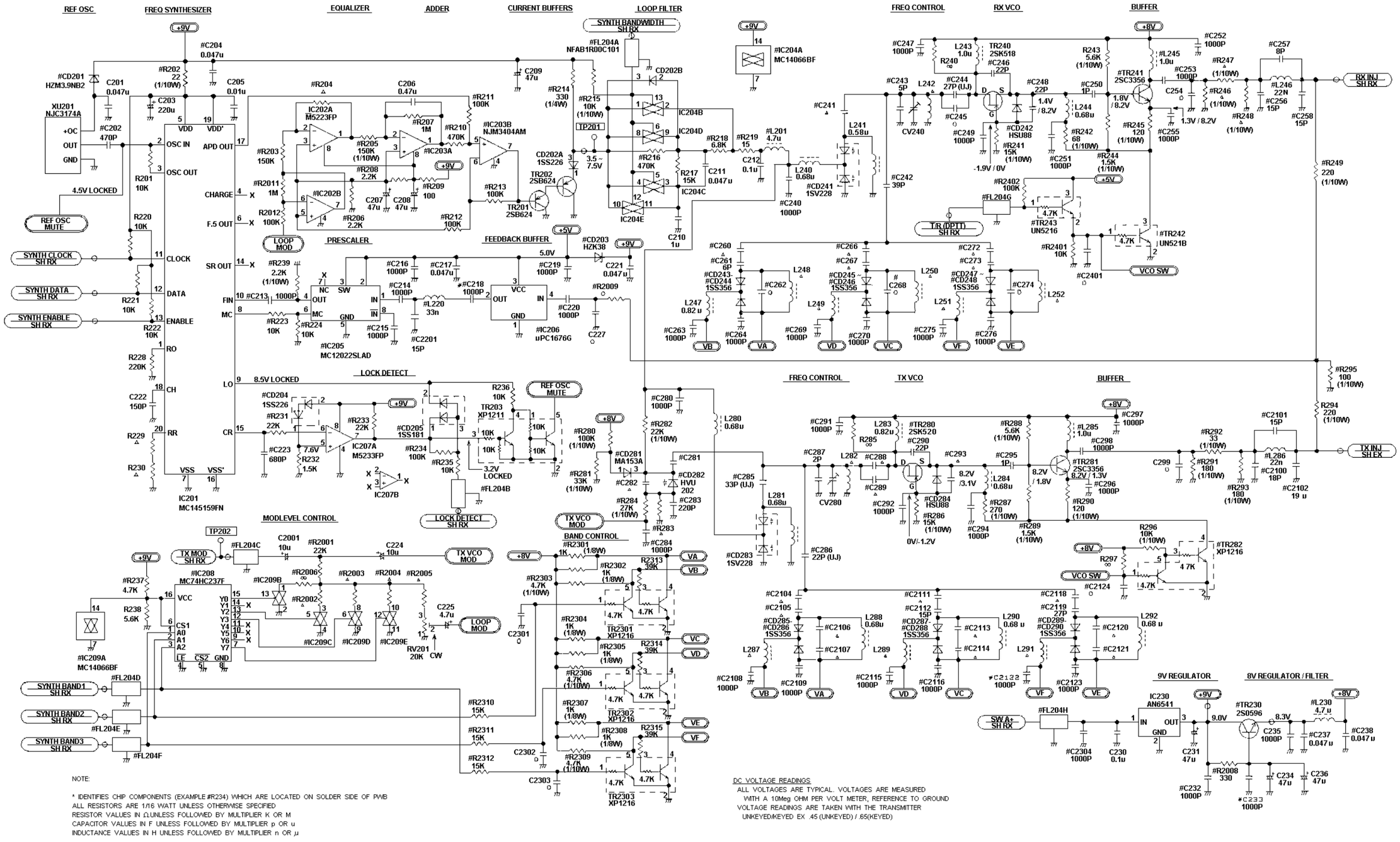


SYNTHESIZER/RECEIVER/EXCITER



NOTE:

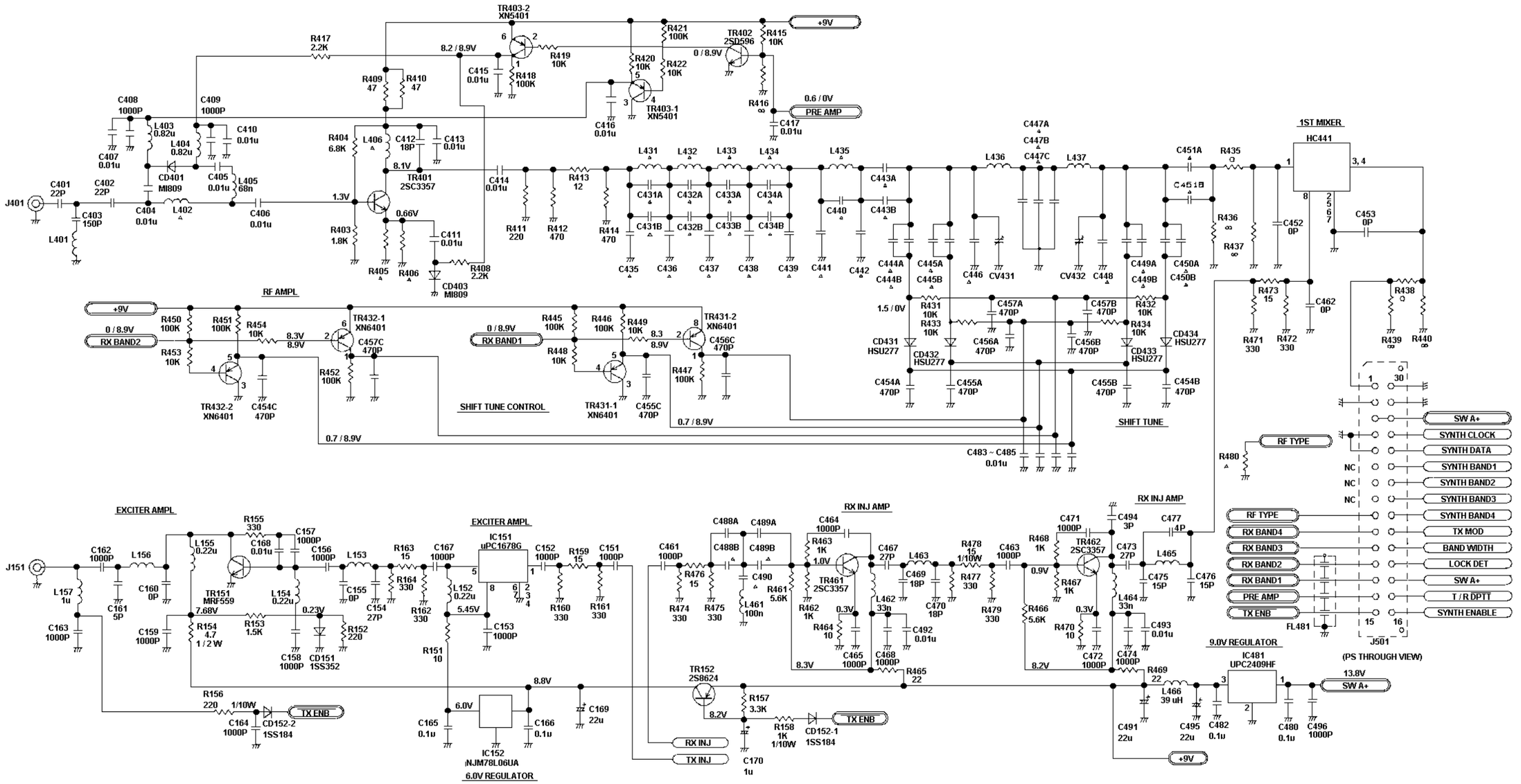
* IDENTIFIES CHIP COMPONENTS (EXAMPLE #R234) WHICH ARE LOCATED ON SOLDER SIDE OF PWB
ALL RESISTORS ARE 1/16 WATT UNLESS OTHERWISE SPECIFIED
RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER K OR M
CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER p OR u
INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER n OR µ

DC VOLTAGE READINGS

ALL VOLTAGES ARE TYPICAL. VOLTAGES ARE MEASURED WITH A 10Meg OHM PER VOLT METER, REFERENCE TO GROUND
VOLTAGE READINGS ARE TAKEN WITH THE TRANSMITTER UNKEYED/KEYED EX .45 (UNKEYED) / .65(KEYED)

SYNTHESIZER

(DD01-CMN-352-4)



NOTE:

ALL RESISTORS ARE 1/16 WATT UNLESS OTHERWISE SPECIFIED
RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER K OR M
CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER p OR u
INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER n OR µ

RECEIVER/EXCITER

(DD01-CMN-352-3)