# MAINTENANCE MANUAL
# ORION™
# 136-174 MHz (Dual Bandwidth)
# SYNTHESIZER/RECEIVER/EXCITER BOARD
# B19/CMN-352 DA/DB

## TABLE OF CONTENTS



## 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 101) is 136-153 MHz, and range B (or Part 102) 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 Control Logic/IF Board (refer to Maintenance Manual LBI-39174).

ERICSSON

**Ericsson Inc.**
Private Radio Systems
Mountain View Road
Lynchburg, Virginia 24502
1-800-528-7711 (Outside USA, 804-528-7711)

Printed in U.S.A.

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 CD202-A 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 **$\overline{\text{T/R}}$** line. When the **$\overline{\text{T/R}}$** 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 $\overline{\text{T/R}}$ 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 | ON | ON | OFF | ON | C260, C261, C272, C273 C2104, C2105 C2118, C2119 |
| 4 | 1 | 1 | 1 | OFF | OFF | OFF | OFF | OFF | OFF | NONE |

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

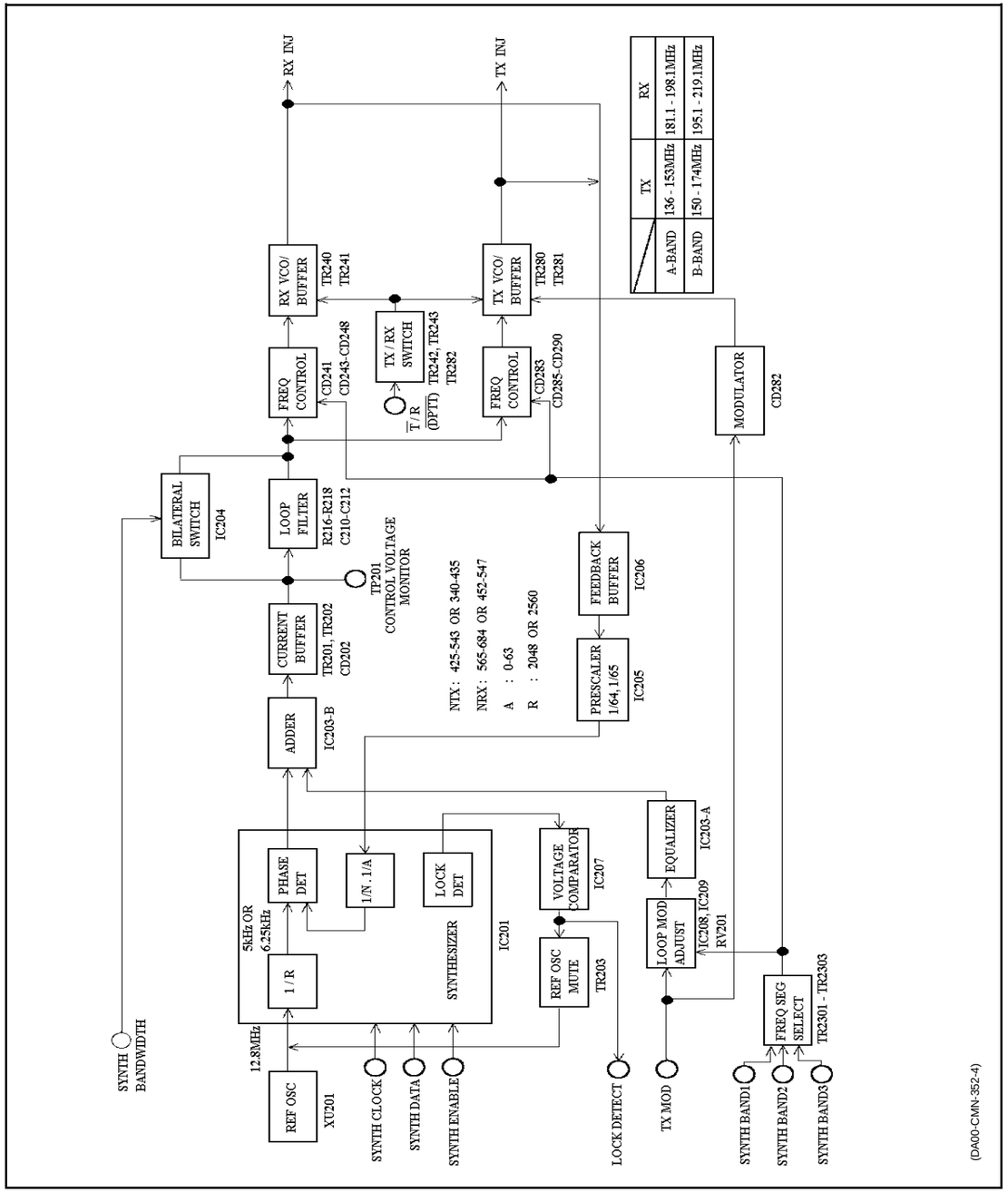



Figure 1 - Synthesizer Block Diagram

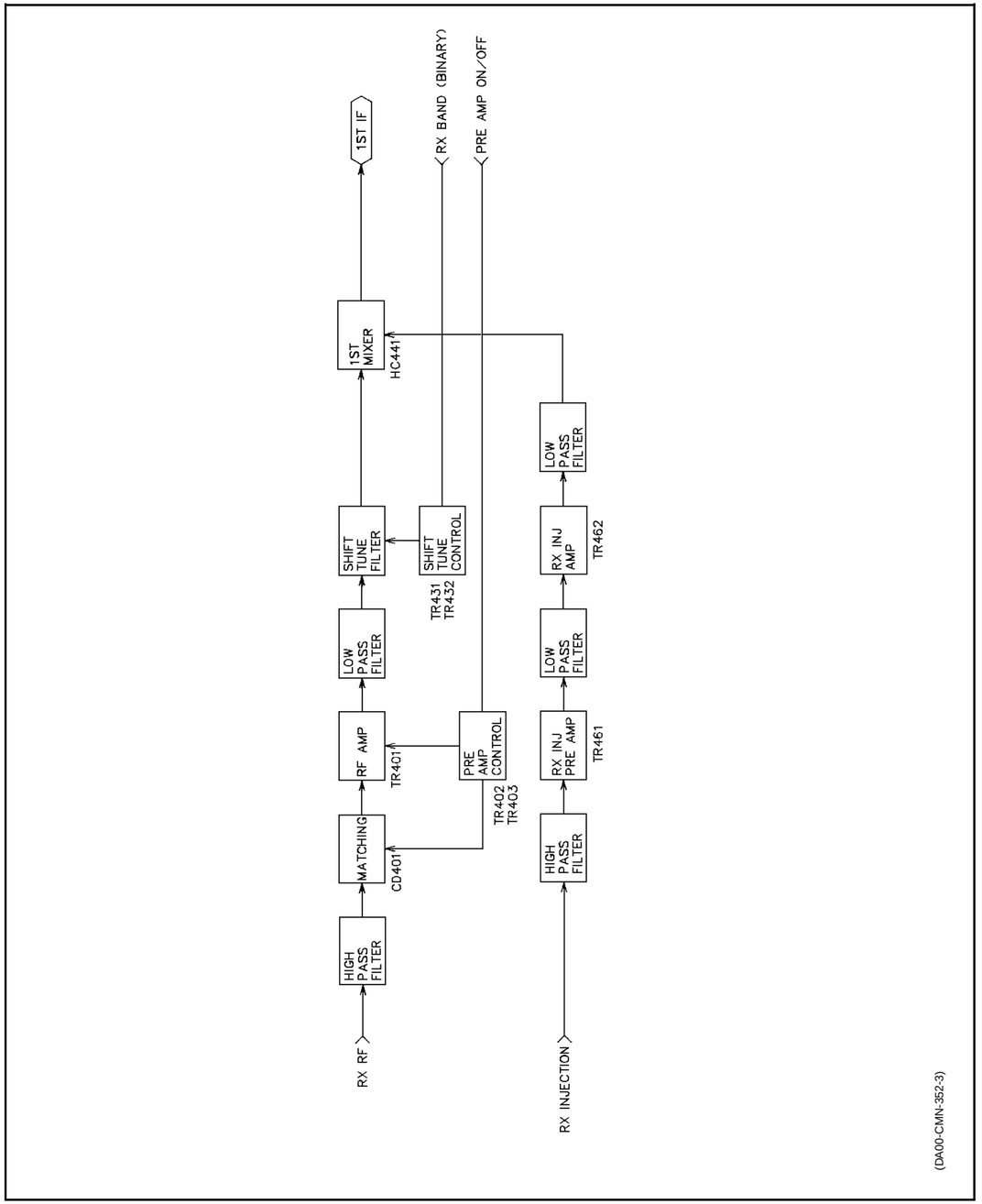



Figure 2 - Receiver Block Diagram

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.

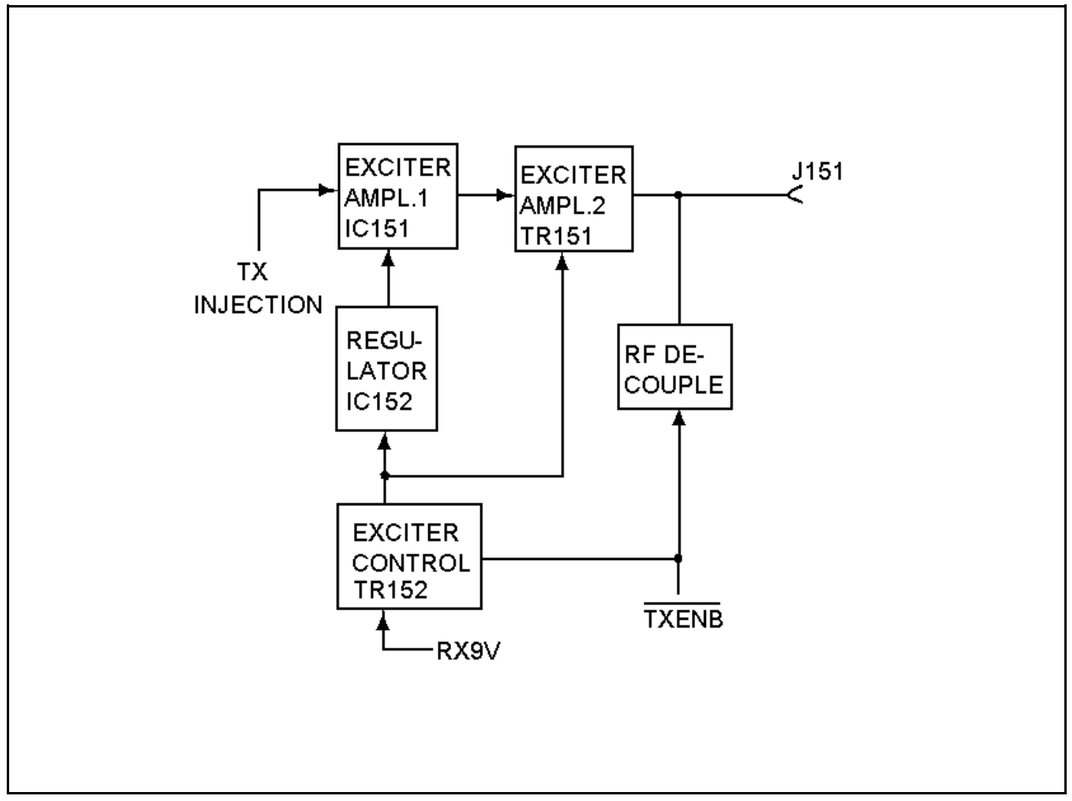
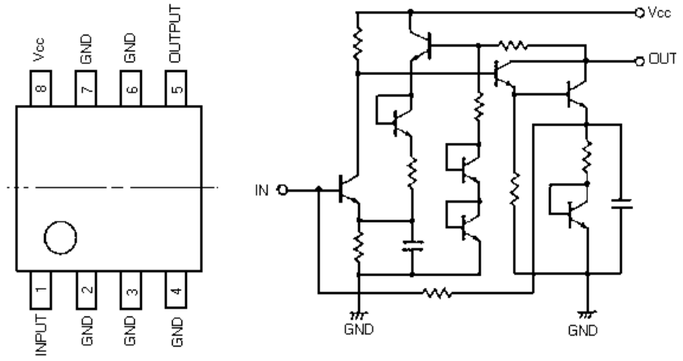
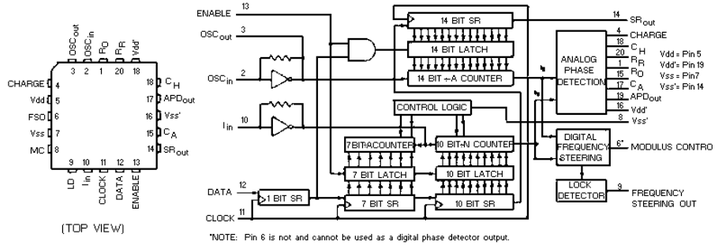



Figure 3 - Exciter Block Diagram

## RF WIDE BAND AMPLIFIER IC151

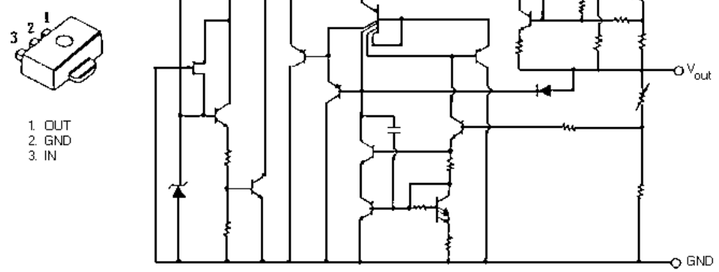



## SYNTHESIZER IC201

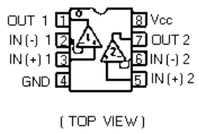


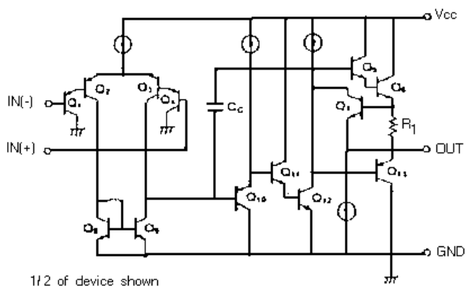

*NOTE: Pin 6 is not and cannot be used as a digital phase detector output.

## POSITIVE VOLTAGE REGULATOR IC152

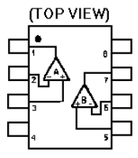


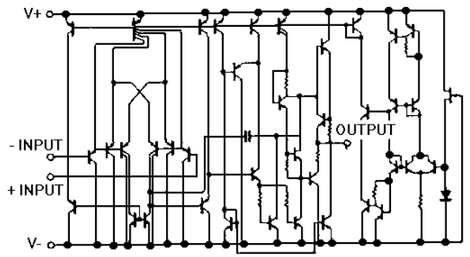

## DUAL OPERATIONAL AMPLIFIER IC202



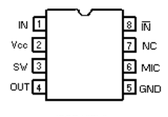



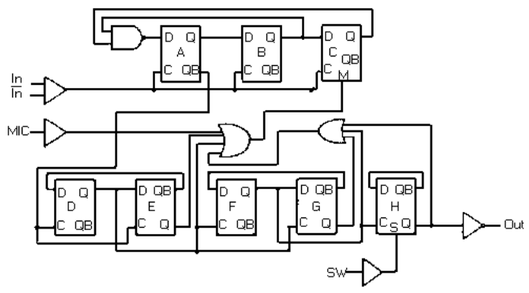

## DUAL OPERATIONAL AMPLIFIER IC203



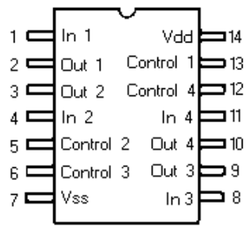



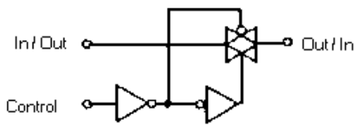

## PRESCALER IC205



## BILATERAL SWITCH IC204, IC209

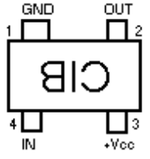


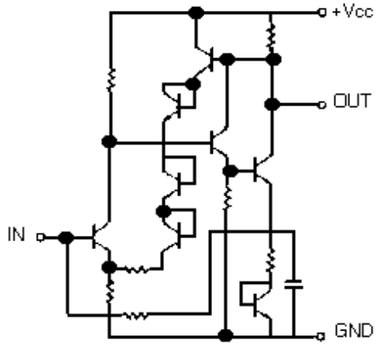

1/4 of device shown

| Control | Switch |
|---|---|
| 0 = Vss | OFF |
| 1 = Vdd | ON |

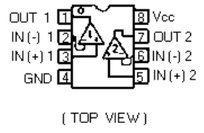
## RF WIDE BAND AMPLIFIER IC206



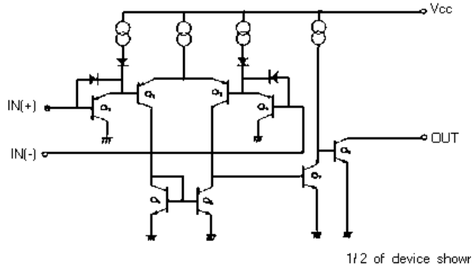

( TOP VIEW )




## DUAL COMPARATOR IC207

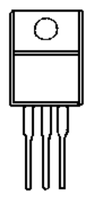



( TOP VIEW )

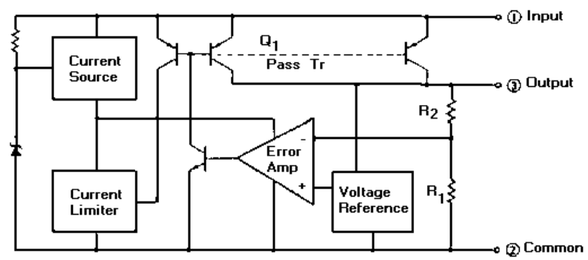



1/2 of device shown

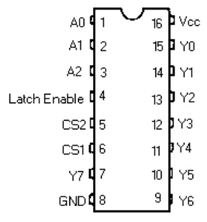
## POSITIVE VOLTAGE REGULATOR IC230

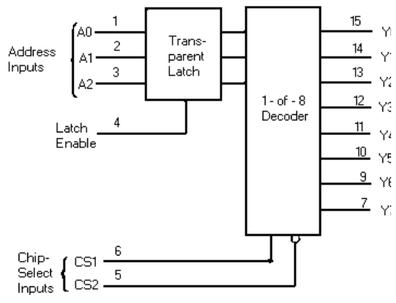



(Top View)

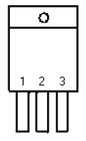



## DECODER IC208

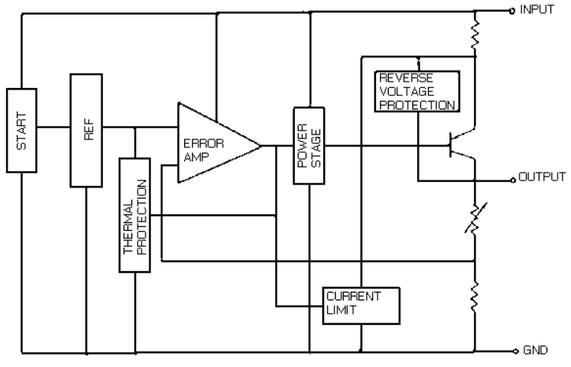



## POSITIVE VOLTAGE REGULATOR IC481




1. INPUT
2. GND
3. OUTPUT



**RF/EX/SYNTHESIZER BOARD**
**RECEIVER/EXCITER SECTION**
**CMN-3524DA (Used in P101)**
**CMN-3524DB (Used in P102)**

| 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. |
| C448A | | Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0±60 PPM. (Used in A). |
| C448B | | 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 C84 | | 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 1SS352. |
| CD152 | | Silicon: fast recovery (2 diodes in cathode ); sim to TOSHIBA 1SS184. |
| 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 uPC2409AHF. |
| | | ---------- 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 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: 100 nH ±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, 1/6W. |
| 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: 1.5K ohms, ±5% 50 VDCW, 1/16W. (Used in A). |
| R480 | | Metal film: 3.3K 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, NPN; 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-352A4D (Used in P101)**
**CMN-352B4D (Used in P102)**

| SYMBOL | PART NO. | DESCRIPTION |
|---|---|---|
| | NOTE: Parts listed are for reference only. Refer to Service Section for serviceable parts. | ---------- CAPACITORS ---------- |
| C201 | | 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 ±0.5 pF 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 ±0.5 pF 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 ±0.5 pF 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: 2 pF ±0.25 pF 50 VDCW, temp coef 0±30 PPM (Used in A). |
| C281 | | Ceramic: 1 pF ±0.25 pF 50 VDCW, temp coef 0±30 PPM (Used in B). |
| 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). |

| SYMBOL | PART NO. | DESCRIPTION |
|---|---|---|
| C290 | | Ceramic: 22 pF ±5% 50 VDCW, temp coef 0±30 PPM. |
| 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 pF 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. |

| SYMBOL | PART NO. | DESCRIPTION |
|---|---|---|
| CD243 thru CD248 | | Silicon: Epitaxial Planer Diode: sim to ROHM 1SS356. |
| 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 1SS356. |
| 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 | | Coil RF: 4.7 uH ±10%. |
| L220 | | Coil RF: 33 nH ±10%. |
| L230 | | Coil RF: 4.7 uH ±10%. |
| L240 and L241 | | Coil RF: 0.68 uH ±10%. |
| L242 | | Coil RF (Used in A). |
| L242 | | Coil RF (Used in B). |
| L243 | | Coil RF: 1 uH ±10%. |
| L244 | | Coil RF: 0.68 uH ±10%. |
| L245 | | Coil RF: 1 uH ±20%. |
| L246 | | Coil RF: 22 nH ±20%. |
| L247 | | Coil RF: 0.82 uH ±10%. |
| L248 thru L252 | | Coil RF: 0.82 uH ±10% (Used in A). |
| L248 thru L252 | | Coil RF: 0.68 uH ±10% (Used in B). |
| L280 and L281 | | Coil RF: 0.68 uH ±10%. |
| L282 | | Coil RF (Used in A). |
| L282 | | Coil RF (Used in B). |
| L283 | | Coil RF: 0.82 uH ±10%. |
| L284 | | Coil RF: 0.68 uH ±10%. |
| L285 | | Coil RF: 1 uH ±20%. |
| L286 | | Coil RF: 22 nH ±20%. |
| L287 | | Coil RF: 1 uH ±10% (Used in A). |
| L287 | | Coil RF: 0.68 uH ±10% (Used in B). |
| L288 | | Coil RF: 0.68 uH ±10%. |
| L289 | | Coil RF: 1 uH ±10% (Used in A). |
| L289 | | Coil RF: 0.68 uH ±10% (Used in B). |
| L290 | | Coil RF: 0.68 uH ±10% . |
| L291 | | Coil RF: 1 uH ±10% (Used in A). |
| L291 | | Coil RF: 0.68 uH ±10% (Used in B). |
| L292 | | Coil RF: 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: 330K ohms ±5% 50 VDCW 1/16W (Used in A). |
| R204 | | Metal film: 270K ohms ±5% 50 VDCW 1/16W (Used in B). |
| 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. |
| R212 | | Metal film: 100K ohms ±5% 50 VDCW 1/16W. |
| R213 | | Metal film: 100K ohms ±5% 50 VDCW 1/16W. |
| 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: 120K ohms ±5% 50 VDCW 1/16W (Used in A). |
| R229 | | Metal film: 180K ohms ±5% 50 VDCW 1/16W (Used in B). |
| R230 | | Metal film: 22K 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. |
| R282 | | Metal film: 22K ohms ±5% 100 VDCW 1/10W. |
| R283 | | Metal film: 15K ohms ±5% 100 VDCW 1/10W (Used in A). |
| R283 | | Metal film: 150K ohms ±5% 100 VDCW 1/10W (Used in B). |
| 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: Less than 50m ohms 1/10W. |
| 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. |
| TR203 | | Silicon, NPN; sim to PANASONIC XP1211. |
| TR230 | | Silicon, NPN; sim to NEC 2SD596. |
| TR240 | | N-channel, field effect.(Junction Singe Gate);sim to NEC 2SK518. |
| TR241 | | Silicon, NPN; sim to NEC 2SC3356. |
| TR242 and TR243 | | Silicon, NPN; sim to PANASONIC UN5216. |
| TR280 | | N-channel, field effect.(Junction Singe Gate);sim to NEC 2SK520. |
| TR281 | | Silicon, NPN; sim to NEC 2SC3356. |
| TR282 | | Silicon, NPN; sim to PANASONIC XP1216. |
| TR2301 thru TR2303 | | Silicon, NPN; sim to PANASONIC XP1216. |
| | | ---------- CRYSTAL ---------- |
| XU201 | | Reference Oscillator unit: 12.8MHz 2PPM. |

## Δ COMPONENT IDENTIFICATION CHART

| SYMBOL | A<br>136~153MHz | B<br>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 |

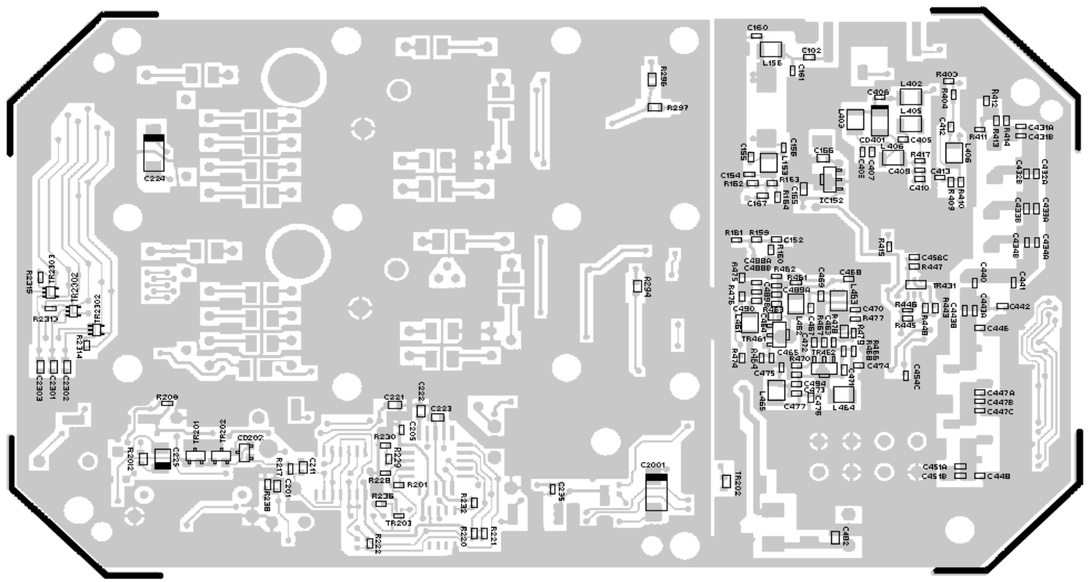
**SYNTHESIZER** (DD01-CMN-352-4, 2/2)

## Δ COMPONENT IDENTIFICATION CHART

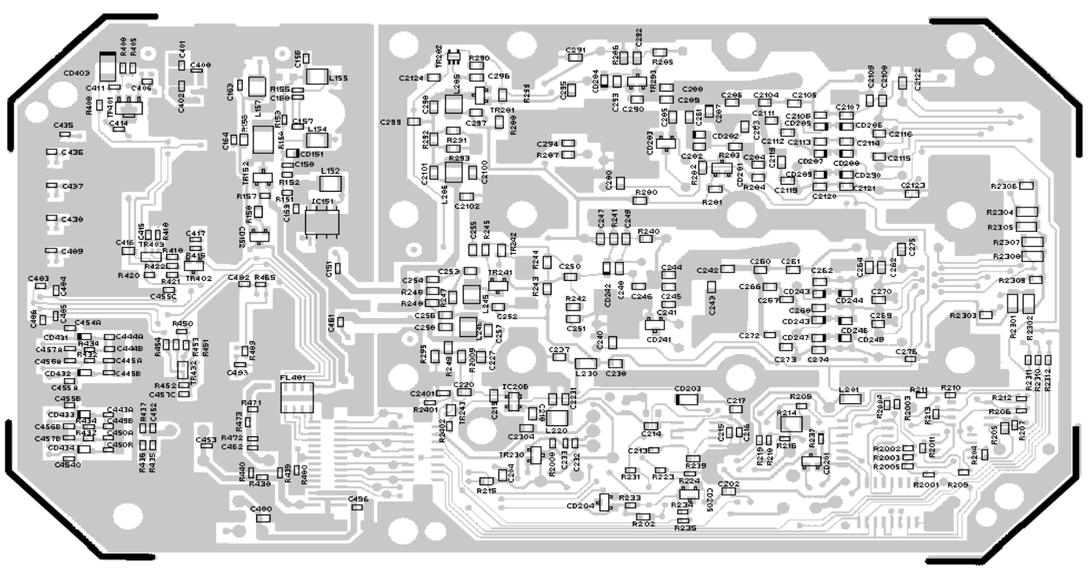
| PARTS<br>NO. | CMN-352A-1<br>136-153MHz | CMN-352B-1<br>150-174MHz |
|---|---|---|
| C431A | 9PF | 10PF |
| C431B | 0PF | 0PF |
| C432A | 22PF | 22PF |
| C432B | 0PF | 0PF |
| C433A | 15PF | 10PF |
| C433B | 0PF | 4PF |
| C434A | 4PF | 2PF |
| C434B | 0PF | 0.5PF |
| C435 | 15PF | 15PF |
| C436 | 22PF | 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 | H-6LALD19206A | H-6LALD19205A |
| L432 | H-6LALD19185A | H-6LALD19204A |
| L433 | H-6LALD19254A | H-6LALD19205A |
| L434 | H-6LALD19255A | H-6LALD19255A |
| L435 | H-6LALD19185A | H-6LALD19204A |
| R405 | 27Ω | 39Ω |
| R406 | 27Ω | 27Ω |
| R480 | 1.5KΩ | 3.3KΩ |

**RECEIVER/EXCITER** (DD01-CMN-352-3, 2/2)

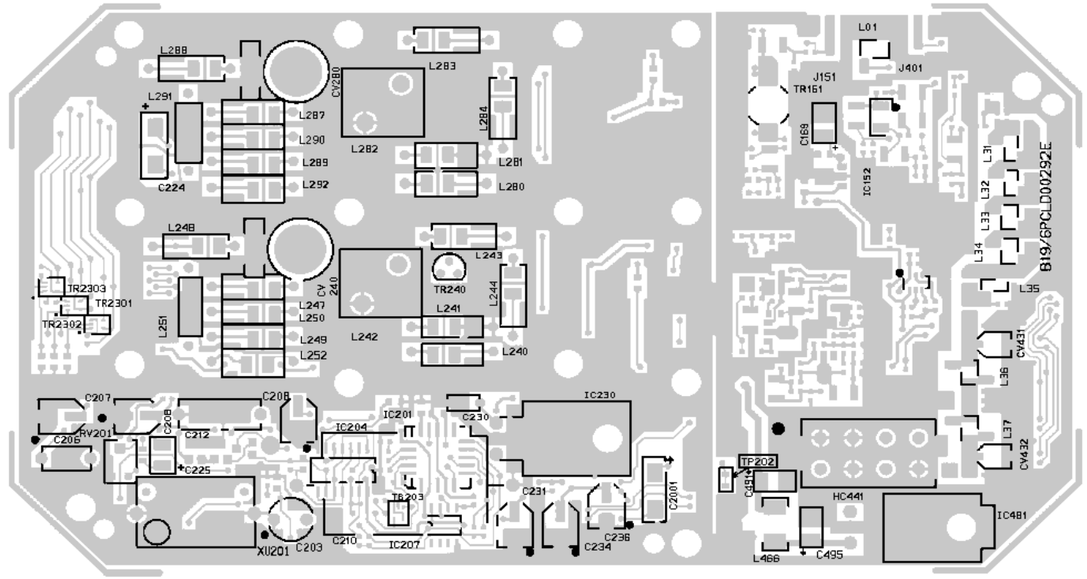
**COMPONENT SIDE**



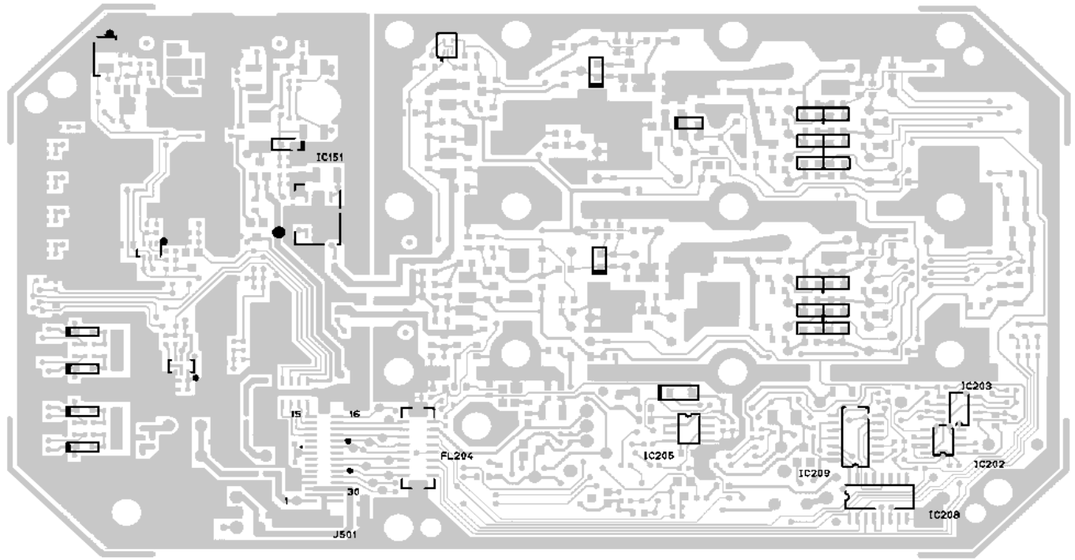
**SOLDER SIDE**



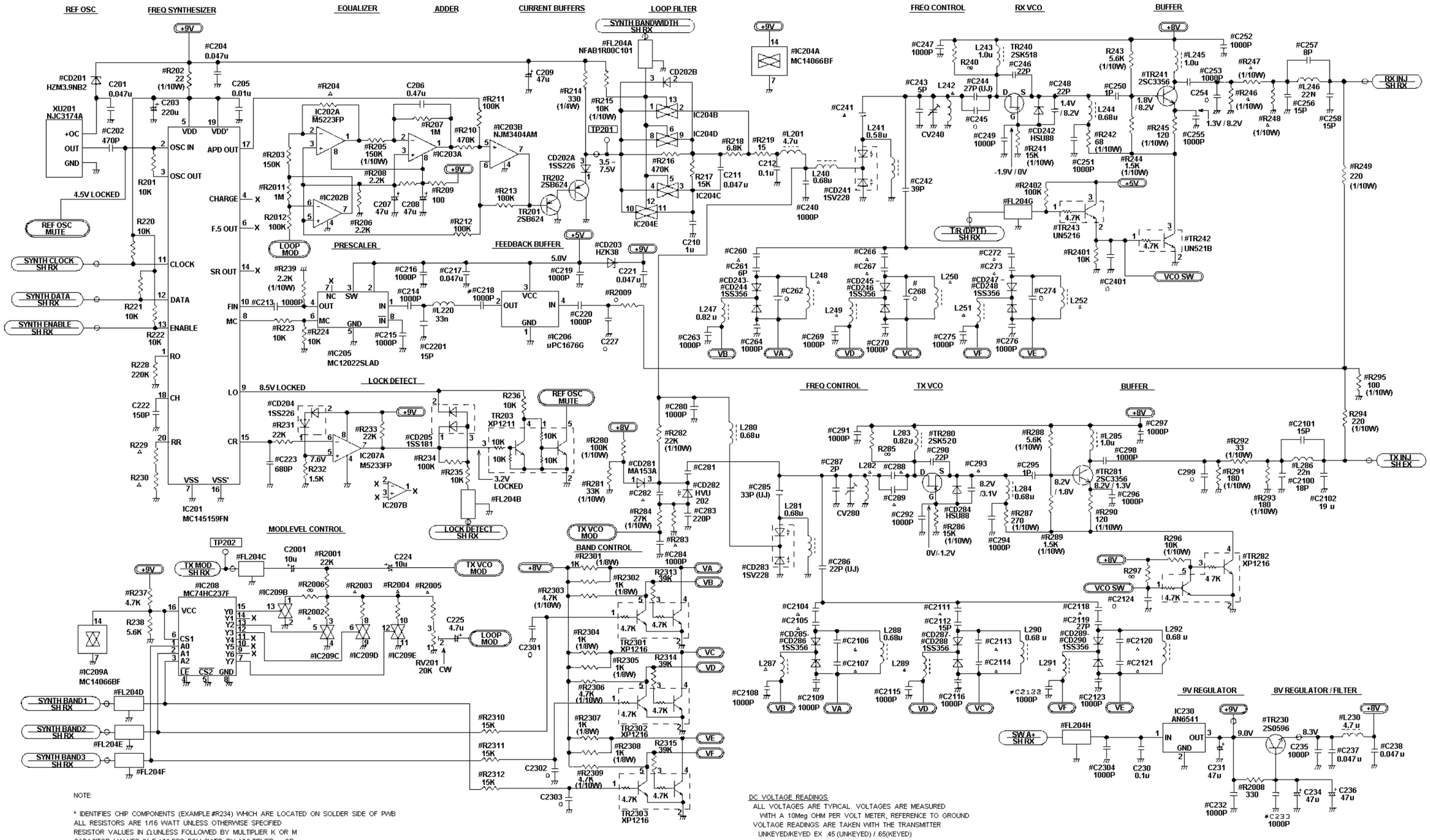
**COMPONENT SIDE**




**SOLDER SIDE**



**SYNTHESIZER/RECEIVER/EXCITER**




NOTE:

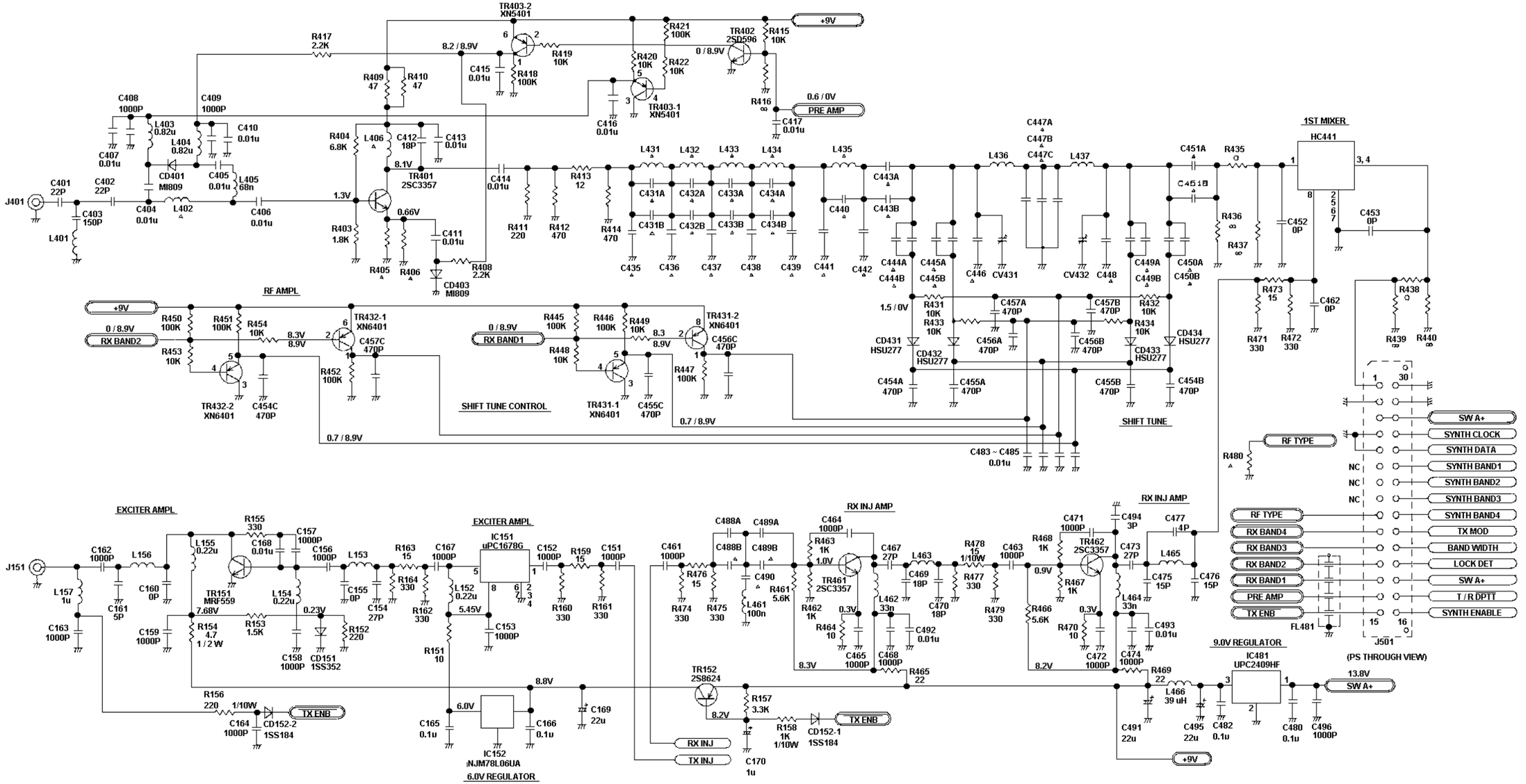
* IDENTIFIES CHIP COMPONENTS (EXAMPLE #R234) WHICH ARE LOCATED ON SOLDER SIDE OF PWB
ALL RESISTORS ARE 1/16 WATT UNLESS OTHERWISE SPECIFIED
RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER K OR M
CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER p OR u
INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER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




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, Sh. 1)