MAINTENANCE MANUAL
ORION™
900 MHz SYNTHESIZER/RECEIVER/EXCITER BOARD
B19/CMN-359

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DESCRIPTION

The **ORION**™ Synthesizer/Receiver/Exciter board provides, on one printed circuit board, circuits for the synthesizer, receiver and transmit exciter. The synthesizer circuit generates transmit frequencies for two ranges, which are 896-902 MHz and 935-941 MHz. The synthesizer circuit also generates receiver injection frequencies, 426.4-429.4 MHz.

The FM dual-conversion, super-heterodyne receiver is designed for operation in the 935-941 MHz frequency range. A regulated 9.0 volts is provided to all receiver stages except the audio PA IC, which operates from the switched A+ supply.

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

The receive circuit except for the synthesizer circuit consists of:

- Front End and Mixer
- 82.2 MHz First IF, 455 kHz Second IF and FM Detector
- Audio Signal Processor (ASP), includes Squelch
- Audio PA

The receiver RF Front End and First Mixer circuit is on the Receive/Exciter/Synthesizer board. The 82.2 MHz first IF, FM Detector, **A**udio **S**ignal **P**rocessor (**ASP**) and Audio PA circuits are on the System Control Logic/IF/Audio board. (Refer to Maintenance Manual LBI-39057).

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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, transmit and receiver **V**oltage **C**ontrolled **O**scillators (**VCO**'s), feedback amplifier, 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 feed back buffer, prescaler, and synthesizer. The transmit VCO operates over a frequency range of 448 MHz to 470.5 MHz. The receiver VCO operates over a range of 426.4 MHz to 429.4 MHz.

Reference Oscillator

The reference oscillator consists of a 1.5 PPM Temperature Compensated X(crystal) Oscillator (TCXO). The standard reference oscillator frequency is 12.8 MHz.

The TCXO is enclosed in an RF shielded can. Access to the oscillator trimmer is made through the hole in the top of the can. The TCXO is compensated by an internal temperature-compensated circuit for both low and high temperatures. With no additional compensation, the oscillators will provide 1.5 PPM stability from -30-degrees Centigrade to +60-degrees Centigrade.

Synthesizer

Synthesizer 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 oscillator, is divided by a fixed integer number to obtain a 6.25 kHz or a 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 phase-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 reset 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 **P**hase-**L**ock-**L**oop (**PLL**) 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 C205. 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 or by adder operational amplifier IC203-B.

DC Offset And High Current Buffers

DC offset buffer transistors TR201 and TR202 and diode CD202-A receive the 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 **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 transistor TR202. Resistor R124, diode CD202-A and transistor TR202 complete a high-current rapid charge or discharge path for capacitors C210-C212. As the error voltage decreases, TR201, TR202 and CD202-A turn on, completing a discharge path for C210 to C212. When the error voltage goes positive, TR201, TR202 and CD212 are turned off allowing C210 - C212 to charge through R214.

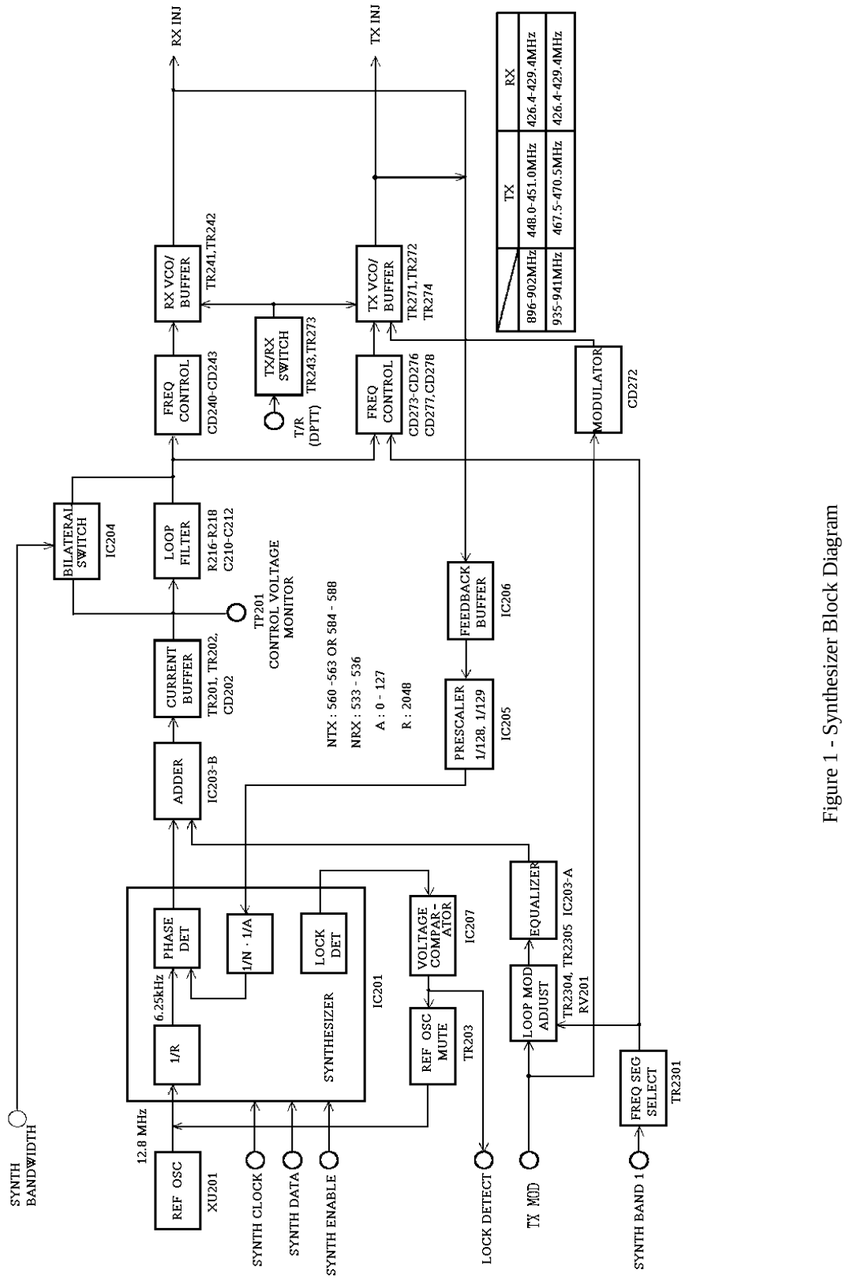


Figure 1 - Synthesizer Block Diagram

When a channel is changed in receive and when changing from transmit to receive, bilateral switches IC204-C, E, B and D are turned on for 4 milliseconds. When changing from receive to transmit, IC204-C, E, B and D 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, silicon, JFET oscillator transistor, TR241, followed by high-gain buffer transistor TR242. Transistor TR242 prevents external loading and provides power gain. The VCO is a Collpoitts 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 Receive VCO is turned on (Transistor TR243 is on). Oscillator output is typically 0 dBm. The output is applied to the feedback buffer for VCO frequency control and as the receive injection frequency to the receiver first mixer through Local Oscillator buffers on the receive board. The receive VCO also uses a high-Q resonator to achieve superior noise performance. The VCO operates over a frequency range of 426.4-429.4 MHz . The VCO voltage need only be set once at the highest frequency of the band split, after which it will operate over the entire split with no more tuning.

Transmit Voltage Controlled Oscillator

The transmit VCO is basically the same as the receive VCO. The wideband VCO allows frequency separation of 6 MHz as determined by the bandsplit the radio is operating on, 896-902 MHz or 935-941 MHz. The varactors in conjunction with the frequency segment selector (transistor TR2301 and bandswitching diodes CD277 and CD278) provide a voltage-controlled adjustment range that extends across the entire frequency split. VCO control switch TR273 turns the transmit VCO on when **T/R** line is low.

Feedback Buffer

The buffered output of the receive VCO and transmit VCO from buffer transistors TR242 and TR247 respectively, are supplied to the feedback buffer IC206. The buffered VCO output also provides receive or transmit injection drive.

Dual Modulus Prescaler

The dual Modulus prescaler completes the PLL feedback path from the synthesizer to 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 128 or 129 under control of **M CONT** from the synthesizer. The output of the prescaler is applied to the synthesizer where it is divided down to 6.25 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 data received from the microcomputer. Depending on the operating frequency, the DC voltage at TP201 should be within the range 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 and the reference oscillator if the loop loses lock. It also provides a fast lock detect signal to the microcomputer to turn to the out-of-lock indicator. If a large change in frequency is required, the ramp capacitor output (**C**R) of the synthesizer may increase positive **L**ock **D**etect (**LD**) line from the synthesizer. Thus, transistor TR203 disables the reference oscillator and allows the PLL to be brought back to synchronization rapidly.

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

Loop Modulation Adjust

The loop modulation adjustment circuit automatically sets the loop modulation level applied to the equalizer IC202 and IC203 through loop modulation adjust RV201. The loop modulation adjust modulation circuits consists of transistors TR2304, and TR2305 and resistors R238, R2001, R2005 and RV201. The loop modulation level is controlled by turning transistor switch TR230 on or off to include attenuators R238, R2001 and R2005 in the circuit. Resistors R238, R2001 and R2005 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 switches capacitance in and out of the transmit and receive VCO tank circuits to select the frequency segment containing the selected channel. The frequency segment selector consists of transistor TR2301, and diodes CD277 and CD278 and operates under control of the microcomputer. Capacitors C289, C292 and C2710 are selected or deselected for operation in a given segment. Table 2 identifies the circuit conditions existing for selection of each segment and the capacitor used.

Reverse bias to turn off the band switching diodes are provided by the +8 Volts filtered supply through resistor R2303. Forward bias for the diodes and current for the switching transistors is provided by the +8 Volts supply through resistors R2301 and R2302. When segment 1 is selected, transistor TR2301 is turned on. In the transmit VCO diodes CD277 and CD278 are turned on. Capacitors C289 and C2710 are connected to ground by CD277 and CD278.

Table 1 - Frequency Segment Selection

Segment	Frequency Split (MHz)	Synth Band 1 (Input TR2301)	Grounded Modulation Resistor
1	896-902	1	R238
2	935-941	0	R2005

Table 2 - Capacitor Selection

Segment	Transistor Switch TR2301	Band Switching Diodes CD277, CD278T	Grounded Capacitors
1	1	ON	C289, C2710
2	0	OFF	None

RECEIVE CIRCUIT

Receiver Front End

The RF signal from the antenna is coupled through the low-pass filter, antenna switch and dielectric band-pass filter FL401 to the input of RF amplifier transistor TR401 (refer to Figure 2). The output of TR401 is coupled through dielectric band-pass filter FL402 and capacitor C411 to the input of the first mixer circuit at Z421. Receive Front End selectivity is provided by dielectric band pass filters FL401 and FL402.

Receiver Injection

Receiver RF injection (426.4 - 429.4 MHz) from the synthesizer VCO is applied to **DOUBLER** transistor TR461. The input level of TR461 is between 0.5 and 1.0 milliwatts. The output of TR461 is coupled to the input of amplifier transistor TR462. The output of amplifier TR462 is filtered by dielectric filter FL403. This filter is tuned to pass frequency in the 852.8 - 858.8 MHz pass band. The output of FL403 is coupled through capacitor C422 to the input of the first mixer circuit at Z421.

1st Mixer

RF from the receive front-end and injection frequency/voltage from the multiplier stage are mixed together at Z421. This mixture of RF and Injection frequencies is applied through capacitor C420 to the base of transistor TR421. Transistor TR421 provides high power gain for the mixer stage. The difference between the RF and the injection frequency produces an 82.2 MHz first IF output on the collector of TR421. The 82.2 MHz first IF output signal is coupled from the collector of TR421 through an impedance matching network consisting of Z422, capacitor C424, resistor R425, inductor L401, capacitor C430 and an attenuator pad consisting of resistors R428 through R430 to connector J501, Pin 1. Connector J501 connects to P501 located on the System Control Logic/IF/Audio Board CMF-138.

Circuit analysis for the receive circuit continues in Maintenance Manual LBI-39057, System Control Logic/IF/Audio Board, CMF-138. Maintenance Manual LBI-39057 continues with the 1st IF, 2nd Mixer and 2nd IF and Detector.

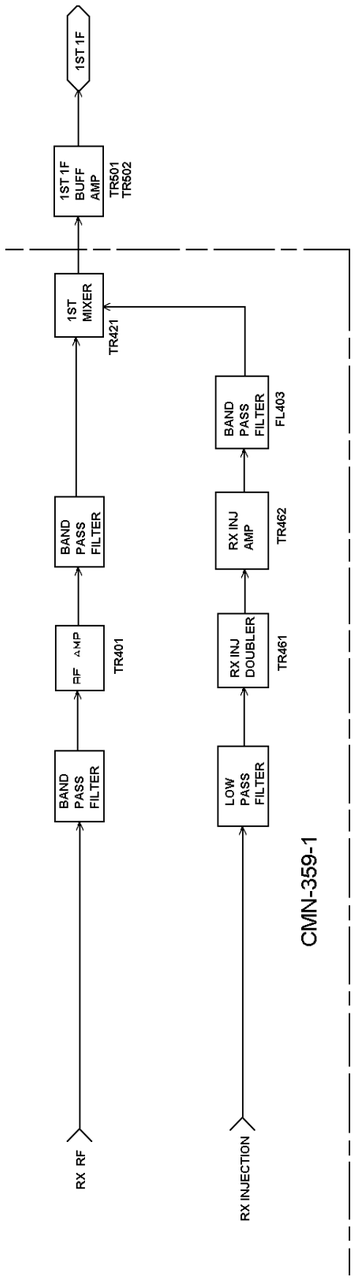


Figure 2 - Receiver Block Diagram

9-VOLT REGULATOR

The **SWITCHED A+** supplied from J501, Pin 17 is regulated to +9 Vdc by regulator IC481 (3-terminal Regulator). The +9 volts regulated output on IC481, Pin 3 is applied to exciter transistors TR151 and TR153 through Tx power switch TR152.

When $\overline{\text{TX ENBL}}$ is high (receive mode), +9V is <u>not</u> applied.

The Exciter is energized by 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.**

EXCITER CIRCUIT

The Exciter circuit consist of a multiplier circuit (doubler) and a wide-band amplifier stage operating over a frequency range of 896-941 MHz without any tuning (refer to Figure 3). The exciter amplifies the approximately 1.0 milliwatt signal from the synthesizer transmit VCO to provide 9 milliwatt (typical) drive to the RF power amplifier circuit.

The 448-470.5 MHz transmit injection input from the synthesizer transmit VCO is applied to the base circuit of doubler transistor TR151 through an attenuator pad consisting of resistors R152 thru R153. Supply voltage (+9 Vdc) from TR152 is applied to TR151 through a collector feed network consisting of resistor R168 and Z151. Capacitors C156 and C157 are bypass capacitors.

The output of TR151 drives amplifier transistor TR153 through the impedance matching components consisting of capacitor C168, resistor R162 and the coupling capacitor C158. Collector voltage +9 Vdc is applied to TR153 through collector the feed network consisting of resistor R167 and Z152. Capacitors C159 and C165 are bypass capacitors.

The output of TR153 is coupled to FL151 band pass filter at pass band 896-941 MHz through an attenuator pad consisting of resistors R164 through R166. The output of FL151 is coupled to connector J151. Transistor TR153 amplifies the approximately 1 milliwatt input level to 9 milliwatt (typical).

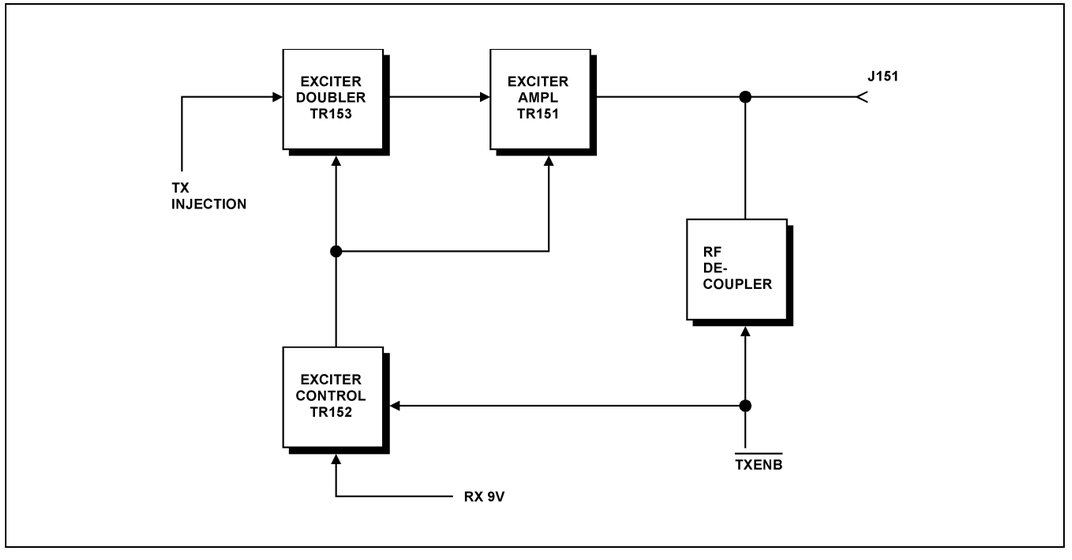
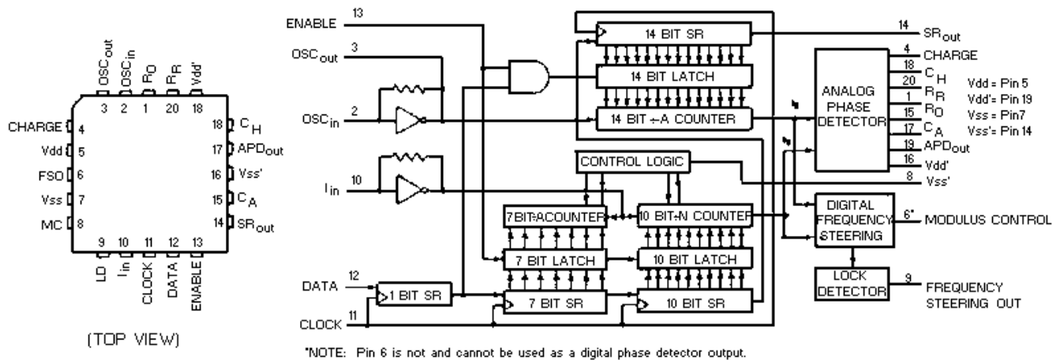
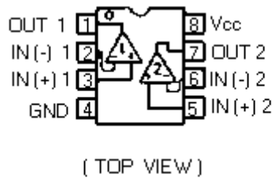


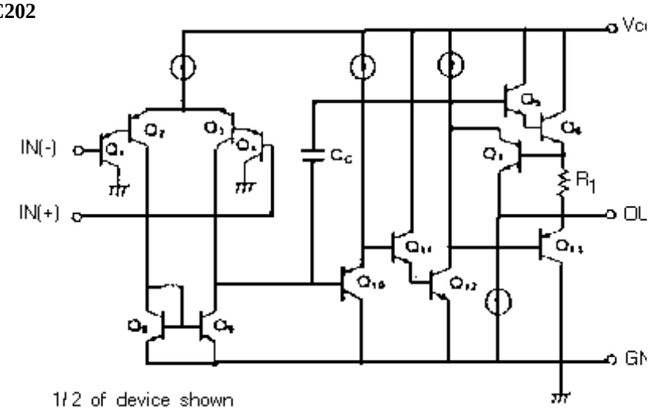
Figure 3 - Exciter Block Diagram

SYNTHESIZER IC201

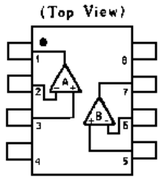


DUAL OPERATIONAL AMPLIFIER IC202

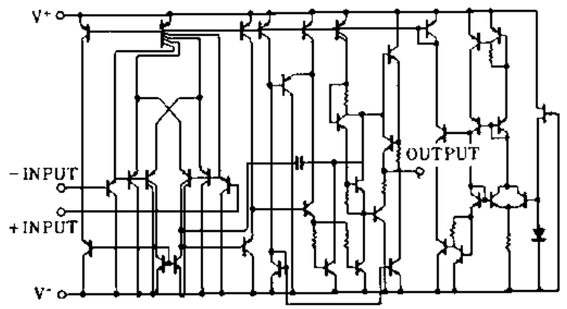




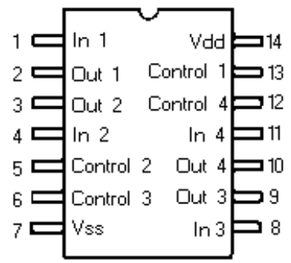
DUAL OPERATIONAL AMPLIFIER IC203

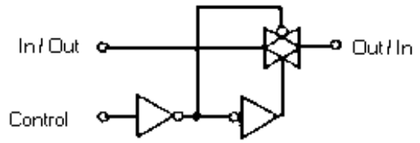


1. A OUTPUT
2. A−INPUT
3. A+INPUT
4. V⁻
5. B+INPUT
6. B−INPUT
7. B OUTPUT
8. V+



BILATERAL SWITCH IC204





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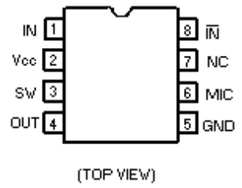
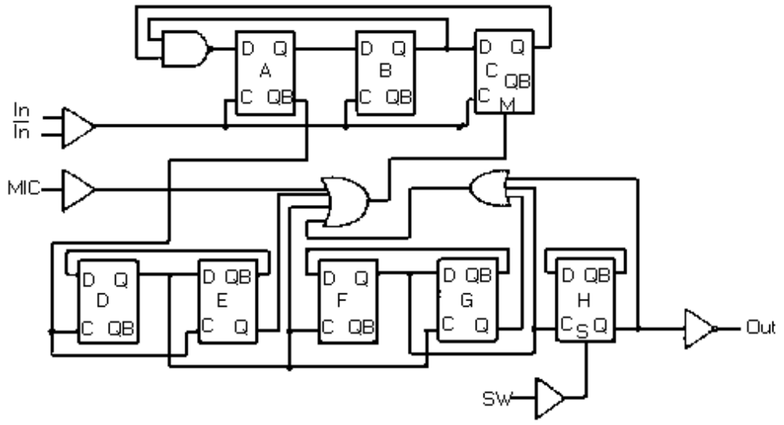
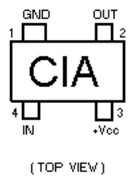
Control	Switch
0 = Vss	OFF
1 = Vdd	ON

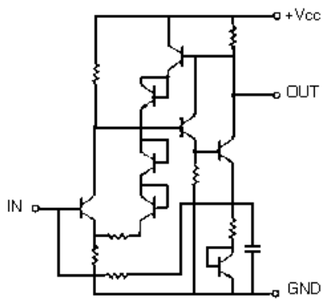
PRESCALER IC205





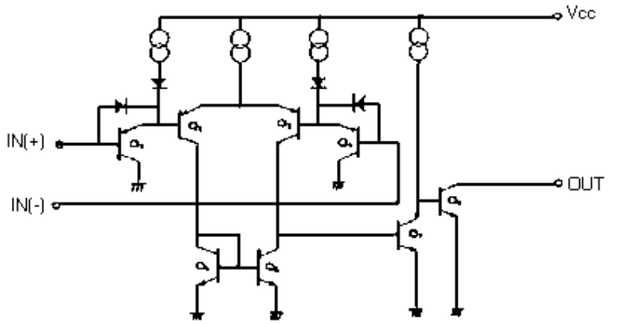
RF WIDE BAND AMPLIFIER IC206





DUAL COMPARATOR IC207

(TOP VIEW)



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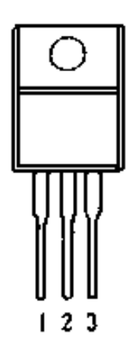
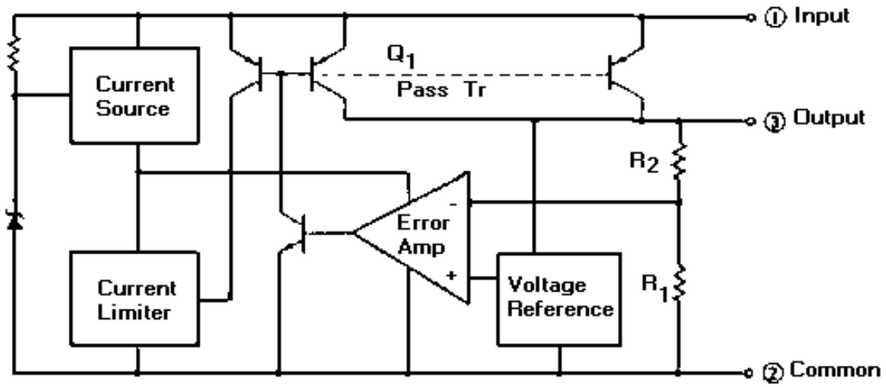
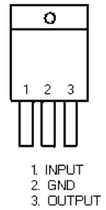
POSITIVE VOLTAGE REGULATOR IC230



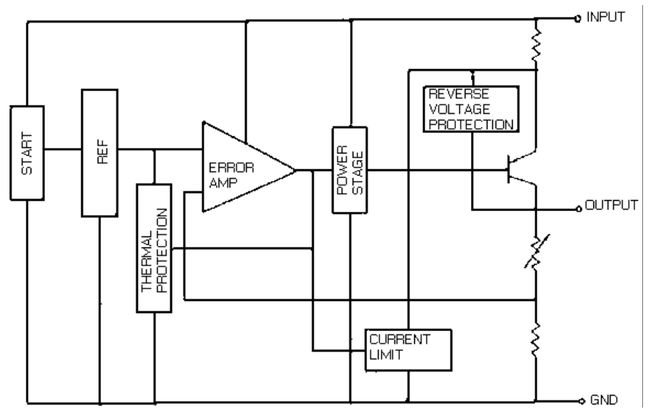
(Top View)



POSITIVE VOLTAGE REGULATOR IC481



1. INPUT
2. GND
3. OUTPUT



SYNTHESIZER/RECEIVER/EXCITER BOARD
SYNTHESIZER SECTION
CMN-359-2
Issue 1

SYMBOL	PART NUMBER	DESCRIPTION
		- - - - - - CAPACITORS - - - - - - -
C201	NOTE: Parts listed are for reference only. Refer to Service Section for serviceable parts.	Ceramic: 0.047 µF ±10% 25 VDCW, temp coef ±15%.
C202		Ceramic: 470 pF ±5% 50 VDCW, temp coef +350-1000 PPM.
C203		Electrolytic: 220 µF ±20% 10 VDCW.
C204		Ceramic: 0.047 µF ±10% 25 VDCW, temp coef ±15%.
C205		Ceramic: 0.01 µF ±10% 50 VDCW, temp coef ±15%.
C206		Polyester: 0.47 µF ±5% 50 VDCW.
C207 thru C209		Electrolytic: 47 µF ±20% 16 VDCW.
C210		Polypropylene: 1 µF ±10%.
C211		Ceramic: 0.047 µF ±10% 25 VDCW, temp coef ±15%.
C212		Polypropylene: 0.1 µF ±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 µF ±10% 25 VDCW, temp coef 0±15%.
C218 thru C220		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C221		Ceramic: 0.047 µF ±10% 25 VDCW, temp coef ±15%.
C222		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 30 PPM.
C223		Ceramic: 680 pF ±5% 50 VDCW, temp coef 350-1000 PPM.
C224		Tantalum: 10 µF ±20% 10 VDCW.
C225		Tantalum: 4.7 µF ±20% 16 VDCW.
C230		Polyester: 0.1 µF ±5% 50 VDCW.
C231		Electrolytic: 47 µF ±20% 16 VDCW.
C232 and C233		Ceramic:1000 pF ±10% 50 VDCW, temp coef ±15%.
C234		Electrolytic: 47 µF ±20% 16 VDCW.
C235		Ceramic:1000 pF ±10% 50 VDCW, temp coef ±15%.
C236		Electrolytic: 47 µF ±20% 16 VDCW.
C241		Ceramic: 7 pF ±0.5 pF 50 VDCW, temp coef 0 ± 30 PPM.
C242		Ceramic: 6 pF ±0.5 pF 50 VDCW, temp coef 0 ± 30 PPM.
C244		Ceramic: 4 pF ±0.25 pF 50 VDCW, temp coef -750±120 PPM.
C245		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C246 and C247		Ceramic: 15 pF ±5% 50 VDCW, temp coef 0 ± 30 PPM.
C248		Ceramic: 2 pF ±0.25 pF 50 VDCW, temp coef 0 ± 30 PPM.
C249 and C250		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C251		Ceramic: 6 pF ±0.5 pF 50 VDCW, temp coef 0 ± 30 PPM.
C252		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C253		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C266 and C267		Ceramic: 5 pF ±0.25 pF 50 VDCW, temp coef 0 ± 30 PPM.
C268		Ceramic: 1 pF ±0.25 pF 50 VDCW, temp coef 0 ± 30 PPM.
C269		Ceramic: 5 pF ±0.25 pF 50 VDCW, temp coef 0 ± 30 PPM.
C270		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C271		Ceramic: 1 pF ±0.25 pF 50 VDCW, temp coef 0 ± 30 PPM.
C272		Ceramic: 2 pF ±0.25 pF 50 VDCW, temp coef 0 ± 30 PPM.
C273 and C274		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C275		Ceramic: 7 pF ±0.5 pF 50 VDCW, temp coef -750120 PPM.
C276		Ceramic: 1 pF ±0.25 pF 50 VDCW, temp coef 0 ± 30 PPM.
C278		Ceramic: 8 pF ±0.5 pF 50 VDCW, temp coef 0 ± 30 PPM.
C279		Ceramic: 3 pF ±0.25 pF 50 VDCW, temp coef -750±120 PPM.
C280 and C281		Ceramic: 12 pF ±5% 50 VDCW, temp coef 0 ± 30 PPM.
C282		Ceramic: 1 pF ±0.25 pF 50 VDCW, temp coef 0 ± 30 PPM.
C283 and C284		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C285		Ceramic: 6 pF ±0.5 pF 50 VDCW, temp coef 0 ± 30 PPM.
C286 thru C288		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C293		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C298		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C2001		Tantalum: 10 µF ±20% 10 VDCW.
C2101		Ceramic: 3 pF ±0.25 pF 50 VDCW, temp coef 0 ± 30 PPM.
C2304		Ceramic: 0.047 µF ±10% 25 VDCW, temp coef ±15%.
C2701		Ceramic: 5 pF ±0.25 pF 50 VDCW, temp coef 0 ± 30 PPM.
C2702		Ceramic: 6 pF ±0.5 pF 50 VDCW, temp coef 0 ± 30 PPM.
C2703		Ceramic: 5 pF ±0.25 pF 50 VDCW, temp coef 0 ± 30 PPM.
C2704		Ceramic: 1 pF ±0.25 pF 50 VDCW, temp coef 0 ± 30 PPM.
C2705		Ceramic: 5 pF ±0.25 pF 50 VDCW, temp coef 0 ± 30 PPM.
C2706		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.
CD240 thru CD243		Silicon: Variable Capacitance Diode; sim to HITACHI HVU351.
CD247		Silicon: Schottky Barrier Diode; sim to HITACHI HSU88.
CD271		Silicon: fast recovery (2 diodes in series); sim to PANASONIC MA153A.
CD272		Silicon: Variable Capacitance Diode; sim to HITACHI HVU202.
CD273 thru CD276		Silicon: Variable Capacitance Diode; sim to HITACHI HVU351.
CD277 and CD278		Silicon: Epitaxial Planer Diode: sim to ROHM 1SS318.
CD283		Silicon: Schottky Barrier Diode; sim to HITACHI HSU88.
		- - - - - - VARIABLE CAPACITOR - - - - -
CV201 and CV202		Variable: 10 pF max.
		- - - - - - - - - - - - FILTER - - - - - - - - - -
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 band amplifier: sim to NEC PC1675G.
IC207		Linear: Dual Comparator; sim to MITSUBISHI M5233FP.
IC230		Linear: Positive Voltage Regulator; sim to PANASONIC AN6541.
		- - - - - - - - - - COILS - - - - - - - -
L201		Choke Coil: 10 µH ±10%.
L240 and L241		Choke Coil: 0.18 µH ±10%.
L242		Coil: Dielectric resonator.
L243		Choke Coil: 0.47 µH ±10%.
L244		Choke Coil: 0.18 µF ±10%.
L245		Choke Coil: 33 nH ±10%.
L249		Coil: RF 19 nH ±10%.
L270 and L271		Choke Coil: 0.18 µH ±10%.
L272		Coil: Dielectric resonator.
L273		Choke Coil: 0.47 µH ±10%.
L274		Choke Coil: 0.18 µH ±10%.
L275		Choke Coil: 33 nH ±10%.
L276		Choke Coil: 0.18 µH ±10%.
L279		Choke Coil: 33 nH ±10%.
L280		Coil: RF 19 nH ±10%.
L281		Coil: RF 4.7 µH ±10%.
		- - - - - - - - - RESISTORS - - - - - - -
R201		Metal film: 10K ohms ±5%, 50 VDCW, 1/16 Watt.
R202		Metal film: 22 ohms ±5%, 100 VDCW, 1/10 Watt.
R203		Metal film: 150K ohms ±5%, 50 VDCW, 1/16 Watt.
R204		Metal film: 470K ohms ±5%, 50 VDCW, 1/16 Watt.
R205		Metal film: 150K ohms ±5%, 100 VDCW, 1/10 Watt.
R206		Metal film: 2.2K ohms ±5%, 50 VDCW, 1/16 Watt.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	PART NUMBER	DESCRIPTION
R207		Metal film: 1M ohms ±5%, 50 VDCW, 1/16 Watt.
R210		Metal film: 470K ohms ±5%, 50 VDCW, 1/16 Watt.
R211		Metal film: 100K ohms ±5%, 50 VDCW, 1/16 Watt.
R213		Metal film: 0 ohm.
R214		Metal film: 330 ohms ±5%, 200 VDCW, 1/4 Watt.
R215		Metal film: 10K ohms ±5% 100 VDCW, 1/10 Watt.
R216		Metal film: 150K ohms ±5%, 50 VDCW, 1/16 Watt.
R217		Metal film: 6.8K ohms ±5%, 50 VDCW, 1/16 Watt.
R218		Metal film: 3.3K ohms ±5%, 50 VDCW, 1/16 Watt.
R219		Metal film: 15 ohms ±5%, 50 VDCW, 1/16 Watt.
R220 thru R224		Metal film: 10K ohms ±5%, 50 VDCW, 1/16 Watt.
R225		Metal film: 47 ohms ±5%, 100 VDCW, 1/10 Watt.
R226		Metal film: 0 ohm.
R228		Metal film: 220K ohms ±5%, 50 VDCW, 1/16 Watt.
R229		Metal film: 18K ohms ±5%, 50 VDCW, 1/16 Watt.
R230		Metal film: 2.7K ohms ±5%, 50 VDCW, 1/16 Watt.
R231		Metal film: 22K ohms ±5%, 50 VDCW, 1/16 Watt.
R232		Metal film: 1.5K ohms ±5%, 50 VDCW, 1/16 Watt.
R233		Metal film: 22K ohms ±5%, 50 VDCW, 1/16 Watt.
R234		Metal film: 100K ohms ±5%, 50 VDCW, 1/16 Watt.
R235 and R236		Metal film: 10K ohms ±5%, 50 VDCW, 1/16 Watt.
R238		Metal film: 270K ohms ±5%, 100 VDCW, 1/10 Watt.
R240		Metal film: 2.2K ohms ±5%, 100 VDCW, 1/10 Watt.
R241		Metal film: 6.8K ohms ±5%, 100 VDCW, 1/10 Watt.
R242		Metal film: 2.2K ohms ±5%, 100 VDCW, 1/10 Watt.
R244		Metal film: 150 ohms ±5%, 100 VDCW, 1/10 Watt.
R245		Metal film: 5.6K ohms ±5%, 100 VDCW, 1/10 Watt.
R246		Metal film: 1.5K ohms ±5%, 100 VDCW, 1/10 Watt.
R247		Metal film: 120 ohms ±5%, 100 VDCW, 1/10 Watt.
R248		Metal film: 470 ohms ±5%,100 VDCW, 1/10 Watt.

SYMBOL	PART NUMBER	DESCRIPTION
R249		Metal film: 12 ohms ±5%,100 VDCW, 1/10 Watt.
R250		Metal film: 470 ohms ±5%, 100 VDCW, 1/10 Watt.
R251		Metal film: 220 ohms ±5%, 100 VDCW, 1/10 Watt.
R260		Metal film: 100 ohms ±5%, 100 VDCW, 1/10 Watt.
R270		Metal film: 100K ohms ±5%, 100 VDCW, 1/10 Watt.
R271		Metal film: 33K ohms ±5%, 100 VDCW, 1/10 Watt.
R272		Metal film: 22K ohms ±5%, 100 VDCW, 1/10 Watt.
R273		Metal film: 6.8K ohms ±5%, 100 VDCW, 1/10 Watt.
R274		Metal film: 390K ohms ±5%, 100 VDCW, 1/10 Watt.
R275		Metal film: 6.8K ohms ±5%, 100 VDCW, 1/10 Watt.
R276		Metal film: 2.2K ohms ±5%, 100 VDCW, 1/10 Watt.
R278		Metal film: 150 ohms ±5%, 100 VDCW, 1/10 Watt.
R279		Metal film: 5.6K ohms ±5%, 100 VDCW, 1/10 Watt.
R280		Metal film: 1.5K ohms ±5%, 100 VDCW, 1/10 Watt.
R281		Metal film: 150 ohms ±5%, 100 VDCW, 1/10 Watt.
R282		Metal film: 10K ohms ±5%, 100 VDCW, 1/10 Watt.
R283		Metal film: 56K ohms ±5%, 100 VDCW, 1/10 Watt.
R284		Metal film: 220 ohms ±5%, 100 VDCW, 1/10 Watt.
R285		Metal film: 270 ohms ±5%, 100 VDCW, 1/10 Watt.
R286		Metal film: 18 ohms ±5%, 100 VDCW, 1/10 Watt.
R287		Metal film: 270 ohms ±5%, 100 VDCW, 1/10 Watt.
R288 and R289		Metal film: 100 ohms ±5%, 50 VDCW, 1/16 Watt.
R294		Metal film: 10K ohms ±5%, 100 VDCW, 1/10 Watt.
R2001		Metal film: 27K ohms ±5%, 50 VDCW, 1/16 Watt.
R2005		Metal film: 100K ohms ±5%, 50 VDCW, 1/16 Watt.
R2008		Metal film: 330K ohms ±5%, 50 VDCW, 1/16 Watt.
R2011		Metal film: 1M ohms ±5%, 50 VDCW, 1/16 Watt.
R2012		Metal film: 100K ohms ±5%, 50 VDCW, 1/16 Watt.
R2013		Metal film: 0 ohm.

SYMBOL	PART NUMBER	DESCRIPTION
R2303		Metal film: 4.7K ohms ±5%, 100 VDCW, 1/10 Watt.
R2310		Metal film: 15K ohms ±5%, 50 VDCW, 1/16 Watt.
R2313		Metal film: 39K ohms ±5%, 50 VDCW, 1/16 Watt.
R2316		Metal film: 10K ohms ±5%, 100 VDCW, 1/10 Watt.
R2801		Metal film: 68 ohms ±5%, 100 VDCW, 1/10 Watt.
RV201		Variable: 20K ohms ±25% ,1/10 Watt.
		- - - - - - - - - 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).
TR241		Silicon, NPN: sim to HITACHI 2SC4591.
TR242		Silicon, NPN: sim to NEC 2SC3356.
TR243		Silicon, NPN: sim to PANASONIC UN5216.
TR271		Silicon, NPN: sim to HITACHI 2SC4591.
TR272		Silicon, NPN: sim to NEC 2SC3356.
TR273		Silicon, NPN: sim to PANASONIC XP1216.
TR274		Silicon, NPN: sim to NEC 2SC3356.
TR2301		Silicon, NPN: sim to PANASONIC XP1216.
TR2304 and TR2305		Silicon, NPN: sim to PANASONIC UN5216.
		- - - - - - - - CRYSTAL - - - - - - - - -
XU201		Reference Oscillator unit: 12.8MHz ±1.5 PPM.

SYNTHESIZER/RECEIVER/EXCITER BOARD
RECEIVER/EXCITER SECTION
CMN-359
Issue 1

SYMBOL	PART NUMBER	DESCRIPTION
		- - - - - - - - - CAPACITORS - - - - - -
C150		Ceramic: 15 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C151		Ceramic: 7 pF 0.5 pF 50 VDCW, temp coef 0 ± 60 PPM.
C152		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C153		Ceramic: 470 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C154		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C155		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C156		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C157		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C158		Ceramic: 6 pF ±0.5 pF 50 VDCW, temp coef 0 ± 60 PPM.
C159		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C160		Ceramic: 22 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C161		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C162		Ceramic: 15 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C163		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C164		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C165		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C166		Tantalum: 22 µF ±20% 16 VDCW.
C167		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C168		Ceramic: 0.5 pF ±0.25 pF 50 VDCW, temp coef 0 ± 250 PPM.
C169		Ceramic: 5 pF ±0.25 pF 50 VDCW, temp coef 0 ± 60 PPM.
C401		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C402		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C403		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C404		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C405		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C406		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

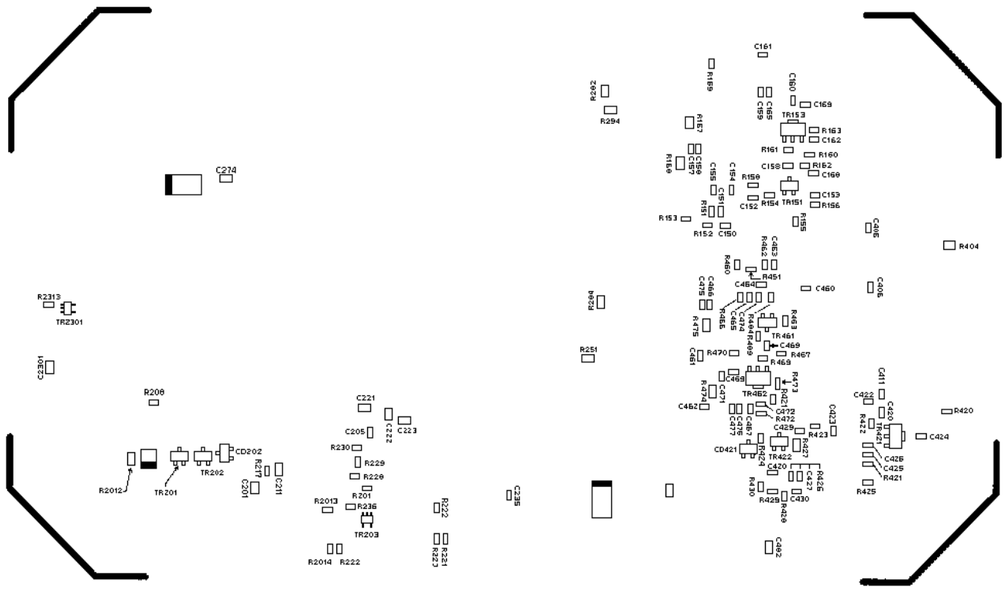
SYMBOL	PART NUMBER	DESCRIPTION
C407		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C408		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C410		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C411		Ceramic: 5 pF 0.25 pF 50 VDCW, temp coef 0 ± 60 PPM.
C412		Ceramic: 3 pF ±0,5 pF 50 VDCW, temp coef 0 ± 120 PPM.
C420		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C422		Ceramic: 3 pF ±0.25 pF 50 VDCW, temp coef 0 ± 120 PPM.
C424		Ceramic: 3 pF ±0.25 pF 50 VDCW, temp coef 0 ± 60 PPM.
C425		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C426		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C428		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C429		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C430		Ceramic: 0.01 µF ±10% 50 VDCW, temp coef ±15%.
C460		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C461		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C462		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C463		Ceramic: 5 pF ±0,5 pF 50 VDCW, temp coef 0 ± 60 PPM.
C464		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C465		Ceramic: 470 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C466		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C467		Ceramic: 4 pF ±0.25 pF 50 VDCW, temp coef 0 ± 60 PPM.
C468		Ceramic: 10 pF ±0.5 pF 50 VDCW, temp coef 0 ± 60 PPM.
C469		Ceramic: 15 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C471		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C472		Ceramic: 6 pF ±0,5 pF 50 VDCW, temp coef 0 ± 60 PPM.
C473		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C474		Ceramic: 33 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C475		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.
C476		Ceramic: 100 pF ±5% 50 VDCW, temp coef 0 ± 60 PPM.
C477		Ceramic: 1000 pF ±10% 50 VDCW, temp coef ±15%.

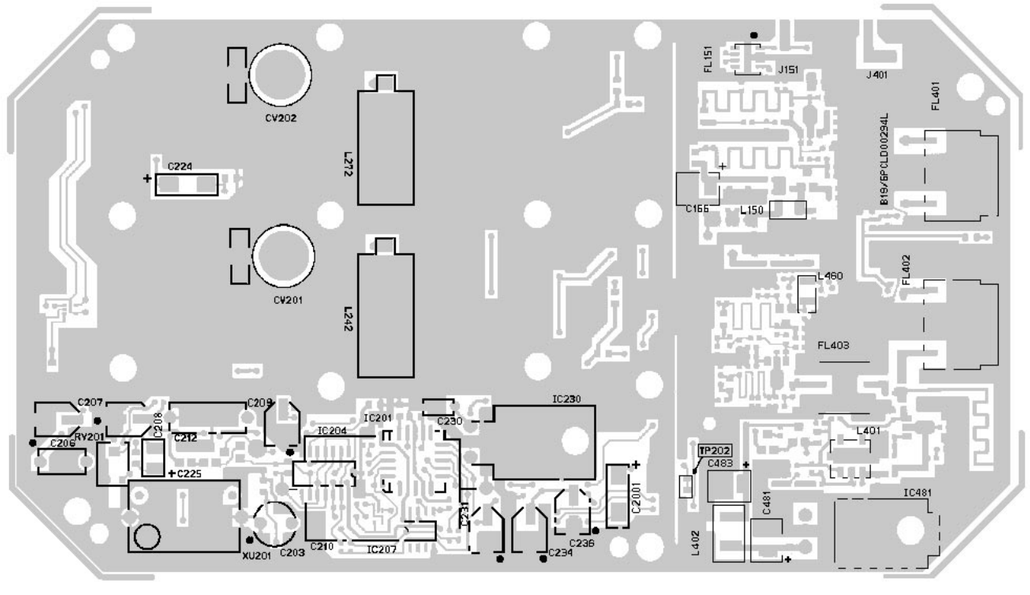
SYMBOL	PART NUMBER	DESCRIPTION
C480		Ceramic: 0.1 µF ±10% 25 VDCW, temp coef ±15%.
C481		Tantalum: 22 µF ±20% 16 VDCW.
C482		Ceramic: 0.1 µF ±10% 25 VDCW, temp coef ±15%.
C483		Tantalum: 22 µF ±20% 16 VDCW.
		- - - - - - - - - DIODES - - - - - - - - -
CD150 CD421		Silicon: fast recovery (2 diodes in cathode). sim to TOSHIBA ISS184.
		- - - - - - - - - - FILTER - - - - - - - - - -
FL151		RF B.P.F. Pass band 896 to 941 MHz.
FL401		Dielectric RF Filter
FL402		Dielectric RF Filter
FL403		RF B.P.F. Pass band 852 to 860 MHz. : 2-POLE
		- - - - - INTEGRATED CIRCUITS - - - - -
IC481		Linear: Positive Voltage Regulator; sim to NEC PC2409HF.
		- - - - - - - - - - JACKS - - - - - - - - -
J151		Connector: RF.
J401		Connector: RF.
J501		Connector: 30 pins.
		- - - - - - - - - - -COILS - - - - - - - - - -
L150		Coil: RF 22 nh ±10%
L157		Coil: RF 10 nh ±10%
L401		H-6LALD00166
L402		Coil: µH ±20%
L460		Coil: RF 22 nh ±10%
		- - - - - - - - - RESISTORS - - - - - - - - -
R150		Metal film 1k ohms ±5% 100 VDCW, 1/10 Watt.
R151		Metal film: 470 ohms ±5% 50 VDCW, 1/16 Watt.
R152		Metal film: 12 ohms ±5% 50 VDCW, 1/16 Watt.
R153		Metal film: 470 ohms ±5% 50 VDCW, 1/16 Watt.
R154		Metal film: 2.2K ohms ±5% 50 VDCW, 1/16 Watt.
R155		Metal film: 2.2K ohms ±5% 50 VDCW, 1/16 Watt.
R156		Metal film: 220 ohms ±5% 50 VDCW, 1/16 Watt.
R157		Metal film: 3.3K ohms ±5% 50 VDCW, 1/16 Watt.
R158		Metal film: 100 ohms ±5% 50 VDCW, 1/16 Watt.

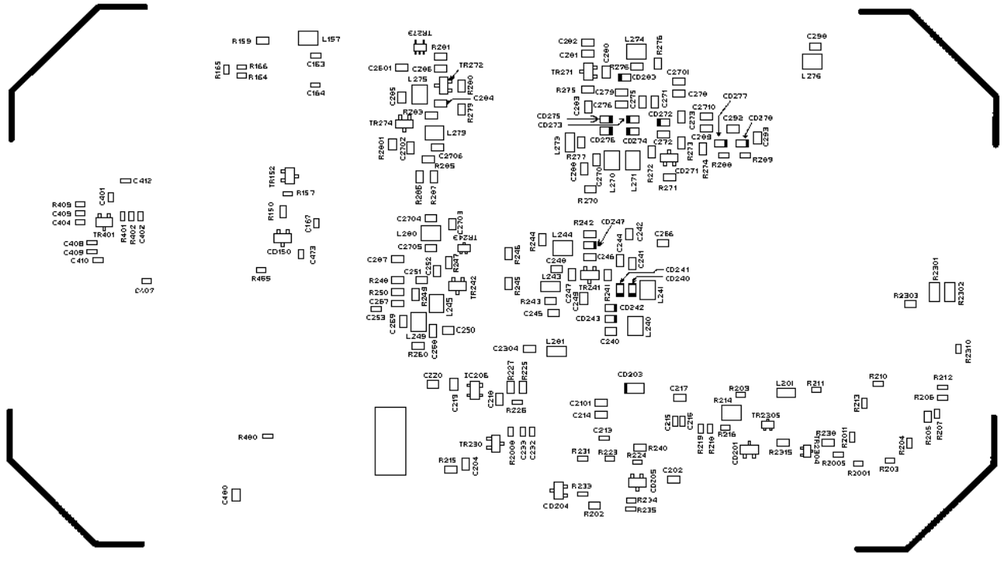
SYMBOL	PART NUMBER	DESCRIPTION
R159		Metal film: 220 ohms ±5% 100 VDCW, 1/10 Watt.
R160		Metal film: 1K ohms ±5% 50 VDCW, 1/16 Watt.
R161		Metal film: 5.6K ohms ±5% 50 VDCW, 1/16 Watt.
R162		Metal film: 10 ohms ±5% 50 VDCW, 1/16 Watt.
R163		Metal film: 10 ohms ±5% 50 VDCW, 1/16 Watt.
R164		Metal film: 12 ohms ±5% 50 VDCW, 1/16 Watt.
R165		Metal film: 470 ohms ±5% 50 VDCW, 1/16 Watt.
R166		Metal film: 470 ohms ±5% 50 VDCW, 1/16 Watt.
R167		Metal film: 47 ohms ±5% 100 VDCW, 1/10 Watt.
R168		Metal film: 100 ohms ±5% 100 VDCW, 1/10 Watt.
R169		Metal film: 0 ohms.
R401		Metal film: 1.5K ohms ±5% 50 VDCW, 1/16 Watt.
R402		Metal film: 3.3K ohms ±5% 50 VDCW, 1/16 Watt.
R403		Metal film: 100 ohms ±5% 50 VDCW, 1/16 Watt.
R404		Metal film: 0 ohms.
R420		Metal film: 0 ohms.
R421		Metal film: 220 ohms ±5% 50 VDCW, 1/16 Watt.
R422		Metal film: 1.8K ohms ±5% 50 VDCW, 1/16 Watt.
R423		Metal film: 2.2K ohms ±5% 50 VDCW, 1/16 Watt.
R424		Metal film: 2.2K ohms ±5% 50 VDCW, 1/16 Watt.
R425		Metal film: 100 ohms ±5% 50 VDCW, 1/16 Watt.
R427		Metal film: 100 ohms ±5% 100 VDCW, 1/10 Watt.
R428		Metal film: 100 ohms ±5% 50 VDCW, 1/16 Watt.
R429		Metal film: 68 ohms ±5% 50 VDCW, 1/16 Watt.
R430		Metal film: 100 ohms ±5% 50 VDCW, 1/16 Watt.
R460		Metal film: 180 ohms ±5% 50 VDCW, 1/16 Watt.
R461		Metal film: 27 ohms ±5% 50 VDCW, 1/16 Watt.
R462		Metal film: 180 ohms ±5% 50 VDCW, 1/16 Watt.
R463		Metal film: 2.2K ohms ±5% 50 VDCW, 1/16 Watt.
R464		Metal film: 2.2K ohms ±5% 50 VDCW, 1/16 Watt.
R465		Metal film: 100 ohms ±5% 50 VDCW, 1/16 Watt.

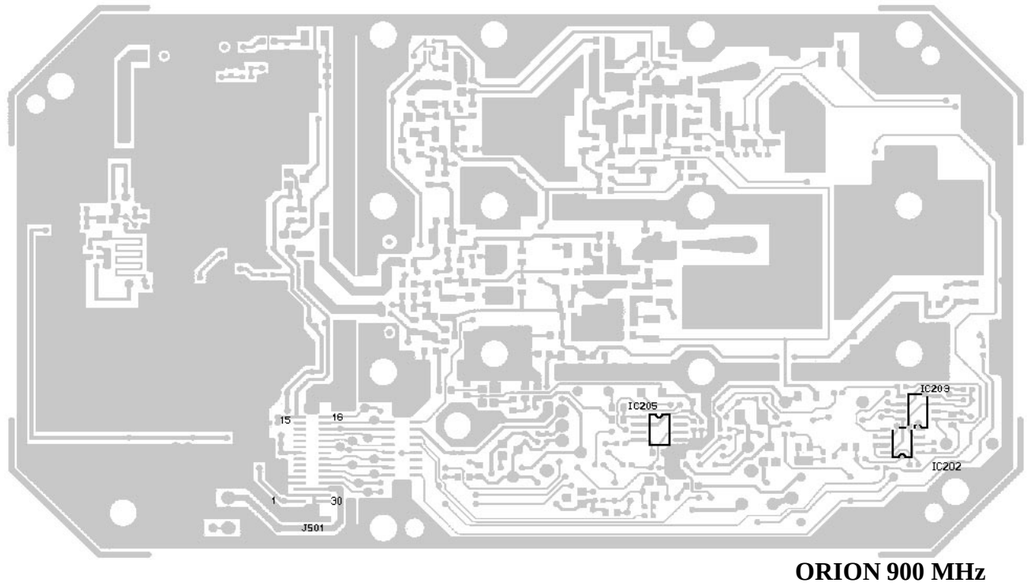
SYMBOL	PART NUMBER	DESCRIPTION
R466		Metal film: 220 ohms ±5% 50 VDCW, 1/16 Watt.
R467		Metal film: 1K ohms ±5% 50 VDCW, 1/16 Watt.
R468		Metal film: 5.6K ohms ±5% 50 VDCW, 1/16 Watt.
R469		Metal film: 10 ohms ±5% 50 VDCW, 1/16 Watt.
R470		Metal film: 10 ohms ±5% 50 VDCW, 1/16 Watt.
R471		Metal film: 18 ohms ±5% 50 VDCW, 1/16 Watt.
R472		Metal film: 270 ohms ±5% 50 VDCW, 1/16 Watt.
R473		Metal film: 270 ohms ±5% 50 VDCW, 1/16 Watt.
R474		Metal film: 47 ohms ±5% 100 VDCW, 1/10 Watt.
R475		Metal film: 68 ohms ±5% 100 VDCW, 1/10 Watt.
		- - - - - - - TRANSISTORS - - - - - - -
TR151		Silicon, NPN; sim to NEC 2SC3356.
TR152		Silicon, PNP; sim to NEC 2SB624.
TR153		Silicon, NPN; sim to NEC 2SC3357.
TR401		Silicon, NPN; sim to NEC 2SC3356.
TR421		Silicon, NPN; sim to NEC 2SC3357.
TR422		Silicon, NPN; sim to NEC 2SD596.
TR461		Silicon, NPN; sim to NEC 2SC3356.
TR462		Silicon, NPN; sim to NEC 2SC3357.

COMPONENT SIDE



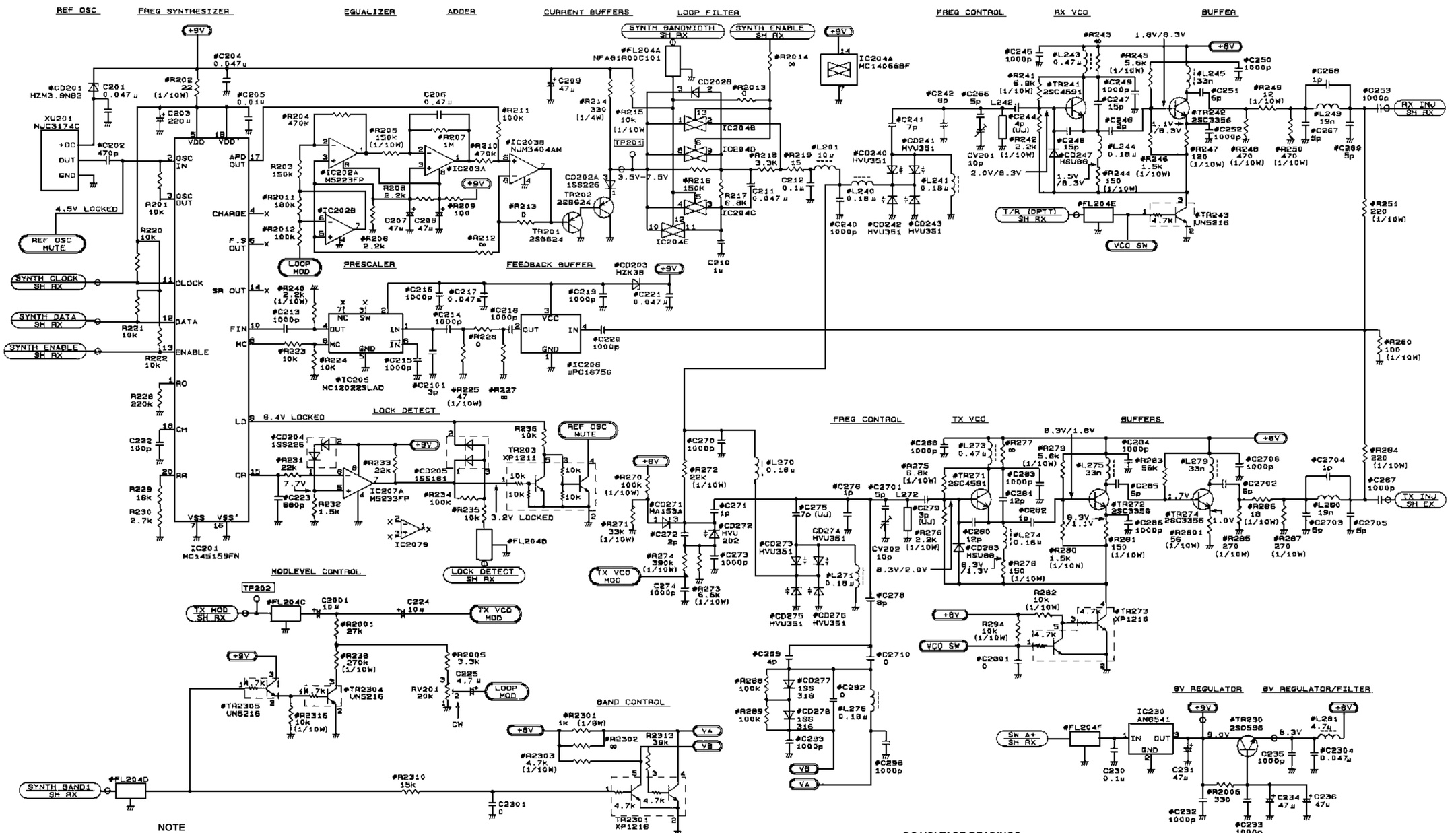






ORION 900 MHz
SYNTHESIZER/RECEIVER/EXCITER

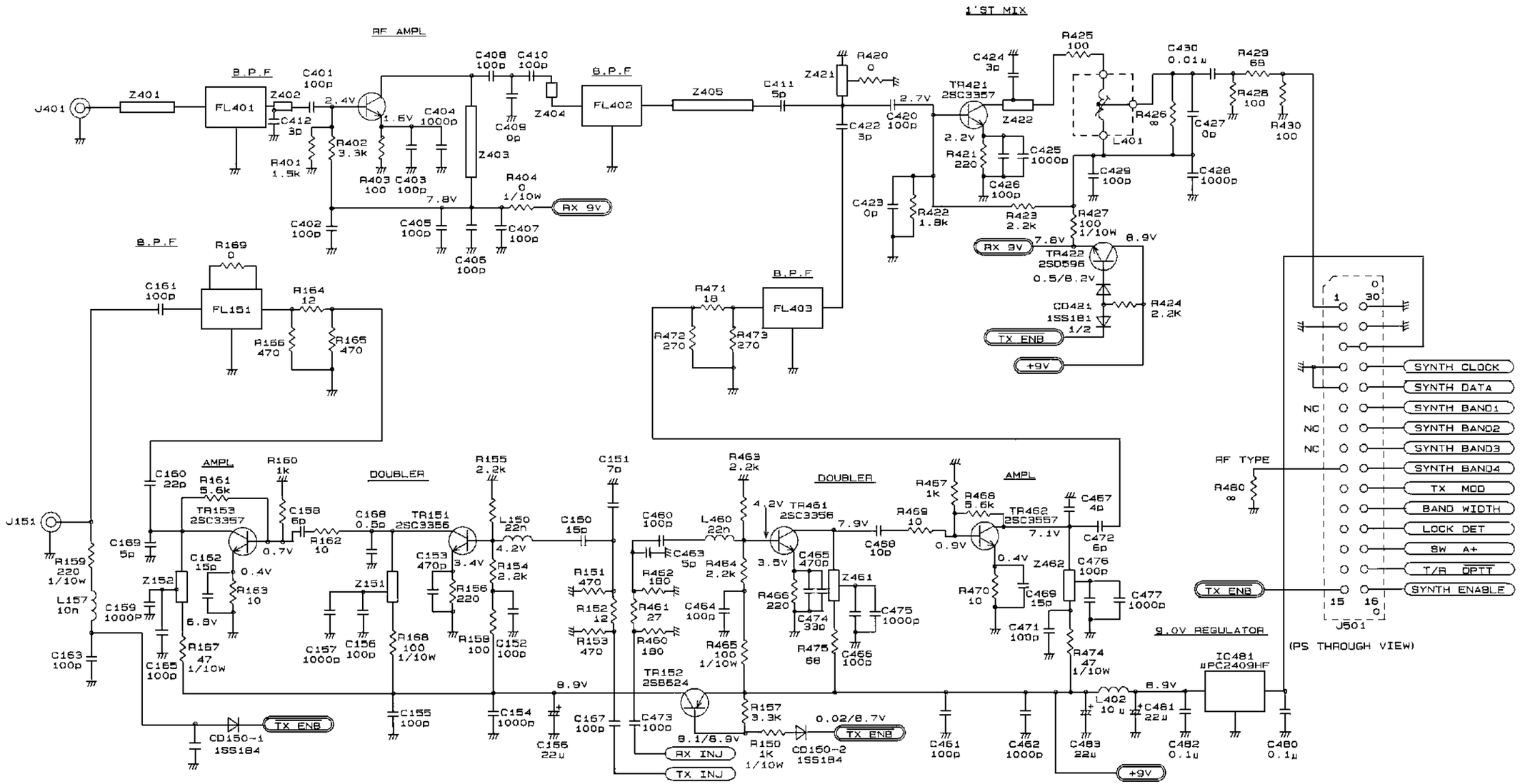
SOLDER SIDE



ORION 900 MHz SYNTHESIZER

NOTE
#IDENTFIES CHIP COMPONENTS (EXAMPLE, #R234) WHICH ARE LOCATED ON SOLDER SIDE OF PWG.
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 µ, or P,
INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER µ, or n.

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).



NOTE
ALL RESISTOR ARE 1/16 WATT UNLESS OTHERWISE SPECIFIED.
RESISTOR VALUES IN Ω UNLESS FOLLOWED BY MULTIPLIER K OR M.
CAPACITOR VALUES IN FUNLESS FOLLOWED BY MULTIPLIER μ OR P.
INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER μ OR n.

ORION 900 MHz
RECEIVER/EXCITER