MAINTENANCE MANUAL
FOR MVS RF BOARD
19D902032G1 (403-440 MHz)
19D902032G2 (440-470 MHz)
19D902032G3 (470-512 MHz)

RF BOARD

TABLE OF CONTENTS

DESCRIPTION

The RF Board for the MVS radio consists of the following circuits:

- A frequency synthesizer for generating the transmit carrier frequency and the receive circuit first mixer injection frequency.
- The transmit exciter, PA and power control stages.
- The receive circuit front end, IF, and FM detector.
- Voltage regulators.

The 403-512 MHz range of UHF frequencies is covered by three groups of RF Boards:

19D902032 G1: 403-440 MHz
19D902032 G2: 440-470 MHz
19D902032 G3: 470-512 MHz

The RF Board is mounted in the bottom of the frame assembly. Refer to Combination Manual for a mechanical layout of the radio. Figure 1 provides a block diagram of the receive and transmit circuits. Figure 2 provides a block diagram of the synthesizer.

Transmit circuit adjustments for frequency, power and deviation are accessible from the topside of the board, as are IF alignment, second oscillator and audio level adjustments for the receive circuit. Chip components on the bottom of the board provide optimum RF performance, while being accessible for easy servicing by removing the "friction fit" bottom shields.

Selected use of sealed modules permits small board size as well as RF and mechanical protection for sensitive circuitry. Modules are not repairable and must be replaced if they are determined to be damaged.

CIRCUIT ANALYSIS

SYNTHESIZER CIRCUIT

The synthesizer generates all transmit and receive RF frequencies. The circuit uses a phase-locked VCO module U201 feeding a doubler circuit. While transmitting, the VCO operates at 1/2 the actual transmitter frequency (201.5-256.0 MHz to produce 403-512 MHz). While receiving, the VCO operates at 1/2 of the difference between the receiver frequency and the 45 MHz IF (179.0-233.5 MHz for 403-512 MHz).

Q201 doubles the VCO output frequency with input and output filters broadly fixed tuned to allow the VCO second harmonic to pass while rejecting all other frequencies. The doubled signal is amplified by Q201 to a level of +10 dBm. This signal feeds the receiver mixer and is attenuated to +3 dBm by R202 to feed the transmitter exciter module.

The synthesizer frequency is controlled by the microprocessor on the Logic Board (A1). Frequency stability is maintained by a temperature compensated crystal controlled oscillator (TCXO) module. The oscillator has a stability of ±5 PPM (0.0005%) over the temperature range of -30°C to +60°C and determines the overall frequency stability of the radio. An optional high stability ±2.5 PPM oscillator module is available.

The VCO output is also buffered by Q204 to feed the divide by 128/129 dual modulus prescaler U205. The prescaler feeds the FIN input of the PLL U206. Within U206, the prescaled signal is further divided down to 6.25 kHz to be compared with a reference signal. This reference signal is derived from the 12.8 MHz TCXO module U204. U206 divides the 12.8 MHz TCXO down to the 6.25 kHz reference frequency.

Divider circuits in U206 are programmed by three inputs from the Logic Board (A1), which are buffered and inverted by transistors Q208, Q209, and Q210. The S ENABLE pulse (5 milliseconds) activates switch U202 to allow more rapid channel acquisition during channel changes.

A LOCK DET signal from the PLL goes to the microprocessor for processing to prevent transmission when the VCO is not on frequency and to provide an error message to the user. During receive, an unlocked synthesizer is indicated by E0 (Error 0) in the LCD and by a quickly pulsed alert tone. The microprocessor will continually try to reload the frequency information into the PLL until the synthesizer locks. During transmit, only a slower pulsed alert tone will be heard. Once unlocked in transmit, the synthesizer will not be reloaded. The transmitter PTT must be unkeyed and then rekeyed to attempt to relock.

Audio modulation from Audio Board A3 is applied to the VCO module through DEVIATION ADJUST potentiometer R226. VCO TUNE potentiometer R218 adjusts the operating frequency range of the VCO by varying a negative bias from D202 and D203.

TRANSMITTER CIRCUIT

The transmitter consists of a fixed-tuned exciter module, a 10 Watt PA module, a pin diode switch, a low pass filter, a directional coupler, a power control circuit, and a transmit voltage switch.

Exciter Module

Figure 1 shows the synthesizer driving the receiver mixer at +10 dBm and is attenuated by R202 to +3 dBm for driving the exciter input. The exciter module A102 operates from a switched 8 volt supply. A different exciter module is required for each of the three band splits. No tuning is required. Both input and output ports operate at 50 ohms impedance. The exciter module provides typically 20 dB of gain and 200 mW of output power to drive the power amplifier module.

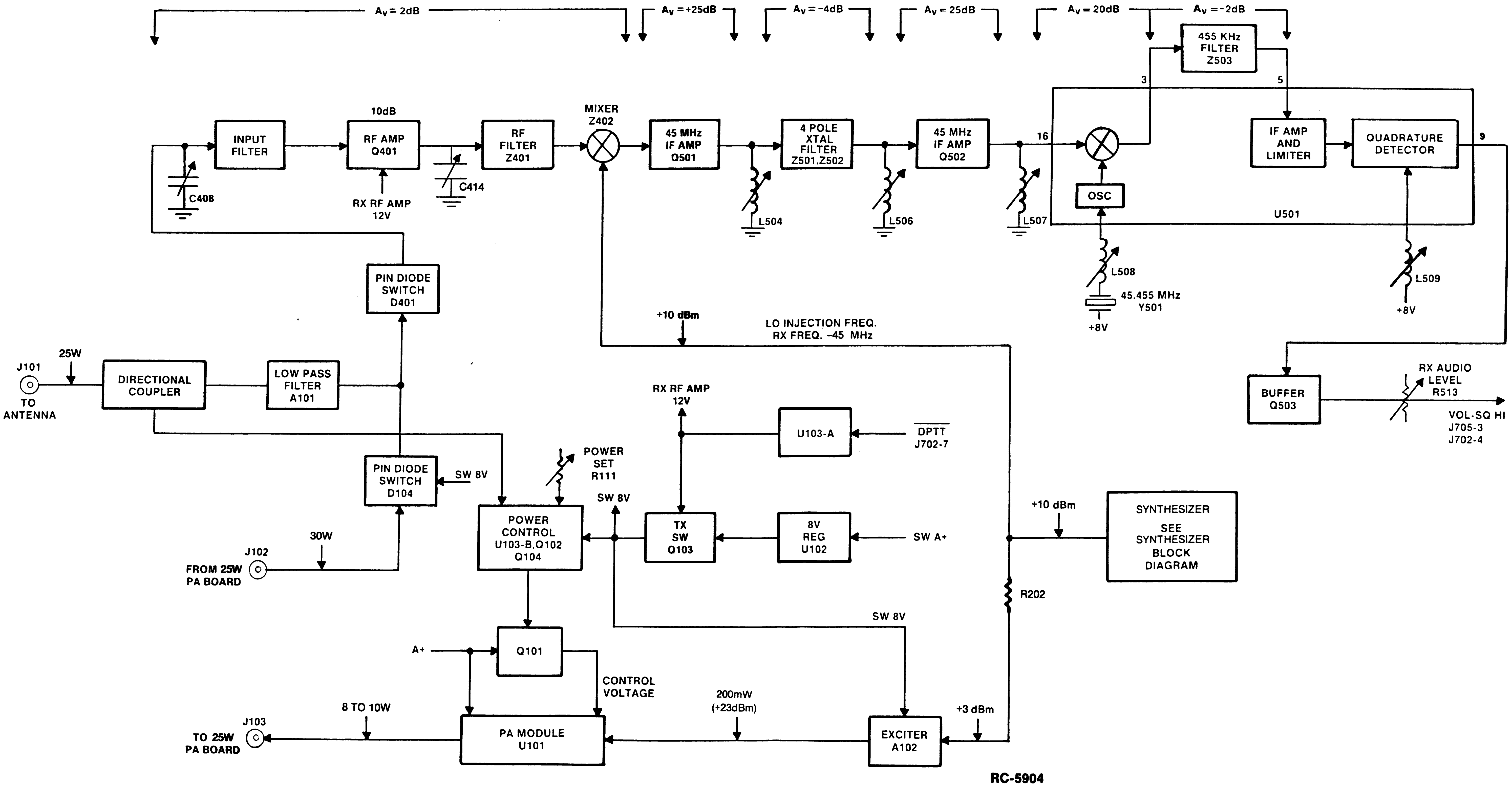
Power Amplifier Module

The PA module U101 requires a drive of 200 mW from the exciter module to deliver up to 10 Watts power output. The module is mounted to the rear heatsink. The PA module output drives the 25 Watt PA Board through J103. The power control circuit controls the PA module output power.

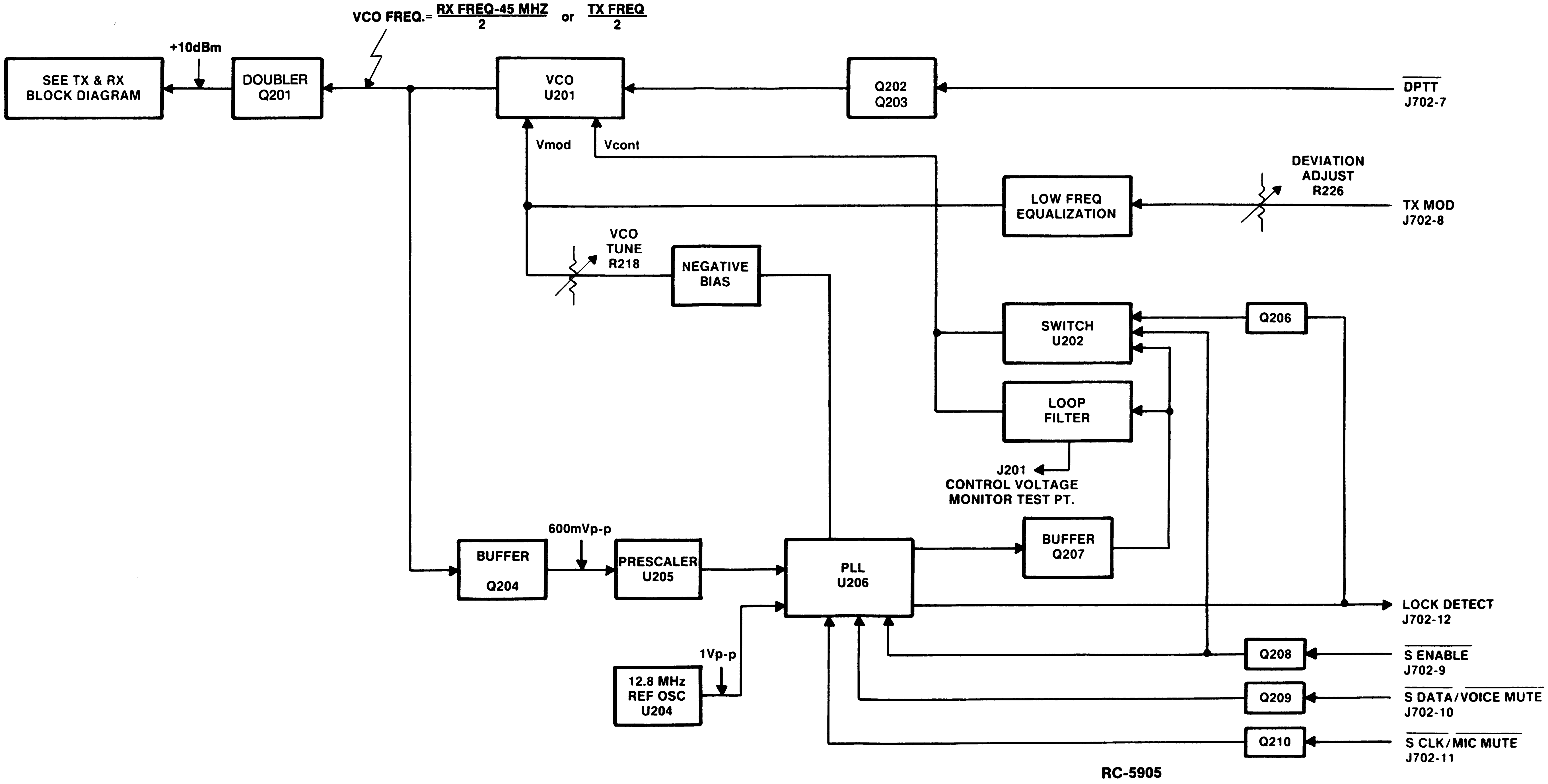
Pin Diode Switch, Low Pass Filter, and Directional Coupler

The output from the 25 Watt PA Board feeds transmit pin diode switch D104 through J102. In transmit, switched 8 volts is applied through L102, turning on pin diodes D104 and D401. The DC path is completed through R401 and R402 with the bias current set at about 40 mA. D104 couples the PA Board power from J102 to low pass filter A101. D401 provides a RF path to ground to protect the receiver input.

The low pass filter reduces the harmonic output from the transmitter. The low pass filter feeds the directional coupler, W101 and W102. The directional coupler provides a sample of transmitter power for the power control circuit. The coupler output feeds the antenna jack J101.



A_V = 2dB
A_V = +25dB
A_V = -4dB
A_V = 25dB
A_V = 20dB
A_V = -2dB
455 KHz FILTER Z503
3
5
INPUT FILTER
10dB
RF AMP Q401
RF FILTER Z401
MIXER Z402
45 MHz IF AMP Q501
4 POLE XTAL FILTER Z501,Z502
45 MHz IF AMP Q502
16
IF AMP AND LIMITER
QUADRATURE DETECTOR
9
C408
RX RF AMP 12V
C414
L504
L506
L507
OSC
U501
L508
45.455 MHz Y501
+8V
L509
+8V
PIN DIODE SWITCH D401
+10 dBm
LO INJECTION FREQ. RX FREQ. -45 MHz
J101
25W
TO ANTENNA
DIRECTIONAL COUPLER
LOW PASS FILTER A101
BUFFER Q503
RX AUDIO LEVEL R513
VOL-SQ HI J705-3 J702-4
RX RF AMP 12V
U103-A
DPTT J702-7
PIN DIODE SWITCH D104
SW 8V
POWER SET R111
SW 8V
POWER CONTROL U103-B,Q102 Q104
TX SW Q103
8V REG U102
SW A+
+10 dBm
SYNTHESIZER SEE SYNTHESIZER BLOCK DIAGRAM
J102
30W
FROM 25W PA BOARD
R202
SW 8V
A+
Q101
CONTROL VOLTAGE
200mW (+23dBm)
+3 dBm
8 TO 10W
J103
TO 25W PA BOARD
PA MODULE U101
EXCITER A102
RC-5904


VCO FREQ.= $\frac{\text{RX FREQ-45 MHZ}}{2}$ or $\frac{\text{TX FREQ}}{2}$
+10dBm
SEE TX & RX BLOCK DIAGRAM
DOUBLER Q201
VCO U201
Q202 Q203
DPTT J702-7
Vmod
Vcont
DEVIATION ADJUST R226
LOW FREQ EQUALIZATION
TX MOD J702-8
VCO TUNE R218
NEGATIVE BIAS
SWITCH U202
Q206
LOOP FILTER
J201 CONTROL VOLTAGE MONITOR TEST PT.
600mVp-p
BUFFER Q204
PRESCALER U205
PLL U206
BUFFER Q207
LOCK DETECT J702-12
1Vp-p
12.8 MHz REF OSC U204
Q208
S ENABLE J702-9
Q209
S DATA/VOICE MUTE J702-10
Q210
S CLK/MIC MUTE J702-11
RC-5905

Power Control Circuit

The power control circuit samples the output power to the antenna to maintain a constant power level across the band. Also, a thermistor senses the heatsink temperature to throttle the power level down above 70°C. The circuit controls the supply voltage to one of the amplifier stages in the PA module U101.

The directional coupler (W101 and W102) provides a sample of transmitter power to diode D101. D101, R106, and C104 produce a positive DC voltage proportional to the transmitter output power level. This DC level feeds the (-) input of amplifier U103-B. Power set pot R111 and thermistor R118 determine the DC level to the (+) input of U103-B. U103-B amplifies the difference between the (-) and (+) inputs, forcing the output power level to equal the power set level by varying the drive to Q102 and Q101. Q101 supplies the control voltage to the PA module U101. For example, if the output power level begins to drop below the power set level, the output of U103-B increases positively, causing Q102 to conduct less. The base of Q101 rises, increasing the control voltage to the PA module, which increases the output power level back to the desired set level.

Q104, C123, and R105 improve the transient stability of the power control loop when the transmitter is keyed.

Transmit Switch

During transmit, the Logic Board (A1) microprocessor pulls the DPTT line low causing the output of U103-A to go low. Q103 turns on to supply SW 8V to the exciter module, the power control circuit and the pin diode switch. During receive, the output of U103-A supplies 12 volts to the receiver RF pre-amp Q401.

RECEIVER CIRCUIT

The dual conversion receiver circuit consists of a front end section, a 45 MHz first IF, and a 455 kHz second IF with a FM detector. All audio processing and squelch functions are accomplished on the Audio Board (A3).

Front End Section

RF is coupled from antenna jack J101 through the directional coupler and the low pass filter to pin diode D401. In transmit, SW 8V is applied through L102, turning on pin diodes D104 and D401, with the DC path completed through R401 and R402. D401 provides a RF path to ground for the receiver input while in transmit. In receive, D401 is off allowing RF to pass by D401 unattenuated.

The RF pre-amplifier is a dual gate FET with a 2 pole preselector filter and 2 pole output filter. The input filter consists of L402, L403 and associated capacitors. These components form a top coupled resonator filter. The input impedance level is 50 ohms while the output is loaded by the FET input impedance. Capacitor C408 is tuned for a flat bandpass response. The output matching filter consists of L404, L405, and associated capacitors. R410 helps establish a consistent impedance at the filter input. C414 is tuned for a flat bandpass response. The output filter matches Q401 to a 50 ohm impedance to terminate Z401. Z401 is a fixed tuned three pole bandpass filter covering a 20 MHz segment of the operating frequency band split.

The mixer, Z402, is a doubly balanced diode mixer. This mixer is driven by a local oscillator signal of +10 dBm or greater to provide good inter-modulation performance, spurious performance, and local oscillator isolation. The mixer conversion loss is typically about 6 dB.

45 MHz IF

The first 45 MHz IF amplifier transistor Q501 is a junction FET operated in the common gate mode. This configuration offers a typical input impedance of 75 ohms. The output circuitry is tuned by L504 and loaded to provide the proper source termination for the four pole crystal filter which follows.

The output of the crystal filter is matched by second IF amplifier transistor Q502. This port is also tuned by L506 and loaded to provide the proper filter termination. Transistor Q502 is a dual gate FET operating at a bias current of about 10 milliamps. The output of Q502 is tuned by L507 for maximum gain at 45 MHz and is loaded by the 2nd mixer in the U501 chip. This Q502 stage has a relatively high input and output impedance and needs high isolation within the active device. The dual gate FET provides the isolation required.

Converter/IF/Detector IC

IF IC U501 is a MC3361 chip. Pins 1 and 2 connect to an internally biased oscillator transistor. The external circuitry of this oscillator transistor includes crystal Y501 and forms an oscillator circuit operating at 45.455 MHz. The frequency of this third mode oscillator is adjusted by inductor L508. The oscillator drives the internal balanced mixer. The 45 MHz IF signal is translated to 455 kHz and appears at Pin 3 of U501. This IF signal is filtered by 6 pole ceramic filter Z503 and drives the internal 455 kHz amplifier and limiter. The limited 455 kHz in turn drives an internal quadrature detector. The phase shift network needed by the quadrature detector is provided by inductor L509. The audio output port is Pin 9 on U501. Inductor L509 is adjusted for maximum audio output level. The audio signal at Pin 9 is filtered by resistor R512 and capacitor C519 to reduce IF feedthrough. Buffer amplifier Q503, drives audio potentiometer R513. This allows a VOL/SQ HI signal whose amplitude may be set for proper system operation using R513.

Power Distribution

Unswitched 13.8 Volts (A+) is supplied to the RF Board through connector J704 and feeds the power control transistor Q101, the PA module U101, and 20V transient suppressor D105. D105 protects the radio from noise spikes and other overvoltage transients appearing on the input power cable.

Switched 13.6 Volts (SW A+) is supplied to the RF Board through J702 and J705 and feeds regulators U102, U207, and U502. U102 supplies 8 Volts to the transmitter switch, the synthesizer 5 Volt regulator U203, and the Logic Board (A1) through J702. U207 supplies 8.3 Volts to the synthesizer. U502 supplies 8 Volts to the receiver.

SERVICE NOTES

TRANSMITTER CIRCUIT

Most transmitter circuit problems can be isolated by checking the TX power gains shown in Figure 1 - RX and TX Block Diagram. The 25 watt PA Board may be bypassed by placing a jumper cable between J103 and J102 on the RF Board. The PA module U101 is capable of producing 10 watts output.

Transmitter DC measurements

1. First ensure that DPTT is low when the mic PTT is keyed low.
2. Check for approximately 8 volts at L105 feeding the Exciter Module. If not present, troubleshoot the TX switch circuitry, Q103 and U103.
3. Check for approximately 7 volts across resistors R401 and R402. If not present, check the pin diodes D104 and D401 and the conduction path from R401 to the TX switch Q103.
4. Check for an adjustable voltage of 0 to 12 volts on pin 2 of the PA module U101. At maximum power, with Power Set adjustment R111 fully clockwise, pin 2 should be at 12 volts. If not present, check the power control circuitry: U103, Q101, Q102, and Q104.
5. Check for 13.6 volts on pins 3 and 4 of the PA module U101, and ensure a good mechanical and electrical ground from the PA module to the bracket and casting.

RECEIVER CIRCUIT

To isolate a receiver circuit problem refer to the Receiver Circuit Symptoms and Checks chart below.

RECEIVER CIRCUIT SYMPTOMS AND CHECKS

SYMPTOMS	CHECKS
• No Audio 4. Quadrature detector circuit	1. U502 regulator 2. The level and frequency of the first mixer injection frequency 3. The level and frequency of the second mixer injection frequency 5. Quadrature detector coil tuning
• Poor SINAD	1. Consult Figure 1 - RX and TX Block Diagram for RX stage gains and troubleshoot 2. Input cable 3. PIN Diode switch is shorted.
• Distorted Audio	1. Both mixer injection frequencies 2. Quadrature detector coil tuning 3. Crystal filter source and load tuning 4. Z503: 455 kHz ceramic filter

SYNTHESIZER CIRCUIT

Synthesizer troubleshooting consists of first checking for the proper DC levels, then determining if the proper waveforms are present and checking individual modules.

DC Analysis

8.3 Vdc is supplied by regulator U207 and serves as the biasing voltage for transistor circuits Q204, Q206, Q207, Q208, Q209, and Q210. Resistor R207 decouples the 8.3 volts for use in the VCO module U201. The 10 milliamp current drain of this module results in approximately 6.5 volts DC on Pin 4. Transistor Q201 also draws approximately 25 milliamps, resulting in a collector voltage of 3.7 volts DC at the junction of resistor R204 and capacitor C201. Lack of VCO RF output will modify this voltage.

Regulator U203 uses the 8 volts from transmitter regulator U102 to generate 5 volts for U204 and U205.

Waveforms

Waveforms associated with the synthesizer were measured with a 10 megohm, 30 pF probe. Use DC coupling (see Figures 3-8).

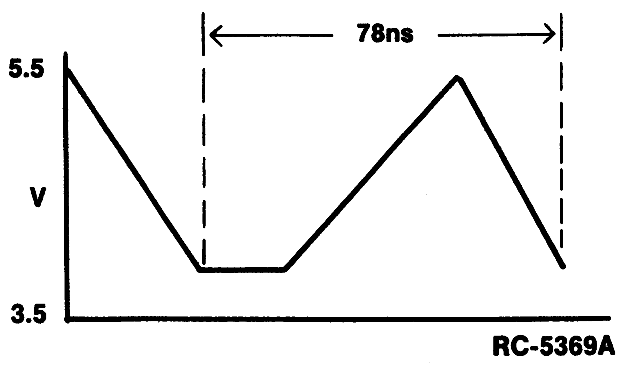


FIGURE 3 - REFERENCE OSCILLATOR (Input to U206, Pin 2)

Select a channel in the center of the band.

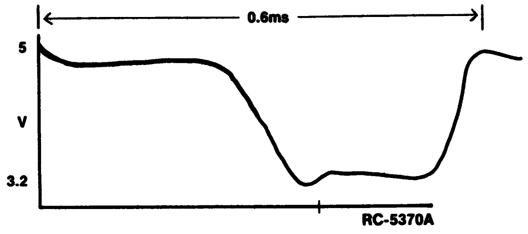


FIGURE 4 - F_{IN} (Input to U206, Pin 10)

The top of the ramp is approximately 0.8 Volt DC greater than the control voltage on PD out, Pin 17. A channel in the center of the band is shown.

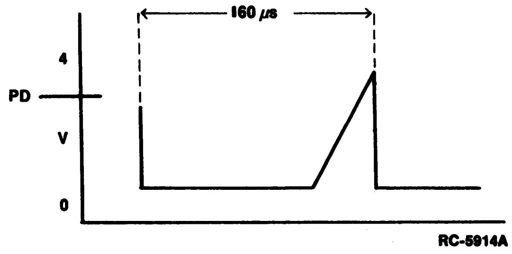


FIGURE 5 - RAMP (Generated in U206 and appears on Pin 15)

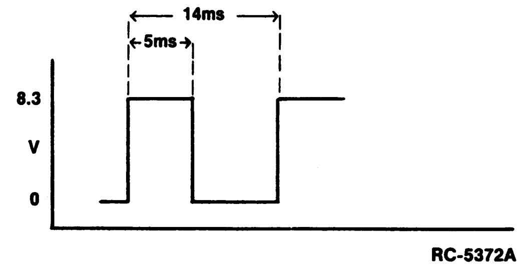


FIGURE 6 - S ENABLE (Input to U206, Pin 13) (Radio in SCAN on a single channel)

Clock pulses (32) appear as jitter on trailing edge of the waveform.

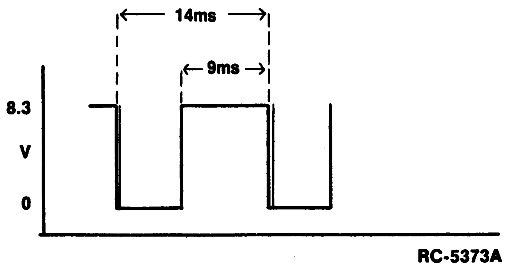
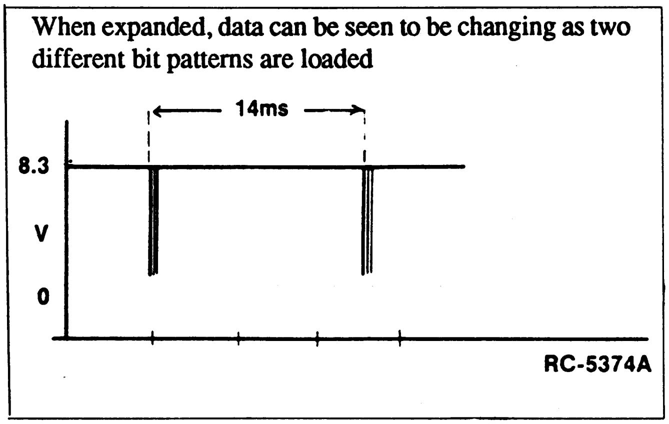


FIGURE 7 - S CLOCK (Input to U206, Pin 12) (Radio in SCAN on a single channel)



When expanded, data can be seen to be changing as two different bit patterns are loaded

FIGURE 8 - S DATA (Input to U206, Pin 11) (Radio in SCAN on a single channel)

Module Isolation

Reference Oscillator U204:

Look for a waveform similar to the reference (Figure 3) on Pin 2. If waveform is not present, the oscillator module is probably defective.

VCO U201:

Connect a DC power supply to Pin 3. With 2.5 volts DC on pin 3, the output of U201 (pin 5) should be approximately 197 MHz. With 6.5 volts DC on pin 3, the output should be approximately 212 MHz. These values are correct for the 440-470 MHz split, with the ranges 179-197 MHz and 212-233 MHz being correct for the lower and upper split, respectively.

Power output of the VCO can be measured by connecting a coax directly to the module, between pin 5 and ground. The output should be approximately 0 dBm with C237 still connected in the circuit. In transmit, a negative bias should exist on pin 1. If not present, check Q202, Q203, and C206 before removing the VCO.

Prescaler U205:

Connect pin 3 of the VCO to 4.5 volts DC. With the radio in receive, monitor the frequencies of the VCO at the connection of capacitor C210 and resistor R211. DC short pin 1 of U205 to ground to cause divide by 129 to occur. The frequency output at pin 3 should be the VCO frequency divided by 129. Tie pin 1 to pin 7 (5 volts) to cause divide by 128 to occur. Check pin 3 to verify that this occurs. Improper division may indicate a defective prescaler.

Bilateral Switch U202:

The bilateral switch is used to short around parts of the loop filter during channel scan. A shorted (to ground or adjacent gate) gate may be isolated by comparing voltages through the loop filter to those of a functioning radio. Defective gates might be suspected when the radio does not change frequency quickly enough.

Phase-Lock-Loop U206:

There are no other specific checks which aid in evaluation of U206. Usually, it is suspected only if all other checks are OK. Before changing, inspect chip components for mechanical damage and check resistances through the loop filter.

Transistor Q201:

After checking for proper DC operation, measure the frequency and gain from the VCO, pin 5 to R202/C203. The gain should be approximately 10 dB at 2 times the VCO frequency.

PA MODULE REPLACEMENT

To Remove PA Module U101

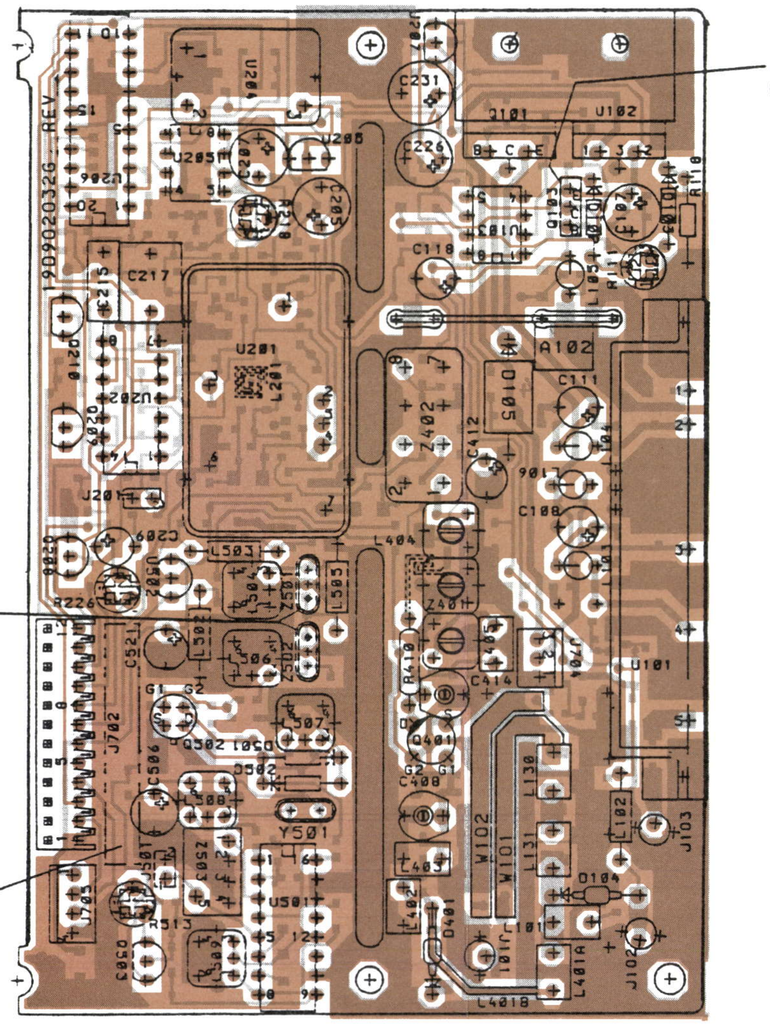
1. Unsolder the four leads from U101, using either solder removal braid, or a mechanical de-soldering tool. These leads are fragile and can be bent very easily. Do NOT unsolder the shield that wraps around the module.
2. Remove the RF Board from the radio chassis assembly. Refer to the disassembly procedure provided in the Service Section. Carefully slide the module out of the shield, and away from the board.

To Install PA Module U101

1. Apply some silicone grease to the metal side of the replacement module.
2. Carefully insert the four leads from the module into the four corresponding PWB holes, and slide the module into the shield. Do NOT solder the leads yet.

3. Slide the RF Board assembly back into the radio frame. Reinstall all hardware, harnesses, cables, etc. Replace all screws.

4. Install the two PA bracket screws before soldering the four module leads. Trim excess wire.

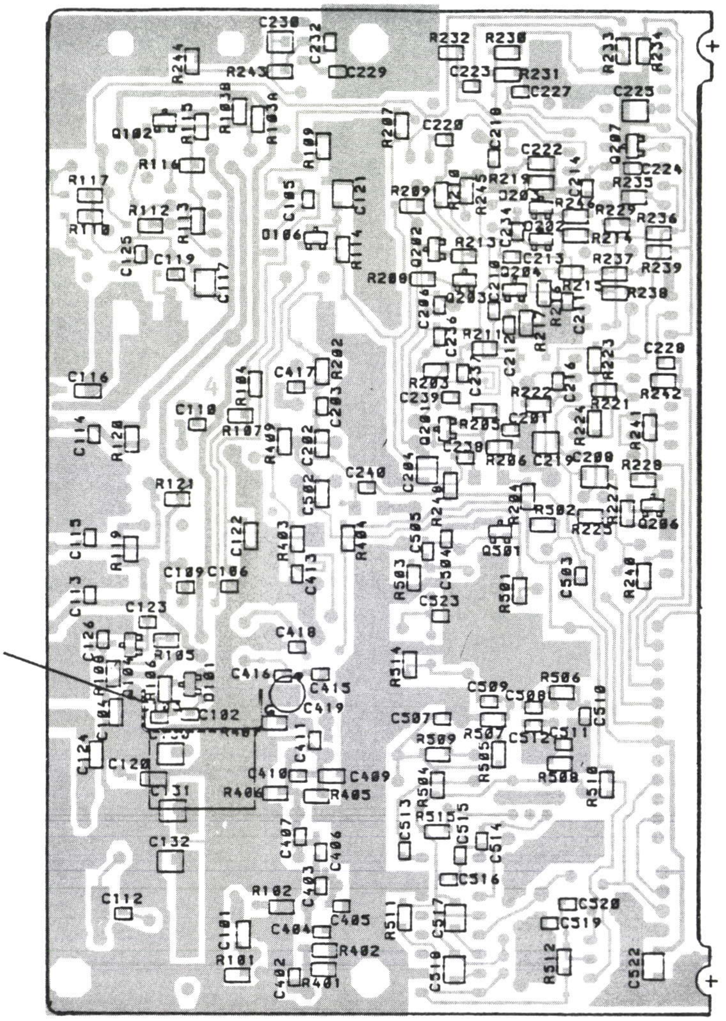


MARKING SIDE OF Q103

Z501 AND Z502 ARE MATCHED PAIR ORIENT DOTS TOWARD EACH OTHER AS SHOWN.

BAR CODE LABEL LOCATED HERE

(19A705413, Sh. 1, Rev. 4)
(19A705413, Sh. 2, Rev. 4)

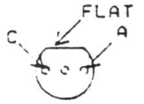


GROUND STRAP

(19A705413, Sh. 2, Rev. 4)

VIEW FROM BACKSIDE

LEAD IDENTIFICATION FOR Q201

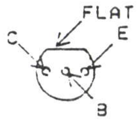


IN-LINE

TOP VIEW

NOTE: CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

LEAD IDENTIFICATION FOR Q208, Q209, Q210, & Q503

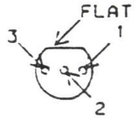


IN-LINE

TOP VIEW

NOTE: CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

LEAD IDENTIFICATION FOR U203, U207 & U502



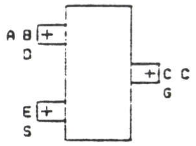
IN-LINE

TOP VIEW

NOTE: CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

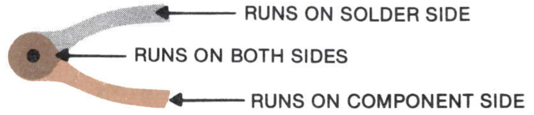
LEAD IDENTIFICATION FOR (SOT) TRANSISTORS AND DIODES

(TOP VIEW)



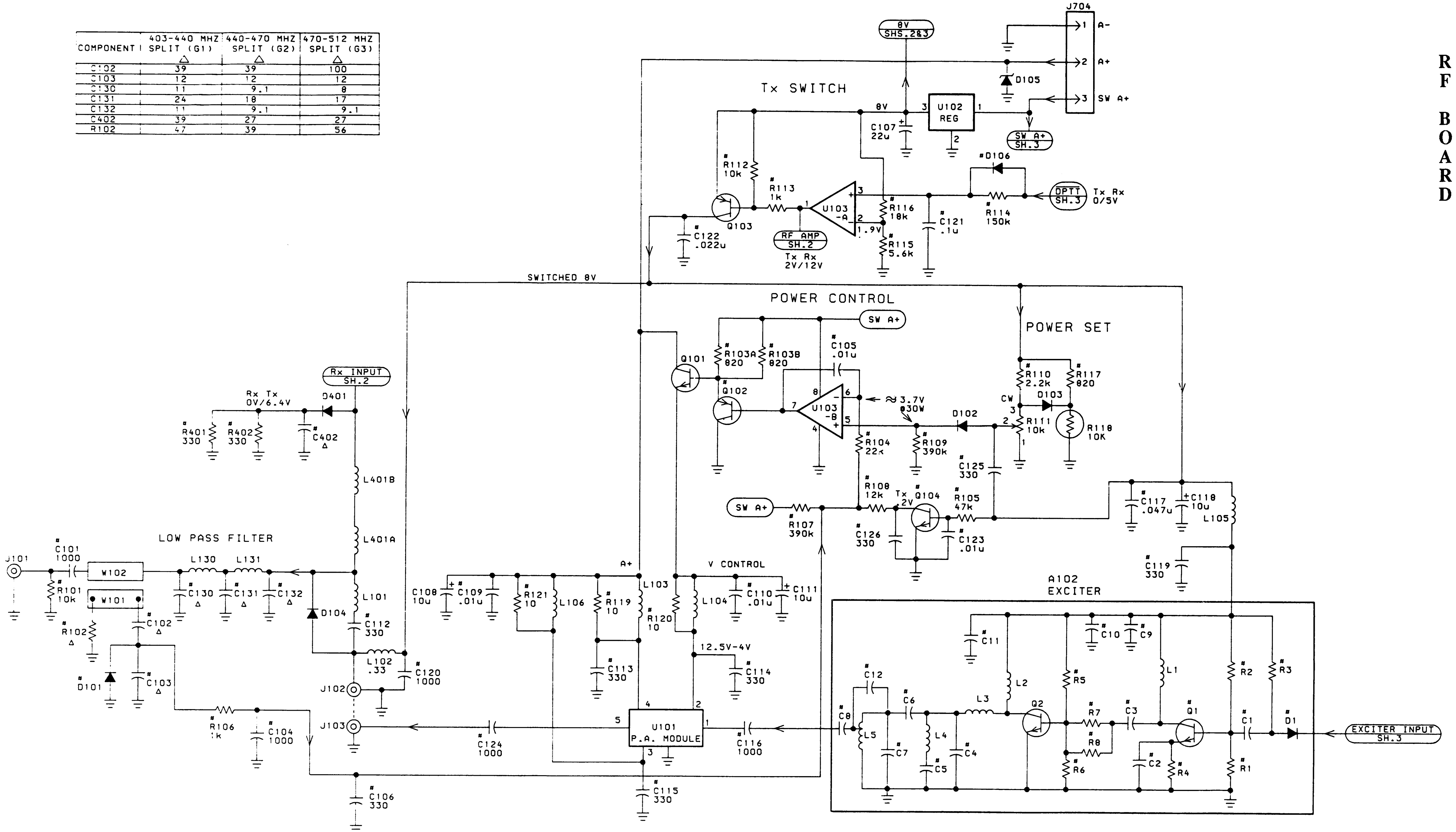
RC-7275

MADE FROM 19D902032 REV. 2



R F B O A R D

COMPONENT	403-440 MHZ SPLIT (G1) △	440-470 MHZ SPLIT (G2) △	470-512 MHZ SPLIT (G3) △
C102	39	39	100
C103	12	12	12
C130	11	9.1	8
C131	24	18	17
C132	11	9.1	9.1
C402	39	27	27
R102	47	39	56

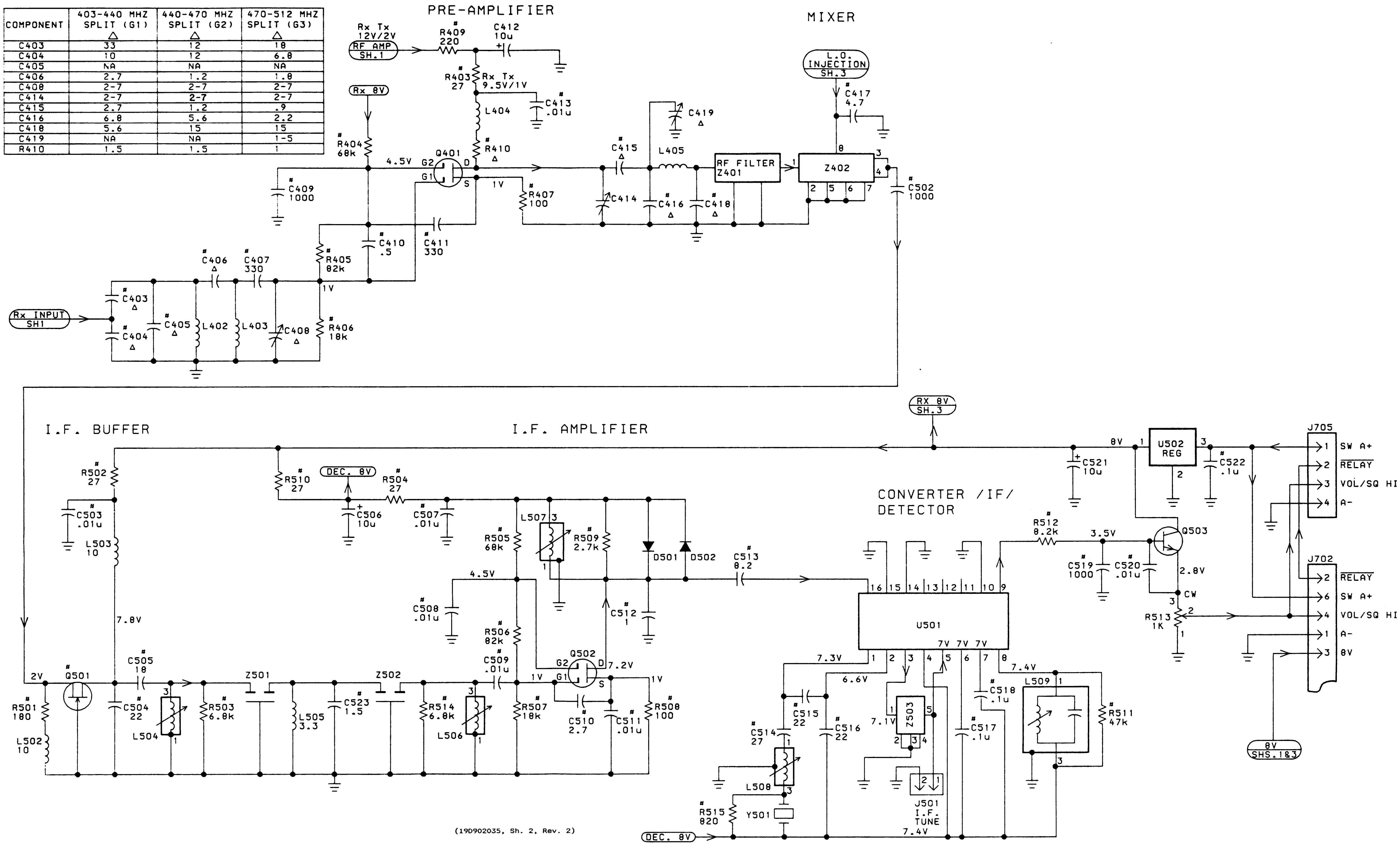


ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K-1000 OHMS OR M-1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY u-MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED B/ MH-MILLIHENRYS, NH-NANOHENRYS OR H-HENRYS.

MODEL NO.	REV. LETTER
19D902032G1	A
19D902032G2	A
19D902032G3	A

(19D902035, Sh. 1, Rev 4)

COMPONENT	403-440 MHZ SPLIT (G1) △	440-470 MHZ SPLIT (G2) △	470-512 MHZ SPLIT (G3) △
C403	33	12	18
C404	10	12	6.8
C405	NA	NA	NA
C406	2.7	1.2	1.8
C408	2-7	2-7	2-7
C414	2-7	2-7	2-7
C415	2.7	1.2	.9
C416	6.8	5.6	2.2
C418	5.6	15	15
C419	NA	NA	1-5
R410	1.5	1.5	1



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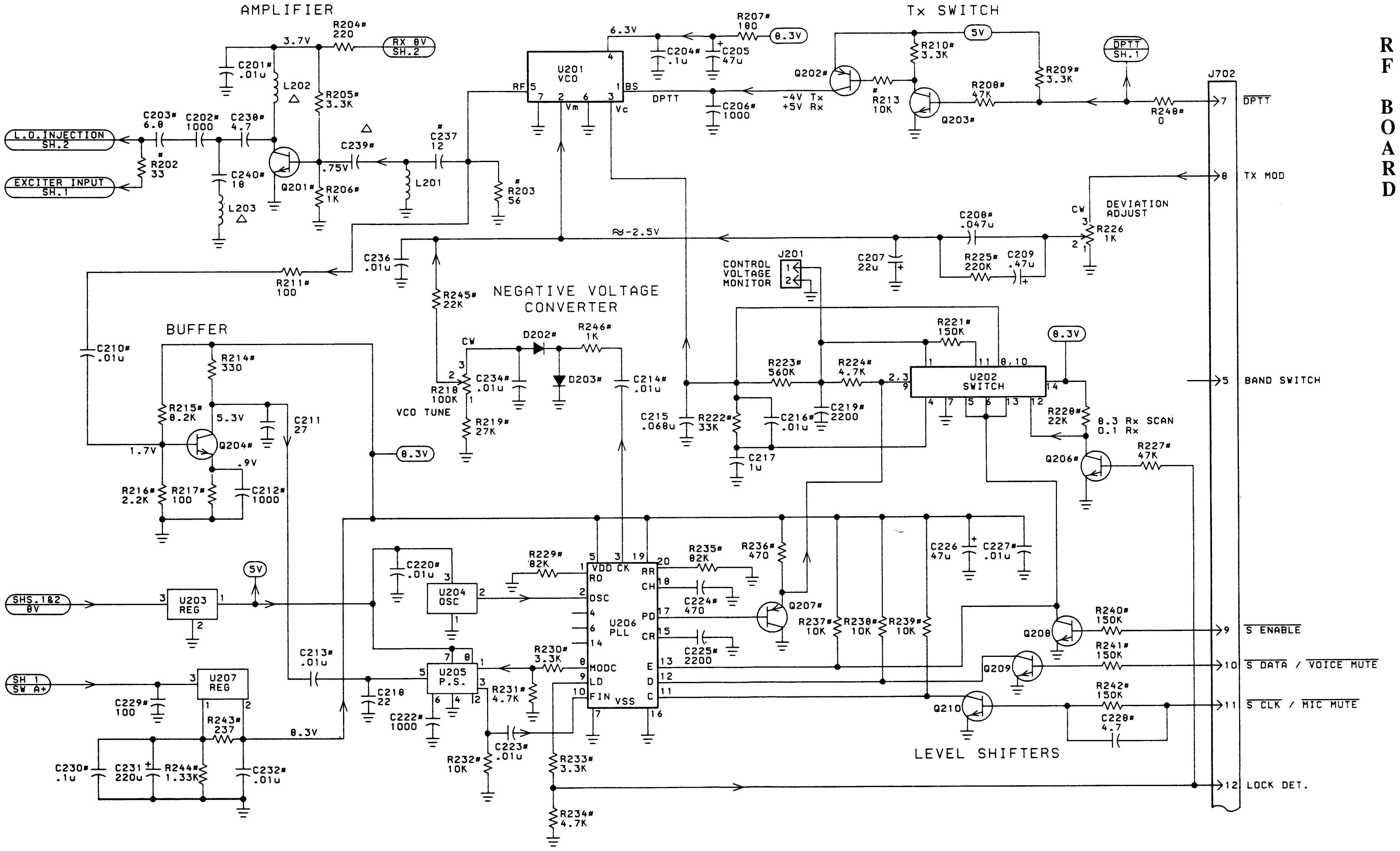
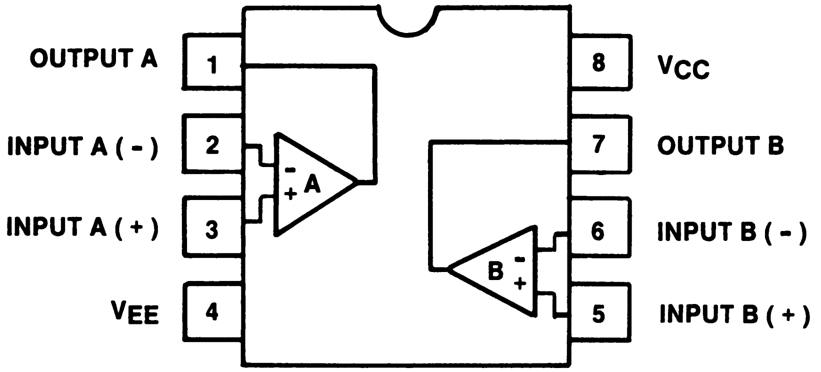
RF
BOARD



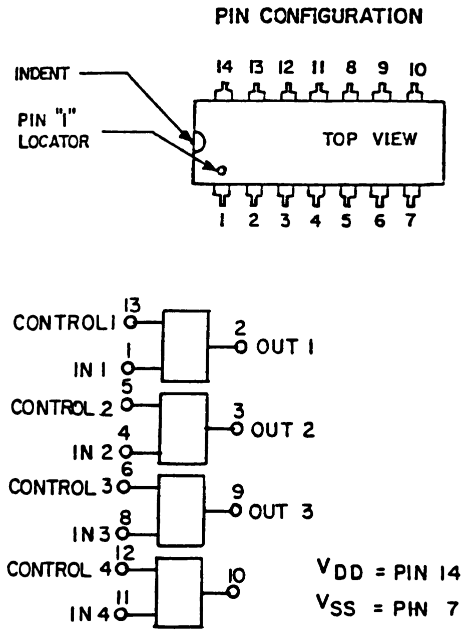
COMPONENT	403-440 MHZ SPLIT (G1) △	440-470 MHZ SPLIT (G2) △	470-512 MHZ SPLIT (G3) △
L202	27NH	27NH	22NH
L203	27NH	27NH	22NH
C239	8.2	8.2	6.8

(19D902035, Sh. 3, Rev. 1)

OPERATIONAL AMPLIFIER
(U103)
19A701789P2

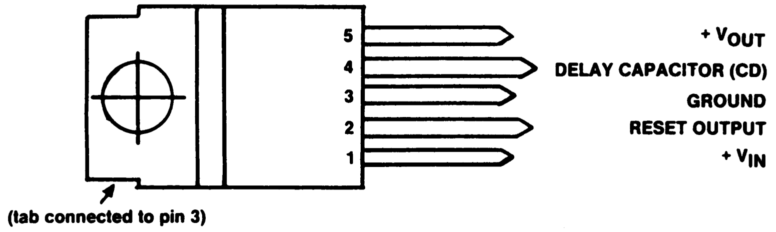


QUAD BILATERAL SWITCH
(U202)
19A700029P44

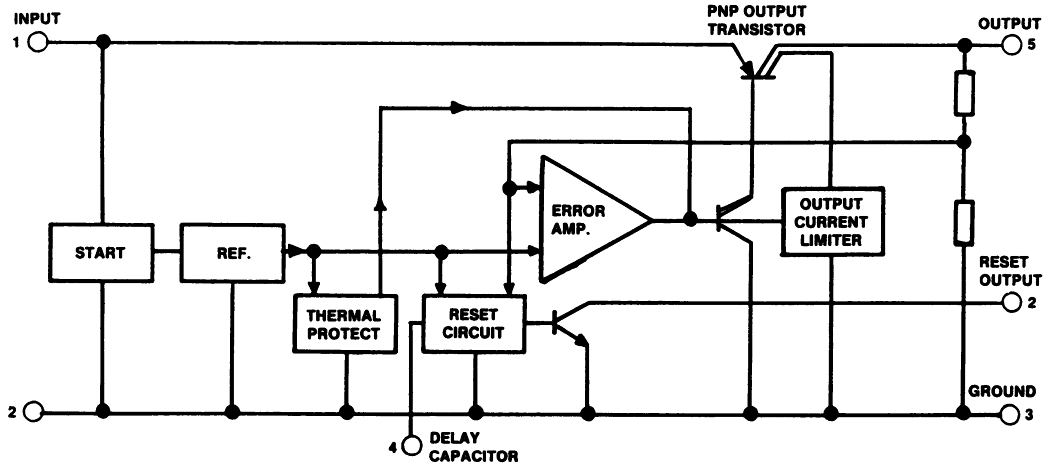


RC-5842

VOLTAGE REGULATORS
(U203)
19A704971P1

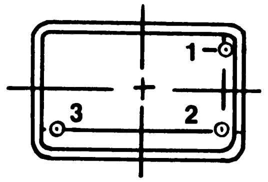


BLOCK DIAGRAM



RC-5854

OSCILLATOR
(U204)
19B801351P6

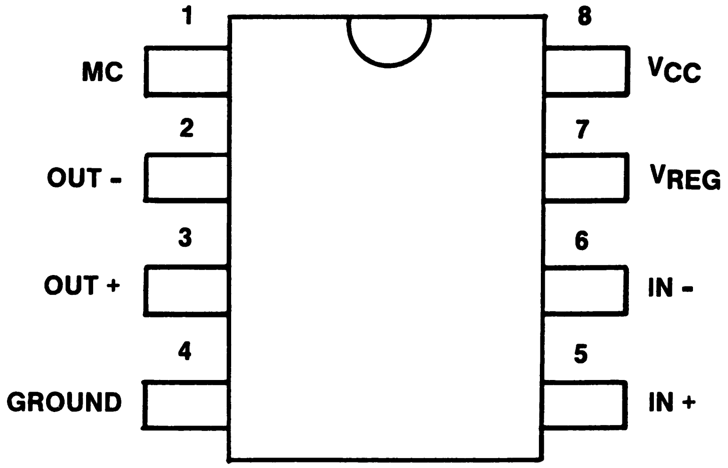


PIN CONNECTIONS (FIG. 3)

1. COMMON AND CASE
2. OUTPUT
3. + VCC

RC-5845

DIVIDER
(U205)
19A704287P2

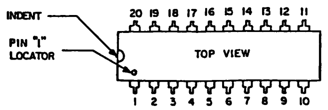


TOP VIEW

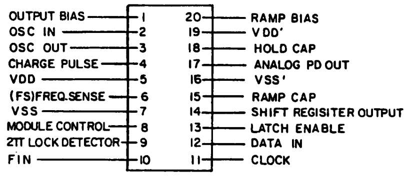
RF BOARD

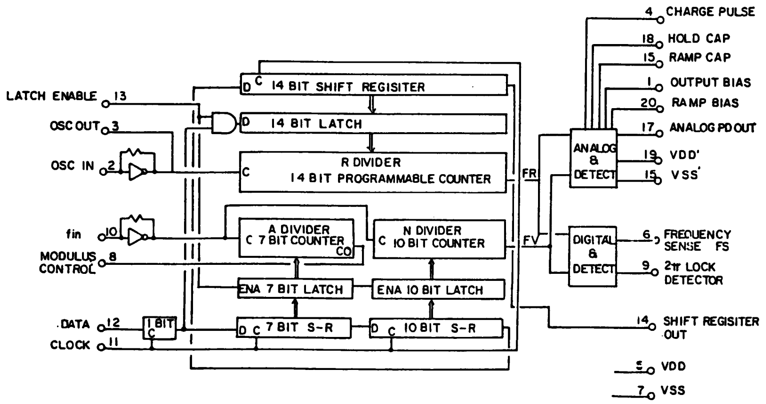
PHASE-LOCK-LOOP MODULE
(U206)
19B800902P4

PIN CONFIGURATION



PIN DESCRIPTION



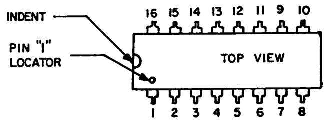


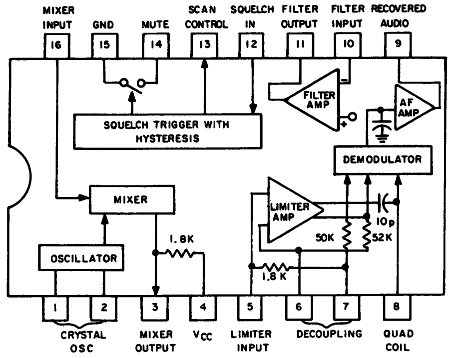
BLOCK DIAGRAM

RC-5843

IF AMPLIFIER AND DETECTOR
(U501)
19A704619P1

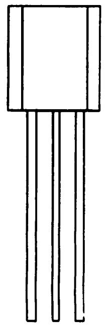
PIN CONFIGURATION

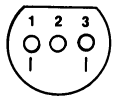




BLOCK DIAGRAM

VOLTAGE REGULATOR
(U207)
19A701999P4



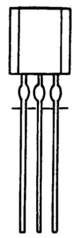


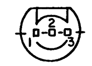
BOTTOM VIEW

PIN INDENTIFICATION

PIN 1 ADJUST
PIN 2. OUTPUT
PIN 3. INPUT

VOLTAGE REGULATORS
(U502)
19A704073P2





BOTTOM VIEW

PIN 1 - OUTPUT
PIN 2 - GROUND
PIN 3 - INPUT

RC-5289

PARTS LIST

RF BOARD
19D902032G1 403-440 MHz
19D902032G2 440-470 MHz
19D902032G3 470-512 MHz
ISSUE 3

SYMBOL	GE PART NO.	DESCRIPTION
A102		TRANSMIT EXCITER BOARD 19C851643G1 403-440 MHz 19C851643G2 440-470 MHz 19C851643G3 470-512 MHz
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1 and C2	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C3 *	19A702061P17	Ceramic: 12 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G1).
C3	19A702061P13	Ceramic: 10 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G2).
C3	19A702061P11	Ceramic: 6.8 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C. (Used in G3).
C4	19A702061P13	Ceramic: 10 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G1).
C4	19A702061P11	Ceramic: 6.8 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C. (Used in G2 & G3).
C5	19A702061P61	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G1).
C5	19A702061P45	Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G2 & G3).
C6	19A702061P10	Ceramic: 5.6 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C. (Used in G1).
C6	19A702061P9	Ceramic: 4.7 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C. (Used in G2 & G3).
C7	19A702061P12	Ceramic: 8.2 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C. (Used in G1).
C7	19A702061P11	Ceramic: 6.8 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C. (Used in G2 & G3).
C8 * thru C10	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C11	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C12 *	19A702061P12	Ceramic: 8.2 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C. (Used in G1).
		- - - - - - - - - - DIODES - - - - - - - - - -
D1	19A702525P2	Silicon.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1		(Part of PWB 19C851644P1).
L2	19B800891P6	Coil, RF: .084 uH; sim to Paul Smith SK-890-1.
L3 thru L5		(Part of PWB 19C851644P1).
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1	19A704708P2	Silicon, NPN; sim to NEC 2SC3356.
Q2	19A701940P1	Silicon, NPN; sim to MRF-559.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	19B800607P471	Metal film: 470 ohms ±5%, 200 VDCW, 1/8 w.
R2	19B800607P222	Metal film: 2.2K ohms ±5%, 200 VDCW, 1/8
R3	19B800607P102	Metal film: 1K ohms ±5%, 200 VDCW, 1/8 w.
R4	19B800607P330	Metal film: 33 ohms ±5%, 200 VDCW, 1/8 w.
R5	19B800607P272	Metal film: 2.7K ohms ±5%, 200 VDCW, 1/8 w.
R6	19B800607P331	Metal film: 330 ohms ±5%, 200 VDCW, 1/8 w.
R7 and R8	19B800607P100	Metal film: 10 ohms ±5%, 200 VDCW, 1/8 w.
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C101	19A702061P99	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C102	19A702061P41	Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G1).
C102	19A702061P37	Ceramic: 33 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G2).
C102	19A702061P61	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G3).
C103	19A702061P17	Ceramic: 12 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C104	19A702061P99	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C105	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C106	19A702061P73	Ceramic: 330 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C107	19A701534P8	Tantalum: 22 uF ±20%, 16 VDCW.
C108	19A703314P10	Electrolytic: 10 uF -10+50% tol, 50 VDCW; sim to Panasonic LS Series.
C109 and C110	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C111	19A703314P10	Electrolytic: 10 uF -10+50% tol, 50 VDCW; sim to Panasonic LS Series.
C112 thru C114	19A702061P73	Ceramic: 330 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C115	19A702061P73	Ceramic: 330 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G2).
C116	19A702061P99	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C117	19A702052P22	Ceramic: 0.047 uF ±10%, 50 VDCW.
C118	19A703314P10	Electrolytic: 10 uF -10+50% tol, 50 VDCW; sim to Panasonic LS Series.
C119	19A702061P73	Ceramic: 330 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C120	19A702061P99	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C121	19A702052P26	Ceramic: 0.1 uF ±10%, 50 VDCW.
C122	19A702052P28	Ceramic: 0.022 uF ±10%, 50 VDCW.
C123	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C124	19A702061P99	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C125 and C126	19A702061P73	Ceramic: 330 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C130	19A705108P14	Mica: 11 pF ±5%, 500 VDCW.(Used in G1).
C130	19A705108P12	Mica: 9.1 pF ±5%, 500 VDCW. (Used in G2).
C130	19A705108P11	Mica: 8.2 pF ±5%, 500 VDCW. (Used in G3).
C131	19A705108P22	Mica: 24 pF ±5%, 500 VDCW. (Used in G1).
C131	19A705108P19	Mica: 18 pF ±5%, 500 VDCW. (Used in G2).
C131	19A705108P200	Mica: 17 pF ±5%, 500VDCW. (Used in G3).
C132	19A705108P16	Mica: 13 pF ±5%, 500 VDCW. (Used in G1).
C132 *	19A705108P12	Mica: 9.1 pF ±5%, 500 VDCW. (Used in G2,G3).
C201	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C202	19A702061P99	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C203	19A702061P11	Ceramic: 6.8 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C.
C204	19A702052P26	Ceramic: 0.1 uF ±10%, 50 VDCW.
C205	19A701534P17	Tantalum: 47 uF ±20%, 10 VDCW.
C206	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C207	19A701534P8	Tantalum: 22 uF ±20%, 16 VDCW.
C208	19A702052P22	Ceramic: 0.047 uF ±10%, 50 VDCW.
C209	19A701534P3	Tantalum: 0.47 uF ±20%, 35 VDCW.
C210	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C211	19A702061P33	Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C212	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C213 and C214	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C215	19A700004P1	Metallized polyester: 0.068 uF ±10%, 63 VDCW.
C216	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C217	19A700004P11	Metallized Polyester: 1.0 uF ±10%, 63 VDCW.
C218	19A702061P33	Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G1).
C218	19A702061P29	Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G2,G3).
C219	19A702061P93	Ceramic: 2200 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C220	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C222	19A702061P99	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C223	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C224	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C225	19A702061P93	Ceramic: 2200 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C226	19A701534P17	Tantalum: 47 uF ±20%, 10 VDCW.
C227	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C228	19A702061P9	Ceramic: 4.7 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C.
C229	19A702061P61	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C230	19A702052P26	Ceramic: 0.1 uF ±10%, 50 VDCW.
C231	19A703314P2	Tantalum: 220 uF, -10+50%, 10 VDCW.
C232	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C234	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C236	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C237	19A702061P17	Ceramic: 12 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C238	19A702061P9	Ceramic: 4.7 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C.
C239	19A702061P12	Ceramic: 8.2 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C. (Used in G1,G2).
C239	19A702061P11	Ceramic: 6.8 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C. (Used in G3).
C240	19A702061P25	Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C402	19A702061P41	Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G1).
C402	19A702061P33	Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G2,G3).
C403	19A702061P37	Ceramic: 33 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G1).
C403	19A702061P17	Ceramic: 12 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G2).
C403 *	19A702061P25	Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G3).
C404	19A702061P13	Ceramic: 10 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G1).
C404	19A702061P17	Ceramic: 12 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G2).
C404 *	19A702061P11	Ceramic: 6.8 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C. (Used in G3).
C406	19A702236P11	Ceramic: 2.7 pF ±0.25 pF, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G1).
C406	19A702236P7	Ceramic: 1.2 pF ±.25 pF, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G2).
C406 *	19A702236P9	Ceramic: 1.8 pF ±0.25 pF, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G3).
C407	19A702061P73	Ceramic: 330 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C408	19A702168P1	Variable, ceramic: 2 to 7 pF, 100 VDCW; sim to JFD DV2SN7A.
C409	19A702061P99	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C410	19A702236P1	Ceramic: 0.5 pF ±.1 pF, 50 VDCW, temp coef 0 ±30 PPM/°C.
C411	19A702061P73	Ceramic: 330 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C412	19A703314P10	Electrolytic: 10 uF -10+50% tol, 50 VDCW; sim to Panasonic LS Series.
C413	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C414	19A702168P1	Variable, ceramic: 2 to 7 pF, 100 VDCW; sim to JFD DV2SN7A.
C415	19A702236P11	Ceramic: 2.7 pF ±0.25 pF, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G1).
C415	19A702236P7	Ceramic: 1.2 pF ±.25 pF, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G2).
C415	19A702236P5	Ceramic: 0.9 pF ±.1 pF, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G3).
C416	19A702236P21	Ceramic: 6.8 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C. (Used in G1).
C416	19A702236P19	Ceramic: 5.6 pF ±.5 pF, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G2).
C416 *	19A702061P5	Ceramic: 2.2 pF ±0.5 pF, 50 VDCW, temp coef 0 ±120 PPM/°C. (Used in G3).
C417	19A702061P9	Ceramic: 4.7 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C.
C418	19A702061P10	Ceramic: 5.6 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C. (Used in G1).
C418 *	19A702061P21	Ceramic: 15 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G2,G3).
C419	19B800873P8	Variable, ceramic: 1 to 5 pF, 150 VDCW; sim to Johanson 9621. (Used in G3).
C502	19A702061P99	Ceramic: 1000 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C503	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C504	19A702061P29	Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C505	19A702061P25	Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C506	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW.
C507 thru C509	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C510	19A702061P6	Ceramic: 2.7 pF ±0.5 pF, 50 VDCW, temp coef 0 ±120 PPM/°C.
C511	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C512	19A702061P1	Ceramic: 1 pF ±0.5 pF, 50 VDCW.
C513	19A702061P12	Ceramic: 8.2 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C.
C514	19A702061P33	Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C515 and C516	19A702061P29	Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C517 and C518	19A702052P26	Ceramic: 0.1 uF ±10%, 50 VDCW.
C519	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C520	19A702052P14	Ceramic: 0.01 uF ±10%, 50 VDCW.
C521	19A703314P10	Electrolytic: 10 uF -10+50% tol, 50 VDCW; sim to Panasonic LS Series.
C522	19A702052P26	Ceramic: 0.1 uF ±10%, 50 VDCW.
C523	19A702236P8	Ceramic: 1.5 pF ±.25 pF, 50 VDCW.
		- - - - - - - - - - DIODES - - - - - - - - - -
D101	19A705377P1	Silicon, Hot Carrier: sim to Motorolla MMB0201.
D102 and D103	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
D104	19J706892P2	Silicon, pin: sim to Unitrode UM9401.
D105	19A703588P3	Zener, transient suppressor: sim to 1N6278A.
D106	19A702526P2	Silicon. (Schottky Barrier): sim to BAT 17.
D202 and D203	19A702526P2	Silicon. (Schottky Barrier): sim to BAT 17.
D401	19J706892P2	Silicon, pin: sim to Unitrode UM9401.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	GE PART NO.	DESCRIPTION
D501 and D502	19A700028P1	Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148.
		- - - - - - - - - - - - JACKS - - - - - - - - - - - -
J101 thru J103	19B801341P1	RF Jack.
J201	19A700072P1	Printed wire: 2 contacts rated @ 2.5 amps; sim to Molex 22-03-2021.
J501	19A700072P1	Printed wire: 2 contacts rated @ 2.5 amps; sim to Molex 22-03-2021.
J702	19A704779P11	Connector: sim to Molex 22-17-2122.
J704	19A700072P29	Printed wire: 3 contacts rated at 2.5 amps; sim to Molex 22-27-2031.
J705	19A700072P30	Printed wire: 4 contacts rated at 2.5 amps; sim to Molex 22-27-2041.
		- - - - - - - - - - - INDUCTORS - - - - - - - - - - -
L101	19B800891P6	Coil, RF: .084 uH; sim to Paul Smith SK-890-1.
L102	19A700024P7	Coil, RF: 330 nH ±10%.
L103 thru L106	19A704921P1	Coil.
L130 and L131	19B800891P1	Coil, RF Choke: sim to Paul Smith SK-890-1.
L201		(Part of PWB 19D902033P1).
L202	19A705470P6	Coil: sim to Toko 380NB-27nM. (Used in G1,G2).
L202	19A705470P5	Coil: sim to Toko 380NB-22nM. (Used in G3).
L203	19A705470P6	Coil: sim to Toko 380NB-27nM. (Used in G1,G2).
L203	19A705470P5	Coil: sim to Toko 380NB-22nM. (Used in G3).
L401A	19B800891P1	Coil, RF Choke: sim to Paul Smith SK-890-1.
L401B		(Part of PWB 19D902033P1).
L402	19B800891P1	Coil, RF Choke: sim to Paul Smith SK-890-1.
L403	19B800891P1	Coil, RF Choke: sim to Paul Smith SK-890-1. (Used in G1,G2).
L403	19B800890P4	RF: sim to Paul Smith SK-891-1. (Used in G3).
L404		(Part of PWB 19D902033P1).
L405	19B800891P1	Coil, RF Choke: sim to Paul Smith SK-890-1.
L502 and L503	H343CLP10022	Coil, Fixed: 10 uH ±10%.
L504	19B801413P4	Coil, 39 MHz.
L505	19A700024P19	Coil, RF: 3.3 uH ±10%.
L506 thru L508	19B801413P4	Coil, 39 MHz.
L509	19B801415P2	Transformer, 455 KHz.: sim to AEPD 162B3277P17.
		- - - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q101		(Part of Heat Sink Assembly 19B801378G3).
Q102	19A703197P2	Silicon, PNP; sim to MMBT4403 Low Profile Pkg.
Q103	19A704972P1	Silicon, PNP: sim to Motorola 2N4918.
Q104	19A700076P2	Silicon, NPN.
Q201	19A704708P2	Silicon, NPN: sim to NEC 2SC3356.
Q202	19A700059P2	Silicon, PNP.
Q203	19A700076P2	Silicon, NPN.
Q204	19A704708P2	Silicon, NPN: sim to NEC 2SC3356.
Q206	19A700076P2	Silicon, NPN.
Q207	19A700059P2	Silicon, PNP.
Q208	19A700023P2	Silicon, NPN: sim to 2N3904.
Q209 and Q210	19A702084P2	Silicon, NPN: sim to MPS 2369.
Q401	19J706019P1	N-Channel, field effect: MOS DUAL GATE; sim to BF960.
Q501	19A702524P2	N-Type, field effect: sim to MMBFU310.
Q502	19A116818P3	N Channel, field effect: sim to Type 3N1877.
Q503	19A700023P2	Silicon, NPN: sim to 2N3904.
		- - - - - - - - - - - RESISTORS - - - - - - - - - - -
R101	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R102	19B800607P470	Metal film: 47 ohms ±5%, 200 VDCW, 1/8 w. (Used in G1).
R102	19B800607P390	Metal film: 39 ohms ±5%, 200 VDCW, 1/8 w. (Used in G2).
R102	19B800607P560	Metal film: 56 ohms ±5%, 200 VDCW, 1/8 w. (Used in G3).
R103A	19B800607P821	Metal film: 820 ohms ±5%, 200 VDCW, 1/8 w.
R103B	19B800607P821	Metal film: 820 ohms ±5%, 200 VDCW, 1/8 w.
R104	19B800607P223	Metal film: 22K ohms ±5%, 200 VDCW, 1/8 w.
R105	19B800607P473	Metal film: 47K ohms ±5%, 200 VDCW, 1/8 w.
R106	19B800607P102	Metal film: 1K ohms ±5%, 200 VDCW, 1/8 w.
R107	19B800607P394	Metal film: 390K ohms ±5%, 200 VDCW, 1/8 w.
R108	19B800607P123	Metal film: 12K ohms ±5%, 200 VDCW, 1/8 w.
R109	19B800607P394	Metal film: 390K ohms ±5%, 200 VDCW, 1/8 w.
R110	19B800607P222	Metal film: 2.2K ohms ±5%, 200 VDCW, 1/8 w.
R111	19B800779P10	Variable: 10K ohms ±25%, 100 VDCW, .3 watt.
R112	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R113	19B800607P102	Metal film: 1K ohms ±5%, 200 VDCW, 1/8 w.
R114	19B800607P154	Metal film: 150K ohms ±5%, 200 VDCW, 1/8 w.
R115	19B800607P562	Metal film: 5.6K ohms ±5%, 200 VDCW, 1/8 w.
R116	19B800607P183	Metal film: 18K ohms ±5%, 200 VDCW, 1/8 w.
R117	19B800607P821	Metal film: 820 ohms ±5%, 200 VDCW, 1/8 w.
R118	19A701864P4	Thermal: 10K ohms ±10%, sim to Midwest Components 2H-103.
R119 thru R121	19B800607P100	Metal film: 10 ohms ±5%, 200 VDCW, 1/8 w.
R202	19B800607P560	Metal film: 56 ohms ±5%, 200 VDCW, 1/8 w. (Used in G1).
R202	19B800607P330	Metal film: 33 ohms ±5%, 200 VDCW, 1/8 w. (Used in G2,G3).
R203	19B800607P560	Metal film: 56 ohms ±5%, 200 VDCW, 1/8 w.
R204	19B800607P221	Metal film: 220 ohms ±5%, 200 VDCW, 1/8 w.
R205	19B800607P332	Metal film: 3.3K ohms ±5%, 200 VDCW, 1/8 w.
R206	19B800607P102	Metal film: 1K ohms ±5%, 200 VDCW, 1/8 w.
R207	19B800607P181	Metal film: 180 ohms ±5%, 200 VDCW, 1/8 w.
R208	19B800607P473	Metal film: 47K ohms ±5%, 200 VDCW, 1/8 w.
R209 and R210	19B800607P332	Metal film: 3.3K ohms ±5%, 200 VDCW, 1/8 w.
R211	19B800607P101	Metal film: 100 ohms ±5%, 200 VDCW, 1/8 w.
R213	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R214	19B800607P331	Metal film: 330 ohms ±5%, 200 VDCW, 1/8 w.
R215	19B800607P822	Metal film: 8.2K ohms ±5%, 200 VDCW, 1/8 w.
R216	19B800607P222	Metal film: 2.2K ohms ±5%, 200 VDCW, 1/8 w.
R217	19B800607P101	Metal film: 100 ohms ±5%, 200 VDCW, 1/8 w.
R218	19B800779P16	Variable: 100K ohms, ±25%, 100 VDCW, .3 w.
R219	19B800607P273	Metal film: 27K ohms ±5%, 200 VDCW, 1/8 w.
R221	19B800607P154	Metal film: 150K ohms ±5%, 200 VDCW, 1/8 w.
R222	19B800607P333	Metal film: 33K ohms ±5%, 200 VDCW, 1/8 w.
R223	19B800607P564	Metal film: 560K ohms ±5%, 200 VDCW, 1/8 w.
R224	19B800607P472	Metal film: 4.7K ohms ±5%, 200 VDCW, 1/8 w.
R225	19B800607P224	Metal film: 220K ohms ±5%, 200 VDCW, 1/8 w.
R226	19B800779P4	Variable: 1K ohms ±25%, 100 VDCW, .3 w.
R227	19B800607P473	Metal film: 47K ohms ±5%, 200 VDCW, 1/8 w.
R228	19B800607P223	Metal film: 22K ohms ±5%, 200 VDCW, 1/8 w.
R229	19B800607P823	Metal film: 82K ohms ±5%, 200 VDCW, 1/8 w.
R230	19B800607P332	Metal film: 3.3K ohms ±5%, 200 VDCW, 1/8 w.
R231	19B800607P472	Metal film: 4.7K ohms ±5%, 200 VDCW, 1/8 w.
R232	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R233	19B800607P332	Metal film: 3.3K ohms ±5%, 200 VDCW, 1/8 w.
R234	19B800607P472	Metal film: 4.7K ohms ±5%, 200 VDCW, 1/8 w.
R235	19B800607P823	Metal film: 82K ohms ±5%, 200 VDCW, 1/8 w.
R236	19B800607P471	Metal film: 470 ohms ±5%, 200 VDCW, 1/8 w.
R237 thru R239	19B800607P103	Metal film: 10K ohms ±5%, 200 VDCW, 1/8 w.
R240 thru R242	19B800607P154	Metal film: 150K ohms ±5%, 200 VDCW, 1/8 w.
R243	19A702931P137	Metal film: 237 ohms ±1%, 200 VDCW, 1/8 w.
R244	19A702931P213	Metal film: 1330 ohms ±1%, 200 VDCW, 1/8 w.
R245	19B800607P223	Metal film: 22K ohms ±5%, 200 VDCW, 1/8 w.
R246	19B800607P102	Metal film: 1K ohms ±5%, 200 VDCW, 1/8 w.
R248	19B800607P1	Metal Film: 0 ohms (50 Milli-ohms Max), 1/8 w.
R401 and R402	19B800607P331	Metal film: 330 ohms ±5%, 200 VDCW, 1/8 w.
R403	19B800607P270	Metal film: 27 ohms ±5%, 200 VDCW, 1/8 w.
R404	19B800607P683	Metal film: 68K ohms ±5%, 200 VDCW, 1/8 w.
R405	19B800607P823	Metal film: 82K ohms ±5%, 200 VDCW, 1/8 w.
R406	19B800607P183	Metal film: 18K ohms ±5%, 200 VDCW, 1/8 w.
R407	19B800607P101	Metal film: 100 ohms ±5%, 200 VDCW, 1/8 w.
R409	19B800607P221	Metal film: 220 ohms ±5%, 200 VDCW, 1/8 w.
R410	H212CRP915C	Deposited carbon: 1.5 ohms ±5%, 1/4 w. (Used in G1,G2).
R410 *	H212CRP910C	Deposited carbon: 1 ohm ±5%, 1/4 w. (Used in G3).
R501	19B800607P181	Metal film: 180 ohms ±5%, 200 VDCW, 1/8 w.
R502	19B800607P270	Metal film: 27 ohms ±5%, 200 VDCW, 1/8 w.
R503	19B800607P682	Metal film: 6.8K ohms ±5%, 200 VDCW, 1/8 w.
R504	19B800607P270	Metal film: 27 ohms ±5%, 200 VDCW, 1/8 w.
R505	19B800607P683	Metal film: 68K ohms ±5%, 200 VDCW, 1/8 w.
R506	19B800607P823	Metal film: 82K ohms ±5%, 200 VDCW, 1/8 w.
R507	19B800607P183	Metal film: 18K ohms ±5%, 200 VDCW, 1/8 w.
R508	19B800607P101	Metal film: 100 ohms ±5%, 200 VDCW, 1/8 w.
R509	19B800607P272	Metal film: 2.7K ohms ±5%, 200 VDCW, 1/8 w.
R510	19B800607P270	Metal film: 27 ohms ±5%, 200 VDCW, 1/8 w.
R511	19B800607P473	Metal film: 47K ohms ±5%, 200 VDCW, 1/8 w.
R512	19B800607P822	Metal film: 8.2K ohms ±5%, 200 VDCW, 1/8 w.
R513	19B800779P4	Variable, 1K ohms ±25%, 100 VDCW, .3 w.
R514	19B800607P682	Metal film: 6.8K ohms ±5%, 200 VDCW, 1/8 w.
R515	19B800607P821	Metal film: 820 ohms ±5%, 200 VDCW, 1/8 w.
		- - - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U102		(Part of Heat Sink Assembly 19B801378G3).
U103	19A701789P2	DUAL OP AMP; sim to LM358.
U201	19D901958G3	Voltage Controlled Oscillator. (Used in G1).
U201	19D901958G4	Voltage Controlled Oscillator. (Used in G2).
U201	19D901958G5	Voltage Controlled Oscillator. (Used in G3).
U202	19A700029P44	Digital: BILATERAL SWITCH.
U203	19A704971P1	Voltage Regulator, 5 volt; sim to: Motorola MC78L05ACP.
U204	19B801351P6	Crystal Oscillator, temperature compensated: 12.80 MHz. ±5 PPM/°C.
U205	19A704287P2	Voltage Divider: sim to Motorolla MC12018.
U206	19B800902P4	Synthesizer: CMOS Serial Input.
U207	19A701999P4	Voltage Regulator, positive. sim to LM317LZ.
U501	19A704619P1	Linear: IF AMPLIFIER AND DETECTOR.
U502	19A704073P2	Voltage Regulator, positive.
		- - - - - - - - - - - - CABLES - - - - - - - - - - -
W101 and W102		(Part of PWB 19D902033P1).
		- - - - - - - - - - - - CRYSTALS - - - - - - - - - -
Y501	19A705376P5	Crystal Unit, fixed frequency: 45.455 MHz.
		- - - - - - - - - - - - FILTER - - - - - - - - - - -
Z401	19A705458P4	Filter, UHF: 403-425 MHz.
Z401	19A705458P1	Filter, UHF: 450-470 MHz.
Z401	19A705458P2	Filter, UHF: 470-492 MHz.
Z402	19B801025P1	Double Balanced Mixer: sim to Mini-Circuits SBL-1.
Z501	19A705328P1	Crystal filter, monolithic: 45.000 MHz., sim to Toyocom 45E2B2.
Z502		(Part of Z501).
Z503	19B801021P2	Bandpass filter: 455 kHz ±1.5; sim to Murata CFW-455E.
		HEAT SINK ASSEMBLY 19B801378G3
		- - - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q101	19A116742P2	Silicon, NPN.
		- - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U102	19A134717P3	Voltage Regulator, positive; sim to uA7808U.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19B801490P1	Ground Strap.
	19A702364P106	Machine screw: TORX Drive, No. M2 - 0.4 x 6.
	19B801382P2	Bracket: Power support. (Used with U101).
	19B801377G3	Heat Sink.
	19A705469P1	Insulator: Plate. (Used with Heat Sink).
	N402P5B6	Washer: Narrow steel. (Used with Heat Sink).
	N404P11B6	Washer: Internal lock, No 4. (Used with Heat Sink).
	N80P9005B6	Screw: Machine, pan head steel. (Used with Heat Sink).
	19A700068P1	Insulator: Bushing. (Used with Heat Sink).

PRODUCTION CHANGES

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

REV. A - 19D902032G1
To improve transmitter operation, changed C3 and C8 and added C12. C3 and C8 were 19A702061P13 Mica: 10 pF ±5%, 50 WVDC.

REV. A - 19D902032G2
To improve transmitter output power and current drain at top end of 440-470 MHz band, changed C132. C132 was 19A705108P13 Mica: 10 pF ±5%, 500 WVDC.

REV. A - 19D902032G3
To improve receiver sensitivity, changed C403, C404, C406, C416, C418, and R410. Also added C419. Old part numbers were:
C403: 19A702061P21 Ceramic: 15 pF ±5%, 50 WVDC.
C404: 19A702061P10 Ceramic: 5.6 pF ±5%, 50 WVDC.
C406: 19A702236P7 Ceramic: 1.2 pF ±.25 pF, 50 WVDC.
C416: 19A702236P17 Ceramic: 4.7 pF ±5%, 50 WVDC.
C418: 19A702061P17 Ceramic: 15 pF ±5%, 50 WVDC.
R410: H212CRP915C Deposited carbon: 1.5 ohms ±5%, 1/4 w.

RF BOARD