MAINTENANCE MANUAL
RECEIVER FRONT END MODULE
19D902782G1: 136 - 151 MHz
19D902782G2: 150 - 174 MHz

TABLE OF CONTENTS

DESCRIPTION

The Receiver Front End (RxFE) Module amplifies and down converts the RF signal to the first IF signal of 21.4 MHz. The 19D902782G1 (Group 1) module uses high side injection, and the 19D902782G2 (Group 2) module uses low side injection. The RxFE module is supplied by a regulated 12 volts and draws about 150 mA. The RxFE printed wiring board contains the following circuits:

- Preselector Filter
- Preamplifier
- Image Rejection Filter
- Injection Amplifier
- Injection Filter
- Double Balanced Mixer
- Fault Detector

All the circuits, except the Fault Detector circuit, have 50 ohm impedance terminations.

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TABLE 1 - GENERAL SPECIFICATIONS	
ITEM	**SPECIFICATION**
FREQUENCY RANGE	136.0 MHz - 151 MHz (Group 1) 150.8 MHz - 174 MHz (Group 2)
IF FREQUENCY	21.4 MHz
3 dB BANDWIDTH	>3 MHz
CONVERSION LOSS	0 dB ±1 dB
NOISE FIGURE (NF)	<7.5 dB
THIRD ORDER INTERCEPT POINT	>+20 dBm
IMAGE REJECTION	>100dB
TEMPERATURE RANGE	-30°C TO +60°C
SUPPLY VOLTAGE	12.0 Vdc
SUPPLY CURRENT	120 mA ±20 mA
INJECTION POWER	+1.5 dBm ±1.5 dB
IMPEDANCE	50 ohms at RF, LO, and IF Ports

CIRCUIT ANALYSIS

PRESELECTOR FILTER

The received RF signal (J2) is routed through the Preselector Filter. This filter provides front end selectivity and attenuates the potential spurious signals of first conversion. Typically, the filter has an insertion loss of 3 dB and an operational bandwidth of 2 MHz. The filter is primarily a five-pole helical bandpass filter (L1 through L5) and is tunable in the following ranges:

Group 1, 136.0-151 MHz
Group 2, 150.8-174 MHz

PREAMPLIFIER

The output from the Preselector Filter is coupled though an impedance matching network consisting of L6, C1, and DC blocking capacitor C2 to the base of Preamplifier Q1. Q1 is a broadband common emitter amplifier capable of operating in the 136-174 MHz range. The Preamplifier stage is supplied by the regulated +12 Vdc line (VCC 1) and draws about 60 mA through R6. It has a low noise figure and high Third Order Intercept Point. Transistor Q2 provides Q1 with a constant voltage and current source. The bias on Q1 is monitored by the Fault Detector circuit via R26. Capacitors C25 and C26 (Group 1), and C26 and C27 (Group 2) prevent the RF component from entering the fault circuit. The output signal is coupled to the Image Rejection Filter via an impedance matching network consisting of C5, L8, and resistors R7 and R8.

IMAGE REJECTION FILTER

Following the Preamplifier is the Image Rejection Filter which rejects the image noise after the preamplification. The Group 1 Image Rejection Filter consists of C6 through C11, and L9 through L11. It is a fixed tuned lowpass filter designed to pass the desired frequency range of 136-151 MHz and reject the image band of 178.8-193.8 MHz. The Group 2 Image Rejection Filter consists of C6 through C11, L9 through L12, and R29. It is a fixed tuned highpass filter designed to pass the desired frequency range of 150.8-174 MHz and reject the image band of 108-131.2 MHz.

INJECTION AMPLIFIER

The local oscillator input (J3) from the Receiver Synthesizer is coupled through an impedance matching network C12 and L19 (Group 1); and C12 and L13 (Group 2) to the base of the Injection Amplifier Q3. Q3 is a common emitter amplifier capable of amplifying the injection signal from 0 dBm to +22 dBm in the 157.4-172.4 MHz range (Group 1), and the 129.4 to 152.6 MHz range (Group 2). The Injection Amplifier stage is supplied by the regulated +12 Vdc line (VCC 1) and draws about 60 mA through R12. Transistor Q4 provides Q3 with a constant voltage and current source. The bias on Q3 is monitored by the Fault Detector circuit via R27. Capacitors C23 and C24 (Group 1), and C29 and C30 (Group 2) prevent the RF component from entering the fault circuit. The output signal is coupled to the Injection Filter via an impedance matching network consisting of C13, L13, resistors R13 and R14 (Group 1); and C13, L15, resistor R13 and R14 (Group 2).

INJECTION FILTER

Following the Injection Amplifier is the Injection Filter consisting of L14 through L18, C15 through C21, and R30 (Group 1); and C15 through C25, L16 through L20, and R30 (Group 2). Configured as a bandpass filter, the Injection Filter has a bandwidth of 157.4-172.4 MHz (Group 1), and 129.4-152.6 MHz (Group 2) and is used to attenuate the harmonics of the Injection Amplifier. The filter also has an insertion loss of about 2 dB.

DOUBLE BALANCE MIXER

The Double Balanced Mixer (DBM) is a broad band mixer. The Group 1 mixer downconverts an RF signal in the 136-151 MHz range to the 21.4 MHz first conversion IF frequency by the use of high side injection. The Group 2 mixer downconverts an RF signal in the 150.8-174 MHz range to the 21.4 MHz first conversion IF frequency by the use of low side injection. In either case the mixer is driven by a local oscillator signal of +20 dBm. The mixer conversion loss is typically about 6.5 dB. The IF output signal is then routed to the output connector (J4) via R28.

FAULT DETECTOR

The Fault Detector circuit monitors the operation of preamplifier and injection amplifier devices. OP Amps U1.1 and U1.2 compare the bias on the Preamplifier Q1 to preset levels, while U1.3 and U1.4 compare the bias on Injection Amplifier Q3.

When the biases for Q1 and Q3 are within the preset window limits, the output from the comparators is a high level. This causes Q5 to conduct, turning off Q6 and the fault indicator, CR2. A high level signal is also sent to the Controller on the FLAG 0 line.

If the biasing for either amplifier is not within the proper operating range, the fault detector circuit will pull the FLAG 0 line low. This turns off Q5 causing Q6 to conduct. Q6 now provides a ground path for CR2, turning on the fault indicator. A low level signal is also sent to the Controller on the FLAG0 line to indicate a diagnostic failure.

MAINTENANCE

TEST PROCEDURE

The RxFE module has to be tested for Noise Figure, Gain, Third Order Intercept Point, Isolation etc.. With proper current drawing of devices, appropriated Bandwidth and Conversion Gain the RxFE module will meet its specifications, therefore to simplify the test procedure, the RxFE module will be tested for only Conversion Gain, Current drawing. The following are test procedure:

1. Supply 12 Vdc to pin 15A, B, C. (1C is ground.)
2. Inject the desired RF signal to RF IN (J2) at a level of -10 dBm.
3. Inject the desired LO signal to LO IN (J3) at a level of 0 dBm (LO frequency = RF frequency + 21.4 MHz [Group 1]; LO frequency = RF frequency - 21.4 MHz [Group 2]).
4. Measure the IF OUT (J4) power at 21.4 MHz, the ratio of RF IN to IF OUT is 0 dB ±1 dB.
5. Measure the current that draw by RxFE module. Typical current drain is 120 mA ±10 mA.

ALIGNMENT PROCEDURE

Alignment for the Receiver Front End module consists of tuning the five-pole Preselector Filter only. Normally, the RxFE should only need the fine-tuning procedures. For a large receiver frequency change, retune the RxFE using the coarse retuning procedures.

For Fine-Tuning

1. Supply 12 Vdc to pin 15A, B, C. (1C is ground.)
2. Inject the desired RF signal to RF IN (J2) at a level of -10 dBm.

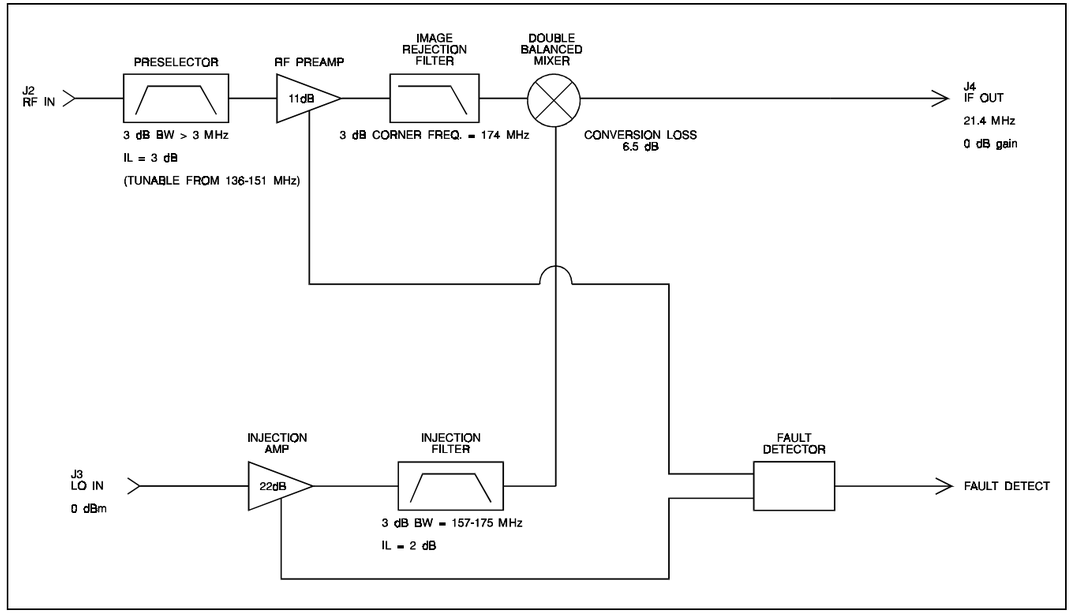


Figure 1 - 19D902782G1 Block Diagram

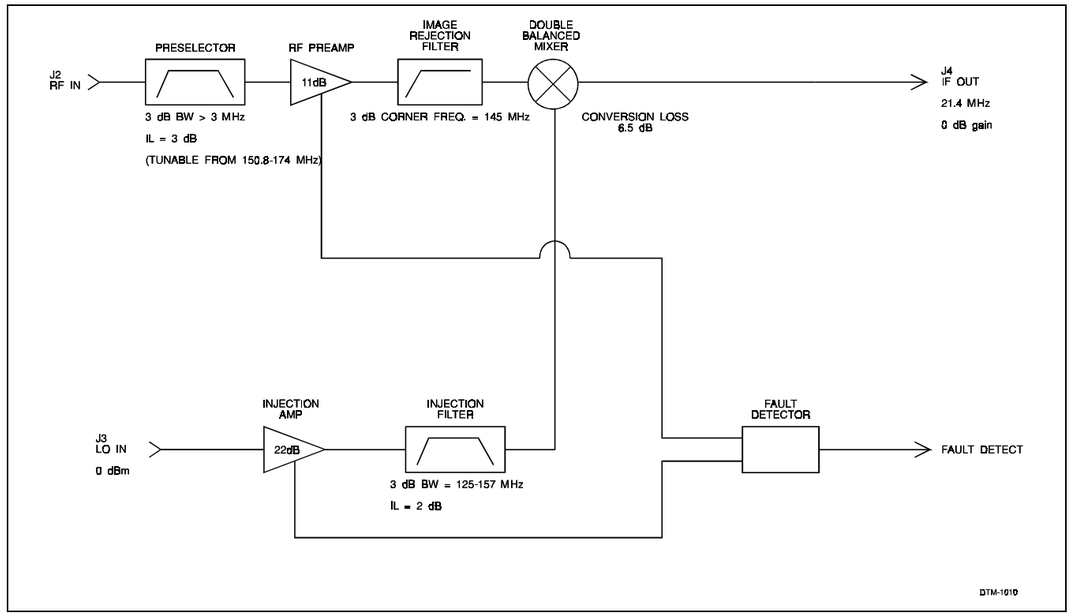


Figure 2 - 19D902782G2 Block Diagram

3. Inject the desired LO signal to LO IN (J3) at a level of 0 dBm (LO frequency = RF frequency + 21.4 MHz [Group 1]; LO frequency = RF frequency - 21.4 MHz [Group 2]).

4. Detect the IF signal at 21.4 MHz. Slightly adjust L1 to L5 to get maximum power (don't adjust more than 10 degrees). If an RF voltmeter is used, connect a low pass filter (LPF) to the IF OUT (J4) to attenuate high frequency components. The corner of the LPF should be set for 40 MHz.

For Coarse Retuning

The best way to do a coarse retuning of the RxFE is with swept frequency tuning. The swept frequency tuning can be done using Spectrum Analyzer and Tracking Generator. With proper Injection power and current drawing, the frequency response of the Preselector Filter can be seen by viewing the RF to IF port feedthrough on the Spectrum Analyzer. This feedthrough is typically 35 dB down from the input level at the RF port. Use the following procedure for swept frequency tuning:

1. Supply 12 Vdc to pin 15A, B, C. (1C is ground.)

2. Inject the Tracking generator output with 0 dBm to RF IN (J2).

3. Inject LO power with 0 dBm to LO IN (LO frequency = RF frequency + 21.4 MHz [Group 1]; LO frequency = RF frequency - 21.4 MHz [Group 2]).

4. Preset the height of slugs with respect to the top of five-pole cavity as shown in Table 2 (Group 1) and Table 3 (Group 2).

5. Center the spectrum analyzer at the desired frequency and set the reference at about -30 dBm. Adjust L1 to L5 for best possible response.

Table 2

Group 1 Frequency (MHz)	HEIGHT (in inches)				
	L1	L2	L3	L4	L5
136	12/64	10/64	15/64	10/64	12/64
139	12/64	11/64	16/64	11/64	12/64
142	14/64	12/64	17/64	13/64	14/64
145	15/64	14/64	19/64	14/64	15/64
148	16/64	16/64	20/64	16/64	17/64
151	18/64	17/64	22/64	17/64	18/64

Table 3

Group 2 Frequency (MHz)	HEIGHT (in inches)				
	L1	L2	L3	L4	L5
150	13/64	13/64	15/64	11/64	13/64
155	15/64	15/64	17/64	14/64	13/64
160	16/64	16/64	18/64	16/64	16/64
165	19/64	18/64	20/64	18/64	18/64
170	21/64	20/64	22/64	20/64	20/64
174	23/64	22/64	24/64	21/64	23/64

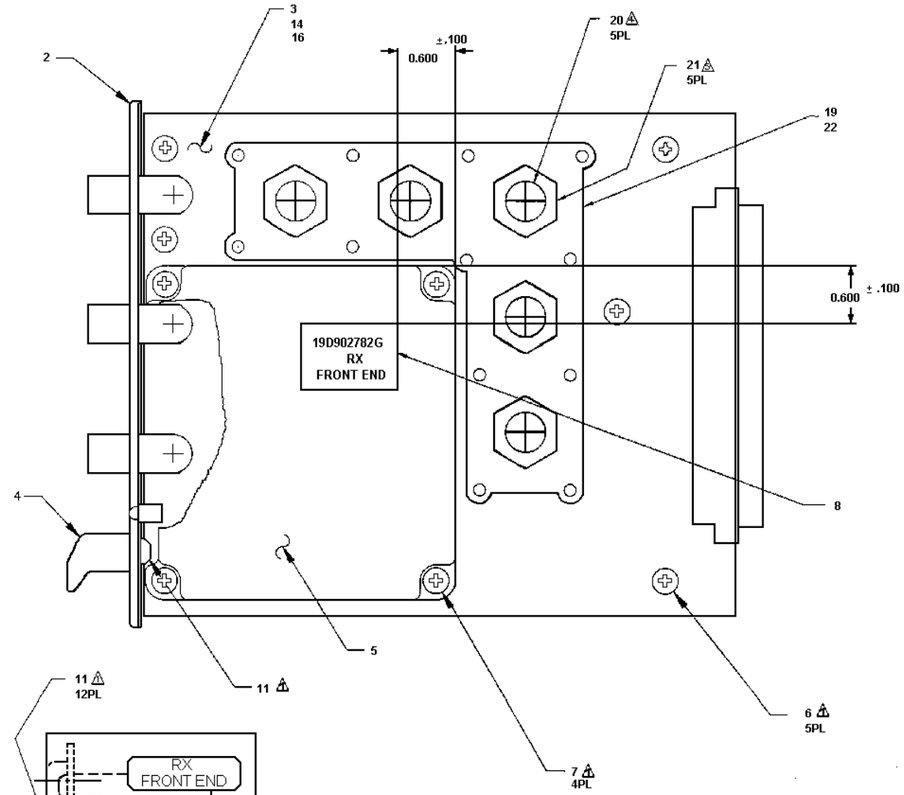
TROUBLESHOOTING PROCEDURES

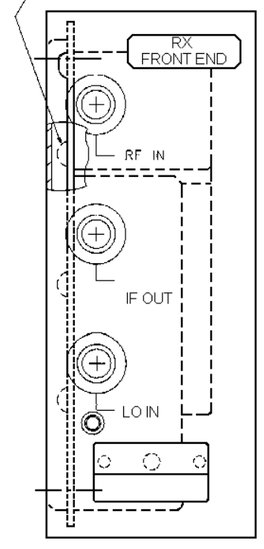
Table 4 - Troubleshooting Guide

SYMPTOM	AREAS TO CHECK	READING (TYP)
LOW CONVERSION GAIN*	Check Vcc	12 volts
	Preselector loss	3.5 dB
	Preamplifier Gain	12.0 dB
	Image Rej. Filter Loss	1 dB
	1st Mixer Conv. Loss	6.5 dB
	1st L.O. Level (@ mixer L.O. port)	+20 dBm ±2 dBm
LED INDICATOR ON	Check Vc of Q1	10 volts
	Check Vc of Q3	7.5 volts
IF FREQUENCY OFF	Check L.O. Frequency	LO frequency = RF frequency + 21.4 MHz [Group 1]; LO frequency = RF frequency - 21.4 MHz [Group 2].
LOW L.O. POWER*	Injection Amp. Gain	23 dB ±2 dB
	Inj. Filter Loss	2 dB

* NOTE: For troubleshooting the gain or loss, the RxFE needs to be operating under normal conditions:

- 12 Vdc supply
- Inject LO power at a level of 0 dBm into LO IN (J3), (LO frequency = RF frequency + 21.4 MHz [Group 1]; LO frequency = RF frequency - 21.4 MHz [Group 2]).
- Inject the desired RF signal at a level of -10 dBm into RF IN (J2).
- Terminate the IF OUT (J4) with a good 50 ohm impedance.
- Use a Spectrum Analyzer and a 50 ohm probe (with good RF grounding) to probe at the input and output of each stage to check its gain or loss (see schematic diagram).





1 NOTES:

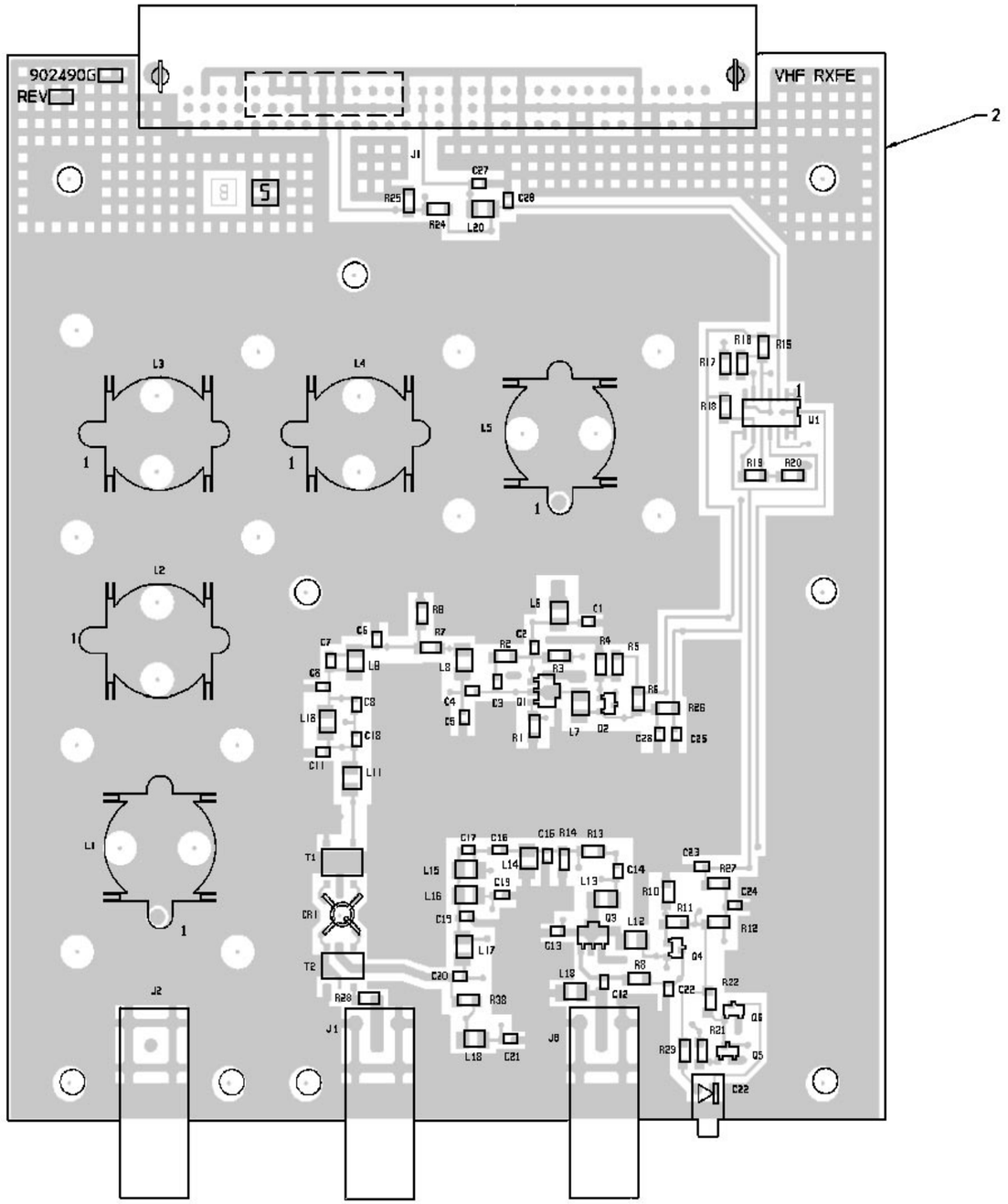
△1 TORQUE SCREWS, ITEMS 6 AND 7, TO 15.5 ±1.3 INCH POUNDS. TORQUE SCREWS, ITEM 11, TO 20 ±1.3 INCH POUNDS.

△4 COAT THREADS OF TUNING SCREWS ITEM 20 PER EGE PROCESS P60-EA111.

△5 TIGHTEN TUNING NUTS, ITEM 21, SO THAT TORQUE ON TUNING SCREWS ITEM 20 ARE 100 IN. OZ. AT MIDDLE OF TUNING RANGE WITH POINTS ON TUNING NUTS BETWEEN RAISED SERATIONS ON CASTING, ITEM 19.

RECEIVER FRONT END MODULE
19D902782G1 & G2

(19D902782, Sh. 1, Rev. 5)



(SOT) TRANSISTORS
(TOP VIEW)

(B) 2
3(C)
(E) 1

LEAD IDENTIFICATION FOR
Q2,Q4,Q5,Q6

(SOT) TRANSISTORS

(B) 2
(C) 3
(E) 1

LEAD IDENTIFICATION FOR
Q1, Q3

RECTIFIER
(TOP VIEW)

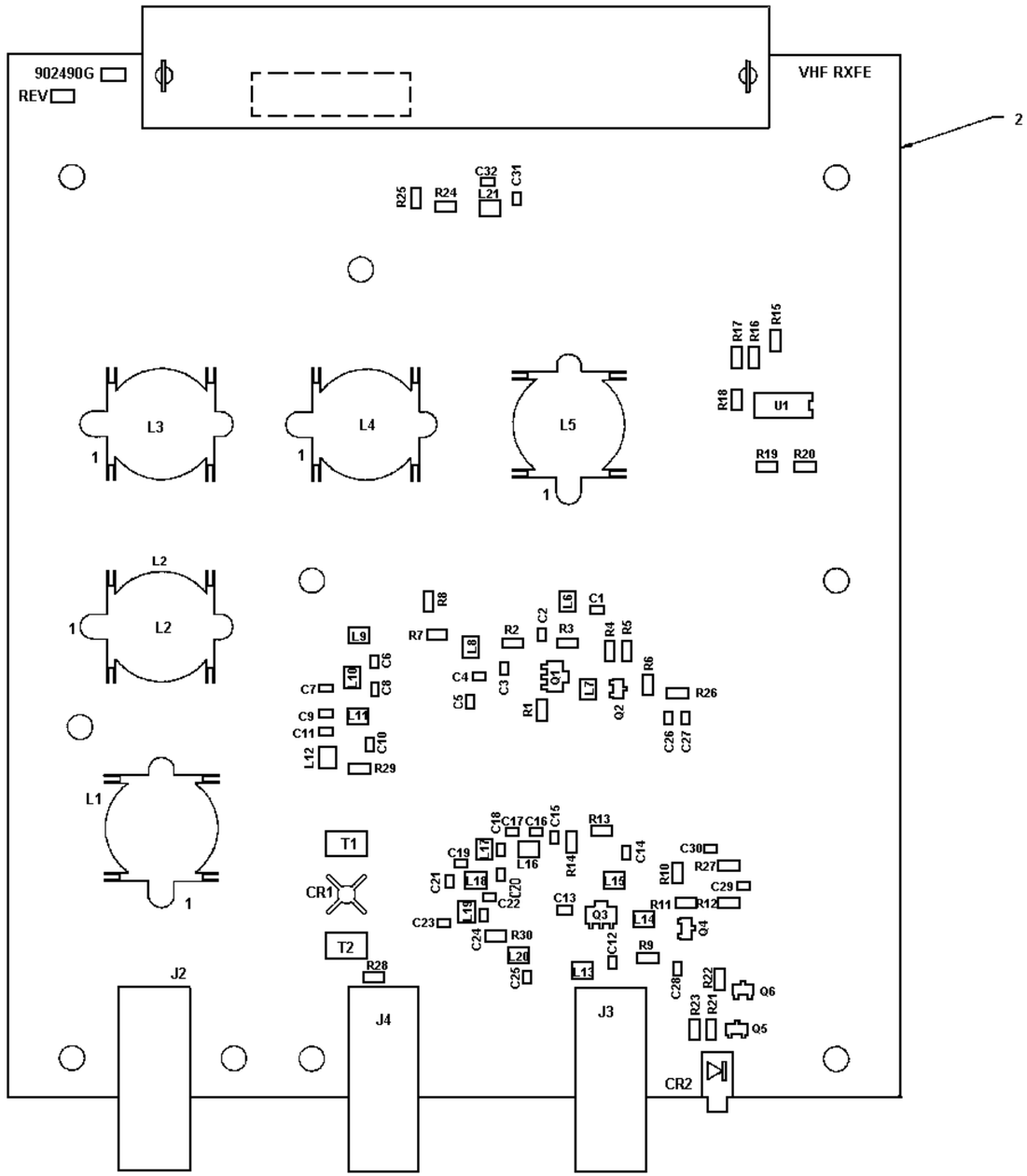
3 2
4 1

LEAD IDENTIFICATION FO
CR1

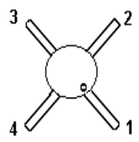
RECEIVER FRONT END PWB
19D902490G1

(19D902490, Sh. 1, Rev. 1)
(19D902489, Layer 1, Rev. 8)
(19D902489, Layer 2, Rev. 8)

CAUTION
OBSERVE PRECAUTIONS
FOR HANDLING
ELECTROSTATIC
SENSITIVE
DEVICES

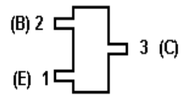


RECTIFIER
(TOP VIEW)



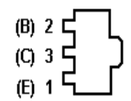
LEAD IDENTIFICATION FOR
CR1

(SOT) TRANSISTORS
(TOP VIEW)



LEAD IDENTIFICATION FOR
Q2, Q4, 15, Q6

(SOT) TRANSISTORS
(TOP VIEW)

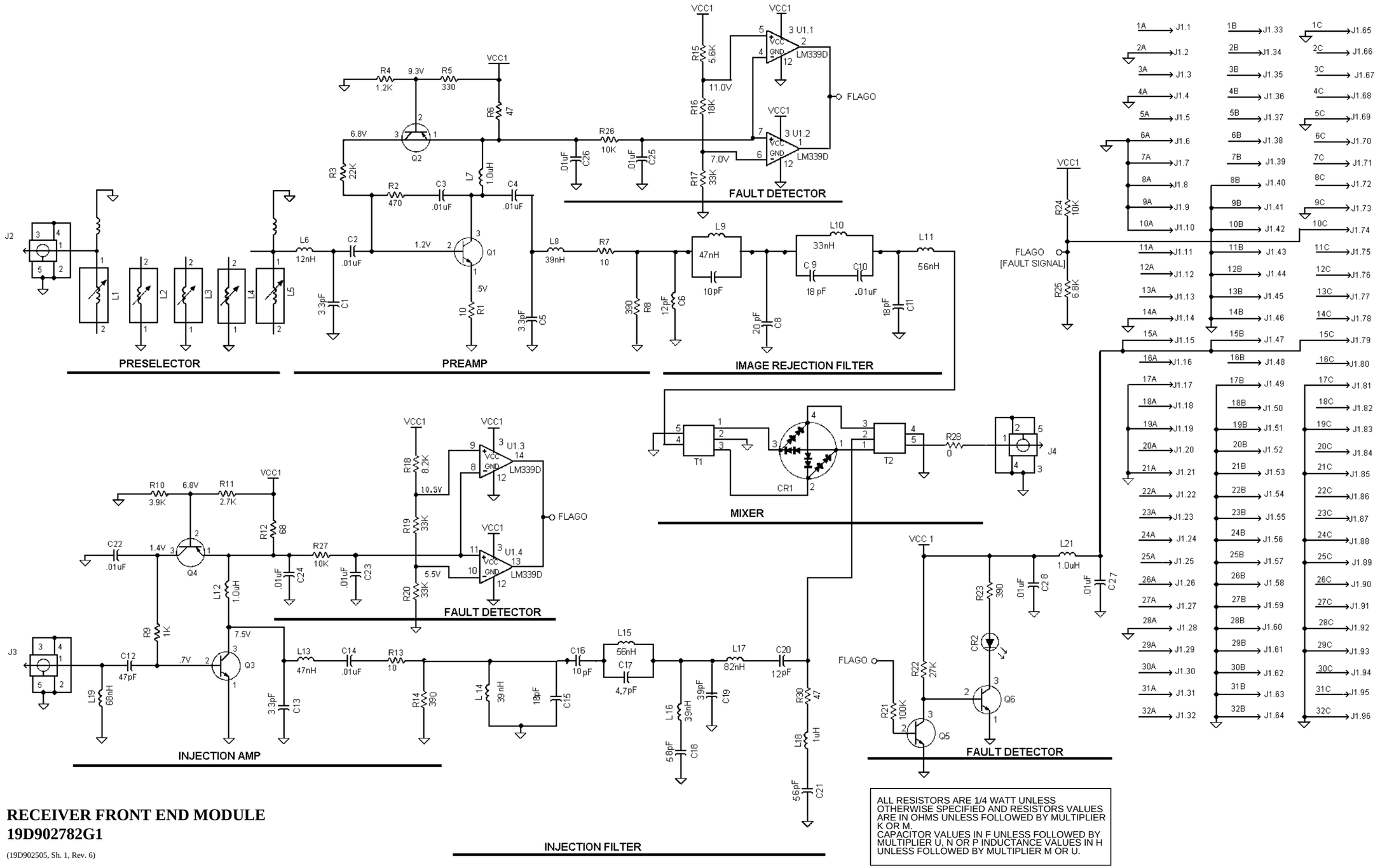


LEAD IDENTIFICATION FOR
Q1, Q3

CAUTION
OBSERVE PRECAUTIONS
FOR HANDLING
ELECTROSTATIC
SENSITIVE
DEVICES

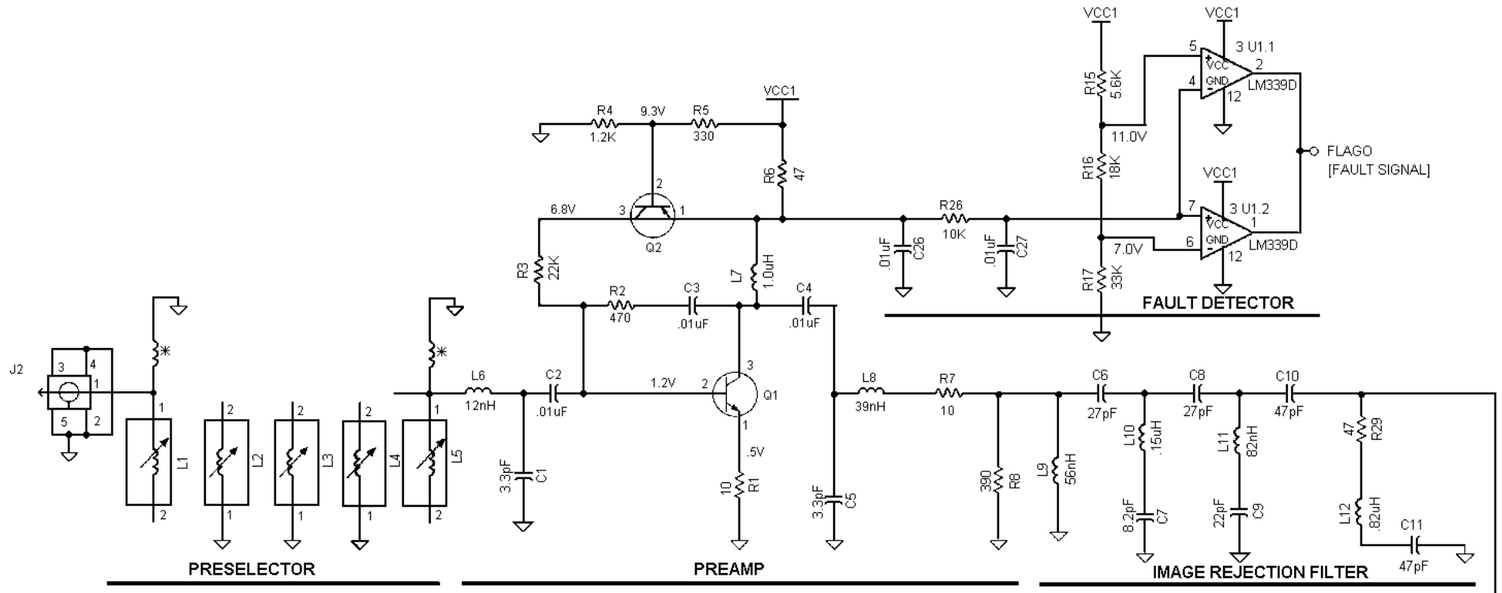
RECEIVER FRONT END PWB
19D902490G2

(19D902490, Sh. 2, Rev. 2)



RECEIVER FRONT END MODULE
19D902782G1

(19D902505, Sh. 1, Rev. 6)



ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTORS VALUES ARE IN OHMS UNLESS FOLLOWED BY MULTIPLIER K OR M.
CAPACITOR VALUES IN F UNLESS FOLLOWED BY MULTIPLIER U, N OR P INDUCTANCE VALUES IN H UNLESS FOLLOWED BY MULTIPLIER M OR U.

NOTE: PRINTED COILS ON PWB.

RECEIVER FRONT END MODULE
19D902782G2

(19D903717, Sh. 1, Rev. 1)

RECEIVER FRONT END MODULE
19D902782G1 136 to MHz
19D902782G2 150.8 to 174 MHz
ISSUE 2

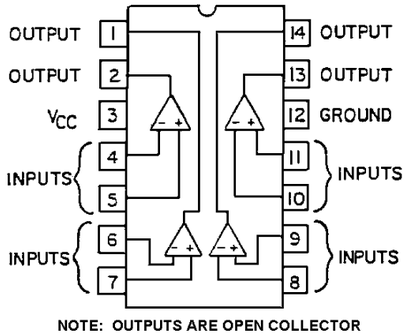
SYMBOL	PART NUMBER	DESCRIPTION
2	19D902508P2	Chassis.
3	19D902490G1	Receiver Front End Board (used in Group 1). (See below.)
4	19D902555P1	Handle.
5	19D902534P1	RF Cover.
6	19A702381P1506	Screw, thread forming: TORX, No. M3.5 - 0.6 X 6.
7	19A702381P1513	Screw, thread forming: TORX, No. M3.5 - 0.6 X 13.
11	19A702381P1508	Screw, thread forming: TORX, No. M3.5 - 0.6 X 8.
14	19D902490G2	Receiver Front End Board (used in Group 2). (See below.)
19	19D902467P1	Casting.
20	19B800701P2	Tuning screw.
21	19A701800P1	Stop nut.
		RECEIVER FRONT END BOARD 19D902490G1 136-151 MHz
		— — — CAPACITORS — — —
C1	19A702061P7	Ceramic: 3.3 pF ±0.5 pF, 50 VDCW, temp coef 0 ±120 PPM/°C.
C2 thru C4	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C5	19A702061P7	Ceramic: 3.3 pF ±0.5 pF, 50 VDCW, temp coef 0 ±120 PPM/°C.
C6	19A702061P17	Ceramic: 12 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C7	19A702061P13	Ceramic: 10 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C8	19A702061P27	Ceramic: 20 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C9	19A702061P25	Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C10	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C11	19A702061P25	Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C12	19A702061P45	Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C13	19A702061P7	Ceramic: 3.3 pF ±0.5 pF, 50 VDCW, temp coef 0 ±120 PPM/°C.
C14	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C15	19A702061P25	Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C16	19A702061P13	Ceramic: 10 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C17	19A702061P9	Ceramic: 4.7 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C.
C18	19A702061P53	Ceramic: 68 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C19	19A702061P41	Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C20	19A702061P17	Ceramic: 12 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C21	19A702061P49	Ceramic: 56 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C22 thru C28	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
		— — — — DIODES — — — — —
CR1	344A3062P1	Schottky.
CR2	19A703595P10	Diode, Optoelectronic. Red LED in right angle housing; sim to Hewlett Packard HLMP-1301-010.
		— — — — — JACKS — — — — —
J1	19B801587P7	Connector, 2 part DIN.
J2 thru J4	19A115938P24	Connector, receptacle.
		— — — — INDUCTORS — — — —
L1 and L2	19B800761P4	Coil, RF.
L3	19B800761P5	Coil, RF.
L4 and L5	19B800761P4	Coil, RF.
L6	19A705470P2	Coil, fixed: 12 nH.
L7	19A705470P25	Coil, fixed: 1 µH ±20%.
L8	19A705470P8	Coil, fixed: 39 nH.
L9	19A705470P9	Coil, fixed: 47 nH.
L10	19A705470P7	Coil, fixed: 33 nH.
L11	19A705470P10	Coil, fixed: 56 nH.
L12	19A705470P25	Coil, fixed: 1 µH ±20%.
L13	19A705470P9	Coil, fixed: 47 nH.
L14	19A705470P8	Coil, fixed: 39 nH.
L15	19A705470P10	Coil, fixed: 56 nH.
L16	19A705470P8	Coil, fixed: 39 nH.
L17	19A705470P12	Coil, fixed: 82 nH.
L18	19A705470P25	Coil, fixed: 1 µH ±20%.
L19	19A705470P11	Coil, fixed: 68 nH.
L20	19A705470P25	Coil, fixed: 1 µH ±20%.
		— — — TRANSISTORS — — —
Q1	344A3058P1	Silicon, NPN.
Q2	19A700059P2	Silicon, PNP.
Q3	19A704708P3	Silicon, NPN.
Q4	19A700059P2	Silicon, PNP.
Q5 and Q6	19A700076P2	Silicon, NPN.
		— — — — RESISTORS — — — —
R1	19B800607P100	Metal film: 10 ohms ±5%, 1/8 w.
R2	19B800607P471	Metal film: 470 ohms ±5%, 1/8 w.
R3	19B800607P223	Metal film: 22K ohms ±5%, 1/8 w.
R4	19B800607P122	Metal film: 1.2K ohms ±5%, 1/8 w.
R5	19B800607P331	Metal film: 330 ohms ±5%, 1/8 w.
R6	19B800607P470	Metal film: 47 ohms ±5%, 1/8 w.
R7	19B800607P100	Metal film: 10 ohms ±5%, 1/8 w.
R8	19B800607P391	Metal film: 390 ohms ±5%, 1/8 w.
R9	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R10	19B800607P392	Metal film: 3.9K ohms ±5%, 1/8 w.
R11	19B800607P272	Metal film: 2.7K ohms ±5%, 1/8 w.
R12	19B800607P680	Metal film: 68 ohms ±5%, 1/8 w.
R13	19B800607P100	Metal film: 10 ohms ±5%, 1/8 w.
R14	19B800607P391	Metal film: 390 ohms ±5%, 1/8 w.
R15	19B800607P562	Metal film: 5.6K ohms ±5%, 1/8 w.
R16	19B800607P183	Metal film: 18K ohms ±5%, 1/8 w.
R17	19B800607P333	Metal film: 33K ohms ±5%, 1/8 w.
R18	19B800607P822	Metal film: 8.2K ohms ±5%, 1/8 w.
R19 and R20	19B800607P333	Metal film: 33K ohms ±5%, 1/8 w.
R21	19B800607P104	Metal film: 100K ohms ±5%, 1/8 w.
R22	19B800607P273	Metal film: 27K ohms ±5%, 1/8 w.
R23	19B800607P391	Metal film: 390 ohms ±5%, 1/8 w.
R24	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R25	19B800607P682	Metal film: 6.8K ohms ±5%, 1/8 w.
R26 and R27	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R28	19B800607P1	Metal film: 0 ohms.
R29		Not used.
R30	19B800607P470	Metal film: 47 ohms ±5%, 1/8 w.
		— — TRANSFORMERS — — —
T1 and T2	344A3063P1	Transformer, Balum.
		— INTEGRATED CIRCUITS —
U1	19A704125P1	Linear: Quad Comparator; sim to LM339D.
		RECEIVER FRONT END BOARD 19D902490G2 150.8 - 174 MHz
		— — — CAPACITORS — — —
C1	19A702061P7	Ceramic: 3.3 pF ±0.5 pF, 50 VDCW, temp coef 0 ±120 PPM/°C.
C2 thru C4	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C5	19A702061P7	Ceramic: 3.3 pF ±0.5 pF, 50 VDCW, temp coef 0 ±120 PPM/°C.
C6	19A702061P33	Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C7	19A702061P12	Ceramic: 8.2 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C8	19A702061P33	Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C9	19A702061P29	Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C10	19A702061P45	Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C11	19A702061P45	Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C12	19A702061P45	Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C13	19A702061P7	Ceramic: 3.3 pF ±0.5 pF, 50 VDCW, temp coef 0 ±120 PPM/°C.
C14	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C15	19A702061P13	Ceramic: 10 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C16	19A702061P12	Ceramic: 8.2 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C17	19A702061P29	Ceramic: 22 pF ±0.5 pF, 50 VDCW, temp coef 0 ±60 PPM/°C.
C18 and C19	19A702061P13	Ceramic: 10 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C
C20	19A702061P37	Ceramic: 33 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C21	19A702061P53	Ceramic: 68 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C22	19A702061P29	Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C23	19A702061P25	Ceramic: 18 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C24	19A702061P49	Ceramic: 56 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C25	19A702061P45	Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C26 thru C32	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
		— — — DIODES — — — —
CR1	344A3062P1	Schottky.
CR2	19A703595P10	Diode, Optoelectronic. Red LED in right angle housing; sim to Hewlett Packard HLMP-1301-010.
		— — — JACKS — — — —
J1	19B801587P7	Connector, 2 part DIN.
J2 thru J4	19A115938P24	Connector, receptacle.
		— — INDUCTORS — — —
L1 and L2	19B800761P1	Coil, RF.
L3	19B800761P2	Coil, RF.
L4 and L5	19B800761P1	Coil, RF.
L6	19A705470P2	Coil, fixed: 12 nH.
L7	19A705470P25	Coil, fixed: 1 µH ±20%.
L8	19A705470P8	Coil, fixed: 39 nH.
L9	19A705470P10	Coil, fixed: 56 nH.
L10	19A705470P15	Coil, fixed: 150 nH.
L11	19A705470P12	Coil, fixed: 82 nH.
L12	19A705470P24	Coil, fixed: 820 nH.
L13	19A705470P11	Coil, fixed: 68 nH.

*COMPONENTS, ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	PART NUMBER	DESCRIPTION
L14	19A705470P25	Coil, fixed: 1 µH ±20%.
L15	19A705470P9	Coil, fixed: 47 nH.
L16	19A705470P9	Coil, fixed: 47 nH.
L17	19A705470P6	Coil, fixed: 27 nH.
L18	19A705470P9	Coil, fixed: 47 nH.
L19	19A705470P14	Coil, fixed: 120 nH.
L20	19A705470P24	Coil, fixed: 820 nH.
L21	19A705470P25	Coil, fixed: 1 µH ±20%.
		—— TRANSISTORS ———
Q1	344A3058P1	Silicon, NPN.
Q2	19A700059P2	Silicon, PNP.
Q3	19A704708P3	Silicon, NPN.
Q4	19A700059P2	Silicon, PNP.
Q5 and Q6	19A700076P2	Silicon, NPN.
		—— RESISTORS ———
R1	19B800607P100	Metal film: 10 ohms ±5%, 1/8 w.
R2	19B800607P471	Metal film: 470 ohms ±5%, 1/8 w.
R3	19B800607P223	Metal film: 22K ohms ±5%, 1/8 w.
R4	19B800607P122	Metal film: 1.2K ohms ±5%, 1/8 w.
R5	19B800607P331	Metal film: 330 ohms ±5%, 1/8 w.
R6	19B800607P470	Metal film: 47 ohms ±5%, 1/8 w.
R7	19B800607P100	Metal film: 10 ohms ±5%, 1/8 w.
R8	19B800607P391	Metal film: 390 ohms ±5%, 1/8 w.
R9	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R10	19B800607P392	Metal film: 3.9K ohms ±5%, 1/8 w.
R11	19B800607P272	Metal film: 2.7K ohms ±5%, 1/8 w.
R12	19B800607P680	Metal film: 68 ohms ±5%, 1/8 w.
R13	19B800607P100	Metal film: 10 ohms ±5%, 1/8 w.
R14	19B800607P391	Metal film: 390 ohms ±5%, 1/8 w.
R15	19B800607P562	Metal film: 5.6K ohms ±5%, 1/8 w.
R16	19B800607P183	Metal film: 18K ohms ±5%, 1/8 w.
R17	19B800607P333	Metal film: 33K ohms ±5%, 1/8 w.
R18	19B800607P822	Metal film: 8.2K ohms ±5%, 1/8 w.
R19 and R20	19B800607P333	Metal film: 33K ohms ±5%, 1/8 w.
R21	19B800607P104	Metal film: 100K ohms ±5%, 1/8 w.
R22	19B800607P273	Metal film: 27K ohms ±5%, 1/8 w.
R23	19B800607P391	Metal film: 390 ohms ±5%, 1/8 w.
R24	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R25	19B800607P682	Metal film: 6.8K ohms ±5%, 1/8 w.
R26 and R27	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.

SYMBOL	PART NUMBER	DESCRIPTION
R28	19B800607P1	Metal film: 0 ohms.
R29	19B800607P470	Metal film: 47 ohms ±5%, 1/8 w.
R30	19B800607P470	Metal film: 47 ohms ±5%, 1/8 w.
		—— TRANSFORMERS ———
T1 and T2	344A3063P1	Transformer, Balum.
		INTEGRATED CIRCUITS ——
U1	19A704125P1	Linear: Quad Comparator; sim to LM339D.

U1
19A704125P1
Quad Operational Amplifier



NOTE: OUTPUTS ARE OPEN COLLECTOR