MAINTENANCE MANUAL FOR 25kHz RECEIVER IF MODULE 19D902783G1

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DESCRIPTION

The MASTR III Receiver IF Module provides amplification and demodulation of the 21.4 MHz Intermediate Frequency signal. The IF Module also includes the receiver squelch circuitry. However, it does not include deemphasis or squelch audio gating circuits. Figure 1 is a block diagram showing the functional operation of the IF Module.

The IF Module circuitry contains the following:

- A 50 ohm input impedance matching network and IF Amplifier
- A chain of two crystal filters and two integrated circuit IF amplifiers
- An integrated circuit containing a crystal oscillator, mixer, limiter, and quadrature detector
- A variable gain AF amplifier
- A squelch circuit
- A fault detector circuit
- An integrated circuit voltage regulator

ERICSSON

Ericsson Inc.
Private Radio Systems
Mountain View Road
Lynchburg, Virginia 24502
1-800-528-7711 (Outside USA, 804-592-7711)

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CIRCUIT ANALYSIS

INPUT MATCHING NETWORK

The input impedance matching network provides a 50 ohm load for the receiver RF module. The network consists of C1 thru C3, L1 thru L3, and R1.

Capacitor C1 provides AC coupling and a DC block on the input line (J1). This DC block protects the module in the event of a failure in a preceding module. L2 and L3 are series resonant at 21.4 MHz and provide a signal path to the FET amplifier Q6. Parallel resonant circuit, L1 and C2, provide a path to the 50 ohm load, R1, for frequencies other than 21.4 MHz.

CRYSTAL FILTERS, IF AMPLIFIERS

Y1, Y2, U1, U2, and associated circuitry provide IF filtering and amplification at 21.4 MHz. Filters Y1 and Y2 are both 4 pole bandpass filters with a center frequency of 21.4 MHz and a bandwidth of ±6.5 kHz. Amplifiers U1 and U2 are integrated circuit amplifiers. U1 provides 30 dB of gain, U2 provides 18 dB of gain. The amplifiers and filters have terminal impedances of 50 ohms. In circuit gain measurements can be made using a high impedance probe.

Inductors L3, L4 and associated resistors and capacitors provide power supply decoupling. R3 and R7 provide paths to the input of the Fault Detector circuit. These inputs enable the Fault Detector circuit to monitor the DC voltages of U1 and U2.

The RF level detectors consist of transistors Q1 and Q2 along with associated resistors and capacitors. These detectors play no role in the normal operation of the IF Module, but they aid in unit testing and module troubleshooting.

OSCILLATOR/MIXER/DETECTOR

Integrated circuit U3 provides several functions including 2nd mixer, if amplifier and limiter, and quadrature detector.

The 20.945 MHz crystal oscillator provides local oscillator injection to the mixer in U3. This mixer converts the 21.4 MHz IF signal to 455 kHz. C20 and C21 are oscillator feedback capacitors and have been chosen to provide the proper capacitance for crystal Y3. The proper oscillator output level is difficult to measure directly without affecting the oscillation.

A preferable measurement is at TP3 which should read about 50 mV pk. (Measured using a 10 megohm, 11 pF oscilloscope probe.)

The mixer is internally connected to the crystal oscillator. Pins 16 and 3 of U3 are the mixer input and output respectively. Typical mixer conversion gain is about 20 dB. The output of the mixer drives the 4 pole ceramic bandpass filter FL1.

The limiter input is U3 pin 5, but the limiter output is internally connected to the detector and is not externally available.

A received signal strength indicator (RSSI) is provided at U3 Pin 13. This indicator signal is generated within the limiter circuitry and provides an output current proportional to the logarithm of the input signal strength. This current develops a voltage across R18. The voltage varies from about 0.7 Vdc for noise input, to about 1 Vdc for a 12 dB SINAD signal, to a maximum of about 2.7 Vdc for a high signal level (50 dB stronger than that required for 12 dB SINAD).

The quadrature detector provides a demodulated audio frequency output. The input to the detector is internally connected to the limiter and is not externally available. The output of the detector is U3 pin 9. R19 and C28 provide low-pass filtering to remove 455 kHz feedthrough. Ceramic resonator Y4 provides the frequency selective component needed for FM demodulation. Y4 replaces the typical LC resonant circuit found in most quadrature detectors. In contrast to the typical LC network, Y4 requires no adjustment.

The DC supply to U3 is provided through voltage dropping resistor R11 to U3 pin 4. R12 provides a path to the input of the Fault Detection circuit. This enables the Fault Detector to monitor the DC voltage on U3.

AUDIO AMPLIFIER

Operational amplifier U6.3 provides audio frequency amplification. Its gain is set by its associated resistors, including variable resistor VR1. VR1 allows for adjusting the AF output level to 1 Vrms with a standard input signal to the module (1 kHz AF, 3 kHz peak deviation). U6.2 is used as a voltage regulator to provide 4 Vdc for biasing the Operational amplifier.

SQUELCH

Buffer Amplifier

Integrated circuit U6.4 is configured as a unity gain buffer amplifier. It provides a high input impedance to minimize loading of the previous circuits.

TABLE 1 - GENERAL SPECIFICATIONS

ITEM	SPECIFICATION
I.F. frequency	21.4 MHz
Input Impedance	50 ohm
12 dB SINAD	-120.0 dBm
Adj. CH SEL (25 kHz)	-103 dB
Image (20.49 MHz)	-100 dB
3rd order Intercept Pt	23 dBm
Variation of Sensitivity with Signal Frequency	2 kHz
2nd I.F. frequency	455 kHz
2nd L.O. frequency	20.945 MHz
AF output (J2 pin 31C)	1 Vrms adjustable (with standard input signal)
AF output impedance	1k ohm
AF distortion	5%
AF response	
10 Hz	-3 dB
300 Hz	±1 dB
1000 Hz	0 dB reference
3 kHz	±1 dB
Hum & Noise	-55 dB
RSSI output (J2 pin 20C)	0.7 to 2.7 Vdc prop to log (sig level)
RSSI time constant	5 ms
SQ Threshold Sensitivity	-119 dBm
SQ Maximum Sensitivity	-102 dBm
SQ Clipping	3 kHz
SQ Attack	150 ms
SQ Close	250 ms
SQ output (J2 pin 26C)	5V logic (low = squelched)
Fault output (J2 pin 11C)	5V logic (low = fault)
DC Supply	1 Vrms (adjustable)

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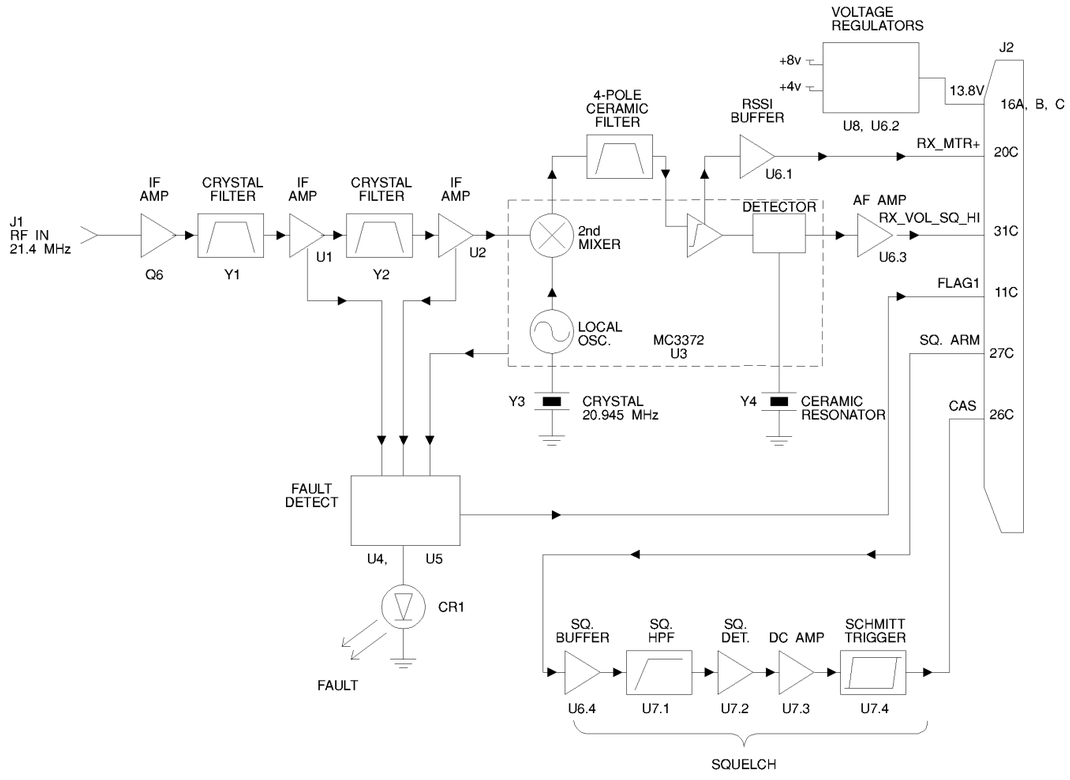


Figure 1 - 25 kHz Receiver IF Module

Highpass Filter

The audio frequency highpass filter consists of U7.1 and its associated circuitry. The purpose of this filter is to reject all voice frequencies and allow only demodulated noise to pass. The functioning of the squelch circuit depends upon the presence or absence of this noise. (When a signal is being received, i.e. the receiver is quiet, the squelch circuit senses the absence of noise and unsquelches the radio.)

Noise Detector

U7.2 along with associated components act as a noise detector. The rectified output of U7.2 charges C44 to a nearly constant DC voltage.

DC Amplifier

U7.3 is configured as a basic amplifier with a gain of 11.

Schmitt Trigger

U7.4 is configured as an amplifier with positive feedback. This arrangement provides hysteresis in the output verses input characteristic. This eliminates the possibility of the squelch circuit repeatedly cutting in and out when the input signal is near a threshold. R56 and R57 act as a voltage divider to provide a 5 volt logic level output. (Logic High = unsqelched)

FAULT DETECTOR

U4 and U5 are voltage comparators. These are configured into four "window detectors" which sense the presence of voltages within specified ranges (windows).

The four window detector circuits are U4.1 & U4.2, U4.4 & U4.3, U5.1 & U5.2, and U5.4 & U5.3. These monitor DC operating voltages on U6.2, U1, U2, and U3 respectively. R29 and R30 comprise a voltage divider to provide a 5 volt logic level output. A fault is indicated when the output drops to zero.

Diode D1 and transistor Q3 monitor the output of the 8V regulator. D1 is a 8.2 volt breakdown diode. If the regulator output voltage should rise above 8.9 V (8.2 + 0.7 base-emitter drop) Q1 will turn on and a fault will be indicated.

Transistors Q4 and Q5 are drivers for the front panel LED CR1. These are powered from the +13.8 Vdc line before the 8V regulator. Therefore, if the regulator opens, a fault will still be indicated.

VOLTAGE REGULATOR

U8 is a monolithic integrated circuit voltage regulator providing 8 Vdc. This powers all circuitry in the module with exception of the front panel LED and its drivers.

MAINTENANCE

RECOMMENDED TEST EQUIPMENT

The following test equipment is required to test the IF Module.

1. FM Signal Generator; HP 8640B, HP 8657A, or equivalent
2. AF Generator or Function Generator
3. Audio Analyzer; HP 8903B, HP 339A, or equivalent
4. Oscilloscope
5. DC Meter for troubleshooting
6. Power Supply; 13.8 Vdc @ 150 mA

ALIGNMENT PROCEDURE

1. Apply 13.8 Vdc supply to module.
2. Verify DC current consumption is between 90 and 150 mA.
3. Verify fault output is 0 to 0.5 Vdc and front panel LED is off.
4. Apply a standard input signal to the module input. (-60 dBm, 21.4 MHz signal modulated with 1kHz AF, 3 kHz peak deviation)
5. Set VR1 for 1 Vrms ±3% at module output (pin 31C on 96 pin connector J2).

TROUBLESHOOTING

Each IF amplifier has a nominal 18 dB gain. U2 has a nominal gain of 30 dB. The mixer has about 20 dB gain with proper LO injection. The proper crystal oscillator level is 50 mV pk measured at TP3.

The following four test points are provided on the PWB for additional test capability:

TP1: 100 mV pk @ 21.4 MHz with -30 dBm input signal

TP2: 100 mV PK @ 21.4 MHz with -50 dBm input signal

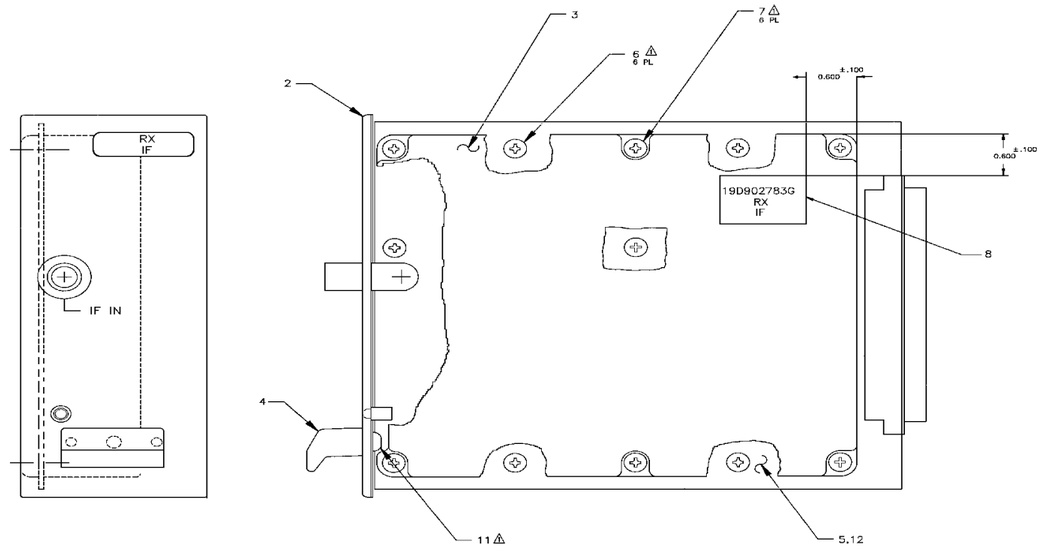
TP3: 50 mV pk @ 20.945 MHz independent of input signal

TP4: 100 mV pk @ 455 kHz with -60 dBm input signal

All RF voltages measured with 10 Megohm, 11 pF probe.

TROUBLE SHOOTING GUIDE

SYMPTOM	CHECK (CORRECT READING SHOWN)	INCORRECT READING INDICATES DEFECTIVE COMPONENT
Fault indicator on	Check DC voltages +8V at U8 Pin 1 +4v at U Pin 7 5.5V at U1 output pin 3.3V at 2 output pin 4.4V at U3 Pin 4	If DC voltages not correct U8 or associated components U6 or associated components U1 or associated components U2 or associated components U3 or associated components If DC voltages correct U4, U5, U6, D1, Q3, Q4, Q5
No audio - no noise	With no signal applied to module IF input Check for AF noise @ C29 ; 200mV Check for AF noise @ U6 Pin 8: 1 V	 U3 or associated components U6 or associated components
Noise only - no demodulated audio	Check crystal oscillator: TP3 50 mVpk 20.945 MHz Apply -30 dBm 21.4 MHz input, check TP1 100 mVpk Apply -50 dBm 21.4 MHz input, check TP2 100 mVpk Apply -60 dBm 21.4 MHz input, check TP4 100 mVpk	U3, Y3 or associated components Q6, Y1, U1 or associated components U2, Y2 or associated components U3, FL1 or associated components
Poor 12 dB SINAD	Check crystal oscillator: TP3 50 mVpk 20.945 MHz Apply -30 dBm 21.4 MHz input, check TP1 100 mVpk Apply -50 dBm 21.4 MHz input, check TP2 100 mVpk Apply -60 dBm 21.4 MHz input, check TP4 100 mVpk	U3, Y3 or associated components Q6, Y1, U1 or associated components U2, Y2 or associated components U3, FL1 or associated components
No squelch function	With squelch pot maximum, or with module AUDIO/ SQUELCH/HI connected to SQUELCH/ARM input and with no signal to module IF input: Check Presence of 1 Vpk noise at U6 Pin 14	U6 or associated components
	Check presence of 1 Vpk noise U7 at Pin 1 Check presence of 1 Vpk noise U7 Pin 1 Check DC voltage U7 at Pin 8: 7 V Check DC voltage U7 Pin 14: 0.5 V	U7 or associated components

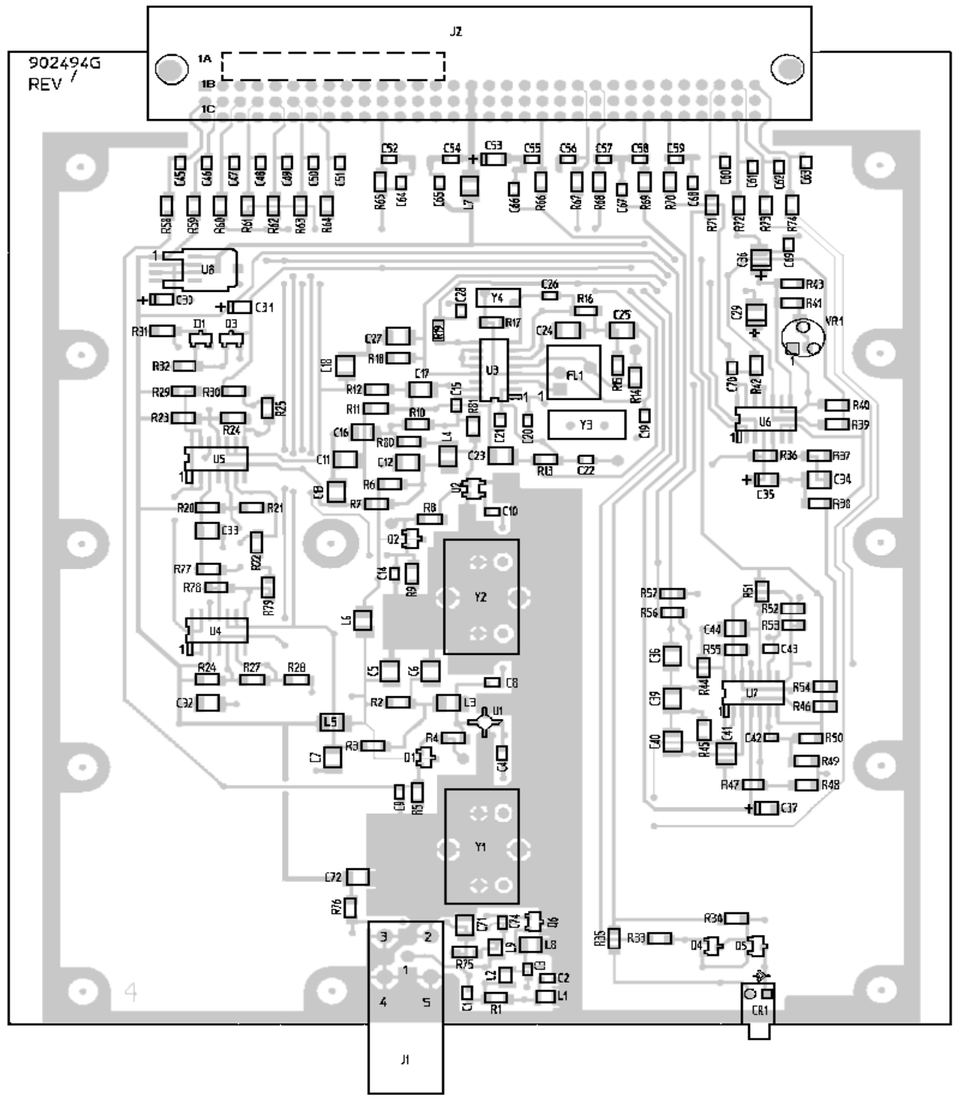


1 NOTES:

⚠1 TORQUE SCREWS, ITEMS 6 AND 7, TO 10.0 ± 1.3 INCH POUNDS.
TORQUE SCREW ITEM 11 TO 20 ± 1.3 INCH POUNDS.

RECEIVER IF MODULE
19D902783G1

(19D902783, Sh. 1, Rev. 3)



LEAD IDENTIFICATION FOR D1 (SOT) DIODES

(TOP VIEW)

LEAD IDENTIFICATION FOR Q1-Q5 (SOT) TRANSISTORS

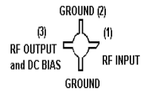
(TOP VIEW)

LEAD IDENTIFICATION FOR Q6 (SOT) TRANSISTORS

(TOP VIEW)

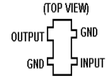
LEAD IDENTIFICATION FOR U1

(TOP VIEW)



LEAD IDENTIFICATION FOR U2 (SOT) INT CKT

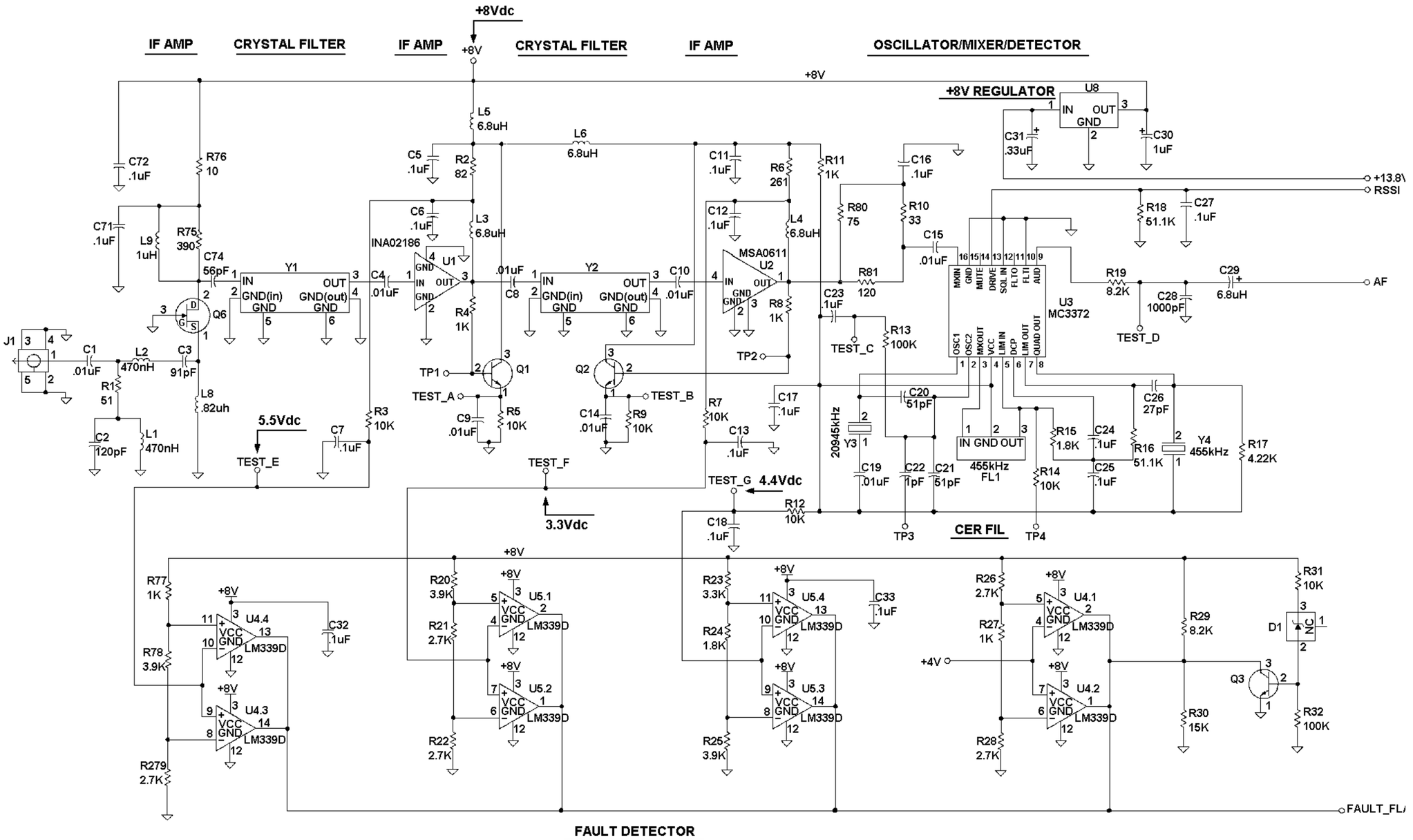
(TOP VIEW)



(19D902494, Sh. 1, Rev. 5B)
(19D902493, Comp. Side, Rev. 5)

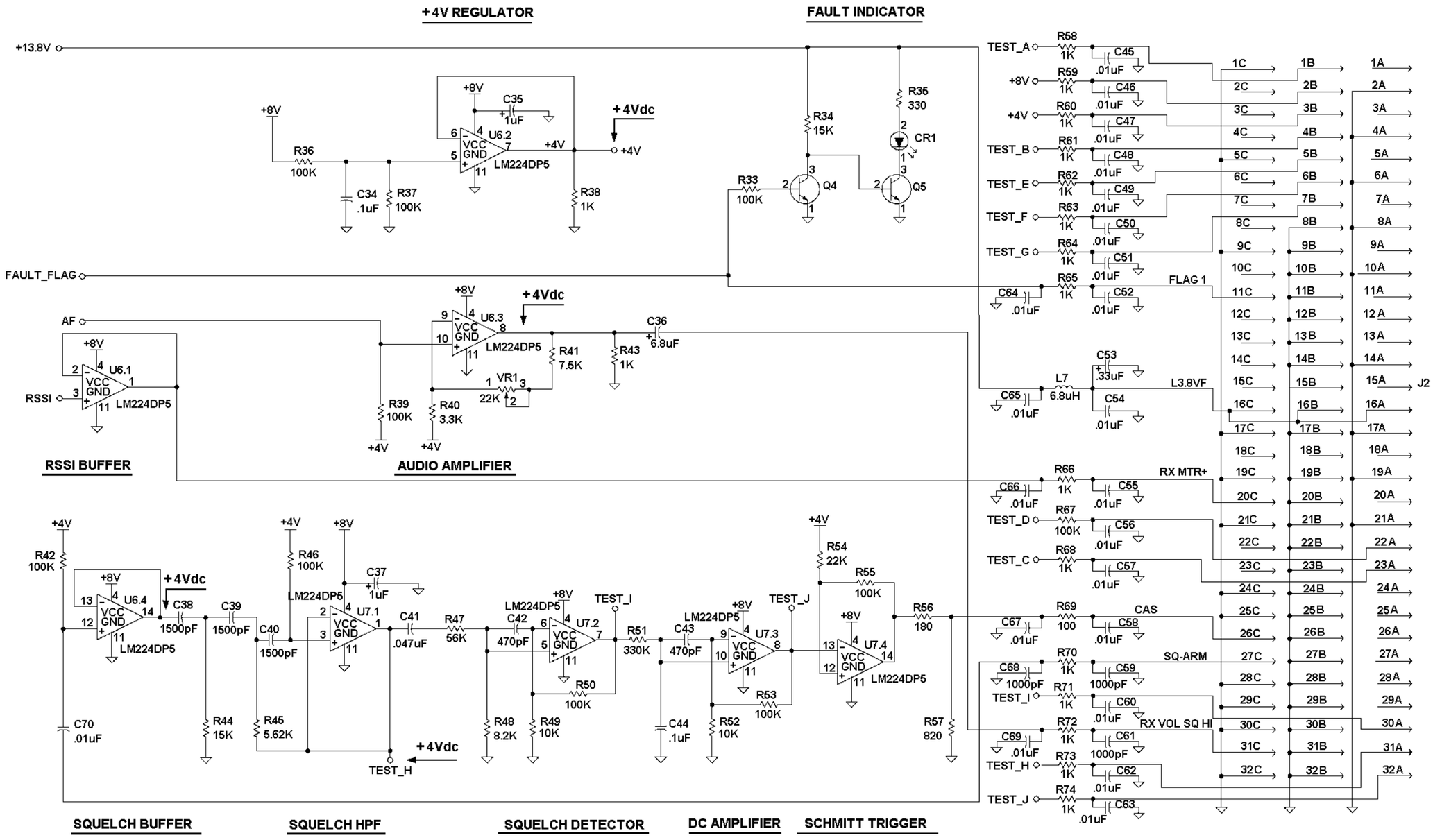
CAUTION
OBSERVE PRECAUTIONS FOR HANDLING
ELECTROSTATIC SENSITIVE DEVICES

RECEIVER IF MODULE
19D902494G1



RECEIVER IF MODULE
19D902494G1

(19D902504, Sh. 1, Rev. 6)



RECEIVER IF MODULE
19D902494G1

(19D902504, Sh. 2, Rev. 6)

VHF RECEIVER RF MODULE
19D902783G1
ISSUE 2

SYMBOL	PART NO.	DESCRIPTION
		- - - - - MISCELLANEOUS - - - -
2	19D902508P1	Chassis.
3	19D902509P1	Cover.
4	19D902555P1	Handle.
6	19A702381P506	Screw, thread forming: TORX, No. M3.5 - 0.6 X 6.
7	19A702381P513	Screw, thread forming: TORX, No. M3.5 - 0.6 X 13.
11	19A702381P508	Screw, thread forming: No. 3.5-0.6 x 8.
		Receiver IF Board 19D902494G1
		- - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C2	19A702236P52	Ceramic: 120 pF, ±5%, 50 VDCW.
C3	19A702236P49	Ceramic: 91 pF, ±5%, 50 VDCW.
C4	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C5 thru C7	19A702052P26	Ceramic: 0.1 µF ±10%, 50 VDCW.
C8 thru C10	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C11 thru C13	19A702052P26	Ceramic: 0.1 µF ±10%, 50 VDCW.
C14 and C15	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C16 thru C18	19A702052P26	Ceramic: 0.1 µF ±10%, 50 VDCW.
C19	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C20 and C21	19A702061P47	Ceramic: 51 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C22	19A702061P1	Ceramic: 1 pF ±0.5 pF, 50 VDCW.
C23 thru C25	19A702052P26	Ceramic: 0.1 µF ±10%, 50 VDCW.
C26	19A702061P33	Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C27	19A702052P26	Ceramic: 0.1 µF ±10%, 50 VDCW.
C28	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C29	19A705205P5	Tantalum: 6.8 µF, 10 VDCW; sim to Sprague 293D.
C30	19A705205P2	Tantalum: 1 µF, 16 VDCW; sim to Sprague 293D.
C31	19A705205P12	Tantalum: .33 µF, 16 VDCW; sim to Sprague 293D.
C32 thru C34	19A702052P26	Ceramic: 0.1 µF ±10%, 50 VDCW
C35	19A705205P2	Tantalum: 1 µF, 16 VDCW; sim to Sprague 293D.
C36	19A705205P5	Tantalum: 6.8 µF, 10 VDCW; sim to Sprague 293D.
C37	19A705205P2	Tantalum: 1 µF, 16 VDCW; sim to Sprague 293D.
C38 thru C40	19A702061P89	Ceramic: 1500 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C41	19A702052P22	Ceramic: 0.047 µF ±10%, 50 VDCW.
C42 and C43	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C44	19A702052P26	Ceramic: 0.1 µF ±10%, 50 VDCW.
C45 thru C52	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C53	19A705205P12	Tantalum: .33 µF, 16 VDCW; sim to Sprague 293D.
C54 thru C58	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C59	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C60	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C61	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C62 thru C67	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C68	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C69 and C70	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C71 and C72	19A702052P26	Ceramic: 0.1 µF ±10%, 50 VDCW.
C74	19A702061P49	Ceramic: 56 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
		- - - - - - - - - - - DIODES - - - - - - - - - - -
CR1	19A703595P10	Optoelectronic: Red LED in right angle housing; sim to HP HLMP-1301-010.
D1	19A700083P105	Zener: 8.2V; sim to BZX84-C8V2.
		- - - - - - - - - - - FILTERS - - - - - - - - - - -
FL1	19A702171P3	Bandpass Filter: Fc = 455 kHz, 6dB BW = ±7.5 kHz; sim to Murata CFU455E2.
J1	19A115938P24	Connector, receptacle.
		- - - - - - - - - - - JACKS - - - - - - - - - - - -
J2	19B801587P7	Connector, DIN: 96 male contacts, right angle mounting; sim to AMP 650887-1.
		- - - - - - - - - - -INDUCTORS - - - - - - - - - - -
L1 and L2	19A700021P13	Coil, fixed: 470 nH.
L3 thru L7	19A705470P35	Coil, fixed: 6.8 µH.
L8	19A705470P24	Coil, fixed: 820 nH.
L9	19A700021P17	Coil, fixed: 1 µH.
		- - - - - - - - TRANSISTORS - - - - - - - - -
Q1 and Q2	19A704708P2	Silicon, NPN: sim to NEC 2SC3356.
Q3 thru Q5	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
Q6	19A702524P2	N-Type, field effect.
		- - - - - - - - - RESISTORS - - - - - - - - - -
R1	19B800607P510	Metal film: 51 ohms ±5%, 1/8 w.
R2	19B800607P820	Metal film: 82 ohms ±5%, 1/8 w.
R3	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R4	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R5	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R6	19A702931P141	Metal film: 261 ohms ±1%, 200 VDCW, 1/8 w.
R7	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R8	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R9	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R10	19B800607P330	Metal film: 33 ohms ±5%, 1/8 w.
R11	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R12	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R13	19B800607P104	Metal film: 100K ohms ±5%, 1/8 w.
R14	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R15	19B800607P182	Metal film: 1.8K ohms ±5%, 1/8 w.
R16	19A702931P369	Metal film: 51.1K ohms ±1%, 200 VDCW, 1/8 w.
R17	19A702931P261	Metal film: 4220 ohms ±1%, 200 VDCW, 1/8 w.
R18	19A702931P369	Metal film: 51.1K ohms ±1%, 200 VDCW, 1/8 w.
R19	19B800607P822	Metal film: 8.2K ohms ±5%, 1/8 w.
R20	19B800607P392	Metal film: 3.9K ohms ±5%, 1/8 w.
R21 and R22	19B800607P272	Metal film: 2.7K ohms ±5%, 1/8 w.
R23	19B800607P332	Metal film: 3.3K ohms ±5%, 1/8 w.
R24	19B800607P182	Metal film: 1.8K ohms ±5%, 1/8 w.
R25	19B800607P392	Metal film: 3.9K ohms ±5%, 1/8 w.
R26	19B800607P272	Metal film: 2.7K ohms ±5%, 1/8 w.
R27	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R28	19B800607P272	Metal film: 2.7K ohms ±5%, 1/8 w.
R29	19B800607P822	Metal film: 8.2K ohms ±5%, 1/8 w.
R30	19B800607P153	Metal film: 15K ohms ±5%, 1/8 w.
R31	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R32 and R33	19B800607P104	Metal film: 100K ohms ±5%, 1/8 w.
R34	19B800607P153	Metal film: 15K ohms ±5%, 1/8 w.
R35	19B800607P331	Metal film: 330 ohms ±5%, 1/8 w.
R36 and R37	19B800607P104	Metal film: 100K ohms ±5%, 1/8 w.
R38	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R39	19B800607P104	Metal film: 100K ohms ±5%, 1/8 w.
R40	19B800607P332	Metal film: 3.3K ohms ±5%, 1/8 w.
R41	19A702931P285	Metal film: 7500 ohms ±1%, 200 VDCW, 1/8 w.
R42	19B800607P104	Metal film: 100K ohms ±5%, 1/8 w.
R43	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R44	19B800607P153	Metal film: 15K ohms ±5%, 1/8 w.
R45	19A702931P273	Metal film: 5620 ohms ±1%, 200 VDCW, 1/8 w.
R46	19B800607P104	Metal film: 100K ohms ±5%, 1/8 w.
R47	19B800607P563	Metal film: 68K ohms ±5%, 1/8 w.
R48	19B800607P822	Metal film: 8.2K ohms ±5%, 1/8 w.
R49	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R50	19B800607P104	Metal film: 100K ohms ±5%, 1/8 w.
R51	19B800607P334	Metal film: 330K ohms ±5%, 1/8 w.
R52	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R53	19B800607P104	Metal film: 100K ohms ±5%, 1/8 w.
R54	19B800607P223	Metal film: 22K ohms ±5%, 1/8 w.
R55	19B800607P104	Metal film: 100K ohms ±5%, 1/8 w.
R56	19B800607P181	Metal film: 180 ohms ±5%, 1/8 w.
R57	19B800607P821	Metal film: 820 ohms ±5%, 1/8 w.
R58 thru R66	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R67	19B800607P104	Metal film: 100K ohms ±5%, 1/8 w
R68	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R69	19B800607P101	Metal film: 100 ohms ±5%, 1/8 w.
R70 thru R74	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R75	19B800607P391	Metal film: 390 ohms ±5%, 1/8 w.
R76	19B800607P100	Metal film: 10 ohms ±5%, 1/8 w.
R77	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R78	19B800607P392	Metal film: 3.9K ohms ±5%, 1/8 w.
R79	19B800607P272	Metal film: 2.7K ohms ±5%, 1/8 w.
R80	19B800607P750	Metal film: 75 ohms ±5%, 1/8 w.
R81	19B800607P121	Metal film: 120 ohms ±5%, 1/8 w.
		- - - - - -INTEGRATED CIRCUITS - - - - - -
U1	344A3740P1	Silicon, bipolar.
U2	19A705927P1	Silicon, bipolar.
U3	19A149980P2	Linear: Osc./Mixer/IF/Det./Amp.; sim to MC3372D.
U4 and U5	19A704125P1	Linear: Quad Comparator; sim to LM339D.
U6 and U7	19A701789P5	Linear:Quad Op Amp; sim to LM224D.
U8	19A704971P10	Voltage regulator: 8 Vdc; sim to MC78M08CDT.
		- - - - - - - - VARIABLE RESISTOR - - - - - -
VR1	19B800779P12	Variable resistor: 22k ohms, 0.1 w; sim to Murata RGV4E223.

*COMPONENTS, ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	PART NO.	DESCRIPTION
		- - - - - - - - - - CRYSTALS - - - - - - - - -
Y1	19A149974G7	Filter, crystal: Fc = 21.4 MHz, 3 dB BW = 15.0 kHz. Insertion loss = 2.0 dB max.
Y2	19A149974G8	Filter, crystal: Fc = 21.4 MHz, 3 dB BW = 15.0 kHz. Insertion loss = 3.0 dB max.
Y3	19A702284G5	Quartz crystal unit: 20.945000 MHz ±10 ppm @ 25°C.
Y4	19A149976P1	Fixed: 455 kHz.

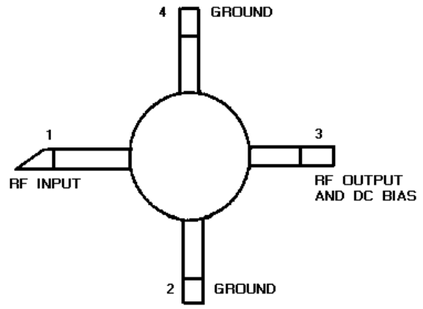
PRODUCTION CHANGES

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.

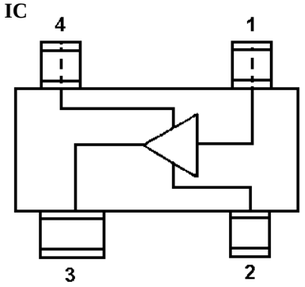
Rev. A - **19D902494G1, 25 kHz IF Module Board**
To improve performance in high temperature environments and to eliminate Audio Level drifting, changed voltage regulator U8 and variable resistor VR1.
U8 was: 19A704971P11, 8 Vdc; sim to MC78L08ACD.
VR1 was: 19A705496P5 20K ohms 0.1w; sim to Murata RGV4E203.

Rev. B - **19D902494G1, 25 kHz IF Module Board**
To change Squelch Driver operation to allow compatibility with GETC, changed resistors R56, R57, and R69.
R56 was: 19B800607P182 Metal film: 1.8K ohms ±5%, 1/8 w.
R57 was: 19B800607P822 Metal film: 8.2K ohms ±5%, 1/8 w.
R69 was: 19B800607P102 Metal film: 1K ohms ±5%, 1/8 w.

U1
344A3740P1
Silicon Bipolar IC

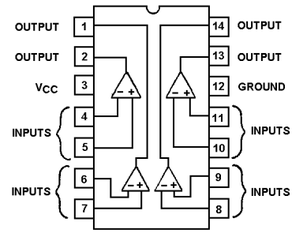


U2
19A705927P1
Silicon Bipolar IC

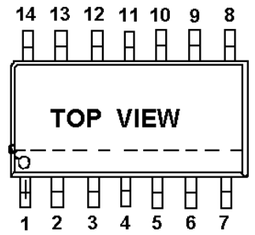


PIN 1. RF INPUT
2. GROUND
3. RF OUTPUT AND BIAS
4. GROUND

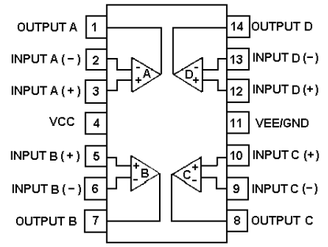
U4 & U5
19A704125P1
Quad Comparator



NOTE: OUTPUTS ARE OPEN COLLECTOR

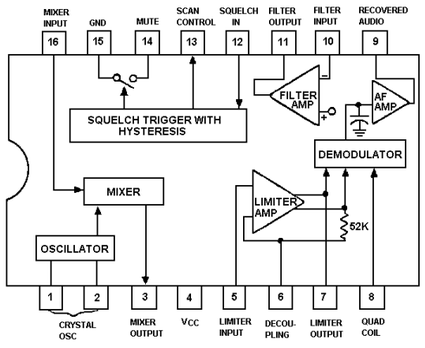


U6 & U7
19A701789P4
Quad Op-Amp

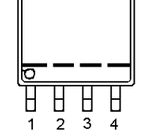


U3
19A149980P2
FM Receiver

PIN CONFIGURATION



U8
19A704971P10
Voltage Regulator

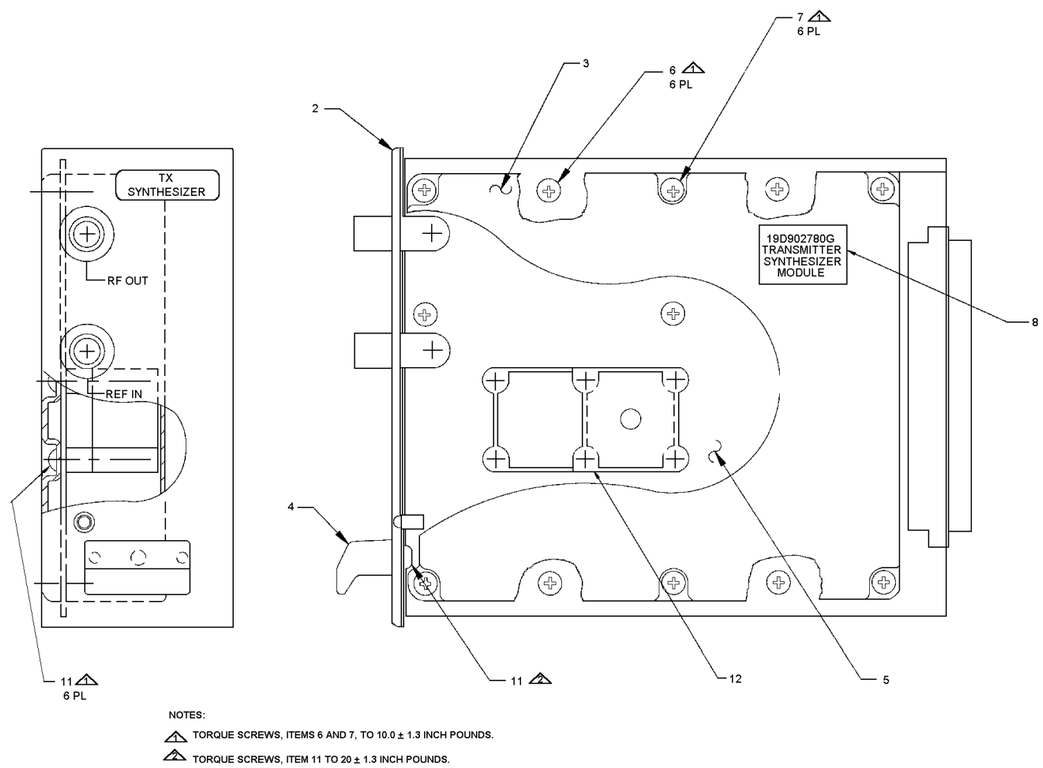


PIN	FUNCTION
1	Vout
2	GROUND
3	GROUND
4	N.C.
5	N.C.
6	GROUND
7	GROUND
8	Vin

MAINTENANCE MANUAL
FOR
UHF TRANSMITTER SYNTHESIZER MODULE
19D902780G3, G6 - G10

TABLE OF CONTENTS

ASSEMBLY DIAGRAM



NOTES:
1. TORQUE SCREWS, ITEMS 6 AND 7, TO 10.0 ± 1.3 INCH POUNDS.
2. TORQUE SCREWS, ITEM 11 TO 20 ± 1.3 INCH POUNDS.

UHF TRANSMITTER SYNTHESIZER MODULE 19D902780G3, G6 - G10

(19D902780, Sh. 1, Rev. 5)

ERICSSON

Ericsson Inc.
Private Radio Systems
Mountain View Road
Lynchburg, Virginia 24502
1-800-528-7711 (Outside USA, 804-592-7711)

Printed in U.S.A.

TABLE 1 - GENERAL SPECIFICATIONS

ITEM	SPECIFICATION
FREQUENCY RANGE	450-470 MHz (G3) 425-450 MHz (G7) 403-430 MHz (G6) 380-400 MHz (G8) 470-494 MHz (G9) 490-512 MHz (G10)
CHANNEL SPACING	6.25 kHz
RF POWER OUT (50 Ohm load)	10 to 13 dBm (10 to 20 mW)
RF HARMONICS	< -30 dBc
NON-HARMONIC SPURS 1 to 200 MHz 200 MHz to 1 GHz	 < - 90 dBc < - 60 dBc
CARRIER ATTACK TIME	<25 mSec
REFERENCE INPUT input level input impedance frequency	 0 dBm ±1.5dB 50 Ohm 5 to 17.925 MHz (must be integer divisible by channel spacing)
MODULATION SENSITIVITY	5 kHz peak dev/1 Vrms, Adjustable
AF INPUT IMPEDANCE	600 Ohm
AF RESPONSE 10 Hz 1000 Hz0 dB reference 3 kHz	 ±1.5 dB ±1.5 dB
10 Hz SQUARE WAVE MODULATION Sq wave droop	<10%
HUM & NOISE	-55 dB
POWER REQUIREMENTS	13.8 Vdc @ 275 mA -12.0 Vdc @ 10 mA

DESCRIPTION

The principle function of the Transmitter Synthesizer Module is to provide the RF excitation for input to the MASTR III station power amplifier. The output of the synthesizer is a frequency modulated signal at the desired frequency. The module contains the following functional blocks:

- A voltage controlled oscillator.
- Frequency Doubler (Multiplier).
- A chain of integrated circuit RF Amplifiers.
- A reference buffer amplifier.
- Dual modulus prescaler and synthesizer integrated circuits.
- Loop amplifiers and passive loop filter.
- An audio amplifier and a pre-modulation integrator.
- IC voltage regulators for +5 and -5 Vdc. A discrete component regulator for +8 Vdc, and an Operational Amplifier regulator for +4 Vdc.
- Logic circuitry: address decoder, input signal gates, and a lock indicator circuit.

CIRCUIT ANALYSIS

VOLTAGE CONTROLLED OSCILLATOR

Transistor Q1 and associated circuitry comprise a low noise Voltage Controlled Oscillator (VCO). Inductor L1 and associated capacitors form the oscillator resonant circuit (tank). The noise characteristic of this oscillator is dependent on the Q of this resonant circuit. The components used in the tank are specified to have especially high Q. Diode D1 aids in setting the bias point for low noise operation. (Any field replacement of oscillator parts should use identical parts).

Variable Capacitor C10 sets the fixed capacitance in the tank, and therefore sets the frequency range over which the oscillator can be voltage tuned.

The oscillator frequency is voltage tuned by the signal applied through R5 and L5 to the two varicap diodes D2 and D3. Additionally, audio modulation is applied as an AF voltage to the two varicap diodes. This RF voltage varies the oscillator frequency at an audio rate (i.e., it frequency modulates the oscillator). Low frequency audio is applied along with the varicap control voltage through R5 and L5 while high frequency audio (MOD) is applied via C16.

Resistors R6 through R9 provide a two volt negative bias on the varicap diodes.

Transistors Q101 and Q102 and associated circuitry form the oscillator enable switch. This switch allows the station control circuitry to turn the VCO ON or OFF via the ANT_REL line. Setting the ANT_REL line to a logic low causes Q102 to conduct. The five (5) volt output at Q102 collector (OSCON) enables the fault indicator gates, U705-3 and U705-4, and turns on Q101. Q101 starts to conduct, providing a ground path for Q1. This turns ON the VCO.

FREQUENCY DOUBLER

Transistors Q801 and Q802 form a buffer stage to drive transistor multiplier Q803. The buffer isolates VCO Q1 from loading effects which could degrade oscillator loaded Q and hence noise performance. Transistor multiplier Q803 is tuned to pass the second harmonic of the VCO output and serves as a frequency doubler. Tank elements L802, C812-C814 and L803 form a resonant circuit and matching network to drive resistive splitter R201-R204.

RF AMPLIFIERS

The RF chain begins with resistive splitter R201-R204 and R216-R218. The output of the splitter at R203 is attenuated by 10 dB and provides impedance matching helical filter FL201, which is tuned to pass the fundamental while rejecting harmonics by approximately 40 dB. The output of FL201 is fed thru resistive pad R205-R207 to MMIC Amplifier U201 which operates in compression. U201 drives output amplifier U202 into compression. The output amplifier is followed by a bandpass filter (C208-C210, L203-L205) and resistive attenuators (R210-R215). The final output at the front panel BNC Connector (J2) is nominally 11.5 dBm, and drives the station Power Amp.

The other output of the resistive splitter at R218 is attenuated by 20 dB and drives buffer amp U203 into compression. U203 drives the synthesizer prescaler providing a feedback signal for the synthesizer phase locked loop.

REFERENCE BUFFER AMPLIFIER

Transistor Q401 and associated components comprise a buffer amplifier for the reference oscillator signal. (The reference oscillator signal is produced by the receiver synthesizer module of a MASTR III station.) The 0 dBm reference oscillator signal is fed through the front panel BNC connector J1. Resistor R405 provides a 50 ohm load to the reference oscillator. The output of the Reference Buffer Amplifier is fed directly to the synthesizer integrated circuit. The output level at TP9 is approximately 3 volts peak to peak.

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PRESCALER AND SYNTHESIZER

Integrated circuit U402 is the heart of the synthesizer. It contains the necessary frequency dividers and control circuitry to synthesize output frequencies by the technique of dual modulus prescaling. U402 also contains an analog sample and hold phase detector and a lock detector circuit.

Within the synthesizer (U402) are three programmable dividers which are loaded serially using the CLOCK, DATA, and ENABLE inputs (pins 11, 12, and 13 respectively). A serial data stream (DATA) on pin 12 is shifted into internal shift registers by low to high transitions on the clock input (CLOCK) at pin 11. A logic high (ENABLE) on pin 13 then transfers the program information from the shift registers to the divider latches.

The reference signal is applied to U402 pin 2 and divided by the "R" divider. This divides the reference signal down to a divided reference frequency (F_r). The typical reference frequency is 12.8 MHz and the typical divided reference frequency is 6.25 kHz providing for synthesizer steps of 6.25 kHz for use with both 12.5 kHz and 25 kHz channel spacing. Other channel spacings are possible by providing proper programming.

The "A" and "N" dividers process the loop feedback signal provided by the VCO (by way of the dual modulus prescaler U401). The output of the "N" divider is a divided version of the VCO output frequency (F_v).

Synthesizer U402 also contains logic circuitry to control the dual modulus prescaler U401. If the locked synthesizer output frequency is 450 MHz. The prescaler output nominally will be equal to 3.515625 MHz (450 MHz/128). This frequency is further divided down to F_v by the "N" divider in U402. F_v is then compared with F_r in the phase detector section.

The phase detector output voltage is proportional to the phase difference between F_v and F_r. This phase detector output serves as the loop error signal. This error signal voltage tunes the VCO to whatever frequency is required to keep F_v and F_r locked (in phase).

LOOP BUFFER AMPLIFIERS AND LOOP FILTER

The error signal provided by the phase detector output is buffered by operational amplifiers (op-amp) U501A and U501B. The audio modulation signal from U601B is also applied to the input of U501B. The output of U501B is the sum of the audio modulation and the buffered error signal.

The output of the second buffer (U501B) is applied to a loop filter consisting of R506, R507, R508, C505 and C506. This filter controls the bandwidth and stability of the synthesizer loop. The UHF transmitter synthesizer has a loop bandwidth of only several Hertz. This is very narrow, resulting in an excessively long loop acquisition time. To speed acquisition, switches U502A and U502C bypass the filter circuit whenever an ENABLE pulse is received by the Input Gates.

AUDIO FREQUENCY AMPLIFIER

The transmitter synthesizer audio input line is fed to U601A. U601A is configured as a unity gain op-amp. Resistor R601 sets the 600 ohm input impedance of this amplifier. (NOTE: Data for digital modulation is fed to the synthesizer through the audio input line).

The amplifier output is split into two components and fed to two variable resistors VR601 and VR602. VR601 sets the level in the low frequency audio path and VR602 sets the level in the high frequency audio path. (There is no clear break between the low and high frequency ranges. All voice frequencies are within the high frequency range. The low frequency range contains low frequency data components).

The wiper of VR601 (low frequency path) connects to the input of U601B, the pre-modulation integrator. U601B performs the function of a low-pass filter and integrator. The integrator output is summed with the PLL control voltage at the input of loop buffer amplifier U501B. This integrated audio signal phase modulates the VCO. The combination of pre-integration and phase modulation is equivalent to frequency modulation.

The wiper of VR602 (high frequency path) is connected to the modulation input of the VCO through C16.

VOLTAGE REGULATORS

U301 and U303 are monolithic voltage regulators (+5 Vdc and -5 Vdc respectively). These two voltages are used by synthesizer circuitry. The +5 V regulator output is also used as a voltage reference for the +8 Vdc discrete regulator circuit.

U302A, Q302 and associated circuitry comprise the +8 volt regulator. Most module circuitry is powered from the +8 volt line. The regulator is optimized for especially low noise performance. This is critical because the low noise VCO is powered by the +8 volt line.

The +8 Vdc line also feeds the +4 Vdc regulator, U302B and associated resistors. The +4 Vdc regulator provides a bias voltage for several op-amps in the module.

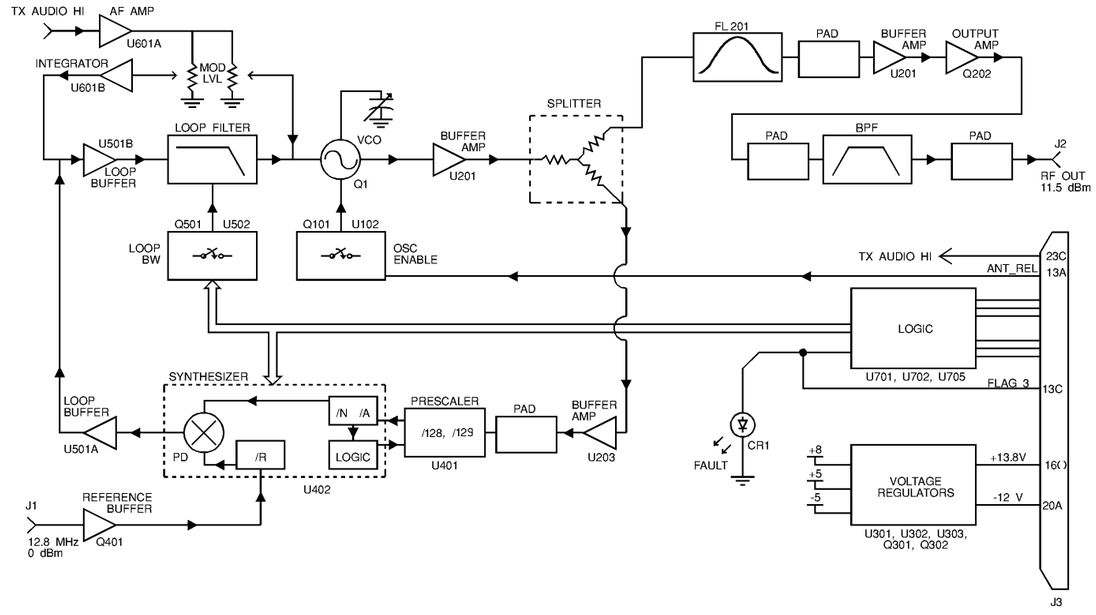


Figure 1 - Block Diagram

LOGIC CIRCUITS

Logic circuitry (other than that inside the synthesizer IC - U402) consists of the following:

- An address decoder
- Input gates and level shifters
- Lock Indicator circuitry

The address decoder, U702, enables the Input Gates when the A0, A1, and A2 input lines receive the proper logic code (110 for the transmitter synthesizer). After receiving the proper code, Y3 (U702-12) sends a logic low signal to U701C. U701C acts as an inverter and uses the logic high output to turn on Input Gates U701A, U701B, and U701D. The Input Gates allow the clock, data and enable information to pass on to the synthesizer via the level shifters. The Level Shifter Transistors Q701, Q702 and Q703 convert the 5 volt gate logic level to the 8 volt logic level required by the synthesizer U402.

The Fault Indicator circuitry indicates when the synthesizer is in an out-of-lock condition. The fault detector latches, U705A and U705B are reset by the enable pulse during initial loading of data into the synthesizer. If at any time afterwards the lock detector signal (LD) goes low, the high output of U705B will cause the output of gates U705C and U705D to go low. The low output from U705C causes Q704 to conduct turning on the front panel LED (CR701). The output of U705D (FLAG) is connected to J3-13C for external monitoring of the Synthesizer Module. A logic low on the FLAG line indicates an out-of-lock condition.

MAINTENANCE

RECOMMENDED TEST EQUIPMENT

The following test equipment is required to test the synthesizer Module:

1. RF signal source for 12.8 MHz, 0 dBm reference (included with item 10)
2. AF Generator or Function Generator
3. Modulation Analyzer; HP 8901A, or equivalent, or a UHF receiver
4. Oscilloscope; 20 MHz
5. DC Meter; 10 meg ohm (for troubleshooting)
6. Power Supply; 13.8 Vdc @ 350 mA
   12.0 Vdc @ 25 mA
7. Spectrum Analyzer; 0-1 GHz
8. Frequency Counter; 10 MHz - 500 MHz
9. Personal Computer (IBM PC compatible) to load frequency data
10. Service Parts Kit, (TQ-0650), (includes software for loading frequency data)

SERVICE NOTES

The following service information applies when aligning, testing, or troubleshooting the TX Synthesizer:

- Standard Modulating Signal = 1 kHz sinusoidal voltage, 0.6 Vrms at the module input terminals (600 ohm R_{in}).
- Logic Levels:
  Logic 1 = high = 4.5 to 5.5 Vdc
  Logic 0 = Low = 0 to 0.5 Vdc
- Transmitter Synthesizer Address = A0 A1 A2 = 110
- Synthesizer data input stream is as follows:

  14-bit "R" divider most significant bit (MSB) = R13 through "R" divider least significant bit (LSB) = R0

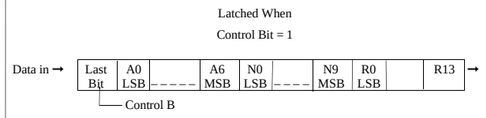
  10-bit "N" divider MSB = N9 through "N" divider LSB = N0

  7-bit "A" divider MSB = A6 through "A" divider LSB = A0

  Single high Control bit (last bit)

  Latched When Control Bit = 1

  DATA ENTRY FORMAT



  For the transmitter synthesizer, 5 kHz channel spacing
  R = 2560
  N = integer part of (frequency in kHz)/(320)
  A = (frequency in kHz)/(5) - 64*N
  All numbers must be converted to binary.
- ANT_REL line must be logic low (0V) in order to lock synthesizer.
- Synthesizer lock is indicated by the extinguishing of the front panel LED indicator and a logic high on the fault flag line (J3 pin 13C).
- Always verify synthesizer lock after each new data loading.

TEST PROCEDURE

(Steps 5, 6, and 7 can be done using a modulation analyzer or UHF receiver with 750 µs de-emphasis switchable in or out.

1. Lock synthesizer at 470.0 (G3), 430 (G6), 450 (G7), 400 (G8), 494 (G9) or 512 (G10) MHz using software provided in the service parts kit.

   Verify lock (flag = high).
   Verify front panel LED is off.

2. Measure output frequency.

   Verify frequency = 470.0000 (G3), 425.000 (G6) or 450.000 (G7) MHz, 400.000 (G8), 494.000 (G9) or 512.000 (G10) ±200 Hz.

3. Measure harmonic content.

   Verify 2nd harmonic is < -30 dBc.

4. Measure RF power output into 50 ohm load.

   Verify 10 to 13 dBm (10 to 20 mW).

5. Measure AF distortion with standard modulating signal input.

   Verify <2.5%.

6. Measure Hum and Noise relative to 0.44 kHz average deviation, (de-emphasis on).

   Verify < -55dB

7. Measure AF response at 300 Hz, 1 kHz (ref) and 3 kHz, (de-emphasis off).

   Verify within ±1.5 dB with respect to 1 kHz reference.

8. Verify lock at different frequencies.

   a. Lock synthesizer at 380 (G8), 450 (G3), 403 (G6), 425 (G7), 470 (G9) or 492 (G10) MHz. Verify LED is off.

   b. Lock synthesizer at 385 (G8), 455 (G3), 408.5 (G6), 430 (G7), 476 (G9) or 497 (G10) MHz. Verify LED is off.

   c. Lock synthesizer at 395 (G8), 465 (G3), 419.5 (G6), 445 (G7), 488 (G9) or 507 (G10) MHz. Verify LED is off.

   d. Lock synthesizer at 400 (G8), 470 (G3), 425 (G6), 450 (G7), 494 (G9) or 512 (G10) MHz. Verify LED is off.

ALIGNMENT PROCEDURE

1. Apply +13.8 Vdc and -12 Vdc. Verify the current drain on the 13.8 volt supply is, <300mA and the current drain on the -12 volt supply is <20 mA.
2. Lock the synthesizer at 380 (G8), 450 (G3), 403 (G6), 425 (G7), 470 (G9) or 492 (G10) MHz. Adjust trimmer C1O until Vtest (23A) reads 2.5 (G3, G8), 2.0 (G6, G7, G9) or 3.0 (G10) V ±0.05V.
3. Lock synthesizer at 460.0 (G3), 390.0 (G8), 414 (G6) or 437.5 (G7), 482 (G9) or 502 (G10) MHz for the following three adjustments.

- Set VR602 for 4.5 kHz peak deviation with a standard modulating signal applied to the audio input.
- Set VR601 for 4.5 kHz peak deviation with 1.0 Vrms, 10 Hz (or 7 Hz for G3) sine wave audio applied to module AF input.
- Apply a 10 Hz 1.4 Vpk square wave to module AF input. Adjust VR601 slightly for the flattest demodulated square wave using a modulation analyzer or receiver (no de-emphasis) and an oscilloscope. The maximum net variation in voltage over 1/2 cycle is 5%.

NOTE

This adjustment is critical for EDACS application and must be reset at customer frequency.

TROUBLESHOOTING

A troubleshooting guide is provided showing typical measurements at the various test points.

TROUBLESHOOTING GUIDE

SYMPTOM	CHECK (CORRECT READINGS SHOWN)	INCORRECT READING INDICATES DEFECTIVE COMPONENT
SYNTHESIZER FAILS TO LOCK	Check DC voltages +5 V @ U301 Pin 1 +8 V @ Q301 collector -5 V @ U303 Pin 1	 U301 or associated components U302, Q301, Q302 or associated components U303 or associated components
	Check 12.8 MHz reference signal 3V P-P, 12.8 MHz @ U402 Pin 2	No reference signal to front panel BNC or Q401
	Check oscillator signal 11.5 ±1.5 dBm 435 to 485 MHz at front panel BNC	Proceed to "Low/No RF output" below
	Check prescaler output IV P-P, 3.5 MHz @ U401 Pin 4	U202, U401
	Check CLOCK, DATA, ENABLE While loading frequency data into synthesizer Check 8V logic signals @ Pins 11, 12, 13 of U402	Wrong address or U701, U702, Q701, Q702, Q703
	Check Phase detector output 6.25 kHz random signal @ U501 Pin 7	U402, U501
Low/No RF Output	Check oscillator LESS than 0.5 Vdc @ collector of Q101 Check RF chain	Synthesizer not keyed (low on ANT relay line) or Q101, Q102
No Modulation	Check AF amplifier Apply IV, 1 kHz signal to TX/Audio/Hi Check IV signal @ U601 Pin 1	U601

UHF TRANSMITTER SYNTHESIZER MODULE
19D902780G3, G6 - G10
ISSUE 9

SYMBOL	PART NO.	DESCRIPTION
		TRANSMITTER SYNTHESIZER BOARD 19D902779G3, G6 - G10
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
2	19D902508P4	Chassis.
3	19D902509P2	Cover.
4	19D902555P1	Handle.
6	19A702381P506	Screw, thread forming: TORX, No. M3.5-.6 x 6.
7	19A702381P513	Screw, thread forming: TORX, No. M3.5 - 0.6 X 13.
11	19A702381P508	Screw, thd. form: No. 3.5-0.6 x 8.
12	19D902824P1	Casting.
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A702236P25	Ceramic: 10 pF + or -.5 pF, 50 VDCW, temp coef + or -30 PPM/°C.
C2	19A702236P32	Ceramic: 18 pF + or -5%, 50 VDCW, temp coef 0 + + or or -30 PPM
C3	19A702236P28	Ceramic: 12 pF + or - 5%, 50 VDCW, temp coef 0 + or -30 PPM.
C4	19A702236P1	Ceramic: 0.5 pF + or - pF, temp coef 0 + or - PPM/°C. (Used in G8).
C4	19A702236P8	Ceramic: 1.5 pF + or -.25 pF, 50 VDCW. (Used in G3, G6, G7)
C4 and C5	19A702236P17	Ceramic: 4.7 pF + or -0.5%, 50 VDCW, temp coef 0 + or -60 PPM. (Used in G9).
C4	19A702236P11	Ceramic: 2.7 pF + or - .25 pF, 50 VDCW, temp coef 0 + or -30 PPM/°C. (Used in G10).
C5	19A702236P17	Ceramic: 4.7 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM. (Used in G3 & G10).
C5	19A702236P17	Ceramic: 4.7 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM. (Used in G6 & G8).
C5	19A702236P15	Ceramic: 3.9 pF + or -.25 pF, 50 VDCW, temp + or -30 PPM/°C. (Used in G7).
C6	19A702236P28	Ceramic: 12 pF + or - 5%, 50 VDCW, temp coef 0 + or -30 PPM. (Used in G8 & G3).
C6	19A702236P30	Ceramic: 15 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C. (Used in G6 & G7).
*C6	19A702236P28	Ceramic: 12 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C. (Used in G9 & G10).
C7	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C8	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C9	19A705205P6	Tantalum: 10 uF, 16 VDCW; sim to Sprague 293D.
C10	19A134227P5	Variable: 1.5 to 14 pF, 100 VDCW.
C11	19A705205P2	Tantalum: 1 uF, 16 VDCW; sim to Sprague 293D.
C12	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C13 and C14	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
*C15	19A700004P6	Metallized polyester: 4.7 uF + or - 10%, 63 VDCW.
*C16	19A702052P106	Ceramic: 1500 pF + or -5%, 50 VDCW.
C17	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C18 and C19	19A705205P2	Tantalum: 1 uF, 16 VDCW; sim to Sprague 293D.
C101	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C102	19A705205P2	Tantalum: 1 uF, 16 VDCW; sim to Sprague 293D.
C103	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.

*COMPONENTS, ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	PART NO.	DESCRIPTION
C201	19A702061P61	Ceramic: 100 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM.
C202	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C203	19A705205P2	Tantalum: 1 uF, 16 VDCW; sim to Sprague 293D.
C204 and C205	19A702061P61	Ceramic: 100 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM.
C206	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C207	19A705205P2	Tantalum: 1 uF, 16 VDCW; sim to Sprague 293D.
C208	19A702236P28	Ceramic: 12 pF + or - 5%, 50 VDCW, temp coef 0 + or -30 PPM.
C209	19A702236P10	Ceramic: 2.2 pF + or -2.5 pF, 50 VDCW, temp + or -30 PPM/°C. (Used in G3, G6, G7, G8).
C209	19A702236P8	Ceramic: 1.5 pF + or -0.25 pF, 50 VDCW, temp + or -30 PPM/°C. (Used in G9 & G10).
C210	19A702236P28	Ceramic: 12 pF + or - 5%, 50 VDCW, temp coef 0 + or -30 PPM.
C211 and C212	19A702061P61	Ceramic: 100 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM.
C213	19A705205P2	Tantalum: 1 uF, 16 VDCW; sim to Sprague 293D.
C214	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C215	19A702061P61	Ceramic: 100 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM.
C301	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C302	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C303 and C304	19A705205P2	Tantalum: 1 uF, 16 VDCW; sim to Sprague 293D.
C305	19A705205P7	Tantalum: 10 uF, 25 VDCW; sim to Sprague 293D.
C306	19A705205P2	Tantalum: 1 uF, 16 VDCW; sim to Sprague 293D.
C307	19A705205P6	Tantalum: 10 uF, 16 VDCW; sim to Sprague 293D.
C308 and C309	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C310	19A705205P6	Tantalum: 10 uF, 16 VDCW; sim to Sprague 293D.
C311	19A705205P2	Tantalum: 1 uF, 16 VDCW; sim to Sprague 293D.
C312	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C313	19A705205P6	Tantalum: 10 uF, 16 VDCW; sim to Sprague 293D.
C401	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C402	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C403 thru C405	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C406	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C407	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C408	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C409	19A705205P6	Tantalum: 10 uF, 16 VDCW; sim to Sprague 293D.
C410	19A702052P26	Ceramic: 0.1uF + or - 10%, 50 VDCW
C411	19A705205P6	Tantalum: 10 uF, 16 VDCW; sim to Sprague 293D.
C412	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C413	19A702052P108	Ceramic: 0.01 uF + or -10%, 50 VDCW.
C414	19A702061P69	Ceramic: 220 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C501	19A705205P2	Tantalum: 1 uF, 16 VDCW; sim to Sprague 293D.
C502	19A705205P2	Tantalum: 1 uF, 16 VDCW; sim to Sprague 293D.
C503	19A702052P33	Ceramic: 0.1 uF + or -10%, 50 VDCW.

SYMBOL	PART NO.	DESCRIPTION
C504	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C505	19A703684P3	Metalized polyester: 2.2 uF + or - 10$, 50 VDCW.
C506	19A703902P3	Metal: 0.047 uF + or -10%, 50 VDCW.
C507	19A702052P33	Ceramic: 0.1 uF + or -10%, 50 VDCW.
C602	19A705205P6	Tantalum: 10 uF, 16 VDCW; sim to Sprague 293D.
C603	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C604	19A705205P2	Tantalum: 1 uF, 16 VDCW; sim to Sprague 293D.
C605	19A703684P3	Metalized polyester: 2.2 uF + or - 10$, 50 VDCW.
C701 thru C712	19A702061P61	Ceramic: 100 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM.
C714 and C715	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C801	19A702061P4	Ceramic: 1.8 pF + or - 0.5 pF, 50 VDCW, temp or - 250 PPM.
C802	19A705205P6	Tantalum: 10 uF, 16 VDCW; sim to Sprague 293D.
C803 and C804	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C805	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C806	19A702061P65	Ceramic: 150 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C807	19A705205P6	Tantalum: 10 uF, 16 VDCW; sim to Sprague 293D.
C808	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C809	19A702061P13	Ceramic: 10 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM.
C810	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C811	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C812	19A702061P13	Ceramic: 3.3 pF + or - 0.25 pF, temp or - 30 PPM/°C. (Used in G8).
C812	19A702061P5	Ceramic: 2.2 pF + or - 0.5 pF, 50 VDCW, temp or - 120 PPM. (Used in G6, G7, G3).
C813 and C814	19A702061P21	Ceramic: 15 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM. . (Used in G6, G7, G3).
C813 and C814	19A702061P32	Ceramic: 18 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM/°C. (Used in G8).
C813 and C814	19A702236P28	Ceramic: 12 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM. . (Used in G9 & G10).
		- - - - - - - - - - DIODES - - - - - - - - - -
CR701	19A703595P10	Optoelectic: Red LED; sim to HP HLMP-1301-010.
D1	19A705377P1	Silicon, Hot Carrier: sim to MMB0201. (Used in G40, G3, G6,
D2 and D3	19A149674P3	High tuning ratio diode: sim to Toko KV1430.
		- - - - - - - - - - FILTERS - - - - - - - - - -
FL201	19A705458P8	Filter: 378-402 MHz; sim to 302MXPR-1785A (Used in G8).
FL201	19A705458P5	Helical, UHF: 424-450 MHz. (Used in G7).
FL201	19A705458P4	Helical, UHF: 403-425 MHz. (Used in G6).
FL201	19A705458P1	Helical, UHF: 450-470 MHz. (Used in G3)
FL201	19A705458P6	Helical, UHF: 492-512 MHz. (Used in G10)
		- - - - - - - - - - JACKS - - - - - - - - - -
J1 and J2	19A115938P24	Connector, receptacle.
J3	19B801587P7	Connector, DIN: 96 male contacts, right angle to AMP 650887-1.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	19C851001P3	Coil, RF: 1 1/2 Turns, sim to Paul Smith SK-901-1. (Used in G8).
L1	19C851001P2	Coil, RF: sim to Paul Smith SK-901-1. (Used in G6).

SYMBOL	PART NO.	DESCRIPTION
L1	19C851001P1	Coil, RF: sim to Paul Smith SK901-1. (Used in G3, G7).
L2	19A705470P28	Coil, Fixed: 1.8 uH; sim to Toko 380LB-1R8M. (Used in G9 & G10).
L2 thru L5	19A705470P24	Coil, Fixed: 0.82 uH; sim to Toko 380NB-R82M. (Used in G3, G6 - G8).
L10	19C851001P4	Coil, RF. (Used in G9, G10).
L201 and L202	19A705470P15	Coil, fixed: 0.15uH; sim to Toko 380NB-R15M.
L203	19A705470P1	Coil, Fixed: 10 nH; sim to Toko 380NB-10nM.
L204	19A705470P10	Coil, fixed: 56 nH; sim to Toko 380NB-56nM.
L205	19A705470P1	Coil, Fixed: 10 nH; sim to Toko 380NB-10nM.
L206	19A705470P15	Coil, fixed: .15uH; sim to Toko 380NB-R15M.
L801 thru L803	19A705470P2	Coil, Fixed: 12 nH; sim to Toko 380NB-12nM.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A702524P2	N-Type, field effect; sim to MMBFU310.
Q101	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
Q102	19A700059P2	Silicon, PNP: sim to MMBT3906, low profile.
Q301	19A134577P2	Silicon, PNP: sim to Phillips BCX51-16.
Q302	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
Q401	19A704708P2	Silicon, NPN: sim to NEC 2SC3356.
Q501	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
Q701 thru Q704	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
Q801 thru Q803	19A704708P2	Silicon, NPN: sim to NEC 2SC3356.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	19B800607P470	Metal film: 47 ohms + or -5%, 1/8 w.
R2	19B800607P183	Metal film: 18K ohms + or -5%, 1/8 w.
R3	19B800607P680	Metal film: 68 ohms + or -5%, 1/8 w.
R4 and R5	19B800607P100	Metal film: 10 ohms + or -5%, 1/8 w.
R6	19B800607P824	Metal film: 820K ohms + or -5%, 1/8 w.
R7	19B800607P104	Metal film: 100K ohms + or -5%, 1/8 w.
R8	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R9	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w. (Used in G9).
R9	19B800607P681	Metal film: 680 ohms + or -5%, 1/8 w.(Used in G3, G7-G8).
R9	19B800607P152	Metal film: 1.5K ohms + or -5%, 1/8 w. (Used in G6).
R101	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R102	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R103	19B800607P473	Metal film: 47K ohms + or -5%, 1/8 w.
R104	19B800607P472	Metal film: 4.7K ohms + or -5%, 1/8 w.
R105	19B800607P392	Metal film: 3.9K ohms + or -5%, 1/8 w.
R201 and R202	19B800607P180	Metal film: 18 ohms + or -5%, 1/8 w.
R203	19B800607P150	Metal film: 15 ohms + or -5%, 1/8 w.
R204	19B800607P101	Metal film: 100 ohms + or -5%, 1/8 w.
R205	19B800607P331	Metal film: 330 ohms + or -5%, 1/8 w.
R206	19B800607P150	Metal film: 15 ohms + or -5%, 1/8 w.
R207	19B800607P331	Metal film: 330 ohms + or -5%, 1/8 w.
R208	19B800607P181	Metal film: 180 ohms + or -5%, 1/8 w.
R209	19B800607P750	Metal film: 75 ohms + or -5%, 1/8 w.
R210	19B800607P331	Metal film: 330 ohms + or -5%, 1/8 w.
*R211	19B800607P120	Metal film: 12 ohms + or -5%, 1/8 w. (Used in G9 & G10)
R211	19B800607P150	Metal film: 15 ohms + or -5%, 1/8 w. (Used in G3, G6-G8)

SYMBOL	PART NO.	DESCRIPTION
R212 and R213	19B800607P331	Metal film: 330 ohms + or -5%, 1/8 w.
*R214	19B800607P120	Metal film: 12 ohms + or -5%, 1/8 w. (Used in G9 & G10)
R214	19B800607P150	Metal film: 15 ohms + or -5%, 1/8 w. (Used in G3, G6-G8)
R215	19B800607P331	Metal film: 330 ohms + or -5%, 1/8 w.
R216	19B800607P510	Metal film: 51 ohms + or -5%, 1/8 w.
R217	19B800607P220	Metal film: 22 ohms + or -5%, 1/8 w.
R218	19B800607P330	Metal film: 33 ohms + or -5%, 1/8 w.
R219	19B800607P181	Metal film: 180 ohms + or -5%, 1/8 w.
R220	19B800607P104	Metal film: 100K ohms + or -5%, 1/8 w.
R221 and R222	19B800607P330	Metal film: 33 ohms + or -5%, 1/8 w.
R301 thru R303	19B800607P100	Metal film: 10 ohms + or -5%, 1/8 w.
R304	19B800607P470	Metal film: 47 ohms + or -5%, 1/8 w.
R305	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R306	19B800607P222	Metal film: 2.2K ohms + or -5%, 1/8 w.
R307	19A702931P230	Metal film: 2000 ohms + or -1%, 200 VDCW, 1/8 w.
R308	19A702931P249	Metal film: 3160 ohms + or -1%, 200 VDCW, 1/8 w.
R309	19B800607P471	Metal film: 470 ohms + or -5%, 1/8 w.
R310	19B800607P470	Metal film: 47 ohms + or -5%, 1/8 w.
R311 and R312	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R401	19B800607P330	Metal film: 33 ohms + or -5%, 1/8 w.
R402	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R403	19B800607P104	Metal film: 100K ohms + or -5%, 1/8 w.
R404	19B800607P561	Metal film: 560 ohms + or -5%, 1/8 w.
R405	19B800607P510	Metal film: 51 ohms + or -5%, 1/8 w.
R406	19B800607P101	Metal film: 100 ohms + or -5%, 1/8 w.
R407	19B800607P104	Metal film: 100K ohms + or -5%, 1/8 w.
R408	19B800607P100	Metal film: 10 ohms + or -5%, 1/8 w.
R409	19B800607P222	Metal film: 2.2K ohms + or -5%, 1/8 w.
R410	19B800607P392	Metal film: 3.9K ohms + or -5%, 1/8 w.
R411	19B800607P562	Metal film: 5.6K ohms + or -5%, 1/8 w.
R412	19B800607P223	Metal film: 22K ohms + or -5%, 1/8 w. (Used IN G3, G6, G7, G8).
R412	19B800607P823	Metal film: 82K ohms + or -5%, 1/8 w. (Used in G9 & G10).
R415	19B800607P100	Metal film: 10 ohms + or -5%, 1/8 w.
R501	19B800607P470	Metal film: 47 ohms + or -5%, 1/8 w.
R502	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R503	19B800607P223	Metal film: 22K ohms + or -5%, 1/8 w.
R504	19B800607P150	Metal film: 15 ohms + or -5%, 1/8 w.
R505	19B800607P104	Metal film: 100K ohms + or -5%, 1/8 w.
R506	19B800607P105	Metal film: 1M ohms + or -5%, 1/8 w.
R507	19B800607P183	Metal film: 18K ohms + or -5%, 1/8 w. (Used IN G3, G6, G7, G8).
*R507	19B800607P393	Metal film: 39K ohms + or -5%, 1/8 w. (Used in G9 & G10).
R508	19B800607P333	Metal film: 33K ohms + or -5%, 1/8 w. (Used IN G3, G6, G7, G8).
R508	19B800607P823	Metal film: 82K ohms + or -5%, 1/8 w. (Used in G9 & G10).
R509	19B800607P473	Metal film: 47K ohms + or -5%, 1/8 w.
R510	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R511	19B800607P101	Metal film: 100 ohms + or -5%, 1/8 w.

SYMBOL	PART NO.	DESCRIPTION
R601	19A702931P176	Metal film: 604 ohms + or -1%, 200 VDCW, 1/8 w.
R602 and R603	19B800607P104	Metal film: 100K ohms + or -5%, 1/8 w.
R604	19B800607P470	Metal film: 47 ohms + or -5%, 1/8 w.
R605	19B800607P104	Metal film: 100K ohms + or -5%, 1/8 w.
R606	19B800607P680	Metal film: 68 ohms + or -5%, 1/8 w.
R607	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R608	19B800607P392	Metal film: 3.9K ohms + or -5%, 1/8 w.
R609	19B800607P472	Metal film: 4.7K ohms + or -5%, 1/8 w.
R610	19B800607P105	Metal film: 1M ohms + or -5%, 1/8 w.
R701 thru R706	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R707	19B800607P472	Metal film: 4.7K ohms + or -5%, 1/8 w.
R708 and R709	19B800607P473	Metal film: 47K ohms + or -5%, 1/8 w.
R710 thru R712	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R720	19B800607P392	Metal film: 3.9K ohms + or -5%, 1/8 w.
R721	19B800607P562	Metal film: 5.6K ohms + or -5%, 1/8 w.
R722	19B800607P473	Metal film: 47K ohms + or -5%, 1/8 w.
R723	19B800607P391	Metal film: 390 ohms + or -5%, 1/8 w.
R724	19B800607P101	Metal film: 100 ohms + or -5%, 1/8 w.
R801 thru R803	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R804 thru R806	19B800607P101	Metal film: 100 ohms + or -5%, 1/8 w.
R807	19B800607P182	Metal film: 1.8K ohms + or -5%, 1/8 w.
R808	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R809	19B800607P270	Metal film: 27 ohms + or -5%, 1/8 w.
R810	19B800607P101	Metal film: 100 ohms + or -5%, 1/8 w.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
U201	19A705927P1	Silicon, bipolar: sim to Avantek MSA-0611.
U202	344A3907P1	Integrated circuit, MMIC: sim to Avantek MSA-1105.
U203	19A705927P1	Silicon, bipolar: sim to Avantek MSA-0611.
U301	19A704971P9	Positive Voltage Regulator, 5 volt; sim to MC78L05ACD.
U302	19A116297P7	Linear: Dual Op Amp; sim to MC4558CD.
U303	19A704971P7	Voltage Regulator, Negative: sim to Motorola MC79L05ACD.
U401	19A149944P201	Dual Modulus Prescaler: sim to Motorola MC12022A.
U402	19B800902P5	Synthesizer, custom: CMOS, serial input.
U501	344A3070P1	Dual Operational Amplifier: sim to Motorola TL072.
U502	19A702705P4	Digital: Quad Analog Switch/Multiplexer.
U601	19A116297P7	Linear: Dual Op Amp; sim to MC4558CD.
U701	19A703483P302	Digital: Quad 2-Input NAND Gate; sim to 74HC00.
U702	19A703471P320	Digital: 3-Line To 8-Line Decoder; sim to 74HC138.
U705	19A703483P302	Digital: Quad 2-Input NAND Gate; sim to 74HC00.
		- - - - - - - - VOLTAGE REGULATORS - - - - - - -
VR601 and VR602	19B235029P7	5 Turn Cermet Trimmer: 5K ohms, + or - 10%, .5w, sim to 3296W-1502-R.

PRODUCTION CHANGES

Changes in the equipment to improve 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 descriptions of parts affected by these revisions.

REV. A - TRANSMITTER SYNTHESIZER BOARD 19D902779G3,6,7
To correct loading problem on synth IC which could cause failure to lock on channel.
R707 was 47k ohms (19B800607P473).

REV. B - TRANSMITTER SYNTHESIZER BOARD 19D902779G3, G6-G7

REV. A - TRANSMITTER SYNTHESIZER BOARD 19D902779G8
To make new band splits compatible with helical filters. New PWB.
C15 was 0.1 µF (19A700004P2).
C16 was 330 pF (19A702061P73).

REV. A - TRANSMITTER SYNTHESIZER BOARD 19D902779G9

REV. B - TRANSMITTER SYNTHESIZER BOARD 19D902779G8

REV. C - TRANSMITTER SYNTHESIZER BOARD 19D902779G3, G6, G7
To meet hum & noise performance.
R101 was 47K ohm (19B800607P473).
C16 was 1500 pF (19A702061P89).
R9 was 680 ohm (19B800607P681) for G9.
R211 was 15 ohm (19B800607P150) for G9.
R214 was 15 ohm (19B800607P150) for G9.
R507 was 27K ohm (19B800607P150) for G9.
C5 was 3.9 pF (19A702236P15) for G9.
C6 was 18 pF (19A702236P32) for G9.
PWB was R1 return to R0.

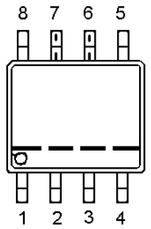
REV. D - TRANSMITTER SYNTHESIZER BOARD 19D902779G3
To improve performance, C5 was 3.3 pF (19A702236P13).

REV. D - TRANSMITTER SYNTHESIZER BOARD 19D902779G6
To improve VCO tuning range, R9 was 680 ohms (19B800607P681).

REV. C - TRANSMITTER SYNTHESIZER BOARD 19D902779G8
To improve output level a wire was soldered between pins 3 and 4 and between pins 9, 10 and 17 of FL101.

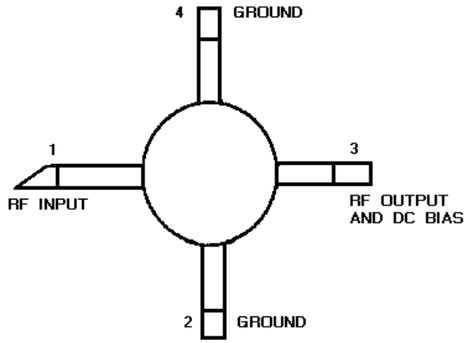
REV. A - TRANSMITTER SYNTHESIZER BOARD 19D902779G10
Adjust tuning range, C4 changed from 4.7 pF (19A702236P17) to 2.7 pF (19A702236P11).

U201 and U203
19A705927P11
Silicon Bipolar MMIC

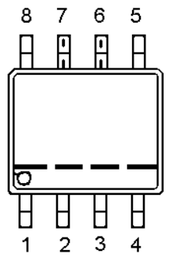


PIN	FUNCTION
1	Vout
2	GROUND
3	GROUND
4	N.C.
5	N.C.
6	GROUND
7	GROUND
8	Vin

U202
344A3907P1
Silicon Bipolar MMIC

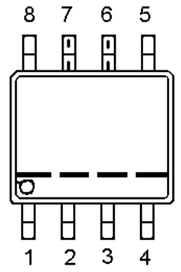


U301
19A704971P9
+5V Regulator



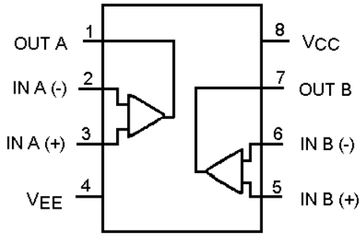
PIN	FUNCTION
1	Vout
2	GROUND
3	GROUND
4	N.C.
5	N.C.
6	GROUND
7	GROUND
8	Vin

U303
19A704971P7
-5V regulator



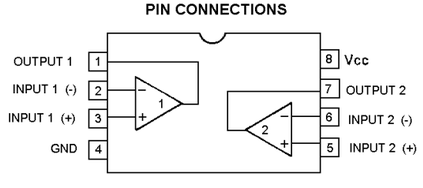
PIN	FUNCTION
1	Vout
2	GROUND
3	GROUND
4	N.C.
5	N.C.
6	GROUND
7	GROUND
8	Vin

U501
344A3070P1
Operational Amplifier



U302 & U601
19A116297P7
Dual Wide Band Op-Amp

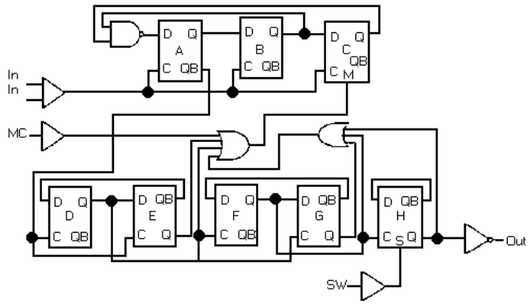
PIN CONNECTIONS



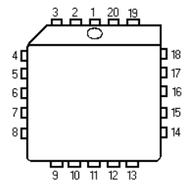
U401
19A149944P201
Dual Modulus Prescaler

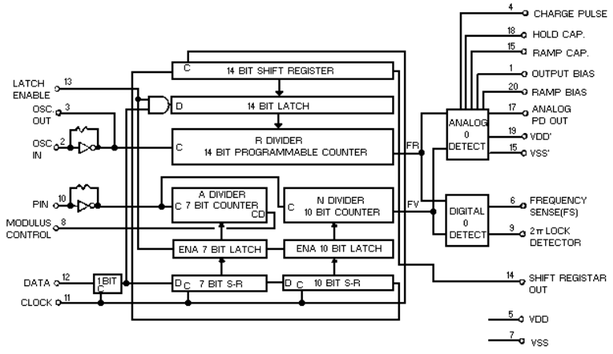
FUNCTION TABLE		
SW	MC	DIVIDE RATIO
H	H	64
H	L	65
L	H	128
L	L	129

SW: H = Vcc L = OPEN
MC: H = 2.0V TO Vcc
L = GND TO 0.8V



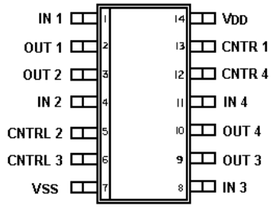
U402
19B800902P5
Synthesizer



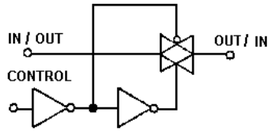


U502
19A702705P4
Quad Analog Switch

PIN CONFIGURATION



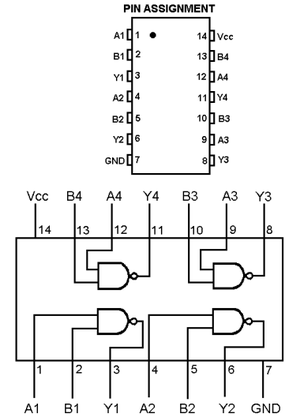
LOGIC DIAGRAM



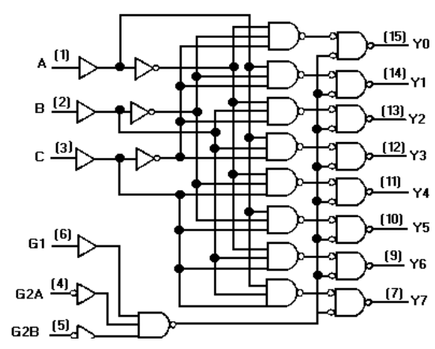
(1/4 OF DEVICE SHOWN)

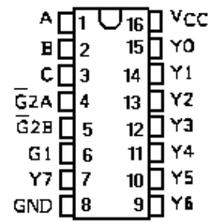
CONTROL	SWITCH
0	OFF
1	ON

U701 & U705
19A703483P302
Quad 2-Input NAND Gate



U702
19A703471P120
Address Decoder

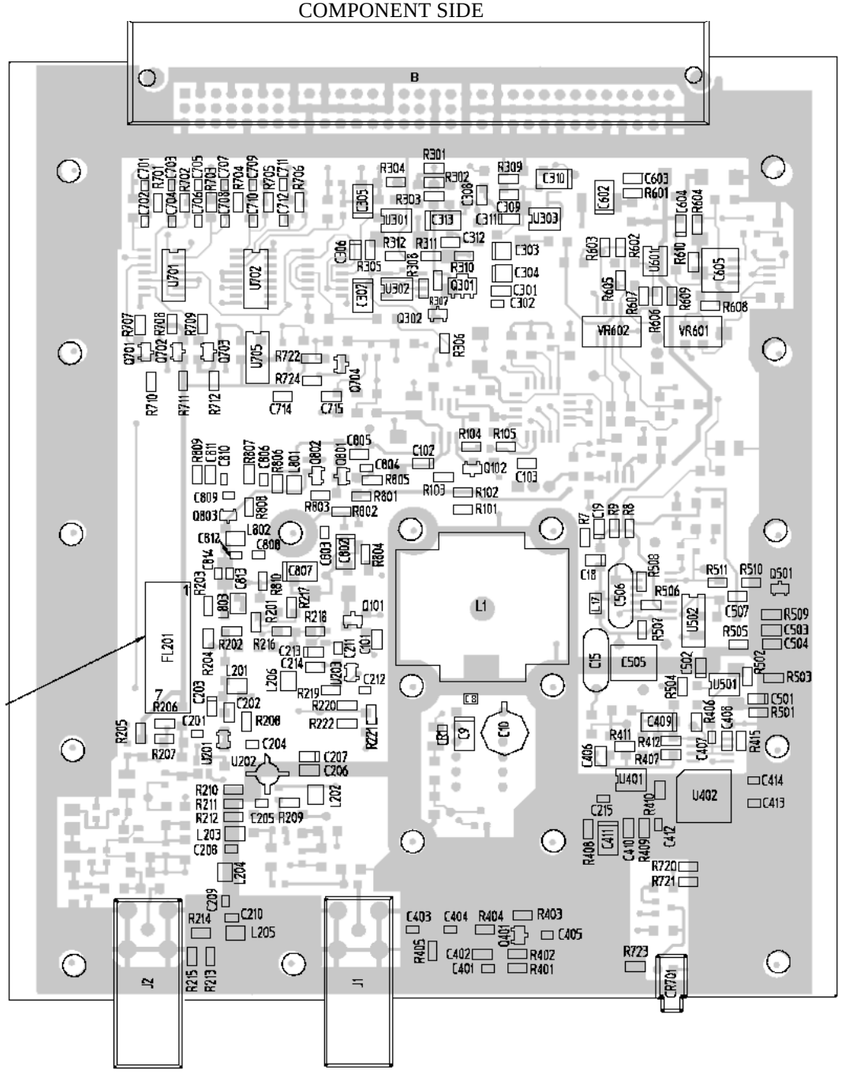




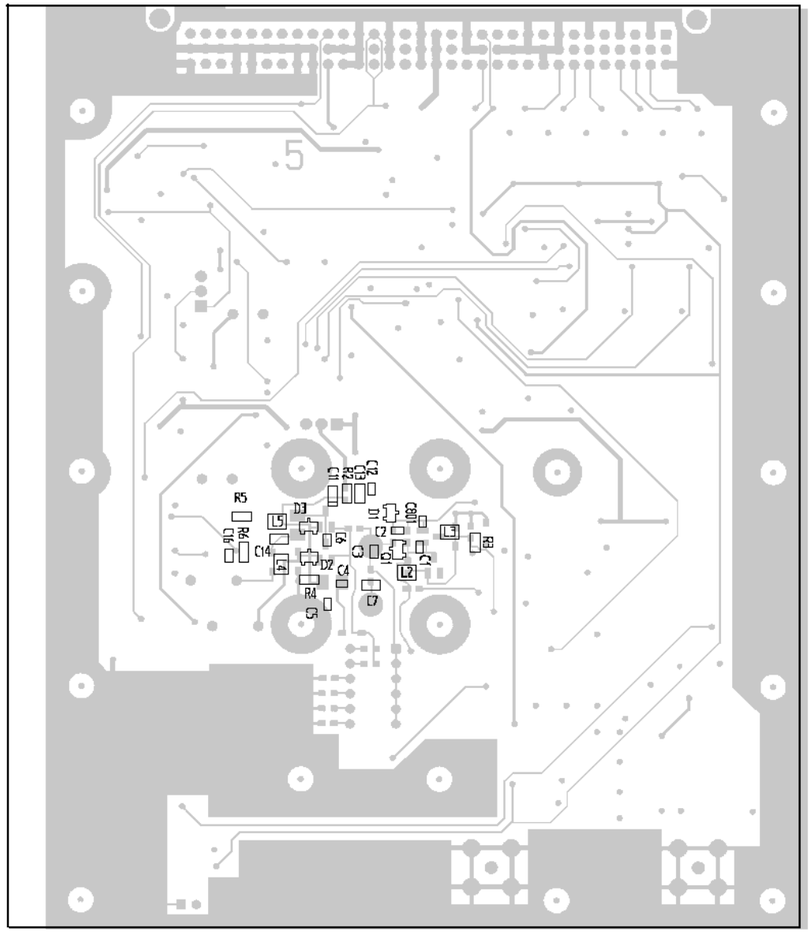
FUNCTION TABLE

ENABLE INPUTS			SELECT INPUTS			OUTPUTS							
G1	$\overline{G2A}$	$\overline{G2B}$	C	B	A	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7
X	H	X	X	X	X	H	H	H	H	H	H	H	H
X	X	H	X	X	X	H	H	H	H	H	H	H	H
L	X	X	X	X	X	H	H	H	H	H	H	H	H
H	L	L	L	L	L	L	H	H	H	H	H	H	H
H	L	L	L	L	H	H	L	H	H	H	H	H	H
H	L	L	L	H	L	H	H	L	H	H	H	H	H
H	L	L	L	H	H	H	H	H	L	H	H	H	H
H	L	L	H	L	L	H	H	H	H	L	H	H	H
H	L	L	H	L	H	H	H	H	H	H	L	H	H
H	L	L	H	H	L	H	H	H	H	H	H	L	H
H	L	L	H	H	H	H	H	H	H	H	H	H	L

COMPONENT SIDE

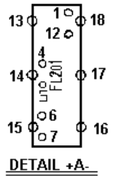


SOLDER SIDE



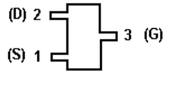
(19D902779, Sh. 2, Rev. 9)
(19D903361, Layer 1 & 4, Rev. 0)

CAUTION
OBSERVE PRECAUTIONS FOR HANDLING
ELECTROSTATIC SENSITIVE DEVICES

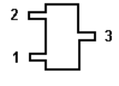


DETAIL +A-

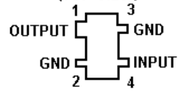
LEAD IDENTIFICATION FOR
Q1
(SOT) TRANSISTORS
(TOP VIEW)



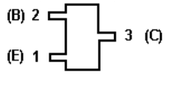
LEAD IDENTIFICATION FOR
D1-D3
(SOT) DIODES
(TOP VIEW)



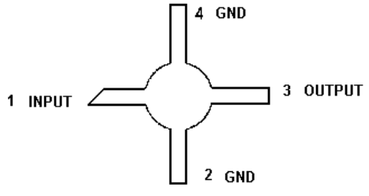
LEAD IDENTIFICATION FOR
U201, U203
(SOT) INT CKT
(TOP VIEW)



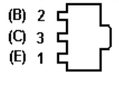
LEAD IDENTIFICATION FOR
Q101, Q102, Q302, Q401, Q501,
Q701-Q704, Q801-Q803
(SOT) TRANSISTORS
(TOP VIEW)



LEAD IDENTIFICATION FOR
U202
(SOT) INT CKT
(TOP VIEW)

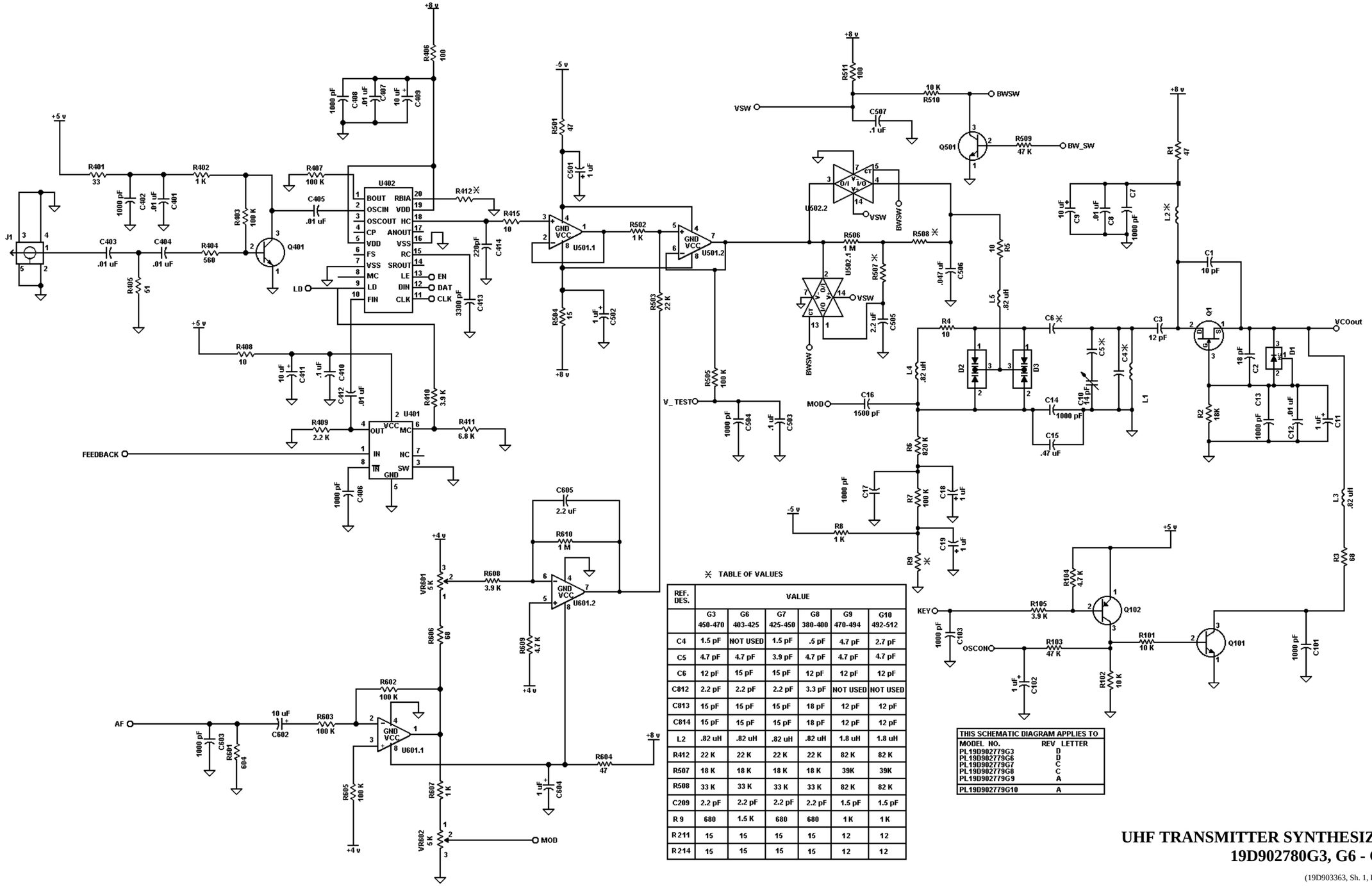


LEAD IDENTIFICATION FOR
Q301
(SOT) TRANSISTORS
(TOP VIEW)



UHF TRANSMITTER SYNTHESIZER BOARD
19D902779G3, G6 - G10

4 ON SOLDER SIDE OF BOARD, SOLDER A WIRE BETWEEN PINS 3 AND 4 OF FL101. SOLDER A WIRE BETWEEN PINS 9, 10, AND 17 OF FL101.



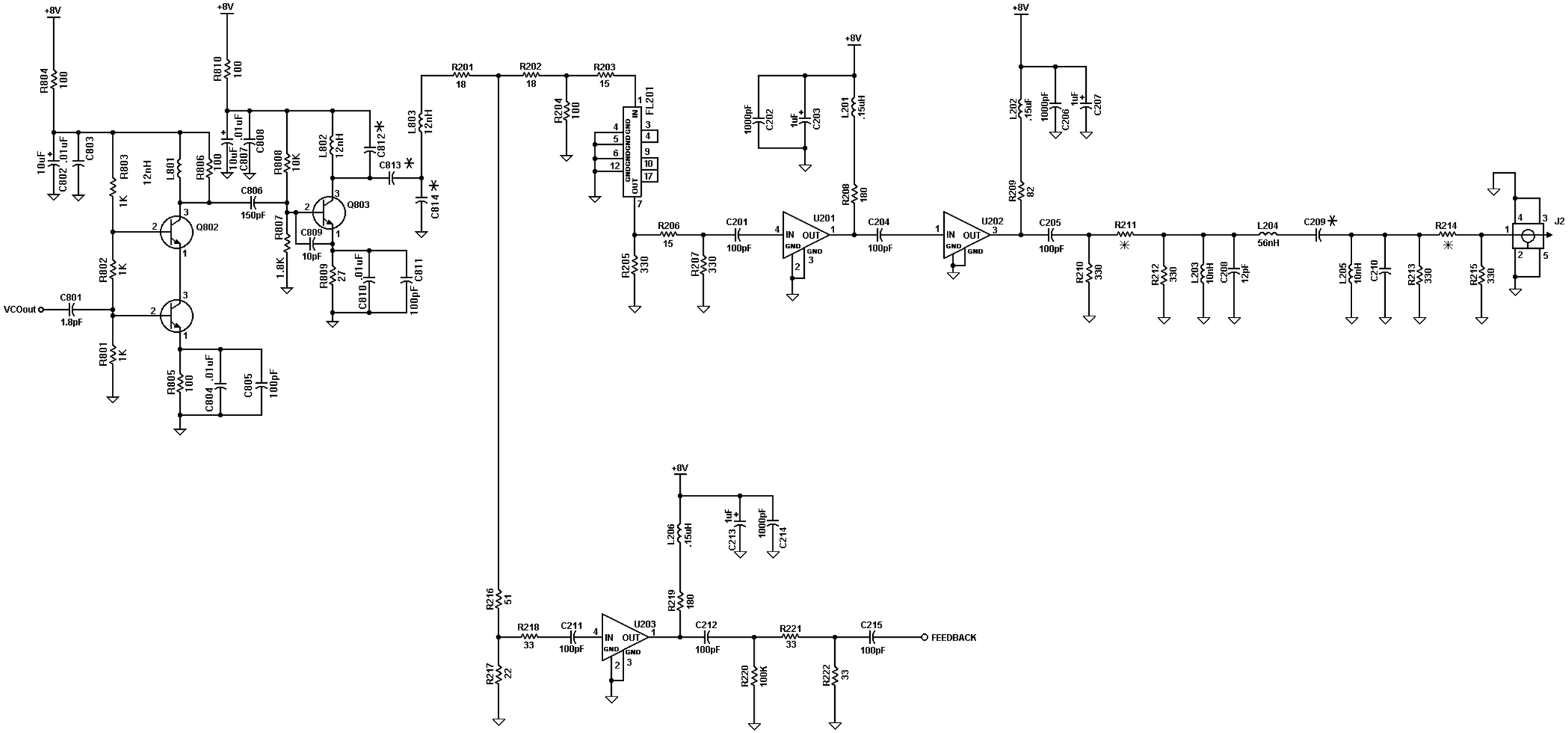
✕ TABLE OF VALUES

REF. DES.	VALUE					
	G3 450-470	G6 403-425	G7 425-450	G8 380-400	G9 470-494	G10 492-512
C4	1.5 pF	NOT USED	1.5 pF	.5 pF	4.7 pF	2.7 pF
C5	4.7 pF	4.7 pF	3.9 pF	4.7 pF	4.7 pF	4.7 pF
C6	12 pF	15 pF	15 pF	12 pF	12 pF	12 pF
C812	2.2 pF	2.2 pF	2.2 pF	3.3 pF	NOT USED	NOT USED
C813	15 pF	15 pF	15 pF	18 pF	12 pF	12 pF
C814	15 pF	15 pF	15 pF	18 pF	12 pF	12 pF
L2	.82 uH	.82 uH	.82 uH	.82 uH	1.8 uH	1.8 uH
R412	22 K	22 K	22 K	22 K	82 K	82 K
R507	18 K	18 K	18 K	18 K	39K	39K
R508	33 K	33 K	33 K	33 K	82 K	82 K
C209	2.2 pF	2.2 pF	2.2 pF	2.2 pF	1.5 pF	1.5 pF
R 9	680	1.5 K	680	680	1 K	1 K
R 211	15	15	15	15	12	12
R 214	15	15	15	15	12	12

THIS SCHEMATIC DIAGRAM APPLIES TO	
MODEL NO.	REV LETTER
PL19D902779G3	D
PL19D902779G6	D
PL19D902779G7	C
PL19D902779G8	C
PL19D902779G9	A
PL19D902779G10	A

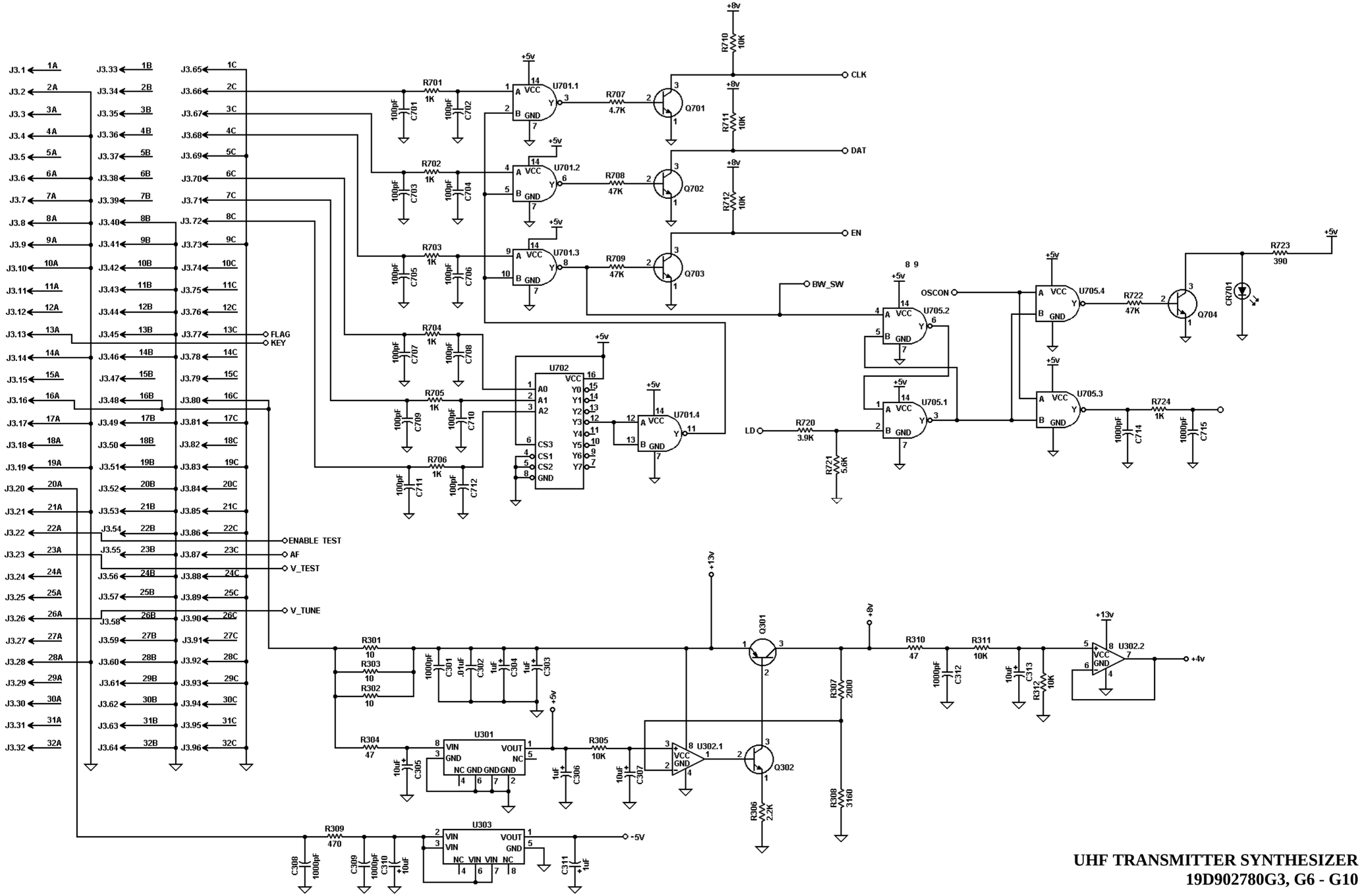
UHF TRANSMITTER SYNTHESIZER
19D902780G3, G6 - G10

(19D903363, Sh. 1, Rev. 10)



UHF TRANSMITTER SYNTHESIZER
19D902780G3, G6 - G10

(19D903363, Sh. 2, Rev. 10)



UHF TRANSMITTER SYNTHESIZER
19D902780G3, G6 - G10

(19D903363, Sh. 3, Rev. 10)

MAINTENANCE MANUAL
FOR
UHF RECEIVER SYNTHESIZER MODULE
19D902781G3, G7, G8, G10, G12

TABLE OF CONTENTS

DESCRIPTION

The Receiver Synthesizer Module, 19D902781G3, G7, G8, G10 or G12 provides the local oscillator signal (LO) to the Receiver Front End Module of the MASTR III base station. The module also provides the reference oscillator signal to the transmitter synthesizer.

Figure 1 is a block diagram of the Receiver Synthesizer Module. The synthesizer is connected in a phase-locked loop (PLL) configuration. The synthesizer°s output is generated by the VCO, Q1, and multiplier Q16. It°s then buffered by the Monolithic Microwave Integrated Circuit (MMIC) U2.

The logic signals from the controller (U10, U12, and U13) control the synthesizer frequency. Frequency stability is maintained by using either the internal reference oscillator Y1 or applying an external high precision reference signal to the EXT Reference Oscillator Port J4. The internal reference oscillator, Y1, is a temperature controlled crystal oscillator (TCXO) operating at 12.8 MHz. The oscillator has a stability of ±1.0 ppm over the temperature range of -30°C to +75°C.

The multiplier output is sampled by the resistive splitter and conditioned by buffer amplifier U3. It is then fed to the divide by 128/129 dual modulus prescaler U5. The divided output from the prescaler is connected to the F_{in} input of the PLL U6. Within the PLL the divided multiplier input signal F_{in} is divided again. The PLL also divides down the 12.8 MHz reference signal. Three inputs from the controller; ENABLE, CLOCK, and serial DATA program the PLL divider circuits.

ERICSSON

Ericsson Inc.
Private Radio Systems
Mountain View Road
Lynchburg,Virginia 24502
1-800-528-7711
(Outside USA, 804-592-7711)

Printed in U.S.A.

The divided reference signal and the divided multiplier signal are compared in the PLL phase detector. When the reference and multiplier signals are identical the PLL phase detector generates a constant DC output voltage. This voltage is buffered by U8 and filtered by the loop filter circuit. It is then applied to Q1 setting the VCO on frequency.

If the compared frequencies (phases) differ, an error voltage is generated which adjusts the VCO frequency. During this out-of-lock condition, the PLL also sends a Lock Detect (LD) signal to the controller and lights the FAULT LED on the front panel of the module.

Table 1 - General Specifications

ITEM	SPECIFICATION	
FREQUENCY TUNING Mechanical	INJECTION FREQ 424.4 MHz-451.4 MHz (G3) 446.4 MHz-472.6 MHz (G7) 401.4 MHz-421.4 MHz (G8) 470.6 MHz-490.6 MHz (G10) 391.4 MHz-421.4 MHz (G12)	FREQ. BAND 450-470 MHz, 403-425 MHz 425-450 MHz, 470-495 MHz 380-400 MHz 492-512 MHz 370-390 MHz
Electrical Full Specifications Degraded Specifications	 2 MHz 3 MHz	
Channel Spacing	6.25 kHz	
FREQUENCY STABILITY	±1.5 ppm	
LO POWER OUTPUT	2.0 dBm ±2 dBm	
LO NOMINAL IMPEDANCE	50 ohms	
PHASE NOISE @ 25 kHz Offset	>-137 dBc/Hz	
HUM AND NOISE Companion Receiver	-55 dB	
HARMONICS @ LO PORT	<-30 dBc	
SWITCHING SPEED	<50 ms	
CURRENT DRAIN +13.8V +12V	 <200 mA <50 mA	
REFERENCE OSCILLATOR Frequency Output Power Output Impedance	 12.8 MHz ±1.5 dBm 1 dBm ±2 dBm 50 ohms	
EXT. REFERENCE OSCILLATOR Frequency Power Impedance	 5.00 MHz to 17.925 MHz (must be integer divisible by the channel spacing) +10 dBm ±3 dBm into 50 ohms 50 ohms	

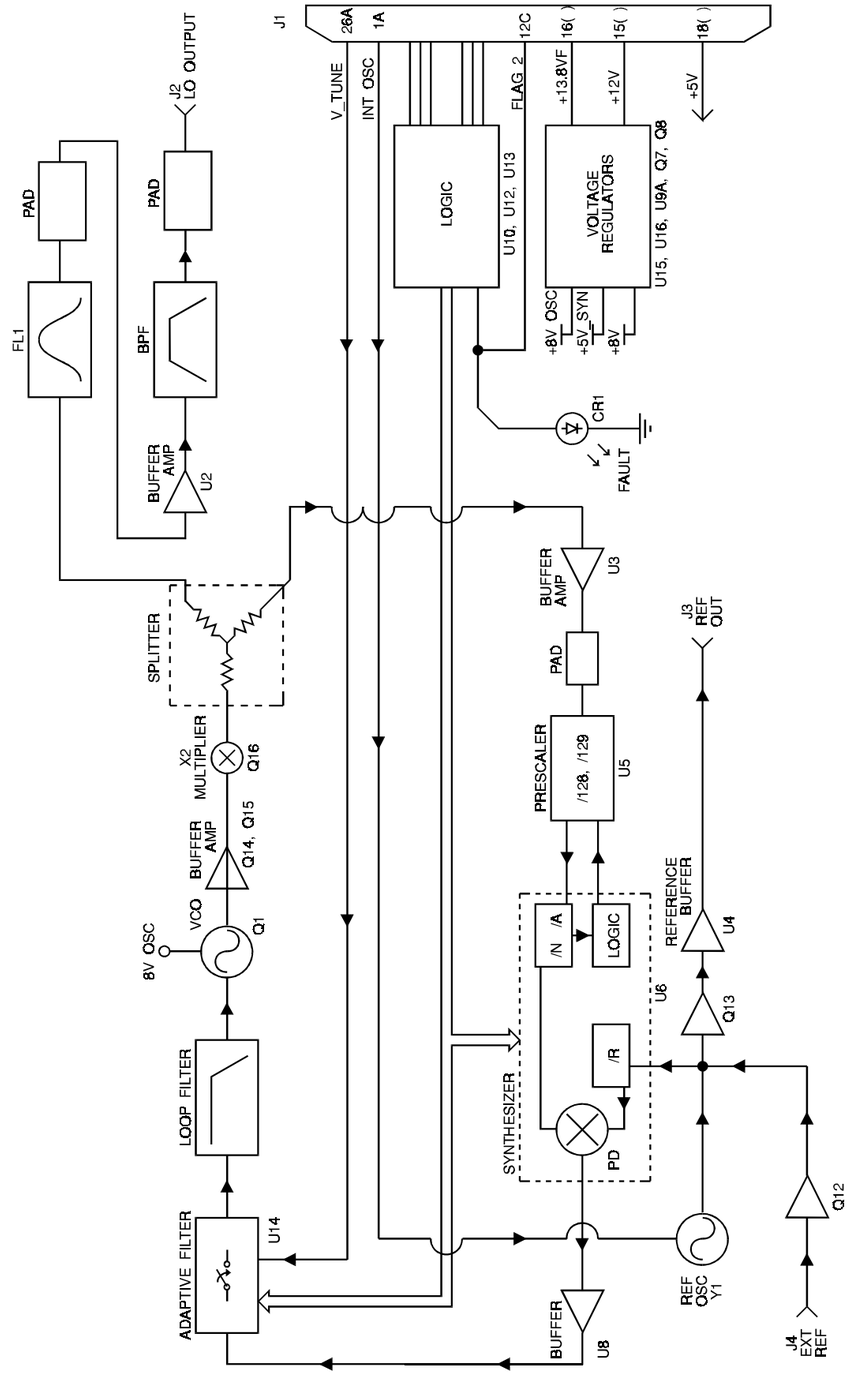


Figure 1 - Receiver Synthesizer Block Diagram

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CIRCUIT ANALYSIS

The Receiver Synthesizer Module consists of the following circuits:

- Voltage Controlled Oscillator
- Multiplier (Frequency Doubler)
- Buffer Amplifiers
- Reference Oscillator and Buffer
- Prescaler and Synthesizer
- Loop Filter
- Digital Control
- Voltage Regulators

VOLTAGE CONTROLLED OSCILLATOR

The free running Voltage Controlled Oscillator (VCO) is composed of a grounded-gate JFET (Q1) and associated circuitry. Inductor L10 and associated capacitors form the resonant tank circuit. The circuit's use of high-Q components minimizes phase noise.

Frequency tuning of the VCO is done by changing the DC output voltage level from the loop filter U14. The Loop Filter Out signal from U14 is routed through L4 and R3 and applied to the two varicap diodes D4 and D5. The voltage level applied determines the diodes' capacitance and sets the resonant frequency of the oscillator. If the VCO drifts or the frequency is changed, the DC voltage level changes causing the VCO's resonant frequency to change. The output of the oscillator is then applied to a buffer amplifier. Course adjustment of frequency is done by adjusting trimmer capacitor C52 while applying a calibration voltage to the V_TUNE line connected to U14.4 pin 11.

FREQUENCY DOUBLER

Transistors Q14 and Q15 form a buffer stage to drive transistor multiplier Q16. They isolate VCO Q1 from loading effects which would degrade oscillator loaded Q and hence noise performance. Transistor multiplier Q16 is tuned to pass the second harmonic of the VCO output and hence serves as a frequency doubler. Tank elements L1, C97-C99 and L12 form a resonant circuit and matching network to drive the resistive splitter (R13, R17, R18, R96, R97, R99, R100).

RF AMPLIFIERS

The RF chain begins with a resistive splitter (R13, R17, R18, R96, R97, R99 and R100). The output of the splitter at R99 is attenuated by 7.5 dB and provides impedance matching to Helical Filter FL1 which is tuned to pass the LO Frequency while rejecting harmonics by about 40 dB. The output of FL1 is fed thru resistive pad R12, R14 and R15 to MMIC Amp U2 which operates in compression. Output Amp U2 is followed by a bandpass filter (L13-L15, C86, C87 and C101) and resistive attenuator (R30, R101 and R102). The final output at the front panel BNC connector J2 is nominally 1.5 dBm and drives the Receiver Front End LO input.

The other output at the resistive splitter at R100 is attenuated by 20 dB and drives buffer amp U3 into compression. U3 drives the synthesizer prescaler, providing a feedback signal for the synthesizer phase locked loop.

REFERENCE OSCILLATOR AND BUFFER

The reference oscillator section provides a reference signal to the PLL section. The circuit design allows using either an external or internal oscillator.

When using an external oscillator, the internal oscillator is disabled by placing a logic low on the INT OSC line from the T/R Shelf Interface Board. A high precision external oscillator may then be connected to the module through the external reference oscillator connector J4, EXT REF IN. J4 has a 50 ohm input impedance and is coupled to the base of Q12. Buffer Q12 conditions the signal and applies it to the synthesizer U6 via coupling capacitor C10.

The internal reference oscillator, Y1, provides a 12.8 MHz signal with a stability of ±1.0 ppm. It is enabled by applying a logic high signal on the INT OSC line. This signal turns on Q2, allowing it to conduct and apply +5 volts to pin 1 of the oscillator Y1. The 12.8 MHz output signal (Y1 pin 2) is then sent to the synthesizer via coupling capacitor C9.

The reference oscillator signal, either external or internal, is also routed to Q13 via coupling capacitor C54. The output taken from the emitter of Q13 is applied through C11 to the input of Buffer Amplifier U4. The buffered signal is coupled through C12 to a low pass filter network (C32,C33,C34, and L7) and a resistive pad (R27, R28, and R31) for isolation. The output from the resistive pad is then connected to J3, REF OUT, making the reference oscillator signal available for external use.

PRESCALER AND SYNTHESIZER IC

The integrated circuit U6 is the heart of the synthesizer. It contains the necessary frequency dividers and control circuitry to synthesize output frequencies by the technique of dual modulus prescaling. U6 also contains an analog sample and hold phase detector and a lock detector circuit.

Within U6 are three programmable dividers which are serially loaded using the CLOCK, DATA, and ENABLE inputs (pins 11, 12, and 13 respectively). A serial data stream (DATA) on pin 12 is shifted into the internal shift registers by low to high transitions on the clock input (CLOCK) at pin 11. A logic high (ENABLE) on pin 13 then transfers the program information from the shift registers to the divider latches. The serial data determines the VCO frequency by setting the internal R, A, and N dividers.

The 12.8 MHz reference oscillator signal OSCIN is internally routed to the "R" divider. The "R" divider divides down the 12.8 MHz reference signal to a lower frequency, F_r, as directed by the input data and applies the signal to the internal analog phase and lock detectors.

The "A" and "N" dividers process the loop feedback signal from the multiplier (by way of the dual modulus prescaler U5). The output of the "N" divider, F_v, is a divided down version of the multiplier output frequency. This signal is also applied to the internal phase detector. The ramp and hold constants are determined by C26, R37, C31, and R36.

The analog phase detector output voltage (PD OUT) is proportional to the phase difference between F_v and F_r. This output serves as the loop error signal. When operating on the correct frequency, the inputs to the phase detector are identical and the output voltage of the analog phase detector is constant. If the compared frequencies (phases) differ, the analog phase detector increases or decreases the DC output voltage (PD OUT). This error signal voltage tunes the VCO to whatever frequency is required to keep F_v and F_r locked (in phase).

The lock detector furnishes the Fault circuit in U13 with the lock detect (LD) signal. When F_v and F_r are in phase, the lock detector output sends a logic high on the LD line to the fault circuit U13. If the VCO is not locked onto the correct frequency, the resulting out-of-phase condition causes the output from the lock detector to be a logic low.

LOOP FILTER

The error signal, ANOUT, is applied to the loop filter at U8.2 pin 5 and U8.1 pin 3. U8.2 acts as a buffer amplifier with gain. The output signal from the amplifier is applied to a loop filter consisting of R42, R43, R44, C35 and C36 via the bilateral switch U14. The filter removes noise and sampling frequencies from the error voltage. The switch, U14, selects the proper filter configuration for operation in the narrow band, wide band or tuning mode. The control signals (OPEN_LOOP, ENABLE_NOT, and TUNE_CTRL) for U14 are derived from the digital control circuits U10, U12, and U13. U8.1 provides a buffered output for testing at the DIN connector on the rear of the module.

DIGITAL CONTROL

Logic control circuits (other than those inside the synthesizer IC - U6) consist of the following:

- Digital Control Circuit (U10, U12, & U13)
- Level Shifters
- Fault Circuit

The Digital Control Circuits U10, U12, & U13 serve as an interface between the controller and the synthesizer IC.

As an address decoder, U10 enables the input gates when the A0, A1, and A2 input lines (pins 4, 3, and 2) receive the correct address code from the controller. For the Receiver synthesizer the enable address is 010 on A0, A1, and A2 respectively. After receiving the proper logic code, the input gate U12 is enabled. This allows the ENABLE, CLOCK, and serial DATA information to pass on to the synthesizer via the level shifters.

The Level Shifters Q3, Q4, and Q5 convert the five volt logic level to the eight volt logic level required by the synthesizer.

The Fault circuit, U13, monitors the lock detect signal from the PLL synthesizer. Under normal (locked) condition, the PLL sends a logic high signal to U13. U13 processes the signal and provides a logic high output which saturates Q6. Saturating Q6 turns off the FAULT LED (CR1). U13 also sends a logic high signal, FLAG 2, (U13.3 pin 8) to the controller indicating the VCO's frequency is correct.

When the VCO is not on the correct frequency, the synthesizer sends a logic low signal to U13. This causes U13 to cutoff Q6 which turns on the FAULT LED (CR1). U13 also sends a logic low signal to the controller, on the FLAG 2 line, indicating the VCO's frequency is incorrect.

VOLTAGE REGULATORS

Voltage regulators U15 and U16 reduce the +13.8 VF line to +5 Vdc and +8 Vdc respectively. The output from U15 (+5V_SYN) is used by both the synthesizer and logic circuitry while the 8 Vdc output from U16 is used for the op-amps, level shifters, and the discrete +8V OSC regulator circuit.

The discrete +8V OSC regulator circuit is a linear regulator consisting of U9A, Q7, Q8, and associated circuitry. The error amplifier U9A controls Q7 and pass element Q8. The +8V OSC is used as the power source for the VCO circuit, where additional filtering is provided to keep noise to a minimum

MAINTENANCE

RECOMMENDED TEST EQUIPMENT

The following test equipment is required to test the Synthesizer Module:

1. Modulation Analyzer; HP 8901A, or equivalent
2. Power Supply; 12.0 Vdc @ 500 mA
3. Frequency Counter; 10 MHz - 250 MHz
4. Power Meter; -20 dBm to +10 dBm
5. Spectrum Analyzer, 0 - 1 GHz

SERVICE NOTES

The following service information applies when aligning, testing, or troubleshooting the RX Synthesizer:

- Logic Levels:
  Logic 1 = high = 4.5 to 5.5 Vdc
  Logic 0 = Low = 0 to 0.5 Vdc

- Receiver Synthesizer Address = A0 A1 A2 = 010

- Synthesizer data input stream is as follows:
  14-bit "R" divider most significant bit (MSB) = R13 through "R" divider least significant (LSB) = R0

  10-bit "N" divider MSB = N9 through "N" divider LSB = N0

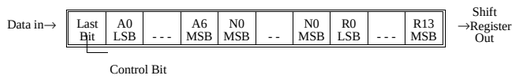
  7-bit "A" divider MSB = A6 through "A" divider LSB = A0

  Single high Control bit (last bit)

  Latched When Control Bit = 1

DATA ENTRY FORMAT

Latched When
Control Bit = 1



- Synthesizer lock is indicted by the extinguishing of the front panel LED indicator and a logic high on the fault FLAG 2 line (J1 pin 12C).
- Always verify synthesizer lock after each new data loading.

TEST AND ALIGNMENT

INITIALIZATION

Apply +12 Vdc to the test fixture.

Current Consumption

Measure the current through pins 15A, 15B, 15C, 16A, 16B, AND 16C.

Verify the current is less than 250 mA. Total current is the +13.8 VF current and +12 Vdc current combined.

Reference Oscillator

Adjust Y1 for an output frequency of 12.8 MHz ±2 Hz. Measure the output power of the reference oscillator output (J3).

Verify the output power is 1 dBm ±2 dBm.

Oscillator Alignment

Ground the ENABLE TEST line (pin 22A). Apply +4 Vdc to the V_TUNE line (pin 26A). Measure the frequency of the free running multiplied oscillator at the LO OUT port (J2).

Adjust the trimmer capacitor C52 for 445 MHz (G3), 470 MHz (G7), 420 MHz (G8), 490 MHz (G10), 420 MHz (G12) or desired injection frequency ±100 kHz.

Synthesizer Loading

Unground the ENABLE TEST line (pin 22A). Load the synthesizer IC for 445 MHz (G3) or 470 MHz (G7) or 420 MHz (G8), 490 MHz (G10), 420 MHz (G12) or desired injection frequency.

Verify the lock indicator (CR1) is off or the FLAG 2 line is high.

Hum and Noise

Initialize the HP 8901A for 300 Hz - 3 kHz, 750 µsec de-emphasis, average FM deviation, and 0.44 dB reference for the deviation.

Verify the hum and noise (J2) is less than -55 dB.

Output Power and Harmonic Content

Adjust both slugs on FL1 for maximum output level measured at J2.

Verify the output power (J2) at the fundamental frequency is:

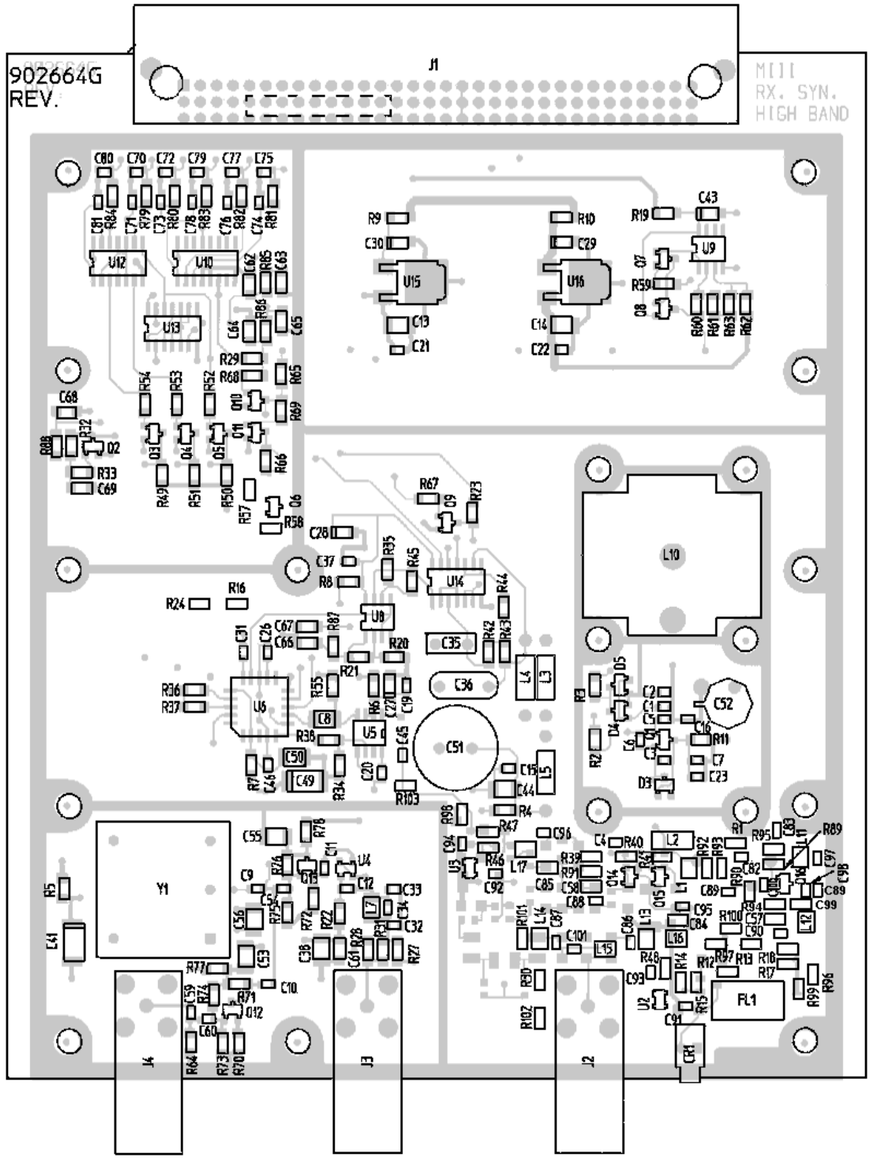
2 dBm ±2 dB

Verify the harmonic content is less than -30 dBc.

TROUBLESHOOTING CHART

SYMPTOM	AREAS TO CHECK	INDICATIONS
I. Loop Fails To Lock	1. Check for: +8 Vdc at U16-3, +5 Vdc at U15-3 +8 Vdc at Q8-C.	Bad Regulation circuitry. Troubleshooting using standard procedures.
	2. Check for 12.8 MHz reference at U6-2 and U6-3. Typical Levels: 500 mVpp @U6-2 2.5 Vpp @U6-3.	Reference Osc. Module defective or supply not present or low. Proceed to reference oscillator section II.
	3. Check for LO output @J2. F_{LO} ±5 MHz, 0 dBm nominal	LO tuning incorrect, or buffer amplifier bad. Proceed to LO tuning and power section III.
	4. Check Prescaler output @U5-4. Typically: 2-4 MHz square wave @1.25 Vpp.	If LO power is good, check for 3.2 Vdc @U2-3. Replace U2, then U5 if necessary.
	5. Check for CLOCK, DATA, and ENABLE signals at U6 pins 11, 12 and 13 respectively. (0, 8V logic levels)	Bad digital control circuitry. Troubleshoot using standard procedures. Ensure all programming signals are present at J1. (CLOCK, DATA, ENABLE, A0, A1 and A2).
	6. Check Ramp Signal @U6-15. It should be 6.25 kHz nominal.	If reference oscillator and programming signals are present for proper programming information. Last resort - replace Synthesizer IC U6.
II. Reference OSC. not present or low power.	1. Check for 4.3 Vdc supply at junction of R5 and C41.	Bad supply switch Q2 or wrong Control Signal Internal Osc. Troubleshooting using standard procedures. Replace Y1 as last resort.
	2. Check 12.8 MHz signal @Q13-E. Should be approx. 350 mVpp.	Bad buffer amplifier Q13. Troubleshoot using standard procedures.
III. LO power low or tuned out of band.	1. Check tuning with 6 Vdc applied using test procedure. F_{LO} ±5 MHz.	LO tuning incorrect. Retune following test procedure.
	2. Check DC bias at Buffer Amplifiers U1, U2, & U3 pin 3 Typ. 3.2 Vdc.	Bad Buffer Amplifier. Replace bad part.
IV. LO signal not present. (i.e. Q1 does not oscillate)	1. Check DC bias at Q1 drain. (Typ. +8Vdc).	Replace Q1.
	2. Check DC bias at Q1 source. (Typ. +0.9 Vdc).	

COMPONENT SIDE



LEAD IDENTIFICATION FOR Q1 (SOT) TRANSISTORS

TOP VIEW

(D) 2 — 3 (G)

(S) 1

LEAD IDENTIFICATION FOR D3 - D5 (SOT) DIODES

TOP VIEW

2 — 3

1

LEAD IDENTIFICATION FOR Q2 - Q16 (SOT) TRANSISTORS

TOP VIEW

(B) 2 — 3 (C)

(E) 1

LEAD IDENTIFICATION U2 - U4 (SOT) INT CKT

TOP VIEW

OUTPUT — GND

GND — INPUT

(19D902664, Sh. 2, Rev. 4)
(19D902665, Layer 1, Rev. 1)

UHF RECEIVER SYNTHESIZER BOARD
19D902664G3 ,G7, G8, G10, G12

UHF RECEIVER SYNTHESIZER MODULE 19D902781G3, G7, G8, G10, G12 ISSUE 8

SYMBOL	PART NO.	DESCRIPTION
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
3	19D902509P4	COVER.
4	19D902555P1	Handle.
6	19A702381P506	Screw, thread forming: TORX, No. M3.5-.6 x 6.
7	19A702381P513	Screw, thread forming: TORX, No. M3.5 - 0.6 X 13.
10	19D902824P1	Casting.
11	19A702381P508	Screw, thd. form: No. 3.5-0.6 x 8.
38	19B802690P1	Grommet.
		UHF RECEIVER SYNTHESIZER BOARD 19D902664G3, G7, G8, G10, G12
		- - - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A702236P15	Ceramic: 3.9 pF + or -0.25 pF, 50 VDCW, temp coef 0 + or -30 PPM/°C. (Used in G7, G3, G10).
C1	19A702236P17	Ceramic: 4.7 pF + or -0.5 pF, 50 VDCW, temp coef 0 + or -60 PPM/°C. (Used in G8, G12).
C2	19A702236P6	Ceramic: 1 pF + or -0.25 pF, 50 VDCW, temp coef 0 + or -30 PPM/°C. (Used in G3).
C2	19A702236P15	Ceramic: 3.9 pF + or -0.25 pF, temp coef 0 + or -30 PPM/°C. (Used in G8).
C2	19A702236P19	Ceramic: 5.6 pF + or -0.5 pF, 50 VDCW, temp coef 0 + or -60 PPM/°C. (Used in G12).
C3	19A702236P38	Ceramic: 33 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C. (Used in G3).
*C3	19A702236P36	Ceramic: 27 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C. (Used in G7 , G8and G12).
C3	19A702236P34	Ceramic: 22 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM. (Used in G10).
C4	19A702236P9	Ceramic: 1.8 pF + or -0.25 pF, 50 VDCW, temp coef 0 + or -30 PPM.
C5	19A702236P30	Ceramic: 15 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C. (Used in G3).
*C5	19A702236P28	Ceramic: 12 pF + or - 5%, 50 VDCW, temp coef 0 + or -30 PPM. (Used in G7, G8, G10, G12).
C6	19A702236P36	Ceramic: 27 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C. (Used in G3).
*C6	19A702236P34	Ceramic: 22 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM. (Used in G7 and G8, G12).
C6	19A702236P32	Ceramic: 18 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM. (Used in G10).
C7	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C8	19A702052P26	Ceramic: 0.1uF + or - 10%, 50 VDCW.
C9	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C10	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C11	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C12	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C13 and C14	19A702052P26	Ceramic: 0.1uF + or - 10%, 50 VDCW
C15	19A702052P5	Ceramic: 1000 pF + or -10%, 50 VDCW.
*C16	19A702236P25	Ceramic: 10 pF + or -.5 pF, 50 VDCW, temp coef 0 + -30 PPM/°C. (Used in G3, G7 & G10).
C16	19A702236P28	Ceramic: 12 pF + or -.5 pF, 50 VDCW, temp coef 0 + -30 PPM/°C. (Used in G8).
C16	19A702236P31	Ceramic: 16 pF + or - 5%, 50 VDCW, temp coef 0 + -30 PPM/°C. (Used in G12).
C19	19A702052P3	Ceramic: 470 pF + or - 10%, 50 VDCW.
C20	19A702052P3	Ceramic: 470 pF + or - 10%, 50 VDCW.
C21	19A702052P3	Ceramic: 470 pF + or - 10%, 50 VDCW.
C22	19A702052P3	Ceramic: 470 pF + or - 10%, 50 VDCW.
C23	19A702052P5	Ceramic: 1000 pF + or -10%, 50 VDCW.
C26	19A702052P8	Ceramic: 3300 pF + or - 10%, 50 VDCW.
C27	19A705205P2	Tantalum: 1 uF, 16 VDCW; sim to Sprague 293D.
C28	19A705205P2	Tantalum: 1 uF, 16 VDCW; sim to Sprague 293D.
C29	19A705205P2	Tantalum: 1 uF, 16 VDCW; sim to Sprague 293D.
C30	19A705205P2	Tantalum: 1 uF, 16 VDCW; sim to Sprague 293D.
C31	19A702052P1	Ceramic: 220 pF + or - 10%, 50 VDCW.
C32	19A702052P1	Ceramic: 220 pF + or - 10%, 50 VDCW.
C33	19A702052P1	Ceramic: 220 pF + or - 10%, 50 VDCW.
C34	19A702236P43	Ceramic: 51 pF + or - 5%, 50 VDCW, temp coef 0 + - 30 PPM/°C.
C35	19A703684P1	Metallized Polyester: 0.47 uF + or -10%, 63 v.
C36	19A703902P3	Metal: 0.047 uF + or -10%, 50 VDCW.
C37	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C38	19A702052P26	Ceramic: 0.1uF + or - 10%, 50 VDCW
C43	19A705205P2	Tantalum: 1 uF, 16 VDCW; sim to Sprague 293D.
C44	19A702052P26	Ceramic: 0.1uF + or - 10%, 50 VDCW.
C45	19A702052P3	Ceramic: 470 pF + or - 10%, 50 VDCW.
C46	19A702052P3	Ceramic: 470 pF + or - 10%, 50 VDCW.
C49	19A705205P6	Tantalum: 10 uF, 16 VDCW; sim to Sprague 293D.
C50	19A702052P26	Ceramic: 0.1uF + or - 10%, 50 VDCW.
C51	19A701225P3	Electrolytic: 220 uF, -10+50%, 25 VDCW.
C52	19A134227P5	Variable: 1.5 to 14 pF, 100 VDCW. (Used in G40, G3 and G8).
C53	19A702052P26	Ceramic: 0.1uF + or - 10%, 50 VDCW.
C54	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C55	19A702052P26	Ceramic: 0.1uF + or - 10%, 50 VDCW.
C56	19A702052P26	Ceramic: 0.1uF + or - 10%, 50 VDCW
C57	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C58	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C59	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C60	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C61 and C62	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C63	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C64	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C65	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C66	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C67	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C68	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C69	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C70	19A702061P61	Ceramic: 100 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM.
C71	19A702061P61	Ceramic: 100 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM.
C72	19A702061P61	Ceramic: 100 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM.
C73	19A702061P61	Ceramic: 100 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM.
C74	19A702061P61	Ceramic: 100 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM.
C75	19A702061P61	Ceramic: 100 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM.
C76	19A702061P61	Ceramic: 100 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM.
C77	19A702061P61	Ceramic: 100 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM.
C78	19A702061P61	Ceramic: 100 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM.
C79	19A702061P61	Ceramic: 100 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM.
C80	19A702061P61	Ceramic: 100 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM.
C81	19A702061P61	Ceramic: 100 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM. (Used in G40, G3, G7 and G8).
C82 and C83	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW. (Used in G80, G5, G40,
C84	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C85	19A702061P99	Ceramic: 1000 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C86 and C87	19A702236P28	Ceramic: 12 pF + or - 5%, 50 VDCW, temp coef 0 + or -30 PPM. (Used in G80, G5, G40, G3, G7 and G8).
C88	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C89	19A702061P61	Ceramic: 100 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM.
C90	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW. (Used in G40, G3, G7
C91	19A702061P61	Ceramic: 100 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM. (Used in G80, G5, G40, G3, G7 and G8).
C92 thru C96	19A702061P61	Ceramic: 100 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM. (Used in G40, G3, G7 and G8).
C97	19A702236P1	Ceramic: 0.5 pF + or -.l pF, 50 VDCW, temp coef -30 PPM. (Used in G3, and G7).
C97	19A702236P11	Ceramic: 2.7 pF + or -.25 (Used in G8, G12).
C98 and C99	19A702236P30	Ceramic: 15 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C. (Used in G3, and G7).
C98 and C99	19A702236P31	Ceramic: 16 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C. (Used in G8, G12).
C98 and C99	19A702236P28	Ceramic: 12 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C. (Used in G10).
C100	19A702236P25	Ceramic: 10 pF + or -.5 pF, 50 VDCW, temp coef -30 PPM/°C.
C101	19A702236P10	Ceramic: 2.2 pF + or -2.5 pF, 50 VDCW, temp or -30 PPM/°C.
		- - - - - - - - - - DIODES - - - - - - - - - -
CR1	19A703595P10	Optoelectic: Red LED; sim to HP HLMP-1301-010.
		- - - - - - - - - - FILTERS - - - - - - - - - -
FL1	344A3802P4	FILTER ,HEL RF (Used in G8).
FL1	344A3802P2	FILTER ,HEL RF (Used in G3).
FL1	344A3802P3	FILTER, RF: 475 MHz SIM TO TOKO SHW-44545A-475 (Used in G7, G10)
FL1	344A3802P5	FILTER ,HEL RF: sim to TOKO SHW-39545A-415 (Used in G12).
		- - - - - - - - - - JACKS - - - - - - - - - -
J1	19B801587P7	Connector, DIN: 96 male contacts, right angle to AMP 650887-1.
J2 thru J4	19A115938P24	Connector, receptacle.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
*L2	19A705470P25	Coil, fixed: .1uH; sim to Toko 380LB-1R0M.
L3 and L4	19A700024P13	Coil, RF: 1.0 uH + or -10%.
L5	19A700024P15	Coil, RF: 1.5 uH + or - 10%.
L10	19C851001P4	Coil, RF: sim to Paul Smith SK901-1.
		- - - - - - - - - - - CRYSTALS - - - - - - - - -
Y1	19B801351P14	Module: Crystal Oscillator, 12.8 MHz + or -1.0 PPM.
		- - - - - - - - - - - DIODES - - - - - - - - - -
D3	19A705377P1	Silicon, Hot Carrier: sim to MMB0201.
D4 and D5	19A149674P1	DIODE ,SILICON.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	19A705470P2	Coil, Fixed: 12 nH; sim to Toko 380NB-12nM.
L7	19A705470P24	Coil, Fixed: 0.82 uH; sim to Toko 380NB-R82M.
L11 and L12	19A705470P2	Coil, Fixed: 12 nH; sim to Toko 380NB-12nM.
L13 and L14	19A705470P1	Coil, Fixed: 10 nH; sim to Toko 380NB-10nM.
L15	19A705470P10	Coil, fixed: 56 nH; sim to Toko 380NB-56nM.
L16 and L17	19A705470P15	Coil, fixed: .15uH; sim to Toko 380NB-R15M.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	19A702524P2	N-Type, field effect; sim to MMBFU310.
Q2	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
Q3 thru Q5	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
Q6	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
Q7	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
Q8	19A700059P2	Silicon, PNP: sim to MMBT3906, low profile.
Q9 thru Q11	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
Q12 and Q13	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
Q14 thru Q16	19A704708P2	Silicon, NPN: sim to NEC 2SC3356.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	19B800607P680	Metal film: 68 ohms + or -5%, 1/8 w.
R2	19B800607P100	Metal film: 10 ohms + or -5%, 1/8 w. (Used in G40, G3, G7
R3	19B800607P100	Metal film: 10 ohms + or -5%, 1/8 w.
R4	19B800607P100	Metal film: 10 ohms + or -5%, 1/8 w.
R5 thru R9	19B800607P100	Metal film: 10 ohms + or -5%, 1/8 w.
R10	19B800607P1	Metal film: 0 ohms.
R11	19B800607P183	Metal film: 18K ohms + or -5%, 1/8 w.
R12	19B800607P271	Metal film: 270 ohms + or -5%, 1/8 w.
R13	19B800607P510	Metal film: 51 ohms + or -5%, 1/8 w.
R14	19B800607P271	Metal film: 270 ohms + or -5%, 1/8 w.
R15	19B800607P180	Metal film: 18 ohms + or -5%, 1/8 w.
R16	19B800607P392	Metal film: 3.9K ohms + or -5%, 1/8 w.

* COMPONENTS, ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	PART NO.	DESCRIPTION
R17	19B800607P120	Metal film: 12 ohms + or -5%, 1/8 w.
R18	19B800607P180	Metal film: 18 ohms + or -5%, 1/8 w.
R19	19B800607P100	Metal film: 10 ohms + or -5%, 1/8 w.
R20	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R21	19B800607P472	Metal film: 4.7K ohms + or -5%, 1/8 w.
R22	19B800607P271	Metal film: 270 ohms + or -5%, 1/8 w.
R23	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R24	19B800607P562	Metal film: 5.6K ohms + or -5%, 1/8 w.
R27	19B800607P181	Metal film: 180 ohms + or -5%, 1/8 w.
R28	19B800607P181	Metal film: 180 ohms + or -5%, 1/8 w.
R29	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R30	19B800607P560	Metal film: 56 ohms + or -5%, 1/8 w. (Used in G3, G7, G8, G12).
R30	19B800607P680	Metal film: 68 ohms + or -5%, 1/8 w. (Used in G10).
R31	19B800607P270	Metal film: 27 ohms + or -5%, 1/8 w.
R32	19B800607P472	Metal film: 4.7K ohms + or -5%, 1/8 w.
R33	19B800607P472	Metal film: 4.7K ohms + or -5%, 1/8 w.
R34	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R35	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R36	19B800607P393	Metal film: 39K ohms + or -5%, 1/8 w.
R37	19B800607P104	Metal film: 100K ohms + or -5%, 1/8 w.
R38	19B800607P682	Metal film: 6.8K ohms + or -5%, 1/8 w.
R39	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R40	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R41	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R42	19B800607P823	Metal film: 82K ohms + or -5%, 1/8 w.
R43	19B800607P333	Metal film: 33K ohms + or -5%, 1/8 w.
R44	19B800607P274	Metal film: 270K ohms + or -5%, 1/8 w.
R45	19B800607P472	Metal film: 4.7K ohms + or -5%, 1/8 w.
R46	19B800607P181	Metal film: 180 ohms + or -5%, 1/8 w.
R47	19B800607P271	Metal film: 270 ohms + or -5%, 1/8 w.
R48	19B800607P181	Metal film: 180 ohms + or -5%, 1/8 w.
R49	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R50	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R51	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R52	19B800607P473	Metal film: 47K ohms + or -5%, 1/8 w.
R53	19B800607P473	Metal film: 47K ohms + or -5%, 1/8 w.
R54	19B800607P473	Metal film: 47K ohms + or -5%, 1/8 w.
R55	19B800607P222	Metal film: 2.2K ohms + or -5%, 1/8 w.
R57	19B800607P473	Metal film: 47K ohms + or -5%, 1/8 w.
R58	19B800607P681	Metal film: 680 ohms + or -5%, 1/8 w.
R59	19B800607P222	Metal film: 2.2K ohms + or -5%, 1/8 w.
R60	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R61	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R62	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R63	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R64	19B800607P510	Metal film: 51 ohms + or -5%, 1/8 w.
R65	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R66	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R67	19B800607P473	Metal film: 47K ohms + or -5%, 1/8 w.
R68	19B800607P473	Metal film: 47K ohms + or -5%, 1/8 w.
R69	19B800607P333	Metal film: 33K ohms + or -5%, 1/8 w.
R70	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R71	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R72	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R73	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R74	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R75	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R76	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R77	19B800607P101	Metal film: 100 ohms + or -5%, 1/8 w.
R78	19B800607P101	Metal film: 100 ohms + or -5%, 1/8 w.
R79	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R80	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R81	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R82	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R83	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R84	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R85	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R86	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R87	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R88	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R89	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R90	19B800607P222	Metal film: 2.2K ohms + or -5%, 1/8 w.
R91	19B800607P101	Metal film: 100 ohms + or -5%, 1/8 w.
R92 thru R94	19B800607P101	Metal film: 100 ohms + or -5%, 1/8 w.
R95	19B800607P101	Metal film: 100 ohms + or -5%, 1/8 w.
R96	19B800607P221	Metal film: 220 ohms + or -5%, 1/8 w.
R97	19B800607P220	Metal film: 22 ohms + or -5%, 1/8 w.
R98	19B800607P180	Metal film: 18 ohms + or -5%, 1/8 w.
R99	19B800607P120	Metal film: 12 ohms + or -5%, 1/8 w.
R100	19B800607P330	Metal film: 33 ohms + or -5%, 1/8 w.
R101 and R102	19B800607P121	Metal film: 120 ohms + or -5%, 1/8 w. (Used in G3, G7, G8, G12).
R101 and R102	19B800607P101	Metal film: 100 ohms + or -5%, 1/8 w. (Used in G10).
R103	19B800607P390	Metal film: 39 ohms + or -5%, 1/8 w.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
U2	19A705927P1	Silicon, bipolar: sim to Avantek MSA-0611.
U3	19A705927P1	Silicon, bipolar: sim to Avantek MSA-0611.
U4	19A705927P1	Silicon, bipolar: sim to Avantek MSA-0611.
U5	19A149944P201	Dual Modulus Prescaler: sim to Motorola MC12022A.
U6	19B800902P5	Synthesizer, custom: CMOS, serial input.
U8	19A702293P3	Linear: Dual Op Amp; sim to LM358D.
U9	19A702293P3	Linear: Dual Op Amp; sim to LM358D.
U10	19A703471P320	Digital: 3-Line To 8-Line Decoder; sim to 74HC138.
U12 and U13	19A703483P302	Digital: Quad 2-Input NAND Gate; sim to 74HC00.
U14	19A702705P4	Digital: Quad Analog Switch/Multiplexer; sim to 4066BM.
U15	19A704971P8	Voltage Regulator, Positive: sim to Motorola MC78M05CDT.
U16	19A704971P10	Voltage Regulator, 8V: sim to MC78M08CDT

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 - UHF RECEIVER SYNTHESIZER BOARD 19D902664G3

The UHF Receiver Synthesizer module was modified to meet ETSI requirements.

Items 3 and 7 were changed and item 23 was added.

Item 3 was: 19D902509P3.
Item 7 was: 19A702381P513.
C16 was 6.8 pF (19A702236P21).
C2 was deleted (19A702236P10).

REV. A - UHF RECEIVER SYNTHESIZER BOARD 19D902664G7
REV. B - UHF RECEIVER SYNTHESIZER BOARD 19D902664G3

To improve operation.
C3 was 22 pF (19A702236P34).
C5 was 10 pF (19A702236P25).
C6 was 18 pF (19A702236P32).
C16 was 8.2 pF (19A702236P23).
R4 was 47 ohms (19B800607P470).

REV. B - UHF RECEIVER SYNTHESIZER BOARD 19D902664G7
REV. C - UHF RECEIVER SYNTHESIZER BOARD 19D902664G3

To support 12.5kHz operation, changed Y1.
Was 1.5PPM crystal (19B801351P12).

REV. C - UHF RECEIVER SYNTHESIZER BOARD 19D902664G7

To reduce spurious radiation to meet ETSI specs.
L12 and R18 interchanged. L2 was 1uH (19A700024P13).

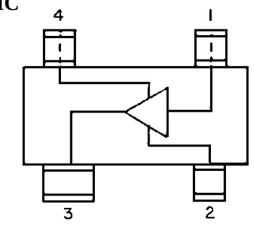
REV. D - UHF RECEIVER SYNTHESIZER BOARD 19D902664G3 & G7

To prevent regulator from drop out at low voltages.
R10 was 10 ohms (19B800607P100).

REV. E - UHF RECEIVER SYNTHESIZER BOARD 19D902664G3

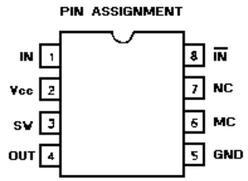
To correct timing range added C2 (and changed C16).
C16 was 8.2 pF (19A702236P23).

U2 thru U4
19A705927P1
Silicon Bipolar IC



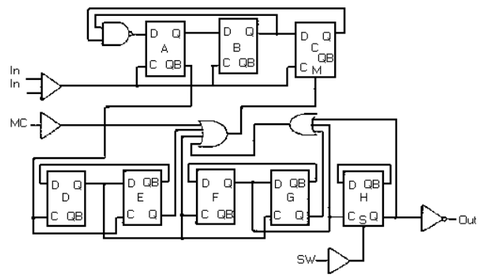
PIN 1. RF INPUT
2. GROUND
3. RF OUTPUT AND BIA
4. GROUND

U5
19A149944P201
Modulus Prescaler

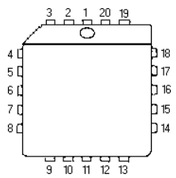


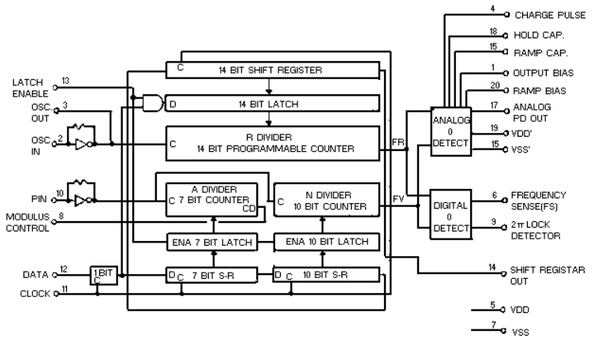
FUNCTION TABLE		
SW	MC	DIVIDE RATIO
H	H	64
H	L	65
L	H	128
L	L	129

SW: H = Vcc L = OPEN
MC: H = 2.0V TO Vcc
L = GND TO 0.8V

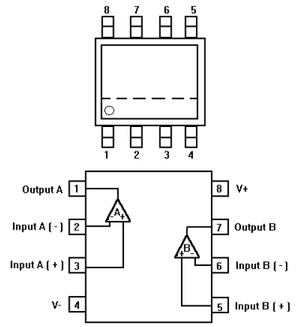


U6
19B80090P5
Synthesizer

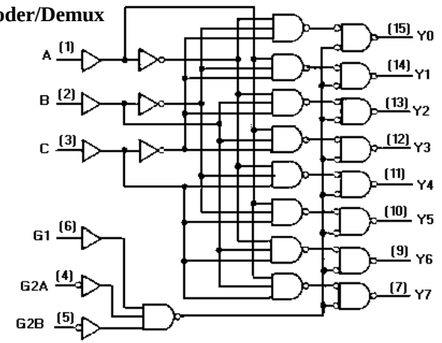


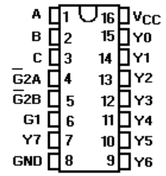


U8 & U9
19A702293P3
Dual Operational Amplifier

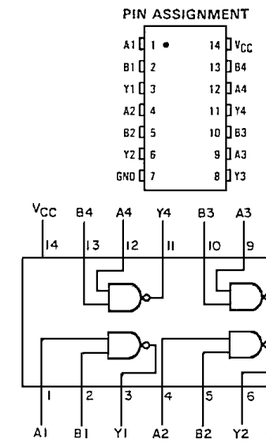


U10
19A703471P120
Decoder/Demux

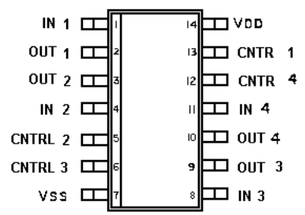


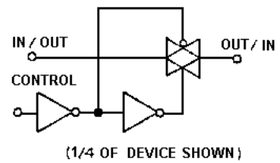


U12 & U13
19A703483P302
Logic Gate/Inverter



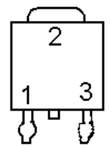
U14
19A702705P4
Quad Analog Switch





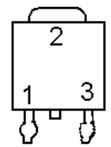
CONTROL	SWITCH
0	OFF
1	ON

U15
19A704971P8
+5V Regulator



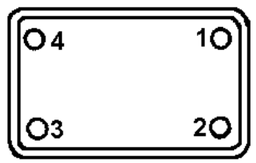
PIN	FUNCTION
1	INPUT
2	GROUND
3	OUTPUT

U16
19A704971P10
+8V Regulator



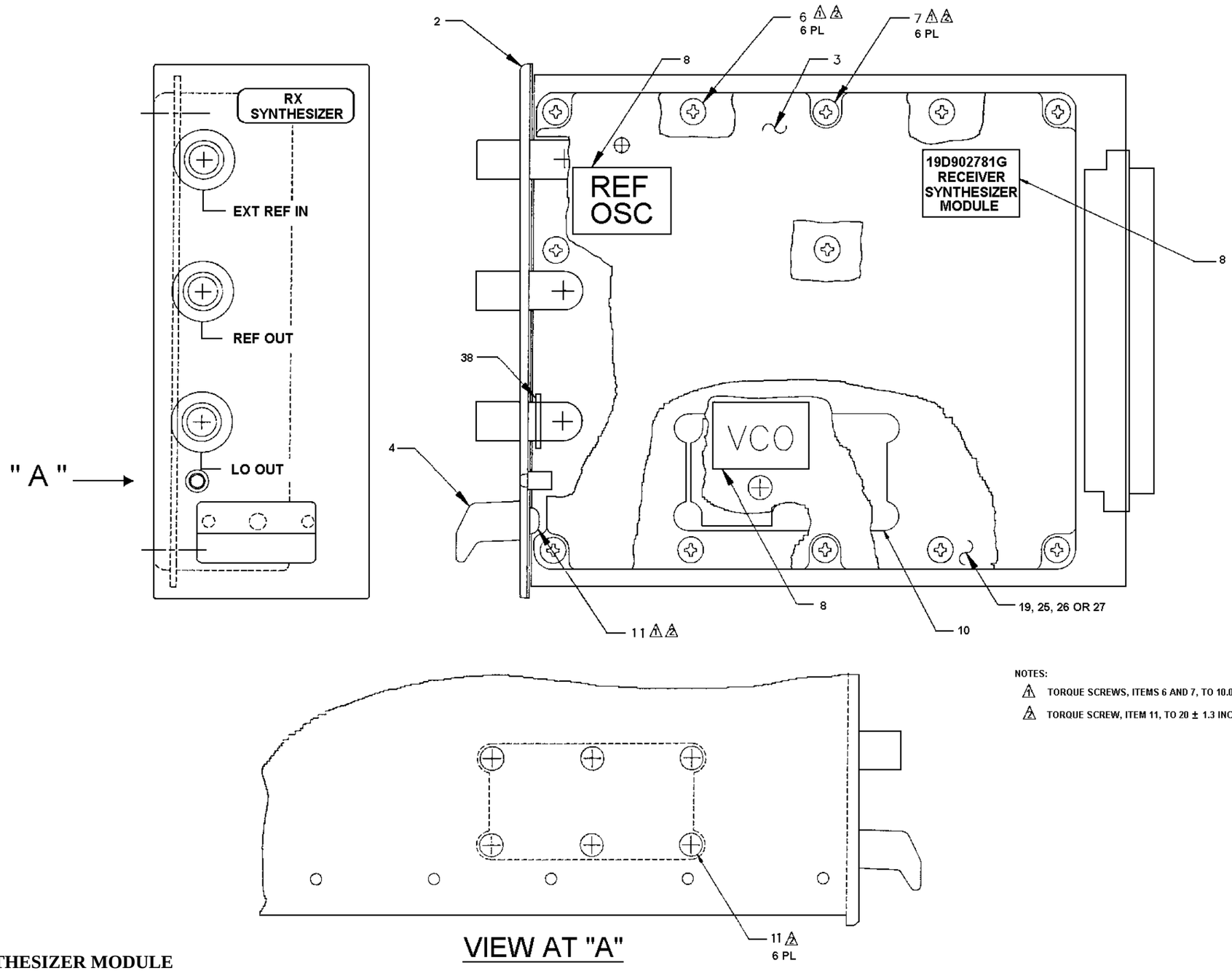
PIN	FUNCTION
1	INPUT
2	GROUND
3	OUTPUT

Y1
19B801351P12
Crystal Oscillator



PIN CONNECTIONS

1. COMMON & CASE
2. OUTPUT
3. + Vcc
4. MODULATION



NOTES:

⚠1 TORQUE SCREWS, ITEMS 6 AND 7, TO 10.0 ± 1.3 INCH POUNDS.

⚠2 TORQUE SCREW, ITEM 11, TO 20 ± 1.3 INCH POUNDS.

RECEIVER SYNTHESIZER MODULE
19D902781G3, G7, G8, G10, G12

(19D902781, Sh. 2, Rev. 5)

REFERENCE OSCILLATOR & BUFFER

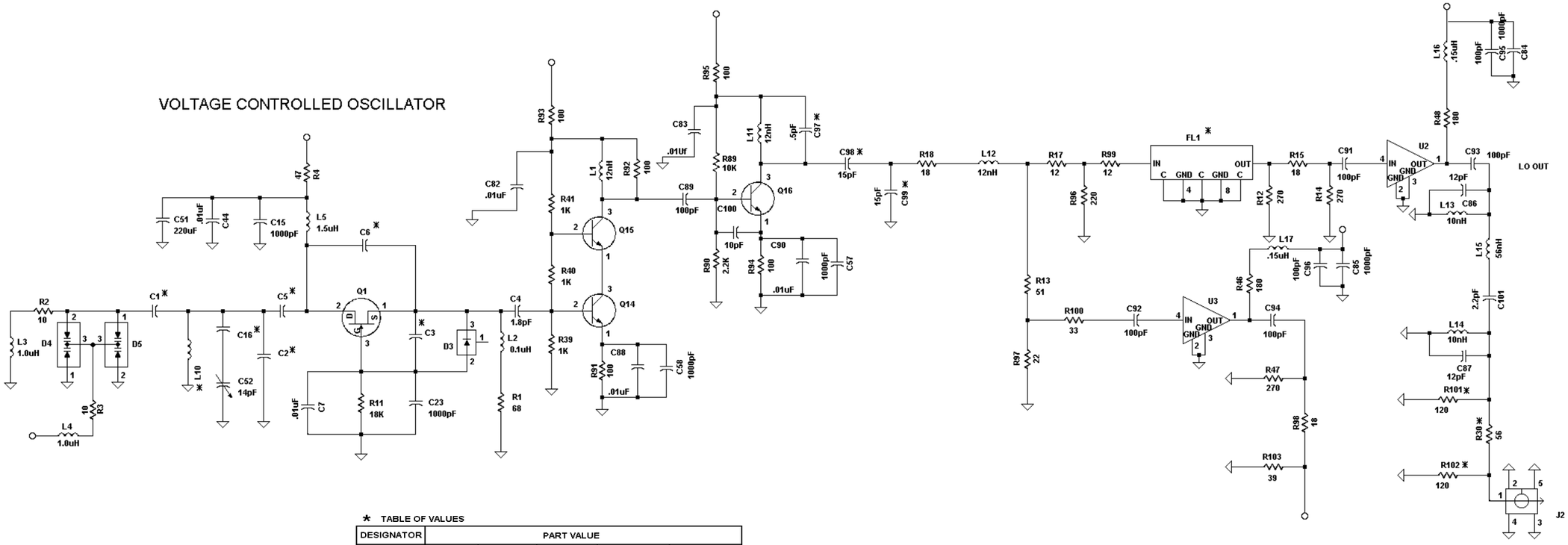
LOOP FILTER

SYNTHESIZER IC'S

THIS SCHEMATIC DIAGRAM APPLIES TO	
MODEL NO.	REV LETTER
19D902664G3	E
19D902664G7	D
19D902664G8	A
19D902664G10	A

RECEIVER SYNTHESIZER MODULE
19D902664G3, G7, G8, G10, G12

(19D904091, Sh. 1, Rev. 9A)

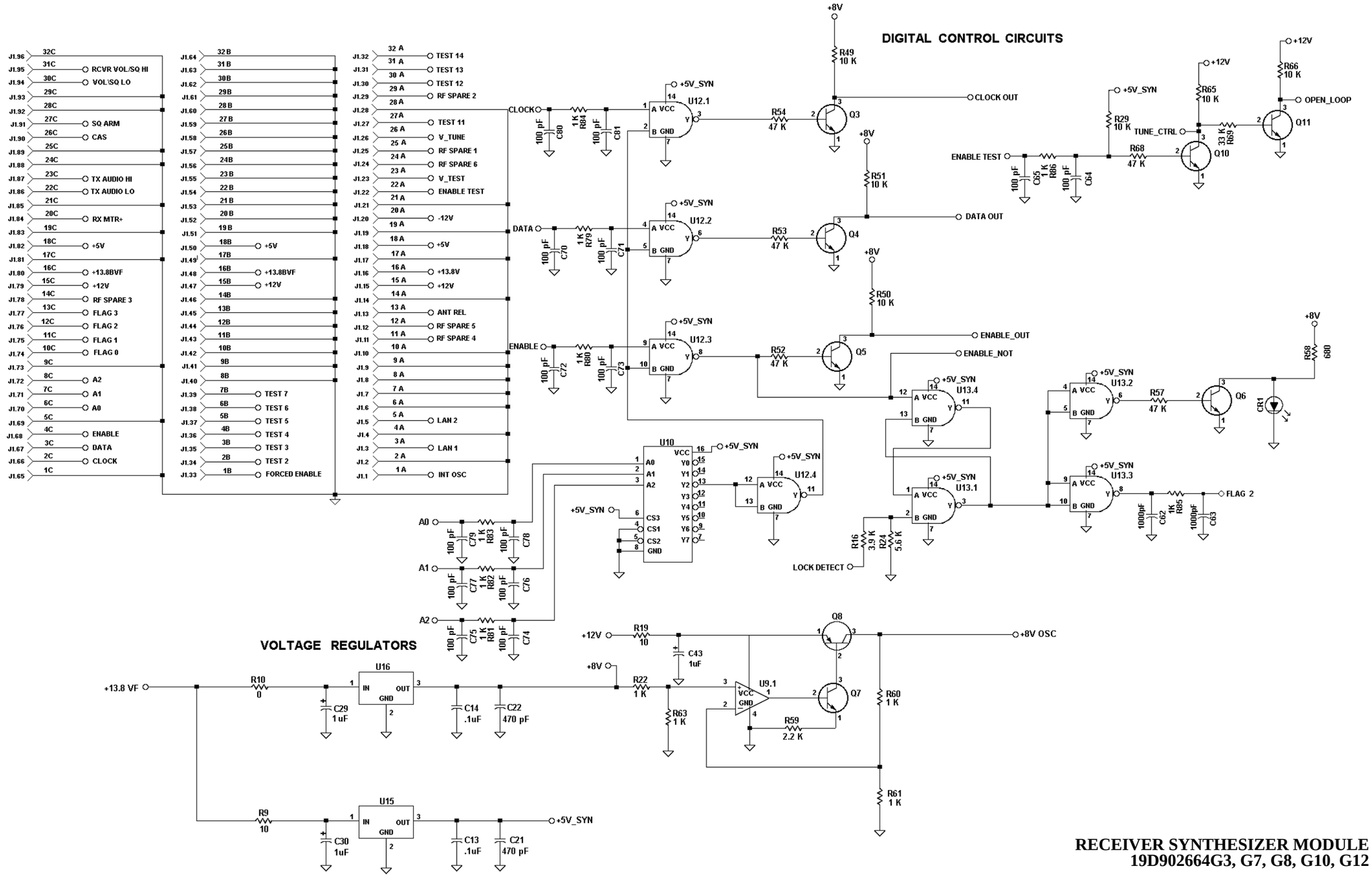


* TABLE OF VALUES

DESIGNATOR	PART VALUE				
	902781G3	902781G7	902781G8	902781G10	902781G12
C1	3.9pF	3.9pF	4.7pF	3.9pF	4.7pF
C2	1pF	NOT USED	3.9pF	NOT USED	5.6pF
C3	33pF	27pF	27pF	22pF	27pF
C5	15pF	12pF	12pF	12pF	12pF
C6	27pF	22pF	22pF	18pF	22pF
C16	10pF	10pF	12pF	10pF	16pF
C97	.5pF	.5pF	2.7pF	NOT USED	2.7pF
C98	15pF	15pF	16pF	12pF	16pF
C99	15pF	15pF	16pF	12pF	16pF
R30	56	56	56	68	56
R101	120	120	120	100	120
R102	120	120	120	100	120

RECEIVER SYNTHESIZER MODULE
19D902664G3 , G7, G8, G10, G12

(19D904091, Sh. 2, Rev. 9A)



RECEIVER SYNTHESIZER MODULE
19D902664G3, G7, G8, G10, G12

(19D904091, Sh. 3, Rev. 9A)

MAINTENANCE MANUAL FOR RECEIVER FRONT END MODULE 19D902782G3, G4, & G7

TABLE OF CONTENTS

DESCRIPTION

The Receiver Front End (RXFE) Module amplifies and converts the Rf signal to the first IF signal of 21.4 MHz. This is a down conversion process using low side (G3, G4) or high side (G7) injection. The RXFE module is powered by a regulated 12 volts. The RXFE printed wiring board contains the following functional circuits:

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

All but the Fault Detector circuit in the RXFE module have 50 ohm impedance terminations.

ERICSSON

Ericsson Inc.
Private Radio Systems
Mountain View Road
Lynchburg, Virginia 24502
1-800-592-7711 (Outside USA, 804-592-7711)

Printed in U.S.A.

Table 1 - General Specifications

ITEM	SPECIFICATION
FREQUENCY RANGE	450.0 MHz - 470.0 MHz (G3, G4) 425.0 MHz - 470.0 MHz (G7)
IF FREQUENCY	21.4 MHz
3 dB BANDWIDTH	>3 MHz
IMPEDANCE	50 ohms at RF, LO, and IF Ports
CONVERSION LOSS	-2 dB ±1 dB
NOISE FIGURE (NF)	<7.5 dB
THIRD ORDER INTERCEPT POINT	>+20 dBm (G3, G4) >+15 dBm (G7)
IMAGE REJECTION	>100dB
INJECTION POWER	+2 dBm ±2 dB
TEMPERATURE RANGE	-30°C TO +60°C
SUPPLY VOLTAGE	12.0 Vdc
SUPPLY CURRENT	290 mA ±20 mA typical 230 mA ±20 mA typical (G3)

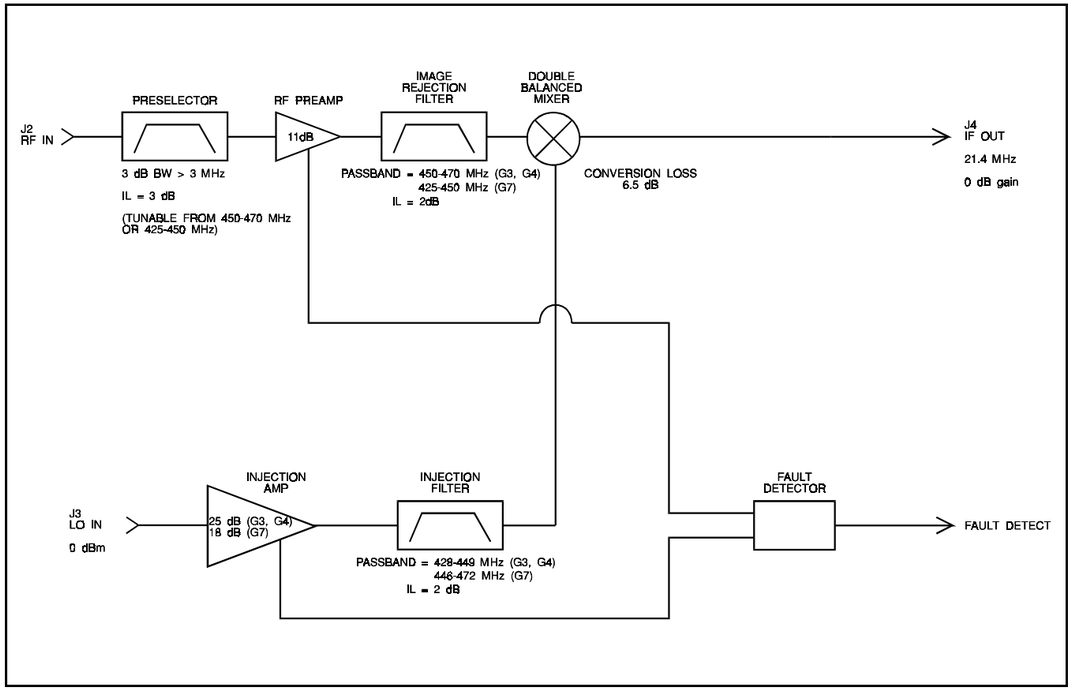


Figure 1 - Block Diagram

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 is 3 dB and an operational bandwidth of 2 MHz. The filter is primarily a five-pole helical bandpass filter (L1 thru L5) and is tunable in the band split MHz range.

PREAMPLIFIER

The output from the Preselector is coupled through an impedance matching network consisting of L6, C2, and DC blocking capacitor C1 to the base of Preamplifier Q1. Q1 is a broadband common emitter amplifier. The Preamplifier stage is supplied by the regulated +12 Vdc line (VCC1) and draws about 70 mA through R4. 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 R17. Capacitors C20 and C21 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 C4, L8, and resistors R5 and R6.

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IMAGE REJECTION FILTER

Following the Preamplifier is the Image Rejection Filter. The Image Rejection Filter is a fixed tuned helical bandpass filter and can meet the desired image rejection of the frequency band.

INJECTION AMPLIFIER

The local oscillator input (J3) from the Receiver Synthesizer is coupled through an impedance matching network (C5 and L9) to the base of the Injection Amplifier Q3. Q3 and Q8 are common emitter amplifiers. The output from Q3 is coupled through an impedance matching network (C6, C7, and L11) to the base of Q8. The Injection Amplifier, consisting of Q3, Q8, and associated circuitry, is capable of amplifying the injection signal from 0 dBm to +25 dBm in the 428 to 449 MHz range or to +18 dBm in the 446-472 MHz range. The amplifier is powered by the regulated +12 Vdc line (VCC1). Transistors Q4 and Q7 provide Q3 and Q8 with a constant voltage and current source. The bias on Q3 and Q8 is monitored by the Fault Detector circuit via R21 and R31, respectively. Capacitors C22, C23 and C26 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 C8, L13, and resistors R15 and R16.

INJECTION FILTER

Following the Injection Amplifier is the Injection Filter consisting of C9 through C19, L14 through L20, and R30. Configured as a bandpass filter, the Injection Filter has a bandwidth of 428 to 450 MHz (G3, G4) or 446 to 472 MHz (G7) 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 Balance Mixer (DBM) is a broadband mixer. It converts an RF signal to the 21.4 MHz first conversion IF frequency. The mixer uses low side (G3, G4) or high side (G7) injection driven by a local oscillator signal of +20 (G3, G4) or +15 (G7) dBm. The mixer conversion loss is typically about 6.5 dB. The IF output signal is then routed to the output connector (J4).

FAULT DETECTOR

The Fault Detector circuit monitors the operation of preamplifier and injection amplifier devices. Operational amplifiers U1.1 and U1.2 compare the bias on the Preamplifier Q1 to preset levels, while U1.3 and U1.4 compare the bias levels on Injection Amplifiers Q3 and Q8.

When the bias for Q1, Q3, and Q8 is 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 the amplifiers 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.

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, Bandwidth and Conversion Gain the RXFE module will meet its specifications. The following are test procedures will verify proper Conversion Gain and current drain:

1. Supply 12 Vdc to pin 15A, B, C. (1C is ground.)
2. Inject the desired RF signal into RF IN at a level of -10 dBm.
3. Inject the desired local oscillator signal into LO IN at a level of 0 dBm [LO frequency = RF frequency - 21.4 MHz (G3, G4) + 21.4 MHz (G7)].
4. Measure the IF OUT power at 21.4 MHz, the ratio of RF IN to IF OUT is -2 dB ±1 dB.
5. Measure the current drawn by the RXFE module. Typical current drain is 290 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 major receiver frequency change, the RXFE needs to be adjusted using the major-retuning procedures.

For Fine-Tuning

1. Supply 12 Vdc to pin 15A, B, C. (1C is ground.)
2. Inject the desired RF signal into RF IN (J2) at a level of -10 dBm.
3. Inject the desired local oscillator signal into LO IN (J3) at a level of 0 dBm [LO frequency = RF frequency - 21.4 MHz (G3, G4) + 21.4 MHz (G7)].
4. Detect IF signal at 21.4 MHz. Slightly adjust L1 to L5 to get maximum power (don’t adjust more than ten 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.
5. Repeat Test Procedure steps to verify conversion gain and current drain.

For Major Retuning

The best way to do a major retuning of the RXFE is with swept frequency tuning. The swept frequency tuning can be done using a Spectrum Analyzer and Tracking Generator. With proper Injection power and current drain, 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 at 0 dBm into the RF IN connector, (J2).
3. Inject local oscillator power at 0 dBm into the LO IN connector, (J3) [LO frequency = RF frequency - 21.4 MHz (G3, G4) + 21.4 MHz (G7)].
4. Preset the height of slugs with respect to the top of five-pole cavity as follows (Table 2):

Table 2

Frequency (MHz)	HEIGHT (in inches)				
	L1	L2	L3	L4	L5
450	15/64	16/64	17/64	17/64	16/64
454	16/64	17/64	17/64	18/64	15/64
458	16/64	19/64	19/64	19/64	17/64
462	18/64	19/64	20/64	20/64	18/64
466	21/64	22/64	23/64	21/64	20/64
470	22/64	24/64	24/64	23/64	22/64

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.

TROUBLESHOOTING GUIDE

SYMPTOM	AREAS TO CHECK	READING (TYP.)
LOW CONVERSION GAIN	Check Vcc	12 V
	Preselector Loss	3.5 dB
	Preamplifier Gain	11 dB
	Image Rej. Filter Loss	2 dB
	1st Mixer Conversion Loss	6.5 dB
	1 L.O. Level (@ mixer L.O. port)	+22 ±2 dBm (G3, G4) +14 ±2 dBm (G7)
LED INDICATOR ON	Check Vc of Q1	10 V
	Check Vc of Q3 and Q8	10 V
IF FREQUENCY OFF	Check L.O. FREQUENCY	L.O. frequency = RF frequency - 21.4 MHz (G3,G4) + 21.4 MHz (G7)
LOW L.O. POWER*	Injection Amplifier Gain	23 ±2 dB (G3, G4) 18 ±2 dB (G7)
	Injection Filter Loss	2 dB

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

- 12 Vdc supply.
- Inject L.O. power at a level of 0 dBm into LO IN (J3), [LO freq. = RF freq. - 21.4 MHz (G3, G4) + 21.4 MHz (G7).
- 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 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).

RECEIVER FRONT END MODULE
19D902782G3 (450-470 MHz)
19D902782G4 (450-470 MHz ETSI)
19D902782G7 (425-450 MHz)
ISSUE 5

SYMBOL	PART NUMBER	DESCRIPTION
4	19D902555P1	Handle.
5	19D902534P1	Cover, RF.
6	19A702381P506	Screw, thread forming: TORX, No. M3.5-.6 x 6.
7	19A702381P513	Screw, thread forming: TORX, No. M3.5-0.6 X 13.
11	19A702381P508	Screw, thd. form: No. 3.5-0.6 x 8.
		RECEIVER FRONT END BOARD 19D902490G3 (450-470 MHz) 19D902490G4 (450-470 MHz ETSI) 19D902490G7 (425-450 MHz)
		——— CAPACITORS ———
C1	19A702052P14	Ceramic: 0.01 µF ± 10%, 50 VDCW.
C2	19A702061P17	Ceramic: 12 pF ±5%, 50 VDCW, temp coef 0 ± 30 PPM.
C3	19A702052P14	Ceramic: 0.01 µF ± 10%, 50 VDCW.
C4	19A702061P12	Ceramic: 8.2 pF ± 0.5 pF, 50 VDCW, temp coef 0 ± 60 PPM. (Used in G3, G4).
C4	19A702061P61	Ceramic: 100pF,±5%, 50VDCW, temp coef 0±30 PPM/°C. (Used in G7).
C5	19A702061P17	Ceramic: 12 pF ±5%, 50 VDCW, temp coef 0 ± 30 PPM.
C6	19A702061P57	Ceramic: 82 pF ±5%, 50 VDCW, temp coef 0 ± 30 PPM. (Used in G3, G4).
C6	19A702061P63	Ceramic: 120 pf,±5%, 50VDCW, temp coef 0±30 PPM/°C. (Used in G7).
C7	19A702061P17	Ceramic: 12 pF ±5%, 50 VDCW, temp coef 0 ± 30 PPM. (Used in G3, G4).
C7	19A702061P10	Ceramic: 5.6 pF, 0.5 pF, 50VDCW, temp coef 0±60 PPM/°C. (Used in G7).
C8	19A702061P29	Ceramic: 22 pF ±5%, 50 VDCW, temp coef 0 ± 30 PPM. (Used in G3, G4).
C8	19A702061P63	Ceramic: 120 pF,±5%, 50VDCW, temp coef 0±30 PPM. (Used in G7).
C9	19A702061P13	Ceramic: 10 pF ±5%, 50 VDCW, temp coef 0 ± 30 PPM. (Used in G3, G4).
C9	19A702061P17	Ceramic: 12 pF, ±5%, 50VDCW, temp coef 0±30 PPM. (Used in G7).
C10	19A702061P11	Ceramic: 6.8 pF ± 0.5 pF, 50 VDCW, temp coef 0 ± 60 PPM. (Used in G3, G4).
C10	19A702061P21	Ceramic: 15 pF,±5%, 50VDCW, temp coef 0±30 PPM. (Used in G7).
C11	19A702061P12	Ceramic: 8.2 pF ± 0.5 pF, 50 VDCW, temp coef 0 ± 60 PPM. (Used in G3, G4).
C11	19A702061P25	Ceramic: 18 pF,±5%, 50VDCW, temp coef 0±30 PPM. (Used in G7).
C12 and C13	19A702061P13	Ceramic: 10 pF ±5%, 50 VDCW, temp coef 0 ± 30 PPM. (Used in G3, G4).
C12	19A702061P21	Ceramic: 15 pF,±5%, 50VDCW, temp coef 0±30 PPM. (Used in G7).
C13	19A702061P13	Ceramic: 10 pF,±5%, 50VDCW, temp coef 0±30 PPM.
C14	19A702061P8	Ceramic: 3.9 pF ± 0.5 pF, 50 VDCW, temp coef 0 ± 120 PPM. (Used in G3, G4).
C14	19A702061P7	Ceramic: 3.3 pF, 0.5 pF, 50VDCW, temp coef 0±120 PPM. (Used in G7).
C15	19A702061P11	Ceramic: 6.8 pF ± 0.5 pF, 50 VDCW, temp coef 0 ± 60 PPM. (Used in G3, G4).
C15	19A702061P69	Ceramic: 220 pF,±5%, 50VDCW, temp coef 0±30 PPM. (Used in G7).
C16	19A702061P8	Ceramic: 3.9 pF ± 0.5 pF, 50 VDCW, temp coef 0 ± 120 PPM. (Used in G3, G4).
C16	19A702061P7	Ceramic: 3.3 pF, 0.5 pF, 50VDCW, temp coef 0±120 PPM. (Used in G7).
C17	19A702061P9	Ceramic: 4.7 pF ± 0.5 pF, 50 VDCW, temp coef 0 ± 60 PPM. (Used in G3, G4).
C17	19A702061P69	Ceramic: 220 pF,±5%, 50VDCW, temp coef 0±30 PPM. (Used in G7).
C18	19A702061P8	Ceramic: 3.9 pF ± 0.5 pF, 50 VDCW, temp coef 0 ± 120 PPM. (Used in G3, G4).
C18	19A702061P7	Ceramic: 3.3 pF, 0.5 pF, 50VDCW, temp coef 0±30 PPM. (Used in G7).
C19	19A702061P45	Ceramic: 47 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C20 thru C28	19A702052P14	Ceramic: 0.01 µF ± 10%, 50 VDCW.
C29 and C30	19A702061P89	Ceramic: 1500 pF, ±5%, 50VDCW, temp coef 0±120 PPM. (Used in G4 & G7).
*C29 and *C30	19A705205P26	Tantalum: 3.3 µF ±20%, 16VDCW, (Used in G3).
*C31 and *C32	19A705205P15	Tantalum: 33 µF ±20%, 16VDCW, (Used in G3).
C31 thru C33	19A702236P40	Ceramic: 39 pF, ±5%, 50VDCW, temp coef 0±30 PPM. (Used in G4 & G7).
C34 thru C36	19A702061P37	Ceramic: 33 pF,±5%, 50VDCW, temp coef 0±30 PPM. (Used in G4 & G7).
*C37 and *C38	19A705205P26	Tantalum: 3.3 µF ±20%, 16VDCW, (Used in G4, G7).
*C39 and *C40	19A705205P15	Tantalum: 33 µF ±20%, 16VDCW, (Used in G4, G7).
		——— DIODES———
CR1	344A3062P1	Diode, Schotty (part of 19D902782G3).
CR2	19A703595P10	Diode, Optoelectric: Red; sim to HP HLMP-1301-010. (Used in G3).
		——— FILTERS———
FL1	19A705458P1	Helical, UHF: 450-470 MHz. (Used in G3, G4).
FL1	19A705458P5	Helical, UHF: 425-450 MHz. (Used in G7).
		——— JACKS ———
J1	19B801587P7	Connector, DIN: 96 male contacts, right angle mounting; sim to AMP 650887-1.
J2 thru J4	19A115938P24	Connector, receptacle.
		——— INDUCTORS ———
L1	19C850817P10RF	Coil: sim to Paul Smith SK853-1. (Used in G3, G4).
L1	19C850817P25	Coil. (Used in G7).
L2 thru L4	19C850817P9	RF Coil: sim to Paul Smith SK853-1. (Used in G3, G4).
L2 thru L4	19C850817P5	Coil. (Used in G7).
L5	19C850817P10	RF Coil: sim to Paul Smith SK853-1. (Used in G3, G4).
L5	19C850817P25	Coil. (Used in G7).
L6	19A705470P3	Coil, Fixed: 15 nH; sim to Toko 380NB-15nM.
L7	19A705470P16	Coil, Fixed: 0.18 µH; sim to Toko 380NB-R18M.
L8	19A705470P7	Coil, fixed: 33 nH ±20%; sim to Toko 380NB-33nM.
L9	19A705470P5	Coil, Fixed: 22 nH; sim to Toko 380NB-22nM. (Used in G3, G4).
L9	19A705470P3	Coil, fixed: 15 nH; sim to Toko 380NB-15nM. (Used in G7).
L10	19A705470P16	Coil, Fixed: 0.18 µH; sim to Toko 380NB-R18M.
L11	19A705470P3	Coil, Fixed: 15 nH; sim to Toko 380NB-15nM. (Used in G3, G4).
L11	19A705470P5	Coil, fixed: 22 nH: sim to Toko 380NB-22nM. (Used in G7).
L12	19A705470P16	Coil, Fixed: 0.18 µH; sim to Toko 380NB-R18M.
L13	19A705470P6	Coil, Fixed: 27 nH; sim to Toko 380NB-27nM. (Used in G3, G4).
L13	19A705470P8	Coil, fixed: 39 nH; sim to Toko 380NB-35nM. (Used in G7).
L14	19A705470P4	Coil, Fixed: 18 nH; sim to Toko 380NB-18nM. (Used in G3, G4).
L15	19A705470P7	Coil, fixed: 33 nH ±20%; sim to Toko 380NB-33nM. (Used in G3, G4).
L14 and L15	19A705470P1	Coil, fixed: 10 nH; sim to Toko 380NB-10nM. (Used in G7).
L16 and L17	19A705470P5	Coil, Fixed: 22 nH; sim to Toko 380NB-22nM. (Used in G3, G4).
L16 and L17	19A705470P2	Coil, fixed: 12 nH; sim to Toko 380NB-12 nM. (Used in G7).
L18	19A705470P1	Coil, Fixed: 10 nH; sim to Toko 380NB-10nM. (Used in G3, G4).
L18	19A705470P3	Coil, fixed: 15 nH; sim to Toko 380NB-15nM. (Used in G7).
L19	19A705470P3	Coil, fixed: 15 nH; sim to Toko 380NB-15nM.
L20	19A705470P24	Coil, Fixed: 0.82 µH; sim to Toko 380NB-R82M.
L21	19A705470P16	Coil, Fixed: 0.18 µH; sim to Toko 380NB-R18M.
L22	19A700021P105	Coil, RF ceramic: 22 nH. (Used in G4).
L22	19A705470P6	Coil, fixed: 27 nH; sim to Toko 380NB-27nM. (Used in G7).
L23	19A700021P13	Coil, RF ceramic: 470 nH. (Used in G4).
L23	19A705470P21	Coil, fixed: 0.47 uH; sim to Toko 380NB-R47M. (Used in G7).
*L24	19A700000P122	Coil, fixed: 8.2 uH ± 10%; sim to Jeffers 22-8.2-10.
		——— TRANSISTORS———
Q1	344A3058P1	Silicon, NPN.
Q2	19A700059P2	Silicon, PNP: sim to MMBT3906, low profile.
Q3	19A704708P3	Silicon NPN.
Q4	19A700059P2	Silicon, PNP: sim to MMBT3906, low profile.
Q5 and Q6	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile. (Used in G3).
Q7	19A700059P2	Silicon, PNP: sim to MMBT3906, low profile.
Q8	344A3058P1	Silicon, NPN.
		——— RESISTORS ———
R1	19B800607P183	Metal film: 18K ohms ±5%, 1/8 w.
R2	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R3	19B800607P331	Metal film: 330 ohms ±5%, 1/8 w.
R4	19B800607P270	Metal film: 27 ohms ±5%, 1/8 w.
R5	19B800607P100	Metal film: 10 ohms ±5%, 1/8 w. (Used in G3, G4).
R5	19B800607P1	Metal film: 0 ohms. (Used in G7).
R6	19B800607P391	Metal film: 390 ohms ±5%, 1/8 w. (Used in G3, G4).
R7	19B800607P183	Metal film: 18K ohms ±5%, 1/8 w.
R8	19B800607P682	Metal film: 6.8K ohms ±5%, 1/8 w.
R9	19B800607P182	Metal film: 1.8K ohms ±5%, 1/8 w.
R10	19B800607P470	Metal film: 47 ohms ±5%, 1/8 w. (Used in G3).
R10	19B800607P221	Metal film: 220 ohms ±5%, 1/8w. (Used in G4).
R11	19B800607P331	Metal film: 330 ohms ±5%, 1/8 w.
R12	19B800607P562	Metal film: 5.6K ohms ±5%, 1/8 w.
R13	19B800607P122	Metal film: 1.2K ohms ±5%, 1/8 w.
R14	19B800607P180	Metal film: 18 ohms ±5%, 1/8 w. (Used in G3, G4).
R14	19B800607P270	Metal film: 27 ohms ±5%, 1/8 w (Used in G7).
R15	19B800607P270	Metal film: 27 ohms ±5%, 1/8 w.
R16	19B800607P181	Metal film: 180 ohms ±5%, 1/8 w.
R17	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R18	19B800607P562	Metal film: 5.6K ohms ±5%, 1/8 w.
R19	19B800607P183	Metal film: 18K ohms ±5%, 1/8 w.
R20	19B800607P333	Metal film: 33K ohms ±5%, 1/8 w.
R21	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R22	19B800607P822	Metal film: 8.2K ohms ±5%, 1/8 w.

* COMPONENTS, ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	PART NUMBER	DESCRIPTION
R23 and R24	19B800607P333	Metal film: 33K ohms ±5%, 1/8 w.
R25	19B800607P104	Metal film: 100K ohms ±5%, 1/8 w. (Used in G3).
R26	19B800607P273	Metal film: 27K ohms ±5%, 1/8 w. (Used in G3).
R27	19B800607P391	Metal film: 390 ohms ±5%, 1/8 w. (Used in G3).
R28	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R29	19B800607P682	Metal film: 6.8K ohms ±5%, 1/8 w.
R30	19B800607P470	Metal film: 47 ohms ±5%, 1/8 w.
R31	19B800607P103	Metal film: 10K ohm,±5%, 1/8w.
R32	19B800607P560	Metal film: 56 ohms,±5%, 1/8w.
R33	19B800607P510	Metal film: 51 ohms,±5%, 1/8w. (Used in G7).
R34	19B801251P1	Metal film: 0 ohms.
R35	19B800607P270	Metal film: 27 ohms,±5%, 1/8w. (Used in G7).
		——— TRANSFORMERS ——
T1 and T2	344A3063P1	Transformer.
		—— INTEGRATED CIRCUITS —
U1	19A704125P1	Linear: Quad Comparator; sim to LM339D.
		——— MISCELLANEOUS ——
20	19B800701P2	Tuning screw.
21	19A701800P1	Stop nut.
22	19D902467P2	Casting.
28	19D902534P2	Cover, RF. (Used in G4).
29	19D904572P1	Cover, Gasket. (Used in G4).
30	19B802690P1	Grommet. (Used in G4).

PRODUCTION CHANGES

Changes in the equipment to improve 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 descriptions of parts affected by these revisions.

REV. A - RECEIVER FRONT END BOARD 19D902490G3
Upgrade to ETSI specs. New PWB.

REV. B - RECEIVER FRONT END BOARD 19D902490G3

REV. A - RECEIVER FRONT END BOARD 19D902490G4
To correct overheating problem.
R14 was 10 ohms (19B800607P100).

REV. C - RECEIVER FRONT END BOARD 19D902490G3
To eliminate receiver spurious response at 100 kHz switching power supply frequency.
Added C29, C30, C31, C32 and L24.

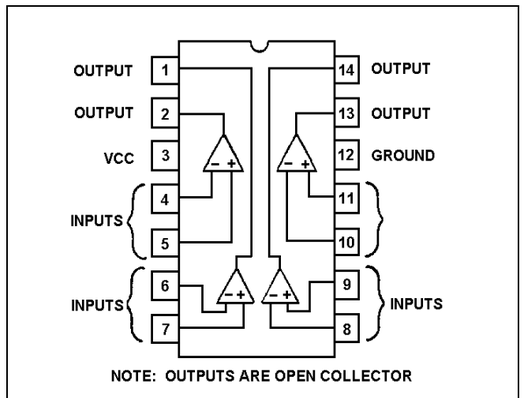
REV. B - RECEIVER FRONT END BOARD 19D902490G4

REV. A - RECEIVER FRONT END BOARD 19D902490G7
To eliminate receiver spurious response at 100 kHz switching power supply frequency.
Added C37, C38, C39, C40 and L24.

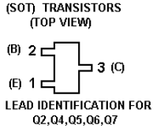
PRODUCTION CHANGES - CONT.

REV. B - RECEIVER FRONT END BOARD 19D902490G7
To improve receiver sensitivity L8 changed from 18nH (19A705470P4) to 33nH (19A705470P7);
R5 changed from 10 ohms (19B800607P100) to 0 ohms (19B800607P1);
R14 changed from 18 ohms (19B800607P180) to 27 ohms (19B800607P270);
R6 (19B800607P391) and R36 (19B800607P391) were deleted.

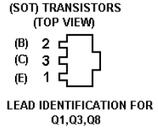
REV. D - RECEIVER FRONT END BOARD 19D902490G3
Reduce excessive LO drive level. Changed R15 from 10 ohms (19B800607P100) to 27 ohms (19B800607P270).
Changed R16 from 390 ohms (19B800607P391) to 180 ohms (19B800607P181).



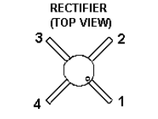
U1
19A704125P1
Quad Operational Amplifier



LEAD IDENTIFICATION FOR Q2,Q4,Q5,Q6,Q7

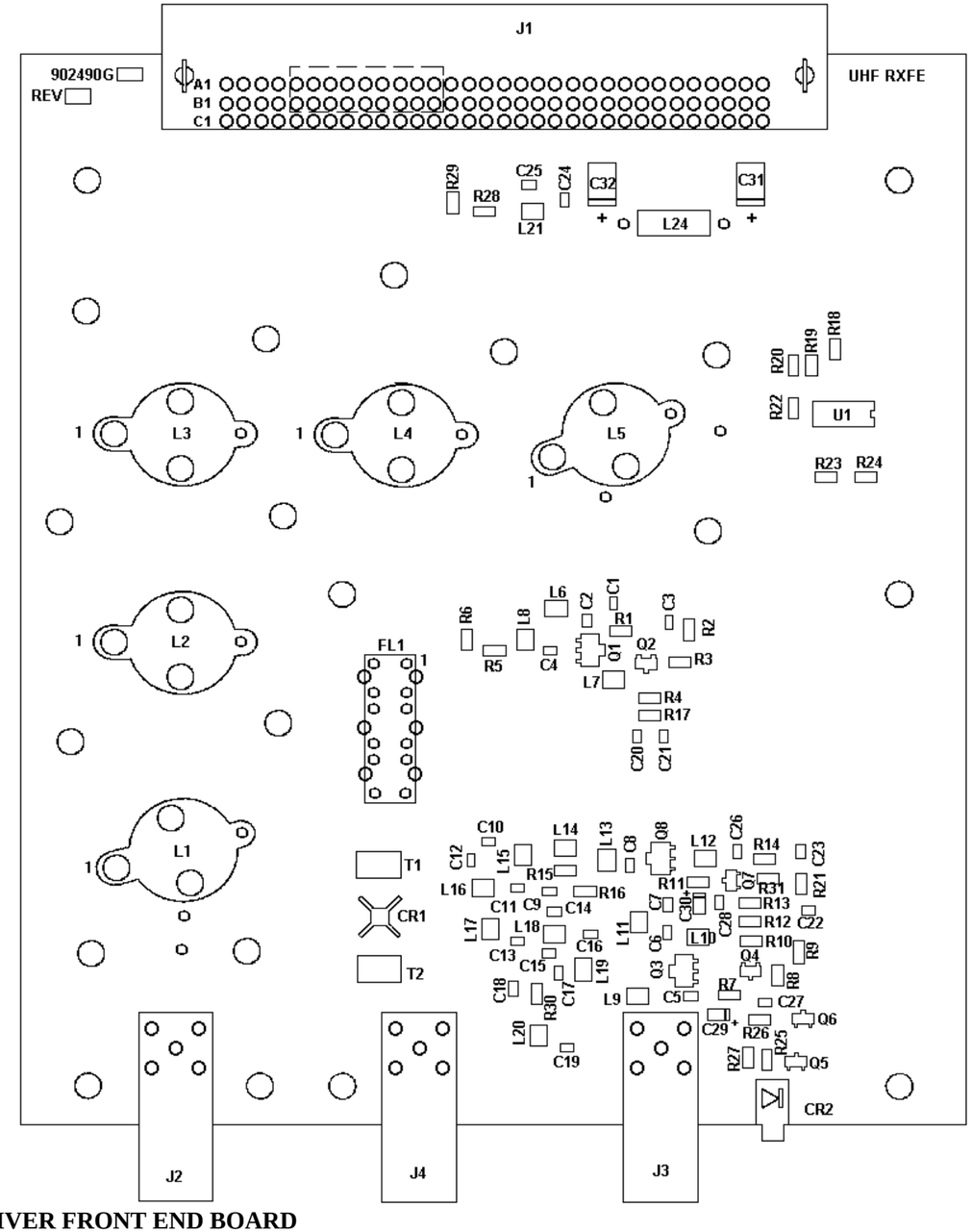


LEAD IDENTIFICATION FOR Q1,Q3,Q8

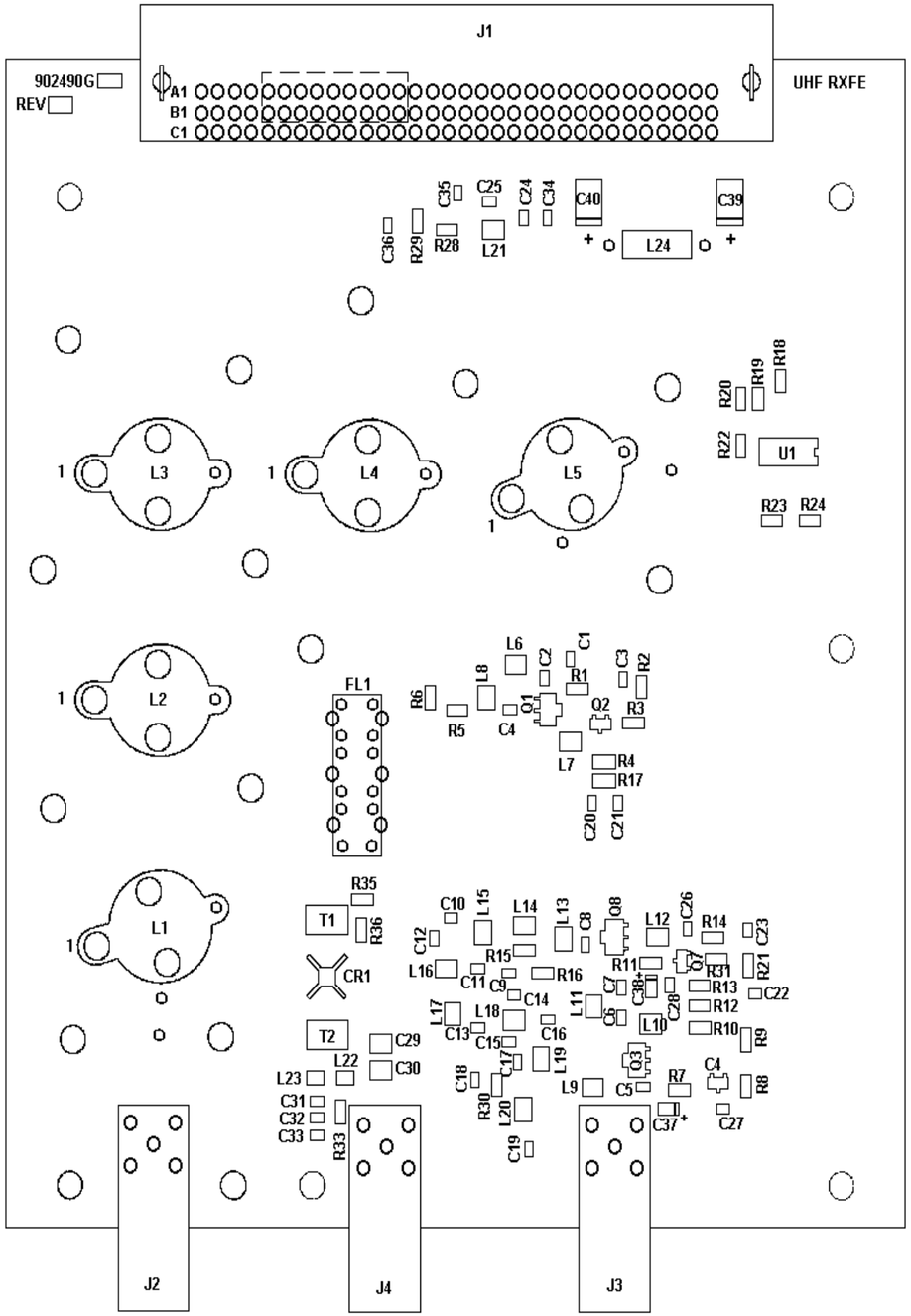


LEAD IDENTIFICATION FOR CR1

OUTLINE DIAGRAM



RECEIVER FRONT END BOARD
19D902490G3
(19D902490, Sh. 3, Rev. 5)



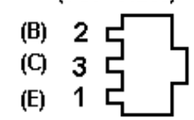
CAUTION

OBSERVE PRECAUTIONS FOR HANDLING

ELECTROSTATIC SENSITIVE DEVICES

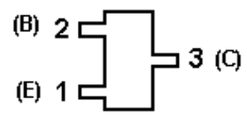
COMP.	GROUP 4 VALUE	GROUP7 VALUE
R5	10 OHMS	0 OHMS
R6	390 OHMS	NOT USED
R35	0 OHMS	27 OHMS
R36	NOT USED	390 OHMS
R14	10 OHMS	18 OHMS

(SOT) TRANSISTORS (TOP VIEW)



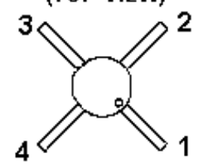
LEAD IDENTIFICATION FOR Q1,Q3,Q8

(SOT) TRANSISTORS (TOP VIEW)



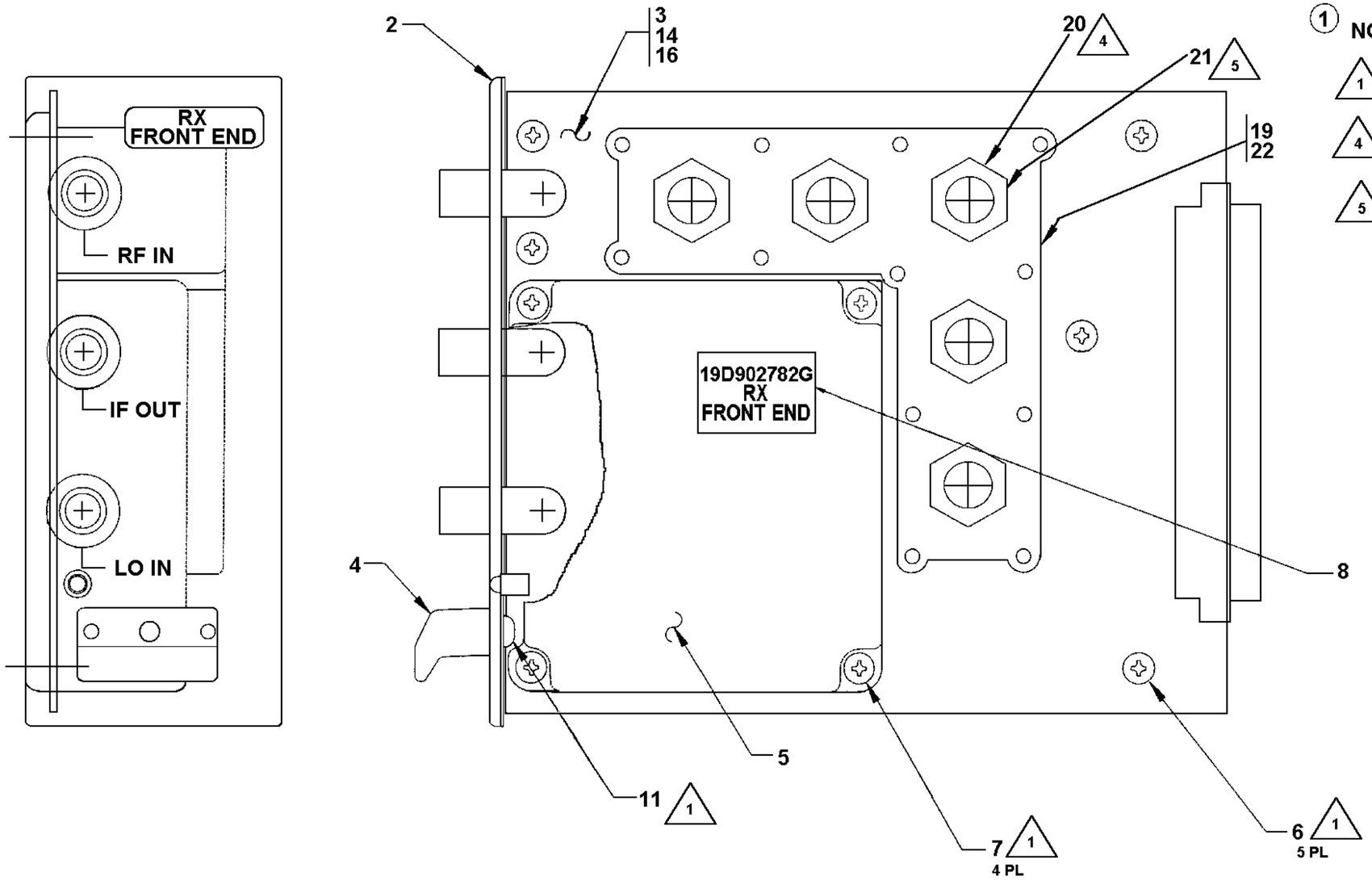
LEAD IDENTIFICATION FOR Q2,Q4,Q7

RECTIFIER (TOP VIEW)



LEAD IDENTIFICATION FOR CR1

RECEIVER FRONT END BOARD
19D902490G4 & G7
(19D902490, Sh. 4, Rev. 6A)

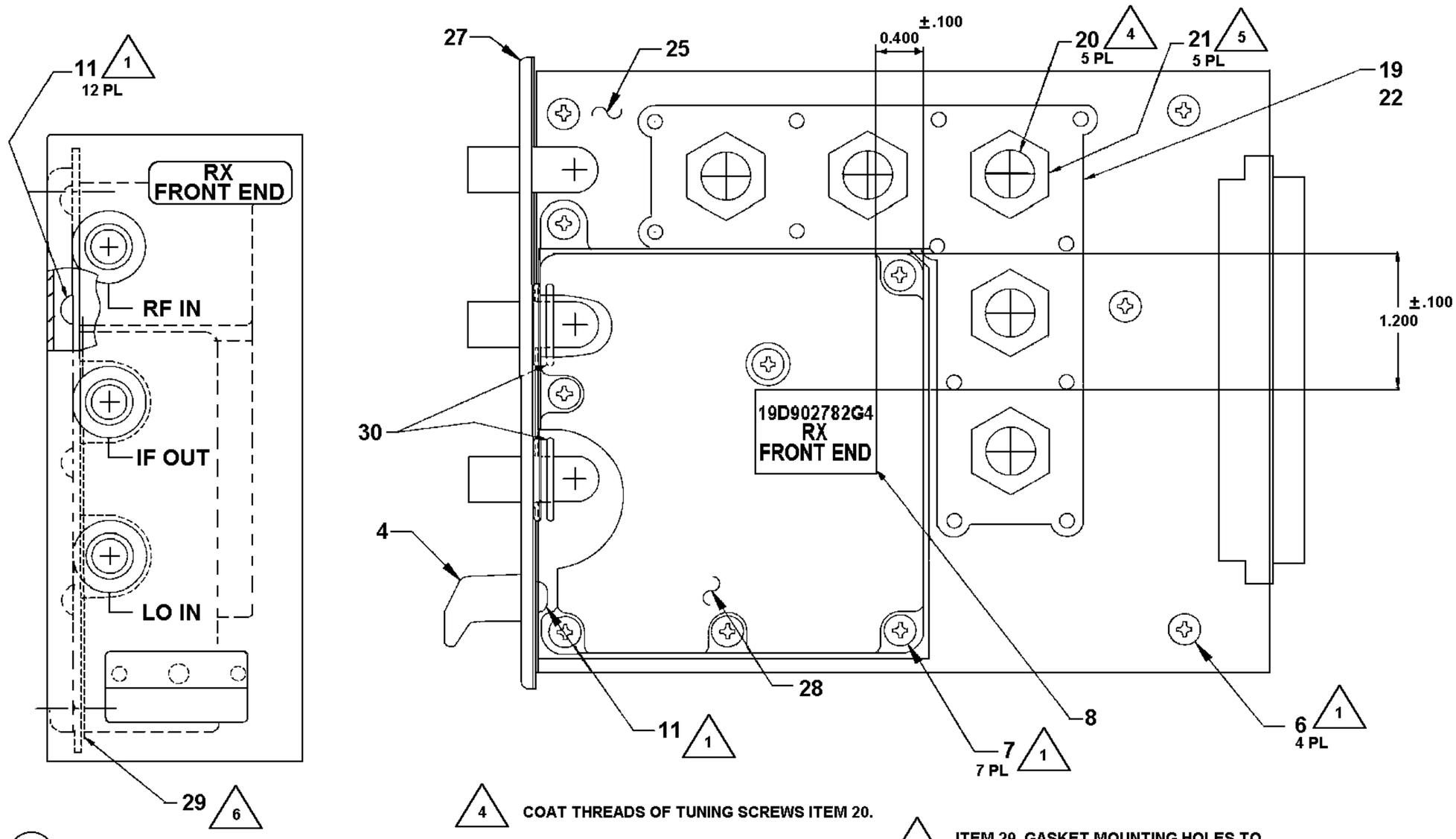


NOTES:

1. TORQUE SCREWS, ITEMS 6 & 7, TO 15.5 ± 1.3 INCH POUNDS. TORQUE SCREW, ITEM 11, TO 20 ± 1.3 INCH POUNDS.
4. COAT THREADS OF TUNING SCREWS ITEM 20.
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 SERRATIONS ON CASTINGS ITEM 19.

RECEIVER FRONT END MODULE
19D902782G3

(19D902782 Sh.1 Rev. 6)



23 **NOTES:**

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

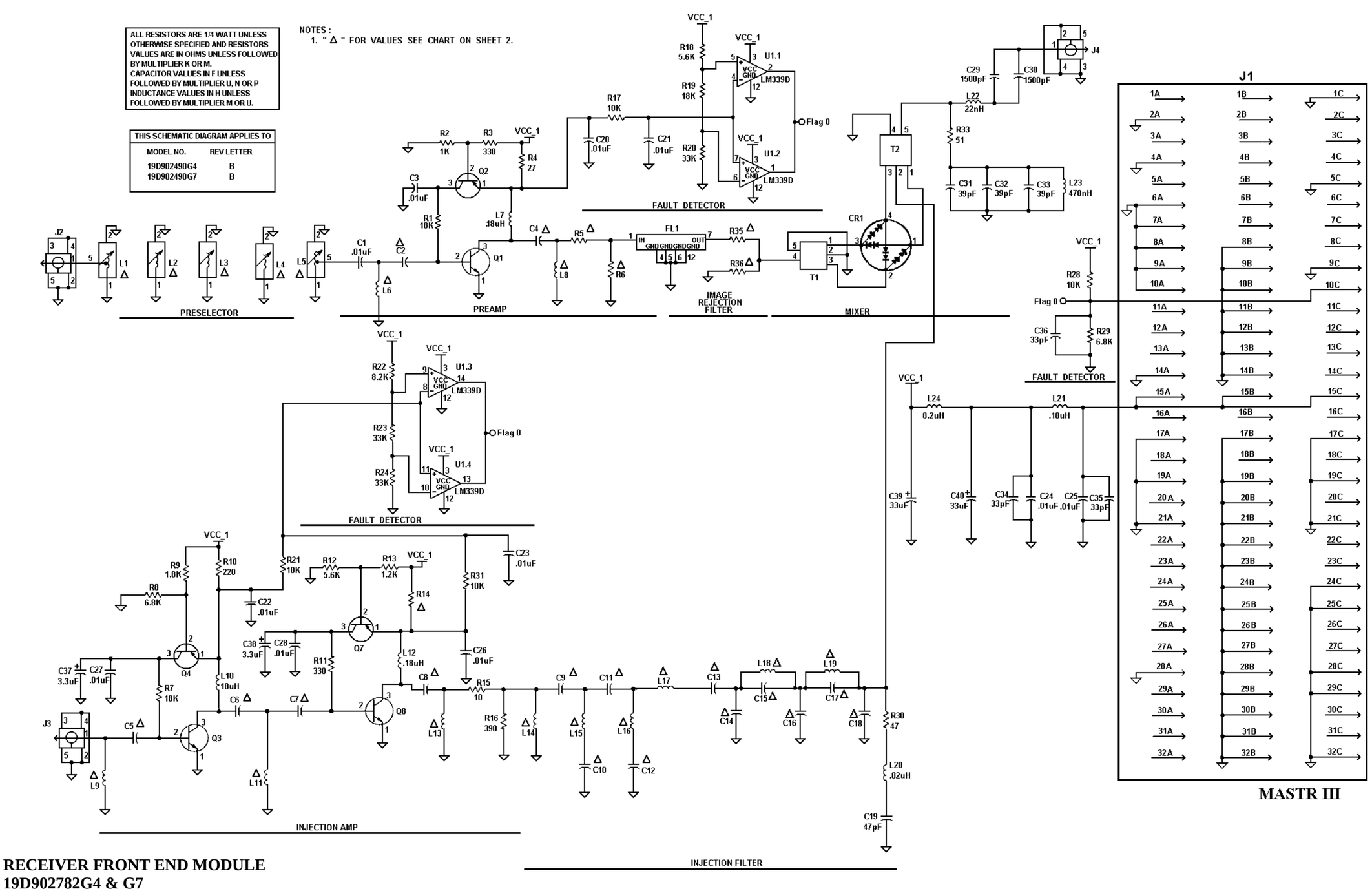
4. COAT THREADS OF TUNING SCREWS ITEM 20.

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 SERRATIONS ON CASTINGS ITEM 19.

6. ITEM 29, GASKET MOUNTING HOLES TO ALIGN WITH ITEM 28, COVER.

RECEIVER FRONT END MODULE
19D902782G4 & G7

(19D902782 Sh.2 Rev. 6)



RECEIVER FRONT END MODULE
19D902782G4 & G7

(19D904768 Sh.1 Rev. 6)

COMPONENT	450-470 MHZ SPLIT (G450) Δ G3	450-470 MHZ SPLIT (G455) Δ G4	425-450 MHZ SPLIT (G425) Δ G7
C2	12pF	12pF	12pF
C4	8.2pF	8.2pF	100pF
C5	12pF	12pF	12pF
C6	82pF	82pF	100pF
C7	12pF	12pF	5.6pF
C8	22pF	22pF	120pF
C9	10pF	10pF	12pF
C10	6.8pF	6.8pF	15pF
C11	8.2pF	8.2pF	18pF
C12	10pF	10pF	15pF
C13	10pF	10pF	10pF
C14	3.9pF	3.9pF	3.3pF
C15	6.8pF	6.8pF	220pF
C16	3.9pF	3.9pF	3.3pF
C17	4.7pF	4.7pF	220pF
C18	3.9pF	3.9pF	3.3pF
FL1	HELICAL FILTER	HELICAL FILTER	HELICAL FILTER
L1	HELICAL COIL	HELICAL COIL	HELICAL COIL
L2	HELICAL COIL	HELICAL COIL	HELICAL COIL

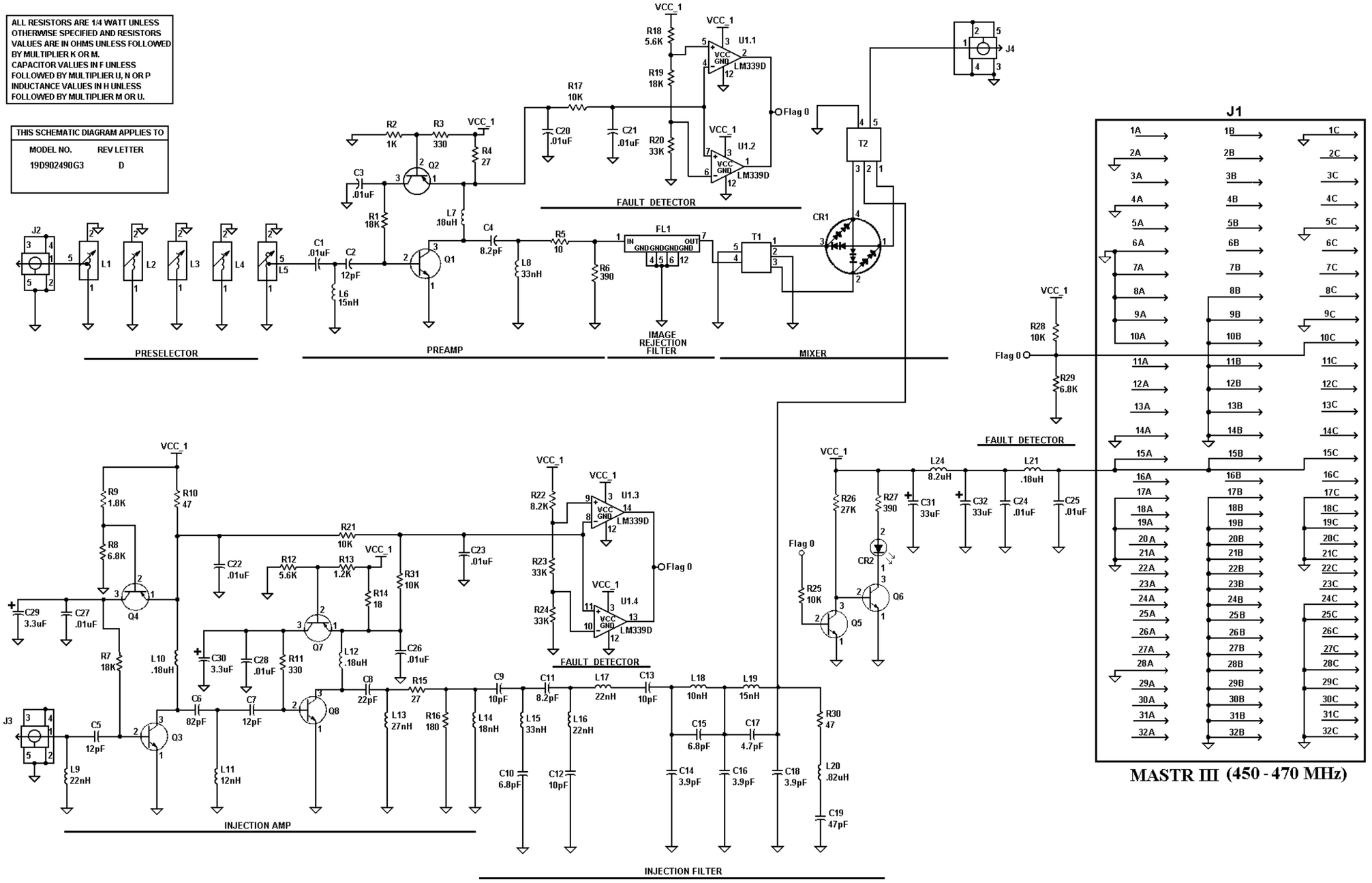
COMPONENT	450-470 MHZ SPLIT (G450) Δ G3	450-470 MHZ SPLIT (G455) Δ G4	425-450 MHZ SPLIT (G425) Δ G7
L3	HELICAL COIL	HELICAL COIL	HELICAL COIL
L4	HELICAL COIL	HELICAL COIL	HELICAL COIL
L5	HELICAL COIL	HELICAL COIL	HELICAL COIL
L6	15nH	15nH	15nH
L8	33nH	33nH	33nH
L9	22nH	22nH	15nH
L11	12nH	12nH	22nH
L13	27nH	27nH	39nH
L14	18nH	18nH	10nH
L15	33nH	33nH	10nH
L16	22nH	22nH	12nH
L17	22nH	22nH	12nH
L18	10nH	10nH	15nH
L19	15nH	15nH	15nH
R5	10 OHMS	10 OHMS	0 OHMS
R6	390 OHMS	390 OHMS	NOT USED
R35	0 OHMS	0 OHMS	27 OHMS
R36	NOT USED	NOT USED	NOT USED
R14	18 OHMS	18 OHMS	27 OHMS

RECEIVER FRONT END MODULE
19D902782G3,G4 & G7

(19D904768 Sh.2 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.

THIS SCHEMATIC DIAGRAM APPLIES TO	
MODEL NO.	REV LETTER
19D902490G3	D



RECEIVER FRONT END MODULE
19D902782G3

(19D903498, Rev. 7)

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MAINTENANCE MANUAL FOR
450-470 MHz, 110 WATT POWER AMPLIFIER
19D902797G3
425-450 MHz, 90 WATT POWER AMPLIFIER
19D902797G7
403-425 MHz, 90 WATT POWER AMPLIFIER
19D902797G6
380-400 MHz, 75 WATT POWER AMPLIFIER
19D902797G8
470-494 MHz, 90 WATT POWER AMPLIFIER
19D902797G9
492-512 MHz, 90 WATT POWER AMPLIFIER
19D902797G10
410-430 MHz, 90 WATT POWER AMPLIFIER
19D902797G11

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ERICSSON

Ericsson Inc.
Private Radio Systems
Mountain View Road
Lynchburg, Virginia 24502
1-800-528-7711 (Outside USA, 804-592-7711)

Printed in U.S.A.

Table 1 - General Specifications

ITEM	SPECIFICATION
FREQUENCY	450 MHz - 470 MHz (G3) 403 MHz - 425 MHz (G6) 425 MHz - 450 MHz (G7) 380 MHz - 400 MHz (G8) 470 MHz - 494 MHz (G9) 492 MHz - 512 MHz (G10) 410 MHz - 430 MHz (G11)
OUTPUT POWER (RF)	65 watts - 130 watts (G3) 55 watts - 110 watts (G6, G7, G9, G10 & G11) 45 watts - 90 watts (G8)
INPUT POWER (RF)	10 mW min. into ≤ 2:1 VSWR.
TEMPERATURE RANGE	-30°C TO +60°C (Ambient air)
SUPPLY VOLTAGE	13.4 Vdc
CURRENT	29 Amps max. (26 A typical @ rated power, 13.4V) (G3) 29 Amps max. (21 A typical @rated power , 13.4V)(G6, G7, G9, G10 & G11) 29 Amps max. (20 A typical @ rated power, 13.4V) (G8)
DUTY CYCLE Continuous	
STABILITY	Stable into 3:1 VSWR; all temp.,voltage,freq. 55 watts - 110 watts (G3) or 45 watts - 90 watts (G6, G7, G9, G10 & G11) or 45watts - 90 watts (G8)
RUGGEDNESS AT HIGH VSWR	No damage into open or shorted load.

DESCRIPTION

The UHF Power Amplifier Assembly is a wide band RF power amplifier operating over the 380-400, 410-430, 403-425, 425-450, 450-470, 470-494, and 492-512 MHz range without tuning. Its main function is to amplify the 10 mW FM signal from the Transmitter Synthesizer to the rated RF output at the antenna port. The output of the Power Amplifier Assembly is adjustable from rated power to 3dB lower at the PA output J104.

The assembly consists of a printed wiring board (A1) and associated components, including a power module and three RF power transistors, mounted to the heat sink assembly. The printed wiring board (A1) contains both the power amplifier circuitry and the power control circuitry.

Unfiltered supply voltage, A+, for the power amplifier circuits enters the assembly via feedthrough capacitor, C1. Power cable W4 routes the A+ from C1 to J103 on the PWB. Filtered A+ voltage for the power control circuit enters the assembly via control cable W13 which connects to the PWB at J201.

The Power Control circuitry sets the output power level by adjusting the PA Power Set level. It keeps the output power constant despite variations in input power, power amplifier gain, or temperature through the use of a feedback control loop in the PA assembly.

CIRCUIT ANALYSIS

POWER AMPLIFIER

The power amplifier section of the PA Board consists of an Exciter, a Small Signal Gain Stage, a Low Level Amplifier, a Driver, and the Power Amplifier Finals. All these gain stages have an input and output impedance of 50 ohms. Figure 1 is a block diagram showing the signal flow within the Power Amplifier Assembly.

Exciter (U101)

The Exciter stage uses a broadband silicon monolithic microwave integrated circuit (MMIC) amplifier. The signal from transmitter synthesizer, typically 10 dBm (10 mW), is input to the Exciter through a 10 dB resistive pad (R1, R2, and R31). The Exciter amplifies the resulting 0 dBm (1 mW) signal to 12 dBm (16 mW).

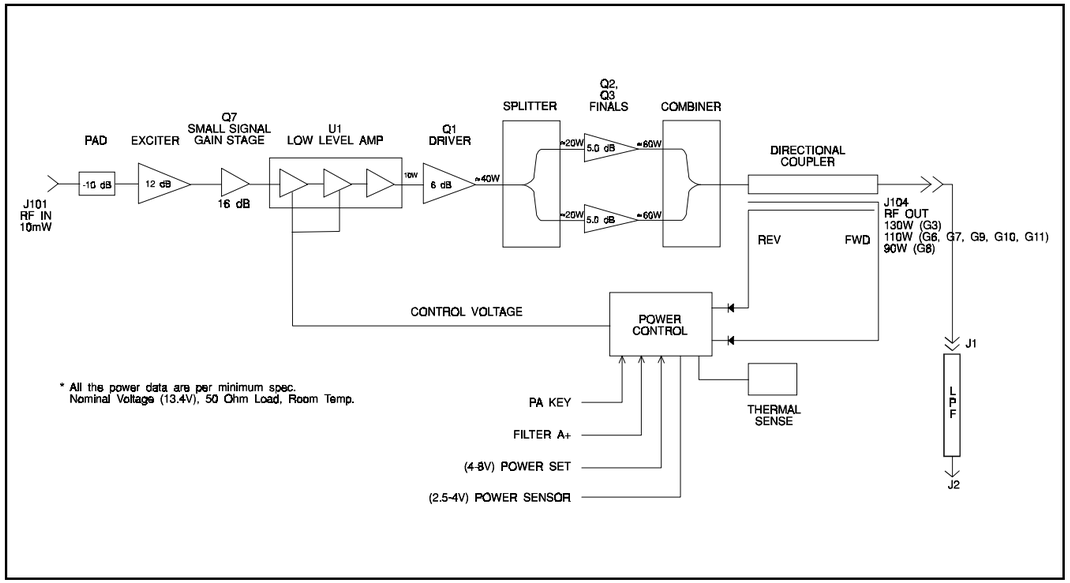

Figure 1 - Block Diagram

The MMIC requires a 5 volt supply source. The 8 volt regulator (U100) provides the 5 volts to the MMIC via a dropping resistor R30.

Small Signal Gain Stage

The Small Signal Gain Stage consists of Q7 and its associated bias and matching circuitry. Collector voltage is fed through R39, R40, and L23. Resistor R33 sets the quiescent bias of the part. The transistor input impedance is matched to the 50 ohm output of the Exciter by C59, C61, C62, and C63. L24 provides the necessary output matching. The stage provides 14 dB of gain to amplify the signal from the Exciter to 26 dBm (400 mW).

Low Level Amplifier (U102)

The Low Level Amplifier (LLA) stage uses a 50 ohm thick film RF Power Module to amplify and control of the output power. Internally, the module is a three stage amplifier. The power control circuitry controls the gain of the first and second stages by varying the collector voltage level of Q203. The third stage gain remains constant with A+ providing the DC supply voltage.

The signal from the Small Signal Gain stage, typically 26 dBm (400 mW), is input into the LLA. Under typical Power Set conditions, the LLA amplifies the signal to a typical output level of 40.5 dBm (11.2 W).

Driver (Q1)

The driver is a 6 dB RF amplifier consisting of transistor Q1 and its associated circuitry. The signal from the LLA, typically 40.5 dBm (11.2 W), is amplified to 46.5 dBm (45.0 W). The transistor input is matched to 50 ohms by C65, C66, C27, C67, and a piece of printed transmission line. The drive signal is then split with a printed in-phase Wilkenson splitter, providing equal power to each of the final devices.

Power Amplifier Finals (Q2, Q3)

Each of the Power Amplifier Final devices is capable of producing 5 to 6 dB of gain. The output signal from the Splitter is impedance matched to each of the finals. Under optimum conditions each final amplifies the input signal to between 50 and 70 watts output power (depending on band split). The outputs are then impedance matched to the input of the Combiner. The Combiner is a printed in-phase Wilkinson type which combines (sums) the output power of the finals. This produces an output power of approximately 100W, (depending on band split) which is coupled to the directional coupler (part of A1 PWB) and on to the antenna circuits. In addition, the directional coupler samples both forward and reverse power and sends this sample to the Power Control circuitry.

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POWER CONTROL

The Power Control circuitry performs three basic functions. It keys and unkeys the PA, sets the PA output power, and protects the PA against adverse conditions.

Keying and Unkeying the PA

To key the PA, the digital controller places 5 volts on the PA key line, J201-2. Zero volts on the PA key line causes the PA to unkey. If the control cable (W13) is disconnected, with nothing actively driving the PA key line, the PA will remain unkeyed.

PA Output Power Set

PA output power is set according to the level of the Power Set line. Four (4) volts on this line will produce minimum power. As the voltage increases toward eight (8) volts, the power will increase to its maximum rated output. The PA output power is initially set at the factory. This is done by adjusting R43 while injecting a 10 mW signal at J1 and applying 8 volts to J201-3. After setting the maximum power level, changing the output power in done by varying the voltage applied on the Power Set line.

PA Protection

The power control also protects the PA against over temperature and high VSWR conditions.

An over temperature condition exists when the flange temperature of the final output transistor reaches 80°C. At this point the output power will drop below its set level. The output power will continue to drop such that when the flange temperature reaches 125°C the PA output drops at least 10 dB below its set level.

Reflected power is limited to 25% of the set power. If the output VSWR degrades to worse than 3:1 the forward power will be reduced to limit the reflected power to 25% of the set power. The Power Sensor line indicates when the PA is operating in a cutback condition. If the PA is keyed and the power control is cutting back, the Power Sensor line will drop to zero (0) volts and the PA alarm light on the station will turn on.

Theory of Operation

Power control of the MASTR III Power Amplifier is accomplished with a feedback control loop. The three possible feedback signals are: representation of forward power, temperature sensitive scaled representation of forward power, or representation of reflected power. These three signals are input to a diode summing junction which selects the largest of the three for use as the feedback.

The stripline directional coupler samples the output power and produces a voltage, Vf, proportional to the forward output power. The power control compares the forward voltage, Vf, to a reference voltage at U3. The output of U3 controls the current flow thru Q5 and the output of Q203. The collector output of Q203 adjusts the control voltage, Vct1 and Vct2. This control voltage is capable of adjusting the total PA output power since it provides the first two stages DC supply to the Low Level Amplifier, U1.

During over temperature operation, a scaled representation of the forward power is maintained constant by varying the control voltage line. Thermal resistor RT1 sensing an increase in temperature causes the output of U3.1 to increase. If the output of U3.1 becomes larger than the other feedback lines, the output of U3.4 will begin to decrease. This in turn will cause the output of Q203 to decrease reducing the supply voltage to U1. Since the scaling is a function of temperature the power is reduced as the temperature increases.

Under VSWR cutback operation the reverse voltage, Vr, representative of the reflected output power is held below a threshold by reducing the control voltage as necessary. If Vr increases at U3.1 beyond the preset threshold an increase at U3.4 will result. This causes a subsequent reduction in the control voltage to U1. Thus the power control circuit reduces the output power in order to limit the reflected power to 25% of the set power.

Signal Interface

The signal interface to the MASTR III Power Amplifier is supported by a six position feedthrough connector, J201, with the following pinout:

1 – PWR Sensor

2 – PA Key

3 – PA PWR Set

4 – NC

5 – Ground

6 – Fil A+

Pwr Sensor

This line indicates when the PA is experiencing adverse conditions. Under normal operation, while the PA is keyed, this line will be proportional to forward power. Minimum power (zero watts) corresponds to 2.5 volts while maximum power corresponds to 4.5 volts. This voltage is not temperature compensated and no effort is made to calibrate this signal to an absolute power level. It is intended to provide a relative indication of forward power and to discriminate between normal and cutback operation.

Zero volts on this line, when the PA is keyed, indicates the forward power is cutback. This power cutback may be due to high reflected power or may be due to high PA temperatures. This fault condition may indicate a problem with the PA or may indicate a system problem external to the Power Amplifier. High VSWR may be due to a poor antenna and high temperature may be due to a blocked cabinet vent. Zero volts on this line, when the PA is keyed, does not indicate zero forward power. Zero volts indicates the PA is protecting itself due to adverse conditions. If the adverse condition, either high VSWR or high temperature is eliminated, the power will return to normal and the PWR SENSOR voltage will rise above 2.5 volts.

PA Key (Interface Connector pin 2)

This line is used to key and unkey the PA. UNKEY = 0 volt and KEY = 5 volts. The driver of this line must be capable of supplying 5 volts at 1.0 mA. The appropriate key sequence requires RF from the transmit synthesizer be input to the PA before the KEY line is energized.

PA PWR Set (Interface Connector pin 3)

This line is used to set the RF Power Output of the PA. Minimum power output equals 4 volts and maximum power output equals 8 volts. The driver of this line must be capable of supplying 8 volts at 1.0 mA.

Fil A+ (Interface Connector pin 6)

This line provides the filtered supply voltage for the Power Control. The driver of this line must be capable of supplying 13.4 volts ±20% at 100 mA.

TROUBLESHOOTING GUIDE

SYMPTOM	AREAS TO CHECK	INDICATIONS
1. No Power or low Power at Antenna Port.	1. Measure the transmitter output power before the duplexer or antenna switch (for simplex mode).	The presence of power at this port is an indication of a defective duplexer, switch, or cables.
	2. Measure the transmitter output power before the low pass filter.	The presence of power at this port is an indication of a defective filter or cables.
	3. Measure the transmitter output power before the optional isolator at the PA output port.	The presene of power at this port is an indication of a defective isolator or cables.
2. No power at PA output port and PA ALARM is OFF.	1. Station is in receive mode.	
3. No power at PA output port and PA ALARM is ON.	1. No RF input to PA. Check connection between PA and TX Synthesizer.	TX Synthesizer should deliver a minimum of 10 mW (10 dBm) to the PA.
	2. Check the logic or DC inputs to the PA from the Interface Board through J201.	
	a. J201-2 PA KEY	5volts during transmit
	b. J201-3 POWER SET	4 volts to 8 volts (4 volts represents zero RF power)
	c. J201-6 13.8 VF	13.8 Vdc ±20%
	3. Defective PA	Replace PA

TROUBLESHOOTING GUIDE (cont'd)

SYMPTOM	AREAS TO CHECK	INDICATIONS
4. Low power at PA output port and PA ALRAM is OFF.	1. Low RF input to PA from TX Synthesizer. 2. Check the voltage on J201-3 (POWER SET). 3. Check the power supply voltage on the collector of Q1, Q2 and Q3 4. One of the two final PA transistors (Q2 or Q3) is defective.	Power should be a minimum of 10 mW (10 dBm). For minimal output power, this voltage should be above 7 volts. Voltage should be minimal 13.4 Vdc. Replace the defective transistor.
5. Low power at PA output port and PA ALARM is ON.	1. Check for over temperature and/ or a high VSWR condition due to a mismatch at the output port.	The power control circuit protects the PA by cutting back the power. In case of a mismatch, refer to symptom 1.

UHF POWER AMPLIFIER VOLTAGE CHART

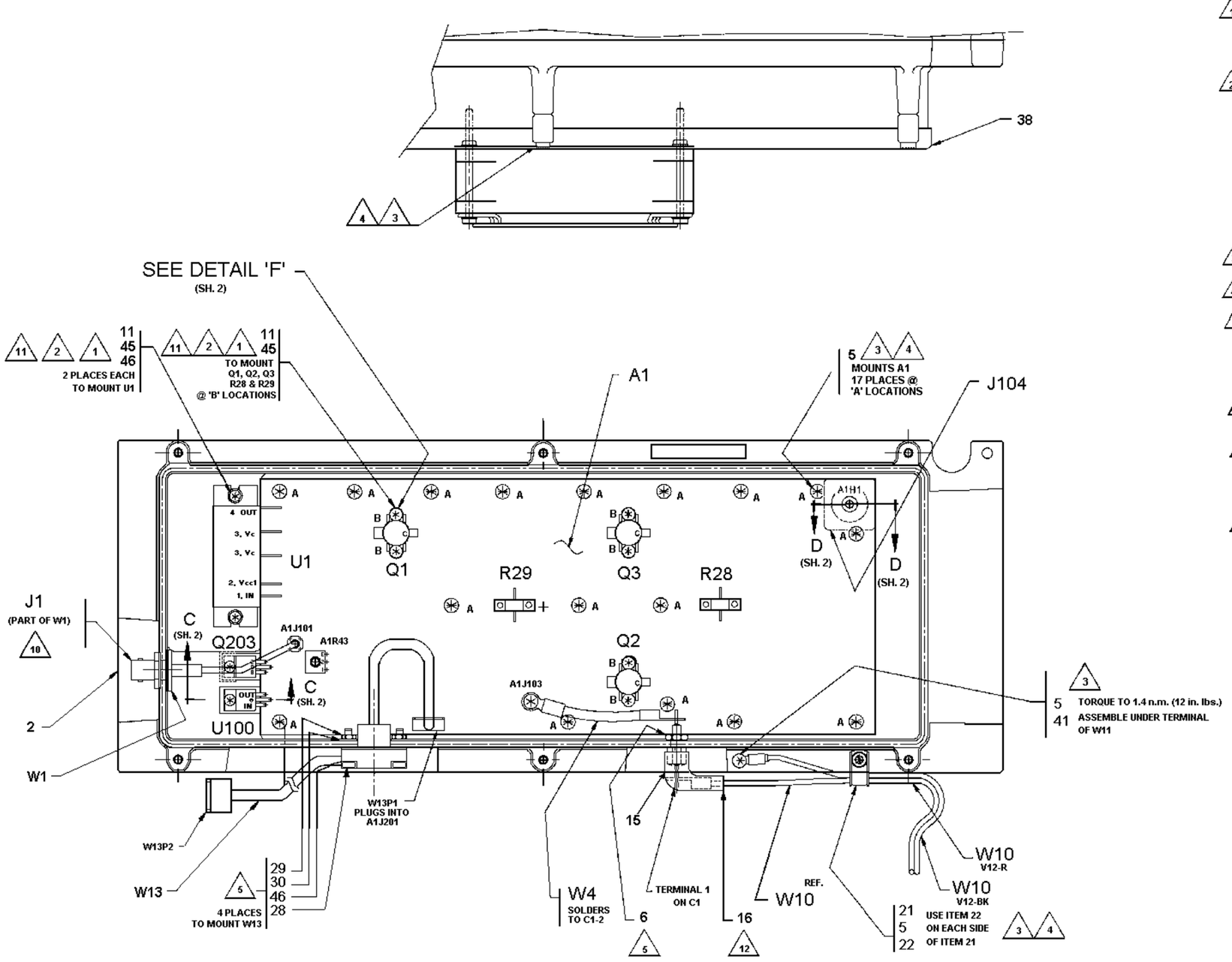
PARAMETER (50 ohm, -30°C to +60°C)	REFERENCE SYMBOL	READINGS (volts DC)
SUPPLY VOLTAGE	A+	13.4 V ±20%
CONTROL VOLTAGE	Vct1	0 - 12 V
FORWARD VOLTAGE	Vf	3 - 7 V
REVERSE VOLTAGE	Vr	2 - 6 V
POWER SENSE	J201-1	2.5 - 4 V
PA KEY	J201-2	5 V
POWER SET	J201-3	4 - 8 V
13.8 VF	J201-6	13.8 V ±20%

UHF POWER AMPLIFIER TYPICAL VOLTAGE READINGS (50 ohm, room temperature, 13.4 Vdc supply voltage, and rated output)

	Group	Low	Mid	High
Frequency	G3	450 MHZ	460 MHZ	470 MHZ
	G6	403 MHZ	414 MHZ	425 MHZ
	G7	425 MHZ	437 MHZ	450 MHZ
	G8	380 MHZ	390 MHZ	400 MHZ
	G9	470 MHZ	482 MHZ	494 MHZ
	G10	492 MHZ	502 MHZ	512 MHZ
	G11	410 MHZ	420 MHZ	430 MHZ
Vct 1 (Volts DC)	G3	7 - 10 Volts	6 - 8 Volts	4 - 6 Volts
	G6	6 - 8 Volts	6 - 8 Volts	6 - 8 Volts
	G7	6 - 8 Volts	6 - 8 Volts	6 - 8 Volts
	G8	6 - 8 Volts	6 - 8 Volts	6 - 8 Volts
	G9 & G10	6 - 8 Volts	6 - 8 Volts	6 - 8 Volts
	G11	6 - 8 Volts	6 - 8 Volts	6 - 8 Volts
Vf (Volts DC)	G3	5 - 7 Volts	5 - 7 Volts	5 - 7 Volts
	G6	6 - 8 Volts	6 - 8 Volts	6 - 8 Volts
	G7	6 - 8 Volts	6 - 8 Volts	6 - 8 Volts
	G8	6 - 8 Volts	6 - 8 Volts	6 - 8 Volts
	G9 & G10	6 - 8 Volts	6 - 8 Volts	6 - 8 Volts
	G11	6 - 8 Volts	6 - 8 Volts	6 - 8 Volts
Vr (Volts DC)	G3	2 - 3 Volts	2 - 3 Volts	2 - 3 Volts
	G6	2 - 3 Volts	2 - 3 Volts	2 - 3 Volts
	G7	2 - 3 Volts	2 - 3 Volts	2 - 3 Volts
	G8	2 - 3 Volts	2 - 3 Volts	2 - 3 Volts
	G9 & G10	2 - 3 Volts	2 - 3 Volts	2 - 3 Volts
	G11	2 - 3 Volts	2 - 3 Volts	2 - 3 Volts
J201 - 1 (Volts DC)	G3	2.5 - 4 Volts	2.5 - 4 Volts	2.5 - 4 Volts
	G6	2.5 - 4 Volts	2.5 - 4 Volts	2.5 - 4 Volts
	G7	2.5 - 4 Volts	2.5 - 4 Volts	2.5 - 4 Volts
	G8	2.5 - 4 Volts	2.5 - 4 Volts	2.5 - 4 Volts
	G9 & G10	2.5 - 4 Volts	2.5 - 4 Volts	2.5 - 4 Volts
	G11	2.5 - 4 Volts	2.5 - 4 Volts	2.5 - 4 Volts
J201 - 3 (Volts DC)	G3	6 - 8 Volts	6 - 8 Volts	6 - 8 Volts
	G6	6 - 8 Volts	6 - 8 Volts	6 - 8 Volts
	G7	6 - 8 Volts	6 - 8 Volts	6 - 8 Volts
	G8	6 - 8 Volts	6 - 8 Volts	6 - 8 Volts
	G9 & G10	6 - 8 Volts	6 - 8 Volts	6 - 8 Volts
	G11	6 - 8 Volts	6 - 8 Volts	6 - 8 Volts
J201- 6 (Volts DC)	G3	13.4 Volts	13.4 Volts	13.4 Volts
	G6	13.4 Volts	13.4 Volts	13.4 Volts
	G7	13.4 Volts	13.4 Volts	13.4 Volts
	G8	13.4 Volts	13.4 Volts	13.4 Volts
	G9 & G10	13.4 Volts	13.4 Volts	13.4 Volts
	G11	13.4 Volts	13.4 Volts	13.4 Volts

RATED POWER FOR MASTR III UHF BASE STATION

FREQUENCY MHz	STANDARD @J2	ADJUSTABLE RANGE @J104	WITH DUPLEXER	WITH ISOLATOR	WITH DUPLEXER AND ISOLATOR
450-470	110W	65-130W	75W	100W	70W
425-450	90W	55-110W	60W	82W	55W
403-425	90W	55-110W	60W	82W	55W
380-400	75W	45-90W	50W	68W	47W
410-430	90W	55-110W	60W	82W	55W
470-494	90W	55-110W	60W	82W	55W
492-512	90W	55-110W	60W	82W	55W



NOTES:

1. APPLY SILICONE GREASE BETWEEN THE HEAT SINK, ITEM 2 AND THE MOUNTING SURFACES OF:
   Q1, Q2, Q3, U1, R28 & R29

2. RECOMMENDED ASSEMBLY PROCEDURE:
   a——PRETIN LEADS
   b——ASSEMBLE ALL MOUNTING HARDWARE LOOSE
   c——ALIGN LEADS ON DEVICES WITH MICROSTRIP, POSITIONING THEM SO THAT MAXIMUM AMOUNT OF LEAD IS IN CONTACT WITH MICROSTRIP.
   d——TIGHTEN MOUNTING HARDWARE TO 4 ± 1 in. lbs.,
   e——SOLDER LEADS TO MICROSTRIP USING 2% SILVER
   f——TIGHTEN MOUNTING HARDWARE, TORQUE TO 0.6 N.m (6 in. lbs.)

3. LUBRICATE HARDWARE BEFORE ASSEMBLY USING ITEM 10

4. TORQUE HARDWARE TO 1.1 N.m. (10in. lbs.)

5. TORQUE HARDWARE TO 0.6N.m. (6in. lbs.)

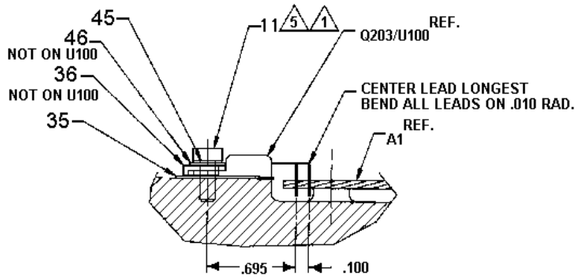
10. USE HARDWARE SUPPLIED WITH COMPONENT, TORQUE TO 0.6 N.m. (6in. lbs.)

11. CARE MUST BE USED IN SOLDERING LEADS OF Q1, Q2, Q3, R28, R29 & U1 TO BOARD, (A1) TO AVOID SHORTING SOLDER TABS TOGETHER.

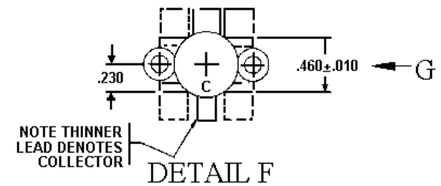
12. TERMINATE W10 BY SOLDERING TO C1-1. SLEEVE ENTIRE ELECTRICAL CONNECTION WITH SLEEVING, ITEM 15.

POWER AMPLIFIER ASSEMBLY
19D902797G3, G6, G7, G8, G9, G10 & G11

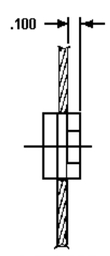
(19D902797 Sh. 3, Rev. 10)



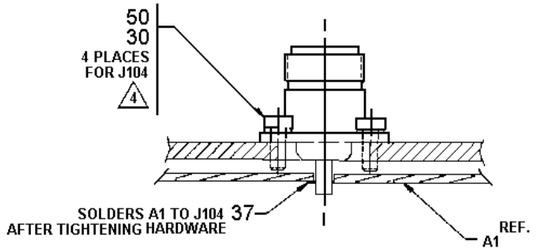
SECTION C - C
(TAKEN FROM SHEET 1)
LEAD FORMING AND HARDWARE
STACKUP FOR Q203 & U100
FOR Q203, U100 USE
EGE TOOL #423445G1A



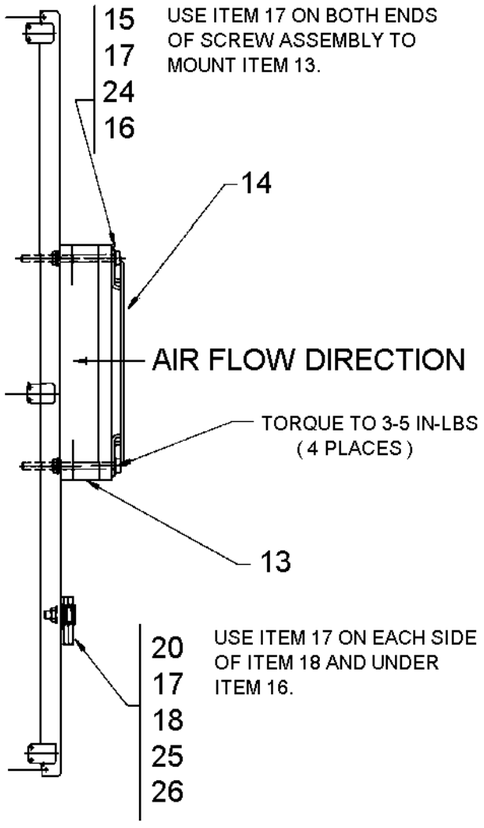
DETAIL F
LEAD TRIMMING
FOR Q1 THRU Q3 G3 USE EGE TOOL #423445 G1C
FOR Q101 THRU Q103, G1 USE EGE TOOL #902/97-G1A
(TAKEN FROM SHEET 1)

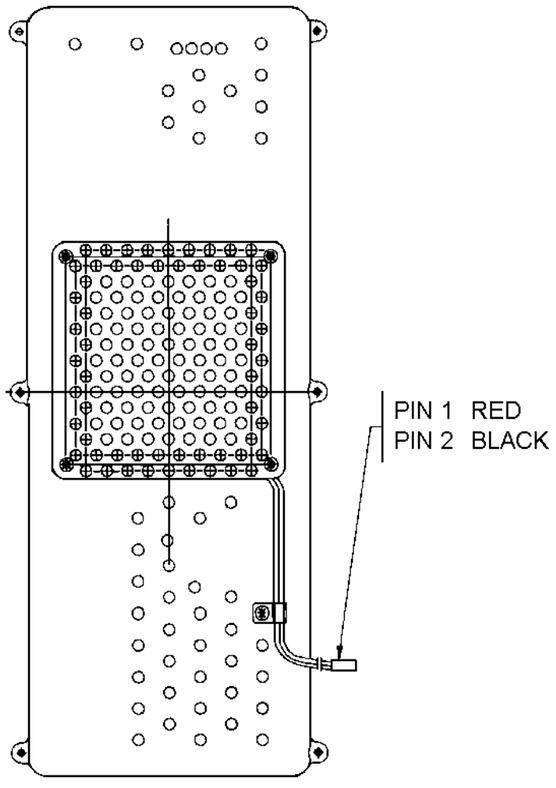


VIEW G
TYPICAL LEAD FORMING
& ASSEMBLY POSITIONING
FOR Q1 THRU Q3
FOR Q101 THRU Q103



SECTION D - D
(TAKEN FROM SHEET 1)



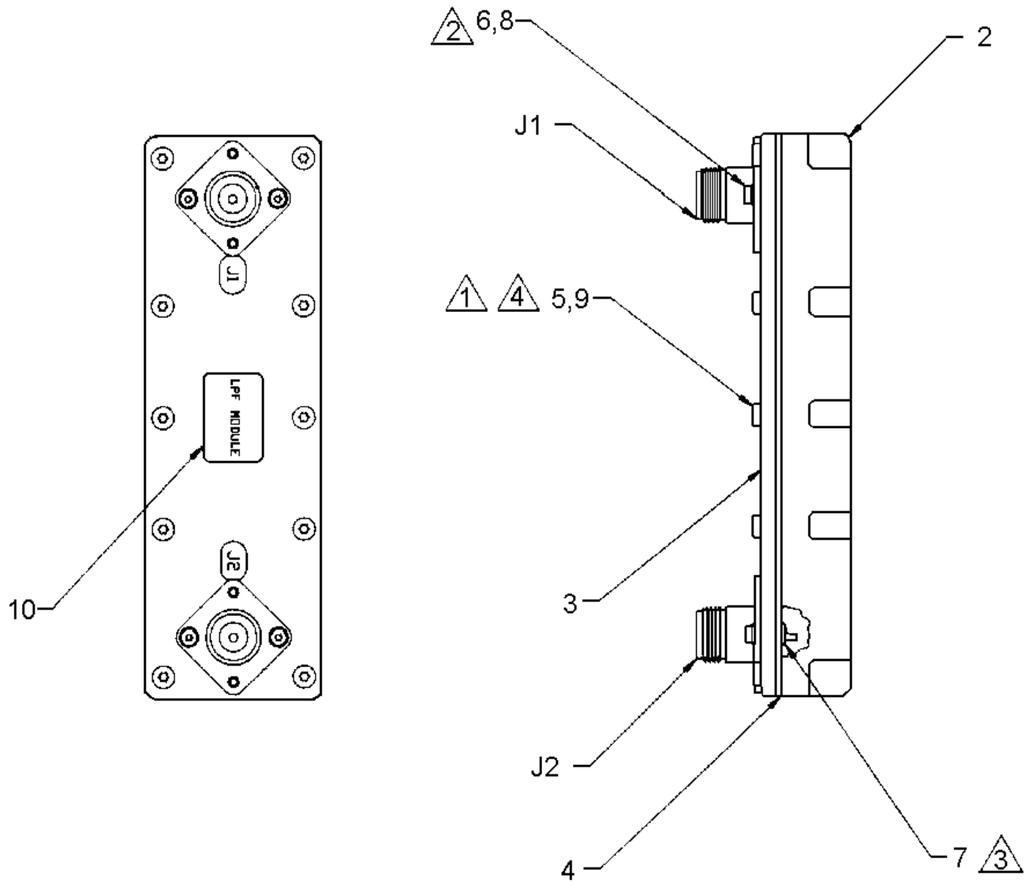


POWER AMPLIFIER ASSEMBLY
19D902797G3, G6, G7, G8, G9, G10 & G11

(19D902797 Sh. 2, Rev. 10)

COVER ASSEMBLY
19B801659G3

(19B801659, Sh. 2, Rev. 3)



NOTES:

1. TORQUE SCREW, ITEM 5, TO 15.5±1.3 IN-LB.
2. TORQUE SCREW, ITEM 6, TO 6 IN-LBS.
3. SOLDER CONNECTORS J1 AND J2 AND ITEM 7 TO ITEM 4.
4. COAT THREADS OF SCREW, ITEM 5, WITH LUBRICANT, BEFORE INSTALLING.

LOW PASS FILTER MODULE
19D902856G3

(19D902856 Sh. 1, Rev. 0)

110 WATT UHF POWER AMPLIFIER 19D902797G3
90 WATT UHF POWER AMPLFIER 19D902797G6, G7
& G9 - G11
75 WATT UHF POWER AMPLFIER 19D902797G8
ISSUE 6

SYMBOL	PART NO.	DESCRIPTION
		ASSEMBLIES
A1		**POWER AMPLIFIER BOARD 19D902794G3, G6 - G11**
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A116708P2	Feedthru: 0.01uF +100-0%, 500 VDCW; sim to Erie 327-050-X5W0103P.
C1	19A702052P26	Ceramic: 0.1 µF ±10%, 50 VDCW,
C2 thru C9	19A702061P63	Ceramic: 120 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C10	344A3126P38	Porcelain: 100 pF ±5%, 500 VDCW. sim to 101JT500X.
C11	19A702061P63	Ceramic: 120 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C12	19A705108P40	Mica chip: 120 pF, ±5%, 100 VDCW. temp coef 0 ±50 PPM°C.
C13 thru C16	344A3126P38	Porcelain: 100 pF ±5%, 500 VDCW. sim to 101JT500X.
C17	19A702052P26	Ceramic: 0.1 µF ±10%, 50 VDCW.
C18	19A705108P40	Mica chip: 120 pF, ±5%, 100 VDCW. temp coef 0 ±50 PPM°C.
C19	344A3126P38	Porcelain: 100 pF ±5%, 500 VDCW. sim to 101JT500X.
C20 and C21	19A705108P40	Mica chip: 120 pF, ±5%, 100 VDCW. temp coef 0 ±50 PPM°C.
C22 and C23	19A702052P26	Ceramic: 0.1 µF ±10%, 50 VDCW.
C24	19A702061P63	Ceramic: 120 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C25	344A3126P38	Porcelain: 100 pF ±5%, 500 VDCW. sim to 101JT500X.
C26	344A3126P62	Porcelain: 1000 pF ±5%, 500 VDCW; sim to 102JT500X.
C27	344A3126P13	Porcelain: 15 pF ±5%, 500 VDCW; sim to 100JT500X. (Used in G7 and G8).
C27	344A3126P15	Porcelain: 12 pF ±5%, 500 VDCW; sim to 120JT500X. (Used in G6 and G11).
C28	344A3126P18	Porcelain: 15 pF ±5%, 500 VDCW; sim to 150JT500X. (Used in G8).
C28	344A3126P15	Porcelain: 12 pF ±5%, 500 VDCW; sim to 120JT500X. (Used in G6).
C28	344A3126P13	Porcelain: 15 pF ±5%, 500 VDCW; sim to 100JT500X. (Used in G11).
C28	344A3126P11	Porcelain: 8.2 pF ±5%, 500 VDCW; sim to 8R2CT500X. (Used in G7).
C29	344A3126P18	Porcelain: 15 pF ±5%, 500 VDCW; sim to 150JT500X. (Used in G8).
C29	344A3126P15	Porcelain: 12 pF ±5%, 500 VDCW; sim to 120JT500X. (Used in G6).
C29	344A3126P13	Porcelain: 15 pF ±5%, 500 VDCW; sim to 100JT500X. (Used in G11).
C29	344A3126P11	Porcelain: 8.2 pF ±5%, 500 VDCW; sim to 8R2CT500X. (Used in G7).
C30	344A3126P15	Porcelain: 12 pF ±5%, 500 VDCW; sim to 120JT500X. (Used in G8).
C30	344A3126P11	Porcelain: 8.2 pF ±5%, 500 VDCW; sim to 8R2CT500X. (Used in G3, G9, G10).
C31	344A3126P15	Porcelain: 12 pF ±5%, 500 VDCW; sim to 120JT500X. (Used in G8).
C31	344A3126P11	Porcelain: 8.2 pF ±5%, 500 VDCW; sim to 8R2CT500X. (Used in G3, G9, G10).
C32 and C33	344A3126P1	Porcelain: 3.3 pF ±.25pF, 500 VDCW; sim to 3R3CT500X. (Used in G3).
C34 and C35	344A3126P18	Porcelain: 15 pF ±5pF, 500 VDCW; simto 150JT500X. (Used in G6, G7 and G11).
C36	344A3126P3	Porcelain: 3.9 pF ±0.25%, 500 VDCW; sim to 3R9CT500X. (Used in G8).
C36	344A3126P5	Porcelain: 4.7 pF ±0.25%, 500 VDCW; sim to 4R7CT500X. (Used in G6 and G11).
C37	344A3126P2	Porcelain: 2.2 pF ±0.25%, 500 VDCW; sim to 2R2CT500X. (Used in G8).
C38	19A705205P7	Tantalum: 10 µF, 25 VDCW; sim to Sprague 293D. (Used in G8, G9, G10 and G11).
C39	19A705108P40	Mica chip: 120 pF, ±5%, 100 VDCW. temp coef 0 ±50 PPM/°C. (Used in G8, G9, G10 and G11).
C40	19A702052P26	Ceramic: 0.1 µF ±10%, 50 VDCW. (Used in G8, G9 and G10).
C41	344A3126P38	Porcelain: 100 pF ±5%, 500 VDCW. sim to 101JT500X. (Used in G11).
C42 thru C45	19A702052P26	Ceramic: 0.1 µF ±10%, 50 VDCW.
C46 and C47	344A3126P11	Porcelain: 8.2 pF ±5%, 500 VDCW; sim to 8R2CT500X. (Used in G9 and G10).
C46 and C47	344A3126P13	Porcelain: 15 pF ±5%, 500 VDCW; sim to 100JT500X. (Used in G10).
C48	19A702052P26	Ceramic: 0.1 µF ±10%, 50 VDCW.
C49	19A702236P40	Ceramic: 39 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C50	19A702052P26	Ceramic: 0.1 µF ±10%, 50 VDCW.
C51	19A705205P7	Tantalum: 10 µF, 25 VDCW; sim to Sprague 293D.
C53 and C54	19A705205P7	Tantalum: 10 µF, 25 VDCW; sim to Sprague 293D.
C57	19A705205P7	Tantalum: 10 µF, 25 VDCW; sim to Sprague 293D.
C58	344A3126P11	Porcelain: 8.2 pF ±5%, 500 VDCW; sim to 8R2CT500X. (Used in G3).
C58	344A3126P15	Porcelain: 12 pF ±5%, 500 VDCW ; sim to 120JT500X. (Used in G6, G7, G8 and G11).
C58	344A3126P7	Porcelain: 5.6 pF ±0.25%, 500 VDCW; sim to 5R6CT500X. (Used in G9, G10).
C59	19A702061P49	Ceramic: 56 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C60	19A702061P65	Ceramic: 150 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C61	19A702061P17	Ceramic: 12 pF ±10 pF, 50 VDCW, temp coef 0 ±30 PPM/°C.
C62	19A702236P52	Ceramic: 120 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C64	344A3126P38	Porcelain: 100 pF ±5%, 500 VDCW; sim to 101JT500X.
C65	344A3126P11	Porcelain: 8.2 pF ±5%, 500 VDCW; sim to 8R2CT500X. (Used in G3).
C65	344A3126P5	Porcelain:4.7 pF ±0.25%, 500 VDCW; sim to 4R7CT500X. (Used in G9, G10).
C66	19A700006P58	Mica/teflon: 47 pF ±2%, 100 VDCW. (Used in G8).
C66	19A700006P55	Mica/teflon: 27 pF ±2%, 100 VDCW. (Used in G9 and G10).
C66	19A700006P50	Mica/teflon: 39 pF ±2%, 100 VDCW. (Used in G6, G7, and G11).
C66	19A700006P48	Mica/teflon: 33 pF ±2%, 100 VDCW. (Used in G3).
C67	19A700006P58	Mica/teflon: 47 pF ±2%, 100 VDCW. (Used in G6 and G11).
C67	19A700006P50	Mica/teflon: 39 pF ±2%, 100 VDCW. (Used in G7 and G8).
C67	19A700006P49	Mica/teflon: 36 pF ±2%, 100 VDCW (G3).
C67	19A700006P55	Mica/teflon: 27 pF ±2%, 100 VDCW. (Used in G9 and G10).
C68	19A700006P58	Mica/teflon: 47 pF ±2%, 100 VDCW. (Used in G8 and G11).
C68	19A700006P50	Mica/teflon: 39 pF ±2%, 100 VDCW. (Used in G6, G7, and G11).
C68	19A700006P48	Mica/teflon: 33 pF ±2%, 100 VDCW (G3).
C68 and C69	19A700006P53	Mica/teflon: 22 pF ±2%, 100 VDCW. (Used in G10).
C68	19A700006P55	Mica/teflon: 27 pF ±2%, 100 VDCW. (Used in G9).
C69	19A700006P49	Mica/teflon: 36 pF ±2%, 100 VDCW (G3).
C69	19A700006P58	Mica/teflon: 47 pF ±2%, 100 VDCW. (Used in G6 and G11).
C69	19A700006P50	Mica/teflon: 39 pF ±2%, 100 VDCW (G7).
C69	19A700006P55	Mica/teflon: 27 pF ±2%, 100 VDCW. (Used in G9).
C69	19A700006P57	Mica/teflon: 43 pF ±2%, 100 VDCW. (Used in G8).
C70	19A702061P49	Ceramic: 56 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C71	19A702061P63	Ceramic: 120 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C72 and C73	19A702052P26	Ceramic: 0.1 µF ±10%, 50 VDCW.
C75 thru C77	19A702052P26	Ceramic: 0.1 µF ±10%, 50 VDCW.
C78 and C79	19A705205P7	Tantalum: 10 µF, 25 VDCW; sim to Sprague 293D.
C81	344A3126P62	Porcelain: 1000 pF ±5%, 500 VDCW; sim to 102JT500X.
C82 and C83	19A705108P40	Mica chip: 120 pF, ±5%, 100 VDCW, temp coef 0 ±50 PPM/°C.
C84	19A702061P89	Ceramic: 1500 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.(Used in G3, G6-G9, G11).
C85 and C86	19A705108P40	Mica chip: 120 pF, ±5%, 100 VDCW, temp coef 0 ±50 PPM/°C.
C87	19A700006P60	Mica/teflon: 56 pF ±2%, 100 VDCW. (Used in G8).
C87	19A700006P58	Mica/teflon: 47 pF ±2%, 100 VDCW. (Used in G6, and G11).
C87	19A700006P57	Mica/teflon: 43 pF ±2%, 100 VDCW. (Used in G7).
C87	19A700006P50	Mica/teflon: 39 pF ±2%, 100 VDCW. (Used in G3).
C87	19A700006P48	Mica/teflon: 33 pF ±2%, 100 VDCW. (Used in G9 and G10).
C88	19A700006P59	Mica/teflon: 51 pF ±2%, 100 VDCW. (Used in G6, G8, and G11).
C88	19A700006P57	Mica/teflon: 43 pF ±2%, 100 VDCW. (Used in G7).
C88	19A700006P50	Mica/teflon: 39 pF ±2%, 100 VDCW. (Used in G3).
C88	19A700006P48	Mica/teflon: 33 pF ±2%, 100 VDCW. (Used in G9 and G10).
C89	19A700006P59	Mica/teflon: 51 ohms ±2%, 100 VDCW. (Used in G6, G8, and G11).
C89	19A700006P57	Mica/teflon: 43 pF ±2%, 100 VDCW. (Used in G7).
C89	19A700006P50	Mica/teflon: 39 pF ±2%, 100 VDCW. (Used in G3).
C89	19A700006P48	Mica/teflon: 33 pF ±2%, 100 VDCW. (Used in G9 and G10).
C90	19A700006P60	Mica/teflon: 56 pF ±2%, 100 VDCW. (Used in G8).
C90	19A700006P58	Mica/teflon: 47 pF ±2%, 100 VDCW. (Used in G6 and G11).
C90	19A700006P57	Mica/teflon: 43 pF ±2%, 100 VDCW. (Used in G7).
C90	19A700006P50	Mica/teflon: 39 pF ±2%, 100 VDCW. (Used in G3).
C90	19A700006P48	Mica/teflon: 33 pF ±2%, 100 VDCW. (Used in G9 and G10).
C91	19A700006P57	Mica/teflon: 43 pF ±2%, 100 VDCW. (Used in G8).
C91	19A700006P58	Mica/teflon: 47 pF ±2%, 100 VDCW. (Used in G9 and G11).
C91	19A700006P49	Mica/teflon: 36 pF ±2%, 100 VDCW. (Used in G7).
C91	19A700006P48	Mica/teflon: 33 pF ±2%, 100 VDCW. (Used in G3, G9 and G10).
C92	19A700006P59	Mica/teflon:(Used in G8).
C92	19A700006P57	Mica/teflon: 43 pF ±2%, 100 VDCW. (Used in G6 and G11).
C92	19A700006P50	Mica/teflon: 39 pF ±2%, 100 VDCW. (Used in G7).
C92	19A700006P48	Mica/teflon: 33 pF ±2%, 100 VDCW. (Used in G3).
C92	19A700006P55	Mica/teflon: 27 pF ±2%, 100 VDCW. (Used in G9 and G10).
C93	19A700006P59	Mica/teflon: 51 ohms ±2%, 100 VDCW. (Used in G8).
C93	19A700006P57	Mica/teflon: 43 pF ±2%, 100 VDCW. (Used in G6 and G11).
C93	19A700006P50	Mica/teflon: 39 pF ±2%, 100 VDCW. (Used in G7).
C93	19A700006P48	Mica/teflon: 33 pF ±2%, 100 VDCW. (Used in G3).
C93	19A700006P55	Mica/teflon: 27 pF ±2%, 100 VDCW. (Used in G9 and G10).
C94	19A700006P57	Mica/teflon: 43 pF ±2%, 100 VDCW. (Used in G8).
C94	19A700006P49	Mica/teflon: 36 pF ±2%, 100 VDCW (G7).
C94	19A700006P58	Mica/teflon: 47 pF ±2%, 100 VDCW. (Used in G6 and G11).
C94	19A700006P48	Mica/teflon: 33 pF ±2%, 100 VDCW. (Used in G3, G9, and G10).
		- - - - - - - - - - - DIODES - - - - - - - - - - -
D1 thru D3	19A705377P4	Silicon: Hot Carrier; sim to HP HSMS-2802.
D4 thru D6	19A700053P3	Silicon: 2 Diodes in Series, Common Cathode; sim to MBAV70L.
		- - - - - - - - - - - - - JACKS - - - - - - - - - - - - -
J101	19A705512P1	Connector, RF SMB Series: sim to AMP No. 221111-1.
J103	19A134263P1	Contact, electrical: sim to Selectro 229-1082-00-0-590.
J104	7777145P5	Receptacle: sim to Amphenol 82-97.
J201	19A704852P32	Printed wire, two part: 6 contacts, sim to Molex 22-29-2061.
		- - - - - - - - - - - - - INDUCTORS - - - - - - - - - - - - -
L1	19C320617P10	Coil.(Used in G3, G6-G9 and G11).
L1	19C320617P17	Coil.(Used in G10).
L2	19A701091G1	Coil (Used in G6, G7, G8 and G11).
L3	19C320617P10	Coil (Used in G6, G7, G8, G10 and G11).
L4	19C320617P28	Coil.
L5	19A701091G1	Coil (Used in G6, G7, G8 and G11).
L6	19C320617P10	Coil (Used in G6, G7, G8, G10 and G11).
L7	19A705470P4	Coil, Fixed: 15 nH; sim to Toko 380NB-15nM.
L8	19A705470P8	Coil, Fixed: 39 nH; sim to Toko 380NB-39nM.
L14	19C320617P17	Coil.
L15 thru L17	19A700024P13	Coil, RF: 1.0 µH ±20%.
L18	19C320617P17	Coil.
L23	19A705470P8	Coil, Fixed: 39 nH; sim to Toko 380NB-39nM.
L25	19A701091G1	Coil.
L29 and L30	19C320617P10	Coil.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1	344A3948P1	Silicon, NPN: 440-512 MHz, 50W; sim to MRF 650.
Q2 and Q3	344A4134P1	Silicon, NPN: 470-512 MHz, 65W; sim to MRF 658.
Q4 and Q5	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
Q7	19A701940P1	Silicon, NPN: sim to MRF 559.
Q7	344A3058P1	Silicon, NPN.
Q203	19A700055P1	Silicon, PNP.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1 and R2	19B800607P270	Metal film: 27 ohms ±5%, 1/8 w.
R3 thru R6	19B801486P101	Metal film: 100 ohms ±5%, 1/2 w.
R7	19B800607P183	Metal film: 18K ohms ±5%, 1/8 w.

* COMPONENTS, ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	PART NO.	DESCRIPTION
R8 thru R10	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R11	19B800607P223	Metal film: 22K ohms ±5%, 1/8 w.
R12 thru R18	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R19 and R20	19B800607P472	Metal film: 4.7K ohms ±5%, 1/8 w.
R21 thru R23	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R24 thru R26	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R27	19B800607P822	Metal film: 8.2K ohms ±5%, 1/8 w.
R28 and R29	19A143832P6	Power: 100 ohms ±5%, 40 w.
R30	19B800607P750	Metal film: 75 ohms ±5%, 1/8w.
R31	19B800607P330	Metal film: 33 ohms ±5%, 1/8 w.
R32	19A700050P17	Wirewound: 2.2 ohms ±10%, 2 w. (Used in G3, G9, and G10).
R33	19B800607P392	Metal film: 3.9K ohms ±5%, 1/8 w.
R34	19B801486P100	Metal film: 10 ohms ±5%, 1/2 w.
R35	19A700050P17	Wirewound: 2.2 ohms ±10%, 2 w. (Used in G3, G9).
R36	19B801486P101	Metal film: 100 ohms ±5%, 1/2 w. (Used in G40, G3, and G6).
R37	19B801486P331	Metal film: 330 ohms ±5%, 1/2 w. (Used in G3, G6-G9, G11).
R38	19B800607P223	Metal film: 22K ohms ±5%, 1/8 w.
R39 and R40	19B800607P100	Metal film: 10 ohms ±5%, 1/8 w.
R41	19A702931P333	Metal film: 21.5K ohms ±1%, 200 VDCW, 1/8 w.
R42	19A702931P293	Metal film: 9090 ohms ±1%, 200 VDCW, 1/8 w.
R43	19A700109P5	Variable, cermet: 25 ohms to 10K ohms ±20%, 1/4 w.
R44 thru R46	19B801486P101	Metal film: 100 ohms ±5%, 1/2 w.
R47 and R48	19B801486P750	Metal film: 75 ohms ±5%, 1/2 w.
R49	19B801486P101	Metal film: 100 ohms ±5%, 1/2 w. (Used in G3, G6-G9, G11).
R50	19B800607P1	Metal film: Jumper. (Used in G8, G9, G10 and G11).
R51	19B801486P331	Metal film: 330 ohms ±5%, 1/2 w.(Used in G3, G6-G9, G11).
R52	19B801486P100	Metal film: 10 ohms ±5%, 1/2 w.
R53	19B800607P1	Metal film: Jumper.
R54	19B800607P472	Metal film: 4.7 ohms ±5%, 1/8 w.
R55	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R56	19B800607P330	Metal film: 33 ohms ±5%, 1/8 w.
R57	19B800607P222	Metal film: 2.2 ohms ±5%, 1/8 w.
R58 and R59	19A700113P7	Composition: 4.7 ohms ±5%, 1/2 w (Used in G10).
		- - - - - - - - - - - - - THERMISTOR - - - - - - - - - - - - -
RT1	19A705813P2	Thermistor: sim to AL03006-58.2K-97-G100.
		- - - - - - - - - - VOLTAGE REGULATORS - - - - - - - - - -
VR1 and VR2	19A700083P102	Silicon: 5.1 Volt Zener; sim to BZX84-C5V1.
		- - - - - - - - - - - - - CAPACITORS - - - - - - - - - - - - -
C1	19A116708P2	Ceramic feedthru: 0.01 µF -0 +100%, 500 VDCW; sim to Erie 327-050-X5W0103P.

SYMBOL	PART NO.	DESCRIPTION
		- - - - - - - - - - - - - JACKS - - - - - - - - - - - - -
J1		Part of W1.
J104	7777145P5	Receptacle: sim to Amphenol 82-97.
		- - - - - - - - - - - - - TRANSISTORS - - - - - - - - - - - - -
Q1	344A3948P1	Silicon, NPN: UHF Amplifier; sim to Motorola MRF 650.
Q2 and Q3	344A4134P1	Silicon, NPN: UHF Amplifier.
Q203	19A700055P1	Silicon, PNP: Darlington; sim to TIP-125.
		- - - - - - - - - - - - - RESISTORS - - - - - - - - - - - - -
R28 and R29	19A143832P6	Power: 100 ohm 5%, 40 w.
		- - - - - - - - - - -INTEGRATED CIRCUITS - - - - - - - - - - -
U1	19A705457P2	PA module: 440-470 MHz; sim to M57704H. (Used in G3).
U1	19A705457P1	PA module: 400-450 MHz; sim to M57704M. (Used in G7).
U1	19A705457P3	PA module: 470-512 MHz; sim to M57704SH. (Used in G9 and G10).
U1	19A705457P7	PA module: 380-400 MHz; sim to M57704UL. (Used in G8).
U1	19A705457P4	PA module: 400-420 MHz; sim to M57704L. (Used in G6).
U2	19A702293P3	Linear: Dual Op Amp; sim to LM358D.
U3	19A701789P4	Linear: Quad Op Amp; sim to LM224D.
U7	344A3907P1	Monolithic microwave IC (MMIC): sim to Avantek MSA-1105.
U100	19A705532P2	Integrated Circuit, Linear (Positive Voltage Regulator): sim to MC78T15CT.
		- - - - - - - - - - - - - - - CABLES - - - - - - - - - - - - - - -
W1	19B801529G4	RF Input Cable. Includes the following:
	19B800560P2	RF Cable.
	19A705512P3	Connector, RF SMB series: sim to AMP 228213-1.
	19A115938P1	Connector, coaxial: (BNC Series); sim to Amphenol 31-318.
W4	19B801695G11	Power Cable. Includes the following:
	19B209268P115	Solderless terminal.
	19B209260P11	Solderless terminal.
	19A115959P2	Wire, stranded.
	19A701503P2	Cable: battery, red.
	19A701503P10	Cable: battery, black.
	19B209268P116	Solderless terminal.
W10	19B801937P1	Power cable.
W13	19B801739P1	Power control cable.
		- - - - - - - - - - - - - MISCELLANEOUS - - - - - - - - - - - - -
2	19D902420P6	Heatsink.
5	19A702381P510	Screw, thread forming: TORX DRIVE No. M3.5 0.6 x 10.
6	7139898P3	Nut, hex, brass: No. 1/4-28.
11	19A702364P310	Machine screw, TORX Drive: No. M3-0.5 x 10.
14	19B209268P113	Terminal, solderless: sim to AMP 2-34835-4. (Used in G11).
	19A115959P2	Wire, stranded. (Used in G11).
	19B209268P116	Solderless terminal. (Used in G11).
15	7147306P2	Insulator.
16	19A700136P7	Insulated sleeving.
21	19A701863P27	Clip, loop.
22	19A701312P5	Flatwasher: M3.5.
28	19A702364P316	Machine Screw: Pan Head, Steel.
29	19A700034P4	Nut, hex: No. M3 x 0.5MM.
30	19A700033P5	Lock washer, external tooth: No. 3.

SYMBOL	PART NO.	DESCRIPTION
35	19A705469P1	Insulator Plate, TO-220.
36	19A700068P1	Insulator, bushing.
37	19A134455P3	Flat washer.
38	19B801659G3	Cover (see separate parts list).
41	19A700033P6	Loackwasher, external tooth, M3.5.
45	N405P5B6	Lockwasher.
46	19A701312P4	Flatwasher: 3.2 ID.
50	19A702381P408	Tap screw, TORX Drive, M3-0.5 x 8.
51	19A705106P1	Resistor Spacer.
		COVER 19B801659G3
2	19D902421P1	Power Amplifier Cover.
4	19A702381P522	Screw, thread forming:
5	19A701365P4	Washer.
11	19A149969P3	Shield.
13	5493477P9	Axial fan.
14	5493477P10	Grille.
15	N80P13028B6	Machine screw.
16	N210P21B6	Machine nut.
17	19A701312P5	Flatwasher: M3.5.
18	19A701863P10	Clip, loop.
20	19A702364P410	Machine screw.
24	N405P37B6	Lock washer.
25	L401P23B6	Split washer.
26	19A700034P5	Hex nut.

LOW PASS FILTER MODULE
19D902856G3 & G9
ISSUE 2

SYMBOL	PART NO.	DESCRIPTION
		- - - - - - - - - - - - - JACKS - - - - - - - - - - - - -
J1 and J2	7777145P5	Receptacle: sim to Amphenol 82-97.
		- - - - - - - - - - - - - MISCELLANEOUS - - - - - - - - - - - - -
2	19D903063P1	Casting.
3	19D903064P1	Casting.
5	19A702381P513	Screw, thread forming: TORX, No. M3.5 - 0.6 X 13.
6	19A702364P210	Machine screw, metric: M2.5-.45 x 10.
7	19A134455P3	Flatwasher.
8	19A700032P3	Lockwasher, tooth, steel, metric: 2.5.
		UHF FILTER BOARD 19D902853G3
		- - - - - - - - - - - - - CAPACITORS - - - - - - - - - - - - -
C1 thru C3	19A700006P2	Mica: 5.6 pF ±10%, 100 VDCW; sim to Underwood 3HS0020.
C4	19A700006P1	Mica: 4.7 pF ±10%, 100VDCW.
C5	19A700006P2	Mica: 5.6 pF ±10%, 100 VDCW; sim to Underwood 3HS0020.
		- - - - - - - - - - - - - INDUCTORS - - - - - - - - - - - - -
L1 and L2	19C320618P7	Coil.

* COMPONENTS, ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	PART NO.	DESCRIPTION
L3 thru L6	19B227929P1	Coil.
		UHF FILTER BOARD 19D902853G9
		- - - - - - - - - - - - CAPACITORS - - - - - - - - - - - -
C1	19A700006P1	Mica: 4.7 pF ±10%, 100 VDCW.
C2 and C3	19A700006P3	Mica: 6.8 pF ±10%, 100VDCW.
		- - - - - - - - - - - - INDUCTORS - - - - - - - - - - - -
L1 thru L4	19C320617P17	Coil.
		- - - - - - - - - -MISCELLANEOUS - - - - - - - - - -
11	19A702455P5	Nut, self clinching.

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 **POWER AMPLIFIER 19D902797G3**
POWER AMPLIFIER BOARD 19D902794G3
To make unit ETS compliant.
C17, C44, C45 were 19A702052P33.
C50 was 0.068 µF (19A702052P24).
C61 was 8.2 pF (19A702061P12).
C62 was 27 pF (19A702061P33).
C84 was 1000 pF (19A705108P40).
D1, D2, D3 were (19A700047P3)
L15 thru L17 were (19A700024P37).
L24 was 15nH (19A705470P3).
R33 was 5.6K (19B800607P562).
R34 was 3.9 ohms composition (19A700113P5).
L26 and L27 were removed.
C48, C49, C63, C74 were removed.
C1, (19A702052P26) was added.
C25, C26 (344A3126P38) were added.
R37, R51 (19B801486P331) were added.
R52 (19B801486P100) was added.
Q7 was 19A701940P1.
RT1 (19A705813P2) was added.
VR2 (19A700083P102) was added.

REV. B **POWER AMPLIFIER 19D902797G3**
POWER AMPLIFIER BOARD 19D902794G3
To update PWB for new split.
PWB changed
C26 was 100 pF (344A3126P38).
C81 was 100 pF (344A3126P38).
C27 thru C29 added: 8.2 pF (344A3126P11).
C34 and C35 added: 12 pF (344A3126P15).
R36 was 150 ohms (19B801486P151).
R44 thru R46 were 150 ohm (19B801486P151).
R47 and R48 were 39 ohm (19B801486P390).
R32 and R35 added: 2.2 ohm (19A700050P17).

PRODUCTION CHANGES - CONT.

REV. C **POWER AMPLIFIER 19D902797G3**
POWER AMPLIFIER BOARD 19D902794G3
To update PWB for new band splits.

REV. D **POWER AMPLIFIER 19D902797G3**
POWER AMPLIFIER BOARD 19D902794G3
To update PWB for new band splits and add power monitor circuitry.
Added U2, C48, R54, R53, R55.

REV. A **POWER AMPLIFIER 19D902797G6**
To update PWB to new band splits.

REV. A **POWER AMPLIFIER 19D902797G7**
POWER AMPLIFIER BOARD 19D902794G7
To update PWB to new band splits and add power monitor circuitry.
Added U2, C48, R54, R53, R55.

REV. A **POWER AMPLIFIER 19D902797G8, G9, G11**
POWER AMPLIFIER BOARD 19D902794G8, G9, G11

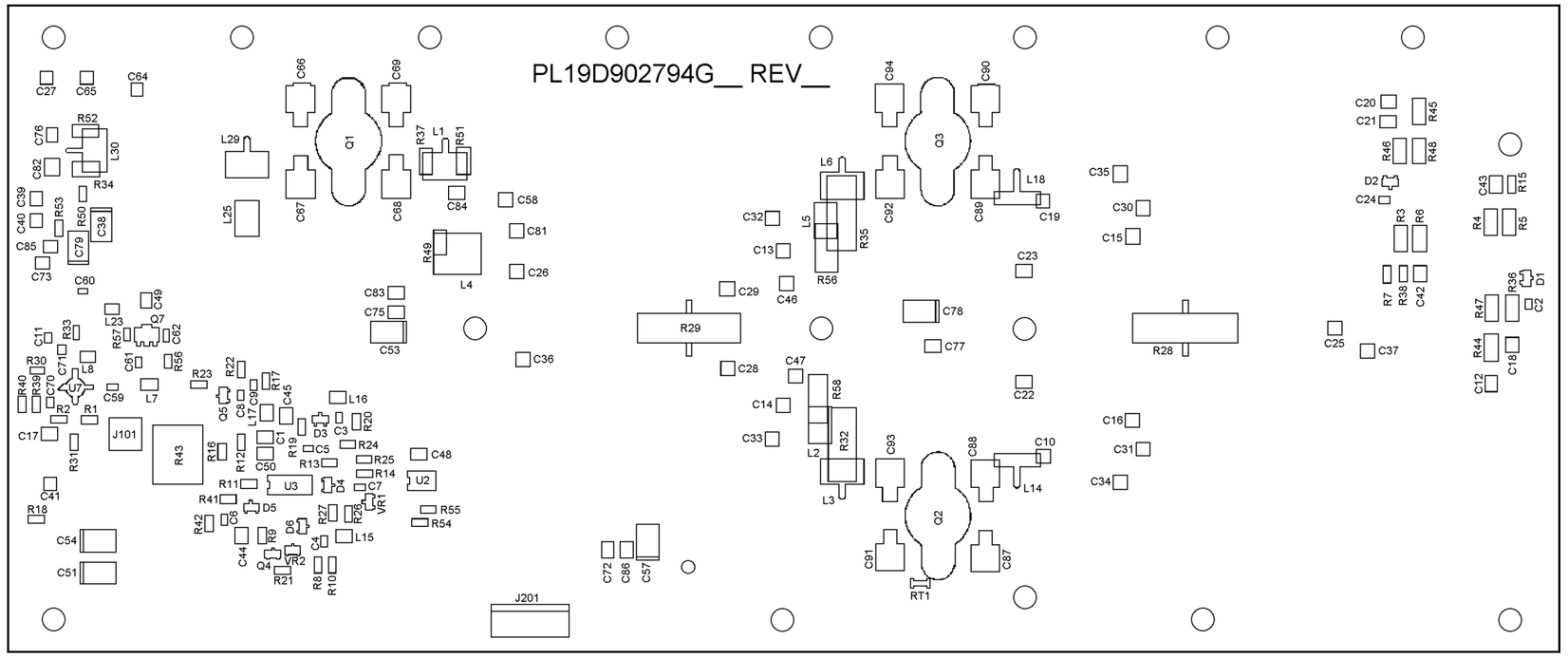
REV. B **POWER AMPLIFIER 19D902797G6, G7**
POWER AMPLIFIER BOARD 19D902794G6, G7

REV. E **POWER AMPLIFIER 19D902797G3**
POWER AMPLIFIER BOARD 19D902794G3

To update PWB to new band splits for 492-512 MHz.

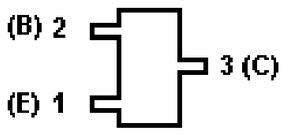
REV. B **POWER AMPLIFIER BOARD 19D902797G11**
Improve reliability.
C67 was 39 pF (19A700006P50).

COMPONENT SIDE

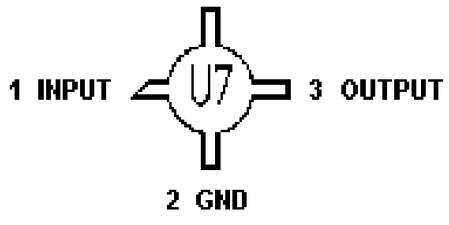


(19D902794 Sh. 2, Rev. 14)

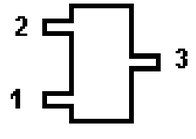
LEAD IDENTIFICATION FOR Q4, Q5, Q7 (SOT) TRANSISTORS (TOP VIEW)



LEAD IDENTIFICATION FOR U7

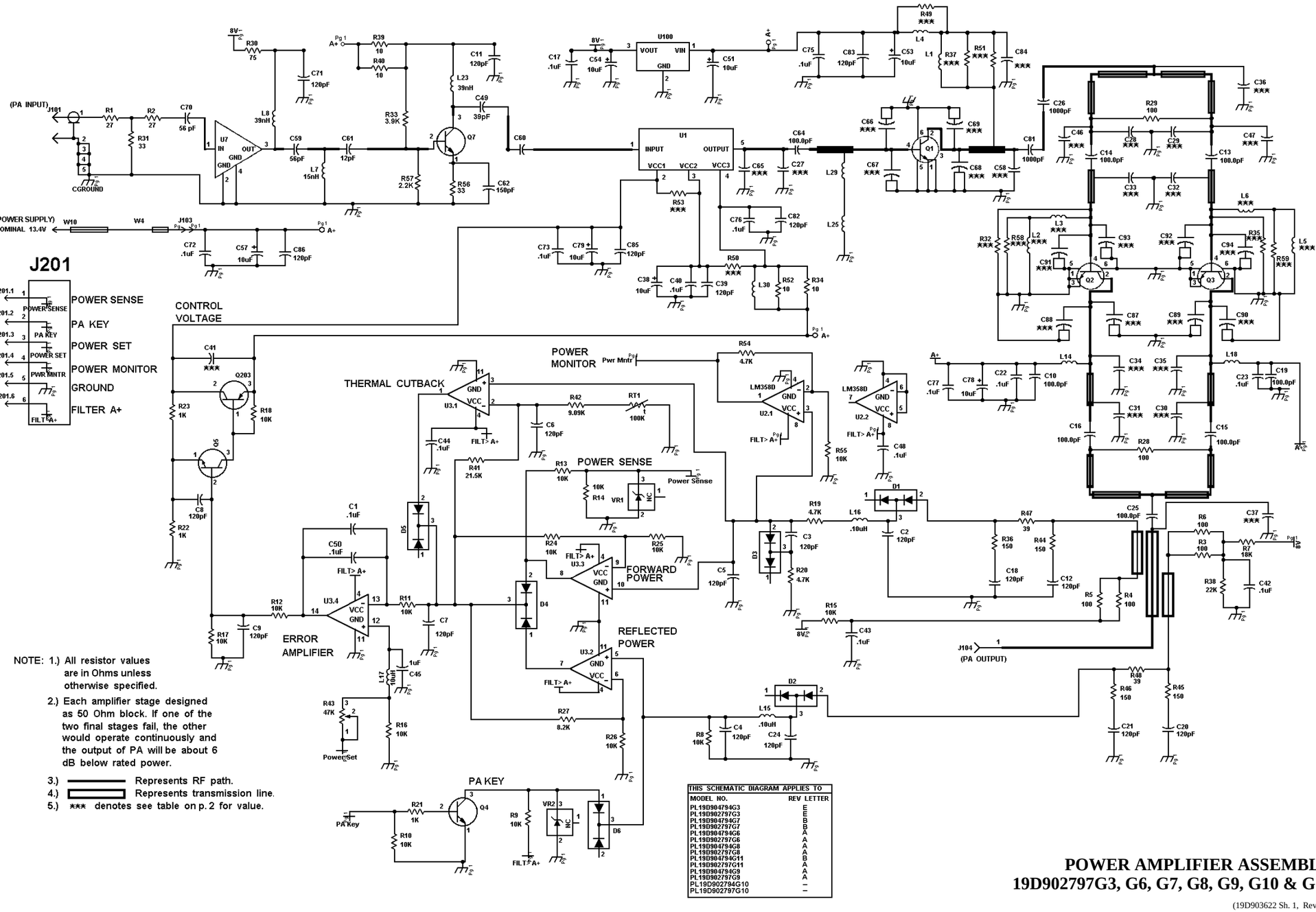


LEAD IDENTIFICATION FOR D4,D5,D6, VR1 (SOT) DIODES (TOP VIEW)



CAUTION
OBSERVE PRECAUTIONS FOR HANDLING
ELECTROSTATIC SENSITIVE DEVICES

POWER AMPLIFIER BOARD A1
19D902856G3, G6, G7, G8, G9, G10 & G11



THIS SCHEMATIC DIAGRAM APPLIES TO

MODEL NO.	REV LETTER
PL19D904794G3	E
PL19D902797G3	E
PL19D904794G7	B
PL19D902797G7	B
PL19D904794G6	A
PL19D902797G6	A
PL19D904794G8	A
PL19D902797G8	A
PL19D904794G11	B
PL19D902797G11	A
PL19D904794G9	A
PL19D902797G9	A
PL19D902794G10	–
PL19D902797G10	–

POWER AMPLIFIER ASSEMBLY
19D902797G3, G6, G7, G8, G9, G10 & G11

(19D903622 Sh. 1, Rev. 11)

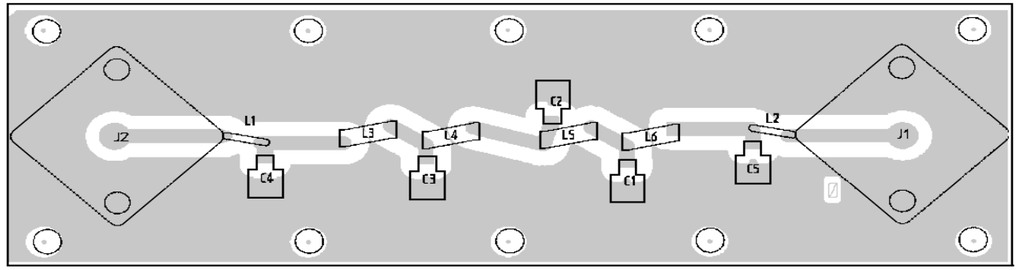
TABLE I

REF. DES.	380-400 MHz	403-425 MHz	425-450 MHz	450-470 MHz	470-494 MHz	492-512 MHz	410-430 MHz
C27	10.0 pf	12.0 pf	10.0 pf	not used	not used	not used	12.0 pf
C28	15.0 pf	12.0 pf	8.2 pf	not used	not used	not used	10.0 pf
C29	15.0 pf	12.0 pF	8.2 pF	not used	not used	not used	10.0 pf
C30	12.0 pF	not used	not used	8.2 pF	8.2 pF	8.2 pF	not used
C31	12.0 pF	not used	not used	8.2 pF	8.2 pF	8.2 pF	not used
C32	not used	not used	not used	3.3 pF	not used	not used	not used
C33	not used	not used	not used	3.3 pF	not used	not used	not used
C34	not used	15.0 pF	15.0 pF	not used	not used	not used	15.0 pF
C35	not used	15.0 pF	15.0 pF	not used	not used	not used	15.0 pF
C36	3.9 pF	4.7 pF	not used	not used	not used	not used	4.7 pF
C58	12.0 pF	12.0 pF	12.0 pF	8.2 pF	5.6 pF	5.6 pF	12.0 pF
C65	not used	not used	not used	8.2 pF	4.7 pF	4.7 pF	not used
C66	47.0 pF	39.0 pF	39.0 pF	33.0 pF	27.0 pF	27.0 pF	39.0 pF
C67	47.0 pF	47.0 pF	39.0 pF	36.0 pF	27.0 pF	27.0 pF	47 pF
C68	47.0 pF	39.0 pF	39.0 pF	33.0 pF	27.0 pF	22.0 pF	39.0 pF
C69	47.0 pF	47.0 pF	39.0 pF	36.0 pF	27.0 pF	22.0 pF	43.0 pF
C87	56.0 pF	47.0 pF	43.0 pF	39.0 pF	33.0 pF	33.0 pF	47.0 pF
C88	51.0 pF	51.0 pF	43.0 pF	39.0 pF	33.0 pF	33.0 pF	51.0 pF
C89	51.0 pF	51.0 pF	43.0 pF	39.0 pF	33.0 pF	33.0 pF	51.0 pF
C90	56.0 pF	47.0 pF	43.0 pF	39.0 pF	33.0 pF	33.0 pF	47.0 pF
C91	51.0 pF	47.0 pF	36.0 pF	33.0 pF	33.0 pF	33.0 pF	43.0 pF
C92	51.0 pF	43.0 pF	39.0 pF	33.0 pF	27.0 pF	27.0 pF	43.0 pF
C93	51.0 pF	43.0 pF	39.0 pF	33.0 pF	27.0 pF	27.0 pF	43.0 pF
C94	51.0 pF	47.0 pF	36.0 pF	33.0 pF	33.0 pF	33.0 pF	43.0 pF
L2	BEAD	BEAD	BEAD	not used	not used	not used	BEAD
L3	AIR COIL	AIR COIL	AIR COIL	not used	not used	not used	AIR COIL
L5	BEAD	BEAD	BEAD	not used	not used	not used	BEAD
L6	AIR COIL	AIR COIL	AIR COIL	not used	not used	not used	AIR COIL
R32	not used	not used	not used	2.2 pF	2.2 pF	not used	not used
R35	not used	not used	not used	2.2 pF	2.2 pF	not used	not used
C37	2.2 pF	not used	not used	not used	not used	not used	not used
R53	not used	0	0	0	not used	not used	not used
R50	0	not used	not used	not used	0	0	0
C41	not used	not used	not used	not used	not used	not used	100.0 pF
C46	not used	not used	not used	not used	8.2 pF	10.0 pF	not used
C47	not used	not used	not used	not used	8.2 pF	10.0 pF	not used
R58	not used	not used	not used	not used	not used	4.7 pF	not used
R59	not used	not used	not used	not used	not used	4.7 pF	not used
R49	100	100	100	100	100	not used	100
R37	330	330	330	330	330	not used	330
R51	330	330	330	330	330	not used	1200 pF
C84	1200 pF	1200 pF	1200 pF	1200 pF	1200 pF	not used	1200 pF
L1	3 turn	3 turn	3 turn	3 turn	3 turn	1 turn	3 turn

POWER AMPLIFIER ASSEMBLY
19D902797G3, G6, G7, G8, G9,G10 & G11

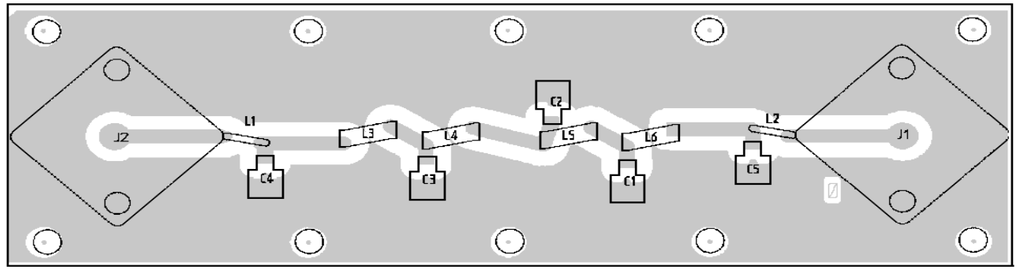
(19D903622 Sh.2 Rev. 11)

COMPONENT SIDE

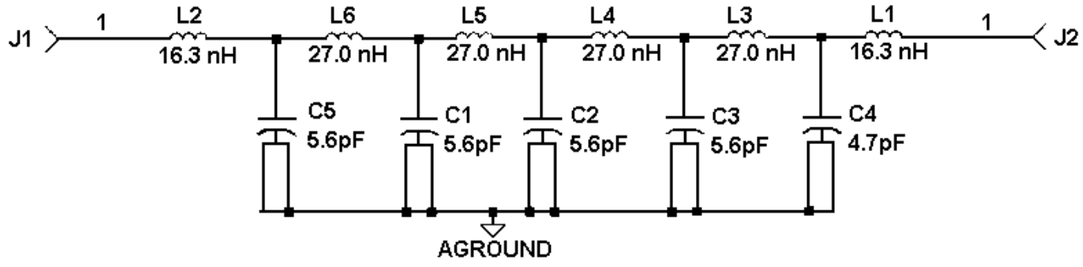


(19D902853, Sh. 2, Rev. 0)
(19D903638, Component Side, Rev. 0)

SOLDER SIDE

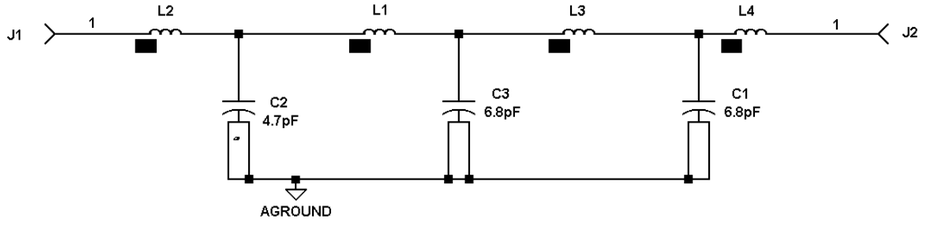


(19D902853, Sh. 2, Rev. 0)
(19D903638, Solder Side, Rev. 0)

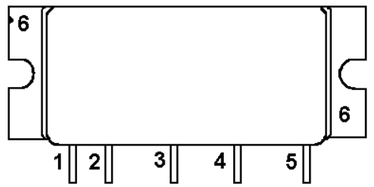


LOW PASS FILTER MODULE
19D902856G3

(19D903623 Sh.1, Rev. 1)

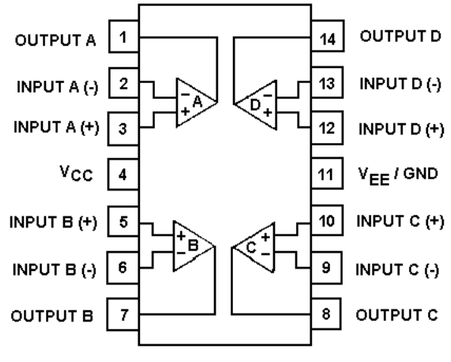


U1
19A705457P1, P2 AND P4
PA Amplifier Module

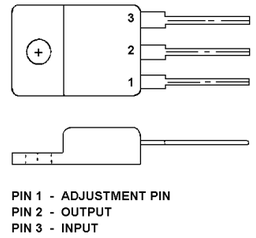


1. P in
2. Vcc1 - 1ST STAGE
3. Vcc - 2ND STAGE
4. Vcc - OUTPUT STAGE
5. P out
6. FIN - GROUND

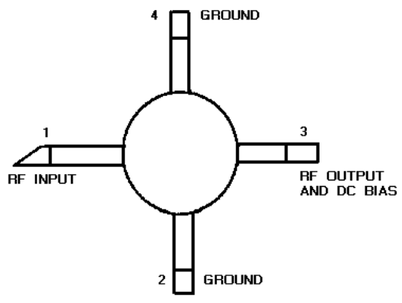
U3
19A701789P4
Quad Op-Amp



U100
19A705532P2
Voltage Regulator



U7
344A3907P1
MMIC Amplifier



LOW PASS FILTER MODULE
470 - 512 MHz
19D902856G9

(19B804157, Rev. 0)

Maintenance Manual

MASTR® III
RF PACKAGE, UHF
380-512 MHz

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ILLUSTRATIONS

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CONVENTIONAL OPTIONS and ACCESSORIES

Programmable Options

- Transmit Frequencies
- Receive Frequencies
- Channel Spacing
- Channel Guard Digital and Tone
- Channel Guard Disable
- Repeater Disable
- Intercom Function
- Type 90
- DTMF Decode
- Morse Code ID
- Squelch Tail Elimination (STE)
- Carrier Control Timer
- Station Control
- DC Control
- Tone Control
- Repeater
- DC/Repeat
- Tone/Repeat
- 2 or 4 Wire Audio
- Scan

Additional Options

- Service Microphone
- Antenna Multicoupler
- 50 Hz Power Supply
- Duplexer
- Antenna Relay (VHF/UHF)
- Combiner
- Isolator
- Squelch Operated Relay
- Remote Controllers
- Battery Standby (VHF/UHF)
- Battery Charger (VHF/UHF)
- Gel Cell Battery (VHF/UHF)
- Voice Guard Encryption
- Aegis Digital

CONVENTIONAL TONE & DC REMOTE CONTROLLED STATIONS

AUDIO (Line to Transmitter)

Line Terminating Impedance:	600 W
Line Level (Adjustble):	-20 dBm to +7 dBm
Frequency Response:	± 3 dB @ 300-3000 Hz

TONE CONTROL

Function Tones:	1050,1150,1250,1350,1450, 1550,1650, 1750,1850,1950 & 2050 Hz
Secur-it Tone & Transmit Tone:	2175 Hz
Transmitted 2175 Hz Tone Level:	20 dB Below Voice
Permissible Control Line Loss @2175 Hz:	30 dB

Continued

CONVENTIONAL TONE & DC REMOTE CONTROLLED STATIONS - Cont.

AUDIO (Receiver-to-Line)	
Audio Amplifier Input Impedance:	10 KΩ
Input Level:	1 V RMS (For 5 kHz Deviation)
Output Impedance to Line:	600 Ω
Output Level to Line Voice (1 kHz ref):	+7 dBm (Adjustable)
Tone (1 kHz ref):	+7 dBm (Ref. 7 dBm)
Freqency Response:	+1 dB and -3dB @ 300-3000 Hz
Hum and Noise, Noise Squelch:	-55 dB (Ref. 7 dBm)
Tone Squelch:	-30 dB (Ref. 7 dBm)
DC CONTROL Control Control Currents:	-2.5, ± 6 & ± 11 mA
Line Loop Resistance (maximum):	11 KΩ (Includes 3K Termination)

REGULATORY DATA EDACS and CONVENTIONAL

FCC FILING DATA (for cabinet or open rack mounting)				
FREQUENCY BAND	POWER OUTPUT (Internally Adjustable)	FREQ. STABILITY AND MODULATION TYPE	APPLICABLE TO FCC RULES PART NUMBERS	FCC FILLING NUMBER
403-430	45 to 90 W	(Freq. Mod. PLL Exc.) 1.0 PPM	22,90,80,74	AXATR-307-A
425-450	45 to 90 W	(Freq. Mod. PLL Exc.) 1.0 PPM	22,90,80,74	AXATR-307-A2
450-470	50 to 100W	(Freq. Mod. PLL Exc.) 1.0 PPM	22,90,80,74	AXATR-307-B2
470-494 492-512	45 to 90 W	(Freq. Mod. PLL Exc.) 1.0 PPM	22,90,80,74	AXATR-307-C2 AXATR-307-D2

DOC FILING DATA		
FREQUENCY BAND	TYPE NUMBER	APPLICABLE SPEC
403-430	TR-307	RSS-119
425-450	TR-307	RSS-119
450-470	TR-307	RSS-119
470-494, 492-512	NA	NA

GENERAL

CABINET	INDOOR CABINET (Floor Mount) 37" (CNV)	69"
SIZE [in. (mm)]		
Height:	37.0 (940)	69.1 (1750)
Width:	21.5 (550)	23.1 (590)
Depth:	18.25 (460)	21 .0 (533)
Weight (min) [(lb. (Kg)]		
Continuous Duty	150 (68)	300 (136)
Packed , Domestic Shipping	165 (75)	317 (147)
Number of Rack Units	17	33
Maximum Units w/Power Supply	2	3
Maximum Units w/o Power Supply	2	4

NOTE: One Rack Unit equals 1.75 inches, Stations occupy 8 rack units of cabinet space.

SERVICE SPEAKER:	1 Watt @ 8Ω
SERVICE MICROPHONE:	Transistorized Dynamic
DC 5A @ 120 VAC or 3A @ 230 VAC DUTY CYCLE (EIA) Continuous:	Transmit/Receive - 100%
AMBIENT TEMPERATURE: (or full spec performance per EIA)	-30°C to +60°C (-22°F to +140°F)
HUMIDITY (EIA):	90% @ 50°C (122°F)
INPUT POWER SOURCE: Optional: Standby Battery Source:	120 VAC (± 20%) or 230 VAC (± 15%), 50 Hz 13.8 VDC, 100 AH (min.)
ANTENNA CONNECTIONS:	Type N
LENGTH OF AC POWER CABLE:	10 ft (3048mm)
METERING:	Provided through Handset or TQ0619 Utility Software.
ALTITUDE Operable: Shipable:	 Up to 15,000 ft (4,570 m) Up to 50,000 ft (15,250 m)

SOURCE POWER DRAIN		UHF					
Frequency Range(MHz)		380-400	403-430	425-450	450-470	470-494	492-512
AC Input Power:		5A @ 120 VAC or 3A @ 230 VAC					
DC Input Power:	VDC						
Tx (full / half power):	13.8	33/25A	33/25A	33/25A	33/25A	33/25A	33/25A
Rx only:	13.8	2 A	2 A	2 A	2 A	2 A	2 A
Tx (full / half power):	26.4						
EDACS Applications:	13.8	2 A	2 A	2 A	2 A	2 A	2 A

TRANSMITTER

	UHF					
FREQUENCY RANGE (MHz)	380-400	403-430	425-450	450-470	470-494	492-512
RATED POWER OUTPUT (Watts):	75	90	90	100	90	90
RF OUTPUT IMPEDANCE (W):	50	50	50	50	50	50
CONDUCTED SPURIOUS & HARMONIC EMISSION (dBm):	-36	-36	-36	-36	-36	-36
FREQUENCY STABILITY (%):	±0.0001	±0.0001	±0.0001	±0.0001	±0.0001	±0.0001
MODULATION DEVIATION (kHz): 16F3 & 16F9 20F5Y & 20F9Y (VHF & UHF)	0 to ± 5	0 to ± 5	0 to ± 5	0 to ± 5	0 to ± 5	0 to ± 5
FM NOISE (dB):	-55	-55	-55	-55	-55	-55
CHANNEL STEPS (kHz)	6.25	6.25	6.25	6.25	6.25	6.25
FREQUENCY SPREAD Full Spec (MHz)	20	22	25	20	24	20

AUDIO DISTORTION (@ 1 kHz): Less than 3%

NUMBER OF CHANNELS (Conventional): up to 16

AUDIO RESPONSE (pre-emphasis): Within +1 and -3 dB of 6dB/octave, 300 to 3000 Hz per EIA.

NOTE: Rated power output is measured at the transmitter power amplifier output connector per FCC Type Acceptance filling information. Any customer- required optional items such as power measuring devices and/or duplexers will introduce loss between the transmitter output connector and the station cabinet output connector. This loss will reduce the available power at the station connector.

RECEIVER

	UHF					
FREQUENCY RANGE (MHz)	380-400	403-430	425-450	450-470	470-494	492-512
RF INPUT IMPEDANCE (W):	50	50	50	50	50	50
CHANNEL SPACING (kHz):	12.5/25	12.5/25	12.5/25	12.5/25	12.5/25	12.5/25
SENSITIVITY (dBm) EIA 12 dB SINAD:	-115 (0.40 µV)	-116 (0.35 µV)	-116 (0.35 µV)	-116 (0.35 µV)	-116 (0.35 µV)	-116 (0.35 µV)
Threshold Squelch (dBm):	-118 (0.28 µV)	-119 (0.25 µV)	-119 (0.25 µV)	-119 (0.25 µV)	-119 (0.25 µV)	-119 (0.25 µV)
SELECTIVITY EIA 2-Signal (dB) 12.5 kHz:	-80	-80	-80	-80	-80	-80
25 kHz:	-90	-90	-90	-90	-90	-90

Continued

RECEIVER - Cont.

	UHF					
FREQUENCY RANGE (MHz)	380-400	403-430	425-450	450-470	470-494	492-512
FREQUENCY STABILITY (%):	±0.0001	±0.0001	±0.0001	±0.0001	±0.0001	±0.0001
SIGNAL DISPLACEMENT BANDWIDTH (kHz):	±2	±2	±2	±2	±2	±2
INTERMODULATION (dB)						
12.5 kHz:	-80	-80	-80	-80	-80	-80
25 kHz:	-85	-85	-85	-90	-90	-90
30 kHz: ETSI				-85		
SPURIOUS & IMAGE REJECTION (dB):	-100	-100	-100	-100	-100	-100
FREQUENCY SPREAD						
Full Specs. (MHz):	2.0	2.0	2.0	2.0	2.0	2.0
3 dB Degradation in Sensitivity (MHz):	3.0	3.0	3.0	3.0	3.0	3.0

AUDIO RESPONSE (de-emphasis): Within +2 and -8 dB of 6 dB/octave (@ Local Speaker), 300 to 3000 Hz per EIA.

Within +1 and -3 dB of 6 dB/octave (@ Line Output), 300 to 3000 Hz per EIA.

AUDIO OUTPUT: 1 Watt at less than 3% distortion @ 1000 Hz, 25 kHz Channel

MODULE NUMBERS

TRANSMIT SYNTHESIZER (450-470 MHz) 19D902780G3
(425-450 MHz) 19D902780G7
(403-425 MHz, 410-430MHz) 19D902780G6
(380-400 MHz) 19D902780G8
(470-494 MHz) 19D902780G9
(492-512 MHz) 19D902780G10

RECEIVE SYNTHESIZER (450-470 MHz, 403-425 MHz, 410-430 MHz) 19D902781G3
(425-450 MHz, 470-494 MHz) 19D902781G7
(380-400 MHz) 19D902781G8
(492-512 MHz) 19D902781G10

RX FRONT END MODULE (450-470 MHz) 19D902782G3
(425-450 MHz) 19D902782G7
(403-425 MHz) 19D902782G6
(410-430 MHz) 19D902782G11
(380-400 MHz) 19D902782G8
(470-494 MHz) 19D902782G9
(492-512 MHz) 19D902782G10

IF MODULE 19D902783G1
(470-494 MHz, 492-512 MHz) 19D902783G7

Continued

MODULE NUMBERS - Cont.

POWER AMPLIFIER	(450-470 MHz)	19D902797G3
	(425-450 MHz)	19D902797G7
	(403-425 MHz)	19D902797G6
	(410-430 MHz	19D902797G11
	(380-400 MHz)	19D902797G8
	(470-494 MHz)	19D902780G9
	(492-512 MHz)	19D902780G10
LOW PASS FILTER		19D902856G1
	(470-512 MHz)	19D902780G9
ANTENNA SWITCH		19B235897P2
DUPLEXER	(440-470 MHz)	344A4047P1

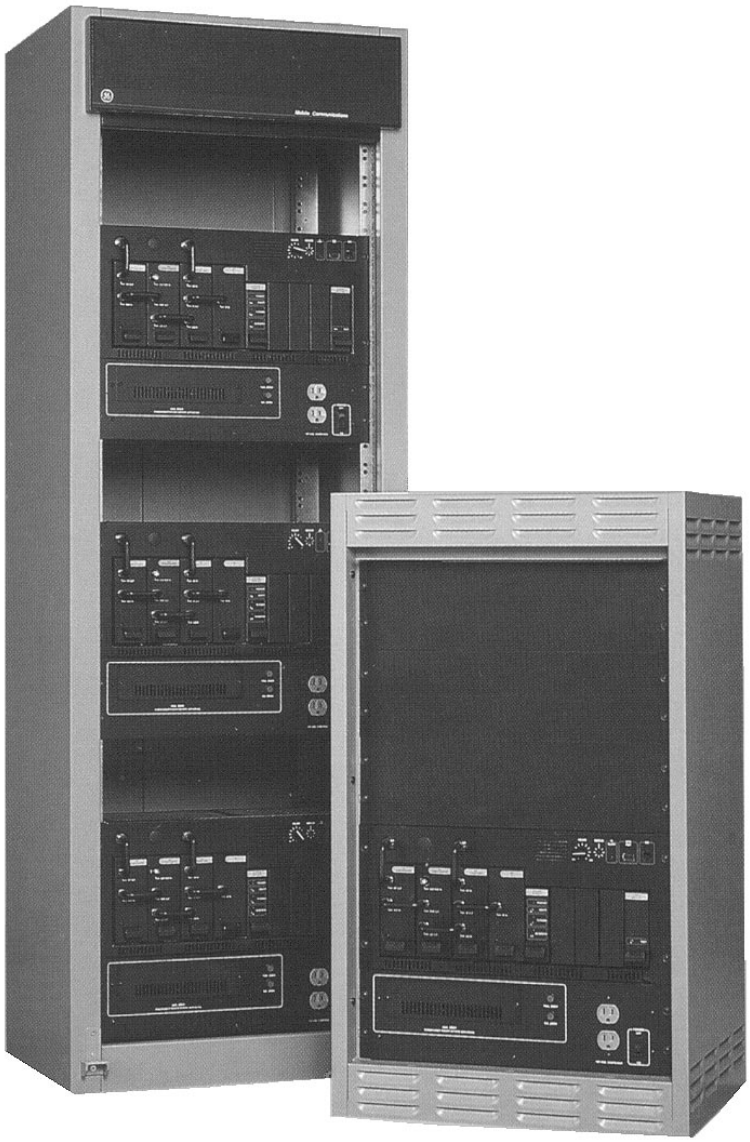
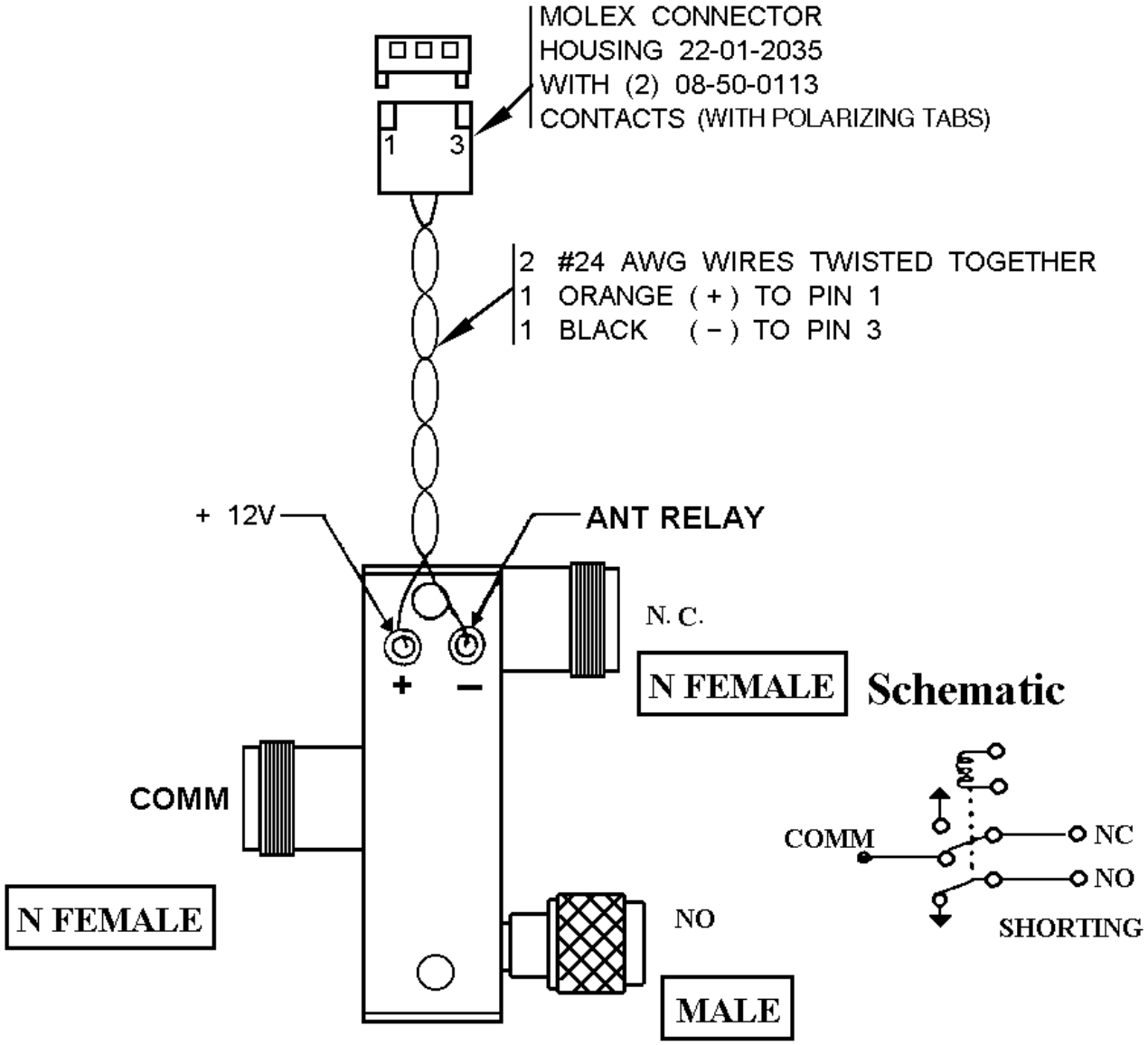


Fig 1 - 69" & 37" Cabinet Mount



ANTENNA SWITCH
19B235897P2

Ericsson Inc.
Private Radio Systems
Mountain View Road
Lynchburg, Virginia 24502
1-800-528-7711 (Outside USA, 804-592-7711)

Printed in U.S.A.

MAINTENANCE MANUAL FOR 21.4 MHz RECEIVER IF MODULE 12.5/25 kHz CHANNEL SPACING 19D902783G7 & G11

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DESCRIPTION

The MASTR III Receiver IF Module provides amplification and demodulation of the 21.4 MHz Intermediate Frequency signal. The IF Module also includes the receiver squelch circuitry. However, it does not include de-emphasis or squelch audio gating circuits. Figure 1 is a block diagram showing the functional operation of the IF Module.

The IF Module circuitry contains the following:

- A 50 ohm input impedance IF Amplifier
- A chain of two crystal filters and an integrated circuit IF amplifier
- An integrated circuit containing a crystal oscillator, mixer, limiter, and quadrature detector
- A variable gain AF amplifier
- A squelch circuit
- A fault detector circuit
- An integrated circuit voltage regulator
- An address decoder

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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. B - RECEIVER IF MODULE 19D902494G7

To improve production of Group 7 boards.
New schematic (193D1065).

REV. A - RECEIVER IF MODULE 19D902494G11

To ensure correct operation, U7 (19A701789P4) was replaced.

REV. B - RECEIVER IF MODULE 19D902494G11

To increase margins on squelch threshold sensitivity and 12 dB SINAD in 12.5 kHz mode. C86 was 0.01 µF (19A702052P14), R6 was 50 ohms (19B800607P510), R97 was 39 ohms (19B801251P390) and R98 and R99 were 150 ohms (19B801251P151). Added L6 (19A705430P24).

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TABLE 1 - GENERAL SPECIFICATIONS

ITEM	SPECIFICATION
I.F. frequency	21.4 MHz
Input Impedance	50 ohm
l2 dB SINAD	-120 dBm (25 kHz); -119 dBm (12.5 kHz)
Adj. CH SEL	-90 dB (25 kHz); -80 dB (12.5 kHz)
Image	-100 dB
3rd order Intercept Pt	23 dBm (25 kHz); 11 dBm *(12.5 kHz) *@ 50 kHz offset
Variation of Sensitivity with Signal Frequency	2 kHz (25 kHz); 1 kHz (12.5 kHz)
2nd I.F. frequency	455 kHz
2nd L.O. frequency	20.945 MHz
AF output (J2 pin 31C)	1 Vrms adjustable (with standard input signal)
AF output impedance	1k ohm
AF distortion	5% (25 kHz); 5% (12.5 kHz)
AF response	
10 Hz	-3 dB
300 Hz	±1 dB
1000 Hz	0 dB reference
3 kHz	±1 dB
Hum & Noise	-55 dB (25 kHz); -50 dB (12.5 kHz)
RSSI output (J2 pin 20C)	0.7 to 2.7 Vdc prop to log (sig level)
RSSI time constant	5 ms
SQ Threshold Sensitivity	-123 dBm (25 kHz); -122 dBm (12.5 kHz)
SQ Maximum Sensitivity	-110 dBm (25 kHz); -109 dBm (12.5 kHz)
SQ Clipping	3 kHz
SQ Attack	150 ms
SQ Close	250 ms
SQ output (J2 pin 26C)	5V logic (low = squelched)
Fault output (J2 pin IIC)	5V logic (low = fault)
DC Supply	13.8V, 150 mA max.; 12.0V, 18 mA max.

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CIRCUIT ANALYSIS

INPUT AMPLIFIER NETWORK

The input amplifier, consisting of Q2 and T1, provides a 50 ohm load for the receiver RF module.

Capacitor C1 provides AC coupling and a DC block on the input line (J1). This DC block protects the module in the event of a failure in a preceding module.

C1 and L9 are series-resonant at 21.4 MHz and provide a low-impedance path from J1 to amplifier Q2. C89 and L8 are parallel-resonant at 21.4 MHz and provide a path to the 50-ohm lead, R105, for mixer products other than 21.4 MHz.

CRYSTAL FILTERS, IF AMPLIFIERS

Y1, Y2, U1, and associated circuitry provide IF filtering and amplification at 21.4 MHz. Filters Y1 and Y2 are both 4-pole bandpass filters with a center frequency of 21.4 MHz and a bandwidth of ±6.5 kHz. Amplifier UI is an integrated-circuit amplifier. U1 provides 30 dB of gain. The amplifier and filters have terminal impedances of 50 ohms. In-circuit gain measurements can be made using a high impedance probe.

Inductors L3, L5 and associated resistors and capacitors provide power supply decoupling. R3 provides a path to the input of the Fault Detector circuit. This input enables the Fault Detector circuit to monitor the DC voltage of U1.

The RF level detector consists of transistor Q1 along with associated resistors and capacitors. This detector plays no role in the normal operation of the IF Module, but aids in unit testing and module troubleshooting.

OSCILLATOR/MIXER/DETECTOR

Integrated circuit U3 provides several functions including 2nd mixer, if amplifier and limiter, and quadrature detector.

The 20.945 MHz crystal oscillator provides local oscillator injection to the mixer in U3. This mixer converts the 21.4 MHz IF signal to 455 kHz. C20 and C21 are oscillator feedback capacitors and have been chosen to provide the proper capacitance for crystal Y3. The proper oscillator output level is difficult to measure directly without affecting the oscillation.

A preferable measurement is at TP3 which should read about 10 mV pk. (Measured using a 10 megohm 11 pF oscilloscope probe.)

The mixer is internally connected to the crystal oscillator. Pins 1 and 20 of U3 are the mixer input and output respectively. Typical mixer conversion loss is about 2 dB.

In the 12.5 kHz mode, the output of the mixer drives the IF amplifier via analog switch U11-2, filter FL1 and analog switch U11-3. In the 25 kHz mode, the mixer output is routed through analog switch U11-1 and C85 to the IF amplifier. The analog switches are controlled by the signal at point 'A'; high for 25 kHz, low for 12.5 kHz.

The IF amplifier output drives the limiter via the 6-pole ceramic filter FL2.

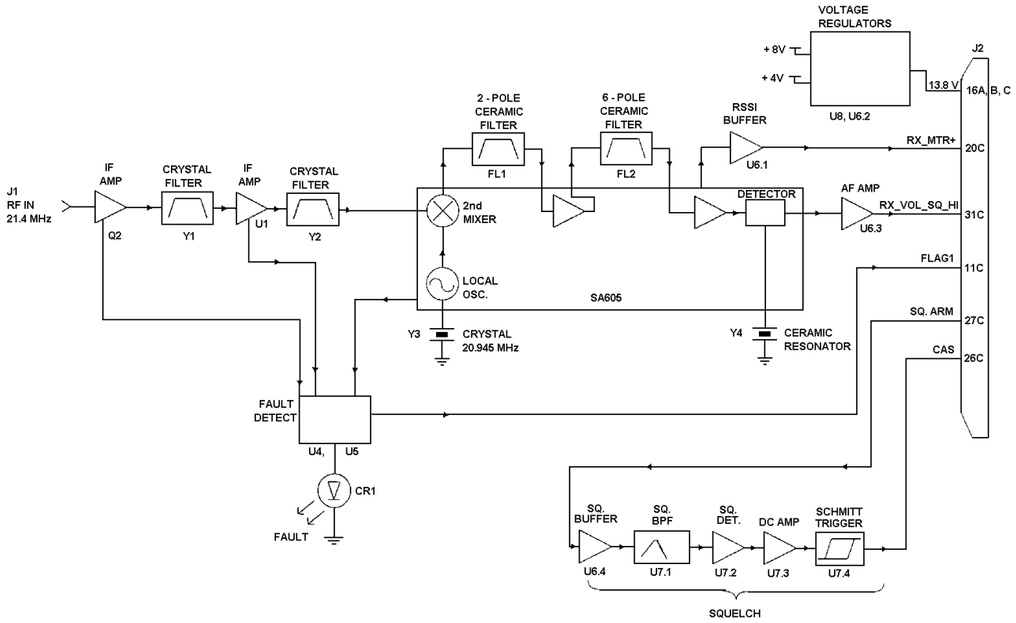
A received-signal-strength indicator (RSSI) is provided at U3 Pin 7. This indicator signal is generated within the limiter circuitry and provides an output current proportional to the logarithm of the input signal strength. This current develops a voltage across R18. The voltage varies from about 1 Vdc for noise input, to about 1.4 Vdc for a 12 dB SINAD signal, to a maximum of about 4.8 Vdc for a high signal level (70 dB stronger than that required for 12 dB SINAD).

The quadrature detector provides a demodulated audio frequency output. The input to the detector is internally connected to the limiter and is not externally available. The output of the detector is U3 pin 9. C28 provides low-pass filtering to remove 455 kHz feedthrough. Ceramic resonator Y4 provides the frequency selective component needed for FM demodulation. Y4 replaces the typical LC resonant circuit found in most quadrature detectors. In contrast to the typical LC network, Y4 requires no adjustment.

The DC supply to U3 is provided through voltage dropping resistor R11 to U3 pin 6. R12 provides a path to the input of the Fault Detection circuit. This enables the Fault Detector to monitor the DC voltage on U3.

AUDIO AMPLIFIER

Operational amplifier U6.3 provides audio frequency amplification. Its gain is set by its associated resistors, including variable resistor VR1. VR1 allows for adjusting the AF output level to 1 Vrms with a standard input signal to the module (1 kHz AF, 3 kHz peak deviation). In the 12.5 kHz mode, the demodulated audio is at a lower level than in the 25 kHz mode. The gain of amplifier U6.3 is, therefore, increased to give the same 1V rms output with a standard input signal to the module of 1.5 kHz deviation. This is done by transistor switch Q6 connecting R1 across R40. U6.2 is used as a voltage regulator to provide 4 Vdc for biasing the operational amplifier.



21.4 MHz IF MODULE - BLOCK DIAGRAM

SQUELCH

Buffer Amplifier

Integrated circuit U6.4 is configured as a unity gain buffer amplifier. It provides a high input impedance to minimize loading of the previous circuits.

Bandpass Filter

The audio frequency bandpass filter consists of U7.1 and its associated circuitry. The purpose of this filter is to reject all voice frequencies and allow only demodulated noise to pass. The functioning of the squelch circuit depends upon the presence or absence of this noise. (When a signal is being received, i.e. the receiver is quiet, the squelch circuit senses the absence of noise and unsquelches the radio.)

Noise Detector

U7.2 along with associated components act as a noise detector. The rectified output of U7.2 charges C11/C44 to a nearly constant DC voltage.

DC Amplifier

U7.3 is configured as a basic amplifier with a gain of 3.

Schmitt Trigger

U7.4 is configured as an amplifier with positive feedback. This arrangement provides hysteresis in the output versus input characteristic. This eliminates the possibility of the squelch circuit repeatedly cutting in and out when the input signal is near a threshold. R56 and R57 act as a voltage divider to provide a 5 volt logic level output. (Logic High = unsquelched)

FAULT DETECTOR

U4 and U5 are voltage comparators. These are configured into four "window detectors" which sense the presence of voltages within specified ranges (windows).

The four window detector circuits are U4.1 & U4.2, U4.4 & U4.3, U5.1 & U5.2, and U5.4 & U5.3. These monitor DC operating voltages on U6.2, U1, Q2, and U3 respectively. R29 and R30 comprise a voltage divider to provide a 5 volt logic level output. A fault is indicated when the output drops to zero.

Diode D1 and transistor Q3 monitor the output of the 8V regulator. DI is a 8.2 volt breakdown diode. If the regulator output voltage should rise above 8.9 V (8.2 + 0.7 base-emitter drop) Q1will turn on and a fault will be indicated.

Transistors Q4 and Q5 are drivers for the front panel LED CRI. These are powered from the +13.8 Vdc line before the 8V regulator. Therefore, if the regulator opens, a fault will still be indicated.

VOLTAGE REGULATOR

U8 is a monolithic integrated-circuit voltage regulator providing 8 Vdc. This powers all circuitry in the module with the exception of Q2, the front panel LED and its drivers.

ADDRESS DECODER

The address decoder consists of U2, an 8-stage shift register, and U9, a BCD-to-decimal decoder. When A2, A1 and A0 are '1', '1', '0', respectively and the ENABLE line is high, Q7 on U9 goes high. This enables data input to U2 to propagate through it, controlled by the clock pulses on U2-3. When the ENABLE signal goes low, U9-4 goes low, and the shift-register outputs are latched. Q1 on U2 is then high for the 12.5 kHz mode, and low for the 25 kHz mode.

MAINTENANCE

RECOMMENDED TEST EQUIPMENT

The following test equipment is required to test the IF Module.

1. FM Signal Generator; HP 8640B, HP 8657A, or equivalent
2. AF Generator or Function Generator
3. Audio Analyzer; HP 8903B, HP 339A, or equivalent
4. Oscilloscope
5. Frequency Counter; Racal-Dana 9919 or equivalent
6. DC Meter for troubleshooting
7. Power Supply; 13.8 Vdc @ 150 mA
8 Power Supply; 12 Vdc @20 mA

ALIGNMENT PROCEDURE

1. Apply 13.8 Vdc and 12 Vdc supplies to module.
2. Verify 13.8 V DC current consumption is between 90 and 150 mA, and 12 Vdc current is between 12 and 18 mA.
3. Verify fault output is 0 to 0.5 Vdc and front panel LED is off.

4. Apply a standard input signal to the module input. (-60 dBm, 21.4 MHz signal modulated with 1 kHz AF, 3 kHz peak deviation)

5. Monitor TP5 with a high-impedance probe connected to the frequency counter. Adjust L10 for a reading of 455 kHz ± 100 Hz.

6. Set VRI for 1 Vrms ±3% at module output (pin 31C on 96 pin connector J2).

TROUBLESHOOTING

When troubleshooting the module, it is most convenient if the standard test fixture is used. The following conditions are with the module in the 25 kHz mode. This can be set up using a PC with the necessary software connected to the test fixture. Alternatively, a wire link can be soldered between holes H1 and H2 on the PC board.

IF amplifier Q2 has a nominal 8 dB gain. U1 has a nominal gain of 30 dB. The mixer has about 2 dB loss with proper LO injection. The proper crystal oscillator level is 10 mV pk measured at TP3.

The following four test points are provided on the PWB for additional test capability:

TP1: 60 mV pk @ 21.4 MHz with -30 dBm input signal

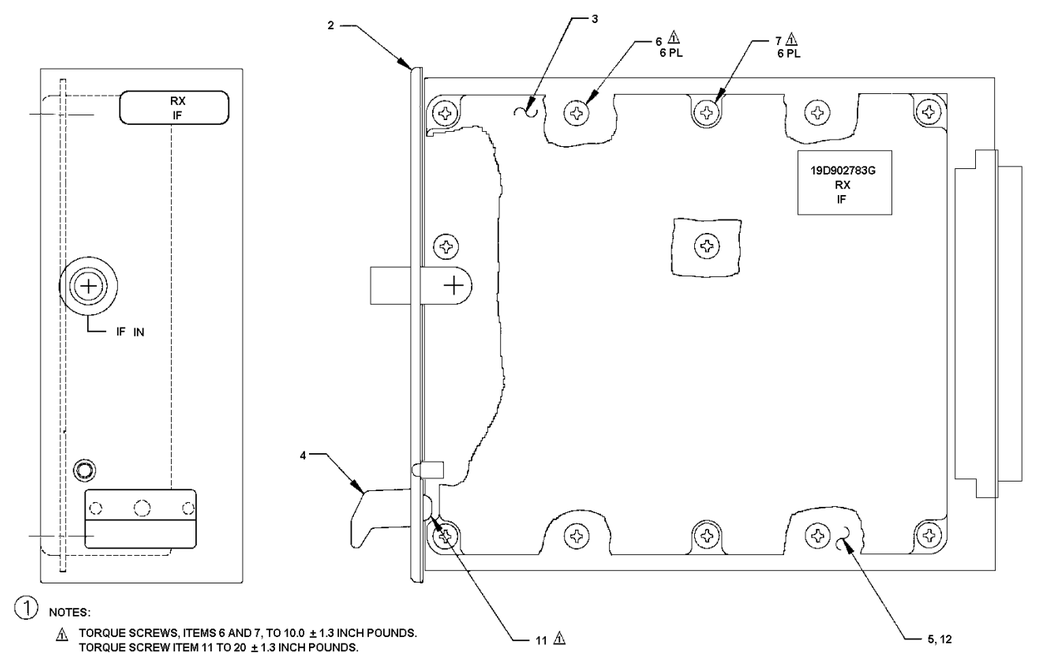
TP3: 10 mV pk @ 20.945 MHz independent of input signal

TP4: 20 mV pk @ 455 kHz with -60 dBm input signal

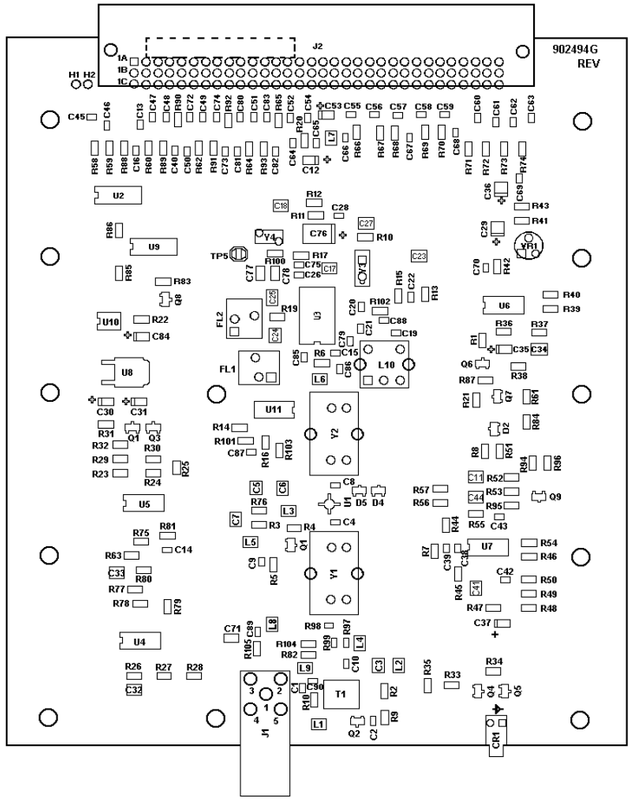
TP5: 750 mV pk @ 455 kHz with -60 dbm input signal
All RF voltages measured with 10 Megohm, 11 pF probe.

TROUBLE SHOOTING GUIDE

SYMPTOM	CHECK (CORRECT READING SHOWN)	INCORRECT READING INDICATES DEFECTIVE COMPONENT
Fault indicator on	Check DC voltages +8V at U8 Pin 1 +4v at U6 Pin 7 5.5V at U1 output pin 6V at U3 Pin 5	If DC voltages not correct U8 or associated components U6 or associated components U1 or associated components U3 or associated components If DC voltages correct U4, U5, U6, DI, Q3, Q4, Q5
No audio - no noise	With no signal applied to module IF input Check for AF noise @ C29 ; 200mV Check for AF noise @ U6 Pin 14:1 V	U3 or associated components U6 or associated components
Noise only - no demodulated audio	Check crystal oscillator: TP3 10 mVpk 20.945 MHz Apply-30 dBm 21.4 MHz input, check TPl 60 mVpk Apply-60 dBm 21.4 MHz input, check TP4 20 mVpk	U3, Y3 or associated components Q2, Y1, U1 or associated components U3, FL1 or associated components
Poor 12 dB SINAD	Check crystal oscillator: TP3 10 mVpk 20.945 MHz Apply-30 dBm 21.4 MHz input, check TP1 60 mVpk Apply-60 dBm 21.4 MHz input, check TP4 20 mVpk	U3, Y3 or associated components Q6, Y1, U1 or associated components U3, FL1 or associated components
No squelch function	With squelch pot maximum, or with module AUDIO/ SQUELCH/HI connected to SQUELCH/ARM input and with no signal to module IF input: Check Presence of 1 Vpk noise at U6 Pin 14 Check presence of 1 Vpk noise U7 at Pin 1 Check DC voltage U7 at Pin 8: 7V Check DC voltage U7 at Pin 14: 0.5V	U6 or associated components U7 or associated components



RECEIVER IF MODULE
19D902783G7, G11
(19D902783, Sh. 1, Rev. 3)



LEAD IDENTIFICATION FOR
D1, D2, D4, D5
(SOT) DIODES
(TOP VIEW)

(A) (C)

LEAD IDENTIFICATION FOR
U1
(TOP VIEW)

GROUND (2)
(3) RF OUTPUT AND DC BIAS
(1) RF INPUT
GROUND (4)

7 ITEM 19, PAD, USED UNDER Y3

LEAD IDENTIFICATION FOR
Q1-Q9
(SOT) TRANSISTORS
(TOP VIEW)

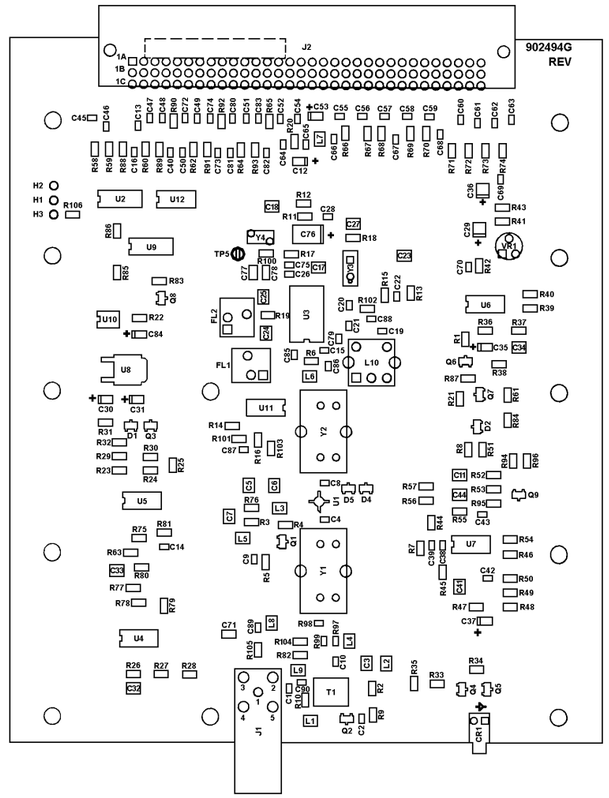
(B) (E) (C)

CAUTION
OBSERVE PRECAUTIONS FOR HANDLING
ELECTROSTATIC SENSITIVE DEVICES

RECEIVER IF MODULE (EARLIER VERSION)

19D902494G7, G11

(19D902494, Sh.3, Rev. 6)



7. ITEM 19, PAD USED UNDER Y3 IN GROUP 11.

LEAD IDENTIFICATION FOR
D1,D2,D4,D5
(SOT) DIODES
(TOP VIEW)

(A) (C)

LEAD IDENTIFICATION FOR
U1
(TOP VIEW)

GROUND (2)
(3) RF OUTPUT AND DC BIAS
(1) RF INPUT
GROUND (4)

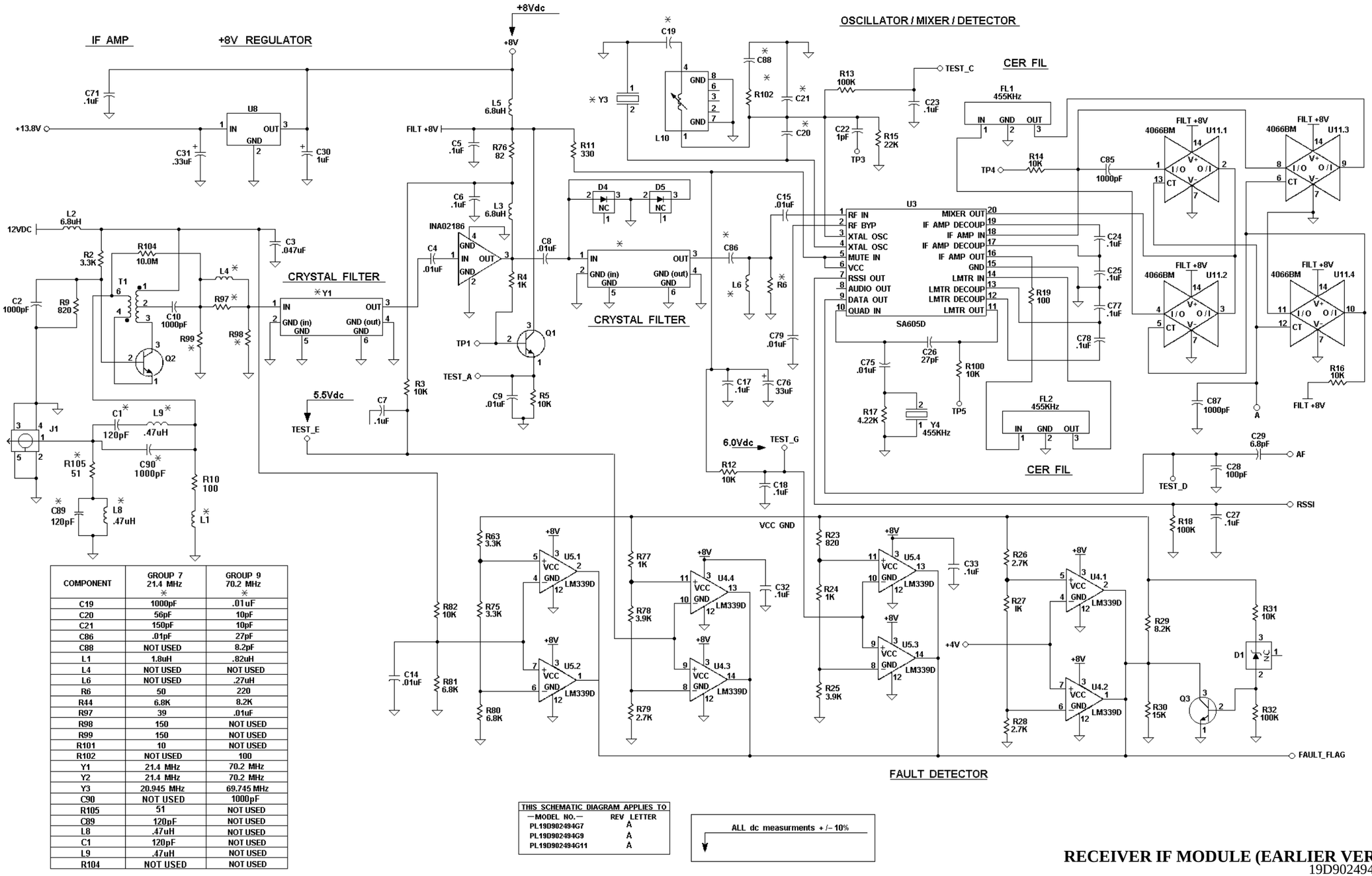
LEAD IDENTIFICATION FOR
Q1-Q9
(SOT) TRANSISTORS
(TOP VIEW)

(B) (E) (C)

RECEIVER IF MODULE

19D902494G7 & G11

(19D902494, Sh.4, Rev. 6)



COMPONENT	GROUP 7 21.4 MHz	GROUP 9 70.2 MHz
C19	1000pF	.01uF
C20	56pF	10pF
C21	150pF	10pF
C86	.01pF	27pF
C88	NOT USED	8.2pF
L1	1.8uH	.82uH
L4	NOT USED	NOT USED
L6	NOT USED	.27uH
R6	50	220
R44	6.8K	8.2K
R97	39	.01uF
R98	150	NOT USED
R99	150	NOT USED
R101	10	NOT USED
R102	NOT USED	100
Y1	21.4 MHz	70.2 MHz
Y2	21.4 MHz	70.2 MHz
Y3	20.945 MHz	69.745 MHz
C90	NOT USED	1000pF
R105	51	NOT USED
C89	120pF	NOT USED
L8	.47uH	NOT USED
C1	120pF	NOT USED
L9	.47uH	NOT USED
R104	NOT USED	NOT USED

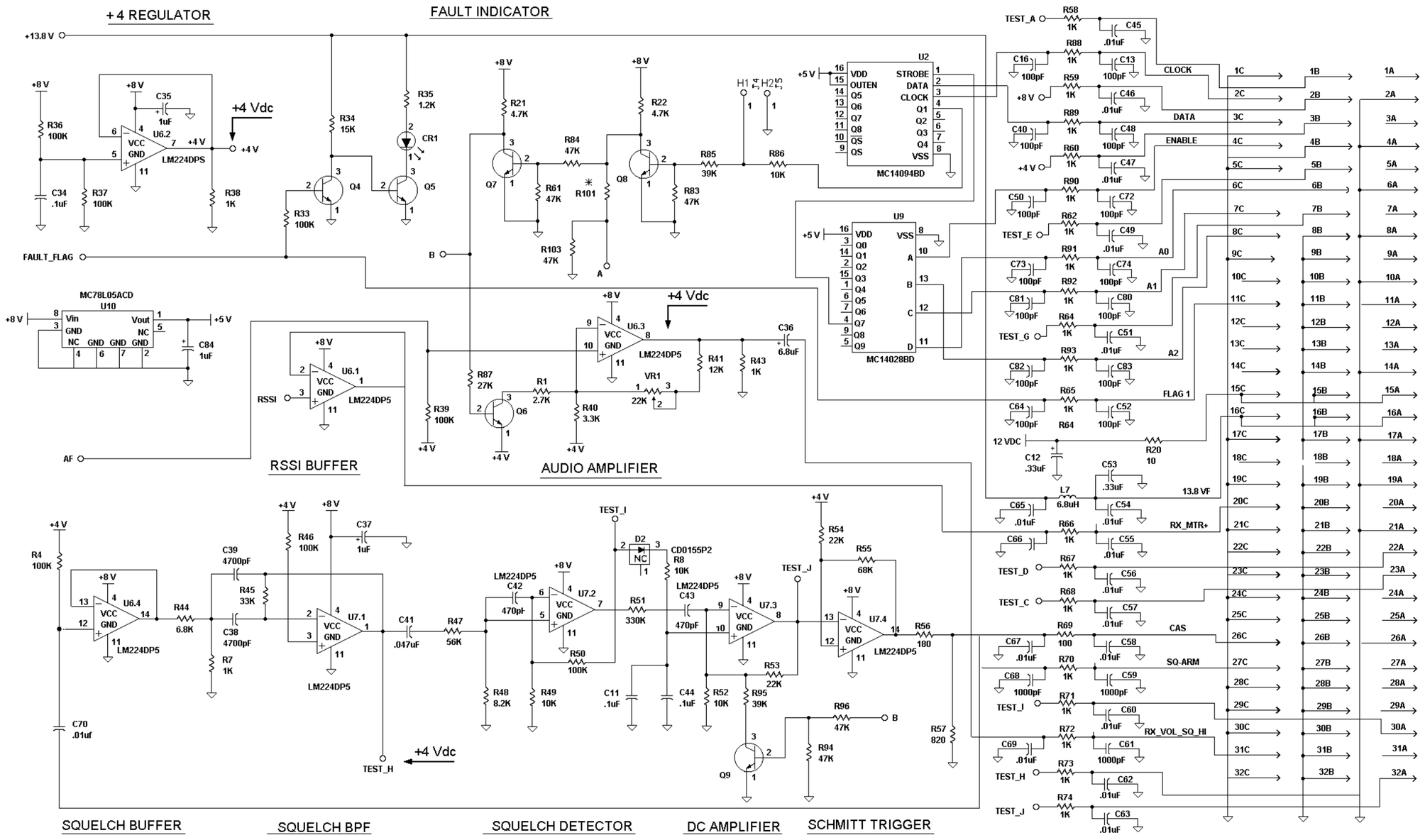
THIS SCHEMATIC DIAGRAM APPLIES TO	
—MODEL NO.—	REV LETTER
PL19D902494G7	A
PL19D902494G9	A
PL19D902494G11	A

ALL dc measurments +/– 10%

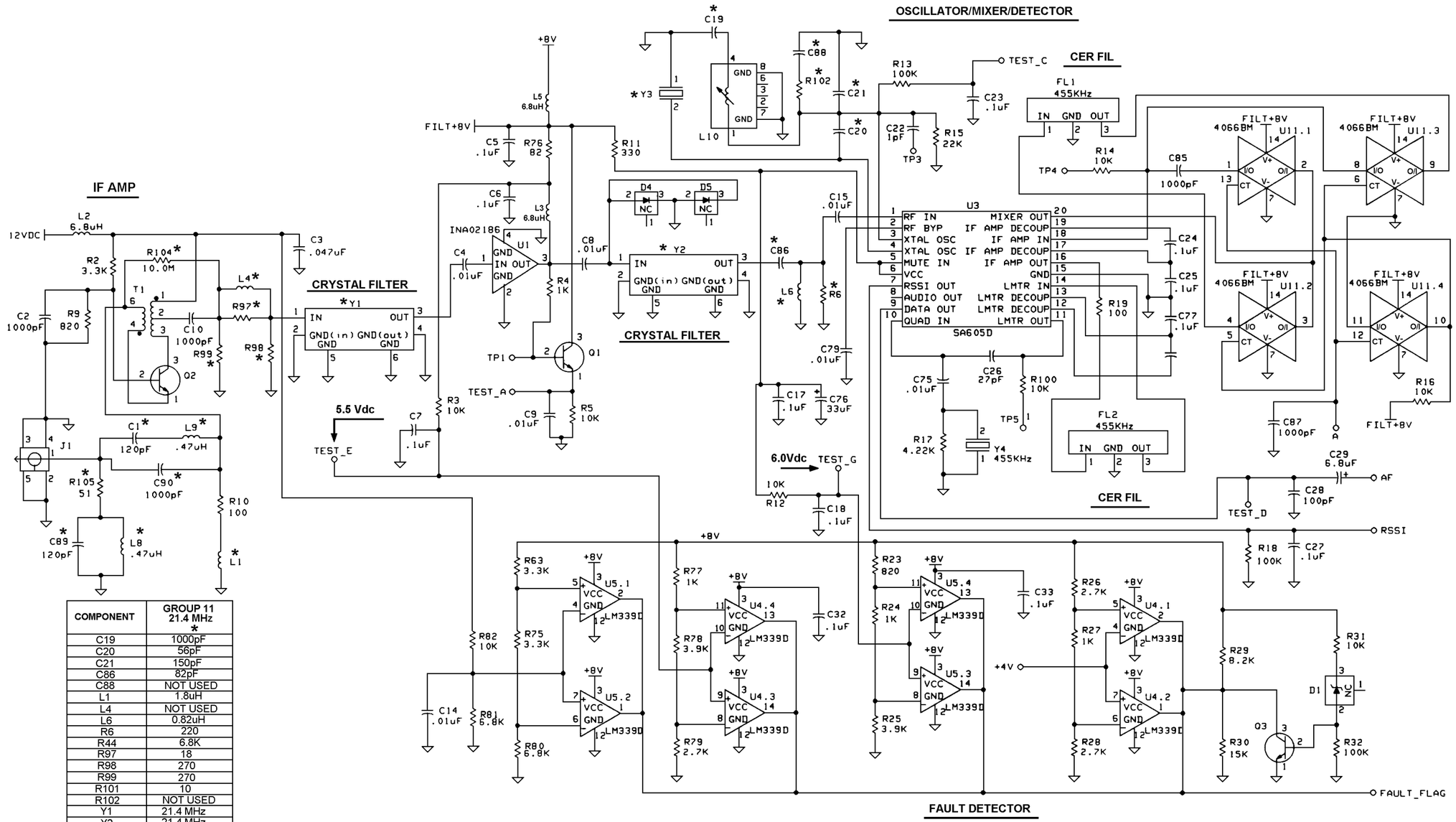
RECEIVER IF MODULE (EARLIER VERSION)

19D902494G7, G11

(188D5586, Sh. 1, Rev. 3)



RECEIVER IF MODULE (EARLIER VERSION)
19D902494G7, G11
(188D5586, Sh. 2, Rev. 3)

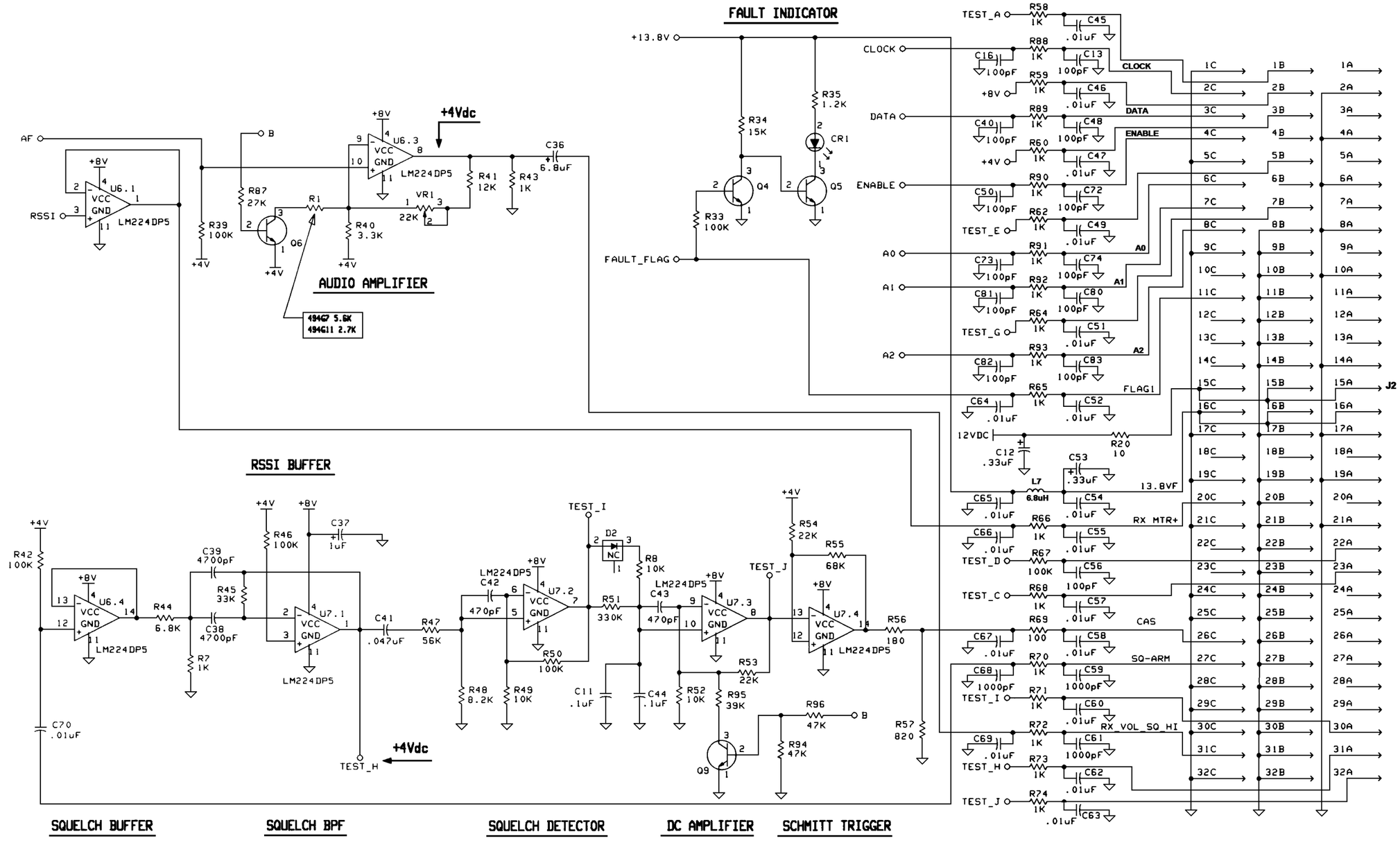


COMPONENT	GROUP 11 21.4 MHz *
C19	1000pF
C20	56pF
C21	150pF
C86	82pF
C88	NOT USED
L1	1.8uH
L4	NOT USED
L6	0.82uH
R6	220
R44	6.8K
R97	18
R98	270
R99	270
R101	10
R102	NOT USED
Y1	21.4 MHz
Y2	21.4 MHz
Y3	20.945 MHz
C90	NOT USED
R105	51
C89	120pF
L8	.47uH
C1	120pF
L9	.47uH
R104	NOT USED

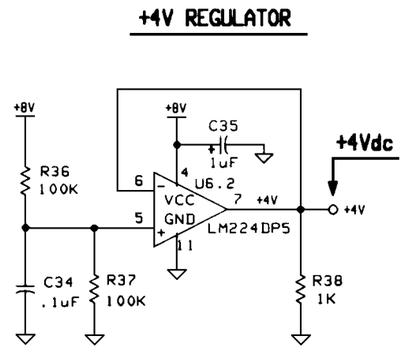
THIS SCHEMATIC DIAGRAM APPLIES TO	
MODEL NO.	REV LETTER
PL19D902494G7	B
PL19D902494G11	B

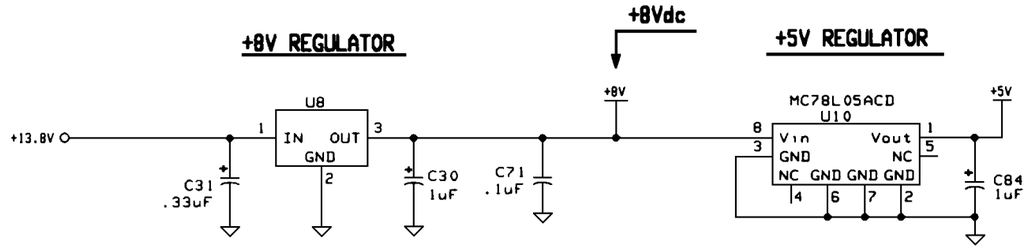
All dc measurements +/-10%

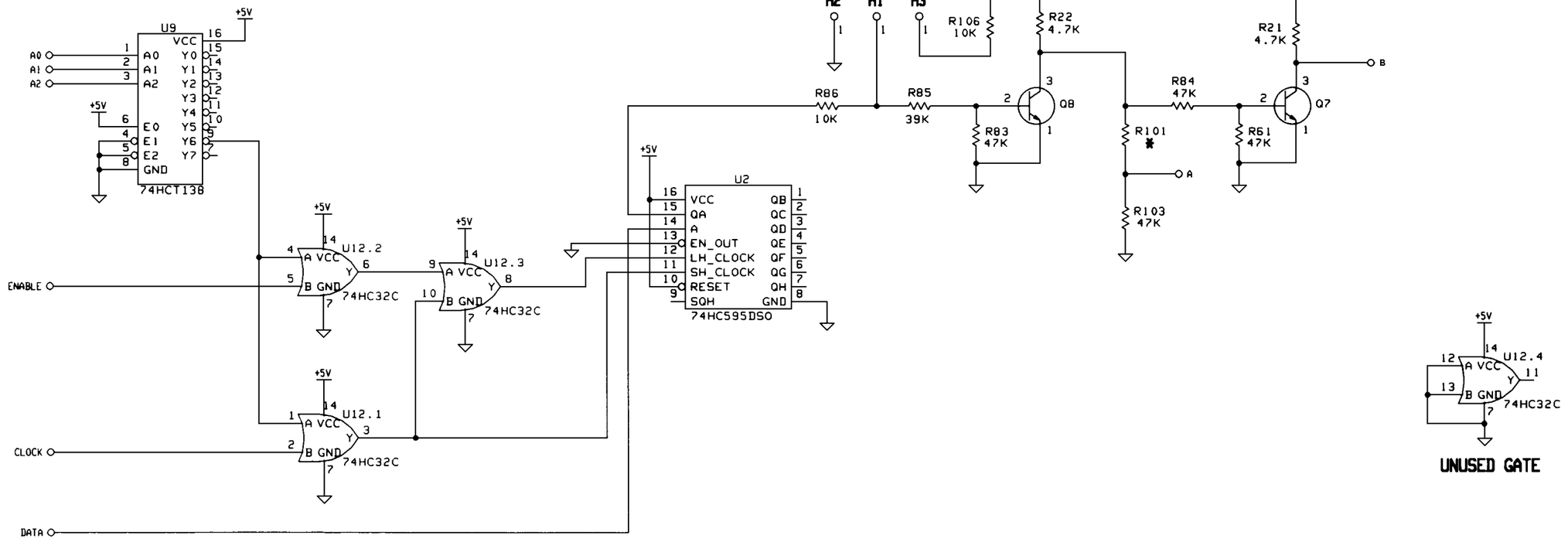
RECEIVER IF MODULE
19D902494G7 & G11
(193D1065, Sh. 1, Rev. 3)



RECEIVER IF MODULE
19D902494G7 & G11
(193D1065, Sh. 2, Rev. 3)

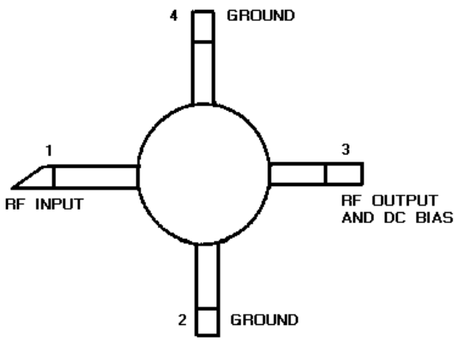




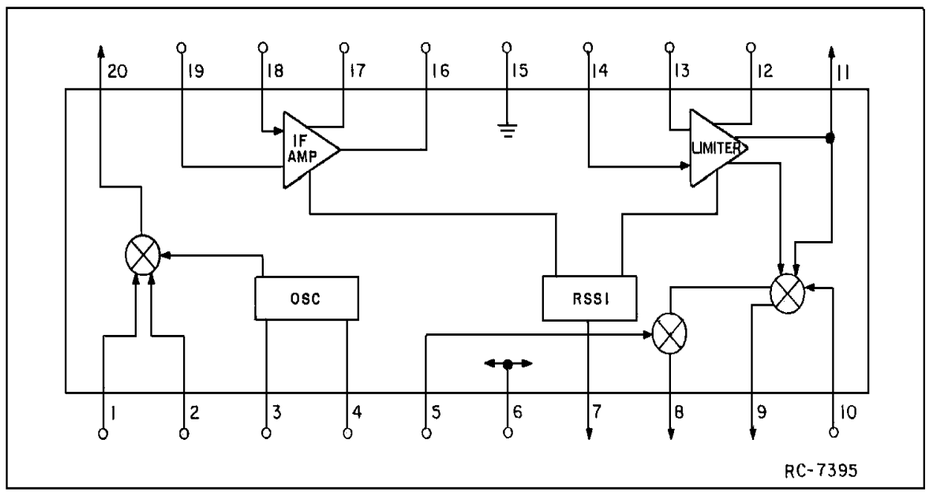


RECEIVER IF MODULE
19D902494G7 & G11
(193D1065, Sh. 3, Rev. 3)

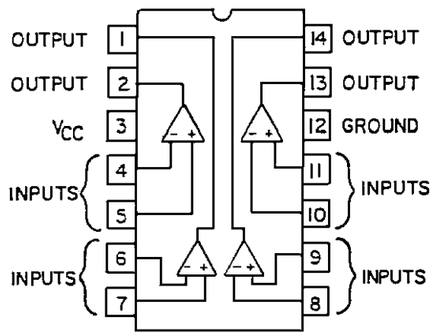
U1
344A3740P1
Silicon Bipolar IC

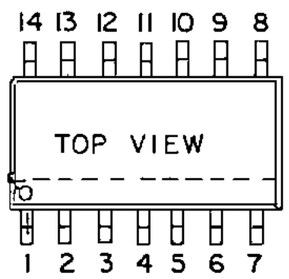


U3
19A705535P3
FM Receiver

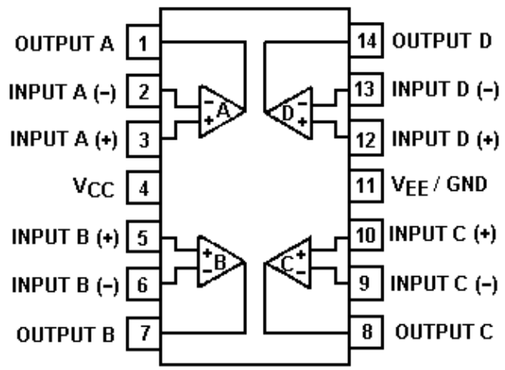


U4 & U5
19A704125P1
kQuad Comparator





U6 & U7
19A701789P4
Quad Op-Amp



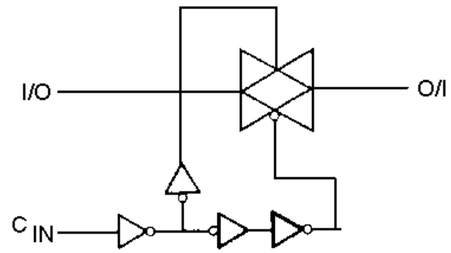
U8
19A704971P10
Voltage Regulator

(Heatsink surface connected to Pin 2)

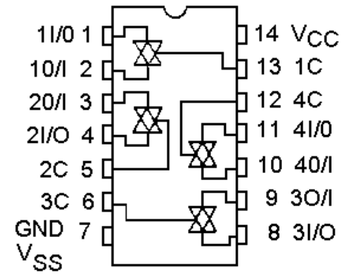
PIN 1. INPUT
2. GROUND
3. OUTPUT

U11
RYT3066018/C
Bilateral Switch

LOGIC DIAGRAM (PER CHANNEL)



PIN ASSIGNMENT



(TOP VIEW)

RECEIVER IF MODULE 19D902783G7, G11 ISSUE 5

SYMBOL	PART NUMBER	DESCRIPTION
		19D902783G7
		- - - - - - - MISCELLANEOUS - - - - - - - - -
2	19D902508P1	Chassis.
3	19D902509P1	Cover.
4	19D902555P1	Handle.
6	19A702381P506	Screw, thread forming: TORX, No. M3.5-.6 x 6.
7	19A702381P513	Screw, thread forming: TORX, No. M3.5 - 0.6 X 13.
8	19B235310P1	Nameplate.
11	19A702381P508	Screw, thd. form: No. 3.5-0.6 x 8.
19	19A149009P1	Pad.
		19D902494G7 & G11
		- - - - - - - - - - CAPACITORS - - - - - - -
C1	19A702236P52	Ceramic: 120 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C2	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C3	19A702052P22	Ceramic: 0.047 µF ±10%, 50 VDCW.
C4	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C5 thru C7	19A702052P26	Ceramic: 0.1+ or µF ±10%, 50 VDCW.
C8 and C9	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C10	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C11	19A702052P26	Ceramic: 0.1µF ±10%, 50 VDCW.
C12	19A705205P12	Tantalum: .33 µF, 16 VDCW; sim to Sprague 293D.
C13	19A702236P50	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C14 and C15	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C16	19A702236P50	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C17 and C18	19A702052P26	Ceramic: 0.1µF ±10%, 50 VDCW.
C19	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C20	19A702236P44	Ceramic: 56 pF ±10%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C21	19A702236P54	Ceramic: 150 pF ±10%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C22	19A702061P1	Ceramic: 1 pF ±0.5% pF, 50 VDCW.
C23 thru C25	19A702052P26	Ceramic: 0.1µF ±10%, 50 VDCW.
C26	19A702061P33	Ceramic: 27 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C27	19A702052P26	Ceramic: 0.1µF ±10%, 50 VDCW.
C28	19A702236P50	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C29	19A705205P5	Tantalum: 6.8 µF, 10 VDCW; sim to Sprague 293D.
C30	19A705205P2	Tantalum: 1 µF, 16 VDCW; sim to Sprague 293D.
C31	19A705205P12	Tantalum: .33 µF, 16 VDCW; sim to Sprague 293D.
C32 thru C34	19A702052P26	Ceramic: 0.1µF ±10%, 50 VDCW.
C35	19A705205P2	Tantalum: 1 µF, 16 VDCW; sim to Sprague 293D.
C36	19A705205P5	Tantalum: 6.8 µF, 10 VDCW; sim to Sprague 293D.
C37	19A705205P2	Tantalum: 1 µF, 16 VDCW; sim to Sprague 293D.
C38 and C39	19A702052P10	Ceramic: 4700 pF ±10%, 50 VDCW.
C40	19A702236P50	Ceramic: 10 0 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C41	19A702052P22	Ceramic: 0.047 µF ±10%, 50 VDCW.
C42 and C43	19A702061P77	Ceramic: 470 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM.
C44	19A702052P26	Ceramic: 0.1µF ±10%, 50 VDCW.
C45 thru C47	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C48	19A702236 P50	Ceramic: 10 0 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C49	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C50	19A702236P50	Ceramic: 10 0 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C51 and C52	19A702052P14	Ceramic: 0.01µF±10%, 50 VDCW.
C53	19A705205P12	Tantalum: .33 µF, 16 VDCW; sim to Sprague 293D.
C54 and C55	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C56	19A702236P50	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0+ or -30 PPM/°C.
C57 and C58	19A702052P14	Ceramic: 0.01 µF±10%, 50 VDCW.
C59	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C60	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C61	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C62 thru C67	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C68	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C69 and C70	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C71	19A702052P33	Ceramic: 0.1 µF ±10%, 50 VDCW.
C72	19A702236P50	Ceramic: 100 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C73 and C74	19A702236P50	Ceramic: 10 0 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C75	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C76	19A705205P15	Tantalum: 33 µF, 16 VDCW; sim to Sprague 293D.
C77 and C78	19A702052P33	Ceramic: 0.1µF ±10%, 50 VDCW.
C79	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW.
C80 thru C83	19A702236P50	Ceramic: 10 0 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
C84	19A705052P2	Tantalum: .1 µF, 16 VDCW; sim to Sprague 293D.
C85	19A702052P5	Ceramic: 10 00 pF ±10%, 50 VDCW.
C86	19A702052P14	Ceramic: 0.01 µF ±10%, 50 VDCW. (Used in G7).
C86	19A702236P48	Ceramic: 82 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C. (Used in G11).
C87	19A702052P5	Ceramic: 1000 pF ±10%, 50 VDCW.
C89	19A702236P52	Ceramic: 120 pF ±5%, 50 VDCW, temp coef 0 ±30 PPM/°C.
		- - - - - - - - - - DIODES - - - - - - - - - -
CR1	19A703595P10	Optoelectric: Red LED; sim to HP HLMP-1301-010.
		- - - - - - - - - - DIODES - - - - - - - - - -
D1	19A700083P105	Silicon: Zener; 8.2 Volt.
D2	19A700155P2	Silicon: 100 mA, 35 PIV; sim to BAT 18.
		- - - - - - - - - - FILTERS - - - - - - - - - -
FL1 and FL2	19A702171P2	Bandpass Filter: 455 ± 0.5 kHz, sim to Murata CFU455F2.
		- - - - - - - - - - JACKS - - - - - - - - - -
J1	19A115938P24	Coaxial Connector.
J2	19B801587P7	Connector, DIN: 96 male contacts, right angle mounting; sim to AMP 650887-1.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	19A705470P28	Coil: 1.8 µH, ±20%; sim to Toko 380LB-1R8M.
L2 and L3	19A705470P35	Coil: 6.8 µH, ±20%; sim to Toko 380LB-6R8M.
L5	19A705470P35	Coil: 6.8 µH ±20%; sim to Toko 380LB-6R8M.
L6	19A705470P24	Coil: 0.82 µH, ±20%; sim to Toko 380NB-R82M. (Used in G11).
L7	19A705470P35	Coil: 6.8 µH ±20%; sim to Toko 380LB-6R8M.
L8 and L9	19A705470P21	Coil, RF: 0.47 µH, ±20%; sim to Toko 380NB-R42M.
L10	19A703311P1	Coil, RF: sim to Toko American KON-K6572BA.
Q1 and Q2	19A704708P2	- - - - - - - - - - TRANSISTORS - - - - - - - - - Silicon, NPN: sim to NEC 2SC3356.
Q3 thru Q9	19A700076P2	Silicon, NPN: sim to MMBT3904, low profile.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	19B800607P562	Metal filter: 5.6 K ohms ±5%, 1/8 w. (Used in G7).
R1	19B800607P272	Metal filter: 2.7 K ohms ±5%, 1/8 w. (Used in G11).
R2	19B800607P332	Metal film: 3.3K ohms ±5%, 1/8 w.
R3	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R4	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R5	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R6	19B800607P510	Metal film: 51 ohms ±5%, 1/8 w. (Used in G7).
R6	19B800607P221	Metal film: 220 ohms ±5%, 1/8 w. (Used in G11).
R7	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R8	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R9	19B800607P821	Metal film: 820 ohms ±5%, 1/8 w.
R10	19B800607P101	Metal film: 100 ohms ±5%, 1/8 w.
R11	19B800607P331	Metal film: 330 ohms ±5%, 1/8 w.
R12	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R13	19B800607P104	Metal film: 100K ohms ±5%, 1/8 w.
R14	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R15	19B800607P223	Metal film: 22K ohms ±5%, 1/8 w.
R16	19B800607P103	Metal film: 10 ohms ±5%, 1/8 w.
R17	19A702931P261	Metal film: 4220 ohms ±1%, 200 VDCW, 1/8 w.
R18	19A702931P401	Metal film: 100K ohms ±1%, 200 VDCW, 1/8 w.
R19	19B800607P101	Metal film: 100 ohms ±5%, 1/8 w.
R20	19B800607P100	Metal film: 10 ohms ±5%, 1/8 w.
R21 and R22	19B800607P472	Metal film: 4.7K ohms ±5%, 1/8 w.
R23	19B800607P821	Metal film: 820 ohms ±5%, 1/8 w.
R24	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R25	19B800607P392	Metal film: 3.9K ohms ±5%, 1/8 w.
R26	19B800607P272	Metal film: 2.7K ohms ±5%, 1/8 w.
R27	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R28	19B800607P272	Metal film: 2.7K ohms ±5%, 1/8 w.
R29	19B800607P822	Metal film: 8.2K ohms ±5%, 1/8 w.
R30	19B800607P153	Metal film: 15K ohms ±5%, 1/8 w.
R31	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R32 and R33	19B800607P104	Metal film: 100K ohms ±5%, 1/8 w.
R34	19B800607P153	Metal film: 15K ohms ±5%, 1/8 w.
R35	19B800607P122	Metal film: 1.2K ohms ±5%, 1/8 w.
R36 and R37	19B800607P104	Metal film: 100K ohms ±5%, 1/8 w.
R38	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R39	19B800607P104	Metal film: 100K ohms ±5%, 1/8 w.
R40	19B800607P332	Metal film: 3.3K ohms ±5%, 1/8 w.
R41	19B800607P123	Metal film: 12K ohms ±5%, 1/8 w.
R42	19B800607P104	Metal film: 100K ohms ±5%, 1/8 w.
R43	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R44	19B800607P682	Metal film: 6.8K ohms ±5%, 1/8 w.
R45	19B800607P333	Metal film: 33K ohms ±5%, 1/8 w.
R46	19B800607P104	Metal film: 100K ohms ±5%, 1/8 w.
R47	19B800607P563	Metal film: 56K ohms ±5%, 1/8 w.
R48	19B800607P822	Metal film: 8.2K ohms ±5%, 1/8 w.
R49	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R50	19B800607P104	Metal film: 100K ohms ±5%, 1/8 w.
R51	19B800607P334	Metal film: 330K ohms ±5%, 1/8 w.
R52	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R53 and R54	19B800607P223	Metal film: 22K ohms ±5%, 1/8 w.
R55	19B800607P683	Metal film: 68K ohms ±5%, 1/8 w.
R56	19B800607P181	Metal film: 180 ohms ±5%, 1/8 w.
R57	19B800607P821	Metal film: 820 ohms ±5%, 1/8 w.
R61	19B800607P473	Metal film: 47K ohms ±5%, 1/8 w.
R62	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R63	19B800607P332	Metal film: 3.3K ohms ±5%, 1/8 w.
R64 thru R66	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R67	19B800607P104	Metal film: 100K ohms ±5%, 1/8 w.
R68	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R69	19B800607P101	Metal film: 100 ohms ±5%, 1/8 w.
R70 thru R74	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R75	19B800607P332	Metal film: 3.3K ohms ±5%, 1/8 w.
R76	19B800607P820	Metal film: 82 ohms ±5%, 1/8 w.
R77	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R78	19B800607P392	Metal film: 3.9K ohms ±5%, 1/8 w.
R79	19B800607P272	Metal film: 2.7K ohms ±5%, 1/8 w.
R80 and R81	19B800607P682	Metal film: 6.8K ohms ±5%, 1/8 w.
R82	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R83 and R84	19B800607P473	Metal film: 47K ohms ±5%, 1/8 w.
R85	19B800607P393	Metal film: 39K ohms ±5%, 1/8 w.
R86	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R87	19B800607P273	Metal film: 27K ohms ±5%, 1/8 w.
R88 thru R93	19B800607P102	Metal film: 1K ohms ±5%, 1/8 w.
R94	19B800607P473	Metal film: 47K ohms ±5%, 1/8 w.
R95	19B800607P393	Metal film: 39K ohms ±5%, 1/8 w.
R96	19B800607P473	Metal film: 47K ohms ±5%, 1/8 w.
R97	19B801251P390	Metal film: 39 ohms ±5%, 1/10 w. (Used in G7).
R97	19B801251P180	Metal film: 18 ohms ±5%, 1/10 w. (Used in G11)
R98 and R99	19B801251P151	Metal film: 150 ohms ±5%, 1/10 w. (Used in G7).
R98 and R99	19B801251P271	Metal film: 270 ohms ±5%, 1/10 w. (Used in G11).
R100	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
R101	19B800607P100	Metal film: 10 ohms ±5%, 1/8 w.
R103	19B800607P473	Metal film: 47K ohms ±5%, 1/8 w.
R105	19B800607P510	Metal film: 51 ohms ±5%, 1/8 w.
R106	19B800607P103	Metal film: 10K ohms ±5%, 1/8 w.
		- - -- - - - - - - TEST POINT - - - - - - - - - -
TP5	344A3367P1	Test Point.
		- - - - - - - - - TRANSFORMERS - - - - - - - -
T1	REGUA10003/1	Transformer.
		- - - - - - - INTEGRATED CIRCUITS - - - - - -
U1	344A3740P1	Linear: Amp; sim to INA-02186.
U2	19A703987P324	8-Bit 3-State Shift Latch Register CMOS
U3	19A705535P3	Linear: RF/IF Signal Processor; sim to SA605N.
U4 and U5	19A704125P1	Linear: Quad Comparator; sim to LM339D.
U6	19A701789P4	Linear: Quad Op Amp; sim to LM224D.
U7	19A701789P5	Linear.
U8	19A704971P10	Linear: 8V; Voltage Regulator.
U9	344A3064P201	Digital: 3-To-8 Line Decoder/Demultiplexer; sim to 74HCT138.
U10	19A704971P9	Voltage Regulator: +5V.
U11	RYT3066018/C	Switch, Bilateral: CMOS QUAD.
U12	19A703483P311	Digital: CMOS Quad-Input OR Gate; sim to 74HC32. (Used in G11).
		- - - - - VARIABLE RESISTOR - - - - - - -
VR1	19B800779P12	Resistor, variable.
		- - - - - - - - - - CRYSTALS - - - - - - - - -
Y1	19A149974G7	Filter, Crystal: 21.4 MHz.
Y2	19A149974G8	Filter, Crystal: 21.4 MHz.
Y3	19A702289G8	Crystal: 20.945 MHz.
Y4	19A149976P1	Discriminator: 455 kHz.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

MAINTENANCE MANUAL FOR RECEIVER FRONT END MODULE 19D902782G6, G8, G9, G10, G11, G12

TABLE OF CONTENTS

DESCRIPTION

The Receiver Front End (RXFE) Module amplifies and converts the RF signal to the first IF at 21.4 MHz. This is a down conversion process using low side (G9, G10) or high side (G6, G8, G11, G12) injection. The RXFE module is powered by a regulated 12 volts. The RXFE printed wiring board contains the following functional circuits:

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

All but the Fault Detector circuit in the RXFE module have 50 ohm impedance terminations.

ERICSSON

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

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Table 1 - General Specifications

ITEM	SPECIFICATION
FREQUENCY RANGE	380 - 400 MHz (G8) 403 - 430 MHz (G11) 470 - 492 MHz (G9) 492 - 512 MHz (G10) 403 - 425 MHz (G6) 370 - 390 MHz (G12)
IF FREQUENCY	21.4 MHz
3 dB BANDWIDTH	>3 MHz
IMPEDANCE	50 ohms at RF, LO, and IF Ports
CONVERSION LOSS	-1.5 ± 1.5dB
NOISE FIGURE (NF)	<7.5 dB
THIRD ORDER INTERCEPT POINT	>20 dBm (G9, G10) >16 dBm (G6, G8, G11, G12)
IMAGE REJECTION	>100dB
INJECTION POWER	-1.5 ± 1.5dB
TEMPERATURE RANGE	-30°C TO +60°C
SUPPLY VOLTAGE	12.0 Vdc
SUPPLY CURRENT	200 mA typical

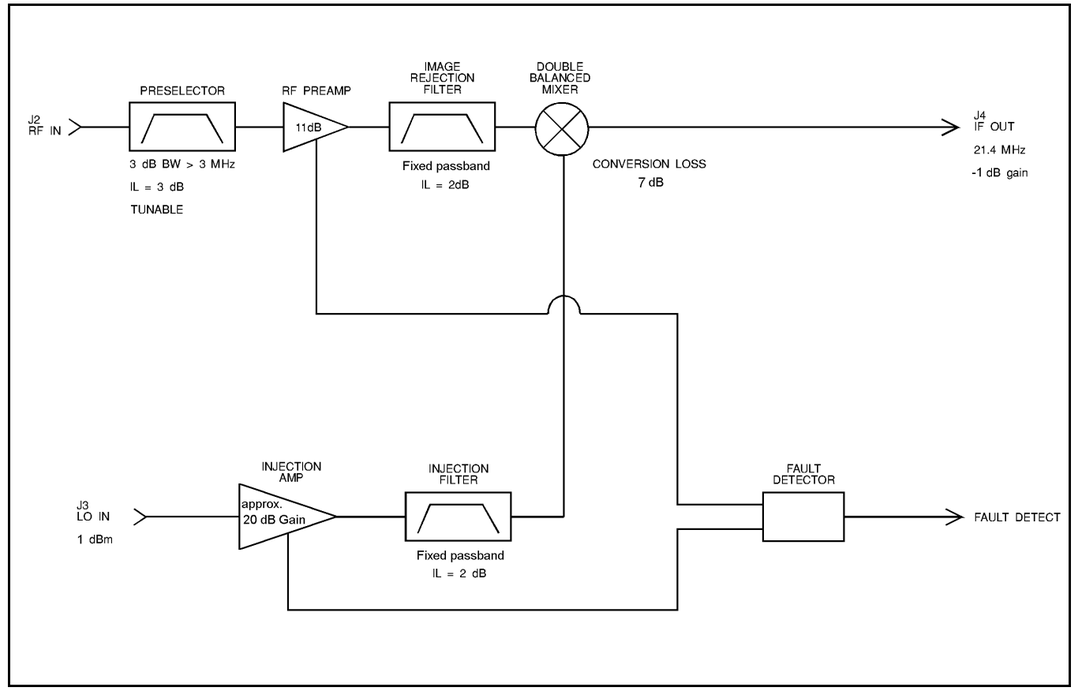

Figure 1 - Block Diagram

CIRCUIT ANALYSIS

PRESELECTOR FILTER

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

PREAMPLIFIER

The output from the Preselector is coupled through an impedance matching network consisting of C1, C2 and L6 to the base of Preamplifier Q1. The Preamplifier stage is supplied by the regulated +12 Vdc line (VCC1) and draws about 80 mA. It has a low noise figure and high Third Order Intercept point. Transistor Q2 provides Q1 with a constant current source. The bias on Q1 is monitored by the Fault Detector circuit via R17. Capacitors C20 and C21 prevent any RF from entering the fault circuit. The preamplifier output signal is coupled to the Image Rejection Filter via an impedance matching network consisting of C4, C11, L8, L15, R5 and R6.

IMAGE REJECTION FILTER

Following the Preamplifier is the Image Rejection Filter. The Image Rejection Filter is a fixed tuned helical bandpass filter. The Filter has an insertion loss of about 2 dB.

INJECTION AMPLIFIER

The local oscillator input (J3) from the Receiver Synthesizer is coupled to monolithic amplifier U2, then to the base of Q8. The Injection Amplifier, consisting of U2, Q8, and associated circuitry, is capable of amplifying the injection signal to approximately 18 to 22 dBm. The amplifier is powered by the regulated +12 Vdc line (VCC1). Transistor Q7 provides Q8 with a constant current source. The bias on U2 and Q8 is monitored by the Fault Detector circuit via R21 and R31, respectively. Capacitors C22, C23 and C26 prevent RF from entering the fault circuit. The Injection Amplifier output signal is coupled to the Injection Filter via an impedance matching network consisting of C8, L13, and resistors R15 and R16.

INJECTION FILTER

Following the Injection Amplifier is the Injection Filter. The injection filter is a fixed, tuned helical bandpass filter. It is used to attenuate harmonics of the Injection Amplifier. The filter has an insertion loss of about 2 dB.

DOUBLE BALANCE MIXER

The Double Balance Mixer (DBM) is a broadband mixer. It converts an RF signal to the 21.4 MHz first conversion IF frequency. The mixer uses low side (G9, G10) or high side (G6, G8, G11, G12) injection driven by a local oscillator signal. The mixer conversion loss is typically about 7 dB. The IF output signal is then routed through a diplexer circuit to the output connector (J4).

FAULT DETECTOR

The Fault Detector circuit monitors the operation of the preamplifier and injection amplifier devices. Operational amplifiers U1.1 and U1.2 compare the bias on the Preamplifier Q1 to preset levels, while U1.3 and U1.4 compare the bias levels on Injection Amplifiers U2 and Q8.

When the bias for Q1, U2, and Q8 is within the preset window limits, the output from the comparators is a logic high level. This high level signal is sent to the Station Controller on the FLAG 0 line.

If the biasing for the amplifiers is not within the proper operating range, the fault detector circuit will pull the FLAG 0 line low.

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MAINTENANCE

TEST PROCEDURE

Following is a test procedure of the module to verify proper Conversion Gain :

1. Supply 12 Vdc to pin 15A, B, C. (1C is ground.)
2. Inject the desired RF Frequency into RF IN at a level of -10 dBm.
3. Inject the desired local oscillator frequency into LO IN at a level of 0 dBm [LO frequency = RF frequency - 21.4 MHz (for groups G9, G10), or, LO frequency = RF frequency + 21.4 MHz (for groups G6, G8, G11, G12)].
4. Measure the IF OUT power at 21.4 MHz, the ratio of RF IN to IF OUT should be -1.5 ±1.5 dB.
5. Measure the current drawn by the RXFE module. Typical current drain is 180 to 230 mA.

ALIGNMENT PROCEDURE

Alignment for the Receiver Front End module consists of tuning the five-pole Preselector Filter only. The Image Rejection Filter and LO injection filter are not to be tuned. Normally, the RXFE should only need the fine-tuning procedure. For a major receiver frequency change, the RXFE should be adjusted using the major-retuning procedure.

For Fine-Tuning

1. Supply 12 Vdc to pin 15A, B, C. (1C is ground.)
2. Inject the desired RF Frequency into RF IN (J2) at a level of -10 dBm.
3. Inject the desired local oscillator frequency into LO IN (J3) at a level of 0 dBm [LO frequency = RF frequency - 21.4 MHz (for groups G9, G10), or, LO frequency = RF frequency + 21.4 MHz (for groups G6, G8, G11, G12)].
4. Detect IF signal at 21.4 MHz. Slightly adjust L1 to L5 to get maximum power (don't adjust more than 1/4 turn). 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.
5. Repeat Test Procedure steps to verify conversion gain.

For Major Retuning

The best way to do a major retuning of the RXFE is with swept frequency tuning. The swept frequency tuning can be done using a Spectrum Analyzer and Tracking Generator. With proper Injection level 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 at 0 dBm into the RF IN connector, (J2).
3. Inject local oscillator power at 0 dBm into the LO IN connector, (J3) [LO frequency = RF frequency - 21.4 MHz (for groups G9, G10), or, LO frequency = RF frequency + 21.4 MHz (for groups G6, G8, G11, G12)].
4. Preset the height of slugs with respect to the top of five-pole cavity as follows (Table 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

G6 & G11	HEIGHT (in inches)				
Frequency (MHz)	L1	L2	L3	L4	L5
403	12/64	10/64	12/64	13/64	12/64
408	13/64	13/64	14/64	14/64	13/64
413	14/64	14/64	14/64	15/64	14/64
418	16/64	16/64	15/64	16/64	15/64
423	17/64	17/64	16/64	18/64	16/64

G8, G12	HEIGHT (in inches)				
Frequency (MHz)	L1	L2	L3	L4	L5
380	16/64	16/64	16/64	16/64	16/64
385	17/64	17/64	17/64	17/64	17/64
390	18/64	18/64	18/64	18/64	18/64
395	19/64	19/64	19/64	19/64	19/64
400	20/64	20/64	20/64	20/64	20/64
370	14/64	14/64	14/64	14/64	14/64
375	15/64	15/64	15/64	15/64	15/64

G9	HEIGHT (in inches)				
Frequency (MHz)	L1	L2	L3	L4	L5
470	12/64	12/64	12/64	12/64	12/64
474	13/64	13/64	13/64	13/64	13/64
478	14/64	14/64	14/64	14/64	14/64
482	15/64	15/64	15/64	15/64	15/64
486	16/64	16/64	16/64	16/64	16/64
490	17/64	17/64	17/64	17/64	17/64
492	18/64	18/64	18/64	18/64	18/64

G10	HEIGHT (in inches)				
Frequency (MHz)	L1	L2	L3	L4	L5
492	12/64	10/64	10/64	10/64	8/64
497	12/64	10/64	12/64	12/64	9/64
502	14/64	12/64	13/64	14/64	10/64
507	15/64	15/64	16/64	16/64	12/64
512	17/64	16/64	17/64	17/64	14/64

TROUBLESHOOTING GUIDE

SYMPTOM	AREAS TO CHECK	READING (TYP.)
LOW CONVERSION GAIN	Check Vcc	12 V
	Preselector Loss	3 dB
	Preamplifier Gain	11 dB
	Image Rej. Filter Loss	2 dB
	1st Mixer Conversion Loss	7 dB
FAULT INDICATOR LOW	Check Vc of Q1	9 TO 10V
	Check Vc of U2	5 TO 6 V
	Check Vc of Q8	9 TO 10 V
IF FREQUENCY OFF	Check L.O. FREQUENCY	L.O. frequency=RF frequency - 21.4 MHz (G9,G10) + 21.4 MHz (G6, G8, G11, G12)
LOW L.O. POWER*	Injection Amplifier Gain	approx 20 dB Gain
	Injection Filter Loss	2 dB

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

- 12 Vdc supply.
- Inject L.O. power at a level of 0 dBm into LO IN (J3), [LO freq. = RF freq. - 21.4 MHz (G9, G10) or, LO frequency = RF frequency + 21.4 MHz (G6, G8, G11, G12)].
- 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 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).

RECEIVER FRONT END MODULE
19D902782G6 (403-425 MHz)
19D902782G8 (380-400 MHz)
19D902782G9 (470-494 MHz)
19D902782G10 (492-512 MHz)
19D902782G11 (403-430 MHz)
19D902782G12 (370-390 MHz)
ISSUE 3

SYMBOL	PART NO.	DESCRIPTION
		RECEIVER FRONT END BOARD 19D902782G6, G8-G12
		- - - - - - - - - - DIODES - - - - - - - - - -
CR1	344A3062P1	Diode, Schottky.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
CR2	19A703595P10	Diode, optoelectric: Red; sim to HP HLMP-1301-010 (Used in G8).
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	19A702061P37	Ceramic: 33 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C. (Used in G8, G12).
C1	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW. (Used in G6, G10 and G11).
C1	19A702061P21	Ceramic: 15 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM. (Used in G9).
C2	19A702061P17	Ceramic: 12 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM. (Used in G6, G8, G11 and G12).
C2	19A702061P21	Ceramic: 15 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM. (Used in G9).
C2	19A702061P12	Ceramic: 8.2 pF + or - 0.5 pF, 50 VDCW, temp or - 60 PPM. (Used in G10).
C3	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C7	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW. (Used in G8, G12).
C7	19A702061P33	Ceramic: 27 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM. (Used in G6 and G11).
C7	19A702236P32	Ceramic: 18 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM. (Used in G9).
C7	19A702061P37	Ceramic: 33 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C. (Used in G10).
C8	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW. (Used in G6, G8, G9, G11, and G12).
C8	19A702061P17	Ceramic: 12 pF + or - 5%, 50 VDCW, temp coef 0 + or - 30 PPM. (Used in G10).
C9	19A702061P9	Ceramic: 4.7 pF + or - 0.5 pF, 50 VDCW, temp or - 60 PPM. (Used in G6, G8, G11 and G12).
C10	19A702061P11	Ceramic: 6.8 pF + or - 0.5 pF, 50 VDCW, temp or - 60 PPM. (Used in G6, G8, G10, G11 and G12).
C10	19A702236P17	Ceramic: 4.7 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM. (Used in G9).
C11	19A702061P33	Ceramic: 27 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C. (Used in G10).
C12	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW. (Used in G6, G8, G11 and G12).
C12	19A702061P8	Ceramic: 3.9 pF + or - 0.5 pF, 50 VDCW, temp or - 120 PPM. (Used in G9 and G10).
C20 thru C26	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C28	19A702052P14	Ceramic: 0.01 uF + or - 10%, 50 VDCW.
C29 and C30	19A702061P89	Ceramic: 1500 pF + or - 5%, 50 VDCW, temp coef - 30 PPM.
C31 thru C33	19A702236P40	Ceramic: 39 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM.
C34 thru C36	19A702061P37	Ceramic: 33 pF + or -5%, 50 VDCW, temp coef 0 + or -30 PPM/°C.
C37 and C38	19A705205P26	Tantalum: 3.3 uf + or - 20%, 16 VDCW. (Used in G8, G10 and G11).
C39 and C40	19A705205P15	Tantalum: 33 uf + or - 20%, 16 VDCW. (Used in G8, G10 and G11).
		- - - - - - - - - - FILTERS - - - - - - - - - -
FL1	19A705458P8	Helical, 378-402 MHz. (Used in G8).
FL1	19A705458P4	Helical, UHF: 403-425 MHz. (Used in G6).
FL1	19A705458P9	Helical, 403-430 MHz. (Used in G11).
FL1	19A705458P2	Helical, UHF: 470-492 MHz. (Used in G9).
FL1	19A705458P6	Helical, UHF: 492-515 MHz. (Used in G10).
FL1	19A705458P13	Helical, UHF: 391-415 MHz. (Used in G12).
FL2	19A705458P4	Helical, UHF: 403-425 MHz. (Used in G8).
FL2	19A705458P5	Helical, UHF: 424-450 MHz. (Used in G6 and G11).
FL2	19A705458P1	Helical, UHF: 450-470 MHz. (Used in G9).
FL2	19A705458P2	Helical, UHF: 470-492 MHz. (Used in G10).
FL2	19A705458P12	Helical, UHF: 370-390 MHz. (Used in G12).
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
J1	19B801587P7	Connector, Din: 96 male contacts, right angle mounting; sim to AMP 650889-1.
J2 thru J4	19A115938P24	Connector, receptacle.
		- - - - - - - - - - INDUCTORS - - - - - - - - - -
L1	19C850817P30	Coil, RF. (Used in G8).
L1	19C850817P29	Coil, RF. (Used in G6 and G11).
L1	19C850817P3	RF Coil: sim to Paul Smith SK853-1. (Used in G9).
L1	19C850817P18	RF Coil: sim to Paul Smith SK853-1. (Used in G10).
L2	19C850817P31	Coil. RF. (Used in G8).
L2	19C850817P5	RF Coil: sim to Paul Smith SK853-1. (Used in G6 and G11).
L2	19C850817P4	RF Coil: sim to Paul Smith SK853-1. (Used in G9).
L2	19C850817P17	RF Coil: sim to Paul Smith SK853-1. (Used in G10).
L3	19C850817P31	RF Coil: (Used in G8).
L3	19C850817P5	RF Coil: sim to Paul Smith SK853-1. (Used in G6 andG11).
L3	19C850817P4	RF Coil: sim to Paul Smith SK853-1. (Used in G9).
L3	19C850817P17	RF Coil: sim to Paul Smith SK853-1. (Used in G10).
L4	19C850817P31	Coil, RF. (Used in G8).
L4	19C850817P5	RF Coil: sim to Paul Smith SK853-1. (Used in G6 and G11).
L4	19C850817P4	RF Coil: sim to Paul Smith SK853-1. (Used in G9).
L4	19C850817P17	RF Coil: sim to Paul Smith SK853-1. (Used in G10).
L5	19C850817P30	Coil, RF. (Used in G8).
L5	19C850817P29	Coil, RF. (Used in G6and G11).
L5	19C850817P3	RF Coil: sim to Paul Smith SK853-1. (Used in G9).
L5	19C850817P18	RF Coil: sim to Paul Smith SK853-1. (Used in G10).
L6	19A705470P4	Coil, Fixed: 18 nH; sim to Toko 380NB-18nM. (Used in G8, G12).
L6	19A705470P1	Coil, Fixed: 10 nH; sim to Toko 380NB-10nM. (Used in G6, G9 and G11).
L6	19A705470P5	Coil, Fixed: 22 nH; sim to Toko 380NB-22nM. (Used in G10).
L7	19A705470P16	Coil, Fixed: 0.18 uH; sim to Toko 380NB-R18M.
L8	19A705470P12	Coil, fixed: 82nH; sim to Toko 380NB-82nM. (Used in G8, G12).
L8	19A705470P11	Coil, fixed: 68 nH; sim to Toko 380NB-68nM. (Used in G6 and G11).
L8	19A705470P6	Coil: 27 nH; sim to Toko 380NB-27nM. (Used in G9 and G10).
L9	19A705470P6	Coil: 27 nH; sim to Toko 380NB-27nM. (Used in G8 and G9, G12).
L9	19A705470P14	Coil, fixed: 0.12 uH; sim to Toko 380NB-R12M. (Used in G6 and G11).
L9	19A705470P1	Coil, fixed: 10 nH; sim to Toko 380NB-10nM. (Used in G10).
L10	19A705470P16	Coil, fixed: 0.18 nH; sim to Toko 380NB-R18M.
L11	19A705470P16	Coil, fixed: 0.18 nH; sim to Toko 380NB-R18M. (Used in G8 and G12).
L11	19A705470P1	Coil, fixed: 10 nH; sim to Toko 3 80NB-10nM.(Used in G6 and G11).
L11	19A705470P48	Coil, fixed: 82 uH; sim to TOKO 380KB-820K. (Used in G9).
L11	19A705470P7	Coil, fixed: 33 nH + or -20%; sim to Toko 380NB-33nM. (Used in G10).
L12	19A705470P16	Coil, fixed: 0.18 uH; sim to Toko 380NB-R18M.
L13	19A705470P10	Coil, fixed: 56 nH; sim to Toko 380NB-56nM. (Used in G6 and G11).
L14	19A705470P4	Coil, fixed: 18 nH; sim to Toko 380NB-18nM. (Used in G6, G8, G11 and G12).
L14 and L15	19A705470P6	Coil: 27 nH; sim to Toko 380NB-27nM. (Used in G10).
L21	19A705470P16	Coil, fixed: 0.18 uH; sim to Toko 380NB-R18M.
L22	19A700021P105	Coil, RF: fixed. (Used in G6, G8, G10, and G11).
L22	19A700021P106	Coil, RF. (Used in G9).
L23	19A700021P13	Coil, RF: fixed, 470 nH.
L24	19A700000P122	Coil, fixed: 8.2 uF + or -10%; sim to Jeffers 22-8.2-10 (Used in G8, G10 and G11).
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q7	19A700059P2	Silicon, PNP: sim to MMBT3906, low profile.
Q8	344A3058P1	Silicon, NPN.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	19B800607P332	Metal film: 3.3K ohms + or -5%, 1/8 w. (Used in G8).
R1	19B800607P183	Metal film: 18K ohms + or -5%, 1/8 w. (Used in G6, G9, G10, and G11).
R2	19B800607P102	Metal film: 1K ohms + or -5%, 1/8 w.
R3	19B800607P331	Metal film: 330 ohms + or -5%, 1/8 w.
R4	19B800607P560	Metal film: 56 ohms + or -5%, 1/8 w.
R5	19B800607P1	Metal film: Jumper. (Used in G8 , G9 and G12).
R5	19B800607P100	Metal film: 10 ohms + or -5%, 1/8 w. (Used in G6 and G11).
R6	19B800607P101	Metal film: 100 ohms + or -5%, 1/8 w. (Used in G8, G12).
R6	19B800607P391	Metal film: 390 ohms + or -5%, 1/8 w. (Used in G6 and G11).
R7	19B800607P201	Metal film: 200 ohms + or -5%, 1/8 w.
R8	19B800607P121	Metal film: 120 ohms + or -5%, 1/8 w.
R9	19B800607P100	Metal film: 10 ohms + or -5%, 1/8 w. (Used in G6, G8 G11 and G12).
R9	19B800607P1	Metal film: Jumper. (Used in G9 and G10).
R10	19B800607P101	Metal film: 100 ohms + or -5%, 1/8 w. (Used in G8, G12).
R10	19B800607P391	Metal film: 390 ohms + or -5%, 1/8 w. (Used in G6 and G11).
R11	19B800607P332	Metal film: 3.3K ohms + or -5%, 1/8 w.
R12	19B800607P562	Metal film: 5.6K ohms + or -5%, 1/8 w.
R13	19B800607P122	Metal film: 1.2K ohms + or -5%, 1/8 w.
R14	19B800607P390	Metal film: 39 ohms + or -5%, 1/8 w. (Used in G8 , G10, and G12).
R14	19B800607P560	Metal film: 56 ohms + or -5%, 1/8 w. (Used in G6 and G11).
R14	19B800607P330	Metal film: 33 ohms + or -5%, 1/8 w. (Used in G9).
R15	19B800607P1	Metal film: Jumper. (Used in G8, G9, G10, and G12).
R15	19B800607P100	Metal film: 10 ohms + or -5%, 1/8 w. (Used in G6 and G11).
R16	19B800607P101	Metal film: 100 ohms + or -5%, 1/8 w. (Used in G8, G12).
R16	19B800607P391	Metal film: 390 ohms + or -5%, 1/8 w. (Used in G6 and G11).
R17	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R18	19B800607P562	Metal film: 5.6K ohms + or -5%, 1/8 w.
R19	19B800607P183	Metal film: 18K ohms + or -5%, 1/8 w.
R20	19B800607P333	Metal film: 33K ohms + or -5%, 1/8 w.
R21	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R22	19B800607P272	Metal film: 2.7K ohms + or -5%, 1/8 w.
R23	19B800607P152	Metal film: 1.5K ohms + or -5%, 1/8 w.
R24	19B800607P153	Metal film: 15K ohms + or -5%, 1/8 w.
R25	19B800607P390	Metal film: 39 ohms + or -5%, 1/8 w. (Used in G8, G10, and G12).
R25	19B800607P560	Metal film: 56 ohms + or -5%, 1/8 w. (Used in G6 and G11).
R25	19B800607P330	Metal film: 33 ohms + or -5%, 1/8 w. (Used in G9).
R26	19B800607P560	Metal film: 56 ohms + or -5%, 1/8 w.
R27	19B800607P121	Metal film: 120 ohms + or -5%, 1/8 w.
R28	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R29	19B800607P682	Metal film: 6.8K ohms + or -5%, 1/8 w.
R30	19B800607P201	Metal film: 200 ohms + or -5%, 1/8 w.
R31	19B800607P103	Metal film: 10K ohms + or -5%, 1/8 w.
R32	19B800607P101	Metal film: 100 ohms + or -5%, 1/8 w. (Used in G8).
R32	19B800607P331	Metal film: 330 ohms + or -5%, 1/8 w. (Used in G10).
R32	19B800607P201	Metal film: 200 ohms + or -5%, 1/8 w. (Used in G12).
R33	19B800607P510	Metal film: 51 ohms + or -5%, 1/8 w.
		- - - - - - - - - - TRANSFORMERS - - - - - - - -
T1 and T2	344A3063P1	Transformer.
		- - - - - - - INTEGRATED CIRCUITS - - - - - - -
U2	344A3907P1	Integrated circuit, MMIC: sim to Avantek MSA-1105.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
4	19D902555P1	Handle.
6	19A702381P1506	Screw, thread forming: Torx, No. M3.5-.6 x 6.
7	19A702381P1513	Screw, thread forming: Panhead..
11	19A702381P1508	Screw, thread forming: No. 3.5-0.6 x 8.
20	19B800701P2	Tuning screw.
21	19A701800P1	Stop nut.
22	19D902467P2	Casting.
27	19D902508P5	Chassis..
28	19D902534P2	Cover, RF.
29	19D904572P1	Gasket.
30	19B802690P1	Grommet.

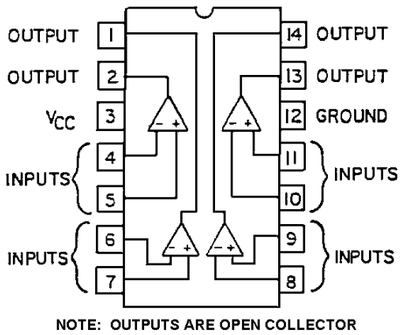
* COMPONENTS, ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PRODUCTION CHANGES

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

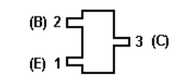
REV. A - RECEIVER FRONT END BOARD 19D902490G6
RECEIVER FRONT END BOARD 19D902490G11
Add new splits. PWB changed.

REV. A - RECEIVER FRONT END BOARD 19D902490G8
REV. B - RECEIVER FRONT END BOARD 19D902490G11 & G10
To eliminate receiver spurious response at 100 kHz switching power supply frequency. Added C37 thru C40 and L24.



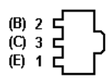
U1
19A704125P1
Quad Operational Amplifier

(SOT) TRANSISTORS
(TOP VIEW)



LEAD IDENTIFICATION FOR
Q2, Q7

(SOT) TRANSISTORS
(TOP VIEW)



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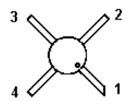
Q1, Q8

RECTIFIER
(TOP VIEW)



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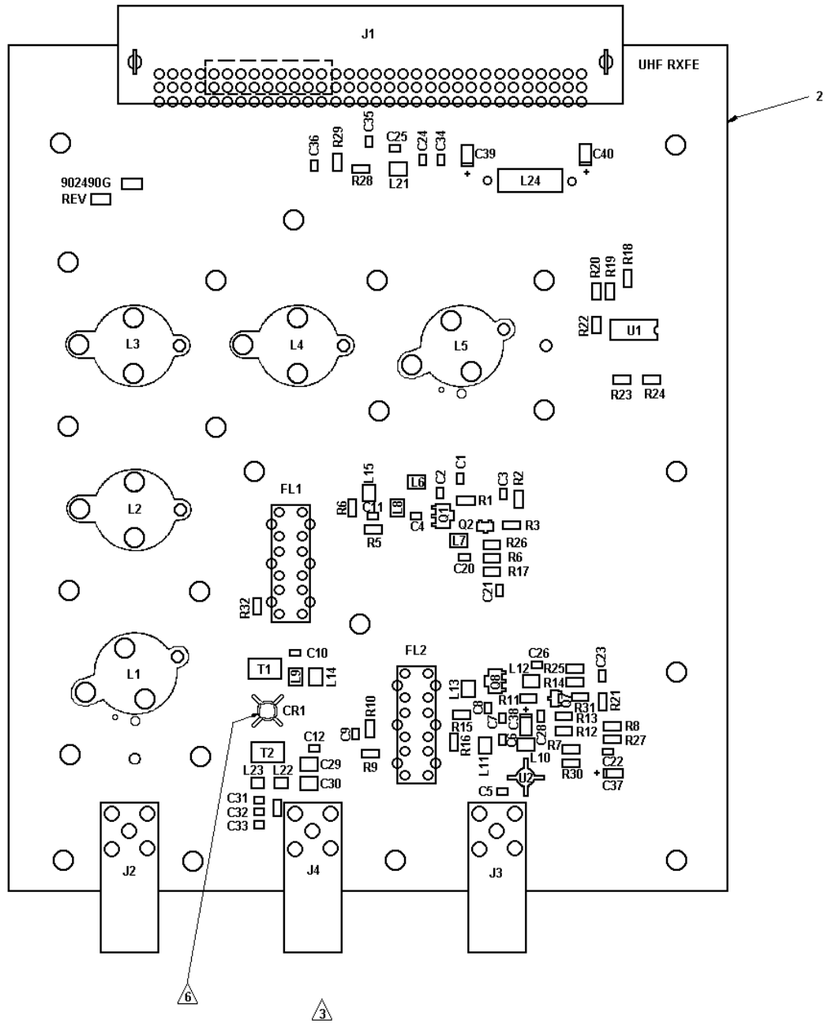
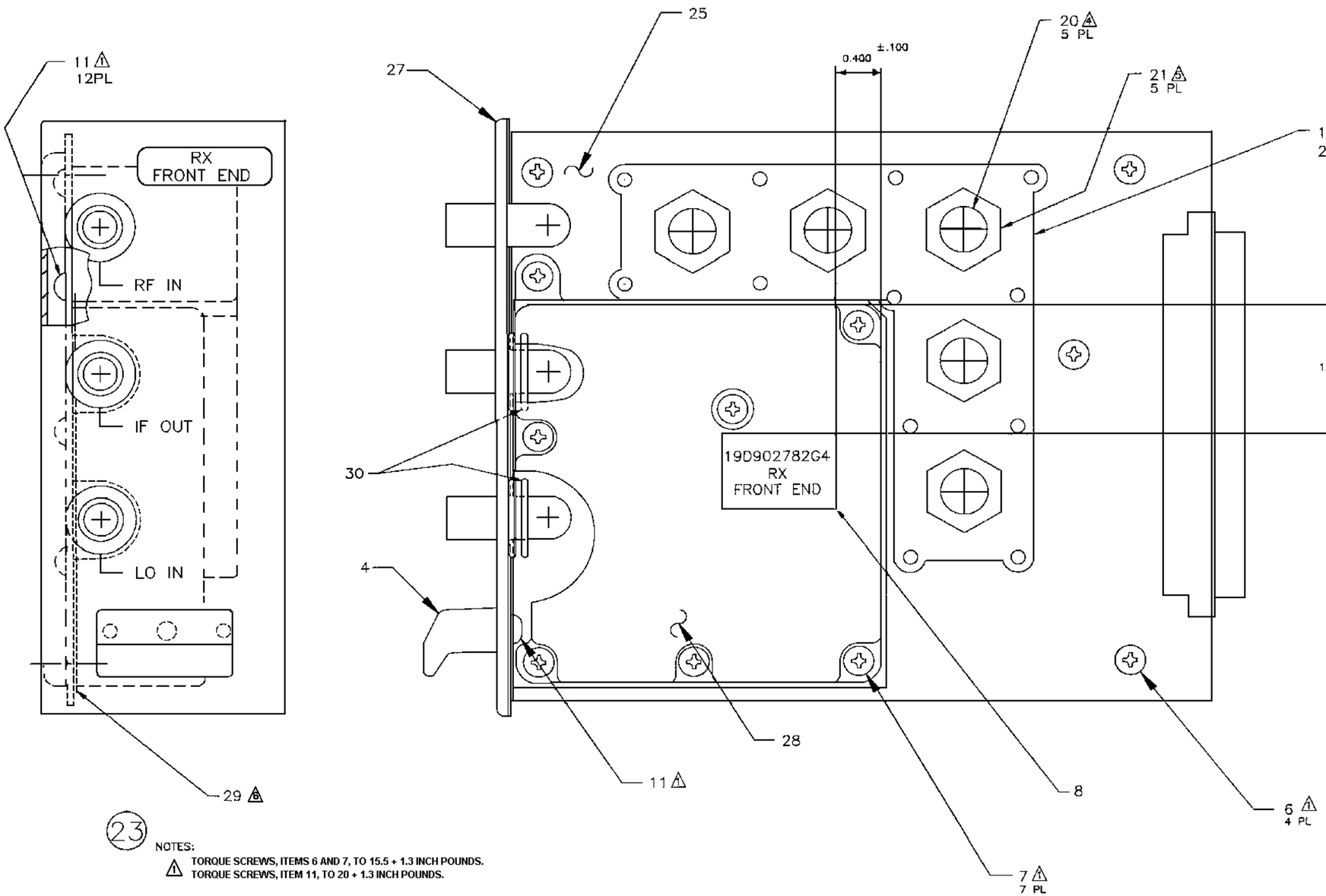
CR1



(19D902490, Sh. 7, Rev. 5)

RECEIVER FRONT END BOARD
19D902490G6, G8 - G12



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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.

⚠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 CASTINGS ITEM 19.

⚠6 ITEM 29, GASKET MOUNTING HOLES TO ALIGN WITH ITEM 28, COVER.

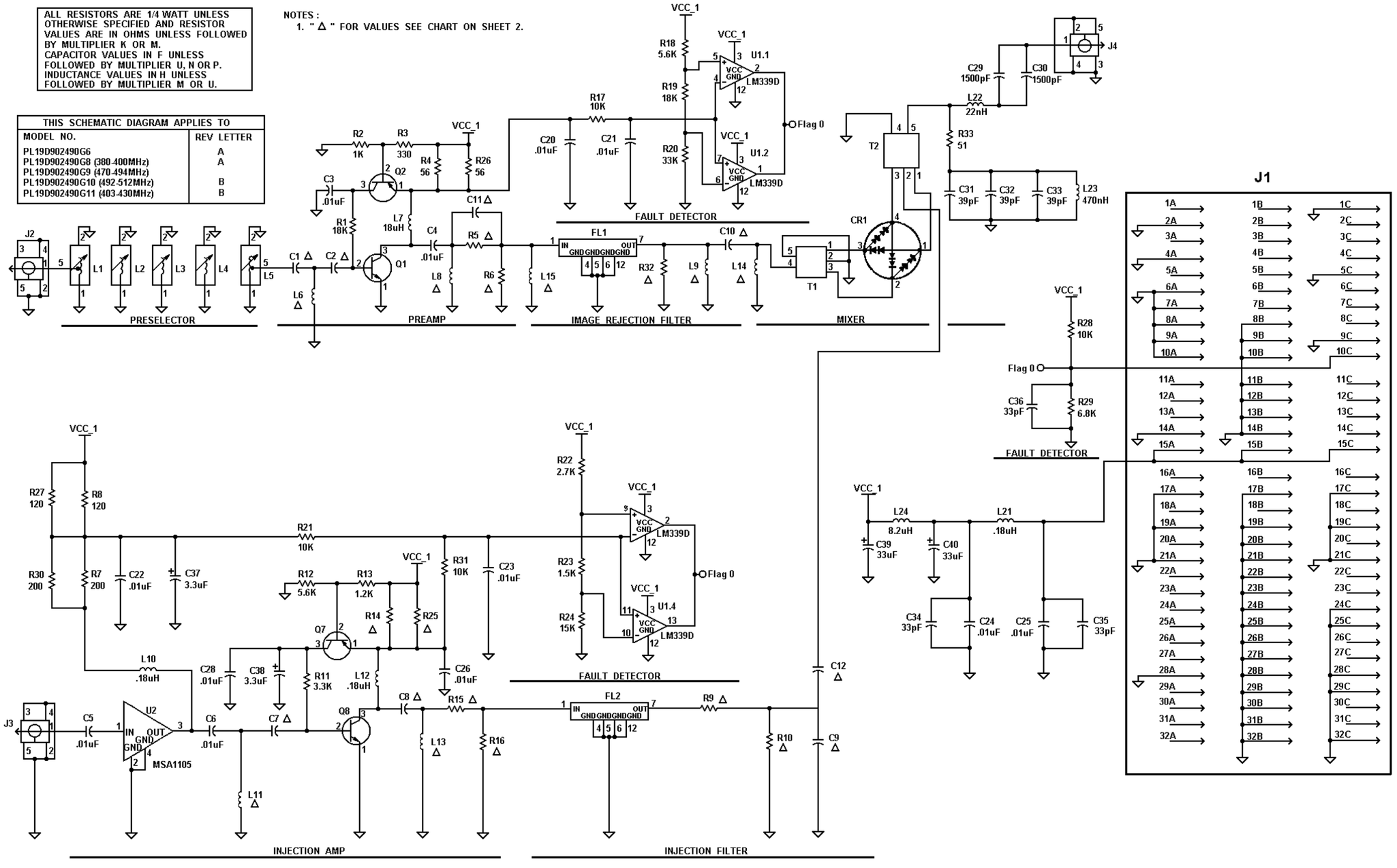
RECEIVER FRONT END MODULE
19D902782G6, G8 - G12

(19D902782 Sh.2 Rev.3)

ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR 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.

NOTES :
1. " Δ " FOR VALUES SEE CHART ON SHEET 2.

THIS SCHEMATIC DIAGRAM APPLIES TO	
MODEL NO.	REV LETTER
PL19D902490G6	A
PL19D902490G8 (380-400MHz)	A
PL19D902490G9 (470-494MHz)	
PL19D902490G10 (492-512MHz)	B
PL19D902490G11 (403-430MHz)	B



RECEIVER FRONT END MODULE
19D902782G6, G8-G12

(188D5789 Sh.1, Rev. 6A)

COMPONENT	380-100 MHZ SPLIT G8	403-425 MHZ SPLIT G6	470-492 MHZ SPLIT G9	492-512 MHZ SPLIT G10	403-430 MHZ SPLIT G11	370-390 MHZ SPLIT G12
C1	33pF	0.01uF	15pF	0.01uF	0.01uF	33pF
C2	12pF	12pF	15pF	8.2pF	12pF	12pF
C7	0.01uF	27pF	18pF	33pF	27pF	0.01uF
C8	0.01uF	0.01uF	0.01uF	12pF	0.01uF	0.01uF
C9	4.7pF	4.7pF	NOT USED	NOT USED	4.7pF	4.7pF
C10	6.8pF	6.8pF	4.7pF	6.8pF	6.8pF	6.8pF
C11	NOT USED	NOT USED	NOT USED	27pF	NOT USED	NOT USED
C12	0.01uF	0.01uF	3.9pF	3.9pF	0.01uF	0.01uF
L6	18nH	10nH	10nH	22nH	10nH	18nH
L8	82nH	68nH	27nH	27nH	68nH	82nH
L9	27nH	0.12uH	27nH	10nH	0.12uH	27nH
L11	0.18nH	10nH	82nH	33nH	10nH	0.18nH
L13	NOT USED	56nH	NOT USED	NOT USED	56nH	NOT USED
L14	18nH	18nH	NOT USED	27nH	18nH	18nH
L15	NOT USED	NOT USED	NOT USED	27nH	NOT USED	NOT USED
R5	0 OHMS	10 OHMS	0 OHMS	NOT USED	10 OHMS	0 OHMS
R6	100 OHMS	390 OHMS	NOT USED	NOT USED	390 OHMS	100 OHMS
R9	10 OHMS	10 OHMS	0 OHMS	0 OHMS	10 OHMS	10 OHMS
R10	100 OHMS	390 OHMS	NOT USED	NOT USED	390 OHMS	100 OHMS
R14	39 OHMS	56 OHMS	33 OHMS	39 OHMS	56 OHMS	39 OHMS
R15	0 OHMS	10 OHMS	0 OHMS	0 OHMS	10 OHMS	0 OHMS
R16	100 OHMS	390 OHMS	NOT USED	NOT USED	390 OHMS	100 OHMS
R25	39 OHMS	56 OHMS	33 OHMS	39 OHMS	56 OHMS	39 OHMS
R32	100 OHMS	NOT USED	NOT USED	390 OHMS	NOT USED	200 OHMS

RECEIVER FRONT END MODULE
19D902782G6, G8 - G12

(188D5789 Sh.2, Rev. 6A)