MAINTENANCE MANUAL
FOR
RECEIVER FRONT END MODULE
19D902782G5

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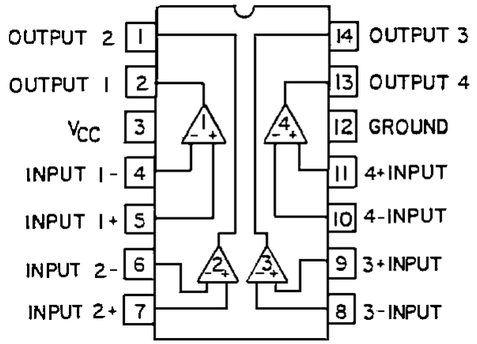
DESCRIPTION

The Receiver Front End (RXFE) Module amplifies and converts the RF signal to the first IF signal of 70.2 MHz. This is a down conversion process using low side injection. The RXFE module is powered by a regulated 12 volts and draws about 260 mA. The RXFE printed wiring board contains the following functional circuits:

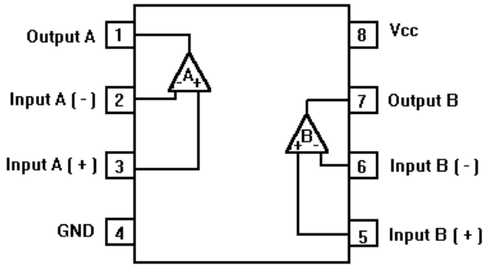
- Preselector Filter
- Preamplifier
- Image Rejection Filter
- Injection Amplifier
- Injection Filter
- Double Balanced Mixer
- Fault Detector

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

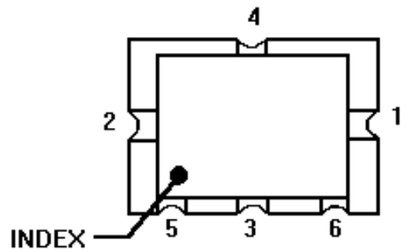
U1
19A704125P1
Quad Operational Amplifier

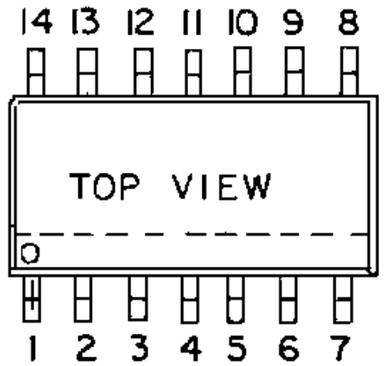


U40
19A704125P1
Quad Comparator



U30
RYTUA901201/1
Power Module





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

Printed in U.S.A.

Table 1 - General Specifications

ITEM	SPECIFICATION
FREQUENCY RANGE	806 MHz - 825 MHz
IF FREQUENCY	70.2 MHz
3 dB BANDWIDTH	>19 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	>+16 dBm
IMAGE REJECTION	>100 dB
INJECTION POWER	+2 dBm ±2 dB
TEMPERATURE RANGE	-30°C to +60°C
SUPPLY VOLTAGE	12.0 Vdc
SUPPLY CURRENT	260 mA ±20 mA

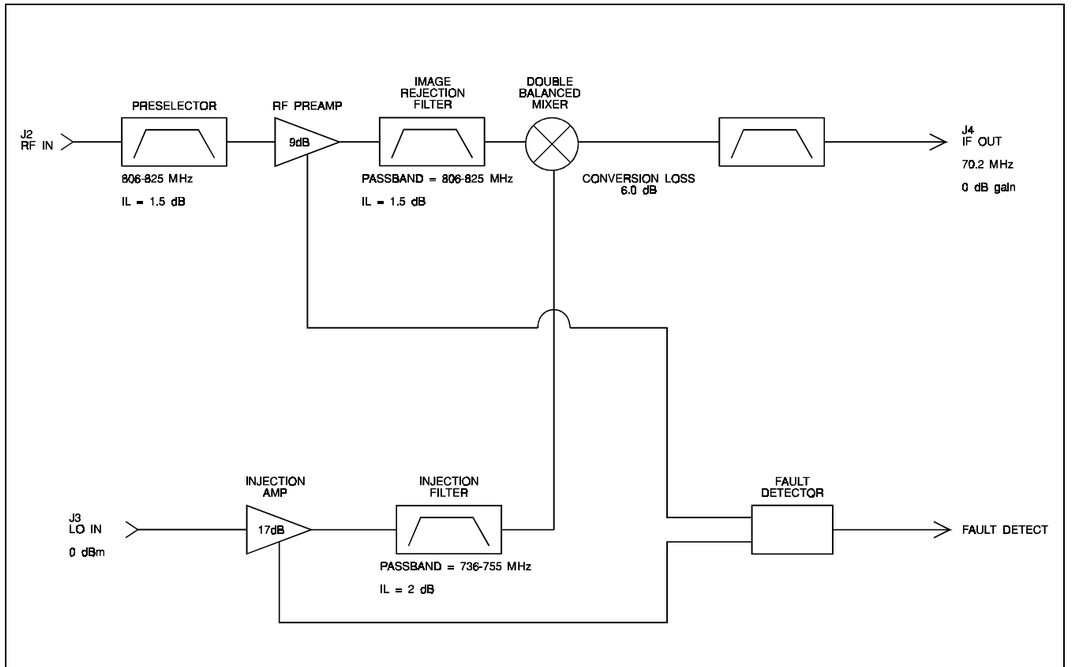


Figure 1 - Block Diagram

CIRCUIT ANALYSIS

PRESELECTOR FILTER

The received RF sigual (J2) is routed through the Preselector Filter. This filter provides front end selectivity and attenuates the potential spurious signals of first conversion. Typically, the filter has an insertion loss of 1.5 dB and an operational bandwidth of 19 MHz. The filter is primarily a five-pole dielectric bandpass filter and in the 806-825 MHz range.

PREAMPLIFIER

The output from the Preselector is coupled through an impedance matching network consisting of L10, C11, and DC blocking capacitor C10 to the base of Preamplifier Q1. Q1 is a broadband common emitter amplifier capable of operating in the 806 to 825 MHz range. The Preamplifier stage is supplied by the regulated +12 Vdc line (VCC1) and draws about 60 mA through R13. 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 R40. Capacitors C40 and C41 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 C12 and L12.

IMAGE REJECTION FILTER

Following the Preamplifier is the Image Rejection Filter. The Image Rejection Filter is a fixed 3-pole dielectric bandpass filter and can meet the desired image rejection of the 806-825 MHz frequency band.

INJECTION AMPLIFIER

The local oscillator input (J3) from the Receiver Synthesizer is coupled through a DC blocking capacitor C20 to U20 which is a MMIC that has about 10dB power gain in the 736-755 MHz range. R20 and R25 provide necessary DC biasing for U20. L20 is a RF blocking inductor.

The second stage of the Injection Amplifier, consisting of Q20, Q21, and associated circuitry, is capable of amplifying the injection signal from 10 dBm to +19 dBm in the 736 to 755 MHz range. The amplifier is powered by the regulated +12 Vdc line (VCC1) and draws about 70 mA through R24. Transistors Q4 and Q7 provide Q3 and Q8 with a constant voltage and current source. The bias on Q20 and U20 is monitored by the Fault Detector circuit via R20, R25, and R24 respectively. Capacitors C42, C43 and C44 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 C23 and L23.

INJECTION FILTER

Following the Injection Amplifier is the Injection Filter which is a dielectric bandpass filter. It has a bandwidth of 736 to 755 MHz 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 in the 806-825 MHz range to the 70.2 MHz first conversion IF frequency. The mixer uses low side injection driven by a local oscillator signal of +17 dBm. The mixer conversion loss is typically about 6.0 dB. The IF signal is then coupled to a diplexer, consisting of R30, L30, C30, C31 and L31. Finally, the IF signal is routed to the output connector (J4).

FAULT DETECTOR

The Fault Detector circuit monitors the operation of preamplifier and injection amplifier devices. Operational amplifiers U40.1 and U40.2 compare the bias on the Preamplifier Q1 to preset levels, while U40.3 and U40.4 compare the bias levels on Injection Amplifiers Q20 and U20.

When the bias for Q1, Q20, and U20 is within the preset window limits, the output from the comparators is a high level. This causes Q40 to conduct, turning off Q41 and the fault indicator, CR40. 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 Q40 causing Q41 to conduct. Q41 now provides a ground path for CR40, 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-70.2 MHz).
4. Measure the IF OUT power at 70.2 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 260 mA.

TROUBLESHOOTING GUIDE

SYMPTOM	AREAS TO CHECK	READING (TYP.)
LOW CONVERSION GAIN	Check Vcc Preselector Loss Preamplifier Gain Image Rej. Filter Loss 1st Mixer Conversion Loss 1 L.O. Level (@ mixer L.O. port)	12 V 1.5 dB 9 dB 1.5 dB 6.0 dB +17 ±2 dBm
LED INDICATOR ON	Check Vc of Q1 Check Vc of Q20 and U20	10V 10V
IF FREQUENCY OFF	Check L.O. FREQUENCY	L.O. frequency = RF frequency - 70.2 MHz
LOW L.O. POWER*	Injection Amplifier Gain Injection Filter Loss	19 ±2 dB 2 dB

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

- I2 Vdc supply.
- Inject L.O. power at a level of 0 dBm into LO IN (J3), (LO freq. = RF freq. - 70.2 MHz).
- 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
19D902782G5
ISSUE 3

SYMBOL	PART NO.	DESCRIPTION
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.
11	19A702381P508	Screw, thread forming: No. 3.5-06 x 8.
		RECEIVER FRONT END BOARD 19D902490G5
		- - - - - - CAPACITORS - - - -
C10	19A702061P12	Ceramic: 8.2 pF 0.5 pF, 50 VDCW, temp coef 0 ±60 PPM.
C11	19A702061P10	Ceramic: 5.6 pF 0.5 pF, 50 VDCW, temp coef 0 ±60 PPM.
C12	19A702061P45	Ceramic: 47 pF 0.5 pF, 50 VDCW, temp coef 0 ±30 PPM.
C13	19A702052P14	Ceramic; 0.01 µF ±10%, 50 VDCW.
C20 and C21	19A702061P45	Ceramic: 47 pF 0.5 pF, 50 VDCW, temp coef 0 ±30 PPM.
C22	19A702061P8	Ceramic: 3.9 pF 0.5 pF, 50 VDCW, temp coef 0 ±120 PPM.
C23	19A702061P12	Ceramic: 8.2 pF 0.5 pF, 50 VDCW, temp coef 0 ±60 PPM.
C24	19A702052P14	Ceramic; 0.01 µF ±10%, 50 VDCW.
C30 and C31	19A702061P49	Ceramic: 56 pF ±5 %, 50 VDCW.
C40 thru C46	19A702052P14	Ceramic: Ceramic; 0.01 µF ±10%, 50 VDCW.
*C47 and *C48	19A705205P26	Tantalum: 3.3 µF ±20%, 16 VDCW.
*C49 and *C50	19A705205P15	Tantalum: 33 µF ±20%, 16 VDCW
		- - - - - - - - - DIODES - - - - - - -
CR1	344A3062P1	Diode, Schotty.
CR40	19A703595P10	Diode, Optoelectric: Red; sim to HP HLMP-1301-010.
		- - - - - - - - FILTERS - - - - - - -
FL10	RTNUA20201/1	Ceramic Bandpass.
FL11	19A704888P5	RF Filter: 806-825 MHz.
FL20	19A705767P1	Bandpass.
		- - - - - - - - -JACKS - - - - - - - -
J1	19B801587P7	Connector, DIN: 96 male contacts, right angle mounting; sim to AMP 650887-1.
J2 thru J4	19A115938P24	Connector, receptacle.
		- - - - - - - INDUCTORS - - - - -
L10	344A4540P100	Inductor: 10.6 nH.
L11	19A705470P13	Coil, Fixed: 0.1 µH.
L12	344A4540P150	Inductor: 16.7 nH.
L20	19A705470P13	Coil, Fixed: 0.1 µH.
L21	19A705470P1	Coil, Fixed: 10 nH; sim to Toko 380NB-10nM.
L22	19A705470P13	Coil, Fixed: 0.1 µH ±20%; sim to Toko 380NB-R10M.
L23	19A705470P7	Coil, Fixed: 33 nH ±20%; sim to Toko 380NB-33nM.
L30 and L31	19A705470P13	Coil, Fixed: 0.1 µH ±20%; sim to Toko 380NB-R10M.
L40	19A705470P16	Coil, Fixed: 0.18 µH; sim to Toko 380NB-R18M.
*L41	19A70000P122	Coil, Fixed: 8.2 µH ±10%; sim to Jeffers 22-8.2-10.
		- - - - - - TRANSISTORS - - - - -
Q1	344A3058P1	Silicon, NPN.
Q2	19A700059P2	Silicon, PNP; sim to MMBT3906, low profile.
Q20	344A3058P1	Silicon, NPN.
Q21	19A700059P2	Silicon, PNP; sim to MMBT3906, low profile.
Q40 and Q41	19A700076P2	Silicon, NPN; sim to MMBT3904, low profile.
		- - - - - - RESISTORS - - - - - - -
R10	19B800607P183	Metal Film: 18K ohms ±5%, 1/8w.
R11	19B800607P102	Metal Film: 1K ohms ±5%, 1/8w.
R12	19B800607P331	Metal Film: 330 ohms ±5%, 1/8w.
R13 and R20	19B800607P270	Metal Film: 27 ohms ±5%, 1/8w.
R21	19B800607P183	Metal Film: 18K ohms ±5%, 1/8w.
R22	19B800607P102	Metal Film: 1K ohms ±5%, 1/8w.
R23	19B800607P331	Metal Film: 330 ohms ±5%, 1/8w.
R24	19B800607P270	Metal Film: 27 ohms ±5%, 1/8w.
R25 and R30	19B800607P510	Metal Film: 51 ohms ±5%, 1/8w.
R31	19B800607P100	Metal Film: 10 ohms ±5%, 1/8w.
R32	19B800607P201	Metal Film: 200 ohms ±5%, 1/8w.
R40	19B800607P103	Metal Film: 10K ohms ±5%, 1/8w.
R41	19B800607P562	Metal Film: 5.6K ohms ±5%, 1/8w.
R42	19B800607P183	Metal Film: 18K ohms ±5%, 1/8w.
R43	19B800607P333	Metal Film: 33K ohms ±5%, 1/8w.
R44 and R45	19B800607P103	Metal Film: 10K ohms ±5%, 1/8w.
R46	19B800607P822	Metal Film: 8.2K ohms ±5%, 1/8w.
R47 and R48	19B800607P333	Metal Film: 33K ohms ±5%, 1/8w.
R49	19B800607P104	Metal Film: 100K ohms ±5%, 1/8w.
R50	19B800607P273	Metal Film: 27K ohms ±5%, 1/8w.
R51	19B800607P102	Metal Film: 1K ohms ±5%, 1/8w.
R52	19B800607P103	Metal Film: 10K ohms ±5%, 1/8w.
R53	19B800607P682	Metal Film: 6.8K ohms ±5%, 1/8w.
		- - INTEGRATED CIRCUITS - -
U20	344A3907P1	MMIC: sim to Avantek MSA-1105.
U30	RYTUA901201/1	Power Module: MOS FET.
U40	19A704125P1	Linear: Quad Comparator; sim to LM339D.

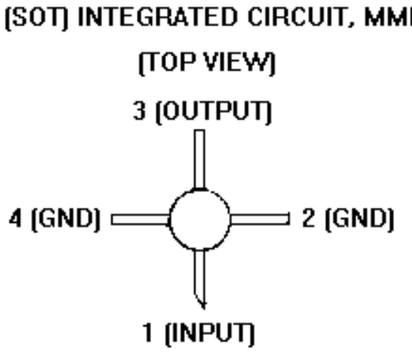
*COMPONENTS, ADDED OR DELETED OR CHANGED BY PRODUCTION CHANGES

PRODUCTION CHANGES

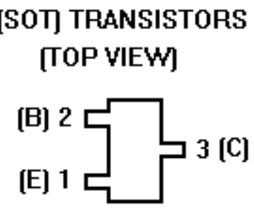
Changes in the equipment to improve performance or to simplify circuits are identified by a "Revision Letter" which is stamped after the model number of the unit. The revision stamped on the unit includes all previous revisions. refer to the Parts List for the descriptions of parts affected by these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

REV. A - RECEIVER FRONT END BOARD 19D902490G5

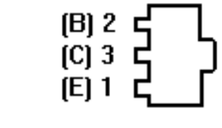
To eliminate receiver spurious response at 100 kHz switch power supply frequency.
Added C47 thru C50 and L41.



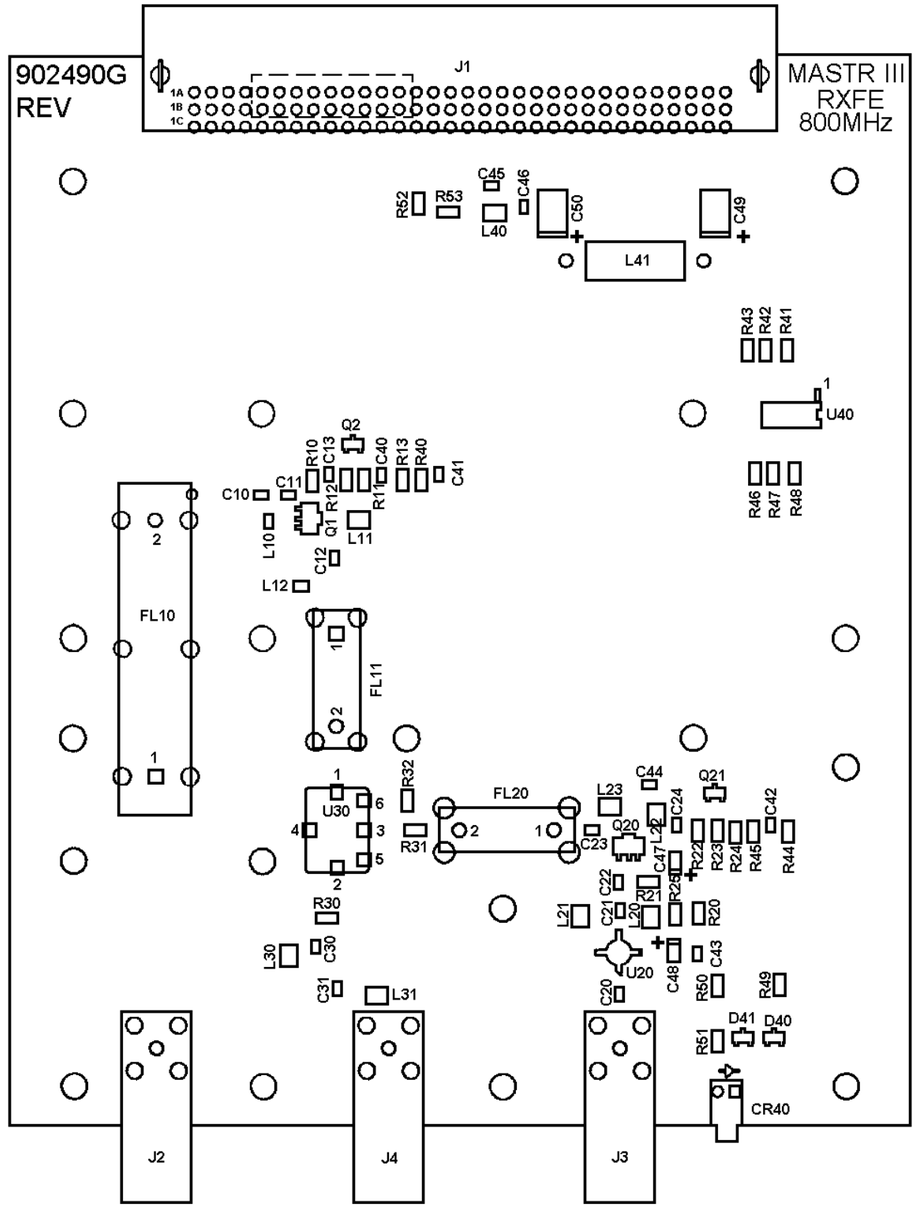
LEAD IDENTIFICATION FOR U20



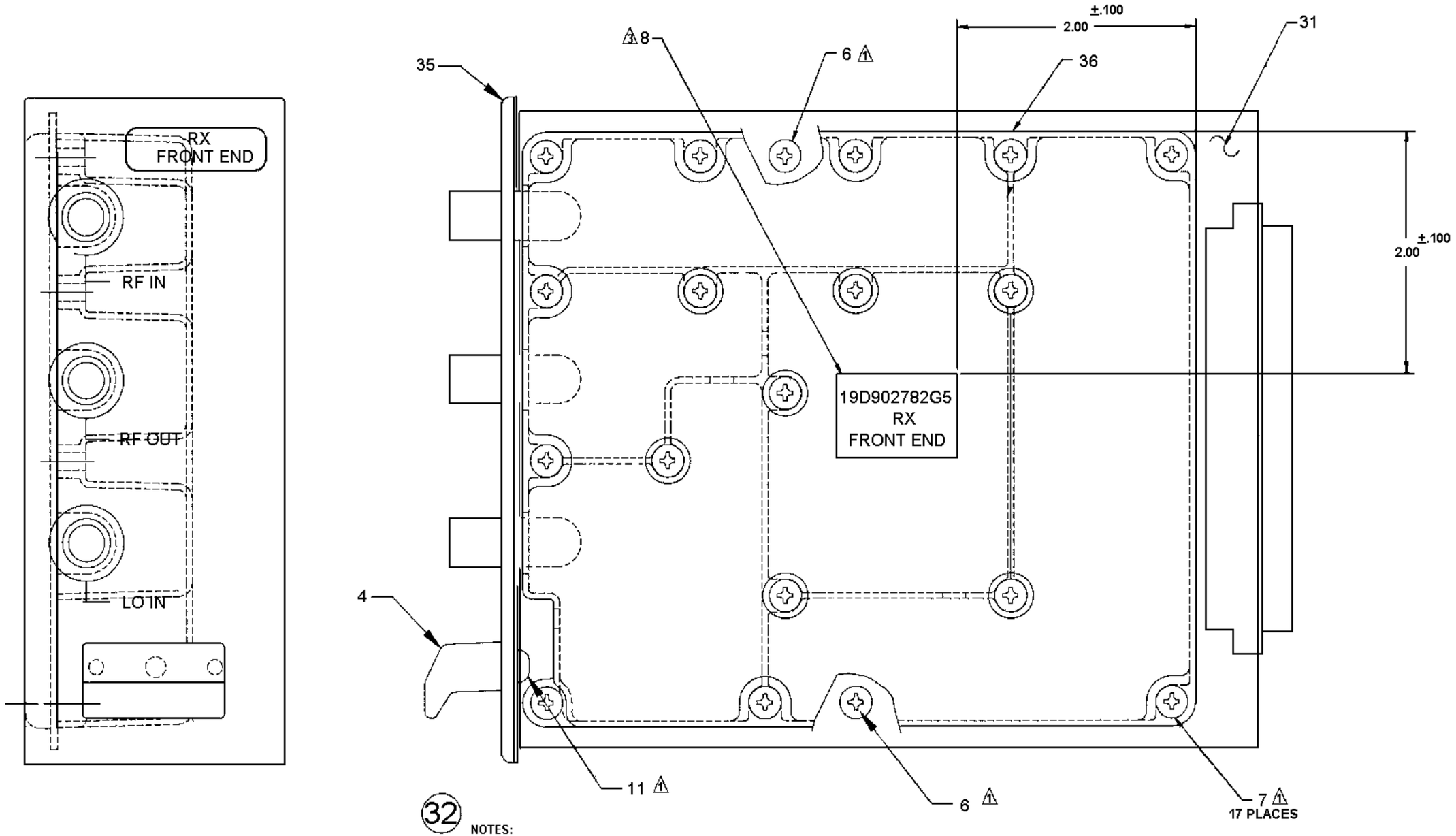
LEAD IDENTIFICATION FOR Q2, Q21, Q40, AND Q41



LEAD IDENTIFICATION FOR Q1, AND Q20



RECEIVER FRONT END PWB
19D902490G5
(19D902490, Sh. 5, Rev. 5)

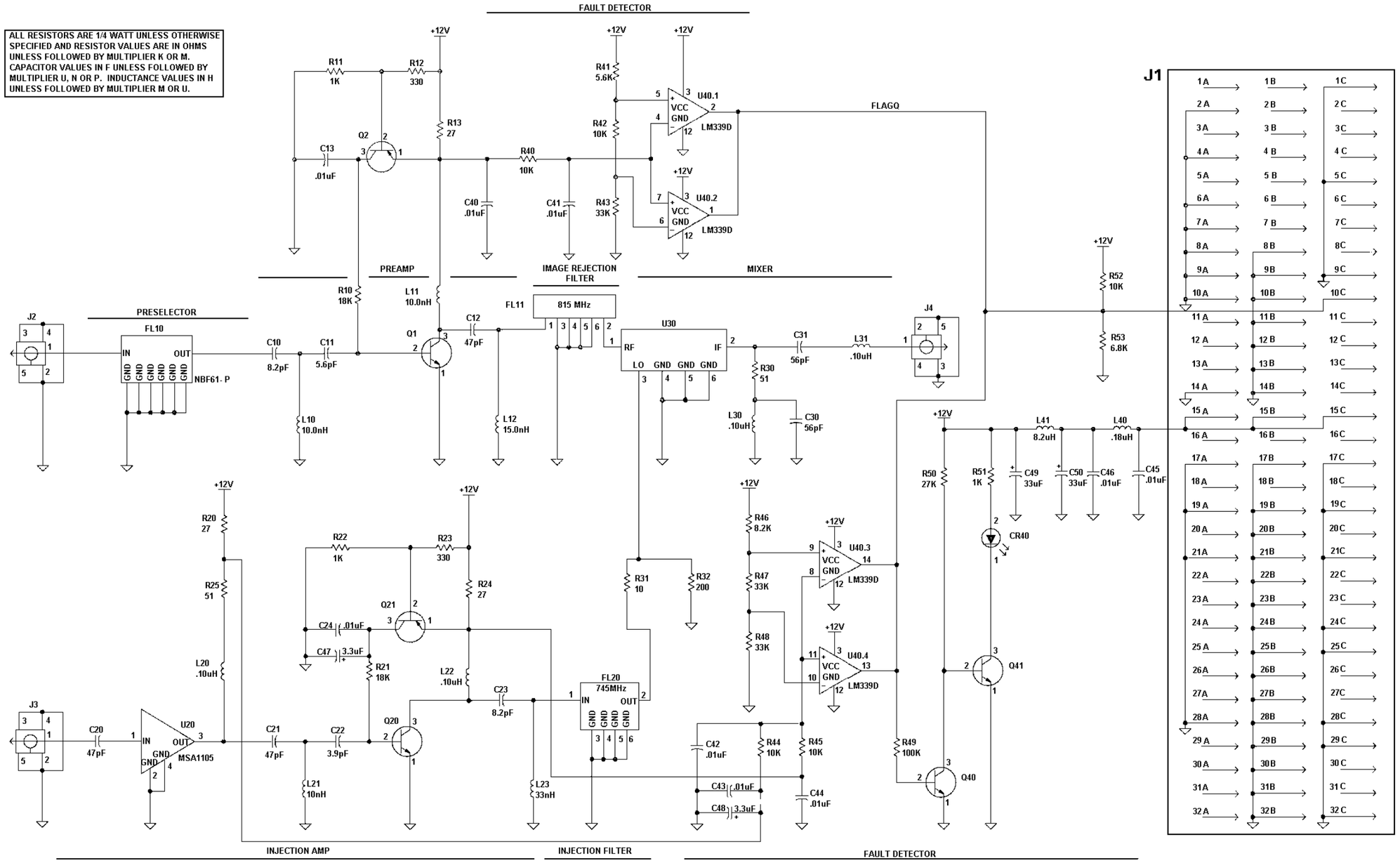


RECEIVER FRONT END MODULE
19D902782G5

(19D902782, Sh. 3, Rev. 5A)

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

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.



RECEIVER FRONT END MODULE

19D902782G5

(19D904935, Sh. 1, Rev. 4)