GE MOBILE RADIO

LBI-4991D
(DF1107)

MAINTENANCE MANUAL

25—50 MHz RF ASSEMBLY 19D416478G1-G4 AND MIXER/IF/NOISE BLANKER BOARD 19D416562G1-G4

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DESCRIPTION

The RF Assembly uses two tuned helical resonators and four L-C tuned circuits to provide front end selectivity.

The Mixer/IF/Noise Blanker board (MIF/NB) uses the RF input from the RF Assembly and the mixer injection frequency from the oscillator/multipler board to generate the IF frequency. The noise blanker eliminates undesirable noise interference in the received audio.

CIRCUIT ANALYSIS

RF ASSEMBLY

ANTENNA INPUT A301A/A301B

An RF signal is applied from the antenna input circuit (L551) of the noise blanker section of the MIF/NB board to A301-J1. The antenna input circuit provides an AC ground between vehicle ground and receiver A-. Resistor R1 prevents a static charge from building up on the vehicle antenna. The output of A301 is coupled through two high-Q helical resonators (L301, C301 and L302, C302) to the RF amplifier. The coils are tuned to the incoming frequency by C301 and C302. Lamp DS1 protects the RF amplifier stage against an excessive RF input.

RF AMPLIFIER A302

RF Amplifier Q1 is a Field-Effect Transistor (FET). Q1 operates as a grounded gate amplifier, with the RF input applied to the "source" terminal. This method of operation provides a low impedance input to the amplifier. The amplified output is taken from the "drain" terminal and coupled through four L-C tuned circuits (L1-C7, L2-C8, L3-C9 and L4-C10) to the mixer. The four tuned circuits and the two helical resonators provide the receiver front end selectivity.

MIXER/IF/NOISE BLANKER

MIXER & CRYSTAL FILTER

The mixer uses a FET (Q501) as the active device. The FET mixer provides a high input impedance, high power gain, and an output relatively free of harmonics (low in intermodulation products).

In the mixer stage, RF from the RF amplifier stage is coupled through tuned circuit L501 and C502 which matches the RF output to the gate of mixer Q501. Injection voltage from the multiplier-selectivity stages is inductively coupled through L502 to the source of the mixer. The mixer IF output signal is coupled from the drain of Q501 through a tuned circuit (L504 and C511) to the first FET noise blanker gate Q502. The IF signal is then coupled through a tuned circuit (L506 and C517) to the second FET noise blanker gate Q503.

During the presence of impulse noise from the antenna, the noise blanker circuit (U551) provides a positive pulse to the gates of Q502 and Q503 which attenuates the IF signal during the noise pulse period (see Noise Blanker description for details). This eliminates undesirable noise interference in the received audio without degrading receiver performance.

The mixer IF output signal is then coupled to the input of the four-pole monolithic crystal filter. The highly selective crystal filter (FL501 and FL502) provides the first portion of the receiver IF Selectivity. The output of the crystal filter is coupled through impedance-matching network Z502 (L520 and C501) to IF Amplifier Q520.

Service Note: Variable capacitor C521 does not require adjustment when performing normal alignment. If the four-pole monolithic crystal filter is replaced, then adjustment of C521 is necessary for optimum IF response.

IF AMPLIFIER

IF amplifier Q520 is a dual-gate FET. The crystal filter output is applied to Gate 1 of the amplifier, and the output is taken from the drain. The biasing on Gate 2 and the drain load determines the gain of the stage. The amplifier provides approximately 20 dB of IF gain. The output of Q520 is coupled through a network (L521 and C528) that matches the amplifier output to the next IF stage. The output of the MIF/NB board is applied through feed-through capacitor C305 to the next IF stage or to the MIF switch when a dual front end is used.

Supply voltage for the RF amplifier and MIF/NB board is supplied through feed-through capacitor C306.

NOISE BLANKER

An RF signal and noise pulse from the antenna (J551) fed simultaneously to the Noise Blanker 1st RF Amplifier and the RF Assembly (A302) RF Amplifier. The signal and noise is transformer coupled through L551 to the 1st RF amplifier Q551 (dual-gate FET). The input signal is applied to Gate 1 of the amplifier, and the output is taken from the drain. The biasing of Gate 2 and the drain load determines the gain of the stage. The signal is then coupled through tuned circuits L552/C558 and L553/C560 to the 2nd RF amplifier Q552, which is also a dual-gate FET. The combined gain of Q551 and Q552 is approximately 50 dB.

The amplified signal is coupled through tuned circuit L554/C564 to pulse detector/amplifier/switch IC (U551). IC (U551) is a custom hybrid integrated circuit which contains a pulse detector, pulse amplifier, pulse amplifier/switch, intermodulation detector and a blanker disable switch. The IC functions as a pulse detector and processing circuit for the noise blanker. Regulated 10 VDC, which powers U551, is applied through pin 3. The associated capacitors (C571, C572 and C574) provide emitter decoupling for various stages of the IC.

Pulse Detector

The impulse noise from the RF amplifier is applied to pin 6 of U551 through tuned circuit L554/C564 to the pulse detector. Bias for the detector is established by R563, R564 and CR551. Diode CR551 is normally conducting, thus biasing the pulse detector. A positive pulse applied to the pulse detector causes it to conduct heavily. The output of the detector is a negative going pulse that is relatively free of any RF components. The pulse detector metering point (Blanker Meter) connects from pin 2 of U551 thru P553 to J605 on the next IF stage (J2305 on MIF switch when a DFE is used) and serves as a convenient measuring point when performing alignment.

Pulse Amplifier and Noise Blanker Disable Switch

The negative pulse output from the pulse detector turns the pulse amplifier on, producing a positive output pulse. The threshold point of the pulse amplifier and the RF gain of the 1st and 2nd RF amplifier stages (Q551 and Q552) in the noise blanker circuit prevent noise blanking due to any low-level inherent receiver noise.

A noise blanker disable switch provides a means for manually disabling the noise blanker circuits. Connecting pin 4 of U551 to A- turns the disable switch on, which in turn inhibits the pulse amplifier. The blanker disable function is also provided at pin 5 of the system plug (P904) for external control.

Pulse Amplifier/Switch

The positive output pulse from the pulse amplifier is fed to the pulse amplifier/switch. This circuit functions as a constant width pulse generator whose output is a positive 6 Volt pulse with a duration of 2 microseconds. This pulse is applied from pin 11 of U551 to the noise blanker gates (Q502 and Q503).

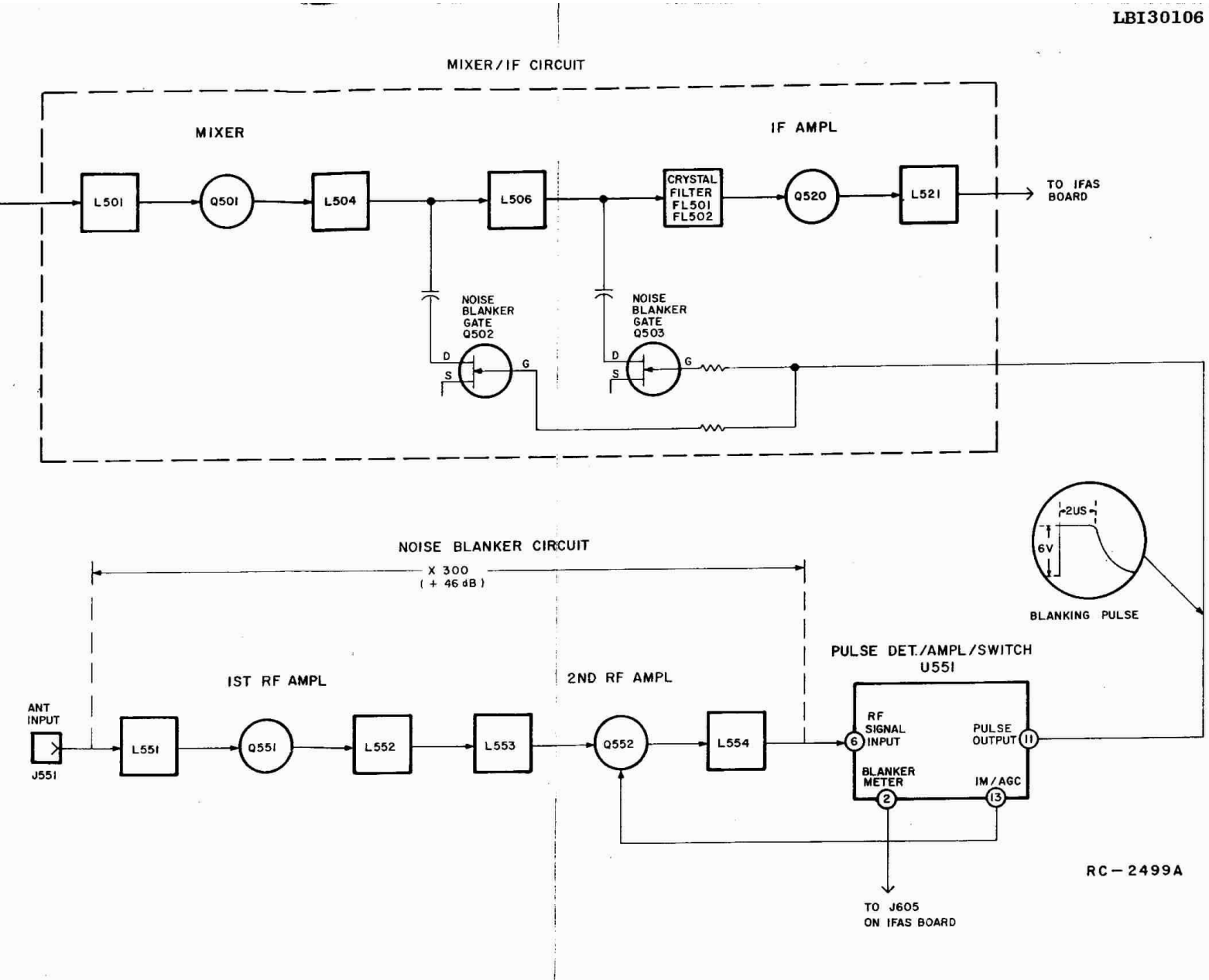
Noise blanker gates Q502 and Q503 are turned ON (conducting) during the presence of the noise blanking pulse. These gates present a low impedance RF path to A- for the pulse duration (approximately 3 microseconds), providing approximately 60 dB attenuation of the IF signal and the impulse noise present. As the noise signal from the antenna is applied to the noise blanker circuits, the RF signal is also applied to

the receiver RF input. The inherent delay presented to the received RF signal and the impulse noise by the helical resonators in the receiver RF assembly (L301 and L302) and the four tuned circuits (L1/C7 through L4/C10) allows the noise blanking pulse to turn on the blanking gates. This attenuates the received signal just prior to the arrival of the impulse noise.

Intermodulation (IM) Detector

The output of the pulse amplifier is also applied to the IM detector. The IM detector does not respond to noise pulses appearing at its input because of the circuit design utilized, but the detector is activated during the presence of a sinusoidal signal. This sinusoidal signal is the beat frequency difference of two signals present in the noise blanker channel.

A resultant AGC voltage (approximately +3 VDC) is developed through the integrating action of C573 and is applied from pin 13 of U551 to the 2nd RF amplifier (Q552) of the noise blanker circuit. This action sufficiently reduces the gain of the noise blanker RF stage (Q552) so that receiver performance is not degraded by blanking pulses which would create receiver intermodulation close to the receiver operating frequency.


MIXER/IF CIRCUIT
MIXER
IF AMPL
L501
Q501
L504
L506
CRYSTAL FILTER FL501 FL502
Q520
L521
TO IFAS BOARD
NOISE BLANKER GATE Q502
NOISE BLANKER GATE Q503
D
S
G
NOISE BLANKER CIRCUIT
X 300 (+ 46 dB)
2US
6V
BLANKING PULSE
PULSE DET./AMPL/SWITCH U551
IST RF AMPL
2ND RF AMPL
ANT INPUT
J551
L551
Q551
L552
L553
Q552
L554
RF SIGNAL INPUT
6
PULSE OUTPUT
11
BLANKER METER
2
IM/AGC
13
TO J605 ON IFAS BOARD
RC-2499A

TROUBLESHOOTING PROCEDURE

STEP 1—PERFORMANCE CHECK

Before starting the Noise Blanker troubleshooting procedure, make sure the receiver is operating properly. Align the Noise Blanker circuits as described for the ALIGNMENT PROCEDURE. Perform the following checks:

Equipment Required:

1. RF Signal Generator coupled through a 6 dB pad.
2. Pulse Generator with repetition rate and level controls.
3. T-Connector
4. AC Voltmeter or Distortion Analyzer
5. Oscilloscope

Procedure:

Noise Blanker Threshold Sensitivity

1. Connect Pulse Generator and RF Signal Generator to receiver antenna jack (J551) through a T-Connector, and connect AC Voltmeter to receive audio output (Speaker LO, P904-18, Speaker HI, P904-19) as shown in Figure 1.
2. Apply an unmodulated RF signal and check the 20 dB quieting sensitivity of the receiver. (Measure with Pulse Generator connected but turned OFF.) Then adjust the RF level for an additional 10 dB on the signal generator.
3. Set the pulse generator for 10 kHz continuous pulses. Slowly increase the pulse output level, degrading the receiver quieting level as measured on the AC VTVM. Prior to the sudden drop in quieting, the degradation should not exceed 20 dB quieting. The noise blanking pulse may be observed where indicated on the Troubleshooting Block Diagram.

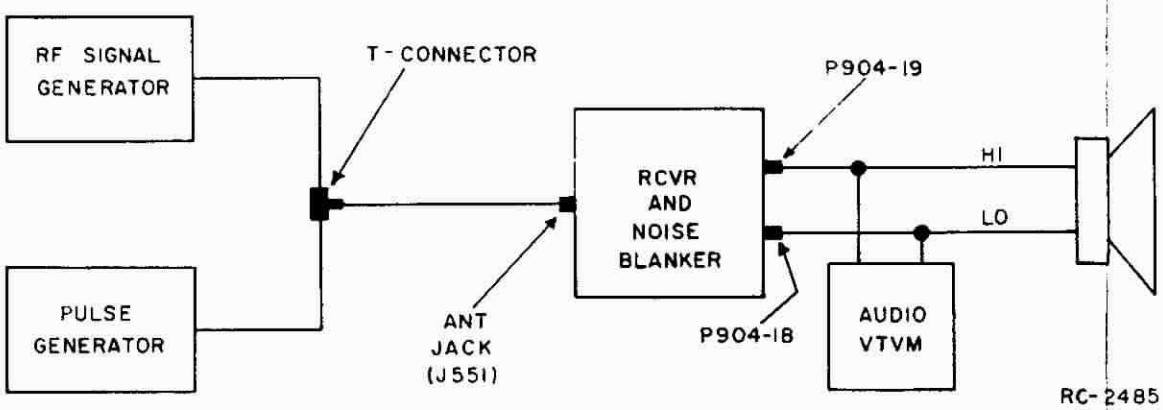


Figure 1 - Equipment Connection Diagram

IF Attenuation

1. Disable the noise blanker by connecting J604 on IFAS module or pin 5 of P904 to A-. (Use noise blanker disable switch on Control Unit if present).
2. Measure the 20 dB quieting sensitivity as in Step 2 of Threshold sensitivity measurement.
3. Adjust the RF output of the signal generator for 50 dB greater RF level than that established for 20 dB quieting sensitivity.
4. Adjust the pulse generator for a repetition rate up to 40 kHz. Adjust the pulse level until the receiver is degraded to 20 dB quieting.
5. Remove the noise blanker disabling jumper from J604 (or if noise blanker disable switch is provided, place to operate position), and then adjust the signal generator RF level for 20 dB quieting. The receiver sensitivity should restore to within 5 dB of 20 dB quieting level obtained in Step 2.

STEP 2—QUICK CHECKS

Equipment Required:

1. RF Voltmeter
2. RF Signal Generator
3. AC Voltmeter or Distortion Analyzer

SYMPTOMS	PROCEDURE
NO Blanking	Check voltage ratios (STEP 3)
Partial or no Blanking	a. Check IF attenuation of Noise Blanker Gates as follows: Connect signal generator to antenna jack (J551). Adjust the signal generator for on frequency signal and output level for 20 dB quieting sensitivity (Level A). Connect +10 VDC directly to the gates of Q502 and Q503. Increase the RF output level to achieve 20 dB quieting (Level B). The difference between "Level A" and "Level B" must be 60 dB or greater.
Intermodulation Interference (AGC action)	b. Check gain of Noise blanker RF circuit (IM/AGC ACTI0N) as follows: Connect signal generator to antenna Jack (J551). Adjust the frequency of the signal generator to the noise blanker channel frequency and adjust the RF level for 100 microvolts (see Alignment Procedure, Step 12 for frequencies). Measure RF signal level at pin 6 of U551. This level should be 31 millivolts or greater. Apply +10 VDC through a 270 ohm resistor to the source pin of Q552 (or pin 13 of U551). (This applies approximately +3 VDC bias to Q552, simulating intermodulation AGC voltage). The RF voltage measured at pin 6 of U551 should be approximately 1 millivolt (Corresponds to approx. 30 dB decrease of gain in RF amplifier Q552).

FROM RF AMPL

STEP 3—VOLTAGE RATIO READINGS

Equipment Required:

1. RF Voltmeter.
2. Signal Generator.

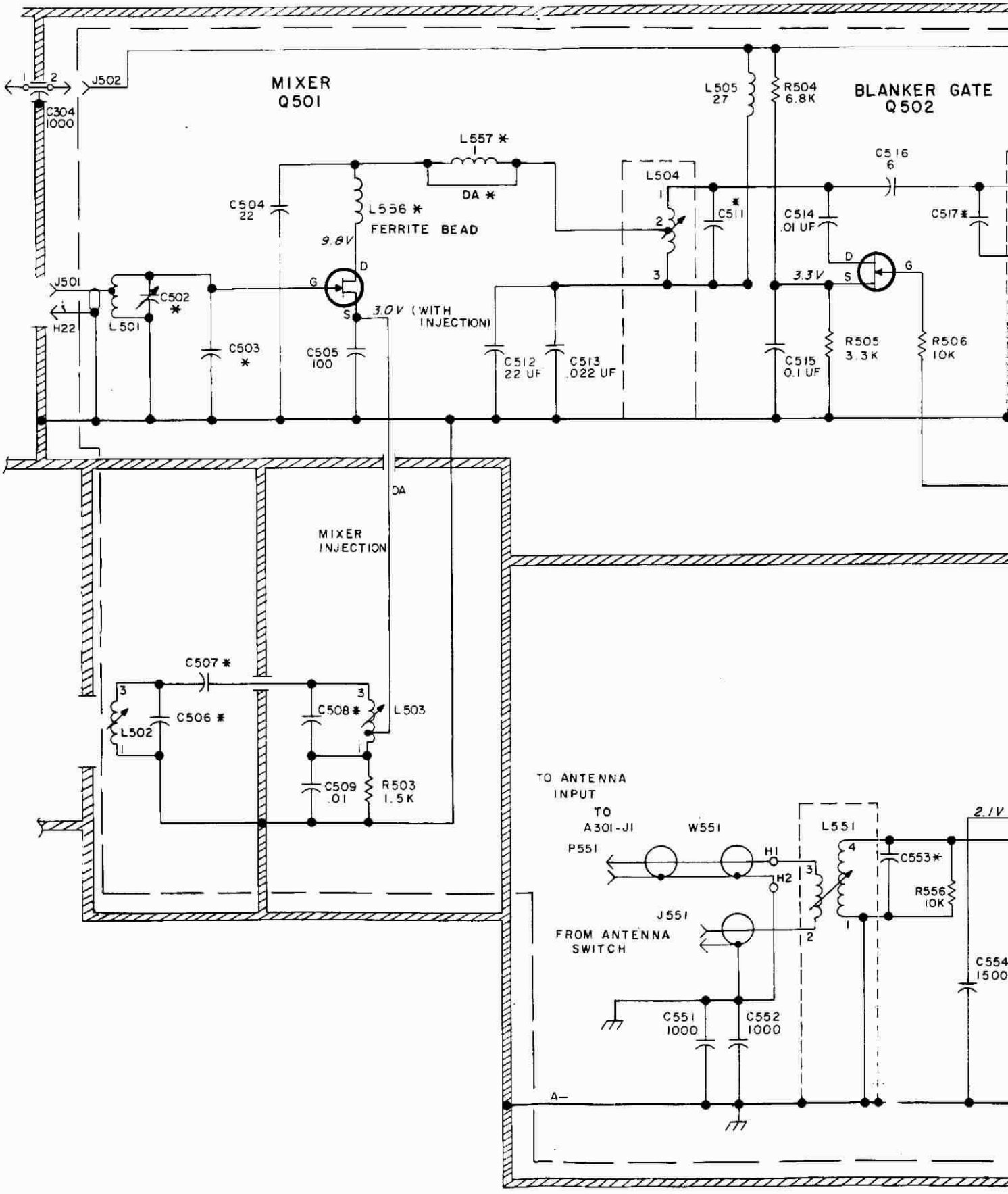
Procedure:

1. Connect signal generator to Antenna Jack (J551). Adjust the frequency of the signal generator to the channel frequency of the noise blanker (see Alignment procedure, Step 12). Adjust the RF level for 100 microvolts output.
2. Apply probe of RF Voltmeter to Antenna Jack (J551). Peak resonant circuit L551 and take voltage reading (E_1).
3. Move probe to input of IC-U551 (Pin 6). Repeak resonant circuit L551. Then peak resonant L554 and take reading (E_2).
4. Convert reading by means of the following formula:

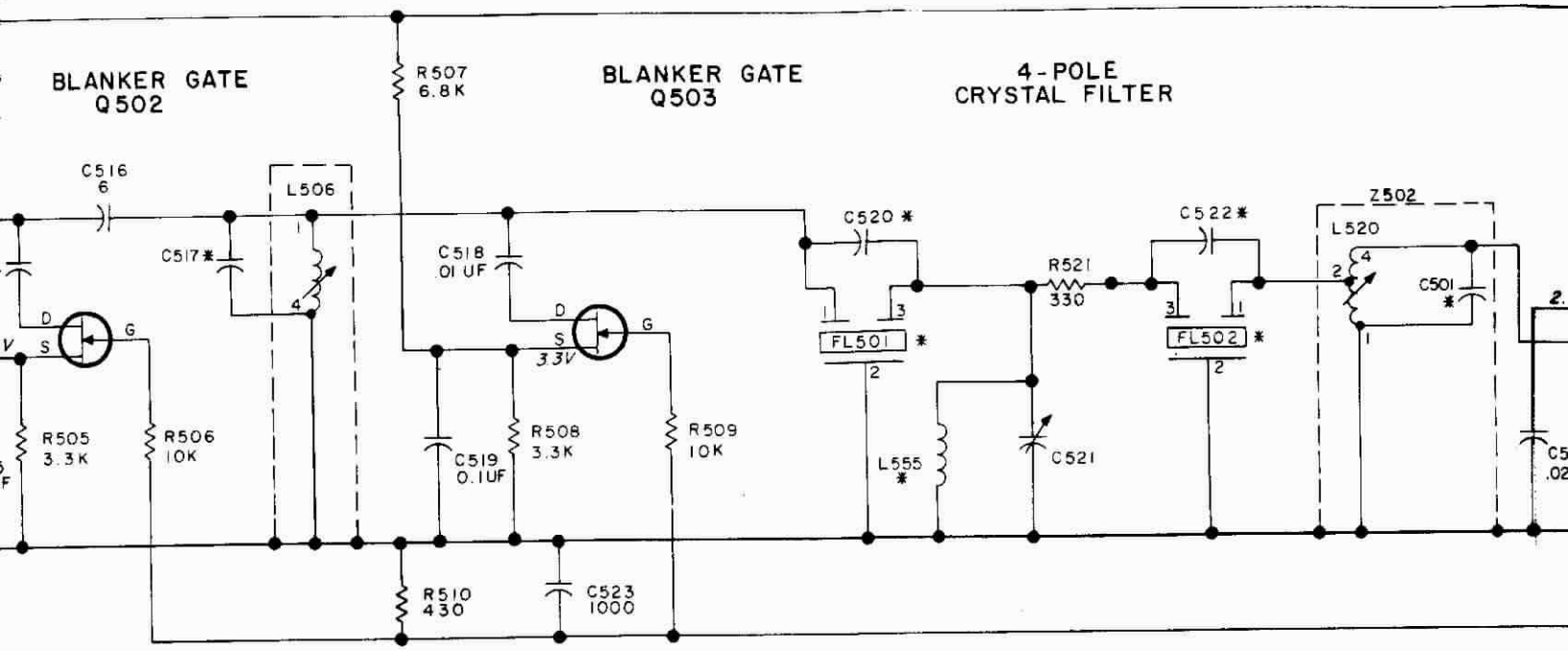
$$\text{Voltage Ratio} = \frac{E_2}{E_1}$$

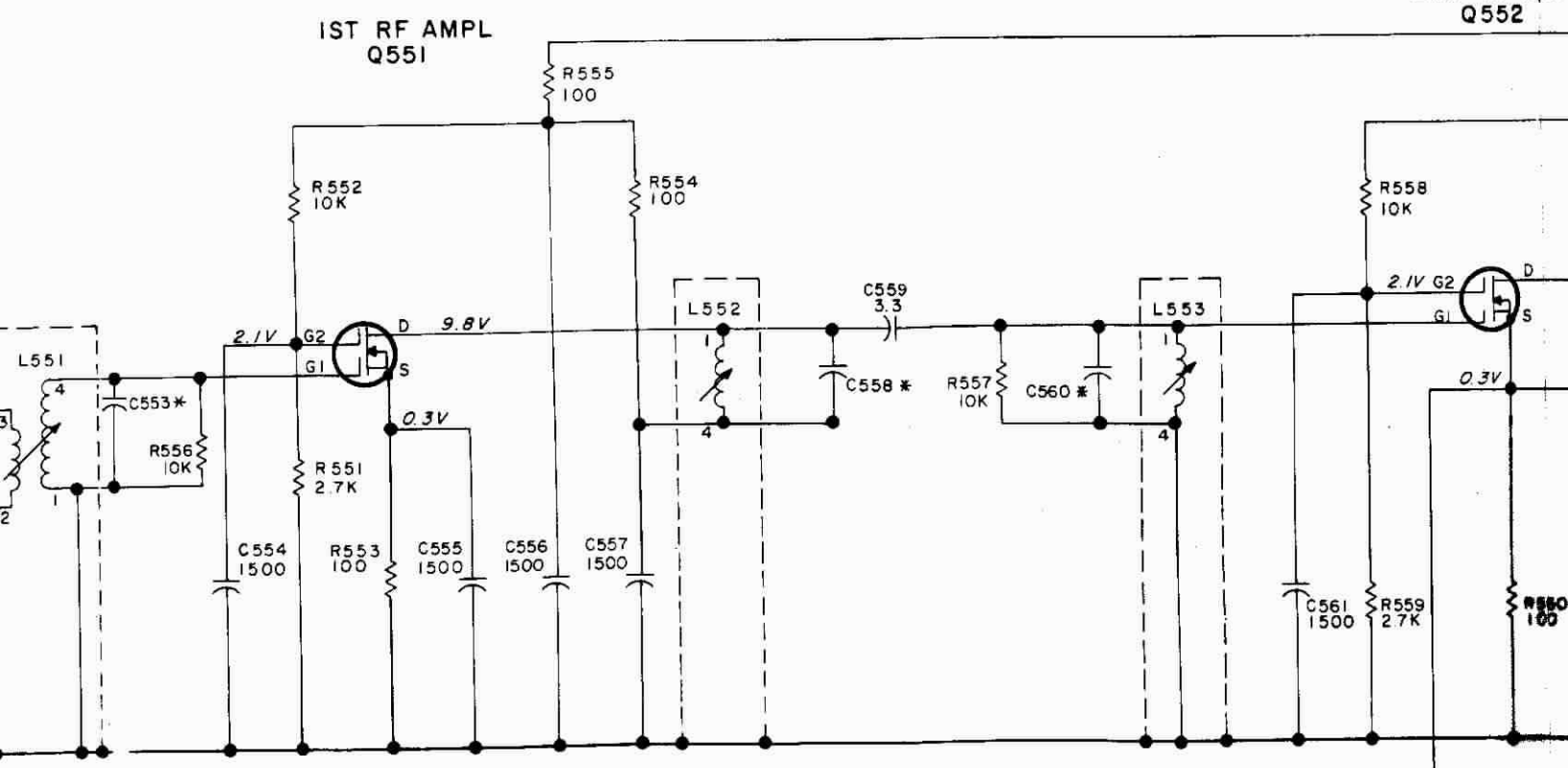
5. Check results with the typical voltage ratio shown on diagram.

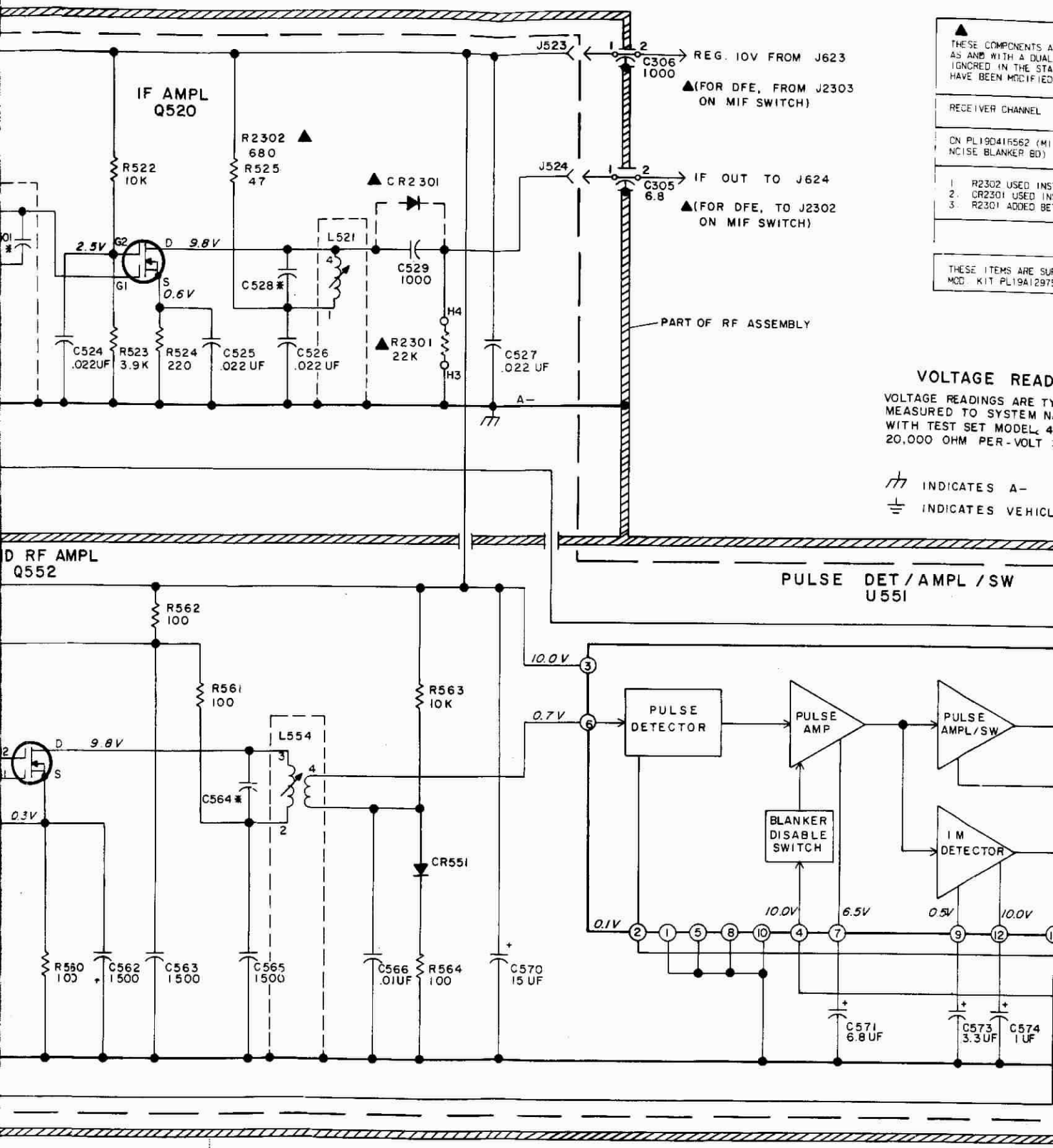
MIXER / IF NOISE BLAN
PL19D416562



XER / IF NOISE BLANKER BD.
PL19D416562






IF AMPL
Q520
R522
10K
R2302 ▲
680
R525
47
▲ CR2301
J523
1
2
C306
1000
REG. 10V FROM J623
▲(FOR DFE, FROM J2303
ON MIF SWITCH)
J524
C305
6.8
IF OUT TO J624
▲(FOR DFE, TO J2302
ON MIF SWITCH)
2.5V
G2
D
9.8V
G1
S
0.6V
L521
C528*
C529
1000
H4
H3
▲R2301
22K
C524
.022UF
R523
3.9K
R524
220
C525
.022 UF
C526
.022 UF
C527
.022 UF
A–
PART OF RF ASSEMBLY
▲
THESE COMPONENTS A
AS AND WITH A DUAL
IGNORED (IN THE STA
HAVE BEEN MODIFIED
RECEIVER CHANNEL
ON PL19D416562 (MI
NCISE BLANKER BD)
1. R2302 USED INS
2. CR2301 USED IN
3. R2301 ADDED BE
THESE ITEMS ARE SU
MOD. KIT PL19A1297
VOLTAGE READ
VOLTAGE READINGS ARE TY
MEASURED TO SYSTEM N
WITH TEST SET MODEL 4
20,000 OHM PER-VOLT
INDICATES A–
INDICATES VEHICL
D RF AMPL
Q552
PULSE DET/AMPL/SW
U551
R562
100
R561
100
R563
10K
L554
9.8V
0.3V
C564*
CR551
10.0V
0.7V
PULSE
DETECTOR
PULSE
AMP
PULSE
AMPL/SW
BLANKER
DISABLE
SWITCH
I M
DETECTOR
0.1V
10.0V
6.5V
0.5V
10.0V
R560
100
C562
1500
C563
1500
C565
1500
C566
.01UF
R564
100
C570
15 UF
C571
6.8 UF
C573
3.3 UF
C574
1 UF

▲ THESE COMPONENTS ARE USED TO ADAPT A STANDARD MASTR II RECEIVER TO OPERATION AS AND WITH A DUAL FRONT END. THESE COMPONENTS SHOULD BE IGNORED IN THE STANDARD RECEIVER. BOARDS IDENTIFIED BY A RED DOT HAVE BEEN MODIFIED FOR DFE OPERATION PER MOD KIT 19A129750G1 OR G2

RECEIVER CHANNEL	D F E CHANNEL
ON PL19D416562 (MIXER IF NOISE BLANKER BD)	ON PL19D416562 (MIXER IF NOISE BLANKER BD)
1. R2302 USED INSTEAD OF R525 2. CR2301 USED INSTEAD OF C529 3. R2301 ADDED BETWEEN H3 & H4	NO MODIFICATION REQUIRED
	SEE GSC MULT BD FOR OTHER DFE CHANGES
THESE ITEMS ARE SUPPLIED IN MOD KIT PL19A129750G1	THESE ITEMS ARE SUPPLIED IN MOD KIT PL19A129750G2.

IN ORDER TO RETAIN RATED EQUIPMENT PERFORMANCE, REPLACEMENT OF ANY SERVICE PART SHOULD BE MADE ONLY WITH A COMPONENT HAVING THE SPECIFICATIONS SHOWN ON THE PARTS LIST FOR THAT PART.

	REV LETTER	FREQ RANGE (MHZ)	IF FREQ (MHZ)
MIXER/IF NB BD			
19D416562G1	G	25-30 (LL)	11.2
19D416562G2	G	30-36 (L)	9.4
19D416562G3	G	36-42 (M)	11.2
19D416562G4	G	42-50 (H)	9.4

OLTAGE READINGS

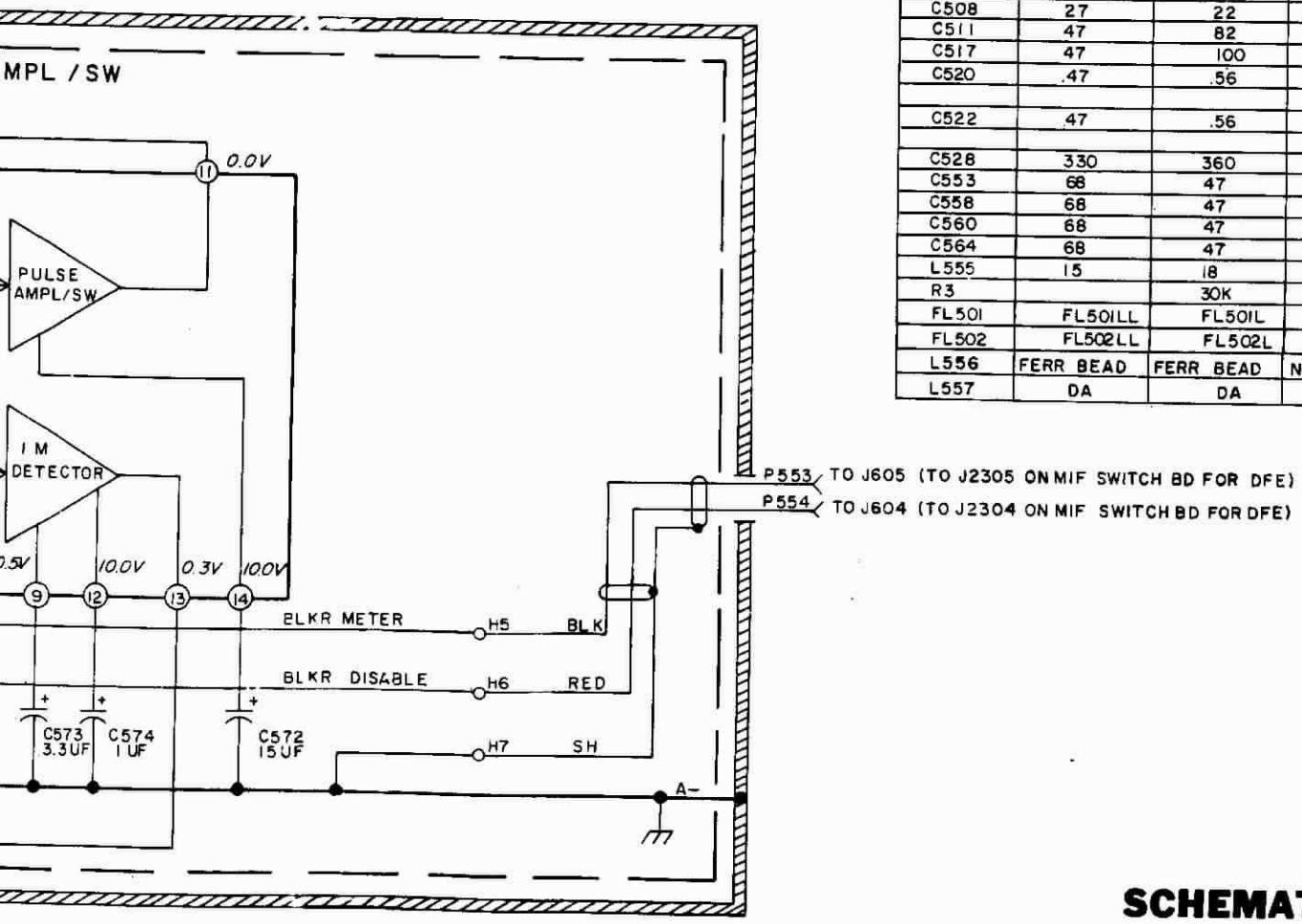
GE READINGS ARE TYPICAL READINGS
RED TO SYSTEM NEGATIVE (P903-10)
TEST SET MODEL 4EX3A11 OR A
0 OHM PER-VOLT METER

NDICATES A-

NDICATES VEHICLE GROUND

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

* COMPONENT VALUE TABLE				
COMP DESIG	L L	L	M	H
RF FREQ	25-30MHZ	30-36MHZ	36-42 MHZ	42-50MHZ
IF FREQ	11.2 MHZ	9.4 MHZ	11.2 MHZ	9.4 MHZ
C502	8-50	8-50	2-20	2-20
C503	56	39	27	15
C506	27	24	15	12
C507	1.0	.82	.68	.56
C508	27	22	15	12
C511	47	82	47	82
C517	47	100	47	100
C520	.47	.56	.47	.56
C522	.47	.56	.47	.56
C528	330	360	330	360
C553	68	47	68	47
C558	68	47	68	47
C560	68	47	68	47
C564	68	47	68	47
L555	15	18	15	18
R3		30K	15K	6.2K
FL501	FL501LL	FL501L	FL501M	FL501H
FL502	FL502LL	FL502L	FL502M	FL502H
L556	FERR BEAD	FERR BEAD	NOT USED	NOT USED
L557	DA	DA	1	1



SCHEMATIC DIAGRAM

25—50 MHz MIXER/IF/NOISE BLANKER