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## SPECIFICATIONS*

| | |
|---|---|
| Input Voltage | 10 Volts DC |
| Current Drain | 50 Milliamperes Maximum |
| Frequency Range | 67-210.7 Hz |
| Maximum Frequency | ±0.2% |
| Encode Output Level | |
| 67 Hz | 0.8 Volts RMS Minimum |
| 156 Hz | 0.4 Volts RMS Minimum |
| 210 Hz | 0.2 Volts RMS Minimum |
| Encode Tone Distortion | 1.5% Maximum |
| Programming Increments | 0.25 Hz |
| Decode Input Level | 45 Millivolts RMS Minimum |
| Decode Response Time | 250 Milliseconds Maximum @ 100 Hz |
| PTT Delay | 160 Milliseconds |
| STE Phase Shift | 135° |
| Temperature Range | -30°C (-22°F) to +60°C (140°F) |

* These specifications are intended primarily for the use of the serviceman. Refer to the appropriate Specification Sheet for the complete specifications.

**WARNING**

Although the highest DC voltage in the unit is supplied by the vehicle battery, high current may be drawn under short circuit conditions. These currents can possibly heat metal objects such as tools, rings, watchbands, etc. enough to cause burns. Be careful when working near energized circuits.

ERICSSON

Ericsson GE Mobile Communications Inc.
Mountain View Road • Lynchburg, Virginia 24502

Printed in U.S.A.

MOBILE RADIO

LBI4991D
(DF 1107)

# 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

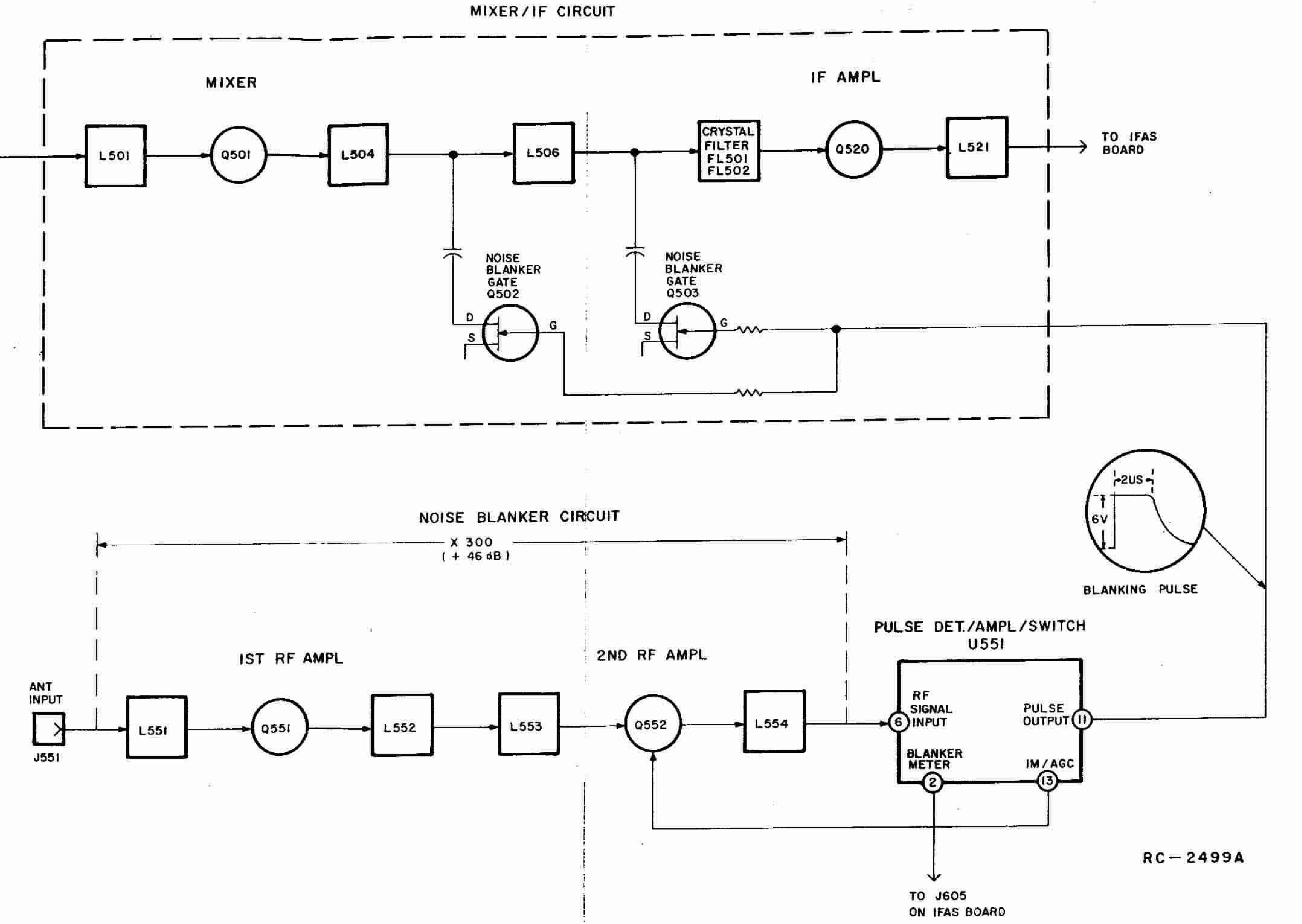
The positive output pulse from the pulse amplifier is fed to the pulse amplifier/switch. This circuit functions as a constant width pulse generator whose output is a positive 6 Volt pulse with a duration of 2 microseconds. This pulse is applied from pin 11 of U551 to the noise blanker gates (Q502 and 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
D
S
G
2US
6V
BLANKING PULSE
NOISE BLANKER CIRCUIT
X 300
( + 46 dB )
PULSE DET./AMPL/SWITCH U551
1ST RF AMPL
2ND RF AMPL
ANT INPUT
J551
L551
Q551
L552
L553
Q552
L554
6
RF SIGNAL INPUT
PULSE OUTPUT
11
BLANKER METER
2
IM/AGC
13
TO J605 ON IFAS BOARD
RC—2499A

## DESCRIPTION

General Electric Channel Guard Modules 19D432500 are field programmable, synthesized single tone Channel Guard encoder/decoders for use with MASTR® II mobile and station combinations.

The encode function provides continuous tone-coded modulation for the transmitter. The decode function is used with the receiver to eliminate all calls that are not tone coded with the proper Channel Guard (CG) frequency.

Three different Channel Guard boards are available:

- 19D432500G1 - single tone encode/decode
- 19D432500G2 - single tone encode only
- 19D432500G3 - single tone decode only

## OPERATION

In mobile Channel Guard applications, a microphone hookswitch is supplied with the radio. The CG hookswitch is equipped with a CG disable switch.

Placing the disable hookswitch in the "up" position (towards the small speaker symbol) disables the receive Channel Guard. With the switch in the "down" position, the receive Channel Guard is disabled when the microphone is removed from the hookswitch.

In station applications, a desk microphone is available for use with Channel Guard. Pressing the MONITOR bar on the base of the desk microphone disables the CG decode function. This permits the channel to be monitored before sending a message.

## CIRCUIT ANALYSIS

Channel Guard is a continuous-tone controlled squelch system that provides communications control in accordance with EIA standard RS-220-A. The basic Channel Guard system utilizes standard tone frequencies from 67 to 210.7 Hz with both the encoder and decoder operating on the same frequency. The standard Channel Guard tone frequencies are shown in the following chart.

| STANDARD TONE FREQUENCIES | | | | |
|---|---|---|---|---|
| 67.0 | 88.5 | 107.2 | 131.8 | 167.9 |
| 71.9 | 91.5 | 110.9 | 136.5 | 173.8 |
| 74.4 | 94.8 | 114.8 | 141.3 | 179.9 |
| 77.0 | 97.4 | 118.8 | 146.2 | 186.2 |
| 79.7 | 100.0 | 123.0 | 151.4 | 192.8 |
| 82.5 | 103.5 | 127.3 | 156.7 | 203.5 |
| 85.4 | | | 162.2 | 210.7 |

The Channel Guard circuitry consists of frequency synthesizer U1001, encoder/decoder U1002/U1003, tone programming switch S1001 and associated discrete circuitry.

Frequency synthesizer U1001 includes the synthesizer IC and a 32,768 Hz reference crystal that provides the clock inputs for the encoder/decoder module. The clock inputs are required to produce the tone frequency and the digitally generated time delays for the DELAYED PTT and squelch tail elimination (STE) circuits.

Tone frequency programming is accomplished by setting the 10 station switch (S1001) for the proper binary input to the synthesizer. The switch can be set to produce any CG tone from 67 Hz to 210.7 Hz in 0.25 Hz increments. Complete instructions for setting the switch are contained in the Programming Instructions (see Table of Contents).

Encode/decode hybrid U1002 contains the encoder and decoder, a voice reject filter, STE circuit and the interface circuitry. The interface circuitry provides increased output drive for RX MUTE, DELAYED PTT (Push-To-Talk) and other functions. Encode hybrid U1003 has the decoder removed for encode only operation.

### ENCODE MODE

Depressing the PTT switch applies a low (A-) to PTT lead J908-6. This causes the DELAYED PTT lead (J908-8) to go low, keying the transmitter. The encoder then generates the CG tone which is applied to a low pass filter to remove any tone or clock harmonics. The filter output is then coupled through J908-7 to the transmitter.

**NOTE**

**When jumper W1003 is connected, the tone output has a 6 dB/octave de-emphasis required for phase modulation transmitters. Jumper W1003 is removed for direct FM transmitters.**

When the PTT button on the microphone is released (transmitter unkeyed), the DELAYED PTT circuit in U1002/U1003 keeps the transmitter keyed for an additional 160 milliseconds. During the 160 milliseconds delay time, the encoder shifts the phase of the CG tone output 135°. This combination of 160 milliseconds delay and the 135° phase shift causes the CG decoder in other receivers to squelch the audio before the loss of RF signal, eliminating the receiver noise burst (squelch tail elimination).

The encoder circuit can be disabled to allow the serviceman to make transmitter distortion and modulation checks. To disable the encoder, apply a ground to J908-2.

DECODE MODE

In the receive mode, receiver audio from VOLUME/SQUELCH HI lead J908-1 is applied to a voltage divider (R1002 and R1003) and then to a voice reject filter in the decode circuit. The filter removes any voice information to prevent voice blocking of clipping.

The digital decoder compares the frequency of the incoming tone to a reference clock input produced by the synthesizer. If the correct tone is detected, the decoder circuit causes the REC MUTE lead at J908-5 to go high, unsquelching the receiver. The REC MUTE lead is normally held in a low voltage condition until a correct CG tone is detected.

After the CG tone is decoded, the decoder then waits for a phase shift in the tone to occur. When the phase shift occurs, the STE delay circuit in the decoder pulls the REC MUTE lead to a low voltage state. This squelches the receiver for 200 milliseconds and keeps the receiver squelched until the RF carrier applied to the receiver is removed.

The decode circuit can be disabled by grounding J908-3.

## MAINTENANCE

Troubleshooting the Channel Guard assembly is facilitated when using the Channel Guard extender board (19C320966G1). The extender board contains three slide switches which disable the decode and encode circuitry, and also bridges the PTT input to the delayed PTT output when the CG board is removed. In addition, "test points" are provided for all pins on J908.

PTT Bridge - Allows the transmitter to be keyed when the Channel Guard board is removed. Note: If transmitter is keyed with Channel Guard installed and PTT bridge closed the Channel Guard PTT delay will lock up until PTT bridge is opened.

Encode Disable - Applies A- to pin 2 of J908 and Pin 11 of the Encode IC to prevent transmitting the Channel Guard Tone.

Rx CG Disable - Applies A- to J908-3 and pin 2 of the Decode IC to disable the decoder. Under this condition the receiver is not muted.

A troubleshooting chart provides a method of checking the Channel Guard functions.

## INSTALLATION

### IN MOBILE RADIOS

To install Channel Guard in radios not previously equipped with this feature, proceed as follows:

1. Gain access to System Board and clip out the DA jumper wire between H71 and H72 on the System Board (Refer to the MASTR II Maintenance Manual for the Front Panel and System Board).
2. Plug the Channel Guard unit into J908 and J909 on the System Board.
3. Install the hookswitch to the control unit as directed in the Control Unit Maintenance Manual.
4. Adjust transmitter deviation in accordance with the Alignment Procedures in the Transmitter Maintenance Manual. No other adjustments are required.

### IN STATIONS

Refer to the Station Combination Maintenance Manual for installation instructions.

CHANNEL GUARD STRAPPING

When an "open" channel is required on a multi-frequency radio, the encode/decode function on the Channel Guard board must be disabled for each "open" channel. This modification may be incorporated into any of the Channel Guard boards.

Refer to the Schematic Diagram and Strapping Diagram for strapping instructions.

REPEATER APPLICATION

The following modification must be made on the Programmable Decode only Channel Guard Board 19D432500G3 when used in a repeater application.

Cut the PWB pattern on solder side that connects to U1002-8.

REMOVING INTEGRATED CIRCUITS

Removing IC's (and all other soldered-in components) can be easily accomplished by using a de-soldering tool such as a SOLDA●PULLT® or equivalent. To remove an IC, heat each lead separately on the solder side and remove the old solder with the de-soldering tool.

An alternate method is to use a special soldering tip that heats all of the pins simultaneously.

## TROUBLESHOOTING PROCEDURE

Before starting the TROUBLESHOOTING PROCEDURE, check to see that +10 volts and ground are connected to the Channel Guard board.

| SYMPTOM | PROCEDURE |
|---|---|
| No Encode Tone | Check the PTT lead for a "low" (0.7 volt or less). Next, check the TX CG DSBL lead for 1.5 to 5 volts. If a "low" is not present on the PTT lead check the microphone and hookswitch circuits. If a "high" is present on the TX CG DISABLE lvead, check the DELAY CLOCK output at U1001-9 for 64 Hz and the TONE CLOCK output at U1001-8 for 256 times the Channel Guard (CG) frequency. EXAMPLE: If the CG frequency is 100 Hz, the TONE CLOCK output should be 25,600 Hz (see waveforms below). |
| Encode Disable (Tone present when CG disabled) | If either clock output is not present, replace U1001. If both clock outputs are correct, check U1001-5 for a tone output. If no tone is present, replace U1002/U1003.<br>Key the microphone and check for a tone output at J908-7. If no tone output, make the checks listed for "No Encode Tone". If tone is present, ground the TX CG DSBL lead (J908-3). Tone should not be present at CG HI lead. If tone is present, replace U1002/U1003. |
| No Decode (Receiver won't unsquelch) | With the correct CG tone applied and the CG DSBL lead high (or open), the REC MUTE lead should be "high". If not, check the clock outputs at U1003-8 (256 x CG Freq.) and U1003-9 (64 Hz). If clock outputs are incorrect, perform the steps called for in "Wrong Encode or Decode Tone". |
| Decode Disable (Receiver won't unsquelch with disabled) | With the correct CG tone applied to VOL/SQ HI, the REC MUTE lead should go "high". Next, ground the CG DSBL input J908-3 and check to see that the RX MUTE lead goes "high" (approx. CG 10 volts). If the REC MUTE lead does not go "high", replace U1001. |
| Wrong Encode or Decode Tone | Check to determine that S1001 is programmed for the correct CG frequency (refer to the FREQUENCY PROGRAMMING INSTRUCTIONS listed in the Table of Contents). If S1001 is set correctly, check the tone programming pins at U1001-2 thru -7 and -10 thru -13. NOTE: Logic "1" is approx. supply voltage and logic "0" is approx. A-. If logic readings correspond to S1001 settings, replace U1002/U1003. If readings do not correspond to S1001 settings, replace S1001. |
| Squelch Tail Present (no STE) | When the PTT lead is "low", P1005-8 should be "low". When the PTT lead goes "high" (PTT released), the PTT DELAYED lead should remain "low" for an additional 160 milliseconds. If not, replace U1002/U1003. |
| <br>64 Hz Clock | <br>256 X CG Tone (Tone - 100 Hz) |

▲

THESE COMPONENTS A ARE USED TO ADAPT A STANDARD MASTR II RECEIVER TO OPERATION AS AND WITH A DUALAL 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 (MIIXER IF NOISE BLANKER BD) | ON PL19D416562 (MIXER IF NOISE BLANKER BD) |
| 1. R2302 USED INSISTEAD OF R525<br>2. CR2301 USED ININSTEAD OF C529<br>3. R2301 ADDED BEETWEEN H3 & H4 | NO MODIFICATION REQUIRED |
|  | SEE OSC MULT BD FOR OTHER DFE CHANGES |
| THESE ITEMS ARE SUUPPLIED IN MOD. KIT PL19A129775G1 | 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 |

## VOLTAGE READINGS

VOLTAGE READINGS ARE TYYPICAL READINGS MEASURED TO SYSTEM NEGATIVE (P903-10) WITH TEST SET MODEL 4EX3A11 OR A 20,000 OHM PER-VOLT METER

⏚ INDICATES A-

⏚ INDICATES 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 | LL | L | M | H |
| RF FREQ | 25-30MHZ | 30-36MHZ | 36-42 MHZ | 42-50 MHZ |
| 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 |

1R622195, Rev. 3)

## SCHEMATIC DIAGRAM

25—50 MHz MIXER/IF/NOISE BLANKER

Issue 4

## PARTS LIST

CHANNEL GUARD ENCODER/DECODER
19D432500G1 ENCODE/DECODE - REV D
19D432500G2 ENCODE ONLY - REV C
19D432500G3 DECODE ONLY - REV C
ISSUE 5

| SYMBOL | GE PART NO. | DESCRIPTION |
|---|---|---|
| | | - - - - - - - - - - - CAPACITORS - - - - - - - - - |
| C1001 | 19A701534P8 | Tantalum: 22 uF ±20%, 16 VDCW. |
| C1002 | 19A701534P6 | Tantalum: 4.7 uF ±20%, 35 VDCW. |
| | | - - - - - - - DIODES AND RECTIFIERS - - - - - - - |
| CR1001<br>and<br>CR1002 | 19A700028P1 | Silicon, fast recovery: fwd current 75 mA, 75 PIV; sim to Type 1N4148. |
| | | - - - - - - - JACKS AND RECEPTACLES - - - - - - - |
| J908 | 19A116659P76 | Connector, printed wiring: 9 contacts rated at 5 amps; sim to Molex 09-52-3091. |
| J909 | 19A116659P77 | Connector, printed wiring: 8 contacts rated at 5 amps; sim to Molex 09-52-3081. |
| | | - - - - - - - - - - - RESISTORS - - - - - - - - - - |
| R1001 | H212CRP010C | Deposited carbon: 10 ohms ±5%, 1/4 w. |
| R1002 | H212CRP322C | Deposited carbon: 22K ohms ±5%, 1/4 w. |
| R1003 | H212CRP333C | Deposited carbon: 33K ohms ±5%, 1/4 w. |
| R1004 | H212CRP239C | Deposited carbon: 3.9K ohms ±5%, 1/4 w. |
| R1005 | H212CRP122C | Deposited carbon: 220 ohms +5%, 1/4 w. |
| | | - - - - - - - - - - - SWITCHES - - - - - - - - - - |
| S1001 | 19B800010P1 | Push: 10 station, contacts rated 25 mA at 24 VDC; sim to CTS 206-10. |
| | | - - - - - - - - - INTEGRATED CIRCUITS - - - - - - - |
| U1001 | 19D900260G1 | Frequency Synthesizer. |
| U1002 | 19D900496G1 | Channel Guard, Encode/Decode Hybrid. |
| U1003 | 19D900496G2 | Channel Guard, Encode Hybrid. |
| | | - - - - - - - - - - - - CABLES - - - - - - - - - - |
| W1003 | 19A700184P1 | Jumper. |

*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 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 - Channel Guard Board 19D432500G1-G3

Incorporated in original shipment

REV. B - Channel Guard Board 19D432500G1,G2

To provide similiar tone output levels for single tone and multitone synthesized channel guard units. Changed R1004 to 3.9K ohms. Old part number for R1004 was:
19A700019P45- Deposited carbon 4.7K ohms ±5% 1/4W.

REV. C - Channel Guard Board 19D432500G1
REV. B - Channel Guard Board 19D432500G3

To improve channel guard decode sensitivity. Changed R1002 from 12 K ohms to 22K ohms and R1003 from 47K ohms to 33K ohms. Old part number was:
R1002- 19A700019P50-Deposited carbon; 12K ohms ±5%, 1/4W.
R1003- 19A700019P57-Deposited carbon; 47K ohms ±5% 1/4W.

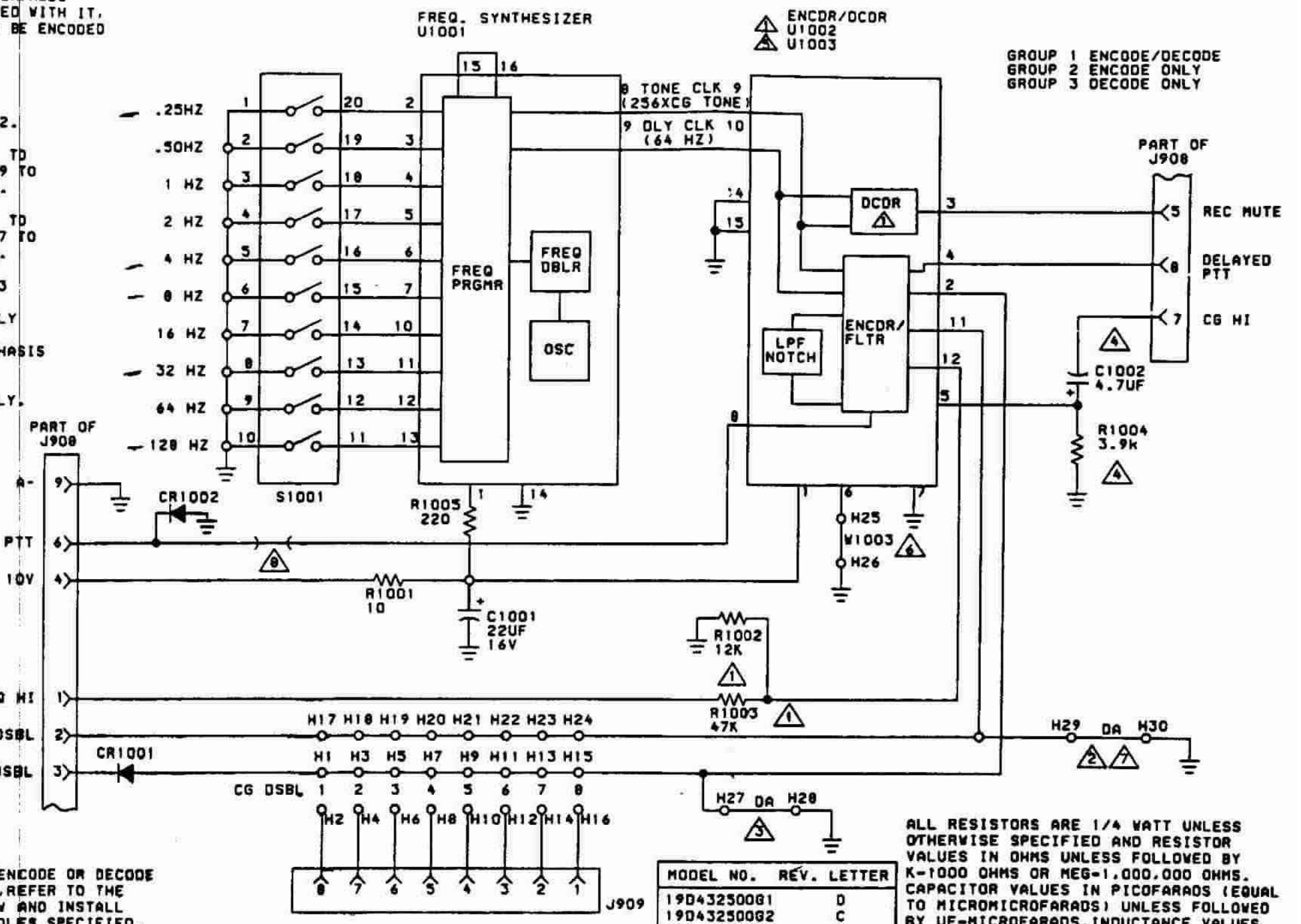
REV. D - Programmable Channel Guard Board 19D432500G1
REV. C - Programmable Channel Gurad Board 19D432500G2,3

To improve performance of synthesizer hybrid at high temperatures. Added R1005.

OPENING A SWITCH STATION ADDS THE FREQUENCY ASSOCIATED WITH IT, TO THE CG FREQUENCY TO BE ENCODED OR DECODED.

NOTES:

1. NOT USED IN GROUP 2.
2. TO CONVERT GROUP 1 TO GROUP 3 CONNECT H29 TO H30, USING DA WIRE.
3. TO CONVERT GROUP 1 TO GROUP 2 CONNECT H27 TO H28, USING DA WIRE.
4. NOT USED IN GROUP 3
5. USED IN GROUP 2 ONLY
6. FOR 6dB/OCT DE-EMPHASIS INSTALL W1003.
7. USED IN GROUP 3 ONLY.
8. THIS PATTERN CUT IN GRP 3 FOR REPEATER OPERATION



TO DISABLE EITHER CG ENCODE OR DECODE ON A SPECIFIC CHANNEL, REFER TO THE APPROPIATE CHART BELOW AND INSTALL A DIODE BETWEEN THE HOLES SPECIFIED.

| | DECODE DISABLE | | ENCODE DISABLE | |
|---|---|---|---|---|
| CHANNEL | CATHODE ⊣◁ | ANODE | CATHODE ⊣◁ | ANODE |
| 1 | H2 | H1 | H2 | H17 |
| 2 | H4 | H3 | H4 | H18 |
| 3 | H6 | H5 | H6 | H19 |
| 4 | H8 | H7 | H8 | H20 |
| 5 | H10 | H9 | H10 | H21 |
| 6 | H12 | H11 | H12 | H22 |
| 7 | H14 | H13 | H14 | H23 |
| 8 | H16 | H15 | H16 | H24 |

EXAMPLE:

TO DISABLE CG DECODE, TO MAKE AN "OPEN" CHANNEL, ON CHANNEL 3, INSTALL THE CATHODE OF A DIODE IN HOLE 6, AND THE ANODE IN HOLE 5.

IT IS POSSIBLE TO DISABLE BOTH ENCODE AND DECODE, BY INSTALLING BOTH DIODES.

| MODEL NO. | REV. LETTER |
|---|---|
| 19D432500G1 | D |
| 19D432500G2 | C |
| 19D432500G3 | C |

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.

(19C330976, Rev. 8)

# SCHEMATIC DIAGRAM

## CHANNEL GUARD

# 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.

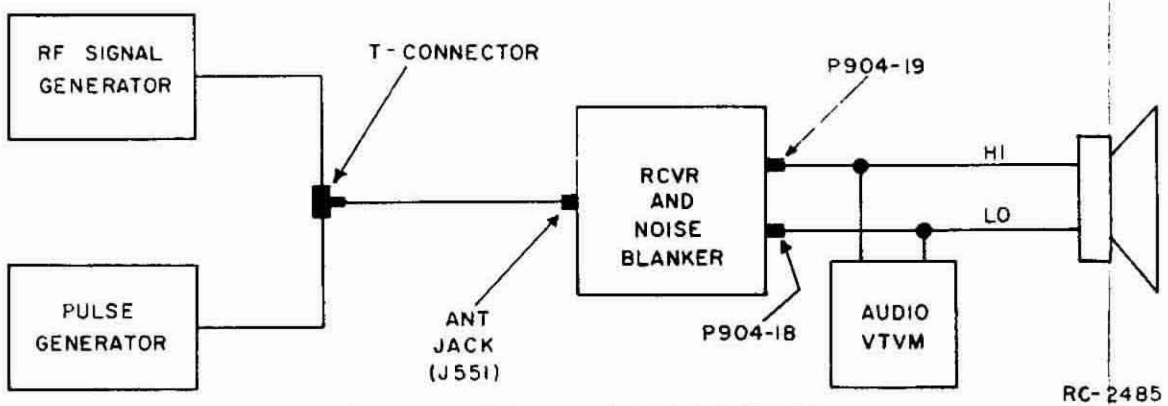


Figure 1 - Equipment Connection Diagram

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:<br>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 ACTION) as follows:<br>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). |

## 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.

FROM RF AMPL

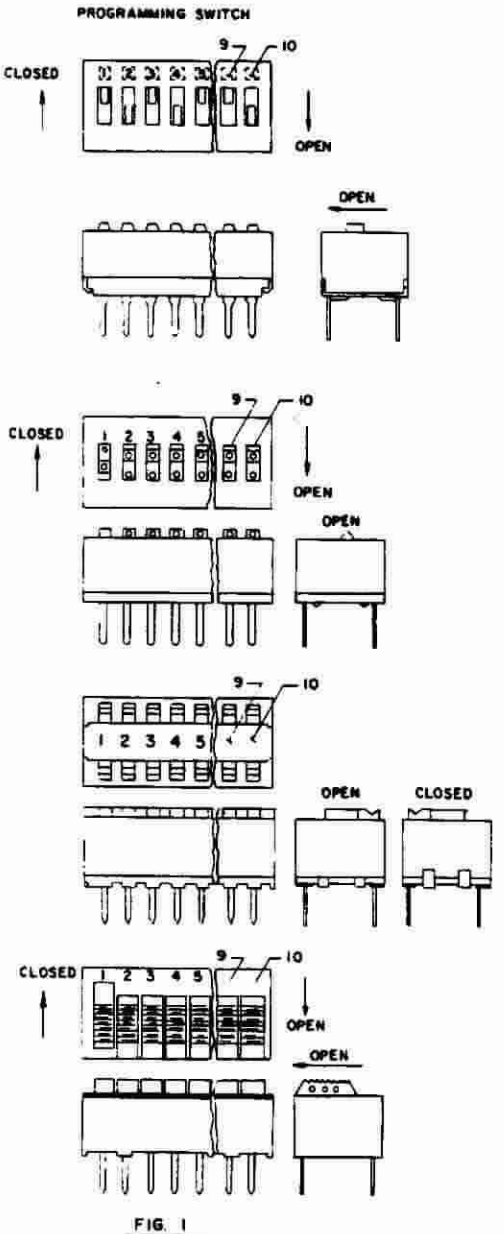


FIG. 1

①

1. TO PROGRAM A STANDARD CHANNEL GUARD FREQUENCY FROM THE CHART. OPEN EACH SWITCH STATION INDICATED BY AN "X". CLOSE EACH SWITCH STATION INDICATED BY A BLANK. SEE FIG 1.
2. TO PROGRAM A NEW STANDARD FREQUENCY. USE THE ÷2 BINARY FORMULA. PLUS THE FRACTIONAL BITS. STATIONS 1-10 REPRESENT BINARY DIGITS FROM 0.25 TO 128. I.E., 0.25, 0.5, 1,2,4,... 128. FOR EACH "ONE" CALCULATED BY THE ÷2 FORMULA. OPEN THE CORRESPONDING SWITCH STATIONS.

FOR EXAMPLE. TO DETERMINE SWITCH SETTING FOR 134.7 Hz.
SET STATIONS 1, 2 FROM THE FRACTIONAL PART
CHART SET STATIONS 3-10 BY THE ÷2 FORMULA

| | REMAINDER | STATION |
|---|---|---|
| 134÷2= 67 | 0 | 3 |
| 67÷2= 33 | 1 | 4 |
| 33÷2= 16 | 1 | 5 |
| 16÷2= 8 | 0 | 6 |
| 8÷2= 4 | 0 | 7 |
| 4÷2= 2 | 0 | 8 |
| 2÷2= 1 | 0 | 9 |
| 1÷2= 0 | 1 | 10 |

FIRST DIVISION ALWAYS CORRESPONDS TO SWITCH STATION 3

THUS THE SWITCH SETTING FOR 134.7 Hz IS

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|
| X | X | | X | X | | | | | X |

WHERE "X" INDICATES AN OPEN STATION.

FRACTIONAL PART CHART

| FROM TO | STA. 1 | 2 |
|---|---|---|
| 0.00-0.12 | | |
| 0.13-0.37 | X | |
| 0.38-0.62 | | X |
| 0.63-0.87 | X | X |
| *0.88-0.99 | | |

BY INSPECTION, 0.7 IS BETWEEN 0.63 AND 0.87, OPEN STATIONS 1, 2.

*IF FRACTIONAL PART IS BETWEEN 0.88 AND 0.99, SET STATIONS 1 AND 2 AS ABOVE AND ROUND FREQUENCY UP TO THE NEXT HIGHER INTEGER. (I.E. FOR 179.9 Hz, PROGRAM AS IF FREQUENCY WAS 180 Hz)

| FREQ. | SWITCH STATIONS 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 67 | | | X | X | | | | | X | |
| 71.9 | | | | | | X | | | X | |
| 74.4 | | X | | X | | X | | | X | |
| 77 | | | X | | X | X | | | X | |
| 79.7 | X | X | X | X | X | X | | | X | |
| 82.5 | | X | | X | | | X | | X | |
| 85.4 | | X | X | | X | | X | | X | |
| 88.5 | | X | | | | X | X | | X | |
| 91.5 | | X | X | X | | X | X | | X | |
| 94.8 | X | X | | X | X | X | X | | X | |
| 100 | | | | | X | | | X | X | |
| 103.5 | | X | X | X | X | | | X | X | |
| 107.2 | X | | X | X | | X | | X | X | |
| 110.9 | | | X | X | X | X | | X | X | |
| 114.8 | X | X | | X | | | X | X | X | |
| 118.8 | X | X | | X | X | | X | X | X | |
| 123.0 | | | X | X | | X | X | X | X | |
| 127.3 | X | | X | X | X | X | X | X | X | |
| 131.8 | X | X | X | X | | | | | | X |
| 136.5 | | X | | | | X | | | | X |
| 141.3 | X | | X | | X | X | | | | X |
| 146.2 | X | | | X | | | X | | | X |
| 151.4 | | X | X | X | X | | X | | | X |
| 156.7 | X | X | | | X | X | X | | | X |
| 162.2 | X | | | X | | | | X | | X |
| 167.9 | | | | | | X | | X | | X |
| 173.8 | X | X | X | | X | X | | X | | X |
| 179.9 | | | | | X | | X | X | | X |
| 186.2 | X | | | X | | X | X | X | | X |
| 192.8 | X | X | | | | | | | X | X |
| 203.5 | | X | X | X | | X | | | X | X |
| 210.7 | X | X | | X | | | X | | X | X |

## PROGRAMMING INSTRUCTIONS

(19C850733, Sh. 1, Rev. 4)