MOBILE RADIO

LBI-31546B

VOICE GUARD™
DIGITAL SPEECH ENCRYPTION

SERVICE SECTION
FOR
MASTR®II VOICE GUARD REPEATER & END-TO-END STATION APPLICATIONS

GENERAL ELECTRIC

TABLE OF CONTENTS

INTRODUCTION

This section contains the information required for testing and servicing the GE Voice Guard station shelf type 19D438054G1 and G2. This includes the station configuration, VG modifications, adjustment procedures and troubleshooting procedures. This section also includes the VG shelf Interconnection Diagram, Outline and Schematic Diagrams and Parts List for the VG logic board and power supply.

STATION CONFIGURATION

The station configuration capability includes: operating mode (i.e., remote, repeater, etc.), data polarity and outside addressing. These are determined by setting three DIP switches located on the VG logic board.

The setting on DIP switch S1 and S3-5 determines the receiver outside address (OA). S2 determines the transmit OA, and the remainder of S3 establishes the operating mode and data polarity.

Switch setting information for the different configurations is contained in the Adjustment section of this manual (see Table of Contents).

OUTSIDE ADDRESSING

To duplicate the function of multiple-tone Channel Guard encode in the station transmitter when in the Guarded mode, a field of 8 unencrypted bits in the VG sync word are used for Guarded mode selective signalling and control. This field of bits is called the outside address or OA. The outside address capability is used only in the Guarded mode.

There are several ways in which the outside addressing (OA) can be configured. As shipped from the factory, the station has default OA programming unless otherwise specified at time of order. Switches S1 and S2 normally will be set for the default value of 55 (hex). Also, S3-5 will be set for disabling the RX All Call OA.

Figure 1 contains the flow diagrams for OA (Outside Address) operation. Switch S1 establishes the required bit pattern which must be matched in the OA field of an incoming VG sync word before the station will respond. This is similar to the clear mode operation with single tone Channel Guard. If switch S1 is set for hex 'AC', all OAs will be received and passed. This is analogous to non-channel guard operation.

If switch S3-5 is enabled, then a received OA of hex 'AC' will serve as a second valid input OA code. The first valid OA code being that value set in S1.

IDLE (STANDBY)

In the idle state, the VG shelf logic will monitor the received serial data streams from both the remote controller and the radio receiver for a proper sync pattern. The shelf logic uses a sync maintenance algorithm similar to that used in the Voice Guard mobile software. Since the VG shelf has no cryptographic capability, it cannot compare initialization vectors to determine when sync is lost. Therefore, reliance is placed on the continued reception of sync and OA fields for sync maintenance.

Reception of the proper data pattern from the remote controller initiates a remote transmit. Transmitter frequency selection information is contained in 5 bits of the 16-bit sync pattern. Only the four least significant bits are defined as F1 thru F4. The fifth bit is presently unassigned.

Reception of the proper data pattern via the radio receiver causes a remote receive and/or a repeat transmit to be initiated.

REMOTE STATION

Hardware

The station will accept clear or Guarded input from a remote controller or Console Interface Unit (CIU) via half of a 4-wire data grade telephone line and transmit it over the RF channel (transmitter). The station will also receive clear or Guarded signals from the RF channel (receiver) and send it to the remote controller or CIU via the other half of the 4-wire telephone line.

When keying in the clear mode station control is performed by standard AC tone control sequences independent of the VG shelf. In the Guarded mode, the remote controller or CIU will apply 9600 baud VG data to the same transmit (up-link) telephone line pair. The VG shelf telephone line modem, which is bridging the telephone line, will demodulate the signal and deliver it to the VG shelf logic. This logic recognizes the VG data preamble and proceeds to extract the transmitter frequency select information from the VG sync word. During this time the VG shelf logic is also storing the data being received. The VG shelf logic reconstructs the preamble, inserting the proper OA, and

then proceeds to select transmit frequency, key the transmitter and then send the entire data stream delayed by approximately 60 msec.

The station will apply a 1950 Hz tone to the receive (down-link) line pair when no radio signal is being received. The tone is removed and clear audio is applied to the line when a clear signal is being received, or VG modem data is applied to the line when a VG signal with a correct OA is being received.

Transmit Software

The VG shelf will perform the Remote Transmit function when a valid VG data signal is received via the remote control line. The software immediately activates "DET DISABLE" to inhibit clear mode remote keying and maintains it until the end of the remote transmit sequence. The VG logic also monitors "LOCAL PTT" before initiating the transmit sequence. If "LOCAL PTT" is active, the remote initiated transmit will be pre-empted. Once the remote initiated transmission has started, the LOCAL PTT line is no longer examined and a local (clear mode) transmission cannot be started until the remote initiated transmission is completed.

The preamble consists of two parts; the Outside Address (OA) part, and the initialization vector (IV) part. The software buffers the received VG preamble and data for delayed transmission. All bits of the OA part of the preamble are restored before retransmission. The OA that is transmitted by a station is established by one of three criteria (see Figure 1). If the VG signal being transmitted entered the VG station shelf via the RF receiver path and switch S1 is not set to hex 'AC', the transmitted OA will be the value set in switch S2. If S1 is set to hex 'AC', the transmitted OA will equal the received OA and S2 will be ignored. If the VG signal being transmitted entered the VG station shelf via the telephone line path, the transmitted OA will equal the received OA and switches S1, S2 and S3-5 will be ignored.

To begin a remote transmit sequence, the software will set output TX F1 thru TX F4 corresponding to the least significant 4 bits of the 16-bit sync word. TX F1 corresponds to the LSB. In addition, the software will set the TX CG Disable bit, and set the TX Audio Switch bit. It then sets the REMOTE PTT bit which keys the station. After about 60 msec of delay, data transmission commences. At the end of the Guarded transmission, the software resets REMOTE PTT, TX Freq., TX CG DISABLE, TX Audio Switch and DET Disable.

Receive Software

The logic board begins a Remote Receive sequence by detecting VG data on the radio channel. The OA is then validated by meeting one of the following criteria:

- The OA matches the setting of switch S1 on the VG shelf.
- An OA of hex 'AC' is present with switch S3-5 on the VG shelf enabled.
- Pass any OA if switch S1 is set for hex 'AC'.
- Pass any OA if CG MON input is active.

The software will begin buffering the received VG data while reconstructing the VG data preamble. It also immediately activates RUS and modem RTS (request-to-send). When modem CTS (clear-to-send) becomes active, VG data transmission over the telephone line begins. This continues until an EOM (end-of-message) signal is received, or the sync maintenance algorithm indicates loss of sync. At this time, the logic board will deactivate RUS, and RTS, and return to idle condition.

REPEATER & REMOTE/REPEATER

Repeater

The repeater configuration does not interface to a remote controller. It will accept either clear or Guarded signals from the RF receiver and retransmit them over the RF transmitter. VG signals will be delayed by about 60 milliseconds and the OA portion of the preamble will be reconstructed. No telephone line modem is required.

Remote/Repeater

The remote/repeater functions both as a repeater and as a remote controlled base station sharing the same RF transmitter. It will repeat clear or Guarded signals and also send them down to a remote controller via the down-link pair of a 4-wire, data-grade telephone line. The repeated path VG data will be delayed approximately 60 milliseconds in order to permit the VG shelf logic time to process and validate the signal before repeating the entire data signal. The VG signal thruput delay for the remote controller path will be somewhat longer due to the additional training time for the telephone line modems.

The station will accept keying tones and clear audio, or VG data from the remote controller or CIU and transmit them over the RF transmitter. When in the VG mode, the remote control link will pre-empt the repeater.

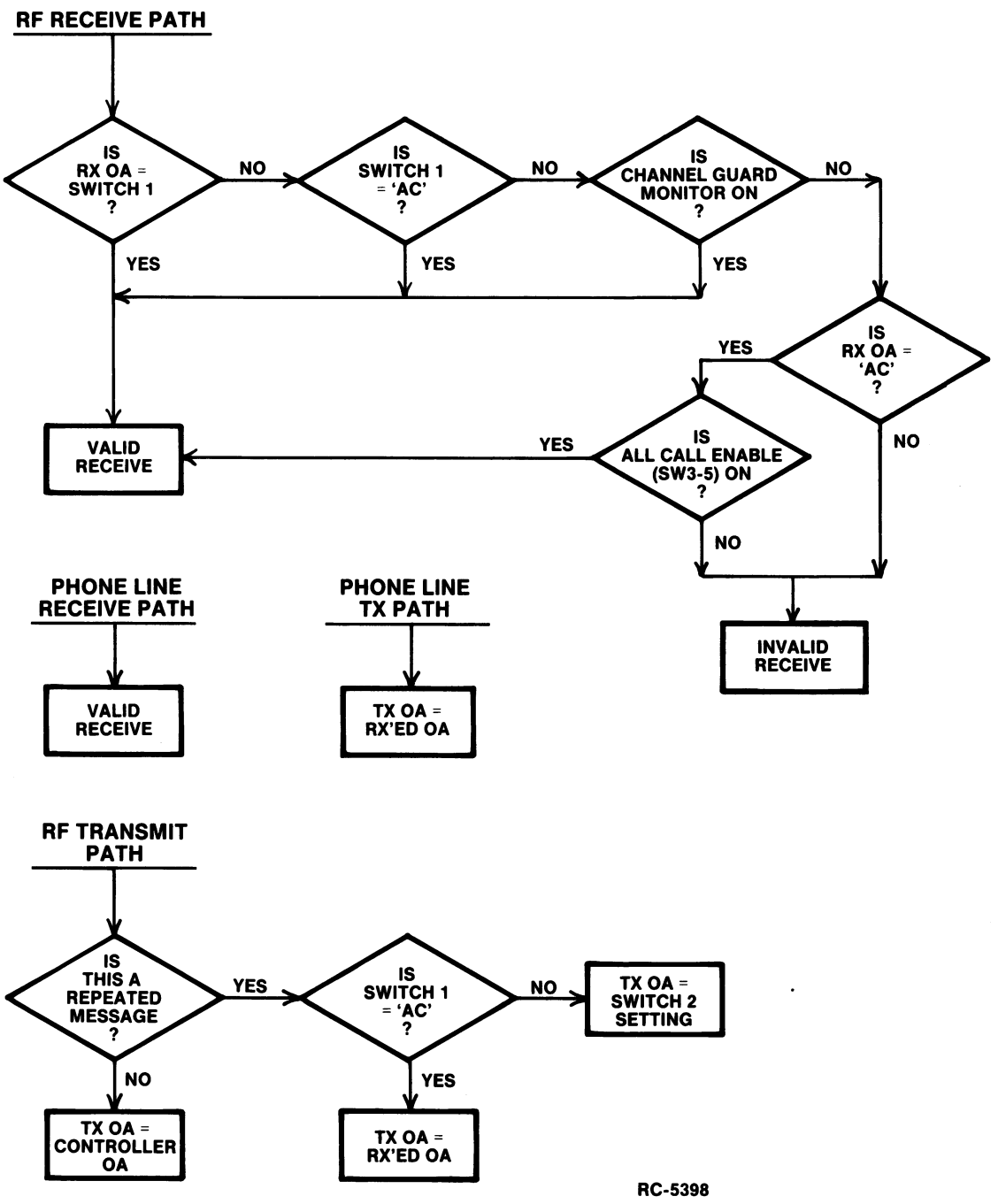


Figure 1 - OA Flow Diagrams

Repeater stations operate in the same manner as Remote Receive except that if CG DISABLE is active, a non-matching OA will be passed on to the remote station but will not key the repeater transmitter.

Software

To begin a VG repeat transmit sequence, the VG shelf software will activate TX F1, TX CG DISABLE and the TX Audio Switch. Then, RPT KEY will key ON the repeater transmitter. After the 60 msec delay, VG data transmission will commence.

At the end of the VG repeater transmission, the VG shelf software will deactivate RPT KEY and TX F1. TX CG DISABLE and the TX Audio Switch will remain active until COMB PTT IN goes inactive, at which time, TX CG DISABLE and TX Audio Switch will be deactivated.

OPERATING MODE

The setting of configuration switches S3-6, S3-7 and S3-8 on the VG Logic Board establishes the basic mode of operation in the Guard mode. Refer to the Adjustment section for setting S3.

DATA POLARITY

The data polarity is selected so as to satisfy the criteria that a data '0' is a decreasing (or lower) transmitted RF frequency and a data '1' is an increasing (or higher) transmitted RF frequency. At logic level, a data '0' is a nominal zero volts while a data '1' is a nominal +5 volts. Different transmitters and receivers may or may not invert the data as it passes thru. Since VG data is NRZ (non-return to zero), it cannot be inverted and retain it's original information content. The data inversion characteristics of the 138-174 MHz and 406-512 MHz MASTR II VG stations are shown in Figure 2.

138-174 MHz:

Transmitter = no inversion
Receiver = inverted

406-512 MHz:

Transmitter = no inversion
Receiver = inverted

Figure 2 - Transmit and Receive Data Polarity

MODIFICATIONS

In Voice Guard applications, MASTR II stations are shipped from the factory equipped with direct FM exciters, VC option 9780 and 9781, and minor modifications to the station. This section contains the equipment and other modifications required for a field modification.

EXCITER

In 138-174 MHz VG applications, the MASTR II PLL (phase-lock-loop) exciter is used. In 406-512 MHz applications, the UHF direct FM exciter is used. The part number and frequency range of each exciter is shown in Figure 3.

FREQUENCY RANGE	EQUIPMENT	MODEL NUMBER
138-155 MHz	EXCITER	19D423249G2
	AUDIO PROCESSOR	19C321542G2
	FM ICOM	19A130605G1
	FILTER	19B226748G1
150.8-174 MHz	EXCITER	19D423249G2
	AUDIO PROCESSOR	19C321542G2
	FM ICOM	19A130605G2
	FILTER	19B226748G2
406-450 MHz	EXCITER	19D432679G1
	AUDIO PROCESSOR	19C321542G2
	FM ICOM	19A130605G3
450-512 MHz	EXCITER	19D432679G1
	AUDIO PROCESSOR	19C321542G2
	FM ICOM:	
	450-470 MHz	19A130605G4
	470-494 MHz	19A130605G5
	494-512 MHz	19A130605G6

Figure 3 - Direct FM Exciters

VG STATION OPTIONS

VG Options 9780 and 9781 provide the digital interface and telephone line modems for the different modes of station operation.

The equipment provided with each option is shown in Figure 4.

STATION MODIFICATIONS

In addition to the installation of the FM exciter and VG option panel; modifications are required to the FM exciter and receiver IFAS boards. A list of the modifications is shown in Figure 5. Instructions for the station modifications are listed in the Table of Contents.

The exciter modifications involve breaking the audio path between the clear mode audio processor output and the modulator input. Both of these leads are then delivered to the VG shelf where they are involved in the clear/Guarded mode switching.

Receiver modifications consist of changing a 0.47 uF capacitor to 10 uF in the FM detector output on the IFAS board. This improves the low frequency response required by the VG data signal. The IFAS board must also be type 19D432667.

Modifications to the Mother Board and repeater control board consists of jumper changes and cutting two runs.

FIELD INSTALLATION

If options 9780 or 9781 are to be applied to a MASTR II station in the field, it is necessary to first up-grade the station per the flow diagram in Figure 6.

ADJUSTMENTS

Before making any adjustments to the VG logic board, make sure that the station transmitter, receiver and audio line level adjustments have been completed with the station operating in the clear (not Guarded) mode.

S1, S2 and S3 SETTING

The three 8-position DIP switches (S1, S2 and S3) on the VG logic board must be set properly before any digital Voice Guard operation can take place. Both S1 and S2 are shipped from the factory set for a default value of 55 (HEX) unless otherwise specified. Pressing any of the eight switch positions towards "OPEN" or "OFF" equals a logic 1. Pressing the switches towards "CLOSED" or "ON" equals a logic 0. See Figure 1 for outside address flow diagrams and Figure 7 for a description of switches S1, S2 and S3.

OPTION 9780 FOR Remote and Remote/Repeater	OPTION 9781 FOR Repeater Only
VG Panel 19D438054G1 Panel includes: VG Logic Board 19D901685G1 Power Supply 19C851477G1 Telephone Line Modem R96FT	VG Panel 19D438054G2 Panel includes: VG Logic Board 19D901685G1 Power Supply 19C851477G1
Harness 19C851484G4	Harness 19C851484G4
Tone Voting Board 19C320880G1	
Capacitor 315A6047P106N (10uF, 16V)	Capacitor 315A6047P106N (10uF, 16V)

Figure 4 - VG Station Options 9780 and 9781

Equipment	Option 9780 Modifications	Option 9781 Modifications
Exciter Harness Receiver Tone Voting Board	19C336664P1 19C336664P2 19C336664P3 19D417633P1	19C336664P1 19C336664P2 19C336664P3

Figure 5 - Option Modifications

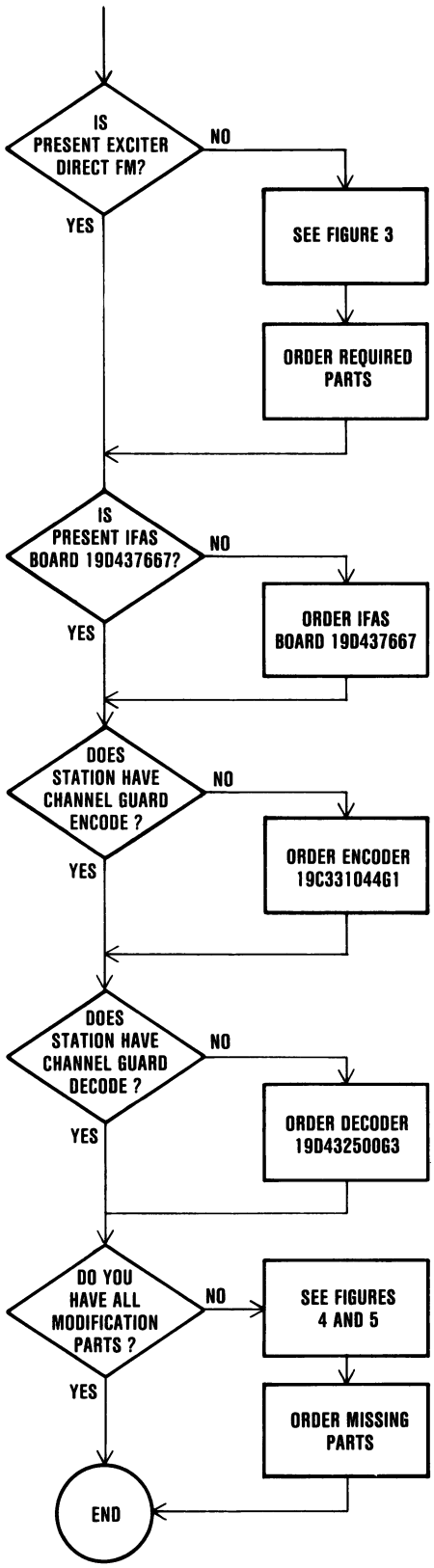


Figure 6 - Station VG Upgrade Flow Diagram

NOTE

If any switch position is changed, always press in and release reset button S4 on the VG logic board to get any changes read into the system. This is required for each change as the DIP switch positions are only read during processor initialization (reset).

LINE LEVEL ADJUSTMENTS

Receiver Tone Board

With no signal being received, and with the receiver squelched, adjust R9 on the Receiver Tone Voting Board for 0.77 volts RMS (0 dBm) across the down-link telephone line pair.

VG Logic Board

1. Remote only: While receiving a Guarded mode RF signal, adjust R2 (Tx Modem Level) for 0.77 volts RMS (0 dBm) measured across the down- link telephone line pair (see Figure 8).

2. Remote only: With the remote controller feeding the up-link phone line pair with 0 dBm of Guarded mode signal, set R1 (Rx Modem Level) for 0.16 volts RMS between U18- pin 1 and ground.

3. Remote/Repeater and Repeater: With the remote controller, mobile, or portable keying up the station transmitter in the Guarded mode, set R31 (Digital Deviation) for ±3.0 kHz deviation on the station transmitter.

IF ALIGNMENT

This procedure involves repeaking the IF adjustments with an RF signal source being modulated with a 9600 baud pseudorandom data signal, and using MASTR II test set 4EX3A12 for DC meter readings. An oscilloscope is also used to observe the data signal (eye pattern) while making adjustments.

PROCEDURE:

1. If IFAS Board 19D432667G1 is being replaced, make sure that C622 has been changed from a 0.47 uF to a 10 uF capacitor. This is to improve the low frequency response required for VG data.

Switch S1 and S2

- Switch S1

  Receive Outside Address
  8-section DIP switch S-1
  Switch S-1 is the least significant bit

  Switch Positions: 1 2 3 4 5 6 7 8

  Logic State: (LSB) 1 0 1 0 1 0 1 0 (MSB) (Hex 55 is default)

- Switch S2

  Transmit Outside Address
  8-section DIP switch S-2
  Switch S2-1 is the least significant bit

  Switch Positions: 1 2 3 4 5 6 7 8

  Logic State: (LSB) 1 0 1 0 1 0 1 0 (MSB) (Hex 55 is default)

- Switch S3

  Station Configuration Selection

  8-section DIP switch S-3

  S3-8 - Station configuration
  S3-7 - Station configuration
  S3-6 - Station configuration
  Switch: 8 7 6
  0 0 0 = Reserved
  0 0 1 = Remote Station
  0 1 0 = Repeater Station
  0 1 1 = Remote/Repeat Station
  1 0 0 = Voted Remote Repeat
  1 0 1 = Satellite Receiver
  1 1 0 = Reserved
  1 1 1 = Reserved

  S3-5 - Radio Path All-Call Function Enable
  0 = Disable, 1 = Enable
  S3-4 - Tx Data Polarity - from controller (Phone Line)
  0 = Normal, 1 = Inverted
  S3-3 - Rx Data Polarity - to controller (Phone Line)
  0 = Normal, 1 =Inverted
  S3-2 - Tx Data Polarity - to radio exciter
  0 = Normal, 1 = Inverted
  S3-1 - Rx Data Polarity - from radio receiver
  0 = Normal, 1 = Inverted

Figure 7 - Dip Switch S1, S2, S3 Settings

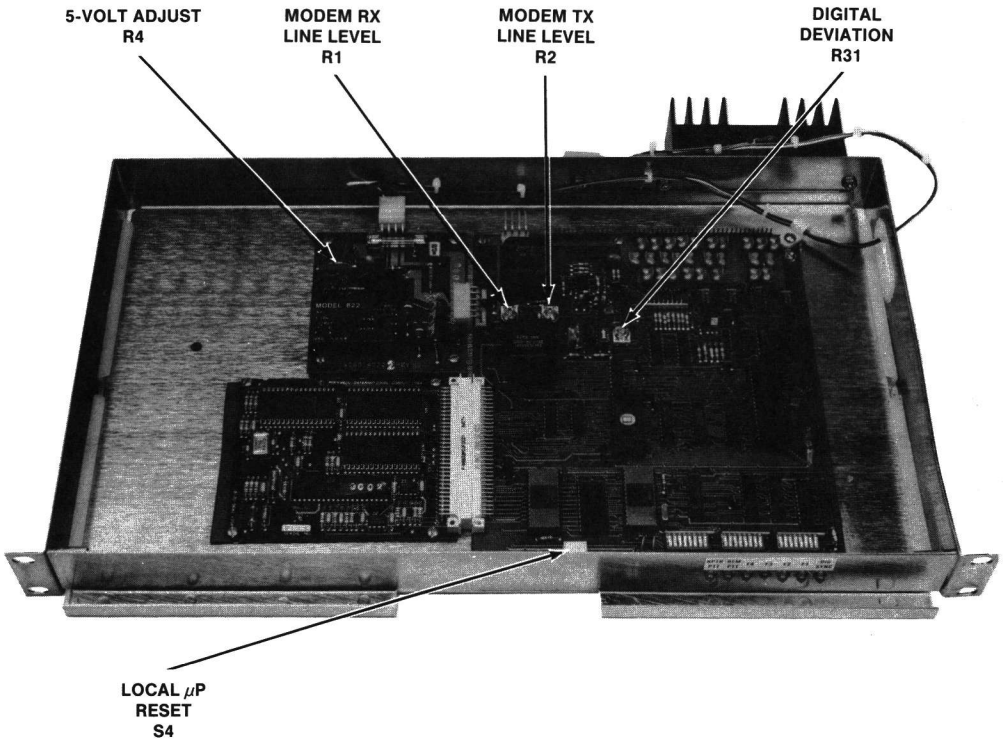


Figure 8 - Logic Board Adjustment

NOTE

After C622 is changed, any adjustments to detector coil L6 will have to be made very slowly to avoid measurement problems due to low frequency transients.

2. Use a signal generator that will produce RF in the desired frequency operating range of the receiver. Also, determine that the signal generator can be FM modulated so as to produce constant deviation with constant input over the frequency range of 10 Hz to 4.8 kHz.

3. Connect a 9600 baud pseudorandom modulating signal either from a VG9600 module or from a Voice Guard Digital Test Generator to the modulation input of the signal generator and set for ±3.0 kHz deviation.

4. Set the signal generator to the operating frequency of the receiver and connect the generator RF output to the receiver input.

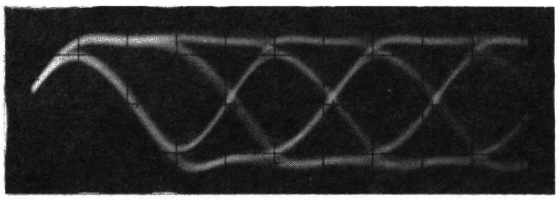
5. Adjust the RF level out of the signal generator to produce a below-limiting reading on the "B" position of the MASTR II test set.

6. Connect an oscilloscope to VOLUME/SQUELCH HIGH (IFAS board terminal 11), and adjust the scope display to show an eye pattern as shown in Figure 9.

7. Make sure that the receiver front end and local oscillator chain are properly aligned first. Then, peak IFAS adjustments T4, T3 and T2 being careful to stay out of limiting.

8. Adjust the MIF coils and crystal filter trimmer capacitor for a maximum reading on the "B" position of the test set while, again, staying out of limiting. Some of the peaks may be rather broad.

9. Now, starting with the MIF crystal filter trimmer capacitor, slightly detune the MIF adjustments each side of the peak to find the best eye pattern display on the scope. Care should be taken to stay near the peak of the "B" reading.



RC-5207

Figure 9 - "Eye" Pattern at VOL/SQ HIGH

MAINTENANCE

Two levels of maintenance and troubleshooting are provided for servicing the VG station. The first level consists of a functional checklist to be used with the VG shelf installed in a station.

The second level of maintenance employs a service kit containing PROM (19A149172G1) that has a test program called SIMON (for SImple MONitor), customized for VG station shelf testing.

After replacing the PROM in the shelf with the SIMON PROM and making a few simple checks on the logic board, a 2400 baud ASCII terminal connected to J8 can now communicate with the logic board. Specific tests can be run in order to isolate a problem to a specific circuitry, or to a specific component.

MAINTENANCE LEVEL ONE

When a Voice Guard station is suspected of malfunction, the following functional checklist should be employed with the VG station shelf installed in the station.

1. Confirm that the station RF components function in the clear mode under local control (i.e., use the local microphone and the service speaker to communicate with a mobile or portable.)
2. If a repeater, confirm proper clear mode repeater functioning.
3. If a remote base, confirm that the remote controller can operate the station. Verify that the transmit telephone line pair has audio and control tones present. Confirm that the clear mode telephone line levels are set up per LBI-30700. Note: a 0 dBm, 1950-Hz tone should be on the down-link (receive) line when the station receiver is squelched.
4. If a repeater, verify that a Guarded mode transmission from a mobile or portable causes LED's H1, H2, and H7 on the front of the VG shelf to illuminate. The transmitter should now be on the air and should have digital modulation. Verify that the transmitter deviation and frequency are proper.
5. If a remote base, verify that a Guarded mode transmission from the remote control point via the telephone line causes LED's H1 and H6 and only one of the frequency indicators (H2 thru H5) on the VG shelf to illuminate. The transmitter should now be on the air with digital modulation. Verify frequency and deviation are proper. Verify presence of modem data on the transmit telephone line pair.
6. Verify that the station receiver sensitivity and frequency in the clear mode are proper. Then observe the received digital data on the VOL/SQ HI (IFAS board pin 11) and verify presence of an eye pattern display.
7. Verify that the three DIP selector switches on the VG station shelf are set correctly.
8. Verify the presence of correct power supply voltages from VG shelf DC-DC converter A1.
9. If an oscilloscope is available, verify the following signals on the VG station shelf logic board.

U1 pin 18: 11,059.2 kHz logic level clock signal.

U1 pin 29 - PSEN: This logic level signal should be changing state rapidly. This is the enable signal for the program PROM and the changing of state indicates that the uP is executing code.

U1 pin 9 - RESET: Should be logic 0. If steady logic 1, the uP is being held permanently reset.

U4 pin 24 - INT: Should be a steady logic 1 if no VG signal is being received. If a valid VG signal is being received on the radio channel, a continuous string of logic level interrupt pulses should be seen. If pulses in bursts during the VG transmission, check that the data polarity is not inverted.

U19 pin 24 - INT: Same as for U4 pin 24 except that the valid received data signal is being received on the remote control telephone line path.

10. At this point, replace the VG station shelf with a spare unit or, remove the shelf and return the station to only clear-mode operation by performing the following procedure. Refer to the Interconnection Diagram listed in the Table of Contents.

    (a) Turn off station power supply.

    (b) Unplug the eight connectors of VG cable 19C851484G1 from the station control shelf backplane and radio housing harness.

    (c) Connect the now freed-up radio housing harness connectors to the mating backplane connectors.

    (d) Remove the orange wire from the exciter connector P901-18 and the G-BK-R wire from P901-2. Then add a jumper between P901-18 and P901-2. Tie back the freed-up wires so as to not short to anything else.

    (e) The station is now operational as a clear-mode-only station, and the shelf can be tested at maintenance level two.

MAINTENANCE LEVEL TWO

To further examine a failed VG station shelf, it is suggested that the VG Station Service Kit be obtained and the examination be continued with the SIMON station test program (contained in LBI-31593). In order to use SIMON (acroynm for SImple MONitor), an additional 2400 baud RS-232 serial ASCII computer terminal and interconnect cable (not supplied in the Service Kit) is required. The interface levels at J8 of the VG station logic board are compatible with RS-232, thus no interface translations are required. The interconnect between J8 on the logic board and the ASCII terminal are as follows:

RS-232-pin 2 to J8-pin 2 = TXD

RS-232-pin 3 to J8-pin 1 = RXD

RS-232-pin 7 to J8-pin 3 = Sig Gnd

The procedure for setting up SIMON operation is as follows:

1. Assure that the supply voltage and signal tests described in the maintenance level one tests are satisfactory.

2. Remove power from the shelf and replace PROM U2 in the logic shelf with the SIMON Station test PROM. Connect the ASCII terminal to logic board J8.

3. Reapply power to the shelf and proceed with the test instructions for SIMON included in the VG Station Service Kit.

4. At the completion of the SIMON testing, be sure to replace the SIMON PROM with the station operating PROM.

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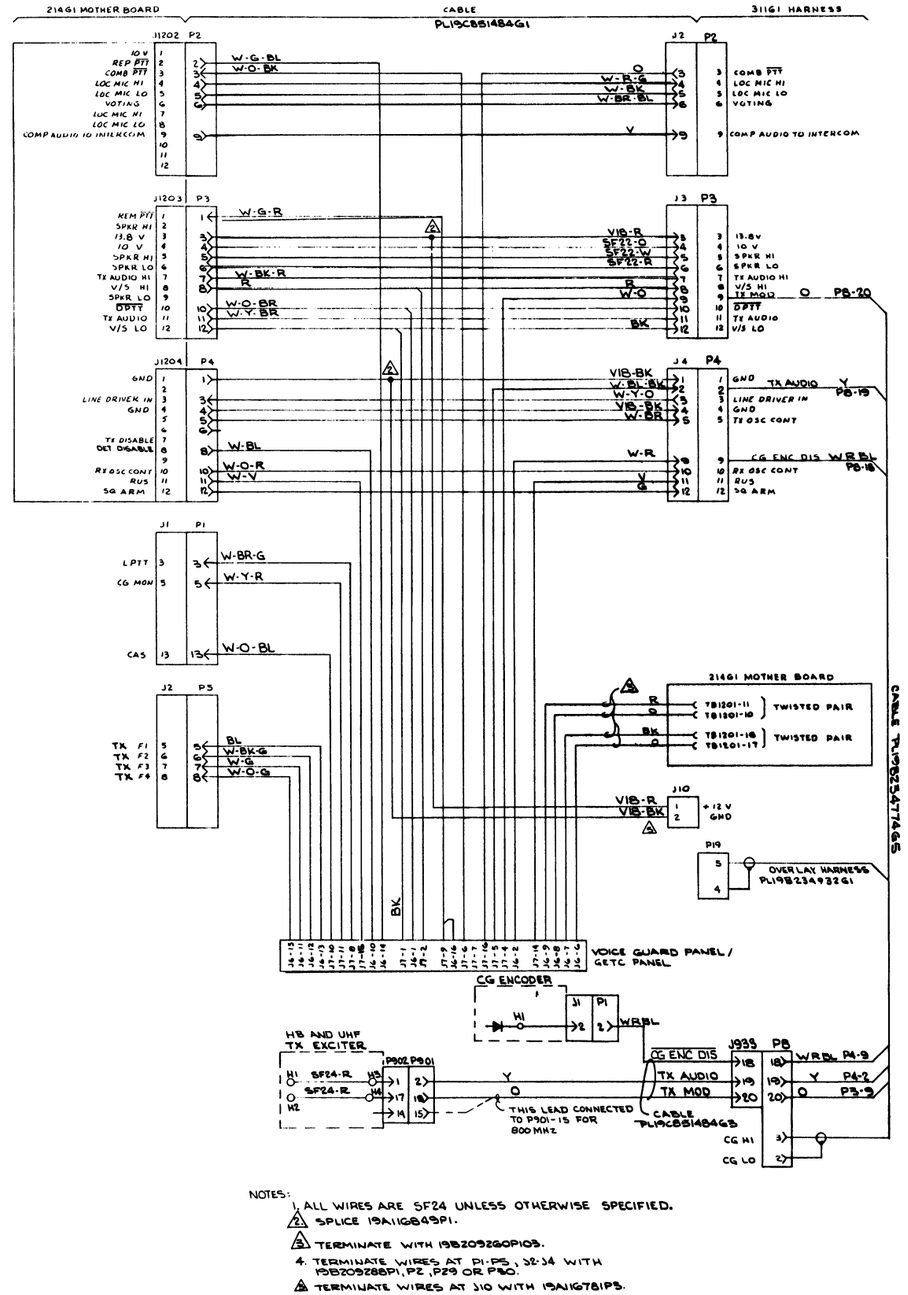
PARTS LIST

VOICE GUARD STATION HARNESS
19C851484G1-4

ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
		MASTER II STATION WITH VOICE GUARD 19C851484G1
		- - - - - - - JACKS AND RECEPTACLES - - - - - - -
J2 thru J4	19B209288P24	Connector Receptacle.
J6 and J7	19A700041P42	Connector Receptacle.
J10	09-50-3021	Connector Receptacle.
		- - - - - - - - - - - PLUGS - - - - - - - - - - -
P1	19B209288P6	Connector Receptable.
P2 thru P4	19B209288P20	Connector, rectangular: 12 contacts; sim to Molex 09-03-1122.
P5	19B209288P4	Connector Receptacle.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	5496809P17	Contact, pin: female, brass; sim to Molex Products 1381-T. (Quantity 9).
	5496809P18	Contact, pin: male, sim to Molex Products 1380-T. (Quantity 6).
	19A116849P1	Insulated splice. (Quantity 2).
	19B209260P103	Solderless terminal; sim to AMP 60495-1. (Quantity 4).
	19B209288P29	Contact, electrical: wire size No. 22-30 AWG; sim to Molex 02-09-1141. (Quantity 15).
	19B209288P30	Contact, electrical: male; sim to Molex 02-09-2141. (Quantity 26).
		MASTER II STATION WITH VOICE GUARD OVERLAY 19C851484G2
		- - - - - - - - - - - CABLES - - - - - - - - - - -
	19B234774G5	Interconnect Cable.
		MASTER II STATION VOICE GUARD MOD KIT 19C851484G3
		- - - - - - - - - - - CABLES - - - - - - - - - - -
	19B234774G1	Interconnect Cable. (Quantity 2).
	19B234774G2	Interconnect Cable. (Quantity 1).
	19B234774G3	Interconnect Cable. (Quantity 1).
	19B234774G4	Interconnect Cable. (Quantity 1).
	19B234774G6	Interconnect Cable. (Quantity 1).
		MASTER II STATION WITH VOICE GUARD (ALL CABLES) 19C851484G4
		- - - - - - - - - - - CABLES - - - - - - - - - - -
	19C851484G1	Cable.
	19C851484G3	Cable.
	19B234774G5	Cable.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

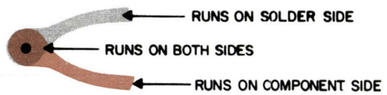


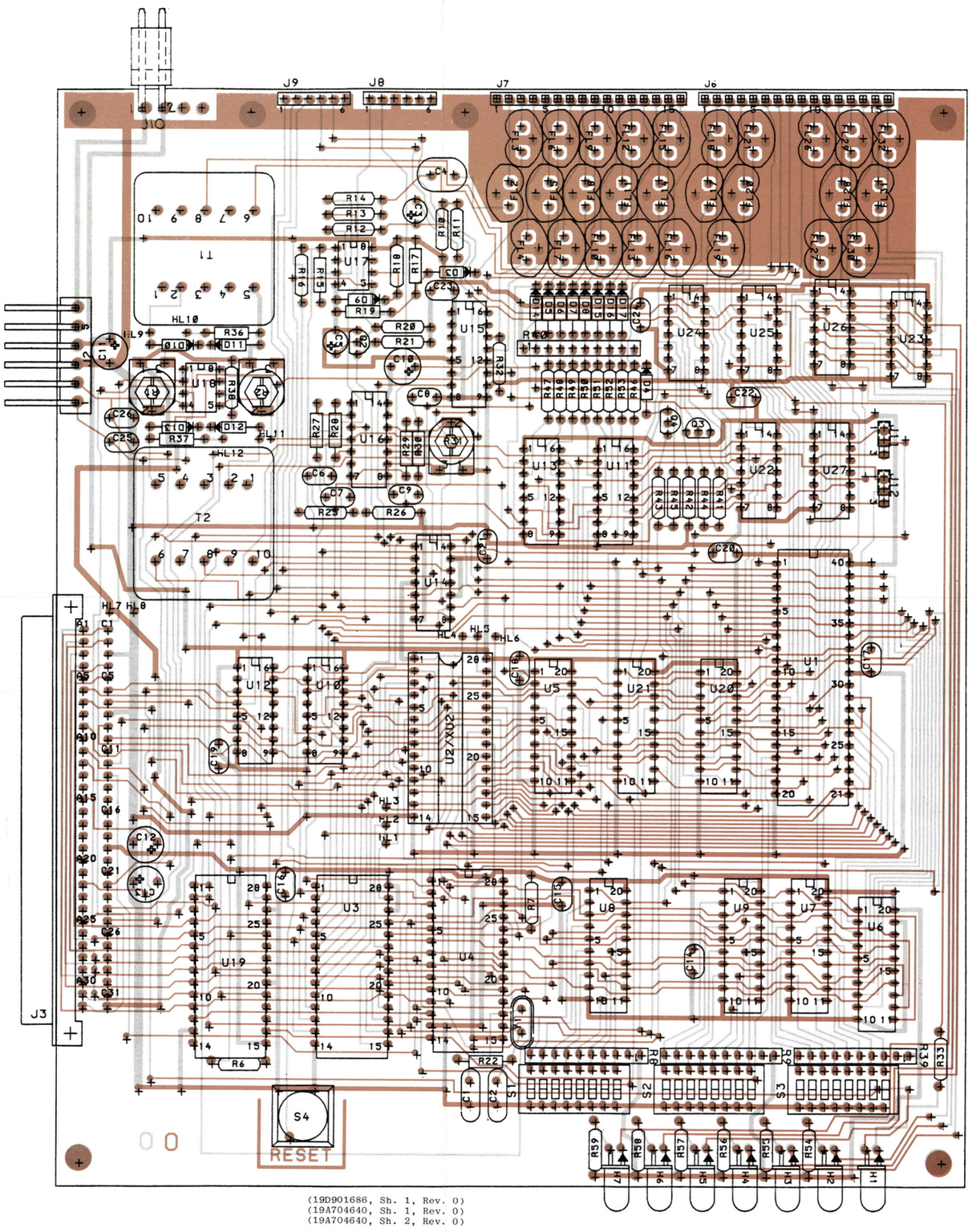
NOTES:
1. ALL WIRES ARE SF24 UNLESS OTHERWISE SPECIFIED.
2. SPLICE 19A116849P1.
3. TERMINATE WITH 19B209260P103.
4. TERMINATE WIRES AT P1-P5, J2-J4 WITH 19B209288P1, P2, P29 OR P30.
5. TERMINATE WIRES AT J10 WITH 19A116781P5.

(19D901678, Sh. 1, Rev. 2)

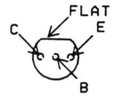
INTERCONNECTION DIAGRAM

VG Station Harness & Parts List





LEAD IDENTIFICATION
FOR Q2, Q3, & Q4.



TOP VIEW

(19D901686, Sh. 1, Rev. 0)
(19A704640, Sh. 1, Rev. 0)
(19A704640, Sh. 2, Rev. 0)

OUTLINE DIAGRAM

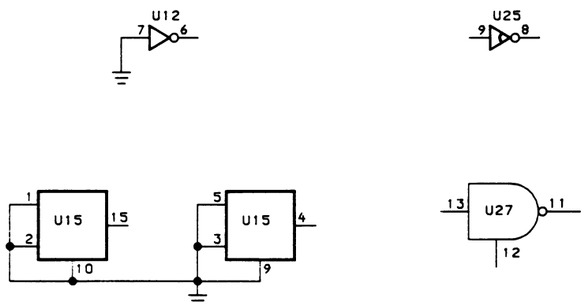
VG Logic Board

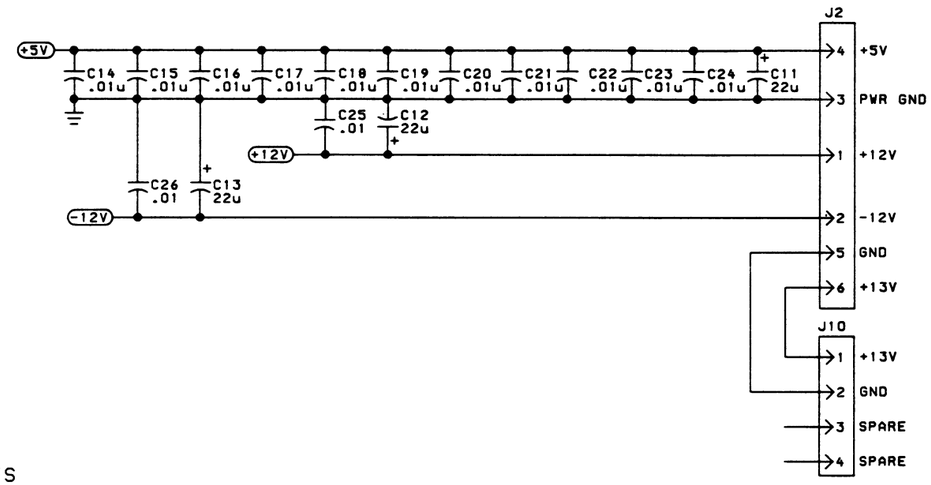
12 Issue 1

POWER & GND CONNECTIOS

DEVICE	GND PIN NO	+5V PIN NO	+12 PIN NO	-12 PIN NO
U1	20	40		
U2	14	28		
U3	14	26,28		
U4	13	15		
U5	10	20		
U6	10	20		
U7	10	20		
U8	10	20		
U9	10	20		
U10	8	16		
U11	8	1		
U12	8	1		
U13	8	1		
U14	7		14	1
U15	6,8		16	7
U16			4	11
U17	4	8		
U18			8	4
U19	13	15		
U20	10	20		
U21	10	20		
U22	7	14		
U23	7	14		
U24	7	14		
U25	7	14		
U26	7	14		
U27	7	14		

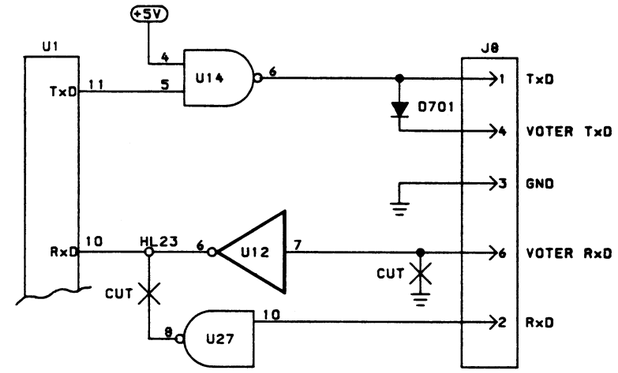
UNUSED GATES



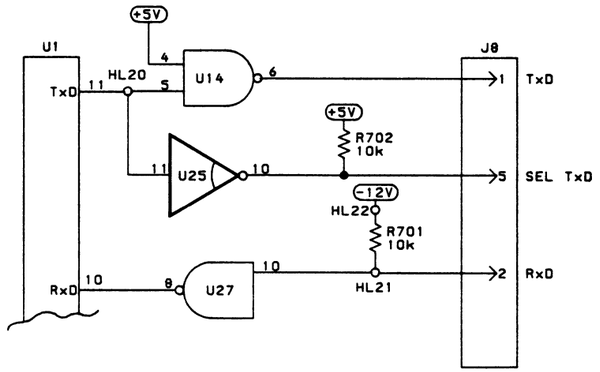


NOTES:

1. FOR PHONE MODEM OPERATION, SHORT J11-1 TO J11-2 AND J12-1 TO J12-2. FOR EXTERNAL MODEM OPERATION VIA J9 AT RS232C LEVELS, SHORT J11-2 TO J11-3 AND J12-2 TO J12-3.
2. FOR 2764 OR 27128 EPROM SHORT HL5 TO HL4. FOR 27256 SHORT HL5 TO HL6.
3. FOR 6116 RAM SHORT HL1 TO HL2 FOR 6164 SHORT HL2 TO HL3.
4. SEE FIGURE 1 FOR BOARD USED AS VOTER RECEIVER.
5. SEE FIGURE 2 FOR BOARD USED AS VOTER SELECTOR.



- FIGURE 1 -
VOTER RECEIVER

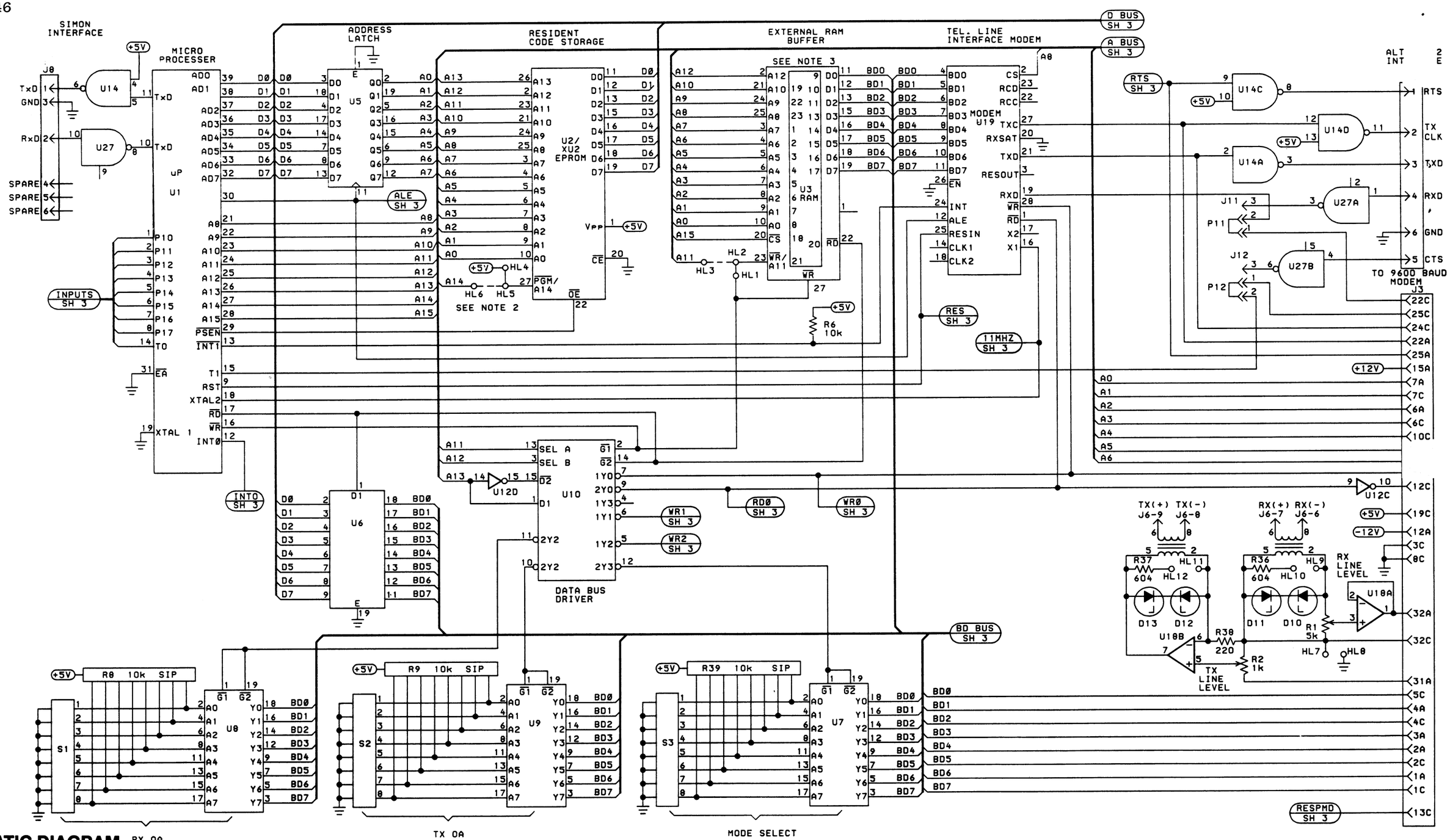


- FIGURE 2 -
VOTER SELECTOR

(19D438051, Sh. 1, Rev. 1)

SCHEMATIC DIAGRAM

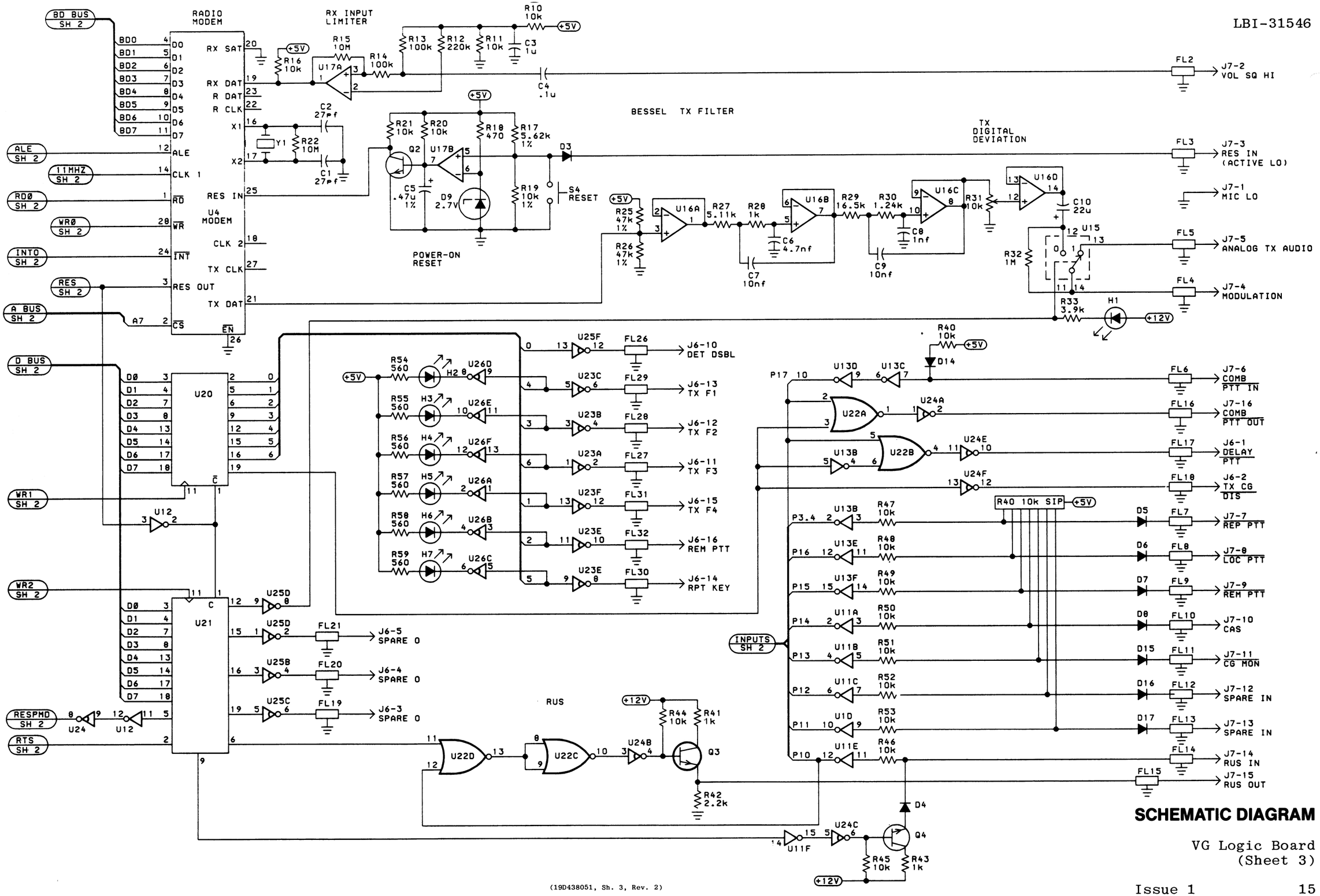
VG Logic Board
(Sheet 1)



SCHEMATIC DIAGRAM

VG Logic Board
(Sheet 2)

(19D438051, Sh. 2, Rev. 3)



(19D438051, Sh. 3, Rev. 2)

SCHEMATIC DIAGRAM

VG Logic Board
(Sheet 3)

PARTS LIST

VG LOGIC BOARD
19D901685G1
(ASY/R300125)

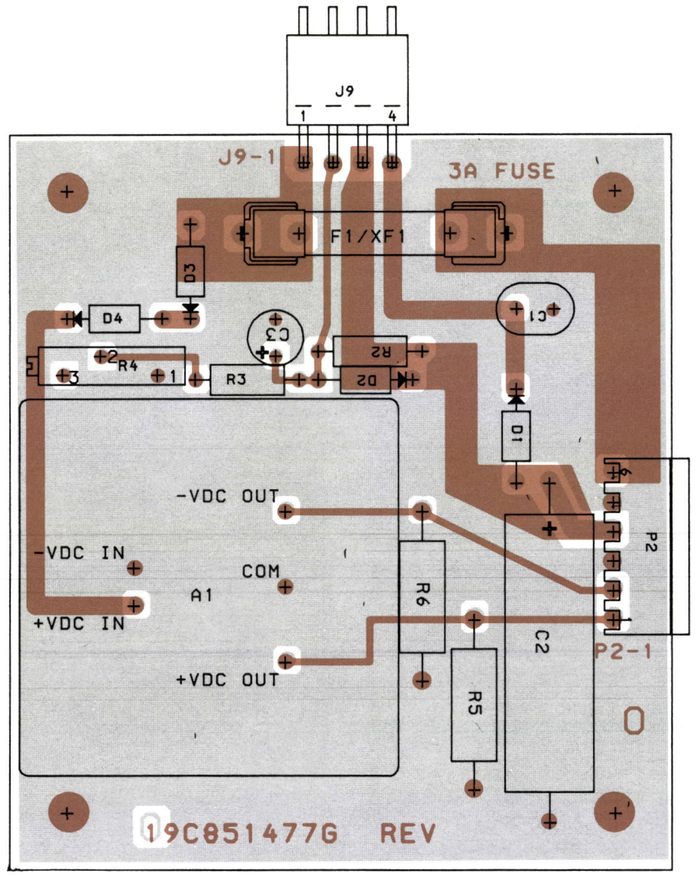
SYMBOL	VENDOR PART NO.	GE PART NO.	DESCRIPTION
			NOTE: When ordering replacement parts, all vendor part numbers should be preceded by: ASY/
			- - - - - - - - - CAPACITORS - - - - - - -
C1,2		19A701624P118	Ceramic, 27 pF, 20%, 50V
C3		19A701534P4	Tantalum, 1.0 uF, 20%, 35V
C4		19A700234P13	Polyester, 0.1 uF, 10%, 50V
C5		19A701534P3	Tantalum, .47 uF, 20%, 35 V
C6		19A702059P5	Polyester, 4.7 nF, 10%, 50V
C7		19A702059P7	Polyester, .01 uF, 10%, 50V
C9		19A702059P7	Polyester, .01 uF, 10%, 50V
C14-26		19A700234P7	Polyester, .01 uF, 10%, 50V
C8		19A702059P1	Polyester, 1 nF, 5%, 50V
C10-13		19A701534P8	Tantalum, 22 uF, 20%, 16V
			- - - - - - - - - DIODES - - - - - - - -
D3-8, 14-17	1N4148	19A700028P1	Diodes, Silicon; MFG: JEDEC
D9	1N5226	19A700025P2	Diode, Zener, 2.7V, 400 MW; MFG: JEDEC
D10-13	1N5235	19J706030P2	Diode, Zener, 6.8V, 400 MW; MFG: JEDEC
H1-7		19A134354P8	Diode, Red Led
			- - - - - - - - - JACKS - - - - - - - -
J6-7	09751164	19A700072P15	Connector, 16 Pin; MFG: MOLEX
J8-9	09751064	19A700072P5	Connector, 6 Pin; MFG: MOLEX
J3			Connector, 64 Pin; SIM TO: BURNDY P196B32P00F00Z0
J11-12	22032031	19A700072P2	Connector, 3 Pin; MFG: MOLEX
J10	09-75-1028		Connector, 4 Pin; MFG: MOLEX
J2	09-66-1064		Connector, 6 Pin; MFG: MOLEX
			- - - - - - - - - PLUGS - - - - - - - -
P11-12		19A702104P1	Plug, 2 Pin
			- - - - - - - - TRANSISTORS - - - - - -
Q2,3,4	2N3904	19A700023P2	Transistor, NPN; MFG: JEDEC

SYMBOL	VENDOR PART NO.	GE PART NO.	DESCRIPTION
			- - - - - - - - RESISTORS - - - - - - -
R1		19B800784P106	Resistor, Pot, 5K
R2		19B800784P105	Resistor, Pot, 1K
R6,7,10, 11,16,20, 21,44-53		19A700019P49	Carbon Film, 10K, 5%, 0.25 w.
R8,9,39 40	4310R101103	19A701630P2	Resistor, Network, Sip, 10K, 2%; MFG: BOURNS
R13,14		19A700019P61	Carbon Film, 100K, 5%, 0.25 w.
R15,22		19A701537P1	Composition, 10M, 1/4 w.
R17		19A701250P273	Metal Film, 5620, 1/4 w.
R18		19A700019P33	Carbon Film, 470, 5%, 0.25 w.
R19		19A701250P301	Metal Film, 10K, 1/4 w.
R25,26		19A700019P57	Carbon Film, 47K, 5%, 0.25 w.
R27		19A701250P269	Metal Film, 5110, 1/4 w.
R28		19A701250P201	Metal Film, 1000, 1/4 w.
R29		19A701250P322	Metal Film, 16.5K, 1/4 w.
R30		19A701250P210	Metal Film, 1240, 1/4 w.
R31		19B800784P108	Resistor, Pot, 10K
R32		19A700019P44	Carbon Film, 1M, 5%, 0.25 w.
R33		19A700019P73	Carbon Film, 3.9K, 5%, 0.25 w.
R36,37		19A701250P176	Metal Film, 604, 1/4 w.
R38		19A700019P29	Carbon Film, 220 ohm, 5%, 0.25 w.
R41,43,12		19A700019P37	Carbon Film, 1K, 5%, 0.25 w.
R42		19A700019P41	Carbon Film, 2.2K, 5%, 0.25 w.
R54-59		19A700019P34	Carbon Film, 560, 5%, 0.25 w.
			- - - - - INTEGRATED CIRCUITS - - - - -
U1	P8031AH	19A703104P2	IC, Microcomputer; MFG: INTEL
	OR		
	P8031AH		IC, Microcomputer; MFG: AMD
U2	D2764	19A703482P1	IC, 8Kx8 PROM; MFG: INTEL
	OR		
	HN482764GI		IC, 8Kx8 PROM; MFG: HITACHI
	OR		
	TMM2764D250		IC, 8Kx8 PROM; MFG: TOSHIBA

SYMBOL	VENDOR PART NO.	GE PART NO.	DESCRIPTION
U3	HM6116LP14	19A702934P1	IC, 2Kx8 RAM; MFG: HITACHI
	OR		
	D446C-1		IC, 2Kx8 RAM; MFG: NEC
	OR		
	CDM6116AE9		IC, 2Kx8 RAM; MFG: RCA
U5	MC74LS373N	19A700037P415	IC, Digital; MFG: MOTO
	OR		
	SN74LS373N		IC, Digital; MFG: TI
U6	MC74LS245N	19A700037P409	IC, Digital; MFG: MOTO
	OR		
	SN74LS245N		IC, Digital; MFG: TI
U7,8,9	MC74LS244N	19A700037P408	IC, Digital; MFG: MOTO
	OR		
	SN74LS244N		IC, Digital; MFG: TI
U10	MC74LS155N	19A700037P363	IC, Digital; MFG: MOTO
	OR		
	SN74LS155N		IC, Digital; MFG: TI
U11-13	MC4049UBC	19A700176P1	IC, Digital Inverter; MFG: MOTO
	OR		
	CD4049UBE		IC, Digital Inverter; MFG: RCA
U14	MC1488L	19A116704P1	IC, Quade Line Driver; MFG: MOTO
U15	MC14053BCP	19A700029P38	IC, Digital Multiplexer; MFG: MOTO
	OR		
	CD4053BE		IC, Digital Multiplexer; MFG: RCA
U4,19		19B801136G2	IC, Modem
U16	MC3303P		IC, QUAD OP AMP; MFG: MOTO
	OR		
	MC3303P		IC, QUAD OP AMP; MFG: NAT
U17	LM393AN	19A134764P2	IC, Comparator; MFG: MOTO
	OR		
	LM393AN		IC, Comparator; MFG: NAT
U18	MC4558CP	19A700086P4	IC, OP AMP; MFG: MOTO
U20,21	MC74LS273N	19A700037P411	IC, Digital; MFG: MOTO
	OR		
	SN74LS273N		IC, Digital; MFG: TI

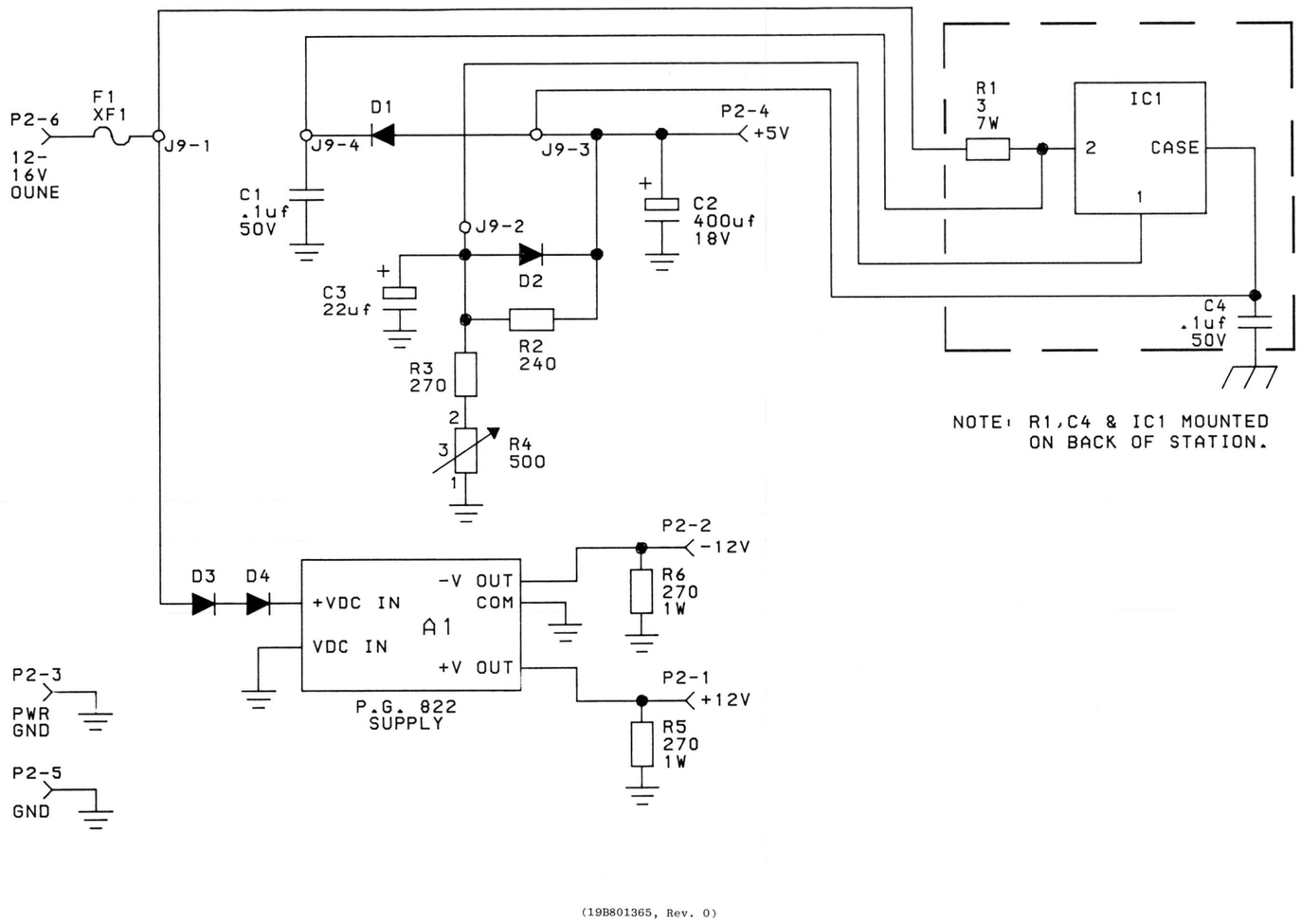
SYMBOL	VENDOR PART NO.	GE PART NO.	DESCRIPTION
U22	MC74LS02N	19A700037P303	IC, Digital; MFG: MOTO
	OR		
	SN74LS02N		IC, Digital; MFG: TI
U23-26	SN7406N	19A116180P75	IC, Digital; MFG: TI
	OR		
	DM7406N		IC, Digital; MFG: NAT
U27	MC1489L	19A116704P2	IC, Quad Line Receiver; MFG: MOTO
			- - - - - - - - - SOCKETS - - - - - - - -
XU2	DILB28P-108	19A700156P3	Dip Socket, 28 Pin; MFG: BURNDY
	OR		
	328-AG39D		Dip Socket, 28 Pin; MFG: AUGAT
	OR		
	640362-3		Dip Socket, 28 Pin; MFG: AMP
			- - - - - - - - TRANSFORMERS - - - - - - -
T1,2	5577060001	19A703656P1	Transformer, 600 ohm; MFG: NOVA MAGNETICS
			- - - - - - - - - SWITCHES - - - - - - - -
S1-3	206-8	19B800010P2	Switch, 8 Pos. Dip; MFG: CTS
S4	210091	19B701324P1	Switch, Push Button; MFG: IEE/SCHADOW
			- - - - - - - - - CRYSTALS - - - - - - -
Y1		19A7025J1G15	Crystal, 11.0592 MHz
			- - - - - - - - - FILTERS - - - - - - - -
FL1-32	DSS310-55Y-SS271M		Line Protector; MFG: MURATA

OUTLINE DIAGRAM



(19B801364, Sh. 1, Rev. 0)
(19A704648, Sh. 1, Rev. 0)
(19A704648, Sh. 2, Rev. 0)

SCHEMATIC DIAGRAM



(19B801365, Rev. 0)

RUNS ON SOLDER SIDE
RUNS ON BOTH SIDES
RUNS ON COMPONENT SIDE

PARTS LIST

POWER SUPPLY
19C851477G1
(ASY/R300108)

SYMBOL	VENDOR PART NO.	GE PART NO.	DESCRIPTION
			NOTE: When ordering replacement parts, all vendor part numbers should be preceded by: ASY/
A1	822		Power Supply Module; MFG: POWER GEN
			- - - - - - - - CAPACITORS - - - - - - -
C1	1FT-P10		Capacitor, 0.1 uF, 50V; MFG: SPRAGUE
C2		19A115680P24	Capacitor, Electrolytic, 400 uF, 18V; MFG: RUBYCON
	OR		
C2	501D687F016PR		Capacitor, Elect., 400-500 uF, 16-25V; MFG: SPRAGUE
C3	226KO15NLF		Capacitor, Tantalum Dip., 22 uF, 15V; MFG: MALLORY
			- - - - - - - - - JACKS - - - - - - - - -
J9	09-75-1048		Connector, 4 Pin, .045 Rt Angle Plug; MFG: MOLEX
			- - - - - - - - - PLUGS - - - - - - - - -
P2	09-52-3061		Connector, 6 Cavity Rt Angle Conn; MFG: MOLEX
			- - - - - - - - DIODES - - - - - - - - -
D1-4	1N4001		Diode; MFG: JEDEC
			- - - - - - - - - FUSES - - - - - - - - -
F1	AGC-3		Fuse; MFG: BUSSMAN
			- - - - - - - - RESISTORS - - - - - - - -
R2		3R77P241K	Resistor, C Comp., 240 ohm, 1/2 w., 5%
R3		3R77P271K	Resistor, C Comp., 270 ohm, 1/2 w., 5%
R4	3009P-1-501		Resistor, Trimpot, 500 ohm; MFG: BOURNS
R5-6		3R78P271K	Resistor, C Comp., 270 ohm, 1 w., 5%
			- - - - - - - FUSE HOLDER - - - - - - -
XF1	3529		Hardware, Fuse Clip; MFG: KEYSTONE

PARTS LIST

VG SHELF ASSEMBLY
19D438054G1 (REM OR REM/REPTR)
19D438054G2 (REPTR)
(ASY/R300127)

SYMBOL	VENDOR PART NO.	GE PART NO.	DESCRIPTION
			NOTE: When ordering replacement parts, all vendor part numbers should be preceded by: ASY/
		19B234776G1	Spt., Assembly
		19C336672G1	Pnl., Assembly
		19C315963P1	Card Guide (Quantity 4)
		N80P13004C6	Scr., Mach (Quantity 3)
		19A701863P20	Cable Clamp
		N80P13003C6	Scr., Mach (Quantity 12 - G1) (Quantity 9 - G2)
		19A703624G1	Heat Sink
		4036835P9	Terminal
	4875		Socket W/Insulator; MFG: THERMALLOY
		N80P9010C6	Screw (Quantity 2)
IC1	LM317K		IC, Linear Regulator; MFG: NAT.
	8903		Insulator Cover; MFG: THERMALLOY
		4034968P1	Washer (Quantity 2)
		N402P5C6	Flat Washer (Quantity 2)
		N404P11C6	Lockwasher (Quantity 2)
	N210P9		Nut (Quantity 2)
		19A702381P506	Screw Thd. Form
		4038930P1	Clamp
R1	HR-10W		Resistor, 3 ohm, 10W; MFG: DALE
		19D901685G1	VG Logic Board; MFG: A-SYSTEMS
	R96FT		Modem, 9600 Baud; MFG: ROCKWELL
		19C851477G1	Power Supply; MFG: A-SYSTEMS
		19A701502P2	Bumper, Plastic
C4	1FT-P10		Capacitor, 0.1 uF, 50 VDCW; MFG: SPRAGUE

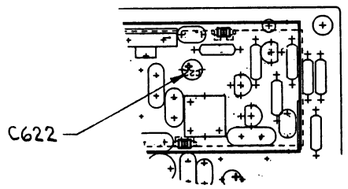
RECEIVER

③

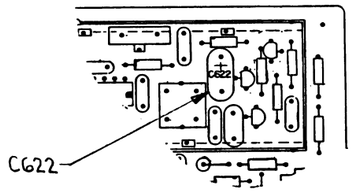
THIS INSTRUCTION MODIFIES A HIGH BAND OR UHF MASTR II RECEIVER IFAS BOARD FOR VOICE GUARD OPERATION.

1. REMOVE COVER FROM FM DETECTOR AREA.
2. REPLACE C622(0.47 UFD) WITH A 10 UFD CAPACITOR PART NUMBER 315A6047P106N (OBSERVE CORRECT POLARITY).
3. REPLACE COVER.

IF /AUDIO/SQUELCH BOARD
19D432667G1



IF/AUDIO/SQUELCH BOARD
19D417707G1

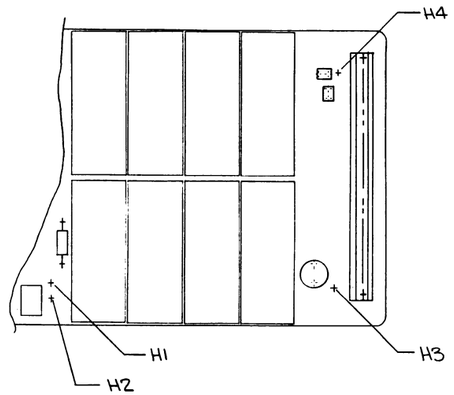


EXCITER

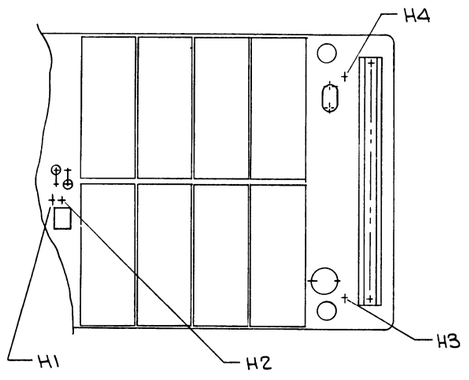
①

THIS INSTRUCTION MODIFIES A HIGH BAND OR UHF MASTR II FM EXCITER FOR VOICE GUARD OPERATION.

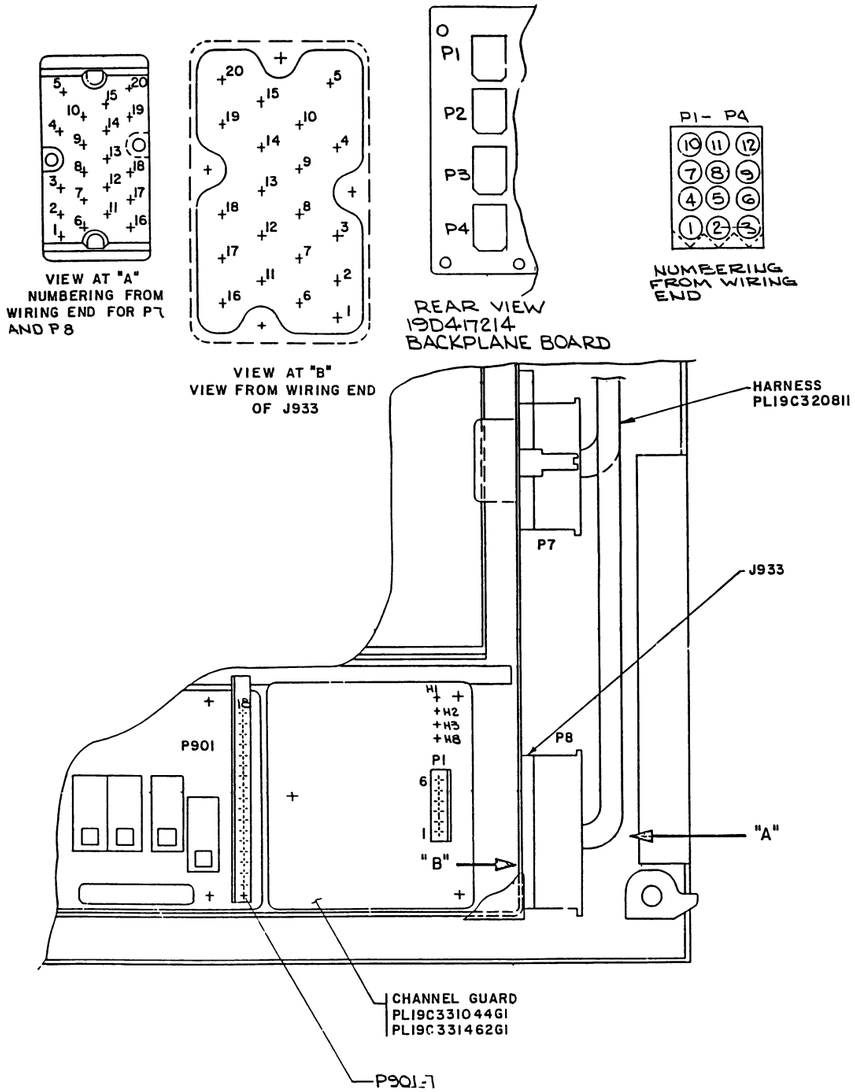
1. REMOVE JUMPER BETWEN H1 & H2.
2. SOLDER SF24-R FROM H1 TO H3. (PL19B234774G1).
3. SOLDER SF24-R FROM H2 TO H4. (PL19B234774G1)



EXCITER BOARD (UHF)
PL19D432G79



EXCITER BOARD HB
PL19D423249



(19C336664, Sh. 2, Rev. 4)

(2) THESE INSTRUCTIONS COVER THE INSTALLATION OF CABLE HARNESS PL19C851484 G2 & G3

1. INSTALL DA JUMPER BETWEEN H3 & H8 ON CG ENCODER. IF H8 NOT PRESENT CUT TERMINAL FROM WRBL WIRE (PL19234774G3) AND SOLDER TO H3. CONNECT OTHER END TO J933-18 AND SPOT TIE TO EXISTING CHANNEL GUARD HARNESS. SKIP TO STEP 3 IF H8 IS NOT PRESENT.
2. IF H8 IS PRESENT, INSTALL WRBL WIRE (PL19B234774G3) IN P1-2 & SOLDER OTHER END TO J933-18 & SPOT TIE TO EXISTING CHANNEL GUARD HARNESS.
3. INSTALL YELLOW WIRE (PL19B234774G4) IN P901-2 & SOLDER OTHER END TO J933-19 & SPOT TIE TO EXISTING EXCITER HARNESS.
4. INSTALL ORANGE WIRE (PL19B234774G2) IN P901-18 & SOLDER OTHER END TO J933-20 & SPOT TIE TO EXISTING EXCITER HARNESS.
5. INSTALL ORANGE WIRE PART OF PL19C851484G2 HARNESS IN P3-9 SOLDER OTHER END TO P8-20. INSTALL YELLOW WIRE PART OF PL19C851484G2 HARNESS IN P4-2 & SOLDER OTHER END TO P8-19. INSTALL WRBL WIRE PART OF PL19C851484G2 HARNESS IN P4-9 & SOLDER THE OTHER END TO P8-18. SPOT TIE THE PL19C851484G2 HARNESS TO EXISTING PL19C320811 HARNESS.

(4) THESE INSTRUCTIONS COVER THE INSTALLATION OF CABLE HARNESS PL19C851484G3 AND PL19B234841G1.

1. DO STEPS 1 THRU 4 OF PART 2 ABOVE.
2. INSTALL YELLOW WIRE PART OF PL19B234841G1 HARNESS IN P1-1 SOLDER OTHER END TO P7-5. INSTALL WHITE-RED WIRE PART OF PL19B234841G1 HARNESS IN P4-9 SOLDER OTHER END TO P8-18. INSTALL WHITE-BLUE-BLACK WIRE PART OF PL19B234841G1 HARNESS IN P4-2 SOLDER OTHER END TO P8-19. INSTALL WHITE-ORANGE WIRE PART OF PL19B234841G1 HARNESS IN P3-9 SOLDER OTHER END TO P8-20.
3. SPOT TIE PL19B234841G1 TO EXISTING PL19C320811 HARNESS WITH CABLE CLAMPS SUPPLIED WITH PL19B234841G1 HARNESS.

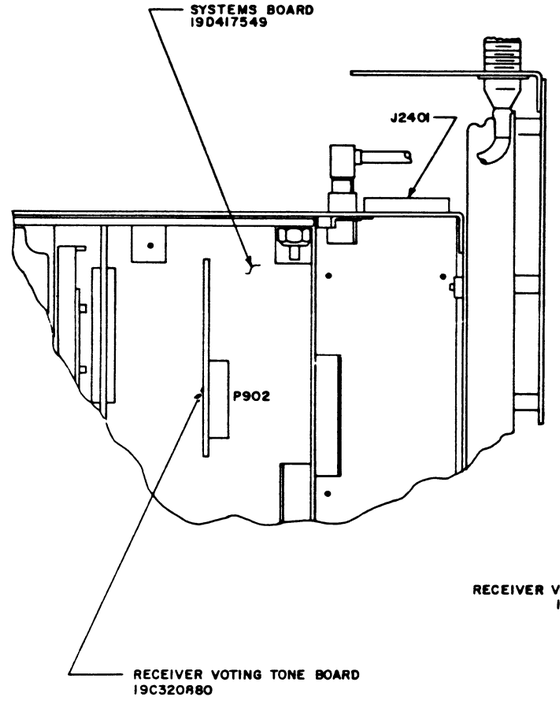
(5) NOTES:

800 MHz PST

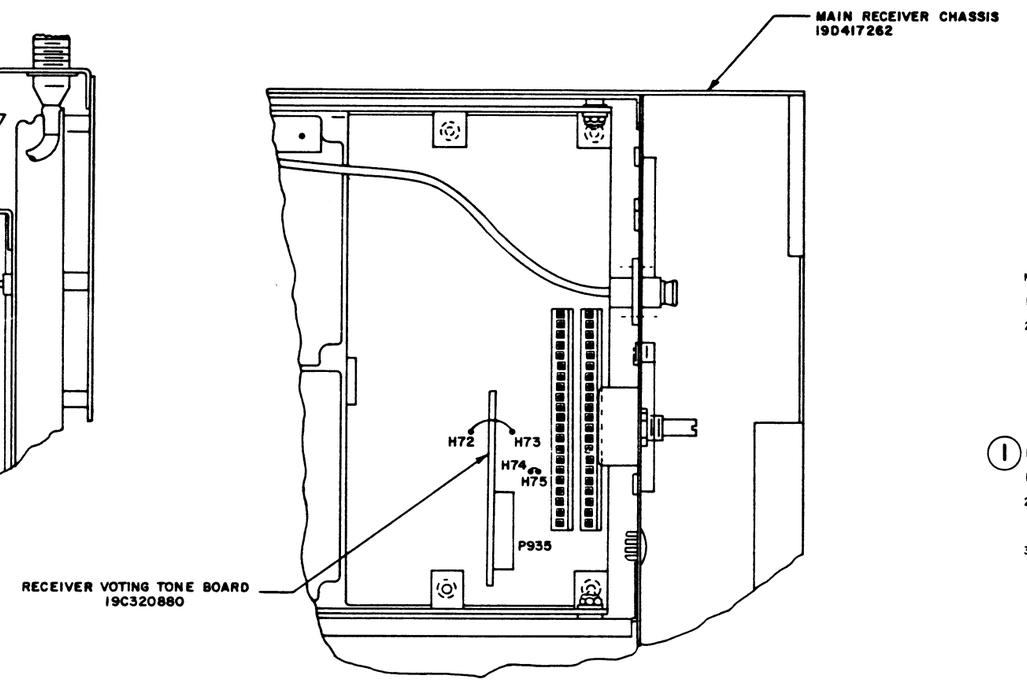
1. INSTALL YELLOW WIRE IN P901-2 & SOLDER OTHER END TO J933-19.
2. INSTALL ORANGE WIRE IN P901-15 AND SOLDER OTHER END TO J933-20. SPOT TIE YELLOW AND ORANGE WIRES TO EXISTING EXCITER HARNESS.
3. INSTALL ORANGE WIRE PART OF PL19C851484G2 HARNESS IN P3-9 SOLDER OTHER END TO P8-20. INSTALL YELLOW WIRE PART OF PL19C851484G2 HARNESS IN P4-2 & SOLDER OTHER END TO P8-19. INSTALL WRBL WIRE PART OF PL19C851484G2 HARNESS IN P4-9 & SOLDER THE OTHER END TO P8-18. SPOT TIE THE PL19C851484G2 HARNESS TO EXISTING PL19C320811 HARNESS.
4. INSTALL 19B234932G1 CABLE FROM GETC BOARD 19D901868 J19.
   TO: P8-2 SHIELD
   P8-3 CENTER CONDUCTOR
   SPOT TIE TO EXISTING HARNESS.

MODIFICATION INSTRUCTIONS

Harness 19C851484G4
Modification 19C336664P2



(1) FIG. 1
(AUX RECEIVER)



(2) FIG. 2
(MAIN RECEIVER)

THESE INSTRUCTIONS COVER THE INSTALLATION OF THE RECEIVER VOTING TONE BOARD (19C320880) IN THE MAIN RECEIVER CHASSIS (19D417262) AND ON THE SYSTEMS BOARD (19D417549) LOCATED IN THE AUX RECEIVER CHASSIS (19D417546)

NOTES:

1) INTERCOM AND RCVR VOTING TONE BOARD ARE NOT COMPATIBLE.

2) EACH VOTED RECEIVER REQUIRES A SEPARATE LINE. WHEN AN AUXILLIARY RECEIVER IS PRESENT IN A STATION COMBINATION WITH VOTING, THE AUDIO MAY NOT BE COMBINED EITHER THROUGH 2ND RCVR 600Ω HI OR BY PARALLELING THE OUTPUT LINES.

(1) INSTRUCTIONS FOR INSTALLING RECEIVER VOTING TONE BOARD (19C320880)

1) REMOVE THE COVER (IF PRESENT)

2) AUX RECEIVER
PLUG RECEIVER VOTING TONE BOARD ON SYSTEMS BOARD (19D417549) AT P902 AS SHOWN IN FIG. 1.

3) MAIN RECEIVER
MODIFY 19D417213 SYSTEM BOARD AS FOLLOWS:
A) IN 2-WIRE DC CONTROL (STATIONS WITH FIFTH DIGIT R,U AND SEVENTH DIGIT G,N,P,S,U,M). REMOVE JUMPER A901-H74 TO A901-H75. INSTALL JUMPER A901-H72 TO A901-H73.
B) IN 4-WIRE DC OR TONE CONTROL WITH SEVENTH DIGIT D,L OR WHEN OPTION 950T OR OPTION 960I IS PRESENT, REMOVE JUMPER A901-H74 TO A901-H75.

C) PLUG IN RECEIVER VOTING TONE BOARD AT P935 AS SHOWN IN FIG. 2.

4) REPLACE THE COVER.

CONNECTIONS:

1. IN 2-WIRE DC CONTROL SYSTEMS WITH VOTING TONE BOARD, JUMPER FROM A901-H74 TO A901-H75 IS NOT PRESENT. JUMPER FROM A901-H72 TO A901-H73 IS PRESENT.
IN 4-WIRE STATIONS WITH VOTING TONE BOARD, JUMPER H74-H75; H72-H73 ARE NOT PRESENT.

(19D417633, Rev. 8)

PARTS LIST CHANGES

When ordering replacement vendor parts listed in this manual from the GE Mobile Communications Service Parts Operation, please precede each vendor part number with the prefix "A19/".