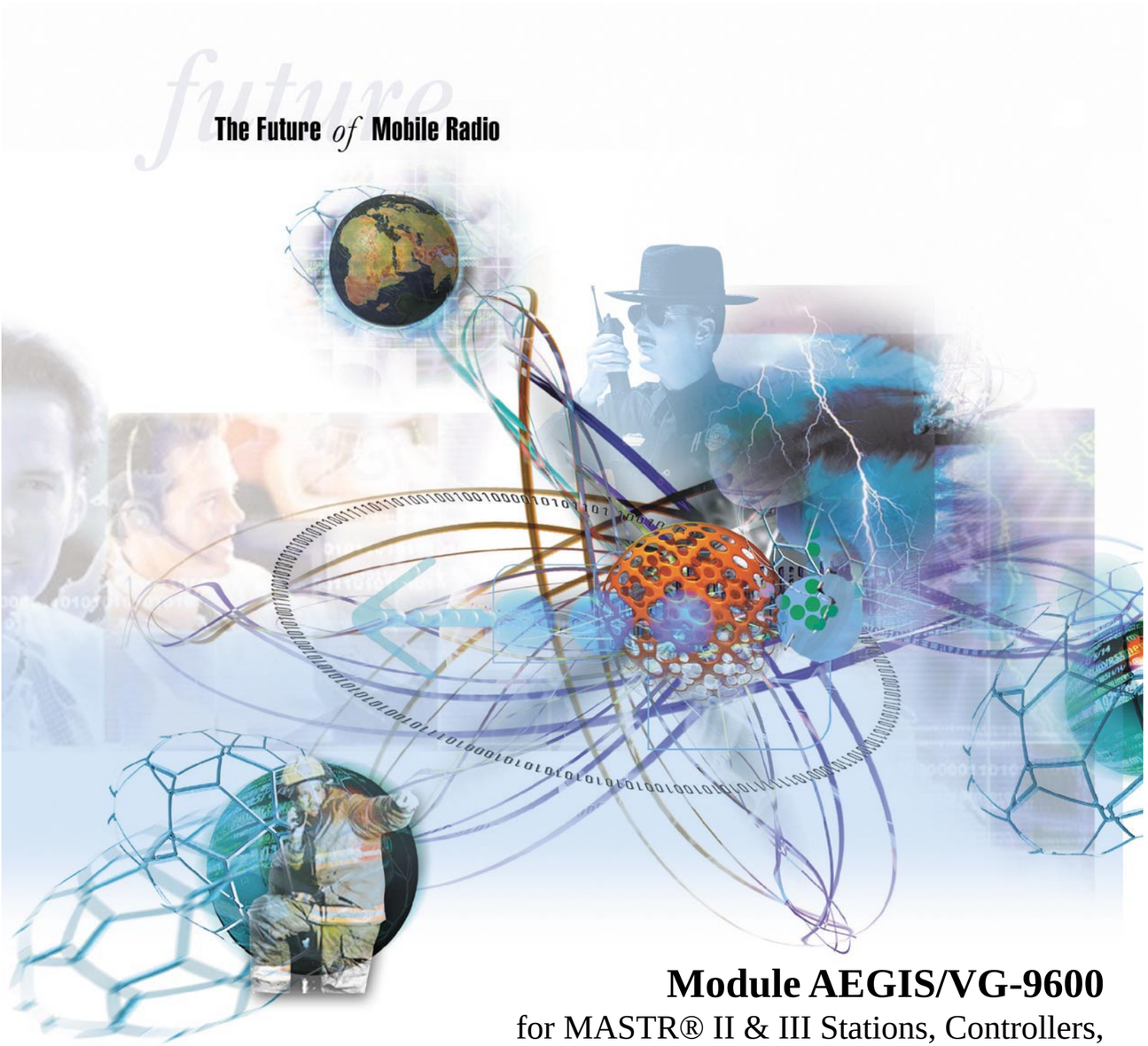

Module AEGIS/VG-9600

for MASTR® II & III Stations, Controllers,
CIU, DVIU & Auxiliary Receivers

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NOTICE!

Repairs to this equipment should be made only by an authorized service technician or facility designated by the supplier. Any repairs, alterations or substitution of recommended parts made by the user to this equipment not approved by the manufacturer could void the user's authority to operate the equipment in addition to the manufacturer's warranty.

NOTICE!

DESCRIPTION

AEGIS/Voice Guard module AEGIS/VG-9600 is a digital speech encryption/decryption system used with MASTR II & III stations, MASTR Controllers, Receiver Voting systems and the Console Interface Unit (CIU). The AEGIS/Voice Guard (AEGIS/VG) module provides the digital encryption/decryption with no reduction in the radio range.

The AEGIS/VG-9600 module permits the operator to switch between the CLEAR (not encrypted) or DIGITAL (encrypted) mode when transmitting. The module automatically switches to the correct mode when receiving.

The AEGIS/VG module may be used in either end-to- end AEGIS/Voice Guard stations, auxiliary receivers, the CIU, and in Encrypt/Decrypt (E/D) station applications.

End-to-end encryption consists of encrypted (DIGITAL) audio from a remote control location through telephone lines, microwave link or other communications link to the remote or remote/repeater station, and then to a personal or mobile radio.

In E/D voting systems, encrypted audio from a personal radio or mobile unit is applied to the auxiliary receiver, where it is decrypted and applied to the Voting Selector as a clear audio signal.

In E/D station applications, unencrypted (clear) audio is applied to the E/D station where it is encrypted and transmitted. Voice encryption is provided only over the RF path.

The AEGIS/VG-9600 module is available in two different versions. The two versions are:

- FS-1027 endorsed includes DES algorithm and the required security provisions defined by Fed Std 1027.
- Non-FS-1027 endorsed includes DES algorithm without the security requirements of FS-1027.

The model number, the Part Number, description and application for each of the AEGIS/VG module is shown in Table l.

SPECIFICATIONS

Cryptographic

Encryption Technique:	DES 64-bit output Feedback Mode.
Key Permutations:	7.2 X 10^{16} user selected using Key Variable Loader

System

Guarded Mode Performance:	Assured acquisition at 12 dB SINAD (SINAD measured in clear mode).
Speech Digitization:	9600 baud Sub-Band Coding.
Automatic Clear/Digital Switching:	Automatically accepts clear or digital signals based on presence of digital sync data.
Signalling:	Digital Continual Signalling in digital mode. Thirty-two Outside Addresses available in some applications.
Programming:	
Personalization	Externally programmable using Universal Radio Programmer TQ-2310.
Cryptographic	Externally programmable using Key Variable Loader 19A148910P3

Electrical

Key Storage:	30-second power interruption allowed.
RAM Keep-Alive Current:	12 mA Maximum
Power Requirement:	+10.8 to +16 Vdc, 200 mA nominal during quiescent state, 500 mA nominal during DIGITAL TX or RX.

Mechanical

Height:	51.6 mm (2.03 in.)
Width:	175 mm (6.9 in.)
Depth:	206 mm (8.1 in.)
Weight (with mounting bracket)	9.5 kg (4.3 Ib.)

Environmental

Temperature Range:	-30°C to +60°C (-22°F to +140°F)
Altitude:	5 km (16,500 ft.)
Shock:	EIA
Vibration:	EIA, USFS

Figure 1 - Operating Controls (FS-1027 Endorsed)

AEGIS/VG-9600-PR AND AEGIS/VG-9600-PRW

The AEGIS/VG-9600-PR and AEGIS/VG-9600-PRW Voice Guard modules are utilized in EDACS Console Interface Unit (CIU) applications and the AEGIS/VG-9600-DR and AEGIS/VG-9600-DRW modules utilized in Digital Voice Interface Unit (DVIU) applications. The DVIU modules are Aegis compatible and they are therefore referred to as “Aegis Modules”.

Aegis Modules VG-9600-DR and VG-9600-DRW are similar to the Voice Guard Module described in this manual with the following exceptions:

Analog Board Changes

- Rev. A thru G units: resistors R8, R15 and R16 are changed.
- Rev. H or later units: resistors R8, R15, R16 and R2 are changed, and capacitor C42 is removed.

Logic Board Changes

- EPROM integrated circuit U2 is changed.
- DSP integrated circuit U10 is changed.
- personality programming is changed and EEPROM integrated circuit U12 re-labeled (See Table 6).
- transistor Q9 is removed and replaced with a jumper (between collector and emitter holes).

AEGIS/VG-9600-AR AND AEGIS/VG-9600-ARW

The AEGIS/VG-9600-AR and AEGIS/VG-9600-ARW Modules are utilized in MASTR III station applications. These modules are Aegis compatible and they are therefore referred to as "Aegis Modules".

Aegis Modules VG-9600-AR and VG-9600-ARW are similar to the Voice Guard Module described in this manual with the following exceptions:

Logic Board Changes

- EPROM integrated circuit U2 is changed.
- personality programming is changed and EEPROM integrated circuit U12 re-labeled (See Table 6).
- transistor Q9 is removed and replaced with a jumper (between collector and emitter holes).

TABLE 1 - AEGIS/VG MODULE CONFIGURATION

MODEL NUMBER	PART NUMBER	DESCRIPTION	APPLICATION
AEGIS/VG-9600-C	19A148909P2	DES, FS-1027 endorsed	MASTR Controller
AEGIS/VG-9600-CW	19A148909P12	DES, Non-FS-1027 endorsed	MASTR Controller
AEGIS/VG-9600-SR	19A148909P16	DES, FS-1027 endorsed	MASTR II E/D Station/ Console Interface Unit
AEGIS/VG-9600-SRW	19A148909P14	DES, Non-FS-1027 endorsed	MASTR II E/D Station/ Console Interface Unit
AEGIS/VG-9600-SW	19A148909P15	DES, Non-FS-1027 endorsed	Auxilliary Receiver
AEGIS/VG-9600-PR	19A148909P30	DES, FS-1027 endorsed	EDACS CIU (VG)
AEGIS/VG-9600-PRW	19A148909P31	DES, Non-FS-1027	EDACS CIU (VG)
AEGIS/VG-9600-DR	19A148909P40	DES, FS-1027 endorsed	EDACS DVIU (Aegis)
AEGIS/VG-9600-DRW	19A148909P41	DES, Non-FS-1027	EDACS DVIU (Aegis)
AEGIS/VG-9600-AR	19A148909P60	DES, FS-1027 endorsed (pending as of August 1994)	MASTR III E/D Station (Aegis)
AEGIS/VG-9600-ARW	19A148909P61	DES, Non-FS-1027	MASTR III E/D Station (Aegis)

FED-STD-1027

FS-1027 endorsed Aegis/VG equipment means equipment that encrypts, decrypts or stores the cryptographic key meets the requirements of Federal Standard FS-1027 including use of the DES algorithm, and provides the required physical and electrical security. The physical security consists of pickproof keylocks for mode control and for enabling cryptographic key loading on the unit. The electrical security provides added methods for safeguarding the loaded cryptographic key.

DES ALGORITHM

The Data Encryption Standard (DES) algorithm uses a 64-bit binary number (56 bits plus 8 bits of parity) as a cryptographic code or key. There are 7.2 X 1016 possible keys. This electronic key is used for encryption and decryption of the digitized voice data being transmitted, and precludes unauthorized monitoring of voice communications.

A Cryptographic Keyfill Loader (19A148910P3) is available for programming the cryptographic key into the AEGIS/Voice Guard unit.

CRYPTOGRAPHIC KEY

The term "cryptographic key" refers to an electronic code inserted through the Key Loader Jack on the front of the AEGIS/VG module.

If no valid cryptographic key has been loaded into the AEGIS/VG module when an encrypted message is received, the radio will remain muted. The "no key" condition will be indicated in an attempt to transmit in the DIGITAL mode. Any attempt to transmit in the DIGITAL mode without a valid cryptographic key will cause a two-tone alert to be heard at the speaker, and the transmission will be inhibited.

NOTE

To complete communications path in the DIGITAL mode, the cryptographic key must be the same in both the transmitting and receiving units.

KEYFILL LOADERS

Cryptographic Key Loader, 19A148910P3, (Option V4025) is a small, handheld calculator- type keyboard display unit that permits easy entry, storage and transfer of the cryptographic keyword (key). The Keyloader connects into the Key Loader Jack located on the front of the AEGIS/VG module through a coil-cord cable.

In FS-1027 endorsed AEGIS/VG modules, a mechanical key must be inserted into the FILL/LOCK switch and the switch set in the FILL position before the cryptographic keys can be loaded into the AEGIS/VG module. After the key is loaded into the AEGIS/VG module, the FILL/LOCK switch is placed back into the LOCK position, after which the mechanical key and the Key Loader cable are removed.

In non-FS-1027 endorsed AEGIS/VG modules, simply inserting the cable from the Key Loader into the Key Loader jack enables the keyloading circuit in the AEGIS/VG module. The cable is disconnected after the key is loaded.

Complete operating instructions for the key loader are contained in LBI-31541.

The Aegis/VG module is contained in a metal housing. A metal frame assembly provides mounting support for the logic and analog printed boards, and the front panel. The front panel contains all operating controls. All external system connections are made to four connectors at the rear of the AEGIS/VG module.

OPERATION

Two different operating procedures are required for the AEGIS/VG modules. One procedure is for operating the FS-1027 endorsed AEGIS/VG modules, and one for the non-FS-1027 endorsed AEGIS/VG modules (see Table 1).

FS-1027 ENDORSED MODULES

All controls and indicators, to operate the AEGIS/VG unit, are conveniently located on the front panel. These controls consist of the Mode Select switch, a Zeroization pushbutton switch, FILL/LOCK switch and the DIGITAL RX indicator (see Figure l).

Mode Select Switch

This three-position key switch determines the operating mode of the AEGIS/VG unit. The operator must have possession of the key to this switch. The three positions are as follows:

1. CLEAR TX: All transmissions are made in the "clear" (unencrypted) mode. This mode is characterized by a short single warning tone heard in the operator's speaker preceding each transmission to remind the operator that the transmission is in the clear and may be monitored. Received messages may be either clear or digital. A DIGITAL RX (receive) indicator will light, when received messages are digital. Clear messages including normal Channel Guard operation, are received as on a standard radio.

2. OFF: The AEGIS/VG function is inoperative and the radio operates normally in the clear voice mode, for both transmit and receive. Each time the PTT switch is operated, a short 2-tone warning tone indicating a clear transmission is sounded to indicate a CLEAR (unencrypted) transmission. If an encrypted message is received, the receiver will remain muted. However, if Channel Guard is disabled, a noise similar to that of an unsquelched receiver will be heard.

3. DIGITAL TX: All transmissions are encrypted and no warning tone is sounded. The receiver operates as described under CLEAR TX. Both clear and encrypted messages will be received.

Zeroization Pushbutton

The zeroization (key dump) pushbutton enables the operator to immediately erase the cryptographic key. The key must be re-loaded to resume encrypted communications. After zeroization, communications are possible only in the CLEAR voice mode with the Mode Select switch "OFF", or in "CLEAR TX".

FILL/LOCK Switch

The FILL/LOCK switch must be in the "FILL" position to allow a cryptographic key to be loaded into the AEGIS/VG unit. The radio will be inoperative until this switch is placed in the "LOCK" position after cryptographic key loading. The FILL/LOCK key is not normally in the possession of the operator since it is only used for loading the cryptographic key, and for physical removal of the AEGIS/VG module.

To start sending or receiving messages:

1. Insert the key in the mode select switch and select the desired operating mode:

   CLEAR TX (Clear transmission, clear or digital receive).

   OFF (Clear transmit, clear receive).

   DIGITAL TX (Guarded transmit, clear or digital receive).

   NOTE

   The key may be removed in any position desired.

2. Operation is now similar to operating a standard, non-AEGIS/VG equipped radio. Monitor the channel to insure it's not in use before transmitting.

NON-FS-1027 ENDORSED AEGIS/VG MODULES

The non-FS-1027 endorsed AEGIS/VG module has only one operating control: a CLEAR or DIGITAL mode switch on the front panel selects the mode for transmitting only. When receiving, the DIGITAL or CLEAR mode is automatically selected regardless of the mode switch position.

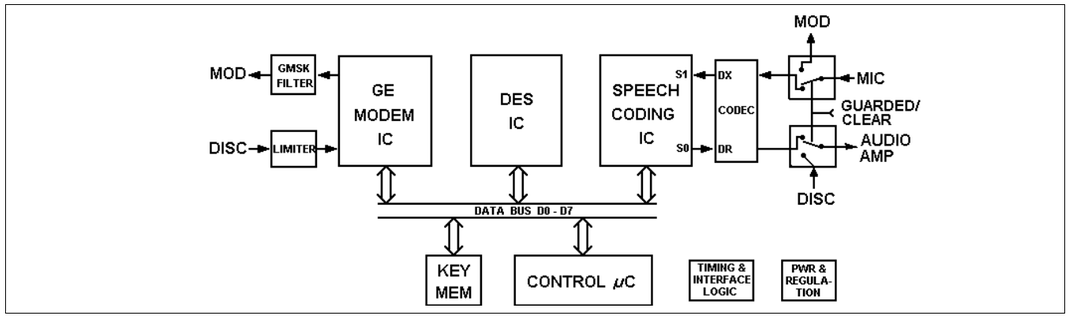


Figure 2 - VGE Module Block Diagram

CIRCUIT ANALYSIS

The AEGIS/VG unit contains two printed wiring boards: an Analog Board and a Digital Logic board.

The Analog Board consists of a CODEC integrated circuit (IC), audio filtering, transmit data filtering, receive data filtering, analog signal switching, CODEC timing, I/O buffering and power supply and voltage regulation circuitry. The CODEC IC provides "anti-aliasing" filtering, analog to digital (A/D) and digital to analog (D/A) conversion and output reconstruction filtering.

The Digital Logic Board consists of a control microprocessor, a digital signal processing (DSP), IC for speech bandwidth compression, a DATA ENCRYPTI0N STANDARD (DES) IC for encryption/decryption, a modem IC for NRZ (Non-return to zero) data transmission and reception, a key RAM to store the cryptographic key and, input and output logic circuits.

A block diagram of the AEGIS/VG module is shown in Figure 2.

In the transmit mode, the AEGIS/VG circuitry converts the analog voice to a digital bit stream. Then a bandwidth compression is performed using a sub-band coding algorithm programmed into a Digital Signal Processor. This reduces the digital voice data rate from about 46 kb/s to about 9.2 kb/s. This bit stream of data is then encrypted and synchronization and overhead bits are added to form a 9600 baud data signal. This signal is then filtered and passed on to the radio transmitter modulator circuit.

When the AEGIS/VG module is in the receive mode, the process is reversed. Synchronization and overhead bits are removed from the incoming 9600 baud signal. The signal is decrypted, a bandwidth expansion is performed, and the CODEC converts the digital bit stream to an analog signal which is passed on to the receive audio circuit.

Refer to the Functional Diagram listed in the Table of Contents.

When operating in the encrypted mode, the function of multi-tone Channel Guard encode/decode in the clear mode can be duplicated by using eight unencrypted bits in the recurring synchronization header (see Figures 3 and 4).

These eight bits comprise the Outside Address(es) (OA). They are assigned on an individual channel basis when programmed into the AEGIS/VG module EEPROM using the TQ2310 Programmer, and the AEGIS/VOICE GUARD EPROM Kit, TQ2344. The OA can be used for selective unit or group calling, or selective repeater activation.

POWER SUPPLY AND VOLTAGE REGULATION

The logic power supply of +5 volts is provided by two regulators supplied by the radio switched B+. Analog -5 volts, required by the CODEC and associated analog circuitry, is derived from a switching inverter powered by the radio switched B+ followed by a -5 volt regulator. Analog +8 volts that is required by some of the analog circuitry, is provided from the radio switch B+ by a separate regulator.

CONTROL MICROCOMPUTER

Control microprocessor UI controls the data flow between the DSP IC (U10), the DES IC (U9) and the Modem IC (U6). It also provides interfacing to the key variable loader and the Key RAM (U1 1). In addition, the control processor monitors AEGIS/VG and radio control tones (e.g. PTT, Digital/Clear... etc.) to determine the proper mode of operation.

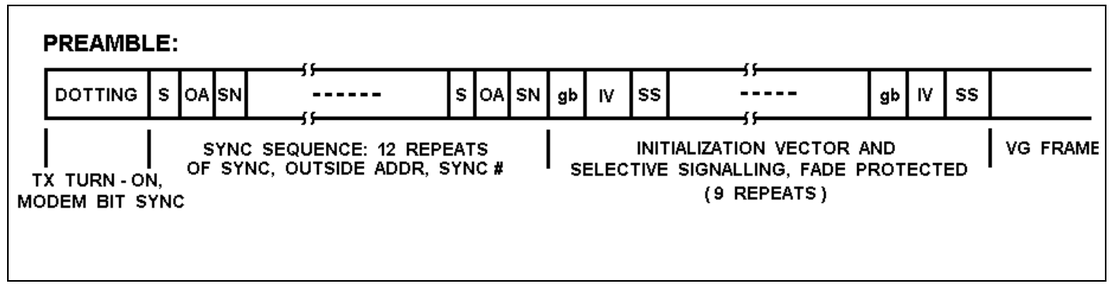


Figure 3 - Preamble Format

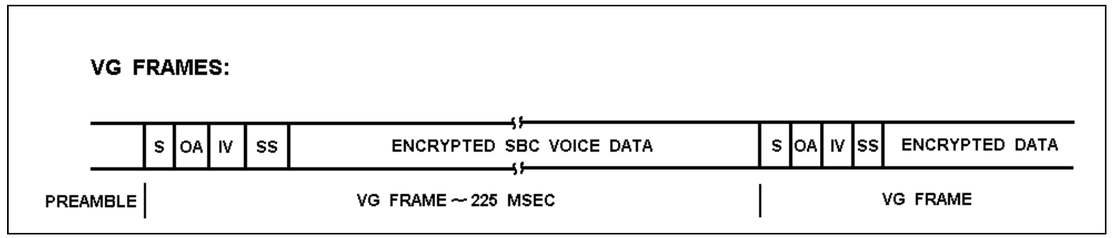


Figure 4 - Frame Header Format

DIGITAL SIGNAL PROCESSOR

The digital signal processor (U10) receives A/D converted data from CODEC IC U4-A. It is programmed with a proprietary Sub-Band Coder bandwidth compression algorithm, which reduces the digitized voice data rate from 46.4 kb/s to 9244 bits-per-second. The Sub-Band Coder compressed voice data is then passed to the control processor through the 8-bit wide parallel data bus.

A/D AND D/A CONVERSION

The transmitting in the DIGITAL mode, the microphone signal is filtered by Ul -A, then applied to CODEC U4-A. The CODEC provides input anti-aliasing filtering, A/D conversion, D/A conversion and output reconstruction filtering. 0n transmit, the A/D converter provides an 8-bit u-law companded representation of the input waveform every 172.4 usec. This 8-bit sample is shifted serially into the SI port of the DSP IC, U9.

DES IC

U9 is the DES IC. The control processor is programmed to implement the 64-bit output feedback mode (OFB) of U9. This is done by using the DES chip as an Electronic Code Book (ECB) DES device and loading the input with an initialization vector, feeding the output back to the input and XOR'ing the results with the data to be encrypted.

DES IC TIMING

In order to interface U9 to control microprocessor UI, some additional timing circuitry is required. The RD, /WR and ALE signal lines of Ul are gated to provide a continuous clock to the E and 2XE clock inputs of the DES (U9). IC's Ul9 and U7 provide this function.

KEY RAM

Key RAMUl1 is a COMS, 2KX8, static RAM. The key is transferred from the key loader through the control processor to the Key RAM. In addition, the initial Initialization Vector (IV) is stored in the key RAM and maintained through normal radio power-off times in the same manner the key(s) are maintained. Precautions are also provided to insure that intermediate key locations in the processor RAM are properly zeroized.

The key(s) and IV are scrambled and stored in image RAM locations to assure data integrity.

RAM KEEP-ALIVE CIRCUITRY

Power for Key RAM U1 1 on the logic board is supplied from two different sources. The RAM Vcc is normally supplied through diode D30 to P6-8 (RAM Vcc) on the Logic Board. The Keep-Alive 3- volts is supplied through diode D20.

In the event of power failure, the Keep-Alive supply maintains the Key RAM memory.

An interruption in the station supply voltage allows the Keep-Alive 3-volts through D20 to be applied to the Logic Board RAM Vcc input to retain the Key RAM memory.

ZEROIZE CIRCUITRY

The zeroize (key dump) circuitry is required for FS-1027 endorsed AEGIS/VG modules only. The RAM Vcc goes through two switches on the Analog Board before being applied to the Logic Board. One of these switches is the cover interlock switch. When the AEGIS/Voice Guard unit is locked on its base, this switch is depressed, allowing power to the RAM. If the unit is moved on its base, this switch will open. When it is open, RAM Vcc is isolated from the power source and connected to ground. This immediately dumps the cryptographic keys.

The second switch is the zeroization switch that is recessed in the AEGIS/VOICE GUARD front panel to prevent accidental operation. One pole of the switch normally connects the RAM to Vcc. When the switch is depressed, the RAM is disconnected from Vcc and connected to ground. This insures erasure of the cryptographic keys.

The second pole of the switch resets the AEGIS/Voice Guard unit. Part of the reset process is to zeroize all working key locations within the control processor. Reset also zeroizes the DES IC, U9. The RAM zeroize switch will make the AEGIS/Voice Guard unit unable to transmit or receive digital transmissions.

Pressing the zeroize button does not do any physical damage to the AEGIS/Voice Guard unit.

However, since the microprocessor operation has been randomly interrupted by zeroizing the cryptographic keys, the AEGIS/Voice Guard unit may not work even in the CLEAR mode after zeroization until the radio has been momentarily turned OFF and then turned back ON.

MODEM IC

The discriminator output is presented to the limiter circuitry composed of U3A and associated components. The non-inverting comparator input uses the low-pass filtered data stream, which is an estimate of the average DC level of the received signal. The discriminator output (VOL/8W HI) is then compared to this voltage to produce the 0 to 5 volt NRZ (non-return to zero) data stream which is input to modem U6.

Modem U6 contains a digital Phase-Locked loop, which provides bit sync on the incoming 9600 b/sec data. The modem also contains a hardware correlator circuit which can be enabled to look for the 11-bit Barker code sequence (11100010010) which is used to establish frame synchronization. Upon reception of the 11-bit Barker code, the modem IC interrupts the control processor. The control processor then reads succeeding bytes of received data from the modem over the data bus.

TIMING AND CLOCK GENERATION

The required clocks for control microprocessor UI and modem U6 are derived by a crystal oscillator, running at 7.3728 MHz. The DSP and CODEC are provided an input from an 8.0 MHz crystal oscillator, located on the Analog Board. Timing and control signals for the CODEC IC are derived from the 8.0 MHz clock using U6 and U7A IC.

ANALOG SIGNAL GATES

Analog switches are used to route various signals. Analog switch U5A switches the receive CLEAR/DIGITAL signals. Switch U5B is the TX DIGITAL data enable switched, and U5C is the alert tone generator switch.

I/0 EXPANDERS AND BUFFERS

The control processor's data bus in connected to two input port IC's (U1 3 and UI 6) and two output port IC's (U14 and U15). IC U13 buffers the mode switch and frequency select lines. U16 buffers the multiple key select inputs. Power switching, alert tones and radio controls are outputs buffered by U14 and U15.

TRANSMIT DATA FILTER

The TX data filter is composed of U2A (sections a, b and d). It filters the sharp transitions of the NRZ logic level data stream to reduce the occupied RF frequency spectrum of the transmitted data. Jumper PI4A permits the use of a second stage of filtering in some test configurations.

ALERT TONE GENERATION

Alert tones are generated by software and outputted as logic level squarewaves and applied to the Analog Board on P6-7. The signal is applied to a voltage divider consisting of R8 1, R37 and R28. PI 7 allows R8 1 to be bypassed to increase the alert for applications requiring a higher level tone.

PREAMBLE FORMAT

At the start of transmission (PTT), a preamble consisting of dotting, repeated sync, IV and addressing information is sent before voice encryption begins. The preamble provides a high probability of correct reception of sync, IV and outside address (see Figure 3).

FRAME HEADER

The encrypted voice data frame header is shown expanded in Figure 4. Information is provided at the beginning of a frame to insure maintenance of data and cryptographic sync and to allow late entry into a conversation during DIGITAL receive. Following the 112 bits of the AEGIS/VG frame header are 2040 bits of encrypted SBC voice data. The AEGIS/VG frame header is then repeated with a new IV.

END OF MESSAGE (EOM)

In order to signal the end of a transmission an inverted sync-plus-a dotting sequence is transmitted for about 50 msecs. This allows for a long fade in the signal and still ensures that the receiver decodes the E0M correctly.

FIELD MODIFICATION KIT SPK-9206

An upgrade kit is available that includes the necessary parts and instructions to convert an AEGIS/VG-9600-PR (19A148909P30) or AEGIS/VG-9600-PRW (19A148909P31) AEGIS/Voice Guard Module to an AEGIS/VG-9600-DR or AEGIS/VG-9600-DRW Aegis Module, respectively. This kit, part number SPK-9206, can be ordered from Ericsson Service Parts. Converting any other DES Voice Guard Module to a DES DVIU Aegis Module will require jumper/plug changes per Table 2.

Table 2 - Analog Board Jumper-Plug Chart

	POSITION 1-2	POSITION 2-3	MASTR CONTROLLER	MASTR II & III E/D STATION & CIU	AUXILIARY RECEIVER
P10	FLAT RX AUDIO	PRE-EMPHASIZED RX AUDIO	1-2	1-2	2-3
Pll	LOW LVL RX AUDIO	HIGH LVL RX AUDIO	2-3	2-3	1-2
P13	REMOTE CONTROLLER	MOBILE	1-2	2-3	2-3
P14	1 STAGE TX DATA FILTER	2 STAGE TX DATA FILTER	1-2	1-2	1-2
P15	CONTROL OUTPUTS TO GROUND	CONTROL OUTPUTS TO CONTROL A-	1-2	1-2	1-2
P17	HIGH LVL ALERT TONE	LOW LVL ALERT TONE	1-2	1-2	2-3
P18	HIGH GAIN MIC INPUT	LOW GAIN MIC INPUT	1-2	2-3	2-3
Pl9	6dB/OCTAVE PRE-EMPHASIS	12 dB/OCTAVE PRE-EMPHASIS	2-3	2-3	2-3
P20	NO MIC BIAS	MIC BIAS	1-2	1-2	2-3
P21	UNSWITCHED TX DATA	SWITCHED TX DATA	1-2	1-2	2-3
P22	UNSW A+ NOT REGULATED	UNSW A+ REGULATED TO 3.9V	1-2	1-2	2-32
P23	RX DATA FROM DVG AUD HI	TX DATA FROM DVG RX AUDIO	1-2	2-3	1-2

MAINTENANCE

This section contains maintenance and troubleshooting information required to service the AEGIS/VG-9600 module. Included in this section are the Set-Up and AEGIS/VG module Configuration Procedures, Disassembly Procedures and two levels of troubleshooting for the AEGIS/VG module. This section also includes Mechanical Layout Diagrams, Outline and Schematic Diagrams, and Parts Lists for the AEGIS/VG module.

The Set-Up and Adjustment procedure includes an introduction to the test program called SIMON (SImple MONitor). Instructions for using SIMON for the AEGIS/VG module are contained in LBI-31550.

SET-UP AND ADJUSTMENTS

AEGIS/Voice Guard modules must be configured for either controller or station applications by positioning jumpers on the AEGIS/VG analog board as shown in Table 2.

In addition, the module must also be configured for either FS-1027 endorsed or non-FS1027 endorsed operation (Table 2), and for front panel mode select or remote mode select (Table 4).

Logic Board jumpers are shown in Table 5.

NOTE

The letter "W" in the model number suffix denotes a non-FS-1027 configuration. Model numbers without the letter "W" denote a FS-1027 endorsed configuration (see Table 3).

The letter "R" in the model number suffix denotes Remote CLEAR/DIGITAL mode selection (see Table 4).

Adjustments

Several adjustments are normally required in the initial system set-up. The adjustments may include the radio deviation adjustment, transmitter digital deviation and local receive audio level adjustments. In addition, the receiver IF stages may require re-alignment for optimum AEGIS/VG performance. Refer to the applicable Combination manual for the required procedures.

NOTE

When using a AEGIS/VG-9600 SR or SRW in con junction with a Console Interface Unit (CIU), the analog board strapping is correct as defined for SR or SRW. However, the default personality PROM programming should be changed to be as follows

1. When a TQ23l0 programmer asks for Type S, R or C; answer: C

2. When the TQ2310 programmer asks for Options; set the options as follows:

   Clear TX Alert Y System Failure Alarm Y Tx Attack Delay- 20 msec
   Addnl Data Delay 50 msec

3. When the TQ2310 programmer asks Channels; level the default value as set by the TQ23l0 for type. The default values for channel l and 2 are:

   Tx and Rx 0A-55 (hex)
   Tx Data Inverted - Y
   Rx Data Inverted - Y

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 through. Since AEGIS/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 AEGIS/VG stations are shown in Figure 5.

138-174 MHz:

Transmitter=no inversion

Receiver=inverted

406-512 MHz:

Transmitter=no inversion

Receiver=inverted

Figure 5 - Transmit and receive data polarity

Table 3 - FS-1027/Non-FS-1027 Configuration

POSITION 1-2		POSITION 2-3	NON-FS-1027 ("W" SUFFIX)	FS-1027 NO "W" SUFFIX
P24	KEYLOAD ENABLED W/FILL/LOCK SWITCH	KEYLOAD ENABLED W/LOADER JACK	2-3	1-2
P16	ANTI-TAMPER SWITCH		J16-1 TO J16-2	P16 (From Anti-Tamper Switched)

Table 4 - Remote Mode Selection

FUNCTION	"R" SUFFIX (E/D STATION CONFIGURATION)	NO "R" SUFFIX (ALL OTHER CONFIGURATION)
REMOTE MODE SELECTION	DISCONNECT FROM PANEL SELECTOR SWITCH CABLE FROM J9 ON LOGIC BOARD THEN CONNECT CABLE l9B234849Gl TO J25 ON ANALOG BOARD AND J9 ON LOGIC BOARD	CONNECT CABLE FROM FRONT PANEL MODE SELECTOR SWITCH TO J9 ON LOGIC BOARD. J25 ON ANALOG BOARD IS OPEN.

Table 5 - Logic Board Jumper Chart

LOGIC BOARD JACKS	STANDARD CONNECTIONS	EXCEPTIONS
J11/P11 (Hl & H2)	J11/P11 connected. (Hl to H2 connected in earlier boards).	Jumper-plug removed when using 8751 SIMON EPROM.
H3, H4 & H5	Jumper-plug connected from H4 to H5. (H3 not used).	Jumper-plug may be removed for field test.
H6, H7 & H8	Jumper-plug connected from H7 to H8 when using standard 2764 EPROM.	Jumper-plug connected from H6 to H7 if using 2732 EPROM.
H9, H10 & H11	Jumper-plug connected from H9 to Hll. H10 not used.	Jumper-plug may be removed for field test.
H15 & H16	Open. (H15 and H16 not used).	Jumper-plug may be connected for testing RAM Vcc.
H18 & Hl9	Jumper-plug connected from H18 to Hl9.	Jumper-plug may be removed for field test.
H21 & H22	Jumper-plug connected for single key.	Removing jumper-plug will produce Key Loader ERROR 1. Key will not load

DISASSEMBLY PROCEDURE

The Disassembly Procedure provides instructions for gaining access to the logic and analog boards for servicing and removal, if required. (Refer to the Applicable Mechanical Parte Breakdown listed in the Table of Contents).

To remove the AEGIS/VG module from the station shelf mounting bracket:

1. Unplug the connectors from the rear of the AEGIS/VG module.

2. Remove the two #8-32 x 1/2 inch washerhead screws and lock washers securing the AEGIS/VG module to the shelf mounting bracket.

To remove the AEGIS/VG cover:

1 Remove the two pan-head screws located on each side of the cover, and the flat-head screw located at the back of the top cover.

2. While holding the AEGIS/VG Unit, push on the back of the AEGIS/VG chassis and slide the chassis forward and out of the cover.

PERSONALITY PROGRAMMING

In the AEGIS/VG-9600, personality information is stored in EEPROM U12. This information can be reprogrammed with an IBM PC compatible computer using programming software TQ-3334, RDI and cable TQ-3330, and cable TQ-3345. See TQ-3334 Chapter 4 for specific programming operations. The AEGIS/VG-9600 may also be reprogrammed with the TQ-2310 Universal Radio Programmer (with TQ-2344 PROM). Table 6 lists factory programmed personality data for all AEGIS/VG-9600 modules covered by this maintenance manual.

Table 6 - AEGIS/VG9600 Personality Programming Data

MODULE / PARAMETER	AEGIS/Voice Guard Modules				Aegis Modules	
	AEGIS/VG-9600-C (19A148909P2) and AEGIS/VG-9600-CW (19A148909P12)	AEGIS/VG-9600-SW (19A148909P15)	AEGIS/VG-9600-SR (19A148909P16) and AEGIS/VG-9600-SRW (19A148909P14)	AEGIS/VG-9600-PR (19A148909P30) and AEGIS/VG-9600-DRW (19A148909P31)	AEGIS/VG-9600-DR (19A148909P40) and AEGIS/VG-9600-DRW (19A148909P41)	AEGIS/VG-9600-AR (19A148909P60) and AEGIS/VG-9600-ARW (19A148909P61)
EEPROM U12 Identification	344A3000P20	344A3000P10	344A3000P30/P50	344A3000P41	344A3000P240	344A3000P230
Type	Console	Mobile	Mobile/Console**	Console	Console	Console
AEGIS/VG Option	AEGIS/VG	AEGIS/VG	AEGIS/VG	AEGIS/VG	AEGIS/VG AME	AEGIS/VG AME
Clear Tx Alert	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled
System Failure Alarm	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled
Tx Attack Delay	175 milliseconds	10 milliseconds	10 ms/20 ms**	10 milliseconds	10 milliseconds	10 milliseconds
Additional Data Delay	250 milliseconds	30 milliseconds	30 ms/50 ms**	0 milliseconds	0 milliseconds	0 milliseconds
Tx OA (Chan. 1)	55 (hex)	*	55 (hex)	3F (hex)***	3F (hex)***	3F (hex)
Tx OA (Chan. 2)	55 (hex)	*	55 (hex)	FF (hex)***	FF (hex)***	FF (hex)
Tx OA (Chan. 3-32)	55 (hex)	*	55 (hex)	55 (hex)***	55 (hex)***	55 (hex)
Rx OA (Chan. 1-32)	55 (hex)	*	55 (hex)	55 (hex)***	55 (hex)***	55 (hex)
Tx Inversion (Data Polarity)	Yes (inverted)	*	Yes (inverted)**	Yes (inverted)	Yes (inverted)	Yes (inverted)
Rx Inversion (Data Polarity)	Yes (inverted)	*	Yes (inverted)	Yes (inverted)	Yes (inverted)	Yes (inverted)

* Tx and Rx Outside Addresses and Data Polarities for AEGIS/VG-9600-SW (19A148909P15:

Channels 1 - 22	=	55	Yes (inverted)
Channel 23	=	77	No (not inverted)
Channel 24	=	55	No (not inverted)
Channel 25	=	AA	Yes (inverted)
Channels 26 - 27	=	77	No (not inverted)
Channel 28	=	AC	Yes (inverted)
Channels 29 - 32	=	77	No (inverted)

** Settings on the left side of "/" are for station (non-CIU) applications. Settings on the right side of "/" are for CIU applications. Tx Data Polarity in station (non-CIU) applications are set to No (not inverted).

*** EDACS trunked systems do not use Outside Address (OA) selective signalling techniques; however, the hex values listed in this table are necessary for proper operation.

To remove the Logic Board:

l. Remove the chassis from the cover.

2. Remove the 11 pan-head screws securing the board to the chassis, and the two 4-40 nuts securing the back supporting plate to the chassis assembly. These are located on the outside edges of the heatsink. NOTE: There are two screw sizes used to secure the board (4- 40 x 1/4 and 4-40 x 7/16). Remember the sizes and locations for reassembly.

3. Unplug connector from J9.

4. Unplug optional rotary or toggle switch connectors if installed.

5. Remove the five flat head screws located on the side of the chassis assembly.

6. The Logic Board and attached metal shield can now be lifted free of the chassis assembly. Be careful not to damage connectors when removing and replacing Logic Board.

To remove the Analog Board from mounting frame:

1. Remove Logic Board. The Analog board is now accessible for servicing.

2. Remove the AEGIS/VG front panel by removing the four 4-40 nuts from the panel studs.

3. Remove the six 4-40 x 1/4 pan-head screws from the bottom of the Analog Board. Remove the Analog Board.

4. Unsolder the ground wire between the rear of the Analog Board and the mounting board.

5. Remove the Analog Board.

AEGIS/VG-9600 MAINTENANCE

Two levels of maintenance and troubleshooting are provided for servicing the AEGIS/VG module. The first level uses a SYMPTOM/CAUSE table involving functional operation and response. Also, some voltage and waveform checks are provided on the Schematic Diagrams for the Analog and Logic Boards.

These checks will result in a complete functional system checkout, and a fairly complete checkout of the Analog Board. This will also permit isolation of a problem to a particular printed wire board for board substitution.

The second level of maintenance requires an AEGIS/VG-9600 service kit that includes a PROM containing a test program called SIMON, for SImple MONitor. The kit also contains an adapter for connecting an RS-232, 2400 baud data terminal to the suspect AEGIS/VG unit. After a few simple checks are made to the Logic Board of the AEGIS/VG unit, the test PROM can be plugged into the Logic Board in place of the AEGIS/VG operating program residing in the EPROM (U2). The 2400-baud terminal can now communicate with SIMON and a number of specific tests can be run to isolate the problem to a specific area of circuitry, and possibly to a specific component.

The service kit contains:

l-Microprocessor l9A149l73G2 (8751) with SIMON in residence.

1-PROM 19A149l73G1 (27C64) with an expanded version of SIMON in residence.

l- SIMON level adapter cable l9Al49116Pl to interconnect an RS-232 terminal to a Voice Guard unit.

l-Maintenance plug to defeat anti-tamper switch in FS-l027 endorsed units.

l-Instructions for use of SIMON, LBI-31550.

LEVEL ONE MAINTENANCE

In order to evaluate the functional operation of an AEGIS/Voice Guard installation, the following sequence of tests can be performed with the AEGIS/VG unit installed:

l. In FS-1027 endorsed units, place Mode switch on VOICE GUARD to OFF, and the FILL/LOCK switch to LOCK. In non-endorsed AEGIS/VG units, place the mode switch in the CLEAR position.

2. In all AEGIS/VG units, use another radio or service, monitor to determine that the unit being examined can receive a clear transmission direct to it. The DIGITAL RX light on FS l 027 endorsed AEGIS/VG units should not light.

3. In FS-1027 endorsed units, press the PTT button on the unit being examined. The transmitter should now be on the air, and a momentary two tone beep should be heard in the unit's speaker at the start of the transmission. It should be confirmed on a system monitor or another radio that clear voice modulation capability exists. Let up on the PTT button.

4. In all AEGIS/VG units, place the AEGIS/VG MODE switch in the CLEAR or CLEAR TX position and repeat the test described in Step 3 above. Note that only a single tone alert beep should be heard.

5. In FS-l 027 endorsed units, momentarily depress the KEY DUMP button on the front of the AEGIS/VG unit. Place the AEGIS/VG MODE switch in the DIGITAL or DIGITAL TX position. Depress the PTT button and note that a repetitive two tone alarm sequence is heard from the speaker. (This indicates to all that a transmitter is being used without a valid cryptographic key.) Let up on the PTT button.

6. In FS-l 027 endorsed units only, leave the FILL/LOCK switch in the LOCK position. Connect the KEY LOADER to the AEGIS/VG unit and attempt to load a valid cryptographic key. The resultant display on the KEY LOADER should be ERROR l . Now, place the FILL/LOCK switch in the FILL position and repeat the key load sequence. The response should now be "GOOD TRANSFER".

   In Non-FS-l027 endorsed units, connect the key loader to the AEGIS/VG unit. Attempt to load a cryptographic key into the AEGIS/VG unit. The resulting Key Loader display should be "GOOD TRANSFER". Leave the key loader connected to the AEGIS/VG unit.

   Depress the PTT button; nothing should happen. Place the FILL/LOCK switch to the LOCK position in FS-l 027 endorsed units or disconnect the key loader in non-l027 units. Again depress the PTT button. The transmitter should now key on and no beep should be heard from the speaker. It should also be noted that data modulation (sounds like unsquelched receiver noise) should be observed on the system monitor. Also, a companion AEGIS/VG equipped radio with the same cryptographic key and outside address should be recovering any modulating signal applied to the microphone of the unit being examined and the DIGITAL RX light on the unit (if present), being examined should be out while the same light on the companion AEGIS/Voice Guard unit (if present) should be lit. Release the PTT button.

7. Depress the PTT button on a companion AEGIS/VG unit having the same cryptographic key and outside address. Note that the DIGITAL RX indicator is lit (if present), and the AEGIS/VG unit being examined should be receiving audio modulation being applied to the companion radio.

8. If multiple outside addresses are being employed, confirm proper channel tracking by attempting communication on another channel having a different OA.

At the successful completion of the above sequence of functional tests, the AEGIS/VG unit should be considered as operational. Refer to the SYMPTOM/CAUSE Troubleshooting Procedure of common problems that could cause failure of the above tests.

If substituting a known good AEGIS/VG unit into an installation being examined still results in either no digital or clear modulation with the other being present, the CIU, Controller AEGIS/VG Interface module or the GETC or AEGIS/VG repeater shelf should be considered as the most probable failed item.

AEGIS/VG Failure

Should the failure be determined to be the AEGIS/VG unit, the following preliminary checks can be performed.

l. Remove the AEGIS/VG unit from its base mounting plate or bracket, and remove the three retaining screws from the sides and top of the case.

2. Attach the AEGIS/VG unit with cover removed to a test mobile, or station on a service bench.

3. In FS-l 027 endorsed units, insert main tenance plug in hole in the right side of the AEGIS/VGunit in a manner as to hold the anti-tamper microswitch leaf in its depressed position (toward the rear of the unit).

4. Apply power to the test system and confirm that Ul-40 and Ull-24 on the Logic Board have +5 volts present. Depress the PTT and confirm presence of +5 volts on U9-6. Release the PTT button.

5. Confirm presence of the following voltages on the bottom side of the Analog Board:

   U4-l6 +5 volts
   U4-l -5 volts
   U3-3 +8 volts

6. With these voltages all present, then confirm presence of 7.3728 MHz clock signal at Ul-18 on the logic board using an oscilloscope.

7. Then confirm the presence of 8.00 MHz ±l00 PPM at J8-5 on the logic board.

8. Confirm that the microprocessor RESET line Ul-9 is not stuck in the reset (high) state. This pin should be low for normal operation.

9. If the reset line is pulsing high for a few microseconds approximately every two seconds, or failure of steps 4, 6 or 8, would indicate a most probable Logic Board problem. If the reset line is continuously held high, or failure of steps 5 or 7 would indicate a most probable Analog Board problem.

10. Substitution of an otherwise known working Logic Board or Analog Board into an AEGIS/AEGIS/VG unit being examined is a valid board level test after the above voltages and signals have been checked.

LEVEL TWO MAINTENANCE

Level Two maintenance on a failed AEGIS/VG unit requires the use of AEGIS/VG Service Kit. The examination of the AEGIS/VG unit should be continued with the test program called SIMON (supplied in the Service Kit). In order to use SIMON (meaning SImple MONitor), an additional 2400 baud RS-232 serial ASCII computer terminal (not supplied in the Service Kit) is required. SIMON Level Adapter Cable l9A1491 l6Pl is supplied to interface from Logic Board connector Jl0 to provide the RS-232 terminations for the 2400 baud terminal.

The procedure for setting up for SIMON operation is as follows:

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

2. Remove all power from the unit and replace the AEGIS/VG PROM U2 with the SIMON test PROM. Connect the level adapter to Logic Board Jl0, and connect the power lead to +5V at H37. Connect the 2400 baud terminal to the level adapter.

3. Reapply power and continue with the test in structions for SIMON supplied in the Service Kit.

4. If SIMON does not run, there is a possibility that the microprocessor address or data bus may be latched. In order to troubleshoot this circuitry, remove power and replace microprocessor Ul with the 8751microprocessor supplied in the kit and remove the jumper between Hl and H2 on the Logic Board. Then proceed with Step 3. The 8751 is a UV PROM version of microprocessor Ul that has a limited version of the SIMON program in residence. (This is due to the limited PROM space in the 8751.) Once the 8751 has successfully verified the address and data bus condition, operation should be moved back to microprocessor Ul, and the 27C64 SIMON PROM. Be sure to re-install the jumper between Hl and H2.

5. At completion of the SIMON testing, be sure to replace the SIMON PROM with the AEGIS/VG operational code PROM.

TROUBLESHOOTING PROCEDURE

This troubleshooting procedure provides a series of symptoms and checks for tracing the path through a AEGIS/VG system. Before starting the procedure, make the following checks:

l. The regulators are operating properly.

2. Both 8-MHz and 7.37-MHz clocks are running.

3. Reset is low and not watch-dogging.

4. The ALE and PSEN signals out of the processor are running.

An AEGIS/VG unit has no chance of operating unless these conditions are met. Typically, such units may receive clear, will not receive private, will not transmit, will not accept a key from the key loader, and will not give the usual alert and warning tones. It is and will appear to be dead. Troubleshoot the Logic Board and the regulators on the Analog Board until these conditions are met. Remember the TX clock at J5, Pin 7 of the Logic Board must be running to get -5V.

SYMPTOM 1: REDUCTION IN RANGE COMPARED TO OTHER UNITS

If the range reduction is in both private and clear, then the problem is probably in the RF sections of the radio. Check the radio for the usual power, frequency, sensitivity, and deviation. This is probably not an AEGIS/VG unit problem.

If the reduction in range is in digital mode only, check the digital transmission by looking at recovered audio of a deviation monitor. The eye pattern will probably be distorted. The most common cause of this is for the deviation on the radio, AEGIS/VG Control Shelf or repeater control shelf to be improperly adjusted. Refer to the appropriate Alignment Procedure for instructions.

- If the deviation seems to be adjusted correctly, refer to SYMPTOM 3 (DOES NOT TRANSMIT DIGITAL).
- Check to see that the waveform at receive data J8-Pin 3 of the Logic Board seems right. If not, refer to the SYMPTOM 6 (DOES NOT RECEIVE DIGITAL).

SYMPTOM 2: RADIO DOES NOT KEY

Typically, the transmit light will light on the control head but the radio will not transmit.

Check to see that J6, Pin 28 on the Logic Board follows the Fill key. The radio will not transmit if it thinks it is in the keyfill mode.

Check to see that the PTT (low) is getting to the AEGIS/VG unit on J1, Pin 6 on the Analog Board. This says that the PTT in signal is getting to the AEGIS/VG unit. If not, the problem is in the interconnect cable.

Check to see that the PTT In signal is getting to the Logic Board on J6, Pin 21. If not,trace the PTT in line through the Analog Board.

Note that PTT In is really just a request to key. The radio is really keyed through the PTT Out line. Verify that the PTT Out signal is getting off the Logic Board on J6 Pin 5. If not, troubleshoot the Logic Board to see if PTT In is being recognized and PTT Out is indeed being generated.

Check to see if PTT is getting to J2, Pin l4 of the Analog Board. If not, the signal is not getting through the Analog Board.

SYMPTOM 3: RADIO DOES NOT TRANSMIT DIGITAL

The radio will key, but there is no data modulation. The radio will probably transmit clear. It is assumed that a key has been successfully loaded and that the mode select is in the private position.

There are three main areas to check for when a radio does not transmit in the private mode. They are:

l. Make sure the radio is in fact in the DIGITAL mode.

2. That data is getting out of the AEGIS/VG unit.

3. That data is getting to the modulator.

The first issue is the easiest. If the radio can receive DIGITAL, then it is already answered. If it does not receive DIGITAL, then one should pay attention to what happens when MIC PTT is pressed. If there is a clear transmission alert tone, then the mode switch is not connected to the Logic Board (J9). If connected, then the mode switch must be defective. If there is a two tone warning, then the lock switch has the private and clear Tx lines shorted together. Note that there is a valid key. Hence the DES and RAM IC's are working. The tone should be noticeably different than the invalid key alarm. If there is silence, then the AEGIS/VG unit does in fact see itself as in the private mode and should be transmitting data.

The next area to check is the data getting out of the AEGIS/VG unit. If it is not, the first step would be to see if data is getting to the Analog Board. If TTL level data is not present on J8, Pin l of the Logic Board, then troubleshoot the Logic Board. The problem will probably be in modem U6 or DSPUI 0. It is a good idea to isolate the pin from the jack with a toothpick to make sure something on the Analog Board is not killing the signal so as to make it appear to be a logic board problem.

Digital data is converted to analog data on the Analog Board. One should be able to follow the data through the filter sections of U2. The DC level should be at 4.5 volts. There should be around 2.5 Vpp of data at the last section of the filter. The data will appear to have its edges rounded into sine wave like transitions.

The output of the filter goes to a switch section in U3. It should go in on Pin 5 and out on Pin 4. The control line is pin 9 and the controlling signal is Data PTT. Pin 9 of U5 should be low for DIGITAL transmit. If not, the switch will be open and no data will get through. If high, check Q1 and Data PTT.

Data seen at the output of the switch should go to the back connector. If it does not, one problem could be with the protection diodes. The DC level should give this away. A level of close to 8V or close to ground indicates one of the diodes is shorted out.

SYMPTOM 4: RADIO TRANSMITS DATA, COMPANION RECEIVER SYNCS UP, BUT THERE IS NO RECOVERED MODULATION

Make sure that the microphone path to the AEGIS/VG unit is good and that audio is present at the input to U1C.

If this is not a problem, then the next step would be to look at Pin I5 of CODEC U14. This is the output of an internal operational amplifier. No modulation here indicates a problem around UlC. If there is audio here, verify the Analog +5 and especially -5V supplies. If these are OK, then the problem is probably internal to the CODEC.

Transmit audio is also looped through DSPUl0 and regenerated on Pin 2 of the CODEC. The presence of audio here pretty much verifies the operation of the CODEC and DSP circuits.

SYMPTOM 5: RADIO DOES NOT TRANSMIT CLEAR

Clear audio requires a 600-ohm microphone or an appropriately loaded source. It comes into the AEGIS/VG unit on J1, Pin 4 and goes out of the AEGIS/VG unit on J2, Pin 16. Along the path it goes through amp U2C. This is really a switch controlled by the Mic Switch line on the Logic Board. Verify that audio does in fact get through this switch and gets out of the AEGIS/VG unit. If it does not, check U2 or Ql3. Ql3 should be turned off for clear audio.

SYMPTOM 6: RADIO DOES NOT RECEIVE DIGITAL

The first step is to determine if the AEGIS/VG unit thinks it is in the DIGITAL mode. If the radio can transmit DIGITAL, then it is already answered. If it does not transmit DIGITAL, then one should pay attention to what happens when MIC PTT is pressed. If PTT is pressed and if there is a clear transmission alert tone, then the mode switch is not connected to the Logic Board (J9). If connected, then the switch must be open. If there is a two tone warning, then the mode switch has the private and clear Tx lines shorted together. Note that there is a valid key. If so, the DES and RAM IC's are working. The tone should be noticeably different than the no/invalid key alarm. If there is not tone, then the AEGIS/VG unit does in fact see itself as in the DIGITAL mode and should be transmitting data.

Receive DIGITAL requires that the receiving radio's key and outside address match that of the transmitting radio. It may be a good idea to verify the EEPROM program. It may not even hurt to verify that the Logic Board can in fact correctly read the EEPROM.

VOLUME/SQUELCH High comes onto the interface board on Pl, Pin 14. It goes through two protection diodes on its way to switch U2D. The DC level should be around 4.5 volts. If not, one of these diodes may be questionable. switch U2D should be on (Pin 12, 9V) so data goes to DVG DATA HI. There are also protection diodes on the output of this switch.

Switch U2C is off (Pin 6=low) so that the decrypted audio is separated from the data path. Again, be aware of shorted or open switches.

The next step is to check the AEGIS/VG unit. TTL level data should be on J8, Pin 3 of the Logic Board. There will be a jitter on the trace that is not too clear on the photograph. This is normal. The 9600 bit pattern should be apparent. If it is, then there is probably a problem with the Logic Board.

If it is not, then the problem is in the Analog Board. The data coming into J3, Pin 6 should be on the common side of Rl9 and R20. Pin 9 of the comparator should have an attenuated version of the data. Pin 8 should be almost a DC level. If there is data on Pin 8, then there is a problem with C7. Data on U3, Pin 9 should show up at Pin 14 at TTL levels. If not, the problem is probably the comparator.

Decrypted audio comes out of Pin 2 of the CODEC (U14) on the Analog Board. It goes through two or three filter sections before going through switch U5A. This switch switches the decrypted audio or the clear audio onto the VOLUME/SQUELCH high line to the control head. It is controlled by the Rx switch. During private receive, the control pin of this switch (Pin 10), will below.

If audio is getting out of Jl,Pin 16, then it will either be a control head problem or a Delta radio problem.

SYMPTOM 7: RADIO DOES NOT RECEIVE CLEAR

The radio will normally want to receive CLEAR. If it does not, the problem will usually be in the radio. However, there are some items in the AEGIS/VG unit that should be checked.

The Logic Board controls the signal Rx Mute. This could keep a radio quiet if it is stuck in the wrong state.

Gate U2C on the interface board could also be open. This will also prevent clear audio from getting to the speaker.

Finally, there are numerous protection diodes along the various boards on the audio lines. If one of these shorts, the line will be tied to ground or 8V. Either way, there will not be any audio getting through the system.

SYMPTOM 8: AEGIS/VOICE GUARD UNIT DOES NOT ACCEPT A VALID KEY

There are four main reasons why an AEGIS/VG until will not accept a key. The first is that the key-fill microswitch on FS-l027 endorsed units is not functioning or the key fill jack on non-FS-l027 units is defective. A working AEGIS/VG unit will give an alert tone if a key fill that is turned off is inserted into its jack while in the fill mode. If there is silence with the fill lock in the fill position, then the switch is bad or the jack is defective.

A second reason has to do with the cover interlock microswitch on FS-l027 endorsed units. It maybe possible for this to go bad in such a way as it may not be closed by putting the unit on the fame. Without power, the RAM will be useless. Any keyfill operation will then be bad.

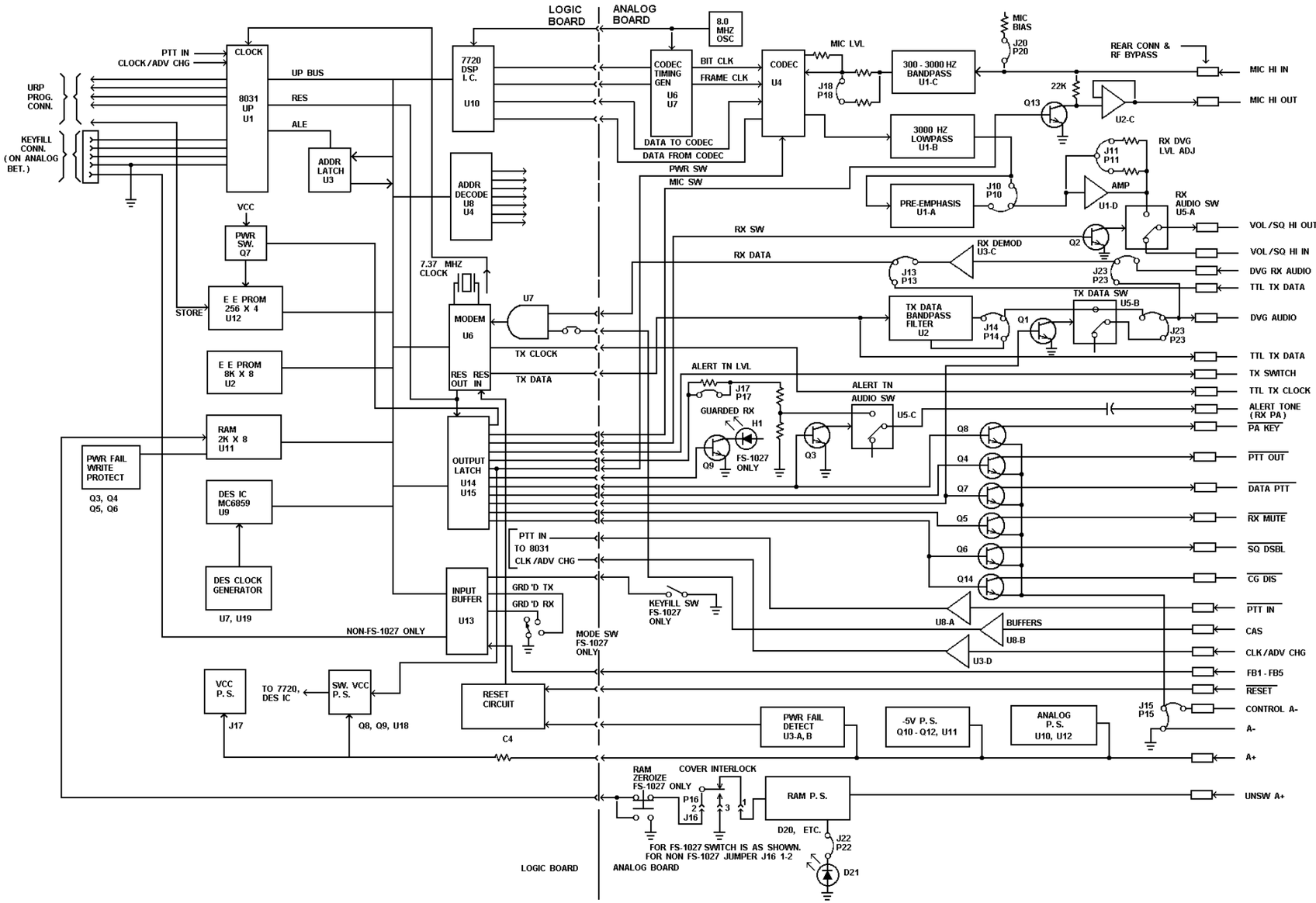
Thirdly, there are many protection diodes on the keyfill lines. A loss of any of them could cause some lines to behave erratically. That result would probably cause a transfer error.

Finally, an AEGIS/VGE Keyloader is being used to attempt a key transfer into a DES AEGIS/VG unit.

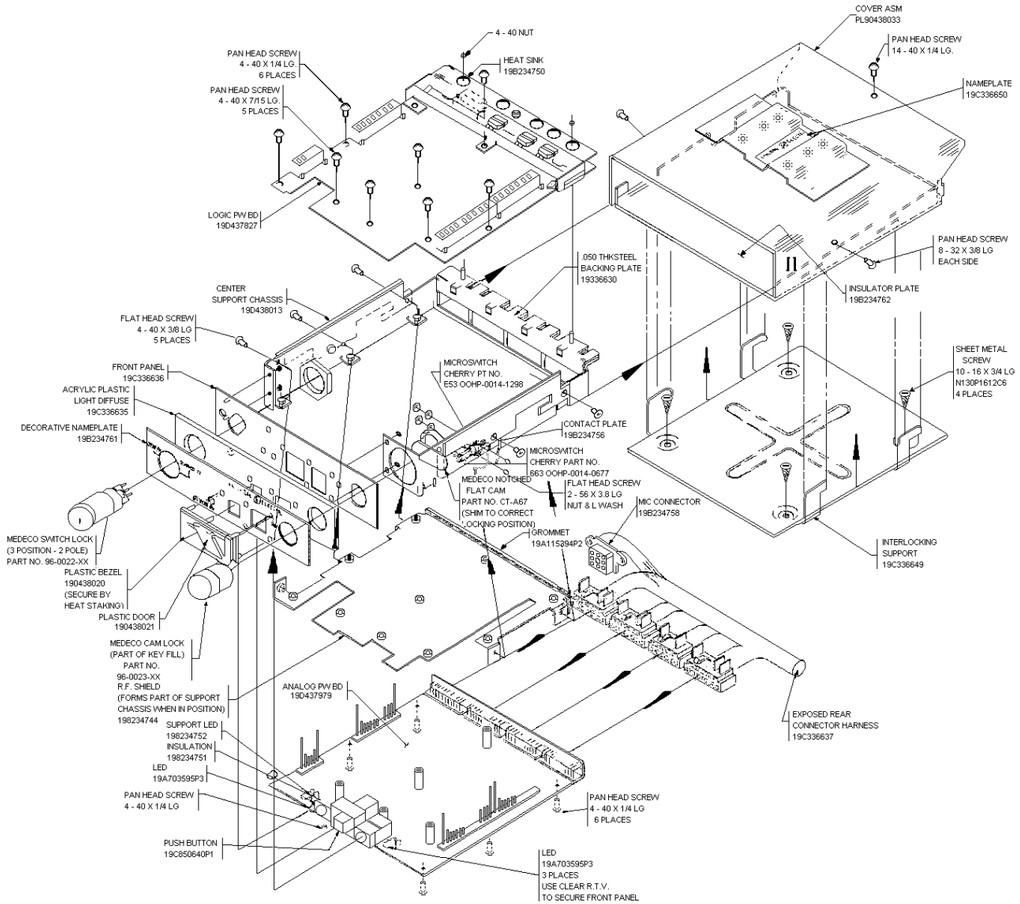
SYMPTOM 9: AEGIS/VOICE GUARD UNIT DOES NOT RETAIN KEYS

In this situation, an AEGIS/VG unit will accept a key. However, it will forget that key within 30 seconds of losing power. The main cause for this is probably the loss of the Schottky diode (D30). When shorted, it acts like a resistor thus causing the RAM +5 to follow Vcc to ground quite rapidly.

Other causes could include the cover interlock microswitch if present, loss of C2l, loss of D20, and the loss of D2l.



AEGIS/VG-9600 Module



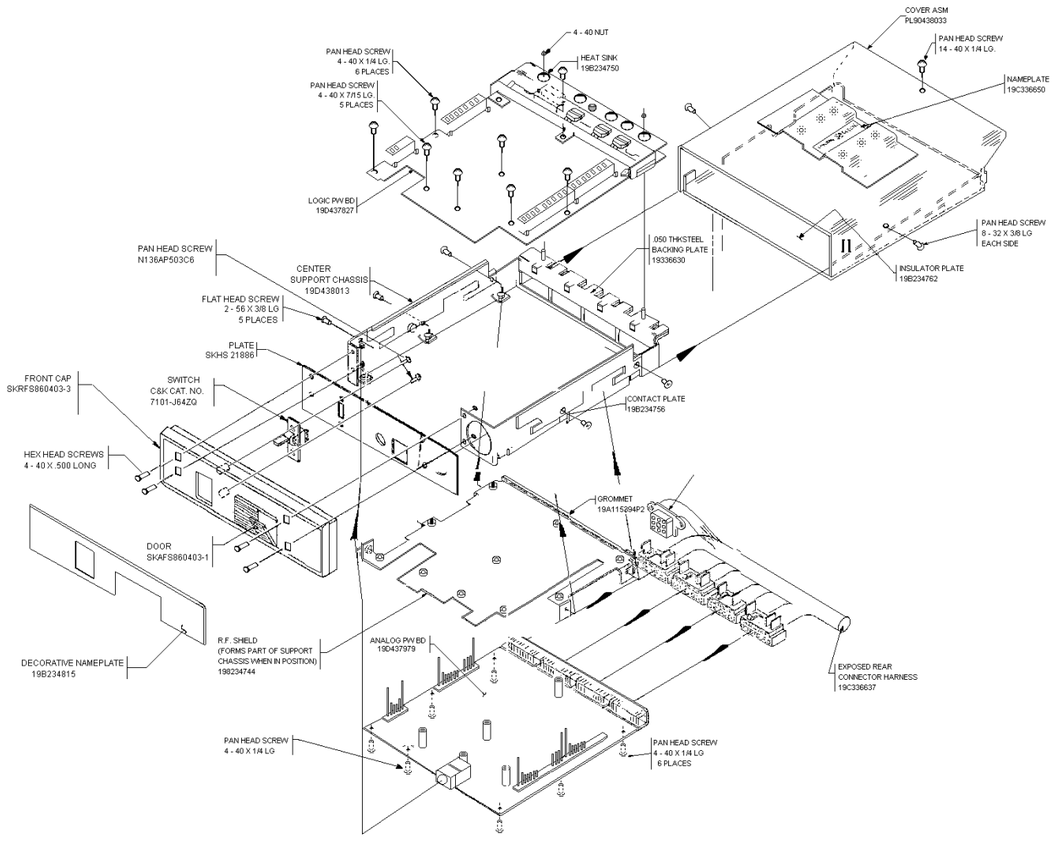
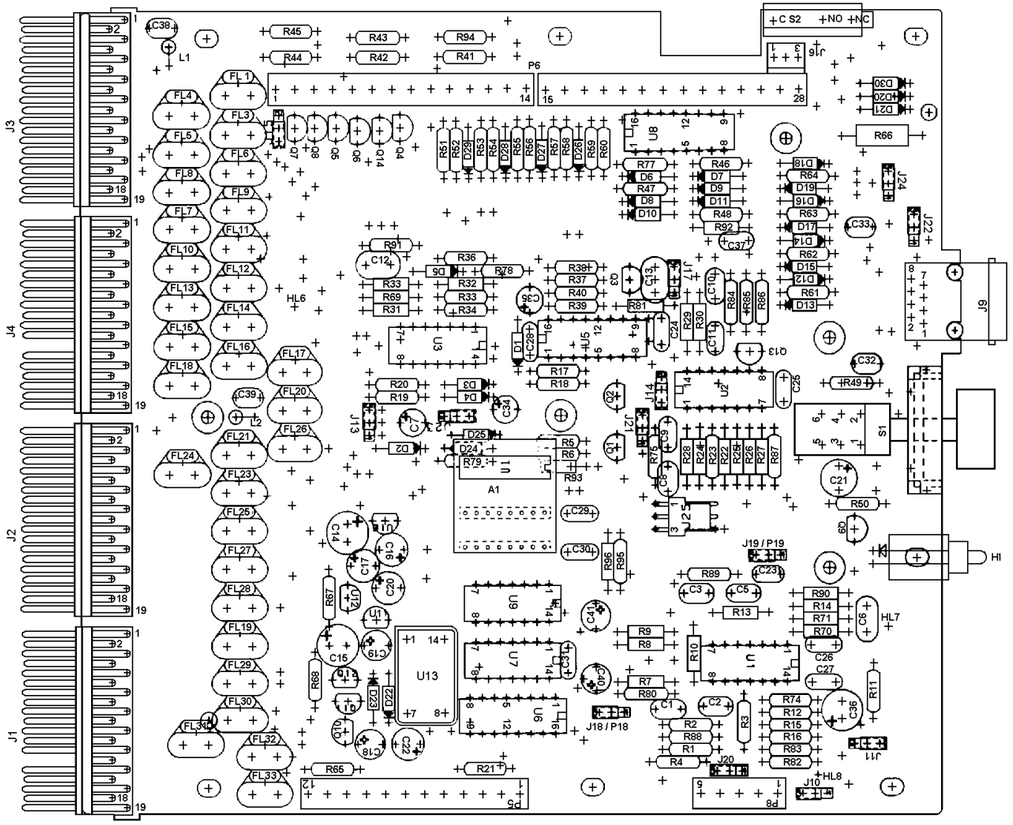


FIG. 1.

Module
FS-1027 Endorsed
(19C336655, Rev. 0)

AEGIS/Voice GuardModule
Non-FS-1027 Endorsed with DES
(19D438166, Rev. 0)

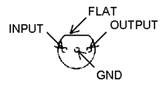


LEAD IDENTIFICATION FOR Q1 THRU Q14

IN - LINE
TOP VIEW

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

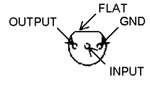
LEAD IDENTIFICATION FOR U10 AND U12



IN - LINE
TOP VIEW

NOTE: CASE SHAPE IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

LEAD IDENTIFICATION FOR U11

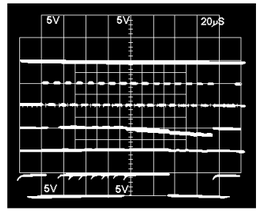


IN - LINE
TOP VIEW

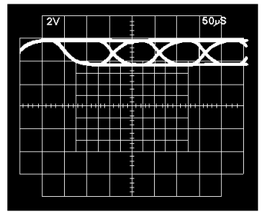
NOTE: LEAD ARRANGEMENT IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

Analog Board
19D437979G1
(19D437977, Rev. 5)

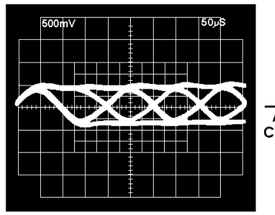
CODEC - GUARDED RX
(P5-2, P5-4, P5-3, & P5-5)



SECOND STAGE TX FILTER
(U2 - 14)

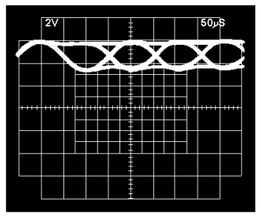


TYPICAL RCVD VG DATA
(DVG AUDIO HI)

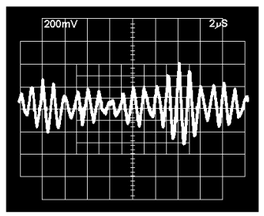


TRANSMITTING UNIT DATA
MODULATION SET TO 3 KHz DEVATION

FIRST STAGE FILTER
(U2-2)



RCVD GUARDED AUDIO
(VOL / SQ HI OUT)



TRANSMITTING UNIT HAD 1 KHz,
300 mV P-P INTO MIC HI

VOLTAGE READINGS (SHEET 3)
(DC, NOMINAL)

OPERATING CONDITION	MEASUREMENT POINT			
	U2 (B) - 5	U5 (A) - 10	U5 (B) - 5	U5 (B)- 9
GUARDED RX	2.5V	0.5V	4.5V	8V
CLEAR RX	2.5V	8V	4.5V	8V
GUARDED TX	——	8V	——	0.5V
CLEAR TX	2.5V	8V	4.5V	8V

JUMPER - PLUG CHART 2

	POSITION 1 - 2	POSITION 2 - 3	W SUFFIX NOTE 5	NON - W SUFFIX NOTE 5
P24	K / L ENABLED PANEL SWITCH	K / L ENABLED LOADER JACK	2 - 3	1 - 2
P16	ANTI - TAMPER SWITCH		NOTE 1	NOTE 2

JUMPER - PLUG CHART 3

	FUNCTION	R SUFFIX	NON - R SUFFIX
P25	REMOTE MODE SELECTION	NOTE 3	NOTE 4

JUMPER - PLUG CHART

POSITION 1 - 2		POSITION 2 - 3	S POSITION FOR DELTA RADIO	C POSITION FOR CONTROLLER	SR,PR,AR,DR,CR POSITION FOR CIU & MASTR II E / D STATION
P10	FLAT RX AUDIO	PRE-EMPHASIZED RX AUDIO	2 - 3	1 - 2	1 - 2
P11	LOW LVL RX AUDIO	HIGH LVL RX AUDIO	1 - 2	2 - 3	2 - 3
P13	REMOTE CONTROLLER	MOBILE	2 - 3	1 - 2	2 - 3
P14	1 STAGE TX DATA FILTER	2 STAGE TX DATA FILTER	1 - 2	1 - 2	1 - 2
P15	CONTROL OUTPUTS TO GROUND	CONTROL OUTPUTS TO GROUND	1 - 2 ⚠	1 - 2	1 - 2
P17	HIGH LVL ALERT TONE	LOW LVL ALERT TONE	2 - 3	1 - 2	1 - 2
P18	HIGH GAIN MIC INPUT	LOW GAIN MIC INPUT	2 - 3	1 - 2	2 - 3
P19	6dB / OCTAVE PRE-EMPHASIS	12dB / OCTAVE PRE-EMPHASIS	2 - 3	2 - 3	2 - 3
P20	NO MIC BIAS	MIC BIAS	2 - 3	1 - 2	1 - 2
P21	UNSWITCHED TX DATA	SWITCHED TX DATA	2 - 3	1 - 2	1 - 2
P22	UNSW A+ NOT REGULATED	UNSW A+ REGULATED TO 3.9V	2 - 3	1 - 2	1 - 2
P23	RX DATA FROM DVG AUD HI	RX DATA FROM DVG RX AUDIO	1 - 2	1 - 2	2 - 3

⚠ MOVE P15 TO POSITION 2 - 3 FOR DUAL CONTROL APPLICATIONS.

SIGNAL LEVELS (SHEET 3)
(P - P, NOMINAL)

WITH 300 uV P - P o f 1 KHZ SINUSOID SIGNAL INPUT AT J1 - 4 AND UNIT IN GUARDED TX MODE THE FOLLOWING SIGNAL LEVELS, NOMINAL, SHOULD BE PRESENT.

OPERATING CONDITION	MEASUREMENT POINT				
	U1 (A) - 1	U1 (B) - 7	U1 (C) - 8	U1 (D) - 14	U4 - 15
P18 ON J18 - 2 & 3	100uV	200uV	300uV	450uV	700uV
P18 ON J18 - 1 & 2	——	——	——	——	2.2V
P11 ON J11 - 2 & 3	——	——	——	450uV	——

NOTE 1....USE JUMPER PLUG TO CONNECT J16-1 TO J16-2 FOR ALL "W" SUFFIX MODEL NUMBER.

NOTE 2....CONNECT ANTI-TAMPER SWITCH VIA P16 TO J16 FOR ALL NON-"W" SUFFIX MODEL NUMBERS.

NOTE 3....CONNECT 3 CIRCUIT CABLE BETWEEN J25 OF ANALOG BOARD AND J9 OF LOGIC BOARD. DISCOUNT FRONT PANEL MODE SELECTOR SWITCH CABLE FROM LOGIC BOARD J9.

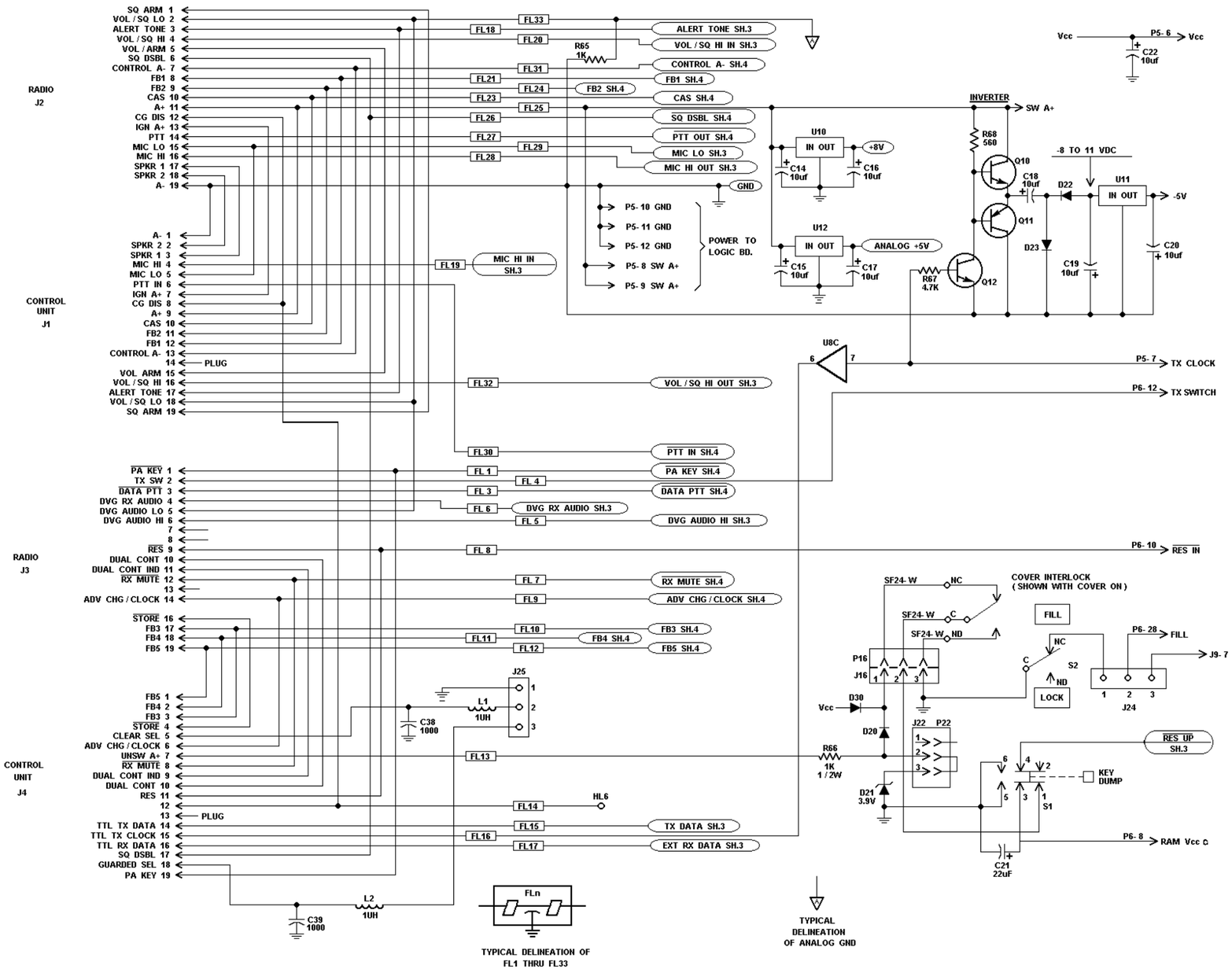
NOTE 4....CONNECT CABLE FROM FRONT PANEL MODE SELECTOR SWITCH TO LOGIC BOARD J9. LEAVE ANALOG BOARD J25 OPEN.

NOTE 5....SUFFIX TO MODEL NUMBER DENOTES NON-FED-SDT-1027 APPROVED PACKAGE.

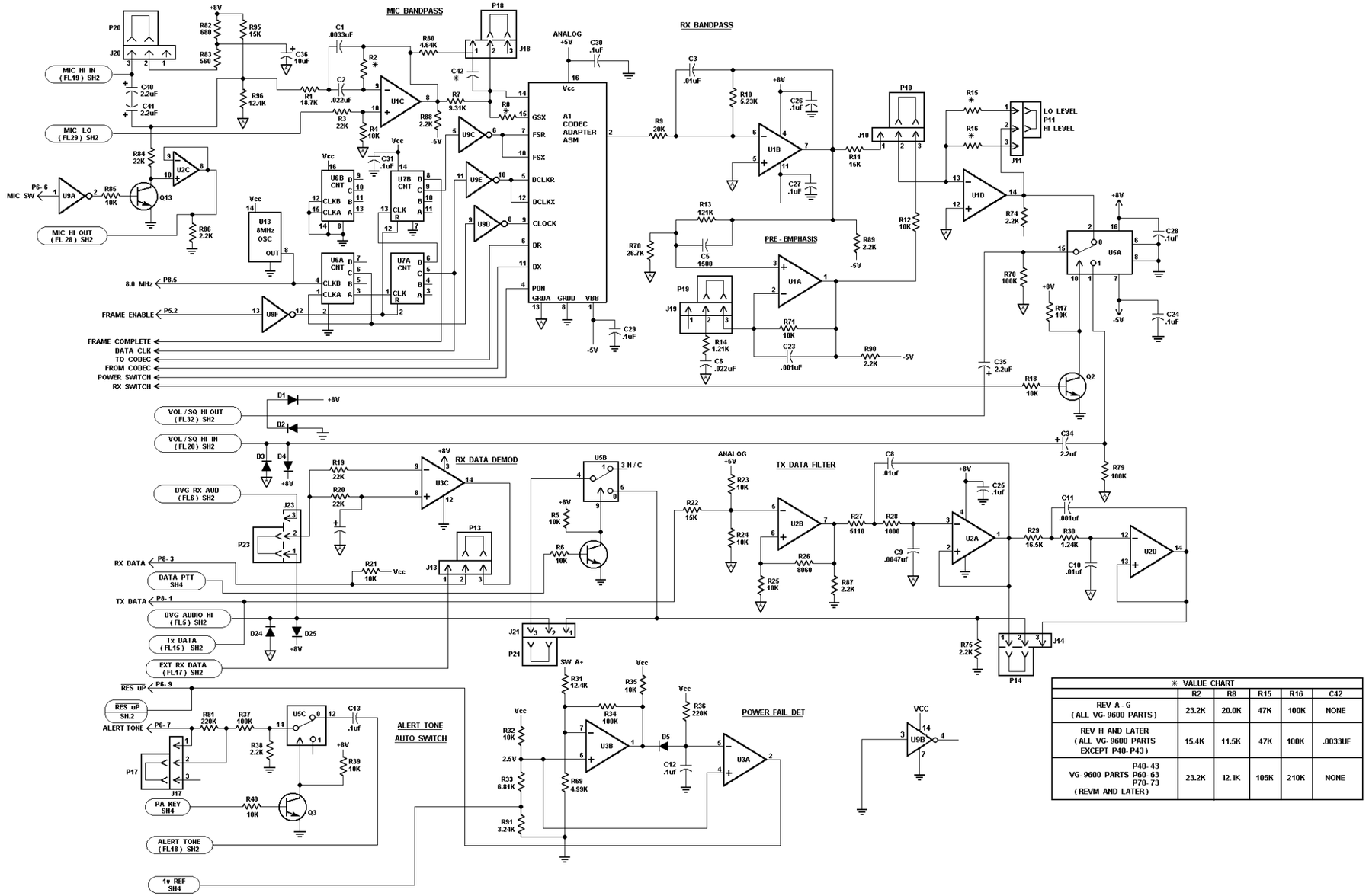
ALL RESISTORS ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K-1000 OHMS OR MEG-1,000,000 OHMS. CAPACITOR VALUES IN PICOFARADS (EQUAL TO MICROMICROFARADS) UNLESS FOLLOWED BY UF-MICROFARADS. INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH-MILLIHENRYS OR H-HENRYS.

[19D437976, Sh. 1, Rev. 1A]

Analog Board
19D437979G1
(19D437976, Sh. w, Rev. 7)

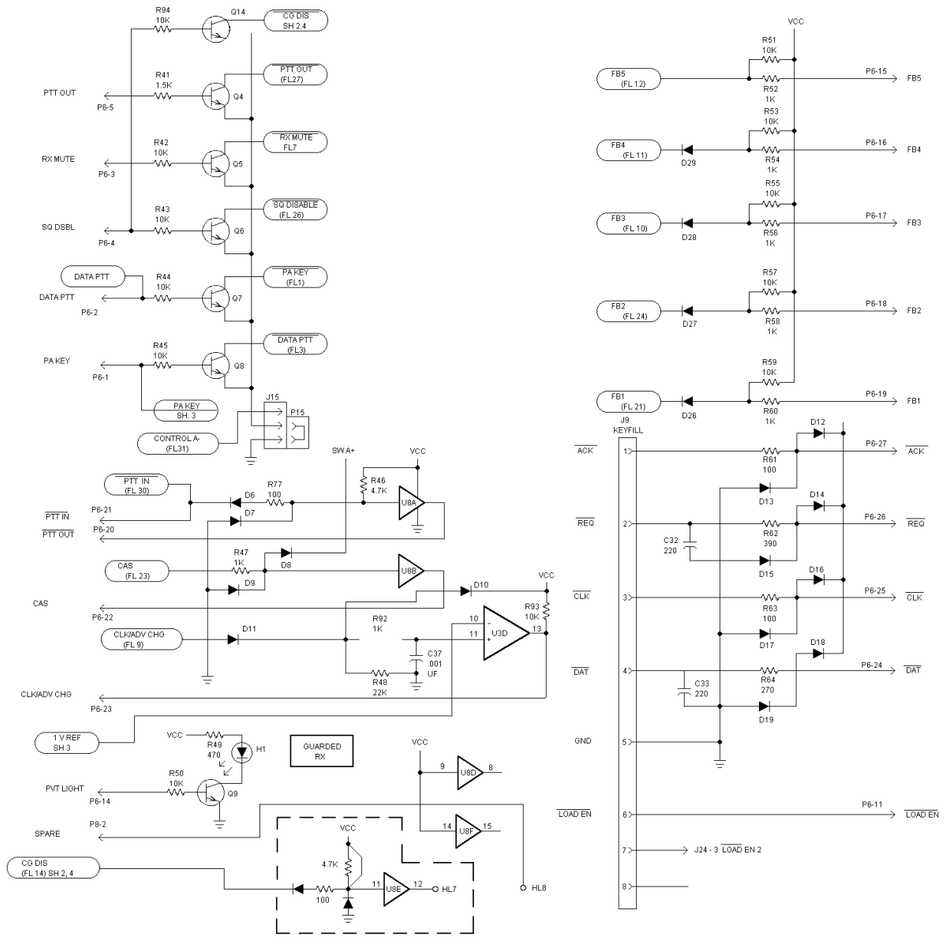


Analog Board
19D437979G1
(19D437976, Sh. 2, Rev. 7)



* VALUE CHART					
	R2	R8	R15	R16	C42
REV A - G (ALL VG- 9600 PARTS)	23.2K	20.0K	47K	100K	NONE
REV H AND LATER (ALL VG- 9600 PARTS EXCEPT P40- P43)	15.4K	11.5K	47K	100K	.0033UF
P40- 43 VG- 9600 PARTS P60- 63 P70- 73 (REVM AND LATER)	23.2K	12.1K	105K	210K	NONE

Analog Board
19D437979G1
(19D437976, Sh. 3, Rev. 7)



Analog Board
19D437979G1
(19D437976, Sh. 4, Rev. 7)

PARTS LIST

ANALOG BOARD
19D43797G1
(A19 / R300101)

ISSUE: 8

SYMBOL	PART NO.	DESCRIPTION
A1	19C852714G1	CODEC Adapter Assembly.
		----------CAPACITORS----------
C1	T644ACP233J	Polyester: .0033 uF ±5%, 50 VDCW, MFG: NISSEI.
C2	T644ACP322J	Polyester: .022 uF ±5%, 50 VDCW, MFG: NISSEI.
C3	T644ACP310J	Polyester: .010 uF ±5%, 50 VDCW, MFG: NISSEI.
C5	T644ACP215J	Polyester: .0015 uF ±5%, 50 VDCW, MFG: SPRAGUE.
C6	T644ACP322J	Polyester: .022 uF ±5%, 50 VDCW, MFG: NISSEI.
C7	19A701534P3	Tantalum: 0.47 uF ±20%, 35 VDCW, MFG: SPRAGUE
C8	T644ACP310J	Polyester: .010 uF ±5%, 50 VDCW, MFG: NISSEI.
C9	T644ACP247J	Polyester: .0047 uF ±5%, 50 VDCW, MFG: NISSEI.
C10	T644ACP310J	Polyester: .010 uF ±5%, 50 VDCW, MFG: NISSEI.
C11	T644ACP210J	Polyester: .0010 uF ±5%, 50 VDCW, MFG: NISSEI.
C12 and C13	19A702250P113	Polyester: 0.1 uF ±10%, 50 VDCW, MFG: NISSEI.
C14 and C15	19A701225P1	Electrolytic: 15 uF -10 +75%, 25 VDCW; MFG: Sprague.
C16 and C17	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW, MFG: SPRAGUE.
C18	19A701534P10	Tantalum: 10 uF ±20%, 25 VDCW, MFG: SPRAGUE.
C19 and C20	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW, MFG: SPRAGUE.
C21	19A701534P8	Tantalum: 22 uF ±20%, 16 VDCW.
C22	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW, MFG: SPRAGUE.
C23	T644ACP210J	Polyester: .0010 uF ±5%, 50 VDCW, MFG: NISSEI.
C24 thru C31	19A116192P14	Ceramic: 0.1 uF ±20%, 50 VDCW; MFG: CENTRALAB.
C32 and C33	19A700233P3	Ceramic: 220 pF ±10%, 50 VDCW, MFG: GE.
C34 and C35	19A701534P5	Tantalum: 2.2 uF ±20%, 35 VDCW, MFG: SPRAGUE.
C36	19A701534P7	Tantalum: 10 uF ±20%, 16 VDCW, MFG: SPRAGUE.
C37	T644ACP210J	Polyester: .0010 uF ±5%, 50 VDCW, MFG: NISSEI.
C38 and C39	19A700233P7	Ceramic: 1000 pF ±20%, 50 VDCW.
C40 and C41	315A6047P225U	Tantalum: 2.2 uF ±20%, 35 VDCW, MFG: SPRAGUE.
C42	T644ACP233K	Polyester: .0033 uF ±10%, 50 VDCW. (Used in AEGIS/Voice Guard Module).
		----------DIODES----------
D1 thru D11	19A700028P1	Silicon, fast recovery: fwd current 75 mA,75 PIV; MFG: JEDEC.
D12	19A700047P2	Silicon, 100 mW, continuous dissipation; MFG: MP.
D13	19A700028P1	Silicon, fast recovery: fwd current 75 mA,75 PIV; MFG: JEDEC.
D14	19A700047P2	Silicon, 100 mW, continuous dissipation; MFG: MP.
D15	19A700028P1	Silicon, fast recovery: fwd current 75 mA,75 PIV; MFG: JEDEC.
D16	19A700047P2	Silicon, 100 mW, continuous dissipation; MFG: MP.
D17	19A700028P1	Silicon, fast recovery: fwd current 75 mA,75 PIV; MFG: JEDEC.
D18	19A700047P2	Silicon, 100 mW, continuous dissipation; MFG: MP.
D19 and D20	19A700028P1	Silicon, fast recovery: fwd current 75 mA,75 PIV; MFG: JEDEC.
D21	19A700025P4	Silicon, zener: 400 mW max; MFG: GE
D22 thru D29	19A700028P1	Silicon, fast recovery: fwd current 75 mA,75 PIV; MFG: JEDEC.
D30	19A700047P2	Silicon, 100 mW, continuous dissipation; MFG: MP.
		----------FILTERS----------
FL1		Filter, MFG: MURATA ERIE, DSS310-55Y271M.
FL3 thru FL21		Filter, MFG: MURATA ERIE, DSS310-55Y271M.
FL23 thru FL33		Filter, MFG: MURATA ERIE, DSS310-55Y271M.
		----------LEDS----------
H1	19A703595P2	Optoelectronic: yellow; MFG: MP.
		------ JACKS & RECEPTACLES ------
J1 thru J4	19B234771G1	Connector, MFG: MOLEX
J9	19J706197P3	Connector: 8 contacts; sim to AMP Type 520251-4.
J10 and J11	19A700072P2	Printed wire: 3 contacts rated @ 2.5 amps: MFG: MOLEX.
J13 thru J15	19A700072P2	Printed wire: 3 contacts rated @ 2.5 amps: MFG: MOLEX.
J16	19A700072P29	Printed wire: 3 contacts rated @ 2.5 amps: MFG: MOLEX.
J17 thru J24	19A700072P2	Printed wire: 3 contacts rated @ 2.5 amps: MFG: MOLEX.
J25		MFG: Molex #22-05-3031
		----------INDUCTORS----------
L1 and L2	19A700024P15	Coil.
		----------PLUGS----------
P5		Connector, MFG: MOLEX, 2461-12AK.
P6		Connector, MFG: MOLEX, AX-40187-A-YA14AAF102.
P8		Connector, MFG: MOLEX, 2461-05AK.
P10 and P11	19A702104P1	Receptacle: 2 position, shorting, rated at 3 amps; MFG: AMP.
P13 thru P15	19A702104P1	Receptacle: 2 position, shorting, rated at 3 amps; MFG: AMP.
P17 thru P24	19A702104P1	Receptacle: 2 position, shorting, rated at 3 amps; MFG: AMP.
		---------- TRANSISTORS ----------
Q1 thru Q10	19A700023P1	Silicon, NPN: MFG: JEDEC
Q11	19A700022P1	Silicon, PNP: MFG: JEDEC
Q12 thru Q14	19A700023P1	Silicon, NPN: MFG: JEDEC
		----------RESISTORS----------
R1	19A701250P327	Metal film: 18.7 ohms ±1%, 250 VDCW, 1/4 w.
R2	19A701250P319	Metal film: 15.4 ohms ±1%, 1/4 w. (Used in Voice Guard Module).
R2	19A701250P336	Metal film: 23.2 ohms ±1%, 1/4 w. (Used in AEGIS Module).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES.

SYMBOL	PART NO.	DESCRIPTION
R3	H212CRP322C	Deposited carbon: 22K ohms ±5%, 1/4 w.
R4 thru R6	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R7	19A701250P294	Metal film: 9.31K ohms ±1%, 1/4 w.
R8	19A701250P307	Metal film: 11.5K ohms ±1%, 1/4 w. (Used in Voice Guard Modules)
R8	19A701250P309	Metal film: 12.1K ohms ±1%, 1/4 w. (Used in AEGIS Modules)
R9	19A701250P330	Metal film: 20K ohms ±1%, 1/4 w.
R10	19A701250P270	Metal film: 5.23K ohms ±1%, 1/4 w.
R11	H212CRP315C	Deposited carbon: 15K ohms ±5%, 1/4 w.
R12	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R13	19A701250P409	Metal film: 121K ohms ±1%, 1/4 w.
R14	19A701250P209	Metal film: 1.21K ohms ±1%, 1/4 w.
R15	H212CRP347C	Deposited carbon: 47K ohms ±5%, 1/4 w. (Used in Voice Guard Modules)
R15	19A701250P403	Metal film: 105K ohms ±1%, 1/4 w. (Used in AEGIS Modules)
R16	H212CRP410C	Deposited carbon: 0.1M ohms ±5%, 1/4 w. (Used in Voice Guard Modules)
R16	19A701250P432	Metal film: 210K ohms ±1%, 1/4 w. (Used in AEGIS Modules)
R17 and R18	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R19 and R20	H212CRP322C	Deposited carbon: 22K ohms ±5%, 1/4 w.
R21	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R22	19A701250P318	Metal film: 15K ohms ±1%, 1/4 w.
R23 thru R25	19A701250P301	Metal film: 10K ohms ±1%, 1/4 w.
R26	19A701250P288	Metal film: 8060 ohms ±1%, 250 VDCW, 1/4 w.
R27	19A701250P269	Metal film: 5.11K ohms ±1%, 1/4 w.
R28	19A701250P201	Metal film: 1K ohms ±1%, 250 VDCW, 1/4 w.
R29	19A701250P322	Metal film: 16.5K ohms ±1%, 250 VDCW, 1/4 w.
R30	19A701250P210	Metal film: 1240 ohms ±1%, 250 VDCW, 1/4 w.
R31	19A701250P310	Metal film: 12.4K ohms ±1%, 1/4 w.
R32	19A701250P301	Metal film: 10K ohms ±1%, 1/4 w.
R33	19A701250P281	Metal film: 6.81K ohms ±1%, 1/4 w.
R34	H212CRP410C	Deposited carbon: 0.1M ohms ±5%, 1/4 w.
R35	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R36	H212CRP422C	Deposited carbon: 0.22M ohms ±5%, 1/4 w.
R37	H212CRP410C	Deposited carbon: 0.1M ohms ±5%, 1/4 w.
R38	H212CRP222C	Deposited carbon: 2.2K ohms ±5%, 1/4 w.
R39 and R40	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R41	H212CRP215C	Deposited carbon: 1.5K ohms ±5%, 1/4 w.
R42 thru R45	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R46	H212CRP247C	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R47	H212CRP210C	Deposited carbon: 1K ohms ±5%, 1/4 w.
R48	H212CRP322C	Deposited carbon: 22K ohms ±5%, 1/4 w.
R49	H212CRP147C	Deposited carbon: 470 ohms ±5%, 1/4 w.
R50 and R51	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R52	H212CRP210C	Deposited carbon: 1K ohms ±5%, 1/4 w.
R53	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R54	H212CRP210C	Deposited carbon: 1K ohms ±5%, 1/4 w.
R55	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R56	H212CRP210C	Deposited carbon: 1K ohms ±5%, 1/4 w.
R57	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R58	H212CRP210C	Deposited carbon: 1K ohms ±5%, 1/4 w.
R59	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R60	H212CRP210C	Deposited carbon: 1K ohms ±5%, 1/4 w.
R61	H212CRP110C	Deposited carbon: 100 ohms ±5%, 1/4 w.
R62	H212CRP139C	Deposited carbon: 390 ohms ±5%, 1/4 w.
R63	H212CRP110C	Deposited carbon: 100 ohms ±5%, 1/4 w.
R64	H212CRP127C	Deposited carbon: 270 ohms ±5%, 1/4 w.
R65	H212CRP210C	Deposited carbon: 1K ohms ±5%, 1/4 w.
R66	19A700113P63	Composition: 1K ohms ±5%, 1/2 w.
R67	H212CRP247C	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R68	H212CRP156C	Deposited carbon: 560 ohms ±5%, 1/4 w.
R69	19A701250P268	Metal film: 4.99K ohms ±1%, 1/4 w.
R70	19A701250P341	Metal film: 26.1K ohms ±1%, 1.4 w.
R71	19A701250P301	Metal film: 10K ohms ±1%, 1.4 w.
R72	19A700113P57	Composition: 560 ohms ±5%, 1/2 w.
R73	19A700113P55	Composition: 470 ohms ±5%, 1/2 w.
R74 and R75	H212CRP222C	Deposited carbon: 2.2K ohms ±5%, 1/4 w.
R77	H212CRP110C	Deposited carbon: 100 ohms ±5%, 1/4 w.
R78 and R79	H212CRP410C	Deposited carbon: 0.1M ohms ±5%, 1/4 w.
R80	19A701250P265	Metal film: 4.6K ohms ±1%, 1/4 w.
R81	H212CRP422C	Deposited carbon: 0.22M ohms ±5%, 1/4 w.
R82	H212CRP168C	Deposited carbon: 680 ohms ±5%, 1/4 w.
R83	H212CRP156C	Deposited carbon: 560 ohms ±5%, 1/4 w.
R84	H212CRP322C	Deposited carbon: 22K ohms ±5%, 1/4 w.
R85	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R86 thru R90	H212CRP222C	Deposited carbon: 2.2K ohms ±5%, 1/4 w.
R91	19A701250P250	Metal film: 3240 ohms ±1%, 1/4 w.
R92	H212CRP210C	Deposited carbon: 1K ohms ±5%, 1/4 w.
R93 and R94	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R95	H212CRP315C	Deposited carbon: 15K ohms ±5%, 1/4 w.
R96	19A701250P310	Metal film: 12.4K ohms ±1%, 1/4 w.
		----------SWITCHES----------
S1 and S2	19B800563P3	Push: DPDT, contacts rated 15 mA at 130 VDC; MFG: SCHADOW.
		----------INTEGRATED CIRCUITS----------
U1 and U2	19A701789P3	Operational Amplifier: QUAD-OP-AMP; MFG; MOTO.
U3	19J706018P2	Linear, QUAD COMPARATOR; MFG: MOTO.
U5	19A700029P38	Digital: TRIPLE 2-CHANNEL MULTIPLEXER.
U6	19A703987P13	Digital:MFG: MOTO.
U7	19A702987P14	Digital: MFG: MOTO.
U8	19A700029P35	Digital: HEX BUFFER/CONVERTER (NON-INVERTING). MFG: MOTO.
U9	19A703483P4	Digital, hex inverter, MFG: PANASONIC.
U10	19J706031P2	Linear, MFG: MOTO.
U11	19A704013P1	Voltage Regulator. (Negative). MFG: MOTO.
U12	19J706031P1	Linear: POSITIVE VOLTAGE REGULATOR, MFG: MOTO.
U13		Oscillator, 8.0 MHz, MFG: CTS, MXO-559A-2I.
		----------MISCELLANEOUS----------
	19C336648P1	Shield.
	19C336647P1	Shield.
		Standoff; MFG: R.A.F. Electronic Hardware, Inc., 3045-B-440-S-1-MOD. L = .600.
	19C850640P1	Knob for S1.
	19A701699P22	Nameplate for S1.
	19A121175P44	Insulator plate. (Used with J9).

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 - ANALOG BOARD 19D437979G1

To make Voice Guard compatible with Type 90, Type 99, DTMF and emergency GE-STAR when signalling is initiated by other than microphone PTT. Added C40, C41, R95 and R96. Changed J25 from a vertical type jack to a horizontal type jack.

J25 was 19A700072P29: Printed wire: 3 contacts rated @ 2.5 amps; MFG: MOLEX.

PARTS LIST

REMOTE MODE SELECT CABLE ISSUE 119B234849G1

SYMBOL	PART NO.	DESCRIPTION
	19A700041P30	Connector Shell.
	19A700041P29	Connector Shell.
	19A7000041P25	Contacts (Quantity 6).
	19A115871P30	Black Wire, 24 Ga.
	19A115871P22	White Wire, 24 Ga.
	19A115871P32	Blue Wire, 24 Ga.

4 - PIN CONNECTOR CONNECTS TO J9 ON LOGIC BOARD

3 - PIN CONNECTOR CONNECTS TO J25 ON ANALOG BOARD

NOTE: CONNECTORS ARE NOT KEYED. CONNECT PIN 1 TO PIN 1 ON JACKS.

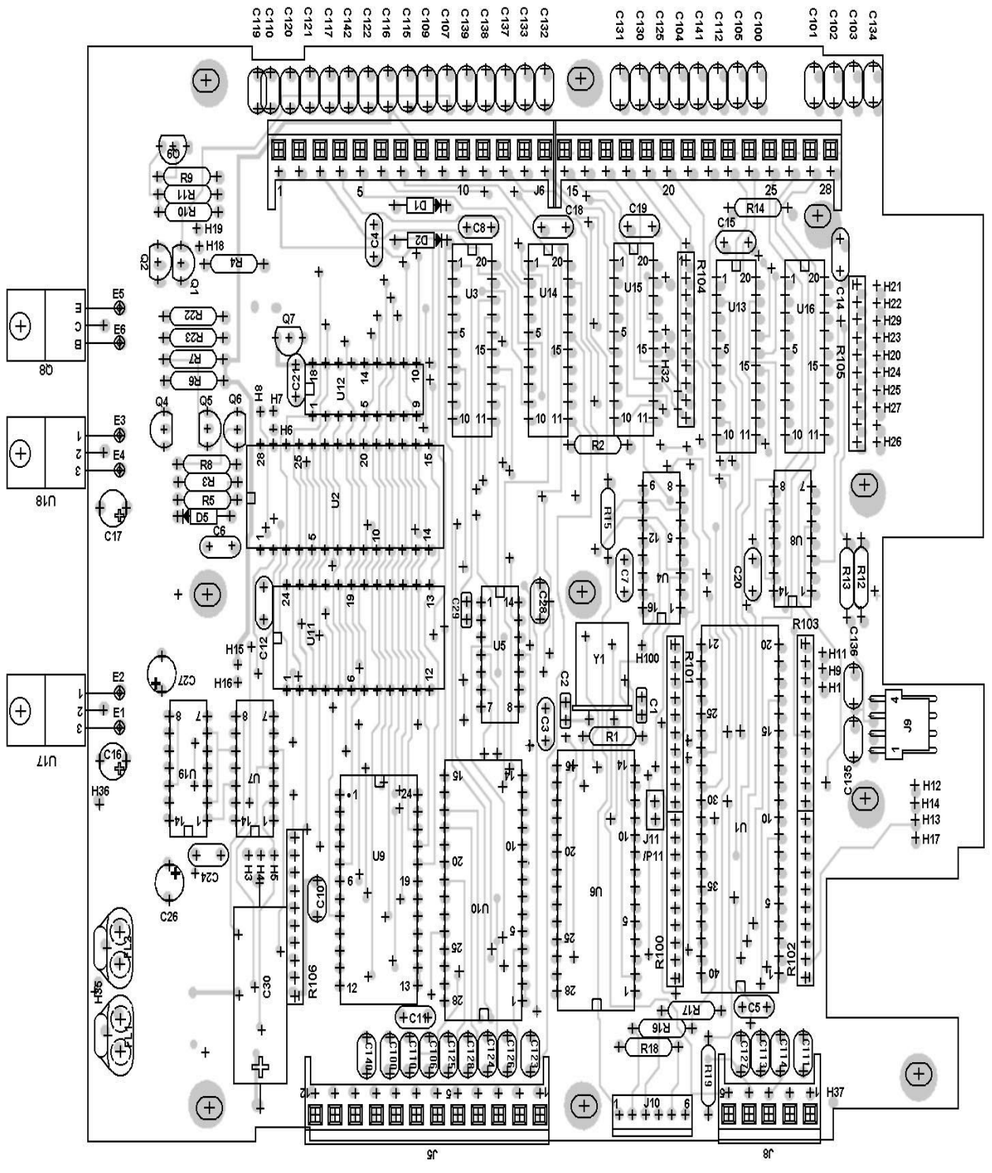
RC5262

PARTS LIST

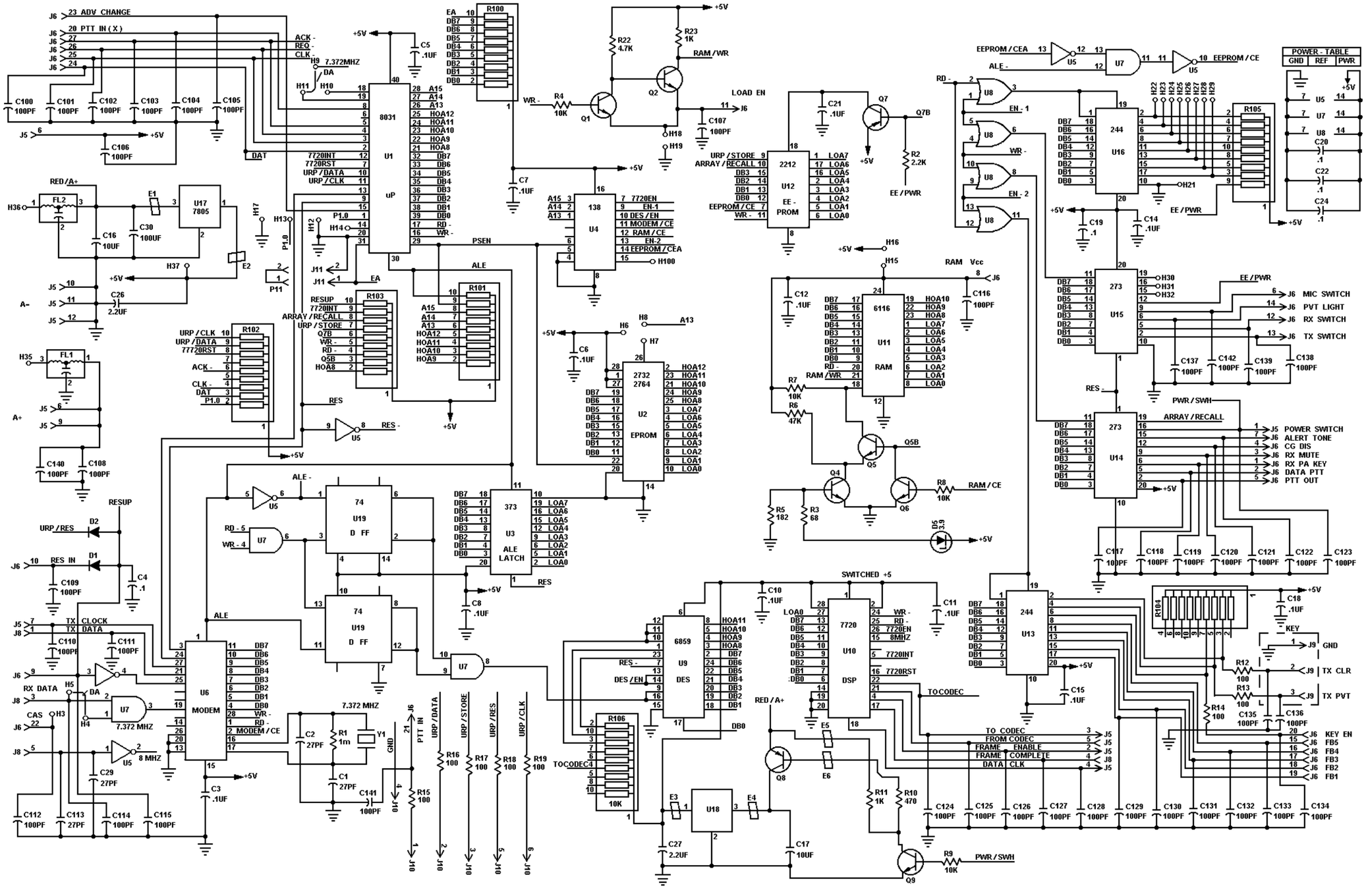
MECHANICAL PARTS VOICE GUARD ASSEMBLY (ASY/R3000100)

SYMBOL	PART NO.	DESCRIPTION
		NOTE: When ordering replacement parts, all vendor part numbers should be preceded by: ASY/
	R300101	Analog Board Assembly
	R300102	Logic Board Assembly
	R200064	Plate
	R400004	Frame Assembly
	R300113	Front Panel Assembly
	R300114	Light Diffuser
	R200067	Decorative Nameplate (Front)
L1	96-0022-XX	Mode Switch Assembly (includes Hardware and Mechanical Key 19A148909P51) MFG: MEDECO
L2	96-0023-XX	Fill / Lock Switch Assembly (includes Hardware and Mechanical Key 19A148909P50) MFG: MEDECO
	CT-A67	Flat Notched Cam
	R400005	Plastic Beyel
	R400006	Plastic Door
S1	E63-00HP-0014-0577	Micro Switch, MFG: CHERRY
S2	E63-00HP-0014-1248	Micro Switch, MFG: CHERRY
	R200068	Contact Plate
	R300115	Plate Backing
	R200069	Heat Sink Assembly
	R400009	Cover Assembly
	R300117	Interlocking Support
	R300118	Connector Harness Assembly
	R300120	Nameplate (GE Logo)
	N80P5006C6	Screw, 2-56 x 3/8 large flat head, Phillips (Quantity 5)
	N404P8C6	#2 Lock Washer (Quantity 4)
	N210P5C6	Hex Nut 2-56 (Quantity 4)
	N80P9006C6	Screw, 4-40 x 3/8 large flat head, Phillips (Quantity 4)
	N80P9004C6	Screw, 4-40 x 1/4 pan head, Phillips (Quantity 12)
	N80P9007C6	Screw, 4-40 x 7/17 large pan head, Phillips (Quantity 5)
	N80P15006C6	Screw, 8/32 x 3/8 large pan head, Phillips (Quantity 2)
		Hex Nut 4-40 (Quantity 6)
	N130P1712C	Screw #10 x 3/4 large slotted head, sheet metal (Quantity 4)

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



Logic Board
19D437827G1
(19D437828, Rev. 0)
(19A148718, Sh. 1, Rev. 5)



Logic Board
19D437827G1
(19D437980, Rev. 0)

PARTS LIST

LBI-31732
VGE LOGIC BOARD
ISSUE 3

SYMBOL	PART NO.	DESCRIPTION
		----------CAPACITORS----------
C1 and C2	19A700219P44	Ceramic: 27 pF ±5%, 100 VDCW.
C3 thru C8	19A116192P14	Ceramic: 0.1 uF ±20%, 50 VDCW; MFG: ERIE.
C10 thru C15	19A116192P14	Ceramic: 0.1 uF ±20%, 50 VDCW; MFG: ERIE.
C16 and C17	19A703314P10	Electrolytic: 10 uF -10+50%, 50 VDCW.
C16 and C17	19A703314P1	Electrolytic: 100 uF -10+50%, 10 VDCW; MFG: SPRAGUE.
C18 thru C21	19A116192P14	Ceramic: 0.1uF ±20%, 50 VDCW; MFG: ERIE.
C24 and C25	19A116192P14	Ceramic: 0.1uF ±20%, 50 VDCW; MFG: ERIE.
C26 and C27	19A701534P5	Tantalum: 2.2uF ±20%, 35 VDCW; MFG: SPRAGUE.
C28	19A116192P14	Ceramic: 0.1uF ±20%, 50 VDCW; MFG: ERIE.
C30	19A700064P4	Electrolytic: 100 uF, -10+150%, 250 VDCW.
C31	19A700219P64	Ceramic: 100pF ±5%.
C100 thru C142	19A700233P1	Ceramic: 100pF ±20%, 50 VDCW.
		----------DIODES----------
D1 and D2	19A700028P1	Silicon, fast recovery: fwd current 75mA, 75 PIV; MFG: JEDEC.
D5	19A700025P3	Silicon, zener: 400 mW max; MFG: MEDEC
D6 thru D9		Diode, LED, Green. MFG: HP.
		----------JACKS----------
J5		Connector. Sim to: MOLEX 26-11-6125.
J6		Connector. Sim to: MOLEX 26-11-6145.
J8		Connector. Sim to: MOLEX 26-11-6055.
J9		Connector. Sim to: MOLEX 22-05-3041.
J10	19A700072P32	Printed wire: 6 contacts rated at 2.5 amps; MFG: MOLEX.
		----------PLUGS----------
P11 thru P15	19A702104P1	Receptacle: 2 position, shorting, rated at 3 amps; MFG: AMP.
		----------RESISTORS----------
R1	19A701537P1	Composition: 10M ohms ±5%, 250 VDCW, 1/4 w.
R2	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R2	H212CRP222C	Deposited carbon: 2.2K ohms ±5%, 1/4 w.
R3	H212CRP068	Deposited carbon: 68 ohms ±5%, 1/4 w.
R3	H212CRP410C	Deposited carbon: 0.1M ohms ±5%, 1/4 w.
R4	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R5	H212CRP339C	Deposited carbon: 39K ohms ±5%, 1/4 w.
R5	H212CRP118	Deposited carbon: 180 ohms ±5%, 1/4 w.
R6	H212CRP347C	Deposited carbon: 47K ohms ±5%, 1/4 w.
R7 thru R9	H212CRP310C	Deposited carbon: 10K ohms ±5%, 1/4 w.
R11	H212CRP210C	Deposited carbon: 1K ohms ±5%, 1/4 w.
R12 thru R19	H212CRP110C	Deposited carbon: 100 ohms ±5%, 1/4 w.
R20	5493035P1	Wirewound: 5 ohms ±5%, 5 watt; MFG: HAMILTON HALL.
R22	H212CRP247C	Deposited carbon: 4.7K ohms ±5%, 1/4 w.
R23	H212CRP210C	Deposited carbon: 1K ohms ±5%, 1/4 w.
R24 thru R27	H212CRP127C	Deposited carbon: 270 ohms ±5%, 1/4 w.
R100 thru R106	19A701630P2	Resistor, network: 9 resistors rated 10K ohms ±2%, 50 VDCW; MFG: BOURNS.
		----------TRANSISTORS----------
Q1 and Q2	19A700084P1	Silicon, NPN; MFG: MOTO.
Q4	19A700023P1	Silicon, NPN; MFG: JEDEC.
Q5 and Q6	19A700084P1	Silicon, NPN; MFG: MOTO.
Q7	19A700022P1	Silicon, PNP; MFG: JEDEC.
Q8	19A116942P1	Silicon, PNP; MFG: GE.
Q8	19A116942P1	Silicon, PNP. (Not used in VG-9600-AR and VG-9600-ARW.)
Q9	19A70023P1	Silicon, NPN. (Used in Voice Guard Modules.)
Q9	19A700023P1	Silicon, NPN; MFG: JEDEC.
		----------INTEGRATED CIRCUITS----------
U1	19A704345P1	IC, Microcomp, MFG: INTEL.
U1	19A703104P1	Microcomputer: NMOS 8-bit; sim to P8031 AH.
U2	19A148972G7	Digital: 8K x 8-bit CMOS EPROM; sim to 2764. (Programmed. Used in VG-9600-C, VG-9600-CW, VG-9600-SR, VG-9600-SRW and VG-9600-SW.)
U2	19A705868G2	Digital: 8K x 8-bit CMOS EPROM; sim to 2764. (Programmed. Used in VG-9600-PR and VG-9600-PRW.)
U2	344A4513G3	Digital: 8K x 8-bit CMOS EPROM; sim to 2764. (Programmed. Used in VG-9600-DR and VG-9600-DRW.)
U2	344A4513G3	Digital: 8K x 8-bit CMOS EPROM; sim to 2764. (Programmed. Used in VG-9600-AR and VG-9600-ARW.)
U3	19A703471P2	IC, Digital, MFG: MOTO.
U4	19A704445P1	IC, Digital, MFG: MOTO.
U5	19A103483P4	IC, Digital, MFG: PANASONIC.
U6	ROA 110 688/3A	IC, Modem.
U7	19A703483P5	IC, Digital, MFG: RCA.
U8	19A703483P11	IC, Digital, MFG: MOTO.
U10	19A703984P40	IC, Microprocesssor, MFG: GE.
U10	344A4452P3	Digital Signal Processor; sim to 77C25. (Used in VG-9600-DR and VG-9600-DRW.)
U11	19A703952P1	EEPROM (NOT PROGRAMMED)
U12	19A703072P1	EEPROM (NOT PROGRAMMED)
U12	344A3000P10	Digital: EEPROM. (Programmed. Used in VG-9600-SW.)
U12	344A3000P20	Digital: EEPROM. (Programmed. Used in VG-9600-C and VG-9600-CW.)
U12	344A3000P30	Digital: EEPROM. (Programmed. Used for station applications in VG-9600-SR and VG-9600-SRW.)
U12	344A3000P50	Digital: EEPROM. (Programmed. Used for CIU applications in VG-9600-SR and VG 9600-SRW.)
U12	344A3000P41	Digital: EEPROM. (Programmed. Used in VG-9600-PR and VG-9600-PRW.)
U12	344A3000P240	Digital: EEPROM. (Programmed. Used in VG-9600-DR and VG-9600-DRW.)
U12	344A3000P230	Digital: EEPROM. (Programmed. Used in VG-9600-AR and VG-9600-ARW.)
U13	19A703471P1	Digital: OCTAL TRI-STATE BUFFER, MFG: MOTO.
U14 and U15	19A704380P11	IC, Digital, MFG: MOTO.
U16	19A703471P1	Digital: OCTAL TRI-STATE BUFFER, MFG: MOTO.
U17 and U18	299A6459P8685	Linear: POSITIVE VOLTAGE REGULATOR; MFG: MOTO.
		----------SOCKETS----------
XU1		Sim to : C. A. CA-40SDL-1T
XU2		Sim to : C. A. CA-28SDL-1T
XU6		Sim to : C. A. CA-28SDL-1T
XU9		Sim to : C. A. CA-24SDL-1T
XU10		Sim to : C. A. CA-28SDL-1T
XU11		Sim to : C. A. CA-24SDL-1T
XU12		Sim to : C. A. CA-18SDL-1T
		----------CRYSTALS----------
Y1	19A702511	7.372800.54 MHz, MFG: NDK.

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 VG-9600 (19A148909P2, P12, P14 and P15)
To improve Voice Guard compatibility with T90, T99, DTMF and GE-STAR when signalling is initiated by other than a microphone PTT, added C40, C41, R95 and R96 to the Analog Board. Also changed J25 to a horizontal jack. Jack J25 was 19A700072P2. Changed firmware EPROM (U2) to 19A148972G2.

REV. B VG-9600 (19A148909P2, P12, P14 and P15)
To improve operation, changed microcomputer U1 from an 80C31 (19A704345P1) to an P8031AH (19A703104P1). Also changed firmware EPROM (U2) to 19A148972G3.

REV. C VG-9600 (I9AI48909P2, P12,P14, P15 andP16)
To improve RFI characteristics, added 100 pF decoupling capacitors C111, C114, C115, C120, C121 and C122 to the Logic Board.

REV. D VG-9600 (19A148909P2, P12,P14, P15 andP16)
No change.

REV. E VG-9600 (19A148909P2, P12, P14, P15 and P16)
To provide two-frequency operation in CIU applications, updated firmware. New EPROM (U2) is 19A148972G4.

REV. F VG-9600 (19A148909P2, P12, P14, P15 and P16)
To improve PSLM hangtime and GE-STAR operation, updated firmware. New EPROM (U2) is 19A148972G6.

REV. G VG-9600 (19A148909P2, P12, P14, P15 and P16)
To provide "start data" timer for CIU applications, updated firmware. New EPROM (U2) is 19A148972G7.

REV. H VG-9600 (19A148909P2, P12, P14, P15, P16, P30 andP31)
To improve VG intelligibility, the following components were changed on the Analog Board in the microphone input band-pass circuit: Resistor R2 was changed from 23.2K to 15.4K ohms and R8 was changed from 20K to 11.5K ohms. Also, capacitor C42 (0.0033 mF) was added.

REV. J VG-9600 (19A148909P30 and P31)
To improve operation of CIU and GE-STAR timers, updated firmware. New EPROM (U2) to 19A705868G2.

REV. K VG-9600 (19A148909P2, P12, P14, P15, P16,P30 andP31)
To improve DES key retention and EDACS CIU operation, added R97 to all modules and changed EEPROM (U12) in VG-9600-PR (19A148909P30) and VG-9600-PRW (I9A148909P31) modules to 344A3000P41.

REV. L VG-9600 (19A148909P16 and P30)
Changed front panel nameplate.

REV. M VG-9600 (19A148909P40 and P41)
Added DVIU Aegis Modules VG-9600-DR and VG-9600-DRW. Both modules use firmware EPROM (U2) 344A4513G2 and personality EEPROM (U12) 344A3000P240. In addition, on the Logic Board, DSP U10 is changed and Q9 is removed and replaced with a jumper (collector to emitter). Also, on the Analog Board, C42 is removed, and R2, R8, R15 and R16 are changed.

REV. N VG-9600 (19A148909P40 and P41)
To improve operation, changed firmware EPROM (U2) to 344A4513G3. Add the following Production Change information to page 30:

REV. O (Not Used)

REV. P VG-9600 (19A148909P60 and P61)
Added E/D station Aegis Modules VG-9600-AR and VG-9600-ARW. Both modules use firmware EPROM (U2) 344A4511G3 and personality EEPROM (U12) 344A3000P230. In addition, on the Logic Board, Q8 is removed and replaced with a jumper (collector to emitter).

REV. P VG-9600 (19A148909P40 thru P43)
REV. Q VG-9600 (19A148909P60 thru P63)
REV. M VG-9600 (19A148909P1 thru P33)
Obsolete part for U4 (19A703924P1).
Changed R8 from 10K (19A701250P301)
and R9 from 23.7K (19A701250P337).

REV. N VG-9600 (19A148909P1 thru P32)
REV. Q VG-9600 (19A148909P40 thru P43)
REV. R VG-9600 (19A148909P60 thru P63)
To eliminate a clock slip problem U6 was changed to ROA 101 688/3A.