Maintenance Manual

EDACS® RCN 1000
TONE REMOTE CONTROLLER

CAUTION

THESE SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID ELECTRIC SHOCK DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN THE OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO. REFER ALL SERVICING TO QUALIFIED SERVICE PERSONNEL.

WARNING: TO PREVENT FIRE OR ELECTRIC SHOCK HAZARD.
DO NOT EXPOSE THIS PRODUCT TO RAIN OR MOISTURE.

CAUTION: TO PREVENT ELECTRIC SHOCK DO NOT USE THIS (POLARIZED PLUG WITH AN EXTENSION CORD, RECEPTACLE OR OTHER OUTLET UNLESS THE BLADES CAN BE FULLY INSERTED TO PREVENT BLADE EXPOSURE

ERICSSON

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NOTICE!

This manual covers Ericsson and General Electric products manufactured and sold by Ericsson Inc.

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!

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SPECIFICATIONS *

Audio Output Receive Mode (Speaker)	3 watts into a 4 ohm load with less than 3% distortion
Transmit Mode	+ 11 dBm into a 600 ohm line load (Line)
Compression Range	With an audio increase of 30 dB beyond the start of compression, output level increases less than 3 dB
Frequency Response	±1 dB for the frequency range from 300 to 3000 Hz
Power Requirements	110/220 Vac ±20%, 50/60 Hz, 12 watts (TX), 16 watts (RX) and 10 watts (Stby)
Dimensions (H x W x D)	3-1/2" X 10-3/8" X 8-1/8" (Without handset holder)

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

WARNING

No one should be permitted to handle any portion of the equipment that is supplied with high voltage; or to connect any external apparatus to the units while the units are supplied with power. **KEEP AWAY FROM LIVE CIRCUITS**.

High-level RF energy in the transmitter power amplifier assembly can cause RF burns. **KEEP AWAY FROM THESE CIRCUITS WHEN THE TRANSMITTER IS ENERGIZED!**

IMPORTANT SAFETY INSTRUCTIONS

SAVE THIS MANUAL - It contains important safety and operating instructions for the RCN 1000 Remote Control Unit.

Do not use auxiliary equipment not recommended or sold by the manufacturer. To do so may result in a risk of fire, electric shock, or injury to persons.

To reduce risk of damage to electric plug and cord, pull by plug rather than cord when disconnecting unit.

Make sure the cord is located so that it will not be stepped on, tripped over, or otherwise subjected to damage or stress.

An extension cord should not be used unless absolutely necessary. Use of improper extension cord could result in risk of a fire and electric shock. If extension cord must be used, make sure:

a. that pins on plug of extension cord are the same number, size and shape as those of plug on unit

b. that extension cord is properly wired and in good electrical condition; and

c. that wire size has large enough AC ampere rating as specified in Table 1.

Table 1 - Recommended Minimum Size For Extension Cords

Length of Cord(ft)	25	50	100	150
AWG Size of Cord	18	18	18	16

Do not operate unit with damaged cord or plug - replace them immediately.

Do not operate unit if it has received a sharp blow, been dropped, or otherwise damaged in any way; take it to a qualified service shop.

Do not disassemble the unit; return it to a qualified service shop when service or repair is required. Incorrect reassembly may result in a risk of electrical shock or fire.

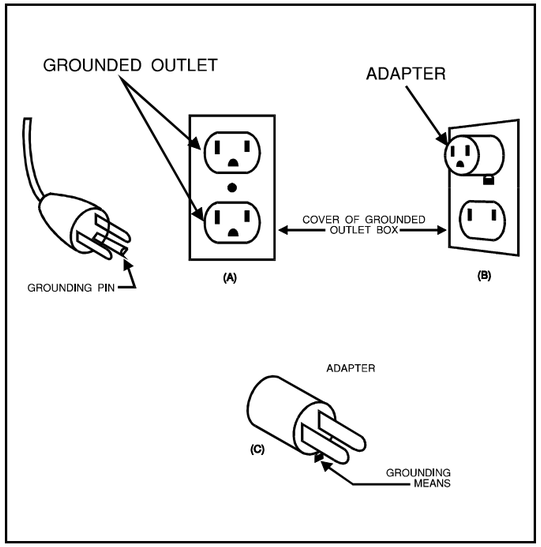
To reduce risk of electrical shock, unplug unit from outlet before attempting any maintenance or cleaning.

GROUNDING AND AC POWER CORD CONNECTION - To reduce risk of electrical shock use only a properly grounded outlet. The unit is equipped with an electric cord having an equipment grounding conductor and a grounding plug. Be sure that the outlet is properly installed and grounded in accordance with all local codes and ordinances.

DANGER - Never alter AC cord or plug provided. If it will not fit outlet, have proper outlet installed by a qualified electrician. Improper connection can result in a risk of an electric shock.

This unit is for use on a 110-volt circuit and has a grounding plug that looks like the plug illustrated in Figure 1. A temporary adapter, which looks like the adapter illustrated in sketches **B** and **C**, may be used to connect this plug to a two-pole receptacle as shown in sketch **B** if a properly grounded outlet is not available. The temporary adapter should be used only until a properly grounded outlet can be installed by a qualified electrician.

DANGER - Before using adapter as illustrated, be certain that center screw of outlet plate is grounded. The green-color rigid ear or lug extending from adapter must be connected to a properly grounded outlet - make certain it is grounded. If necessary, replace original outlet cover plate screw with a longer screw that will secure adapter ear or lug to outlet cover plate and make ground connection to grounded outlet.



OPTION	DESCRIPTION
RCZ001	ALERT TONE
RCZ002	CLOCK/VU METER
RCZ003	SUPERVISORY CONTROL
RCZ004	ALTERNATE LINE
RCZ005	4 WIRE AUDIO (STANDARD)
RCZ011	SPEAKER MUTE
RCZ012	INTERCOM
RCZ017	WALL MOUNT BRACKET
RCZ021	FOOTSWITCH
RCZ022	FOOTSWITCH W/ EARMUFF
RCZ023	FOOTSWITCH W/ EARPIECE HEADSET

DESCRIPTION

The **RCN 1000** Remote Controller is used to control remote or remote/repeater base station radios. The **RCN 1000** remote controller is housed in a specifically designed plastic enclosure to provide a modern clean design. It is available with either a handset or desk microphone.

The **RCN 1000** Remote Controller utilizes audio tones in the range from 1050 Hz to 2175 Hz. These audio tones are applied to the voice grade audio circuit that connects the remote controller to the termination panel. These tones are used to activate specific functions on the panel which allow the remote operator to control the base station radio. Each specific function tone is proceeded by a "**Secur-It**" tone which is a burst of 2175 Hz at a level that is 10 dB higher than the function tone. The Secur-It tone must be present for 100 milliseconds before the panel will recognize it as valid. The function tone is then transmitted for 40 milliseconds. See Table 2 for a listing of the function tone frequencies and their related functions.

A "**Hold**" tone (2175 Hz) is transmitted at a level 20 dB below the level of the function tone, which is 30 dB below the Secur-It tone. This "**Hold**" tone enables the transmit function on the appropriate frequency and holds the transmitter keyed as long as the PTT button on the remote is pressed. When the PTT is released the 2175 Hz Hold tone is removed and the transmission stops.

Table 2 - Tone Control Function And Frequency

FUNCTION	FREQUENCY (HERTZ)
SF1	1950
SF2	1850
SF3	1350
SF4	1250
SF5	1050

OPTIONS

In addition to the variations available in the combination nomenclature, there are other options available to the tone control versions. These versions are as follows:

RCZ001 Alert Tone: Permits the dispatcher to transmit an alerting tone for messages of more than the usual importance.

RCZ002 Clock/VU Meter: Displays time in either 12 or 24 hour format, and audio level indication.

RCZ003 Supervisory Control: Enables the dispatcher to comply with FCC regulations in connection with parallel remotes. Not compatible with RCZ004. Requires one switch position.

RCZ004 Alternate Line Selection: Allows selection of an alternate line, but, does not monitor un-selected line. Not compatible with RCZ003. Requires one switch position.

RCZ005 Four Wire Audio: Provides connections for four wire circuits.

RCZ011 Partial Speaker Mute: Permits operator to reduce volume for phone calls, etc. Requires one switch position.

RCZ012 Intercom: Permits intercom function between paralleled units without keying transmitter.

RCZ017 Wall Mount Bracket

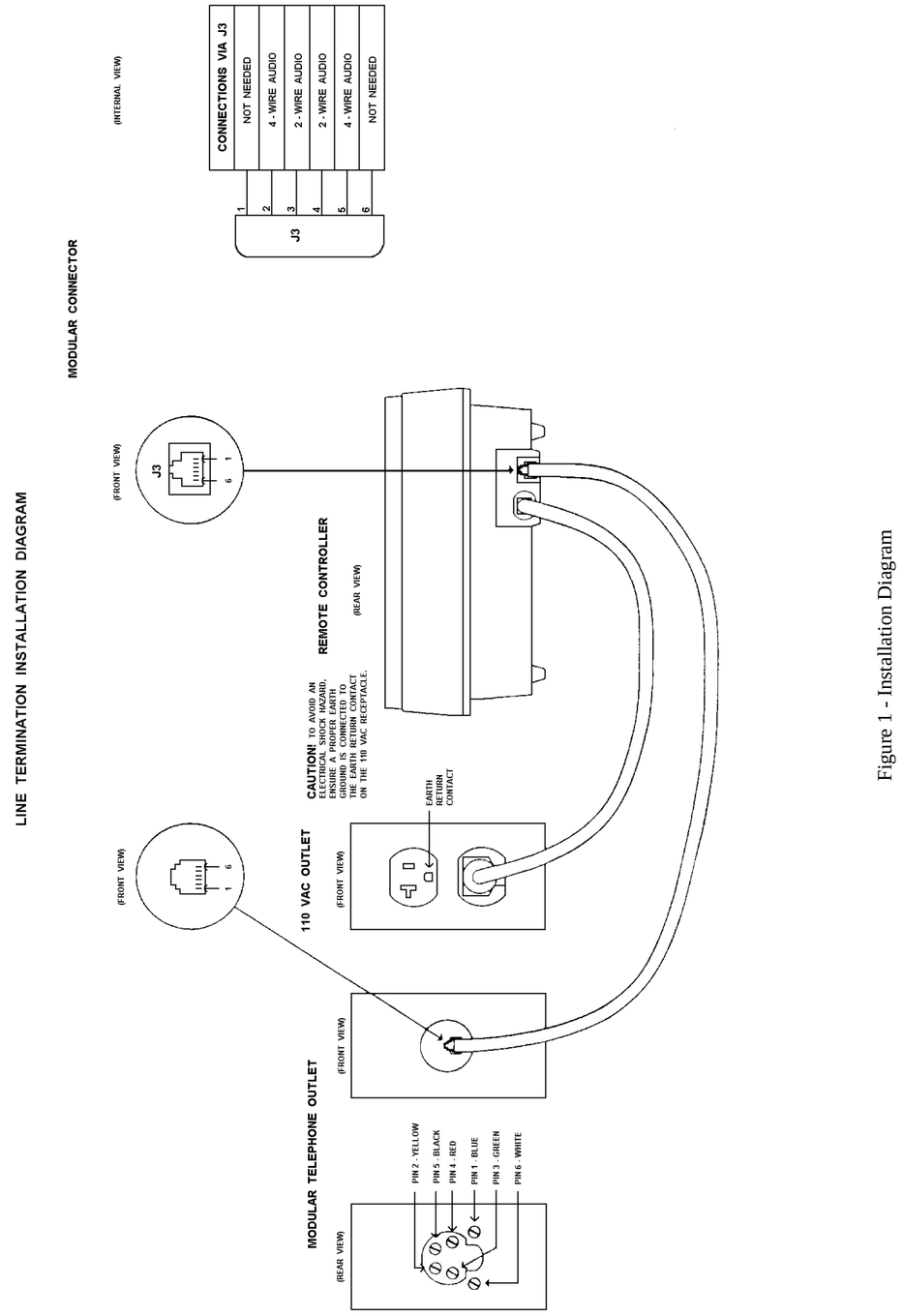


Figure 1 - Installation Diagram

INSTALLATION

Installation of the RCN 1000 involves connecting power and ground to the controller, connecting audio/control lines, and adjustment of audio levels (some cases). Power and telephone line connection to the RCN 1000 are shown in Figure 1. The four-wire path between the RCN 1000 and the remote station panel is shown in Figure 2.

AUDIO/CONTROL LINE CONNECTIONS

A standard 6-pin modular connector (J3) is used on the remote controller for telephone audio connections. A 6-wire cable is supplied with the unit for connection between J3 and the telephone outlet. A standard 4- or 6-wire harness available from any telephone sales and service center can also be used.

Connections to J3 are described in Table 3. See Figure 1 for pin locations.

Table 3 - Telephone Connections To J3

J3-PIN	WIRE COLOR	SIGNAL
1	WHITE	NOT USED
2	BLACK	RECEIVE AUDIO
3	RED	TRANSMIT AUDIO
4	GREEN	TRANSMIT AUDIO
5	YELLOW	RECEIVE AUDIO
6	BLUE	NOT USED

DC POWER CONNECTION

The RCN 1000 may be operated from + 13.8 Vdc. Connect + 13.8 Vdc (nominal) to J6-2 and ground to J6-1. Maximum current drain is 0.7 amp. No battery charging is provided by the RCN 1000. Make sure the power supply line is adequately fused.

AC POWER CONNECTION

The RCN 1000 may be operated from a 110 Vac, 50/60 Hz power source. The unit may be converted for 220 Vac operation by a qualified technician. The power plug must be changed after the unit is converted for 220 volt operation.

PROPER GROUNDING PRACTICES

A good earth ground is required to maintain surge protection on the power and audio lines. It is imperative that a good earth ground be used on the ground conductor of the power cord. A **SERIOUS SHOCK HAZARD** could develop if lightning struck the control or power line. See the safety instructions at the front of this manual.

WARNING

Do not service this unit in the presence of a local lightning storm. Lightning may strike audio or power lines and travel down to the unit causing serious injury. Lightning may also cause damage to internal circuits when a good earth ground is not provided and lightning strikes audio or power lines.

DISCUSSION OF TELEPHONE LINES

GENERAL

This discussion covers telephone lines that are commonly used between remote control units and remotely controlled base stations.

Characteristics of these voice grade lines and their application to Land Mobile communications systems will be covered. This discussion refers to frequency response only to the point where it affects tone signalling. It does not cover total audio frequency response as related to audio quality.

SIMPLE LINES

In a number of cases the radio user will provide wires within a building or complex of buildings. Normally these are short and involve very little loss.

TYPES OF VOICE GRADE TELEPHONE LINES

These lines are normally obtained from a communications common carrier ("phone company" for our purposes here). When you ask for a voice grade (as contrasted to a "data line") telephone line you don’t know what type of line you will get from the phone company. Worse than that, they may supply one type first and later change it to another type without telling you or the user.

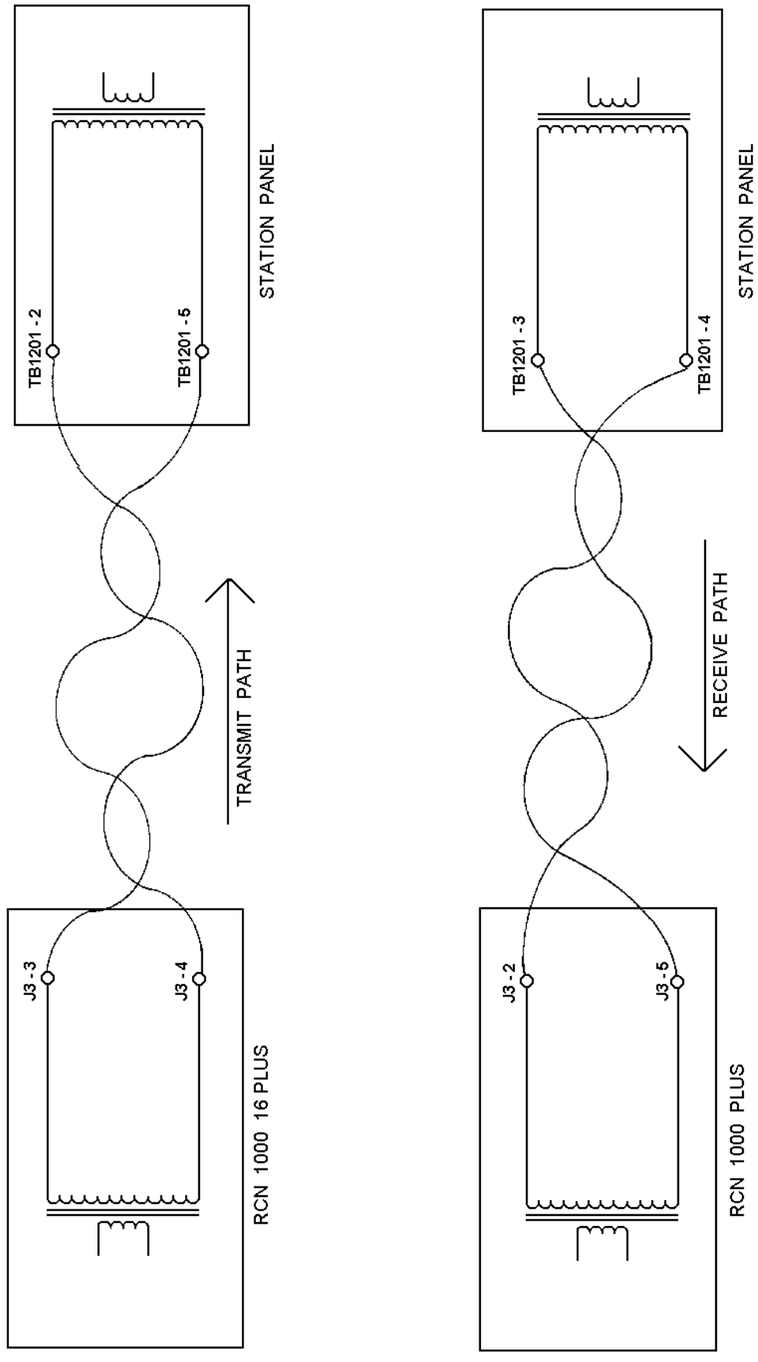


Figure 2 - Audio Path

You can expect one of the following:

1. Wire lines with no amplifiers.

2. Wire lines with amplifiers added to compensate for line loss.

3. Facilities derived from carrier (multiplex).

These three types of lines are different and each must be treated differently. In large systems you may end up with all three types of lines. In long haul applications you may end up with two or three of these types of lines in tandem (tied together end-to-end).

The first type is **WIRE LINE WITH NO AMPLIFIERS**. These are the same lines that you have been using for years to control DC systems. These are the easiest to work with since they include no problem causing electronic equipment. These are usable on tone systems, we just don't apply DC current to them. You will find these lines in less populated areas where the phone company has not yet gone to carrier systems.

These lines have a fixed amount of loss which varies with frequency, temperature, from deterioration of splices, and from moisture getting into the cables. When these cables get old, the phone company sometimes applies DC current to improve the joints and lower the line loss.

You are normally allowed to apply + 10 dBm test tone to these lines. These lines do not normally include any type of voice limiters.

The second type of line is a **WIRE LINE WITH AMPLIFIERS**. These lines are normally supplied when the loss of available lines is too high. An amplifier or several amplifiers are added to the line to make up for the loss.

One commonly used amplifier is the E-6 repeater. This amplifier will pass DC current and has been used on DC lines for years. These amplifiers include limiters which start limiting around 0 dBm input to the amplifier. The limiters do not cause any real problems on DC systems since only the voice peaks are clipped. However, special care must be used when you apply them to tone remote control systems.

Each amplifier can be adjusted for up to 12 dB of gain. If the loss the phone company is making up is more than 12 dB, one or more amplifiers are added. The amplifier(s) may be placed at any point in the line.

The third type of telephone line is a **DERIVED FACILITY** using carrier equipment. Since this is the most complicated we have to apply much more care when connecting our radio equipment. This type of line is becoming more common.

The phone company supplies two wires at each end of the circuit. Each two wire end goes to some point in the circuit where it is converted to a four wire circuit and connected to the carrier equipment. Of course, you can order a four wire circuit if that is what you desire. At the other end it is taken out of the carrier equipment and converted back to the two wire. The carrier equipment has a transmit path and a receive path. The gain is adjustable each way.

The phone company wants to see a maximum three second level of -13 dBm at the carrier equipment as measured on a modified Western Electric 3-type noise measuring set. The telephone equipment will limit the audio if the signal is above -13 dBm at the carrier input. This does not mean that the maximum you can put into the two wire end is -13 dBm. If your equipment is a good distance from the carrier equipment, you will have some line loss. If the loss is 5 dB, for instance, then you could put in -8 dBm into the two wire end. Therefore, you will have to ask the phone company in each case what level you are allowed to put into the two wire end. If the phone company checks and finds that you are putting too much audio into the carrier equipment, they will put a pad into the circuit to cut the audio down.

When you ask the phone company what level you can put into the line they will either give the level to you in Volume Units (VU) or test tone. VU is average voice which is generally considered to be 10 dB below test tone. Test tone is 1004 or 1000 Hz tone used to line up the circuit. Test tone is normally given in dBm. If you are not careful, you and the phone company will be 10 dB apart. If the phone company says the limit is 0 VU, use + 10 dBm for your lineup.

The two wire ends of these lines are normally designed to work with 600 ohms impedance in and out. The transmit and receive carrier equipment gains are set up for 600 ohm terminations. If the line to the carrier equipment is fairly long, the impedance at which you feed the two wire end is not very critical. But, if the two wire end is close to the carrier equipment then the impedance is critical. If your impedance is not 600 ohms you can cause the gain of the carrier equipment to go up or down. In some cases, your will get feedback (oscillations) from the receive path to the transmit path. A common problem which causes oscillations in the carrier equipment is gain change, whether from misadjustment or other reasons.

American Telephone and Telegraph Company has published a reference for Voice Grade Lines entitled, "Private Line Interconnections, Voice Applications" (Publication Number 43201). It covers several types of private line interfaces. There is no publication that covers radio control alone. There are several parameters given which are important to us.

The 1000 Hz loss design objective is 0 to 10 dB. If you do not specify the loss, you will get a loss of 10 dB at 1000 Hz in most cases. The phone company allows itself a **SHORT-TERM** fluctuation of ±3 dB and a **LONG-TERM** variation of ±4 dB. If a 10 dB loss line at 1000 Hz is specified, you can expect up to 14 dB loss and the phone company would still be within their design limits. The loss between 500 and 2500 Hz can be + 2 dB and -8 dB relative to 1000 Hz loss. Note that the phone company may refer to this as -2 and + 8. The loss between 300 and 3000 Hz can be + 3 dB to -12 dB relative to the 1000 Hz loss. This says that if you have a line with 10 dB of loss at 1000 Hz, you can expect as much as 18 dB of loss at 2500 Hz and 22 dB of loss at 3000 Hz. You must also add the ±4 dB of long-term variation to this loss.

The noise of this type of line is measured at each end with a Western Electric 3-type noise meter. The allowable level of a line from 0 to 50 miles is 31 dBrnC and for a line from 51 to 100 miles is 34 dBrnC. If you do not have this type of meter, use an AC VTVM. If you get a noise reading of -50 dBm or less, generally this is considered an acceptable circuit.

TONE REMOTE CONTROLLED SYSTEMS

As contrasted with DC systems, where audio level setting was not as critical, it is important that levels be set properly. Failing to do so results in the control function not working properly. For example, you put the system in and after the user has a little experience he finds that he is not always picking up the function he selected. Then you will have a hard time pinning down the problems. A little extra time spent at the installation will save many problems in the end.

Our equipment is designed so that the tone sequence consists of either two or three parts. The first part is the **Secur-it** tone (2175 Hz) which is sent at the highest level or approximately 125 milliseconds. This is followed by the function tone which is sent at a level 10 dB lower for approximately 40 ms. In the case of a transmit function, the function tone if followed by 2175 Hz at a level 30 dB down from the **Secur-it** burst (therefore, it is 20 dB down from the function tone burst). This tone continues for the duration of the transmit function. The average voice (0 VU) is sent at the same level as the function tone, therefore, the test tone for the voice is sent at the same level as the **Secur-it** tone.

Secur-it tone must arrive at the base station at no less than -20 dBm. The transmit hold tone must arrive at the base station at no less than -50 dBm. The test tone for the voice must arrive at the base station at no less than -20 dBm. Therefore, the limits of system operation is usually established by only three things:

1. The maximum level at 2175 Hz that the phone company will allow you to send from the most distant point in the system. Normally this will not be higher than 0 dBm. In some cases it may even be less, or on rare occasions it may be + 5 or + 10 dBm.

2. The loss of the circuit at 2175 Hz. Do not forget the long-term variation of up to 4 dB more.

3. The requirement that the **Secur-it** burst must arrive at the base station at no less than -20 dBm.

Normally most systems will not crowd these limits. However, if you come up a few dB short you can consider adding C-1 conditioning. Do not turn up the tone sending level because that will cause improper operation. When you increase the level, the **Secur-it** tone burst will go into limiting in the phone company equipment. The limited tone causes the **Secur-it** tone filter in the base station to ring and thereby pick up or drop out functions which you did not select. **NEVER** allow the **Secur-it** tone to be in limiting.

There is an easy way to check and see if the **Secur-it** tone is in limiting. With the phone lines connected to the equipment at both ends, connect an AC VTVM across the phone line at the base station. Arrange to send a burst of Secur-it tone long enough to measure the incoming level on the AC VTVM. Then arrange to send a burst of 1950 Hz function tone long enough to measure the incoming level on the AC VTVM. If the 1950 Hz tone does not arrive 10 dB (±1 dB) less than the **Secur-it**, then the **Secur-it** is in limiting. You will have to lower the sending level at the remote controller until you are below limiting.

If the audio is high enough to cause the telephone equipment to go into limiting it will cause amplitude distortion. On a high loss line the amplitude distortion will cause the HOLD tone (2175 Hz) to vary and the transmitter to drop out. This can be checked by monitoring the test point specified. If the level is below the amount indicated, the transmitter will unkey from time to time.

On tone controlled remote controlled systems, you must be very careful when connecting two telephone lines in tandem. For instance, if you have a base station and two remotes. You order a phone line to connect the station to the first remote and a second line to connect the second remote. The loss of each line is added and the tones from the second remote may not operate the base station. You can either specify a low loss on each line or run each line directly to the base station. You should check with the phone company and see which approach is the least expensive over a period of time, i. e. an analysis of nonrecurring costs versus recurring costs over the expected length of time the circuit will be used.

VOTING SYSTEM CONSIDERATIONS

The voting system has one problem that the tone remote system does not have. That is, we put continuous 1950 Hz tone on the line when the receiver is squelched. The **Secur-it** tone, by contrast, is a short burst and can be sent higher than the 1950 Hz continuous tone.

The 1950 Hz tone must arrive at the voting selector at not less than -30 dBm. If you order a voice grade line and don't specify the loss, you normally get a line with 10 dB of loss at 1000 Hz. The 1950 Hz loss will normally be 8 dB more than at 1000 Hz. By adding the 4 dB long-term variation the worst case 1950 Hz loss would be 22 dB. It then follows that you cannot send any lower than -8 dBm. If the phone company will not allow you to send continuous tone as high as -8 dBm, then you will have to ask for a lower loss circuit or add C-1 conditioning.

When ordering phone lines for a voting system, if possible, you should get all lines of the same type with the same amount of loss. The voter includes the telephone line characteristics in its selection of the best signal. It is improper system design to have the received signal selection biased by a "poorer" telephone circuit. Many phone companies will add pads to build out the lines. If you ask when the lines are ordered it should not cause any problem to build them all out to have the same loss.

ORDERING VOICE GRADE TELEPHONE LINES

If you order a standard voice grade circuit and do not specify the loss you will normally get the following:

1. Loss at 1000 Hz: 5 to 10 dB; normally 10 dB
2. Long-term variation: ±4 dB
3. Amplitude distortion (frequency response) Referenced to 1000 Hz; + = more loss
   300 to 3000 Hz: -3 to + 12 dB
   500 to 2500 Hz: -2 to + 8 dB
4. Noise: 31 dBrnC maximum
5. Frequency translation error: ±5 Hz
6. Normal impedance: 600 ohms
7. Maximum permitted signal into the line: -6 dBm to -13 dBm in band three second average (the level arriving at the carrier equipment cannot be more than -13 dBm)

By adding C-1 conditioning you change the loss to:

Amplitude distortion (frequency response) Referenced to 1000 Hz: + = more loss
300 to 2700 Hz: -2 to + 6 dB
1000 to 2400 Hz: -1 to + 3 dB

One added advantage to C-1 conditioning is that the voice quality will be improved, by boosting the high frequency components.

ORDERING INFORMATION FOR THE PHONE COMPANY

1. Type circuit: Voice grade, 2 wire termination, for radio control, and tone remote system - send/receive (voting system - receive only)
2. DC continuity not required
3. Impedance: 600 ohms ±20%
4. Loss: Tone remote system

   We send 125 ms of 2175 Hz tone and it must arrive at the base station at no less than -20 dBm including long-term variation. Average voice is 10 dB below the 2175 Hz tone burst.

   Voting system: We send continuous 1950 Hz tone when the receiver is squelched. The tone must arrive at the voting selector at no less than -30 dBm including the long-term variation.
5. C-1 conditioning if necessary. If two phone lines are to be tied in tandem, it is usually proper to specify C-1 conditioning.
6. If more than one phone line is to be used, you should provide a block diagram showing locations and type of equipment to be used.

DISCUSSION ON E & M CONNECTIONS

Audio

The four wire audio option, RCZ005, will be required in most cases. It is suggested that a pad of approximately 16 dB be placed in the line between the **RCN 1000** transmit audio (J3-3 and -4) and the carrier/MUX input terminals which normally expects a -16 dBm input. This enables the **RCN 1000** output to be adjusted to 0 dBm. Similarly, it is suggested that a pad of approximately 7 dB be placed in the line between the carrier/MUX output terminals (which normally deliver a + 7 dBm output) and the **RCN 1000** receive audio (J3-2 and -5).

Control

Usually no control provisions need be made as the tone models of the **RCN 1000** utilize in-band tone signaling.

CIRCUIT ANALYSIS

GENERAL

The tone control RCN 1000 is comprised of two major printed circuit boards. The main board (-0167), and the keypad/display board (-0164). There is also a board known as the parallel option board (-0171). A block diagram is shown in Figure 3.

KEYPAD/DISPLAY BOARD (0164) ANALYSIS

Volume Control

Volume control switches set the volume control circuit on the main board. The switches are ORed together by diodes D21 and D23, which in turn is connected to inverter U7B. The output from this inverter is again ORed by diodes D24 and D25 which disables the volume function when the "**CLK**" function is activated. This feature accomplishes clock setting using the "**VOL UP**" and "**VOL DWN**" switches for fast and slow controls of clock module U5.

The input to inverter U7C is normally low (less than 0.8 Vdc). This inverter is controlled by the ORed diodes and its output is fed to connector P1-15 which interfaces with the remote controllers main board.

Transistor Q4 is controlled by "**VOL UP**" switch and interfaces to output connector P1-16. Normally this output is low (less than 0.3 Vdc) when the switch is not depressed and goes high (greater than 4.5 Vdc) when it is pressed. The function of this output is to inform the volume control circuit, on the remote controllers main board, which direction the operator has commanded the volume to proceed, either increment or decrement.

Intercom Control

The "**INTCM**" switch (KEY 1) is a push on/push off control function which permits the communication between paralleled remote controllers without keying the transmitter. It also permits communications between the controller and the remote control panel when the panel contains the intercom feature.

The output on P1-14 is normally low (less than 0.8 Vdc) when the switch is not pressed, and goes high (greater than 4.5 Vdc) when the switch is pressed. In addition, INTCM LED D18 will illuminate when the function is latched by the main remote controller board.

Clock Setting Control

The "**CLOCK**" switch, (KEY 3) is a momentary contact control which enables the clock setting function within clock module U5.

When the switch is pressed, it grounds the cathode side of diode D24 thus disabling the volume control setting port. Transistor Q1 is also turned on illuminating CLK LED D14 and turns on transistor Q2 driving the SET terminal on pin II of U5 low (less than 0.3 Vdc). The clock setting procedure is now enabled and the SLOW on pin 12 and the FAST on pin 3 are also enabled to operate by depressing the VOLUME ▲ or VOLUME ▼ Switches to set the proper time. By depressing both switches at the same time, the clock module will reset its internal register to 12:00 and display this in the window.

Supervisory Control (Take Over Switch)

When a number of remote controllers are connected in parallel on the same control pair, this function allows all paralleled units to be completely disabled and the main dispatcher to assume full control over the remote system.

When "**SUPV**" switch KEY 8 is pressed, the output of U6E will go high (greater than 4.5 Vdc). In addition, SUPV LED D11 will illuminate indicating that the function has been latched on.

Partial Speaker Mute Control

The speaker muting function permits the dispatcher to temporarily reduce the volume of the incoming calls to a low level.

When "**MUTE**" switch KEY 9 is pressed, the output of U7E will go high (greater than 4.5 Vdc) reducing the audio in the speaker by 20 dB. In addition, MUTE indicator D12 will illuminate indicating the function has been selected.

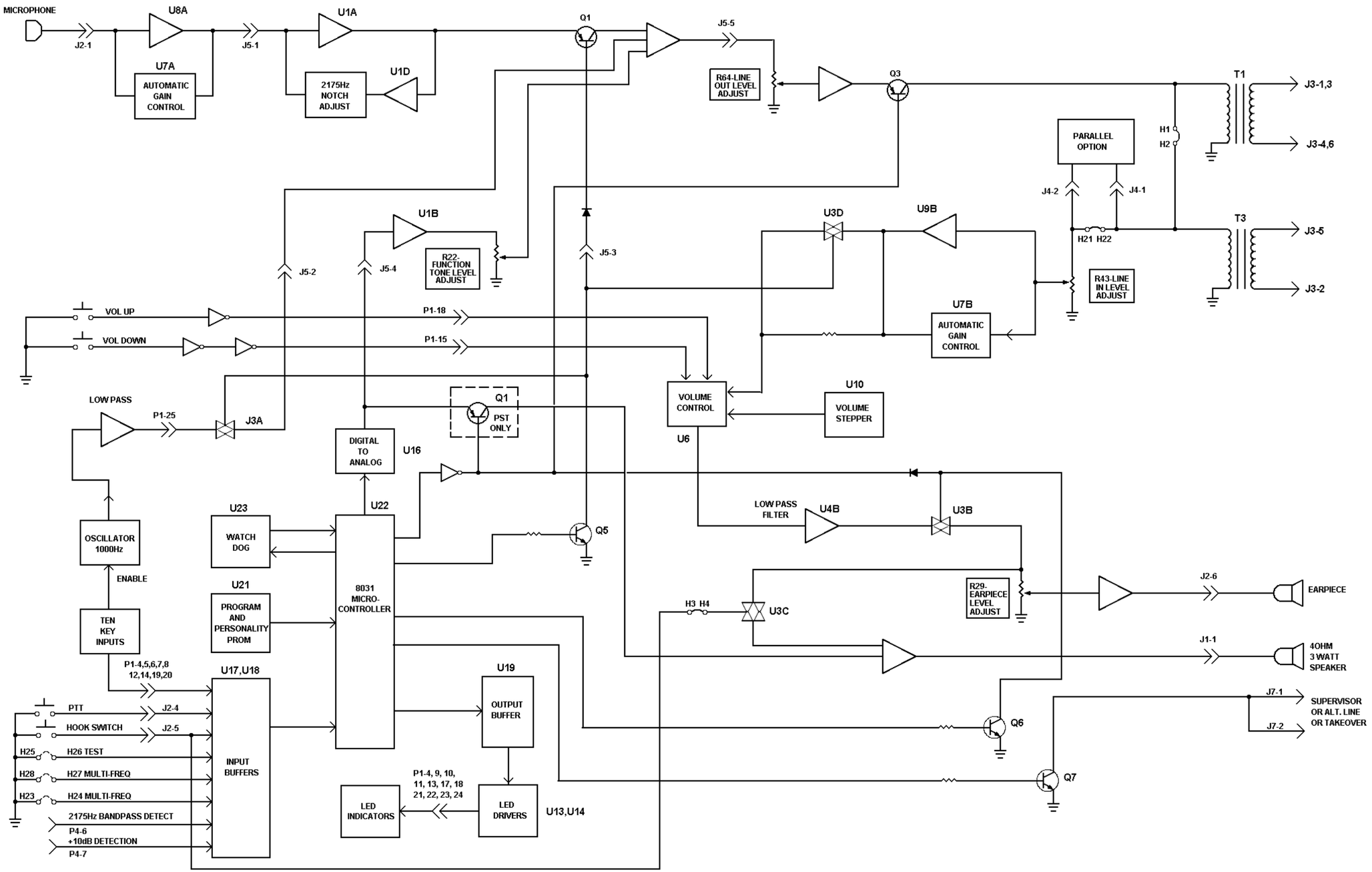


Figure 3 - EDACS RCN Block Diagram

Alert Tone Control

The Tone Alert Oscillator is used by the dispatcher to transmit an alerting tone to call attention to messages.

ALERT switch KEY 10 is a momentary action switch that controls inverter U7F. The inverter is used to shut off timer U2 by applying a ground (less than 0.3 Vdc) to pin 4. The oscillator frequency of approximately 1000 Hz is set by timing resistors R1 and R2 and capacitor C3. Low pass filter U1B removes the higher order harmonics from the square-wave output from the timer U2. The filtered audio signal is then applied to the output terminal on P1-25 which feeds the main controller board. In addition, ALERT LED D13 is illuminated when switch KEY 10 is pressed.

Clock And VU Meter

VU meter U4 enables the operator to check the line level of the remote controller in the transmit, receive and intercom modes. This meter is a ten segment bar graph which provides a relative indication of the audio level applied to and received from the audio pair. The unit is calibrated indicating audio peaks in the 7 to 10 bar range (from -10 dB to + 3 dB) when the operator is talking into the microphone at a normal level.

Amplifier U1A is a preamp which amplifies the level of the applied signal such that the audio rectifier comprised of diodes D5 and D6 can produce a DC voltage level for VU meter module U4.

Clock Module U5 is a self contained 12 or 12/24 hour digital clock mounted adjacent to the VU meter in the crystal area of the remote controller. The unit is shipped from the factory with the clock in the 12 hour mode (jumper between H5 and H6 is installed). If the 12/24 hour mode is desired, remove the jumper between H5 and H6, and install a jumper between H6 and H7.

The brightness of the clock can be adjusted in the field by removing resistor R18 or R19 from the circuit.

Clock Module J19/130-0245 has been discontinued. A new module is available if a replacement for U5 is needed in an earlier **RCN 1000**. The part number for the new module is J19/101-0219. All new **RCN 1000** Remote Controllers contain the new module. The new module does not have pins 4 - 6.

Diode D9 and resistor R16 on the Keypad/Display Board will also have to be replaced if an earlier module is replaced with new Clock Module J19/101-0219. If U5 is replaced on an earlier Keypad/Display Board, also replace D9 and R16 per the **NEW UNITS** parts listed in Table 4.

The 12/24-hour jumpers, H5-H6 and H6-H7, are not used on Keypad/Display Boards that have a new Clock Module installed. The new Clock Module has one (1) jumper on it, JP1, that selects a 12 or 24 hour format. When JP1 is installed, the 12-hour format is selected. When JP1 is removed, the 24-hour format is selected. JP1 is located on the lower left-hand side of the new Clock Module near pin 1.

MAIN BOARD (-0167) ANALYSIS

The Controller can perform a maximum of five different tone control functions. This is accomplished by applying two or three tones in sequence at the prescribed level to the transmission medium for detection at the remote base station. All of the tones are generated in the controller by one oscillator whose frequency is selected by a combination of switch selection and logic circuitry. The control tone frequencies required to select each function in remote and repeater stations are listed in Table 2.

When a non-transmit function is selected, the Secur-it tone frequency of 2175 Hz is transmitted for a period of 125 milliseconds at a level equal to normal voice peaks (Figure 4). If the normal voice is at 0 VU, the **Secur-it** tone is transmitted at a level of + 10 dBm. At the end of the 125 millisecond burst, the microprocessor changes the frequency of oscillation to the proper function selected. This tone is then transmitted for a period of 40 milliseconds at a level that is 10 dB below the Secur-it tone level. Upon completion of this sequence, the microprocessor returns to the keypad scanning routine and awaits another keypad input command.

Table 4 - Clock Module U5 Replacement Details

	EALIER UNITS		NEW UNITS	
PART	**PART NUMBER**	**DESCRIPTION**	**PART NUMBER**	**DESCRIPTION**
U5	J19/130-0245	Clock Module: MA1136RZW	J19/101-0219	Clock Module: IDA
D9	J19/111-0005	Zener Diode: 9.1 V.	J19/111-0004	Zener Diode: 5.1 V.
R16	J19/312-0056	Res.: 150 Ohms, 1/4 W.	J19/313-0041	Res. : 220 Ohms, 1/2 W.

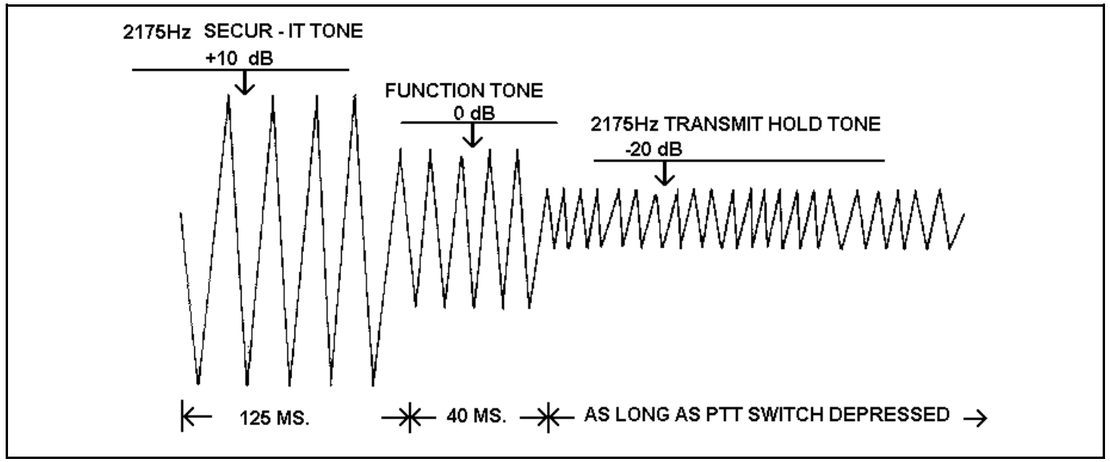


Figure 4 - Tone Control Sequence

When a transmit function is selected, the **Secur-it** tone is transmitted in the sequence described above followed by a 40 millisecond burst of either the SF1, SF2, SF3, SF4 or SF5 transmit function tone. At the end of the function tone period, the Secure-it tone will be enabled by the microprocessor, but this time at a level 30 dB below the initial burst level. This level remains on in the presence of voice as long as the operator has the PTT switch depressed.

Voltage Regulators

The remote controller gets its input power from a 110 Vac source which is applied to power transformer T1 via the 3/8 amp fuse, F1.

WARNING

The fuse is connected to the input 110 Vac lead. Use care when replacing it to ensure that the power cord is disconnected from the outlet prior to removing protector cover. Qualified service personnel should be contacted when the internal fuse needs replacement and all safety precautions must be observed.

The low voltage secondary winding provides the remote controller its internal power requirements. The full wave bridge comprised of diodes D1-D4 and capacitor C7 rectify the input sine wave into a DC voltage level and applies it to 13.8 Vdc regulator U1. This regulator and its associated components provide the internal audio circuits with 13.8 Vdc and provides pre-regulation for regulator U2. Regulator U2 provides the digital circuitry with a 5.0 Vdc source.

Audio Circuitry

The audio paths in the Tone remote controller are best described by separating the transmit audio (microphone to line) and receive audio (line to speaker).

Transmit Audio

The transmit audio consists of an automatic gain control, notch filter, digital to analog tone generation and line driver amplifier. Each part is described in the following paragraphs.

Automatic Gain Control

The transmit audio originates from the microphone element in the handset board and is amplified by the FET amplifier located on this board. The resistor/capacitor combination comprised of R12, R16 and C12 provide the microphone element with a 600 ohm isolated power source. The audio signal is then applied to the compressor/expander amplifier comprised of U7A and U8A. The AGC amplifier has a 30 dB dynamic range with 15 dB change. Amplifier U8A is gain-controlled by the impedance of the gain cell within U7A. The compressor/ex-

pander has an independent rectification input on pin 13 which produces a DC voltage level which controls the internal variable gain cell connected between pins 9 and 11. This voltage level attack time (8 milliseconds) is controlled by C16, and the decay time (10 seconds) is controlled by C32. The voltage on pin 14 of U7A is proportional to the amount of signal that is on the input line and ranges from 0.2 Vdc to 1.75 Vdc.

Notch Filter

The Secur-it tone frequency of 2175 Hz is used to alert the panel of a pending function tone generation and to hold the transmitter keyed. Therefore the voice that is being transmitted along with the Secur-it must have the 2175 Hz frequency notched out of it in order to eliminate false keying. The notch filter comprised of U1A and U1D with their associated components (located on the extension board) provides a notch with a depth of 20 dB and with 3 dB points at 2000 Hz and 2350 Hz.

Digital-To-Analog Tone Generation

The Secur-it and function tones are all generated by the 8031 microprocessor (U22) via digital to analog converter U16. The frequency of each complete wave-form is made up of between 16 and 20 individual steps from the microprocessor. The levels, frequency and lengths are all predetermined within the micro and will not drift with temperature. The microprocessor provides extremely predictable, distortion free waveforms which are applied to low-pass filter U1B (located on the extension board). The low-pass filter with its associated components removes all of the high frequencies from the wave form thus producing a clean sine wave.

In addition, the Alert Audio from the keypad panel is summed into the low-pass filter circuit via resistor R10 and U1C (located on the extension board).

Audio Tone Generation (REV. E and earlier)

In addition to **Secur-it**, function and hold tone generation, U16 also generates (under U22 control) the "warble" tones These tones are applied to the speaker and handset earpiece. They are generated when the **RCN 1000** is not transmitting, to alert the operator of various operating conditions. The D-A output from U16 is summed with the speaker and handset audio when Q1 is on. When COMB PTT is high, Q1 is on, and the "warble" tones pass from the D-A line to speaker and handset level adjustment potentiometers via C8, R9 and U3C. Transistor Q1 is turned off by the active low COMB PTT line and inverter U5D when the unit is transmitting to prevent the **Secur-it**, function and hold tones from passing to the speaker and handset amplifiers.

Microprocessor U22 generates the CTS (Clear-To-Send) channel-available tone. The CTS output (actually digital pulses) from U22 pin 11 is summed with the speaker audio at U12 pin 1 via R69 and C55. Diode D12 clamps negative audio currents from U9A out of the microprocessor's output.

Audio Tone Generation (REV. F and later)

Microprocessor U22 generates the "warble" and channel-available tones at its CTS output on pin 11. These tones are summed with the speaker audio at U12 pin 1 via R69 and C55. Diode D12 clamps negative audio currents from U9A out of the microprocessor's output. Transistor Q1 is not installed in later models of the **RCN 1000**.

Line Driving Amplifier

All of the audio from the microphone, digital-to-analog converter and alert tone meet at connector P5-5 on the extension board and are fed to "**LINE OUT LEVEL ADJUST**" potentiometer R64. This potentiometer sets the level on the input to line driver amplifier U11. When the digital-to-analog converter is generating the Secur-It tone or function tones, the voice audio and alert tone are disabled. When the digital-to-analog converter is generating the Hold tone, the paths are enabled. When the PTT button or the Alert Tone button is pressed or a function is selected on the keypad panel, the line driver is enabled. The audio is then passed to the line.

Receive Audio

The receive audio consists of an automatic gain control, speaker mute, volume control, earpiece speaker and base speaker. Each part is described in the following paragraphs.

The receive audio from the audio pair is applied through the **LINE AUDIO** connections on to J3-3 and J3-4. The secondary side of coupling transformer T2 is terminated with resistor R66 which matches the impedance of the incoming line to 600 ohms. When the bridging impedance of 6000 ohms is desired, simply remove resistor R66 from the circuit by clipping one of its leads.

When the four wire configuration is used, transformer T3 is installed and the jumper between H1 and H2 is removed The incoming audio is then applied to J3-2 and J3-5 and is coupled to potentiometer R43.

Automatic Gain Control

The compression circuit comprised of amplifier U9B and compressor/expander IC U7B, allows the input signal to have a 30 dB dynamic range with less than 3 dB of output change. Amplifier U9B's gain is controlled by the impedance of the gain cell within U7B. The compressor/expander has an independent rectification input on pin 3 which produces a DC voltage level controlling the internal variable gain cell connected between pins 3 and 5. This voltage level attack time (5 milliseconds) is controlled by C17 and the decay time (10 seconds) is controlled by C18. The voltage on pin 2 of U7B is proportional to the amount of signal that is on the input line and ranges from 0.2 Vdc to 1.75 Vdc.

Speaker Mute

Analog gate (U3D) is normally in the on state and the control on pin 12 is high (greater than 13.5 Vdc). Thus the audio output from compressor amplifier U9B is passed directly through the gate and applied to volume control circuit U6. When the **SPEAKER MUTE** function is enabled on the remote controller's keypad, then the voltage on pin 12 will go low and the gate will be turned off. Thus the audio must then pass through parallel resistor R8 which reduces the audio in the speaker by 20 dB permitting the dispatcher to temporarily reduce the volume to a lower level for business discussions, telephone calls, etc.

Volume Control Circuit

Volume control circuit U6 sets the level of op-amp U4B and output amplifier U12, thus controlling the volume of the remote controller. This is accomplished by varying the internal resistance from pin 3 to pin 5 with respect to lower reference on pin 6. In addition, this circuit stores the last volume setting in long-term memory (EEPROM). Timer U10 provides the pulse train which steps the volume control through its 100-step range at the rate of 30 steps per second.

Earpiece Amplifier

The audio from U4B is split into two directions; one being applied to earpiece amplifier adjustment potentiometer R29. This potentiometer is labeled "**EARPIECE ADJ**" and controls the amount of signal that is applied to amplifier U4A and thus presented to the earpiece located in the handset.

Speaker Amplifier

The other path is to analog gate U3C which is controlled by the HUHS (hang up handset switch) located in the handset. The control on pin 6 is high (greater than 13.5 Vdc) when the handset is in its cradle. The audio signal is then coupled to speaker potentiometer R52 and applied to speaker amplifier U12. The jumper between HA and HB is normally installed with a handset. The "**SPEAKER LEVEL**" control (R52) sets the maximum output from the speaker audio amplifier U12 to 3 watts into a 4 ohm load (this is 3.45 Vrms measured across the 4 ohm speaker).

Control Circuitry

The heart of the Tone remote controller is the Intel 8031 microprocessor. The basic building blocks of the control circuitry are the input buffer, output buffer, watchdog and EPROM control program. Each segment is described in the following paragraphs.

Input Buffer

The input buffer consist of two 74HC373 octal D-type latches U17 and U18. The microprocessor enables one latch at a time and reads the information. The PTT, Hook Switch, Key Inputs and 2175 Bandpass Detect are constantly read and acted upon. The exact function of each is described under the PROM section. The Test Jumper (H25-H26), Multifreq jumper opt 1 (H23-H24), and the Multifreq jumper opt 2 (H27-H28) are read only when the unit is first powered up. If the test jumper is in place when the unit is powered up, then it will begin the test mode until powered down.

Output Buffer

The output buffer consists of one 74HC374 octal D-type flip-flop (U19) and seven external bits from the 8031 microprocessor (U22). The LED indicators are turned on and off with the open collector outputs from drivers U13 and U14. Since the microprocessor and control circuitry operate at 5 Vdc and the audio circuitry operated at 13.8 Vdc, open-collector outputs are used to control the analog gates (MUTE and COMB PTT). The MUTE is used to mute the speaker output and shut off the AGC and Alert audio while the function tones are being generated. COMB PTT enables audio to be transmitted to the line. The Hard Audio Mute (first mute) and SUP-LN are open-collector outputs (Q5 and Q6) to control external relays capable of sinking 80 milliamps of current.

Watch Dog

When using a microprocessor, a watch dog (U23), is used to make sure the micro is always operating in a predictable manner or the watch dog will reset it. The IC used for this purpose is a 4528 dual monostable multivibrator. The micro must write to pin 6 of U23 every 100 milliseconds, or pin 10 of U23 will drive the reset on pin 9 of U22 low and cause the processor to reset. The 8031 microprocessor may be reset by connecting H29 and H30. This reset method is only used when testing the unit.

EPROM Control Program

The 27C64 EPROM (U21) has the entire control logic programmed into it. The logic control is explained in the following paragraphs.

Microprocessor Control

The tone remote controller has two modes: The Operating Mode and Test Mode. The Test Mode is a self diagnostic for testing the different functions of the controller.

Operating Mode

If during power up or reset, the jumper labeled "**TEST**" is not in place, the Operating Mode begins.

The micro will monitor a keypad of up to 10 keys. These keys will control a tone panel and will require the micro to generate 1050, 1150,1250,1350, 1450,1550, 1650, 1750, 1850,1950, 2050, and 2175 hertz waveforms. The exact function of the keys will be stored in the EPROM. The micro also controls many LEDs on the controller to indicate the state of the unit. Lastly, the unit utilizes bilateral switches to control audio paths.

Test Mode

If at power up or reset the "**TEST**" jumper is in place, the LEDs will flash four times and the test mode begins.

The micro will monitor a keypad of up to 10 keys. These keys will produce tones which represent the function they denote. This allows testing of the accuracy of the function tones. Since all keys require more than one tone, the operator will step through the tones one by one by pressing and releasing the key, testing the tone frequency and amplitude, and then pressing and releasing it again.

For instance, to test SF1, press the key that corresponds to it. The LED by the key will turn on. The Secur-It tone will be generated. Other key functions are ignored and the micro will continue to generate the tone and will wait until the key is pressed again. Once the key is pressed again, the next tone (1450 Hz) is generated. One more press of the key and the LED will stay on and all keys are scanned again.

A list of the functions and frequencies as used by the micro during the test mode are listed below.

Functions dependent on the PTT will not be tested until PTT is pressed.

Functions	Frequencies (Hertz)
SF1	2175-1950-None (Only when PTT)
SF2	2175-1850-None (Only when PTT)
SF3	2175-1350-None (Only when PTT)
SF4	2175-1250-None (Only when PTT)
SF5	2175-1050-None

The following will not cause any tones to be sent to the station.

Functions	Frequencies (Hertz)
Alt-Line, SUPR, Takeover	Provides external open collector switch.
Spkr Mute	Mutes the remote speaker audio.
Intercom	Disallows TX tones from being sent.
Clock	Clock Function.

MAINTENANCE

DISASSEMBLY

The RCN 1000 is disassembled as follows:

1. Remove power.

2. Place the unit upside down and remove the two #4 black screws located along the sides of the plastic bottom. Then the four #6 located along the front and back of the plastic bottom. **DO NOT** try to remove the two #6 screws on the bottom near the vent slots as they hold the power transformer to the plastic bottom.

3. The plastic bottom with the main PCB and power transformer, and the plastic top with the Keypad/Display PCB and speaker are now separate and can be positioned for service without disconnecting the ribbon cable and wires that run between the top and bottom.

MECHANICAL PARTS

These parts are listed with the parts list for the Keypad/Display board.

ADJUSTMENTS

General

As shipped from the factory, this unit was adjusted to an input and output level of 0 dBm toward the phone line. It may be that this will match your system requirements, if so, no installation adjustments will be required. If your system uses a longer circuit, it should only be necessary to adjust the controls listed in the "**Installation Adjustments**" paragraphs below. If there is more than one remote control unit and one station, prepare a system layout by measuring and recording the frequency response of the various circuits in the system. This will enable you to establish the proper system level at each point in the system. You may wish to review the discussion about phone lines in the **INSTALLATION** section of this manual.

Certain adjustments, noted as "**Factory Adjust**," will not normally require adjustment and have been sealed. Procedures for these adjustments are given in the "**Internal Adjustments**" section.

INSTALLATION ADJUSTMENTS

Procedure

SET UP RCN (microphone to line)

1. Apply 1000 Hz (600 ohm) signal to J2-1 and J2-2 (gnd) at 1000 millivolts. This is the test tone level. Key PTT by connecting the lead from J2-4 to the lead from J2-2 (gnd). You will find it very convenient to prepare a short length of cable with a modular plug to insert into J2.

2. Terminate output of RCN (J3-3 & 4) with 600 ohms. Again preparing a short length of cable with a modular plug and resistor is very convenient.

3. Set **LINE OUT LEVEL** (R64) at (or below if desired) the test tone level permitted on the transmission path as measured across the resistor. Note that the Secur-it tone will be sent at this level (adjust R22 as set out below if necessary). The Secur-it tone will be 10 dB higher than the function tones. The function tones will be sent at the average voice level. Remove the test plug from J2 which unkeys PTT.

SET UP RCN (line to speaker)

4. Feed 1000 Hz at a 600 ohm impedance into J3-3 & -4 (J3-2 & -5 if four wire) at the test tone <u>received</u> level.

5. With the Volume Control and the **LINE IN LEVEL** (R43) set to maximum, measure the level across the speaker. Reduce R43 until the meter falls 1.0 dB.

6. Place the most distant **RCN 1000** in test mode and send Secur-it tone. Reduce **DETECTION GAIN** (R30) until transmit light goes out. Then increase R30 until it lights and then a little more to give some margin. Remove RCN from test mode.

CLOCK

1. For a 12 hour format, jumper H5 to H6. For a 12/24 hour format jumper H6 to H7.

2. To set the clock, press and hold the "**Clock**" button and then press the Volume Up button for fast setting or the Volume Down for slow setting.

Internal Adjustments

The following procedures define the adjustments for all remaining potentiometers on the assembly. They should not require adjustment in the field and have been factory sealed to prevent accidental misalignment. If adjustment to these potentiometers is required, follow the procedures and seal these potentiometers again. It may be necessary to recheck some of the installation adjustments above.

R52 sets the level into U12, the Speaker amplifier
R29 sets the level into U4A, the Earpiece amplifier

1. Apply a 1000 Hz tone (600 ohm impedance) to J3-3 and -4 (J3-2 and -5 for four wire) at 0 dBm.

2. Increase volume control to maximum.

3. Adjust R43 fully clockwise (maximum input).

4. Apply an audio voltmeter across the speaker.

5. Adjust R52 for a reading of 3.45 volts (3 watts).

6. Adjust R29. This control does not need to be adjusted unless an earpiece is present, i.e. the unit is equipped with a handset instead of a desk microphone.

   Apply an audio voltmeter at TP3.

   Adjust R29 for a reading of 0.1 volts.

7. Adjust R43 as described in Installation Adjustments.

R22 sets the level of the tones transmitted

1. Set R64 in accordance with "**SET UP RCN** (microphone to line)" for the test tone level, or for 0 dBm if the test tone level is not known at the time the internal adjustments are being made.

2. Place the RCN in the test mode and send Secur-it tone.

3. Adjust R22 so that the Secur-it tone is sent at the same level as measured in step 1.

4. Remove the test plug from J2 which unkeys PTT.

R20 and 21 set the notch in the microphone circuit

1. Terminate J3-3 & -4 with the J3 test plug and 600 ohm resistor.

2. Using the J2 test plug which keys PTT, apply 2174 Hz (actual frequency of "2175" generated in the RCN) (600 ohm impedance) signal to J2-1 and J2-2 (gnd) at -10 dBm. Another RCN in test mode can be used as the 2174 signal source.

3. Meter across J3-3 & -4. Alternately adjust R20 and R21 for minimum. Do this several times as there is some interaction.

4. Remove the test plug from J2 which unkeys PTT.

R31 and R32 set the notch in the LINE IN circuit

1. Meter across the speaker.

2. Apply 2174 Hz (600 ohm impedance) signal to J3-3 & -4 (J3-2 & -5 if four wire) at -30 dBm. Another RCN in test mode, sending Hold tone, can be used as the 2174 signal source.

3. Alternately adjust R31 and R32 for minimum. Do this several times as there is some interaction.

4. You may be able to get a more precise adjustment by using the ear or a selective voltmeter.

R30 and R33 set the parallel transmit detector circuit

1. Apply 2174 Hz (600 ohm impedance) signal to J3-3 & -4 (J3-2 & -5 if four wire) at + 10 dBm. Another RCN in test mode can be used as the 2174 signal source, however, note that 2124 Hz from another source will also be required.

2. Adjust R33 for maximum reading at TP2, using an audio voltmeter or oscilloscope.

3. Change frequency to 2124 Hz, still at + 10 dBm, and adjust R30 until LED just comes on.

Microphone Level

The control located in the microphone (not present in earlier revisions) permits the sensitivity of the microphone to be reduced to attenuate background noise between syllables. This control can be lowered dependent upon the ambient noise conditions until its reduction affects the desired audio. This control is not present in handsets.

Alert Level

Fixed resistor R14 (on the Keypad/Display Board - 0164) controls the Alert level.

1. To increase the alert level, install a parallel resistor of the same value in the unused position labeled R13. Further adjust R13 if necessary.

2. To reduce the alert level, increase the value of R14.

TROUBLESHOOTING

Problem:	Procedure:
Microphone audio (J12-1) doesn't reach the line audio (J3-3, 4)	1) The Push-to-Talk button should be pressed fully so that the Tx indicator is on. If the Tx indicator does not turn on, check the cord and connector. 2) The output of the automatic gain control (AGC) amplifier (Pin 1, U8) should be biased at 6 Vdc with audio visible on it. The audio on connector (J5-1) should be identical. 3) On the extension board (J19/900-0171), the 2175 notch filter output (U1, Pin 1) should be biased at 6 Vdc with audio riding on it. 4) On the extension board, the transistor switch (Q1) should be allowing audio to pass. J5-3 must be low (less than 0.7 Vdc). 5) On the extension board, the output of the summing amplifier (Pin 8 of U1) should be biased at 6 Vdc with audio visible on it. 6) The potentiometer (R64) may need readjustment. Adjust this potentiometer and observe the output on the line (J3-3, 4). The output should be 0 dBm (0.77 Vrms) for 0 dBm (0.77 Vrms) of 1000 Hertz at the microphone input (J2-1). If this has no effect, the transistor switch (Q3) or U11 (on the base board) is defective.
VU meter doesn't function	1) If audio isn't getting to the line (J3-3, 4), then follow the procedure for "Microphone audio (J2-1) doesn't reach the line audio (J3-3, 4)". 2) Check the ribbon connector Pin 26 for continuity. 3) Refer to Keypad Display Board.

Problem:	Procedure:
Alert tone does not reach the line J3-4	1) When the "Alert" button is pressed and there is no 1000 Hertz tone at Pin 2 of U3, check the continuity of the ribbon cable, P1-25. If there is good continuity, refer to the Keypad Display Board troubleshooting procedure. 2) If the Alert tone is present at Pin 2 of the bilateral switch (U3) and not at Pin 1 of U3, Pin 13 of U3 isn't being pulled high or has failed. 3) On the extension board (J19/900-0171), the Alert tone should be detectable at Pin 8 of U1.
Control Tones have no effect on the Tone Panel	1) Observe the control tones on P5-4. The digitized tones will be present when a button is pushed that produces them (such as PTT button). If there are no tones at this point, check to see if the tones are present on the digital to analog IC (U16) Pins 14, 15 and 16. If not present on these pins and the faceplate LEDs toggle ON and OFF, there is a problem with U16. 2) If the LEDs do not toggle, check the "Microprocessor functioning improperly" troubleshooting procedure. 3) On the extension board U19/900-0171), U1, Pin 7 should be biased at 6 Vdc and have control tones present. 4) On the extension board U19/900-0171), U1, Pin 8 be biased at 6 Vdc and have control tones present. If they are present, the line loss between the panel and remote controller is greater than 0 dB and line out level adjust (R64), needs adjustment (review "Control tone level needs adjustment") or check the Tone Panel's troubleshooting procedure.

TROUBLESHOOTING (cont'd)

Problem:	Procedure:
Control tone level needs adjustment This is a basic Internal Adjustment After this adjustment has been made, you may have to readjust R64 to the used system level	1) Under test conditions, the voice audio at the microphone input J2-1) will cause 0 dBm (0.77 Vrms) on the line J3-3, 4) across a 600 ohm load. The control tones are then set up as follows. 2) Place remote controller in test mode by shorting across H25-H26 while plugging in the unit. The faceplate LEDs will flash ON and OFF four times to indicate test mode. 3) Press and release any key and measure the output frequency across J3-3, 4. It should be 2175 Hertz. If not, the remote is generating a function tone. If the tone is generating a function tone, continue to press a faceplate key until a 2175 hertz Secure-it tone is produced. 4) Place a 600 or 620 ohm load across the output of the remote controller J3-3, 4). 5) On the extension board U19/900-0171), adjust the function tone level adjust potentiometer R22 for (cont.) 10 dBm (2.45 Vrms) on the line connector (P3-3, 4). 6) Unplug the remote controller to remove unit from test mode. Reconnect the unit.
Line audio (J3-3, 4 or J3-2, 5 for four wire) doesn't reach the base speaker U4-1,2)	1) Incoming audio at P4-1 and not at P4-2 is a good indication that the parallel option is suspect. On the extension board U19/900-0171) check the biasing on the output pins of U2. They should all be at 6 Vdc. 2) Pin 7 of U9 should be at 6 Vdc with audio on it.

Problem:	Procedure:
	3) Check U4, Pin 5, 6 and 7 for 6 VDC biasing. Audio should be clearly visible at Pin 7. If audio is not visible, increase the volume with the buttons on the faceplate. If still a problem, refer to "Volume control inoperative" troubleshooting procedure. 4) Make sure audio is on the bilateral switch (U3) on Pins 3 and 4. 5) The bilateral switch (U3) Pin 8 and Pin 9 are controlled by the HUHS switch J2-5 6) The potentiometer R52 that adjusts the speaker setting has been set to accept 0 dBm (0.77 Vrms) at the line U3-3, 4 or J3-2, 5 for four wire) at 1 kHz and output 3.45 Vrms on the speaker. If this potentiometer was disturbed, readjust it according to this procedure.
Line audio (J3-3, 4 or J3-5, 5 for four wire) doesn't reach the earpiece U2-3, 6)	1) If audio doesn't reach the base speaker J4-1, 2), refer to the section "Line audio J3-3, 4 or J3-2, 5 for four wire doesn't reach the base speaker J4-1, 2)". 2) Pin 1, 2 and 3 of U4 should be biased at 6 Vdc and audio should be visible on Pin 1. If not try the earpiece adjustment (R29) and find a satisfying listening level. 3) Voltages at U6 are as follows. Pin 8 should be at 5 Vdc. Pin 2 will be high (5 Vdc) when volume up button is pressed and low (0.7 Vdc or less) when volume down is pressed. Chip select (Pin 7) will normally be high (5 Vdc) but U6 will be controlled by U10 and will oscillate when either volume control is used.

TROUBLESHOOTING (cont'd)

Problem:	Procedure:
The volume control tone is intermittent	1) When a volume control button is used, Pin 1-15 goes low. At that time, Pin 4 of U10 goes high to allow the volume stepper to run. Volume tone oscillator (U5 Pins 1 and 2) begins to oscillate. The oscillation is a result of R25 and C52 on the schmitt trigger. This output then feeds into the Volume Control IC.
Earpiece is not loud enough/too loud	1) Use ear piece adjustment potentiometer (R29) to adjust the earpiece to a comfortable listening level.
Background tone (2175 Hz) present in receive audio Use your ear or a selective volt meter for this procedure	All adjustments described are performed on the extension board U19/900-0171) 1) Adjust the notch filter (U2). To reset this filter, you must receive the 2175 Hertz hold tone from a parallel remote and adjust R31 until a minimum of 2175 Hertz is heard. 2) Next, adjust R32 until a minimum noise level of 2175 Hertz is heard. Adjust R31 again until a minimum is reached. 3) Continue procedure 2 until the tone is no longer audible.
Parallel Tx indicator intermittent or stuck on The levels listed will change if other than 0 dBm output is used. Make the adjustment at the actual system levels	All adjustments described are performed on the extension board (U19/900-0171). 1) Parallel indication is achieved by the detection of 2175 Hertz Secur-it tone which is 125 milliseconds of a + 10 dBm (2.45 Vrms) tone. This is followed by the transmit hold tone, 2175 Hertz at -20 dBm (0.08 Vrms), detected for the duration of the parallel transmit.

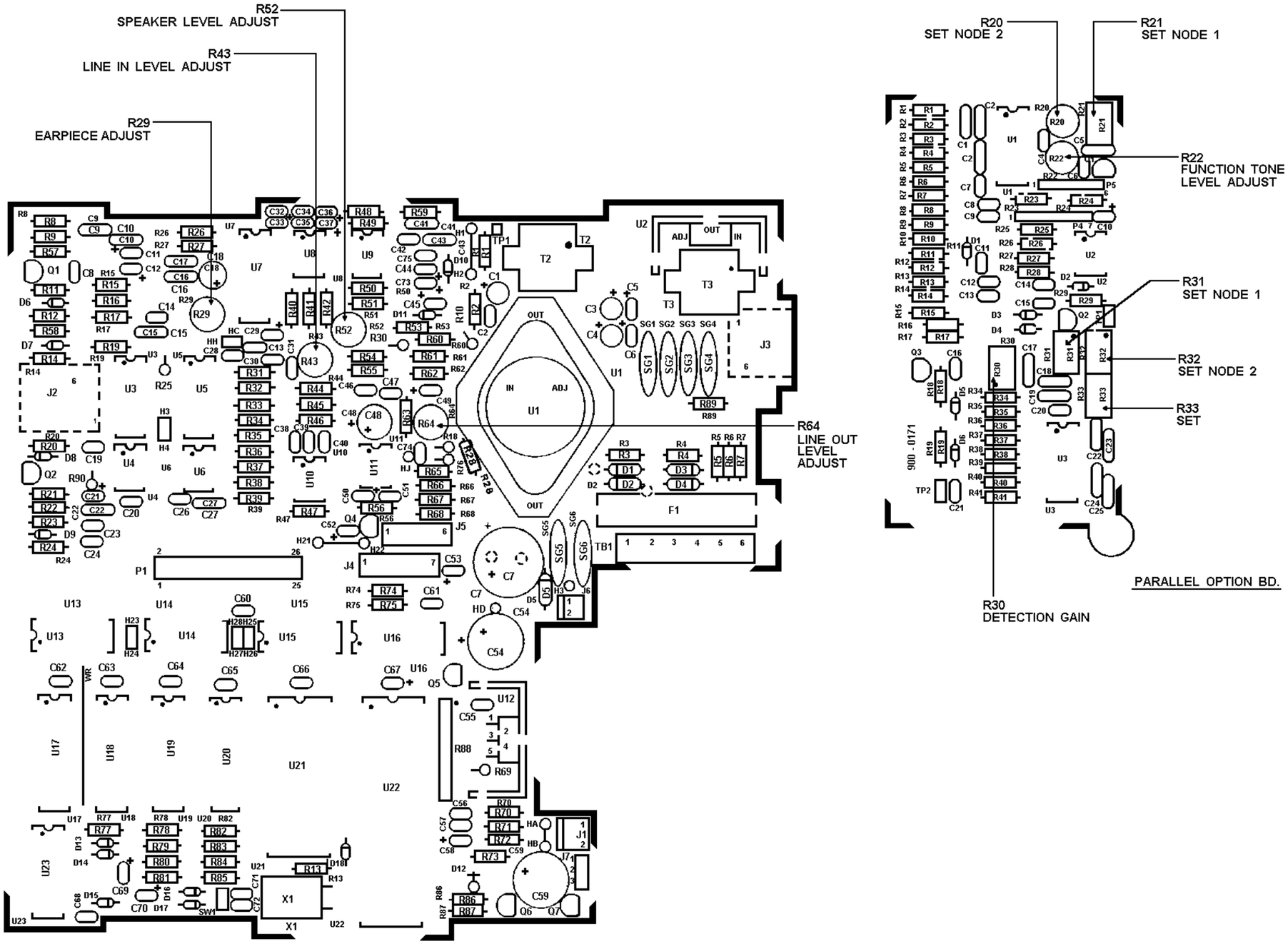
Problem:	Procedure:
	2) The input to this detector is P4-1. Potentiometer R30 is used to vary the gain of the detector (U3). While detecting a parallel transmit, adjust this potentiometer until the Tx indicator LED shuts off. Then readjust the potentiometer back by about 1/16 of a turn so that detection is guaranteed. 3) If this doesn't cure the problem, check the DC levels of Pin 1, 7, 8 and 14 or U3. They should all be at 6 Vdc with audio riding on them. 4) Pins P4-6 and P4-7 should normally be held high (5 Vdc) and will be pulled low by transistors Q2 and Q3 when 2175 Hertz is detected.
One key stuck ON or OFF	1) If one single key is stuck ON or OFF, check the continuity of the ribbon cable. 2) Check both connectors. 3) Monitor the input to IC U17 or U18 for a voltage transition from ground to 5 Vdc.
Several keys stuck ON or OFF	1) If any key, other than Clock or Alert works, then the microprocessor is working, so check U17, U18 or U19 buffers. 2) Check the "Microprocessor functioning improperly" trouble-shooting procedure.
Clock doesn't work	1) Check the Keypad Display Board troubleshooting procedure.

TROUBLESHOOTING (cont'd)

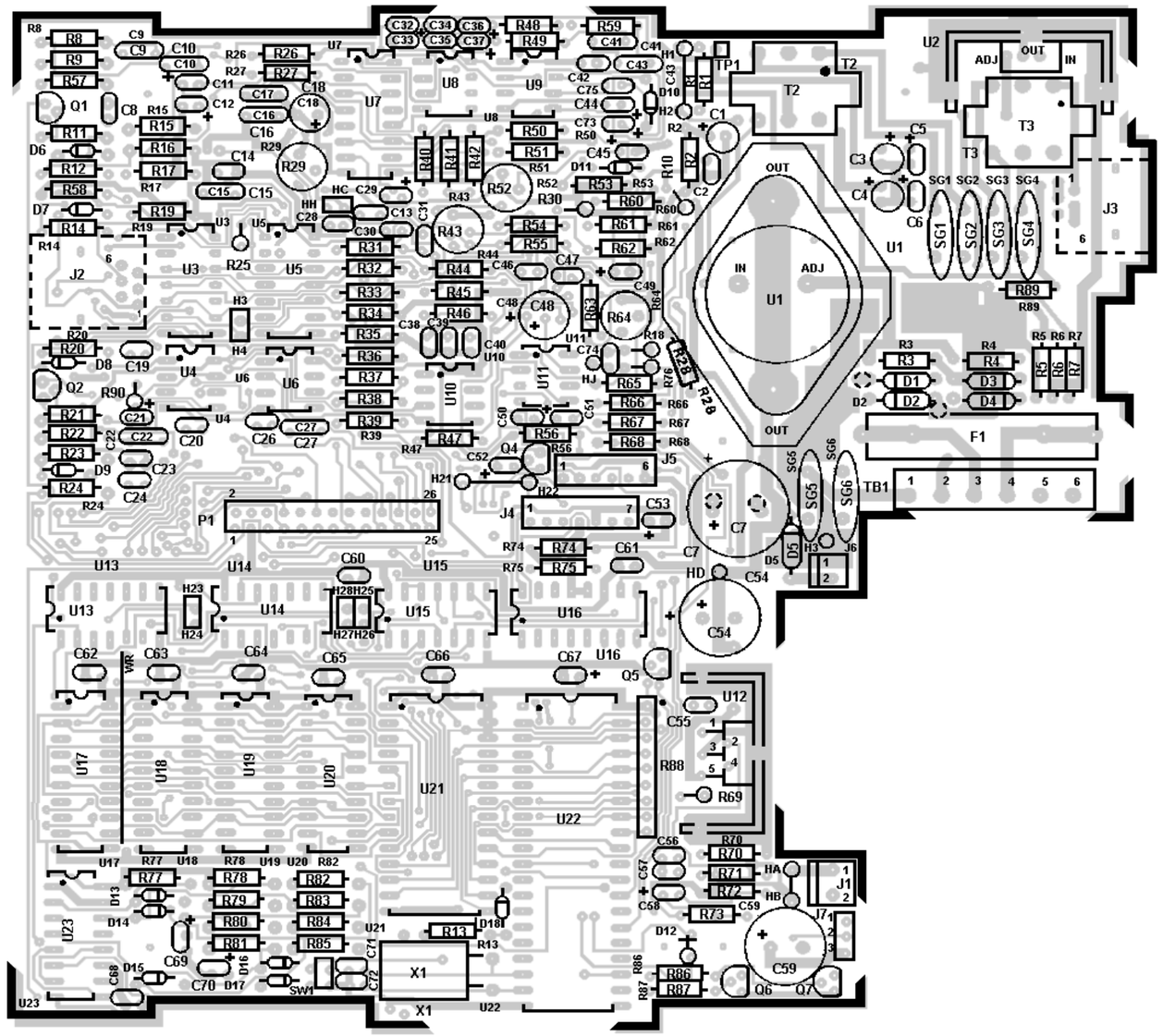
Problem:	Procedure:
Microprocessor functioning improperly	1) Check for 12 megahertz clock frequency between Pin 18 and 19 on microprocessor (U22). NOTE: Use a high impedance probe. 2) Make sure Pin 9 of microprocessor (U22) is now (0.7 Vdc or less) at all times 3) If Pin 9 of the microprocessor (U22) is constantly pulsing, the watchdog (U23) is trying to cause a reset. This means that Pin 1 of the microprocessor isn't writing to the watch-dog (U23 Pin 6) every 100 milliseconds as it should be. 4) Pin 30 of the microprocessor (U22) is used to latch the contents of ROM (U21) to the latch (U20). This line should be constantly pulsing. 5) The write line (Pin 16 of U22) should be pulsing. This indicates the microprocessor is writing. 6) The outputs of U15 (Pin 3 and 6) should pulse constantly. This means the microprocessor is reading key inputs. 7) The Output of U15 (Pin 8) should pulse when a key is pushed. This indicates an LED is being written to.

KEYPAD/DISPLAY BOARD

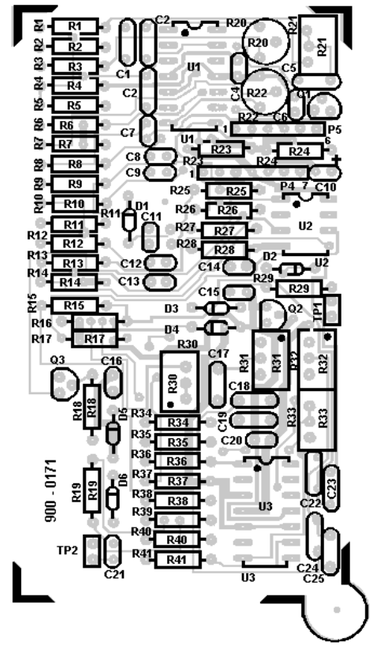
Problem:	Procedure:
Alert tone does not work	1) When the "Alert" button is pressed, the TX indicator should come on. If not, the button contact may be faulty. 2) When the button is pressed, the 555 timer (U2) should begin to oscillate at approximately 1000 Hertz. If this doesn't occur check the 5-volt supply on Pin 8 of the 555. Also make sure that Pin 4 goes high when the "Alert" button is pressed.
VU meter not functioning	1) There should be voice audio biased at 5 volts on U1. 2) Pin 6 of the VU meter (U4) will be a DC voltage derived from a rectified version of the voice audio. 3) Check Pins 4 and 10 of U4 for power.
Clock running improperly	1) The clock oscillator (X1) should be running at 3.58 megahertz (Pin 15 and 16). 2) Pin 7 of U5 will determine the LED brightness and should be at a DC level above 1 volt. 3) The set slow and fast lines (Pin 11, 12 and 3) of the clock chip will normally be held at 5 volts. When a button is pushed, these lines will be pulled low accordingly. 4) Check Pin 18 of U5 for 9.1 volts supply.
LEDs not lit	Check power (Pin P1-3 and P1-2) line to the keypad display board.



ADJUSTMENT LOCATIONS



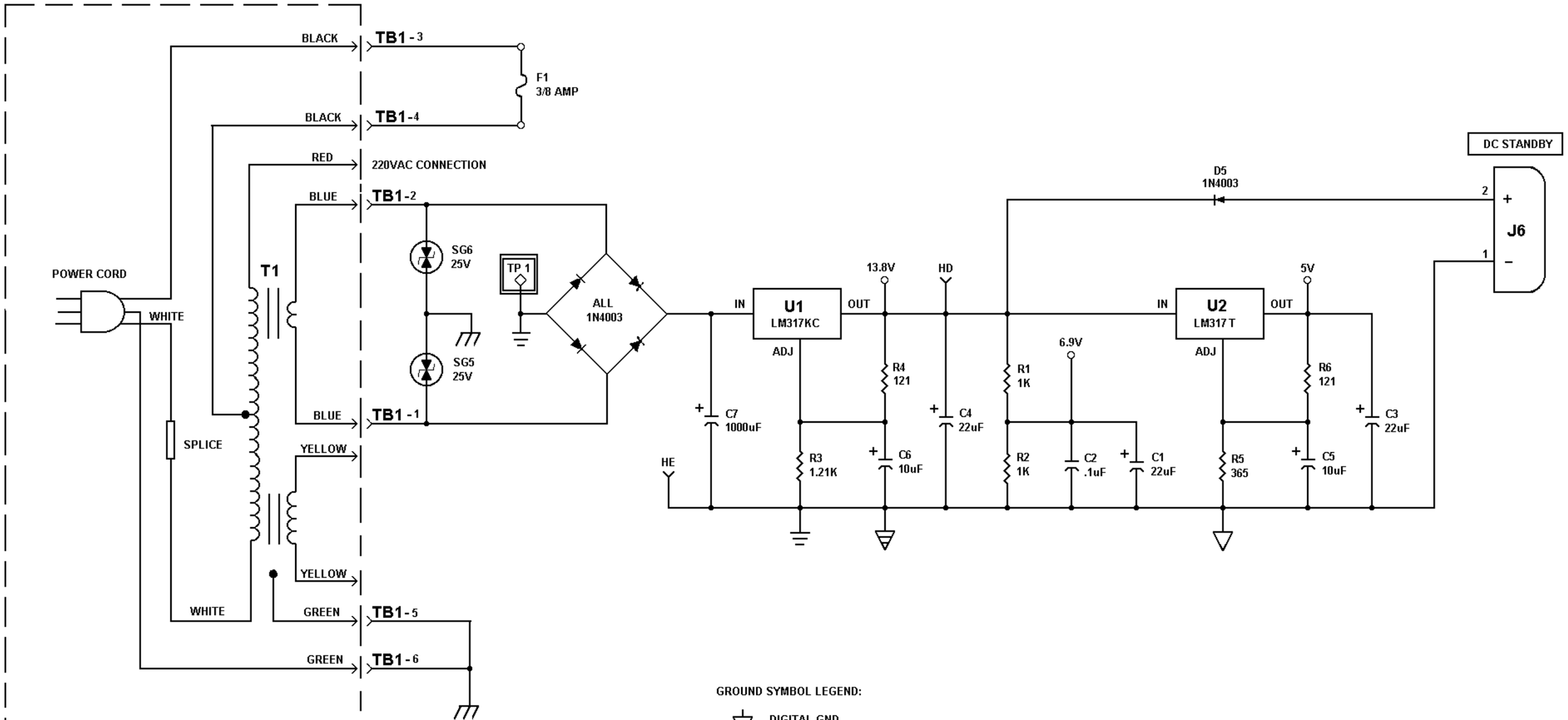
(4164-A-03, Rev. J)
(4164-A-01, Rev. J)



(4166-A-03, Rev. E)
(4166-A-01, Rev. E)

TONE REMOTE CONROLLER
J19/980-0167

TONE REMOTE PARALLEL OPTION
J19/900-0171



GROUND SYMBOL LEGEND:

DIGITAL GND

RECEIVE GND

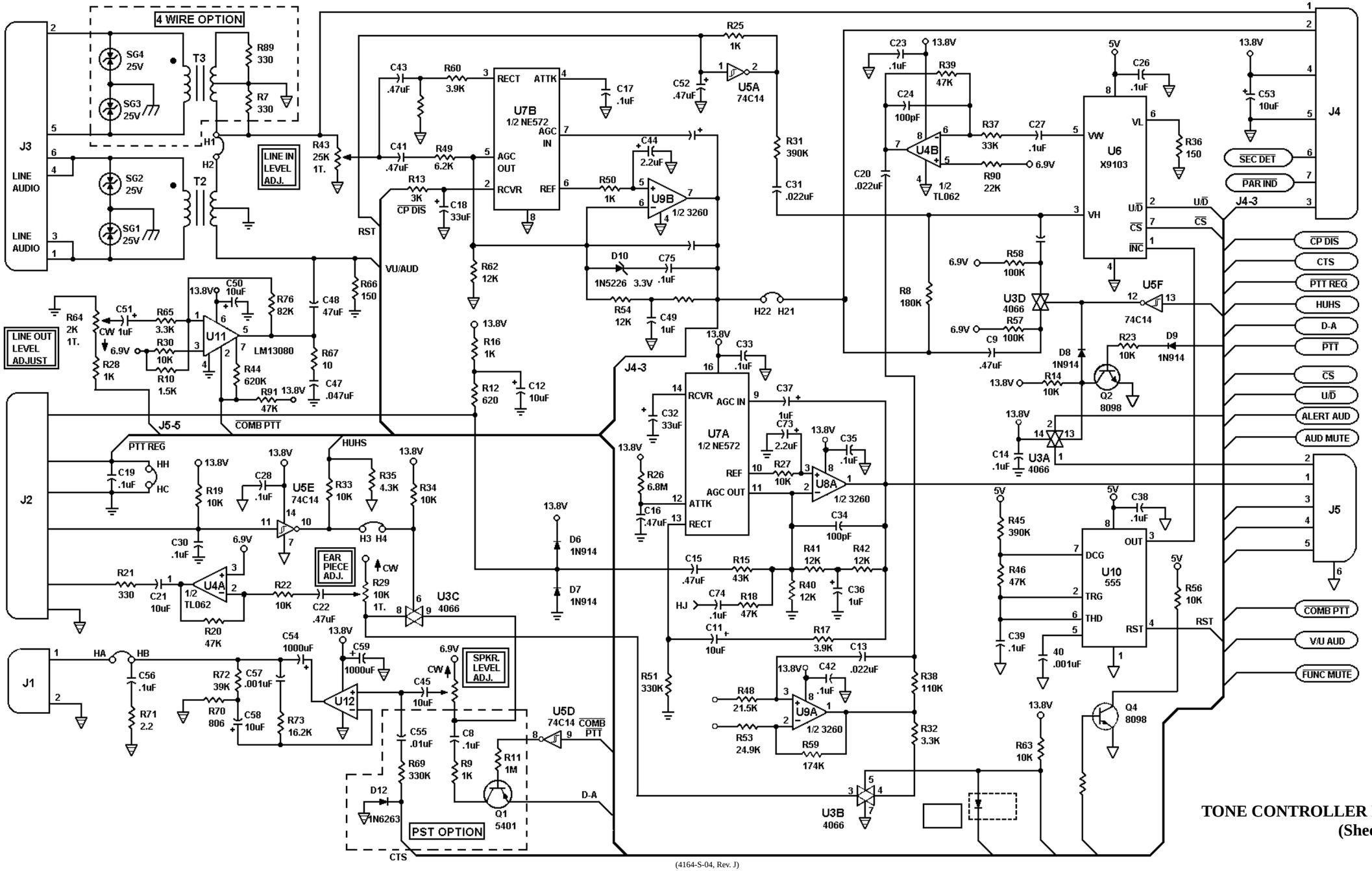
TRANSMIT GND

EARTH GND

(4164-S-03, Rev. J)

TONE CONTROLLER BOARD
(Sheet 1 of 5)

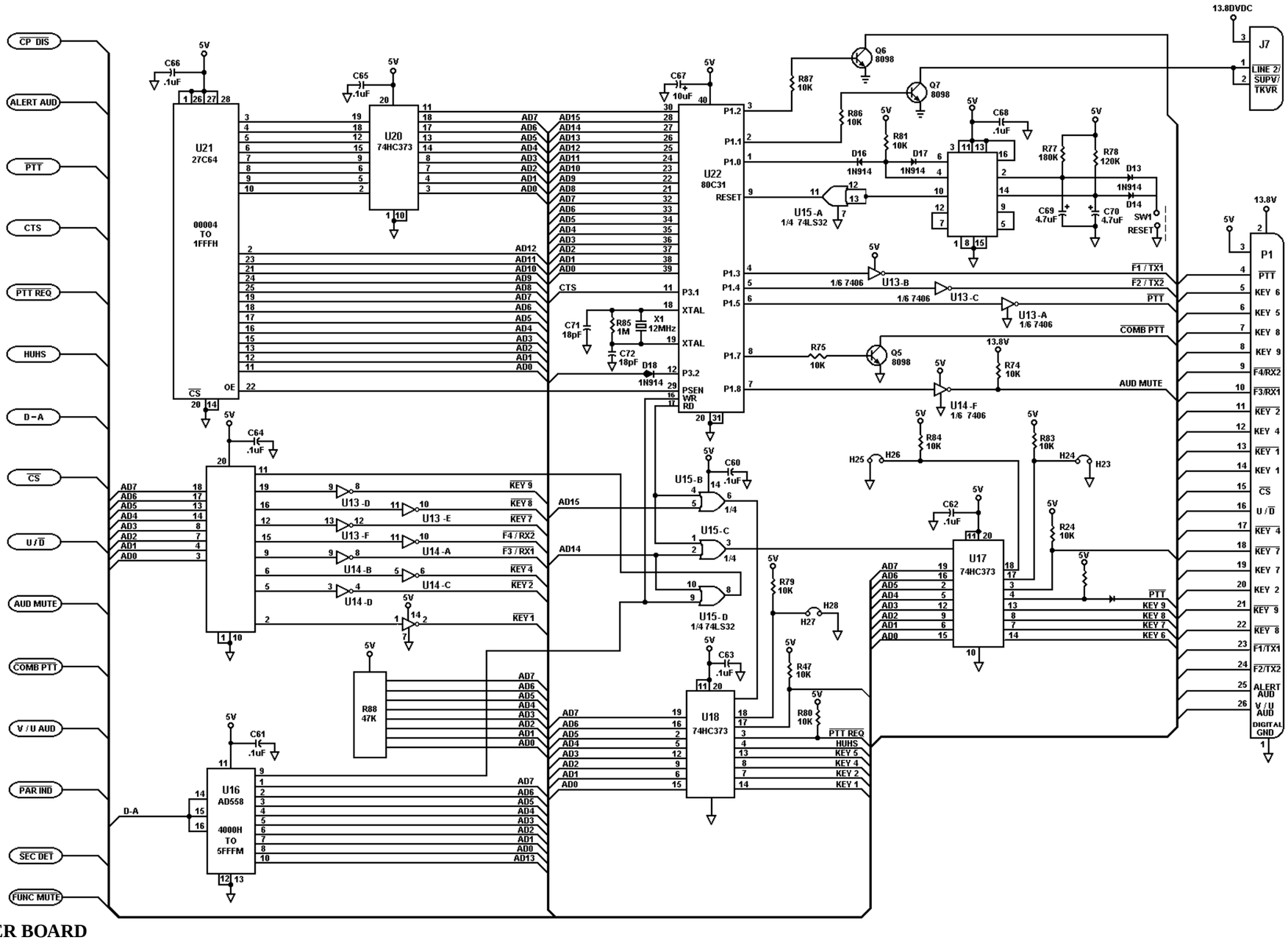
POWER SUPPLY



TONE CONTROLLER BOARD
(Sheet 2 of 5)

AUDIO

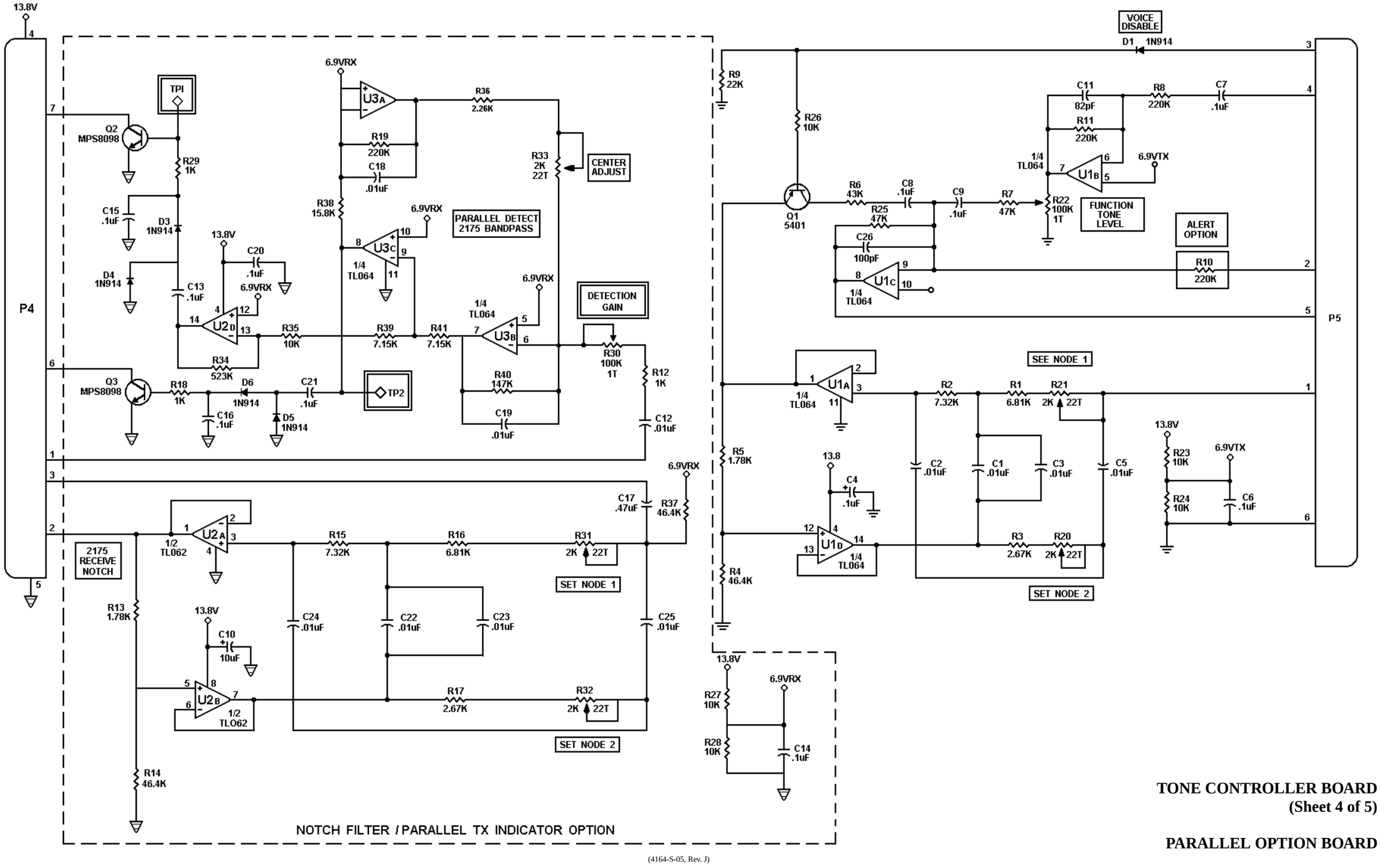
(4164-S-04, Rev. J)



TONE CONTROLLER BOARD
(Sheet 3 of 5)

DIGITAL

(4164-S-01, Rev. J)



(4164-S-05, Rev. J)

TONE CONTROLLER BOARD
(Sheet 4 of 5)

PARALLEL OPTION BOARD

JUMPER SCHEDULE

NUMBER	FUNCTION
HA TO HB	REMOVE FOR RCZ014 (TONE CABLE)
HC TO HH & H25 TO H26	INSTALL FOR TESTING AND SET - UP
H1 TO H2	REMOVED FOR RCZ005 (4 - WIRE)
H3 TO H4	REMOVED WHEN DIGIT 6 IS M (DESK MIC)
H21 TO H22	REMOVED FOR RCZ013 (NOTCH / PARALLEL TX IND)
H23 TO H24 & H27 TO H28	INSTALLED WHEN DIGIT 4 IS 4 (FOUR FREQUENCY)
SW1	MICROPROCESSOR RESET

TONE CABLE CONNECTIONS

CONNECTION NUMBER	DESCRIPTION
HA	SPEAKER OUT
HB	SPEAKER IN
HC	MIC LO & SPEAKER LO
HD	13.8VDC
HE	GROUND
HH	PTT
HJ	MIC HI

LAST USED REFERENCE NUMBERS
TONE REMOTE BASE
J19 / 900 - 0167

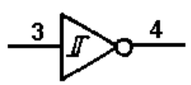
C75	H28	R91	TP1
D18	Q7	SG6	U23

LAST USED REFERENCE NUMBERS
TONE REMOTE EXTENTION
J19 / 900 - 0171

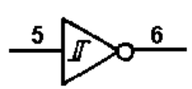
C26	Q3	TP2
D6	R41	U3

NOT USED
TONE REMOTE BASE
J19 / 900 - 0167

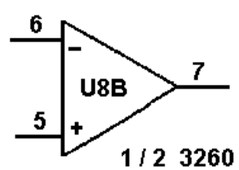
C25 Q3
H5 THRU H20



U5 - B
74C14



U5 - C
74C14



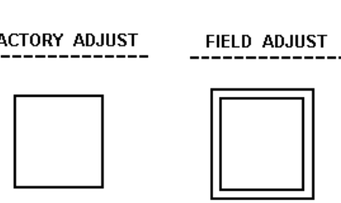
1 / 2 3260

GROUND SYMBOLS

DIGITAL TRANSMIT RECEIVE

ADJUSTMENT SYMBOLS

FACTORY ADJUST FIELD ADJUST



TONE CONTROLLER BOARD
(Sheet 5 of 5)

JUMPERS AND MISCELLANEOUS

(4164-S-06, Rev. J)

PARTS LIST
TONE REMOTE BOARD
J19/900-0167

SYMBOL	VENDOR NUMBER	DESCRIPTION
C1	J19/360-0002	Capacitor, electrolytic, 22uf/16V
C2	J19/362-0001	Capacitor, Monolithic, .luf
C3	J19/360-0002	Capacitor, electrolytic, 22uf/16V
C4	J19/360-0002	Capacitor, electrolytic, 22uf/16V
C5	J19/390-0010	Capacitor, tantalum, 10uf/16V
C6	J19/390-0010	Capacitor, tantalum, 10uf/16V
C7	J19/360-0018	Capacitor, electrolytic 1000uf/35V
C8	J19/362-0001	Capacitor, monolithico .luf
C9	J19/362-0002	Capacitor, monolithic,.47 uf
C10	J19/362-0002	Capacitor, monolithic,.47 uf
C11	J19/390-0010	Capacitor, tantalum, 10uf/16V
C12	J19/390-0010	Capacitor, tantalum, 10uf/16V
C13	J19/362-0011	Capacitor, monolithic, .022UF.
C14	J19/362-0001	Capacitor, monolithic, .luf
C15	J19/362-0002	Capacitor, monolithic,.47 uf
C16	J19/362-0002	Capacitor, monolithic,.47 uf
C17	J19/362-0001	Capacitor, monolithico .luf
C18	J19/360-4336	Capacitor, electrolytic. 33uf/16V
C19	J19/362-0001	Capacitor, monolithic, .luf
C20	J19/362-0011	Capacitor, monolithic, .022UF.
C21	J19/390-0010	Capacitor, tantalum, 10uf/16V
C22	J19/362-0002	Capacitor, monolithic,.47 uf
C23	J19/362-0001	Capacitor, monolithic, .luf
C24	J19/362-0016	Capacitor, monolithic, 100 pf.
C25		NOT USED
C26	J19/362-0001	Capacitor, monolithic, .luf
C27	J19/362-0001	Capacitor, monolithico .luf
C28	J19/362-0001	Capacitor, monolithic, .luf
C29	J19/390-0012	Capacitor, tantalum luf/25 v
C30	J19/362-0001	Capacitor, monolithic, .luf
C31	J19/362-0011	Capacitor, monolithic, .022UF.
C32	J19/390-2336	Capacitor, tantalum, 33uf/16v
C33	J19/362-0001	Capacitor, monolithic, .luf
C34	J19/370-0020	Capacitor, ceramic, 100 pf
C35	J19/362-0001	Capacitor, monolithic, .luf
C36	J19/390-0012	Capacitor, tantalum luf/25 v
C37	J19/390-0012	Capacitor, tantalum luf/25 v
C38	J19/362-0001	Capacitor, monolithic, .luf
C39	J19/362-0001	Capacitor, monolithic, .luf
C40	J19/362-0006	Capacitor, monolithic, .001
C41	J19/362-0002	Capacitor, monolithic, .47 uf
C42	J19/362-0001	Capacitor, monolithic, .luf
C43	J19/362-0002	Capacitor, monolithic, .47uf/16V
C44	J19/390-0005	Capacitor, tantalum, 2.2uf/35V
C45	J19/390-0010	Capacitor, tantalum, 10uf/16V
C46	J19/362-0006	Capacitor, monolithic, .001
C47	J19/362-0009	Capacitor, monolithic, .047UF
C48	J19/390-2476	Capacitor, tantalum, 47uf/16v
C49	J19/390-0012	Capacitor, tantalum, luf/25 v
C50	J19/390-0010	Capacitor, tantalum, 10uf/16V
C51	J19/390-0012	Capacitor, tantalum, luf/25 v
C52	J19/390-0002	Capacitor, tantalum, .47uf/35V
C53	J19/390-0010	Capacitor, tantalum, 10uf/16V
C54	J19/360-0012	Capacitor, electrolytic, 1000uf/16
C55	J19/362-0003	Capacitor, monolithic, .01uf
C56	J19/362-0001	Capacitor, Monolithic, .luf
C57	J19/362-0006	Capacitor, monolithic, .001
C58	J19/390-0010	Capacitor, tantalum, 10uf/16V
C59	J19/360-0012	Capacitor, electrolytic, 1000uf/16
C60	J19/362-0001	Capacitor, monolithic, .luf
C61	J19/362-0001	Capacitor, monolithic, .luf
C62	J19/362-0001	Capacitor, monolithic, .luf
C63	J19/362-0001	Capacitor, monolithic, .luf
C64	J19/362-0001	Capacitor, monolithic, .luf
C65	J19/362-0001	Capacitor, monolithic, .luf
C66	J19/362-0001	Capacitor, monolithic, .luf
C67	J19/390-0010	Capacitor, tantalum, 10uf/16V
C68	J19/362-0001	Capacitor, monolithic, .luf
C69	J19/390-0011	Capacitor, tantalum, 4.7uf/16V
C70	J19/390-0011	Capacitor, tantalum, 4.7uf/16V
C71	J19/362-0007	Capacitor, monolithic, 18pF 200V 10%
C72	J19/362-0007	Capacitor, monolithic, 18pF 200V 10%
C73	J19/390-0005	Capacitor, tantalum, 2.2uf/35V
C74	J19/362-0001	Capacitor, monolithic, .luf
C75	J19/362-0001	Capacitor, monolithic, .luf

SYMBOL	VENDOR NUMBER	DESCRIPTION
D1	J19/110-0002	Diode, IN4003
D2	J19/110-0002	Diode, IN4003
D3	J19/110-0002	Diode, IN4003
D4	J19/110-0002	Diode, IN4003
D5	J19/110-0002	Diode, IN4003
D6	J19/110-0001	Diode, 1N914/1N4148
D7	J19/110-0001	Diode, 1N914/1N4148
D8	J19/110-0001	Diode, 1N914/1N4148
D9	J19/110-0001	Diode, 1N914/1N4148
D10	J19/111-0015	Diode, Zener, 1N5226/4728 3.3V
D11	J19/110-0001	Diode, 1N914/1N4148
D12	J19/110-0008	Diode, Schotky,IN6263
D13	J19/110-0001	Diode, 1N914/1N4148
D14	J19/110-0001	Diode, 1N914/1N4148
D15	J19/110-0008	Diode, Schotky,IN6263
D16	J19/110-0001	Diode, 1N914/1N4148
D17	J19/110-0001	Diode, 1N914/1N4148
D18	J19/110-0001	Diode, 1N914/1N4148
F1	J19/290-0004	Fuse, 3/8 Amp
F1	J19/291-0001	Clip, Fuse, PC Mount
F1	J19/291-0005	Fuse Cover, #840836
HA	J19/265-0005	Wire, jump, .19 in
HC	J19/231-1002	Connector, 22-03-2021 Mol
H1	J19/265-0004	Wire, jump, .4 in
H3	J19/231-1002	Connector, 22-03-2021 Mol
H3	J19/234-0046	Plug Short 925250R
H21	J19/265-0004	Wire, jump, .4 in
H23	J19/231-1002	Connector, 22-03-2021 Mol
H23	J19/234-0046	Plug,short, #925250-R
H25	J19/231-1002	Connector, 22-03-2021 Mol
H27	J19/231-1002	Connector, 22-03-2021 Mol
H27	J19/234-0046	Plug,short, #925250-R
J1	J19/231-1067	2 Position, 156 POST.
J2	J19/234-0066	Jack, mod.,520250-3
J3	J19/234-0066	Jack, mod.,520250-3
J4	J19/231-3017	7 pos top entry recp
J5	J19/231-3112	Connector.6Pos top/en rec
J6	J19/234-0019	Post, 2 Pos Frm 234-0006
J7	J19/231-1003	Connector.22-03-2031 Molx
P1	J19/231-1071	26 positon .1 X .1 post
Q1	J19/180-0006	Transistor, 2N5401
Q2	J19/180-0009	Transistor, MPS8098
Q3		NOT USED
Q4	J19/180-0009	Transistor, MPS8098
Q5	J19/180-0009	Transistor, MPS8098
Q6	J19/180-0009	Transistor, MPS8098
Q7	J19/180-0009	Transistor, MPS8098
R1	J19/312-0019	Resistor, 1K 5%, 1/4W
R2	J19/312-0019	Resistor, 1K 5%, 1/4W
R3	J19/311-1211	Resistor, 1.21K 1%, 1/4W
R4	J19/311-1210	Resistor, 121 1%, 1/4W
R5	J19/311-3650	Resistor, 365 1%, 1/4W
R6	J19/311-1210	Resistor, 121 1%, 1/4W
R7	J19/312-0079	Resistor, 330 5%, 1/4W
R8	J19/312-0057	Resistor, 180K 5%, 1/4W
R9	J19/312-0019	Resistor, 1K 5%, 1/4W
R10	J19/312-0078	Resistor, 1.5K 5%, 1/4W
R11	J19/312-0047	Resistor, 1M 5%, 1/4W
R12	J19/312-0045	Resistor, 620 5%, 1/4W
R13	J19/312-0023	Resistor, 3K 5%, 1/4W
R14	J19/312-0011	Resistor, 10K 5%, 1/4W
R15	J19/312-0027	Resistor, 43K 5%, 1/4W
R16	J19/312-0019	Resistor, 1K 5%, 1/4W
R17	J19/312-0070	Resistor, 3.9 K 5%, 1/4W
R18	J19/312-0020	Resistor, 47K 5%, 1/4W
R19	J19/312-0011	Resistor, 10K 5%, 1/4W
R20	J19/312-0020	Resistor, 47K 5%, 1/4W
R21	J19/312-0079	Resistor, 330 5%, 1/4W
R22	J19/312-0011	Resistor, 10K 5%, 1/4W
R23	J19/312-0011	Resistor, 10K 5%, 1/4W
R24	J19/312-0011	Resistor, 10K 5%, 1/4W
R25	J19/312-0019	Resistor, 1K 5%, 1/4W

SYMBOL	VENDOR NUMBER	DESCRIPTION
R26	J19/312-0016	Resistor, 6.8 M 5%, 1/4W
R27	J19/312-0011	Resistor, 10K 5%, 1/4W
R28	J19/312-0019	Resistor, 1K 5%, 1/4W
R29	J19/351-1103	Potentiometer, 10K 1 turn mini
R30	J19/312-0011	Resistor, 10K 5%, 1/4W
R31	J19/312-0001	Resistor, 390K 5%, 1/4W
R32	J19/312-0035	Resistor, 3.3 K 5%, 1/4W
R33	J19/312-0011	Resistor, 10K 5%, 1/4W
R34	J19/312-0011	Resistor, 10K 5%, 1/4W
R35	J19/312-0071	Resistor, 4.3K 5%, 1/4W
R36	J19/312-0056	Resistor, 150 5%, 1/4W
R37	J19/312-0014	Resistor, 33K 5%, 1/4W
R38	J19/311-1103	Resistor, 110K 1%, 1/4W
R39	J19/312-0020	Resistor, 47K 5%, 1/4W
R40	J19/312-0021	Resistor, 12K 5%, 1/4W
R41	J19/312-0021	Resistor, 12K 5%, 1/4W
R42	J19/312-0021	Resistor, 12K 5%, 1/4W
R43	J19/351-1253	Potentiometer, 25K 1 TURN MINI
R44	J19/312-0072	Resistor, 620K 5%, 1/4W
R45	J19/312-0001	Resistor, 390K 5%, 1/4W
R46	J19/312-0020	Resistor, 47K 5%, 1/4W
R47	J19/312-0011	Resistor, 10K 5%, 1/4W
R48	J19/311-2152	Resistor, 21.5K 1%, 1/4W
R49	J19/312-0041	Resistor, 6.2K 5%, 1/4W
R50	J19/312-0019	Resistor, 1K 5%, 1/4W
R51	J19/312-1334	Resistor, 330K 5%, 1/4W
R52	J19/351-1202	Potentiometer, 2K, 1 Turn
R53	J19/311-2492	Resistor, 24.9 K 1%, 1/4W
R54	J19/312-0021	Resistor, 12K 5%, 1/4W
R55	J19/312-0021	Resistor, 12K 5%, 1/4W
R56	J19/312-0011	Resistor, 10K 5%, 1/4W
R57	J19/312-0003	Resistor, 100K 5%, 1/4W
R58	J19/312-0003	Resistor, 100K 5%, 1/4W
R59	J19/311-1743	Resistor, 174K 1%, 1/4W
R60	J19/312-0070	Resistor, 3.9K 5%, 1/4W
R61	J19/311-2803	Resistor, 280K 1%, 1/4W
R62	J19/312-0021	Resistor, 12K 5%, 1/4W
R63	J19/312-0011	Resistor, 10K 5%, 1/4W
R64	J19/351-1202	Potentiometer, 2K, 1 Turn
R65	J19/312-0035	Resistor, 3.3 K 5%, 1/4W
R66	J19/312-0056	Resistor, 150 5%, 1/4W
R67	J19/312-0038	Resistor, 10 5%, 1/4W
R68	J19/312-0011	Resistor, 10K 5%, 1/4W
R69	J19/312-1334	Resistor, 330K 5%, 1/4W
R70	J19/311-8060	Resistor, 806 1%, 1/4W
R71	J19/312-1229	Resistor, 2.2 5%, 1/4W
R72	J19/312-0059	Resistor, 39K 5%, 1/4W
R73	J19/311-1622	Resistor, 16.2K 1%, 1/4W
R74	J19/312-0011	Resistor, 10K 5%, 1/4W
R75	J19/312-0011	Resistor, 10K 5%, 1/4W
R76	J19/312-1823	Resistor, 82K 5%, 1/4W
R77	J19/312-0057	Resistor, 180K 5%, 1/4W
R78	J19/312-0008	Resistor, 120K 5%, 1/4W
R79	J19/312-0011	Resistor, 10K 5%, 1/4W
R80	J19/312-0011	Resistor, 10K 5%, 1/4W
R81	J19/312-0011	Resistor, 10K 5%, 1/4W
R82	J19/312-0019	Resistor, 1K 5%, 1/4W
R83	J19/312-0011	Resistor, 10K 5%, 1/4W
R84	J19/312-0011	Resistor, 10K 5%, 1/4W
R85	J19/312-0047	Resistor, 1M 5%, 1/4W
R86	J19/312-0011	Resistor, 10K 5%, 1/4W
R87	J19/312-0011	Resistor, 10K 5%, 1/4W
R88	J19/316-0001	Resistor Network, 47K,9 Ele
R89	J19/312-0079	Resistor, 330 5%, 1/4W
R90	J19/312-0015	Resistor, 22K 5%, 1/4W
R91	J19/312-0020	Resistor, 47K 5%, 1/4W
SG1	J19/300-0004	Varistor, 25 volt
SG2	J19/300-0004	Varistor, 25 volt
SG3	J19/300-0004	Varistor, 25 volt
SG4	J19/300-0004	Varistor, 25 volt
SG5	J19/300-0004	Varistor, 25 volt
SG6	J19/300-0004	Varistor, 25 volt
SW1	J19/231-1002	Connector, 22-03-2021 Mol
T2	J19/410-0005	Transformer, GE rmt.MIDCOM
T3	J19/410-0005	Transformer, GE rmt.MIDCOM

SYMBOL	VENDOR NUMBER	DESCRIPTION
TB1	J19/231-0002	Connector, 6-Pin Electro
TP1	J19/200-0015	Post, 85931-4
U1	J19/130-0247	IC, LM317KC
U1	J19/199-3073	Screw,6-32 X 1/2 phillips
U1	J19/200-0068	Spacer,1/8 threaded
U1	J19/210-0001	Heat sink, 1/2
U1	J19/210-0012	Heat sink, 5423B, AAVID
U1	J19/210-0100	Insulator, TO-3
U2	J19/130-0237	LM317T
U2	J19/199-0020	Nut, Hex, 6-32
U2	J19/199-2002	Washer, Star #6
U2	J19/199-3070	Screw, 6-32 X 1/4 phillips
U2	J19/210-0009	Heat sink, 5630B
U2	J19/210-0103	Insulator, TO220
U3	J19/130-0067	IC, 4066
U3	J19/220-0002	Socket, Dip, 14 Pin IC
U4	J19/130-0120	IC, TL062CP
U4	J19/220-0003	Socket, Dip, 8 Pin IC
U5	J19/130-0238	CD74C14
U5	J19/220-0002	Socket, Dip, 14 Pin IC
U6	J19/130-0243	XICOR X9103
U6	J19/220-0003	Socket, Dip, 8 Pin IC
U7	J19/130-0240	IC, NE572
U7	J19/220-0001	Socket, Dip, 16 Pin IC
U8	J19/130-0229	IC, SUPOP-AMP,CA3260E
U8	J19/220-0003	Socket, Dip, 8 Pin IC
U9	J19/130-0229	IC, SUPOP-AMP,CA3260E
U9	J19/220-0003	Socket, Dip, 8 Pin IC
U10	J19/130-0010	IC, LM555
U10	J19/220-0003	Socket, Dip, 8 Pin IC
U11	J19/130-0278	IC, LM13080
U11	J19/220-0003	Socket, Dip, 8 Pin IC
U12	J19/130-0248	IC, LM2003AT
U12	J19/199-0020	Nut, Hex, 6-32
U12	J19/199-2002	Washer, Star #6
U12	J19/199-3070	Screw, 6-32 X 1/4 phillips
U12	J19/210-0009	Ht sink, 5630B
U12	J19/210-0103	Insulator, TO220
U13	J19/130-0099	IC, DM7406
U14	J19/130-0099	IC, DM7406
U14	J19/220-0002	Socket, Dip, 14 Pin IC
U15	J19/130-0112	IC, 74LS32
U15	J19/220-0002	Socket, Dip, 14 Pin IC
U16	J19/130-0119	IC, AD558JN
U16	J19/220-0001	Socket, Dip, 16 Pin IC
U17	J19/130-0218	IC, 74HC373
U18	J19/130-0218	IC, 74HC373
U18	J19/220-0009	Socket, Dip, 20 Pin IC
U19	J19/130-0228	IC, 74HC374
U19	J19/220-0009	Socket, Dip, 20 Pin IC
U20	J19/130-0218	IC, 74HC373
U20	J19/220-0009	Socket, Dip, 20 Pin IC
U21	J19/130-0217	IC, 27C64-250ns
U21	J19/220-0008	Socket, Dip, 28 Pin IC
U22	J19/130-0219	IC, 80C31
U22	J19/220-0007	Socket, Dip, 40 Pin IC
U23	J19/130-0066	IC, CD4528BN
WR	J19/265-0003	Wire, jump 1.25",
X1	J19/201-2013	PORON 1/8",
X1	J19/222-0036	Crystal Tie-Down
X1	J19/305-0002	Crstl, 12 MHz
	J19/199-3070	Screw. 6-32X1/4 phillips
	J19/200-0304	Spcr,Pem,KPE-440-16

PARTS LIST
PARALLEL OPTION BOARD
J19/900-0171

SYMBOL	VENDOR NUMBER	DESCRIPTION
C1	J19/362-0019	Capacitor, monolithic, 01/50v Ultra
C2	J19/362-0019	Capacitor, monolithic, 01/50v Ultra
C3	J19/362-0019	Capacitor, monolithic, 01/50v Ultra
C4	J19/362-0001	Capacitor, monolithic, .1uf
C5	J19/362-0019	Capacitor, monolithic, 01/50v Ultra
C6	J19/362-0001	Capacitor, monolithic, .1uf
C7	J19/362-0001	Capacitor, monolithic, .1uf
C8	J19/362-0001	Capacitor, monolithic, .1uf
C9	J19/362-0001	Capacitor, monolithic, .1uf
C10	J19/390-0010	Capacitor, tantalum, 10uf/16V
C11	J19/362-0014	Capacitor, 82PF
C12	J19/362-0003	Capacitor, monolithic, .01uf
C13	J19/362-0001	Capacitor, monolithic, .1uf
C14	J19/362-0001	Capacitor, monolithic, .1uf
C15	J19/362-0001	Capacitor, monolithic, .1uf
C16	J19/362-0001	Capacitor, monolithic, .1uf
C17	J19/362-0002	Capacitor, monolithic,.47 uf
C18	J19/362-0019	Capacitor, monolithic, 01/50v Ultra
C19	J19/362-0019	Capacitor, monolithic, 01/50v Ultra
C20	J19/362-0001	Capacitor, monolithic, .1uf
C21	J19/362-0001	Capacitor, monolithic, .1uf
C22	J19/362-0019	Capacitor, monolithic, 01/50v Ultra
C23	J19/362-0019	Capacitor, monolithic, 01/50v Ultra
C24	J19/362-0019	Capacitor, monolithic, 01/50v Ultra
C25	J19/362-0019	Capacitor, monolithic, 01/50v Ultra
C26	J19/362-0016	Capacitor, monolithic, 100 pf
D1	J19/110-0001	Diode, 1N914/1N4148
D2		NOT INSTALLED
D3	J19/110-0001	Diode, 1N914/1N4148
D4	J19/110-0001	Diode, 1N914/1N4148
D5	J19/110-0001	Diode, 1N914/1N4148
D6	J19/110-0001	Diode, 1N914/1N4148
P4	J19/231-3107	7 Pos 1100-1-107-07
P5	J19/231-3106	6 pos. 1100-1-106-04
Q1	J19/180-0006	Transistor, 2N5401
Q2	J19/180-0009	Transistor, MPS8098
Q3	J19/180-0009	Transistor, MPS8098
R1	J19/311-6811	Resistor, 6.81K 1%, 1/4W
R2	J19/311-7321	Resistor, 7.32K 1%, 1/4W
R3	J19/311-0017	Resistor, 2.67K 1%, 1/4W
R4	J19/311-4642	Resistor, 46.4K 1%, 1/4W
R5	J19/311-1781	Resistor, 1.78K 1%, 1/4W
R6	J19/312-0027	Resistor, 43K 5%, 1/4W
R7	J19/312-0020	Resistor, 47K 5%, 1/4W
R8	J19/312-0012	Resistor, 220K 5%, 1/4W
R9	J19/312-0015	Resistor, 22K 5%, 1/4W
R10	J19/312-0012	Resistor, 220K 5%, 1/4W
R11	J19/312-0012	Resistor, 220K 5%, 1/4W
R12	J19/312-0014	Resistor, 33K 5%, 1/4W
R13	J19/311-1781	Resistor, 1.78K 1%, 1/4 W
R14	J19/311-4642	Resistor, 46.4K 1%, 1/4 W
R15	J19/311-7321	Resistor, 7.32K 1%, 1/4W
R16	J19/311-6811	Resistor, 6.81K 1%, 1/4 W
R17	J19/311-0017	Resistor, 2.67K 1%, 1/4W
R18	J19/312-0019	Resistor, 1K 5%, 1/4W
R19	J19/312-0073	Resistor, 750K 5%, 1/4W
R20	J19/351-1202	Potentiometer, 2k mini 1 turn
R21	J19/352-0004	Potentiometer, 2K, 22 Turn
R22	J19/352-0005	100K 1 TPOT(36C15-DK
R23	J19/312-0011	Resistor, 10K 5%, 1/4W
R24	J19/312-0011	Resistor, 10K 5%, 1/4W
R25	J19/312-0020	Resistor, 47K 5%, 1/4W
R26	J19/312-0011	Resistor, 10K 5%, 1/4W
R27	J19/312-0011	Resistor, 10K 5%, 1/4W
R28	J19/312-0011	Resistor, 10K 5%, 1/4W
R29	J19/312-0019	Resistor, 1K 5%, 1/4W
R30	J19/352-0003	Potentiometer, 1 Meg, 22 Turn
R31	J19/352-0004	Potentiometer, 2K, 22 Turn
R32	J19/352-0004	Potentiometer, 2K, 22 Turn
R33	J19/352-0004	Potentiometer, 2K, 22 Turn
R34	J19/311-5233	Resistor, 523K 1%, 1/4 W
R35	J19/312-0011	Resistor, 10K 5%, 1/4W
R36	J19/311-6811	Resistor, 6.81K 1%, 1/4 W
R37	J19/311-4642	Resistor, 46.4K 1%, 1/4 W
R38	J19/311-7151	Resistor, 7.15K 1%, 1/4 W
R39	J19/311-7151	Resistor, 7.15K 1%, 1/4 W
R40	J19/312-0012	Resistor, 220K 5%, 1/4W
R41	J19/311-7151	Resistor, 7.15K 1%, 1/4 W
TP1	J19/265-0016	Staple Jumper
TP2	J19/265-0016	Staple Jumper
U1	J19/130-0251	IC, TL064
U1	J19/220-0002	Socket, Dip, 14 Pin IC
U2	J19/130-0120	IC, TL062CP
U2	J19/220-0003	Socket, Dip, 8 Pin IC
U3	J19/130-0251	IC, TL064
U3	J19/220-0002	Socket, Dip, 14 Pin IC

PRODUCTION CHANGES

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

REV. E - TONE REMOTE CONTROLLER BOARD J19/900-0167
TONE REMOTE PARALLEL OPTION BOARD J19/900-0171
To reduce noise by incorporating new line driver, low pass filter, transformer location, and option 13 notches.

900-0167

Begin using PC board artwork revision I.
Change C13 from 2.2uF (390-0005) to .022uF (362-0011).
Change C20 from 2.2uF (390-0005) to .022uF (362-0011).
Change C24 from 150K (311-1503) to 100pF (362-0016).
Change C25 from 3.3K (312-0035) to NOT USED.
Change C27 from .022uF (362-0011) to .1uF (362-0001).
Change C44 from .1uF (362-0001) to 2.2uF (390-0005).
Change C48 from 220uF (360-0007) to 47uF (390-2476).
Change C51 from .1uF (362-0001) to 1uF (390-0012).
Change C73 from .047uF (362-0009) to 2.2uF (390-0005).
Add C74 .1uF (362-0001).
Add C75 .1uF (362-0001).
Change D10 from NOT INSTALLED to 1N5226 3.3V (111-0015).
Change Q3 from 2N5401 (180-0006) to NOT USED.
Change R10 from .4" jumper (265-0004) to NOT USED.
Change R13 from NOT INSTALLED to 3K (312-0023) M.
Change R18 from NOT INSTALLED to 10K (312-0011) V.
Change R20 from 150K (311-1503) to 47K (312-0020) H.
Change R30 from NOT INSTALLED to 10K (312-0011) V.
Change R32 from 330K (312-1334) to 3.3K (312-0035) H.
Change R37 from .022uF (362-0011) to 33K (312-0014) H.
Change R38 form 3K (312-0023) to 110K (311-1103) H.
Change R39 from 100K (312-0003) to 47K (312-0020) H.
Change R44 from 270 ohm (312-0076) to 620K (312-0072) H.
Change R48 from 1K (312-0019) to 21.5K (311-2152) M.
Change R51 from 100K (312-0003) to 330K (312-1334) H.
Change R53 from NOT INSTALLED to 24.9K (311-2492) H.
Change R57 from NOT INSTALLED to 100K (312-0003) H.
Change R58 from 1N5226 3.3V (111-0015) to 100K (312-0003) H.
Change R59 from 49.9K (311-4992) to 174K (311-1743) H.
Change R65 from 10K (312-0011) to 3.3K (312-0035) H.
Change R76 from 1K (312-0019) to 82K (312-1823) V.
Change R90 from 37.4K (311-3742) to 22K (312-0015) V.
Remove R91 100K (312-0003).
Remove R92 100K (312-0003).
Change U11 from LM386-4 (130-0224) to LM1308C (130-0278).

900-0171

Cut solder side trace going from C17 to C12 and P4-1.
Add jumper wire from C17 to P4-3.

REV. F - TONE REMOTE CONTROLLER BOARD J19/900-0167
TONE REMOTE PARALLEL OPTION BOARD J19/900-0171
To reduce popping in the Audio. Added R10 on the 900-0167 board. Changed R9 on the 900-0171 board. Changed the software from 1.32 to 1.33.

R9 was 312-0011 - 10K.

REV. G - TONE REMOTE CONTROLLER BOARD J19/900-0171
To improve parallel detect band pass filter. Changed R19, R38, R36, R40, R30, and R12.

R19 was 312-0073 - 750K ohms.
R38 was 311-7151 - 7.15K ohms.
R36 was 311-6811 - 6.81K ohms.
R40 was 312-0012 - 220K ohms.
R30 was 352-0003 - 1M ohms.
R12 was 312-0014 - 33K ohms.

REV. H - TONE REMOTE CONTROLLER MAIN BOARD J19/101-0167
TONE REMOTE PARALLEL OPTION BOARD J19/101-0171
To improve mic autio operation by increasing turn-off attenuation (in four-wire units with D11 removed), added R91 from U11 pin 2 to U11 pin 6 on the Main Board. The resistor is 47K ohms (J19/312-0020). Also revised Option Board PWB from Rev. E to F to incorporate new R20, R22 and R30 potentiometers.

KEYPAD/DISPLAY BOARD J19/101-0164
Changed D20 from 1N914 (J19/110-0001) to 1N5818 (J19/101-0011). (PWB from Rev. D to E).

REV. J - TONE REMOTE CONTROLLER MAIN BOARD J19/101-0167
To prevent HJ input from interfering with Secur-it and function tones, changed R18 from 10K ohms (J19/311-1103V) to 47K ohms (J19/312-0020) and mounted on the solder side of board. Moved input connection from U11 pin 1 to U8 pin 2. (PWB Rev. J)

PARTS LIST

EDACS TOP HOUSING
J19/900-4002

ISSUE 2

SYMBOL	VENDOR NUMBER	DESCRIPTION
	J19/199-0040	Nut.
	J19/199-6011	Nameplate, Remote.
	J19/200-0069	Insert, #860632 x .25.
	J19/200-0091	Insert, 860632-4 X .180.
	J19/222-0016	Wire, 22 awg Green UL.
	J19/233-0024	Recpt. Amp. 640433-2.
	J19/900-0519A	Lens 1/2FG/DC/TN/CLK.
	J19/900-0523	Base top, Remote.
	J19/901-0013	Speaker, 3 watt, 4 ohm square.

BOTTOM HOUSING
J19/900-4000

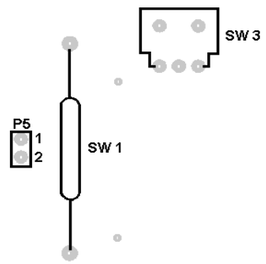
SYMBOL	VENDOR NUMBER	DESCRIPTION
	J19/199-0020	Nut, Hex, 6-32
	J19/199-3080	Screw, 6-32 X 1/4 phillips, blk
	J19/199-4030	Screw, phillips, 1L #4 .
	J19/199-4032	Machine screw, phillips, 5/16 #6
	J19/199-6010	GE rem ser no plate
	J19/199-6102	Label,Caut. Fuse Rmt UL
	J19/199-6103	Label, Elec-Shock UL
	J19/199-6104	Label, Caution Class 3 UL
	J19/199-6105	Label, Warning UL
	J19/200-0024	Splice, Butt, UL for GE
	J19/200-0069	Insert, #860632 x .25
	J19/200-0081	Cable tie (Short)
	J19/203-1054	Rubber feet .25 dia
	J19/203-1107	Strain relief, SR6P3-4
	J19/234-0069	Connector, Winchester
	J19/260-0009	Cord, Power, GE Blck UL
	J19/420-0005	TRANS, UL FOR REMOTE
	J19/800-1111	Cable,6 Conductor Shielded.
	J19/900-0524	GE rem base bottom

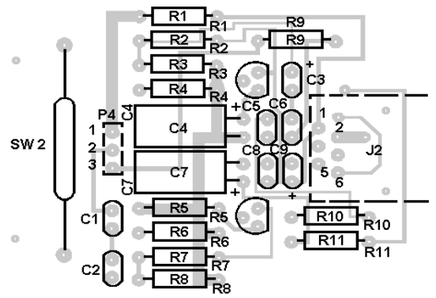
WALL BRACKET KIT
OPTION RC2017

SYMBOL	VENDOR NUMBER	DESCRIPTION
	J19/900-5104B	Bracket, Wall Mount, opt17
	J19/900-5104A	Bracket Wall, Painted
	J19/199-4012	PLASTIC ANCHOR, #6-8
	J19/199-4011	SHEET METAL SCREW, #6 X 1
	J19/199-4010	SHEET METAL SCREW, #6 X 1/2

PARTS LIST
REMOTE HANDSET BOARD
J19/900-0166

SYMBOL	VENDOR NUMBER	DESCRIPTION
C1	J19/362-0009	Capacitor, monolithic, .047UF
C2	J19/362-0009	Capacitor, monolithic, .047UF
C3	J19/390-2226	Capacitor, tantalum, 22uf/16v
C5	J19/390-0011	Capacitor, tantalum, 4.7uf/16V
C6	J19/362-0003	Capacitor, monolithic, .01uf
C7	J19/360-0025	Capacitor, electrolytic 47uf 16v
C8	J19/362-0014	Capacitor, monolithic, 82 pf
C9	J19/390-0002	Capacitor, tantalum .47uf/35V
J2	J19/234-0066	Jack, mod.,520250-3
Q1	J19/180-0009	Transistor, MPS8098
Q2	J19/180-0009	Transistor, MPS8098
R1	J19/311-2101	Resistor, 2.10K 1%, 1/4W
R2	J19/312-0057	Resistor, 180K 5%, 1/4W
R3	J19/312-0003	Resistor, 100K 5%, 1/4W
R4	J19/312-0010	Resistor, 100 5%, 1/4W
R5	J19/312-0078	Resistor, 1.5K 5%, 1/4W
R6	J19/312-0019	Resistor, 1K 5%, 1/4W
R7	J19/312-0057	Resistor, 180K 5%, 1/4W
R8	J19/312-0003	Resistor, 100K 5%, 1/4W
R9	J19/312-0036	Resistor, 8.2K 5%, 1/4W
R10	J19/312-0056	Resistor, 150 5%, 1/4W
R11	J19/312-0002	Resistor, 5.6K 5%, 1/4W
SW1	J19/611-0030	Switch, reed MDRR-4
SW3	J19/611-0031	Switch, GE PTT



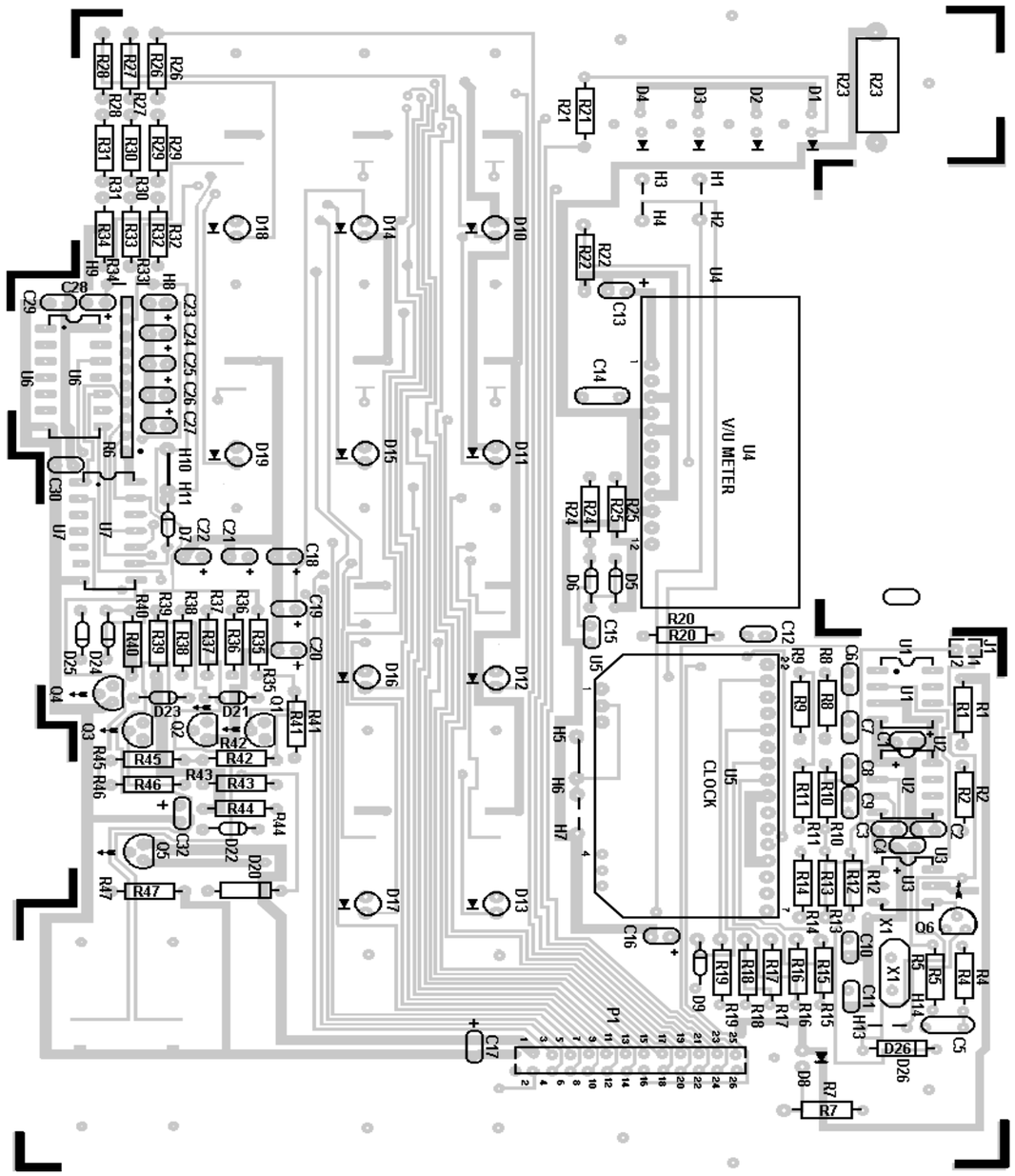


(4162-A-01)
(4162-A-02)

HANDSET
J19/900-4001

SYMBOL	VENDOR NUMBER	DESCRIPTION
	J19/199-1002	Screw, Latch, 20-11
	J19/199-3080	Screw, phillips, 6-32X1/4
	J19/199-4027	Screw, sheet metal, #4 x 1/2
	J19/199-6099	Heat Shrink Tube 3/8
	J19/200-0094	Magnet, HUHS
	J19/201-0063	Styro, GE remote handset
	J19/260-0023	Cord, 6 conductor mdr blk
	J19/800-0037	Cable, Alpha, 3553
	J19/900-0514	GE handset top
	J19/900-0515	GE handset bottom
	J19/900-0516	GE ptt button
	J19/900-0517	GE handset retainer
	J19/900-0517	GE handset retainer
	J19/900-0525	Remote handset cradle
	J19/900-5006	GE handset weight
	J19/901-0009	Element, Ear, DH-32
	J19/901-0011	Mount, Rbr. shack 80A
	J19/901-0014	Element, Mic, E M-60
	J19/901-0016	Speaker Cloth, Black

REMOTE HANDSET BOARD
J19/900-0166



(4160-A-01)
(4160-A-03)

PARTS LIST

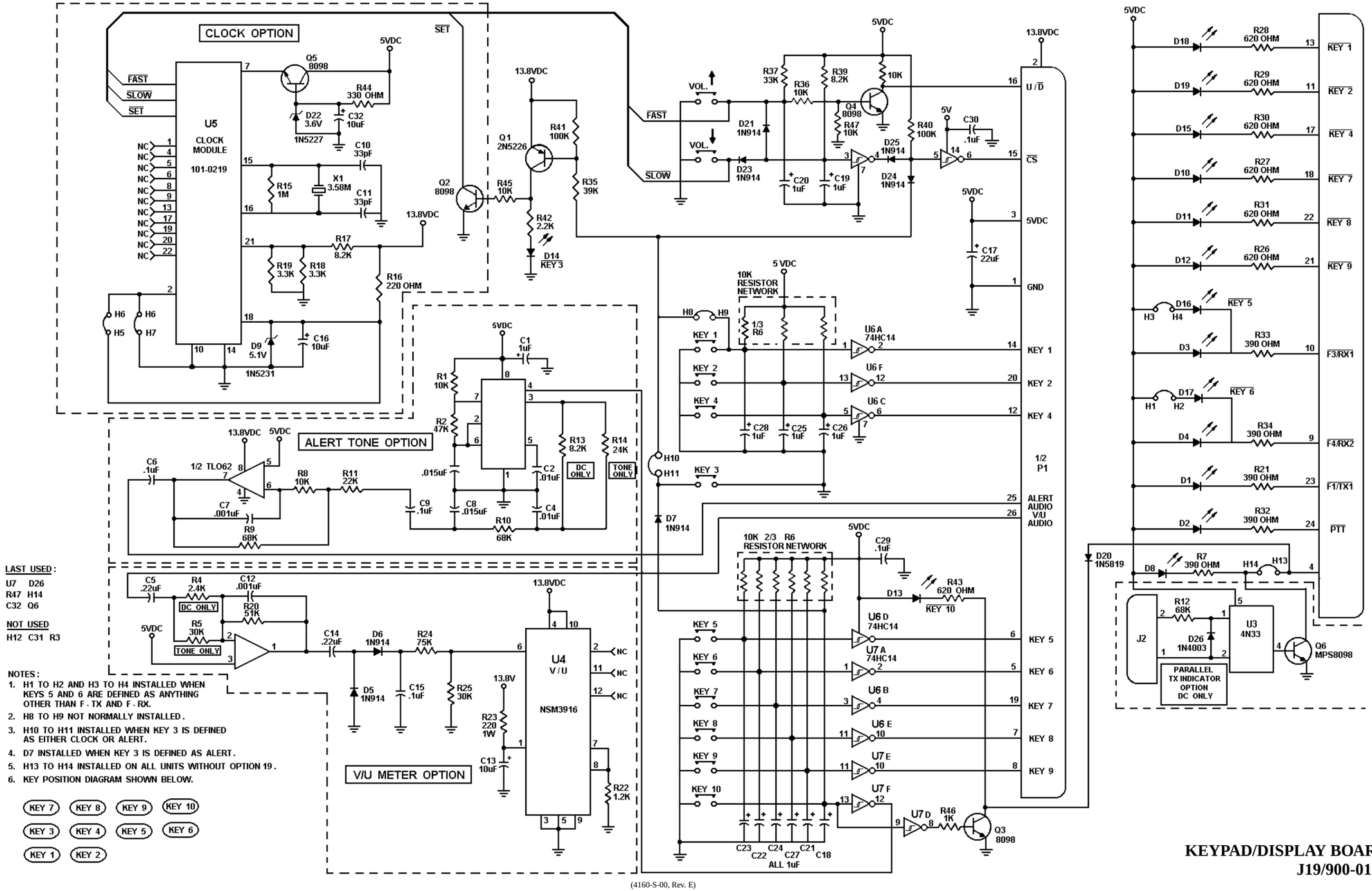
EDACS KEYPAD DISPLAY BOARD
J19/900-0164

ISSUE 3

SYMBOL	VENDOR NUMBER	DESCRIPTION
C1	J19/390-0003	Capacitor, tantalum, 1 uF, 35 V.
C2	J19/362-0003	Capacitor, monolithic, .01 uF.
C3	J19/362-0012	Capacitor, monolithic, .015 uF.
C4	J19/362-0003	Capacitor, monolithic, .01 uF.
C5	J19/362-5224	Capacitor, monolithic, .22 uF, 50 V.
C6	J19/362-0001	Capacitor, monolithic, .1 uF.
C7	J19/362-0006	Capacitor, monolithic, .001 uF.
C8	J19/362-0012	Capacitor, monolithic, .015 uF.
C9	J19/362-0001	Capacitor, monolithic, .1 uF.
C10	J19/362-5330	Capacitor, monolithic, 33 pF.
C11	J19/362-5330	Capacitor, monolithic, 33 pF.
C12	J19/362-0006	Capacitor, monolithic, .001.
C13	J19/390-0010	Capacitor, tantalum, 10 uF, 16 V.
C14	J19/362-5224	Capacitor, monolithic, .22uF, 50 V.
C15	J19/362-0001	Capacitor, monolithic, .1 uF.
C16	J19/390-0010	Capacitor, tantalum, 10 uF, 16 V.
C17	J19/390-2226	Capacitor, tantalum, 22 uF, 16 V.
C18	J19/390-0003	Capacitor, tantalum, 1 uF, 35 V.
C19	J19/390-0003	Capacitor, tantalum, 1 uF, 35 V.
C20	J19/390-0003	Capacitor, tantalum, 1 uF, 35 V.
C21	J19/390-0003	Capacitor, tantalum, 1 uF, 35 V.
C22	J19/390-0003	Capacitor, tantalum, 1 uF, 35 V.
C23	J19/390-0003	Capacitor, tantalum, 1 uF, 35 V.
C24	J19/390-0003	Capacitor, tantalum, 1 uF, 35 V.
C25	J19/390-0003	Capacitor, tantalum, 1 uF, 35 V.
C26	J19/390-0003	Capacitor, tantalum, 1 uF, 35 V.
C27	J19/390-0003	Capacitor, tantalum, 1 uF, 35 V.
C28	J19/390-0003	Capacitor, tantalum, 1 uF, 35 V.
C29	J19/362-0001	Capacitor, monolithic, .1 uF.
C30	J19/362-0001	Capacitor, monolithic, .1 uF.
C32	J19/390-0010	Capacitor, tantalum, 10 uF, 16 V.
D1	J19/112-0016	LED, Red, Rectangular.
D2	J19/112-0016	LED, Red, Rectangular.
D3	J19/112-0016	LED, Red, Rectangular.
D4	J19/112-0016	LED, Red, Rectangular.
D5	J19/110-0001	Diode, 1N914/1N4148.
D6	J19/110-0001	Diode, 1N914/1N4148.
D8	J19/112-0016	LED, Red, Rectangular.
D9	J19/111-0005	Zener, 1N5239 9.1 V.
D10	J19/112-0012	LED, Red, T-1 pkg.
D11	J19/112-0012	LED, Red, T-1 pkg.
D12	J19/112-0012	LED, Red, T-1 pkg.
D13	J19/112-0012	LED, Red, T-1 pkg.
D14	J19/112-0012	LED, Red, T-1 pkg.
D15	J19/112-0012	LED, Red, T-1 pkg.
D16	J19/112-0012	LED, Red, T-1 pkg.
D17	J19/112-0012	LED, Red, T-1 pkg.
D18	J19/112-0012	LED, Red, T-1 pkg.
D19	J19/112-0012	LED, Red, T-1 pkg.
D20	J19/101-0011	Diode, IN5818.
D21	J19/110-0001	Diode, 1N914/1N4148.
D22	J19/111-0008	Zener, 1N5227/4729 3.6 V.
D23	J19/110-0001	Diode, 1N914/1N4148.
D24	J19/110-0001	Diode, 1N914/1N4148.
D25	J19/110-0001	Diode, 1N914/1N4148.
D26	J19/110-0002	Diode, IN4003.
H5	J19/265-0006	Wire, jumper, .25".
H8	J19/265-0006	Wire, jumper, .25".
H10	J19/265-0006	Wire, jumper, .25".
H11	J19/110-0001	Diode 1N914/1N4148.
H13	J19/265-0006	Wire, jumper, .25".
J2	J19/234-0033	Connector 2 pos.
J2-1	J19/222-0020	Wire, Brown.
J2-2	J19/222-0014	Wire, Red.
P1	J19/231-1071	26 pos .1 X .1 post.

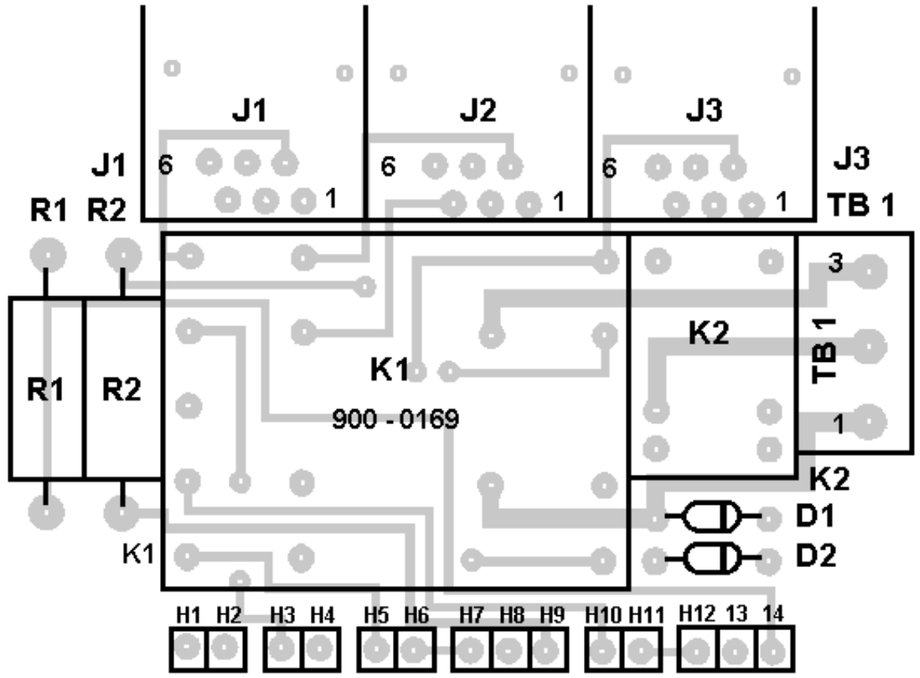
SYMBOL	VENDOR NUMBER	DESCRIPTION
Q1	J19/180-0005	Transistor, 2N5226.
Q2	J19/180-0009	Transistor, MPS8098.
Q3	J19/180-0009	Transistor, MPS8098.
Q4	J19/180-0009	Transistor, MPS8098.
Q5	J19/180-0009	Transistor, MPS8098.
Q6	J19/180-0009	Transistor, MPS8098.
R1	J19/312-0011	Resistor, 10K ohms ±5%, 1/4 w.
R2	J19/312-0020	Resistor, 47K ohms ±5%, 1/4 w.
R3		NOT INSTALLED.
R4	J19/311-0013	Resistor, 2.4K ohms ±1%, 1/4 w.
R6	J19/316-1103	Resistor Network, 9 X 10K ohms.
R7	J19/312-0044	Resistor, 390 ohms ±5%, 1/4 w.
R8	J19/312-0011	Resistor, 10K ohms ±5%, 1/4 w.
R9	J19/312-0058	Resistor, 68K ohms ±5%, 1/4 w.
R10	J19/312-0058	Resistor, 68K ohms ±5%, 1/4 w.
R11	J19/312-0015	Resistor, 22K ohms ±5%, 1/4 w.
R12	J19/312-0058	Resistor, 68K ohms ±5%, 1/4 w.
R13	J19/312-0036	Resistor, 8.2K ohms ±5%, 1/4 w.
R15	J19/312-0047	Resistor, 1M ohms ±5%, 1/4 w.
R16	J19/312-0056	Resistor, 150 ohms ±5%, 1/4 w.
R17	J19/312-0036	Resistor, 8.2K ohms ±5%, 1/4 w.
R18	J19/312-0035	Resistor, 3.3K ohms ±5%, 1/4 w.
R19	J19/312-0035	Resistor, 3.3K ohms ±5%, 1/4 w.
R20	J19/312-0032	Resistor, 51K ohms ±5%, 1/4 w.
R21	J19/312-0044	Resistor, 390 ohms ±5%, 1/4 w.
R22	J19/312-0034	Resistor, 1.2K ohms ±5%, 1/4 w.
R23	J19/314-1224	Resistor, 220 ohms, 1 w.
R24	J19/312-0055	Resistor, 75K ohms ±5%, 1/4 w.
R25	J19/312-1303	Resistor, 30K ohms ±5%, 1/4 w.
R26	J19/312-0045	Resistor, 620 ohms ±5%, 1/4 w.
R27	J19/312-0045	Resistor, 620 ohms ±5%, 1/4 w.
R28	J19/312-0045	Resistor, 620 ohms ±5%, 1/4 w.
R29	J19/312-0045	Resistor, 620 ohms ±5%, 1/4 w.
R30	J19/312-0045	Resistor, 620 ohms ±5%, 1/4 w.
R31	J19/312-0045	Resistor, 620 ohms ±5%, 1/4 w.
R32	J19/312-0044	Resistor, 390 ohms ±5%, 1/4 w.
R33	J19/312-0044	Resistor, 390 ohms ±5%, 1/4 w.
R34	J19/312-0044	Resistor, 390 ohms ±5%, 1/4 w.
R35	J19/312-0059	Resistor, 39K ohms ±5%, 1/4 w.
R36	J19/312-0011	Resistor, 10K ohms ±5%, 1/4 w.
R37	J19/312-0014	Resistor, 33K ohms ±5%, 1/4 w.
R38	J19/312-0013	Resistor, 10K ohms ±5%, 1/4 w.
R39	J19/312-0036	Resistor, 8.2K ohms ±5%, 1/4 w.
R40	J19/312-0003	Resistor, 100K ohms ±5%, 1/4 w.
R41	J19/312-0003	Resistor, 100K ohms ±5%, 1/4 w.
R42	J19/312-0007	Resistor, 2.2K ohms ±5%, 1/4 w.
R43	J19/312-0045	Resistor, 620 ohms ±5%, 1/4 w.
R44	J19/312-0079	Resistor, 330 ohms ±5%, 1/4 w.
R45	J19/312-0011	Resistor, 10K ohms ±5%, 1/4 w.
R46	J19/312-0019	Resistor, 1K ohms ±5%, 1/4 w.
R47	J19/312-0011	Resistor, 10K ohms ±5%, 1/4 w.
U1	J19/130-0120	Integrated circuit, TL062CP.
U2	J19/130-0010	Integrated circuit, LM555 (TI ONLY).
U3	J19/130-0256	Integrated circuit, 4N33.
U4	J19/130-0244	NSM3916 V/U module.
U5	J19/130-0245	MA1136RZW clock module.
U6	J19/130-0246	Integrated circuit, 74HC14.
U7	J19/130-0246	Integrated circuit, 74HC14.
X1	J19/305-0011	Crystal, 3.58MHz lo pro.
	J19/199-3070	Screw, 6-32 X 1/4 Phlp.
	J19/199-4029	Screw, #4x1/4 sht.mtl..
	J19/199-4031	#4 X 5/16 Slotted Tr.
	J19/203-0018	Vol up/dwn keypad.
	J19/203-0020	Remote keypad.
	J19/233-0013	Receptacle, 26 Pos w/St.r.
	J19/800-0035	Cable, 26 Conductor Ribbon, UL.
	J19/900-0164	PC Bd, Keypad-Display.
	J19/900-0422	Microphone, Desk.
	J19/900-0518	Button, Blank.
	J19/900-0518A	Button, CLOCK.
	J19/900-0518B	Button, Volume.
	J19/900-0518C	Button, SUPV.
	J19/900-0518D	Button, INTCM.
	J19/900-0518I	Button, ALERT.
	J19/900-0518J	Button, MUTE.
	J19/900-0518T	Button, SF1.
	J19/900-0518U	Button, SF2.
	J19/900-0518V	Button, SF3.
	J19/900-0518W	Button, SF4.
	J19/900-0518X	Button, SF5.
	J19/900-0521A	Control Panel,12 Hole.
	J19/900-0522A	Key Panel,12 Hole.

KEYPAD/DISPLAY BOARD



(4160-S-00, Rev. E)

KEYPAD/DISPLAY BOARD
J19/900-0164



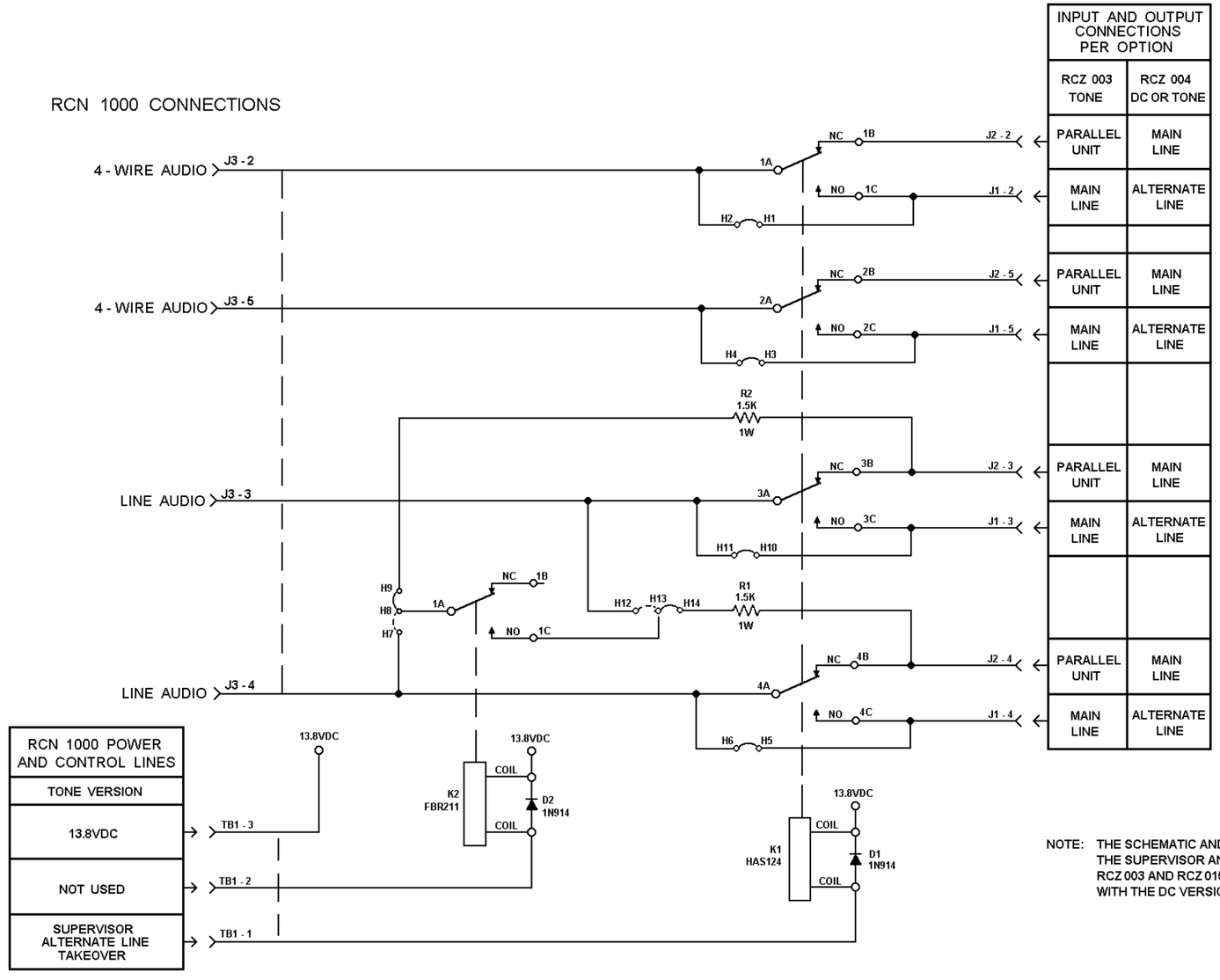
(4163-A-00)
(4163-A-02)

ALTERNATE LINE/SUPERVISORY CONTROL BOARD

J19/900-0169

PARTS LIST
SUPERVISORY/ALTERNATE LINE
J19/900

SYMBOL	VENDOR NUMBER	DESCRIPTION
D1	J19/110-0001	Diode, 1N914/1N4148
D2	J19/110-0001	Diode, 1N914/1N4148
H1	J19/265-0016	Staple Jumper
H3	J19/265-0016	Staple Jumper
H5	J19/265-0016	Staple Jumper
H7	J19/265-0016	Staple Jumper
H8	J19/265-0016	Staple Jumper
H10	J19/265-0016	Staple Jumper
H12	J19/265-0016	Staple Jumper
H13	J19/265-0016	Staple Jumper
J1	J19/234-0066	Jack, mod., 520250-3
J2	J19/234-0066	Jack, mod., 520250-3
J3	J19/234-0066	Jack, mod., 520250-3
K1	J19/700-0001	Relay 4PDT Maycraft
K2	J19/700-0005	Relay SPDT BR211
R1	J19/314-1152	Resistor, 1.5K 5%, 1 W
R2	J19/314-1152	Resistor, 1.5K 5%, 1 W
TB 1	J19/199-6099	Heat Shrink Tube 3/8
TB 1	J19/200-0081	Cable tie (Short)
TB 1	J19/203-1050	Grommet, 3/8
TB 1	J19/231-0028	Connector, 3 Pin Electro
TB 1	J19/234-0005	Headr,3 Pin,640440-3
TB 1	J19/800-1005	22AWG 3 conductor cable
	J19/199-6108	Label
	J19/199-6109	Label 'RCZ003/4'
	J19/199-6111	Label RCZ-015
	J19/199-6112	Label RCZ-0004
	J19/199-6113	Label
	J19/201-3003	3/4 DS FOAM TAPE
	J19/900-0039	Cab,Alt.Line Box

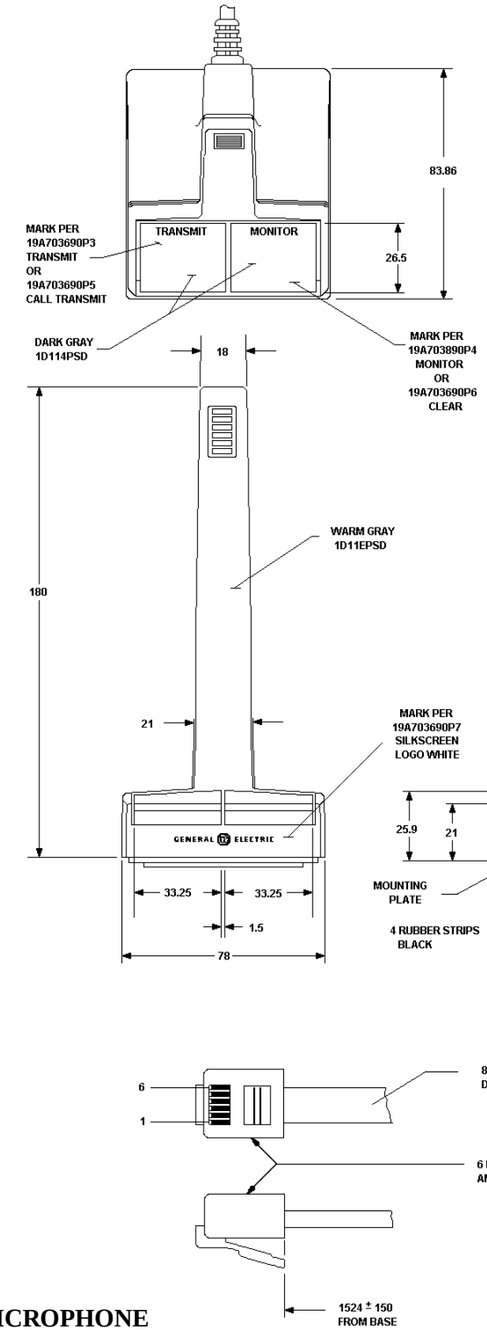


NOTE: THE SCHEMATIC AND JUMPER POSITIONS SHOWN REPRESENT THE SUPERVISOR AND TAKEOVER CONTROL, OPTION NUMBER RCZ 003 AND RCZ 015. THIS COMBINATION IS AVAILABLE, WITH THE DC VERSION ONLY.

OPTION NUMBER	RCZ 003	RCZ 004
FUNCTION	SUPERVISOR	ALTERNATE LINE
VERSION	TONE	DC OR TONE
PARTS NOT INSTALLED	D2, H7 - 8, 8 - 9, 12 - 13, 13 - 14 K2, R1, 2	D2, H1 - 2, 3 - 4, 5 - 6 7 - 8, 8 - 9, 10 - 11, 12 - 13, 13 - 14, K2, R1, 2.

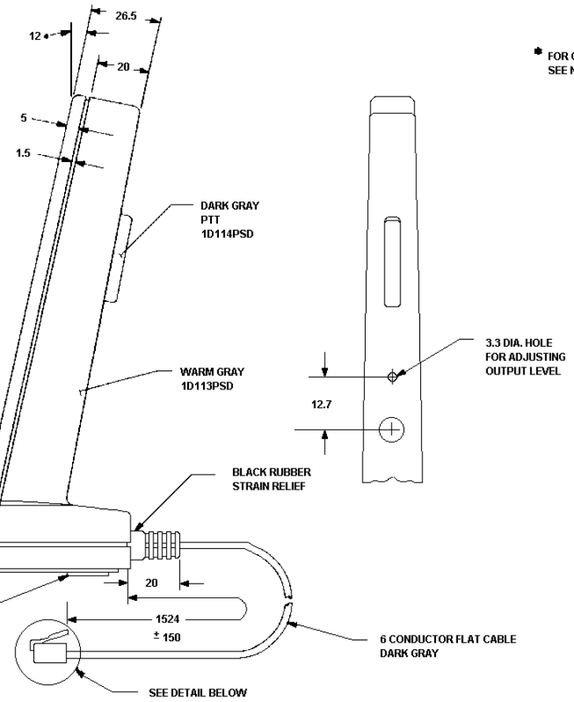
ALTERNATE LINE/SUPERVISORY CONTROL BOARD

J19/900-0169



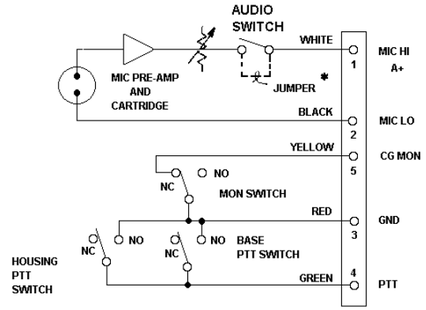
NOTES:

1. STANDARD UNIT WITH "TRANSMIT" AND "MONITOR" MARKINGS IS PART NO. 900-0423. MARC 5 UNIT IS IDENTICAL, EXCEPT FOR MARKINGS "CALL TRANSMIT" AND "CLEAR", PART NO. 900-0424.
2. WARM GRAY IDENTIFICATION NUMBER IS 1D113PSD.
3. DARK GRAY IDENTIFICATION NUMBE IS 1D114PSD.
4. COLOR CHIPS TO MATCH THOSE OF G.E. INDUSTRIAL DESIGN.



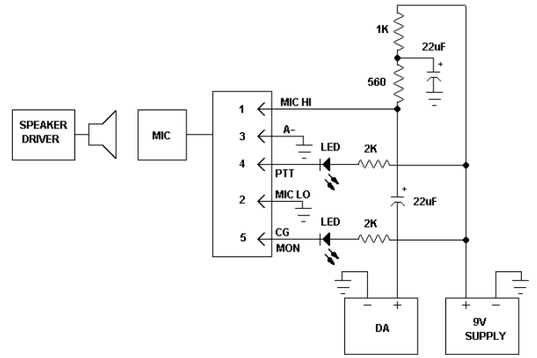
DESK MICROPHONE
J19/900-0423

(4027-D-00, Rev. A)

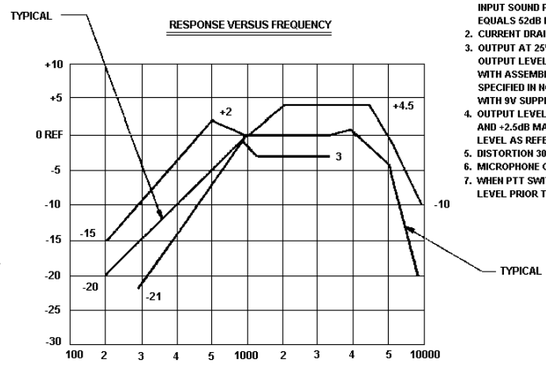


MICROPHONE WIRING DIAGRAM

* FOR CONTINUOUS AUDIO JUMPER 18 INSTALLED IN THE FIELD. SEE NOTE 17 IN REQUIREMENTS.



TEST CIRCUIT FOR MEASURING MICROPHONE RESPONSE

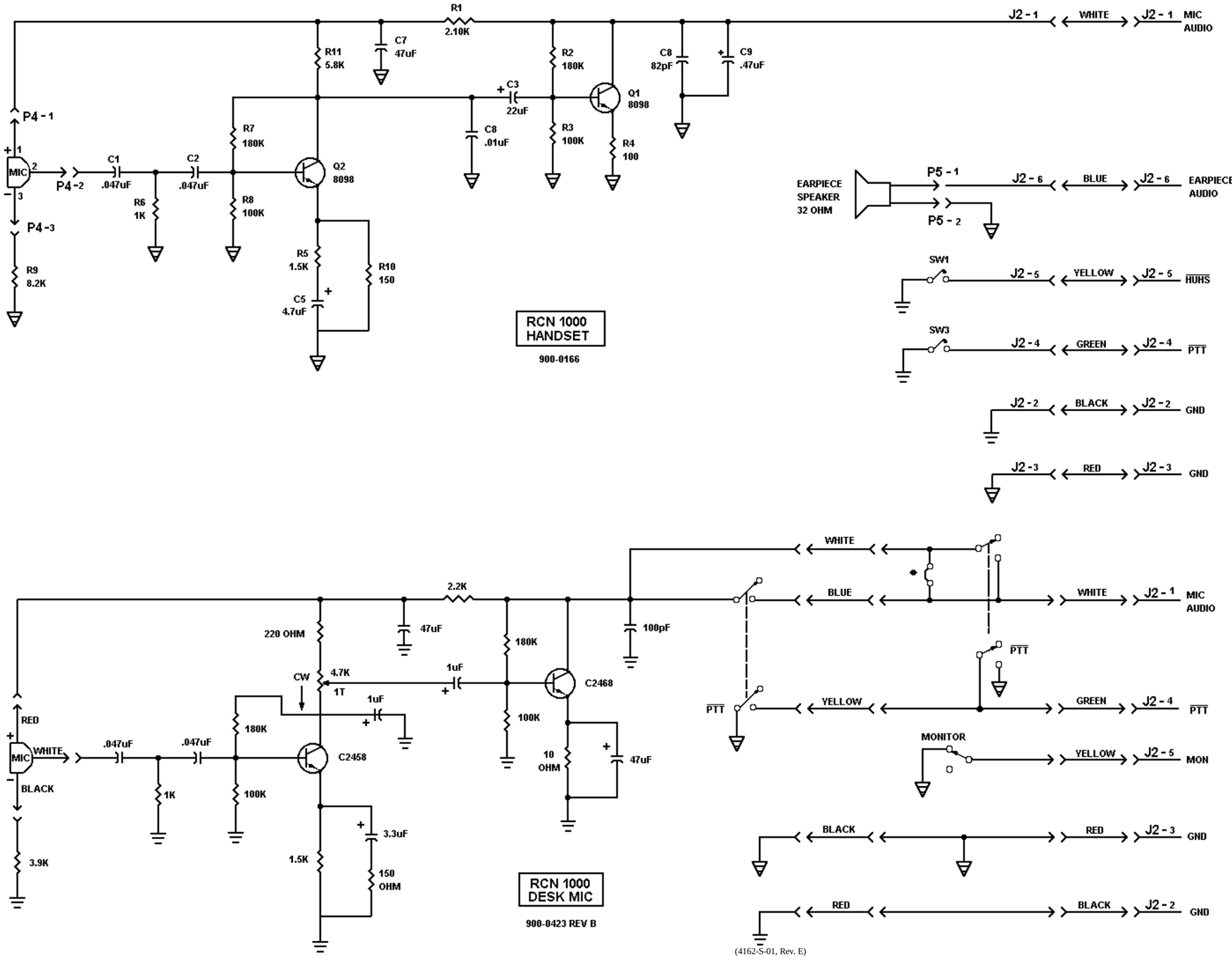


TEST NOTES:

1. RESPONSE MEASUREMENTS ARE MADE WITH THE MICROPHONE GRILLE LOCATED 8mm FROM B&K 4219 ARTIFICIAL VOICE OR EQUIVALENT. INPUT SOUND PRESSURE LEVEL HELD CONSTANT AT 94dB. (0dB EQUALS 52dB BELOW 1 VOLT PER 0.1 PASCAL INPUT AT 1000 HERTZ)
2. CURRENT DRAIN AT 4mA MAXIMUM.
3. OUTPUT AT 25%C, 1000 HERTZ:
   OUTPUT LEVEL ADJUSTABLE FROM 20mV TO 400mV WITH SCREWDRIVER WITH ASSEMBLED UNIT. PRESET TO 120mV OUTPUT WITH INPUT AS SPECIFIED IN NOTE 1. MEASURED ON D.A. (HP 331A OR EQUIVALENT WITH 9V SUPPLY SET AT 9VDC + - 0.1 VOLT.
4. OUTPUT LEVEL DEVIATION WITH TEMPERATURE -4dB MAX. AT -30%C AND +2.5dB MAX. AT +60%C WHEN MEASURED AT 1KHZ WITH 25%C LEVEL AS REFERENCE.
5. DISTORTION 300 TO 3000 Hz 5% MAXIMUM.
6. MICROPHONE OUTPUT TO BE WITHIN FREQUENCY CHART LIMITS.
7. WHEN PTT SWITCH IS SLOWLY DEPRESSED THE DA MUST INDICATE OUTPUT LEVEL PRIOR TO OR AT THE SAME TIME AS LED ILLUMINATES.

REQUIREMENTS:

1. MICROPHONE TO BE TRANSISTORIZED ELECTRET. CARTRIDGE WILL BE PRIMO EM-60 OR EQUIVALENT. ACTIVE DEVISES MUST BE SILICON. MICROPHONE ELECTRICALLY COMPATIBLE WITH G.E. 19D900141G1.
2. CORD TO BE 6 CONDUCTOR CADMIUM COPPER WIRE AS SHOWN. JACKET TO BE PVC.
3. SWITCH TO BE CAPABLE OF 1 MILLION OPERATIONS AT 18VCD AT 250mA RELAY LOAD WITHOUT FAILURE.
4. MICROPHONE SHALL MEET REQUIREMENTS AFTER 250 HOURS EXPOSURE AT 90 TO 95% RELATIVE HUMIDITY AT 40%C.
5. MICROPHONE SHALL OPERATE OVER A RANGE OF -40%C TO +60%C.
6. MICROPHONE SHALL MEET ALL REQUIREMENTS AFTER BEING VIBRATED AT SIMPLE HARMONIC MOTION WITH TOTAL EXCURSION OF 0.762mm (.030") AT FREQUENCIES OF 10 TO 55 HERTZ IN ANY PLANE FOR 30 MINUTES.
7. MARK PACKAGE AND BASE OF MICROPHONE WITH IDA PART NUMBER AND REVISION LEVEL A. EXAMPLE: 900-0423 REV A.
   PACKAGE MUST BE AS SINGLE UNITS SUITABLE FOR RESHIPMENT.
8. TEXTURE: ALL SURFACES TO BE UNTEXTURIZED.
9. ALL FERROUS PARTS MUST RESIST CORROSION.
10. CARTRIDGE AND PREAMPLIFIER MUST BE PROTECTED AGAINST RF AND ELECTROSTATIC ENERGY FIELD.
11. ADEQUATE PROTECTION FROM MALFUNCTIONS CAUSED BY PICKUP DUST WILL BE PROVIDED.
12. MICROPHONE CARTIDGE MUST BE WEATHERPROOF.
13. RESISTANCE BETWEEN RED AND GREEN CONDUCTORS MEASURED AT THE FREE END WITH PUSH SWITCH DEPRESSED SHALL NOT EXCEED 2.5 OHMS.
14. CORD TO WITHSTAND AN 89 NEWTON PULL TEST WITH FORCE APPLIED BETWEEN THE MICROPHONE AND THE FREE END OF THE CORD. WIRES SHALL BE KNOTTED TOGETHER AT PWB END TO PREVENT TRANSMITTING PULL FORCE TO CONNECTOR.
15. STRAIN RELIEF TO BE MADE FROM CADMIUM PLATED 1.27 DIAMETER BRASS (BIIH2IC)
16. MICROPHONE WEIGHT TO BE 325 + - 25 GRAMS.
17. MICROPHONE SUPPLIED WITHOUT JUMPER ACROSS AUDIO SWITCH CONTACTS, WITH BASE REMOVED. HOLES IN PWB TO BE LOCATED AND MARKED SO THAT JUMPER CAN BE ADDED FOR CONTINUOUS AUDIO. AUDIO SWITCH OPERATED BY DEPRESSING EITHER PTT SWITCH.
18. SWITCHES TO BE NORMALLY OPEN MOMENTARY PUSH BUTTON TYPE.



(4162-S-01, Rev. E)

HANDSET
J19/900-0166
DESK MICROPHONE
J19/900-0423