GE Mobile Communications

TONE REMOTE AND TONE REMOTE/REPEATER CONTROL PANEL

19B234871 P51-74

Maintenance Manual

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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!

SPECIFICATIONS *

Power Input	13.8 VDC ±20%
Input Current	300 mA.
Frequency Response	±1 dB from 300 to 3000 Hz
Temperature Range	-30° to +85°C (-22°F to +185°F)
Distortion	Less than 3%
Repeater Timer	Jumper selectable, 1, 3 or 10 minutes
Drop-Out Timer	Jumper selectable, 1, 3 or 10 seconds
Size	4.22h X 11.0w X 8.43d Inches
Impedance	600 ohms
Audio Input	-19 dBm to +11 dBm
Audio Output	-19 dBm to +11 dBm

* These specifications are intended primarily for the use of the service personnel. Refer to the appropriate base station specification sheet for the complete specifications.

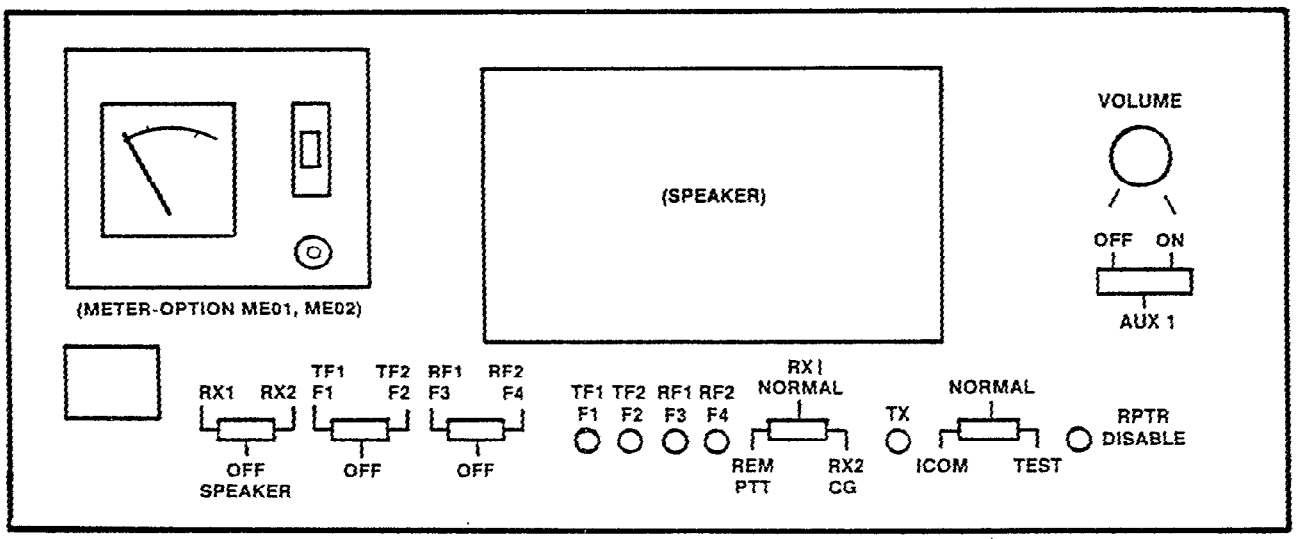
DESCRIPTION

The Tone Remote or Remote/Repeater station panels (19B234871P51-74) are self contained units that contain the audio, regulated power supplies, function tone detection, function decoders and timing control circuits required to operate the station. The capabilities of this panel are one to four frequency transmit and receive, with Channel Guard, repeat disable, Channel Guard on-off, auxiliary relay and scan (see Table 1). The station panel is located within the 7-rack unit radio panel and is accessed by opening the receiver exciter door on the front of the cabinet. Figure 1 provides a sketch of the front panel marking. Figure 2 provides a Block Diagram of the Tone Remote/Repeater Assembly.

Panels (19D234871P53-74) include a Tone Extension Board (-0173) in addition to the Main Board (-0172). This provides the detection and output control for the 1050 Hz, 1150 Hz, 1250 Hz, 1350 Hz, 1450 Hz, 1550 Hz, 1650 Hz, 1750 Hz, and 1850 Hz function tones. This board assembly contains function tone detection, function decoders, PROM decoders and output driver circuits required to operate the radio station. When the Battery Backup feature is desired to maintain the latches in their last decoded position (during a power failure), install battery B1 and remove jumper H15-H16.

The tone extension board (-0173) is located on top of the main board (-0172). To gain access to the components on the main board, remove the two screws located on the front side of the -0173 assembly and swivel the assembly upwards.

The tone sequence consists of three intervals as depicted in Figure 3. The first interval, known as the Secur-It tone is sent by the control unit for 125 milliseconds at a level equal to normal voice peaks (in the case of 0 VU voice tone level is +10 dB) to alert the panel that a function tone follows. The proper function tone (see Table 2 for a listing of function and frequency) is then sent for a 40 millisecond interval. For a function that does not include transmitting this completes the sequency. For transmit functions, the third interval is the HOLD tone, which is the same frequency as the Secur-It but it is sent 30 dB lower and it continues for as long as the PTT switch is depressed.



RC-5683A

FRONT PANEL MARKING FOR PARTS 21-74

Figure 1 - Station Control Panel

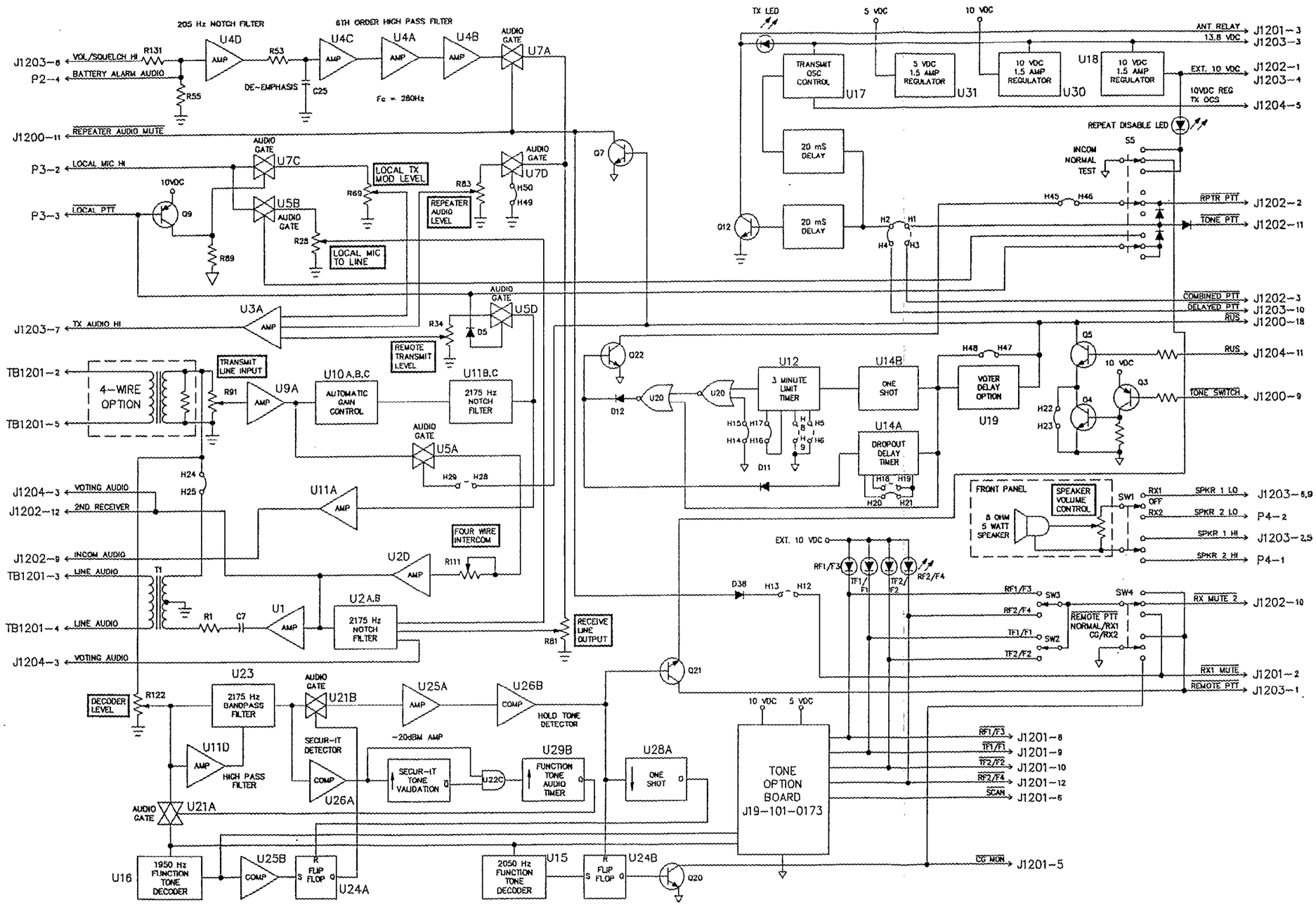


Figure 2 - Tone Remote/Repeater Panel

(4168-S-02, Rev.L)

Part No.	Description	One Freq	Two Freq	Four Freq	Channel Guard	Repeat Disable	CG On-Off	Aux. 1	Scan
51	*Remote or Remote/Repeater	X							
52	*Remote or Remote/Repeater	X			X				
53	Remote		X						
54	Remote		X		X				
55	Remote			X					
56	Remote			X	X				
57	Remote/Repeater	X				X			
58	Remote/Repeater	X			X	X			
59	*Remote or Remote/Repeater	X			X		X		
60	Remote/Repeater	X			X	X	X		
61	Remote		X		X		X		
62	Remote			X	X		X		
63	*Remote or Remote/Repeater	X						X	
64	*Remote or Remote/Repeater	X			X			X	
65	Remote		X					X	
66	Remote		X		X			X	
67	Remote/Repeater	X				X			
68	Remote/Repeater	X			X	X		X	
69	*Remote or Remote/Repeater	X			X		X	X	
70	Remote/Repeater	X			X		X	X	
71	Remote		X		X		X	X	
72	Remote		X					X	X
73	Remote	X				Aux Receiver Application			
74	Remote		X			Aux Receiver Application			

* To make Remote/Repeater for these units requires 19C327001P2 Modification Instructions.

TABLE 1- CONFIGURATION

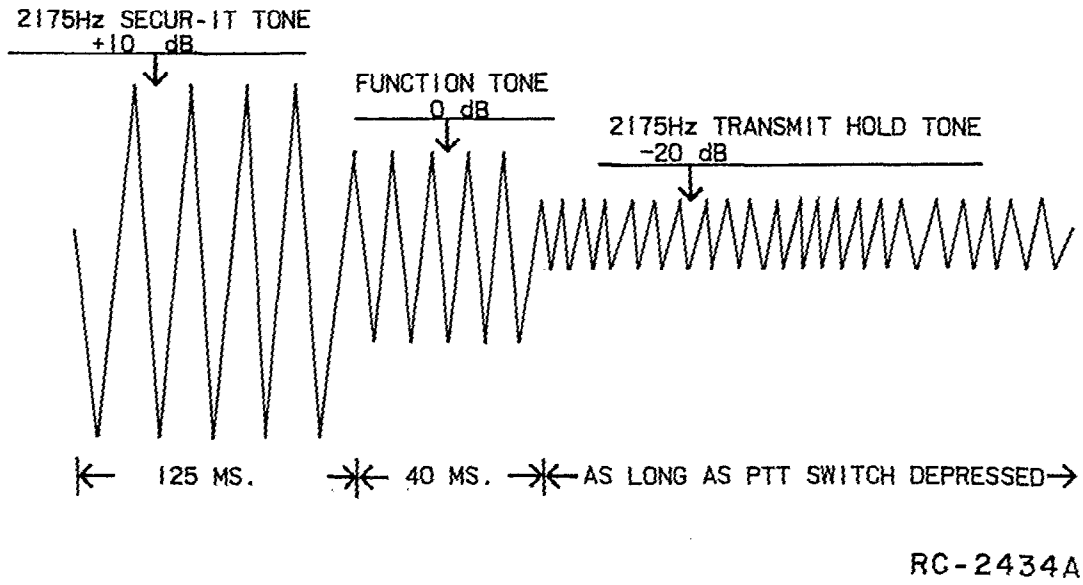


Figure 3 - Tone Control Sequence

TABLE 2 - TONE CONTROL FUNCTION AND FREQUENCY

RX Channel Guard Disable (Reset by PTT)	2050 Hertz
TX-Freq. No. 1	1950 Hertz
TX-Freq. No. 2	1850 Hertz
RX-Freq. No. 1 or Receiver No. 1	1750 Hertz
RX-Freq. No. 2 or Receiver No. 2	1650 Hertz
Channel Guard On or Repeater Enable*	1550 Hertz
Channel Guard Off or Repeater Disable*	1450 Hertz
TX-Freq. No. 3 or Aux. Function 1 On	1350 Hertz
TX-Freq. No. 4 or Aux. Function 1 Off	1250 Hertz
Repeater Enable*	1150 Hertz
Repeater Disable* or Scan or Simultaneous Monitor	1050 Hertz

NOTES:

* Repeater Enable/Disable is 1150/1050 only when Channel Guard On/Off is present.

CIRCUIT ANALYSIS

The Tone Remote or Remote/Repeater Panel assembly is completely solid state and uses a combination of discrete components and integrated circuits (IC's) to achieve maximum reliability. Discrete components are used primarily in the audio filtering input/output stages. The IC's are used primarily in the timers and decoding circuitry that control the repeater.

CG Filter, De-Emphasis and High Pass Filter Amplifiers

Audio from the station receiver section is applied to the panel on the "VOL/SQ HI" port on J1203-8. Amplifier U4D is a notch filter that is centered at 205 Hz and has 25 dB of attenuation. Resistor R53 and capacitor C25 form the de-emphasis filtering that causes the audio to roll off at 6 dB per octave in the frequency range from 300-3000 Hz. Amplifiers U4C, U4A and U4B form a sixth order high pass filter which is factory adjusted by potentiometer R82 to have a cut-off at 280 Hz. The combination of all the supporting components and amplifiers in this section provide the frequency envelope shaping requirements of the graph in Figure 4.

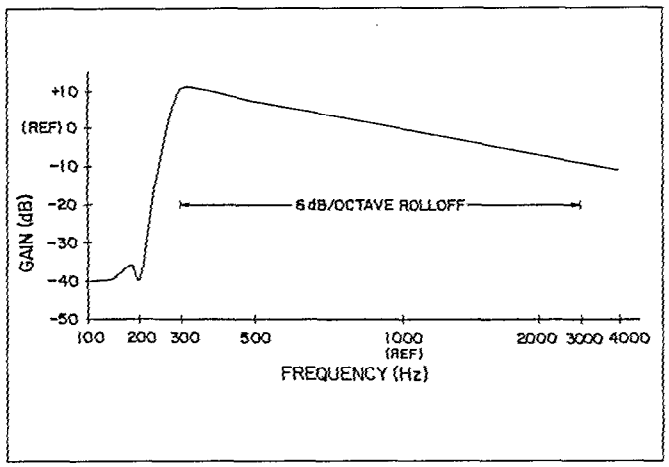


Figure 4 - Frequency Response

Analog gates U7A and U7D control the audio from the "VOL/SQ HI" input to Combiner/Output Amp U3A. Upon detection of a high (in the range from 0.8 to 1.6 Vdc) on the "RUS" input on J1204-11, transistor Q5 will turn on causing the voltage on the collector to go low (less than 0.3 Vdc). This level is inverted by transistor Q7 and places a high (greater than 9.5 Vdc) on the gate control, pin 13 of U7A, which then couples the audio to the input of second analog gate U7D. The gate control on pin 12 is controlled by transistor Q10 which is normally "on" thus the collector is low (less than 0.3 Vdc). This gate will be enabled when transistor Q10 turns off during a remote PTT function decoded by OR gate U27A. Audio is then coupled through analog gate U7D and is applied to potentiometer R83 (REPEATER AUDIO LEVEL CONTROL) which is used to set the deviation on the transmitter.

If during the time that the "RUS" port is high a "LOCAL PTT" is depressed, diode D37 is forward biased and disables analog gate U7A from conducting and disables the "VOL/SQ HI" audio path th the "TX AUDIO HI" port on J1203-7. In addition, if a low is applied to "REP AUDIO MUTE" port on J1200-11 this will also terminate the audio path from "VOL/SQ HI" by pulling gate U7A control pin 13 low (less than 0.8 Vdc).

Local Mic I/O

The "LOCAL MIC HI" port on P3-2 couples audio from the mic element to analog gate U7C. The DC bias and 600 ohm terminating impedance required by the mic is provided by the RC network comprised of R85, R86 and C43. Analog gate U7C is controlled by transistor Q9 which interfaces the "LOCAL PTT" line on P3-3 to the gate pin 6. When the PTT button is not depressed, Q9 is off and the voltage on top of resistor R89 is low (less than 1 Vdc). Upon activation of the PTT switch, the voltage on R89 will be high (greater than 9.5 Vdc). The audio level from the "LOCAL MIC HI" input on P3-2 to the "TX AUDIO OUT" port on J12-3-7 is set by potentiometer R69.

In addition, the audio from the "LOCAL MIC HI" port is applied to analog gate U5B which is controlled by transistor Q9. This transistor is normally off and thus the voltage on the top of resistor R89 is low (less than 0.5 Vdc). The voltage on the top of resistor R67 will be high (greater than 9.5 Vdc) when the Local PTT button is depressed. The audio level from the "LOCAL MIC HI" input on P3-2 to the "LINE" ports on TB1201-3 and TB1201-4 is set by potentiometer R28 "LOCAL MIC TO LINE".

Transmit Audio and Compression

Audio from the remote controller is coupled by transformer T1 to terminating resistor R1 which matches the output imped-

ance of the control panel to 600 ohms. When the panel is used in the standard two wire configuration, the jumper between H24 and H25 is installed, which applies the receive audio to potentiometer R91. This potentiometer is labeled "TX LINE INPUT" and sets the level of the audio applied to line compensation amplifier U9A. This amp can be set up to provide compensation for high frequency roll-off on long lines. This modification should be used when the roll-off in the 2500 to 3000 Hz range is more than 10 dB below the response in the 400 to 600 Hz level. See the schematic diagram for specific component changes.

Following U9A is the compression circuit composed of: U10B; U10A; U10C; D6; D46; Q6; and Q23. Transmit audio from U9A is applied to U10B-3 where it is amplified and connected from U10B-4 through a network composed of C50; R99; Q23; C57; and R95 to the input of U10A at pin 6. After it is amplified by U10A, the output at U10A-5 is supplied to two different places. The first is through C65 to the 2175 Hz notch filter (U11B and U11C) on its way to the bilateral switch U5D. The second is to amplifier U10C through C46. The output of U10C is rectified by voltage doubler D6 and D46 which charges C91. The voltage on C91 is amplified by emitter follower Q6 and applied to the base of Q23. Q23 serves as a variable resistor in the voltage divider composed of R99 and Q23 which limits the input to U10A. It is the purpose of this circuit to operate in a linear fashion normally with Q23 turned off, thereby appearing as a high resistance. Upon receipt of higher than normal audio at U10B-4, the amplification of U10A and U10C is rectified by D6 and D46 increasing the voltage across C91. The increased voltage across C91 through the emitter follower Q6 starts turning on Q23 reducing its collector to emitter resistance, which in turn lowers the audio to U10A. Since this affects not only the output through C65, but the turn on voltage of Q23 through C46 a state of equilibrium can be reached for a steady audio. Normally, however, voicelevels vary widely and the size of C91 is chosen to provide some smoothing.

Notch filter U11B and U11C notches the 2175 Hz frequency from the transmit audio thus preventing the Secur-It tone from being transmitted over the air. The depth of this notch is a minimum of 40 dB below a reference set at 1000 Hz and 0 dB on the line. Potentiometers R229 and R76 set the center frequency of this notch.

NOTE

These potentiometers are factory set and should not require adjustment in the field. They are sealed to prevent accidental movement.

Potentiometer R34, which is labeled "REMOTE TRANSMIT LEVEL", sets the audio that is presented to output amp U3A from the line terminals. Analog gate U5D is enabled when the decoding logic detects a remote PTT function. At that time control pin 12 will go high (greater than 9.5 Vdc) and the receive audio will be on output pin 11. If a Local PTT is enabled on P3-3, then diode D5 will be forward biased and gate control pin 12 will be low (0.8 Vdc or less) and no audio will be allowed on the "TX AUDIO OUT" line on J1203-7.

4-Wire Option

The four wire option adds the transformer T2, terminating resistor R1 and surge arrestors SG1 and SG2. The function of these is to form another 600 ohm terminating port for incoming audio to the panel in the transmitter audio section. When this option is installed the jumper between H24 and H25 is removed. Also, transformer T1 is then used only for receive audio.

Receive Audio

Line driver amplifier U1, with its combiner and notch filter/pre-amplifier U2, are capable of driving the receive 600 ohm line at +11 dBm. The notch filter/combiner takes audio from the "LOCAL MIC HI" port via resistor R25 and capacitor C31. It also takes audio from the "VOL/SQ HI" port via resistor R23 and capacitor C32, and from the "LINE" ports on TB1201-2 and TB1201-5 via resistor R24 and capacitor C33. Analog gate U5A is controlled by the RUSOS lead when the jumper between H28 and H29 is installed. This path allows the line audio from the incoming 600 ohm line on TB1201-2 and TB1201-5 to be coupled to the outgoing line on TB1201-3 and TB1201-4 when the RUSOS is high (greater than 9.5 Vdc). This feature is only available on the four wire audio option. The other port on the output amp is the "VOTING TONE" on J1204-3 which is coupled via resistor R8 and couples the external 1950 Hz tone to the phone line.

NOTE

The jumper between H28 and H29 allows intercom between parallel remotes with 4 wire audio. Each remote must mute itself unless a handset is used during remote transmit.

Control Tone Detection and Decoding (main board -0172)

The tone control frequencies that the remote controller puts on the voice grade line are detected by the panel which produces the appropriate functions on the output. Function tone detection is performed by tone decoders U15 and U16. These detectors are tuned by potentiometers R142 and R193 which set the 2211 decoders to 2050 Hz and 1950 Hz respectively. The tones enter the panel on termianls TB1201-3 and TB1201-4, or if four wire option is installed, on TB1201-2 and TB1201-5. They are applied to line compensation amplifier U9A with the voice audio Potentiometer R122 sets the level that is applied to the tone detection circuitry and analog gate U21A which is normally controlled by function tone detection one-shot U29B on pin 13. During the initial +10 dB Secur-It tone burst, comparator U26A's output on pin 1 will go high (greater than 9.5 Vdc). When the tone is present longer than 100 msec, validation one-shot U29A's output on pin 7 will go low (less than 0.7 Vdc). When this output returns to its high state, and if the output of U26A is still low, one-shot U29B will trigger allowing the receive tone to pass through analog gate U21A. This tone is then applied to the tone decoders via capacitor C77 and C83. TP2 is used to test the input frequency and level of the tone required by the detectors. U15 is the CHANNEL GUARD detector whose output on pin 6 is normally low and goes high upon the detection of 2050 Hz. This in turn feeds the set input on CG flip-flop U24B on pin 6 which sets the output on pin 9 to a high level. This high (9.5 Vdc) causes transistor Q20 to turn on and the "C-G MONITOR" on J1201-5 to go low (less than 0.3 Vdc).

U16 is the TRANSMIT F1 detector whose output on pin 6 is normally low and goes high upon detection of 1950 Hz. This high is then applied to minus 20 dB flip-flop U24A via level translator U25B. The high on set input pin 4 of U24A causes the output on pin 2 to go high which is applied to AND gate U22A on pin 1. The output of the AND gate is held low until decoder U16 stops detecting 1950 Hz (this keeps the function tones from being applied to the minus 20 dB detector, causing falsing). Analog gate U21B controls the signal that is applied to minus 20 dB amplifier U25A and comparator U26B. The 2175 Hz tone from bandpass filter U23 is applied to minus 20 dB amplifier U25A and causes the full wave rectifier comprised of diodes D17 and D20 to go high. Comparator U26B's output will go low (less than 0.7 Vdc) and remain until the minus 20 dB Hold tone is removed. At this time, transmit hold tone one-shot U28A will trigger and its output on pin 6 will generate a positive pulse of 100 msec duration that causes the minus 20 dB flip-flop (U24A) to reset and force its output on pin 2 low. In addition, the output from minus 20 dB comparator U26B is used to pull the REMOTE PTT port on J1203-1 low (less than 0.3 Vdc) via transistor Q21 and OR gate U27A. The comparator output is also used to reset the C-G flip-flop (U24B) via OR gate U27C.

Power on one-shot U28B is used to reset all of the flip-flops to their reset state when the power is first applied to the panel or if a power spike causes the unit to change states during the transition. This is accomplished by applying the positive pulse from the output of U28B to OR gate U27D which in turn passes it along to the other OR gates that are connected to the reset input of the flip-flops. The other input to OR gate U27D is an inverted signal from the "TEST" position of selector switch SW5 when contacts 1A and 1D are shorted. This also causes the flip-flops to reset.

Selector switch SW4 permits the operator to select "REMOTE PTT" or NORMAL/RX1" from the front panel when selector switch SW5 is in the "TEST" position. The function "C-G/RX2" can always be selected independent of switch SW5, and is used to monitor the receive channel that is equipped with Channel Guard.

Control Tone Detection and Decoding (tone ext board -0173)

Tone control frequencies that the remote controller puts on the voice grade line are detected by the panel which produces the appropriate functions on the output. Tone detection is performed by tone decoders, U1 through U9. These detectors are tuned by potentiometers R6, R12, R18, R24, R30, R36, R42, R48 and R54 which set the 2211 decoders to 1050 Hz, 1250 Hz, 1350 Hz, 1450 Hz, 1550 Hz, 1650 Hz, 1750 Hz and 1850 Hz respectively. Receive tone passes through connector P1-8. This tone is then applied to the tone decoders via input capacitors C2, C8, C35, C41, C14, C20, C44, C50 and C26. The output on pin 6 is normally low and goes high upon the detection of the respective frequencies. This, in turn, feeds the input on the PROM decoders which cause their respective output to set or reset R-S flip-flops U10, U11 and U12. The output on the flip-flops go high (9.5 Vdc), which causes transistors Q1 through Q8 to turn on and the respective output ports to go low (less than 0.3 Vdc).

Power Up Reset (tone ext board -0173)

The power on reset line P1-5 is used to put all of the flip-flops in their reset state when the power is first applied to the panel, or if a power spike causes the unit to change states during the

transition. This feature must be disabled by removing the jumper between H15 and H16 when the battery backup option is installed.

Auxiliary Relay (tone ext board -0173)

Auxiliary Relay K1 is driven by transistor Q5 which, in turn, is driven by R-S latch U11 from pin 10. When the remote controller commands the auxiliary relay to turn on by placing 1350 Hz on the function tone, K1 will change states and AUX 1 LED (D3) will illuminate. To disable the relay, the remote controller can send 1250 Hz for the function tone and the R-S latch will reset its Q2 output. Also, an input greater than 3.0 Vdc from the reset port on J1214-10 will cause the R-S latch to reset Q2. The Auxiliary Switch on the front panel of the control shelf will also enable or disable output relay K1.

Receive Mute Function

When "CG DECODE OUTPUT" pin J1201-11 goes low (less than 0.3 Vdc), transistor Q17 turns off and transistor Q19 turns on, grounding output port "RX 1 MUTE" on J1201-2 if jumper H12 to H13 is installed. If selector switch SW4 is placed in the "CG" mode by closing contacts 1A to 1D and selector switch SW5 is placed in the "TEST" mode and jumper H38 to H39 is installed, the output of "RX 1 MUTE" will be low.

RUS and Tone Switch Control

The "RUS" port on J1204-11 controls the "VOL/SQ HI" port as described in the first section of the circuit description. This port, in itself, is controlled by another port, that being the "TONE SWITCH" on J1200-9. When the "TONE SWITCH" is pulled low (less than 0.3 Vdc), transistor Q3 will energize causing transistor Q4 to turn on, thus enabling RUS transistor Q5 to operate. This sequence is normally what occurs when the repeater is equipped with a tone option board and it receives the valid tone from the mobile. If for some reason the tone option board does not decode the proper tones, the "TONE SWITCH" port will never go low, thus removing the ground from the emitter of Q5 and, in effect, disabling the "RUS" function. When the "TONE SWITCH" port is used, the jumper between H22 and H23 is removed. It is installed in all other cases.

Voltage Regulators

Input supply voltage for the panel is provided by the repeater power supply and is applied to "13.8 Vdc" input terminal J1203-3. This port feeds the output regulators comprised of U18, U30, and U31. Regulator U18 provides all of the external current requirements for the repeater on J1202-1, J1203-4 and J1200-1. The voltage on any of these pins is specified at 10.0 -0.3 Vdc with the maximum combined current for the above ports not to exceed 1.5 amps. Regulator U30 provides all of the on-card power requirements for the panel and for terminal "REG 10 Vdc" on J1204-10. The voltage on this pin is specified at 10.0 $\pm$0.1 Vdc with the maximum current not to exceed 0.5 amps. Regulator U31 provides +5 Vdc for the audio amplifiers and logic decoder circuits.

The input filter formed by inductor L1 and capacitor C67 remove 60 Hz or 120 Hz from the input power source. Capacitor C66 is a bypass for any high frequencies that can be induced into the input supply from high powered RF sources. All of the remaining regulators and their respective components provide the above described functions.

Call Length and Dropout Timers

The "$\overline{\text{RUS}}$" input also starts master call length timer, U12. On the negative edge of the "$\overline{\text{RUS}}$" function, one-shot IC U14B sends a positive pulse from its Q output on pin 10 to the reset input on pin 6 of U12. This pulse resets the internal counters within U12 and causes the Q output on pin 8 to go high. This output will remain high until the internal counters have exceeded the number of clock cycles that have been programmed into it by the control line on pins 12 and 13. The internal clock frequency is set by resistors R123 and R124 and capacitors C62 and C63. Refer to the schematic (see Table of Contents) for the chart regarding repeater timer jumpers.

Also, when $\overline{\text{RUS}}$ returns to its high state, drop-out timer U14A is triggered on the rising edge. This one-shot sets its Q output on pin 6 high for the period of time that is controlled by resistors R136, R137 and R138 and capacitor C72. Refer to the schematic (see Table of Contents) for the chart on repeater dropout timer jumpers. The clear input on pin 3 is controlled

by NOR gate U20D that sends the output from the master timer into the dropout timer which allows the dropout timer to operate only if the timers have not been disabled by the removal of the jumper from H14 to H15. Diodes D11 and D12 OR the outputs from the timers and feeds them to output transistor Q22. This transistor can be disabled by bringing "REPEATER DISABLE" pin J1201-7 low (less than 0.3 Vdc) by the remote control function from open collector driver on the top expansion board. Timer output is also available to the outside on "RPTR TIMER" port J1200-7.

Selector switch SW5 located on the front panel, allows the operator to place the panel into the "RPTR DISABLE MODE" which disconnects the collector of transistor Q22 from summing diode D33 thus causing the repeater to enter a standby mode. In addition, this switch grounds repeater disable LED D36 by moving the selector to the position where terminals 1A and 1B or 1D make contact. The contact of 3A to either 3C or 3D allows the Local PTT function to be coupled to the control circuits in U13.

Antenna Relay and Transmit Oscillator Control

Upon detection of a PTT function at the input to antenna relay sequence timer U13F pin 13, the output on pin 12 goes high and is inverted by U13C and fed to forward biased diode D9 causing the input to U13B to go low, resulting in its output going high. A high at the output of U13B drives transistor Q12 into saturation and pulls the "ANT RELAY" port on J1201-3 low (less than 0.3 Vdc). This causes the relay within the repeater to be energized putting it into a transmit condition.

When the PTT function is released, the input to U13F pin 13 will go high and the output on pin 12 will go low. The low on the input to U13C on pin 5 causes the output to go high and reverse biases diode D9. During this time, capacitor C68 is charging through resistor R134 and forms a delay of 20 milliseconds that is required in order to shut down the transmit oscillator before the antenna relay is opened, thus reducing the arcing across the contacts.

The PTT function also feeds another set of delay timers comprised of inverters U13D and U13E which provide a 20 millisecond delay on the output of U13A pin 2. This output is fed to transistor Q13 which shuts off Q14 when the PTT function is high. When the PTT function goes low at the input of U13D, transistor Q14 turns on and goes to 10.0 ±0.1 Vdc. Its output is fed to "TX OSC CNTRL" on J1204-5. During this state, the repeater transmit oscillator will run and the output power amplifier will be energized.

Front Panel Speaker

The front panel mounted speaker and volume control allow the operator to set the proper listening level for servicing. Resistors R108 and R109 provide the terminating impedance required by the speaker drive circuits within the station.

NOTE

When the speaker is not being used, turn the volume control all the way counterclockwise to reduce the amount of audio.

Selector switches SW2 and SW3 allow the operator to select the proper operating frequency requirements during the "TEST" mode only; otherwise these switches have no effect on the panel's operating characteristics. Selector switch SW2 is used to select the appropriate receive audio when the station is equipped with two receivers.

NOTE

Prior to leaving the station site, be sure that all of the selector switches are in their proper operating position. Especially switches SW4 and SW5, which must be in their "NORMAL" position for the station to operate properly.

OPTIONS

Metering S3ME02

Adds a metering panel (19B234871P101) to the remote panel, and a metering harness to the radio station. Manual LBI-31983 covers this option.

Squelch Operated Relay S3SU01

Adds a SOR kit (19B234871P102) to the remote panel.

When an incoming signal causes the receiver to unsquelch, a positive voltage appears on the RUS line and forward biases diode D3. This positive voltage appears on the base of Q1 turning it on. When Q1 conducts, LED D2 is turned on and relay K1 is energized. Diode D1 is connected across the relay coil for spike suppression.

NOTE

In radios equipped with Channel Guard, the RUS switch will operate only when an "on frequency" signal with the correct Channel Guard tone is applied to the receiver.

Battery Standby Alarm Tone S3BC02

Adds a BSAT Kit (19B234871P103) to the remote panel.

The battery alarm periodically warns the operator at the remote controller that the AC power has been interrupted and that the station is operating off a DC voltage source.

In the event AC power is interrupted from the station, a low is applied to the base of Q5 turning it on. With Q5 turned on, Q6 is on and Q7 is off. Integrated circuit U2 acts as a 1200 Hz oscillator and applies the tone to bandpass filter U3. The signal is filtered by U3 and associated circuitry and then coupled to the audio stage on the remote/repeater main board. Timer U1 and associated circuitry provide the repetition rate of the tone and is adjustable by R19. The On-Time rate is adjustable by R22. The tone audio level is also adjustable by R23.

Four Wire Audio S3TX02

Adds a Four Wire Kit (19B234871P104) to the remote panel. This transformer does NOT have a split winding.

BSAT and SOR (combined) S3SU02

Adds a BSAT and SOR Kit (19B234871P105) to the remote panel.

Provides the Battery Standby Alarm Tone and Squelch Operated Relay functions in one remote panel.

Logic Standby Battery S3B0U1

Adds logic standby to battery component board.

Radio Controlled Base Stations S3SC01-2-4

Adds material to permit one station to control another station. Manual LBI-4723 covers these options.

FIELD MODIFICATIONS

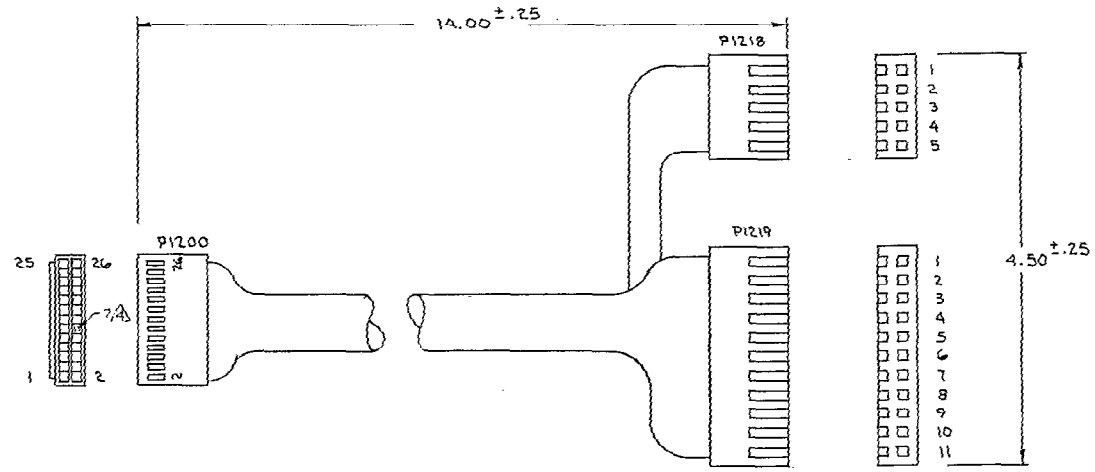
Occasionally it is desired to modify a version of the 19B234871 panel in the field.

This section of the manual is to direct your attention to the availability of J1200.

This connector provides the connections for the optional control shelf back plane (S3MB01), however, it has many additional circuit connections available. The Service Sheet for the option cable listed in the Table of Contents of this manual gives information on connections and ordering information on the mating connector.

You may find that your modification is better suited to use the back plane, in which case the Outline Diagram of the Control Shelf Backplane listed in the Table of Contents of this manual will be of help.

In using the back plane you may find that Field Application Module 19D417491G1, and Extender Card 19D417458G1 to be helpful. These are listed in the Table of Contents of this manual.

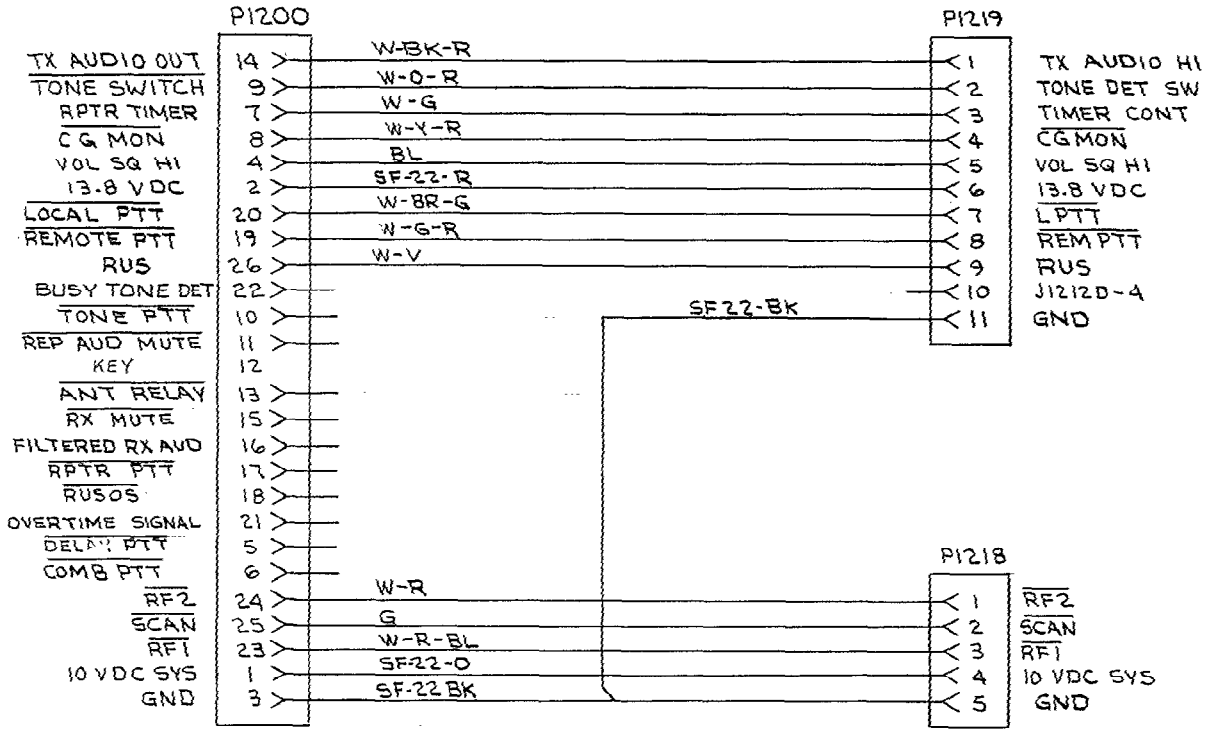


(1)

NOTES:
1. TERMINATE WIRES: AT P1200 WITH ITEM 2; AT P1218 AND P1219 WITH ITEM 3. AT P1218-5 WITH ITEM 6.
2. SPOT TIE CABLE WITH ITEM 4.
3. ON P1200 MARK PINS 1, 25 ON ONE SIDE AND PINS 2, 26 ON OTHER SIDE, (LOCATION TYPICAL AS SHOWN PINS 2, 26); MARK PER 19A115748P1.

⚠ INSTALL ITEM 7 INTO P1200-12 FROM WIRING SIDE.

(19B234949, Rev. 2)



NOTE:
1. ALL WIRING TO BE SF-24 UNLESS OTHERWISE SPECIFIED.

(19B234956, Rev. 2)

OPTION CABLE (CONTROL SHELF BACKPLANE INTERCONNECT CABLE)

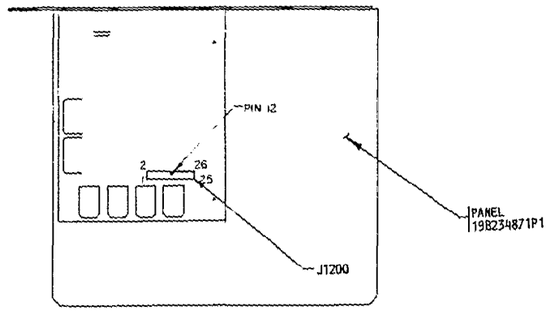
PARTS LIST

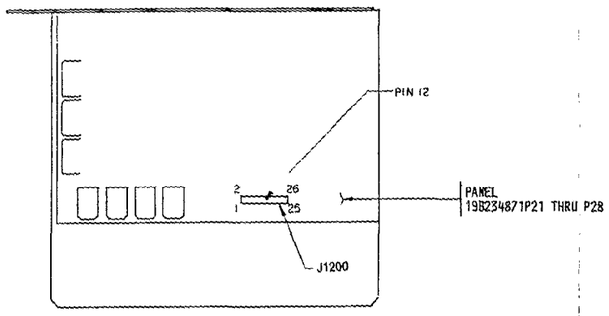
MASTR II STATION OPTION CABLE
19B234949G1

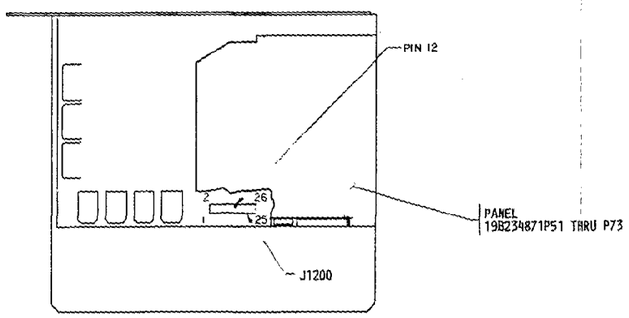
ISSUE 2

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - - - PLUGS - - - - - - - - - - - -
P1200	19A116572P4	Connector. Includes:
	19A116573P4	Contact, electrical. (Quantity of 14).
P1218	19A116659P18	Connector shell. Includes:
	19A116781P4	Contact, electrical: wire range No. 22-26 AWG; sim to Molex 08-50-0107.
P1219	19A116659P143	Connector shell. Includes:
	19A116781P3	Contact, electrical: wire range No. 16-20 AWG; sim to Molex 08-50-0105.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - - -
	19J706152P5	Retainer strap: sim to Panduit Corp. SST-1.
	19A705684P1	Polarizing Tab. (Used in P1200).

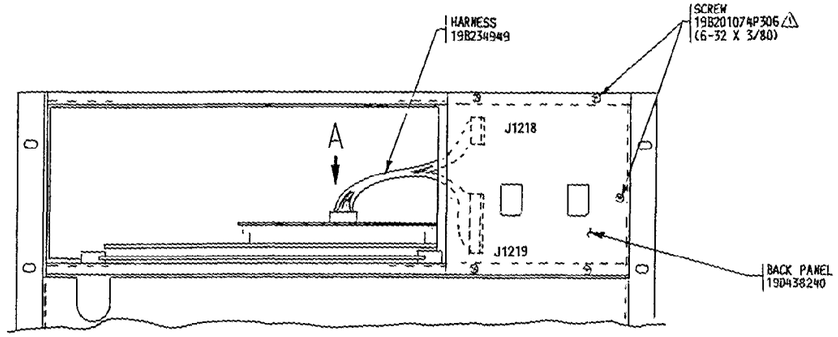
*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES





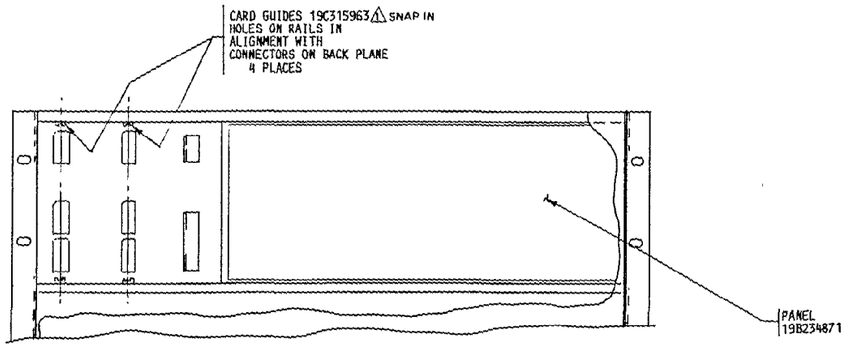


VIEW A
SHOWING J1200 ON
THREE DIFFERENT
CONFIGURATIONS OF PANEL



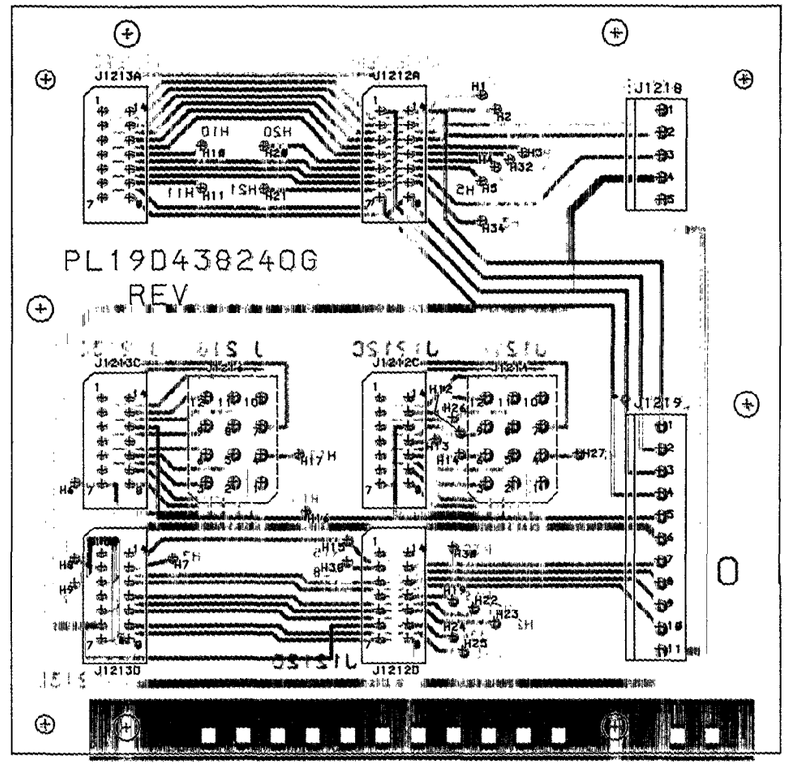
REAR VIEW
CONTROL SHELF

⚠ SUPPLIED IN HARDWARE KIT 19A149326G2

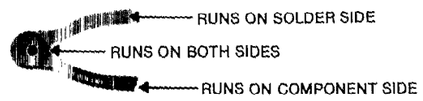


FRONT VIEW
CONTROL SHELF

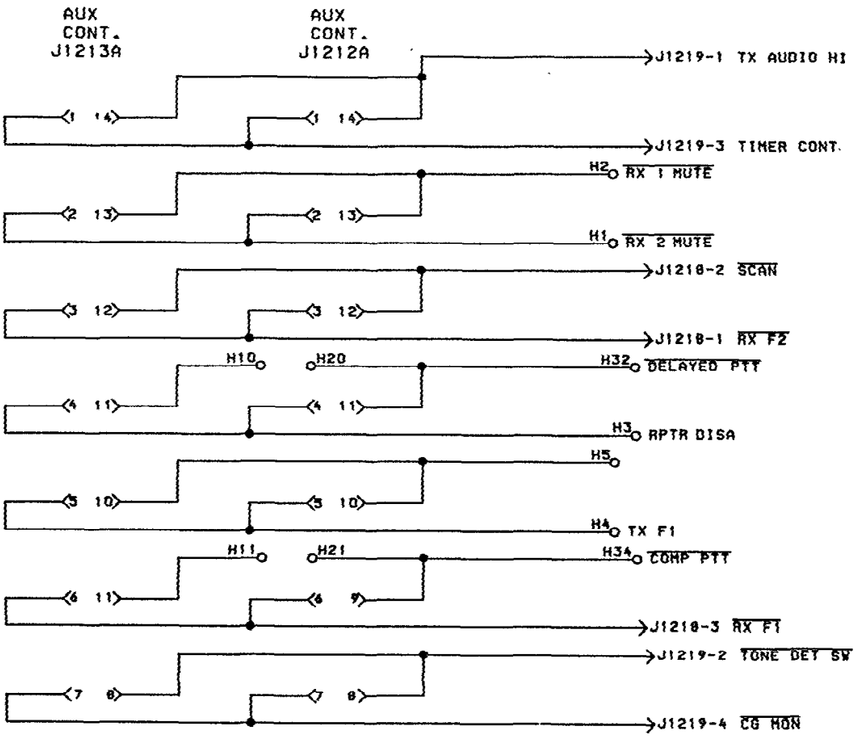
(19D438341, Rev. 1)

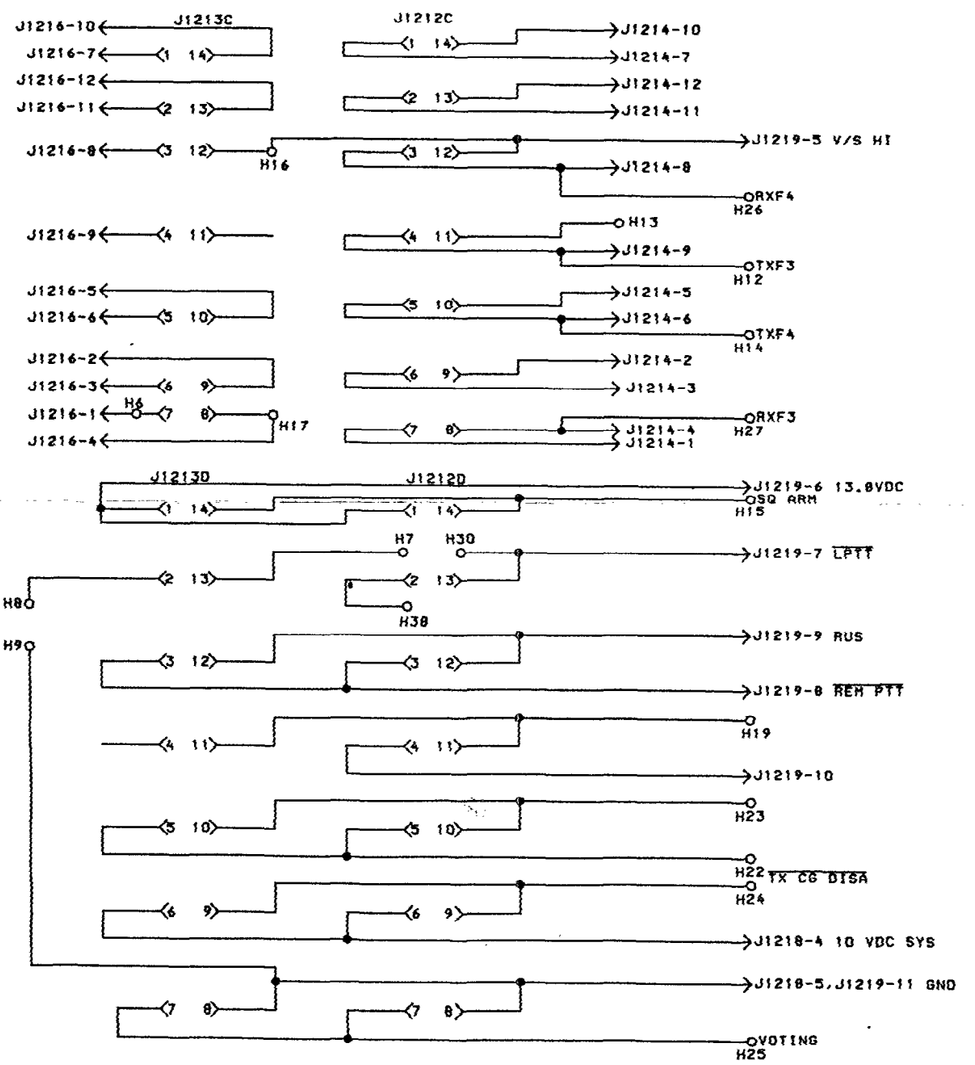


(19D438240, Rev. 0)
(19A149200, Sh. 1, Rev. 0)
(19A149200, Sh. 2, Rev. 0)



CONTROL SHELF BACKPLANE 19D438240G1


AUX CONT. J1213A
AUX CONT. J1212A
J1219-1 TX AUDIO HI
J1219-3 TIMER CONT.
H2 RX 1 MUTE
H1 RX 2 MUTE
J1218-2 SCAN
J1218-1 RX F2
H10
H20
H32 DELAYED PTT
H3 RPTR DISA
H5
H4 TX F1
H11
H21
H34 COMP PTT
J1218-3 RX F1
J1219-2 TONE DET SW
J1219-4 CG HON

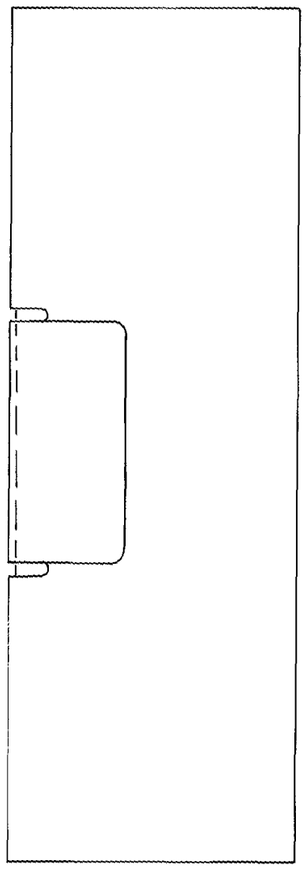

J1213C
J1212C
J1216-10
J1216-7
J1216-12
J1216-11
J1216-8
J1216-9
J1216-5
J1216-6
J1216-2
J1216-3
J1216-1
J1216-4
H6
H16
H17
J1214-10
J1214-7
J1214-12
J1214-11
J1219-5 V/S HI
J1214-8
RXF4 H26
H13
J1214-9
TXF3 H12
J1214-5
J1214-6
TXF4 H14
J1214-2
J1214-3
RXF3 H27
J1214-4
J1214-1
J1213D
J1212D
J1219-6 13.8VDC
SQ ARM H15
H7
H30
J1219-7 LPTT
H8
H38
H9
J1219-9 RUS
J1219-8 REM PTT
H19
J1219-10
H23
H22
TX CG DISA H24
J1218-4 10 VDC SYS
J1218-5, J1219-11 GND
VOTING H25

PARTS LIST

CONTROL SHELF BACKPLANE
19D438240G1

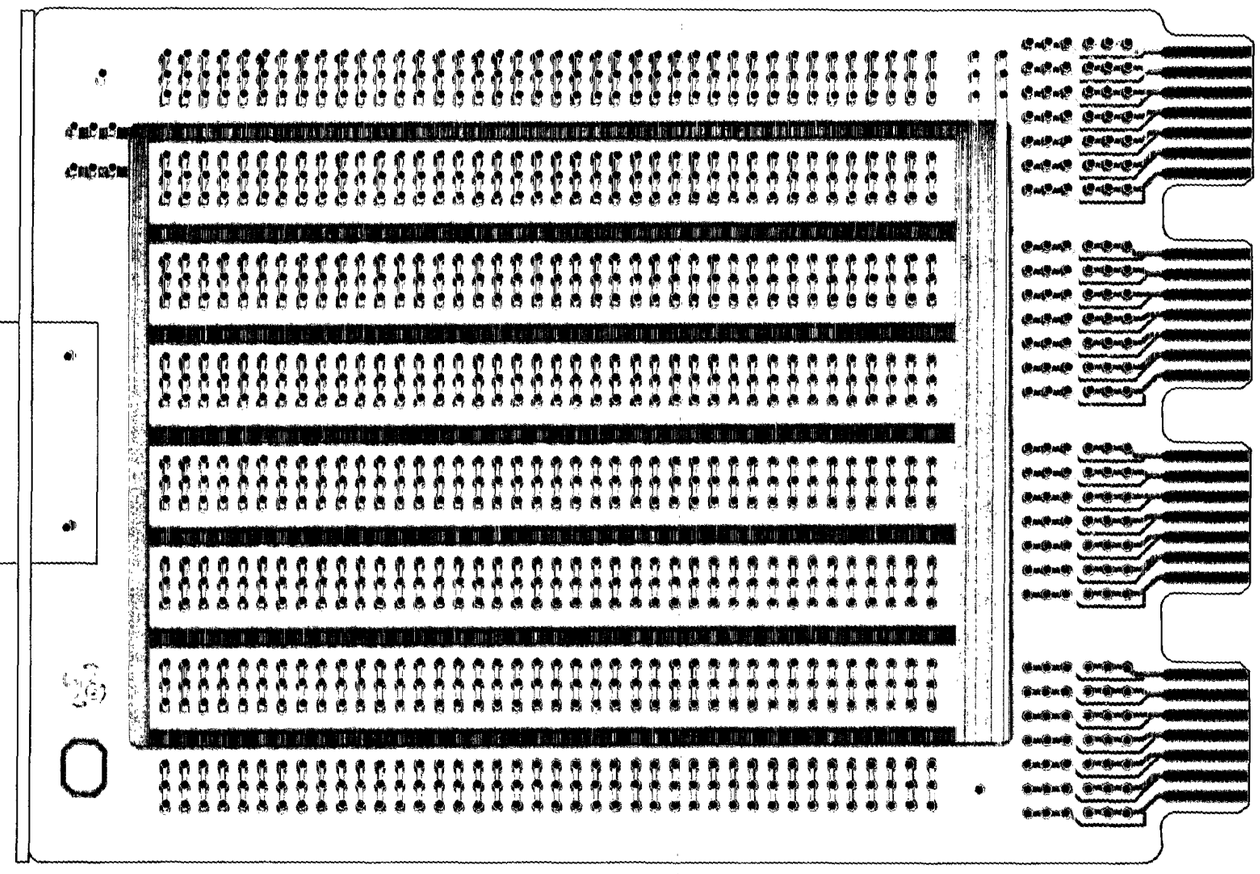
ISSUE 1

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CONNECTORS - - - - - - - - - -
J1212A	19A116446P5	Connector, printed wiring: 14 contacts rated at 3 amps.
J1212C	19A116446P5	Connector, printed wiring: 14 contacts rated at 3 amps.
J1212D	19A116446P5	Connector, printed wiring: 14 contacts rated at 3 amps.
J1213A	19A116446P5	Connector, printed wiring: 14 contacts rated at 3 amps.
J1213C	19A116446P5	Connector, printed wiring: 14 contacts rated at 3 amps.
J1213D	19A116446P5	Connector, printed wiring: 14 contacts rated at 3 amps.
J1214	19A116647P4	Connector, printed wiring: 12 terminals; sim to Molex 09-18-5121.
J1216	19A116647P4	Connector, printed wiring: 12 terminals; sim to Molex 09-18-5121.
J1218	19A116658P56	Printed wire, 5 contacts rated @ 5 amps; sim to Molex 09-65-1051.
J1219		Connector. Includes:
	19A116658P52	Connector, printed wiring: 8 contacts rated at 5 amps; sim to Molex 09-65-1081.
	19A116658P55	Connector, printed wiring: 3 contacts rated at 5 amps; sim to Molex 09-65-1031.
		HARDWARE KIT 19A149328G2
	19B201074P305	Tap screw, Phillips POZIDRIV: No. 6-32 x 5/16.
	19C315963P1	Card guide.

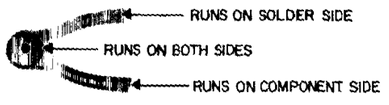


FRONT PANEL: 19D417384P5
HANDLE: 19B219690G1

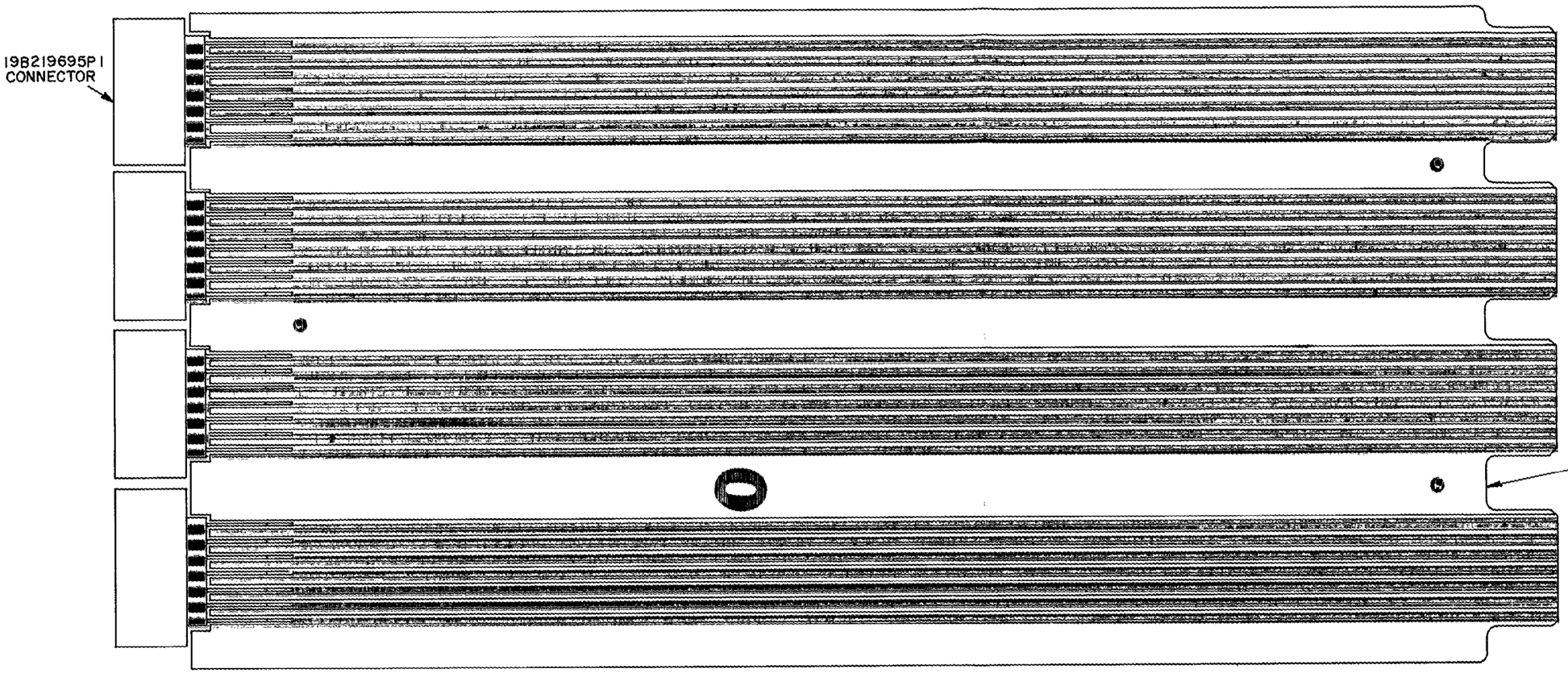
COMPONENT BOARD 19C320912P1



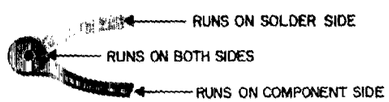
(19C321422, Rev. 0)
(19B226246, Sh. 1, Rev. 0)
(19B226246, Sh. 2, Rev. 0)



FIELD APPLICATION MODULE 19D417941G1



(19D423102, Rev. 0)
(19D417215, Sh. 2, Rev. 0)
(19D417215, Sh. 3, Rev. 0)



EXTENDER BOARD 19D417458G1

A DISCUSSION ON "TELEPHONE LINES"

GENERAL

This discussion covers "telephone lines" that are commonly used between GE remote control units and remotely controlled GE base stations. While specifically directed to systems that use tone signalling, it will also be helpful in connection with systems that use direct current (DC) signalling. 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 his building or his complex of buildings. In these cases he will have much more freedom in the levels that he may use. 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 do not 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. You can expect one of these:

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 apply 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 they have been used on DC lines for years. These amplifiers include limiters which start limiting at somewhere 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 phones 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. You will be getting this type of line more often in the future.

The phone company supplies you 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 aren't careful you and the phone company man will be talking 10 dB apart. If the phone man 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 can be +2 dB and -8 dB relative to 1000 Hz loss. Note that the phone man may refer to this as -2 and +8 in his way of talking. 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.

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 this type meter is not available, an AC VTVM can be used. If 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.

The 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 for 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 is 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 are usually established by only three things:

1. The maximum level at 2175 Hz that the phone company will allow to be sent 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.

However, if the limits are surpassed C-1 conditioning can be added at additional expense. It is important for proper operation not to turn up the tone sending level. When the level is increased, 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 that were not selected. 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. Lower the sending level at the remote controller until it is 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 and remote-controlled systems care must be taken when connecting two telephone lines in tandem (i.e., a base station and two remotes). This would require a phone line to connect the station to the first remote and a second line to connect the second remote to the first. The loss of each line is now added together and the tones from the second remote may not operate the base station. To avoid this possibility, low loss should be specified for each line, or run each line directly to the base station. The phone company should be consulted to determine which approach would be the most cost efficient, by requesting an analysis of non-recurring 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. A continuous 1950 Hz tone is put 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.

Remember that the 1950 Hz tone must arrive at the voting selector at not less than -30 dBm. For instance, by ordering a voice grade line and not specifying the loss the line normally received would have a 10 dB loss at 1000 Hz. The 1950 Hz loss will normally be 8 dB. By adding the 4 dB long-term variation the worst case 1950 Hz loss would be 22 dB. It then follows that nothing can be sent any lower than -8 dBm. If the phone company will not allow a continuous tone as high as -8 dBm, a lower loss circuit or C-1 conditioning will be required.

When ordering phone lines for a voting system, all lines should be the same type with the same amount of loss in each. 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 inferior telephone circuit. Many phone companies will add pads to build out the lines. If requested when the phone lines are ordered, it should not cause problems to build them all out to have the same loss.

ORDERING VOICE GRADE TELEPHONE LINES

Normally, if the loss is not specified when ordering a standard voice grade circuit, the following will be received:

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 inband 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 TO BE PROVIDED TO 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
A tone of 2175 Hz is sent, for a period of 125 ms, 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
A continuous 1950 Hz tone is sent when the receiver is squelched and it 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 best to specify C-1 conditioning).

6 If more than one phone line is to be used, a block diagram should be provided showing locations and type of equipment to be used.

MAINTENANCE

General

This station panel is designed for minimal maintenance and requires no special fixtures or test equipment in the event that it must be serviced in the field. To gain access to the panel, open the station cabinet and the receiver/exciter door. The panel can then be pulled forward with its handle to the limit allowed by the pawl catch. Should you desire to remove it from the station, it will be necessary to: release the pawl catch, remove the connecting plugs and the ground strap which is mechanically fastened to the rear of the cabinet. If power is to be applied to the panel be sure to refer to the schematic diagram for the proper terminals (J1203-3 is the 13.8 Vdc INPUT and J12304-1 is the GROUND). If the printed circuit board is to be removed from the mounting plate, disconnect the harnessses that are connected to the faceplate and remove the six screws. Refer to the Troubleshooting Procedure (see Table of Contents) when further information on component functionality is desired.

CAUTION

When the panel is installed in the station cabinet again, be sure to attach the ground strap/retainer. If left ungrounded, the operator could be exposed to a serious shock hazard in the event of a lightning strike to the line ports on TB1201-1 thru 6.

CONNECTING THE PHONE LINE(S)

Two wire operation

Connect the pair to TB1201-3 and -4. If the remote control unit at the other end is an RCN1000, use J3 -3 (red) and -4 (green).

Four wire operation

Transmit pair (which modulates the transmitter)

Connect this pair to TB1201-2 and -5. If the remote control unit at the other end is an RCN1000, use J3 -3 (red) and -4 (green).

Receive pair (which listens to the receiver)

Connect this pair to TB1201-3 and -4. If the remote control unit at the other end is an RCN1000, use J3 -2 (black) and -5 (yellow).

ADJUSTMENT PROCEDURES

Certain adjustments, noted as "Factory Adjust" will not normally be required to be adjusted and have been sealed. Procedures for these adjustments are given in the section below.

2175 Hz Transmit Notch Filter (Factory Adjustment)

This procedure sets the 2175 Hz Notch Filter using R27 and R115.

1. Apply a 1000 Hz tone at 1 V rms to the VOL/SQ HI port on J1203-8.

2. Terminate the output line on TB1201-3 and TB1201-4 with a 600-ohm load. Calibrate voltmeter to measure decibels such that the level in Step 1 is the 0 dB reference.

3. Adjust the tone in Step 1 for 2175 Hz.

NOTE

Use frequency counter to insure that all tone inputs are at the correct frequency.

4. Adjust potentiometer R115 so that the notch depth is at a minimum below the reference. Then adjust R27 such that the notch depth is at a minimum below the reference.

5. Repeat Step 4 several times and check that the depth is a minimum of 35 dB below the reference. Also check that the 3 dB points are at 2035 Hz and 2325 Hz. (Optionally, R22 and R115 may be set for a minimum reading at 2035 and 2325 Hz.)

NOTE

The audio path from VOL/SQ HI to LINE has deemphasis which causes the audio to roll off at 6 dB per octave. This should be taken into account during this adjustment procedure in order to adjust the reading to the actual decibel level.

2175 Hz Receive Notch Filter (Factory Adjustment)

R76 and R229 set the frequency of the 2175 receive notch filter.

1. Apply a 1000 Hz tone at 0 dBm (0.77 V rms) to TB1201-3 and -4 (2-wire) or TB1201-2 and -5 (4-wire).

2. Install a jumper from TP1 to ground (TP3).

3. Connect voltmeter to TX AUDIO HI output on J1203-7 and calibrate meter to measure decibels such that the signal applied in Step 1 is the 0 dB reference.

4. Change the signal applied in Step 1 to 2175 Hz.

5. Adjust R229 until the notch depth is at a minimum below the referernce. Then adjust R76 until the notch depth is also at a minimum below the reference. Repeat the two adjustments until the notch depth is at a minimum of 45 dB below the reference.

6. Check that 3 dB points are at 2025 and 2325 Hz.

7. Remove jumper applied in Step 2.

2050 Hz Detector (Factory Adjustment)

R142 sets the frequency of the 2050 Hz tone decoder U15.

1. Remove the input to the panel.

2. Using the high impedance input to the frequency counter, check the frequency at pin 11 of U15. Adjust R142 for 2050 Hz indication on the counter.

2175 Hz Bandpass Filter (Factory Adjustment)

R174 sets the frequency of the bandpass filter U23.

1. Apply a 2175 Hz tone at -6 dBm to TB1201-3 and -4 (2-wire) or TB1201-2 and -5 (4-wire).

2. Connect voltmeter to TP5 (U23-8).

3. Adjust R174 until the bandpass filter output at U23-8 is maximum.

1950 Hz Detector (Factory Adjustment)

R193 sets the frequency of the 1950 Hz tone decoder U16.

1. Remove any input to the tone panel.

2. Connect the high impedance input of the frequency counter to U16-11.

3. Adjust R193 for an indication of 1950 Hz on the frequency counter.

Function Tone Detectors (Factory Adjustment)

The following procedures set the frequency of the function tone detectors located on the Tone Extension Board.

1. Remove any line input or signal source to the tone panel.

2. Adjust the applicable controls to set the frequency of the tone detectors using the high impedance input of the frequency counter per the following chart:

DETECTOR	MEASURE AT	ADJUSTMENT
1050 Hz	U1-11	R6
1150 Hz	U2-11	R12
1250 Hz	U6-11	R36
1350 Hz	U7-11	R42
1450 Hz	U3-11	R18
1550 Hz	U4-11	R24
1650 Hz	U8-11	R48
1750 Hz	U9-11	R54
1850 Hz	U5-11	R30

REMOTE CONTROLLER TO CONTROL STATION PANEL ADJUSTMENTS

Although audio levels should be considered on a system basis, it is appropriate to set the levels of the remote controller and the control station panel by themselves with reference to the levels required by the transmission path and then connect the controller(s) and station to the path. The transmission path, if it is more than just a simple twisted pair, is usually set up with a "test tone". The "average voice" level is defined as being a certain number of decibels below the test tone. The test tone is normally the maximum level that can be sent through the path without clipping or being regulated. Although there is no definite agreement on the difference between the test tone and average voice levels, 10 db is an appropriate level.

In order to align the RCN1000 Remote Controller and 19B234871 Control Station Panel properly, it will be necessary that to have some information on the transmission path. This will help to determine the levels at each end required by the system. Specifications needed include:

1) Loss at 1 kHz
2) Test tone or maximum level
3) Average voice level (if defined)
4) Loss at 2175 Hz

This section contains adjustments for the following circuitry of the system:

RCN1000 adjustments:

a) Transmit Audio (Line Out) Level	R64
b) Receive Audio (Line In) Level	R43
c) Detection Gain Level	R30
d) 2175 Hz Notch Filter	R31, R32

STATION PANEL adjustments:

e) Transmit Line Input	R91
f) Remote Transmit Level	R34
g) Four Wire Intercom	R111
h) Decoder Level	R122
i) Local Transmit Modulation Level	R69
j) Local Mic to Line	R28
k) Receive Line Out Level	R81
l) Repeater Audio Level	R83
m) High Pass Filter Cutoff	R82

a) Transmit Audio Level

1) Prepare a modular plug to key the PTT circuit and inject audio by connecting J2-4 (PTT) to J2-2 (gnd) and short lengths of wire at J2-1 (audio) and J2-2 (gnd) for connection to the signal generator.

2) Prepare a modular plug to terminate and measure the transmitted audio by connecting a 600 ohms resistor across J3-3 and J3-4.

3) Apply a 1 kHz, 1 volt (600 ohm) signal to J2-1 and key the PTT. This signal is the test tone level.

4) Set the LINE OUT LEVEL, R64 at (or below, if desired) the test tone level permitted on the transmission path. The SECUR-IT tone will be sent at this level (adjust R22 if necessary). The SECUR-IT tone will be 10 db higher than the function tones. The function tones are sent at the average voice level.

5) Remove modular plug which unkeys the PTT.

b) Receive Audio Level

1) Prepare a modular plug to inject audio into J3-3 and J3-4 (J3-2 and J3-5 in four wire option) by connecting short lengths of wire for connection to the signal generator.

2) Apply a 1 kHz, 1 volt (600 ohm) signal to J3. This signal is the test tone level.

3) Set LINE IN LEVEL R43 and the volume control to maximum levels and measure the level across the speaker.

4) Reduce R43 until the meter falls 1.0 db.

c) Detection Gain Level

1) Place the most distant RCN1000 in test mode and send the SECUR-IT tone.

2) Adjust DETECTION GAIN R30 on the Parallel Option Board to find the threshold point as indicated by the transmit light.

3) Increase R30 slightly until the transmit light lights steadily.

d) 2175 Notch Filter

For best operation of the notch filter it may be necessary to adjust the filter by listening to the audio or by the use of a selective voltmeter. The use of a non-selective audio voltmeter may result in a less than optimum adjustment. While receiving a 2175 Hz Hold Tone, alternately adjust R31 and R32 for the deepest notch.

e) Transmit Line Input
f) Remote Transmit Level
g) Four Wire Intercom

1) Apply a 1000 Hz (600 ohms) signal into the panel input at TB1201-3 and TB1201-4 (TB1201-2 and TB1201-5 if Four Wire Option) at the test tone receive level.

2) Preset TRANSMIT LINE INPUT R91 to maximum.

3) Connect an audio voltmeter to the panel output J1203-7 (high) and J1203-11 (low) with the panel output connected to the transmitter.

4) Place SW4 in REM PTT position.

5) Adjust REMOTE TRANSMIT LEVEL R34 for 100 millivolts.

6) Preset R91 to minimum then increase until the meter reads 79 millivolts, a reduction of 2 db. Use 50 millivolts on tone panels before Rev. K.

7) Adjust R34 to set 3.0 kHz deviation. Note audio meter reading.

8) Increase R34 until meter reading doubles (6 db). In four wire operation, terminate panel output TB1201-3 and TB1201-4 with 600 ohms and set FOUR WIRE INTERCOM R111 for the test tone level as measured across the resistor.

9) Return SW4 to the NORMAL position.

h) Decoder Level (Factory Adjustment)

Line loss at 2175 Hz may be up to 8 db more than the loss at 1000 Hz; therefore, DECODER LEVEL R122 should be adjusted to the most distant RCN1000 after connection to the actual circuit. Use the following procedure to align R122 in the Tone RCN1000's:

1) Turn R122 to its maximum clockwise position.

2) Lower R122 counterclockwise until one of the tones (SECUR-IT, Function or Hold) does not decode reliably.

3) Increase R122 slightly to give a safe margin of operation.

4) If an oscilloscope is available, check TP5 to assure that the nearest RCN1000 SECUR-IT tone is not going into squaring. Before Rev. K, R122 was electrically after R91 so each change of R91 required readjustment of R122. Also, before Rev. K, R149 was present and might need adjustment on long noisy lines.

i) Local Transmit Modulation Level

Set LOCAL TX MOD LEVEL, R69, for 3 kHz peaks when speaking into local mic.

j) Local Mic to Line

1) Apply a 1000 Hz tone at 0.1 Vrms to the local mic hi input P3-2 with ground to P3-1.

2) Place ICOM/NORMAL/TEST switch SW5 in the ICOM position.

3) Key local microphone (or connect P3-3 to ground).

4) Set LOCAL MIC TO LINE (R28) for the test tone level across the resistor between TB1201-3 and TB1201-4.

5) Remove keying and return SW5 to NORMAL.

k) Receive Line Out Level
l) Repeater Audio Level

1) Receive an RF signal from a generator with 3.0 kHz of 1000 Hz deviation.

2) Terminate panel output TB1201-3 and TB1201-4 with a 600 ohm resistor and connect an audio voltmeter across the resistor.

3) Adjust RECEIVE LINE OUT LEVEL R81 for the test tone level.

4) Adjust REPEATER AUDIO LEVEL R83 for a 3.0 kHz deviation on the transmitter.

m) High Pass Filter Cutoff

R82 sets the cutoff frequency of the filter on the receiver audio such that no Channel Guard tones are heard.

1. Disconnect the receiver from J1203-8.
2. Apply a 1000 Hz tone at 1 Vrms to J1203-8.
3. Terminate TB1201-3 and -4 with a 600 ohm resistor.
4. Place the Rem PTT/Rx Normal/CG switch in the CG position.
5. Connect a jumper from H28 to TP3 (ground).
6. Connect an audio voltemter across the 600 ohm resistor and calibrate it such that the level is 0 dB reference.
7. Change the tone from 1000 Hz to 300 Hz at the same level.
8. Adjust R82 for a meter reading of 10.4 dB higher.
9. Return switch to Rx Normal, and remove jumper.
10. Reconnect the receiver to J1203-8.

NOTE

Special Condition for MUX and CARRIER:

* Add a pad of approximately 15 db in the connection between the RCN output and the MUX input. It is common for the MUX input to have a test tone level of -16 db and an average voice level of -29 db.

* Add a pad of approximately 15 db in the connection between the Panel output and the MUX input.

TROUBLESHOOTING PROCEDURES

PROBLEM	PROCEDURE
No repeat audio from "VOL/SQ HI" J1203-8 to "TX AUDIO HI" on J1203-7.	1. Check the setting of R83 which may be misadjusted (the setting is low). 2. Check U7A. Pin 13 should be at 10 Vdc when the "RUS" port on J1204-1 is in unsquelched mode. Pins 1 and 2 should be at 5 Vdc with the presence of the repeater audio on them. 3. The "REP AUDIO MUTE" port on J1200-11 should be at 10 Vdc. 4. The "LOCAL PTT" port on J1201-4 must be high (at least 9.5 Vdc). 5. The audio filtering amplifiers consisting of U4D (205 Hz notch), U4C (Stage 1 High Pass), U4A (Stage 2 High Pass) and U4B (Stage 3 High Pass) must have their respective outputs at 5 Vdc with the presence of repeater audio. 6. On units that use the "TONE SWITCH" option on J1200-9 this should be at 0.8 Vdc or less in order to enable the "RUS" line. 7. Check U7D. Pin 12 should be at 10 Vdc when the "REMOTE PTT" on J1203-1 is ungrounded. Pins 10 and 11 should be at 5 Vdc with the presence of the repeater audio on them.
No audio from "LOCAL AUDIO HI" on P3-2 to "TX AUDIO HI" J1203-7.	1. Check U7C pin 6 should be at 10 Vdc when "LOCAL PTT" port on P3-2 is low (0.3 Vdc or less). Pins 8 and 9 should be 5 Vdc with audio from the "LOCAL MIC HI" port riding on the DC level. 2. The positive side of capacitor C43 should be at 10 Vdc without any audio from the local mic and will drop to not less than 5 Vdc with full audio from the "LOCAL MIC HI" port. 3. Check the setting of R69 which may be misadjusted (the setting is too low). 4. The summing amplifier U3A should have its output on pin 1 at 5 Vdc with the local audio riding on it.
Lack of audio at "TX AUDIO HI" J1203-7 from Line input port TB1201-3 & 4. When in four wire configuration, Line input port is TB1201-2 & 5.	1. Check the setting of R91 "TRANSMIT LINE INPUT" and R34 "REMOTE TRANSMIT LEVEL" as set out in the alignment section of this manual. 2. Check U5D-12. It should be at 10 Vdc when cathode of D42 is low and local PTT input on P3-3 is high. Test point TP1 can be grounded to simulate a remote PTT. In addition, U5D-10 and U5D-11 should be at 5 Vdc with line audio riding on top.

PROBLEM	PROCEDURE
	3. U3A-1 should be at 5 Vdc with line audio. 4. U9A-1 should be at 5 Vdc with line audio. 5. U10B-4 should be at 5 Vdc with line audio. 6. U10A-5 should be at 5 Vdc with line audio.
Lack of compression on high audio input.	1. Check the setting of R91 "TRANSMIT LINE INPUT" and R34 "REMOTE TRANSMIT LEVEL" as set out in the alignment section of this manual. 2. U10C-9 should be at 5 Vdc with line audio. 3. Check for a DC voltage across C91. Check that this voltage increases with increased audio input. 4. Check for a DC voltage across R160. Check that this voltage increases with increased audio input.
No receive audio from "VOL/SQ HI" J1203-8 to "LINE" across TB1201-3 or TB1201-4.	1. Check the setting of R81 which may be misadjusted (the setting is too low). 2. Check U7A. Pin 13 should be at 10 Vdc when "RUS" port on J1204-11 is in the unsquelched mode. Pins 1 and 2 should be at 5 Vdc with repeater audio riding on the DC level. 3. The notch filter/combiner circuit U2 should have its output on pin 5 at 5 Vdc with the receive audio on it.
No audio from "LOCAL MIC HI" on P3-2 to the "LINE" ports on TB1201-3 and 4.	1. Check the setting of R28 which maybe misadjusted (the setting is too low). 2. Check U5. Pin 5 should be at 10 Vdc when the "LOCAL PTT" port on P3-3 is activated. 3. The notch filter/combiner circuit U2 should have its output on pin 1 at 5 Vdc with the local audio riding on it.

PROBLEM	PROCEDURE
No control tones from the "LINE" TB1201-3 and 4 to 2175 Hz bandpass filter U23. When in 4-wire configation no control tones from the "LINE" TB1201-2 and 5 to 2175 Hz bandpass filter U23.	1. Check the setting of R122 which may be misadjusted (the setting is too low). 2. The 2175 Hz bandpass filter U23 should have output on TP5 at 5 Vdc with the controllers 2175 SECUR-IT tone riding on top of it. 3. Check the setting of R174 which may be misadjusted (the setting is not tuned to 2175 Hz) and the filter will not pass the SECUR-IT tone. 4. The +10 dB detector comparator U26A should have its output on pin 1 low (less than 0.8 Vdc) when there is no SECUR-IT tone. In the presence of +10 dB 2175 Hz the output should go high (greater than 9.5 Vdc). 5. The validation one-shot U29A output on pin 7 will go low for 100 ms then return high when an uninterrupted SECUR-IT tone at +10 dB is detected. 6. The AND gate, U22C output on pin 8 will be low during idle and validation times. The output will go high and remain high as long as the SECUR-IT tone at +10dB is present on the line and has passed validation. 7. The function tone one-shot U29B output on pin 10 will put out a 100 ms positive pulse upon completion of validation, which allows the function tones to be applied to the decoders via analog gate U21A. 8. The analog gate U21A will pass the function tones when the control on pin 13 is high (greater than 9.5 Vdc).
No +10 Vdc on the "EXTERNAL 10 Vdc" ports J1201-1 or J1203-4.	1. Check the input power source on J1203-3 for +13.8 Vdc. 2. Check the input to the voltage regulator U18 for 13.8 Vdc - 20%. 3. Check the output from the regulator for +10 Vdc.
No +10 Vdc for the internal requirements and on J1204-10.	1. Check the input power source on J1203-3 for +13.8 Vdc. 2. Check the input to the voltage regulator U30 for +13.8 Vdc -20%. 3. Check the output from the regulator for +10 Vdc.

PROBLEM	PROCEDURE
No + 5 Vdc for the internal references and logic circuits.	1. Check the input to U31 for +10 Vdc. 2. Check the output from the regulator for +5 Vdc.
Not the proper voltage on the "TX OCS CNTROL" at J1204-5, or at improper time.	1. Check Q14-E for 10 Vdc. It not present check U30 as in paragraph above. 2. Check Q13-E. It must be low for Q14 to be on. 3. Schmitt trigger delay circuit comprised of U13D and U13E is not functioning properly. The input on U13D-9 goes low when the CG circuits decode a PTT. This causes the output on U13A-2 to go high 20 milliseconds after the input transition. The high on pin 2 turns on Q13 which in turn turns on Q14.
The "ANT RELAY" on J1201-3 will not pull in the transmitter relay.	1. If the TX LED, D30, is illuminated then the output line between the panel and the transmitter is open or the antenna relay is bad. (See the repeater maintenance manual for details). 2. The output from U13B pin 4 should go high (at least 6 Vdc) when the PTT is activated. This will happen at the same time that the CG circuits decoder feeds the input on U13F pin 13. When the PTT is released the output on pin 4 will be delayed on for 20 ms in order to reduce the arcing across the contacts when the transmitter shuts off. 3. Check the position of jumper H1, H2, H3 and H4 for proper placement. See the schematic diagram for placement chart.
MASTER TIMER U12 will not function properly.	1. Check the repeater disable jumper H14 to H15. It must be present. 2. The input trigger to U14B is the falling edge of the RUSOS which causes a reset to be applied to the input of the master timer U12. The output from pin 8 should go high (at least 9.5 Vdc) at this time and remain high for the entire cycle time. The high time is controlled by the jumpers on H5-H10 and H16 to H17 (refer to schematic for listing). 3. Check U20A and U20D. The input on pin 1 should go high and the input on pin 6 to go low and the other input on pin 5 whould be low. This causes the output on pin 4 to be high which turns on transistor Q22. When the selector switch SW5 is in the "NORMAL" position then diode D33 will be forward biased and the PTT sequence begins.

PROBLEM	PROCEDURE
DROPOUT TIMER U14A will not function properly.	1. Check the jumpers H18-H21 for the proper connection. 2. On the rising edge of RUSOS the timer U14A will trigger and the output on pin 6 will go high if the clear is low on pin 3. The clear is controlled by the master timer via U20D. The output is summed by diode D11 to the drive transistor Q22. This transistor will start the PTT function when switch SW5 is in the "NORMAL" operating position.
"RX MUTE 1" on J1201-2 doesn't work properly.	1. Jumper H12 to H13 installed for CG equipped radios. 2. When the "CG DECODE OUTPUT" on J1201-11 goes low (less than 0.8 Vdc) transistor Q17 turns off and its collector goes high. This turns on transistor Q19 which causes the number one receiver to mute. In addition to this, diode D38 is forward biased which causes the analog gate U7A to shut off, disabling receiver audio to the line.
The Channel Guard doesn't work properly and doesn't provide correct control function.	1. Check the incoming tone level on test point TP2 to ensure the tone levels and proper frequency (2050 Hz) is being received. 2. Check the output of the 2050 Hz detector U15 on pin 6. This should go high (greater than 9.5 Vdc) when the CG function is generated at the remote controller. 3. Check the setting of potentiometer R142 which may be misadjusted (the frequency is not proper). 4. The CG flip-flop U24B output should go high (greater than 9.5 Vdc) when set input on pin 6 goes high. This should turn on transistor Q20 which pulls the output on J1201-5 low (less than 0.3 Vdc). 5. The CG flip-flop should be reset when the PTT from U13F goes high, or when the power up one-shot U28B output on pin 10 goes high, or when the operator moves the selector switch, SW5 into the "TEST" position.
Transmit Freq 1 doesn't work properly and doesn't provide the correct control function.	1. Check the incoming tone level on test point TP2 to ensure the tone levels and proper frequency (1950 Hz) is being received. 2. Check the output of the 1950 Hz detector U16 on pin 6. This should go high (greater than 9.5 Vdc) when the TX1 function is generated at the remote controller.

PROBLEM	PROCEDURE
	3. Check the setting of potentiometer R193 which may be misadjusted (the frequency is not proper). 4. The function flip-flop U24A output on pin 2 should go high (greater than 9.5 Vdc) when the set input pin 6 goes high. This in turn applies a logic one to the input of the AND gate U22A pin 1. The other input comes from the set input and requires that the detection of the function tone disappear before the Hold tone can be applied to the -20 dB detector. 5. The transmit flip-flop should be reset when the -20 dB comparator U26B output on pin 7 goes low and triggers the one-shot U28A and causes its output on pin 6 to go high. Or when the power up one-shot U28B output pin 10 goes high. Or when the operator moves the selector switch SW5 into the "TEST" position. 6. The collector on the output transistor Q21 should go low (less than 0.3 Vdc), which is connected to J1203-1 when the panel decodes a remote PTT function. 7. This remote PTT forward biases diode D31 which causes the repeater timer control circuit to operated via jumper selection to H1-H2.
The panel powers up with control function selected.	1. The power on reset one-shot U28B should send out a 100 ms positive pulse on initial application of +13.8 Vdc to the panel. This pulse can be examined at pin 10. And OR gate U27D output on pin 10 should have the same positive present on it. This high level should cause the OR gates U27B and U27C to go high on their respective outputs on pins 4 and 11. The outputs, in turn cause the flip-flops U24B and U24A to go to a reset state in which their respective outputs on pins 9 and 2 go low (less than 0.8 Vdc). 2. The selector switch SW5 when in the "TEST" position and terminals 1A and 1D make contact, OR gate U27D output on pin 10 should go high (greater than 9.5 Vdc). This high level should cause the OR gates U27B and U27C to go high on their respective outputs on pins 4 and 11. These outputs in turn cause the flip-flops U24B and U24A to go to a reset state in which their respective outputs on pins 9 and 2 go low (less than 0.8 Vdc).

TONE EXTENTION BOARD (-0173)

PROBLEM	PROCEDURE
No +5 Vdc for the decoder references and logic circuits.	1. Check the input on P1-3 for +5 Vdc. 2. If the Battery Backup Option is installed, check the battery and charging circuit comprised of D7, D8, and R70.
The panel powers up with control function selected.	1. The power reset one-shot should send out a 100 mSec positive pulse upon initial application of +13.8 Vdc to the panel. This pulse can be examined at P1-5. This causes flip-flops U10 thru U12 to go to a reset state in which their respective outputs go low (less than 0.8 Vdc). 2. When the Battery Backup Option is installed, flip-flops U10 thru U12 remain in their last decoded position and thus will come up in a function decoded state. Make sure the jumper H15 to H16 is removed when battery B1 is installed.
The panel will not decode the function tones.	1. Check the +5 Vdc on P1-3, P1-4. 2. Check the +10 Vdc on P1-1, P1-2. 3. Check the signal level on P1-8 to make sure a level of 800 mV p-p is present during a function tone decode. 4. Check the alignment of the function tone decoders U1-U9 according to the procedure outline in the MAINTENANCE SECTION of this manual. 5. Check the PROMs U13 thru U15 to ensure the proper code is installed within them. 6. Check the voltage in pin 16 of U10, U11 and U12 when the Battery Backup Option is installed, it should be at least 4.4 Vdc. 7. Refer to the Tone Extension Road Maps in this manual for greater detail.

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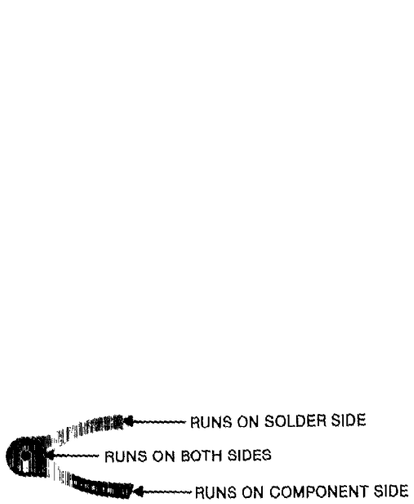

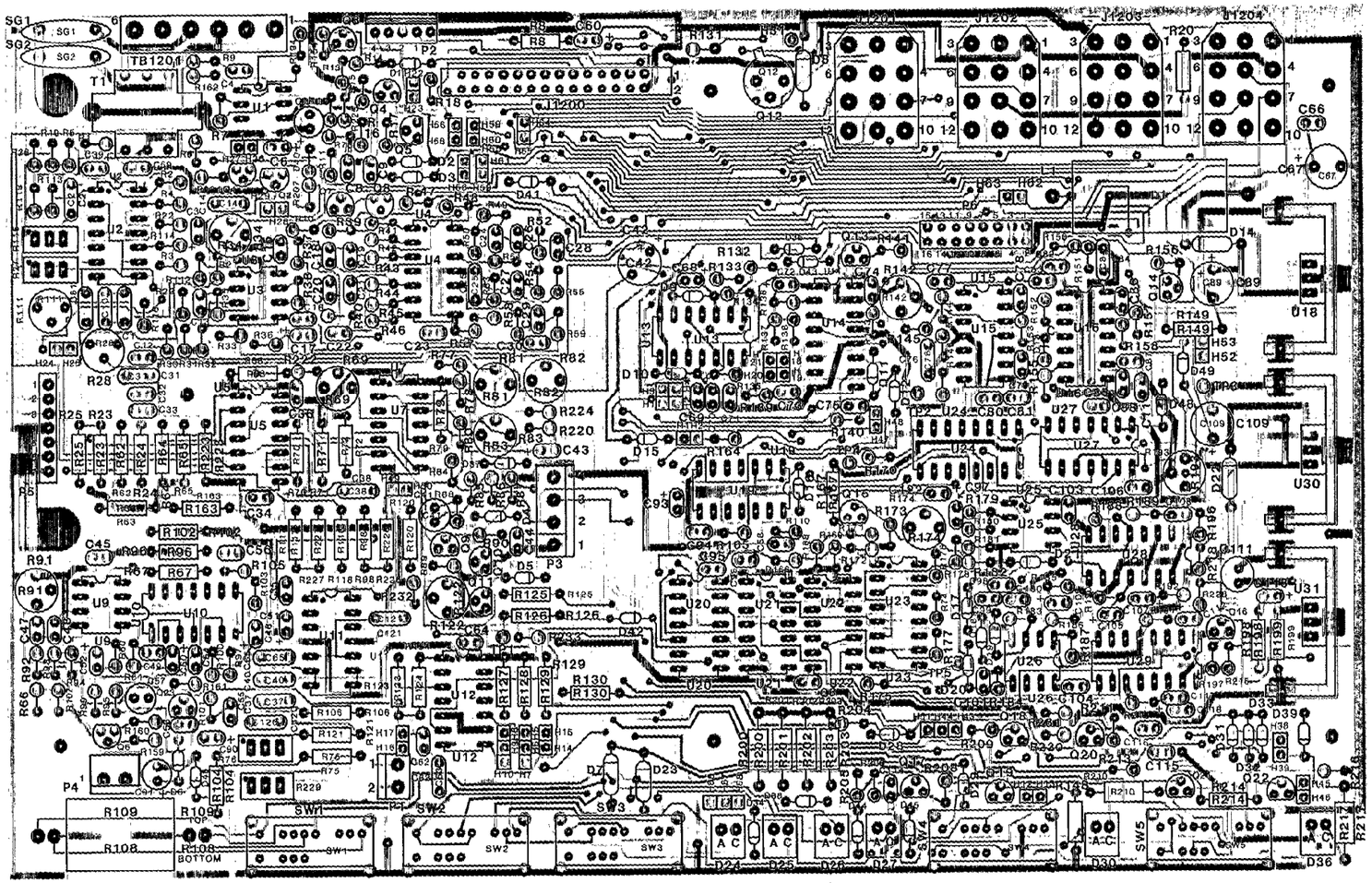

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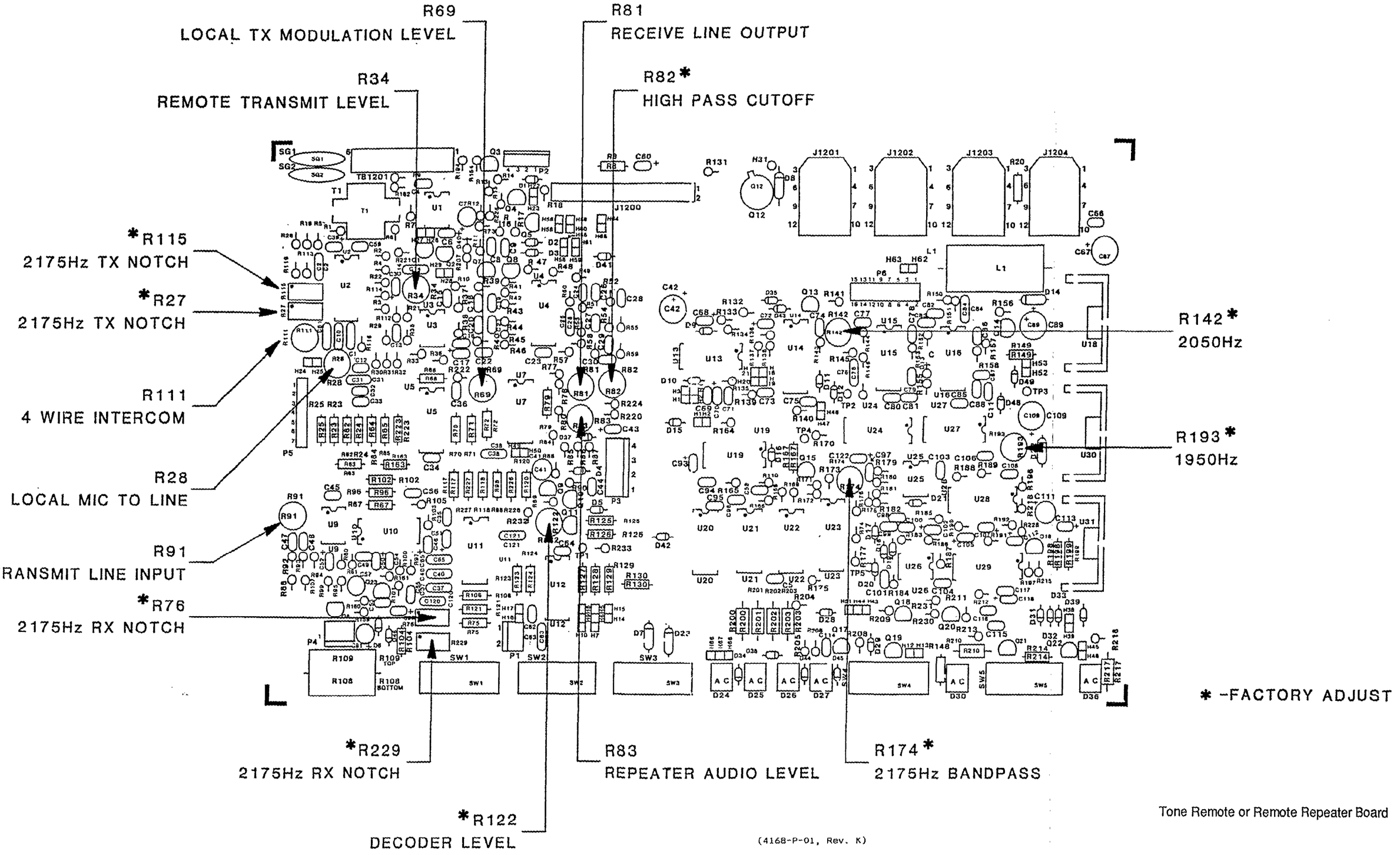
(900-0172, Component Side, Rev. G.)
(900-0172, Solder Side, Rev. G.)

Tone Remote or Remote/Repeater Board



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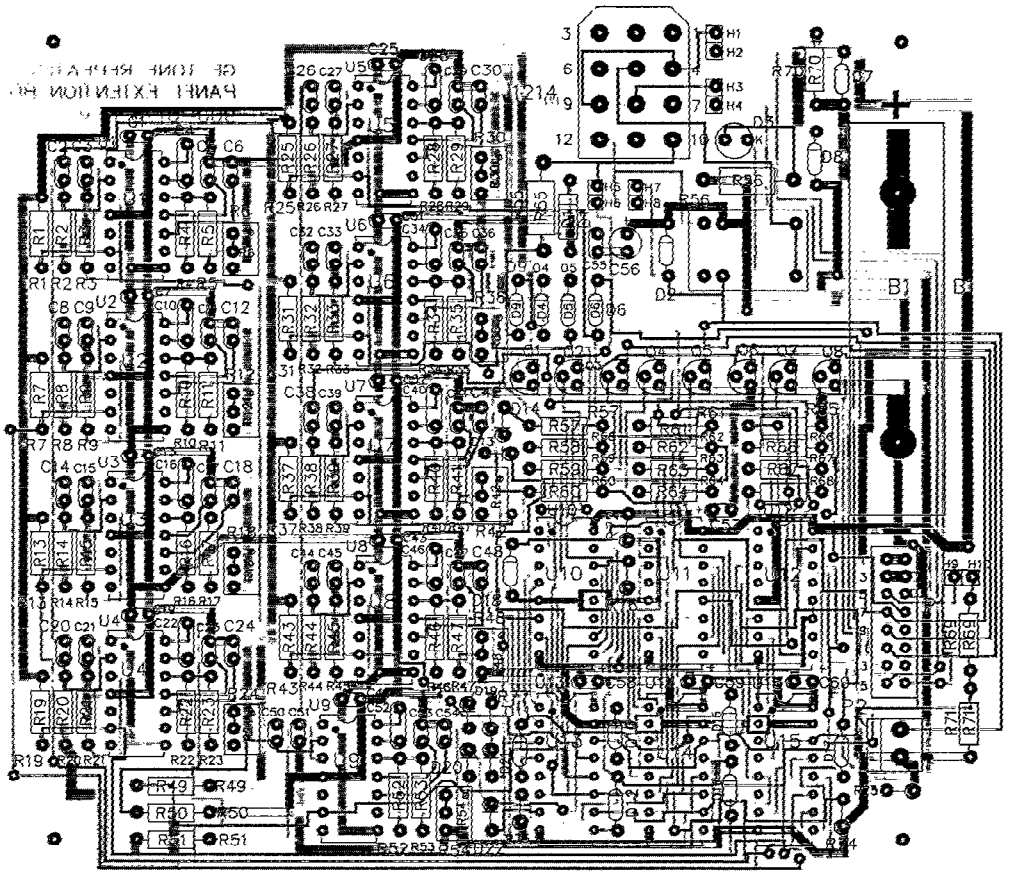
Tone Remote or Remote Repeater Board



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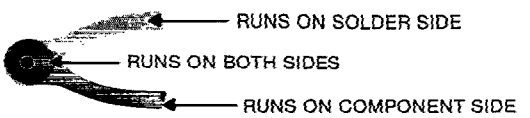
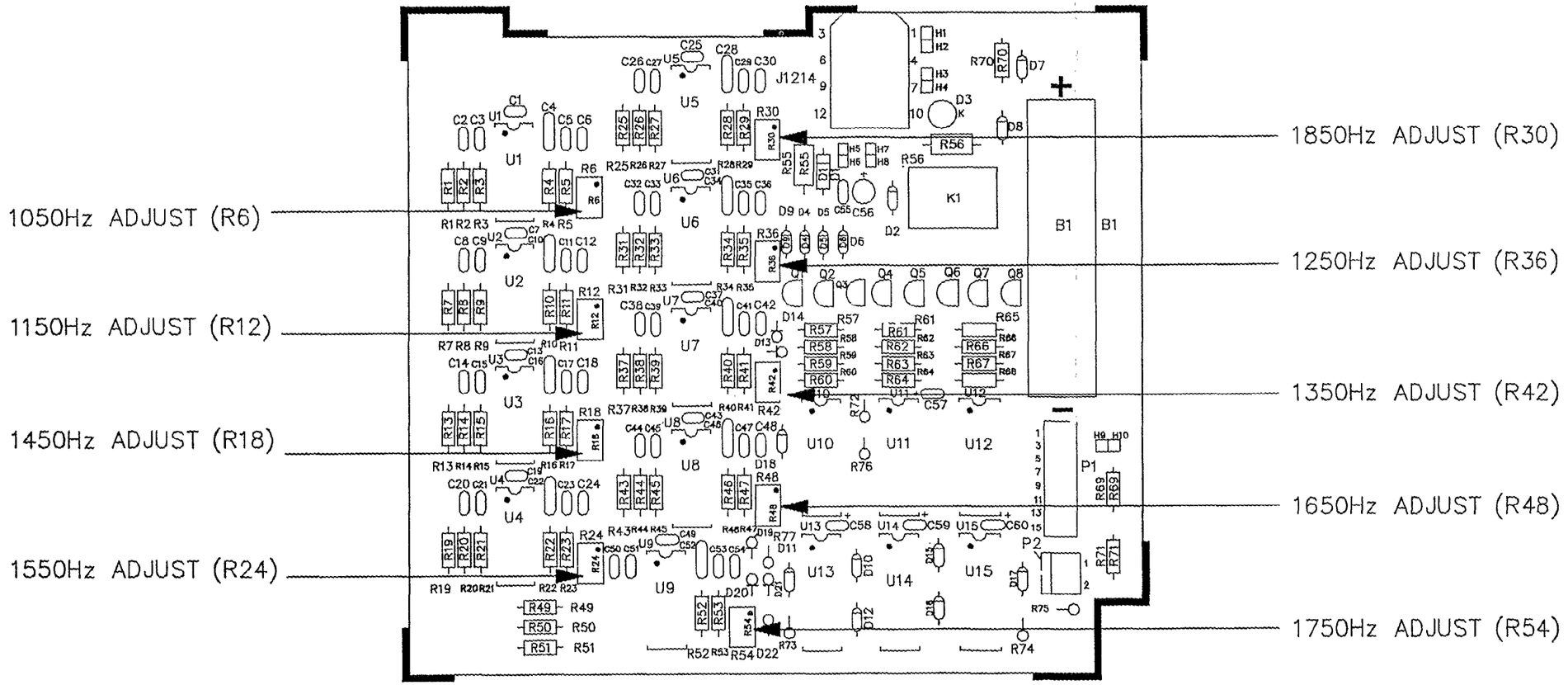


Tone Extension Board

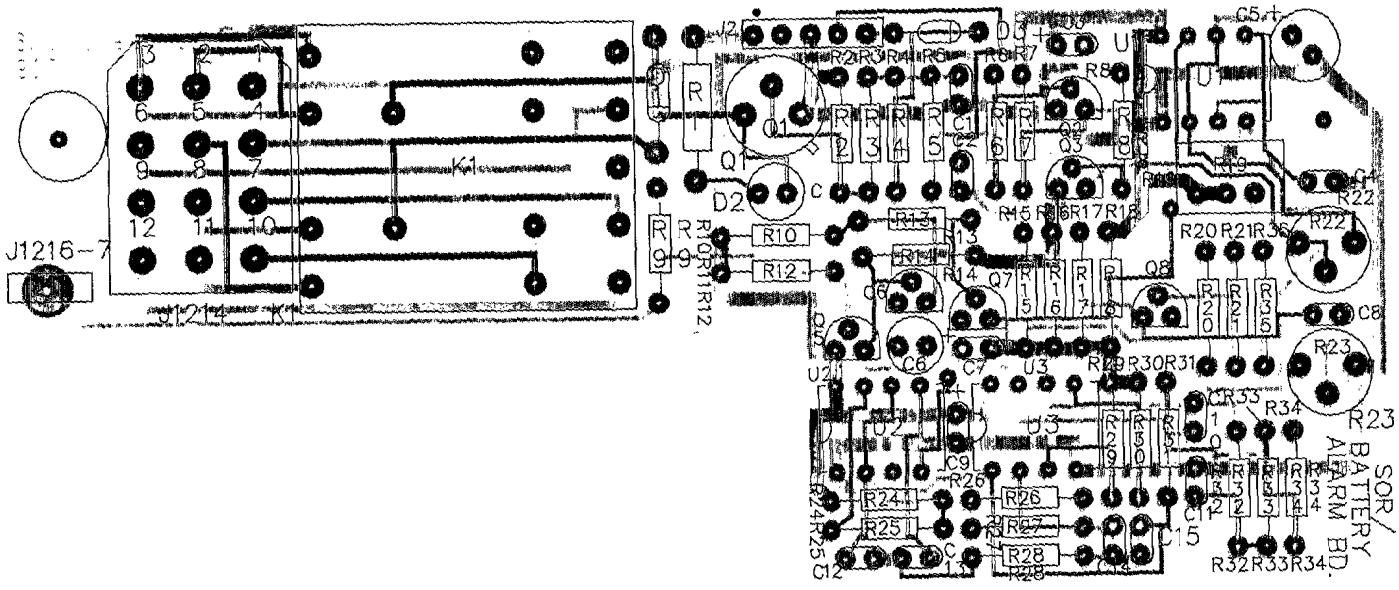


NOTE:

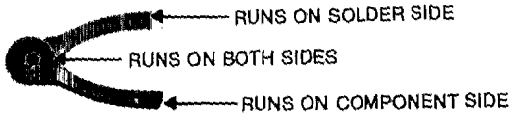
ALL ADJUSTMENTS FACTORY SET ONLY

(4170-P-01, Rev. B.)

Tone Extension Board



(900-0168, Silkscreen, Rev. D.)
(900-0168, Component Side, Rev. D.)
(900-0168, Solder Side, Rev. D.)



SOR/BATTERY ALARM

EXPLANATION OF DIAGRAMS AND ROAD-MAPS

General

Tone Panels 19B234871P51 through P74 provide a family of functions as set out in Table 1. Since there are 24 different versions it is appropriate to provide one set of drawings in this manual instead of 24 sets. There are two printed circuit boards one for each panel (except P51 and P52 which only have the main PCB).

Main Board

The main board, number -0172, contains most of the audio circuitry and power supplies. A five page schematic diagram (4168-S-01 through 05) covers all of the variations of this board. As a general rule, this board varies in leaving certain functions out:

If the panel is for remote, only the timer circuits (U12, U14 and their associated parts on 4168-S-02) are not present.

If the panel is not for Channel Guard, the 2050 Hz decoder (U15 and its associated parts on 4168-S-05) is not present.

There are a few other component or wiring differences between the different panels.

Tone Extension Board

The tone extension board, number -0173, contains the tone detectors (except 1950 Hz and 2050 Hz which are on the main board) applicable for any particular panel 19B234871P53 through P74. Also contained are one, two, or three PROMs and latches to interpret the signals from the decoders and output the correct functions to the base station.

A one page schematic diagram, 4170-S-00, applies to all twenty two variations of this PCB. To assist in understanding and troubleshooting this board, twenty two "road-maps" have been prepared. Each road-map shows what decoders, which PROMs, and which latches are present for that particular panel. Also shown on the road-map is an abbreviated description of the signal flow for each tone/function on that panel.

Note that the PROMs (U13, U14, and U15) are generally unique for each panel, and are therefore usually not interchangable between panels of different part numbers.

PRODUCTION CHANGES

REV. K (ECO-46-15 & 16)

Extensive changes have been made to the 19B234871P51-74 station panels by Revision K. It is not practical to upgrade these prior revision panels to Revision K. These panels were covered by maintenance manual LBI-31853D and it is not the intent to cover them in this manual.

REV. L (ECO-46-18)

Change R78 from 120K to 100K (J19/312-0003)
Change R220 from 20K to 4.7K (J19/312-0040)
To allow a lower minimum setting on R83 "RPTR AUDIO LEVEL".
Remove jumper from H62 to H63.
Removes ground from "TX AUDIO LO" (J1203-11) to eliminate possible ground loop path.
On PART 72 ONLY
-0173 Extension Board
Cut trace going to U12-5 (component side)
Connect U12-5 to U11-5
To disable scan function while in test mode.

(ECO-46-20)

Add R237 1M from U25B-5 to 10 VDC (J19/312-0047)
To make U25B circuit less sensitive to device date codes.

REV M. (ECO-46-21)

Change R169 from 1.13K to 3.01K (J19/311-3011)
Change R172 from 1.13K to 3.01K (J19/311-3011)
To improve keying PTT operation at temperature extremes.

REV. N (ECO-46-23)

Removed P75, 76, 77, 78 and 81. Added D28, D51 and D52 to jumper chart.

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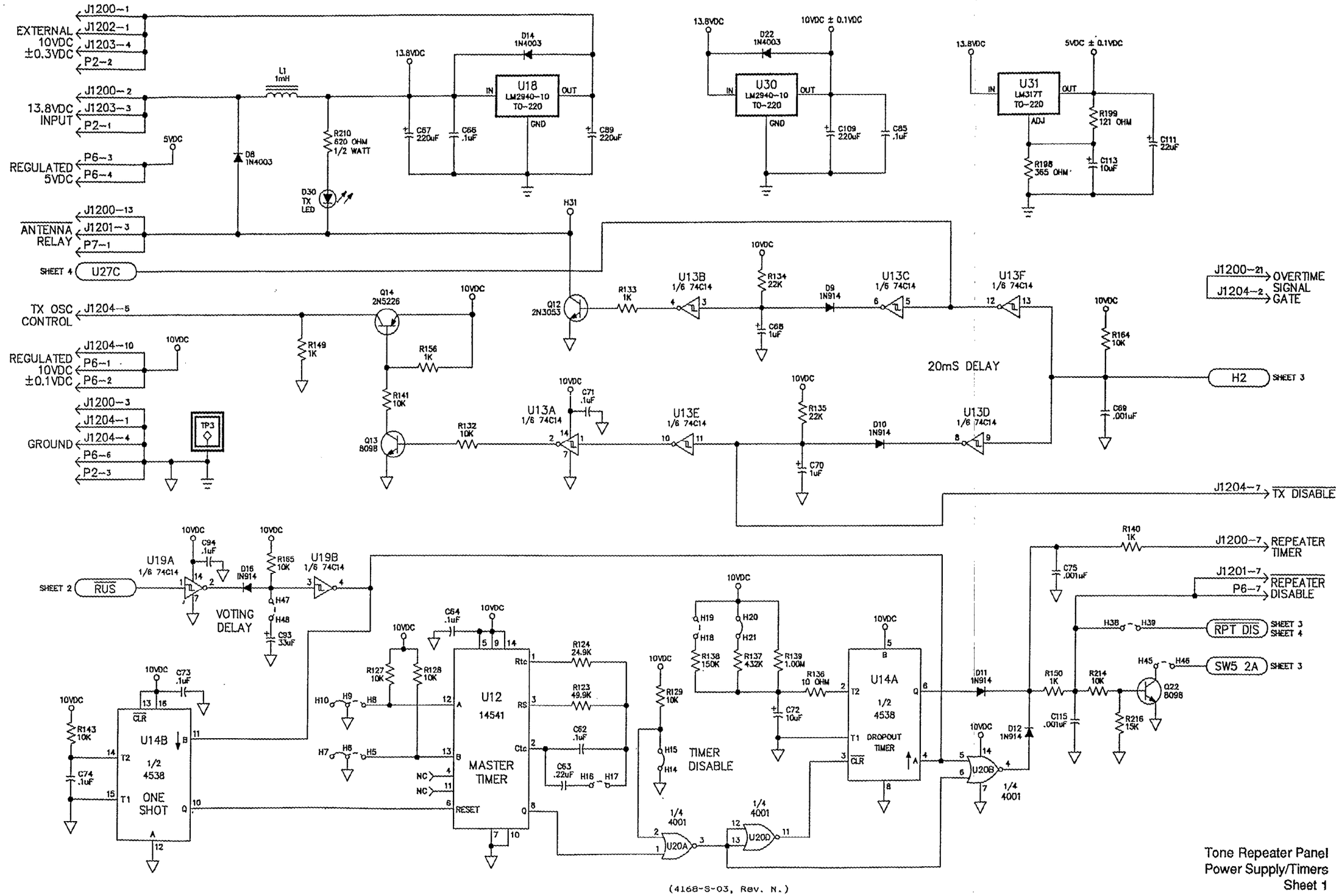
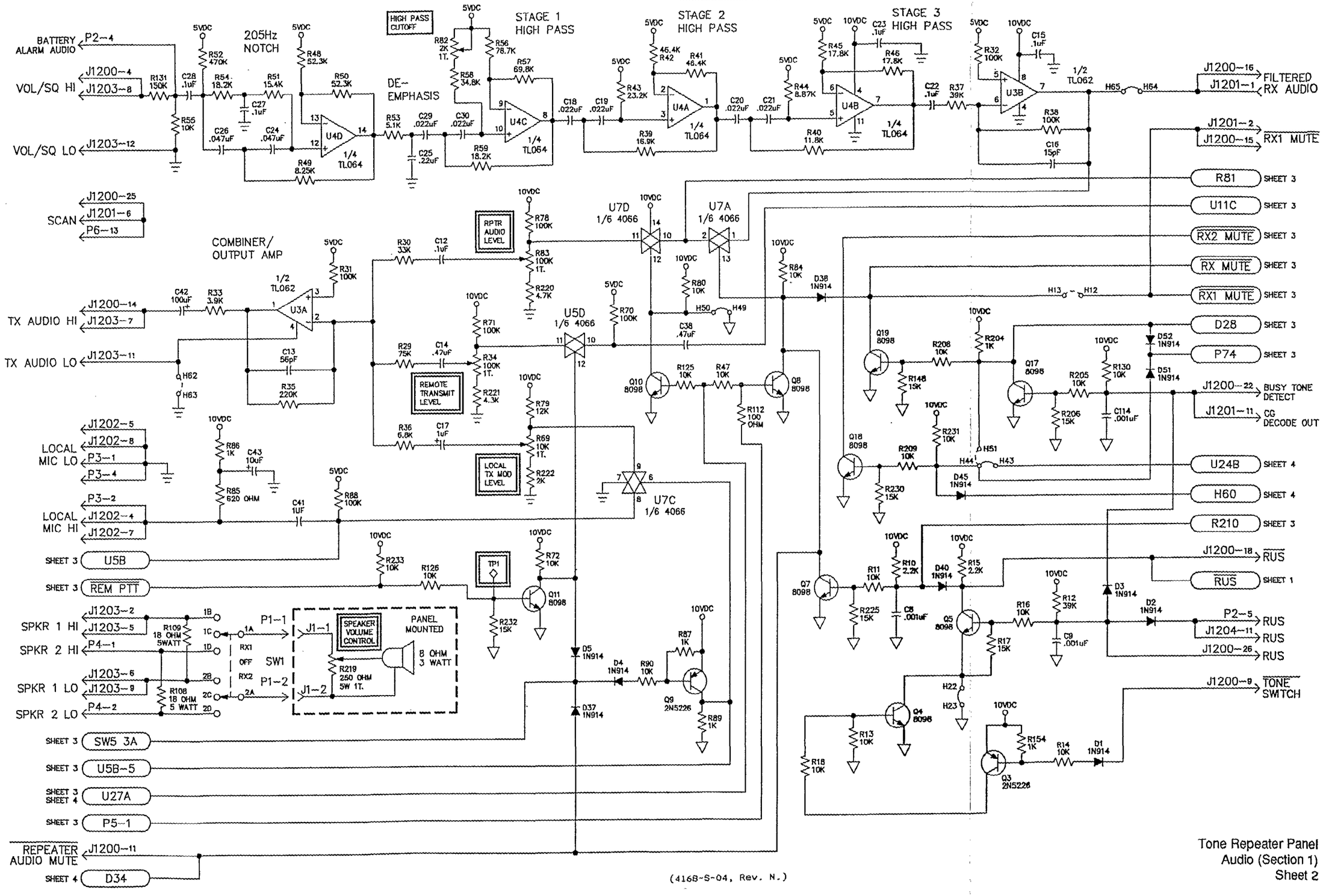
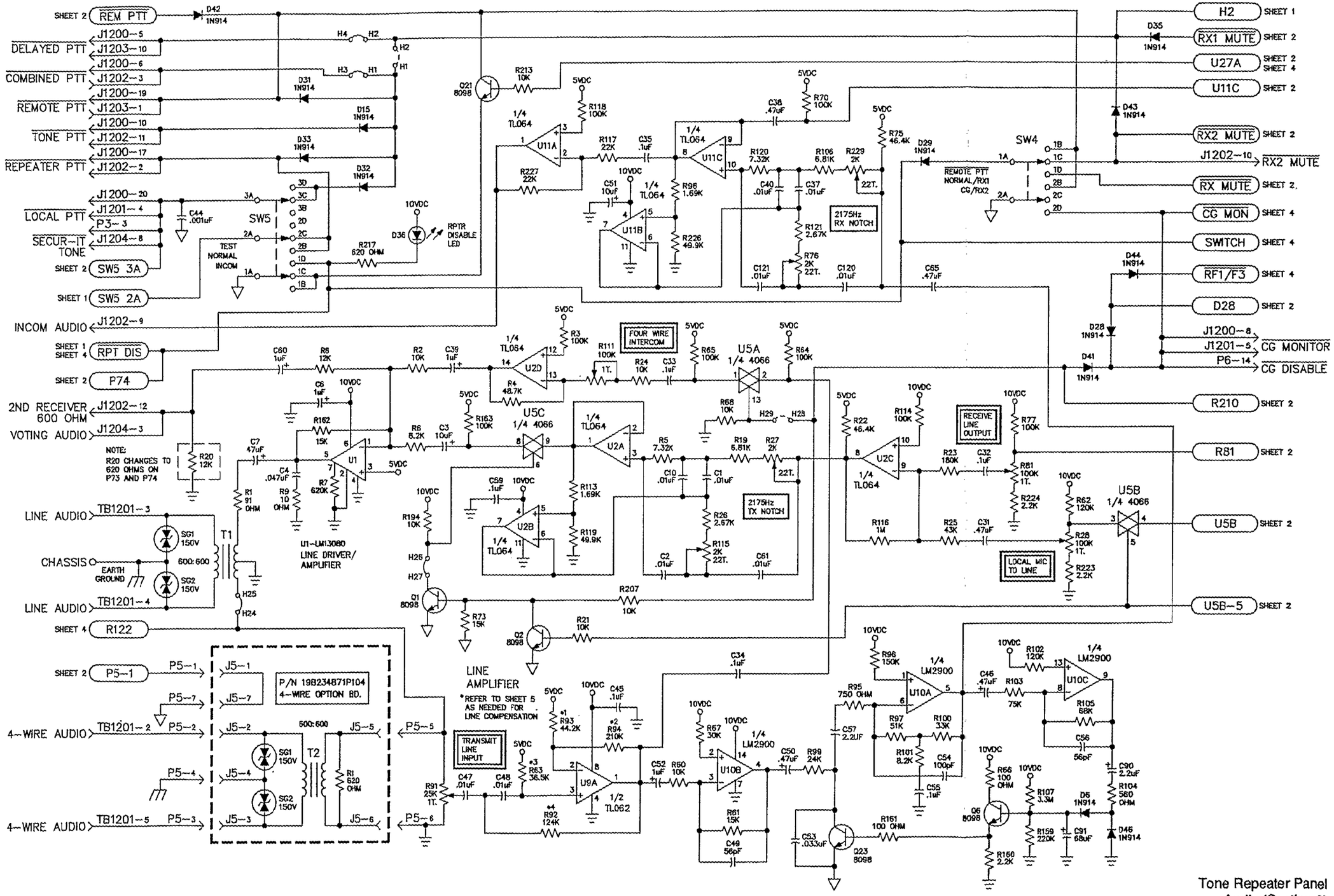

J1200-1
J1202-1
J1203-4
P2-2
EXTERNAL 10VDC ±0.3VDC
J1200-2
J1203-3
P2-1
13.8VDC INPUT
P6-3
P6-4
REGULATED 5VDC
J1200-13
J1201-3
P7-1
ANTENNA RELAY
SHEET 4 U27C
TX OSC CONTROL J1204-5
J1204-10
P6-1
P6-2
REGULATED 10VDC ±0.1VDC
J1200-3
J1204-1
J1204-4
P6-6
P2-3
GROUND
TP3
L1 1mH
D8 1N4003
R210 620 OHM 1/2 WATT
D30 TX LED
5VDC
13.8VDC
D14 1N4003
U18 LM2940-10 TO-220
IN
OUT
GND
C57 220uF
C65 .1uF
C89 220uF
D22 1N4003
U30 LM2940-10 TO-220
C109 220uF
C85 .1uF
U31 LM317T TO-220
ADJ
R199 121 OHM
R198 365 OHM
C113 10uF
C111 22uF
5VDC ± 0.1VDC
10VDC ± 0.1VDC
H31
Q12 2N3053
R133 1K
U13B 1/6 74C14
R134 22K
C68 1uF
D9 1N914
U13C 1/6 74C14
U13F 1/6 74C14
J1200-21 OVERTIME SIGNAL
J1204-2 GATE
20mS DELAY
R164 10K
C69 .001uF
H2
SHEET 3
Q14 2N5226
R149 1K
R156 1K
R141 10K
Q13 8098
R132 10K
U13A 1/6 74C14
C71 .1uF
U13E 1/6 74C14
R135 22K
C70 1uF
D10 1N914
U13D 1/6 74C14
J1204-7 TX DISABLE
U19A 1/6 74C14
D16 IN914
R165 10K
U19B 1/6 74C14
SHEET 2 RUS
VOTING DELAY
H47
H48
C93 33uF
C94 .1uF
C64 .1uF
C73 .1uF
U14B 1/2 4538 ONE SHOT
R143 10K
C74 .1uF
R127 10K
R128 10K
U12 14541 MASTER TIMER
R124 24.9K
R123 49.9K
C62 .1uF
C63 .22uF
H10 H9 H8
H7 H6 H5
H16 H17
NC
RESET
R129 10K
H19 H20
H18 H21
R138 150K
R137 432K
R139 1.00M
R136 10 OHM
C72 10uF
TIMER DISABLE
H15
H14
U14A 1/2 4538 DROPOUT TIMER
1/4 4001
U20A
U20D
U20B
D11 1N914
D12 1N914
R140 1K
C75 .001uF
J1200-7 REPEATER TIMER
J1201-7 REPEATER DISABLE
P6-7
H38 H39
RPT DIS
SHEET 3 SHEET 4
H45 H46
SW5 2A
SHEET 3
R150 1K
R214 10K
C115 .001uF
R216 15K
Q22 8098
Tone Repeater Panel
Power Supply/Timers
Sheet 1
(4168-S-03, Rev. N.)



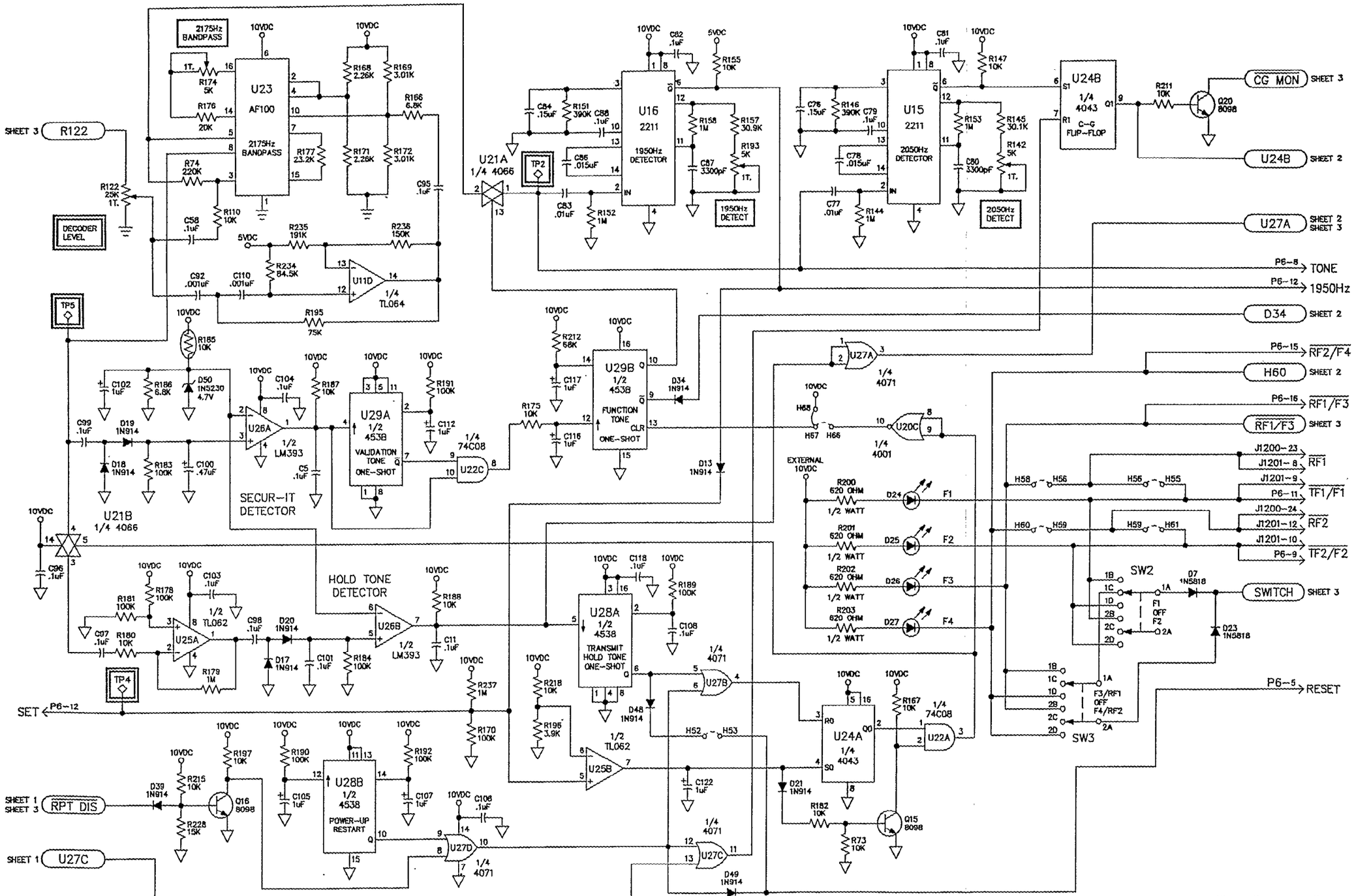
(416B-S-04, Rev. N.)

Tone Repeater Panel
Audio (Section 1)
Sheet 2



(4168–S–05, Rev. N.)

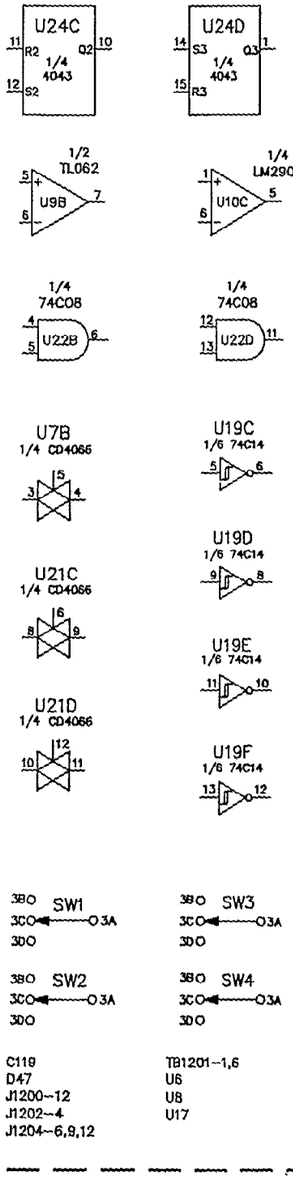
Tone Repeater Panel
Audio (Section 2)
Sheet 3



Tone Repeater Panel
Tone Detectors
Sheet 4

(4168-S-06, Rev. N.)

NOT USED



C119
D47
J1200–12
J1202–4
J1204–6,9,12

TB1201–1,6
U6
U8
U17

USE VALUES LISTED FOR LINE COMPENSATION

◆1	◆2	◆3	◆4
R93	R94	R63	R92
17.8K	69.1K	14.3K	45.3K

LAST USED

C122	R237
D52	SG2
H68	SW5
L1	T1
Q23	TP5
	U31

JUMPER CHART FOR P51 THRU P82 TONE PANELS

X–INSTALLED

JUMPER NUMBERS	P51	P52	P53	P54	P55	P56	P57	P58	P59	P60	P61	P62	P63	P64	P65	P66	P67	P68	P69	P70	P71	P72	P73	P74	P79	P80	P82	
H1 TO H2	X		X		X		X						X		X		X					X	X	X				
H1 TO H3		X		X		X		X	X	X	X	X		X		X		X	X	X	X				X	X	X	
H2 TO H4	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	SEE NOTE 1
H5 TO H6																												SEE TABLE 1
H6 TO H7	X	X					X	X	X	X			X	X			X	X	X	X					X	X		SEE TABLE 1
H8 TO H9																												SEE TABLE 1
H9 TO H10	X	X					X	X	X	X			X	X			X	X	X	X					X	X		SEE TABLE 1
H12 TO H13								X		X								X		X		X	X	X	X			SEE NOTE 8
H14 TO H15	X	X					X	X	X	X			X	X			X	X	X	X					X	X		SEE NOTE 2
H16 TO H17																												SEE TABLE 1
H18 TO H19																												SEE TABLE 2
H20 TO H21	X	X					X	X	X	X			X	X			X	X	X	X					X	X		SEE TABLE 2
H22 TO H23	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	SEE NOTE 3
H24 TO H25	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	SEE NOTE 4
H26 TO H27	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	SEE NOTE 4
H28 TO H29																												SEE NOTE 5
H38 TO H39			X	X	X	X					X	X			X	X					X	X	X	X				SEE NOTE 10
H43 TO H44		X		X		X		X	X	X	X	X		X		X		X	X	X	X				X	X	X	
H44 TO H51	X		X		X		X						X		X		X											
H45 TO H46							X	X		X							X	X		X					X			SEE NOTE 6
H47 TO H48																												SEE NOTE 7
H49 TO H50	X	X	X	X	X	X			X		X	X	X	X	X	X			X		X	X	X	X		X	X	
H52 TO H53																												
H55 TO H56					X	X						X															X	
H56 TO H58			X	X							X				X	X					X	X	X	X				
H59 TO H60			X	X							X				X	X					X	X	X	X				
H59 TO H61					X	X						X															X	
H62 TO H63																												SEE NOTE 12
H64 TO H65	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				SEE NOTE 9
H66 TO H67																												
H67 TO H68	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
D7,D24,D25			X	X	X						X	X			X	X					X	X		X			X	
D15	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
D23			X	X							X				X	X					X	X	X	X			X	
D26,D27			X	X	X	X					X	X			X	X					X	X	X	X			X	
D28	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	
D29,D43,D44,D45																							X	X				
D35	X	X	X	X	X	X		X		X	X	X	X	X	X			X		X	X	X	X	X		X	X	SEE NOTE 11
D39	X	X					X	X	X			X	X			X	X	X	X						X	X		
D41								X		X								X		X					X			
D51,D52																							X	X				
R6																							X	X				SEE NOTE 13

TABLE 1

REPEATER MASTER TIMER CHART

JUMPER NUMBERS	1MIN	3MIN	10MIN	TEST
H5 TO H6	X			X
H6 TO H7		X	X	
H8 TO H9	X			X
H9 TO H10		X	X	
H16 TO H17	X		X	

TABLE 2

REPEATER DROPOUT TIMER CHART

JUMPER NUMBERS	1SEC	3SEC	10SEC
H18 TO H19	X		
H20 TO H21	X	X	

NOTES:

ALL JUMPER POSITIONS IN SCHEMATIC SHEETS 1–4 APPLY TO THE TONE PANEL PART NO. P52. IT IS USING A 3 MINUTE MASTER TIMER, A 3 SECOND DROPOUT TIMER, AND NONE OF THE OPTIONS.

1. REMOVE JUMPER WITH CHANNEL GUARD DECODE ONLY APPLICATIONS.
2. REMOVE JUMPER TO DISABLE THE REPEATER MASTER & DROPOUT TIMERS.
3. REMOVE JUMPER TO ENABLE THE TONE SWITCH INPUT.
4. REMOVE JUMPER WITH 4 WIRE AUDIO OPTION.
5. INSTALL JUMPER WITH 4 WIRE OPTION, EXCEPT WITH VOTER DELAY OPTION.
6. REMOVE JUMPER FOR REPEATER PTT DISABLE.
7. INSTALL JUMPER WITH VOTER DELAY OPTION.
8. INSTALL JUMPER IN REMOTE/REPEAT WITH CG OR AUX RECEIVER APPLICATIONS.
9. REMOVE JUMPER WITH VOICE GUARD APPLICATIONS.
10. REMOVE RESISTORS R150 AND R214 WHEN THIS JUMPER IS USED.
11. REMOVE D35 FOR REPEAT OPERATION.
12. INSTALL JUMPER WHEN TX GROUND ISOLATION IS NOT NEEDED.
13. INSTALL WHEN USING VOTING TONE BOARD.

(4168-S-07, Rev. N.)

Tone Repeater Panel
Jumper Chart
Sheet 5

PARTS LIST

TONE CONTROL PANEL BOARD
J19/900-0172 Rev. M

ISSUE 2

SYMBOL	GE PART NO.	DESCRIPTION
		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ CAPACITORS ~ ~ ~ ~ ~ ~ ~ ~ ~
C1 and C2	J19/362-0019	Monolithic: .01 uF 50v Ultra.
C3	J19/390-0010	Tantalum: 10 uF 16v.
C4	J19/362-0009	Monolithic: .047 uF.
C5	J19/362-0001	Monolithic: .1 uF.
C6	J19/390-0012	Tantalum: 1 uF 25v.
C7	J19/360-0025	Electrolytic: 47 uF 16v.
C8 and C9	J19/362-0006	Monolithic: .001.
C10	J19/362-0019	Monolithic: .01 uF 50v Ultra.
C11	J19/362-0001	Monolithic: .1 uF.
C13	J19/362-0015	Monolithic: 56 pF.
C14	J19/362-0002	Monolithic: .47 uF.
C15	J19/362-0001	Monolithic: .1 uF.
C16	J19/362-0015	Monolithic: 56 pF.
C17	J19/390-0012	Tantalum: 1 uF 25v.
C18 thru C21	J19/362-0011A	Monolithic: .022 uF 2%.
C22 and C23	J19/362-0001	Monolithic: .1 uF.
C24	J19/362-5473A	Monolithic: .047 uF 2%.
C25	J19/362-5224	Monolithic: .22 uF 50v.
C26	J19/362-5473A	Monolithic: .047 uF 2%.
C27	J19/362-0001A	Monolithic: .1 uF 2%.
C28	J19/362-0001	Monolithic: .1 uF.
C29 and C30	J19/362-0011A	Monolithic: .022 uF 2%.
C31	J19/362-0002	Monolithic: .47 uF.
C32 thru C36	J19/362-0001	Monolithic: .1 uF.
C37	J19/362-0019	Monolithic: .01 uF 50v Ultra.
C38	J19/362-0002	Monolithic: .47 uF.
C39	J19/390-0012	Tantalum: 1 uF 25v.
C40	J19/362-0019	Monolithic: .01 uF 50v Ultra.
C41	J19/361-0003	Electrolytic: Non-polarized, 1 uF.
C42	J19/360-0005	Electrolytic: 100 uF 16v.
C43	J19/390-0010	Tantalum: 10 uF 16v.
C44	J19/362-0006	Monolithic: .001 uF.
C45	J19/362-0001	Monolithic: .1 uF.
C46	J19/390-0002	Tantalum: .47 uF 35v.
C47 and C48	J19/362-5103	Monolithic: .01 uF 2%.
C49	J19/362-0015	Monolithic: 56 pF.
C50	J19/390-0002	Tantalum: .47 uF 35v.
C51	J19/390-0010	Tantalum: 10 uF 16v.
C52	J19/390-0012	Tantalum: 1 uF 25v.
C53	J19/362-0005	Monolithic: .033 uF.
C54	J19/362-0016	Monolithic: 100 pF.
C55	J19/362-0001	Monolithic: .1 uF.
C56	J19/362-0015	Monolithic: 56 pF.
C57	J19/361-0002	Electrolytic: Non-Polarized, 2 uF.
C58 and C59	J19/362-0001	Monolithic: .1 uF.
C60	J19/390-0012	Tantalum: 1 uF 25v.
C61	J19/362-0019	Monolithic: .01 uF 50v Ultra.
C65	J19/362-0002	Monolithic: .47 uF.
C66	J19/362-0001	Monolithic: .1 uF.
C67	J19/360-0007	Electrolytic: 220 uF 16v.
C68	J19/390-0012	Tantalum: 1 uF 25v.
C69	J19/362-0006	Monolithic: .001 uF.
C70	J19/390-0012	Tantalum: 1 uF 25v.
C71 thru C82	J19/362-0001	Monolithic: .1 uF.
C83	J19/362-0003	Monolithic: .01 uF.
C84	J19/362-5154	Monolithic: .15 uF 50v.
C85	J19/362-0001	Monolithic: .1 uF.
C86	J19/363-0001	ULST .015 uF 50v.
C87	J19/362-0018	Monolithic: 3300 pF 50v.
C88	J19/362-0001	Monolithic: .1 uF.
C89	J19/360-0007	Electrolytic: 220 uF 16v.
C90	J19/390-0005	Tantalum: 2.2 uF 35v.
C91	J19/360-2686	Electrolytic: 68 uF 16v.
C92	J19/362-0006	Monolithic: .001.
C95 thru C99	J19/362-0001	Monolithic: .1 uF.
C100	J19/390-0002	Tantalum: .47 uF 35v.
C101	J19/362-0001	Monolithic: .1 uF.
C102	J19/390-0012	Tantalum: 1 uF 25v.
C103 and C104	J19/362-0001	Monolithic: .1 uF.
C105	J19/390-0012	Tantalum: 1 uF 25v.
C106	J19/362-0001	Monolithic: .1 uF.
C107	J19/390-0012	Tantalum: 1 uF 25 v.
C108	J19/362-0001	Monolithic: .1 uF.
C109	J19/360-0007	Electrolytic: 220 uF 16v.
C110	J19/362-0006	Monolithic: .001.
C111	J19/360-0002	Electrolytic: 22 uF 16v.
C112	J19/390-0012	Tantalum: 1 uF 25v.
C113	J19/390-0010	Tantalum: 10 uF 16v.
C114	J19/362-0006	Monolithic: .001.
C116 and C117	J19/390-0012	Tantalum: 1 uF 25 v.
C118	J19/362-0001	Monolithic: .1 uF.
C120 and C121	J19/362-0019	Monolithic: .01 uF 50v Ultra.
C122	J19/390-0012	Tantalum: 1 uF 25 v.
		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ DIODES ~ ~ ~ ~ ~ ~ ~ ~ ~
D1 thru D6	J19/110-0001H	1N914/1N4148.
D8	J19/110-0002	1N4003.
D9 and D10	J19/110-0001H	1N914/1N4148.
D13	J19/110-0001	1N914/1N4148.
D14	J19/110-0002	1N4003.
D17 thru D21	J19/110-0001H	1N914/1N4148.
D22	J19/110-0002	1N4003.
D30	J19/112-0001	LED: XC5569R OR 526R.
D31 and D32	J19/110-0001H	1N914 1N4148.
D34	J19/110-0001H	1N914/1N4148.
D36	J19/112-0001	LED: XC5569R OR 526R.
D37 and D38	J19/110-0001H	1N914/1N4148.
D40	J19/110-0001	1N914/1N4148.
D42	J19/110-0001H	1N914/1N4148.
D46	J19/110-0001H	1N914/1N4148.
D48 and D49	J19/110-0001H	1N914/1N4148.
D50	J19/111-0001	Zener: 1N5230A 4.7v.
		~ ~ ~ ~ ~ ~ ~ ~ CONNECTORS AND PLUGS ~ ~ ~ ~ ~ ~ ~
H1-2	J19/231-1002	Connector: 22-03-2021 Molex.
H1-2	J19/234-0046	Plug: short #925250-R.
H1-3	J19/231-1002	Connector: 22-03-2021 Molex.
H2-4	J19/231-1002	Connector: 22-03-2021 Molex.
H2-4	J19/234-0046	Plug: short #925250-R.
H12-13	J19/231-1002	Connector: 22-03-2021 Molex.
H22-23	J19/231-1002	Connector: 22-03-2021 Molex.
H22-23	J19/234-0046	Plug: short #925250-R.
H24-25	J19/231-1002	Connector: 22-03-2021 Molex.
H24-25	J19/234-0046	Plug: short #925250-R.
H26-27	J19/231-1002	Connector: 22-03-2021 Molex.
H26-27	J19/234-0046	Plug: short #925250-R.
H28-29	J19/231-1002	Connector: 22-03-2021 Molex.
H31	J19/200-0015	Connector: #5931-4.
H43-51	J19/231-1003	Connector: 22-03-2031 Molx.
H49-50	J19/231-1002	Connector: 22-03-2021 Molex.
H52-53	J19/231-1002	Connector: 22-03-2021 Molex.
H62-63	J19/231-1002	Connector: 22-03-2021 Molex.
H67-68	J19/265-0016	Staple Jumper .100.
J1200	J19/231-1071	26 position, .1 X .1 position.
J1201	J19/231-3109	09-18-5121 Molex.
J1202	J19/231-3110	09-18-5927 Molex.
J1203	J19/231-3109	09-18-5121 Molex.
J1204	J19/231-3110	09-18-5927 Molex.
		~ ~ ~ ~ ~ ~ ~ ~ ~ INDUCTORS ~ ~ ~ ~ ~ ~ ~ ~ ~
L1	J19/306-0003	Filter Choke,IHA-105.
		~ ~ ~ ~ ~ ~ ~ ~ ~ PLUGS ~ ~ ~ ~ ~ ~ ~ ~ ~
P1	J19/231-1067	2 position, .156.
P2	J19/233-0034	5 position, .100.
P3	J19/231-1072	4 position, .156.
P5	J19/231-3108	7 position, .1.
		~ ~ ~ ~ ~ ~ ~ ~ ~ TRANSISTORS ~ ~ ~ ~ ~ ~ ~ ~ ~
Q1 and Q2	J19/180-0009	MPS8098.
Q3	J19/180-0005	2N5226.
Q4 thru Q8	J19/180-0009	MPS8098.
Q9	J19/180-0005	2N5226.
Q10 and Q11	J19/180-0009	MPS8098.
Q12	J19/180-0017	2N3053.
Q13	J19/180-0009	MPS8098.
Q14	J19/180-0005	2N5226.
Q15 thru Q21	J19/180-0009	MPS8098.
		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ RESISTORS ~ ~ ~ ~ ~ ~ ~ ~ ~
R1	J19/312-1910V	91 ohms ±5%, 1/4 w.
R2	J19/312-0311V	10K ohms ±5%, 1/4 w.
R3	J19/312-0003V	100K ohms ±5%, 1/4 w.
R4	J19/311-4872V	48.7K ohms ±1%, 1/4 w.
R5	J19/311-7321V	7.32K ohms ±1%, 1/4 w.
R6	J19/312-0036V	8.2K ohms ±5%, 1/4 w.
R7	J19/312-0072V	620K ohms ±5%, 1/4 w.
R9	J19/312-0038V	10 ohms ±5%, 1/4 w.
R10	J19/312-0007V	2.2K ohms ±5%, 1/4 w.
R11	J19/312-0011V	10K ohms ±5%, 1/4 w.
R12	J19/312-0059V	39K ohms ±5%, 1/4 w.
R13 and R14	J19/312-0011V	10K ohms ±5%, 1/4 w.
R15	J19/312-0007V	2.2K ohms ±5%, 1/4 w.
R16	J19/312-0011V	10K ohms ±5%, 1/4 w.
R17	J19/312-0009V	15K ohms ±5%, 1/4 w.
R18	J19/312-0011V	10K ohms ±5%, 1/4 w.
R19	J19/311-6811V	6.81K ohms ±1%, 1/4 w.
R21	J19/312-0011V	10K ohms ±5%, 1/4 w.
R22	J19/311-4642V	46.4K ohms ±1%, 1/4 w.
R23	J19/312-0057H	180K ohms ±5%, 1/4 w.
R24	J19/312-0011H	10K ohms ±5%, 1/4 w.
R25	J19/312-0027H	43K ohms ±5%, 1/4 w.
R26	J19/311-0017V	2.67K ohms ±1%, 1/4 w.
R27	J19/352-0004	Varible: 2K ohms, 22 Turn.
R28	J19/352-0005	Varible: 100K ohms, 1 Turn.
R29	J19/312-0055V	75K ohms ±5%, 1/4 w.
R31 and R32	J19/312-0003V	100K ohms ±5%, 1/4 w.
R33	J19/312-0070V	3.9K ohms ±5%, 1/4 w.
R34	J19/352-0005	Varible: 100K ohms, 1 Turn (36C15-DK.
R35	J19/312-0012V	220K ohms ±5%, 1/4 w.
R36	J19/312-0018V	6.8K ohms ±5%, 1/4 w.
R37	J19/312-0059V	39K ohms ±5%, 1/4 w.
R38	J19/312-0003V	100K ohms ±5%, 1/4 w.
R39	J19/311-1692V	16.9K ohms ±1%, 1/4 w.
R40	J19/311-1182V	11.8K ohms ±1%, 1/4 w.
R41 and R42	J19/311-4642V	46.4K ohms ±1%, 1/4 w.
R43	J19/311-0004V	23.2K ohms ±1%, 1/4 w.
R44	J19/311-6871V	8.87K ohms ±1%, 1/4 w.
R45 and R46	J19/311-1782V	17.8K ohms ±1%, 1/4 w.
R47	J19/312-0011V	10K ohms ±5%, 1/4 w.
R48	J19/311-5232V	52.3K ohms ±1%, 1/4 w.
R49	J19/311-8251V	8.25K ohms ±1%, 1/4 w.
R50	J19/311-5232V	52.3K ohms ±1%, 1/4 w.
R51	J19/311-1542V	15.4K ohms ±1%, 1/4 w.
R52	J19/312-0046V	470K ohms ±5%, 1/4 w.
R53	J19/312-0024V	5.1K ohms ±5%, 1/4 w.
R54	J19/311-1822V	18.2K ohms ±1%, 1/4 w.
R55	J19/312-0011V	10K ohms ±5%, 1/4 w.
R56	J19/311-7872V	78.7K ohms ±1%, 1/4 w.
R57	J19/311-6982V	69.8K ohms ±1%, 1/4 w.

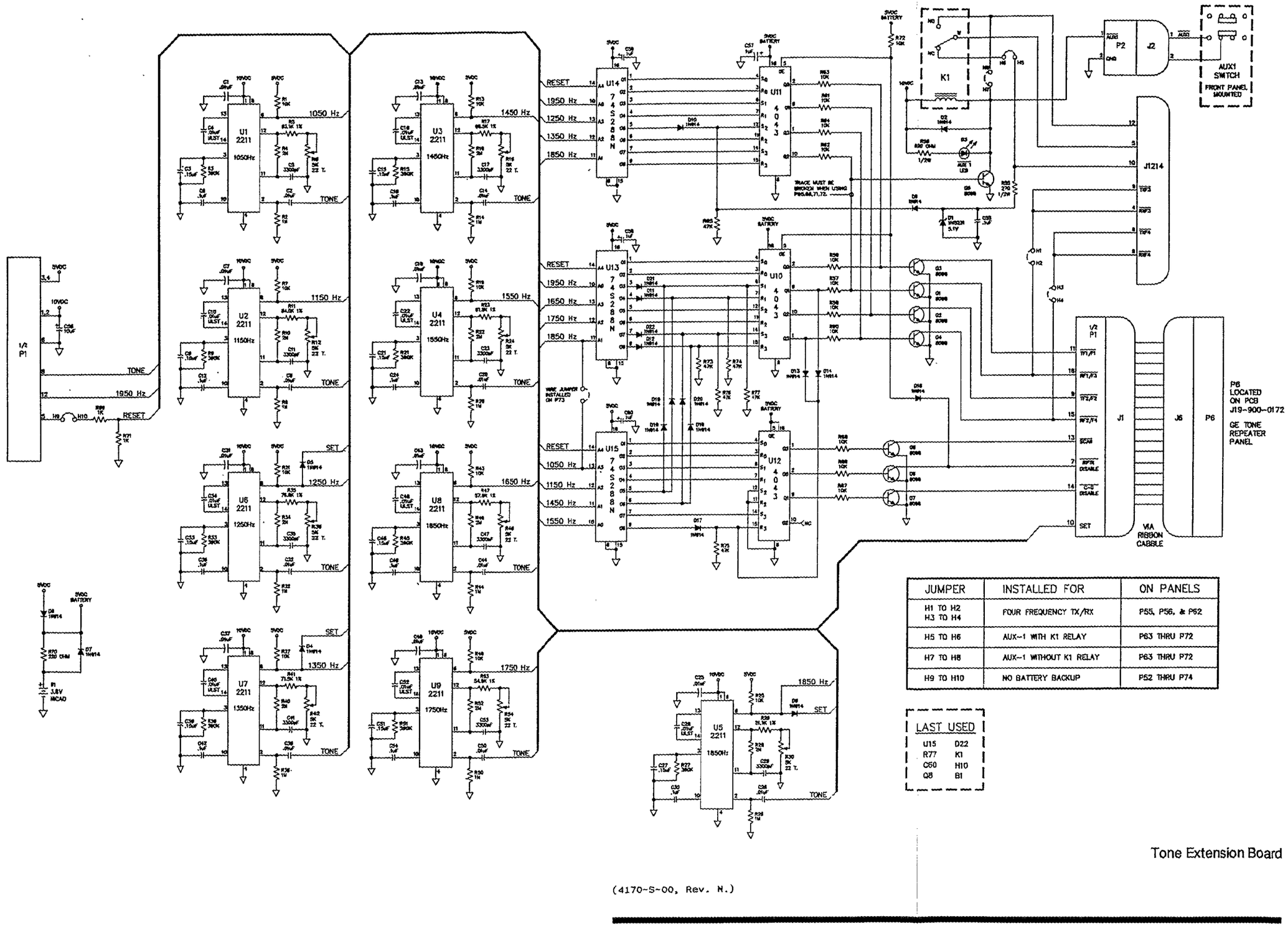
*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	GE PART NO.	DESCRIPTION
R58	J19/311-3482V	34.8K ohms ±1%, 1/4 w.
R59	J19/311-1822V	18.2K ohms ±1%, 1/4 w.
R60	J19/312-0011V	10K ohms ±5%, 1/4 w.
R61	J19/312-0039V	15K ohms ±5%, 1/4 w.
R62	J19/312-0008H	120K ohms ±5%, 1/4 w.
R63	J19/311-3652H	36.5K ohms ±1%, 1/4 w.
R64 and R65	J19/312-0003H	100K ohms ±5%, 1/4 w.
R66	J19/312-0010V	100 ohms ±5%, 1/4 w.
R67	J19/312-1303H	30K ohms ±5%, 1/4 w.
R68	J19/312-0011H	10K ohms ±5%, 1/4 w.
R69	J19/351-1103	Variable: 10K ohms, 1 Turn mini.
R70	J19/312-0003H	100K ohms ±5%, 1/4 w.
R71	J19/312-0003H	100K ohms ±5%, 1/4 w.
R72	J19/312-0011H	10K ohms ±5%, 1/4 w.
R73	J19/312-0039V	15K ohms ±5%, 1/4 w.
R74	J19/312-0012V	220K ohms ±5%, 1/4 w.
R75	J19/311-4642H	46.4K ohms ±1%, 1/4 w.
R76	J19/352-0004	Variable: 2K ohms, 22 Turn.
R77	J19/312-0003V	100K ohms ±5%, 1/4 w.
R78	J19/312-0003	100K ohms.
R79	J19/312-0022H	12K ohms ±5%, 1/4 w.
R80	J19/312-0011V	10K ohms ±5%, 1/4 w.
R81	J19/352-0005	Variable: 100K ohms, 1 Turn (36C15-DK).
R82	J19/351-1202	Variable: 2K ohms, 1 Turn mini.
R84	J19/312-0011V	10K ohms ±5%, 1/4 w.
R85	J19/312-0045V	620 ohms ±5%, 1/4 w.
R86	J19/312-0019V	1K ohms ±5%, 1/4 w.
R87	J19/312-0019V	1K ohms ±5%, 1/4 w.
R88	J19/312-0003V	100K ohms ±5%, 1/4 w.
R89	J19/312-0019V	1K ohms ±5%, 1/4 w.
R90	J19/312-0011V	10K ohms ±5%, 1/4 w.
R91	J19/351-1253	Variable: 25K ohms, 1 Turn mini.
R92	J19/311-1243V	124K ohms ±1%, 1/4 w.
R93	J19/311-0026V	44.2K ohms ±1%, 1/4 w.
R94	J19/311-2103V	210K ohms ±1%, 1/4 w.
R95	J19/311-7500V	750 ohms ±1%, 1/4 w.
R96	J19/311-1503H	150K ohms ±1%, 1/4 w.
R97	J19/312-0032V	51K ohms ±5%, 1/4 w.
R98	J19/311-1691H	1.69K ohms ±1%, 1/4 w.
R99	J19/312-0064V	24K ohms ±5%, 1/4 w.
R100	J19/312-0024V	33K ohms ±5%, 1/4 w.
R101	J19/312-0016V	8.2K ohms ±5%, 1/4 w.
R102	J19/312-0008H	120K ohms ±5%, 1/4 w.
R103	J19/312-0055V	75K ohms ±5%, 1/4 w.
R104	J19/312-0069H	560 ohms ±5%, 1/4 w.
R105	J19/312-0058V	68K ohms ±5%, 1/4 w.
R106	J19/311-6811H	6.81K ohms ±1%, 1/4 w.
R107	J19/312-0050V	3.3M ohms ±5%, 1/4 w.
R109	J19/315-1180	18 ohms, 5 w.
R110	J19/312-0011V	10K ohms ±5%, 1/4 w.
R111	J19/352-0005	100K ohms, 1 Turn 36C15-DK.
R112	J19/312-0010V	100 ohms ±5%, 1/4 w.
R113	J19/311-1691V	1.69K ohms ±1%, 1/4 w.
R114	J19/312-0003V	100K ohms ±5%, 1/4 w.
R115	J19/352-0004	Variable: 2K ohms, 22 Turn.
R116	J19/312-0047V	1M ohms ±5%, 1/4 w.
R117	J19/312-0015H	22K ohms ±5%, 1/4 w.

SYMBOL	GE PART NO.	DESCRIPTION
R118	J19/312-0003H	100K ohms ±5%, 1/4 w.
R119	J19/311-4992V	49.9K ohms ±1%, 1/4 w.
R120	J19/311-7321H	7.32K ohms ±1%, 1/4 w.
R121	J19/311-0017H	2.67K ohms ±1%, 1/4 w.
R122	J19/351-1253	Variable: 25K ohms, 1 Turn mini.
R126 and R130	J19/312-0011H	10K ohms ±5%, 1/4 w.
R131	J19/311-1503V	150K ohms ±1%, 1/4 w.
R132	J19/312-0011V	10K ohms ±5%, 1/4 w.
R133	J19/312-0019V	1K ohms ±5%, 1/4 w.
R134 and R135	J19/312-0015V	22K ohms ±5%, 1/4 w.
R141 and R147	J19/312-0011V	10K ohms ±5%, 1/4 w.
R148	J19/312-0009H	15K ohms ±5%, 1/4 w.
R149	J19/312-0019H	1K ohms ±5%, 1/4 w.
R151	J19/312-0001V	390K ohms ±5%, 1/4 w.
R152	J19/312-0047V	1M ohms ±5%, 1/4 w.
R154	J19/312-0019V	1K ohms ±5%, 1/4 w.
R155	J19/312-0011V	10K ohms ±5%, 1/4 w.
R156	J19/312-0019V	1K ohms ±5%, 1/4 w.
R157	J19/311-3892V	38.9K ohms ±1%, 1/4 w.
R158	J19/312-0047V	1M ohms ±5%, 1/4 w.
R159	J19/312-0012V	220K ohms ±5%, 1/4 w.
R160	J19/312-0007V	2.2K ohms ±5%, 1/4 w.
R161	J19/312-0010V	100 ohms ±5%, 1/4 w.
R162	J19/312-0009V	15K ohms ±5%, 1/4 w.
R163	J19/312-0003H	100K ohms ±5%, 1/4 w.
R164	J19/312-0011V	10K ohms ±5%, 1/4 w.
R166	J19/312-0018V	6.8K ohms ±5%, 1/4 w.
R167	J19/312-0011H	10K ohms ±5%, 1/4 w.
R168	J19/311-2261V	2.26K ohms ±1%, 1/4 w.
R169	J19/311-3011V	3.01K ohms ±1%, 1/4 w.
R170	J19/312-0003V	100K ohms ±5%, 1/4 w.
R171	J19/311-2261V	2.26K ohms ±1%, 1/4 w.
R172	J19/311-3011V	3.01K ohms ±1%, 1/4 w.
R173	J19/312-0011V	10K ohms ±5%, 1/4 w.
R174	J19/351-0007	Variable: 5K ohms, 1 Turn Mini.
R175	J19/312-0011V	10K ohms ±5%, 1/4 w.
R176	J19/312-0054V	20K ohms ±5%, 1/4 w.
R177	J19/312-0004V	23.2K ohms ±1%, 1/4 w.
R178	J19/312-0003V	100K ohms ±5%, 1/4 w.
R179	J19/312-0047V	1M ohms ±5%, 1/4 w.
R180	J19/312-0011V	10K ohms ±5%, 1/4 w.
R181	J19/312-0003V	100K ohms ±5%, 1/4 w.
R182	J19/312-0011V	10K ohms ±5%, 1/4 w.
R183 and R184	J19/312-0003V	100K ohms ±5%, 1/4 w.
R185	J19/309-0001	Thermistor: NTC 10K ohms.
R186	J19/312-0018V	6.8K ohms ±5%, 1/4 w.
R187 and R188	J19/312-0011V	10K ohms ±5%, 1/4 w.
R189 thru R192	J19/312-0003V	100K ohms ±5%, 1/4 w.
R193	J19/351-0007	Vacible: 5K ohms, 1 Turn Mini.
R194	J19/312-0011V	10K ohms ±5%, 1/4 w.
R195	J19/312-0055	75K ohms ±5%, 1/4 w.
R196	J19/312-0070V	3.9K ohms ±5%, 1/4 w.

SYMBOL	GE PART NO.	DESCRIPTION
R197	J19/312-0011V	10K ohms ±5%, 1/4 w.
R198	J19/311-3650H	365 ohms ±1%, 1/4 w.
R199	J19/311-1210H	121 ohms ±1%, 1/4 w.
R204	J19/312-0019V	1K ohms ±5%, 1/4 w.
R205	J19/312-0011V	10K ohms ±5%, 1/4 w.
R206	J19/312-0009V	15K ohms ±5%, 1/4 w.
R207 thru R209	J19/312-0011V	10K ohms ±5%, 1/4 w.
R210	J19/313-0046	620 ohms ±5%, 1/2 w.
R212	J19/312-0058V	68K ohms ±5%, 1/4 w.
R213 and R215	J19/312-0011V	10K ohms ±5%, 1/4 w.
R217	J19/313-0046	620 ohms ±5%, 1/2 w.
R218	J19/312-0011V	10K ohms ±5%, 1/4 w.
R220	J19/312-0040	4.7K ohms.
R221	J19/312-0071V	4.3K ohms ±5%, 1/4 w.
R222	J19/312-1202V	2K ohms ±5%, 1/4 w.
R223 and R224	J19/312-0007H	2.2K ohms ±5%, 1/4 w.
R225	J19/312-0009V	15K ohms ±5%, 1/4 w.
R226	J19/311-4992H	49.9K ohms ±1%, 1/4 w.
R227	J19/312-0015H	22K ohms ±5%, 1/4 w.
R228	J19/312-0009V	15K ohms ±5%, 1/4 w.
R229	J19/352-0004	Varible: 2K ohms, 22 Turn.
R232	J19/312-0009V	15K ohms ±5%, 1/4 w.
R233	J19/312-0011V	10K ohms ±5%, 1/4 w.
R234	J19/311-8452	84.5K ohms ±1%, 1/4 w.
R235	J19/311-1913	191K ohms ±1%, 1/4 w.
R236	J19/311-1503	150K ohms ±1%, 1/4 w.
R237	J19/312-0047	1M ohms ±5%, 1/4 w.
SG1 and SG2	J19/300-0001	Varistor: 150v UL GE.
		- - - - - - - - - - - SWITCHES - - - - - - - - -
SW1	J19/611-0026	Slide: 3P3T Rt. Angle.
SW4 and SW5	J19/611-0026	Slide: 3P3T Rt. Angle.
		- - - - - - - - - - TRANSFORMERS - - - - - - - -
T1	J19/410-0003	Coupling: 600 ohms.
		- - - - - - CONNECTORS AND TEST POINTS - - - - -
TB1201	J19/231-0002	Connector: 6-Pin Electro.
TP1	J19/200-0015	85931-4.
TP2	J19/200-0015	85931-4.
TP3	J19/200-0015	85931-4.
TP4	J19/200-0015	85931-4.
TP5	J19/200-0015	85931-4.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U1	J19/130-0278	LM13080.
U2	J19/130-0251	TL064.
U3	J19/130-0120	TL062CP.
U4	J19/130-0251	TL064.
U5 and U7	J19/130-0067	4066.
U9	J19/130-0120	TL062CP.
U10	J19/130-0069	LM2900N.
U11	J19/130-0251	TL064.

SYMBOL	GE PART NO.	DESCRIPTION
U13	J19/130-0238	MM74C14N.
U16	J19/130-0062	XR2211.
U18	J19/130-0277	LM2940 T-10 NATL.
U21	J19/130-0067	4066.
U22	J19/130-0074	MM74C08N.
U23	J19/130-0064	AF100.
U24	J19/130-0095	CD4043 BCH.
U25	J19/130-0120	TL062CP.
U26	J19/130-0139	LM393.
U27	J19/130-0006	CD4071 BCN.
U28 and U29	J19/130-0094	CD4538BCN.
U30	J19/130-0277	LM2940 T-10 NATL.
U31	J19/130-0237	LM317T.
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - - -
	J19/200-0305	Spacer: KFE-440-12.
	J19/199-2002	Washer: Star #6 (Used with U30 and U31).
	J19/210-0103	Insulator: TO220 (Used with U18, U30 and U31).
	J19/210-0102	Insulator. (Used with Q12).
	J19/220-0003	Socket: 8 Pin IC (Used with all 8 pin IC's).
	J19/220-0002	Socket: 14 Pin IC (Used with all 14 pin IC's).
	J19/220-0001	Socket: 16 Pin IC (Used with all 16 pin IC's).
	J19/210-0009	Heat sink: 5630B (Used with U18).
	J19/199-2002	Washer: Star #6 (Used with U18).
	J19/199-0020	Nut: Hex, 6-32 (Used with U18).
	J19/199-3070	Screw: 6-32 X 1/4 Phlp (Used with U18).
	J19/210-0009	Heat sink: 5630B (Used with U30).
	J19/199-0020	Nut: Hex, 6-32 (Used with U30).
	J19/199-3070	Screw: 6-32 X 1/4 Phlp (Used with U30).
	J19/210-0009	Heat sink: 5630B (Used with U31).
	J19/199-0020	Nut: Hex, 6-32 (Used with U31).
	J19/199-3070	Screw: 6-32 X 1/4 Phlp (Used with U31).
	J19/113-0101	Guide: Right Angle LED (Used with D30 and D36).



JUMPER	INSTALLED FOR	ON PANELS
H1 TO H2 H3 TO H4	FOUR FREQUENCY TX/RX	P55, P56, & P62
H5 TO H6	AUX-1 WITH K1 RELAY	P63 THRU P72
H7 TO H8	AUX-1 WITHOUT K1 RELAY	P63 THRU P72
H9 TO H10	NO BATTERY BACKUP	P52 THRU P74

LAST USED	
U15	D22
R77	K1
C60	H10
Q8	B1

Tone Extension Board

(4170-S-00, Rev. N.)

PARTS LIST

TONE EXTENSION BOARD
J19/800-0173 Rev. N

ISSUE 3

SYMBOL	GE PART NO.	DESCRIPTION
		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ CAPACITORS ~ ~ ~ ~ ~ ~ ~ ~ ~
C1 and C2	J19/362-0003	Monolithic: .01 uF.
C3	J19/362-5154	Monolithic: .15 uF 50v.
C4	J19/362-0019	Monolithic: .01 uF 50v Ultra.
C5	J19/362-0018	Monolithic: 3300 pF.
C6	J19/362-0001	Monolithic: .1 uF.
C7 and C8	J19/362-0003	Monolithic: .01 uF.
C9	J19/362-5154	Monolithic: .15 uF 50v.
C10	J19/362-0019	Monolithic: .01 uF 50v Ultra.
C11	J19/362-0018	Monolithic: 3300 pF.
C12	J19/362-0001	Monolithic: .1 uF.
C13 and C14	J19/362-0003	Monolithic: .01 uF.
C15	J19/362-5154	Monolithic: .15 uF 50v.
C16	J19/362-0019	Monolithic: .01 uF 50v Ultra.
C17	J19/362-0018	Monolithic: 3300 pF.
C18	J19/362-0001	Monolithic: .1 uF.
C19 and C20	J19/362-0003	Monolithic: .01 uF.
C21	J19/362-5154	Monolithic: .15 uF 50v.
C22	J19/362-0019	Monolithic: .01 uF 50v Ultra.
C23	J19/362-0018	Monolithic: 3300 pF.
C24	J19/362-0001	Monolithic: .1 uF.
C25 and C26	J19/362-0003	Monolithic: .01 uF.
C27	J19/362-5154	Monolithic: .15 uF 50v.
C28	J19/362-0019	Monolithic: .01 uF 50v Ultra.
C29	J19/362-0018	Monolithic: 3300 pF.
C30	J19/362-0001	Monolithic: .1 uF.
C31 and C32	J19/362-0003	Monolithic: .01 uF.
C33	J19/362-5154	Monolithic: .15 uF 50v.
C34	J19/362-0019	Monolithic: .01 uF 50v Ultra.
C35	J19/362-0018	Monolithic: 3300 pF.
C36	J19/362-0001	Monolithic: .1 uF.
C37 and C38	J19/362-0003	Monolithic: .01 uF.
C39	J19/362-5154	Monolithic: .15 uF 50v.
C40	J19/362-0019	Monolithic: .01 uF 50v Ultra.
C41	J19/362-0018	Monolithic: 3300 pF.
C42	J19/362-0001	Monolithic: .1 uF.
C43 and C44	J19/362-0003	Monolithic: .01 uF.
C45	J19/362-5154	Monolithic: .15 uF 50v.
C46	J19/362-0019	Monolithic: .01 uF 50v Ultra.
C47	J19/362-0018	Monolithic: 3300 pF.
C48	J19/362-0001	Monolithic: .1 uF.
C49 and C50	J19/362-0003	Monolithic: .01 uF.
C51	J19/362-5154	Monolithic: .15 uF 50v.
C52	J19/362-0019	Monolithic: .01 uF 50v Ultra.
C53	J19/362-0018	Monolithic: 3300 pF.
C54 and C55	J19/362-0001	Monolithic: .1 uF.
C56	J19/390-0010	Tantalum: 10 uF 16v.
C57 thru C60	J19/390-0012	Tantalum: 1 uF 25v.
		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ DIODES ~ ~ ~ ~ ~ ~ ~ ~ ~
D1	J19/111-0004	Zenar: 1N5231/4733 5.1v.
D2	J19/110-0001	1N914/1N4148.
D3	J19/112-0001	LED: XC5569R OR 526R.
D4 thru D22	J19/110-0001	1N914/1N4148.
		~ ~ ~ ~ ~ ~ ~ ~ CONNECTORS AND PLUGS ~ ~ ~ ~ ~ ~ ~ ~
H1	J19/231-1002	Connector: 22-03-2021 Molex.
H1	J19/234-0046	Plug: short #925250-R.
H3	J19/231-1002	Connector: 22-03-2021 Molex.
H3	J19/234-0046	Plug: short #925250-R.
H5	J19/231-1002	Connector: 22-03-2021 Molex.
H5	J19/234-0046	Plug: short #925250-R.
H7	J19/231-1002	Connector: 22-03-2021 Molex.
H9	J19/231-1002	Connector: 22-03-2021 Molex.
H9	J19/234-0046	Plug: short #925250-R.
J1	J19/234-0056	Receptacle: 16 pos .1X.1.
J1	J19/800-0030	Ribbon Cable: 16 Conductor.
J6	J19/234-0056	Receptacle: 16 pos .1X.1.
J1214	J19/231-3109	09-18-5121 Molex
K1	J19/233-0023	Connector: Miniature jack.
K1	J19/231-1073	Post: 16 Pos. .1x.1.
K2	J19/231-1067	Post: 2 Postion .156
		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ RELAY ~ ~ ~ ~ ~ ~ ~ ~ ~
K1	J19/700-0005	Relay: Miniature, SPDT, SR211.
		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ TRANSISTORS ~ ~ ~ ~ ~ ~ ~ ~ ~
Q1 thru Q8	J19/180-0009	MPS8098
		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ RESISTORS ~ ~ ~ ~ ~ ~ ~ ~ ~
R1	J19/312-0011	10K ohms ±5%, 1/4 w.
R2	J19/312-0047	1M ohms ±5%, 1/4 w.
R3	J19/312-0001	390K ohms ±5%, 1/4 w.
R4	J19/312-0048	2M ohms ±5%, 1/4 w.
R5	J19/311-9312	93.1K ohms ±1%, 1/4 w.
R6	J19/352-0001	Potentiometer: 5K ohms, 22 Turn.
R7	J19/312-0011	10K ohms ±5%, 1/4 w.
R8	J19/312-0047	1M ohms ±5%, 1/4 w.
R9	J19/312-0001	390K ohms ±5%, 1/4 w.
R10	J19/312-0048	2M ohms ±5%, 1/4 w.
R11	J19/311-8452	84.5K ohms ±1%, 1/4 w.
R12	J19/352-0001	Potentiometer: 5K ohms, 22 Turn.
R13	J19/312-0011	10K ohms ±5%, 1/4 w.
R14	J19/312-0047	1M ohms ±5%, 1/4 w.
R15	J19/312-0001	390K ohms ±5%, 1/4 w.
R16	J19/312-0048	2M ohms ±5%, 1/4 w.
R17	J19/311-6652	66.5K ohms ±1%, 1/4 w.
R18	J19/352-0001	Potentiometer: 5K ohms, 22 Turn.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	GE PART NO.	DESCRIPTION
R19	J19/312-0011	10K ohms ±5%, 1/4 w.
R20	J19/312-0047	1M ohms ±5%, 1/4 w.
R21	J19/312-0001	390K ohms ±5%, 1/4 w.
R22	J19/312-0048	2M ohms ±5%, 1/4 w.
R23	J19/311-0025	61.9K ohms ±1%, 1/4 w.
R24	J19/352-0001	Potentiometer: 5K ohms, 22 Turn.
R25	J19/312-0011	10K ohms ±5%, 1/4 w.
R26	J19/312-0047	1M ohms ±5%, 1/4 w.
R27	J19/312-0001	390K ohms ±5%, 1/4 w.
R28	J19/312-0048	2M ohms ±5%, 1/4 w.
R29	J19/311-5112	51.1K ohms ±1%, 1/4 w.
R30	J19/352-0001	Potentiometer: 5K ohms, 22 Turn.
R31	J19/312-0011	10K ohms ±5%, 1/4 w.
R32	J19/312-0047	1M ohms ±5%, 1/4 w.
R33	J19/312-0001	390K ohms ±5%, 1/4 w.
R34	J19/312-0048	2M ohms ±5%, 1/4 w.
R35	J19/311-7682	76.8K ohms ±1%, 1/4 w.
R36	J19/352-0001	Potentiometer: 5K ohms, 22 Turn.
R37	J19/312-0011	10K ohms ±5%, 1/4 w.
R38	J19/312-0047	1M ohms ±5%, 1/4 w.
R39	J19/312-0001	390K ohms ±5%, 1/4 w.
R40	J19/312-0048	2M ohms ±5%, 1/4 w.
R41	J19/311-7152	71.5K ohms ±1%, 1/4 w.
R42	J19/352-0001	Potentiometer: 5K ohms, 22 Turn.
R43	J19/312-0011	10K ohms ±5%, 1/4 w.
R44	J19/312-0047	1M ohms ±5%, 1/4 w.
R45	J19/312-0001	390K ohms ±5%, 1/4 w.
R46	J19/312-0048	2M ohms ±5%, 1/4 w.
R47	J19/311-5762	57.6K ohms ±1%, 1/4 w.
R48	J19/352-0001	Potentiometer: 5K ohms, 22 Turn.
R49	J19/312-0011	10K ohms ±5%, 1/4 w.
R50	J19/312-0047	1M ohms ±5%, 1/4 w.
R51	J19/312-0001	390K ohms ±5%, 1/4 w.
R52	J19/312-0048	2M ohms ±5%, 1/4 w.
R53	J19/311-5492	54.9K ohms ±1%, 1/4 w.
R54	J19/352-0001	Potentiometer: 5K ohms, 22 Turn.
R55	J19/313-1271	270 ohms ±5%, 1/2 w.
R56	J19/313-0046	620 ohms ±5%, 1/2 w.
R57 thru R64	J19/312-0011	10K ohms ±5%, 1/4 w.
R65	J19/312-0020	47K ohms ±5%, 1/4 w.
R66 thru R68	J19/312-0011	10K ohms ±5%, 1/4 w.
R69	J19/312-0019	1K ohms ±5%, 1/4 w.
R70	J19/312-0052	220 ohms ±5%, 1/4 w.
R71	J19/312-0019	1K ohms ±5%, 1/4 w.
R72	J19/312-0011	10K ohms ±5%, 1/4 w.
R73 thru R77	J19/312-0020	47K ohms ±5%, 1/4 w.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U1 thru U9	J19/130-0062	XR2211.
U10 thru U12	J19/130-0095	CD4043 BCH.
U13 thru U15	J19/130-0214	74S288 PROM.

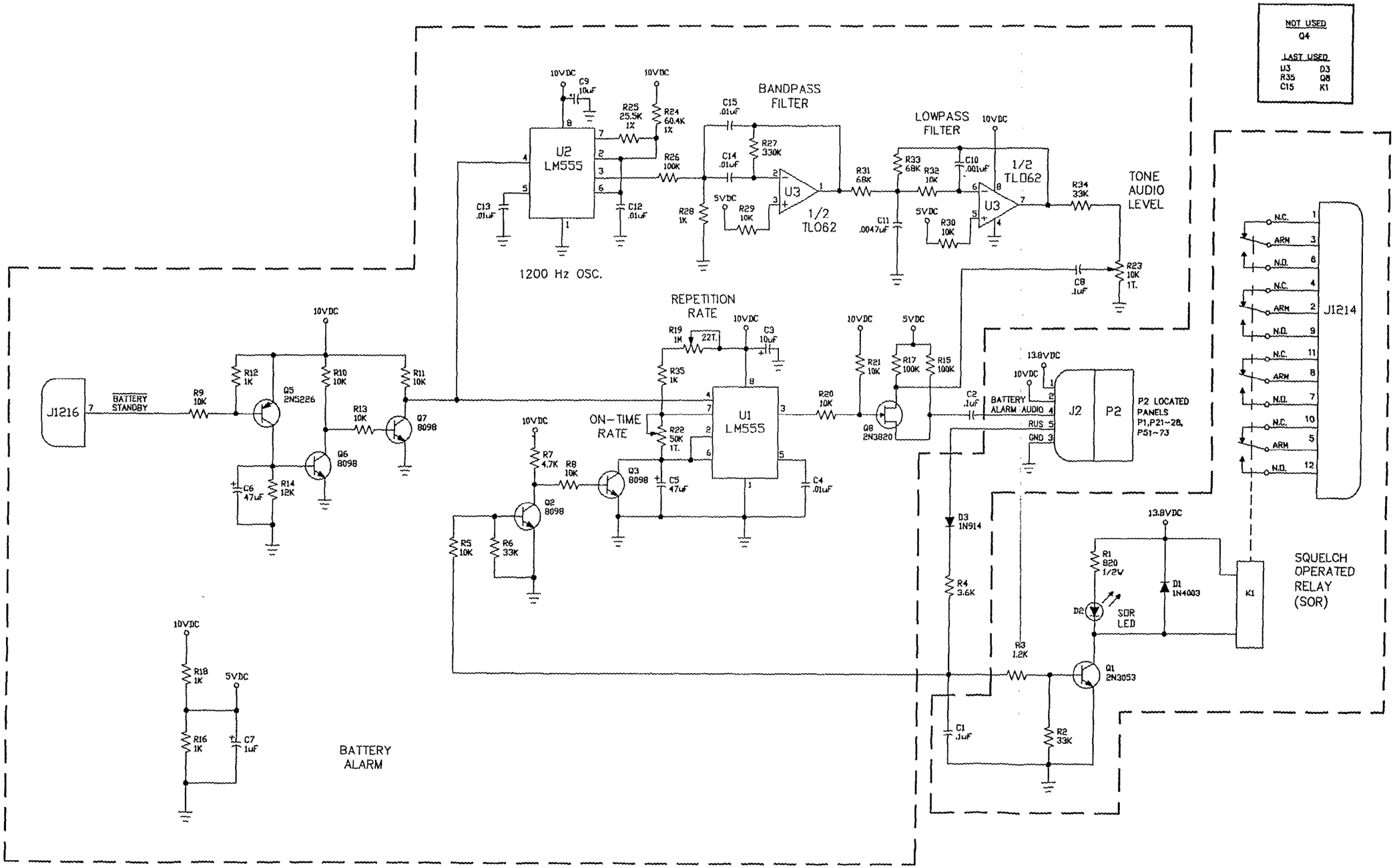
SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - MISCELLANEOUS - - - - - - - - - -
	J19/199-0020	Nut: Hex, 6-32.
	J19/199-3070	Screw: 6-32 X 1/4 Phlp.
	J19/200-0026	Stand-off: m/f 6-32x1.25.
	J19/200-0027	Stand-off: m/f 6-32x1/2.
	J19/200-0096	Stand-off: 6-32x5/8.
	J19/291-0006	Battery Clip, 2 pc. (B1).
	J19/220-0002	Socket: 14 pin IC (Used with all 14 pin IC's.).
	J19/220-0001	Socket: 16 pin IC (Used with all 16 pin IC's.).

JUMPERS

When the Tone Extension Board is used in Tone Remote or Remote/Repeater Panels 19B234887P53-P74, the jumpers must be installed in the Tone Extension Board as indicated in Table 4.

	JUMPERS							
PANEL NUMBERS PL19B234871	H1 TO H2	H3 TO H4	H5 TO H6	H7 TO H8	H9 TO H10	H11 TO H12	H13 TO H14	H15 TO H16
P53								X
P54								X
P55	X	X					X	X
P56	X	X					X	X
P57								X
P58								X
P59								X
P60								X
P61								X
P62	X	X					X	X
P63			X					X
P64			X					X
P65			X					X
P66			X					X
P67			X					X
P68			X					X
P69			X					X
P70			X					X
P71			X					X
P72			X					X
P73								X
P74					X	X		X

TABLE 4 - TONE EXTENSION BOARD JUMPERS CHART



Battery Alarm 19B234871P103
SOR 19B234871P102
SOR/Battery Alarm 19B234871P105

(4165-S-00, Rev.A)

PARTS LIST

SQUELCH OPERATED RELAY
19B234871P102

ISSUE 2

SYMBOL	GE PART NO.	DESCRIPTION
		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ CAPACITORS ~ ~ ~ ~ ~ ~ ~ ~ ~ ~
C1	J19/362-0001	Monolithic: .1uF 50v.
		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ DIODES ~ ~ ~ ~ ~ ~ ~ ~ ~ ~
D1	J19/110-0002	1N4003.
D2	J19/112-0001	LED: XC526R Red.
D3	J19/110-0001	1N914.
		~ ~ ~ ~ ~ ~ ~ CONNECTORS AND PLUGS ~ ~ ~ ~ ~ ~ ~
J2	J19/233-0035	Receptacle: 5 POS .1".
J1214	J19/231-3109	Connector: 12 Position Rt. Molex.
		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ RELAYS ~ ~ ~ ~ ~ ~ ~ ~ ~ ~
K1	J19/700-0001	4PDT: HAS124.
		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ RESISTORS ~ ~ ~ ~ ~ ~ ~ ~ ~ ~
R1	J19/313-1821	820 ohms ±5%, 1/2w.
R2	J19/312-0014	33K ohms ±5%, 1/4w.
R3	J19/312-0034	1.2K ohms ±5%, 1/4w.
R4	J19/312-0029	3.6K ohms ±5%, 1/4w.
		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ TRANSISTORS ~ ~ ~ ~ ~ ~ ~ ~ ~ ~
Q1	J19/180-0017	NPN: 2N3053.
		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ MISCELLANEOUS ~ ~ ~ ~ ~ ~ ~ ~ ~ ~
	J19/222-0020	Wire: 10" 22AWG BRN STRD. (J2 PIN 1).
	J19/222-0014	Wire: 10" 22AWG RED STRD. (J2 PIN 2).
	J19/222-0023	Wire: 10" 22AWG ORG STRD. (J2 PIN 3).
	J19/222-0018	Wire: 10" 22AWG YEL STRD. (J2 PIN 4).
	J19/222-0016	Wire: 10" 22AWG GRN STRD. (J2 PIN 5).
	J19/200-0026	Standoff: #6-32x1.25" M/F.
	J19/199-3070	Screw: #6-32x1/4" PHLP.
	J19/210-0102	Insulator: (USED WITH Q1).

BATTERY ALARM TONE
19B238718P103

ISSUE 2

SYMBOL	GE PART NO.	DESCRIPTION
		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ CAPACITORS ~ ~ ~ ~ ~ ~ ~ ~ ~ ~
C2	J19/362-0001	Monolithic: .1uF 50v.
C3	J19/390-0010	Tantalum: 10uF 16v.
C4	J19/362-0003	Monolithic: .01uF 50v.
C5 and C6	J19/360-0025	Electrolytic: 47uF 16v.
C7	J19/390-0012	Tantalum: 1uF 25v.
C8	J19/362-0001	Monolithic: .1uF 50v.
C9	J19/390-0010	Tantalum: 10uF 16v.
C10	J19/362-0006	Monolithic: .001uF 50v.
C11	J19/362-0008	Monolithic: .0047uF 50v.
C12 thru C15	J19/362-0003	Monolithic: .01uF 50v.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

SYMBOL	GE PART NO.	DESCRIPTION
		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ DIODES ~ ~ ~ ~ ~ ~ ~ ~ ~ ~
D3	J19/110-0001	1N914.
		~ ~ ~ ~ ~ ~ ~ CONNECTORS AND PLUGS ~ ~ ~ ~ ~ ~ ~
J2	J19/233-0035	Receptacle: 5 Position .1".
J1216-7	J19/231-0025	Receptacle: 1 Position PCB Spade.
		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ TRANSISTORS ~ ~ ~ ~ ~ ~ ~ ~ ~ ~
Q2 and Q3	J19/180-0009	MPN: MPS8098.
Q5	J19/180-0005	PNP: 2N5226.
Q6 and Q7	J19/180-0009	MPN: MPS8098.
Q8	J19/180-0002	P-Channel: 2N3820.
		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ RESISTORS ~ ~ ~ ~ ~ ~ ~ ~ ~ ~
R4	J19/312-0029	3.6K ohms ±5%, 1/4w.
R5	J19/312-0011	10K ohms ±5%, 1/4w.
R6	J19/312-0014	33K ohms ±5%, 1/4w.
R7	J19/312-0040	4.7K ohms ±5%, 1/4w.
R8 thru R11	J19/312-0011	10K ohms ±5%, 1/4w.
R12	J19/312-0019	1K ohms ±5%, 1/4w.
R13	J19/312-0011	10K ohms ±5%, 1/4w.
R14	J19/312-0021	12K ohms ±5%, 1/4w.
R15	J19/312-0003	100K ohms ±5%, 1/4w.
R16	J19/312-0019	1K ohms ±5%, 1/4w.
R17	J19/312-0003	100K ohms ±5%, 1/4w.
R18	J19/312-0019	1K ohms ±5%, 1/4w.
R19	J19/352-0003	Varible: 1M ohms, 22 Turn.
R20 and R21	J19/312-0011	10K ohms ±5%, 1/4w.
R22	J19/351-0010	Varible: 50K ohms, 1 Turn Mini.
R23	J19/351-1103	Varible: 10K ohms, 1 Turn Mini.
R24	J19/311-6042	60.4K ohms ±1%, 1/4w.
R25	J19/311-2552	25.5K ohms ±1%, 1/4w.
R26	J19/312-0003	100K ohms ±5%, 1/4w.
R27	J19/312-1334	330K ohms ±5%, 1/4w.
R28	J19/312-0019	1K ohms ±5%, 1/4w.
R29 and R30	J19/312-0011	10K ohms ±5%, 1/4w.
R31	J19/312-0058	68K ohms ±5%, 1/4w.
R32	J19/312-0011	10K ohms ±5%, 1/4w.
R33	J19/312-0058	68K ohms ±5%, 1/4w.
R34	J19/312-0014	33K ohms ±5%, 1/4w.
R35	19/312-0019	1K ohms ±5%, 1/4w.
		~ ~ ~ ~ ~ ~ ~ INTEGRATED CIRCUITS ~ ~ ~ ~ ~ ~ ~
U1 and U2	J19/130-0010	Timer: NE555.
U3	J19/130-0120	Dual Op Amp: TL062CP.
		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ MISCELLANEOUS ~ ~ ~ ~ ~ ~ ~ ~ ~ ~
	J19/222-0020	Wire: 10" 22AWG BRN STRD. (J2 PIN 1).
	J19/222-0014	Wire: 10" 22AWG RED STRD. (J2 PIN 2).
	J19/222-0023	Wire: 10" 22AWG ORG STRD. (J2 PIN 3).
	J19/222-0018	Wire: 10" 22AWG YEL STRD. (J2 PIN 4).
	J19/222-0016	Wire: 10" 22AWG GRN STRD. (J2 PIN 5).
	J19/200-0026	Standoff: #6-32x1.25" M/F. (U1-3).
	J19/199-3070	Screw: #6-32x1/4" PHLP.

PARTS LIST

SQUELCH OPERATED RELAY
AND
BATTERY ALARM TONE
19B234871P105

ISSUE 2

SYMBOL	GE PART NO.	DESCRIPTION
		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ CAPACITORS ~ ~ ~ ~ ~ ~ ~ ~ ~ ~
C1 and C2	J19/362-0001	Monolithic: .1uF 50v.
C3	J19/390-0010	Tantalum: 10uF 16v.
C4	J19/362-0003	Monolithic: .01uF 50v.
C5 and C6	J19/360-0025	Electrolytic: 47uF 16v.
C7	J19/390-0012	Tantalum: 1uF 25v.
C8	J19/362-0001	Monolithic: .1uF 50v.
C9	J19/390-0010	Tantalum: 10uF 16v.
C10	J19/362-0006	Monolithic: .001uF 50v.
C11	J19/362-0008	Monolithic: .0047uF 50v.
C12 thru C15	J19/362-0003	Monolithic: .01uF 50v.
		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ DIODES ~ ~ ~ ~ ~ ~ ~ ~ ~ ~
D1	J19/110-0002	1N4003.
D2	J19/112-0001	LED: XC526R Red.
D3	J19/110-0001	1N914.
		~ ~ ~ ~ ~ ~ ~ CONNECTORS AND PLUGS ~ ~ ~ ~ ~ ~ ~
J2	J19/233-0035	Receptacle: 5 Position .1".
J1214	J19/231-3109	Connector: 12 Position Rt. Molex.
J1216-7	J19/231-0025	Receptacle: 1 Position PCB Spade.
		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ RELAYS ~ ~ ~ ~ ~ ~ ~ ~ ~ ~
K1	J19/700-0001	4PDT: HAS124.
		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ TRANSISTORS ~ ~ ~ ~ ~ ~ ~ ~ ~ ~
Q1	J19/180-0017	NPN: 2N3053.
Q2 and Q3	J19/180-0009	MPN: MPS8098.
Q5	J19/180-0005	PNP: 2N5226.
Q6 and Q7	J19/180-0009	MPN: MPS8098.
Q8	J19/180-0002	P-Channel JFET: 2N3820.
		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ RESISTORS ~ ~ ~ ~ ~ ~ ~ ~ ~ ~
R1	J19/313-1821	820 ohms ±5%, 1/2w.
R2	J19/312-0014	33K ohms ±5%, 1/4w.
R3	J19/312-0034	1.2K ohms ±5%, 1/4w.
R4	J19/312-0029	3.6K ohms ±5%, 1/4w.
R5	J19/312-0011	10K ohms ±5%, 1/4w.
R6	J19/312-0014	33K ohms ±5%, 1/4w.
R7	J19/312-0040	4.7K ohms ±5%, 1/4w.
R8 thru R11	J19/312-0011	10K ohms ±5%, 1/4w.
R12	J19/312-0019	1K ohms ±5%, 1/4w.
R13	J19/312-0011	10K ohms ±5%, 1/4w.
R14	J19/312-0021	12K ohms ±5%, 1/4w.
R15	J19/312-0003	100K ohms ±5%, 1/4w.
R16	J19/312-0019	1K ohms ±5%, 1/4w.
R17	J19/312-0003	100K ohms ±5%, 1/4w.
R18	J19/312-0019	1K ohms ±5%, 1/4w.
R19	J19/352-0003	Varible: 1M ohms, 22 Turn.
R20 and R21	J19/312-0011	10K ohms ±5%, 1/4w.
R22	J19/351-0010	Varible: 50K ohms, 1 Turn Mini.
R23	J19/351-1103	Varible: 10K ohms, 1 Turn Mini.
R24	J19/311-6042	60.4K ohms ±1%, 1/4w.
R25	J19/311-2552	25.5K ohms ±1%, 1/4w.
R26	J19/312-0003	100K ohms ±5%, 1/4w.
R27	J19/312-1334	330K ohms ±5%, 1/4w.
R28	J19/312-0019	1K ohms ±5%, 1/4w.
R29 and R30	J19/312-0011	10K ohms ±5%, 1/4w.
R31	J19/312-0058	68K ohms ±5%, 1/4w.
R32	J19/312-0011	10K ohms ±5%, 1/4w.
R33	J19/312-0058	68K ohms ±5%, 1/4w.
R34	J19/312-0014	33K ohms ±5%, 1/4w.
R35	J19/312-0019	1K ohms ±5%, 1/4w.
		~ ~ ~ ~ ~ ~ ~ INTEGRATED CIRCUITS ~ ~ ~ ~ ~ ~ ~
U1 and U2	J19/130-0010	Timer: NE555.
U3	J19/130-0120	Dual Op Amp: TL062CP.
		~ ~ ~ ~ ~ ~ ~ ~ ~ ~ MISCELLANEOUS ~ ~ ~ ~ ~ ~ ~ ~ ~ ~
	J19/222-0020	Wire: 10" 22AWG BRN STRD. (J2 PIN 1).
	J19/222-0014	Wire: 10" 22AWG RED STRD. (J2 PIN 2).
	J19/222-0023	Wire: 10" 22AWG ORG STRD. (J2 PIN 3).
	J19/222-0018	Wire: 10" 22AWG YEL STRD. (J2 PIN 4).
	J19/222-0016	Wire: 10" 22AWG GRN STRD. (J2 PIN 5).
	J19/210-0102	Insulator: (USED WITH Q1).
	J19/220-0003	Socket: 8 Pin DIP. (U1-3).
	J19/200-0026	Standoff: #6-32x1.25" M/F.
	J19/199-3070	Screw: #6-32x1/4" PHLP.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

Tone Extention Board "Road Map"

Panel 19B234871P53

DESCRIPTION

This panel provides for remote operation of a two frequency transmit - two frequency receive station.

FUNCTIONS

Transmit F1 1950 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U16 (main)	U13 (A0 to O1 & O6)	U10	Q3 (reset A4 to O1 & O6)	P1-11	Q2	P1-9

Transmit F2 1850 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U5	U13 (A1 to O2 & O5)	U10	Q2	P1-9	Q3	P1-11

Receive F1 1750 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U9	U13 (A2 to O3 & O8)	U10	Q1 (reset A4 to O3 & O8)	P1-16	Q4	P1-15

Receive F2 1650 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U8	U13 (A3 to O4 & O7)	U10	Q4	P1-15	Q1	P1-16

Panel 19B234871P54

DESCRIPTION

This panel provides for remote operation of a two frequency transmit - two frequency receive station with Channel Guard Monitor.

FUNCTIONS

CG Enable (reset by Push-to-Talk)

CG Monitor 2050 Hz

Decode	Latch	Operate	Low
U15 (main)	U24B (main)	Q20 (main)	J1201-5 (main)

Transmit F1 1950 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U16 (main)	U13 (A0 to O1 & O6)	U10	Q3 (reset A4 to O1 & O6)	P1-11	Q2	P1-9

Transmit F2 1850 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U5	U13 (A1 to O2 & O5)	U10	Q2	P1-9	Q3	P1-11

Receive F1 1750 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U9	U13 (A2 to O3 & O8)	U10	Q1 (reset A4 to O3 & O8)	P1-16	Q4	P1-15

Receive F2 1650 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U8	U13 (A3 to O4 & O7)	U10	Q4	P1-15	Q1	P1-16

Panel 19B234871P55

DESCRIPTION

This panel provides for remote operation of a four frequency transmit - receive station.

FUNCTIONS

F1 1950 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U16	U14	U11	Q3	P1-11	Q2	P1-9
(main)	(A0 to O1 & O4 & O6 & O8)				Q1	J1214-9&4
	(reset A4 to O1 & O4 & O6 & O8)				Q4	J1214-6&8

F2 1850 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U5	U14	U11	Q2	P1-9	Q3	P1-11
		(A1 to O2 & O3 & O6 & O8)			Q1	J1214-9&4
					Q4	J1214-6&8

F3 1350 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U7	U14	U11	Q1	J1214-9&4	Q3	P1-11
	(A2 to O2 & O4 & O5 & O8)				Q2	P1-9
					Q4	J1214-6&8

F4 1250 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U6	U14	U11	Q4	J1214-6&8	Q3	P1-11
	(A3 to O2 & O4 & O6 & O7)				Q2	P1-9
					Q1	J1214-9&4

Panel 19B234871P56

DESCRIPTION

This panel provides for remote operation of a four frequency transmit - receive station with Channel Guard Monitor.

FUNCTIONS

CG Enable (reset by Push-to-Talk)

CG Monitor 2050 Hz

Decode	Latch	Operate	Low
U15	U24B	Q20	J1201-5
(main)	(main)	(main)	(main)

F1 1950 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U16 (main)	U14 (A0 to O1 & O4 & O6 & O8) (reset A4 to O1 & O4 & O6 & O8)	U11	Q3	P1-11	Q2 Q1 Q4	P1-9 J1214-9&4 J1214-6&8

F2 1850 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U5	U14 (A1 to O2 & O3 & O6 & O8)	U11	Q2	P1-9	Q3 Q1 Q4	P1-11 J1214-9&4 J1214-6&8

F3 1350 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U7	U14 (A2 to O2 & O4 & O5 & O8)	U11	Q1	J1214-9&4	Q3 Q2 Q4	P1-11 P1-9 J1214-6&8

F4 1250 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U6	U14 (A3 to O2 & O4 & O6 & O7)	U11	Q4	J1214-6&8	Q3 Q2 Q1	P1-11 P1-9 J1214-9&4

Panel 19B234871P57

DESCRIPTION

This panel provides for remote/repeater operation of a one frequency station with Repeat Disable.

FUNCTIONS

Repeat Enable 1550 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U4	U15 (A0 to O2)	U12	Q6 (reset A4 to O2)	P1-7		

Repeat Disable 1450 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U3	U15 (A1 to O1)	U12			Q6	P1-7

Panel 19B234871P58

DESCRIPTION

This panel provides for remote/repeater operation of a one frequency station with Repeat Disable and Channel Guard Monitor.

FUNCTIONS

CG Enable (reset by Push-to-Talk)

CG Monitor 2050 Hz

Decode	Latch	Operate	Low
U15 (main)	U24B (main)	Q20 (main)	J1201-5 (main)

Repeat Enable 1550 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U4	U15 (A0 to O2)	U12 (reset A4 to O2)	Q6	P1-7		

Repeat Disable 1450 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U3	U15 (A1 to O1)	U12	Q6	P1-7		

Panel 19B234871P59

DESCRIPTION

This panel provides for remote/repeater operation of a one frequency station with Channel Guard On-Off, and Channel Guard Monitor.

FUNCTIONS

CG Enable (reset by Push-to-Talk)

CG Monitor 2050 Hz

Decode	Latch	Operate	Low
U15 (main)	U24B (main)	Q20 (main)	J1201-5 (main)

Channel Guard Enable 1550 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U4	U15 (A0 to O4)	U12 (reset A4 to O4)			Q7	P1-14

Channel Guard Disable 1450 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U3	U15 (A1 to O3)	U12	Q7	P1-14		

Panel 19B234871P60

DESCRIPTION

This panel provides for remote/repeater operation of a one frequency station with Repeat Enable-Disable, Channel Guard On-Off, and Channel Guard Monitor.

FUNCTIONS

CG Enable (reset by Push-to-Talk)

CG Monitor 2050 Hz

Decode	Latch	Operate	Low
U15 (main)	U24B (main)	Q20 (main)	J1201-5 (main)

Channel Guard Enable 1550 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U4	U15 (A0 to O4)	U12 (reset A4 to O4)			Q7	P1-14

Channel Guard Disable 1450 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U3	U15 (A1 to O3)	U12	Q7	P1-14		

Repeater Enable 1150 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U2	U15 (A2 to O2)	U12 (reset A4 to O2)			Q6	P1-7

Repeater Disable 1050 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U1	U15 (A3 to O1)	U12	Q6	P1-7		

Panel 19B234871P61

DESCRIPTION

This panel provides for remote operation of a two frequency transmit - two frequency receive station with Channel Guard On-Off, and Channel Guard Monitor.

FUNCTIONS

CG Enable (reset by Push-to-Talk)

CG Monitor 2050 Hz

Decode	Latch	Operate	Low
U15 (main)	U24B (main)	Q20 (main)	J1201-5 (main)

Transmit F1 1950 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U16 (main)	U13 (A0 to O1 & O6)	U10	Q3 (reset A4 to O1 & O6)	P1-11	Q2	P1-9

Transmit F2 1850 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U5	U13 (A1 to O2 & O5)	U10	Q2	P1-9	Q3	P1-11

Receive F1 1750 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U9	U13 (A2 to O3 & O8)	U10	Q1 (reset A4 to O3 & O8)	P1-16	Q4	P1-15

Receive F2 1650 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U8	U13 (A3 to O4 & O7)	U10	Q4	P1-15	Q1	P1-16

Channel Guard Enable 1550 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U4	U15 (A0 to O4)	U12 (reset A4 to O4)			Q7	P1-14

Channel Guard Disable 1450 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U3	U15 (A1 to O3)	U12	Q7	P1-14		

Panel 19B234871P62

DESCRIPTION

This panel provides for remote operation of a four frequency transmit - receive station with Channel Guard On-Off, and Channel Guard Monitor.

FUNCTIONS

CG Enable (reset by Push-to-Talk)

CG Monitor 2050 Hz

Decode	Latch	Operate	Low
U15 (main)	U24B (main)	Q20 (main)	J1201-5 (main)

F1 1950 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U16 (main)	U14 (A0 to O1 & O4 & O6 & O8) (reset A4 to O1 & O4 & O6 & O8)	U11	Q3	P1-11	Q2 Q1 Q4	P1-9 J1214-9&4 J1214-6&8

F2 1850 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U5	U14 (A1 to O2 & O3 & O6 & O8)	U11	Q2	P1-9	Q3 Q1 Q4	P1-11 J1214-9&4 J1214-6&8

F3 1350 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U7	U14 (A2 to O2 & O4 & O5 & O8)	U11	Q1	J1214-9&4	Q3 Q2 Q4	P1-11 P1-9 J1214-6&8

F4 1250 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U6	U14 (A3 to O2 & O4 & O6 & O7)	U11	Q4	J1214-6&8	Q3 Q2 Q1	P1-11 P1-9 J1214-9&4

Channel Guard Enable 1550 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U4	U15 (A0 to O4)	U12 (reset A4 to O4)			Q7	P1-14

Channel Guard 1450 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U3	U15 (A1 to O3)	U12	Q7	P1-14		

Presence of R1 without U1 puts U15-13 always high
Presence of R7 without U2 puts U15-12 always high

Tone Extention Board "Road Map"

Panel 19B234871P63

DESCRIPTION

This panel provides for remote/repeater operation of a one frequency station with AUX 1 On-Off.

FUNCTIONS

AUX 1 Off 1250 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U6	U14 (A3 to O6)	U11 (reset A4 to O6)			Q5 & K1	

AUX 1 On 1350 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U7	U14 (A2 to O5)	U11	Q5 & K1			

Presence of R25 without U5 puts U14-11 always high

Panel 19B234871P64

DESCRIPTION

This panel provides for remote/repeater operation of a one frequency station with AUX 1 On-Off, and Channel Guard Monitor.

FUNCTIONS

CG Enable (reset by Push-to-Talk)

CG Monitor 2050 Hz

Decode	Latch	Operate	Low
U15 (main)	U24B (main)	Q20 (main)	J1201-5 (main)

AUX 1 Off 1250 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U6	U14 (A3 to O6)	U11 (reset A4 to O6)			Q5 & K1	

AUX 1 On 1350 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U7	U14 (A2 to O5)	U11	Q5 & K1			

Presence of R25 without U5 puts U14-11 always high

Panel 19B234871P65

DESCRIPTION

This panel provides for remote operation of a two frequency transmit - two frequency receive station with AUX-1 On-Off.

FUNCTIONS

Transmit F1 1950 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U16 (main)	U13 (A0 to O1 & O6)	U10	Q3 (reset A4 to O1 & O6)	P1-11	Q2	P1-9

Transmit F2 1850 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U5	U13 (A1 to O2 & O5)	U10	Q2	P1-9	Q3	P1-11

Receive F1 1750 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U9	U13 (A2 to O3 & O8)	U10	Q1 (reset A4 to O3 & O8)	P1-16	Q4	P1-15

Receive F2 1650 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U8	U13 (A3 to O4 & O7)	U10	Q4	P1-15	Q1	P1-16

AUX 1 Off 1250 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U6	U14 (A3 to O6)	U11 (reset A4 to O6)			Q5 & K1	

AUX 1 On 1350 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U7	U14 (A2 to O5)	U11	Q5 & K1			

Panel 19B234871P66

DESCRIPTION

This panel provides for remote operation of a two frequency transmit - two frequency receive station with AUX-1 On-Off, and Channel Guard Monitor.

FUNCTIONS

CG Enable (reset by Push-to-Talk)

CG Monitor 2050 Hz

Decode	Latch	Operate	Low
U15 (main)	U24B (main)	Q20 (main)	J1201-5 (main)

Transmit F1 1950 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U16 (main)	U13 (A0 to O1 & O6)	U10	Q3 (reset A4 to O1 & O6)	P1-11	Q2	P1-9

Transmit F2 1850 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U5	U13 (A1 to O2 & O5)	U10	Q2	P1-9	Q3	P1-11

Receive F1 1750 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U9	U13 (A2 to O3 & O8)	U10	Q1 (reset A4 to O3 & O8)	P1-16	Q4	P1-15

Receive F2 1650 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U8	U13 (A3 to O4 & O7)	U10	Q4	P1-15	Q1	P1-16

AUX 1 Off 1250 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U6	U14 (A3 to O6)	U11 (reset A4 to O6)			Q5 & K1	

AUX 1 On 1350 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U7	U14 (A2 to O5)	U11	Q5 & K1			

Panel 19B234871P67

DESCRIPTION

This panel provides for remote/repeater operation of a one frequency station with Repeat Enable-Disable, and AUX-1 On-Off.

FUNCTIONS

Repeater Enable 1550 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U4	U15 (A0 to O2)	U12 (reset A4 to O2)			Q6	P1-7

Repeater Disable 1450 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U3	U15 (A1 to O1)	U12	Q6	P1-7		

AUX 1 Off 1250 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U6	U14 (A3 to O6)	U11 (reset A4 to O6)			Q5 & K1	

AUX 1 On 1350 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U7	U14 (A2 to O5)	U11	Q5 & K1			

Presence of R25 without U5 puts U14-11 always high

Panel 19B234871P68

DESCRIPTION

This panel provides for remote/repeater operation of a one frequency station with Repeat Enable-Disable, AUX-1 On-Off, and Channel Guard Monitor.

FUNCTIONS

CG Enable (reset by Push-to-Talk)

CG Monitor 2050 Hz

Decode	Latch	Operate	Low
U15 (main)	U24B (main)	Q20 (main)	J1201-5 (main)

Repeater Enable 1550 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U4	U15 (A0 to O2)	U12 (reset A4 to O2)			Q6	P1-7

Repeater Disable 1450 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U3	U15 (A1 to O1)	U12	Q6	P1-7		

AUX 1 Off 1250 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U6	U14 (A3 to O6)	U11 (reset A4 to O6)			Q5 & K1	

AUX 1 On 1350 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U7	U14 (A2 to O5)	U11	Q5 & K1			

Presence of R25 without U5 puts U14-11 always high

Panel 19B234871P69

DESCRIPTION

This panel provides for remote/repeater operation of a one frequency station with Channel Guard On-Off, AUX-1 On-Off, and Channel Guard Monitor.

FUNCTIONS

CG Enable (reset by Push-to-Talk)

CG Monitor 2050 Hz

Decode	Latch	Operate	Low
U15 (main)	U24B (main)	Q20 (main)	J1201-5 (main)

Channel Guard Enable 1550 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U4	U15 (A0 to O4)	U12 (reset A4 to O4)			Q7	P1-14

Channel Guard Disable 1450 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U3	U15 (A1 to O3)	U12	Q7	P1-14		

AUX 1 Off 1250 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U6	U14 (A3 to O6)	U11 (reset A4 to O6)			Q5 & K1	

AUX 1 On 1350 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U7	U14 (A2 to O5)	U11	Q5 & K1			

Presence of R25 without U5 puts U14-11 always high

Panel 19B234871P70

DESCRIPTION

This panel provides for remote/repeater operation of a one frequency station with Repeat Enable-Disable, Channel Guard On-Off, AUX-1 On-Off, and Channel Guard Monitor.

FUNCTIONS

CG Enable (reset by Push-to-Talk)

CG Monitor 2050 Hz

Decode	Latch	Operate	Low
U15 (main)	U24B (main)	Q20 (main)	J1201-5 (main)

Channel Guard Enable 1550 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U4	U15 (A0 to O4)	U12 (reset A4 to O4)			Q7	P1-14

Channel Guard Disable 1450 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U3	U15 (A1 to O3)	U12	Q7	P1-14		

Repeater Enable 1150 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U2	U15 (A2 to O2)	U12 (reset A4 to O2)			Q6	P1-7

Repeater Disable 1050 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U1	U15 (A3 to O1)	U12	Q6	P1-7		

AUX 1 Off 1250 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U6	U14 (A3 to O6)	U11 (reset A4 to O6)			Q5 & K1	

AUX 1 On 1350 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U7	U14 (A2 to O5)	U11	Q5 & K1			

Presence of R25 without U5 puts U14-11 always high

Panel 19B234871P71

DESCRIPTION

This panel provides for remote operation of a two frequency transmit - two frequency receive station with Channel Guard On-Off, AUX 1 On-Off, and Channel Guard Monitor.

FUNCTIONS

CG Enable (reset by Push-to-Talk)

CG Monitor 2050 Hz

Decode	Latch	Operate	Low
U15 (main)	U24B (main)	Q20 (main)	J1201-5 (main)

Transmit F1 1950 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U16 (main)	U13 (A0 to O1 & O6)	U10	Q3 (reset A4 to O1 & O6)	P1-11	Q2	P1-9

Transmit F2 1850 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U5	U13 (A1 to O2 & O5)	U10	Q2	P1-9	Q3	P1-11

Receive F1 1750 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U9	U13 (A2 to O3 & O8)	U10	Q1 (reset A4 to O3 & O8)	P1-16	Q4	P1-15

Receive F2 1650 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U8	U13 (A3 to O4 & O7)	U10	Q4	P1-15	Q1	P1-16

AUX 1 Off 1250 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U6	U14 (A3 to O6)	U11 (reset A4 to O6)			Q5 & K1	

AUX 1 On 1350 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U7	U14 (A2 to O5)	U11	Q5 & K1			

Channel Guard Enable 1550 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U4	U15 (A0 to O4)	U12 (reset A4 to O4)			Q7	P1-14

Channel Guard Disable 1450 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U3	U15 (A1 to O3)	U12	Q7	P1-14		

Tone Extention Board "Road Map"

Panel 19B234871P72

DESCRIPTION

This panel provides for remote operation of a two frequency transmit - two frequency receive station with Scan, and AUX 1 On-Off.

FUNCTIONS

Transmit F1 1950 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U16 (main)	U13 (A0 to O1 & O6)	U10	Q3 (reset A4 to O1 & O6)	P1-11	Q2	P1-9

Transmit F2 1850 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U5	U13 (A1 to O2 & O5)	U10	Q2	P1-9	Q3	P1-11

Receive F1 1750 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U9	U13 (A2 to O3 & O8)	U10	Q1 (reset A4 to O3 & O8)	P1-16	Q4	P1-15

Receive F2 1650 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U8	U13 (A3 to O4 & O7)	U10	Q4	P1-15	Q1	P1-16

AUX 1 Off 1250 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U6	U14 (A3 to O6)	U11 (reset A4 to O6)	Q5 & K1			

AUX 1 On 1350 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U7	U14 (A2 to O5)	U11			Q5 & K1	

Scan On 1050 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U1	U15 (A3 to O7)	U12	Q8	P1-13		

Scan Reset

Decode	Prom	Latch	Operate	Low	Release	High
	U15	U12			Q8	P1-13

(U15 A4 to O8)
(U13 A2 to O3 to U10 to D14 to U12)
(U13 A3 to O4 to U10 to D13 to U12)

Presence of R 7 without U2 puts U15-12 always high
Presence of R13 without U3 puts U15-11 always high
Presence of R19 without U4 puts U15-10 always high

Panel 19B234871P73

DESCRIPTION

This panel provides for remote operation of a one frequency transmit - two receiver station.

FUNCTIONS

Transmit F1 1950 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U16 (main)	U13 (A0 to O1 & O6)	U10	Q3	P1-11	Q2	P1-9

Receive F1 1750 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U9	U13 (A2 to O3 & O8)	U10	Q1	P1-16	Q4	P1-15

Receive F2 1650 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U8	U13 (A3 to O4 & O7)	U10	Q4	P1-15	Q1	P1-16

Simultaneous Receive 1050 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U1	U13	U10	Q1	P1-16		
		U10	Q4	P1-15		
	(A1 to O3 & O7)		(reset A4 to O3 & O7)			

Simultaneous Receive Reset

By selection of either Receive F1 or Receive F2

Panel 19B234871P74

DESCRIPTION

This panel provides for remote operation of a two frequency transmit - two receiver station.

FUNCTIONS

Transmit F1 1950 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U16 (main)	U13 (A0 to O1 & O6)	U10	Q3	P1-11	Q2	P1-9

Transmit F2 1850 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U5	U13 (A1 to O2 & O5)	U10	Q2	P1-9	Q3	P1-11

Receive F1 1750 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U9	U13 (A2 to O3 & O8)	U10	Q1	P1-16	Q4	P1-15

Receive F2 1650 Hz

Decode	Prom	Latch	Operate	Low	Release	High
U8	U13 (A3 to O4 & O7)	U10	Q4	P1-15	Q1	P1-16

Simultaneous Receive 1050 Hz (reset mode)

Decode	Prom	Latch	Operate	Low	Release	High
U1	U15	U10	Q1	P1-16		
		U10	Q4	P1-15		
	(A3 to O5 to D19 & to O6 to D20)					
	(reset A4 to O5 to D19 & to O6 to D20)					

Simultaneous Receive Reset

By selection of either Receive F1 or Receive F2

NOTE:
Presence of R 7 without U2 puts U15-12 always high
Presence of R13 without U3 puts U15-11 always high
Presence of R19 without U4 puts U15-10 always high

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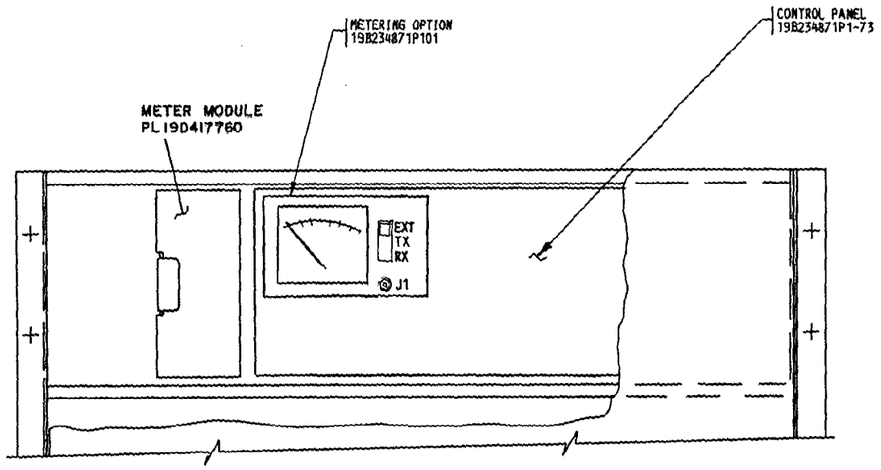
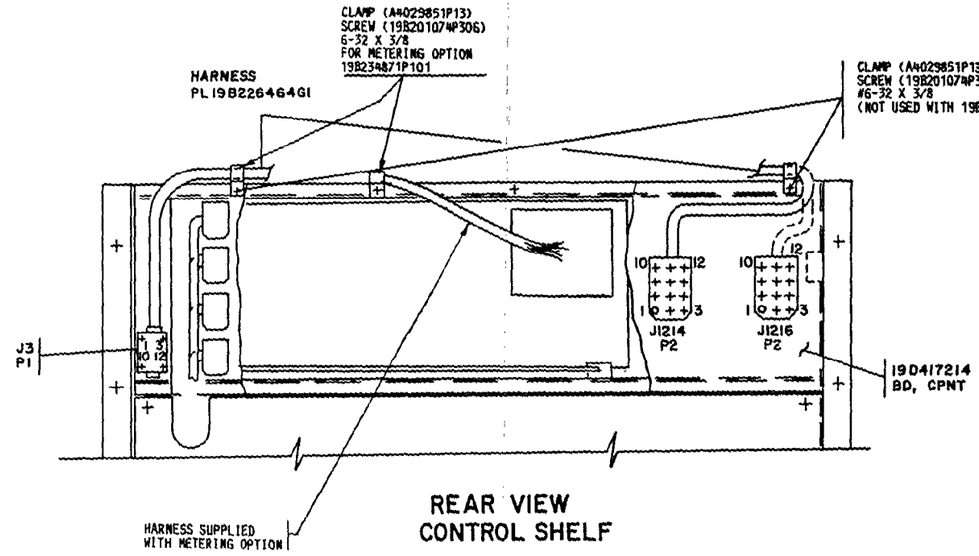


FRONT VIEW
CONTROL SHELF



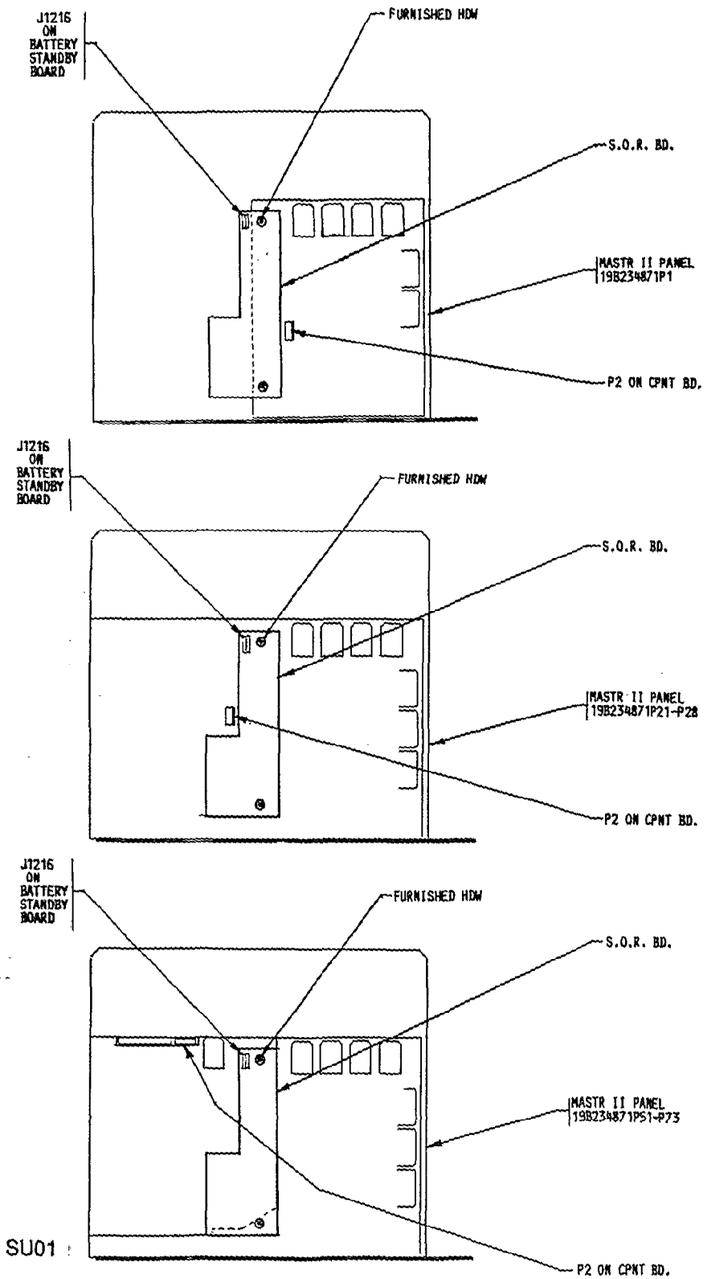
REAR VIEW
CONTROL SHELF

(2) THESE INSTRUCTIONS COVER THE INSTALLATION OF THE METERING OPTION (19B234871P101) ONTO THE CONTROL PANEL 19B234871P1 THRU 73.

1. REMOVE BLANK PANEL ON CONTROL PANEL & DISCARD.
2. ASSEMBLE METERING OPTION, USING SAME HARDWARE USED TO MOUNT BLANK PANEL.
3. ROUTE HARNESS FROM METERING OPTION UP AROUND TOP OF SHELF & PLUG ONTO J3.

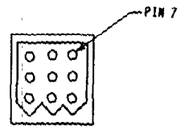
(2) THIS INSTRUCTION COVERS A SQUELCH OPERATED RELAY BOARD, (S.O.R. BD) 19B234871P102 MOUNTING TO THE MASTR II PANEL.

MOUNT S.O.R. BD. TO VARIOUS MASTR II PANELS AS SHOWN BELOW USING HARDWARE FURNISHED. PLUG CABLE ONTO P2 ON COMPONENT BD. ON PANEL AS SHOWN.



(3) THIS INSTRUCTION COVERS THE INSTALLATION OF BATTERY STANDBY, OR BATTERY STANDBY/SQUELCH OPERATED RELAY BOARD.

1. MOUNT THE BATTERY STANDBY BOARD PER INSTRUCTIONS OUTLINED IN PT 2.
2. INSTALL WIRE SUPPLIED, BY CONNECTING ONE END TO J1216 ON BATTERY STANDBY BD. ROUTING ALONG SIDE EXISTING HARNESS AND PLUGGING OTHER END ONTO PIN 7 OF P9 ON STATION POWER SUPPLY. (SEE FIG. 1).



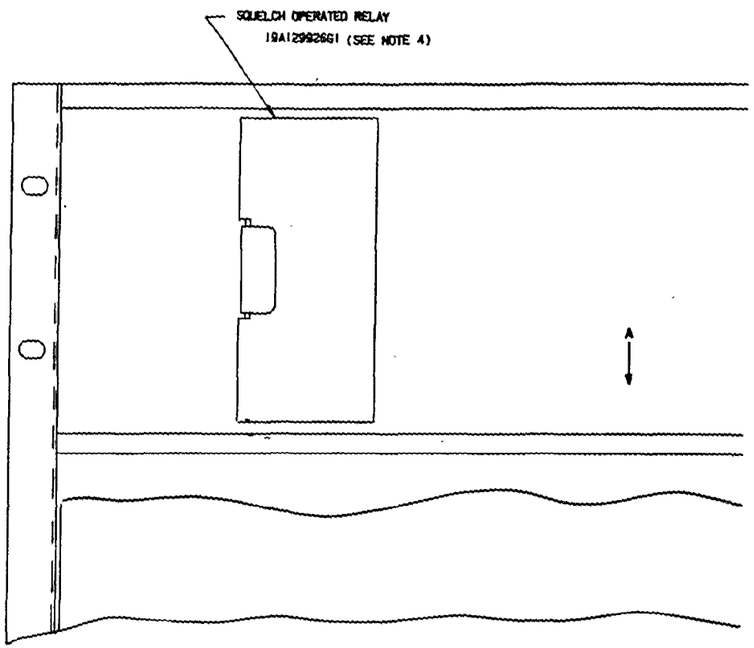
P9
ON STATION
POWER SUPPLY
FIG. 1

(1) THESE INSTRUCTIONS COVER THE MODIFICATION OF THE CONTROL SHELF FOR INSTALLATION OF THE SQUELCH OPERATED RELAY BOARD.

INSTRUCTIONS:

1. AFFIX NAMEPLATE NP276173E TO SHELF AS SHOWN IN FRONT OF SLOT IN WHICH SQUELCH OPERATED RELAY IS TO BE INSTALLED.
2. INSTALL SQUELCH OPERATED RELAY IN SECOND POSITION FROM LEFT IN SHELF, UNLESS THAT SLOT IS FILLED, IN WHICH CASE THE SQUELCH OPERATED RELAY IS TO BE INSTALLED IN THE FIRST POSITION ON THE LEFT.
3. TEST PER 19A129945.
4. KIT, PL19A129520G1 USED WITH THIS MODULE MUST BE SECURED TO CABLE AT MOTHER BOARD FOR SHIPPING.

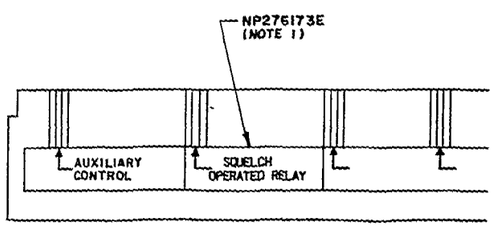
SQUELCH OPERATED RELAY



FRONT VIEW
CONTROL SHELF

NOTES:

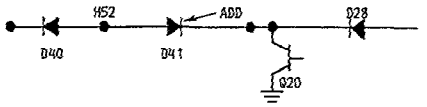
1. MOUNT NP276173E OVER AUXILIARY CONTROL PORTION OF EXISTING NP. ALIGN ARROW WITH CENTER OF GUIDE WITHIN .060.



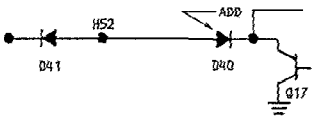
VIEW A

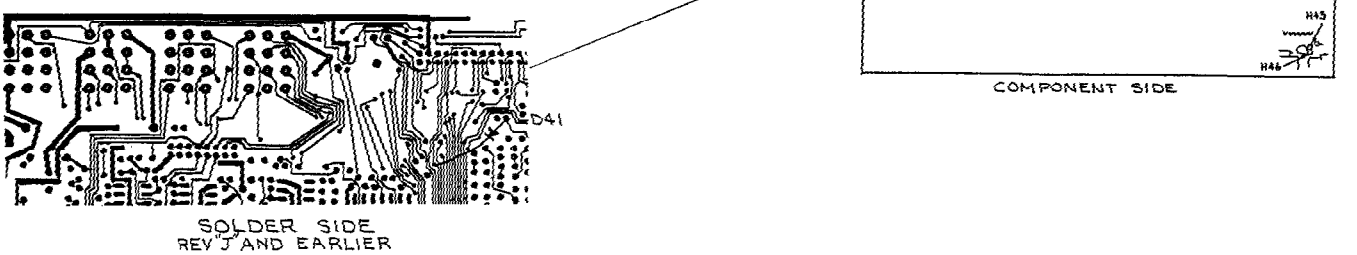
(2) REMOTE/REPEAT COMBINATIONS

1. REMOVE JUMPER H49-H50.
2. ADD JUMPER H45-H46
3.
4. WITH CG (NINTH DIGIT G, H, L, M, U, V), ADD JUMPER H12-H13.
5.
6. FOR TONE CONTROL (SEVENTH DIGIT V), REMOVE DIODE D35 FROM H2 TO H12.
7. FOR CG AND TONE CONTROL (SEVENTH DIGIT V AND NINTH DIGIT G, H, L, M, U, V, W) ADD D41 19A700028P1 DIODE FROM H52 (ANODE) TO D28 CATHODE.



8. FOR CG (SEVENTH DIGIT U AND NINTH DIGIT G, H, L, M, U, V, W) ADD D40 19A700028P1 DIODE FROM H52 (ANODE) TO Q17-C.





(19C327001, Sh. 2, Rev. 1)

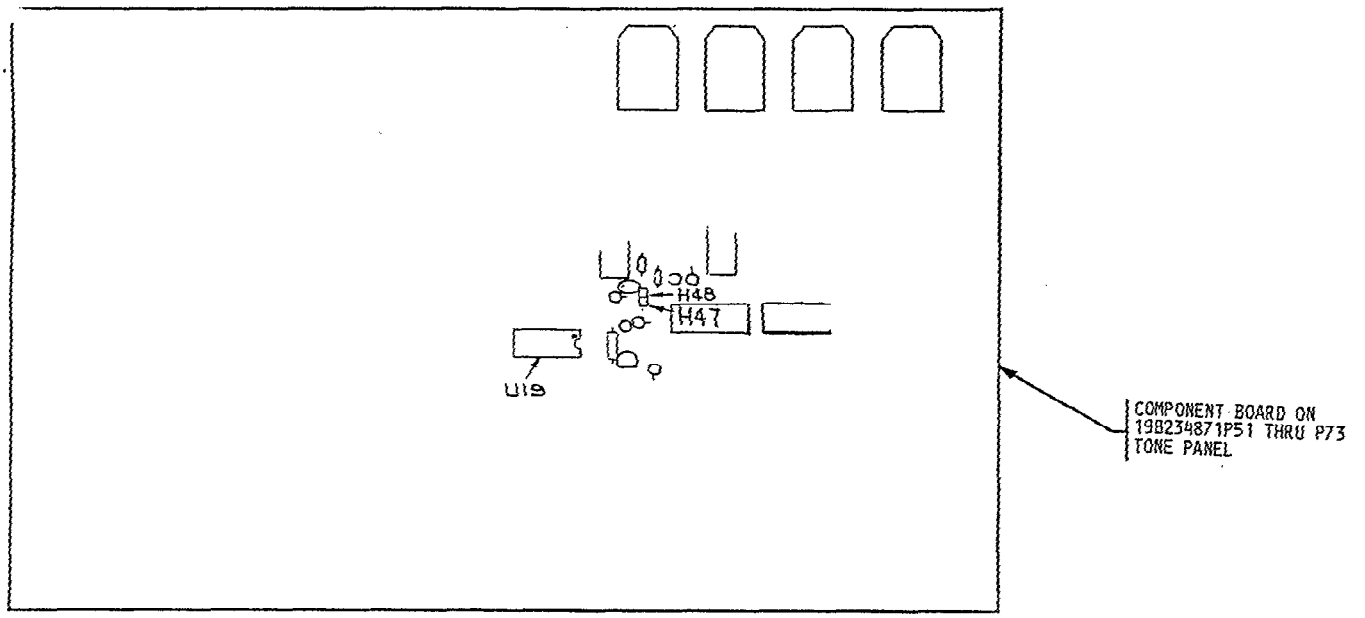
REMOTE KEYING PANEL

(3) THIS INSTRUCTION COVERS THE MODIFICATION OF THE COMPONENT BOARD ON THE 19B234871P51 THRU P73 TONE REPEATER PANEL, FOR USE WITH A REMOTE KEYING PANEL.
REVISION "E" AND EARLIER TONE PANELS.

1. REMOVE JUMPER FROM H47 TO H48 AND DISCARD.
2. ADD U19 TO TONE (19A149433P1).

REVISION "F" AND LATER TONE PANELS

1. ADD JUMPER H47-H48.



Remote Keying Panel Applications

(19C320820, Sh. 2, Rev. 1)

(1) THIS INSTRUCTION COVERS THE INSTALLATION OF 19B234871P104, FOUR WIRE AUDIO INTO TONE CONTROL STATIONS.

1. REMOVE JUMPER FROM H24 TO H25.
2. REMOVE JUMPER FROM H26 TO H27 IF SEVENTH DIGIT T AND NINTH DIGIT D, L, M OR SEVENTH DIGIT IS V.
   IF OPTION VT01 IS PRESENT, REMOVE H26-H27 FOR ALL COMBINATIONS.
3. ADD JUMPER H28-H29 UNLESS OPTION VT01 OR SC03 IS PRESENT.
4. REMOVE R112 ON SIMPLEX UNITS. (SEVENTH DIGIT T AND NINTH DIGIT S, G, H, N, P, U, V, W). IF R112 NOT PRESENT, REMOVE P5-1 PIN.
5. ON DUPLEX UNITS, REMOVE D35 DIODE IF PRESENT, FROM H2 TO H12. (NINTH DIGIT D, L, M OR SEVENTH DIGIT V).
6. MOUNT 19B234871P104 PER FIG. 2.
7. IF INTERCOM (19C320671) IS PRESENT, ADD A DA WIRE JUMPER FROM H1 TO H2 PER FIGURE 3.

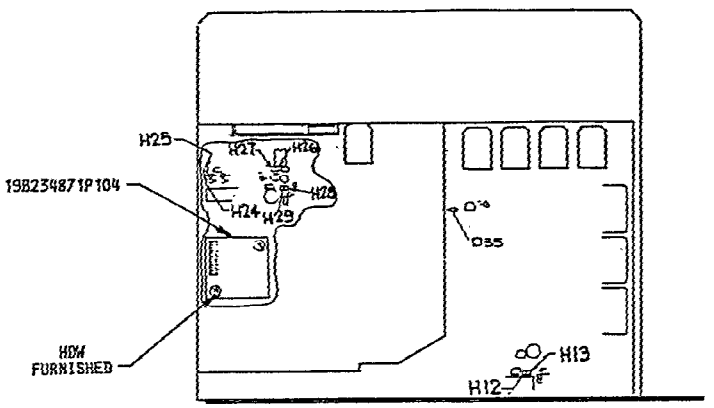


FIG. 2
TONE PANEL
19B234871P51-P73

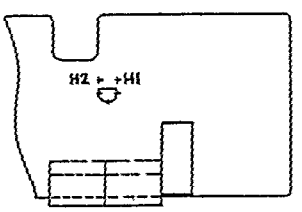


FIG. 3
INTERCOM BD.
19C320671

Four Wire Audio Option TX02
(19B234871P104)

(19C336896, Sh. 1, Rev. 2)

(2) INSTALL BATTERY, 19A116252P1, ONTO COMPONENT BD. ON PANEL, 19B234871, AS SHOWN IN FIG. 2
REMOVE JUMPER H15-H16.

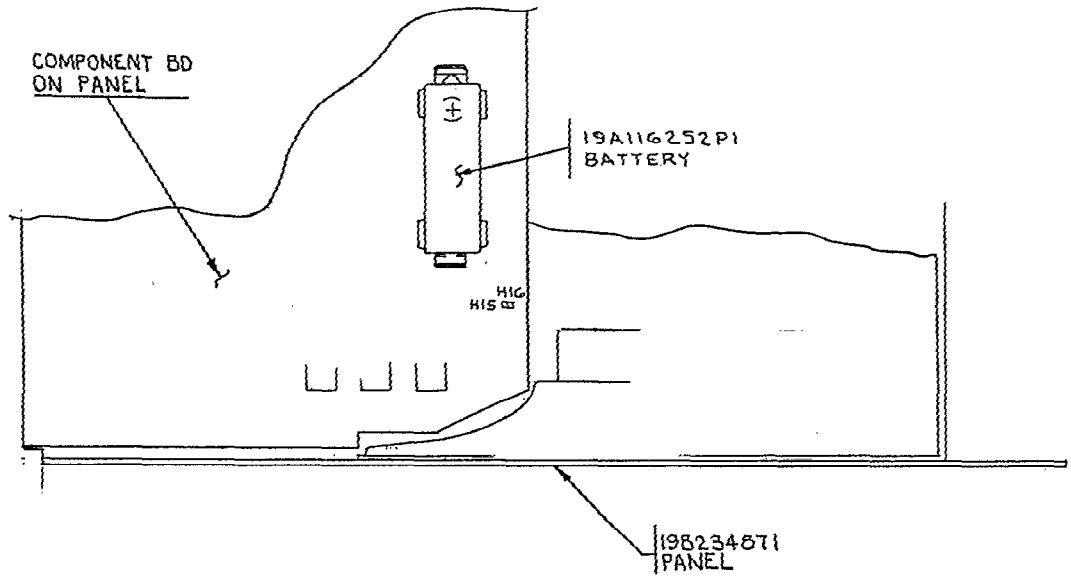


FIG. 2

Logic Standby Battery Option BU01
(19A116252P1)

(198233711, Sh. 2, Rev. 2)

This addendum incorporates updated information on the Squelch Operated Relay / Battery Alarm Tone Board 19B234871P102/3/5 (900-0168).

Revision D schematic and parts list are included. Note that several components are located on the underside of this board in the later revisions. The Production Changes that follow give details on the changes. When this maintenance manual is reprinted, this information will be incorporated.

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. A - SQUELCH OPERATED RELAY 19B234871P102
BATTERY STANDBY ALARM TONE 19B234871P103
SOR/BATTERY STANDBY ALARM TONE 19B234871P105
To improve bias on RUS line, changed R4 from 3.6K to 1K ohms. Resistor R4 was 312-0029, 3.6K ohms.

REV. B - BATTERY STANDBY ALARM TONE 19B234871P103
SOR/BATTERY STANDBY ALARM TONE 19B234871P105
To prevent unnecessary loading of audio line, changed 555 enable circuit as follows: Removed R11 (312-0011 10K ohms), connected U1 pin 4 to pin 8 and connected collector of Q7 to C5.

REV. C - BATTERY STANDBY ALARM TONE 19B234871P103
SOR/BATTERY STANDBY ALARM TONE 19B234871P105
To improve Q6 bias, added R36 from collector of Q5 to base of Q6. Resistor R36 is located on the underside of the board.

REV. D - BATTERY STANDBY ALARM TONE 19B234871P103
SOR/BATTERY STANDBY ALARM TONE 19B234871P105
To improve operation of alarm tone, added D4 and R11 (312-0053, 2.7M ohms) between U1 pins 2 and 6. Also moved Q3 and Q7 collectors to U1 pin 2. Changed R34 to a jumper. Diode D4 and resistor R11 are located on the bottom of the board.

PARTS LIST

SQUELCH OPERATED RELAY
19B234971P102

REV. D

ISSUE 3

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	J19/362-0001	Monolithic: .1 uF, 50 v.
		- - - - - - - - - - - DIODES - - - - - - - - - -
D1	J19/110-0002	Silicon: sim to 1N4003.
D2	J19/112-0001	Light Emitting Diode: Red; sim to XC526R.
D3	J19/110-0001	Silicon: sim to 1N914.
		- - - - - - - CONNECTORS AND PLUGS - - - - - - -
J2	J19/233-0035	Receptacle: 5 Position .1" centers.
J1214	J19/231-3109	Connector: 12 Position; sim to Molex 09-18-5121.
		- - - - - - - - - - - RELAYS - - - - - - - - - -
K1	J19/700-0001	4PDT: sim to HAS124.
		- - - - - - - - - - TRANSISTORS - - - - - - - - -
Q1	J19/180-0017	Silicon, NPN: sim to 2N3053.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	J19/313-1821	820 ohms ±5%, 1/2 w.
R2	J19/312-0014	33K ohms ±5%, 1/4 w.
R3	J19/312-0034	1.2K ohms ±5%, 1/4 w.
R4 *	J19/312-0019	1K ohms ±5%, 1/4 w.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	J19/222-0020	Wire: 10" 22 AWG Brown. (J2 pin 1).
	J19/222-0014	Wire: 10" 22 AWG Red. (J2 pin 2).
	J19/222-0023	Wire: 10" 22 AWG Orange. (J2 pin 3).
	J19/222-0018	Wire: 10" 22 AWG Yellow. (J2 pin 4).
	J19/222-0016	Wire: 10" 22 AWG Green. (J2 pin 5).
	J19/200-0026	Standoff: #6-32 x 1.25".
	J19/199-3070	Screw: #6-32 x .25", Phillips.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PARTS LIST

BATTERY STANDBY ALARM TONE
19B238718P103

REV. D

ISSUE 3

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C2	J19/362-0001	Monolithic: .1 uF, 50 v.
C3	J19/390-0010	Tantalum: 10 uF, 16 v.
C4	J19/362-0003	Monolithic: .01 uF, 50 v.
C5 and C6	J19/360-0025	Electrolytic: 47 uF, 16 v.
C7	J19/390-0012	Tantalum: 1 uF, 25 v.
C8	J19/362-0001	Monolithic: .1 uF, 50 v.
C9	J19/390-0010	Tantalum: 10 uF, 16 v.
C10	J19/362-0006	Monolithic: .001 uF, 50 v.
C11	J19/362-0008	Monolithic: .0047 uF, 50 v.
C12 thru C15	J19/362-0003	Monolithic: .01 uF, 50 v.
		- - - - - - - - - - DIODES - - - - - - - - - -
D3	J19/110-0001	Silicon: sim to 1N914.
D4 *	J19/110-0001	Silicon: sim to 1N914.
		- - - - - - - - CONNECTORS AND PLUGS - - - - - - - -
J2	J19/233-0035	Receptacle: 5 Position .1" centers.
J1216-7	J19/231-0025	Receptacle: 1 Position.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q2 and Q3	J19/180-0009	Silicon, NPN: sim to MPS8098.
Q5	J19/180-0005	Silicon, PNP: sim to 2N5226.
Q6 and Q7	J19/180-0009	Silicon, NPN: sim to MPS8098.
Q8	J19/180-0002	FET P-Channel: 2N3820.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R4 *	J19/312-0019	1K ohms ±5%, 1/4 w.
R5	J19/312-0011	10K ohms ±5%, 1/4 w.
R6	J19/312-0014	33K ohms ±5%, 1/4 w.
R7	J19/312-0040	4.7K ohms ±5%, 1/4 w.
R8 thru R10	J19/312-0011	10K ohms ±5%, 1/4 w.
R11 *	J19/312-0053	2.7M ohms ±5%, 1/4 w.
R12	J19/312-0019	1K ohms ±5%, 1/4 w.
R13	J19/312-0011	10K ohms ±5%, 1/4 w.
R14	J19/312-0021	12K ohms ±5%, 1/4 w.
R15	J19/312-0003	100K ohms ±5%, 1/4 w.
R16	J19/312-0019	1K ohms ±5%, 1/4 w.
R17	J19/312-0003	100K ohms ±5%, 1/4 w.
R18	J19/312-0019	1K ohms ±5%, 1/4 w.
R19	J19/352-0003	Varible: 1M ohms, 22 Turn.
R20 and R21	J19/312-0011	10K ohms ±5%, 1/4 w.
R22	J19/351-0010	Varible: 50K ohms, 1 Turn Mini.
R23	J19/351-1103	Varible: 10K ohms, 1 Turn Mini.
R24	J19/311-6042	60.4K ohms ±1%, 1/4 w.
R25	J19/311-2552	25.5K ohms ±1%, 1/4 w.
R26	J19/312-0003	100K ohms ±5%, 1/4 w.
R27	J19/312-1334	330K ohms ±5%, 1/4 w.
R28	J19/312-0019	1K ohms ±5%, 1/4 w.
R29 and R30	J19/312-0011	10K ohms ±5%, 1/4 w.
R31	J19/312-0058	68K ohms ±5%, 1/4 w.
R32	J19/312-0011	10K ohms ±5%, 1/4 w.
R33	J19/312-0058	68K ohms ±5%, 1/4 w.
R34	J19/265-0004	Jumper.
R35	J19/312-0019	1K ohms ±5%, 1/4 w.
R36 *	J19/312-0011	10K ohms ±5%, 1/4 w.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U1 and U2	J19/130-0010	Linear: Timer: LM555 (TI Only).
U3	J19/130-0120	Linear: Dual Op Amp; sim to TL062CP.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	J19/220-0003	IC Socket: 8 Pin DIP.
	J19/222-0020	Wire: 10" 22 AWG Brown. (J2 Pin 1).
	J19/222-0014	Wire: 10" 22 AWG Red. (J2 Pin 2).
	J19/222-0023	Wire: 10" 22 AWG Orange. (J2 Pin 3).
	J19/222-0018	Wire: 10" 22 AWG Yellow. (J2 Pin 4).
	J19/222-0016	Wire: 10" 22 AWG Green. (J2 Pin 5).
	J19/200-0026	Standoff: #6-32 x 1.25",
	J19/199-3070	Screw: #6-32 x .25" Philips.
	J19/222-0021	Wire: 36" 22 AWG Black.
	J19/233-0041	Pin, Male.
	J19/200-0014	Spade: 42783-2.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

PARTS LIST

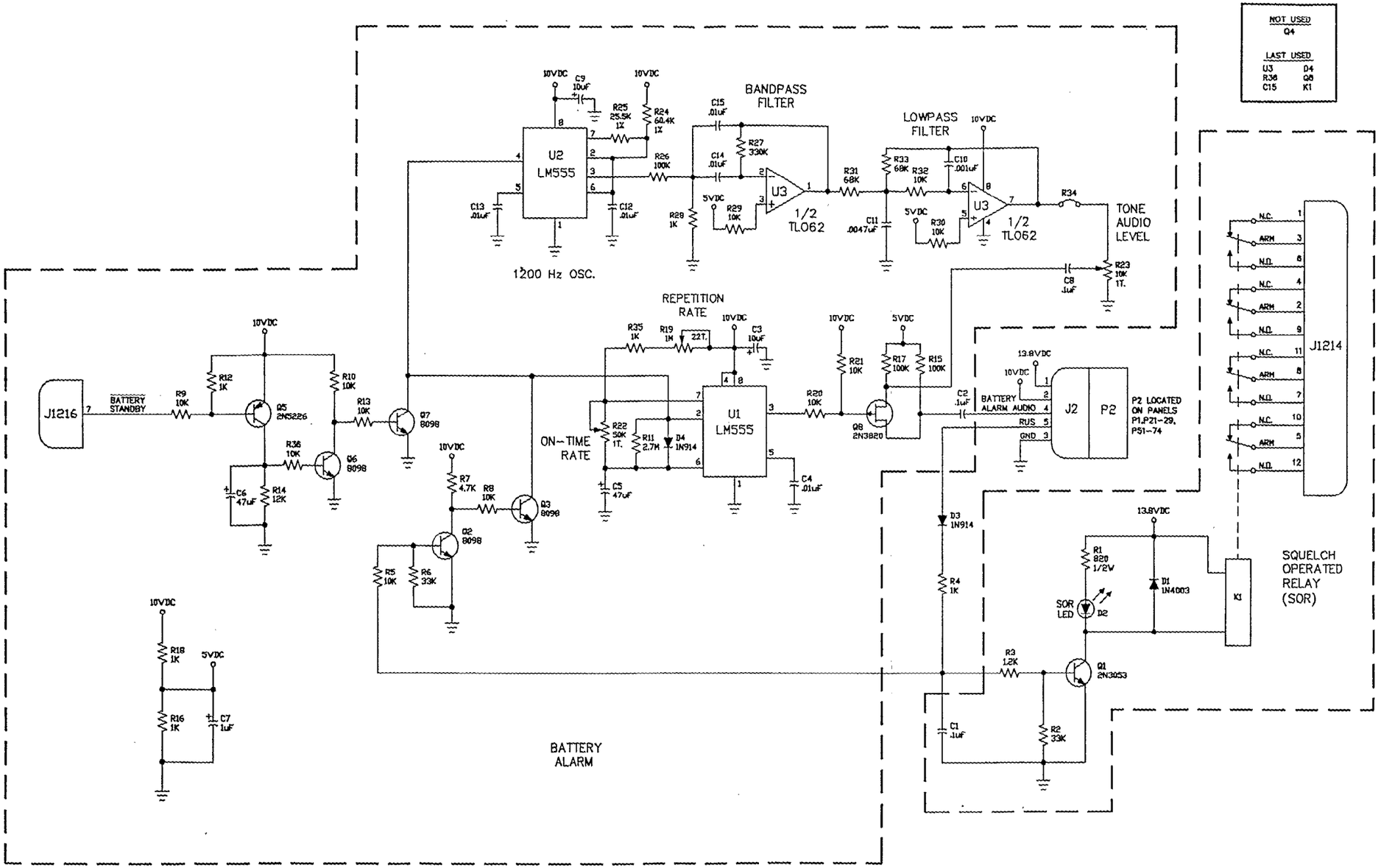
SQUELCH OPERATED RELAY
AND
BATTERY STANDBY ALARM TONE
19B234871P105

REV. D

ISSUE 3

SYMBOL	GE PART NO.	DESCRIPTION
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1	J19/362-0001	Monolithic: .1 uF, 50 v.
C2	J19/362-0001	Monolithic: .1 uF, 50 v.
C3	J19/390-0010	Tantalum: 10 uF, 16 v.
C4	J19/362-0003	Monolithic: .01 uF, 50 v.
C5 and C6	J19/360-0025	Electrolytic: 47 uF, 16 v.
C7	J19/390-0012	Tantalum: 1 uF, 25 v.
C8	J19/362-0001	Monolithic: .1 uF, 50 v.
C9	J19/390-0010	Tantalum: 10 uF, 16 v.
C10	J19/362-0006	Monolithic: .001 uF, 50 v.
C11	J19/362-0008	Monolithic: .0047 uF, 50 v.
C12 thru C15	J19/362-0003	Monolithic: .01 uF, 50 v.
		- - - - - - - - - - DIODES - - - - - - - - - -
D1	J19/110-0002	Silicon: sim to 1N4003.
D2	J19/112-0001	Light Emitting Diode: Red; sim to XC526E.
D3	J19/110-0001	Silicon: sim to 1N914.
D4 *	J19/110-0001	Silicon: sim to 1N914.
		- - - - - - - - CONNECTORS AND PLUGS - - - - - - - -
J2	J19/233-0035	Receptacle: 5 Position .1" centers.
J1216-7	J19/231-0025	Receptacle: 1 Position.
		- - - - - - - - - - RELAYS - - - - - - - - - -
K1	J19/700-0001	4PDT: sim to HAS124.
		- - - - - - - - - - TRANSISTORS - - - - - - - - - -
Q1	J19/180-0017	Silicon, NPN: sim to 2N3053.
Q2 and Q3	J19/180-0009	Silicon, NPN: sim to MPS8098.
Q5	J19/180-0005	Silicon, PNP: sim to 2N5226.
Q6 and Q7	J19/180-0009	Silicon, NPN: sim to MPS8098.
Q8	J19/180-0002	FET P-Channel: 2N3820.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1	J19/313-1821	820 ohms ±5%, 1/2 w.
R2	J19/312-0014	33K ohms ±5%, 1/4 w.
R3	J19/312-0034	1.2K ohms ±5%, 1/4 w.
R4 *	J19/312-0019	1K ohms ±5%, 1/4 w.
R5	J19/312-0011	10K ohms ±5%, 1/4 w.
R6	J19/312-0014	33K ohms ±5%, 1/4 w.
R7	J19/312-0040	4.7K ohms ±5%, 1/4 w.
R8 thru R10	J19/312-0011	10K ohms ±5%, 1/4 w.
R11 *	J19/312-0053	2.7M ohms ±5%, 1/4 w.
R12	J19/312-0019	1K ohms ±5%, 1/4 w.
R13	J19/312-0011	10K ohms ±5%, 1/4 w.
R14	J19/312-0021	12K ohms ±5%, 1/4 w.
R15	J19/312-0003	100K ohms ±5%, 1/4 w.
R16	J19/312-0019	1K ohms ±5%, 1/4 w.
R17	J19/312-0003	100K ohms ±5%, 1/4 w.
R18	J19/312-0019	1K ohms ±5%, 1/4 w.
R19	J19/352-0003	Varible: 1M ohms, 22 Turn.
R20 and R21	J19/312-0011	10K ohms ±5%, 1/4 w.
R22	J19/351-0010	Varible: 50K ohms, 1 Turn Mini.
R23	J19/351-1103	Varible: 10K ohms, 1 Turn Mini.
R24	J19/311-6042	60.4K ohms ±1%, 1/4 w.
R25	J19/311-2552	25.5K ohms ±1%, 1/4 w.
R26	J19/312-0003	100K ohms ±5%, 1/4 w.
R27	J19/312-1334	330K ohms ±5%, 1/4 w.
R28	J19/312-0019	1K ohms ±5%, 1/4 w.
R29 and R30	J19/312-0011	10K ohms ±5%, 1/4 w.
R31	J19/312-0058	68K ohms ±5%, 1/4 w.
R32	J19/312-0011	10K ohms ±5%, 1/4 w.
R33	J19/312-0058	68K ohms ±5%, 1/4 w.
R34	J19/265-0004	Jumper.
R35	J19/312-0019	1K ohms ±5%, 1/4 w.
R36 *	J19/312-0011	10K ohms ±5%, 1/4 w.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - - -
U1 and U2	J19/130-0010	Linear: Timer; LM555 (TI Only).
U3	J19/130-0120	Linear: Dual Op Amp; sim to TL062CP.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	J19/220-0003	IC Socket: 8 Pin DIP.
	J19/222-0020	Wire: 10" 22 AWG Brown. (J2 Pin 1).
	J19/222-0014	Wire: 10" 22 AWG Red. (J2 Pin 2).
	J19/222-0023	Wire: 10" 22 AWG Orange. (J2 Pin 3).
	J19/222-0018	Wire: 10" 22 AWG Yellow. (J2 Pin 4).
	J19/222-0016	Wire: 10" 22 AWG Green. (J2 Pin 5).
	J19/200-0026	Standoff: #6-32 x 1.25".
	J19/199-3070	Screw: #6-32 x .25" Philips.
	J19/222-0021	Wire: 36" 22 AWG Black.
	J19/233-0041	Pin, Male.
	J19/200-0014	Spade: 42783-2.

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES



(4165-S-00, Rev. D)

This addendum updates configuration data found in Table 1 on page four. The revised table is shown below.

Part No.	Description	One Freq	Two Freq	Four Freq	Channel Guard	Repeat Disable	CG On-Off	Aux. 1	Scan
51	*Remote or Remote/Repeat	X							
52	*Remote or Remote/Repeat	X			X				
53	Remote		X						
54	Remote		X		X				
55	Remote			X					
56	Remote			X	X				
57	Remote/Repeat	X				X			
58	Remote/Repeat	X			X	X			
59	*Remote or Remote/Repeat	X			X		X		
60	Remote/Repeat	X			X	X	X		
61	Remote		X		X		X		
62	Remote			X	X		X		
63	*Remote or Remote/Repeat	X						X	
64	*Remote or Remote/Repeat	X			X			X	
65	Remote		X					X	
66	Remote		X		X			X	
67	Remote/Repeat	X				X		X	
68	Remote/Repeat	X			X	X		X	
69	*Remote or Remote/Repeat	X			X		X	X	
70	Remote/Repeat	X			X	X	X	X	
71	Remote		X		X		X	X	
72	Remote		X					X	X
73	Remote	X				Aux Receiver Application			
74	Remote		X			Aux Receiver Application			

* To make Remote/Repeat for these units requires 19C327001P2 Modification Instructions.

TABLE 1- CONFIGURATION

INTRODUCTION

This addendum incorporates **Revision P** information for the Tone Control Panel. The panel has the following major changes from Revision N to Revision P:

- 2175 Hz Bandpass Board (J19/101-0213) has replaced U23 on the Main Board (J19/101-0172). This change is due to the limited availability of stable AF100 IC's.

- Tone decoder circuits on the Tone Extension Board (J19/101-0173) have been changed to improve the adjustment range of the decoders.

The schematic diagram for the new Bandpass Board is included on the schematic (Sheet 4) of the Main Board. Main Board printed-wire-board revision is now H and the Bandpass Board printed-wire-board revision is A.

DETAIL DESCRIPTION OF CHANGES

MAIN BOARD J19/101-0172

1. U23 (and associated circuitry) has been removed and connector P7 has been added. The 2175 Hz Bandpass Board plugs to P7 via J7. Main Board Revision is H.
2. C18 - C21, C29 and C30 locations will now accept component lead spacings of .1" and .2".
3. H69 - H70 has been added for voting applications.
4. R8 has changed from 12K to 4.7K (J19/312-0040H).
5 Trace was cut on solder-side of board from R79 to U7 pin 9.
6. H31, TP4 and TP5 have changed from J19/200-0015 to J19/231-1001.

TONE EXTENSION BOARD J19/101-0173

1. Changed R6, R12, R18, R24, R30, R36, R42, R48 and R54 from 5K pots to 10K pots (J19/352-1103).
2. Changed R5 from 93.1K to 90.9K (J19/311-0002H).
3. Changed R11 from 84.5K to 82.5K (J19/311-8252H).
4. Changed R17 from 66.5K to 63.4K (J19/311-6342H).
5. Changed R23 from 61.9K to 59.0K (J19/311-5902H).
6. Changed R29 from 51.1K to 48.7K (J19/311-4872H).
7. Changed R35 from 76.8K to 75.0K (J19/311-0023H).
8. Changed R41 from 71.5K to 69.8K (J19/311-6982H).
9. Changed R47 from 57.6K to 56.2K (J19/311-5622H).
10. Changed R53 from 54.9K to 52.3K (J19/311-5232H).

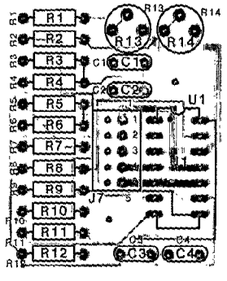
ADDENDUM NO. 3 TO LBI-31853E
(PCS3)

PARTS LIST

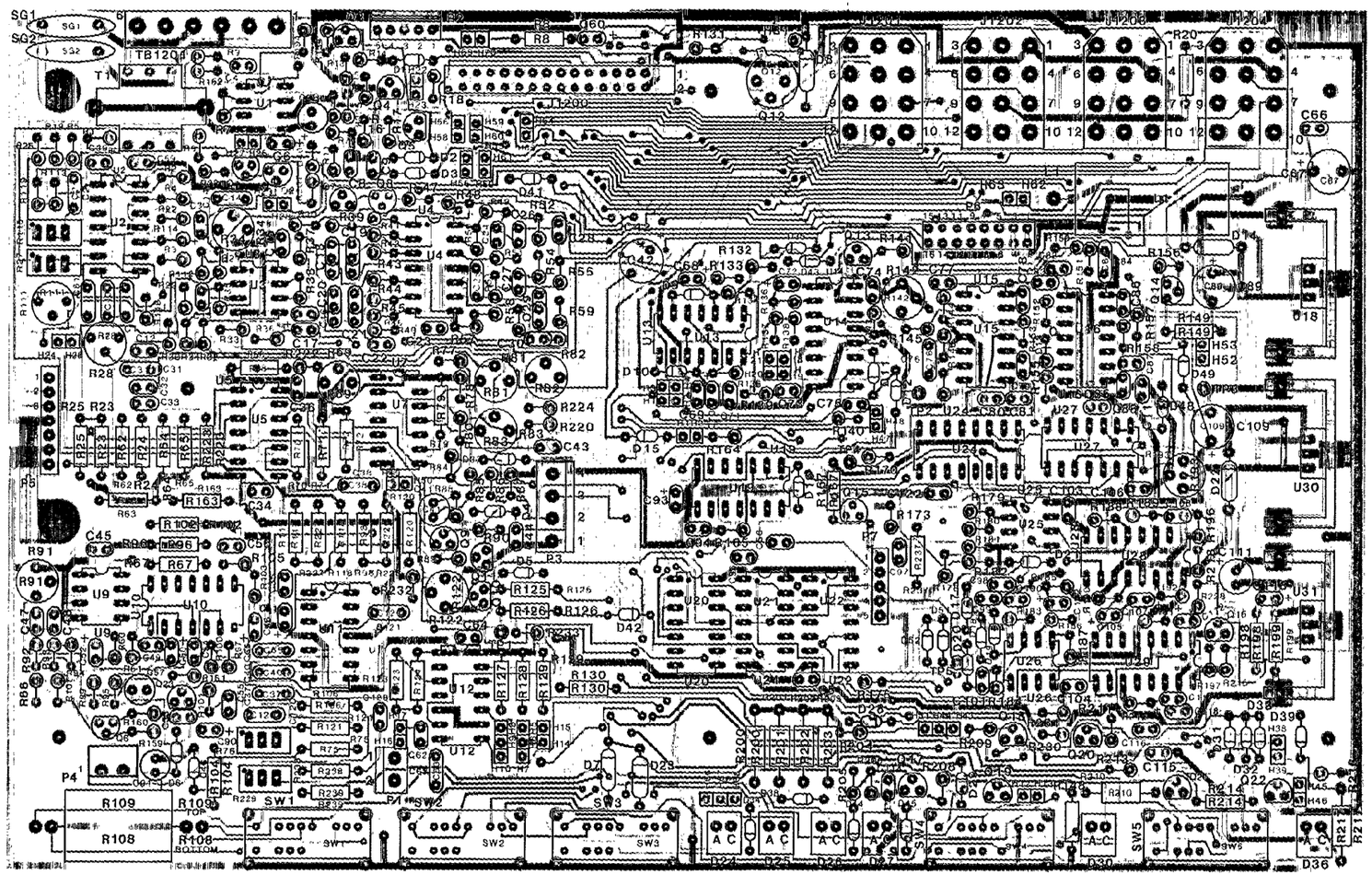
2175 Hz BANDPASS BOARD
J19/101-0213

ISSUE 1

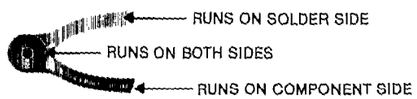
		- - - - - - - - - - CAPACITORS - - - - - - - - - -
C1 thru C4	J19/362-0019	Monolithic: .01 uF 50 v.
		- - - - - - - - - - - JACKS - - - - - - - - - - -
J7	J19/231-3006	DIP: 5 Position, .100" centers.
		- - - - - - - - - - RESISTORS - - - - - - - - - -
R1 and R2	J19/311-8450H	845 ohms ±1%, 1/4 w.
R3	J19/311-5112H	51.1K ohms ±1%, 1/4 w.
R4	J19/311-5492H	54.9K ohms ±1%, 1/4 w.
R5 and R6	J19/311-5112H	51.1K ohms ±1%, 1/4 w.
R7	J19/311-0009H	97.6K ohms ±1%, 1/4 w.
R8	J19/311-5112H	51.1K ohms ±1%, 1/4 w.
R9	J19/311-0009H	97.6K ohms ±1%, 1/4 w.
R10	J19/311-5492H	54.9K ohms ±1%, 1/4 w.
R11 and R12	J19/311-5112H	51.1K ohms ±1%, 1/4 w.
R13 and R14	J19/351-1252	Potentiometer: 500 Ohms 1 Turn.
		- - - - - - - - - INTEGRATED CIRCUITS - - - - - - -
U1	J19/130-0286	Linear: Quad Op Amp; sim to LM348.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	J19/199-3056	Screw: #4-40 x 3/8" Phillips.
	J19/220-0002	Socket: 14 Pin DIP.



(900-0213, Silkscreen, Rev. A)
(900-0213, Component Side, Rev. A)
(900-0213, Solder Side, Rev. A)

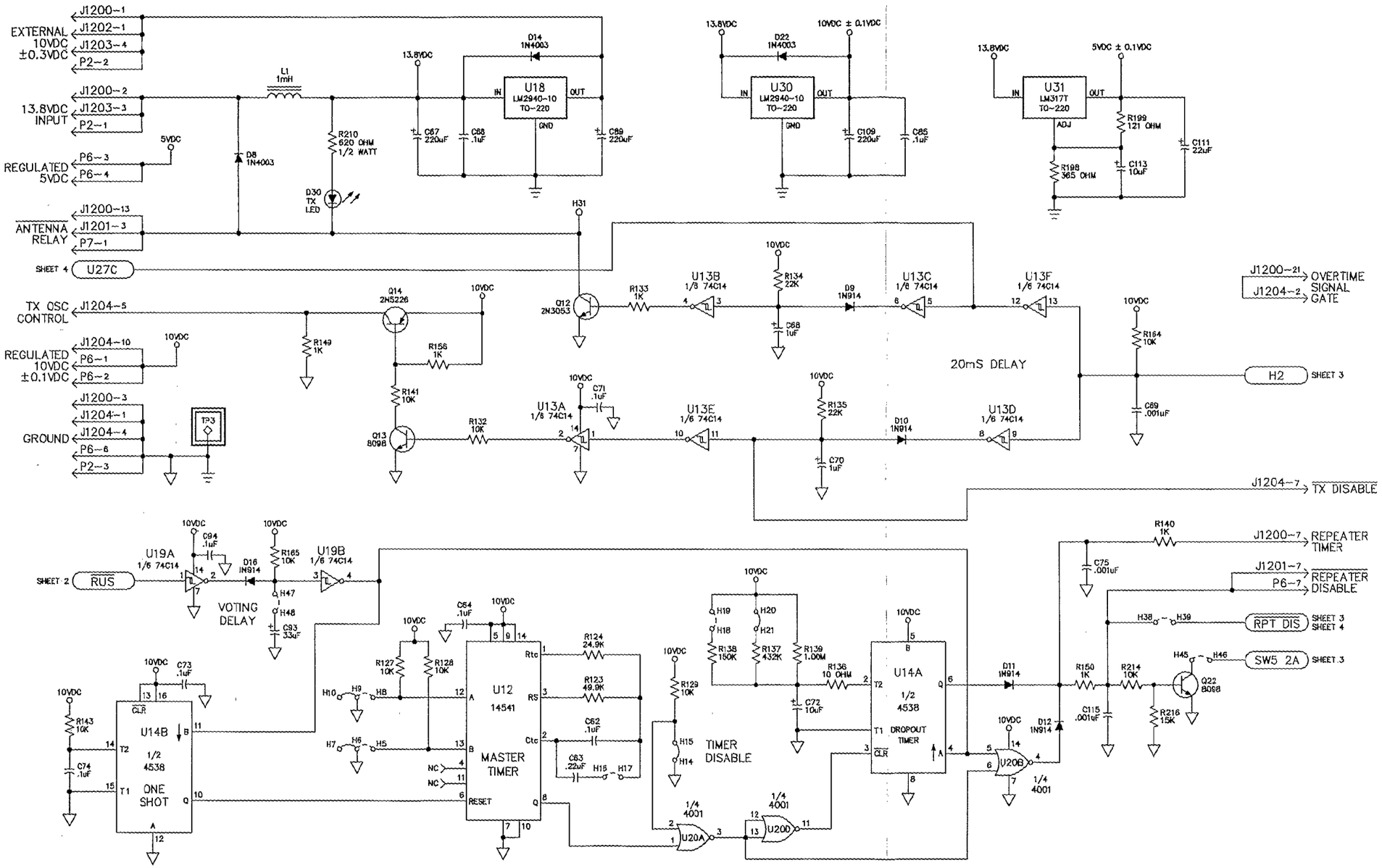


(900-0172, Silkscreen, Rev. H)
(900-0172, Component Side, Rev. H)
(900-0172, Solder Side, Rev. H)



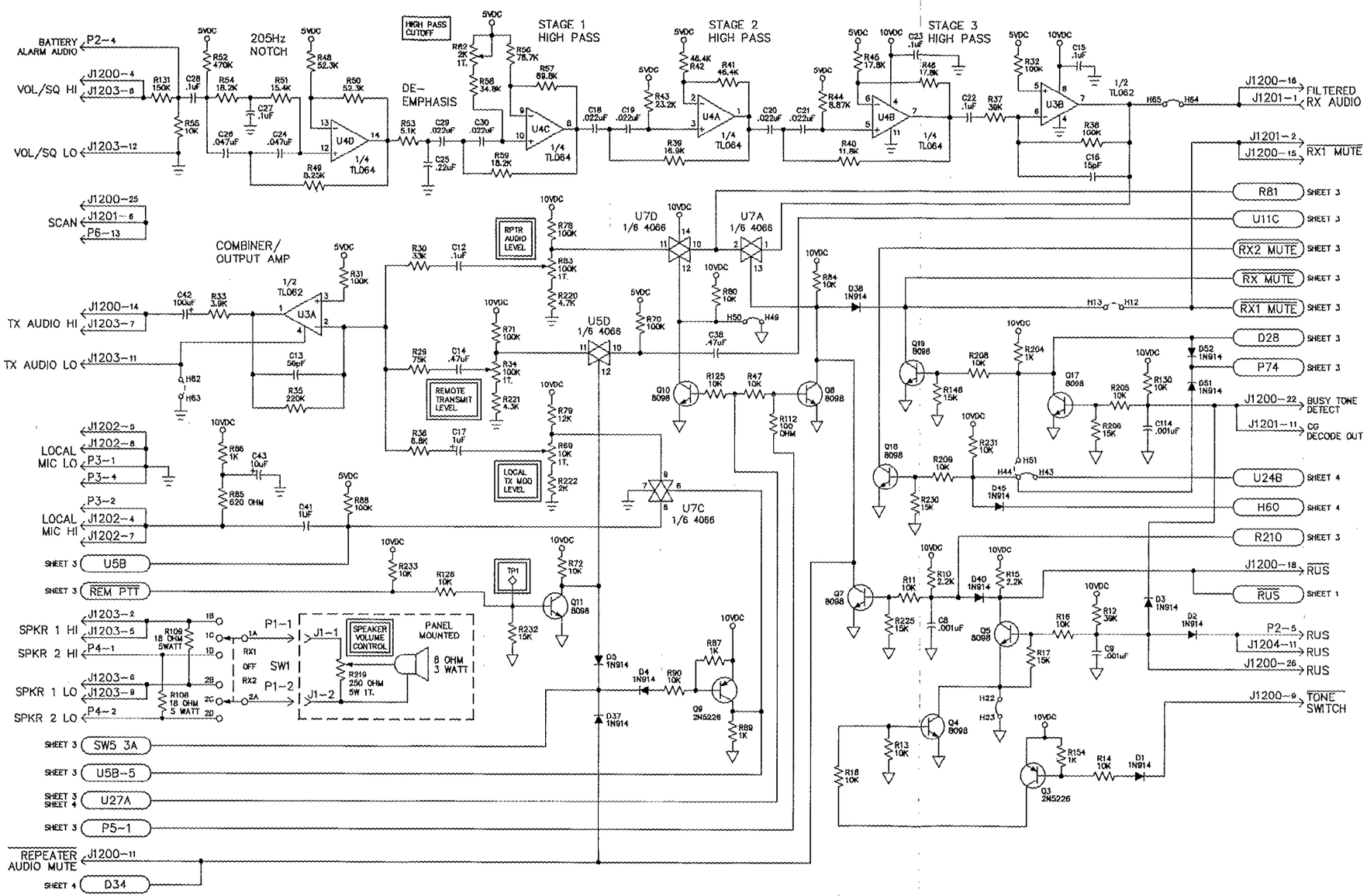
OUTLINE DIAGRAMS

Tone Remote / Remote Repeater Board
and 2175 Hz Bandpass Board



SCHEMATIC DIAGRAM (4168-S-03, Rev. P)

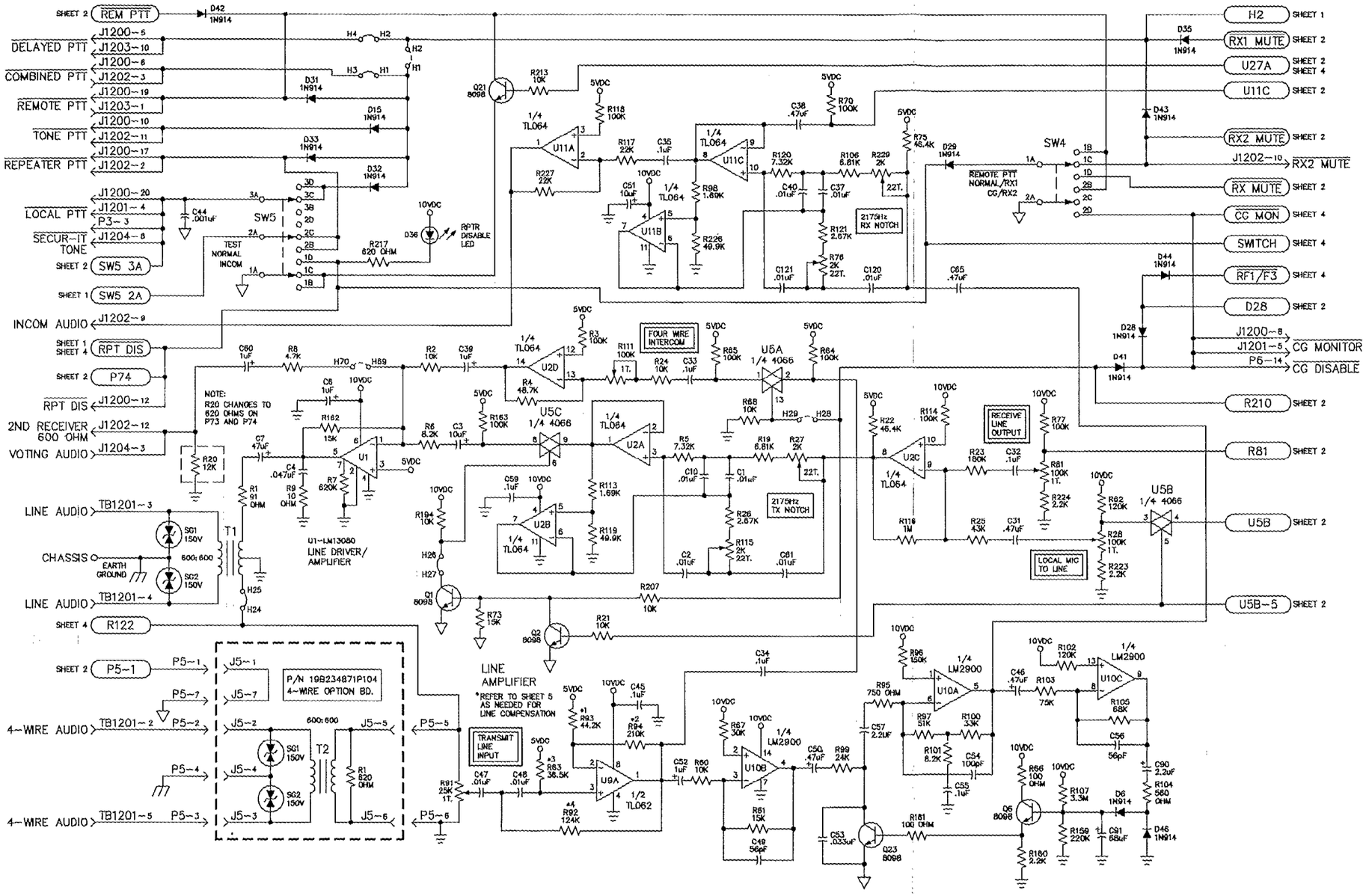
Sheet 1 of 5



(4168-S-04, Rev. P)

SCHEMATIC DIAGRAM

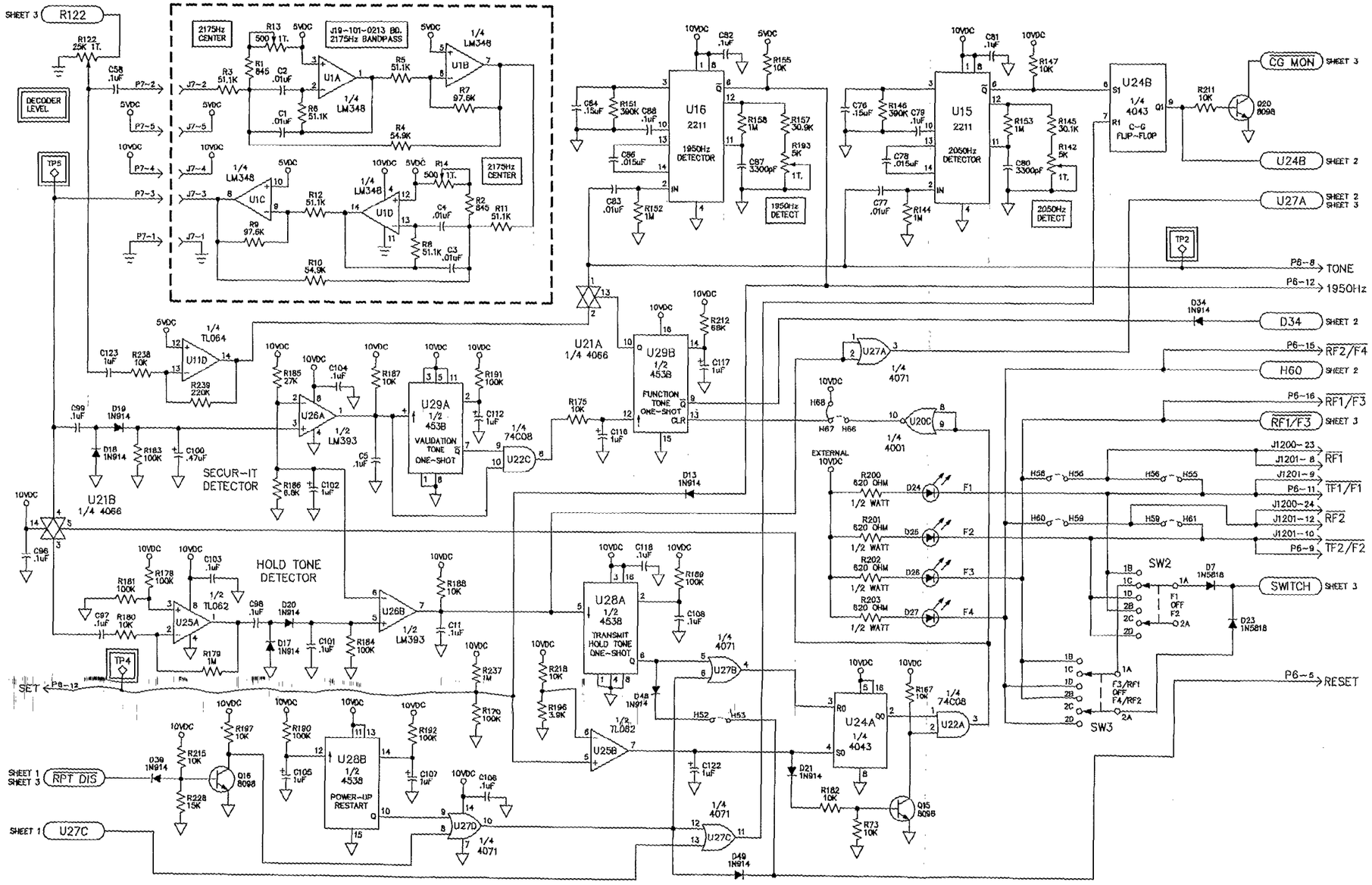
Sheet 2 of 5



SCHEMATIC DIAGRAM

(4168-S-05, Rev. P)

Sheet 3 of 5



(4168-S-06, Rev. P)

SCHEMATIC DIAGRAM

Sheet 4 of 5

NOT USED

U24C 1/4 4043 — pins 11 R2, 12 S2, 10 Q2
U24D 1/4 4043 — pins 14 S3, 15 R3, 1 Q3
1/2 TL062 U9B — pins 5, 6, 7
1/4 LM2900 U10C — pins 1, 6, 5
1/4 74C08 U22B — pins 4, 5, 6
1/4 74C08 U22D — pins 12, 13, 11
U7B 1/4 CD4066 — pins 3, 5, 4
U19C 1/6 74C14 — pins 5, 6
U19D 1/6 74C14 — pins 9, 8
U21C 1/4 CD4066 — pins 8, 6, 9
U19E 1/6 74C14 — pins 11, 10
U21D 1/4 CD4066 — pins 10, 12, 11
U19F 1/6 74C14 — pins 13, 12

SW1 3B, 3C, 3A, 3D
SW3 3B, 3C, 3A, 3D
SW2 3B, 3C, 3A, 3D
SW4 3B, 3C, 3A, 3D

C92,C95,C110,C119
D47,D50
J1202-4
J1204-6,9,12
R74,R110,R166,R168
R169,R171,R172,R174
R176,R177,R195
R234,R235,R236
TB1201-1,6
U6,U8,U17,U23

JUMPER CHART FOR P51 THRU P82 TONE PANELS
X-INSTALLED

JUMPER NUMBERS	P51	P52	P53	P54	P55	P56	P57	P58	P59	P60	P61	P62	P63	P64	P65	P66	P67	P68	P69	P70	P71	P72	P73	P74	P79	P80	P82	
H1 TO H2	X		X		X		X						X		X		X					X	X	X				
H1 TO H3		X		X		X		X	X	X	X	X		X		X		X	X	X	X				X	X	X	
H2 TO H4	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	SEE NOTE 1
H5 TO H6																												SEE TABLE 1
H6 TO H7	X	X					X	X	X	X			X	X			X	X	X	X					X	X		SEE TABLE 1
H8 TO H9																												SEE TABLE 1
H9 TO H10	X	X					X	X	X	X			X	X			X	X	X	X					X	X		SEE TABLE 1
H12 TO H13								X		X								X		X			X	X	X			SEE NOTE 8
H14 TO H15	X	X					X	X	X	X			X	X			X	X	X	X					X	X		SEE NOTE 2
H16 TO H17																												SEE TABLE 1
H18 TO H19																												SEE TABLE 2
H20 TO H21	X	X					X	X	X	X			X	X			X	X	X	X					X	X		SEE TABLE 2
H22 TO H23	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	SEE NOTE 3
H24 TO H25	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	SEE NOTE 4
H26 TO H27	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	SEE NOTE 4
H28 TO H29																												SEE NOTE 5
H38 TO H39			X	X	X	X					X	X			X	X					X	X	X	X				SEE NOTE 10
H43 TO H44		X		X		X		X	X	X	X	X		X		X		X	X	X	X				X	X	X	
H44 TO H51	X		X		X		X						X		X		X											
H45 TO H46							X	X		X							X	X		X					X			
H47 TO H48																												SEE NOTE 6
H49 TO H50	X	X	X	X	X	X			X		X	X	X	X	X	X			X		X	X	X	X		X	X	SEE NOTE 7
H52 TO H53																												
H55 TO H56					X	X						X															X	
H56 TO H58			X	X							X				X	X					X	X						
H59 TO H60			X	X							X				X	X					X	X						
H59 TO H61					X	X						X															X	
H62 TO H63																												SEE NOTE 12
H64 TO H65	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				SEE NOTE 9
H66 TO H67																												
H67 TO H68	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
H69 TO H70																							X	X				SEE NOTE 13
D7,D24,D25			X	X	X	X					X	X			X	X					X	X		X			X	
D15	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
D23			X	X							X				X	X					X	X	X	X			X	
D26,D27			X	X	X	X					X	X			X	X					X	X	X	X			X	
D28	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	
D29,D43,D44,D45																							X	X				
D35	X	X	X	X	X	X			X		X	X	X	X	X				X		Y	X	X	X		X	X	SEE NOTE 11
D39	X	X					X	X	X	X			X	X			X	X	X	X					X	X		
D41								X		X								X		X					X			
D51,D52																							X	X				

TABLE 1
REPEATER MASTER TIMER CHART

JUMPER NUMBERS	1MIN	3MIN	10MIN	TEST
H5 TO H6	X			X
H6 TO H7		X	X	
H8 TO H9	X			X
H9 TO H10		X	X	
H16 TO H17	X		X	

USE VALUES USTED FOR LINE COMPENSATION

*1	*2	*3	*4
R93	R94	R63	R92
17.8K	69.1K	14.3K	45.3K

LAST USED

C123	R239
D52	SG2
H70	SW5
L1	T1
P7	TP5
Q23	U31

TABLE 2
REPEATER DROPOUT TIMER CHART

JUMPER NUMBERS	1SEC	3SEC	10SEC
H18 TO H19	X		
H20 TO H21	X	X	

NOTES:

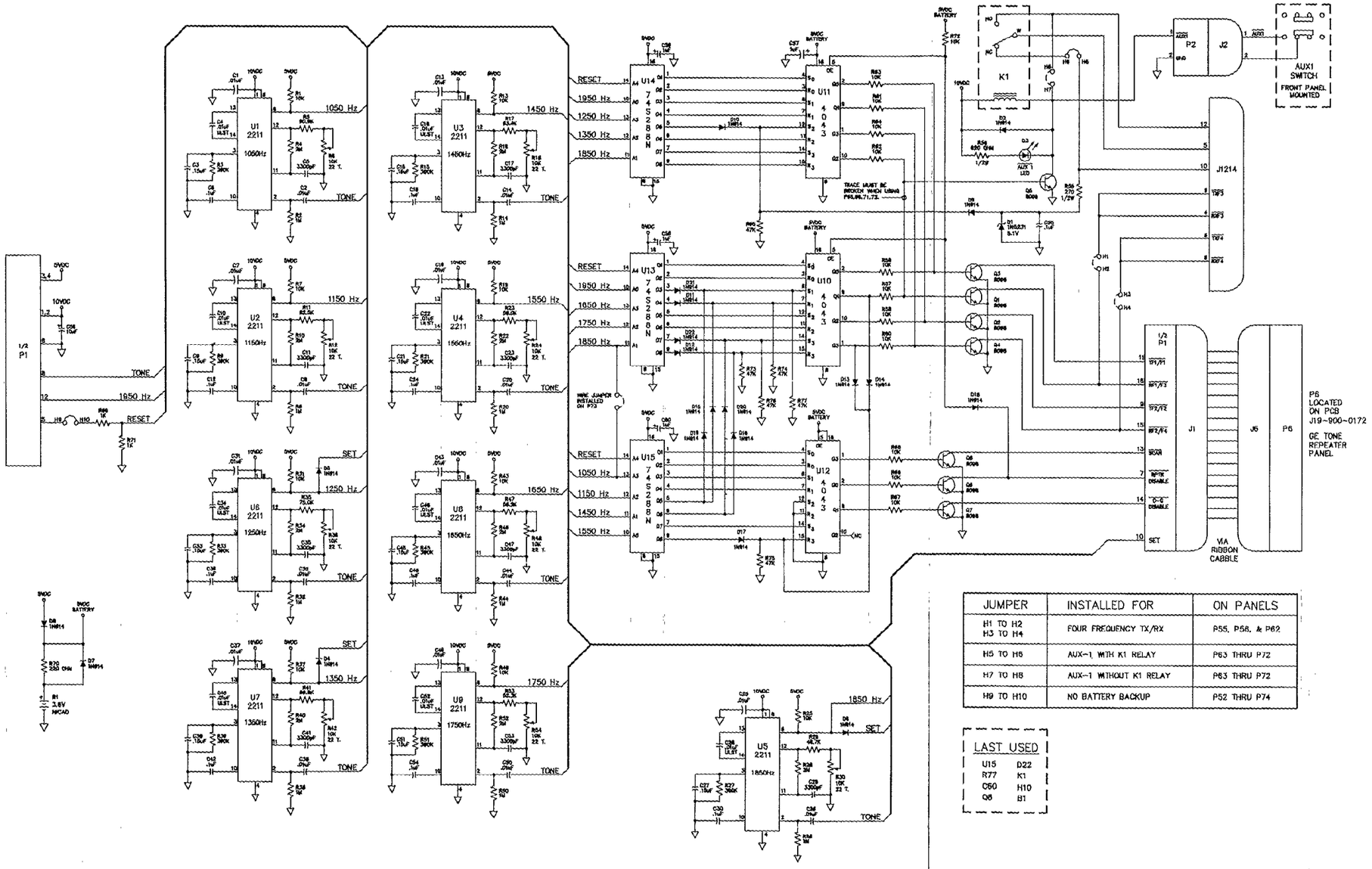
ALL JUMPER POSITIONS IN SCHEMATIC SHEETS 1--4 APPLY TO THE TONE PANEL PART NO. P62. IT IS USING A 3 MINUTE MASTER TIMER, A 3 SECOND DROPOUT TIMER, AND NONE OF THE OPTIONS.

1. REMOVE JUMPER WITH CHANNEL GUARD DECODE ONLY APPLICATIONS.
2. REMOVE JUMPER TO DISABLE THE REPEATER MASTER & DROPOUT TIMERS.
3. REMOVE JUMPER TO ENABLE THE TONE SWITCH INPUT.
4. REMOVE JUMPER WITH 4 WIRE AUDIO OPTION.
5. INSTALL JUMPER WITH 4 WIRE OPTION, EXCEPT WITH VOTER DELAY OPTION.
6. REMOVE JUMPER FOR REPEATER PTT DISABLE.
7. INSTALL JUMPER WITH VOTER DELAY OPTION.
8. INSTALL JUMPER IN REMOTE/REPEAT WITH CG OR AUX RECEIVER APPLICATIONS.
9. REMOVE JUMPER WITH VOICE GUARD APPLICATIONS.
10. REMOVE RESISTORS R150 AND R214 WHEN THIS JUMPER IS USED.
11. REMOVE D35 FOR REPEAT OPERATION.
12. INSTALL JUMPER WHEN TX GROUND ISOLATION IS NOT NEEDED.
13. INSTALL WHEN USING VOTING TONE BOARD.

(4168-S-07, Rev. P)

SCHEMATIC DIAGRAM

Sheet 5 of 5



JUMPER	INSTALLED FOR	ON PANELS
H1 TO H2 H3 TO H4	FOUR FREQUENCY TX/RX	P55, P56, & P62
H5 TO H6	AUX-1 WITH K1 RELAY	P63 THRU P72
H7 TO H8	AUX-1 WITHOUT K1 RELAY	P63 THRU P72
H9 TO H10	NO BATTERY BACKUP	P52 THRU P74

LAST USED	
U15	D22
R77	K1
C60	H10
Q6	B1

(4170-8-00, Rev. P)

SCHEMATIC DIAGRAM

Tone Extension Board

Sheet 1 of 1