MOBILE RADIO

MAINTENANCE MANUAL

FOR

VOTING SELECTOR RECEIVER MODULE 19D413994G3

(OPTIONS 5276, 5277)

LBI30768 (DF9025)

CONTENTS

SPECIFICATIONS*

Input Voltage	20 VDC ±20%
Input Level	-25 dBm to 0 dBm
Output Level (A4)	-30 dBm ±0.75 dBm
Distortion	3% Maximum
Frequency Response	±1 dB, 300 to 3000 Hz
Option 5276	Factory Installation
Option 5277	Field Installation

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

DESCRIPTION

The Receiver Module consists of a Receiver Board, and input level jack, the FAILED, SELECTED and RECEIVING indicator lights, and a three-position, SELECT-NORMAL-DISABLE switch. The Receiver Board contains the Line Input and Audio stages, the Signal Quality, Tone Receiver, Selection and failure circuits.

The A4 Line Level Compensator board (19D429656G1) is mounted to the sheet metal wrap-around of the Receiver Module and interconnects to the module by jumpers. The compensator provides an automatic gain circuit between the telephone line from the Auxiliary receiver and the Receiver Module. The AGC circuit eliminates all level adjustments on the Receiver Module due either to module installation variables or telephone line level variations.

CIRCUIT ANALYSIS

LINE INPUT & AUDIO LEVEL COMPENSATION

Tone or audio from the auxiliary receiver is coupled through line transformer T1 to H2 on the compensator board A4. The audio is then coupled through C1 of A4 to the electronic attenuator IC AT1. After the level has been compensated in AT1, the tone audio is then connected via H1 to RC-coupled amplifiers Q37 and Q38.

The output of AT1 is also fed to amplifier AR1-D on the compensator board and diode CR1 which serves as an envelope detector. The resultant DC voltage developed across C3 is applied to pin 6, the (-) input of AR1-B, and to pin 3, the (+) input of AR1-A, through voltage divider R6-R7. A threshold voltage for the operational amplifiers (AR1-A and AR1-B) is set by R8 and

applied to the alternate inputs of the op-amps. The adjustment of R8 is set at the factory and should need no further adjustment.

The differential outputs of AR1-A and AR1-B create a "threshold window" approximately 1.5 dB wide. The output of NOR gate U3A triggers the 8 bit counter (U1 and U2) to count up or down depending on whether the output level of the comparator is above or below the "window" threshold. A clock, composed of U3B, U3C and U3D, advances the counter. This clock is gated on only during the presence of status tone.

The 8 bits of the counter are converted to an analog current ramp by resistor-ladder network R10-R26. This analog ramp is applied to summing amplifier AR1-C, developing a control voltage. The control voltage is applied to pin 2 of the attenuator (AT1). As the control voltage increases, the attenuation increases which, in turn, decreases the input tone level. The result is a constant output tone level from the attenuator over an input tone level variation of zero to -25 dBm. The attenuation of AT1 is adjusted to provide a level of -20 dBm, measured at J1 on the receiver board, during the presence of status tone. When the status tone is removed, the attenuation of AT1 is held constant during the period that a voice message is received.

The output of Q37-Q38 is passed through Q1 which provides the low-impedance required for driving the audio circuits, metering circuits, the logarithmic amplifier and tone receiver.

Following Q1 is Audio Squelch Gate Q2. When tone is applied (satellite receiver squelched), Q2 is turned off, presenting a high impedance to the input signal. When tone is removed (receiver unsquelches), Q2 turns on. Audio at the collector of Q2 is applied to pin W, to the log amp and to a 1950 Hz notch filter. The filter consists of C27 and L2 and provides 20 dB attenuation for the 1950 Hz tone. The filter output is applied to selected Audio Gate Q3.

The operation of Q3 is controlled by the Selection circuit. When the receiver audio has not been selected, Q3 is turned on. This shunts the filter output to ground. When the audio has been selected, Q3 is turned off and the selected audio is applied to Emitter-Follower Q9. The output of Q9 is connected through pins 11/M to the Audio PA circuit in the Audio Module.

TONE RECEIVER

The Tone Receiver circuit consists of two Amplifier-Limiters, a tuned circuit, a Detector, a Regulator and an Output Switch.

When the satellite receiver is squelched, the 1950 Hz tone from the emitter of Q1 is coupled through blocking capacitor C11 to Amplifier-Limiters Q31 and Q32. A negative feedback path from the collector of Q31 to diode limiters CR28 and CR29 limits the signal applied to the base of Q32. Following Q32 is a tuned circuit consisting of C16 and L1.

Applying the 1950 Hz tone to the tuned circuit varies the bias on CR30. The diode now conducts on the positive half cycles of tone, and is reverse biased on the negative half cycle.

When a negative half cycle turns CR30 off, Q33 turns on. Turning on Q33 back biases CR31. This forward biases CR32 and CR33, and turns on output switch Q35. Q34 acts as a regulator for keeping the emitter voltage of Q33 constant over the temperature range.

When a positive half cycle forward biases CR30, Q33 turns off. Now C17 starts discharging through R84 and R85 which back biases CR31, keeping Q35 turned on. Q35 remains on as long as tone is applied to the circuit.

Turning on Q35 performs the logic functions shown in Table I.

When the tone is removed from the tuned circuit (receiver unsquelches), diode CR30 is forward biased by current through L1, turning off Q33. This turns off output switch Q35. Turning off Q35 performs the logic functions shown in Table II.

In applications where the Voting Selector panel is mounted in repeater stations, the +20 Volt output of Select Hold Timer switch Q43 is also used as the COS feed for keying the station. Diode CR42 is provided to prevent the repeater from being keyed on a failed receiver. When the failure circuit turns on light driver Q40, its collector drops to ground potential, cutting off Q43.

SIGNAL QUALITY CIRCUIT

The Signal Quality circuit consists basically of a Logarithmic Amplifier, an Envelope Detector, a Valley Detector and a Selection Voltage Follower. The circuit measures the audio quality of the incoming signal and compares it with the audio quality of the other receivers in the satellite systems. The best quality signal is selected and applied to the audio PA and speaker.

Logarithmic Amplifier

The Logarithmic Amplifier consists of Q10, Q11 and Q12 connected as an operational amplifier (op amp), and a non-linear

Table I - Functions With Q35 On

STAGES TURNED OFF	FUNCTIONS
Unsquelch Audio Gate Q2	Blocks tone to the audio line (pin W) and Selected Audio Gate Q3.
Detector Switch Q39	Disables valley detector circuits.
Squelch Switch Q36	Turns on Selection Cut-off stage (Q17) which disables the selection circuit. Turns on Inverter Q22 which disables Q21 in the fail "AND" Gate.
Light Driver Q41	Turns off RECEIVING light DS2. Turns on Lockup Defeat Switch Q42 which prevents the selection hold timer from locking up until the receiver unsquelches. Operates Q1 on the level compensating board A4, operating the clock.
Select Hold Timer Switch Q43	Removes the +20 Volt supply to the Selection Hold Timer circuit on the Audio Module.

Table II - Logic Functions with Q35 Off

STAGES TURNED ON	FUNCTIONS
Unsquelch Audio Gate Q2	Applies audio to the audio line (pin W), to the notch filter and Selected Audio Gate Q3, and the log amp input.
Detector Switch Q39	Enables Valley Detector circuit.
Squelch Switch Q36	Reverse biases CR34. Turns off Inverter Q22 which enables Q21 in the fail AND gate.
Light Driver Q41	Turns on RECEIVING light DS2. Turns off Lockup Defeat switch Q42. Turns off Q1 on the level compensating board A4, disabling the clock.
Select Hold Timer Switch Q43	Applies +20 Volts to the Selection Hold Timer circuit.

feedback network consisting of diodes CR7 through CR20, and feedback resistors R21 through R28. The network is non-linear so that low level signals are amplified more than high level signals.

Operation for the amplifier can be determined by the following formula:

$$A = \frac{R_f}{R_{in}}$$

where A is the amplification, R_f is the feedback resistance, and R_{in} is the input resistance.

When the receiver unsquelches, audio from the collector of unsquelch Audio Gate Q2 is applied to the amplifier through blocking capacitor C7 and input resistor R29. Audio at the collector of Q12 is applied to the feedback network.

Applying 0.6 Volts of audio to the network causes CR20 and CR13 to conduct. The positive 016 Volt forward biases CR20 while the negative 016 Volt forward biases CR13. With the two diodes conducting R28 is, in effect, removed from the network. This reduces the feedback resistance and the amplifier output.

Each additional 0.6 Volt of audio applied to the network will short out an additional resistor until all of the feedback resistors are shorted out except R21. This provides a linear decrease in voltage for each dB of quieting of the input signal.

The amplifier output is coupled through Emitter-Follower Q13 and Class B Amplifier Q14 to the Envelope Detector stage.

Envelope Detector

The Envelope Detector consists of Q15, CR21, C9 and R42. The positive portion of the audio signal is applied to the base of Q15, causing it to conduct. The output is applied to C9 and R42 which are connected in parallel when Q39 is turned on (receiver unsquelched). The output of the circuit is a fluctuating DC voltage that follows the audio envelope (See Figure 1). Due to background noise, the envelope voltage will decrease only to the noise threshold detected between each syllable.

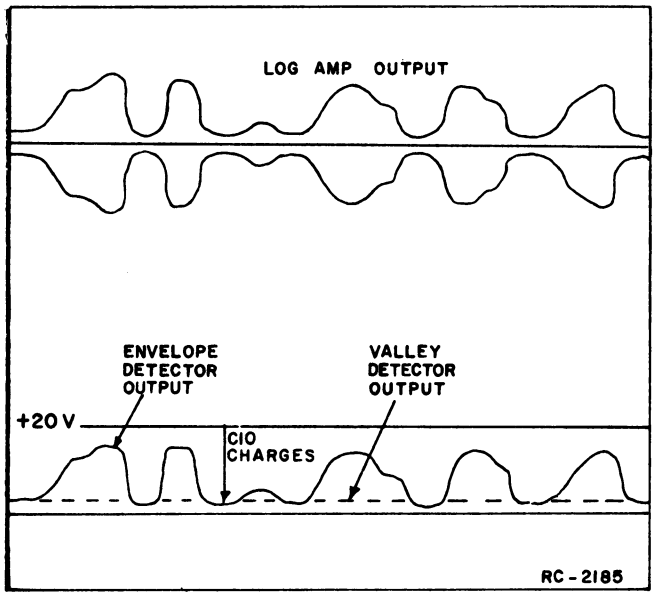


Figure 1 - Signal Quality Waveforms

Valley Detector

The Valley Detector is an inverted peak detector with a long time constant. The circuit consists of CR22, C10 and R46.

Negative peaks from the Envelope Detector cause Emitter-Follower Q16 to conduct. Turning on Q16 forward biases CR22, causing C10 to charge down to the lowest voltage in the envelope detector output. This voltage is held between syllables by the relatively large value of R46 which prevents C10 from discharging during that interval. The output of the Valley Detector is a DC voltage that is proportional to the noise level between syllables (See Figure 1). The resultant DC voltage is coupled through a high-impedance Emitter-Follower circuit (Q18 and Q19) to the cathode of CR27 in the base circuit of Selection Voltage Follower Q26. The high impedance followers allow very little of the DC signal quality voltage to be lost across resistors R47 and R48.

Selection Voltage Follower

Selection Voltage Follower Q26 is a PNP Emitter-Follower. The emitters of all of these stages (one on each receiver Board) are connected in parallel to the constant current source (See Figure 2). The current available is enough to turn on only one follower so that only one receiver can be selected.

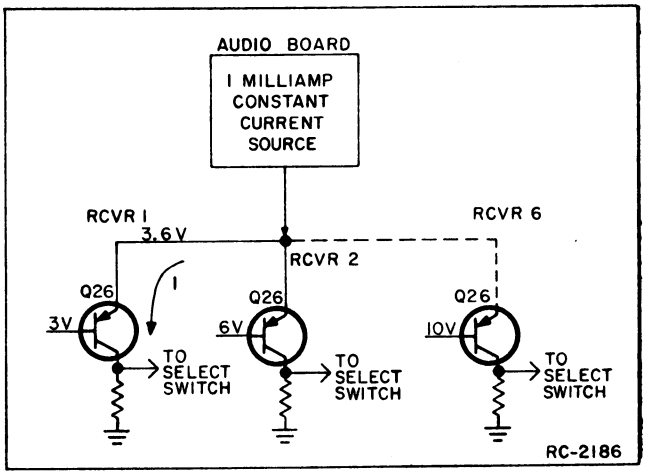


Figure 2 - Selection Voltage Circuit

The channel with the best signal (least signal quality voltage) will turn on the PNP follower because its base is more negative. Turning on the follower activates the Selection circuit, and back biases all of the remaining Voltage Followers for more positive selection.

Selection Cutoff

Selection Cutoff transistor Q17 can be used to over-ride the Signal Quality circuit and disable the selection circuit. Q17 turns on when the receiver squelches, on a line failure (Q25 turns off), or when toggle switch S1 is placed in the disable position. Turning on the transistor applies approximately +20 Volts to the base of the PNP Selection Voltage follower, simulating a signal too noisy to be selected. It also discharges C10 in the Valley Detector so that the circuit is ready for the next call.

Placing S1 in the SELECT position shorts out the Constant Current source so that the receiver can be manually selected.

SELECT CIRCUIT

The Select Circuit consists of the Select Switch, Select Light Driver and the 10% Latchup circuit.

Select Switch

When a Selection Voltage Follower is turned on, the voltage developed across R64 is sufficient to turn on Select Switch Q28 on that channel. Turning on Q28 causes its collector to go to ground potential. This turns off the Selected Audio Gate (Q3), allowing audio to be applied to the audio PA and speaker. The ground also turns off Q29, which turns on Q30, completing the ground path for SELECTED light DS1 and a remote light if used. The collector of Q28 can be grounded manually by placing switch S1 in the SELECT position.

Turning on Q28 also applies a ground to the base of Q23 in the 10% Latchup circuit.

10% Latchup

Q23 and Q24 make up the 10% Latchup circuit. Q23 remains on (and Q24 off) until three conditions occur at the same time. The conditions are:

- Failed Switch Q25 is on (no failure)
- Squelch Switch Q36 is on (receiver unsquelched)
- Select Switch Q28 is on or manually selected (receiver selected)

When these three conditions occur, Q23 turns off and Q24 turns on. Turning on Q24 reduces the Signal Quality output by approximately 10%, giving the selected channel a slight advantage. The circuit provides a sharp switching action and prevents the Voting Selector from switching back and forth on two nearly identical signals.

FAILURE CIRCUIT

The Failure Circuit prevents a dead receiver with a quiet line, a quiet line or a line with a continuous audio level from being selected and tying up the Voting Selector system. A dead line would be selected since the tone is removed and the line would be very quiet.

The circuit consists of a Peak and Valley Detector, two Failed switches, a Fail AND Gate and a light driver circuit.

Peak and Valley Detector

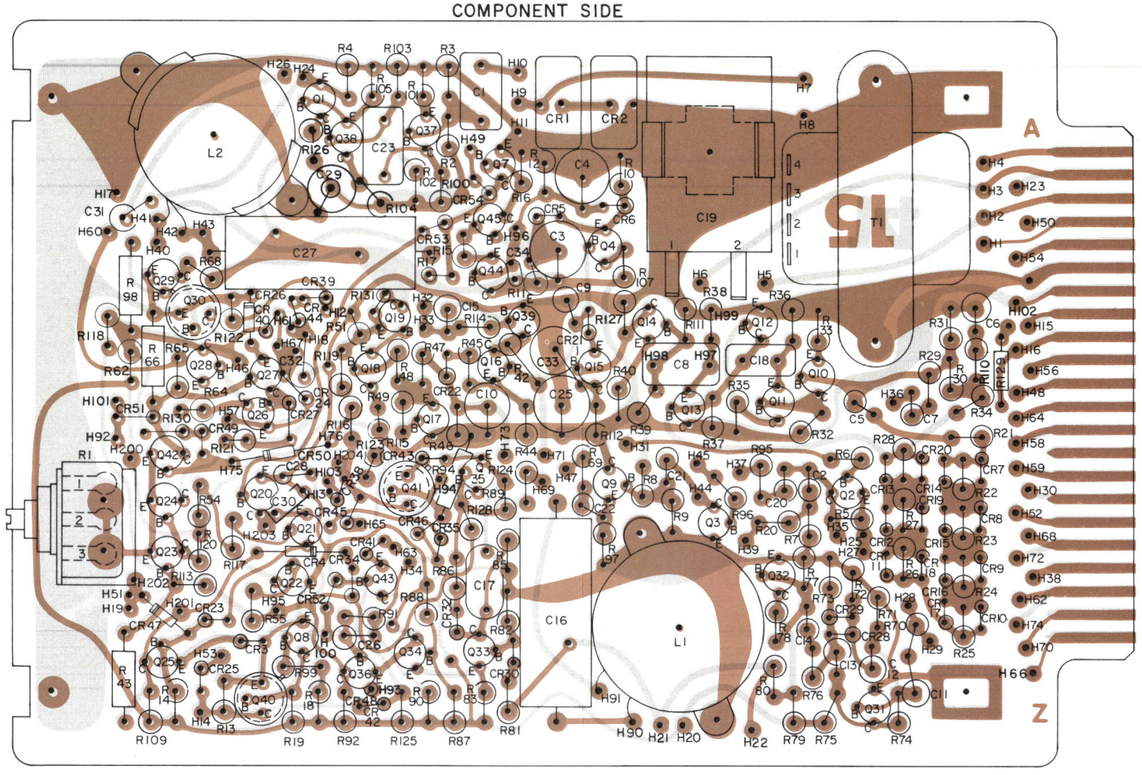
The output of the Envelope Detector is applied through Emitter-Follower Q4 to the peak and valley detectors. The negative audio peaks forward bias CR5 and discharge C3, turning on Q6. The positive audio peaks forward bias CR6 turning on Q5. When both of the cascaded followers are conducting, current flows through R15 and R16. The voltage developed across R16 keeps Q7 on (its collector at ground) which disables Q20 in the Failed AND Gate. Q5 and Q6 will remain on, keeping Q7 on, as long as there is approximately 3 dB difference in the audio peaks and valleys.

If complete silence, continuous level noise or continuous level hum appears on the line, capacitors C3 and C4 discharge to approximately the same voltage in 15 seconds. This turns off Q5 and Q6 which turns off Q7, turning on Q20 in the AND gate. However, both the 1950 Hz tone and audio must be removed to activate the Failure Circuit.

When the 1950 Hz tone is applied to the line, Q21 in the Failed AND gate is disabled by Output Switch Q35. Removing the 1950 Hz tone turns off Q35 and turns on Q36. This turns off Inverter Q22. If Q20 is turned on, Q21 turns on which indicates the absence of both audio and the 1950 Hz tone.

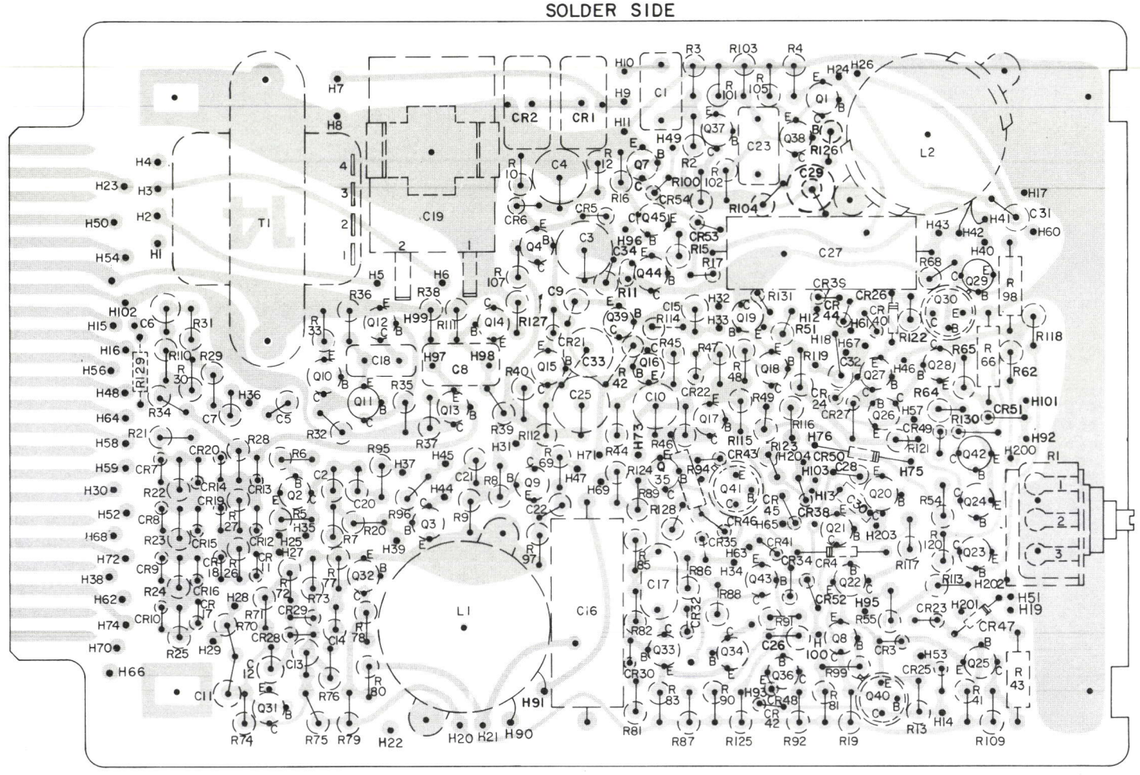
The ground at the collector of Q21 turns off Q8, allowing Q40 to turn on. This completes the ground path for FAILED light DS3 and the external alarm circuit. The ground also turns off Q25, which turns on the Selection Cutoff stage and disables the 10% Latchup circuit. Turning off Q25 also operates the FAIL LATCH CIRCUIT (Q2) on the level compensating board A4.

COMPONENT SIDE



(19D413982, Sh. 1, Rev. 15)
(19D413982, Sh. 2, Rev. 14)

SOLDER SIDE



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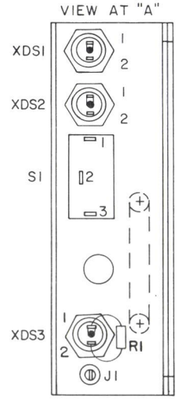
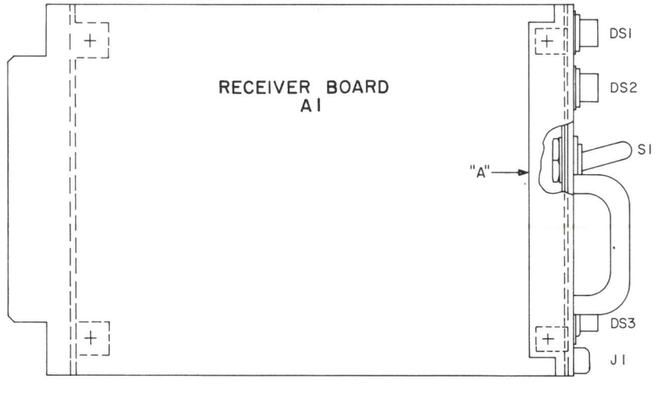
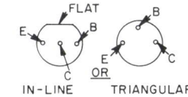


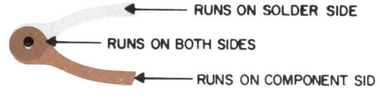


(19D416381, Rev. 10)

LEAD IDENTIFICATION
FOR Q1 THRU Q43

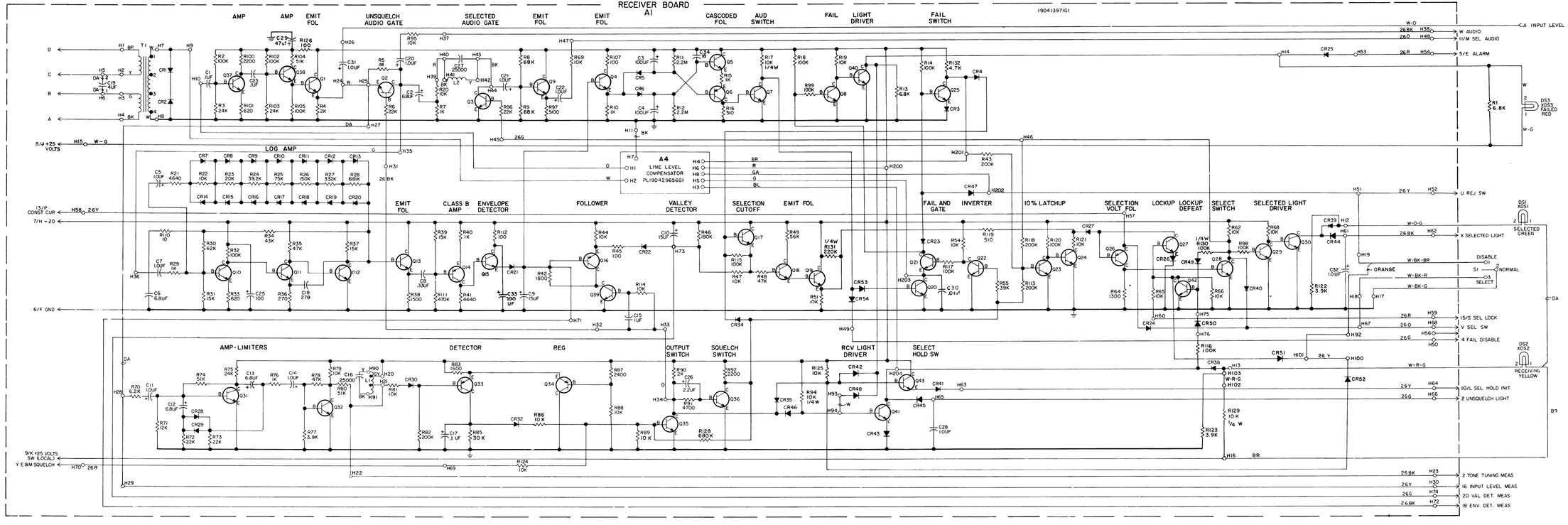


NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.



OUTLINE DIAGRAM

RECEIVER MODULE 19D413994G3



NOTES:
1. ALL WIRING SF24 UNLESS OTHERWISE SPECIFIED.
2. DA = #22 AWG WIRE SIZE.
3. ALL WHITE WIRE MUST BE 19A115075P1.

ALL RESISTORS ARE 1/2 WATT UNLESS OTHERWISE SPECIFIED AND RESISTOR VALUES IN OHMS UNLESS FOLLOWED BY K=1000 OHMS OR MEG=1,000,000 OHMS. CAPACITOR VALUES IN MICROFARADS (1/2UF, TO MICROMICROFARADS) UNLESS FOLLOWED BY UF= MICROFARADS, INDUCTANCE VALUES IN MICROHENRYS UNLESS FOLLOWED BY MH= MILLIHENRYS OR H=HENRYS.

SEE APPLICABLE PRODUCTION CHANGE SHEETS IN INSTRUCTION BOOK SECTION DEALING WITH THIS UNIT, FOR DESCRIPTION OF CHANGES UNDER EACH REVISION LETTER.

THIS ELEM. DIAG APPLIES TO	
MODEL NO	REV LETTER
PL19D413994G3	

(19B622388, Rev. 0)

SCHEMATIC DIAGRAM

RECEIVER MODULE 19D413994G3

Issue 1

PARTS LIST

VOTING SELECTOR RECEIVER MODULE
19D413994G3

SYMBOL	GE PART NO.	DESCRIPTION
A1		RECEIVER BOARD 19D413971G1
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A116080P107	Polyester: 0.1 µf ±10%, 50 VDCW.
C2	5496267P18	Tantalum: 6.8 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C3 and C4	5496267P16	Tantalum: 100 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
C5	5496267P17	Tantalum: 1.0 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C6	5496267P18	Tantalum: 6.8 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C7	5496267P17	Tantalum: 1.0 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C8	19A116080P110	Polyester: 0.33 µf ±10%, 50 VDCW.
C9 and C10	5496267P414	Tantalum: 15 µf ±5%, 20 VDCW; sim to Sprague Type 150D.
C11	5496267P17	Tantalum: 1.0 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C12 and C13	5496267P18	Tantalum: 6.8 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C14 and C15	5496267P17	Tantalum: 1.0 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C16	5496249P2500G	Polystyrene: 0.025 µf ±2-1/2%, 125 VDCW.
C17	19A116080P107	Polyester: 0.1 µf ±10%, 50 VDCW.
C18	7489162P37	Silver mica: 270 pf ±5%, 500 VDCW; sim to Electro Motive Type DM-15.
C19	748644SP1	Electrolytic, non polarized: 4 µf +100% -10%, 150 VDCW.
C20 thru C22	5496267P17	Tantalum: 1.0 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C23	19A116080P107	Polyester: 0.1 µf ±10%, 50 VDCW.
C25	5496267P16	Tantalum: 100 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
C26	5496267P13	Tantalum: 2.2 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
C27	5496249P2500G	Polystyrene: 0.025 µf ±2-1/2%, 125 VDCW.
C28	5496267P17	Tantalum: 1.0 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C29	5496267P15	Tantalum: 47 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
C30	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C31 and C32	5496267P17	Tantalum: 1.0 µf ±20%, 35 VDCW; sim to Sprague Type 150D.
C33	5496267P16	Tantalum: 100 µf ±20%, 20 VDCW; sim to Sprague Type 150D.
C34	19A116114P38	Ceramic: 18 pf ±5%, 100 VDCW; temp coef 0 PPM.
		- - - - - - - - - DIODES AND RECTIFIERS - - - - - -
CR1 and CR2	19A116062P2	Selenium.
CR3 thru CR6	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR7 thru CR22	19A115775P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR23 thru CR26	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR27	19A115775P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR28 thru CR30	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR32	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR34 and CR35	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR38 and CR39	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
CR40	4038056P1	Germanium, fast recovery, 20 reverse volts, Fwd current 40 mA.
CR41 thru CR54	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
		- - - - - - - - - INDUCTORS - - - - - - - - -
L1	19B205354G7	Coil.
L2	19B205354G2	Coil.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q1 and Q2	19A115123P1	Silicon, NPN.
Q3	19A129184P1	Silicon, NPN.
Q4 and Q5	19A115123P1	Silicon, NPN.
Q6	19A115768P1	Silicon, PNP; sim to Type 2N3702.
Q7 thru Q13	19A115123P1	Silicon, NPN.
Q14	19A115768P1	Silicon, PNP; sim to Type 2N3702.
Q15	19A115362P1	Silicon, NPN; sim to Type 2N2925.
Q16	19A115768P1	Silicon, PNP; sim to Type 2N3702.
Q17 thru Q25	19A115123P1	Silicon, NPN.
Q26	19A115852P1	Silicon, PNP; sim to Type 2N3906.
Q27 thru Q29	19A115123P1	Silicon, NPN.
Q30	19A115300P4	Silicon, NPN.
Q31 and Q32	19A115123P1	Silicon, NPN.
Q33 and Q34	19A115768P1	Silicon, PNP; sim to Type 2N3702.
Q35	19A116774P1	Silicon, NPN; sim to Type 2N5210.
Q36 thru Q39	19A115123P1	Silicon, NPN.
Q40 and Q41	19A115300P4	Silicon, NPN.
Q42 and Q43	19A115123P1	Silicon, NPN.
		- - - - - - - - - RESISTORS - - - - - - - - -
R2	3R77P104J	Composition: 100K ohms ±5%, 1/2 w.
R3	3R77P243J	Composition: 24K ohms ±5%, 1/2 w.
R4	3R77P202J	Composition: 2K ohms ±5%, 1/2 w.
R5	3R77P105J	Composition: 1 megohm ±5%, 1/2 w.
R6	3R77P223J	Composition: 22K ohms ±5%, 1/2 w.
R7	3R77P102J	Composition: 1K ohms ±5%, 1/2 w.
R8 and R9	3R77P683J	Composition: 68K ohms ±5%, 1/2 w.
R10	3R77P102J	Composition: 1K ohms ±5%, 1/2 w.
R11 and R12	3R77P225J	Composition: 2.2 megohms ±5%, 1/2 w.
R13	3R77P682J	Composition: 6.8K ohms ±5%, 1/2 w.
R14	3R77P104J	Composition: 100K ohms ±5%, 1/2 w.
R15	3R77P102J	Composition: 1K ohms ±5%, 1/2 w.
R16	3R77P511J	Composition: 510 ohms ±5%, 1/2 w.
R17	3R152P103J	Composition: 10K ohms ±5%, 1/4 w.
R18	3R77P104J	Composition: 100K ohms ±5%, 1/2 w.
R19 and R20	3R77P103J	Composition: 10K ohms ±5%, 1/2 w.
R21	19A116278P265	Metal film: 4.6K ohms ±2%, 1/2 w.
R22	19A116278P301	Metal film: 10.0K ohms ±2%, 1/2 w.
R23	19A116278P330	Metal film: 20K ohms ±2%, 1/2 w.
R24	19A116278P358	Metal film: 39.2K ohms ±2%, 1/2 w.
R25	19A116278P385	Metal film: 75K ohms ±2%, 1/2 w.
R26	19A116278P418	Metal film: 150K ohms ±2%, 1/2 w.
R27	19A116278P451	Metal film: 332K ohms ±2%, 1/2 w.
R28	19A116278P481	Metal film: 681K ohms ±2%, 1/2 w.
R29	19A116278P201	Metal film: 1K ohms ±2%, 1/2 w.
R30	3R77P623J	Composition: 62K ohms ±5%, 1/2 w.
R31	3R77P153J	Composition: 15K ohms ±5%, 1/2 w.
R32	3R77P104J	Composition: 100K ohms ±5%, 1/2 w.
R33	3R77P621J	Composition: 620 ohms ±5%, 1/2 w.
R34	3R77P433J	Composition: 43K ohms ±5%, 1/2 w.
R35	3R77P473J	Composition: 47K ohms ±5%, 1/2 w.
R36	3R77P271J	Composition: 270 ohms ±5%, 1/2 w.
R37	3R77P153J	Composition: 15K ohms ±5%, 1/2 w.
R38	3R77P152J	Composition: 1.2K ohms ±5%, 1/2 w.
R39	3R77P153J	Composition: 15K ohms ±5%, 1/2 w.
R40	19A116278P201	Metal film: 1K ohms ±2%, 1/2 w.
R41	19A116278P265	Metal film: 4.6K ohms ±2%, 1/2 w.
R42	3R77P182J	Composition: 1.8K ohms ±5%, 1/2 w.
R43	3R77P204J	Composition: 200K ohms ±5%, 1/2 w.
R44	3R77P103J	Composition: 10K ohms ±5%, 1/2 w.
R45	3R77P101J	Composition: 100 ohms ±5%, 1/2 w.
R46	3R77P184J	Composition: 180K ohms ±5%, 1/2 w.
R47	3R77P103J	Composition: 10K ohms ±5%, 1/2 w.
R48	3R77P473J	Composition: 47K ohms ±5%, 1/2 w.
R49	3R77P563J	Composition: 56K ohms ±5%, 1/2 w.
R51	3R77P103J	Composition: 10K ohms ±5%, 1/2 w.
R52	3R77P103J	Composition: 10K ohms ±5%, 1/2 w.
R55	3R77P993J	Composition: 39K ohms ±5%, 1/2 w.
R62	3R77P103J	Composition: 10K ohms ±5%, 1/2 w.
R64	3R77P132J	Composition: 1.3K ohms ±5%, 1/2 w.
R65 and R66	3R77P103J	Composition: 10K ohms ±5%, 1/2 w.
R68 and R69	3R77P103J	Composition: 10K ohms ±5%, 1/2 w.
R70	3R77P022J	Composition: 6.2K ohms ±5%, 1/2 w.
R71	3R77P123J	Composition: 12K ohms ±5%, 1/2 w.
R72 and R73	3R77P223J	Composition: 22K ohms ±5%, 1/2 w.
R74	3R77P513J	Composition: 51K ohms ±5%, 1/2 w.
R75	3R77P243J	Composition: 24K ohms ±5%, 1/2 w.
R76	3R77P102J	Composition: 1K ohms ±5%, 1/2 w.
R77	3R77P392J	Composition: 3.9K ohms ±5%, 1/2 w.
R78	3R77P473J	Composition: 47K ohms ±5%, 1/2 w.
R79	3R77P103J	Composition: 10K ohms ±5%, 1/2 w.
R80	3R77P513J	Composition: 51K ohms ±5%, 1/2 w.
R81	3R77P103J	Composition: 10K ohms ±5%, 1/2 w.
R82	3R77P204J	Composition: 200K ohms ±5%, 1/2 w.
R83	3R77P162J	Composition: 1.6K ohms ±5%, 1/2 w.
R85	3R77P303J	Composition: 30K ohms ±5%, 1/2 w.
R86	3R77P103J	Composition: 10K ohms ±5%, 1/2 w.
R87	3R77P242J	Composition: 2.4K ohms ±5%, 1/2 w.
R88 and R89	3R77P103J	Composition: 10K ohms ±5%, 1/2 w.
R90	3R77P202J	Composition: 2K ohms ±5%, 1/2 w.
R91	3R77P472J	Composition: 4.7K ohms ±5%, 1/2 w.
R92	3R77P222J	Composition: 2.2K ohms ±5%, 1/2 w.
R94	3R152P103J	Composition: 10K ohms ±5%, 1/4 w.
R95	3R77P103J	Composition: 10K ohms ±5%, 1/2 w.
R96	3R77P223J	Composition: 22K ohms ±5%, 1/2 w.
R97	3R77P512J	Composition: 5.1K ohms ±5%, 1/2 w.
R98 and R99	3R77P104J	Composition: 100K ohms ±5%, 1/2 w.
R100	3R77P222J	Composition: 2.2K ohms ±5%, 1/2 w.
R101	3R77P621J	Composition: 620 ohms ±5%, 1/2 w.
R102	3R77P104J	Composition: 100K ohms ±5%, 1/2 w.
R103	3R77P243J	Composition: 24K ohms ±5%, 1/2 w.
R104	3R77P513J	Composition: 51K ohms ±5%, 1/2 w.
R105	3R77P104J	Composition: 100K ohms ±5%, 1/2 w.
R107	3R77P101J	Composition: 100 ohms ±5%, 1/2 w.
R110	3R77P100J	Composition: 10 ohms ±5%, 1/2 w.
R111	3R77P474J	Composition: 470K ohms ±5%, 1/2 w.
R112	3R77P101J	Composition: 100 ohms ±5%, 1/2 w.
R113	3R77P204J	Composition: 200K ohms ±5%, 1/2 w.
R114	3R77P103J	Composition: 10K ohms ±5%, 1/2 w.
R115 thru R117	3R77P104J	Composition: 100K ohms ±5%, 1/2 w.
R118	3R77P204J	Composition: 200K ohms ±5%, 1/2 w.
R119	3R77P511J	Composition: 510 ohms ±5%, 1/2 w.
R120	3R77P104J	Composition: 100K ohms ±5%, 1/2 w.
R121	3R77P103J	Composition: 10K ohms ±5%, 1/2 w.
R122 and R123	3R77P392J	Composition: 3.9K ohms ±5%, 1/2 w.
R124 and R125	3R77P103J	Composition: 10K ohms ±5%, 1/2 w.
R126	3R77P101J	Composition: 100 ohms ±5%, 1/2 w.
R128	3R77P684J	Composition: 680K ohms ±5%, 1/2 w.
R129	3R152P103J	Composition: 10K ohms ±5%, 1/4 w.
R130	3R152P104J	Composition: 100K ohms ±5%, 1/4 w.
R131	3R152P224J	Composition: 220K ohms ±5%, 1/4 w.
R132	3R77P472J	Composition: 4.7K ohms ±5%, 1/2 w.
		- - - - - - - - - TRANSFORMERS - - - - - - - - -
T1	19A115731P1	Audio freq: 300 to 6000 Hz, +1.0 db; Power: +18 dBm; max DC 20 mA combined, Pri: 600 ohms, Sec 1 and 2: 600 ohms.
A4		LINE LEVEL COMPENSATOR 19D429855G1
		- - - - - - - - - INTEGRATED CIRCUITS - - - - - -
AR1	19A134511P1	Linear, Quad OP AMP; sim to NSCLM 224N or MLM224P.
AT1	19A134609P1	Linear, Dual In-Line 8 Pin Mini Dip Package; sim to MC 3340P.
		- - - - - - - - - CAPACITORS - - - - - - - - -
C1	19A116080P107	Polyester: 0.1 µf ±10%, 50 VDCW.
C2	19A116080P101	Polyester: 0.01 µf ±10%, 50 VDCW.
C3	19A134202P5	Tantalum: 3.3 µf ±20%, 15 VDCW.
C4	19A116080P107	Polyester: 0.1 µf ±10%, 50 VDCW.
C5	19A116080P105	Polyester: 0.047 µf ±10%, 50 VDCW.
C6	19A134202P6	Tantalum: 22 µf ±20%, 15 VDCW.
C7	19A134202P15	Tantalum: 6.8 µf ±20%, 35 VDCW.
C8	5496267P11	Tantalum: 68 µf ±20%, 15 VDCW; sim to Sprague Type 150D.
C9	19A115680P10	Electrolytic: 200 µf +150% -10%, 18 VDCW; sim to Mallory Type TTX.
C10	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
C12 thru C16	19A116080P1	Polyester: 0.01 µf ±20%, 50 VDCW.
		- - - - - - - DIODES AND RECTIFIERS - - - - - - -
CR1 thru CR8	19A115250P1	Silicon, fast recovery, 225 mA, 50 PIV.
		- - - - - - - - - TRANSISTORS - - - - - - - - -
Q1 and Q2	19A115910P1	Silicon, NPN; sim to Type 2N3904.
		- - - - - - - - - RESISTORS - - - - - - - - -
R1	3R152P471J	Composition: 470 ohms ±5%, 1/4 w.
R2	3R152P131J	Composition: 130 ohms ±5%, 1/4 w.
R3	3R152P103J	Composition: 10K ohms ±5%, 1/4 w.
R4	3R152P474J	Composition: 470K ohms ±5%, 1/4 w.
R5	3R152P470J	Composition: 47 ohms ±5%, 1/4 w.
R6	19C314256P21740	Metal film: 174 ohms ±1%, 1/4 w.
R7	19C314256P2909	Metal film: 9.09K ohms ±1%, 1/4 w.
R8	19A116430P8	Variable, cermet: 10K ohms ±10%, 0.75 w; sim to Helitrim Model 79P.
R9	3R152P104J	Composition: 100K ohms ±5%, 1/4 w.
R10 and R11	19C314256P2003	Metal film: 200K ohms ±1%, 1/4 w.
R12	19C314256P21003	Metal film: 100K ohms ±1%, 1/4 w.
R13	19C314256P22003	Metal film: 200K ohms ±1%, 1/4 w.
R14	19C314256P21003	Metal film: 100K ohms ±1%, 1/4 w.
R15	19C314256P22003	Metal film: 200K ohms ±1%, 1/4 w.
R16	19C314256P21003	Metal film: 100K ohms ±1%, 1/4 w.
R17	19C314256P22003	Metal film: 200K ohms ±1%, 1/4 w.
R18	19C314256P21003	Metal film: 100K ohms ±1%, 1/4 w.
R19	19C314256P22003	Metal film: 200K ohms ±1%, 1/4 w.
R20	19C314256P21003	Metal film: 100K ohms ±1%, 1/4 w.
R21	19C314256P22003	Metal film: 200K ohms ±1%, 1/4 w.
R22	19C314256P21003	Metal film: 100K ohms ±1%, 1/4 w.
R23	19C314256P22003	Metal film: 200K ohms ±1%, 1/4 w.
R24	19C314256P21003	Metal film: 100K ohms ±1%, 1/4 w.
R25 and R26	19C314256P22003	Metal film: 200K ohms ±1%, 1/4 w.
R27	3R152P392J	Composition: 3.9K ohms ±5%, 1/4 w.
R28	3R152P393J	Composition: 39K ohms ±5%, 1/4 w.
R29	3R152P512J	Composition: 5.1K ohms ±5%, 1/4 w.
R30	3R152P104J	Composition: 100K ohms ±5%, 1/4 w.
R31	3R152P474J	Composition: 470K ohms ±5%, 1/4 w.
R32	3R152P103J	Composition: 10K ohms ±5%, 1/4 w.
R33	3R152P513J	Composition: 51K ohms ±5%, 1/4 w.
R34	3R152P333J	Composition: 10K ohms ±5%, 1/4 w.
R35	3R152P513J	Composition: 51K ohms ±5%, 1/4 w.
R36	3R152P333J	Composition: 10K ohms ±5%, 1/4 w.
R37	3R77P331J	Composition: 330 ohms ±5%, 1/2 w.
R38	3R152P511J	Composition: 510 ohms ±5%, 1/4 w.
R39 and R40	3R152P333J	Composition: 10K ohms ±5%, 1/4 w.
R41 and R42	3R152P513J	Composition: 51K ohms ±5%, 1/4 w.
R43	3R152P682J	Composition: 6.8K ohms ±5%, 1/4 w.
R44	3R152P684J	Composition: 680K ohms ±5%, 1/4 w.
R45	3R152P682J	Composition: 6.8K ohms ±5%, 1/4 w.
R46	3R152P684J	Composition: 680K ohms ±5%, 1/4 w.
		- - - - - - - - INTEGRATED CIRCUITS - - - - - - -
U1 and U2	19A134097P208	Digital, Binary Up/Down Counter: Identification No. 4516.
U3	19A134097P2	Digital, Quad 2-input Nor Gate: Identification No. 4001.
		- - - - - - - - VOLTAGE REGULATORS - - - - - - -
VR1	4036887P11	Zener: 500 mW, 10.0 v. nominal.
		- - - - - - - - INDICATING DEVICES - - - - - - -
DS1 thru DS3	19A115825P1	Lamp, incandescent: 28 v; sim to Drake 2840.
		- - - - - - - - JACKS AND RECEPTACLES - - - - - -
J1	7150763P4	Jack, tip, stake-in: green nylon body, sim to Alden Products 1108C1.
		- - - - - - - - - RESISTORS - - - - - - - - -
R1	3R77P682J	Composition: 6.8K ohms ±5%, 1/2 w.
		- - - - - - - - - SWITCHES - - - - - - - - -
S1	5491875P3	Toggle: SPDT, 15 amps at 125 or 250 VAC; sim to Vendor Micro Switch 11TS115-1.
		- - - - - - - - - SOCKETS - - - - - - - - -
XDS1 thru XDS3	19B201122P2	Lampholder: sim to Drake Mfg 121 Series.
		- - - - - - - - - MISCELLANEOUS - - - - - - - - -
	19A122682P2	Handle.
	7115195P2	Hex nut: No. 15/32-32. (Secures S1).
	4033394P1	Nut, knurled: thd. Size 15/32-32 NS-2. (Secures S1).
	7115130P11	Lockwasher, internal tooth: sim to Shakeproof 1222-1. (Secures S1).
	7160861P1	Nut, sheet spring: sim to Tinnerman C1996-632-157. (Secures front support).
	X6819P13006C6	Screw, phillips head: No. 6-32 x 3/8. (Secures front support).
	9509P1C6	Button plug. (Located between S1 & DS3).
	19A129463P5	Harness.
	19B201122P3	Panel light, lens: green translucent nylon. (DS1).
	19B201122P4	Panel light, lens: red translucent nylon. (DS3).
	19B201122P6	Panel light, lens: yellow translucent nylon. (DS2).
	19B200525P153	Rivet, tubular. (Secures C19 on A1).
	7118719P4	Clip, spring tension: sim to Prestole E-50005-007. (Secures C19 on A1).
	4033536P26	Fiber, washer. (Used with C25 on A1).
	X80P9003C6	Machine screw: No. 4-40 x 3/16. (Secures L1 & L2 on A1).
	4036555P1	Insulator, washer: nylon. (Used with Q30, Q40, & Q41).
	X80P9130S5C6	Machine screw: No. 6-32 x 5/16. (Secures T1 on A1).
	9402P7	Flatwasher: No. 6. (Secures T1).
	4035656P65	Spacer, threaded. (Located on A4).

*COMPONENTS ADDED, DELETED OR CHANGED BY PRODUCTION CHANGES

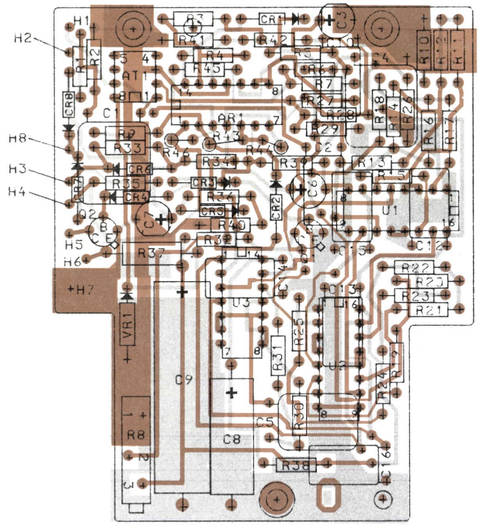
All voltages are DC readings taken with a DC-VTVM with an 11 megohm impedance, and with the Failure circuit disabled (Violet jack on Interconnection Board Grounds). Voltages are measured from transistor pin to ground.

Transistor	SQUELCHED (With 1950 Hz tone applied set to -20 dBm at J1)			UNSQUELCHED (With 1000 Hz tone applied set to -20 dBm at J1)			UNSQUELCHED (With no signal or noise applied)		
	Emitter	Base	Collector	Emitter	Base	Collector	Emitter	Base	Collector
Q1	2.8	3.4	20	2.8	3.4	20			
Q2	2.8	0.12	2.7	2.8	3.45	2.45			
Q3	0	0.68	0	0	0.04	0			
Q4	18	18.2	19.0	13.6	14.2	19.0			
Q5	17.0	17.0	20.0	13.0	13.4	20			
Q6	16.0	17.0	0	13.0	13.8	0			
Q7	0	0	0	0	0	0			
Q8	0	0.62	0.06	0	0.62	0.08			
Q9	9.0	9.5	20	9	9.6	20.0			
Q10	0.1	0.68	0.68	0.12	0.68	0.7			
Q11	0.12	0.68	0.59	0.12	0.7	0.6			
Q12	0	0.59	5.4	0	0.6	5.5			
Q13	0.48	5.4	20.0	4.7	5.6	20.0			
Q14	19.0	19.5	0.36	18.5	19.5	7.4	19.5	19.0	0.36
Q15	0.12	0.36	20.0	11.0	7.2	19.5	0.12	0.36	20.0
Q16	18.0	17.5	18.0	12.8	13.8	0	0.68	0.04	0.02
Q17	18.5	18.5	20.0	15.0	14.9	20	1.14	1.13	20.0
Q18	18.0	18.5	19.5	14.5	15.0	19.0	0.74	1.13	20.0
Q19	17.5	18.2	20.0	13.9	14.6	20.0	0.24	0.75	19.8
Q20	0	0	0	0	0	0			
Q21	0	0	10.2	13.0	13.5	13.0			
Q22	0	0.67	0.05	0	0.05	19.5			
Q23	0	0.6	0	0	0.28	0.64			
Q24	0	0	17.5	0	0.64	0.04			
Q25	0.66	1.28	0.7	0.66	1.3	0.72			
Q26	16.5	16.0	0	13.6	13.0	2.15	1.2	0.58	0.62
Q27	0.1	0	16.0	0.1	0	16			
Q28	0	0	12.4	0	0.65	0.04			
Q29	0	0.62	0.08	0	0.05	0.78			
Q30	0	0.08	26	0	0.78	0.12			
Q31	0	0.6	3.3	0	0.6	3.3			
Q32	0	0.62	16.4	0	0.62	15.4			
Q33	17.0	19.0	11.4	16.5	18.0	0.55			
Q34	17.0	16.5	0	16.5	16.0	0			
Q35	0	0.7	0.12	0	0.4	10.0			
Q36	0	0.12	19.0	0	0.7	0.02			
Q37	2.9	3.6	9.4	2.8	3.5	9.2			
Q38	3.4	3.9	18.2	3.4	3.8	17.8			
Q39	0	0	18.2	0	0.7	0.05			
Q40	0	0	24.0	0	0.05	23.5			
Q41	0	0	24.0	0	0.75	0.2			

VALLEY DETECTOR

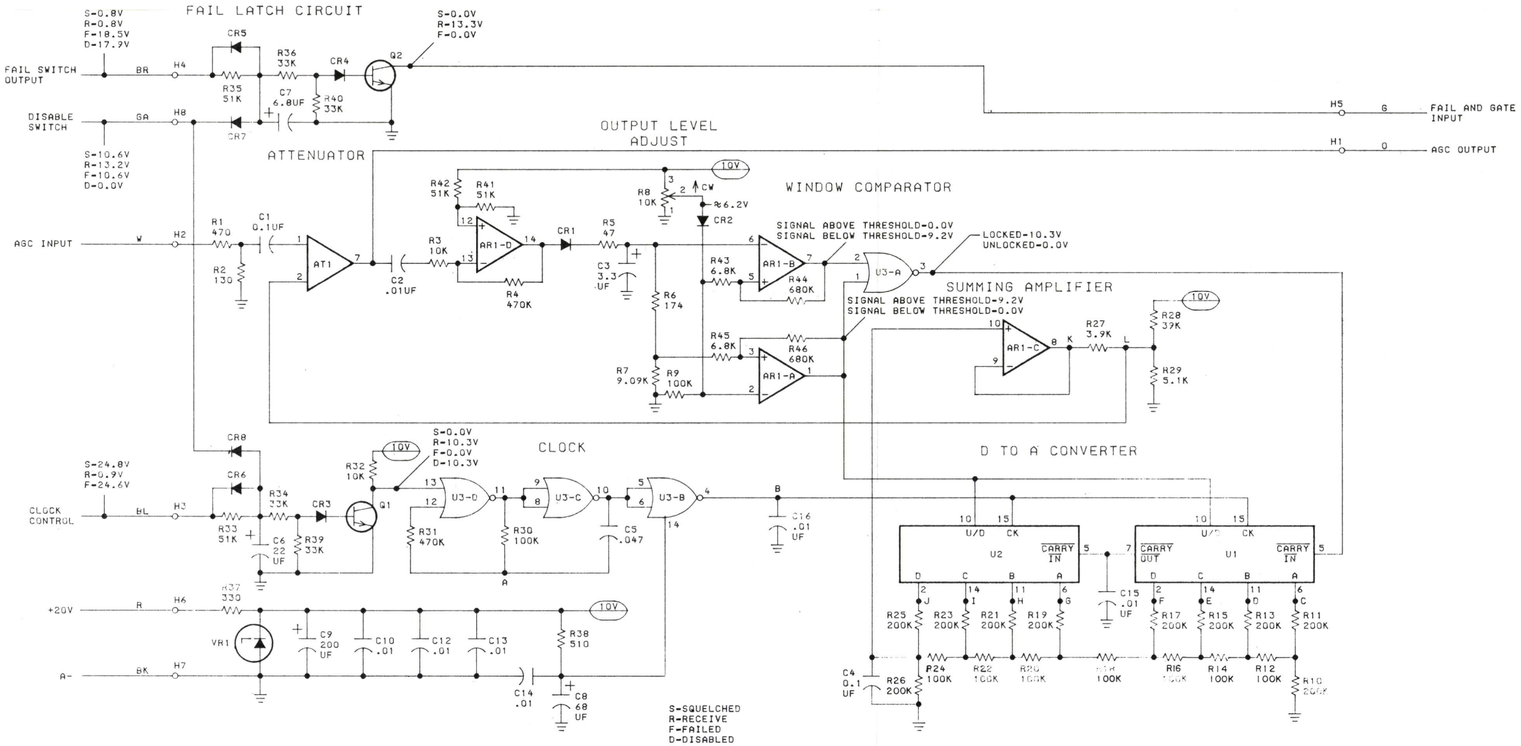
DC Readings taken with 1000 Hz applied, measured from Blue Jack to Gnd.

Level at J1	Reading At Blue Jack
-20 dBm	15.5 V
-25 dBm	14.0 V
-30 dBm	12.3 V
-40 dBm	8.6 V
-50 dBm	4.9 V
-55 dBm	3.3 V
-60 dBm	2.4 V



WIRE CHART		
WIRE	FROM	REMARKS
T22-O	H1	LET HANG FROM COMPONENT SIDE
T22-W	H2	
T22-BL	H3	
T22-BR	H4	
T22-G	H5	
T22-R	H6	
T22-BK	H7	
T22-GA	H8	LET HANG FROM COMPONENT SIDE

(19D429812, Rev. 0)
(19B232779, Sh. 1, Rev. 0)
(19B232779, Sh. 2, Rev. 0)

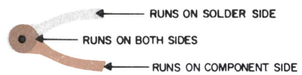


POWER AND GROUND CONNECTIONS		
DEVICE	V+ (10V) PIN NO.	GND PIN NO.
AR1	4	11
AT1	8	3
U1,U2	16	1,3,4,8,9,12,13
U3		7

MODEL NO	REV LETTER
PL19D429656G1	

(19D429975, Rev. 1)

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

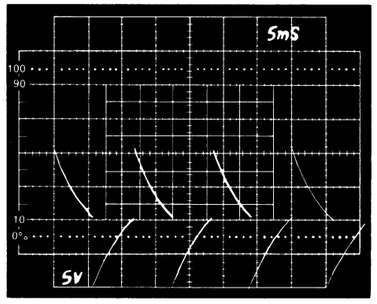


SERVICE SHEET

LINE LEVEL COMPENSATING
BOARD A4 (SHEET 1)

WAVEFORMS (A - L) CORRESPOND TO DESIGNATIONS ON SCHEMATIC DIAGRAM. WAVEFORMS SHOWN ARE WITH RECEIVER MODULE FAILED WITH NO AUDIO INPUT, RESULTING IN FREE-RUNNING CLOCK AND RAMP GENERATOR. 0 VOLTS IS BASE LINE ABOVE VOLTAGE SCALE.

A



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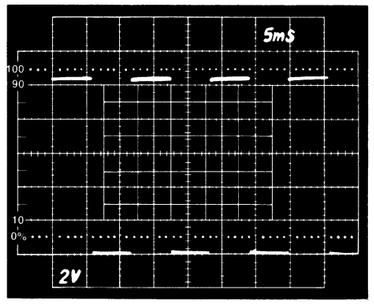

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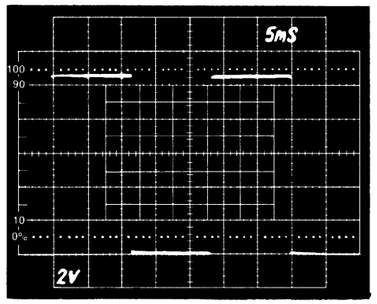

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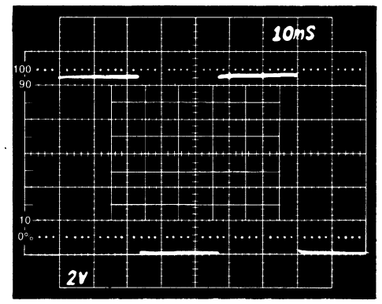

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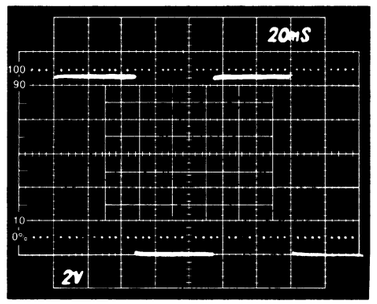

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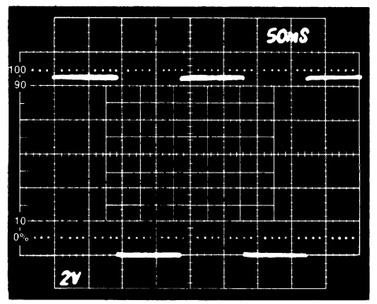

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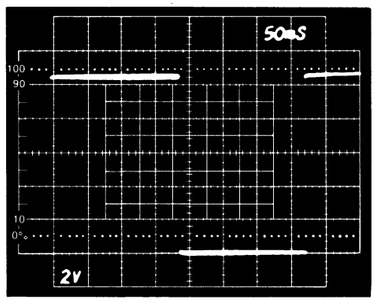
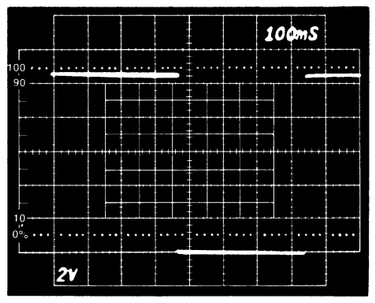
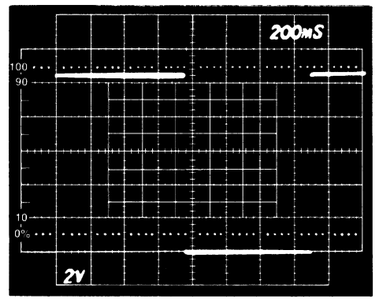


H



I



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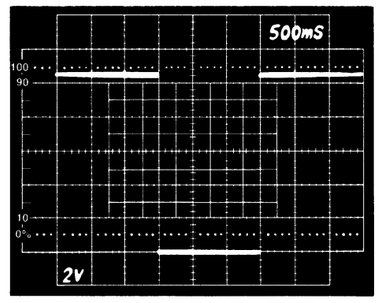

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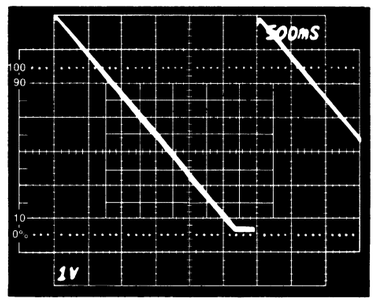

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