SPECIFICATIONS

Operating Range	Varies with installation. Typical maximum range is 25 feet.
Operating Times	Turn-on delay: Approximately 10 seconds. Alarm delay: 20 to 30 seconds (lamp-on time). Automatic reset delay: 20 to 30 seconds (alarm-on time).
Ultrasonic Frequency	Approximately 41 kHz.
Power Outlets	Two AC sockets: One for Lamp, one for Alarm.
Power Outlet Current	Three amperes total for both sockets (360 watts at 120 volts).
Power Requirements	110-130 or 220-260 VAC, 50/60 Hz, 1-1/2 watts.
Dimensions	Chassis only, 2" wide x 9-1/4" high x 7" deep (approximately). In book-style cover, 2-3/8" wide x 10-1/8" high x 7-1/2" deep (approximately).
Net Weight	Approximately 3 lbs. in book-style cover; approximately 2-1/4 lbs. without cover.

TRANSMITTER TESTS

7. Test Point N (Figure 2, Page 21).	A. 11 VDC ±1V.	Leave meter leads connected for checks B and C that follow.
	B. REading should increase .1 or .2 VDC.	When base (B) of Q19 is shorted to chassis.
	C. Reading should decrease .2 or .3 VDC.	When emitter (E) of Q19 is shorted to chassis.
NOTE: If voltages do not change as stated, make sure all parts have been correctly installed and all controls, switches, and sockets have been correctly wired.		

CIRCUIT DESCRIPTION

Refer to the Schematic Diagram (fold-out from Page 39) as you read this "Circuit Description."

GENERAL

An RF signal is transmitted by transducer TR2. The receiving transducer, TR1, receives the transmitted signal and monitors it for a change in amplitude. If a change is detected (produced by a moving object), then the Lamp and Alarm outlets are switched on until they are reset either automatically or manually.

TRANSMITTER

A Colpitts oscillator circuit (Q19 and associated components) provide the basic drive for the transmitting transducer, TR2. The signal voltage developed at the collector is stepped up through autotransformer action in coil L1. The widely varying reactance of the transducer near resonance is partially isolated from the oscillator by a series resistor, R22. The transducer exerts a strong influence on the final frequency because it "pulls" the oscillator toward its own resonant frequency.

If a frequency counter is available, the oscillator frequency can be checked across the emitter resistor, R21. Use a DC blocking capacitor.

RF RECEIVER AND DETECTOR

The receiving transducer, TR1, is direct-coupled to transistor Q1, the first amplifier, through an AC low-pass filter capacitor C2 and resistor R3. A large capacitor, C1, provides turn-on delay by offering a large time constant for the base bias voltage. Another resistor, R2, keeps the large capacitor from shorting out the signal.

The second stage (transistor Q2) is an amplifier feeding the voltage-doubler type of detector, diodes D1 and D2. Some forward bias is applied through resistor R9 to these diodes for greater sensitivity to small signals.

LF AMPLIFIER AND DETECTOR

Variations in the rectified RF carrier level constitute a modulation of the signal, whether attributed to a variation in reflected signal strength, or a sideband differing slightly in frequency from the carrier (Doppler effect). Such demodulated signals are passed through a low-pass filter (R13, R14, R15, C9, C11, and C12) to the LF amplifier (transistors Q3 and Q4), an emitter follower and a voltage amplifier. The input and output coupling time constants are chosen to give a roll-off for low frequencies such that the overall characteristic yields a bandpass suitable for the range of frequencies generated by normal human movement within the acoustic field (approximately 50 to 150 Hz).

The LF detector, transistor Q5, is normally saturated by a stable bias. The stage is barely saturated, and any signal coupled to the base leads to momentary reduction of the effective bias. This results in positive voltage pulses in the collector circuit.

The sensitivity can be reduced by adjusting control R25 to attenuate the signal. A larger signal from transistor Q4 is therefore required to produce an output in the Q5 collector circuit.

CONTROL AND TIMING CIRCUITS

Schmitt trigger circuits are used to modify the analog type input signals. The Schmitt trigger circuit output is either "high" or "low" and these levels depend upon whether the analog input voltage is above or below certain levels. The normal bias for the first of the three Schmitt triggers is set by resistors R31 and R32, which form a voltage divider.

These Schmitt triggers have a wide range of permissible input levels (a large amount of hysteresis) as shown by the space between voltage levels "A" and "B" in Figure 8. Input signals higher than level "A" will drive the output level "high," and signals lower than level "B" will drive the output "low." The output retains its high or low level until driven to the opposite level, as shown. The output level transitions are sharp and result in a squared waveform in the output.

The pulses from the LF detector are coupled to transistor Q6, which is connected across the upper leg of the voltage divider. Thus, any signal pulse turns on the transistor and momentarily shorts out resistor R31, the upper leg of the divider. This raises the voltage input to the Schmitt trigger and turns it on. Because instant response to a single random signal is not desirable, an integrating type of delay (capacitor C19) is added across the lower leg of the divider. Further delay is provided by an RC low-pass filter (R33 and C22) between the voltage divider and Schmitt trigger #1.

"Reset" is obtained by shorting the Schmitt trigger #1 input to common through a reset transistor, Q7. Resistor R34 between the RC filter and the Schmitt trigger limits the current in the reset transistor and shortens the "off" time in the presence of an incoming signal.

The output of Schmitt trigger #1 is DC coupled through zener diode D5 to transistor Q10, the relay control transistor. The relay current is taken from the unregulated supply, and is limited by resistor R41. Inductive behavior of the relay coil is neutralized by a paralleled circuit, R42 and C24.

When Q10, the relay control transistor, is turned on, it removes the forward bias of transistor Q11, which shorted the timing capacitor, C25. That capacitor can now charge up through the timing resistor, R45, and turn on Schmitt trigger #2. It will charge slowly for normal use, or rapidly for testing purposes by turning the adjusting screw (SW2) tight. This places R44 in parallel with R45 and alters the time delay.

At the moment Schmitt trigger #2 turns on, it closes relay RL2. The second timing capacitor, C27, is unshorted. It charges and turns on Schmitt trigger #3, Q16 and Q17. This provides the signal to drive Q7, the reset transistor, providing switch SW4 is in the "Auto Reset" position. If the switch is in the Hold position, both relays will remain tripped until SW4 is returned to Auto-Reset, or the Power switch is placed at Off.

A quick chain reaction follows the reset of Schmitt trigger #1: RL1 opens, the timing capacitor is shorted, Schmitt trigger #2 resets, etc., until the original condition is re-established.

POWER SUPPLY

The power transformer primary can be wired for either 120 VAC or 240 VAC nominal voltages by means of wire jumpers on the circuit board.

Electric line power is supplied through the relay contacts to two AC outlet sockets. The relay contacts are shunted with RC arc suppressors (C32-R62 and C33-R63).

The power transformer secondary feeds a bridge rectifier, D9 through D12. The rectifier output supplies the relay coils as well as Q18, the B+ regulator, which uses a zener reference, D8.

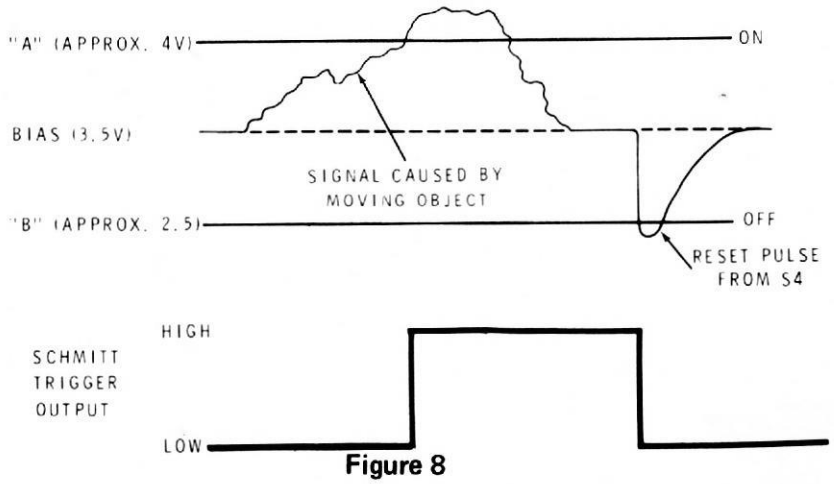


Figure 8

CIRCUIT BOARD X-RAY VIEWS

NOTE: To identify a part shown in one of these Views, (shown on Pages 34 and 35) so you can order a replacement, proceed in either of the following ways:

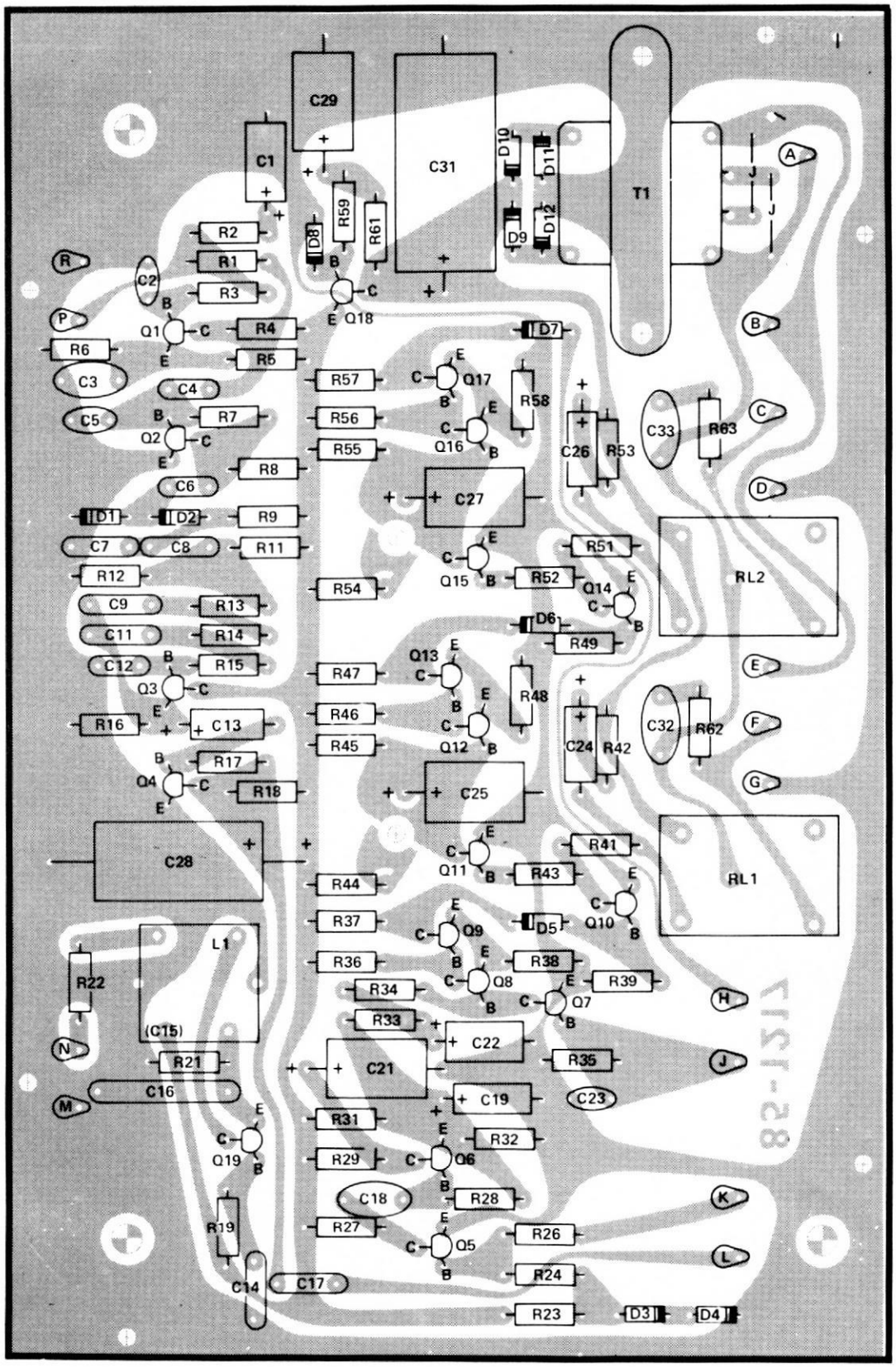
1. A. Refer to the place where the part is installed in the Step-by-Step instructions and note the "Description" of the part (for example: 22 kΩ, .05 μF, or 2N2712).

   B. Look up this Description in the "Parts List."

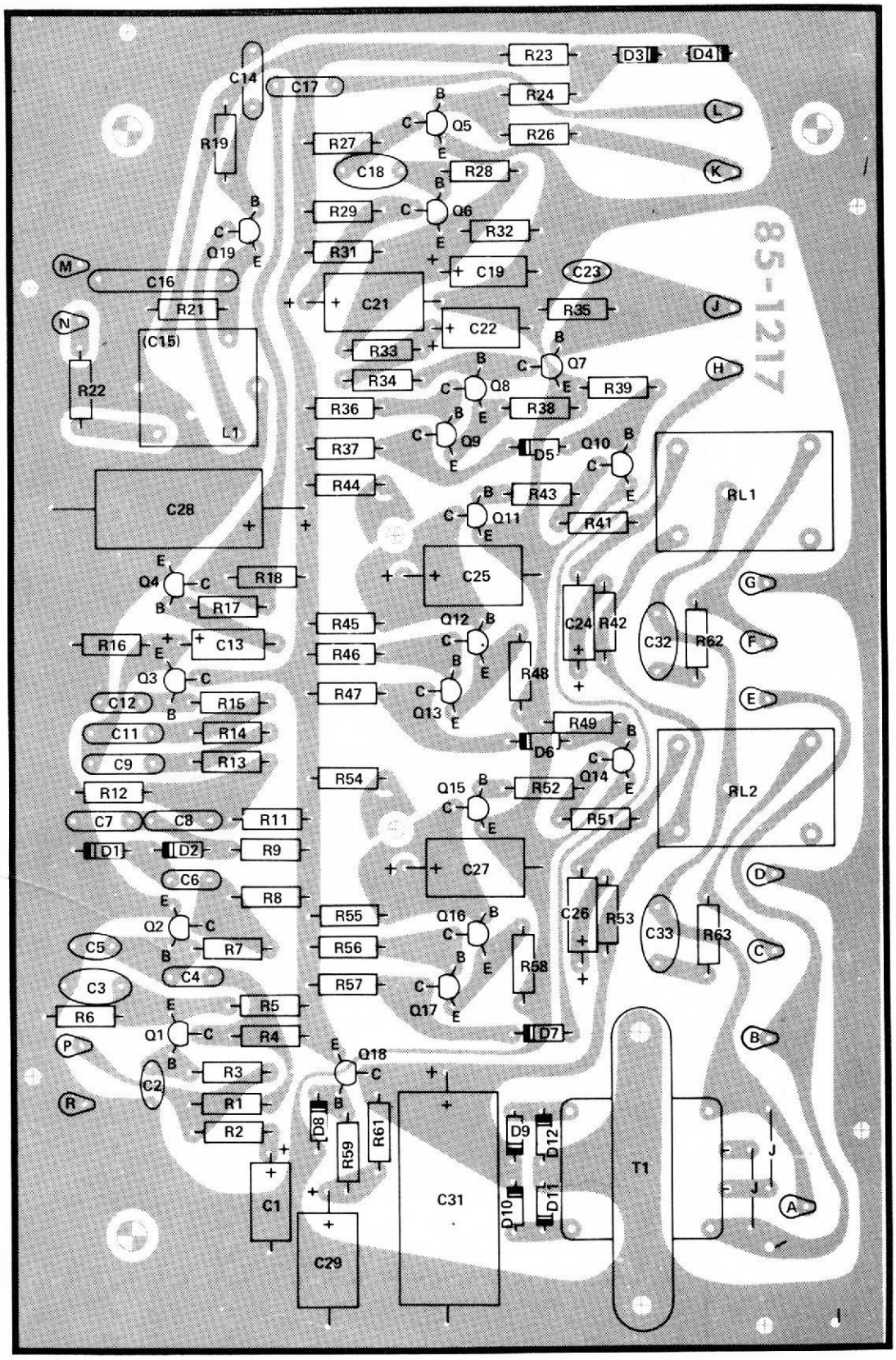
2. A. Note the identification number of the part (R-number, C-number, etc.).

   B. Locate the same identification number (next to the part) on the Schematic. Except for solid state devices, the "Description" of the part will also appear near the part.

   C. Look up this Description in the "Parts List." Refer to "Transistor and Diode Identification" on Page 38, for these devices.

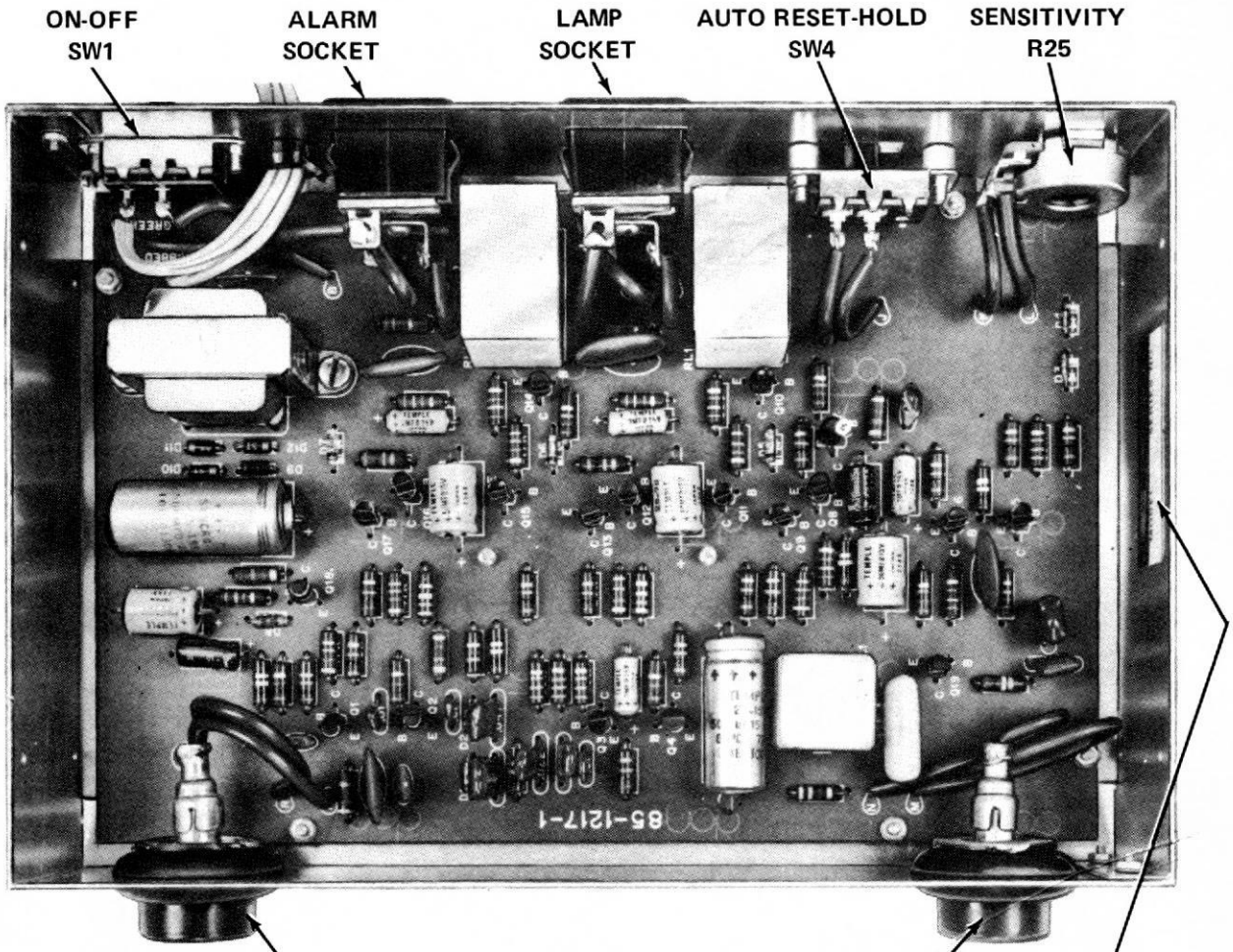


(Viewed from component side)



(Viewed from foil side)

CHASSIS PHOTOGRAPH



VOLTAGE CHARTS

Use a high input impedance voltmeter. Voltages may vary 20%.

LONG = Adjusting screws backed out.
SHORT = Adjusting screws tight.
UT = Relays untripped.
T = Relays tripped.
U = Voltage under:
\+ = Voltage over:
E = Emitter.
B = Base.
C = Collector.
H = Auto Reset-Hold switch at Hold.

*No signal. Transmitter disabled by shorting emitter resistor R21.

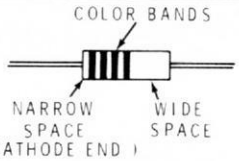
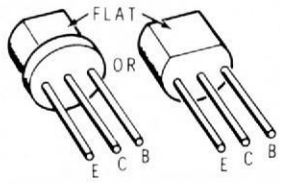
**No signal. Transmitter disabled. May respond to acoustic signals.

#May respond to high frequency acoustic signals.

	E	B	C
Q1	4.2	4.7	5.4
Q2	–	*0.6	*4.6
Q3	4.5	5.0	–
Q4	–	0.6	5.8
Q5	–	**0.6	**0.1
Q6	**3.5	**3.5	11
Q8	–	**3.4	–
Q18	11.2	11.8	–
Q19	0.3	0.7	–
D2 Anode			*0.1
D9 & D10 cathodes			18
Test Point N (See Figure 2 on Page 21.)			11

DEVICE	LEAD	LONG		SHORT
		UT	T	T
Schmitt Trigger #1				
Q8	C	5.2	**2.2#	
Q9	C	U 5.5	+5.5	
Q8 & Q9	E	4.6	**2.1#	
Q10	B	U 0.5	+0.6	
Q11	B	+0.6	U 0.5	
Schmitt Trigger #2				
Q12	C	5.2	2.2	5.8
Q13	C	U 5.5	+5.5	+5.5
Q12 & Q13	E	4.6	2.1	5.8
Q14	B	U 0.5	+0.6	+0.6
Q15	B	+0.6	U 0.5	U 0.5
Schmitt Trigger #3				
Q16	C	5.2	H 2.2	H 5.8
Q17	C	U 5.5	+5.5	+5.5
Q16 & Q17	E	4.6	2.1	5.8
Q7	B	U 0.5	0	0

TRANSISTOR AND DIODE IDENTIFICATION

COMPONENT	HEATH PART NUMBER	REPLACEMENT TYPE	IDENTIFICATION
D1, D2	56-26	1N191 (BROWN-WHITE-BROWN)	HEATH PART NUMBERS OR THE TYPE NUMBERS ARE STAMPED ON MOST DIODES. NOTE: DIODES MAY BE SUPPLIED IN ANY OF THE FOLLOWING SHAPES. ALWAYS POSITION THE BANDED END AS SHOWN ON THE CIRCUIT BOARD.  BAND OR BANDS
D3, D4	56-56	1N4149	
D5, D6, D7	56-58	1N709A	
D9, D10, D11, D12	57-65	1N4002	
D8	56-57	1N716A (VIOLET-BROWN-BLUE-BROWN)	
Q1, Q2	417-91	2N5232A	
Q3 THRU Q9	417-118	2N3393	