

Trapshoot

ELECTRONIC WALL GAME

MODEL 5001A

MANUFACTURED BY

Gremlin
Industries, inc.

OWNER'S MANUAL

TRAPSHOOT

an **ELECTRONIC WALL GAME** by

GREMLIN INDUSTRIES, INCORPORATED

8401 Aero Drive
San Diego, California 92123

OPERATING INSTRUCTIONS

and

SERVICE MANUAL

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INTRODUCTION

TRAPSHOOT is an electronic game that makes extensive use of digital integrated circuits. This manual assumes that the maintenance technician possesses a general knowledge of solid-state circuitry and TTL digital integrated circuits. Any individual not knowledgeable in this area should not attempt to repair the electronic portions of the game. IT SHOULD BE NOTED THAT ANY ATTEMPT TO REPAIR THE GAME IN THE FIELD WITHOUT THE EXPRESS CONSENT OF THE FACTORY WILL IMMEDIATELY VOID THE WARRANTY!

IMPORTANT NOTES:

NEVER replace any component with anything other than an EXACT replacement part. This includes LAMPS, TRANSISTORS, INTEGRATED CIRCUITS, and the like.

LAMPS used in this game are #1813, which operate at 14.4 volts, 100 ma. and #756 lamps which operate at 14.4 volts, 80 ma. NEVER use a lamp that operates at a lower voltage or higher current. To do so will very likely damage the circuitry in the game.

DO NOT use metal objects (screwdrivers, pliers, etc.) around the lamp sockets with the game turned "ON". The outer shell of the sockets have voltage on them, and shorting them to each other or to other points on the game will damage the circuitry.

DO NOT replace the fuse with anything other than the proper value. A blown fuse indicates an overload condition within the game. Replacing the fuse with a larger value can cause severe damage to internal components if an overload occurs.

ALWAYS consult the manual before attempting any repairs.

CORRESPONDENCE regarding this game should be addressed to:

GREMLIN INDUSTRIES, INCORPORATED
8401 Aero Drive
San Diego, California 92123

Phone: 714-277-8700

UNPACKING AND INSPECTION:

The TRAPSHOOT Game is normally shipped in a single package containing the game main frame and the accessory kit, which consists of the coin box, transmitter and associated parts.

The box must be opened immediately upon arrival and inspected for freight damage. It is advisable to connect the game for operation and determine that it is operating properly, as some freight damage can occur within the main frame and not be immediately evident during a cursory visual inspection.

If damage has occurred during shipment, the recipient should immediately file a damage claim with the carrier. Filing a claim will protect the recipient from bearing the full cost of any repairs that may arise from the damage.

Any game or accessory claimed to be defective must be returned to GREMLIN INDUSTRIES, INC., 8401 Aero Drive, San Diego, California 92123, transportation charges prepaid. The game will be repaired and returned to the customer, transportation charges prepaid, if still within the warranty period. If the game is found to be damaged by misuse, improper attempts at repair, or abuse, it will be returned to the customer with transportation and repair charges billed.

In the instance of a defect of sub-assemblies or assemblies manufactured by other than GREMLIN INDUSTRIES, every effort will be made to assist the customer in obtaining satisfaction from the original manufacturer.

TRAPSHOOT DESCRIPTION

The TRAPSHOOT Game is a single, wall-mounted unit that needs only an external coin box and transmitter (control box) to operate. Both of the latter units are supplied with the game.

Within the main frame of the game assembly is a large (2.5 feet by 5 feet) printed circuit board, which contains plug-in provisions for the POWER/SOUND board and the LOGIC board. Additionally, a receiver module is incorporated to receive and process the signals transmitted from the hand-held transmitter control.

The transmitter/controller is a standard, tone-modulated 27 MHz radio transmitter. The only control necessary for its operation is the top-mounted push button that is actuated to play the game.

The coin box provided with the game is a Quarter acceptor Type that causes a switch contact closure with each coin inserted. Each coin activates the circuitry in the main frame and allows a game to be played.

The game is played in the following manner:

Two players compete in TRAPSHOOT, each taking turns at the control box that enables them to play from any place in the room.

A coin is deposited and the game activates, allowing the transmitter control box to initiate action.

The first player momentarily depresses the control button, at which time one of the traphouses will remain illuminated and the other will go out. The "READY" light will come on next to the selected traphouse and remain lit for a random delay period. When the "READY" light goes out, a bird is launched from the illuminated traphouse.

When the bird is launched from the traphouse on the left, the shooter on the right increases in brightness and the STATION C sign lights up. When the control button is pressed again, STATION C will fire at the bird.

When the bird is launched from the right-hand traphouse, STATION A is likewise selected.

The player must time his shot so that it strikes the bird as it crosses the point of intersection. Just how accurately he does so determines what his HIT SCORE will be. The game will award one through four points, depending upon the HIT SCORE achieved. If the player misses the bird, his opponent is awarded one point.

When DOUBLES is illuminated, birds will be launched from both traphouses simultaneously and the center shooter (STATION B) will be designated to fire. A "Hit" in the DOUBLES mode will score double the number of points shown on HIT SCORE.

When a HIT SCORE of four is achieved, a large EXPERT trophy is illuminated and a crowd noise is generated. Each hit of this nature illuminates a small cup on the display panel to keep a record of the number of EXPERT hits.

A free game is awarded when a preselected number of EXPERT hits are accumulated during the period of a game.

TRAPSHOOT is internally programmable to allow control over the speed of the bird flight and the gunshot.

The length of the game is controlled by score. The score at which the game ends is internally selectable by means of jumpers provided on the LOGIC BOARD. The game may be ended on any increment of ten, up through a total of seventy points.

SYSTEM DESCRIPTION

TRAPSHOOT is a digitally controlled, sequentially animated game. Digital integrated circuits control the rate, interval, and sequence of events.

Figure A is a block diagram of the game. The receiver output is applied to an Input Processor which determines whether or not a game is in play. If the Games Counter has not been activated by the coin box, the Input Processor will not allow the receiver output to continue through to activate the game. Thus, a game cannot be played until a coin is deposited in the coin box.

If the games counter is not at "Zero" count, the Input Processor allows the receiver input to activate the game action. When the transmitter button is momentarily depressed, the Input Processor output signal causes the Traphouse Select circuitry to select the traphouse which will launch the Bird.

The Input Processor also latches the Bird Launch Delay into a specific delay time, and it causes the Bird Speed Select circuit to stop its alternating action and apply a fixed voltage to the "clock" circuit. This voltage determines the frequency at which the clock oscillator operates.

The Shooter Select circuit monitors the Traphouse Select and activates the proper shooter. When DOUBLES is lit, both traphouses are selected and the center shooter (Station B) is illuminated.

When the Bird Launch Delay times out, its output signal transition causes the Bird Flight circuitry to activate and the bird flight is initiated.

When the transmitter button is depressed a second time, the Input Processor activates the Gunshot circuit.

If the animated bird and bullet coincide in their paths, the Hit Gate senses the coincidence and scores a hit. The accuracy of the Hit determines the score that is awarded to the player. If DOUBLES is lit, double score is awarded.

The Hit Score circuit displays the Hit accuracy on the graphics panel, and when EXPERT hits are scored it activates the Cups Tally circuit, which totalizes the number of EXPERT hits scored.

The Team 1 - Team 2 Select circuit switches between the two players alternately and awards the points to the proper player.

The DOUBLES circuit counts the number of times Team 1 is selected, and every fourth time activates the DOUBLES Gate circuit that allows double scoring when a hit is achieved.

The Free Game circuit is energized after a specific number of EXPERT hits are scored during the game. Should that number be reached, the games counter is inhibited and, at game end, a free game is awarded.

The End-of-Game circuit monitors the score, and when a predetermined score (which is internally selectable) is achieved, the games counter is "stepped" down one count and the game is ended. If the games counter is then at "Zero" count, no further play is possible. However, if more than one game was registered, it simply steps down to the next game and, after a short delay, the score is reset to zero and the next game is started.

SIMPLIFIED BLOCK DIAGRAM

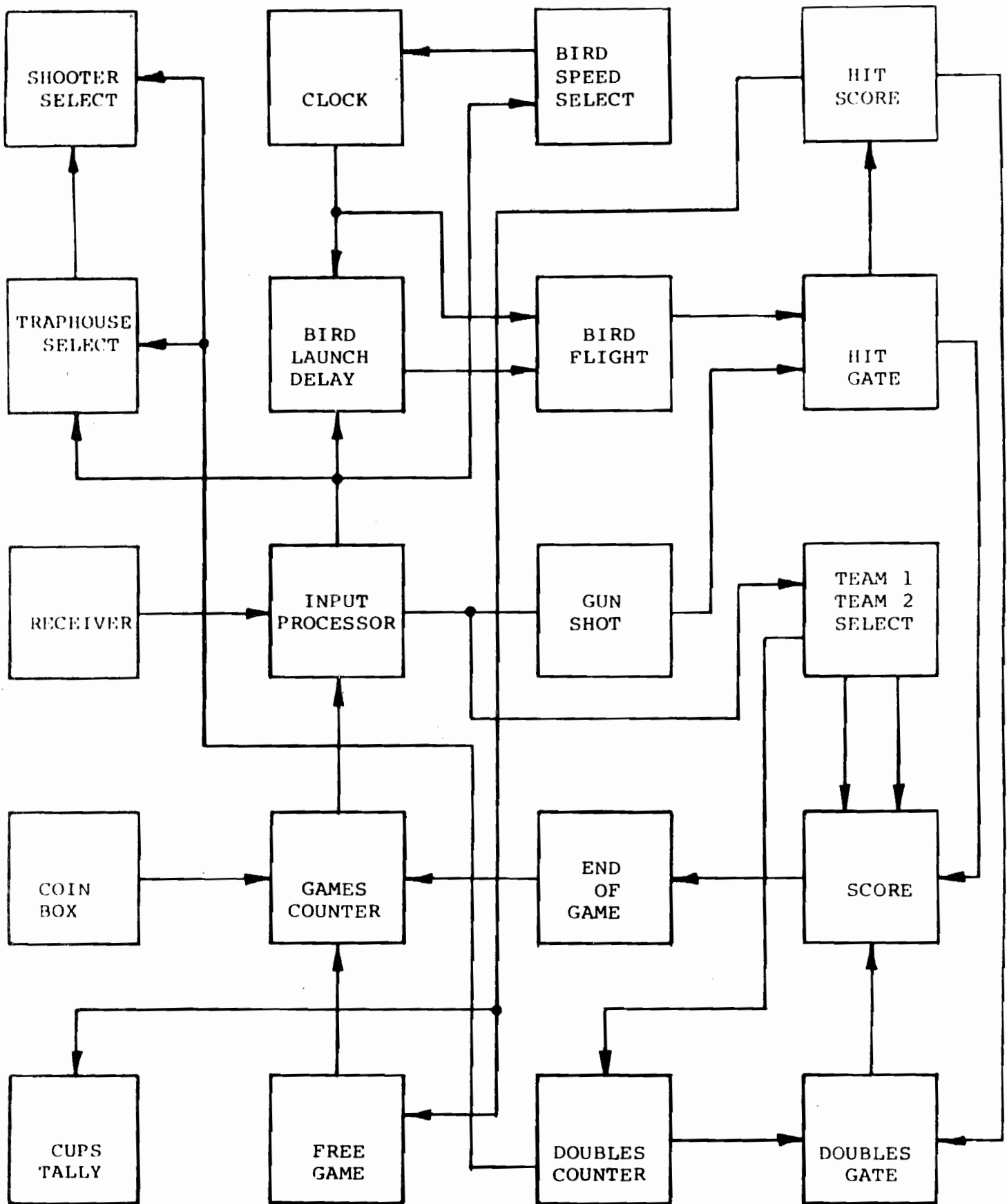


FIGURE A

N7404

HEX INVERTER

SCHEMATIC (each inverter)

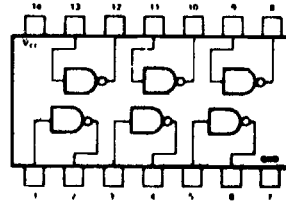
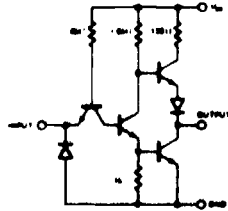


FIGURE 1

N7408

QUADRUPLE 2-INPUT POSITIVE AND GATES

SCHEMATIC (each gate)

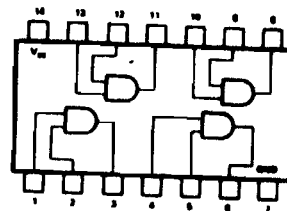
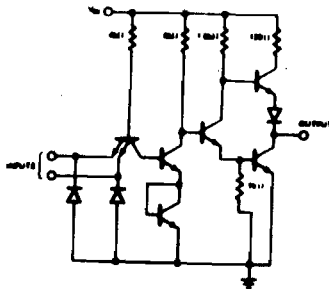


FIGURE 2

INTEGRATED CIRCUIT CHARACTERISTICS

GENERAL:

Digital integrated circuits possess a unique characteristic in that their outputs can assume only two states. They are either HIGH (output at a positive voltage level), or LOW (output at or near ground potential). While there are many types of digital integrated circuits of varying complexity, all must conform to this limitation: Their outputs are limited to switching between two voltage levels, HIGH and LOW.

For the purposes of this discussion, only "TTL" (Transistor-Transistor-Logic) circuits used in GREMLIN'S TRAPSHOOT Game will be examined.

7404 HEX INVERTER:-----

Figure 1 illustrates an integrated circuit containing six simple inverter circuits. Each circuit functions simply to "invert" the state of the voltage applied to its input. If the input is LOW, the output will be HIGH. Conversely, if the input changes to a HIGH state, the output will immediately change to a LOW state. Thus, it "inverts" the signal applied to the input terminal. Inverters are used primarily to invert a signal that is of the wrong polarity to interface with, or drive, another circuit or device.

7408 AND GATE:-----

Figure 2 depicts a Quadruple 2-input AND gate, the 7408. In operation, the output of each gate will go HIGH only if both inputs are HIGH. Restated, the output will change to a HIGH state only when both input 1 AND input 2 are HIGH. It is therefore called an AND gate.

Consider a typical application: If input 1 remains at a LOW state, the output will be LOW and any changes at the other input will not affect the output. However, if input 1 then goes HIGH, it will allow the changes at the other input to appear at the output. Returning input 1 to the LOW state will again cause the output to go to the LOW state and inhibit any further signals at input 2 from being felt at the output. Thus, the signal at input 2 has been "gated" to the output by a signal applied at input 1. Hence the term GATE.

The TRAPSHOOT Game uses several circuits of this type to gate signals on and off.

N7400

QUADRUPLE 2-INPUT POSITIVE NAND GATE

SCHEMATIC (each gate)

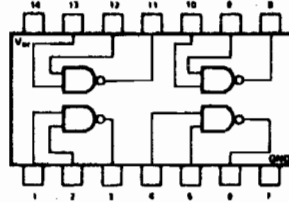
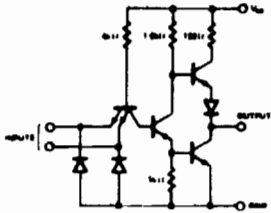


FIGURE 3

N7410

TRIPLE 3-INPUT POSITIVE NAND GATE

SCHEMATIC (each gate)

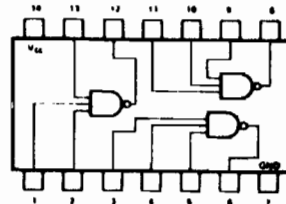
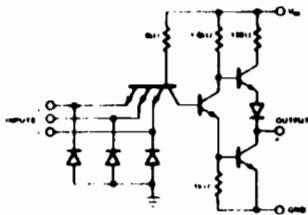


FIGURE 4

N7474

DUAL D-TYPE EDGE-TRIGGERED FLIP-FLOP

TRUTH TABLE

D_n	Q_{n+1}	\bar{Q}_{n+1}
1	1	0
0	0	1
Preset	Clear	Q
1	1	Q
1	0	0
0	1	1
0	0	!

! Both outputs in 1 state
n is time prior to clock
n+1 is time following clock

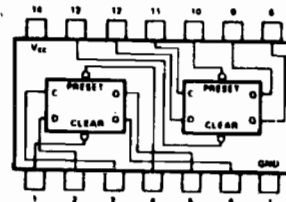


FIGURE 5

7400 NAND GATE:-----

Figure 3 illustrates the 7400 Quadruple 2-Input NAND Gate. It operates exactly like the AND gate, but it performs the added function of inverting the output. Therefore, when both Input 1 and Input 2 are HIGH, the output will go LOW. A NAND gate can be thought of as an inverting AND gate.

7410 3-INPUT NAND GATE:-----

Figure 4 shows a Triple Three-Input NAND Gate. All three inputs of each gate (Input 1 AND Input 2 AND Input 3) must go HIGH to obtain a LOW state at the output. A LOW at any of the inputs will maintain a HIGH condition at the output.

7474 "D" FLIP-FLOP:-----

The circuit shown in Figure 5 is a Dual D-Type, Edge-Triggered Flip-Flop. It is a relatively complex circuit made up of several of the gates discussed above. It is conventionally shown as a "block" diagram with input and output functions designated as shown, and it operates as follows:

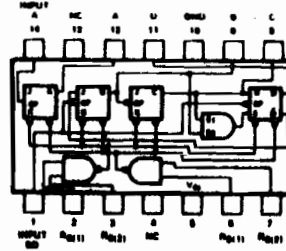
Input information is applied at the "D" input. This may be either a HIGH or LOW potential. The input is transferred to the Q output upon the positive transition of a pulse applied to the clock (CK) input. For instance, if a HIGH is applied to the "D" input, and held there, no change in the Q output will be noted until a clock pulse is applied to the CK input. When the positive edge of the clock pulse occurs, the HIGH felt at the input will be transferred to the Q output. Any additional clock pulses that occur while the "D" input remains HIGH will cause no further change. However, should the "D" input go to a LOW state, the positive transition of the next clock pulse will cause the Q output to go LOW.

The "D" Flip-Flop also has a \bar{Q} (pronounced "Q-Bar") output, which simply provides an output that is always the opposite of the Q output. If Q is HIGH, \bar{Q} will always be LOW, and vice-versa.

A "D" Flip-Flop also has two other inputs labeled "PRESET" and "CLEAR". These inputs may be used to set the outputs to a desired state. With both the PRESET and CLEAR inputs held HIGH, the circuit will operate normally. If a LOW is applied to the PRESET input, it will cause the Q output to go LOW. Conversely, if a LOW is applied to the CLEAR input, it will cause the Q output to go HIGH. It is important to note that a LOW input to either the PRESET or CLEAR will override any other input functions.

N7490

DECADE COUNTER



LOGIC TRUTH TABLES

BCD COUNT SEQUENCE (See Note 1)					RESET/COUNT (See Note 2)				
COUNT	OUTPUT				RESET INPUTS				OUTPUT
	D	C	B	A	R ₀ (2)	R ₀ (1)	R ₉ (1)	R ₉ (2)	
0	0	0	0	0	1	1	0	X	0 0 0 0
1	0	0	0	0	1	1	X	0	0 0 0 0
2	0	0	1	0	X	X	1	1	1 0 0 1
3	0	0	1	1	X	0	X	0	COUNT
4	0	1	0	0	0	X	0	X	COUNT
5	0	1	0	1	0	X	X	0	COUNT
6	0	1	1	0	0	X	X	0	COUNT
7	0	1	1	1	0	X	X	0	COUNT
8	1	0	0	0	X	0	0	X	COUNT
9	1	0	0	1	X	0	0	X	COUNT

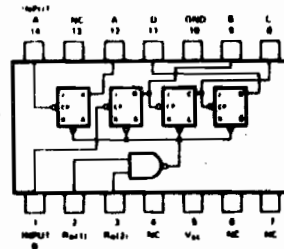
NOTES:

- Output A connected to input BD for BCD count.
- X indicates that either a logical 1 or a logical 0 may be present.
- Fanout from output A to input BD and to 10 additional Series 54/74 loads is permitted.

FIGURE 6

N7493

4-BIT BINARY COUNTER



TRUTH TABLE (See Notes 1 and 2)

LOGIC									
COUNT	OUTPUT				COUNT	OUTPUT			
	D	C	B	A		D	C	B	A
0	0	0	0	0	9	1	0	0	1
1	0	0	0	1	10	1	0	1	0
2	0	0	1	0	11	1	0	1	1
3	0	0	1	1	12	1	1	0	0
4	0	1	0	0	13	1	1	0	1
5	0	1	0	1	14	1	1	1	0
6	0	1	1	0	15	1	1	1	1
7	0	1	1	1					
8	1	0	0	0					

NOTES:

- Output A connected to input B.
- To reset all outputs to logical 0, both R₀(1) and R₀(2) inputs must be at logical 1.

FIGURE 7

It should also be noted that clock triggering occurs on the positive-going transition of the clock pulse. Thus, the 7474 is called an "edge-triggered" Flip-Flop. Triggering occurs at a voltage level of the clock pulse and is not directly related to the transition time of the positive-going pulse. After the clock input threshold voltage has been passed, the data input "D" is locked out, and any change in the "D" input after that time will not affect the outputs until the next positive-going transition of the clock pulse.

7490 DECADE COUNTER:-----

Figure 6 illustrates a 7490 decade counter which is a circuit composed of several internally connected Flip-Flop circuits. They are connected in a manner that allows division of the input signal frequency by a factor of 10. In addition, the state of the count is provided at four digital output pins, which are the outputs of the four internal Flip-Flop circuits.

Figure 6a shows the output configuration of these four output pins as the number of input pulses applied goes from one to ten. These four outputs provide "Binary-Coded Decimal" (BCD) information which may be decoded by additional circuits for display as numbers or sequential events.

The 7490 counter has gated direct reset lines which inhibit all count inputs and returns all outputs to a LOW (Logical 0) state (Pins 1 & 2 on the IC). Additional reset lines are provided at pins 6 & 7 which will preset the counter to a BCD 9 count for certain applications. With both reset circuits (Pins 1, 2, 6, and 7) held LOW, the counter will count normally.

7493 4-BIT COUNTER:-----

Figure 7 illustrates the 7493. This circuit is similar in operation to the 7490 decade counter, except that it has a count capability of 16. That is, it will divide the input frequency by 16 and provide a BCD output to indicate the state-of-count.

The 7493 consists of four internally connected Flip-Flops which provide proper count capability. A gated direct reset line is provided which inhibits the count inputs and simultaneously returns the four Flip-Flop outputs to a LOW state. Figure 7a shows the logic truth table associated with the 7493 for a count sequence of 0 through 15.

This counter is used primarily for frequency division and sequential display in the TRAPSHOOT Game.

7448 BCD-TO-SEVEN SEGMENT DECODER/DRIVER:-----

The 7448 integrated circuit that is used to decode a BCD output such as that from the 7490 previously discussed is shown in Figure 8. This circuit converts the four outputs of the BCD counter into seven outputs which, when used to drive a Seven-Segment Readout, will display in numerical form the count configuration of the counter and change it into a readable numerical form. The numerical designations of the resultant display are shown in Figure 8a.

7475 QUADRUPLE BISTABLE LATCH:-----

The 7475 latch circuit is shown in Figure 9. This device contains the equivalent of four Flip-Flops that operate similar to the 7474 previously discussed. The Flip-Flops here are not edge-triggered, however. Information present at the data (D) inputs is transferred to the Q output when the clock is HIGH, and the Q output will follow the data input as long as the clock remains HIGH. When the clock goes LOW, the information (that was present at the data input at the time the transition occurred) is retained at the Q output until the clock is permitted to go HIGH.

The 7475 is commonly used between a decade counter circuit and a decoder/driver circuit such as the 7448. In this application the clock input is held LOW, retaining the previous display, while the counter is advancing. When the desired count is reached, the clock on the 7475 is allowed to go HIGH and the information from the counter is then allowed to be transferred to the decoder/driver, changing the presentation to the new resultant display. This eliminates the distraction of seeing the numbers randomly cycling until the proper count is reached and it also adds versatility to the circuitry.

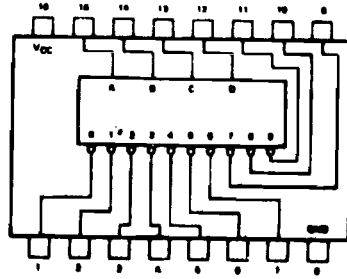
74154 4-LINE TO 16-LINE DECODER:-----

Figure 10 depicts the 74154. This circuit decodes the 4 BCD inputs applied to it from a 4-bit counter (similar to the 7493, for instance) into sixteen individual outputs. Thus, for every possible state of the BCD count of sixteen, there is one output of the 74154 that will change to the LOW state. Figure 10a shows the truth table for the device.

In operation, if a counter input were applied to the circuit and allowed to count normally, the output of the 74154 would progressively sequence from 0 to 15, and continue to repeat the sequence.

N7442

BCD-TO-DECIMAL DECODER



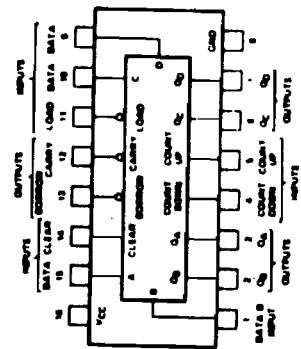
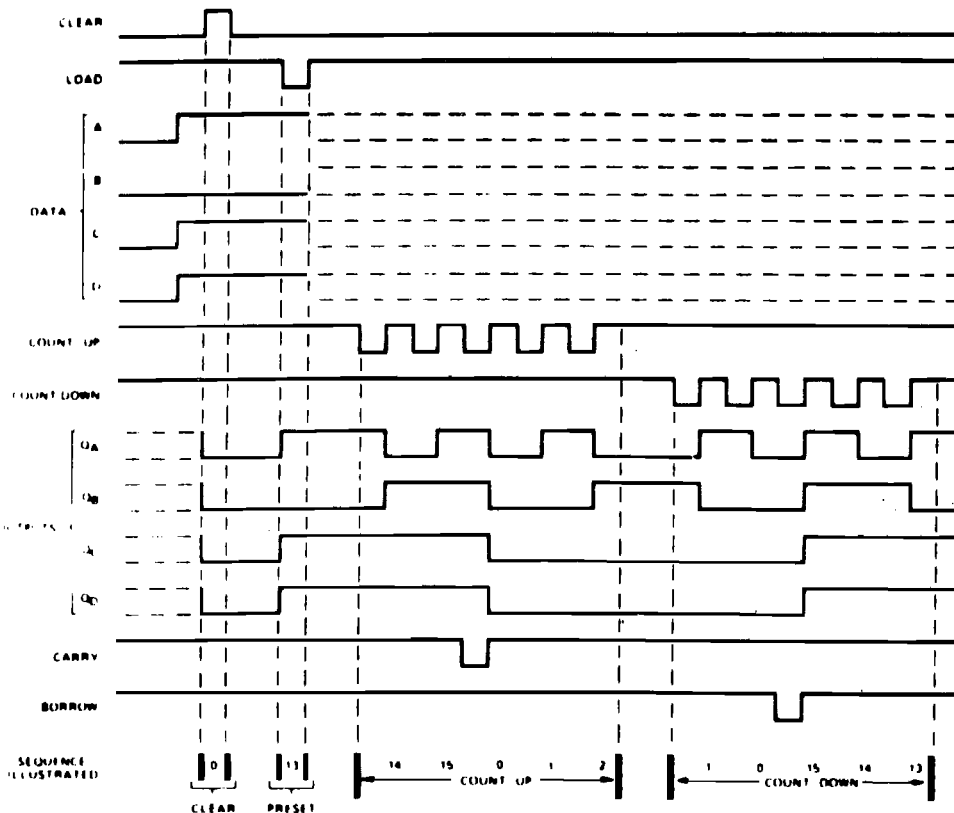
TRUTH TABLE

BCD INPUT				DECIMAL OUTPUT									
D	C	B	A	0	1	2	3	4	5	6	7	8	9
0	0	0	0	1	0	0	0	0	0	0	0	0	0
0	0	0	1	0	1	0	0	0	0	0	0	0	0
0	0	1	0	0	0	1	0	0	0	0	0	0	0
0	0	1	1	0	0	0	1	0	0	0	0	0	0
0	1	0	0	0	0	0	0	1	0	0	0	0	0
0	1	0	1	0	0	0	0	0	1	0	0	0	0
0	1	1	0	0	0	0	0	0	0	1	0	0	0
0	1	1	1	0	0	0	0	0	0	0	1	0	0
1	0	0	0	0	1	0	0	0	0	0	0	1	0
1	0	0	1	0	0	1	0	0	0	0	0	0	1
1	0	1	0	0	0	0	1	0	0	0	0	0	0
1	0	1	1	0	0	0	0	1	0	0	0	0	0
1	1	0	0	0	0	0	0	0	1	0	0	0	0
1	1	0	1	0	0	0	0	0	0	1	0	0	0
1	1	1	0	0	0	0	0	0	0	0	1	0	0
1	1	1	1	0	0	0	0	0	0	0	0	1	0

FIGURE 11

N74193

SYNCHRONOUS 4-BIT BINARY UP/DOWN COUNTER WITH PRESET INPUTS



NOTES

- A. Clear overrides load, data, and count inputs.
- B. When counting up, count-down input must be high, when counting down, count-up input must be high.

FIGURE 12

7442 BCD TO DECIMAL DECODER:-----

Figure 11 illustrates the 7442. It is generally used in decoding and logic conversion applications. It decodes a four-bit BCD number (from the 7493, for instance) and converts it to 1-of-10 output configuration.

The 7442 is used in the TRAPSHOOT Game to provide sequential animation from a binary counter.

74193 4-BIT BINARY UP/DOWN COUNTER:-----

The circuit shown in Figure 12 represents the 74193. This counter has a capability of counting from 0 to 15 (as did the 7493 previously discussed), but it possesses the capability of counting in either direction. There are two separate inputs (pins 4 & 5), one for "count up" operation, and one for "count down" operation.

Count operation is triggered by a low-to-high level transition of either count (clock) input. The direction of counting is determined by which count input is pulsed while the other count input is held HIGH.

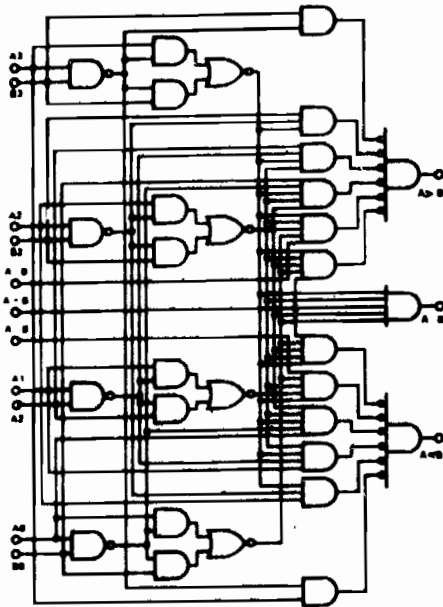
A CLEAR input is provided which forces all outputs to the LOW state when a HIGH level is applied. The CLEAR function is independent of the count inputs and overrides any other input.

The counter has a BORROW and CARRY output as well. The CARRY output provides a pulse in the "count up" mode to indicate when full count has been reached. Conversely, the BORROW output provides a pulse in the "count down" mode to indicate when "0" has been reached in the count-down sequence.

The 74193 has LOAD inputs which allow it to be "loaded" to any preset state by applying input signals to the 4 inputs and allowing the LOAD input to go HIGH. The respective outputs will then assume the signal level of the inputs. Count inputs will then cause the counter to sequence properly from this pre-selected configuration. Figure 12a is a sequence diagram of a typical CLEAR, LOAD, and COUNT operation.

The 74193 is used in the TRAPSHOOT Game in two places where a reverse in count direction is necessary: the game counter and the ball flight counter. The LOAD inputs are not used in the game.

N7485



4-BIT MAGNITUDE COMPARATOR

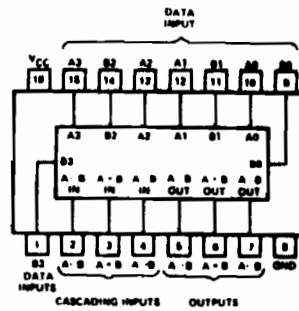


FIGURE 13

N7403

QUADRUPLE 2-INPUT POSITIVE NAND GATE WITH OPEN COLLECTOR OUTPUT

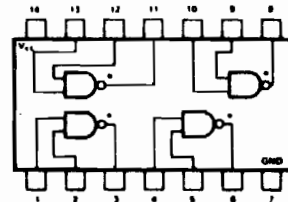
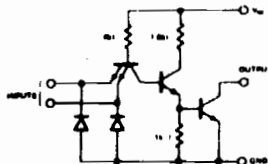


FIGURE 14

N7402

QUADRUPLE 2-INPUT POSITIVE NOR GATE

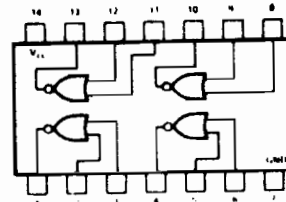
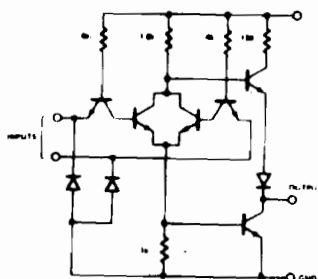


FIGURE 15

7485 4-BIT MAGNITUDE COMPARATOR:-----

The 7485 is a device which accepts inputs from two separate 4-bit counters (such as the 7493) and compares them for magnitude of count. If the inputs from both counters are equal, the output (at pin 6) goes HIGH, while the other two outputs (pins 5 and 7) remain LOW. If the inputs from counter A advance to a binary number higher than that of counter B, the A=B output goes LOW and the output at pin 5 goes HIGH. Should the binary number of counter B exceed that of counter A, the output at pin 7 goes HIGH and the other two outputs remain in the LOW state.

7403 QUAD 2-INPUT NAND GATE WITH OPEN COLLECTOR OUTPUT:-----

The 7403 is similar to the 7400 in its operation, except that the collectors of the output transistors are left open. A collector load must be provided by external circuitry. In the TRAPSHOOT Game these gates are used to select which of several resistors or capacitors are pulled to ground potential.

7402 QUAD 2-INPUT NOR GATE:-----

The 7402 is a device whose output goes LOW if either input goes HIGH. In other words, if input A or input B goes HIGH, the output will go LOW, thus inverting the input. For this reason it is called a NOR (negative OR) Gate.

N7411

TRIPLE 3-INPUT POSITIVE AND GATE

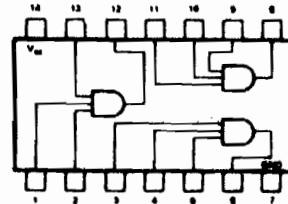
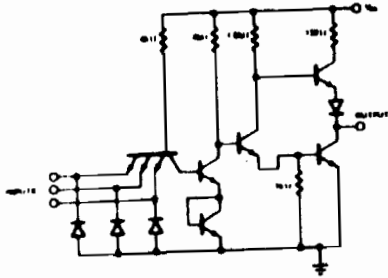


FIGURE 16

N7414

HEX INVERTER SCHMITT TRIGGER

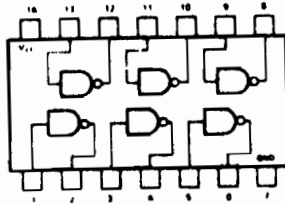


FIGURE 17

N74164

8-BIT PARALLEL-OUT SERIAL SHIFT REGISTERS

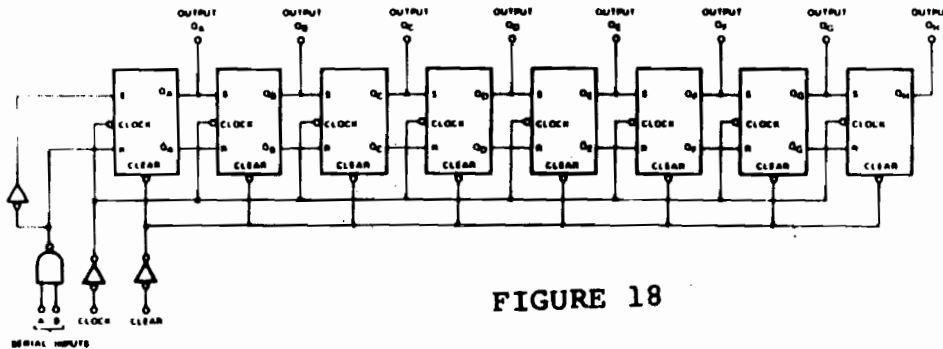
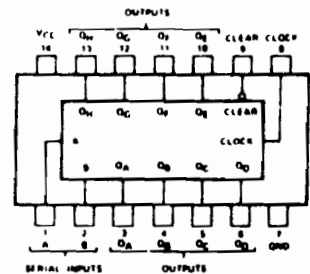


FIGURE 18



7411 TRIPLE 3-INPUT AND GATE:-----

The 7411 is identical in operation to the 7410 except that its output is not inverted (three HIGH inputs result in the output going HIGH.)

7414-HEX SCHMITT TRIGGER:-----

The 7414 functions exactly as the 7404, providing an inverted output for any input signal. It is called a Schmitt Trigger because the inverter has different input threshold levels for positive and negative going signals. The hysteresis, or backlash, which is the difference between the two threshold levels, is typically 800 mv.

74164 8-BIT PARALLEL-OUT SERIAL SHIFT REGISTERS:-----

A shift register is a device which consists of serially connected circuits (usually Flip-Flops) which, when all are clocked simultaneously, transfers data from one circuit to another. In Figure 18, (which shows the 74164), assume that all outputs are LOW. If a HIGH is applied to input A or B, at the next LOW-to-HIGH-LEVEL transition of the clock pulse, this HIGH will be transferred to output A. The next clock pulse will transfer it to output B, and so on. The gated serial inputs (A & B) permit complete control over incoming data as a low at either (or both) input(s) inhibits entry of the new data and resets the first Flip-Flop to the low level at the next clock pulse.

NE555 TIMER CIRCUIT:-----

The NE555 is properly called a LINEAR integrated circuit because not all of its inputs are digital two-state levels. The 555 is a highly stable controller capable of producing accurate time delays, or oscillation. Additional terminals are provided for triggering or resetting if desired.

In the time delay mode of operation, the time is precisely controlled by one external resistor and capacitor. For stable operation as an oscillator, the free-running frequency and the duty cycle are both accurately controlled with two external resistors and one capacitor.

The circuit may be triggered and reset on falling, (negative-going) waveforms, and the output structure can source or sink up to 200 ma or drive TTL integrated circuits.

This circuit is used in the game as both a timing device and a controlled oscillator.

DETAILED CIRCUIT DESCRIPTION

GAMES COUNTER:-----

The Games Counter is a circuit designed to accumulate credits on the game when coins are deposited, and subtract credits as games are completed. It is also somewhat unique in that it will reject any signals (contact closures) from the coin box that are not of sufficient duration to have been caused by a quarter falling through the coin chute.

The signal from the coin box is applied to Pins 44 and 45 on the LOGIC BOARD. A ground (LOW) is normally held at Pin 44. When a coin is deposited, the ground is removed from input Pin 44 and applied at Pin 45.

U-53, the 7474 "D" Flip-Flop is being held in the CLEAR mode while the LOW is applied to its Pin 13. In this mode, Pin 8 (the \bar{Q} output) is forced HIGH. When a coin is deposited, Pin 13 of U-53 goes HIGH, releasing the CLEAR mode and Pin 11 (the Clock input) goes LOW. (Since the clock responds to a positive transition, the LOW signal does not effect any change.) The LOW transition is also differentiated by C-19 and triggers U-54 (a one-shot multivibrator), which gives a positive output at its Pin 3. The duration of this output pulse is determined by the values of R-83 and C-20.

The HIGH output pulse from U-54 is inverted by U-71 (Pins 5 to 6) and the resultant LOW pulse is applied at the "D" input to the Flip-Flop.

When the coin has completed its traverse through the chute, Pin 11 (the clock input) goes HIGH, clocking the Flip-Flop to a state where the \bar{Q} output is the same as the "D" input. (\bar{Q} , the output of interest here, is the inverse of the "D" input.) Thus, if the multivibrator U-54 has not timed out completely, the LOW that it is causing at U-53, Pin 12 ("D" input) will not cause a change of state when the clock transition occurs. However, if U-54 has timed out, the HIGH at the "D" input will cause \bar{Q} to go LOW.

As the Coin Box Switch returns to its rest position, forcing a LOW at the clear input to the Flip-Flop, the \bar{Q} output returns to the HIGH state.

The LOW pulse that results from a proper switch closure is felt at U-28, Pin 5 (the "Up Count") and causes it to advance one count. The BCD output of this

UP/DOWN COUNTER is decoded into 10-line form by U-16, inverted by the 7404 inverters (U-2 and U-1) and applied to driver transistors 43 through 46.

When a single coin of the proper type is inserted, GAME 1 will light on the display panel. More coins will cause additional games to be sequentially indicated.

GAMES RESET:-----

The reset input of U-28 (Pin 14) is held LOW for normal counter operation. However, when the game is first turned on, a HIGH input is felt at this terminal due to the inverter (U-1, Pins 9 to 8) that is attached to it. When power is applied, Pin 9 of U-1 is LOW and Pin 8 is HIGH, which holds counter U-28 in RESET. As capacitor C-22 changes to a HIGH level, the gate output at Pin 8 goes LOW and the counter may then operate normally. This assumes that the counter will always come up on "0" games when power is applied to the circuitry.

Additionally, C-21 (which is connected to U-28, Pin 14) reenforces the above action by coupling the positive transition from the +5 volt supply that occurs when power is first applied. This positive transition also serves to reset the counter.

PLAY INHIBIT:-----

When counter U-28 is at "0", Pin 1 of U-16 applies a LOW to Pin 5 of U-5, an AND gate. Pin 6 of U-5 therefore also goes LOW and holds the "D" Flip-Flop, U-52 in the PRESET mode until this signal is removed. U-53 and U-52 comprise the input processor for the receiver signal, and with U-52 held in the PRESET mode, it will not allow any signal to pass. Thus, a game cannot be played at this time. If a coin is inserted, the PRESET input will go HIGH, allowing U-52 to operate normally, and a game may be played.

BIRD SPEED CONTROL:-----

The bird speed control is comprised of an oscillator, U-37, a control gate (part of U-34), a counter (U-22) and decoding gates U-36.

The clock oscillator that controls the speed and sequence timing for the game (U-37) is an NE555. Its natural period of oscillation is controlled by capacitor C-1 and the resistance of R-6 and R-7. The NE555 also has an input at Pin 5 that allows the frequency to be

changed by the application of a DC voltage. Changes in voltage at this point will cause changes in the output frequency. The voltage is changed by the resistive divider that is tied to Pin 5, (made up of R-1 through R-4.) When one of the gates of U-36 is turned on, it essentially connects one side of the resistor to ground, thus establishing a voltage divider between that resistor and R-5. This yields a particular voltage at Pin 5 of U-37. When one gate turns off and another of the four turns on, a different resistor is placed into the divider and the voltage applied to Pin 5 changes. Thus, if the action of sequentially selecting resistors 1 through 4 continues, the output frequency of U-37 will change accordingly.

The switching action is controlled by the decoded outputs of U-22, a D-type Flip-Flop that is connected as a two-bit counter. Reference to the integrated circuit data will show that there are two independent Flip-Flop circuits in a 7474 I. C. These may be hooked up in such a manner that they will "toggle", or count. When the two Flip-Flop circuits are then connected in series, they possess the capability to count or divide by 4. U-22 is connected in such a configuration. U-36, containing four AND gates with open collector outputs decodes the counter output into a serial output (0-1-2-3) and provides a path to ground for the selected resistors as previously discussed.

The output of the oscillator (Pin 3) is applied to Pin 2 of gate U-34 and, when the gate is OPEN, thence to counter U-22. However, during a game, once the transmitter button is depressed, the master clock U-37 must not be allowed to continue changing frequency. Consequently, when the receiver input indicates that the transmitter button has been depressed, and U-52 Flip-Flop "latches", Pin 1 of U-34 goes LOW and all further oscillator signal is inhibited from passing through to the counter. The counter, therefore, stops and a constant DC potential is applied to the U-37, Pin 5 input.

LAUNCH DELAY:-----

The variable bird launch delay is achieved in the following manner: When the transmitter button is depressed, the input processor, U-52, goes LOW at pin 8. This negative excursion is differentiated by capacitor C-2, which triggers U-11, a one-shot multivibrator. The output pulse width of U-11 is determined by the RC time constant of R-33 and one of the capacitors connected to U-23. Only one of the four capacitors is in the circuit at any time due to the counting and decoding

action of U-35 and U-23.

Prior to the time U-11 is triggered, U-35 is counting at a rapid rate and U-23 is decoding the count and sequentially selecting one of the four capacitors (C-3, 4, 5, or 6). The same negative pulse that triggered U-11 is also applied at U-34, Pin 10, and it turns off the count sequence by closing Gate U-34. The decoder stops sequencing and selects a single capacitor, which determines the pulse width of U-11's output.

The output at U-11, Pin 3, turns on SCR Q-21 and lights the READY light. When U-11 times out and the output at Pin 3 again goes negative, the READY light goes out. The negative excursion of the U-11 output is differentiated by capacitor C-7 and applied to the BIRD LAUNCH latch at U-30, Pin 10. This initiates the bird flight.

Thus, from the time the transmitter button is depressed until actual bird launch, there is a delay, determined by the pulse width from multivibrator U-11.

BIRD FLIGHT:-----

When a negative pulse from the READY DELAY circuit is applied to the Bird Launch LATCH at U-30, Pin 10, a HIGH is applied to Gate U-30, Pin 12, where it remains until the latch is reset. The HIGH opens gate U-30 and allows pulses from the master clock to proceed to U-30, Pins 2 and 4. There is a HIGH at U-30, Pin 1, which allows the pulses to proceed to the UP-DOWN Counter U-18, Pin 5. U-18 will then count UP.

The 74154 4-line to 16-line decoder converts the counters's BCD output into a sequential format which turns on transistors Q-2 through Q-17 sequentially from left to right. When the decoder reaches a count of 15, the output at U-17, Pin 17, goes negative. This LOW SIGNAL is applied to U-43, Pin 1, changing the state of Flip-Flop. U-43, applying a LOW to U-30, Pin 1 and a HIGH to U-30, Pin 5. The pulse train is now gated into the DOWN count input to counter U-18 and it reverses its order of count and the decoder, (U-17), reverses direction and sequences from right to left. This would normally have the effect of causing the lamps (which the transistors control) to sequence from left-to-right and then reverse and sequence right-to-left. However, because of the manner in which power is applied to the lamps (by power buss switching), such is not the case. (See Power Buss Switching.)

POWER CONTROL (BIRD FLIGHT):-----

Figure 19 illustrates the operation of the Power Control system for the Bird Flight. The transistors should be assumed to be sequentially turning "ON" and "OFF", Q-2 through Q-17. If the output from IC-1 is HIGH and the output from IC-2 is LOW, only SCR-1 will be on. Thus, as the transistors sequence from 2 through 17, only the #1 lamps will be illuminated. This is exactly the action that occurs during Bird Flight in the game. The first half of the Bird Flight (16 lamps) receives power from an SCR POWER BUSS. When the last transistor turns on, a signal ("Reverse Control") causes the sequence to reverse itself and sequentially turn on transistors 17 through 2. This time, however, SCR-2 is on and SCR-1 is off and only the #2 lamps will light. It can be seen in the diagram that the remainder of the lamps are arranged in reverse order across the flight path. Therefore, even though the counter has reversed direction, the apparent flight path continues in the original direction uninterrupted.

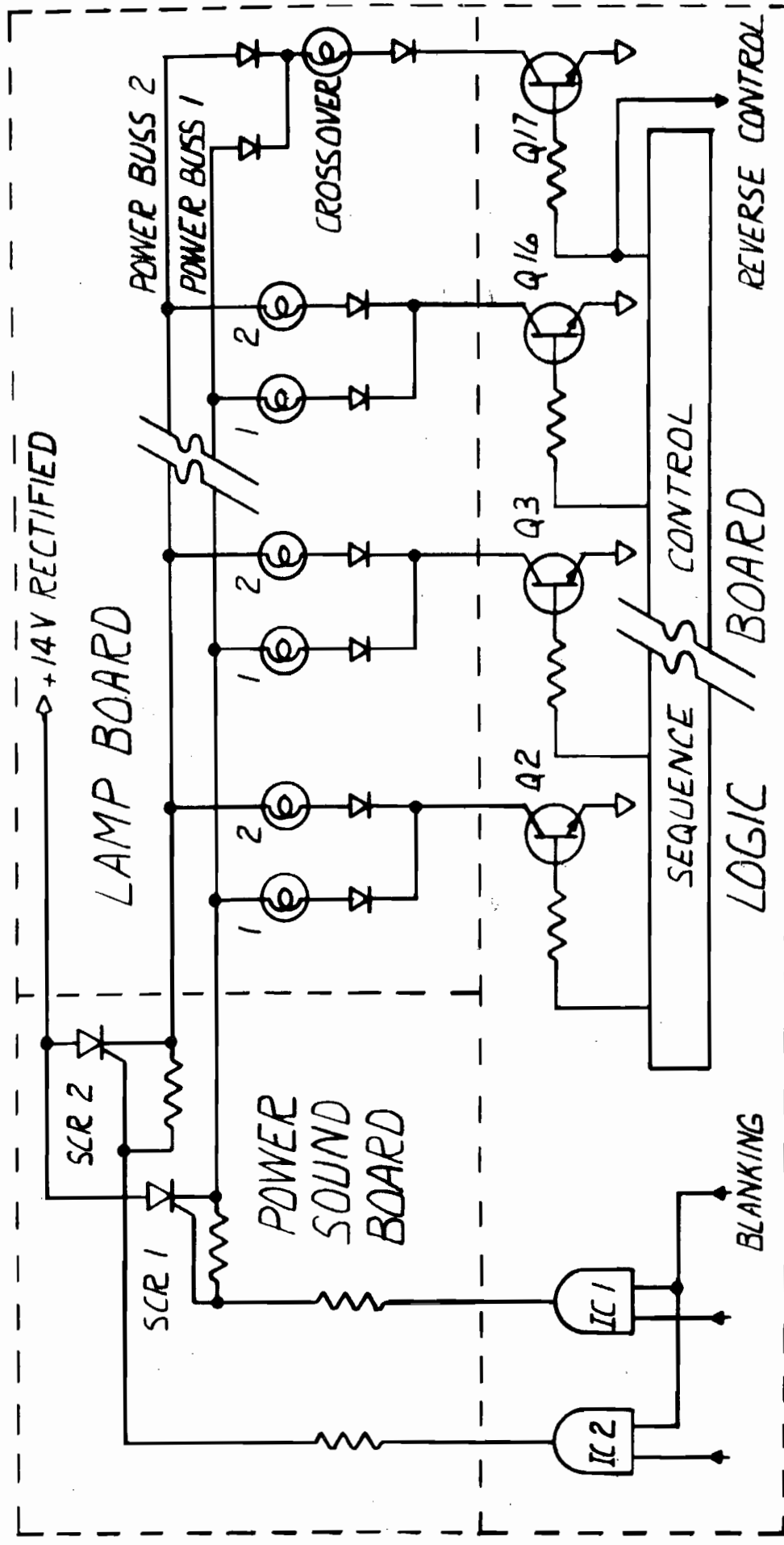
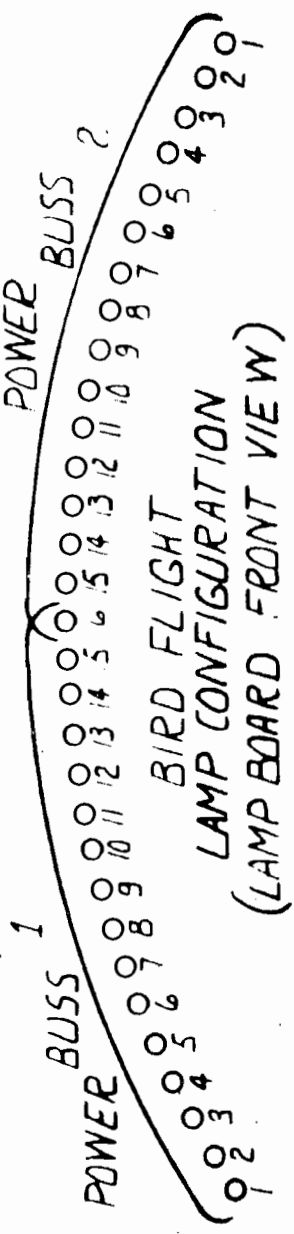
When DOUBLES is lit on the game graphics panel, both IC-1 and IC-2 have positive outputs and both Power Buss SCR's are on. Thus, it appears that two birds are launched simultaneously.

When the Bird Flight is completed, a LOW input is applied to IC-1 and IC-2 via the "Blanking" line and both outputs go LOW, turning both SCR's OFF and removing all power from the Power Busses.

It can be seen that it makes no difference which power buss is on initially--the action is the same. Therefore, if the bird is launched from either side, the counter reversal and Power Buss switching provide for smooth animation.

On the Logic Board schematic, Logic Board output pins 99 and 100 are routed to the Power/Sound Board and switch the SCR's. U-42 (Pins 2 and 5) provides the control signals that determine which power buss is energized. Because it is a D Flip-Flop connected in the toggling mode, and LOW-to-HIGH transition at the "Clock" (pin 3) input will cause it to reverse states and select the alternate power buss.

U-40 (Pins 8, 9, and 10) is a gate which allows either of two signals to toggle the Flip-Flop. Pin 9 is receiving a pulse train from U-34 (Pin 6) that is generated by oscillator U-46. This causes the Flip-Flop to toggle at a rapid rate. However, when



SIMPLIFIED POWER CONTROL SCHEMATIC
MODEL 5001A

Figure 19

the transmitter button is pressed, Gate U-34 receives a LOW signal at Pin 4 and the pulse train is inhibited. The Flip-Flop then stops toggling and latches into one of its two possible states. Thus, depressing the transmitter button has the effect of randomly selecting which power buss will come on first.

As the bird is launched and the flight progresses sequentially, U-17 (Pin 17) goes LOW after a count of 15 and this is coupled to the Flip-Flop (U-42) and it toggles, switching to the other power buss for the remainder of the flight. (It is this same signal that reverses the count sequence.)

Thus, U-42 randomly selects which power buss will come on first (determining bird flight direction), and switches power busses in midflight.

POWER CONTROL (SHOOTER SELECT):-----

The Power Control system that selects which shooter will be activated to fire at the bird is similar to that used for the Bird Flight. Logic Board output Pins 101, 102 and 103 serve to activate 3 separate Power Buss SCR's on the Power Sound Board. This determines which shooter and bullet path will be illuminated.

U-42 (Pins 8 and 9) drives two 3-input gates that will activate Shooter "A" or Shooter "C". This Flip-Flop is operated by forcing it into either the PRESET or CLEAR Mode (at Pins 10 and 13). PRESET and CLEAR signals are derived from the Bird Flight Power Control Flip-Flop, U-42 (Pins 5 and 2). It can be seen that these signals (routed through gates U-41, Pins 8, 9, 10, and 12, 13, 11) will assure that the proper shooter will be activated for the chosen direction of flight.

DOUBLES is activated every fourth turn, when U-29 counter gives a HIGH at U-41, Pins 4 and 5. A LOW results at U-41, Pin 6. This signal is felt at U-27, Pins 4 and 10, which inhibits illumination of Shooter "A" and Shooter "C". This same LOW is inverted through U-13 (Pins 1 to 2) and turns on SCR Q-18, lighting the DOUBLES nomenclature. U-40, Pin 11, also goes HIGH, activating Shooter "B" (in the center position).

GUN SHOT:-----

U-50 is a 7493 Counter whose outputs are decoded by U-49 into a 1 through 10, in-line output and inverted by U-55 and U-56. The inverted outputs are applied to transistors Q-48 through Q-55 to sequentially illuminate the gunshot flight path.

The gunshot sequence begins when the input processor provides a LOW-to-HIGH level transition at U-51, Pin 3 (the Clock input). This causes the output at Pin 5 to go HIGH, opening Gate U-57. At the same time, Pin 6 goes LOW, releasing U-50 from RESET (Pins 2 and 3).

Pin 12 of U-57 has a pulse train from U-46 (the gun oscillator) present at all times, and when the gate opens this is routed to counter U-50, causing it to advance. Lights begin to sequence along the gunshot path as transistors Q-48 through Q-55 are energized. When the counter reaches a count of 14, U-48 (Pins 9, 10, and 11) decodes that condition and Pin 8 goes LOW, resetting U-51 into its original condition. This closes gate U-57 and resets counter U-50 back to its "0" condition.

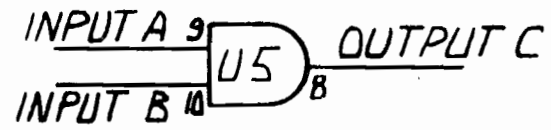
When the gunshot sequence reaches the point at which it intersects the Bird Flight path, it is necessary to generate a Gate pulse that will be used to detect coincidence when a "Hit" is scored. To score properly, this gate pulse must be of the same width as a similar pulse that is generated by the Bird Flight circuit when it reaches the point of coincidence. This is not as straightforward as it may seem, because the Bird Flight occurs at different speeds (generating pulse widths which are dependent on the speed) and the gunshot oscillator is a fixed frequency. The circuitry which consists of U-57 and U-61 compensates for the difference.

Two of the U-57 gates are cross-connected into an R-S latch configuration. When the gunshot reaches the point of coincidence, U-57, Pin 5 receives a LOW pulse that latches Pin 6 HIGH. This HIGH is applied to U-57, Pin 9, allowing the master clock frequency (always present at Pin 10) to proceed through to advance counter U-61, a 7493 which will give an output pulse after a count of 16. This HIGH-to-LOW transition is differentiated by C-29 and resets the R-S latch U-57. This of course places a LOW at U-57, Pin 9, and the gate closes. Thus, the gate was open for the period during which the counter advanced to a count of 16. It can be seen that, as the clock frequency changes for each bird flight, the output pulse width at U-57, Pin 6, will change accordingly. This yields a pulse width equal to that generated by the bird flight.

HIT GATE:-----

The HIT GATE is comprised of U-5 (Pins 8, 9, and 10). Figure 20 illustrates the signal that is generated at

AND GATE



TYPICAL WAVEFORMS PRESENT AT U5

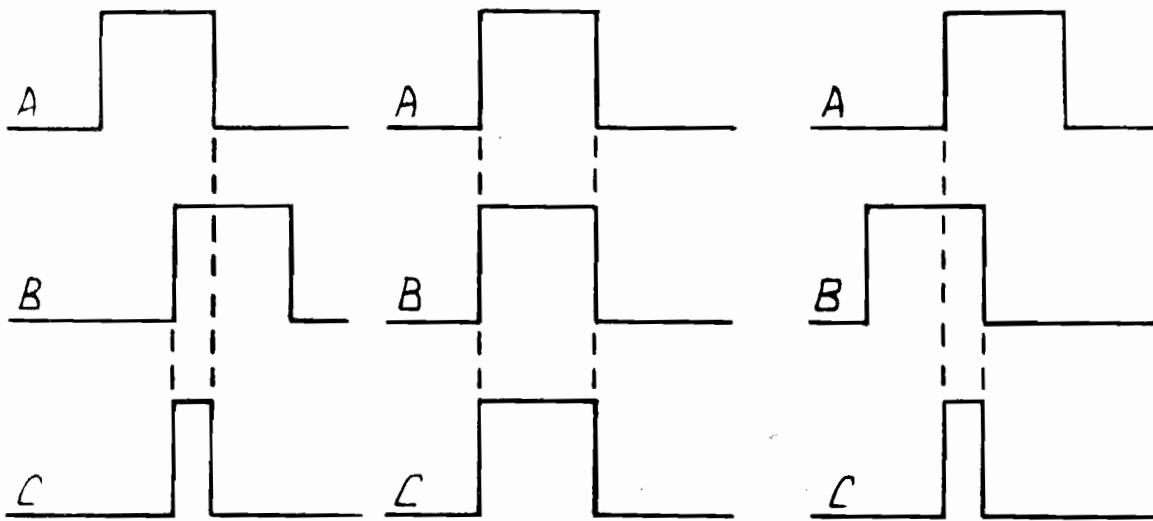


Figure 20

Pin 8 when a Hit is registered. Several conditions are shown illustrating that the output pulse width is dependent upon the timing with which the two inputs to the gate are applied. If the two input pulses are coincident only at the pulse edges, a narrow width pulse is obtained, and if there is no coincidence, there will obviously not be an output.

It is the width of the pulse which occurs at Pin 8 of U-5 that determines what type of "Hit" is obtained. Perfect coincidence scores a "4" (EXPERT). Less perfect coincidence will result in a narrower pulse and score a "3". A "2" results from an even narrower pulse, and a "1" occurs when coincidence is only at 25%. Circuit operation is as follows:

The HIGH gate pulse is applied to U-6, Pin 10, and opens this NAND gate, allowing the signal that is felt at Pin 9 to be routed through. The signal at Pin 9 is at a frequency that is 4 times higher than the Bird Flight sequencing frequency. Therefore, there are 4 pulses that may fit into the same time-frame that is occupied by one pulse of the Flight sequence. It can be seen that if coincidence is perfect, the gate applied at Pin 10 of U-6 will allow four pulses of the signal applied at Pin 9 to pass. Less coincidence will allow fewer (perhaps three, or two, or one) to pass. These pulses are fed to the scoring circuitry.

HIT SCORE CIRCUIT:-----

When the Hit Gate pulse is applied to U-19, Pin 10, it allows a specific number of pulses (which are always present at U-19, Pin 9) to proceed from Pin 8 into U-39, Pin 1 (a test gate), and then into U-38, Pin 14.

U-38 is a 7493 counter which counts the number of pulses applied and presents this information, in BCD form to U-25, a 4-Bit Magnitude Comparator.

U-25, the comparator, is also monitoring the output of U-24, another 7493 counter. When the outputs of U-24 and U-38 are the same, the comparator output, at Pin 6, is HIGH. When pulses are applied to U-38, it counts, and the comparator notes that the outputs from the two counters are no longer the same. When this occurs, U-25, Pin 6 goes LOW.

The LOW output from the comparator is routed to Q-23 which was shorting capacitor C-15. This short across C-15 inhibits oscillation of U-26. When the transistor is turned OFF, U-26 begins to oscillate at a

low frequency, yielding a square wave at Pin 3. These pulses are applied through inverter U-31 (pins 11-10) to counter U-24. U-24 counts until its outputs are equal to those of counter U-38. At that time the comparator senses that they are equal and U-25, Pin 6 again goes HIGH. The HIGH turns Q-23 on again and oscillator U-26 ceases oscillation.

The HIGH transition is inverted by U-13 (Pins 9 to 8) and the resultant LOW transition at U-31, Pin 8, is differentiated by capacitor C-17 and applied to U-45, a one-shot multivibrator. When triggered, Pin 3 of U-45 goes HIGH and remains there until the multivibrator times out, at which time it goes LOW. The HIGH-to-LOW transition is differentiated by capacitor C-18 and inverted by U-33 (Pins 11 to 10). The resultant positive pulse resets both counters (U-38 and U-24) to their "Zero" state.

It should be noted that the same pulses from U-26 that advanced counter U-24 are also applied to Pins 3 and 11 of U-14 and U-15. These two I.C.'s are Dual "D" Flip-Flops hooked up in a shift register configuration. As the pulses are applied, outputs 5 and 9 are progressively forced HIGH and these outputs turn on Q-24, Q-25, Q-26, and Q-27, which light the front panel HIT SCORE nomenclature. Q-24 illuminates the HIT SCORE words and the number "1", Q-25 lights the number "2", Q-26 lights "3", and Q-27 lights "4" and the large EXPERT trophy.

The same reset pulse that returned the counters to "Zero" is inverted by U-13 (Pins 13 to 12) and it also resets the shift register.

In typical sequence, the HIT SCORE circuitry might operate as follows:

A hit worth 3 points is scored, and 3 high frequency pulses are applied to counter U-38, which causes its output to unbalance the comparator. The comparator puts out a signal that starts oscillator U-26, which puts out 3 pulses and advances counter U-24. At this point, the comparator senses that both counters are now equal and it puts out a transition that starts U-24 one-shot. When the one-shot times out, it resets the whole circuit.

While the counter, U-24 was counting, the shift register U-14 and U-15 was advancing the HIT SCORE to 3.

It should be noted that the comparator has an output

at Pin 7 that goes HIGH when the device is unbalanced. This signal turns SCR Q-28 ON and lights the burst when a "HIT" is scored.

"EXPERT" TALLY BOARD:-----

When an "EXPERT" hit of 4 points is scored, U-15, Pin 8, goes LOW when the "4" lights. This pulse is applied through U-39 (Pins 13 to 11) to U-9 and U-10, a shift register arrangement that advances one step for each input pulse. The outputs are connected to transistors which turn on the small cups on the front panel that tally the number of "EXPERT" hits.

U-9 is an 8-stage shift register and U-10 is a 7474 Dual "D" Flip-Flop hooked in a shift register configuration.

When the game ends, a reset pulse is applied to U-9, Pin 9 and U-10, Pins 1 and 13 to return the tally to "Zero".

SCORING:-----

The negative-going pulses that are gated through U-6 (Hit Gate) are fed through NAND Gate U-31 (Pins 1 to 3) and applied to the "Score Switch", U-21. When not in the DOUBLES mode, a score of 1, 2, 3, or 4 will be awarded.

If TEAM 1 is selected, U-51 (Pin 12) will apply a HIGH to U-21, Pin 1. This will allow the scoring pulse to proceed through U-21 (Pins 2 to 3) and through U-8 (Pins 5 to 6) and into the 7490 score counter U-62.

U-62 is a 7490 Decode Counter which drives a 7475 Quad Latch. (Refer to IC information at the front of the manual.) The Latch, in turn feeds a 7448 seven-segment decoder, U-64. U-64 drives the individual segment driver transistors and illuminates the lamps in the score board.

U-62 output at Pin 11 is fed to U-58, Pin 14, another decode counter which counts the second digit of the two-digit score.

If TEAM 2 is selected, the same procedure is followed through Pin 5 of U-21, to Pin 10 of U-8 and thence into scoring counter U-66 and U-69 which accumulate the TEAM 2 score.

If a "Hit" is not registered, a point is awarded to the opposing team. This is accomplished as follows:

U-21, Pins 9 and 13 are being alternately provided

with a HIGH signal, opening these two gates. If a "Hit" is not registered, a single pulse appears at U-21, Pins 10 and 12. Depending upon which gate is open, this pulse is routed through and awards one point to the opposing player. The pulse is derived from U-30 (Pin 3) which goes LOW upon completion of the Bird Flight. This transition is differentiated by C-9 and inverted by U-33 and ultimately routed to U-21, the score switch.

When DOUBLES is illuminated on the graphics panel, a means is provided to award double scoring whenever a Hit is achieved. Referring back to the HIT SCORE description, it will be seen that, as the Hit nomenclature (i.e., "1", "2", "3", and "4") is sequentially illuminated, the pulses that advance this circuit are available at U-31, Pin 10. This signal is applied to Gate U-31 (Pin 12) and if there is a HIGH at Pin 13 (which occurs when DOUBLES is selected) will proceed to U-31, Pin 2. These pulses will be added to the score that was awarded when the Hit Gate was enabled. Thus, if the Hit Gate had originally allowed two pulses through, the HIT SCORE circuit would shortly thereafter add an additional two pulses as it advances the graphics panel HIT SCORE readout.

END OF GAME:-----

The game is ended when an internally selected score is achieved. Pins 9, 10, and 11 of U-47 monitor TEAM 1 score and can end it on any score increment of 10. Jumpers are provided to select any score from 10 to 70. The game is normally shipped with the score set to end the game at 30 points. Pins 1, 2, and 13 of U-47 monitor TEAM 2 score. The output of either of these two gates goes negative when the preselected score is reached. Either negative going (LOW) signal will be inverted through the NAND gate U-48, Pin 6, and into U-39, Pin 5. Pin 4 of U-39 is HIGH only if TEAM 1 is selected. This assures that the game will not end until the second player (TEAM 2) has had his last turn. The resultant pulse at U-39, Pin 6, is fed at U-6, Pin 12. The other U-6 input (Pin 13) receives a pulse from the End of Sequence circuitry and these two inputs produce a NEGATIVE pulse at U-6, Pin 11.

The negative pulse that occurs triggers the Timer (U-7), causing a positive (HIGH) output from Pin 3 of the Timer. This output pulse (which lasts about five seconds) is fed through the pulse shaping network of U-20 and then applied to Pin 4 of U-28, the DOWN input of the GAMES COUNTER. The output of U-7 is also used to inhibit the receiver input, through U-6, Pin 11 to U-5, Pin 4. The negative signal that results at U-5, Pin 6 is applied to U-52, (the input processor) Pin 4 and holds it in the CLEAR mode. The signal also goes to U-51, Pin 13 to clear the 7474, assuring that when a new game is initiated, it will always start with TEAM 1 at bat.

The output of U-7, Pin 3, is also differentiated by C-27, and applied to Pin 1 of U-1, which puts out a positive pulse at Pin 2 that resets all of the Score counters and brings the score back to zero.

FREE GAME:-----

A free game is awarded after a preselected number of EXPERT Hits are awarded during the period of a game. This number is selectable from 1 to 16. The EXPERT Hit Counter, U-44, counts the output from U-15, Pin 8, which goes HIGH every time an EXPERT Hit is awarded. When the preselected number is achieved, a positive (HIGH) signal is applied to Pin 13 of U-43, a "D" Flip-Flop. This triggers the Flip-Flop and a LOW output appears at Pin 8. This is applied to Pin 5 of U-20 and, when present, inhibits the "Game Over" signal from proceeding to the Games counter. Thus, when the game is over, it will not step down and another game may be played without depositing another coin. Signal from U-7, Pin 3 will reset the EXPERT counter just prior to the start of a new game.

POWER SOUND BOARD

POWER CONTROL:-----

Power switching to the five power busses is achieved by SCR's Q-18 through Q-22. The anodes of all of the SCR's are commonly tied to the incoming rectified AC waveform (approximately 14 volts). For instance, when power buss one is to be turned on, a HIGH signal at U-31 will be coupled through diode D-7 and resistor R-56 to the gate of Q-19. Q-19 will remain on as long as this positive potential remains at the gate, thereby coupling power through Q-19 to Pin 38 and thence to power buss one.

All five power busses operate in the same manner.

CROWD NOISE:-----

Transistor Q-1 is an NPN transistor which, with its emitter-base junction back-biased in the manner shown, breaks down and produces random, high frequency noise spikes. This "white" noise is amplified by Q-2 and Q-3 and is applied to the cathode of diode D-3. Diode D-3 is normally back-biased and will, therefore, not allow the crowd noise to pass. When a crowd cheer is desired, a HIGH logic level is applied to Pin 29 of the power sound board, which is routed through R-11 to the base of Q-5, turning it on and applying a LOW level to the base of Q-4. When Q-4 turns off, its collector rises to the positive supply voltage as capacitor C-6 charges through resistor R-6. This positive potential forward biases diode D-3 and allows the crowd noise to appear at the base of transistor Q-6.

Transistor Q-6 is a filter circuit that removes some of the higher frequencies contained in the white noise for a more realistic sound.

The whistle that accompanies the crowd noise is generated by an oscillator consisting of Q-7 and Q-8. This circuit is normally biased so that it does not oscillate. However, when the collector of Q-5 goes LOW, the voltage change at the anode of diode D-5 causes the circuit (Q-7 and Q-8) to oscillate for a short period of time. The time duration is a function of the charge time constant of C-13 through R-21. When the collector of Q-5 returns to the HIGH state at the end of the EXPERT hit gate, the biased change again causes a short period of oscillation, generating the second whistle.

GUN SHOT AND HIT SOUND:-----

Q-13 is a white noise generator, operating similar to Q-1 and it provides a signal which is amplified by Q-12 and Q-11. The white noise so produced is applied to an FET switch, Q-10. When a gunshot occurs, a HIGH logic level is

applied to Pin 28 of the power sound board. A leading edge of this pulse is differentiated by capacitor C-14 and resistor R-23. The resultant voltage spike at the base of Q-9 turns the transistor on for a short period of time allowing the gate of the FET switch to go negative, turning it on. Shaping of the noise envelope to approximate a gunshot is achieved through the use of capacitor C-18, resistors R-24 and R-25. The output of the FET switch is routed through R-44 to Pin 13 of amplifier U-1, a summing amplifier that is used to combine the various sounds and route them to the audio amplifier.

The hit sound is achieved by applying a positive logic level to Pin 27 of the power sound board. This pulse is also differentiated by resistor R-31 and capacitor C-23 and applied to Q-14. Transistor Q-14 is essentially in parallel with Q-9 and therefore its switching action achieves a sound somewhat similiar to the gunshot.

BELL TONE GENERATOR:-----

Three operational amplifiers comprise the bell tone generator and they consist of three-fourths of an LM324 operational amplifier (Pins 1 through 10). The circuit operates essentially as a damped oscillator and it produces an output signal only when it is shocked into operation. The subsequent output tone decays over a short period of time, producing a bell tone-like sound.

The bell tone generator is activated by applying a HIGH level at Pin 26 on the power sound board. This signal is differentiated by capacitor C-29 and applied to transistor Q-17. The resulting pulse at the collector of Q-17 is applied to Pin 6 of U-1 and this initiates the bell sound.

AUDIO AMPLIFIER:-----

U-1 (Pins 12, 13, and 14) is a summing amplifier which combines the various sounds in the power sound board and routes them through C-41 to Pin 9 on the power sound board. Pin 9 is routed to an external potentiometer (located on the right hand side of the game). The attenuated sound returns to the power sound board on Pin 10 and is applied through R-52 into audio amplifier U-2. The output of the audio amplifier occurs at Pin 1 and this is routed through U-34 to Pin 19 of the power sound board, thence to the speaker system.

VOLTAGE REGULATION:-----

The power supply voltage for the entire power sound board is achieved by rectifying and filtering the incoming waveform at Pin 1 and applying it through a 15 volt voltage regulator, VR1. The output of this voltage regulator provides a stable and ripple-free 15 volts to all the circuitry.

MAINTENANCE

TRAPSHOOT has been designed to simplify, insofar as is possible, the maintenance and repair procedures necessary to get the game back "on line" as rapidly as possible.

Before any attempt is made to troubleshoot the circuitry of the game, it is recommended that the section of this manual entitled DETAILED CIRCUIT DESCRIPTION be read thoroughly.

EQUIPMENT:-----

Two main pieces of equipment are desirable when servicing the circuitry, a volt-ohmmeter and an oscilloscope. The following section on MAINTENANCE PROCEDURES assumes the use of these two instruments. While it is possible to troubleshoot the game without the oscilloscope, it is not a recommended procedure.

SERVICE FEATURE:-----

A unique feature of the TRAPSHOOT Game is the incorporation of a Test Connector to facilitate checkout of the electronic system. A TEST INSTRUMENT (Model 5001A-TB) is available, that, when plugged into the Logic Board, checks every major circuit element in the system. This considerably reduces troubleshooting time and greatly simplifies all aspects of service to the unit.

The 5001A-TB is available from Gremlin Industries.

The Maintenance Procedures section on the next few pages does not assume the use of a TEST INSTRUMENT. Special instructions for the use of the 5001A-TB accompany each instrument.

MAINTENANCE PROCEDURES

The TRAPSHOOT Wall Game has been designed to be a reliable and easily maintained unit. It employs very little point-to-point wiring, with most interconnections being made using printed circuit paths.

If service becomes necessary, both the Power/Sound Board and the Logic Board are easily removed by simply unplugging them. Spare boards may then be substituted if desired.

FACTORY ASSISTANCE:-----

Technical help is available from the Gremlin factory. If a problem occurs which cannot be easily resolved, a phone call or letter to the factory will bring attention to your problem by a trained representative.

SPARES:-----

A spares kit (listed elsewhere in this manual) is available from the factory. It contains items necessary to effect repairs in those areas that would be most likely to need service. Integrated circuits, transistors, and lamps comprise the majority of the spare parts.

Spare boards (Logic, Power/Sound, and Receiver) are available. Spare transmitters are also stocked.

MAINTENANCE:-----

Should the TRAPSHOOT Game fail to operate properly, it is always best to check system operation in a logical, step-by-step manner. Doing so will many times reveal a rather simple problem that is easily corrected, and eliminate time-consuming and costly repair attempts on "circuit problems" that do not exist.

Some problems that may fall into the above category are included in the following guidelines:

BURNED OUT LAMPS:-----

If a lamp burns out, it should never be replaced with anything but the EXACT replacement device. The lamps used in this game have been selected for proper voltage and current characteristics. Use of anything other than the proper type may cause malfunction and destruction of internal transistor drivers.

Many instances of damage to the Logic Board and Power Supply can be directly attributed to the use of an improper lamp type in the front panel display.

COMPONENTS:-----

When replacing any components in the game, always use an exact replacement part. All parts have been chosen for optimum circuit performance. Transistors and SCR's, used to drive lamps, have specific current and power characteristics which are very important to proper operation, and replacement with a device of less capability can result in damage to the component or associated circuitry.

COIN BOX:-----

Operation of the coin box is quite simple. Inserting a coin causes a mechanical switch contact closure which causes games to register. It is important that the correct connections to the coin box be maintained. If any of the wires that connect the box to the game are connected in anything other than the proper order, THE GAMES COUNTER WILL NOT OPERATE PROPERLY. It may give extra games at erratic intervals, not count up, not count down, or otherwise operate incorrectly. If any repairs have been made to the coin box, or if the cable has been extended, or otherwise modified, proper connections must be maintained.

TRANSMITTER:-----

The transmitter is a battery powered device, and the batteries need to be changed occasionally. The transmitter contains two 9 volt batteries of the type that are commonly used to power transistor radios. When the batteries begin to weaken, the range at which the control box will work reliably will shorten. Also, because of weaker output, extraneous signals may cause the game to operate erratically. Typically, when the signal is weak, the game may operate erratically. If the battery is down considerably, the game may not operate at all; that is, it will not launch or shoot. If any of the above conditions exist, ALWAYS CHANGE THE BATTERIES IN THE TRANSMITTER BEFORE ANY OTHER ATTEMPTS AT REPAIR ARE MADE.

The transmitter is also subject to abuse by the game players. If the unit is dropped or thrown, it is possible that the crystal that controls the frequency has been damaged. If this is the case, a new unit must be substituted, or the existing unit repaired.

The transmitter operation may be checked by placing an oscilloscope at the receiver input to the Logic Board within the game and observing the input level as the

transmitter button is depressed. The signal at this input (Pin 23) is normally at 5 VDC and momentarily goes to ground potential (LOW) when the receiver is responding to a transmitted signal. If this occurs, it may then be assumed that the transmitter and receiver are operating normally, and that any problems must be elsewhere.

LAMPS ARE DIM:-----

Check diode rectifiers and transformers for proper output. Lamps operate at 12 to 14 volts. All of the background illumination operates on AC voltage provided by the transformer located at the left side of the game (viewed from the rear). All other animated or electronically-switched lamps operate on rectified voltage supplied by the other transformer.

If a lamp has shorted, or any other unusual load is applied to the game, the fuse should blow in a short time.

DEFECTIVE REGULATED FIVE VOLTS:-----

If the game is operating improperly, particularly if it is operating in an erratic manner, the five volt regulator on the lamp board should be checked. If the voltage out of the regulator is not within a few tenths of a volt of plus five volts, the circuit should be examined carefully. It should be remembered that the five volt regulator has an internal protection circuit which shuts it down in the event that excessive current is drawn by the game. This can cause the output of the regulator to appear to be several volts low, but does not necessarily indicate a bad regulator. The excessive current drain may be caused by a malfunction or a shorted component on either the logic board or the power sound board. In the event that these two boards are determined to be operating normally, the regulator should be changed.

CANNOT START GAME:-----

Check coin box as previously discussed. If o.k., check integrated circuit U-28 or U-16. Problem could also be U-5.

GAMES COUNTER ERRATIC:-----

Games counter U-28 counts up when an input is applied at Pin 5 and counts down when an input is applied at Pin 4. Normally, both Pins 4 and 5 should be HIGH. Should a continuous low level be applied at either input, an attempt to count on the other input will result in erratic operation. Erratic up count can be caused by defective wiring in the coin box or a possible malfunction of U-53 or U-54 on the coin box input circuit.

TRANSMITTER WILL NOT ACTUATE GAME:-----

If the games counter operates normally, but the game will not respond to the transmitter, U-52 and U-53 should be checked. If these circuits are operating normally, check U-11, the READY multivibrator, to be sure it is being triggered properly. If triggering is occurring, but the unit is not timing out, check U-23 or replace U-11. If the READY light is operating normally, it is possible that the master oscillator circuit, U-37 is at fault. Check for proper frequency at Pin 3. If U-37 does not operate properly, it should be changed or the problem could also be associated with U-36.

BIRD FLIGHT DOES NOT CHANGE SPEED:-----

If the bird flight occurs at the same speed on each turn, check U-22 and the operation of Gate U-34 (Pins 1, 2, and 3).

LAMPS DO NOT LIGHT IN BIRD FLIGHT PATH:-----

In the event a single lamp does not illuminate in the bird path flight, it is possible that one of the driver transistors (Q-2 through Q-17) is defective. Should these transistors test normal, check inverters U-2, 3, and 4, which serve to invert the signal from U-17, the four to sixteen line decoder. If normal, check the outputs of U-17.

If the bird flight path is illuminating only during the first half of the flight, check operation of the power buss 1 and power buss 2 gate outputs located at Pins 99 and 100 on the logic board. If the proper signals are not present, it is possible that U-40 is defective or U-42 may not be toggling properly. If these two devices are o.k., the problem could be associated with Gate U-40 (Pins 8, 9, and 10). It should also be remembered that U-40, Pins 2 and 4 will inhibit both power buss 1 and 2 if a LOW level is continuously applied.

GUN WILL NOT FIRE:-----

Check the output of U-46, the gun oscillator for proper signal. If present, check that Gate U-57, Pin 13, has the proper gate pulse applied. If this pulse is not present, (Pin 13 should be HIGH to allow gun oscillator signal to pass) check U-51 for proper operation. If U-51 is operating normally, (applying a HIGH output to Pin 5 when the input at Pin 3 goes HIGH), Pin 1 of U-51 should be checked to see that it is not being held in the CLEAR mode. If Pin 1 is being improperly held LOW, check U-48 and U-50.

If all of the above are normal, check U-49 for proper

operation. Inverters U-55 and U-56 and transistors Q-48 through 55 may also be checked. If all this circuitry appears normal, the problem may be in the power buss switching circuitry on the power sound board.

DEFECTIVE GUNSHOT POWER BUSS SWITCHING:-----

Check for proper output at Pins 101, 102, and 103 on the logic board. If the proper signal is not present, check U-27 and U-40, together with U-42 and U-41. Since the power buss switching for the gunshot is directly slaved to the power buss switching for the bird flight, it must, of course, first be determined that the bird flight power buss switching is operating normally.

WILL NOT RESET AFTER BIRD FLIGHT:-----

The reset pulse that is derived after the play action sequence has been completed is ultimately felt at Pin 11 of Gate U-5. If the bird has not been hit, this pulse is derived by the differentiating network consisting of C-9, R-38 and R-39, which is shaped through inverter U-33 (Pins 5 to 6). This pulse is applied to Pin 1 of U-48 and directed into U-5, Pin 12.

Pin 2 of U-48 realizes a pulse which is generated by U-39, Pin 8. Pins 9 and 10 of U-39 generate this pulse from the completion of the HIT SCORE sequence when the bird has been hit. All of the gates associated with these functions should be checked for proper operation and replaced if found to be defective.

HIT CIRCUIT NOT WORKING:-----

Check U-5, Pin 8 for a pulse to occur whenever a "Hit" should be registered. There should occur a pulse if the bird and bullet coincide in their flight paths. If no pulse is present, check U-5, Pins 9 and 10 for the respective gate pulse inputs (see Detailed Theory of Operation). U-19 determines which point in the bird flight path is selected for coincidence and it too should be checked for proper operation.

HIT SCORE CIRCUIT DOES NOT OPERATE PROPERLY:-----

Before attempting to repair the hit score circuitry, the Detailed Circuit Theory on this circuit should be read carefully. The two counters, U-24 and U-38 should be checked for proper operation and U-25 should be replaced if it does not provide a low transition to Pin 9 of U-13 when the outputs from the two counters are not equal. All of the inverters associated with this circuit (U-13 and U-33) should also be checked. U-26 should operate as a free-running multivibrator when Q-23 is turned off. U-45 should operate as a one-shot

multivibrator when a negative transition is applied to Pin 2.

The shift register which is comprised of U-14 and U-15 could be at fault if the HIT SCORE (1, 2, 3, and 4) do not sequentially illuminate in the proper manner. Should any of these fail to illuminate, one of the SCR's, Q-24 through Q-27 may be at fault.

GAME SCORES IMPROPERLY:-----

If the games score circuit is not operating normally, it is important to determine if the malfunction occurs on both Team 1 and Team 2 score presentation. If the problem is peculiar to only one side, it is probable that the defect will be in the particular counters associated with that read out. For instance, U-62, 63 and 64 form the "unit's" read out circuit for Team 1. The malfunction here will generally reflect only in this particular digit, however, its carry output (from Pin 11) proceeds to U-58, Pin 14, providing the count signal for the "10's" digit.

Should the malfunction be common to both Team 1 and Team 2, it will be necessary to examine that scoring circuitry which is common to both. U-21 and U-8 should be checked for proper operation since they are the devices that route the signal to the respective scoreboard. U-1, (Pins 3 and 4) should be checked for proper operation in the event that the scoring system does not award 1 point to the opponent when a "Hit" is not achieved. Improper scoring may also be caused by a malfunction in Hit Gate U-5 (Pins 9, 10, and 8). U-6 (Pins 9, 10, and 8) and U-31 (Pins 1, 2, and 3) may also be at fault.

If the problem occurs only in the DOUBLES mode, Pin 2 of U-31 should be checked for the presence of pulses when the HIT SCORE circuitry is operating. Should these not be present, check U-31 (Pins 11, 12, and 13) for proper operation.

TEAM ONE AND TEAM TWO DO NOT ALTERNATE:-----

If all other areas of the game are operating properly, change U-51.

GAME DOES NOT END AT PRESELECTED SCORE:-----

Check U-48, Pin 6, for a positive transition when the preselected score is achieved. If not, check U-47, Pins 8 and 12 for a negative going transition when the proper score is achieved.

If U-47 and U-48 are operating normally, check U-39 (Pins 4, 5, and 6) and U-6 (Pins 11, 12, and 13). If all of these circuits are operating normally, the end result should be a negative transition at Pin 11 of U-6 when the game ends. The negative pulse should trigger U-7, a one-shot multivibrator, and effect a positive pulse at Pin 3. If not, change U-7.

IMPROPER HIT SCORE:-----

Proper HIT SCORE is achieved when the HIGH gate pulses at Pin 9 and 10 of U-5 coincide. The degree of coincidence determines the pulse width out on Pin 8 of U-5. This pulse, in turn, gates count pulses through U-6 (Pins 8, 9, and 10).

If the gate pulses applied at Pins 9 and 10 of U-5 are of improper width, the HIT SCORE circuitry will not operate properly (that is, it may always award 4 points, or conversely it may never award more than 1 or 2 points).

Since the master clock oscillator and the gun oscillator operate independently, it is necessary to alter the pulse width of the gunshot to achieve a proper gate pulse (see Detailed Circuit Description). If the proper gate width is not present, change U-57 or U-61.

WILL NOT AWARD FREE GAMES:-----

Check U-44, Pin 14, for a LOW signal when a HIT SCORE of 4 is achieved. With this normal signal applied, U-44 should count properly. The four diodes at Pins 8, 9, 11, and 12 should decode the binary output of U-44. The HIGH level appearing at U-43, Pin 11, will award the free game. If a HIGH level is not present at U-43, Pin 11, change U-44 or a possible defective diode. If a HIGH level is present at U-43, Pin 11, and the game light comes on, change U-20.

EXPERT TALLY CIRCUIT DOES NOT OPERATE PROPERLY:-----

The small cups that are awarded whenever an EXPERT hit is achieved are driven by transistors Q-30 through Q-39 and these should be checked for proper operation. U-9 and U-10 form a shift register network and should be changed if an erratic or improper count sequence is being experienced.

DEFECTIVE BALL DRIVER TRANSISTOR:-----

This problem is easily identified by the unique presentation that results on the display panel. Prior to starting the launch, a bird located in the first half of the launch trajectory will be continuously illuminated. When the launch is started, the bird will remain illuminated while the animation progresses normally. When power buss 2 turns on, a stationary bird will illuminate and remain lit until the buss turns off.

The above is due to a shorted transistor in the bird animation circuit, Q-2 through Q-17. Because the same transistor is used in association with both power busses (see Detailed Circuit Description) it is immediately evident when failure occurs.

Conversely, if the transistor is open, (due, for example, to an incorrect lamp having been installed in place of the correct number, 1813 or 756) the above pattern will be apparent with the exception that the lamps, instead of remaining illuminated while the buss is on, will fail to light at all.

This same pattern of events will also hold true in the gunshot bullet path.

MAINTENANCE PROCEDURES FOR POWER SOUND BOARD

The maintenance procedures on the power sound board differ somewhat from the logic board because the circuitry is composed primarily of discreet components (transistors, resistors, capacitors, etc.). Additionally, the circuits that are used are analog in nature; that is, the individual transistors are generally biased into the linear region and, therefore, any troubleshooting must take into account their proper operation. All of this circuitry is best maintained and repaired by using an oscilloscope and a voltmeter as test equipment.

INOPERATIVE POWER BUSS:-----

In the event that the lamps do not illuminate on any of the five power busses, the input pins on the power sound board should be checked for a proper logic signal. If these signals are normal, the specific SCR (Q-18 through Q-22) would likely be defective and should be changed.

15 VOLT POWER SUPPLY OUT OF REGULATION:-----

The 15 volt regulator, VR-1 should maintain 15 volts plus or minus a few tenths of a volt at Pin 3. In the event that it does not, change the regulator.

It should be remembered that the voltage regulator has an internal overload shut-down capability which can cause its output to be reduced in voltage by a considerable amount in the event of a short circuit or inordinately heavy load.

NO CROWD NOISE:-----

Refer to the detailed circuit description of the power sound board or theory of operation on this circuit. The noise generated by transistor, Q-1, may be traced throughout the circuitry with an oscilloscope. It should appear at the cathode of diode, D-3, at all times. When the circuit is gated ON, transistor, Q-4, will forward bias diode, D-3, and allow the noise to proceed through to Q-6. Amplifier Q-6 should then route the amplified noise signal through capacitor C-11 to the summing amplifier which consists of Pins 12, 13, and 14 of U-1.

If the whistle is inoperative, check for a proper logic signal at the anode of D-5. If it is present, the trouble may logically be assumed to be transistor Q-7 or Q-8.

GUNSHOT AND HIT SOUND DEFECTIVE:-----

Potentiometer R-25 should be adjusted for the most effective gunshot sound. If it is adjusted too far, it may result in a continuous "roaring" sound. It should be positioned just below the threshold of this point. Field effect transistor Q-10 serves as the gate which allows the gunshot signal to

pass and it may be checked for proper operation with an oscilloscope. It also routes its signal to the summing amplifier U-1.

BELL TONE CIRCUIT INOPERATIVE:-----

If the bell tone circuit does not produce the proper sound, U-1 should be changed. If that does not remedy the problem, check transistors Q-16 and Q-17. Proper operation of the bell tone generator is dependent upon a voltage level that is obtained from voltage regulator Q-15 and applied through the emitter follower, Q-16. The voltage level here is approximately 7 volts. If it is necessary to change Q-15, which acts as a zener diode, a transistor of the same type must be used.

NO SOUND:-----

In the event that the game produces no sound at all, the probable defective components would be U-2, the audio amplifier, or the summing amplifier consisting of Pins 12, 13, and 14 of U-1. If replacement of these two devices does not cure the problem, check the potentiometer located on the side of the game and the connections to the speakers.

PROGRAMMING AND ADJUSTMENTS FOR THE GAME

The TRAPSHOOT Game employs means of changing several of the game functions. Changes that can be made are: (1) change of score at which the game ends, (2) change in the number of expert hits required for a free game, (3) change in the bird flight speed, and (4) change in the gunshot speed.

SCORE NECESSARY TO END GAME:-----

The score necessary to end the game is selected by means of jumpers located on the logic board (shown in Figure 21). The game is normally shipped with the end-of-game score set to 30 points. This may be changed at any time, however, by simply changing the jumpers on the logic board as follows:

Game ends at:	20	Jumpers installed:	2
	30	(NOTE: Jumpers should	2 & 1
	40	be connected identi-	4
	50	cally for each team	4 & 1
	60	for score desired.)	4 & 2

EXPERT HITS NECESSARY FOR FREE GAME:-----

Jumpers may be changed at the output of U-53 to control the number of Expert Hits necessary for a free game. The board is marked with the output BCD code (1, 2, 4, & 8) as shown in Figure 21.

Expert Hits for free game:	10	Jumper installed at:	8 & 2
	9		8 & 1
	8		8
	7		4, 2, & 1
	6		4 & 2
	5		4 & 1
	4		4

From the above, it can be seen that it is necessary to simply install jumpers at the terminals until their BCD total adds up to the desired number.

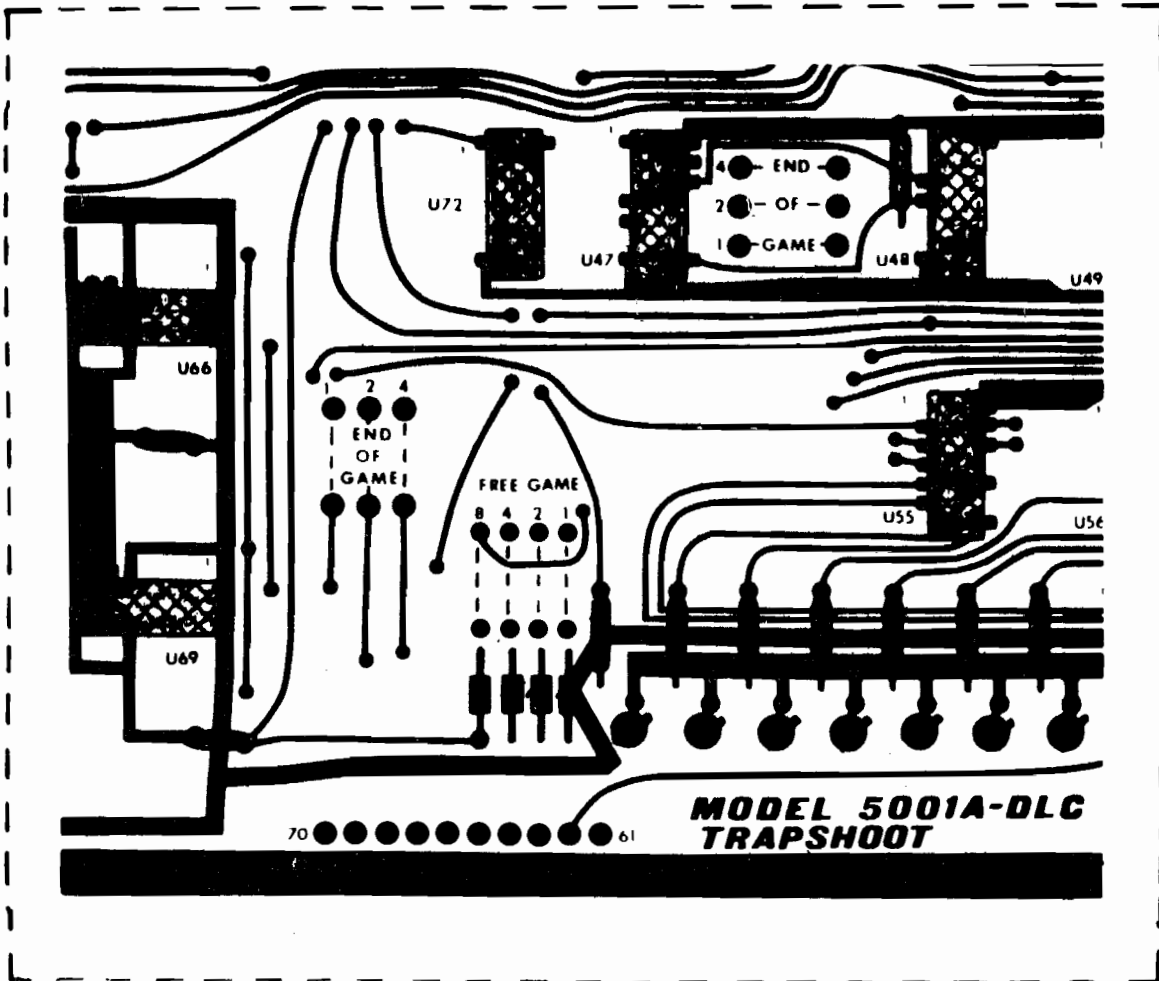
To inhibit free games, remove all jumpers from free game circuit.

BIRD FLIGHT SPEED:-----

Potentiometer R-6, located at the right-hand side of the logic board, controls the bird flight speed.

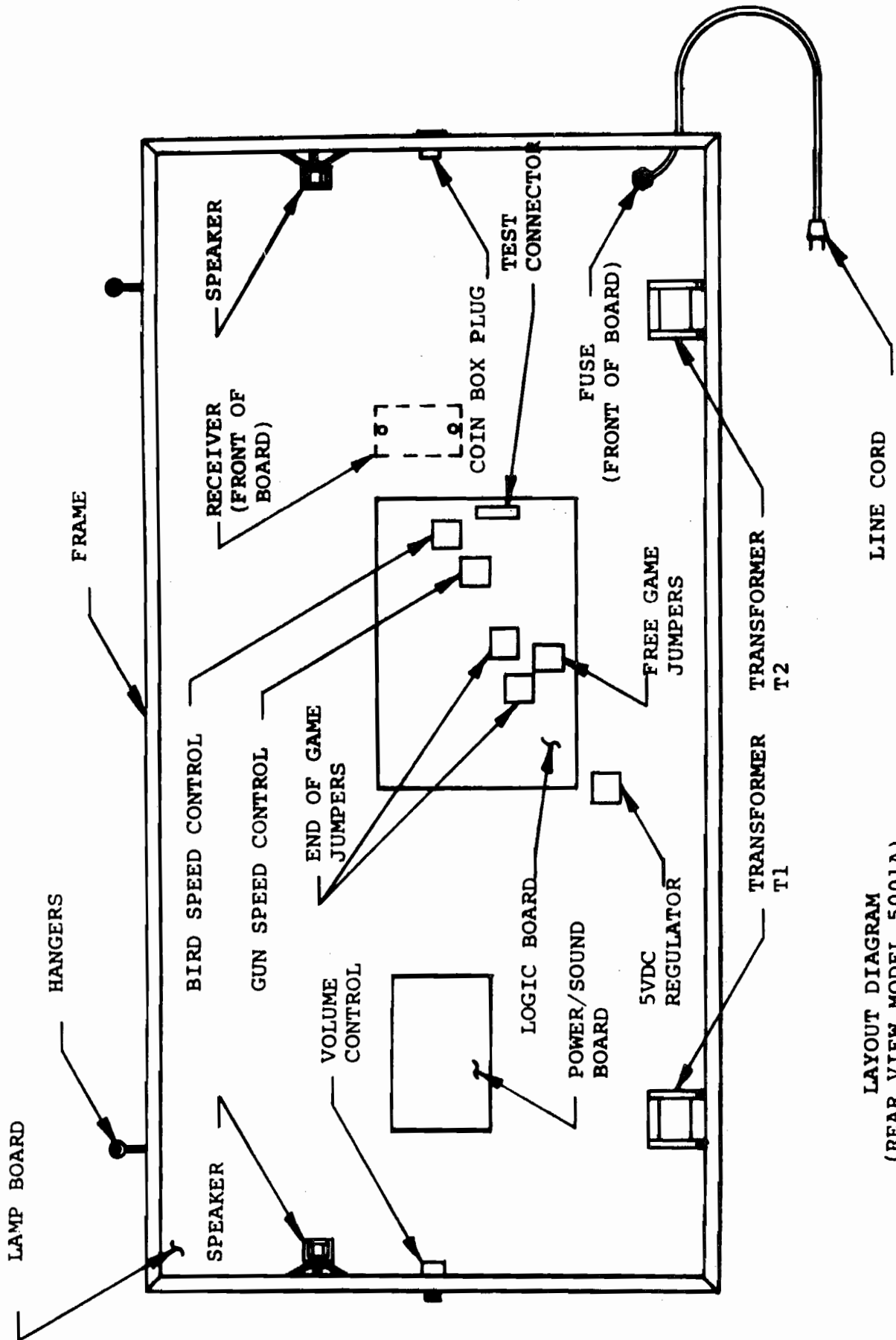
GUNSHOT SPEED:-----

Potentiometer R-97 also located on the right-hand side of the logic board governs the bullet speed.



JUMPER LOCATION
 END OF GAME SCORE & FREE GAME

Figure 21



LAYOUT DIAGRAM
(REAR VIEW MODEL 5001A)

PARTS LIST
TRAPSHOOT
LOGIC BOARD ASSEMBLY
5001A-DLC

<u>Reference Desig.</u>	<u>Description</u>	<u>Gremlin Part #</u>
U-6, 19, 20, 21, 30, 31, 34, 41, 57	IC-7400	314-0009
U-72	7402	314-0024
U-23, 36	7403	314-0025
U-1, 2, 3, 4, 13, 55, 56	7404	314-0015
U-5, 39, 40	7408	314-0012
U-47, 48	7410	314-0010
U-8, 27	7411	314-0014
U-33, 71	7414	314-0026
U-16, 49	7442	314-0011
U-60, 64, 67, 70	7448	314-0013
U-10, 14, 15, 22, 35, 42, 43, 51	7474	314-0006
52, 53	"	"
U-59, 63, 65, 68	7475	314-0021
U-25	7485	314-0027
U-58, 62, 66, 69	7490	314-0003
U-24, 29, 32, 38, 44, 50, 61	7493	314-0005
U-17	74154	314-0008
U-9	74164	314-0028
U-18, 28	74193	314-0007
U-7, 11, 26, 37, 45, 46, 54	NE555	314-0001
Q1-17, 23, 30-39, 42-46, 48-83	Transistor 2N2222A/2N4401	482-0003/482-0014
Q-22, 24, 27	SCR 106-1	482-0012
Q-18, 19, 20, 25, 26, 28, 47	SCR 2N5060	482-0009
All Diodes	Diode 1N4002	481-0001
C-19	Cap. 820pfd	151-0010
C-2, 7, 8, 9, 10, 11, 12, 14, 17,	Cap. .05mfd @50V	151-0001
18, 23, 24, 29, 30-40	"	"
C-1, 20	Cap. .15 @200V	152-0011
C-6	Cap. 1mfd @16V	150-0009
C-28	Cap 2.2mfd @25V	150-0014
C-4, 13	Cap. 4.7mfd @16V	150-0002
C-3, 15, 25	Cap. 10mfd @16V	150-0006
C-5, 22	Cap. 22mfd @16V	150-0015
Decoupling Capacitors	Cap. 100mfd @16V	150-0010
R-30, 73, 86	180 OHM	314-0181
R9-28, 43, 44, 53, 62-71, 74, 75,	680 OHM	314-0681
80, 87-91, 100-111	"	"
R-8, 29, 40, 41, 47, 57, 72, 79,	1K	314-0102
85, 93, 94, 98	"	"
R1, 5, 7	4.7K	314-0472
R-2	8.2K	314-0822
R-4, 31, 32, 34-39, 45, 49-52,	10K	314-0103
54, 55, 56, 76, 77, 81-83, 95,	"	"
96, 99, 112, 113, 114, 115	"	"
R-46	68K	314-0683
R-84	100K	314-0104
R-33	120K	314-0124
R-42, 78, 92	390K	314-0394
R-6, 97	100K Pot	475-0006
n/a	Pins .045 sq. 3/4 in.	212-0002
n/a	5001A-DLC Logic PC Board	170-0009
n/a	Connector, 10 Pin	212-0005

PARTS LIST

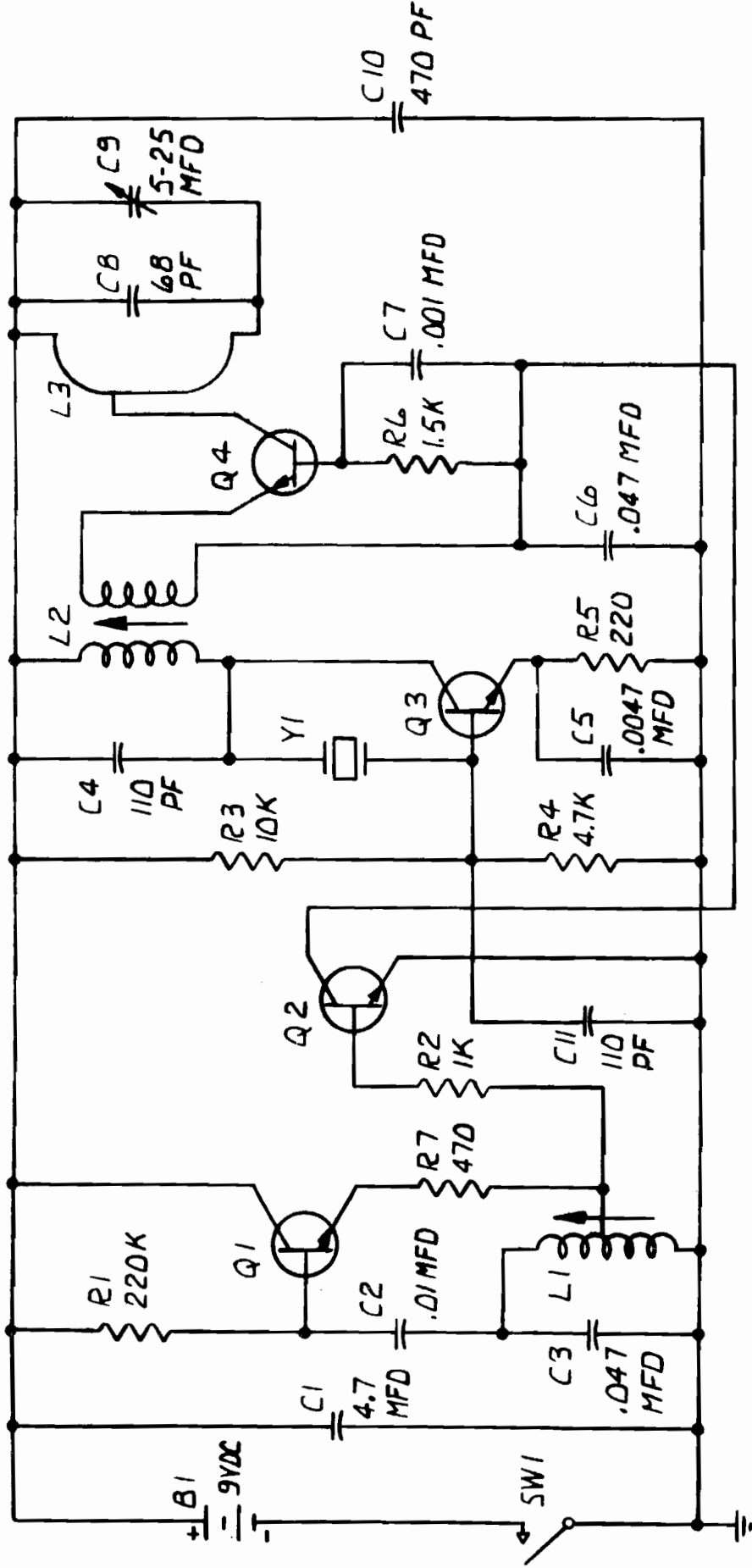
Lamp Board and Frame Assembly

<u>Reference Desig.</u>	<u>Description</u>	<u>Gremlin Part #</u>
VR1	Voltage Regulator-LM340T5	313-0003
T1	Transformer	560-0004
T2	Transformer	560-0005
D-1,D-2	Diode MR751	481-0002
D-3,D-4	Diode MR-501	481-0004
all other diodes	Diode 1N4002	481-0001
55 each	Lamp #756	390-0004
147 each	Lamp #1813	390-0005
202 each	Socket, Lamp	390-0002
-	Fuseholder	514-0005
F-1	Fuse, 1.5A	514-0006
-	Line Cord	600-0002
J-1	Socket (4 Pin, Female, Coin Box)	211-0003
-	Conn. Term. (Male, 10 Pin)	212-0008
R-36	Potentiometer, 10K	475-0007
R-1	Resistor 5 OHM, 15W	474-0005
-	Speaker	130-0004
-	Latches, Frame	280-0015
-	Receiver	190-0006
-	Transmitter	190-0005
-	Hinges	280-0013
-	Coin Box	220-0001

PARTS LIST
TRAPSHOOT
POWER/SOUND BOARD
5001A-PS

<u>Reference Desig.</u>	<u>Description</u>	<u>Gremlin Part #</u>
VR-1	LM340-T15	313-0009
U-1	LM-324N I.C.	313-0008
U-2	706 APC I.C.	313-0007
Q-5,6	2N2222A Transistor	482-0017
Q-1,4,13	2N3565 "	482-0002
Q-15	2N3638A "	482-0001
Q-2,3,7-9,11,12,14,16,17	2N4401 "	482-0014
Q-18-22	2N5060 S.C.R.	482-0009
Q-10	LS4360 F.E.T.	482-0004
All Diodes	1N4002 Diode	481-0001
C-12,36,42	820 pfd Capacitor	151-0010
C-10,11	.001 mfd "	151-0008
C-8,9	.0016 "	152-0014
C-7	.003 mfd "	151-0009
C-40,41	.01 mfd "	151-0011
C-5,43-47	.02 mfd "	151-0006
C-30,32	.033 mfd "	152-0015
C-3,4,16,17,20,21,24,25,29	.05 mfd "	151-0001
C-19,23,28	.15 mfd "	152-0016
C-2,14	1 mfd @ 16V "	150-0009
C-13,26,27,31	4.7 mfd @16V	150-0007
C-18	4.7 mfd @50V	150-0002
C-34	22 mfd @ 35V	150-0001
C-6,15,33,35,38,39	100 mfd @ 25V	150-0013
C-1	2200 mfd @ 25V	150-0016
R-1,49	Resistor 3.3 ohms @ 1/2 Watt	471-0010
R-50	" 33 ohms "	471-0330
R-48	" 47 ohms "	471-0470
R-51	" 100 ohms "	471-0101
R-53-62	" 680 ohms "	471-0681
R-26,34	" 1K "	471-0102
R-23,31,32	" 1.3K "	471-0132
R-3,5,16,27,29	" 4.7K "	471-0472
R-6,13,17,24,35,37,41,42,43	" 10K "	471-0103
R-40	" 22K "	471-0223
R-8,11,52	" 27K "	471-0273
R-12,46	" 33K "	471-0333
R-22	" 62K "	471-0623
R-21,36,44,47	" 100K "	471-0104
R-45	" 180K "	471-0184
R-7,10,14,18,39	" 220K "	471-0224
R-19,38	" 680K "	471-0684
R-2,4,9,20,28,30,33	" 1 Meg "	471-0105
R-15	" 2.2 Meg "	471-0225
R-25	" 100K Potentiometer	475-0006

REVA 5-5-74



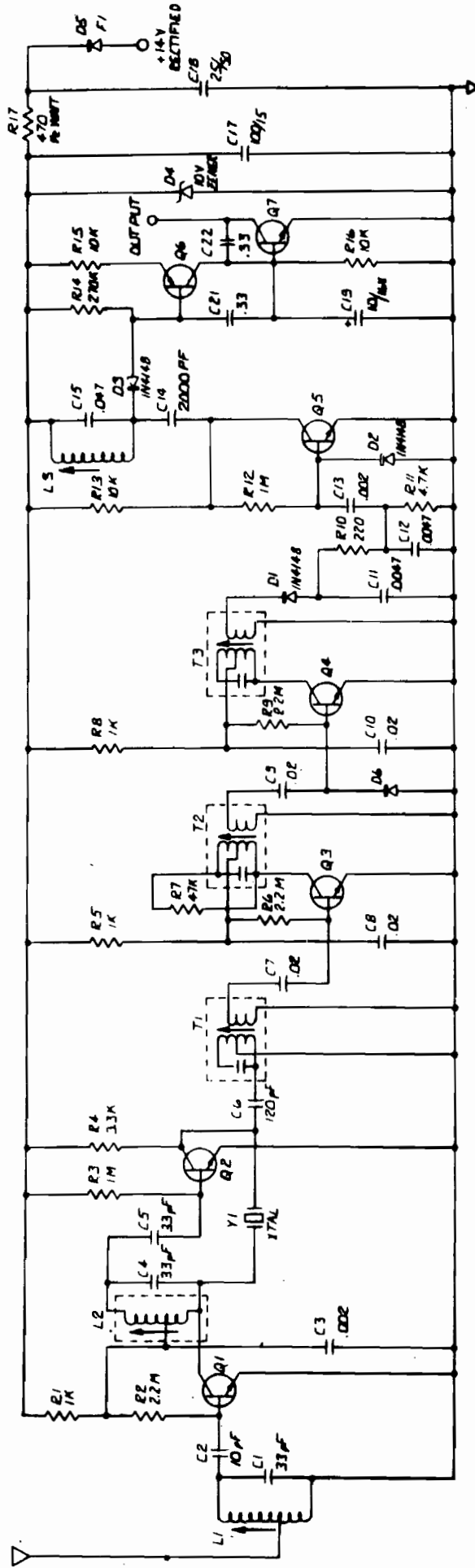
GREMLIN INDUSTRIES, INC.
8401 AERO DRIVE, SAN DIEGO, CALIFORNIA 92123

SINGLE TONE 27 MHZ XMTR. SCHEMATIC DIAGRAM

190-0005A

SCALE: NONE
DATE: 1-14-75
DWN: J.P.F.

1. ALL RESISTOR VALUES IN OHMS, 1/4 WATT 5%.
NOTES: (UNLESS OTHERWISE SPECIFIED.)

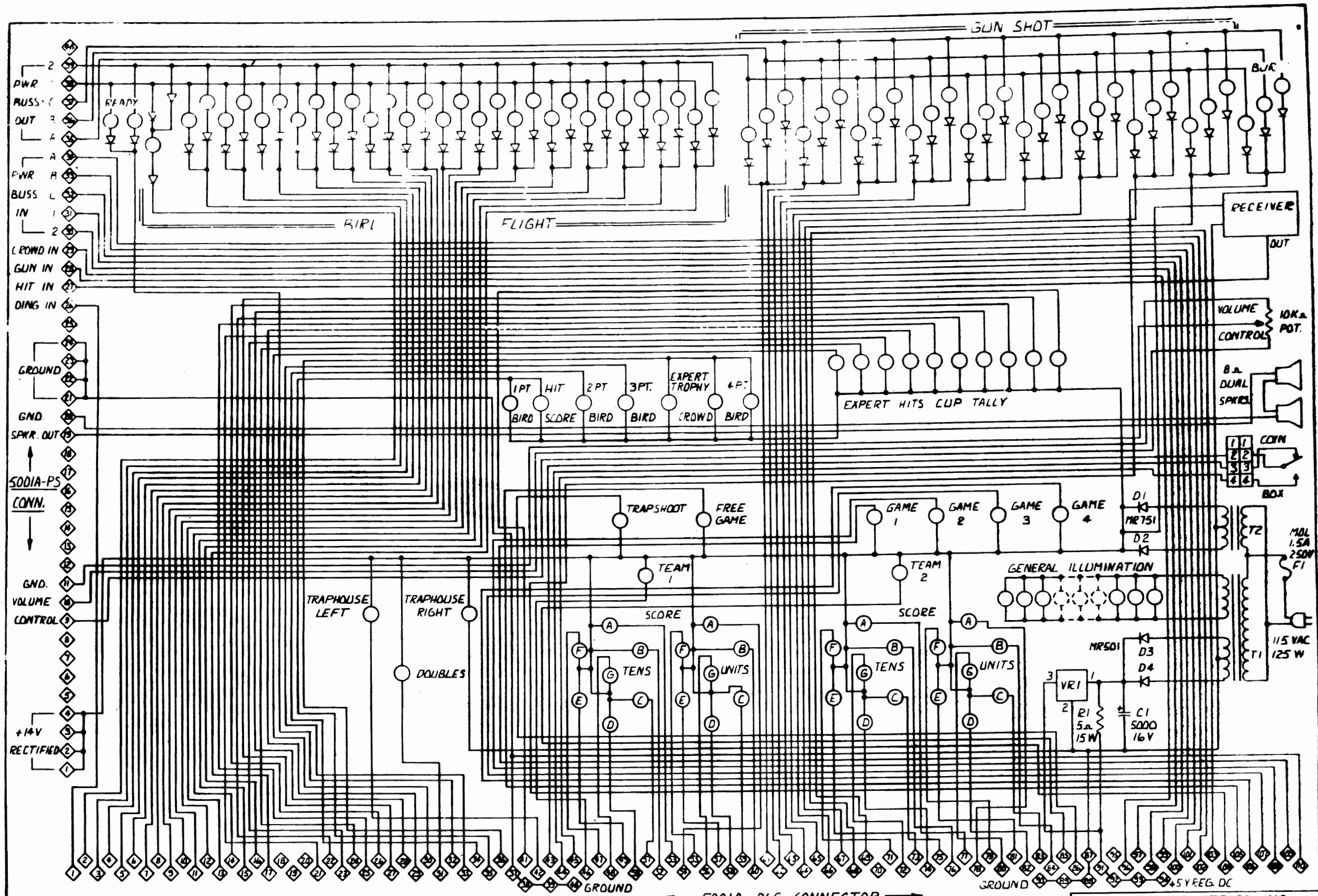


GREMLIN INDUSTRIES, INC.
 3401 AERO DRIVE, SAN DIEGO, CA. 92123

SINGLE TONE 27MHZ RCVR.
SCHEMATIC DIAGRAM
 190-0006A

SCALE: 1/4"=1"
 DATE: 1-14-58
 DRAWN: J.T.

- 2 ALL CAPACITOR VALUES IN MICROFARADS.
- 1 ALL RESISTOR VALUES IN OHMS, 1/4 WATT, 5%
 NOTES: (UNLESS OTHERWISE SPECIFIED)



2. ALL DIODES IN 4002.
 1. ALL CAPACITOR VALUES IN MICROFARADS.
 NOTES: (UNLESS OTHERWISE SPECIFIED)

GREMLIN INDUSTRIES, INC.
 7030 CONVOY CT., SAN DIEGO, CA 92111
 LAMP BOARD & FRAME
 SCHEMATIC
 5001A-LB
 SCALE: NONE
 DATE: 1-14-75
 DWN: J.J.

REVISIONS			
ZONE	LTR	DESCRIPTION	DATE

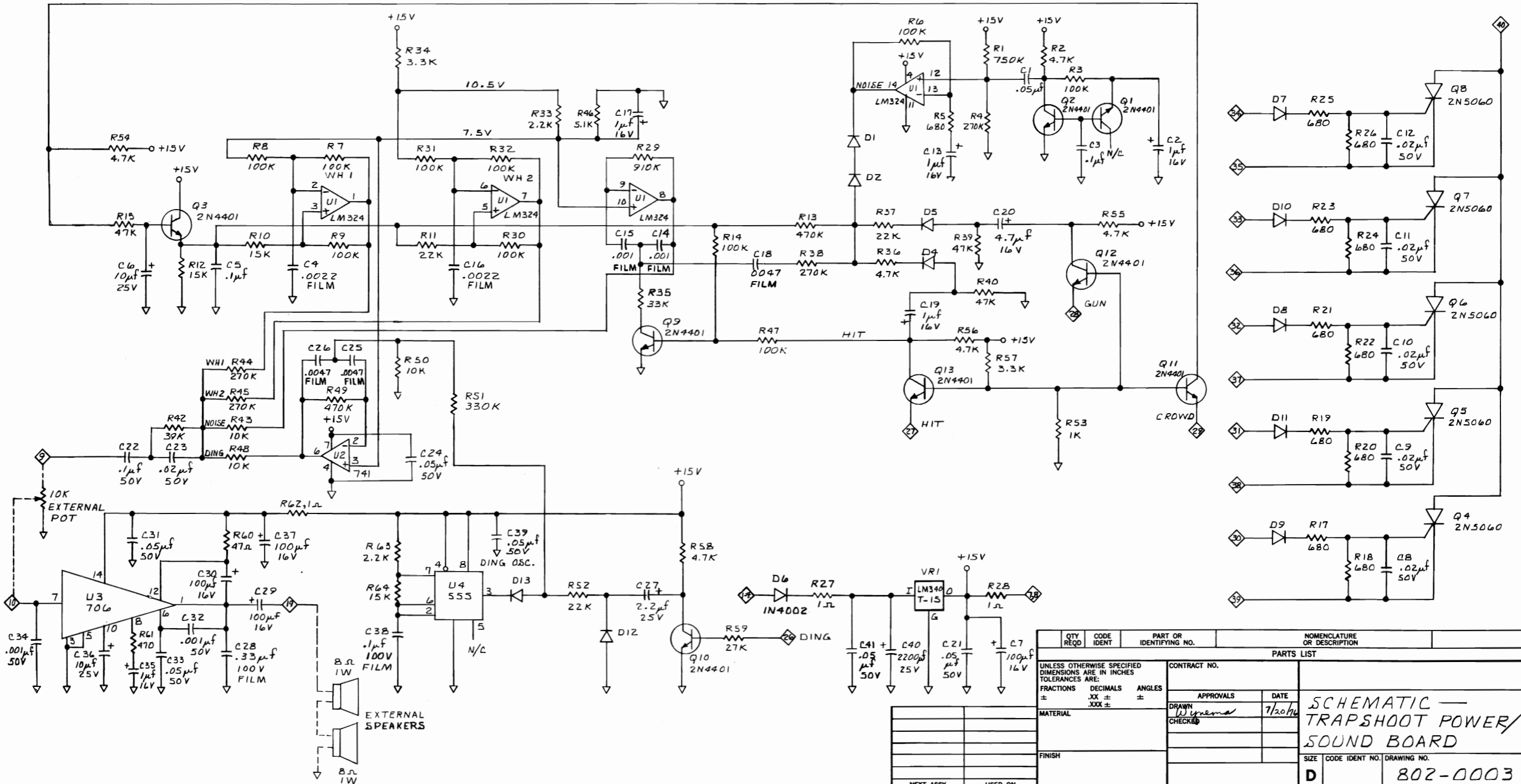
NOTES: UNLESS OTHERWISE SPECIFIED
 1. ALL RESISTORS ARE IN OHMS, 1/2 W, 5%.
 2. ALL CAPACITORS ARE IN MICROFARAD.
 3. ALL DIODES ARE IN 914.

D

C

B

A



D

C

B

A

802-0003 B

QTY	REQD	CODE	IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION

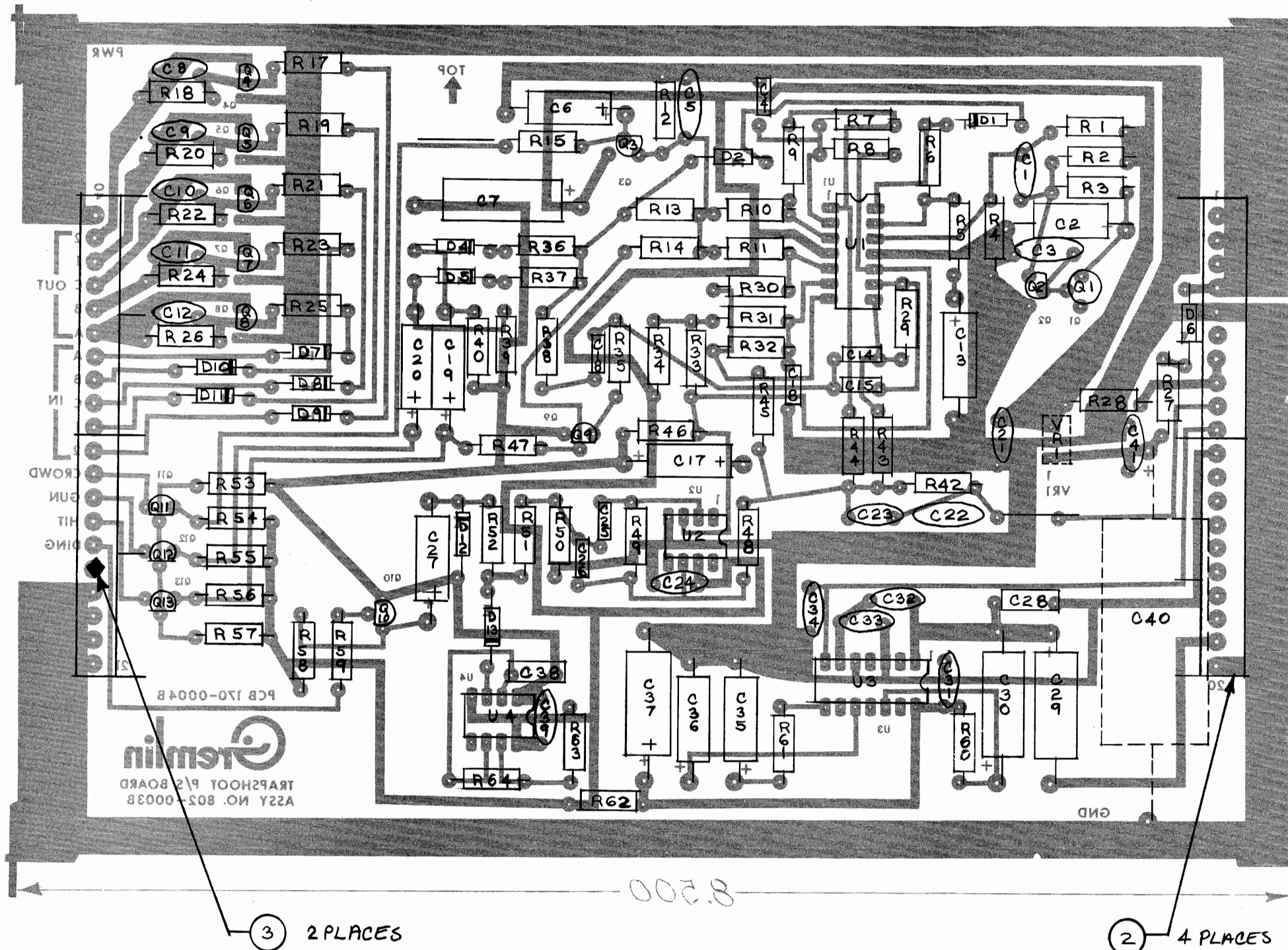
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
 TOLERANCES ARE:
 FRACTIONS .XX ±
 DECIMALS .XXX ±
 ANGLES ° ±

CONTRACT NO. _____
 DATE 7/20/76
 DRAWN Wynema
 CHECKED _____

MATERIAL _____
 FINISH _____

SIZE D CODE IDENT NO. 802-0003 B
 DRAWING NO. 802-0003 B
 SHEET 1 OF 1

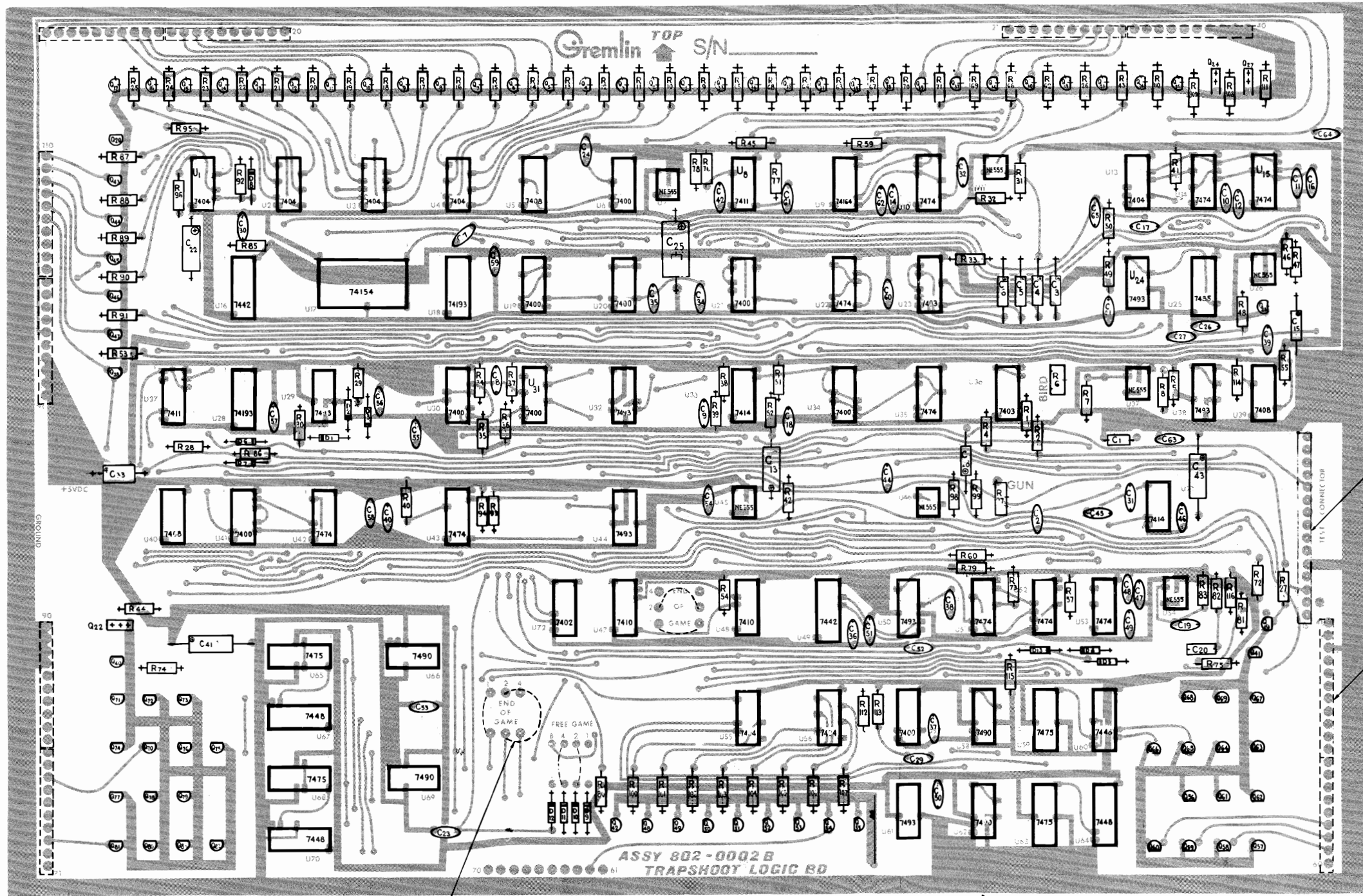
SCALE NONE
 DO NOT SCALE DRAWING



ITEM NO.	QTY	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
3	2	211-0007	CONN. KEY POLARIZING
2	4	212-0002	CONN. FEM. 10 PIN
1	1	170-0004-A	P.C.B. T/S PWR SND A
VR 1	1	313-0009	I.C. LM 340T-15. 7815
Q4-Q8	5	482-0009	XISTOR. SCR. 2N5D60
Q1-Q3Q9-Q13	8	482-0014	XISTOR. 2N4401
D6	1	481-0001	DIODE IN4002
D1-D2D4-D5-D7-D8	11	481-0006	DIO. IN914 OR IN4148
C40	1	150-0008	CAP. E. 2200M 25V
C38	1	152-0001	CAP. F. .1M 100V
C32C34	2	151-0008	CAP. CER. .001M 50V
C28	1	152-0017	CAP. F. .33 M 100V
C27	1	150-0014	CAP. E. 2.2 M 25V
C20	1	150-0007	CAP. E. 4.7 M 16V
C18C25C26	3	152-0005	CAP. F. .0047M
C14C15	2	152-0007	CAP. F. .001 M 250V
C9-C12C23	6	151-0006	CAP. CER. .02 M 50V
C7C29C30C37	4	150-0010	CAP. E. 100 M 16V
C6C36	2	150-0004	CAP. E. 10 M 25V
C4C16	2	152-0004	CAP. F. .0022 M
C3C5C22	3	151-0012	CAP. CER. .1 M 50V
C2C13C17C18C25	5	150-0016	CAP. E. 1 M 16V
U1U2U3U4	5	151-0001	CAP. CER. .05 M 50V
U1C39	2	151-0001	CAP. CER. .05 M 50V
R61	1	471-0471	RES. 470 OHM 1/2W 5%
R60	1	471-0470	RES. 47 OHM 1/2W 5%
R59	1	471-0273	RES. 27K OHM 1/2W 5%
R53	1	471-0102	RES. 1K OHM 1/2W 5%
R51	1	471-0334	RES. 330K OHM 1/2W 5%
R46	1	471-0512	RES. 5.1K OHM 1/2W 5%
R43R48R50	3	471-0103	RES. 10K OHM 1/2W 5%
R42	1	471-0393	RES. 39K OHM 1/2W 5%
R35	1	471-0333	RES. 33K OHM 1/2W 5%
R34R57	2	471-0332	RES. 3.3K OHM 1/2W 5%
R33R63	2	471-0222	RES. 2.2K OHM 1/2W 5%
R29	1	471-0914	RES. 910K OHM 1/2W 5%
R27R28R62	3	471-0010	RES. 1 OHM 1/2W 5%
R15R39R40	3	471-0473	RES. 47K OHM 1/2W 5%
R13R49	2	471-0174	RES. 470K OHM 1/2W 5%
R11R37R52	3	471-0223	RES. 22K OHM 1/2W 5%
R10R12R64	3	471-0153	RES. 15K OHM 1/2W 5%
R5R17-R26	11	471-0681	RES. 680 OHM 1/2W 5%
R4R38R44R45	4	471-0274	RES. 270K OHM 1/2W 5%
R30-R32R47	4	471-0104	RES. 100K OHM 1/2W 5%
R24R25R31	6	471-0104	RES. 100K OHM 1/2W 5%
R21R22R23R68	6	471-0472	RES. 47K OHM 1/2W 5%
R1	1	417-0754	RES. 750K OHM 1/2W 5%
U4	1	314-0001	I.C. TIMER NE555
U3	1	313-0007	I.C. 706 APC
U2	1	313-0004	I.C. LM 741
U1	1	313-0008	I.C. LM 324

PARTS LIST

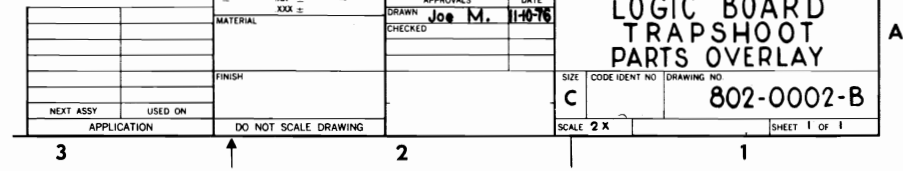
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES 1/16 .005 .015 1/32 .002 .010 1/64 .001 .005		CONTRACT NO.		<h2 style="text-align: center;">TRAPSHOOT POWER SOUND BOARD PARTS OVERLAY</h2>	
MATERIAL		APPROVALS	DATE		
FINISH		DRAWN <i>Wynona</i>	12/3/76		
NEXT ASSY USED ON		CHECKED			
APPLICATION		DO NOT SCALE DRAWING		SIZE	CODE IDENT NO. DRAWING NO.
				D	802-0003 A
				SCALE NONE	SHEET 1 OF 1

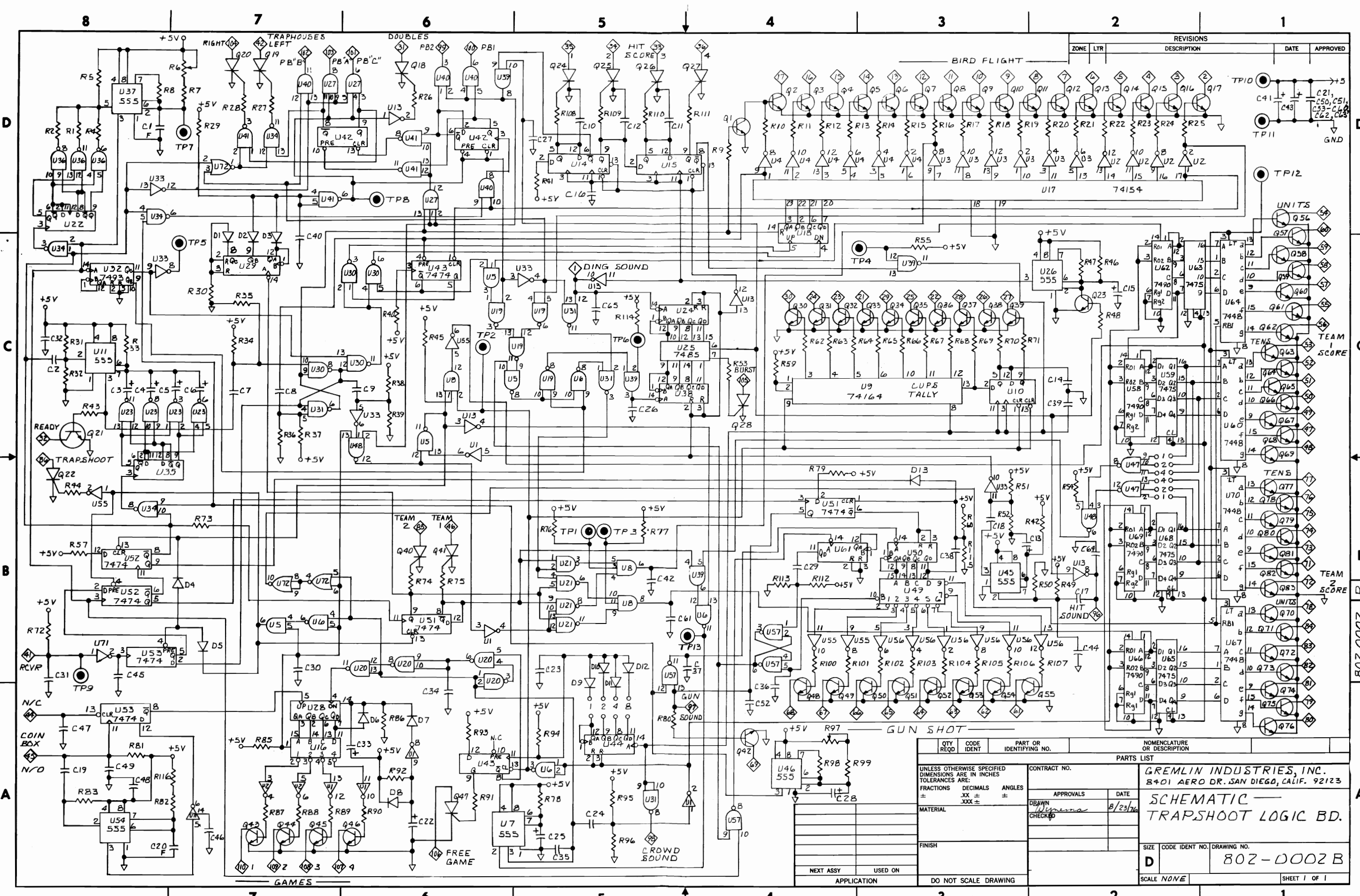


ITEM NO.	QTY	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
5	1	170-0003B	LOGIC P.C. BOARD
4	1	212-0008	CONN MALE 15 PIN
3	20	211-0004	CONN PIN TEST PT.
2	12	211-0006	CONN CRIMP JUMP
1	11	212-0002	CONN. FEM. 10 PIN
R1-R99	2	475-0006	POT. 100 K OHM
R100-R111	12	471-0681	RES. 680 OHM 1/2 W 5%
R112-R123	12	471-0681	RES. 680 OHM 1/2 W 5%
R124-R135	12	471-0681	RES. 680 OHM 1/2 W 5%
R136-R147	12	471-0681	RES. 680 OHM 1/2 W 5%
R148-R159	12	471-0681	RES. 680 OHM 1/2 W 5%
R160-R171	12	471-0681	RES. 680 OHM 1/2 W 5%
R172-R183	12	471-0681	RES. 680 OHM 1/2 W 5%
R184-R195	12	471-0681	RES. 680 OHM 1/2 W 5%
R196-R207	12	471-0681	RES. 680 OHM 1/2 W 5%
R208-R219	12	471-0681	RES. 680 OHM 1/2 W 5%
R220-R231	12	471-0681	RES. 680 OHM 1/2 W 5%
R232-R243	12	471-0681	RES. 680 OHM 1/2 W 5%
R244-R255	12	471-0681	RES. 680 OHM 1/2 W 5%
R256-R267	12	471-0681	RES. 680 OHM 1/2 W 5%
R268-R279	12	471-0681	RES. 680 OHM 1/2 W 5%
R280-R291	12	471-0681	RES. 680 OHM 1/2 W 5%
R292-R303	12	471-0681	RES. 680 OHM 1/2 W 5%
R304-R315	12	471-0681	RES. 680 OHM 1/2 W 5%
R316-R327	12	471-0681	RES. 680 OHM 1/2 W 5%
R328-R339	12	471-0681	RES. 680 OHM 1/2 W 5%
R340-R351	12	471-0681	RES. 680 OHM 1/2 W 5%
R352-R363	12	471-0681	RES. 680 OHM 1/2 W 5%
R364-R375	12	471-0681	RES. 680 OHM 1/2 W 5%
R376-R387	12	471-0681	RES. 680 OHM 1/2 W 5%
R388-R399	12	471-0681	RES. 680 OHM 1/2 W 5%
R400-R411	12	471-0681	RES. 680 OHM 1/2 W 5%
R412-R423	12	471-0681	RES. 680 OHM 1/2 W 5%
R424-R435	12	471-0681	RES. 680 OHM 1/2 W 5%
R436-R447	12	471-0681	RES. 680 OHM 1/2 W 5%
R448-R459	12	471-0681	RES. 680 OHM 1/2 W 5%
R460-R471	12	471-0681	RES. 680 OHM 1/2 W 5%
R472-R483	12	471-0681	RES. 680 OHM 1/2 W 5%
R484-R495	12	471-0681	RES. 680 OHM 1/2 W 5%
R496-R507	12	471-0681	RES. 680 OHM 1/2 W 5%
R508-R519	12	471-0681	RES. 680 OHM 1/2 W 5%
R520-R531	12	471-0681	RES. 680 OHM 1/2 W 5%
R532-R543	12	471-0681	RES. 680 OHM 1/2 W 5%
R544-R555	12	471-0681	RES. 680 OHM 1/2 W 5%
R556-R567	12	471-0681	RES. 680 OHM 1/2 W 5%
R568-R579	12	471-0681	RES. 680 OHM 1/2 W 5%
R580-R591	12	471-0681	RES. 680 OHM 1/2 W 5%
R592-R603	12	471-0681	RES. 680 OHM 1/2 W 5%
R604-R615	12	471-0681	RES. 680 OHM 1/2 W 5%
R616-R627	12	471-0681	RES. 680 OHM 1/2 W 5%
R628-R639	12	471-0681	RES. 680 OHM 1/2 W 5%
R640-R651	12	471-0681	RES. 680 OHM 1/2 W 5%
R652-R663	12	471-0681	RES. 680 OHM 1/2 W 5%
R664-R675	12	471-0681	RES. 680 OHM 1/2 W 5%
R676-R687	12	471-0681	RES. 680 OHM 1/2 W 5%
R688-R699	12	471-0681	RES. 680 OHM 1/2 W 5%
R700-R711	12	471-0681	RES. 680 OHM 1/2 W 5%
R712-R723	12	471-0681	RES. 680 OHM 1/2 W 5%
R724-R735	12	471-0681	RES. 680 OHM 1/2 W 5%
R736-R747	12	471-0681	RES. 680 OHM 1/2 W 5%
R748-R759	12	471-0681	RES. 680 OHM 1/2 W 5%
R760-R771	12	471-0681	RES. 680 OHM 1/2 W 5%
R772-R783	12	471-0681	RES. 680 OHM 1/2 W 5%
R784-R795	12	471-0681	RES. 680 OHM 1/2 W 5%
R796-R807	12	471-0681	RES. 680 OHM 1/2 W 5%
R808-R819	12	471-0681	RES. 680 OHM 1/2 W 5%
R820-R831	12	471-0681	RES. 680 OHM 1/2 W 5%
R832-R843	12	471-0681	RES. 680 OHM 1/2 W 5%
R844-R855	12	471-0681	RES. 680 OHM 1/2 W 5%
R856-R867	12	471-0681	RES. 680 OHM 1/2 W 5%
R868-R879	12	471-0681	RES. 680 OHM 1/2 W 5%
R880-R891	12	471-0681	RES. 680 OHM 1/2 W 5%
R892-R903	12	471-0681	RES. 680 OHM 1/2 W 5%
R904-R915	12	471-0681	RES. 680 OHM 1/2 W 5%
R916-R927	12	471-0681	RES. 680 OHM 1/2 W 5%
R928-R939	12	471-0681	RES. 680 OHM 1/2 W 5%
R940-R951	12	471-0681	RES. 680 OHM 1/2 W 5%
R952-R963	12	471-0681	RES. 680 OHM 1/2 W 5%
R964-R975	12	471-0681	RES. 680 OHM 1/2 W 5%
R976-R987	12	471-0681	RES. 680 OHM 1/2 W 5%
R988-R999	12	471-0681	RES. 680 OHM 1/2 W 5%
C1-C50	1	151-0010	CAP. CER. .05 M 50 V
D1-D10	13	481-0006	DIODE 1N914
U1-U50	51	314-0001	I.C. NE 555
U51-U100	50	314-0007	I.C. 74193
U101-U150	50	314-0028	I.C. 74164
U151-U200	50	314-0008	I.C. 74154
U201-U250	50	314-0005	I.C. 7493
U251-U300	50	314-0003	I.C. 7490
U301-U350	50	314-0027	I.C. 7485
U351-U400	50	314-0021	I.C. 7475
U401-U450	50	314-0006	I.C. 7474
U451-U500	50	314-0006	I.C. 7474
U501-U550	50	314-0013	I.C. 7448
U551-U600	50	314-0011	I.C. 7442
U601-U650	50	314-0026	I.C. 7414
U651-U700	50	314-0014	I.C. 7411
U701-U750	50	314-0010	I.C. 7410
U751-U800	50	314-0012	I.C. 7408
U801-U850	50	314-0015	I.C. 7404
U851-U900	50	314-0015	I.C. 7403
U901-U950	50	314-0024	I.C. 7402
U951-U1000	50	314-0009	I.C. 7400

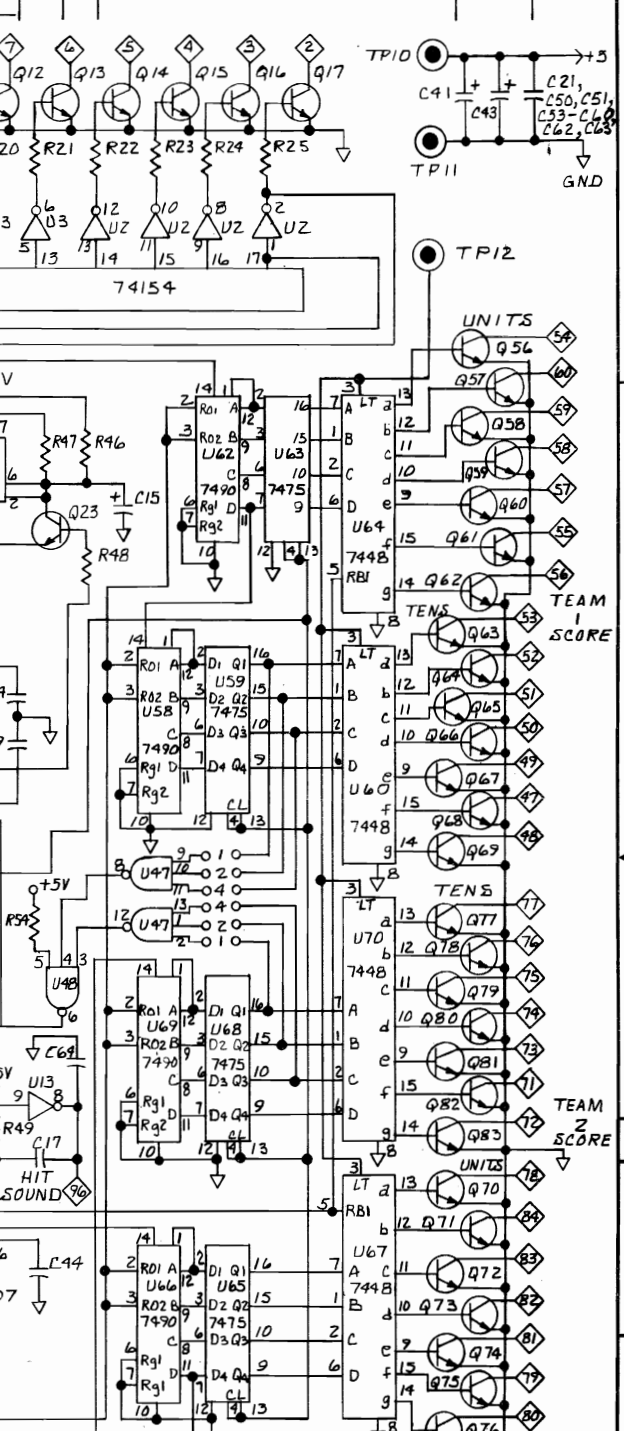
ITEM NO.	QTY	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
PARTS LIST			
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES		CONTRACT NO.	
TOLERANCES ARE:		APPROVALS	
FRACTIONS	DECIMALS	ANGLES	DATE
XX =	XX =	XX =	XX =
XXX =	XXX =	XXX =	XXX =
MATERIAL	CHECKED	DRAWN Joe M. 11-10-76	
FINISH	USED ON	GREMLIN INDUSTRIES INC. 8401 AERO DR. SAN DIEGO, CA. 92123	
NEXT ASSY	APPLICATION	LOGIC BOARD TRAPSHOOT PARTS OVERLAY	
		SIZE CODE IDENT NO DRAWING NO C 802-0002-B	
		SCALE 2 X SHEET 1 OF 1	

② ③ ⑤





ZONE		REVISIONS	DATE	APPROVED
LTR	DESCRIPTION			



QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE:		CONTRACT NO.	
FRACTIONS	DECIMALS	ANGLES	DATE
±	.XX ±	±	8/23/76
	.XXX ±		
MATERIAL		APPROVALS	
		DRAWN: <i>W. J. ...</i>	
		CHECKED: <i>...</i>	
FINISH		DATE	
NEXT ASSY		USED ON	
APPLICATION		DO NOT SCALE DRAWING	

NOMENCLATURE OR DESCRIPTION		DRAWING NO.	
GREMLIN INDUSTRIES, INC.		802-0002 B	
8401 AERO DR. SAN DIEGO, CALIF. 92123			
SCALE: NONE		SHEET 1 OF 1	

2000-208