HUSTLE

MANUFACTURED BY

Gremlin
Industries, inc.

OWNER'S MANUAL

HUSTLE
OPERATING INSTRUCTIONS
AND
SERVICE MANUAL

GREMLIN INDUSTRIES, INC.
8401 Aero Dr.
San Diego, CA. 92123

"HUSTLE"

TABLE OF CONTENTS

INTRODUCTION

HUSTLE is an electronic game that makes extensive use of digital integrated circuitry and television monitor circuitry. This manual assumes the maintenance technician possesses a general knowledge of solid state circuitry, TTL digital integrated circuitry and T.V. monitor concepts. Any individual NOT knowledgeable in these areas SHOULD NOT attempt repair of the electronic portion of this 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 components with anything other than exact replacement parts. (See Parts List located on Service Schematics.)
NEVER	remove circuit boards/connections while power is on.
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 higher value can cause severe damage to internal components if an overload occurs.
ALWAYS	consult the manual before attempting repairs.
CORRESPONDENCE	regarding this game should be addressed to:

GREMLIN INDUSTRIES, INC.
8401 Aero Drive
San Diego, California 92123
(714) 277-8700

IMPORTANT NOTES

An important service note is posted in the HUSTLE game and is repeated here for emphasis:

> IF AT ANY TIME THE T.V. SCREEN SHOWS A MEANINGLESS DISPLAY OR THE GAME OTHERWISE MALFUNCTIONS, SIMPLY DROP A COIN INTO THE COIN MECHANISM. THIS SHOULD CORRECT THE PROBLEM. IF NOT, THE GAME REQUIRES SERVICE.

The circuitry in HUSTLE has been arranged so that the insertion of a quarter through the coin mechanism will reset the system. This clears up temporary problems caused by power line disturbances, static, etc.

SERVICE TECHNICIAN NOTE:

The system reset circuitry described above requires that the coin counter is attached to the system. If there is a coin counter problem and no replacement is available, the game will function properly if a 10K Ohm resistor is connected across the coin counter pins to the video logic board.

WARRANTY/FACTORY SERVICE INFORMATION

WARRANTY

HUSTLE is under factory warranty (Parts and Labor) for the following time periods:

A. All electronic components/connectors for one (1) year except:

1. Transformers - 90 days
2. Fuses/Lamps - No Warranty

The Warranty covers defects/failure under normal use.

FACTORY SERVICE

Should an assembly become defective, contact your local distributor. Factory authorization to return the assembly will be issued with transportation charges prepaid. If decided upon by factory representative, an advance replacement will be made. No merchandise may be returned to the factory without prior authorization.

The assembly will be repaired and returned, transportation charges prepaid, if still in Warranty and no advance replacement made.

If the assembly is found to be damaged by misuse, improper attempts at repair, or abuse, it will be repaired and returned with transportation and repair charges billed.

Out of Warranty assemblies, if returned to the factory with transporation charges prepaid, will be repaired and returned with transportation and repair charges billed.

In the instance of a defect of an assembly manufactured by other than GREMLIN INDUSTRIES, INC., every effort will be made to assist the customer in obtaining satisfaction from the origianl manufacturer.

CRATING INSTRUCTIONS

Should it be necessary to ship this game, the following instructions are provided for game crating.

A) If the original shipping bolts (REF 1) have been discarded, obtain four 5/16-18 x 1 3/4 hex head bolts with 5/16 flat washer. Lay game on its side and attach skid (REF 2).

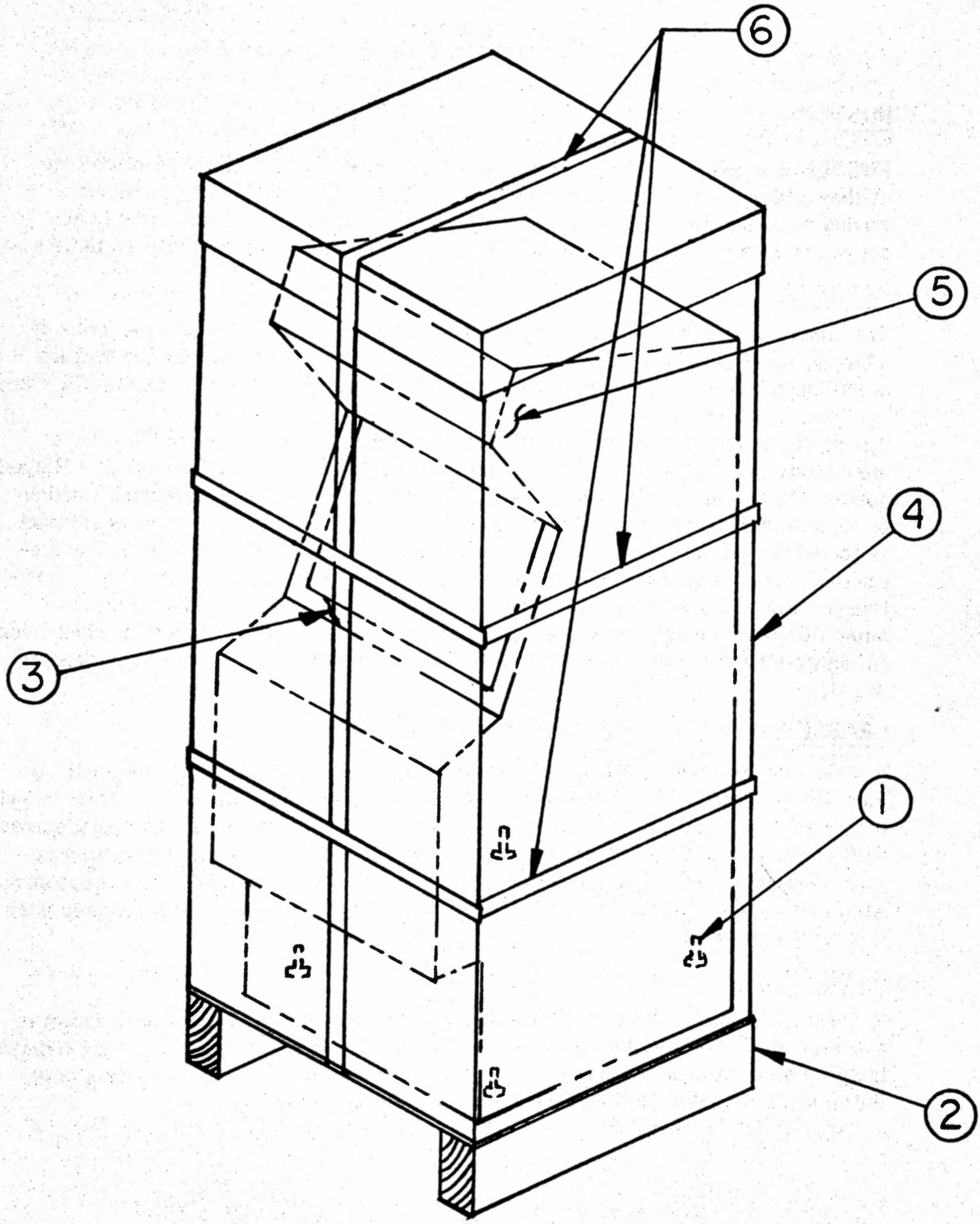
B) Place game upright. Tape game keys to upper flange of operator's panel (REF 3). Crate the game using appropriate shock-absorbent packing material (REF 4). Include padding on all four corners of the game (REF 5).

C) After crating is completed, secure package with strapping (REF 6).

Game is now ready for shipping.

Diagram #1

CRATING INSTRUCTIONS



GAME CONCEPT

HUSTLE

HUSTLE is a one or two player video game which challenges players' reaction time as they attempt to build up a high score. The object of the game is to maneuver a moving arrow into targets which appear randomly on the screen. Each arrow is accompanied by a "tail", which can be used to block the opponent from scoring targets.

TARGETS -

The targets appear randomly on the playfield. The position of a target, the value of a target, the time a target stays on the screen, and the time before a target appears are all unpredictable. There are never more than two targets on the screen at any time.

To add to the unpredictability, some targets appear with a value of "???". These are mystery targets, and can have a value from -900 points to +900 points. Players go after the mystery targets at their own risk since the only way to determine whether or not a mystery target is positive or negative is to hit the target. Whenever a target is scored, the game pauses while the appropriate player's score is tallied. Two distinctive sounds accompany the scoring, depending on whether the target score is positive or negative. All non-mystery targets (which are all positive), and all mystery targets (which have positive values) are scored with an attention-getting "warble" sound. All mystery targets which prove to be negative are scored with a distinctive "penalty" sound.

CRASHES -

A crash (accompanied by a loud boom sound) occurs whenever a player hits anything other than a target. The three obstacles a player might hit are one of the screen boundaries, the other player's tail, or his own tail. Whenever a crash occurs, the opponent scores 400 points PLUS all target values on the screen. If any mystery targets are on the screen during a crash, their values are revealed, and they are awarded to the opponent. All mystery targets whose values are revealed as the result of a crash are scored positive for the opponent.

GAME SPEED -

The game begins with the players moving at a moderate pace. Every time a target is scored, the pace picks up slightly. After ten targets have been scored without a crash, the pace stays at a maximum rate. Whenever a crash occurs, the pace reverts to its initial moderate value, and increases with each score, as before.

GAME CONCEPT (Cont'd.)

TAIL LENGTH -

Whenever a crash occurs, both players' tails grow longer. The game plays quite differently as it progresses. At the beginning of a game, both players have short tails and are highly maneuverable. At this stage the game is a "foot race" to score the targets. As players crash and tails get longer, a blocking strategy is added to the race for the targets. This constantly changing nature of the game is designed to provide long-lasting appeal, and insure a long earning history.

SINGLE PLAYER -

HUSTLE has been designed to be just as exciting for one player as it is for two. A single player plays against himself, and not against "the computer".

The single player game is initiated by simply pressing the ONE PLAYER START button instead of the TWO PLAYER START button after inserting a coin. The controls for one player are located on the right side of the control panel. The game plays the same as for two players, with these exceptions:

1. There is a single arrow and tail, instead of two.

2. Crashes are scored as PENALTY points, with the same score as in the two player game. That is, a crash scores 400 plus all on-screen targets into the PENALTY score.

3. At the end of the game, the PENALTY points are subtracted from the player's score.

The object of the single player game is to rack up as many points as possible. The game action is the same as the two player game, with the lengthening tail and the accelerating pace.

FREE GAMES -

For areas of the country where free games are legal, HUSTLE can be set to award free games for scores of 11,000; 13,000; 15,000 or 17,000 points. The game is shipped with the free game option disabled. If free games are legal in your area, it is highly recommended that you enable them---they provide an extremely powerful incentive to play the game, and thus increase your earnings.

Free games are awarded only in the single player game, since the two player game could give free games any time two players cooperated to give one of the players a very high score.

It is not possible to win two free games in a row (i.e. no free games on free games).

GAME CONCEPT (Cont'd.)

FREE GAMES - (Cont'd.)

Whenever free games are enabled, the message "SCORE XX000 POINTS FOR FREE GAME" appears on the screen just after the ONE PLAYER START button is pressed. The XX will be 11, 13, 15, or 17 depending on how you jumper the game (see OPERATING INSTRUCTIONS). This message is displayed for about 5 seconds, and then the single player game begins. Whenever a free game is won, the message FREE GAME! is momentarily displayed on the screen, followed by the message PRESS START. If at this point ONE PLAYER START is pressed, the free game score message will not be displayed before the game starts, since a second consecutive free game will not be awarded. It is also possible to press the TWO PLAYER START after a free game is awarded and play a two player game.

GAME TIME -

The top margin of the game contains the word TIME, with a two digit timer above it. The game starts with a time value of 90, and decrements to 0, at which time the game is over. The timer actually counts player moves rather than "ticking" once per second. Also, the timer stops during all scoring. These effects produce a repeatable game time of about 2 minutes.

It is possible to shorten the game time to about 1-1/2 minutes by changing an internal jumper. In this case, the timer still begins at 90, but it "ticks" faster.

COINS -

HUSTLE is set to play either the one or two player game for a single coin (both games take approximately the same time). An internal option allows game play for two coins, three coins or four coins. If this option is enabled, the message "MORE COINS" appears each time a coin is inserted, until the proper number is inserted. At this time, the message "PRESS START" appears. Our location tests indicate that the single coin mode (as shipped) will maximize your income, so no adjustment should be necessary.

ANTI-CHEAT -

HUSTLE contains a feature which will not give game credits if the coin switch is manually depressed, or if the coin door is slammed. In checking out the game, you must actually insert a coin to get things started--flicking the coin switch will not always start the game.

OPERATOR OPTIONS

HUSTLE is shipped with the following preset options:

1. FREE GAME option disabled.
2. Game length approximately 2 minutes.
3. One coin per play.

If free games are legal in your area, it is highly recommended that the game be set for free games. A single jumper inside the game sets the free game score at 11,000; 13,000; 15,000 or 17,000 points.

Our location tests indicate that most games should initially be set at 11,000 or 13,000. It is a good idea to start with 11,000, and after 1-2 weeks, increase to 13,000. Only in high skill areas such as college recreation areas should the free game score be set for 15,000. 17,000 should be used only if the game has been mastered by many people.

DO NOT set the free game score too high to start--this will turn off many beginning players.

To enable freegame option diagram, follow these instructions:

1. Disconnect power and remove the back from the game.
2. Locate the large printed circuit board (mounted on the horizontal shelf).
3. At the rear of the circuit board is a row of connectors. These connectors are arranged in four groups of ten pins. The right hand connector has no receptacle on it--only ten pins with a wire jumper. This jumper sets the free game option as shown in the figures in Diagram #2.

OPERATOR OPTIONS (Contd.)

4. Remove the jumper from pin 1 and plug it into pin 7, 8, 9, or 10, depending on the desired free game score. To disable free games, place the jumper on pin 1.

The game length and number of coins per play are jumpered in a similar manner. For details refer to the cabinet wiring schematic at the rear of the manual. The jumper wires required to activate these options are taped to the appropriate connector harnesses.

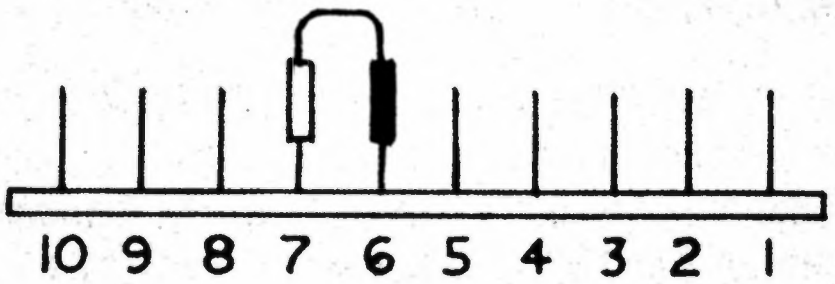
Whenever HUSTLE is not being played, an advertisement sequence is initiated. Targets continuously appear and disappear from the screen to attract attention. To avoid patron confusion, the words "Game Over" appear while the advertising is in progress.

E-Z Adjust^{tm} Control Panel - HUSTLE has one adjustment which is located on the back of the coin door:

VOLUME CONTROL - Set to desired volume for boom and tones during the game.

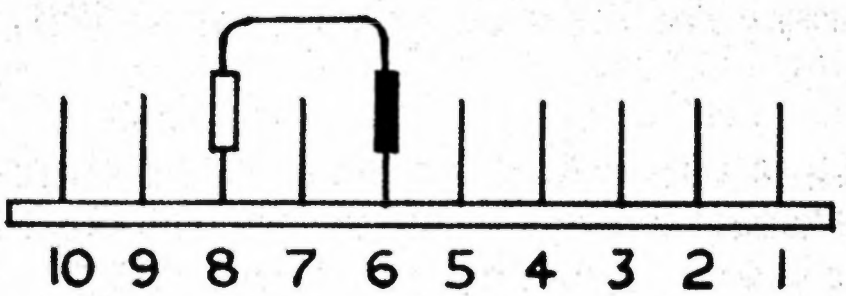
FREE GAME OPTION DIAGRAM

FIG. A



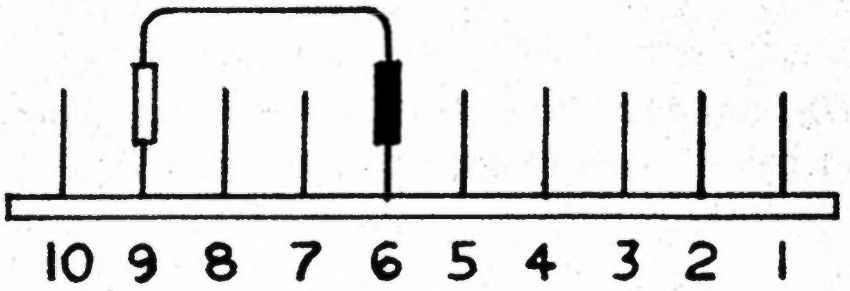
FREE GAME
AT 17,000 POINTS

FIG. B



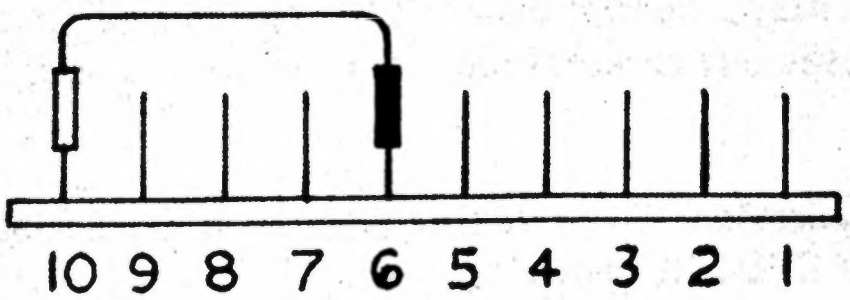
FREE GAME
AT 15,000 POINTS

FIG. C



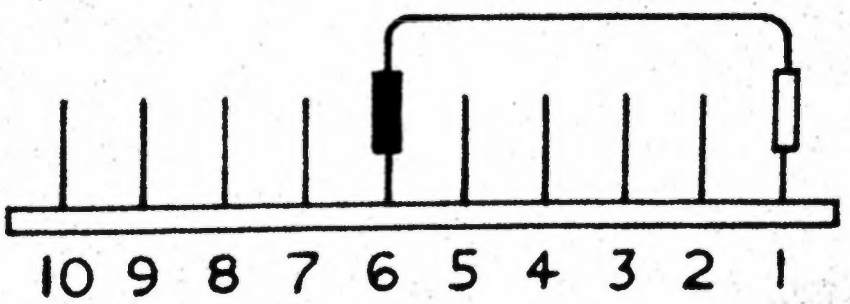
FREE GAME
AT 13,000 POINTS

FIG. D



FREE GAME
AT 11,000 POINTS

FIG. E



NO FREE GAMES

SYSTEM DESCRIPTION

1. SEE SYSTEM BLOCK DIAGRAM (Fig. 3)

2. MICROPROCESSOR -

The game microprocessor is a Model 8080A and it functions as the Central Processing Unit (CPU) in the system. The CPU (1) is synchronized by a clock circuit which provides frequencies required by the CPU and the Video Timing Logic (14).

Address Bus (4) selects the memory addresses to be accessed by the CPU. It is routed to three subsystems:

1. Read Write Memory (6): A random Access Memory (RAM) used to form a first in/last out (stack) memory. Used to perform subroutine calls and returns, also used for temporary data storage during program execution.

2. Read Only Memory (ROM) (7): Stores program instructions for the CPU.

3. Address Multiplexer (8): Selects either CPU addresses or addresses from the Video Timing Logic. Used to address the Video Refresh Memory (9).

Data Bus (5) carries data to and from the CPU. It receives data from Read Write Memory, Read Only Memory, Video Refresh Memory and Input Ports (12). The Bus transmits data to Read Write Memory, Output Ports and Video Refresh Memory. The Input Ports accept player control data (19). The Output Port (13) initiates sound control and activates any external logic and indicators needed by the game.

Timing and Control Logic (11) generates synchronizing signals to keep system operation and synchronized to the CPU. It controls:

1. Memory Read
2. Memory Write
3. Input Port Read
4. Output Port Write

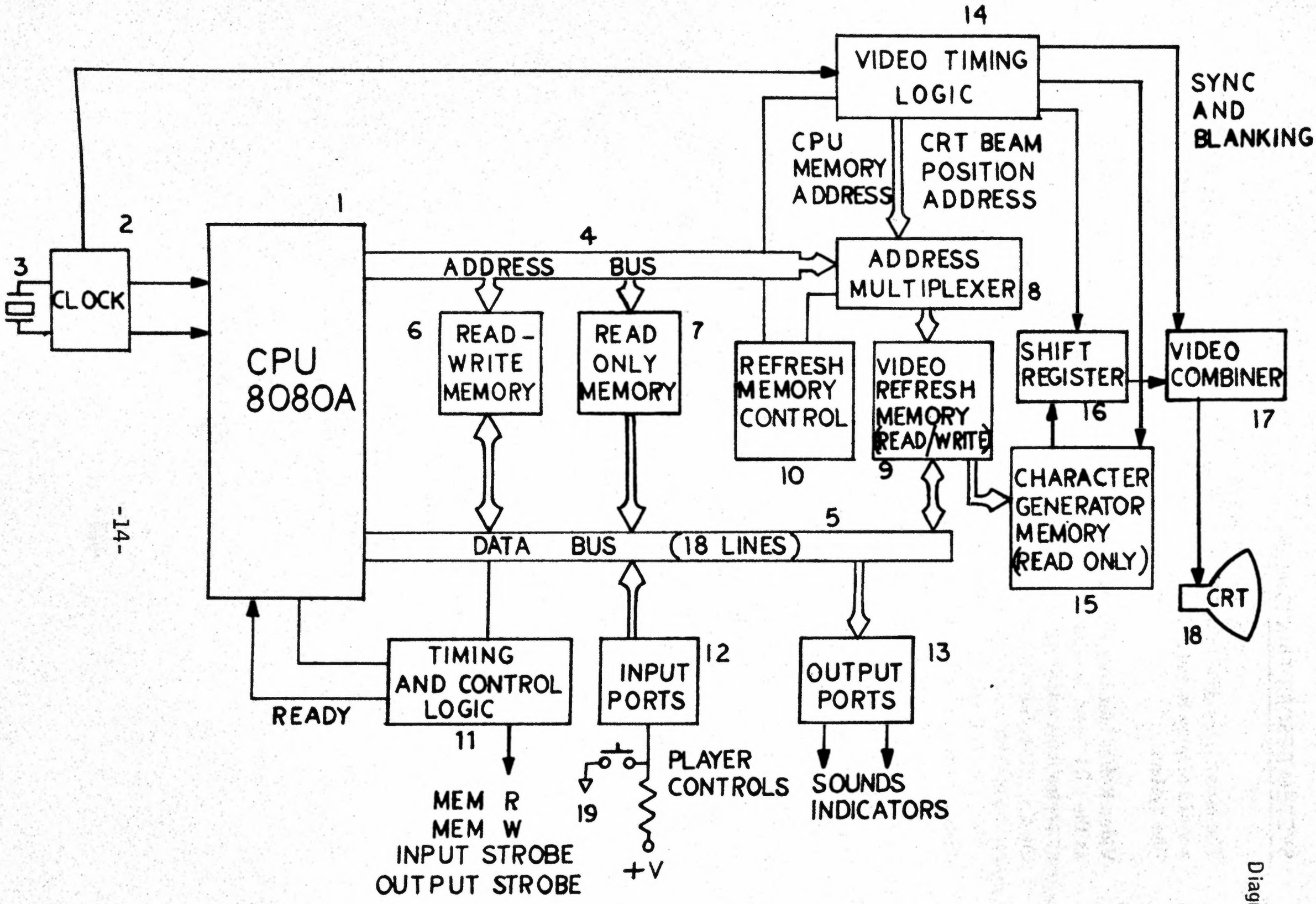
SYSTEM DESCRIPTION (Cont.d)

The remaining elements in Figure 1 convert CPU system information into a video display format. The T.V. monitor (18) uses a standard 525 scan line system.

Video Refresh Memory (9) stores information from the CPU which is read out as the CRT beam sweeps across the screen. It is addressed from two sources as controlled by Address Multiplexer (8). During vertical sweep retrace of the CRT, the Video Refresh Memory is addressed by the CPU so information can be updated. During scan time, Video Refresh Memory is addressed by Video Timing Logic (14). Refresh Memory Control (10) insures that address demands from Video Timing Logic and the CPU never occur simultaneously.

Character Generator Memory (15) provides a means for Video Refresh Memory to select 64 dots for each 8 word access. Each image, on the display, has the dimensions of 8 dots high, and 8 dots wide. Shift register (16) develops this into a video signal. (See Fig. 2)

A Tone Generator is driven by Output Ports (13). The CPU controls the frequency of the tone by loading a number (0-255) into the Output Ports (13). A direction change by a player will cause the CPU to load a different number into the Output Port, changing the tone. (See Fig. 3) This generator also produces the "warble" sound heard during scoring.



SYSTEM BLOCK DIAGRAM

Diagram #3

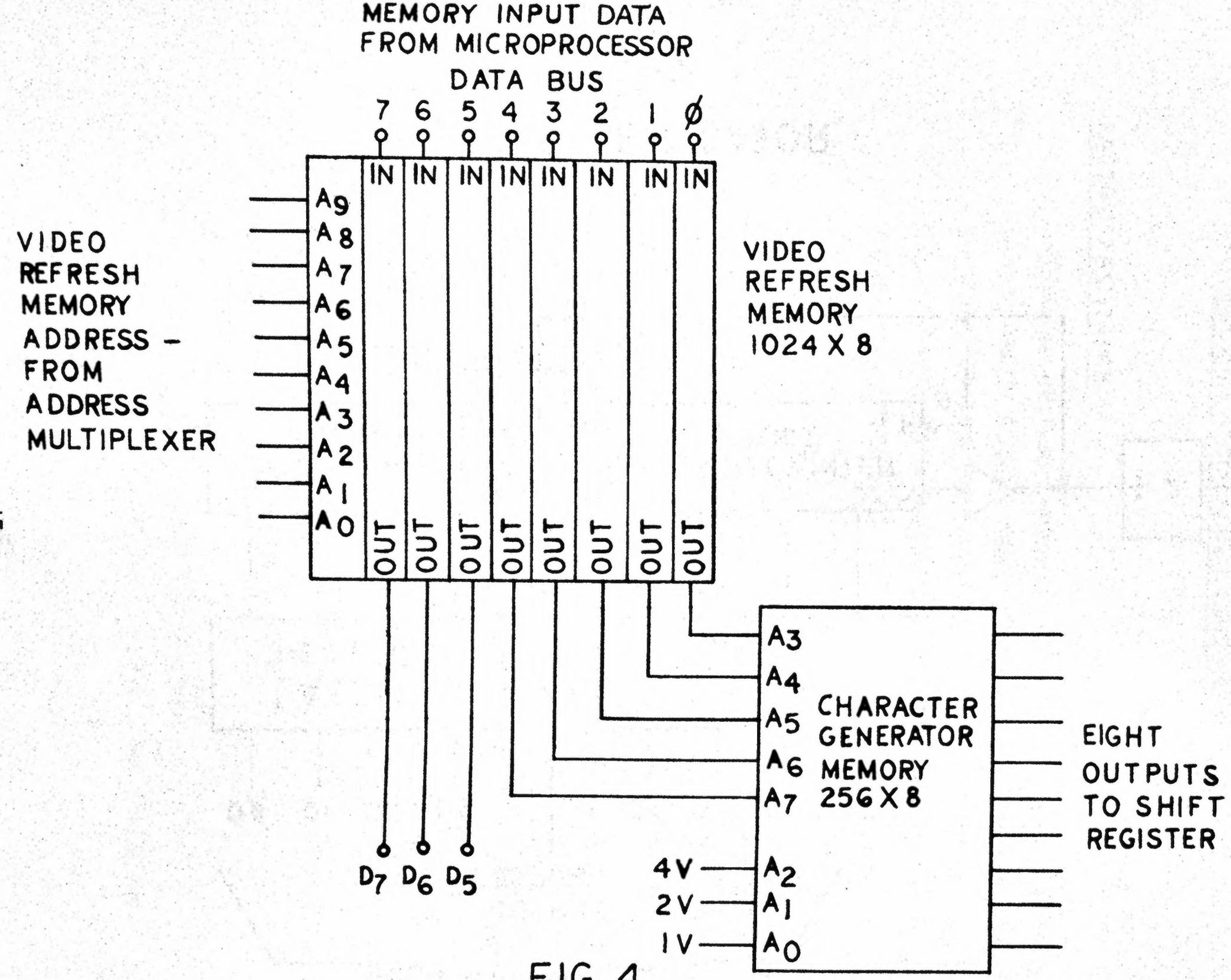


FIG. 4

CHARACTER GENERATION CIRCUITRY

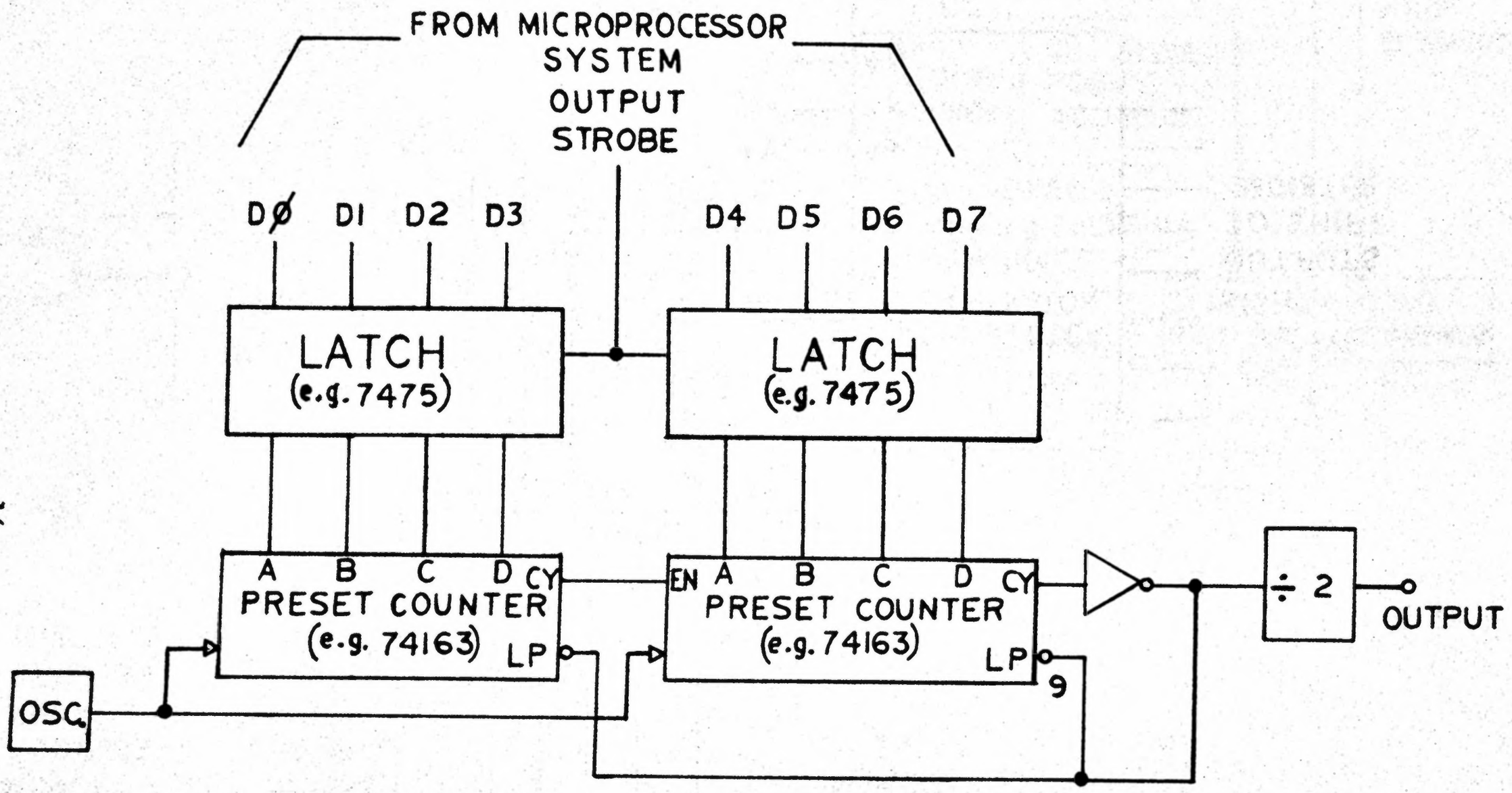
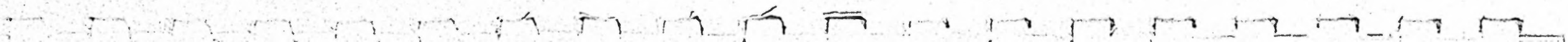


Diagram #5

TONE GENERATOR

FIG. 5



FACTORY ASSISTANCE & EQUIPMENT

FACTORY ASSISTANCE:

TECHNICAL HELP IS AVAILABLE FROM THE GREMLIN FACTORY, IF A PROBLEM OCCURS WHICH CANNOT BE EASILY RESOLVED BY YOUR DISTRIBUTOR, A PHONE CALL OR LETTER TO THE FACTORY WILL BRING ATTENTION TO YOUR PROBELM BY A TRAINED REPRESENTATIVE

NOTE: IF AT ANY TIME THE T.V. SCREEN SHOWS A MEANINGLESS DISPLAY OR THE GAME OTHERWISE MALFUNCTIONS, DROP A COIN IN THE COIN MECHANISM. THIS SHOULD CORRECT THE PROBLEM. IF NOT, THE GAME REQUIRES SERVICE.

EQUIPMENT:

The following is a recommended list for anyone attempting to service HUSTLE.

1. Oscilliscope - 50 mhz or wider band width
2. DVM (Digital Volt Meter)
3. OHM Meter
4. Logic Probe
5. Solder Station - 75 Watt or less
6. Jumpers
7. Replacement parts including game programs:

   1024 x 4 proms 316-0016, 316-0017, 316-0018, and 316-0019

SYMPTOMS/CAUSES

HUSTLE POWER SUPPLY MALFUNCTIONS:

1. Remove Output Connectors
2. Initial Tests: (GND lead to C-18 negative terminal located off board.)
   a. +9v at "+" of C-18
   b. +19v at C-6 (4700 mfd)
   c. -19v at C-5 (4700 mfd)
   d. -12v at pin 11
   e. +12v at pin 12
   f. +5v at pins 18-20
   g. zero v (GND) at pins 14-16
3. If adjustments are required, attach meter ground to pins 14, 15 or 16 or equivalent local ground and:
   a. +5v adjust - input lead to pins 18, 19, 20 and adjust R-9 for +5.0 to +5.1VDC
   b. +12v adjust - input lead to pin 12 and adjust R-8 for 11.5 to -12.1VDC
4. If initial test is good, attach output connectors to Video Logic Board. Repeat Step 2.
   a. If readings differ from those previously taken, a loading problem exists on the Video Logic Board.

No -12VDC or 5VDC on the Video Logic Board: (Power Supply Normal)

Video Logic Board Schematic (VLBS) (SH. 2). CHECK U-65, C-29 for open/short. CHECK R-40, C-12, D-2 (VLBS) (SH. 1).

No +12VDC at CPU: (Power Supply Normal)

(VLBS) (SH. 2). CHECK U-65, C-28, (VLBS) (SH. 1). CHECK C-23, C-25.

SYMPTOMS/CAUSES (Cont'd.)

No Ø1, Ø2 CLOCKS: (Ref. Fig. 4A)

(VLBS), (SH. 1). CHECK U-32 pins 1 and 3 for 20.79MHZ. CHECK U-31 pins 14, 13, 12 and 11 for 150 nsec sinewave. CHECK U-17 pins 1, 3, 4, and 10. CHECK latch network U-18 and U-8. CHECK high voltage outputs of U-30 pins 3 and 6. If not present, remove driver transistor. Should U-30 now output, replace driver transistor, if still not present replace U-30. U-45 could load down Ø1 clock.

No Coin Start:

(VLBS) (SH. 1) CHECK output U-9 pin 6. If signal not present, lift U-10 pin 5. Should signal return, replace U-10. If still not present, CHECK output of U-8 pin 3. CHECK D-8 pull up diode and C-18. CHECK U-14. U-32 could be shorting signal to Q_3 and Q_4.

No Coin Meter Action:

(VLBS) (SH. 1). Signal from U-8 pin 11 feeds current limiter R-27 to Q_4. Saturated Q_4 turns on high current transistor Q_5. Either Q_4 or Q_5 faulty, will inhibit meter.

No Player Control:

(VLBS) (SH. 1). Input accepted through U-12 and U-13 via data lines when strobe IND2 signal is generated through U-18 from U-45 and U-51 (status latch). CHECK U-18 pin 11, U-45 pin 8, U45 pin 11, U-51 pin 10 for strobe pulse.

No Game Time Select:

(VLBS) (SH. 1). Input accepted through U-10 and U-11 via data lines when strobe IND1 signal is generated through U-18 from U-45 and U-51. CHECK U-18 pin 3, U-45 pin 8, U-45 pin 11, U-51 pin 10 for strobe pulse.

Meaningless Display on Screen: (Inserting coin does not correct problem)

There are two probable areas:

1. A program malfunction -

   a. CHECK PROM sockets, U-2, U-3, U-4 and U-5

2. A data transfer malfunction -

   a. Test the CPU Data Bus by ensuring proper voltage levels. Pullup resistors are used to make memory outputs compatible with the 8080A. High State Logic on the Data Bus should be 3.3v minimum. For involved problems in this area contact GREMLIN INDUSTRIES.

Characters on Screen not correct: (Wrong image behaves normally)

(VLBS) (SH. 2). Use character generator code table to isolate possible bad RAM (U-38; U-39; U-40; U-41; or U-42). Also probable are U-22. U-23 (data buffers), U-24, U-25, U-26 (multiplexers), U-29 and U-43, U-49 (shift register).

No Video: (Ref. Fig. 4B, 4C, 4D)

(VLBS) (SH. 2). CHECK U-54, U-53 circuitry for H reset. U-52 pin 1, clock for horizontal scan. U-55, U-58 provides timing for vertical scan. U-64 develops sync pulses.

Monitor Malfunction:

Refer to Motorola Service Manual (File VP 12). This manual included with HUSTLE schematics.

Audio Tones; Sour/None:

(VLBS) (SH. 2). U-68, U-61, U-62, U-66, U-67, U-60 comprise tone generator. Amplifier on Power Supply Board (U-4, Q_5, Q_3, QX, Q_9). Could also be problem area.

Boom; Sour/None:

(VLBS) (SH. 1, SH. 2). D-6, Q_{10}, Q_9, Q_{11}, U-5, Q_7, Q_8. Generates Boom.

Amplifier section on Power Supply Board (U-4, Q_5, Q_3, Q_8, Q_9), also probable.

MICROPROCESSOR CLOCKS

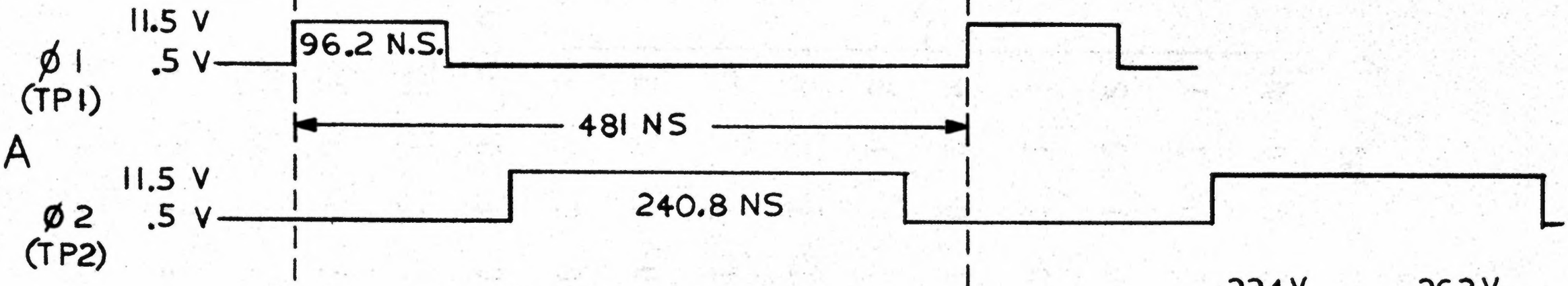


FIG. A

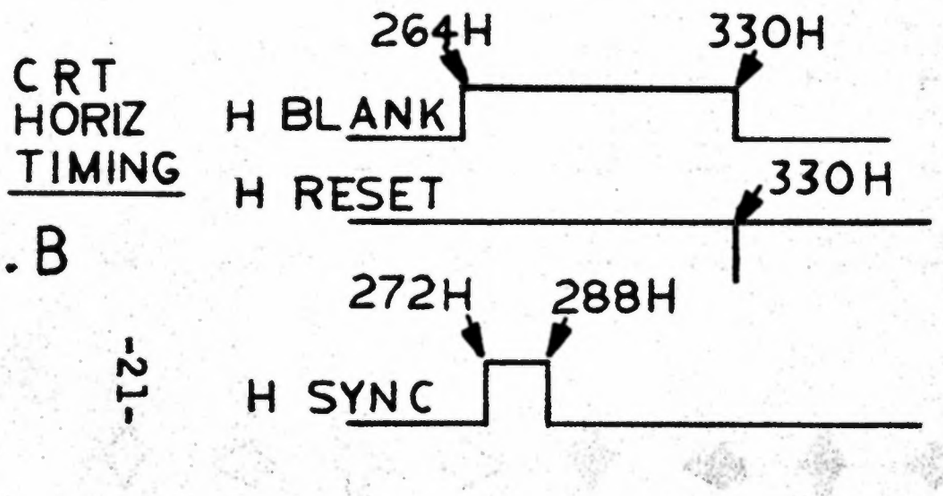


FIG. B

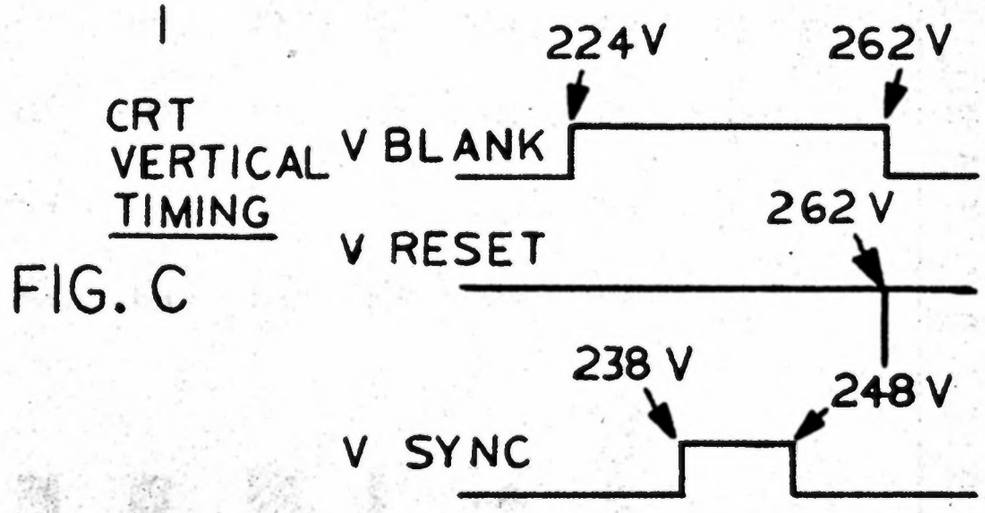


FIG. C

VIDEO OUTPUT

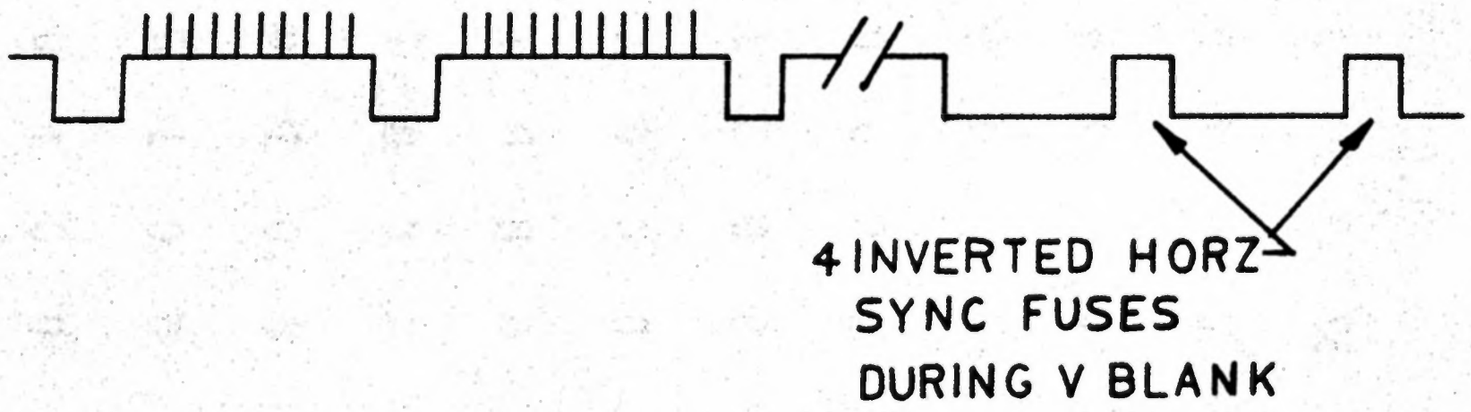


FIG. D

KEY WAVEFORMS

Diagram #6

CHARACTER CODE TABLE

I.C. (U#) 37	38	39	40	41	42		I.C. (U#) 37	38	39	40	41	42	
0	0	0	0	0	0	(SPACE)	1	1	0	0	0	0	ø
0	0	0	0	0	1	?	1	1	0	0	0	1	1
0	0	0	0	1	0	–	1	1	0	0	1	0	2
0	0	0	0	1	1	▨	1	1	0	0	1	1	3
0	0	0	1	0	0	■	1	1	0	1	0	0	4
0	0	0	1	0	1	■	1	1	0	1	0	1	5
0	0	0	1	1	0	■	1	1	0	1	1	0	6
0	0	0	1	1	1	■	1	1	0	1	1	1	7
0	0	1	0	0	0	♦	1	1	1	0	0	0	8
0	0	1	0	0	1	▶	1	1	1	0	0	1	9
0	0	1	0	1	0	◆	1	1	1	0	1	0	(NOT USED)
0	0	1	0	1	1	◀	1	1	1	0	1	1	▣
0	0	1	1	0	0	◇	1	1	1	1	0	0	▨
0	0	1	1	0	1	◇	1	1	1	1	0	1	▬
0	0	1	1	1	0	◇	1	1	1	1	1	0	!
0	0	1	1	1	1	◇	1	1	1	1	1	1	⁘

SMALL

CHARACTER CODE TABLE

I.C. (U#) 37	38	39	40	41	42		I.C. (U#) 37	38	39	40	41	42		
1	0	0	0	0	0	A	1	1	0	0	0	0	Ø	LARGE
1	0	0	0	0	1	C	1	1	0	0	0	1	1	
1	0	0	0	1	0	E	1	1	0	0	1	0	2	
1	0	0	0	1	1	F	1	1	0	0	1	1	3	
1	0	0	1	0	0	□	1	1	0	1	0	0	4	
1	0	0	1	0	1	□	1	1	0	1	0	1	5	
1	0	0	1	1	0	□	1	1	0	1	1	0	6	
1	0	0	1	1	1	□	1	1	0	1	1	1	7	
1	0	1	0	0	0	G	1	1	1	0	0	0	8	
1	0	1	0	0	1	I	1	1	1	0	0	1	9	
1	0	1	0	1	0	L	1	1	1	0	1	0	S	
1	0	1	0	1	1	M	1	1	1	0	1	1	T	
1	0	1	1	0	0	N	1	1	1	1	0	0	V	
1	0	1	1	0	1	O	1	1	1	1	0	1	Y	
1	0	1	1	1	0	P	1	1	1	1	1	0	(NOT USED)	
1	0	1	1	1	1	R	1	1	1	1	1	1	(NOT USED)	

HUSTLE PARTS LIST

DESCRIPTION	QTY USED	PART NUMBER
ASSY, COIN COUNTER	1	807-0011
CONN, CRIMP LOCK	2	211-0005
CONN, KEY POLARIZING	1	211-0007
CONN, FEM 10 PIN	1	211-0016
COUNTER, DIGITAL	1	220-0008
ASSY, CONTROL BLOCK	1	813-0004
CONN, CRIMP COINBOX	6	211-0001
CONN, CRIMP LOCK	10	211-0005
CONN, KEY, POLARIZING	4	211-0007
CONN, SPADE LUG 1/4"	1	211-0019
SOLDER LUG #10	1	211-0027
CONN, FEM 4 PIN BLK	2	212-0005
CONN, FEM 10 PIN	1	212-0016
KNOB, VOL CONTROL	1	240-0001
SWITCH BRACKET	1	250-0031
ASSY, HUS OPER. SWITCH	1	813-0002
CONN CRIMP LOCK	11	211-0005
CONN, KEY, POLARIZING	1	211-0007
CONN, SPADE LUG 1/4"	1	211-0019
CONN SPADE LUG #10	1	211-0027
SWITCH ASSY WICO	10	212-0016
CONN, FEM 10 PIN	1	510-0023
ASSY, HUS VIDEO LOGIC	1	813-0001
ASSY, JUMPER HARNESS	1	807-0006
CONN, CRIMP LOCK	16	211-0005
CONN, KEY, POLARIZING	4	211-0007
CONN, FEM 10 PIN	2	212-0016
ASSY, JUNCTION BOX	1	807-0009
BOX, JUNCTION	1	140-0016

HUSTLE PARTS LIST (Cont'd.)

DESCRIPTION	QTY USED	PART NUMBER
COVER, JUNCTION BOX	1	140-0017
CONN, QUICK, 1/4" FEM	2	211-0017
CONN, SPADE LUG 1/4"	14	211-0019
CONN, QUICK 3/16" FEM	4	211-0022
BUSHING, STR/RELIEF	2	280-0007
TERMINAL STRIP 6 POS	1	280-0011
MARKER, TERM STRIP	1	280-0017
SWITCH SPDT CHERRY	1	510-0013
FUSE, 2 AMP 250V SB	1	514-0001
HOLDER, FUSE	1	514-0005
CORD, LINE, 3 COND.	1	600-0001
ASSY, MONITOR HARNESS	1	807-0005
CONN, CRIMP LOCK	2	211-0005
CONN, KEY, POLARIZING	2	211-0007
CONN, SPADE LUG 1/4"	3	211-0019
CONN, 12 PIN BLOCK	1	211-0025
CONN, PIN CRIMP, FEM	5	211-0026
CONN, FEM 4 PIN BLK	1	212-0005
ASSY, POWER INTERRUPT	1	807-0012
CAP, E, 1M50V	2	150-0009
CAP, F, .22M100V	1	152-0002
PCB POWER INTERRUPT	1	170-0073
CONN, FEM 10 PIN RT/A	1	212-0017
IC TIMER NE555	2	314-0001
RES 1K OHM ;/2W 5%	7	471-0102
RES, 100K 1/2W 5%	2	471-0104
RES, 33K 1/2W 5%	1	471-0333
RES, 470K 1/2W 5%	1	471-0474
DIODE, ZENER 1N5231	1	481-0008
XISTOR 2N4403	1	482-0006
ASSY, POWER SUPPLY	1	807-0003
ASSY, PWR SUPP/AMP B	1	807-0002

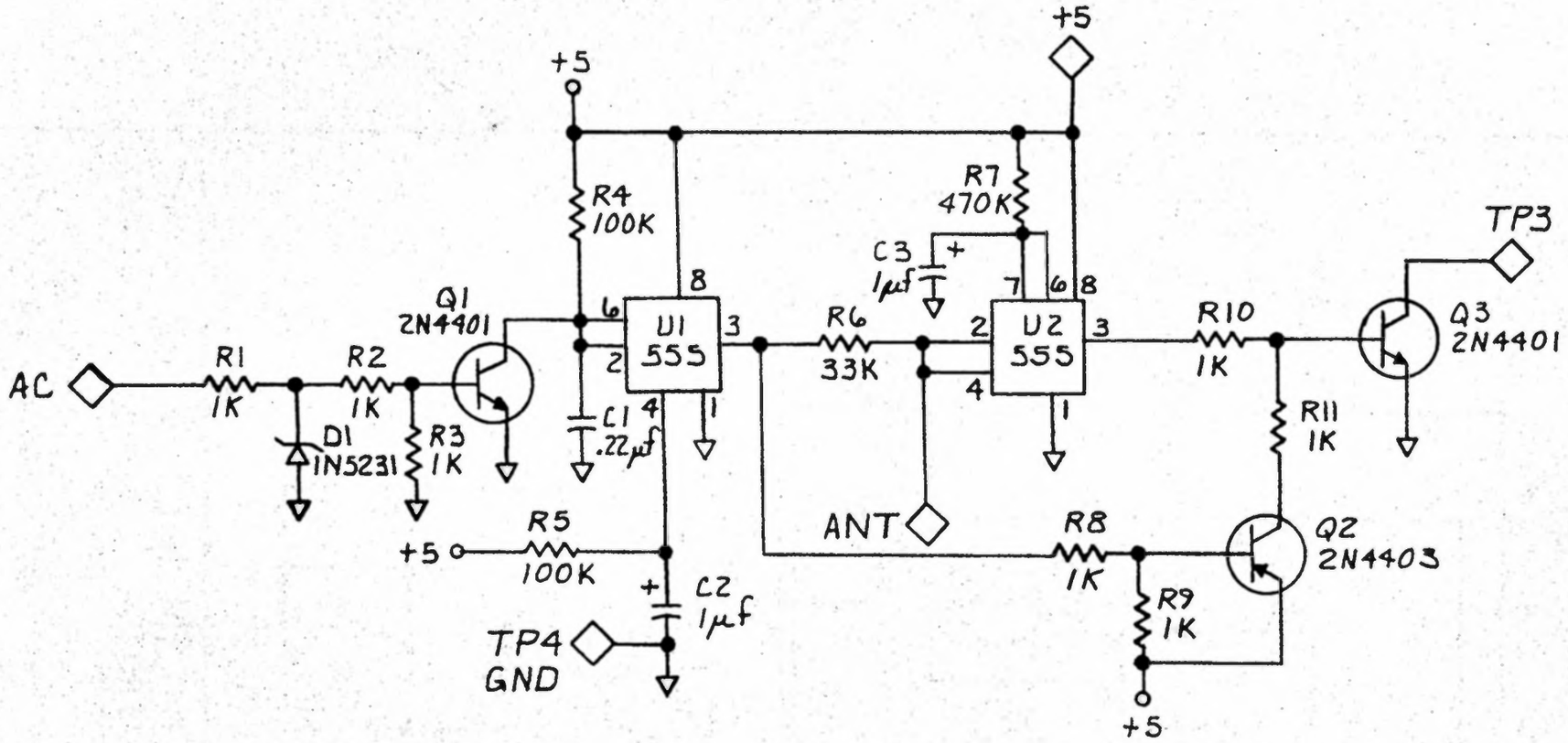
HUSTLE PARTS LIST (Cont'd.)

DESCRIPTION	QTY USED	PART NUMBER
BUSHING S/REL 3/8"	1	280-0001
BUTTON, PLUNGER WHITE	10	240-0008
CABINET, UPRIGHT	1	140-0014
CASHBOX, UPRIGHT	1	220-0012
CLIP, SWITCH	1	250-0048
CLIP, WIRE HOLDDOWN	35	280-0004
COIN MECHANISM, DUAL	1	220-0010
CORNER STRIP	4	420-0037
COVER GRAPHIC PANEL	1	253-0030
COVER, SPEAKER 6 x 9	1	130-0002
DECAL, CAUTION 115V	1	420-0030
DECAL, HUSTLE	1	420-0067
DECAL, IMPORTANT NOTE	2	420-0038
DECAL, RE-CYCLE	1	420-0040
DECAL, S/N	1	420-0028
DECAL, S/N SMALL	1	420-0041
DECAL, SERVICE	1	420-0029
DECAL, TIP N.TELL	1	420-0060
DRAWINGS, HUSTLE	1	420-0068
FEET, CABINET	4	280-0030
FIXT, LAMP FLUOR 18"	1	390-0012
FRAME, BEZEL	1	250-0032
GRAPHIC, PANEL OPTR.	1	253-0027
LAMP, FLUORESCENT, 18"	1	390-0011
LATCH, LOCK UPRIGHT	1	220-0015
LID, ASSY, COIN BOX	1	220-0016
LOCK, PANEL	1	220-0009
MANUAL, HUSTLE	1	420-0069
MASK, SHADOW CABINET	1	253-0014
MOLDING STRIP	1	250-0038
MOLDING-TRIM, LOWER	1	250-0109
MONITOR, VIDEO 19 IN	1	200-0002
MOUNT BKT COIN BOX	1	252-0014
NUT, WIRE	2	280-0010
PANEL, DISPLAY UPPER	1	253-0036
PANEL, GRAPHIC FRONT	1	253-0034
PANEL, MONITOR SCREEN	1	253-0037
PANEL, OPERATOR	1	250-0102

HUSTLE PARTS LIST (Cont'd.)

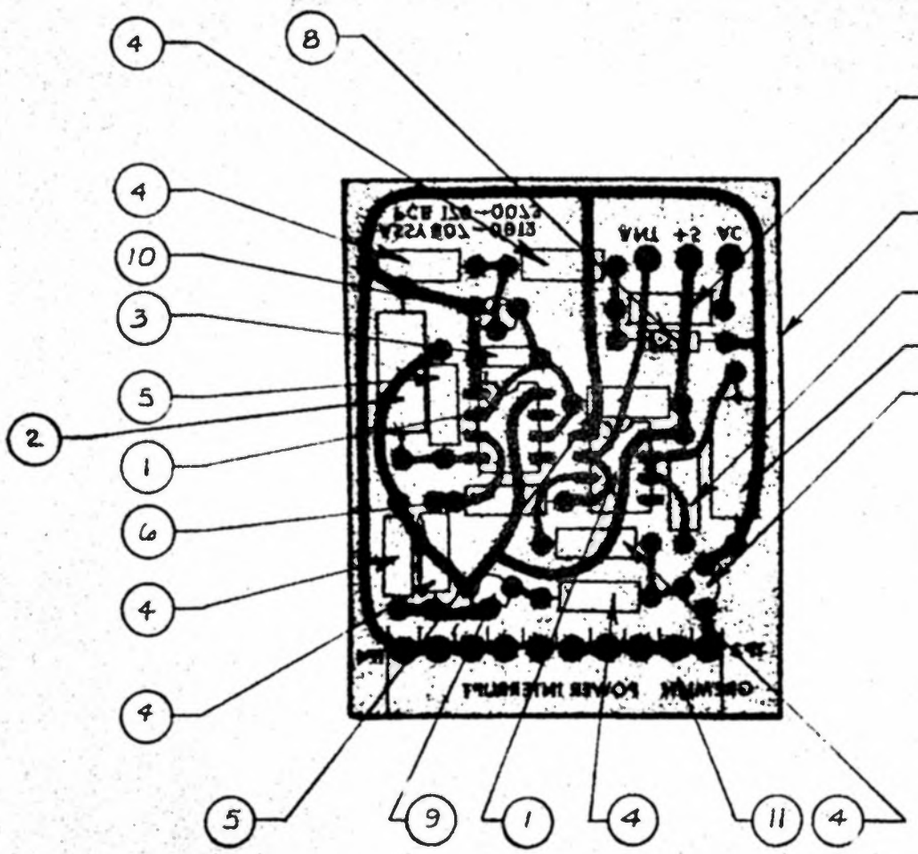
DESCRIPTION	QTY USED	PART NUMBER
PLATE, COIN RETENSION	1	250-0062
PLATE, LOCK STRIKE	1	250-0033
SPACER, WICO SWITCH	12	253-0031
SPEAKER, GAME 6 x 9	1	130-0001
SPRING, RETAINER	1	250-0034
TRIM, CONTROL PANEL	2	250-0106
TOP COVER	1	420-0035
WASHER, ANCHOR	1	280-0028
WRAPAROUND SIDE	1	420-0034

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED



		UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ARE: FRACTIONS DECIMALS ANGLES ± .XX ± ± .XXX ±	CONTRACT NO.	GREMLIN INDUSTRIES INC. 8401 AERO DR. SAN DIEGO, CA. 92123	
			APPROVALS / DRAWN Wynema	DATE 12/27/76	SCHEMATIC — POWER INTERRUPT
		MATERIAL	CHECKED		
		FINISH		SIZE B	CODE IDENT NO. — DRAWING NO. 807-0012
NEXT ASSY	USED ON			SCALE NONE	SHEET 1 OF 1
APPLICATION		DO NOT SCALE DRAWING			

ZONE	LTR	DESCRIPTION	DATE	APPROVED



ITEM NO.	QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	
12	1		170-0073	P.C. BOARD	
11	1		212-0017	CONN FEMALE 10PIN RT ANGLE	
10	2		482-0014	TRANSISTOR 2N4401	Q1,Q3
9	1		482-0006	TRANSISTOR 2N4403	Q2
8	1		481-0008	DIODE ZENER IN5231	D1
7	1		471-0474	RES. 470K OHM 1/2W 5%	R7
6	1		471-0333	RES. 33K OHM 1/2W 5%	R6
5	2		471-0104	RES. 100K OHM 1/2W 5%	R4,R5
4	7		471-0102	RES. 1K OHM 1/2 W 5%	R1-R3,R8-R10
3	1		152-0002	CAP. F. .22M 100V C1	C1
2	2		150-0016	CAP. E. 1M 16V	C2,C9
1	2		314-0001	IC TIMER NE555	U1,U2

PARTS LIST

NEXT ASSY	USED ON
APPLICATION	

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

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN Wigmore	12/29/h
CHECKED	

GREMLIN INDUSTRIES INC.,
8401 AERO DR. SAN DIEGO, CA. 92123

POWER INTERRUPT ASSY
PARTS OVERLAY

SIZE	CODE IDENT NO.	DRAWING NO.
C		807-0012

SCALE NONE | SHEET 1 OF 1

REV B PER ECN 63 WJB 2/15/77

T1
120 V
100 V
0 V
SHIELD
8.2 VRMS
13.5 VRMS
13.5 VRMS
560-0003 B
NOT ON P.C. BOARD

D9 MDA 3500

+9 V
C18 9,000 µf 12V

TIP115
Q7
Q10
MJ3000

BLANK KEYING PINS
3 N.C. 13 N.C. 17 N.C. 22 N.C. 23 N.C. 27 N.C.

D3 MR501 D1 MR501 D4 MR501 D2 MR501

+12 V
+17 V

R27 100Ω
C16 10µf 25V
C17 .001µf
R26 2.7K
Q5 2N4401
Q9 TIP 29
R21 10K
IN914 D8
R20 1K
C13 10µf 25V
U4 LM741EN
IN914 D7
R24 1K
R31 1Ω 1W
Q3 2N4403
Q8 TIP 29
R29 1Ω 1W
C19 100pf
R25 2.7 K
R22 1K
R11 10K REF. ONLY
R33 100K
R19 100Ω
C14 10µf 25V
-17 V

C5 4700µf 25V
C6 4700 µf 25V
C3 .1µf
R30 1Ω 1W
C2 10µf 25V
R23 1K
Q1 2N4403
D6 5.1V IN5231

C11 .05µf
U3 LM723
R9 1K
R13 1.5 K
R32 3.3 K
C10 .001µf
R16 1.5K
2N4403 Q4
C12 .01µf
R15 100Ω
R28 .1Ω 5W
+5V
R18 1.5K
R17 1K
R14 10K

C9 .01µf
U2 LM741EN
R8 2K
R7 2.7 K
R12 5.6 K
7.15 V

+12 V
C1 10µf 25V
R6 1K
R1 5.6K
C8 .05µf
C4 .01µf
R10 2K
R3 8.2K
R2 1K
C15 10µf 25V
-12 V

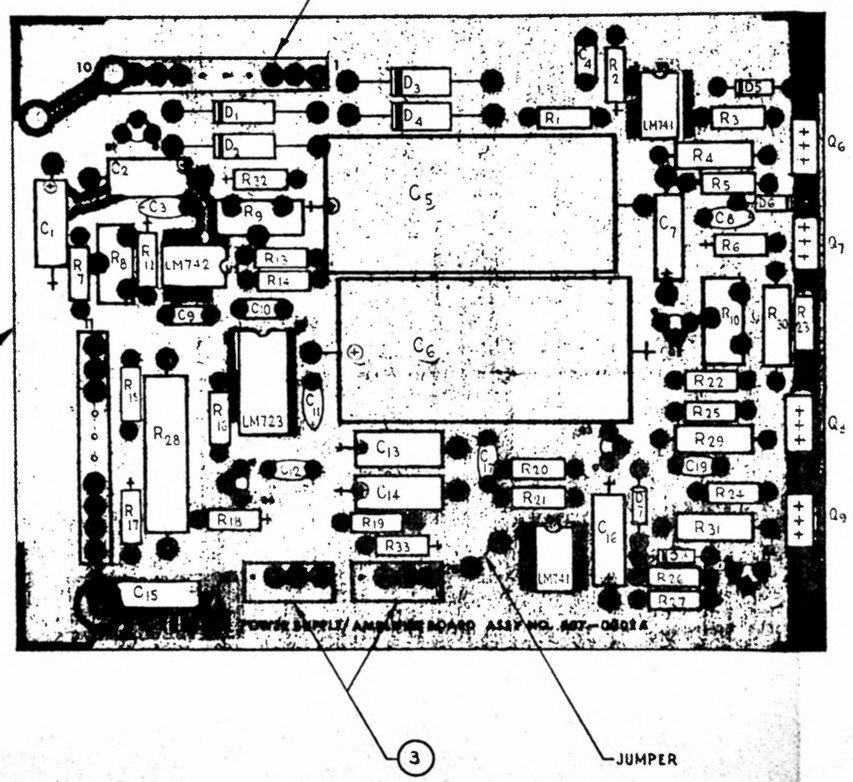
Q2 2N4401
R5 1K
C7 10µf 25V
R4 1Ω 1W
U1 LM741EN
D5 5.1 V IN5231
Q6 TIP110
-17 V

LAST C NO. USED C 19
LAST D NO. USED D 9
LAST Q NO. USED Q 10
LAST R NO. USED R 33
LAST U NO. USED U 4

GREMLIN INDUSTRIES INC.
8401 AERO DR. SAN DIEGO, CA. 92123

REVISIONS	TITLE	
	SCHEMATIC BLOCKADE PWR. SUPPLY	
DRAWN Joe M. CHECKED	SCALE	DRAWING NO.
APPROVED	NONE	807-0002B

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	B	PER ECN 63 WJB	2/15/77	



OMIT R11

ITEM NO.	QTY	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION
3	2	212 - 0004	CONN. MALE 4 PIN
2	2	212 - 0003	CONN. MALE 10 PIN
1	1	170 - 0058A	P.C. BOARD
Q8Q9	2	482 - 0016	XISTOR TIP 29
Q7	1	482 - 0015	XISTOR TIP 115
Q6	1	482 - 0013	XISTOR TIP 110
Q2Q5	2	482 - 0014	XISTOR 2N4401
Q1Q3Q4	3	482 - 0006	XISTOR 2N4403
D7 D8	2	481 - 0006	DIODE IN914 OR IN4148
D5 D6	2	481 - 0008	DIODE ZENER IN5231
D1-D4	4	481 - 0004	DIODE MR 501
C19	1	151 - 0002	CAP. CER. 100 P 50 V
C18 C17	2	151 - 0008	CAP. CER. .001 M 50 V
C8 C11	2	151 - 0001	CAP. CER. .05 M 50 V
C5 C6	2	150 - 0019	CAP. E. 4700 M 25 V
C4 C9 C12	3	151 - 0011	CAP. CER. .01 M 50 V
C3	1	151 - 0012	CAP. CER. .1 M 50 V
C1C2C7C13 C14-C16	7	150 - 0004	CAP. E. 10 M 25 V
R9	1	475 - 0004	POT. 1 K TRIMMER
R8 R10	2	475 - 0005	POT. 2 K TRIMMER
R28	1	473 - 00R1	RES. .1 OHM 5 W 3%
R15 R19 R27	3	471 - 0101	RES. 100 OHM ½ W 5%
R4 R29 - R31	4	472 - 0010	RES. 1 OHM 1 W 5%
R33	1	471 - 0104	RES. 100 K OHM ½ W 5%
R32	1	471 - 0332	RES. 3.3 K OHM ½ W 5%
R14 R21	2	471 - 0103	RES. 10 K OHM ½ W 5%
R13 R16 R18	3	471 - 0152	RES. 1.5 K OHM ½ W 5%
R17 R20 R16	3	471 - 0272	RES. 2.7 K OHM ½ W 5%
R3	1	471 - 0822	RES. 8.2 K OHM ½ W 5%
R1R2R5R11R10 R22-R26	8	471 - 0102	RES. 1 K OHM ½ W 5%
R1 R12	2	471 - 0562	RES. 5.6 K OHM ½ W 5%
U3	1	313 - 0001	I.C. LM 723
U1U2U4	3	313 - 0004	I.C. LM 741 EN

PARTS LIST

NEXT ASSY	USED ON
APPLICATION	

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

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN Joe M.	11-18-76
CHECKED	

GREMLIN INDUSTRIES INC.
8401 AERO DR. SAN DIEGO, CA. 92123

POWER SUPPLY/AMP BOARD
BLOCKADE
PARTS OVERLAY

SIZE	CODE IDENT NO.	DRAWING NO.
D		807-0002B

SCALE 2 X | SHEET 1 OF 1

807-0002 B1

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

U19 8080 A CPU

Y1 20.790 MHZ

IF POWER INTERRUPT BOARD IS NOT USE ADD C11

1. ON CONNECTOR PINS 15,27,39,44,48,52,54,57 ARE BLANK KEYING PINS.

NOTES:

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

PARTS LIST

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

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN LIPTAK L.J	3-23-77
CHECKED	3-24-77

GREMLIN INDUSTRIES INC.
8401 AERO DR. SAN DIEGO, CA. 92123

SCHEMATIC
HUSTLE
VIDEO LOGIC BOARD

SIZE	CODE IDENT NO.	DRAWING NO.	REV
D		813-0001	

SCALE NONE SHEET 1 OF 3

713-0001	HUSTLE
NEXT ASSY	USED ON
APPLICATION	

813-0001

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

AUDIO

VIDEO

NOTES:

⚠ JUMPER AT LC. PINS 9 TO 12 AT U35, U36

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

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

MATERIAL

FINISH

DO NOT SCALE DRAWING

NEXT ASSY | USED ON
APPLICATION

CONTRACT NO.

APPROVALS	DATE
DRAWN UPTAK L.W.	3-23-77
CHECKED Dave Hein	3-24-77

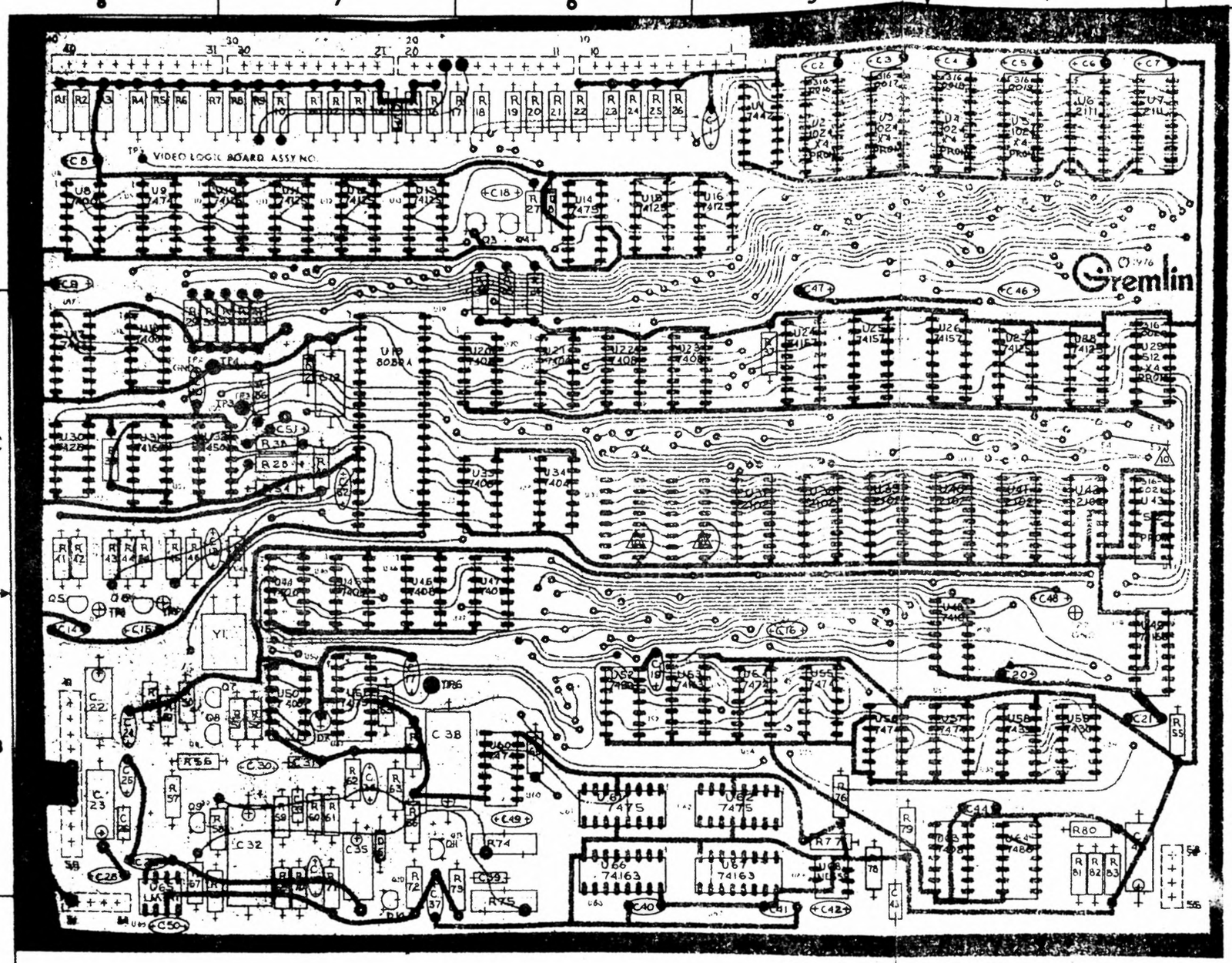
GREMLIN INDUSTRIES INC.
9401 AERO DR. SAN DIEGO, CA. 92123

SCHEMATIC
HUSTLE
VIDEO LOGIC BOARD

SIZE	CODE IDENT NO.	DRAWING NO.	REV
D		813-0001	

SCALE NONE | SHEET 2 OF 3

813-0001



REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED

	QTY.	PART NO.	NOMENCLATURE OR DESCRIPTION
T1-T7	7	211-0004	TEST POINT PINS
Y1	1	230-0006	XTAL 20.790 MHZ CLK
U2-U5 (REF. ONLY)	4	213-0002	SKT, 18 PIN DUAL INLN
J6, J7	2	212-0004	CONN. MALE 4 PIN
J1-J5	5	212-0003	CONN. MALE 10PIN
PCB.1	1	170-0057 D	P.C. BOARD B/A LOGIC
Q8	1	482-0006	XISISTOR 2N4403
Q4-Q7, Q9-Q11	7	482-0014	XISISTOR 2N4401
Q3	1	482-0010	XISISTOR PE 6050
D7	1	390-0003	LED RED
D6	1	481-0003	DIODE ZENER 1N960B
D5	1	481-0001	DIODE 1N4002
D2	1	481-0008	DIODE ZENER 1N5231
D8	1	481-0006	DIODE 1N914 OR 1N4148
C52	1	151-0001	CAP. CER. .05μf 50V
C50	1	151-0008	CAP. CER .001μf 50V
C49, C51	2	151-0011	CAP. CER. .01μf 50V
C43	1	152-0007	CAP. F. .001μf 250V
C32, C38	2	150-0012	CAP. E. 47μf 25V
C31, C33	2	152-0015	CAP. F. .033μf 250V
C28-C30, C34, C36, C37, C39-C	8	151-0012	CAP. CER. .1μf 50V
C27, C35,	2	150-0015	CAP. E. 22μf 16V
C26	1	152-0001	CAP. F. 1μf 100V
C13	1	151-0005	CAP. CER. 680pf 50V
C12, C22, C23, C45	4	150-0004	CAP. E. 10μf 25V
C25, C40-C42, C44, C46-C48	26	151-0001	CAP. CER. .05μf 50V
C1-C10, C14-C17, C19-C21, C24	"	"	"
R75	1	475-0002	POT 1 MEG Ω CTS
R74	1	475-0008	POT 50 K CTS
R38	1	471-0222	RES 2.2K 1/2W 5%
R78	1	471-0272	RES 2.7K 1/2W 5%
R62	1	471-0473	RES 47K 1/2W 5%
R72	1	471-0154	RES 150K 1/2W 5%
R68	1	471-0224	RES 220K 1/2W 5%
R61, R71	2	471-0682	RES. 6.8K 1/2W 5%
R59, R63, R66, R70	4	471-0333	RES 33K 1/2W 5%
R57	1	471-0334	RES 330K 1/2W 5%
R55	1	471-0101	RES 100Ω 1/2W 5%
R52	1	471-0471	RES 470Ω 1/2W 5%
R49	1	471-0150	RES 15Ω 1/2W 5%
R48, R51, R56, R73	4	471-0512	RES 5.1K 1/2W 5%
R46, R47, R81, R82	4	471-0331	RES 330Ω 1/2W 5%
R43, R45	2	471-0220	RES 22Ω 1/2W 5%
R29-R36, R60	9	471-0223	RES 22K 1/2W 5%
R42, R28, R84, R54, R86	5	471-0221	RES 220Ω 1/2W 5%
R58 R67 R77	3	471-0103	RES 10K 1/2W 5%
R1-R27, R37, R39-R41, R44	42	471-0102	RES 1K 1/2W 5%
R50, R55, R64, R65, R69	"	"	"
R76, R79, R80, R83, R85	"	"	"
U3	1	316-0017	I.C. 1024X4 PROM
U37-U42	6	315-0015	I.C. 2102 RAM (500NS)
U8, U7	2	315-0018	I.C. 2111 RAM (500NS)
U68	1	314-0001	I.C. TIME NE555
U65	1	313-0004	I.C. LM 741
U64	1	314-0022	I.C. 7486
U59	1	314-0020	I.C. 7450
U53, U66, U67	3	314-0038	I.C. 74163
U52 U58	2	314-0030	I.C. 74393
U49	1	314-0039	I.C. 74166
U43	1	316-0021	I.C. 512 X4 PROM
U48	1	314-0010	I.C. 7410
U14, U51, U61, U62	4	314-0021	I.C. 7475
U 34	1	314-0015	I.C. 7404
U 32	1	314-0046	I.C. 74S04
U 31	1	314-0032	I.C. 74160
U30	1	314-0031	I.C. 7426
U29	1	316-0020	I.C. 512X4 PROM
U24-U26	3	314-0029	I.C. 74157
U20, U22, U23, U33, U45-U47, U63	8	314-0012	I.C. 7408
U19	1	315-0014	I.C. 8080A CPU
U10-U13, U15 U16, U27, U28	8	314-0017	I.C. 74125
U9 U54, U57 U60	5	314-0006	I.C. 7474
U8, U18 U21 U44 U50	5	314-0008	I.C. 7400
U5	1	316-0019	I.C. 1024X4 PROM
U4	1	316-0018	I.C. 1024X4 PROM
U2	1	316-0016	I.C. 1024X4 PROM
U1, U17	2	314-0011	I.C. 7442

PARTS LIST

JUMPER WIRES AT NOTES

NOTES:
3. CAPACITANCE VALUES ARE IN MICRO FARADS EXCEPT C 13 NOTED AS PICO FARADS
8. RESISTANCE VALUES ARE IN OHMS (K = 1000)
7. ON CONNECTOR PINS 3, 15, 27, 39, 44, 48, 52, 54, 57 ARE BLANK KEYING PINS
6. OMIT Q1, Q2, D1, D3, D4, U35, U36
5. LAST C NO. USED C52
4. LAST D NO. USED D8
3. LAST Q NO. USED Q11
2. LAST R NO. USED R86
1. LAST U NO. USED U68

NEXT ASSY	USED ON
APPLICATION	

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

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN LIPTAK L J	4/1/77
CHECKED	4/4/77
	4/4/77

Gremlin Industries, Inc.
San Diego, California 92123

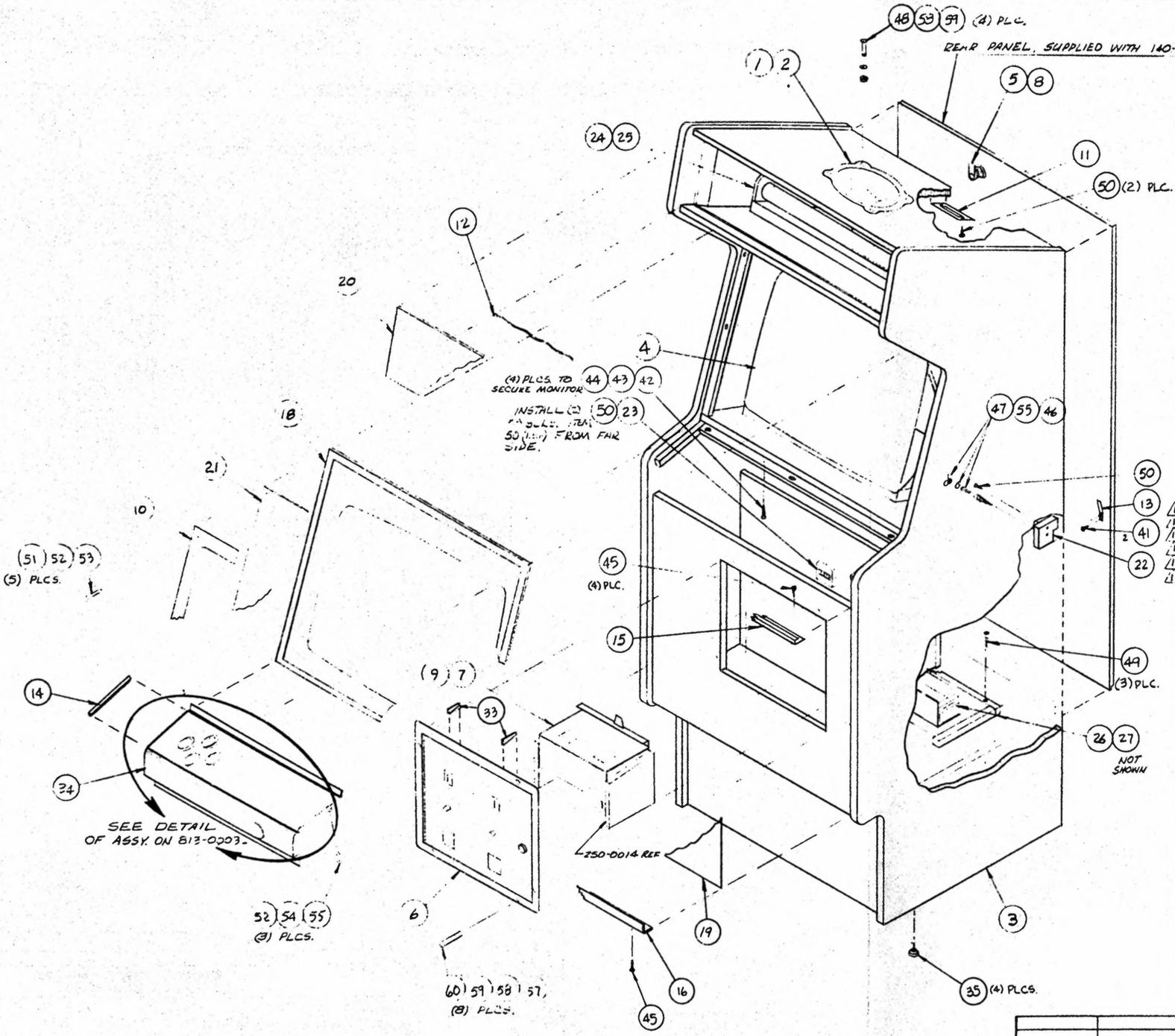
VIDEO LOGIC BOARD
HUSTLE
PARTS OVERLAY

SIZE	CODE IDENT NO.	DRAWING NO.	REV
D		813-0001	

SCALE 2X/ SHEET 3 OF 3

813-0001

ZONE	LTR	REVISIONS DESCRIPTION	DATE	APPROVED
	B	INITIAL RELEASE ECN 106	4-14-77	V. Olson



QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION		
8			8-32 BOLT RD. HD. CARRIAGE 1/4 LG.		60
8			8-32 HEX NUT		59
8			#8 FLAT WASHER		58
8			#8 LOCK WASHER		57
					56
3			#10 LOCK WASHER		55
2			10-32 HEX NUT		54
5			10-24 BOLT RD. HD. CARRIAGE 1 3/8" LG.		53
8			#10 FLAT WASHER		52
5			10-24 HEX NUT		51
5			#8 RD. HD. CR. REC. SHT. MTL. SCR. 1/2" LG.		50
3			#8 FLT. HD. CR. REC. WOOD SCR 1 1/4" LG.		49
4			8-32 SLOT. CHL HD. MACH SCR 1/2 LG.		48
1			10-24 HANGER BOLT 3 1/2" LG		47
1			10-24 WING NUT		46
8			#4 RD HD CRS. REC WOOD SCR. 1/2 LG		45
4			#8 SELF TAP SHT. MTL SCR HEX HD. 1/4 LG		44
4			#8 INT.-EXT. TOOTH LOCK WASHER		43
4			#8 CLIP NUT		42
2			#6 LD. HD. CRS REC. SHT. MTL. SCR. 1/2 LG		41
					40
					39
					38
					37
					36
4		280-0030	CABINET FEET		35
1		813-0003	OPERATOR PANEL ASSY.	SHEET 1 & 2 OF 3	34
2		250-0062	COIN RETENTION PLATE		33
1		813-0004	ASSY CONTROL BLOCK	SHEET 2 OF 3	32
1		807-0006	ASSY JUMPER HARNESS	SHEET 2 OF 3	31
1		807-0010	ASSY SPEAKER CABLE	SHEET 2 OF 3	30
1		807-0012	ASSY. POWER INTERRUPT	SHEET 2 OF 3	29
1		807-0005	ASSY. MONITOR HARNESS	SHEET 2 OF 3	28
1		813-0001	VIDIO LOGIC BD ASSY	SHEET 2 OF 3	27
1		807-0003	ASSY. POWER SUPPLY	SHEET 1 & 2 OF 3	26
1		390-0012	LAMP, FIXTURE, FLUOR, 18"	SHEET 1 & 2 OF 3	25
1		390-0011	LAMP, FLUORESCENT, 18"		24
1		807-0011	COIN COUNTER ASSY.	SHEET 1 & 2 OF 3	23
1		807-0009	ASSY. JUNCTION BOX	SHEET 1 & 2 OF 3	22
1		253-0037	PANEL, MONITOR SCREEN		21
1		253-0036	PANEL, DISPLAY UPPER		20
1		253-0034	PANEL, GRAPHIC FRONT		19
1		253-0016	MASK, SHADOW CABINET		18
					17
1		250-0107	MOLDING-TRIM LOWER		16
1		250-0108	MOLDING-TRIM UPPER		15
-		250-0106	TRIM CONTROL PANEL		14
1		250-0048	CLIP, SWITCH		13
1		250-0034	RETAINER SPRING		12
1		250-0033	PLATE, COIN STRIKE		11
1		250-0032	BEZEL, FRAME		10
1		220-0016	COIN BOX LID ASSY.		9
1		220-0015	LATCH, LOCK B/A		8
1		220-0012	CASHBOX, UPRIGHT		7
1		250-0010	DUAL COIN MECHANISM	SHEET 1 & 2 OF 3	6
1		220-0009	LOCK, PANEL		5
1		200-0002	VIDEO, MONITOR 19 IN.	SHEET 1 & 2 OF 3	4
1		140-0014	CABINET, B/A		3
1		130-0002	SPEAKER COVER 6x9		2
1		130-0001	SPEAKER, GAME 6x9	SHEET 1 & 2 OF 3	1

PARTS LIST

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

MATERIAL

FINISH

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN [illegible] TH	4-12-77
CHECKED V. Olson	4-14-77

NEXT ASSY | USED ON
APPLICATION

Gremlin Industries, Inc.
San Diego, California 92122

TOP ASSY.
HUSTLE

SIZE	CODE IDENT NO.	DRAWING NO.
D		713-0001

SCALE NONE | SHEET 1 OF 2

713-0001 W1

⚠ 1 NOT SHOWN ON BODY OF DRAWING. SEE SHEET 2 OF 3 OF THIS DWG.

NOTES:

713-0001

ZONE	LTR	DESCRIPTION	DATE	APPROVED
	B	PER ECN # 106	6-15-77	
	C	REV. AFFECTS SHEET 1 ONLY	4-29-77	

REVISIONS

FLOURESCENT LAMP FIXTURE 18" P/N 390-0012 — (25)

GRN

BLK

SPEAKER, OVAL 6"X9" P/N 130-0001 — (1)

ORN

BLU

(30) SPEAKER CABLE ASSY.

OPERATOR SWITCH ASSY P/N 813-0002 — (34)

P2

P1

REAR VIEW

BLU

VIO

BLK

BRN

YEL

GRY

WHT

RED

ONE PLAY

TWO PLAY

GRN

GND

ORN

DUAL COIN MECH. P/N 220-0010

CONTROL BLOCK ASSY. — (32)

VOLUME CONTROL

N.O.

N.C.

MOUNT. SCR

(6)

19" MONITOR CHASSIS — (4)

GRY

BRAID

WHT

MONITOR HARNESS ASSY. (28)

JUNCTION BOX ASSY. 807-0009 — (22)

6 VOLT COIN COUNTER #220-0008 — (23)

2 BLK, TO LAMP

BLK, TO MONITOR

TO MONITOR, WHT

TO MONITOR, GRN

GRN, TO LAMP FIX.

INTLK SW.

NO.

COM.

FUSE HOLDER

TO OPERATOR SWITCH ASSY.

TO CONTROL BLOCK ASSY.

TO TRANSFORMER

SIDE VIEW OF JUNCTION BOX

2 COND. SHIELDED WIRE

560-0003B TRANSFORMER

POWER SUPPLY ASSY. P/N 807-0002

JUMPER HARNESS ASSY. — (31)

POWER INTERRUPT 807-0012 — (29)

TP4

TP3

VIDEO LOGIC BOARD ASSY. P/N 807-0001 — (27)

SINGLE COND SHIELDED WIRE

(26)

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

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

CONTRACT NO.

APPROVALS — DATE

DRAWN LIPTAK L.J. 3/29/77

CHECKED 3/31/77

MATERIAL

FINISH

HUSTLE

NEXT ASSY — USED ON

APPLICATION

DO NOT SCALE DRAWING

Gremlin Industries, Inc.
San Diego, California 92123

CABINET WIRING
HUSTLE

SIZE D — CODE IDENT NO. — DRAWING NO. 713-0001

SCALE NONE — SHEET 2 OF 5

REVISIONS				
ZONE	LTR	DESCRIPTION	DATE	APPROVED
	B	PER ECN # 106	4-15-77	

FREE GAME SCORE
11,000 / 13,000 / 15,000 / 17,000
NO FREE GAMES

VIDEO LOGIC CONN.

BLK
KEYING PIN
YEL
YEL
COIN COUNTER
GND
GRN
GRN
FRONT PANEL CHASSIS GND
BLK
BRN
RED
ORN
YEL
PUR
BLU
KEYING PIN
GRY
WHT
BLK
BRN
RED
ORN
YEL
PUR
GRY
KEYING PIN
BLK
RED
ORN
+5 GRN
KEYING PIN
RED
ORN
GND GRN
KEYING PIN
+12 RED
-12 ORN
BLK
KEYING PIN
BRN
KEYING PIN
KEYING PIN
KEYING PIN
KEYING PIN
KEYING PIN
KEYING PIN
KEYING PIN
KEYING PIN
KEYING PIN

FRONT PANEL
N.O. COM
P1 UP
P1 RIGHT
P1 DOWN
P1 LEFT
P2 UP
P2 RIGHT
P2 DOWN
P2 LEFT
1 PLR START
2 PLR START

P1 IS THE LEFT PLAYER FACING THE GAME.
P2 IS THE RIGHT PLAYER FACING THE GAME.

COIN MECH GND
S3 N.O. COM
S4 N.O. COM
BLUE
N.C. N.C.
S3, S4 ARE MOUNTED ON COIN MECH DOOR

VOLUME CONTROL
1 2 3

WHT (ANTENNA) N.C.
BLK
BRN
SPEAKER 8Ω 5"X 9"

N.C.
K.P.
POWER SUPPLY CONN

TRANSFORMER
120V ③ SMOOTH
100V ②
0V ① RIBBED
SHIELD GRN

POWER PLUG BACK VIEW

SMOOTH
RIBBED
TRIGGER START SINGLE 18 INCH FLUORESCENT LAMP
GRN

WHT
BLK
GRN

1 2 3 4 5 6
2 AMP SLO-BLO
N.C.
COM
N.O.
INTERLOCK SWITCH
POWER BOX

1 4 7 10
2 5 8 11
3 6 9 12
211-0025
19 INCH MONITOR

YEL TO TRANSFORMER PIN B
RED TO +5 END OF R28 ON POWER SUPPLY/AMP. BD

POWER INTERRUPT B07-0012
⑨ TO TP3 ON VIDEO LOGIC BD.
③ TO TP4 ON VIDEO LOGIC BD.

SHIELDED WIRE

NOTES:

1. THESE JUMPERS ALLOW MULTIPLE COIN OPITION. JUMPER ACCORDING TO TABLE BELOW

# COINS, PER GAME	JUMPER PINS
1	NO JUMPERS
2	16-17 ; 16-11
3	16-18 ; 16-11
4	16-17 ; 16-18

2. THIS JUMPER SETS GAME TIME 2 MINUTE GAME, JUMPER OUT 1 1/2 MINUTE GAME, JUMPER 34-31.
3. FREE GAME SELECT

NO FREE GAME	6-1
11,000	6-10
13,000	6-9
15,000	6-8
17,000	6-7

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

PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±
MATERIAL
FINISH
DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS	DATE
DRAWN LIPTAK L. J.	3/24/77
CHECKED	

NEXT ASSY | USED ON
APPLICATION

GREMLIN INDUSTRIES INC.
8401 AERO DR. SAN DIEGO, CA. 92123

SCHEMATIC — HUSTLE CABINET WIRING

SIZE D | CODE IDENT NO. | DRAWING NO. 713-0001
SCALE NONE | SHEET 3 OF 3

713-0001

CHASSIS 19VP111 23VP111 MODEL XM501-10 XM701-10

FILE VP12

MANUAL 68P65130A70-1

MOTOROLA

service manual

FILE VP12

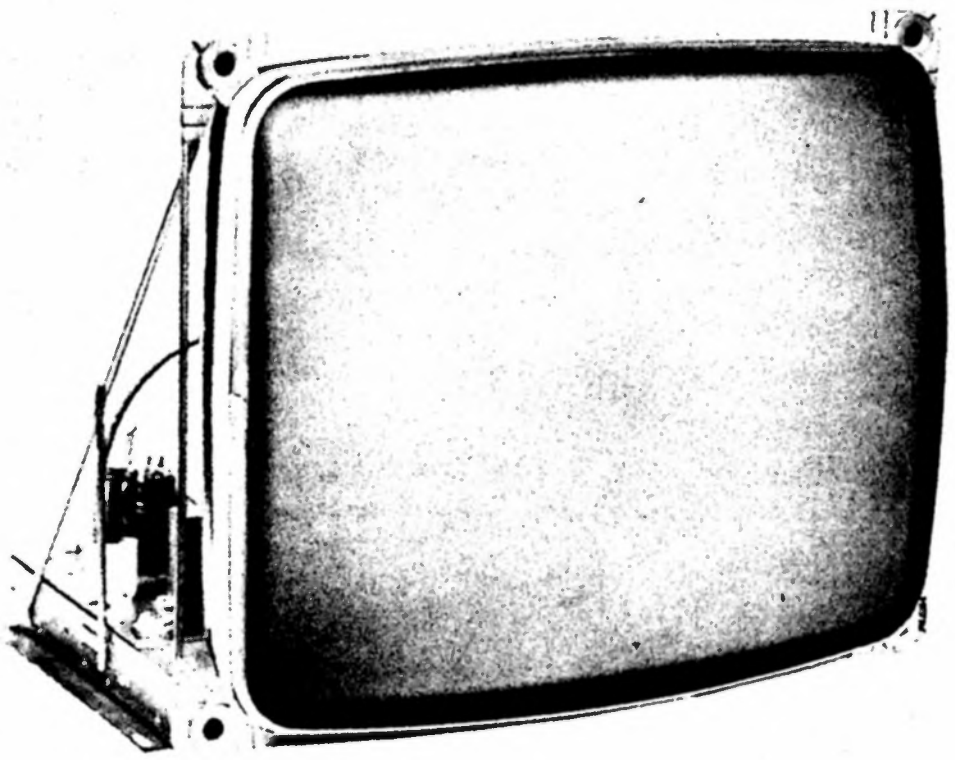
DISPLAY PRODUCTS

CHASSIS

19VP111
23VP111

MODELS

XM501-10
XM701-10



GENERAL INFORMATION

These models are transistorized monitors designed for the video game market. They are identical except for the CRT size. See V1 in Replacement Parts List.

Circuitry includes four stages of video amplification, a two stage audio amplifier, sync and deflection circuits and a regulated power supply. An additional 5 volt 3 amp supply is included to power external logic systems. The picture tube is a 114 degree deflection CRT with implosion protection. Composite video is fed to the monitor through a connector mounted on the rear of the chassis.

Rear panel controls include Horizontal Hold, Vertical Hold, Contrast, Brightness, Volume and width controls. Additional service controls are mounted on the plated circuit panel, and are accessible from the rear of the chassis.

The chassis utilizes plug-in etched panel construction with components mounted on the top side and plated wiring on the bottom. Component reference numbers and circuit legend are printed on the board to aid in servicing. Horizontal, vertical output and regulator transistors are mounted on the chassis base which also serves as a heat sink and CRT support.

CAUTION

NO WORK SHOULD BE ATTEMPTED ON ANY EXPOSED MONITOR CHASSIS BY ANYONE NOT FAMILIAR WITH SERVICING PROCEDURES AND PRECAUTIONS.

ELECTRICAL SPECIFICATIONS

Power Rating: 110 watts nominal.
50 watts without 5 volt supply.

Source: 120/240V AC at 50/60Hz
Switch selected.

Video Input: 0.5 to 2.5 volts composite PP (sync negative).

Audio Output: 5 watts peak

TABLE OF CONTENTS

MOTOROLA INC. *Display Products* CAROL STREAM, ILLINOIS 60187

PART NO. 68P65130A70-1 3-75 PRICE 80 CENTS PRINTED IN U.S.A.

SAFETY WARNING

CAUTION: NO WORK SHOULD BE ATTEMPTED ON AN EXPOSED MONITOR CHASSIS BY ANYONE NOT FAMILIAR WITH SERVICING PROCEDURES AND PRECAUTIONS.

1. SAFETY PROCEDURES should be developed by habit so that when the technician is rushed with repair work, he automatically takes precautions.

2. A GOOD PRACTICE, when working on any unit, is to first ground the chassis and to use only one hand when testing circuitry. This will avoid the possibility of carelessly putting one hand on chassis or ground and the other on an electrical connection which could cause a severe electrical shock.

3. Extreme care should be used in HANDLING THE PICTURE TUBE as rough handling may cause it to implode due to atmospheric pressure (14.7 lbs. per sq. in). Do not nick or scratch glass or subject it to any undue pressure in removal or installation. When handling, safety goggles and heavy gloves should be worn for protection. Discharge picture tube by shorting the anode connection to chassis ground (not cabinet or other mounting parts). When discharging, go from ground to anode or use a well insulated piece of wire. When servicing or repairing the monitor, if the cathode ray tube is replaced by a type of tube other than that specified under the Motorola Part Number as original equipment in this Service Manual, then avoid prolonged exposure at close range to unshielded areas of the cathode ray tube. Possible danger of personal injury from unnecessary exposure to X-ray radiation may result.

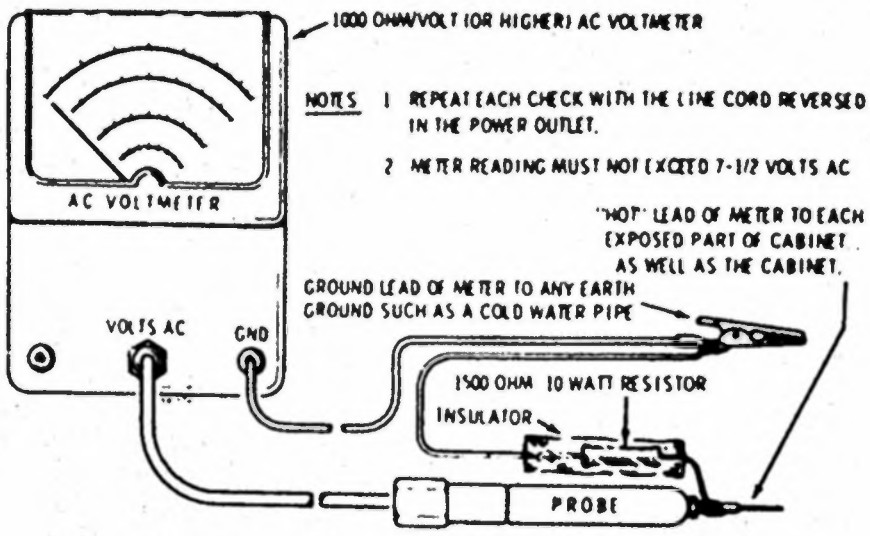
4. An ISOLATION TRANSFORMER should always be used during the servicing of a unit whose chassis is connected to one side of the power line. Use a transformer of adequate power rating as this protects the serviceman from accidents resulting in personal injury from electrical shocks. It will also protect the chassis and its components from being damaged by accidental shorts of the circuitry that may be inadvertently introduced during the service operation.

5. Always REPLACE PROTECTIVE DEVICES, such as fishpaper, isolation resistors and capacitors and shields after working on the unit.

6. If the HIGH VOLTAGE is adjustable, it should always be ADJUSTED to the level recommended by the manufacturer. If the voltage is increased above the normal setting, exposure to unnecessary X-ray radiation could result. High voltage can accurately be measured with a high voltage meter connected from the anode lead to chassis.

7. BEFORE RETURNING A SERVICED UNIT, the service technician must thoroughly test the unit to be certain that it is completely safe to operate without danger of electrical shock. DO NOT USE A LINE ISOLATION TRANSFORMER WHEN MAKING THIS TEST.

In addition to practicing the basic and fundamental electrical safety rules, the following test, which is related to the minimum safety requirements of the Underwriters Laboratories should be performed by the service technician before any unit which has been serviced is returned.



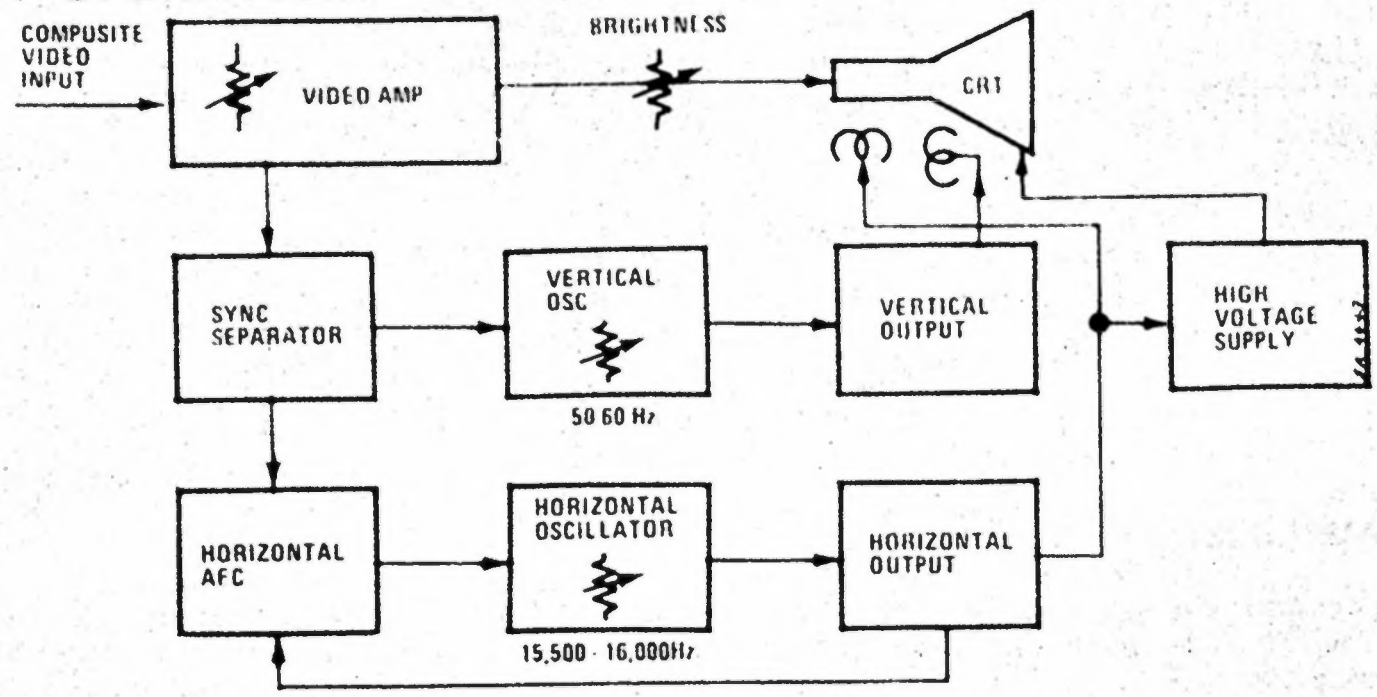
Voltmeter Hook-up for Safety Check.

A 1000 ohm per volt AC voltmeter is prepared by shunting it with a 1500 ohm, 10 watt resistor. The safety test is made by contacting one meter probe to any portion of the unit exposed to the operator such as the cabinet trim, hardware, controls, knobs, etc., while the other probe is held in contact with a good "earth" ground such as a cold water pipe.

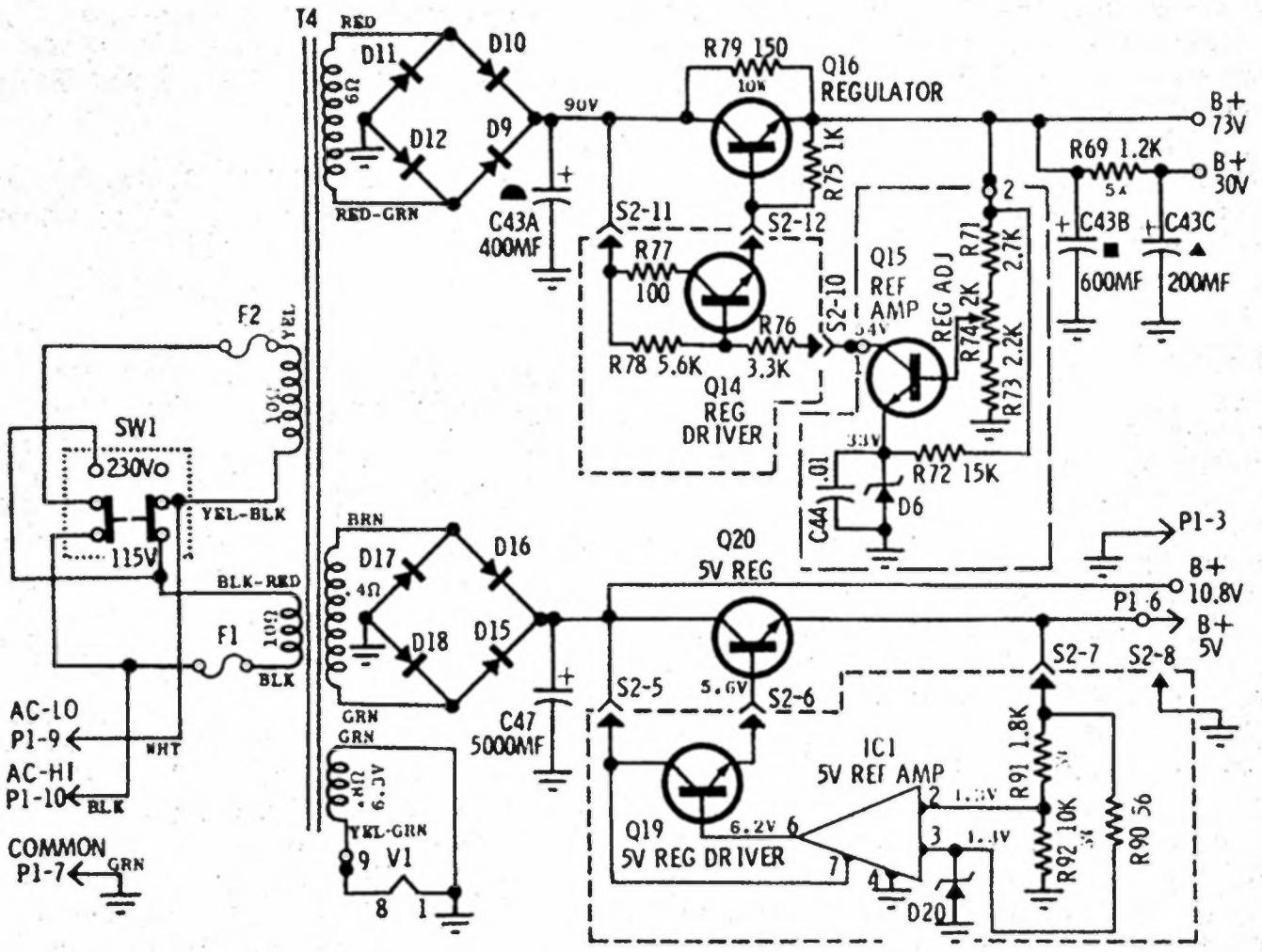
The AC voltage indicated by the meter may not exceed 7½ volts. A reading exceeding 7½ volts indicates that a potentially dangerous leakage path exists between the exposed portion of the unit and "earth" ground. Such a unit represents a potentially serious shock hazard to the operator.

The above test should be repeated with the power plug reversed, when applicable.

NEVER RETURN A MONITOR which does not pass the safety test until the fault has been located and corrected.



Block Diagram



POWER SUPPLY

The power supply is a transformer operated, full wave, regulated supply which maintains constant output voltage with input variations of ±15%. A switch (SW1) is provided to allow operation from 115/230 volts, 50/60Hz. The regulator is a series pass circuit. Q16 is the series pass transistor, Q15 the reference amplifier and Q14 the output driver.

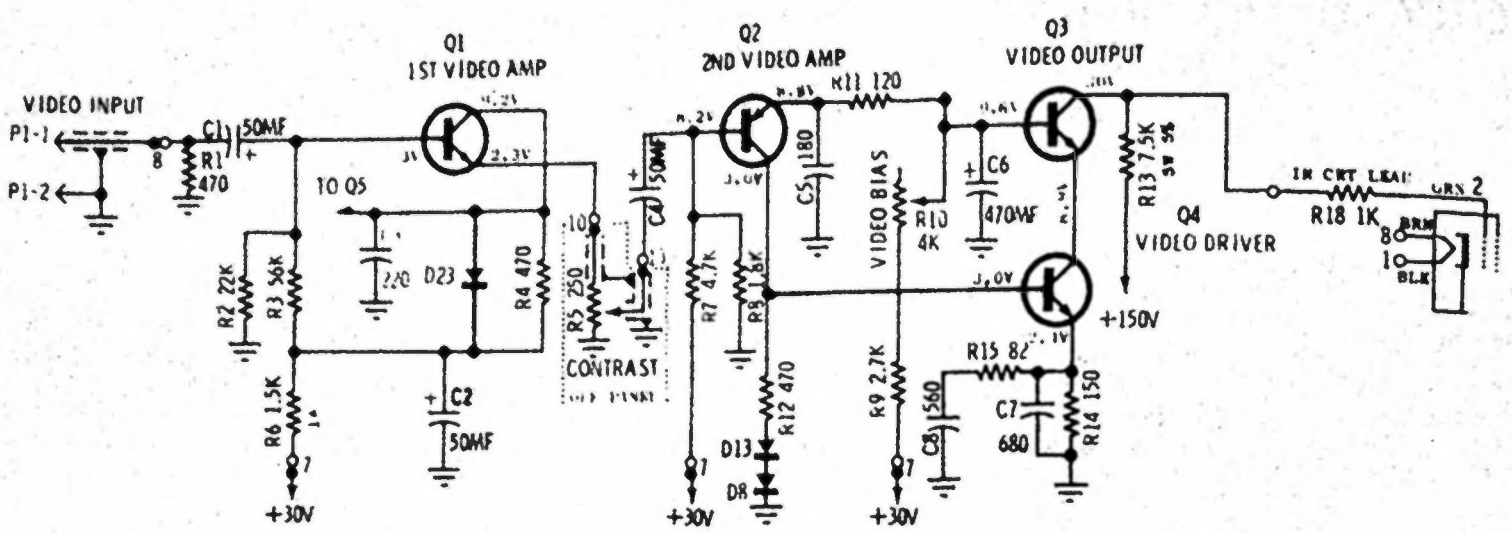
The output voltage of the regulator appears at the emitter of Q16. This voltage is divided between R71, R74 and R73. The voltage appearing on the arm of potentiometer R74 is a reference input to the base of Q15.

A temperature compensated zener diode (D6) is used to establish a fixed reference voltage at the emitter of Q15. R72 provides a bias current for D6, establishing its operating point.

An increase in output voltage will result in an increase of voltage at the base of Q15. Since the emitter of Q15 is held at a fixed reference voltage, the change in base voltage will turn Q15 on harder, reducing its collector voltage. This reduces forward bias for Q14 resulting in less emitter current and less base current for Q16. Q16 will conduct less, lowering the output voltage.

R79 provides a shunt current path for Q16 allowing it to run cooler, improving reliability. C44 is an RF noise filter.

A fixed, regulated 5V DC supply is used to power circuits external from the monitor. Its operation is similar to the 73V regulator except for the reference amplifier which is contained in the IC package.



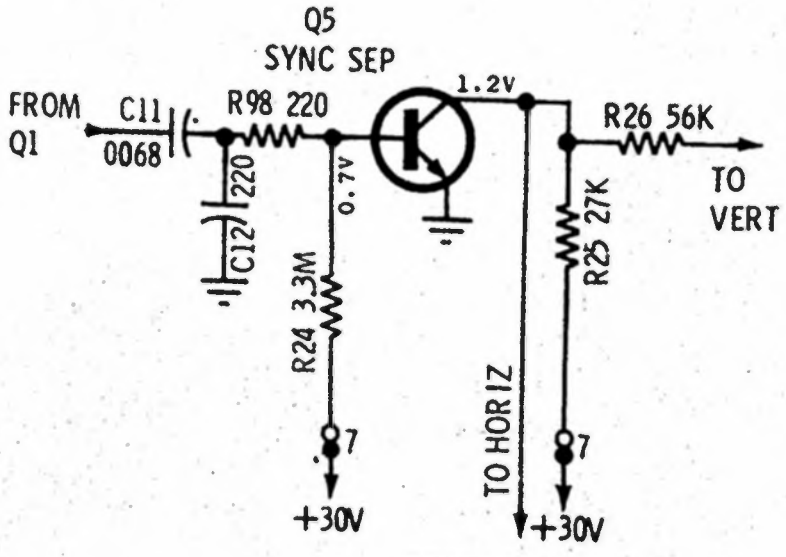
VIDEO AMPLIFIER

The video amplifier has four stages incorporating devices Q1, Q2, Q3 and Q4. The first stage, Q1, functions as an emitter follower. The low output impedance of the first stage permits use of a low resistance contrast control which furnishes flat video response over its entire range without the need for compensation. The collector output of Q1 is used to drive the sync separator. C3 provides high frequency roll off to limit the collector output to the bandwidth required to pass synchronization signals. Q2 is a common emitter stage and is directly coupled to Q4. Q3 and Q4 are connected in a cascode configuration. This common emitter-common base connection greatly reduces the effect of Miller capacity compared with a conventional single transistor video output stage. C6 provides a ground for video at the base of Q3, the grounded base transistor of the video output cascode pair. Diodes D13 and D8 provide temperature compensation for the video output stages, and diode D23 protects Q1 from transients.

The video bias control R10, is used to set the quiescent collector voltage of Q3. C5, C7, C8 and R15 are used for high frequency compensation. The video amplifier output is direct coupled to the control grid of the CRT through R18 which is used to isolate Q3 from transients that may occur as a result of CRT arcing.

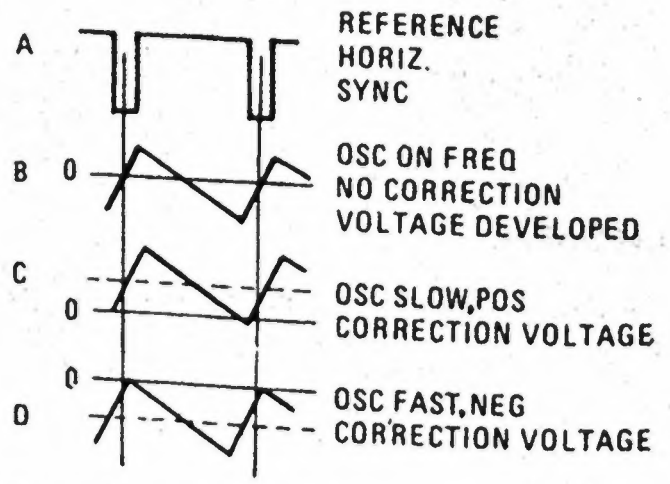
SYNC SEPARATOR

The sync separator employs a single stage, Q5, to recover sync from the composite video signal. A single stage sync separator is adequate due to the high impedance of the following stages. The video input to the sync separator is black positive. C11 is charged by the peak base current that flows when the positive peak of the input takes Q5 to saturation. This charge depends on the peak to peak input to Q5 and thus makes the bias for Q5 track the amplitude of the input signal. As a result Q5 amplifies only the positive peaks of the input signal. The initial bias current through R24 sets the clipping level. R98 is used for transient protection.



PHASE DETECTOR

The Phase Detector consists of two diodes in a keyed clamp circuit. Two inputs are required to generate the required output, one from the sync separator and one from the horizontal deflection system. The required output must be of the correct polarity and amplitude to correct phase differences between the input sync and the horizontal time base. The horizontal collector pulse is integrated into a sawtooth by R45 and C15. During sync time both diodes in D7 conduct, shorting C15 to ground.

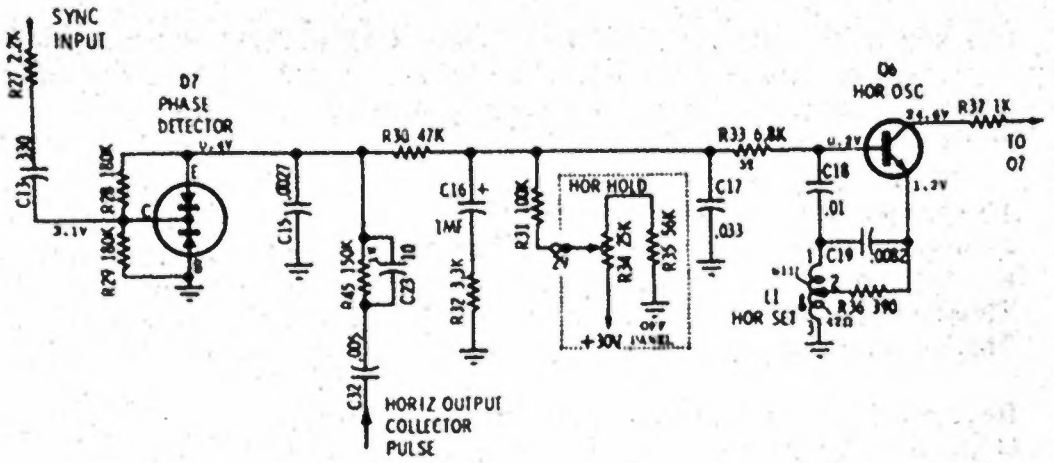


The sawtooth on C15 is thus clamped to ground at sync time. If the horizontal time base is in phase with the sync, the sync pulse will occur when the sawtooth is passing through its AC axis and the net charge on C15 will be zero. (Figure B). If the horizontal time base is lagging the sync, the sawtooth on C15 will be clamped to ground at a point negative from the AC axis. This will result in a positive DC charge on C15. (Figure C). This is the correct polarity to cause the horizontal oscillator to speed up to correct the phase lag.

Likewise, if the horizontal time base is leading the sync, the sawtooth on C15 will be clamped at a point positive from its AC axis, resulting in a net negative charge on C15 which is the required polarity to slow the horizontal oscillator (Figure D). R30, C17, C16 and R32 comprise the phase detector filter. The bandpass of this filter is chosen to provide correction of horizontal oscillator phase without ringing or hunting. Capacitor C23 times the phase detector for correct centering of the picture on the raster.

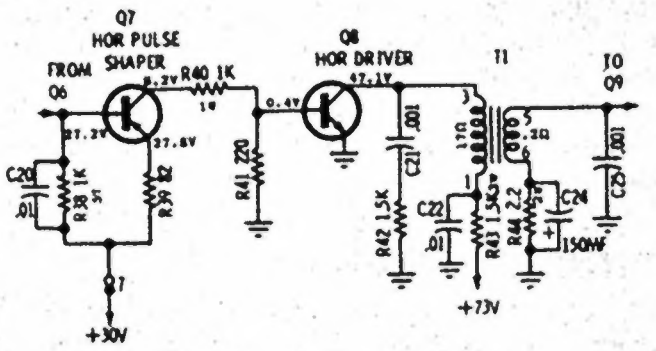
HORIZONTAL OSCILLATOR

Q6 is employed in a modified type of Hartley oscillator. The operating frequency of this oscillator is sensitive to its base input voltage. This permits control by the output of the phase detector and also by the setting of the horizontal hold control, R34. The horizontal hold range is set by adjustment of the core of L1.



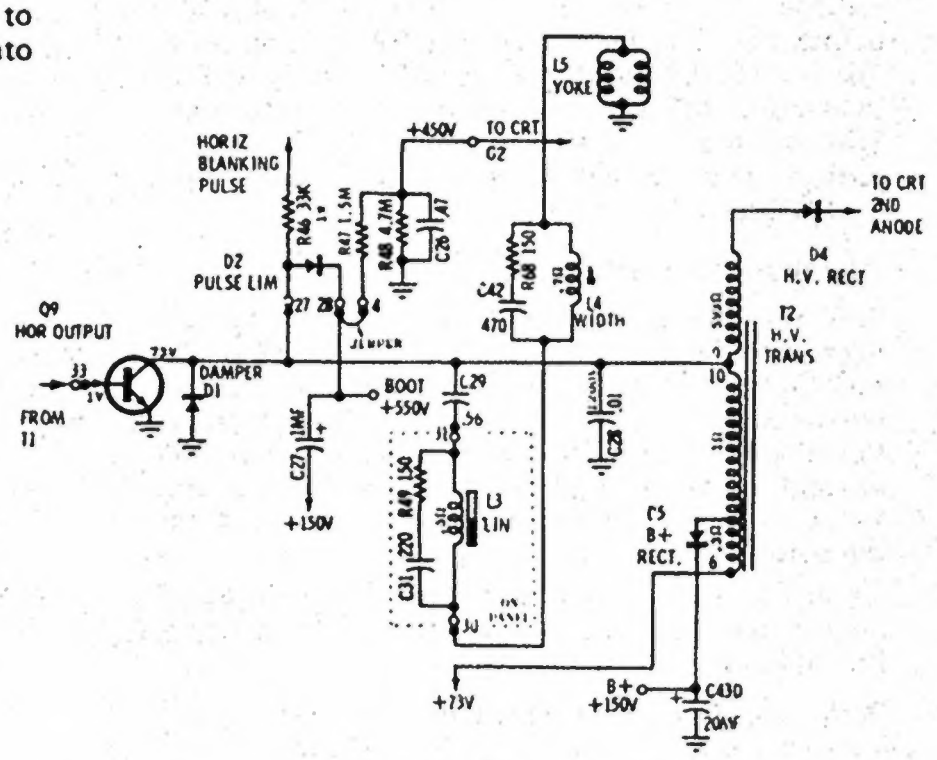
PULSE SHAPER & HORIZONTAL DRIVER

Q7 is used as a buffer stage between the horizontal oscillator and horizontal driver. It provides isolation for the horizontal oscillator as well as a low impedance drive for the horizontal driver. R38 and C20 form a time constant which shapes the oscillator output to the required duty cycle (approximately 50%), to drive the horizontal output circuitry. The horizontal driver stage, Q8 operates as a switch to drive the horizontal output transistor through T1. Because of the low impedance drive and fast switching times furnished by Q7, very little power is dissipated in Q8. C21 and R42 provide damping to suppress ringing of the primary of T2 when Q8 goes into cutoff.

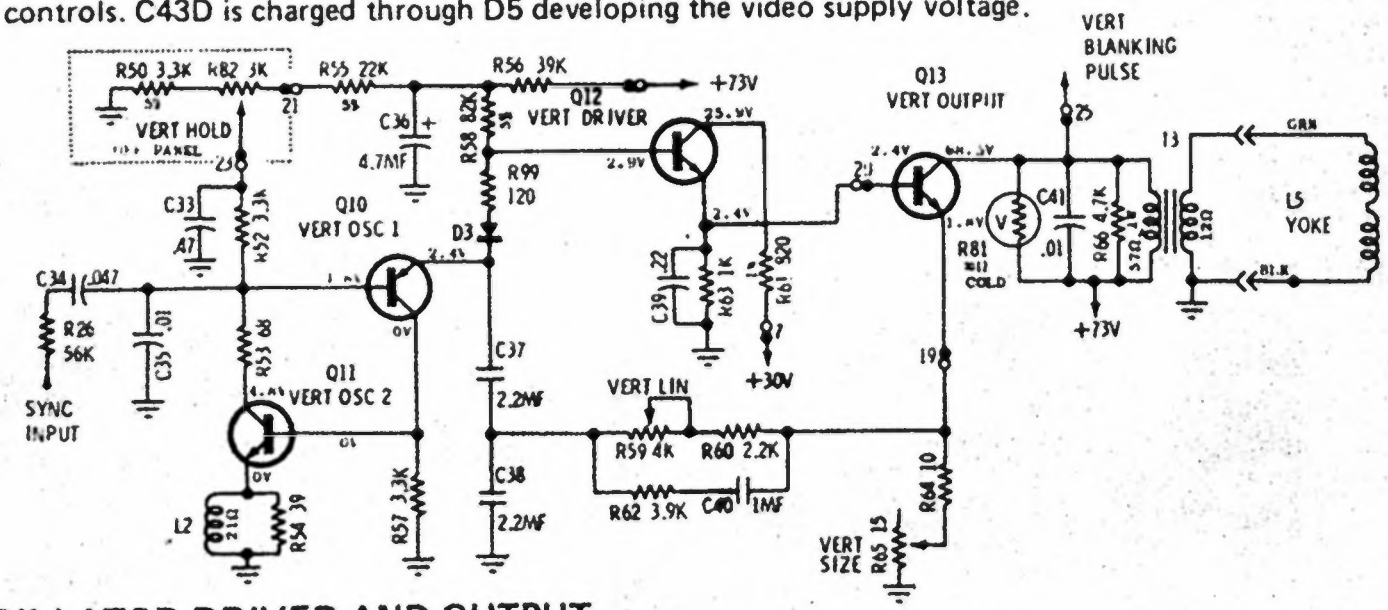


HORIZONTAL OUTPUT

The secondary of T1 provides the required low drive impedance for Q9. R44 and C24 form a time constant for fast turn-off of the base of Q9. Q9 operates as a switch which, once each horizontal period, connects the supply voltage across the parallel combination of the horizontal deflection yoke and the primary of T2. The required sawtooth of deflection current through the horizontal yoke is formed by the L-R time constant of the yoke and output transformer primary. The horizontal retrace pulse charges C27 through D2 to provide operating voltage for G2 of the CRT. Momentary transients at the collector of Q9, should they occur, are limited to the voltage on C27 since D2 will conduct if the collector voltage exceeds this value.



The damper diode, D1, conducts during the period between retrace and turn on of Q9. C28 is the retrace tuning capacitor. C29 blocks DC from the deflection yoke. L3 is a magnetically biased linearity coil which shapes deflection current for optimum trace linearity. L4 is a series width control. C31 and R49, C42 and R68 are damping network components for the linearity and width controls. C43D is charged through D5 developing the video supply voltage.



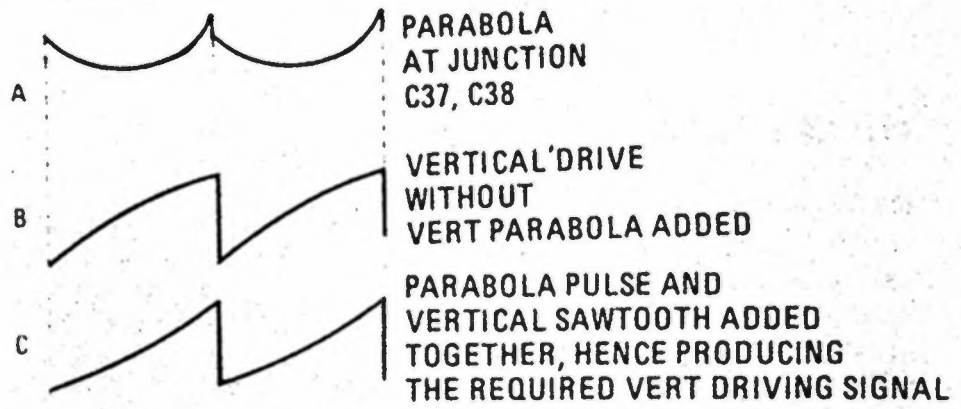
VERTICAL OSCILLATOR DRIVER AND OUTPUT

Sync from the collector of Q5 is integrated by R26 and C35. Q10 and Q11 are connected as a regenerative switch. The series combination of C37 and C38 charges through R58, R56 and D3 until Q10 turns on. This occurs when the emitter of Q10 exceeds its base voltage and causes current to flow into the base of Q11, turning that device on. When Q10 and Q11 conduct,

C37 and C38 are discharged to nearly zero. Q10 and Q11 then shut off and the cycle repeats. The setting of R82 determines the repetition rate of the charge and discharge of C37 and C38. The waveform generated is a positive going ramp or sawtooth with a fast retrace to zero. D3 provides a small incremental voltage above ground to overcome the forward sawtooth to a low impedance drive for Q13.

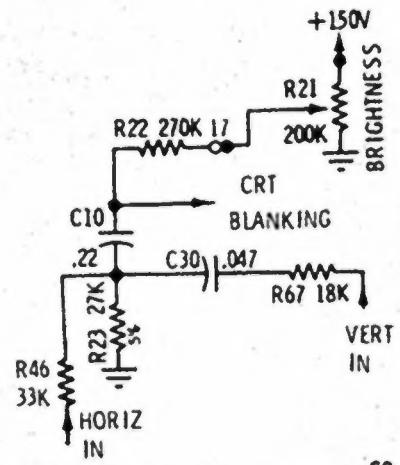
T3 matches the collector of Q13 to the vertical yoke. When Q13 is cut off during vertical retrace, a high voltage pulse is developed across the primary of T3. To limit this pulse to a safe value a varistor, R81, is connected across the primary. R66 and C41 provide damping to shape the collector pulse so it may be used for retrace blanking. Since the primary impedance of T3 decreases with current, the degree to which the primary shunts the reflected load impedance varies with collector current. This would result in severe vertical non-linearity unless some compensation is employed.

Resistors R59 and R60 couple the emitter voltage of Q13 to the junction of C37 and C38. Since this path is resistive, the waveform coupled back will be integrated into a parabola by C38. This results in a pre-distortion of the drive sawtooth as shown in Figure C. This is done to compensate for the non linear charging of C37 and C38 and the changing impedance of the primary of T3. An additional feedback path through R62 and C40 serves to optimize the drive waveshape for best linearity.



RETRACE BLANKING

Both vertical and horizontal retrace blanking are provided by positive pulses applied to the CRT cathode. The collector pulse from the horizontal output transistor is placed across R23 through R46. The vertical collector voltage is differentiated by C30 to remove the sawtooth portion of the waveform. The remaining pulse appears across R23. The mixed vertical and horizontal pulses on R23 are coupled to the CRT cathode by C10.

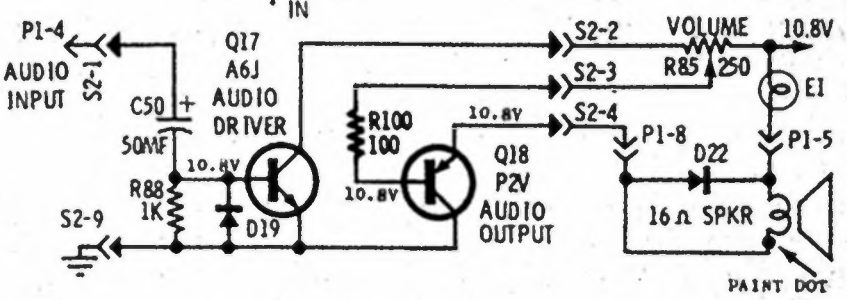


AUDIO AMPLIFIER

Q17 and Q18 form a DC coupled "switching tone burst amplifier". An input signal biases Q17 on, in turn driving Q18 into conduction. When the signal is removed both stages return to a quiescent mode. Coupling capacitor C50, diode D19 and resistor R88 establish a bias voltage which is signal dependent. Volume control R85 sets the peak to peak level for the output stage.

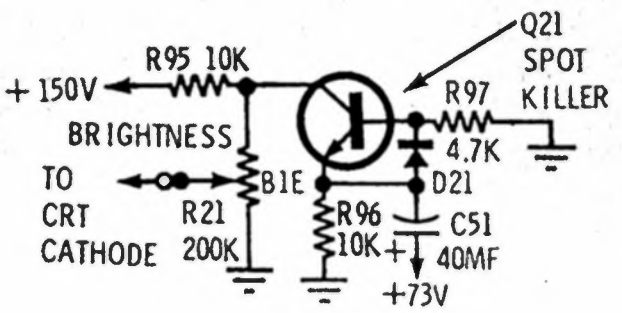
Lamp E1 serves to protect the speaker if the audio output transistor fails, it also protects the transistor should the speaker leads be shorted.

Diode D22 (on early models) polarizes the speaker insuring proper installation. If it is installed wrong, little or no audio will be developed.



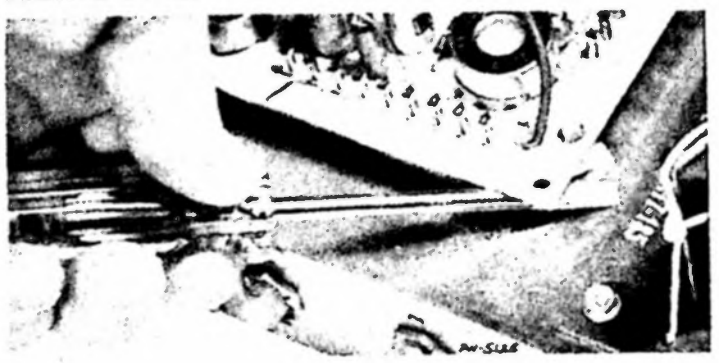
SPOT KILLER

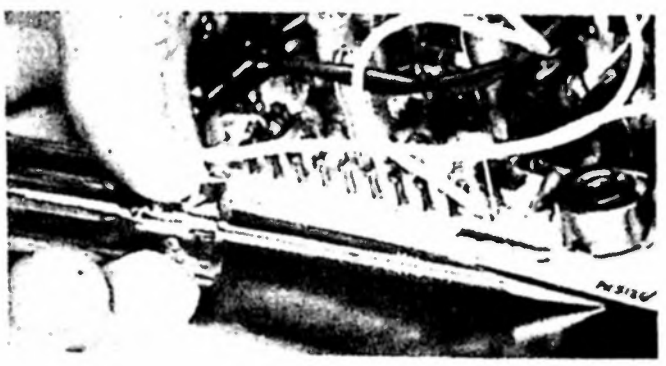
Normally Q21 is not conducting and capacitor C51 is charged to the supply voltage. When the monitor is turned off, C51 discharges through R96 turning the transistor on. It in turn removes the positive potential from the brightness control connecting the CRT cathode to ground, causing the tube to conduct hard, discharging the high voltage.



SERVICE NOTES

PANEL REMOVAL/INSTALLATION





To prevent damage to the board or foil when removing the circuit panel it may be necessary to pry up slowly, IN STAGES around the edges as shown. Start at one corner and move all around the board keeping the screw driver tip against the chassis. When installing, apply pressure at the edges near the pins. Do not force down on the components.

CIRCUIT TRACING

Component reference numbers are printed on top and bottom of the plug-in circuit board to facilitate circuit tracing. In addition, control names and board terminal numbers are also shown and are referenced on the chassis schematic diagram in this manual.

Transistor elements are identified as follows:

E – emitter, B – base, and C – collector.

COMPONENT REMOVAL

Removing components from the etched board is facilitated by the fact that the circuitry (plating) appears on one side of the board only and the component leads are inserted straight through the holes and are not bent or crimped.

It is recommended that a solder extracting gun be used to aid in component removal. An iron with a temperature controlled heating element would be desirable since it would reduce the possibility of damaging the board due to over-heating.

The nozzle of the soldering gun is inserted directly over the component lead and when sufficiently heated, the solder is drawn away leaving the lead free from the copper plating. This method is particularly suitable in removing multi-terminal components.

REGULATOR ADJUSTMENT

NOTE: Misadjustment of the low voltage regulator, or the horizontal oscillator may result in damage to the Horizontal Output Transistor or pulse limiter diode. The following procedures are recommended to insure reliable operation.

1. Connect monitor to AC line supply. Adjust supply to 120 volts (240 on some models).

2. Apply test signal to proper input. Signal should be of same amplitude and sync rate as when monitor is in service.

3. Adjust vertical and horizontal oscillator controls until display is synced.

4. Connect a DC digital voltmeter or other precision accuracy voltmeter to the emitter of the regulator output transistor, (or any 73 volt test point).

5. Adjust the regulator control R74, on circuit board for an output of 73 volts. **Do not "run" the regulator control through its range or damage to the monitor may result.**

6. When adjustment is complete, the AC line supply can be varied between 105 and 130 volts to check for proper regulator operation. With regulator operating properly, changes in display size should be negligible.

HORIZONTAL OSCILLATOR ADJUSTMENT

1. Set the horizontal hold potentiometer to mid-range (R34).

2. Adjust core of horizontal hold coil L1 until the horizontal blanking lines are vertical.

3. Rotate potentiometer R34 through its full range. Display should go out of sync in each direction and hold in sync at the center of its range. Retouch L1 as necessary to center the hold range.

VIDEO AMPLIFIER BIAS ADJUSTMENT

Adjust video bias control R10 for 30 volts DC on collector of video output transistor Q3 with no signal input.

Disconnect cable from video input jack if necessary to eliminate noise.

POWER TRANSISTOR REPLACEMENT

When replacing any "plug-in" transistor, i.e., the horizontal or vertical output, please observe the following precautions:

1. The transistor sockets are not "Captive", that is, the transistor mounting screws also secure the socket. When installing the transistor, the socket must be held in its proper location. This location is indicated by flanges on the socket which fit into the heat sink.

2. When replacing the output transistors, silicone grease (Motorola Part No. 11M490487) should be applied evenly to both sides of the mica insulator.

3. All transistor mounting screws must be tight before applying power to the receiver. This insures proper cooling and electrical connections.

NON-COMPLIANCE WITH THESE INSTRUCTIONS CAN RESULT IN FAILURE OF THE TRANSISTOR AND/OR ITS RELATED COMPONENTS.

NOTE: Use caution when tightening transistor mounting screws. If the screw threads are stripped by excessive pressure, a poor electrical and mechanical connection will result.

CRT REPLACEMENT

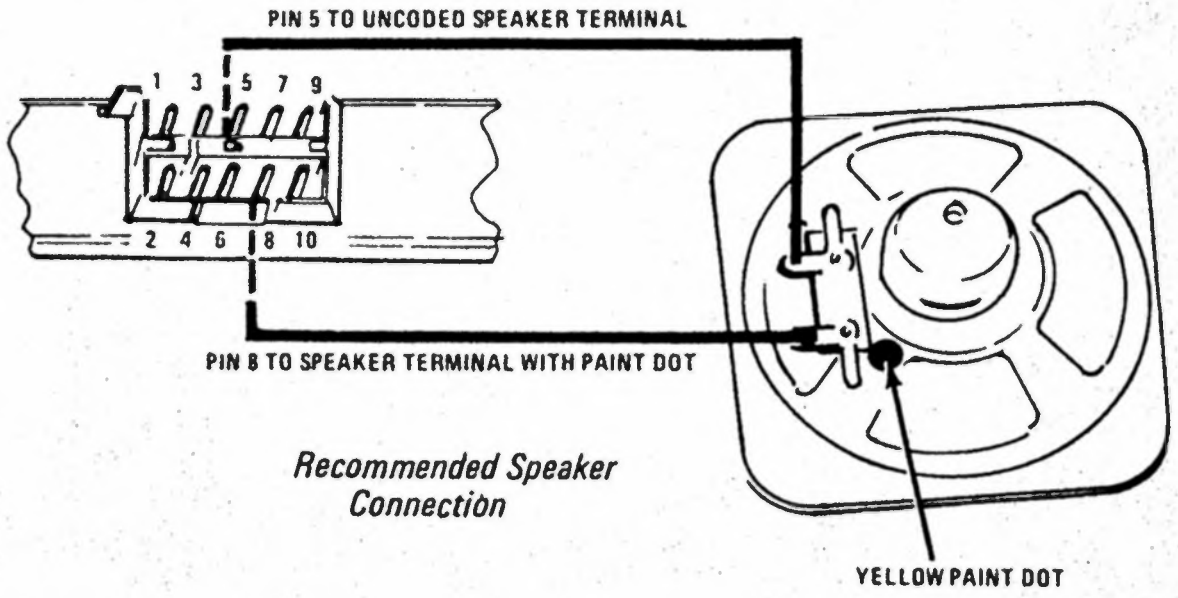
Use extreme care in handling the CRT as rough handling may cause it to implode due to atmospheric pressure. Do not nick or scratch glass or subject it to any undue pressure in removal or installation. Use goggles and heavy gloves for protection.

1. Discharge CRT by shorting 2nd anode to ground. Remove CRT socket, yoke and 2nd anode lead.

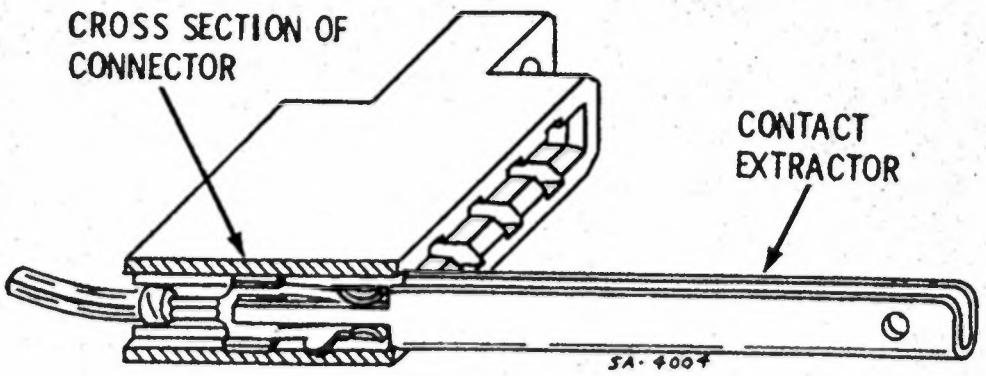
2. Remove CRT from chassis by removing four screws at corners.

PANEL CONNECTOR CONTACT REMOVAL

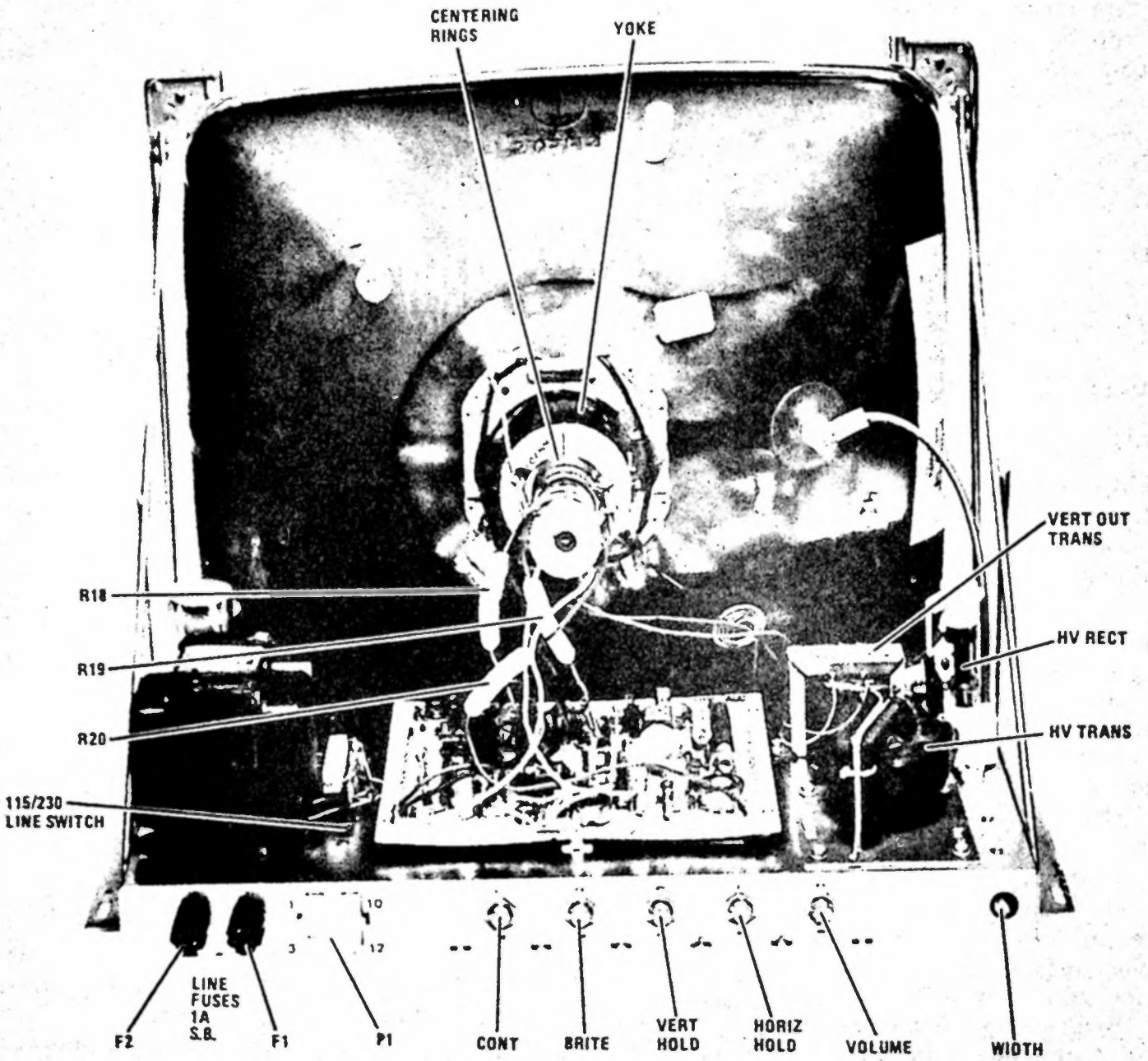
Contacts can be removed from the mulitpin panel connector by using extractor tool, Part No. 66P65173A47. Insert the tool over contact and seat fully. Tool will release contact. Pull contact out from wired side.



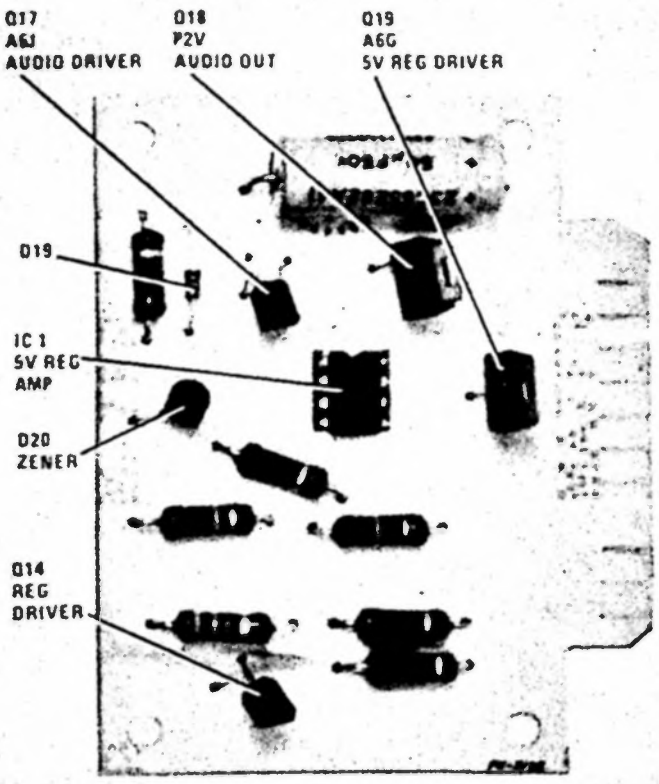
Recommended Speaker Connection



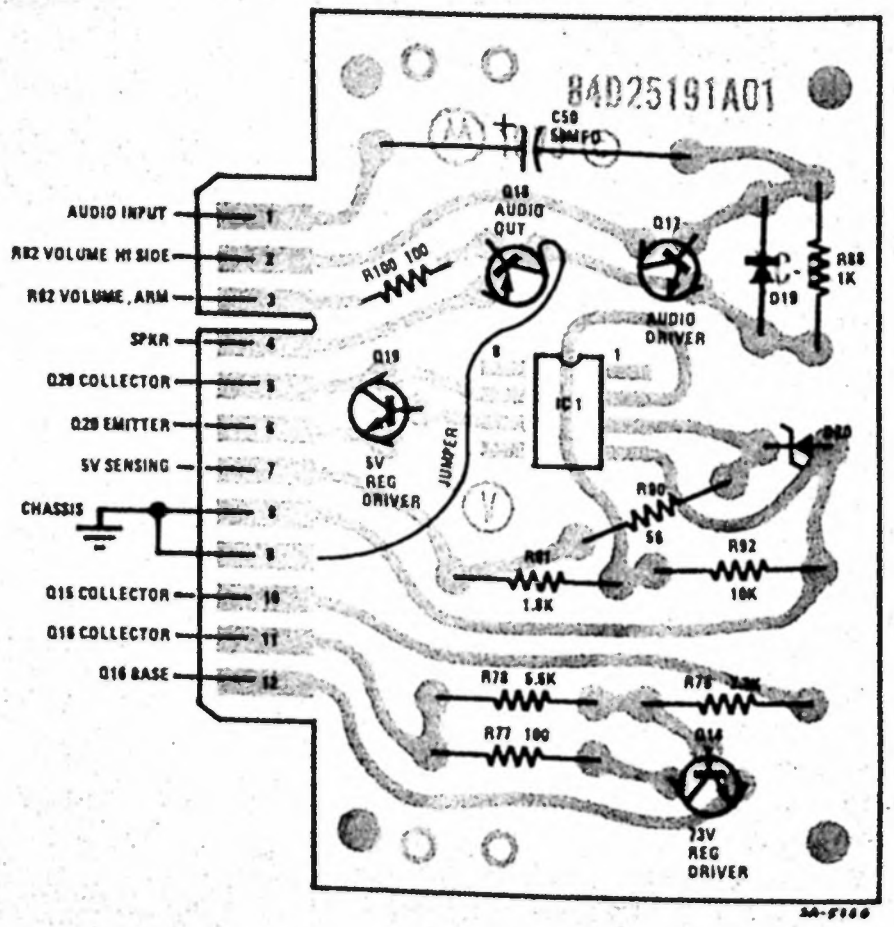
Edge Connector Contact Removal



Chassis Component Location Rear View

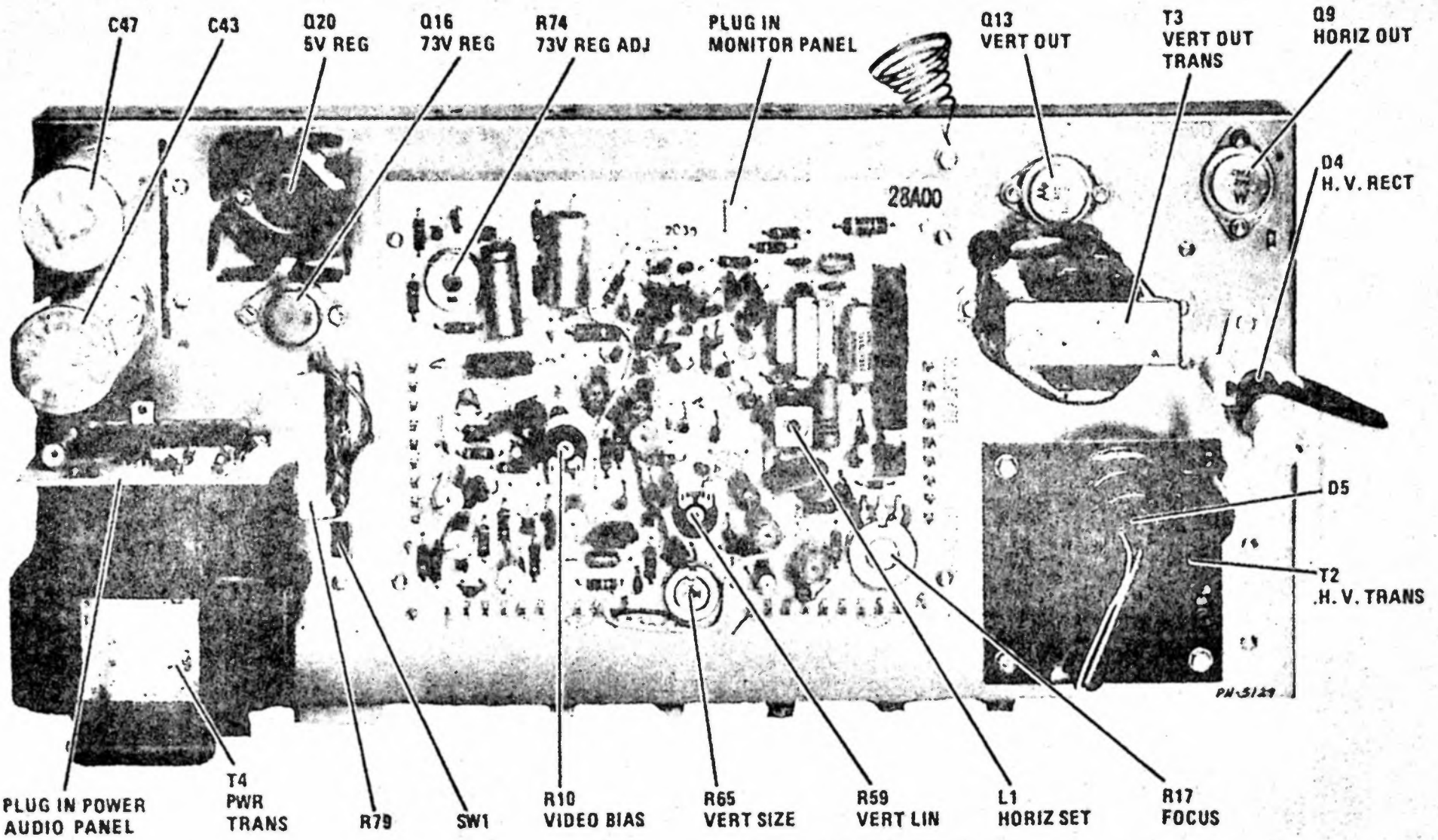


Top View

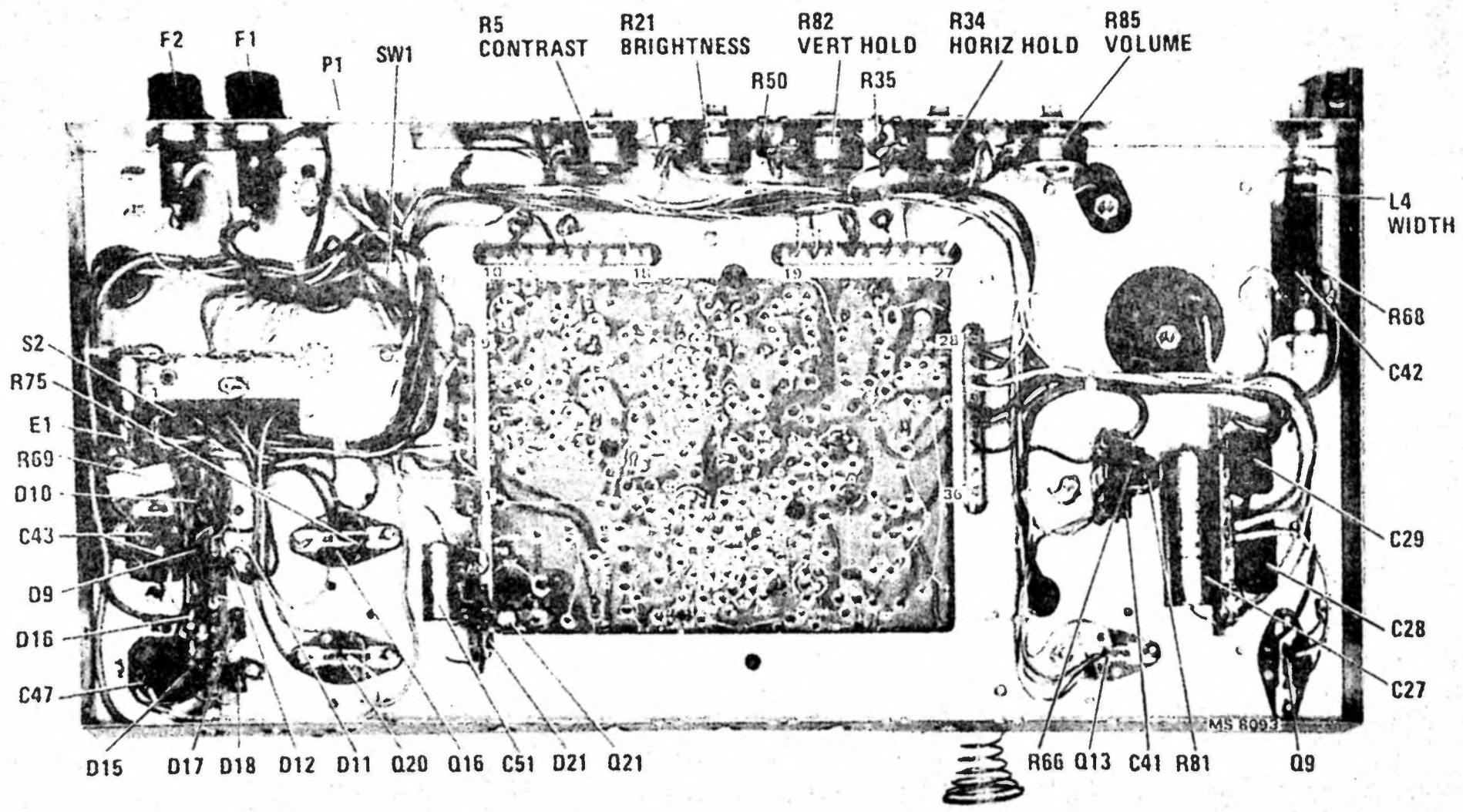


Circuit Side

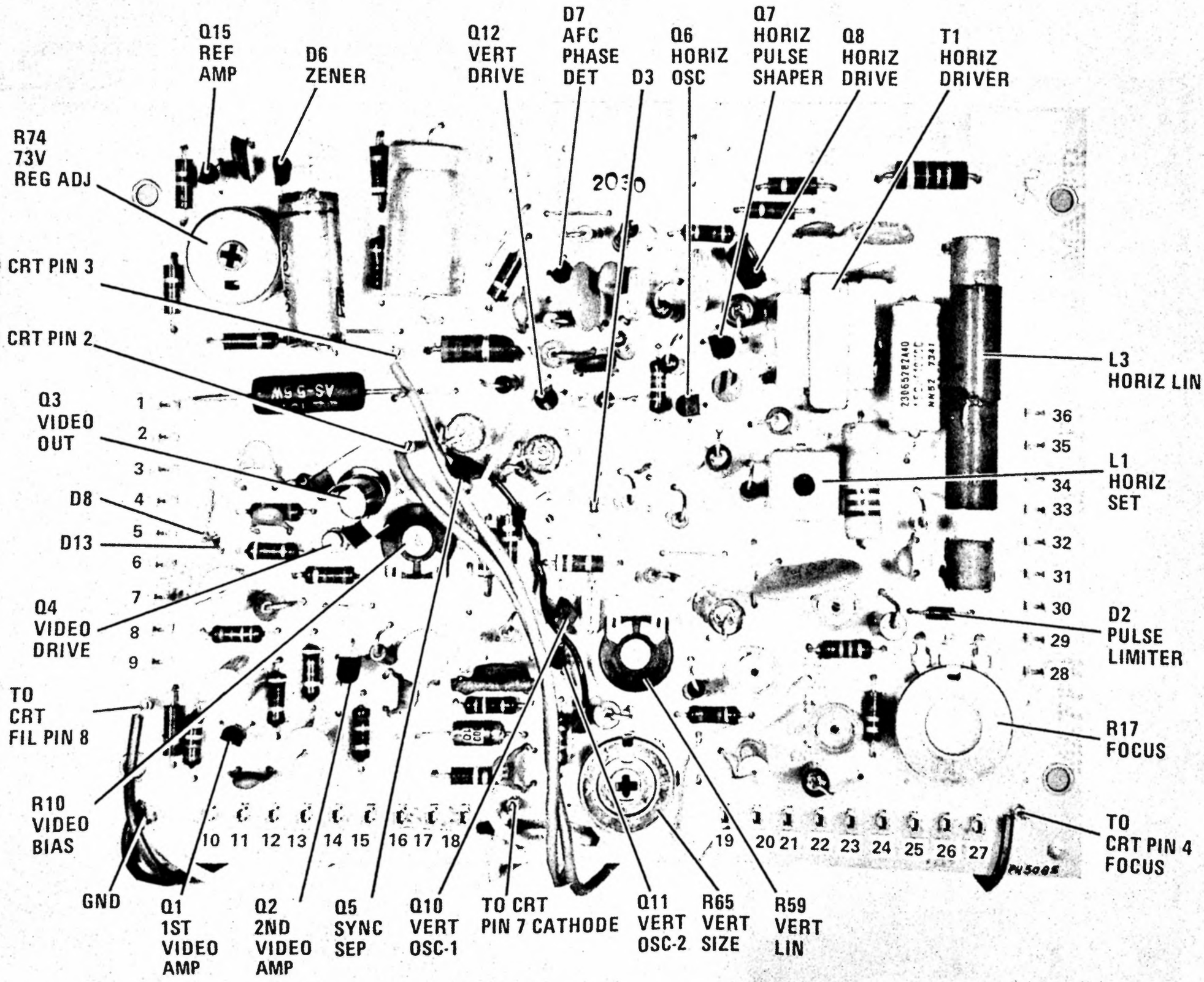
Power, Audio Panel Component Location



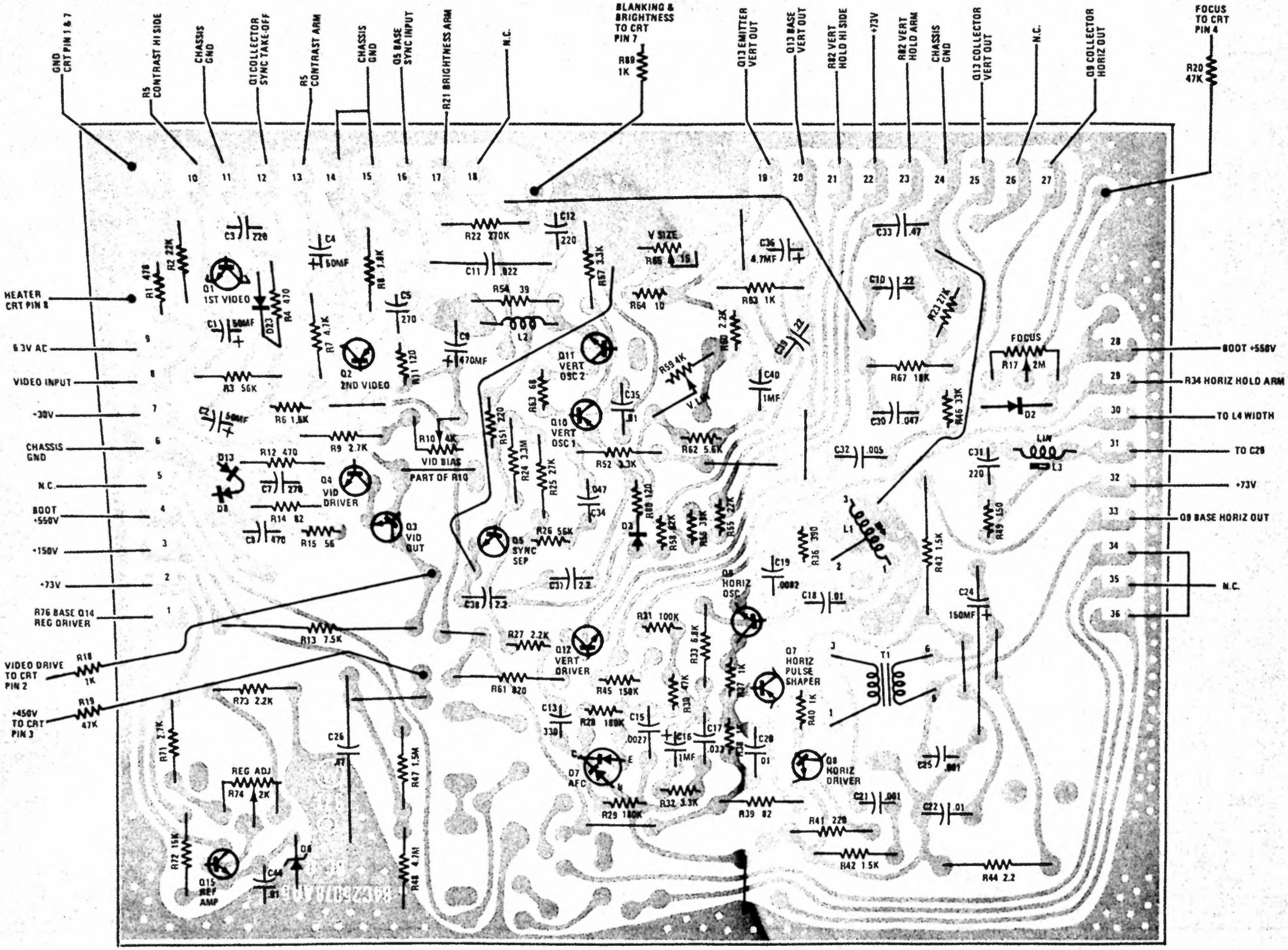
Chassis Component Location Top View



Chassis Component Location Bottom View



Monitor Panel — Component Side



Monitor Panel — Circuit Side

NOTES:
1. VOLTAGES VARY WITH ASSOCIATED CONTROL SETTING. LINE VOLTAGE MAINTAINED AT 120V AC.
2. ALL VOLTAGES ± 10% AS MEASURED FROM POINT INDICATED TO CHASSIS USING A HIGH IMPEDANCE VTVM, NO SIGNAL INPUT. CONTRAST & BRIGHTNESS CONTROLS AT MAXIMUM. ALL OTHER CONTROLS IN NORMAL OPERATING POSITION.

WAVEFORM MEASUREMENTS
1. TAKEN FROM POINT INDICATED TO CHASSIS WITH A WIDE-BAND OSCILLOSCOPE SYNCED NEAR SWEEP RATE INDICATED. INPUT SIGNAL .5V PP. CONTRAST & BRIGHTNESS CONTROLS AT MAXIMUM. ALL OTHER CONTROLS IN NORMAL OPERATING POSITION.

——— & ------ INDICATES PRINTED CIRCUIT BOARDS.

UNLESS OTHERWISE SPECIFIED:
CAPACITOR DECIMAL VALUE IN MF. ALL OTHERS PF. CAPACITANCE VALUES ONLY ARE SHOWN ON SCHEMATIC DIAGRAM. FOR COMPLETE DESCRIPTION REFER TO PARTS LIST.
RESISTORS ARE 10%, 1/2W.

Q3, Q4

Q8, Q18, Q19

Q9, Q13, Q16

ALL OTHERS

S2 EDGE CONNECTOR

P1

Schematic Diagram

REPLACEMENT PARTS LIST

ELECTRICAL PARTS

REF NO	PART NUMBER	DESCRIPTION
	1Y25017A01	MONITOR PANEL: complete; KT364LM
	1Y25017A02	POWER, Audio Panel: complete: KT365LM

CAPACITORS

REF NO	PART NUMBER	DESCRIPTION
C 1	23C65282A41	50 mf 50V Lytic
C 2	23C65282A41	50 mf 50V Lytic
C 3	21S180D10	220 pf 20% 100V X5F (Use 21R132503)
C 4	23C65282A41	50 mf 50V Lytic
C 5	21S180B98	180 pf 10% 500V X5F
C 6	23S10255A78	470 mf 16V Lytic
C 7	21S180C01	680 pf 10% 500V X5F
C 8	21S180B85	560 pf 10% 500V X5F
C 10	8S10191B67	.22 mf 10% 250V Polyester
C 11	8S10191A54	.0068 mf 10% 160V Polyester
C 12	21S180D10	220 pf 20% 100V X5F (Use 21R132503)
C 13	21S131625	330 pf 10% X5F
C 15	21S180C41	.0027 mf 10% 500V Z5F (Use 21K121699)
C 16	23S10229A07	1.0 mf +40- 20% 15V Lytic (Use 23C43280A17)
C 17	8S10191B90	.033 mf 10% 160V Polyester
C 18	8S10299A73	.01 mf 10% 100V Poly carb
C 19	8S10299A74	.0082 mf 10% 160V Poly carb
C 20	8S10191B98	.01 mf 10% 250V Polyester
C 21	21S180B51	.001 mf 10% 500V X5F
C 22	8S10191B98	.01 mf 10% 160V Polyester
C 23	21S180C02	10 pf 10% N150
C 24	23D65282A40	150 mf 10V Lytic
C 25	21S180B51	.001 mf 10% 500V X5F
C 26	8S10212B53	.47 mf 10% 630V Mtlz Poly
C 27	8S10212A11	1.0 mf 10% 630V Mtlz Poly
C 28	8S10571A06	.01 mf 5% 1200V Poly Prop Foil
C 29	8S10571A23	.56 mf 10% 250V Prop Foil
C 30	8S10191A32	.047 mf 10% 250V Polyester
C 31	21S180B87	220 pf 10% 500V X5F
C32	21S180D34	.005 mf 20% 1KV Z5F (Use 21S180D31)
C 33	8S10212A69	.47 mf 10% 100V Mtlz Poly
C 34	8S10191A32	.047 10% 250V Polyester
C 35	8S10191B98	.01 mf 10% 250V Polyester
C 36	23S10255A69	4.7 mf 100V Lytic
C 37	8S10212A20	2.2 mf 10% 100V Mtzl Poly
C 38	8S10212A20	2.2 mf 10% 100V Mtlz Poly
C 39	8S10191B67	.22 mf 10% 250V Polyester
C 40	8S10212A10	1.0 mf 10% 100V Mtlz Poly (Use 8S10191A46
C 41	8S10064A06	.01 mf 10% 600V Mylar
C 42	21S180A71	470 pf 10% 500V X5F
C43	23C65807A47	400 mf 125V; 600 mf/50V; 20 mf/200V Lytic
C 44	21S180E60	.01 mf +80–20% 50V Z5V
C 47	*23C65807A52	5000 mf 20V Lytic
C 50	23D65282A41	50 mf 50V Lytic
C 51	23S10255B43	40 mf 100V Lytic

DIODES & RECTIFIERS

REF NO	PART NUMBER	DESCRIPTION
D 1	48S134921	DIODE, Silicon: D1D; Damper
D 2	48S134978	DIODE, Silicon: D1K; Pulse Limiter
D 3	48D67120A11	DIODE, Low Power
D 4	48S137114	RECTIFIER, H. V.: Silicon; D2Y
D 5	48S191A05	RECTIFIER, Silicon: 91A05 (Use 48S191A07)
D 6	48S137469	DIODE, Silicon: zener; D7G
D 7	48S134917	DIODE, Dual: D1C; Detector
D 8	48S67120A11	DIODE, Low Power
D 9	*48S191A07	RECTIFIER, Silicon: 91A07
D 10	48S191A07	RECTIFIER, Silicon: 91A07
D 11	48S191A07	RECTIFIER, Silicon: 91A07
D 12	48S191A07	RECTIFIER, Silicon: 91A07
D 13	48D67120A11	DIODE, Low Power
D 15	48S191A10	RECTIFIER, Silicon: 91A10
D 16	48S191A10	RECTIFIER, Silicon: 91A10
D 17	48S191A10	RECTIFIER, Silicon: 91A10
D 18	48S191A10	RECTIFIER, Silicon: 91A10
D 19	48D67120A11	DIODE, Low Power
D 20	*48S10641D43	DIODE, Silicon, D4.3
D 21	48D67120A11	DIODE, Low Power
D 23	48S191A05	RECTIFIER, Silicon: (Use 48S191A07)

FUSES

REF NO	PART NUMBER	DESCRIPTION
F 1	6S139424	FUSE: 1A 250V
F 2	6S139424	FUSE: 1A 250V

INTEGRATED CIRCUITS

REF NO	PART NUMBER	DESCRIPTION
IC 1	*51S10732A01	INTEGRATED CIRCUIT: T3F

COILS & CHOKES

REF NO	PART NUMBER	DESCRIPTION
L 1	24D68822A08	HORIZ SET
L 2	24D68801A67	COMPENSATING: 2000 uh
L 3	24D69163A18	HORIZ LINEARITY
L 4	24V25000A74	HORIZ WIDTH. incls C42 & R68
L 5	24D68523A15	DEFLECTION YOKE

TRANSISTORS

REF NO	PART NUMBER	DESCRIPTION
Q 1	48S137171	1st VIDEO: A6H
Q 2	48S137127	2nd VIDEO: P2S
Q 3	48S134919	VIDEO OUTPUT: A1M
Q 4	48S137317	VIDEO DRIVER: A8H
Q 5	48S137115	SYNC SEPERATOR: A5U
Q 6	48S137172	HORIZ OSCILLATOR: A6J
Q 7	48S137127	HORIZ PULSE SHAPER: P2S
Q 8	48S137093	HORIZ DRIVER: A5F
Q 9	48S137570	HORIZ OUTPUT: B2L
Q 10	48S137173	VERT OSCILLATOR (1): P2W
Q 11	48S137171	VERT OSCILLATOR (2): A6H
Q 12	48S137115	VERT DRIVER: A5U
Q 13	48S134900	VERT OUTPUT: A1C
Q 14	48S134952	REGULATOR DRIVER; A2J
Q 15	48S137574	REFERENCE AMP: B2N
Q 16	48S137368	REGULATOR: A8W
Q 17	48S137172	AUDIO DRIVER: A6J
Q 18	48S137168	AUDIO OUTPUT: P2V
Q 19	48S137169	5V REGULATOR, Driver: A6G
Q 20	48S137344	5V REGULATOR: A8U
Q 21	48S137476	SPOT KILLER: B1E

CONTROLS

REF NO	PART NUMBER	DESCRIPTION
R 5	18D68222A34	CONTRAST: 250 Ohm
R 10	18D66401A44	VIDEO BIAS: 4K
R 17	18D67858A12	FOCUS: 2 meg
R 21	18D68222A35	BRIGHTNESS: 200K
R 34	18D68222A37	HORIZ HOLD: 25K
R 59	18D66401A44	VERT LINEARITY: 4K
R 65	18D67671A18	VERT SIZE: 15 Ohm
R 74	17D65820A37	REGULATOR ADJUST: 2K
R 82	18D68222A36	VERT HOLD: 3K
R 85	18D68222A34	VOLUME: 250 Ohm

RESISTORS

REF NO	PART NUMBER	DESCRIPTION
R 1	6S127633	470 10% 1/2W
R 2	6S125568	22K 10% 1/2W
R 3	6S127541	56K 10% 1/2W
R 4	6S127633	470 10% 1/2W
R 6	6S128955	1500 10% 1W
R 7	6S121847	4700 10% 1/2W
R 8	6S122445	1800 10% 1/2W
R 9	6S119926	2700 10% 1/2W
R 11	6S128226	120 10% 1/2W
R 12	6S127633	470 10% 1/2W
R 13	17S10731A02	7500 5% 5W WW
R 14	6S124797	150 10% 1/2W
R 15	6S127516	82 10% 1/2W
R 18	- - - -	Part of CRT socket assembly
R 19	- - -	Part of CRT socket assembly
R 20	- - -	Part of CRT socket assembly
R 22	6S129296	270K 10% 1/2W
R 23	6S10053C67	27K 5% 1/2W
R 24	6S127538	3.3 meg 10% 1/2W
R 25	6S121300	27K 10% 1/2W
R 26	6S127541	56K 10% 1/2W
R 27	6S129875	2200 10% 1/2W
R 28	6S125531	180K 10% 1/2W
R 29	6S125531	180K 10% 1/2W
R 30	6S125892	47K 10% 1/2W
R 31	6S125534	100K 10% 1/2W
R 32	6S124506	3300 10% 1/2W
R 33	6S10053C53	6800 5% 1/2W
R 35	6S127541	56K 10% 1/2W
R 36	6S125545	390 10% 1/2W
R 37	6S121301	1000 10% 1/2W
R 38	6S10053C33	1000 5% 1/2W
R 39	6S127516	82 10% 1/2W
R 40	6S127547	1000 10% 1W
R 41	6S127009	220 10% 1/2W
R 42	6S127513	1500 10% 1/2W
R 43	17S10130B07	1500 10% 3W fxd mtl film
R 44	17S744356	2.2 10% 2W WW
R 45	6S120141	150K 10% 1W
R 46	6S127634	33K 10% 1W
R 47	6S129417	1.5 MEG 10% 1/2W
R 48	6S10053D21	4.7 meg 10% 1/2W
R 49	6S124797	150 10% 1/2W
R 50	6S10053C45	3300 5% 1/2W
R 52	6S124506	3300 10% 1/2W
R 53	6S129874	68 10% 1/2W
R 54	6S131972	39 10% 1/2W
R 55	6S10053C65	22K 5% 1/2W
R 56	6S125535	39K 10% 1/2W
R 57	6S124506	3300 10% 1/2W
R 58	6S129793	82K 5% 1/2W
R 60	6S129875	2200 10% 1/2W
R 61	6S10053F29	820 10% 1W
R 62	6S127515	3900 10% 1/2W

REPLACEMENT PARTS LIST

REF. NO.	PART NUMBER	DESCRIPTION
R-63	6S121301	1000 10% 1/2W
R-64	17S10130C91	10 10% 1/2W (special)
R-66	6S129064	4700 10% 1W
R-67	6S122848	18K 10% 1/2W
R-68	6S124797	150 10% 1/2W
R-69	17S647132	1200 10% 5W WW (Use 17S136197)
R-71	6S119926	2700 10% 1/2W
R-72	6S124551	15K 10% 1/2W
R-73	6S129875	2200 10% 1/2W
R-75	6S121301	1000 10% 1/2W
R-76	6S124506	3300 10% 1/2W
R-77	6S129221	100 10% 1/2W
R-78	6S127005	5600 10% 1/2W
R-79	17S135589	150 10% 10W WW
R-81	6C66263A08	VARISTOR (Use 6S66263A16)
R-88	6S121301	1000 10% 1/2W
R-89	- - - -	Part of CRT Socket
R-90	6S131412	56 10% 1/2W
R-91	6S10053C39	1800 5% 1/2W
R-92	6S10053C57	10K 5% 1/2W
R-95	6S119932	10K 10% 1/2W
R-96	6S119932	10K 10% 1/2W
R-97	6S121847	4700 10% 1/2W
R-98	6S127099	220 10% 1/2W
R-99	6S128226	120 10% 1/2W
R-100	6S129221	100 10% 1/4W
SWITCHES		
SW-1	40S10624A01	SWITCH, Slide: DPDT (115V–230V)
TRANSFORMERS		
T-1	25D67440A03	HORIZ DRIVER
T-2	24D25240A04	H.V. TRANSFORMER: complete
T-3	25D25221A07	VERT OUTPUT
T-4	*25D68164A31	POWER
MISCELLANEOUS ELECTRICAL PARTS		
V-1	20WP4	CRT (XM501-10 19VP111)
	23JEP4	CRT (XM701-10 23VP111)
	50D68164A27	SPEAKER: 4" PM
E-1	65S139451	LAMP: No. 1436

MECHANICAL PARTS

	9D66133A28	CAP, SS Rect (HV Transformer – PRI/SEC lead)
	42B25158A01	CLAMP, Metal : Defl Yoke Mtg
	31D70080B04	CONNECTOR, PC panel: 9 contact; on chassis
S-2	*15S10390A06	CONNECTOR, PC panel: 12 contact; less key and contacts (power audio panel)
P-1	*15S10183A69	CONNECTOR, Plug: 12 contact; less contacts (power)
	*39S10184A63	CONTACT, Plug: for power connector 15S10183A69
	39S10184A22	CONTACT: for S2 connector
	15S10630A01	COVER, nylon: slide switch; SW1
	*7S10609A03	GROMMET, Plastic: PC panel mtg
	26C66745A05	HEAT SINK: Q3
	*26C25198A01	HEAT SINK: Q20
	9C66238A02	HOLDER, Fuse: F1 & F2
	14A562353	INSULATOR, Mica: Transistor socket; Q9, Q13, Q16 & Q20 (Use 14A543810)
	28S10733A01	KEY, Plug: for S2 connector
	2S7051	NUT, hex: 3/8-32; control mtg
	5S10281A03	RIVET, drive pin: nylon; HV transf mtg
	47C66082A03	ROD, Adjustment: width coil; L4
	3S136050	SCREW, tpg: 6-20 x 1/2 clu pan hd; Q9, Q13, Q16 & Q20
	9S10143A41	SOCKET, lamp: E1
	9D67555V27	SOCKET, CRT: incls leads & resistors
	*9D25201A01	SOCKET, HV Rectifier (4): complete; incls 2nd anode lead & cup
	9C63825A01	SOCKET, transistor: Q9, Q13, Q16
	9C63825A02	SOCKET, transistor: Q20
	41D65987A01	SPRING, special: CRT aquadag grnd
	66P65173A47	TOOL, contact removel (S2 connector)

* DENOTES NEW ITEM APPEARING ON ANY LIST FOR FIRST TIME.