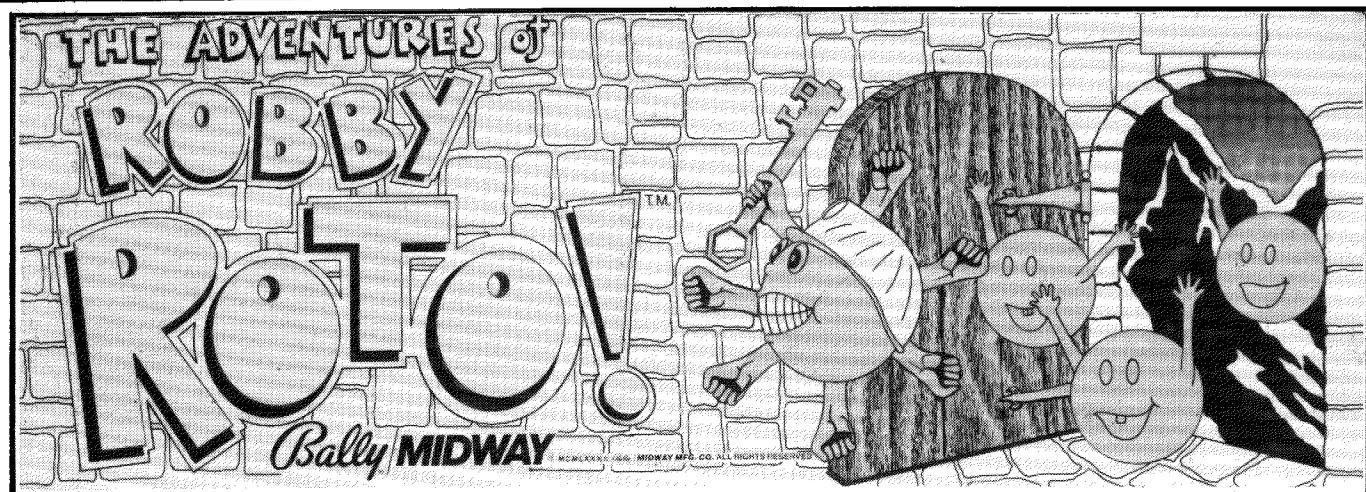
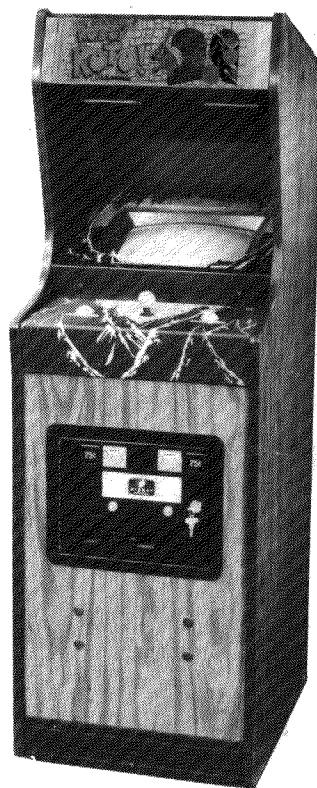
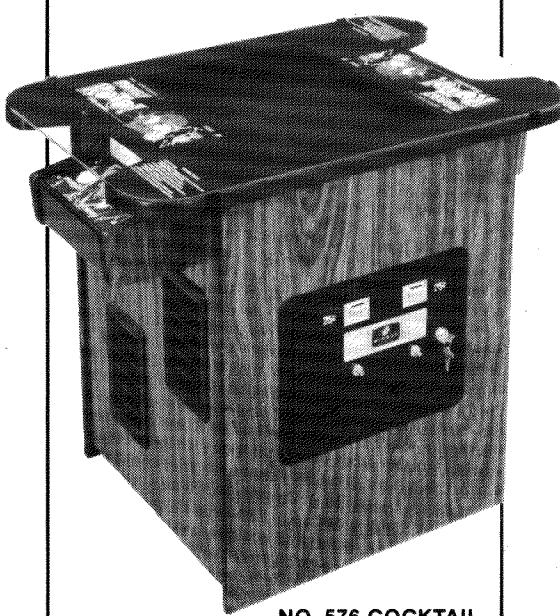
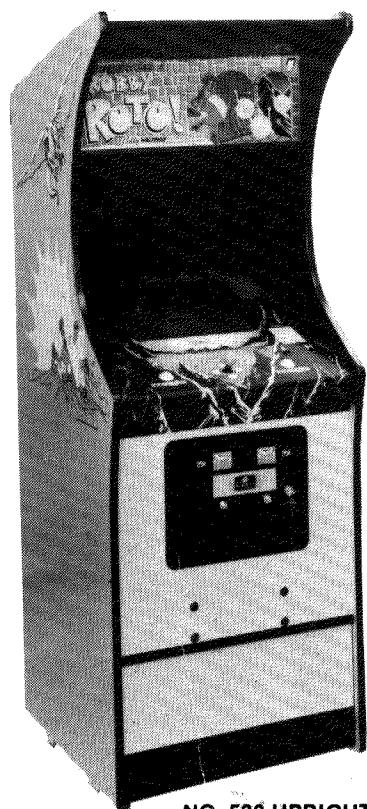


JUNE, 1982

Game Nos. 530, 574, 576



## Parts and Operating Manual



*Bally*

MIDWAY MFG. CO.

10750 W. GRAND AVENUE  
FRANKLIN PARK, ILLINOIS 60131  
USA



Phone: (312) 451-1360    Cable Address: MIDCO    Telex No.: 72-1596

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ELECTRICAL BULLETIN: FOR ALL APPARATUS COVERED BY THE CANADIAN STANDARDS ASSOCIATION (CSA) STANDARD C22.2 NO. 1, WHICH EMPLOYS A SUPPLY CORD TERMINATED WITH A POLARIZED 2-PRONG ATTACHMENT PLUG.

**CAUTION:** TO PREVENT ELECTRIC SHOCK DO NOT USE THIS (POLARIZED) PLUG WITH AN EXTENSION CORD, RECEPTACLE OR OTHER OUTLET UNLESS THE BLADES CAN BE FULLY INSERTED TO PREVENT BLADE EXPOSURE.

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## **IMPORTANT NOTE**

**DO NOT plug in your new game yet.  
Before you do anything to your game, we  
recommend that you read SECTIONS I  
and II of this manual completely. It will  
not take more than a few minutes and it  
may be very helpful.**

# **I. Introduction**

ROTO is a one or a two player game. There are three models: the "UPRIGHT", "MINI", and "COCKTAIL TABLE". When the two player mode is selected on the Upright or Mini model, the players take turns at the controls to guide ROTO to the stolen treasures and the captured hostages while avoiding VOLTAR and his co-conspirators. If you have purchased the Cocktail Table model of this game, the rules of play are the same. The only **difference** is that in the two player mode of the Cocktail Table game, the picture flips to face you when it's your turn.

When playing this game, **YOU** are ROTO's mentor. He takes his directions **ONLY from YOU** and will do your bidding exclusively. YOU determine the strategies he will use to defeat the evil monster VOLTAR who has invaded the Earth, stealing all types of treasures and burying them deep within the earth. VOLTAR also takes hostages and seals them in vaults deep within the earth.

There is only one way to save the hostages and recover the stolen treasures. We must send in ROTO. He will follow VOLTAR right into his own home tunnels to rescue the hostages and recover the stolen treasures VOLTAR has salted away.

To say the least, this makes VOLTAR more than just a little bit upset with ROTO. To help protect his stolen treasures and kidnapped hostages, VOLTAR has developed a breed of giant SPIDER that can sense ROTO's location and that can also travel through solid earth. These SPIDERS attempt to corner and

capture ROTO. And to direct their hunt for ROTO, VOLTAR turns himself into a TROLL that can travel through solid earth.

If and when ROTO is captured by the SPIDERS or the TROLL, he is forcibly ejected from VOLTAR's tunnels and you loose one player.

As your skill level increases and you get into the higher racks of the game, the ability of the SPIDERS and the TROLL to sense ROTO's location increases. This makes ROTO's chances of survival considerably smaller. And VOLTAR, being what he is, has reinforcements in the form of a set of disembodied TEETH that he can call on to help him track ROTO down and put the bite on him. These TEETH also have the ability to travel through solid earth.

ROTO has no reinforcements he can call on to help him defend himself against his enemies. He has **ONLY YOUR SKILL** at maneuvering and forming strategies plus one use of the MAGIC button (which makes ROTO and any hostages he has with him invisible to all monsters for a short period of time) per rack to keep him safe as he carries out his rescue missions.

Bonus ROTOS are awarded to you periodically throughout the game: after you complete every third rack of the game. Each recaptured treasure and rescued hostage has an assigned point value as listed in Figure 1-1. In the "2 times" and "3 times" racks, the values of all items are doubled or tripled respectively.

# Major Features

Your ROTO game has several outstanding features among which is the fact that: 1) A bonus ROTO is awarded to each player after every third rack completed; 2) The award of these bonus ROTOS is NOT tied to any scoring ability of the player (a low scoring player can receive just as many bonus ROTOS as a high scoring one if he can survive as long as the other player. Surviveability is what the award of bonus ROTOS is tied to); 3) Your ROTO is allowed one use of the MAGIC button per rack of the game; 4) If you do not use the MAGIC button in any particular rack, you are allowed to accumulate your unused MAGICS; 5) When you do use the MAGIC button, your ROTO and any hostages he has with

him at that time will become invisible to all the monsters on the screen for approximately 5 to 7 seconds (He can go right through them and not be caught); 6) The Upright model is provided with a front slide out service shelf for ease of maintenance; and 7) All models are provided with a service outlet to aid the service technician and provide an electrical source for whatever purpose he may have in mind.

## Game Objective

The object of the game is to **HAVE FUN** and survive as long as possible while constantly improving your skills, rescuing as many of the hostages as you can, and recapturing as much stolen treasure as possible. As you do this, each following maze will be harder and harder to complete.

DESCRIPTION	RACK NO	1 X MAZE POINT VALUE	2 X MAZE POINT VALUE	3 X MAZE POINT VALUE
<b>EACH HOSTAGE</b>				
PICK UP - EACH TIME OUT OF DOOR	1st 2nd 3rd	100 POINTS 200 POINTS 250 POINTS 300 POINTS ETC.	200 POINTS 400 POINTS 500 POINTS 600 POINTS ETC.	300 POINTS 600 POINTS 750 POINTS 900 POINTS ETC.
<b>ALL TREASURE VALUES</b>				
2nd MAZE 3rd MAZE 4th MAZE 5th MAZE 6th MAZE & BEYOND		200 POINTS EA. 400 POINTS EA. 600 POINTS EA. 800 POINTS EA. 1000 POINTS EA.	400 POINTS EA. 800 POINTS EA. 1200 POINTS EA. 1600 POINTS EA. 2000 POINTS EA.	1200 POINTS EA. 1800 POINTS EA. 2400 POINTS EA. 3000 POINTS EA.
<b>ALL ROOMS ENTERED VALUES</b>				
1st MAZE 2nd MAZE 3rd MAZE 4th MAZE 5th MAZE 6th MAZE & BEYOND		5 POINTS EA. 10 POINTS EA. 20 POINTS EA. 30 POINTS EA. 40 POINTS EA. 50 POINTS EA.	20 POINTS EA. 40 POINTS EA. 60 POINTS EA. 80 POINTS EA. 100 POINTS EA.	60 POINTS EA. 90 POINTS EA. 120 POINTS EA. 150 POINTS EA.
<b>MAZE MULTIPLIER DETERMINATION</b>				
3 HOSTAGES TOGETHER 3 HOSTAGES TOGETHER 2 MAZES IN A ROW			NEXT MAZE IS NEXT MAZE IS	2 X MAZE 3 X MAZE

Figure 1-1 Assigned Point Values

# II Location and Setup

## INSPECTION

1. Remove the game from its shipping crate.
  2. Inspect the entire outside of it for any signs of damage.
    - Any scratches? dents? cracks?
    - Any broken controls?
    - Any broken glass or plastic?
    - Just look it over closely and make a note of any signs of damage.
  3. Remove the shipping cleats from the bottom of the cabinet.
    - UPRIGHT MODEL ONLY:** Remove the red shipping brackets shown in Figure 2-1 which hold down the slide out utility shelf. See label on top of coin box cover.
  4. Install the four levelers, one at each corner of the cabinet.
    - Level the cabinet.
  5. Open the cabinet and inspect the inside of the game for any signs of damage. See Figure 2-2.
    - Also check to make sure all plug-in connectors on the wire harness are firmly seated.
- NOTE:** All connectors or plugs are keyed so they will only go together when all pins are properly lined up.
- Replug any connectors found unplugged. DO NOT FORCE PLUGS ONTO CONNECTORS. DO NOT FORCE PLUGS TOGETHER. If it won't go on easily, assuming the keys are lined up, it either does not belong there or is damaged.
  - Make sure all printed circuit boards (P.C.B.'s) are firmly seated in their connectors. See Figure 2-2. These connectors are also keyed. The P.C.B.'s will only go into them one way without being damaged.
  - Note the location of the game's serial number. See Figure 2-2.
  - Check all major subassemblies to be sure they are mounted securely. These are called out in Figures 2-2 and 2-3.
    - Power supply.
    - Control panel(s).
    - T.V. monitor.
    - Other P.C.B.'s and/or P.C.B. rack, etc.
    - Service shelf assembly (Upright ONLY).
6. Make a note of any problems that can't be easily corrected.
  7. Call your distributor and/or service man about your problem list.

## INSTALLATION

### 1. Location requirements:

#### Power:

Domestic 110 V @ 60 Hz  
Foreign 200 V to 240 V @ 50 Hz

#### Temperature: 32° to 100° F (0° to 38° C)

#### Humidity: Not over 95% relative

#### Space required:

Upright	25" x 32" (64 x 82 cm)
Mini	20" x 29" (51 x 74 cm)
Cocktail	32" x 22" (82 x 56 cm)

#### Game height:

Upright	72" (183 cm)
Mini	60" (153 cm)
Cocktail	29" (74 cm)

### 2. Voltage Selection:

Your game is designed to work properly on the line voltage where you are located. Check your line voltage with a meter to determine what its value is. Then check the power input wires to the main power supply transformer on your game to be sure they are connected to taps which correspond to your line voltage value.

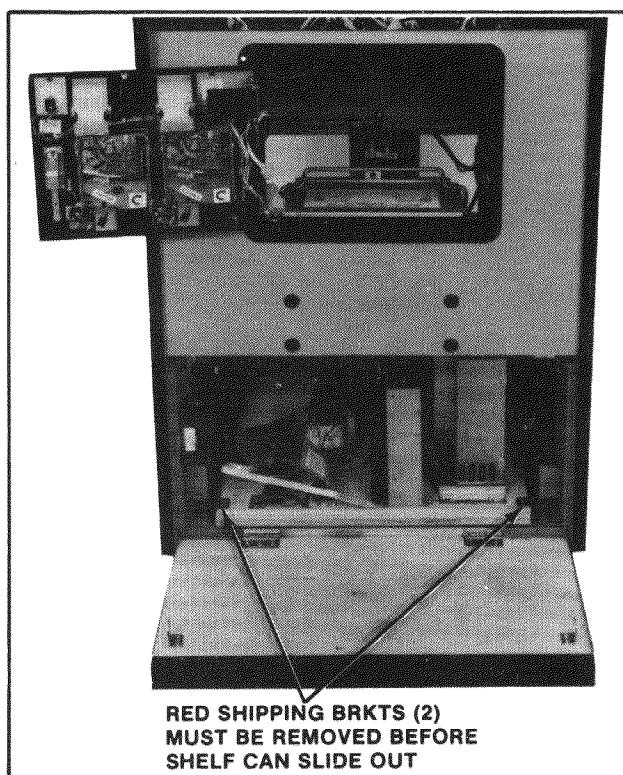


Figure 2-1 Removal of Shipping Brkts — Upright

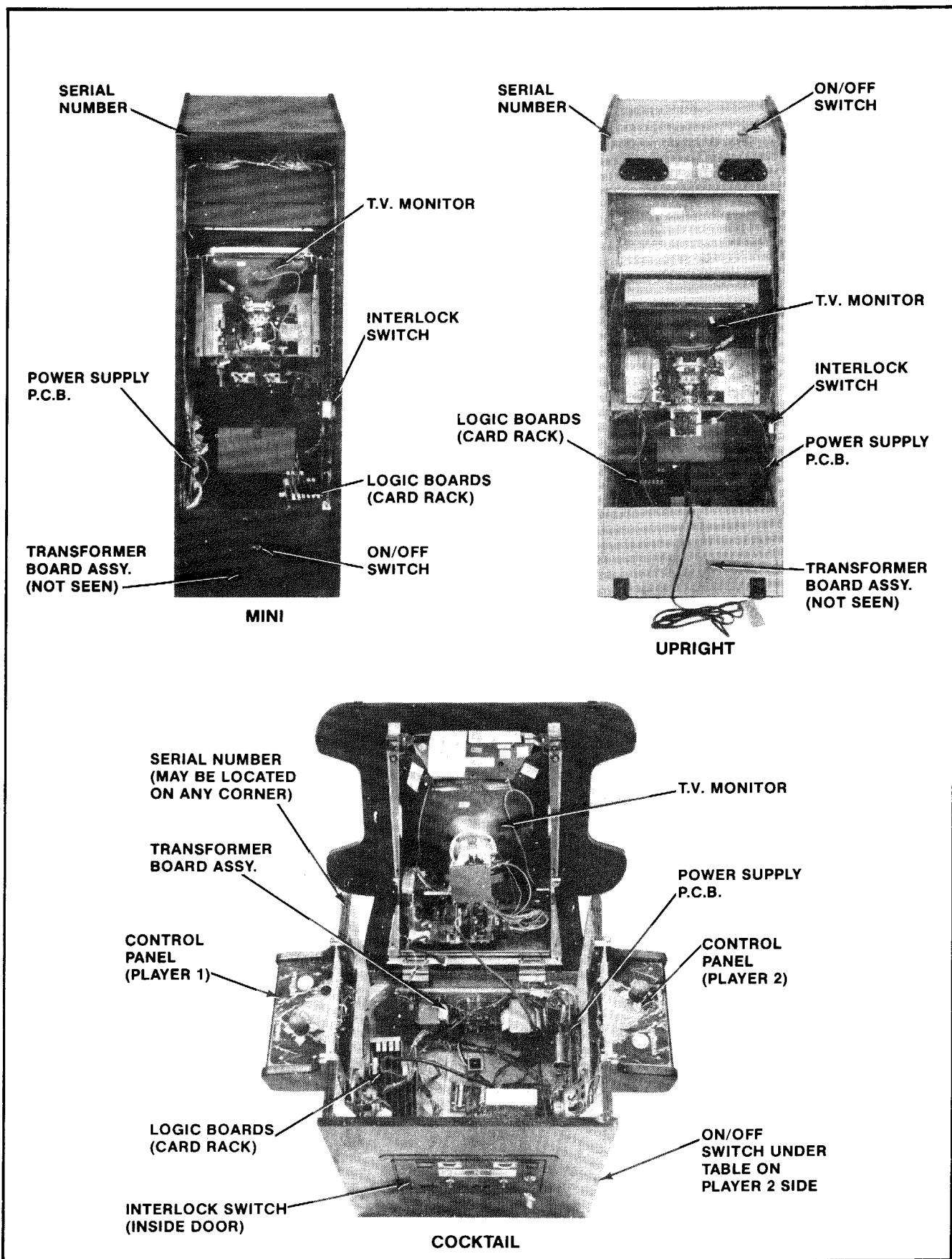


Figure 2-2 Location of Serial No., Interlock Switch, On/Off Switch, & Major Sub-Assys

If the power input wires to the main power supply transformer are not connected to taps which correspond to your local line voltage, move them to the proper taps.

If the line voltage in your area falls outside the upper or lower limits of the range of inputs covered by the main power supply transformer, **DO NOT PLUG YOUR GAME IN** until you have talked with your distributor and/or service man and obtained a solution to this problem. Otherwise you could damage your game.

3. Interlock and power ON/OFF switches. See Figure 2-2.

- To help prevent the possibility of getting an electric shock while working inside the game cabinet, interlock switches have been installed at each cabinet access door (this **DOES NOT** include the coin door in the Upright and Mini models).
- When any access door is opened, the interlock switch installed there turns off all power to the game.
- Check each interlock switch for proper operation.

After checking the line voltage in your area and determining that the input wires to the main power supply transformer of your game are connected properly — or — after obtaining a solution to your over or under voltage problem

from your distributor and/or your service man, plug the game into your A.C. wall outlet.

The game ON/OFF switches for all models are located as shown in Figure 2-2. Turn the game on and allow it to warm up a few minutes.

Slowly open each access door to the game (this **does not** include the coin door on the Upright and Mini models).

As the door is opened approximately 1" (2.54cm) the power to the game should go off (the T.V. monitor, all the lights, and all sounds will stop).

If this does not happen, check the interlock switch by this door to see if it has broken loose from its mounting or if it is stuck in the "ON" position.

If the switch is found to be bad, turn the game off, unplug it, and replace the interlock switch.

When done, plug the game back into the wall outlet, close the access door, and turn the game back on.

After the game has warmed up, repeat the above interlock switch test.

When the interlock switch is working properly and turns the power to the game off, power may be restored to the game with the access door(s) open. Take hold of the interlock switch plunger and **gently** pull it out to its fully extended position. **THIS IS TO BE USED ONLY FOR SERVICING THE GAME.** See Figure 2-4.



Figure 2-3 Major Sub-Assys (cont. from Fig. 2-2)

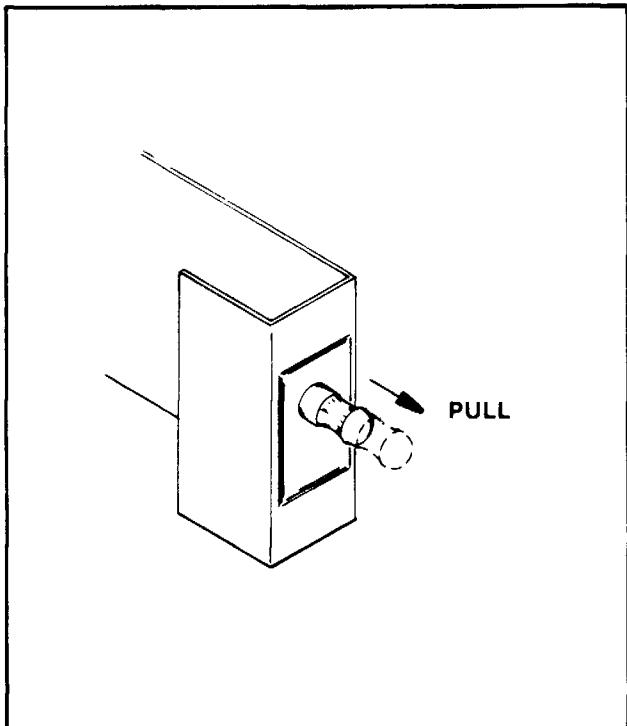


Figure 2-4 Interlock Switch Operation

## SELF-TEST

Your new game will Self-Test itself to see if it has any bad parts. The information it receives while testing itself will be shown on the T.V. monitor. See the GAME OPERATION section for a more detailed description of this function.

When there is a bad result according to the Self-Test, call your distributor and/or service man to have the trouble fixed unless it is something you can do yourself (such as replace a bad RAM or ROM chip).

## GAME VOLUME ADJUSTMENT CONTROL. (See Figure 2-5.)

The game volume control pots are located on a panel: Upright model — mounted on the monitor skirt behind the coin box; Mini and Cocktail Table models — inside coin door mounted to right side of cabinet as you face coin door. For adjustment, they may be reached through the coin door on **ALL** models.

To make the sounds louder, turn the pots clockwise as you face them (  ).

To make the sounds **less** loud, turn the pots counter-clockwise as you face them (  ).

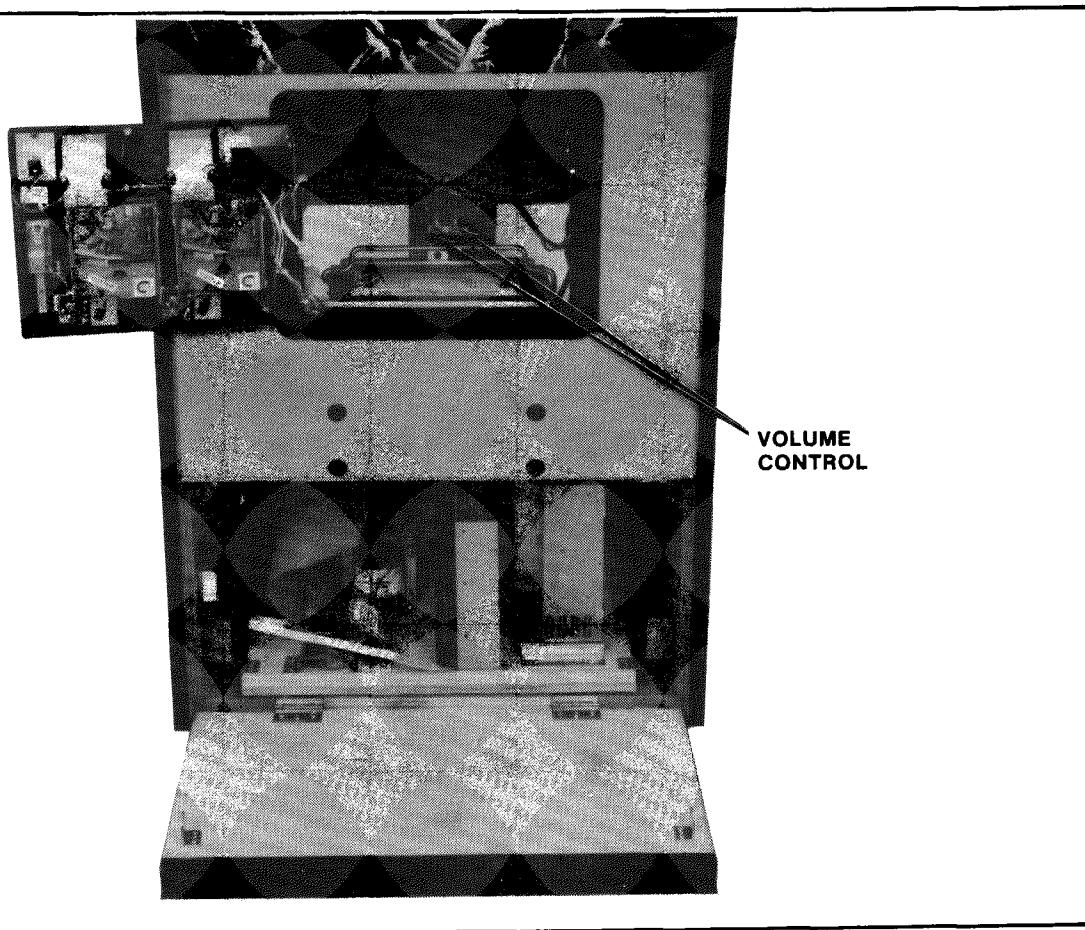


Figure 2-5 Location of Volume Control

## OPTION SWITCH SETTINGS

To change the most common option settings, you **DO NOT** have to take the game apart or go into the cabinet and hunt for tiny switches on P.C. boards. These most common options can be changed from the main console of the game while it is in the Self-Test mode. The Self-Test switch is located on the bracket for the coin counter on the back side of the coin door closest to the door hinge.

When changing any options, **ALWAYS** perform the Self-Test and play the game to be sure the ones selected are working properly. Of course, when you must change one of the switches that is located on one of the game's P.C. boards, it is also recommended that you perform the Self-Test and play the game to be sure the switches have worked properly and that no switches were accidentally moved that were not meant to be. (These switches are small and this can happen.)

The P.C. Board option switch settings, and what they will make the game do are shown in Figure 2-6. See Figure 2-7 for option switch locations.

**NOTE:** In order to set the option switches located on the game's P.C. Boards, these Boards need not be removed from their card rack. But, in order to have the system read these new option switch settings, the power to the game **MUST** be turned "OFF" and then back "ON" again. This is because the program **ONLY** reads the positions that these option switches are set in on "POWER-UP". Once you have turned the power on, you can move them all over the place and the game won't know it.

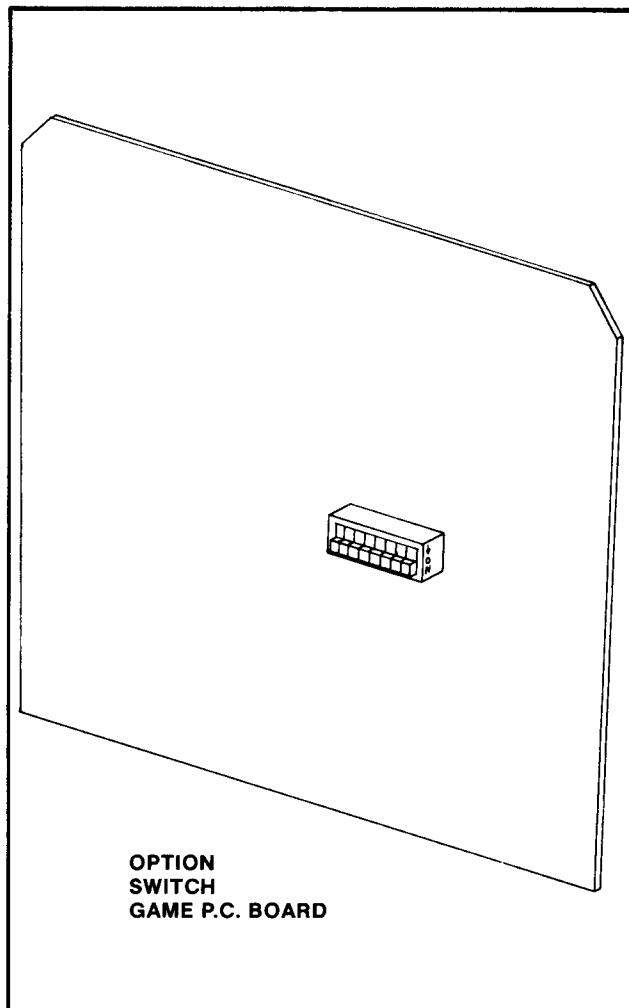


Figure 2-7 Option Switch Locations

ROTO								
OPTION SWITCH SETTINGS								
LOCATED ON GAME BOARD								
NORMAL OPERATION FULL RESET	SW#1 OFF ON	SW#2 NOT USED	SW#3 NOT USED	SW#4 NOT USED	SW#5 NOT USED	SW#6 NOT USED	SW#7 NOT USED	SW#8 NOT USED
OPTIONS ADJUSTABLE FROM GAMES CONTROL PANEL  OPTIONS RETURN TO FACTORY RECOMMENDED SETTINGS	OFF  ON	THE REMAINDER OF ROTO's MOST COMMON OP- TION SETTINGS ARE ADJUSTED DURING THE SELF-TEST MODE AND WILL BE COVERED IN DE- TAIL IN THE "GAME OPERATION" SECTION OF THIS MANUAL.						
NORMAL PLAY FREE PLAY	OFF ON							

Figure 2-6 Option Switch Settings

# III Game Operation

ROTO is a one or a two player game with a color T.V. monitor. The game gives a display which has all the parts shown in Figure 3-1.

The game has five possible modes of operation: ATTRACT, READY-TO-PLAY, PLAY, HIGH SCORE/INITIAL, and SELF-TEST.

## SELF-TEST MODE

The Self-Test mode is a special mode for checking the game switches and computer functions. It is the easiest and best way to check for proper operation of the entire game.

**NOTE:** Putting the game into Self-Test will cause it to **erase** any CREDITS already on it from its memory.

You may begin a Self-Test at any time by sliding the Self-Test switch to the "ON" position after the power to the game is on (once this occurs, there is no way out of the Self-Test mode except to go through all the Test Displays). When this is done, the game will react as follows:

1. In the First Test Display, you will see vertically striped curtains which go from the top of the screen to the bottom.

2. There is no Second Test Display unless there is a malfunction of the last RAM chip on the ROM/RAM Board.

**SPECIAL NOTE:** IF EITHER THE **FIRST** OR **SECOND** TEST DISPLAY IS BAD THIS WOULD MEAN THAT THE GAME IS NOT CAPABLE OF COMPLETING THE SELF-TEST ON ITSELF. THE BAD INDICATIONS YOU WOULD GET ARE AS FOLLOWS:

- First Test Display: if bad, the monitor screen will lock up with alternating black and white **DIAGONAL** lines. This means that the first ROM (IN SOCKET X1) on the ROM/RAM Board is bad.
- Second Test Display: if bad, the monitor screen will lock up with alternating red and black **DIAGONAL** lines. This means that the last RAM (IN SOCKET X24) on the ROM/RAM Board is bad.

**BOTH OF THE ABOVE CHIPS MUST BE GOOD IN ORDER FOR THE GAME TO BE ABLE TO CONDUCT A SELF-TEST ON ITSELF. IF BAD, REPLACE THEM **ONLY** WITH CORRESPONDING CHIPS AS CALLED OUT IN THE PARTS LIST OF THIS MANUAL.**

3. The Third Test Display looks like the following Figure 3-2.

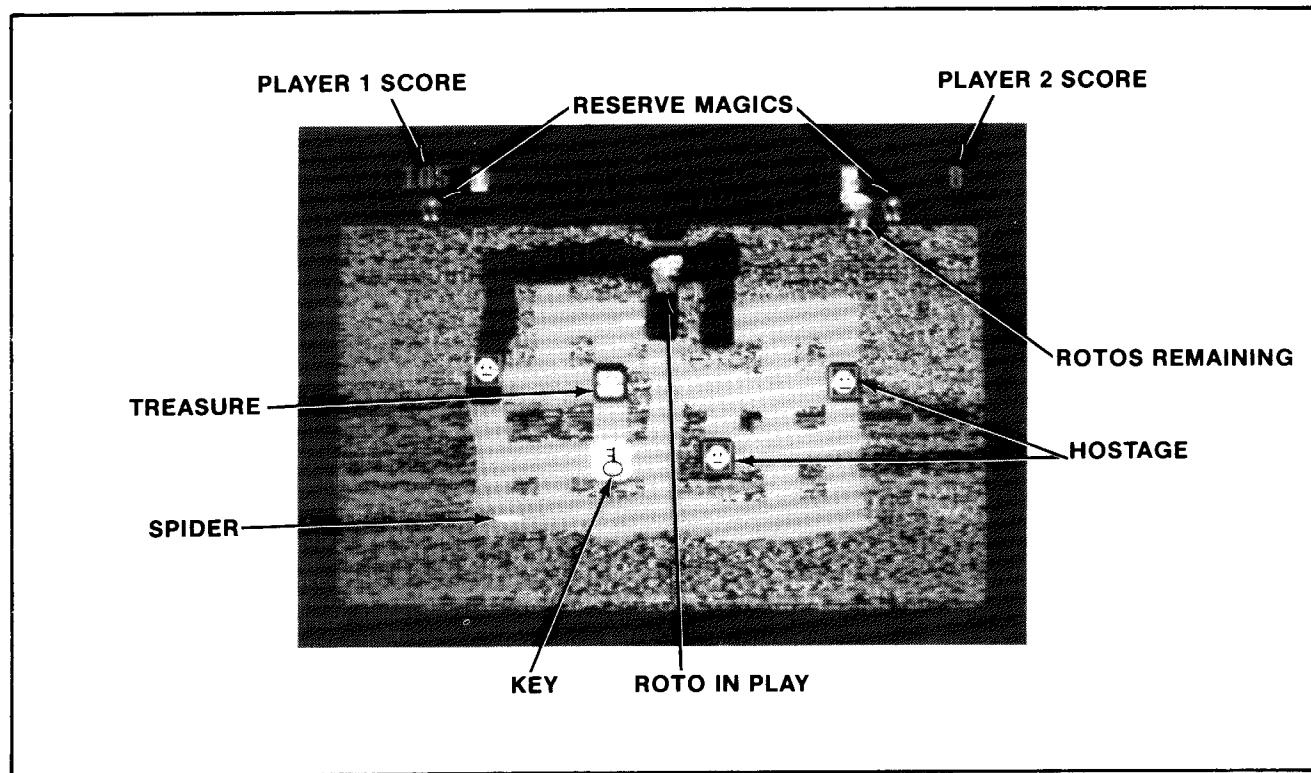
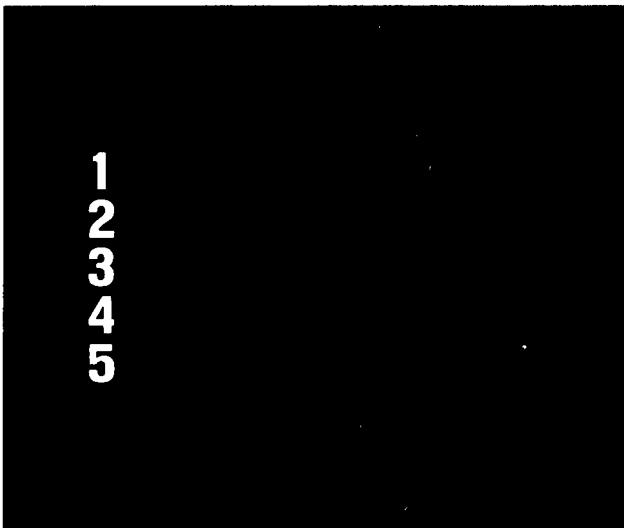


Figure 3-1 Identification of "On Screen" Graphics During Play



**Figure 3-2 Self-Test — ROM/RAM**

If nothing is written out beside the numbers 1, 2, 3, and 4, they are O.K. 5 is a sound mode ONLY (for purposes of volume adjustment) and provides no diagnostic type information.

- "1" checks the Screen RAM — If no good — "BAD" is written out beside this number.
- "2" checks the Write Protect RAM — If no good — one or more of the following numbers is written out beside this number: 12345678. These numbers tell what is wrong with the Write Protect RAM test.

1 = testram high did not zero  
 2 = testram low did not zero  
 3 = testram high did not set  
 4 = testram low did not set  
 5 = testram high zeroed and should not have  
 6 = testram low zeroed and should not have  
 7 = scratch ram next to write protect did not  
     set and should have  
 8 = scratch ram next to write protect did not  
     zero and should have

The meaning of the RAM tests is this: If Write Protect tests 1, 2, 3, and/or 4 fail, X21 should also fail. If Write Protect tests 5 or 6 fail, Write Protect is not enabled. If **ONLY** Write Protect test number 6 fails, Write Protect is not covering enough memory. If Write Protect tests 7 or 8 fail, Write Protect is covering too much memory — which should also show an X21 failure reading.

- "3" checks the Scratch/Battery Back Up RAM — If no good — one or more of the following numbers is written out beside this number: X21, X22, X23, or X24 — depending on which RAM is bad. These numbers tell which socket the bad RAM is in on the ROM/RAM board.
  - "4" checks ROMs "B, C, D, E, F, G, H, J, and K" — If no good — Their respective letter(s) are written out beside this number.
4. If a bad ROM or RAM chip is found by the game's internal check system during the Self-Test, the game indicates this to you by showing the location code of the bad chip(s) to the right of the check number. The following table translates the chip location codes into actual positions on the various P.C. Boards.

<b>DISPLAY</b>	<b>DESCRIPTION</b>
WHITE & BLACK DIAGONAL STRIPES	ROM located on ROM/RAM board at position X1 is bad.
RED & BLACK DIAGONAL STRIPES	RAM located on ROM/RAM board at position X14 is bad.
1 BAD	<b>CHECK BOTH RAM BOARDS FOR MALFUNCTIONING PART(S).</b>
2 1 2 3 4 5 6 7 8	RAM located on ROM/RAM board at position X21 is bad.
3 X21, X22, X23, X24	<b>CHECK RAMS AT INDICATED POSITIONS ON ROM/RAM BOARD.</b>
4 B	ROM located on ROM/RAM board at position X2 is bad.
4 C	ROM located on ROM/RAM board at position X3 is bad.
4 D	ROM located on ROM/RAM board at position X4 is bad.
4 E	ROM located on ROM/RAM board at position X5 is bad.
4 F	ROM located on ROM/RAM board at position X6 is bad.
4 G	ROM located on ROM/RAM board at position X7 is bad.
4 H	ROM located on ROM/RAM board at position X8 is bad.
4 J	ROM located on ROM/RAM board at position X9 is bad.
4 K	ROM located on ROM/RAM board at position X10 is bad.

- "5" is a sound mode to enable the operator to adjust the game's sound levels. The game's program automatically sets the tones emitted at half volume at the beginning of this mode.
- You advance to the next Test Display by pressing the 1 and 2 Player Buttons at the SAME time.
  - During the Player Input Test Display the game will give a display which looks like that shown in Figure 3-3.

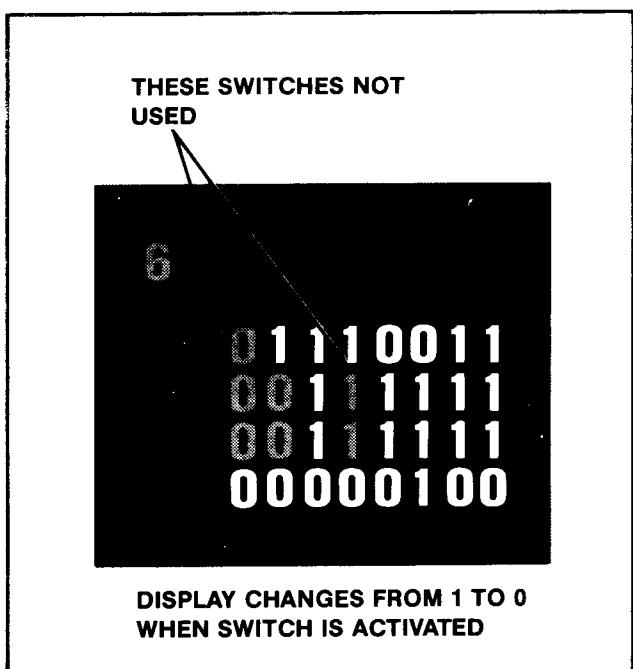


Figure 3-3 Self-Test — Player Input

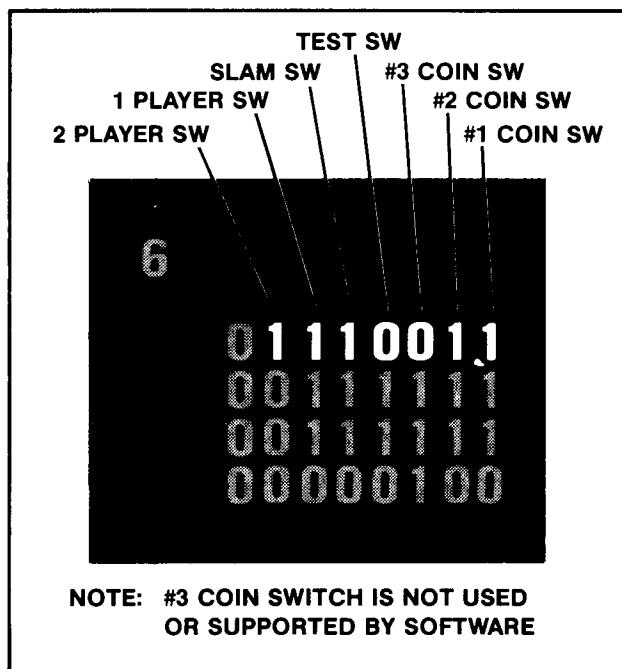


FIGURE 3-3a

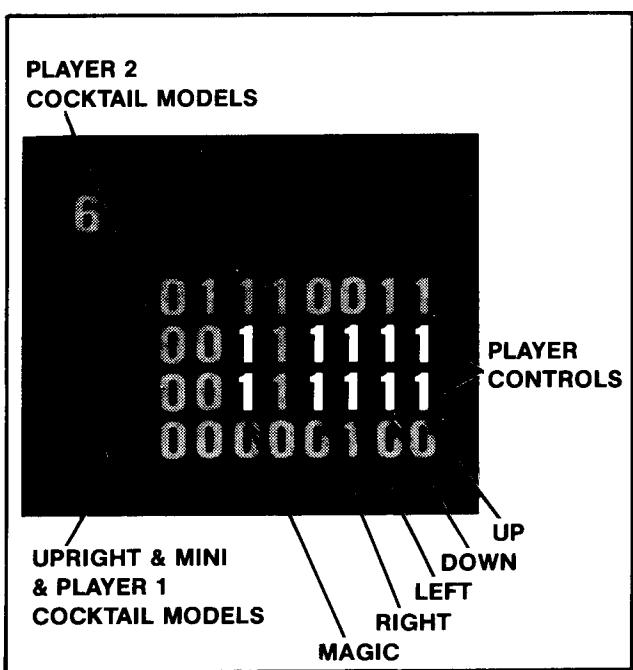


FIGURE 3-3b

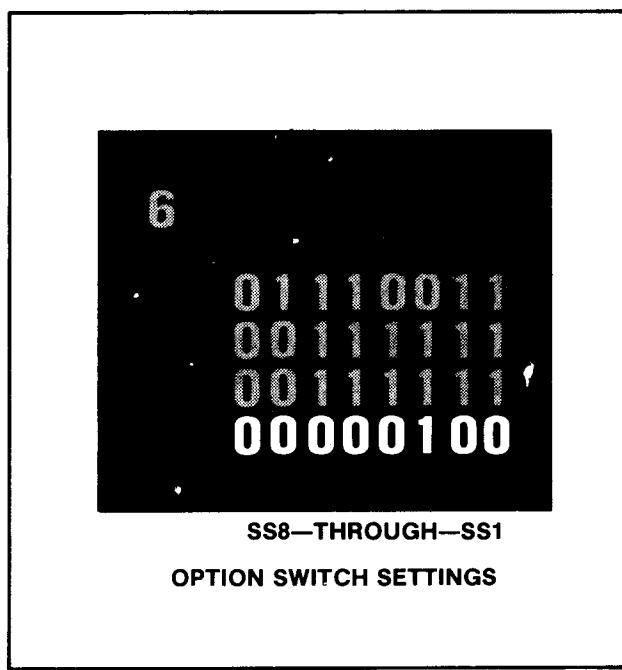


FIGURE 3-3c

- In this category, each of the game's player operated controls — including the coin switches on the back side of the coin door and the option switches located on the Game Board — may be checked individually. A "1" means that that particular switch is in the open condition and a "0" means that that particular switch is in the closed condition.
7. You advance to the next Test Display by pressing the 1 and 2 Player Buttons at the SAME time.
8. During the Setup Options Test Display the game will give a display which looks like that shown in Figure 3-4 .
- In this category, all common game options may be changed from the control console: coins per credit and difficulty level.
  - The Difficulty Level setting has a range of 1 to 9 with 1 being the easiest and 9 being the most difficult. Three (3) is the factory recommended game setting.  
The value of the Difficulty Level may be **increased** by pushing forward on the control stick or **decreased** by pulling backward on the control stick.
  - Push the 1 and 2 Player Buttons at the SAME time to move between subdivisions of this category.  
Upon reaching the last subdivision, hesitation of about 2 seconds will cause the cursor to cycle back to the first category of the subdivisions (DIFFICULTY LEVEL).
  - The coins and Credits may be adjusted respectively by pushing the One Player Button to select the left hand figure (coins) and then pushing forward on the control stick to **increase** this figure or pulling backward on the control stick to **decrease** the figure. By pushing the Two Player Button to select the right hand figure (credits), you may adjust it in the same manner as stated above.
  - Push the 1 and 2 Player Buttons at the SAME time to select the last subdivision in this category and then **QUICKLY** press them both again to advance to the next Test Display.
9. The next Test Display is a cross hatch pattern which can be used for various alignment procedures. This pattern will stay on the monitor screen until you advance to the next Test Display.
10. You advance to the next Test Display by pressing the 1 and 2 Player Buttons at the SAME time.
11. The next, and last, Test Display is a color bar display showing Green, Red, Blue, and Yellow on the left side of the monitor screen and Black, Dark Gray, Light Gray, and White on the right side of the monitor screen.

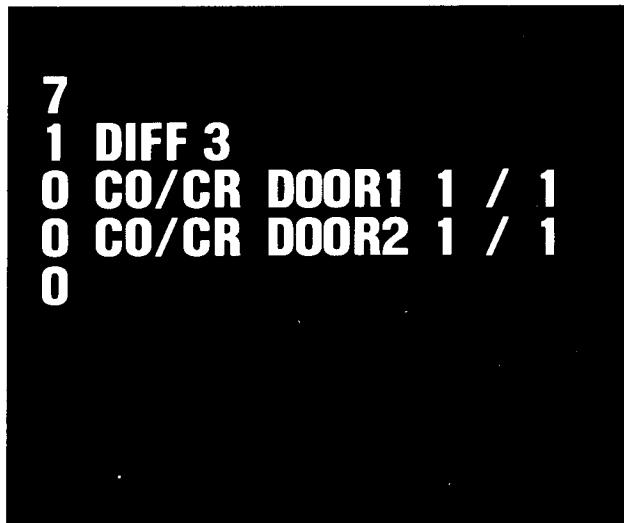


Figure 3-4 Self-Test — Setup Options

- Again, this pattern will remain on the monitor screen until you press both the 1 and 2 Player Buttons at the same time.
- If you have turned the Self-Test switch to the "OFF" position **before** pressing the 1 and 2 Player Buttons, normal game functions will return to the monitor screen.
- If you **HAVE NOT** turned the Self-Test switch to the "OFF" position **before** pressing the 1 and 2 Player Buttons, normal game functions **WILL NOT** return to the monitor screen. **The game will return to the First Test Display.**

## ATTRACT MODE

1. The Attract mode starts:

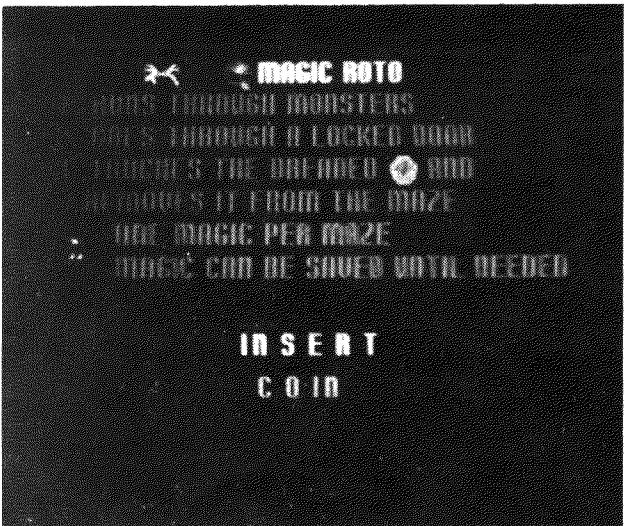
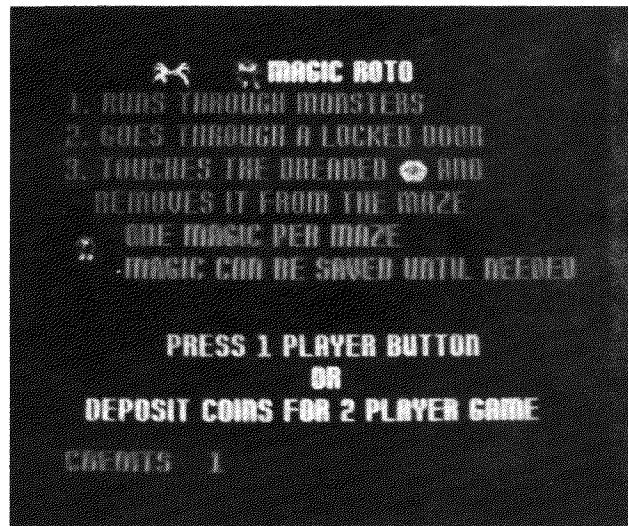
- Just after power has been turned on to the game when there are no credits in its memory. (Self-Test switch is in the "OFF" position.)
- After a Self-Test has been completed, no game was in progress, and no credits are left in game's memory. (Performing a Self-Test **WILL NOT** set the credits in the game's memory to zero "0".)
- After the High Score/Initial mode when there are no more credits left in its memory.
- In the Attract mode, the game will give the following displays **centered** on the monitor screen:



**NOTE:** The Attract Mode has no sound until a player control is touched. Then you get sound for the first display in the Attract Mode sequence. (One time ONLY unless a control is touched again.)

- No matter where the game is in the Attract Mode sequence, it will immediately go to the following display as soon as a game has been paid for. It will hold this display on the monitor screen until the "1 PLAYER" or the "2 PLAYER" start button is pushed.

BALLY/MIDWAY MFG. CO. PROUDLY PRESENTS ITS HALL OF FAME			
1 JAY	22430		
2 EDC	22150	12 PES	10000
3 USA	21860	13 QJH	9890
4 BMS	21620	14 QZU	9500
5 AXS	20890	15 UYL	9210
6 EMJ	20230	16 BXG	8780
7 IUL	19650	17 DRR	8230
8 LUP	19540	18 DNG	7900
9 GYS	19180	19 JHS	7230
10 TKC	18920	20 QSP	6930
11 OCK	18390	21 CGX	6140



## READY TO PLAY MODE

1. The Ready-To-Play mode starts when enough coins have been accepted for a 1 or a 2 player game.
2. The Ready-To-Play mode ends when either the "1 PLAYER" or the "2 PLAYER" push button is pressed.
  - After the coins have been accepted by the game, the "1 PLAYER" and/or "2 PLAYER" buttons will start flashing according to whether or not you have bought enough credits for a one or a two player game.
3. In the Ready-To-Play mode, the game will give the above display centered on the monitor screen. The credit sign tells you EXACTLY how many credits you have purchased.
4. If no START button is pressed, the game will hold the above display on the screen indefinitely.

## PLAY MODE

1. The Play mode begins when either the "1 PLAYER" or the "2 PLAYER" start button is pressed. "PLAYER 1 UP" or "PLAYER 2 UP" is displayed **centered** on the screen **ONLY** when a 2 player game has been selected. In a 1 player game, the screen says "GET READY" and play begins.
2. The Play mode ends when all of your ROTOS have been captured by VOLTAR. When this happens, "GAME OVER" is written across the center of the monitor screen.
3. The game is made up of buried stolen treasures and imprisoned kidnapped hostages which it is ROBBY ROTOS mission to rescue. The evil VOLTAR is the one responsible for all of this. When playing this game, **YOU** are ROBBY's mentor. He takes his directions **ONLY from YOU** and will do your bidding exclusively. YOU determine the strategies he will use to defeat the evil monster VOLTAR who has invaded the Earth, stealing treasures and kidnapping hostages.
4. There is only one way to save the hostages and recover the stolen treasures. We must send in ROBBY ROTO. He will follow VOLTAR right into his own home tunnels to rescue the hostages and recover the stolen treasures VOLTAR has salted away.
5. The player begins each game with 3 ROTOS and 1 Magic. Reserve Magics are symbolized by "Ghost ROTOS" behind your regular reserve ROTOS. The Magic will make ROBBY ROTO and any hostages with him invisible to VOLTAR and all his creatures. It also makes ROBBY able to move faster. If you do not use your Magic in this rack, it will accumulate to the next rack. You get 1 Magic at the beginning of **each** rack. When used, they will last for 5

seconds, the game makes a special magical sound, the screen flashes, and ROTO becomes a ghost image of his former self.

6. A bonus ROTO is awarded to the player after the completion of every third rack (3rd, 6th, 9th, 12th, 15th, 18th, and so on). The award of these bonus ROTOS is in **NO** way related to the level of a player's score. You **MUST SURVIVE** long enough to make it to the ends of these particular racks to collect your bonus ROTOS. There are 3 different "BONUS ROTO MACHINES".
7. There are 30 DIFFERENT mazes in the game divided into categories as follows:

CATEGORY	NUMBER OF MAZES
BEGINNERS .....	2
MEDIUM .....	3
HARD.....	25

Generally speaking, a player should never get the same maze twice in any game until he has gone through all 25 of the "HARD" mazes. After the 2nd rack, all future racks are in the "HARD" category.

ROBBY ROTO enters all mazes through the door at the top center of the monitor screen. When he is in the mazes, ROBBY can only dig in the directions of the pointing arrows at each room (tunnel junction point). He can move freely about any of the tunnels that have been dug out.

## 8. GAME PARTICIPANTS — THEIR SIDE:

The evil monster VOLTAR has invaded the Earth, stealing all types of treasures and burying them deep within the earth. VOLTAR also takes hostages and seals them in vaults. To help protect his stolen treasures and kidnapped hostages, VOLTAR has developed a breed of giant SPIDER that can sense ROTO's location and that can also travel through solid earth. These SPIDERS attempt to corner and capture ROTO. And to direct their hunt for ROTO, VOLTAR turns himself into a TROLL that can travel through solid earth.

If and when ROTO is captured by the SPIDERS or the TROLL, he is forcibly ejected from VOLTAR's tunnels and you lose one player.

As your skill level increases and you get into the higher racks of the game, the ability of the SPIDERS and the TROLL to sense ROTO's location increases. This makes ROTO's chances of survival considerably smaller. And VOLTAR, being what he is, has reinforcements in the form of a set of disembodied TEETH that he can call on to help him track ROTO down and put the bite on him. These TEETH also have the ability to travel through solid earth.

## 9. GAME PARTICIPANTS — YOUR SIDE:

ROTO has no reinforcements he can call on to help him defend himself against his enemies. He has **ONLY YOUR SKILL** at maneuvering and forming strategies plus one use of the MAGIC button (which makes ROTO and any hostages he has with him invisible to all monsters for a short period of time) per rack to keep him safe as he carries out his rescue missions.

## 10. GAME PLAY:

ROTO always enters the maze through the door at the top center of the monitor screen. His primary mission is to save as many hostages at one time as he can while keeping an eye out for buried treasures to recover along the way.

If ROBBY touches, or is touched by, any creature, that creature holds him down until VOLTAR can get there to carry him away and you lose one player.

If any of the hostages ROBBY ROTO is towing around with him are touched by any of the creatures (except the TEETH), he is immediately boxed in and carried off to some far away section of the screen.

When the TEETH put the bite on any hostage, they DO NOT carry him off. The hostage stops and is sealed in while the TEETH continue on toward ROTO. This means that you can't "feed the TEETH a hostage" to get away from them as you can with any of the other creatures.

**NOTE:** There are only two SPIDERS in the first rack. All remaining racks have three SPIDERS each.

- The buried treasures are only displayed one at a time. As soon as ROTO recovers one, another will appear at some other point in the maze. There are only four treasures to recover per rack.

To get back out of the maze once he has entered it, ROBBY must recover the key. Once this has been done, he can get out of the maze any time he wants.

TO COMPLETE ANY RACK AND MOVE ON TO THE NEXT ONE, ALL THREE HOSTAGES MUST BE TAKEN OUT OF THE DOOR TO THE MAZE AT THE TOP CENTER OF THE MONITOR SCREEN. They may be taken out in any order, ONE at a time, TWO one time and ONE the next, or THREE at a time. The more hostages you take out of the maze at one time the higher will be your bonus at the end of the rack. Also, if you can get all three out at one time, the next maze will have a higher scoring value for each item.

When your last ROTO is captured and physically ejected from the maze by VOLTAR, "GAME OVER" is written across the screen.

After this display, the game will go into the High Score/Initial mode and display the scores of the "BEST 21" players. If your score is not high enough to cause the game to add it to the list, the game will then either go to the Attract mode (if there are no more credits left in its memory) or into the Ready-To-Play mode (if there are still credits left in its memory).

## 11. HIGH SCORE/INITIAL MODE:

In the High Score/Initial mode the game gives a display which looks like the following:

BALLY/MIDWAY MFG. CO. PROUDLY PRESENTS ITS HALL OF FAME			
1	JAY	22130	
2	EDC	22150	12 PES
3	USA	21860	13 QJH
4	BMS	21620	14 QZU
1	R	20880	15 UYL
6	EMJ	20230	16 BXC
7	IUL	19650	17 DLR
8	LUP	19540	18 ONG
9	GYS	19190	19 JNS
10	TKC	18920	20 QSP
11	OCK	18386	21 CGX

When in the High Score/Initial mode, your score is highlighted and there is one "A" and two blank spaces to the side of your score.

By moving the control stick to the right, the letter can be made to sequence forward through the alphabet: "A", "B", "C", "D", etc. By moving the control stick to the left, the letter can be made to sequence backward through the alphabet: "Z", "Y", "X", "W", etc.

When you reach your initial, release the control stick and push the MAGIC button. Your initial is frozen in place and a duplicate of that letter appears in the blank space next to your first initial. Select your next initial in the same manner as the previous one and so on.

If you do not wish to put your initials opposite your score, just press the MAGIC button three times. Three "A"s will appear opposite your score.

After the High Score/Initial mode, the game will either go to the Attract mode (if there are no more credits left in its memory) or into the Ready-To-Play mode (if there are still credits left in its memory).

Most of the above holds true in the "2 PLAY-ER" mode also. But there are a few minor differences.

## **TWO PLAYER OPERATION**

The Upright, Mini, and Cocktail Table models all have two player operation.

In the two player mode, the rules of play are the same as in the single player mode. There are some additional rules, however.

1. In the Upright and Mini models, the players must take turns at the controls.
2. In the Cocktail Table model, each player has his own set of individual controls. The picture will flip to face you when it is your turn. (When it is not your turn, your set of controls will have **NO** effect on the game.)
3. Your turn lasts until your ROTO is captured. At this point, the game will do one of several things depending on whether or not the captured ROTO was your last or if you still have others remaining in reserve.

### **ROTO CAPTURED — ROTOS REMAINING IN RESERVE**

- All action stops.
- Next, it displays "PLAYER \_\_\_\_ UP" and the maze changes to the one the other player is in.
- Play begins for the other player.

### **ROTO CAPTURED — NO ROTOS REMAINING IN RESERVE**

- Next, it displays "PLAYER \_\_\_\_ UP" and the maze changes to the one the other player is in.
- Play begins for the other player.
- After the last player's last ROTO is captured, the game displays "GAME OVER" for him too.
- After this display, the game will go into the High Score/Initial mode and display the scores of the "BEST 21" players. If neither of your scores is high enough to cause the game to add it to the list, the game will then either go to the Attract mode (if there are no more credits left in its memory) or into the Ready-To-Play mode (if there are still credits left in its memory). However, if one or both of your scores was high enough to make you one of the "BEST 21" players, the game will add your score(s) to the list and allow you to enter your initials opposite your score. The number "1" and/or "2" is displayed to the side of each score to indicate which player made which score.
- After you've entered your initials opposite your score(s), the game will then either go to the Attract mode (if there are no more credits left in its memory) or into the Ready-To-Play mode (if there are still credits left in its memory).

## **SLAM — OR — TILT SWITCH**

If activated, the SLAM — or — TILT SWITCH will end the game that was in progress and also remove one credit from any credit balance in the game's memory at that time. This is the case in all models regardless of whether it is a one or a two player game.

# IV Maintenance and Repair

Your **NEW** game needs certain types of maintenance to keep it in good working order. **CLEAN**, well **MAINTAINED** games **attract players** and **EARN MORE PROFITS**.

The most important thing for you to remember is to run the Self-Test EVERY TIME you collect money from the coin box. **JUST LOOKING** at your game **WILL NOT** tell you if all its controls and inside parts are working correctly. The Self-Test will inform you whether or not your game is working the way it should.

The second most important thing you should remember is to clean the outside of the game and coin acceptor mechanisms on a regular basis.

## CLEANING

The outside of the game cabinet plus the metal can be cleaned with any non-abrasive household cleaner. However, the front of the T.V. monitor tube and **both sides** of all other glass and plastic on or in the game **MUST** be cleaned with anti-static cleaner **ONLY**. For cleaning the coin acceptors: hot soapy water may be used on the plastic ones and any household cleanser may be used on the metal ones. If you wish, special coin machine cleaners that leave no residue may be purchased from your distributor.

DO NOT dry-wipe any of the plastic panels. This is because any dust that was on them can scratch their surfaces. If this has happened, anyone looking

through this type of damaged plastic would feel he was looking at the game through a fog. This fogging damage **CANNOT** be repaired or reversed. The **ONLY** solution is to **replace** the damaged piece of plastic.

## FUSE REPLACEMENT

This game contains several fuses located as shown in Figure 4-1.

### 1. UPRIGHT MODEL:

As viewed from the front, facing the cabinet, with the utility shelf slid out through the game's front access door, the fuses are located: between the Main Power Transformer and the T.V. Isolation Transformer, just to the left of the Service Outlet, and on the Power Supply Board Assembly.

### 2. MINI MODEL:

As viewed from the back, facing the cabinet, with the rear access door removed; the fuses are located on the Transformer and Power Supply Board Assemblies.

### 3. COCKTAIL TABLE MODEL:

As viewed from the coin door side of the cabinet, with the monitor tilted open to one side; the fuses are located on the Transformer and Power Supply Board Assemblies.

Replace fuses **ONLY** with the type and size listed in the Illustrated Parts Breakdown Section of this manual.

See the T.V. Monitor Manual (available on request from your distributor or the Monitor Manufacturer) and/or the T.V. Troubleshooting Section of this manual for information on these fuses.

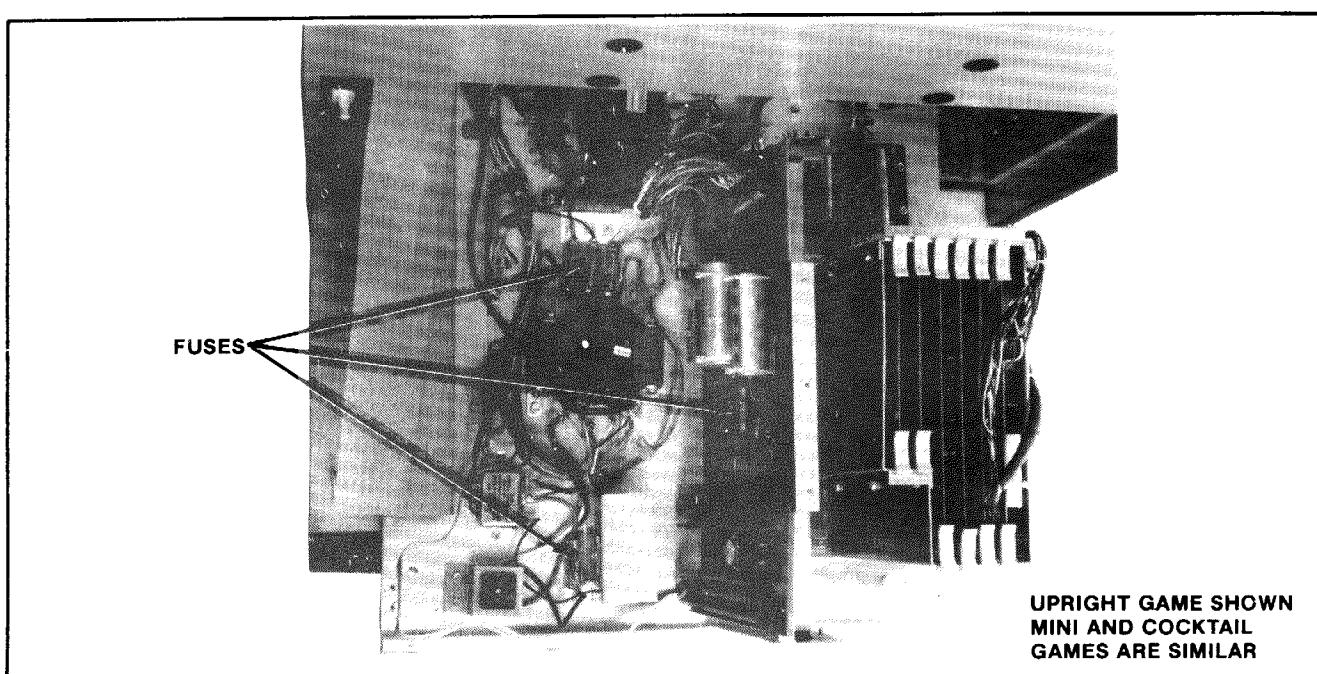


Figure 4-1 Location of Fuses

## OPENING THE CONTROL PANEL (See Figure 4-2).

### 1. UPRIGHT MODEL:

- The control panel is held in place by three latches, one on the left side, one on the right side, and one on the front center.  
They are spring loaded to provide constant positive pressure on their latch plates.  
They can be reached through the coin door **AFTER turning power to the game off.**  
To release the latches, lift up and toward the center of the control panel.  
Once they are released, unhook them from their latch plates.
- To remove the control panel:  
Raise it up and tilt it toward you until you can see the cable behind it.  
Cradling the control panel between yourself and the cabinet, disconnect it from its cabling.  
The control panel is now free and can be removed.
- To reinstall the control panel, reverse this procedure.

### 2. MINI MODEL:

- The control panel is held in place by two latches, one on the right side and one on the left side of the cabinet.  
They are spring loaded to provide constant positive pressure on their latch plates.  
They can be reached through the coin door **AFTER turning power to the game off.**  
To release the latches, lift up and toward the center of the control panel.  
Once they are released, unhook them from their latch plates.
- To remove the control panel:  
Raise it up and tilt it toward you until you can see the cable behind it.  
Cradling the control panel between yourself and the cabinet, disconnect it from its cabling.  
The control panel is now free and can be removed.
- To reinstall the control panel, reverse this procedure.

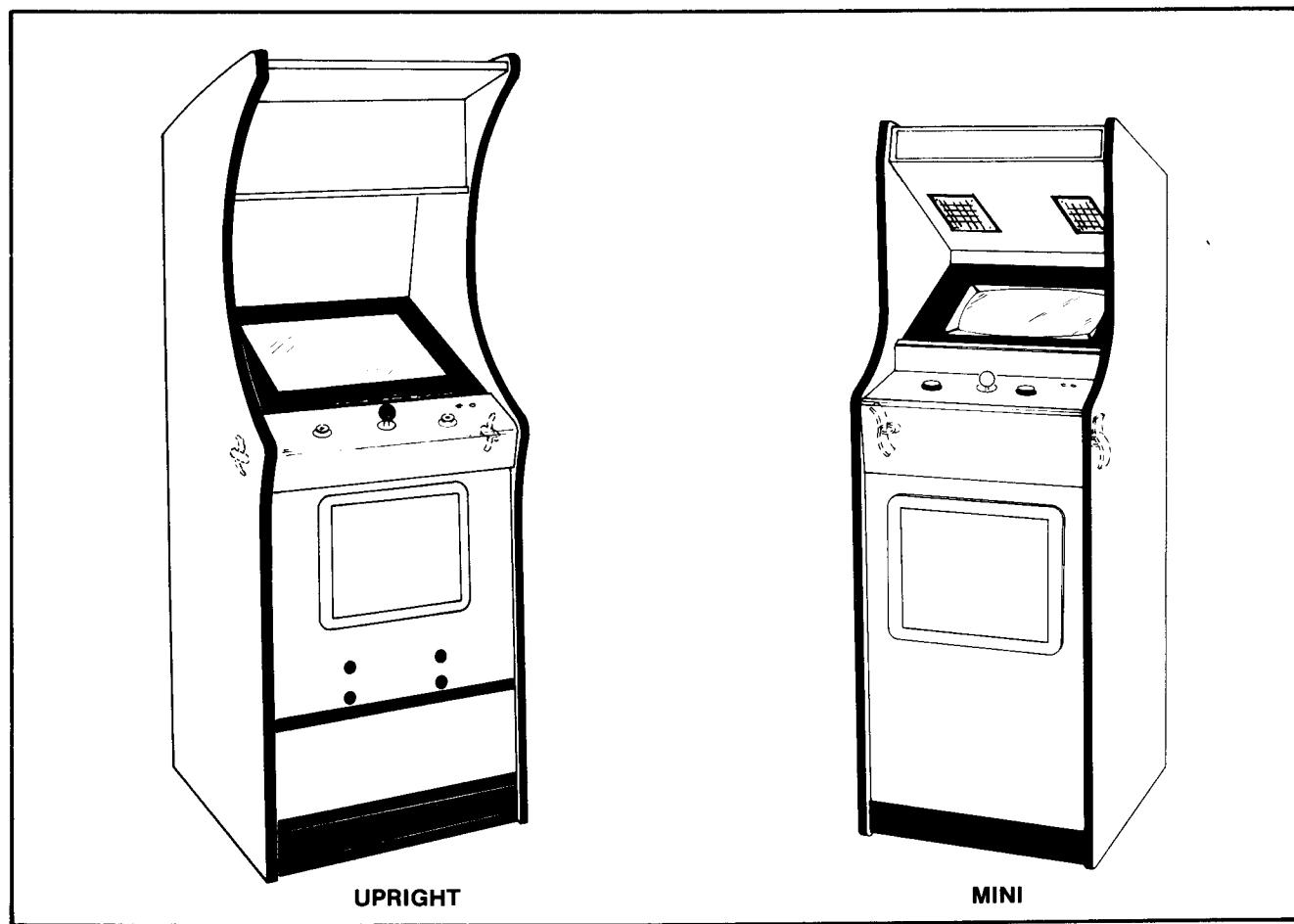
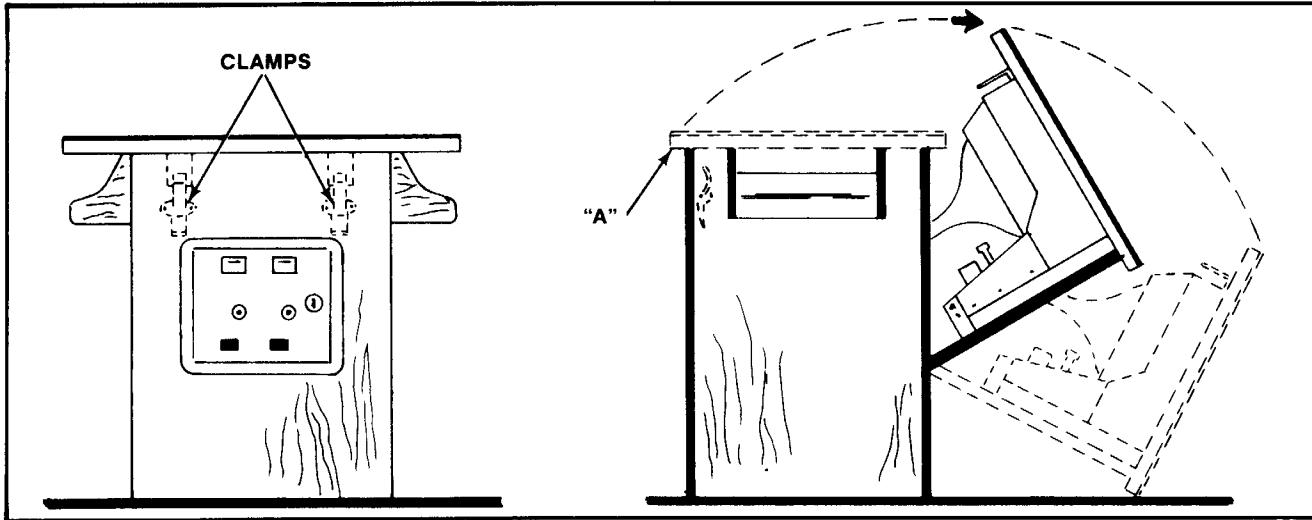


Figure 4-2 Opening the Control Panel — Upright & Mini



**Figure 4-3 Opening the Cocktail Game**

### 3. COCKTAIL TABLE MODEL:

- Each control panel is held in place by several screws, two on the inside of the cabinet and three along the outside bottom edge of the control panel.

**Turn power to the game off.**

Open the coin box door and release the two latches indicated in Figure 4-3.

**CAUTION: The right hand latch is very close to the HIGH VOLTAGE on the monitor.**

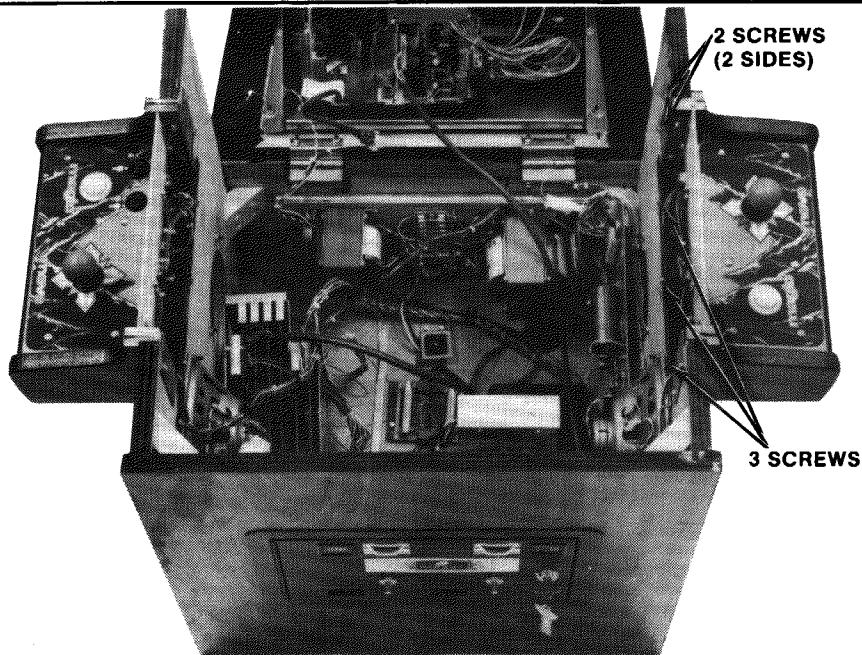
Once they're released, unhook them from their latch plates.

Grasp the table top at "A" and open it as indicated in Figure 4-3.

**CAUTION: Due to the weight of the monitor, EXTREME CARE MUST be taken when opening the cabinet.**

Remove the screws which secure the control panel in place. See Figure 4-4.

- To remove the control panel(s):
  - Disconnect it from its cabling.
  - The control panel is now free and can be removed.
- To reinstall the control panel, reverse this procedure.



**Figure 4-4 Removing the Control Panel — Cocktail**

## REMOVAL OF THE MAIN-DISPLAY-GLASS AND/OR THE T.V. BEZEL ASSEMBLY

### 1. UPRIGHT MODEL: (See Figure 4-5).

NOTE: In order to do this, the control panel **MUST** be removed first. See the "UPRIGHT MODEL" procedure.

- Turn the power to the game off and remove the control panel. This frees the main-display-glass so it can be lifted up.
- By putting your finger in the hole in the middle of the main-display-glass support, you can lift it up and out.
- Loosen the screws which secure the T.V. bezel-glass-clamps in place.  
Move the clamps to the side and the bezel glass may be removed.  
Remove the above mentioned screws and the bezel with four bezel-glass-clamps may be removed.
- To reinstall the T.V. bezel assembly and the main-display-glass, reverse this procedure.

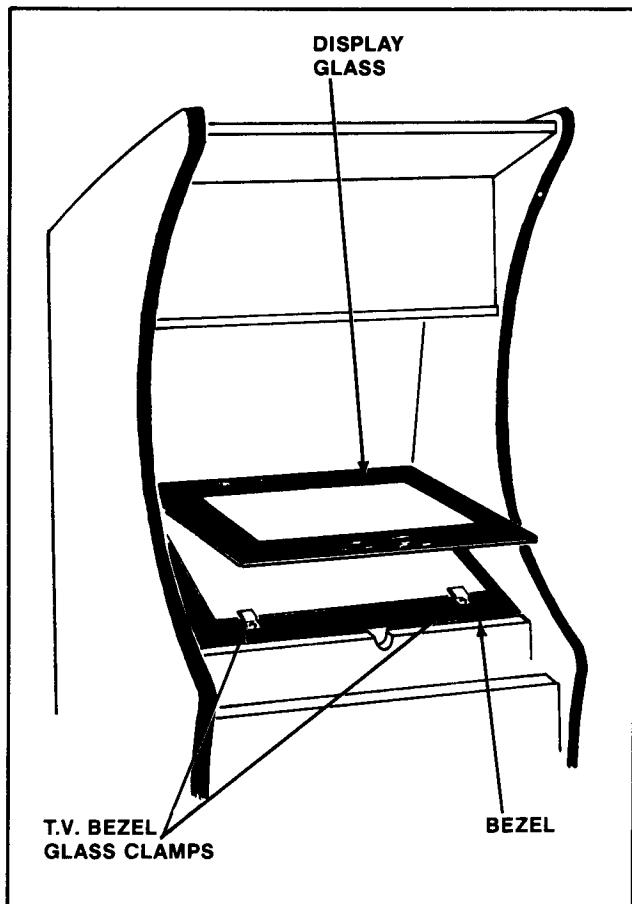


Figure 4-5 Removing the Main Display Glass &  
T.V. Bezel — Upright

### 2. MINI MODEL: (See Figure 4-6).

NOTE: In order to do this, the control panel **MUST** be removed first. See the "MINI MODEL" procedure.

- Turn the power off to the game and remove the control panel.
- Remove the screws which secure the glass clamping plate.
- Lift out the glass clamping plate. This frees the main-display-glass so it can be lifted up.
- By putting your finger in the hole in the middle of the main-display-glass support, you can lift it up and out.
- Remove the screws which secure the T.V. bezel assembly and lift it out.

NOTE: Use the hole in the center of the main-display-glass support to grasp it.

- Reverse this procedure to reinstall the T.V. bezel assembly and the main-display-glass.

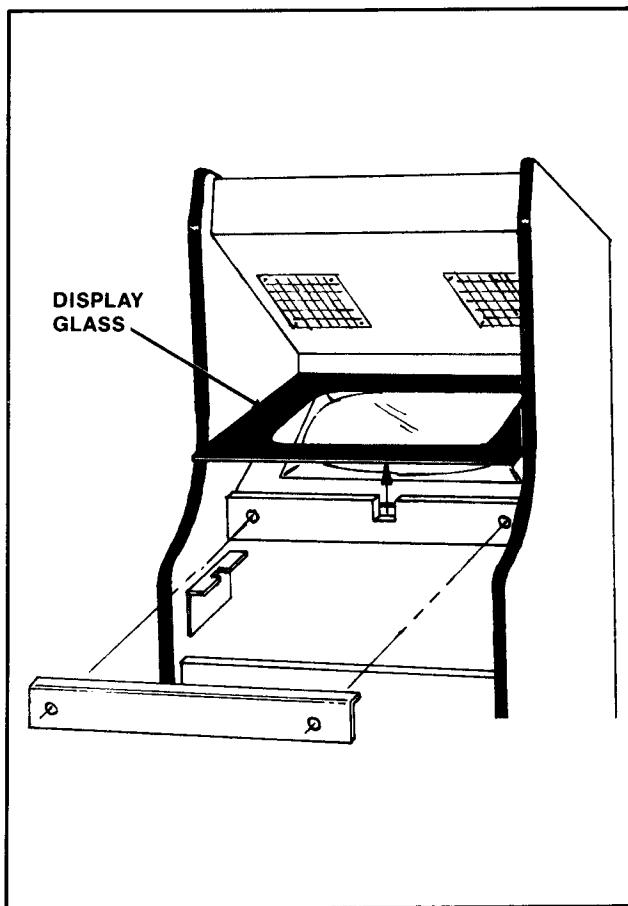


Figure 4-6 Removing the Main Display Glass &  
T.V. Bezel — Mini

### 3. COCKTAIL TABLE MODEL: (See Figure 4-7).

**NOTE:** This may be done with the table top in the open or the closed position. If you decide to open the table top, TURN THE POWER TO THE GAME OFF FIRST.

- Remove the screws which secure the table top glass clamps in place.
- Remove the table top glass.
- Loosen the screws which secure the T.V. bezel-glass-clamps in place.
- Move the clamps to the side and the bezel glass may be removed.
- Remove the screws which secure the bezel assembly to the table top and the bezel with four bezel-glass-clamps may be removed.
- To reinstall the T.V. bezel assembly and the table top glass, reverse this procedure.

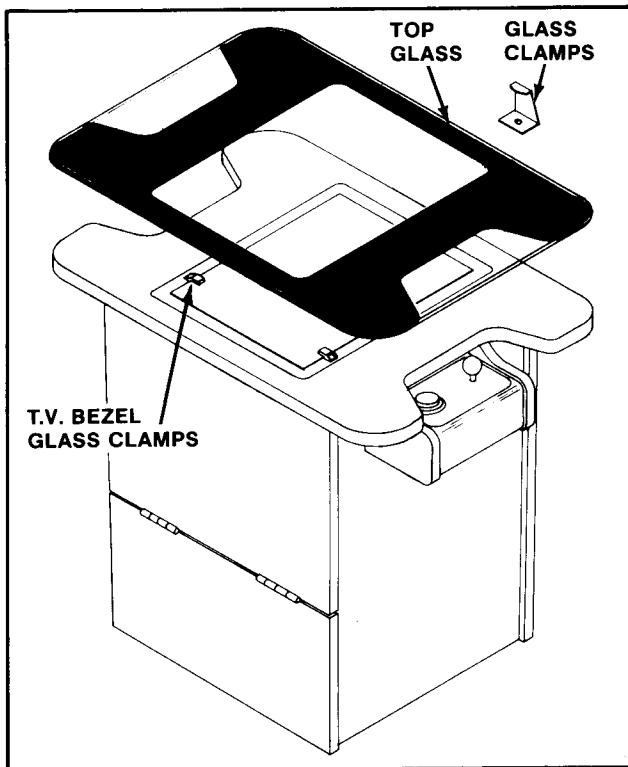


Figure 4-7 Removing the Top Glass & T.V. Bezel  
— Cocktail

### T.V. MONITOR REPLACEMENT:

**CAUTION:** High voltages may exist in any television unit, even with the power disconnected. Use EXTREME CAUTION and do not touch electrical parts or the T.V. yoke area with your hands or with metal objects held in your hands!

In addition, BE SURE TO USE HEAVY GLOVES when handling the monitor. You could cut your hands on the metal T.V. chassis without such protection.

**DANGER:** The T.V. monitor DOES NOT contain an isolation transformer on its chassis (it is mounted instead on the floor of the cabinet). When servicing the monitor on a test bench, YOU MUST ISOLATE THE MONITOR FROM AC VOLTAGE WITH AN ISOLATION TRANSFORMER.

### 1. UPRIGHT MODEL: (See Figure 4-8).

- Turn power off to the game.
- Open the rear access door.
- Completely disconnect the T.V. monitor from all its cabling. **DON'T FORGET THE CHASSIS GROUND WIRE.**
- Before removing the T.V. monitor, the main-display-glass and bezel **MUST** be removed. See above "Upright Model" procedure.
- With the removal of only four bolts, the T.V. monitor and its mounting channels will be loose.
- The monitor mounting channels slide on top of and against two metal guides mounted to the cabinet's right and left side. The monitor is removed by sliding it out the back of the cabinet. See Figure 4-8.
- To reinstall the T.V. monitor, reverse this procedure.
- After replacing the T.V. monitor, be sure to run the game Self-Test.

### 2. MINI MODEL: (See Figure 4-9).

- Turn the power off to the game.
- Open the rear access door.
- Completely disconnect the T.V. monitor from all its cabling. **DON'T FORGET THE CHASSIS GROUND WIRE.**
- Before removing the T.V. monitor, the main-display-glass and bezel **MUST** be removed. See above "Mini Model" procedure.
- With the removal of only four nuts, the T.V. monitor will be loose.

**CAUTION: BE SURE to support the T.V. monitor from the rear while removing the four bolts so it will not fall out of the cabinet.**

- The monitor is removed by supporting it and pulling straight back as shown in Figure 4-9.
- To reinstall the T.V. monitor, reverse this procedure.
- After replacing the T.V. monitor, be sure to run the game Self-Test.

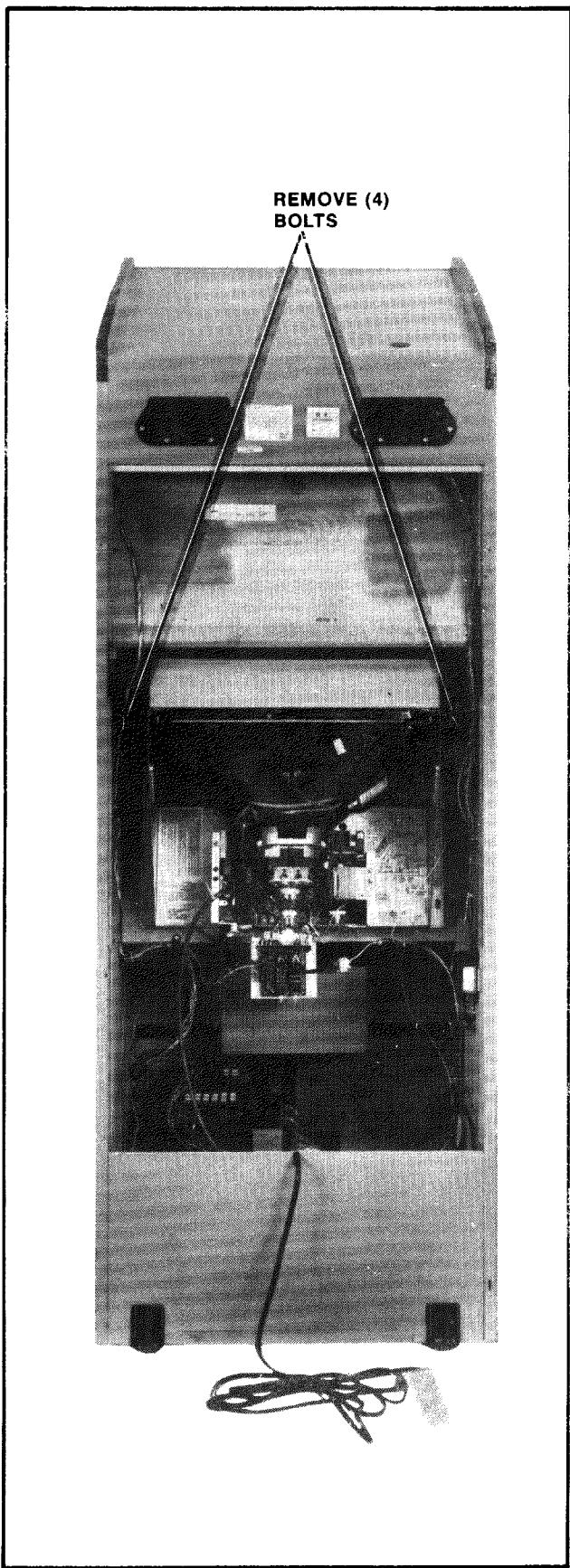


Figure 4-8 Removing the Monitor — Upright

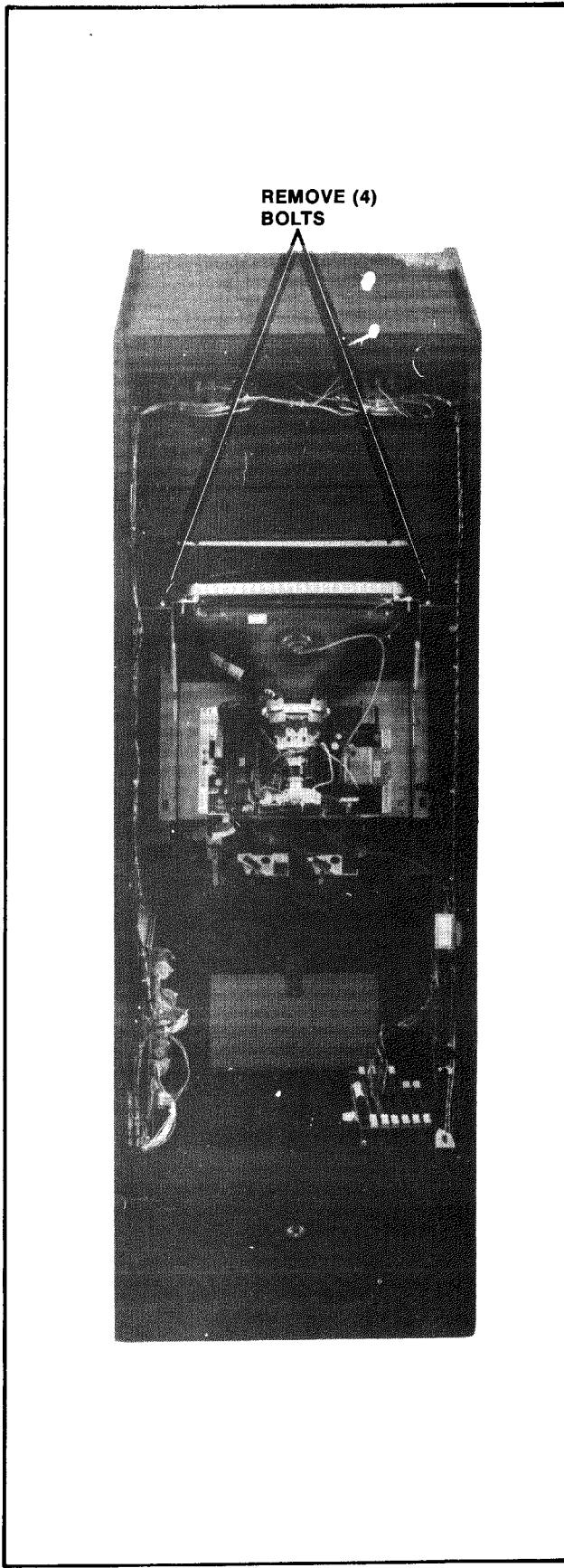
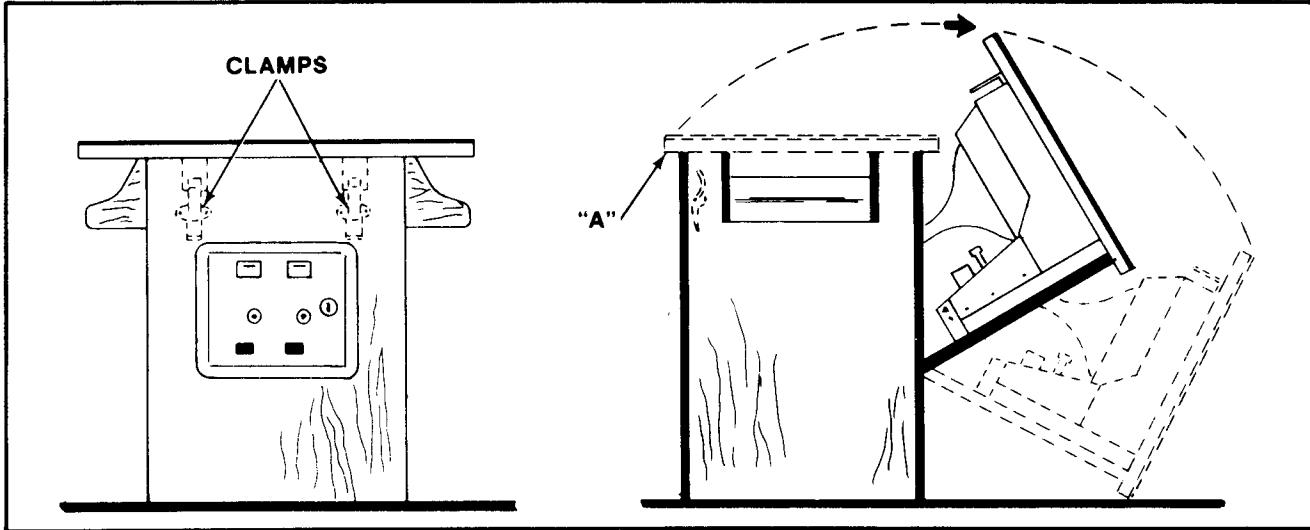


Figure 4-9 Removing the Monitor — Mini



**Figure 4-10 Opening the Cocktail Game**

**3. COCKTAIL TABLE MODEL: (See Figure 4-11).**

- Turn power off to the game.
- Open the coin box door and release the two latches indicated in Figure 4-10.

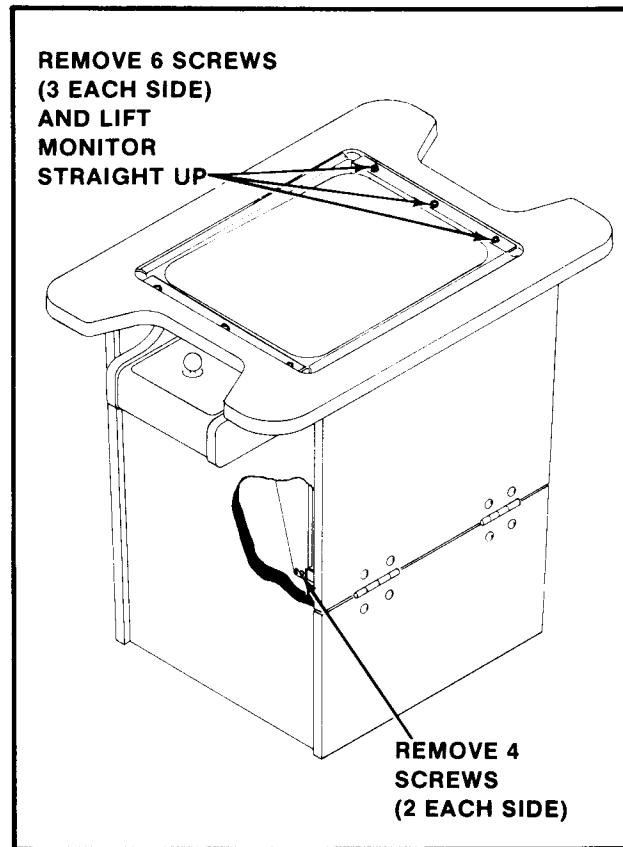
**CAUTION: The right hand latch is very close to the HIGH VOLTAGE on the monitor.**

- Once the latches are released, unhook them from their latch plates.
- Grasp the table top at "A" and open it as indicated in Figure 4-10.

**CAUTION: due to the weight of the monitor, EXTREME CARE MUST be taken when opening the cabinet.**

- Remove the screws which hold the table top glass clamps in place.
- Remove the table top glass.
- Lift out the T.V. bezel assembly.
- Completely disconnect the T.V. monitor from all its cabling. **DON'T FORGET THE CHASSIS GROUND WIRE.**
- Remove the screws holding the T.V. monitor chassis to the "L" by the door hinge(s). See Figure 4-11.
- Close the Cocktail Table top and re-latch it.
- Remove the screws which secure the T.V. monitor mounting brackets to the edges of the slot cut in the table top. See Figure 4-11.
- Pry up the end of each monitor mounting bracket with a screwdriver or similar tool until you can grasp them both.
- Lift the T.V. monitor straight up and out of the table top being VERY CAREFUL not to bump the neck of the picture tube.

- To reinstall the T.V. monitor, reverse this procedure.
- Be sure to check the clearance of the "L" brackets BEFORE setting the monitor into the table top.
- After replacing the T.V. monitor, be sure to run the game Self Test.



**Figure 4-11 Removing the Monitor — Cocktail**

## PRINTED CIRCUIT BOARD (P.C.B.) REPLACEMENT:

**NOTE:** P.C.B.'s are all keyed and will **ONLY** fit into their connectors one way without forcing them. The plugs on the cable harness which connect it to the P.C.B.'s are also keyed and will **ONLY** go onto their connectors one way without forcing them.

### 1. UPRIGHT MODEL: (See Figure 4-13).

- Turn the power to the game off.
- Unlock and open the coin door.
- Reach inside and release the game's front access door locking latches. See Figure 4-12 and the drawing on top of the coin box lid.
- Slide out the utility shelf. See Figure 4-13.

Mounted on the utility shelf is the commercial card rack with six cards in it.

Mounted next to the commercial card rack is its power supply PCB.

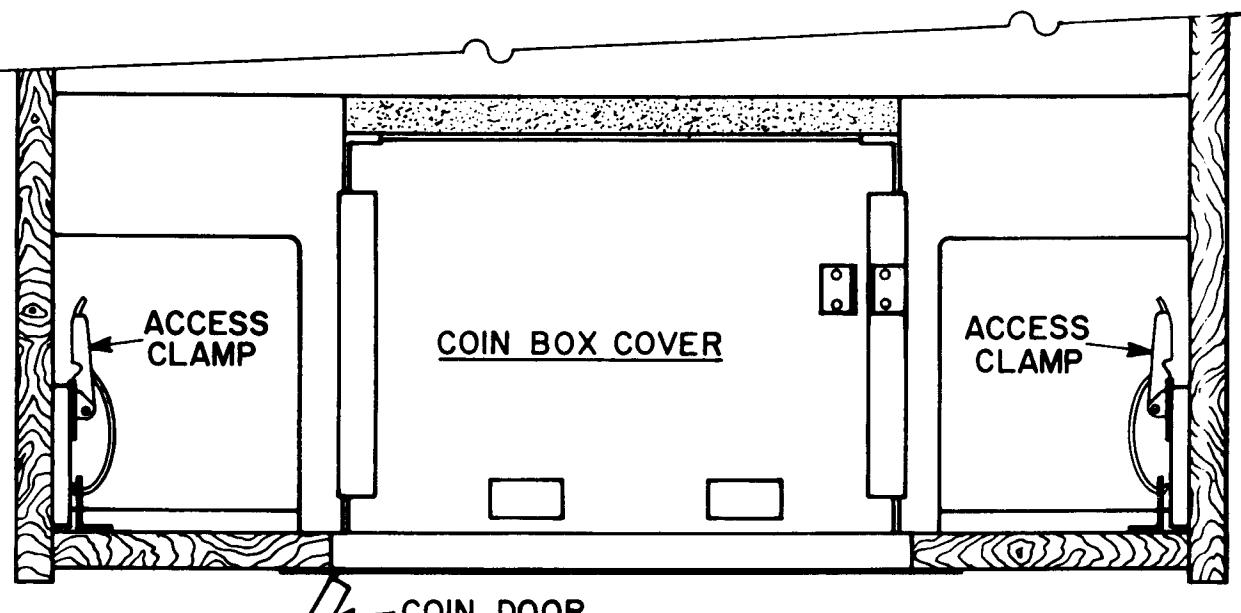
To remove the cards from the commercial card rack, simply lift on their extractors and remove them.

**NOTE: BEFORE** removing the "GAME PCB", be sure to disconnect it from all its cabling.

To remove the power supply PCB for the commercial card rack. See Figure 4-13.

Disconnect it from all its cabling, remove the screws which secure the top PCB support to its mounting bracket (be careful not to lose the washers), and lift it out.

To reinstall the above P.C.B.'s, reverse this procedure.

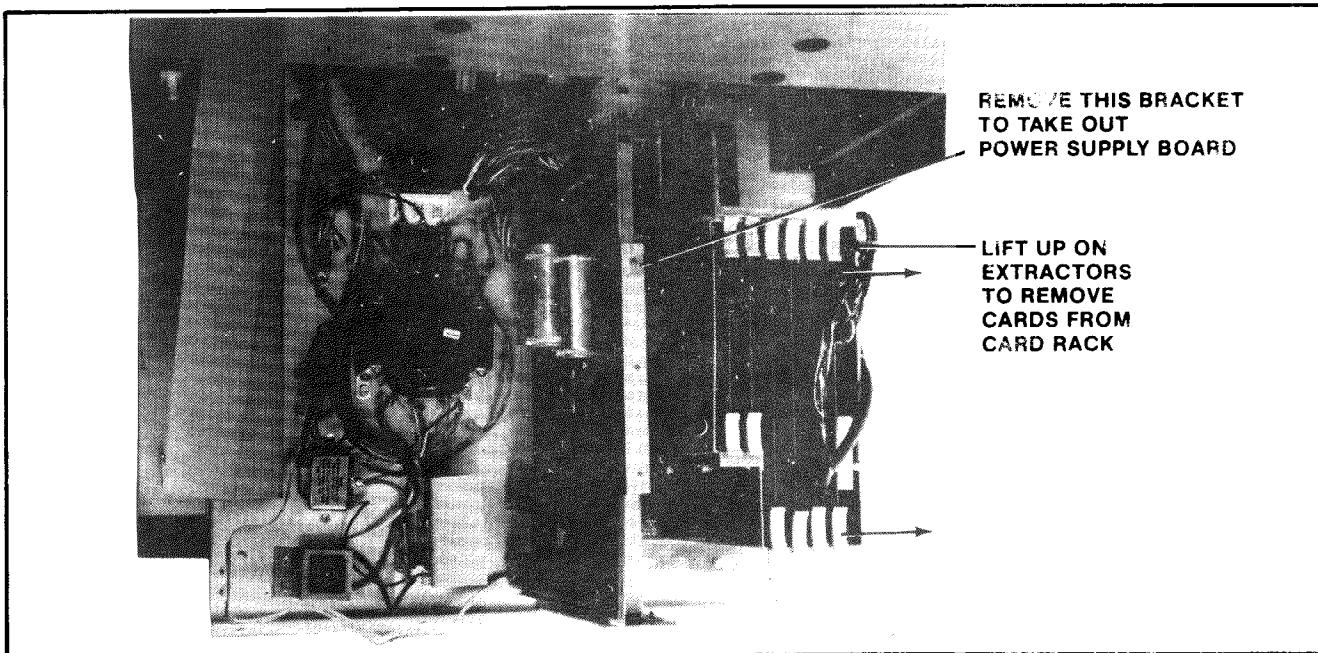


### FOR SERVICE ACCESS

1. OPEN LOWER SERVICE DOOR BY RELEASING TWO ACCESS CLAMPS. (LOCATIONS AS SHOWN)
2. REMOVE TWO RED SHIPPING BRACKETS AND SLIDE OUT SERVICE SHELF.

MOSI-00100-0000

Figure 4-12 Opening the Front Access Door — Upright



**Figure 4-13 Removing Printed Circuit Boards — Upright**

**2. MINI MODEL: (See Figure 4-14).**

- Turn the power off to the game.
- Unlock and open the rear access door.
- Disconnect the "GAME PCB" from all its cabling.
- To remove any of the PCB's from the commercial card rack, just lift up on their extractors and slide them up and out.  
They may now be removed from the cabinet.
- Disconnect the power supply board from all its cabling, remove the P.C.B. supports indicated in Figure 4-14, and slide it out the back of the cabinet.
- To reinstall the above P.C.B.'s, reverse this procedure.

**3. COCKTAIL TABLE MODEL: (See Figure 4-15).**

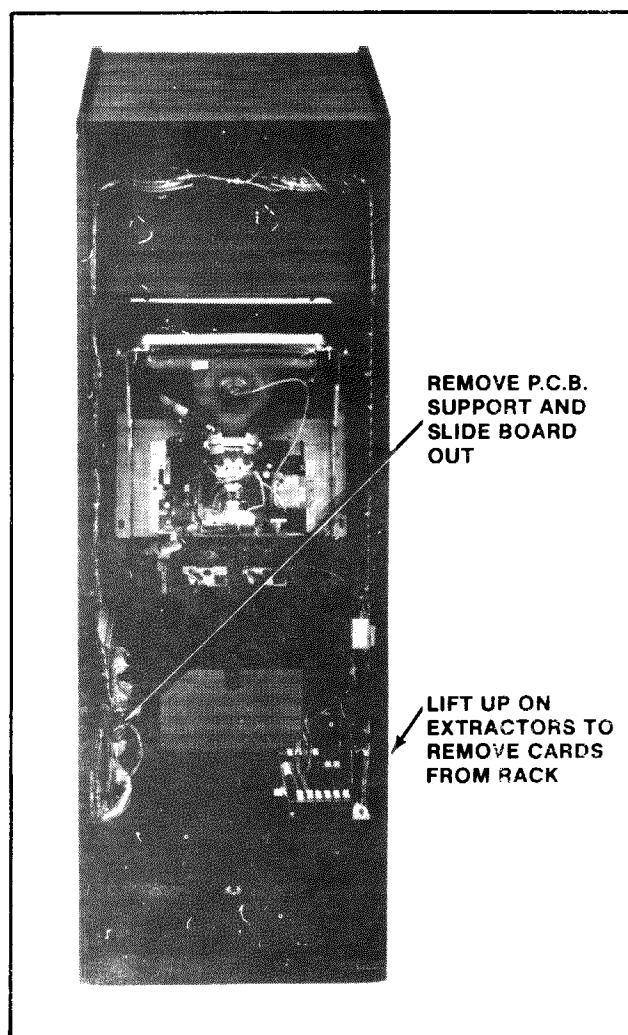
- Turn the power off to the game.
- Open the cabinet:  
Open the coin box door and release the two latches indicated in Figure 4-10.

**CAUTION: The right hand latch is very close to the HIGH VOLTAGE on the monitor.**

Once they're released, unhook them from their latch plates.

- Grasp the table top at "A" and open it as indicated in Figure 4-10.

**CAUTION: Due to the weight of the monitor, EXTREME CARE MUST be taken when opening the cabinet.**



**Figure 4-14 Removing Printed Circuit Boards — Mini**

- To remove the power supply board. See Figure 4-15.  
Disconnect it from all its cabling.  
Remove the two smallest P.C.B. supports.  
Once these are removed, the power supply can be lifted out the top of the cabinet.  
To reinstall the power supply board, reverse this procedure.
- To remove the PCB's from the commercial card rack. See Figure 4-15.

Disconnect the "GAME PCB" from all its cabling.  
To remove any of the PCB's from the commercial card rack, just lift up on their extractors and slide them up and out.  
They may now be removed from the cabinet.  
To reinstall these PCB's, reverse this procedure.



Figure 4-15 Removing Printed Circuit Boards — Cocktail

## OPENING THE ATTRACTION PANEL:

### 1. UPRIGHT MODEL: (See Figure 4-16).

Turn the power to the game off.

Opening the attraction panel:

Remove the screws which secure the bottom bracket in place. (They are on its under side.) See Figure 4-16.

Remove the bottom bracket and let the attraction panel drop down. This exposes the attraction panel fluorescent light tube and its mounting bracket assembly.

To reinstall the attraction panel, reverse this procedure.

The fluorescent light tube may be replaced at this time. BE CAREFUL NOT TO DROP IT.

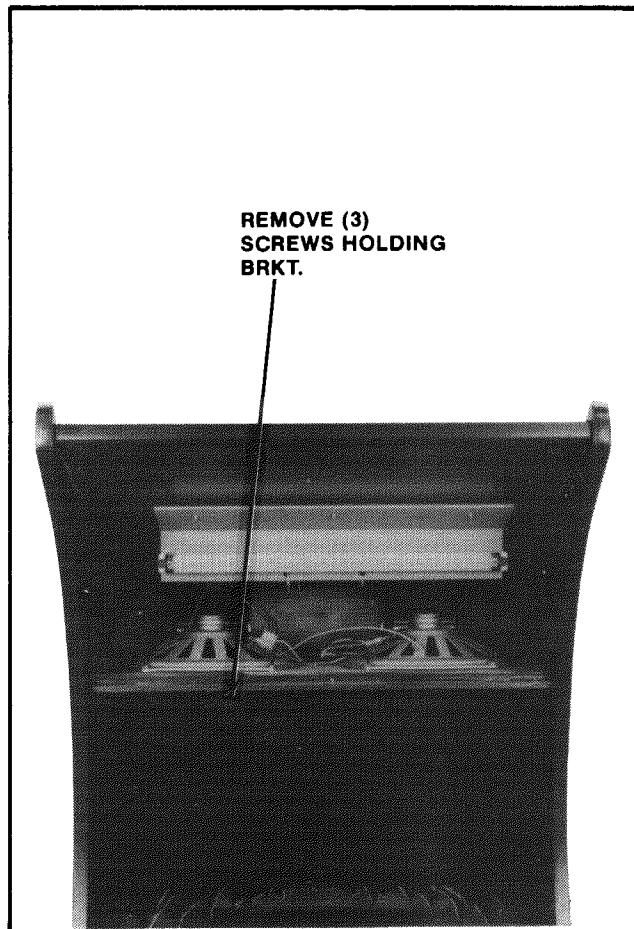
**WARNING: If you drop a fluorescent tube and it breaks, IT WILL IMPLODE! Shattered glass can fly six (6) feet or more from the implosion. Use care when replacing any fluorescent tube.**

Replacing the fluorescent tube starter. See Figure 4-17.

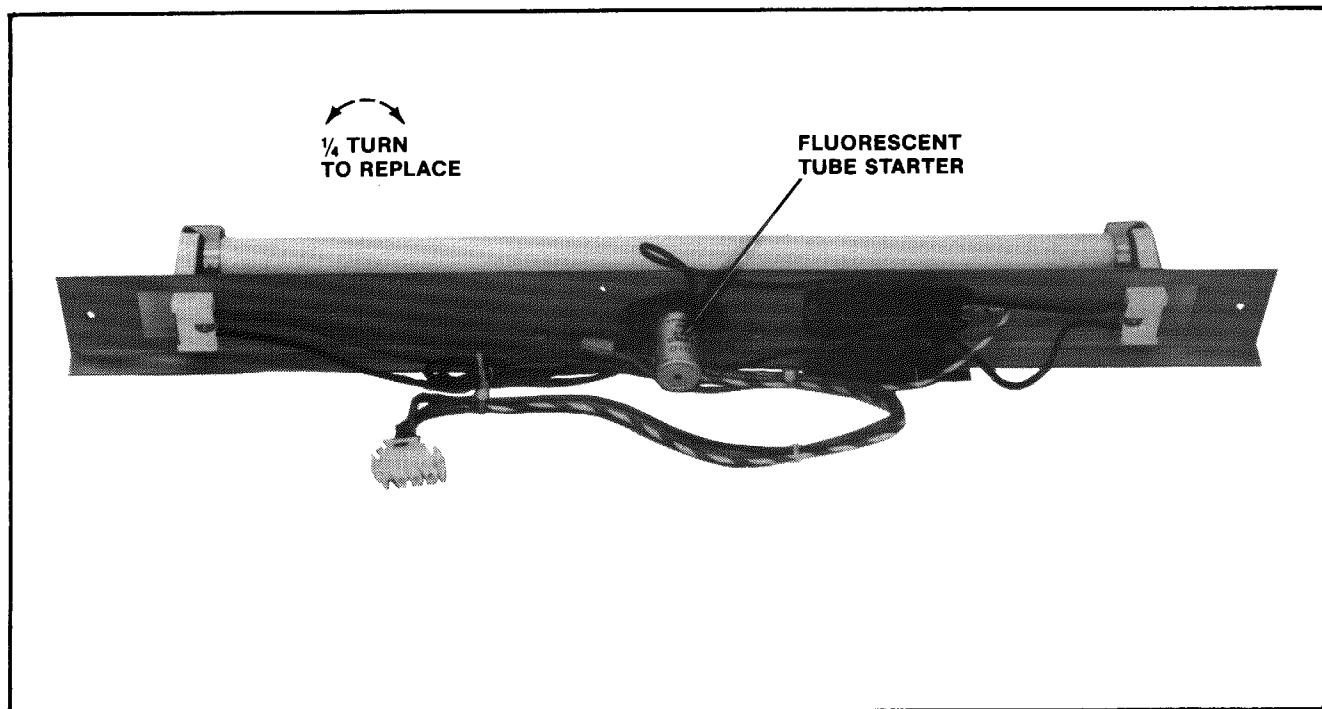
**Be sure the power to the game has been turned off.**

Grasp the starter (it is on the back of the mounting bracket), give it a quarter turn, and remove it from its socket.

To replace the fluorescent light tube starter, reverse this procedure.



**Figure 4-16 Opening the Attraction Panel — Upright**



**Figure 4-17 Replacing the Fluorescent Tube Starter — Upright**

- Replacement of the fluorescent tube mounting bracket assembly.

**Be sure the power is off to the game.**

Disconnect it from its power cable.

Remove the screws at its right and left hand sides which secure it and gently slide it out the front of the cabinet, being careful not to catch its power cable on anything.

To reinstall the fluorescent tube mounting bracket assembly, reverse this procedure.

- Replacing the speaker.

**Be sure the power is off to the game.**

Remove the attraction panel and disconnect the speaker from its cabling.

Remove the nuts and bolts which secure the speaker and speaker grill in place and set them and the speaker grill aside.

Once the bolts which secure the speaker in place are removed, the speaker may be removed through the opening where the attraction panel was.

Reverse this procedure to reinstall the speaker.

## 2. MINI MODEL: (See Figure 4-18).

- Turn the power off to the game.

- Remove the screws from the top and bottom of the formed attraction panel.

- Remove the formed attraction panel by pulling it straight away from the cabinet. This exposes the attraction panel light bulbs and their mounting board.

- To service the light bulbs and their mounting board:

Turn the power to the game back on so you can see which bulbs are burnt out.

Mark the burnt out bulbs and **turn the power to the game back off again.**

To replace the burnt out bulbs, grasp them gently and pull straight out.

The new bulbs are gently pushed into the empty sockets.

To completely replace the light bulb mounting board:

Open the cabinet rear access door and unplug the mounting board from its power cable

Remove the screws that hold the mounting board to the cabinet.

Gently slide the mounting board out the front of the cabinet being careful not to catch its cable on anything.

To reinstall the above removed items, reverse this procedure.

- To replace the speaker.

**Be sure the power is off to the game.**

Disconnect the speaker from its cabling.

Remove the nuts and bolts securing the speaker.

Slide the speaker out through the rear access door.

To reinstall the speaker, simply reverse this procedure.

## 3. THE COCKTAIL TABLE MODEL HAS NO BACK-LIT ATTRACTION PANEL.

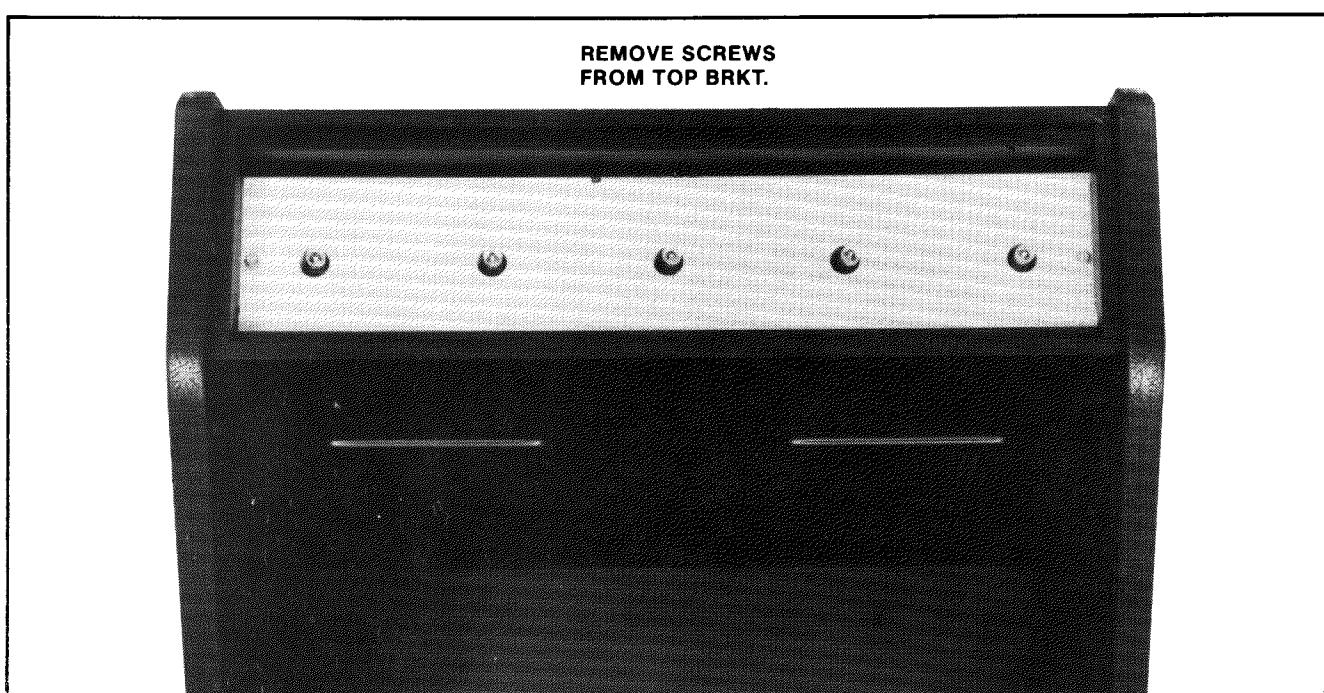
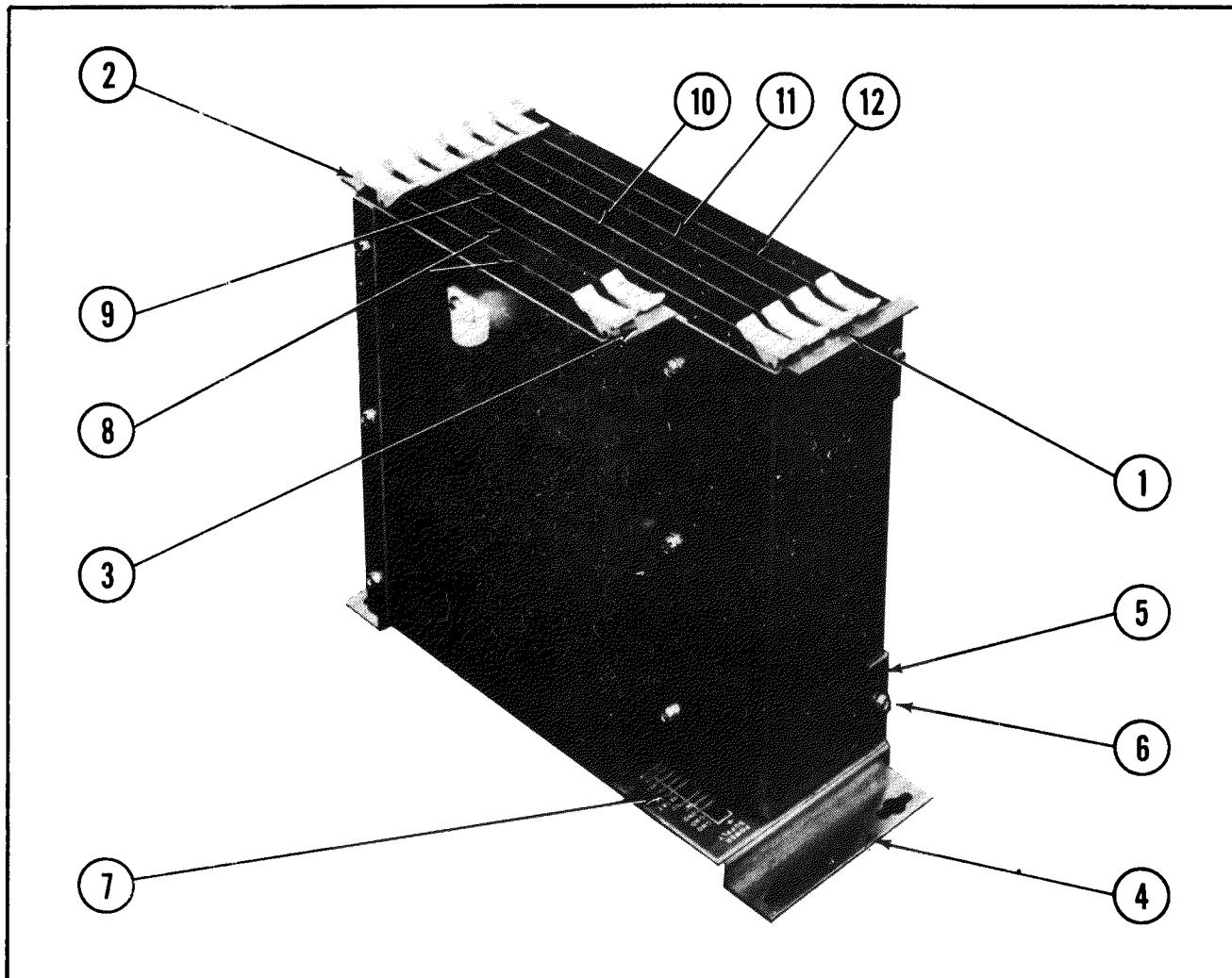


Figure 4-18 Opening the Attraction Panel — Mini

## **V Illustrated Parts Breakdown**

**ROBBY ROTO — COMMERCIAL CARD RACK ASSEMBLY**

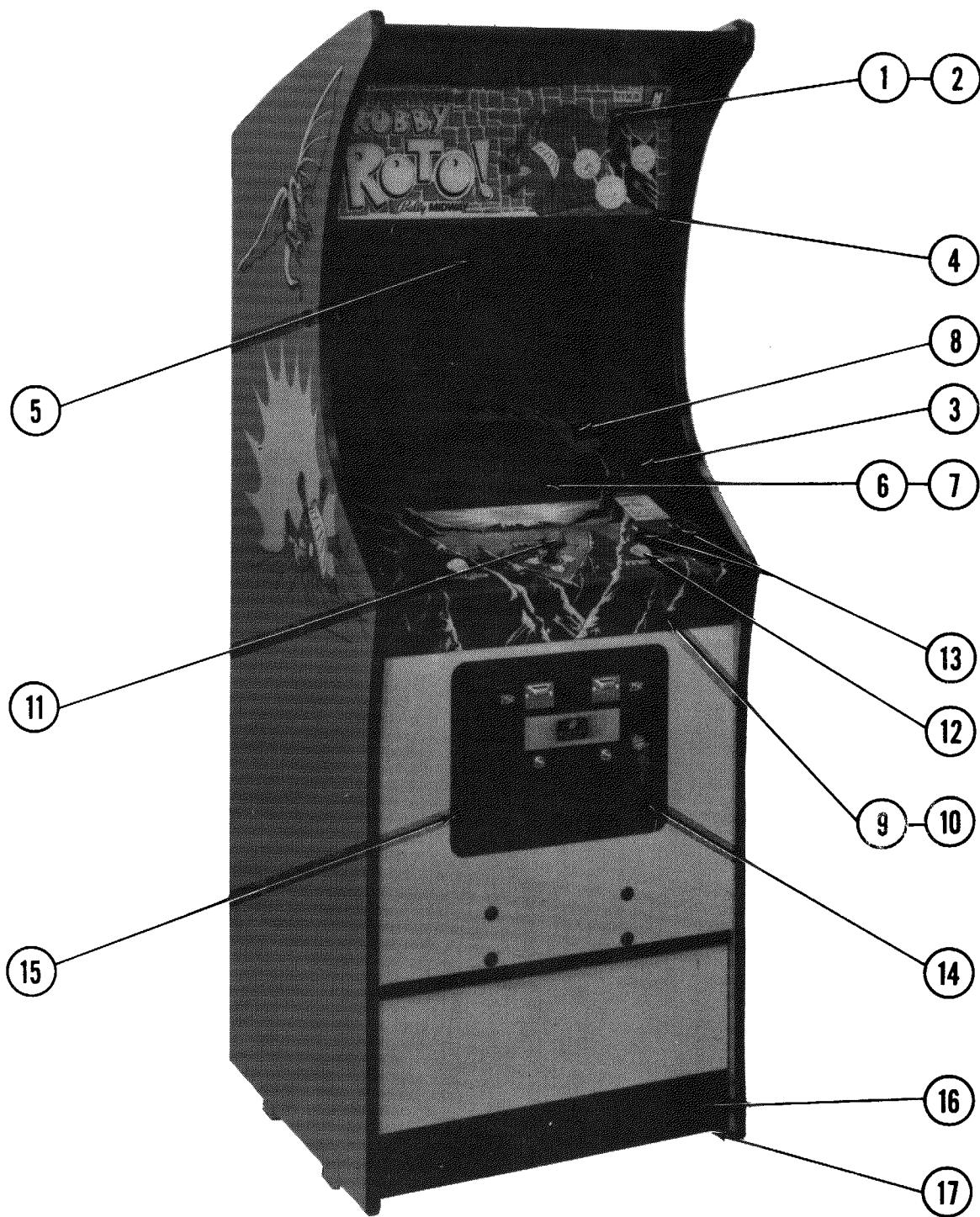


**ROBBY ROTO — COMMERCIAL CARD RACK ASSEMBLY — PARTS LIST**

**ORDER BY PART NUMBER ONLY**

ITEM	PART NO.	DESCRIPTION
1	A789-00003-0100	P.C. RACK ASSY. — RIGHT
2	A789-00004-0100	P.C. RACK ASSY. — LEFT
3	A789-00005-0000	P.C. RACK ASSY. — BASE
4	0789-00100-0000	MTG. BRKT. SUPPORT (2 REQ'D.)
5	0789-00106-0000	RACK STRAP (2 REQ'D.)
6	0017-00101-0099	#6 x 1/4 SLT. HEX HD. SCREW (11 REQ'D.)
	0017-00104-0019	#6 FLAT WASHER (3 REQ'D.)
7	A082-90006-B000	BACK PANEL P.C. ASSY. (MOTHER BOARD)
8	A082-91356-C000	RAM BOARD ASSY.
9	A082-91354-F000	CPU BOARD ASSY.
10	A082-91355-C000	PATTERN TRANSFER BOARD ASSY.
11	A084-91423-A530	MEMORY BOARD ASSY.
12	A084-90708-A530	GAME LOGIC BOARD ASSY.
	0017-00007-0153	P.C. BOARD SUPPORT (2 REQ'D.) (NOT SHOWN)

NO. 530 — ROBBY ROTO — UPRIGHT — FRONT

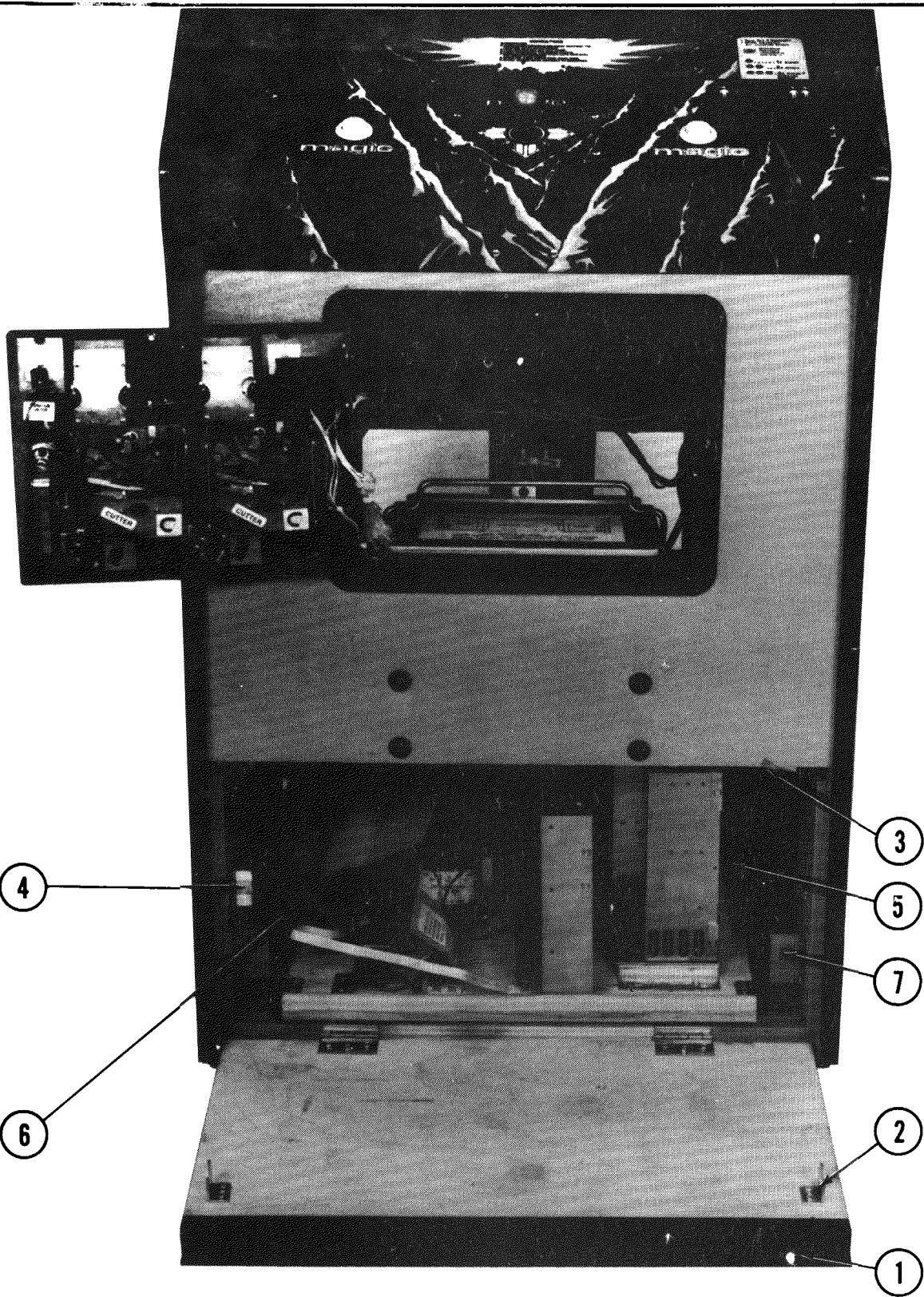


## NO. 530— ROBBY ROTO — UPRIGHT — FRONT — PARTS LIST

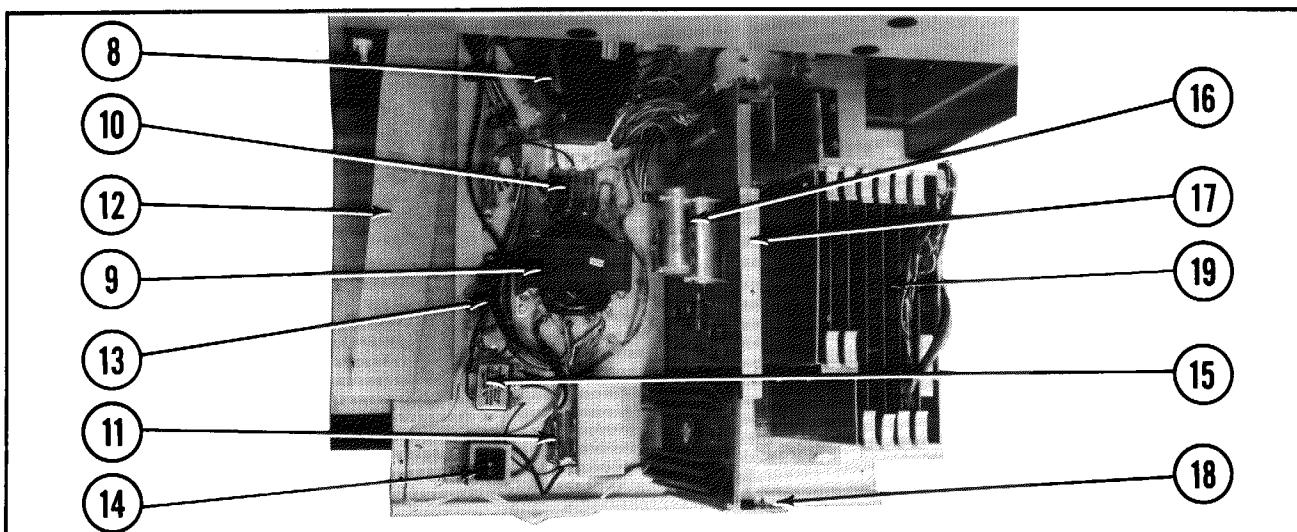
ORDER BY PART NUMBER ONLY

ITEM	PART NO.	DESCRIPTION
1	0530-00900-00XF	HEADER DISPLAY PLEXI — 23" x 8-7/8" x 3/16"
2	A595-00011-0000	HEADER LIGHT ASSY.
3	0537-00903-0052	GLASS CHANNEL — 8-1/8" LG. (2 REQ'D.)
4	0530-00102-00XF	HEADER RETAINER
	0017-00101-0138	#8 x 5/8 TORX TAMPER PROOF PAN HD. SCREW (3 REQ'D.)
	0017-00009-0522	LONG ARM KEY T-20 (FOR ABOVE SCREW)
5	0017-00009-0393	BLACK SPEAKER GRILLE W/SLOTS (2 REQ'D.)
	0017-00003-0187	6" x 9" SPEAKER 8 OHM, 9W. (2 REQ'D.)
	0017-00101-0127	#8-32 x 1-1/2 CARRIAGE BOLT (8 REQ'D.)
	0017-00103-0061	#8-32 HEX NUT W/SEMS (8 REQ'D.)
6	0508-00900-0000	19" T.V. BEZEL
7	0508-00903-0000	T.V. SMOKED PLEXI-GLASS — 17-3/8" x 13-1/4" x 1/8"
	0508-00901-0000	PLEXI-GLASS CLIPS (4 REQ'D.)
	0017-00101-0017	#6 x 1/2 SLT. HEX HD. BLK. SCREW (3 REQ'D.)
8	0530-00901-00XF	MAIN VIEWING GLASS — 23" x 19-11/16" x 3/16"
	0508-00108-0000	GLASS STOP BRKT. (CABINET REAR)
	0017-00101-0027	#8 x 3/4 SLT. HEX HD. M.S. (3 REQ'D.)
9	0530-00902-0000	DECORATIVE CONTROL SHELF OVERLAY
10	A530-00006-0000	WELDED-CONTROL SHELF PLATE ASSY.
	A530-00005-0000	CONTROL SHELF PLATE ASSY. W/OVERLAY
	0017-00101-0620	#8-32 x 1/2 CARRIAGE BOLT (10 REQ'D.)
	0017-00103-0061	#8-32 HEX NUT W/SEMS (10 REQ'D.)
	0508-00115-0000	CENTER CONTROL SHELF LOCK BRKT.
	0961-00115-00XF	STRIKE (2 REQ'D.)
	0017-00009-0033	LATCH CLAMP ( 3 REQ'D.)
	0550-00101-0100	CONTROL SHELF MTG. BRKT. — RIGHT
	0550-00101-0200	CONTROL SHELF MTG. BRKT. — LEFT
	0555-00901-0000	PLASTIC LOCATING PIN (4 REQ'D.)
	0017-00101-0141	#8 x 11/16 UNSLOT. HEX HD. M.S. (18 REQ'D.)
11	A595-00005-0000	CONTROL ASSY.
	A530-00015-0000	CONTROL SHELF CABLE ASSY.
12	0017-00042-0257	PUSH BUTTON ASSY. — YELLOW (2 REQ'D.)
	0017-00032-0093	PUSH BUTTON SWITCH W/HOLDER (2 REQ'D.)
	0017-00103-0054	5/8-11 PAL NUT (2 REQ'D.)
13	0017-00032-0092	SMALL LIGHTED PUSH BUTTON SWITCH (2 REQ'D.)
	0929-00905-00XF	SWITCH BEZEL (2 REQ'D.)
	0017-00103-0089	5/8-24 HEX NUT (2 REQ'D.)
	0017-00104-0112	WASHER (2 REQ'D.)
14	A090-00300-09BK	U.S.A. 25¢ DOUBLE COIN DOOR ASSY.
	A530-00017-0000	COIN DOOR CABLE ASSY.
15	0090-00002-04BK	LARGE COIN DOOR FRAME
	0017-00101-0121	#6-32 x 5/16 PHIL. TRS. HD. SCR. (3 REQ'D.)
16	0935-00906-0200	KICK PLATE — 22-7/8" LG.
17	0017-00102-0048	3/8-16 x 2" LEG LEVELERS (4 REQ'D.)
	0017-00103-0026	3/8-16 LEG LEVELER HEX NUTS (4 REQ'D.)

NO. 530 — ROBBY ROTO — UPRIGHT — SERVICE DOOR & UTILITY SHELF ASSY.



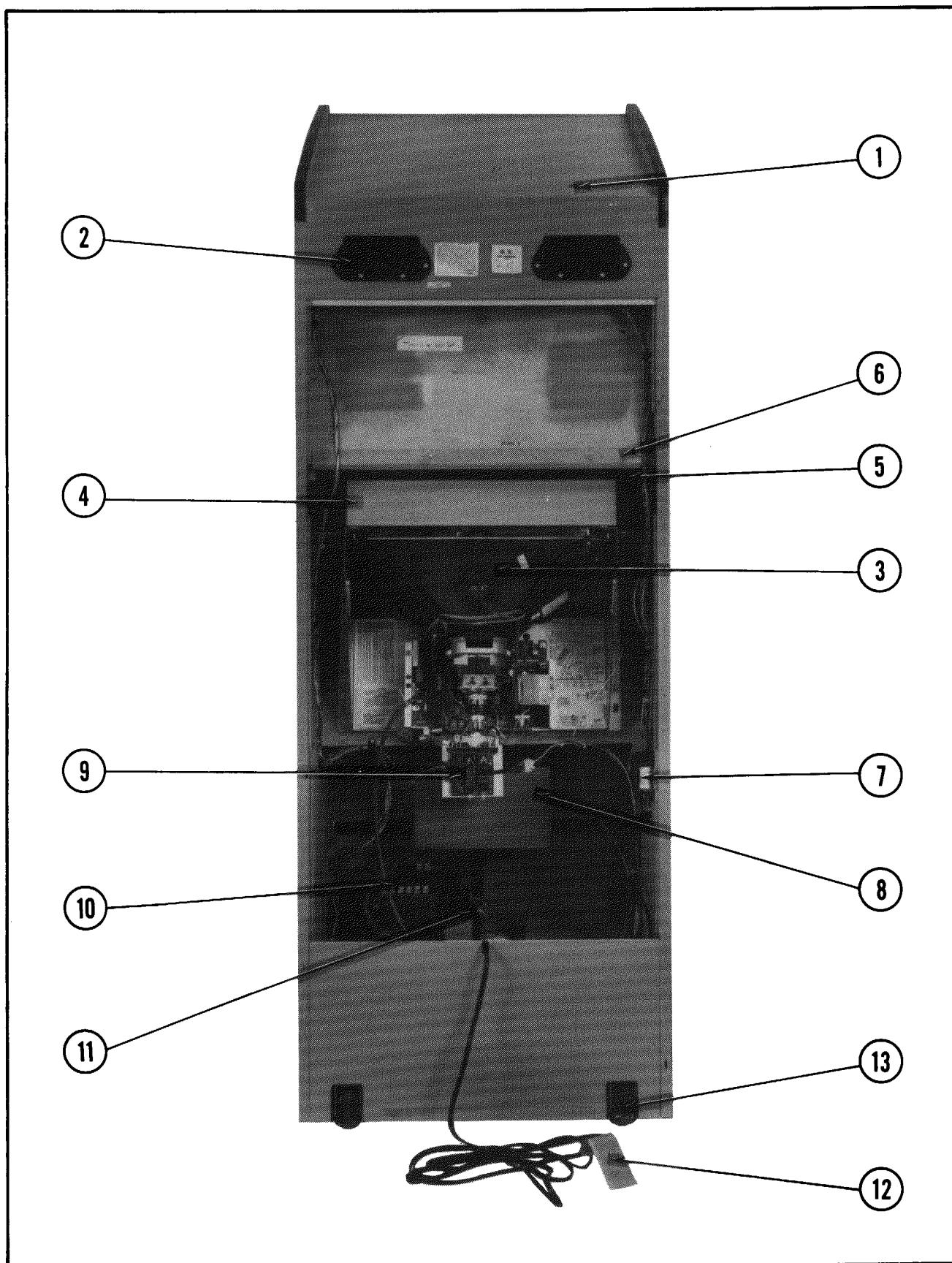
**NO. 530 — ROBBY ROTO — UPRIGHT — SERVICE DOOR & UTILITY SHELF ASSY.**



**NO. 530— ROBBY ROTO — UPRIGHT — SERVICE DOOR & UTILITY SHELF ASSY. — PARTS LIST  
ORDER BY PART NUMBER ONLY**

ITEM	PART NO.	DESCRIPTION
1	0961-00904-0100 0017-00009-0512 0017-00101-0027	DOOR PULL — 22-7/8" LG. DOOR HINGE (2 REQ'D.) #8 x 3/4 SLT. HEX HD. SCR. (12 REQ'D.)
2	0961-00115-00XF	STRIKE (2 REQ'D.)
3	0017-00009-0033 0017-00101-0141	LATCH CLAMP (2 REQ'D.) #8 x 11/16 UNSLOT HEX HD. M.S. (8 REQ'D.)
4	A088-00015-0000	INTERLOCK SWITCH & BRKT. ASSY.
5	0961-00119-0100	UTILITY SHELF RAIL — RIGHT
6	0961-00119-0200	UTILITY SHELF RAIL — LEFT
	0961-00117-0000	UTILITY SHELF STOP BRKT.
	0961-00121-0000	SHELF STOP BRKT.
7	0961-00120-0000 0017-00101-0141	CABINET STOP BRKT. (2 REQ'D.) #8 x 11/16 UNSLOT HEX HD. M.S. (36 REQ'D.)
8	MT00-00087-0000	POWER TRANSFORMER 120/240V.
9	MT00-00092-0000 0017-00101-0628 0017-00103-0061 0017-00101-0060	TRANSFORMER #8-32 x 3/4 CARRIAGE BOLT (4 REQ'D.) #8-32 HEX NUT W/SEMS (4 REQ'D.) #8 x 7/16 SLT. HEX HD. SCR. (4 REQ'D.)
10	0720-00001-0300	3 POSITION FUSE CLIP ASSY.
11	0720-00001-0200 0017-00003-0004 0017-00003-0002	2 POSITION FUSE CLIP ASSY. SLO-BLO FUSE — 2A, 250V. SLO-BLO FUSE — 1/2A., 250V. (4 REQ'D.)
	0961-00906-0000	FISHPAPER SHIELD — FUSE
12	0961-00905-0000	LARGE FISHPAPER SHIELD
13	3010-13106-0000	TERMINAL STRIP
14	A151-00079-0000	115V. CONVENIENCE OUTLET ASSY.
15	A508-00037-0000	2 LEAD TRANSFORMER BRD. FILTER ASSY.
16	A082-90421-B000	POWER SUPPLY ASSY.
17	A530-00023-0000	TOP BRKT. ASSY.
18	A961-00049-0000 0017-00101-0015	MOUNTING FRAME & SUPPORT BRKT. ASSY. #6 x 1/2 SLT. HEX HD. M.S. (15 REQ'D.)
19	A530-00004-0000 3000-17246-0600 3000-17246-0900 3000-17246-0000	CARD RACK ASSY. W/BOARDS (SEE SEPARATE PHOTOGRAPH) 7" GROUND STRAP 48" GROUND STRAP GROUND STRAP

NO. 530 — ROBBY ROTO — UPRIGHT — REAR ACCESS

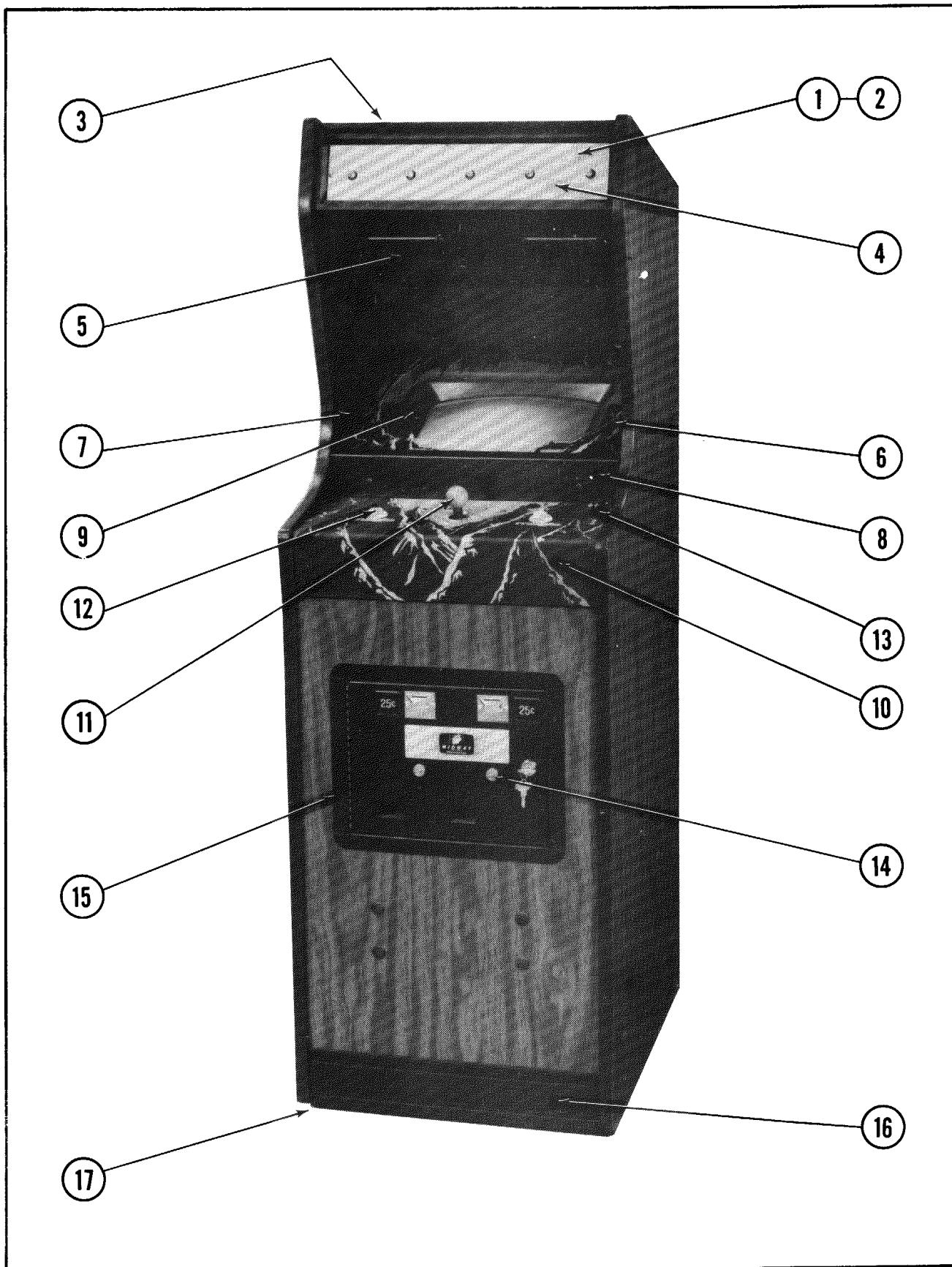


**NO. 530— ROBBY ROTO — UPRIGHT — REAR ACCESS — PARTS LIST**

**ORDER BY PART NUMBER ONLY**

ITEM	PART NO.	DESCRIPTION
1	A088-00013-0000	ON-OFF SWITCH & BRKT. ASSY.
2	0894-00916-0000	PLASTIC PULL & VENT (2 REQ'D.)
	0017-00101-0141	#8 x 11/16 UNSLOT. HEX HD. M.S. (8 REQ'D.)
3	0017-00003-0339	ELECTROHOME — 19" COLOR DUAL SYNC HORIZONTAL MTG. MONITOR (OR)
3	0017-00003-0418	WELLS-GARDNER — 19" COLOR DUAL SYNC HORIZ. MTG. MONITOR
	0636-00101-0000	MONITOR RAIL (2 REQ'D.)
	0555-00901-0000	PLASTIC LOCATING PIN (4 REQ'D.)
	0017-00102-0006	1/4-20 x 3/4 SQR. NECK BOLT (4 REQ'D.)
	0017-00104-0014	7/8" DISH WASHER (4 REQ'D.)
	0017-00101-0141	#8 x 11/16 UNSLOT. HEX HD. M.S. (8 REQ'D.)
4	0508-00106-0000	T.V. BEZEL MTG. BRKT. (2 REQ'D.)
5	0508-00900-0000	19" T.V. BEZEL
6	0508-00108-0000	GLASS STOP BRKT.
	0017-00101-0017	#6 x 1/2 SLT. HEX HD. SCR. (3 REQ'D.)
7	A088-00015-0000	INTERLOCK SWITCH & BRKT. ASSY. (2 REQ'D.)
8	A950-00004-0000	COIN BOX ASSY.
	A950-00006-0000	COIN BOX CRADLE ASSY.
	0950-00105-0000	COIN BOX COVER
	0950-00104-0000	COIN BOX HANDLE
	0950-00101-0000	COIN DEFLECTOR (2 REQ'D.)
	0950-00900-0000	LARGE PLASTIC COIN BOX
	0017-00101-0142	1/4-20 x 1-3/8 BLACK RND. HD. BOLT (4 REQ'D.)
	0017-00104-0014	7/8" DISH WASHER (4 REQ'D.)
	0017-00103-0018	1/4-20 HEX NUT (4 REQ'D.)
9	A084-90912-A530	AUDIO AMP P.C. BRD. ASSY.
	0530-00101-0000	AUDIO AMP & HEAT SINK BRKT.
	0017-00042-0286	1/2" SPACERS (4 REQ'D.)
	0017-00101-0010	#6 x 3/8 SLT. HEX HD. SCR. (4 REQ'D.)
	0017-00101-0774	#6-32 x 3/8 SLT. PAN HD. SCR. (2 REQ'D.)
	0017-00103-0060	#6-32 HEX NUT (2 REQ'D.)
10	A530-00004-0000	CARD RACK W/BOARDS ASSY.
11	A082-90421-B000	UNIVERSAL POWER SUPPLY ASSY.
12	0017-00003-0064	LINE CORD — 16 FOOT LONG
13	A961-00007-0000	CASTER ASSY. (2 REQ'D.)
	0961-00109-0000	WHEEL BRKT. (2 REQ'D.)
	0017-00042-0255	PLASTIC WHEEL (2 REQ'D.)
	0894-00702-00XF	SHAFT (2 REQ'D.)
	0017-00100-0037	3/8" E-RING (2 REQ'D.)
		<b>ADDITIONAL PARTS LIST</b>
	A151-00098-0000	BACK DOOR LOCK ASSY.
	0017-00009-0490	5-5/8" SQR. VENT GRILLE (4 REQ'D.) — BACK DOOR
	A530-00012-0000	HIGH VOLTAGE CABLE ASSY.
	A530-00013-0000	LOW VOLTAGE CABLE ASSY.
	A530-00014-0000	MASTER CABLE ASSY.
	A530-00018-0000	VIDEO ADAPTOR CABLE ASSY.
	A530-00019-0000	VIDEO SIGNAL CABLE ASSY.
	3000-17246-1000	36" GROUND STRAP — CONTROL SHELF
	3000-17246-0700	20" GROUND STRAP — CONTROL SHELF
	0950-00103-0000	COIN BOX DIVIDER — OPTIONAL
	A082-91363-B000	R-G-B INTERFACE BRD. ASSY.

NO. 574 — ROBBY ROTO — MINI — FRONT

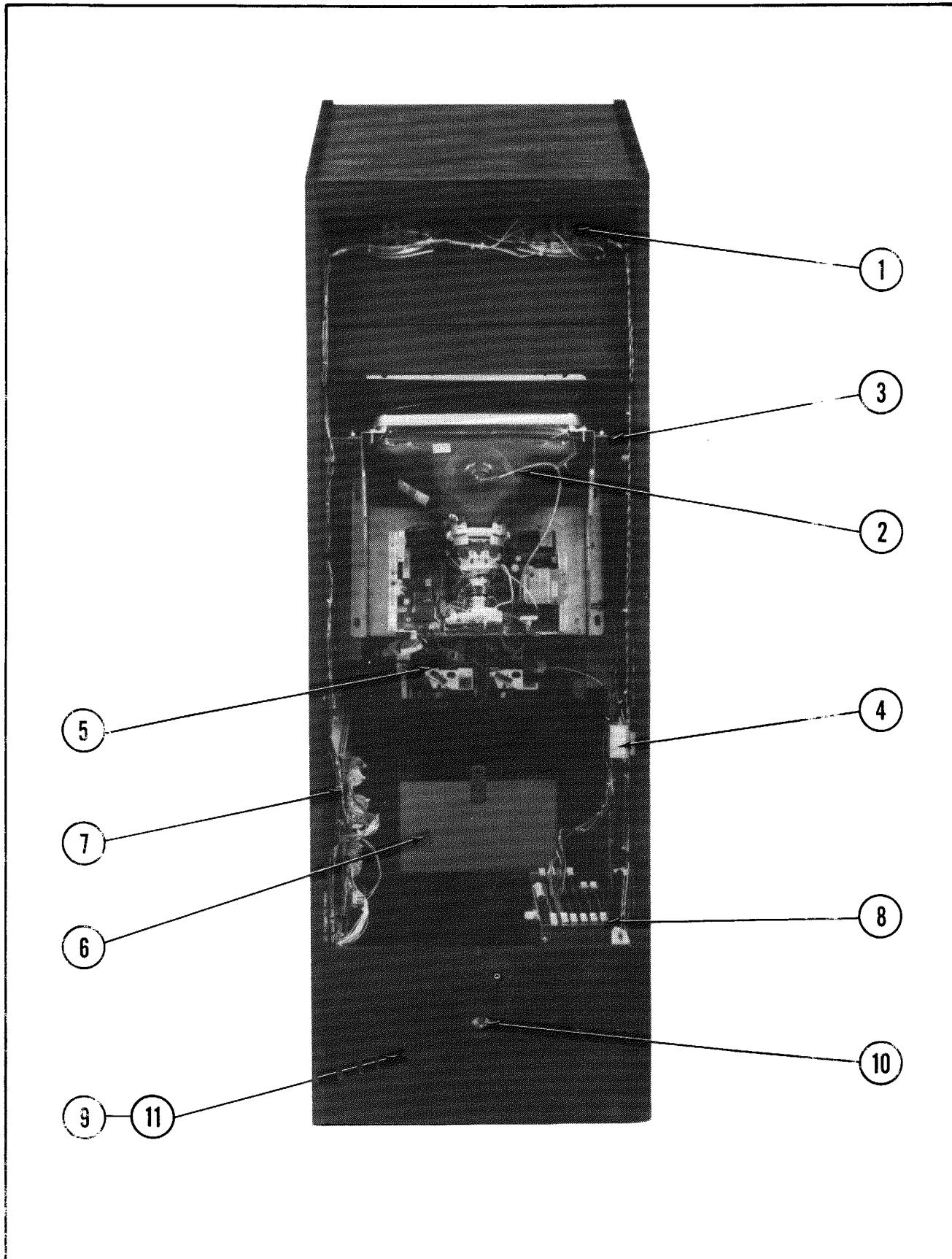


**NO. 574— ROBBY ROTO — MINI — FRONT — PARTS LIST**

**ORDER BY PART NUMBER ONLY**

ITEM	PART NO.	DESCRIPTION
1	0574-00901-00XF	HEADER DISPLAY PANEL
2	0537-00903-0060	GLASS CHANNEL — 4-1/2" LG. (2 REQ'D.)
3	0574-00100-00XF	HEADER BRKT. RETAINER (2 REQ'D.)
	0017-00101-0138	#8 x 5/8 TORX TAMPER RESISTANT SCREW (8 REQ'D.)
	0017-00009-0522	LONG ARM KEY T-20 (FOR ABOVE SCREW)
4	A574-00007-0000	INSERT DISPLAY ASSY.
	0017-00031-0030	WEDGE BASE LIGHT SOCKET (5 REQ'D.)
	0017-00003-0219	#194 LAMP — 14 V., .27A (5 REQ'D.)
	A574-00015-0000	INSERT DISPLAY CABLE ASSY.
5	0017-00009-0393	BLACK SPEAKER GRILLE W/SLOTS (2 REQ'D.)
	0017-00003-0187	6" x 9" SPEAKER — 8 OHM, 9W. (2 REQ'D.)
	0017-00101-0127	#8-32 x 1-1/2 CARRIAGE BOLT (8 REQ'D.)
	0017-00103-0061	#8-32 HEX NUT W/SEMS (8 REQ'D.)
6	0574-00900-00XF	MAIN VIEWING GLASS — 17-13/16" x 14-13/16" x 3/16"
7	0537-00903-0056	GLASS CHANNEL — 14-1/2" LG. (2 REQ'D.)
8	A555-00016-0000	GLASS CLAMPING PLATE ASSY.
	0017-00101-0138	#8 x 5/8 TORX TAMPER RESISTANT SCREW (2 REQ'D.)
9	0931-00903-0000	T.V. BEZEL
	A961-00026-0000	BEZEL MTG. BRKT. ASSY. (2 REQ'D.)
10	A574-00014-0000	OVERLAY TO CONTROL PLATE ASSY.
	0574-00101-0000	CONTROL SHELF PLATE
	0574-00902-0000	DECORATIVE CONTROL SHELF OVERLAY
	0017-00101-0620	#8-32 x 1/2 CARRIAGE BOLT (8 REQ'D.)
	0017-00103-0061	#8-32 HEX NUT W/SEMS (8 REQ'D.)
	0550-00101-0100	CONTROL SHELF MTG. BRKT. — RIGHT
	0550-00101-0200	CONTROL SHELF MTG. BRKT. — LEFT
	0555-00901-0000	PLASTIC LOCATING PIN (4 REQ'D.)
	0961-00115-00XF	STRIKE (2 REQ'D.)
	0017-00009-0033	LATCH CLAMP (2 REQ'D.)
	0017-00101-0141	#8 x 11/16 UNSLOT. HEX HD. M.S. (8 REQ'D.)
11	A595-00005-0000	CONTROL ASSEMBLY
	A574-00016-0000	CONTROL SHELF CABLE ASSY.
12	0017-00042-0256	PUSH BUTTON ASSY. — RED (2 REQ'D.)
	0017-00032-0093	PUSH BUTTON SWITCH W/HOLDER (2 REQ'D.)
	0017-00103-0054	5/8-11 PAL NUT (2 REQ'D.)
13	0017-00032-0092	LIGHTED PUSH BUTTON SWITCH (2 REQ'D.)
	0929-00905-00XF	SWITCH BEZEL (2 REQ'D.)
	0017-00104-0112	INTERNAL WASHER (2 REQ'D.)
	0017-00103-0089	5/8-24 HEX NUT (2 REQ'D.)
14	A090-00300-09BK	U.S.A. 25¢ DOUBLE COIN DOOR ASSY.
	A530-00017-0000	COIN DOOR CABLE ASSY.
15	0090-00002-04BK	LARGE COIN DOOR FRAME
	0017-00101-0121	#6-32 x 5/16 PHIL. TRS. HD. SCR. (3 REQ'D.)
16	0935-00906-0400	KICK PLATE — 17-15/16" LG.
17	0017-00102-0048	3/8-16 x 2" LEG LEVELERS (4 REQ'D.)
	0017-00103-0026	3/8-16 LEG LEVELER HEX NUTS (4 REQ'D.)

NO. 574 -- ROBBY ROTO -- MINI -- REAR ACCESS

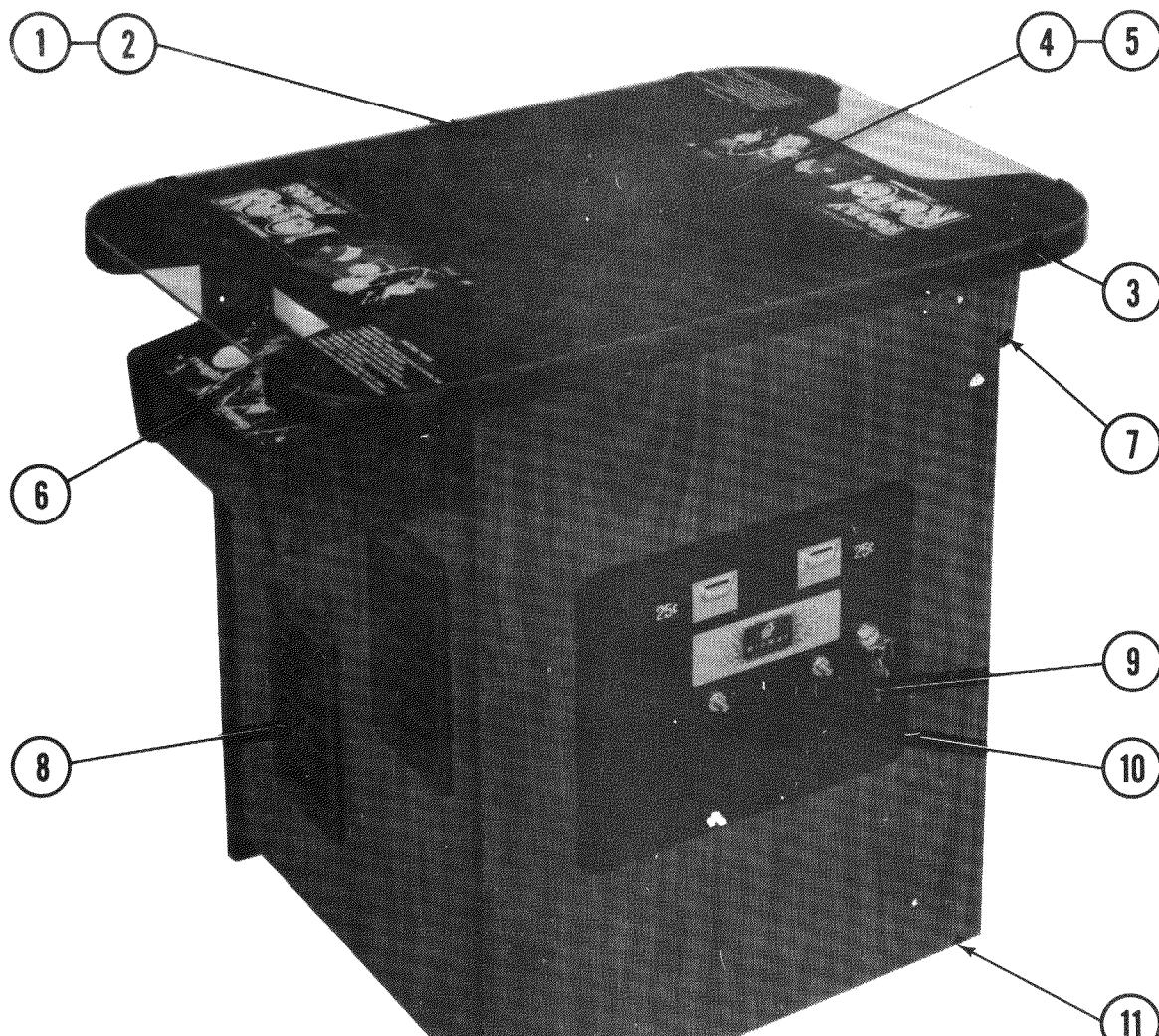


**NO. 574— ROBBY ROTO — MINI — REAR ACCESS — PARTS LIST**

**ORDER BY PART NUMBER ONLY**

ITEM	PART NO.	DESCRIPTION
1	0017-00003-0187	6" x 9" SPEAKER — 8 OHM, 9W (2 REQ'D.)
2	0017-00003-0340	ELECTROHOME — 13" COLOR DUAL SYNC HORIZ. MTG. MONITOR (OR)
2	0017-00003-0396	WELLS-GARDNER — 13" COLOR DUAL SYNC HORIZ. MTG. MONITOR
3	A926-00012-00XF 0017-00101-0141 0555-00100-0000 0017-00102-0066 0017-00104-0014 0017-00103-0018	T.V. MTG. BRKT. ASSY. #8 x 11/16 UNSLOT HEX HD. M.S. (2 REQ'D.) MONITOR MTG. BRKT. (2 REQ'D.) 1/4-20 x 3/4 UNSLOT HEX HD. BOLT (4 REQ'D.) 7/8" DISH WASHER (4 REQ'D.) 1/4-20 HEX NUT (4 REQ'D.)
4	A088-00015-0000	INTERLOCK SWITCH & BRKT. ASSY.
5	A090-00300-09BK	DOUBLE ENTRY COIN DOOR ASSY.
6	A950-00004-0000 A950-00006-0000 0950-00105-0000 0950-00104-0000 0950-00101-0000 0950-00900-0000 0950-00103-0000 0017-00101-0142 0017-00104-0014 0017-00103-0018	COIN BOX ASSY. COIN BOX CRADLE ASSY. COIN BOX COVER COIN BOX HANDLE COIN DEFLECTOR (2 REQ'D.) LARGE PLASTIC COIN BOX COIN BOX DIVIDER — OPTIONAL 1/4-20 x 1-3/8 RND. HD. BOLT (4 REQ'D.) 7/8" DISH WASHER (4 REQ'D.) 1/4-20 HEX NUT (4 REQ'D.)
7	A082-90421-B000 0624-00902-0100 0624-00902-0300 0624-00902-0500 0017-00101-0141 0017-00104-0037	POWER SUPPLY P.C. ASSY. P.C. SUPPORT BRKT. — 12" LG. (2 REQ'D.) P.C. SUPPORT BRKT. — 2-1/2" LG. P.C. SUPPORT BRKT. — 6-1/2" LG. #8 x 11/16 UNSLOT. HEX HD. M.S. (10 REQ'D.) #8 FLAT WASHER (10 REQ'D.)
8	A530-00004-0000	CARD RACK W/BOARDS ASSY.
9	A574-00009-0000	TRANSFORMER BOARD ASSY.
10	A088-00013-0000	ON/OFF SWITCH & BRKT. ASSY.
11	0017-00003-0064	16 FT. LINE CORD
	A151-00098-0000 0017-00009-0490 A574-00010-0000 A574-00011-0000 A574-00012-0000 A574-00017-0000 A574-00018-0000 3010-03003-0000 A082-91363-B000 A530-00011-0000	<b>ADDITIONAL PARTS LIST</b> BACK DOOR LOCK ASSY. 5-5/8" SQR. VENT GRILLE (4 REQ'D.) LOW VOLTAGE CABLE ASSY. HIGH VOLTAGE CABLE ASSY. MASTER CABLE ASSY. VIDEO ADAPTOR CABLE ASSY. VIDEO SIGNAL CABLE ASSY. GROUNDING CLIP R-G-B INTERFACE BRD. ASSY. AUDIO BRD. & HEAT SINK MTG. BRKT. ASSY.

NO. 576 — ROBBY ROTO — COCKTAIL — FRONT

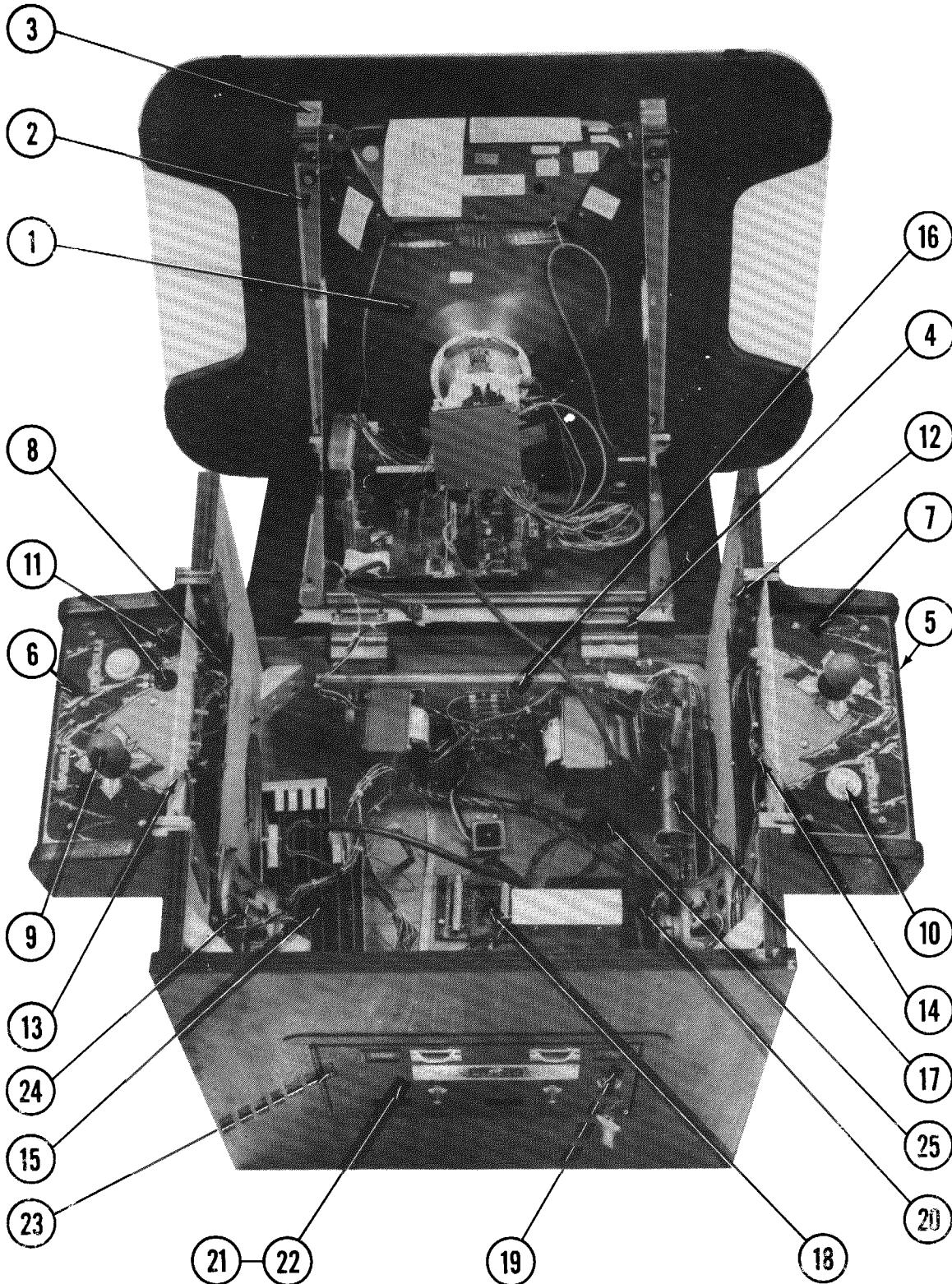


**NO. 576— ROBBY ROTO — COCKTAIL — FRONT — PARTS LIST**

**ORDER BY PART NUMBER ONLY**

ITEM	PART NO.	DESCRIPTION
1	0017-00009-0499	COVER GLASS — 32" x 22" x 1/4"
2	0576-00900-0000	DECORATIVE ARTWORK UNDERLAY
3	0775-00104-00XF	GLASS CLIPS (8 REQ'D.)
4	0017-00101-0117	#8 x 5/8 BLK. PHIL. TRS. HD. SCR. (16 REQ'D.)
4	0557-00900-0000	T.V. BEZEL
5	0508-00905-0000	SMOKED T.V. PLEXI-GLASS — 17-3/8" x 13-1/4" x 1/8"
	0508-00901-0000	PLEXI-GLASS CLIPS (4 REQ'D.)
5	0017-00101-0017	#6 x 1/2 SLT. HEX HD. SCREW (4 REQ'D.)
6	A576-00004-0100	CONTROL SHELF ASSY. — PLYR. #1
7	A576-00004-0200	CONTROL SHELF ASSY. — PLYR. #2
8	0017-00009-0393	BLACK SPEAKER GRILLE W/SLOTS (4 REQ'D.)
	0017-00003-0187	6" x 9" SPEAKER — 8 OHM, 9W. (2 REQ'D.)
	0017-00101-0127	#8-32 x 1-1/2 CARRIAGE BOLT (8 REQ'D.)
	0017-00101-0136	#8-32 x 1-1/4 CARRIAGE BOLT (8 REQ'D.)
	0017-00103-0061	#8-32 HEX NUT W/SEMS (16 REQ'D.)
9	A090-00300-07BK	U.S.A. 25¢ DOUBLE COIN DOOR ASSY.
	A530-00017-0000	COIN DOOR CABLE ASSY.
10	0090-00002-02BK	LARGE COIN DOOR FRAME
	0017-00101-0121	#6-32 x 5/16 PHIL. TRS. HD. SCR. (3 REQ'D.) (MOUNTS COIN DOOR TO FRAME)
11	0017-00102-0048	3/8-16 x 2" LEG LEVELERS (4 REQ'D.)
	0017-00103-0026	3/8-16 LEG LEVELER HEX NUTS (4 REQ'D.)

NO. 576 — ROBBY ROTO — COCKTAIL — INTERIOR ACCESS



**NO. 576— ROBBY ROTO — COCKTAIL — INTERIOR ACCESS — PARTS LIST**

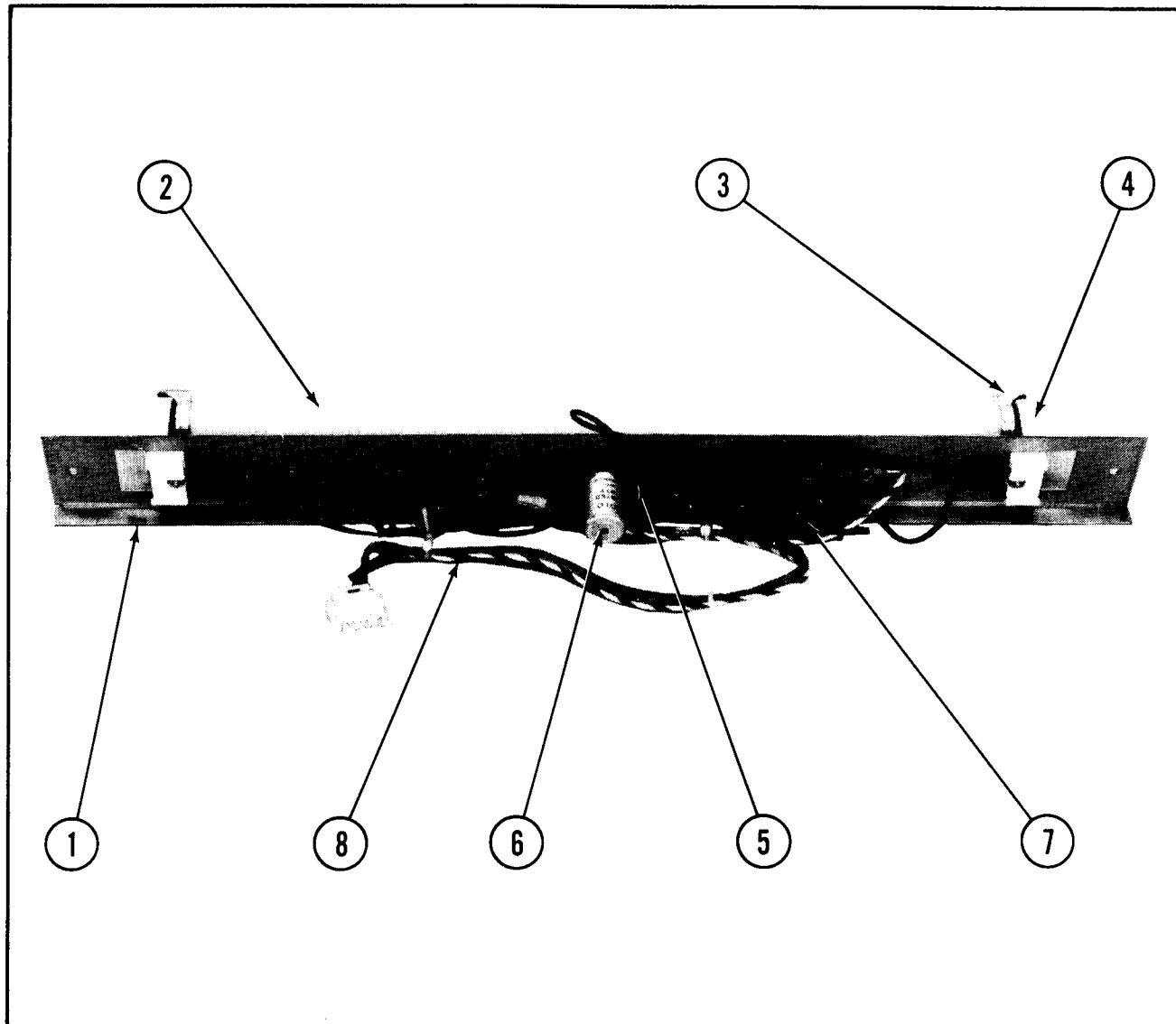
**ORDER BY PART NUMBER ONLY**

ITEM	PART NO.	DESCRIPTION
1	0017-00003-0428	ELECTROHOME — 19" COLOR DUAL SYNC VERT. MTG. MONITOR
2	A557-00004-00XF 0017-00101-0642 0017-00104-0031 0017-00103-0061 0017-00102-0002 0017-00102-0052 0017-00104-0014	MONITOR MTG. BRKT. ASSY. (2 REQ'D.) #8-32 x 1-1/2 CARRIAGE BOLT (4 REQ'D.) #8 FLAT WASHER (4 REQ'D.) #3-32 HEX NUT W/SEMS (4 REQ'D.) 1/4-20 x 1/2 SLT. HEX HD. BOLT (4 REQ'D.) 1/4-20 x 1" UNSLOT. HEX FLAT HD. BOLT (4 REQ'D.) 7/8" DISH WASHER (8 REQ'D.)
3	0921-00107-00XF 0017-00101-0769 0017-00009-0033 0017-00101-0141	STRIKE (2 REQ'D.) #10 x 3/4 SLT. HEX HD. M.S. (4 REQ'D.) LATCH CLAMP (2 REQ'D.) #8 x 11/16 UNSLOT. HEX HD. SCREW (4 REQ'D.)
4	0017-00009-0514 0017-00101-0639 0017-00103-0061	2-1/2" HINGE (2 REQ'D.) #8-32 x 1-1/4 CARRIAGE BOLT (8 REQ'D.) #8-32 HEX NUT W/SEMS (8 REQ'D.)
5	0576-00100-00XF	CONTROL PANEL (2 REQ'D.)
6	0576-00901-0100	DECORATIVE OVERLAY — PLAYER #1
7	0576-00901-0200 0017-00101-0620 0017-00103-0061	DECORATIVE OVERLAY — PLAYER #2 #8-32 x 1/2 CARRIAGE BOLT (8 REQ'D.) #8-32 HEX NUT W/SEMS (8 REQ'D.)
8	0510-00101-00XF 0017-00101-0341	BOTTOM PAN (2 REQ'D.) #6 x 1/4 PHIL. TRS. HD. SCR. (10 REQ'D.)
9	A595-00005-0000 A576-00005-0100 A576-00005-0200	CONTROL ASSY. (2 REQ'D.) CONTROL SHELF CABLE ASSY. — PLAYER #1 CONTROL SHELF CABLE ASSY. — PLAYER #2
10	0017-00042-0301 0017-00032-0093 0017-00103-0054	YELLOW PUSH BUTTON ASSY. (2 REQ'D.) PUSH BUTTON SWITCH W/HOLDER (2 REQ'D.) 5/8-11 PAL NUT (2 REQ'D.)
11	0017-00032-0092  0929-00905-00XF 0017-00104-0112 0017-00103-0089	SMALL RED LIGHTED PUSH BUTTON SWITCH — PLAYER #1 PANEL ONLY (2 REQ'D.) SWITCH BEZEL (2 REQ'D.) WASHER (2 REQ'D.) 5/8-24 HEX NUT (2 REQ'D.)
12	0930-00104-0000 0017-00101-0025	CONTROL PANEL LOCATING BRKT. (4 REQ'D.) #8 x 1/2 SLT. HEX HD. M.S. (16 REQ'D.)
13	0930-00904-0000	LIGHT SHIELD (2 REQ'D.)
14	0017-00031-0044 0017-00003-0219 0017-00101-0555	WEDGE BASE LAMP SOCKET (4 REQ'D.) #194 WEDGE LAMP 14V., .27A (4 REQ'D.) #6-32 x 5/16 SLT. HEX HD. M.S. (4 REQ'D.)
15	A530-00004-0000	CARD RACK W/BOARDS ASSEMBLY
16	A576-00008-0000	TRANSFORMER BOARD ASSY.
17	A082-90421-B000	UNIVERSAL POWER SUPPLY ASSY. — CARD RACK
18	A082-91363-B000	R-G-B INTERFACE BRD. ASSY.
19	A084-90912-A530 0530-00101-0000 0017-00042-0286 0017-00101-0010 0017-00101-0774 0017-00103-0087	AUDIO AMP P.C. BRD. ASSY. AUDIO AMP & HEAT SINK BRKT. 1/2" SPACERS (4 REQ'D.) #6 x 3/8 SLT. HEX HD. SCR. (4 REQ'D.) #6-32 x 3/8 SLT. PAN HD. SCR. (2 REQ'D.) #6-32 HEX NUT (2 REQ'D.)

**NO. 576 — ROBBY ROTO — COCKTAIL — INTERIOR ACCESS — PARTS LIST (Continued)****ORDER BY PART NUMBER ONLY**

ITEM	PART NO.	DESCRIPTION
20	A775-00013-0000 0151-00081-0000 0775-00110-00XF 0749-00106-00XF 0017-00101-0347 0017-00104-0009 0017-00103-0005 0017-00101-0026	FAN ASSEMBLY 4" FAN FAN PLATE VENT SCREEN #6-32 x 1/2 R.H.M.S. (4 REQ'D.) #6 EXT. WASHER (4 REQ'D.) #6-32 HEX NUT (4 REQ'D.) #8 x 5/8 SLT. HEX HD. M.S. (4 REQ'D.)
21	A927-00019-0000 A962-00004-0000 A962-00005-0000 0962-00101-0000 0017-00101-0628 0017-00104-0022 0017-00103-0061	COIN BOX ASSY. COIN BOX COVER ASSY. COIN BOX SIDE CHANNEL ASSY. — SHORT COIN BOX SIDE CHANNEL — SHORT #8-32 x 3/4 CARRIAGE BOLT (4 REQ'D.) #8 WASHER (4 REQ'D.) #8-32 HEX NUT W/SEMS (4 REQ'D.)
22	A090-00300-07BK	U.S.A. 25¢ DOUBLE COIN DOOR ASSY.
23	A088-00014-0000	INTERLOCK SWITCH & BRKT. ASSY.
24	0017-00003-0187	6" x 9" SPEAKER — 8 OHM, 9W (2 REQ'D.)
25	A088-00013-0000	ON-OFF SWITCH & BRKT. ASSY.
		<b>ADDITIONAL PARTS LIST</b>
	A576-00009-0000 A576-00010-0000 A576-00011-0000 A576-00012-0000 A576-00013-0000 0927-00907-0000 A927-00005-0000 0017-00003-0064	LOW VOLTAGE CABLE ASSY. HIGH VOLTAGE CABLE ASSY. MASTER CABLE ASSY. VIDEO ADAPTOR CABLE ASSY. VIDEO SIGNAL CABLE ASSY. FORMED HIGH VOLTAGE SHIELD HIGH BASE LEG KIT ASSY. — OPTIONAL 16 FT. LINE CORD

**NO. 530 — ROBBY ROTO — UPRIGHT — HEADER FLUORESCENT LIGHT ASSY.**

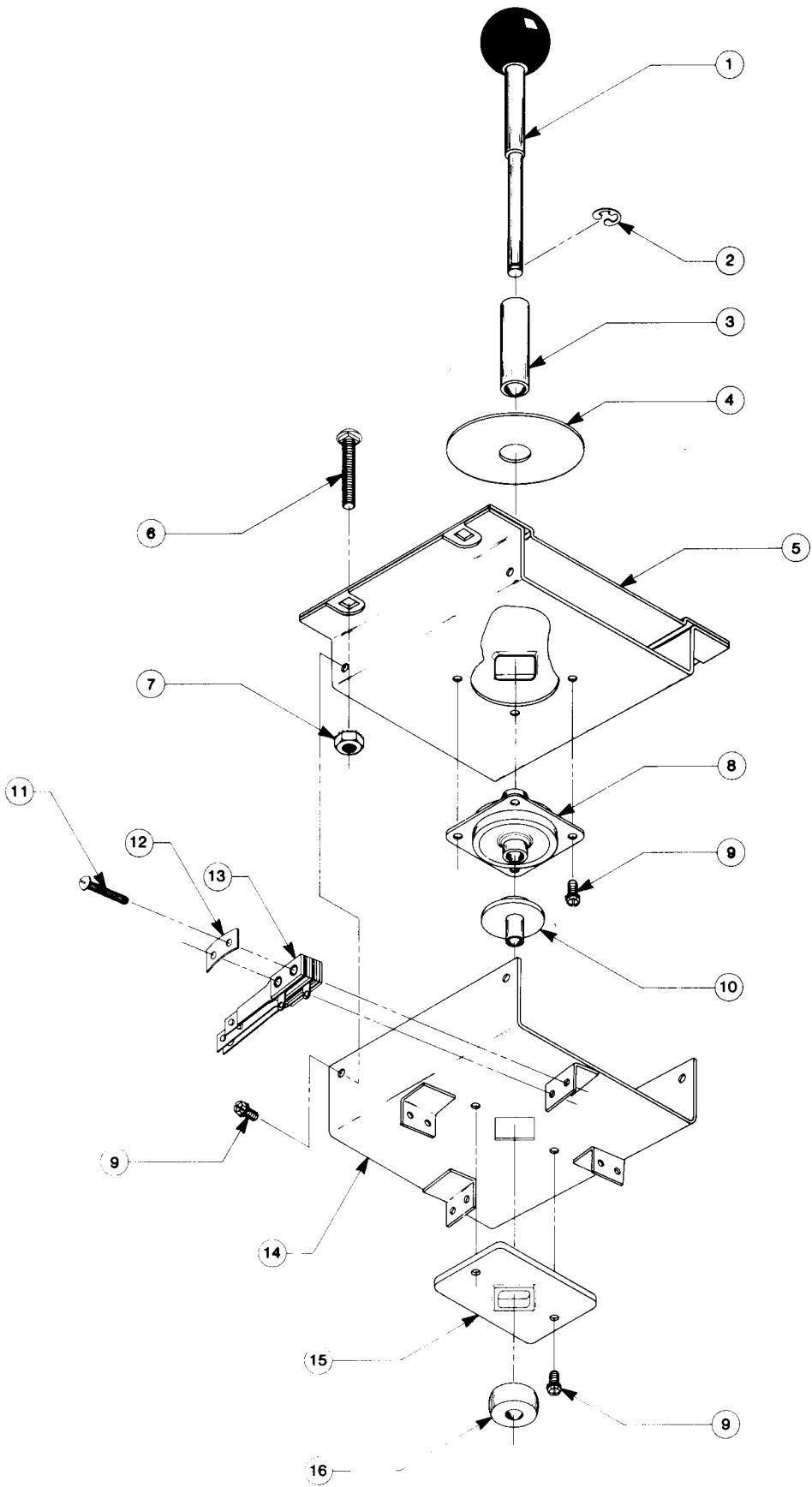


**NO. 530— ROBBY ROTO — UPRIGHT — HEADER FLUORESCENT LIGHT ASSY. — PARTS LIST**

**ORDER BY PART NUMBER ONLY**

ITEM	PART NO.	DESCRIPTION
1	0595-00105-0000	FLUORESCENT BRKT.
2	0017-00003-0043	18" COOL WHITE FLUOR. LAMP
3	0017-00021-0005	FLUORESCENT LOCKS (2 REQ'D.)
4	0017-00031-0036	FLUORESCENT SOCKET (2 REQ'D.)
5	0017-00003-0412	FLUOR. STARTER HOLDER W/LEADS
	0017-00101-0573	#6-32 x 1/2 PHIL. RND. HD. M.S. (4 REQ'D.)
	0017-00104-0009	#6 EXT. WASHER (4 REQ'D.)
6	0017-00003-0019	FLUOR. STARTER
7	0017-00003-0026	BALLAST
	0017-00101-0598	#8-32 x 5/16 SLT. HEX HD. SCR. (4 REQ'D.)
	A961-00042-0000	LINE FILTER ASSY. — NOT SHOWN

**ROBBY ROTO — CONTROL ASSEMBLY — ALL VERSIONS**

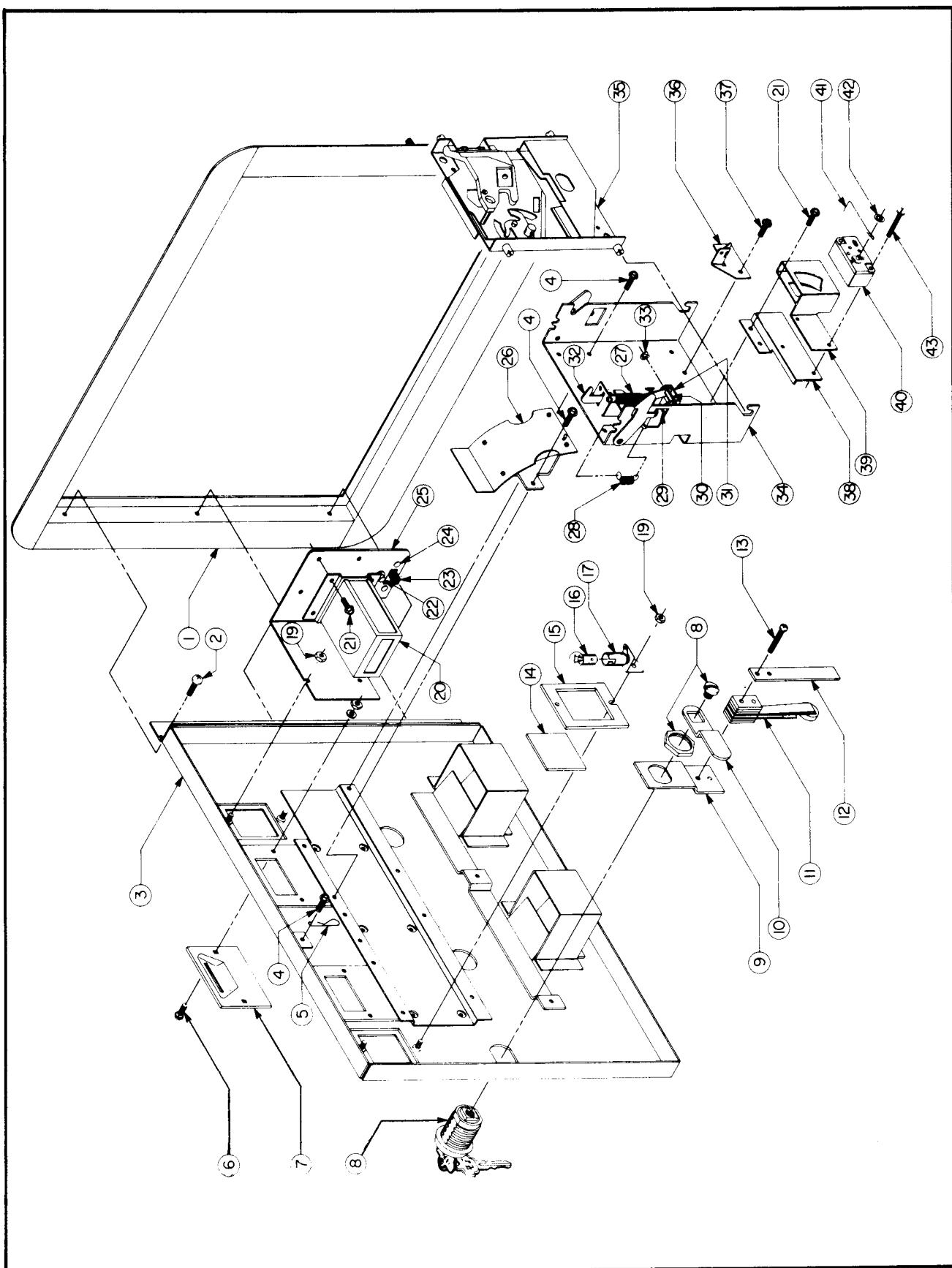


**ROBBY ROTO — CONTROL ASSEMBLY — ALL VERSIONS — PARTS LIST**

**ORDER BY PART NUMBER ONLY**

ITEM	PART NO.	DESCRIPTION
1	A932-00022-0000	BALL & SHAFT ASSEMBLY
2	0017-00100-0025	1/4 E-RING
3	0921-00702-0000	STOP SPACER
4	0921-00902-0000	SLIDE PLATE
5	A595-00006-0000	PIVOT PLATE WELD ASSY.
6	0017-00101-0637	#8-32 x 1" CARRIAGE BOLT (4 REQ'D.)
7	0017-00103-0061	#8-32 HEX NUT W/SEMS (4 REQ'D.)
8	0932-00902-0000	GROMMET
9	0017-00101-0598	#8-32 x 5/16 SLT. HEX HD. M.S. (10 REQ'D.)
10	0962-00904-0000	SLEEVE
11	0017-00101-0527	#5-40 x 5/8 SLT. RND. HD. SCR. (8 REQ'D.)
12	0020-00202-0000	SWITCH PLATE (4 REQ'D.)
13	A932-00009-0000	SWITCH ASSEMBLY (4 REQ'D.)
14	A932-00012-00XF	STOP PLATE & SWITCH BRKT. ASSY.
15	0932-00905-0000	WEAR PLATE
16	0921-00700-0000	ACTUATOR

**FRONT DOOR ASSEMBLY — U.S.A. 25¢**



**FRONT DOOR ASSEMBLY — U.S.A. 25¢**

**ORDER BY PART NUMBER ONLY**

<b>ITEM</b>	<b>PART NO.</b>	<b>DESCRIPTION</b>
1	0090-00002-02BK	DOUBLE ENTRY COIN DOOR FRAME
2	0017-00101-0121	#6-32 x 5/16 PHIL. TRS. HD. SCR. (3 REQ'D.)
3	A090-00073-02BK	DOUBLE ENTRY COIN DOOR W/DRESS PLATE
4	0017-00101-0123	#8 x 1/4 UNSLOT. HEX HD. SCREW (4 REQ'D.)
5	0017-00007-0019	KEY HOOK
6	0017-00101-0552	#6-32 x 1/4 CARRIAGE BOLT (4 REQ'D.)
7	0090-00117-03XF	COIN ENTRY PLATE — 25¢ (2 REQ'D.)
8	A097-00005-0000	DOOR LOCK & KEY W/SCREW & NUT (OR)
8	A097-00006-0000	DOOR LOCK & KEY W/SCREW & NUT
9	0090-00128-00XF	DOOR TILT SWITCH BRKT.
10	0017-00005-0041	DOOR CAM
11	A090-00096-0000	DOOR TILT SWITCH
12	0090-00126-01XF	SWITCH BACK-UP PLATE
13	0017-00101-0525	#5-40 x 9/16" PHIL. HD. M.S. (2 REQ'D.)
	A090-00096-0000	DOOR TILT SWITCH & BRKT. ASSY. (ITEMS 9 & 11 THRU 13)
14	0090-00903-9500	25¢ WINDOW (2 REQ'D.)
15	0090-00143-00XF	COIN PLEX RETAINER
16	0017-00003-0219	12 VOLT LAMP — G.E. #194 (2 REQ'D.)
17	0017-00031-0048	WEDGE SOCKET W/BRKT. (2 REQ'D.)
19	0017-00103-0084	#6-32 HEX NUT W/SEMS (4 REQ'D.)
20	A090-00089-0000	COIN METER W/DIODE
21	0017-00101-0124	#6 x 1/4 UNSLOT. HEX HD. SCR. (8 REQ'D.)
22	0017-00032-0051	PUSH BUTTON SWITCH
23	0017-00032-0007	SLIDE SWITCH
24	0017-00072-0034	STEEL OVAL HD. RIVET
25	0090-00173-0000	COIN COUNTER MTG. BRKT.
	A090-00082-0100	TEST SWITCH & BRKT. ASSY. (ITEMS 23 THRU 25)
26	A090-00087-0000	COIN CHUTE & TOP ASSY. (2 REQ'D.)
27	0010-00134-0000	SPRING
28	0010-00181-0000	SPRING
29	0017-00007-0083	1/8 x 1-5/8 ROLL PIN
30	0090-00129-00XF	PIVOT POST
31	0090-00167-00XF	PIVOT LEVER
32	0093-00155-00XF	REJECT LEVER
33	0017-00100-0018	E-RING
	A090-00088-0000	REJECT LEVER ASSY. (2 REQ'D.) (ITEMS 30 THRU 33)
34	A090-00085-0000	COIN ACCEPTOR FRAME ASSY. (2 REQ'D.)
35	0017-00005-0003	COIN ACCEPTOR W/STRING CUTTER (2 REQ'D.) (OR)
35	0017-00005-0211	COIN ACCEPTOR W/ANTI STRING DEVICE (2 REQ'D.) (OR)
35	0017-00005-0214	COIN ACCEPTOR W/STRING CUTTER (2 REQ'D.)
36	A090-00064-0000	ANTI-PENNY DEVICE
37	0017-00101-0099	#6 x 1/4 SLT. HEX HD. M.S. (2 REQ'D.)
38	0090-00162-00XF	COIN SWITCH MTG. BRKT.
39	0017-00005-0203	COIN SWITCH CHUTE
40	0017-00005-0195	COIN SWITCH
41	0010-00599-0000	COIN SWITCH WIRE
42	0017-00007-0132	PUSH-ON RING
	A090-00059-0400	COIN SWITCH & WIRE ASSY. (ITEMS 40 THRU 42)
43	0017-00101-0698	#4-40 x 3/4 SLT. RND. HD. M.S. (2 REQ'D.)
	A090-00077-0000	COIN GUIDE & SWITCH ASSY. (ITEMS 38 THRU 43)

# VI Technical Troubleshooting

## Introduction

The most common problems occur in harness components such as the coin acceptor, player controls, interconnecting wiring, etc. The TV monitor and PCB computer cause their share of problems too, but not as much as the harness and its component parts. TV monitor troubleshooting will not be covered here because it is covered in that section of this manual.

As you already know, the PCB computer is a complex device with a number of different circuits. Some circuits remain basically the same among games, but overall there are a great many differences between them. PCB troubleshooting procedures, therefore, can be lengthy and will differ greatly among games. However, some basic Z-80 CPU information is involved in this section.

## General Suggestions

The first step in any troubleshooting procedure is correctly identifying the malfunction's symptoms. This includes not only the circuits or features malfunctioning, but also those still operational. A carefully trained eye will pick up other clues as well. For instance, a game in which the computer functions fail completely just after money was collected may have a quarter shorting the PCB traces. Often, an experienced troubleshooter will be able to spot the cause of the problem even before opening the cabinet.

After all the clues are carefully considered, the possible malfunctioning areas can be narrowed down to one or two good suspects. Those areas can be examined by a process of elimination until the cause of the malfunction is discovered.

## Harness Component Troubleshooting

Typical problems falling in this category are coin and credit problems, power problems and failure of individual features.

### NO GAME CREDIT

For example, your prospective player inserts his quarter and is not awarded a game. The first item to check is if the quarter is returned. If the quarter is returned, the malfunction most certainly lies in the coin acceptor itself. First, use a set of test coins (both old and new) to ascertain that the player's coin is not undersize or underweight. If your test coins are also returned, coin acceptor servicing is indicated. Generally, the cause of this particular problem is a maladjusted magnet gate. Normally, this will mean slightly closing the magnet gate a little by turning the adjusting screw out a bit (see section on coin acceptor for more details).

If the quarter is not returned and there is no game credit, the cause of the malfunction may be in one of several areas. First try operating the coin return button; if the coin is returned, the problem is most likely in the magnet gate. Enlarge the gap according to the coin acceptor service procedures. If this does not cure the problem, remove the coin acceptor, clean it and perform the major adjustment procedure.

If the trapped coin is not returned when the wiper lever is actuated, you may have an acceptor jammed by a slug, gummed up with beer, a jammed coin chute, or mechanical failure of the acceptor mechanism. In this case, first check for the slug that will generally be trapped against the magnet. If so, simply remove the slug and test the acceptor. If the chute is blocked, remove the acceptor and remove the jammed coins. If there is actual failure of the acceptor, remove the unit and repair as indicated in the coin acceptor service procedures.

If the coin is making its way through the acceptor (that is, falling into the coin box), yet there is still no game credit, you either have a mechanical failure of the coin switch or electrical failure of the coin and credit circuits. The first place to begin is by checking the coin switch. Most of these switches are the make/break variety of micro switch, which is checked by testing for continuity between the NO, NC, and C terminals. When not actuated, the NC and C terminals should be continuous and the NO terminal open. When operated, the NO and C terminals should close and the NC should be open. If the coin switch checks out, examine the connections to the terminals to make sure there is good contact. If necessary, use the continuity tester and check from the terminal lug on the switch to the associated PCB trace. This will tell you if there is a continuous line all the way to the credit circuit.

If the coin switch wires do not check out, the problem is in the computer — most likely in the coin and credit circuitry.

If you do get game credit when a coin is deposited, but the game will not start when the start switch is pressed, you may have a problem in the start switch, the interconnecting wiring or in the computer. First check the switch. If the switch is OK, proceed to check the wiring. Again, make sure you go from the terminal lug on the switch to the PCB trace. This way, you will check the terminal contact as well as PCB edge connector contact. If the wiring is continuous, proceed to check the PCB credit circuit. If not, check each section of the wiring, until the discontinuity is located. If the wiring is OK, the problem must lie in the computer.

## Transformer and Line Voltage Problems

Your machine must have the correct line voltage to operate properly. If the line voltage drops too low, a circuit in the computer will disable game credit. The point at which the computer will fail to work will vary some from game to game, but no game will work on line voltage that drops below 105 VAC.

Low line voltage may have many causes. Line voltage normally fluctuates a certain amount during the day as the total usage varies. Peak usage times occur mainly at dawn or dusk, so if your machine's malfunction seems to be related to the time of day, this may be a factor. A large load connected to the same line as the game (such as a large air conditioner or other device with an exceptionally large motor) may drop the line voltage significantly when starting up. This drop can result in an intermittent credit problem. In addition, poor connections in the location wiring, plug, or line cord may also cause a significant drop in power. Cold solder joints in the game's harness, especially in areas like the transformer connections, interlock switch, or fuse block, may also produce the same results, although probably on a more permanent basis.

Sometimes location owners (especially in bars) replace light switches with dimmer rheostats, and the game is sometimes on the same line. Obviously, the voltage available to the game is going to drop dramatically when the dimmer is turned.

In any case, the way to check for correct line voltage is with your VOM. Set the VOM to 250 VAC and stick the probes in the wall receptacle. If it's OK here, check the transformer primary connections. If you do not get 117 VAC, examine the solder joints on the transformer, fuse block, and interlock switch. If you do get 117 VAC, the problem must be either in the transformer, harness connections, or in the PCB power supply.

If you suspect the transformer, check its secondaries with the VOM set to 50 VAC and correlate the readings with the legend on the side of the transformer. The transformer must also be correctly grounded, so check the ground potential as well, especially if there is a hum bar rolling up or down the TV screen.

## HARNESS PROBLEMS

Other harness problems include blowing fuses and malfunctioning controls. The repeating blown-fuse problem can sometimes be quite exasperating to solve, for short circuits have the tendency to occur in areas almost impossible to find. First, try inserting a new fuse, as old fuses age and blow without cause. If the new one also blows, you definitely have a short.

The best way to approach this problem is by turning the power off and disconnecting devices that may be causing the problem, such as the TV, transformer, and PCB. Disconnect the devices by pulling off their connectors, but do not allow them to touch. If necessary, insulate them with small pieces of electrical tape. Then, connect your VOM across the terminals of the fuse block (all electrical power shut off), and set it to one of the resistance scales. This will save blowing a fuse each time you want to check the circuit.

If the VOM reveals that disconnecting the devices removed the short, reconnect the devices one by one until the short returns. The last device connected is the one that is at fault. If the VOM reads a short even after the devices are disconnected, the fault must lie in the harness itself, and only patient exploration will reveal its location. First, carefully examine all the wiring, looking for terminals that may be touching, metal objects such as coins shorting connections or burned insulation. If necessary, use the VOM to check each suspected wire.

## MALFUNCTIONING CONTROLS

One of the most common problems here is a bad potentiometer. Typically, a bad pot will cause the image to jump as it reaches a certain point. The only cure for this one is to install a new pot.

If a feature that is operated by a switch (for example, joysticks, foot pedals, control panel buttons) does not operate at all, check the switch with a VOM or continuity tester to verify its operation. If the switch does not check out, replace it. If the switch is OK, you should suspect the input to the switch from the PCB. In this case, get out the harness and logic schematics and check to see what kind of input it is. In many cases, the input will be +5 VDC. If so, use the VOM to check its presence. Normally, the switch is used to pull a +5 VDC line LOW to GND or to pull a LOW line HIGH. If the PCB output is missing, check the wire length from the PCB. If you find the signal at the PCB trace, the wire length or connection is at fault. If not, begin exploring the PCB using the logic schematics.

# A Glossary of Microprocessor Terms

**MICROPROCESSOR** — one or several microcircuits that perform the function of a computer's CPU. Sections of the circuit have arithmetic and comparative functions that perform computations and executive instructions.

**CPU** — central-processing unit. A computing system's "brain", whose arithmetic, control and logic elements direct functions and perform computations. The microprocessor section of a microcomputer is on one chip or several chips.

**PROM** — programmable read-only memory. User permanently sets binary on-off bits in each cell by selectively fusing or not fusing electrical links. Non-erasable. Used for low-volume applications.

**EPROM** — erasable, programmable, read-only memory. Can be erased by ultraviolet light bath, then reprogrammed. Frequently used during design and

development to get programs debugged, then replaced by ROM for mass production.

**ROM** — read-only memory. The program, or binary on-off bit pattern, is set into ROM during manufacture, usually as part of the last metal layer put onto the chip. Nonerasable. Typical ROM's contain up to 16,000 bits of data to serve as the microprocessor's basic instructions.

**RAM** — random-access memory. Stores binary bits as electrical charges in transistor memory cells. Can be read or modified through the CPU. Stores input instructions and results. Erased when power is turned off.

**LSI** — large scale integration. Formation of hundreds or thousands of so-called gate circuits on semiconductor chips. Very large scale integration (VLS) involves microcircuits with the greatest component density.

**MOS** — metal-oxide semiconductor. A layered construction technique for integrated circuits that achieves high component densities. Variations in MOS chip structures create circuits with speed and low-power requirements, or other advantages (static will damage a MOS chip).

## Introduction to the Z-80 CPU

The term "microcomputer" has been used to describe virtually every type of small computing device designed within the last few years. This term has been applied to everything from simple "microprogrammed" controllers constructed out of TTL MSI up to low end minicomputers with a portion of the CPU constructed out of TTL LSI "bit slices." However, the major impact of the LSI technology within the last few years has been with MOS LSI. With this technology, it is possible to fabricate complete and very powerful computer systems with only a few MOS LSI components.

The Zilog Z-80 family of components can be configured with any type of standard semiconductor memory to generate computer systems with an extremely wide range of capabilities. For example, as few as two LSI circuits and three standard TTL MSI packages can be combined to form a simple controller. With additional memory and I/O devices a computer can be constructed with capabilities that only a minicomputer could previously deliver.

New products using the MOS LSI microcomputer are being developed at an extraordinary rate. The Zilog Z-80 component set has been designed to fit into this market through the following factors:

1. The Z-80 is fully software compatible with the popular 8080A CPU.
2. Existing designs can be easily converted to include the Z-80.
3. The Z-80 component set is at present superior in both software and hardware capabilities to any other microcomputer system on the market today.
4. For increased throughput the Z80A operating at a 4 MHZ clock rate offers the user significant speed advantages.

Microcomputer systems are extremely simple to construct using Z-80 components. Any such system consists of three parts:

1. **CPU (Central Processing Unit)**
2. **Memory**
3. **Interface Circuits to peripheral devices**

The CPU is the heart of the system. Its function is to obtain instructions from the memory and perform the desired operations. The memory is used to contain instructions and in most cases data that is to be processed. For example, a typical instruction sequence may be to read data from a specific peripheral device, store it in a location in memory, check the parity and write it out to another peripheral device. Note that the Zilog component set includes the CPU and various general purpose I/O device controllers, while a wide range of memory devices may be used from any source. Thus, all required components can be connected together in a very simple manner with virtually no other external logic.

## General Purpose Registers

There are two matched sets of general purpose registers, each set containing six 8-bit registers that may be used individually as 8-bit registers or as 16-bit register pairs by the programmer. One set is called BC, DE and HL while the complementary set is called BC', DE' and HL'. At any one time the programmer can select either set of registers to work with through a single exchange command for the entire set. In systems where fast interrupt response is required, one set of general purpose registers and an accumulator/flag register may be reserved for handling this very fast routine. Only a simple exchange command need be executed to go between the routines. This greatly reduces interrupt service time by eliminating the requirement for saving and retrieving register contents in the external stack during interrupt or subroutine processing. These general purpose registers are used for a wide range of applications by the programmer. They also simplify programming, especially in ROM based systems where little external read/write memory is available.

## Arithmetic & Logic Unit (ALU)

The 8-bit arithmetic and logical instructions of the CPU are executed in the ALU. Internally the ALU communicates with the registers and the external

data bus on the internal data bus. The type of functions performed by the ALU include:

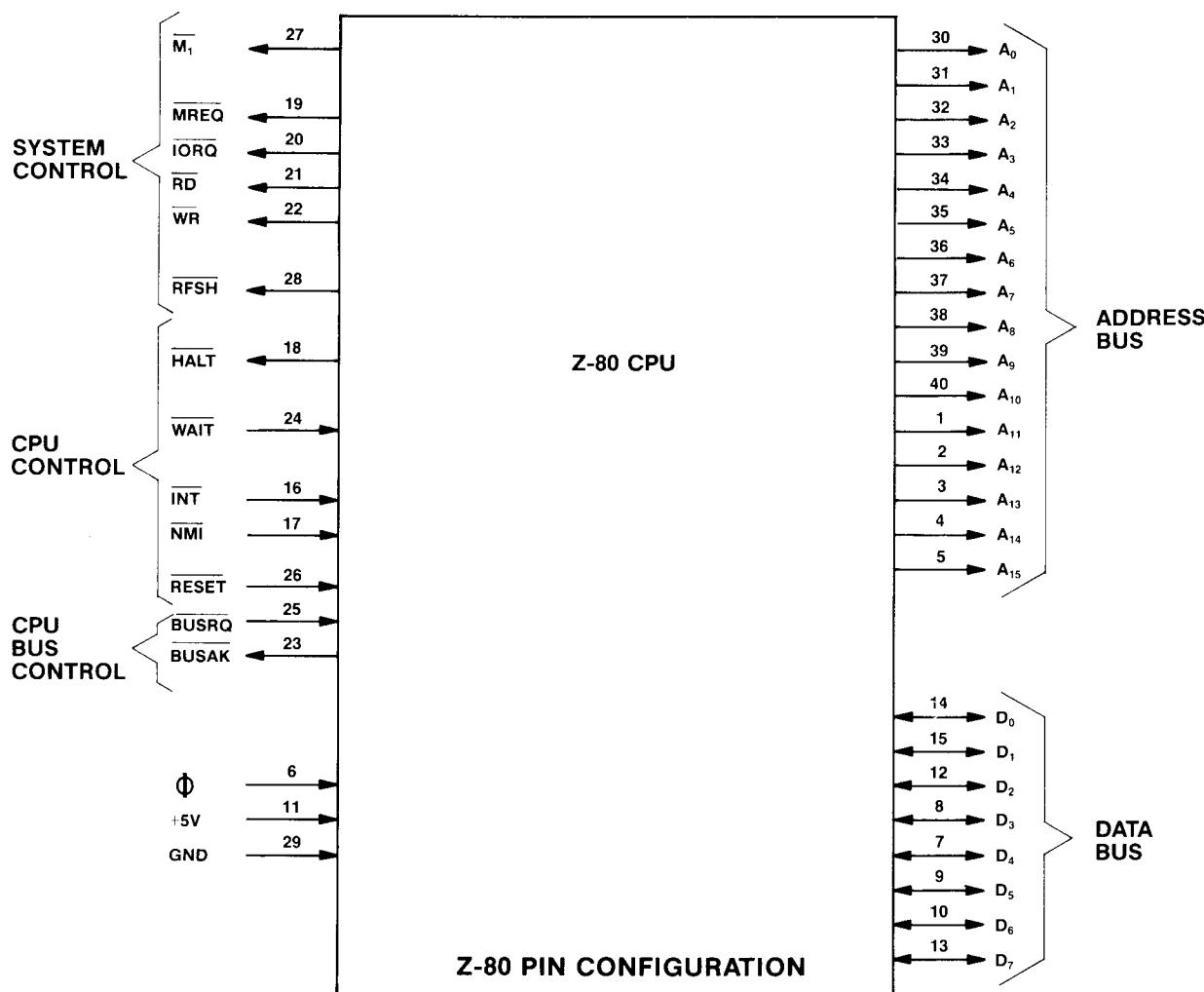
<b>Add</b>	Left or right shifts or rotates (arithmetic and logical)
<b>Subtract</b>	Increment
<b>Logical AND</b>	Decrement
<b>Logical OR</b>	Set bit
<b>Logical Exclusive OR</b>	Reset bit
<b>Compare</b>	Test bit

## Instruction Register and CPU Control

As each instruction is fetched from memory, it is placed in the instruction register and decoded. The control sections performs this function and then generates and supplies all of the control signals necessary to read or write data from or to the registers, control the ALU and provide all required external control signals.

## Z-80 CPU Pin Description

The Z-80 CPU is packaged in an industry standard 40 pin Dual In-Line Package. The I/O pins are shown in the below figure and the function of each is described.



### **A<sub>0</sub>-A<sub>15</sub>** **(Address Bus)**

Tri-state output, active high. A<sub>0</sub>-A<sub>15</sub> constitute a 16-bit address bus. The address bus provides the address for memory (up to 64K bytes) data exchanges and for I/O device data exchanges. I/O addressing uses the 8 lower address bits to allow the user to directly select up to 256 input or 256 output ports. A<sub>0</sub> is the least significant address bit. During refresh time, the lower 7 bits contain a valid refresh address.

### **D<sub>0</sub>-D<sub>7</sub>**, **(Data Bus)**

Tri-state input/output, active high. D<sub>0</sub>-D<sub>7</sub> constitute an 8-bit bidirectional data bus. The data bus is used for data exchanges with memory and I/O devices.

### **M<sub>1</sub>** **(Machine Cycle one)**

Output, active low. M<sub>1</sub> indicates that the current machine cycle is the OP code fetch cycle of an instruction execution. Note that during execution of 2-byte op-codes, M<sub>1</sub> is generated as each op code byte is fetched. These two byte op-codes always begin with CBH, DDH, EDH or FDH. M<sub>1</sub> also occurs with IORQ to indicate an interrupt acknowledge cycle.

### **MREQ** **(Memory Request)**

Tri-state output, active low. The memory request signal indicates that the address bus holds a valid address for a memory read or memory write operation.

### **IORQ** **(Input/Output Request)**

Tri-state output, active low. The IORQ signal indicates that the lower half of the address bus holds a valid I/O address for a I/O read or write operation. An IORQ signal is also generated with an M<sub>1</sub> signal when an interrupt is being acknowledged to indicate that an interrupt response vector can be placed on the data bus. Interrupt Acknowledge operations occur during M<sub>1</sub> time while I/O operations never occur during M<sub>1</sub> time.

### **RD** **(Memory Read)**

Tri-state output, active low. RD indicates that the CPU wants to read data from memory or an I/O device. The addressed I/O device or memory should use this signal to gate data onto the CPU data bus.

### **WR** **(Memory Write)**

Tri-state output, active low. WR indicates that the CPU data bus holds valid data to be stored in the addressed memory or I/O device.

### **RFSH** **(Refresh)**

Output, active low. RFSH indicates that the lower 7 bits of the address bus contain a refresh address for dynamic memories and the current MREQ signal should be used to do a refresh read to all dynamic memories.

### **HALT**

#### **(Halt state)**

Output, active low. HALT indicates that the CPU has executed a HALT software instruction and is awaiting either a non maskable or a maskable interrupt (with the mask enabled) before operation can resume. While halted, the CPU executes NOP's to maintain memory refresh activity.

### **WAIT**

#### **(Wait)**

Input, active low. WAIT indicates to the Z-80 CPU that the addressed memory or I/O devices are not ready for a data transfer. The CPU continues to enter wait states for as long as this signal is active. This signal allows memory or I/O devices of any speed to be synchronized to the CPU.

### **INT**

#### **(Interrupt Request)**

Input, active low. The Interrupt Request signal is generated by I/O devices. A request will be honored at the end of the current instruction if the internal software controlled interrupt enable flip-flop (IFF) is enabled and if the BUSRQ signal is not active. When the CPU accepts the interrupt, an acknowledge signal (IORQ during M<sub>1</sub> time) is sent out at the beginning of the next instruction cycle. The CPU can respond to an interrupt in three different modes that are described in detail in section 5.4 (CPU Control Instructions).

### **NMI**

#### **(Non-Maskable Interrupt)**

Input, negative edge triggered. The non maskable interrupt request line has a higher priority than INT and is always recognized at the end of the current instruction, independent of the status of the interrupt enable flip-flop. NMI automatically forces the Z-80 CPU to restart to location 0066H. The program counter is automatically saved in the external stack so that the user can return to the program that was interrupted. Note that continuous WAIT cycles can prevent the current instruction from ending, and that a BUSRQ will override a NMI.

### **RESET**

Input, active low. RESET forces the program counter to zero and initializes the CPU. The CPU initialization includes:

- 1) Disable the interrupt enable flip-flop

2) Set Register I = 00H

3) Set Register R =00H

4) Set Interrupt Mode 0

During reset time, the address bus and data bus go to a high impedance state and all control output signals go to the inactive state.

#### **BUSRQ**

##### **(Bus Request)**

Input, active low. The bus request signal is used to request the CPU address bus, data bus and tri-state output control signals to go to a high impedance state so that other devices can control these buses. When BUSRQ is activated, the CPU will set these

buses to a high impedance state as soon as the current CPU machine cycle is terminated.

#### **BUSAK**

##### **(Bus Acknowledge)**

Output, active low. Bus acknowledge is used to indicate to the requesting device that the CPU address bus, data bus and tri-state control bus signals have been set to their high impedance state and the external device can now control these signals.

#### **CLK**

##### **(Clock)**

Single phase TTL level clock which requires only a 330 ohm pull-up resistor to +5 volts to meet all clock requirements.

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**MCR II SYSTEM**  
**P.C. BOARD JUMPER OPTIONS**

VIDEO GENERATOR P.C. BOARD														
MANUFACTURER	EPROM NO.	JW#1	JW#2	JW#3	JW#4	JW#5	JW#6	JW#7	JW#8					
MOTOROLA	68764	#	*	*	#	*	*	*	*	*				
	68766	#	*	*	#	*	*	*	*	*				
INTEL	2764	*	#	#	*	#	*	*	#					
T. I.	2564	#	*	*	#	*	#	#	*					
C.P.U. P.C. BOARD														
MANUFACTURER	EPROM NO.	JW#1	JW#2	JW#3	JW#4	JW#5	JW#6	NOTE: JUMPER OP- TION FOR PROGRAM ROMs ONLY.						
NUMEROUS MFR'S	2532	*	#	*	*	#	*	NOTE: JUMPER OP- TION FOR PROGRAM ROMs ONLY.						
NUMEROUS MFR'S	2732	*	#	*	*	*	#	NOTE: JUMPER OP- TION FOR PROGRAM ROMs ONLY.						
SOUND I/O P.C. BOARD														
MANUFACTURER	EPROM NO.	JW#1	JW#2											
NUMEROUS MFR'S	2532	*	#											
NUMEROUS MFR'S	2732	#	*											

# = LEAVE JUMPER WIRES WHERE THIS SYMBOL "#" APPEARS

\* = CUT JUMPER WIRES WHERE THIS SYMBOL "\*" APPEARS.

The above table illustrates the fact that the Video Generator P.C. Board used in the MCR II System has 8 jumper wires, the C.P.U. P.C. Board used in the MCR II System has 6 jumper wires, and the Sound I/O P.C. Board used in the MCR II System has 2 jumper wires.

All of the above Boards can be used with a variety of different **SETS of EPROM chips**. However, these EPROMS are not all made by the same manufacturer and do have some internal differences. So, in order to make them function properly in their respective P.C. Boards, certain jumper wires on these Boards have to be cut.

The above table tells you which jumpers to cut (depending on which EPROM set you're going to use) by showing a "\*" under that jumper wires number. If there is a "#" under a jumper wires number, THAT PARTICULAR JUMPER WIRE IS NOT TO BE CUT.

## VII. Coin Door Maintenance

**SPECIAL NOTE:** If you have any questions about the coin acceptors in your game(s), please feel free to contact their manufacturers. Each manufacturer's name is **PROMINENTLY** imprinted on every acceptor mechanism.

Metal mechanisms only:

**COIN MECHANISMS, INC.**  
817 Industrial Drive  
Elmhurst, IL 60126  
Phone (312) 279-9150

Metal and Plastic mechanisms:

**COINCO COIN ACCEPTORS, INC.**  
860 Eagle Drive  
Bensenville, IL 60106  
Phone (312) 766-6781

### COIN DOOR MAINTENANCE

#### METAL COIN ACCEPTOR MECHANISMS

Periodically, the metal coin acceptor mechanism(s) must be removed from the coin door and cleaned.

1. Make sure the power to the game is off.
2. Unlock and open the coin door.

3. Remove the coin acceptor mechanism as shown in Figure 7-1.
  - Push down on the two spring loaded latches.
  - While holding the latches down, pull the top of the coin acceptor mechanism toward you.
  - Release the latches and lift out the coin acceptor mechanism.

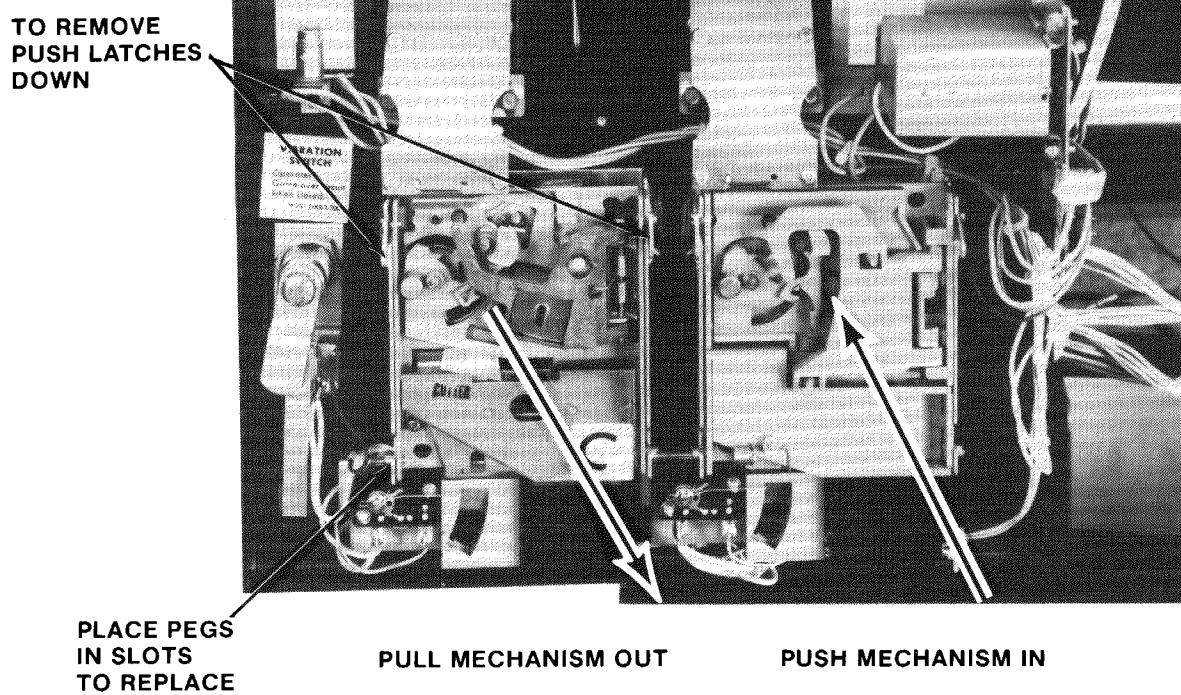


Figure 7-1 Removing and replacing coin acceptor

4. Clean the magnet of all foreign particles. See Figure 7-2.
  - This may be accomplished by swinging the gate open as shown in the above figure.
5. Remove the cradles and undersize levers and clean the bushings. (A pipe cleaner makes a good bushing cleaner.)
  - Also clean the pivot pin.
6. Whenever needed, the coin acceptor should be cleaned with hot water and cleanser in the following manner:
  - Place the coin acceptor in boiling water for about ten minutes.

**CAUTION: BE CAREFUL NOT TO BURN YOUR-SELF.**

- Next, use a brush and kitchen cleaner to remove all remaining foreign matter from the unit.
- Rinse the coin acceptor in clean boiling water.
- Dry the coin acceptor thoroughly by using filtered compressed air to blow it dry.

**NOTE:** The reason we recommend using boiling water is that it evaporates faster than cold water and speeds drying time.

7. To lubricate the coin acceptor:

- Use **ONLY** powdered graphite and put it **ONLY** on the moving parts of the coin acceptor. These parts are called out in Figure 7-3.
- Be extremely careful to keep the powdered graphite away from paths that are traveled by the coins.

**— WARNING —  
DO NOT USE OIL  
TO LUBRICATE THE  
COIN ACCEPTOR.**

8. Check the coin chute for obstructions such as paper, gum, etc.
9. Reinstall the coin acceptor to the coin door. See Figure 7-1.
  - Place the two pegs at the coin acceptor's base into their retaining slots.
  - Now push the top of the coin acceptor toward the coin door until it snaps in place and is held there by the two spring loaded latches.
10. Close and lock the coin door.

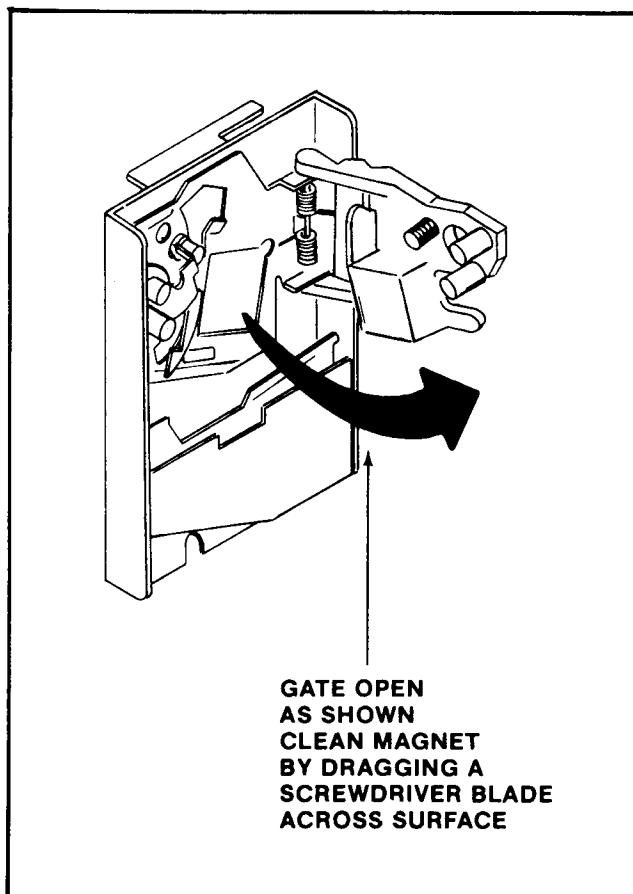


Figure 7-2 Cleaning the metal coin acceptor

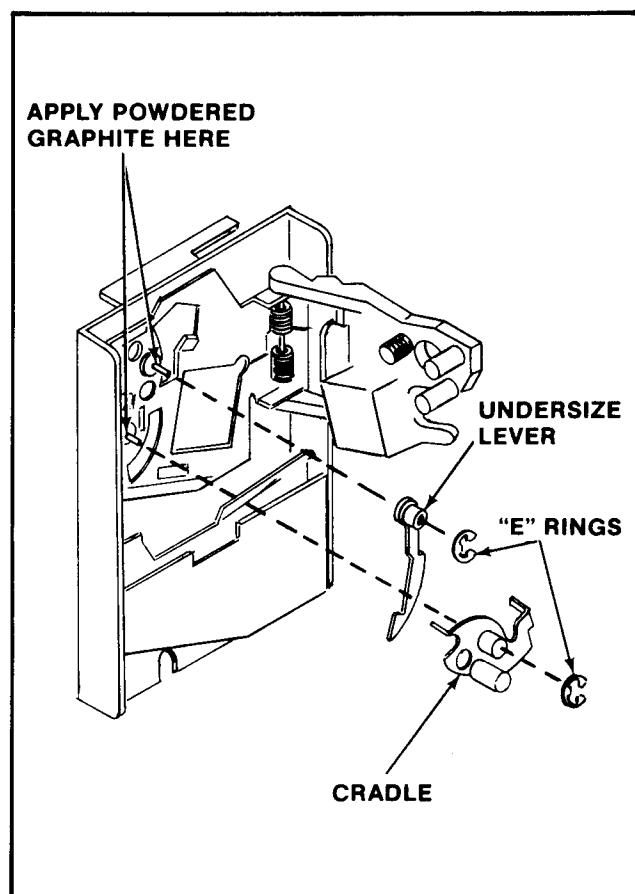
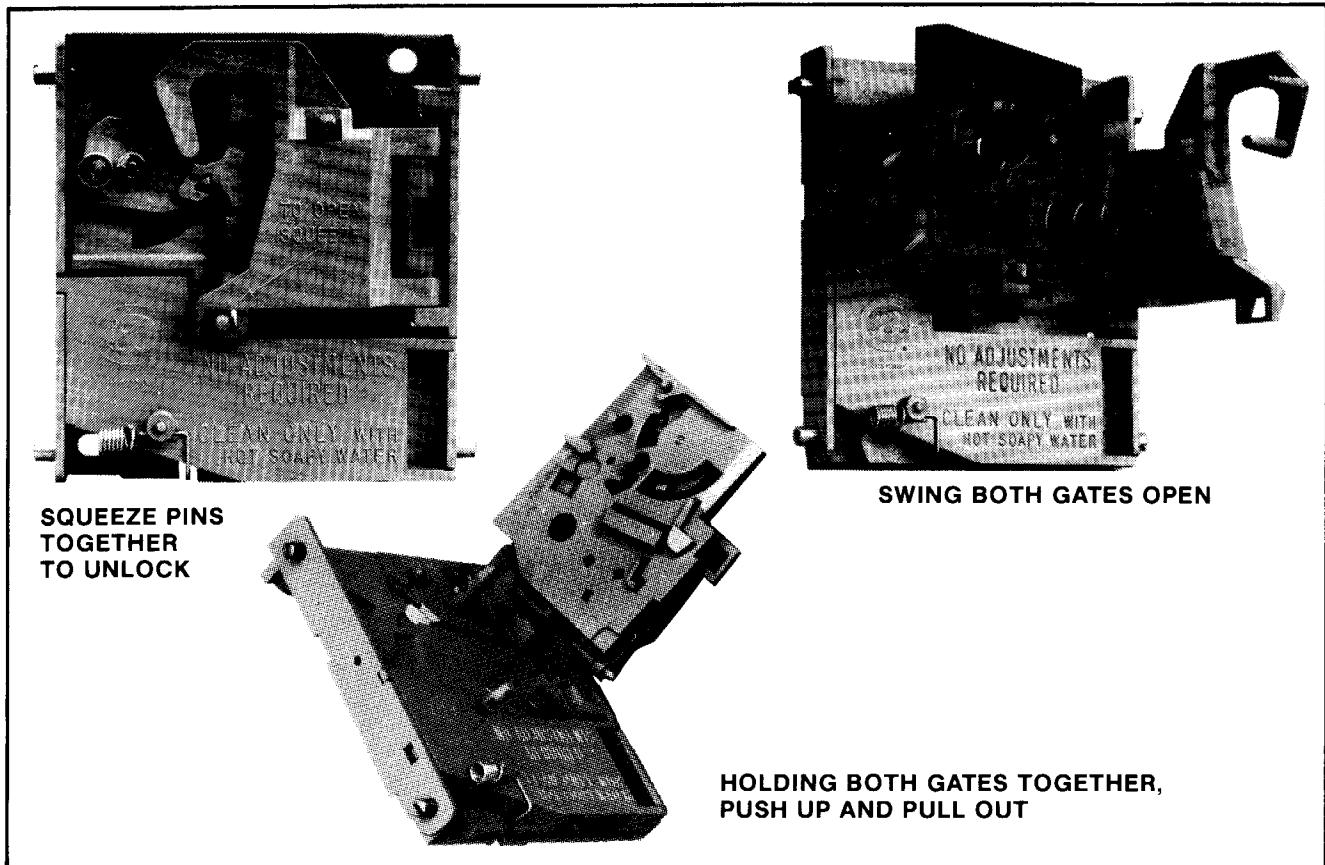


Figure 7-3 Lubricating the metal coin acceptor



**Figure 7-4 Opening the plastic coin acceptor**

#### **PLASTIC COIN ACCEPTOR MECHANISMS**

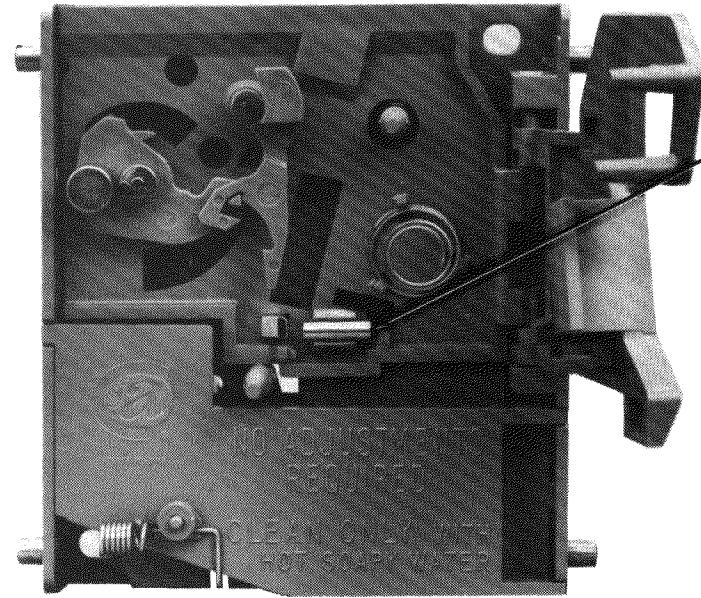
The plastic coin acceptor mechanism(s) must be removed periodically from the coin door and cleaned.

1. **Make sure the power to the game is off.**
2. Unlock and open the coin door.
3. Remove the coin acceptor mechanism(s) as shown in Figure 7-1.
  - Push down on the two spring loaded latches.
  - While holding the latches down, pull the top of the acceptor mechanism toward you.
  - Release the latches and lift out the mechanism.
4. Squeeze the two pins indicated in Figure 7-4 together to open the mechanism and break it down into its three basic parts.
  - Clean the mechanism in hot soapy water. It never rusts.
  - Rinse the mechanism in clean hot water and allow it to dry.

Reassemble the mechanism (it never needs lubrication).

5. Check the coin chute for obstructions such as paper, gum, etc.
6. Reinstall the coin acceptor to the coin door. See Figure 7-5.
  - Place the two pegs at the coin acceptor's base into their retaining slots.
  - Now push the top of the coin acceptor toward the coin door until it snaps in place and is held there by the two spring loaded latches.
7. Close and lock the coin door.

**NOTE:** See Figure 7-6 for instructions on how to set the plastic coin acceptor mechanisms to either accept or reject Canadian quarters.



ACCEPTOR CAN BE SET TO ACCEPT U.S.  
QUARTERS ONLY OR BOTH U.S. AND  
CANADIAN QUARTERS.

MAGNET

SLIDE MAGNET TO EXTREME RIGHT (AS  
SHOWN) TO ACCEPT BOTH U.S. AND  
CANADIAN QUARTERS.

TO ACCEPT U.S. QUARTERS ONLY, SLIDE  
MAGNET TO EXTREME LEFT.

Figure 7-5 Changing the plastic coin acceptor to accept American or Canadian quarters.

**PLEASE NOTE:**

THE INFORMATION CONTAINED IN THIS SECTION  
IS TOLD IN AN EASY TO UNDERSTAND MANNER  
AND IS INTENDED TO AID THOSE WITHOUT AN  
ELECTRONICS DEGREE IN TROUBLESHOOTING AND  
REPAIRING THEIR GAMES T.V. MONITOR.

IF YOU READ THROUGH THIS SECTION AND STILL  
HAVE QUESTIONS, PLEASE CONTACT YOUR DISTRIBUTOR  
OR MIDWAY MANUFACTURING COMPANY AT THE TOLL  
FREE NUMBER PROVIDED WITH YOUR GAMES PAPERS.

**OUR STAFF AND OUR DISTRIBUTORS STAND READY  
TO HELP YOU!**

**THANK YOU**

**VIII T.V. Monitor Manual**

# Color T.V. Monitor

## Introduction: (How to use this section of your manual.)

This section has been designed to simply familiarize you with one of the more mystical components in your game — the T.V. monitor. If you are an electronics technician who is quite knowledgeable on the subject, you may decide to just go to the schematics and start troubleshooting the defective monitor. But if you are like most people, a monitor is a T.V. set, and that means a complex doo-dad that means big buck repairs. This isn't necessarily so. This section of the manual will acquaint you with the monitor and could just help you repair it if you feel adventurous enough to give it a try. If you have any knowledge of electronics, especially the use of a voltmeter, the repairs you can make are astonishing. Just keep in mind that **ELECTRICITY CAN BE VERY DANGEROUS, SO BE CAREFUL!!**

If you want to understand how a monitor works, just read the "THEORY OF OPERATION" subsection. If you wish, you can follow along with the schematics. The information is presented in a very basic manner but more complete treatment of the subject can be found in the technical sections of bookstores.

If you want to attempt to repair your monitor, it would be a good idea to read this whole section beginning to end before starting. **Pay attention to all warnings**

**and take them seriously.** The more equipment you have the better, but a low cost Volt-Ohm-Milliammeter can often do the trick. Here are the steps to take:

1. Find the symptom that matches the problems your monitor has in the "SYSTEM — DIAGNOSIS" subsection. The diagnosis tells the circuit or area the problem may be in and possibly even the actual component causing it.
2. Once you have the circuit that is causing the trouble, read the "TROUBLESHOOTING" subsection to learn the procedure for finding the bad part.
3. Next, go to the schematic section and find the schematic that matches your monitor. It may be helpful to read the "DIFFERENCES BETWEEN MONITORS" subsection if you are unsure of which monitor you have. Use the schematic to see what parts are in the offending circuit.

That really is all there is to it. Just remember that there are some bizarre or rare symptoms not covered, or that a monitor may have two or more different problems that only a genius, the experienced, or an experienced genius can figure out. But be patient, follow safety precautions, and remember that there is also literature available from the monitor companies through your distributor or from Midway Manufacturing Company on request. (There is a toll free number on the back side of the front cover of this manual.)

# Symptom Diagnosis

## 1. Insufficient width or height:

- A. Horizontal line (due to VERTICAL CIRCUIT DEFECT).
  - Bad yoke.
  - Bad vertical output section.
  - Open fusible resistor in vertical section.
  - Bad height control.
  - Bad flyback.
- B. Vertical line (due to HORIZONTAL CIRCUIT DEFECT).
  - Bad yoke.
  - Open width coil.
  - Open part in horizontal output section.

## 2. Picture spread out too far or crushed in certain areas:

- A. Horizontal or vertical output transistor.
- B. Bad component in output circuitry.

## 3. Line too close with black spacing:

- A. Problem in vertical section causing poor linearity.

## 4. Poor focus and convergence:

- A. Bad high voltage transformer ("flyback") or control.
- B. Focus voltage wire not connected to neck-board terminal.

## 5. Colors missing; check:

- A. Interface color transistors.
- B. Color output transistors.
- C. Cracked printed circuit board.
- D. Color circuits.
- E. Video input jack.

## 6. Picture not bright enough:

- A. Weak emission from picture tube. (Turn horizontal sync off frequency and put brightness all the way up for about 15 minutes. Occasionally this cures the problem.)

## 7. Silvery effect in white areas; check:

- A. Beam current transistors.
- B. Weak picture tube emission.

## 8. Too much brightness with retrace lines; check:

- A. Beam limiter transistors.
- B. Brightness and/or color blanking control set too high.

## 9. Increasing brightness causes an increase in size and poor focus.

- A. Weak high voltage rectifier or regulation (high voltage unit).

## 10. Small picture and/or poor focus:

- A. Low B+ voltage (power supply trouble).

## 11. Vertical rolling:

- A. Vertical oscillator transistor, IC, or circuit.
- B. No sync from logic board.

## 12. Horizontal line across center:

- A. Vertical output circuit is dead (see symptom No. 1. A.).
- B. Vertical oscillator is not putting out the right wave form.

## 13. Picture bends:

- A. Horizontal sync needs adjusting.
- B. Magnetic or electromagnetic interference.

## 14. Flashing picture, visible retrace lines:

- A. Broken neck board.
- B. Internal short circuit in the picture tube (arcing).

## 15. Unsymmetrical picture or sides of picture:

- A. Defective yoke.

## 16. No brightness, power supply operating — No high voltage for the picture tube; check:

- A. Horizontal oscillator.
- B. Horizontal amplifier and output.
- C. Flyback transformer (high voltage unit).

## 17. No brightness, high voltage present; check:

- A. Heater voltage to the tube at the neck board.
- B. Screen-grid voltage for the tube.
- C. Focus voltage.
- D. Grid to cathode picture tube bias.

## 18. No high voltage; check:

- A. For AC input to the "flyback".
- B. Horizontal deflection stages.
- C. Flyback transformer.
- D. Yoke.
- E. Power supply.

## 19. No horizontal and vertical hold; check:

- A. Sync transistors and circuit.
- B. Wires and jack from logic board to the monitor.

## 20. Wavey picture — (power supply defect); check:

- A. Transistors, diodes, electrolytic capacitors in the power supply.

**21. Moving bars in picture:**

- A. Ground connector off between monitor and logic boards.
- B. Defect in the power supply (see wavy picture symptom).

**22. Washed out picture (see picture not bright enough):**

- A. Check video signal at the cathode pins with an oscilloscope. If there is about 80 volts peak to peak, the picture tube has weak emission.

**23. Monitor won't turn on:**

- A. Problem in the power supply: Check fuse, transistors, open fusible resistor.
- B. Shorted horizontal output transistor.

**C. Defective high voltage disabling circuit.**

- D. Crack(s) somewhere on main chassis board.

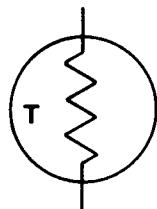
**24. Can't adjust purity or convergence:**

- A. Use a degausser to demagnetize the picture tube carefully following your degausser's instructions.
- B. Picture tube defective.
- C. Metal foreign material is in picture tube shield.
- D. Nearby equipment is electromagnetically interfering.
- E. The poles of the earth are pulling off the purity.
- F. Poor focus or width of picture.

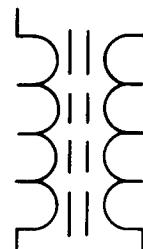
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## Guide To Schematic Symbols



**THERMISTOR**  
(POLARITY DOESN'T MATTER)



**IRON CORE TRANSFORMER**  
(SUCH AS A FLYBACK)



**INDUCTOR, COIL, CHOKE**  
(POLARITY DOESN'T MATTER)

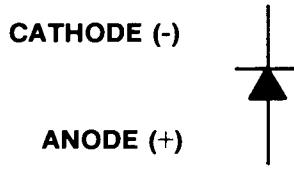


**FUSE**  
(POLARITY DOESN'T MATTER)



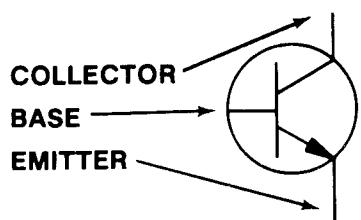
**(-) CATHODE**  
**(+) ANODE**

**ZENER DIODE**

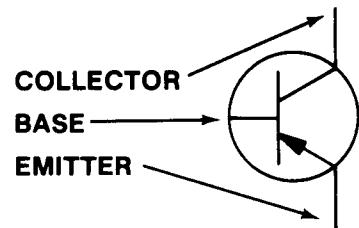


**CATHODE (-)**  
**ANODE (+)**

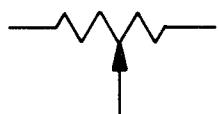
**DIODE**



NPN TRANSISTOR



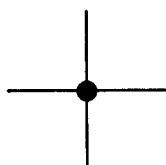
PNP TRANSISTOR



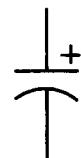
VARIABLE RESISTOR, POT, CONTROL  
(POLARITY DOESN'T MATTER)



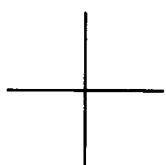
RESISTOR  
(POLARITY DOESN'T MATTER)



LINES ARE CONNECTED



ELECTROLYTIC CAPACITOR



LINES ARE NOT CONNECTED



CAPACITOR  
(POLARITY DOESN'T MATTER)



GROUND

# Troubleshooting

Troubleshooting monitors requires experience, patience, **and luck**. The first step is to match the symptom the monitor displays to the diagnosis next to it in the "SYMPTOM-DIAGNOSIS" subsection. This will pinpoint the circuit the problem is probably in, and often the parts to check. Next, the circuit should be visually inspected to see if there are any parts broken, burned, or if something is there that shouldn't be, like a loose screw, etc. Some parts go bad before others and should be checked first. In fact, following is the general order in which parts usually go bad:

1. Semiconductors (like transistors, diodes, and integrated circuits).
2. Fusible resistors.
3. Electrolytic capacitors.
4. Resistors.
5. Capacitors and coils.

Always remember that a monitor can bite like a snake. Even when it is turned off, capacitors hold voltage and will discharge it to you should you be touching chassis ground. The picture tube or CRT, itself, is a giant capacitor, so avoid the flyback anode plug hole. With the monitor on, the power supply circuit and/or the flyback, which puts out at least 18,000 volts, **CAN BE KILLERS!!** Avoid handling power transistors (usually output transistors), yoke terminals, and other high power components when the monitor is on.

## **WARNING: That picture tube is a bomb!**

When it breaks, first it implodes, then it explodes. Large pieces of glass have been known to fly in excess of 20 feet in all directions. **DO NOT** carry it by the long, thin neck. Discharge its voltage to ground by shorting the anode hole to ground. Use a plastic handled screwdriver, connect one end of a wire with an alligator clip at each end to chassis ground and the other end to the metal shaft of the screwdriver. Using **ONE HAND ONLY** (put the other in your pocket) and touching **ONLY** the plastic handle of the screwdriver (**DO NOT TOUCH THE METAL SHAFT**) stick the blade of the screwdriver into the anode hole. Be prepared for a fairly loud pop and a flash. The longer the monitor has been turned off, the smaller the pop and dimmer the flash. But **BE CAREFUL**, picture tubes will hold a very

healthy charge for at least a week if not longer. Even after you've discharged it once, it may still carry a residual charge. It's better to be too careful than dead, which is why electronic equipment always carries stickers referring servicing to qualified personnel. Handle the side with the viewing screen against your chest when changing it. **ALWAYS** wear safety goggles when handling the picture tube.

To maintain the safety and performance of the monitor, always use exact replacement parts. For instance, the wrong components in the power supply can cause a fire, or the wrong color transistor may give a funny color to the picture. Service your monitor on a nonconductive firm table like wood, **NOT METAL**, and take off all of your jewelry just in case. With all this in mind, you are ready to begin troubleshooting.

Observe the picture carefully. Try to vary the appropriate control that would most likely affect your particular symptom. For example, if there is poor brightness or no picture, try turning up the brightness or contrast control. If the controls have no effect at all, chances are there is trouble with the control itself, the circuit it controls, or a nearby circuit that may be upsetting voltages. Go to the list of symptoms and determine with the schematic where the bad circuit is.

## **CAUTION:**

**Keep in mind that capacitors hold a charge as can the picture tube (for at least a week and usually longer), and could shock you.**

First, check for obvious visual defects such as broken or frayed wires, solder where it is not supposed to be, missing components, burned components, or cracked printed circuit boards. If everything looks good up to this point, make sure that diodes, electrolytic capacitors, and transistors have their leads connected in the right polarity as shown on the schematic and the circuit board.

Turn on the power and measure the voltages at the leads of the active devices such as tubes, transistors, or integrated circuits. Any voltage that does not come within at least 10% to 15% of the voltage specified on the schematic indicates either a problem with that device or a component connected with it in the circuit. The next step is to use the ohmmeter to narrow down the field of possible offenders.

To test a transistor, one lead of the ohmmeter is placed on the base; and the other lead placed just on the emitter, then on the collector. A normal transistor will read either high resistance (infinite), or little resistance (400 to 900 ohms), depending on the polarity of this type transistor. Then the leads should be switched, one remaining on the base, and the other switched from the emitter to the collector. Now the opposite condition should result: the resistance should be infinite if it was lower when the other lead was on the base. Consistently infinite readings indicate an open, and a short is demonstrated by 0-30 ohms on most of these test readings. Finally, place one lead on the collector, then the other on the emitter. No matter which lead is used, there should be infinite resistance. Any lower reading, such as 50 ohms (which is typical on a bad transistor), indicates a short.

This all sounds pretty confusing, but a little experience on a good transistor will make you an expert in no time. Usually, the lowest ohmmeter setting is used for testing transistors. Once in a great while a transistor may check out good on this test, but may actually be "leaky" or break down only on higher voltages. If in doubt, change it. It is also wise to check the transistor out of the circuit just in case some component in the circuit is affecting the ohmmeter reading.

A diode is tested like a transistor except it only has two leads. Again, there should be high resistance one

way and little resistance the other. If it tests bad, take one lead out of the circuit in case some component is messing up the ohmmeter reading.

**NOTE:** **DO NOT** leave soldering equipment on the leads too long since all semiconductors, especially integrated circuits, are easily destroyed by heat.

Without special equipment, integrated circuits are checked by verifying the proper DC voltage on the pins and the correct AC wave form using an oscilloscope. **BE CAREFUL:** Shorting their pins can easily destroy them.

Resistors are checked with an ohmmeter and should usually be within ten percent of the value stated on them and on the schematic. You may have to desolder one lead from the printed circuit board. If you wreck the foil on the board, carefully solder a small wire over the break to reconnect the conductive foil.

Capacitors are tricky. Their resistance goes up when checked with an ohmmeter which shows a charging action. As they suck up current from the meter, the voltage goes up and so does the resistance. If you are sure a particular circuit is giving you a problem and everything else checks out O.K., Electrolytic capacitors are prime suspects. Substitute a new one and keep your fingers crossed.

## Theory of Operation

To understand what goes on inside the monitor, large general groups of circuits will be examined instead of laboriously analyzing the branches and small circuits that make up these groups. This will help avoid confusion and aid in a basic, concrete, knowledge of what makes up a monitor.

### THE POWER SUPPLY —

The AC going to the monitor from the game transformer is just like the voltage and current from your wall outlet. It jumps up and down going positive and negative sixty times a second. But a monitor needs nice, smooth DC; direct current, not alternating. So diodes chop up the AC and a big electrolytic capacitor filters it out to make it even smoother. Since the monitor is a big piece of electronic equipment, with many circuits demanding a lot of power from the power supply, there are also zener diodes and transistors to help maintain a nice, constant, smooth voltage so that the monitor circuits don't jump around. And this is what happens when you see a wavy picture. There is AC creeping

through the power supply, so it must be malfunctioning. If the voltage from the power supply is too low, the other circuits will be starved for power and you may see a small, wavy picture, or none at all.

Some circuits receive voltages that are higher than what the power supply should put out. But they come from the flyback transformer which will be discussed later.

### THE INTERFACE SECTION OF THE CHASSIS —

The interface section of the chassis is fairly easy to identify. It is right by the place where the video jack(s) from the logic board(s) plug into. There are sets of transistors that receive the separate red, green, blue, and sync information from the cables that come from the logic boards. The circuits jack up the voltage and match impedances, or in other words, prepare the logic board outputs for the circuits that will really amplify them for the output devices such as the yoke in the case of the sync, or the picture tube that shows the colors.

An interesting aside is that our sync is composite negative sync. That means two things:

1. The sync is a negative going wave form.
2. There are two pulses going at different speeds over the same wire:
  - a. Vertical wave forms at 60 times per second (or Hertz) and
  - b. Horizontal wave forms at about 15,750 times per second (Hz).

The sync is amplified by a sync amplifier transistor and sent on its way to the oscillators. The sync or timing information will be explained along with the oscillator shortly.

The color information is sent via wires to the neck board where the main amplification occurs. This will also be discussed later.

## **VERTICAL AND HORIZONTAL DEFLECTION —**

After the sync signal is amplified by the sync amp, it goes to two different sections, the vertical and horizontal circuits. Basically, the sync signals are for timing so the picture doesn't mess up since it is assembled like an orderly jigsaw puzzle, but so fast that you can't see the electron beams for each color painting the picture on the screen. This will all become clear soon. For now, we will follow the 60 cycle component of the sync as it goes on its journey to the deflection yoke.

The 60 cycle pulse goes to the vertical oscillator to make sure this circuit goes back and forth (or oscillates) at 60 times a second. Without this pulse keeping the circuit at the correct speed, it may get lazy and oscillate at 58 cycles or lower, or get ambitious and oscillate at 62 cycles or higher. At the wrong speed, the picture will start to roll up or down.

A Wells Gardner 13" or 19" color monitor uses transistors for its sync section. An Electrohome 13" or 19" color monitor uses an integrated circuit IC501 for its sync section. The idea is all the same. The output to the vertical amplifying transistors for all monitors must be a sawtooth wave form, sort of like a bunch of pyramids racing to the yoke's vertical coils at 60 times a second.

Along the way to the output transistors, the 60 cycle pulse is shaped and amplified to do the job: the yoke magnetically pushes the electron beam to fill the screen out sideways looking at the screen with the greatest length going up and down. Or viewing the screen sitting like a home television set. The amplified vertical output fills the screen up and down. Watching a monitor like this, seeing only a horizontal line means a problem with the vertical coils of the yoke or anything from the vertical output section on back to the oscillator.

The horizontal section is very similar with a few exceptions. The horizontal wave shape is more like a square and has a frequency of 15,750 cycles a second. Again, Wells Gardner uses transistors for the horizontal oscillator, and Electrohome uses the other side of IC501. Still, the effect is the same. If the oscillator isn't going at the correct speed, the picture may move sideways, start to slant, or tear up with slanted thin figures. With both the vertical and horizontal of all monitors, there are variable resistors that change the speed of the oscillators up and down. This way you have controls that can make the correct frequencies to keep the electronic jigsaw puzzle nicely locked in place. If you're driving in a car and next to you someone else is driving their car at exactly the same speed, it will appear that they are not moving. And this is why the sync frequency and the oscillators frequencies must match, so the picture doesn't appear to move.

The correct wave form is shaped and amplified in the circuitry just like in the vertical section. But the horizontal output transistor is a large power transistor and not only serves to give current to the horizontal yoke windings, it also feeds the flyback transformer.

## **THE FLYBACK TRANSFORMER (OR HIGH VOLTAGE UNIT) —**

The picture tube needs high voltage to light up, and the power supply can't meet this demand. The flyback transformer receives current alternating at about 15,750 times per second from the horizontal output transistor. The "flyback" jacks up its input voltage and puts out a higher voltage alternating at the same speed. But, in your "flyback" there are diodes that chop up the alternating voltage to make it a smooth DC output just like in the power supply. This is what goes through that thick red wire to your picture tube. **THIS AREA HAS ABOUT 18,000 VOLTS ON IT AND IT CAN KILL YOU!!**

The "flyback" may be dangerous, but it is also generous. It has extra output windings which give voltage to the heater pins of the picture tube, voltage for the vertical deflection circuits, and picture tube screen-grid voltage. So in a way, the high voltage "flyback" is like a second power supply.

## **COLOR CIRCUITS**

The color circuits are pretty straight forward. The signals go into the interface section where some amplification and impedance matching occurs. These circuits are pretty sparse and simple. Each color just has two transistors and a diode with some resistors and capacitors. From here, the AC color signal is sent by wires to the neck board.

The color output circuits are on the neck board. The color signals going to the transistors are controlled by two variable resistors called drive controls. There are only two, one for the red and one for the green. The

blue doesn't have one. In the emitter part of each transistor is another variable resistor that is the cut off control. These controls vary the amount of amplified AC signal that goes to the cathodes of the picture tube. The more signal, the more color. The bases of each of these transistors are connected together and are all connected to the blanking and beam limiting transistors which are in the interface section.

The beam limiter helps control the brightness level, and the blanking transistor rapidly turns the picture tube on and off so that retrace lines don't show up on the screen. By turning up the brightness on a good monitor, these four to six retrace lines can be seen slanting diagonally across the picture.

## PROTECTION CIRCUIT —

To protect the high voltage section against voltages that are too high coming from the power supply which could cause X-rays to be emitted from the "flyback", a circuit senses the higher power supply voltage, and using a transistor, turns off the horizontal oscillator. Since the horizontal oscillator doesn't work, the horizontal output transistor has nothing to feed the "flyback" which in turn has nothing to feed the picture tube. The monitor will be silent, have no picture, and will appear to be off. **But don't be fooled.** There is still that excessive amount of voltage coming from the power supply. To find out, check the emitter on TR502 of the Wells Gardner monitors; or the emitter of X04 for the Electrohome monitor. Here are the voltages you should receive:

Wells Gardner = 127VDC  
Electrohome = 120VDC

The best place to measure this voltage on an Electrohome monitor is at a pin marked B1 on the chassis. This is because a 13 inch color Electrohome

monitor, the G07-FB0 or G07-902, has an integrated circuit and very little else in the power supply. Still, there should be 120VDC at B1.

## THE PICTURE TUBE (OR CRT) —

The picture tube or CRT is an output device. In other words, the end result of the circuits work is displayed by this part. Actually, the output of other circuits is in the neck of the picture tube.

First, there is the heater. The heater boils off electrons from the cathodes so that they (the electrons) shoot up to the screen to excite the phosphors so that the three phosphors emit three colors of light.

The cathodes are next, and again they emit electrons to turn on the tube phosphors, making it glow. The cathode can arc or short to the heater resulting in no picture and a defective picture tube.

Next come the grids. The first grid is grounded. The following grid is the screen grid which receives about 300VDC depending on the brightness setting. The next grid closest to the picture tube screen is the focus grid which gets about one fifth the amount of voltage that is applied to the picture tube anode.

After jetting from the cathode through all these grids, the electrons speed through a mask, a sheet of material with tiny holes, and then excite the tiny dots of phosphor in the inside surface of the picture tube screen. The green electron gun (or cathode and circuitry) spits out electrons which head for the green phosphors only. The same goes for the red and blue guns. The way the phosphor light blends determines the color seen. Should these electron beams become too intense, they may burn the phosphor. With the monitor off, this can be seen as a dark permanent image of the video information on the tube screen.

# Differences Between Monitors

The easiest way to identify the brand of monitor you are working with, assuming you can't find the brand name written on it anywhere, is to see if there are two circuit boards rising up from the chassis toward the picture tube neck. In other words, they stand up, or are perpendicular to the chassis, with a black plastic bracket holding them in place. This is a description of a Wells Gardner monitor. They use separate boards for main chunks of circuitry. Therefore, you have a "power board" (the power supply), an "interface board" (the interface section), and a "horizontal/vertical board" (for the deflection circuitry). Still, there are a few parts on the chassis, but most can be found on the board. An Electrohome monitor has no

separate boards, except for the neck board, and just has a flat chassis.

Another good way to determine which monitor you have is to check the transistor call out numbers that are printed on the chassis next to the part. For instance, on the neck board, one of the color output transistors is TR401. If you look through the schematics or the parts lists, you will find TR401 in the Wells Gardner literature. On the other hand, the neck board transistor may say X101. X101 can be found in the Electrohome literature. So, all Wells Gardner transistor call outs begin with TR, and Electrohome transistor call outs start with an "X".

# Parts Interchangeability

Some parts can be interchanged on all of the monitors. Here are the rules:

1. You **CAN** swap the voltage regulator TR502 or X01 on any Wells Gardner or Electrohome 19 inch monitor. You **CAN NOT** swap the voltage regulator on the 13 inch Wells Gardner or Electrohome (G07-902) since the Electrohome uses an integrated circuit for the power supply.
2. You **CAN** swap any resistor between monitors that has the same resistance, wattage rating, and tolerance.
3. You **CAN** swap any capacitor between monitors that has the same capacitance, and voltage rating.
4. **PICTURE TUBES:**

Due to the fact that "ELECTROHOME" is now (October, 1981) using a picture tube with an **internal shield**, these picture tubes can be used in EITHER "WELLS GARDNER" or "ELECTROHOME" monitors.

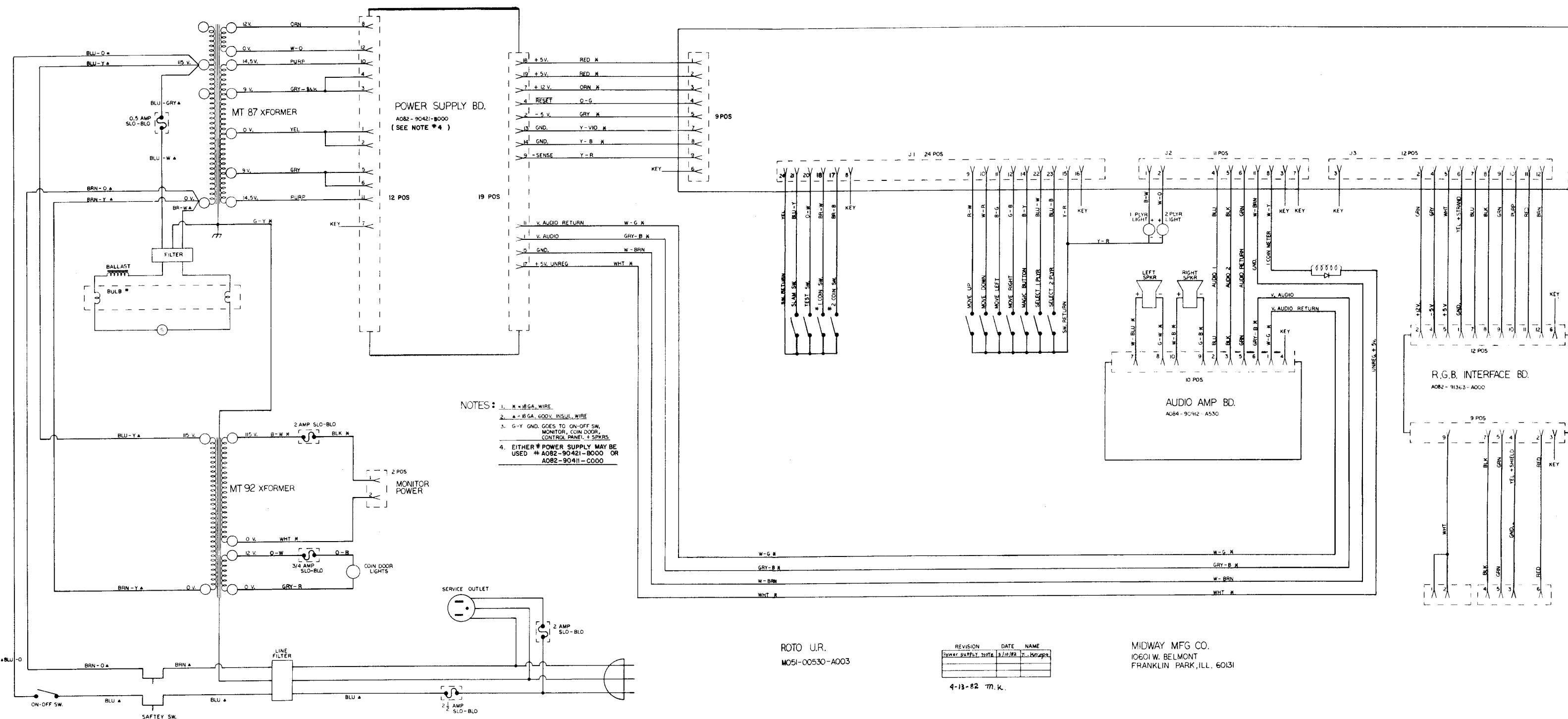
However, a "WELLS GARDNER" picture tube can **ONLY** be used in a "WELLS GARDNER" monitor. It will not function properly if installed in an "ELECTROHOME" monitor. The picture purity will be off.

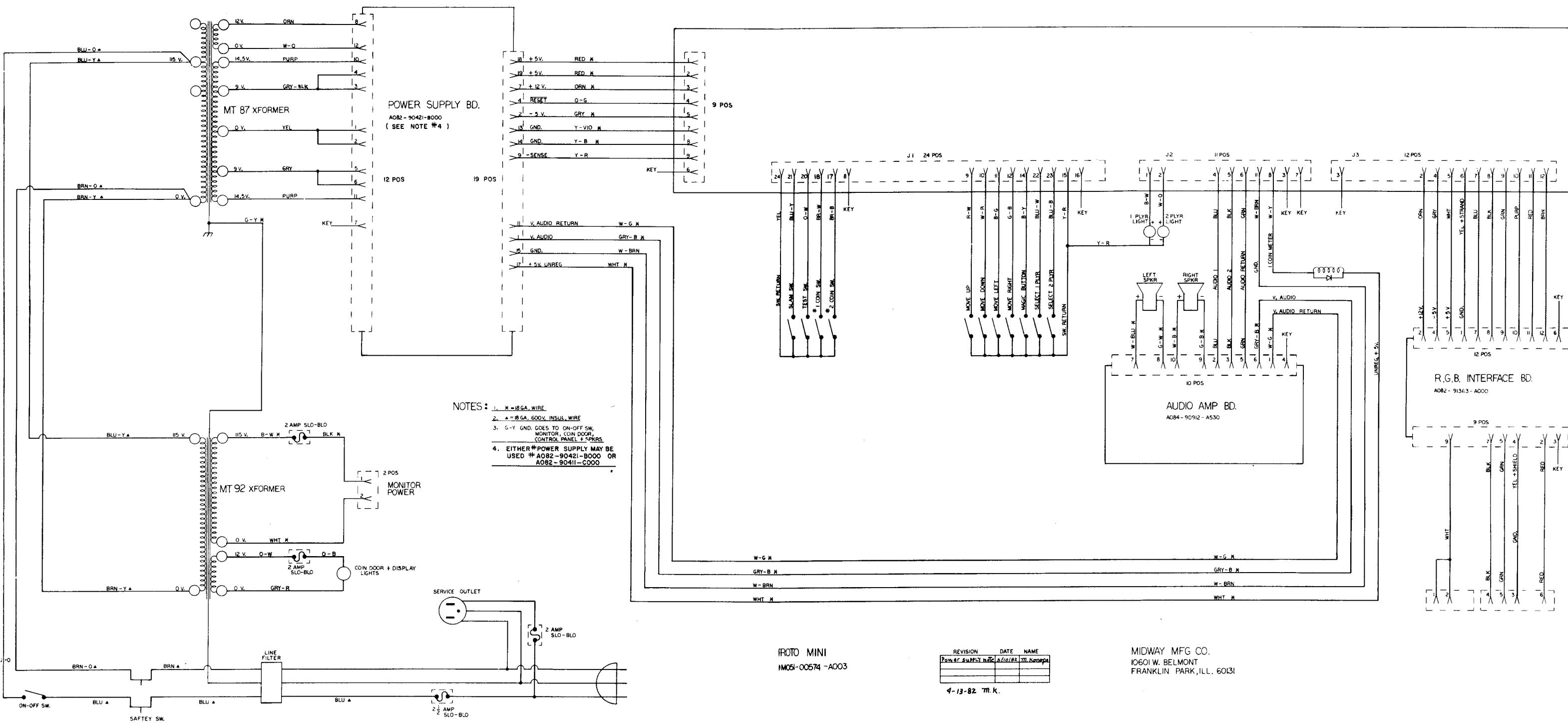
5. You **CAN NOT** change any part that is a **safety part**, one that is shaded in gray on the schematic; it **MUST** be **IDENTICAL** to the original. **To do otherwise IS DANGEROUS.** For instance, the 13 inch Electrohome (G07-904) monitor "flyback". looks identical to the 19 inch Electrohome (G07-904) monitor "flyback". In fact, there is even a 19 inch Electrohome (G07-905) monitor (which is an obsolete model) with a similar looking "flyback". **NONE OF THESE ARE INTERCHANGEABLE!!**
6. You **CAN** change any of the parts between the G07-904 and G07-907. They're essentially the same monitor except that the G07-907 has a vertically mounted picture tube.

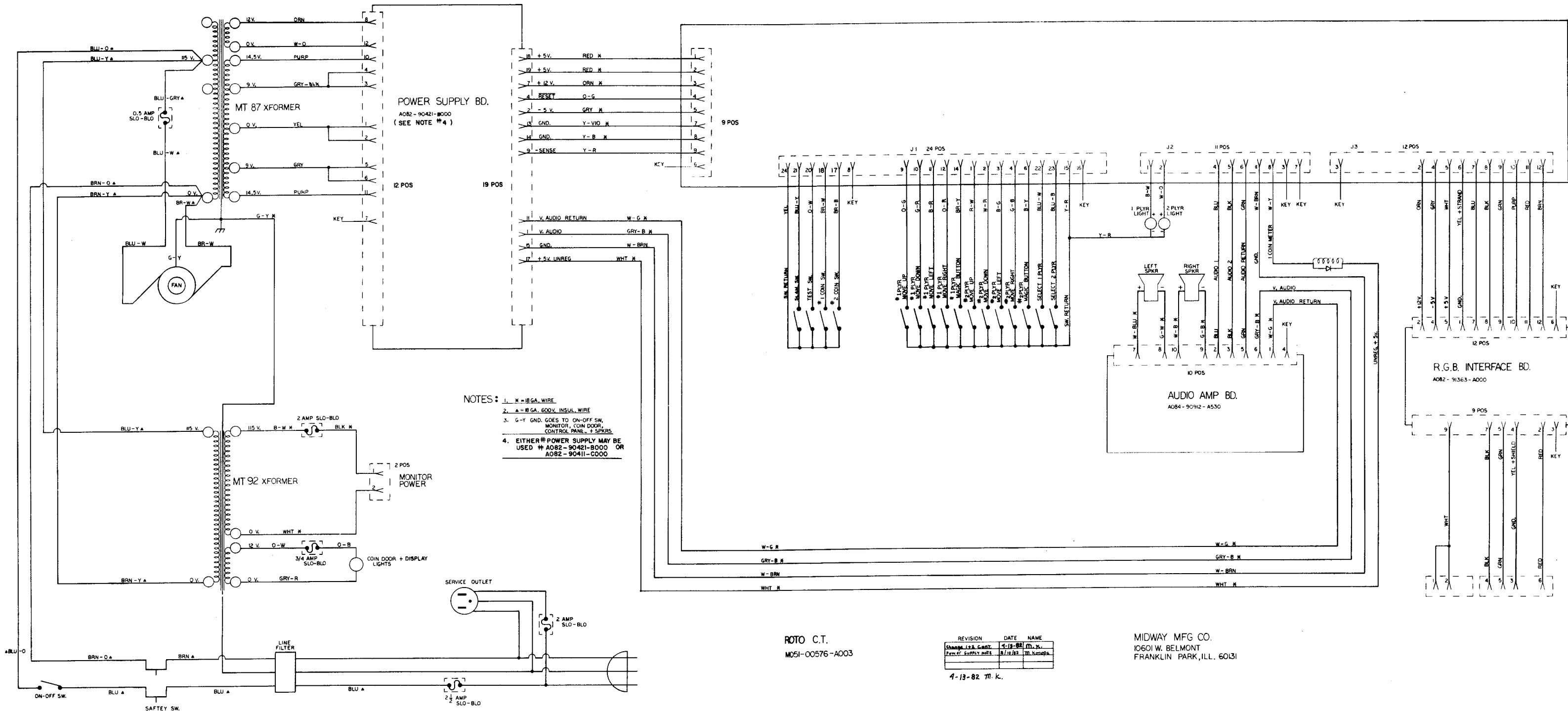
If there is any doubt about what parts can be swapped between each manufacturer's 19 inch and 13 inch models, compare the manufacturer's part number between each one. If they match up, they are the same part.

**Monitor schematics and parts lists omitted**

## **IX Schematics and Wiring Diagrams**

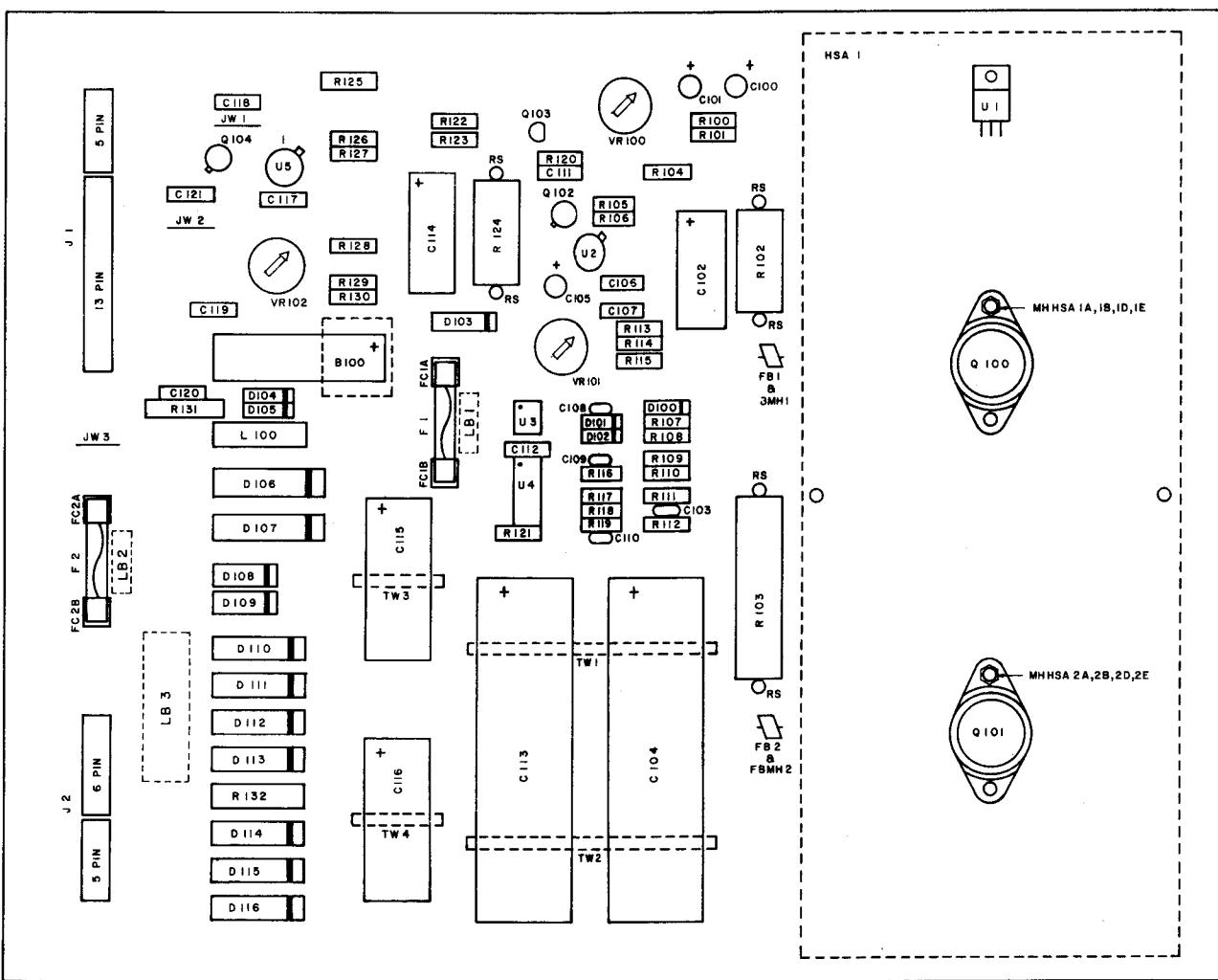






DESIGNATION LIST

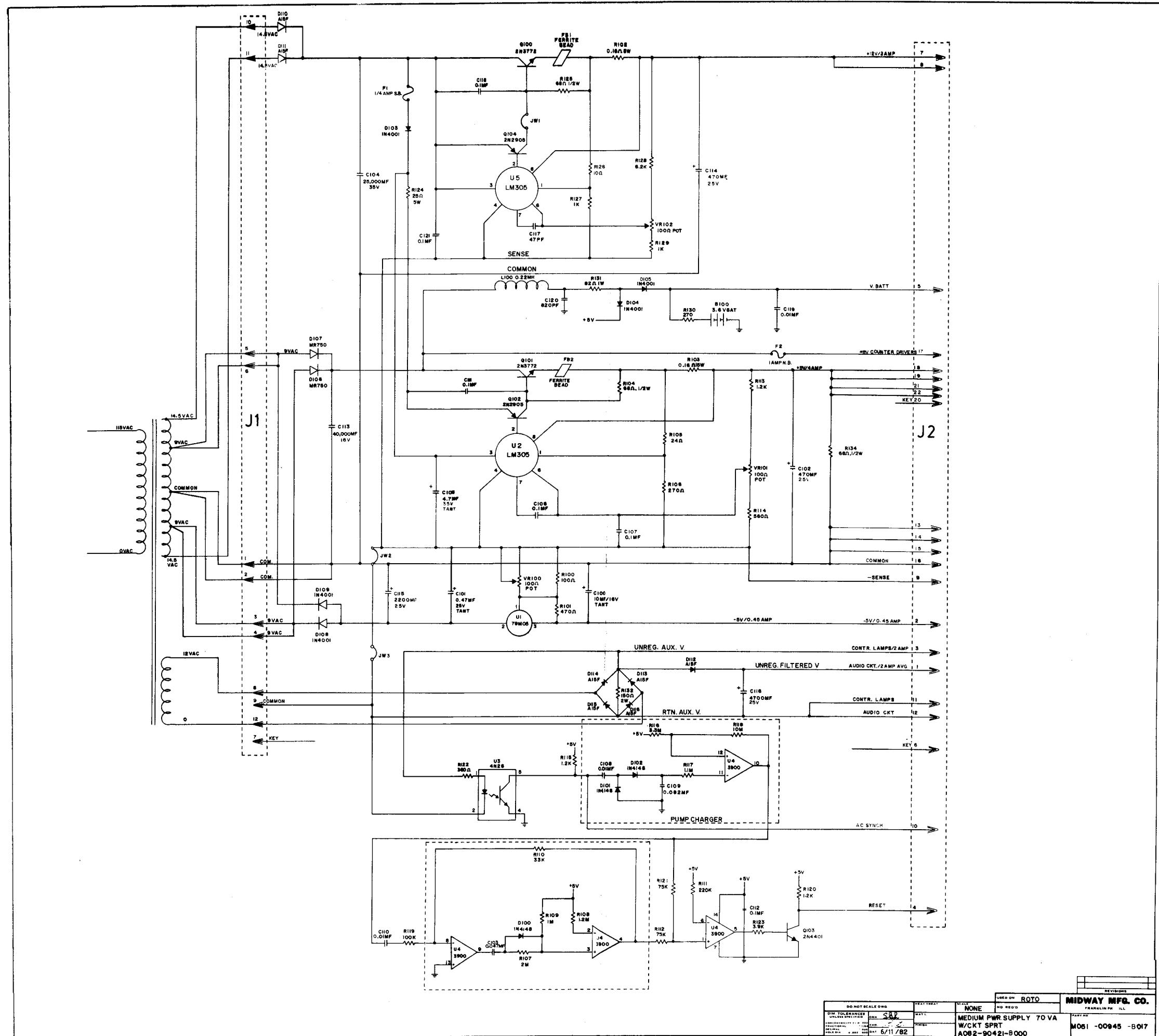
DESIG. NO.	DESCRIPTION	DESIG. NO.	DESCRIPTION
C 100	10 $\mu$ F RAD. TANT	F 1	1A NORMAL BLO
C 101	0.47 $\mu$ F RAD. TANT	F 2	1/4A SLO-BLO
C 102	470 $\mu$ F AX. ELECT	FC 1A,1B	FUSE CLIP
C 103	0.047 $\mu$ F ESTR	FC 2A,2B	FUSE CLIP
C 104	25000 $\mu$ F AX. ELECT	FBI,2	FERRITE BEAD
C 105	4.7 $\mu$ F RAD. TANT	TW 1-2	TIE WRAP 108 3/4"
C 106	0.1 $\mu$ F AX. CER.	TW 3,4	TIE WRAP 78 5/8"
C 107	0.1 $\mu$ F AX. CER.	J 1	5 PIN P.C. MOUNT
C 108	0.01 $\mu$ F ESTR	J 2	5 PIN P.C. MOUNT
C 109	0.082 $\mu$ F ESTR	LB 1	6 PIN P.C. MOUNT
C 110	0.01 $\mu$ F ESTR	LB 2	1A FUSE TAG
C 111	0.1 $\mu$ F AX. CER.	LB 3	ID POWER SUPPLY TAG
C 112	0.1 $\mu$ F AX. CER.	HSA 1	HEAT SINK ASS'Y 1
C 113	40000 $\mu$ F AX. ELECT	MH HSA 1A,2A	MOUNTING HARDWARE
C 114	470 $\mu$ F AX. ELECT	MH HSA 1B,2B	4-40X10 SLT RND SCREW
C 115	2200 $\mu$ F AX. ELECT	ID,2D.	WASHER 4-120-.250-018
C 116	4700 $\mu$ F AX. ELECT	MH HSA IE,2E	HEX NUT 4-40
C 117	47 pf AX. CER.	JW 1-3	22 AWG JUMPER WIRE
C 118	0.1 $\mu$ F AX. CER.	FB MH 1,2	FERRITE BEAD MOUNTING HARDWARE
R 100	100 ohm 1/4W 5%		
R 101	470 ohm 1/4W 5%		
R 102	.18 ohm 5W W/R.S.		
R 103	.16 ohm 15W W/R.S.		
R 104	68 ohm 1/2W 5%		
R 105	24 ohm 1/4W 5%		
R 106	270 ohm 1/4W 5%		
R 107	2M 1/4W 5%		
R 108	1.2 M 1/4W 5%		
R 109	1 M 1/4W 5%		
R 110	33 K 1/4W 5%		
R 111	220 K 1/4W 5%		
R 112	75 K 1/4W 5%		
R 113	1.2 K 1/4W 5%		
R 114	560 ohm 1/4W 5%		
R 115	1.2 K 1/4W 5%		
R 116	3.3 M 1/4W 5%		
R 117	1.1 M 1/4W 5%		
R 118	10 M 1/4W 5%		
R 119	100 K 1/4W 5%		
R 120	1.2 K 1/4W 5%		
R 121	75 K 1/4W 5%		
R 122	360 ohm 1/4W 5%		
R 123	3.9 K 1/4W 5%		
R 124	25 ohm 5W W/R.S.		
R 125	68 ohm 1/2W 5%		
R 126	10 ohm 1/4W 5%		
R 127	1 K 1/4W 5%		
R 128	6.2 K 1/4W 5%		
R 129	1 K 1/4W 5%		
R 130	270 ohm 1/4W 5%		
R 131	82 ohm 1W 10%		
R 132	150 ohm 2 W 5%		
VR 100	100 ohm POT		
VR 101	100 ohm POT		
VR 102	100 ohm POT		



\*\* NOTE : RS - RESISTOR SPACER

CROSS REFERENCE LIST

DESCRIPTION	Q'ty	DESIG. NO.	PART NO.
47 pf AX. CER.	1	C 117	0945-00811-0100
820 pf AX. CER.	1	C 120	0945-00816-0400
0.01 $\mu$ F AX. CER.	1	C 119	0945-00816-0100
0.01 $\mu$ F ESTR	2	C 108,110	0945-00816-0200
0.047 $\mu$ F ESTR	1	C 103	0945-00816-0300
0.082 $\mu$ F ESTR	1	C 109	0945-00816-1900
0.1 $\mu$ F AX. CER.	6	C 106,107,111,112,116,121	0945-00811-0200
0.01 $\mu$ F AX. CER.	1	C 101	0945-00816-1100
0.47 $\mu$ F RAD. TANT	1	C 105	0945-00816-0400
4.7 $\mu$ F RAD. TANT	1	C 100	0945-00816-1000
10 ohm 1/4W 5%	2	C 102,114	0945-00816-0600
470 $\mu$ F AX. ELECT	1	C 115	0945-00816-1300
2200 $\mu$ F AX. ELECT	1	C 116	0945-00816-1700
4700 $\mu$ F AX. ELECT	1	C 104	0945-00816-1800
40000 $\mu$ F AX. ELECT	1	C 113	0945-00816-1800
.16 ohm 15W 5% (W/RESISTOR SPACER)	1	R 103	0945-00815-0100
.18 ohm 5W 5% (W/RESISTOR SPACER)	1	R 102	0945-00815-0200
10 ohm 1/4W 5%	1	R 126	0062-051B3-IXXX
24 ohm 1/4W 5%	1	R 105	0062-065B3-IXXX
25 ohm 5W 10% (W/RESISTOR SPACER)	1	R 124	0062-098B3-IXXX
68 ohm 1/2W 5%	2	R 131	0945-00815-0800
82 ohm 1W 10%	1	R 100	0062-110B3-IXXX
100 ohm 1/4W 5%	1	R 132	0945-00812-0200
150 ohm 2 W 5%	1	R 106,130	0062-138B3-IXXX
270 ohm 1/4W 5%	2	R 122	0062-147B3-IXXX
360 ohm 1/4W 5%	1	R 101	0062-156B3-IXXX
470 ohm 1/4W 5%	1	R 114	0062-162B3-IXXX
560 ohm 1/4W 5%	1	R 127,129	0062-179B3-IXXX
1K 1/4W 5%	2	R 113,115,120	0062-183B3-IXXX
1.2K 1/4W 5%	3	R 123	0062-207B3-IXXX
3.9K 1/4W 5%	1	R 128	0062-217B3-IXXX
6.2K 1/4W 5%	1	R 110	0062-251B3-IXXX
75K 1/4W 5%	2	R 112,121	0062-269B3-IXXX
100K 1/4W 5%	1	R 119	0062-275B3-IXXX
220K 1/4W 5%	1	R 111	0062-291B3-IXXX
1M 1/4W 5%	1	R 109	0062-323B3-IXXX
1.1M 1/4W 5%	1	R 117	0062-325B3-IXXX
1.2M 1/4W 5%	1	R 108	0062-327B3-IXXX
2M 1/4W 5%	1	R 107	0062-337B3-IXXX
3.3M 1/4W 5%	1	R 116	0062-347B3-IXXX
10M 1/4W 5%	1	R 118	0062-371B3-IXXX
100 ohm POT	3	VR 100,101,102	0945-00814-0000
A15F RECTIFIER	7	D 110,111,112,113,114,115,116	0945-00804-0200
MR 750	2	D 106,107	0945-00804-0800
IN4001	5	D 103,104,105,108,109	0945-00804-0300
IN4148	3	D 100,101,102	0945-00804-0500
2N2905	2	Q 102,104	0945-00808-0300
2N4401	1	Q 103	0945-00804-0400
4N28	1	U 3	0945-00813-0300
LM 305	2	U 2,5	0945-00813-0100
LM 3900	1	U 4	0945-00813-0200
.22 $\mu$ H INDUCTOR	1	L 100	0017-00003-0200
BATTERY 3.6VDC 60DEG-C	1	B 100	0017-00003-0377
FUSE 1/4A S-BLO	1	F 2	0017-00003-0446
FUSE 1A N-BLO	1	F 1	0017-00003-0001
FUSE CLIP	4	FC 1A,1B,2A,2B	0017-00003-0214
FERRITE BEAD	2	FB 1,2	0017-00009-0225
TIE WRAP 108 3/4"	2	TW 1,2	0945-00814-0400
TIE WRAP 78 5/8"	2	TW 3,4	0945-00814-0300
5 PIN P.C. MOUNT	2	J 1,2	3000-16387-0500
6 PIN P.C. MOUNT	1	J 2	3000-16387-0600
13 PIN P.C. MOUNT	1	J 1	3000-16387-1300
22 AWG JUMPER WIRE	3	JW 1-3	0151-00087-0000
FERRITE BEAD MOUNTING HARDWARE	2	FBMH 1,2	0017-00033-0139
1/4A FUSE TAG	1	L 8 1	M051-00945-A020
1A FUSE TAG	1	L 8 2	M051-00945-A021
TAG-ID POWER SUPPLY	1	L 8 3	M051-00945-A022
P.C.B.	1	A080-90421-B000	
4-40X10 SLT RND	2	MH HSA 1A,2A	0017-00101-0727
WSH 4-120-.250-018	4	MH HSA 1B,2B,1D,2D	0017-00104-0071
4-40 HEX N			

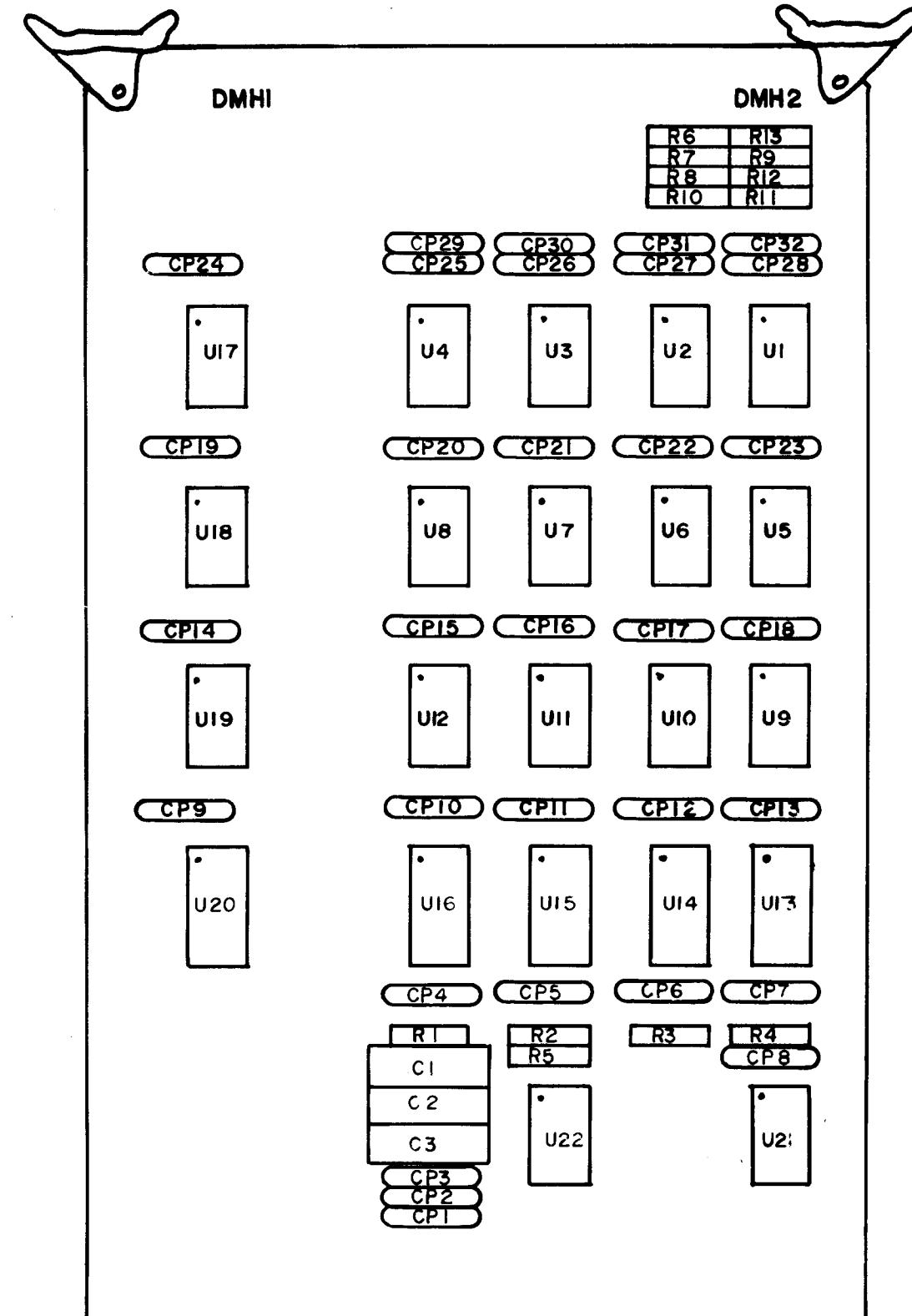


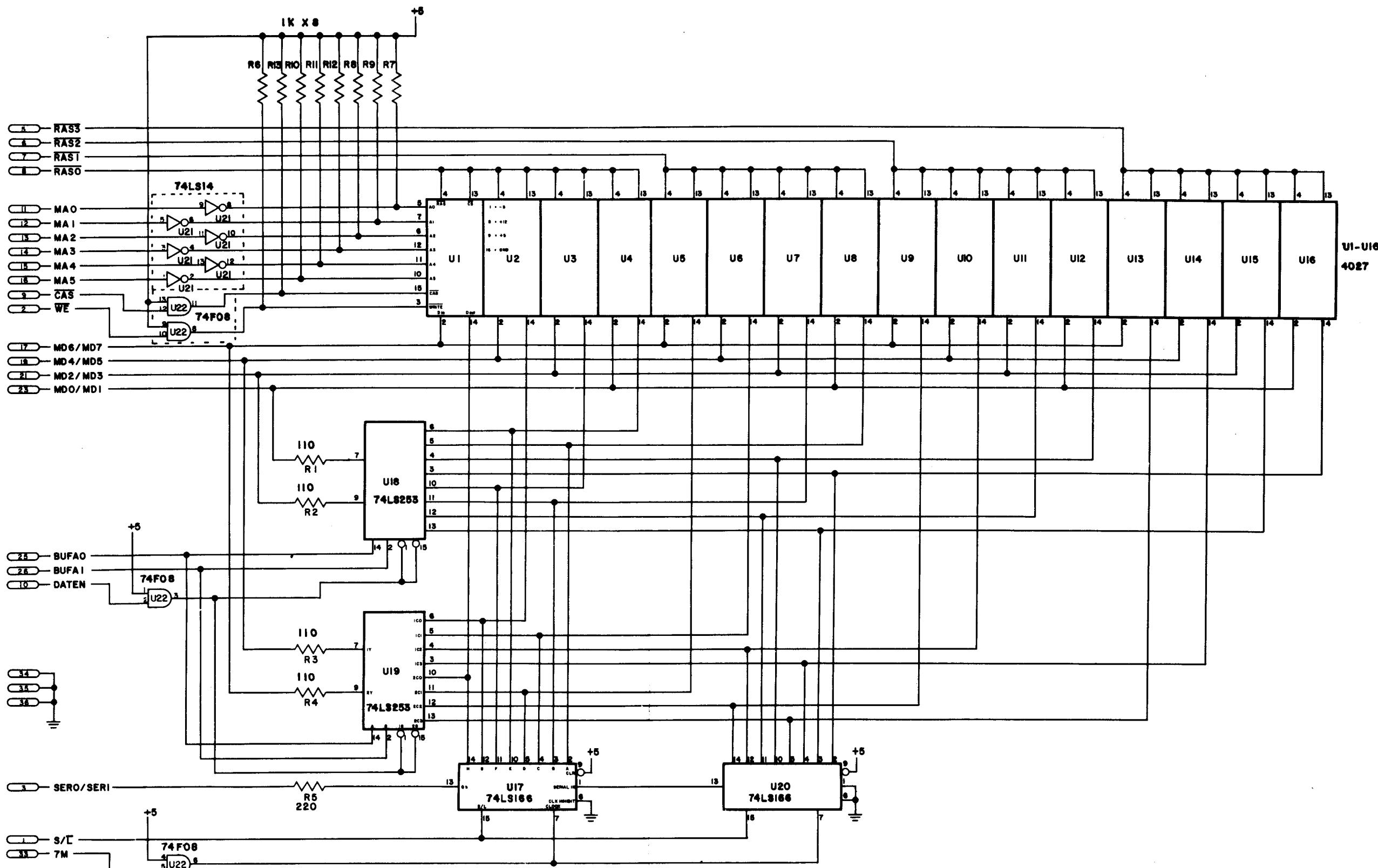
# CROSS REFERENCE LIST

<u>DESCRIPTION</u>	<u>Q'TY</u>	<u>DESIGNATION</u>	<u>PART NO.</u>
0.1 MF AX.CER. 15 MF AX.TANT.	32 3	CPI-CP32 C1-C3	0789-00800-0900 0174-207D 6-EXGX
110 OHM 1/4 w 5% CRBN 220 " " " " 1K " " " "	4 1 8	R1-R4 R5 R6-R13	0062-113B3-1XXX 0062-133B3-1XXX 0062-179B3-1XXX
4027 74F08 74LS14 74LS166 74LS253	16 1 1 2 2	U1-U16 U22 U21 U17,U20 U18,U19	0789-00803-4900 0789-00803-5000 0789-00803-3600 0789-00803-3500 0789-00803-4800
P.C. BOARD EXTRACTOR RAM BOARD	2 1	DMHI, DMH2	0789-00806-0200 A080-91356-C000

## DESIGNATION LIST

<u>DESIGNATION</u>	<u>DESCRIPTION</u>
C1-C3 CPI-CP32	15 MF AX.TANT. 0.1MF AX.CER.
R1-R4 R5 R6-R13	110 OHM 1/4 w 5% CRBN. 220 " " " " 1K " " " "
U1-U16 U17 U18,U19 U20 U21 U22	4027 74LS166 74LS253 74LS166 74LS14 74F08
DMHI, DMH2	P.C. BOARD EXTRACTOR





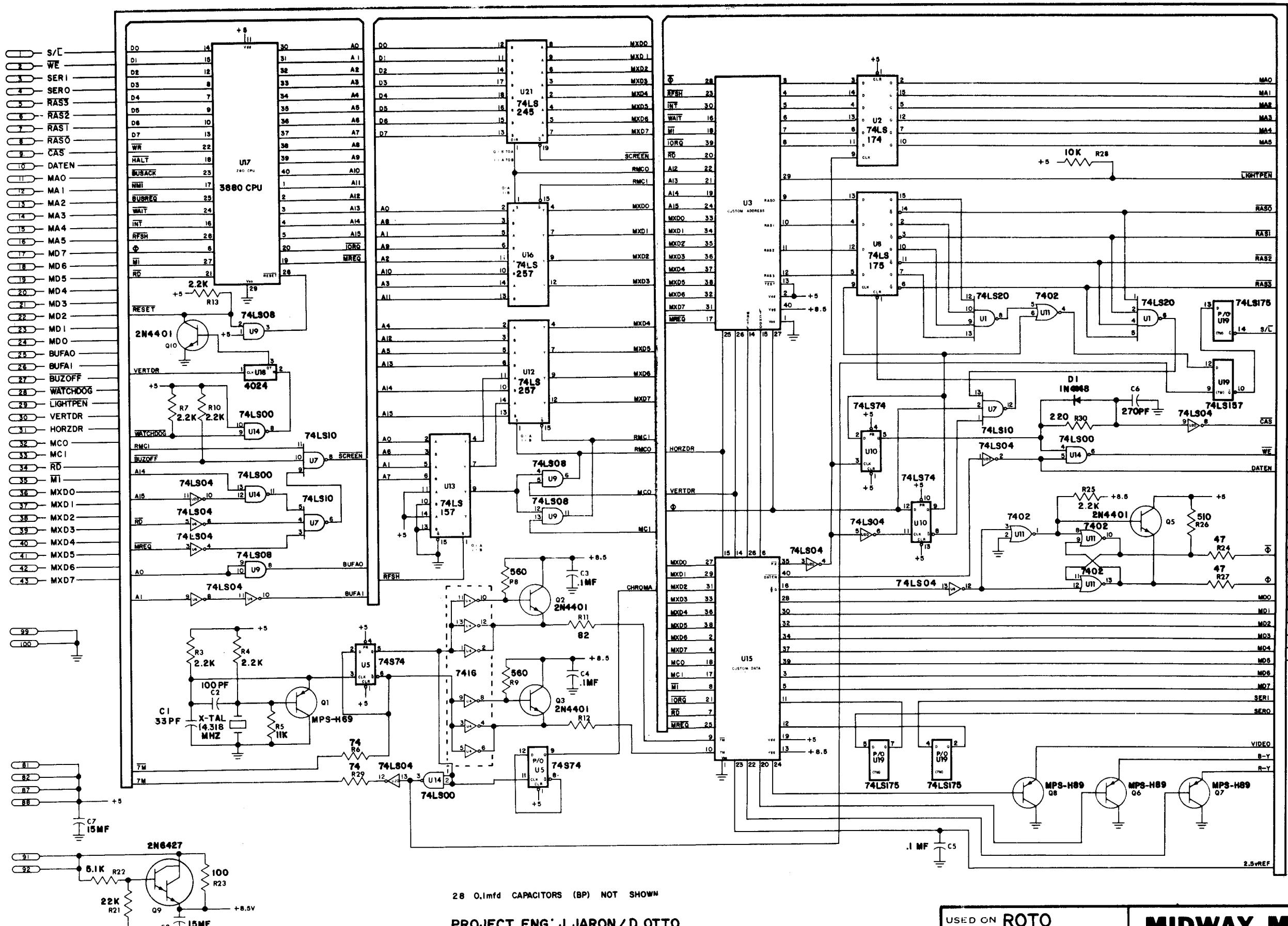
PROJECT ENG: J. JARON/D. OTTO

DO NOT SCALE DWG.		HEAT TREAT	SCALE	USED ON ROTO	MIDWAY MFG. CO. FRANKLIN PK. ILL.
DIM. TOLERANCES UNLESS SPECIFIED		DRN. <i>m.m</i>	FULL	NO. REQ'D 2 PER.	
CONCENTRICITY T.I.R. .003		MATL.			
FRACTIONAL..... 1/164		FINISH			
DECIMAL..... .005					
HOLE DIA..... +.002-.000					
DATE 03/12/82					
SCHEMATIC RAM BOARD A082-91356-C000		PART NO.	M051-00789-C002		

# DESIGNATION LIST

# CROSS REFERENCE LIST

DESIGNATION	DESCRIPTION	DESIGNATION	DESCRIPTION
C1	33 PF AX.CER.	U11	7402
C2	100 PF "	U12	74LS257
C3-C5	0.1 MF "	U13	74LS157
C6	270 PF "	U14	74LS00
C7,C8	15 MF AX.TANT.	U15	CUSTOM DATA
CPI-CP28	0.1 MF AX. CER.	U16	74LS257
		U17	3880 CPU
RI-R3	2.2 K OHM 1/4w 5%CRBN	U18	4024
R4	22 K "	U19	74LS175
R5	11K "	U20	74LS04
R6	47 "	U21	74LS245
R7	2.2K "	ICSU3	40 PIN IC SOCKET
R8,R9	560 "	ICSU15	" " "
R10	2.2K "	ICSU17	" " "
R11,R12	82 "	ICSU21	20 PIN "
R13	2.2K "	X-TAL1	14.318 MHZ CRYSTAL
R21	22 K "	DMHI, DMH2	P.C. BOARD EXTRACTOR
R22	5.1K "	HSUI5	HEAT SINK
R23	100 "		
R24	47 "		
R25	2.2K "		
R26	510 "		
R27	47 "		
R28	10K "		
R29	47 "		
R30	220 "		
D1	IN4148		
Q1	MPS-H69		
Q2,Q3	2N4401		
Q5	2N4401		
Q6-Q8	MPS-H69		
Q9	2N6427		
Q10	2N4401		
U1	74LS20		
U2	74LS174		
U3	CUSTOM ADDRESS		
U4	7416		
U5	74S74		
U6	74LS04		
U7	74LS10		
U8	74LS175		
U9	74LS08		
U10	74LS06		
U11	74LS157		
U12	74LS245		
U13	74LS257		
U14	CUSTOM ADDRESS		
U15	CUSTOM DATA		
U16	20 PIN IC SOCKET		
U17	40 " " "		
U18	CRYSTAL		
U19	P.C. BOARD EXTRACTOR		
U20	HEAT SINK		
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28 0.1mfD CAPACITORS (BP) NOT SHOWN

PROJECT ENG: J.JARON / D.OTTO

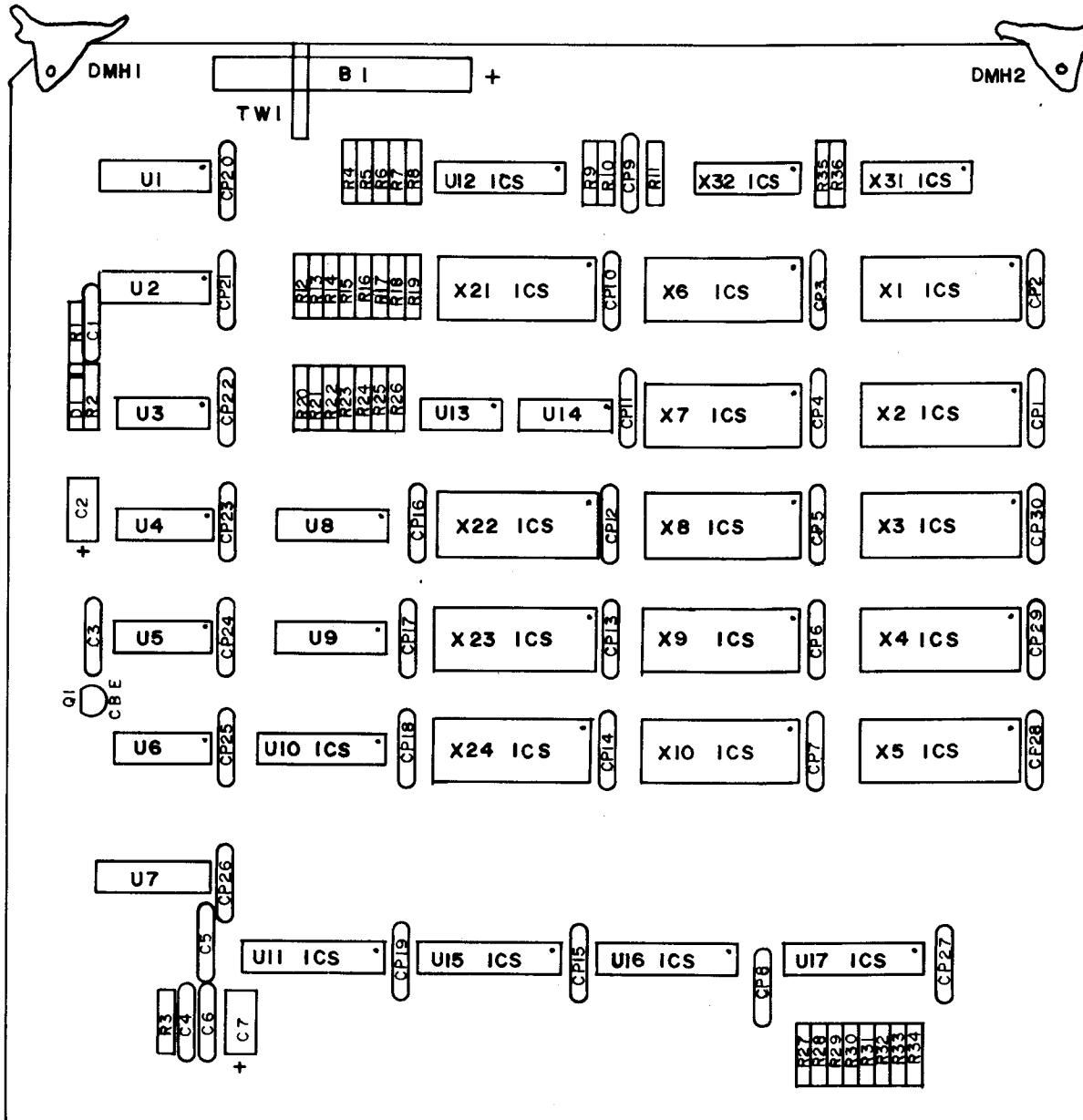
DO NOT SCALE DWG.		HEAT TREAT	SCALE FULL	NO. REQ'D 1 PER.	MIDWAY MFG. CO. FRANKLIN PK. ILL.
DIM. TOLERANCES UNLESS SPECIFIED	DRN. <i>M. M.</i>	MAT'L.	SCHEMATIC CPU BOARD A082-91354-F000	PART NO.	
CONCENTRICITY T.I.R. .003 FRACTIONAL ..... + 1/64	CKD. <i>JJ</i>	FINISH			M051-00789-F005
DECIMAL ..... + .005					
HOLE DIA. .... + .002 -.000					
DATE <b>03/12/82</b>					

# DESIGNATION LIST

## DESIGNATION DESCRIPTION

C1 0.1 MF AX.CER.  
C2 15 MF AX.TANT.  
C3-C6 0.1 MF AX.CER.  
C7 15 MF AX.TANT.  
CPI-CP30 0.1 MF AX.CER.

R1 470K OHM 1/4W 5% CRBN  
R2 220K " " " "  
R3 220 " " " "  
R4 120 " " " "  
R5-R26 10K " " " "  
R27-R34 110 " " " "  
R35,R36 2.7K " " " "  
  
D1 IN4004  
Q1 2N440  
U1 74LS08  
U2 74LS32  
U3 7403  
U4 74LS02  
U5 74LS74  
U6 4078  
U7 74LS133  
U8,U9 74LS139  
U10 82S153  
U11 74LS244  
U12 74LS245  
U13,U14 7417  
U15,U16 74LS244  
U17 74LS245  
X1-X10 EPROM KIT  
X21 8416-20 LOW POWER RAM  
X22-X24 8416-20 RAM  
X31,X32 EPROM KIT  
  
ICSVII,ICSI2 20 PIN IC SOCKET  
ICSV5 - ICSI7 " " " "  
ICSVXI-ICSVIO 24 " " "  
ICSV2I-ICSV24 " " " "  
ICSV3I,ICSV32 16 " " "  
  
B1 3.6V NI-CAD BATTERY  
TWI TIE WRAP  
DMH1,DMH2 P.C BOARD EXTRACTOR



## CROSS REFERENCE LIST

DESCRIPTION	Q'TY	DESIGNATION	PART NO
0.1 MF AX.CER.	35	C1,C3-C6,CPI-CP30	0530-00800-0300
15 MF AX.TANT.	2	C2,C7	0530-00800-0400
110 OHM 1/4W 5% CRBN	8	R27-R34	0062-113B3-IXXX
120 " " " "	1	R4	0062-116B3-IXXX
220 " " " "	1	R3	0062-133B3-IXXX
2.7K " " " "	2	R35,R36	0062-199B3-IXXX
10K " " " "	22	R5-R26	0062-227B3-IXXX
220K " " " "	1	R2	0062-291B3-IXXX
470K " " " "	1	R1	0062-307B3-IXXX
IN4004	1	D1	0530-00801-0200
2N440	1	Q1	0530-00802-0500
4078	1	U6	0530-00803-1400
74LS02	1	U4	0530-00803-0700
7403	1	U3	0530-00803-0500
74LS08	1	U1	0530-00803-0800
7417	2	U13,UI4	0530-00803-0600
74LS32	1	U2	0530-00803-0900
74LS74	1	U5	0530-00803-1000
74LS133	1	U7	0530-00803-1100
74LS139	2	U8,U9	0530-00803-1200
74LS244	3	UI1,UI5,UI6	0530-00803-1500
74LS245	2	UI2,UI7	0530-00803-1300
82S153	1	U10	5300-26AAJ-AXHD
8416-20 L.P.	1	X21	0530-00803-1700
8416-20	3	X22-X24	0530-00803-1800
EPROM KIT	1	XI-X10, X31,X32	A530-90000-R000
16 PIN IC SOCKET	2	ICSV3I,ICSV32	0530-00904-0300
20 " " " "	6	ICSVII,ICSV12,ICSV15- ICSV17	0530-00804-0400
24 PIN IC SOCKET	14	ICSVXI-ICSVIO,ICSV21- ICSV24	0530-00804-0500
3.6V BATTERY	1	B1	0530-00804-0600
TIE WRAP	1	TWI	0017-00042-0048
P.C BOARD EXTRACTOR	2	DMH1,DMH2	0789-00806-0200
MEMORY BD.	1		A080-91423-A530

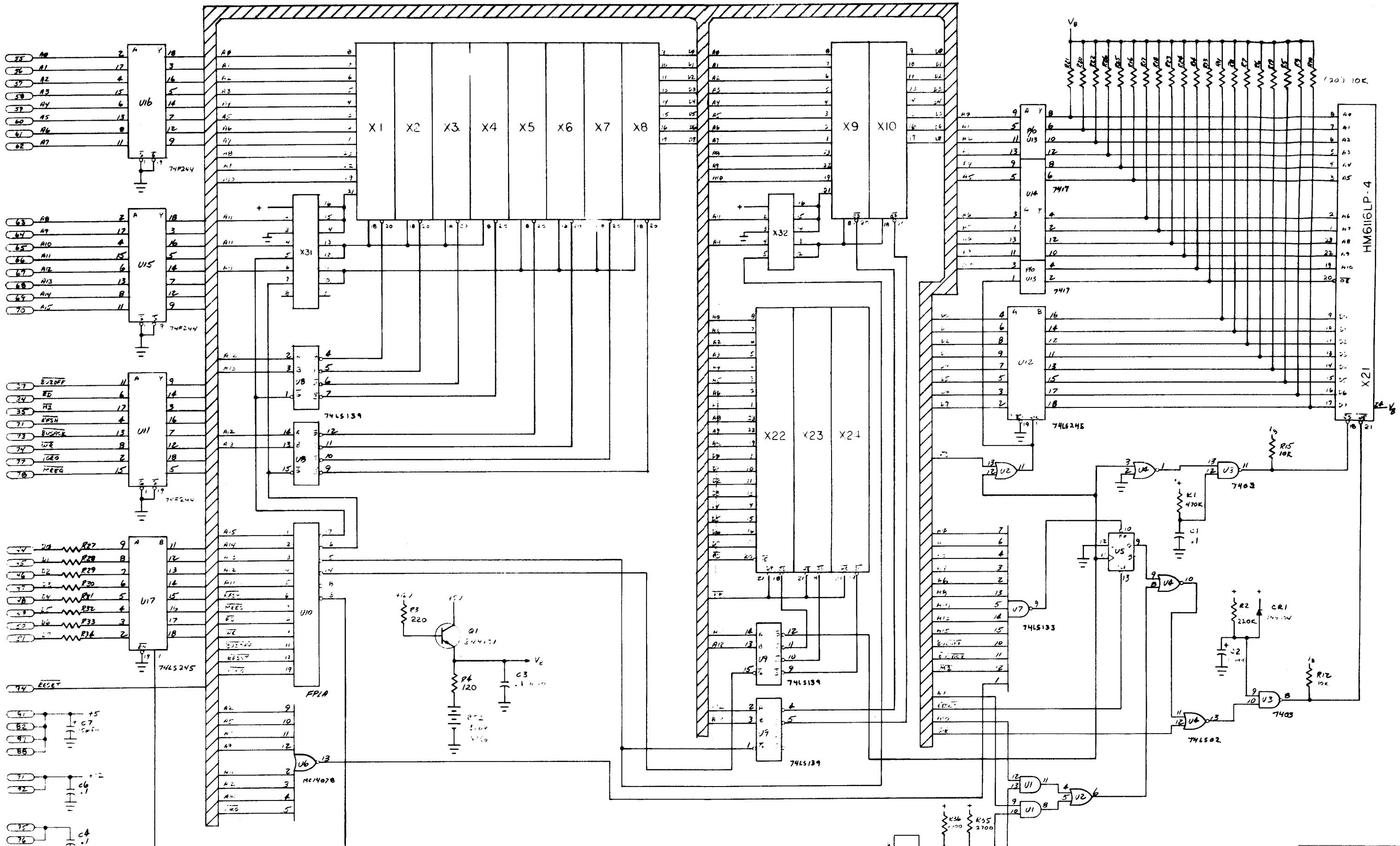
PROJECT ENG: J. JARON / D. OTTO

DO NOT SCALE DWG	FEAT TREAT	SCALE
DIM TOLERANCES UNLESS SPECIFIED	DRW: M.M.	FULL
UNCONSTRAINED FER 0.01 FRACTIONAL 0.004 DECIMAL 0.005 HOLE DIA + 0.02 - 0.00	CKD	NO. REVD 1 PER.
	MATL	PART NO
	FINISH	M051-00530-A007
	DATE 03/08/82	

MIDWAY MFG. CO.

FRANKLIN PK. ILL.

ASS'Y DRAWING  
MEMORY BOARD  
A084-91423-A530



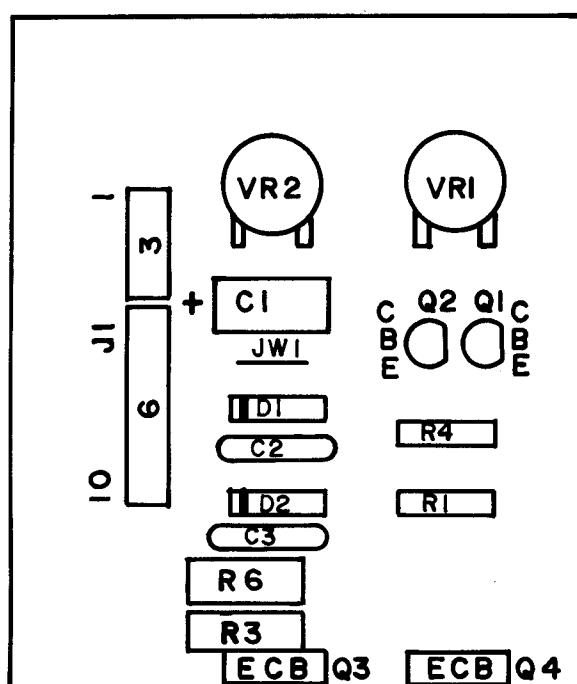
PROJECT ENGS.: D. OTTO, J. JARO

DO NOT SCALE DWG	
DIM. TOLERANCES UNLESS OTHERWISE SPECIFIED	BY M.M.
UNLESS OTHERWISE SPECIFIED	EXCEPT
ALL DIMENSIONS	IN INCHES
ALL MATERIALS	SHOWN
ALL Holes	SHOWN
ALL Diameters	SHOWN
DATE 03/15/88	

1. DATE DRAWN	2. DATE FULL	3. DRAWN BY NO. 1 PER.
DATE	MEMORY BOARD	
1. DRAWN	SCHEMATIC A080-91423-A530	

REVISIONS  
**MIDWAY MFG. CO.**  
FRANKLIN PK. ILL  
PART NO.

# CROSS REFERENCE LIST



<u>DESCRIPTION</u>	<u>Q'TY</u>	<u>DESIGNATION</u>	<u>PART NO.</u>
0.1 MF AX.CER.	2	C2, C3	0530-00800-0500
15 MF 20V AX.TANT	1	C1	0530-00800-0600
3.3 OHM 1w 5% CRBN.	2	R3, R6	0062-038F3-1XXX
330 " 1/4w "	2	R1, R4	0062-144B3-1XXX
200 " POT	2	VRI, VR2	0063-050AX-1DEX
IN4004 DIODE	2	D1, D2	0530-00801-0300
2N4403	2	Q1, Q2	0530-00802-0600
TIP 31	2	Q3, Q4	0530-00802-0700
KK 156 10 POS.	1	J1	3000-16387-1000
AUDIO AMP	1		A084-90912-A530

## DESIGNATION LIST

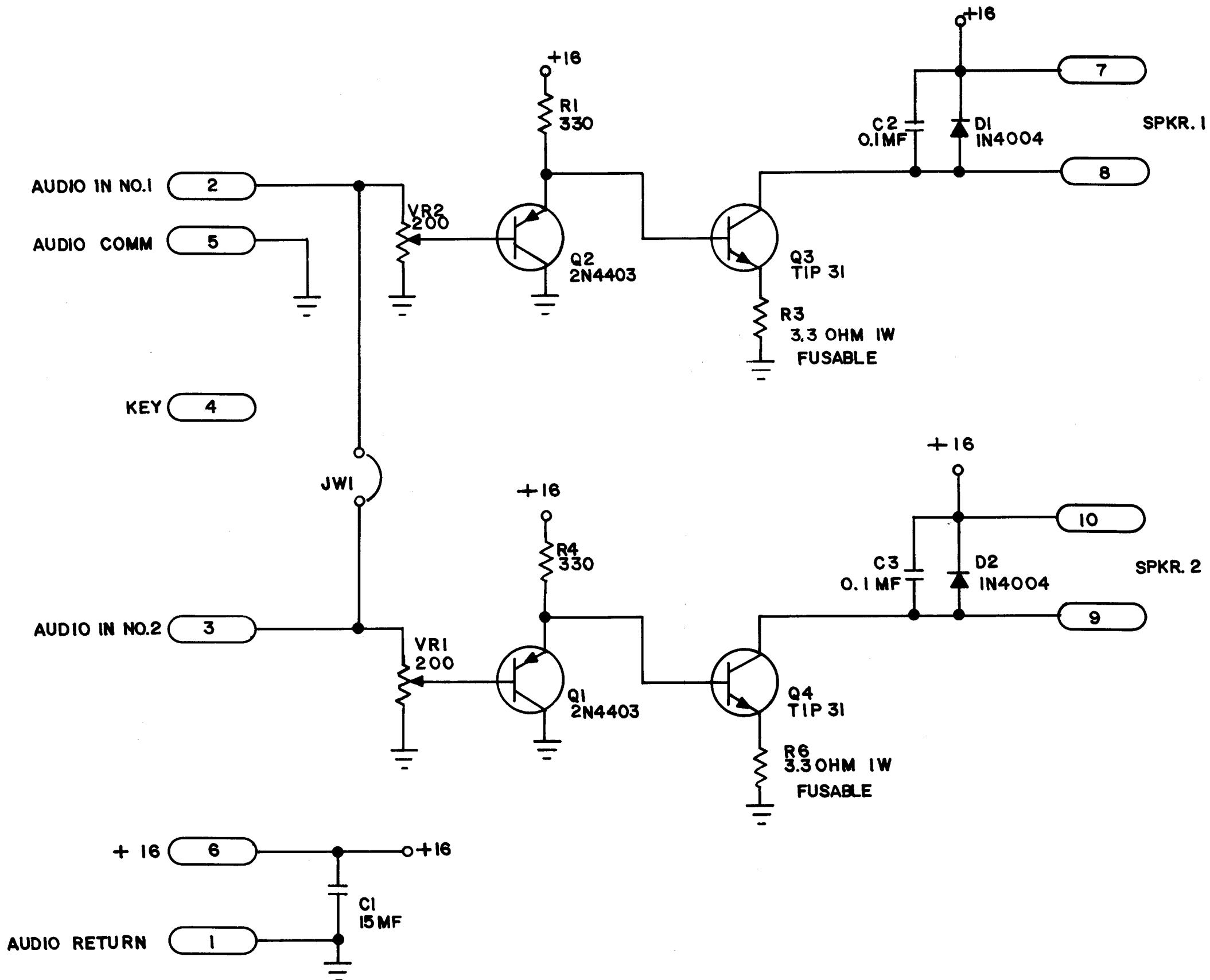
<u>DESIGNATION</u>	<u>DESCRIPTION</u>
C1	15 MF 20V AX.TANT
C2, C3	0.1MF AX.CER.
R1	330 OHM 1/4w 5% CRBN.
R3	3.3 " 1w " "
R4	330 " 1/4w " "
R6	3.3 " 1w " "
VRI, VR2	200 OHM POT
DI, D2	IN4004 DIODE
Q1, Q2	2N4403
Q3, Q4	TIP 31
J1	KK156 10 POS

DO NOT SCALE DWG.

DIM. TOLERANCES UNLESS SPECIFIED	DRN. <i>m. m</i>
CONCENTRICITY T.I.R...003	
FRACTIONAL.....± 1/64	CKD. <i>J. J.</i>
DECIMAL.....± .005	DATE <i>03/04/82</i>
HOLE DIA.....+.002-.000	

PROJECT ENG: J. JARON / D. OTTO

USED ON ROTO		MIDWAY MFG. CO.
SCALE <b>FULL</b>	NO. REQ'D 1 PER.	
ASS'Y DRAWING AUDIO AMP BOARD A084-90912-A530		PART NO. <b>M051-00530-A009</b>

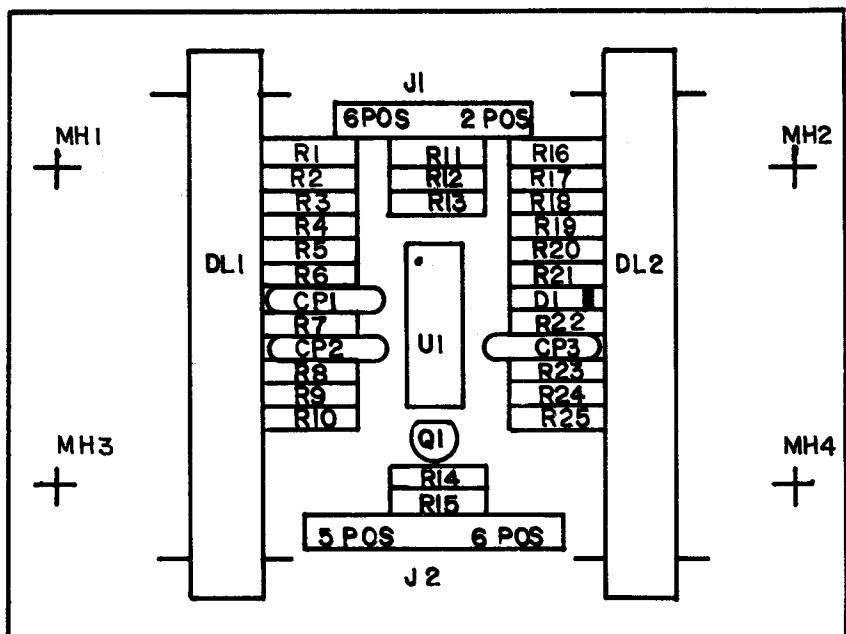


PROJECT ENG: J.JARON/D.OTTO

DO NOT SCALE DWG.		HEAT TREAT	SCALE	USED ON ROTO		MIDWAY MFG. CO.	
DIM. TOLERANCES UNLESS SPECIFIED		DRN. TJK	MAT'L.	NO. REQ'D	1 PER	FRANKLIN PK. ILL.	
CONCENTRICITY T.I.R. .003							
FRACTIONAL.....	+ 1/64						
DECIMAL.....	.005						
HOLE DIA.....	.002-.000	CKD.	FINISH				
		DATE 03/16/82					
		SCHEMATIC AUDIO AMP AO 80-90912-A530				PART NO. M051-00530-A010.	

## DESIGNATION LIST

<u>DESIGNATION</u>	<u>DESCRIPTION</u>
CPI-CP3	Q1 AX. CR.
R1	1.5K OHM 1/4W 5% CCRBN
R2	2K " " " "
R3-R4	3K " " " "
R5	6.2K " " " "
R6	2K " " " "
R7	1.3K " " " "
R8	1.5K " " " "
R9,R10	1K " " " "
R11,R12	1.5K " " " "
R13	2K " " " "
R14	4.3K " " " "
R15	160 " " " "
R16,R17	1K " " " "
R18	6.2K " " " "
R19	620 " " " "
R20	1.2K " " " "
R21	100 " " " "
R22	1K " " " "
R23,R24	160 " " " "
R25	1K " " " "
DI	IN5232
Q1	2N4401
UI	TBA 530
DL1,DL2	270 NS DELAY LINE
J1	CONN-KK100-RA-9 PIN
J2	CONN-KK100-RA-12 PIN
MH1-MH4	SNAP BUSHING 1/4"

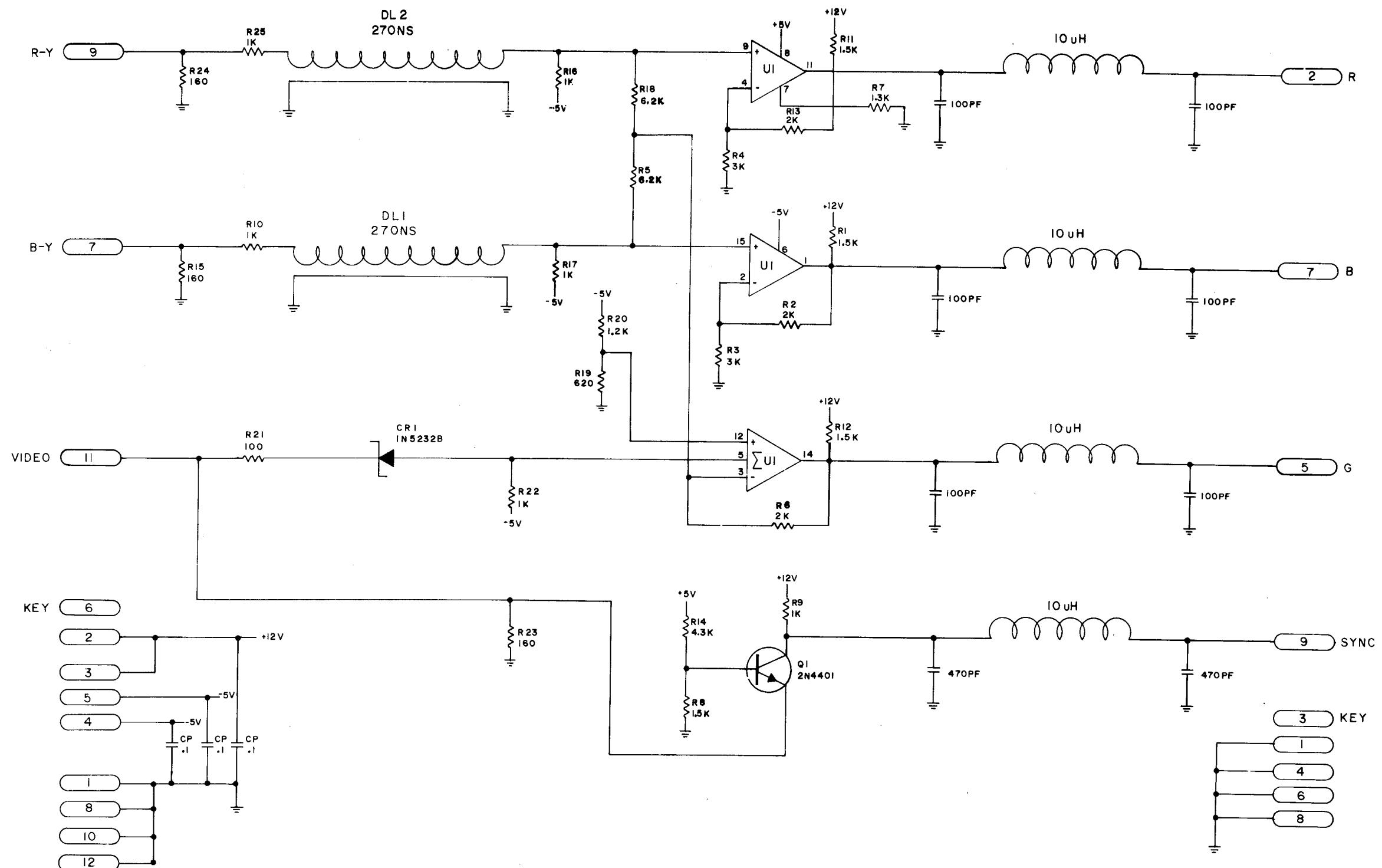


<u>DESCRIPTION</u>	<u>QTY</u>	<u>DESIGNATION</u>	<u>PART NUMBER</u>
Q1 MF AX CR	3	CPI-CP3	0789-00800-0400
100 OHM 1/4W 5% CCRBN	1	R21	0062-110B3-IXXX
160 " " " "	3	R15,R23,R24	0062-124B3-IXXX
620 " " " "	1	R19	0062-165B3-IXXX
1K " " " "	6	R9,R10,R16,R17 R22,R25	0062-179B3-IXXX
1.2K " " " "	1	R20	0062-183B3-IXXX
1.3K " " " "	1	R7	0062-185B3-IXXX
1.5K " " " "	4	R1,R8,R11,R12	0062-187B3-IXXX
2K " " " "	3	R2,R6,R13	0062-193B3-IXXX
3K " " " "	3	R3-R4	0062-201B3-IXXX
4.3K " " " "	1	R14	0062-209B3-IXXX
6.2K " " " "	2	R5,R18	0062-217B3-IXXX-
IN5232 ZENER	1	DI	0789-00801-0100
2N4401	1	Q1	0789-00802-0200
TBA-530	1	UI	0789-00803-5300
270 NS DELAY LINE	2	DL1,DL2	0069-166XX-XAMX
CONN. KK100 RA (9 PIN)	1	J1	3000-16366-0900
CONN. KK100 RA (12 PIN)	1	J2	3000-16366-1200
SNAP BUSHING 1/4"	4	MH1 - MH4	0017-00042-0014
RGB PCB.	1	-	A080-91363-C000

REVISIONS

PROJECT ENG: J.JARON/D.OTTO

DO NOT SCALE DWG.	HEAT TREAT	SCALE	USED ON ROTO	<b>MIDWAY MFG. CO.</b> FRANKLIN PK. ILL.
DIM. TOLERANCES UNLESS SPECIFIED  CONCENTRICITY T.I.R. .003 FRACTIONAL.....± 1/64 DECIMAL.....± .005 HOLE DIA.....+.002-.000	DRN. TJK  CKD.  DATE 4/19/82	MAT'L.  FINISH	NO. REQ'D 1 PER	
ASS'Y DRAWING RGB INTERFACE P.C. A080-91363-B000				PART NO M051-00873-B029



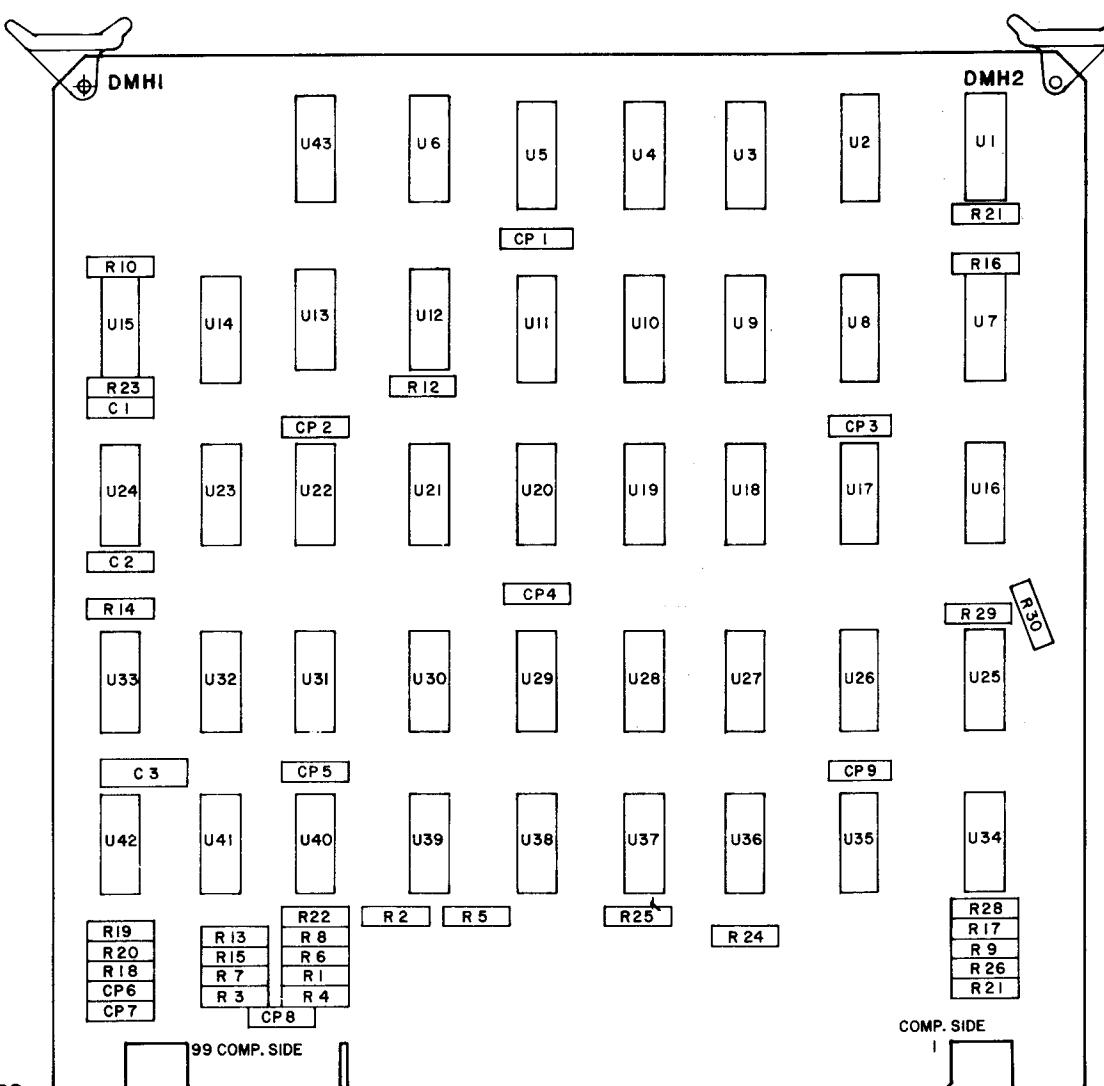
ALL 10  $\mu$ H INDUCTORS RATED AT .9 OHMS D.C. EACH

PROJ. ENGS.: D. OTTO, J. JAROM

DIM. TOLERANCES		THIS DWG IS CONFIDENTIAL & PROPERTY OF MIDWAY MFG CO.			
UNLESS OTHERWISE SPEC	CCRS	MIDWAY MFG. CO.			
CONCENTRICITY TIR	4/19/82	NONE	FRANKLIN PK., IL 60131	A BALLY CO	
FRACTIONAL	1/164				
DECIMAL	.005				
HOLE DIA	.002 .000				
ANGLE	$\pm 1/2$				
DO NOT SCALE DWG					

## DESIGNATION LIST

DESIGNATION NO.	DESCRIPTION
C 1	33 pf AX. CER.
C 2	1000 pf AX. CER.
C 3	15 $\mu$ f AX. TANT.
CP 1—9	0.1 $\mu$ f AX. CER.
R 1—8	100 ohm 1/4 W 5% CARBON
R 9, 10, 12	10 K 1/4 W 5% CARBON
R 13—20	6.2 K 1/4 W 5% CARBON
R 21—29	10 K 1/4 W 5% CARBON
R 30	2.7 K 1/4 W 5% CARBON
U 1, 2	4068
U 3	4572
U 4	4555
U 5	74LS161
U 6	74LS04
U 7	4516
U 8	74LS257
U 9	4516
U 10	74LS175
U 11	74LS367
U 12	74LS00
U 13	74LS74
U 14	4572
U 15	4013
U 16	4516
U 17	74LS257
U 18	4516
U 19	74LS175
U 20	74LS367
U 21	4174
U 22	74LS157
U 23	4539
U 24	4081
U 25	4516
U 26	74LS257
U 27	4516
U 28	4175
U 29	4008
U 30	4175
U 31	4516
U 32	4175
U 33, 34	4516
U 35	74LS257
U 36	4516
U 37	4175
U 38	4008
U 39	4175
U 40	4516
U 41	4175
U 42	4516
U 43	74LS04
DMHI, DMH2	P.C. BOARD EXTRACTOR

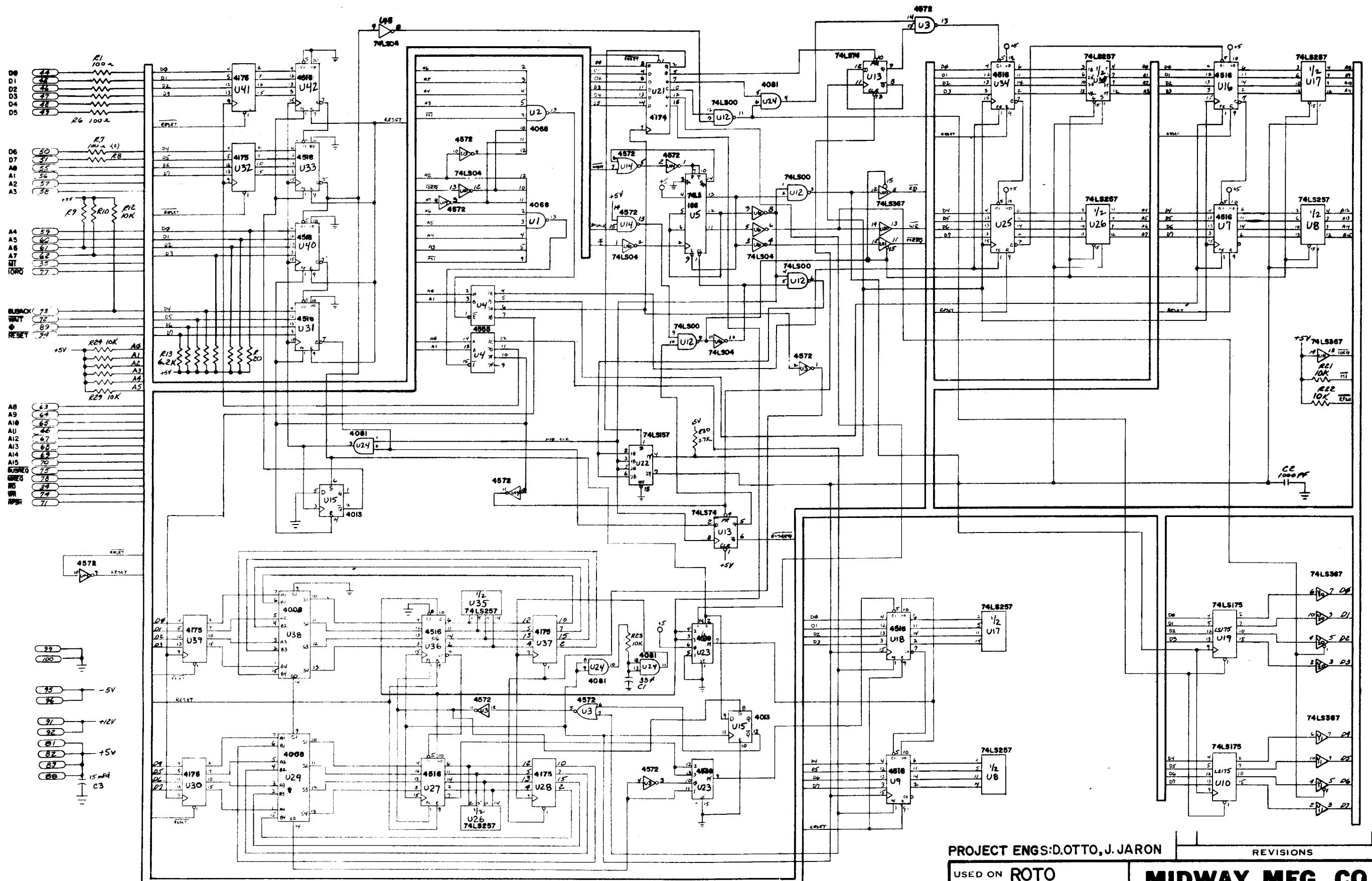


## CROSS REFERENCE LIST

DESCRIPTION	Q'ty	DESIGNATION NO.	PART NO.
33 pf AX. CER.	1	C 1	0789-00800-1600
1000 pf AX. CER.	1	C 2	0789-00800-0700
0.1 $\mu$ f AX. CER.	9	CP 1—9	0789-00800-0800
15 $\mu$ f AX. CER.	1	C 3	0174-207D4-EXGX
100 OHM 1/4W 5% CRBN	8	RI-R8	0062-110B3-IXXX
2.7K " " " "	1	R30	0062-199B3-IXXX
6.2K " " " "	8	RI3-R20	0062-217B3-IXXX
10K " " " "	12	R9, R10, R12, R21-R29	0062-227B3-IXXX
4008	2	U29, U38	0789-00803-2000
4013	1	UI5	0789-00803-2100
4068	2	U1, U2	0789-00803-2300
4081	1	U24	0789-00803-2400
4174	1	U21	0789-00803-2500
4175	6	U28, U30, U32, U37, U39, U41	0789-00803-2600
4516	12	U7, U9, U16, U18, U25, U27, U31, U33, U34, U36, U40, U42	0789-00803-2700
4539	1	U23	0789-00803-2800
4555B	1	U4	0789-00803-1700
4572	2	U3, U14	0789-00803-2900
74LS00	1	UI2	0789-00803-3000
74LS04	2	U6, U43	0789-00803-3100
74LS74	1	UI3	0789-00803-3400
74LS157	1	U22	0789-00803-1800
74LS161	1	U5	0789-00803-1900
74LS175	2	U10, U19	0789-00803-2200
74LS257	4	U8, U17, U26, U35	0789-00803-3200
74LS367	2	U11, U20	0789-00803-3300
P.C. BOARD EXTRACTOR	2	DMHI, DMH2	0789-00806-0200
PATTERN BOARD	1		A080-91355-C000

PROJ. ENG: JOHN JARON / D. OTTO

DO NOT SCALE DWG		HEAT TREAT	SCALE	USED ON CCR
DIM. TOLERANCES UNLESS SPECIFIED		JOHN	I PER	MIDWAY MFG. CO.
CONCENTRICITY TOL. FRACTIONAL		0.005	NO. REQ'D	FRANKLIN PK. ILL.
DECIMAL		0.005	PER	
HOLE DIA.		+ .002 .000	DATE	ASSY DRAWING PATTERN BD A082-91355-C000
		3/8/82		PART NO. M051-00789-C015



# DESIGNATION LIST

DESIGNATION	DESCRIPTION
C1-C22	0.1 MF AX.CER
C26, C27	0.1 MF "
C28	15 MF AX.TANT
C29,C30	0.1MF AX.CER.
C31,C32	15 MF AX.TANT
C33	0.1 MF AX.CER.
C34	15 MF AX.TANT
CPI-CPIO	0.1MF AX.CER.
R1-R21	220 OHM 1/4w 5% CRBN
R22-R27	2.7K " " " "
R28,R29	330 " " " "
R30-R48	2.7K " " " "
R49	100 " " " "
R50	2.2K " " " "
R51	330 " " " "
R52	100 " " " "
R53	2.2K " " " "
R54	330 " " " "
R55	100 " " " "
R56	2.2K " " " "
R57	330 " " " "
R58,R59	2.2K " " " "
R60,R61	100 " " " "
R62-R74	2.7K " " " "
R75,R76	47K " " " "
R77-R80	10K " " " "
R81	22K " " " "
R82	100 " " " "
R83	5.1K " " " "
R84	2.7K " " " "
DI-D3	IN4004 DIODE
Q1-Q3	TIP110
Q4-Q10	2N4401
Q11,Q12	2N4403
Q13	2N6427
Q14	2N4401

U1  
U2  
U3-U6  
U7, U8

4099  
74LS86  
4539B  
1448 CUSTOM I/O

ICSU7, ICSU8    40 PIN IC SOCKET

SWI    8 POS DIP SWITCH

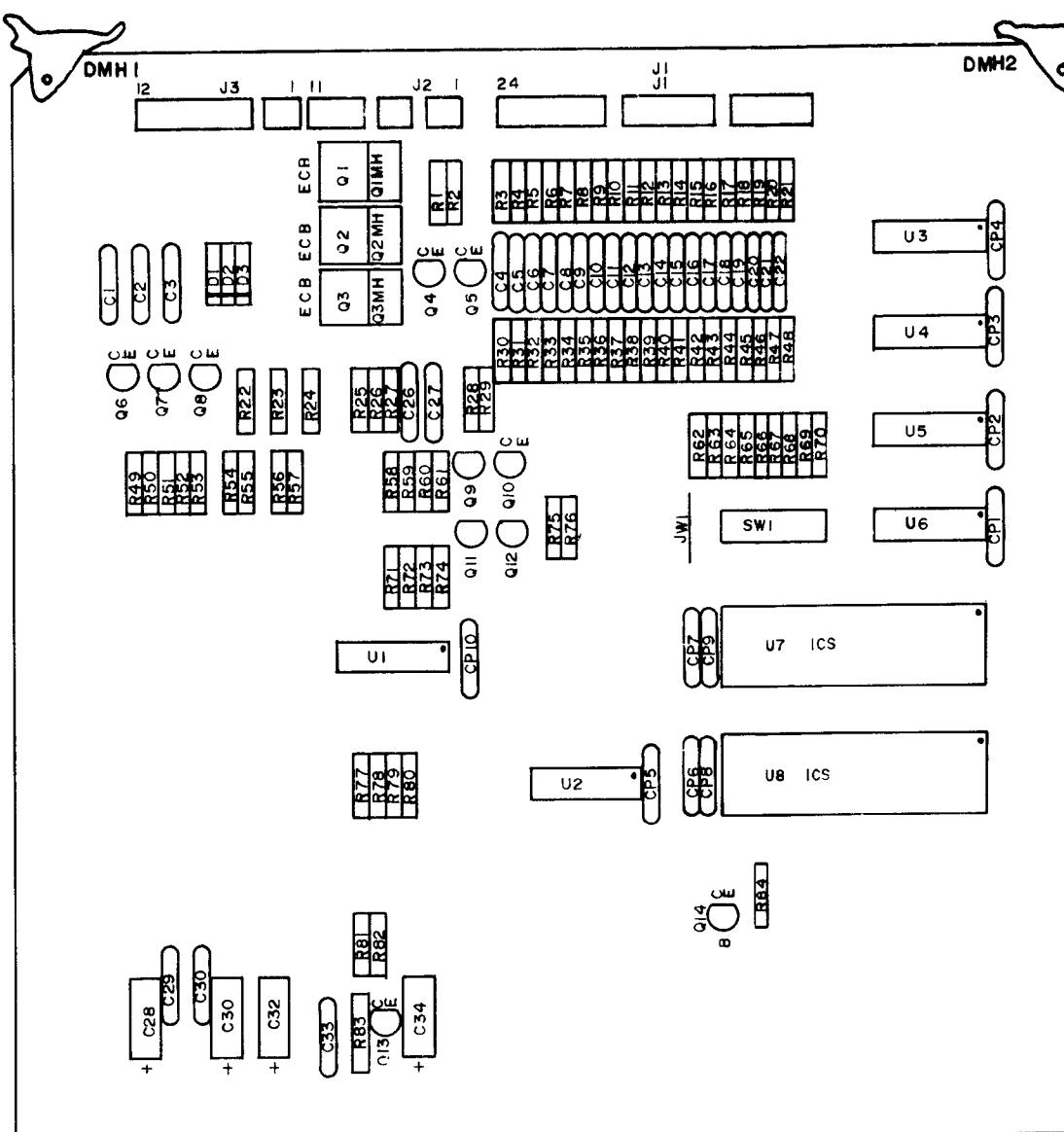
QIMH-Q3MH    METAL SNAP

DMH1, DMH2    P.C BOARD EXTRACTOR

JW1    ZERO OHM 22AWG

J1    24 PIN CONN.

J2 AND J3    24 PIN CONN.

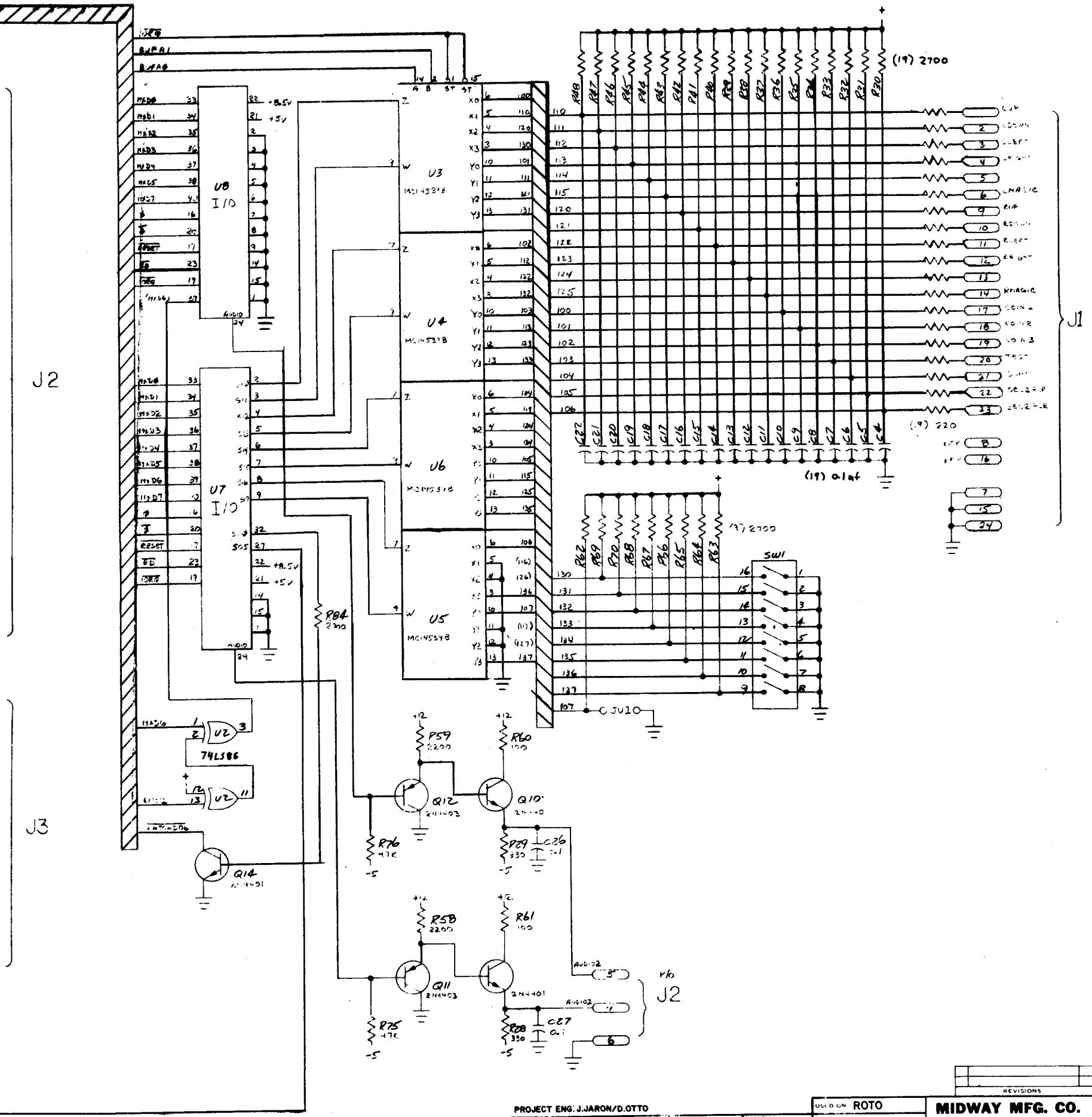
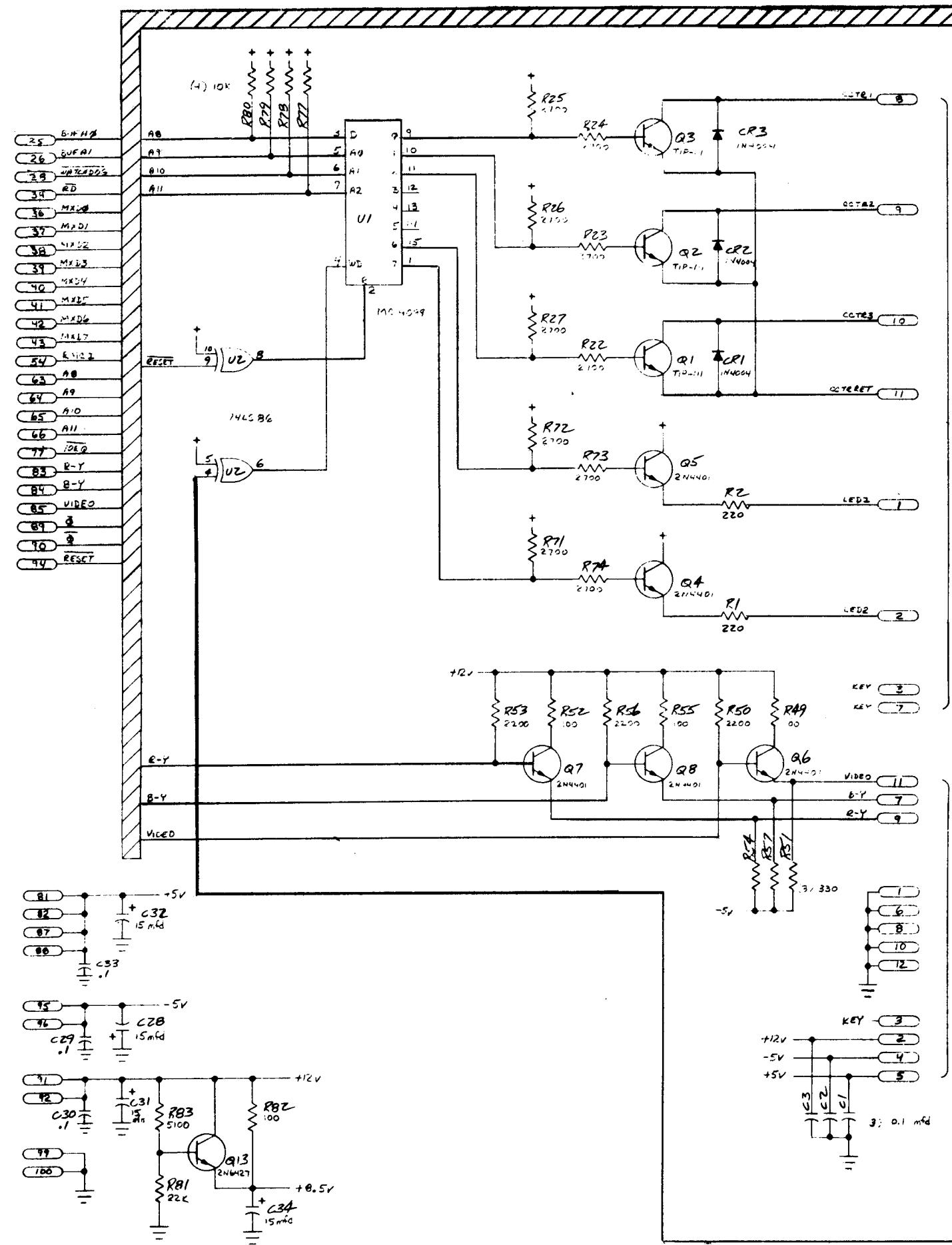


# CROSS REFERENCE LIST

DESCRIPTION	Q'TY	DESIGNATION	PART NO.
0.1 MF AX.CER.	37	CI-C22,C26,C27,C29	0530-00800-0100
15 MF AX.TANT	4	C30,C33,CPI-CPIO	0530-00800-0200
100 OHM 1/4w 5% CRBN	6	R49,R52,R55,R60,R61,R62	0062-110B3-1XXX
220 " " " "	21	R1-R21	0062-133B3-1XXX
330 " " " "	5	R28,R29,R51,R54,R57	0062-144B3-1XXX
2.2K " " " "	5	R50,R53,R56,R58,R59	0062-195B3-1XXX
2.7K " " " "	39	R22-R27,R30-R48,R62-R74, R84	0062-199B3-1XXX
5.1K " " " "	1	R83	0062-213B3-1XXX
10K " " " "	4	R77-R80	0062-227B3-1XXX
22K " " " "	1	R81	0062-243B3-1XXX
47K " " " "	2	R75,R76	0062-259B3-1XXX
IN4004 DIODE	3	DI-D3	0530-00801-0100
TIP110	3	Q1-Q3	0530-00802-0100
2N4401	8	Q4-Q10,Q14	0530-00802-0200
2N4403	2	Q11,Q12	0530-00802-0300
2N6427	1	Q13	0530-00802-0400
1448 CUSTOM I/O	2	U7,U8	0530-00803-0100
74LS86	1	U2	0530-00803-0200
4099	1	U1	0530-00803-0300
4539B	4	U3-U6	0530-00803-0400
40 PIN IC SOCKET	2	ICSU7, ICSUB	0530-00804-0200
8 POS DIP SWITCH	1	SWI	0530-00804-0100
MOUNTING HARDWARE METAL SNAP	3	QIMH-Q3MH	0017-00007-0134
P.C BOARD EXTRACTOR ZERO OHM 22AWG	2	DMH1, DMH2	0769-00806-0200
24 PIN CONN.	1	JWI	0069-23IXX-XBXX
24 PIN CONN.	1	J1	0530-00804-0700
GAME BOARD	1	J2 AND J3	0530-00804-0800
			A080-90708-A530

PROJECT ENG: J. JARON / D. OTTO

DO NOT SCALE DWG	HEAT TREAT	SCALE	USED ON ROTO
DIM. TOLERANCES UNLESS SPECIFIED	DRN	FULL	NO REQ'D PER.
CONCENTRICITY TIR .003 FRACTIONAL .1/64 DECIMAL .005 HOLE DIA +.002 -.000	CKD	MATL	MIDWAY MFG. CO. FRANKLIN PK. ILL.
		FINISH	ASS'Y DRAWING ROTO GAME BOARD A082-90708-A530
			PART NO M051-00530-A005



PROJECT ENG: J.JARON/D.OTTO		USED ON ROTO		REVISIONS	
DO NOT SCALE DWG		NO. 1120 1 PER.		MIDWAY MFG. CO.	
DIM. TOLERANCES UNLESS SPECIFIED		DRAWN BY		FRANKLIN PK. ILL.	
INCHES	MM	MATL	SCALE	SCHEMATIC	
UNLESS OTHERWISE SPECIFIED	MM	DATE	FULL	GAME BOARD	
ALL DIMENSIONS ARE IN INCHES	MM	03/15/82	SCHEMATIC	A082-90708-A530	
ALL MATERIALS ARE IN STOCK	MM	FINISH	PART NO.	MO51-00530-A006	