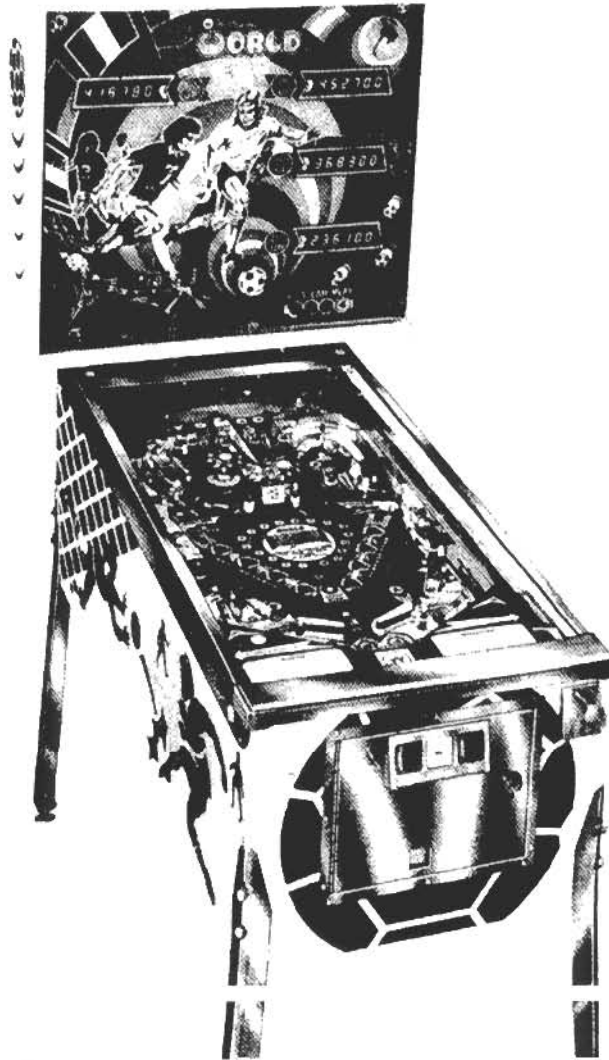


Instruction Manual for **WORLD CUP SOLID STATE**



APRIL
1978

 **Williams**® ELECTRONICS, INC.

SUBSIDIARY OF XCOR CORPORATION

3401 N. California Ave.
(312) 267-2240

Chicago, Ill. 60618, U.S.A.
Cable Address: Wilcoin

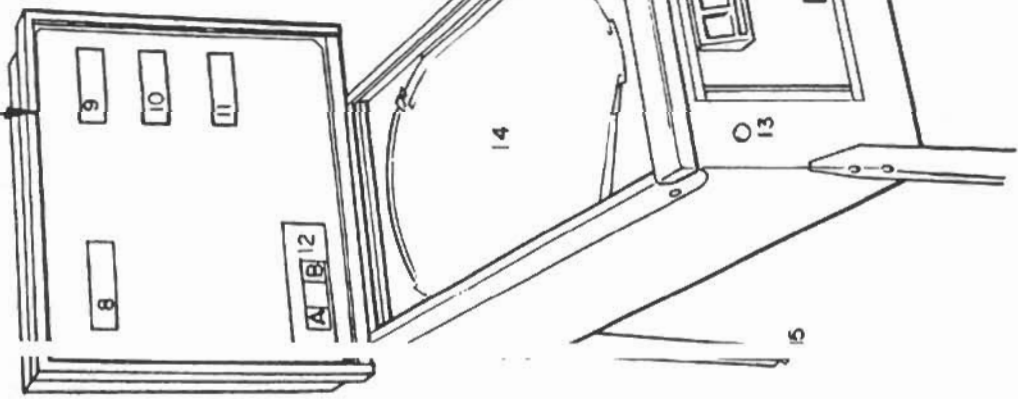
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INSERT

- 1st P . AYER DISPLAY
- 2ndf . AYER DISPLAY
- 3rdf . AYER DISPLAY
- 4thf . AYER DISPLAY
- MAS . ER DISPLAY BOARD
- CR . DIT DISPLAY
- BA . L IN PLAY/MATCH



- BACKBOX

- 1. CPU BOARD
- 2. DRIVER BOARD
- 3. POWER SUPPLY BOARD
- 4. KEY LOCK
- 5. RECTIFIERS
- 6. CAPACITOR
- 7. TRANSFORMER

CABINET (OUTSIDE)

- 13. CREDIT BUTTON
- 14. PLAYFIELD
- 15. LEG LEVELER
- 16. BALL SHOOTER

CABINET (INSIDE)

- 17. BALL ROLL TILT
- 18. PLUMB BOB TILT
- 19. KNOCKER ASSY.
- 21. CHIMES ASS'Y.

FRONT DOOR

- 22. COIN REFLECTOR
- 23. DIAGNOSTIC SWITCHES
- 24. COIN SLOTS
- 25. COIN RETURN

Figure 1

WORLD CUP SECTION 1 INSTALLATION

The initial set up and assembly of the solid state WORLD CUP is identical to mechanical pinballs.

First, remove the backbox and cabinet from their respective shipping cartons. Set up the cabinet and mount the legs. Reach into the large hole in the backbox and pull out the power cord and place it in the slot provided. Do not plug machine in at this time.

Next, remove the red shipping block from insert door and place the assembled backbox on the pedestal. Do not pull up any of the other cables from the cabinet at this time.

Note that the backbox has a metal bracket protruding from the square bottom hole. This bracket engages a similar bracket on the cabinet pedestal to prevent the backbox from tipping forward while the insert door is open.

Open the insert door by lifting the door latch (located at right) up. Install the backbox mounting bolts securely. Level the machine from side to side and front to back by adjusting the leg levelers.

There are six harnesses that must be interconnected next. Four of the harnesses are from the playfield and two are from the cabinet. The connectors are size and color coded and mate wires of the same color together, except in the case of the power line to the transformer connector, where the colors do not match. Connect the black plug to the black connector first. Then interconnect the remaining five connectors. **DO NOT** intermix the white connector and black plug even though they are the same size.

Next, connect the braided ground strap to the backbox shield liner by fastening it under the wing nut located just in front of the rectangular bottom hole in the backbox.

Then check the connectors to make sure that none of the wire terminations have come loose or were pushed out. Reseat any loose wires by pushing in on the wire terminations.

Also push on all the connectors that are attached to the CPU Board (Figure 1 - No. 1) to make sure they are firmly seated. Then push on all the connectors that are attached to the Driver Board (Figure 1 - No. 2) to make sure they are firmly seated. Also push on all the connectors that are attached to the Power Supply Board (Figure 1 - No. 3). Then check the connectors on both bridge rectifiers (Figure 1 - No. 5) and the filter capacitor (Figure 1 - No. 6).

Also check and push on all the connectors that are attached to the Master Display Board (Figure 1 - No. 7) and the connectors that leave the Master Display Board and go off to the four individual player displays (Figure 1 No. 8, 9, 10, 11). Finally, check and push on the connectors which interconnects the coin door mechanism to the cabinet harness.

After all the connectors have been checked as outlined above, gently press on the integrated circuit (IC) packages that are socketed on the CPU and Driver Boards. (See Figure 2). **DO NOT** remove any of the IC packages from their sockets. Also check that the batteries are still securely mounted to the CPU Board. **DO NOT REMOVE THE BATTERIES!** If the batteries are removed with power off the game will go to default values for all the options and particular changes will have to be restored manually before the game can be put on location. The batteries are all installed with the positive (+) end up. Battery life is about the same as shelf life or about one year. When it is time to replace the batteries, remove the batteries while the game is **ON** or the game will go to default values.

Check that all cables are clear of moving parts. Check for any wires that may have come disconnected. Check switches for loose solder or other foreign material that may have come loose in shipment. Check wires on coils for proper soldering. Check that fuses on the Power Supply Board are secure. Check adjustment of the four tilt switches: Playfield Shake on bottom of playfield, Super Slam on front door, Plumb bob tilt on left side of cabinet near front door and Ball Roll tilt above the Plumb bob. Refer to Section 8 for specific mechanical adjustments for each of these tilt switches.

Before plugging the machine in also check that the AC line fuse is secure in its holder. Install the ball in the roll tilt, if not already installed.

This machine **MUST BE PLUGGED INTO A PROPERLY GROUNDED OUTLET TO PREVENT SHOCK HAZARD** and to insure **PROPER GAME OPERATION**. **DO NOT** use a "cheater plug" to defeat the ground pin. **DO NOT** cut off the ground pin. The line voltage **MUST** agree with that on the shipping carton or serious damage to the machine will occur when it is plugged in.

The game is now ready to plug in and check out. Lower the playfield and close the insert door. Plug the game in and flip the power switch located near the right front cabinet leg on. The game will come on and should come up in the game over mode.

The game over mode is indicated by player scores reading zero, player one up light flashing, game over lights lit. The high score to date will alternate with player one score only. Flippers will be inoperative and the general illumination lamps will be lit. The game can now be checked out by play, or diagnostics can be run (See Section 5), or game option adjustments can be made (See Section 3).

If the game comes up in the diagnostic mode, the ball in play display will show 04 (Figure 1 - No. 12B) and the credit display will show 01 (Figure 1 - No. 12A). This indicates that either the batteries were removed or came loose during shipment. The game status has returned to factory default settings, and some values will probably have to be restored according to the procedure outlined in Section 3.

If the game does not light up or does not come up in game over or diagnostic mode, refer to troubleshooting Section 6.

SOCKETED COMPONENTS

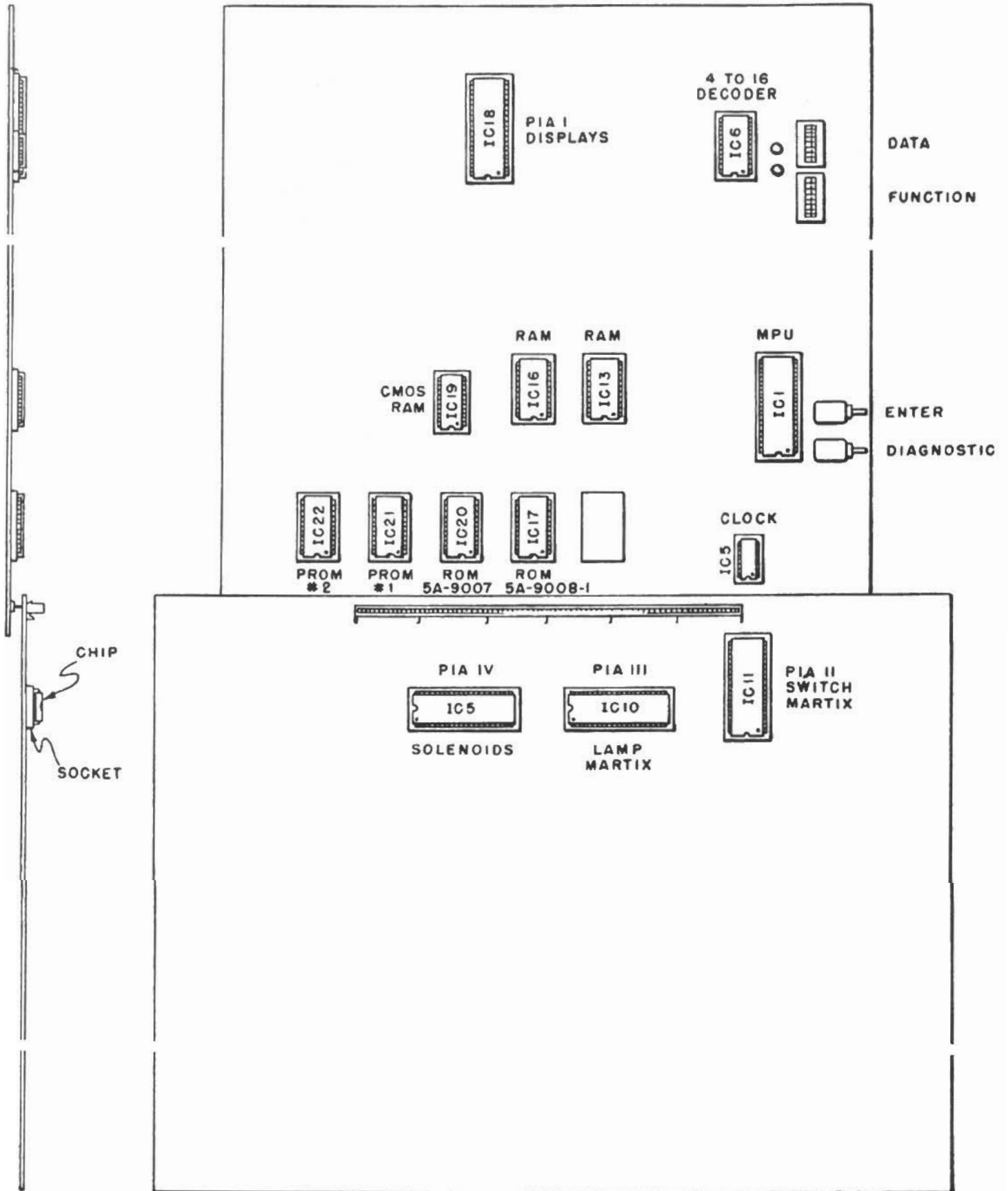


Figure 2

SECTION 2 GENERAL GAME OPERATION AND SCORING

Place ball into playfield by outhole. When machine is turned on it will come on in the game over mode. Player 1 up light will be flashing. All player scores will be zero and Player 1 score will alternate from zero to High Score to Date.* Game over lights will be lit.

Insert coin into machine. The machine should accept coins and post credits. The knocker will sound for each credit. Pressing the credit button on the cabinet front will cause the outhole kicker to serve the ball, the credit display will be reduced by one, the number of players light will show one, the ball in play display will show 01, and the game start up tune will be played. Pressing the credit button at any time before the ball in play displays 02 will allow additional players and change the number of players light and reduce the credits by one for each additional player.

The player one up light will flash until the first switch or bumper is made. The STAR and Goal when lit lights will be on. The goals will all be off. The top standups score 50 points. The left and right rollovers score 100 points and turn off the letter lit.* The center rollover scores 100 points and scores a goal when lit. Turning off S,T,A,R, lights by going through rollovers or making the S,T,A,R targets awards one goal* and advance the bonus star lights. The bonus star lights are the Bronze star, Silver star, Gold star, World Cup star, and Super Star. The Bronze awards 2 times the goal bonus value. The Silver awards 3 times the goal bonus value. The Gold awards 5 times the goal bonus value. The World Cup and Super Star light the extra ball when lit* and special when lit* rollover lanes.

The S,T,A,R targets score 100 points each and turns off that light. All targets off awards a goal, lights the bonus star, and lights the spinner 100 points. The jet bumpers score 100 points. The spinner scores 10 or 100 points when lit. The ball advance standup scores 100 points and advances ball. The super ball advance scores 500 points and lights scores goal when lit ejects and center rollover. The left and right ejects score 500 points and goal when lit. The bottom left and right standups score 500 points. When the ball crosses over a lit ball advance button switch it scores 100 points, turns off the lit button and lights the next ball advance button switch. The left super ball advance scores 500 points or 1000 to 4000 points depending on the number of goals lit and advances the ball advance to the scores goal when lit position. The right corner kick lane scores 500 points or 1000 to 3000 points and advances the ball advance to the scores goal when lit position.

The outside rollovers score 500 points and the special when lit.* The goals lit award 2000 points each, or 4000, 6000 or 10,000 points each if the Bronze, Silver, or Gold stars are lit when the ball leaves the playfield.

The number of goals and the STAR letters turned off are carried from one ball to the next, but the Bonus stars are turned off after each ball. If there is more than one player, that player's individual playfield will be restored when it is that player's next ball.

Extra balls* won during the course of the game are played immediately after the player's regular ball enters the outhole. After the last ball is played, the match digits appear where the ball in play digits were. If match occurs an extra credit will be awarded.* The game over tune will play and the game over lights will light. The high score to date will alternate with the winning player's score and his playfield will be restored. After a few seconds the playfields of the other players will also be displayed and their scores will alternate with the highest score to date.*

If a player's score exceeds the current high score to date, three* credits will be awarded and the game will play "1812 Overture" and the highest score to date lights will remain lit.

The Plumb Bob Tilt tilts the ball in play on the first* closure. The ball roll and playfield shake tilt switches tilt the ball in play immediately. The super slam tilt on the coin door sets all player scores to zero and returns the game to game over.

If coins are inserted and the maximum* number of credits is exceeded, the credit will be posted correctly but the coin lockout coil will be de-energized until the number of remaining credits is below the maximum.

* These features are adjustable and the procedure is outlined in Section 4.

WORLD CUP - REV. A PROMS

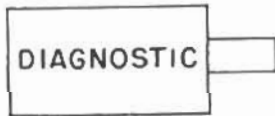
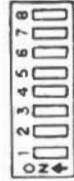
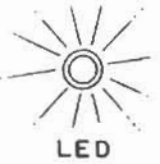
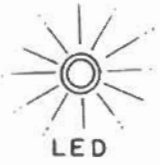
TABLE 1

Test 04 Readout No.	Function Switch (Chart 1)	Data Switch (Chart 1 or Chart 2)	Factory Setting	This Game
01	01	Replay 1 (Chart 2) 10,000 pts *	160,000	(16) _____
02	02	Replay 2 (Chart 2) 10,000 pts *	280,000	(28) _____
03	03	Replay 3 (Chart 2) 10,000 pts *	400,000	(40) _____
04	04	Replay 4 (Chart 2) 10,000 pts *	Disabled	_____
05	05	Maximum Credits (Chart 2)	20	_____
06	06	Match/Credit/Extra Ball (Chart 1)	08	_____
		08-Match ON-Credit award at Replay Points		_____
		09-Match ON-Extra ball award at Replay Points		_____
		12-Match OFF-Credit award at Replay Points		_____
		13-Match OFF-Extra ball award at Replay Points		_____
07	07	Play (Chart 2)	01	_____
		01-Liberal Play 02-Normal Play		
		04-No Special, No Extra Ball		
08	08	Credits awarded for High Score To Date (Chart 1)	03**	_____
09	12	Left coin slot multiplier (Chart 1)	01	_____
10	13	Center coin slot multiplier (Chart 1)	01	_____
11	14	Right coin slot multiplier (Chart 1)	01	_____
12	15	Minimum coin units for credit (Chart 1)	00	_____
13	16	Coin units bonus point (Chart 1)	02	_____
14	17	Coin units required for credit (Chart 1)	01	_____
15	18	Play adjustment (Chart 2)	13	_____
		03 - "S", "R" separate, Special awards credit, 3 balls		
		13 - "S", "R" together, Special awards credit, 3 balls		
		23 - "S", "R" separate, Special awards extra ball, 3 balls		
		33 - "S", "R" together, Special awards extra ball, 3 balls		
		43 - "S", "R" separate, Special awards 1500 points, 3 balls		
		53 - "S", "R" together, Special awards 1500 points, 3 balls		
		05 - "S", "R" separate, Special awards credit, 5 balls		
		15 - "S", "R" together, Special awards credit, 5 balls		
		25 - "S", "R" separate, Special awards extra ball, 5 balls		
		35 - "S", "R" together, Special awards extra ball, 5 balls		
		45 - "S", "R" separate, Special awards 1500 points, 5 balls		
		55 - "S", "R" together, Special awards 1500 points, 5 balls		
16	19	Maximum Tilts (1-9) (Chart 2)	01	_____
17	20	Credits in game (Chart 2)	00	_____
18	21	High score to date (Chart 2) 10,000 pts	35	_____
	22	High score to date (Chart 2) 100 pts	∞	_____
	23	High score to date (Chart 2) 1 pt	00	_____
19	—	Number of coins left chute		Cannot be set
20	—	Number of coins center chute		Cannot be set
21	—	Number of coins right chute		Cannot be set
22	—	Number of credits paid		Cannot be set
23	—	Number of credits won		Cannot be set

* To disable a replay point turn all data switches ON for that replay function number.

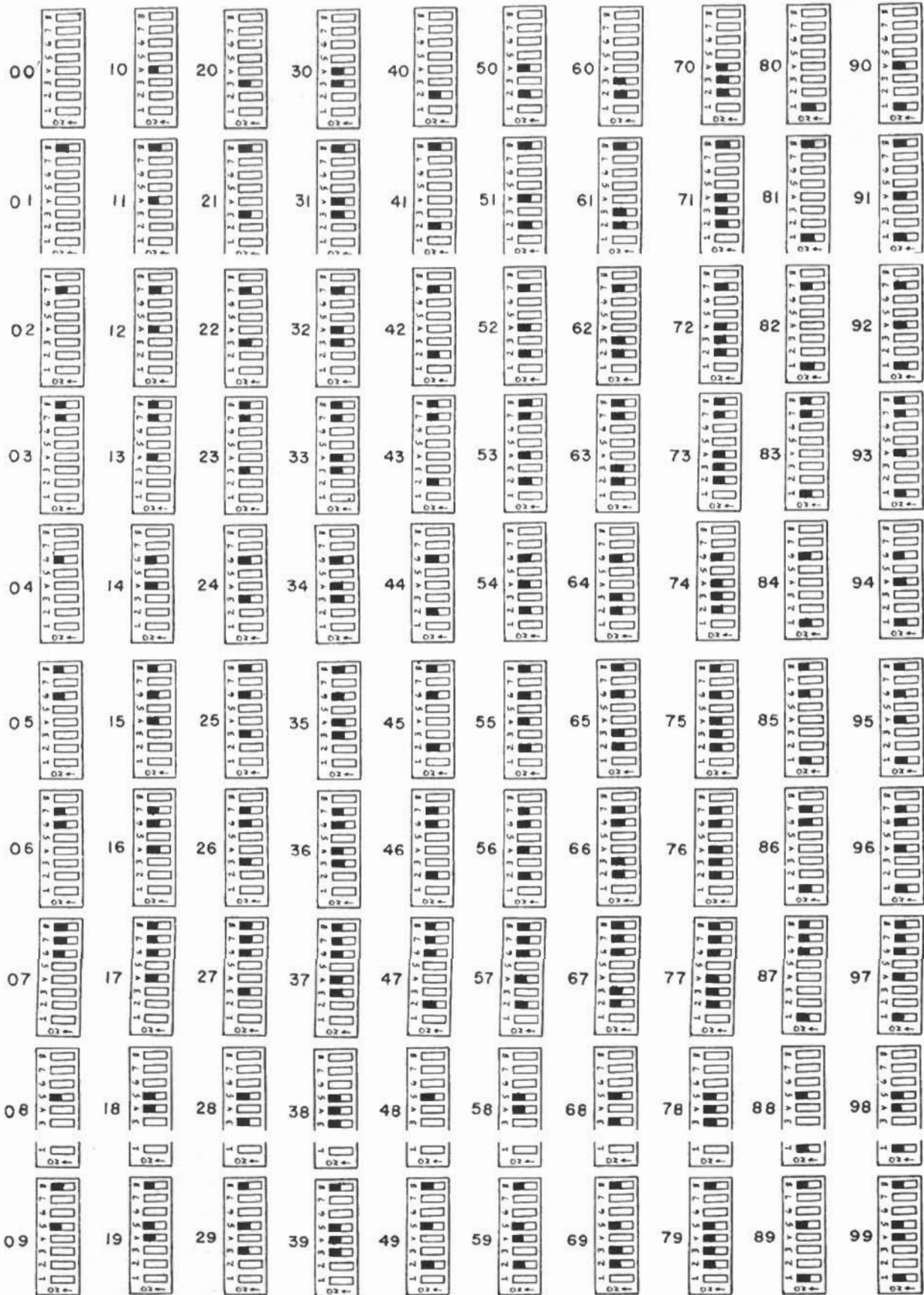
** To eliminate high score to date feature enter a value of 00 for the data for function 08.

CHART 1



00	08	16	24
01	09	17	25
02	10	18	26
03	11	19	27
04	12	20	28
05	13	21	29
06	14	22	30
07	15	23	31

CHART 2



SECTION 3 GAME ADJUSTMENTS

The solid state World Cup offers great versatility in customizing the game to the location or the operator's requirements. A very simple means of altering factory settings of various replay and other options has been devised. This section outlines the general procedure for making these changes.

Open the insert box door and locate the CPU Board (Figure 1 - No. 1). On the right hand side of the CPU Board there are two 8 position miniature slide switches and below them are two pushbuttons.

Prepare to enter the diagnostic mode by first turning off the game and then turning it back on. Then to enter diagnostics, press the lower pushbutton on the CPU Board. The two LED's to the left of the switches will blink twice and go off. If the LED's do not blink twice or stay on continuously, refer to the troubleshooting guide in Section 6.

Determine which function is to be changed by looking at Table 1. To change the third replay point, for example, is function number 3. The game is set to give the third replay when 400,000 points is exceeded but this can be raised or lowered very easily.

Next, since Function 03 is to be changed, set the BOTTOM switch identically to the switch beside the number 03 in Chart 1. A black mark on Chart 1 next to the switch number indicates that that position of the lower switch is ON (move switch to the left). No black mark indicates that that position should be left OFF (move switch to the right).

The third step is to determine the new value for the third replay point. In this example, the third replay point will be raised from 400,000 points to 480,000 points. Table 1 specifies that Chart 2 is to be used when entering the data value and that the value entered is a multiple of 10,000 points. It requires 48 times 10,000 in order to get a value of 480,000 ($48 \times 10,000 = 480,000$), so a value of 48 would be entered on the top switch. The top switch must be set identically to the switch beside number 48 in Chart 2. Data numbers may be specified as either Chart 1 or Chart 2 so care must be exercised to use the correct chart.

Once both the top switch and the bottom switch have been set correctly for the change desired, press the upper pushbutton of the two one time. The two LED's will blink to indicate that the change has been made. If the LED's do not blink when the ENTER pushbutton is depressed and released, recheck switch settings.

Continue to enter any other changes desired by checking the other features in Table 1. Set the function switch number for that feature on the function switch using Chart 1. Then determine the new data desired, and refer to either Chart 1 or Chart 2 and set the data switch accordingly. Press the upper pushbutton (ENTER pushbutton) once to lock in the new data. Continue to repeat this procedure for all changes.

The functions can be entered in any order. If a mistake is made in setting the data switches, the correct settings can be made and the ENTER button pressed again to enter the new data. Only the last data entered will be retained. If the batteries are removed with the game turned OFF, all the changes made to the various features will be lost and the game will be restored to the factory settings.

There are two ways to verify the data changes entered. One is to turn the game OFF then ON again and then to play the game to see if the changes are correct. A faster method is to use Test 4 of the built-in diagnostics to read out the changes and this method is described in Section 5 of this manual.

The following is a summary of all adjustable game features.

REPLAYS

There are four possible replays awarded from scoring. The default factory setting for the first replay occurs at 160,000 points; the second replay occurs at 280,000 points; the third replay at 400,000; and the fourth replay is disabled. Replay 1 is function number 01. It can be increased or decreased by any multiple of 10,000 points. Table 1 specifies to use Chart 2 for setting the data switch. To establish a replay of 220,000 points instead of 160,000 points a value of 22 ($22 \times 10,000 = 220,000$) must be entered on the data switch, using Chart 2 to set up the top switch (DATA switch) and Chart 1 to set up Function 01 in the bottom switch (FUNCTION switch).

1. If not already in diagnostics, enter diagnostics by pressing the lower pushbutton once.
2. Set up function switch exactly like switch 01 in Chart 1.
3. Set up data switch exactly like switch 22 in Chart 2.
4. Press ENTER button once. The LED's will blink once and the new data is locked in.

When the above four step procedure is completed the first replay will be 220,000 points. To change the 2nd, 3rd, or 4th replays, enter Function 02, 03 or 04 in step 2 above and follow steps 1 thru 4, substituting the new desired value in step 3.

To disable a replay point, turn **all** data switches ON (move switch to the left). Follow the procedure steps 1 thru 4, except that in step 3 remember to turn all switches ON. Note also that the replays must be different from one another and that they must be entered in ascending order. Replay 1 is the lowest replay; Replay 2 is the next replay, followed by Replays 3 and 4. The replay points can be any multiple of 10,000 points or they can be disabled altogether.

MAXIMUM CREDITS

Maximum credits is the number of credits that can be posted by putting coins in the game before the coin lock-out relay is released. The factory setting is 20 credits. According to Table 1, maximum credits is Function 05. It can be set for any value from 01 to 99 using Chart 2 for the data switch. To establish maximum credits of 10 for example, the function switch must be set to 05 using Chart 1 and the data switch set to 10 using Chart 2.

1. If not already in diagnostics, enter diagnostics by pressing the lower pushbutton once.
2. Set up function switch exactly like switch 05 in Chart 1.
3. Set up data switch exactly like switch 10 in Chart 2.
4. Press ENTER button once. The LED's will blink once to indicate that the new data is locked in.

MATCH/CREDIT/EXTRA BALL

Whenever a replay point is exceeded, the game can be set to award a credit (free game) or an extra ball. In addition, at the conclusion of a game, a match feature is available to award a credit (free game) if the last two digits match that of the player(s) last two score digits. This feature is Function 06 and Table 1 specifies that for Function 06 Chart 1 is to be used for the data switch values.

The factory setting is that the match awards an extra credit and that credits are awarded at the replay points. Table 1 also shows the various possibilities and the value to enter on the data switch.

Data Switch

- 08 Match ON - Credit awarded at Replay points
- 09 Match ON - Extra ball awarded at Replay points
- 12* Match OFF - Credit awarded at Replay points
- 13* Match OFF - Extra ball awarded at Replay points

1. If not already in diagnostics, enter diagnostics, by pressing the lower pushbutton once.
2. Set up function switch exactly like switch 06 in Chart 1.
3. Set up data switch like switch 08, 09, 12, or 13 in Chart 1.
4. Press ENTER button once. The LED's will blink to indicate that the new data is locked in.

*Note that for data values 12 and 13, when the values are read out during the diagnostic test 4, the readouts on the Player 1 display will show 0 blank, not 12 or 13. This is normal for any value entered in above 09 from Chart 1.

PLAY

This function controls the Extra Ball and Special lights on the playfield. In WORLD CUP, turning off the S, T, A, and R lights the first time will light the Bronze Star (X2). Turning off the S, T, A, and R lights the second time will light the Silver Star (X3). Turning off the S, T, A, and R lights the third time will light the Gold Star (X5).

If the game play feature is set to "liberal" (Factory setting in this case), when the Gold Star lights, the World Cup light will also light. Extra Ball When Lit light comes on when the World Cup light comes on. Making the top center rollover switch at this time will award an extra ball. Turning off the S, T, A and R lights a fourth time in liberal will light the Super Star light. The "Special When Lit" light comes on when the Super Star light comes on. Making the outside rollover lane with the Special Light lit will award the "special".

If the game play feature is set to "normal", the World Cup light does not light at the same time as the Gold Star but rather when the S, T, A, and R lights are turned off a fourth time. The Super Star light would then come on the fifth time S, T, A, and R lights are turned off.

If the game play feature is set to "no extra ball, no special", the Extra Ball When Lit and the Special When Lit lights will never come on from turning off the S, T, A, and R lights any number of times. A player will never be able to win an extra ball or special in this setting.

The game play feature is Function 07. Table 1 specifies that for Function 07 the data switch is set using Chart 2. Table 1 also shows the various possibilities and the value to enter on the data switch.

Data Switch

- 01 - Liberal Play
- 02 - Normal Play
- 04 - No Special, No Extra Ball

1. If not already in diagnostics, enter diagnostics by pressing the lower pushbutton once.
2. Set up the function switch exactly like switch 07 in Chart 1.
3. Set up data switch to 01, 02, or 04 for the play feature using Chart 2.
4. Press ENTER pushbutton once. The LED's will blink to indicate that the new data is locked in.

HIGH SCORE CREDITS

This function controls the high score to date feature. When the highest score to date is exceeded by a player, any number of free credits can be awarded.

High score to date is function 08 and Table 1 specifies to use Chart 1 for setting the data switch. If a value of zero is entered for the data, this feature is disabled and the high score to date is not displayed. If more than 9 free credits are awarded, the number displayed in test 4 readout of this function will be incorrect but the correct number of free credits will be awarded.

1. If not already in diagnostics enter diagnostics by pressing the lower pushbutton once.
2. Set up function switch exactly like switch 08 in Chart 1.
3. Set up data switch according to Chart 1 for the number of credits to be awarded. To disable, enter a value of zero (All data switches off).
4. Press ENTER pushbutton. The LED's will blink to indicate that the new data is locked in.

PLAY ADJUSTMENT

This function controls a number of game features simultaneously. The first feature is 3 ball play or 5 ball play. Next, the "special" feature can be set to award a free credit or an extra ball or 1500 points. Finally, the "S" and "R" targets can be made to operate individually or tied together so that turning one off will also turn the other off automatically.

The factory setting is 3 ball play, "special" awards a free credit, and "S" and "R" operate together. Play adjustments is function 18 and Table 1 specifies to use Chart 2 for the data switch. There are 12 possible combinations for play adjustments. Table 1 also shows the various possibilities and the value to enter on the data switch.

Data Switch

- 03 - "S", "R" separate,
Special awards credit, 3 balls
- 13 - "S", "R" together,
Special awards credit, 3 balls
- 23 - "S", "R" separate,
Special awards extra ball, 3 balls
- 33 - "S", "R" together,
Special awards extra ball, 3 balls
- 43 - "S", "R" separate,
Special awards 1500 points, 3 balls
- 53 - "S", "R" together,
Special awards 1500 points, 3 balls
- 05 - "S", "R" separate,
Special awards credit, 5 balls
- 15 - "S", "R" together,
Special awards credit, 5 balls
- 25 - "S", "R" separate,
Special awards extra ball, 5 balls
- 35 - "S", "R" together,
Special awards extra ball, 5 balls
- 45 - "S", "R" separate,
Special awards 1500 points, 5 balls
- 55 - "S", "R" together,
Special awards 1500 points, 5 balls

1. If not already in diagnostics, enter diagnostics by pressing the lower pushbutton once.
2. Set up function switch exactly like switch 18 in Chart 1.
3. Set up data switch according to Chart 2 for the type of play adjustment desired.
4. Press ENTER pushbutton. The LED's will blink to indicate that the new data is locked in.

MAXIMUM TILTS (Plumb Bob Tilts Only)

This function controls the multiple tilt feature. The plumb bob tilt only can be set so that the ball in play does not tilt the first time that the bob contacts the ring. The factory setting for this feature is tilt the first time but the game can be made more liberal by setting this feature so that the ball in play tilts the second (or third) time that the plumb bob contacts the ring. All other tilts do not have this multiple tilt capability; only the plumb bob tilt.

1. If not already in diagnostics, enter diagnostics by pressing the lower pushbutton once.
2. Set up function switch exactly like switch 19 in Chart 1.
3. Set up data switch according to Chart 2 for any value from 01 to 09.
4. Press ENTER pushbutton once. The LED's will blink to indicate that the new data is locked in.

CREDITS IN GAME

The number of credits in the game can be set to any number using this function. This allows free credits to be entered into the game or credits to be removed. Credits in the game is function 20 and Table 1 specifies to use Chart 2 for the value to be entered on the data switch.

For example, to put 10 free credits into a game with no credits, Function 20 would be set on the function switch and 10 would be set on the data switch. Once the two switches are set and the ENTER pushbutton pressed the game will have 10 credits in it. On the other hand, if a game has 19 credits in it at the end of play, these could be removed by entering function 20 on the function switch and entering a value of zero on the data switch. Once the two switches are set and the ENTER pushbutton pressed the game will have zero credits in it.

1. If not already in diagnostics, enter diagnostics by pressing lower pushbutton once.
2. Set up function switch exactly like switch 20 in Chart 1.
3. Set up data switch according to Chart 2 for whatever number of credits desired.
4. Press ENTER pushbutton once. The LED's will blink to indicate that the new data is locked in.

HIGH SCORE TO DATE

The high score to date features of World Cup is arranged as three separate functions to allow resetting the high score to date to any value. The factory setting for high score to date is 350,000 points. Functions 21, 22, and 23 allow setting the score to any 6 digit number desired; any value from 000,000 to 999,999 can be set for the high score to date. Function 21 is set on the function switch and any number from 00 to 99 can be set on the data switch. Function 21 sets up the value of the 100,000 and 10,000 points digits.

When Function 22 is set on the function switch, the number entered on the data switch will correspond to the 1,000 and 100 points digits.

When Function 23 is set on the function switch, the number entered on the data switch will correspond to the 10 and 1 point digits.

For example, to make the high score to date 525,000 points, three steps are required.

First, start diagnostics, then function 21 is set on the function switch (use Chart 1) and 52 would be set on the data switch using Chart 2. Then press the ENTER pushbutton. This would lock in the 52 part of 525,000.

Step two would be to set function 22 on the function switch (use Chart 1) and 50 on the data switch using

Chart 2. Then press the ENTER pushbutton. This would lock in the 50 part of 525,000.

The third and final step would be to set function 23 on the function switch (using Chart 1) and 00 on the data switch using Chart 2. Then press the ENTER pushbutton. This would lock in the 00 part of 525,000, completing the setting of the high score to date.

When lowering a high score to date, it is not necessary to change all six digits. For example, if the high score to date was 784,550, just the first two digits could be changed, resulting in a new high score to date of XX4,550, where XX is the number entered on the data switch for function 21. If 34 was entered for example, the high score to date would be 344,550. If 47 was entered, the high score to date would be 474,550 etc.

1. If not already in diagnostics, enter diagnostics by pressing lower pushbutton once.
2. Set up function switch exactly like 21, 22 or 23 in Chart 1.
3. Set up data switch for the new value for the two digits selected using Chart 2.
4. Press the ENTER pushbutton once. The LED's will blink to indicate that the new data is locked in.

Repeat steps 2 thru 4 to change any other of the digit pairs, using the appropriate function number in step 2.

GAME PRICING

Refer to Table 2 at the end of this section for sample game pricing. To use Table 2, first refer to the section describing the coin door in your game. Then, if not already in diagnostics, start diagnostics by pressing the lower pushbutton on the CPU Board. Next, select the price scheme desired. Then, using Chart 1, set up Function 12 on the bottom switch. Next, set up the new data shown for the price scheme selected on the data switch using Chart 1. Then press ENTER pushbutton to lock in this change. Continue to do all the changes required for the price scheme selected by setting the next function number on the function switch, entering the new value on the data switch and press ENTER pushbutton.

The following is a more in-depth explanation of game pricing.

There are six different functions used to set the game pricing. Three pertain to the coin door mechanism and the other three determine how credits are awarded. Since there are many combinations of coin values and coin mechanisms, this explanation will detail how the functions relate to each other and describe sample settings and pricing schemes.

The first step in setting game pricing is to establish the number of coin chutes. There are single, twin, or three chute coin doors. Function 12 will be used for the left coin chute (closest to the hinge on coin door). Function 13 will be used for the center coin chute. Function 14 will be used for the right coin chute. If any given chute is not present, that function number can be ignored. For example, in a twin chute mechanism, the center chute is not used so Function 13 can be ignored.

The second step is to establish the ratio of all the coins for the particular coin door being used. If all the coins are of equal value, they would have a ratio of 1:1:1. If the coins are not equal (as is the case for 5¢, 10¢, 25¢ coin door), establish the ratio by dividing the coin values by the largest number possible which leaves a remainder of zero. For the 5, 10, 25 coin door this number is 5 and the ratio would be 1:2:5. The 25¢ is worth 5 times the 5¢.

The 10¢ is worth 2 times the 5¢. These ratios become the values for the data switch for functions 12, 13, and 14. For example, in the twin quarter chute, the ratio is 1:1:1 so that Function 12 would have its data value set to 01, Function 13 does not matter since there is no center chute in a twin quarter chute coin door, and Function 14 would have its data value set to 01.

The relative value of all the coins has now been established. The third step is to determine if there is to be a minimum amount that must be put into the game prior to giving any credits. For example, a 75¢ minimum could be established. No credits would be given until at least 75¢ is deposited in the game. The minimum is Function 15. If there is no minimum required, enter a value of 00 on the data switch for function 15. If a minimum is required, divide it by the same divider used to find the coin ratios. For a twin quarter machine, the number is 25. If 75¢ is required before giving any credits, $75¢ \div 25 = 03$ so a value of 03 must be entered on the data switch for function 15. Any minimum can be established, so long as the divider used to reduce the coin values goes into the minimum an even number of times (remainder must equal zero).

The fourth step in establishing game pricing is to determine the number of coins required to get a credit. Function 17 establishes how many coins are required to give a credit. The values entered in Function 12, 13, and 14 are used as a guideline. Each coin dropped through the coin chute will award the number of units as set by Functions 12, 13, and 14. For twin quarter chutes, if 1 quarter was required to award 1 credit, a 01 would be entered for data for function 17. If 2 quarters were required to award 1 credit, a 02 would be entered for data for function 17. If Functions 12, 13, and 14 are doubled, and Function 17 not changed, a coin would award 2 credits, establishing 2 play for 25¢. To easily determine the data value for Function 17, use the value entered for the lowest coin value and determine how many lowest value coins must be deposited to award a **single** credit.

The last step is to determine if there is a bonus (free game) to be awarded for depositing more than 1 coin at a time. For example, the factory settings are 1 play 25¢, 3 plays 50¢. This means that when the second coin is deposited, a free credit will be awarded. Note that the bonus is awarded only if the second (or additional) coin is deposited prior to the START of the game. Bonus credits is Function 16 and can be disabled by entering a value of 00 for the data switch.

To determine the bonus credit value, use the value entered for Function 17 as follows: To award a bonus for every 2 credits worth of coins, enter double the value of Function 17 as the data for Function 16. To award a bonus credit for every 3 credits worth of coins, enter triple the value of Function 17 as the data for Function 16.

To make any changes to game pricing,

1. If not already in diagnostics, enter diagnostics by pressing **ENTER** pushbutton once.
2. Set up function switch exactly like 12, 13, 14, 15, 16, or 17 in Chart 1.
3. Set up data switch for the new value desired using Chart 1.
4. Press **ENTER** pushbutton once. The LED's will blink to indicate that the new data is locked in.

Repeat steps 2 thru 4 to change any of the other functions, using the correct function number in step 2 and the new data value required in step 3.

Note also that test 04 readout numbers listed in Chart 1 and the function numbers are different. Another caution is that if any values above 09 are entered, they will not display correctly during test 04 readout but the game will function correctly.

The following table shows some data values for functions 12 thru 17 for some of the more common pricing schemes.

FUNCTION NUMBER (CHART 1) 12 13 14 15 16 17

DATA VALUE (CHART 1)

TWIN QUARTER DOOR

1 Play 25¢, 3 Plays 50¢ (Factory Setting)	01	X	01	00	02	01
1 Play 25¢	01	X	01	00	00	01
2 Plays 25¢, 5 Plays 50¢	02	X	02	00	04	01
2 Plays 25¢	02	X	02	00	00	01

X = Doesn't matter

SINGLE QUARTER DOOR

1 Play 25¢, 3 Plays 50¢	X	01	X	00	02	01
1 Play 25¢	X	01	X	00	00	01
2 Plays 25¢, 5 Plays 50¢	X	02	X	00	04	01
2 Plays 25¢	X	02	X	00	00	01

X = Doesn't matter

NICKEL, DIME, QUARTER DOOR

1 Play 25¢, 3 Plays 50¢	01	02	05	00	10	05
1 Play 25¢	01	02	05	00	00	05
2 Plays 25¢	02	04	10	10	00	05
1 Play 15¢, 2 Plays 25¢	02	04	10	00	00	05

1DM, 5DM, 2DM DOOR

2 Plays 1DM, 5 Plays 2DM, 14 Plays 5DM	13	65	26	00	65	06
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1DM, 50 PHG., 2DM DOOR

1 Play 50 PHG., 2 Plays 1DM, 5 Plays 2DM	02	01	04	00	04	01
--	----	----	----	----	----	----

5 FRANC, 10 FRANC DOOR

1 Play 5 Franc	01	X	02	00	00	01
1 Play 10 Franc	01	X	02	00	00	02

X = Doesn't matter

25 CENT, 1 GUILDER DOOR

1 Play 25¢	01	X	04	00	00	01
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X = Doesn't matter

1 FRANC DOOR

1 Play 1 Franc, 3 Plays 2 Franc	X	01	X	00	02	01
1 Play 1 Franc	X	01	X	00	00	01

X = Doesn't matter

TABLE 2

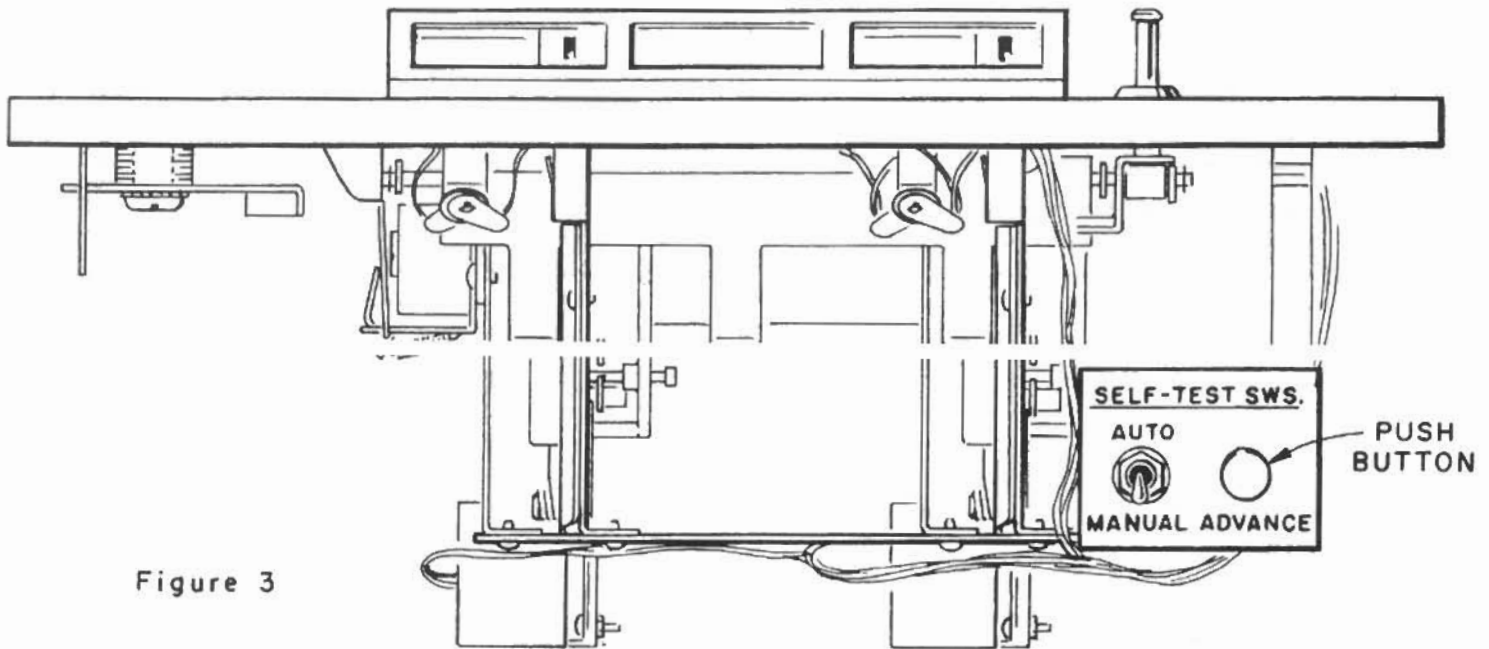


Figure 3

SECTION 4 GAME BOOKKEEPING

The game is designed with operator in mind. There are 5 separate game bookkeeping totals which can be accessed from the coin door. (See Figure 3).

With the game in the game over mode, place the coin door diagnostic switch in the manual position. Then press the advance switch once. This immediately enters the diagnostic at test 4, subtest 18. This displays the current high score to date in the Player 1 display. Press the advance switch again and this advances the diagnostic to test 4, subtest 19. This displays the number of coins through Slot 1. Press the advance switch again to go to subtest 20, which displays the number of coins through Slot 2. Press the advance switch again to go to subtest 21, which displays the number of coins through Slot 3.

There are two additional bookkeeping entries which are again accessed by pressing the advance switch. Test 4, subtest 22 displays the number of credits paid for. Pressing the advance switch again advances to subtest 23, which displays the number of credits won.

To return to game over after reading out the bookkeeping totals, place the AUTO/MANUAL switch to AUTO and press ADVANCE once. This will return the game to game over.

Test 04 Subtest	18	High Score to Date
	19	Number of Coins - Left Chute
	20	Number of Coins - Center Chute
	21	Number of Coins - Right Chute
	22	Number of Credits paid
	23	Number of Credits won

The bookkeeping totals are not resettable to zero, therefore a log similar to Figure 4 is recommended. If there is no center chute, the number displayed is of no significance and should be ignored.

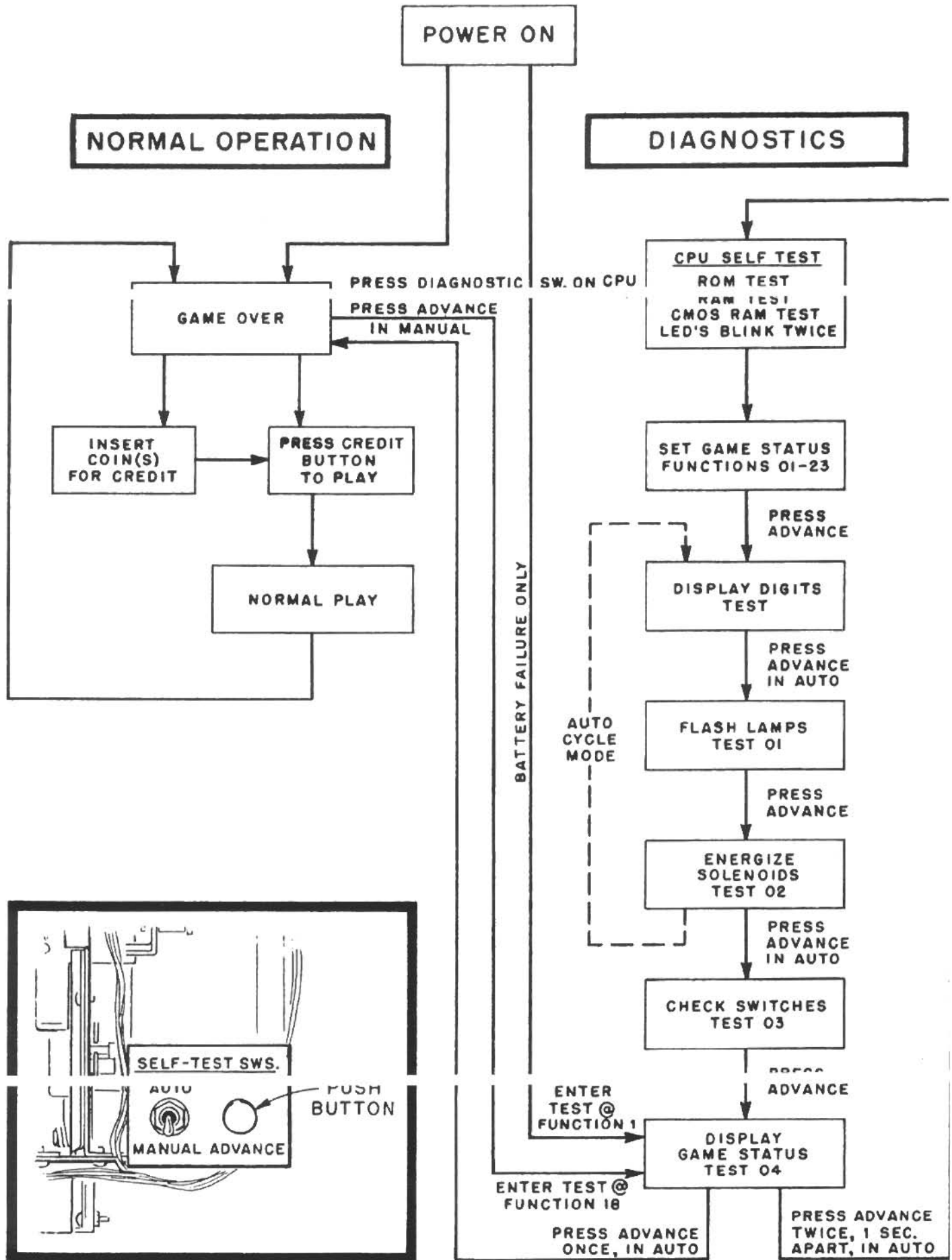


Figure 5

SECTION 5 BUILT IN DIAGNOSTICS

The built in diagnostics were designed for ease of operation and thoroughness. The diagnostics have been organized in such a way as to allow individual testing of different areas in the machine. These areas include:

- a) CPU Board Self - Test
- b) Game Status change
- c) Display digits test*
- d) Lamps (test 01)
- e) Solenoids (test 02)*
- f) Switches (test 03)*
- g) Game status display (test 04)*

* There are specific subtests in these tests. The different ways to enter the diagnostics and normal game operation are shown in Figure 5. There is also an auto cycle test which will be discussed later.

DIAGNOSTIC SWITCHES

There are three switches which are used to control the operation of the diagnostics:

1. Diagnostic switch (lower pushbutton on CPU)
2. Auto/Manual (inside coin door)
3. Advance switch (inside coin door)

Pressing the Diagnostic switch on the CPU Board initiates the diagnostics and causes the CPU to perform three self tests automatically:

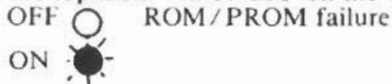
1. ROM/PROM test
2. RAM test
3. CMOS RAM test

If any errors are detected, the two LED's on the CPU Board will light to indicate the specific failure. If all three tests pass successfully, the two LED's will blink twice and then go off. The diagnostics will then be in GAME STATUS CHANGE.

CPU BOARD SELF TESTS

ROM/PROM TEST

The ROM/PROM test specifically checks the contents of CPU Board IC 17, IC 20, IC 21, IC 22 to see if the information in the ROM's and the field PROMS is correct. If the information is incorrect, the bottom LED will light up and the top LED will be OFF on the CPU Board.



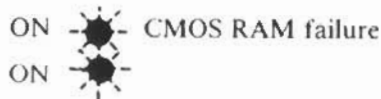
RAM TEST

The RAM test specifically checks the ability of the RAM IC's 13 and IC 16 to retain information correctly. If the information is not retained correctly, the CPU Board top LED will light up and the bottom LED will be OFF.



CMOS RAM TEST

The CMOS RAM test specifically checks the ability of the CMOS RAM IC 19 to retain information correctly. If the information is not retained correctly, both LED's will light up and stay ON on the CPU Board.



GAME STATUS CHANGE

Following the successful completion of the CPU Board self tests, the two LED's blink twice and the diagnostic program enters the game status change area. This is the only time that changes can be entered as outlined in Section 3 of this manual. Replay points, maximum credits, match features, etc. can be changed ONLY during this portion of the diagnostics. Any changes made to the data will not be displayed until the game status display (test 04) described later. After making all game status changes (if any), press the ADVANCE pushbutton once to go to the digits test.

NOTE: This section of the diagnostic is the only section where ALL player and master display digits are turned OFF. No digits show on the displays until the next section of the diagnostics is entered by pressing the ADVANCE pushbutton on the coin door.

DISPLAY DIGITS TEST

This test is controlled by the two switches mounted on the coin door. If the AUTO/MANUAL switch is in the AUTO position, the digits on the display will alternate from 0 to 1 etc to 9 and back to 0, 1, etc. This will continue until the ADVANCE pushbutton is pressed.

If the AUTO/MANUAL switch is in the MANUAL position when entering the test the digit displays will show all zeros and will remain at zero until the ADVANCE is pressed. This will change all the displays to all 1's. Pressing ADVANCE again will change the display to all 2's etc.

Chart 3
WORLD CUP Solenoid List

Each time the ADVANCE pushbutton is pressed the digits will change. Returning the AUTO/MANUAL switch to the AUTO position will cause the digits to start cycling automatically. To regain manual control, place the AUTO/MANUAL switch to the MANUAL position and press the ADVANCE pushbutton. To exit this test and proceed to the LAMP Test (Test 01), place the AUTO/MANUAL switch to the AUTO position and press the ADVANCE pushbutton once. The displays will clear. The match digits will display 01 to indicate test 01 and the diagnostic will go to the lamp test.

LAMP TEST - TEST 01

This test causes all multiplexed lamps to blink on and off. The AUTO/MANUAL switch has no effect in this test. All lamps will continue to blink until the ADVANCE pushbutton is pressed. This causes the diagnostic to proceed directly to the Solenoid Test (Test 02). Note that the general illumination lamps do not blink on and off during this or at any other time.

SOLENOID TEST - TEST 02

When this test is entered the match digits will display 02 to indicate test 02. This test is controlled by the AUTO/MANUAL switch and the ADVANCE pushbutton.

This test is designed to pulse each solenoid for 15 milliseconds. The credit display will indicate the number of the solenoid being pulsed. Refer to Chart 3 for the solenoid identification list. Note that the solenoids numbered 06, 08, 19 to 22 are not used. Also note that 15 milliseconds is too short a pulse duration to actuate the coin lockout coil.

If the AUTO/MANUAL switch is in the AUTO position when this test is entered, the test will automatically sequence from solenoid 01 to 02 to 03 etc. to 22 and back to 01, 02, 03 etc. This will continue until either the ADVANCE pushbutton is pressed to go on to the next test or the AUTO/MANUAL switch placed to the MANUAL position and the ADVANCE pushbutton pressed, causing the test to cycle only the solenoid where the pause occurred.

If the AUTO/MANUAL switch is in the MANUAL position when this test is entered, the test will operate solenoid 01 repeatedly until the ADVANCE pushbutton is pressed. Then the solenoid 02 will be operated repeatedly until the ADVANCE pushbutton is again pressed. Placing the AUTO/MANUAL switch to the AUTO position at any time will cause automatic sequencing to resume. When the ADVANCE pushbutton is pressed with the AUTO/MANUAL switch in the AUTO position, the diagnostics will advance to the SWITCH TEST.

- 01 Left Eject
- 02 Right Eject
- 03 Left Shooter
- 04 Right Shooter
- 05 Ball Release
- 06 Not Used
- 07 Bell
- 08 Not Used
- 09 10 Point Chime (Large)
- 10 100 Point Chime (Medium - Large)
- 11 1,000 Point Chime (Medium - Small)
- 12 10,000 Point Chime (Small)
- 13 Not Used
- 14 Credit Knocker
- 15 Not Used
- 16 Coin Lockout* *NOTE: 15 msec is not long enough to energize this coil.
- 17 Left Jet Bumper
- 18 Right Jet Bumper
- 19 Not Used
- 20 Not Used
- 21 Not Used
- 22 Not Used

SWITCH TEST - TEST 03

When this test is entered the match digits will display 03 to indicate test 03. The position of the AUTO/MANUAL switch has no effect on the operation of this test.

After entering this test, the credit display will display up to four switches on the playfield that are closed or stuck. After this listing is complete only the last switch closed will be indicated. If NO switches are closed when this test is entered the credit display will be blank.

All switches can be checked by closing the switch manually and observing that the switch number appears in the credit display. To exit this section of the diagnostics, press the ADVANCE pushbutton to go to the display game status test 04.

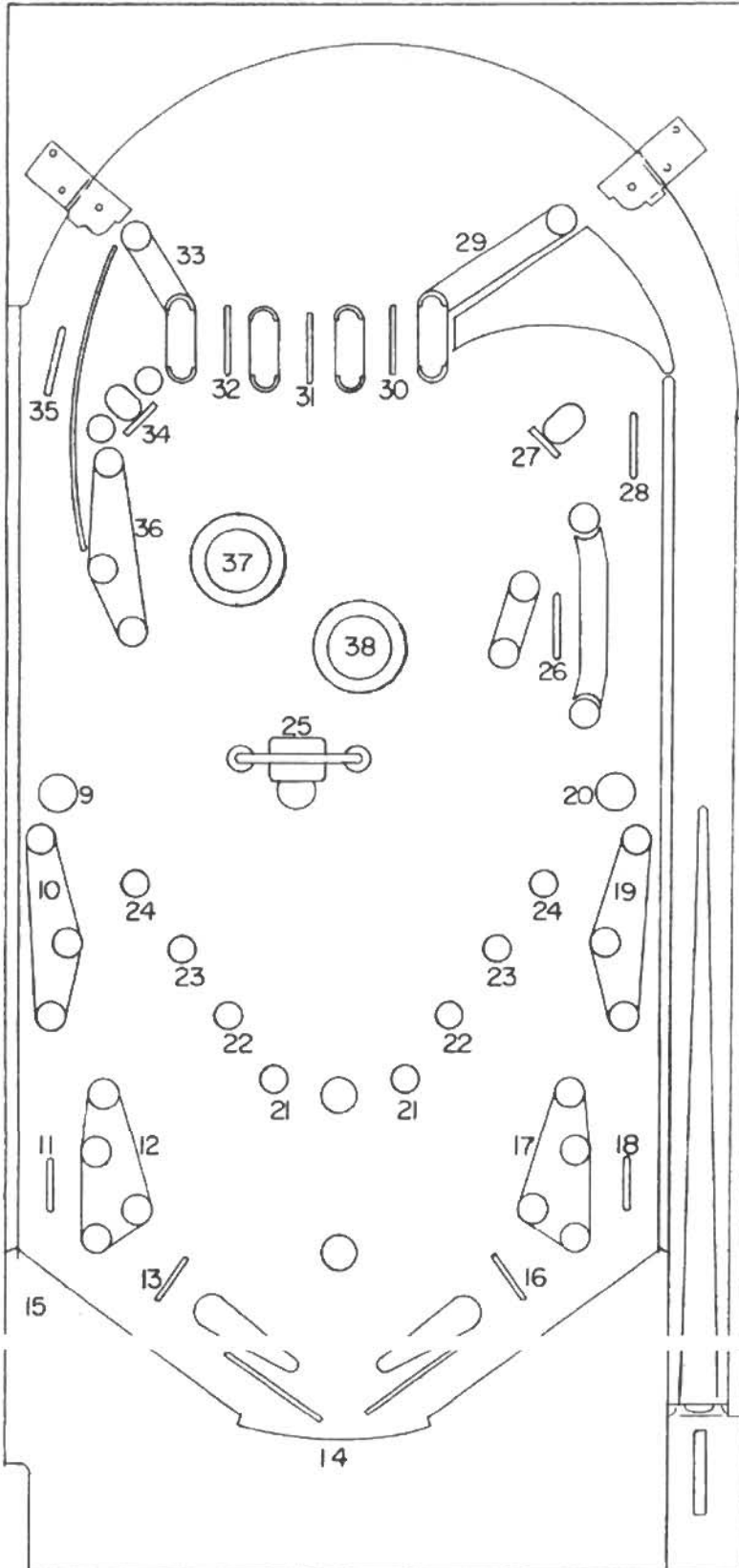
Refer to Chart 4 for the description and location of all switches in the playfield. Note that switches 01 thru 08 are not on the playfield itself.

DISPLAY GAME STATUS - TEST 04

When this test is entered, the match digits will display 04 to indicate test 04. This test displays on Player 1 display the current game status for the 18 functions that can be changed according to section 3 in this manual and for the 5 bookkeeping totals which can be accessed as described in section 4. **CAUTION!** Do not change any of these values unless you are sure you know what you are doing! **CAUTION!** Do not make any changes to the game status until you have made at this time! To make changes the diagnostics must be in the Game Status Change section of the diagnostics as previously explained.

WORLD CUP

PLAYFIELD SWITCHES



"WORLD CUP" PLAYFIELD SWITCH CHART

- 01 Plumb Bob Tilt
- 02 Ball Roll Tilt
- 03 Credit Button
- 04 Right Coin Switch
- 05 Center Coin Switch
- 06 Left Coin Switch
- 07 Slam Tilt
- 08 Not used
- 09 Left Eject
- 10 Left Standup
- 11 Left Special
- 12 Left Standup
- 13 Left Ball Thrower ("T")
- 14 Outhole
- 15 Playfield Tilt
- 16 Right Ball Thrower ("A")
- 17 Right Standup
- 18 Right Special
- 19 Right Standup
- 20 Right Eject
- 21 Ball Advance 1
- 22 Ball Advance 2
- 23 Ball Advance 3
- 24 Ball Advance 4
- 25 Spinner
- 26 Super Ball Advance
- 27 "R" Target
- 28 Right Super Ball Advance
- 29 Top Right Standup
- 30 Top Right Rollover (A/R)
- 31 Top Center Rollover
- 32 Top Left Rollover (S/T)
- 33 Top Left Standup
- 34 "S" Target
- 35 Left Super Ball Advance
- 36 Left Inside Ball Advance
- 37 Left Jet Bumper
- 38 Right Jet Bumper

When this test is entered, if the AUTO/MANUAL switch is in the AUTO position the test will sequentially display the game status data values on the Player 1 display and the function number on the credits display and continue cycling until the ADVANCE pushbutton is pressed. If the ADVANCE pushbutton is pressed once, the diagnostics will end and the game will go to the GAME OVER mode. If the ADVANCE pushbutton is pressed once and then after a 1 second pause pressed a second time, the diagnostics will start all over again with the CPU Self Tests and then go to Game Status Change section of the diagnostics.

If the AUTO/MANUAL switch is in the MANUAL position when the test is entered, the credit display will show 01, Player 1 display the value of whatever is function 01, and will remain that way until the ADVANCE pushbutton is pressed, at which time the value for function 02 will be display on Player 1 display and 02 will display in the credit display. Each time the ADVANCE pushbutton is pressed, the credit display will increment by 1 until 23 is reached then it will return to 01. This will continue until the AUTO/MANUAL switch is returned to the AUTO position and the ADVANCE pushbutton pressed once or twice as described above. Note that for test 4 function numbers 8 thru 14, values above 09 will not be displayed correctly. Refer to Table 1 for an explanation of the values read out during this test.

AUTO CYCLE MODE

As an aid in diagnosing intermittent problems or as a means to let the machine cycle itself through portions of the diagnostics, provision was made for the AUTO CYCLE MODE. This mode will sequence through the digit display test, go to test 01 and flash the lamps 128 times then go to test 02 and energize each solenoid then digit test, test 01, etc. This can be allowed to run indefinitely or until the ADVANCE pushbutton is pressed to regain control of the diagnostics.

To enter the AUTO CYCLE MODE:

1. Turn game OFF then turn game ON.
2. Press the diagnostic pushbutton on the CPU Board to enter diagnostics.
3. Set the data and function switches as follows:
DATA SWITCH (TOP SWITCH) - Turn **all** switches OFF. FUNCTION SWITCH (BOTTOM SWITCH) - Turn **all** switches OFF then turn ON only switch 1.
4. Press ENTER pushbutton on CPU Board. The two LED's will blink to accept the data.
5. Place the AUTO/MANUAL switch to AUTO.
6. Press ADVANCE pushbutton ONCE. The AUTO CYCLE MODE will begin and continue until the ADVANCE pushbutton is pushed again to regain manual control of the diagnostics or the machine is turned OFF.

SECTION 6 TROUBLESHOOTING CHARTS

This section, along with the diagnostics, allows the operator to locate any problems to the specific area responsible for the problem.

If game exhibits a specific problem with

- Lamp - See Section 6A
- Switch - See Section 6B
- Solenoid - See Section 6C
- Master Display - See Section 6D
- Player Display - See Section 6E
- Game Operation - See Section 6F

If the game does not play at all or blows fuses - see Section 6G

If the game plays intermittently - See Section 6H

If the game comes on in diagnostic test 04, subtest 01 - See Section 6I

Section 6A - Place Diagnostics in Test 01

LAMP TROUBLESHOOTING CHART

1 LAMP

Always OFF

1. Check Bulb
2. Check Diode (Observe Polarity)
3. Check wiring (broken wires)

Glows DIM

1. Check Bulb (correct # bulb)
2. Check Diode (Observe Polarity)
3. Check wiring (shorted wires)

Always ON

1. Check Diode (Observe Polarity)
2. Check wiring (shorted wires)

4-8 LAMPS

Always OFF

1. Check wiring (broken wires)
2. Check Connectors (2J5, 2J7)
3. Replace Driver Board

Glows DIM

1. Check wiring (broken wires)
2. Check Diodes
3. Check Connectors (2J5, 2J7)
4. Replace Driver Board

Always ON

1. Check wiring (shorted wires)
2. Check Diodes
3. Check Connectors (2J5, 2J7)
4. Replace Driver Board

ALL LAMPS

Always OFF

1. Check fuse 3F3 on Power Supply
2. Check for + 18 VDC on fuse 3F3 to ground
3. Check Connector 3J4
4. Check Connector 8P2/8J2
5. Check wiring (Broken or shorts)
6. Replace Driver Board

Glows DIM

1. Check line voltage
2. Check for + 18VDC on fuse 3F3 to ground

GENERAL ILLUMI.

Always ON

Normal Condition

Always OFF

1. Check Fuse 3F4 on Power Supply
2. Check for +6.3 VAC
3. Check Connectors (3J3)
4. Check Connectors 9P1 and 8P2/8J2
5. Check wiring (broken or short)

Glows DIM

1. Check line voltage

All lamps are N44 or equivalent
All diodes are IN4001 or equivalent

Section 6B - Place Diagnostics in Test 03

SWITCH TROUBLESHOOTING CHART

1 SWITCH

Always Actuated

1. Check contacts
2. Check shorted wires

Never Actuates

1. Check adjustment
2. Check broken wires
3. Check for open diode by jumpering across diode and actuating.

4-8 SWITCHES

Always Actuated

1. Check adjustments
2. Check shorted wires on playfield or to 2J2, 2J3
3. Replace Driver Board

Never Actuated

1. Check adjustment
2. Check broken wires on playfield or 2J2, 2J3
3. Check plug 8P1/8J1 for broken wires or pushed out pins
4. Replace Driver Board

Switch Closure Displays Multiple Switch Numbers

1. Check adjustments
2. Check shorted wires on playfield or to 2J2, 2J3
3. Replace Driver Board

Switch Displays Incorrect No.

1. Check correct switch chart for game and check adjustment
2. Incorrect wiring on playfield 2J2, 2J3, or 8P1/8J1
3. Check Connector keying

ALL SWITCHES

1. Check adjustments
2. Check Connectors 2J2, 2J3, are not exchanged
3. Replace Driver Board

Section 6C - Place Diagnostics in Test 02

SOLENOID TROUBLESHOOTING CHART

1 SOLENOID

Never Actuates

1. Check solenoid Chart to verify number correct and in use
2. Broken wire to solenoid
3. Shorted diode across solenoid
4. Shorted/burned out solenoid
5. Open driver for that solenoid - replace Driver Board

Always Actuated

1. Shorted wire for that solenoid
2. Shorted driver for that solenoid on Driver Board - replace Driver Board

ALL SOLENOIDS

Never Actuated

1. Check for + 28VDC on Power Supply fuse 3F2 to ground
2. Check fuse 3F2 on Power Supply
3. Check Connectors 3J3 and 3J4 on Power Supply
4. Check Connector 2J9, 2J10, 2J11, 2J12 for broken/shorted wires.
5. Replace Driver Board

FLIPPER INOPERATIVE

1. Switch contacts on flipper button open or out of adjustment
2. Check Connectors from switch to back box to driver board
3. Shorted diode across coil

FLIPPER WEAK

1. Switch contacts on flipper button out of adjustment or pitted contacts.
2. End of stroke switch on solenoid not adjusted properly
3. Check connections on solenoid and check for bind

Section 6D - Place Diagnostics in Display Digits Test

Master Display Troubleshooting Chart

NO DISPLAY

1. Check - 100VDC, + 100VDC & fuse 3F1 on Power Supply.
2. Check connectors 3J5, 4J7, 4J5, 1J3, 1J5, 1J6, 1J7
3. Check for +100VDC and - 100VDC on connector 4J7 - replace Power Supply Board if voltage incorrect
4. Replace Master Display Board.

INCORRECT DISPLAY

1. Check + 100VDC - 100VDC at 4J7
2. Check for broken or shorted wires on 4J5, 4J6, 1J5, 1J6, 1J7
3. Replace Master Display Board

Section 6E - Place Diagnostics in Display Digits Test

Player Display Troubleshooting Chart

1 PLAYER DISPLAY INCORRECT/OFF

1. Check correct location of connector from Master Display Board.
2. Replace Player Display - if still incorrect, replace Master Display Board.

2-4 PLAYER DISPLAYS INCORRECT/OFF

1. Check correct location of connectors from Master Display Board
2. Check voltage + 100VDC and - 100VDC on connector 4J7
3. If voltages are correct - replace Master Display Board.

USE EXTREME CAUTION WHEN MEASURING HIGH VOLTAGES !!!

Section 6F- Game Operation Troubleshooting

Put game in game over mode. Manually play game to verify problem. Go to diagnostic mode and read out functions by stepping through test 04. Review the game adjustments to verify that they are what is desired. Review game operation (Section 2).

Section 6G - Troubleshooting an inoperative machine or a machine that blows fuses.

Machine Inoperative

1. Remove plug from wall outlet and measure wall voltage.
2. With machine unplugged, check the line fuse, line cord, and ON/OFF switch with an Ohmmeter for continuity.
3. Check for any loose connections on line filter, ON/OFF switch.
4. Check that power connector to transformer is securely connected
5. Check all fuses on power supply board.
6. Plug machine in, turn on and check voltage on power supply board fuses.

Machine Blows Fuse

1. Wall fuse or circuit breaker blows -
 - a) Disconnect wall plug.
 - b) Disconnect connector from line filter to transformer.
 - c) Check line cord with Ohmmeter for shorts.
 - d) Check varistor and line filter for shorts.
 - e) Plug cord in wall and see if wall fuse still blows - if yes, disconnect whatever else is on same wall plug circuit and recheck items (c) and (d) above.
2. Machine fuse blows -
 - a) Check for correct fuse rating.
 - b) Check varistor, line filter, line cord for shorts.
 - c) Disconnect connector from line filter to transformer and try another fuse.
 - d) If fuse still blows, do item a, b, c again.
 - e) If fuse does not blow, disconnect 3P1 and 3P2 plugs from the power supply board and reconnect plug from line filter to transformer
 - f) If fuse blows, check transformer and both lamps and solenoid rectifiers for shorts.
 - g) If fuse does not blow, plug in 3P2 and 3P1 then try again. If fuse now blows, disconnect 3P3, 3P4, 3P5, 3P6, and try another fuse. If fuse still blows replace POWER SUPPLY.
 - h) If fuse doesn't blow, hook up 3P3, 3P4, 3P5, and 3P6 one at a time. If fuse blows when any one is plugged in, look for burned out solenoid, dead shorts, etc.

3. Individual Power Supply Fuse Blows

- a) Disconnect load from portion of the power supply that blows the fuse by disconnecting the appropriate plug.
 1. 3F1 (+100VDC, -100VDC) disconnect 3P5
 2. 3F2 (+28VDC) disconnect 3P4, 3P3
 3. 3F3 (+18VDC) disconnect 3P4
 4. 3F4 (6.3VAC) disconnect 3P3
 5. 3F5 (+5VDC) disconnect 3P6
- b) If fuse still blows, replace POWER SUPPLY.
- c) If fuse does not blow, check for shorts in wiring, burned out solenoids, etc.

Section 6H - Game plays intermittently.

This usually indicates a power supply or CPU board problem. Check the +5DVC and the unregulated +5VDC on the CPU board and on the power supply. If the voltage is correct, attempt to run the CPU self tests in the diagnostics. (See Section 5) If the CPU self tests fail, remove the DRIVER BOARD and attempt to run the CPU self tests again. If the diagnostics now run, replace the DRIVER BOARD. Otherwise, replace the CPU Board.

Section 6I - Game repeatedly comes on in diagnostic test 04, subtest 01.

This indicates that there has been either a battery failure or a CPU board failure. Measure the voltage across the batteries. If the voltage is below 3.0VDC, replace the batteries with Power ON and make any necessary game status changes if required. If the voltage is above 3.0VDC, run the CPU Self Test diagnostics. If CMOS RAM test fails, replace the CPU Board.

SECTION 7 INTERCONNECTION CHARTS

The following interconnection charts are used to identify the color and pin number of all the wires for all the components and typical wiring sketches for each type of

The following conventions are used throughout -

1. 1J1 is connector J1 on board 1.
3J6 is connector J6 on board 3.
2. J designations refer to the male part of plug.
P designations refer to the female part of plug.
3. The prefix numbers are as follows:
 1. CPU Board
 2. Driver Board
 3. Power Supply Board
 4. Master Display Board
 5. Slave Display Board
 6. Back Box Miscellaneous
 7. Cabinet
 8. Playfield
 9. Insert Box

Refer to Figures 6, 7, 8 and 9 for the lamps matrix, the switch matrix, solenoid matrix and connector identification.

WORLD CUP - LIGHT

LAMP COLUMNS

	1	2	3	4	5	6	7	8
	YEL-BRN	YEL-RED	YEL-ORG	YEL-BLK	YEL-GRN	YEL-BLU	YEL-VIO	YEL-GRY
RED-BRN	BALL ADVANCE 1 (x2)	TOP "S"	TOP GOAL WHEN LIT	2 GOALS	BONUS 2	BONUS 10	BONUS 18	#1 PLAYER UP
RED-BLK	BALL ADVANCE 2 (x2)	TOP "T"	EXTRA BALL WHEN LIT	4 GOALS	BONUS 3	BONUS 11	1 CAN PLAY	#2 PLAYER UP
RED-ORN.	BALL ADVANCE 3 (x2)	TOP "A"	SPINNER 100 WHEN LIT	6 GOALS	BONUS 4	BONUS 12	2 CAN PLAY	#3 PLAYER UP
RED-YEL	BALL ADVANCE 4 (x2)	TOP "R"	BRONZE STAR	1 GOAL	BONUS 5	BONUS 13	3 CAN PLAY	#4 PLAYER UP
RED-GRN	GOAL WHEN LIT (x2)	"S"	SILVER STAR	3 GOALS	BONUS 6	BONUS 14	4 CAN PLAY	TILT
RED-BLU	LEFT SPECIAL	"T"	GOLD STAR	5 GOALS	BONUS 7	BONUS 15	MATCH	GAME OVER
RED-VIO	RIGHT SPECIAL	"A"	GOLD CUP	7 GOALS	BONUS 8	BONUS 16	BALL IN PLAY	SAME PLAYER SHOOT AGAIN (Back Box)
RED-GRY	SAME PLAYER SHOOT	"R"	SUPER STAR	BONUS 1	BONUS 9	BONUS 17	CREDITS (PLAYFIELD)	HIGH SCORE

FIGURE 6

WORLD CUP - SWITCH

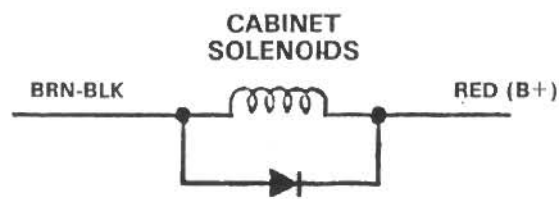
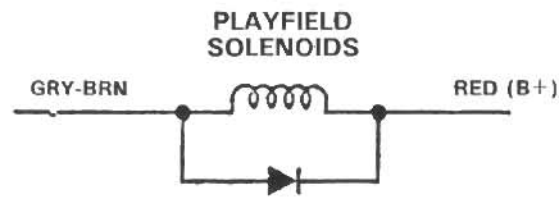
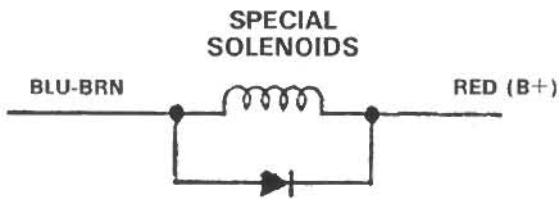
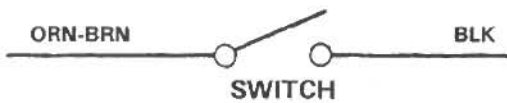
SWITCH COLUMNS

	1	2	3	4	5	6	7	8
	GRN-BRN	GRN-RED	GRN-ORG	GRN-YEL	GRN-BLK	GRN-LU	GRN-VIO	GRN-GRY
1	FLUMB TILT 1	LEFT EJECT 9	RIGHT STANDUP 17	SPINNER 25	TOP LEFT STANDUP 33	41	49	57
2	BALL ROLL TILT 2	LEFT STANDUP 10	RIGHT SPECIAL 18	SUPER BALL ADVANCE 26	"S" TARGET 34	42	50	58
3	CREDIT BITTON 3	LEFT SPECIAL 11	RIGHT STANDUP 19	"R" TARGET 27	LEFT SUPER BALL ADVANCE 35	43	51	59
4	25c SWITCH 4	LEFT STANDUP 12	RIGHT EJECT 20	RIGHT SUPER BALL ADVANCE 28	LEFT INSIDE BALL ADVANCE 36	44	52	60
5	10c SWITCH 5	LEFT BALL THROWER ("T") 13	BALL ADVANCE 1 21	TOP RIGHT STANDUP 29	LEFT JET BUMPER 37	45	53	61
6	5c SWITCH 6	OUTHOLE 14	BALL ADVANCE 2 22	TOP RIGHT ROLLOVER (A/R) 30	RIGHT JET BUMPER 38	46	54	62
7	SLAM TILT 7	PLAYFIELD TILT 15	BALL ADVANCE 3 23	TOP CENTER ROLLOVER 31		47	55	63
8		RIGHT BALL THROWER ("A") 16	BALL ADVANCE 4 24	TOP LEFT ROLLOVER (S/T) 32	40	48	56	64

FIGURE 7

SWITCH ROWS

TYPICAL WIRING



WORLD CUP SOLENOIDS

FIGURE 8

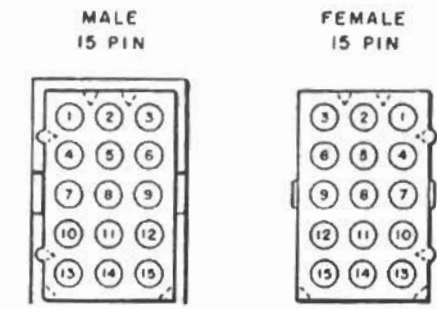
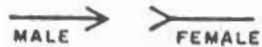
SWITCH →
COIL →

SPECIAL SOLENOIDS	
ORN-BRN	BLU-BRN
17	LEFT JET BUMPER G-23-750-DC
ORN-RED	BLU-RED
18	RIGHT JET BUMPER G-23-750-DC
ORN-BLK	BLU-ORN
19	NOT USED
ORN-YEL	BLU-YEL
20	NOT USED
ORN-GRN	BLU-GRN
21	NOT USED
ORN-BLUE	BLUE-BLK
22	NOT USED
ORN-VIO	BLU-VIO
	RIGHT FLIPPER FL-21-400 33-1300-DC
ORN-GRY	BLU-GRY
	LEFT FLIPPER FL-21-400 33-1300-DC

SOLENOIDS	
PLAYFIELD	CABINET
GRY-BRN	BRN-BLK
1	9
LEFT EJECT G-25-1000-DC	10 POINT SOUND B-31-2000-DC
GRY-RED	BRN-RED
2	10
RIGHT EJECT G-25-1000-DC	100 POINT SOUND B-31-2000-DC
GRY-ORN	BRN-ORN
3	11
LEFT SHOOTER G-25-1000-DC	1000 POINT SOUND B-31-2000-DC
GRY-YEL	BRN-YEL
4	12
RIGHT SHOOTER G-25-1000-DC	10,000 POINT SOUND B-31-2000-DC
GRY-GRN	BRN-GRN
5	13
BALL RELEASE A-23-800-DC	NOT USED
GRY-BLUE	BRN-BLUE
6	14
NOT USED	CREDIT KNOCKER A2-23-750-DC
GRY-VIO	BRN-VIO
7	15
BELL SOUND B1-26-800-DC	NOT USED
GRY-BLK	BRN-GRY
8	16
NOT USED	COIN LOCKOUT M-35-4000-DC

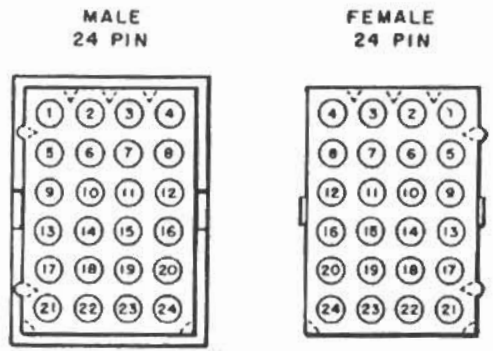
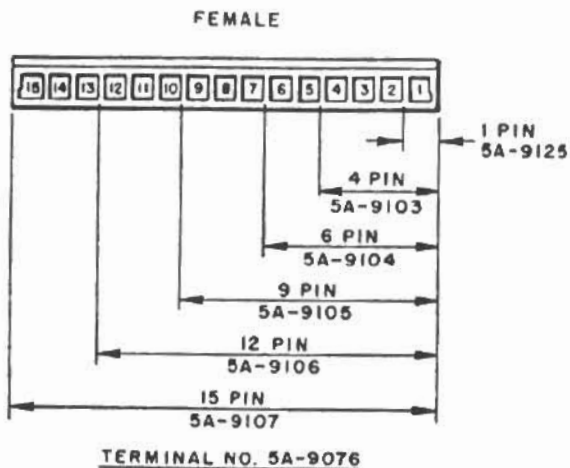
CONNECTOR LEGEND

ELECTRICAL SYMBOL



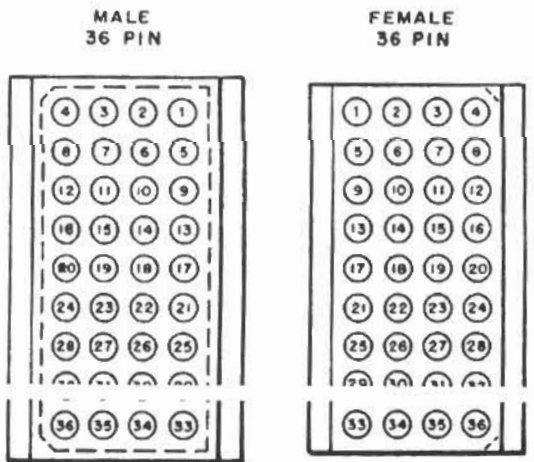
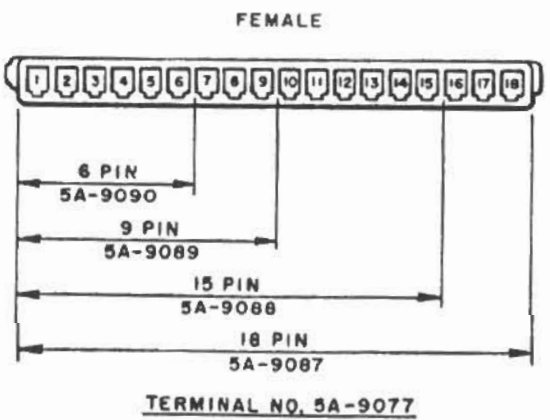
WHITE HOUSING 5A-9093
BLACK HOUSING 5A-9095
TERM. NO. 5A-9078

WHITE HOUSING 5A-9094
BLACK HOUSING 5A-9096
TERM. NO. 5A-9079



WHITE HOUSING 5A-9097
BLACK HOUSING 5A-9099
TERM. NO. 5A-9078

WHITE HOUSING 5A-9098
BLACK HOUSING 5A-9100
TERM. NO. 5A-9079



WHITE HOUSING 5A-9101
TERM. NO. 5A-9078

WHITE HOUSING 5A-9102
TERM. NO. 5A-9079

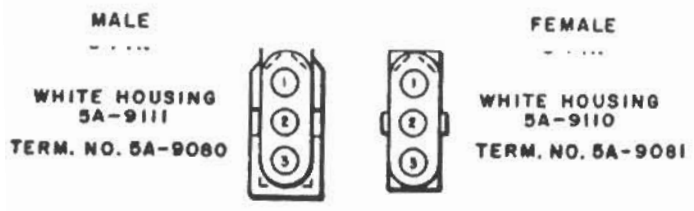


FIGURE 9

CPU BOARD

1J1 - INTERBOARD CONNECTOR

1P2 - LOGIC POWER BUS INPUT

Pin	Wire Color	Function
1	Black	Logic Ground
2	Black	Logic Ground
3	Black	Logic Ground
4	Gray	Logic B + (+5VDC)
5	Gray	Logic B + (+5VDC)
6	Gray	Logic B + (+5VDC)
7	Key	Key
8	N/C	Not Used
9	Gray-White	Logic B + (+12V) (Unregulated)

1P3 - DISPLAY BLANKING

Pin	Wire Color	Function
1	N/C	Not Used
2	N/C	Not Used
3	Key	Key
4	Blue-White	Display Blanking

1P4 - DIAGNOSTIC SWITCH INPUTS

Pin	Wire Color	Function
1	Key	Key
2	White	Diagnostic Common
3	Green	Diagnostic Advance
4	Blue	Diagnostic Auto/Man.

1P5 - MASTER DISPLAY BCD OUTPUTS

Pin	Wire Color	Function
1	Blue-Yellow	Display BCD D1
2	Blue-Orange	Display BCD C1
3	Blue-Red	Display BCD B1
4	Blue-Brown	Display BCD A1
5	Blue-Gray	Display BCD D2
6	Key	Key
7	Blue-Violet	Display BCD C2
8	Blue-Black	Display BCD B2
9	Blue-Green	Display BCD A2

1P6 - MASTER DISPLAY STROBE OUTPUTS

Pin	Wire Color	Function
1	Violet-Gray	Display Strobe #16
2	Violet-Black	Display Strobe #15
3	Violet-Blue	Display Strobe #14
4	Violet-Green	Display Strobe #13
5	Violet-Yellow	Display Strobe #12
6	Violet-Orange	Display Strobe #11
7	Key	Key
8	Violet-Red	Display Strobe #10
9	Violet-Brown	Display Strobe #9

1P7 - MASTER DISPLAY STROBE OUTPUTS

Pin	Wire Color	Function
1	Brown-Gray	Display Strobe #8
2	Brown-Violet	Display Strobe #7
3	Brown-Blue	Display Strobe #6
4	Brown-Green	Display Strobe #5
5	Brown-Yellow	Display Strobe #4
6	Brown-Orange	Display Strobe #3
7	Brown-Red	Display Strobe #2
8	Key	Key
9	Brown-Black	Display Strobe #1

DRIVER BOARD

2P1 - INTERBOARD CONNECTOR

2P2 - SWITCH STROBE DRIVE

Pin	Wire Color	Function
1	N/C	Not Used
2	N/C	Not Used
3	N/C	Not Used
4	Key	Key
5	Green-Black	Switch Strobe # 5
6	Green-Yellow	Switch Strobe # 4
7	Green-Orange	Switch Strobe # 3
8	Green-Red	Switch Strobe # 2
9	Green-Brown	Switch Strobe # 1

2P3 - SWITCH ROW INPUTS

Pin	Wire Color	Function
1	White-Gray	Switch Return # 8
2	Key	Key
3	White-Violet	Switch Return # 7
4	White-Blue	Switch Return # 6
5	White-Green	Switch Return # 5
6	White-Yellow	Switch Return # 4
7	White-Orange	Switch Return # 3
8	White-Red	Switch Return # 2
9	White-Brown	Switch Return # 1

2P4 - LAMP POWER BUS

Pin	Wire Color	Function
1	Blue	Lamp B +
2	Blue	Lamp B +
3	Key	Key
4	Blue	Lamp B +
5	Blue	Lamp B +
6	N/C	Not Used
7	Blue	Lamp B +
8	Blue	Lamp B +
9	Blue	Lamp B +

2P5 - LAMP COLUMN DRIVE

Pin	Wire Color	Function
1	Yellow-Violet	Lamp Column # 7
2	Yellow-Gray	Lamp Column # 8
3	Yellow-Green	Lamp Column # 5
4	Key	Key
5	Yellow-Blue	Lamp Column # 6
6	Yellow-Orange	Lamp Column # 3
7	Yellow-Black	Lamp Column # 4
8	Yellow-Brown	Lamp Column # 1
9	Yellow-Red	Lamp Column # 2

2P6 - LAMP GROUNDS

Pin	Wire Color	Function
1	Black	Lamp Ground
2	Key	Key
3	Black	Lamp Ground
4	Black	Lamp Ground
5	N/C	Not Used
6	Black	Lamp Ground
7	Black	Lamp Ground
8	Black	Lamp Ground
9	Black	Lamp Ground

2P7 - LAMP ROW DRIVE

Pin	Wire Color	Function
1	Red-Brown	Lamp Row # 1
2	Red-Black	Lamp Row # 2
3	Red-Orange	Lamp Row # 3
4	Red-Yellow	Lamp Row # 4
5	Red-Green	Lamp Row # 5
6	Red-Blue	Lamp Row # 6
7	Key	Key
8	Red-Gray	Lamp Row # 8
9	Red-Violet	Lamp Row # 7

DRIVER BOARD

2P8 - LOGIC POWER BUS INPUT

Pin	Wire Color	Function
1	Black	Logic Ground
2	Black	Logic Ground
3	Black	Logic Ground
4	Black	Logic Ground
5	Key	Key
6	Gray	Logic B + (+ 5 VDC)
7	Gray	Logic B + (+ 5 VDC)
8	Gray	Logic B + (+ 5 VDC)
9	Gray	Logic B + (+ 5 VDC)

2P9 - CABINET SOLENOIDS DRIVE

Pin	Wire Color	Function
1	Brown-Orange	Coil #11 1000 Point Chime
2	Brown-Yellow	Coil #12 10,000 Point Chime
3	N/C	Not Used
4	Brown-Blue	Coil #14 Knocker
5	N/C	Not Used
6	Brown-Gray	Coil #16 Coin Lockout
7	Brown-Red	Coil #10 100 Point Chime
8	Key	Key
9	Brown-Black	Coil # 9 10 Point Chime

2P10 - SOLENOID GROUNDS

Pin	Wire Color	Function
1	Black	Solenoid Ground
2	Black	Solenoid Ground
3	Black	Solenoid Ground
4	Black	Solenoid Ground
5	Key	Key
6	N/C	Not Used
7	Black	Solenoid Ground
8	Black	Solenoid Ground
9	Black	Solenoid Ground

2P11 - PLAYFIELD SOLENOIDS DRIVE

Pin	Wire Color	Function
1	N/C	Not Used
2	Gray-Violet	Coil # 7 Bell
3	N/C	Not Used
4	Gray-Brown	Coil # 1 Left Eject
5	Gray-Red	Coil # 2 Right Eject
6	Key	Key
7	Gray-Orange	Coil # 3 Left Thrower
8	Gray-Yellow	Coil # 4 Right Thrower
9	Gray-Green	Coil # 5 Ball Release

2P12 - SPECIAL SOLENOIDS DRIVE

Pin	Wire Color	Function
1	Orange-Violet	Right Flipper Enable
2	Orange-Gray	Left Flipper Enable
3	N/C	Not Used
4	Blue-Red	Right Jet Bumper Coil
5	Key	Key
6	N/C	Not Used
7	Blue-Brown	Left Jet Bumper Coil
8	N/C	Not Used
9	N/C	Not Used

2P13 - SPECIAL SWITCH INPUTS

Pin	Wire Color	Function
1	Key	Key
2	N/C	Not Used
3	Orange-Red	Right Jet Bumper Sw.
4	N/C	Not Used
5	Orange-Brown	Left Jet Bumper Sw.
6	N/C	Not Used
7	N/C	Not Used
8	N/C	Not Used
9	N/C	Not Used

POWER SUPPLY

3P1 - POWER BUS INPUTS

Pin	Wire Color	Function
1	Violet	Lamps (+ 18 VDC)
2	Orange	Solenoids (+ 28 VDC)
3	N/C	Not Used
4	White	90 VAC
5	N/C	Not Used
6	N/C	Not Used
7	N/C	Not Used
8	N/C	Not Used
9	White	90 VAC
10	Gray	18.7 VAC C.T.
11	Gray	18.7 VAC C.T.
12	Gray White	18.7 VAC C.T.

3P2 - POWER BUS INPUTS

Pin	Wire Color	Function
1	N/C	Not Used
2	N/C	Not Used
3	Black	Solenoid Rect. -
4	N/C	Not Used
5	N/C	Not Used
6	Black	Lamp Rect. -

3P3 - DISPLAY LAMPS & SOLENOID POWER BUS

Pin	Wire Color	Function
1	N/C	Not Used
2	N/C	Not Used
3	Black	Ground
4	N/C	Not Used
5	N/C	Not Used
6	Red	Solenoid B+ (+ 28 VDC)
7	Red	Solenoid B+ (+ 28 VDC)
8	N/C	Not Used
9	Key	Key

3P4 - LAMP & SOLENOID POWER BUS

Pin	Wire Color	Function
1	Black	Ground
2	Black	Ground
3	Black	Ground
4	Black	Ground
5	Blue	Lamp B+ (+ 16 VDC)
6	Blue	Lamp B+ (+ 16 VDC)
7	Blue	Lamp B+ (+ 16 VDC)
8	Blue	Lamp B+ (+ 16 VDC)
9	Black	Ground
10	Black	Ground
11	Black	Ground
12	Black	Ground

3P5 - DISPLAY POWER BUS

Pin	Wire Color	Function
1	Black	Ground
2	N/C	Not Used
3	Orange & Wht-Blk	- 100 VDC
4	Brown	+ 100 VDC
5	Key	Key
6	Gray	Logic B+ (+ 5 VDC)

3P6 - LOGIC POWER BUS

Pin	Wire Color	Function
1	N/C	Not Used
2	N/C	Not Used
3	N/C	Not Used
4	N/C	Not Used
5	Key	Key
6	Gray-White	Logic + (+ 12V. Un-regulated)
7	Gray	Logic B+ (+ 5V.)
8	Gray	Logic B+ (+ 5V.)
9	Gray	Logic B+ (+ 5V.)
10	Gray	Logic B+ (+ 5V.)
11	Black	Ground
12	Black	Ground
13	Black	Ground
14	Black	Ground
15	Black	Ground

MASTER DISPLAY

4P1 - MASTER DISPLAY PLAYER #1

Pin	Wire Catalog	Function
1	Brown-Black-2	Units
2	Brown-Red-2	10's
3	Brown-Orange-2	100's
4	Brown-Yellow-2	1,000's
5	Brown-Green-2	10,000's
6	N/C	Key
7	Brown-Blue-2	100,000's
8	Brown-1	a
9	Red-1	b
10	Blue-1	f
11	Violet	g
12	Orange-1	c
13	Green-1	e
14	Yellow-1	d
15	White-Black	Cathode Keep Alive

} Segments
 } Segments

4P3 - MASTER DISPLAY PLAYER #3

Pin	Wire Color	Function
1	White-Black	Cathode Keep Alive
2	Orange-Yellow-1	100's
3	Orange-Green-1	1000's
4	N/C	Key
5	Orange-Blue-1	10,000's
6	Orange-Violet-1	100,000's
7	Orange-Red-1	10's
8	Orange-Brown-1	Units
9	Brown-2	a
10	Red-2	b
11	Blue-2	f
12	Violet-1	g
13	Orange-2	c
14	Green-2	e
15	Yellow-2	d

} Segments
 } Segments

4P2 - MASTER DISPLAY PLAYER #2

Pin	Wire Color	Function
1	White-Black	Cathode Keep Alive
2	Red-Black-1	Units
3	Red-Brown-1	10's
4	Red-Orange-1	100's
5	Red-Yellow-1	1000's
6	Yellow-1	d
7	Green-1	e
8	Orange-1	c
9	N/C	Key
10	Violet	g
11	Blue-1	f
12	Red-1	b
13	Brown-1	a
14	Red-Green-1	10,000's
15	Red-Blue-1	100,000's

} Segments
 } Segments

4P4 - MASTER DISPLAY #4

Pin	Wire Color	Function
1	Yellow-2	d
2	Green-2	e
3	Orange-2	c
4	Violet-1	g
5	Blue-2	f
6	Red-2	b
7	Brown-2	a
8	Yellow-Brown-1	Units
9	Yellow-Red-1	10's
10	Yellow-Orange-1	100's
11	N/C	Key
12	Yellow-Green-1	1000's
13	Yellow-Blue-1	10,000's
14	Yellow-Violet-1	100,000's
15	White-Black	Cathode Keep Alive

} Segments
 } Segments

MASTER DISPLAY

4P5 - MASTER DISPLAY STROBE INPUTS

Pin	Wire Color	Function
1	N/C	Not Used
2	Brown-Gray-1	Strobe # 8
3	Brown-Violet-1	Strobe # 7
4	Violet-Gray	Strobe #16
5	Violet-Black	Strobe #15
6	Brown-Black-1	Strobe # 1
7	Brown-Red-1	Strobe # 2
8	Brown-Orange-1	Strobe # 3
9	Brown-Yellow-1	Strobe # 4
10	Brown-Green-1	Strobe # 5
11	Brown-Blue-1	Strobe # 6
12	Violet-Red	Strobe #10
13	Violet-Orange	Strobe #11
14	N/C	Not Used
15	Violet-Brown	Strobe # 9
16	Violet-Green	Strobe #13
17	Violet-Yellow	Strobe #12
18	N/C	Not Used

4P6 - MASTER DISPLAY BCD INPUTS

Pin	Wire Color	Function
1	Blue-Red-1	B1
2	Blue-Orange-1	C1
3	Blue-White	Blanking
4	Blue-Yellow-1	D1
5	Blue-Brown-1	A1
6	Blue-Black-1	B2
7	Blue-Violet-1	C2
8	Blue-Gray-1	D2
9	Blue-Green-1	A2

4P7 - MASTER DISPLAY POWER INPUTS

Pin	Wire Color	Function
1	N/C	Not Used
2	Brown	+ 100 VDC
3	Gray	Logic B+ + 5VDC
4	N/C	Not Used
5	Black	Ground
6	Orange	- 100 VDC

PLAYER DISPLAYS

5P1 - PLAYER # 1 SLAVE DISPLAY

Pin	Wire Color	Function
1	Blue-1	f
2	Violet	g
3	Brown-Blue-2	100,000's
4	Green-1	e
5	Yellow-1	d
6	Brown-Green-2	10,000's
7	Brown-Yellow-2	1,000's
8	N/C	Not Used
9	Brown-White	Anode Keep Alive
10	White-Black	Cathode Keep Alive
11	Brown-Orange-2	100's
12	Brown-Red-2	10's
13	N/C	Key
14	Orange-1	c
15	Brown-Black-2	Units
16	Red-1	b
17	Brown-1	a
18	N/C	Not Used

5P3 - PLAYER # 3 SLAVE DISPLAY

Pin	Wire Color	Function
1	Blue-2	f
2	Violet-1	g
3	Orange-Violet-1	100,000's
4	Green-2	e
5	Yellow-2	d
6	Orange-Blue-1	10,000's
7	Orange-Green-1	1,000's
8	N/C	Not Used
9	Brown-White	Anode Keep Alive
10	White-Black	Cathode Keep Alive
11	Orange-Yellow-1	100's
12	Orange-Red-1	10's
13	N/C	Key
14	Orange-2	c
15	Orange-Brown-1	Units
16	Red-2	b
17	Brown-2	a
18	N/C	Not Used

5P2 - PLAYER # 2 SLAVE DISPLAY

Pin	Wire Color	Function
1	Blue-1	f
2	Violet	g
3	Red-Blue-1	100,000's
4	Green-1	e
5	Yellow-1	d
6	Red-Green-1	10,000's
7	Red-Yellow-1	1,000's
8	N/C	Not Used
9	Brown-White	Anode Keep Alive
10	White-Black	Cathode Keep Alive
11	Red-Orange-1	100's
12	Red-Brown-1	10's
13	N/C	Key
14	Orange-1	c
15	Red-Black-1	Units
16	Red-1	b
17	Brown-1	a
18	N/C	Not Used

5P4 - PLAYER # 4 SLAVE DISPLAY

Pin	Wire Color	Function
1	Blue-2	f
2	Violet-1	g
3	Yellow-Violet-1	100,000's
4	Green-2	e
5	Yellow-2	d
6	Yellow-Blue-1	10,000's
7	Yellow-Green-1	1,000's
8	N/C	Not Used
9	Brown-White	Anode Keep Alive
10	White-Black	Cathode Keep Alive
11	Yellow-Orange-1	100's
12	Yellow-Red-1	10's
13	N/C	Key
14	Orange-2	c
15	Yellow-Brown-1	Units
16	Red-2	b
17	Brown-2	a
18	N/C	Not Used

BACK BOX MISCELLANEOUS

6P1/6J1 SWITCHED AC INPUT

Pin	Color	Function
1	White-Red	AC
2	N/C	
3	White-Red	AC

6P2/6J2 FLIPPER POWER

Pin	Color	Function
1	White-Red	Flipper B+

CABINET

7P1/7J1 CABINET SOLENOIDS & SWITCHES (White 36 Pin)

Pin	Color	Function
1	Yellow	6.3 VAC Display Lamps
2	Yellow-White	6.3 VAC Display Lamps
3	Red	Solenoid B+
4	White	Diagnostic Common
5	Green	Diagnostic Advance
6	Blue	Diagnostic Auto/Man.
7	Orange-Violet	Right Flipper Switch
8	Blue-Violet	Right Flipper Switch
9	Orange-Gray	Left Flipper Switch
10	Blue-Gray	Left Flipper Switch
11	Brown-Black	Coil # 9 10 Point Chime
12	Brown-Red	Coil #10 100 Point Chime
13	Brown-Orange	Coil #11 1000 Point Chime
14	Brown-Yellow	Coil #12 10,000 Point Chime
15	N/C	Not Used
16	Brown-Blue	Coil #14 Knocker
17	N/C	Not Used
18	Brown-Gray	Coil #16 Coin Lockout
19	Green-Brown	Switch Column # 1
20	N/C	Not Used
21	White-Brown	Switch Row # 1
22	White-Red	Switch Row # 2
23	White-Orange	Switch Row # 3
24	White-Yellow	Switch Row # 4
25	White-Green	Switch Row # 5
26	White-Blue	Switch Row # 6
27	White-Violet	Switch Row # 7
28	N/C	Not Used
29	Gray-Violet	Coil # 7 Bell
30-36	N/C	Not Used

7P2/7J2 CABINET SWITCHES & DISPLAY LAMPS (White) (15 Pin)

Pin	Color	Function
1	Yellow	6.3 VAC Display Lamps
2	Yellow-White	6.3 VAC Display Lamps
3	Red	Coil B+
4	Brown-Gray	Coil #16 Coin Lockout
5	N/C	Not Used
6	Green-Brown	Switch Column # 1
7	N/C	Not Used
8	White-Yellow	Switch Row # 4
9	White-Green	Switch Row # 5
10	White-Blue	Switch Row # 6
11	White-Violet	Switch Row # 7
12	N/C	Not Used
13	White	Diagnostic Common
14	Green	Advance
15	Blue	Auto/Manual

PLAYFIELD

8P1/8J1 PLAYFIELD SWITCHES (White) (15 Pin)

Pin	Color	Function
1	Green-Red	Switch Column # 2
2	Green-Orange	Switch Column # 3
3	Green-Yellow	Switch Column # 4
4	Green-Black	Switch Column # 5
5	N/C	Not Used
6	N/C	Not Used
7	N/C	Not Used
8	White-Brown	Switch Row # 1
9	White-Red	Switch Row # 2
10	White-Orange	Switch Row # 3
11	White-Yellow	Switch Row # 4
12	White-Green	Switch Row # 5
13	White-Blue	Switch Row # 6
14	White-Violet	Switch Row # 7
15	White-Gray	Switch Row # 8

8P2/8J2 PLAYFIELD LAMPS (White) (24 Pin)

Pin	Color	Function
1	Yellow	6.3 VAC Display Lamps
2	Yellow-White	6.3 VAC Display Lamps
3	Yellow-Brown	Lamp Column # 1
4	Yellow-Red	Lamp Column # 2
5	Yellow-Orange	Lamp Column # 3
6	Yellow-Black	Lamp Column # 4
7	Yellow-Green	Lamp Column # 5
8	Yellow-Blue	Lamp Column # 6
9	Yellow-Violet	Lamp Column # 7
10	N/C	Not Used
11	Red-Brown	Lamp Row # 1
12	Red-Black	Lamp Row # 2
13	Red-Orange	Lamp Row # 3
14	Red-Yellow	Lamp Row # 4
15	Red-Green	Lamp Row # 5
16	Red-Blue	Lamp Row # 6
17	Red-Violet	Lamp Row # 7
18	Red-Gray	Lamp Row # 8
19-24	N/C	Not Used

INSERT BOX

9P1/9J1 INSERT DOOR LAMP CONNECTOR (Black) (15 Pin)

Pin	Color	Function
1	Yellow	6.3 VAC Display Lamps
2	Yellow-White	6.3 VAC Display Lamps
3	N/C	Not Used
4	Yellow	6.3 VAC Display Lamps
5	Yellow/White	6.3 VAC Display Lamps
6	Yellow-Violet	Lamp Column # 1
7	Yellow-Gray	Lamp Column # 8
8	Red-Brown	Lamp Row # 1
9	Red-Black	Lamp Row # 2
10	Red-Orange	Lamp Row # 3
11	Red-Yellow	Lamp Row # 4
12	Red-Green	Lamp Row # 5
13	Red-Blue	Lamp Row # 6
14	Red-Violet	Lamp Row # 7
15	Red-Gray	Lamp Row # 8

8P3/8J3 PLAYFIELD SOLENOIDS, SPECIAL SWITCHES (Black) (24 Pin)

Pin	Color	Function
1	Red	Coil B+
2	Black	Ground
		(Special Switch Common)
3	Blue-Violet	Right Flipper Coil
4	Blue-Gray	Left Flipper Coil
5	Orange-Brown	Right Jet Bumper Sw.
6	Orange-Red	Right Jet Bumper Sw.
7	N/C	Not Used
8	N/C	Not Used
9	N/C	Not Used
10	N/C	Not Used
11	Blue-Brown	Left Jet Bumper Coil
12	Blue-Red	Right Jet Bumper Coil
13	N/C	Not Used
14	N/C	Not Used
15	N/C	Not Used
16	N/C	Not Used
17	Gray-Brown	Coil # 1 Left Eject
18	Gray-Red	Coil # 2 Right Eject
19	Gray-Orange	Coil # 3 Left Thrower
20	Gray-Yellow	Coil # 4 Right Thrower
21	Gray-Green	Coil # 5 Ball Release
22	N/C	Not Used
23	N/C	Not Used
24	N/C	Not Used

9P2/9J2 PLAYER 1 KEEP ALIVE

Pin	Color	Function
1	Brown-White	Anode Keep Alive

9P3/9J3 PLAYER 2 KEEP ALIVE

Pin	Color	Function
1	Brown-White	Anode Keep Alive

9P4/9J4 PLAYER 3 KEEP ALIVE

Pin	Color	Function
1	Brown-White	Anode Keep Alive

9P5/9J5 PLAYER 4 KEEP ALIVE

Pin	Color	Function
1	Brown-White	Anode Keep Alive

SECTION 8

MECHANICAL ADJUSTMENTS

SWITCHES

There are different types of switches used throughout the game. The switch blades are made of a highly conductive spring type metal in various lengths, thickness, and form. Each switch is designed to satisfy specific operation conditions such as bounce, current carrying capacity, speed of operation, etc. Therefore, it is important to replace a blade with another of the same kind. When adjusting blades, never kink or bend sharply, as this causes fatigue which leads to fractures. Adjust blades with a sweeping, bowing motion, with a switch adjusting tool or duck bill pliers.

When switch adjustments are called for, before forming blades on any machine, check that the screws holding the switch stacks are down very tight. This is recommended because plastic spacers in the switch stacks will occasionally shrink by drying out causing a poor adjustment.

With the exception of a few instances, all blade type switches should have at least 1/32 inch between the contact points and should follow thru for at least 1/32 inch beyond the point at which the contacts close. This follow thru action provides a wiping motion between the contacts keeping them clean and insuring good contact between the points.

To adjust blade type switches properly, first adjust the actuating blade (usually, the longer one) with relation to the part that it contacts. Then set the gap and follow thru by adjusting the other blade.

SWITCH CONTACTS

With the exception of flipper button and end of stroke switches, all blade switch contacts are gold-plated and must NOT be burnished or filed. To clean the contacts, close them on a clean piece of paper (e.g. business card) and wipe gently until the contacts are clean.

For the flipper button switches, remove tarnish by filing with a contact file and then burnishing. Do the same for the flipper end-of-stroke switch contacts.

DO NOT file or burnish any other contacts.

Severely pitted contacts should be replaced as an assembly. Switch contacts should only be adjusted when they cause a malfunction or do not score properly.

ROLL-OVER LANE SWITCHES

Playfield lane switches are operated by a roll-over wire form which is actuated by the ball. Before the switch is adjusted, the wire should be centered in the playfield slot. The long blade closest to the playfield should be adjusted to hold the wire form up. Check this condition with the playfield down. Then, with the playfield up, adjust the short blade for 1/16 inch clearance. Depress the wire form to its maximum depression with the ball and check for 1/32 inch follow thru. To prevent switch vibration a back-up blade is used. It should be parallel and just barely

FLIPPER

Flippers are controlled by the flipper pushbuttons to either side of the cabinet. The flipper coil consists of two windings: A pull-in winding and a lighter gauge hold-in winding. The hold-in winding is normally bypassed by a closed switch.

The pull-in winding produces a strong stroke. However, if this winding were to remain energized by the player it would overheat. To reduce this high current, the hold winding is put in series with the pull-in winding by opening the end-of-stroke switch.

This switch should be adjusted so that the long blade is moved by the flipper pawl assembly for about the last 1/8 inch of movement. With the plunger completely depressed manually, the short blade should be adjusted for a 3/32 inch gap and 1/32 inch follow thru.

NEVER LUBRICATE THE PLUNGER. The only lubrication required is the link assembly with the special coin machine lubricant.

Weak or sluggish flipper action can be due to dirty or improperly adjusted contact points, worn out coil sleeve, loose or broken bushing, incorrect coil or shorted diodes, worn out fiber links, weak or broken return spring, loose coil between the retaining bracket and coil stop, or loose screws. Check all of the above to correct.

PLUMB BOB TILT

The plumb bob tilt can be made more sensitive by raising the plumb bob on the shaft. It can also be made less sensitive by lowering the bob on the shaft.

SUPER SLAM TILT

The super slam tilt on the coin door is adjustable. The normal adjustment is contacts open 1/32 inch.

PLAYFIELD TILT

The playfield tilt is adjustable by forming the switch contacts. Closing the gap will make the tilt more sensitive.

ROLL TILT

The roll tilt in the cabinet box can be raised (more sensitive) or lowered (less sensitive) at the front pivot slot.

SECTION 9

SPARE PARTS

The parts used on the solid state WORLD CUP are standard Williams parts. Refer to the accompanying sketch for identification of various playfield parts and adjustments.

PLAYFIELD CARE

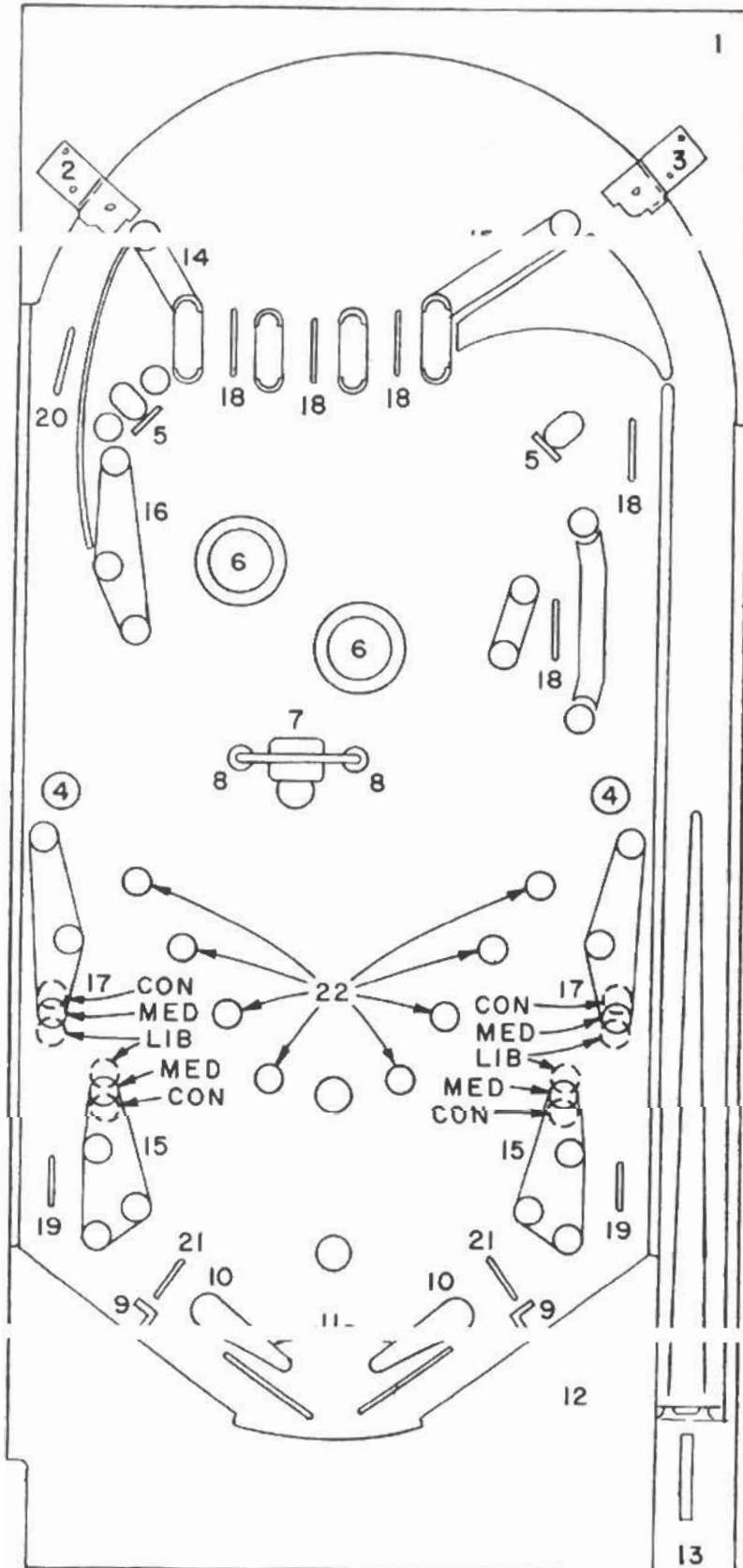
The playfield on this machine has an improved finish with excellent wearing properties. **DO NOT** clean the board with water, water soap solutions, or harsh abrasives. Avoid using steel wool, kitchen cleansers, or abrasive hand soap. Water will weaken the adhering of the paint to the board and abrasives shorten the board life.

A wax base cleaner with negligible abrasive qualities used lightly, but frequently, will extend board life to its full capabilities.

BACKGLASS REMOVAL

Unlock the key lock (Figure 1, - No. 4) then lift the glass up and out.

WORLD CUP



WORLD CUP PARTS

Part Number	Description
1. 1C-2852-456	Top Arch
2. A-4817-L	Left Ball Gate
3. A-4817-R	Right Ball Gate
4. B-7472-5R	Ball Eject Assy
5. A-8054	Stationary Target Assy
6. R-780A	Top Bumper Assy
7. B-7875	Spinning Target Assy
8. A-8052	Bumper Post Assy
9. B-7573	Ball Kicker Assy
10. B-7060	Flipper Assy
11. 23A-6519	Flipper Rubber
12. D-7473	Bottom Arch Assy
13. 1B-3573	Shooter Gauge
14. 23A-6303	Rubber Ring 1 1/4" I.D.
15. 23A-6305	Rubber Ring 2" I.D.
16. 23A-6306	Rubber Ring 2-3/8" I.D.
17. 23A-6307	Rubber Ring 2-7/8" I.D.
18. A-5844-8	Rollover Wire Assy
19. A-5844-9	Rollover Wire Assy
20. A-5844-39	Rollover Wire Assy
21. A-5844-40	Rollover Wire Assy
22. A-7385	Rollover Button Assy
23. 30C-481	Playfield Plastics Set

POST ADJUSTMENTS

To make game more "conservative" or "liberal", move post 3/16" as shown in sketch. Spotting holes are provided and can be seen on removal of posts.

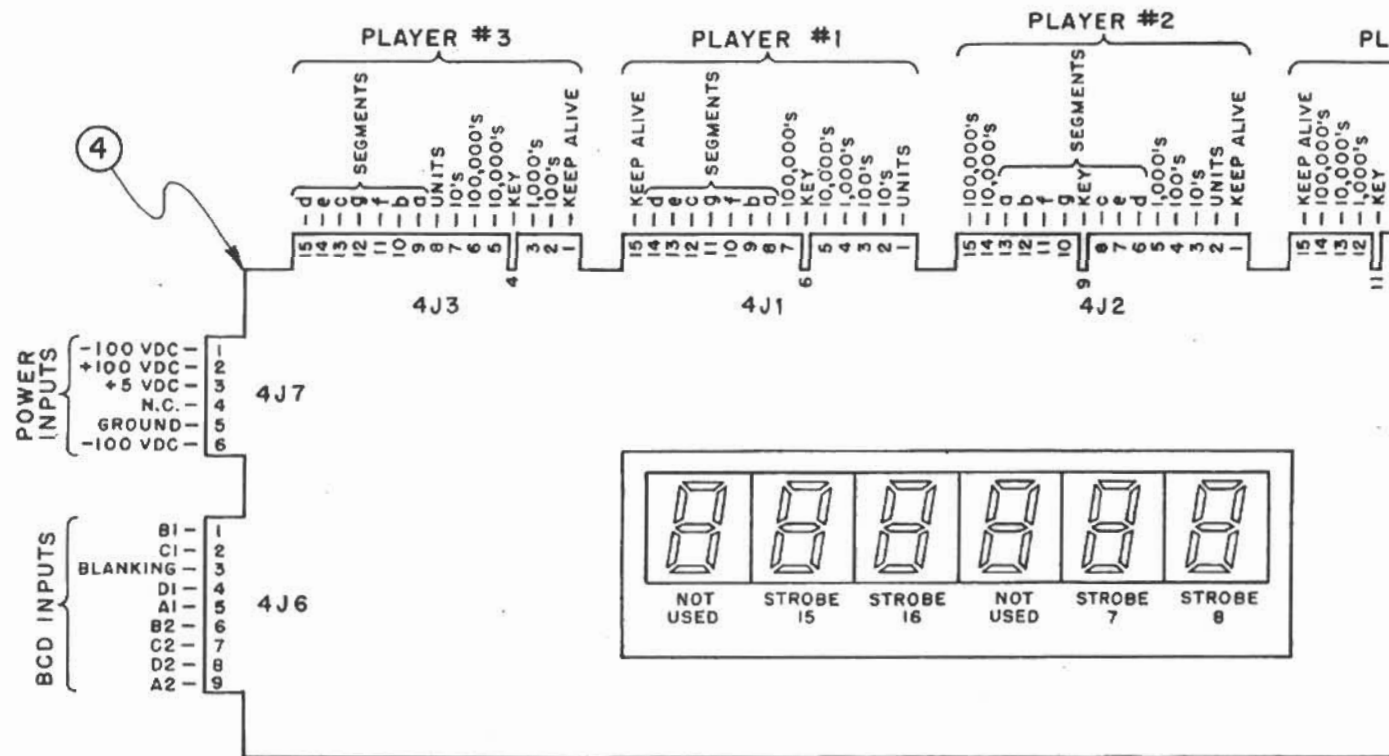
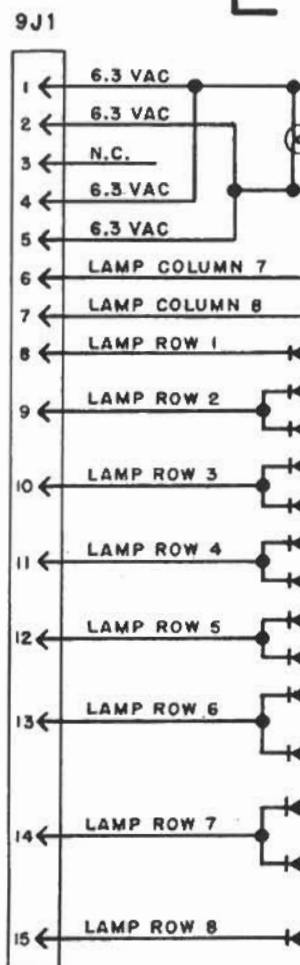
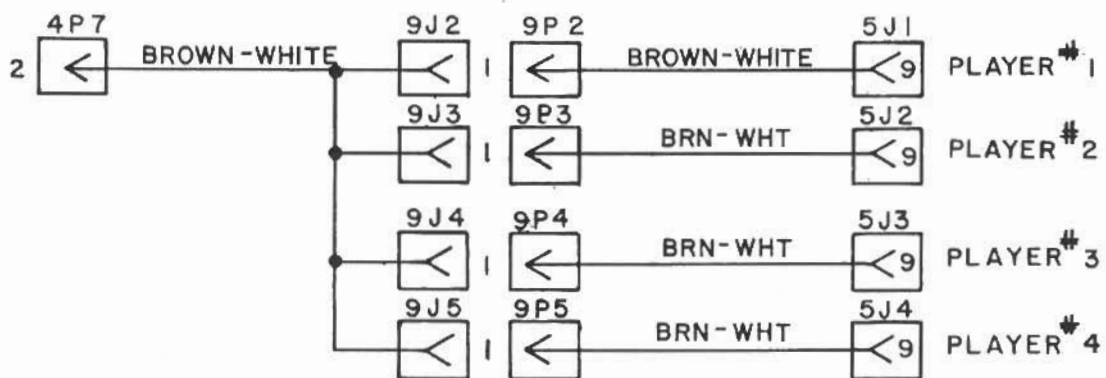
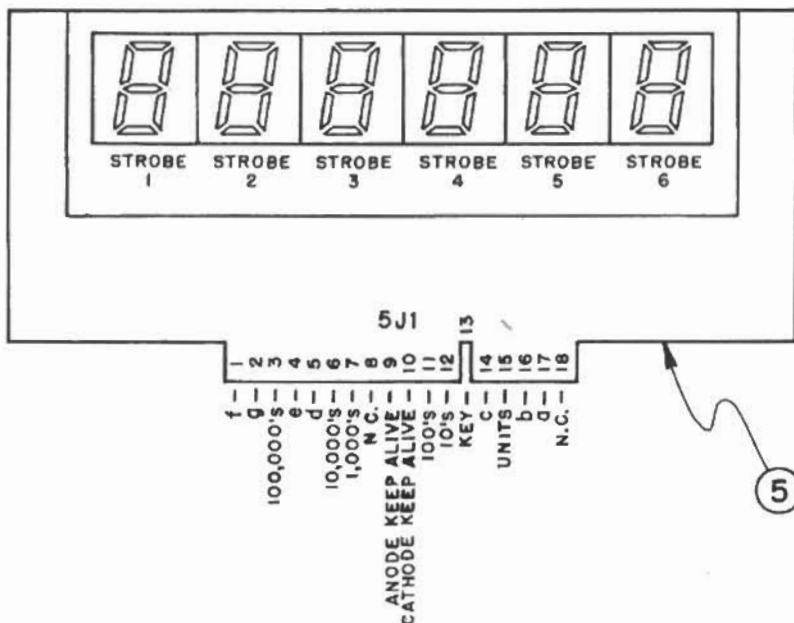
SUGGESTED SCORE CARDS CREDIT GAMES

- 3 Ball 16C-481-12-SS
or 16C-481-28-SS
- 5 Ball 16C-481-43-SS

EXTRA BALLS

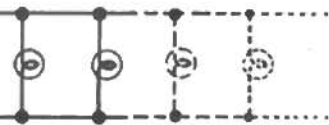
- 3 Ball 16C-481-54-SS
- 5 Ball 16C-481-56-SS

PLAYER #1

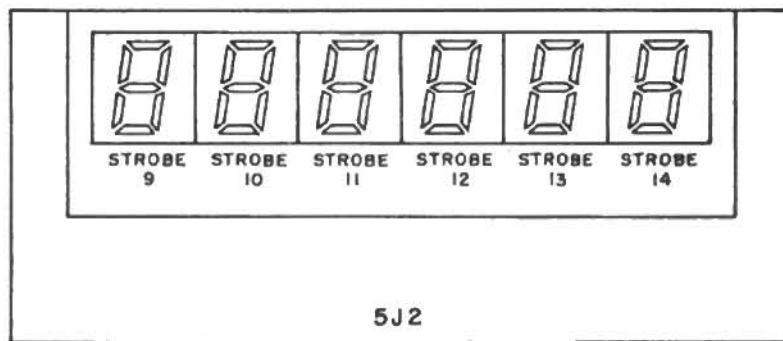


MASTER DISPLAY P.C. BOARD

WORLD CUP
PRINT BOARD WIRING



PLAYER #2

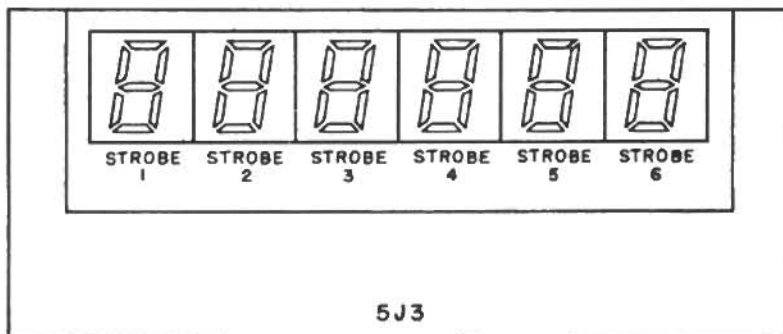


5J2

SAME CONNECTION AS 5J1

5

PLAYER #3

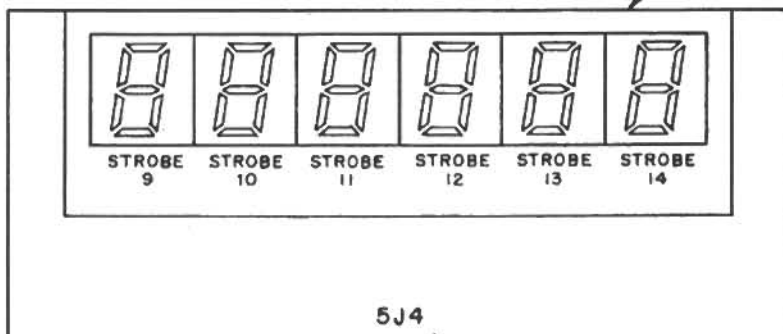


5J3

SAME CONNECTION AS 5J1

5

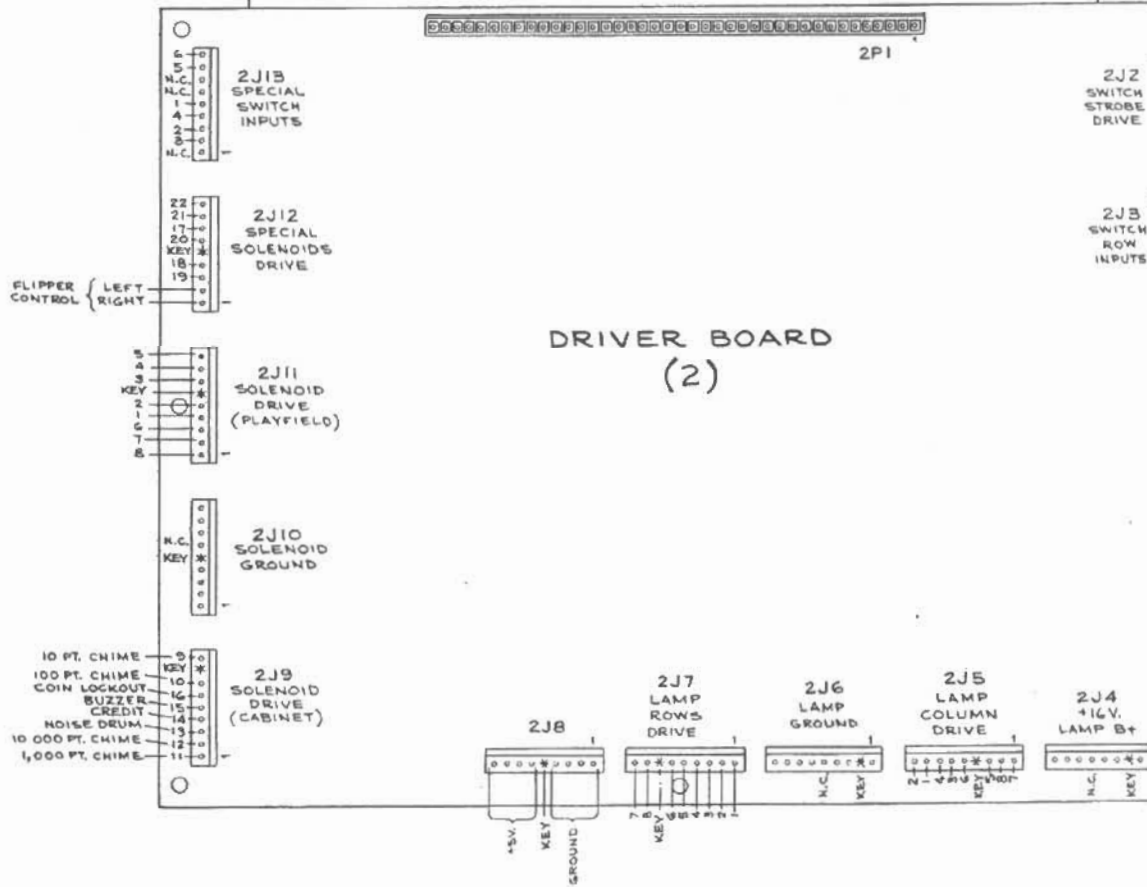
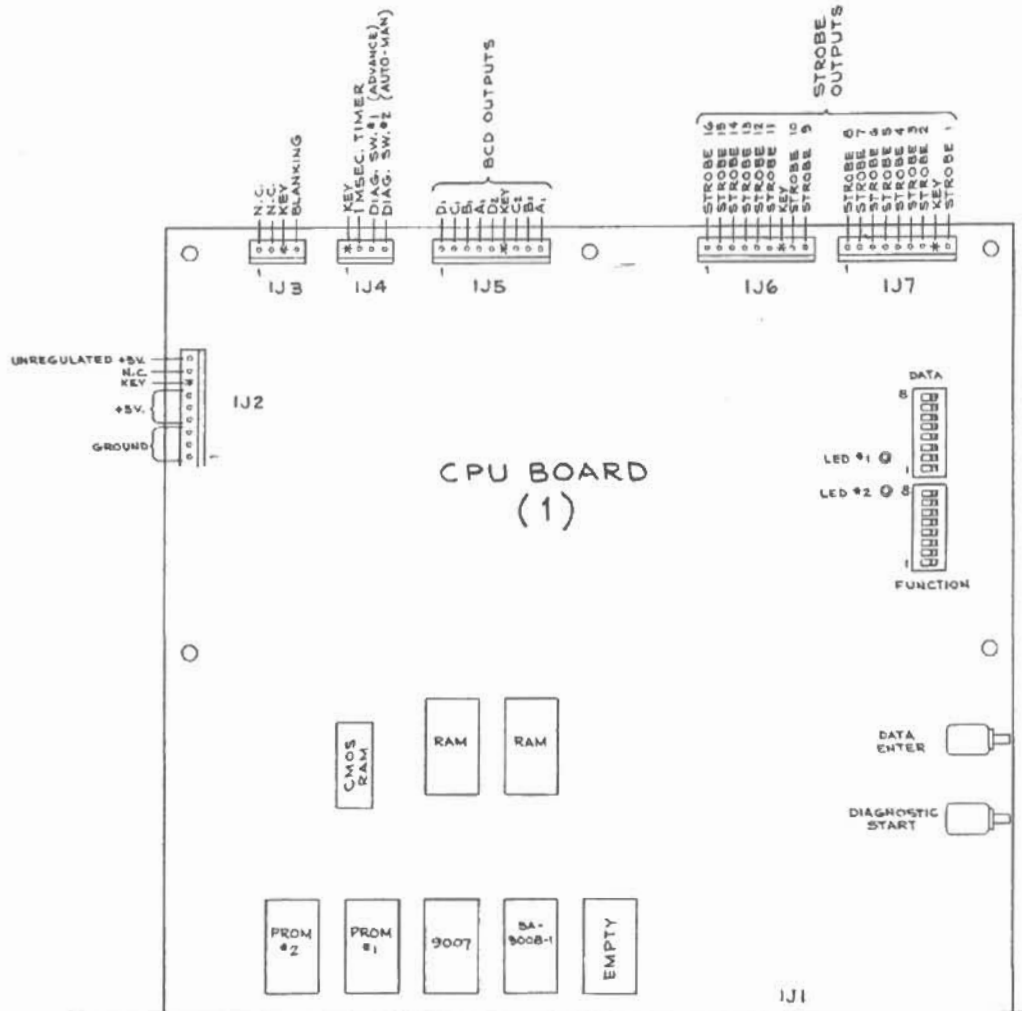
PLAYER #4

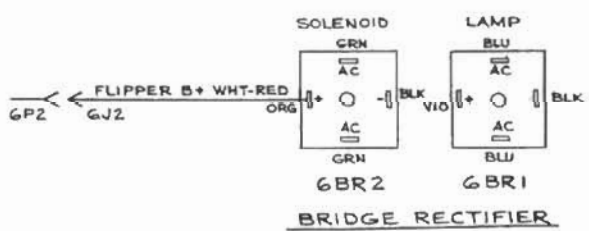
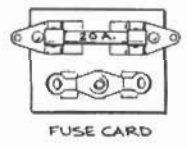
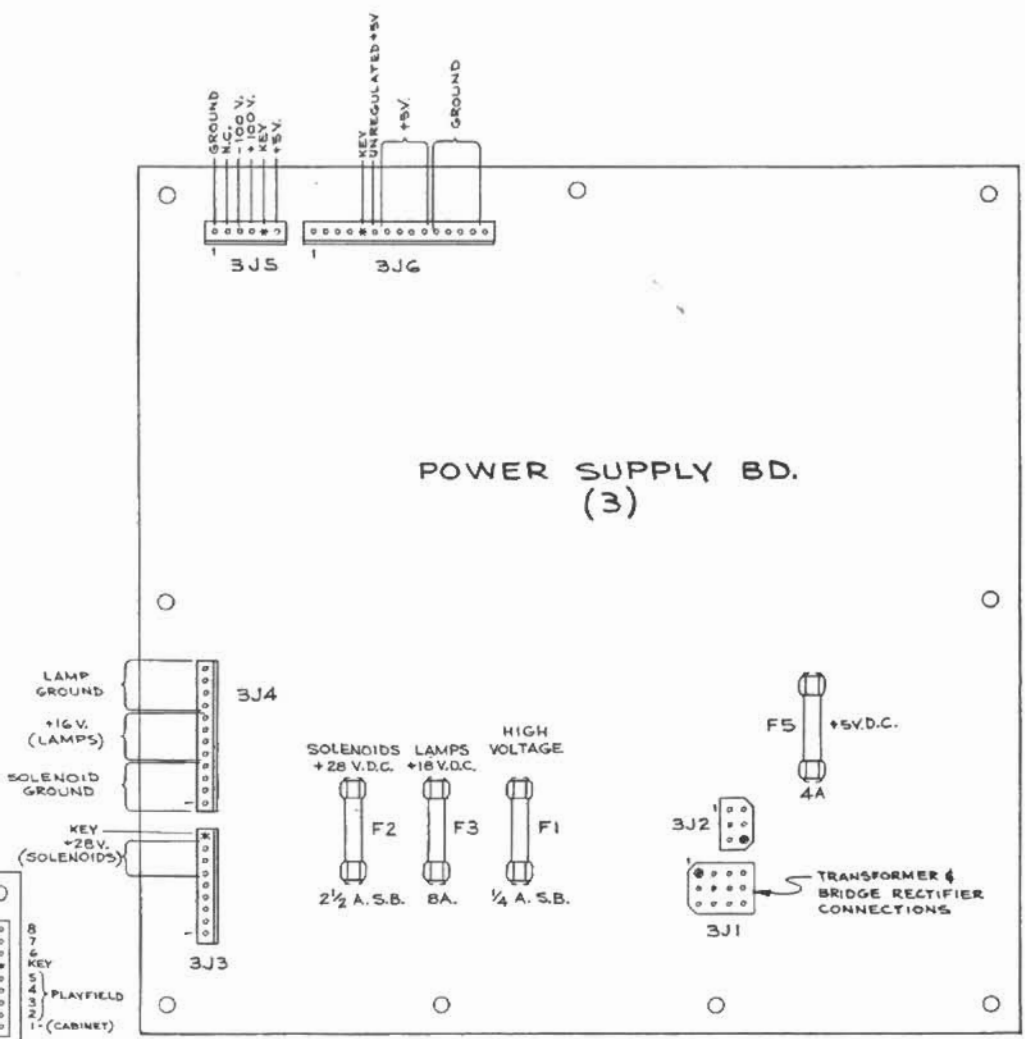


5J4

SAME CONNECTION AS 5J1

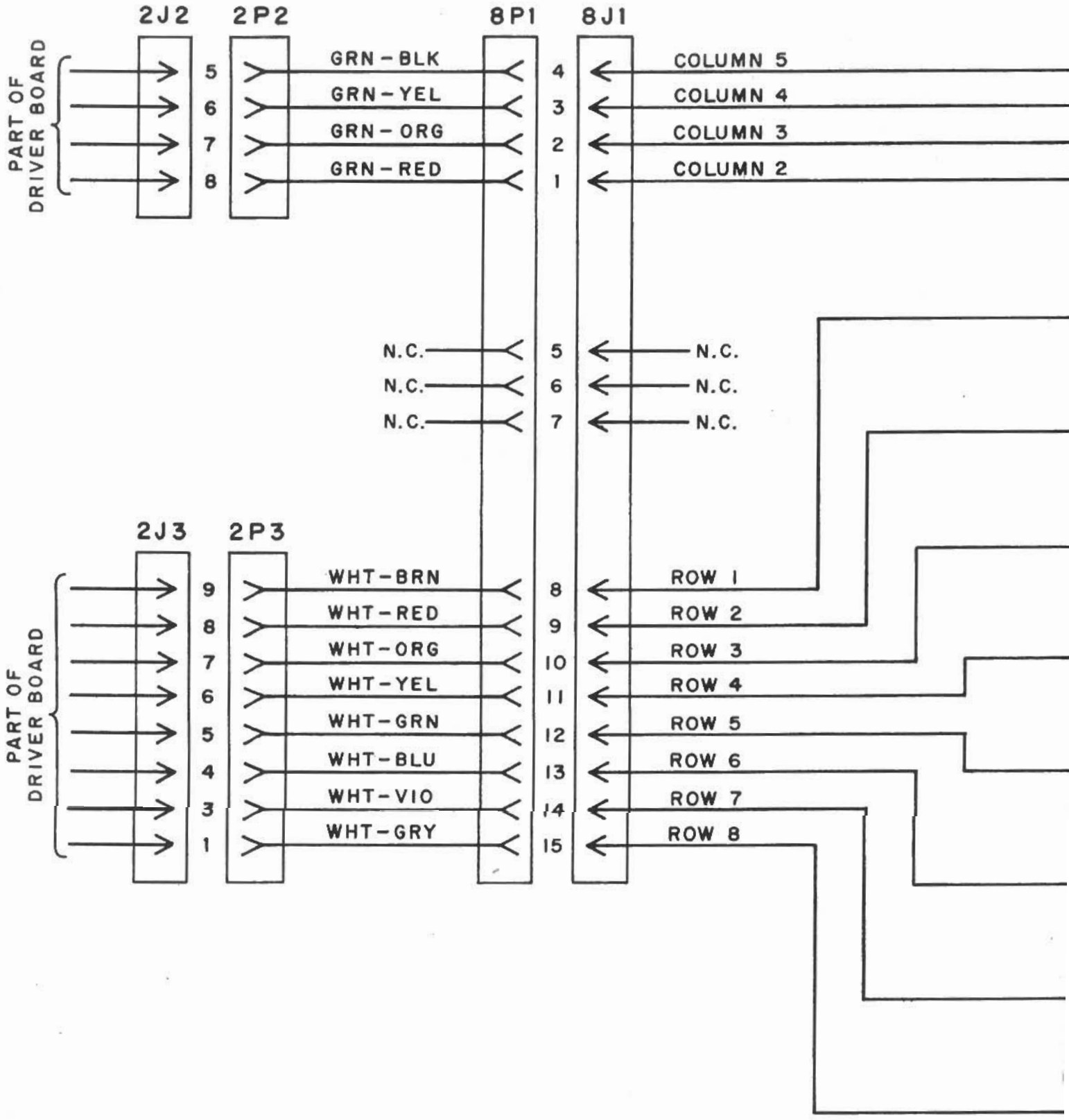
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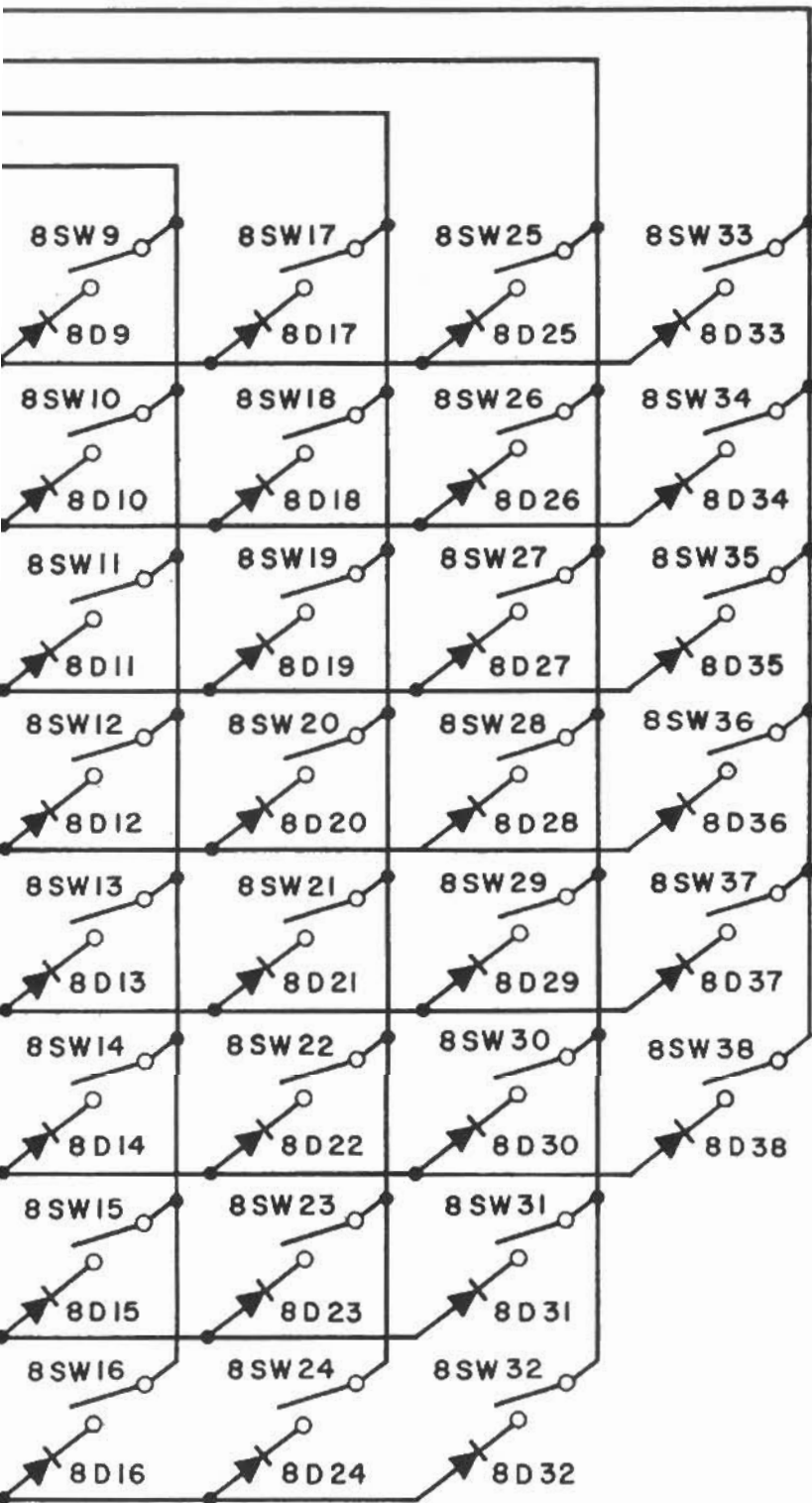


**WORLD CUP
BACK BOX
CONNECTOR IDENTIFICATION**

WORLD CUP PLAYFIELD SWITCH WIRING



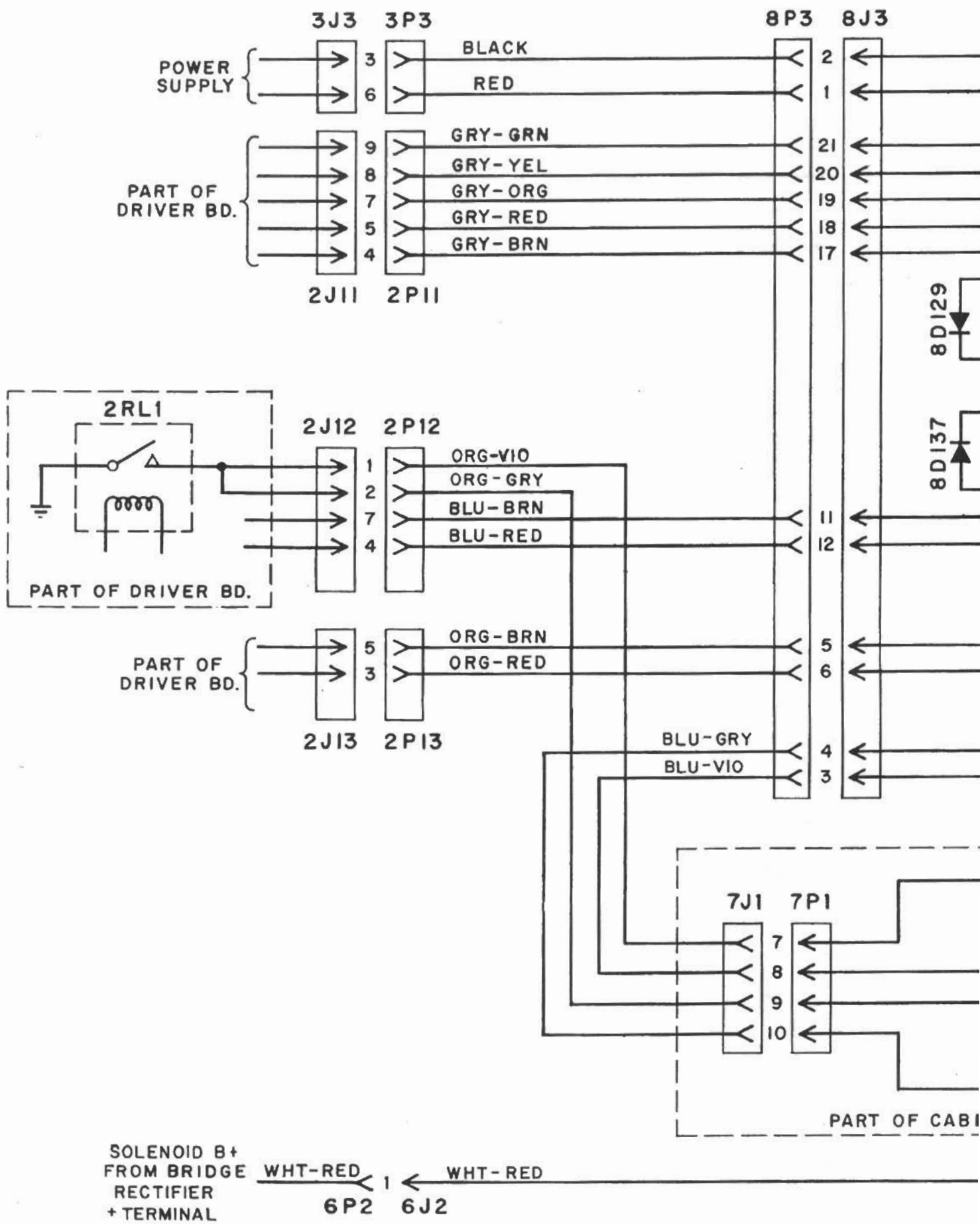
DIAGRAM



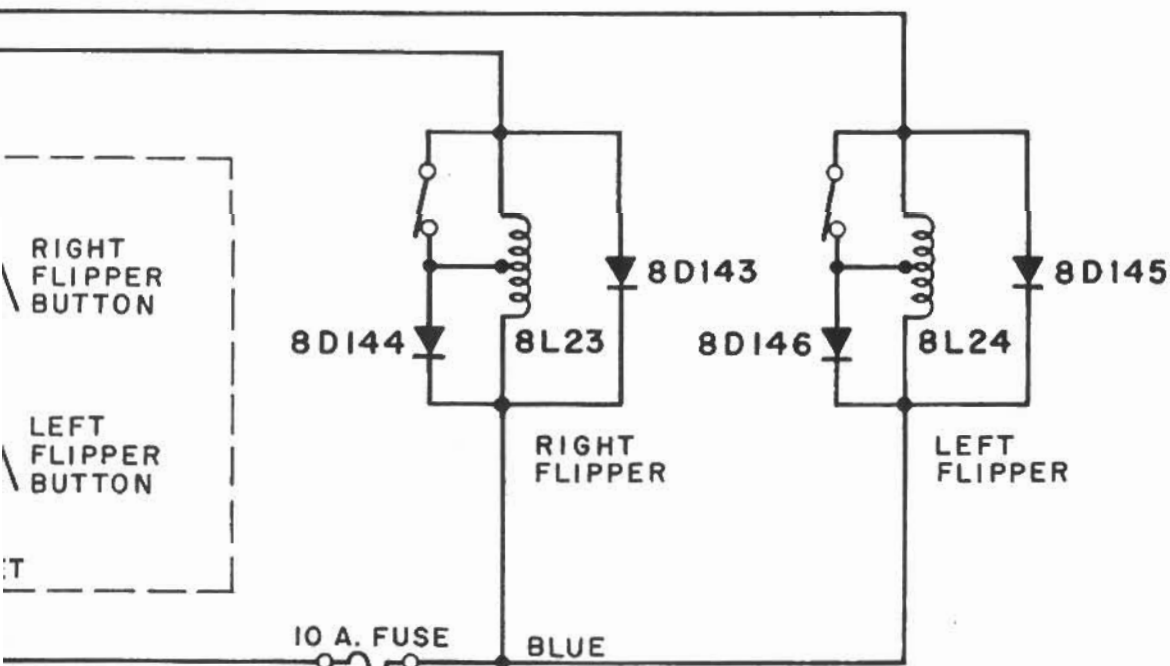
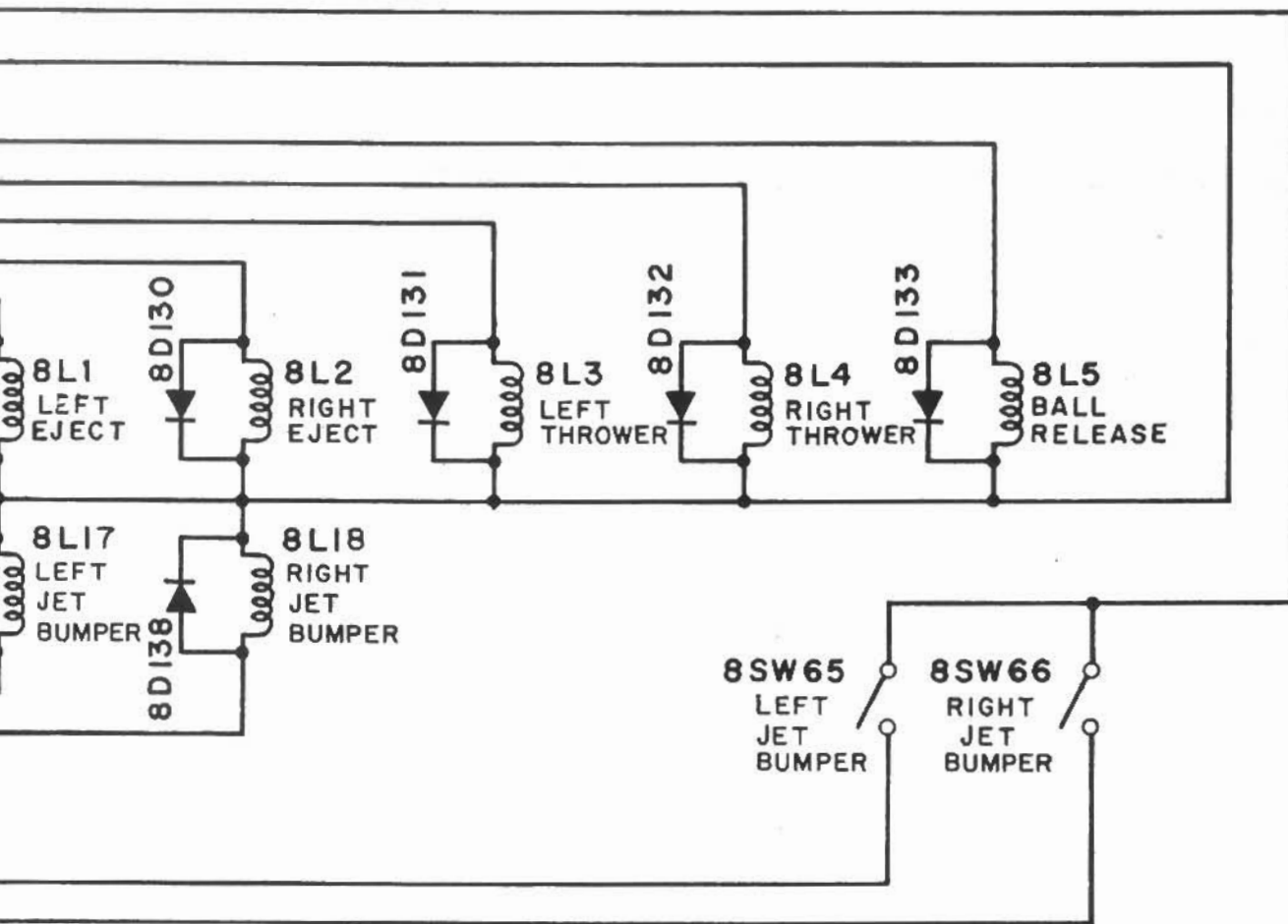
WORLD CUP

SWITCH NO. FUNCTION

- 9 Left Eject
- 10 Left Standup (50 pt)
- 11 Left Special
- 12 Left Standup (10 pt)
- 13 Left Ball Thrower ("T")
- 14 Outhole
- 15 Playfield Tilt
- 16 Right Ball Thrower ("A")
- 17 Right Standup (10 pt)
- 18 Right Special
- 19 Right Standup (50 pt)
- 20 Right Eject
- 21 Ball Advance 1
- 22 Ball Advance 2
- 23 Ball Advance 3
- 24 Ball Advance 4
- 25 Spinner
- 26 Super Ball Advance
- 27 "R" Target
- 28 Right Super Ball Advance
- 29 Top Right Standup (10 pt)
- 30 Top Right Rollover (A/R)
- 31 Top Center Rollover
- 32 Top Left Rollover (S/T)
- 33 Top Left Standup (10 pt)
- 34 "S" Target
- 35 Left Super Ball Advance
- 36 Left Inside Ball Advance
- 37 Left Jet Bumper
- 38 Right Jet Bumper

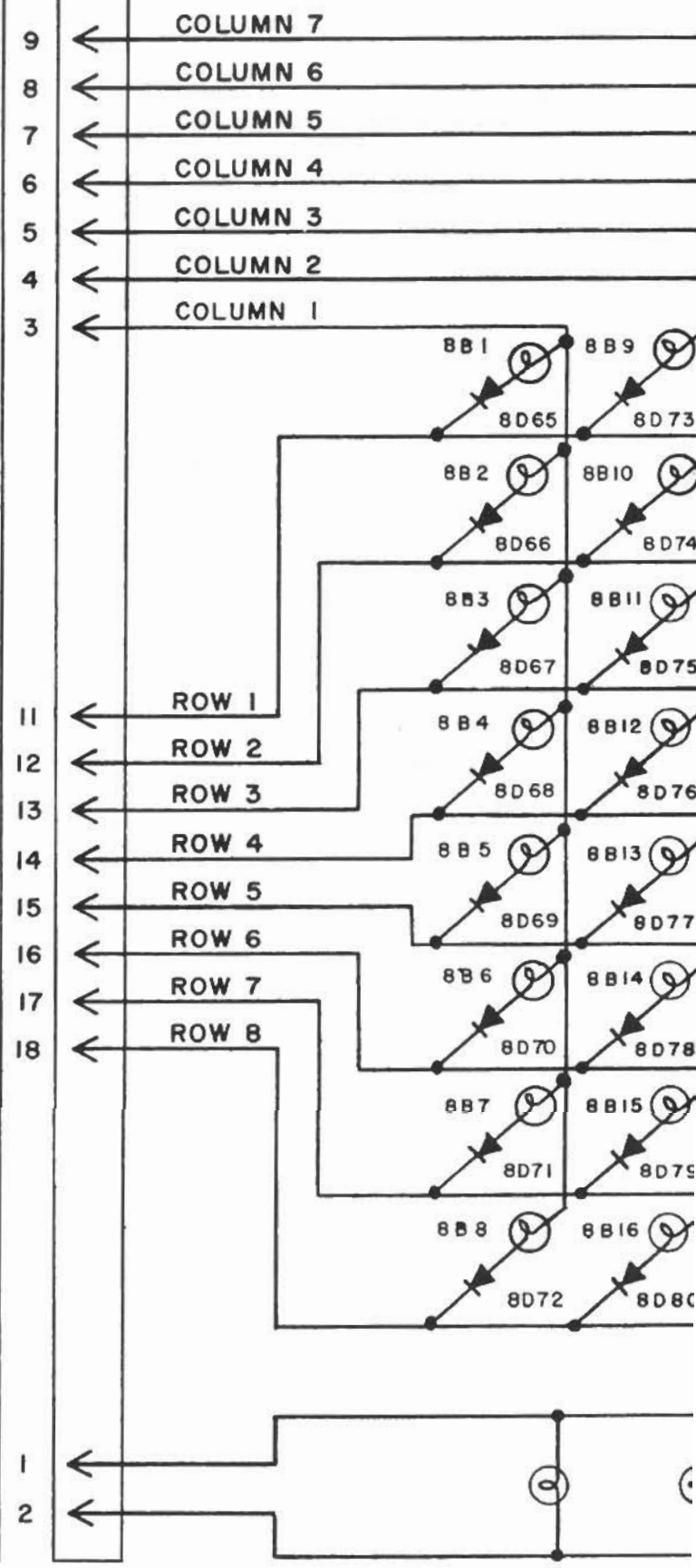
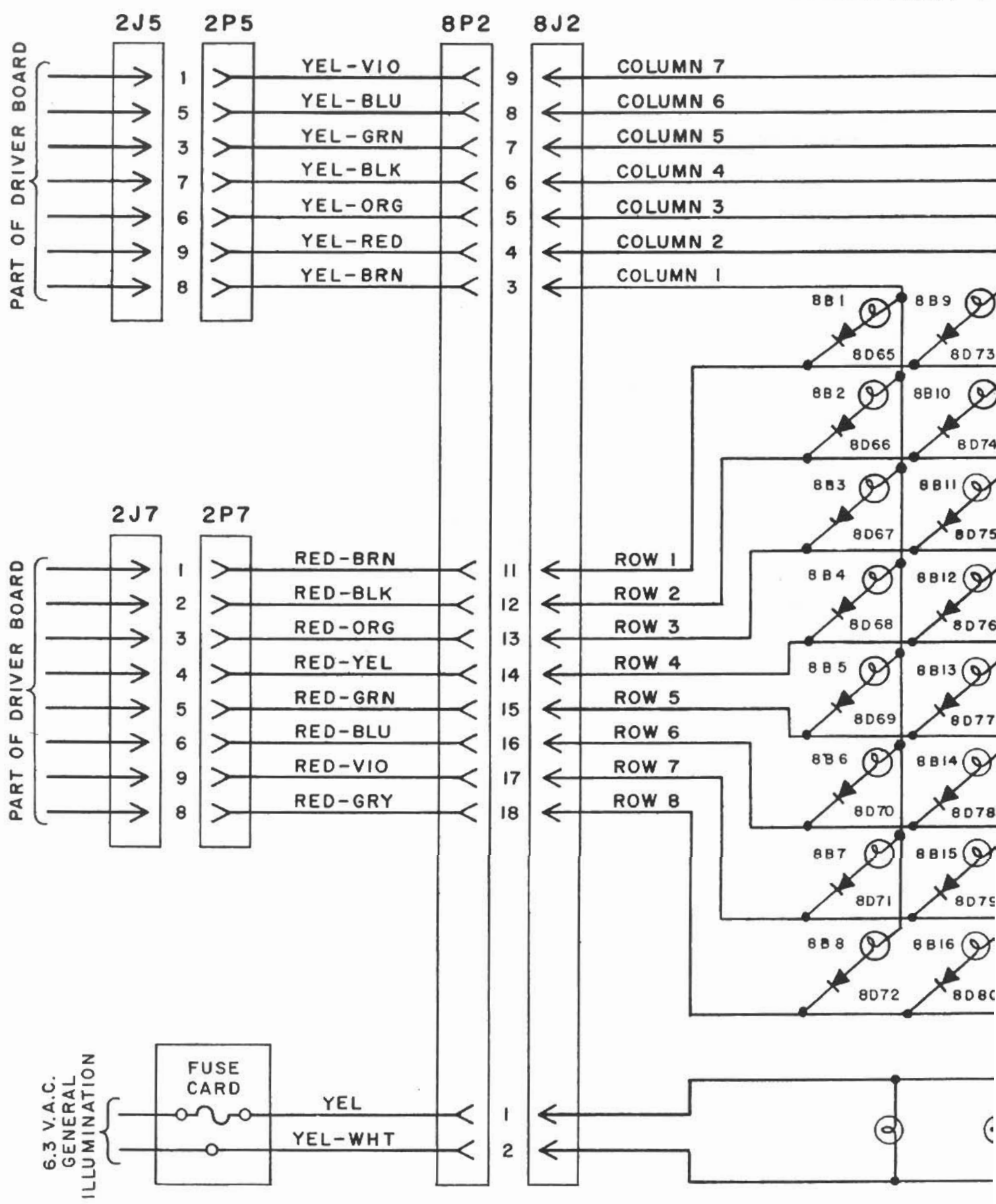


WORLD CUP PLAYFIELD SOLENOIDS WIRING DIAGRAM



* NOTE: THIS FUSE IS FOR FLIPPER SOLENOIDS ONLY AND IS MOUNTED ON PLAYFIELD.

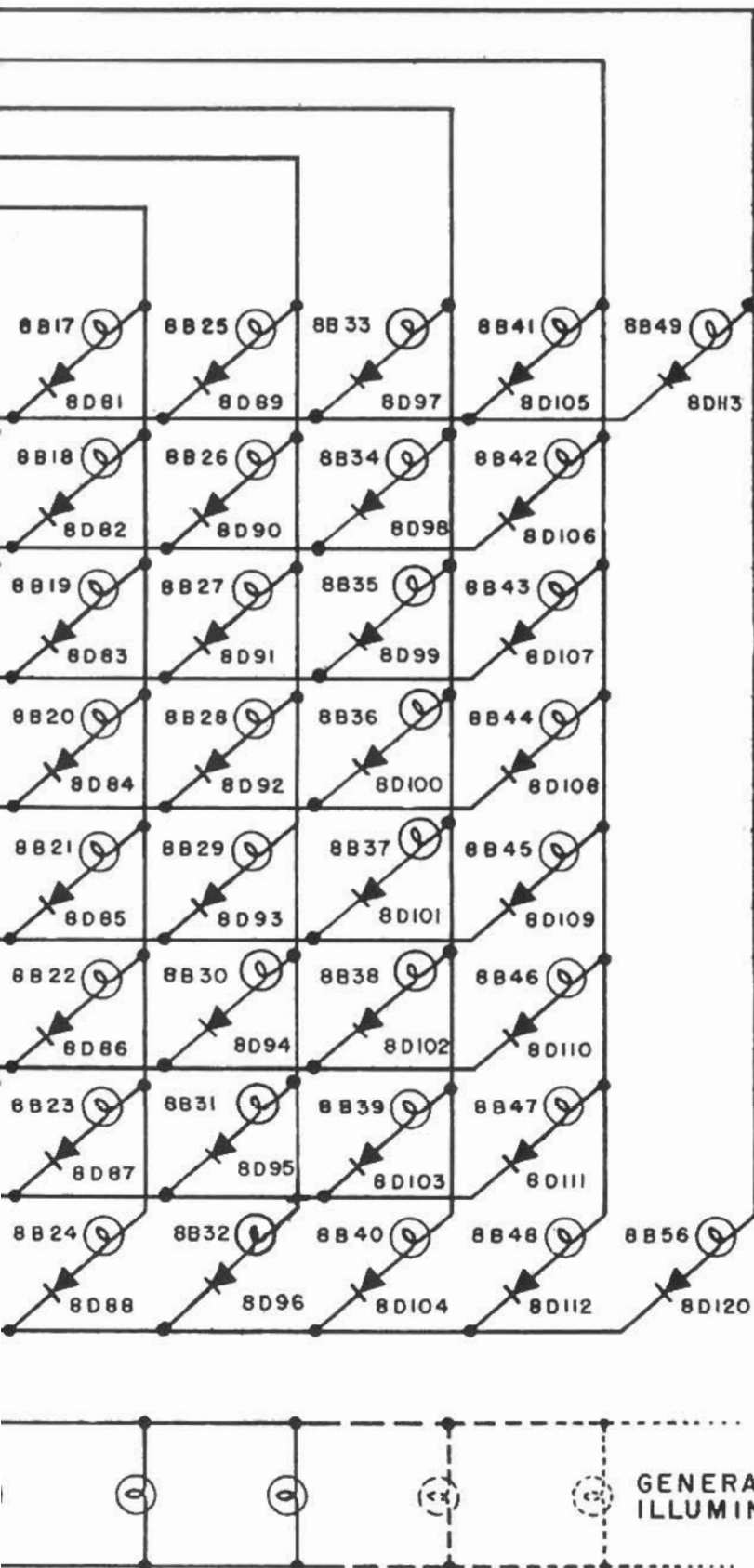
WORLD PLAYFIELD LAMP W



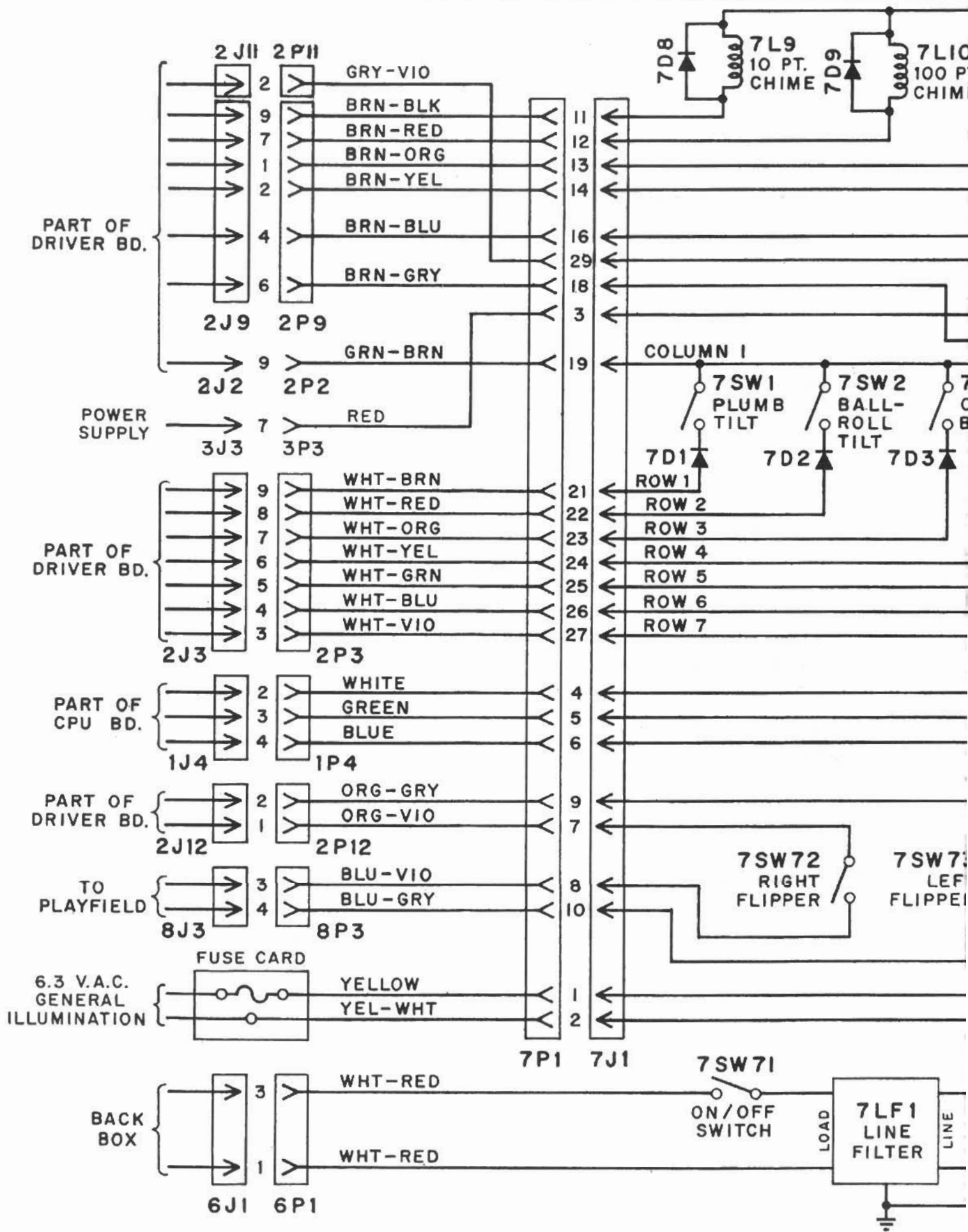
CUP WIRING DIAGRAM

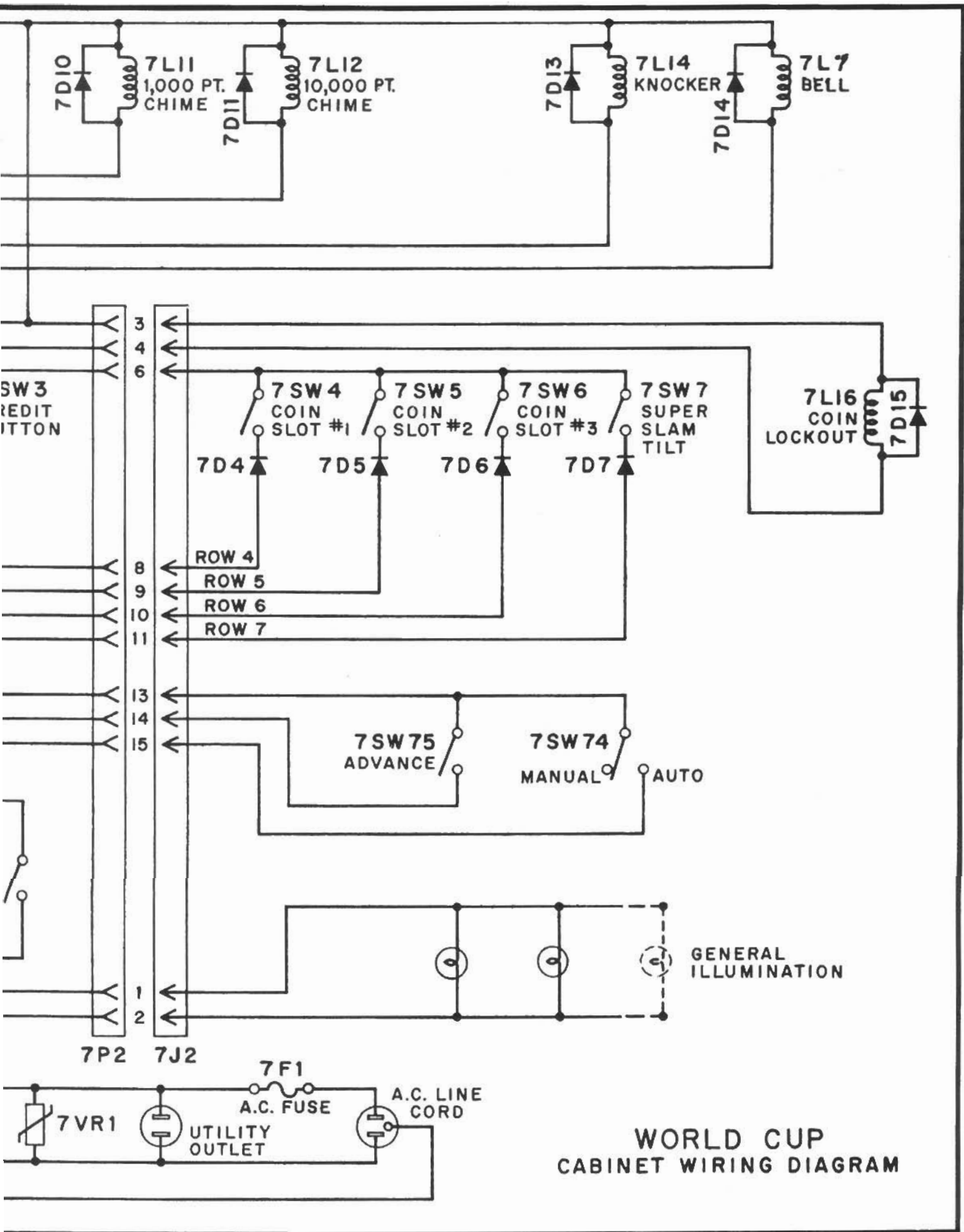
WORLD CUP

BULB NO. FUNCTION

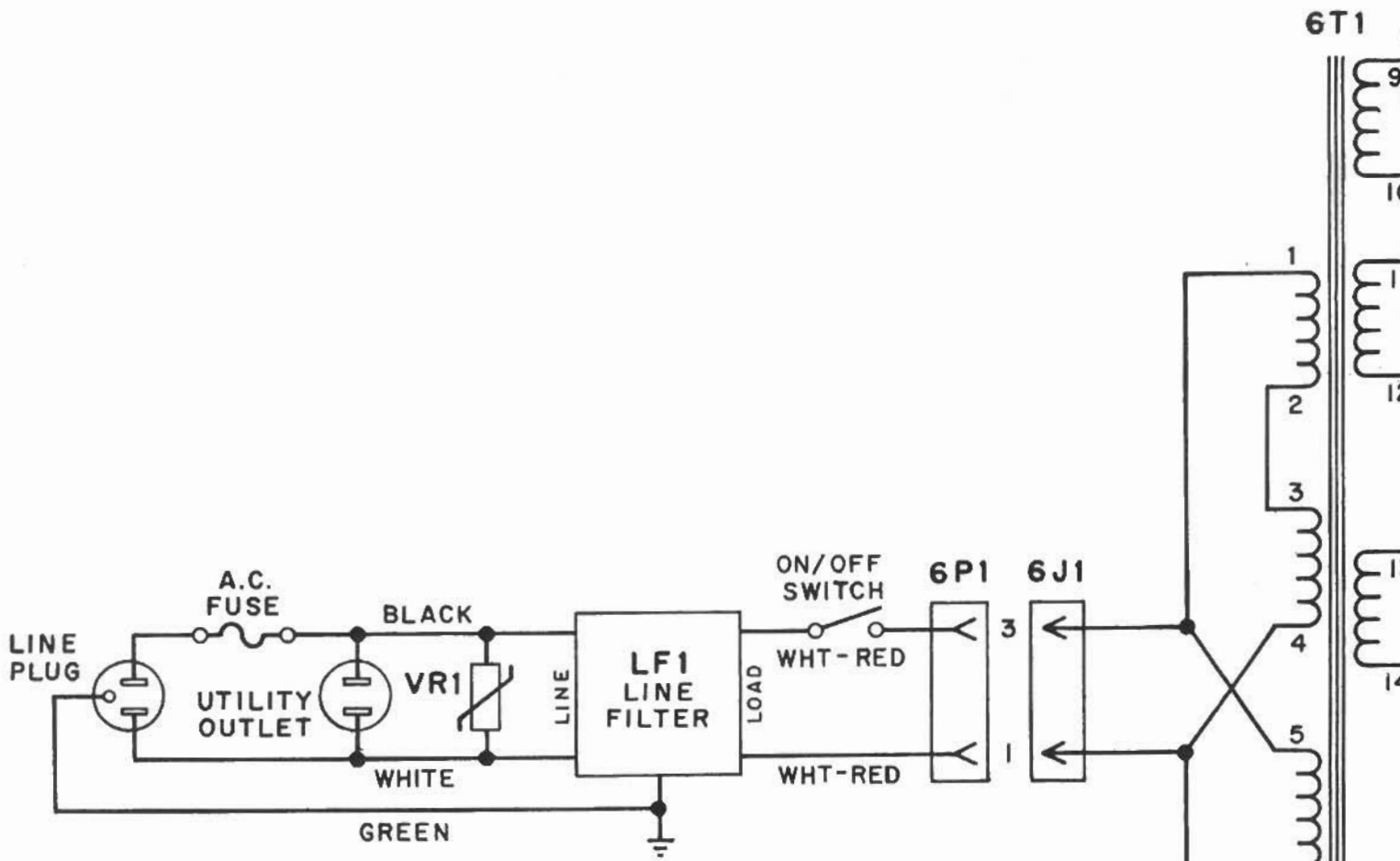


- | | |
|----|----------------------|
| 1 | Ball Advance 1 (X2) |
| 2 | Ball Advance 2 (X2) |
| 3 | Ball Advance 3 (X2) |
| 4 | Ball Advance 4 (X2) |
| 5 | Goal When Lit (X2) |
| 6 | Left Special |
| 7 | Right Special |
| 8 | Same Player Shoots |
| 9 | Top "S" |
| 10 | Top "T" |
| 11 | Top "A" |
| 12 | Top "R" |
| 13 | "S" |
| 14 | "T" |
| 15 | "A" |
| 16 | "R" |
| 17 | Top Goal When Lit |
| 18 | Extra Ball When Lit |
| 19 | Spinner 100 When Lit |
| 20 | Bronze Star |
| 21 | Silver Star |
| 22 | Gold Star |
| 23 | Gold Cup |
| 24 | Super Star |
| 25 | 2 Goals |
| 26 | 4 Goals |
| 27 | 6 Goals |
| 28 | 1 Goal |
| 29 | 3 Goals |
| 30 | 5 Goals |
| 31 | 7 Goals |
| 32 | Bonus 1 |
| 33 | Bonus 2 |
| 34 | Bonus 3 |
| 35 | Bonus 4 |
| 36 | Bonus 5 |
| 37 | Bonus 6 |
| 38 | Bonus 7 |
| 39 | Bonus 8 |
| 40 | Bonus 9 |
| 41 | Bonus 10 |
| 42 | Bonus 11 |
| 43 | Bonus 12 |
| 44 | Bonus 13 |
| 45 | Bonus 14 |
| 46 | Bonus 15 |
| 47 | Bonus 16 |
| 48 | Bonus 17 |
| 49 | Bonus 18 |
| 56 | Credits |





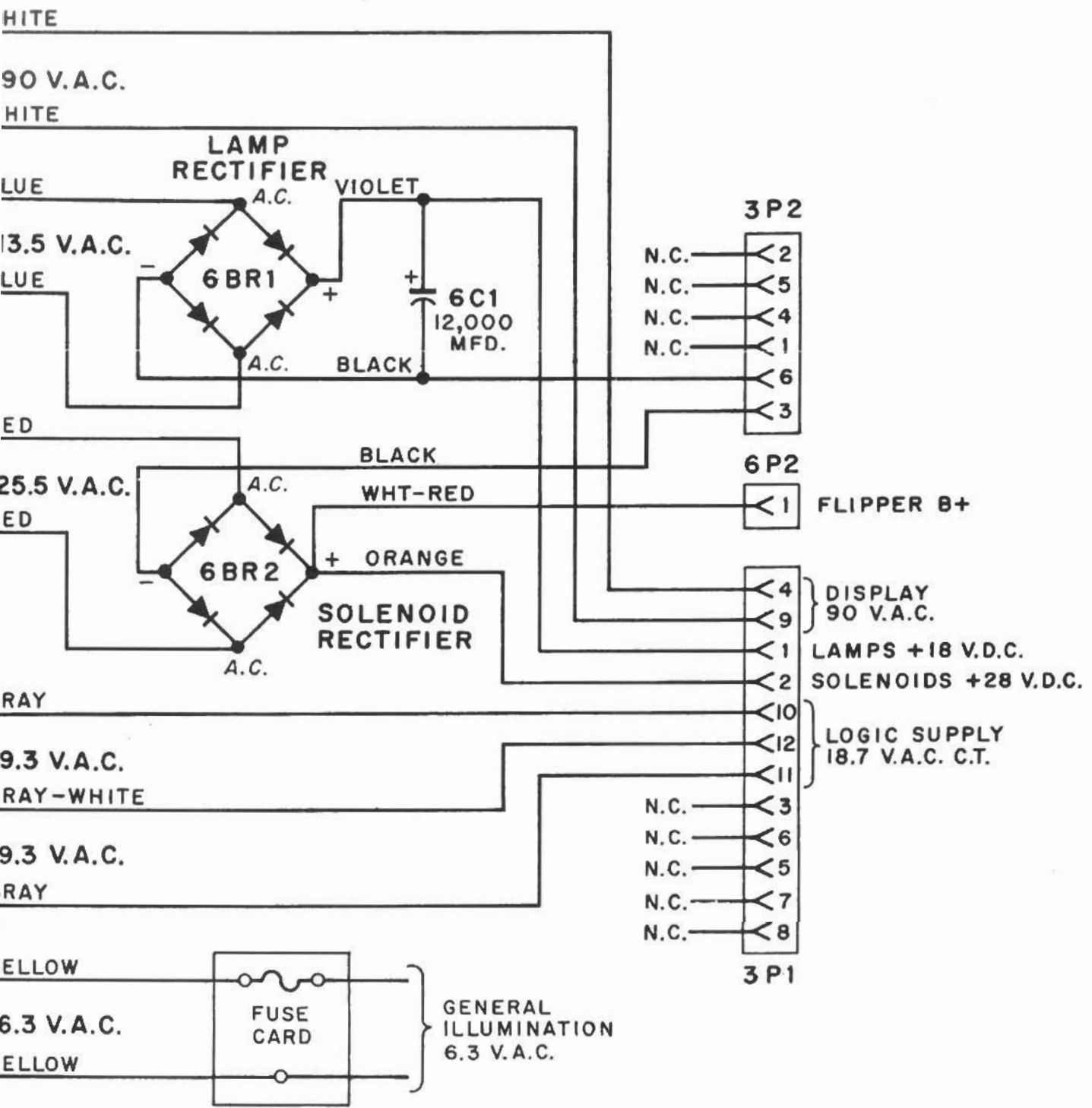
WORLD CUP
CABINET WIRING DIAGRAM



<p>FOR 105 V.A.C.</p> <p>JUMPER 1 & 5 JUMPER 2 & 6 LINE 1 & 6</p> <p>A.C. LINE FUSE 7.5A</p>	<p>FOR 210 V.A.C.</p> <p>JUMPER 2 & 5 LINE 1 & 6</p> <p>A.C. LINE FUSE 4 A</p>
<p>FOR 117 V.A.C.</p> <p>JUMPER 1 & 5 JUMPER 2 & 3 JUMPER 6 & 7 JUMPER 4 & 8 LINE 5 & 8</p> <p>A.C. LINE FUSE 7.5 A</p>	<p>FOR 235 V.A.C.</p> <p>JUMPER 2 & 3 JUMPER 4 & 5 JUMPER 6 & 7 LINE 1 & 8</p> <p>A.C. LINE FUSE 4 A</p>

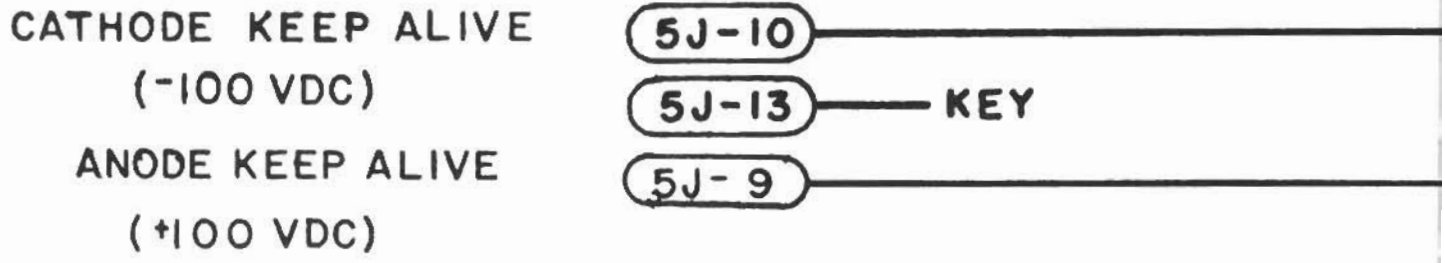
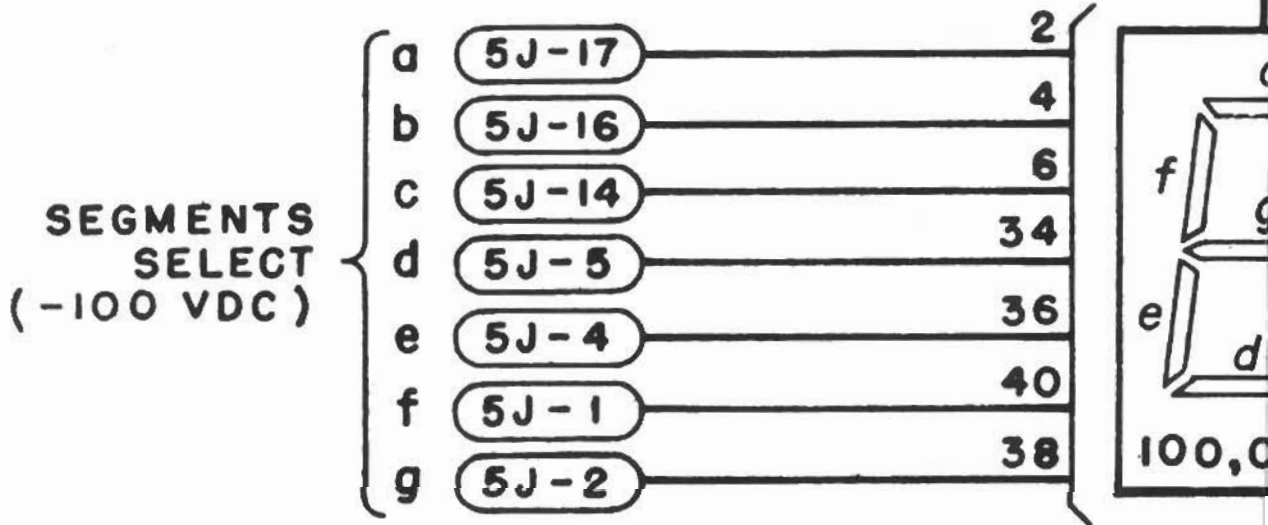
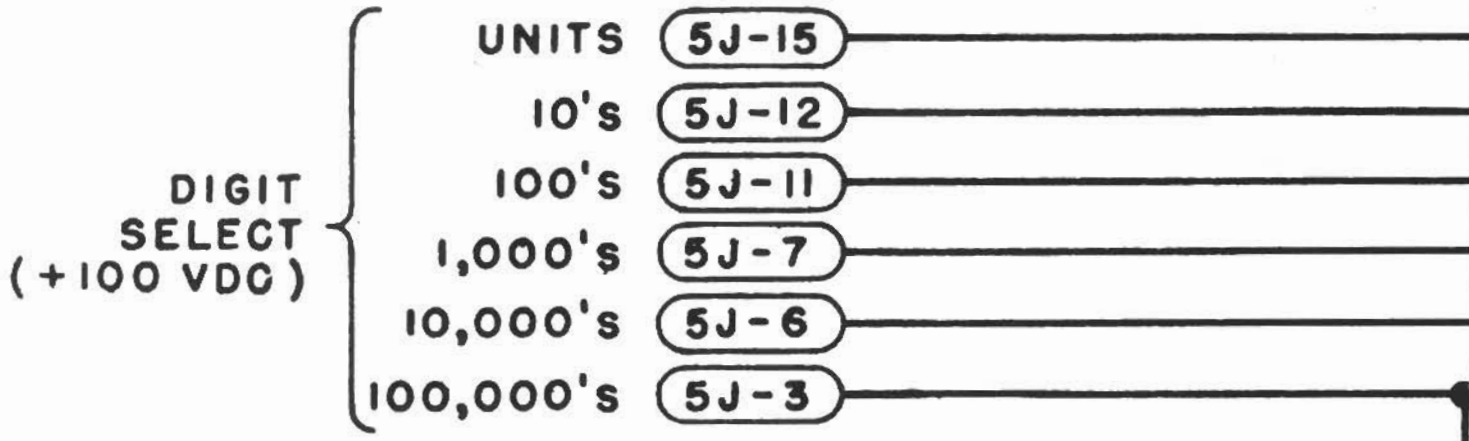
NOTES:

1. FOR 105 OR 117 V.A.C. USE 7.5 A FUSE & 130 V. VARISTOR # 5A-9044
2. FOR 210 OR 235 V.A.C. USE 4A FUSE & 275 V. VARISTOR # 5A-9063.

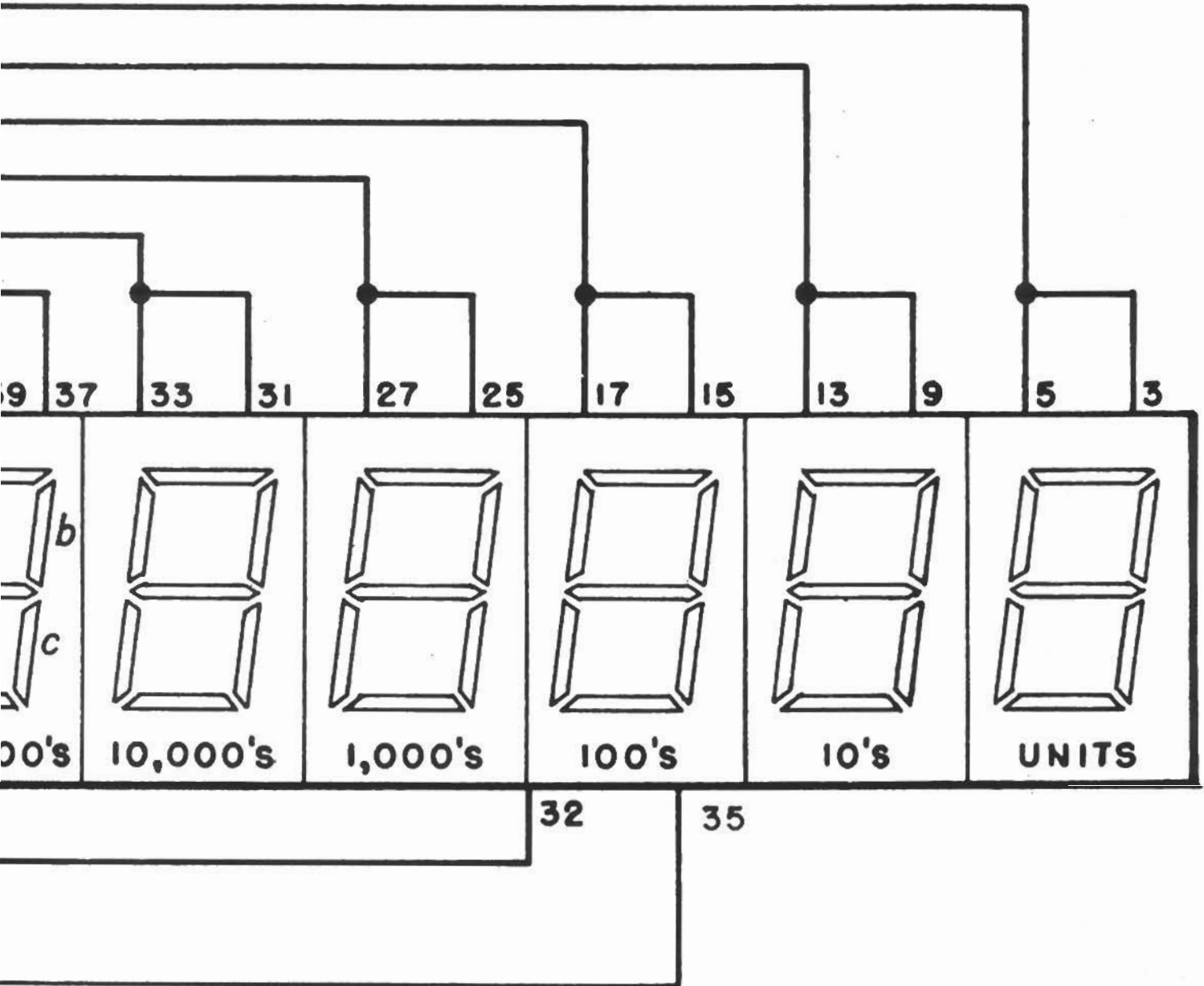


**WORLD CUP
POWER WIRING**

SLAVE

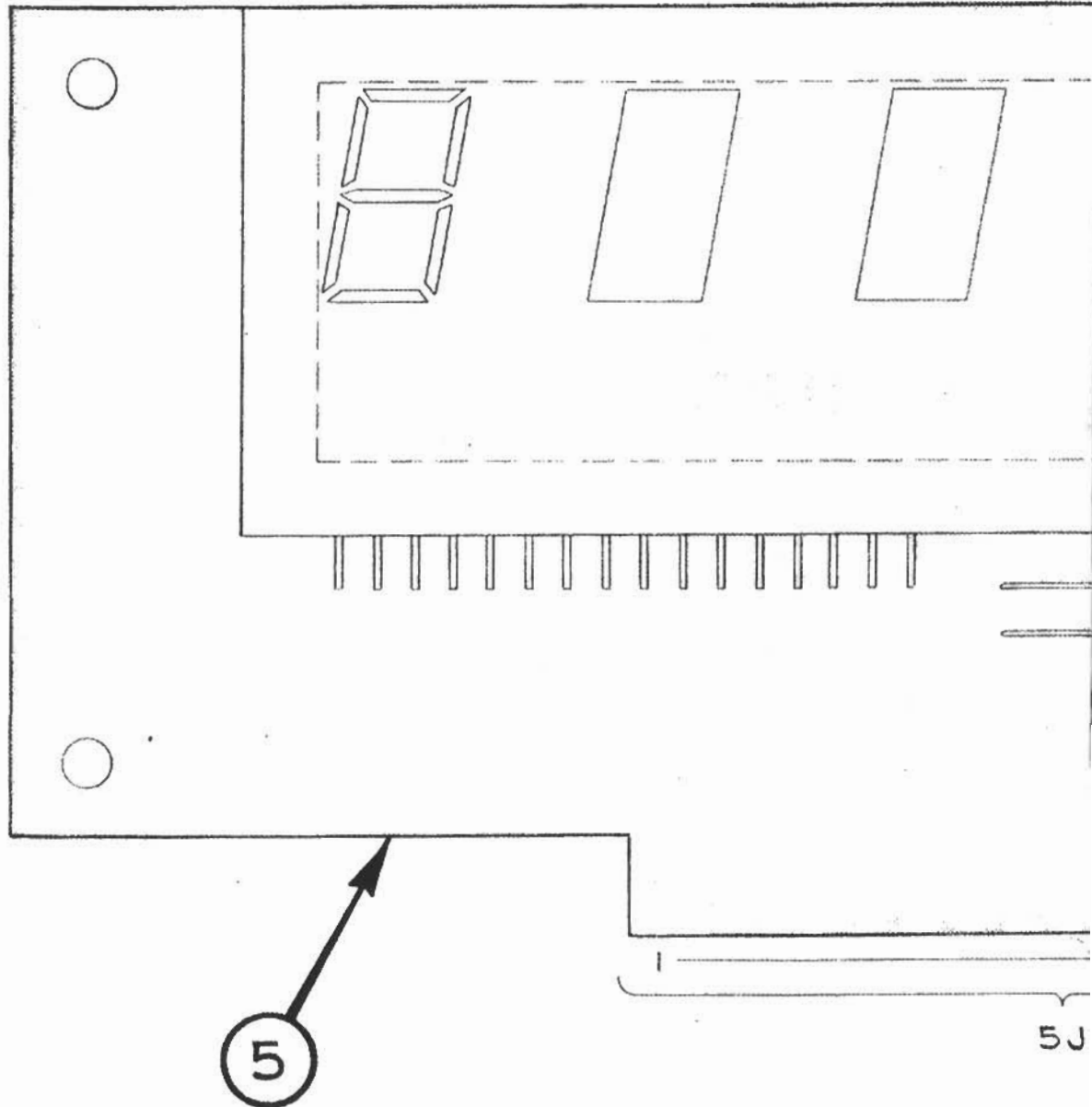


DISPLAY BOARD



C-8019

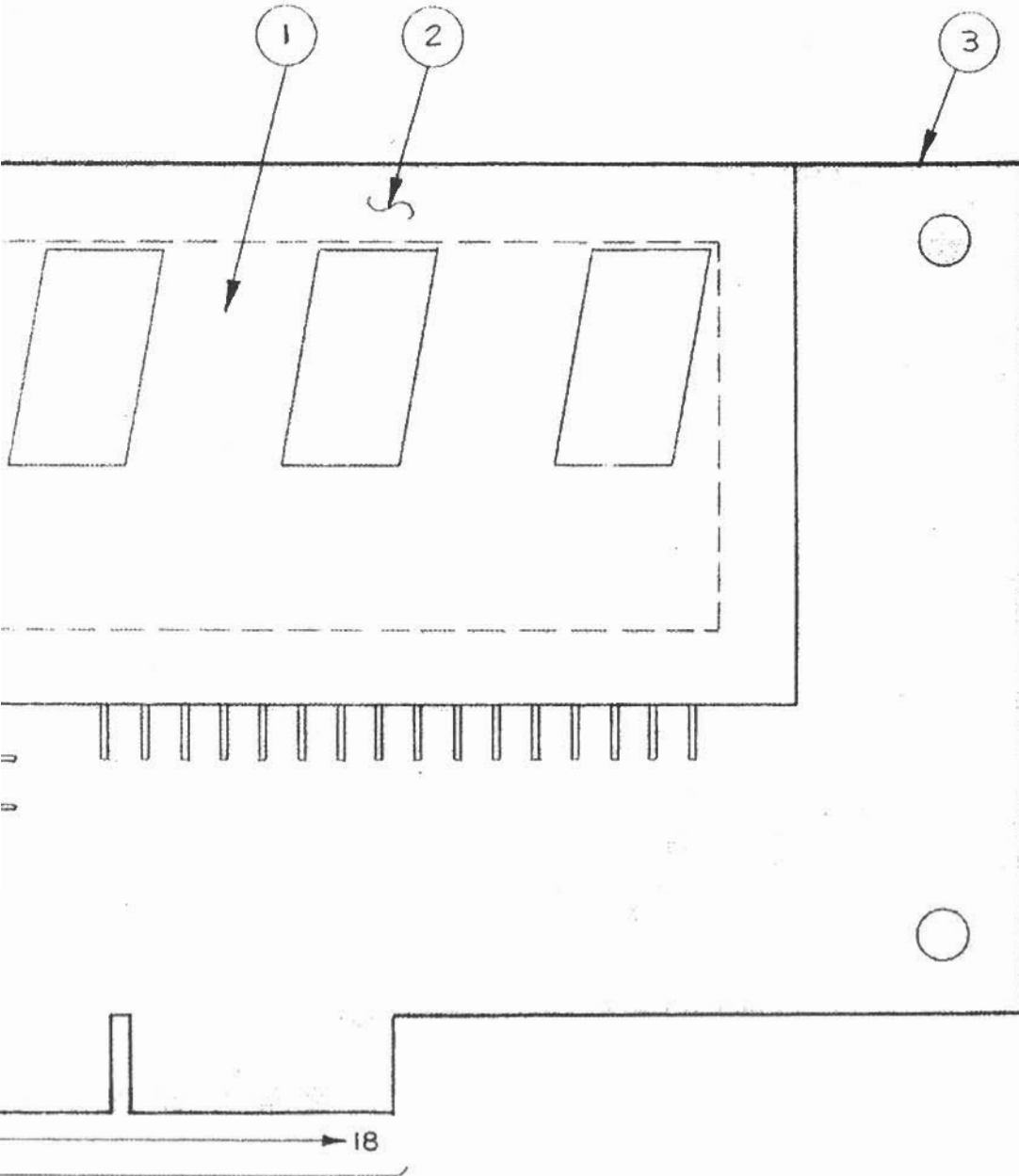
DOCUMENT #1

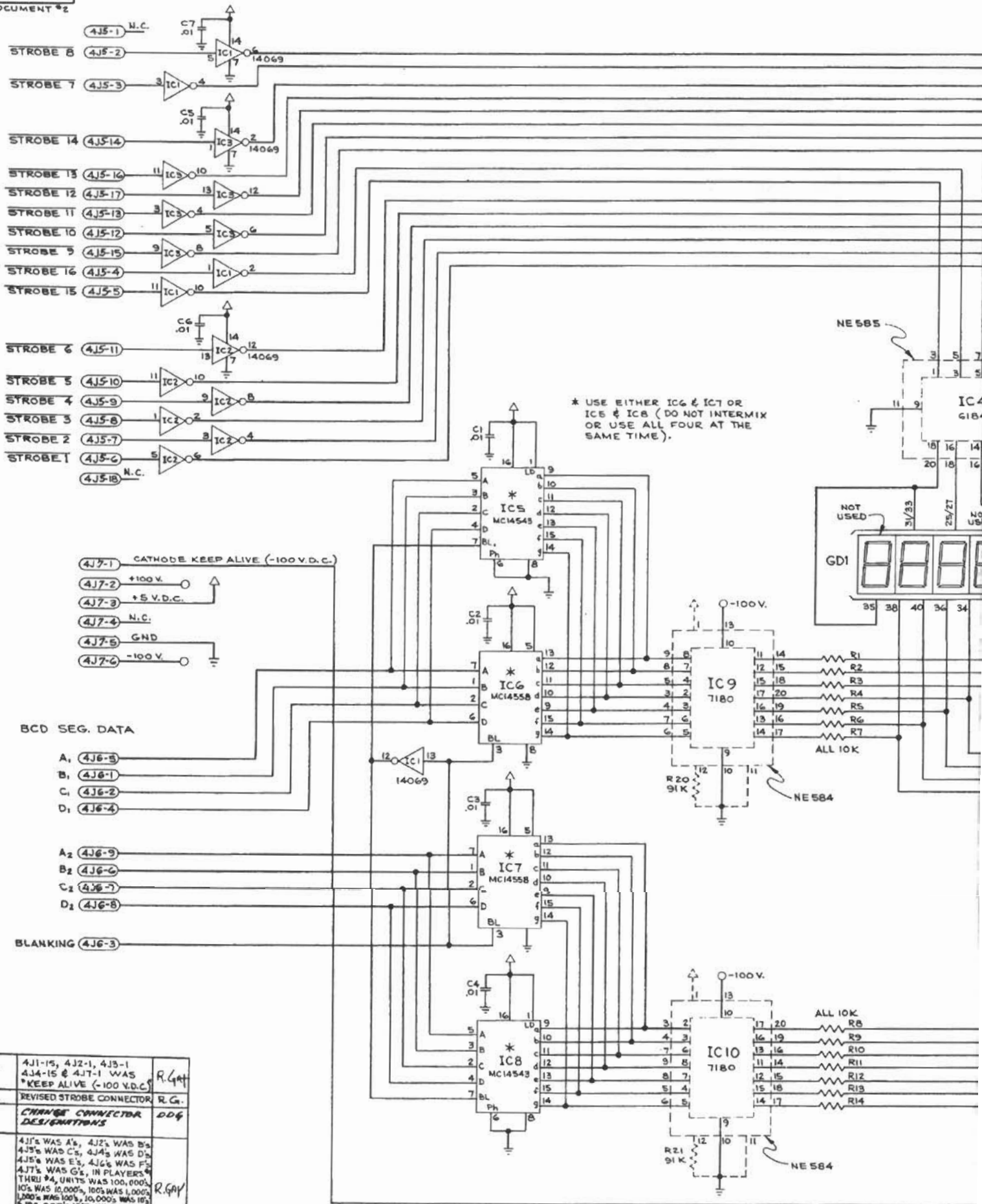


5J

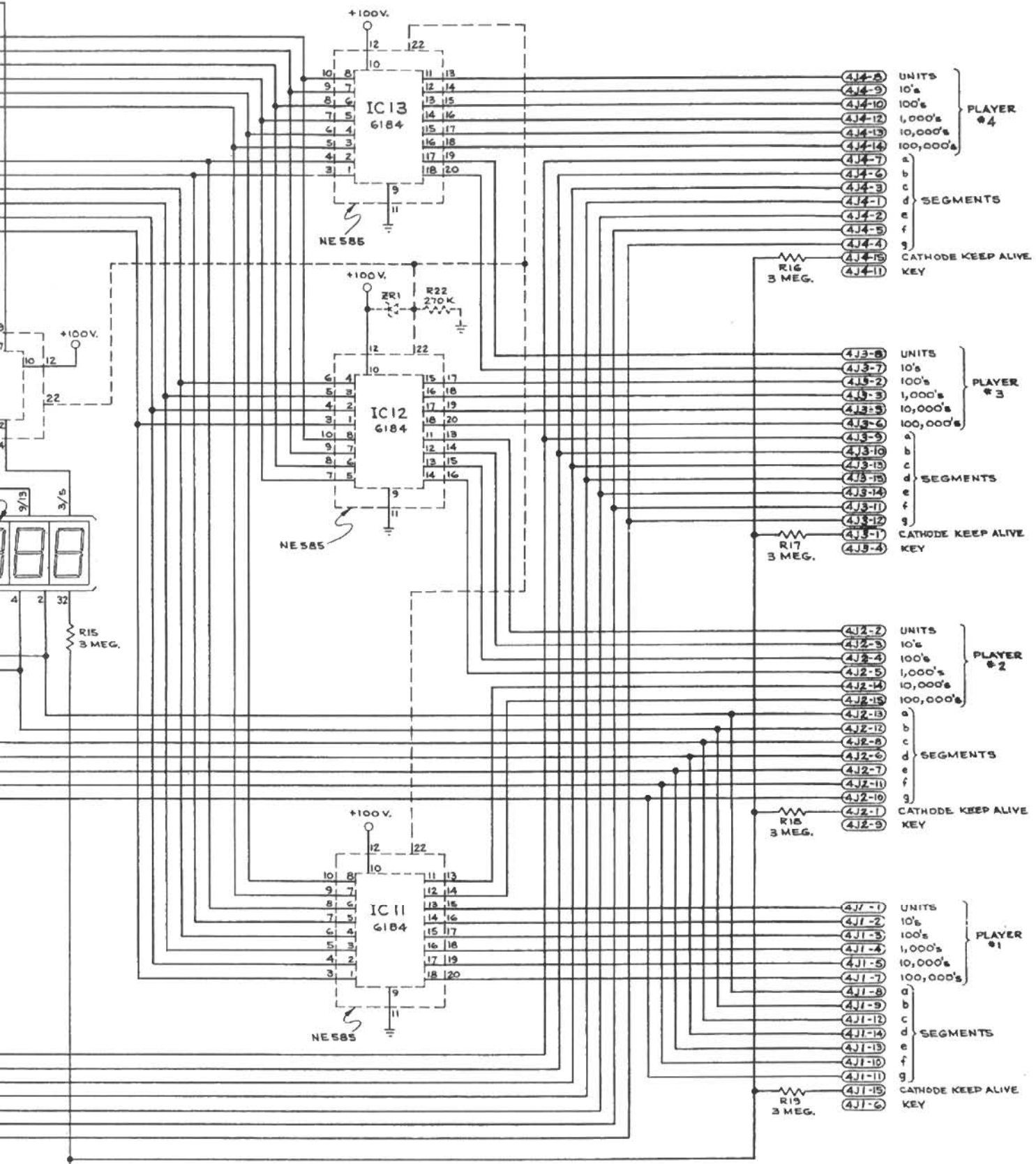
BILL OF MATERIAL

ITEM	PART NO.	PART DESIGNATION	DESCRIPTION	REQ'D.
1	5A-8966	I1	6 DIGIT DISPLAY	1
2	23A-6534	F1	DISPLAY MTG. ADHESIVE FOAM	1
3	ID-2001-132		SLAVE DISPLAY P.C. BOARD	1





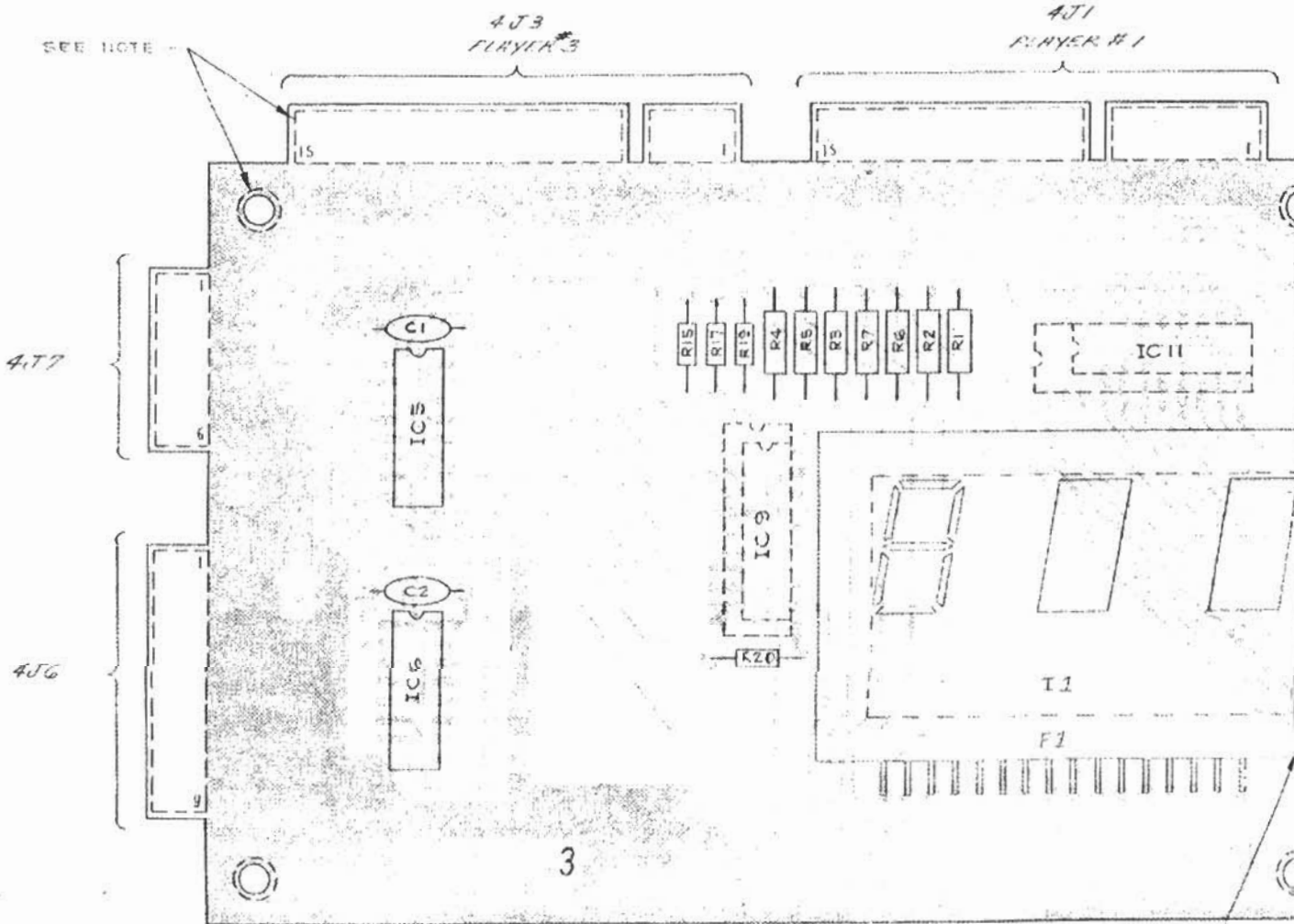
F	4J1-15, 4J2-1, 4J3-1 4J4-15 & 4J7-1 WAS *KEEP ALIVE (-100 V.D.C.)	R.GAY
E	REVISED STROBE CONNECTOR	R.G.
D	CHANGE CONNECTOR DESIGNATIONS	DDG
C	4J1% WAS A's, 4J2% WAS B's 4J3% WAS C's, 4J4% WAS D's 4J5% WAS E's, 4J6% WAS F's 4J7% WAS G's, IN PLAYERS THRU 94, UNITS WAS 100,000's 10% WAS 10,000's, 100% WAS 1,000's 1,000% WAS 100's, 10,000% WAS 10's & 100,000% WAS UNITS, ADD "0" EACH DIGIT & "NOT USED" & DELETED "BLANK" 0-2077	R.GAY
B	REVISION	BY
A	LETTER	BY



TOLERANCES UNLESS OTHERWISE SPECIFIED		WILLIAMS ELECTRONIC MFG. CORP. SUBSIDIARY OF THE BURGESS CORP.		
FRACTIONS	± 1/64	2401 N. CALIFORNIA	CHICAGO 10, ILL.	CORNELIA 7-2240
DECIMALS	± .008	NAME SCHEMATIC, MASTER DISPLAY BD.		
HOLES	± .002	MATERIAL		
ANGULAR	± 1/2°	HEAT TREATMENT		
DATE	9-26-77	SCALE	FINISH	
APP'D.	R.Gat	D-8000		

NOTES:

- DASHED LINES
- HOLES
- 3-1/2" EIGHT
- * FOR CASE WITH 1-1/2"



4

A	CORRECT CONNECTOR DESIGNATIONS, ADD. DISPLAY AND FORM TAPE TO B/M	D.D.G.
REVISION LETTER	REVISION	BY

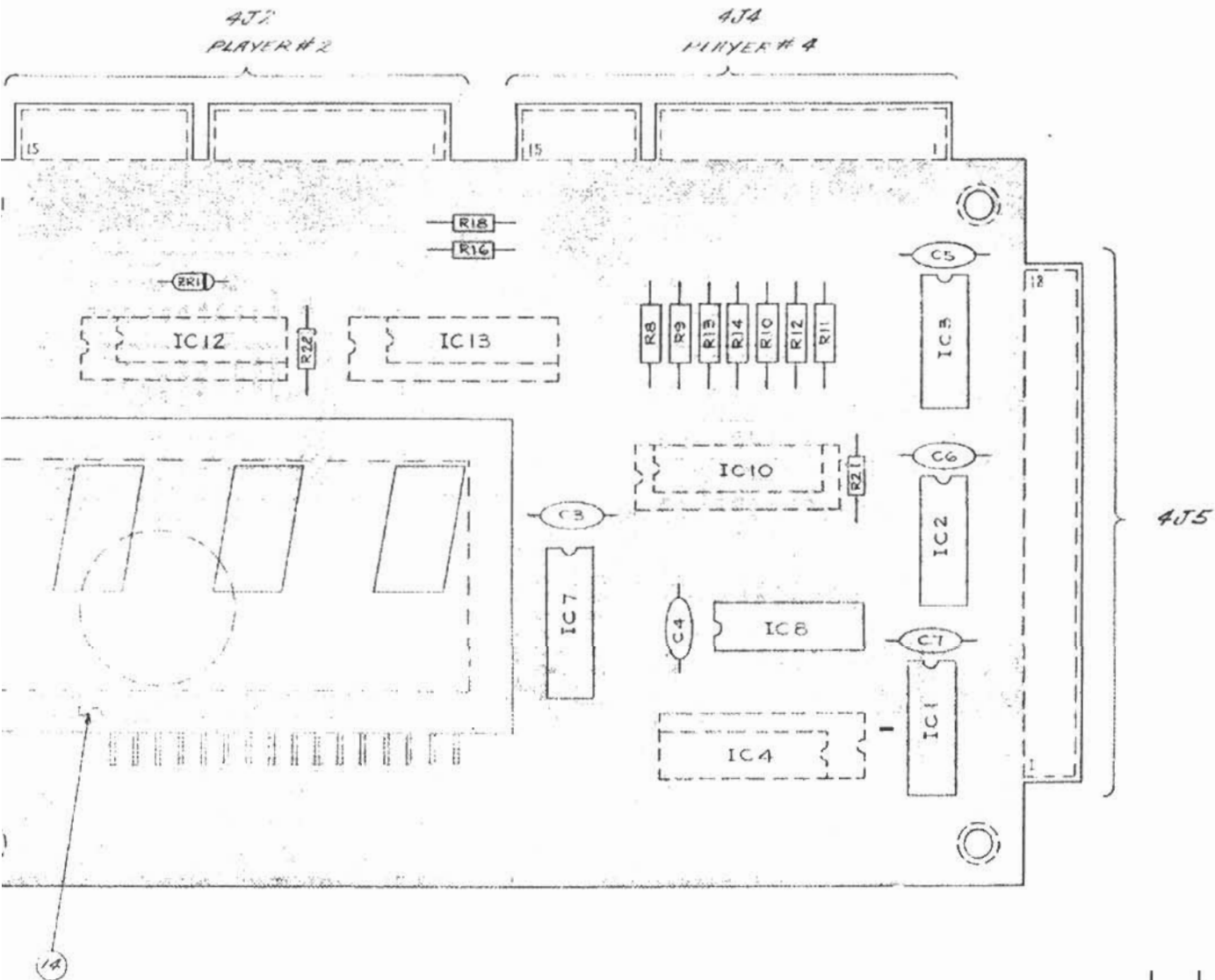
12 DENOTE EDGE CONNECTORS AND MOUNTING BE PROTECTED DURING SOLDERING.

ITEM #3 (IC5 & IC9) OR ITEM #4 (IC6 & IC7).

TURNS OF TURN C4, USE EITHER C1 AND C4 OR C2, C5, C3 AND C3 WITH IC6 & IC7.

BILL OF MATERIAL

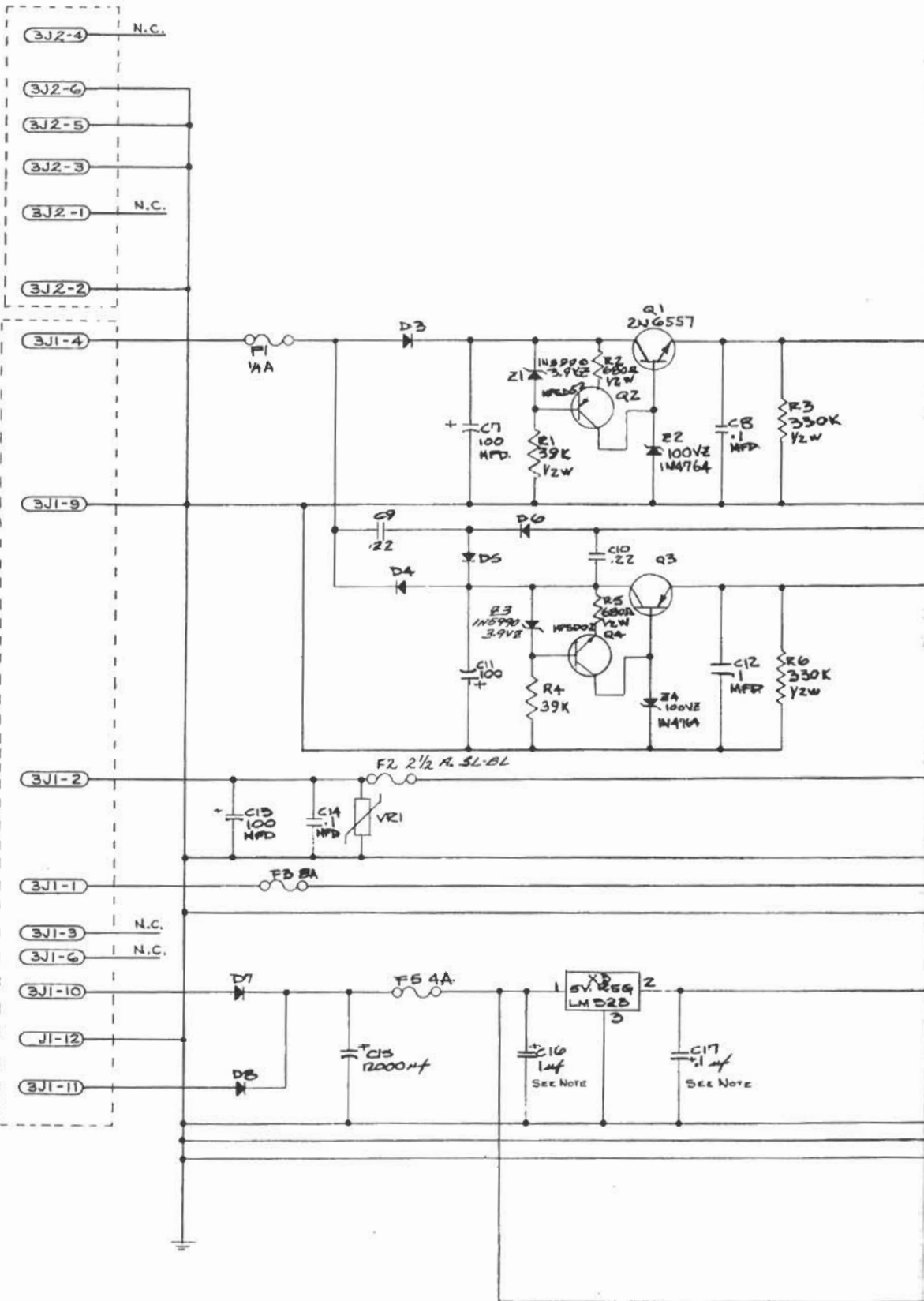
ITEM NO.	PART NO.	PART DESCRIPTION	DESCRIPTION	
1	11-0001-100	PCB	MASTER DISPLAY PCB BOARD	
2	7A-8707	11L, 11P, 11T	MC14067 HEX. INVERTER	
*	3	7A-8707	11L, 11P, 11T	MC14049 PCD TO SEVEN SEGMENT LATCH/DECODER/DRIVER
*	4		11L, 11P, 11T	MC14049 PCD TO SEVEN SEGMENT LATCH/DECODER/DRIVER
5	7A-8709	IC1, IC10	FUNCTION OF NE584 GAS DISCHARGE DISPLAY SEGMENT DRIVERS	
6	5A-8928	IC4, IC11, IC12, IC13	NON-GAS OR NE585 GAS DISCHARGE DISPLAY DIGIT DRIVERS	
7	7A-8981	R1 THROUGH R14	RES., FC., 10K OHM, 10% 1/2 W.	
8	5A-8982	R15 THROUGH R19	RES., FC., 5MEG OHM, 10% 1/4 W.	
9	5A-9119	R20, R21	RES., FC., 10K OHM, 10% 1/4 W.	
10	5A-9120	R22	RES., FC., 270K OHM, 10% 1/4 W.	
11	5A-9118	ZR1	INTEGRATED DIODE 10V-5%	
* *	12	5A-8980	C1 THROUGH C7 CAP., CERAMIC, 0.01 MFD. +50-20%	
13	5H-8966	D1	6 DIGIT DISPLAY	
14	23H-6524	F1	DISPLAY MFG. ADHESIVE FOAM	



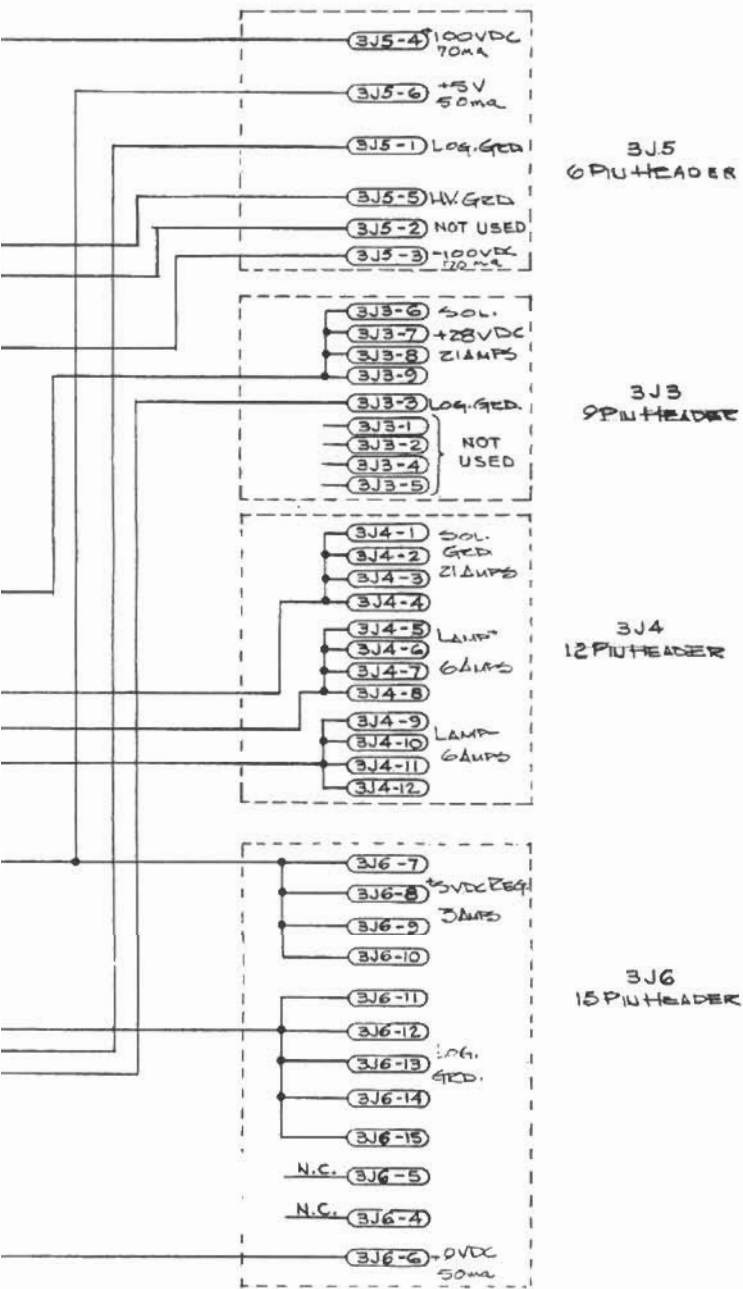
TOLERANCES		WILLIAMS ELECTRONIC MFG. CORP.		
UNLESS OTHERWISE SPECIFIED		SUBSIDIARY OF THE BESSING CORP.		
FRACTIONS	± 1/64	3401 N. CALIFORNIA	CHICAGO 18, ILL.	CORNELIA 7-2240
DECIMALS	± .005	NAME MASTER DISPLAY ASSEMBLY		
HOLES	+ .002	MATERIAL		
ANGULAR	± 1/2°	HEAT TREATMENT FINISH		
DATE	9-27-77	APP'D.	SCALE	D-8000
DRW.	R. GAT			

3J2 6 PIN
GRID HEADER

3J1 12 PIN
GRID HEADER



E	DELETED F4 15A & C.3 RET. LEAD FROM 3J1-3 TO 3J2-4,5, G.3 VAC 2 AMP LEAD FROM 3J1-6 TO 3J2-1,2 & IN 3J2-2 "NOT USED" WAS -300 VDC.	R.G.M 4-13-78
D	3J5 WAS 3J2, 3J6 WAS 3J5, 3J2 WAS 3J6 AND CHANGED F2 FROM 10A- TO 2 1/2 A 50-00	D.R.G 11-18-77
C	3J1'S WAS J1'S, 3J2'S WAS J2'S, 3J3'S WAS J3'S, 3J4'S WAS J4'S, 3J5'S WAS J5'S, 3J6'S WAS J6'S & DELETED C1-500μF, C2-100μF, C3-1μF, C4-500μF, C5-100μF, C6-1μF, D1, D2, F4-1/4A, F7-5A, MC7812 & MC7805	R.G.M 10-28-77
B	IN J6, *4 WAS *3, *6 WAS *1, *5 WAS *2, *3 WAS *5, *1 WAS *6 & *2 WAS *5 & IN J3 *2 WAS *12 & *5 WAS *15	R.G. 9-14-77
8-17-77	IDENTIFY PROTO SECT	D.R.P
REVISION LETTER	REVISION	BY

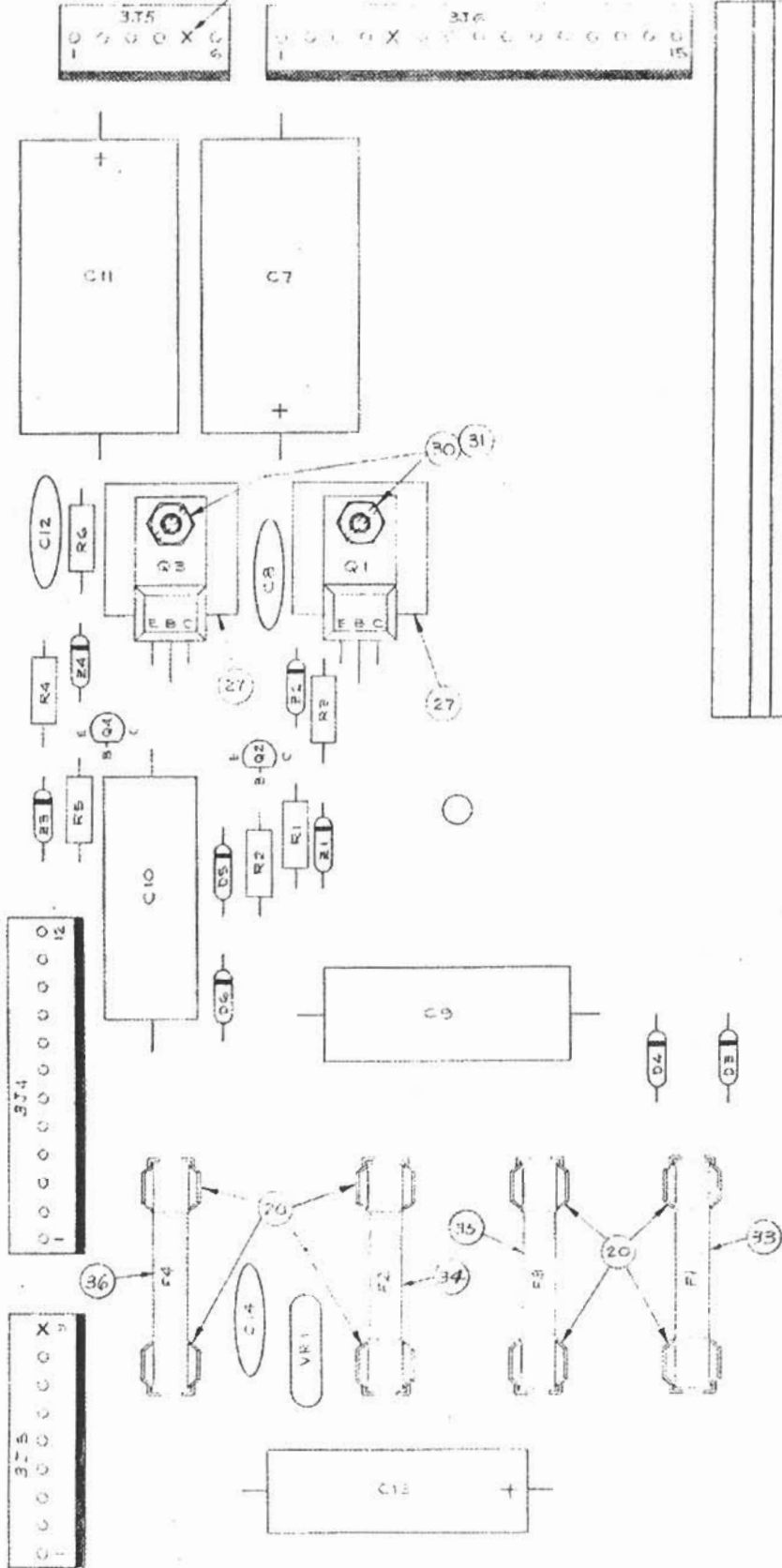


NOTE

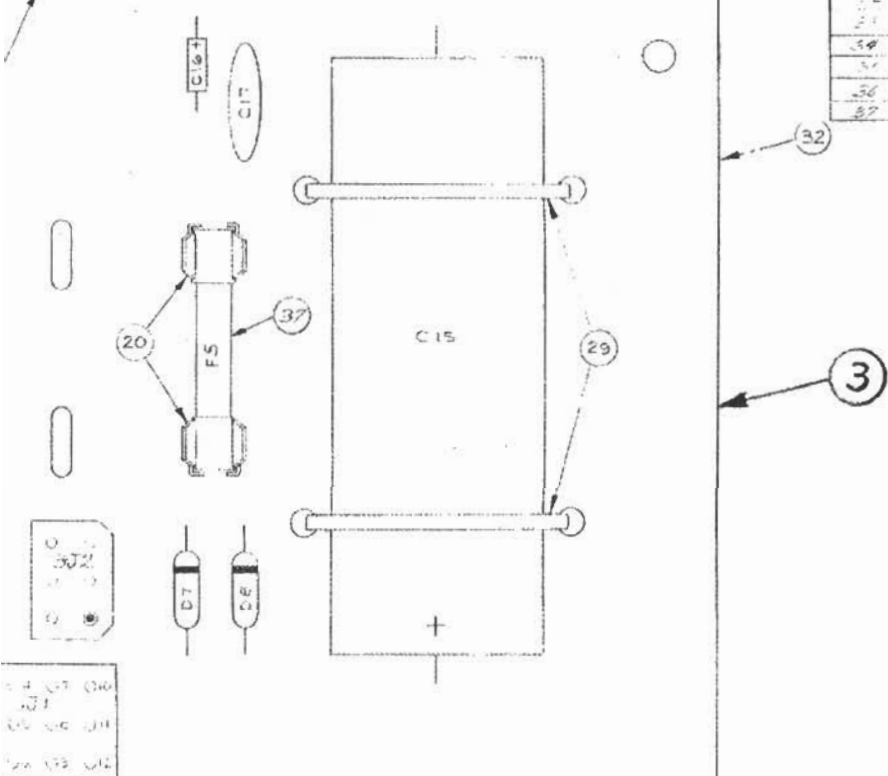
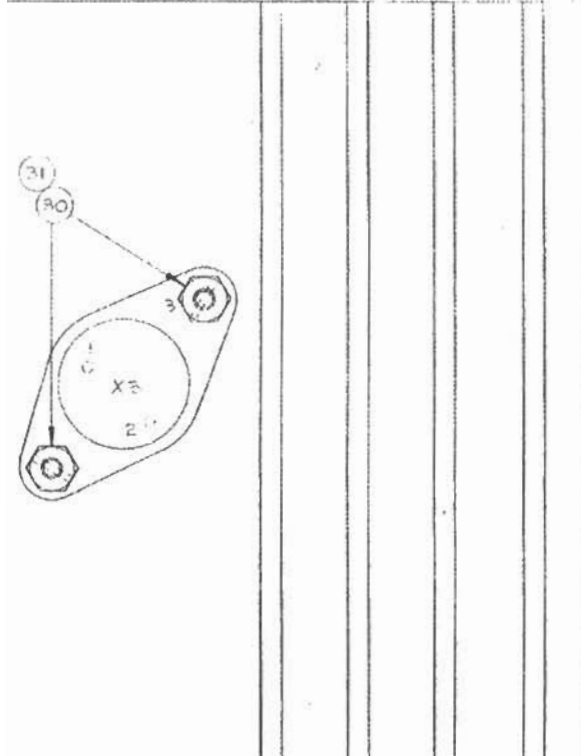
1. C-16 AND C-17 MUST BE LOCATED AS CLOSE TO REGULATOR AS POSSIBLE.

TOLERANCES		WILLIAMS ELECTRONIC MFG. CORP.		
UNLESS OTHERWISE SPECIFIED		SUBSIDIARY OF THE BEBORG CORP.		
FRACTIONS	± 1/64	3401 N. CALIFORNIA	CHICAGO 16, ILL.	CORNELIA 7-2240
DECIMALS	± .005	NAME SCHEMATIC, POWER SUPPLY BOARD		
HOLES	+ .002	MATERIAL	HEAT TREATMENT	FINISH
ANGULAR	± 1/2°	DATE	SCALE	FINISH
		WLB	1/4/77	APPD.
				D-7999

X-IMPACT REVISED



REVISION LETTER	REVISION	BY
G	ADD RESISTORS, CAPACITORS CONNECTION ADJUSTMENTS	D.D.V.
F	INTERCHANGED ITEM #30 & #31, ADDED ITEM #32 TO ITEM #5, INTERCHANGED ITEM #6 & ITEM #7 TO ITEM #7, INTERCHANGED ITEM #8 IN 5990 TO ITEM #8, INTERCHANGED ITEM #9, ITEM #11 WITH 594 U, W. SPELLING CAPACITORS CORRECTLY.	H.C.M.
E	REVISED TO ADD RESISTORS	H.C.M.
D	REVISIONS BY	H.C.M.



BILL OF MATERIAL

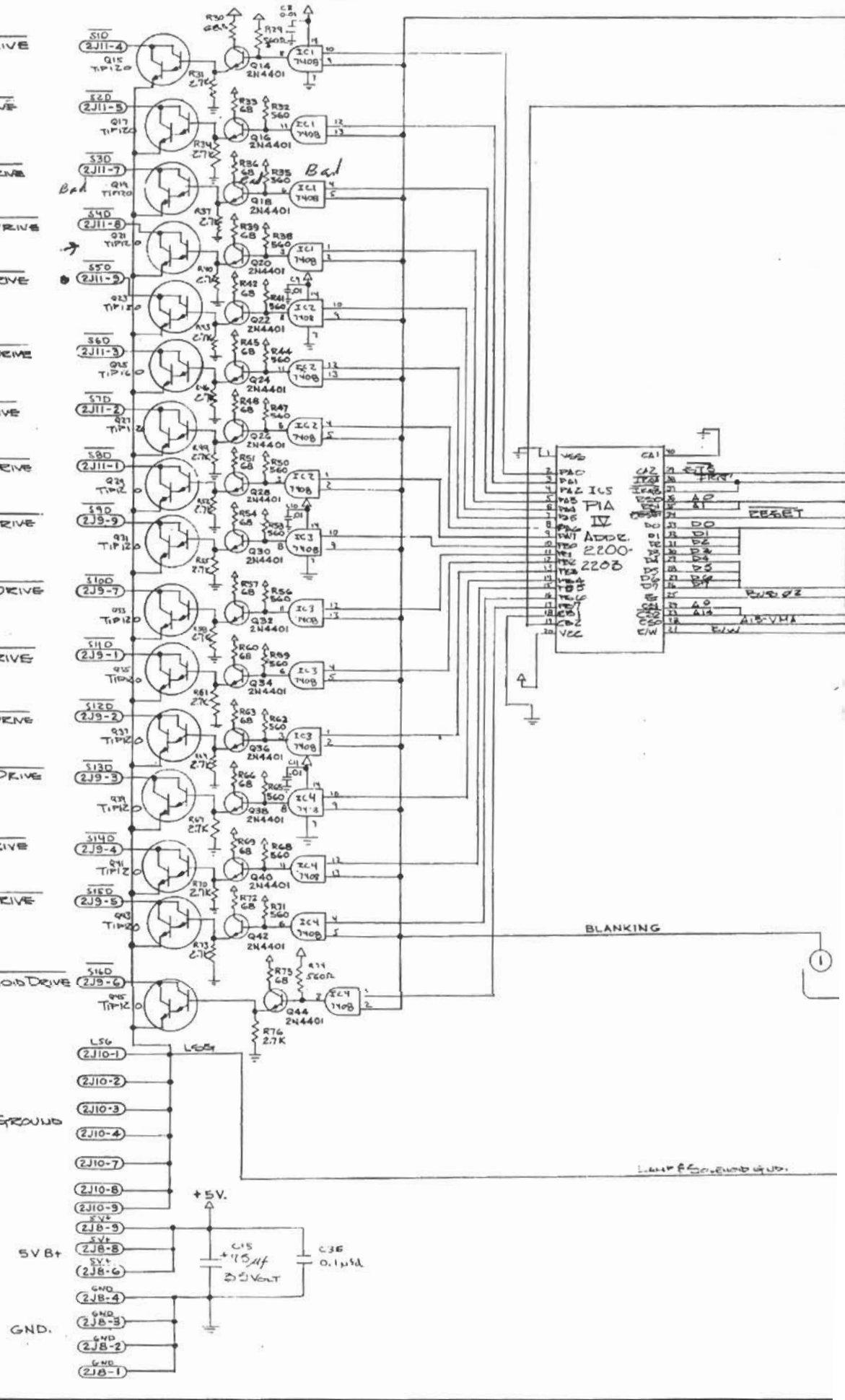
REF	QTY	PART DESCRIPTION	DESCRIPTION
1	1	7	9 AMP. 5 VOLT POSITIVE VOLTAGE REGULATOR
2	5A-9057	Q1	TRANSISTOR NPN TO20Z
3	5A-9058	Q2	TRANSISTOR PNP MFD52
4	5A-9058	Q3	TRANSISTOR PNP TO20Z
5	5A-9058	Q4	TRANSISTOR NPN MFD52
6	5A-9054	D3 1PK 117	DIODE 1N4004
7	5A-9045	D1, D2	DIODE 1N4001
8	5A-9059	P1, P2	ZENER DIODE 1N690
9	5A-9060	Z1, Z2	ZENER DIODE 1N4764
10	5A-9061	VR1	VARIATOR
11	5A-9062	R1, R4	RESISTOR 30K ± 1/2 W.
12	5A-9061	R2, R5	RESISTOR 280 ± 1/2 W.
13	5A-9063	R3, R6	RESISTOR 220K ± 1/2 W.
14	5A-9055	C7, C11	CAPACITOR 100MFD. 150VDC.
15	5A-9070	C13	CAPACITOR 100MFD. 100VDC.
16	5A-9046	C15	CAPACITOR 12,000 MFD. 16 VDC.
17	5A-9072	C8, C12, C14, C16	CAPACITOR 1 MFD. 500VDC.
18	5A-9047	C9, C10	CAPACITOR 22 MFD. 400VDC.
19	5A-9031	C18	CAPACITOR 1 MFD 25 VDC.
20	5A-9052	10-RT 015	FUSE HOLDER
21	5A-9025	J1	12 PIN CONNECTOR
22	5A-9035	J2	6 PIN HEADER CONNECTOR
23	5A-9027	J3	9 PIN HEADER CONNECTOR
24	5A-9043	J4	12 PIN HEADER CONNECTOR
25	5A-9074	J5	15 PIN HEADER CONNECTOR
26	5A-9067	J6	6 PIN CIRCUIT CONNECTOR
27	5A-9042	2-REQ'D.	HEAT SINK
28	5A-9041	1-REQ'D.	4" X 4 1/2" HEAT SINK
29		2-REQ'D.	TIE WRAP
30		4-REQ'D.	5-40 X 1/16 R.H. MECH. SCREW
31		4-REQ'D.	5-40 HEX. NUT
32	10-2001-134	1-REQ'D.	P.C. BOARD
33	5A-9021	F1	5A FUSE 1/4 AMP.
34	5A-9022	F2	5A FUSE 2 1/2 AMP.
35	5A-9023	F3	FUSE 8 AMP.
36	5A-9024	F4	FUSE 15 AMP.
37	5A-9025	F5	5A FUSE 4 AMP.

TOLERANCES UNLESS OTHERWISE SPECIFIED		WILLIAMS ELECTRONIC MFG. CORP.			
FRACTIONS	± 1/64	3401 N. CALIFORNIA		CHICAGO 18, ILL. CORNELIA 7-22	
DECIMALS	± .005	SUBSIDIARY OF VLS ASSURANCE CORP.			
HOLES	+ .002	NAME: <i>ADDA QUINCY ASSEMBLY</i>			
ANGULAR	± 1/2°	MATERIAL	HEAT TREATMENT	FINISH	
OWN.	DATE	APP'D.	SCALE	D 7999	

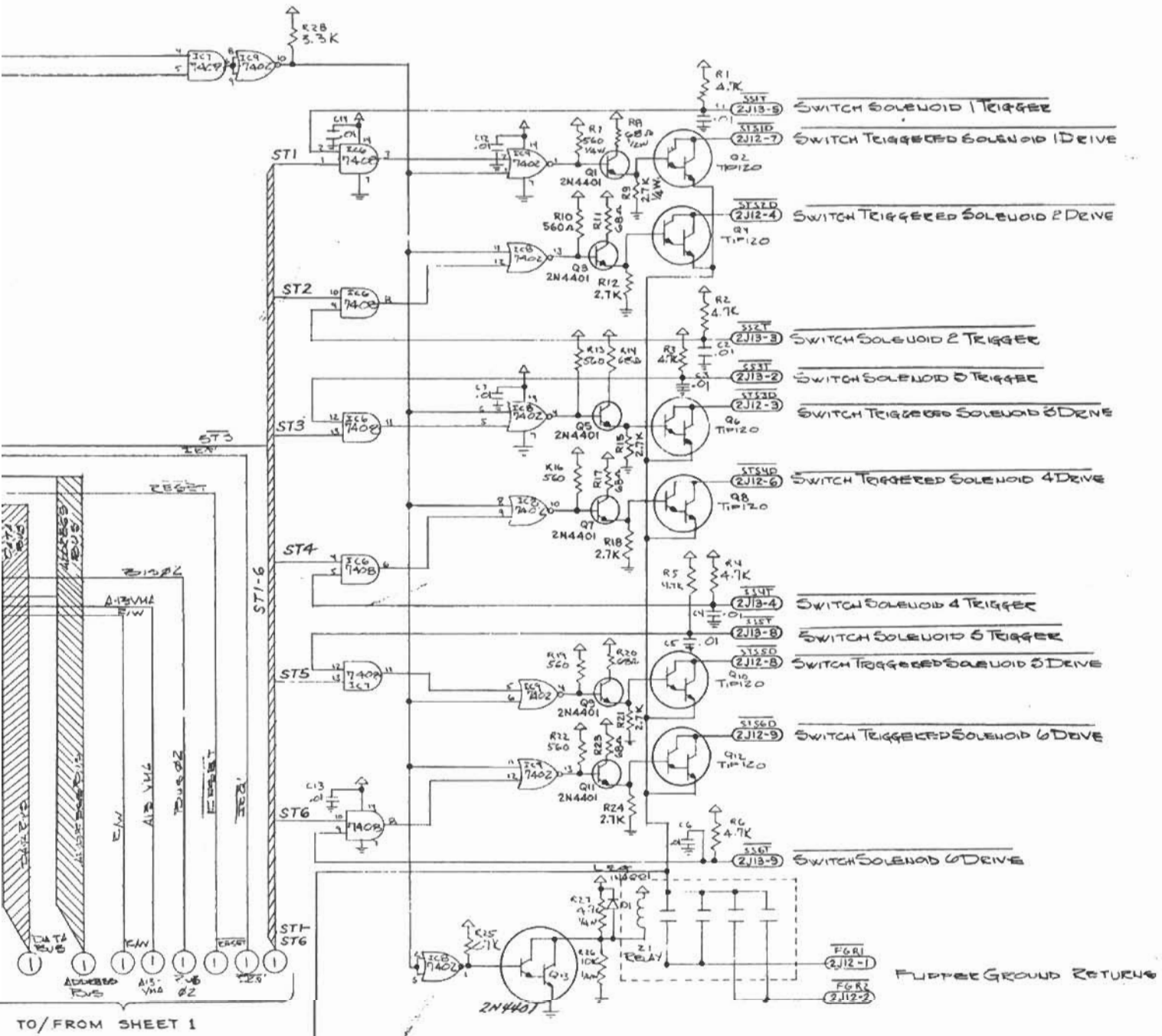
- SOLENOID 1 DRIVE
- SOLENOID 2 DRIVE
- SOLENOID 3 DRIVE
- SOLENOID 4 DRIVE
- SOLENOID 5 DRIVE
- SOLENOID 6 DRIVE
- SOLENOID 7 DRIVE
- SOLENOID 8 DRIVE
- SOLENOID 9 DRIVE
- SOLENOID 10 DRIVE
- SOLENOID 11 DRIVE
- SOLENOID 12 DRIVE
- SOLENOID 13 DRIVE
- SOLENOID 14 DRIVE
- SOLENOID 15 DRIVE

COULDOUT SOLENOID DRIVE

LAMP & SOLENOID GROUND



B	2J8's WAS G's, 2J9's WAS H's, 2J10's WAS J's, 2J11 WAS K's, 2J12 WAS L's 2J13'S WAS M's & ADDED 1 TO/FROM SHEET 1 & CIRCLES TO ALL 2N4401 TRANSISTORS	R. G. Giff 10-28-77
A	REVISION "A"	
REVISION LETTER	REVISION	BY

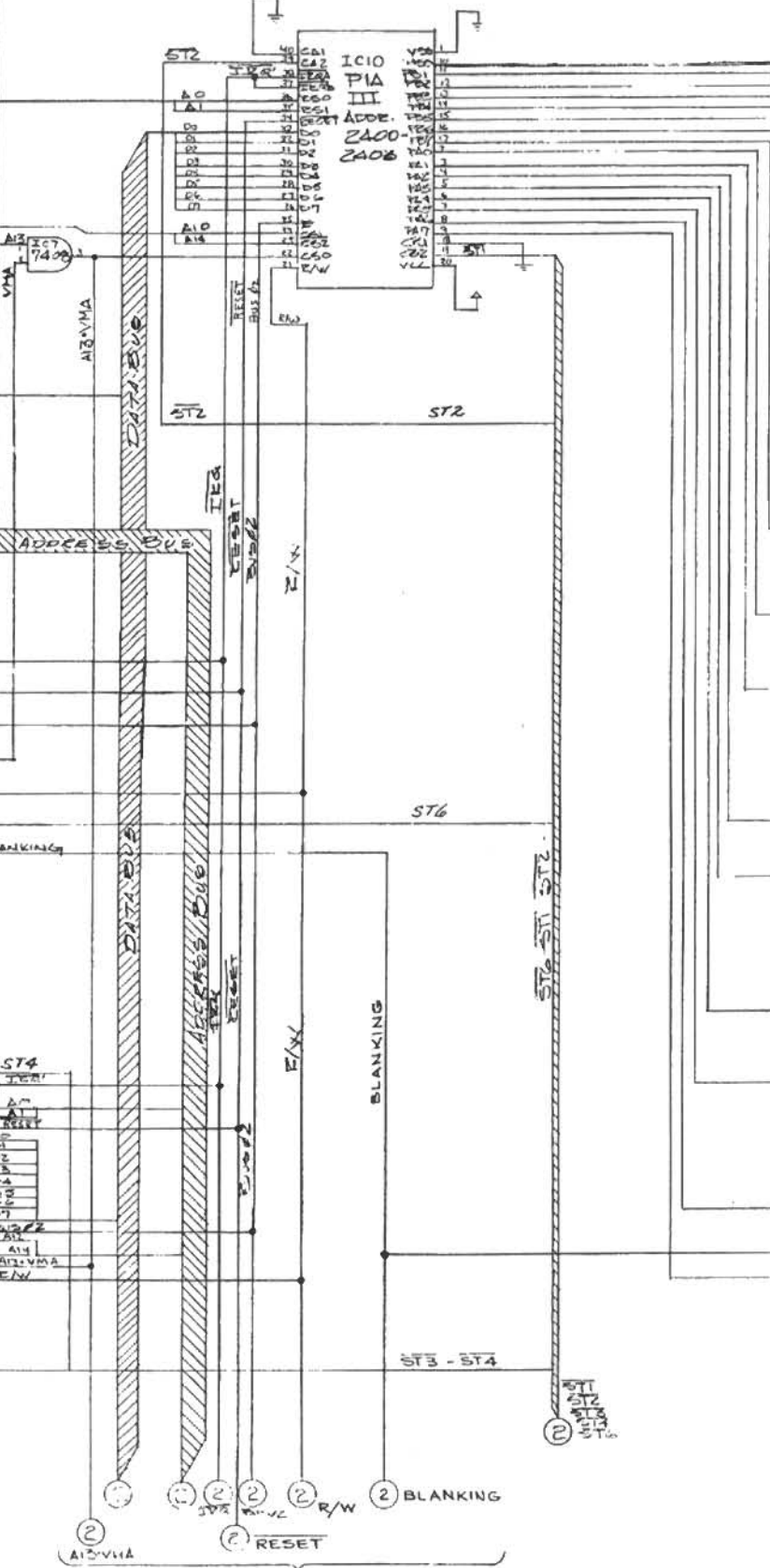
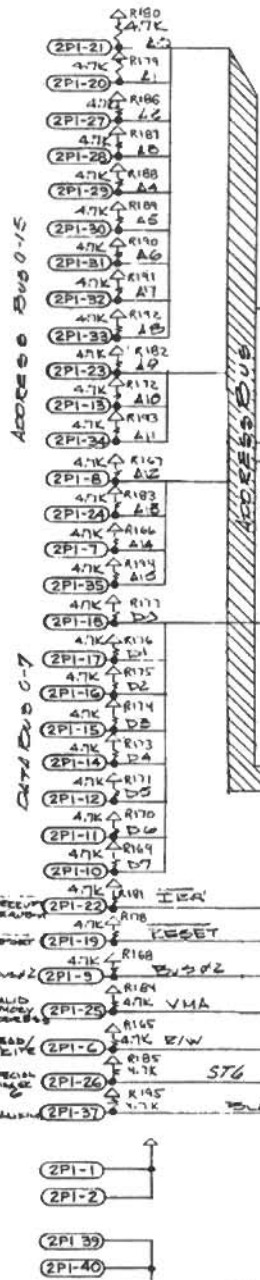
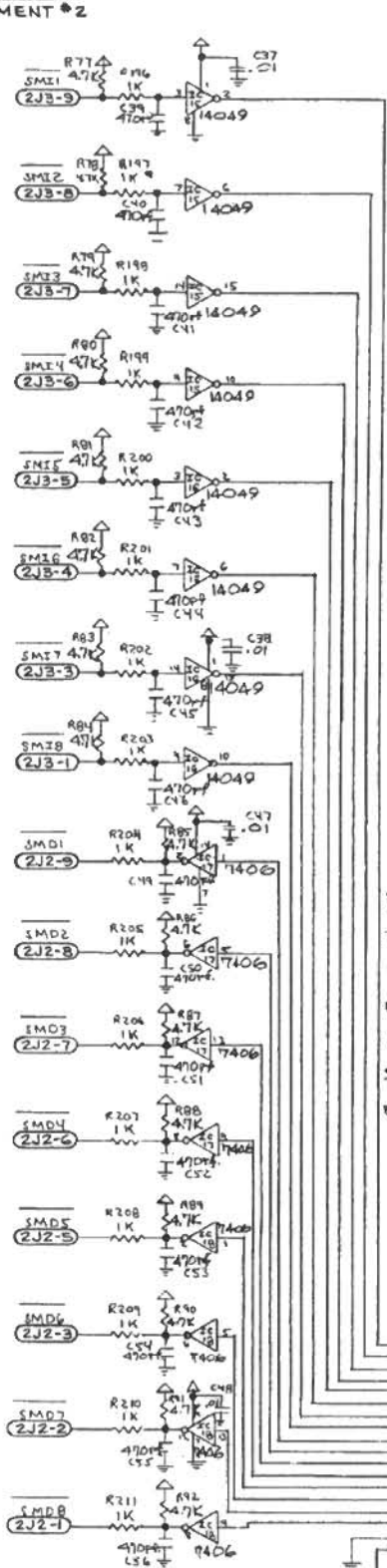


SHEET 2 OF 2

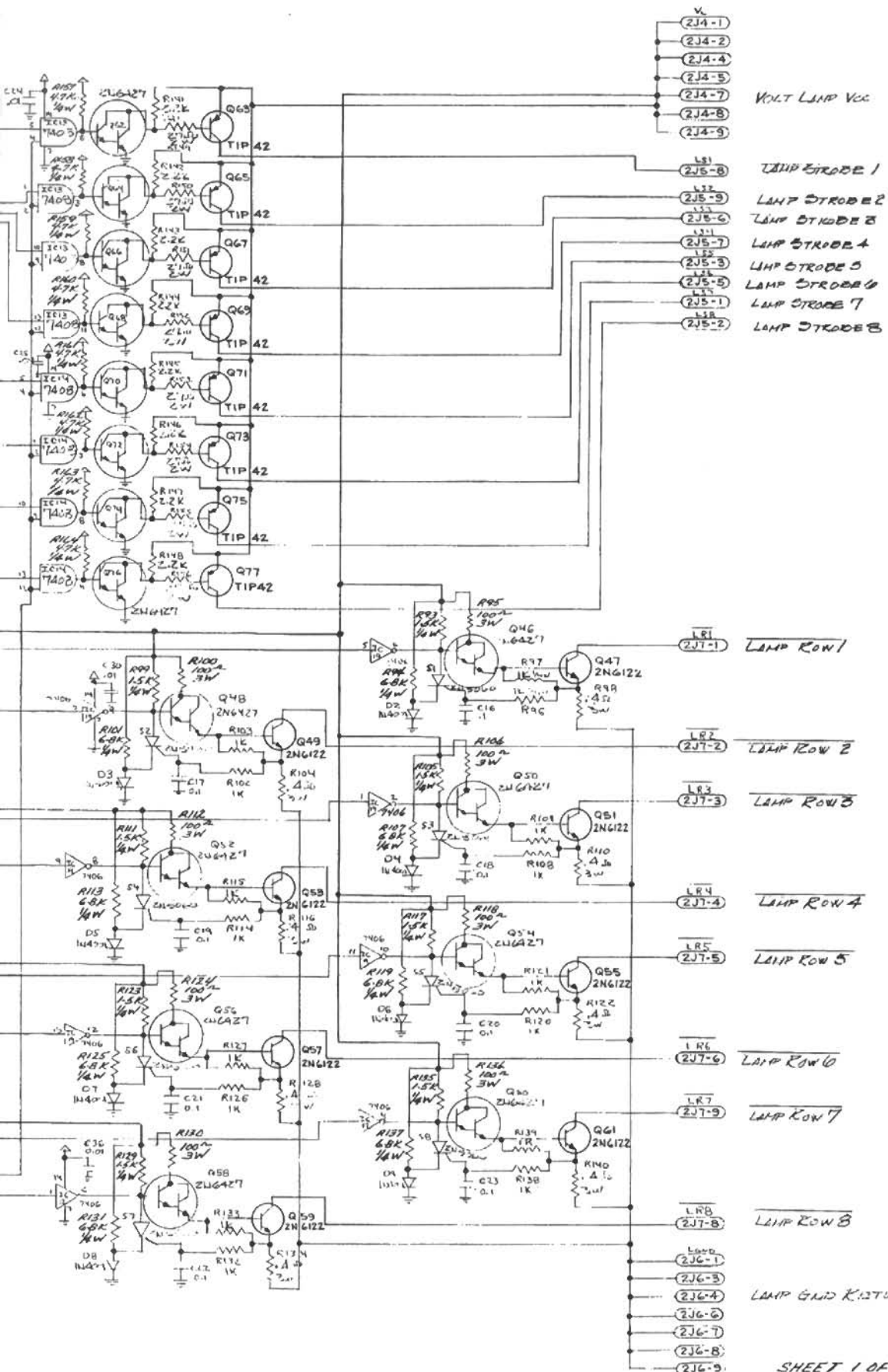
TOLERANCES		WILLIAMS ELECTRONIC MFG. CORP.			
UNLESS OTHERWISE SPECIFIED		SUBSIDIARY OF THE SECURITY CORP.			
FRACTIONS ± 1/84		3401 N. CALIFORNIA		CHICAGO 18, ILL. CORNELIA 7-2240	
DECIMALS ± .008		NAME SCHEMATIC, DRIVER BOARD			
HOLES ± .002		MATERIAL		HEAT TREATMENT FINISH	
ANGULAR ± 1/2°		DATE 1-5-77		SCALE	
DWB		APPD.		D-7997	

SWITCH MATRIX INPUTS 1-8

SWITCH MATRIX DRIVES 1-8



C	2PI's WAS F's, 2J2's WAS A's, 2J3's WAS B's, 2J4's WAS C's, 2J5's WAS D's, 2J6's WAS E's, 2J7's WAS F's, & ADDED CIRCLES TO ALL 2N6122 & TIP42 TRANSISTOR & TO/ FROM SHEETS	RGAF
B	DELETED 15V LEAD & ADDED VOLT LAMP V _{CC} LEAD TO R93-R95, R99-R101, R106-R107, R111-R113, R117-R119, R123-R125, R129-R131 & R135-R137	RGAF
A	REDUCE POWER SUPPLY CURRENT	DLP
REVISION LETTER	REVISION	BY

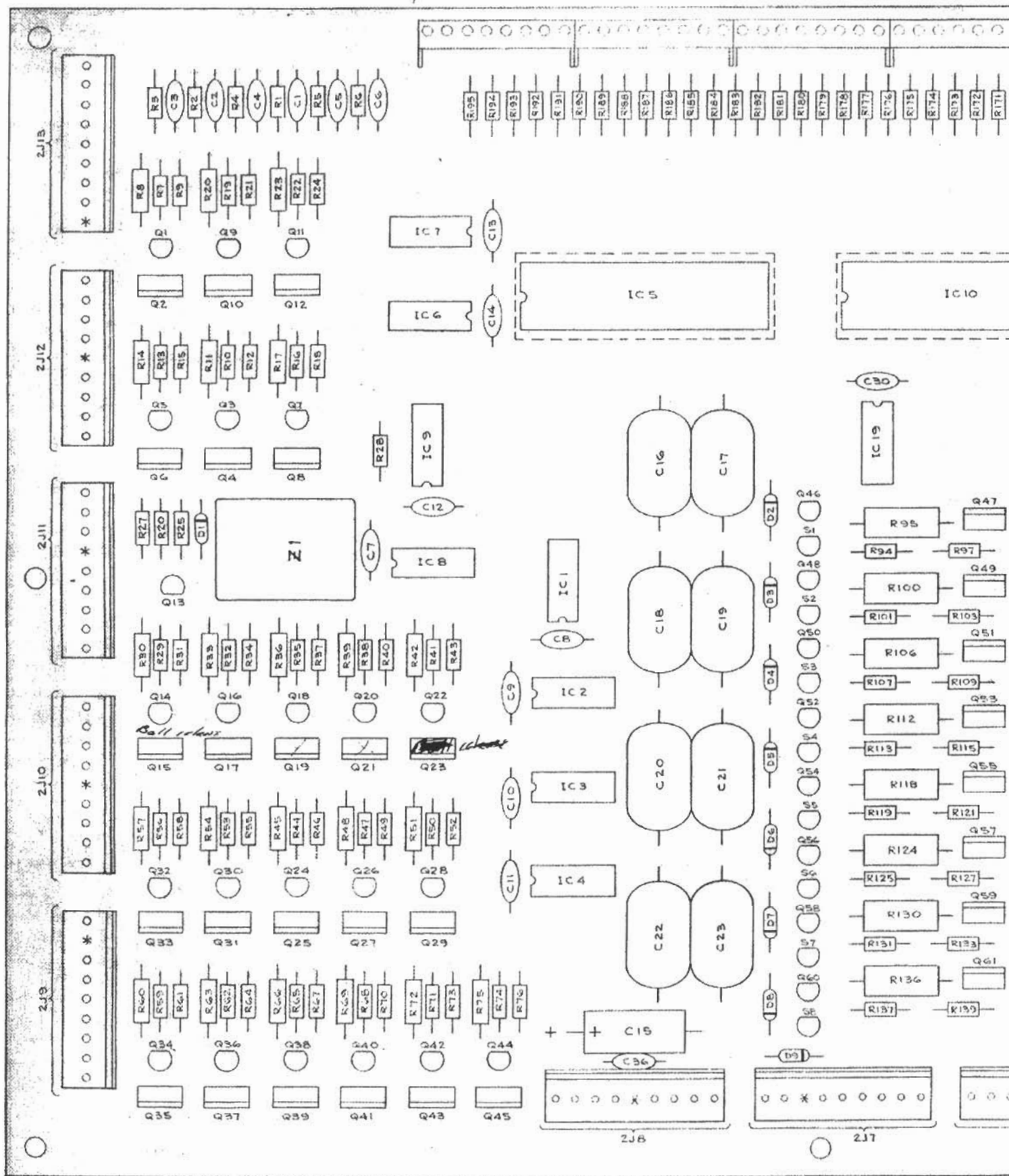


- V
- (2J4-1)
- (2J4-2)
- (2J4-4)
- (2J4-5)
- (2J4-7)
- (2J4-8)
- (2J4-9)
- VOLT LAMP VCC
- LS1
- (2J5-8)
- LS2
- (2J5-9)
- LAMP STROBE 1
- LS3
- (2J5-6)
- LAMP STROBE 2
- LS4
- (2J5-7)
- LAMP STROBE 3
- LS5
- (2J5-3)
- LAMP STROBE 4
- LS6
- (2J5-5)
- LAMP STROBE 5
- LS7
- (2J5-8)
- LAMP STROBE 6
- LS8
- (2J5-1)
- LAMP STROBE 7
- LS9
- (2J5-2)
- LAMP STROBE 8
- LR1
- (2J7-1)
- LAMP ROW 1
- LR2
- (2J7-2)
- LAMP ROW 2
- LR3
- (2J7-3)
- LAMP ROW 3
- LR4
- (2J7-4)
- LAMP ROW 4
- LR5
- (2J7-5)
- LAMP ROW 5
- LR6
- (2J7-6)
- LAMP ROW 6
- LR7
- (2J7-9)
- LAMP ROW 7
- LR8
- (2J7-8)
- LAMP ROW 8
- LAMP
- (2J6-1)
- (2J6-3)
- (2J6-4)
- (2J6-7)
- (2J6-8)
- (2J6-9)
- LAMP GRID RETURN

SHEET 1 OF 2

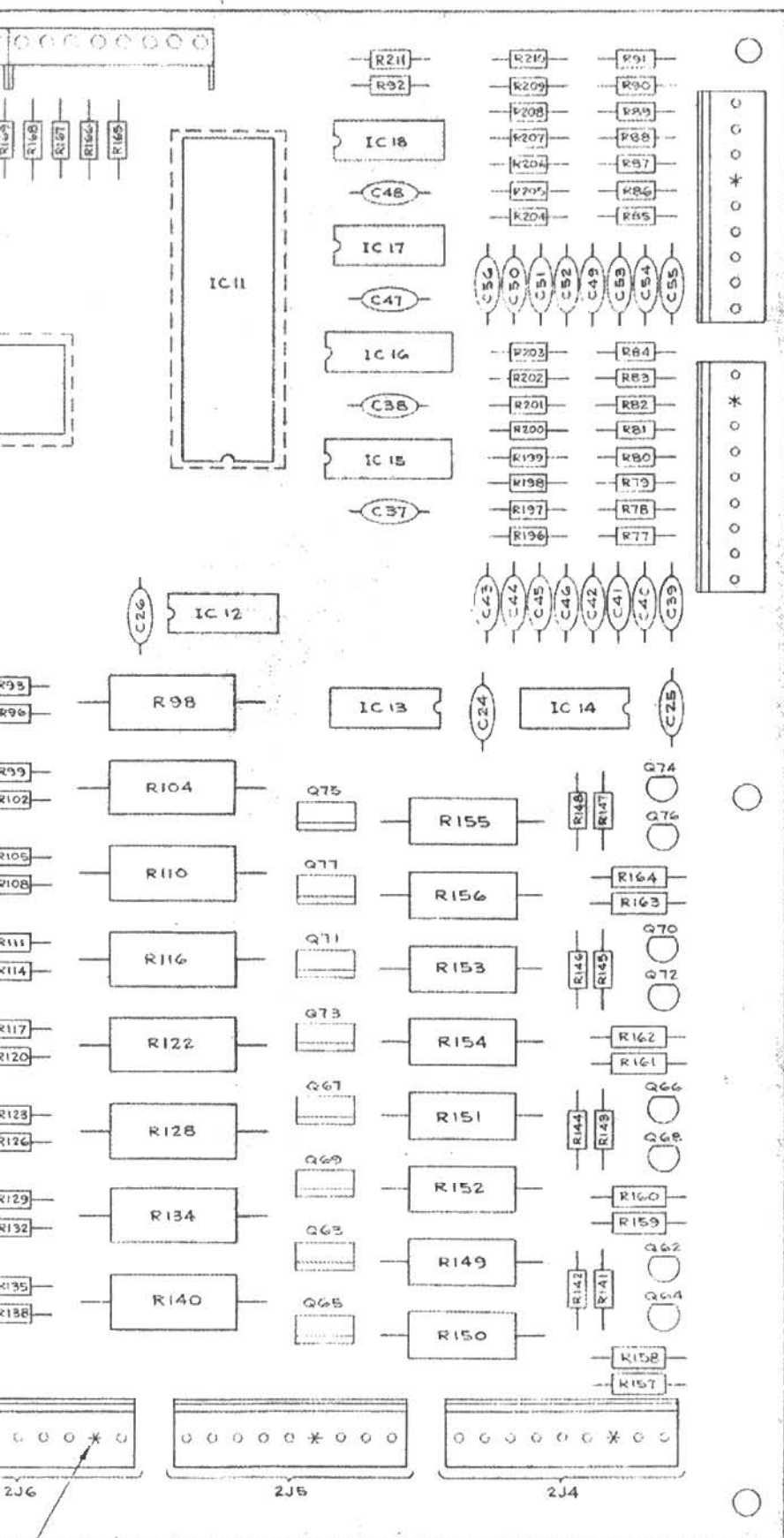
TOLERANCES		WILLIAMS ELECTRONIC MFG. CORP.		
UNLESS OTHERWISE SPECIFIED		3401 N. CALIFORNIA CHICAGO 18, ILL. CORNELIA 7-2240		
FRACTIONS	± 1/64	NAME SCHEMATIC, DRIVER BOARD		
DECIMALS	± .008	MATERIAL		
HOLER	+ .002	HEAT TREATMENT		
ANGULAR	± 1/2°	FINISH		
DATE	7/77	APP'D.	SCALE	D-7997

QTY ASSEMBLY ON



*-INDICATES KEYING PI

REVISION LETTER	REVISION	BY

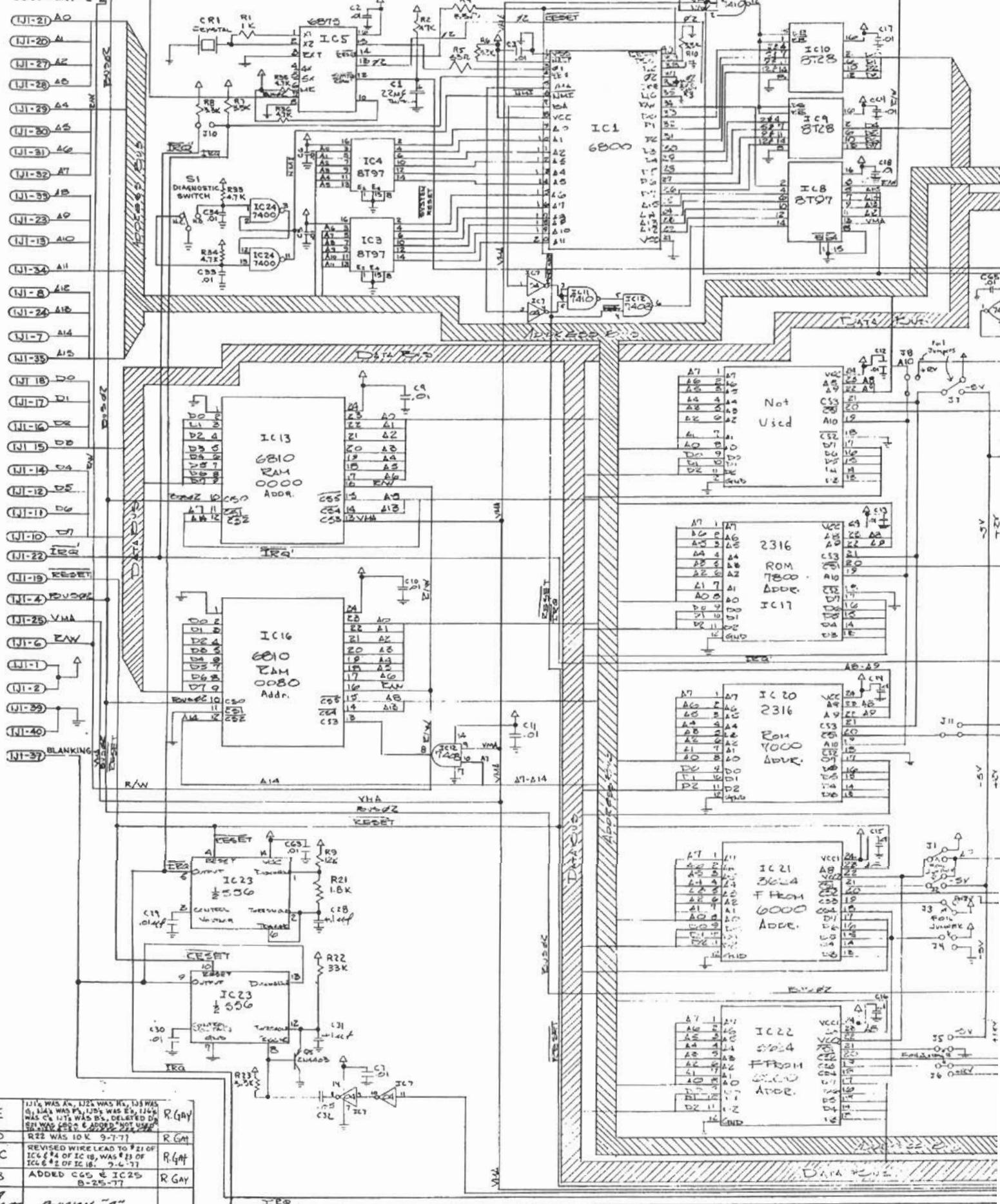


BILL OF MATERIAL

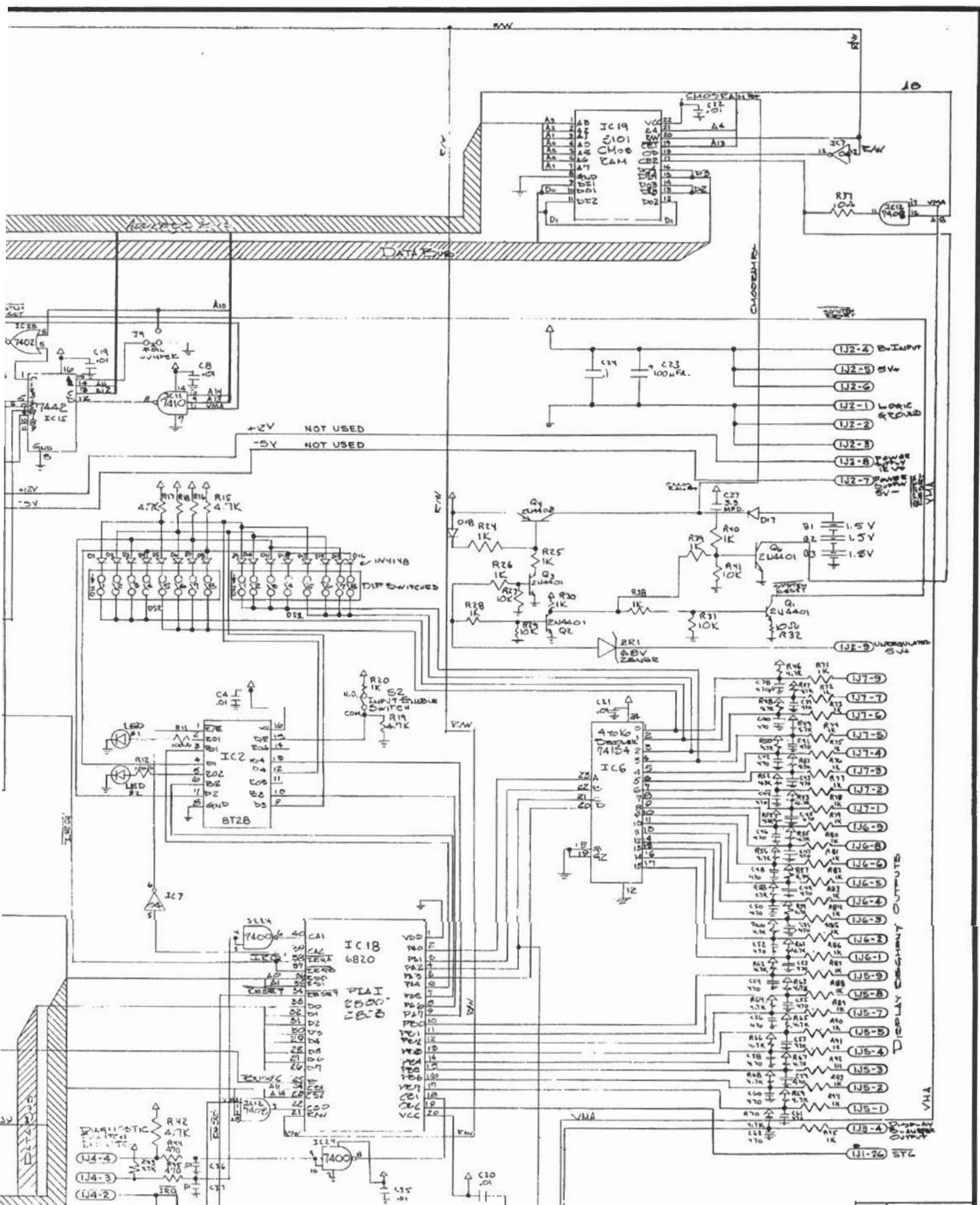
ITEM NO.	PART NO.	PART DESIGNATION	DESCRIPTION	REQ. NO.
1	IP-200-131		DC DRIVER BOARD	1
2	7A-8746	IC 1, IC 2	74140 QUAD BIPLE 2 INPUT POSITIVE NOR GATE	2
3	7A-8746	IC 3, IC 7, IC 8, IC 9	74140 QUAD BIPLE 2 INPUT POSITIVE NOR GATE	4
4	7A-8777	IC 10 THRU IC 14, IC 15, IC 16, IC 17, IC 18, IC 19	74140 QUAD BIPLE 2 INPUT POSITIVE AND GATE	5
5	5A-8075	IC 15, IC 16	MC14049 INVERTING I.C. BUFFER	2
6	5A-8072	IC 5, IC 6, IC 11	MC6820 PERIPHERAL INTERFACE ADAPTER	3
7	5A-8038	Q1, Q3, Q5, Q7, Q9, Q11, Q13, Q14, Q16, Q18, Q20, Q22, Q24, Q26, Q28, Q30, Q32, Q34, Q36, Q38, Q40, Q42, Q44	2N4401 NPN TRANSISTOR	23
8	5A-8074	Q46, Q48, Q50, Q52, Q54, Q56, Q58, Q60, Q62, Q64, Q66, Q68, Q70, Q72, Q74, Q76	2N4427 DARLINGTON NPN TRANSISTOR	16
9	5A-8077	Q3, Q4, Q6, Q8, Q10, Q12, Q14, Q16, Q18, Q20, Q22, Q24, Q26, Q28, Q30, Q32, Q34, Q36, Q38, Q40, Q42, Q44, Q46, Q48, Q50, Q52, Q54, Q56, Q58, Q60, Q62, Q64, Q66, Q68, Q70, Q72, Q74, Q76	1N120 DARLINGTON NPN POWER TRANSISTOR	22
10	5A-8078	Q63, Q65, Q67, Q69, Q71, Q73, Q75, Q77	TIP42 PNP POWER TRANSISTOR	8
11	5A-8070	Q47, Q49, Q51, Q53, Q55, Q57, Q59, Q61	2N6122 NPN POWER TRANSISTOR	8
12	5A-8258	D1	1N4001 DIODE	1
13	5A-8019	D2 THRU D9	1N4148 DIODE	8
14	5A-8014	S1 THRU S8	2N5060 SCR	8
15	5A-8080	C1 THRU C14, C24 THRU C26, C30, C34, C38, C42, C48	0.1 MFD. (+50-20%) CERAMIC CAPACITOR (50V)	27
16	5A-8095	C16 THRU C23	1 MFD. (10%) POLYESTER FILM CAPACITOR	18
17	5A-8065	C39 THRU C45, C49 THRU C56	470 PFD. (20%) CERAMIC CAPACITOR 50V	16
18	5A-8086	C15	100 MFD. ELECTROLYTIC CAPACITOR (10V)	1
19	5A-8096	C36	1 MFD. (+50-20%) CERAMIC CAPACITOR (50V)	1
20	5A-8091	R1 THRU R4, R27, R7 THRU R92, R151 THRU R155	4.7K OHM RESISTOR 10% 1/4 WATT	62
21	5A-8068	R25	3.3K OHM RESISTOR 10% 1/4 WATT	1
22	5A-8084	R56, R57, R58, R103, R105, R106, R107, R108, R109, R110, R111, R112, R113, R114, R115, R116, R117, R118, R119, R120 THRU R211	1K OHM RESISTOR 10% 1/4 WATT	32
23	5A-8092	R7, R10, R11, R16, R19, R22, R29, R37, R45, R50, R41, R44, R47, R50, R53, R54, R59, R62, R65, R66, R71, R74	500 OHM RESISTOR 10% 1/4 WATT	22
24	5A-8093	R4, R11, R14, R17, R18, R19, R21, R23, R24, R25, R26, R28, R30, R31, R32, R33, R34, R35, R36, R38, R39, R40, R42, R43, R46, R48, R49, R51, R52, R54, R55, R57, R58, R60, R61, R63, R64, R67, R68, R70, R72, R73	68 OHM RESISTOR 10% 1/2 WATT	22
25	5A-8097	R9, R12, R15, R18, 121, R24, R25, R28, R33, R34, R40, R43, R46, R48, R49, R51, R52, R54, R55, R57, R58, R60, R61, R63, R64, R67, R68, R70, R72, R73	2.7K OHM RESISTOR 10% 1/4 WATT	23
26	5A-8087	R26	10 K OHM RESISTOR 10% 1/4 WATT	1
27	5A-8095	R141 THRU R148	2.2K OHM RESISTOR 10% 1/4 WATT	8
28	5A-8039	R149 THRU R156	27 OHM RESISTOR 10% 1/4 WATT	8
29	5A-8084	R59, R103, R105, R106, R108, R109, R110, R111, R112, R113, R114, R115, R116, R117, R118, R119, R120	100 OHM RESISTOR 10% 1/4 WATT	8
30	5A-8085	R33, R34, R35, R36, R37, R38, R39, R40, R41, R42, R43, R44, R45	1.5K OHM RESISTOR 10% 1/4 WATT	8
31	5A-8081	R28, R104, R107, R108, R109, R110, R111, R112, R113, R114, R115, R116, R117, R118, R119, R120	4 OHM WIRE WOUND RESISTOR, 10% 1/4 WATT	8
32	5A-8094	Z1	RELAY - 4 POLE - 5 AMP. CONTACTS - 6 V.D.C. 30 OHM COIL	1
33	5A-8066	PR1 THRU PR5	6 PIN RECEPTACLE	5
34	5A-8077	PH1 THRU PH2	9 PIN HEADER	12
35	5A-8085	PH1 THRU PH3	10 PIN I.C. SOCKET	3
36	5A-8086	R74, R101, R102, R113, R114, R115, R116, R117	6.8K OHM RESISTOR 10% 1/4 WATT	6

TOLERANCES		WILLIAMS ELECTRONIC MFG. CORP.	
UNLESS OTHERWISE SPECIFIED		3401 N. CALIFORNIA CHICAGO 18, ILL. CORNELIA 7-2240	
FRACTIONS	1/64	NAME DRIVER BOARD ASSEMBLY MATERIAL _____ HEAT TREATMENT _____ FINISH _____ DWN. _____ DATE 8-16-77 APPD. _____ SCALE 1:1 D-7997	
DECIMALS	± .008		
HOLES	± .008		
ANGULAR	± 1/2°		

D-7998
DOCUMENT #2



E	J16 WAS A7, J125 WAS H6, J35 WAS G, J44 WAS F, J35 WAS B5, J44 WAS C6, J176 WAS B5, DELETED BY S11 WAS C62 & ADDED "NOT USED"	R. GAY
D	R22 WAS 10K 9-7-77	R. GAY
C	REVISED WIRE LEAD TO #21 OF IC6 & #4 OF IC18, WAS #3 OF IC6 & #2 OF IC18. 9-6-77	R. GAY
B	ADDED C65 & IC25 8-25-77	R. GAY
A	REVISION "A"	
0-24-77	REVISION	BY



TOLERANCES UNLESS OTHERWISE SPECIFIED		WILLIAMS ELECTRONIC MFG. CORP. DIVISION OF THE RESOURCE CORP.		
FRACTIONS	± 1/64	3401 N. CALIFORNIA	CHICAGO 18, ILL.	CORNELIA 7-3240
DECIMALS	± .008	NAME SCHEMATIC, CPU BOARD		
HOLES	± .002	MATERIAL		
ANGULAR	± 1/2°	HEAT TREATMENT		
FINISH		FINISH		
DWG. NO. W-20		APPD. 4/23/77		SCALE
REV. 1		DATE		NO. D-7998