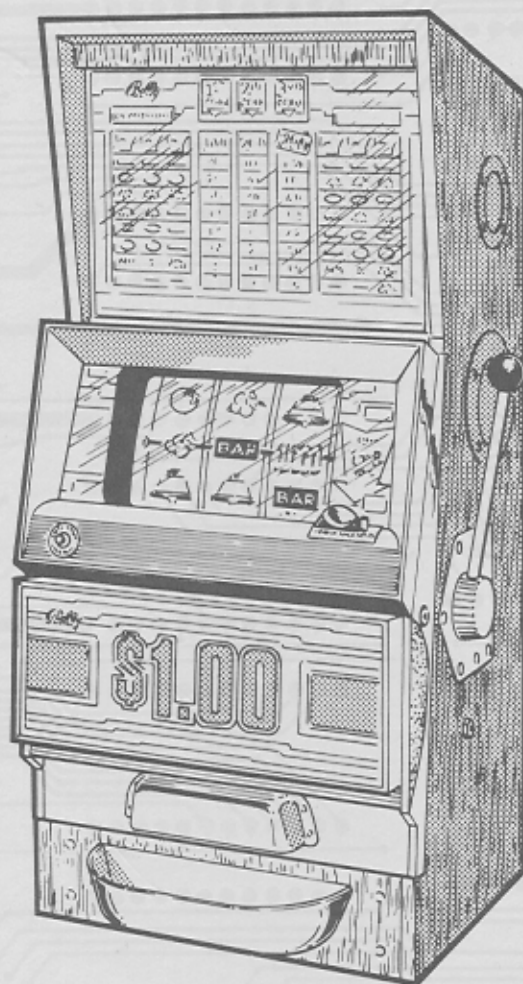


# SERIES V

Manual FO-850-1



Models V-1088  
and V-1090

## Operator Instructions Manual

*Bally*

Manufacturing Corporation  
Export Corporation

2640 Belmont Avenue, Chicago, Illinois 60618 USA  
Telephone: (312) 267-6060 Cables: Balfan Telex: 253076

© 1983 Bally Mfg. Corp.  
All Rights Reserved

-WARNING-

THIS GAME MUST BE GROUNDED! FAILURE TO DO SO  
MAY RESULT IN THE DESTRUCTION OF ELECTRONIC  
COMPONENTS.

RADIO INTERFERENCE NOTICE: This equipment generates, uses and can radiate radio frequency energy. If not installed and used in accordance with the Instruction Manual, this equipment may cause interference to radio communications. As required by FCC regulations, this equipment has been tested and found in compliance with Subpart J and Part 15 of FCC regulations, which are designed to provide reasonable protection against such interference. However, although this equipment complies with all applicable FCC regulations, operation of this equipment in a residential area may cause interference, in which case the equipment user will be required to implement whatever measures may be necessary to eliminate said interference at his/her own expense. BALLY MANUFACTURING CORPORATION is in no way liable for any additional expenses involved with elimination of interference, or for any consequential damages or injuries.

BALLY Manufacturing Corporation maintains a toll-free telephone number which can be used to obtain service information for BALLY manufactured equipment at your location.

**1-800-HOT-SLOT**

COPYRIGHT 1983 BY BALLY MFG. CORP. ALL RIGHTS RESERVED

NO PART OF THIS PUBLICATION MAY BE REPRODUCED BY ANY MECHANICAL, PHOTOGRAPHIC, OR ELECTRONIC PROCESS, OR IN THE FORM OF A PHONOGRAPHIC RECORDING, NOR MAY IT BE TRANSMITTED, OR OTHERWISE COPIED FOR PUBLIC OR PRIVATE USE, WITHOUT PERMISSION FROM THE PUBLISHER.

FOR PERMISSION REQUESTS WRITE:

**BALLY MANUFACTURING CORP.**

**2640 W. BELMONT AVENUE**

**CHICAGO, IL 60618 U.S.A.**



# TABLE OF CONTENTS

1. INTRODUCTION .....	3
2. LOCATION AND SETUP	
Inspection .....	7
Installation .....	7
Volume Adjustment .....	8
Setting Option Switches .....	9
3. GAME OPERATION	
Ready-to-Play Mode .....	11
Play Mode .....	11
Bookkeeping Meters .....	12
Diagnostic Mode .....	13
4. TROUBLESHOOTING	
General Suggestions .....	20
Malfunction Codes .....	21
Glossary of Microprocessor Terms .....	22
The Z-80 CPU .....	23
5. MAINTENANCE AND REPAIR	
General Cleaning .....	25
Coin Acceptors .....	25
Mechanical Coin Acceptors .....	25
Electronic Coin Acceptors .....	27
Fuse Replacement .....	28
Hopper Mechanism .....	29
Printed Circuit Board Replacement .....	32
CRT (Cathode Ray Tube) Video Monitor Replacement .....	34
Recommended Spare Parts List .....	35
6. SCHEMATICS AND DIAGRAMS	
List of Required Drawings .....	37
7. T.V. MONITOR MANUAL	
Introduction .....	41
Symptom Diagnosis .....	41
Guide to Schematic Symbols .....	44
Troubleshooting .....	46
Theory of Operation .....	49
Differences Between Monitors .....	53

# LIST OF ILLUSTRATIONS

Page No.

Figure 1,	Overall View of Machine.....	3
Figure 2,	Overall View of Machine W/ Front Door Open and Major Items Identified.....	4
Figure 3,	Connector Location Diagram.....	5
Figure 4,	Line Code Plug Voltage Chart.....	6
Figure 5,	Volume Adjustment Pot Location.....	8
Figure 6,	DIP Switch Location.....	9
Figure 7,	DIP Switch Settings.....	9
Figure 8,	DIP Switch Bit Numbers.....	10
Figure 9,	Ready-to-Play Mode Display.....	11
Figure 10,	Play Mode Display.....	11
Figure 11,	Typical Feature Glass Pay Schedule.....	11
Figure 12,	Play Mode Final Display.....	12
Figure 13,	Activation of Keyswitch.....	12
Figure 14,	Bookkeeping Meter Display.....	12
Figure 15,	Reset Pushbutton Location.....	13
Figure 16,	Coin-In and Coin-Drop Switch Location.....	13
Figure 17,	Diagnostic Mode Keypad Location.....	14
Figure 18,	Pressing "TEST" on Keypad.....	14
Figure 19,	Menu "B" Displayed.....	15
Figure 20,	Menu "A" Input Test Displayed.....	15
Figure 21,	Menu "A" Output Test Displayed.....	15
Figure 22,	Menu "A" Sound Board Test Displayed.....	16
Figure 23,	Menu "A" DIP Switch Input Test Displayed.....	16
Figure 24,	Menu "A" Align and Color Bar Test Displayed.....	16
Figure 25,	Menu "A" PROM Test Displayed.....	17
Figure 26,	Menu "B" Change Meter Values Displayed.....	17
Figure 27,	Menu "B" Change Meter Values W/ "NEW VALUE" Displayed.....	17
Figure 28,	Menu "B" Change Meter Values W/ "NEW VALUE" Entered and Displayed.....	18
Figure 29,	Menu "B" Hopper Coin Count Displayed.....	18
Figure 30,	Menu "B" Hopper Test Displayed.....	18
Figure 31,	Menu "B" Pay Verification Test Displayed.....	19
Figure 32,	Menu "B" Reinit Win Record Displayed.....	19
Figure 33,	Menu "B" Reel Test Displayed.....	19
Figure 34,	Typical Malfunction Code Display.....	21
Figure 35,	Z-80 CPU Pin Configuration.....	24
Figure 36,	Coin Acceptor Mechanism Location.....	25
Figure 37,	Removing Coin Acceptor.....	26
Figure 38,	Cleaning Mechanical Coin Acceptor Magnet.....	26
Figure 39,	Mechanical Coin Acceptor Lubrication.....	26
Figure 40,	Electronic Coin Acceptor Adjustment Location.....	27
Figure 41,	Fuse Location.....	28
Figure 42,	Hopper Rocker & Roller Assembly.....	30
Figure 43,	Hopper Coin Count Microswitch.....	30
Figure 44,	Rocker Pin Setscrew.....	30
Figure 45,	Hopper Level Sensing Microswitch.....	31
Figure 46,	Rocker & Roller Assembly Lubrication.....	31
Figure 47,	MCR II P.C.B. Rack Removal.....	32
Figure 48,	MCR II P.C.B. Rack Disassembly.....	33
Figure 49,	Remote Monitor Control Wiring Diagrams.....	50

# 1. INTRODUCTION

- CAUTION -  
DO NOT CONNECT GAME LINE CORD PLUG  
INTO POWER SOCKET UNTIL YOU HAVE  
READ AND UNDERSTOOD SECTIONS 1, 2, &  
3 OF THIS MANUAL.

NOTE: The word "user(s)" is defined in this manual as any person, partnership, company, or corporation, and/or their legal representatives, who own, operate, service, maintain, and derive profit from their association with this equipment. The word "player" is defined in this manual as any person who deposits money, tokens, or their equivalents into the machine described in this manual for the purpose of playing the game offered by the machine as defined by the rules and odds set by the machine's user(s).

This manual covers the set-up, operation, and maintenance of the BALLY Electronic Video Slot Machine, a single-player game displaying animated images of conventional symbols on simulated, slot-machine reels (see Fig. 1).

This machine features a large-scale-integrated circuit (LSI) microprocessor which is used to control all machine functions. This monolithic MOS device executes stored instructions to determine the structure and timing of game functions. A self-test, diagnostic mode built into the control system provides quick troubleshooting and primary fault diagnosis using monitor displays.

Control, address, and bi-directional data busses provide efficient communication links between the CPU, I/O, Video Generator, and Sound boards.

Switches serve as an input network while mechanical features are solenoid actuated.

The use of solid-state micro-computer electronics and a television display system results in a gaming device with less downtime, greater reliability, and potential for custom options and feature expansion.

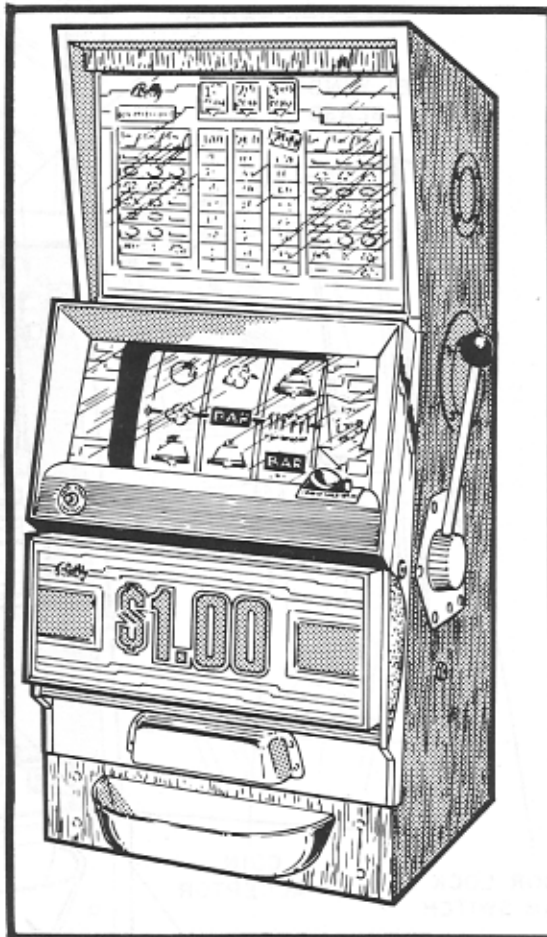


Fig. 1



## 2. LOCATION AND SETUP

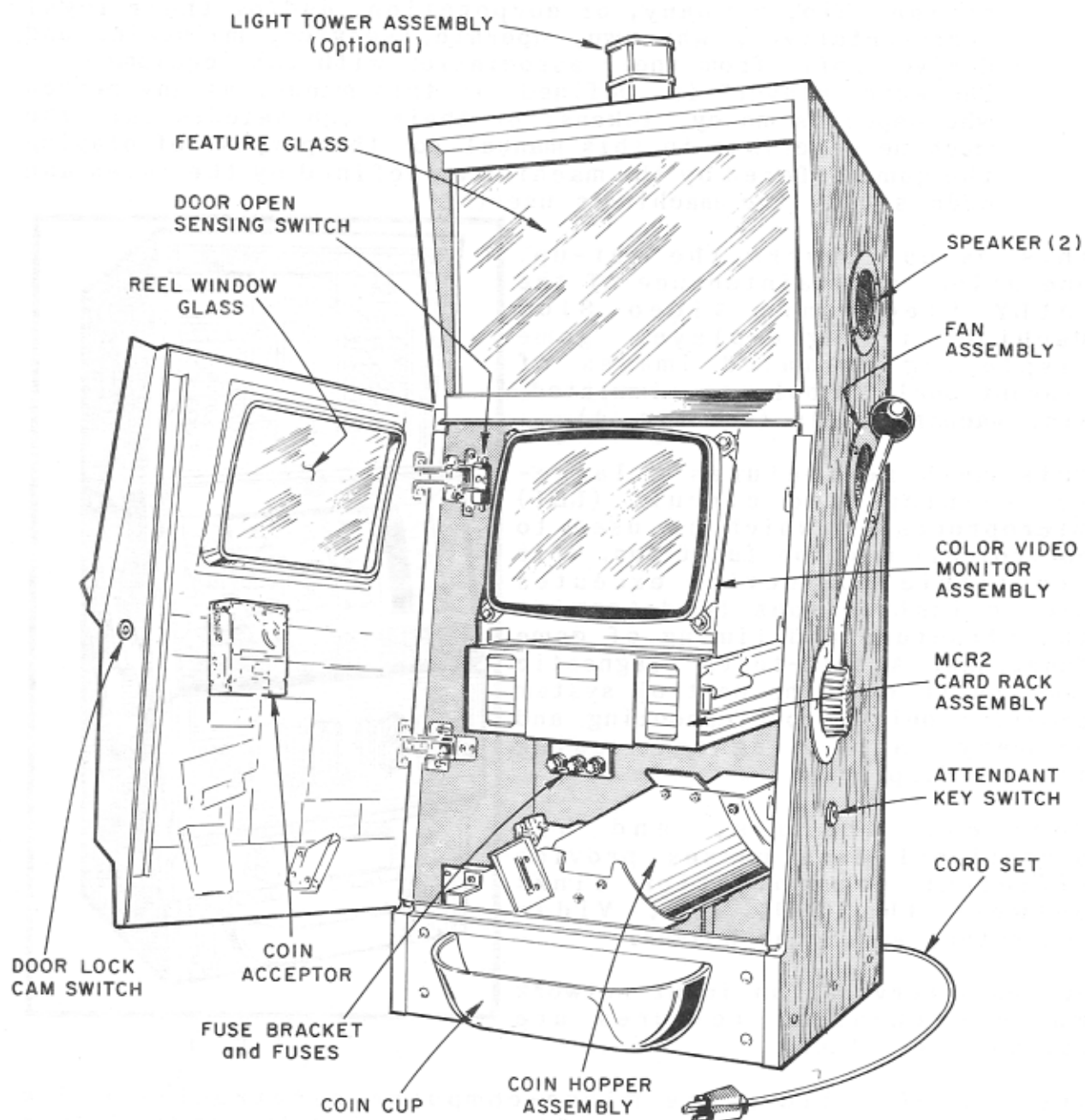


Fig. 2

## 2. LOCATION AND SETUP

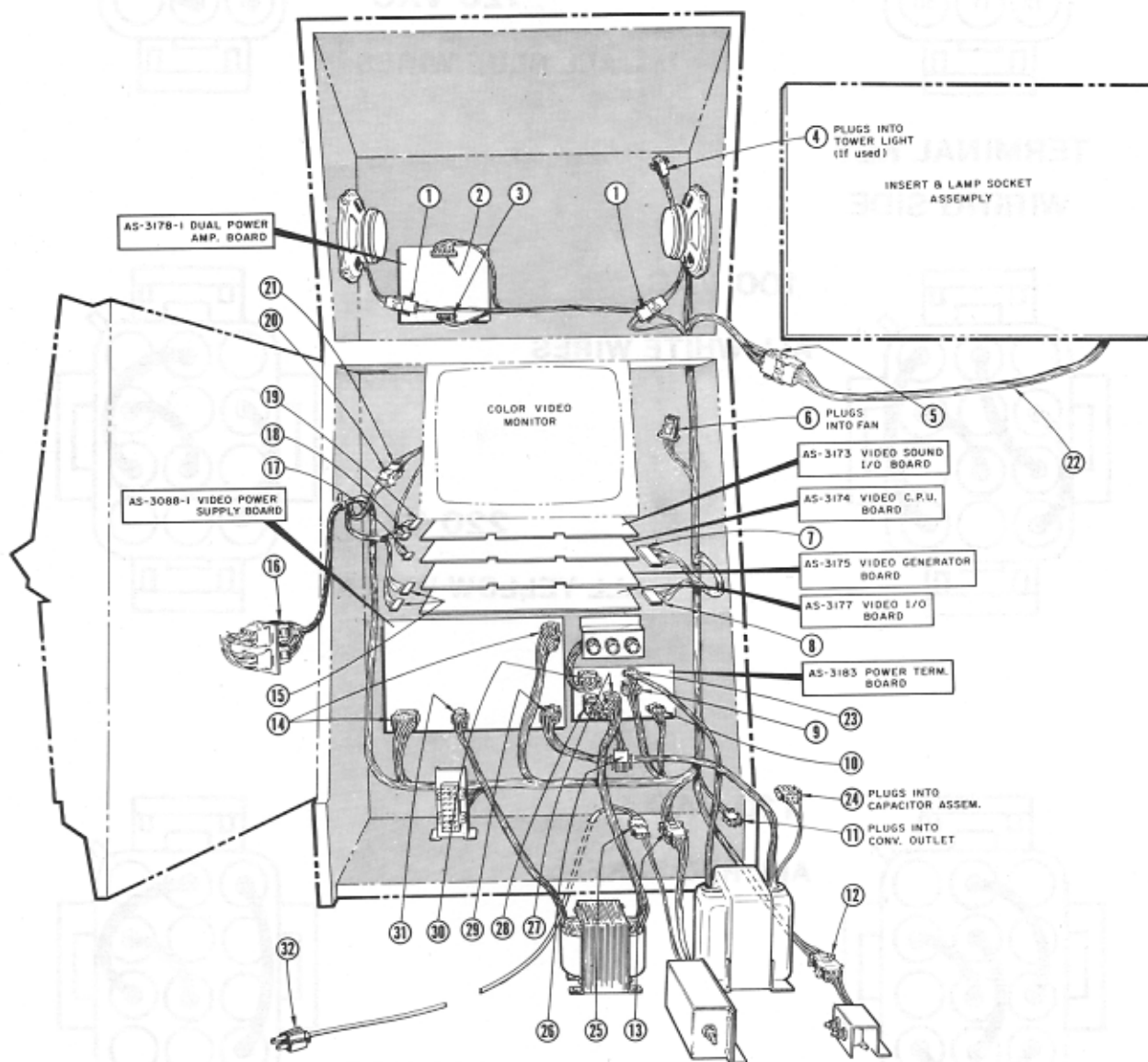


Fig. 3

## 2. LOCATION AND SETUP

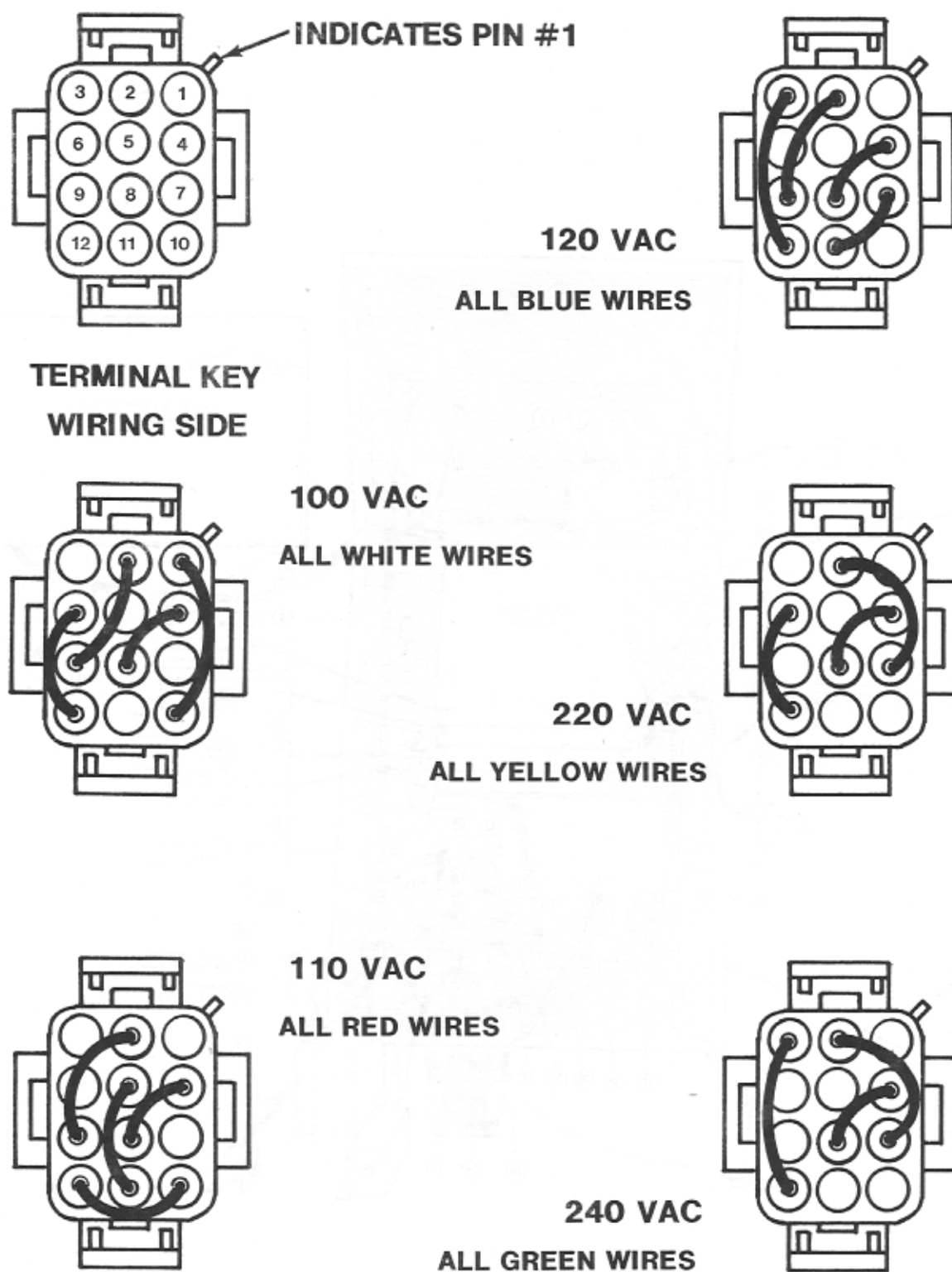


Fig. 4



## 2. LOCATION AND SETUP

### Inspection

1. Carefully remove the machine from its shipping crate.
2. Inspect the machine's exterior for any signs of damage.
  - Any scratches? Dents? Cracks?
  - Any broken controls?
  - Any broken glass or plastic?Check the machine carefully and list any signs of damage.
3. Remove shipping cleats from bottom of cabinet.
4. Open the front door of the machine and inspect its interior for any sign of damage and verify that all plug in connectors on the wiring harness are firmly seated. Plug in any connectors found loose (see Fig. 2, pg. 4 & Fig. 3, pg. 5).

#### - CAUTION -

DO NOT FORCE PLUGS ONTO CONNECTORS.  
DO NOT FORCE PLUGS TOGETHER. ALL  
CONNECTORS OR PLUGS ARE KEYED TO GO  
TOGETHER ONLY WHEN ALL PINS ARE  
PROPERLY ALIGNED.

If connectors won't go on easily and the keys are aligned, they either don't belong there or are damaged.

5. Verify that all printed circuit boards (P.C.B.'s) are firmly seated in their connectors (see Fig. 3, pg. 5). These connectors are also keyed and can only fit onto the P.C.B.'s one way without damage.

6. Check all major sub-assemblies and verify that they are securely mounted (see callouts Fig. 2, pg. 4).  
Some areas to check are:

Power Supply  
T.V. Monitor  
All P.C.B.'s and P.C.B. rack  
Transformer Assemblies

7. Make a list of all problems that you cannot correct.
8. Call your distributor and/or service people about your problem list.

### Installation

#### Power Requirements:

Domestic - 100 V. to 120 V. @ 60Hz.

Foreign - 200 V. to 240 V. @ 50Hz. (requires transformer change)

#### Temperature:

32 to 100 degrees F (0 to 38 degrees C)

## 2. LOCATION AND SETUP

### Installation (cont'd)

#### Humidity:

Not over 95% relative.

#### Space Required:

22" x 20" (56 cm x 51 cm)

#### Machine Height:

48" (122 cm) 51" w/ optional tower light (130 cm)

This machine is designed to work properly on the available line voltage. Check the line voltage with a meter, then check the "line code plug" on the machine's power terminal board (see Fig. 3, pg. 5). Compare the machine's line code plug against the line code plug voltage value chart in Figure 4. If the measured line voltage and the machine's line code plug voltage match, the machine can be plugged in.

If the measured line voltage and the line code plug voltage differ by more than minus 15% or plus 10%, DO NOT PLUG IN THE MACHINE! Call the distributor and/or service personnel to correct the problem and prevent possible damage to the machine.

Set the main power toggle switch to the "ON" position. A series of 6 tones sounds and the start-up PROM test is displayed on the monitor before the machine enters the Ready-to-Play Mode. The vertical and horizontal placement of the monitor display can be adjusted using the 2 pots located near the main power switch.

#### Volume Adjustment

Open front door of machine using key provided. The audio control pot is located on the sound board (top board in the card rack) and is adjusted by sliding the card rack outward until the control pot is visible (see Fig. 5). Turn the adjustment wheel on the control pot until the sound volume is at the desired level, then slide card rack back into position and close front door.

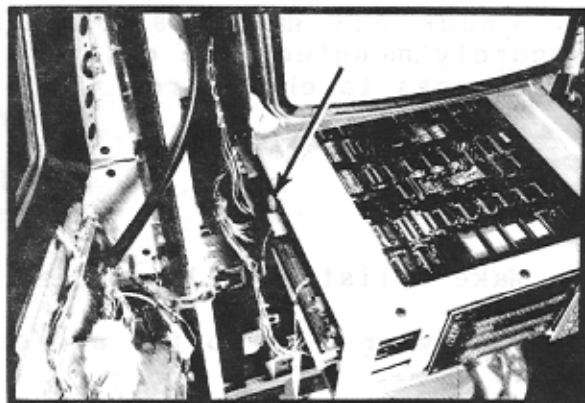


Fig. 5

## 2. LOCATION AND SETUP

### Setting Option Switches

The DIP switch package located on the sound board (see Fig. 6) has 10 single-throw switches which allow a selection of game features and other functions. The unused switches allow the addition of other machine features in the future.

Typical DIP switch settings and the functions they control are shown in Figure 7. Switch #10 must always be in the "RUN" position as shown.

When switch #2 is in the "OFF" position, no music will accompany a payout, but other game sounds are not affected.

Switch number 3 controls novelty animation features in the game display such as cherries "popping", bell clappers "clanging", and BAR symbols flashing when higher winning combinations occur. If switch #3 is "ON", animation is enabled, set to "OFF", animation is disabled.

When a winning combination requires a payout larger than hopper capacity, the machine will normally "lock-up" and wait for an attendant to make the payout and reset the machine. As an alternative to this, Switch #4 determines whether or not the machine prepays a certain amount of payouts larger than hopper capacity. If the switch is set to "MACH. & ATT.", the machine pays a pre-determined amount, then waits for attendant to pay balance and reset machine. If switch is set to "ATTNDNT. ONLY", the machine makes no payout on large winners, requiring attendant to pay entire amount and reset machine.

Switch #7 selects machine coinage between Eisenhower dollars and other coins.

Switch #8 selects either green or blue as the display background color.

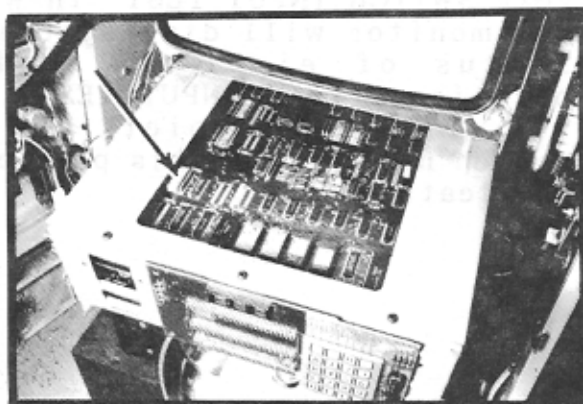


Fig. 6

LEFT		RIGHT	
	<input checked="" type="checkbox"/>	1	NOT USED
MUSIC ON	<input checked="" type="checkbox"/>	2	MUSIC OFF
NOVELTY ON	<input checked="" type="checkbox"/>	3	NOVELTY OFF
MACH. & ATT.	<input checked="" type="checkbox"/>	4	ATTNDNT. ONLY
	<input checked="" type="checkbox"/>	5	NOT USED
	<input checked="" type="checkbox"/>	6	NOT USED
IKE \$	<input checked="" type="checkbox"/>	7	QUARTER
GREEN	<input checked="" type="checkbox"/>	8	BLUE
	<input checked="" type="checkbox"/>	9	NOT USED
RUN	<input checked="" type="checkbox"/>	10	WAIT

Fig. 7



## 2. LOCATION AND SETUP

### Setting Option Switches (cont'd)

Switch operation can be checked by entering the Diagnostic Mode's "DIP SWITCH INPUT TEST" in which the monitor will display the bit status of eight DIP switch positions (see "INPUT TEST", pg. 14). Figure 8 depicts bit vs. switch numbers for this particular application.

SWITCH	BIT NO.
1	01
2	02
3	04
4	08
5	10
6	20
7	40
8	80
9	N/A
10	N/A

Fig. 8

### 3. GAME OPERATION

#### Ready-to-Play Mode

The Ready-to-Play Mode is where a player begins operation of the machine. When in this mode, the machine display is as shown in Fig. 9. The video monitor displays the final reel positions of the last game, the number of coins bet, and the amount won (paid out), if any.

#### Play Mode

The machine enters the Play Mode when a player inserts the first coin (see Fig.10). This illuminates the backlit "COIN ACCEPTED" message located on the reel glass. Player may now play game by pulling handle or increase bet by inserting more coins, up to the limit accepted by the game.

Each additional coin inserted causes the corresponding pay-schedule column on the feature glass to illuminate (see Fig. 11). Any coins inserted after the coining limit is reached are returned to the player. If an extra coin should get past before the coin deflector is in place, it will be credited toward the next game.

Player may pull handle at any time after inserting the first coin. The pulling of the handle causes the reel symbols to cock back. When handle travel limit is reached, reels appear to begin to "spin". All reels begin to spin simultaneously, then stop from left to right at 1/3 second (330ms) intervals. The reels appear to spin at a steady rate for approximately 1.5 seconds, then decelerate quickly for another 0.5 second. The spin ends with a damped "bounce" as the reels stop.

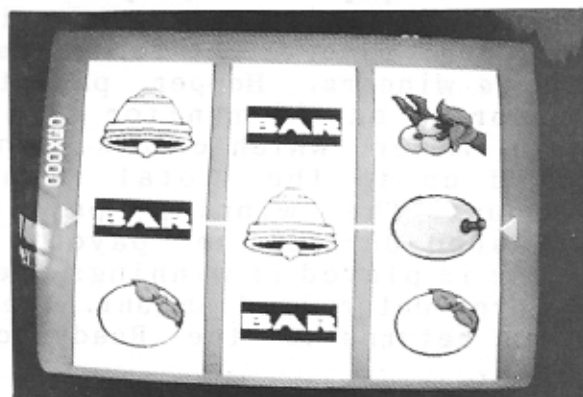


Fig. 9

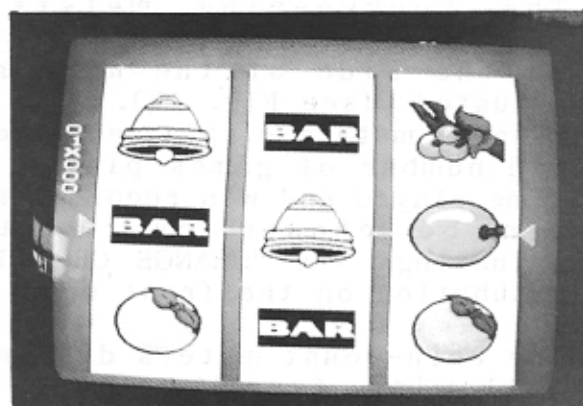


Fig. 10



Fig. 11

### 3. GAME OPERATION

#### Play Mode (cont'd)

If the reels stop in a winning combination, (see Fig. 12) the machine pays the player from the hopper or summons attendant via the optional tower light for payment of large winners. Hopper payouts are recorded on the monitor displayed win meter, which counts each coin paid up to the total winnings amount. The winning payline is flashed during the payout and a tune is played if winnings are over a pre-determined amount. The game then returns to the Ready-to-Play Mode.

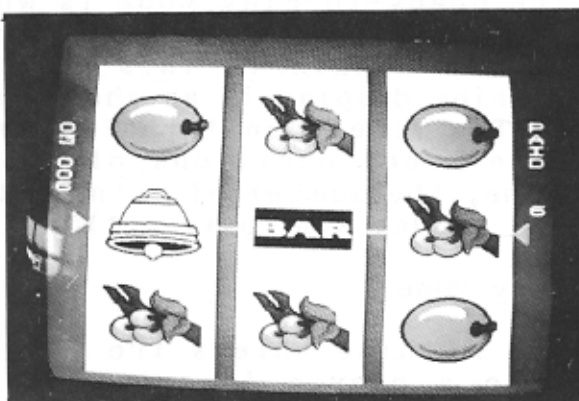


Fig. 12

#### Bookkeeping Meters

The bookkeeping meters are displayed whenever the key switch on the side of the machine is actuated (see Fig. 13). The bookkeeping meters display coin counts and number of games played. Last game played and win record displays can be chosen by manually actuating the "CHANGE OR SERVICE" pushbutton on the front door.



Fig. 13

The coin-count meters display the following: (see Fig. 14)

- COIN-IN (CN-IN) - Coins inserted into machine.
- COIN-OUT (CN-OUT) - Coins paid out of hopper.
- COIN-DROP (CN-DROP) - Inserted coins sent to coin drop.
- HOPPER - Inserted coins sent to hopper or current hopper contents.
- GAMES - Number of games played since last reset of meter.

The "METERS" column counts from 0-999,999 and resets at 1,000,000 to zero (0).

The "PERMTR" (permanent meter) column counts increment in parallel with the "METERS" column, are also 6 digit, and reset at 1,000,000.

	METERS	PERMTR	MD-MTR
CN-IN	88	511	216
CN-OUT	55	309	167
CN-DROP	0	126	
HOPPER	88		
GAMES	55	341	21

Fig. 14



### 3. GAME OPERATION

#### Bookkeeping Meters (cont'd)

The last column, "MCHMTR" (mechanics meter), is provided to record test play during maintenance or repair without disturbing the amounts stored in the "METERS" and "PERMTR" columns.

The condition of the front door determines which meters will increment. If the first coin of a game is inserted with the door closed, all coins subsequently inserted for that game will increment the values in the "METERS" and "PERMTR" columns. If the first coin is inserted with the door open, all coins subsequently inserted for that game will increment the "MCHMTR" column values, even if the door is closed after the first coin is inserted.

#### Diagnostic Mode

The Diagnostic Mode programmed into the machine software can assist in the troubleshooting of machine operating difficulties or component failures.

This mode is entered by opening the front door of the machine and pressing the reset button located on the hopper (see Fig. 15). One of the 2 diagnostic menus will now be displayed on the monitor (see Fig. 18, pg. 14). To select a menu item, manually actuate the coin-in switch to position the item selection cursor (pointer) next to the desired item. Manually actuate the coin-drop switch to execute the selected function (see Fig. 16). If the item is not of the self-returning type, depress the reset button to return to the menu. To return to normal operation from the menu, depress reset button. The following section contains detailed descriptions of the various diagnostic mode items and their use.

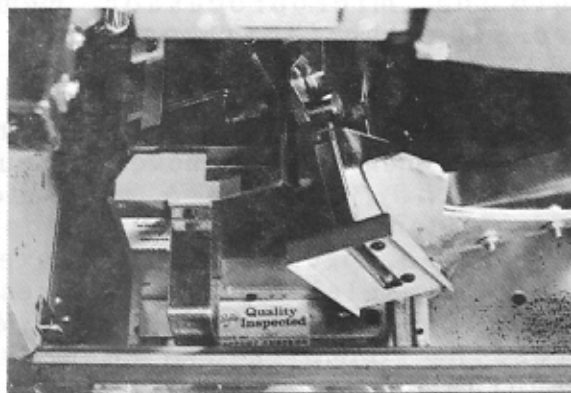


Fig. 15

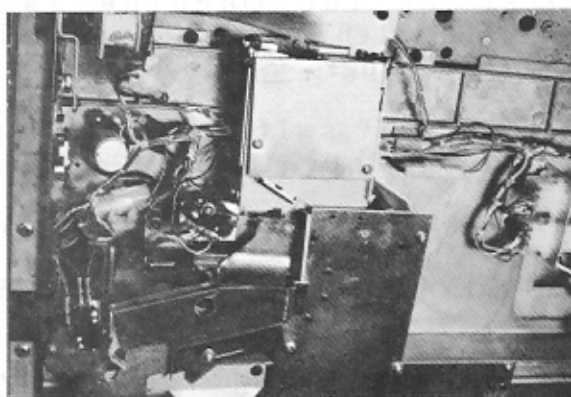


Fig. 16

### 3. GAME OPERATION

#### Diagnostic Mode (cont'd)

The optional touch-type keypad located on the MCR II card rack "Mother Board" (see Fig. 17) increases the versatility of the Electronic Video Slot Machine's built-in Diagnostic Mode. The keypad allows the operator to move the item selection cursor up as well as down, execute test functions, and enter desired bookkeeping meter values directly into the microprocessor memory. Pressing the "TEST" pad (see Fig. 18) causes one of the two diagnostic test menus to be displayed on the video monitor. To select a menu item, move the cursor using the "B" (up) & "C" (down) pads. When the cursor is properly positioned, press "TEST" to execute the the selected item. Pressing "GAME" once returns the main Menu, pressing "GAME" again returns the machine to normal operation. The following instructions detail the use of the keypad with each of the diagnostic mode menu items.

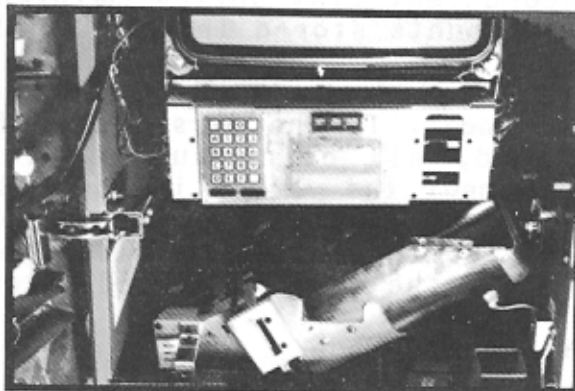


Fig. 17

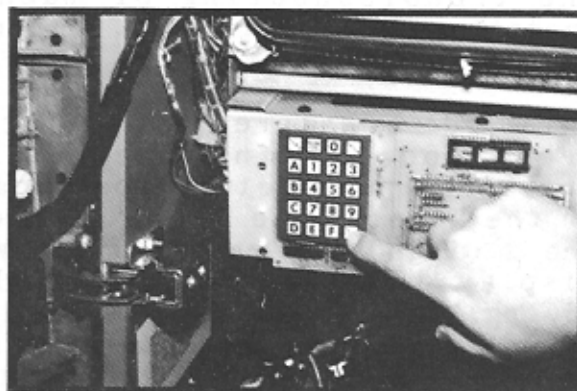


Fig. 18

NOTE: If the machine is not equipped with a keypad, substitute the following:

1. "COIN-IN" switch for "B" (up) & "C" (down). Note that coin-in switch only moves cursor down.
2. "RESET" button for "TEST" pad to enter the diagnostic mode.
3. "COIN-DROP" switch for "TEST" pad to execute selected menu items.
4. "RESET" button for "GAME" pad to return game to normal operation.

NOTE: Numerical values cannot be entered into the machine memory without using a keypad.

### 3. GAME OPERATION

#### Diagnostic Mode (cont'd)

##### MENU A:

"GO TO MENU B" - Press "TEST" and monitor displays Menu B (see Fig. 19).

"INPUT TEST" - Monitor displays 5 eight-bit input ports (00,01,02,24,2C,28). By manually actuating various input switches and observing their bit status on the monitor (see Fig. 20) it is possible to verify proper input operation. The monitor also displays the name of the input operation ("DROP HIT" or "DROP REL" etc.)

"OUTPUT TEST" - Monitor displays the "OUTPUT TEST MENU" (see Fig. 21). The cursor appears next to "AUTO TEST" each time this item is entered. Press "TEST" again and the machine will automatically actuate each output in the sequence displayed on the "OUTPUT TEST MENU" then return the cursor to "AUTO TEST". Outputs can be individually checked by positioning the cursor next to the desired output and pressing "TEST". Output will be actuated once, and can be actuated again by pressing "TEST".

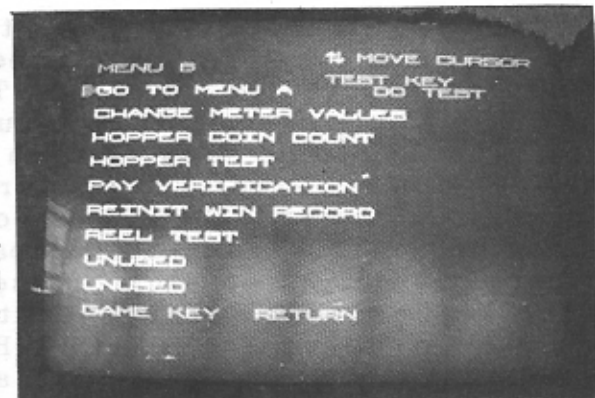


Fig. 19

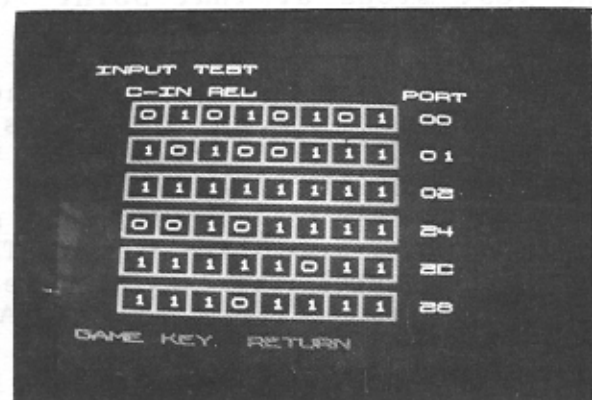


Fig. 20

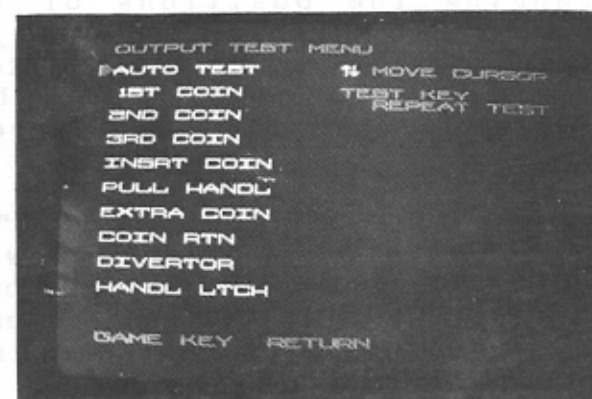


Fig. 21

### 3. GAME OPERATION

#### Diagnostic Mode (cont'd)

"SOUND BOARD TEST" - Monitor displays game copyright date, model number and payout percentage. The test then causes 4 Hex values (00,FF,55,AA) to be sent to each of the 4 sound board input ports (1F,1E,1D,1C) and wait for those values to return from sound-board output port 07. After each of the 4 test values is received, the monitor displays a "RECEIVED" message next to each value. If any value is not returned from port 07, a "NOT RECEIVED" message is displayed next to that value and the test stops at that point (see Fig. 22).

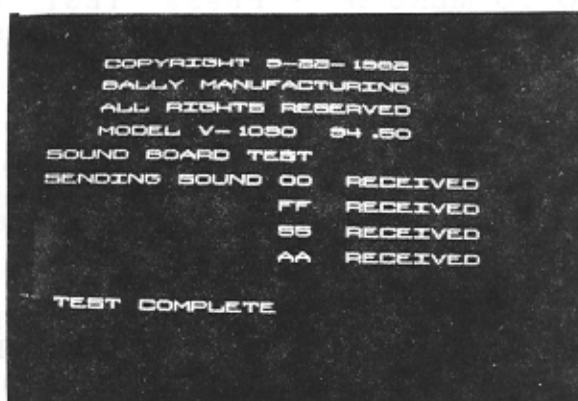


Fig. 22

Next, an internal RAM and ROM check is performed. If a defect exists in the RAM or ROM's 0 through 3, the defective I.C. is identified on the monitor display. If no defects are found, the monitor displays "TEST COMPLETE" and the test self-terminates and returns to Menu A.

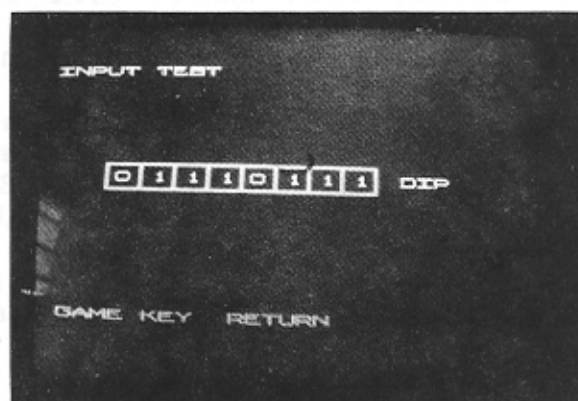


Fig. 23

"DIP SWITCH INPUT TEST" - Monitor displays the bit status of eight of the switch positions on the sound I/O board DIP switch (see Fig. 23). Changing the positions of the individual switches changes the bit status displayed on the monitor, verifying that the switch bit status has changed to the correct value.

"ALIGN AND COLOR BAR TEST" - Monitor displays a blue field with a white alignment grid superimposed (see Fig. 24). Display changes once each time "TEST" is pressed, and monitor will display each of the primary colors (red, blue, and green) with or without an alignment grid.

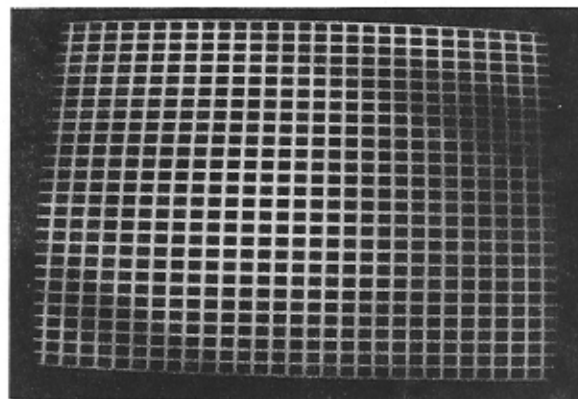


Fig. 24



### 3. GAME OPERATION

#### Diagnostic Mode (cont'd)

"PROM TEST" - Monitor displays the model number, payout percentage, and an "OK" or "NOT OK" message for each PROM, 0 through 6 (see Fig. 25). Test then self-terminates and returns to Menu A.

"OPM (output map) TEST" - Not intended for field use. This item can be entered by pressing "TEST". The monitor will either display the 5 byte values sent to the output ports listed on the right side of the display or "NO OPM". In either case, no change can be made in the display.

"BURN-IN TEST" - If "TEST" is pressed, monitor displays "BURN-IN TEST NOT IMPLEMENTED".

#### MENU B:

"GO TO MENU A" - Press "TEST" and monitor displays Menu A.

"CHANGE METER VALUES" - Monitor displays a 3 column set of book-keeping meters ("METERS", "PERMTR", "MCHMTR") identical to those displayed when the key switch is actuated (see Fig. 26).

Any of the numerical values in the "METERS" or "MCHMTR" columns can be changed after this mode is entered. Enter the desired new value using the numerical portion of the keypad and monitor displays the new value below the meter columns (see Fig. 27). Position the cursor at the desired location and press "ENTER". The new value appears at that location, the cursor moves down one line, and monitor continues to display the new value (see Fig. 28, pg. 18). If it is desired to enter the new value at the next location, press "ENTER" again. Each time "ENTER" is pressed without changing to a different new value or returning to game, the displayed

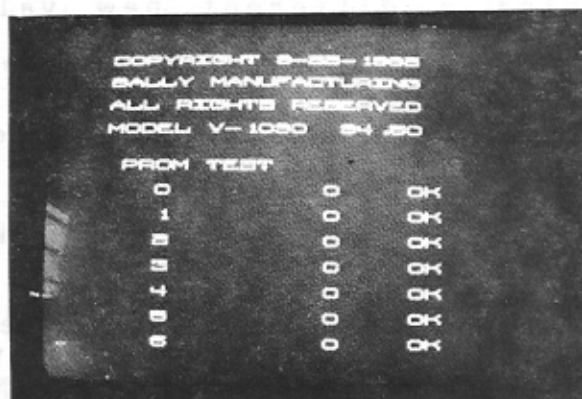


Fig. 25

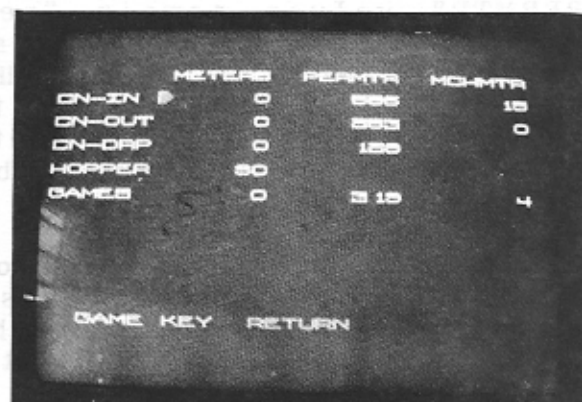


Fig. 26

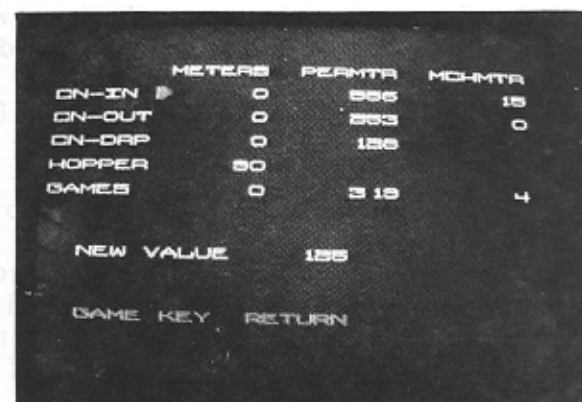


Fig. 27



### 3. GAME OPERATION

#### Diagnostic Mode (cont'd)

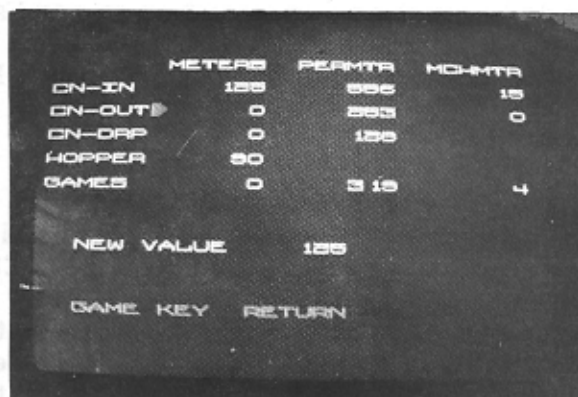
new value is entered, and the cursor moves down one line. To enter a different new value, position the cursor, use the numeric pads, and press "ENTER".

The "PERMTR" column values are intended as a semi-permanent record of machine operation and they cannot be modified unless an emulator is connected to a keypad-equipped "Mother Board" on the front of the card rack. With the emulator connected, the byte at location 7000 (Hex) must be set to TRUE (FF Hex) to enable "PERMTR" column to be reset. Once this change has been performed, the cursor will stop at each location in the "PERMTR" column. The "PERMTR" values remain "reset enabled" while the machine is in the emulator modified "CHANGE METER VALUES" function. Upon exiting this function, location 7000 is reset to FALSE and the cursor reverts back to its regular function.

All meter values (bookkeeping, win record, and last game) are stored in safe RAM so that no loss of meter information occurs if machine is shutdown or in the event of power failure.

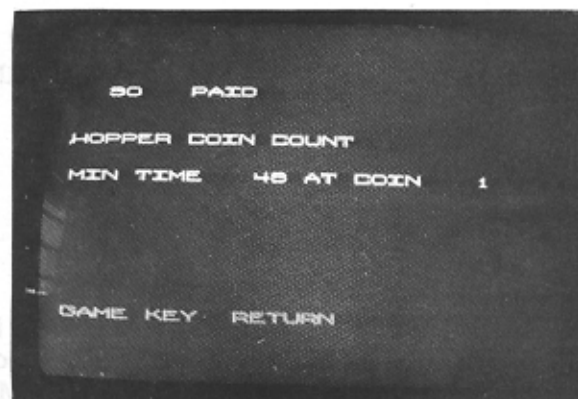
"HOPPER COIN COUNT" - Hopper motor energizes and pays out all coins in the hopper. Monitor displays the count, incrementing one number with each coin paid. Hopper shuts down automatically when empty and monitor displays final count (see Fig. 29)

"HOPPER TEST" - Hopper motor energizes, pays out 25 coins and shuts down. Monitor displays count as well as minimum and maximum count switch closure times, rounded to the nearest multiple of 16 milliseconds. An average of all counts is also displayed (see Fig. 30).



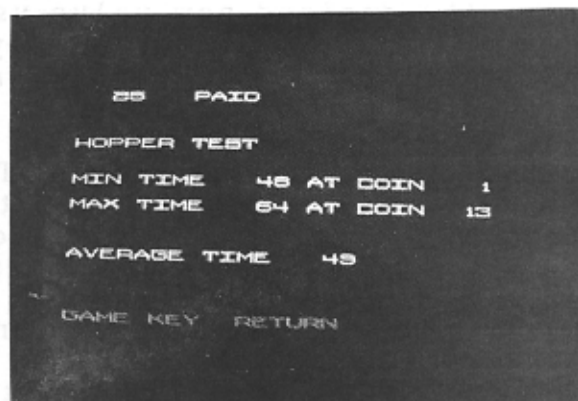
	METERS	PERMTR	MC-MTR
CN-IN	128	556	15
CN-OUT	0	555	0
CN-DRP	0	128	
HOPPER	50		
GAMES	0	3 15	4
NEW VALUE 128			
GAME KEY RETURN			

Fig. 28



50 PAID			
HOPPER COIN COUNT			
MIN TIME	48	AT COIN	1
GAME KEY RETURN			

Fig. 29



25 PAID			
HOPPER TEST			
MIN TIME	48	AT COIN	1
MAX TIME	64	AT COIN	13
AVERAGE TIME	48		
GAME KEY RETURN			

Fig. 30

### 3. GAME OPERATION

#### Diagnostic Mode (cont'd)

"PAY VERIFICATION"-Monitor displays results of production line pay verification test. This is shown in a four-column format, with the numbers displayed in the first column relating to winning combinations (i.e., 1=cherry-cherry-cherry, 2=bar-cherry-cherry, etc.). The second column number equals how many times a given winning combination occurred during the test, with the third column indicating how many coins would be paid out for such a winning combination based on a one-coin bet. The fourth column contains the total number of coins paid out for the total number of times a given winning combination occurred during the test (see Fig. 31).

"REINIT WIN RECORD" - Monitor displays win record meter with all combination counts set to zero (see Fig. 32).

"REEL TEST" - Monitor displays all reels in slow motion so that all symbols on all reels can be checked (see Fig. 33).

The "UNUSED" items listed on Menu B have no function or test that can be performed at this time.

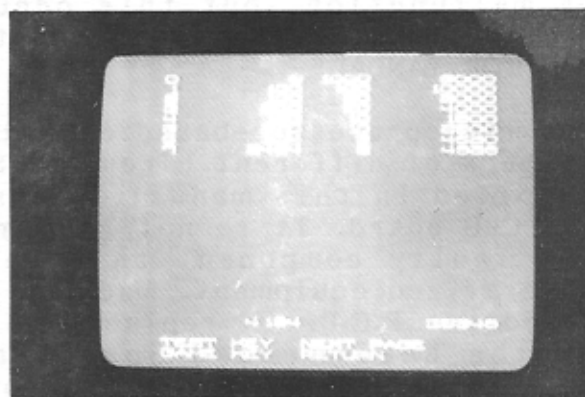


Fig. 31



Fig. 32

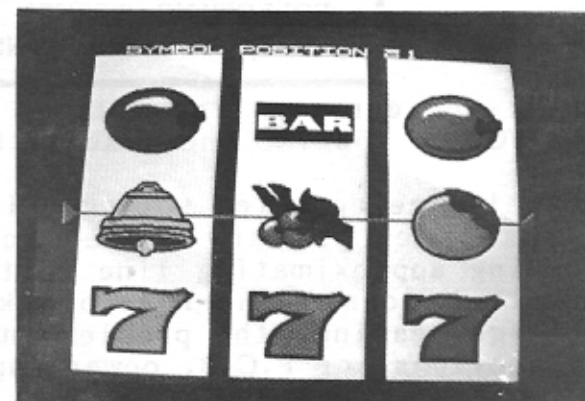


Fig. 33

## 4. TROUBLESHOOTING

### General Suggestions

Most common machine problems occur in harness components such as the coin acceptor, player controls, interconnecting wiring, etc. The television monitor and microprocessor computer can also fail or malfunction, but this occurs infrequently. Procedures for troubleshooting the video monitor can be found in Section 7, "TV MONITOR MANUAL".

The microprocessor-based computer is a complex device with great numbers of different circuits. Some basic Z-80 CPU information is supplied in this manual to assist you in locating a problem in the CPU board. It is not recommended that you attempt to isolate the faulty component on a defective P.C.B., as this requires specialized equipment. Machine downtime is greatly reduced if the defective P.C.B. is replaced as a whole from the stock suggested by the Recommended Spare Parts List (see pg. 35) and the defective P.C.B. returned to your BALLY distributor.

Your machine must have the correct line voltage to operate properly. If the line voltage drops 15% below line-code plug value, the machine will shutdown.

Low line voltage may have many causes, some of which are related to electric utility output capacity and peak demand. If the malfunction seems related to a certain time of day, this may be a factor. A large electrical load (such as an air conditioner) or poor connections in location wiring, sockets, or game line cord can also cause this problem. Cold-solder joints in the harness, especially in the termination board connections or fuse block, can be suspected.

Machine's are sometimes inadvertently connected to lines having dimmer rheostats installed to dim lights. Voltage available for machine operation fluctuates as the dimmer position is changed.

#### -WARNING-

HAZARDOUS VOLTAGES ARE PRESENT AT THE POINTS BEING CHECKED IN THE FOLLOWING TESTS. TAKE ALL NECESSARY PRECAUTIONS AGAINST ELECTRIC SHOCK.

Check for correct line voltage using a VOM (Volt/Ohm Meter). Set the VOM to 250 VAC and insert the probes into the wall socket.

If wall receptacle voltage is correct, check the machine's transformer primary connections. If the VOM does not obtain a reading approximating line voltage, examine the solder joints on the transformer and fuse block. If the VOM does give a correct voltage reading, the problem must be in the transformer, harness connections, or P.C.B. power supply.

Check the transformer secondaries with the VOM set to 50 VAC and

## 4. TROUBLESHOOTING

### General Suggestions (cont'd)

correlate the readings with the schematic diagram. Be certain to check transformer ground potential as well, particularly if a "hum bar" is present on the monitor screen.

Other harness problems includes blowing fuses and malfunctioning controls. If these are suspected, first try inserting a new fuse, as old fuses may blow unexpectedly due to age. If the new fuse also blows, proceed to look for a short in the circuit.

Turn the power off and disconnect the devices that may be causing the problem, such as the monitor, transformer, and P.C.B. rack. Pull all connectors off each device, but do not allow connectors to touch. If necessary, insulate them with electrical tape. Connect the VOM across the terminals of the fuse block and set it to one of the resistance scales before turning on power. This will prevent the blowing of fuses while the circuits are checked.

Restore power and check the VOM reading. If the reading indicates that the short is now no longer present, begin reconnecting devices one at a time until the short returns. The last device reconnected is at fault. If a short or malfunction is suspected in the door, insert and lamp, or hopper assembly, they can be disconnected and inspected individually. If the VOM reads a short even after all devices have been disconnected, the fault lies within the harness itself and patient exploration will be required to reveal its location. First, carefully examine all harness wiring, checking for burned insulation, coins across connections, and incorrect terminal contact. If necessary, use the VOM to check each wire.

If a feature that is switch operated (front panel switches, etc.) does not function, use the Diagnostic Mode "INPUT TEST" (Section 3, pg. 15) to verify proper switch operation. Further tests can be performed with a VOM if desired. If the switch is defective, replace it.

### Malfunction Codes

During normal operation, the coin input, coin drop, and coin output (hopper), are constantly monitored. Any problem in these areas causes machine operation to stop, the optional tower light to illuminate, and the nature of the problem to be displayed on the video monitor. When the front door is opened to remedy the problem, a "CLEAR TILT WITH CLEAR KEY" message becomes visible at the top of the monitor screen (see Fig. 34). After the

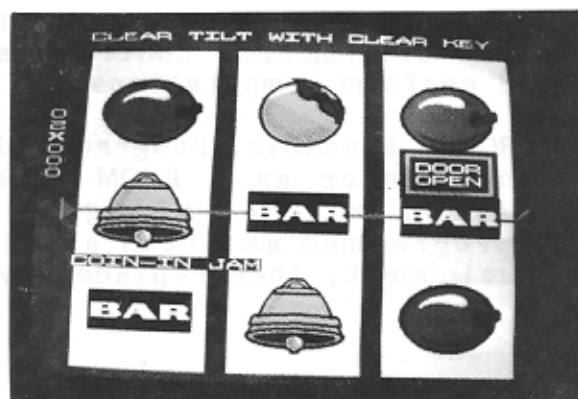


Fig. 34

## 4. TROUBLESHOOTING

### Malfunction Codes (cont'd)

problem has been corrected, pressing the "KEYBD. CLR." pad on the Diagnostic Mode keypad will remove the malfunction-code display from the monitor and return the machine to normal operation. The 5 malfunction codes that can be displayed are:

**COIN-IN JAM** - Caused by a coin jamming in the vicinity of the coin-in switch, forcing it to remain open for over 120 ms. This function also protects against slugs and "stringing". Attendant required to open door, clear jam, and return machine to normal operation.

**COIN-OUT JAM** - Caused by a coin jamming in the vicinity of the coin-out switch, forcing it to remain open for over 480 ms. This detects coin jams on the hopper (coin counting) coin-out switch. Attendant required to open door, clear jam, and return machine to normal operation.

**HOPPER DRY** - Caused by coin-out switch not sensing any coins for 7 seconds. Usually caused when no coins or tokens are available in hopper for payout. Also caused by a faulty hopper or faulty coin-out switch. Attendant required to open door, fill hopper or notify service personnel, and return machine to normal operation if possible.

**OVER PAY** - Caused by actuation of the coin-out switch at the wrong stage in the game. Protects against hopper tampering or a slow stopping hopper. Attendant required to open door, check hopper and/or payout, notify service personnel if necessary, and return machine to normal operation.

### Glossary of Microprocessor Terms

**MICROPROCESSOR** - One of several microcircuits that perform the function of a computer CPU. Sections of the circuit have arithmetic and comparative functions that perform computations and execute instructions. The microprocessor section of a microcomputer can be on one or several integrated circuit chips.

**CPU** - Central Processing Unit. A computer system's "brain", whose arithmetic, control, and logic elements direct functions and perform computations.

**EPROM** - Erasable, Programmable Read-Only Memory. Operates in the same manner as a PROM except that user can also erase any program entered using an ultraviolet light bath. Can be reprogrammed as often as necessary during program design and development, then replaced by ROM for mass production.



## 4. TROUBLESHOOTING

### Glossary of Microprocessor Terms (cont'd)

ROM - Read-Only Memory. The binary on-off bit pattern containing the program is set into the ROM during manufacture, usually as part of the last metal layer placed onto the integrated circuit. ROM's are not erasable and can contain up to 32,000 bits of data which serve as the microprocessor's instructions.

RAM - Random Access Memory. Stores binary data bits as electrical charges in transistor memory cells. Can be read or modified through the CPU. Stores input instructions, results, and other constantly changed data. Erased when power is removed unless a "safe RAM" battery powered backup is provided.

LSI - Large Scale Integration. Formation of hundreds or thousands of gate circuits on semiconductor chips. Very Large Scale Integration (VLSI) involves microcircuits with the greatest component density.

MOS - Metal Oxide Semiconductor. A layered construction technique for integrated circuits that achieves the high component densities required by LSI and VLSI. Variations in MOS chip structures create circuits with high speed and low power requirements, or other design advantages. Static electricity will damage an MOS chip.

### The Z-80 CPU

The term "microcomputer" has been used to describe many different types of small calculating or controlling devices in the last few years. With the advent of MOS LSI technology, however, it has become possible to construct small, powerful computers using only a few MOS LSI components.

The Zilog Z-80 family of I.C. components used in this machine can be used with any type of standard semiconductor memory to create computer systems with many different capabilities.

As used in this machine, the Z-80 microcomputer consists of three parts:

1. CPU (Central Processing Unit)
2. Memory (ROM, PROM, EPROM, and/or RAM)
3. Interface circuits to peripheral devices (I/O circuits)

The CPU is the heart of the system. Its function is to obtain instructions from the memory and perform the desired operations. The memory contains instructions for use by the CPU and other data on game status. In a typical instruction sequence the CPU will read data from a specific peripheral device, store it in the memory, check parity, and write data out to another peripheral device.

The 8-bit arithmetic and logic instructions of the CPU are

## 4. TROUBLESHOOTING

### The Z-80 CPU (cont'd)

executed in the Arithmetic Logic Unit (ALU). Internally, the ALU communicates with the general purpose registers and the external data bus on the internal data bus. The functions performed by the ALU include:

Add	Left or right shifts or rotations (arithmetic and logical)
Subtract	Increment
Logical AND	Decrement
Logical OR	Set bit
Logical Exclusive OR	Reset bit
Compare	Test bit

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

The Z-80 CPU is packaged in an industry-standard 40 pin dual-in-line package. The I/O pins are shown in Fig. 35 and the function of each is described.

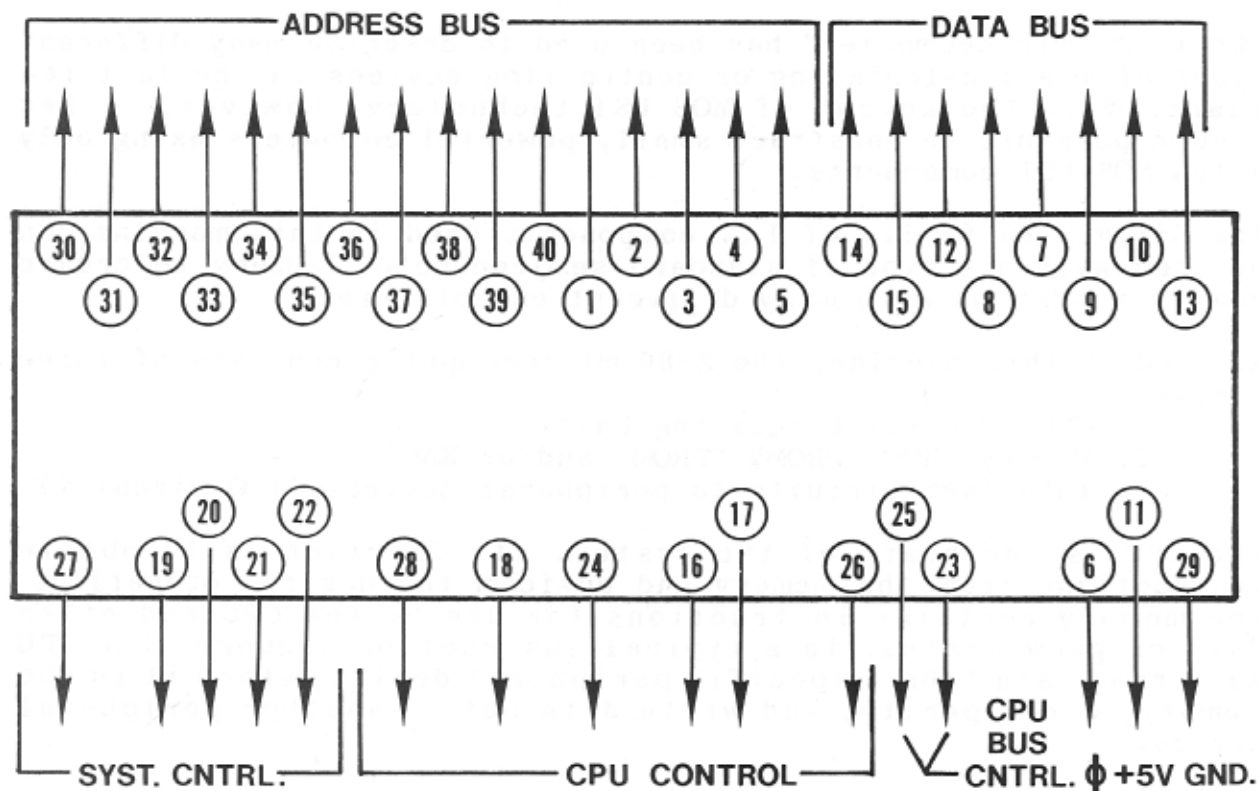


Fig. 35

## 5. MAINTENANCE AND REPAIR

Your BALLY Electronic Video Slot Machine requires regular maintenance to keep it in proper working order. Clean, well maintained machines attract more players and earn higher profits.

The most important part of a regular maintenance program is the machine's built-in Diagnostic Mode, which should be checked whenever the contents of the coin box are collected or the exterior of the machine is cleaned, whichever occurs most frequently. See Section 3, pg. 13 for detailed instructions on the Diagnostic Mode.

### General Cleaning

The outside of the machine cabinet and exterior metal trim can be cleaned with any non-abrasive household cleaner. The front of the picture tube and both sides of all other glass or plastic on or in the machine **MUST** be cleaned with an anti-static type cleaner **ONLY!**

### Coin Acceptors

Each machine is equipped with one coin acceptor designed to reject coins of incorrect weight, thickness, diameter, or metallic content. Two different coin acceptors are supplied, one electronic, the other mechanical. Both use the same mounting hardware and location. Each type has different maintenance requirements, which are described in the following sections.

### Mechanical Coin Acceptors

Many machine operating problems are related directly to the coin acceptor, which is often subjected to spilled beverages, food, and other foreign matter. This is a greater problem with mechanical acceptors, which must be removed and cleaned regularly to avoid game stoppage due to coin jams and related malfunctions.

To clean the coin acceptor, proceed as follows:

1. Open the front door using key provided and locate coin acceptor mechanism (see Fig. 2, pg. 4, & Fig. 36). Turn off main power switch.

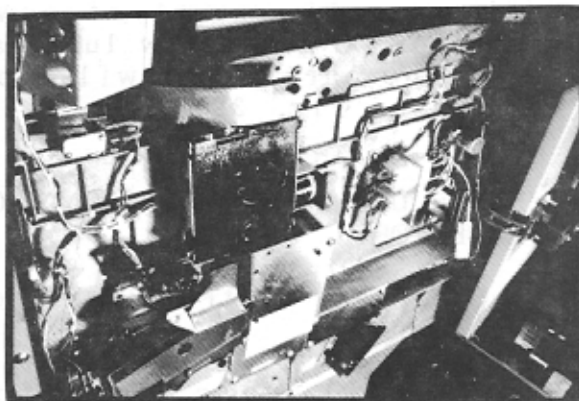


Fig. 36

## 5. MAINTENANCE AND REPAIR

### Mechanical Coin Acceptor (cont'd)

2. Lift the spring loaded latches from the top of the coin acceptor and pull the top of the acceptor away from its housing while holding the latches above the acceptor studs (see Fig. 37).

3. Release the latches and lift the coin acceptor out.

4. Open the coin acceptor gate and remove all metal debris from magnet by applying the blade of a screwdriver along the edges of the magnet (see Fig. 38).

5. Clean off all visible residue and foreign matter from coin acceptor using a brush. Clean the cradle pivot, bushings, and counterweight with a soft pipe cleaner. To complete the job, clean the coin acceptor using the special non-residue cleaner available from your distributor.

6. Lubricate the cradle pivot pin, bushing, and counterweight pivot with a small amount of powdered graphite. DO NOT allow lubricant to reach any parts that will contact coins (see Fig. 39).

**-CAUTION-**  
**NEVER USE OIL TO LUBRICATE COIN ACCEPTOR.**

7. Clear any obstructions from the coin chute.

8. Install coin acceptor by inserting studs on the bottom of the acceptor into the slots in the housing. Carefully push the top of the acceptor into position until the retaining latches snap into place and the acceptor is firmly held.

9. Plug game line cord into wall socket, turn main power on, and close front door. Machine is now ready for normal operation.

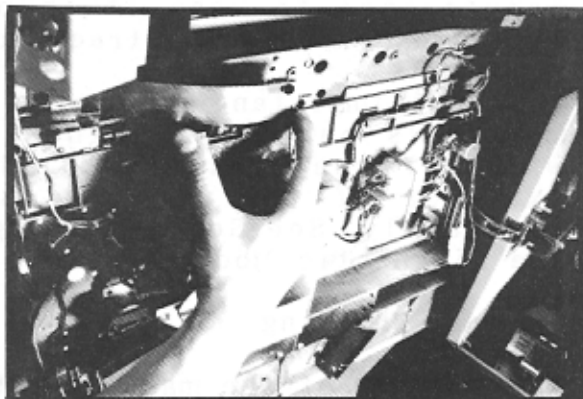


Fig. 37

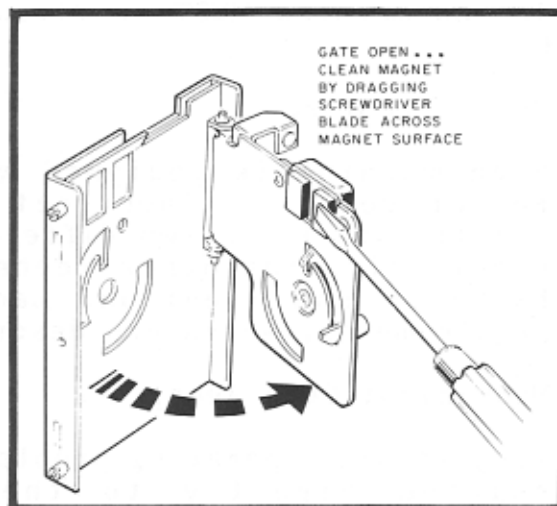


Fig. 38

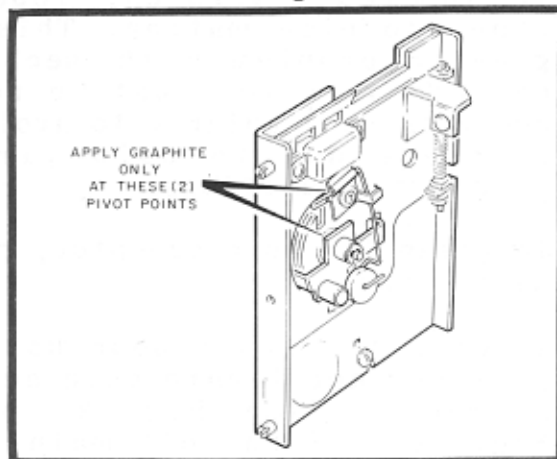


Fig. 39

## 5. MAINTENANCE AND REPAIR

### Electronic Coin Acceptor

Electronic coin acceptors operate in a fashion similar to metal detectors. Only one moving part is used, the solenoid actuated coin lockout. These coin acceptors have no mechanisms that can jam or clog with foreign matter. However, they do require sensitivity adjustments to insure that they operate correctly. This adjustment is performed as follows:

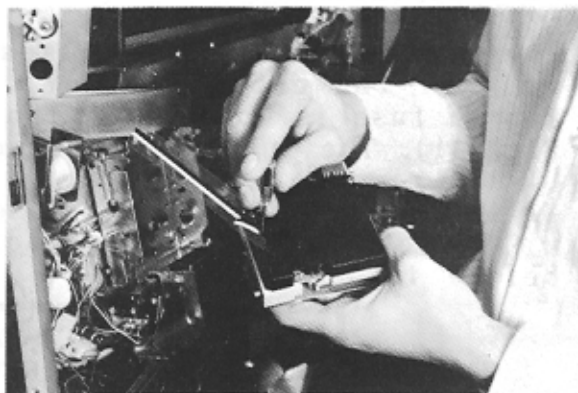


Fig. 40

1. Remove the coin acceptor from its mounting in the front door (see Fig. 37, pg. 26).
2. Locate the adjustment pot and LED on the coin acceptor (see Fig. 40).
3. Pass an acceptable coin through the unit while observing the LED. If the LED flashes and the coin is rejected, turn the pot clockwise. Repeat this procedure, turning the pot 1/4 turn at a time, until the LED stops flashing and the coin is accepted.
4. If coin is rejected and LED does not flash, turn pot 1/4 turn in a counter-clockwise direction. Repeat this procedure until coins are accepted. If LED begins to flash during this procedure, turn pot back clockwise until LED no longer flashes.
5. Within approximately 1 (one) full turn of the pot all good coins will be accepted. The optimum setting for most coins would be in the center of this turn.
6. Re-install coin acceptor in reverse of removal procedure.

It is possible to tune the acceptor for optimal rejection of certain types of slugs. To reduce lead slugging on dollar machines, turn the pot slightly clockwise from its "normal" setting. To increase coin feeding speed, adjust pot slightly counter-clockwise from normal. It is suggested that the unit be tuned for marginal accept/reject rates on the third coin of a three coin fast feed.

Before placing machine into normal operation, check coin acceptor tuning with a variety of coins to be certain that average coins are not rejected.

NOTE: Machines presently equipped with mechanical coin acceptors can be field retrofitted with electronic acceptors if so desired. Contact BALLY distributing or BALLY Mfg. for a copy of publication FO-850-5, "COIN ACCEPTOR CONVERSION".



## 5. MAINTENANCE AND REPAIR

### Fuse Replacement

The machine contains 4 fuses, 3 of which are located on the back wall of the cabinet liner, slightly below the card rack. The fourth fuse is located on the front of the hopper motor case (see Fig. 41). The fuses are housed in standard threaded holders.

If it is suspected that a fuse has blown, disconnect machine from wall socket, open front door, and turn off main power switch before inspecting fuses.

-WARNING-  
MACHINE CIRCUITRY INCLUDES A  
TELEVISION PICTURE TUBE AND VARIOUS  
CAPACITORS WHICH STORE HAZARDOUS  
CHARGES. GAME USER MUST PROVIDE ALL  
PROPER PRECAUTIONS AGAINST ELECTRIC  
SHOCK TO PERSONNEL SERVICING THIS  
MACHINE.

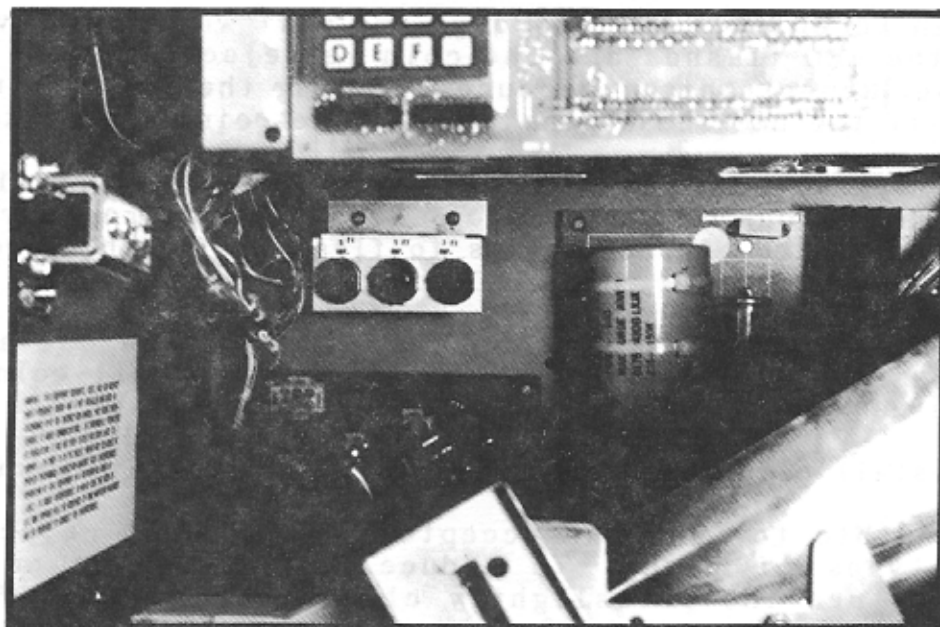


Fig. 41

Replace the blown fuse(s), plug the machine's line cord into a wall socket, and turn on the main power switch.

-WARNING-  
REPLACE A BLOWN FUSE WITH ONE OF  
IDENTICAL SIZE AND RATING. NEVER USE  
FUSES WITH AN AMPERAGE RATING HIGHER  
THAN THAT STATED IN THE ELECTRICAL  
DRAWINGS CONTAINED IN THIS MANUAL.

## 5. MAINTENANCE AND REPAIR

### Fuse Replacement (cont'd)

Test operate machine and if fuse blows again, disconnect game line cord from wall socket, open front door, turn off main power switch, and locate the cause of the blown fuse. Replace all components which show any evidence of having been damaged by a short circuit.

### Hopper Mechanism

The hopper unit is virtually identical to those used on earlier models of BALLY gaming equipment.

The hopper's 3 states of control are determined by the CPU as follows:

1. "OFF" in which the hopper lines are Disable LOW, Enable HIGH.
2. "TRANSITION" in which the hopper lines are Disable HIGH, Enable LOW.
3. "ON" in which the hopper lines are Disable HIGH, Enable HIGH.

The hopper drive motor is energized in the "ON" state and coins are dispensed. As each coin is dispensed, it lifts the roller mechanism, which actuates a microswitch, pulsing the I/O input to change logic levels and record a one coin payout in the machine's memory.

As previously mentioned, the hopper motor and control circuitry is protected by a 5 amp fuse located on the hopper motor case. A neon-bulb indicator illuminates when the hopper fuse is blown.

To remove the hopper unit, open the front door and remove the coin payout cup. The hopper can now be removed by grasping the handle on the hopper unit and pulling it forward, sliding the hopper out of the game.

Clean the hopper assembly with a degreaser or contact cleaner and wipe off all residue with a clean cloth.

The following are hopper maintenance operations which must be performed on a regular basis with frequency dictated by machine usage. These operations can also be performed whenever hopper problems are experienced.

## 5. MAINTENANCE AND REPAIR

### Hopper Mechanism (cont'd)

Check the hopper knife (see Fig. 42). The forward edge must press against the pin wheel and touch the edge of the shelf wheel. No coin should be able to wedge itself between the hopper knife and pin wheel while being dispensed. **DO NOT** apply grease or oil to this or any other area which contacts coins.

The hopper is equipped with a microswitch which is used to detect coins being paid out by the hopper. The mechanism which trips the microswitch is designed to provide a variable time delay between coin detection and actuation of the microswitch (see Fig. 43). Check for positive microswitch actuation with a coin directly beneath the roller. Verify that microswitch is open with no coin beneath the roller. To adjust the time delay, loosen the locknut on the rocker & roller adjustment screw and turn the screw until it is the required distance from the microswitch actuator blade to provide the desired time delay. Tighten locknut after adjustment is finished.

Tighten the rocker pin set screw until all play is taken up, then loosen screw 1/4 turn (see Fig. 44). Rotate the pin wheel manually. It must turn without binding (set screw overtightened) or wobbling (set screw too loose).

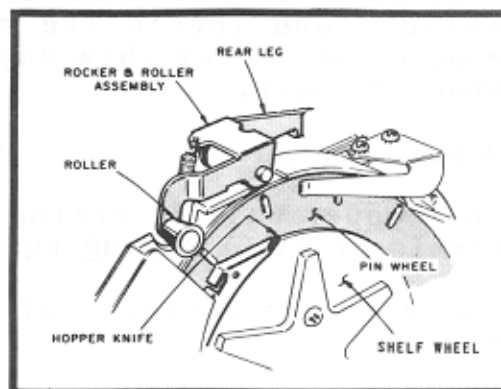


Fig. 42

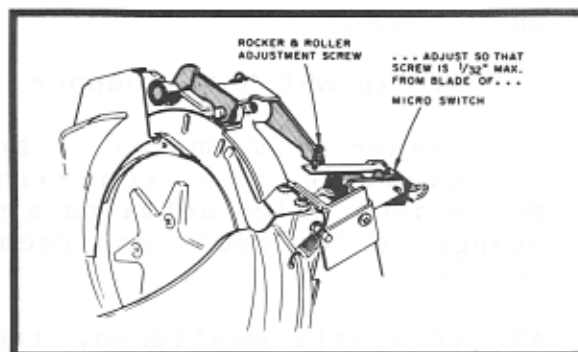


Fig. 43

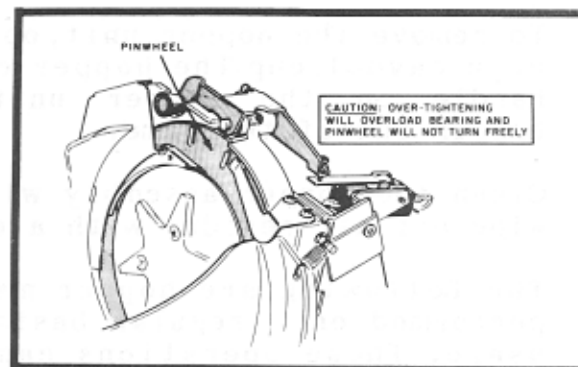


Fig. 44

## 5. MAINTENANCE AND REPAIR

### Hopper Mechanism (cont'd)

The hopper counterbalance must be adjusted with the desired level (number) of coins in the hopper. Slowly turn the set screw counter-clockwise until the microswitch clicks into the "down" position. The hopper is now set at the desired capacity (see Fig. 45).

Lightly grease both ends of the rocker & roller pivot pin and lightly oil rocker & roller shoulder pin. DO NOT allow grease or oil to reach parts which contact coins (see Fig. 46).

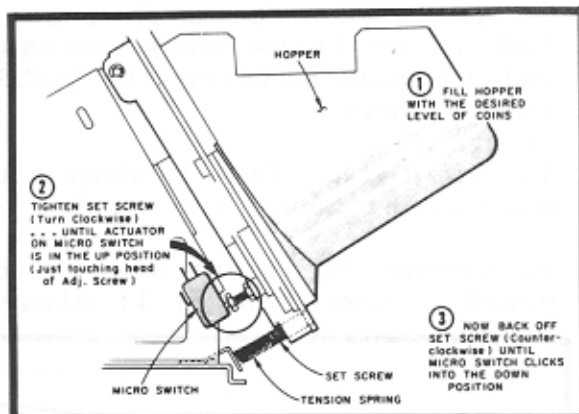


Fig. 45

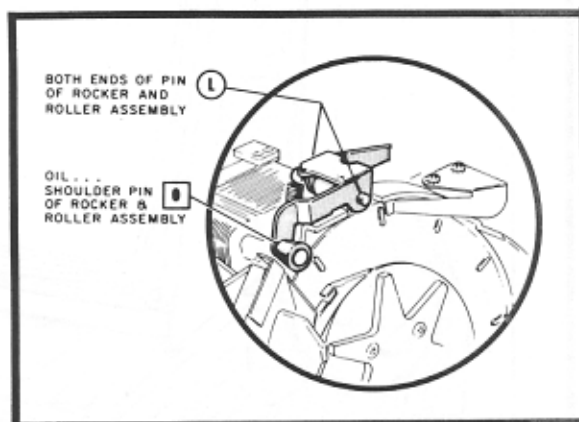


Fig. 46

## 5. MAINTENANCE AND REPAIR

### Printed Circuit Board Replacement

If it is suspected that a printed circuit board component has failed or it becomes necessary to test P.C.B. components, the entire rack holding the P.C.B.'s can be removed from the machine as follows:

1. Open the front door, turn off main power switch, and disconnect game line cord from wall socket.
2. Remove the front screw from the card retainer bracket and lift bracket upward until it clears the card rack (see Fig. 47).

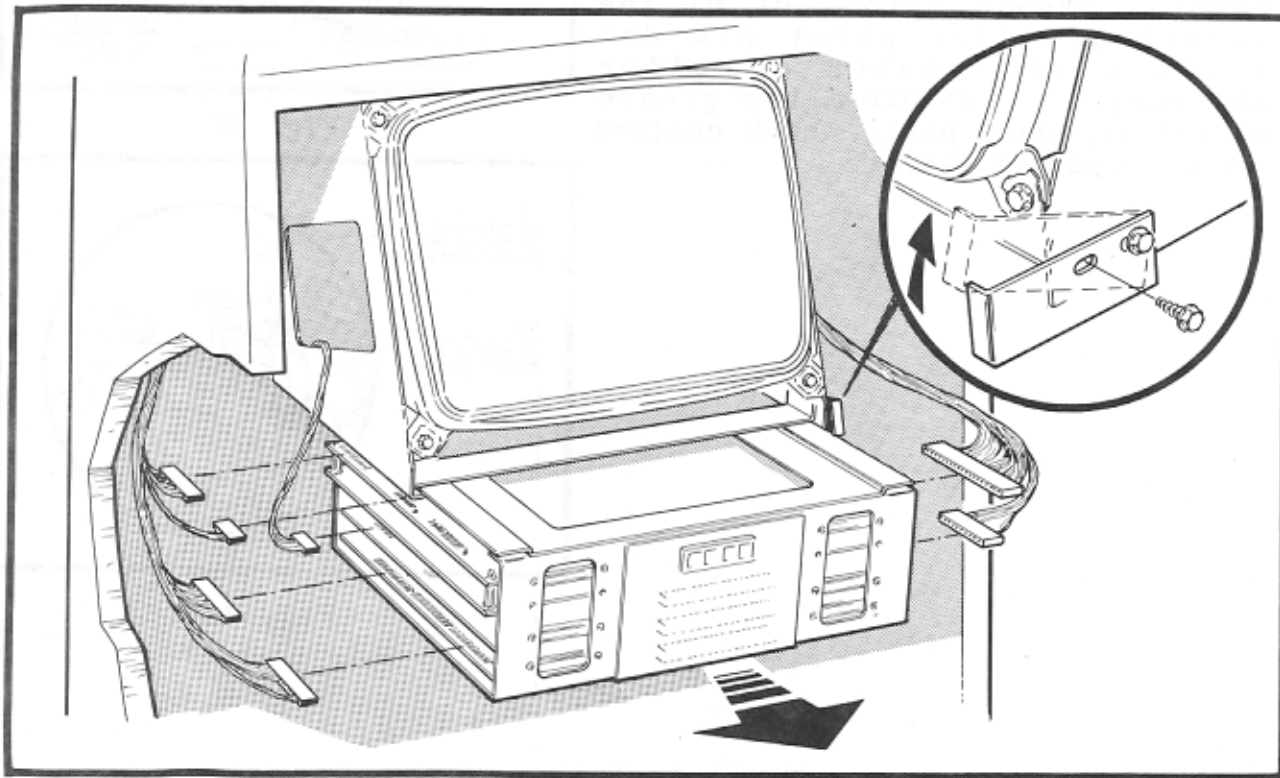


Fig. 47

3. Carefully slide the card rack forward 3 or 4 inches to gain access to P.C.B. cable connectors.
4. Remove ALL cable connectors from both sides of the printed circuit boards.
5. Remove card rack from machine and place on a suitable work area.
6. Unplug and remove "Mother Board" from front of card rack.



## 5. MAINTENANCE AND REPAIR

### Printed Circuit Board Replacement (cont'd)

7. Slide the I/O board out from the bottom of the card rack and set aside (see Fig. 48).

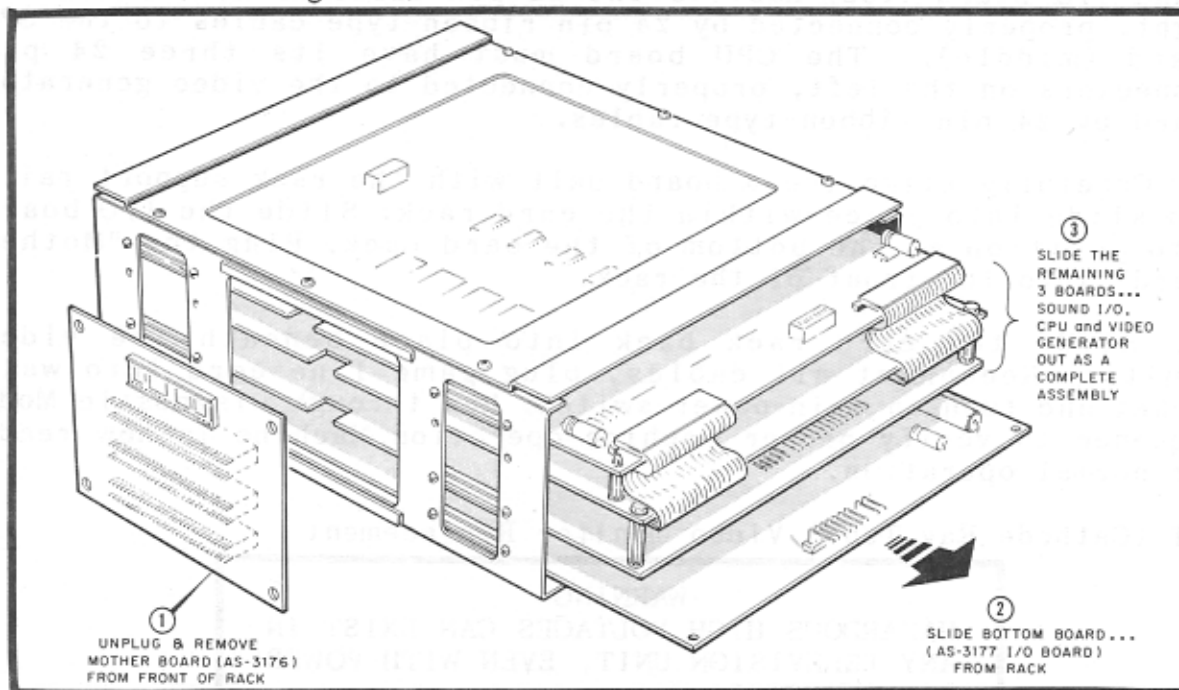


Fig. 48

8. Slide the remaining boards out from the card rack as a unit. Note the position of the 3 P.C.B.'s in relation to each other (sound I/O board on top, CPU board in the middle, and video generator on the bottom) for future reassembly.

9. Place the boards on a suitable work area with the sound I/O board facing up and the 72 pin edge connector towards you.

10. Unlock the nylon spacers and lift the sound I/O board away from the CPU board.

11. Turn over all the boards, unlock the remaining spacers, and unfold the video generator board from the CPU board. All components on all boards are now accessible. Boards can be separated completely after disconnecting the flat, ribbon-type cables.

12. Reassemble the boards in the reverse order. With the component sides of the boards facing each other, attach the video generator board to the CPU board first, using the nylon spacers, then fasten the sound I/O board to the reverse side of the CPU board. Verify that the 72 pin edge connectors of these 3 boards are on the same side and properly aligned.

## 5. MAINTENANCE AND REPAIR

### Printed Circuit Board Replacement (cont'd)

13. With the P.C.B. edge connectors facing you, verify that the sound I/O board (top) has its two 24 pin cable connectors on the right, properly connected by 24 pin ribbon-type cables to the CPU board (middle). The CPU board must have its three 24 pin connectors on the left, properly connected to the video generator board by 24 pin ribbon-type cables.

14. Carefully align the 3 board unit with the rack support rails and slide into place within the card rack. Slide the I/O board into position at the bottom of the card rack. Plug the "Mother Board" into the front of the rack.

15. Slide the card rack back into place beneath the video monitor. Reconnect all cables, plug game line cord into wall socket and turn-on main-power switch. Run through Diagnostic Mode sequence to verify proper machine operation. Machine is now ready for normal operation.

### CRT (Cathode Ray Tube) Video Monitor Replacement

#### -WARNING-

HAZARDOUS HIGH VOLTAGES CAN EXIST IN ANY TELEVISION UNIT, EVEN WITH POWER DISCONNECTED!

EXTREME CAUTION IS REQUIRED WHEN HANDLING A TELEVISION CHASSIS. DO NOT TOUCH ELECTRICAL PARTS OR THE TUBE YOKE AREA WITH YOUR HANDS OR ANY METAL OBJECTS! MACHINE USER IS TO PROVIDE PROPER PRECAUTIONS AGAINST ELECTRIC SHOCK TO PERSONNEL SERVICING OR MAINTAINING THIS EQUIPMENT. THIS INCLUDES, BUT IS NOT LIMITED TO, GLOVES AND OTHER PROTECTIVE CLOTHING REQUIRED TO SUIT THIS OPERATION.

1. Open front door of machine and turn off main power switch. Disconnect game line cord from wall socket.

2. Remove P.C.B. card rack. See "Printed Circuit Board Replacement", pg. 32, for detailed removal instructions.

3. Disconnect the 9 pin "MOLEX" type connector on the left side of the video monitor.

4. Remove the video stop bracket at the upper right corner of the video chassis.

## 5. MAINTENANCE AND REPAIR

### CRT (Cathode Ray Tube) Video Monitor Replacement

5. CAREFULLY slide the video monitor forward out of the game and place it on a non-conductive surface.

**-WARNING-**

IF DROPPED OR OTHERWISE DAMAGED, THE PICTURE TUBE WILL EXPLODE, CREATING A SERIOUS PERSONNEL HAZARD! ALWAYS HANDLE THE PICTURE TUBE CAREFULLY AND WEAR SAFETY GOGGLES AND OTHER PROTECTIVE CLOTHING WHEN WORKING WITH VIDEO PICTURE TUBES.

6. Reinstall the monitor using the reverse of the above procedure. Run through the Diagnostic Mode before placing the machine into operation to verify proper installation of video monitor. See Section 7, pg. 38, "T.V. MONITOR MANUAL" for detailed information on servicing video monitor.

### Recommended Spare Parts List

To minimize machine downtime in the event of component failure or malfunction, it is recommended that the items listed below be kept in stock in the quantities specified.

Always use only genuine BALLY manufactured or specified replacement parts to keep all equipment warranties in force and prevent the generation of radio interference or excessive X-ray emission for which BALLY cannot be responsible.

Feature-Glass Lamps - Part # E-125-2, quantity 10

Display-Glass Lamps - Part # E-412-5, quantity 2

Front-Door Wedge-Base Lamps - Part # E-125-69, quantity 6

I/O Board - Part # AS-3177-1, quantity 1

Video-Generator Board - Part # AS-3175, quantity 1

CPU Board - Part # AS-3174-1, quantity 1

Sound I/O Board - Part # AS-3173-1, quantity 1

Fuses (4): 3 amp - Part # E-133-3, quantity 3

5 amp - Part # E-133-5, quantity 6

8 amp - Part # E-133-8, quantity 3

Video Power-Supply Board - Part # AS-3088-1, quantity 1

Reel-Window Glass - Part # G-388 (specify coin denomination & model number), quantity 1

## 5. MAINTENANCE AND REPAIR

### Recommended Spare Parts List (cont'd)

Flourescent Starter - Part # E-411-7, quantity 1

Coin- Acceptor Assembly - Part # AS-277-167 (specify coin denomination), quantity 1

## 6. SCHEMATICS AND DIAGRAMS

### List of Required Drawings

The schematics and diagrams listed below are to be used for service and maintenance procedures described in this manual. Full-size copies of these drawings can be obtained from your BALLY distributor or BALLY Manufacturing in Chicago.

#### -WARNING-

THE DRAWINGS LISTED BELOW ARE PROPRIETARY INFORMATION OF BALLY MANUFACTURING CORP. THEY ARE FURNISHED FOR THE CONVENIENCE OF BALLY CUSTOMERS IN SERVICING BALLY EQUIPMENT ONLY! THE INFORMATION IS DISCLOSED IN CONFIDENCE AND MUST NOT BE COPIED OR OTHERWISE REVEALED TO OTHERS, IN PART OR IN WHOLE, WITHOUT THE EXPRESS WRITTEN CONSENT OF BALLY MFG. CORP.

ANY PRINTS FURNISHED REMAIN THE PROPERTY OF BALLY MFG. AND MUST NOT BE USED IN ANY MANNER DETRIMENTAL TO BALLY. PRINTS MUST BE RETURNED UPON DEMAND.

Drawing	Number
CPU Board .....	W-1274-1
I/O Board .....	W-1270-1 or W-1270-2
Video Generator Board .....	W-1275-1
Sound Board .....	W-1273-1
Dual Amplifier Power Board .....	W-1276
Power Supply Board .....	W-1269
Power Terminal Board .....	W-1267-1
Hopper Control Board .....	W-1217-37
Overall Connection Schematic .....	W-1046-2787



## 7. T.V. MONITOR MANUAL

### Introduction

This section is intended to familiarize you with the T.V. monitor used in this machine and it can assist you in making repairs should the monitor malfunction. A basic knowledge of electronics is helpful and most of the tests described require the use of a voltmeter.

Before attempting to repair the monitor, read this entire section and obey all warnings and cautions. Then proceed to locate the problem using the following steps:

1. Match your monitor problem against those listed under "Symptom Diagnosis". The chart will then describe which circuits to check and which components are most likely causing the problem.
2. Once you identify the circuit causing the problem, read the "Troubleshooting" section to find out what procedures to use for locating the faulty component(s).
3. Refer to the schematic diagrams to identify the faulty components in the failed circuit.

The above procedure will not solve every video-monitor difficulty. It will help you repair the majority of monitor problems, and for those cases too complex for this manual, assistance is available direct from BALLY by dialing the toll-free 800 number listed on the back of the front cover. Further assistance can also be obtained from your local BALLY distributor and field service personnel.

### Symptom Diagnosis

Insufficient picture width or height:

#### A. Horizontal line (due to VERTICAL CIRCUIT defect).

- Bad yoke.
- Bad vertical output section.
- Open fusible resistor in vertical section.
- Bad height control.
- Bad flyback (high voltage) transformer.

#### B. Vertical line (due to HORIZONTAL CIRCUIT defect).

- Bad yoke.
- Open width coil.
- Open part in horizontal section.

Picture too spread out or crushed in certain areas:

- Bad horizontal or vertical output transistor.
- Defective component in output circuitry.

## 7. T.V. MONITOR MANUAL

### Symptom Diagnosis (cont'd)

#### Poor focus and convergence:

- Bad flyback transformer or control.
- Focus voltage wire not connected to neckboard terminal.

#### Colors missing:

- Check interface color transistors.
- Check color output transistors.
- Check for a cracked printed circuit board.
- Check color circuits.
- Check video input jacks.

#### Insufficient picture brightness:

- Weak emission from picture tube. (Turn horizontal sync off frequency and turn brightness all the way up for about 15 minutes. This occasionally cures this problem.)
- Check video signal at the picture tube cathode pin with an oscilloscope. If the signal is approximately 80 volts peak to peak, the tube has weak emission and must be replaced.

#### Silvery effect in white areas:

- Check beam current transistors.
- Weak picture tube emission.

#### Excessive brightness with retrace lines:

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

#### Increasing brightness causes an increase in size and poor focus:

- Weak high voltage rectifier or high voltage regulation.

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

- Low B+ voltage (power supply problem).

#### Vertical rolling:

- Bad vertical oscillator transistor, I.C., or circuit.
- No sync from logic board.

#### Horizontal line across center:

- Dead vertical output circuit (see "Insufficient picture width or height".)
- Vertical oscillator wave form incorrect.

## 7. T.V. MONITOR MANUAL

### Symptom Diagnosis (cont'd)

#### Picture bends:

- Adjust horizontal sync.
- Magnetic or electromagnetic interference.

#### Flashing picture, visible retrace lines:

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

#### Unsymmetrical picture or sides of picture:

- Defective yoke.

#### No brightness, power supply operating - no high voltage for picture tube:

- Check horizontal oscillator.
- Check horizontal amplifier and output.
- Check flyback transformer.

#### No brightness, high voltage present:

- Check heater voltage to the tube at the neck board.
- Check screen grid voltage for picture tube.
- Check focus voltage.
- Check grid to cathode picture tube bias.

#### No high voltage:

- Check AC input to the flyback transformer.
- Check horizontal deflection stages.
- Check flyback transformer.
- Check yoke.
- Check power supply.

#### No horizontal and vertical hold:

- Check sync transistors and associated circuitry.
- Check wires and jack from logic board to the monitor.

#### Wavy picture (power supply defect):

- Check transistors, diodes, and electrolytic capacitors in power supply.
- Unshielded or ungrounded electric motor operating nearby.

#### Moving bars in picture:

- Ground between monitor and logic boards disconnected.

## 7. T.V. MONITOR MANUAL

### Symptom Diagnosis (cont'd)

#### Moving bars in picture

Power supply defect (see "Wavy picture").

#### Monitor does not energize:

Power supply problem. Check fuse, transistors, open fusible resistor.

Shorted horizontal output transistor.

Defective high voltage disabling circuit.

Crack(s) in main chassis board.

#### No purity or convergence adjustment:

Use a degausser to demagnetize picture tube in accordance with degausser manufacturer's instructions.

Defective picture tube.

Metallic foreign material present in picture tube shield.

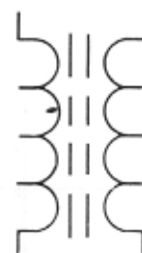
Electromagnetic interference from nearby equipment.

Poor focus or width of picture.

### Guide to Schematic Symbols



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



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



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



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



**ZENER DIODE**

(-) CATHODE

(+) ANODE

CATHODE (-)

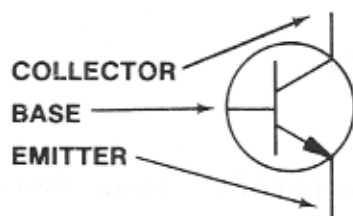
ANODE (+)



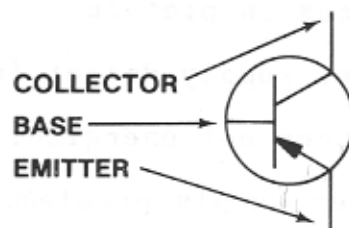
**DIODE**

## 7. T.V. MONITOR MANUAL

### Guide to Schematic Symbols (cont'd)



**NPN TRANSISTOR**



**PNP TRANSISTOR**



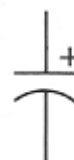
**VARIABLE RESISTOR, POT, CONTROL**  
(POLARITY DOESN'T MATTER)



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



**LINES ARE CONNECTED**



**ELECTROLYTIC CAPACITOR**



**LINES ARE NOT CONNECTED**



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



OR



**GROUND**



## 7. T.V. MONITOR MANUAL

### Troubleshooting

Troubleshooting CRT monitors requires careful attention to detail. The first step is to match the symptom displayed by the monitor against those listed in the "Symptom Diagnosis" section. This will assist you in locating the circuit where the problem is most likely occurring, and often gives specific parts to check. Next, the monitor should be removed from the machine, following the instructions in Section 5, pg. 34, "CRT (Cathode Ray Tube) Video Monitor Replacement". Be certain to obey all warnings and cautions concerning handling of the monitor.

#### -WARNING-

IF DROPPED OR OTHERWISE DAMAGED, THE PICTURE TUBE WILL EXPLODE, CREATING A SERIOUS PERSONNEL HAZARD! ALWAYS HANDLE THE PICTURE TUBE CAREFULLY, NEVER CARRY THE TUBE BY THE NECK, AND ALWAYS WEAR SAFETY GOGGLES AND OTHER PROTECTIVE CLOTHING WHEN WORKING WITH VIDEO PICTURE TUBES.

After removing the monitor from the machine and placing it on a suitable NON-CONDUCTIVE table or workbench, all circuits must be visually inspected for broken, burned, or parts. The usual order of parts failure (with those most likely to fail listed first) is as follows:

1. Semiconductors (transistors, diodes, I.C.'s).
2. Fusible resistors.
3. Electrolytic capacitors.
4. Resistors.
5. Capacitors and coils.

#### -WARNING-

HAZARDOUS HIGH VOLTAGES CAN EXIST IN ANY TELEVISION UNIT, EVEN WITH POWER DISCONNECTED! EXTREME CAUTION IS REQUIRED WHEN HANDLING A TELEVISION CHASSIS. DO NOT TOUCH ELECTRICAL PARTS OR THE TUBE YOKE AREA WITH YOUR HANDS OR ANY METAL OBJECTS! GAME USER IS TO PROVIDE PROPER PRECAUTIONS AGAINST ELECTRIC SHOCK TO PERSONNEL SERVICING OR MAINTAINING THIS EQUIPMENT. THIS INCLUDES, BUT IT IS NOT LIMITED TO, GLOVES AND OTHER PROTECTIVE CLOTHING REQUIRED TO SUIT THIS OPERATION.

To discharge the residual voltage contained in the picture tube, connect one end of a wire to chassis ground and the other end to a PLASTIC HANDLED SCREWDRIVER. Grasping ONLY the plastic handle

## 7. T.V. MONITOR MANUAL

### Troubleshooting (cont'd)

with one hand and touching nothing else except the floor with any other part of your body, CAREFULLY insert the screwdriver blade into the anode hole of the picture tube. Be prepared for a flash and a loud pop. The longer the monitor has been without power, the dimmer the flash and smaller the pop will be.

#### -WARNING-

USE ONLY THE ABOVE PROCEDURE TO REMOVE THE RESIDUAL CHARGE FROM THE PICTURE TUBE. ALWAYS REMOVE THE CHARGE REGARDLESS OF HOW LONG THE PICTURE TUBE HAS BEEN WITHOUT POWER.

To maintain the safety and performance of the monitor, always use exact replacement parts. Service the monitor on a firm, NON-CONDUCTIVE table, and remove all jewelry and other metallic items from your person before beginning troubleshooting procedures.

#### -CAUTION-

THE T.V. MONITOR DOES NOT CONTAIN AN ISOLATION TRANSFORMER ON ITS CHASSIS. WHEN SERVICING THE MONITOR ON A TEST BENCH OR TABLE, THE MONITOR MUST BE ISOLATED FROM ANY AC VOLTAGE WITH AN ISOLATION TRANSFORMER.

Carefully observe a test picture and change the setting of the various controls that most likely affect the symptom displayed. For example, if the problem is poor brightness or no picture, try increasing the brightness or contrast control settings. If the controls have no effect at all, the trouble is most likely in the controls, associated circuitry, or nearby circuits which may be upsetting the voltages.

#### -WARNING-

CAPACITORS, AS WELL AS THE PICTURE TUBE, CAN HOLD A HAZARDOUS ELECTRICAL CHARGE AT LEAST A WEEK OR LONGER AND MUST BE DISCHARGED USING A PLASTIC HANDLED SCREWDRIVER AND THE METHOD USED FOR THE PICTURE TUBE.

First, check for obvious visual defects such as broken or frayed wires, over-soldering, missing and/or burned components, or cracked P.C.B.'s. If everything checks out, make certain that all diodes, electrolytic capacitors, and transistors have their leads connected in the correct polarity as shown on the schematic and the circuit board.

## 7. T.V. MONITOR MANUAL

### Troubleshooting (cont'd)

Turn on the power and measure the voltages at the leads of active devices such as tubes, transistors, or integrated circuits. Any voltage that is not within 10% to 15% of that specified on the schematic indicates either a problem with the device being checked or a component connected to it in the circuit. An ohmmeter must now be used to narrow the field of possibly defective components.

To test a transistor, one lead of the ohmmeter is placed on the base, and the other lead is placed on the emitter. A normal transistor will read high to infinite resistance or little resistance (typically 400 to 900 ohms) depending on the polarity. The ohmmeter lead on the emitter must now be placed on the collector and an opposite resistance reading should be obtained. If resistance read high or infinite when the ohmmeter lead was on the emitter, it should read low when placed on the collector. If resistance was low when the ohmmeter lead was on the emitter, it should read high or infinite when placed on the collector. Consistently infinite readings indicate an open in the transistor while a short is indicated by readings of 0-30 ohms. Now place one ohmmeter lead on the collector, the other on the emitter. No matter which leads are placed where, there should be infinite resistance. A lower reading, for example 50 ohms, indicates a short.

The lowest ohmmeter settings are usually required for testing transistors. On rare occasions, a transistor may pass these tests, but become "leaky" or break down only at higher voltages. If there is any doubt, replace the transistor. The transistor can also be tested out of the circuit in case some other component in the circuit is affecting the ohmmeter reading.

A diode is tested in the same manner as a transistor, with the exception that there are only two leads. Again, there should be high or infinite resistance one way, and little or no resistance the other. If the test indicates the diode is defective, remove one lead from the circuit and retest it in case another component in the circuit is affecting the ohmmeter reading.

#### -CAUTION-

DO NOT LEAVE SOLDERING EQUIPMENT ON  
THE COMPONENT LEADS ANY LONGER THAN  
NECESSARY TO PREVENT DAMAGE TO HEAT  
SENSITIVE SEMICONDUCTOR COMPONENTS.

Integrated circuits can be checked without the use of special equipment by verifying the correct DC voltage on the pins and the correct AC wave form using an oscilloscope.

## 7. T.V. MONITOR MANUAL

### Troubleshooting (cont'd)

-CAUTION-  
SHORTING ACROSS THE PINS OF AN I.C.  
MAY DESTROY IT!

Resistors are checked using an ohmmeter and must be within 10% of the value stated on the resistor body and the schematic. It may be necessary to de-solder one lead from the circuit board for testing purposes. If the board's conductive foil is damaged in the process, carefully solder a small wire over the break to reconnect the foil.

Capacitors cannot be tested using an ohmmeter as both their voltage and resistance increase as they charge themselves using current from the meter. If all other components in a circuit check out, electrolytic capacitors are most likely causing the problem. Substitute a new capacitor and test monitor operation.

### Theory of Operation

This section will assist you in understanding how the T.V. monitor functions. It examines large, general groups of circuits to avoid confusion and aids in achieving a basic knowledge of monitor operation.

### Power Supply

The AC current to the monitor from the game transformer has 60 cycles per second, identical to the current from a wall outlet. A monitor requires a stable DC current for proper operation. Diodes are used to rectify the incoming AC into DC and a large electrolytic capacitor is used to further stabilize the DC supply. Because of its size and power requirements, the monitor also contains zener diodes and transistors to maintain stable DC current. When the monitor picture becomes wavy, it is a sign that AC is finding its way through a malfunctioning power supply. If the voltage from the power supply is too low, other circuits won't receive the necessary power and only a small, wavy picture or none at all will be visible.

### Chassis Interface Section

The interface section of the chassis is identified by the video jacks which receive the input from the logic boards. There are sets of transistors that receive the separate red, green, blue, and sync information from the logic boards. These circuits increase the voltage and match impedances, preparing the logic board outputs for the circuits that will amplify them for use in the yoke or picture tube.

Note that the sync is negative-going. This means that both horizontal and vertical sync are negative going wave forms and

## 7. T.V. MONITOR MANUAL

### Theory of Operation (cont'd)

that these two pulses are going at different speeds. The vertical wave forms are at 60 Hz (Hertz or cycles per second) and the horizontal wave forms are at 15,625 Hz.

The sync signal is amplified by a sync amplifier transistor and the color information is sent to the neck board where main amplification occurs.

### Vertical and Horizontal Deflection

After the sync signal is amplified by the sync amplifier, it goes to both the vertical and horizontal circuits. The sync signals provide the timing for picture assembly, preventing break-up and other distortions as each of the electron beams scan the tube face to create one portion of the picture.

The 60 Hz pulse sent to the vertical oscillator makes sure that this circuit oscillates at 60 cycles per second. Without this pulse, the circuit will oscillate at a higher or lower frequency, causing the picture to "roll" up or down.

The Wells-Gardner 13" color monitor uses transistors for its sync section while an Electrohome 13" uses a single integrated circuit, IC 501. Both components perform the same function, sending a 60 Hz sawtooth waveform to the yoke's vertical coils.

On the way to the output transistors, the 60 Hz pulse is shaped and amplified by the yoke so that the amplified vertical output fills the screen. If only a horizontal line is visible on the monitor screen, there is a problem with one of the components in the vertical section.

The horizontal section is similar to vertical section with the exception that it uses a different wave form. The horizontal wave form is close to square and has a frequency of 15,625 Hz. Again, Wells-Gardner uses transistors for the horizontal oscillator while Electrohome uses the other side of IC 501. If the oscillator doesn't provide the correct frequency, the picture may move sideways, start to slant, or break-up with thin, slanted figures.

In both the horizontal and vertical sections, there are variable resistors that change the oscillation frequency to keep the picture in sync and assembled properly.

The wave form is shaped and amplified in the horizontal section just as in the vertical section. The horizontal section, however, also feeds the high voltage flyback transformer.



## 7. T.V. MONITOR MANUAL

### Theory of Operation (cont'd)

#### The Flyback Transformer

The picture tube requires a higher voltage than the power supply can give to provide a picture. The flyback transformer fulfills this need by increasing the 15,625 Hz. horizontal transistor output to a higher voltage at the same frequency. In the flyback are diodes that rectify the incoming AC into DC before the power is sent through the thick red wire to the picture tube.

-WARNING-  
THIS RED WIRE CARRIES AN 18,000 VOLT  
POTENTIAL! DO NOT TOUCH IT WITH ANY  
PART OF YOUR BODY OR ANY OTHER  
OBJECT!

The flyback has extra output windings to support the picture tube heater, the vertical deflection circuits, and picture tube screen grid voltage. In this way, the flyback transformer resembles a second power supply.

#### Color Circuits

The color signals pass through the interface section where some amplification and impedance matching occurs. These circuits contain relatively few components and from here the AC color signal is sent to the neck board.

The color-output circuits are located on the neck board. The color signals going to the transistors are regulated by two variable resistors called drive controls. There are two of these, one for the red and one for the green (there is no drive control for blue). In the emitter part of each transistor is another variable resistor called the cut-off control. These controls vary the amount of the amplified AC signal that goes to the cathodes of the picture tube. The higher the signal, the deeper the color. The bases of these transistors are connected to each other and to the beam-limiting transistors in the interface section.

The beam limiter helps control the brightness and the blanking transistor rapidly turns the picture tube "ON" and "OFF" so the retrace line don't appear on the screen. By increasing the brightness on a good monitor, the 4 to 6 retrace lines can be seen slanting diagonally across the picture.

#### Protection Circuit

To keep the high voltage section from generating X-rays due to over-voltage from the power supply, a sensing circuit turns off the horizontal oscillator using a transistor. If this circuit is activated, the monitor will have no picture and appear to be off. The excessive amount of voltage from the power supply which

## 7. T.V. MONITOR MANUAL

### Theory of Operation (cont'd)

triggered the circuit in the first place is still present, however. To verify proper power supply voltage, check the emitter on TR502 on Wells-Gardner units or the emitter of X04 on Electrohome monitors. The correct voltages are:

Wells-Gardener - 127 VDC  
Electrohome - 120 VDC

This voltage is measured at pin B1 on Electrohome monitor chassis as this monitor uses an integrated circuit and little else in the power supply.

### The Picture Tube (or CRT)

The picture tube or CRT (Cathode Ray Tube) is an output device, its display being the end result of the circuits described earlier.

The picture tube contains a heater which "boils" electrons off the cathodes to form the beam which excites the three (red, green, and blue) screen phosphors, causing them to emit light and create the picture used for playing the game. The cathodes can be or short to the heater resulting in no picture and a defective tube.

The picture tube contains three grids, the first of which is grounded. The second grid has a potential of approximately 300 VDC applied to it, depending on the brightness setting. The third grid is used to focus the electron beams and receives about 1/5 the voltage applied to the picture tube anode.

After leaving the cathode and passing through all the grids, the electron beam goes through a mask, a sheet of material containing very small holes. The electron beam now reaches the phosphor dots on the inside surface of the tube face, causing them to glow. The green electron "gun" (or cathode and associated circuitry) beams electrons only at the green phosphor dots. The red and blue "guns" beam their electrons only at the red and blue phosphor dots. The blending of the three primary colors in the monitor screen determines the color seen. Too intense an electron beam can "burn" the phosphor dots, leaving a permanently visible dark image after the monitor is turned off.

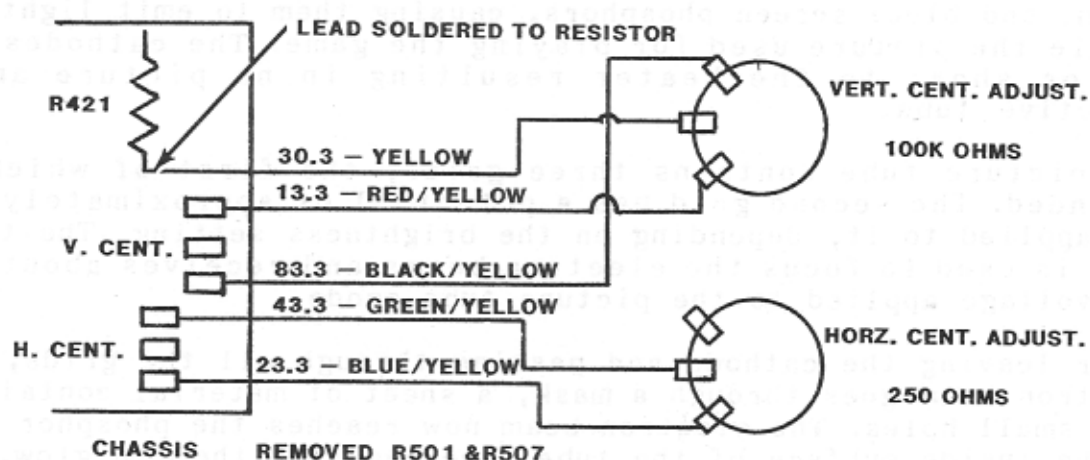
## 7. T.V. MONITOR MANUAL

### Differences Between Monitors

Two different brands of 13" color video monitors are used in BALLY gaming equipment, the "Wells-Gardner" and the "Electrohome". Each uses separate P.C.B.'s for main sections of circuitry. A few parts, however, are still mounted on the chassis. The "Electrohome" monitor can be identified by its lack of separate P.C.B.'s, except for the neck board and its flat chassis. Monitors can also be identified by the callout numbers on components. "Wells-Gardner" part numbers begin with the letters "TR", "Electrohome" part numbers begin with an "X".

NOTE: The following diagrams depict the BALLY installed wiring used to place the monitor vertical and horizontal centering controls at a remote location within the machine cabinet. Because of this installation, the controls for these functions located on the monitor are no longer usable. When the monitor is removed to a test bench, separate vertical and horizontal controls must be temporarily connected to these pin locations while the test procedures are performed.

### ELECTROHOME EXTERNAL MONITOR CONTROLS



### WELLS-GARDNER EXTERNAL MONITOR CONTROLS

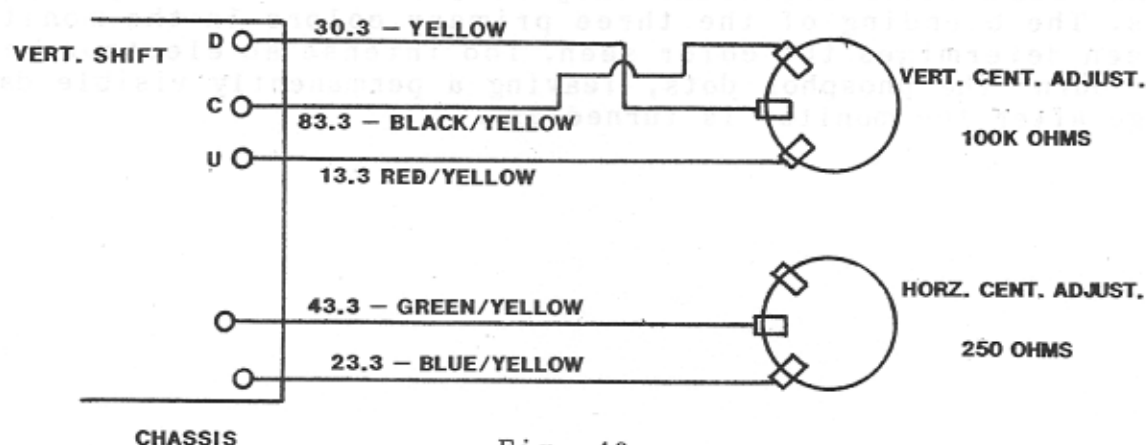


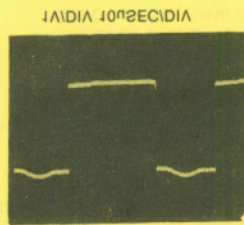
Fig. 49





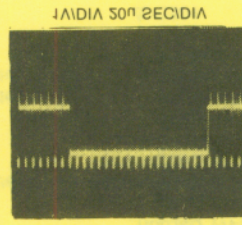
1μDIV 2μSEC/DIV

1'C 304' PIN 3



1μDIV 10μSEC/DIV

1'C 304' PIN 12



1μDIV 50μ SEC/DIV

E



5μDIV 2μSEC/DIV

NEGATIVE SIDE OF C303



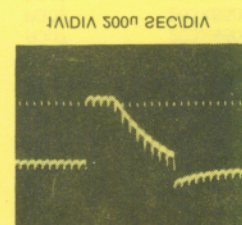
1μDIV 500μ SEC/DIV

1'C 304' PIN 13



1μDIV 5μSEC/DIV

E



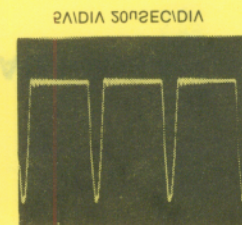
1μDIV 500μ SEC/DIV

1b-31' AC COUPLED



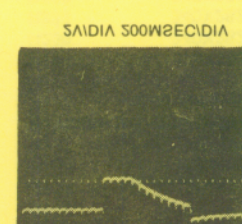
0.5μDIV 50μ SEC/DIV

B



2μDIV 50μSEC/DIV

1405-3



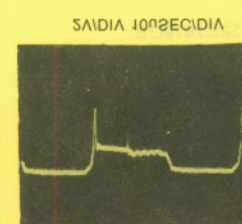
5μDIV 500μSEC/DIV

BOTTOM LINE = 0 VDC  
1b-31 DC COUPLED



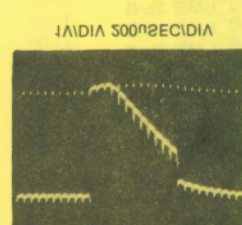
50μDIV 2μSEC/DIV

1b-85



5μDIV 10μSEC/DIV

D



1μDIV 500μSEC/DIV

A



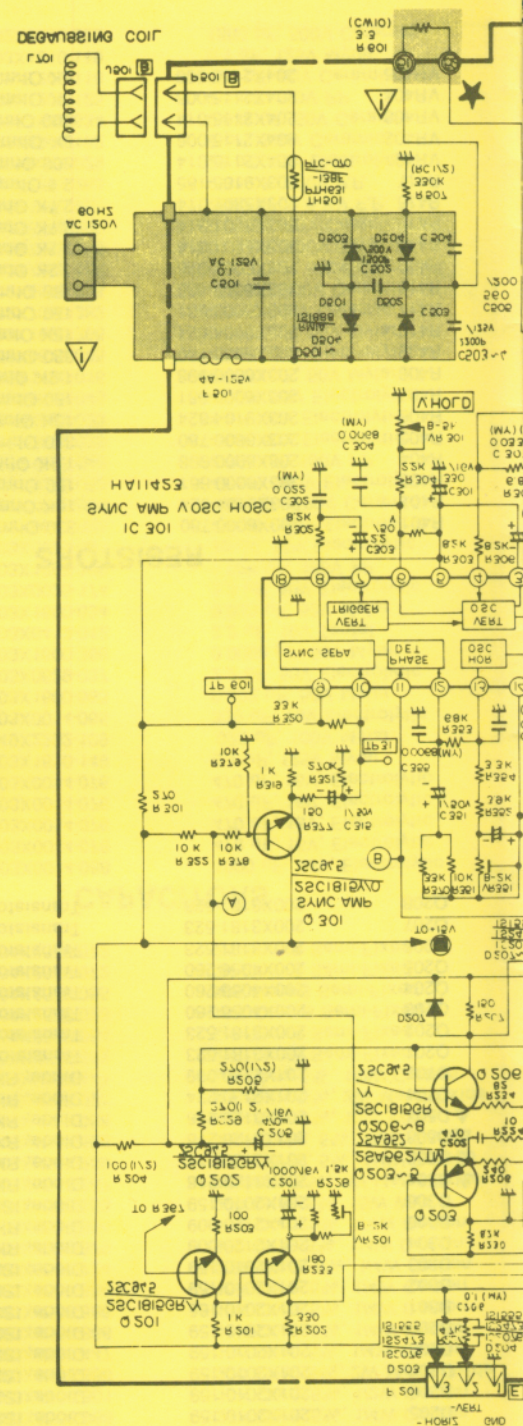
0.5μDIV 2μSEC/DIV

1b-91



50μDIV 10μSEC/DIV

0321 COLLECTOR



●	125V	Video Output
⊗	130V	Vert. Output Horz. Output Horz. Drive Horz. Osc.
■	125V	CRT Cut-Off Blanking Sync Vert. Osc.
Symbol	Voltage	Operating Circuit

Power Supply Voltage and Symbols

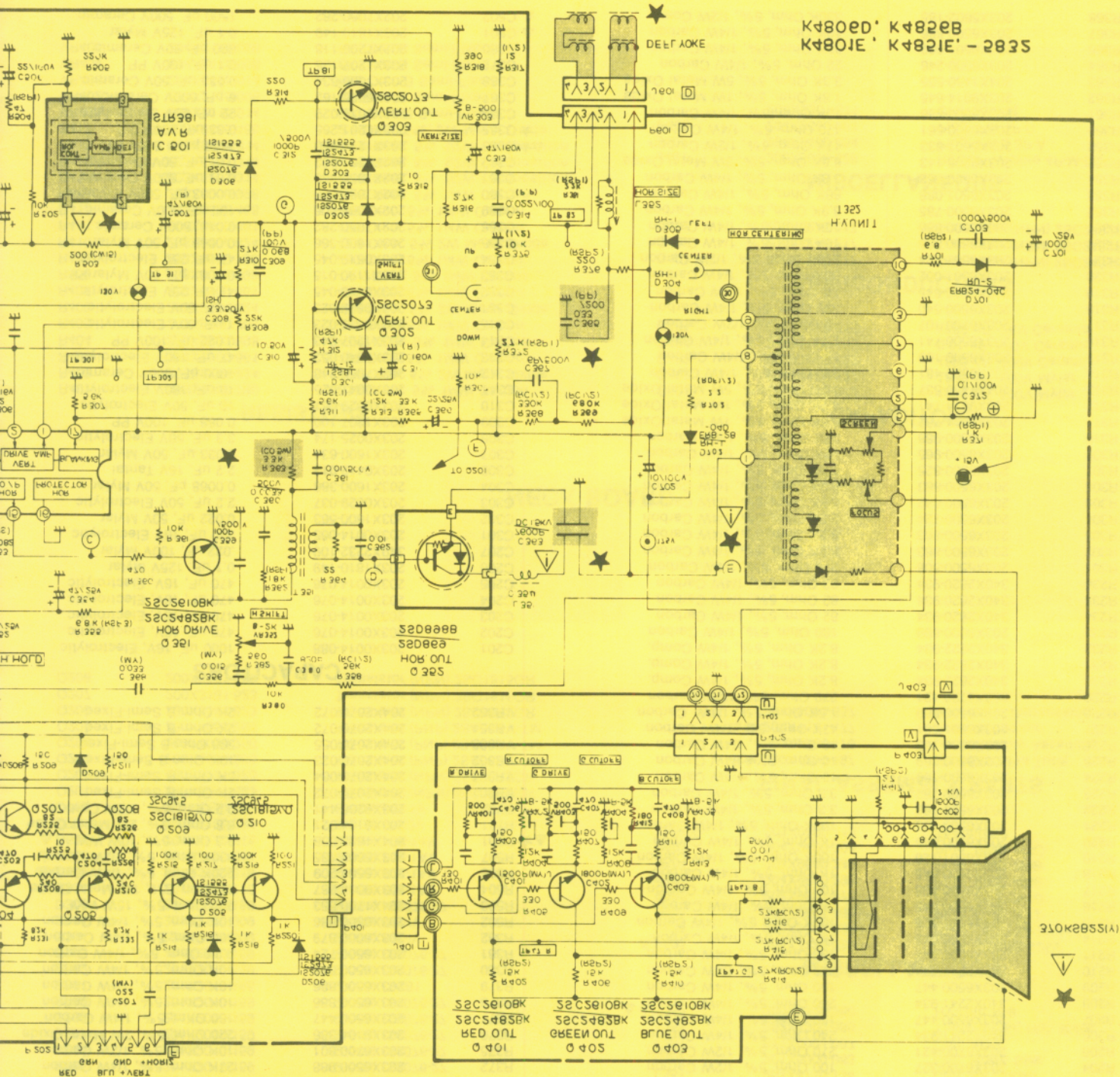
# PARTS LIST

ONLY TYPE PARTS SHOWN IN THE FOR REPLACEMENT PURPOSES. USE PROTECTION ESSENTIAL FOR X-RAY RADIATION ELECTRICAL AND MECHANICAL PARTS THIS PRODUCT CONTAINS CRITICAL X-RAY RADIATION PRECAUTION: SERVICE TECHNICIAN WARNING



MODELS 13K4801, 13K4802  
13" COGOB MONITOR SCHEMATIC





**FABRICANT:**  
DES PIÈCES RECOMMANDÉES PAR LE  
CRITIQUE POUR LA SECURITE QUE PAR  
DOIT LE FONCTIONNEMENT EST  
NE REMPLACER LES COMPOSANTS  
LE DEGRÉ DE SECURITE DE L'APPAREIL  
**AVERTISSEMENT:** POUR MAINTENIR  
TUBES RECOMMENDED PARTS  
BOULENTS ONLY WITH MANUFACT-  
REPLACE SAFETY CRITICAL COM-  
**CAUTION:** FOR CONTINUED SAFETY

tend to be less.  
and the amplitude of any high frequency pulse will  
pulses will tend to be more rounded than those shown  
a poor high frequency response, the corner of the  
If the waveforms are observed on the oscilloscope with  
tubes.  
on each waveform are the approximate peak ampli-  
strong signal and a normal picture. The voltages shown  
oscilloscope with the monitor turned to a reasonably  
The waveforms shown are as observed on the wide band

## OSCILLOSCOPE WAVEFORM PATTERN



H308	503X2005-182	330K Ohm' 200' 115M Comb'	▽ C205	505X1020-585	1200 bE' 200A Ceraemic
H309	503X2000-886	10K Ohm' 200' 114M Cairaou	▽ C201	503X1810-148	0'1 nE' 152A Wli9a
H309	503X2001-005	33K Ohm' 200' 114M Cairaou	C380	505X1500-118	850 bE' 20A Ceraemic
H309	503X2000-548	55 Ohm' 200' 114M Cairaou	C315	503X1501-152	0'1 nE' 100A bB
* H309	504X1420-222	3'3K Ohm' 200' 2M Wef9i Oxi9e	C308	503X1800-834	0'033 nE' 20A Ceraemic
H309	503X2014-042	1'8K Ohm' 200' 1M Wef9i Oxi9e	C381	505X8002-185	8 bE' 200A Ceraemic
H309	503X2000-886	10K Ohm' 200' 114M Cairaou	C380	503X0018-058	55 nE' 52A Electrolitic
H309	503X2000-201	410 Ohm' 200' 114M Cairaou	C382	503X1501-582	0'33 nE' 500A bB
H309	503X2001-833	41K Ohm' 200' 115M Cairaou	★ C382	503X1510-820	1800 bE' 1'2 KA bB'
H322	503X2502-143	8'8K Ohm' 200' 3M Wef9i Oxi9e	C385	505X1503-035	0'01 nE' 20A Ceraemic
H324	503X2000-185	3'3K Ohm' 200' 114M Cairaou	C381	505X1020-483	0'01 nE' 200A Ceraemic
H323	503X2001-088	88K Ohm' 200' 114M Cairaou	C380	505X1020-388	0'0033 bE' 200A Ceraemic
H325	503X2000-182	3'8K Ohm' 200' 114M Cairaou	C328	505X8002-808	100 bE' 200A Ceraemic
H321	503X2000-886	10K Ohm' 200' 114M Cairaou	C328	505X1020-585	0'012' 200A Ceraemic
H325	503X2000-886	10K Ohm' 200' 114M Cairaou	C322	503X1800-388	0'0088 bE' 20A Wli9a
H325	503X2000-886	10K Ohm' 200' 114M Cairaou	C324	503X0818-042	41 nE' 52A Electrolitic
H351	503X2001-554	510K Ohm' 200' 115M Cairaou	C323	503X1180-012	0'0085 bE' 20A Wli9a-bB
H350	503X2001-005	33K Ohm' 200' 114M Cairaou	C325	503X0818-042	41 nE' 52A Electrolitic
H318	503X2000-042	1K Ohm' 200' 114M Cairaou	C321	503X0858-053	1 nE' 20A Electrolitic
H318	503X2000-240	380 Ohm' 200' 114M Cairaou	C312	503X0858-053	1 nE' 20A Electrolitic
H311	503X2100-101	15 Ohm' 200' 115M Cairaou	C314	503X1501-043	0'055 nE' 100A bB
H318	503X2000-141	5'1K Ohm' 200' 114M Cairaou	C313	503X0040-025	41 nE' 180A Electrolitic
H312	503X2000-188	10 Ohm' 200' 114M Cairaou	C315	505X1020-548	1000 bE' 200A Ceraemic
H314	503X2000-481	550 Ohm' 200' 114M Cairaou	C311	503X0041-052	10 nE' 180A Electrolitic
H313	504X1420-231	1'5K Ohm' 200' 2M Wef9i Oxi9e	C310	503X0858-081	0'088 nE' 100A bB
H315	503X2014-141	4'1K Ohm' 200' 1M Wef9i Oxi9e	C308	503X1501-100	3'3 nE' 20A Electrolitic
H311	503X2014-185	2'8K Ohm' 200' 1M Wef9i Oxi9e	C308	503X0052-114	0'033 nE' 20A Wli9a
H310	503X2000-888	51K Ohm' 200' 114M Cairaou	C301	503X1800-834	5'5 nE' 18A 18u9i
H308	503X2000-882	55K Ohm' 200' 114M Cairaou	C308	503X0415-015	0'0088 bE' 20A Wli9a
H301	503X2000-852	2'8K Ohm' 200' 114M Cairaou	C304	503X1800-388	5'5 nE' 20A Electrolitic
H308	503X2000-883	8'5K Ohm' 200' 114M Cairaou	C303	503X0858-031	0'055 nE' 20A Wli9a
H302	503X2000-845	8'8K Ohm' 200' 114M Cairaou	C305	503X1800-283	330 nE' 18A Electrolitic
H304	503X2000-154	5'5K Ohm' 200' 114M Cairaou	C301	503X0014-082	0'55 nE' 100A Wli9a
H303	503X2000-883	8'5K Ohm' 200' 114M Cairaou	CS01	348X5535-108	0'1 nE' 152A Wli9a
H305	503X2000-883	8'5K Ohm' 200' 114M Cairaou	CS08	503X0014-018	410 nE' 18A' Electrolitic
H301	503X2000-208	510 Ohm' 200' 114M Cairaou	CS02	503X0014-018	410 nE' 18A' Electrolitic
H308	340X5850-834	85 Ohm' 200' 114M Cairaou	CS04	503X0014-018	410 nE' 18A' Electrolitic
H302	340X5850-834	85 Ohm' 200' 114M Cairaou	CS03	503X0014-018	410 nE' 18A' Electrolitic
H304	340X5850-834	85 Ohm' 200' 114M Cairaou	CS05	503X0014-018	410 nE' 18A' Electrolitic
H303	503X2000-888	180 Ohm' 200' 114M Cairaou	CS01	503X0014-088	1000 nE' 18A' Electrolitic
H305	340X5855-834	8'5K Ohm' 200' 114M Comb'			
H301	340X5855-834	8'5K Ohm' 200' 114M Comb'			
H303	340X5855-834	8'5K Ohm' 200' 114M Comb'			
H308	503X2100-451	510 Ohm' 200' 115M Cairaou			
H308	503X2000-888	1'2K Ohm' 200' 114M Cairaou			
H301	503X2001-281	41K Ohm' 200' 114M Cairaou			
H308	503X2000-188	10 Ohm' 200' 114M Cairaou			
H302	503X2000-188	10 Ohm' 200' 114M Cairaou			
H304	503X2000-188	10 Ohm' 200' 114M Cairaou			
H303	503X2000-185	3'3 Ohm' 200' 114M Cairaou			
H305	503X2000-185	3'3 Ohm' 200' 114M Cairaou			
H301	503X2000-402	100K Ohm' 200' 114M Cairaou			
H308	503X2000-042	1K Ohm' 200' 114M Cairaou			
H318	503X2001-158	100K Ohm' 200' 114M Cairaou			
H318	503X2000-042	1K Ohm' 200' 114M Cairaou			
H311	503X2000-402	1K Ohm' 200' 114M Cairaou			
H318	503X2000-042	100K Ohm' 200' 114M Cairaou			
H312	503X2001-158	1K Ohm' 200' 114M Cairaou			
H314	503X2000-042	120 Ohm' 200' 114M Cairaou			
H311	503X2000-441	540 Ohm' 200' 114M Cairaou			
H310	340X5541-834	120 Ohm' 200' 114M Cairaou			
H308	503X2000-441	540 Ohm' 200' 114M Cairaou			
H308	340X5541-834	120 Ohm' 200' 114M Cairaou			
H301	503X2000-441	540 Ohm' 200' 114M Cairaou			
H308	340X5541-834	120 Ohm' 200' 114M Cairaou			
H302	503X2100-451	510 Ohm' 200' 115M Cairaou			
H304	503X2100-351	100 Ohm' 200' 114M Cairaou			
H303	503X2000-402	100 Ohm' 200' 114M Cairaou			
H305	503X2000-253	330 Ohm' 200' 114M Cairaou			
H301	503X2000-042	1K Ohm' 200' 114M Cairaou			

## RESISTORS

## RESISTORS (CONT')

## MAIN BOARD

Repair work should be performed by qualified personnel only.

The use of substitute parts may create a shock, fire, radiation or other on parts list should be replaced with exact factory replacement parts.

For continued protection no changes should be made to the original for safety purposes.

This monitor contains circuits and components included specifically

## REPLACEMENT PARTS LIST

Ref. No.	Part No.	Description	Ref. No.	Part No.	Description
----------	----------	-------------	----------	----------	-------------



AB402 504X5112-008  
 AB404 504X5112-008  
 AB403 504X5112-014  
 AB405 504X5112-008  
 AB401 504X5112-014  
 B411 503X8102-182  
 B412 503X2501-314  
 B412 503X2501-314  
 B414 503X2501-314  
 B413 503X8000-888  
 B415 503X8000-888  
 B411 503X8000-888  
 B410 503X8104-854  
 B408 503X8000-180  
 B408 503X8000-888  
 B401 503X8000-888  
 B408 503X8104-854  
 B402 503X8000-180  
 B404 503X8000-888  
 B403 503X8000-888  
 B405 503X8104-854  
 B401 503X8000-180

## RESISTORS

2K Ohm-B Semi-Fixed  
 2K Ohm-B Semi-Fixed  
 200 Ohm-B Semi-Fixed  
 2K Ohm-B Semi-Fixed  
 200 Ohm-B Semi-Fixed  
 5.1K Ohm, 2% 1/4W Carbon  
 5.1K Ohm, 2% 1/4W Carbon  
 5.1K Ohm, 2% 1/4W Carbon  
 5.1K Ohm, 2% 1/4W Carbon  
 1.5K Ohm, 2% 1/4W Carbon  
 180 Ohm, 2% 1/4W Carbon  
 120 Ohm, 2% 1/4W Carbon  
 12K Ohm, 2% 1/4W Carbon  
 330 Ohm, 2% 1/4W Carbon  
 1.5K Ohm, 2% 1/4W Carbon  
 120 Ohm, 2% 1/4W Carbon  
 12K Ohm, 2% 1/4W Carbon  
 330 Ohm, 2% 1/4W Carbon  
 1.5K Ohm, 2% 1/4W Carbon  
 120 Ohm, 2% 1/4W Carbon  
 12K Ohm, 2% 1/4W Carbon  
 330 Ohm, 2% 1/4W Carbon  
 1.5K Ohm, 2% 1/4W Carbon  
 120 Ohm, 2% 1/4W Carbon  
 12K Ohm, 2% 1/4W Carbon  
 330 Ohm, 2% 1/4W Carbon

B403  
 B405  
 B401

504X8301-811  
 504X8000-888  
 504X8400-524  
 504X2008-858

CRT Socket  
 Plug, Pin 1B-D  
 Plug, BMB 3B-A  
 RECEPT W Wire 4B-M-BD

## MISCELLANEOUS

C403  
 C405  
 C401

500X3548-511  
 500X3548-511  
 500X3548-511

Transistor (NPN) 2SC5485BK  
 Transistor (NPN) 2SC5485BK  
 Transistor (NPN) 2SC5485BK

## SEMICONDUCTORS

C402  
 C404  
 C403  
 C405  
 C401

505X1110-018  
 505X1020-483  
 503X1100-155  
 503X1100-155  
 503X1100-015

1200 pF 5KV Ceramic  
 0.01 uF 200V Ceramic  
 1800 pF 200V Ceramic  
 1800 pF 200V Mylar  
 1200 pF 200V Mylar

## CAPACITORS

## NECK BOARD

C508 500X3181-253  
 C501 500X3181-253  
 C502 500X3181-253  
 C502 500X4028-580  
 C504 500X4028-580  
 C503 500X4028-580  
 C505 500X3181-253  
 C501 500X3181-253  
 D105 501X5150-008  
 D101 501X5130-534  
 D204 501X3150-518  
 D203 501X3150-518  
 D205 501X3150-518  
 D201 501X3150-518  
 D308 501X5010-128  
 D302 501X5150-008  
 D304 501X5150-008  
 D303 501X5010-128  
 D305 501X5010-128  
 D301 501X5010-128  
 D508 501X5010-128  
 D508 501X5010-128  
 D501 501X5010-128  
 D508 501X5010-128  
 D502 501X5010-128  
 D504 501X5010-128  
 D503 501X5010-128

## SEMICONDUCTORS

C103 505X1020-548  
 C105 503X0834-081  
 C101 503X0018-085  
 C201 503X0041-021  
 C208 503X0040-034  
 C202 503X0550-012  
 C204 505X1810-514  
 C203 505X1810-514

## CAPACITORS (CONT)

Transistor (NPN) 2SC1812GB  
 Transistor (NPN) 2SC1812GB  
 Transistor (NPN) 2SC1812GB  
 Transistor (PNP) 2SA285-Y-1M  
 Transistor (PNP) 2SA285-Y-1M  
 Transistor (PNP) 2SA285-Y-1M  
 Transistor (NPN) 2SC1812GB  
 Transistor (NPN) 2SC1812GB  
 Diode, BH-1A  
 Diode, BU-5A  
 Diode, BM-1A  
 Diode, BM-1A  
 Diode, BM-1A  
 Diode, BM-1A  
 Diode, 12S018-51  
 Diode, BH-1A  
 Diode, BH-1A  
 Diode, 12S018-51  
 Diode, 12S018-51  
 Diode, 12281  
 Diode, 12S018-51  
 Diode, 12S018-51  
 Diode, 12S018-51  
 Diode, 12S018-51  
 Diode, 12S018-51  
 Diode, 12S018-51  
 Diode, 12S018-51  
 Diode, 12S018-51

1H201  
 B801  
 B201  
 B401  
 B505  
 B501  
 B405  
 E201

501X2003-831  
 505X1111-111  
 502X8800-112  
 500X1500-481

Automatic Degaussing Coil  
 Yoke Deflection  
 Lateral/Vertical Assembly  
 310K2B55 Pix Tube

## FINAL ASSEMBLY PARTS

501X0100-115  
 504X8800-304  
 504X8800-548  
 504X8800-588  
 504X8801-411  
 504X8801-488  
 504X2008-835  
 504X1150-013

Thermistor  
 Plug, BMB 4B-C  
 Plug, BMB 5B-B  
 Plug, BMB 4B-B  
 Plug, BMB 8B-C  
 Plug, BMB 8B-L  
 RECEPT W Wire 3B-M-8C  
 Fuse, 4 Amp 125V

## MISCELLANEOUS

1325  
 1321  
 F101  
 F325  
 F321

500X8150-580  
 505X1300-080  
 811X0004-001  
 501X2000-083  
 501X4110-134

HV Unit M-8  
 Transformer, Hot Drive  
 Coil, VDC  
 Coil, Horiz. Size  
 Coil, RF Choke

## TRANSFORMERS & COILS

IC201  
 IC301  
 O325  
 O321  
 O303  
 O305  
 O301  
 O510  
 O508

500X5800-183  
 500X5300-033  
 500X4288-805  
 500X3548-511  
 500X3501-308  
 500X3501-308  
 500X3181-253  
 500X3181-253  
 500X3181-253

IC 21B381  
 IC HA11453  
 Transistor (NPN) 2SD888B  
 Transistor (NPN) 2SC5485BK  
 Transistor (NPN) 2SC5013GBGFS  
 Transistor (NPN) 2SC5013GBGFS  
 Transistor (NPN) 2SC1821GB  
 Transistor (NPN) 2SC1821GB  
 Transistor (NPN) 2SC1821GB

## SEMICONDUCTORS (CONT)

Ref. No. Part No. Description

## MAIN BOARD (CONT)

Ref. No. Part No. Description



## REPLACEMENT PARTS LIST—ELECTRONIC 13" MONITOR



[illegible]

## Main P.C.B. Assy (20-1103A) Parts List

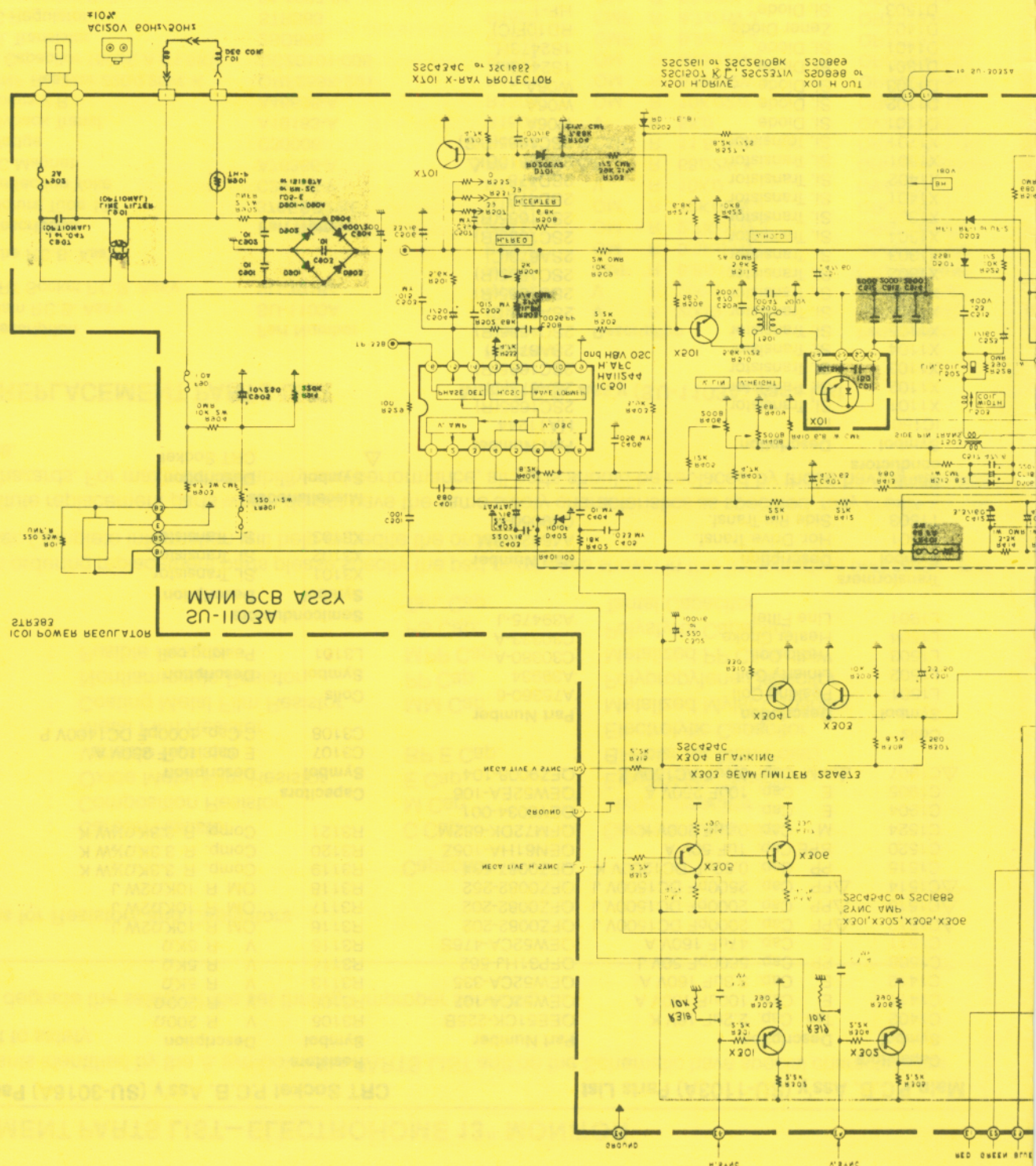
0WEEENI-3B02  
0WEE23NI-1B02  
part number

[illegible]

Symbol	Description	Part Number
<b>Miscellaneous</b>		
X3103	21. Transistor	22C5011
X3105	21. Transistor	22C5011
X3104	21. Transistor	22C5011
<b>Symbol</b>	<b>Description</b>	<b>Part Number</b>
<b>Semiconductors</b>		
G3101	Resisting coil	00G043K-101
<b>Symbol</b>	<b>Description</b>	<b>Part Number</b>
<b>Coils</b>		
C3108	C Cap: 1000pF DC14400V B	0C38001-105M
C3101	E Cap: 10nF 500V A	0EM25EA-100
<b>Symbol</b>	<b>Description</b>	<b>Part Number</b>
<b>Capacitors</b>		
B3151	Comb: B 3'3KΩ/5M K	0B30038-335
B3150	Comb: B 3'3KΩ/5M K	0B30038-335
B3148	Comb: B 3'3KΩ/5M K	0B30038-335
B3148	OM B 10KΩ5M 1	0B00581-103
B3141	OM B 10KΩ5M 1	0B00581-103
B3140	OM B 10KΩ5M 1	0B00581-103
B3142	A B 2KΩ	0A33534-023
B3144	A B 2KΩ	0A33534-023
B3143	A B 2KΩ	0A33534-023
B3100	A B 500Ω	0A33534-055
B3102	A B 500Ω	0A33534-055
<b>Symbol</b>	<b>Description</b>	<b>Part Number</b>
<b>Resistors</b>		

### CRT Socket P.C.B. Ass'y (2U-3016A) Parts List







00-4141-03

C03-EBO

2U3030A (R113 = R3113)

e.g. 2U1156A (R103 = R1103)

Parts identification on circuit boards:

NOTE: ER → fusible resistor (—E—)  
identical type

▽ replace all components marked with safety symbol with  
For safety purposes (and continuing reliability)

Hz indicates cycles per second

⊥ indicates chassis ground unless otherwise specified

⊕ indicates test point connection

Refer to the parts list for additional component information.

NE → non-polar (or bipolar) electrolytic cap.  
Electrolytic Cap: Capacitance Value (μF) / working voltage (V)  
Inductance: (μH)

ceramic capacitor

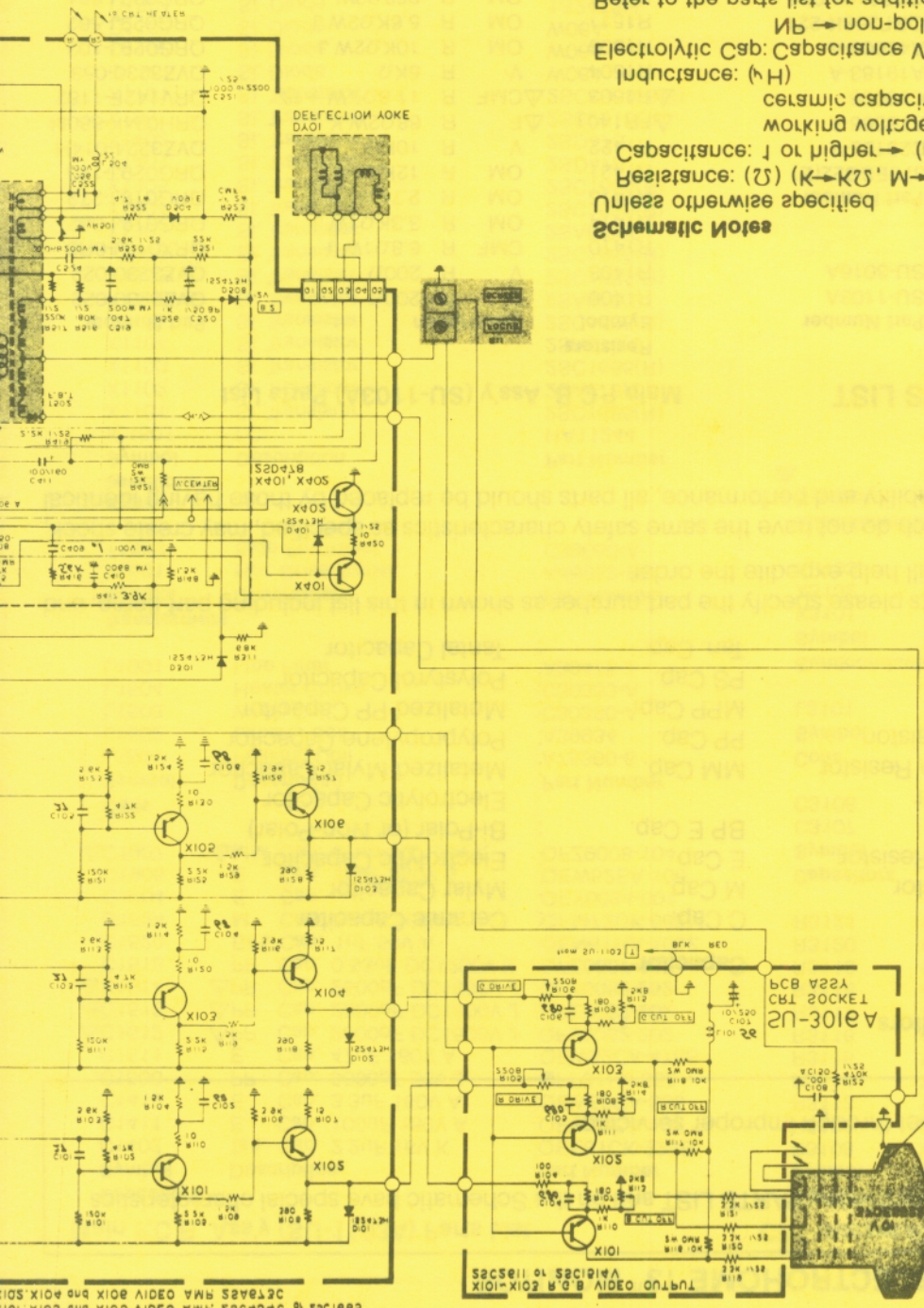
working voltage → 20 (V)

Capacitance: 1 or higher → (pF), less than 1 → (μF)

Resistance: (Ω) (K → KΩ, M → MΩ), 1/4 (W) carbon resistor

Unless otherwise specified

Schematic notes



00-4141-03  
C03-EBO