

SUPER PAC-MAN

General Instructions

Bally

MIDWAY MFG. CO.



GENERAL INSTRUCTIONS

FOR

SUPER PAC-MAN

INSTALLATION

1. Unlock and open the coin box door.
2. Remove four (4) "CABINET LEVELING LEGS" from inside the coin box.
3. Tip the cabinet to the side and remove the shipping cleats from its bottom.
 - ° Locate the threaded holes - one in each corner - and install the "CABINET LEVELING LEGS" in them.
 - ° Level the cabinet.
 - ° When finished, the cabinet should be stable in the upright position.
4. Plug the game into a **standard** A.C. wall outlet **ONLY** .

-----WARNING----- Game MUST be properly grounded.
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5. The power ON/OFF switch is located:
 - ° UPRIGHT MODEL: On top of the cabinet toward the back.
 - ° COCKTAIL TABLE MODEL: Underneath the cabinet on Player No. 2's side.

LINE VOLTAGE SAFETY INTERLOCK SWITCHES

Line voltage SAFETY INTERLOCK SWITCHES have been provided for your protection. The locations of these SAFETY INTERLOCK SWITCHES are:

1. UPRIGHT MODEL: Inside the rear of the cabinet on the right side of the rear access door.
2. COCKTAIL TABEL MODEL: Inside the cabinet on the hinge side of the coin door.

When the cabinet access door(s) are secured in place, the SAFETY INTERLOCK SWITCH plunger(s) are in a fully depressed condition. The game circuit can function normally.

When any cabinet access door(s) are opened, the SAFETY INTERLOCK SWITCH plunger(s) are in a partially extended condition. This isolates the game circuit from the line voltage.

To restore power to the game circuit with the access door(s) open, gently pull the SAFETY INTERLOCK SWITCH plunger(s) out to the fully extended condition. THIS IS TO BE USED FOR SERVICING THE GAME ONLY!

SELF-TEST

Slide switches are provided to make the game run a "Self-Test" on itself. The SELF-TEST SWITCHES are located on a mounting bracket on the inside left hand side of the coin door.

When in the Self-Test mode, the monitor screen will display the results of certain test functions it has run on itself. (These will be discussed in more detail later.)

TO SERVICE THE CONTROL PANEL(S)

1. UPRIGHT MODEL:

- ° The control panel is held in place by three latches, one on the left side, one on the right side, and one in the center of the front of the cabinet.

They are spring loaded to provide constant positive pressure on their latch plates.

They can be reached through the coin door AFTER turning power to the game off.

To release the latches, lift up and toward the center of the control panel.

Once they are released, unhook them from their latch plates.

- ° To remove the control panel:

Raise it up and tilt it toward you until you can see the cable behind it.

Cradling the control panel between yourself and the cabinet, disconnect it from its cabling and nylon retaining strap.

The control panel is now free and can be removed.

- ° To reInstall the control panel(s), reverse this procedure.

2. COCKTAIL TABLE MODEL:

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

Turn the power off to the game.

Open the coin box door and release the two latches on the inside of the cabinet up next to the table top.

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

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

Grasp the table top in the center above the coin door lifting up and to the side to tilt it open.

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

Remove the screws which secure the control panel in place.

° To remove the control panel(s):

Disconnect it from its cabling.

The control panel is now free and can be removed.

° To reinstall the control panel(s), reverse this procedure.

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

1. UPRIGHT MODEL:

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

° **Turn the power to the game off** and remove the control panel. This frees the main-display-glass so it can be lifted up.

° By putting your finger in the hole in the middle of the main-display-glass support, you can lift it up and out.

° Loosen the screws which secure the T.V. bezel-glass-clamps in place.

Move the clamps to the side and the bezel glass may be removed.

Remove the above mentioned screws and the bezel with four bezel-glass-clamps may be removed.

° To reinstall the T.V. bezel assembly and the main-display-glass, reverse this procedure.

2. COCKTAIL TABLE MODEL:

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

- ° Remove the screws which secure the table top glass clamps in place.
- ° Remove the table top glass.
- ° Loosen the screws which secure the T.V. bezel-glass-clamps in place.

Move the clamps to the side and the bezel glass may be removed.

Remove the screws which secure the bezel assembly to the table top and the bezel with four bezel-glass-clamps may be removed.

- ° To reinstall the T.V. bezel assembly and the table top glass, reverse this procedure.

VOLUME CONTROL POT

The volume control pot is located on the C.P.U. board. The other board is the Video board. There is only one pot. For adjustment, it may be reached through the rear access door on the UPRIGHT models. On the COCKTAIL TABLE models, you will have to open the table top to reach it.

To make the sounds louder, turn the pot clockwise as you face it (↷).

To make the sounds less loud, turn the pot counterclockwise as you face it (↶).

VOLTAGE CONTROL POT

The voltage control pot is located on the Power Supply P. C. Board. It is pre-set at the factory and SHOULD NOT be tampered with at all unless the distributors service department is contacted first.

SELF-TEST

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

You may begin a Self-Test at any time after the power to the game is on or by sliding the Self-Test switch to the "ON" position. Now that the game is in the Self-Test mode, it will act as follows:

- ° First, you will see a moving multicolored pattern appear on the screen.
- ° Immediately following this, a rightside up test display is shown on the monitor screen. The game will remain in this Self-Test mode until you set the Self-Test switch back to the "OFF" position. This test display is shown below.

SELF - TEST DISPLAY

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RAM OK      ROM OK
I/O OK
TABLE
1ST COIN   1 CREDIT
2ND COIN   1 CREDIT
PAC-MAN    3
RANK       8
SOUND      00
1ST BONUS  FOR 30000 PTS
2ND BONUS  FOR 100000 PTS
    
```

RAM TEST INDICATIONS AND THEIR MEANINGS

INDICATION	MEANING	CHIP LOCATION
RAM OK	NO RAM IS OUT OF ORDER	
RAM 1	RAM 1 on VIDEO PCB is no good	2E
RAM 2	RAM 2 on VIDEO PCB is no good	2H
RAM 3	RAM 3 on VIDEO PCB is no good	2K
RAM 4	RAM 4 on VIDEO PCB is no good	2J
RAM 5	RAM 5 on C P U PCB is no good	3K
RAM 6	RAM 6 on C P U PCB is no good	3L
RAM 7	RAM 7 on C P U PCB is no good	2D

ROM TEST INDICATIONS AND THEIR MEANINGS

INDICATION	MEANING	CHIP LOCATION
ROM OK	NO ROM IS OUT OF ORDER	
ROM 1	ROM 1 on C P U PCB is no good	1C
ROM 2	ROM 2 on C P U PCB is no good	1B
ROM 3	ROM 3 on C P U PCB is no good	1K

I/O TEST INDICATIONS AND THEIR MEANINGS

INDICATION	MEANING	CHIP LOCATION
I/O OK	NO BIT IS OUT OF ORDER	
I/O 1	BIT C P U 1 is out of order	4F
I/O 2	BIT C P U 2 is out of order	4C

- ° If a bad ROM or RAM chip is found by the games internal check system during the Self-Test, the game indicates this to you by showing the P.C. Board location code of the bad chip(s) in place of the letters "OK":
- ° To check your game function switches and buttons (coin counter switches, SUPER SPEED Button, 1 PLAYER and 2 PLAYER buttons, etc.): activate each one while the game is in the Self-Test mode. You should hear a game sound for each button or switch activated.

If you do not hear it, the switch/button is either not working, miswired, or disconnected. Check it out thoroughly.

- ° "RANK" is a difficulty setting, with "RANK 1" being the **least** difficult level of play and "RANK B" being the **most** difficult level of play. "RANK AUTO"; at these settings the game measures the players skill level and progressively gets harder as the player gets better. "RANK C" is the **least** difficult level of "AUTO" play and "RANK F" is the **most** difficult level of "AUTO" play. See "OPTION SWITCH SETTINGS TABLE".

- ° To check "SOUND":
 - A. Move the controller to the right momentarily and release it - "SOUND" number changes from "00" to "01" and you hear "SOUND 01".
 - B. Repeat Step "A" above and "SOUND 01" will change to "SOUND 02" and it is heard.
 - C. Repeat Step "A" above again and "SOUND 02" changes to "SOUND 03" and it is heard - and so on.

- ° When finished with the Self-Test mode, slide the Self-Test switch back to the "OFF" position.
 - A. A cross hatch pattern appears on the monitor screen for about 1 to 2 seconds.
 - B. If you wish to keep this test pattern on the monitor screen for further use, slide Self-Test switch to the "ON" position after the cross hatch pattern appears and before it disappears.
 - C. When finished with the cross hatch pattern, set the Self-Test switch to the "OFF" position.
 - D. Normal game functions will now return to the monitor screen.

SUPER PAC-MAN OPTION SWITCH SETTINGS

DIP SWITCH SW-3 AT LOCATION 5E		DIP SWITCH SW-2 AT LOCATION 58	
COINS PER CREDIT - COIN SWITCH 1		DIFFICULTY LEVEL SETTINGS - "R1" IS THE EASIEST AND "R8" IS THE MOST DIFFICULT	
*1-COIN	OFF	SW#1 SW#2 SW#3 SW#4 SW#5 SW#6 SW#7 SW#8	OFF OFF OFF OFF
1-COIN	ON		OFF OFF OFF OFF
1-COIN	OFF		ON ON ON ON
1-COIN	ON		ON ON ON ON
1-COIN	OFF		OFF OFF OFF OFF
2-COINS	ON		ON ON ON ON
2-COINS	OFF		OFF OFF OFF OFF
3-COINS	ON		ON ON ON ON
3-COINS	ON		ON ON ON ON
BONUS SUPER PAC-MEN AWARDED AT THE FOLLOWING POINT VALUES:			
BEGAN WITH 1, 2 OR 3 SUPER PAC-MEN	BEGAN WITH 5 SUPER PAC-MEN	SW#1 SW#2 SW#3 SW#4 SW#5 SW#6 SW#7 SW#8	
*1ST S P-M 30000	1ST S P-M 30000		OFF OFF OFF OFF
2ND S P-M 100000	2ND S P-M 100000		ON ON ON ON
1ST S P-M 30000	1ST S P-M 30000		OFF OFF OFF OFF
2ND S P-M 80000	2ND S P-M 120000		ON ON ON ON
1ST S P-M 30000	1ST S P-M 40000		OFF ON OFF
2ND S P-M 120000	2ND S P-M 120000		ON ON ON ON
1ST S P-M 30000	1ST S P-M 30000		OFF OFF OFF OFF
AND EVERY 80000	AND EVERY 100000		ON ON ON ON
1ST S P-M 30000	1ST S P-M 40000		OFF OFF OFF OFF
AND EVERY 100000	AND EVERY 120000		ON ON ON ON
1ST S P-M 30000	ONLY		ON OFF ON
AND EVERY 120000	1 S P-MP 30000		ON OFF ON
ONLY	ONLY		ON ON ON ON
1 S P-M AT 30000	1 S P-M AT 40000		OFF ON ON
NO BONUS SHIPS GIVEN WITH THIS SETTING			ON ON ON ON
DETERMINES NUMBER OF SUPER PAC-MEN PLAYER BEGINS GAME WITH:			
*3 SUPER PAC-MEN	SW#1 SW#2 SW#3 SW#4 SW#5 SW#6 SW#7 SW#8		OFF OFF
1 SUPER PAC-MAN			ON OFF
2 SUPER PAC-MEN			OFF ON
5 SUPER PAC-MEN			ON ON

DIP SWITCH SW-3 AT LOCATION 5E		DIP SWITCH SW-2 AT LOCATION 58	
COINS PER CREDIT - COIN SWITCH 1		DIFFICULTY LEVEL SETTINGS - "R1" IS THE EASIEST AND "R8" IS THE MOST DIFFICULT	
*1-COIN	OFF	SW#1 SW#2 SW#3 SW#4 SW#5 SW#6 SW#7 SW#8	OFF OFF OFF OFF
1-COIN	ON		OFF OFF OFF OFF
1-COIN	OFF		ON ON ON ON
1-COIN	ON		ON ON ON ON
1-COIN	OFF		OFF OFF OFF OFF
2-COINS	ON		ON ON ON ON
2-COINS	OFF		OFF OFF OFF OFF
3-COINS	ON		ON ON ON ON
3-COINS	ON		ON ON ON ON
BONUS SUPER PAC-MEN AWARDED AT THE FOLLOWING POINT VALUES:			
BEGAN WITH 1, 2 OR 3 SUPER PAC-MEN	BEGAN WITH 5 SUPER PAC-MEN	SW#1 SW#2 SW#3 SW#4 SW#5 SW#6 SW#7 SW#8	
*1ST S P-M 30000	1ST S P-M 30000		OFF OFF OFF OFF
2ND S P-M 100000	2ND S P-M 100000		ON ON ON ON
1ST S P-M 30000	1ST S P-M 30000		OFF OFF OFF OFF
2ND S P-M 80000	2ND S P-M 120000		ON ON ON ON
1ST S P-M 30000	1ST S P-M 40000		OFF ON OFF
2ND S P-M 120000	2ND S P-M 120000		ON ON ON ON
1ST S P-M 30000	1ST S P-M 30000		OFF OFF OFF OFF
AND EVERY 80000	AND EVERY 100000		ON ON ON ON
1ST S P-M 30000	1ST S P-M 40000		OFF OFF OFF OFF
AND EVERY 100000	AND EVERY 120000		ON ON ON ON
1ST S P-M 30000	ONLY		ON OFF ON
AND EVERY 120000	1 S P-MP 30000		ON OFF ON
ONLY	ONLY		ON ON ON ON
1 S P-M AT 30000	1 S P-M AT 40000		OFF ON ON
NO BONUS SHIPS GIVEN WITH THIS SETTING			ON ON ON ON
DETERMINES NUMBER OF SUPER PAC-MEN PLAYER BEGINS GAME WITH:			
*3 SUPER PAC-MEN	SW#1 SW#2 SW#3 SW#4 SW#5 SW#6 SW#7 SW#8		OFF OFF
1 SUPER PAC-MAN			ON OFF
2 SUPER PAC-MEN			OFF ON
5 SUPER PAC-MEN			ON ON

COINS PER CREDIT - COIN SWITCH 2

*1-COIN	SW#1 SW#2 SW#3 SW#4 SW#5 SW#6 SW#7 SW#8	OFF OFF
1-COIN		ON OFF
2-COINS		OFF ON
2-COINS		ON ON

SOUND

*SOUND	SW#1 SW#2 SW#3 SW#4 SW#5 SW#6 SW#7 SW#8	OFF
NO SOUND		ON

SCREEN

*NORMAL OPERATION	SW#1 SW#2 SW#3 SW#4 SW#5 SW#6 SW#7 SW#8	OFF
FREEZE VIDEO		ON

*INDICATES FACTORY RECOMMENDED SETTINGS

PART NUMBER M051-00316-0012

VI Technical Troubleshooting

Introduction

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

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

General Suggestions

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

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

Harness Component Troubleshooting

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

NO GAME CREDIT

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

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

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

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

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

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

Transformer and Line Voltage Problems

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

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

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

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

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

HARNESS PROBLEMS

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

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

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

MALFUNCTIONING CONTROLS

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

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

A Glossary of Microprocessor Terms

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

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

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

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

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

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

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

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

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

Introduction to the Z-80 CPU

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

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

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

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

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

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

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

General Purpose Registers

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

Arithmetic & Logic Unit (ALU)

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

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

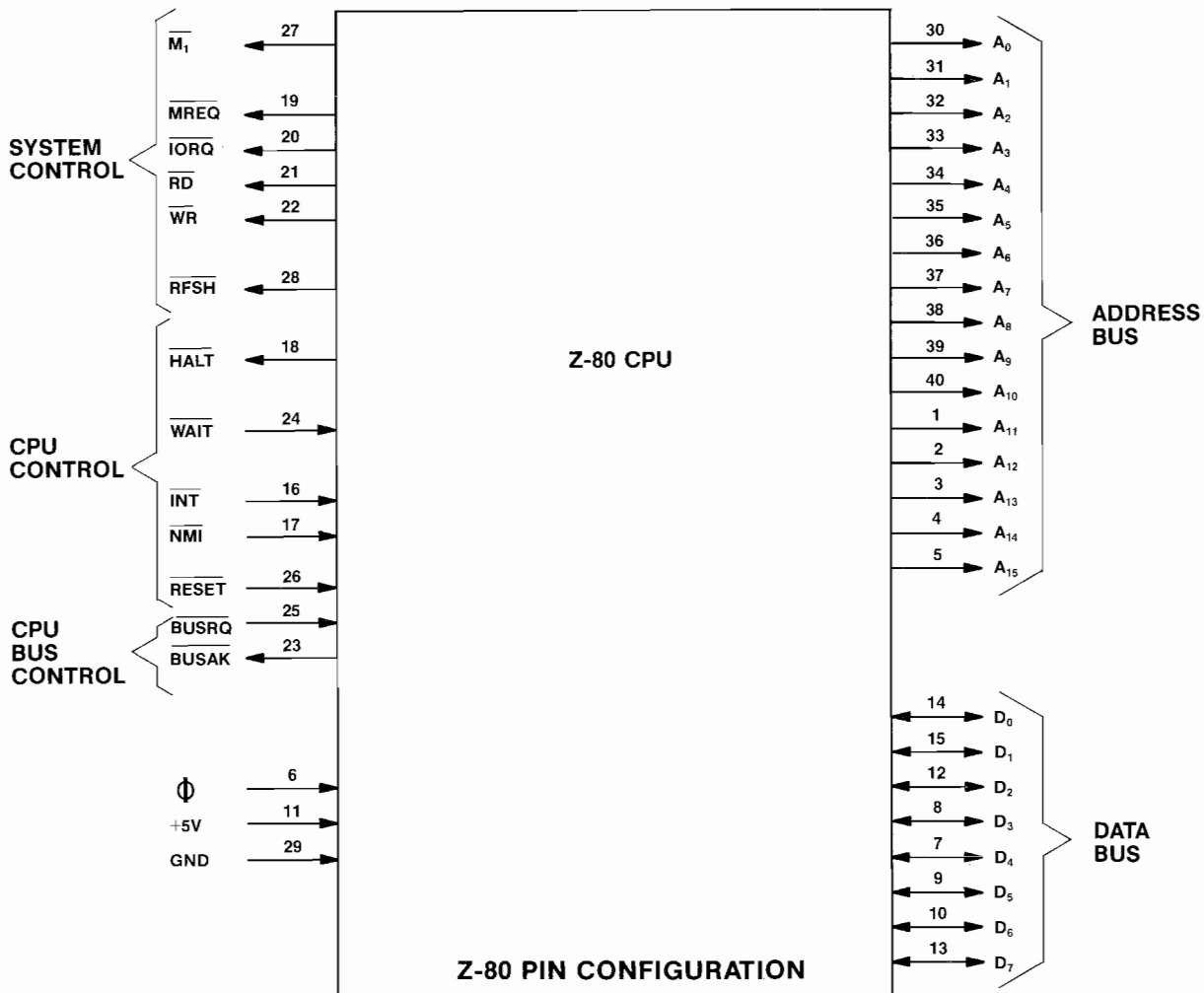
Add	Left or right shifts or rotates (arithmetic and logical)
Subtract	Increment
Logical AND	Decrement
Logical OR	Set bit
Logical Exclusive OR	Reset bit
Compare	Test bit

Instruction Register and CPU Control

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

Z-80 CPU Pin Description

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



A₀-A₁₅
(Address Bus)

Tri-state output, active high. A₀-A₁₅ constitute a 16-bit address bus. The address bus provides the address for memory (up to 64K bytes) data exchanges and for I/O device data exchanges. I/O addressing uses the 8 lower address bits to allow the user to directly select up to 256 input or 256 output ports. A₀ is the least significant address bit. During refresh time, the lower 7 bits contain a valid refresh address.

D₀-D₇
(Data Bus)

Tri-state input/output, active high. D₀-D₇ constitute an 8-bit bidirectional data bus. The data bus is used for data exchanges with memory and I/O devices.

M₁
(Machine Cycle one)

Output, active low. M₁ indicates that the current machine cycle is the OP code fetch cycle of an instruction execution. Note that during execution of 2-byte op-codes, M₁ is generated as each op code byte is fetched. These two byte op-codes always begin with CBH, DDH, EDH or FDH. M₁ also occurs with IORQ to indicate an interrupt acknowledge cycle.

MREQ
(Memory Request)

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

IORQ
(Input/Output Request)

Tri-state output, active low. The IORQ signal indicates that the lower half of the address bus holds a valid I/O address for a I/O read or write operation. An IORQ signal is also generated with an M₁ signal when an interrupt is being acknowledged to indicate that an interrupt response vector can be placed on the data bus. Interrupt Acknowledge operations occur during M₁ time while I/O operations never occur during M₁ time.

RD
(Memory Read)

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

WR
(Memory Write)

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

RFSH
(Refresh)

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

HALT
(Halt state)

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

WAIT
(Wait)

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

INT
(Interrupt Request)

Input, active low. The Interrupt Request signal is generated by I/O devices. A request will be honored at the end of the current instruction if the internal software controlled interrupt enable flip-flop (IFF) is enabled and if the BUSRQ signal is not active. When the CPU accepts the interrupt, an acknowledge signal (IORQ during M₁ time) is sent out at the beginning of the next instruction cycle. The CPU can respond to an interrupt in three different modes that are described in detail in section 5.4 (CPU Control Instructions).

NMI
(Non-Maskable Interrupt)

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

RESET

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

- 1) Disable the interrupt enable flip-flop

- 2) Set Register I = 00H
- 3) Set Register R = 00H
- 4) Set Interrupt Mode 0

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

BUSRQ

(Bus Request)

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

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

BUSAK

(Bus Acknowledge)

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

CLK

(Clock)

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

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

VIDEO GENERATOR P.C. BOARD									
MANUFACTURER	EPROM NO.	JW#1	JW#2	JW#3	JW#4	JW#5	JW#6	JW#7	JW#8
MOTOROLA	68764	#	*	*	#	*	*	*	*
	68766	#	*	*	#	*	*	*	*
INTEL	2764	*	#	#	*	#	*	*	#
T. I.	2564	#	*	*	#	*	#	#	*
SUPER C.P.U. P.C. BOARD									
JUMPER OPTIONS FOR PROGRAM ROMS ONLY									
MANUFACTURER	EPROM NO.	JW#2	JW#4	JW#5	JW#6	JW#7	JW#18	JW#19	
MOTOROLA	68764	#	#	*	#	*	*	#	
	68766	#	#	*	#	*	*	#	
T. I.	2564	#	#	*	#	*	*	#	
INTEL	2764	*	*	#	*	#	#	*	
JUMPER OPTIONS FOR BACKGROUND ROMS ONLY									
MANUFACTURER	EPROM NO.	JW#10	JW#11	JW#12	JW#13	JW#14	JW#15	JW#16	JW#17
MOTOROLA	68764	*	#	*	#	*	#	#	*
	68766	*	#	*	#	*	#	#	*
T. I.	2564	*	#	*	#	*	#	#	*
INTEL	2764	#	*	#	*	#	*	*	#
SOUND I/O P. C. BOARD									
MANUFACTURER	EPROM NO.	JW#1	JW#2						
NUMEROUS MFR'S	2532	*	#						
NUMEROUS MFR'S	2732	#	*						

* = CUT JUMPER WIRES WHERE THIS SYMBOL "*" APPEARS.
= LEAVE JUMPER WIRES IN WHERE THIS SYMBOL "#" APPEARS.

The above table illustrates the fact that the Video Generator P.C. Board used in the MCR II System has 8 jumper wires, the SUPER C.P.U. P.C. Board used in the MCR II System has 19 jumper wires, and the Sound I/O P.C. Board used in the MCR II System has 2 jumper wires.

All of the above Boards can be used with a variety of different **SETS of EPROM chips**. However, these EPROMS are not all made by the same manufacturer

and do have some internal differences. So, in order to make them function properly in their respective P.C. Boards, certain jumper wires on these Boards have to be cut.

The above table tells you which jumpers to cut (depending on which EPROM set you're going to use) by showing a "*" under that jumper wire's number. If there is **NO** "*" under a jumper wire's number, **THAT PARTICULAR JUMPER WIRE IS NOT TO BE CUT.**

VII. Coin Door Maintenance

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

Metal mechanisms only:

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

Metal and Plastic mechanisms:

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

COIN DOOR MAINTENANCE

METAL COIN ACCEPTOR MECHANISMS

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

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

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

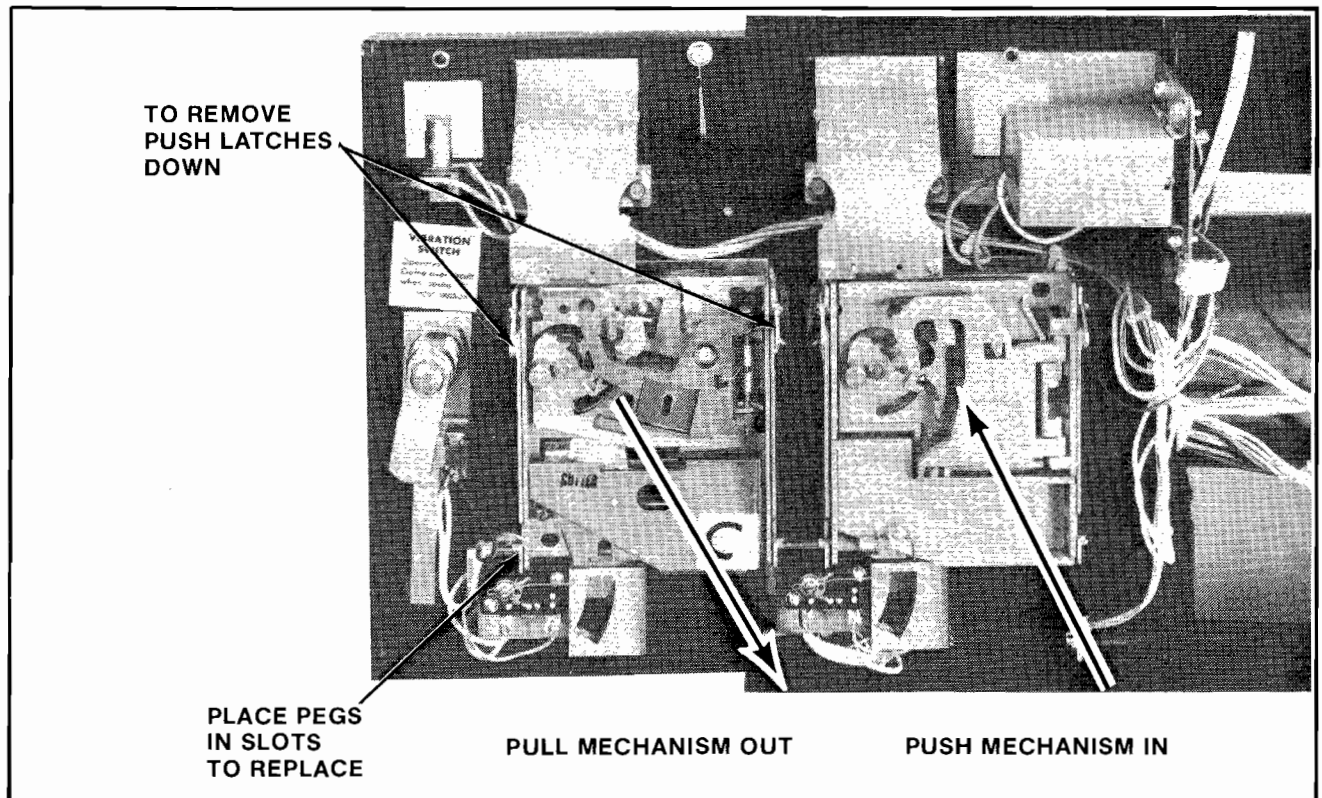


Figure 7-1 Removing and replacing coin acceptor

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

CAUTION: BE CAREFUL NOT TO BURN YOURSELF.

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

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

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

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

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

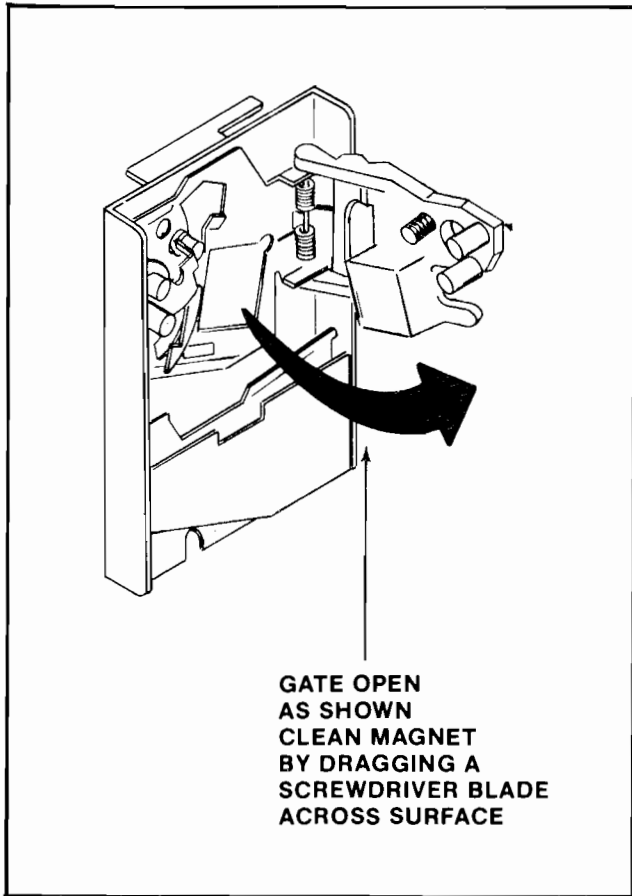


Figure 7-2 Cleaning the metal coin acceptor

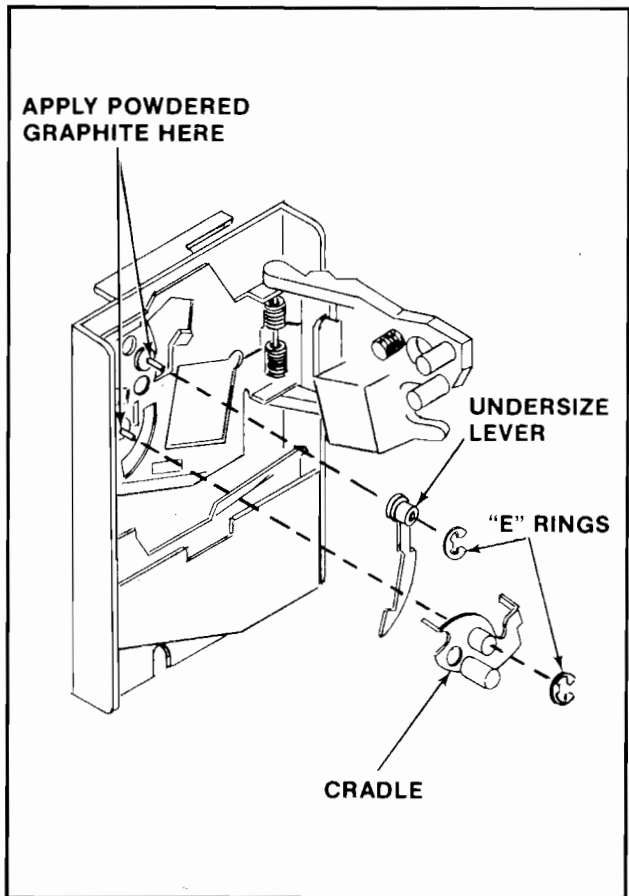


Figure 7-3 Lubricating the metal coin acceptor

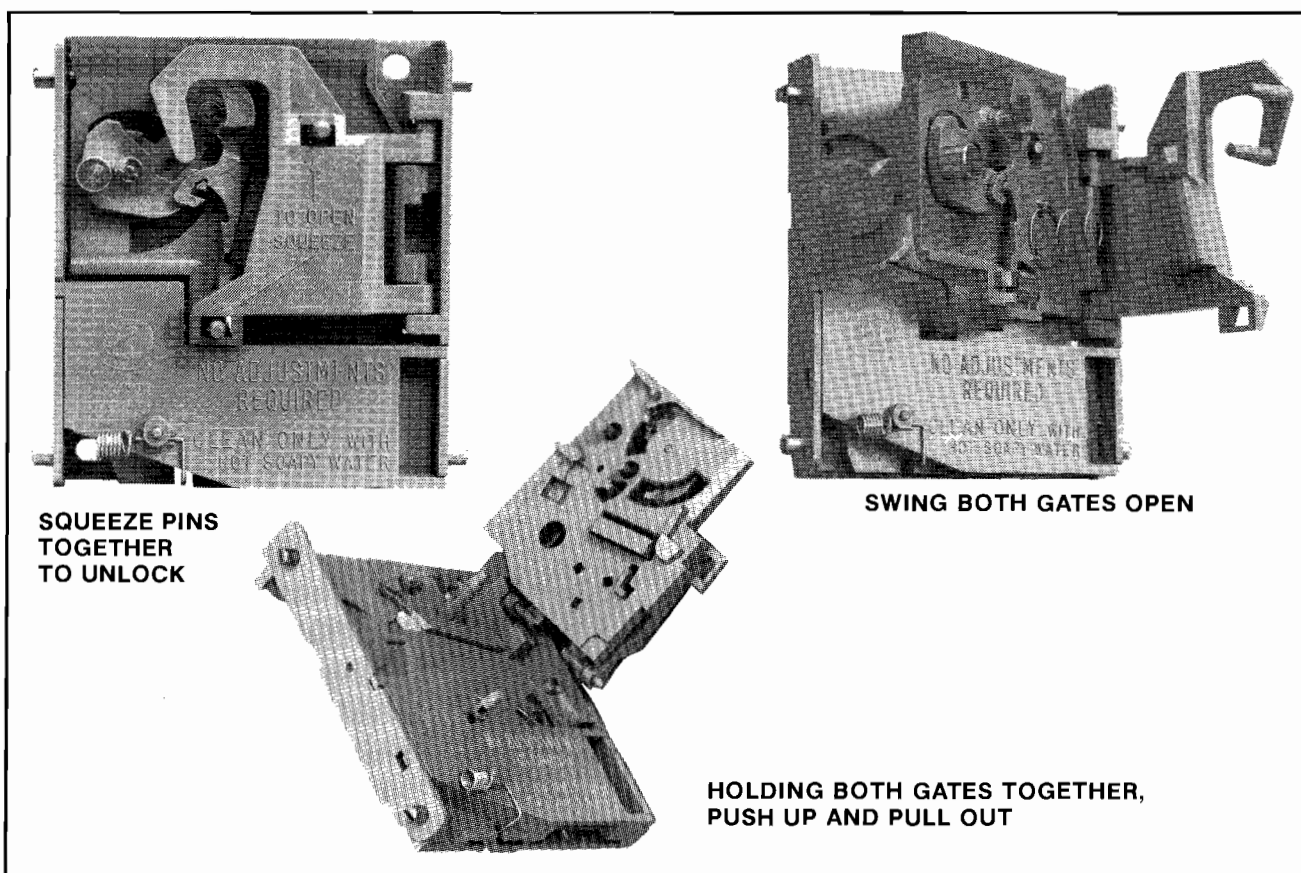


Figure 7-4 Opening the plastic coin acceptor

PLASTIC COIN ACCEPTOR MECHANISMS

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

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

- Reassemble the mechanism (it never needs lubrication).
5. Check the coin chute for obstructions such as: paper, gum, etc.
 6. Reinstall the coin acceptor to the coin door. See Figure 7-5.
 - Place the two pegs at the coin acceptor's base into their retaining slots.
 - Now push the top of the coin acceptor toward the coin door until it snaps in place and is held there by the two spring loaded latches.
 7. Close and lock the coin door.

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

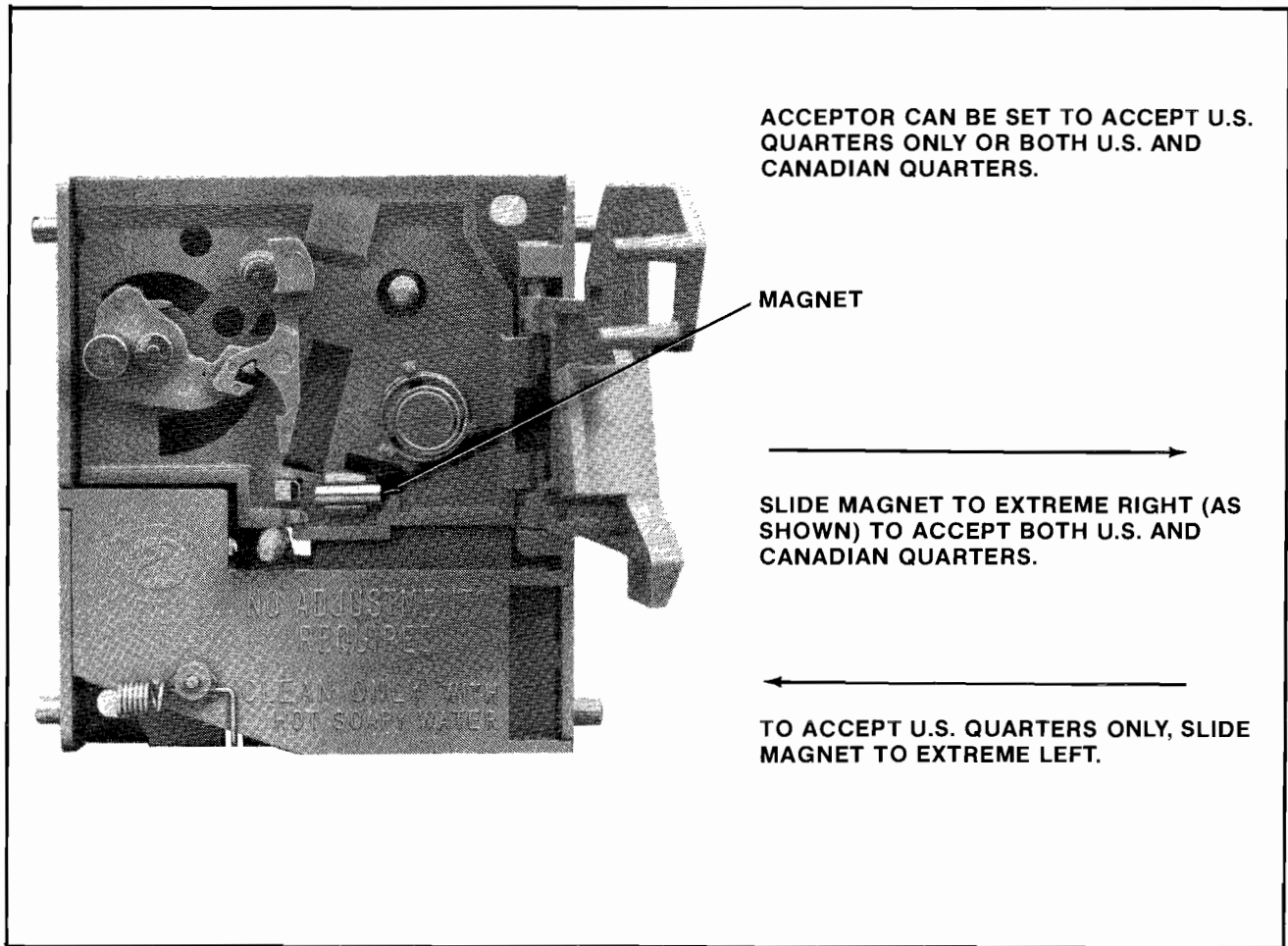


Figure 7-5 Changing the plastic coin acceptor to accept American or Canadian quarters.

PLEASE NOTE:

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

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

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

THANK YOU

VIII T.V. Monitor Manual

Color T.V. Monitor

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

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

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

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

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

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

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

Symptom Diagnosis

- 1. Insufficient width or height:**
 - A. Horizontal line (due to VERTICAL CIRCUIT DEFECT).
 - Bad yoke.
 - Bad vertical output section.
 - Open fusible resistor in vertical section.
 - Bad height control.
 - Bad flyback.
 - B. Vertical line (due to HORIZONTAL CIRCUIT DEFECT).
 - Bad yoke.
 - Open width coil.
 - Open part in horizontal output section.
- 2. Picture spread out too far or crushed in certain areas:**
 - A. Horizontal or vertical output transistor.
 - B. Bad component in output circuitry.
- 3. Line too close with black spacing:**
 - A. Problem in vertical section causing poor linearity.
- 4. Poor focus and convergence:**
 - A. Bad high voltage transformer ("flyback") or control.
 - B. Focus voltage wire not connected to neck-board terminal.
- 5. Colors missing; check:**
 - A. Interface color transistors.
 - B. Color output transistors.
 - C. Cracked printed circuit board.
 - D. Color circuits.
 - E. Video input jack.
- 6. Picture not bright enough:**
 - A. Weak emission from picture tube. (Turn horizontal sync off frequency and put brightness all the way up for about 15 minutes. Occasionally this cures the problem.)
- 7. Silvery effect in white areas; check:**
 - A. Beam current transistors.
 - B. Weak picture tube emission.
- 8. Too much brightness with retrace lines; check:**
 - A. Beam limiter transistors.
 - B. Brightness and/or color blanking control set too high.
- 9. Increasing brightness causes an increase in size and poor focus.**
 - A. Weak high voltage rectifier or regulation (high voltage unit).
- 10. Small picture and/or poor focus:**
 - A. Low B+ voltage (power supply trouble).
- 11. Vertical rolling:**
 - A. Vertical oscillator transistor, IC, or circuit.
 - B. No sync from logic board.
- 12. Horizontal line across center:**
 - A. Vertical output circuit is dead (see symptom No. 1. A.).
 - B. Vertical oscillator is not putting out the right wave form.
- 13. Picture bends:**
 - A. Horizontal sync needs adjusting.
 - B. Magnetic or electromagnetic interference.
- 14. Flashing picture, visible retrace lines:**
 - A. Broken neck board.
 - B. Internal short circuit in the picture tube (arcing).
- 15. Unsymmetrical picture or sides of picture:**
 - A. Defective yoke.
- 16. No brightness, power supply operating — No high voltage for the picture tube; check:**
 - A. Horizontal oscillator.
 - B. Horizontal amplifier and output.
 - C. Flyback transformer (high voltage unit).
- 17. No brightness, high voltage present; check:**
 - A. Heater voltage to the tube at the neck board.
 - B. Screen-grid voltage for the tube.
 - C. Focus voltage.
 - D. Grid to cathode picture tube bias.
- 18. No high voltage; check:**
 - A. For AC input to the "flyback".
 - B. Horizontal deflection stages.
 - C. Flyback transformer.
 - D. Yoke.
 - E. Power supply.
- 19. No horizontal and vertical hold; check:**
 - A. Sync transistors and circuit.
 - B. Wires and jack from logic board to the monitor.
- 20. Wavy picture — (power supply defect); check:**
 - A. Transistors, diodes, electrolytic capacitors in the power supply.

21. Moving bars in picture:

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

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

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

23. Monitor won't turn on:

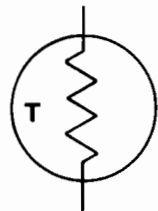
- A. Problem in the power supply: Check fuse, transistors, open fusible resistor.
- B. Shorted horizontal output transistor.

- C. Defective high voltage disabling circuit.
- D. Crack(s) somewhere on main chassis board.

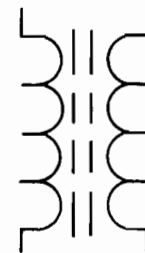
24. Can't adjust purity or convergence:

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

Guide To Schematic Symbols



THERMISTOR
(POLARITY DOESN'T MATTER)



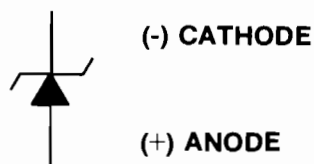
IRON CORE TRANSFORMER
(SUCH AS A FLYBACK)



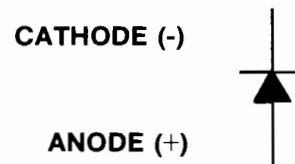
INDUCTOR, COIL, CHOKE
(POLARITY DOESN'T MATTER)



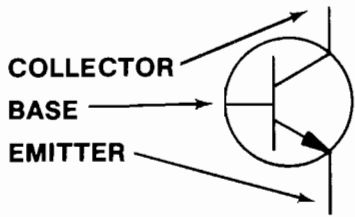
FUSE
(POLARITY DOESN'T MATTER)



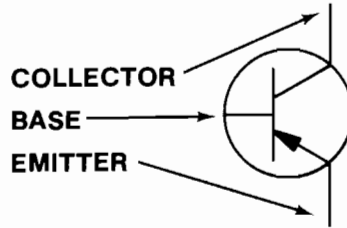
ZENER DIODE



DIODE



NPN TRANSISTOR



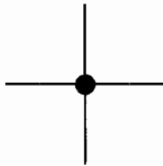
PNP TRANSISTOR



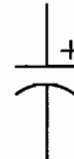
VARIABLE RESISTOR, POT, CONTROL
(POLARITY DOESN'T MATTER)



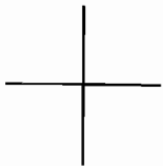
RESISTOR
(POLARITY DOESN'T MATTER)



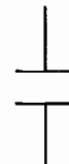
LINES ARE CONNECTED



ELECTROLYTIC CAPACITOR



LINES ARE NOT CONNECTED



CAPACITOR
(POLARITY DOESN'T MATTER)



OR
GROUND

Troubleshooting

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

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

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

WARNING: That picture tube is a bomb!

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

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

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

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

CAUTION:

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

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

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

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

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

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

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

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

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

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

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

Theory of Operation

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

THE POWER SUPPLY —

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

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

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

THE INTERFACE SECTION OF THE CHASSIS —

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

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

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

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

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

VERTICAL AND HORIZONTAL DEFLECTION—

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

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

A Wells Gardner 13" (K4806) or 19" (K4906, K4956) color monitor uses an integrated circuit for its sync section. An Electrohome 13" or 19" color monitor uses an integrated circuit IC501 for its sync section. Wells Gardner uses HA11423 and Electrohome uses HA11244. **These ARE NOT interchangeable!** The idea is all the same. The output to the vertical amplifying transistors for all monitors must form a sawtooth wave form, sort of like a bunch of pyramids, racing through the yoke's vertical coils at 60 times a second.

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

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

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

THE FLYBACK TRANSFORMER (OR HIGH VOLTAGE UNIT) —

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

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

COLOR CIRCUITS —

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

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

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

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

PROTECTION CIRCUIT —

To protect the high voltage section against voltages that are too high coming from the power supply which could cause X-rays to be emitted from the "flyback", a circuit senses the higher power supply voltage, and using a transistor, turns off the horizontal oscillator. Since the horizontal oscillator doesn't work, the horizontal output transistor has nothing to feed the "flyback" which in turn has nothing to feed the picture tube. The monitor will be silent, have no picture, and will appear to be off. **But don't be fooled.** There is still that excessive amount of voltage coming from the power supply. To find out, check at pin two of Wells Gardner's IC501 and emitter of X04 for the Electrohome monitor. Here are the voltages you should receive:

Wells Gardner = 130VDC
Electrohome = 120VDC

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

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

THE PICTURE TUBE (OR CRT) —

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

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

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

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

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

Differences Between Monitors

The easiest way to identify the brand of monitor you are working with, assuming you can't find the brand name written on it anywhere, is to check the color of the suction cup type insulator that houses that dangerous anode plug on the CRT. Both monitors use a red wire but the Wells Gardner anode cup is BLACK while the Electrohome anode cup is LIGHT GRAY. Unfortunately, "call-out-numbers" for parts, circuit layout, and even circuit design are similar enough to confuse the average observer.

Let's say you have an Electrohome that isn't working. No problem. You can scavenge parts from an old broken up one that you may have around.

Now let's say you have a Wells Gardner that isn't working. **STOP!!** This could be a problem. There are 3

different types of Wells Gardner K4900 **SERIES** monitors in the games. Here are ways to identify them.

K4906 (1st TYPE) — This monitor's identifying tags have **BLACK** ink printed on a white background. There is **NO** Vertical Damping Control. (This Control would be next to the Vertical Hold Control but this area is jumpered with a small wire instead.

K4906 (2nd TYPE) — This monitor's identifying tags have **RED** ink printed on a white background. There **IS** a Vertical Damping Control next to the Vertical Hold Control. The Damping Control provides a few more lines on the top of the monitor screen (monitor viewed as a normal T.V. would be) for any video game that may need these lines to fit the picture on the

screen. Moving the Control may distort the top part of your picture (or the side, depending on the game and how the monitor is mounted) so go ahead and move it if you are having this type of problem. To accommodate this new feature, there are a few circuit changes.

ONE MAJOR DIFFERENCE BETWEEN THESE TWO VERSIONS OF THE K4906 IS THE YOKE. They look the same but notice the part numbers:

K4906 **WITHOUT** the Damper Control: 2021111201

K4906 **WITH** the Damper Control: 2021111258

Since the companies like to change part numbers at the drop of a hat, the best thing to do is to request whatever part number is written on your yoke. If you should get the wrong yoke, the results will be:

Picture distortion.

Excessive brightness.

Too much or too little vertical picture size.

K4956 (3rd TYPE) — This monitor is identical to the K4906 **WITHOUT** the Damper Control **EXCEPT** the picture tube is vertically mounted and there is an additional small P.C. Board mounted on the monitor where the yoke plugs in. This monitor is used on some Cocktail Table games where the picture has to flip for the second player.

Generally speaking, some games flip the picture image via the logic board programming but this monitor is used in games that flip the picture image via generation of a small signal voltage which is sent to the extra P.C. Board on this monitor. This signal voltage causes relays on this extra P.C. Board to flip the picture by reversing the horizontal and vertical signals to the yoke pins.

What kind of problems can this extra P.C. Board cause? If the relays become defective, the picture won't flip. If the P.C. Board gets cracked you may have a horizontal line on the screen, a vertical line on the screen, or maybe just a dot in the center of the screen. Of course, the logic board could be defective and not sending the signal to flip the picture. In any case, some people feel that using relays is cheaper, simpler, and more reliable, so this is an advantage.

CONTROLS YOU MAY NOT TOUCH

Basically, on the Electrohome monitor, you can move any control you want **EXCEPT** for the B1 control. This sets the power supply voltage (ideally at 120 VDC) and is located right behind VERTICAL HOLD. The 13" Electrohome **DOES NOT** have this control. It may also be wise not to move the VERTICAL LINEARITY since this distorts the picture and is hard to reset perfectly. If you do move it, turn on the Cross Hatch Test Pattern of your game and try to get the squares to the point where they are equal in size by readjusting this Linearity Control.

On the Wells Gardner monitor, brightness is adjusted by the "BLACK LEVEL" Control which is right next to the Horizontal Frequency Control. Under the Focus Control is the "SCREEN" Control which you **DO NOT** touch. Yes, this control does adjust the brightness, but it is used to set the CRT bias and is adjusted at the factory. When Wells Gardner sets it, they mark the position with a black mark on the knob. If you move it, be sure to realign the mark and **THEN** set the BLACK LEVEL Control to the brightness you desire. So, other than the SCREEN control, you may adjust any of the controls.

Parts Interchangeability

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

1. You **CAN** swap any resistor between monitors that has the same resistance, wattage rating, and tolerance.
2. You **CAN** swap any capacitor between monitors that has the same capacitance and voltage rating.
3. You **CAN** swap many of the parts between the 19" and the 13" versions of each manufacturer's monitor. **BUT**, be certain to compare the manufacturers' part numbers to be positive the parts you want to interchange are identical. **BE SURE** you have read the section DIFFERENCES BETWEEN MONITORS which was covered earlier.
4. You **CANNOT** swap any picture tubes between monitors!! In the past you could, but Wells Gardner is now using a new monitor. When

ordering a replacement picture tube, **ALWAYS SPECIFY THE PICTURE TUBE NUMBER!**

5. You **CANNOT** change any part that is a **safety part**, one that is shaded in gray on the schematic; it **MUST** be **IDENTICAL** to the original. **To do otherwise IS DANGEROUS.** For instance, the 13 inch Electrohome (G07-902) monitor "flyback" looks identical to the 19 inch Electrohome (G07-904) monitor "flyback". In fact, there is even a 19 inch Electrohome (G07-905) monitor (which is an obsolete model) with a similar looking "flyback". **NONE OF THESE ARE INTERCHANGEABLE!!**
6. You **CAN** change any of the parts between the G07-904 and G07-907. They're essentially the same monitor except that the G07-907 has a vertically mounted picture tube.

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

19" COLOR MONITOR SCHEMATIC DIAGRAM

MODELS 19K4901, 19K4906, 19K4951, 19K4956

Power Supply Voltage and Symbols

Symbol	Voltage	Operating Circuit
	15V	Vert. Osc. Sync Blanking CRT Cut-Off
	130V	Horiz. Osc. Horz. Drive Horz. Output Vert. Output
	175V	Video Output

★

SERVICE TECHNICIAN WARNING
X-RAY RADIATION PRECAUTION:

THIS PRODUCT CONTAINS CRITICAL ELECTRICAL AND MECHANICAL PARTS ESSENTIAL FOR X-RAY RADIATION PROTECTION.

FOR REPLACEMENT PURPOSES, USE ONLY TYPE PARTS SHOWN IN THE PARTS LIST.

⚠

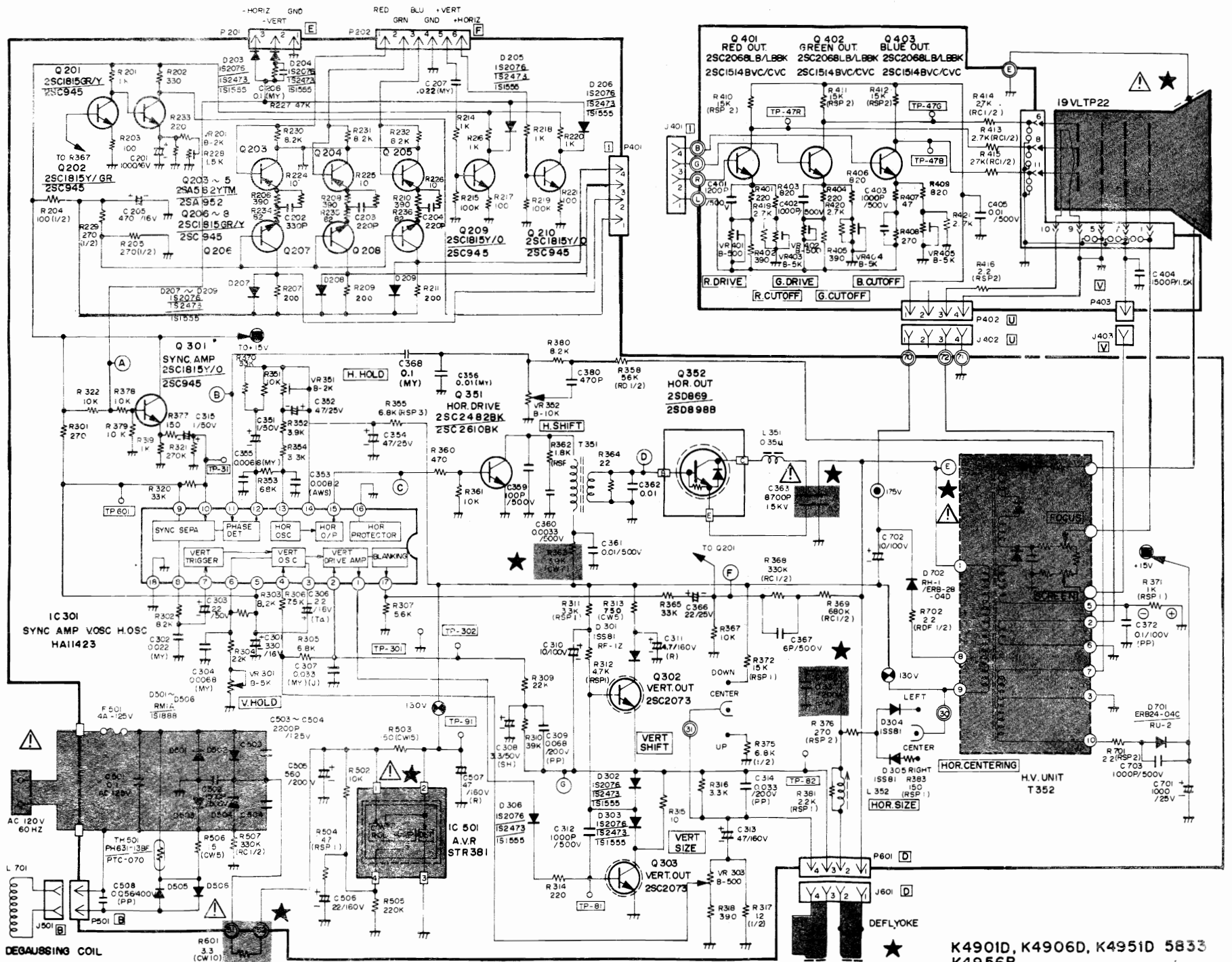
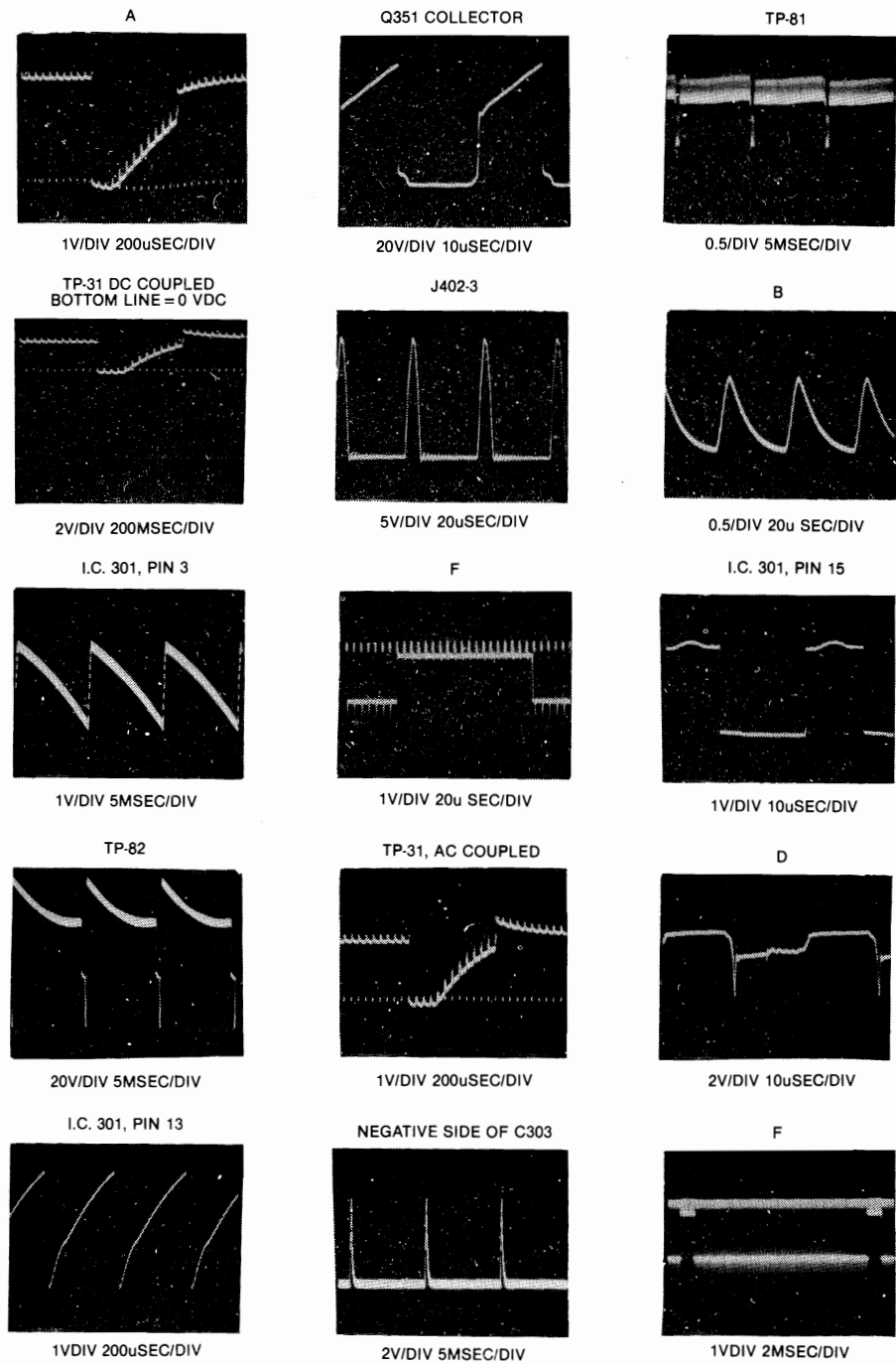
CAUTION: FOR CONTINUED SAFETY, REPLACE SAFETY CRITICAL COMPONENTS ONLY WITH MANUFACTURER'S RECOMMENDED PARTS.

AVERTISSEMENT: POUR MAINTENIR LE DEGRE DE SECURITE DE L'APPAREIL NE REMPLACER LES COMPOSANTS DONT LE FONCTIONNEMENT EST CRITIQUE POUR LA SECURITE QUE PAR DES PIECES RECOMMANDEES PAR LE FABRICANT.

OSCILLOSCOPE WAVEFORM PATTERN

The waveforms shown are as observed on the wide band oscilloscope with the monitor turned to a reasonably strong signal and a normal picture. The voltages shown on each waveform are the approximate peak amplitudes.

If the waveforms are observed on the oscilloscope with a poor high frequency response, the corner of the pulses will tend to be more rounded than those shown and the amplitude of any high frequency pulse will tend to be less.



★ K4901D, K4906D, K4951D 5833
K4956B

REPLACEMENT PARTS LIST

This monitor contains circuits and components included specifically for safety purposes.

For continued protection no changes should be made to the original design, and components shown in shaded areas of schematic, or Δ \star on parts list should be replaced with exact factory replacement parts.

The use of substitute parts may create a shock, fire, radiation or other hazard. Service should be performed by qualified personnel only.

MAIN BOARD

Ref. No.	Part No.	Description	Ref. No.	Part No.	Description
RESISTORS			RESISTORS (CONT.)		
R201	203X6500-645	1K Ohm, 5%, 1/4W Carbon	R369	203X5602-329	680K Ohm, 5%, 1/2W Comp.
R202	203X6500-523	30 Ohm, 5%, 1/4W Carbon	R370	203X6501-002	33K Ohm, 5%, 1/4W Carbon
R203	203X6500-405	100 Ohm, 5%, 1/4W Carbon	R371	203X9014-584	1K Ohm, 5%, 1W Metal Oxide
R204	203X6700-327	100 Ohm, 5%, 1/2W Carbon	R372	203X9101-119	12K Ohm, 5%, 1W Metal Oxide
R205	203X6700-421	270 Ohm, 5%, 1/2W Carbon	R375	203X6700-763	6.8K Ohm, 5%, 1/2W Carbon
R206	203X6500-540	390 Ohm, 5%, 1/4W Carbon	R376	203X9104-404	270 Ohm, 5%, 2W Metal Oxide
R207	340X2201-934	200 Ohm, 5%, 1/4W Carbon	R377	203X6500-447	150 Ohm, 5%, 1/4W Carbon
R208	203X6500-540	390 Ohm, 5%, 1/4W Carbon	R378	203X6500-886	10K Ohm, 5%, 1/4W Carbon
R209	340X2201-934	200 Ohm, 5%, 1/4W Carbon	R379	203X6500-886	10K Ohm, 5%, 1/4W Carbon
R210	203X6500-540	390 Ohm, 5%, 1/4W Carbon	R380	203X6500-865	8.2K Ohm, 5%, 1/4W Carbon
R211	340X2201-934	200 Ohm, 5%, 1/4W Carbon	R381	203X6500-724	2.2K Ohm, 5%, 1W Metal Oxide
R214	203X6500-645	1K Ohm, 5%, 1/4W Carbon	R383	203X9014-387	150 Ohm, 5%, 1W Metal Oxide
R215	203X6501-126	100K Ohm, 5%, 1/4W Carbon	R502	203X6500-886	10K Ohm, 5%, 1/4W Carbon
R216	203X6500-645	1K Ohm, 5%, 1/4W Carbon	R503	204X1700-535	150 Ohm, 5%, 15W Metal Oxide
R217	203X6500-405	100 Ohm, 5%, 1/4W Carbon	R504	203X9014-267	47 Ohm, 5%, 1W Metal Oxide
R218	203X6500-645	1K Ohm, 5%, 1/4W Carbon	R505	203X6501-209	2.2K Ohm, 5%, 1/4W Carbon
R219	203X6501-126	100K Ohm, 5%, 1/4W Carbon	R506	203X9104-105	15 Ohm, 5%, 2W Metal Oxide
R220	203X6500-645	1K Ohm, 5%, 1/4W Carbon	R507	203X5602-185	330K Ohm, 5%, 1/2W Comp.
R221	203X6500-405	100 Ohm, 5%, 1/4W Carbon	Δ \star R601	204X1625-058	3.3 Ohm, 5%, 10W WW
R222	203X6500-762	3.3 Ohm, 5%, 1/4W Carbon	R701	203X9105-141	2.2 Ohm, 5%, 2W Metal Oxide
R224	203X6500-169	10 Ohm, 5%, 1/4W Carbon	R702	203X6206-441	2.2 Ohm, 5%, 1/2W Carbon
R225	203X6500-169	10 Ohm, 5%, 1/4W Carbon	VR201	204X2070-072	2K Ohm-B Semi-Fixed
R226	203X6500-169	10 Ohm, 5%, 1/4W Carbon	VR301	204X2070-084	5K Ohm-B Semi-Fixed
R227	203X6501-044	47K Ohm, 5%, 1/4W Carbon	VR303	204X2070-055	500 Ohm-B Semi-Fixed
R228	203X6500-645	1K Ohm, 5%, 1/4W Carbon	VR351	204X2070-072	2K Ohm-B Semi-Fixed
R229	203X6700-421	270 Ohm, 5%, 1/2W Carbon	VR352	204X2070-072	2K Ohm-B Semi-Fixed
R230	203X6500-863	8.2K Ohm, 5%, 1/2W Comp.			
R231	203X6500-863	8.2K Ohm, 5%, 1/2W Comp.			
R232	203X6500-863	8.2K Ohm, 5%, 1/2W Comp.			
R233	203X6500-468	180 Ohm, 5%, 1/4W Carbon			
R234	340X2820-934	82 Ohm, 5%, 1/4W Carbon			
R235	340X2820-934	82 Ohm, 5%, 1/4W Carbon	C201	203X0014-088	1000 uF, 16V, Electrolytic
R236	340X2820-934	82 Ohm, 5%, 1/4W Carbon	C202	202X7200-064	330 pF, 500V, Ceramic
R301	203X6500-508	270 Ohm, 5%, 1/4W Carbon	C203	202X7200-043	220 pF, 500V, Ceramic
R302	203X6500-863	8.2K Ohm, 5%, 1/4W Carbon	C204	202X7200-043	220 pF, 500V, Ceramic
R303	203X6500-863	8.2K Ohm, 5%, 1/4W Carbon	C205	203X0014-076	470 uF, 16V, Electrolytic
R304	203X6500-724	2.2K Ohm, 5%, 1/4W Carbon	C206	203X1810-149	0.1 uF, 125V Mylar
R305	203X6500-842	6.8K Ohm, 5%, 1/4W Carbon	C207	349X2232-109	.022 uF, 100V Mylar
R306	203X6003-201	7.5K Ohm, 2%, 1/4W Carbon	C301	203X0014-065	330 uF, 50V Electrolytic
R307	203X6500-825	5.6K Ohm, 5%, 1/4W Carbon	C302	203X1600-563	0.033 uF, 50V Mylar
R309	203X6500-965	22K Ohm, 5%, 1/4W Carbon	C303	203X0629-037	3.3 uF, 50V Electrolytic
R310	203X6500-988	39K Ohm, 5%, 1/4W Carbon	C304	203X1600-366	0.068 pF, 50V Mylar
R311	203X6500-762	3.3K Ohm, 5%, 1/4W Carbon	C306	203X0412-012	2.2 uF, 16V Tantal
R312	203X9014-741	4.7K Ohm, 5%, 1/4W Carbon	C307	203X1600-634	0.033 uF, 50V Mylar
R313	204X1450-537	1K Ohm, 5%, 5W Carbon	C308	203X0025-174	3.3 uF, 50V Electrolytic
R314	203X6500-481	220 Ohm, 5%, 1/4W Carbon	C309	203X1207-100	0.068 uF, 100V PP
R315	203X6500-169	10 Ohm, 5%, 1/4W Carbon	C310	203X0629-061	10 uF, 100V Electrolytic
R316	203X6500-762	3.3K Ohm, 5%, 1/4W Carbon	C311	203X0041-025	10 uF, 160V Electrolytic
R317	203X6700-107	12 Ohm, 5%, 1/2W Carbon	C312	202X7050-248	1000 pF, 500V Ceramic
R318	203X6500-540	390 Ohm, 5%, 1/4W Carbon	C313	203X0040-052	47 uF, 160V Electrolytic
R319	203X6500-645	1K Ohm, 5%, 1/4W Carbon	C314	203X1201-265	0.033 uF, 200V PP
R320	203X6501-002	33K Ohm, 5%, 1/4W Carbon	C315	203X0629-023	1 uF, 50V Electrolytic
R321	203X6501-224	270K Ohm, 5%, 1/2W Carbon	C351	203X0629-023	1 uF, 50V Electrolytic
R322	203X6500-886	10K Ohm, 5%, 1/4W Carbon	C352	203X0619-045	47 uF, 25V Electrolytic
R351	203X6500-886	10K Ohm, 5%, 1/4W Carbon	C353	203X1190-015	0.0082 pF, 50V Mylar-PP
R352	203X6500-785	3.9K Ohm, 5%, 1/4W Carbon	C354	203X0619-045	47 uF, 25V Electrolytic
R353	203X6501-086	68K Ohm, 5%, 1/4W Carbon	C355	203X1600-366	0.0068 pF, 50V Mylar
R354	203X6500-762	3.3K Ohm, 5%, 1/4W Carbon	C356	202X7050-483	0.01 uF, 50V Ceramic
R355	203X9205-143	6.8K Ohm, 5%, 3W Metal Oxide	C359	202X8065-606	100 pF, 500V Ceramic
R358	203X5601-878	56K Ohm, 5%, 1/2W Carbon	C360	202X7050-366	0.0033 pF, 500V Ceramic
R360	203X6500-561	470 Ohm, 5%, 1/4W Carbon	C361	202X7050-483	0.01 uF, 500V Ceramic
R361	203X6500-886	10K Ohm, 5%, 1/4W Carbon	C362	202X7203-032	0.01 uF, 50V Ceramic
R362	203X9014-645	1.8K Ohm, 5%, 1W Metal Oxide	Δ \star C363	203X1270-911	8700 pF, 1.5 KV PP
\star R363	204X1527-751	3.9K Ohm, 5%, 7W Metal Oxide	\star C365	203X1201-265	0.33 uF, 200V PP
R364	203X6500-246	22 Ohm, 5%, 1/4W Carbon	C366	203X0019-026	22 uF, 25V Electrolytic
R365	203X6501-002	33K Ohm, 5%, 1/4W Carbon	C367	202X8065-162	6 pF, 500V Ceramic
R367	203X6500-886	10K Ohm, 5%, 1/4W Carbon	C368	202X7203-032	0.01 uF, 50V Ceramic
R368	203X5602-185	330K Ohm, 5%, 1/2W Comp.	C372	203X1207-125	0.1 uF, 100V PP

MAIN BOARD (CONT.)

Ref. No.	Part No.	Description
CAPACITORS (CONT.)		
C380	202X7200-087	470 uF, 500V Ceramic
△ C501	203X1810-149	0.1 uF, 125V Mylar
△ C502	202X7050-282	1500 pF, 500V Ceramic
△ C503	202X7810-214	2200 pF, 125V Ceramic
△ C504	202X7810-214	2200 pF, 125V Ceramic
C505	203X0220-075	560 uF, 200V Electrolytic
C506	203X0040-034	22 uF, 160V Electrolytic
C507	203X0041-057	47 uF, 160V Electrolytic
C701	203X0019-092	1000 uF, 25V Electrolytic
C702	203X0634-061	10 uF, 100V Electrolytic
C703	202X7050-248	1000 pF, 500V Ceramic

SEMICONDUCTORS

D203	201X2010-159	Diode, IS2076-27
D204	201X2010-159	Diode, IS2076-27
D205	201X2010-159	Diode, IS2076-27
D206	201X2010-159	Diode, IS2076-27
D207	201X2010-159	Diode, IS2076-27
D208	201X2010-159	Diode, IS2076-27
D209	201X2010-159	Diode, IS2076-27
D301	201X2010-165	Diode, ISS81
D302	201X2010-159	Diode, IS2076-27
D303	201X2010-159	Diode, IS2076-27
D304	201X2120-009	Diode, RH-IV
D305	201X2120-009	Diode, RH-IV
D306	201X2010-159	Diode, IS2076-27
△ D501	201X3120-216	Diode, RM-1AV
△ D502	201X3120-216	Diode, RM-1AV
△ D503	201X3120-216	Diode, RM-1AV
△ D504	201X3120-216	Diode, RM-1AV
D505	201X3120-216	Diode, RM-1AV
D506	201X3120-216	Diode, RM-1AV
D701	201X2130-234	Diode, RU-2V
D702	201X2120-009	Diode, RH-IV
Q201	200X3181-523	Transistor (NPN) 2SC1815GR
Q202	200X3181-523	Transistor (NPN) 2SC1815GR
Q203	200X4056-260	Transistor (PNP) 2SA562-Y-TM
Q204	200X4056-260	Transistor (PNP) 2SA562-Y-TM
Q205	200X4056-260	Transistor (PNP) 2SA562-Y-TM

Ref. No.	Part No.	Description
SEMICONDUCTORS (CONT.)		
Q206	200X3181-523	Transistor (NPN) 2SC1815GR
Q207	200X3181-523	Transistor (NPN) 2SC1815GR
Q208	200X3181-523	Transistor (NPN) 2SC1815GR
Q209	200X3181-523	Transistor (NPN) 2SC1815GR
Q210	200X3181-523	Transistor (NPN) 2SC1815GR
Q301	200X3181-523	Transistor (NPN) 2SC1815GR
Q302	200X3207-306	Transistor (NPN) 2SC2073LBGL2
Q303	200X3207-306	Transistor (NPN) 2SC2073LBGL2
Q351	200X3248-217	Transistor (NPN) 2SC2482BK
Q352	200X4589-802	Transistor (NPN) 2SD698B
IC301	200X2300-033	IC HA11423
△ ★ IC501	200X2600-183	IC STR381

TRANSFORMERS & COILS

L351	201X4710-134	Coil, (RF Choke)
L352	201X5000-083	Coil, Horiz. Size
L701	611X0004-007	Coil, Adg.
T351	202X1300-080	Transformer, Hor. Drive
△ ★ T352	200X9720-301	HV-Unit M-11

MISCELLANEOUS

△ F501	204X7120-073	Fuse, 4 Amp. 125V
J402	206X5008-632	Recep W Wire 3P-M-BG
P201	204X9600-466	Plug, PWB 3P-J
P202	204X9601-477	Plug, PWB 6P-Q
P401	204X9600-298	Plug, PWB 4P-B
P501	204X9600-249	Plug, PWB 2P-B
P601	204X9600-304	Plug, PWB 4P-C
TH501	201X0100-112	Thermistor

FINAL ASSEMBLY PARTS

△ ★ 88X0138-506	19VLT2? Pix Tube
205X9800-158	Lateral/Purity Assembly
△ ★ 202X1111-201	Yoke Deflection
204X9301-255	CRT Socket
291X5004-262	Automatic Degaussing Coil Unit

NECK BOARD

RESISTORS

R401	203X6000-729	220 Ohm, 5% 1/4W Carbon
R402	203X6500-540	390 Ohm, 5% 1/4W Carbon
R403	203X6000-661	820 Ohm, 5% 1/4W Carbon
R404	203X6000-729	220 Ohm, 5% 1/4W Carbon
R405	203X6500-540	390 Ohm, 5% 1/4W Carbon
R406	203X6000-661	820 Ohm, 5% 1/4W Carbon
R407	203X6000-729	470 Ohm, 5% 1/4W Carbon
R408	203X6000-998	270 Ohm, 5% 1/4W Carbon
R409	203X6000-661	820 Ohm, 5% 1/4W Carbon
R410	203X9104-824	15K Ohm, 5% 2W M.O. Forming
R411	203X9104-824	15K Ohm, 5% 2W M.O. Forming
R412	203X9104-824	15K Ohm, 5% 2W M.O. Forming
R413	203X6000-998	2.7K Ohm, 5% 1/2W Comp.
R414	203X6000-998	2.7K Ohm, 5% 1/2W Comp.
R415	203X6000-998	2.7K Ohm, 5% 1/2W Comp.
R416	203X9105-154	2.2 Ohm, 5% 2W Metal Oxide
R419	203X6500-741	2.7K Ohm, 5% 1/4W Carbon
R420	203X6500-741	2.7K Ohm, 5% 1/4W Carbon
R421	203X6500-741	2.7K Ohm, 5% 1/4W Carbon
VR401	204X2115-014	500 Ohm, -B Semi-Fixed
VR402	204X2115-014	500 Ohm, -B Semi-Fixed
VR403	204X2115-006	5K Ohm, -B Semi-Fixed
VR404	204X2115-006	5K Ohm, -B Semi-Fixed
VR405	204X2115-006	5K Ohm, -B Semi-Fixed

CAPACITORS

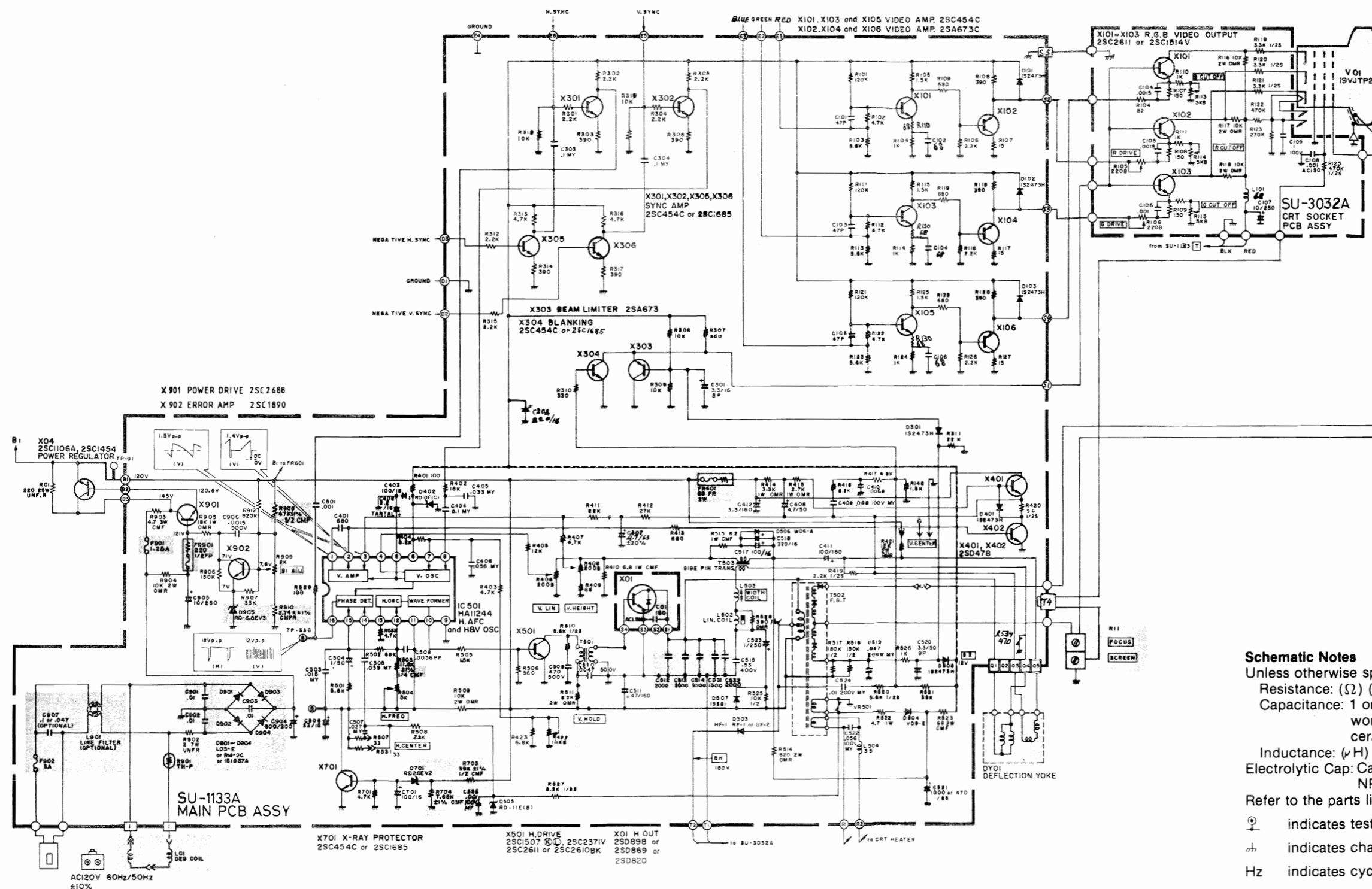
C401	202X7050-269	1200 pF, 500V Ceramic
C402	202X7050-248	1000 pF, 500V Ceramic
C403	202X7050-248	1000 pF, 500V Ceramic
C404	202X7050-282	1500 pF, 1.5KV Ceramic
C405	202X7050-483	0.01 uF, 500V Ceramic

SEMICONDUCTORS

Q401	200X3206-800	Transistor (NPN) 2SC2068LB
Q402	200X3206-800	Transistor (NPN) 2SC2068LB
Q403	200X3206-800	Transistor (NPN) 2SC2068LB

MISCELLANEOUS

J401	206X5009-296	RECEP W Wire 4P-E
P402	204X9600-254	Plug, PWB 3P-A
P403	204X9600-981	Plug, Pin 1P-D
P701	204X9601-020	Plug, PWB 4P-E



Schematic Notes
 Unless otherwise specified
 Resistance: (Ω) (K→KΩ, M→MΩ), 1/4 (W) carbon resistor
 Capacitance: 1 or higher→ (pF), less than 1→ (μF)
 working voltage → 50 (V)
 ceramic capacitor
 Inductance: (μH)
 Electrolytic Cap: Capacitance Value (μF)/working voltage (V),
 NP → non-polar (or bipolar) electrolytic cap.
 Refer to the parts list for additional component information.

⊕ indicates test point connection
 ⚡ indicates chassis ground unless otherwise specified
 Hz indicates cycles per second

For **safety** purposes (and continuing reliability)
 ⚠ replace all components marked with safety symbol with identical type.
 NOTE: FR → fusible resistor

00-4147-04
 G07-CB0

Parts identification on circuit boards:
 e.g. SU1126A (R107 = R1107)
 SU3030A (R113 = R3113)

REPLACEMENT PARTS LIST - ELECTROHOME 19" MONITOR

Components identified by the Δ symbol in the PARTS LIST and on the Schematic have special characteristics important to safety.

DO NOT degrade the safety of the set through improper servicing.

Abbreviations for Resistors and Capacitors

Resistor

C R	: Carbon Resistor
Comp. R	: Composition Resistor
OM R	: Oxide Metal Film Resistor
V R	: Variable Resistor
MF R	: Metal Film Resistor
CMF R	: Coating Metal Film Resistor
UNF R	: Nonflammable Resistor
F R	: Fusible Resistor

Capacitor

C Cap.	: Ceramic Capacitor
M Cap.	: Mylar Capacitor
E Cap.	: Electrolytic Capacitor
BP E Cap.	: Bi-Polar (or Non-Polar) Electrolytic Capacitor
MM Cap.	: Metalized Mylar Capacitor
PP Cap.	: Polypropylene Capacitor
MPP Cap.	: Metalized PP Capacitor
PS Cap	: Polystyrol Capacitor
Tan. Cap.	: Tantal Capacitor

NOTE: When ordering replacement parts please specify the part number as shown in this list including part name, and model number. Complete information will help expedite the order.

Use of substitute replacement parts which do not have the same safety characteristics as specified, may create shock, fire or other hazards. For maximum reliability and performance, all parts should be replaced by those having identical specifications.

SERVICE REPLACEMENT PARTS LIST

Symbol	Description	Part Number
	Main P.C.B. Ass'y	SU-1133A
	CRT Socket P.C.B. Ass'y	SU-3032A
	Purity Shield Ass'y	07-220083-03

Outside of the P.C.B. Ass'y

Symbol	Description	Part Number
△	Picture Tube 19"	17-7198-03
△	△Deflection Yoke	A29779-D = 21-141-01
△	PC Magnet	A75034-B = 29-32-01
△	△Flyback Transf.	A29951-B
△	△HVR	A46600-A
R05	UNF Resistor 220Ω,25W K	QRF258K-221
C04	C Capacitor 150pF, AC1.5KV	QCZ0101-005
X01	Si. Transistor	2SD870
X02	Si. Transistor	2SC1106A
SC	Screw #8-3/8	31-610818-06
SC	Screw 1/4 x 3/4 Pix Tube Mtg. (4)	31-601418-12
WA	Pyramidal Lock Washer (4)	33-255-01
	Nut Retainer, Pix Tube Mtg. (4)	33-494-01
	Clip — P.C.B. Support	33-629-02
	Standoff	33-670-010R-02
	Wire Terminal (Gnd. Strap)	34-228-03
	Terminal Lug (Gnd.)	34-33-04
	Groundstrap Assy.	34-574-02
	Grounding Spring	35-212-03
	Wire Hook (Gnd. Strap)	35-3053-02
	Purity Shield Holddown Clamp	35-2348-01
	Support Brkt. RH	35-3890-01
	Support Brkt. LH	35-3890-02
	Chassis Base	38-449-02
	Yoke Wedge (3)	39-1233-01

Purity Shield Ass'y. Parts List

Symbol	Description	Part Number
D911, D912	Degaussing Coil	21-1007-30
	Rectifier 1 Amp 600V (2)	28-22-27
	Pin Terminal (2)	34-708-01
	Pin Terminal Housing	34-709-01
	Purity Shield (2 pcs.)	35-3847-01
	Purity Shield (2 pcs.)	35-3847-02
C911	Capacitor 100nF 10% 400V	48-171544-62
R921	Resistor, Wirewound 33Ω, 4W	42-113301-03
	Fire Retardant Term. Strip 4 Lug	34-492-09

CRT Socket P.C.B. Ass'y (SU-3032A) Parts List

Resistors

Symbol	Description	Part Number
R3105	V R 200	QVZ3234-022
R3106	V R 200	QVZ3234-022
R3113	V R 5K	QVZ3234-053
R3114	V R 5K	QVZ3234-053
R3115	V R 5K	QVZ3234-053
R3116	OM R 10KΩ2W J	QRG029J-103
R3117	OM R 10KΩ2W J	QRG029J-103
R3118	OM R 10KΩ2W J	QRG029J-103
R3119	Comp. R 3.3KΩ1/2W K	QRZ0039-332
R3120	Comp. R 3.3KΩ1/2W K	QRZ0039-332
C3121	Comp. R 3.3KΩ1/2W K	QRZ0039-332

Capacitors

Symbol	Description	Part Number
C3107	E Cap. 10uF 250V A	QEW53EA-106
C3108	C Cap. 1000pF DC1400V P	QCZ9001-102M

Coils

Symbol	Description	Part Number
L3101	Peaking Coil	QQL043K-101

Semiconductors

Symbol	Description	Part Number
X3101	Si. Transistor	2SC1514VC
X3102	Si. Transistor	2SC1514VC
X3103	Si. Transistor	2SC1514VC

Miscellaneous

Symbol	Description	Part Number
△	CRT Socket	A76068

Main PCB Ass'y (SU-1133A) Parts List**Resistors**

Symbol	Description	Part Number
R1406	V R 200Ω	QVZ3230-002
R1408	V R 200Ω	QVZ3230-002
R1410	CMF R 6.8Ω1W J	QRX019J-6R8
R1414	OM R 3.3KΩ1W J	QRG019J-332
R1415	OM R 2.7KΩ1W J	QRG019J-272
R1421	OM R 12KΩ2W J	QRG026J-123Z
R1422	V R 10KΩ	QVZ3230-014
△FR1401	△F R 68Ω2W K	QRH024K-680M
△R1503	△CMF R 11.8KΩ¼W +1%	QRV142F-1182
R1504	V R 5KΩ	QVZ3230-053
R1509	OM R 10KΩ2W J	QRG026J-103Z
R1512	OM R 8.2KΩ2W J	QRG026J-822Z
R1514	OM R 820Ω2W J	QRG026J-821Z
R1515	CMF R 8.2Ω1W J	QRX019J-8R2
R1522	CMF R 4.7Ω1W J	QRX019J-4R7
R1523	OM R 68Ω2W J	QRG026J-680Z
R1528	OM R 390Ω1W J	QRG019J-391
R1534	ZN R	ERZ-C05ZK471
VR1501	ZN R	ERZ-C05DK271
△R1703	△CMF R 39Ω½W +1%	QRV122F-3902
△R1704	△CMF R 7.68KΩ¼W +1%	QRV142F-7681
△R1901	△Posistor	A75414
R1902	UNF R 2Ω7W K	QRF076K-2R0
R1903	CMF R 4.7Ω3W J	QRX039J-4R7
R1904	OM R 10KΩ2W J	QRG026J-103Z
R1905	OM R 18KΩ1W J	QRG019J-183
△Q1908	△CMF R 47Ω½W +1%	QRV122F-470Z
△R1909	V R 2KΩ	QVP5A0B-023E
R1910	△CMF R 2.74KΩ¼W +1%	QRV142F-274I
△FR1901	△F R 220Ω½W K	QRH124K-221M

Capacitors

Symbol	Description	Part Number
C1301	BPE Cap. 3.3uF 50V A	QEN61HA-335Z
C1402	Tan. Cap. 2.2uF 16V K	QEE51CK-225B
C1407	E Cap. 4.7uF 6.3V A	QEW51JA-475
C1411	E Cap. 100uF 160V A	QEW52CA-107
C1412	E Cap. 3.3uF 160V A	QEW52CA-335
C1508	PP Cap. 5600uF 50V J	QFP31HJ-562
△C1512	△PP Cap. 2000pF DC1500V J	QFZ0082-202
△C1513	△PP Cap. 2000pF DC1500V J	QFZ0082-202
△C1514	△PP Cap. 2000pF DC1500V J	QFZ0082-202
C1515	PP Cap. 0.53uF DC1200V J	QFZ0067-534
C1520	BPE Cap. 3.3uF 50V A	QEN61HA-335Z
C1523	E Cap. 1uF 160V A	QEW62CA-105Z
C1524	M Cap. 0.1uF 200V K	QFM720K-104M
△C1531	△PP Cap. 2000pF DC1500V J	QFZ0082-202
△C1532	△PP Cap. 1500pF DC1500V J	QFZ0082-152
C1904	E Cap.	QEY0034-001
C1905	E Cap. 10uF 250V A	QEW52EA-106

Coils	Description	Part Number
Symbol		
L1502	Linearity Coil	A39835
L1503	Width Coil	C30380-A
L1504	Heater Choke	C30445-A
Transformers		
Symbol	Description	Part Number
T1501	Hor. Drive Transf.	A46022-BM
T1503	Side Pin Transf.	C39050-A
Semiconductors		
Symbol	Description	Part Number
IC1501	IC	HA11244
X1101	Si. Transistor	2SC1685(R)
X1102	Si. Transistor	2SA673(C)
X1103	Si. Transistor	2SC1685(R)
X1104	Si. Transistor	2SA673(C)
X1105	Si. Transistor	2SC1685(R)
X1106	Si. Transistor	2SA673(C)
X1301	Si. Transistor	2SC1685(R)
X1302	Si. Transistor	2SC1685(R)
X1303	Si. Transistor	2SA673(C)
X1304	Si. Transistor	2SC1685(R)
X1305	Si. Transistor	2SC1685(R)
X1401	Si. Transistor	2SD478
X1402	Si. Transistor	2SD478
X1501	Si. Transistor	2SC2610BK
X1901	Si. Transistor	2SC2688 (K.L.M.)
X1902	Si. Transistor	2SC1890A (E.F.)
D1101	Si. Diode	W06A
D1102	Si. Diode	W06A
D1103	Si. Diode	W06A
D1301	Si. Diode	1SZ473H
D1401	Si. Diode	1SZ473H
D1402	Zener Diode	RD10F(C)
D1503	Si. Diode	HF-1
D1504	Si. Diode	V09E
D1505	Zener Diode	RD11E(B)
D1506	Si. Diode	W06A
D1507	Si. Diode	1SS81
D1508	Si. Diode	1SZ473H
△D1701	△Zener Diode	RD20EV2
△D1901	△Si. Diode	1S1887A
△D1902	△Si. Diode	1S1887A
△D1903	△Si. Diode	1S1887A
△D1904	△Si. Diode	1S1887A
△D1905	△Zener Diode	RD6.8EV3
Miscellaneous		
Symbol	Description	Part Number
△F1901	△Fuse 1.25A	QMF53U1-1R25S
△F1902	△UL Fuse 3A	QMF66U1-3R0S

REPLACEMENT PARTS LIST - ELECTROHOME 13" MONITOR

Components identified by the Δ symbol in the PARTS LIST and on the Schematic have special characteristics important to safety.

DO NOT degrade the safety of the set through improper servicing.

Abbreviations for Resistors and Capacitors

Resistor

C R	: Carbon Resistor
Comp. R	: Composition Resistor
OM R	: Oxide Metal Film Resistor
V R	: Variable Resistor
MF R	: Metal Film Resistor
CMF R	: Coating Metal Film Resistor
UNF R	: Nonflammable Resistor
F R	: Fusible Resistor

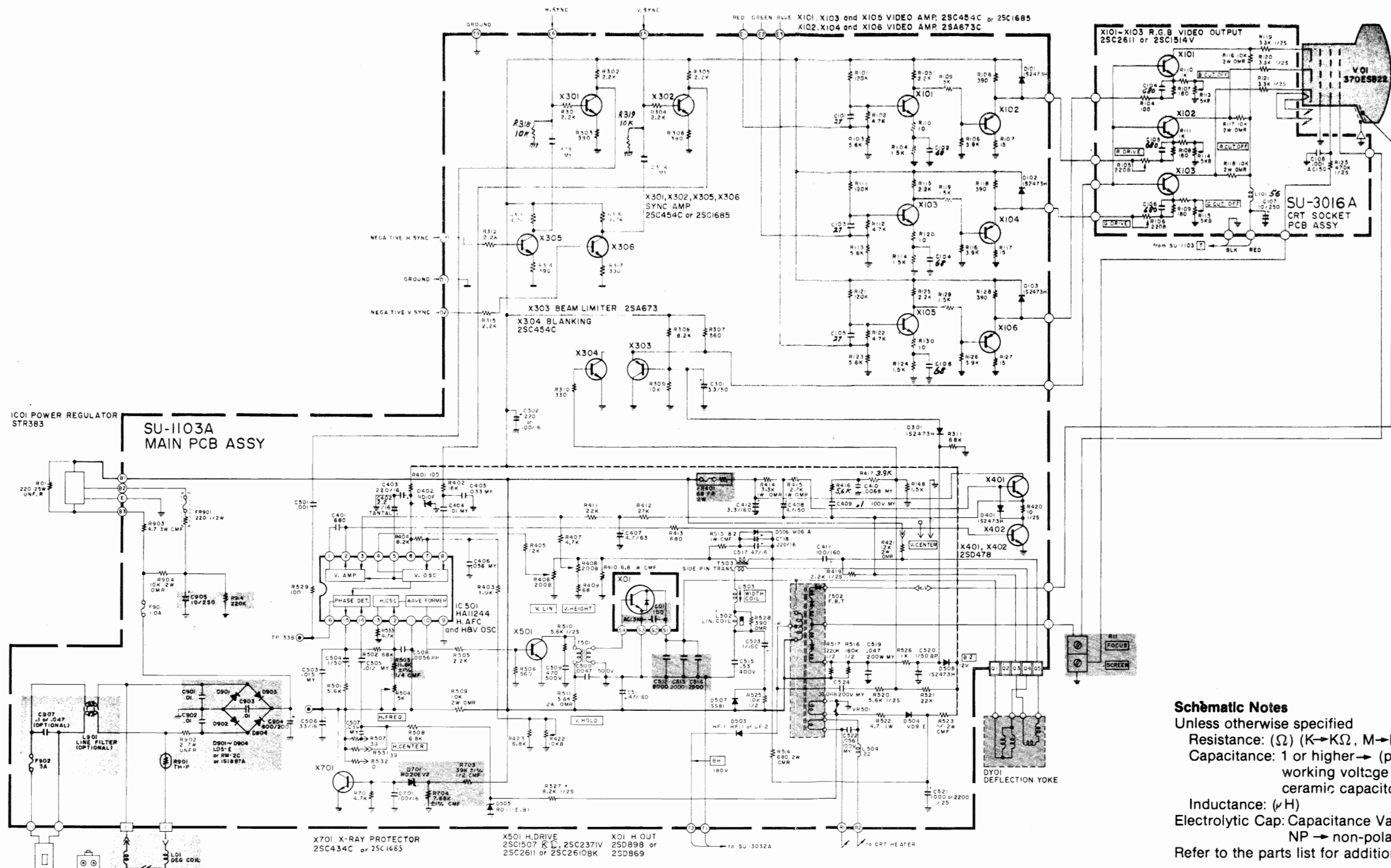
Capacitor

C Cap.	: Ceramic Capacitor
M Cap	: Mylar Capacitor
E Cap.	: Electrolytic Capacitor
BP E Cap.	: Bi-Polar (or Non-Polar) Electrolytic Capacitor
MM Cap.	: Metalized Mylar Capacitor
PP Cap.	: Polypropylene Capacitor
MPP Cap.	: Metalized PP Capacitor
PS Cap	: Polystyrol Capacitor
Tan. Cap.	: Tantal Capacitor

NOTE: When ordering replacement parts please specify the part number as shown in this list including part name, and model number. Complete information will help expedite the order.

Use of substitute replacement parts which do not have the same safety characteristics as specified, may create shock, fire or other hazards. For maximum reliability and performance, all parts should be replaced by those having identical specifications.

Symbol	Description	Part Number
	Main P.C.B. Ass'y	SU-1103A
	CRT Socket P.C.B. Ass'y	SU-3016A
Outside of the P.C.B. Ass'y		
Symbol	Description	Part Number
Δ V01	Δ Picture Tube	370ESB22(E)
Δ DY01	Δ Deflection Yoke	C29123-V
	PC Magnet	A76366-A
	Wedge	C30006
	Δ Flyback Transf.	A19183-A
Δ R11	Δ Focus V R	A46606-A
Δ R05	UNF Resistor 220 Ω , 25W. K	QRF258K-221
Δ C04	Δ C Capacitor 150 pF, AC1.5KV	QCZ0101-005
X01	Si. Transistor	2SD869
IC01	IC Regulator	STR383
L01	Degaussing Coil	21-1007-31
	Degaussing Coil Pin Terminal (2)	34-708-01
	Degaussing Coil Pin Terminal Housing	34-709-01
	Groundstrap Ass'y.	34-697-04
	Groundstrap Wire Terminal	34-228-03
	Groundstrap Spring (2)	35-3560-01
BR	Support Bracket RH	35-3919-01
BR	Support Bracket LH	35-3919-02
SC	SCREW 10- $\frac{1}{2}$ Pix Tube Mtg. (4)	31-631018-08
WA	Pyramidal Lockwasher (4)	33-255-01
	Clip P.C.B. Support (2)	33-629-02
	Ground Lug	34-33-04
CH	Chassis Base	38-452-01



Schematic Notes
 Unless otherwise specified
 Resistance: (Ω) (K \rightarrow K Ω , M \rightarrow M Ω), 1/4 (W) carbon resistor
 Capacitance: 1 or higher \rightarrow (pF), less than 1 \rightarrow (μ F)
 working voltage \rightarrow 50 (V)
 ceramic capacitor
 Inductance: (μ H)
 Electrolytic Cap: Capacitance Value (μ F)/working voltage (V),
 NP \rightarrow non-polar (or bipolar) electrolytic cap.
 Refer to the parts list for additional component information.
 \oplus indicates test point connection
 --- indicates chassis ground unless otherwise specified
 Hz indicates cycles per second
 For **safety** purposes (and continuing reliability)
 \triangle replace all components marked with safety symbol with
 identical type.
 NOTE: FR \rightarrow fusible resistor

G07-FBO
 00-4147-03

Parts identification on circuit boards:
 e.g. SU1126A (R107 = R1107)
 SU3030A (R113 = R3113)

Main P.C.B. Ass'y (SU-1103A) Parts List

Resistors

Symbol	Description	Part Number
R1406	V R 200 Ω	QVZ3230-022
R1408	V R 200 Ω	QVZ3230-022
R1410	CMF R 6.8 Ω 1W J	QRX019J-6R8
R1414	OM R 3.3K Ω 1W J	QRG019J-332
R1415	OM R 2.7K Ω 1W J	QRG019J-272
R1421	OM R 12K Ω 2W J	QRG029J-123
R1422	V R 10K Ω	QVZ3224-014H
Δ FR1401	Δ F R 68 Ω 2W K	QRH024K-680M
Δ R1503	Δ CMF R 11.8K Ω 1/4W +1%	QRV142F-1182
R1504	V R 5K Ω	QVZ3230-053
R1509	OM R 10K Ω 2W J	QRG029J-103
R1511	OM R 5.6K Ω 2W J	QRG029J-562
R1514	OM R 680 Ω 2W J	QRG029J-681
R1515	CMF R 8.2 Ω 1W J	QRX019J-8R2
R1522	CMF R 4.7 Ω 1W J	QRX019J-4R7
R1523	OM R 56 Ω 2W J	ORG029J-560
R1528	OM R 390 Ω 1W J	ORG019J-391
R1534	ZN R	ERZ-C05ZK471
VR1501	ZN R	ERZ-C05DK271
Δ R1703	Δ CMF R 39K Ω 1/2W +1%	QRV122F-3902
Δ R1704	Δ CMF R 7.68K Ω 1/4W +1%	QRV142F-7681
Δ R1901	Δ Posistor	A75414
R1902	UNF R 2 Ω 7W K	QRF076K-2R0
R1903	CMF R 5.6 Ω 3W J	QRX039J-5R6
R1904	OM R 10K Ω 2W J	QRG026J-103Z
Δ FR1901	Δ F R 220 Ω 1/2W K	QRH124K-221M

Capacitors

Symbol	Description	Part Number
C1402	Tan. Cap. 2.2uF 16V K	QEE51CK-225B
C1411	E Cap. 100uF 160V A	QEW52CA-107
C1412	E Cap. 3.3uF 160V A	QEW52CA-335
C1508	PP Cap. 5600pF 50V J	QFP31HJ-562
C1511	E Cap. 47uF 160V A	QEW52CA-476S
Δ C1512	Δ PP Cap. 2000pF DC1500V J	QFZ0082-202
Δ C1513	Δ PP Cap. 2000pF DC1500V J	QFZ0082-202
Δ C1514	Δ PP Cap. 2500pF DC1500V J	QFZ0082-252
C1515	PP Cap. 0.53uF DC1200V K	QFZ0067-534
C1520	BPE Cap. 1uF 50V A	QEN61HA-105Z
C1524	M Cap. 0.1uF 200V K	QFM72DK-682M
C1904	E Cap.	QEY0034-001
C1905	E Cap. 10uF 250V A	QEW52EA-106
Δ C1907	Δ MM Cap. 0.1uF AC150V Z	QFZ9008-104

Coils

Symbol	Description	Part Number
L1501	Peaking Coil	A75360-6
L1502	Linearly Coil	A39934
L1503	Width Coil	C30380-A
L1504	Heater Choke	C30333-A
L1901	Line Filter	A39475-J

Transformers

Symbol	Description	Part Number
T1501	Hor. Drive Transf.	A46022-BM
T1503	Side Pin Transf.	C39050-A

Semiconductors		
Symbol	Description	Part Number
IC1501	I.C.	HA11244
X1101	Si. Transistor	2SC1685(R)
X1102	Si. Transistor	2SA673(C)
X1103	Si. Transistor	2SC1685(R)
X1104	Si. Transistor	2SA673(C)
X1105	Si. Transistor	2SC1685(R)
X1106	Si. Transistor	2SA673(C)
X1301	Si. Transistor	2SC1685(R)
X1302	Si. Transistor	2SC1685(R)
X1303	Si. Transistor	2SA673(C)
X1304	Si. Transistor	2SC1685(R)
X1305	Si. Transistor	2SC1685(R)
X1401	Si. Transistor	2SD478
X1402	Si. Transistor	2SD478
X1501	Si. Transistor	2SC2610BK
X1701	Si. Transistor	2SC1685(P-S)
D1101	Si. Diode	W06A
D1102	Si. Diode	W06A
D1103	Si. Diode	W06A
D1301	Si. Diode	1S2473H
D1401	Si. Diode	1S2473H
D1402	Zener Diode	RD10F(C)
D1503	Si. Diode	HF-1
D1504	Si. Diode	V09E
D1505	Zener Diode	RD11E(B)
D1506	Si. Diode	W06A
D1507	Si. Diode	1SS81
D1508	Si. Diode	1S2473H
△D1701	△Zener Diode	RD20EV2
△D1901	△Si. Diode	1S1887A
△D1902	△Si. Diode	1S1887A
△D1903	△Si. Diode	1S1887A
△D1904	△Si. Diode	1S1887A
Miscellaneous		
Symbol	Description	Part Number
△F1901	△Fuse 1A	QMF53U1-1R0S
△F1902	△UL Fuse 3A	QMF66U1-3R0S

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

Resistors

Symbol	Description	Part Number
R3105	V R 200 Ω	QVZ3234-022
R3106	V R 200 Ω	QVZ3234-022
R3113	V R 5K Ω	QVZ3234-053
R3114	V R 5K Ω	QVZ3234-053
R3115	V R 5K Ω	QVZ3234-053
R3116	OM R 10K Ω 2W J	QRG029J-103
R3117	OM R 10K Ω 2W J	QRG029J-103
R3118	OM R 10K Ω 2W J	QRG029J-103
R3119	Comp. R 3.3K Ω 1/2W K	QRZ0039-332
R3120	Comp. R 3.3K Ω 1/2W K	QRZ0039-332
R3121	Comp. R 3.3K Ω 1/2W K	QRZ0039-332

Capacitors

Symbol	Description	Part Number
C3107	E Cap. 10 μ F 250V A	QEW52EA-106
C3108	C Cap. 1000pF DC1400V P	QCZ9001-102M

Coils

Symbol	Description	Part Number
L3101	Peaking coil	QQL043K-101

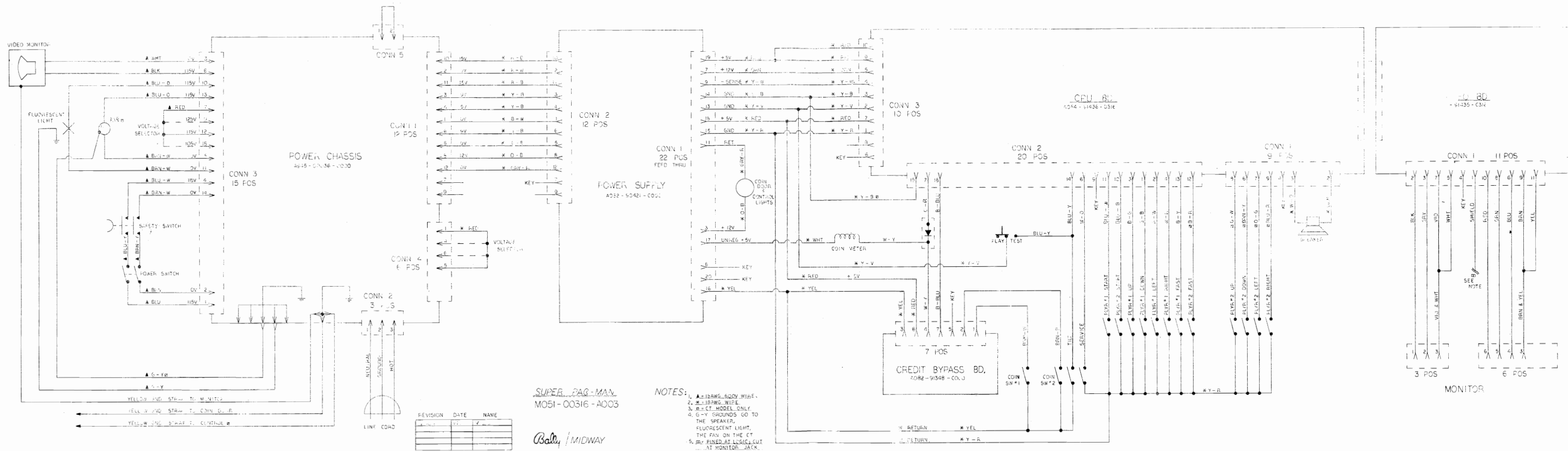
Semiconductors

Symbol	Description	Part Number
X3101	Si. Transistor	2SC2611
X3102	Si. Transistor	2SC2611
X3103	Si. Transistor	2SC2611

Miscellaneous

Symbol	Description	Part Number
Δ	Δ CRT Socket	A75522

IX Schematics and Wiring Diagrams



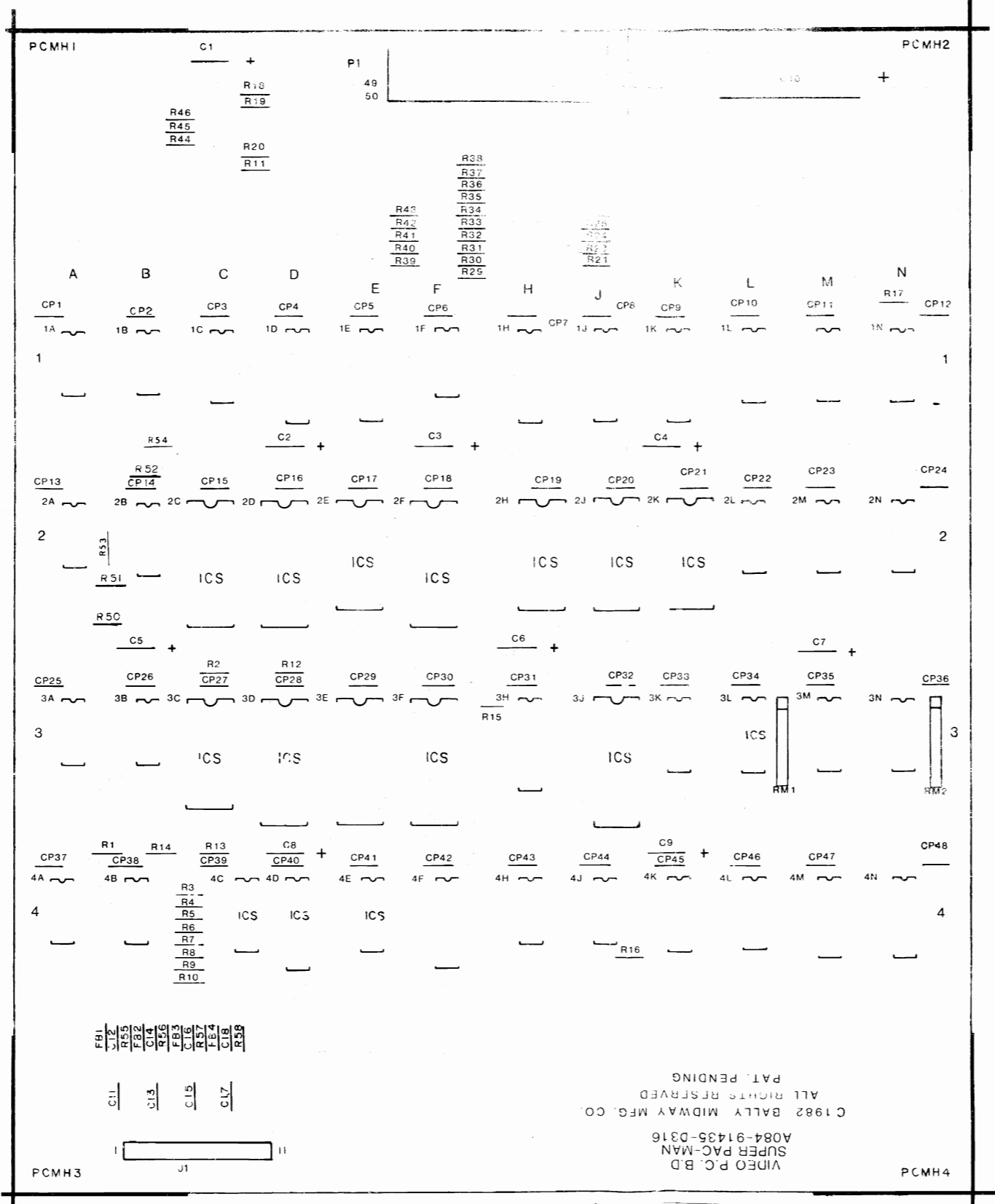
SUPER PAC-MAN
M051-00316-A003

Bally / MIDWAY
10601 W BELMONT
FRANKLIN PARK, ILL 60131

CROSS REFERENCE LIST

DESIGNATION LIST

DESIGNATION	DESCRIPTION
C1 - C9	1 MF AX. TANT.
C10	470 MF AX. ELEC.
C11, C12	470 PF " CER.
C13 - C18	100 PF " "
CPI - CP48	1 MF AX. CER.
R1 - R3	1K OHM 1/4 W 5% CRBN
R4, R7, R9	470 " " " "
R5, R8, R10	220 " " " "
R6, R11 - R13	1K " " " "
R14, R50, R51, R53, R54	100 " " " "
R15 - R17	1K " " " "
R18 - R21, R23 - R46	2.2K " " " "
R52	82 " " " "
RMI, RM2	1 K 9 POS SIP
IC 1A, 1F	74 LS 32
" 1B	" " 08
" 1C	" " 138
" 1D	" " 273
" 1E, 1H, 1J, 1K	" " 245
" 1L, 1M, 1N	" " 161
" 2A	74 LS 04
" 2B	" " 368
" 2C	07XX CUSTOM IC
" 2D	00XX " "
" 2E, 2H, 2J, 2K	N58725 P
" 2F	04XX CUSTOM IC
" 2L, 2M, 2N	74 LS 161
" 3A	74 LS 10
" 3B	" " 86
" 3C	PROM SPV-1
" 3D	11XX CUSTOM IC
" 3E	" " " "
" 3F	PROM SPV-2
" 3H	74 LS 273
" 3J	12XX CUSTOM IC
" 3K	74 LS 378
" 3L	BP-ROM SPV-3 (SPI-4)
" 3M, 3N	74 LS 365
IC 4A	74 LS 74
" 4B	" " CO
" 4C	BP-ROM SPV-4 (SPI-6)
" 4D	PAL SPV-5 (SPI-7)
" 4E	BP-ROM SPV-6 (SPI-5)
" 4F	74 LS 377
" 4I	74 LS 86
" 4J	" " 20
" 4K	" " 157
" 4L	" " 298
" 4M, 4N	2148 STATIC RAM
FBI - FB4	FERRITE BEAD
ICS 2C, 2D, 2F	28 PIN IC SOCKET
" 2E, 2H, 2J, 2K, 3C	24 PIN " "
" 3D, 3F, 3J	28 PIN " "
" 3L	16 PIN " "
" 4C, 4E	16 PIN " "
" 4D	20 PIN " "
P1	50 PIN CONN
J1	11 PIN CONN KK-156 RT ANGLE
PCMHI - PCMH4	SCRW



DESCRIPTION	QTY	DESIGNATION	PART NO.
100 PF AX. CER.	6	C13 - C18	0508-00800-0500
470 PF " "	2	C11 - C12	0550-00800-0200
1 MF " "	48	CPI - CP48	0508-00800-0900
1 MF AX. TANT.	9	C1 - C9	0935-00814-0100
470 MF AX. ELEC.	1	C10	0550-00800-1300
82 OHM 1/4W 5% CRBN	1	R52	0062-10483-1XXX
100 " " " "	5	R14, R50, R51, R53, R54	0062-11083-1XXX
220 " " " "	3	R5, R8, R10	0062-13383-1XXX
470 " " " "	3	R4, R7, R9	0062-15683-1XXX
1K " " " "	10	R1 - R3, R6, R11 - R13, R15 - R17	0062-17983-1XXX
2.2K " " " "	32	R18 - R21, R23 - R46 R55 - R58	0062-19583-1XXX
1K 9 POS SIP	2	RMI, RM2	0508-00814-0200
00XX CUSTOM IC	1	IC 2D	0066-001CX-XAPX
04XX " "	1	" 2F	0066-003CX-XAPX
07XX " "	1	" 2C	0066-006CX-XAPX
11XX " "	1	" 3D	0066-018CX-XAPX
12XX " "	1	" 3J	0066-019CX-XAPX
74 LS 00	1	IC 4B	0300-00803-0027
74 LS 04	1	" 2A	0300-00803-0029
74 LS 08	1	" 1E	0300-00803-0030
74 LS 10	1	" 3A	0300-00803-0051
74 LS 20	1	" 4J	0300-00803-0052
74 LS 32	2	" 1A, 1F	0300-00803-0031
74 LS 74	1	" 4A	0300-00803-0032
74 LS 86	2	" 3B, 4H	0300-00803-0054
74 LS 138	1	" IC	0300-00803-0033
74 LS 157	1	" 4K	0300-00803-0050
74 LS 161	6	" 1L, 1M, 1N, 2L, 2M, 2N	0300-00803-0044
74 LS 245	4	" 1E, 1H, 1J, 1K	0300-00803-0046
74 LS 273	2	" 1D, 3H	0300-00803-0038
74 LS 298	1	" 4L	0316-00803-0019
74 LS 365	2	" 3M, 3N	0316-00803-0020
74 LS 368	1	" 2B	0316-00803-0004
74 LS 377	1	" 4F	0316-00803-0021
74 LS 378	1	" 3K	0316-00803-0018
BP-ROM SPV-6 (SPI-5)	1	IC 4E	0316-00803-0017
PROM SPV-1	1	" 3C	0316-00803-0014
BP-ROM SPV-3 (SPI-4)	1	IC 3L	0316-00803-0016
PROM SPV-2	1	" 3F	0316-00803-0013
BP-ROM SPV-4 (SPI-6)	1	" 4C	0316-00803-0015
PAL SPV-5 (SPI-7)	1	" 4D	0316-00803-0012
N58725 P	4	IC 2E, 2H, 2J, 2K	0508-00803-2500
2148 STATIC RAM	2	" 4M, 4N	0550-00803-6200
FERRITE BEAD	4	FBI - FB4	0316-00804-0004
16 PIN IC SOCKET	3	ICS 3L, 4C, 4E	0508-00804-0700
20 PIN " "	1	" 4D	0550-00804-2300
24 PIN " "	5	" 2E, 2H, 2J, 2K, 3C	0508-00804-0500
28 PIN " "	6	" 2C, 2D, 2F, 3D, 3F, 3J	0508-00804-0400
50 PIN CONN	1	P1	0300-00804-1104
11 PIN " KK-156	1	J1	3000-16387-1111
RT ANGLE			
SCRW	4	PCMHI - PCMH4	0316-00700-00XF
SUPER PAC-MAN VIDEO P.C.	1	A080-91435 - C316	

C1982 BALLY MIDWAY MFG. CO.
SUPER PAC-MAN
VIDEO P.C. B.D.
A084-91435-D316

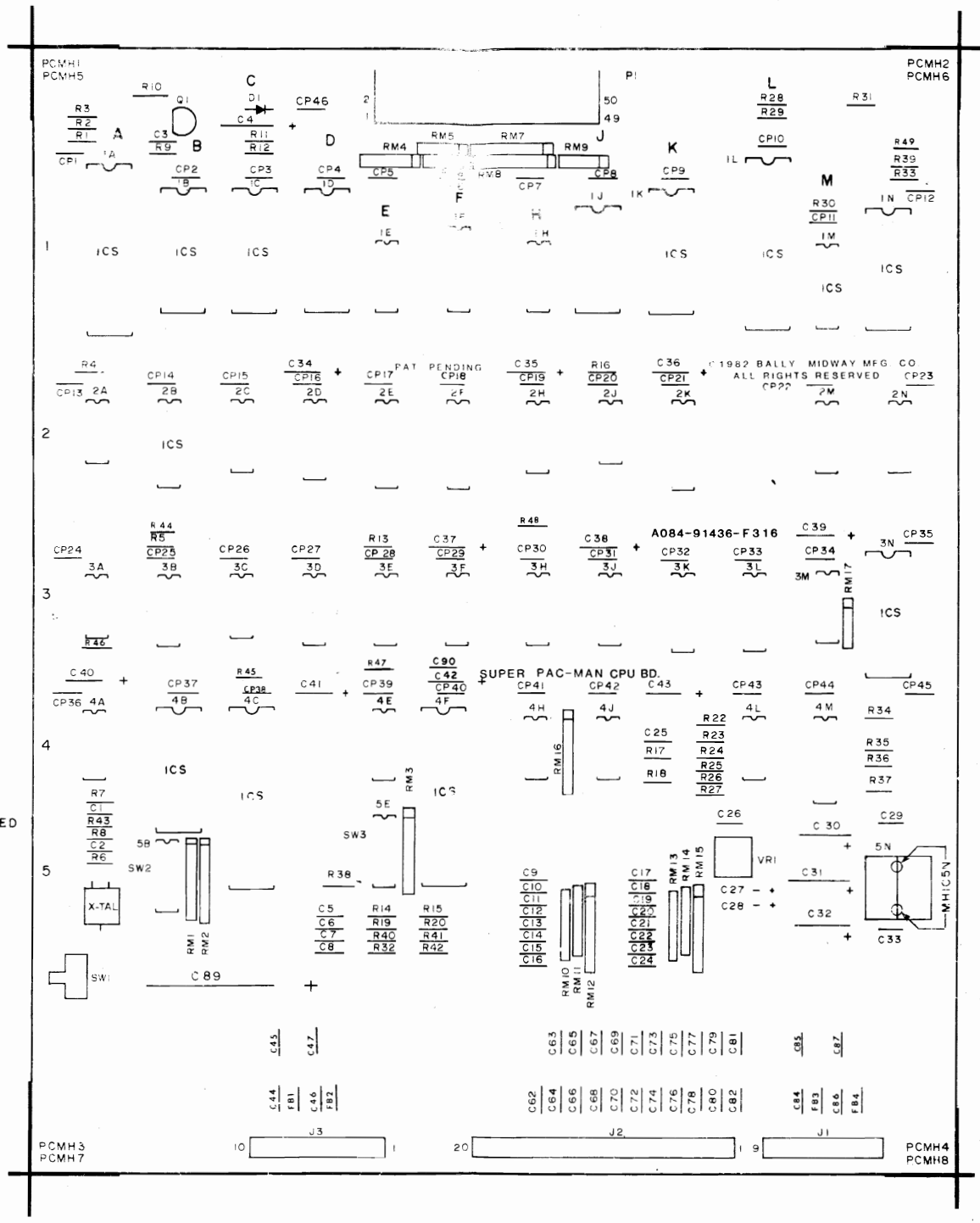
PAT. PENDING
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PROJECT ENG: J. SZERSZEN	USED ON SUPER PAC-MAN	REVISIONS
SCALE: FULL	NO REQ'D IPER	Bally / MIDWAY MFG. CO.
DATE: 11/22/82	ASSEMBLY DWG SUPER PACMAN VIDEO P.C. A084-91435-D316	PART NO: M051-00316 - D006

CROSS REFERENCE LIST

DESIGNATION LIST

DESIGNATION	DESCRIPTION	DESIGNATION	DESCRIPTION
C1	NOT USED	IC 2A	74 LS 74
C2	100 PF AX. CER.	" 2B	PAL IOLB SPC-6 (SPI-1)
C3	1000 PF "	" 2C	74 LS 138
C4	22 MF AX. ELECT.	" 2D	2114 STATIC RAM
C5-C24	.01 MF AX. CER.	" 2E, 2F	74 LS 245
C25	.0047 MF "	" 2H	74 LS 367
C26	.1 MF "	" 2J	74 LS 74
C27, C28	.15 MF AX. TANT.	" 2K	74 LS 245
C29	.01 MF AX. CER.	" 2M	74 LS 259
C30	22 MF AX. ELECT.	" 2N	74 LS 367
C31	220 MF "		
C32	100 MF "	IC 3A	74 LS 04
C33	.1 MF AX. CER.	" 3B	74 LS 109
C34-C43	4.7 MF AX. TANT.	" 3C	74 LS 32
C44-C47	390 PF AX. CER.	" 3D	74 LS 161
C62-C82, C84-C8	.01 MF "	" 3E	74 LS 157
C89	470 MF "	" 3F, 3H	74 LS 257
C90	47 PF "	" 3J	74 LS 158
CP1-CP46	1 MF AX. CER.	" 3K, 3L	STATIC RAM MB 8148-55/L-55
		" 3M	BP-ROM SPC-4 (SPI-3)
		" 3N	15 XX CUSTOM IC
R1	NOT USED		
R2	1K OHM 1/4 W 5% CRBN		
R3	470 "		
R4, R5	1K "	IC 4A	74 LS 368
R6	330 "	" 4B	16 XX CUSTOM IC
R7	NOT USED	" 4C	56 XX CUSTOM IC
R8	330 "	" 4E	74 LS 157
R9	47K "	" 4F	56 XX CUSTOM IC
R10	1K "	" 4H	74 LS 04
R11	4.7K "	" 4J	74 LS 08
R12	2.2K "	" 4L	TC 4066 B
R13, R14	1K "	" 4M	74 LS 273
R15	2.2K "		
R16	1K "	IC 5N	MB 3730
R17	12K "		
R18	33K "	FBI-FB4	FERRITE BEAD
R19	1K "		
R20	2.2K "		
R22	10K "	ICS 1A	40 PIN IC SOCKET
R23	47K "	" 1B, 1C, 1N	28 PIN "
R24	100K "	" 1K	24 PIN "
R25, R27	2.2K "	" 1L	40 PIN "
R26	33K "	" 1M	20 PIN "
R28	NOT USED	" 2B	20 PIN "
R29	1K "	" 3N	28 PIN "
R30	470 "	" 4B	28 PIN "
R31, R32, R33	1K "	" 4C, 4F	42 PIN "
R34	4.7K "	" 3M	16 PIN "
R35	2.2K "		
R36	1K "	J1	9 PIN KK-156 STR W/PIN 4 EXTRACTED
R37	470 "	J2	20 PIN "
R38	4.7K "	J3	10 PIN "
R39, R40	1K "		
R41, R42	2.2K "	PI	50 PIN RIBBON CONN. (CABLE ASSY)
R43	NOT USED		CABLE ASSEMBLY
R44-R49	100 "	PCMHI-PCM4	P.C. BD. SPACER
RM1-RM3	4.7K 9 PIN S.I.P. 8 POS.	PCMHI-PCM8	SCRW
RM4-RM6	2.2K 5 " " 4 "		
RM7, RM8	2.2K 9 " " 8 "	MHIC5N	MOUNTING HARDWARE
RM9	2.2K 5 " " 4 "		(-2) 4-40 HEX NUTS
RM10, RM11	2.2K 8 " " 4 "		(-2) 4-40 X 8 SLT. PAN M.S
RM12	1K 9 " " 8 "		(-2) WSH. 4 .125-.250-.032 FLT. ST.
RM13, RM14	2.2K 8 " " 4 "		(-2) WSH. 4 .120-.250-.018 EXT. ST.
RM15	1K 9 " " 8 "		
RM16	4.7K 9 " " 8 "	SW1	P.B SWITCH
RM17	1K 5 " " 4 "	SW2, SW3	8 POS. DIP SWITCH
VRI	1K OHM POT		
DI	IN914B		
Q1	2N3391A	X-TAL 1	18.432 MHZ CRYSTAL



DESCRIPTION	QTY	DESIGNATION	PART NOS.
100 PF AX. CER.	1	C2	0508-00800-0500
390 PF "	4	C44-C47	0316-00800-0002
47 PF "	1	C90	0316-00800-0003
1000 PF "	1	C3	0550-00800-2400
.0047 MF "	1	C25	0550-00800-2200
.01 MF "	46	C5-C24, C29, C62-C62, C84-C87	0508-00800-0800
.1 MF "	48	C26, C33, CP1-CP46	0508-00800-0900
.15 MF AX. TANT	2	C27, C28	0508-00800-1000
4.7 MF "	10	C34-C43	0316-00800-0001
22 MF AX. ELECT.	2	C4, C30	0508-00800-1200
100 MF "	1	C32	0508-00800-1300
220 MF "	1	C31	0508-00800-1400
470 MF "	1	C89	0550-00800-1300
100 OHM 1/4 W 5% CRBN	6	R44-R49	0062-110B3-1XXX
330 OHM 1/4 W 5% CRBN	2	R6, R8	0062-144B3-1XXX
470 "	3	R3, R30, R37	0062-156B3-1XXX
1K "	15	R2, R4, R5, R10, R13, R14, R16, R19, R29, R31, R32, R33, R36, R39, R40	0062-179B3-1XXX
2.2K "	6	R12, R15, R20, R35, R41, R42	0062-195B3-1XXX
4.7K "	3	R11, R34, R38	0062-211B3-1XXX
10K "	1	R22	0062-227B3-1XXX
12K "	1	R17	0062-231B3-1XXX
22K "	2	R25, R27	0062-247B3-1XXX
33K "	2	R18, R26	0062-251B3-1XXX
47K "	2	R9, R23	0062-259B3-1XXX
100K "	1	R24	0062-275B3-1XXX
1K 9 PIN S.I.P. 8 POS.	2	RM12, RM15	0508-00804-0200
1K 5 " " 4 "	1	RM17	0508-00804-0100
2.2K 5 PIN S.I.P. 4 POS.	3	RM4-RM6, RM9	0316-00804-0001
2.2K 9 " " 8 "	2	RM7, RM8	0508-00804-0300
2.2K 8 " " 4 "	4	RM10, RM11, RM13, RM14	0508-00804-1200
4.7K 9 " " 8 "	4	RM1-RM3, RM16	0508-00804-1000
1K OHM POT	1	VRI	0508-00804-1300
IN914B	1	DI	0508-00801-0100
2N3391A	1	Q1	0508-00802-0200
74 LS 04	2	IC 3A, 4H	0300-00803-0029
74 LS 08	1	" 4J	0300-00803-0030
74 LS 32	1	" 3C	0300-00803-0031
74 LS 74	2	" 2J, 2A	0300-00803-0032
74 LS 109	1	" 3B	0316-00803-0001
74 LS 138	1	" 2C	0300-00803-0033
74 LS 157	2	" 3E, 4E	0300-00803-0050
74 LS 158	1	" 3J	0300-00803-0049
74 LS 161	1	" 3D	0300-00803-0044
74 LS 245	4	" 2E, 2F, 2K, 1F	0300-00803-0046
74 LS 257	2	" 3F, 3H	0316-00803-0002
74 LS 259	1	" 2M	0300-00803-0038
74 LS 273	1	" 4M	0300-00803-0039
74 LS 367	4	" 1E, 1H, 2H, 2N	0300-00803-0039
74 LS 368	1	" 4A	0316-00803-0004
07 XX CUSTOM IC	1	IC 1N	0066-006CX-XAPX
15 XX "	1	" 3N	0066-020CX-XAPX
16 XX "	1	" 4B	0066-021CX-XAPX
56 XX "	2	" 4C, 4F	0066-022CX-XAPX
BP-ROM SPC-4 (SPI-3)	1	IC 3M	0316-00803-0008
EPROM SPC-1	1	" 1B	0316-00803-0005
" SPC-2	1	" 1C	0316-00803-0006
" SPC-3	1	" 1K	0316-00803-0007
MB 3730	1	" 5N	0066-188XX-XX4X
MC 68A09E CPU (1.5MHZ)	2	" 1A, 1L	0316-00803-0011
PAL IOLB SPC-5 (SPI-2)	1	" 1M	0316-00803-0009
PAL IOLB SPC-6 (SPI-1)	1	" 2B	0316-00803-0010
STATIC RAM MB 8148-55/L-55	2	" 3K, 3L	0550-00803-6200
TC 4066 B	1	" 4L	0508-00803-5300
2114 STATIC RAM	1	" 2D	0508-00803-0300
9 PIN CONN KK-156	1	J1	3000-16367-0910
20 PIN " " " "	1	J2	3000-16367-2015
10 PIN " " " "	1	J3	3000-16367-1011
50 PIN RIBBON CONN CABLE ASSEMBLY	1	PI	0300-00804-1104
	1		A300-00020-0000
MOUNTING HARDWARE		MHIC5N	
4-40 HEX NUTS	2		0017-00103-0002
4-40 X 8 SLT PAN M.S	2		0017-00101-0510
WSH. 4 .125-.250-.032 FLT ST.	2		0017-00104-0015
WSH. 4 .120-.250-.018 EXT ST.	2		0017-00104-0071
PC BD SPACER	4	PCMHI-PCM4	0316-00700-00XF
SCRW	4	PCMHI-PCM8	0017-00101-0335
P.B. SWITCH	1	SW1	0300-00804-1300
8 POS. DIP SWITCH	2	SW2, SW3	050-00804-1600

DESCRIPTION	QTY	DESIGNATION	PART NOS.
16 PIN IC SOCKET	1	ICS 3M	0932-00817-0100
20 PIN IC SOCKET	2	ICS 1M, 2B	0550-00804-2300
24 PIN " "	1	" 1K	0508-00804-0500
28 PIN " "	5	" 1B, 1C, 1N, 3N, 4B	0508-00804-0400
40 PIN " "	2	" 1A, 1L	0508-00804-1800
42 PIN " "	2	" 4C, 4F	0508-00804-1900

PROJECT ENG. J. SZERSZEN		USED ON SUPER PAC-MAN		MIDWAY MFG. CO.	
DATE 11/22/82	SCALE FULL	NO RES'D	IPER	PART NO. MO51-00316-FO08	
ASSEMBLY DWG SUPER PAC-MAN CPU BD. A084-91436-F316				PART NO. MO51-00316-FO08	