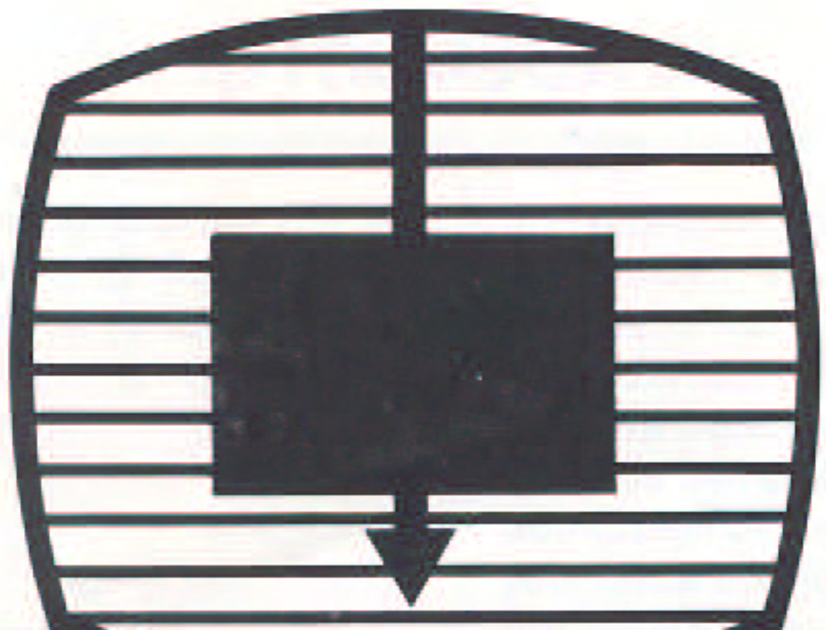

VIDEO RECAP

STARGATE/ROBOTRON
and
General Troubleshooting Summary

SERVICING SERIES

Williams® ELECTRONICS, INC.

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INTRODUCTION

The purpose of this booklet is to provide you with troubleshooting aids for servicing Robotron and Stargate video games. This booklet contains:

- Stargate/Robotron video recap information
- General troubleshooting recommendations
- Power supply troubleshooting flowchart
- Interface board troubleshooting flowchart
- ROM board troubleshooting flowchart
- CPU board troubleshooting flowchart

The first step in using this servicing information is to view the accompanying Stargate/Robotron video tape. This tape provides overview information about both the Stargate and Robotron video games, as well as the differences and similarities between the games. In addition, the video tape discusses the differences between Defender and Stargate/ Robotron.

Both Stargate and Robotron operate very similar to Defender, all three use similar boards and circuitry. The emphasis in this servicing series therefore, is on the major differences between the three games. This basic information is contained in the video tape and in the recap information which follows.

If you are not already familiar with the Defender video-based servicing series, it is recommended that you take these before proceeding further. The Defender servicing series includes:

- Power Supply and Interface board video tape
- ROM board video tape
- CPU board video tape — part 1
- CPU board video tape — part 2
- Sound board and Speech Module video tape

Since the Stargate/Robotron servicing information contained in the video tape and this booklet is based on the differences between these games and Defender, it is important that you become familiar with the Defender servicing series before proceeding. You can use much of the Defender documentation for servicing Stargate and Robotron as long as you follow the guidelines and differences as pointed out here and in the Stargate/Robotron video tape. Remember also to use the specific set of schematics for each game since much of the differences are simply circuit layout changes and consequently reference designation changes.

The remainder of this booklet includes the Stargate/Robotron video recap information, general troubleshooting recommendations, and both new and revised troubleshooting flowcharts. This material takes the basic Defender servicing information and changes it to make it applicable to Stargate and Robotron. Finally, the sound boards used in Stargate, Robotron, and Defender are identical. Therefore, the sound board servicing information is not repeated in this booklet. For your convenience, the sound board troubleshooting flowchart is included in this booklet. However, refer to the Sound Board and Speech Module video tape and recap sheet for specific servicing information.

STARGATE/ROBOTRON VIDEO RECAP INFORMATION

Welcome to Williams Electronics video-based servicing series. This recap sheet contains the most important points covered in the accompanying video tape. This recap sheet provides information on Stargate and Robotron video game servicing, using a multimeter and a logic probe.

This recap sheet should be used together with the flow charts and general troubleshooting information provided in this booklet. It will provide an overview of Stargate and Robotron operation . . . summarize the general way in which the boards are serviced . . . suggest the tools and the references you'll need to make servicing of these games quick and easy . . . and point out the differences between these games and Defender.

The main boards of the Stargate and Robotron games are similar to those boards covered in the Defender servicing series.

These boards are . . . the ROM Board . . . the CPU/Video Board . . . the Power Supply and Interface Boards . . . and the Sound Board.

While these boards generally provide the same basic functions as the Defender game, they are slightly different.

Here's what each of these boards does in Stargate and Robotron.

Coin door and player panel inputs start the game and provide player input.

The ROM and Interface Boards accept these inputs, and provide data about game play to the CPU/Video Board, which is the "Brains" of the game.

The CPU/Video Board also generates the pixel information to drive the monitor, as well as providing timing and control information to the ROM and Interface Boards.

In addition to accepting coin door inputs, the ROM Board also contains the fixed game memories, and provides sound select inputs to drive the Sound Board.

The Sound Board accepts the ROM Board inputs and produces the selected game sounds which drive the game speaker.

Finally, the power supply provides low voltage regulated and unregulated power to all game boards, coin door switches and lighting circuits.

Now let's take a look at these boards in an actual game. As was mentioned earlier . . . the ROM Board contains the fixed memory for Stargate and Robotron. Included in this fixed memory are the startup and self-diagnostic programs, and the main game programs.

In addition to these programs, the ROM Board contains . . . input-output ports and . . . a seven-segment L-E-D readout which indicates ROM and RAM faults.

Should there be a malfunction, the fault readout indicates the faulty chip. Thus providing for easy location and replacement of the chip.

The next board is the CPU/Video Board, which provides the "Brains" of the game.

The CPU/Video Board contains the . . . microprocessor and its buffers . . . the clock circuits . . . and timing and other circuits that are part of the central processor unit or CPU. Together these circuits interact with other parts of the game . . . generating screen information which is stored in the Video RAM banks.

The Video RAM banks are located in the upper right-hand portion of the CPU Board. The Video RAM banks store the game information needed to generate each line of the screen presentation.

The addresses used to scan the Video RAM banks are provided by the multiplexed memory addresses . . . which are a combination of the psuedo address, microprocessor address, video address and video PROM address busses.

The video data read out of the RAM is converted to serial form in the video shift registers. It is then clocked out of the shift registers, and into the color RAM circuit.

The color RAM is latched into the digital to analog

converter/driver circuit, which feeds the red, green and blue guns of the monitor.

In addition to the circuits just discussed, the CPU/ Video Board contains . . . CMOS RAM memory for bookkeeping totals and game adjustments . . . as well as the circuits for monitor sync generation and for both vertical and horizontal blanking.

The next major board in Stargate and Robotron is the power supply board. The Stargate power supply and the Robotron supply are conventional, bridge-type supplies with close voltage regulation and built-in operating indicators.

The interface board of Stargate and Robotron provides the link between the player control panel and the CPU/Video Board.

Player inputs are normally held high by resistors . . . at plus 5 volts . . . until a player control change pulls a HEX inverter input to ground . . . this input is inverted, then fed through the multiplexer IC to the peripheral interface adapter IC or PIA.

This produces an output to the CPU/Video Board.

The input from the interface board allows the game to respond to player game inputs.

The last major Stargate and Robotron game board is the Sound Boad.

Sound Board inputs come directly from the ROM Board under CPU control.

These inputs are fed through a buffer to a . . . PIA, which generates an interrupt signal to the Sound Board microprocessor.

The MPU, under control of the Sound Board ROM program . . . produces a digital representation of the required sound,which is routed through the PIA . . . to the digital to analog converter IC and the analog output of the D to A converter is amplified by the audio amplifier IC and fed to the game speakers.

In addition to the IC's described so far on the Sound Board, there's also a scratchpad RAM for Sound Board MPU use . . . and a bridge-type, regulated DC power supply.

From the description of the Stargate and Robotron boards, you can see that these games are similar in many ways to Defender. Let's next look at how these games compare to Defender, and then we'll compare Robotron to Stargate.

The biggest difference between Defender and Stargate or Robotron is in memory mapping and ROM Board layout. Another difference is an improved fault readout on the ROM Board.

In practical terms, this amounts to different IC's in memory select circuits and replacement of the fault readout LED's. In addition Robotron has even more differences which we'll see in a minute.

Defender's CPU/Video Board is different in several areas, the most important are the addition of . . . CMOS memory timing . . . new CMOS RAM . . . and changes to the Video RAM control and color circuits of the Stargate and Robotron games.

Finally, both the power supply and interface circuits of all three games are similar, despite some differences in board layout, particularly in the Robotron power supply. The main improvements being in the overvoltage protection circuitry of Stargate/ Robotron.

Despite these differences, you'll find that the video servicing tapes for Defender are very helpful in providing a review of game operation and troubleshooting.

Now that you have seen how Defender compares with Stargate and Robotron, let's take a closer look at the differences between Stargate and Robotron.

Both Stargate and Robotron use the same CPU/ Video Board, with only jumpering changes required to use the Stargate boards in Robotron.

There are also no differences between the interface boards or sound boards used on Stargate and Robotron.

There *are* a number of differences between the ROM Boards of Stargate and Robotron, including . . . two special chips and buffers on Robotron for enhanced memory capabilities . . . and different placement of the decoder, inverter and other IC's.

Stargate and Robotron also use different — but interchangeable — power supplies.

Each supplies plus and minus 5 volts DC, plus 12 volts DC of regulated and plus and minus 12 volts DC or unregulated output on 4J2 . . . and 6.3 volts AC and unregulated 27 volts DC on 4J3. Troubleshooting of both power supplies is quite similar . . .

The input jacks are keyed the same but the new style power supply has an isolated 6.3 volts AC for more accurate general illumination voltage.

Troubleshooting faults on Stargate and Robotron begins with a check of the diagnostic readout on the ROM Board.

During power-up, each game automatically checks the ROM, RAM and CMOS IC'S. With a few exceptions, almost all common faults will be found by the game during these self-checks, and the problem location indicated by a series of numbers on the fault display. Here the readout is indicating a faulty Video RAM IC in Bank 2, Chip 8. Information on identifying fault location from the fault readout is included in the game instruction booklet.

In addition to indicating the location on the 7-segment display, the game will also display a message on the screen. Similar messages are displayed for ROM and CMOS RAM faults.

Use of the on-board game diagnostics is covered in detail in the game instruction booklet, and so it is not repeated in this tape or the recap sheet. Instead, we'll concentrate on finding faults not detected by the on-board system, or those faults which can prevent the on-board diagnostics from operating.

The first step in locating a fault which does not show up on the game diagnostics is to check all IC'S and board connectors to be sure each if firmly seated.

Next, power up the game and check for regulated plus and minus 5 volts and regulated 12 volts at Pins 9, 1 and 8 of any Video RAM IC. You should see between plus 4.8 and 5.2 volts on Pin 9, minus 4.8 to 5.2 volts on Pin 1, and plus 11.7 to plus 12.3 volts on Pin 8.

You must be absolutely certain that regulated voltages are within limits. Digital circuits will behave erratically when voltages are not within limits, and even the on-board diagnostics will indicate problems where there are none. Remember, don't change anything until you check the power.

Another early check you should make is to pull the interboard connector connecting the CPU/Video Board and the Interface Board. After disconnecting the Interface Board, touch the reset button. If the game resets and operates normally, you've found the problem, if not, leave the Interface Board disconnected for the next few steps.

At this point, you know that power is OK, and the problem is not in the Interface Board. Your next step is to locate the source of the problem to either the CPU/Video Board or the ROM Board. By far, the easiest way to do this is swap out the two boards, one at a time, with known good boards from a working game.

When swapping boards, always remember to kill the power on both games before making the swap to avoid voltage transients that can cause further damage. If you don't do this, you're liable to find yourself with two non-functioning games.

Once you have located the suspected faulty board by swapping . . . replace the suspected faulty board in the game and use the detailed troubleshooting information contained in the flow charts to narrow the problem down to the specific part or parts which must be replaced. You can also use these same flow charts and other information to troubleshoot board problems when replacement boards are not available.

To review, you should always check the diagnostics first, then check the power . . . pull the Interface Board connector . . . then swap boards to narrow the fault to one board . . . and, finally, use the flow charts to do detailed troubleshooting.

Tools and reference material you should have to service Stargate and Robotron include: a three-state logic probe, — a copy of the drawing set for the game being serviced, and a reliable voltmeter, accurate to one-half percent or better, and reading down to hundredths on the volts scale.

This concludes the video tape recap sheet on Stargate and Robotron servicing.

GENERAL TROUBLESHOOTING RECOMMENDATIONS

This information contains a series of steps recommended for troubleshooting the Stargate and Robotron video games and a description of the troubleshooting flowcharts that are provided.

STEPS IN TROUBLESHOOTING

The general method recommended for troubleshooting all Williams Electronic's video games is the same. It involves the following steps:

1. *On Board Diagnostic Checks.* Williams Electronic's video games all perform an extensive, automatic self-check after being powered up. In addition, more detail diagnostics and game adjustments may be manually accessed at the completion of the automatic self-tests. Complete instructions for the use of the on-board diagnostics are contained in the operating instruction booklet for each game.

2. *Power, Connector/Socketed Parts Check.* There are a few faults that may render the on-board diagnostics inoperative or erratic. These include incorrect voltage levels, complete failure of one or more power supplies, and loose connector or socketed parts (such as ROM's, PROM's, etc.). If the automatic self-tests fail to operate properly, or if it is suspected that the test results are incorrect, then the next step is to check the power supply voltages and all connectors and socketed parts. In the case of the power supplies, each supply has its own built-in LED's to indicate the presence or absence of a voltage on a main power buss. These LED's do not indicate that the supply voltage is correct. A complete check involves measuring the regulated voltage levels at the boards.

   As with all electronic equipment, dust, surface corrosion on pins, or loose connections can cause erratic game operation. Part of a complete game checkout must be the determination that all socketed parts are firmly seated, and that interboard connectors are properly aligned and seated. It may be helpful to remove and replace connectors several times to assure a good fit and to remove or dislodge any dust or corrosion.

3. *Board Substitution.* The fastest method of troubleshooting a fault after the initial diagnostics, power and socketed parts check is to substitute known good boards for the main game boards. The first board to be checked is the Interface board. If disconnecting the Interface board allows the game to be RESET and operate correctly, then the problem is either in the Interface board itself, or in the player switches. If the problem is not isolated by disconnecting the Interface board, the next step is to substitute a known good ROM board, followed by substituting a known good CPU/Video board. When swapping boards, always remember to turnoff the power *before* swapping boards to avoid voltage spikes which could cause damage to the good boards.

4. *Troubleshooting Flowcharts and Logic Schematics.* Once you have narrowed the problem to a specific board, use the accompanying flowcharts to further narrow the problem to a specific replaceable part. The flowcharts can also be used to troubleshoot a game when no replacement boards are available for substitution.

   The use of logic schematics is important in troubleshooting particular faults within circuits. The complete schematics for each game are contained in the "Drawing Set" for that game. The schematics should be reviewed in conjunction with the servicing video tapes and flowcharts to provide a general familiarity with each circuit and group of circuits. When they are not available, it is often helpful to make block diagrams of the logic schematics to assist in understanding the operation of each game board.

THE TROUBLESHOOTING FLOWCHARTS

Six flowcharts are included to assist in troubleshooting the Stargate and Robotron video games. These are:

1. *Overall Flowchart.* Summarizes the initial game checks and board substitutions which isolate the problem to a specific board.

2. *Power Supply.* Aids the service person in isolating the problem to common power elements (fuses, transformer, line switch, etc.) or to individual supplies.

3. *ROM Board.* Follows ROM board checkout through the use of seven-segment LED display, power and connector checks, and replacement of individual ROM's. Use of the "No Op" socket in the CPU/Video board is also covered as a way of checking address lines for faults.

4. *Interface Board.* Checks inputs from player switches through the Inverters, Multiplexers, and PIA. Includes detection of faults in all main IC's as well as capacitors, resistors and connectors.

5. *CPU/Video Board.* Provides a step-by-step check of all major CPU/Video board circuits, replacement of the MPU and Video RAM IC's, and checkout of the on-board stand-by power cells.

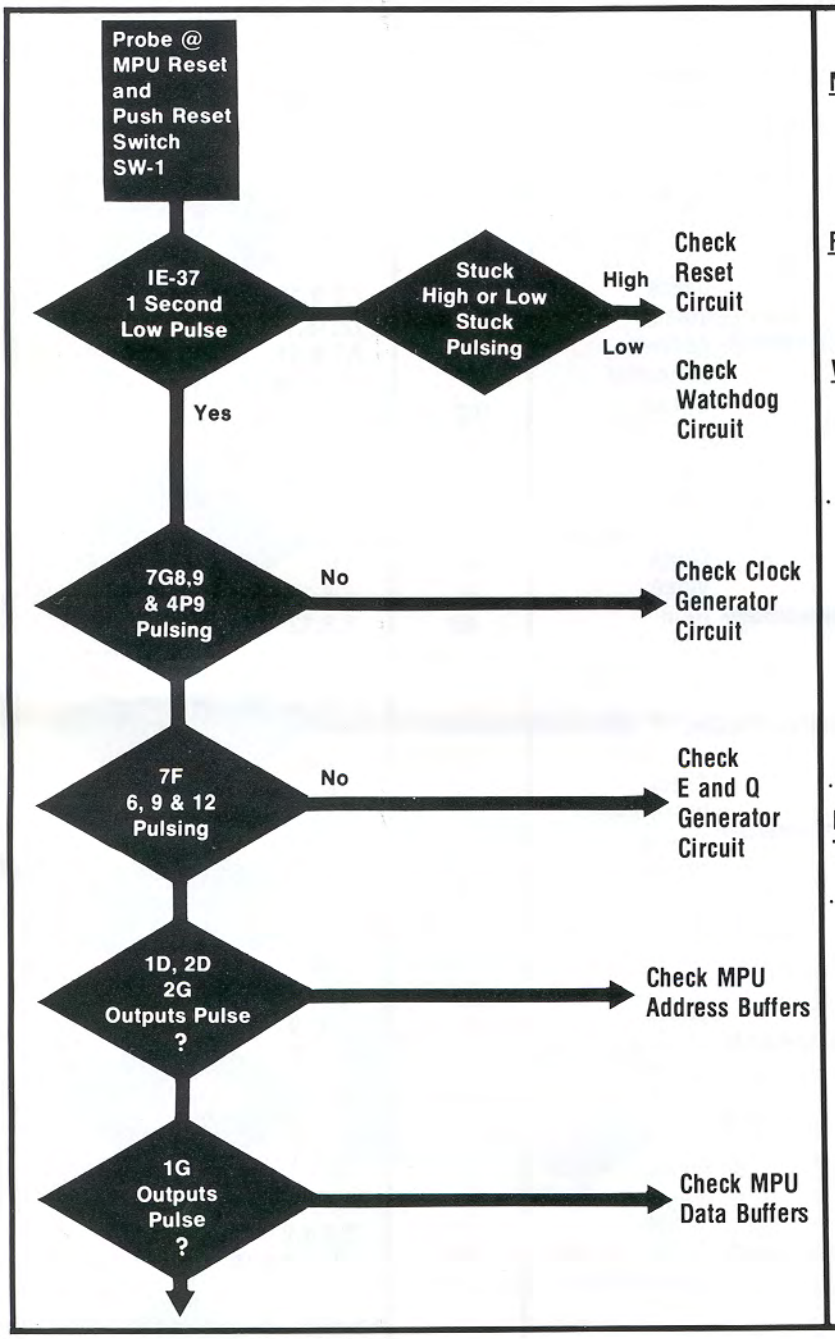
6. *Sound Board.* Follows the operation and checkout of the Sound board from sound select inputs through final D to A signal conversion and audio amplification. Provides checkout of the Sound board MPU, ROM, RAM, PIA, D/A Converter and Audio Amplifier.

It is important when using the flowcharts to complete every step before going on to the next. Unlike schematics, flowcharts cannot be followed "from the middle" without producing misleading results.

If after following the steps outlined here and in the accompanying video tape, flowcharts, and related materials, you are unable to locate and repair a fault, contact the Williams Electronics Service Department at their toll free numbers:

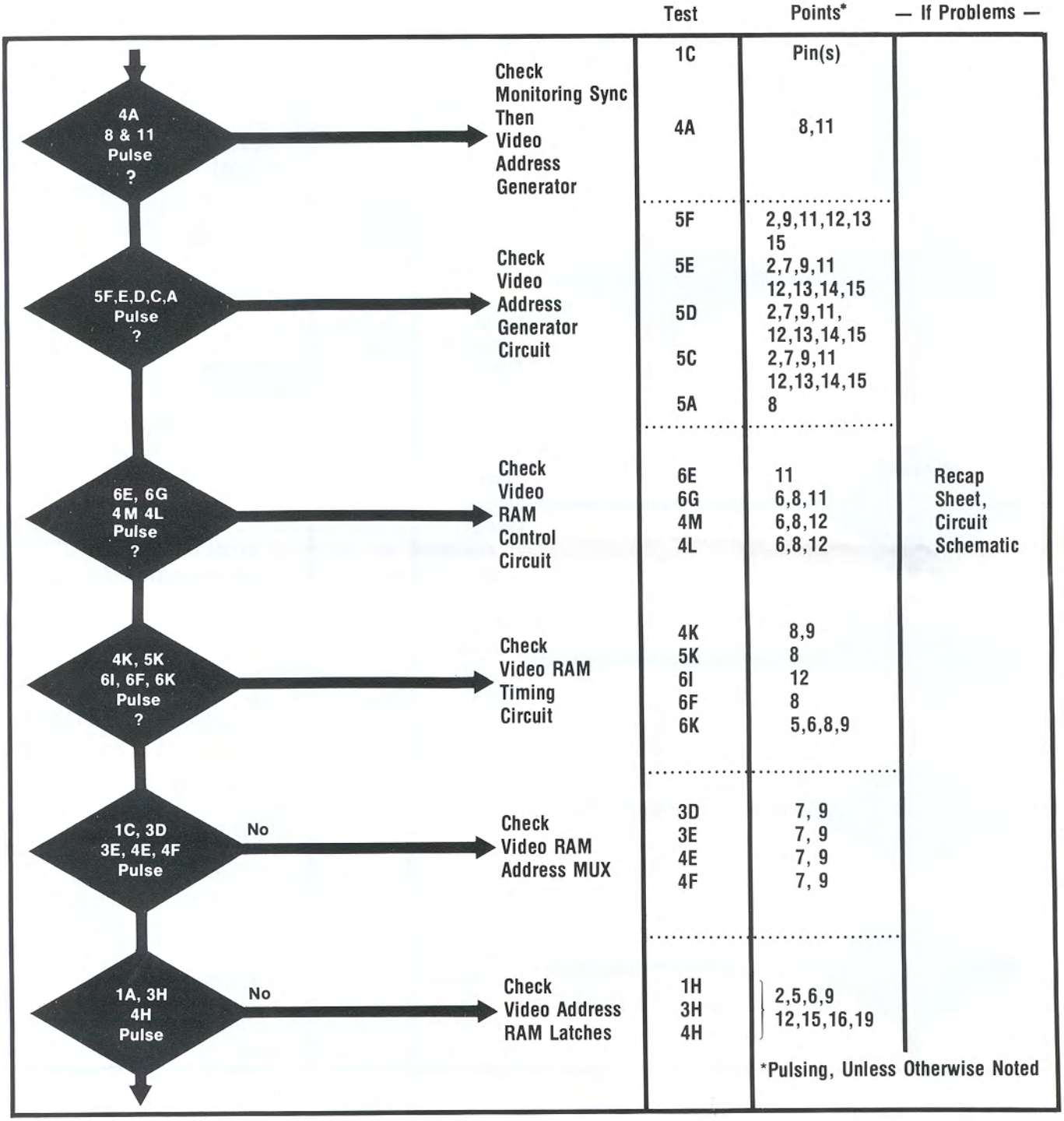
Continental U.S.A. (excluding Illinois): 800-621-1253
In Illinois: 800-572-1324

CPU LOGIC CHECK



Test	Points	— If Problems —
IC	Pin(s)	
MPU IE	37 (1 Second Low, Then High)	See Recap, Circuit Schematic
Reset 7G	1, Then 5 (1 Sec. Low, Then High)	
Watchdog 5H	13 (1 Sec. Low Then High)	
7G 4D	8, 9 9	See Recap, Circuit Schematic
7F	6, 9, 12	
Replace MPU (1 E) Then	Replace Vertical and Horizontal Decoder ROMS (3G, 3C)	
1D 2D 2G	3,5,7,9,11,13 3,5,7,9,11,13 3,5,7,9,11	See Recap, Circuit Schematic
1G	2,3,4,5 6,7,8,9,19	

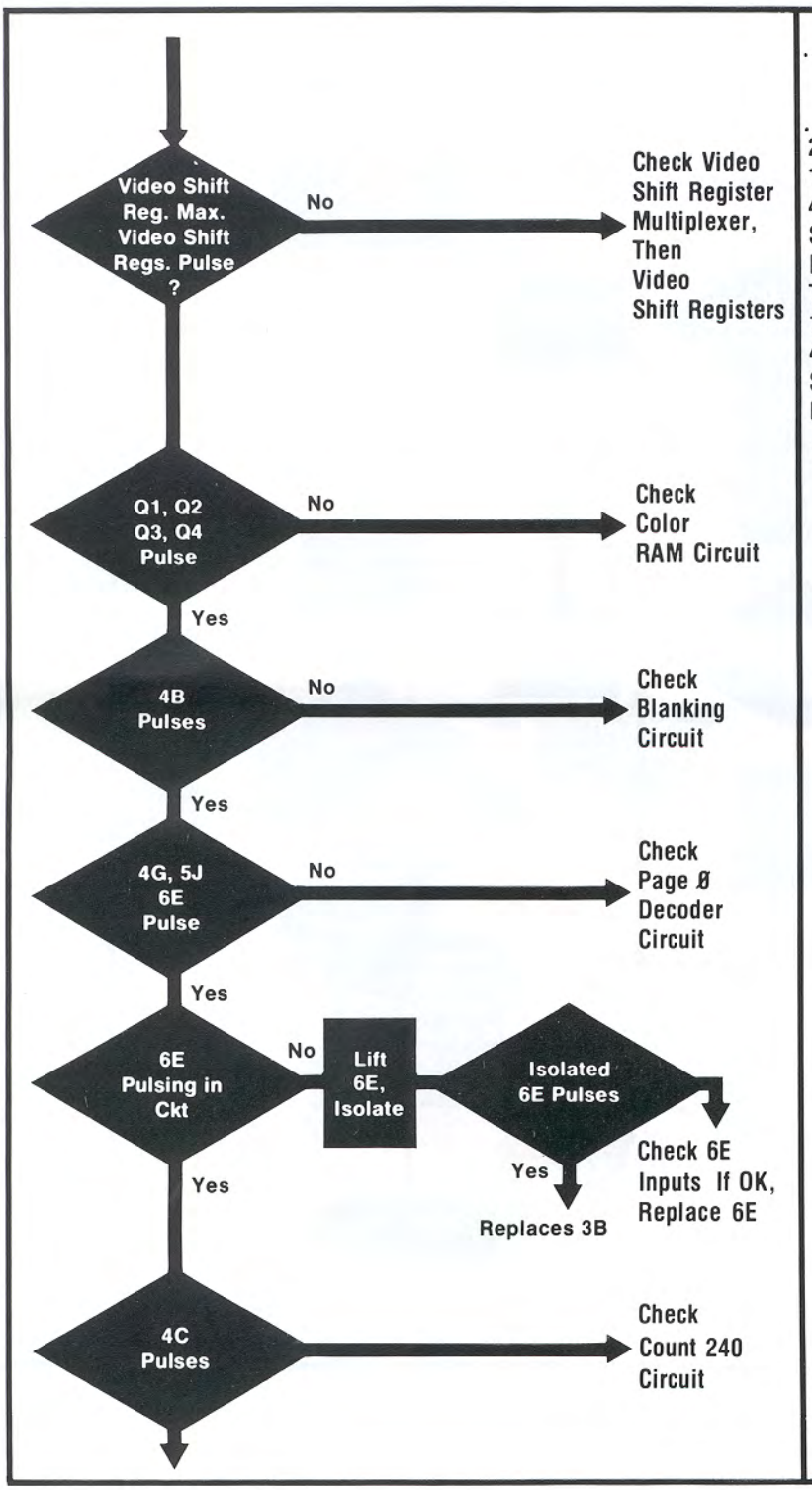
CPU LOGIC CHECK



Test	Points*	— If Problems —
1C	Pin(s)	
4A	8,11	
5F	2,9,11,12,13 15	
5E	2,7,9,11 12,13,14,15	
5D	2,7,9,11, 12,13,14,15	
5C	2,7,9,11 12,13,14,15	
5A	8	
6E	11	Recap Sheet, Circuit Schematic
6G	6,8,11	
4M	6,8,12	
4L	6,8,12	
4K	8,9	
5K	8	
6I	12	
6F	8	
6K	5,6,8,9	
3D	7, 9	
3E	7, 9	
4E	7, 9	
4F	7, 9	
1H	2,5,6,9 12,15,16,19	
3H		
4H		

*Pulsing, Unless Otherwise Noted

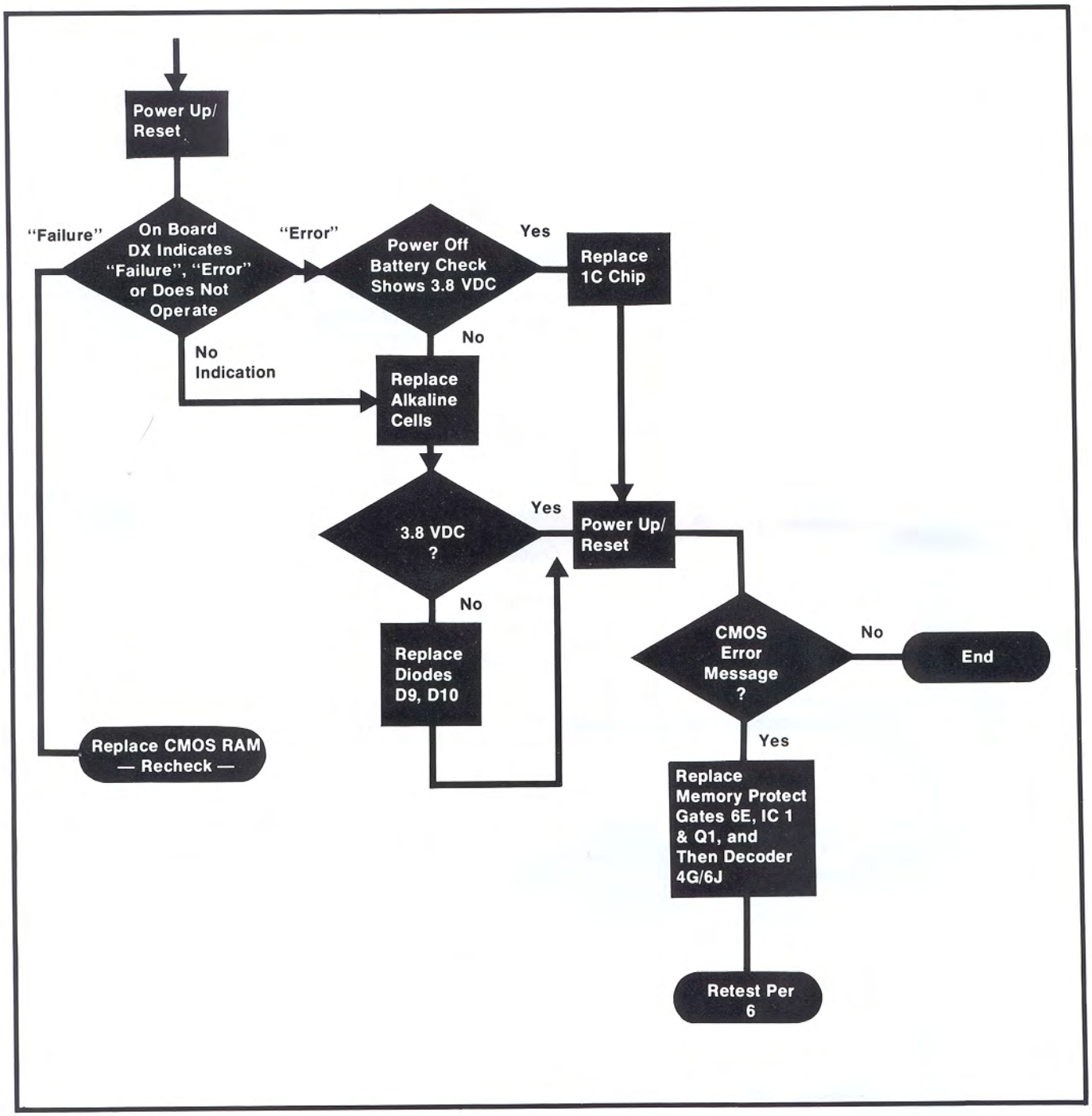
CPU LOGIC CHECK



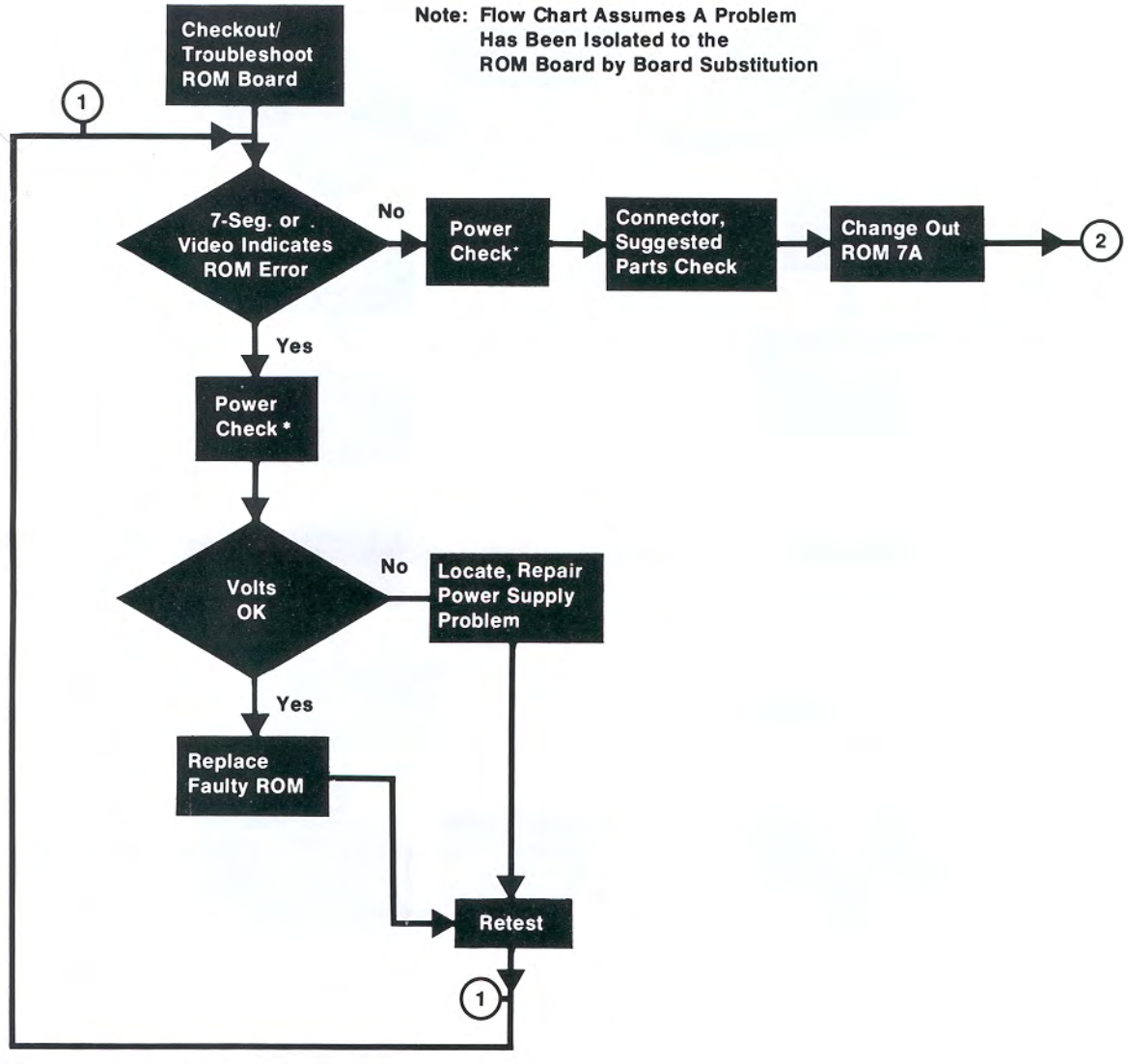
Test	Points*	— If Problems —
1C	Pin(s)	
	Change Out Video RAM Chips	
2H 1I, 2I, 3I, 4I, (With Shift Control Low) Then 1J, 2J, 3J 4J (With Shift Control High)	4,7,9,12 4,5,10,11 12,14	
Component Resistors		
R 10	–	
R 15	–	
R 11	–	
R 13	–	Recap Sheet, Circuit Schematic
4B	–	
4G 5J 6E	1,4,6,7 8 3	
6E	8	6E Inputs Are 9 & 10
4C	6	Recap Sheet, Circuit Schematic

*Pulsing Unless Otherwise Noted

CPU LOGIC CHECK

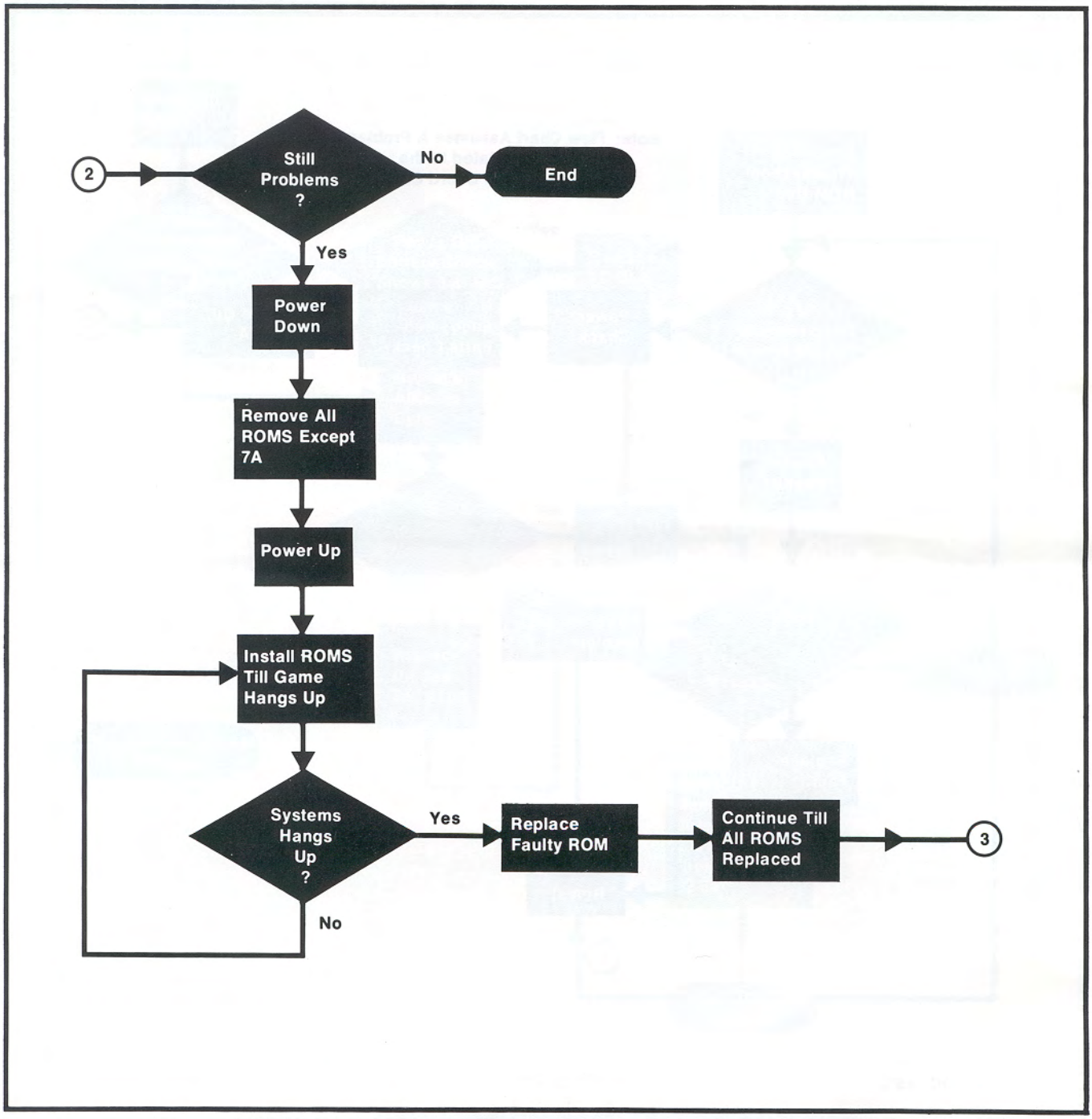


ROM BOARD FLOW CHART

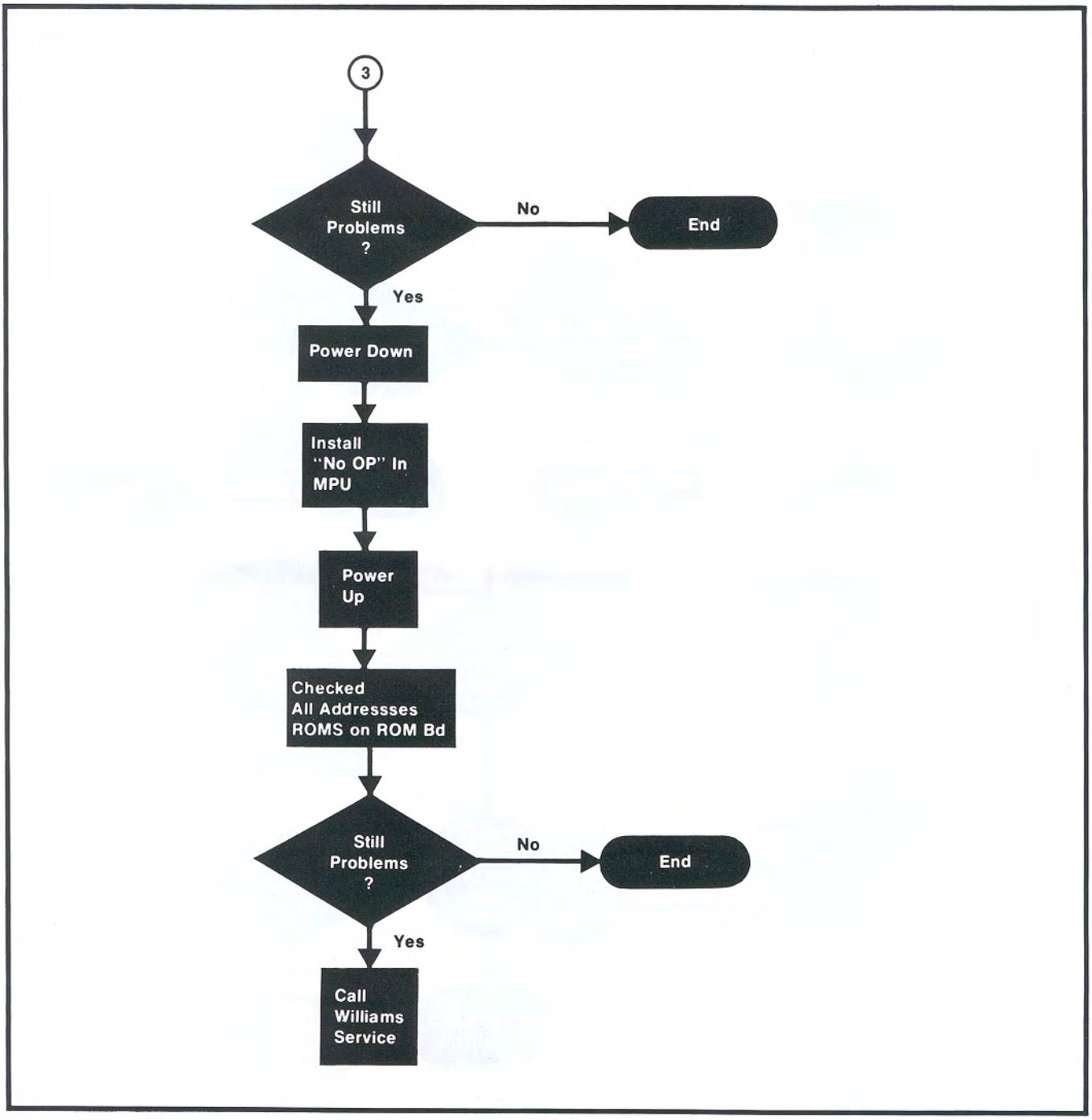


*+5VDC, ±5%

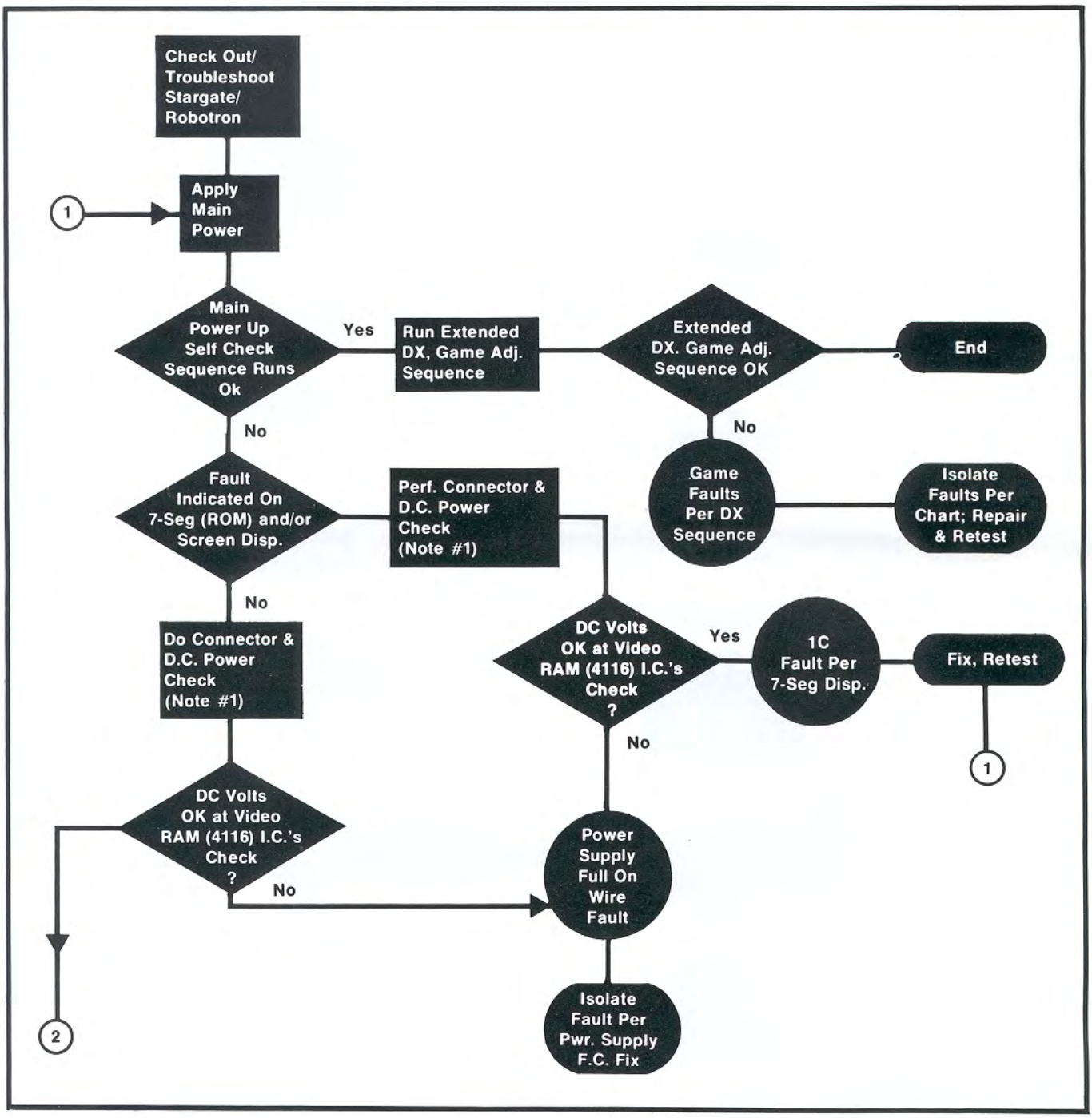
ROM BOARD FLOW CHART



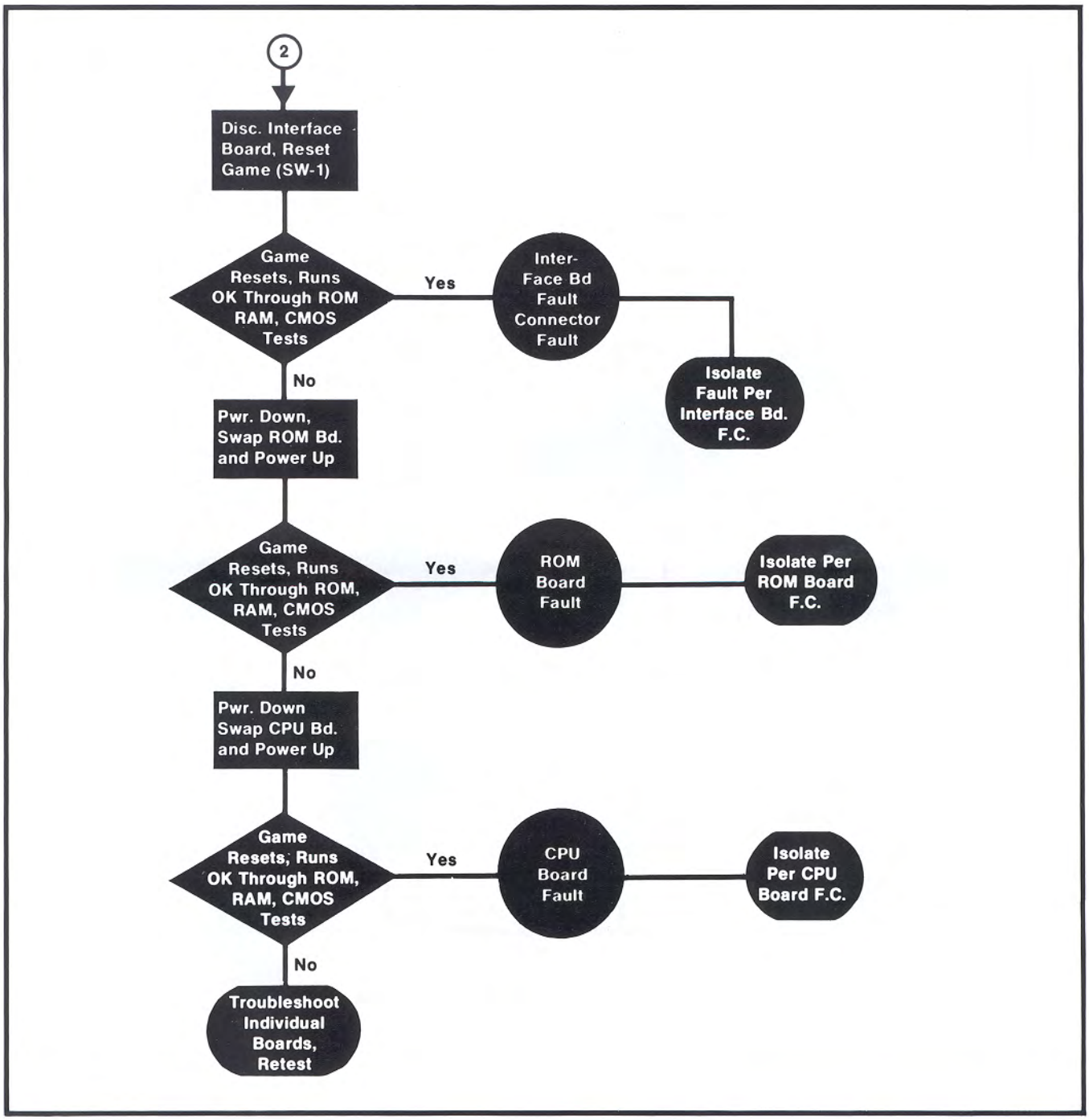
ROM BOARD FLOW CHART



OVERALL FLOW CHART

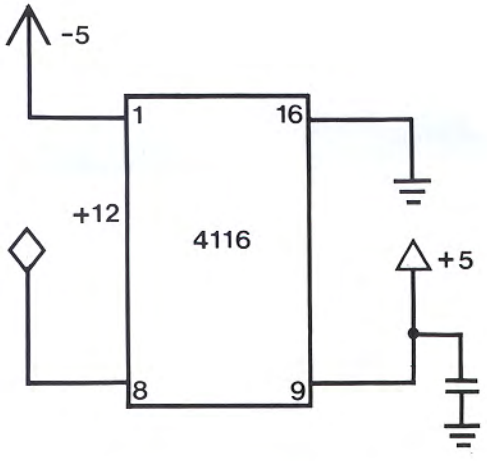


OVERALL FLOW CHART



OVERALL FLOW CHART

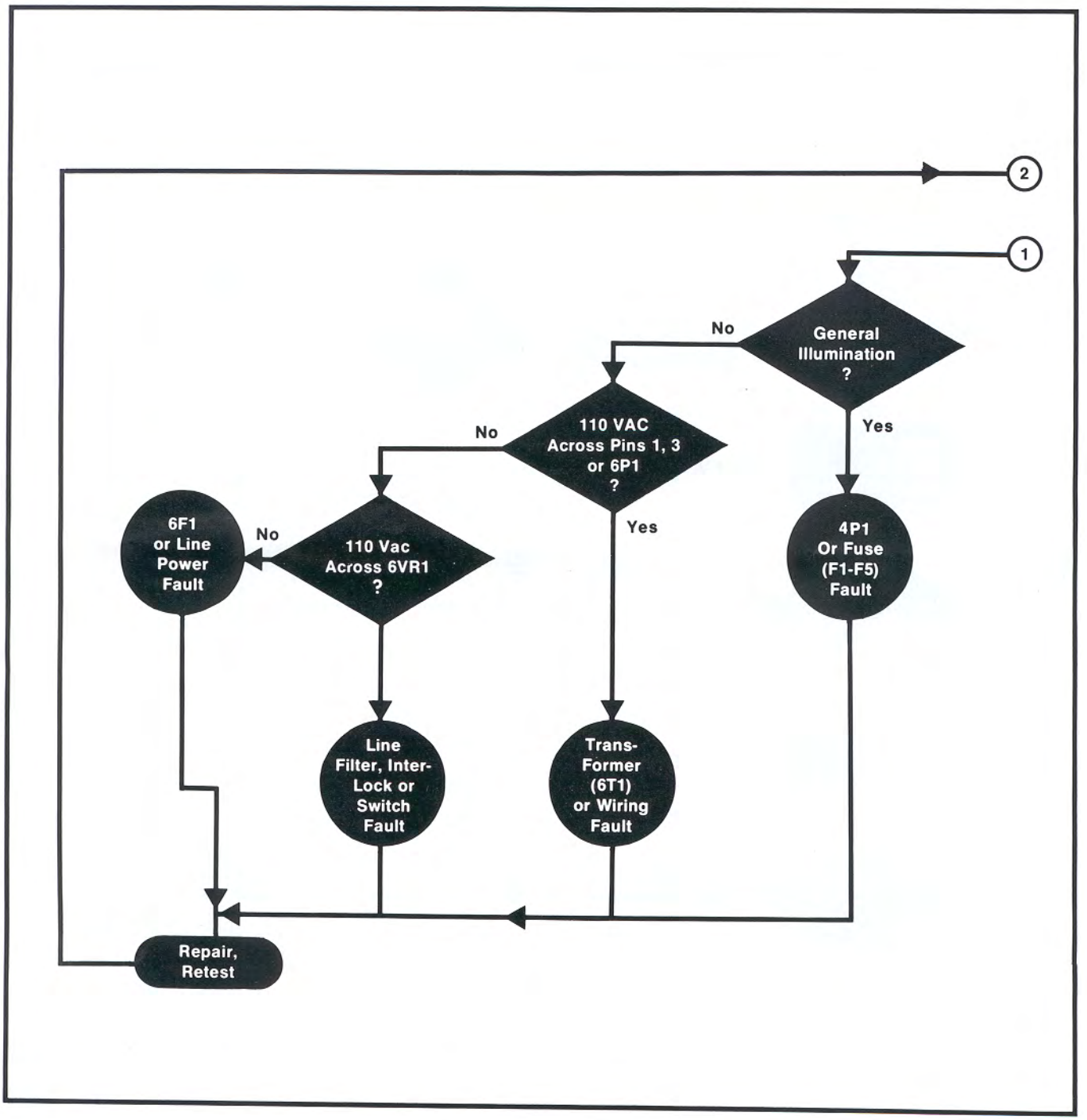
Notes:
1. **All Regulated Supplies Appear On the Pins of Each Video RAM (4116) I.C.**



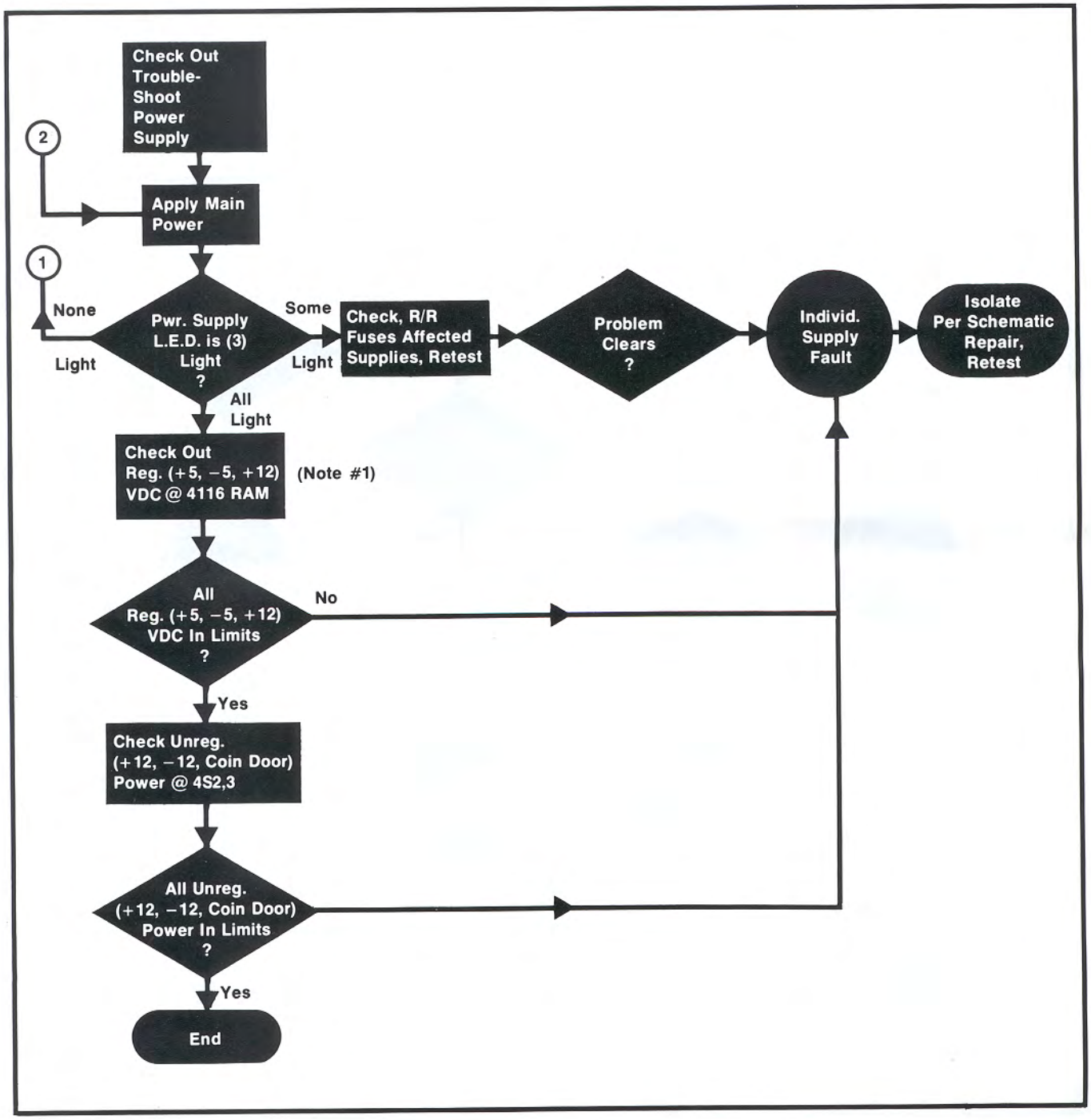
◇ = +12 VDC Regulated
△ = +12 SVDC Regulated
↑ = −5 VDC Regulated

Limits, All Regulated Supplies are ±5%

POWER SUPPLY CHECK OUT, TROUBLESHOOTING FLOW CHART #2

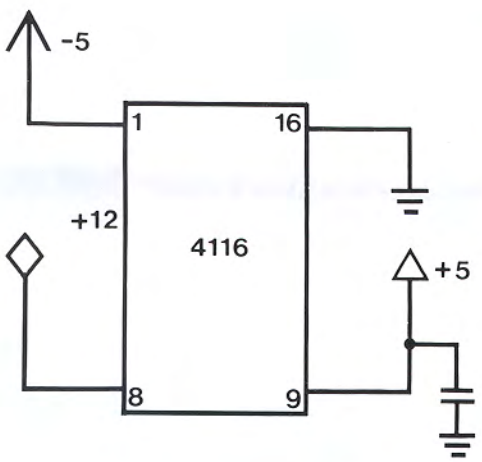


POWER SUPPLY CHECK OUT, TROUBLESHOOTING FLOW CHART #2



POWER SUPPLY CHECK OUT, TROUBLESHOOTING FLOW CHART #2

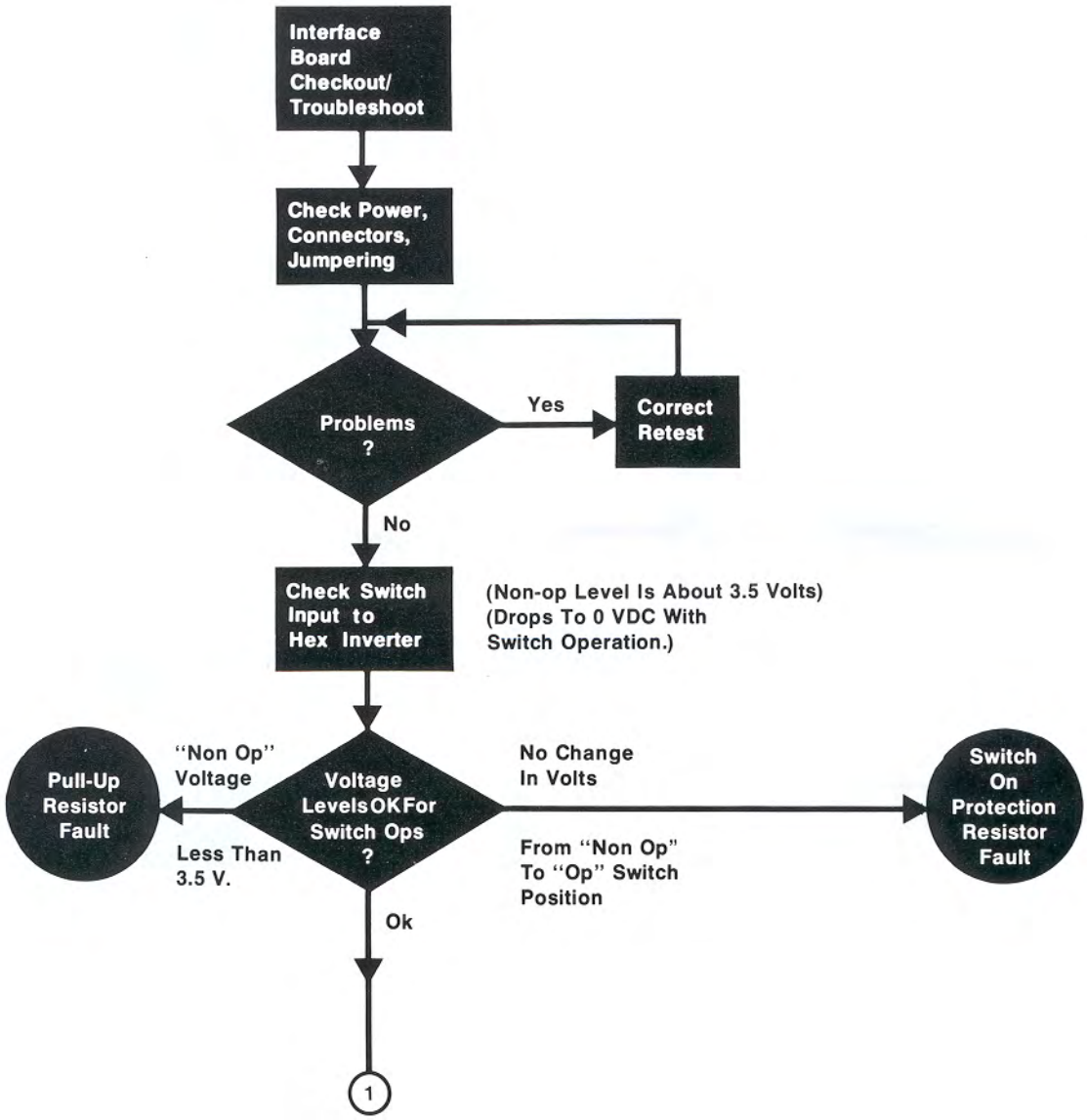
Note #1
All Regulated Digital Supplies Appear On The Pins of Each Video RAM 4116 IC:



◇ = +12 VDC Regulated
△ = +5 VDC Regulated
↑ = −5 VDC Regulated

Limits, All Regulated Supplies are ±5%

INTERFACE BOARD FLOW CHART



INTERFACE BOARD FLOW CHART