2600/2600 A
VCS DOMESTIC (M/N)

Field Service Manual

ATARI®

FD100133
Rev. 02

E.C.R. NO. 0021

ATARI®

ATARI, INC.
Consumer Product Services
845 W. Maude Avenue
Sunnyvale, CA 94041

A Warner Communications Company

ENGINEERING CHANGE REQUEST

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PART TITLE
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ATARI

VIDEO COMPUTER SYSTEM™

FIELD SERVICE MANUAL

MODEL 2600/2600A DOMESTIC (M/N)

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Correspondence regarding this document should be forwarded to Manager of Technical Support, Consumer Product Service, Atari, Incorporated, 845 W. Maude Sunnyvale, California 94086.

Table of Contents

Section	Title	Page
	INTRODUCTION	vii
1	THEORY OF OPERATION	1-1
	Introduction	1-1
	Overview	1-1
	Game Console	1-2
	Outer Casting	1-2
	Switchboard	1-3
	Motherboard	1-4
	2600A Model Differences - All Revisions	1-5
	2600A Model Differences - Revisions 14 and 15	1-6
	2600A Model Differences - Revisions 16 and up	1-6
	Summary	1-7
2	SCHEMATICS AND SILKSCREENS	2-1
3	TESTING AND TROUBLESHOOTING	3-1
	Equipment Requirements	3-1
	Test Procedures and Methods	3-2
	2600 Model Modifications	3-2
	2600A Model Modifications	3-6
	Testing with the Diagnostic Test Cartridge (Version 2.6)	3-7
	Initialization	3-7
	RAM Test	3-8
	Color Bar Test	3-9
	Gray Bar Test	3-10
	Diagnostic Matrix Test	3-11
	Audio Tones Test	3-13
	Paddle Control Lines Test	3-14
4	2600 DIAGNOSTIC FLOWCHART	4-1
5	SYMPTOM CHECKLIST	5-1
	2600 Symptom Checklist	5-2
	2600A Symptom Checklist	5-5
6	2600A DIAGNOSTIC FLOWCHART	6-1
7	GAME CONTROLLERS	7-1
	Overview	7-1
	Joystick (X-Y) Controller	7-1
	Joystick (X-Y) Controller Check	7-3
	Paddle Controller	7-4
	Paddle Controller Check	7-5
	Driving Controller	7-6
	Driving Controller Check	7-7
	Keyboard Controller	7-8
	Keyboard Controller Check	7-10
8	ATARI CX2600 (M/N) PARTS LIST	8-1
	ATARI CX2600A (M/N) PARTS LIST	8-5

Table of Contents

Section	Title	Page
9	SERVICE BULLETINS	9-1

List of Illustrations

Figure	Title	Page
1-1	2600 Functional Diagram	1-1
1-2	2600 Game Console	1-2
1-3	2600 Switchboard and Motherboard Assembly	1-3
1-4	TV Switchbox	1-4
1-5	2600A Game Console	1-5
1-6	2600A Board Layout	1-6
2-1	2600/2600A IC Pinouts	2-3
2-2	2600 Motherboard Silkscreen	2-4
2-3	2600 Channel 3 Switchboard Silkscreen	2-6
2-4	2600 Channel 3 Switchboard Schematic	2-7
2-5	2600 Channel 2-3 Switchboard Silkscreen	2-8
2-6	2600 Channel 2-3 Switchboard Schematic	2-9
2-7	2600A Motherboard Silkscreen (Revs. 1-13)	2-10
2-8	2600A Motherboard Silkscreen (Revs. 14 and 15)	2-11
2-9	2600A Motherboard Silkscreen (Revs. 16 and up)	2-12

Inserted in Front Pocket of Notebook:

2600 Motherboard Schematic
2600A Motherboard Schematic (Revs. 1-13)
2600A Motherboard Schematic (Revs. 14 and 15)
2600A Motherboard Schematic (Revs. 16 and up)

3-1	2600 Trigger Circuitry with Static Modification	3-3
3-2	2600 Static Modification Zener Diode	3-4
3-3	Location of Colored Dot Over Trace	3-4
3-4	2600 Switchboard Static Modification	3-5
3-5	2600A (Revs. 1-13) Static Modifications	3-6
3-6	Switch Initialization Positions	3-7
3-7	Defective RAM Patterns	3-8
3-8	Color Bars Screen	3-9
3-9	Gray Bars Screen	3-10
3-10	Diagnostic Matrix Screen (Shorting Plugs OUT)	3-11
3-11	Diagnostic Matrix Screen (Shorting Plugs IN)	3-12
3-12	Audio Tone Test Screens	3-13

List of Illustrations (Continued)

Figure	Title	Page
4-1	Switch Initialization Positions	4-35
4-2	Color Bars Screen	4-36
4-3	Defective RAM Patterns	4-37
4-4	Gray Bars Screen	4-38
4-5	Defective Gray Bars Screen	4-39
4-6	Diagnostic Matrix Screen (Shorting Plugs OUT)	4-40
4-7	Diagnostic Matrix Screen (Shorting Plugs IN)	4-41
4-8	Diagnostic Matrix Screen with Defective Pattern	4-42
4-9	Audio Tone Test Screens	4-43
4-10	RC Waveforms	4-44
4-11	STC Address Line Waveforms	4-46
4-12	STC Data Line Waveforms	4-46
7-1	Joystick (X-Y) Controller	7-1
7-2	Joystick (X-Y) Schematic	7-2
7-3	Paddle Controller	7-4
7-4	Paddle Controller Schematic	7-5
7-5	Driving Controller	7-6
7-6	Driving Controller Schematic	7-7
7-7	Keyboard Controller	7-8
7-8	Keyboard Wiring Diagram	7-9
7-9	Keyboard Schematic	7-9

List of Tables

Table	Title	Page
4-1	Connected Pins on VCS Motherboard	4-47

INTRODUCTION

The Video Computer System™ (VCS) Field Service Manual is organized in nine sections:

- **THEORY OF OPERATION** - overview of how the VCS works and what the basic assemblies look like.
- **SILKSCREENS AND SCHEMATICS** - electrical drawings and layouts of the printed circuit boards.
- **TESTING AND TROUBLESHOOTING** - overview of the procedures for testing and repairing the VCS unit.
- **2600 DIAGNOSTIC FLOWCHART** - thorough flowchart enabling the technician to test and troubleshoot a defective 2600 unit.
- **SYMPTOM CHECKLIST** - for the experienced technician, a list of the high failure parts and the flowchart entry point for that particular problem.
- **2600A DIAGNOSTIC FLOWCHART** - thorough flowchart enabling the technician to test and troubleshoot a defective 2600A unit.
- **GAME CONTROLLERS** - overview of hand controller construction with electrical schematics and recommended test and repair procedures.
- **PARTS LIST** - detailed breakdown of all parts used in both the 2600 and 2600A.
- **SERVICE BULLETINS** - section to be used to hold service bulletins released by the Manager of Technical Support. These bulletins will include changes in recommended repair procedures and required modifications for units in the field.

The manual is designed for use by both experienced and inexperienced service personnel. The Diagnostic Flowcharts (Sections 4 and 6) provide detailed diagnostic and repair procedures for technicians who are not yet completely familiar with the VCS. The Symptom Checklist (Section 5) provides a fast repair reference for the more experienced technician.

SECTION 1

THEORY OF OPERATION

INTRODUCTION

There are currently four types of ATARI Video Computer Systems. The original model (2600) is composed of two PC Boards connected by a 12-pin ribbon cable with the motherboard surrounded by a heavy aluminum casting.

The other models (2600A: Revisions 1-13, Revisions 14-15, and Revisions 16 and up) are composed of a single board with a light aluminum shield. The single board models differ slightly in the video output circuitry. Component differences are:

- Revisions 1-13 have no diodes on TIA lines LM1 and Sync.
- Revisions 14-15 have diodes and pull-up resistors on TIA lines LM1 and Sync.
- Revisions 16 and up include the above mentioned diodes and resistors as well as a timer chip.

The revision level is etched directly on the PC board.

OVERVIEW

The ATARI Video Computer System (VCS) Models 2600/2600A are state-of-the-art microcomputers. They receive instructions for the operation of different games from individual Read-Only-Memory game cartridges and interpret data from the players' hand-held controllers. They also allow game players to select both a specific version of each game and the player difficulty (on a per player basis). Figure 1-1 is a block diagram of the functional flow of the CS Model 2600. Section 7 describes the player controllers.

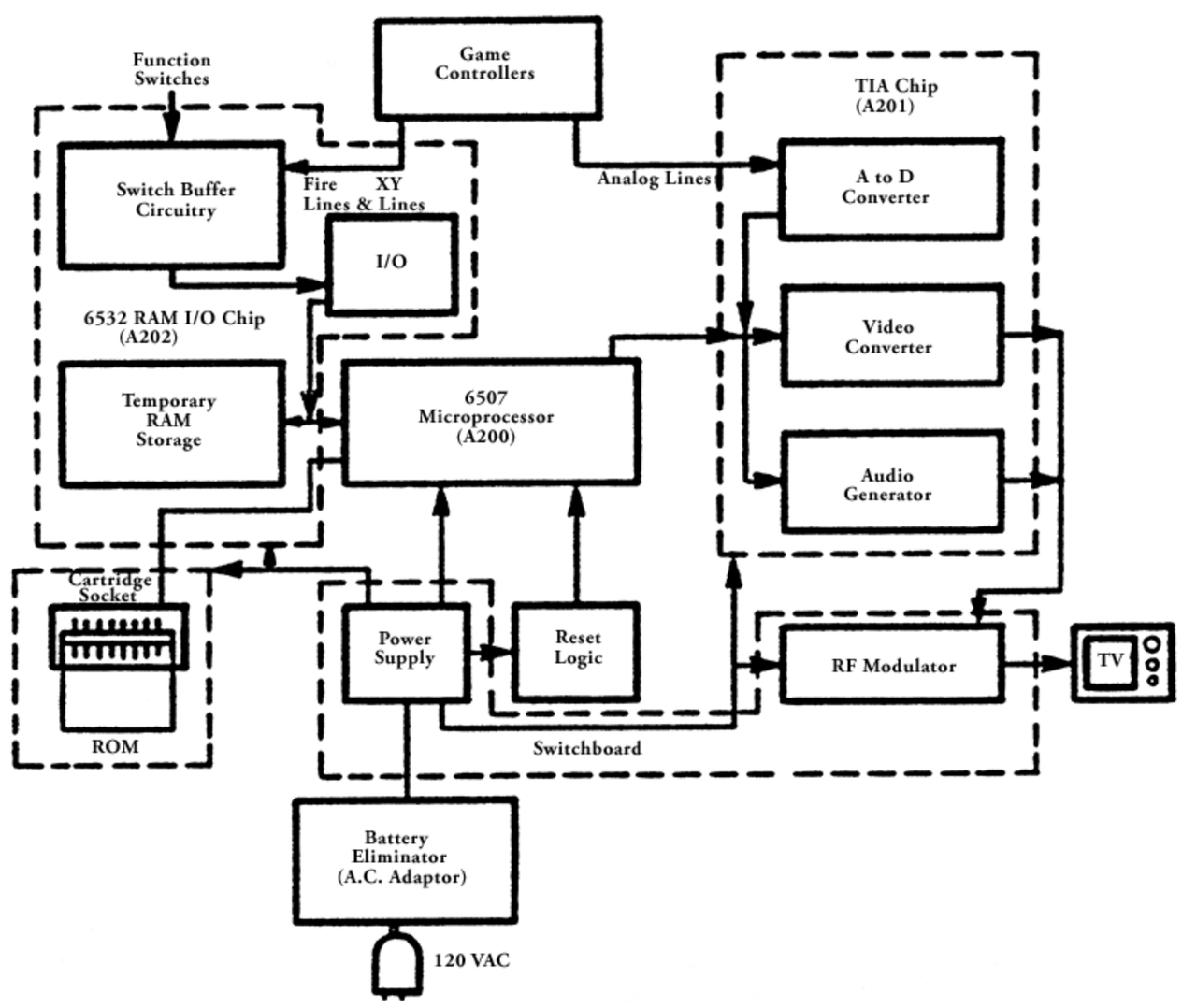


Figure 1-1. 2600 Functional Diagram

GAME CONSOLE

The VCS game console is composed of an outercasting that houses the switchboard and the RF radiation shielded motherboard.

Outer Casting

The casting consists of three pieces of plastic (see Figure 1-2). The pieces include the base, which holds the switchboard and motherboard assembly; the top; and the bezel.

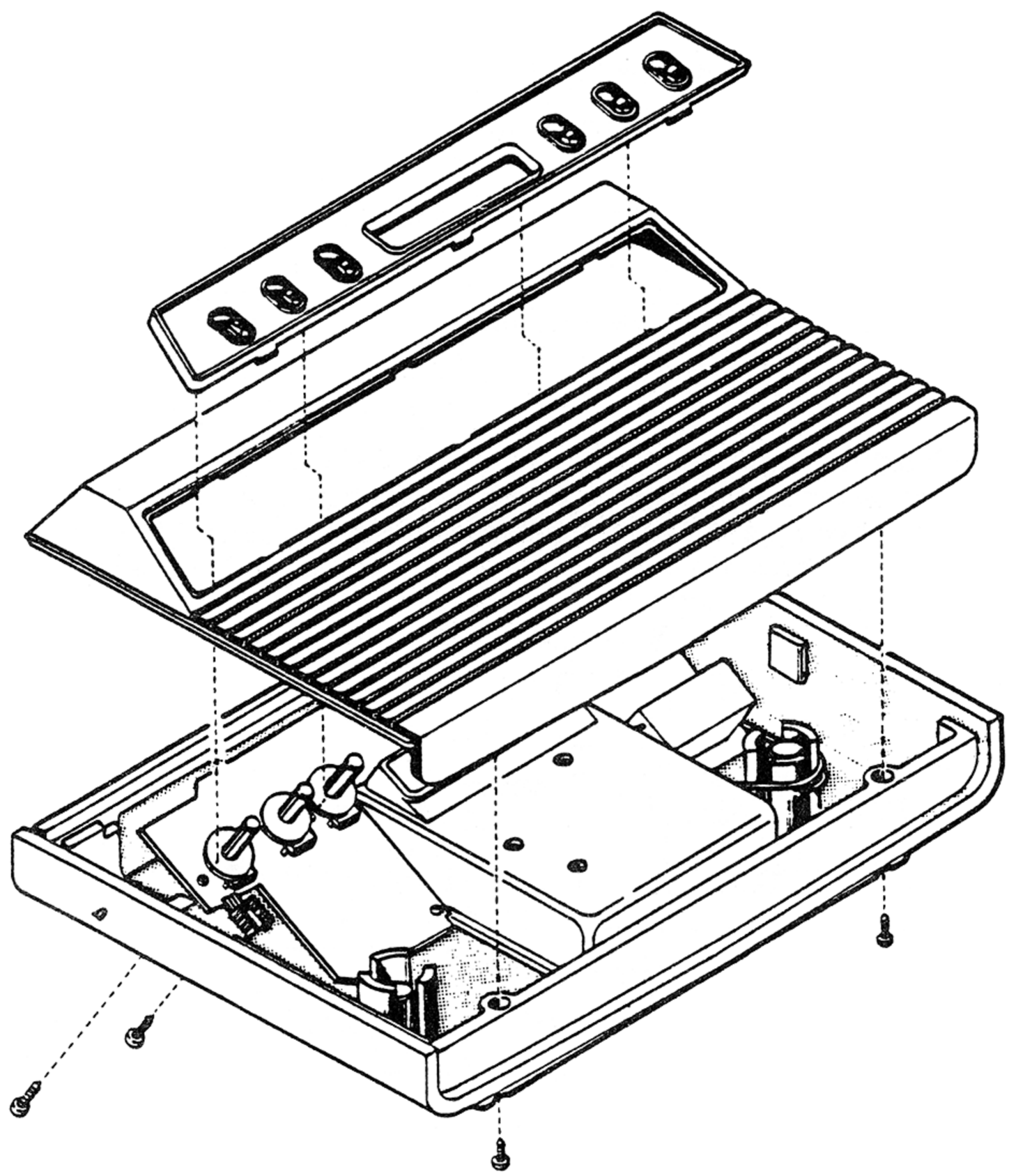


Figure 1-2. 2600 Game Console

Switchboard

The switchboard assembly holds the player option switches, the power supply, and the RF modulator (See Figure 1-3).

- PLAYER OPTION SWITCHES
  Switches S101 thru S104 are double-pole, single-throw. Switches S105 and S106 are double-pole, double-throw. All switches are connected between the switchboard and the motherboard by 12-conductor flexible ribbon cable.

- POWER SUPPLY
  The power supply is composed of a +5 voltage regulator, filter capacitors, and the power on/off switch. Unregulated DC is supplied to the board from the battery eliminator. A supply of +5 volts is routed through a filter circuit to the RF modulator. The motherboard also receives its power (+5 volts Vcc) from the switchboard via the same 12-conductor ribbon cable referenced above.

- RF MODULATOR
  The RF modulator converts the signal received from the Television Interface Adaptor chip on the motherboard to a frequency that a television can receive and interpret. Data between the RF module and the Television Interface Adaptor chip is passed via the 12-conductor ribbon cable which connects the motherboard to the switchboard. A coaxial cable passes this signal from the RF module to the switch box mounted on the back of the television.

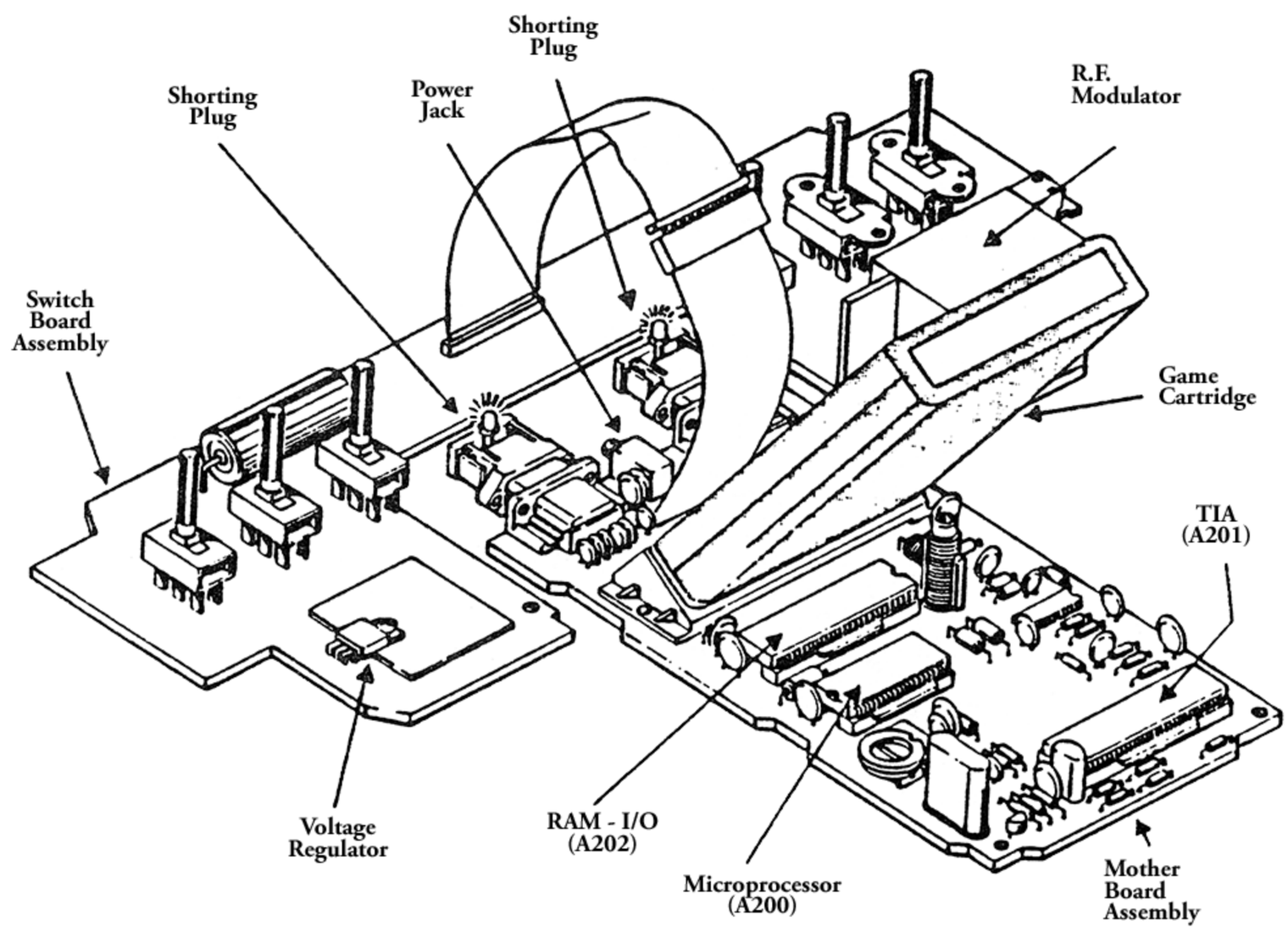


Figure 1-3. 2600 Switchboard and Motherboard Assembly

Motherboard

The motherboard is composed of a PC board containing a microprocessor (MPU) chip, a combination Random Access Memory - Input/Output (RAM-I/O) chip, and a Television Interface Adaptor (TIA) chip (see Figure 1-3). The board also contains numerous capacitors, resistors, transistors, and other assorted electronic components. These parts are all listed in Section 8, PARTS LIST.

- MICROPROCESSOR CHIP
  The heart of the VCS is the 6507 microprocessor chip (MPU). This device makes decisions for the VCS based upon information it receives from the game cartridge and the RAM-I/O (discussed in the next paragraph).

- RANDOM ACCESS MEMORY-INPUT/OUTPUT CHIP
  Temporary storage of data from the MPU is provided by the 6532 Random Access Memory-Input/Output (RAM-I/O) chip. This chip also scans the option switches and the joystick I/O lines for information and maintains time accounting for the MPU.

- TELEVISION INTERFACE ADAPTOR CHIP
  This ATARI proprietary chip generates audio and video signals which are required by the RF modulator. The Television Interface Adaptor (TIA) chip also contains the analog-to-digital converter circuitry that allows the MPU to understand signals originating in the hand-held paddle controllers.

  TIA outputs are processed by additional circuitry into a composite video, sound, and color signal which is routed to the RF module on the switch-board via the 12-conductor ribbon cable. The RF module converts the composite signal to a RF signal acceptable to the television. A coaxial cable transmits this RF signal from the console to a selection box that can be mounted on the T.V. This switchbox (Figure 1-4) allows you to display either a signal received by the antenna (for normal T.V. viewing) or a signal from the VCS (for playing a game).

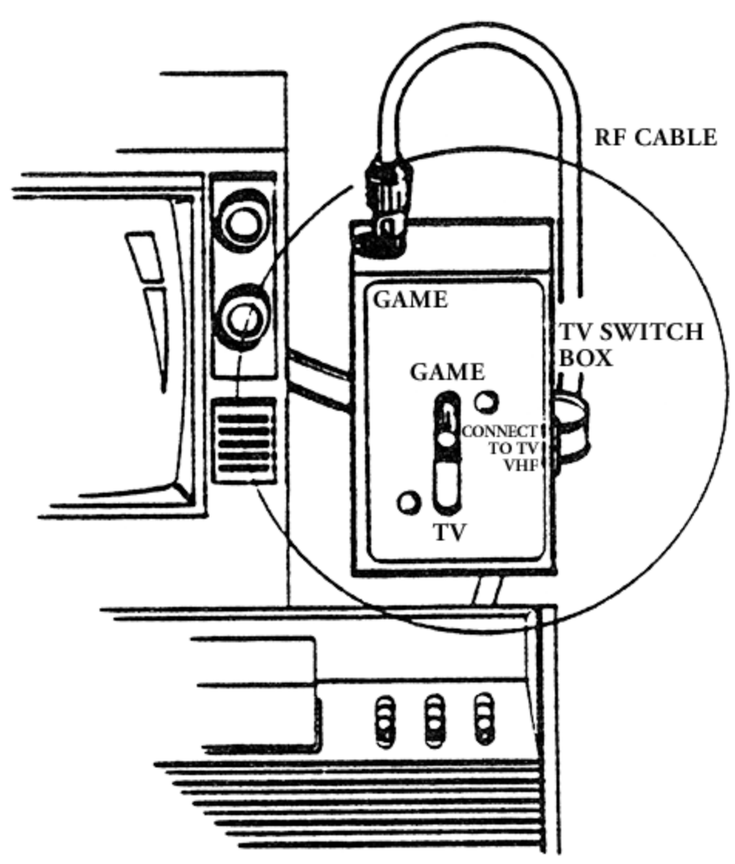


Figure 1-4. TV Switchbox

2600A MODEL DIFFERENCES - ALL REVISIONS

The major difference between the newer single board VCS (2600A) and the original VCS (2600) is that all of the components formerly on the switchboard are now located on the motherboard (See Figure 1-5). This includes the player control function switches (Power ON/OFF, COLOR/BW, GAME SELECT and GAME RESET), RF modulator and power supply circuitry. The single board design eliminates the need for the ribbon cable, which connected the switchboard to the motherboard on the 2600 VCS.

Gone, too, are the luminescence and RF output buffers and the two TIA input buffers, all of which were contained in chip A203. In the oscillator circuit, one of the transistors and its associated network has been eliminated and R227-R230 (paddle control lines) are no longer present. C239, going to pin 7 on J202 and J203, has been replaced by C236 and C237 (See Figure 1-6).

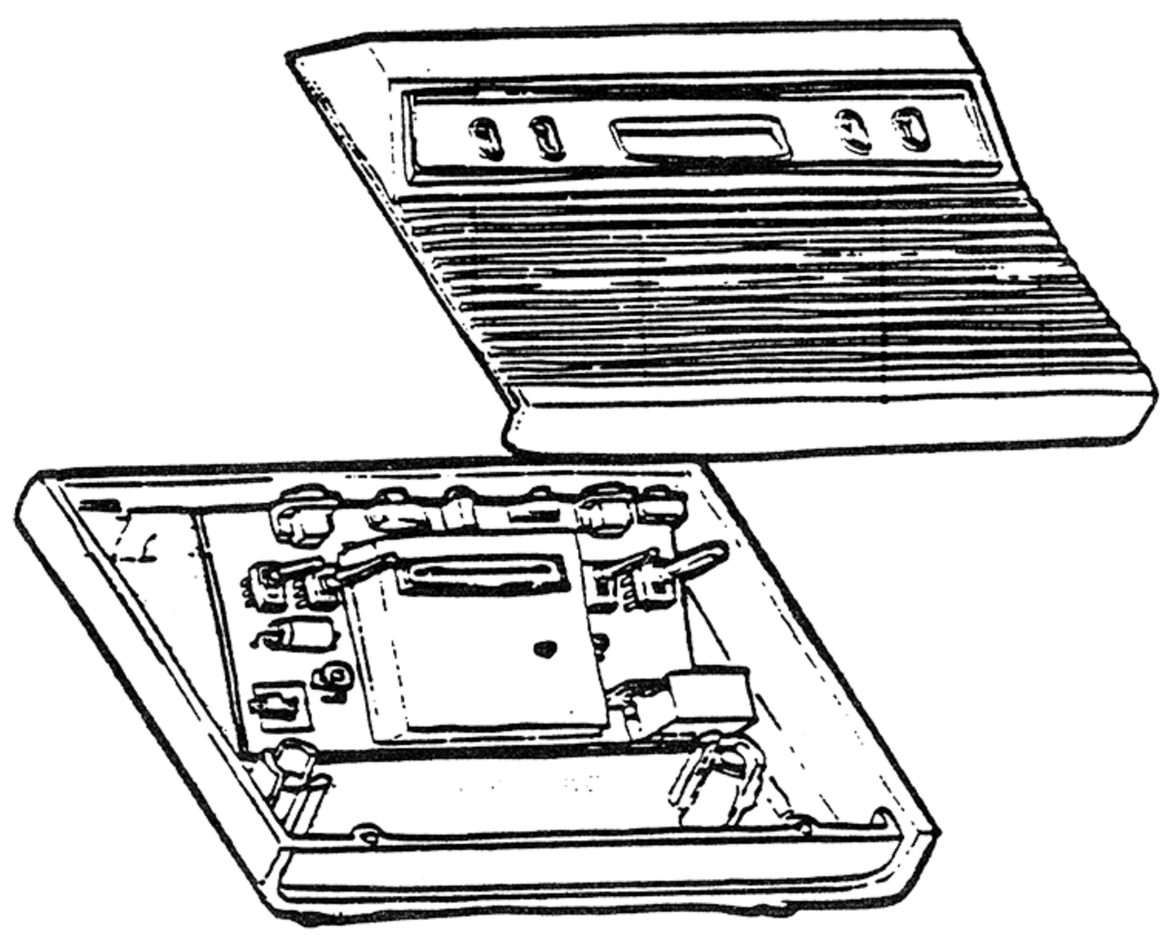


Figure 1-5. 2600A Game Console

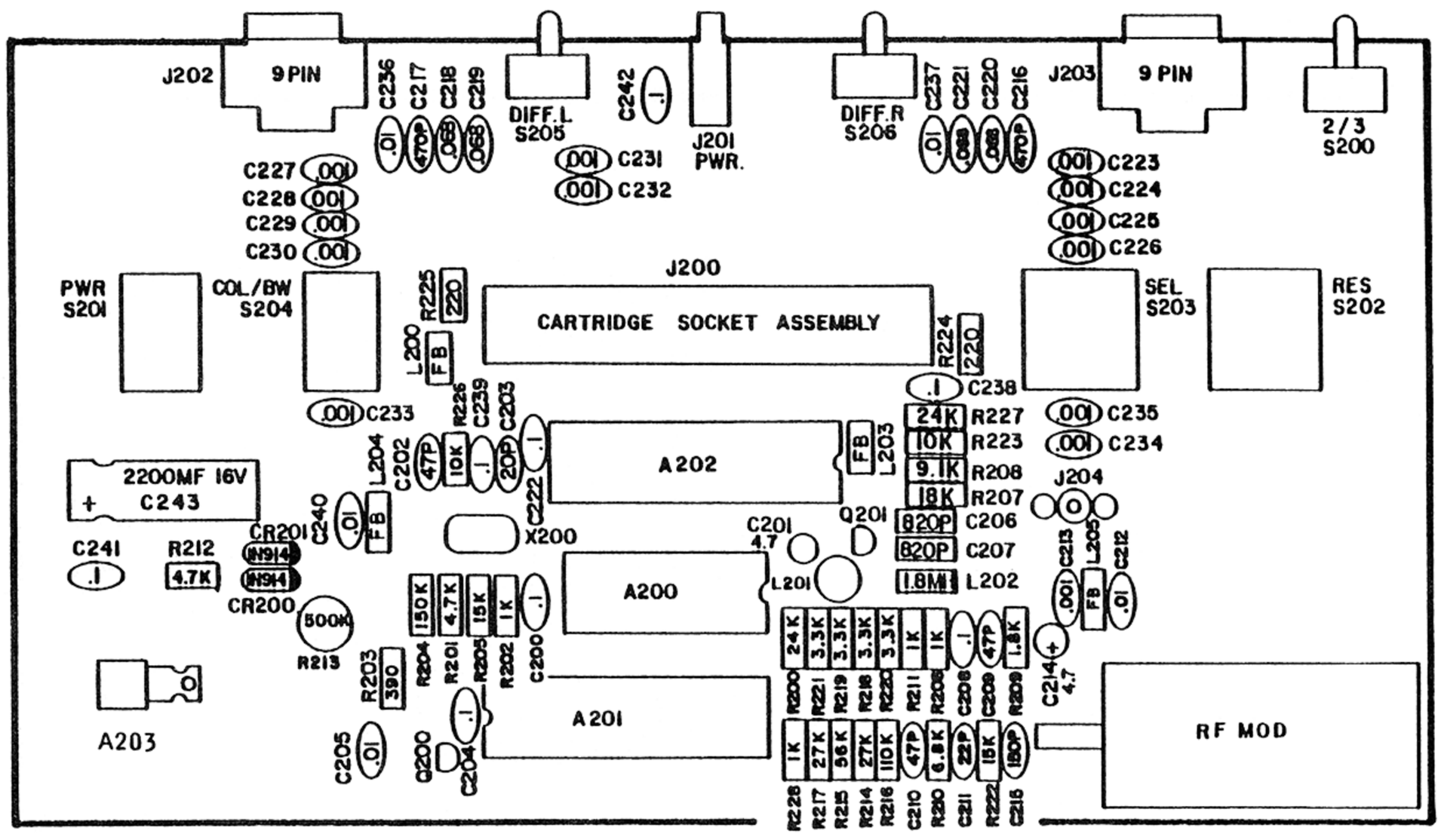


Figure 1-6. 2600A Board Layout (Revs 1-13)

In addition to the component changes, the physical location of several parts has also been changed. Instead of having the right and left difficulty switches placed on top of the game, they are located at the rear of the console next to the game controller plugs. The channel selector switch is also located at the rear of the console. The game cartridge socket is no longer angled, but is mounted vertically on the board.

2600A MODEL DIFFERENCES - REVISIONS 14 AND 15

Revisions 14 and 15 contain the model differences described above, and in addition have new components on the TIA lines, LM1 and Sync. There are two 1N914 diodes to prevent feedback on the lines and two additional pull-up resistors to insure the signal is at +5v. To compensate for any signal loss, R215 and 217 have been changed to 47K (R215) and 24K (R217).

2600A MODEL DIFFERENCES - REVISIONS 16 AND UP

Revisions 16 and up contain the model differences described above; they also include a timer chip (A205) added to the reset circuitry of the MPU chip. This chip eliminates the problem of power-on reset failures.

SUMMARY

The VCS is a microcomputer that receives its operational instructions from game cartridges, the game console, and player controllers. The 2600 switchboard and motherboard assemblies are housed within an outer casting and are the principle assemblies addressed in the remainder of this manual. The boards are connected by a 12-conductor ribbon cable which passes not only power, but also data between the two boards.

Three chips of the motherboard allow for the interaction between the game and the player. These chips are the microprocessor (MPU), the Random Access Memory-Input/Output (RAM I/O), and the Television Interface Adapter (TIA) chips.

The 2600A model differs primarily in the location of the components formerly located on the switchboard. They are attached directly to the motherboard and eliminate the need for the switchboard and the ribbon cable. The 2600A Revisions 14 and up include even further additional components to improve the performance of the output circuitry.

SECTION 2

SILKSCREENS AND SCHEMATICS

On the following pages are representative silkscreens and switchboard schematics for the ATARI Video Computer System. The motherboard schematics for all 2600/2600A VCS models are located in the pocket at the front of this binder. Minor variations in design may be encountered depending on the production date of the game, but these schematics provide all details required for an in-depth inderstanding of all 2600 units, including the various 2600A model revisions..

NOTES

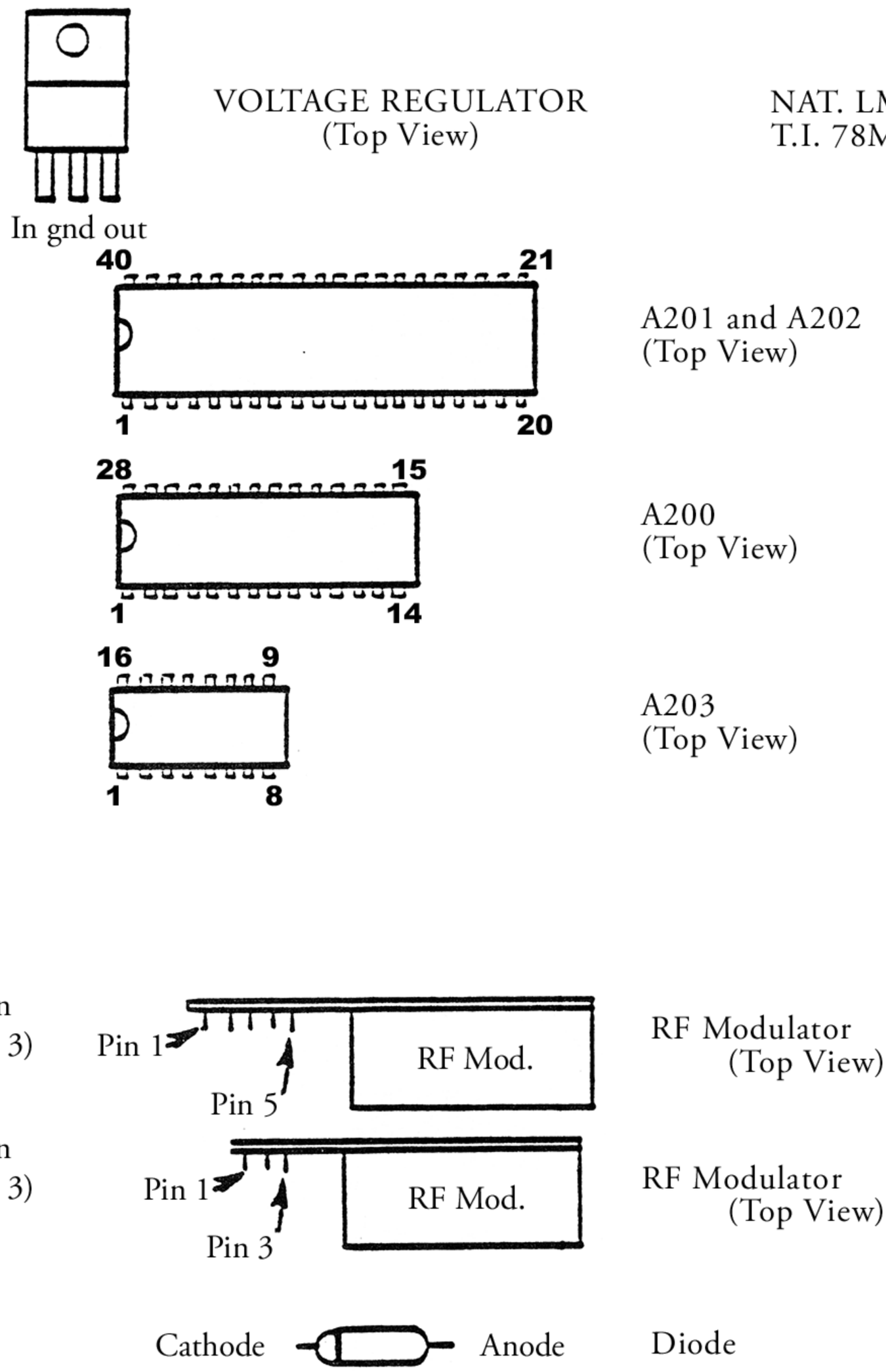


Figure 2-1. 2600/2600A IC Pinouts

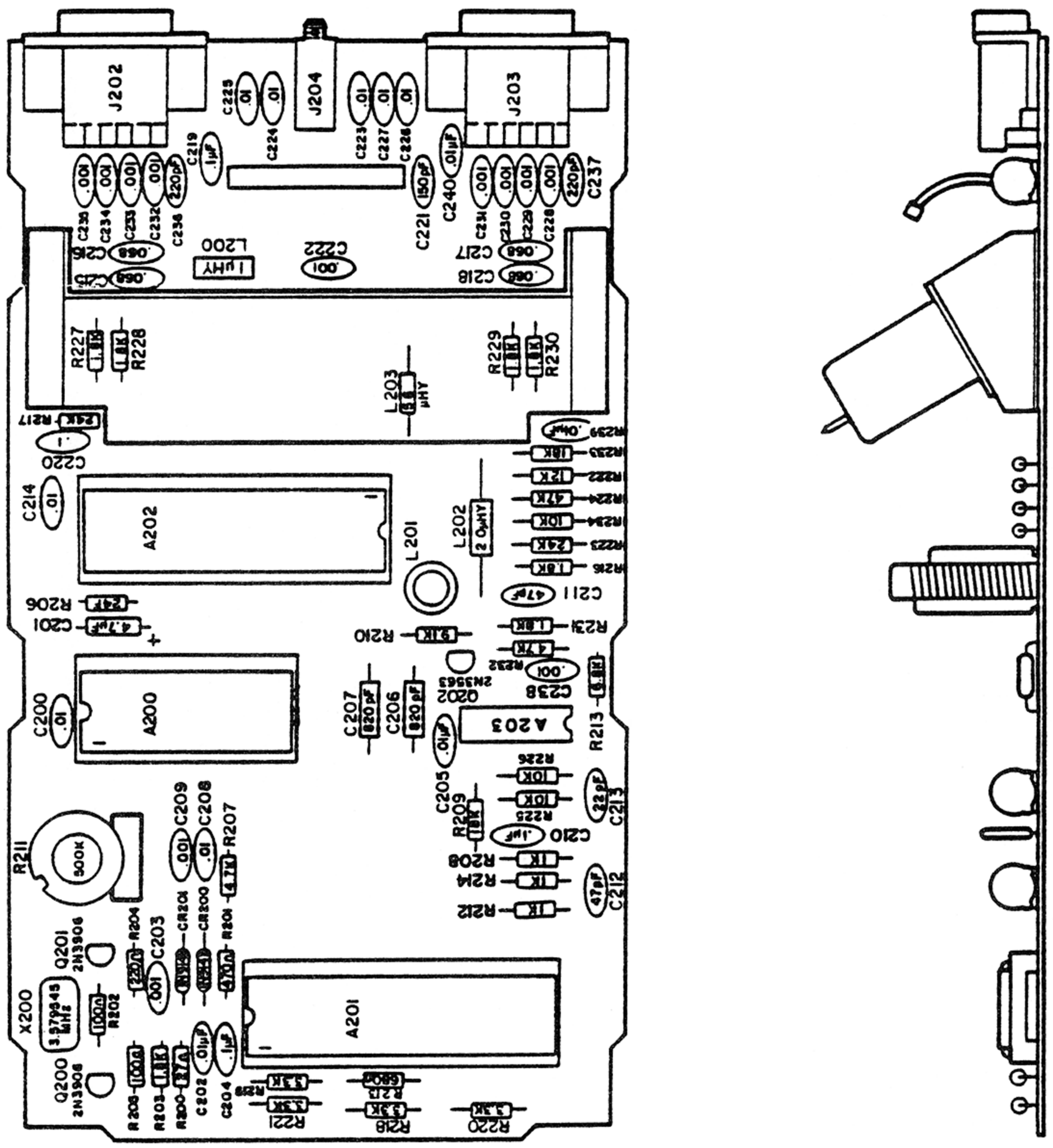


Figure 2-2. 2600 Motherboard Silkscreen

The following variations may appear on the 2600 switchboard:

CHANNEL 3 SWITCHBOARD:

C102 may or may not be in place.
C103 and/or C104 may or may not be in place.
C103 and/or C104 may be mylar dipped .22 uf.
C103 and/or C104 may be ceramic .01uf (See Figures 2-3 and 2-4).

CHANNEL 2 OR 3 SWITCHBOARD:

The holes on the PC board for the GAME RESET and GAME SELECT switches may not be wide enough apart for the switch legs. To correct this the legs of the switch must be bent in so they fit into the holes (See Figures 2-5 and 2-6).

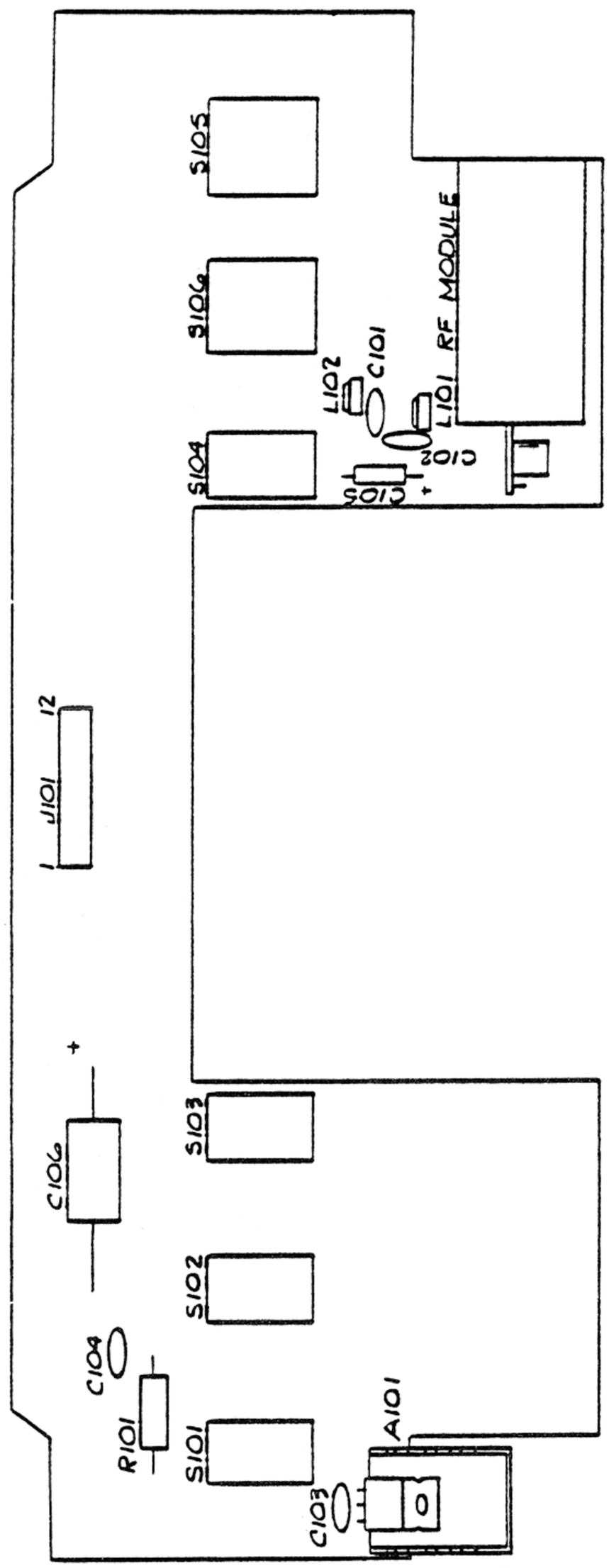


Figure 2-3. 2600 Channel 3 Switchboard Silkscreen

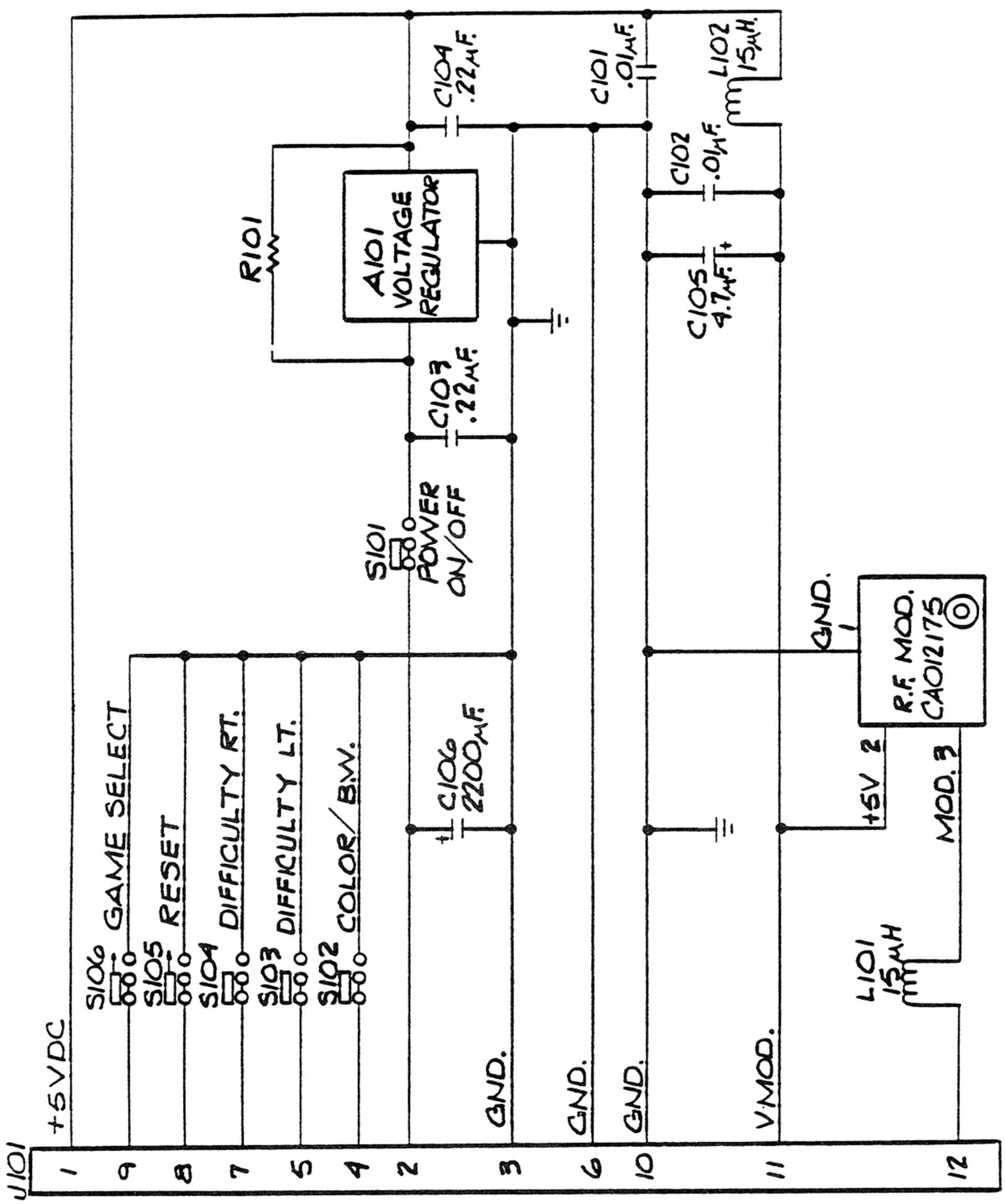


Figure 2-4. 2600 Channel 3 Switchboard Schematic

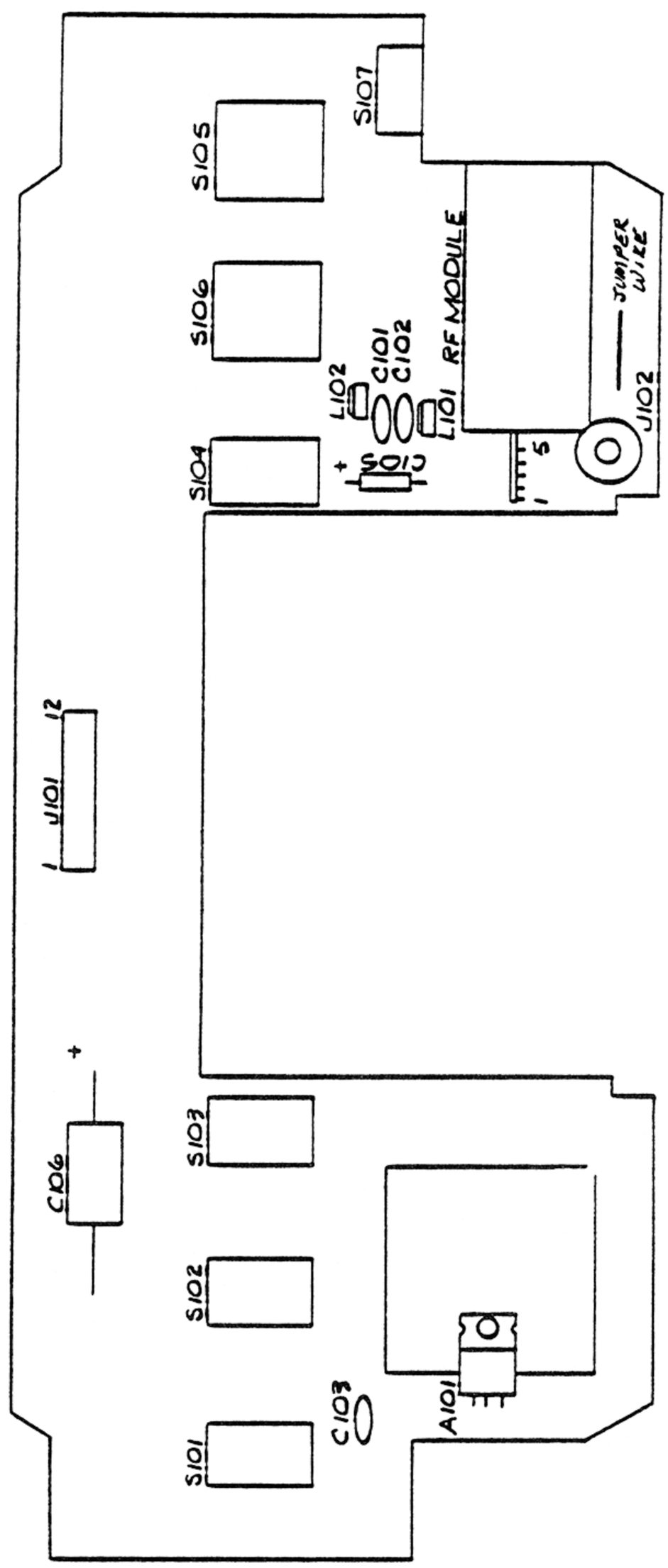


Figure 2-5. 2600 Channel 2-3 Switchboard Silkscreen

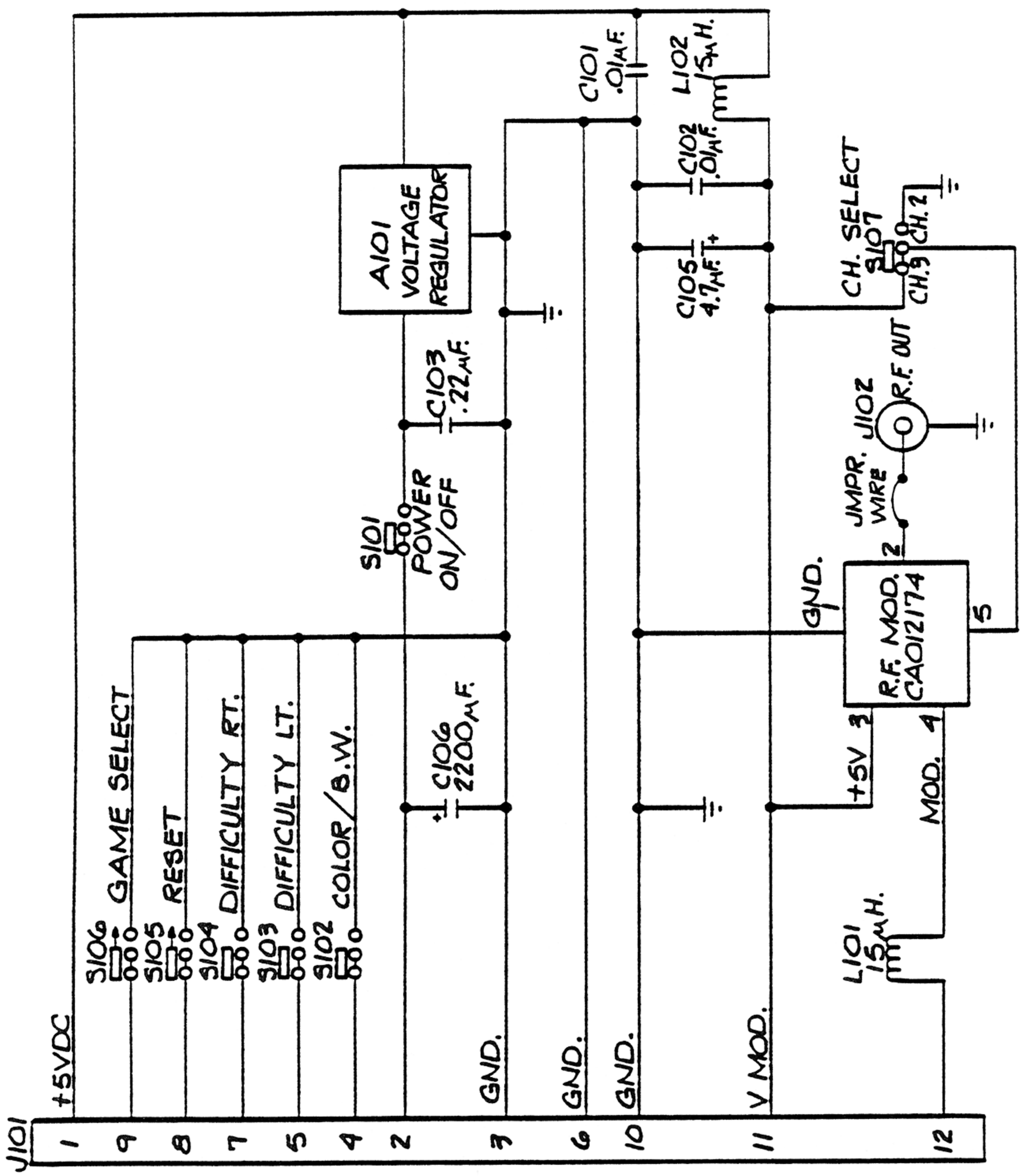


Figure 2-6. 2600 Channel 2-3 Switchboard Schematic

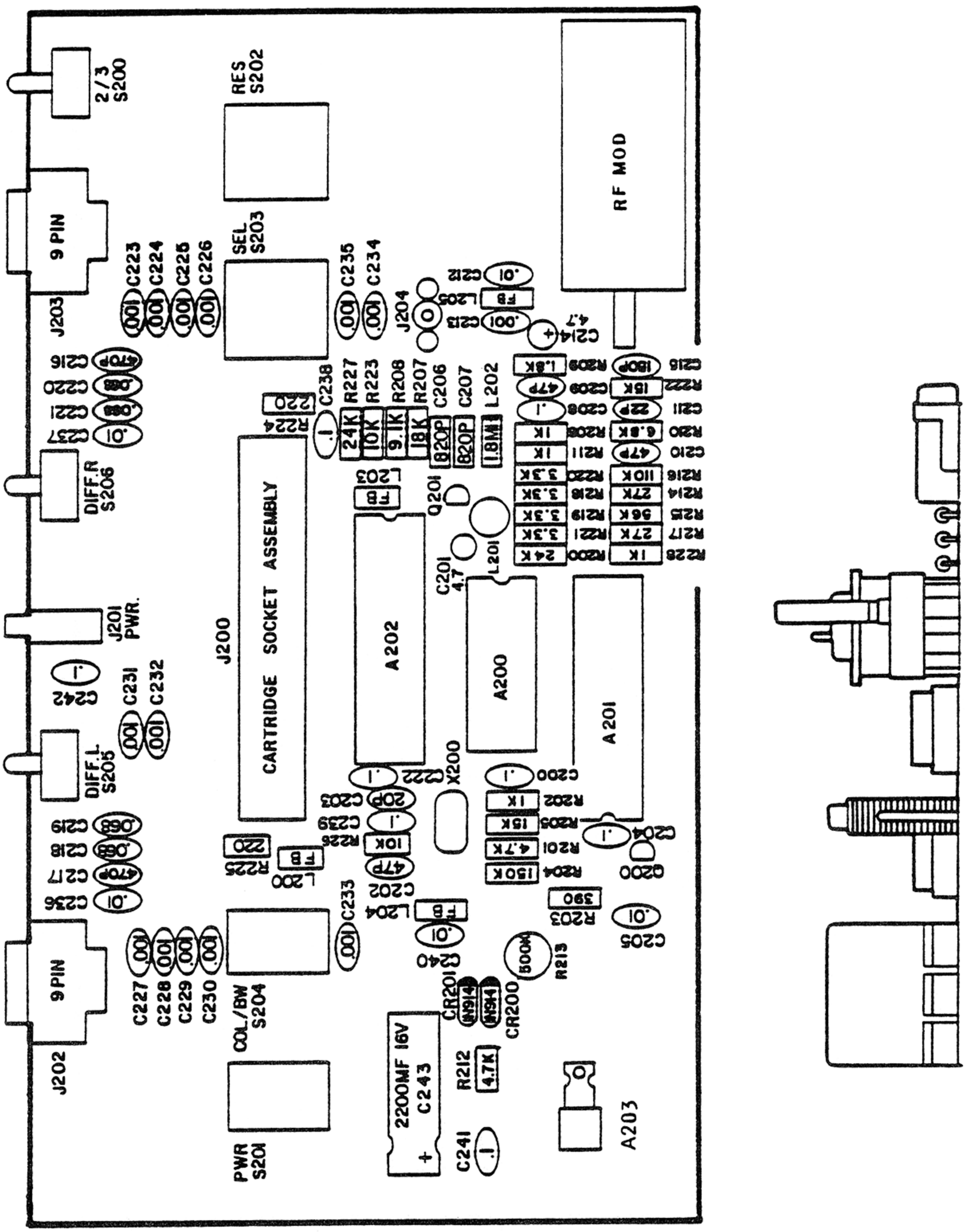


Figure 2-7. 2600A Motherboard Silkscreen (Revs. 1-13)

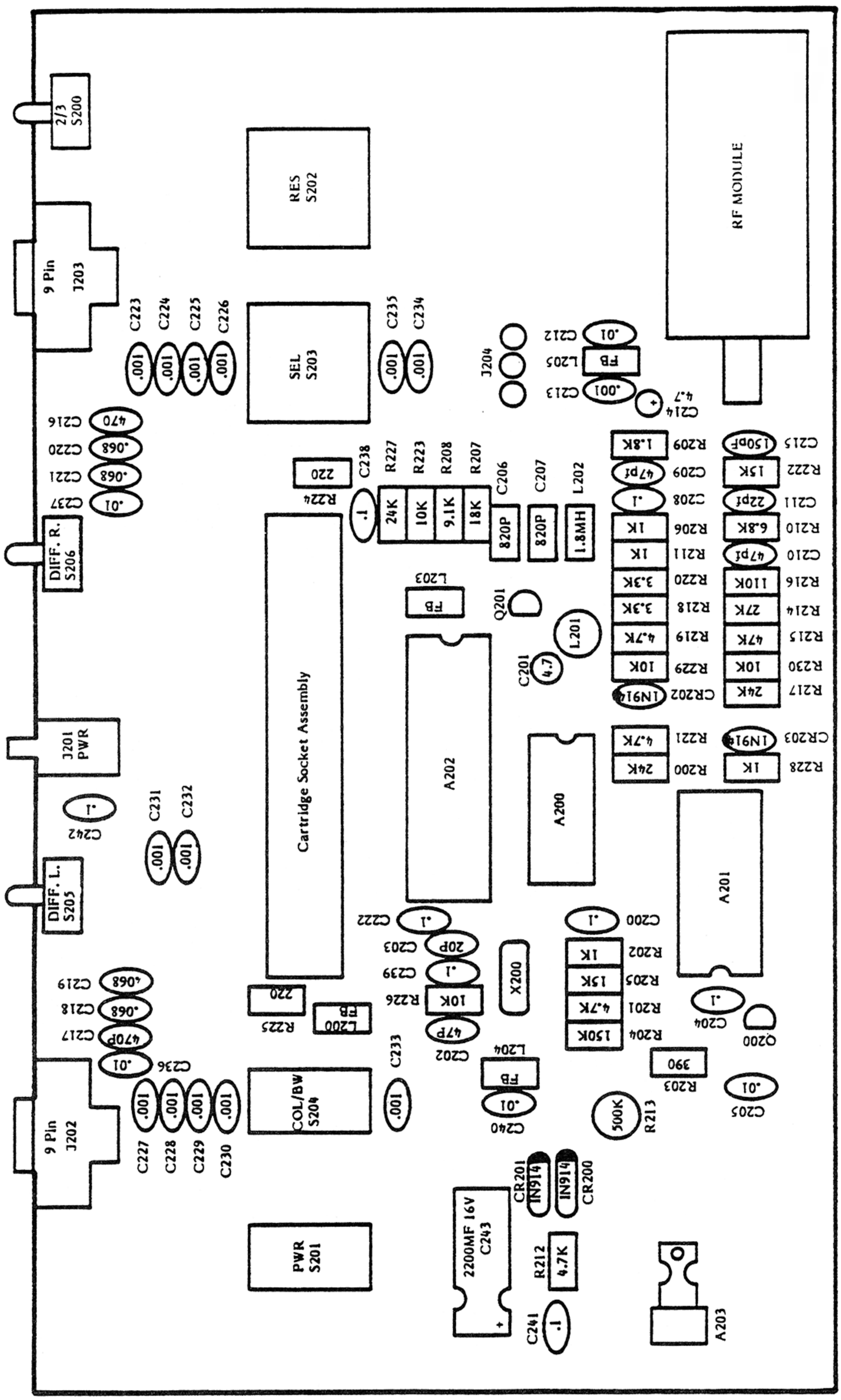


Figure 2-8. 2600A Motherboard Silkscreen (Revs. 14 and 15)

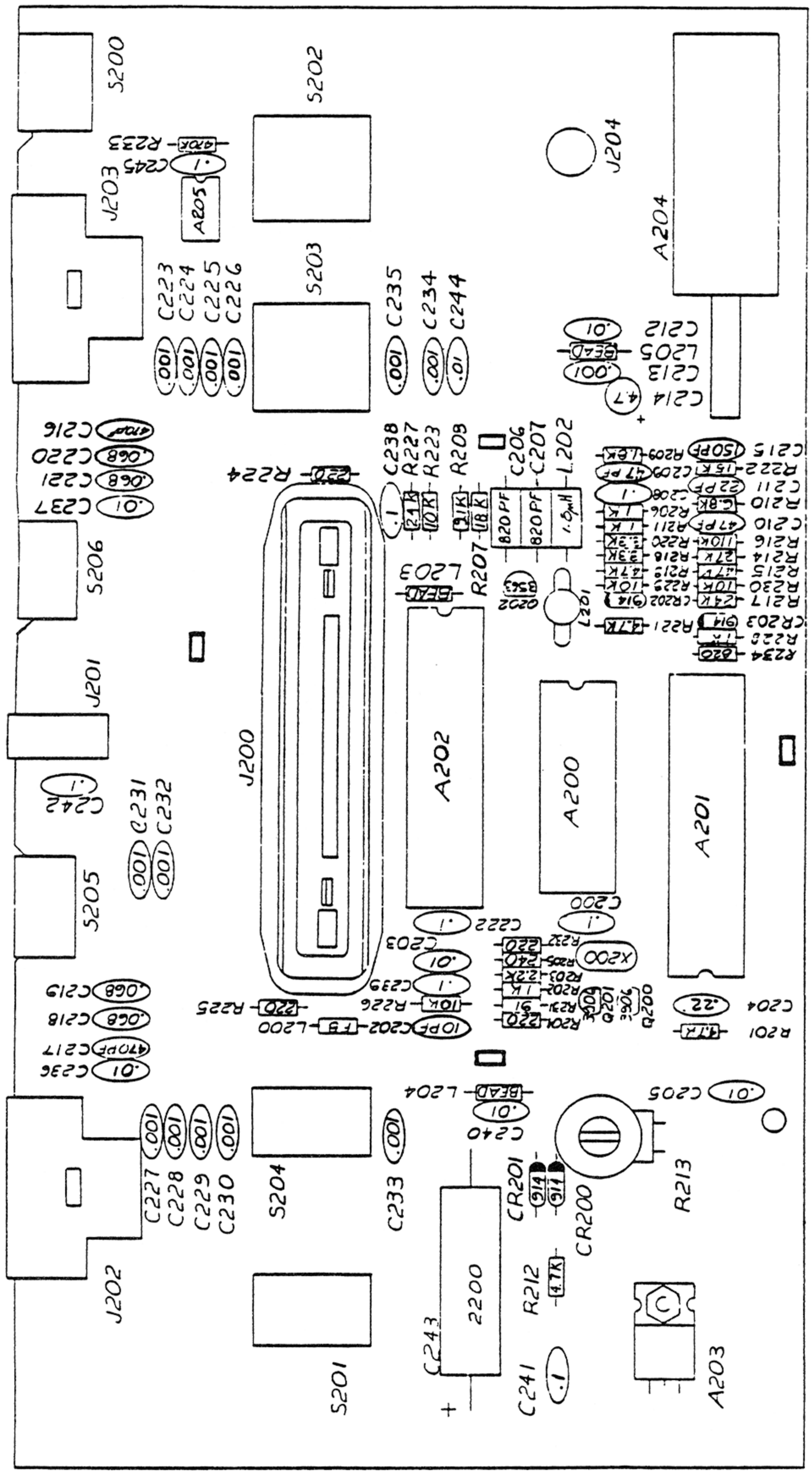
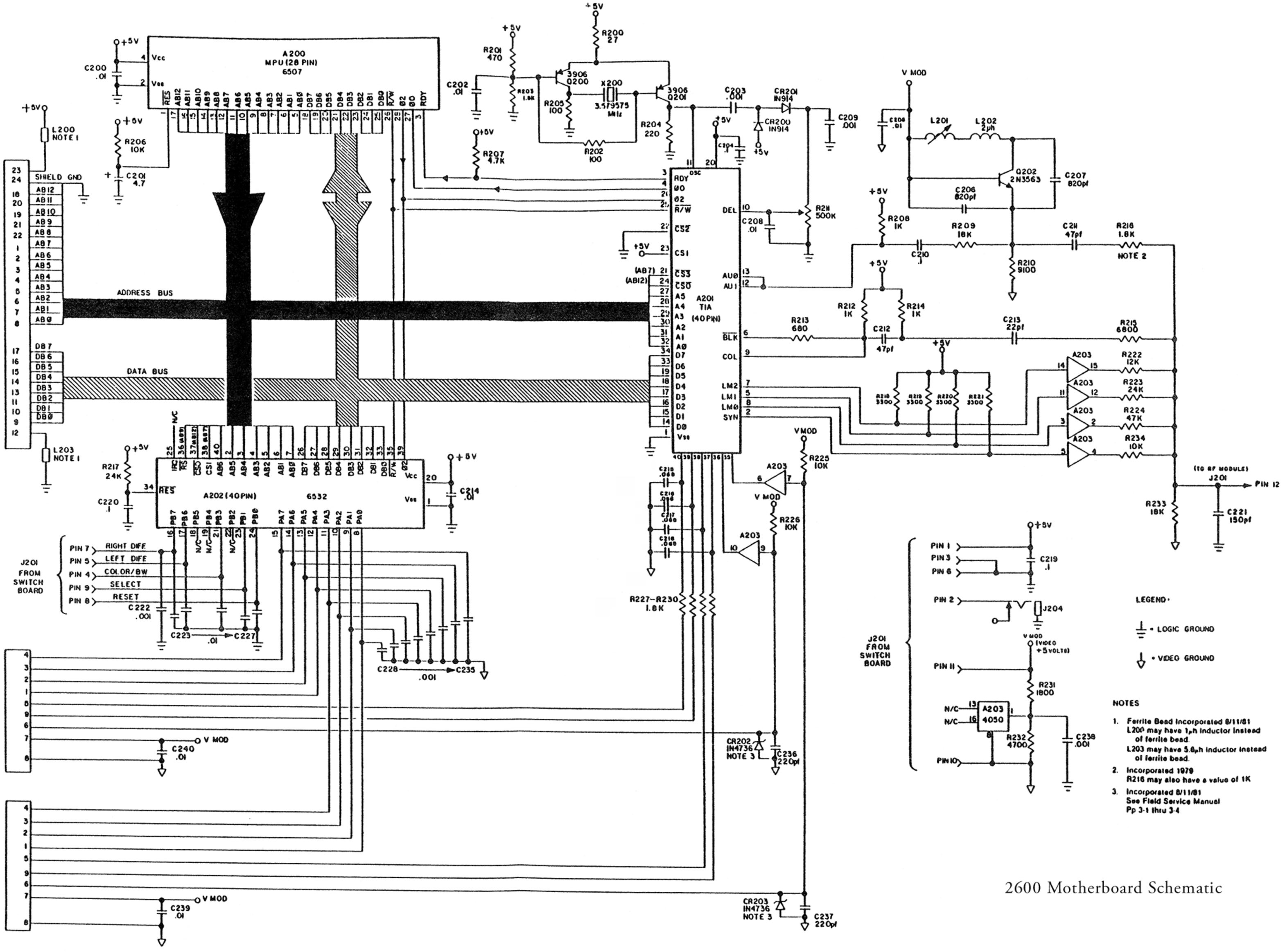
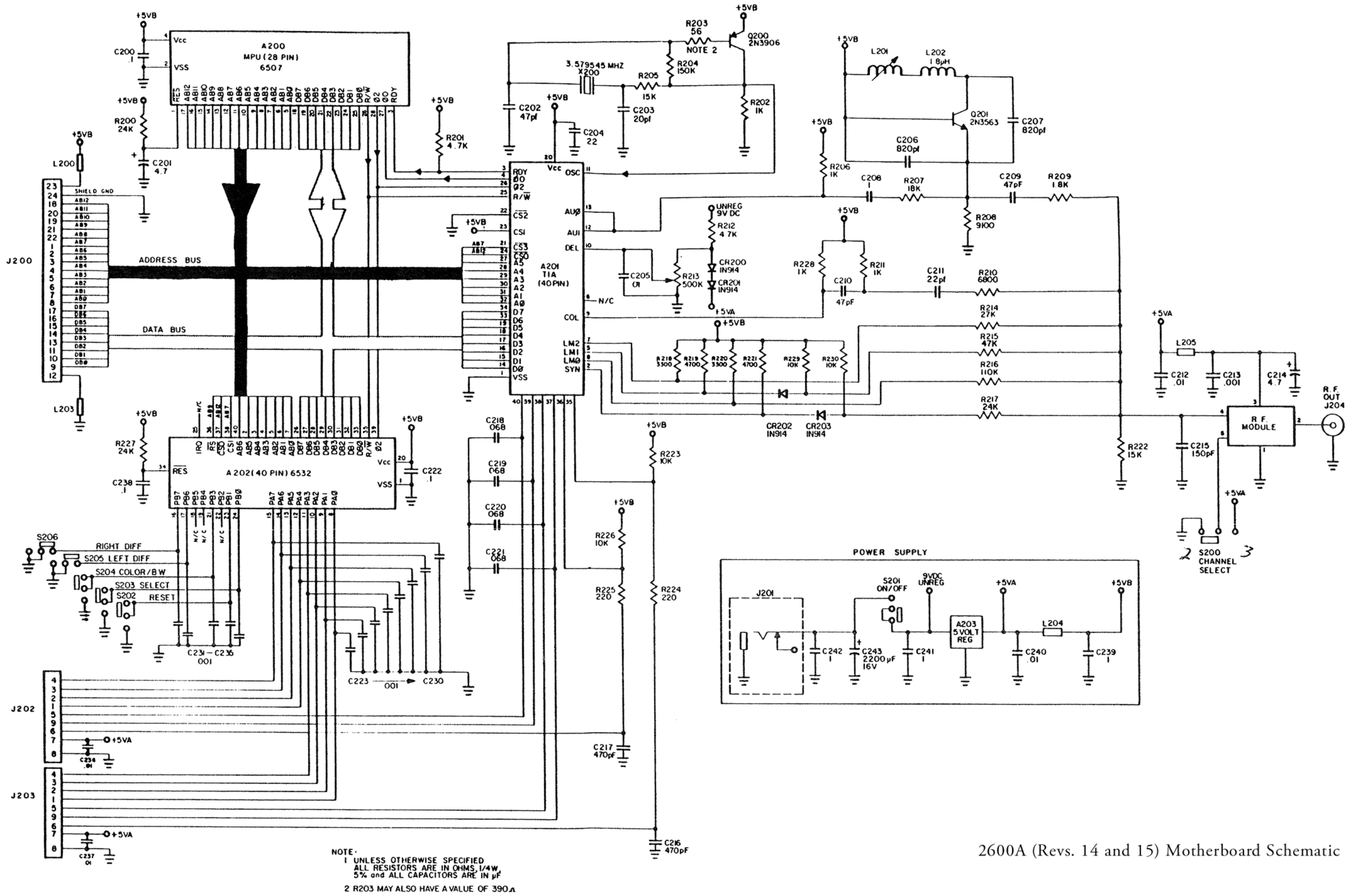


Figure 2-9. 2600A Motherboard Silkscreen (Revs. 16 and up)

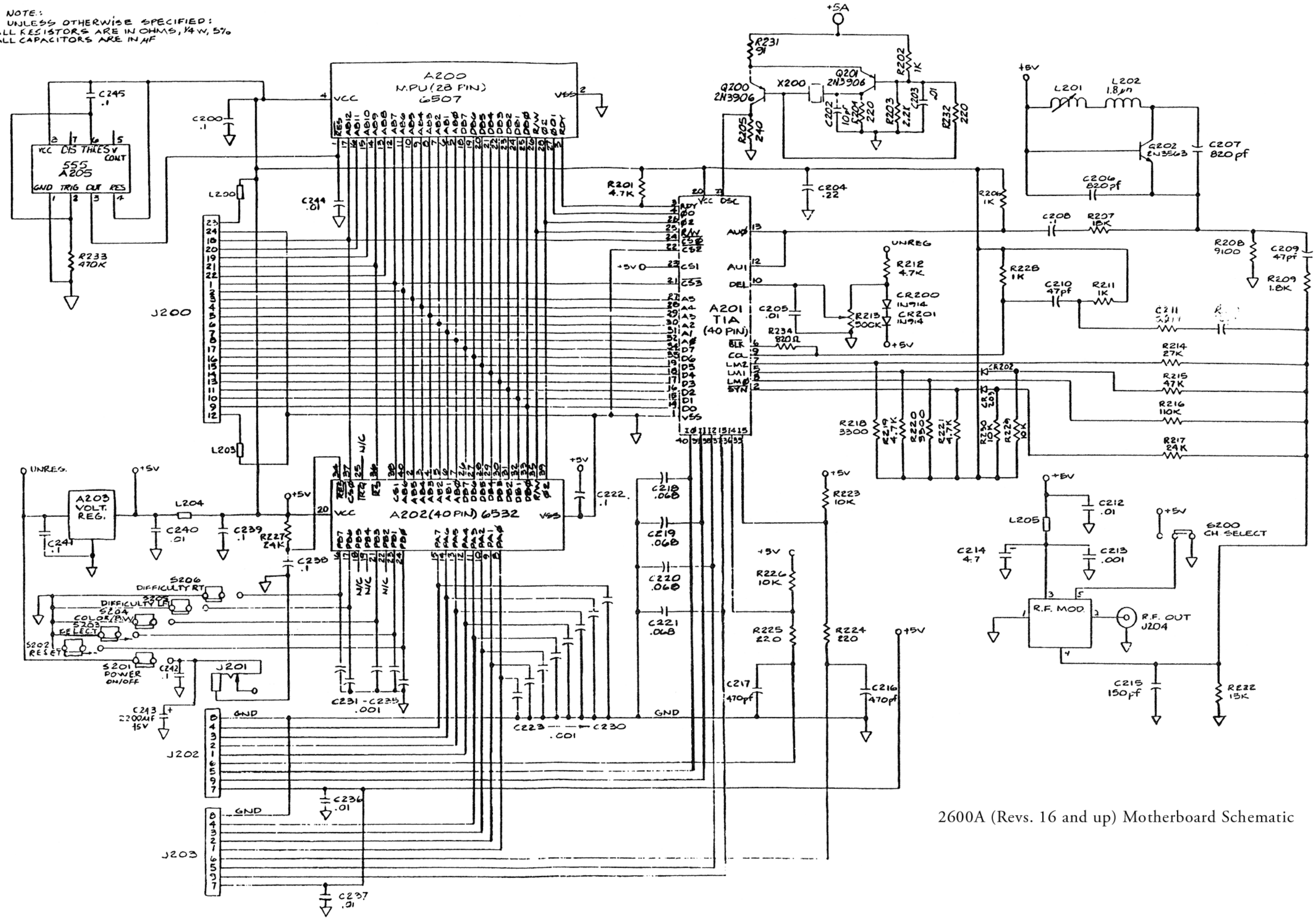


2600 Motherboard Schematic



2600A (Revs. 14 and 15) Motherboard Schematic

NOTE:
UNLESS OTHERWISE SPECIFIED:
ALL RESISTORS ARE IN OHMS, 1/4 W, 5%
ALL CAPACITORS ARE IN µF



2600A (Revs. 16 and up) Motherboard Schematic

SECTION 3

TESTING AND TROUBLESHOOTING

EQUIPMENT REQUIREMENTS

You require eight basic pieces of equipment in order to analyze failures in the 2600/2600A Video Computer Systems (VCS). These items include:

- A 15 MHz oscilloscope
- A Video Computer System switchboard assembly that is known to be operating properly (not required for repairing 2600A units)
- A Video Computer System diagnostic test cartridge, version 2.6 (DTC)
- Two blue controller port shorting plugs for use with the 2.6 (DTC) diagnostic cartridge
- Signal Tracing Cartridge (STC or KLUGE)
- VCS Field Service Manual for Domestic Model 2600/2600A
- Color television set (properly adjusted)
- Frequency Counter

TEST PROCEDURES AND METHODS

Atari requires each 2600/2600A model returned for service to be checked for certain conditions. In some instances, a unit must be modified to conform to Atari standards. These changes are summarized below.

2600 MODEL MODIFICATIONS

- Each 2600 model opened must be modified as shown in Figure 3-1 to provide additional protection from static discharge. A Zener diode is connected between the trigger lines and ground, and static strips are placed on the switches on the switchboard (See Figures 3-1, 3-2 and 3-4). These modifications are crucial to prevent component damage due to static discharge.

- Each connector and plug should be checked for a tight, secure fit. Intermittent failures frequently result from a loose connector or plug.

- Connectors J202 and J203 should be checked for pushed or broken pins.

- If the unit has a green J200 connector, insert cartridge and wiggle it. If the unit shows intermittent problems, replace J200.

- Each board with Molex chip sockets with insertion aids should have the insertion aids removed and the chip reinserted.

- Check that all components (especially those on the perimeter of the motherboard) are properly soldered. Check for broken or shorted trace lines.

- Check for an inductor and capacitor over C201 and R206. Cut the inductor and cap out, being careful not to cut the C201 or R206 leads.

- If unit has a standup regulator and heatsink, inspect for hairline fractures between the regulator and switchboard. Also ensure that the regulator is firmly secured to the heatsink by a Tinnerman clip or rivet.

- Ensure that motherboards (Rev. 8 or lower) have a colored dot over the trace on the upper-left corner of the board. This prevents shorting the board and the casting (See Figure 3-3).

- Two types of 12-conductor cable assemblies have been used on 2600 model units, the flat-wire type and the ribbon type. When a defect is found in the flat-wire type cable assembly or its male connector on the switchboard, the flat-wire cable assembly should be replaced with the ribbon cable assembly and the 12-pin male switchboard connector should be replaced with the 12-pin female switchboard socket.

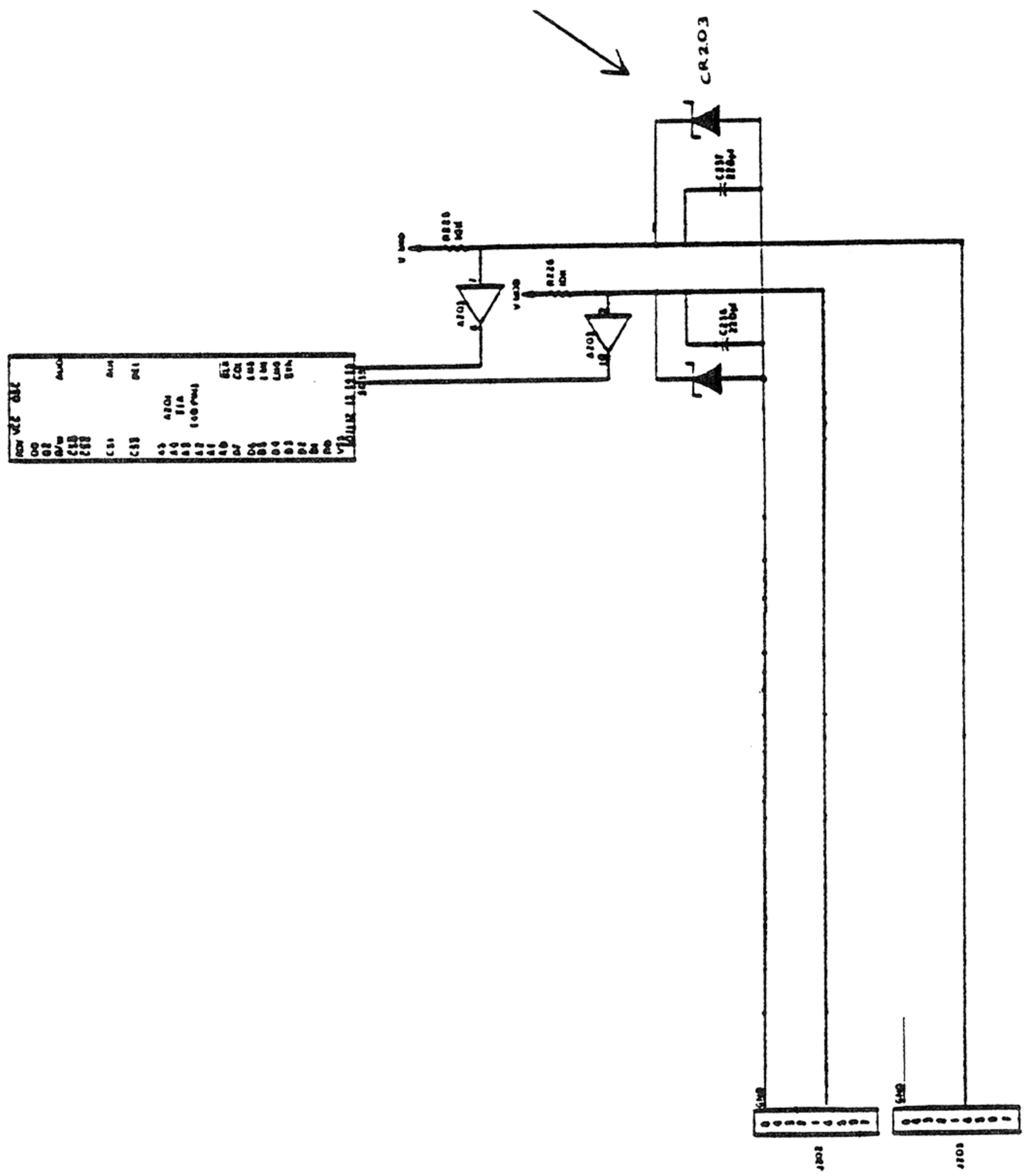


Figure 3-1. 2600 Trigger Circuitry with Static Modification

Install the static modification on all 2600 units. Install CR202 and CR203 by removing C236 and C237 and inserting the C236/CR202 and C237/CR203 assemblies in their place (See Figure 3-2). CAUTION: Observe the polarity on CR202 and CR203 (the dark band must be toward the J202/J203 connectors). On the switchboard, install the static strips as shown in Figure 3-4.

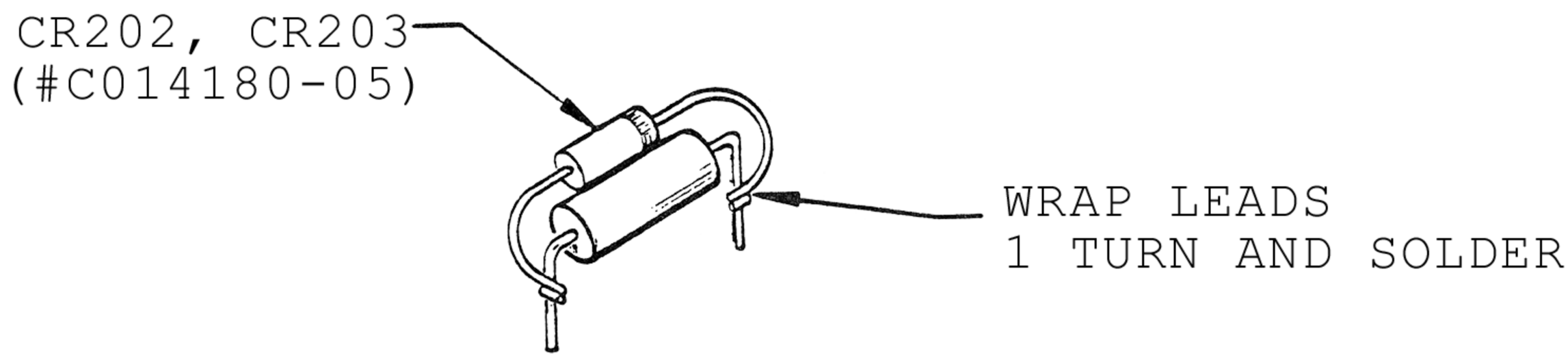


Figure 3-2. 2600 Static Modification Zener Diode

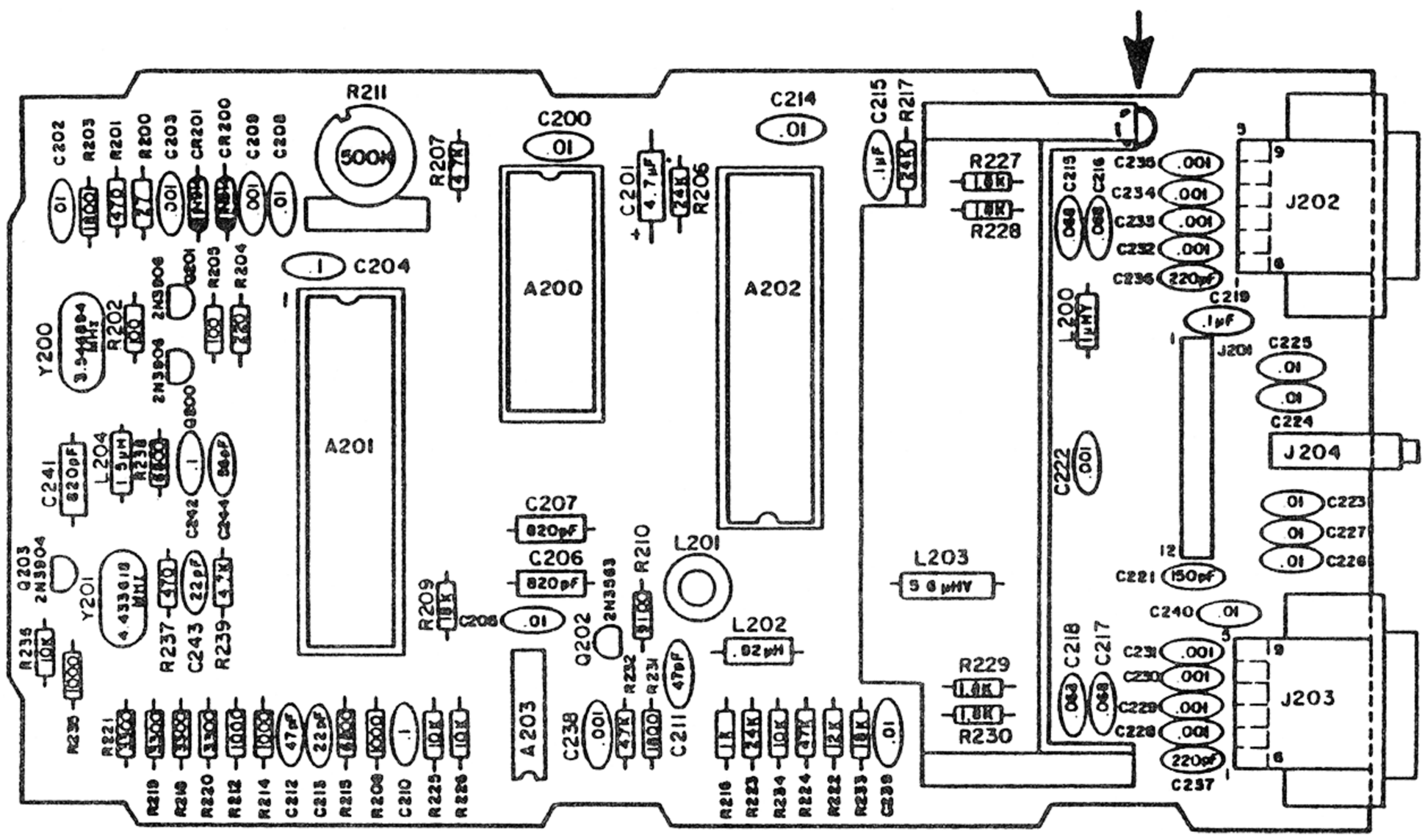


Figure 3-3. Location of Colored Dot Over Trace

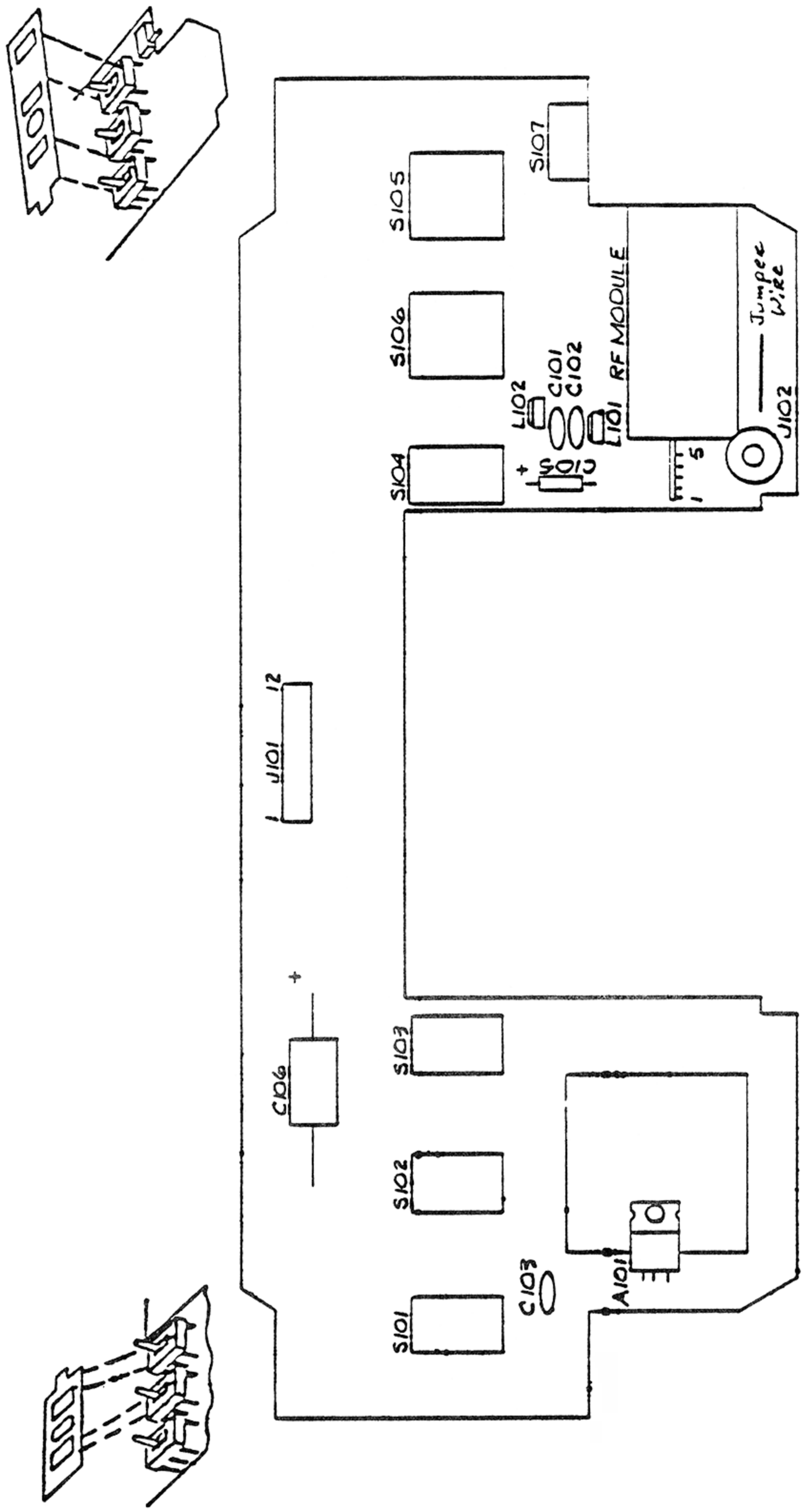


Figure 3-4. 2600 Switchboard Static Modification

2600A MODEL MODIFICATIONS

- Each 2600A (Revs 1-13) model must have static strips placed on the front panel switches (See Figure 3-5).
- Check each connector and plug for a tight, secure fit. Intermittent failures frequently result from a loose connector or plug.
- Check that all components are properly soldered, and check for broken or shorted trace lines.
- If a unit exhibits RF interference that does not clean up using normal adjustment methods, or if a series of lines and bright grid distortions on the screen are accompanied by a loud hum even when properly adjusted, a defective or leaking capacitor may be at fault. Replace C241 (.1 microfarad) and/or C242 (.1 microfarad) located respectively between the power jack and voltage regulator.

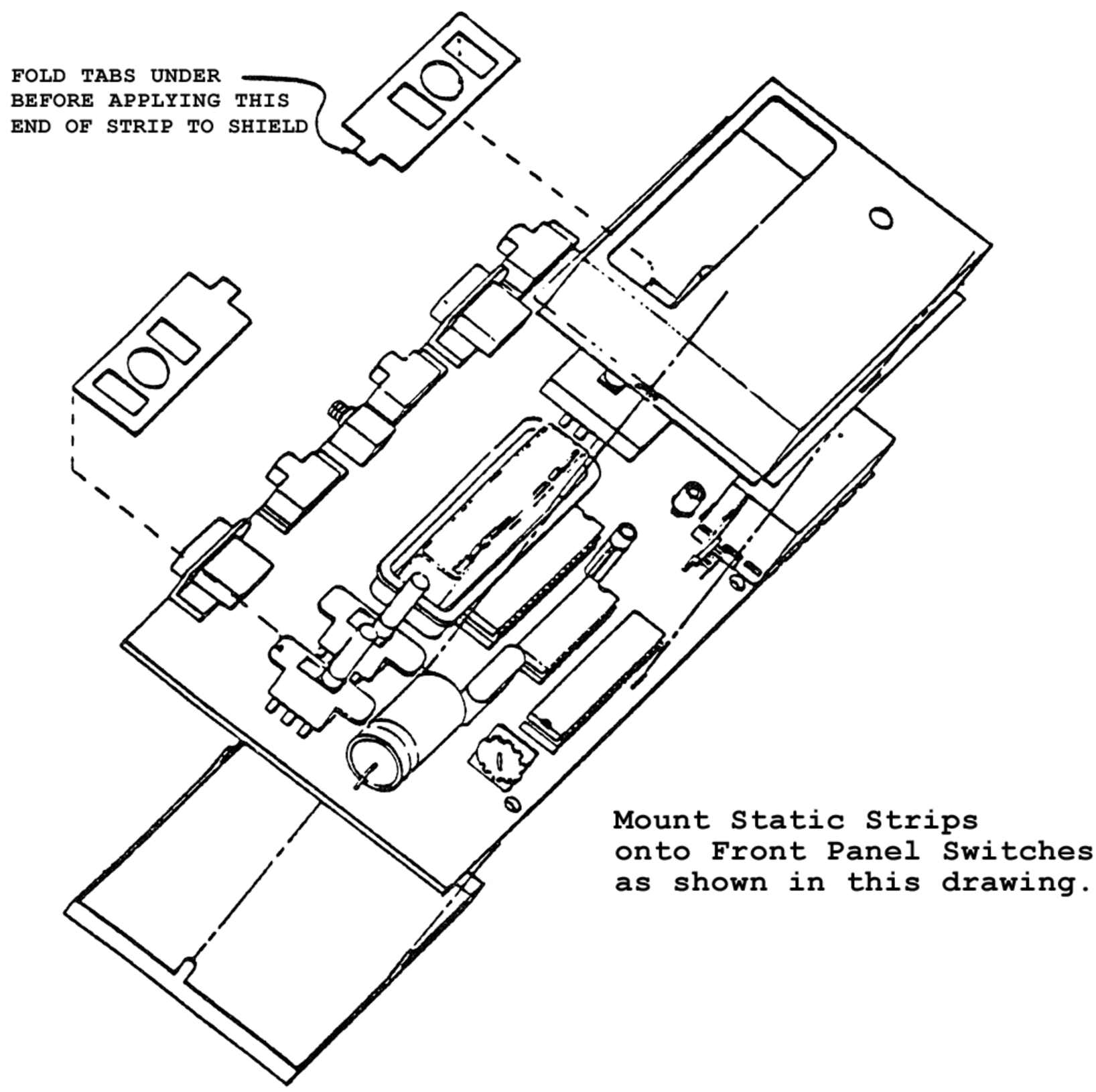


Figure 3-5. 2600A (Revs. 1-13) Static Modifications

TESTING WITH THE DIAGNOSTIC TEST CARTRIDGE (VERSION 2.6)

The 2600 Diagnostic Test Cartridge (version 2.6 DTC) contains a variety of tests to assist the service technician in identifying the source of problems within the VCS switchboard and motherboard hardware. The test cartridge is used in conjunction with the equipment listed at the beginning of this section. Each test is reviewed in the remainder of this section. Detailed procedures for use of the tests are described in Section 4, 2600 Diagnostic Flowchart, and Section 6, 2600A Diagnostic Flowchart. The tests available in the cartridge are:

- RAM Test
- Color Bar Test
- Gray Bar Test
- Diagnostic Matrix Test
- Audio Tones Test
- Paddle Control Lines Test

The technician also has a Signal Trace Cartridge (STC or KLUGE) available for tracking motherboard problems that are not repairable with the Diagnostic Test Cartridge.

INITIALIZATION

- Purpose: To prepare the VCS unit for testing by the diagnostic cartridge.

- Format: Connect VCS unit to television and battery eliminator. Set television to proper channel (channel 3). Plug in the 2.6 diagnostic cartridge. Set all 2600 switches to the up position. On the 2600A, set all front panel switches up and rear panel switches to the left (See Figure 3-6).

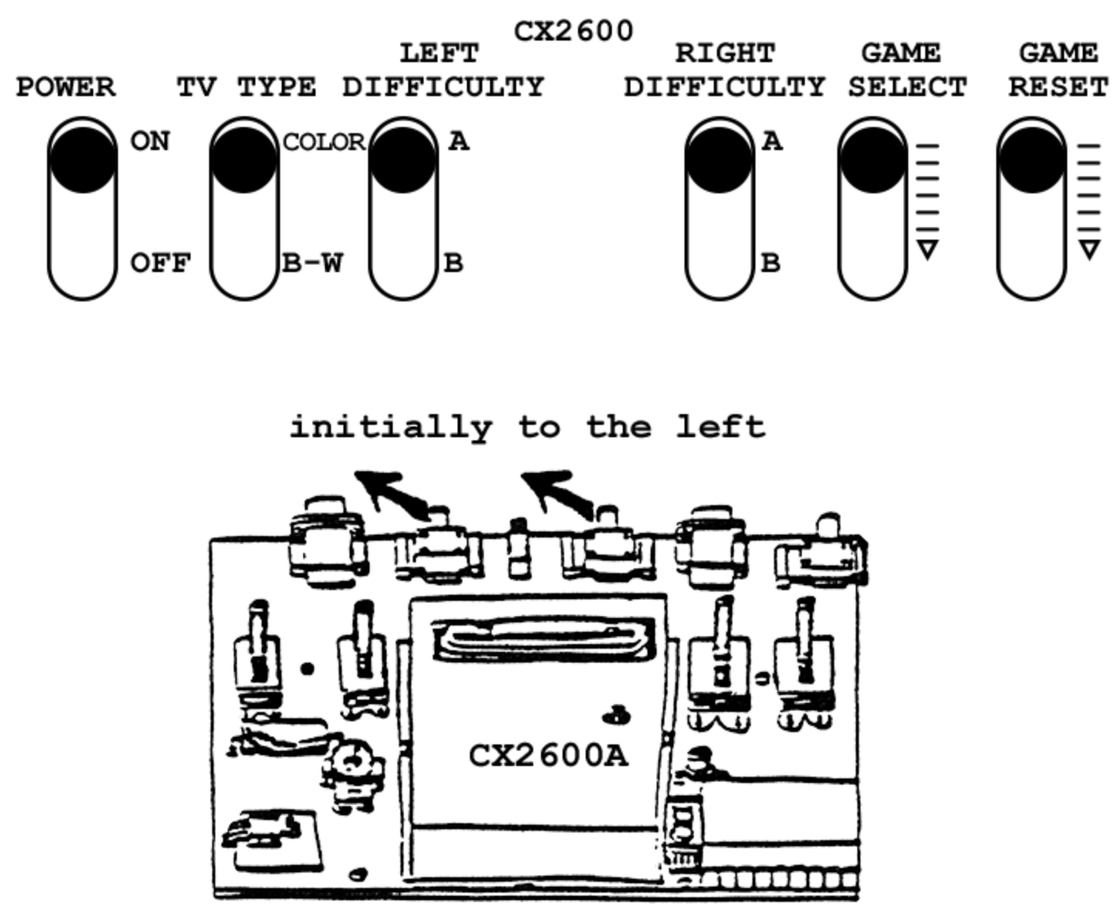


Figure 3-6. Switch Initialization Positions

RAM TEST

- Purpose: To test the 6532 RAM chip for proper operation.
- Format: On power-up the television displays diagonal lines of some type if the RAM is defective. See Figure 3-7 for examples of screens indicating a defective RAM.

  NOTE: The absence of defective patterns is no assurance that the entire chip is sound, only the RAM. The operation of the I/O and Timer functions is not verified by this test.

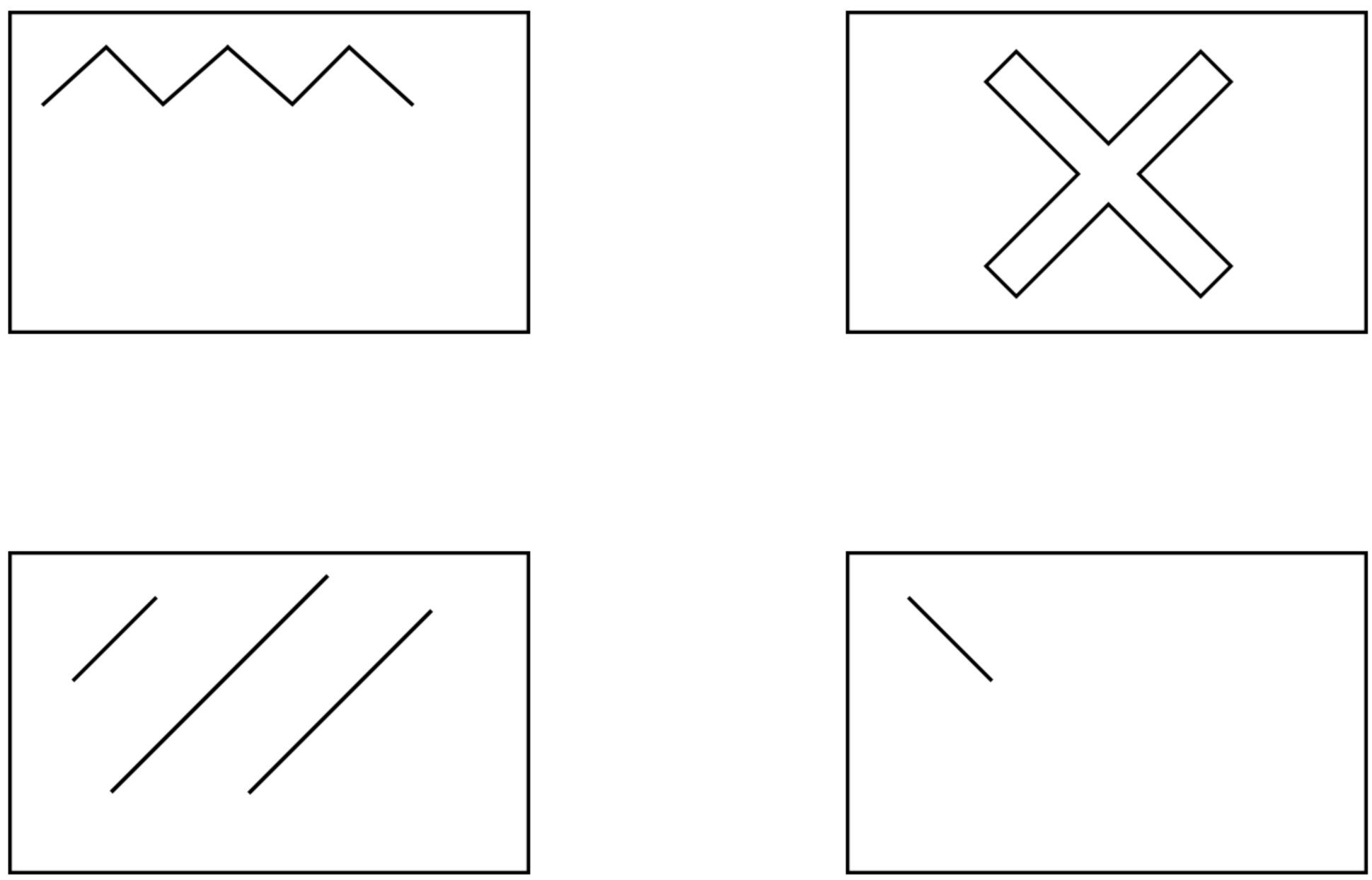


Figure 3-7. Defective RAM Patterns

COLOR BAR TEST

- Purpose: To test the 6507 microprocessor, 6532 RAM - I/O chip, and TIA chip for correct operation.

- Format: Set all switches to initialization position. A screen of horizontal color bars is displayed (See Figure 3-8). The screen should be steady and unchanging. A gray or blue horizontal reference line runs across the screen about three bars from its bottom. This reference line is thinner than the bars around it. R211 (R213 on the 2600A board) should be adjusted so the bars immediately above and below the reference line are within one shade of each other. Proper operation of the unit is indicated by being able to make this adjustment and by consistent color within the entire span of each bar on the screen. Minor glitches on the edges of the color bars are acceptable. Leave this test on for at least ten seconds in order to catch any intermittent problems, such as a bar momentarily changing colors or blanking out.

NOTE: This figure is a black and white representation of a color television screen.

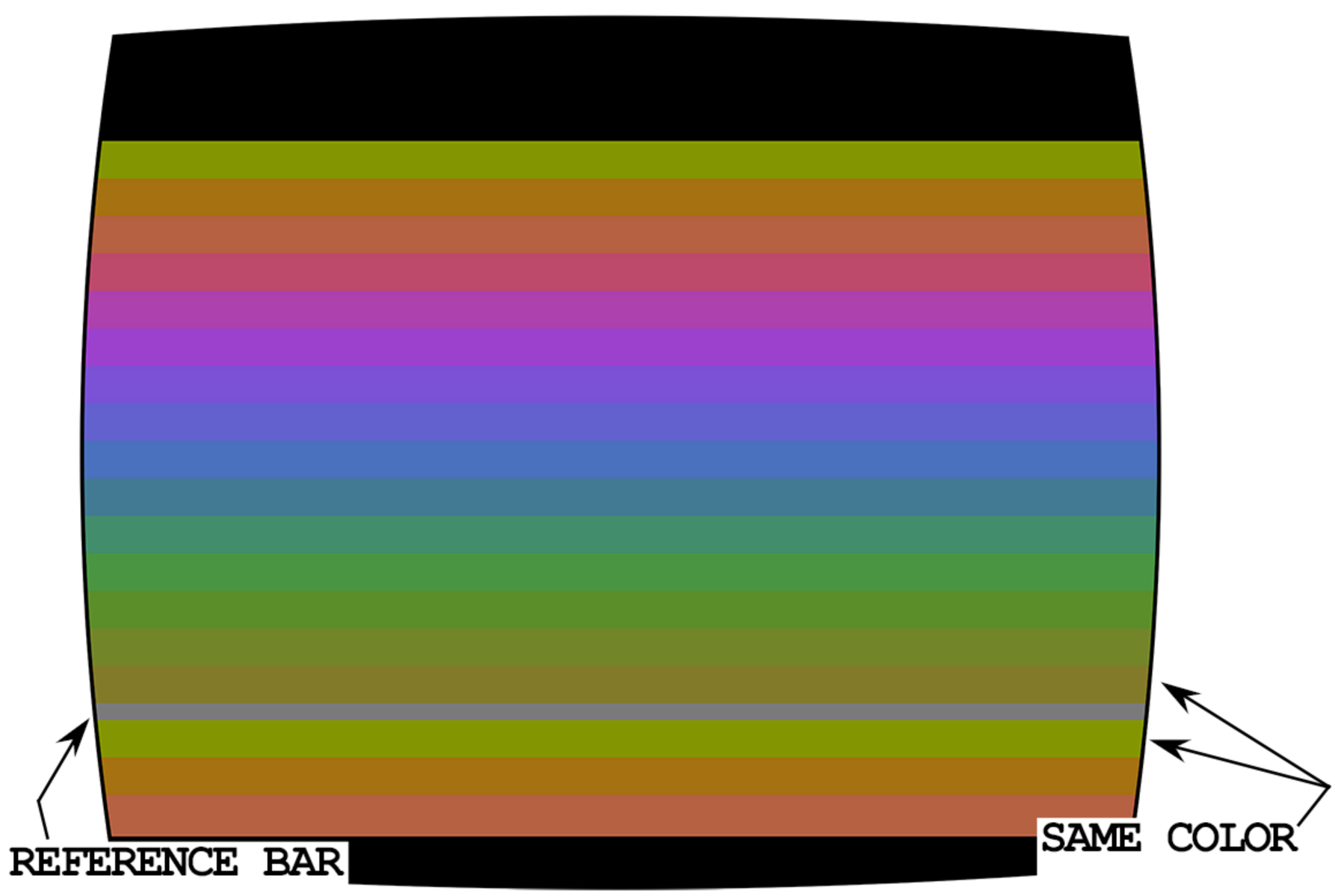


Figure 3-8. Color Bars Screen

GRAY BAR TEST

- Purpose: To test the function of the luminescence lines (LM0, LM1, LM2) from the TIA chip to the RF Module.

- Format: Move the Color/Black & White switch to the Black and White position. There should be eight horizontal gray bars displayed, going from black at the top to white at the bottom in even gradations (See Figure 3-9). The screen should be steady and unchanging. These lines may have minor glitches on their edges. A thin white line always appears just over the top (black) bar. No color should appear anywhere on the screen. The areas above the top (black) bar and below the bottom (white) bar are of no importance to the test. This test should be left on for at least ten seconds to ensure that there is no "flashing" of any color or shifting of the gray bars.

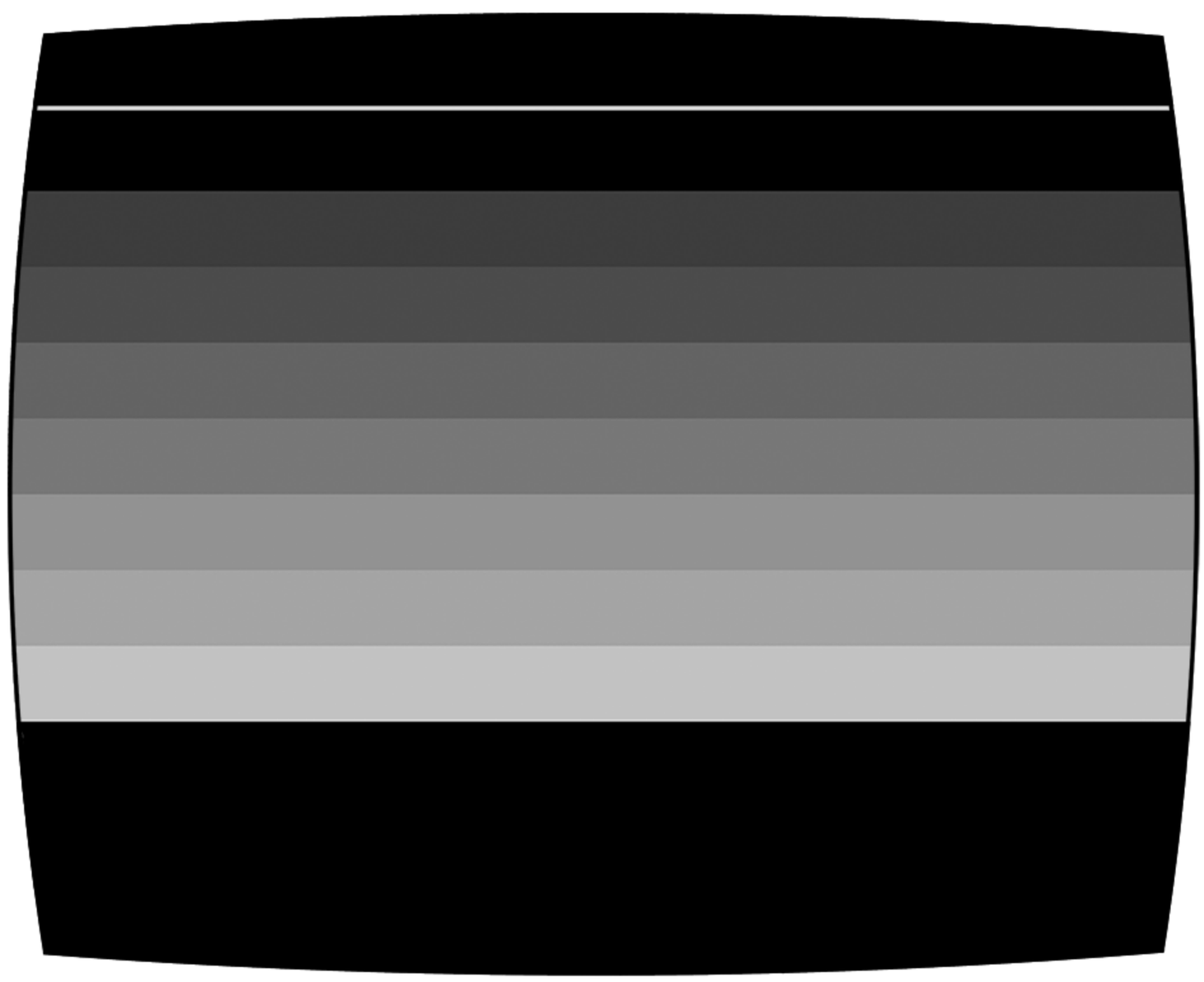


Figure 3-9. Gray Bars Screen

DIAGNOSTIC MATRIX TEST

- Purpose: To test the proper function of the Input-Output ports of the VCS unit.

- Format: Set all switches to the initialized position, then move the Left Difficulty switch to the "B" position. The test is performed in two parts:

  1. With the blue shorting plugs removed, the matrix of nine rectangles on the screen should look like Figure 3-10.

  2. The shorting plugs are then inserted and the pattern should look like Figure 3-11.

  3. Press the GAME SELECT switch. If the switch is properly functioning, that area of the matrix will black out. Release the GAME SELECT switch and repeat the procedure with the GAME RESET switch.

The Matrix jumps once every second.

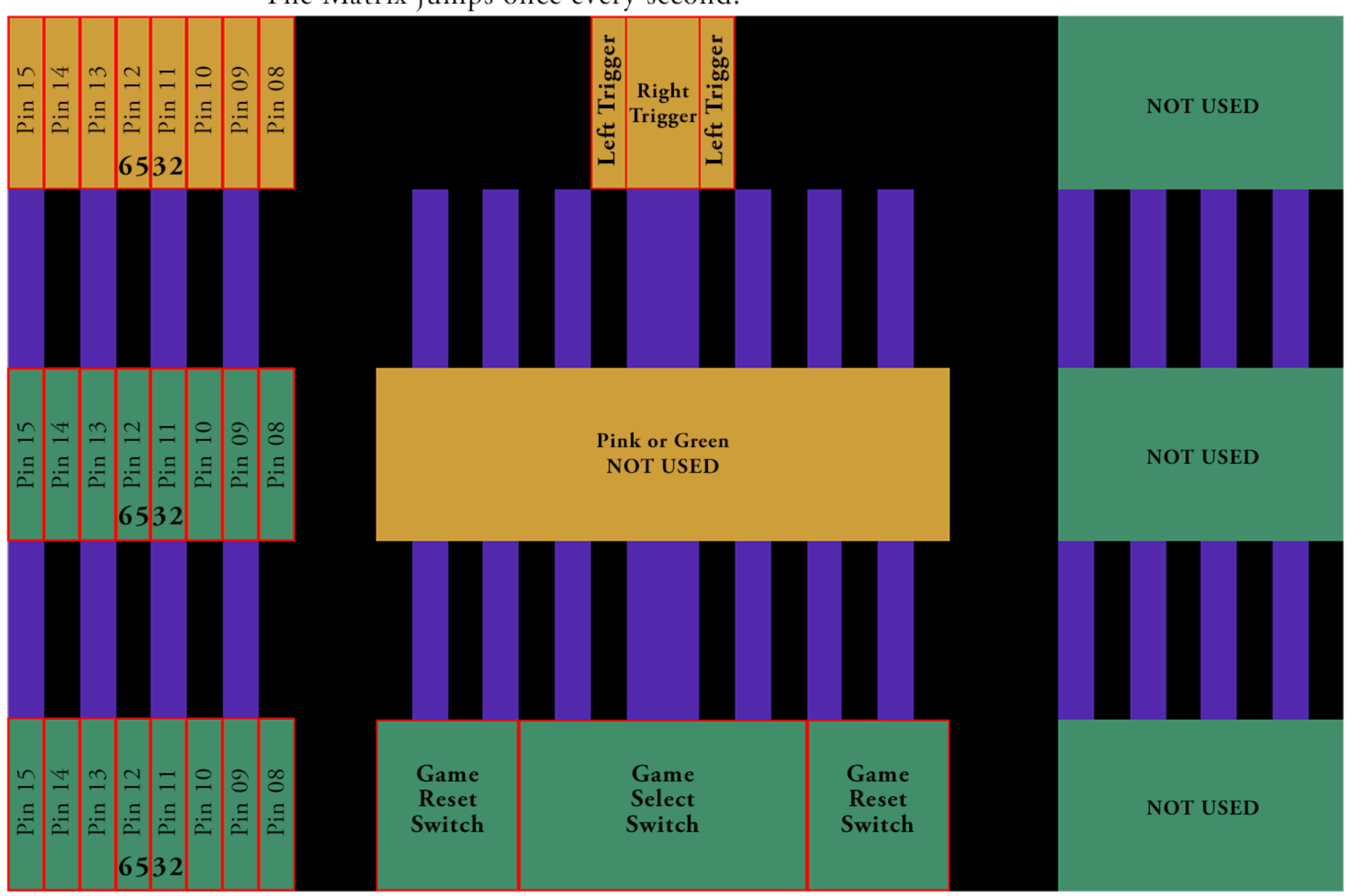


Figure 3-10. Diagnostic Matrix Screen
(Shorting Plugs OUT)

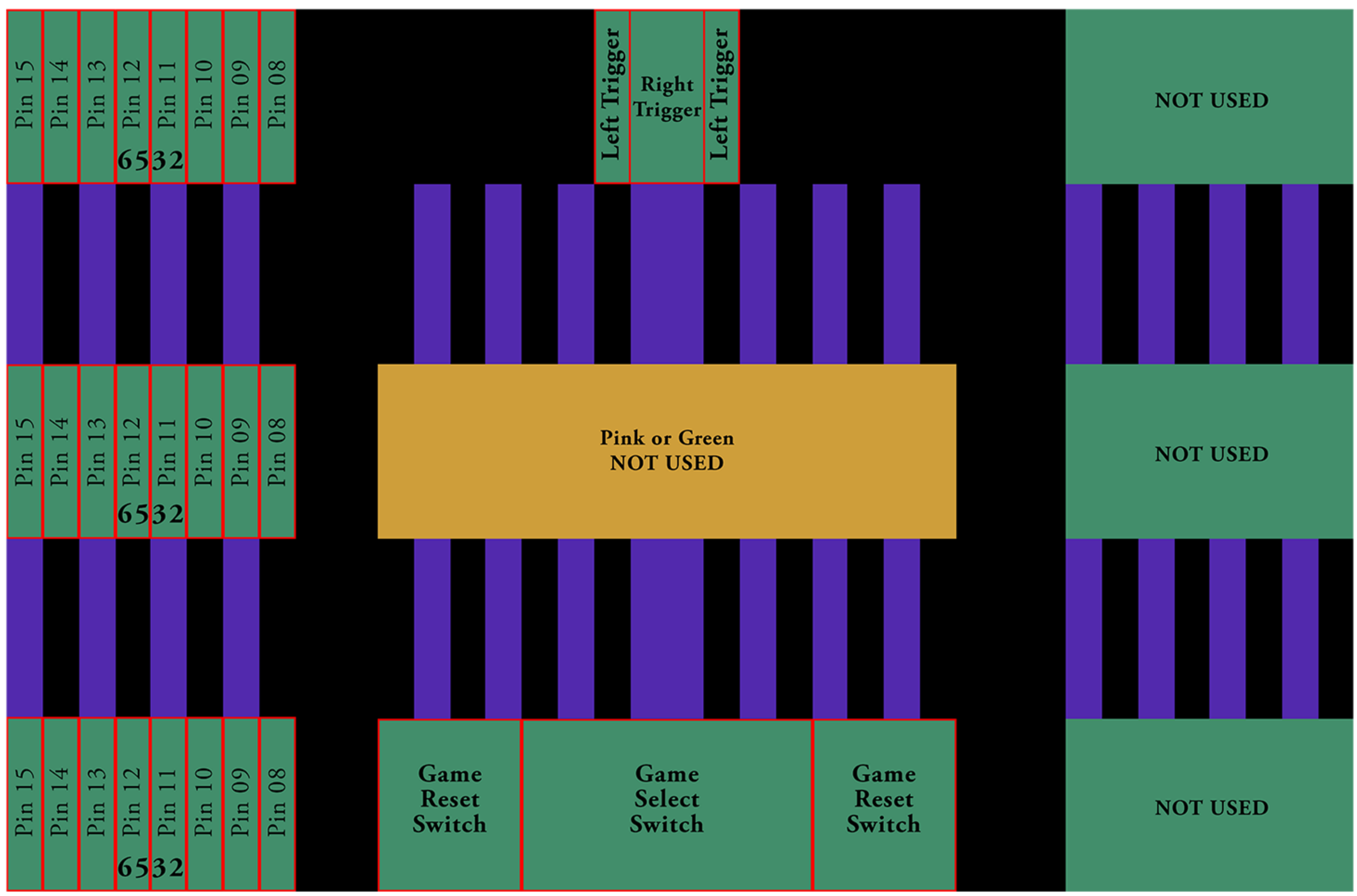


Figure 3-11. Diagnostic Matrix Screen (Shorting Plugs IN)

AUDIO TONE TEST

- Purpose: To test the function of the audio tone generation and modulation circuitry.

- Format: The VCS unit should be in the initialized mode. Move the Right Difficulty switch to the "B" position. The test displays two alternating patterns on the screen (as shown in Figure 3-12) while two alternating tones are heard. The tones change in sync with the screen. This test pattern continues for one full cycle after the Right Difficulty switch has been returned to the initialized position.

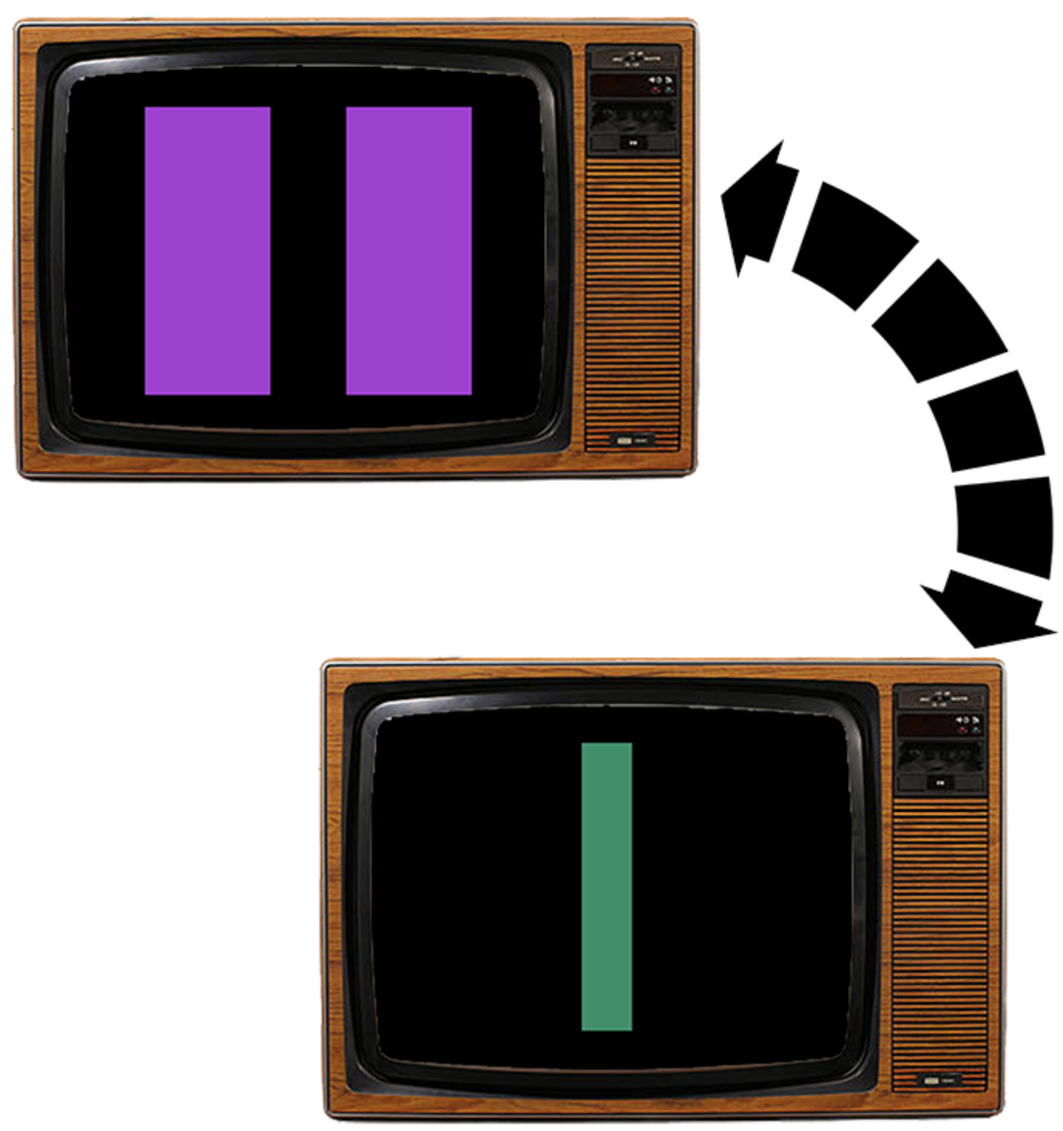


Figure 3-12. Audio Tone Test Screens

PADDLE CONTROL LINES TEST

- Purpose: To test the proper operation of the Paddle Control Lines by viewing the analog waveforms at the analog-to-digital conversion inputs of the TIA chip.

- Format: Pins 37, 38, 39, and 40 of the TIA chip are checked with the oscilloscope with the VCS unit in Diagnostic Matrix mode and with the shorting plugs in place. This test is required only if there is a problem with the hand controller lines. The procedure for this test is detailed in Section 4.

SECTION 4

2600 DIAGNOSTIC FLOWCHART

The Diagnostic Flowchart is intended to be easy to use and the primary aid when troubleshooting the 2600. Follow the prompts in the order presented. When a question is asked, follow the line from that box which best applies to the unit's condition. The figures referenced in the flowcharts are located at the end of this section. When a line terminates with a letter inside a circle, note that a page number (i.e., pg. 4-3) is near it. Turn to that page, locate the letter in another circle, and continue the diagnosis. The flowchart leaves nothing to chance, it tells you when to perform a specific test, and when to replace components, and even when and how long to "burn-in" the unit. "Burn-in" the unit for at least two hours after completing repairs.

When a problem is extremely difficult to diagnose, the flowchart sends you to the Signal Tracing Cartridge (STC) routine, "D" page 4-47. Due to the repetitive nature of the STC routine, no flowchart is used. Read and follow the instructions as directed. Should the STC procedure fail to isolate the problem, after carefully inspecting the switchboard and motherboard assemblies for shorted and/or open trace lines, and solder bridges swap all three chips (6507, 6532, and TIA). Should the problem still persist, call ATARI, Techline Specialist: Inside California at (800) 672-1466 and Outside California at (800) 538-1535. Be certain to always burn-in the unit for two houts after completing repairs. This helps to ensure that intermittent problems are found and also greatly increases your customer's satisfaction with your repair work.

SWAP OUT PROCEDURES

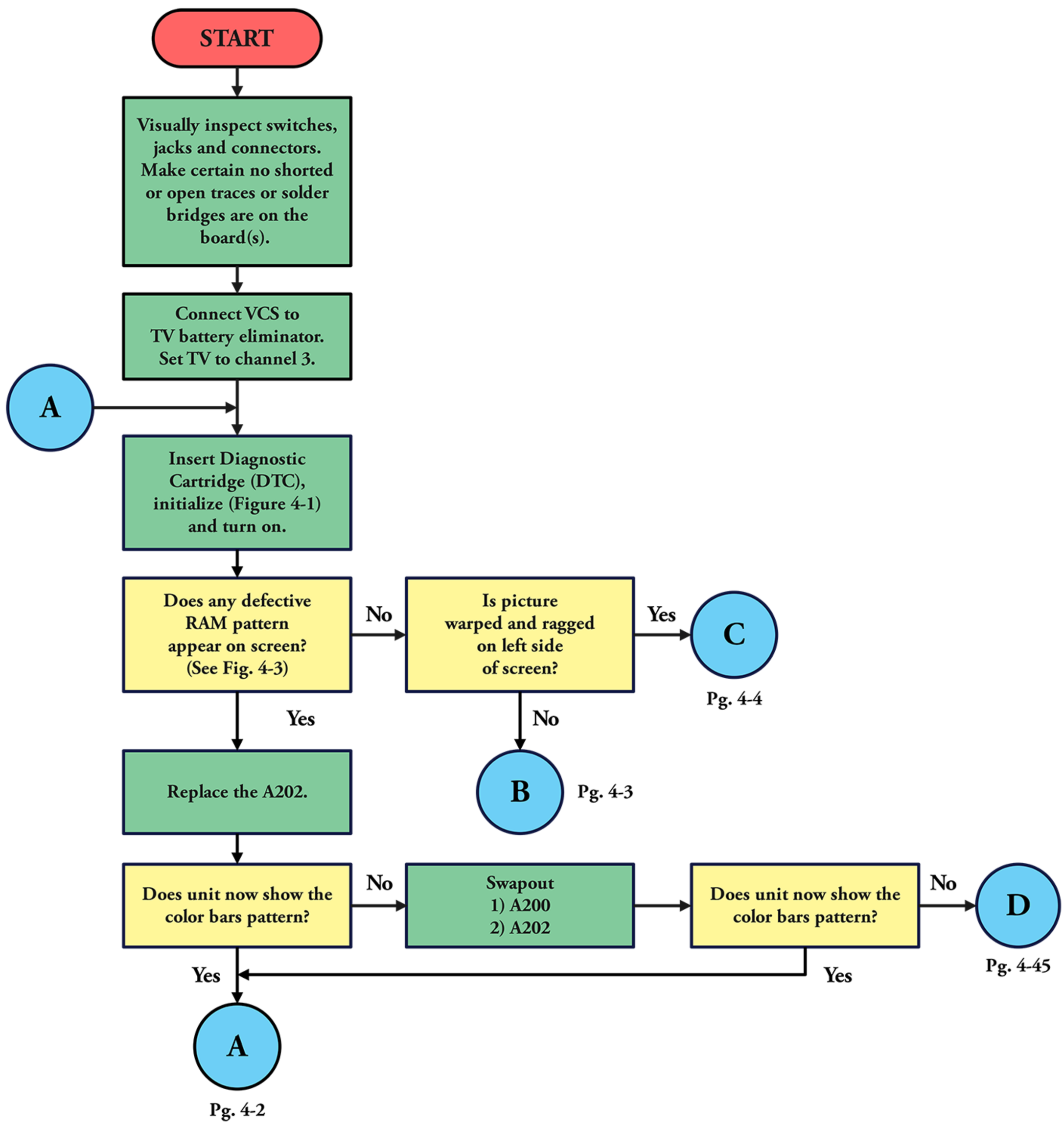
Many places in the diagnostic flowchart, a box tells you to "swapout" a chip or a number of chips in a particular order. The "swapout" instruction means that you should replace the indicated components one at a time with a known good component of the same type. The VCS should then be tested with the new, known-good component in place to see whether the "swapout" solved the problem being checked. If the swapout did not fix the problem, the known-good component should be left in, and the next component inserted. Once the problem is solved, you then place the suspected bad chips one by one into the system to determine whether or not those you pulled out are truly defective. In this way, you avoid needlessly replacing good components.

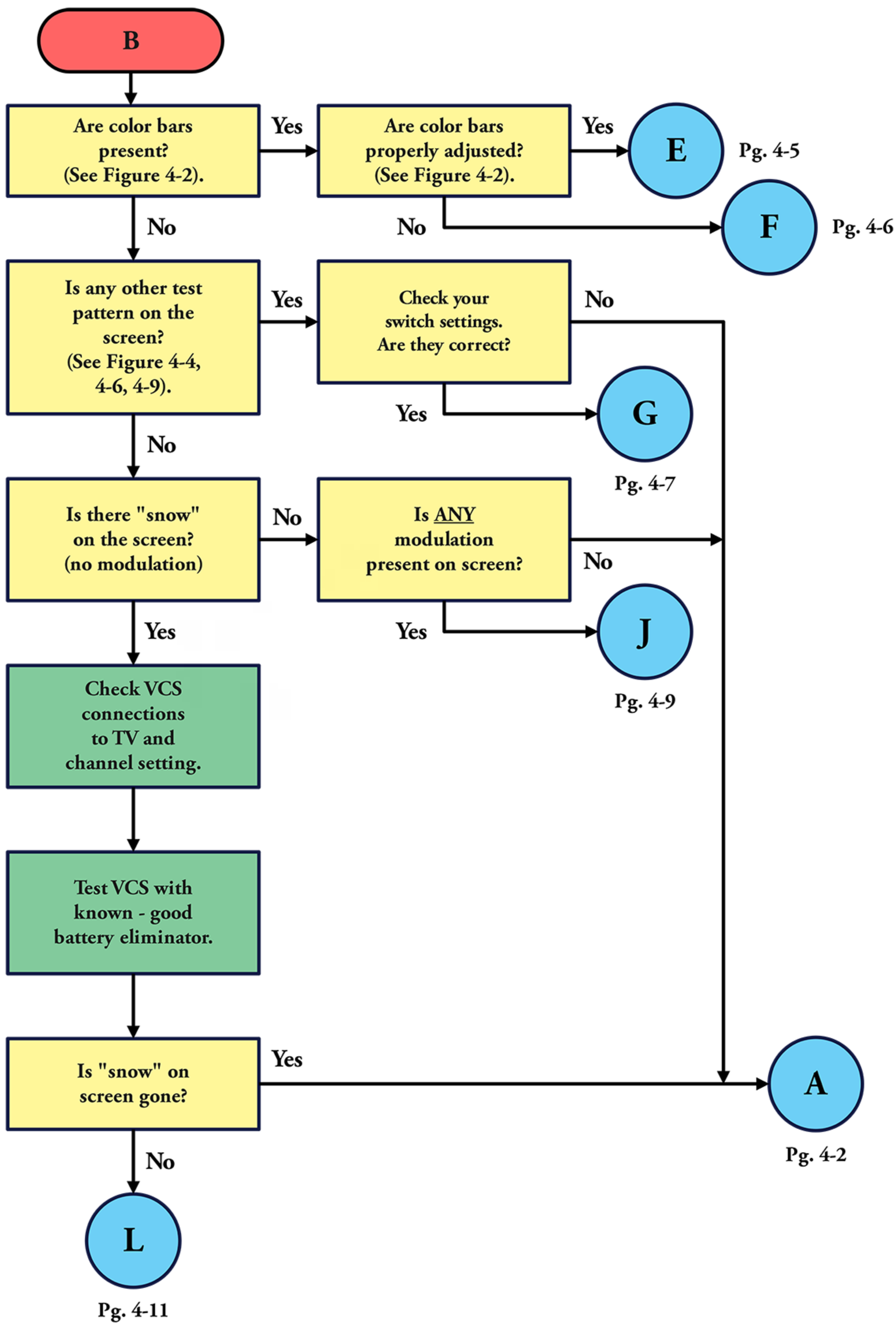
CAUTION

Extreme care should be taken when handling the integrated circuit chips (A200, A201, A202, A203). They are all very sensitive to static electricity and can easily be damaged by careless handling. Always keep the chips in their plastic carrier tubes or on conductive foam when not handling them. Make certain you are well grounded when handling the chips. Atari strongly recommends that you wear a conductive grounding band (which ties from your arm to ground) when handling the chips.

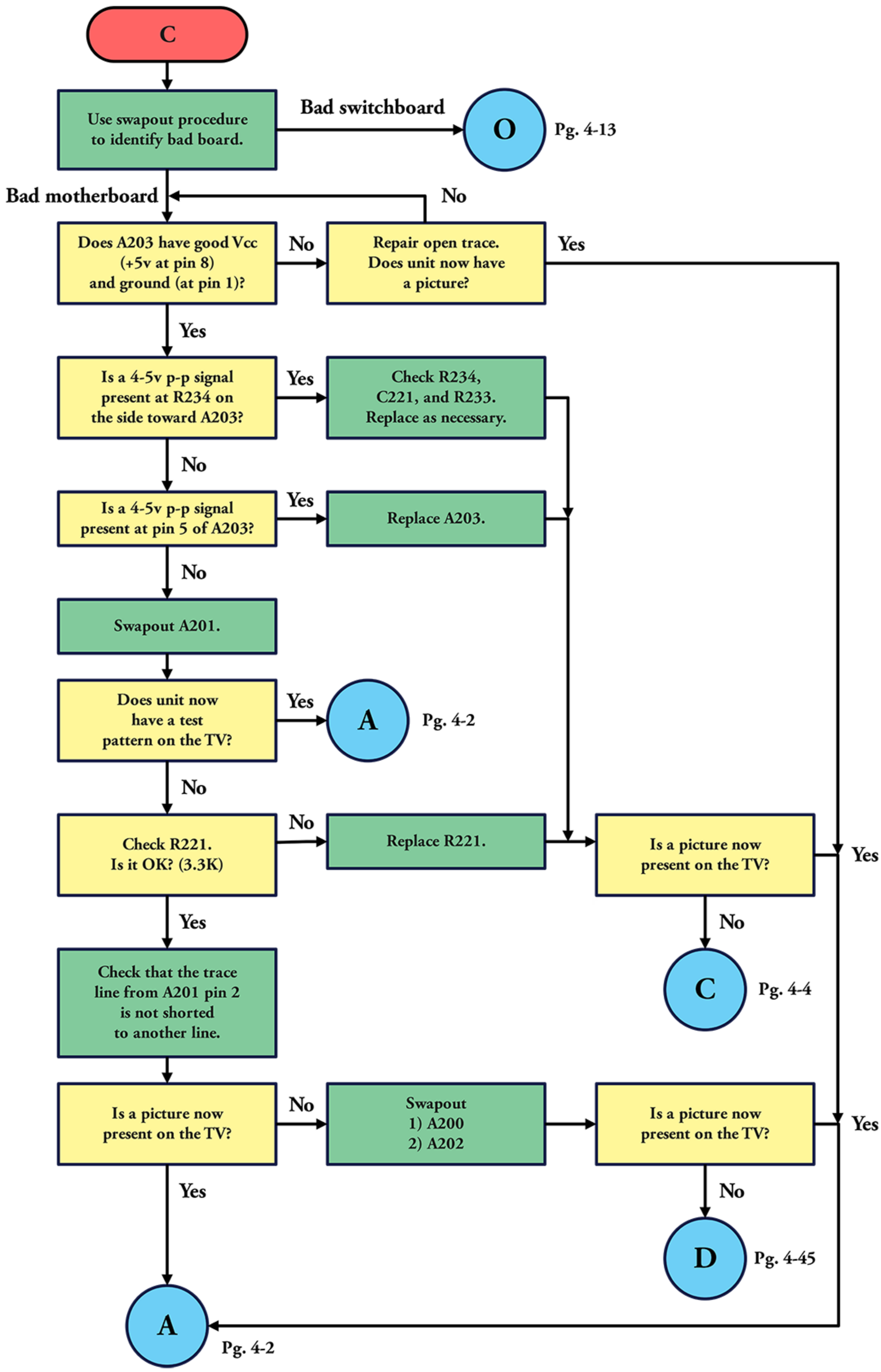
The chips are also susceptible to damage from stress when being removed from or inserted into the sockets. Always use a chip-puller when removing the chips. Do not pry chips out with a screwdriver or any other tool.

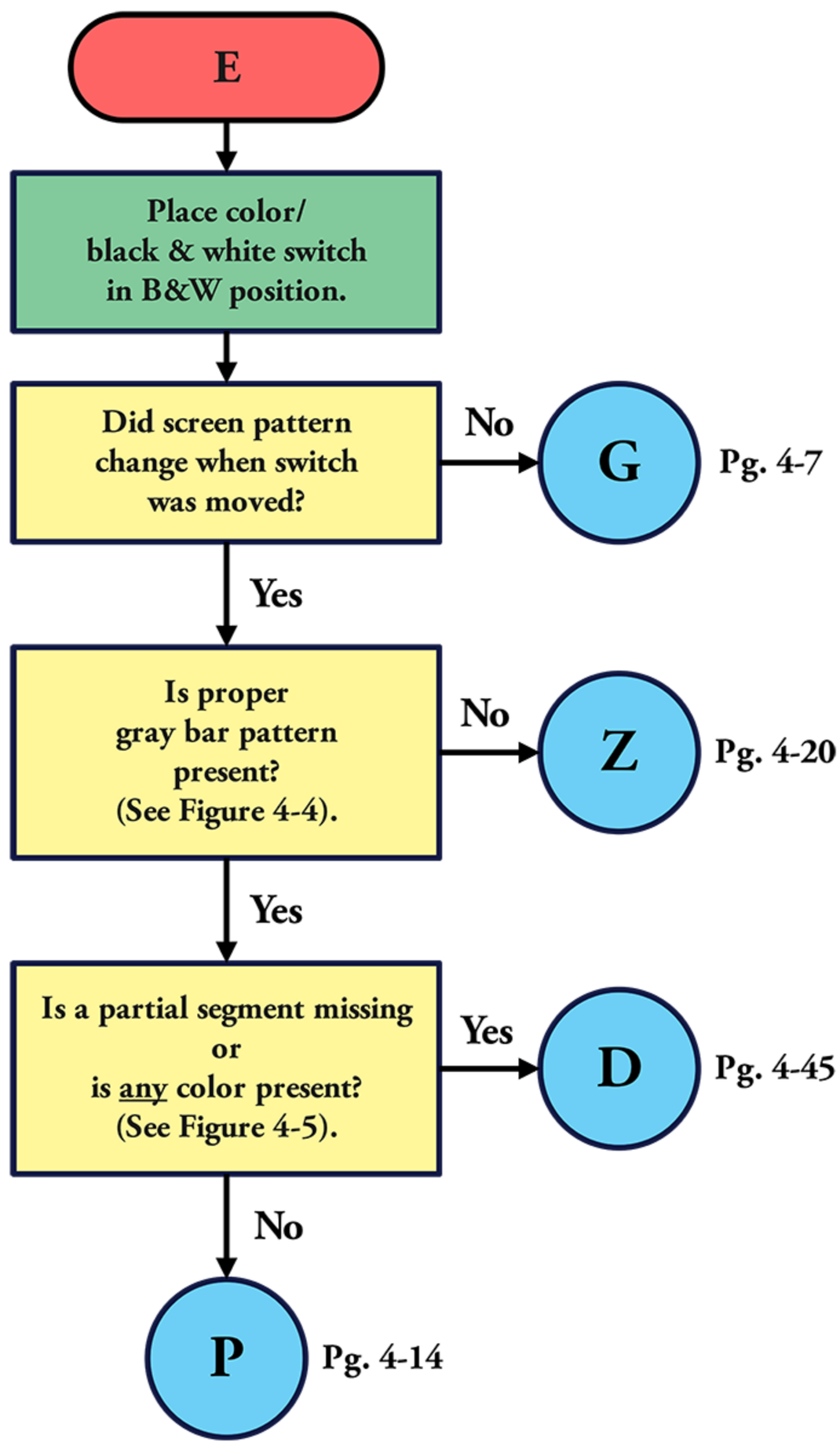
Failure to follow the above guidelines results in unusually high chip failure rates and extra expense.

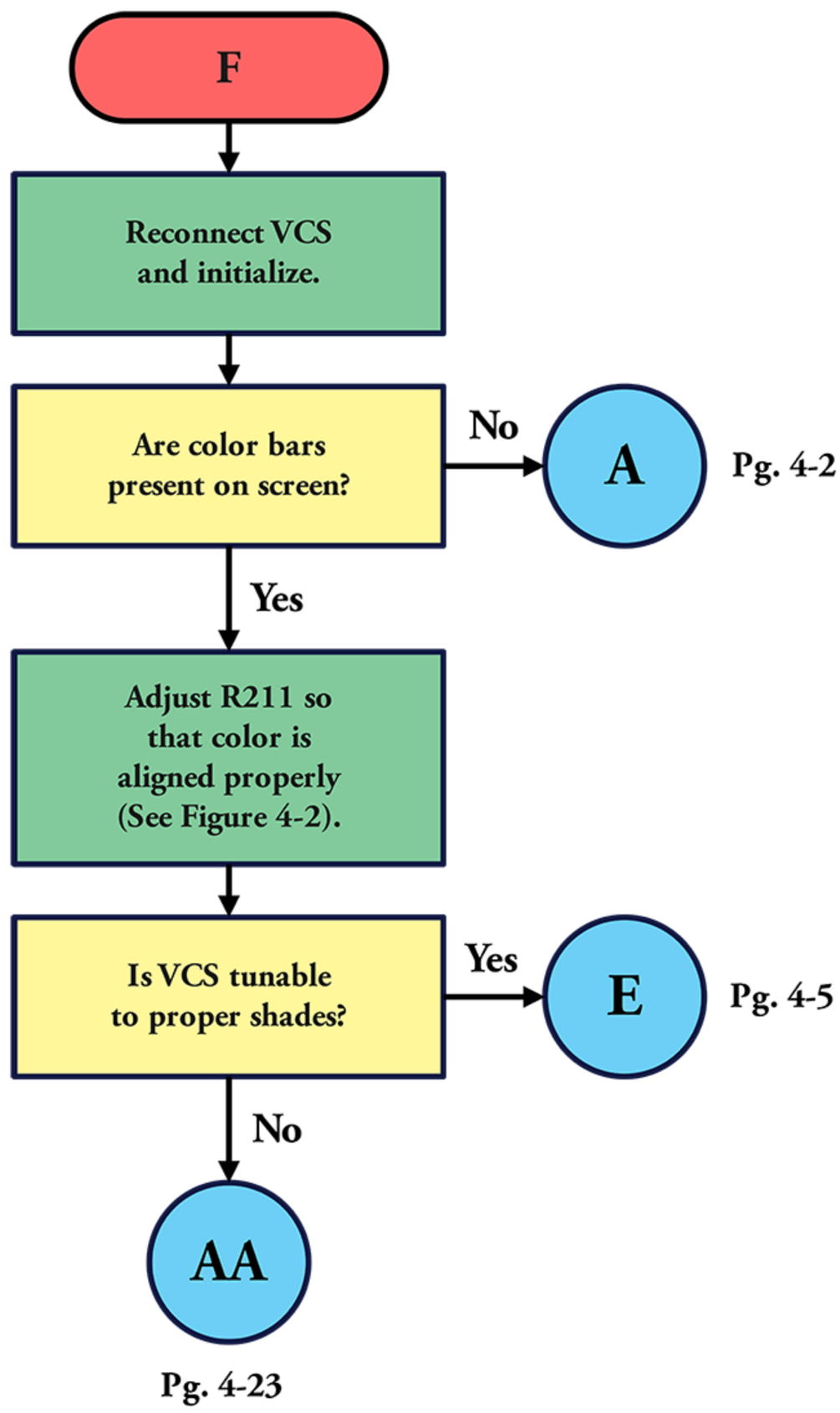

START
Visually inspect switches, jacks and connectors. Make certain no shorted or open traces or solder bridges are on the board(s).
Connect VCS to TV battery eliminator. Set TV to channel 3.
A
Insert Diagnostic Cartridge (DTC), initialize (Figure 4-1) and turn on.
Does any defective RAM pattern appear on screen? (See Fig. 4-3)
No
Is picture warped and ragged on left side of screen?
Yes
C
Pg. 4-4
Yes
No
Replace the A202.
B
Pg. 4-3
Does unit now show the color bars pattern?
No
Swapout
1) A200
2) A202
Does unit now show the color bars pattern?
No
D
Pg. 4-45
Yes
Yes
A
Pg. 4-2


B
Are color bars present? (See Figure 4-2).
Yes
Are color bars properly adjusted? (See Figure 4-2).
Yes
E
Pg. 4-5
No
No
F
Pg. 4-6
Is any other test pattern on the screen? (See Figure 4-4, 4-6, 4-9).
Yes
Check your switch settings. Are they correct?
No
Yes
G
Pg. 4-7
No
Is there "snow" on the screen? (no modulation)
No
Is ANY modulation present on screen?
No
Yes
Yes
J
Pg. 4-9
Check VCS connections to TV and channel setting.
Test VCS with known - good battery eliminator.
Is "snow" on screen gone?
Yes
A
Pg. 4-2
No
L
Pg. 4-11

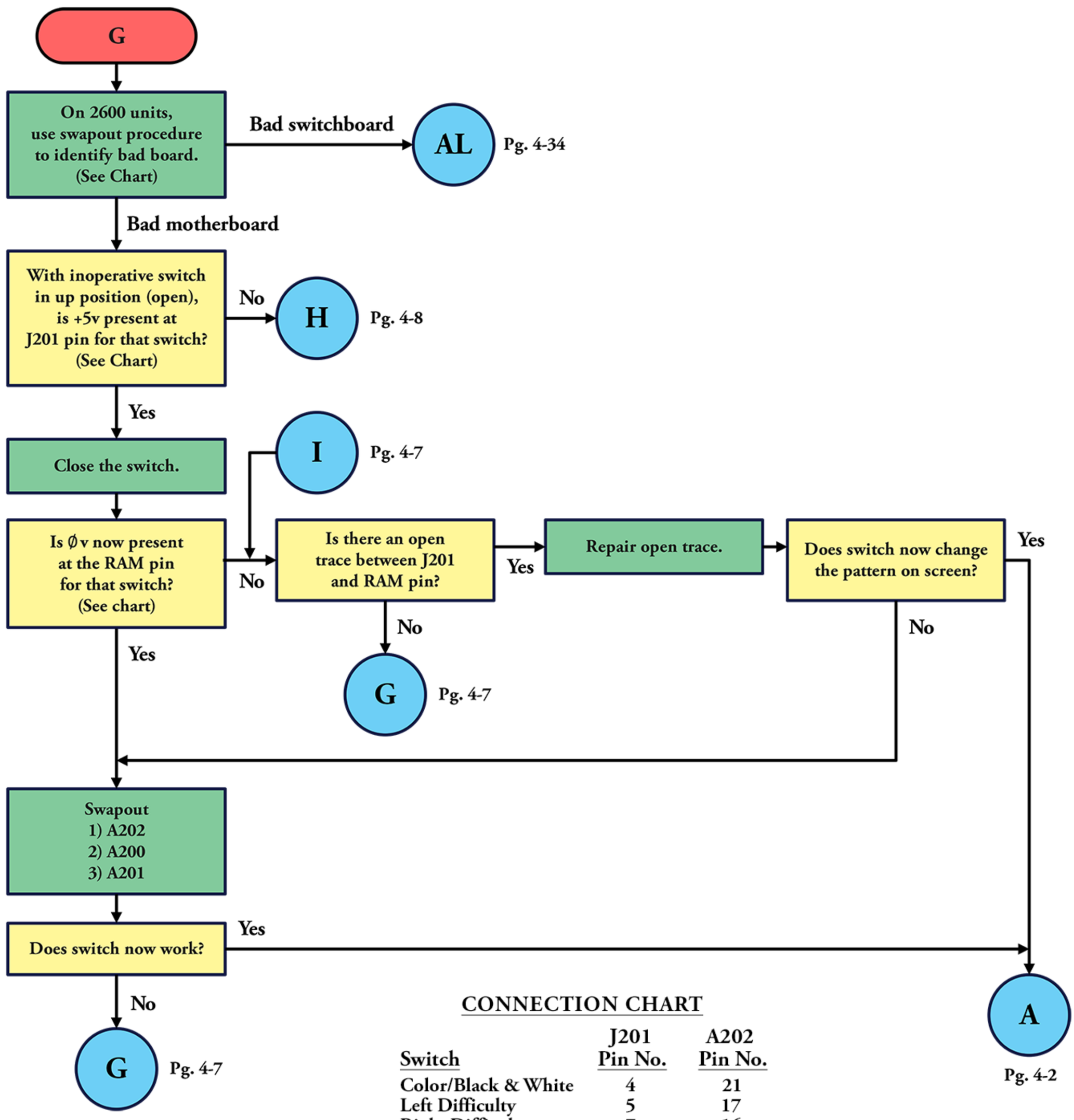
Bad Video Troubleshooting




E
Place color/
black & white switch
in B&W position.
Did screen pattern
change when switch
was moved?
No
G
Pg. 4-7
Yes
Is proper
gray bar pattern
present?
(See Figure 4-4).
No
Z
Pg. 4-20
Yes
Is a partial segment missing
or
is any color present?
(See Figure 4-5).
Yes
D
Pg. 4-45
No
P
Pg. 4-14

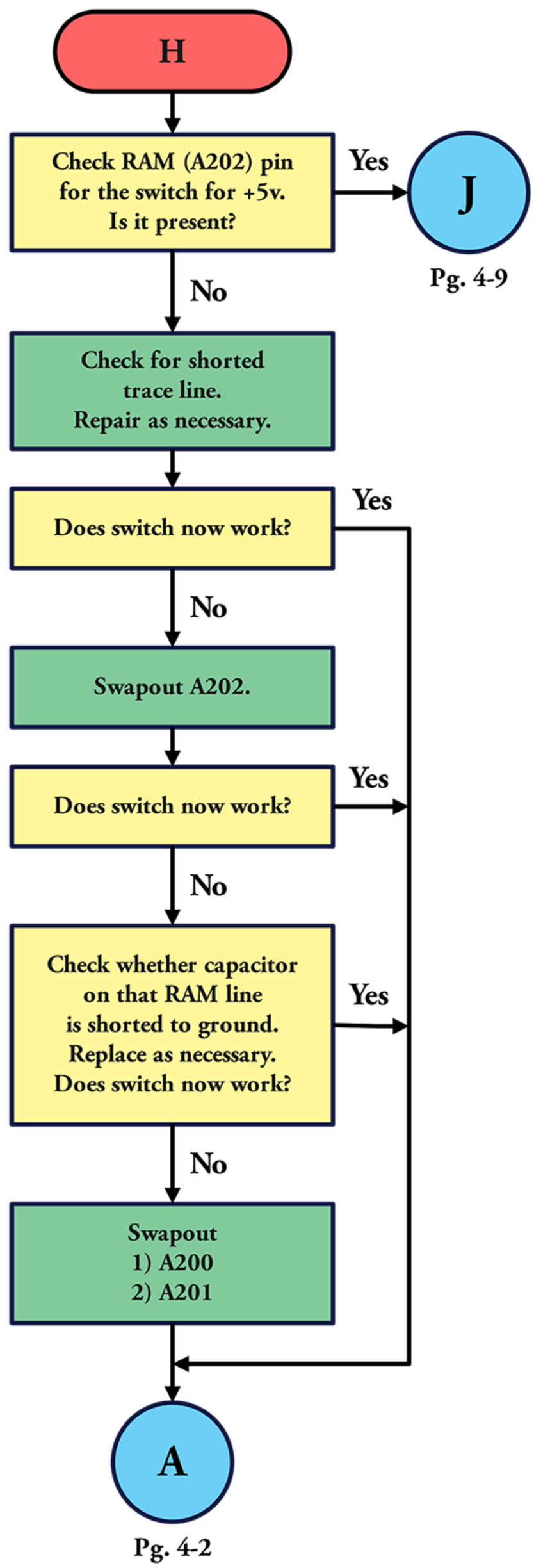

F
Reconnect VCS and initialize.
Are color bars present on screen?
No
A
Pg. 4-2
Yes
Adjust R211 so that color is aligned properly (See Figure 4-2).
Is VCS tunable to proper shades?
Yes
E
Pg. 4-5
No
AA
Pg. 4-23

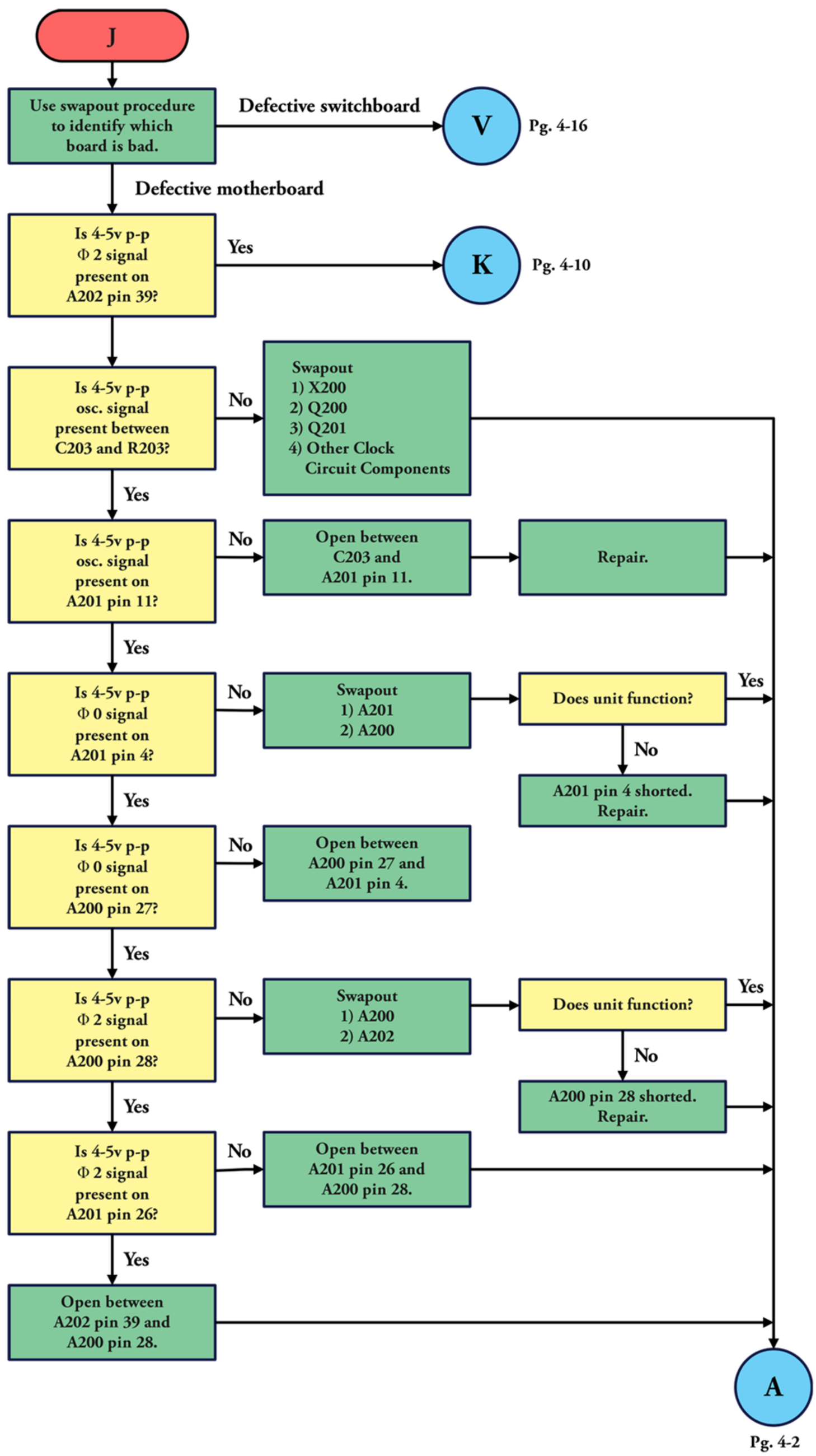
Defective Switch Troubleshooting Procedure

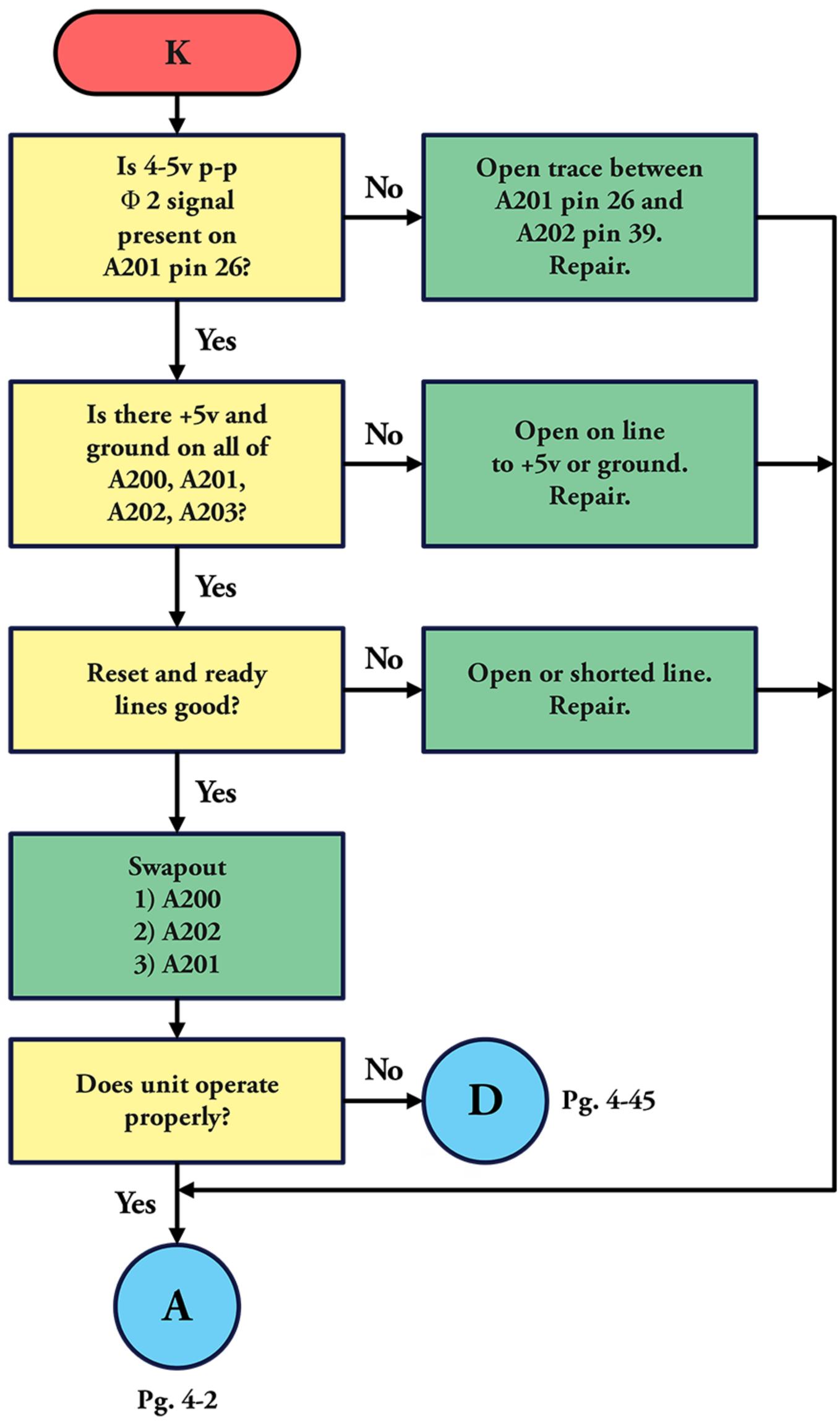


CONNECTION CHART

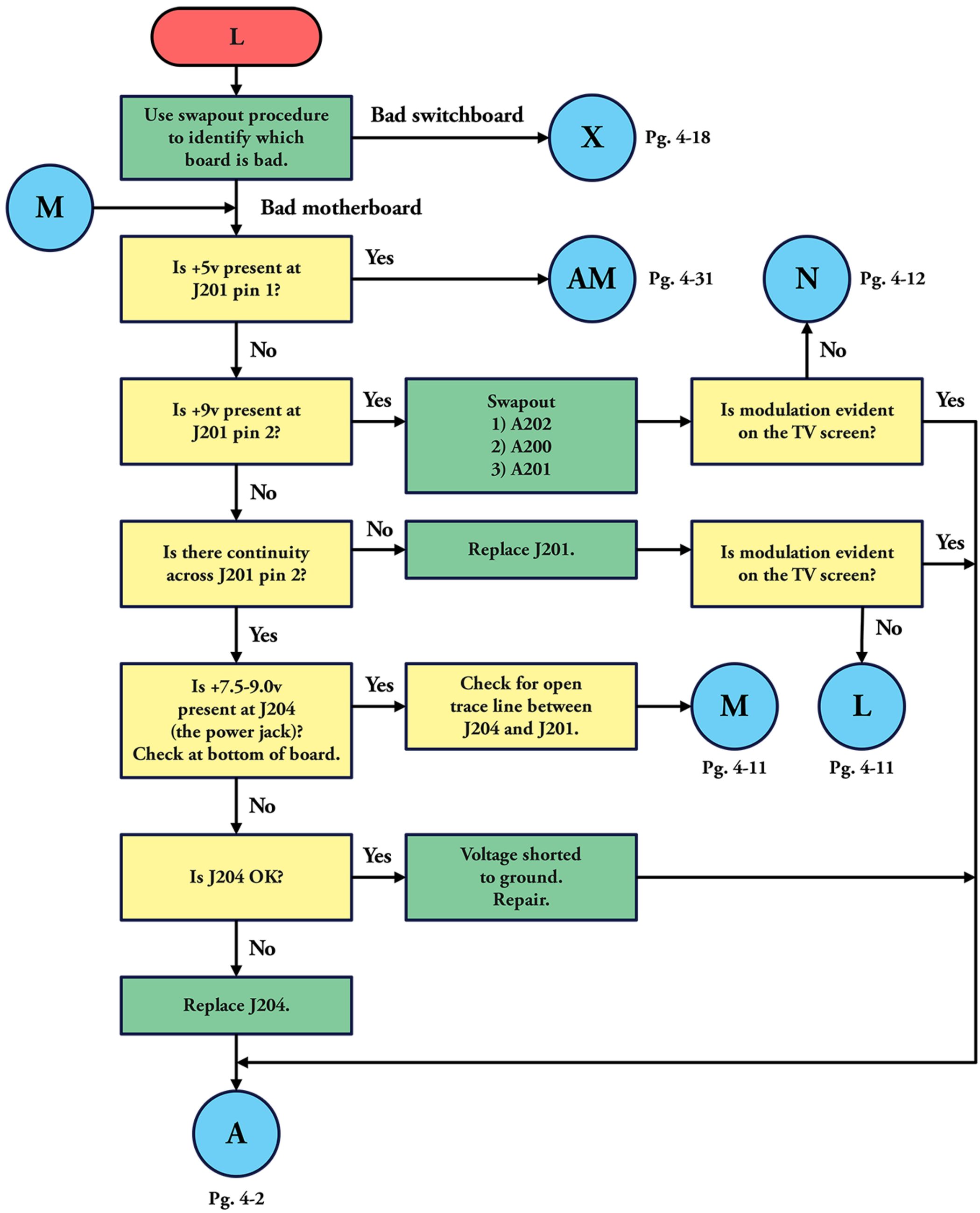
Switch	J201 Pin No.	A202 Pin No.
Color/Black & White	4	21
Left Difficulty	5	17
Right Difficulty	7	16
Select	9	23
Reset	8	24


H
Check RAM (A202) pin for the switch for +5v. Is it present?
Yes
J
Pg. 4-9
No
Check for shorted trace line. Repair as necessary.
Does switch now work?
Yes
No
Swapout A202.
Does switch now work?
Yes
No
Check whether capacitor on that RAM line is shorted to ground. Replace as necessary. Does switch now work?
Yes
No
Swapout
1) A200
2) A201
A
Pg. 4-2

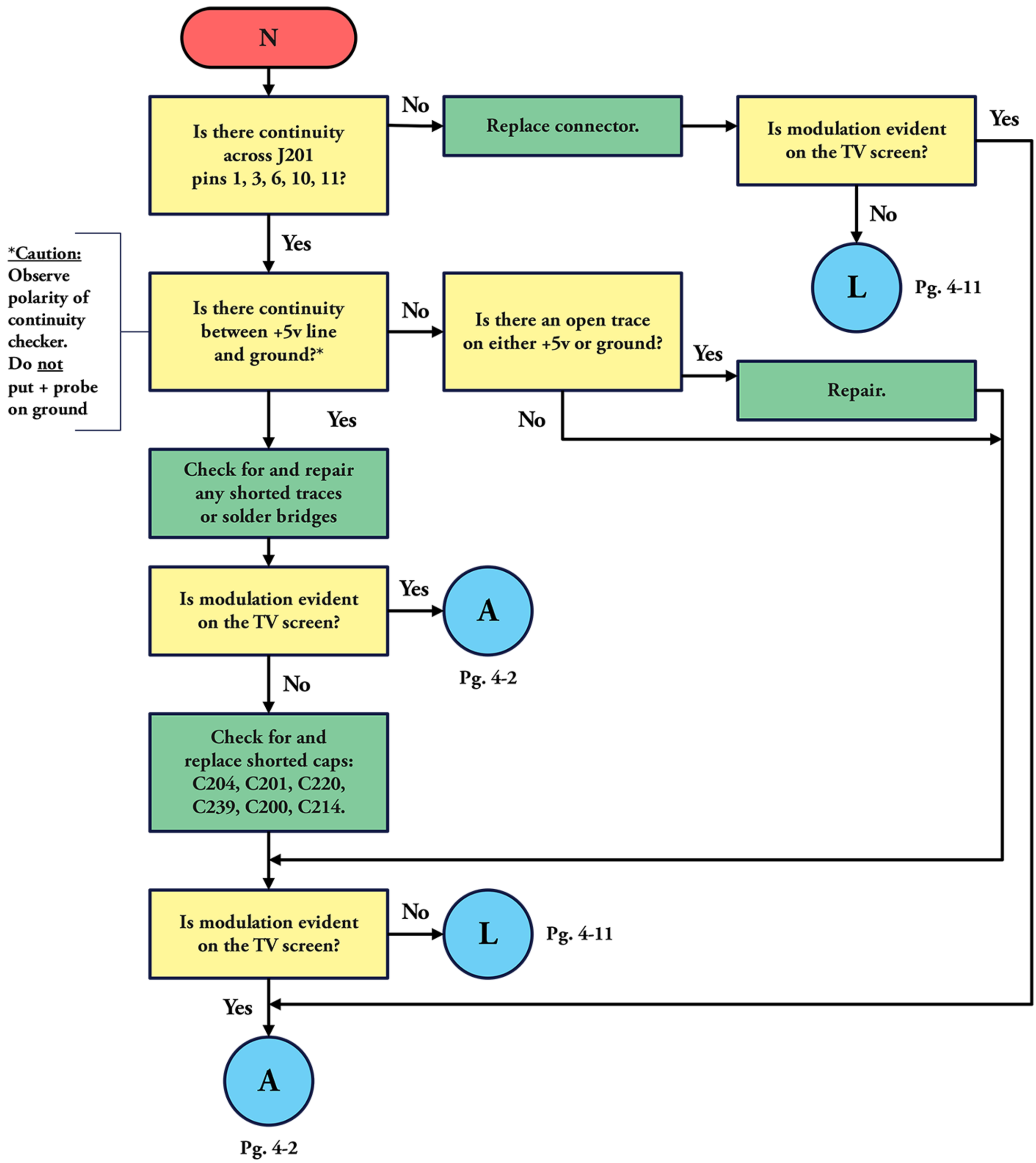

J
Use swapout procedure to identify which board is bad.
Defective switchboard
V
Pg. 4-16
Defective motherboard
Is 4-5v p-p Φ 2 signal present on A202 pin 39?
Yes
K
Pg. 4-10
Is 4-5v p-p osc. signal present between C203 and R203?
No
Swapout
1) X200
2) Q200
3) Q201
4) Other Clock Circuit Components
Yes
Is 4-5v p-p osc. signal present on A201 pin 11?
No
Open between C203 and A201 pin 11.
Repair.
Yes
Is 4-5v p-p Φ 0 signal present on A201 pin 4?
No
Swapout
1) A201
2) A200
Does unit function?
Yes
No
A201 pin 4 shorted. Repair.
Yes
Is 4-5v p-p Φ 0 signal present on A200 pin 27?
No
Open between A200 pin 27 and A201 pin 4.
Yes
Is 4-5v p-p Φ 2 signal present on A200 pin 28?
No
Swapout
1) A200
2) A202
Does unit function?
Yes
No
A200 pin 28 shorted. Repair.
Yes
Is 4-5v p-p Φ 2 signal present on A201 pin 26?
No
Open between A201 pin 26 and A200 pin 28.
Yes
Open between A202 pin 39 and A200 pin 28.
A
Pg. 4-2

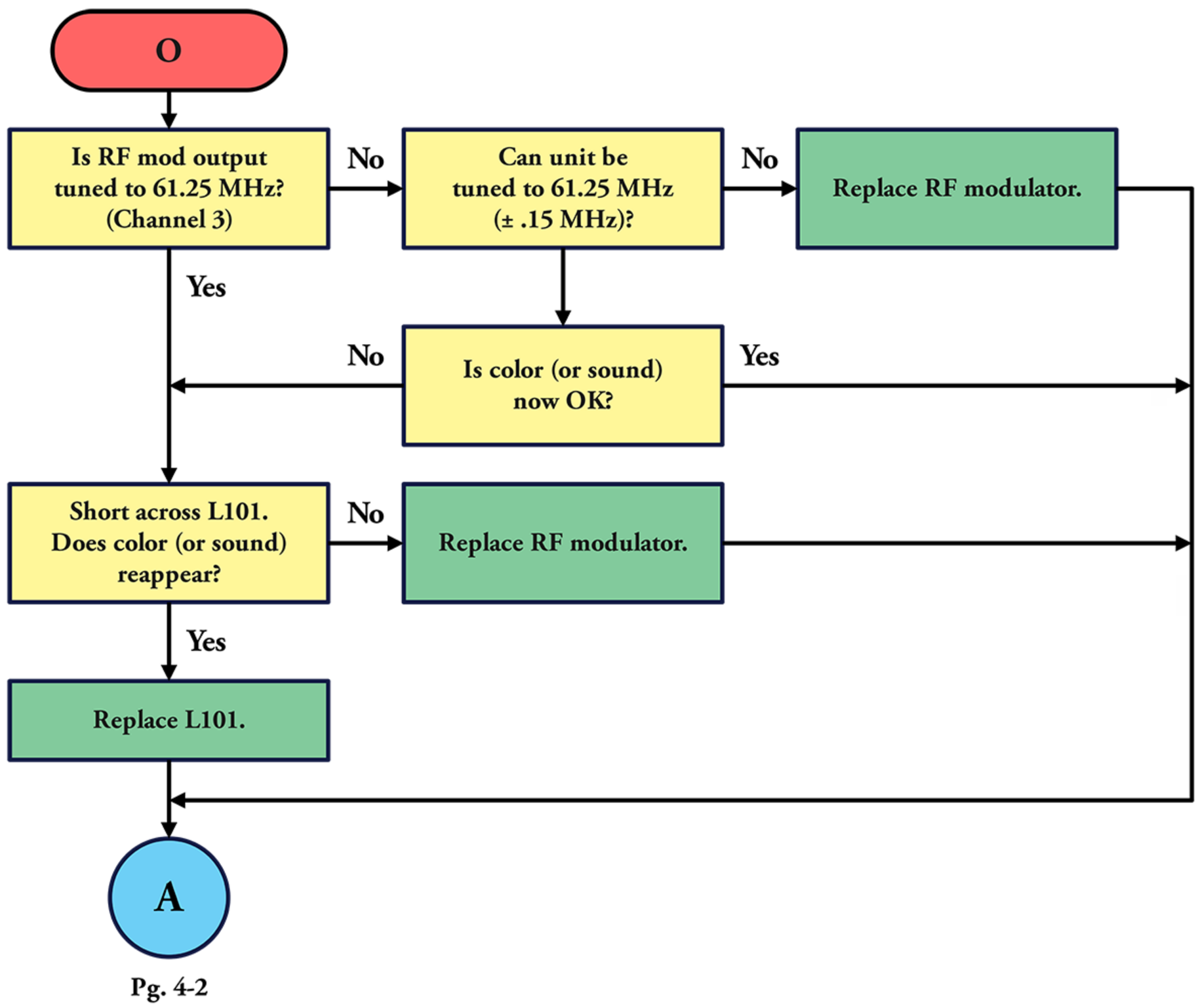

K
Is 4-5v p-p Φ 2 signal present on A201 pin 26?
No
Open trace between A201 pin 26 and A202 pin 39. Repair.
Yes
Is there +5v and ground on all of A200, A201, A202, A203?
No
Open on line to +5v or ground. Repair.
Yes
Reset and ready lines good?
No
Open or shorted line. Repair.
Yes
Swapout
1) A200
2) A202
3) A201
Does unit operate properly?
No
D
Pg. 4-45
Yes
A
Pg. 4-2

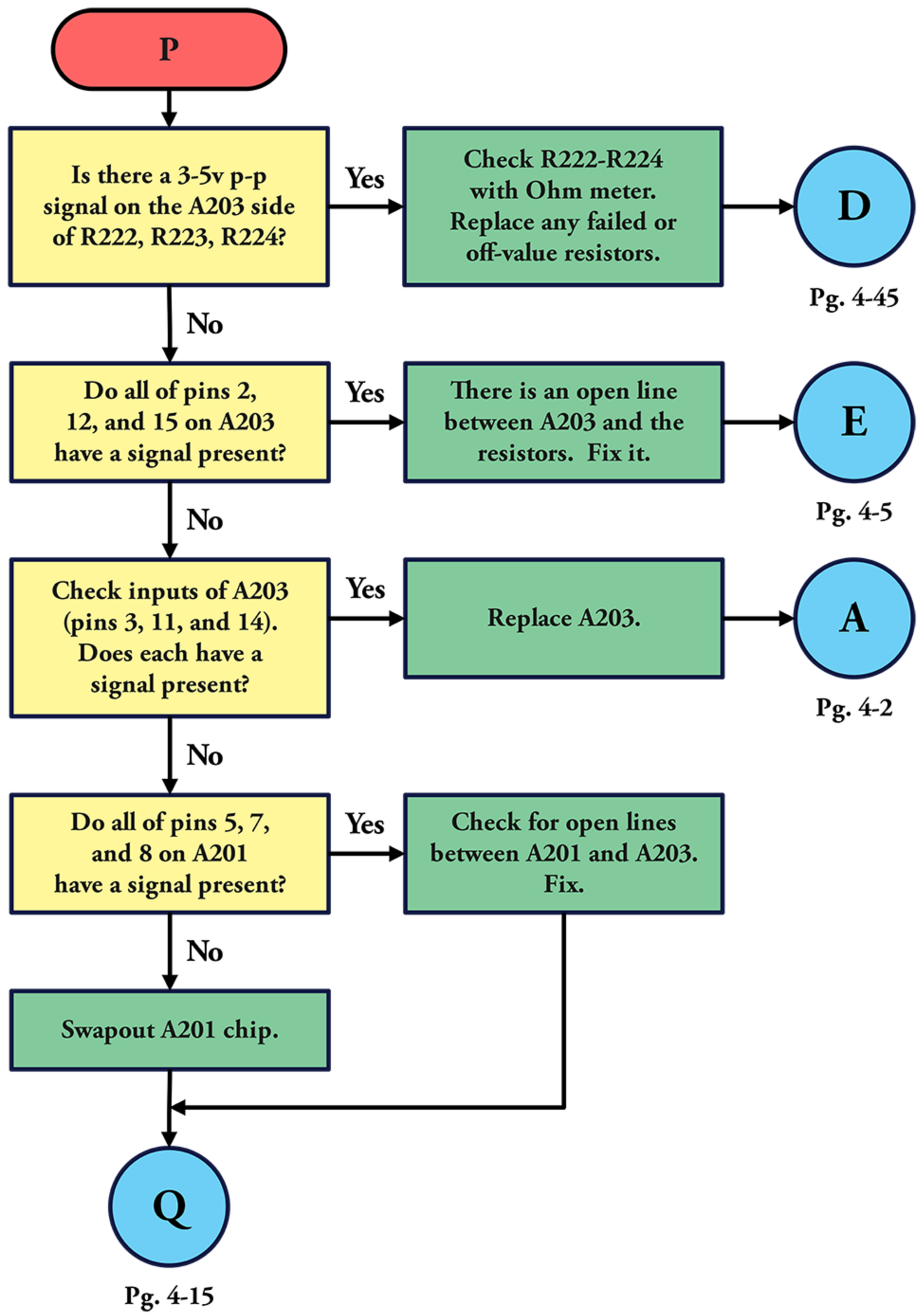
Snowy Screen Troubleshooting Procedure, Motherboard

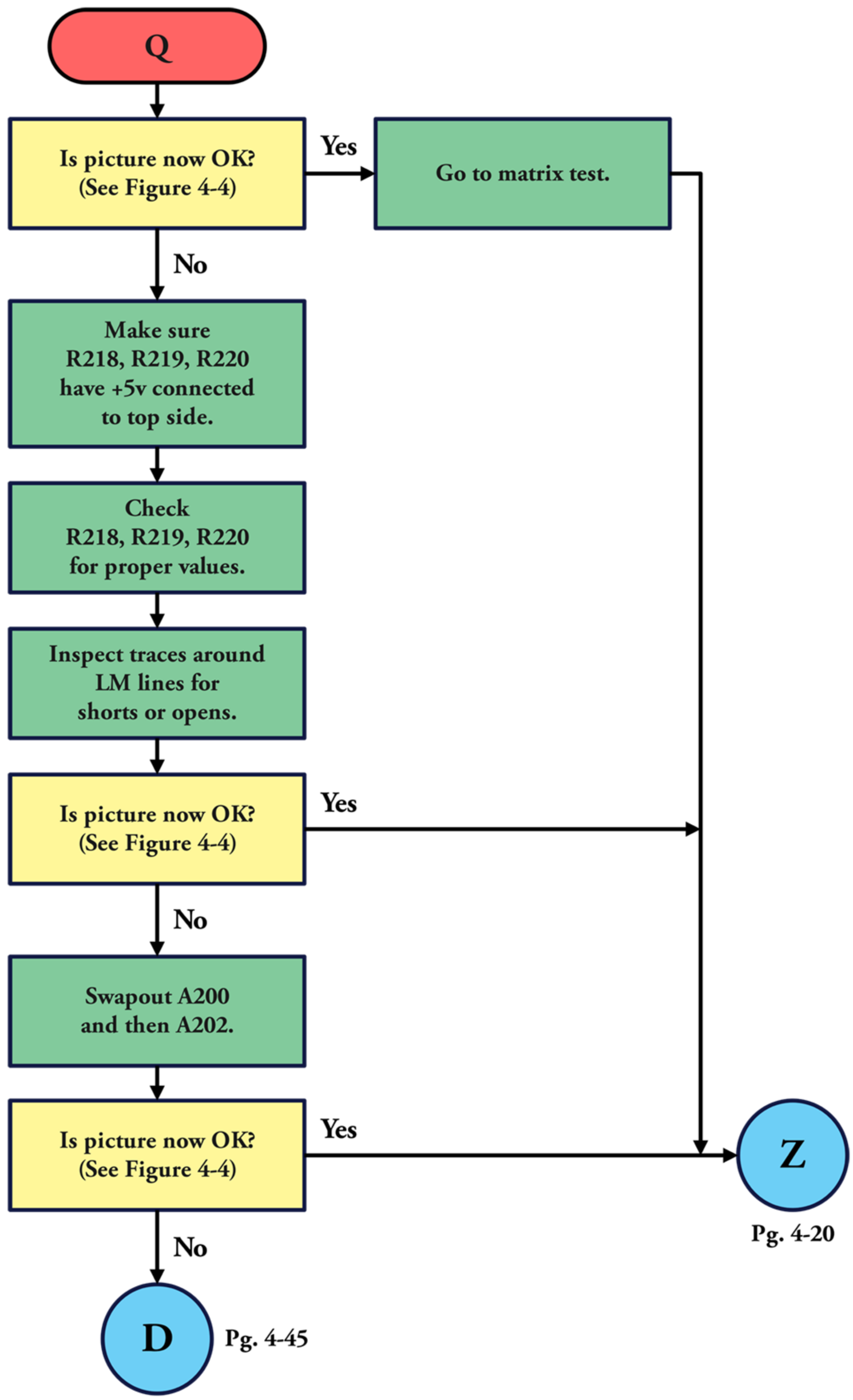


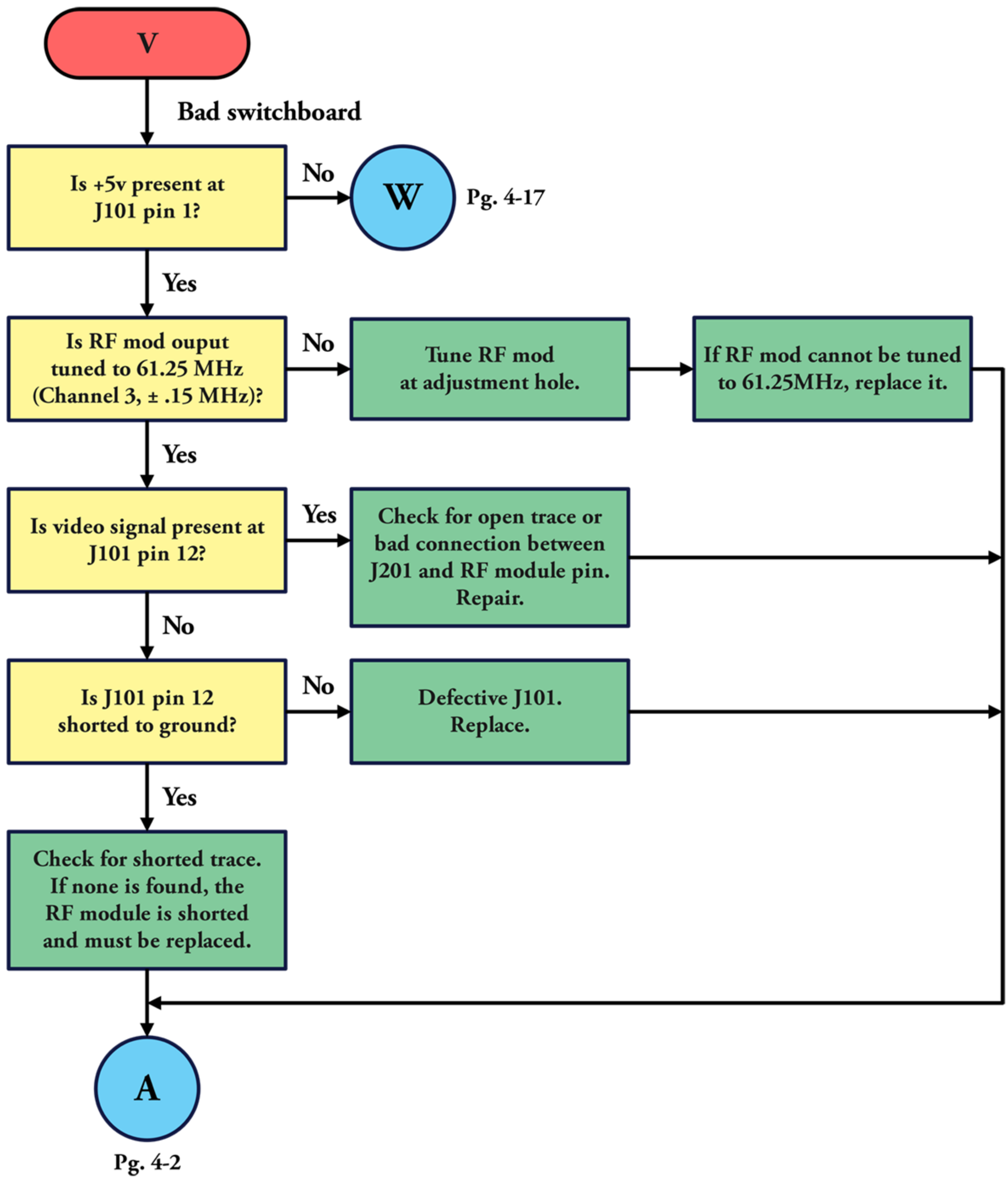
Snowy Screen Troubleshooting Procedure,
Motherboard (Continued)



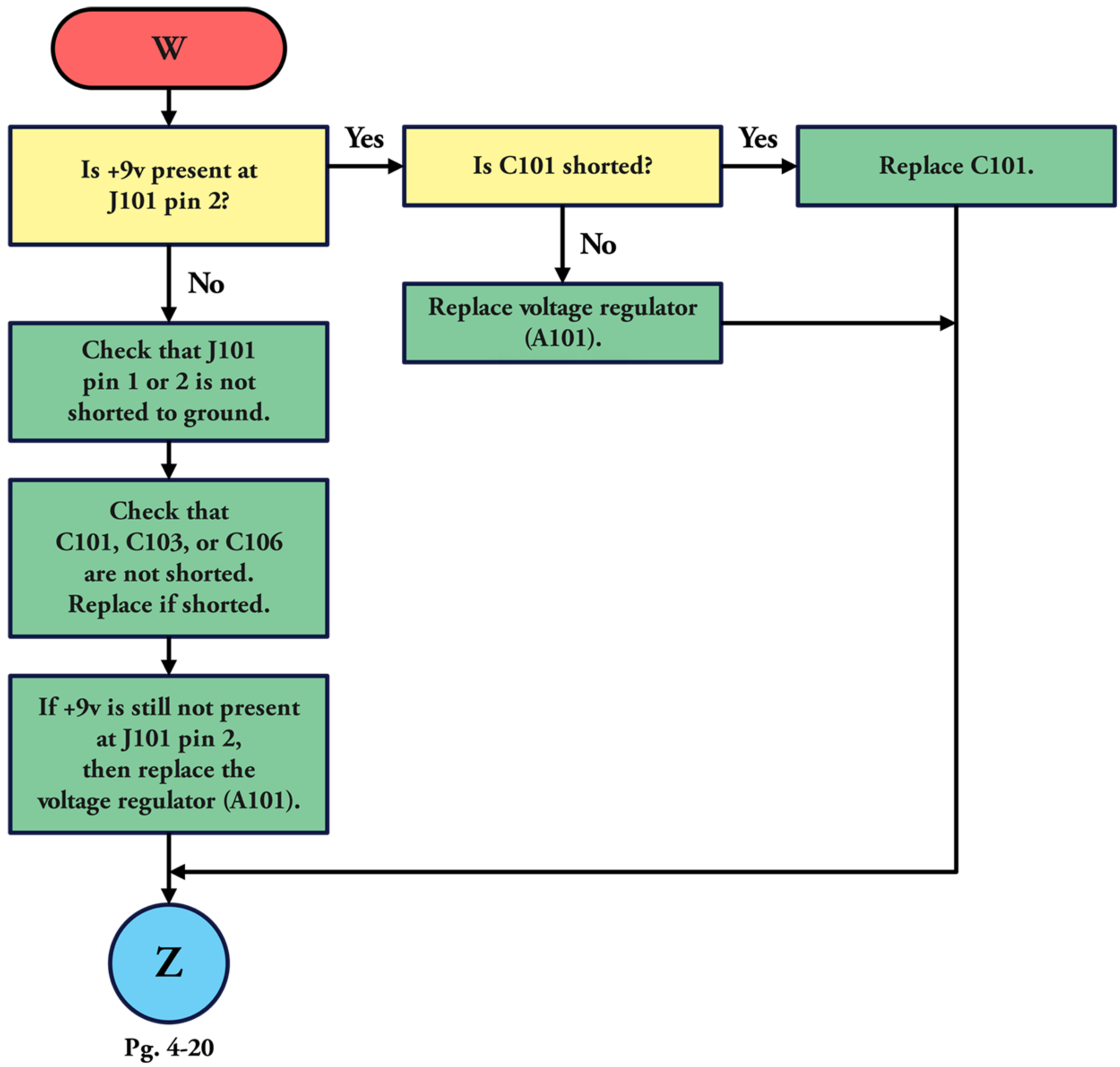

O
Is RF mod output tuned to 61.25 MHz? (Channel 3)
No
Can unit be tuned to 61.25 MHz (± .15 MHz)?
No
Replace RF modulator.
Yes
No
Is color (or sound) now OK?
Yes
Short across L101. Does color (or sound) reappear?
No
Replace RF modulator.
Yes
Replace L101.
A
Pg. 4-2


P
Is there a 3-5v p-p signal on the A203 side of R222, R223, R224?
Yes
Check R222-R224 with Ohm meter. Replace any failed or off-value resistors.
D
Pg. 4-45
No
Do all of pins 2, 12, and 15 on A203 have a signal present?
Yes
There is an open line between A203 and the resistors. Fix it.
E
Pg. 4-5
No
Check inputs of A203 (pins 3, 11, and 14). Does each have a signal present?
Yes
Replace A203.
A
Pg. 4-2
No
Do all of pins 5, 7, and 8 on A201 have a signal present?
Yes
Check for open lines between A201 and A203. Fix.
No
Swapout A201 chip.
Q
Pg. 4-15

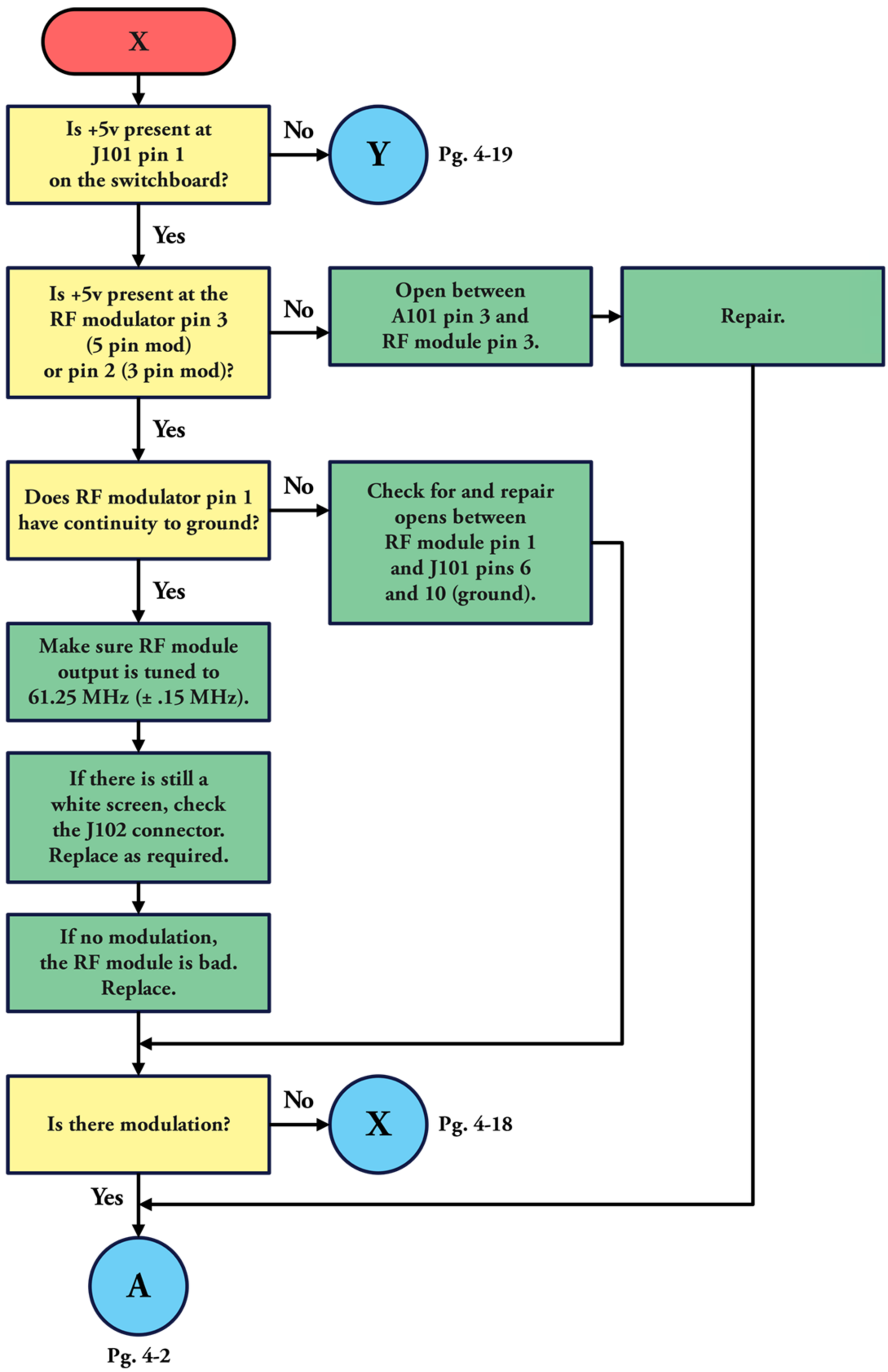

Q
Is picture now OK?
(See Figure 4-4)
Yes
Go to matrix test.
No
Make sure
R218, R219, R220
have +5v connected
to top side.
Check
R218, R219, R220
for proper values.
Inspect traces around
LM lines for
shorts or opens.
Is picture now OK?
(See Figure 4-4)
Yes
No
Swapout A200
and then A202.
Is picture now OK?
(See Figure 4-4)
Yes
Z
Pg. 4-20
No
D
Pg. 4-45


V
Bad switchboard
Is +5v present at J101 pin 1?
No
W
Pg. 4-17
Yes
Is RF mod ouput tuned to 61.25 MHz (Channel 3, ± .15 MHz)?
No
Tune RF mod at adjustment hole.
If RF mod cannot be tuned to 61.25MHz, replace it.
Yes
Is video signal present at J101 pin 12?
Yes
Check for open trace or bad connection between J201 and RF module pin. Repair.
No
Is J101 pin 12 shorted to ground?
No
Defective J101. Replace.
Yes
Check for shorted trace. If none is found, the RF module is shorted and must be replaced.
A
Pg. 4-2

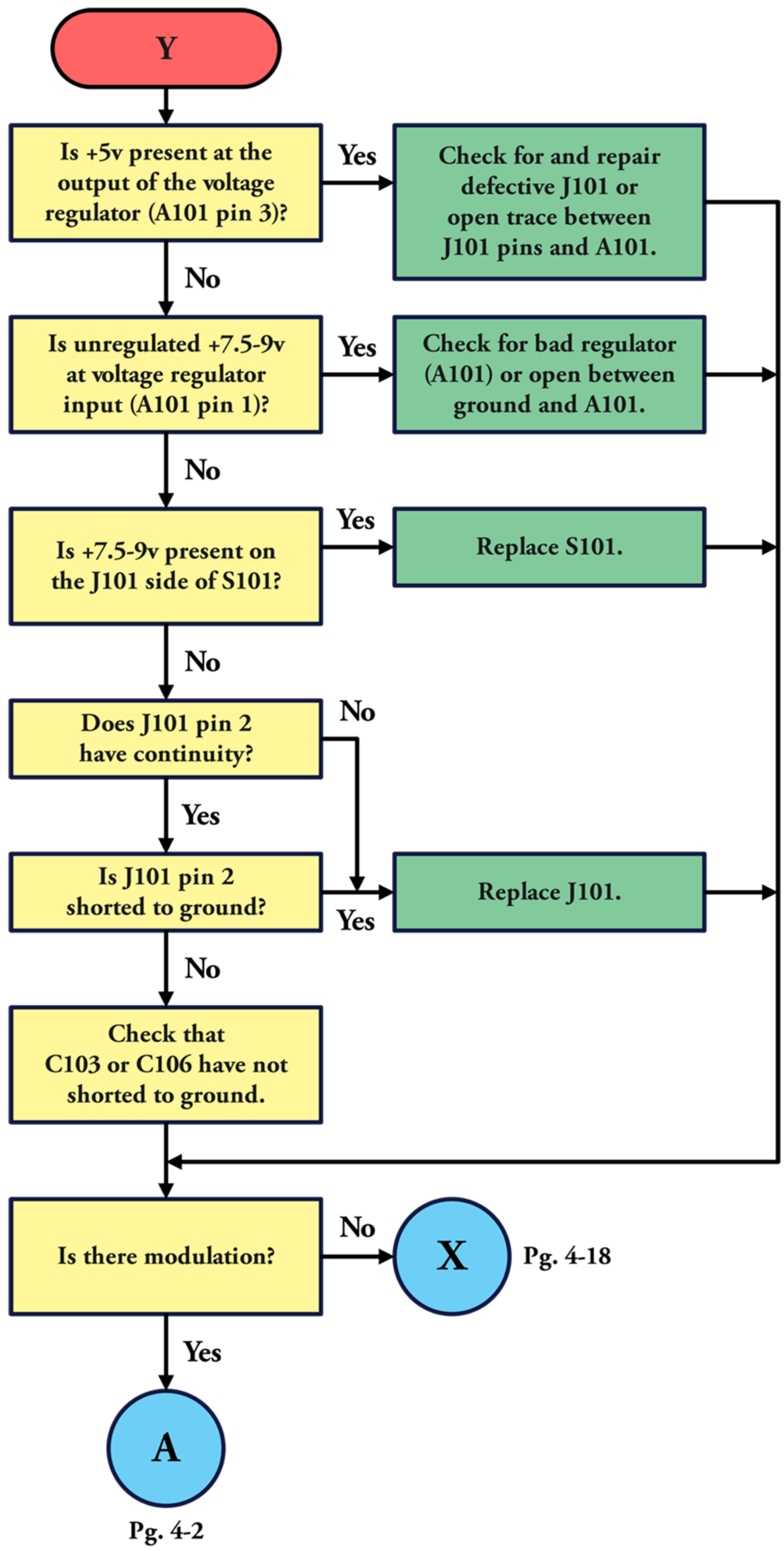
Colored Screen Troubleshooting Procedure
Switchboard (Continued)

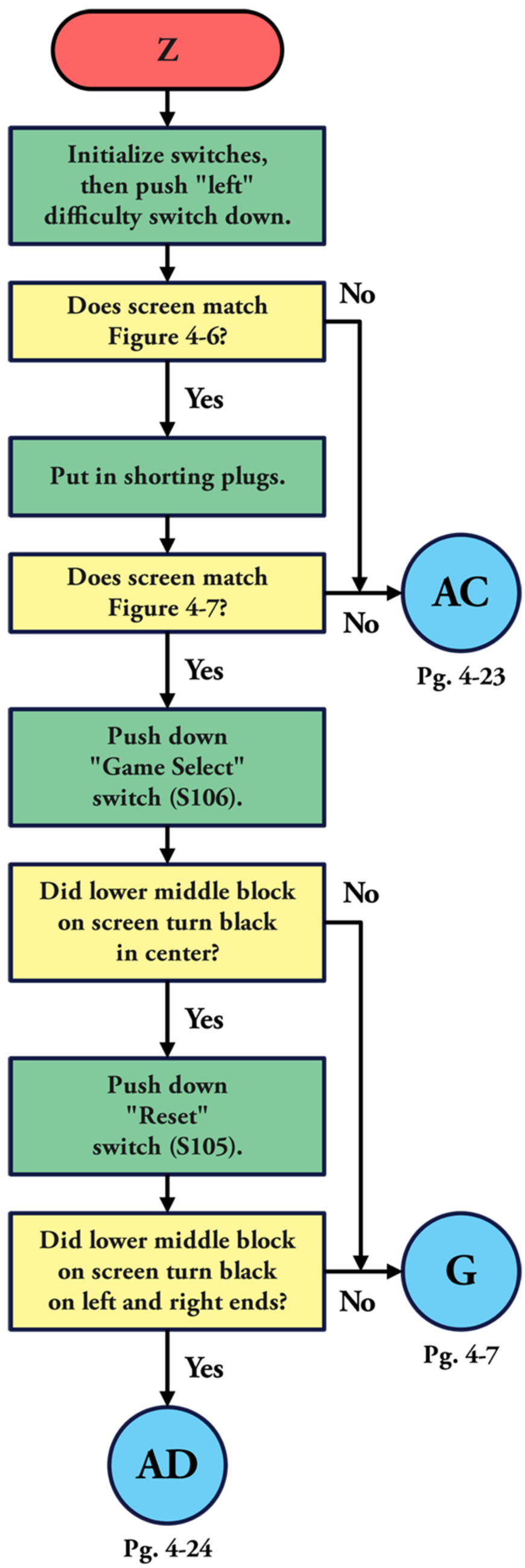


Snowy Screen Troubleshooting Procedure
Switchboard

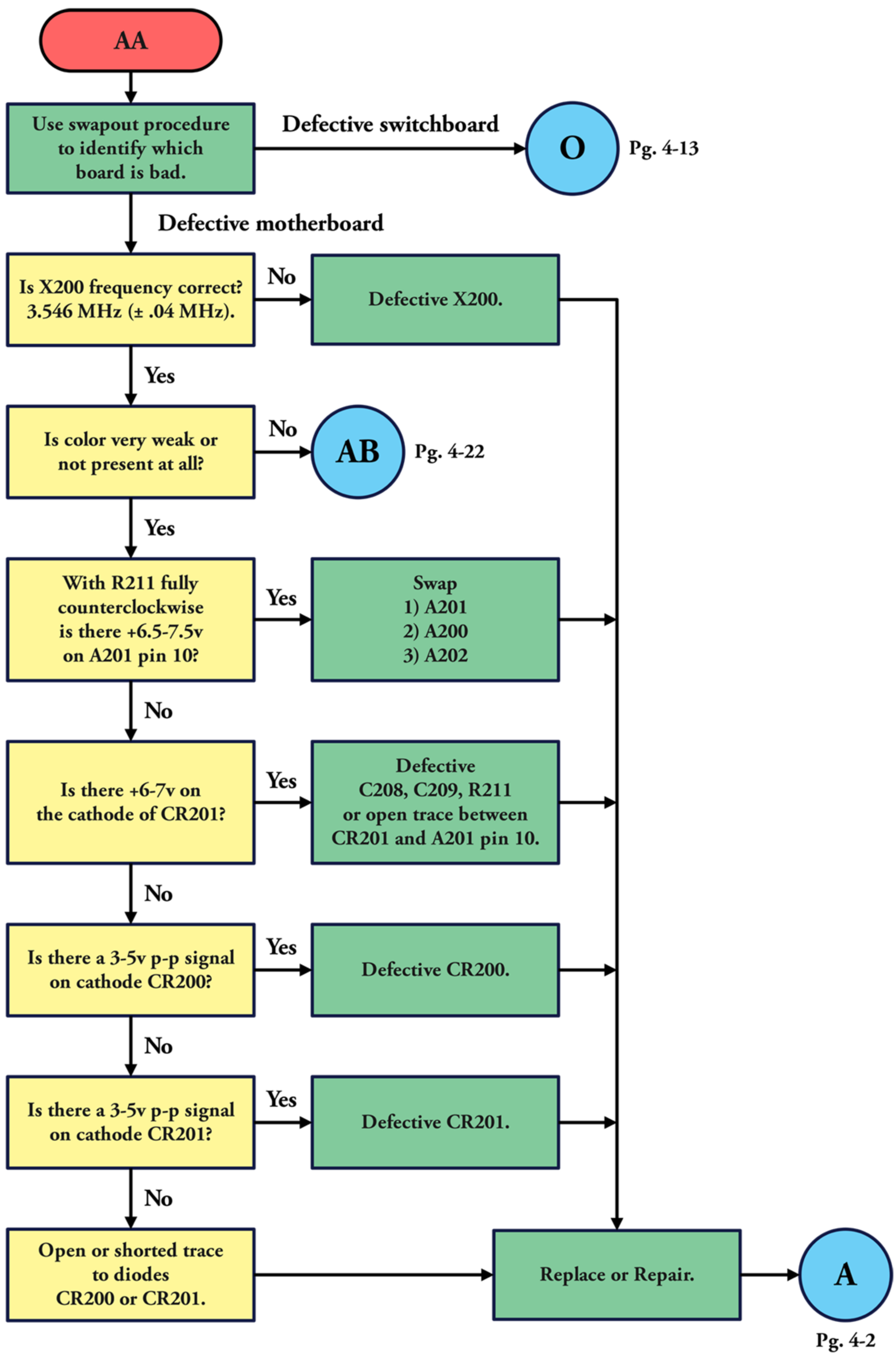


Snowy Screen Troubleshooting Procedure
Switchboard (Continued)

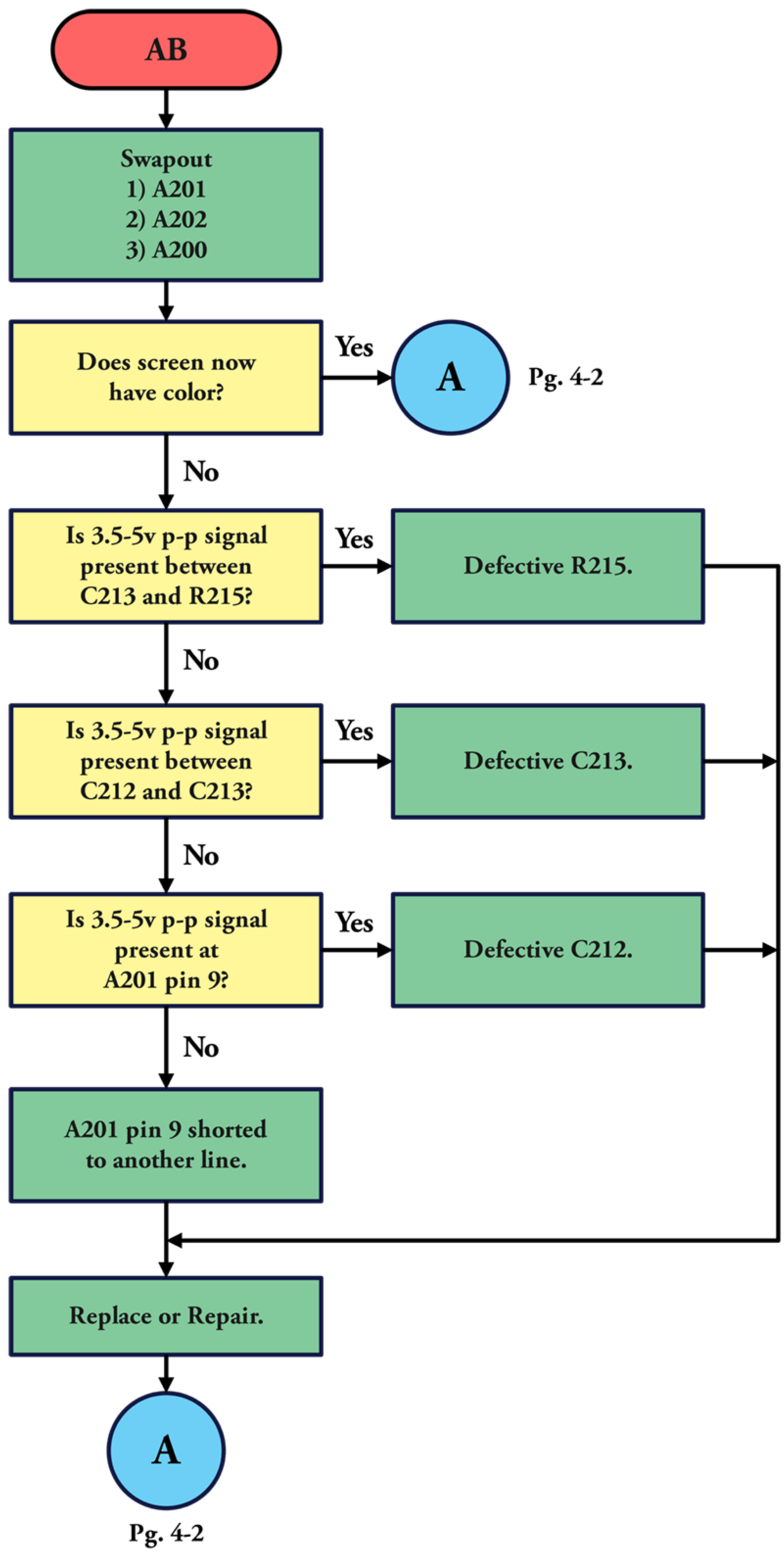



Z
Initialize switches, then push "left" difficulty switch down.
Does screen match Figure 4-6?
No
Yes
Put in shorting plugs.
Does screen match Figure 4-7?
No
AC
Pg. 4-23
Yes
Push down "Game Select" switch (S106).
Did lower middle block on screen turn black in center?
No
Yes
Push down "Reset" switch (S105).
Did lower middle block on screen turn black on left and right ends?
No
G
Pg. 4-7
Yes
AD
Pg. 4-24

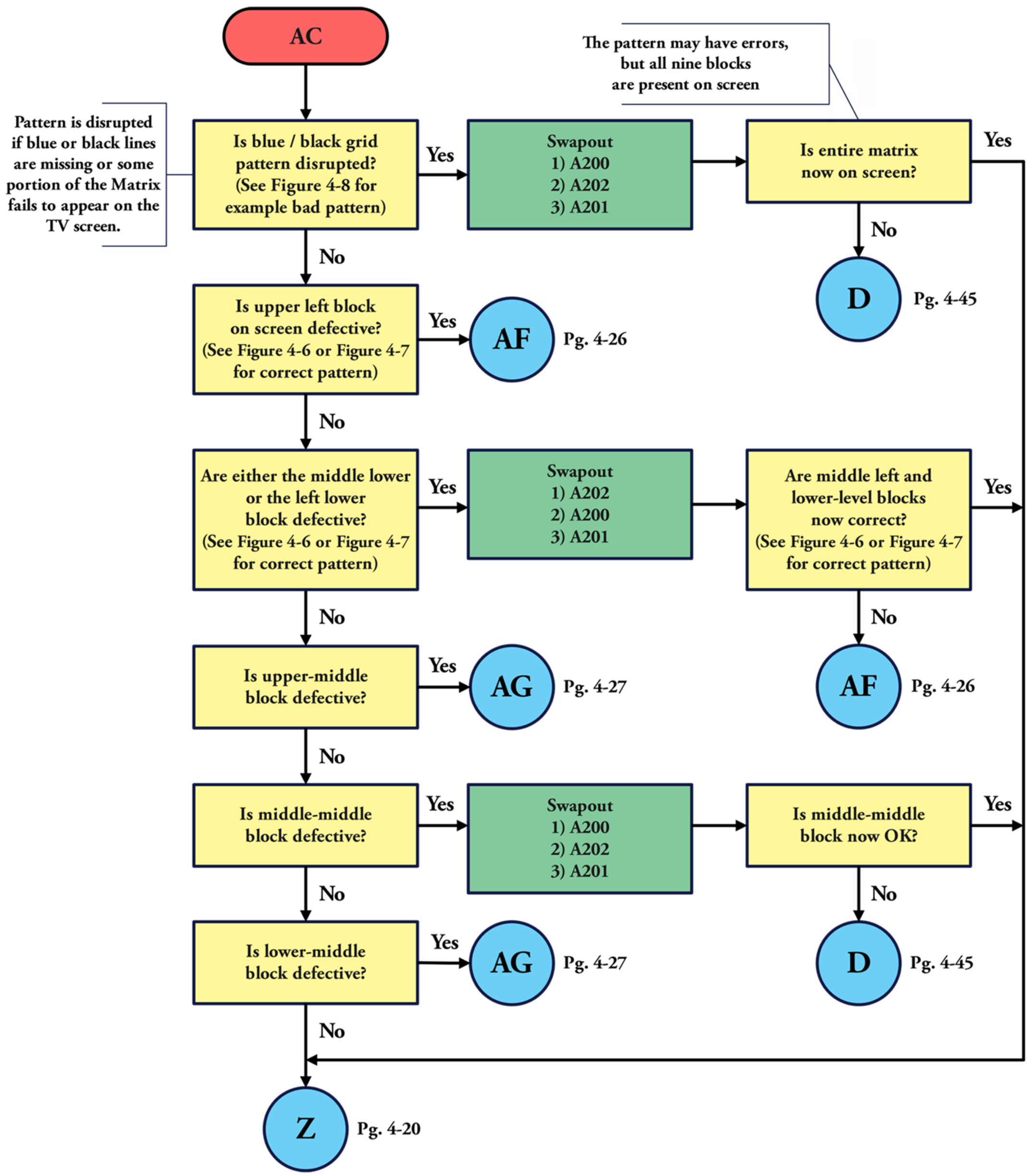
Color Troubleshooting Procedure
Motherboard

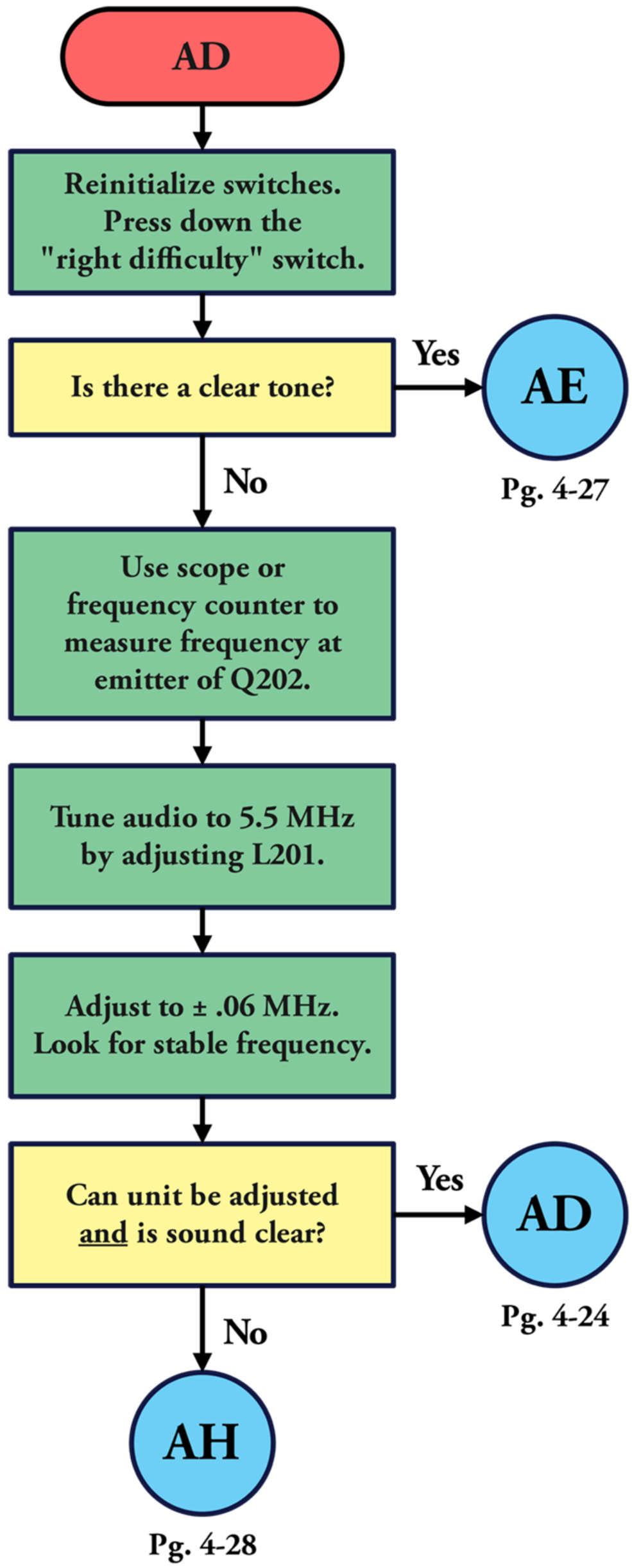


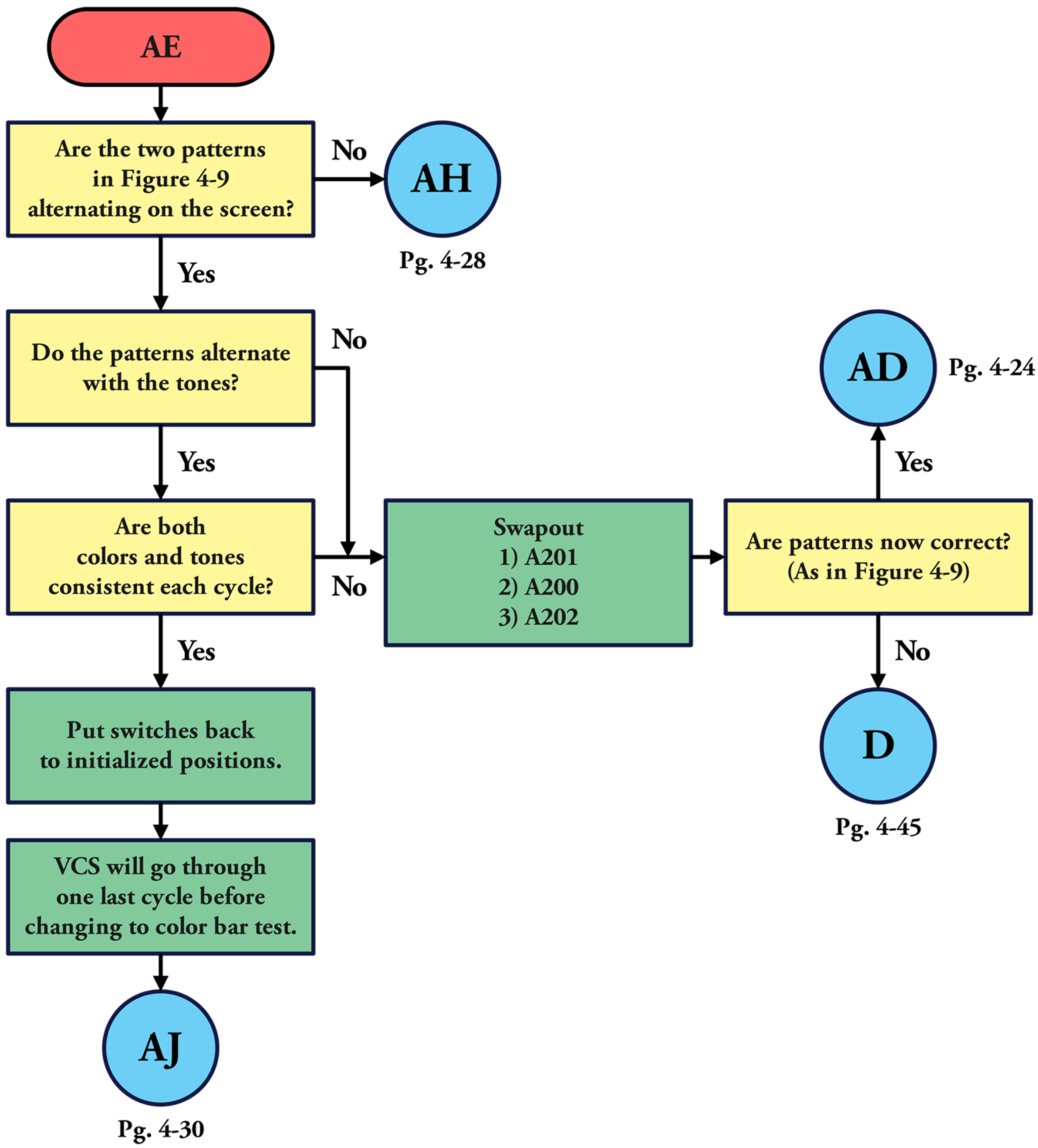
Color Troubleshooting Procedure
Motherboard (Continued)



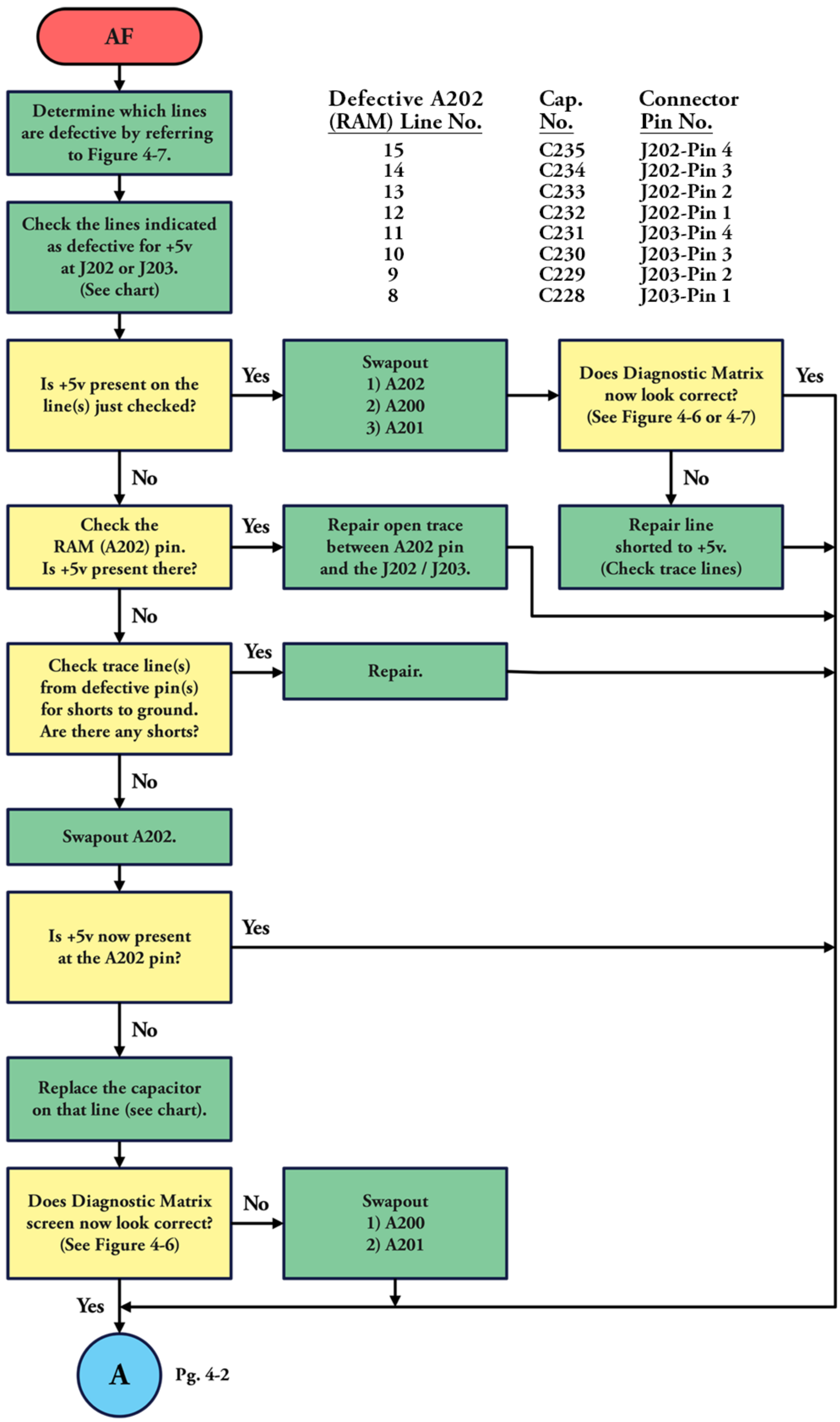
Defective Matrix Troubleshooting Procedure




AD
Reinitialize switches. Press down the "right difficulty" switch.
Is there a clear tone?
Yes
AE
Pg. 4-27
No
Use scope or frequency counter to measure frequency at emitter of Q202.
Tune audio to 5.5 MHz by adjusting L201.
Adjust to ± .06 MHz. Look for stable frequency.
Can unit be adjusted and is sound clear?
Yes
AD
Pg. 4-24
No
AH
Pg. 4-28

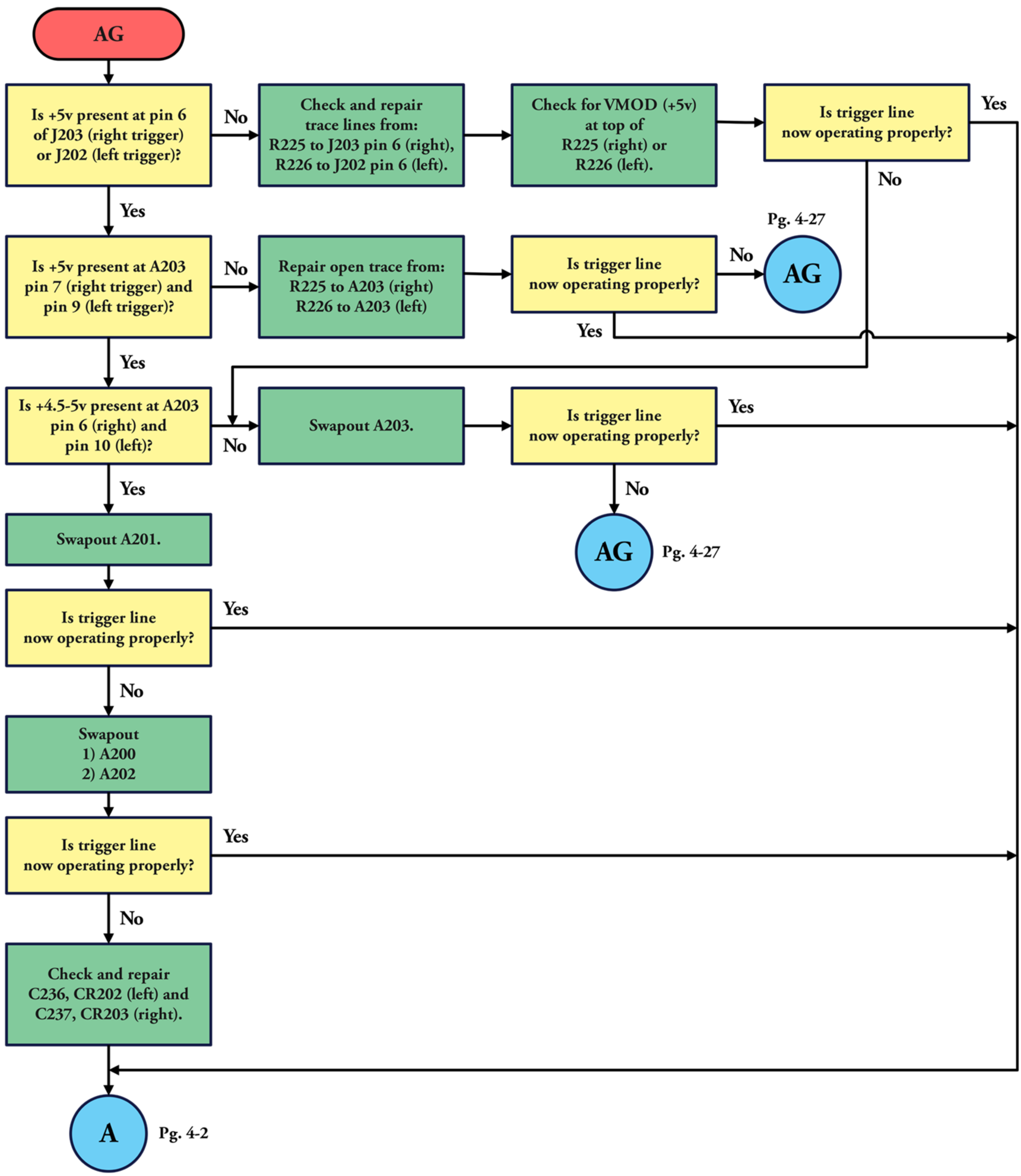

AE
Are the two patterns in Figure 4-9 alternating on the screen?
No
AH
Pg. 4-28
Yes
Do the patterns alternate with the tones?
No
Yes
Are both colors and tones consistent each cycle?
No
Yes
Put switches back to initialized positions.
VCS will go through one last cycle before changing to color bar test.
AJ
Pg. 4-30
Swapout
1) A201
2) A200
3) A202
Are patterns now correct? (As in Figure 4-9)
Yes
AD
Pg. 4-24
No
D
Pg. 4-45

Defective I/O Lines Troubleshooting Procedure

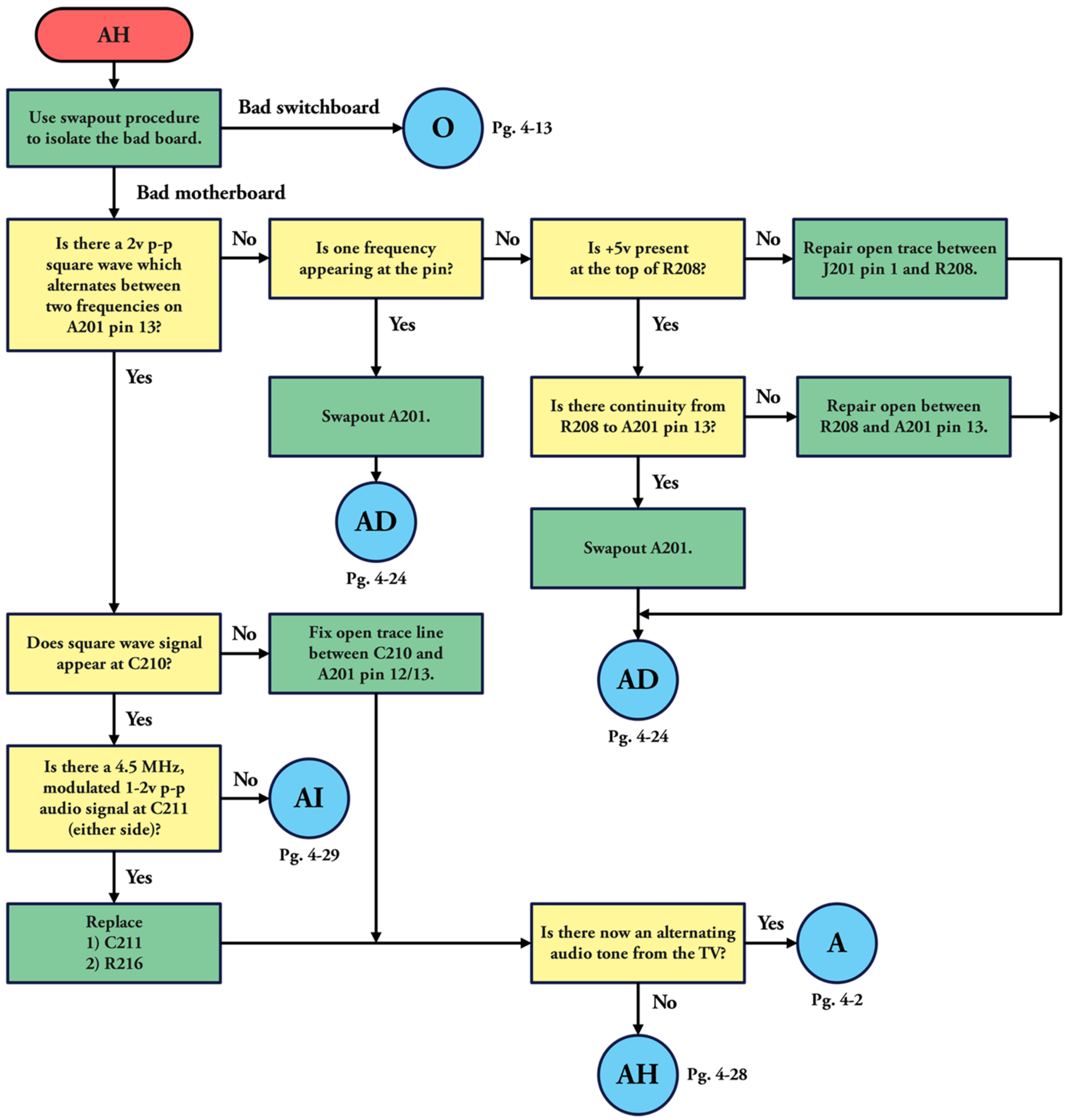


Defective A202 (RAM) Line No.	Cap. No.	Connector Pin No.
15	C235	J202-Pin 4
14	C234	J202-Pin 3
13	C233	J202-Pin 2
12	C232	J202-Pin 1
11	C231	J203-Pin 4
10	C230	J203-Pin 3
9	C229	J203-Pin 2
8	C228	J203-Pin 1

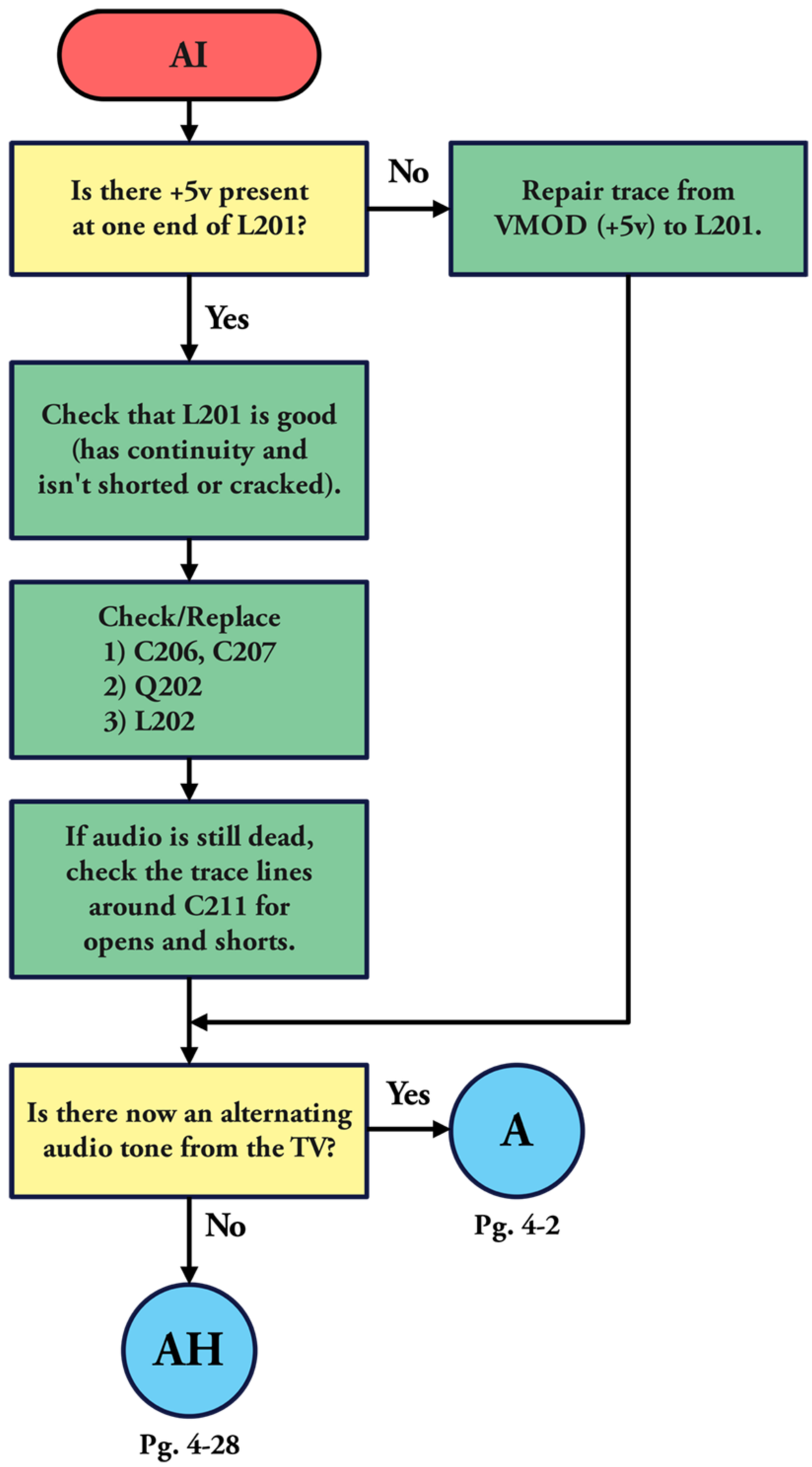
Trigger Line Troubleshooting Procedure

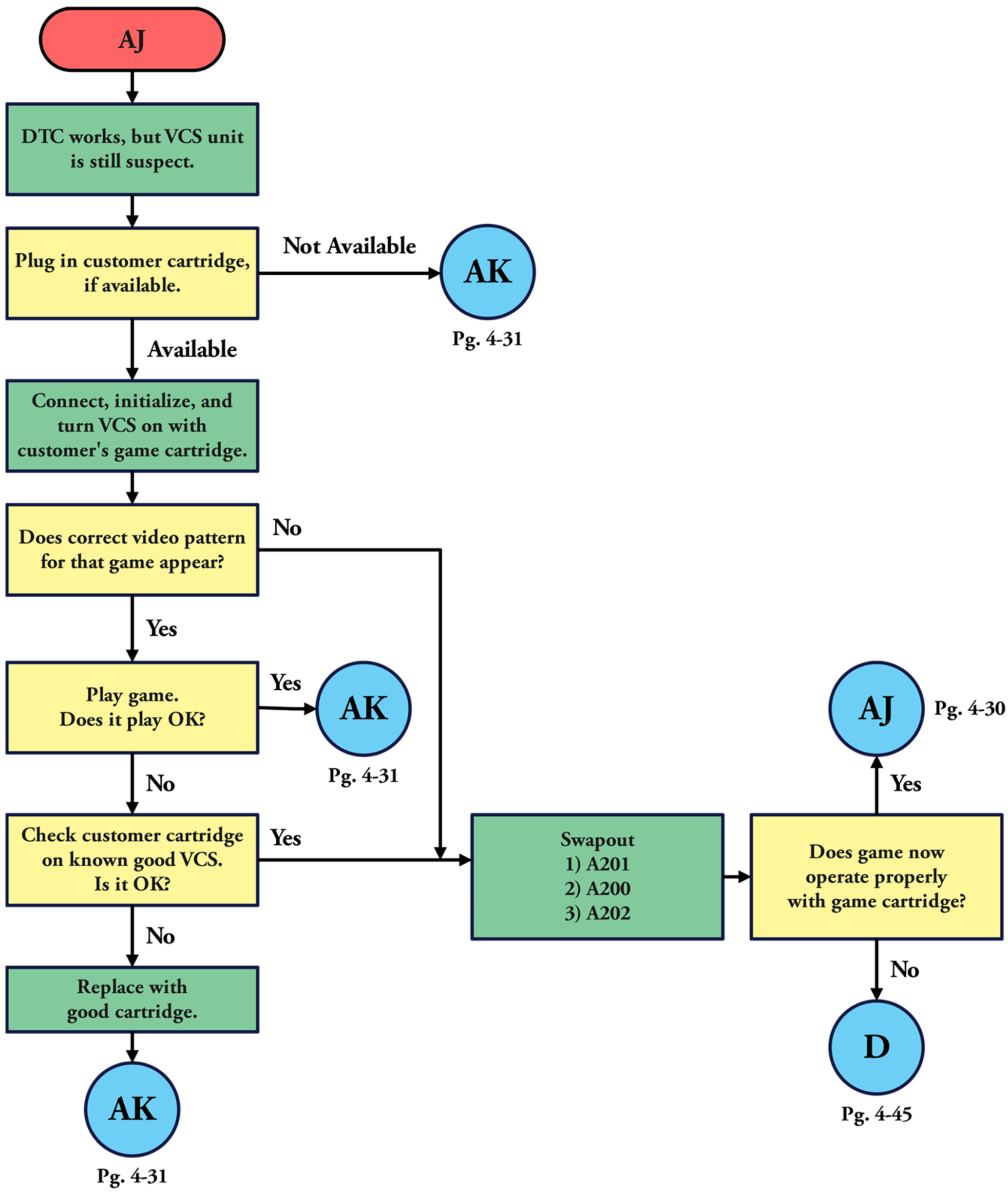


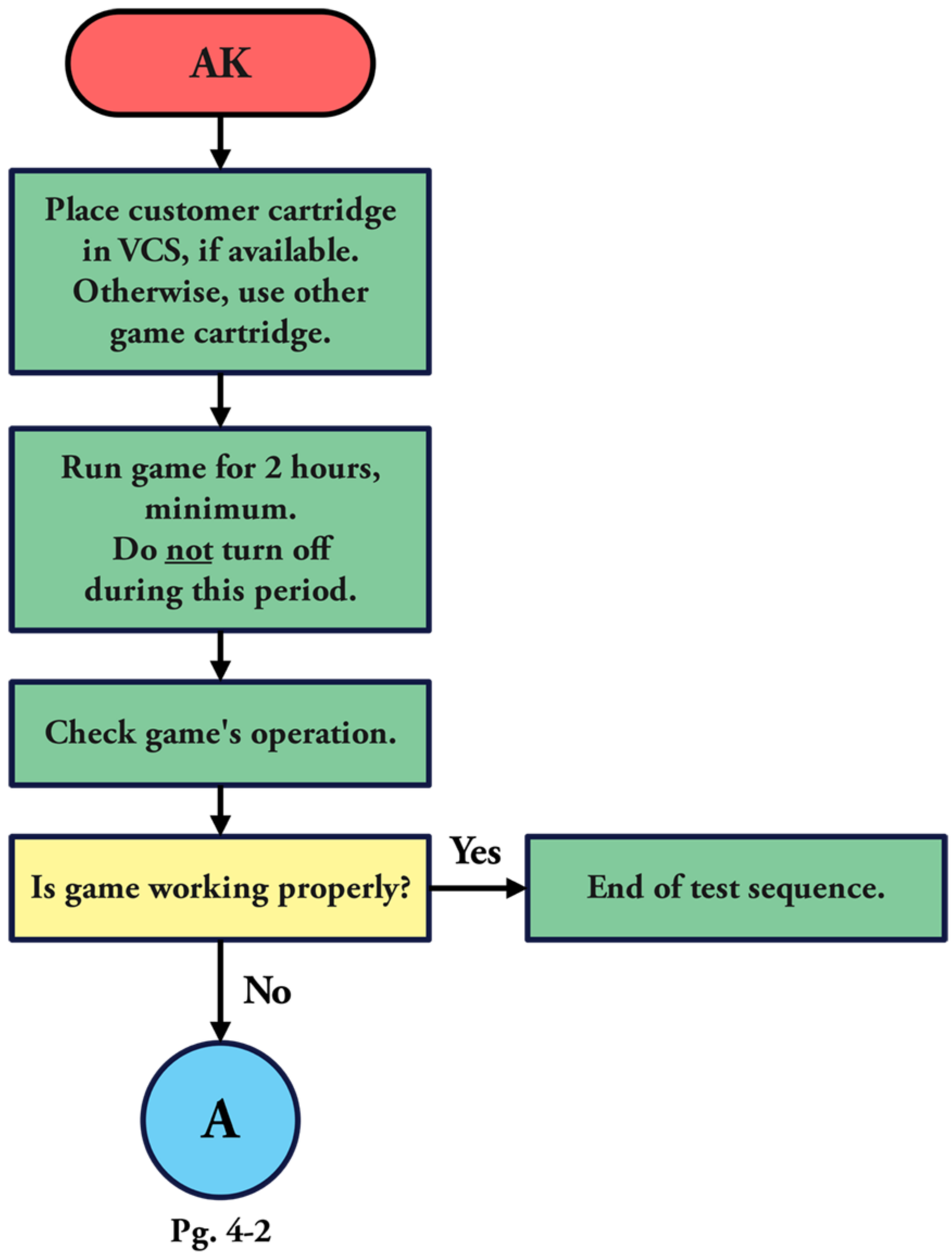
Audio Troubleshooting Procedure
Motherboard

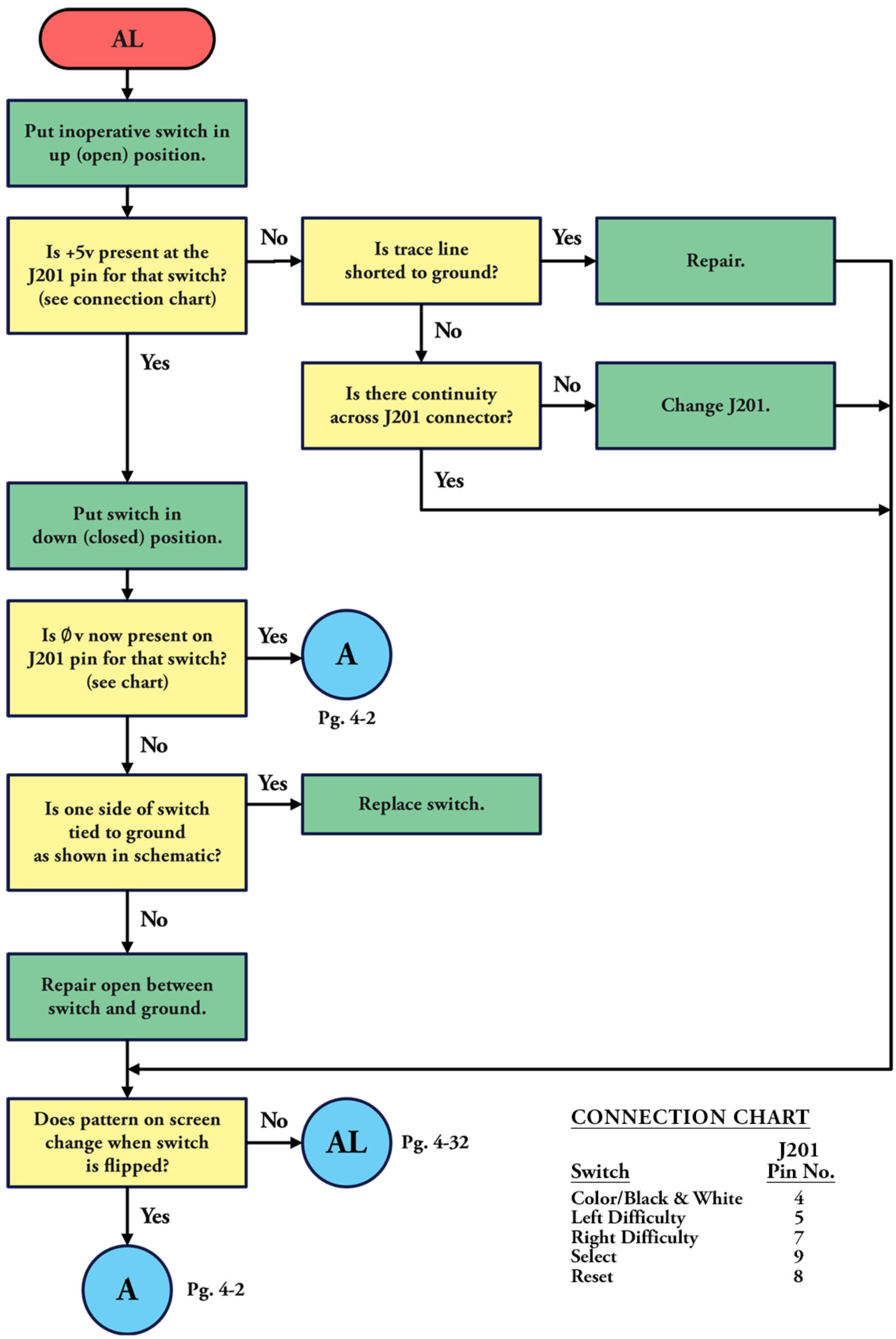


Audio Troubleshooting Procedure
Motherboard (Continued)



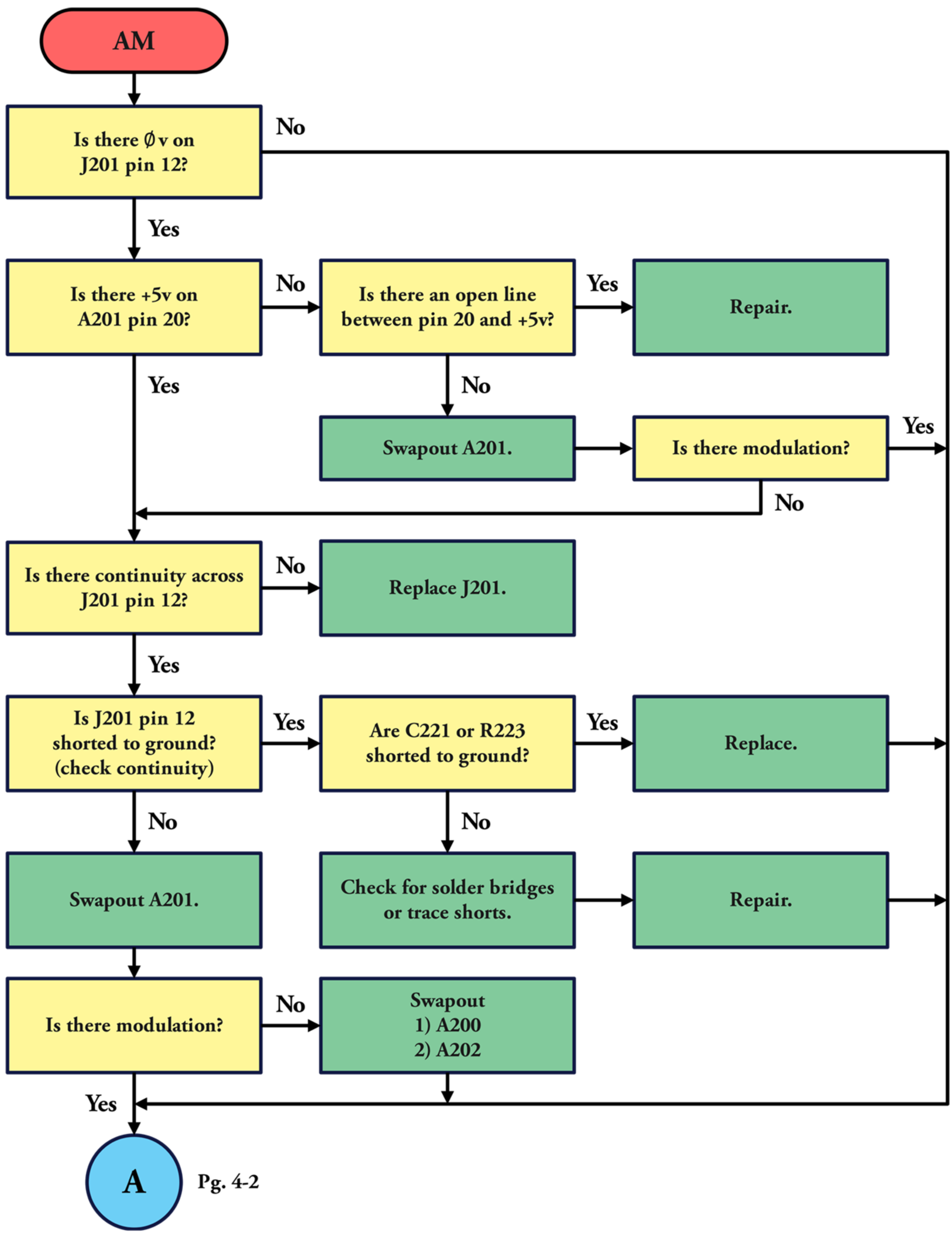

AJ
DTC works, but VCS unit is still suspect.
Plug in customer cartridge, if available.
Not Available
AK
Pg. 4-31
Available
Connect, initialize, and turn VCS on with customer's game cartridge.
Does correct video pattern for that game appear?
No
Yes
Play game. Does it play OK?
Yes
AK
Pg. 4-31
No
Check customer cartridge on known good VCS. Is it OK?
Yes
No
Replace with good cartridge.
AK
Pg. 4-31
Swapout
1) A201
2) A200
3) A202
Does game now operate properly with game cartridge?
Yes
AJ
Pg. 4-30
No
D
Pg. 4-45


AK
Place customer cartridge in VCS, if available. Otherwise, use other game cartridge.
Run game for 2 hours, minimum. Do not turn off during this period.
Check game's operation.
Is game working properly?
Yes
End of test sequence.
No
A
Pg. 4-2

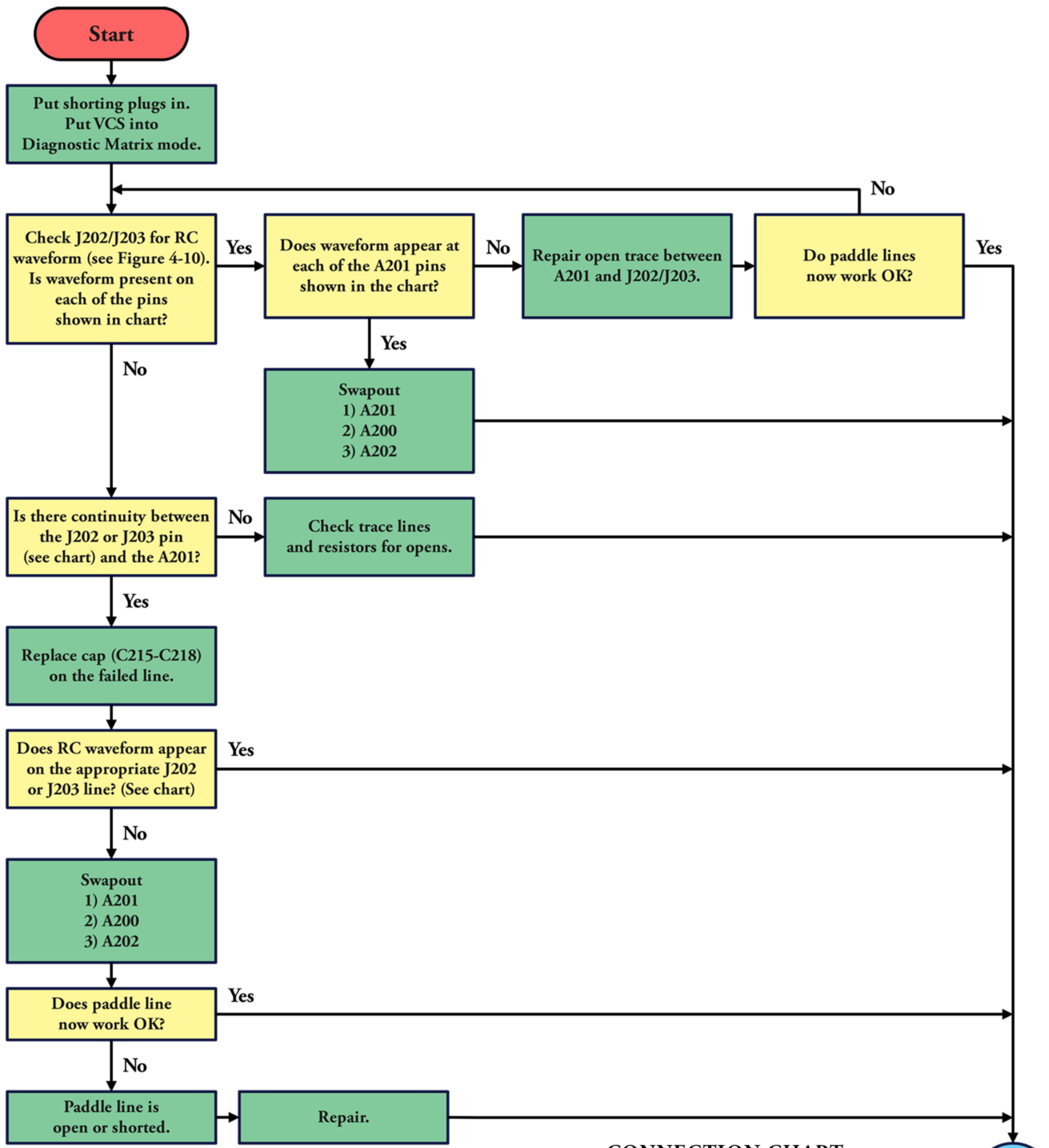


CONNECTION CHART

Switch	J201 Pin No.
Color/Black & White	4
Left Difficulty	5
Right Difficulty	7
Select	9
Reset	8


AM
Is there Øv on J201 pin 12?
No
Yes
Is there +5v on A201 pin 20?
No
Is there an open line between pin 20 and +5v?
Yes
Repair.
No
Swapout A201.
Is there modulation?
Yes
No
Yes
Is there continuity across J201 pin 12?
No
Replace J201.
Yes
Is J201 pin 12 shorted to ground? (check continuity)
Yes
Are C221 or R223 shorted to ground?
Yes
Replace.
No
Swapout A201.
No
Check for solder bridges or trace shorts.
Repair.
Is there modulation?
No
Swapout
1) A200
2) A202
Yes
A
Pg. 4-2

Paddle Lines Test



CONNECTION CHART

Player	Pin A201	Pin J202	Pin J203	Cap No.
1	40	5	--	C215
2	39	9	--	C216
3	38	--	5	C217
4	37	--	9	C218

NOTE: The following figures are referenced in the 2600/2600A Diagnostic Flowcharts, Sections 4 and 6, and are included here for your convenience. They can also be found in Section 3, where the tests are described in more detail.

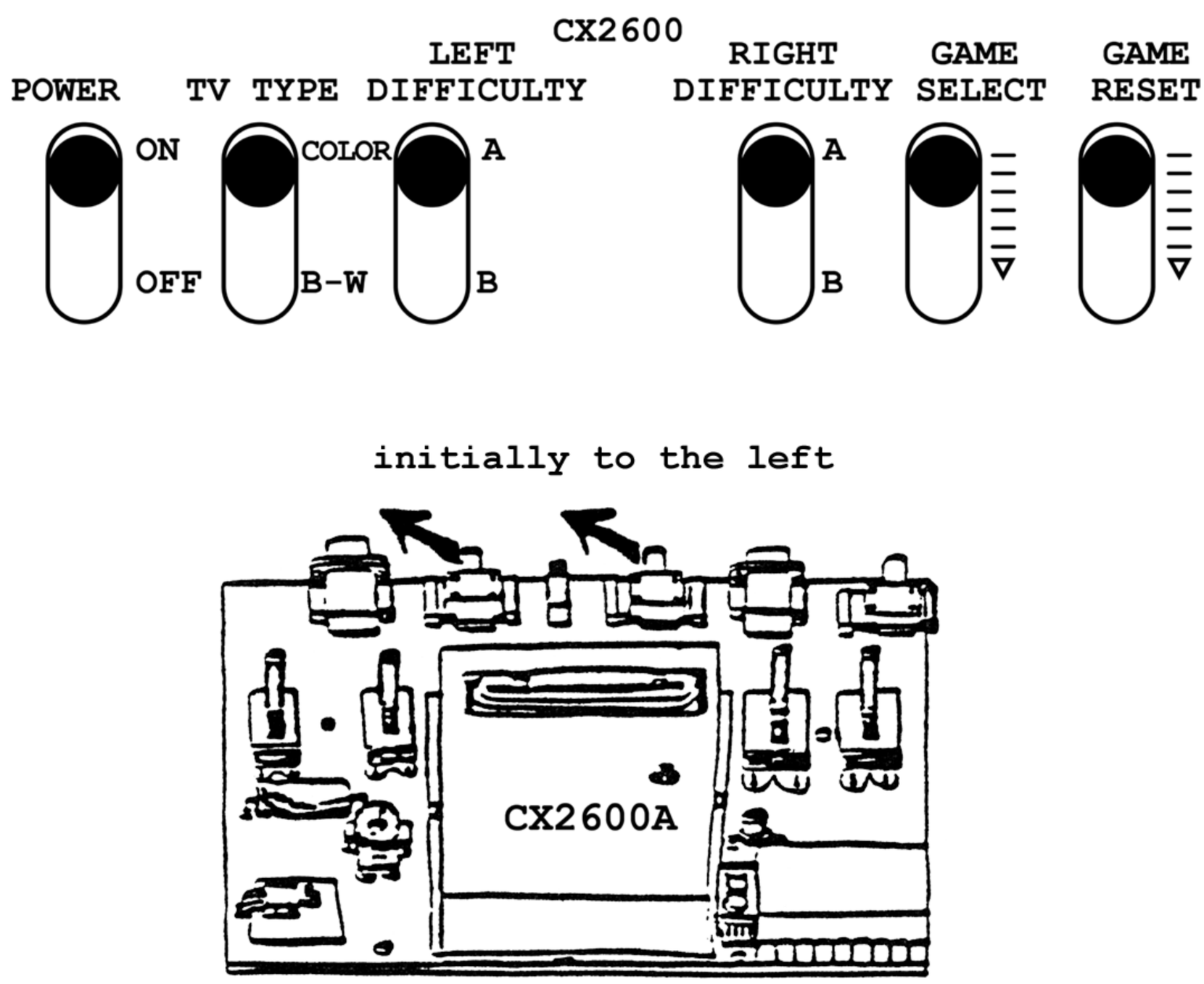


Figure 4-1. Switch Initialization Positions

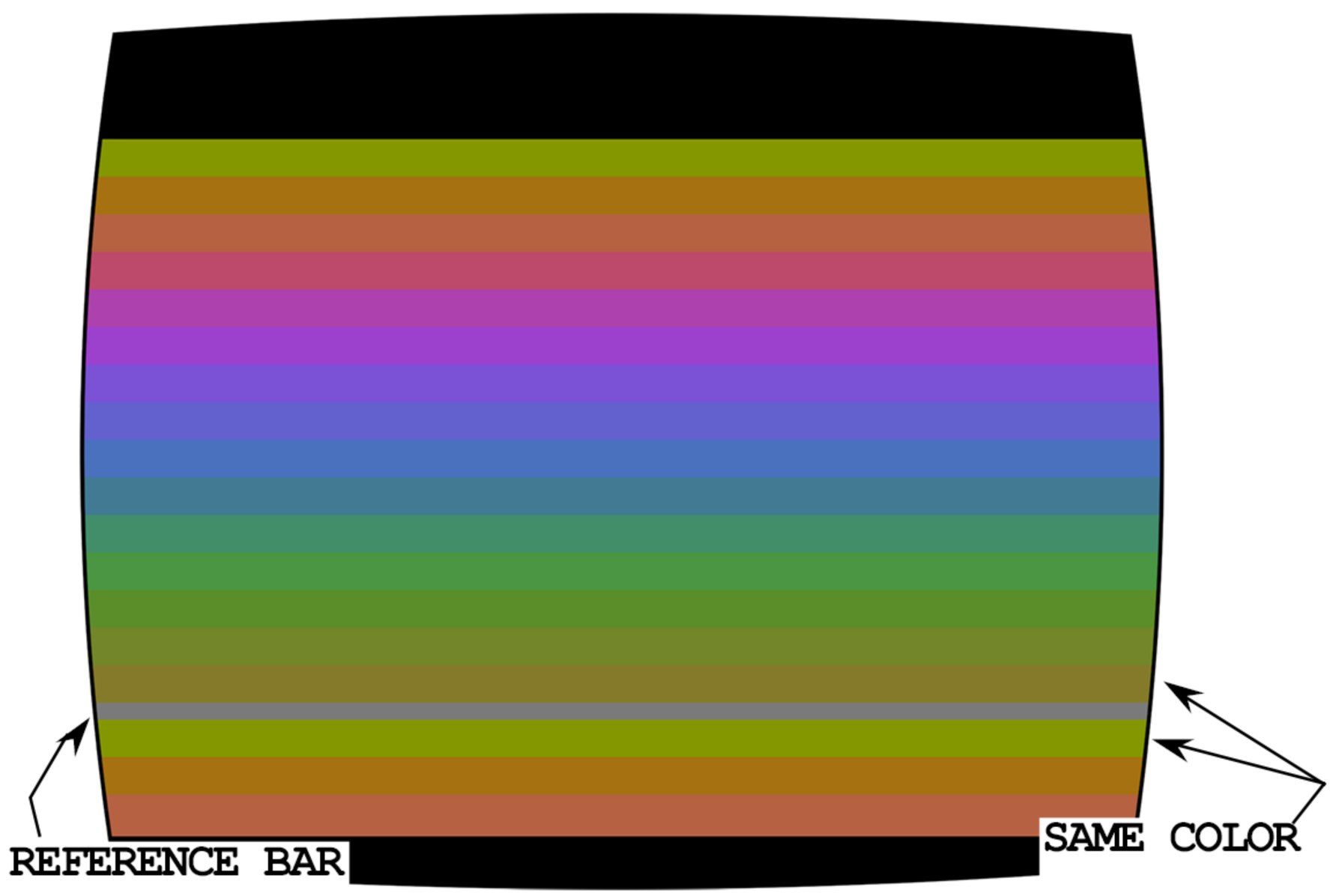
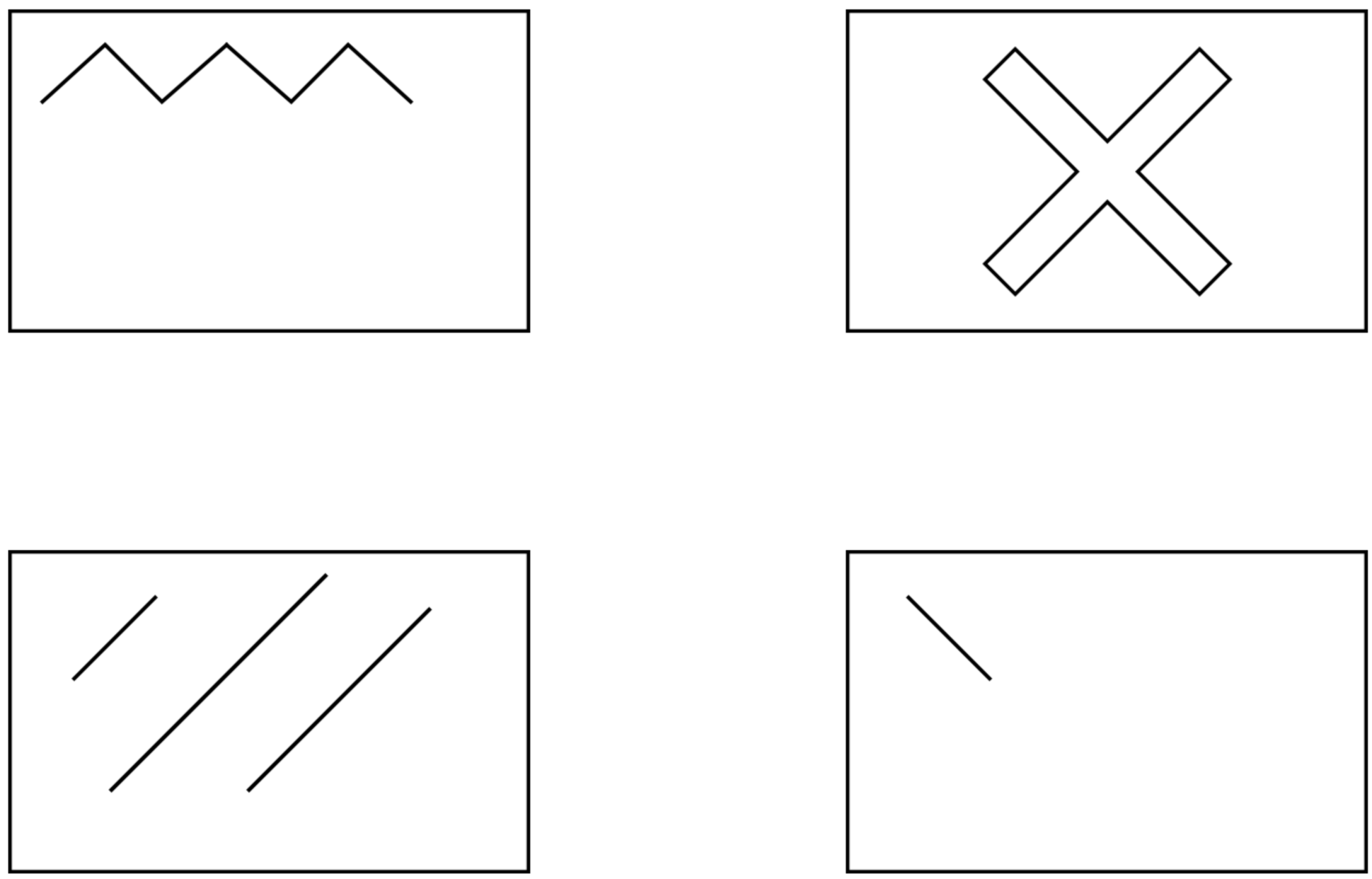


Figure 4-2. Color Bars Screen

NOTE: Set all switches to initialization position. A screen of horizontal color bars is displayed (see Figure 4-2). The screen should be steady and unchanging. A gray or blue horizontal reference line runs across the screen about three bars from its bottom. This reference line is thinner than the bars around it. R211 (R213 on the 2600A board) should be adjusted so the bars immediately above and below the reference line are within one shade of each other. Proper operation of the unit is indicated by being able to make this adjustment and by consistent color within the entire span of each bar on the screen. Minor glitches on the edges of the color bars are acceptable. Leave this test on for at least ten seconds in order to catch any intermittent problems, such as a bar momentarily changing colors or blanking out.



ANY DIAGONAL LINES ON THE SCREEN INDICATE A FAILURE IN THE RAM CHIP (A202).

Figure 4-3. Defective RAM Patterns

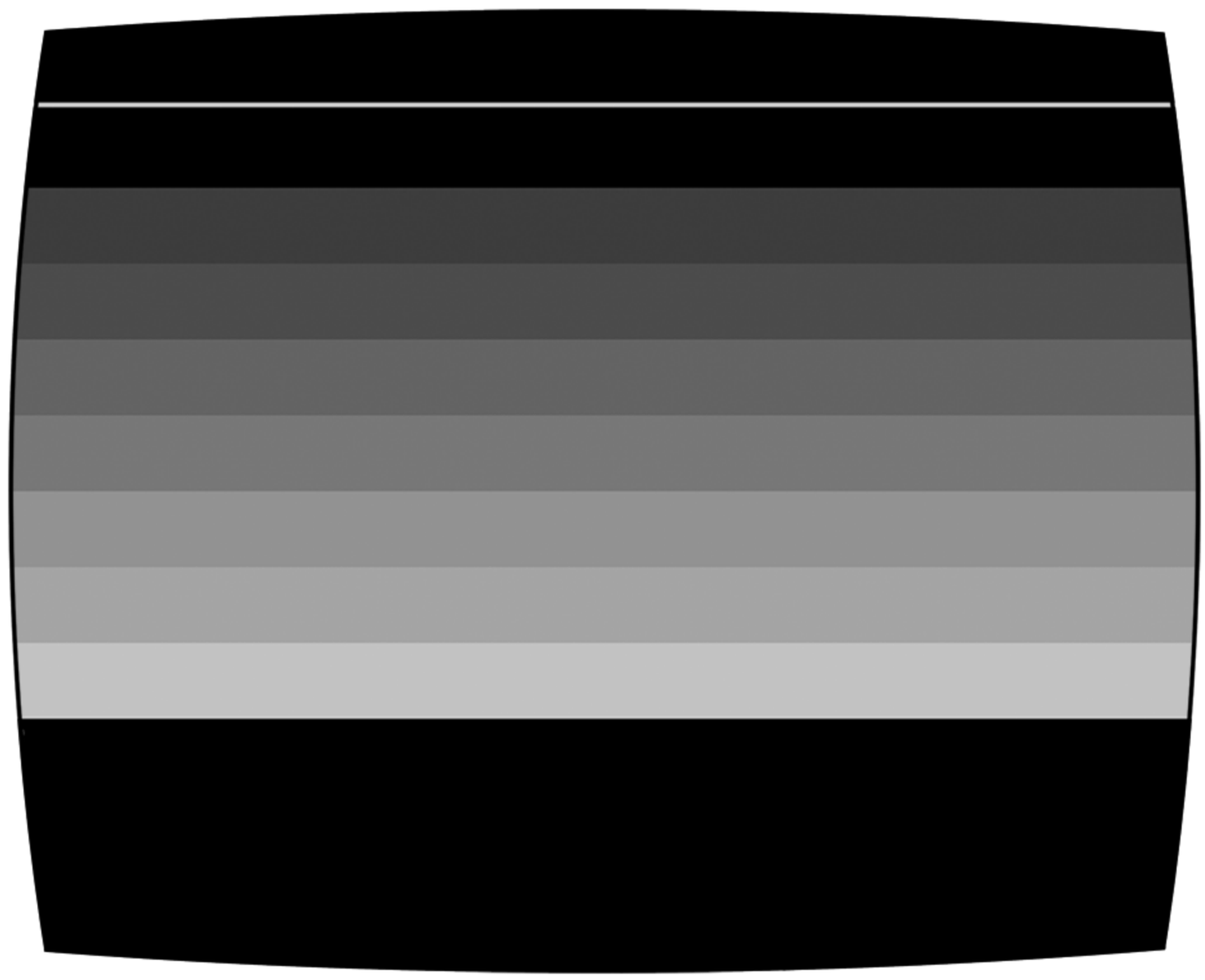


Figure 4-4. Gray Bars Screen

The gray bars screen has eight horizontal shaded bars. It is normal for the bars to have some uneven areas on the upper and lower edges. The bars must appear (in descending order) as going from black to white in even steps. The screen may not have any color in it. All eight bars must be consistent in their shade across the entire bar. The area on the screen outside the bars is irrelevant. The white line immediately above the top bar (black) is normal. This screen tests the operation of the chip set, especially the TIA (A202).

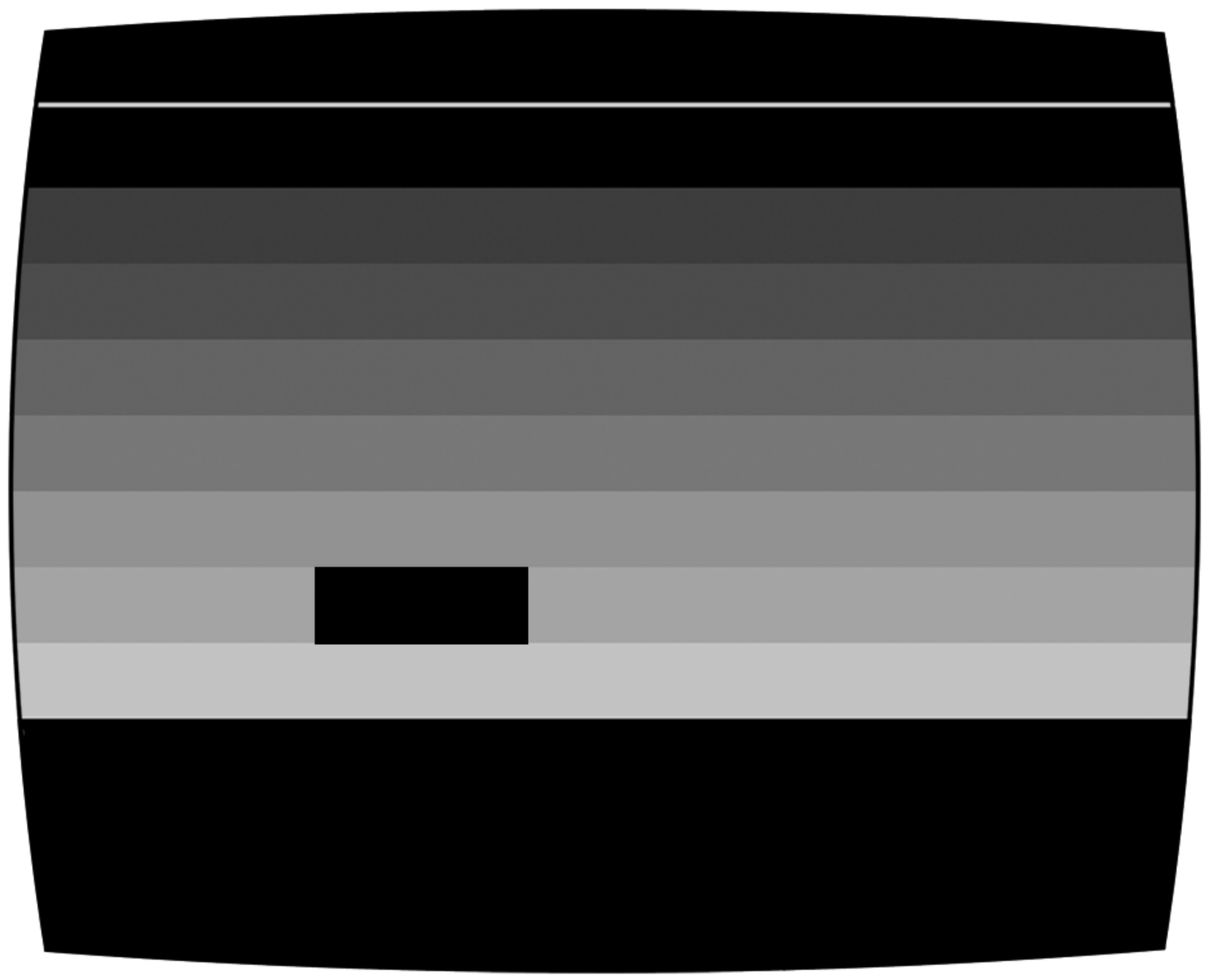


Figure 4-5. Defective Gray Bars Screen

This screen shows an example of a defective gray bars test screen. The appearance of a black rectangle in the middle of a light gray bar means that the data for that part of the screen has failed to be translated properly to the TV. Any disruption of the standard gray bars pattern (See Figure 4-4) or any color in the gray bars screen indicates a failure.

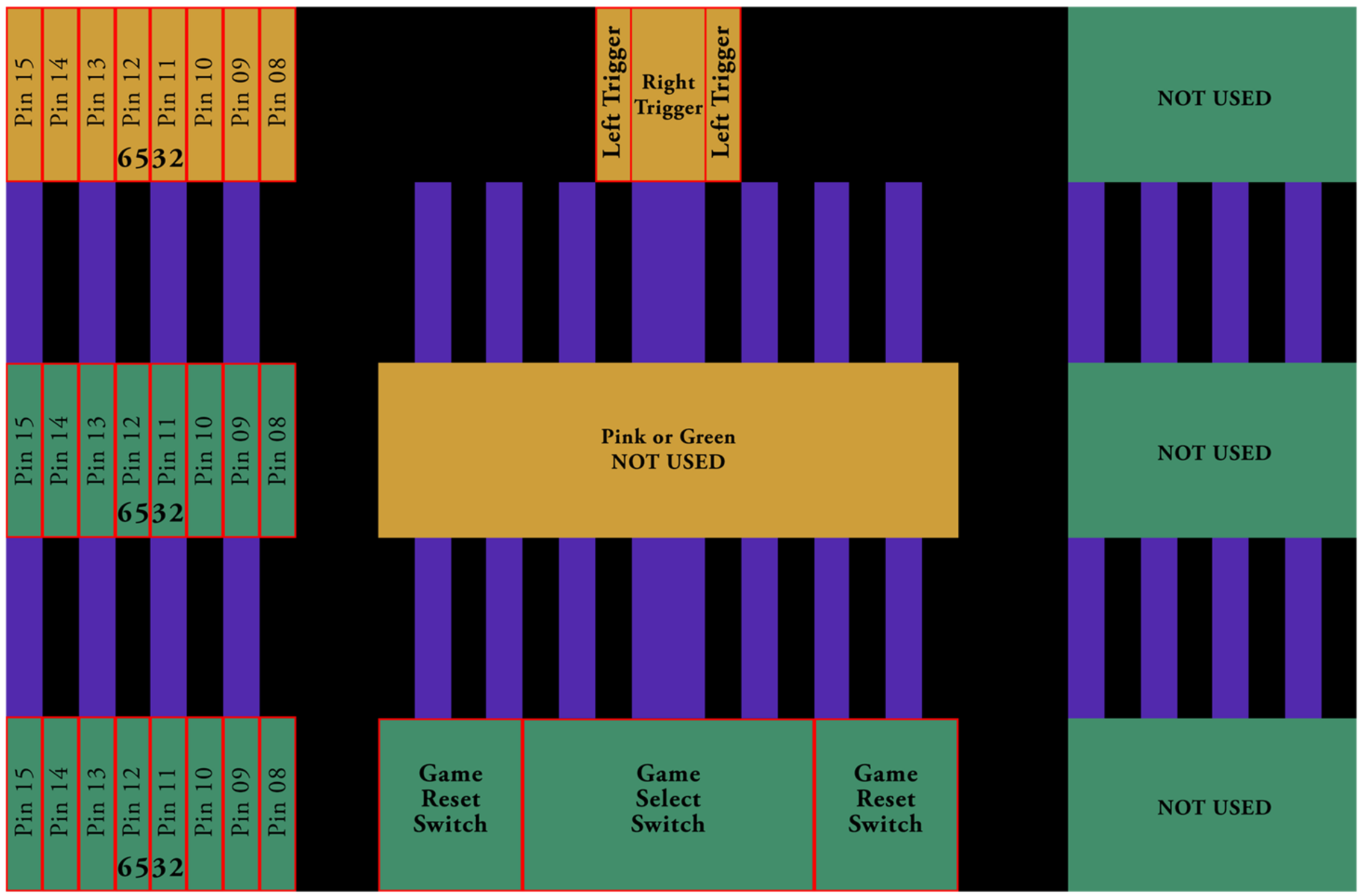


Figure 4-6. Diagnostic Matrix Screen
(Shorting Plugs OUT)

The Diagnostic Matrix Screen appears as above, on a black background, when the shorting plugs are not inserted. The three left rectangles and the blue/black grid joining them indicate the status of the I/O line connections to the 6532 RAM chip (A202).

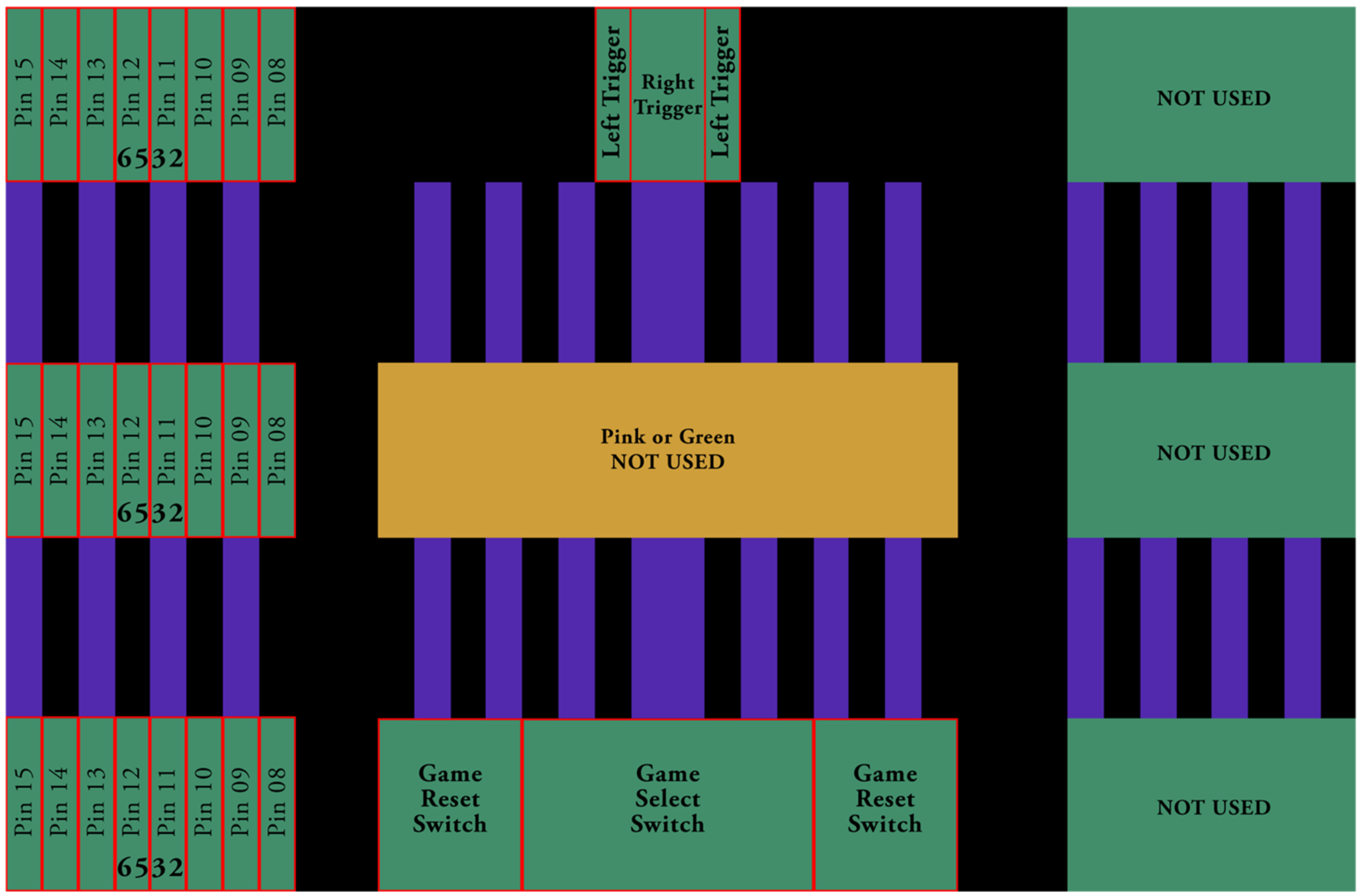


Figure 4-7. Diagnostic Matrix Screen
(Shorting Plugs IN)

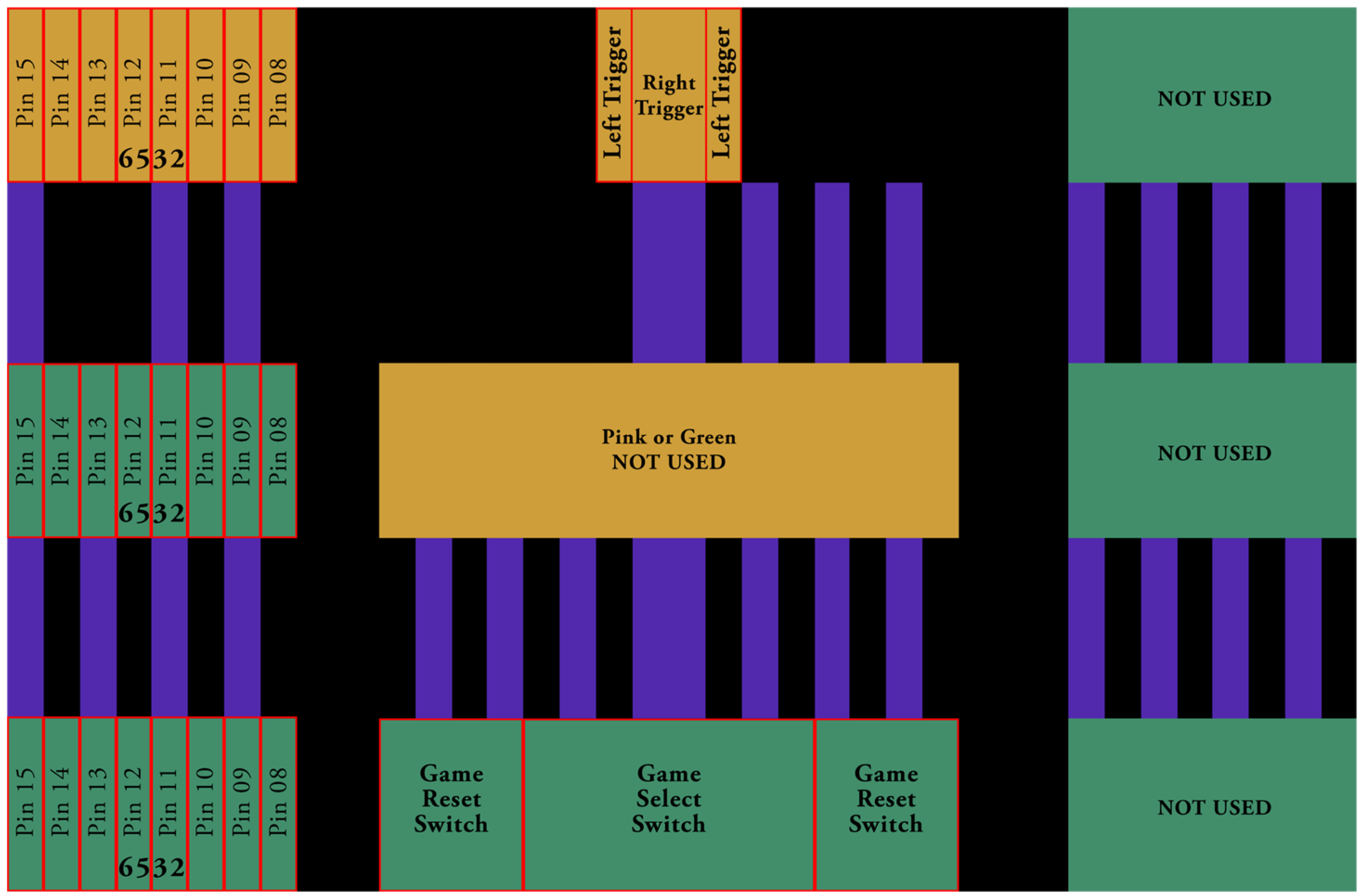


Figure 4-8. Diagnostic Matrix Screen with Defective Pattern

Any missing grid lines or disrupted rectangles indicate an I/O line failure (see page 4-26). Any missing or disrupted blue or black reference lines indicate that there has probably been a microprocessor failure (see page 4-23).

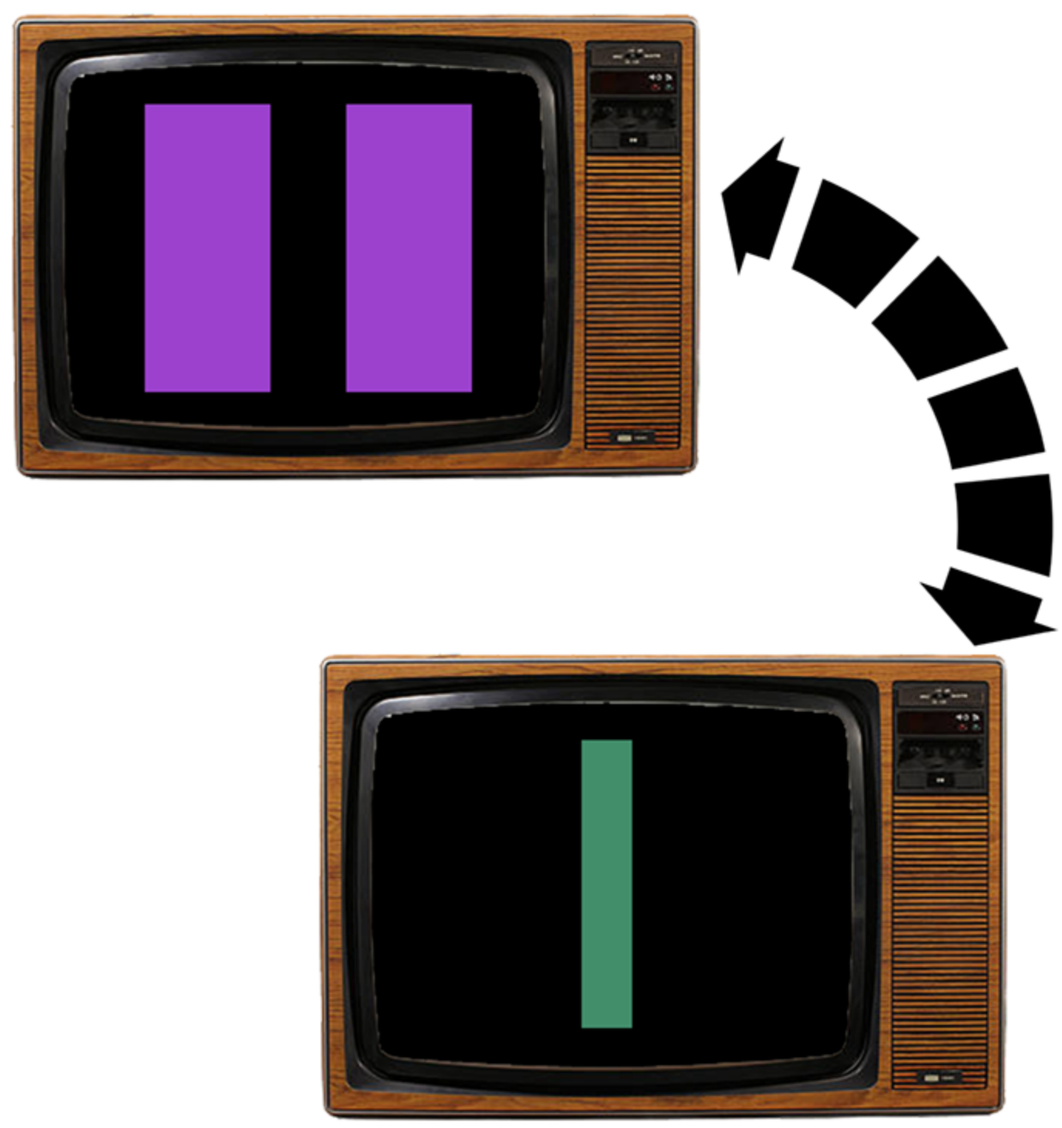
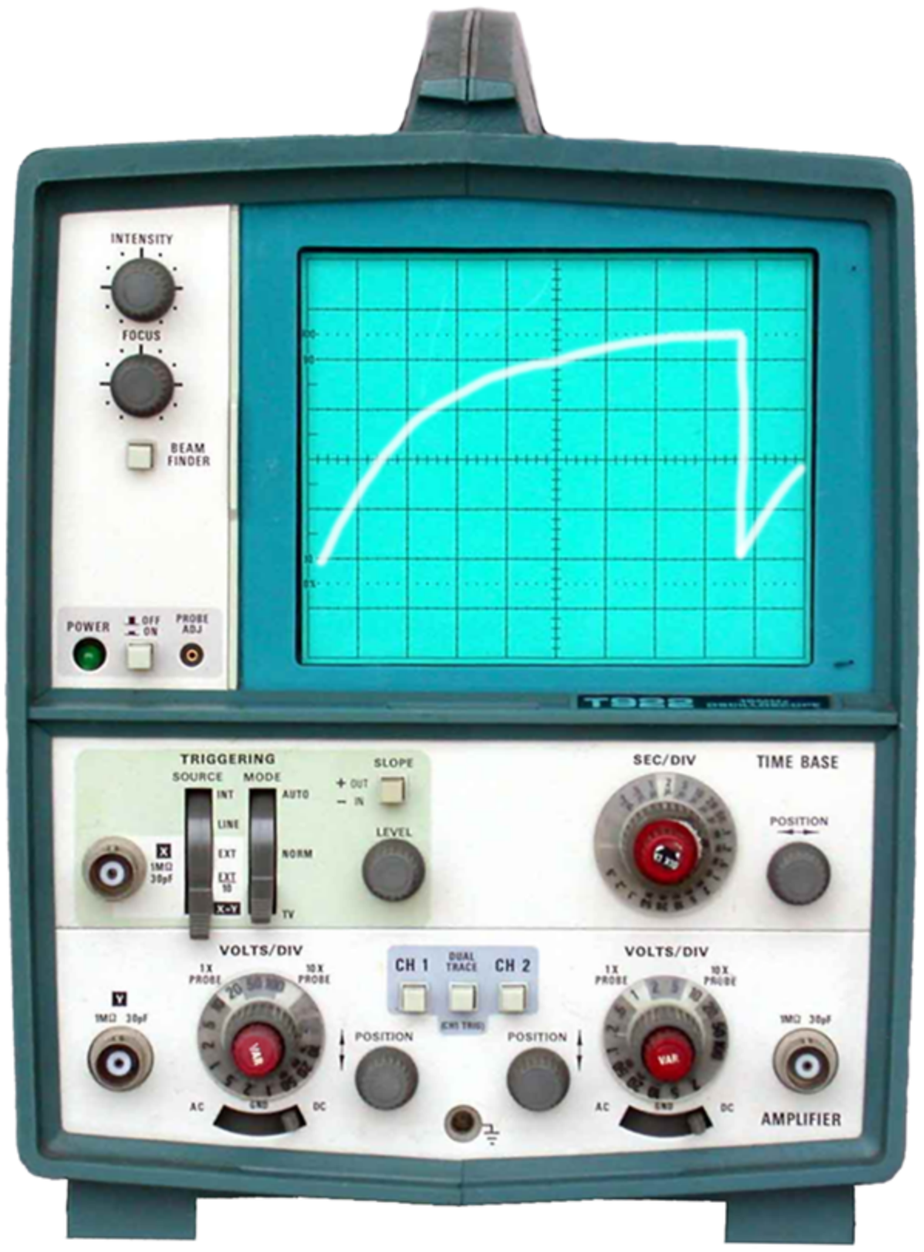
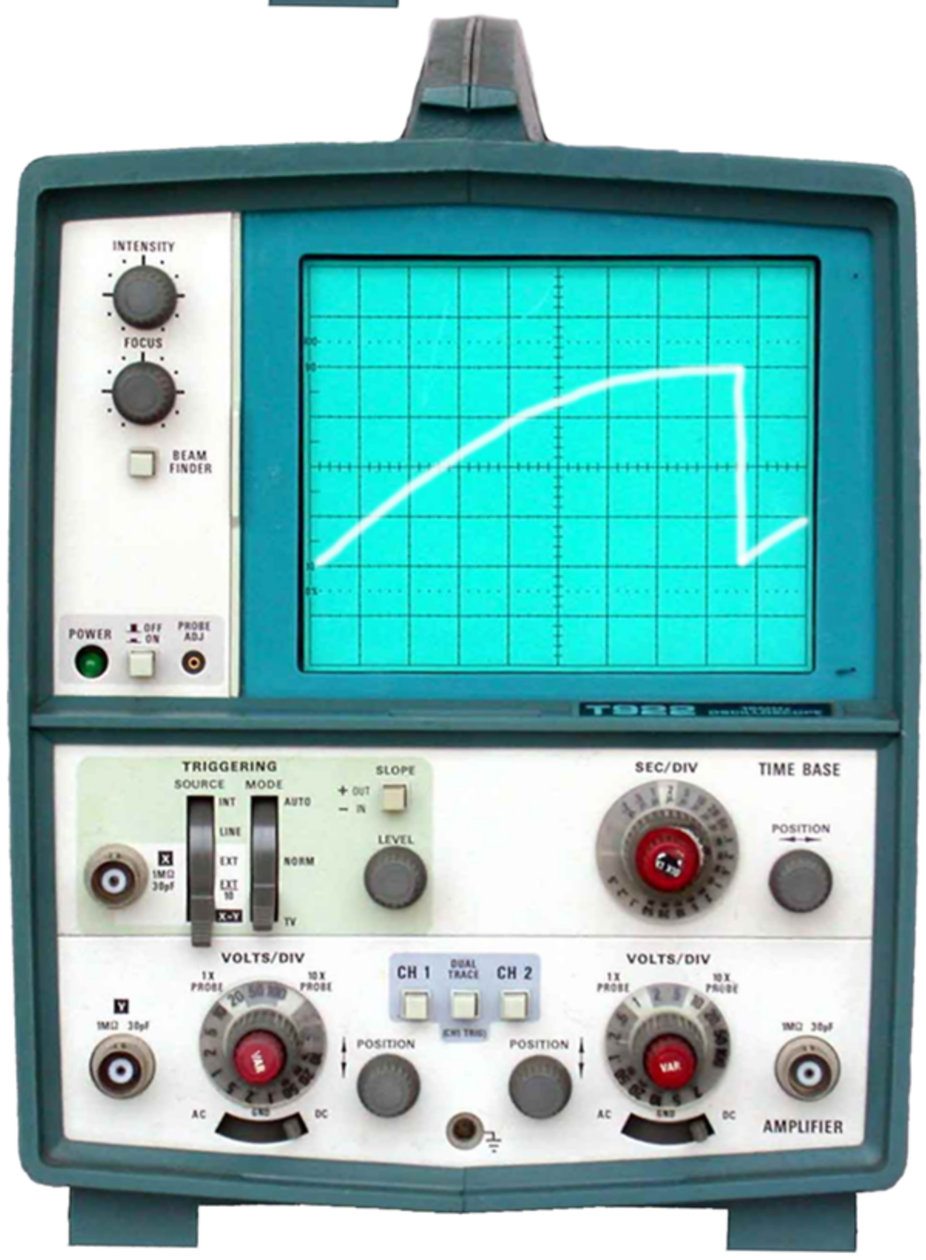


Figure 4-9. Audio Tone Test Screens

The test displays two alternating patterns on the screen (as shown in Figure 4-9) while two alternating tones are heard. The tones change in sync with the screen. This test pattern continues for one full cycle after the Right Difficulty switch has been switched to stop the test.



2ms/div.
1v/div.
Pin 37 and Pin 39



2ms/div.
1v/div.
Pin 38 and Pin 40

Figure 4-10. RC Waveforms

D

SIGNAL TRACING CARTRIDGE (KLUGE) PROCEDURE

The Signal Tracing Cartridge (STC) is used to locate easily open or shorted traces in the address and data lines of the 2600/2600a. The STC causes the 6507 microprocessor (A200) to cycle through the entire memory space while executing "no operation" instructions. This is valuable because it puts a known signal on each address and data line. Then the signal can be traced through to the J200 connector, the TIA and RAM-I/O chips.

Since the STC procedure is not easily reduced to a flowchart, it is presented as a series of written instructions and illustrations on the following pages.

CAUTON: The STC procedure requires three known-good chips and a working clock circuit. The STC should only be used after all other procedures have been tried.

GETTING STARTED

Insert the STC into the 2600/2600A. Turn on the unit. The television screen should be gray or black. If it is "snowy" it indicates that you should return to the start of the Diagnostic Flowchart. Set the scope sweep to .5 microsec/division and set the vertical to 1 volt/division.

ADDRESS LINES AB0 - AB12

Check the address lines at the microprocessor (A200). Check address lines, starting with pin 5. A signal with a waveform similar to those shown in Figure 4-11 should be seen on the address lines, with each succeeding address line's waveform having a frequency half that of the line before it. For example, A1 should be half the frequency of A0. If one or more of the address lines shows no signal, it is likely that the line is either open or shorted to ground or +5v. Check all traces and pins for shorts.

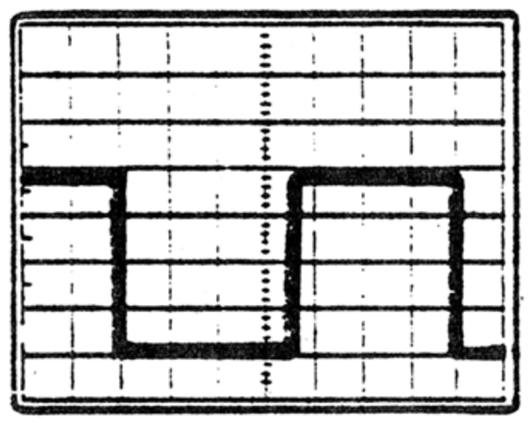
If you have a defective address line and it is not open or shorted, swapout the A200, A202 and A201, in that order.

If all address lines have signals, trace those signals to the J200 and the others chips. Table 4-1 illustrates which address lines connect to which pins on J200, 6532, and the TIA. The signal present on each address line of the microprocessor should also be present on each pin of J200, 6532, and the TIA connected to that line. If the same signal is not found, the trace line and/or solder joints between the microprocessor and the dead pin(s) is (are) broken. Check the trace lines carefully to locate the break.

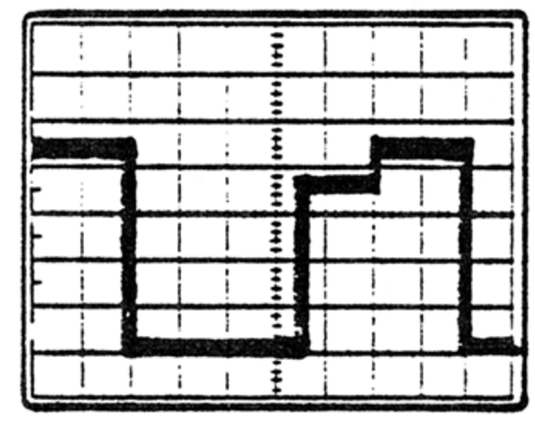
DATA LINES DB0-7

Set the vertical on your scope to 2v/division. The data lines are tested very much like the address lines. The only difference is that the waveform seen on the data lines is different. The signals you should see are illustrated in Figure 4-12. If any data lines are completely inactive (simply remaining a constant voltage), it probably means that the line is either open or shorted to ground or +5v. Check the traces and pins for shorts. If none are found, one of the three chips or the STC itself probably has an internal short. Try swapping out the 6532, TIA, and the microprocessor. Also carefully check J200 for shorts between pins.

If all data lines have signals, trace those signals to J200 and the other chips. Table 4-1 illustrates which lines connect to which pins of J200, 6532 and the TIA. The signal present on each data line of the microprocessor should also be present on each pin of J200, 6532 and the TIA connected to that line. If the same signal is not found, the trace line and/or solder joints between the microprocessor and the dead pin(s) is (are) broken. Check the trace lines carefully to locate the break.

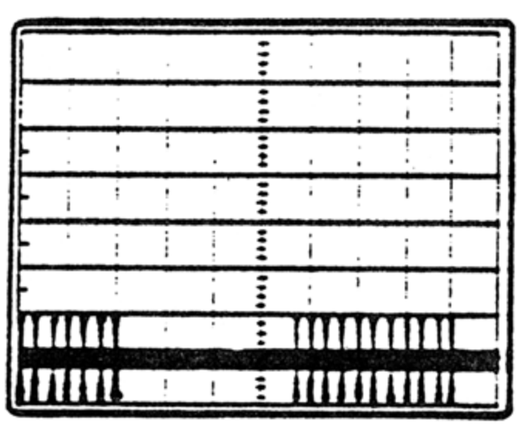


Address lines 0, 7-12
1v/division

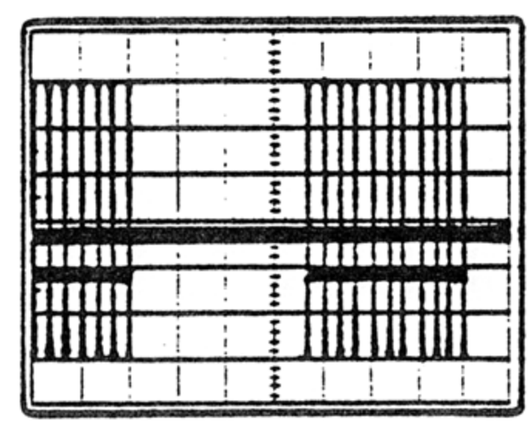


Address lines 1-6
1v/division

Figure 4-11. STC Address Line Waveforms



Data Lines 0,2 and 4
2v/division
2ms./division



Data Lines 1,3,5-7
2v/division
2ms./division

Figure 4-12. STC Data Line Waveforms

TABLE 4-1

Connected Pins on Motherboard

ADDRESS LINES	A200 (MPU)	A201 (TIA)	A202 (RAM)	J200 Connector
AB0	5	32	7	8
AB1	6	31	6	7
AB2	7	30	5	6
AB3	8	29	4	5
AB4	9	28	3	4
AB5	10	27	2	3
AB6	11	--	40	2
AB7	12	21 (CS3)	38 (CS1)	1
AB8	13	--	--	22
AB9	14	--	36 (RS)	21
AB10	15	--	--	19
AB11	16	--	--	20
AB12	17	24 (CS0)	37 (CS0)	18
DATA LINES:				
DB0	25	14	33	9
DB1	24	15	32	10
DB2	23	16	31	11
DB3	22	17	30	13
DB4	21	18	29	14
DB5	20	19	28	15
DB6	19	33	27	16
DB7	18	34	26	17

-- Indicates no connection on that line