

5

Detailed Circuit Troubleshooting/Analysis

Chapter 5 covers the detailed troubleshooting analysis associated with the IBM PC. The chapter is divided into five parts as follows:

1. Start-up problems
2. Run problems
3. Display problems
4. Keyboard problems
5. Other I/O problems

Each malfunction in the computer can be associated with one of these areas. A key problem page index covering each of these five general areas is included to provide both classical and flowchart troubleshooting support. Using the index, you can quickly locate a particular problem area for analysis.

Part 1 covers the symptoms that can occur during initial power-up including no power and no disk boot-up operation. Each PC comes with a built-in diagnostic test program and most technicians have a diagnostic disk to use with the built-in diagnostics. It's possible to get a system error number printed on the screen during start-up that helps localize a malfunction to a particular part of the machine. Error codes were described in Chapter 4.

Part 2 discusses the failure symptoms that can occur after initial boot-up, during system operation. These malfunctions include faulty disk read/write operation, bad memory, and program lock-up.

Part 3 addresses difficulties associated with the display portion of the computer. This section includes no display, no text mode, no high resolution or no low resolution, video synchronization failures, character faults, bad graphics, and other problems.

Keyboard problems are detailed in Part 4. This section covers such faults as single and multiple key operation failures, and unwanted repeat action.

Part 5 encompasses other input and output problems, including speaker faults, cassette I/O failures, and light pen malfunctions.

Each part is subdivided into unique failures and provides symptom and repair action or page reference for each circumstance. This data is followed with classical and step-by-step flowchart troubleshooting instructions. Where appropriate, **COMPUTERFACTS** pages are referenced (for example, CF page 2). Occasionally, in the classical troubleshooting description, a statement is made directing the reader to "check to specs" a

particular part. This means that all the IC input and output pins should be monitored to determine if the correct signals are present on all pins. Sometimes, a flip-flop is being tested. Then, the clock and any preset/preclear inputs should be evaluated with the normal input and output pins.

As you use this manual, you will discover many useful hints for both troubleshooting and repair. Be especially alert to the cautions since further system degradation can occur if you do not follow those procedures exactly as listed.

Before continuing, make sure you've read Chapter 4 and understand the preliminary checks that can be made before dealing with detailed analysis. Few things are as humbling as disassembling a system for troubleshooting and repair, and then discovering that the problem was caused by a bad cable between the IBM system unit and the monitor.

This chapter will not directly discuss malfunctions of components like resistors and capacitors because catastrophic failures of these passive devices are usually quite visible during

examination of the system board and peripheral cards. If you feel that a resistor or capacitor has failed, check the component resistance with an ohmmeter. The resistor value should closely approximate that of the code printed on the part (and as listed in the schematic), and the capacitor should not register a short. Most capacitor failures are obvious because caps usually blow apart or char in the circuit. A preliminary check statement referring to "visually examining" a board or card means look for charred, hot, or physically broken parts.

To complement the COMPUTERFACTS component layout photos, the following board layouts will aid in quickly locating possible bad ICs. Figure 5-1 is an IC layout diagram for the IBM PC system board. Figure 5-2 is an IC layout for the color/graphics adapter, and Figure 5-3 shows the board layout of the monochrome display/printer adapter. Figure 5-4 is an IC layout diagram for the disk drive adapter card, and Fig. 5-5 shows the IC layout for the disk drive analog card.

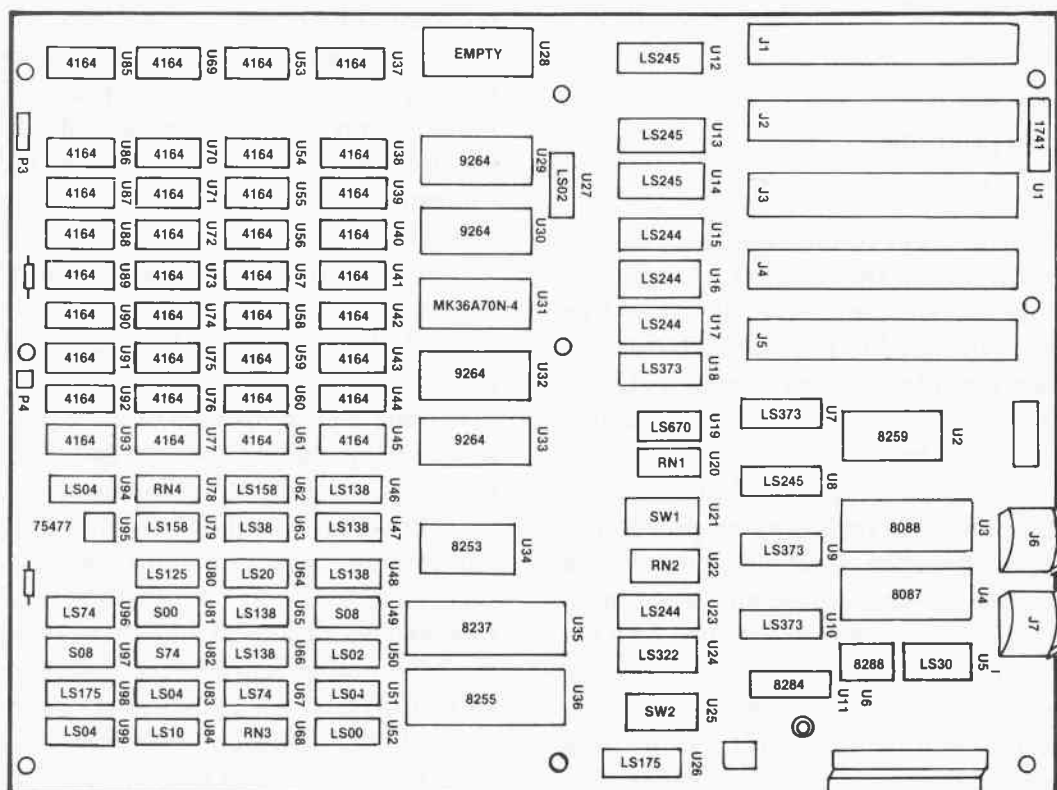


Fig. 5-1. IC layout for IBM PC system board.

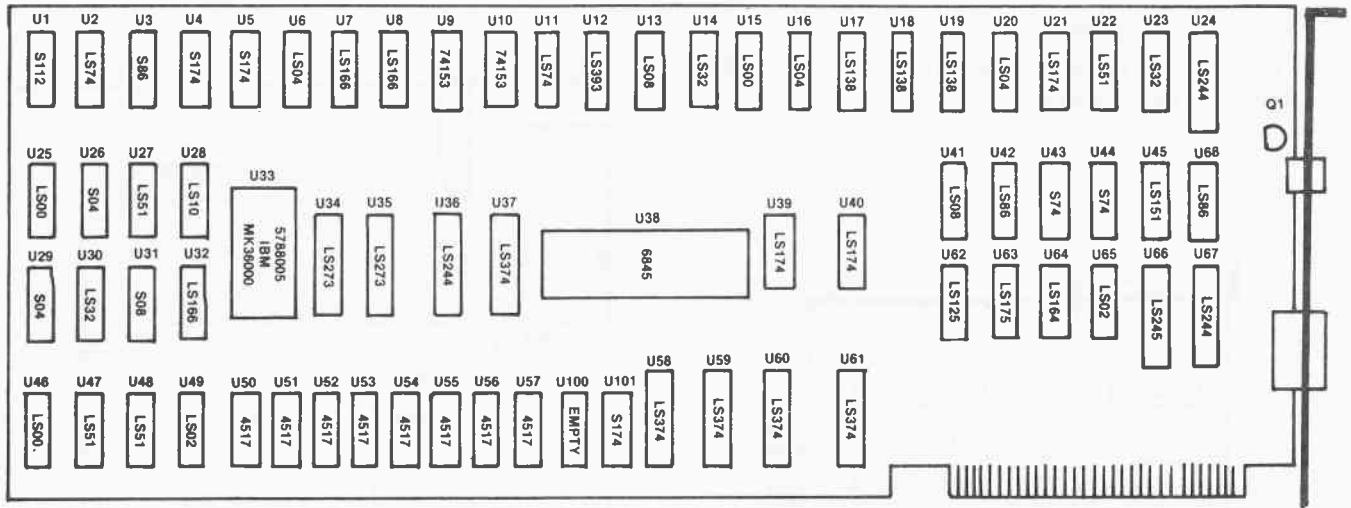


Fig. 5-2. IC layout diagram for color/graphics adapter card.

Note: The following troubleshooting techniques may require soldering, be sure you are proficient at this process before you proceed.

Caution: Opening the IBM PC system unit may void its warranty.

TROUBLESHOOTING CONTENTS

1. Start-Up Problems

Won't boot, no fan, screen blank	199
Won't boot, fan works, screen blank	199
Won't boot, both drive lights on	200

2. Run Problems

Can't read from one drive	202
Can't read from either drive	206
Can't write to one drive	206
Can't write to either drive	207
Can't access either drive.	
No drive access lights.	
No drive motor energized.	207
Drive destroys data on write-protected disk.	209
Computer locks up, no response from keyboard.	210
Power turns off after running for a while	212

3. Display Problems

(Monochrome monitor and adapter)

No display	212
No horizontal synchronization	213
No vertical synchronization	215
No low res or high res display.	215
Bad characters	215

(Color/Graphics monitor adapter)

No display.	216
No horizontal synchronization	217
No vertical synchronization	219
No text, graphics works	220
No graphics, text works	221
Bad characters	221
Bad or no color (image correct)	226
Cursor missing or not blinking.	227

4. Keyboard Problems

Keyboard won't respond at all or wrong character is produced	228
Bad key action—some or one key won't work	230
Unwanted key repeat action	230

5. Other I/O Problems

Cassette—can't write data to tape	231
Cassette—can't load data from tape	236
Light pen won't work.	236

Printer won't print	236
Printer locks up or prints garbage	237
Speaker won't work	237

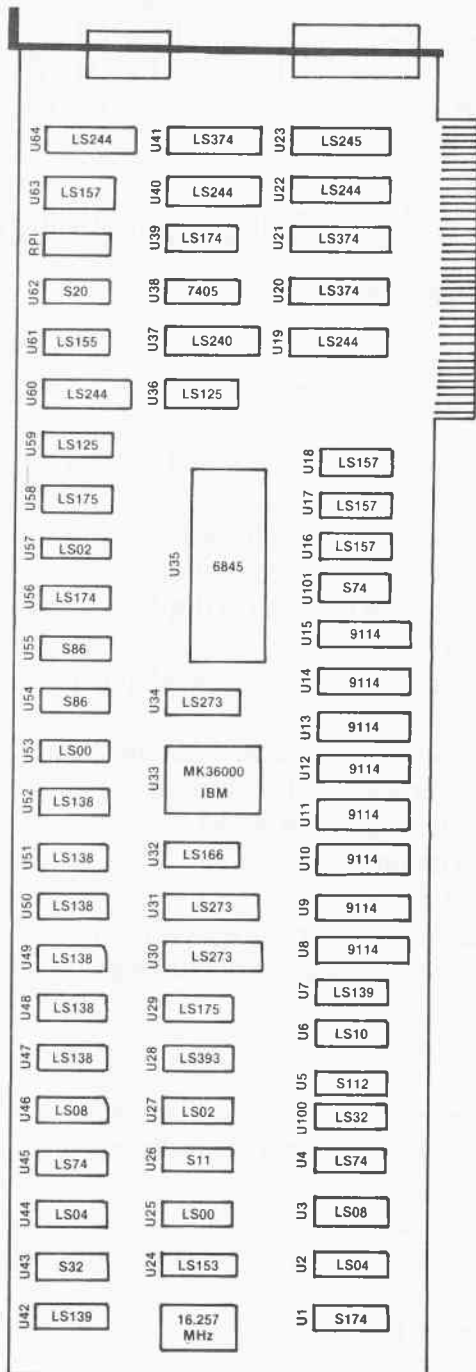


Fig. 5-3. IC layout for the monochrome display/printer adapter.

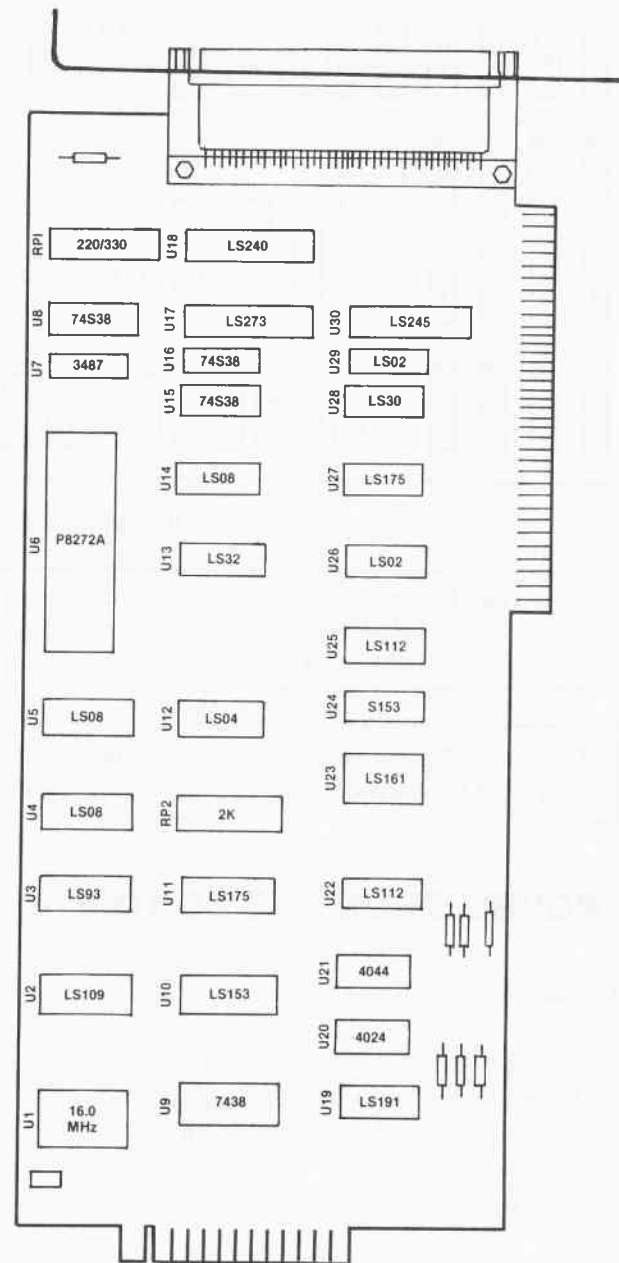


Fig. 5-4. IC layout for disk drive adapter card.

1. IBM PC START-UP PROBLEMS

Four types of error-indications can occur during the initialization or start-up process: beep indicators from the built-in speaker, system error code displays, I/O error code displays, and other error displays. The listing of these codes was covered in Chapter 4. Refer to Chapter 4 if an

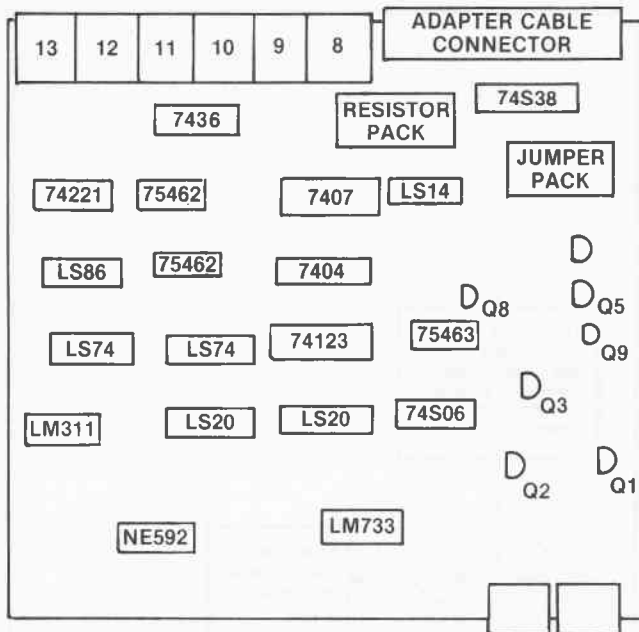


Fig. 5-5. IC layout for disk drive analog card.

error indication occurs. These indications help in isolating a failure to a module, subunit, or peripheral.

Note: If the system won't boot, the IBM PC DOS manual suggests you reread the manual. You can probably deduce a particular problem faster by noting the conditions of the machine at the time of "failure" and following the troubleshooting steps outlined in this chapter.

Many things can cause the computer to boot improperly or not to boot at all: wrong diskette in the drive, no operating system on the diskette, cables loose, adapter card not fully seated, disk drive failure, memory chip bad, no clock pulses, or even a forgotten unplugged power cord.

Select the subcategory that best describes the symptoms and turn to the appropriate page for troubleshooting.

Problem: Won't Boot, No Fan, Screen Blank

Symptom Described

When the ON/OFF switch is rocked to the ON position, nothing happens. No fan sound can be heard.

Preliminary Checks

1. Check that the external power cable is plugged into the system unit and into a wall socket.
2. Check that the fuse (F1) in the power supply is good.
3. Check the power supply cables to ensure that they are properly seated on the system board (P8, P9).
4. Refer to appropriate section in Chapter 4.

Classical Approach

(Figs. 2-1, 2-2, and CF pages 3, 8, 9, 52, and 53 apply) Remove all the peripherals including the disk drive adapter cards. Power up and note if the fan energizes. If it does, turn off the system and plug each peripheral in one at a time, powering up and testing each time to see if a failure on one of the adapter cards is causing the system to malfunction. When failure occurs, the last card plugged in is bad. Check for shorts between power and ground on the failed board.

If the fan does not turn on after all peripherals are removed, power-down, unplug P8 and P9, and check the voltages in the connectors on the cable from the power supply. If proper power is present on the cable pins, turn off the machine and replug P8 and P9 into the system board. Turn power back on and check pin 1 of P8 for +5 volts. If the logic high is not present, go to (2) in flowchart 5-1. If a logic high is present, check for a short on the system board between power and ground.

If the proper voltages are not present on the cable pins of P8 and P9 when the cables are disconnected from the system board, go to flowchart 5-2. (Also see flowcharts 5-3 and 5-4.)

Problem: Won't Boot, Fan Works, Screen Blank

Symptom Described

No cursor, no screen display, no keyboard response, but can hear fan running in power supply.

Preliminary Checks

1. Check cables for proper mating.
2. Clean all edge connectors on adapter cards.
3. Reseat the CPU chip (U3).
4. Visually inspect the system board.
5. Refer to appropriate section in Chapter 4.

Classical Approach (Figs. 2-5, 2-6, and CF pages 2, 4, and 59 apply)

Remove all peripherals except keyboard, monitor with adapter card. Power-up. Does system boot to ROM BASIC? If it does, turn machine off, and reinstall one adapter card at a time, testing after each installation. When the system fails to boot to ROM BASIC, the last card installed is bad.

If the system doesn't boot to ROM BASIC with all peripheral cards except keyboard and monitor adapter cards installed, check for approximately 14.318 MHz signal on pins 16 and 17 of U11. If the signal is not present, replace crystal X1. If the signal is present, check for a 4.7727 MHz signal on pin 8 of U11. If it is not present, check U11 to specs and replace if bad. If it is present, replace ROM U33 and retest. If the system still fails, check CPU U3, U46, and U6 to specs. Replace if bad. Should this not correct the problem, refer to section "Computer Locks Up, No Keyboard Response" and flowchart 5-5.

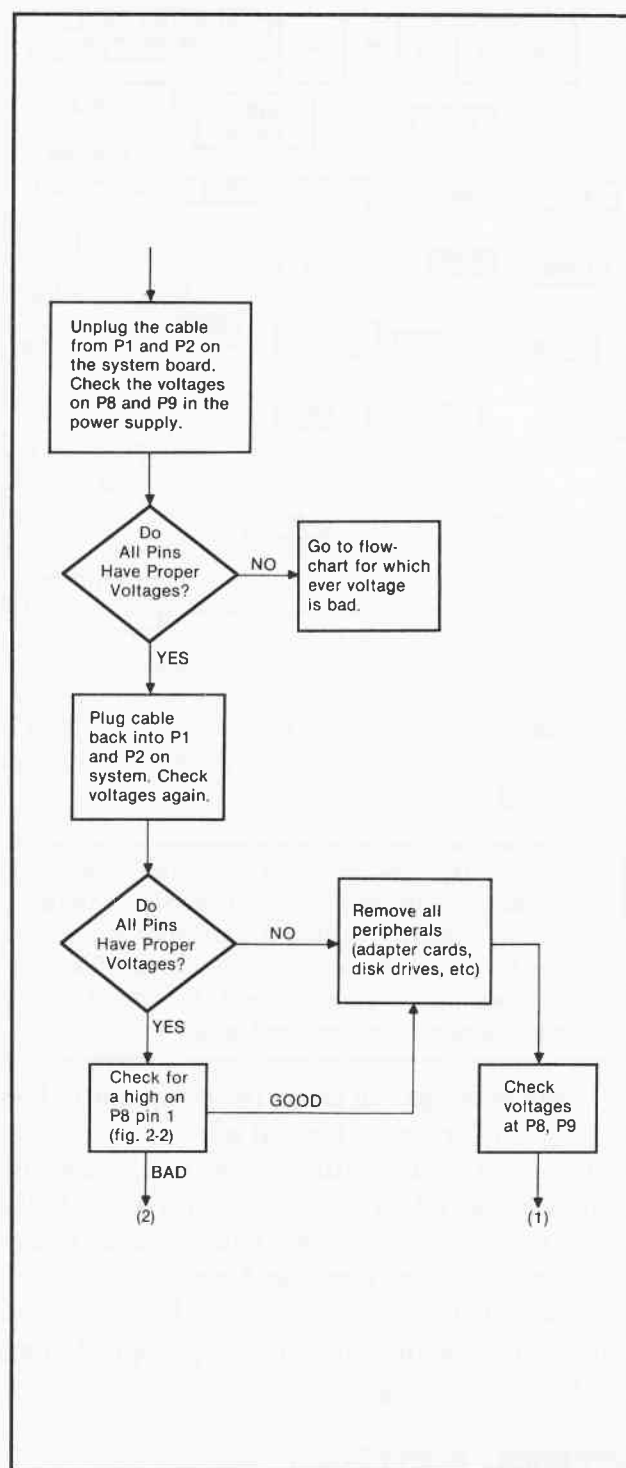
Problem: Won't Boot, Both Drive Lights On

Symptom Described

When system is turned on, drives A and B access indicators light and remain on.

Preliminary Checks (Figs. 2-98 and 2-101 apply)

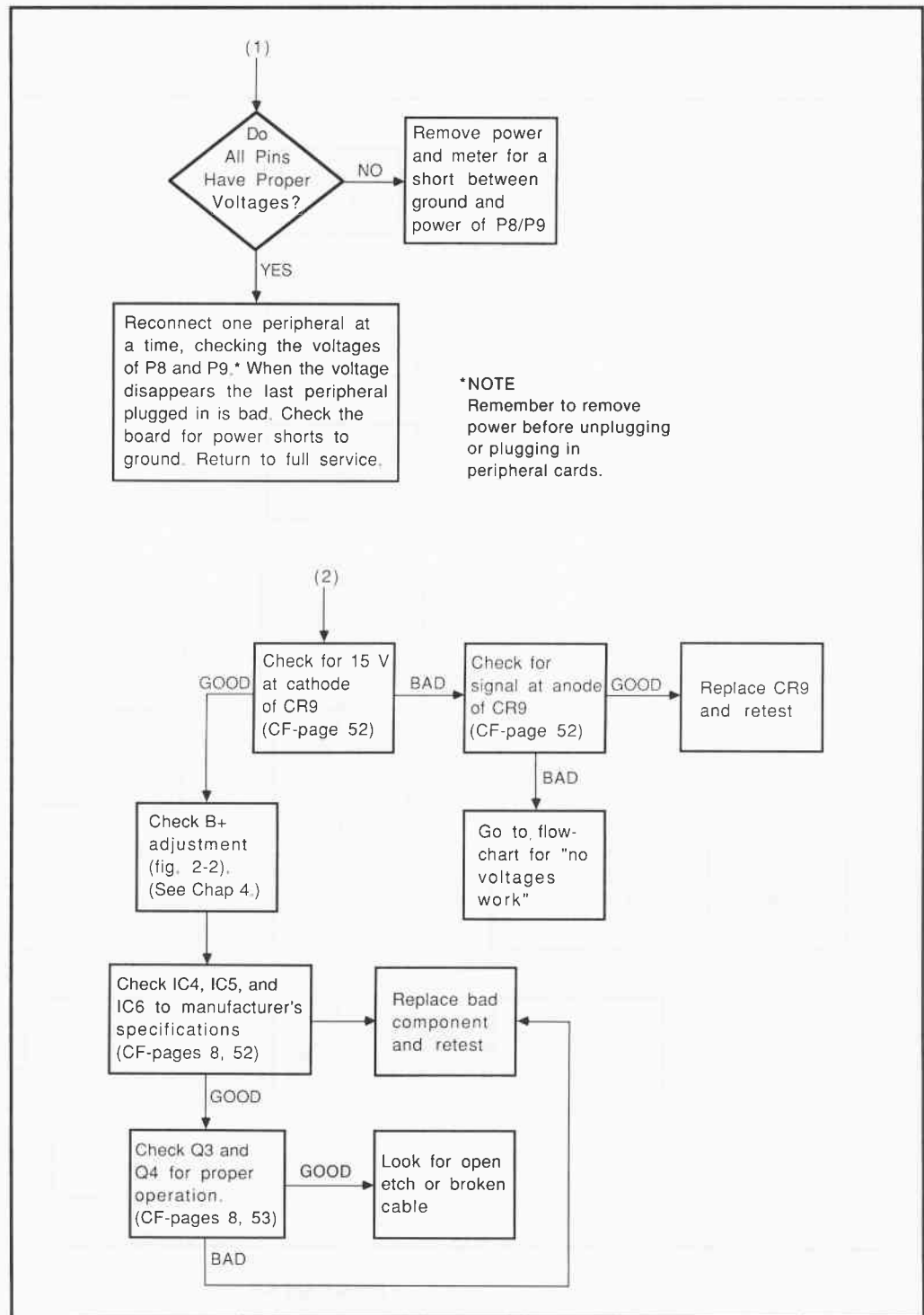
1. Check that all drive cables are installed correctly.
2. Clean all board header connections, especially on the disk drive adapter card.



Flowchart 5-1.

3. Check that resistor pack at 2F on drive analog card is set for correct drive.
4. Visually inspect the system board, disk drive adapter card, and disk drive analog card.
5. Refer to appropriate section in Chapter 4.

Flowchart 5-1.
"cont."

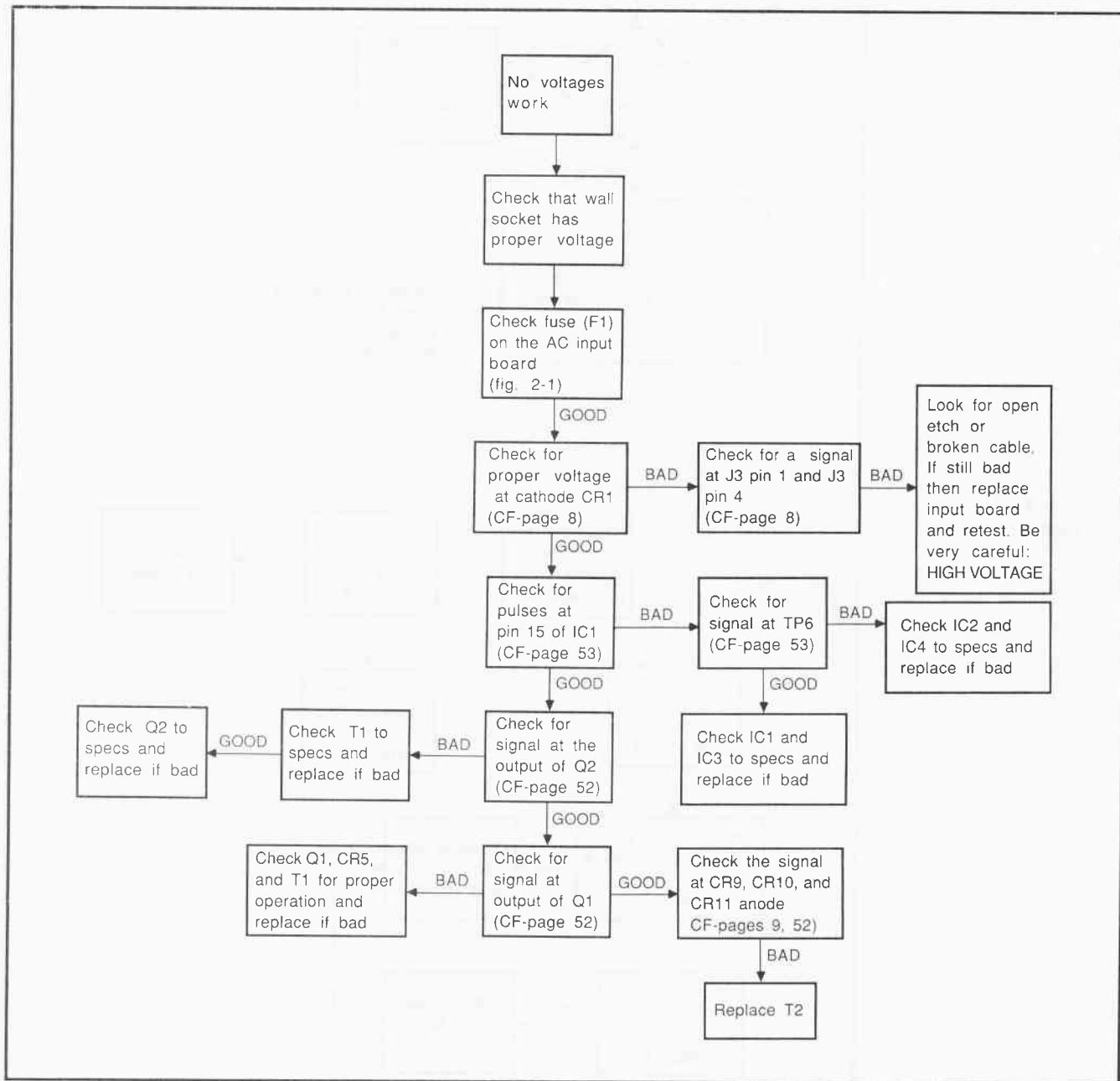


Classical Approach (Figs. 2-98 and 2-102 apply)

Replace U16 on disk drive adapter card and retest. If this doesn't correct problem, replace U17 and retest. (See flowchart 5-6.)

2. IBM PC RUN PROBLEMS

This section covers those problems you might encounter while your system is running. For example, you attempt to do something and get a



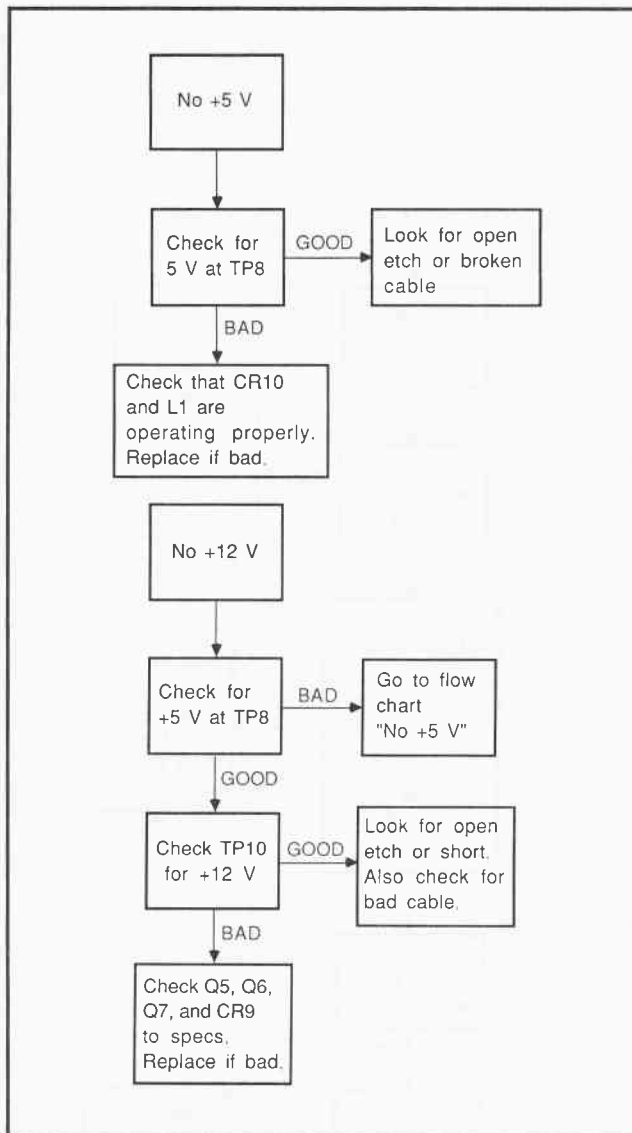
Flowchart 5-2.

response entirely different from what you expected. The following three sections will cover broad malfunctions such as display failure, keyboard failure, and input/output failures (although these may also occur during the time you start up your system).

Problem: Can't Read From One Drive

Symptom Described

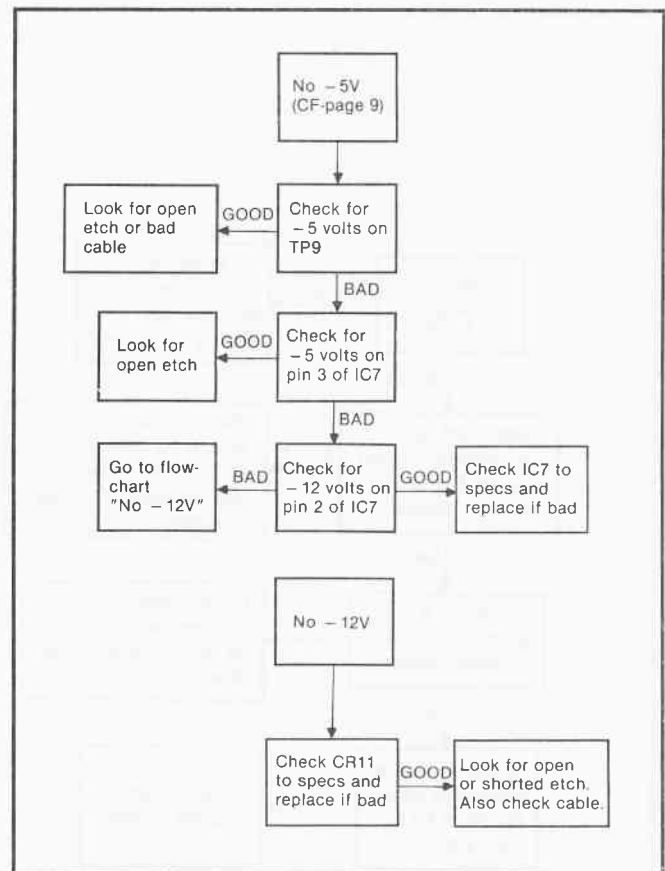
An error display occurs or the drive spins, continuously trying to load data from the disk into the system board.



Flowchart 5-3.

Preliminary Checks

1. Check cables for continuity and proper mating.
2. Try another known good program disk.
3. Shift the bad drive to position A (if not already installed as drive A).
4. Check for disk spinning action during disk read sequence. If no drive motor activation is observed, go to flowchart 5-8.
5. With system turned off, move drive head towards center of disk. Turn system on and note if head moves to track 00. If it doesn't, go to flowchart 5-9.



Flowchart 5-4.

6. Conduct the following adjustments and checks (see Chapter 4).

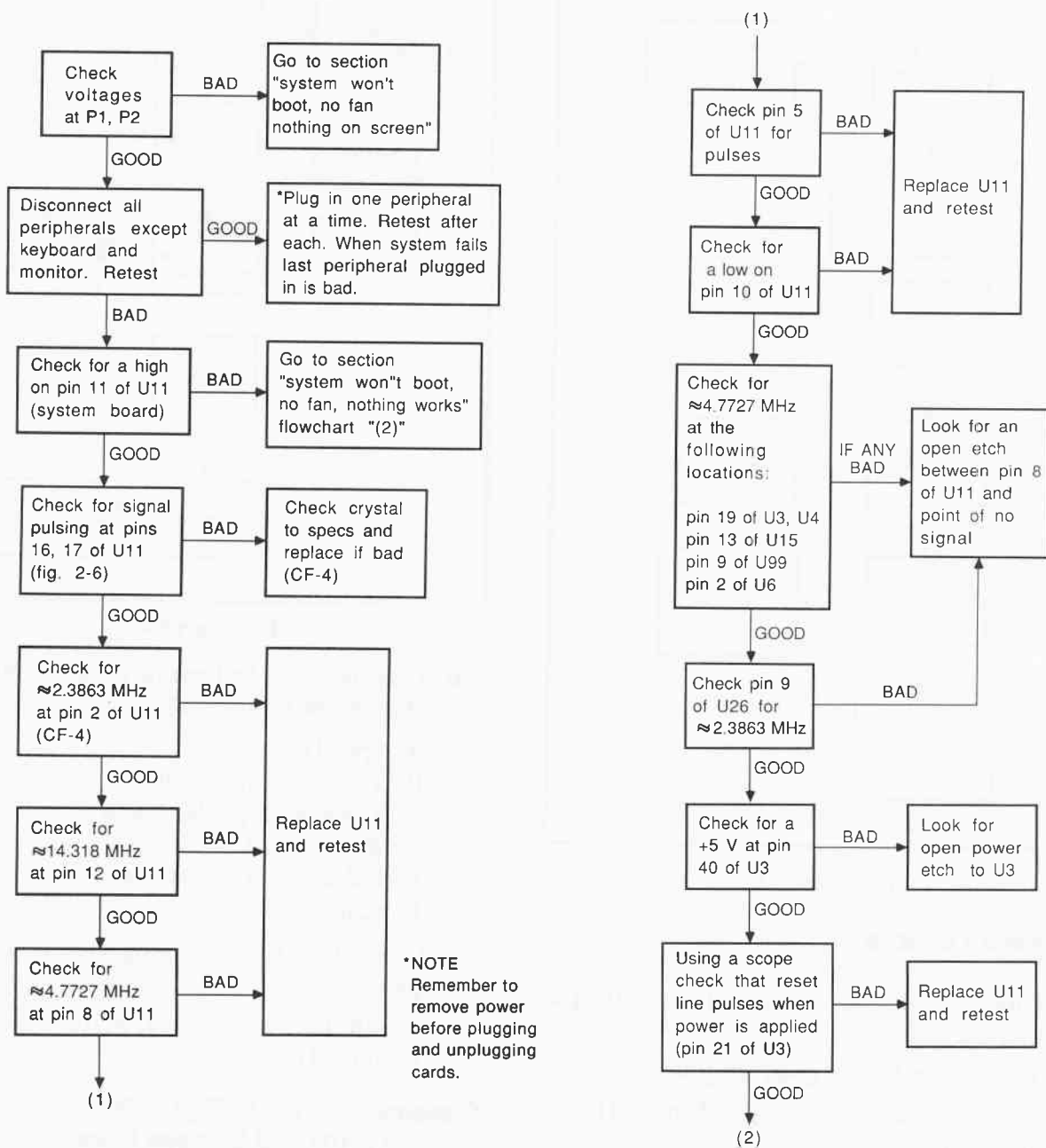
- A. Speed adjustment
- B. Track 00 adjustment
- C. Track 00 stop adjustment
- D. Radial head alignment
- E. Index sensor adjustment
- F. Azimuth check

7. Check that E1 on analog card is properly jumpered.

8. Clean the drive read/write heads (see Chapter 4).

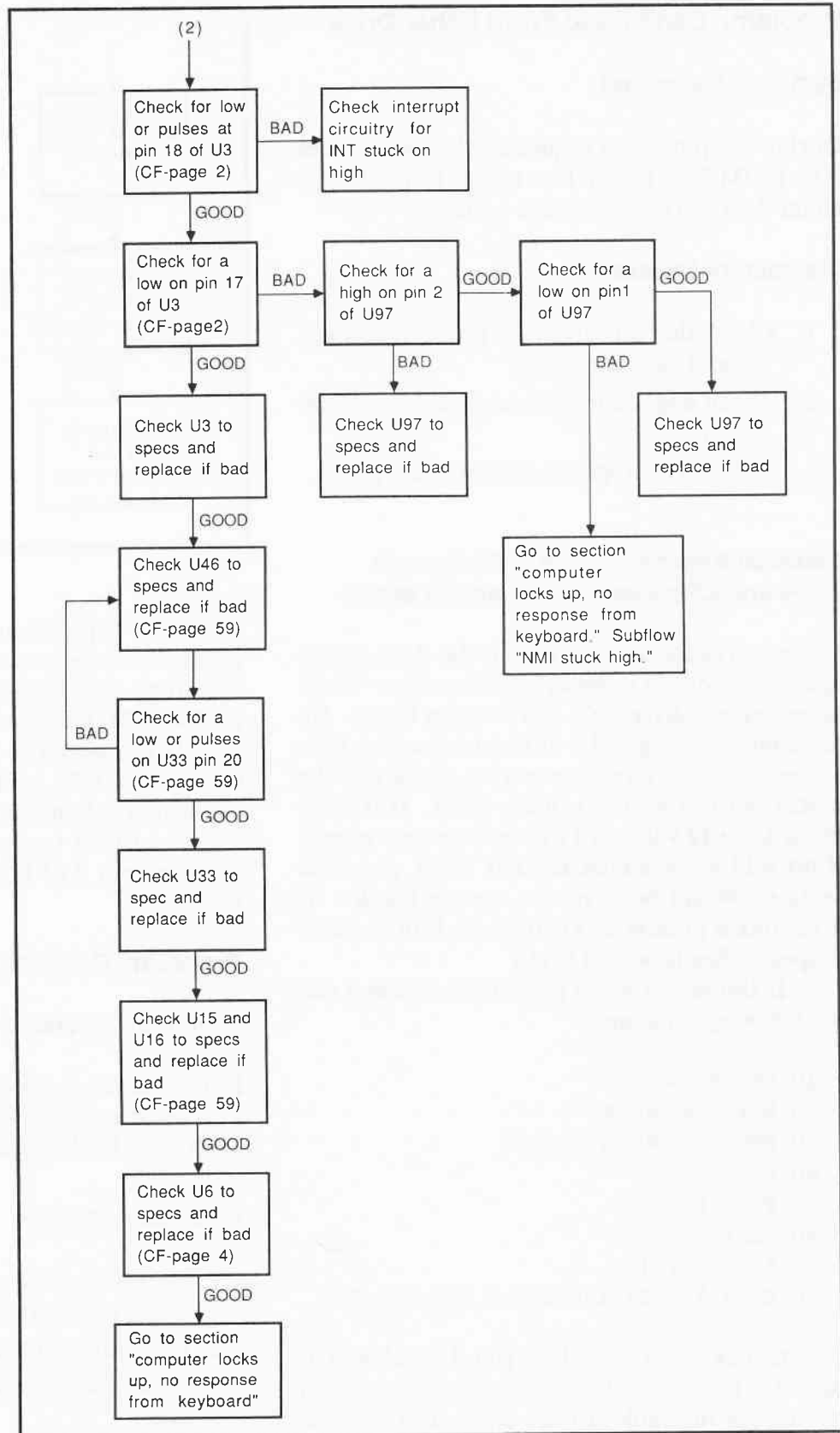
Classical Approach (Figs. 2-98 through 2-102 and CF page 2 apply)

A drive that will not read is one of the most common failures. Be alert for the clues. Conduct all the preliminary service checks. The flowchart for this problem follows this classical approach to solving the drive won't read problem. (Also see flowcharts 5-7 and 5-10.)



Flowchart 5-5.

Flowchart 5-5. "cont."



Problem: Can't Read From Either Drive

Symptom Described

During the power-up sequence, the system goes into ROM BASIC. When trying to load from either drive, an error message occurs.

Preliminary Checks

1. Check that all cables are properly connected and have continuity.
2. Clean edge connector on disk drive adapter card.
3. Refer to appropriate section in Chapter 4.

Classical Approach (Figs. 2-98 through 2-104 and CF pages 5, 9, 20, and 21 apply)

During a read sequence, note if the drive access light comes on. If it doesn't, go to section "Can't access either drive. No drive access lights. No drive motor energized." If the drive access light comes on during a read operation, check that the motor is rotating the spindle shaft. If it isn't, check for +12 volts on TP10 in the power supply. If no +12 volts is measured at TP10, go to the section "Won't boot, no fan, screen blank." If +12 volts is present at TP10, check U16 and U17 to specs. (See flowchart 5-11.)

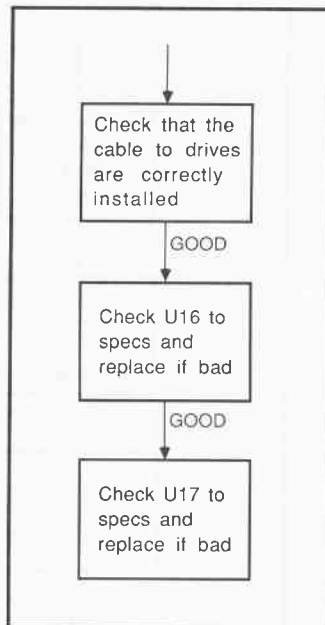
If the motor spins properly, write and run the following program:

```

10 DEF SEG=0
20 DEF USR=40000
30 FOR X=40000 TO 40007
40 READ Y
50 POKE X,Y
60 NEXT X
70 A = USR(0)
80 DATA 176,37,186,242,3,238,235,253

```

Check for a signal on pin 8 of U18 (CF page 4). If no signal is present, check for an open or short in the cables to the drive. If a signal is present on pin 8 of U18, check for pulses on pin



Flowchart 5-6.

23 of U6. If pulses are present, replace U6 and check for the signal on pin 6 of U20 (CF page 20). If no signal is present, check for a signal on pin 7 of U24 (CF page 21).

If the signal is present on pin 6 of U20, check U19, U25, and U26 to specs. If no or a bad signal is found on pin 7 of U24, check U22, U23, and U24 to specs. If a good signal was noted at pin 7 of U24, check U21 and U20 to specs.

Problem: Can't Write to One Drive

Symptom Described

Drive reads properly, but won't write to disk. The error message "DISK WRITE-PROTECTED" may be displayed.

Preliminary Checks

1. Verify no write-protect tab on the diskette being used in the drive.
2. Try a different disk.
3. Check the speed and tracking of the drive in use.
4. Refer to appropriate section in Chapter 4.

Classical Approach (CF page 2 applies)

Configure the bad disk drive as drive B. Insert a nonwrite-protected disk into drive B and close the drive door. Check for a logic low on pin 6 of 3D. If a high is found, check the write protect switch. If pin 6 of 3D is low, place the system in ROM BASIC and write and run the following program:

```
10 OPEN "B:SAM.DAT" FOR OUTPUT AS #1
20 FOR X = 1 TO 300
30 PRINT #1, "THIS IS A TEST"
40 NEXT X
50 CLOSE #1
60 GOTO 10
```

Check for pulses on pin 8 of 3B. If no pulses are found, check 3B to specs. Follow any improper signal back to its origin. If 3B has proper pulses, check the waveform on the collector of Q1 and Q2 (CF page 2). If a good waveform is noted, check the resistance of the heads and the operation of Q6 and Q7.

If the waveform is bad, check for pulses on pins 8 and 9 of 5C. If the pulses are present, check 2B to specs and replace if bad. If 2B is good, check Q1 and Q2 to specs. If bad pulses are noted on pin 8 or pin 9 of 5C, check 2E to specs and replace if bad. Check Q3 to specs and replace if bad. Go to the section "Can't read from one drive," subflowchart "Head Switching Bad" in flowchart 5-12.

Problem: Can't Write to Either Drive**Symptom Described**

When writing to either drive, an error message occurs and the operation ends, or the data that was written to the disk is not present during a later read operation.

Preliminary Checks

1. Check all cables for continuity and proper mating.

2. Clean disk drive adapter card edge connector.
3. Configure system as single drive, and test each drive individually.
4. Verify no write-protect tabs on disks being used.
5. Refer to appropriate section in Chapter 4.

Classical Approach (Figs. 2-98 through 2-103 and CF pages 4 and 20 apply)

Insert a blank, nonwrite-protected disk in drive B. Go into ROM BASIC and write and run the following program:

```
10 OPEN "B;SAMS.DAT" FOR OUTPUT AS #1
20 FOR X = 1 TO 300
30 PRINT #1, "THIS IS A TEST"
40 NEXT X
50 CLOSE #1
60 GOTO 10
```

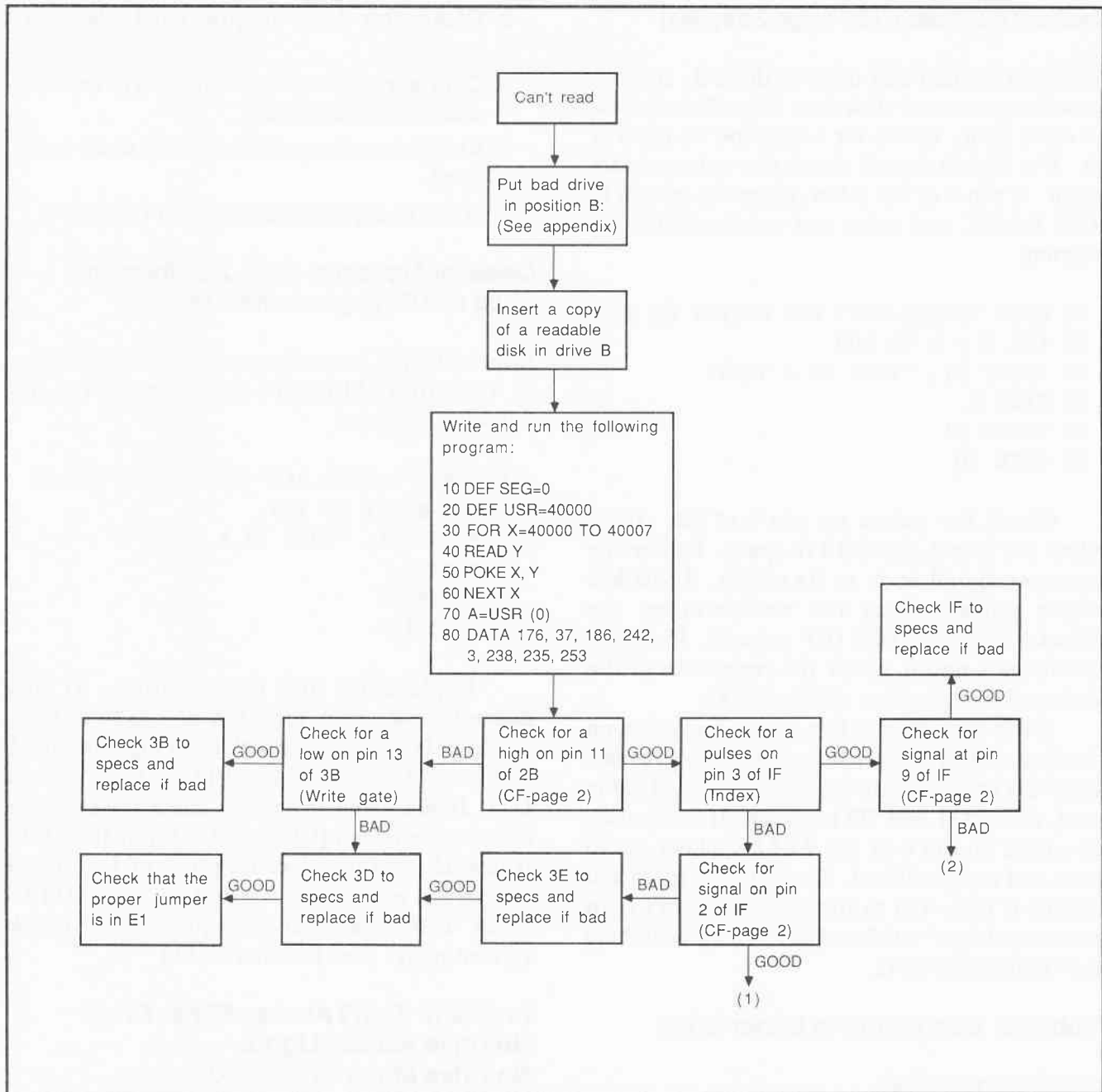
Replace U6 and retry writing. If this doesn't work, check for a low on pin 16 of U18. If a high is measured, check for a high on pins 4 and 15 of U18. If pins 4 and 18 are high, replace U18. If pins 4 and 18 are low, check the cable for a short or an open (CF page 4). If pin 16 of U18 is low, check for pulses on pin 3 of U9. If no pulses are noted, check U9, U10, and U11 to specs. If there are pulses on pin 3 of U9, check P2 continuity. (See flowchart 5-13.)

Problem: Can't Access Either Drive. No Drive Access Lights. No Drive Motor Energized**Symptom Described**

Both drives fail to react to any read or write operation.

Preliminary Checks

1. Check that all drive data and power cables are properly connected and have good continuity.



Flowchart 5-7.

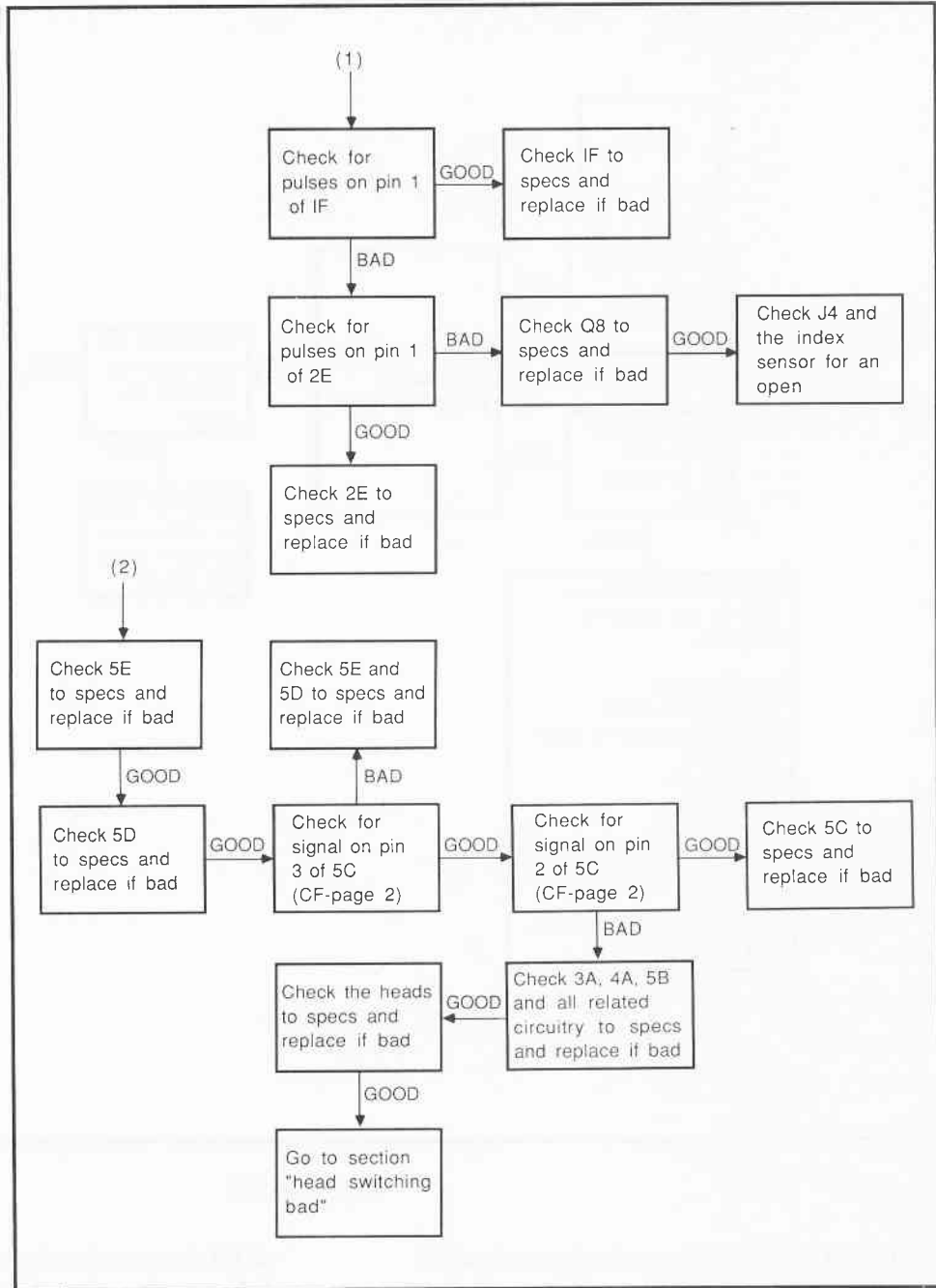
2. Clean edge connector on drive adapter cards.
3. Refer to appropriate section in Chapter 4.

Classical Approach (Figs. 2-98 and 2-101 apply)

Go into ROM BASIC and write and run the following program:

```

10 DEF SEG=0
20 DEF USR=40000
30 FOR X = 40000 TO 40007
40 READ Y
50 POKE X,Y
60 NEXT X
70 A=USR(0)
80 DATA 176,37,186,242,3,
    238,235,253
  
```

Flowchart 5-7.
"cont."

Check for a low on pin 6 of U16. If pin 6 is low, check the cables on P2 for continuity. If pin 6 is high, check U30 and U17 by replacing each. If neither of these is bad, check U29, U14, and U16 to specs and replace if bad. (See flowchart 5-14.)

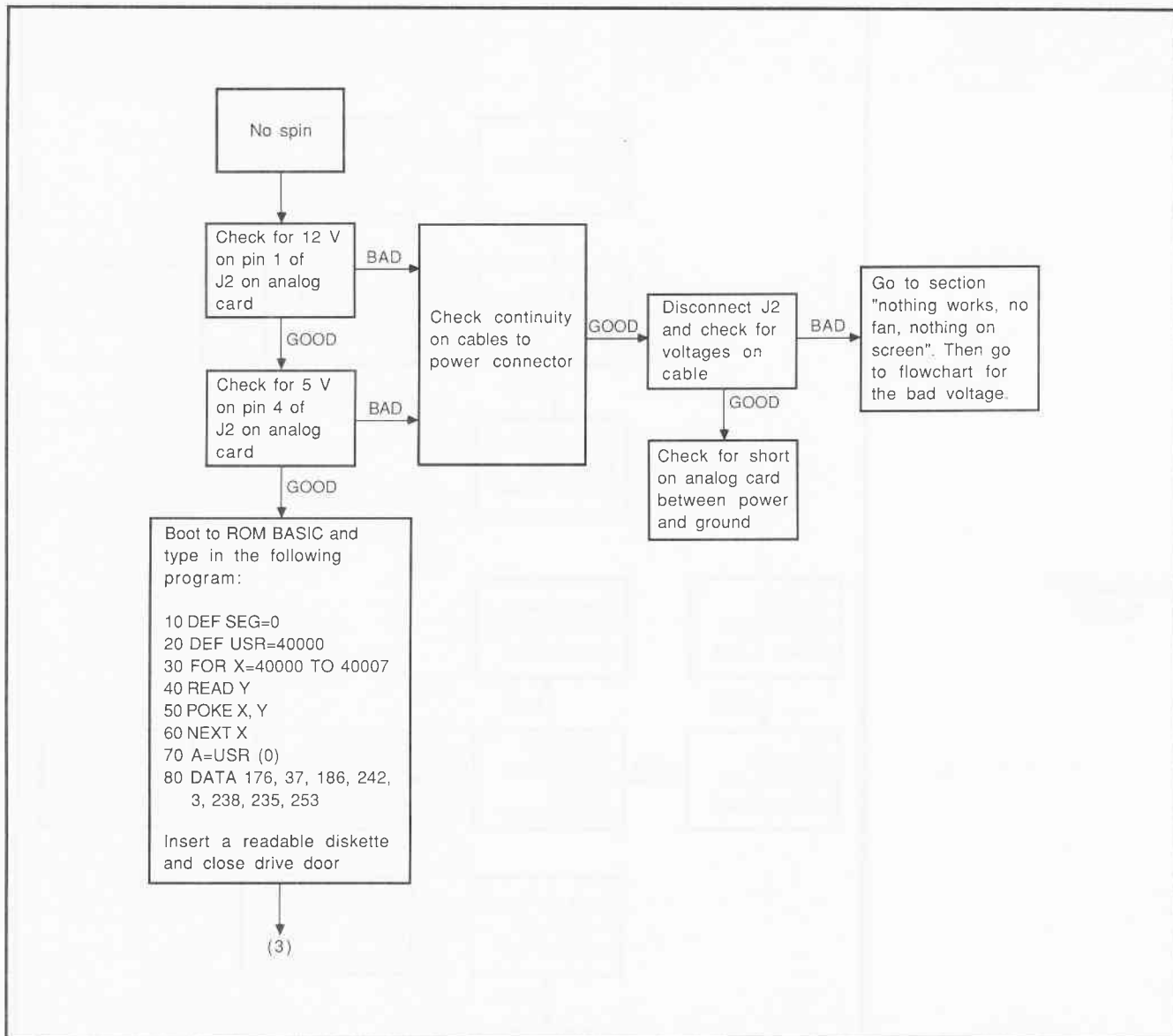
Symptom Described

When inadvertently trying to write to a disk which has a write-protect tab installed, data is written on the disk. The write-protect feature is not functioning.

Preliminary Checks

1. Check the drive cables for proper mating and continuity.

Problem: Drive Destroys Data on Write-Protected Disk



Flowchart 5-8.

2. Clean the adapter card edge connector.
3. Refer to appropriate section in Chapter 4.

Classical Approach (CF page 2 applies)

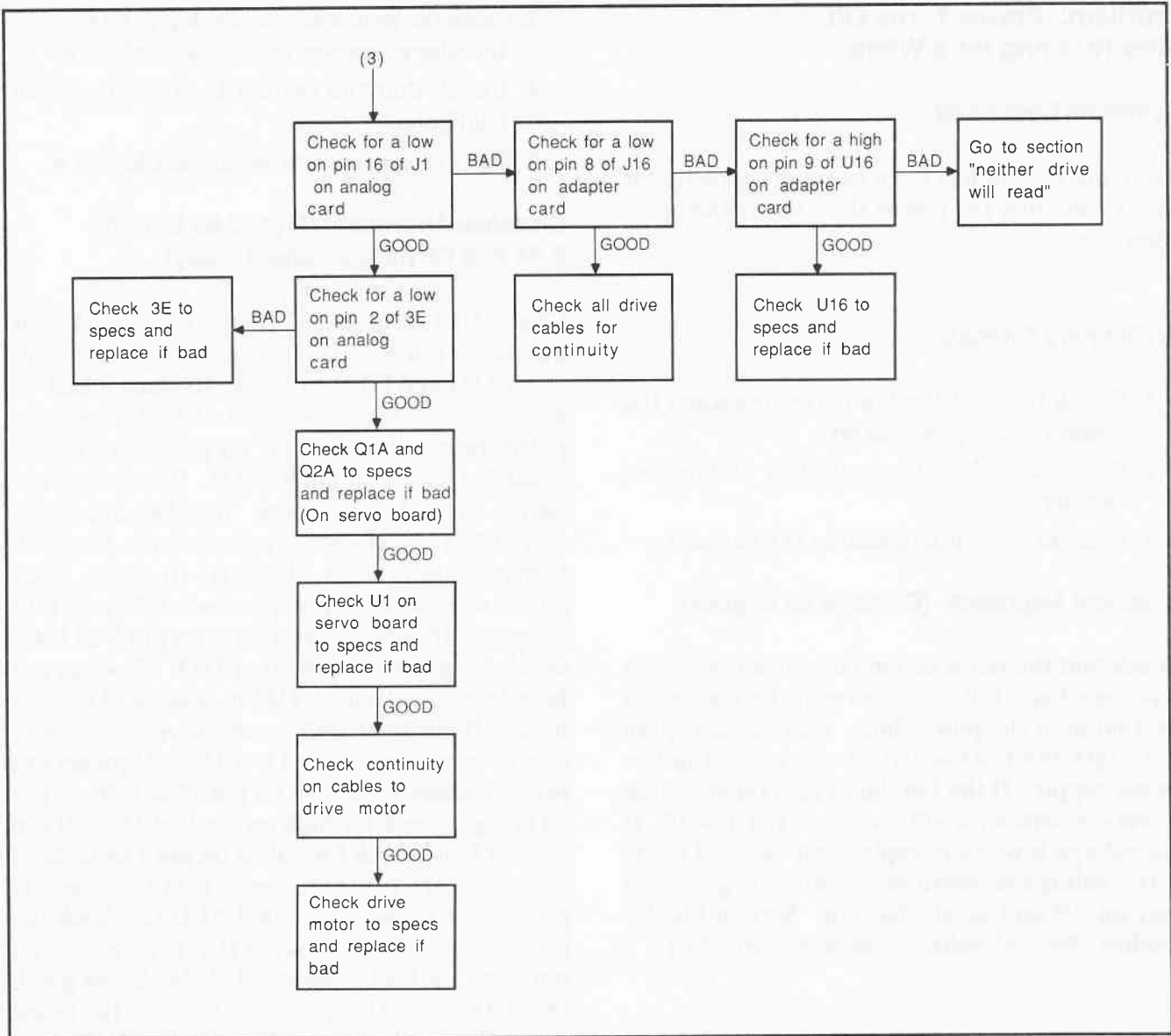
Insert a write-protected blank disk into the bad drive and close the drive door. Check for a low on pin 10 of 3D (analog card). If pin 10 is high, check for a high on pin 11 of 3D. If pin 10 is low, check 3B to specs and replace if bad. If pin 11 of 3D is high, replace 3D. If pin 11 of 3D is low, check the write protect switch (check pins 1 and 2

of P8 for continuity when the disk is not in the drive, and open when a write-protected disk is inserted). (See flowchart 5-15.)

Problem: While Running, Computer Locks Up. No Keyboard Response

Symptom Described

During operation of known-good program, the computer locks up, the display freezes, and keyboard inputs have no effect.



Flowchart 5-8. "cont."

Preliminary Checks

1. Try a different program disk.
2. Check all cables for continuity and proper mating.
3. Clean edge connectors on adapter cards.
4. Reseat the CPU (U3) on the system board.
5. Refer to appropriate section in Chapter 4.

Classical Approach: (Figs. 2-7, 2-13, 2-15, and CF pages 2, 3, 4, 58, and 60 apply)

This problem can be caused by a failure in the non-maskable interrupt section, the ready circuitry, the bus control circuitry, the reset circuitry, the timing circuitry, or the processor circuitry. The flowchart follows the classical approach. (See flowcharts 5-16 through 5-20.)

Problem: Power Turns Off after Running for a While

Symptom Described

After the system has been running correctly for about 1 minute, the power shuts down and operation stops.

Preliminary Checks

1. Check to see if the fan is running when the system is first powered up.
2. Check all cables for continuity and proper mating.
3. Refer to appropriate section in Chapter 4.

Classical Approach (CF page 53 applies)

Check that the fan is turning on when the system is powered up. If it spins correctly, let the system heat up until the power fails. Use coolant spray to isolate the heat sensitive component in the power supply. If the fan didn't turn on at system power-up, check for -12.2 volts on pin 1 of J5. If the voltage is present, replace the fan and retry. If the voltage is improper or missing, go to the section "Won't boot. No fan. Screen blank" subflow "No +15 volts." (See flowchart 5-21.)

3. IBM PC DISPLAY PROBLEMS

Problem: No Display (Monochrome Adapter)

Symptom Described

No graphics or text characters can be produced on the display monitor.

Preliminary Checks

1. Check the video cable for continuity and proper mating.
2. Try another monitor.

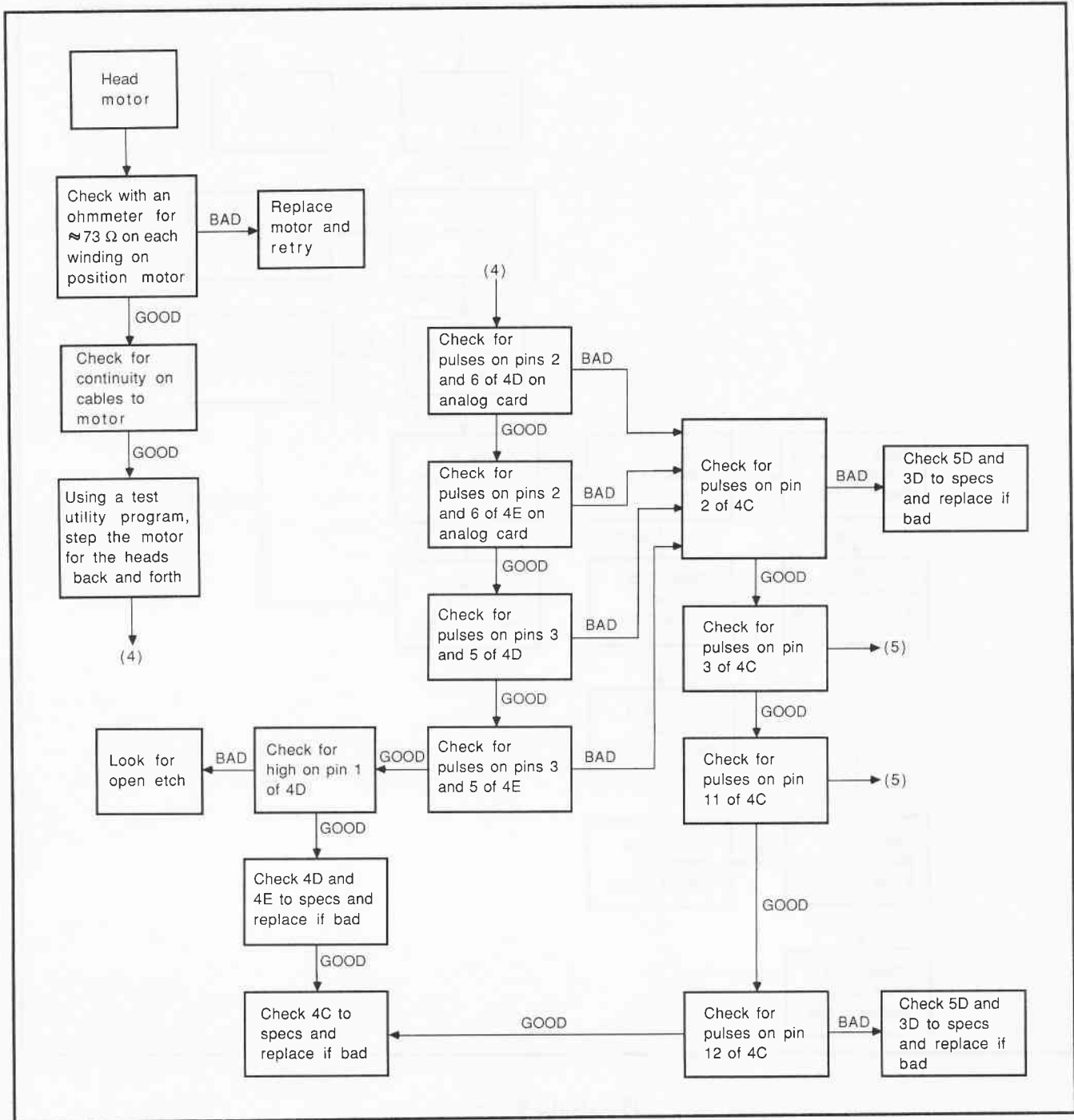
3. Clean the monochrome display/printer adapter edge connector and reseat the board.
4. Check that the system is properly switch configured.
5. Refer to appropriate section in Chapter 4.

Classical Approach (Figs. 2-65 through 2-84 and CF pages 2 and 3 apply)

Check U64 to specs. If U64 is good, check for pulses on pin 8 of U43. If pulses are present, check U54 and U101 to specs. Replace if bad. If no pulses are found on pin 8 of U43, check for pulses on pin 9 of U43. If no pulses are found, check for pulses on pin 9 of U3. If no pulses are found, check U28 to specs. If pulses are found on pin 9 of U3, check for pulses on pin 10 of U3. If pulses are present, check U3 to specs. If no pulses are found on pin 10, check U55 and U35 to specs. If pulses were found on pin 9 of U43, check for pulses on pin 10 of U43. If pulses are found on pin 10, check U43 to specs and replace if bad. If pin 10 of U43 doesn't have pulses on it, check for pulses on pin 11 of U26. If pulses are present, check for a high on pin 10 of U26. If pin 10 is high, check for high on pin 9 of U26. If pin 9 is not high, check for pulses on pin 1 of U62. If no pulses are present, check U28 to specs. If pulses are present on pin 1 of U62, check for pulses on pin 5 of the same IC. If no pulses on pin 5, check U44 to specs. If U44 checks good, check U35 and U55 to specs. Replace the failed part. If pulses were noted on pin 5 of U62, refer to (3) on flowchart 5-22.

If pin 10 of U26 is not high, check for pulses on pin 8 of U27. If pin 8 is pulsing, check for pulses on pin 9 of U27. If pulses are noted on pin 9, check U27 and U29 to specs. Replace the failed component. If pin 8 of U27 is not pulsing, check U48 to specs and replace if bad. If U48 checks good, refer to the flowchart, subsection 7.

If pin 9 of U27 is not pulsing, check U49 to specs. If U49 checks good, refer to (7) on flowchart 5-22. If pin 11 of U26 is not pulsing, check for a low on pin 13 of U43. If pin 13 is low, check for pulses on pin 12 of U43. If pulses are present, replace U43. If pulses are not on pin 12, check U32 to specs. If U32 checks good, check



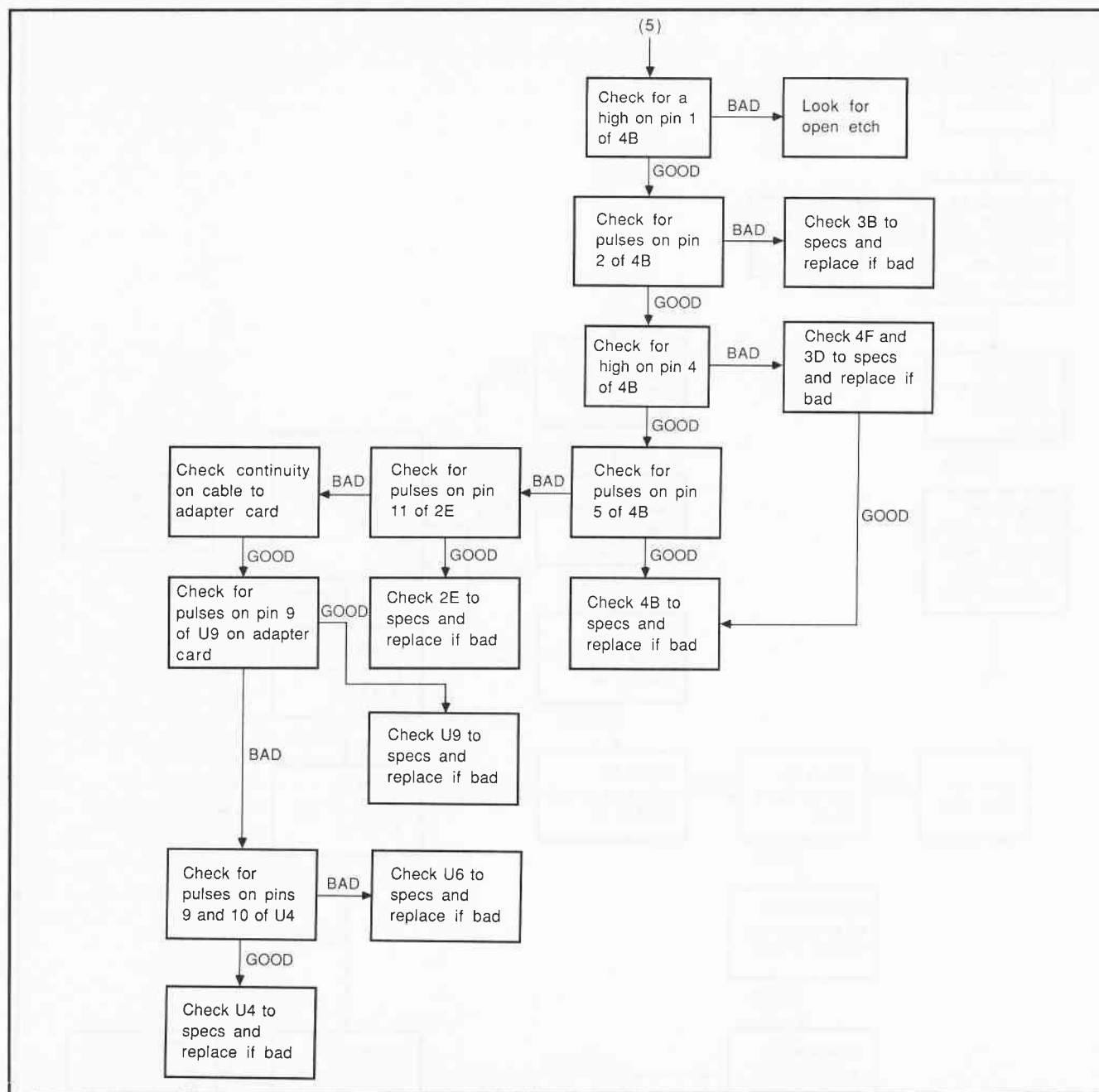
Flowchart 5-9.

U33 to specs. If U33 also checks good, refer to (4) of flowchart 5-22. If pin 13 of U43 is not low, check for a low on pin 12 of U29. If pin 12 is high, refer to (5) of flowchart 5-22. If pin 12 is low refer to (2) of flowchart 5-22.

Problem: No Horizontal Sync (Monochrome Adapter)

Symptom Described

The display is unreadable due to a lack of horizontal sync signals.



Flowchart 5-9. "cont."

Preliminary Checks

1. Check the video cable for continuity and proper mating.
2. Clean the monochrome adapter card edge connector pins.
3. Try a different, known-good monitor.
4. Refer to appropriate section in Chapter 4.

Classical Approach (Fig. 2-80 and CF pages 2, 3, and 15 apply)

Check for a signal on pin 13 of U64 (CF page 3). If a signal is found, check U64 to specs and replace if bad. If no signal is on pin 13, check for

a signal on pin 13 of U55 (CF page 2). If no signal is found, check U35 by substitution. If a signal is found on pin 13, check for the signal on pin 5 of U3 (CF page 3). If no signal is on pin 5, check U55 to specs. If U55 checks good, check U100 to specs. If a good signal is noted on pin 5 of U3, check for a high on pin 4 of U3. If pin 4 is high, replace U3. If pin 4 is low, check for a high on pin 10 of U58. If pin 10 is high, check for a high on pin 1 of U45. If pin 1 is high, check U45 to specs. If pin 1 isn't high, check U56 to specs. If pin 10 of U58 is low, check U50 and U60 to specs. Replace the failed part. (See flowchart 5-23.)

Problem: No Vertical Sync (Monochrome Adapter)

Symptom Described

The display continues to roll due to lack of a vertical sync signal.

Preliminary Checks

1. Check the video cable for continuity and proper mating.
2. Clean the monochrome adapter card edge connector pins.
3. Try a different known-good display monitor.
4. Refer to appropriate section in Chapter 4.

Classical Approach (Fig. 2-80 and CF pages 2 and 3 apply)

Check for signal on pin 14 of U55 (CF page 2). If the signal is not present, check U35 by substitution. If a signal is present on pin 14, check for signal on pin 11 of U64 (CF page 3). If a signal is found, check U64 to specs. If pin 11 of U64 has no signal present, check for a high on pin 2 of U54. If pin 2 is low, check that there is no jumper at J1. If pin 2 is high, check U54 to specs. (See flowchart 5-24.)

Problem: No Low or High Resolution Display (Monochrome Adapter)

Symptom Described

The text works, but there is no low or high resolution graphics display capability.

Preliminary Checks

1. Check all cables for continuity and proper mating.
2. Clean the adapter card edge connector pins.
3. Refer to appropriate section in Chapter 4.

Classical Approach (Figs. 2-72, 2-76, 2-80, and CF page 2 apply)

Run a program that activates the high resolution screen. Check U58 to specs. If U58 is good, check for a low on pin 2 of monochrome adapter card IC U24. If pin 2 is low, check U24 to specs. If pin 2 is not low, check for a high on pin 6 of U53. If pin 6 is high, check U6 to specs. If pin 6 is not high, check U53 to specs. (See flowchart 5-25.)

Problem: Bad Characters (Monochrome)

Symptom Described

Garbage on screen, illegal characters, strange shapes in both graphics and text modes.

Preliminary Checks

1. Verify cables connected correctly.
2. Clean adapter card edge connector pins.
3. Check that system is configured properly.
4. Try different known-good monitor.
5. Refer to appropriate section in Chapter 4.

Classical Approach (Figs. 2-76, 2-79, 2-80, and CF pages 2 and 3 apply)

Check U33 by substitution. If problem persists, check U64 to specs. If U64 is good, check for signal on pin 4 of U54 (CF page 2). If a good pin 4 signal is noted, check for pulses on pin 5 of U54. If pulses are present, check U54 and U101 to specs. If no signal was found on pin 4 of U54, check U32 to specs. If U32 is good, check for signal on pin 10 of U43. If the pin 10 signal is good, check for pulses on pin 9 of U43. If pulses are found, check U43 to specs. If no pulses are found, check U35 to specs. If U35 checks good, check U3 to specs. If U3 checks good, check U55 to specs. If U55 checks good, check U28 to specs.

If a bad or no signal was found on pin 10 of U43, check for signal on pin 11 of U26. If a good signal is found, check U26 to specs. If a bad signal is noted, check U43 to specs. If U43 is good, refer to (4) of flowchart 5-26.

If pin 5 of U54 is bad, check for pulses on pin 5 of U29. If pulses are found, check for pulses on pin 9 of U29. If pulses are found, check for pulses on pin 1 of U29. If pulses are found, check U29 to specs. If no pulses are found on pin 5 of U29, check U48 and U49 to specs. If these ICs check good, check U27 to specs.

If no pulses were found on pin 9 of U29, check U100 to specs. If U100 checks good, check U1 and U6 to specs.

If no pulses were found on pin 1 of U29, check U35 by substitution. If U35 checks good, check U43 to specs. If U43 checks good, check U55 to specs. If U55 is good, check U23 to specs.

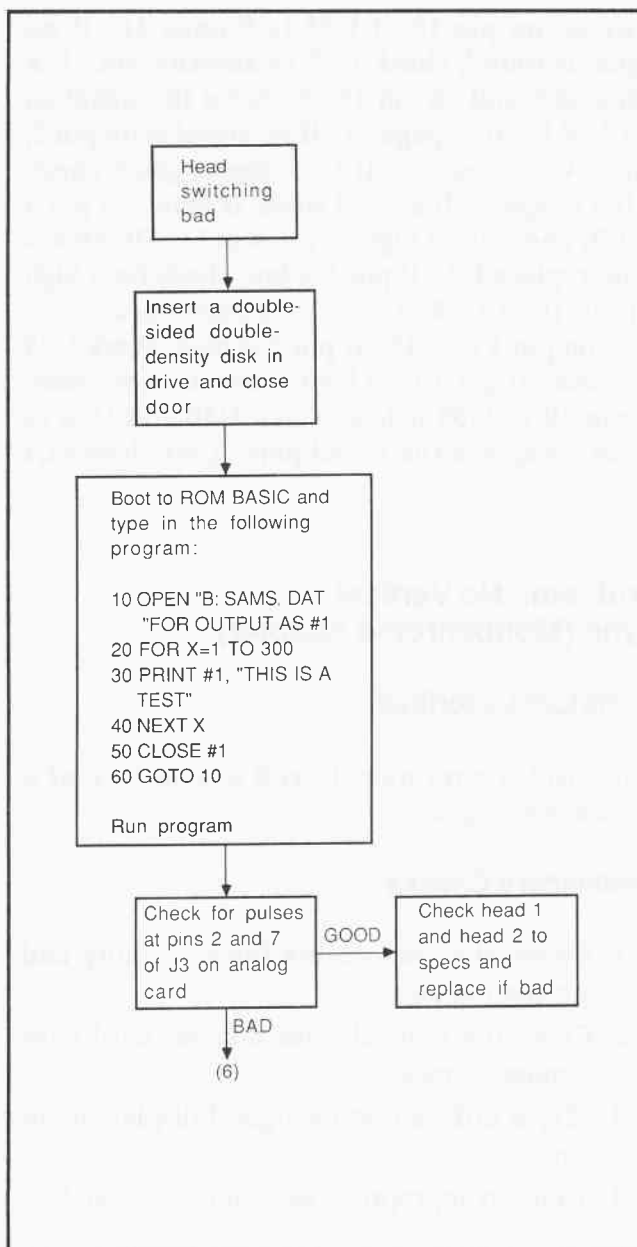
Problem: No Display (Color Graphics Adapter)

Symptom Described

No screen display. No graphics; no text.

Preliminary Checks

1. Check the cable for continuity and proper mating.

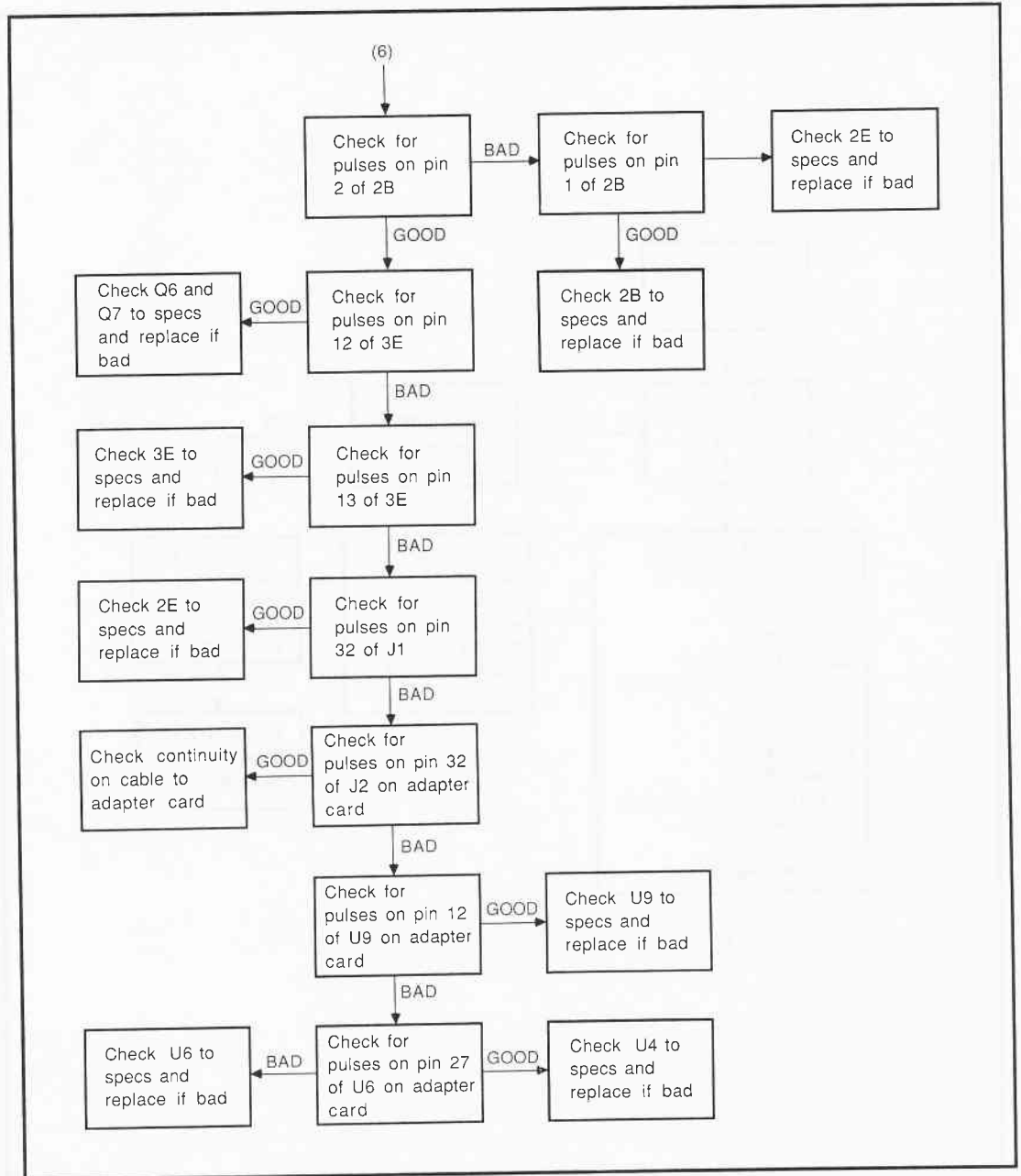


Flowchart 5-10.

2. Try another known-good display monitor.
3. Clean the adapter card edge connector pins.
4. Check for proper system configuration.
5. Refer to appropriate section in Chapter 4.

Classical Approach (Figs. 2-91, 2-94, 2-95, and CF pages 16 and 17 apply)

Does the direct drive video work? If it does, check Q1 to specs. Look for an open between

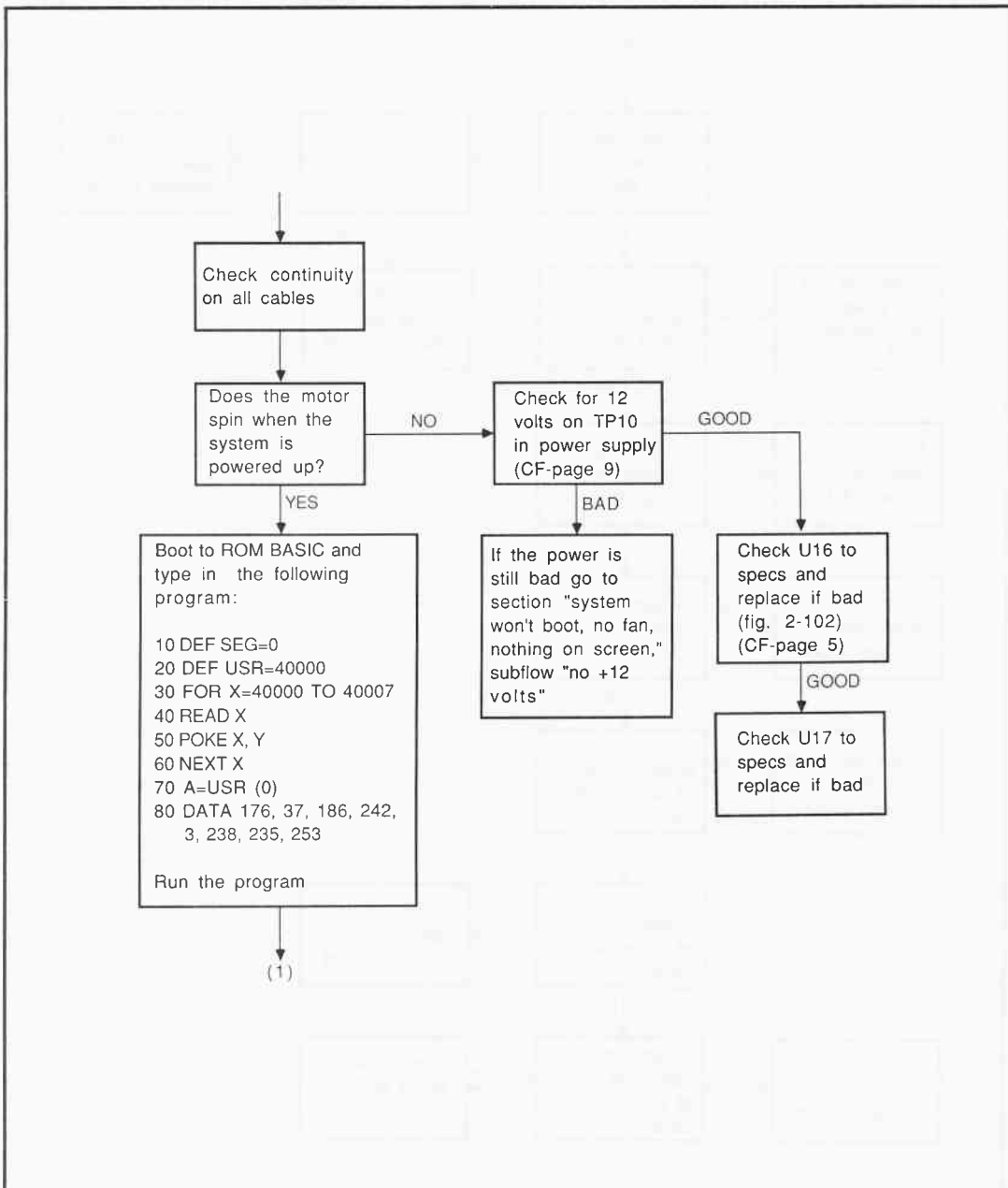
Flowchart 5-10.
"cont."

Q1 and the connector P1. If the direct drive video does not work, check U67 to specs. If U67 checks good, check for about 14 MHz on pin 13 of U6. If the signal is bad or not present, check U26 to specs. If pin 13 has a good signal, check for a signal on pin 9 of U101 (CF page 16). If the signal on pin 9 is bad, check U6 to specs. If the signal is good, check U101 to specs. (See flowchart 5-27.)

Problem: No Horizontal Sync (Color)

Symptom Described

Display unreadable due to lack of horizontal sync.



Flowchart 5-11.

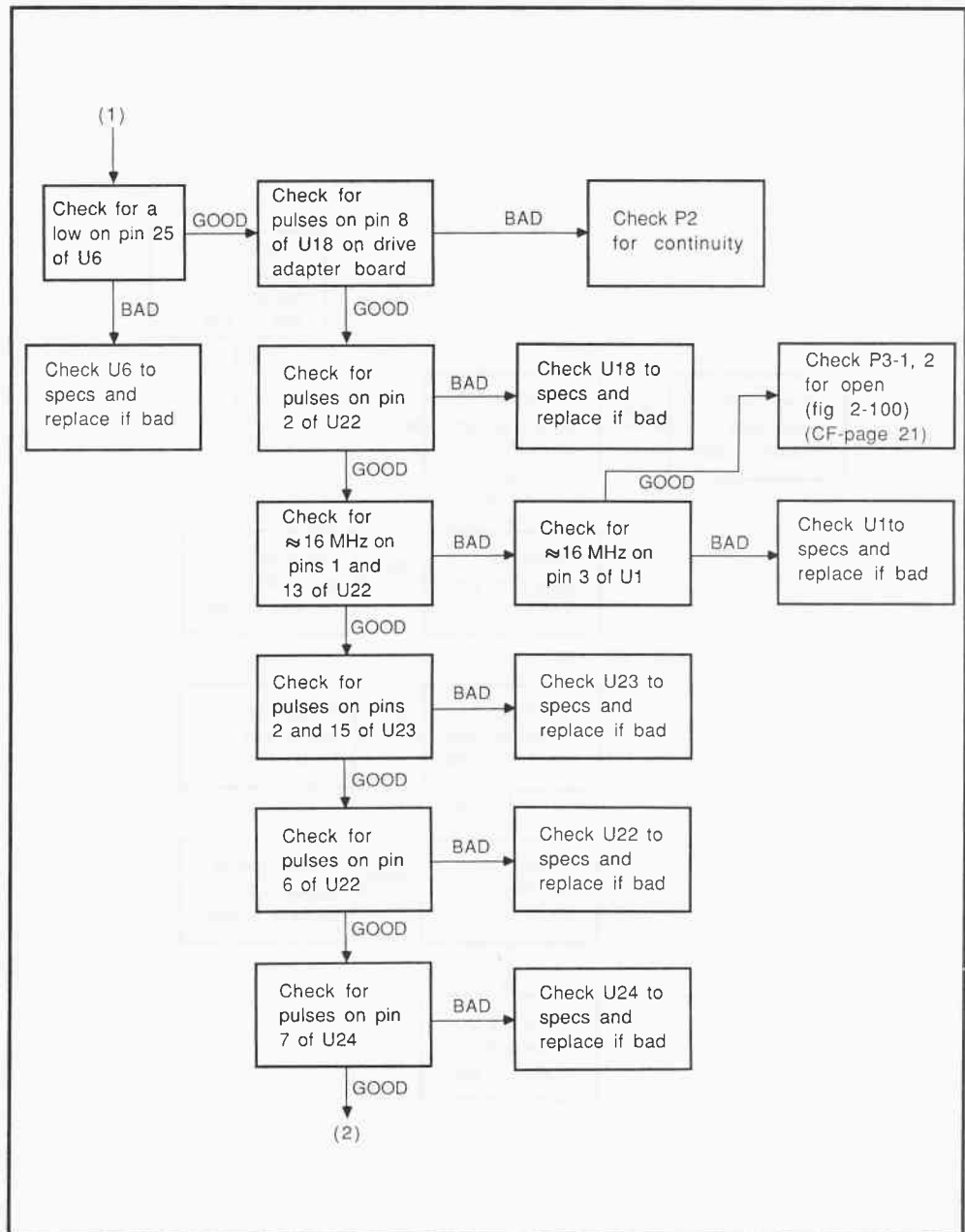
Preliminary Checks

1. Check the cable for continuity and proper mating.
2. Clean the adapter card edge connector pins.
3. Try a different known-good display monitor.
4. Refer to appropriate section in Chapter 4.

Classical Approach (Figs. 2-94, 2-95, and CF pages 15, 16, and 17 apply)

Check for a signal on pin 7 of U21. If no signal is found, check U21 to specs. If U21 is good, check U38 by substitution. If good signal is found on pin 7 of U21, check for pulses on pin 8 of U42. If pulses are found, check U67 to specs. If no pulses are found on pin 8, check U64 to specs. If U64 is good, check U42 to specs. (See flowchart 5-28.)

Flowchart 5-11.
"cont."



Problem: No Vertical Sync (Color)

Symptom Described

Display continues to roll due to lack of proper vertical sync signal.

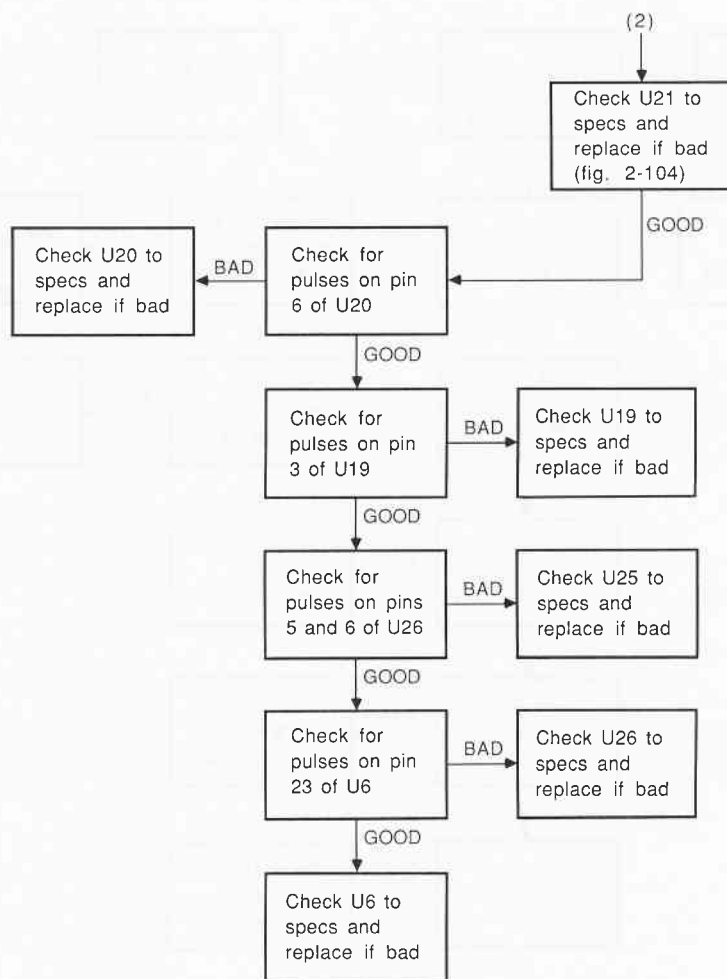
Preliminary Checks

1. Check the cable for continuity and proper mating.

2. Clean the adapter card edge connector pins.
3. Try a different known-good display monitor.
4. Refer to appropriate section in Chapter 4.

Classical Approach (Figs. 2-94, 2-95, and CF pages 15, 16, and 17 apply)

Check for signal on pin 11 of U21 (CF page 15). If no signal is present, check U38 by substitution.



Flowchart 5-11.
"cont."

If signal is present, check for signal on pin 9 of U67 (CF page 17). If a signal is noted on pin 9, check J2-8 for an open or bad cable. If pin 9 of U67 had signal, check for signal on pin 1 of U63. If pin 1 has signal, check for pulses on pin 9 of U63. If pulses are present, check for pulses on pin 8 of U41. If pulses are found, check U67 to specs. If no pulses are found on pin 8 of U41, check U41 and U63 to specs. If pin 9 of U63 doesn't have pulses check U42 and U64 to specs. If no signal was found on pin 1 of U63, check U21 to specs. (See flowchart 5-29.)

Problem: No Text, Graphics Works (Color)

Symptom Described

When running a graphic program, the display is fine, but when running in text mode, no display or a garbage display is produced.

Preliminary Checks

1. Clean the adapter card edge connector pins.
2. Try a different known-good monitor.

3. Verify that the system is configured properly (switches on system board correctly set).
4. Refer to appropriate section in Chapter 4.

Classical Approach (Fig. 2-93 and CF page 2 apply)

Check U33 by substitution. If problem persists, check U32 by substitution. If this doesn't correct problem, check for pulses on pin 9 of U23. If pulses are present, check U23 to specs and replace if bad. If no pulses are found on pin 9 of U23, check for pulses on pin 4 of U14. If no pulses are found, check for a high on pin 12 of U13. If pin 12 is high, check U13 to specs. If pin 12 is not high, check U14 to specs.

If pulses are found on pin 4 of U14, check for pulses on pin 5 of U14. If pulses are present, check U14 to specs. If no pulses are found on pin 5 of U14, check U49 to specs and replace if bad. (See flowchart 5-30.)

Problem: No Graphics, Text Works

Symptom Described

When trying to run a graphic program, garbage is displayed, or no display is produced, but when running a text program, the display looks fine.

Preliminary Checks

1. Verify system configuration. Check switches on system board.
2. Clean the color graphics adapter card edge connector.
3. Try a different monitor.
4. Refer to appropriate section in Chapter 4.

Classical Approach (Fig. 2-93 and CF page 2 apply)

Check for a high on pin 13 of U23. If pin 13 is not high, check U40 to specs. If pin 13 is high, check U23 to specs. (See flowchart 5-31.)

Problem: Bad Characters (Color Graphics Adapter)

Symptom Described

Garbage on screen, illegal characters, strange shapes in both graphic and text mode.

Preliminary Checks

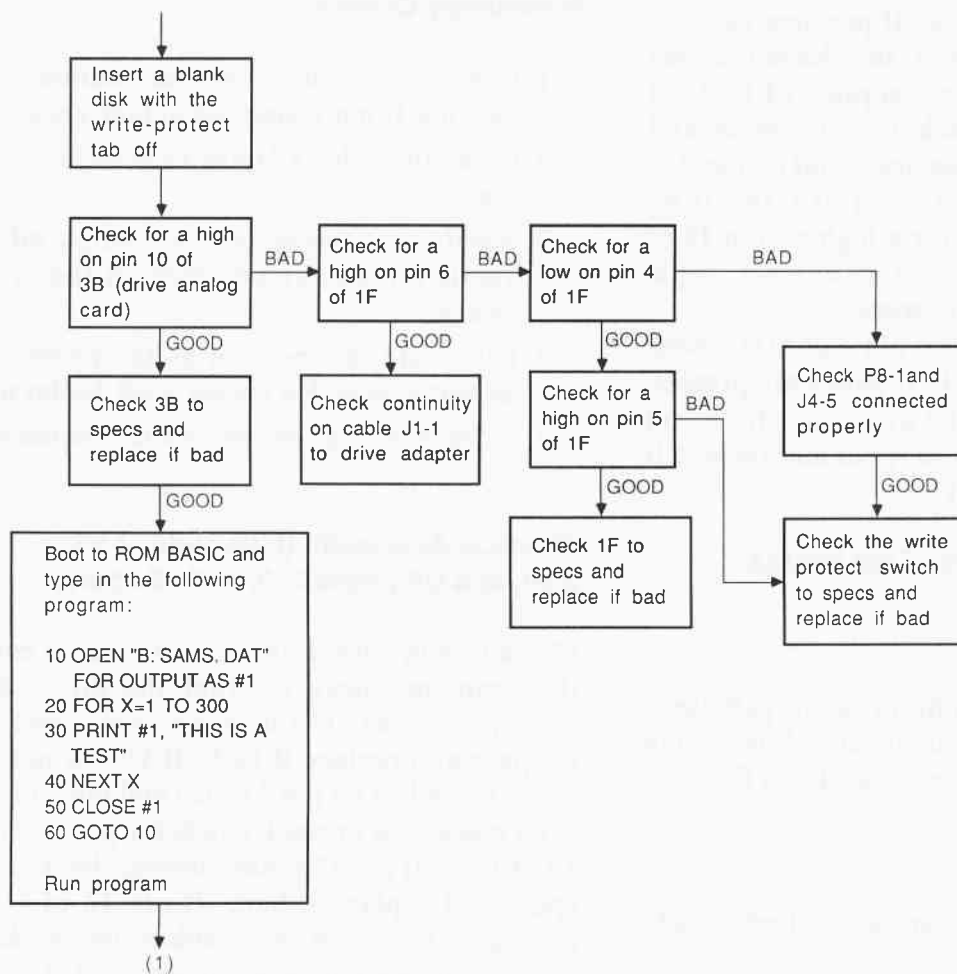
1. Check the monitor cable for continuity and that it is firmly connected at both ends.
2. Clean the color adapter card edge connector.
3. Verify that the system is configured correctly (check the switches on the system board).
4. Eliminate the monitor as the problem by substitution with a known good display unit.
5. Refer to appropriate section in Chapter 4.

Classical Approach (Figs. 2-86, 2-93, 2-94, and CF pages 2, 3, and 15 apply)

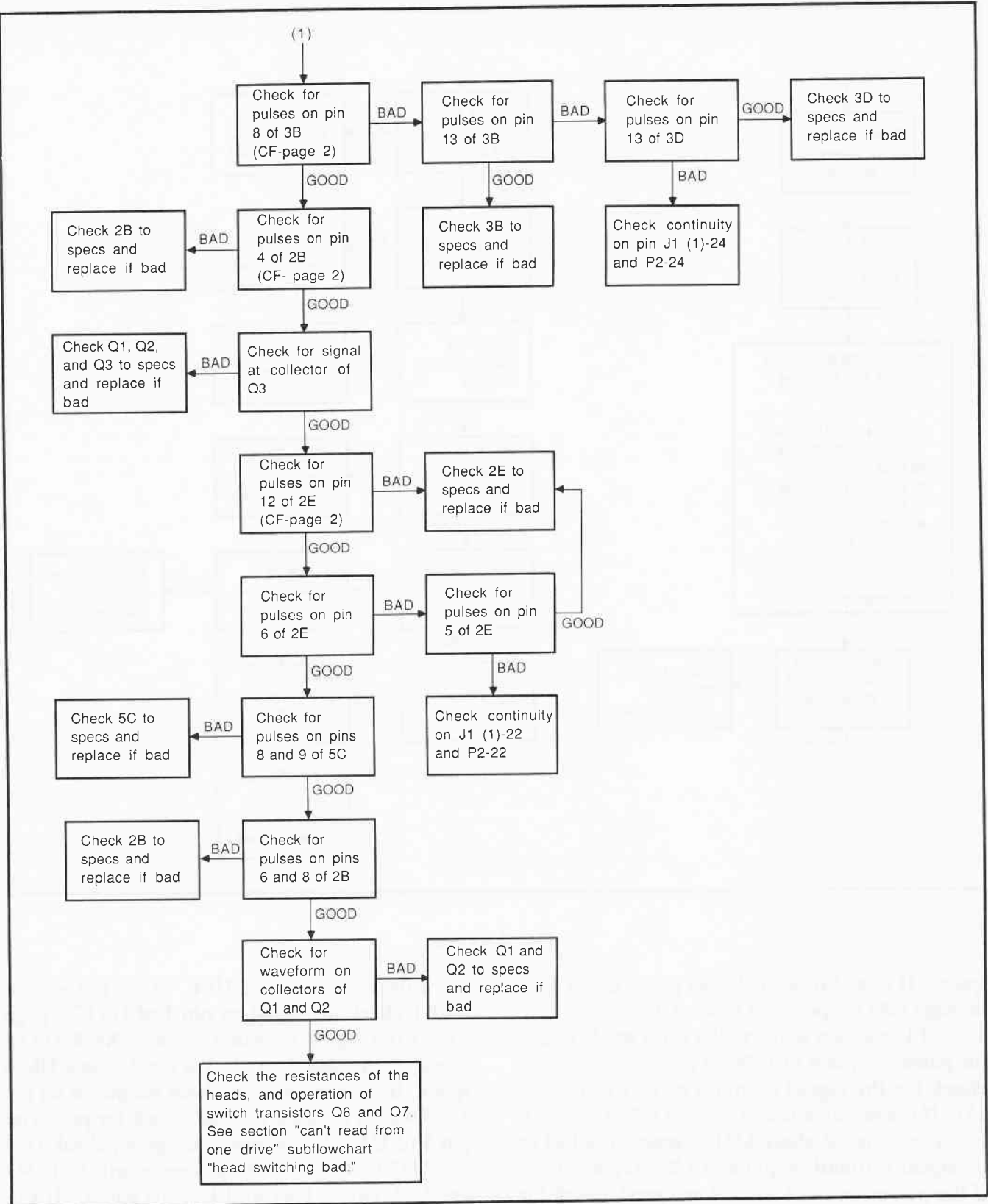
Check U38 by substitution. If that doesn't correct the problem, check whether the direct drive video port works. If it does not work, check U67 to specs and replace if bad. If U67 is not bad, check for pulses on pin 2 of U9 and pin 2 of U10. If no pulses are present, check for pulses on pin 12 of U23. If pin 12 is not pulsing, check U21 to specs and replace if bad. If pin 12 of U23 is pulsing, go to section "No graphics, text works."

If pulses are present on pin 2 of U9 and pin 2 of U10, check for pulses on pin 14 of U9 and pin 14 of U10. If no pulses are found, check for pulses on pin 10 of U23. If pin 10 is not pulsing, check U21 to specs and replace if bad. If pulses are found on pin 10 of U23, go to section "No text, graphics works."

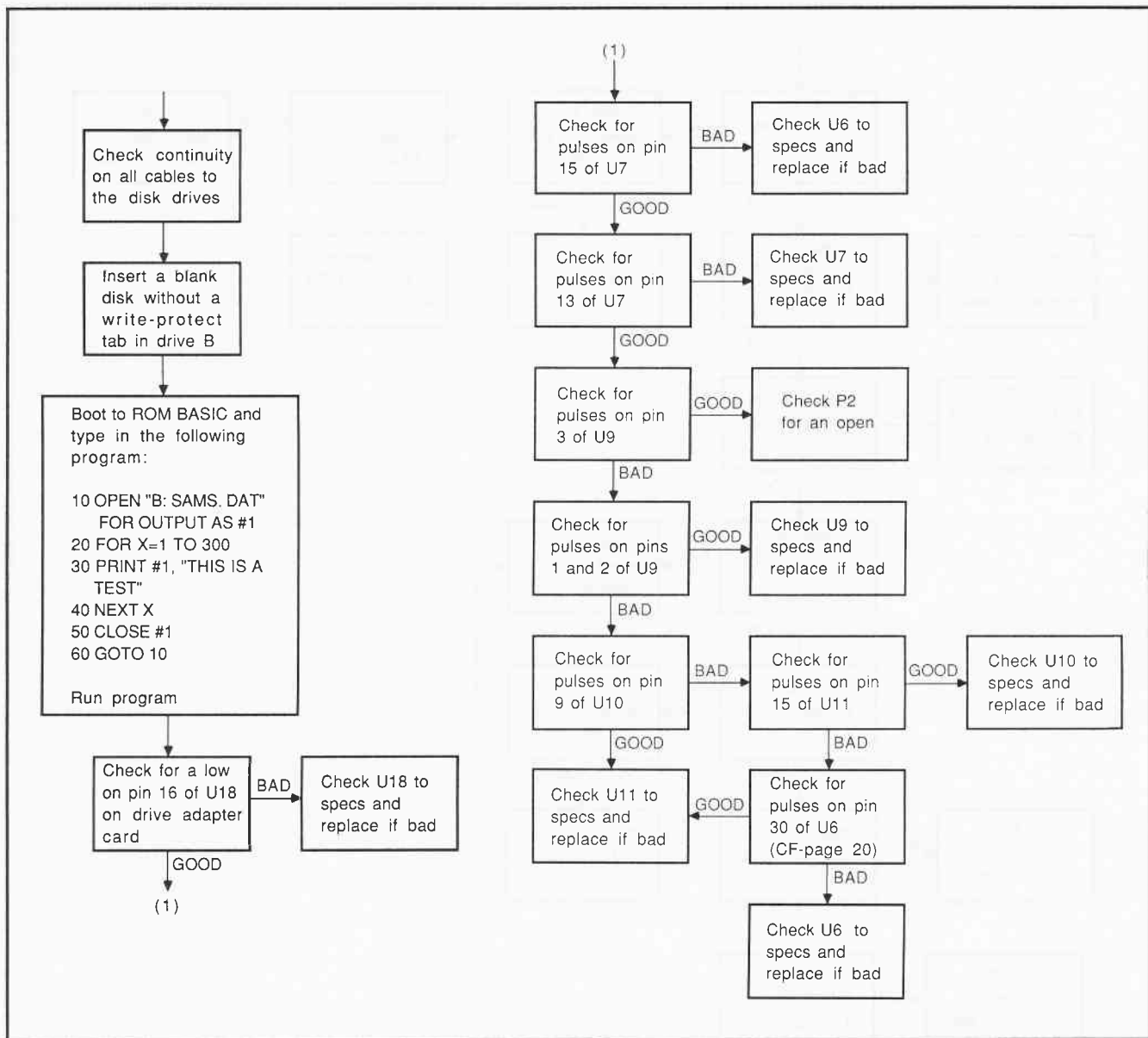
If pulses were found on pin 14 of U9 and pin 14 of U10, check U66 to specs and replace if bad. If U66 is good, check U9 and U10 to specs and replace if bad. If U9 and U10 check good, check U36 to specs. If U36 is good, check U58 to



Flowchart 5-12.



Flowchart 5-12. "cont."

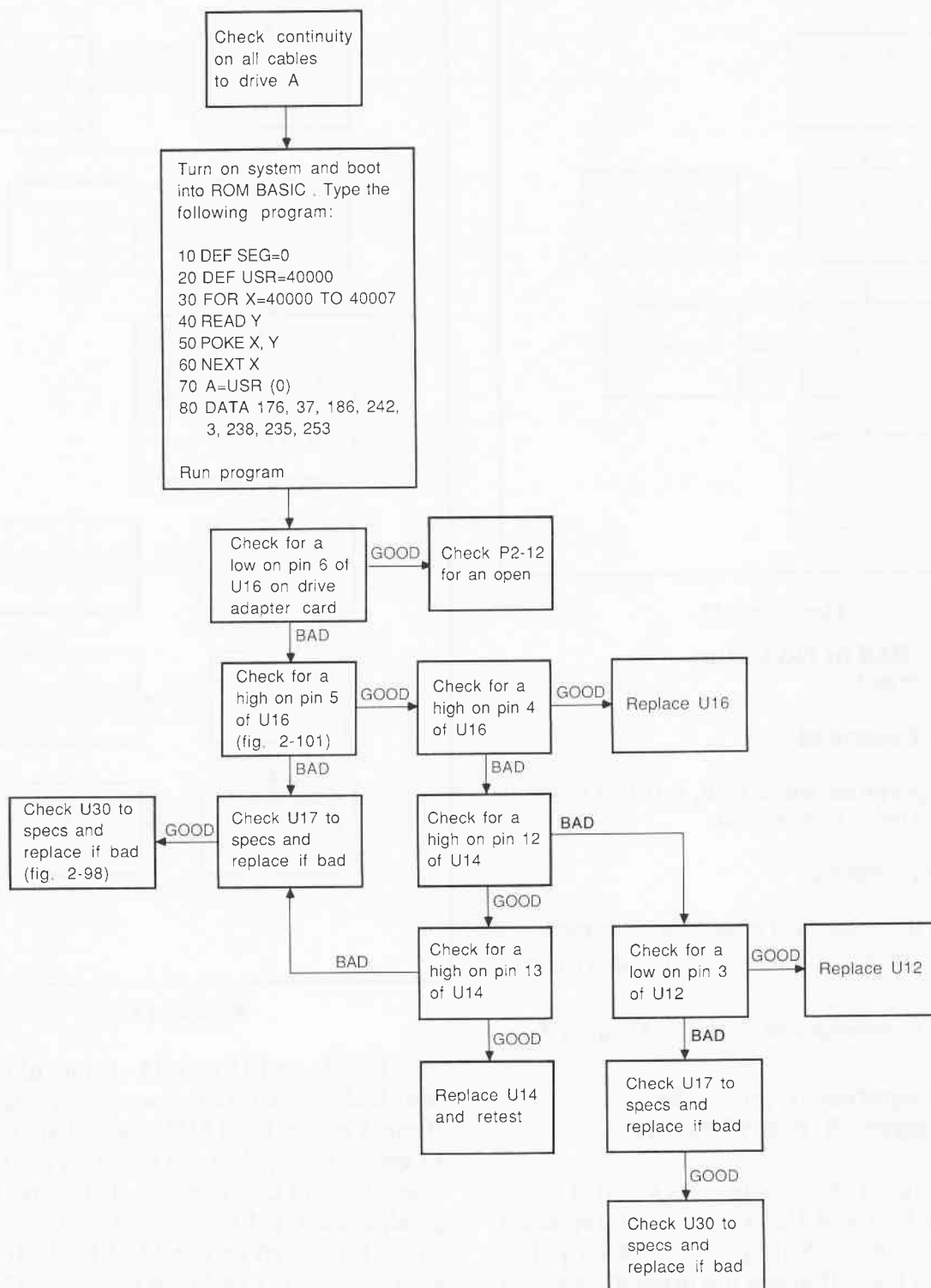


Flowchart 5-13.

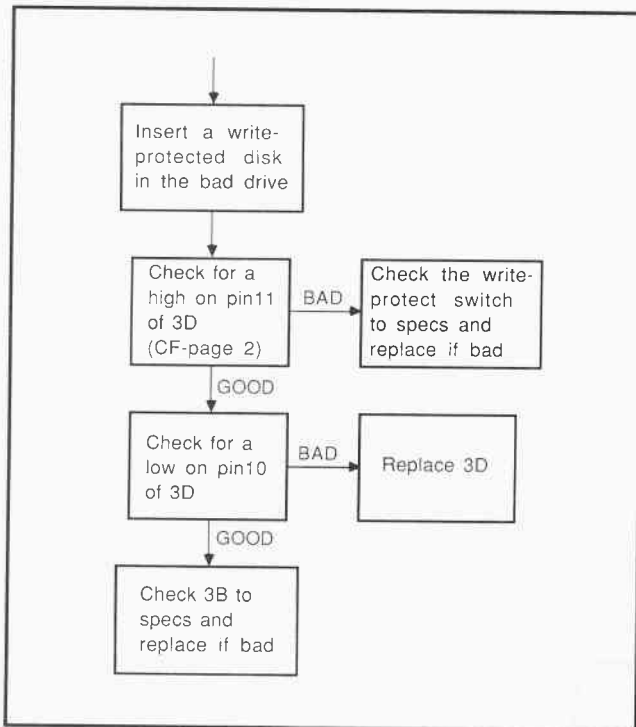
specs. If this chip also checks good, check U50 through U57 to specs and replace if bad.

If the direct drive video does work, check for pulses on pin 4 of U24. If pulses are missing, check for the signal on pin 6 of U21 (CF page 15). If the signal is found, check U65 to specs. If U65 checks good, check U21 to specs. If a bad or no signal is found on pin 6 of U21, replace U38. If the pulses on pin 4 of U24 are good, check for pulses on pin 2 of U24. If pulses are present, check U24 to specs and replace if bad. If the pulses on pin 2 of U24 are bad or missing, check

for pulses on pin 8 of U64. If no pulses are found, check for signal on pin 1 of U6 (CF page 3). If the signal on pin 1 is bad, check U4 to specs. If the signal on pin 1 is good, check U6 to specs. If U6 checks good, check for pulses on pin 4 of U42. If pulses are found, check for pulses on pin 5 of U42. If the pulses are good, check U20 and U42 to specs. If the pulses on pin 4 of U42 are bad, check U41 and U63 to specs. If the pulses on pin 5 of U42 are bad, check U64 to specs. If U64 checks good, check U4 and U6 to specs.



Flowchart 5-14.



Flowchart 5-15.

Problem: Bad or No Color-Image Correct

Symptom Described

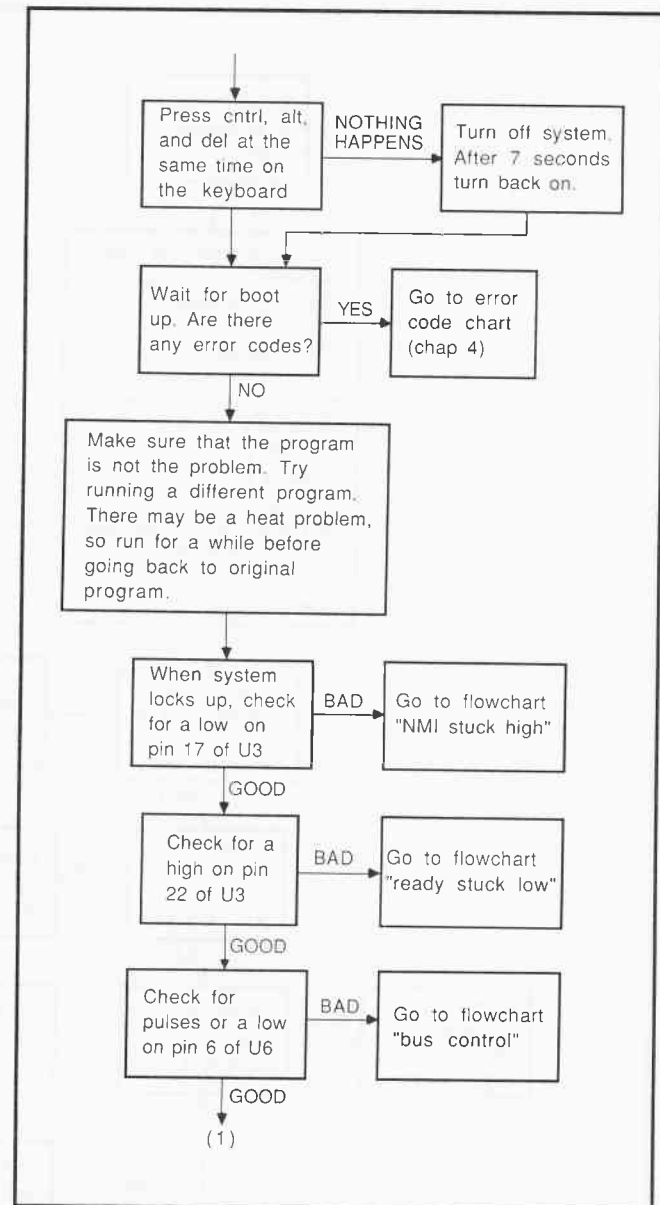
Text and graphics work fine, but the color is wrong or no color is produced.

Preliminary Checks

1. Clean the color card edge connector pins.
2. Try a different known-good display monitor.
3. Refer to appropriate section in Chapter 4.

Classical Approach (Fig. 2-94 and CF pages 16 and 17 apply)

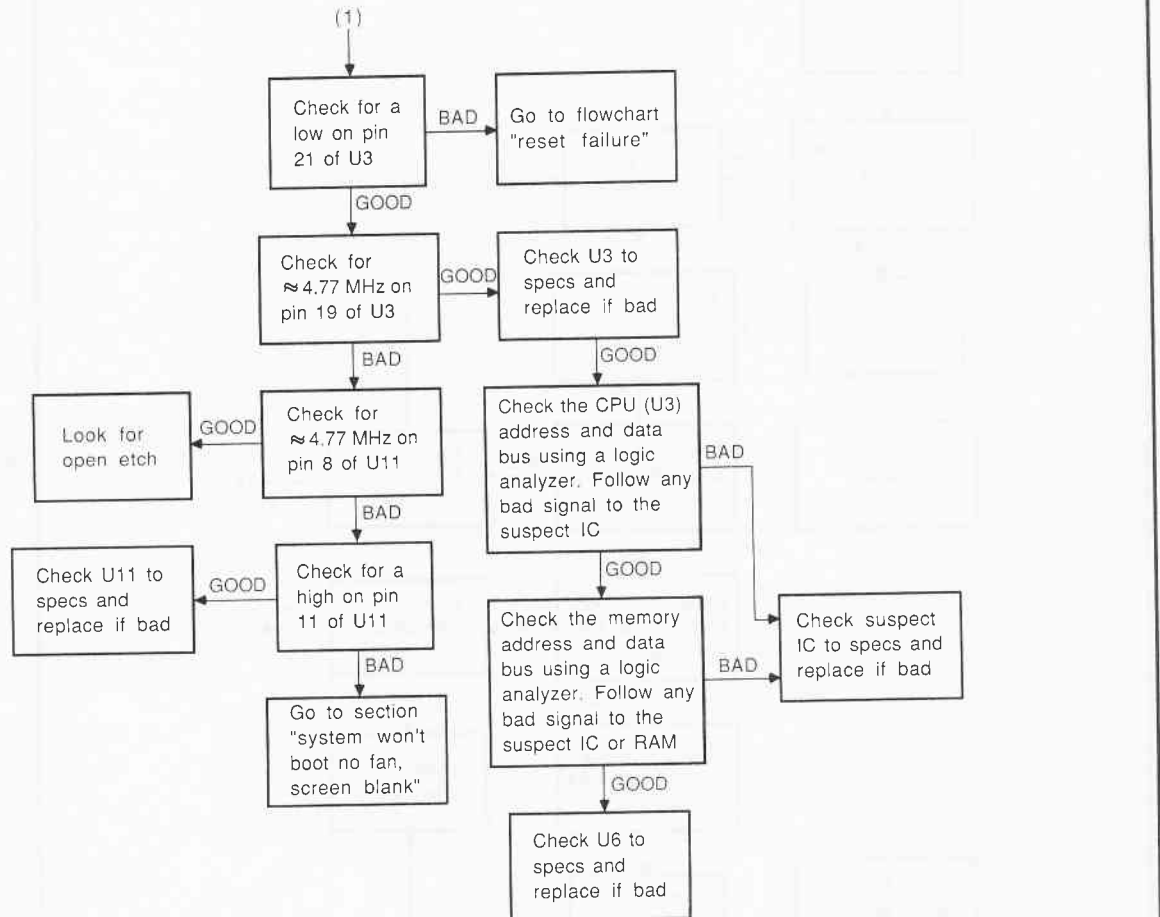
Does the direct drive video work? If it does, then check U24 and U25 to specs and replace if bad. If U24 and U45 are good, check for pulses on pin 11 of U45. If pulses are present, check for pulses on pin 4 of U45. If pulses are found on pin 4, check for pulses on pin 10 of U45. If pin 10 is good, check for pulses on pin 3 of U45. If pulses are found on pin 3, check for pulses on pin 13 of U45. If pin 13 is good, check for pulses on



Flowchart 5-16.

pins 1, 2, 14 and 15 of U45. If one of these pins tests bad, check U44 to specs and replace if bad. If pin 3 or pin 13 of U45 checks bad, check U43 to specs. If no pulses are found on pin 10 of U45, check U9 and U10 to specs. If U9 and U10 tests good, check U101 to specs. If U101 checks good, check for a high on pin 12 of U14. If pin 12 is high, check U65 and U68 to specs. If pin 12 is low, check U20 to specs and replace if bad.

If the direct drive video doesn't work, check U67 to specs and replace if bad. If U67 tests good, check U101, U9, and U10 to specs. (See flowchart 5-33.)



Flowchart 5-16. "cont."

Problem: Cursor Missing or Not Blinking

Symptom Described

No cursor on display or cursor is present, but not blinking.

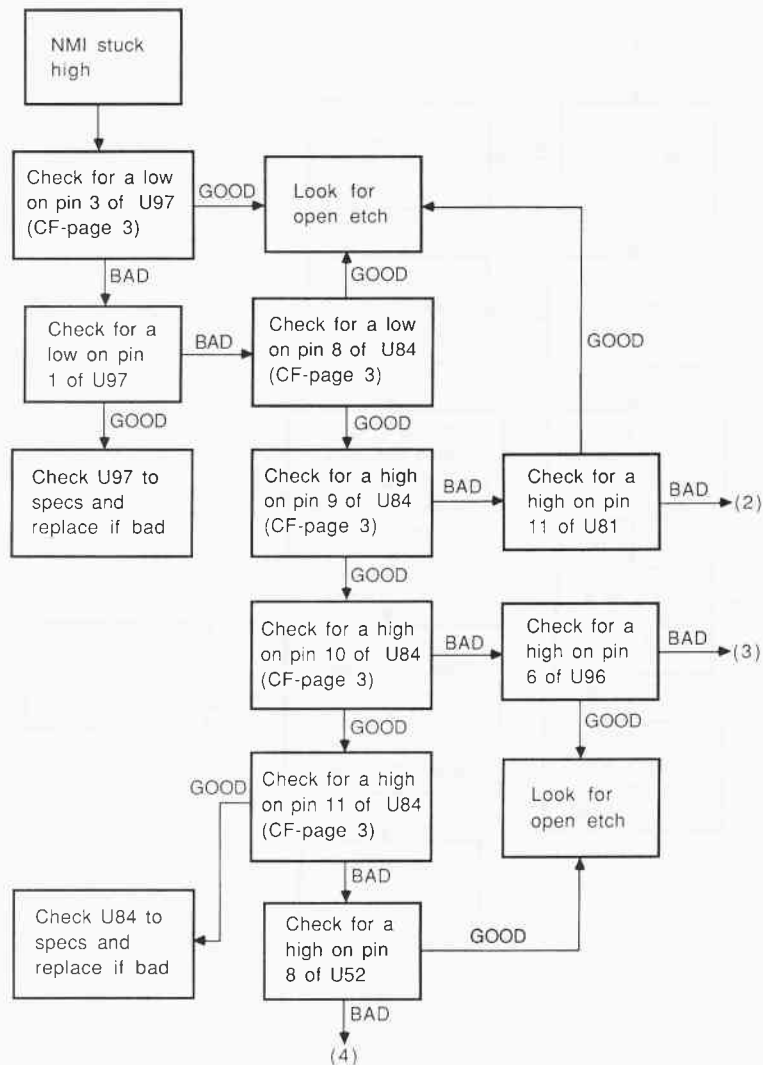
Preliminary Checks

1. Clean color card edge connector pins.
2. Try a different, known-good display monitor.

3. Refer to appropriate section in Chapter 4.

Classical Approach (Figs. 2-93, and CF pages 2 and 15 apply)

Check for pulses on pin 2 of U20. If pulses are present, check U21 to specs and replace if bad. If no pulses are found, check U12 to specs and replace if bad. If U12 tests good, check for pulses on pin 19 of U38. If pulses are present on pin 19 of U38, check U20 to specs. If no pulses are found on pin 19, check U38 to specs and replace if bad. (See flowchart 5-34.)



Flowchart 5-17.

4. IBM PC KEYBOARD PROBLEMS

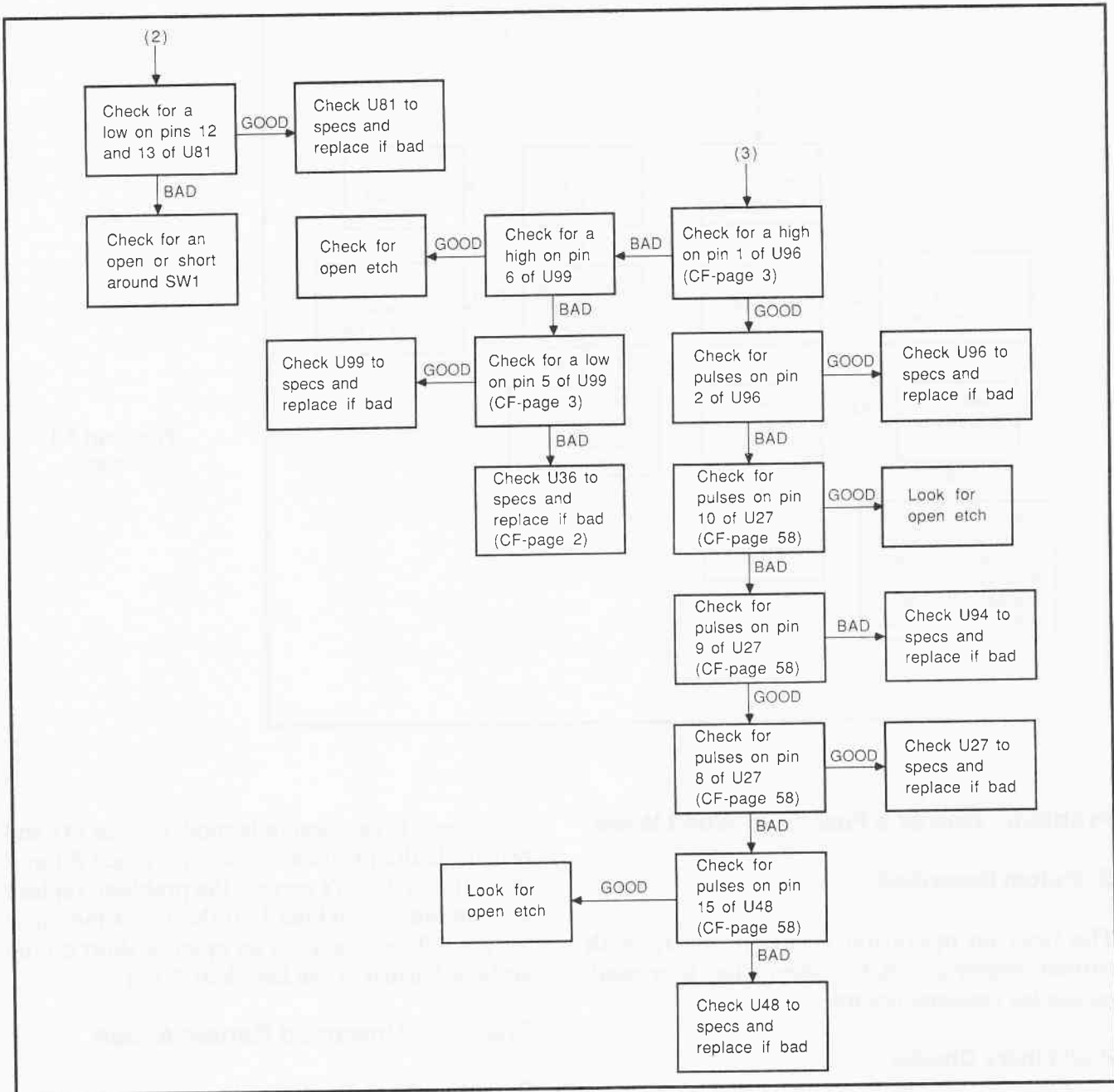
Preliminary Checks

Problem: Keyboard Won't Respond at All or Wrong Character Is Produced

Symptom Described

When any key is pressed, no display response is noted; or when a key is pressed, the wrong character is displayed on the monitor.

1. Check the video cable for continuity and proper mating.
2. Clean the keys with a tuner cleaning spray.
3. Refer to appropriate section in Chapter 4.

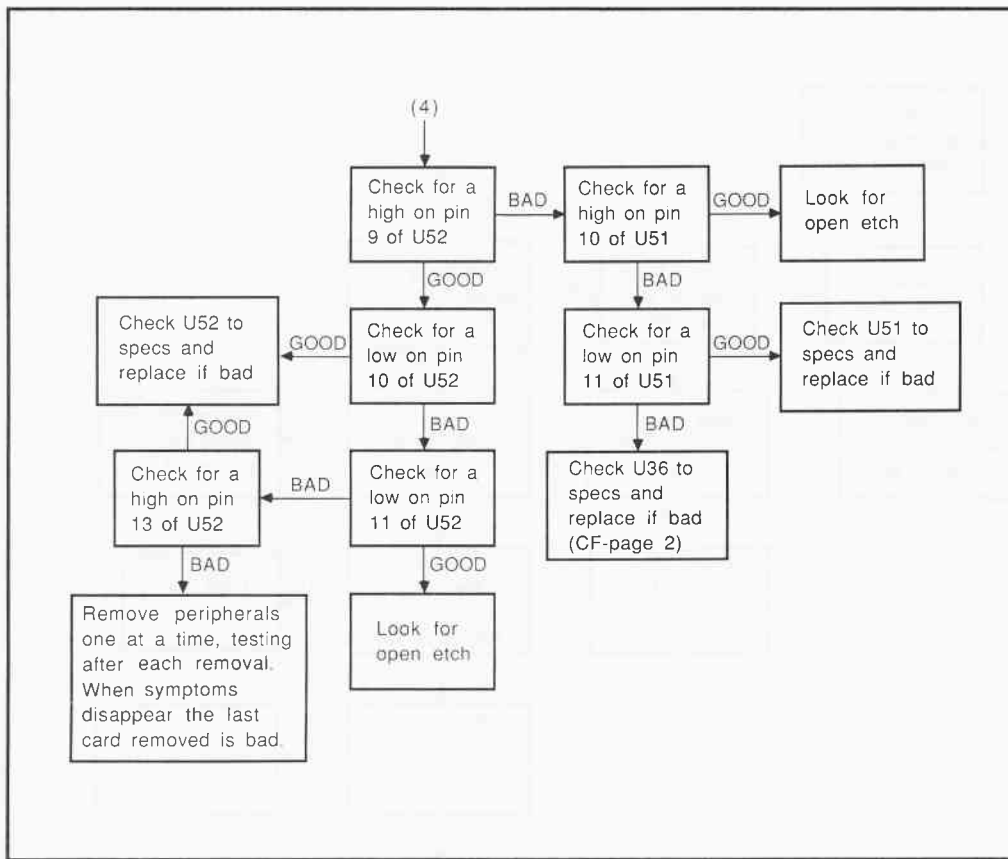


Flowchart 5-17. "cont."

Classical Approach (Figs. 2-59, 2-60, and CF page 2 apply)

While pressing a key, check for a signal on pin 17 of U24 (system board through CF page 2). If the signal is bad, check for proper signal on pin 3 of M2 in the keyboard. If pin 3 is bad, check to see if M1 and M3 are swapping. If pin 3 of M2 is good, check M2 by replacement. If pin 3 is still bad, check Z1 and replace if bad.

If pin 17 of U24 is good, while pressing a key, check for a signal on pin 1 of U24. If a bad or no signal is found, check U82 to specs and replace if bad. If pin 1 of U24 is good, check U36 to specs and replace if bad. If U36 also tests good, check for a signal on pin 11 of U24. If pin 11 tests bad, check U26 and U80 to specs and replace if bad. If pin 11 tests good, check U24 by replacement. (See flowchart 5-35.)

Flowchart 5-17.
"cont."**Problem: One or a Few Keys Won't Work****Symptom Described**

The boot-up operation occurs properly, with correct display action, but when a key is pressed, no display response occurs.

Preliminary Checks

1. Verify that the keyboard-system board cable has continuity and is properly connected.
2. Clean the keys with a tuner cleaner spray.
3. Refer to appropriate section in Chapter 4.

Classical Approach (Fig. 2-58, 2-59, and CF page 2 apply)

Check the continuity of the key that is bad. Measuring across the key, verify an open with the key unpressed, and shorted when the key

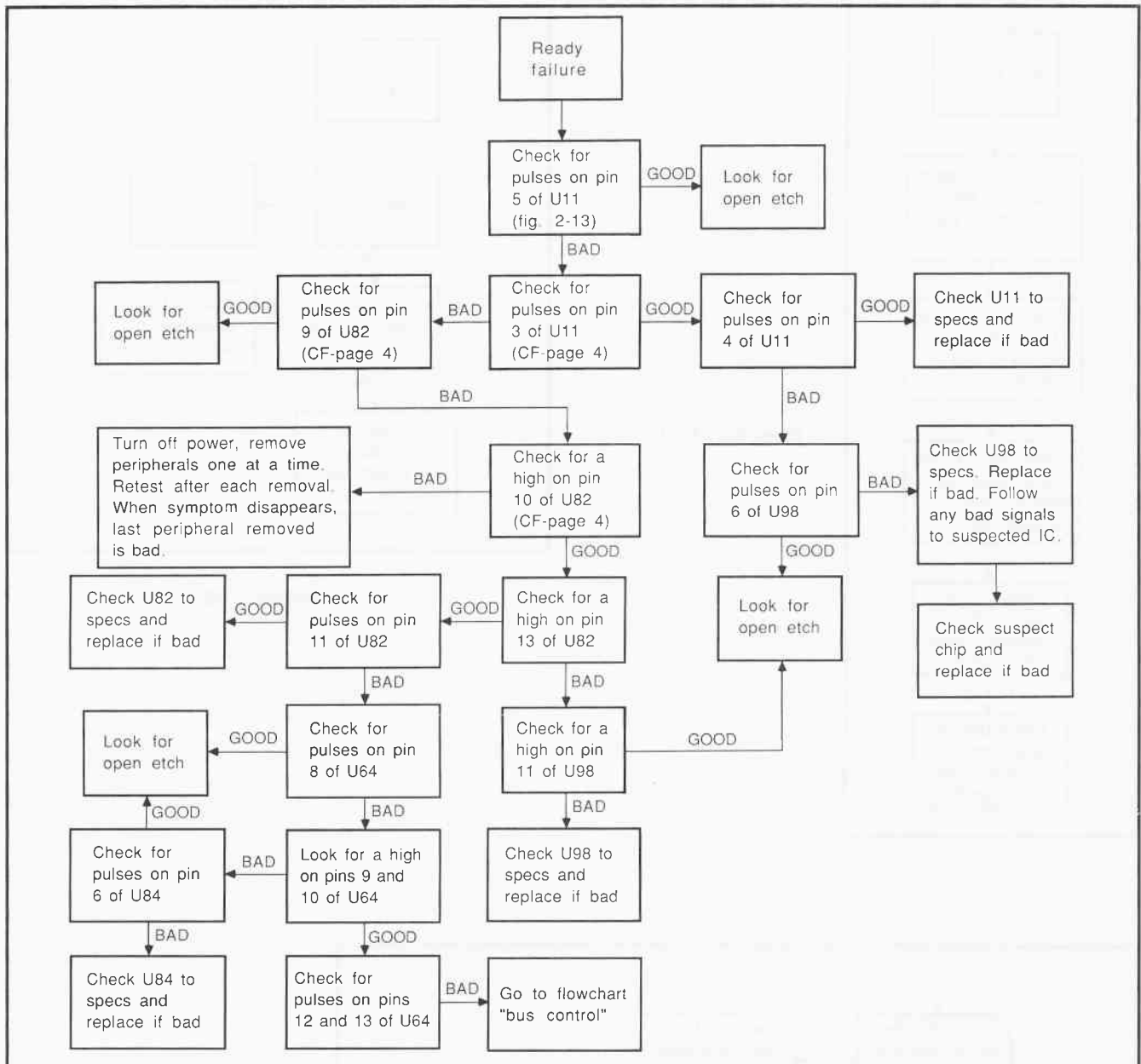
is pressed. If key closure is good, replace M1 and retest. If the problem persists, replace Z1 and test. If this doesn't correct the problem, replace U24 on the system board. If this is not the cause for the failure, check for an open or short on the keyboard matrix. (See flowchart 5-36.)

Problem: Unwanted Repeat Action**Symptom Described**

When a key is pressed, more than one image of the same character is displayed on the screen. This occurs even when not holding the key down for an intended repeat action.

Preliminary Checks

1. Check the cable for continuity and proper mating.
2. Clean the keyboard keys with a tuner spray.



Flowchart 5-18.

3. If only one key fails, replace the key.
4. Refer to appropriate section in Chapter 4.

Classical Approach (Fig. 2-58 and CF page 2 apply)

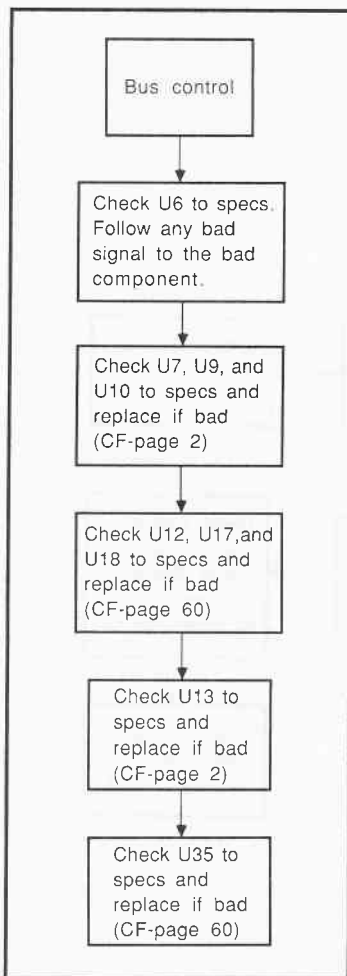
Replace M1 in the keyboard chassis. If this does not correct the problem, check Z1 to specs and replace if bad. (See flowchart 5-37.)

5. IBM PC INPUT/OUTPUT PROBLEMS

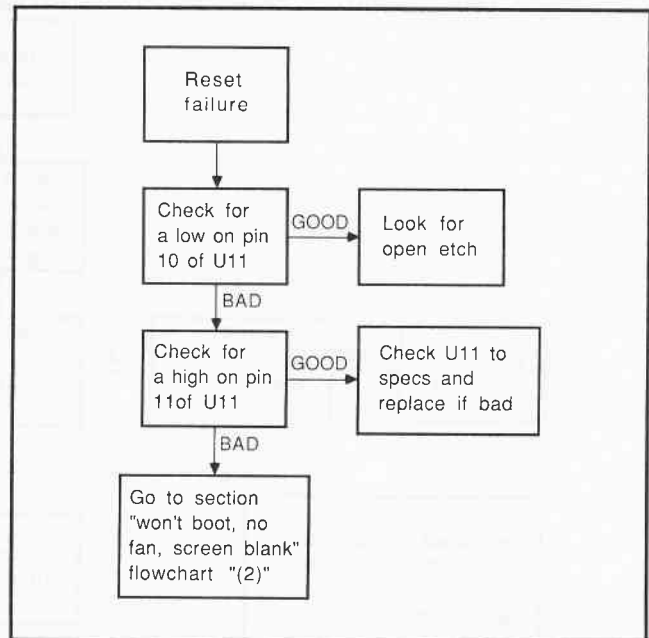
Problem: Cassette—Can't Write Data to Tape

Symptom Described

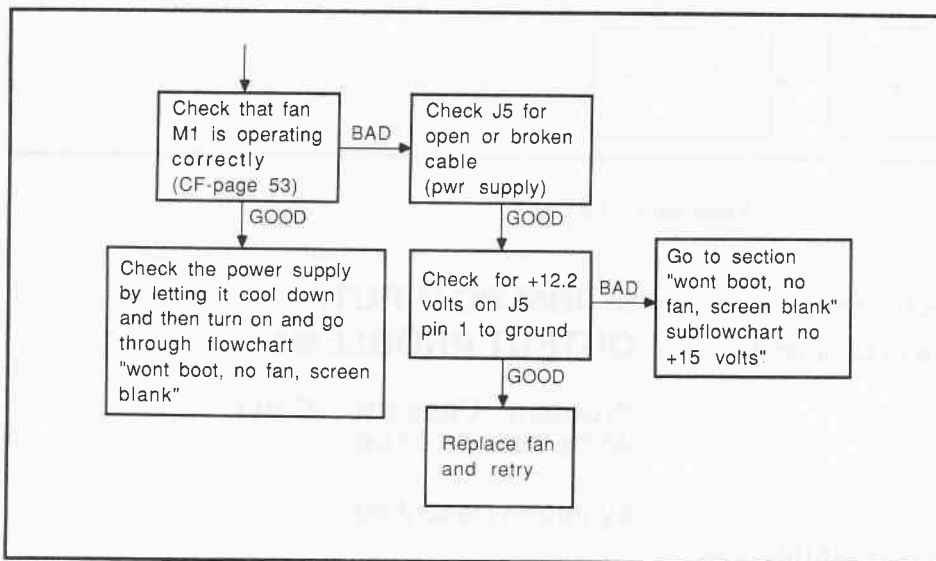
When trying to write to the tape, an error occurs or nothing is written.



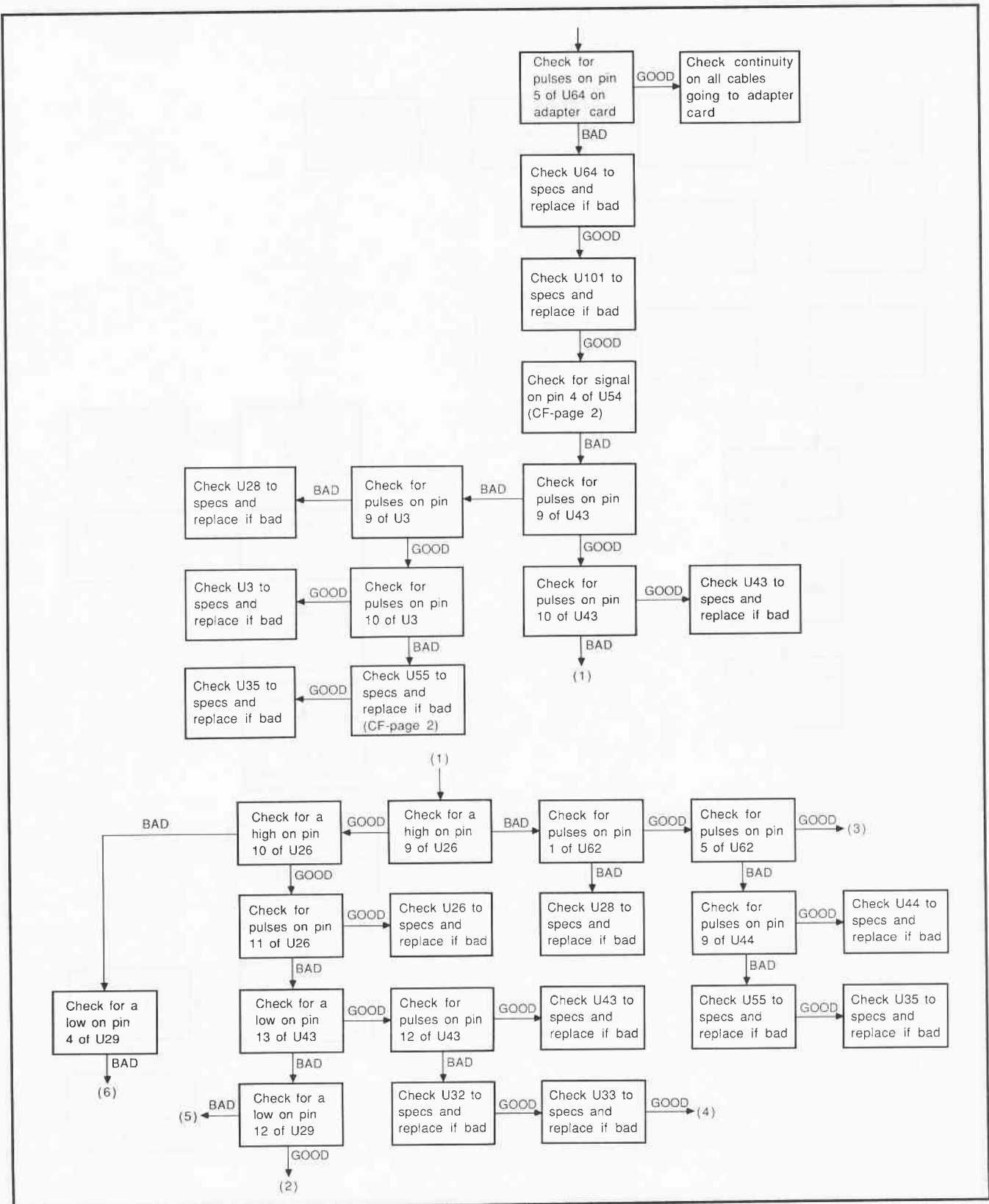
Flowchart 5-19.



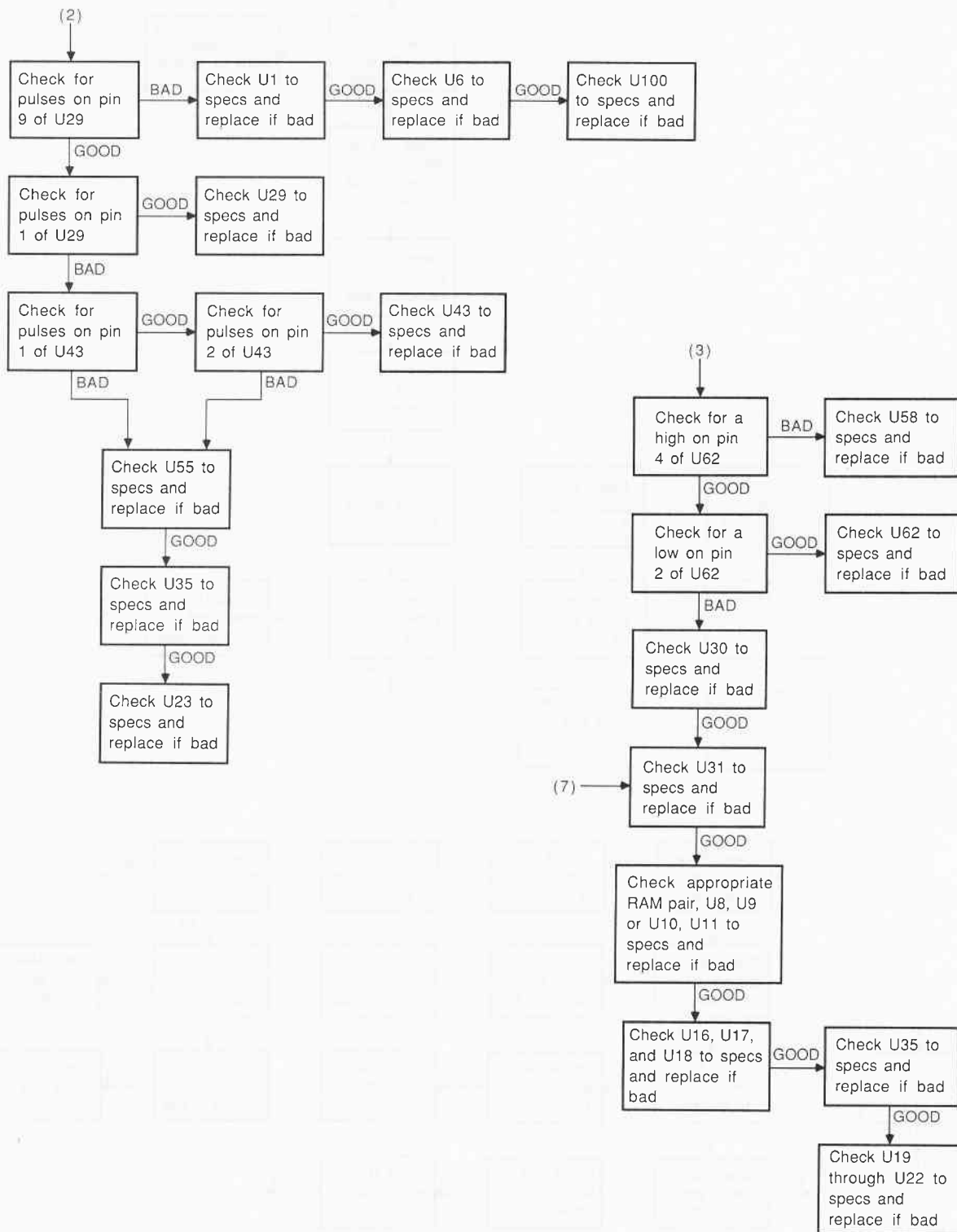
Flowchart 5-20.



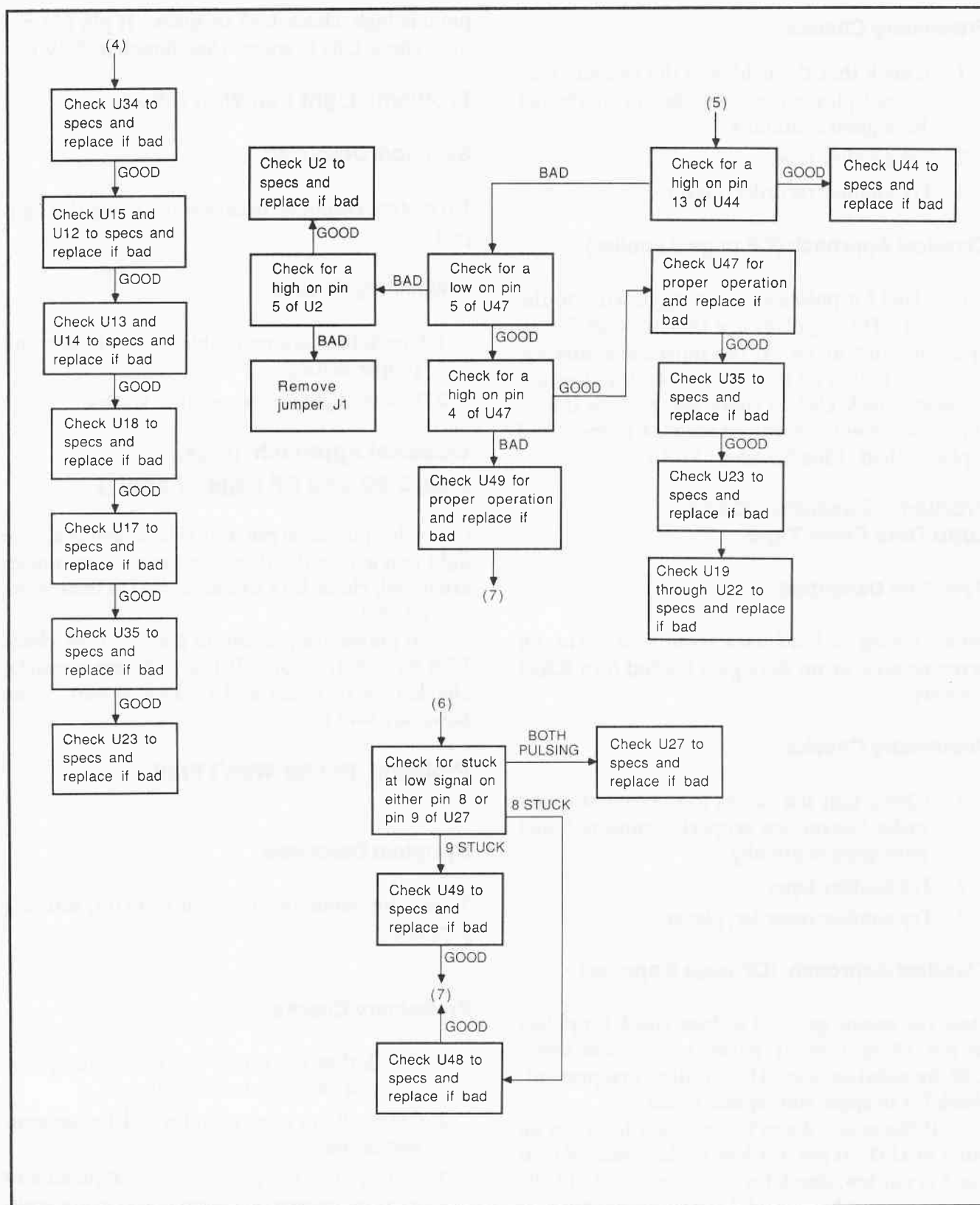
Flowchart 5-21.



Flowchart 5-22.



Flowchart 5-22. "cont."



Flowchart 5-22. "cont."

Preliminary Checks

1. Check that the cables to the cassette recorder/ player are connected properly and have good continuity.
2. Try another tape.
3. Try another recorder/player.

Classical Approach (CF page 2 applies)

Check U63 for pulses when trying to write to the recorder. If the pulses are there, check for an open or short at P4. If the pulses are missing, check for pulses on pin 17 of U34. If pulses are present, check U63 to specs and replace if bad. If pulses are not present, check U34 to specs and replace if bad. (See flowchart 5-38.)

Problem: Cassette—Can't Load Data From Tape**Symptom Described**

When trying to load data from a cassette, an error occurs, or no data gets loaded into RAM memory.

Preliminary Checks

1. Check that the cables to the cassette recorder/player are properly connected and have good continuity.
2. Try another tape.
3. Try another recorder/player.

Classical Approach (CF page 2 applies)

Does the motor spin? If it does, check for pulses on pin 13 of U36. If pulses are present, check U36 by substitution. If no pulses are present, check U1 to specs and replace if bad.

If the motor doesn't spin, check for a low on pin 3 of U95. If pin 3 is low, replace relay K1. If pin 3 is not low, check for a low on pin 21 of U36. If pin 21 is not low, check U36 by substitution. If pin 21 is low, check for a high on pin 6 of U63. If

pin 6 is high, check U95 to specs. If pin 6 is not high, check U63 to specs. (See flowchart 5-39.)

Problem: Light Pen Won't Work**Symptom Described**

No system response occurs when using the light pen

Preliminary Checks

1. Check the light pen cable for continuity and proper mating.
2. Test the light pen on another system.

Classical Approach (Figs. 2-85, 2-90, and CF page 17 apply)

Check for pulses on pin 3 of U38 as you draw the light pen across the display screen. If no pulses are noted, check U11 to specs. If U11 tests good, check U29 to specs.

If pulses are present on pin 3 of U38, check U38 by substitution. If the problem persists, check U24 to specs and replace if bad. (See flowchart 5-40.)

Problem: Printer Won't Print**Symptom Described**

When the command is given to print, nothing happens.

Preliminary Checks

1. Check that the cables are connected properly and have good continuity.
2. Clean the printer adapter card edge connector pins.
3. Verify that the printer is configured and working properly. Conduct a printer self-test.

Classical Approach (CF pages 2, 7, and 54 apply if using printer adapter card; CF pages 2 and 13 apply if using monochrome monitor/printer adapter card)

The following description assumes a monolithic printer adapter card. For the monochrome monitor/ printer adapter card, map the ICs as follows:

Printer Adapter	Monochrome Monitor/ Printer Adapter
U1	U23
U6	U61
U7	U39
U8	U38

While running a program that continuously outputs data to the printer, check for signal on pin 8 of U5. If the signal is not present, replace U5. If a signal is present, check for pulses on pin 2 of U8. If the pulses are present, check U8 to specs and replace if bad. If no pulses are present on pin 2, check U7 to specs. If U7 is good, check U6 to specs. If U6 is good, check U1 to specs. (See flowchart 5-41.)

Problem: Printer Locks Up or Prints Garbage

Symptom Described

When beginning or in a print operation, the printer stops or begins printing garbage.

Preliminary Checks

1. Check that the cables are properly connected and have good continuity.
2. Clean the printer adapter card edge connector pins.
3. Verify that the printer is configured properly and operates properly. Conduct a printer self-test.

Classical Approach (CF pages 2, 7, and 54 if using printer adapter card; CF pages 2 and 13 if using monochrome monitor/printer adapter card)

The following description assumes a monolithic printer adapter card. For the monochrome monitor/printer adapter card, map the ICs as follows:

Printer Adapter	Monochrome Monitor/ Printer Adapter
U2	U37
U3	U40
U4	U41

While running a program that continuously outputs to the printer, check U2 to specs and replace if bad. If U2 is good, check U4 and U3 to specs. Replace if bad. If the problem persists, go to section "Printer won't print." (See flowchart 5-42.)

Problem: Speaker Won't Work

Symptom Described

No noise from speaker.

Preliminary Checks

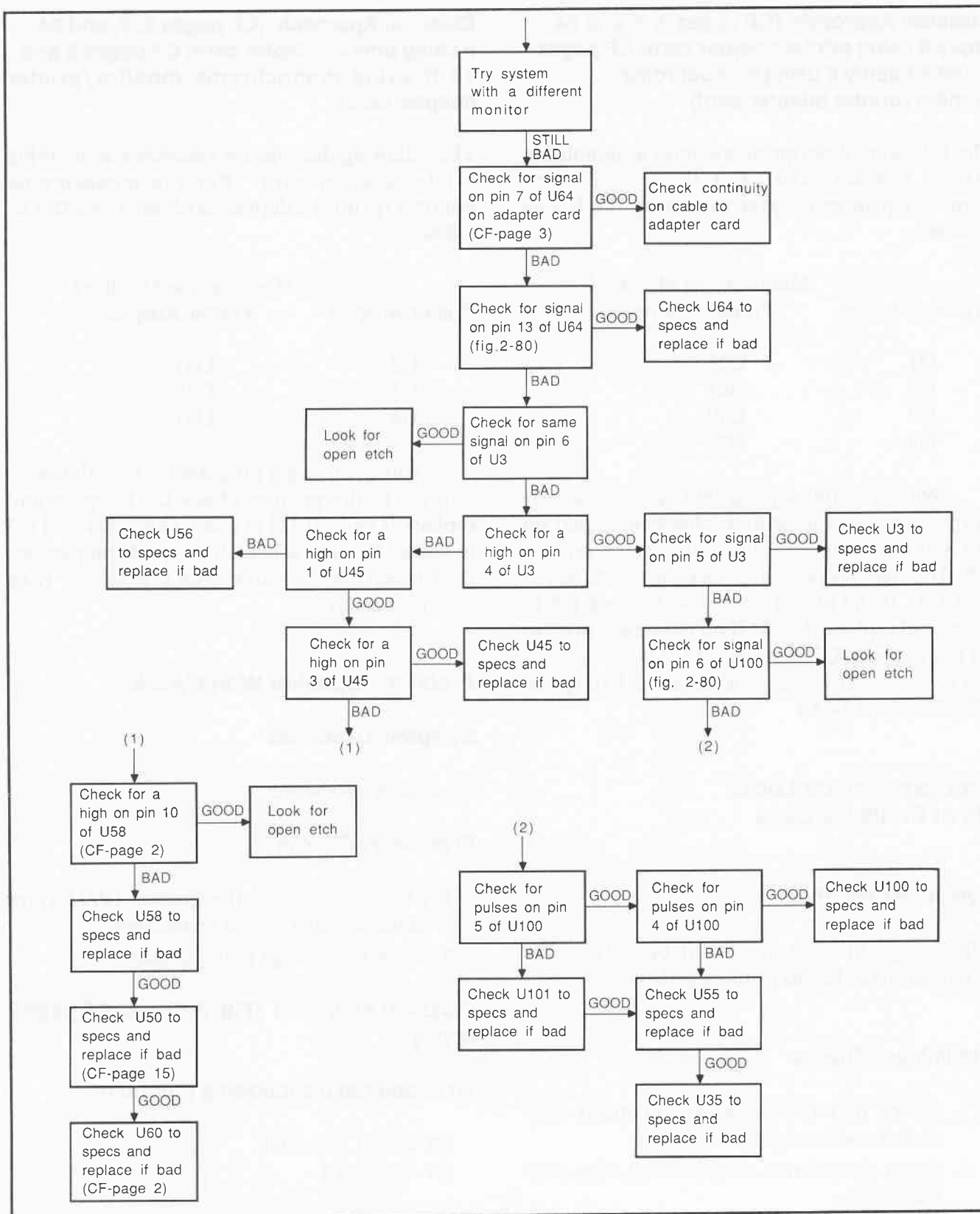
1. Check the cable to the speaker (P/J3A) for continuity and proper connection.
2. Check for damage to the speaker.

Classical Approach (Fig. 2-57 and CF page 2 apply)

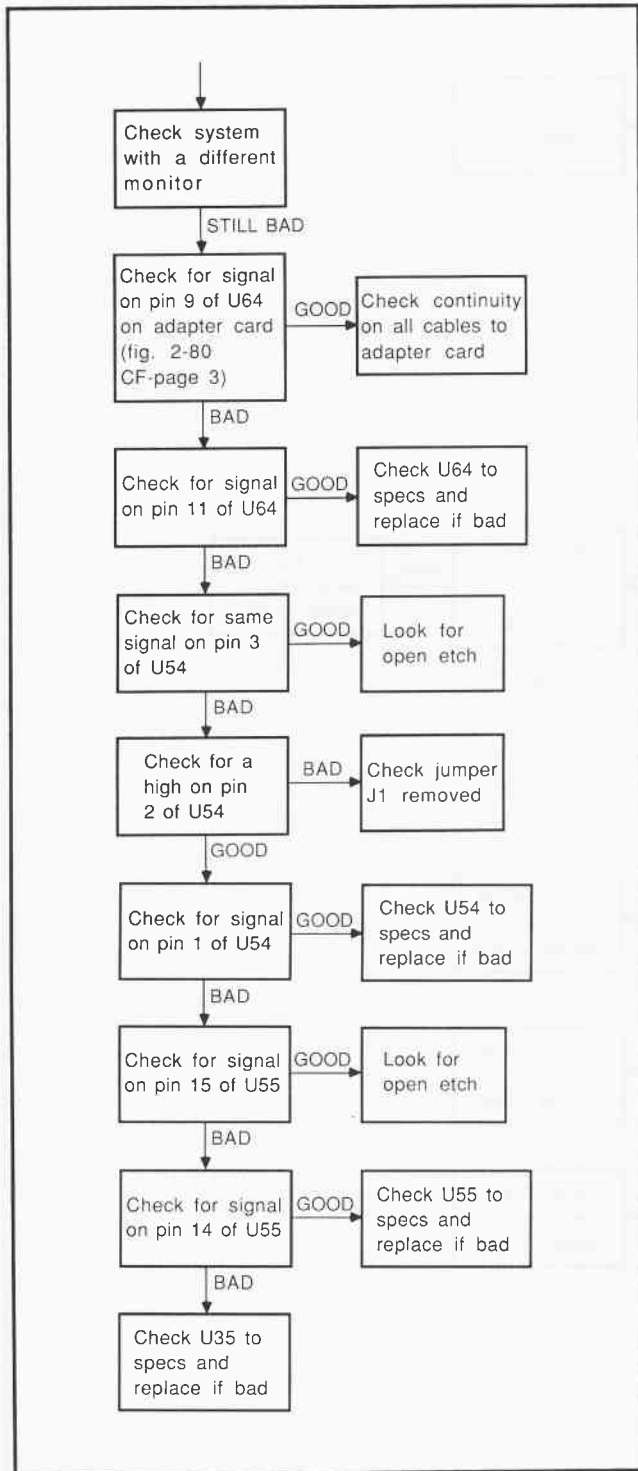
Write and run the following program:

```
10 SOUND 200,200
20 GO TO 10
```

Check for pulses on pin 6 of U95. If pulses are present, replace the speaker. If no pulses are present on pin 6, check for a signal (CF page 57)

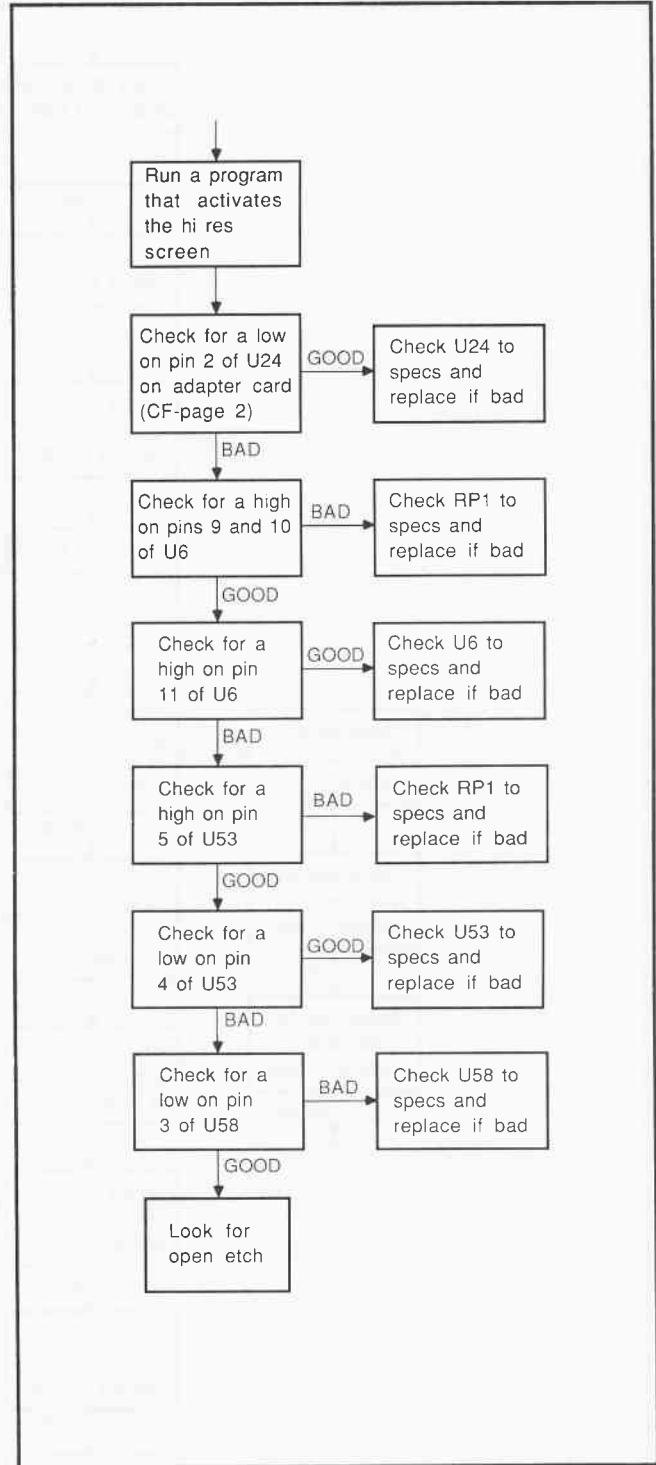


Flowchart 5-23.



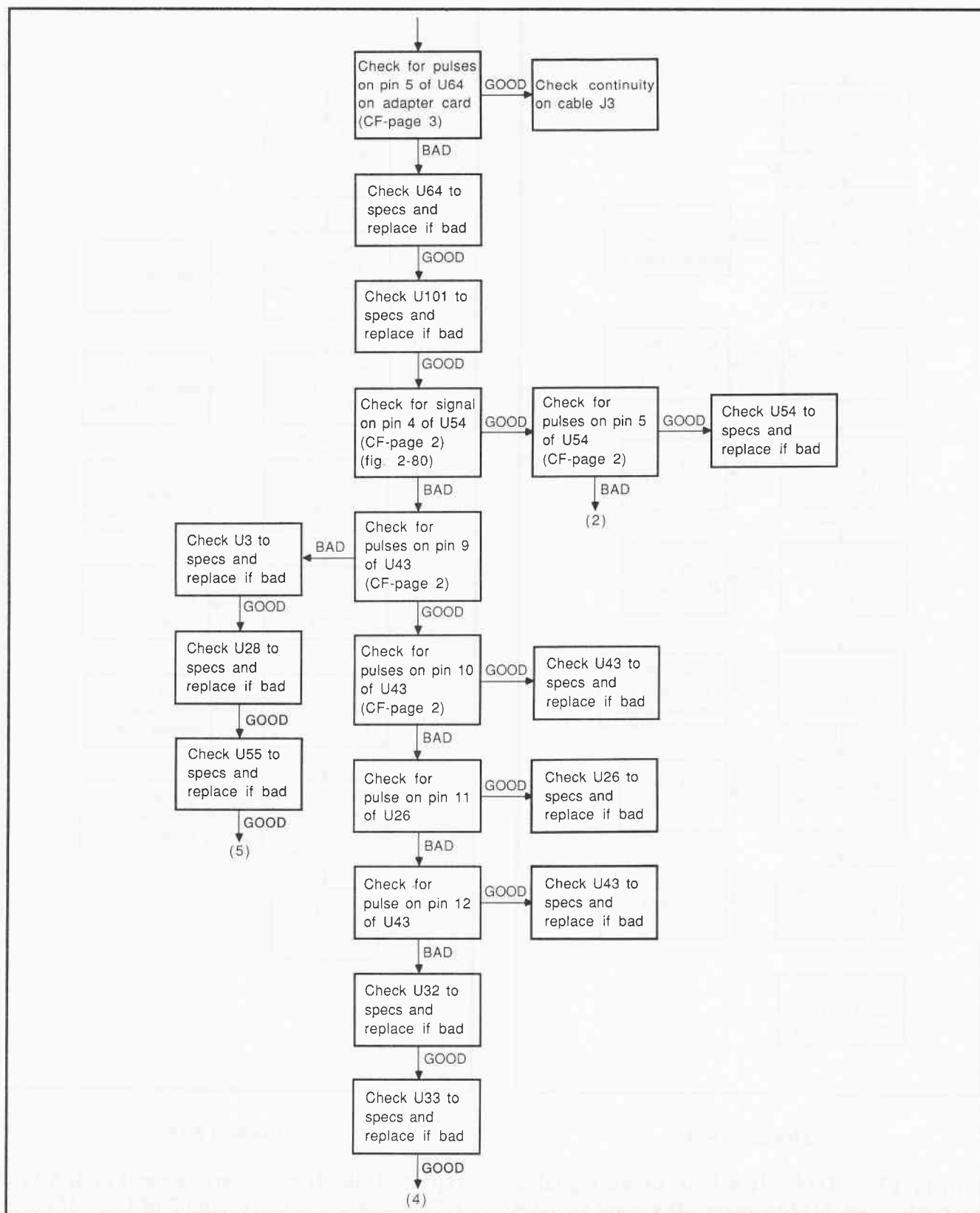
Flowchart 5-24.

on pin 17 of U34. If a bad, or no signal is present, check U34 to specs. If a good signal is present on pin 17 of U34, check for pulses on pin 12 of U63. If no pulses are found on pin 12,

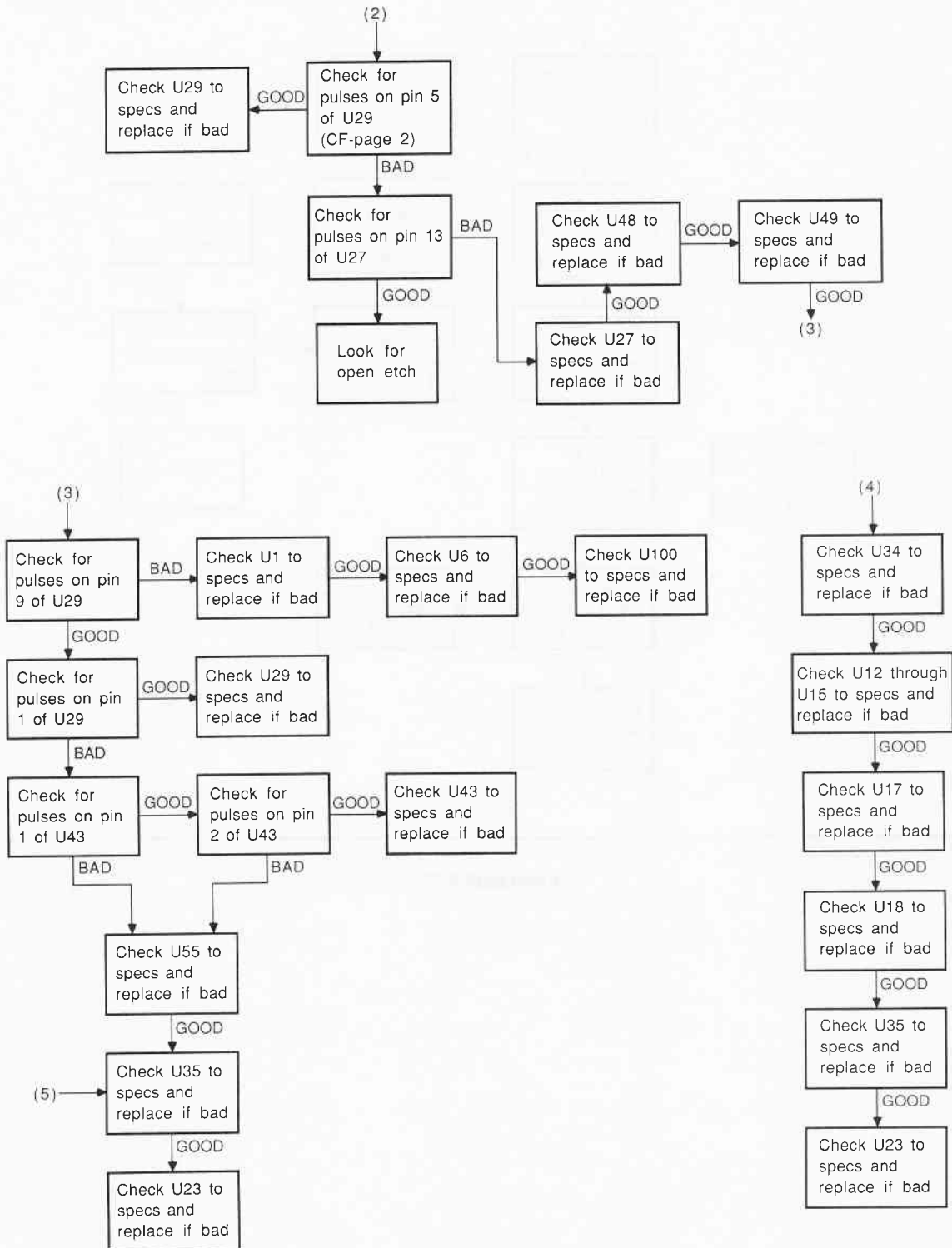


Flowchart 5-25.

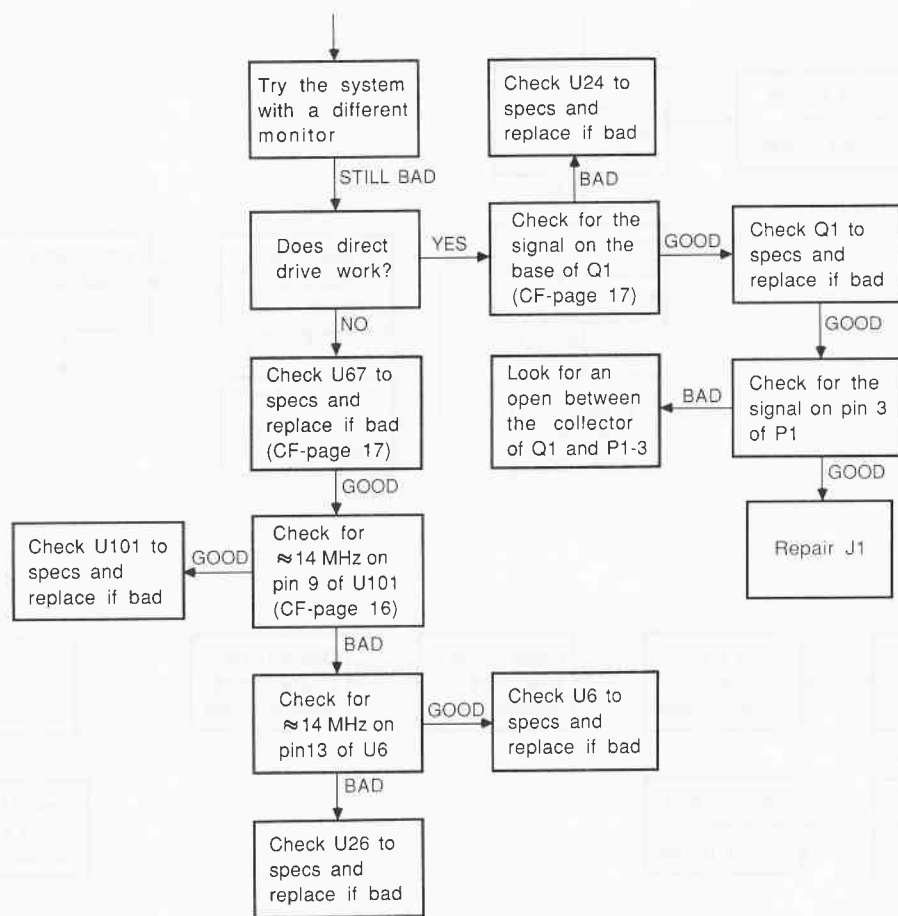
replace U36. If pulses are present on pin 12 of U63, check for pulses on pin 7 of U95. If pulses are present, check U95 to specs. If no pulses are found, check U63 to specs. (See flowchart 5-43.)



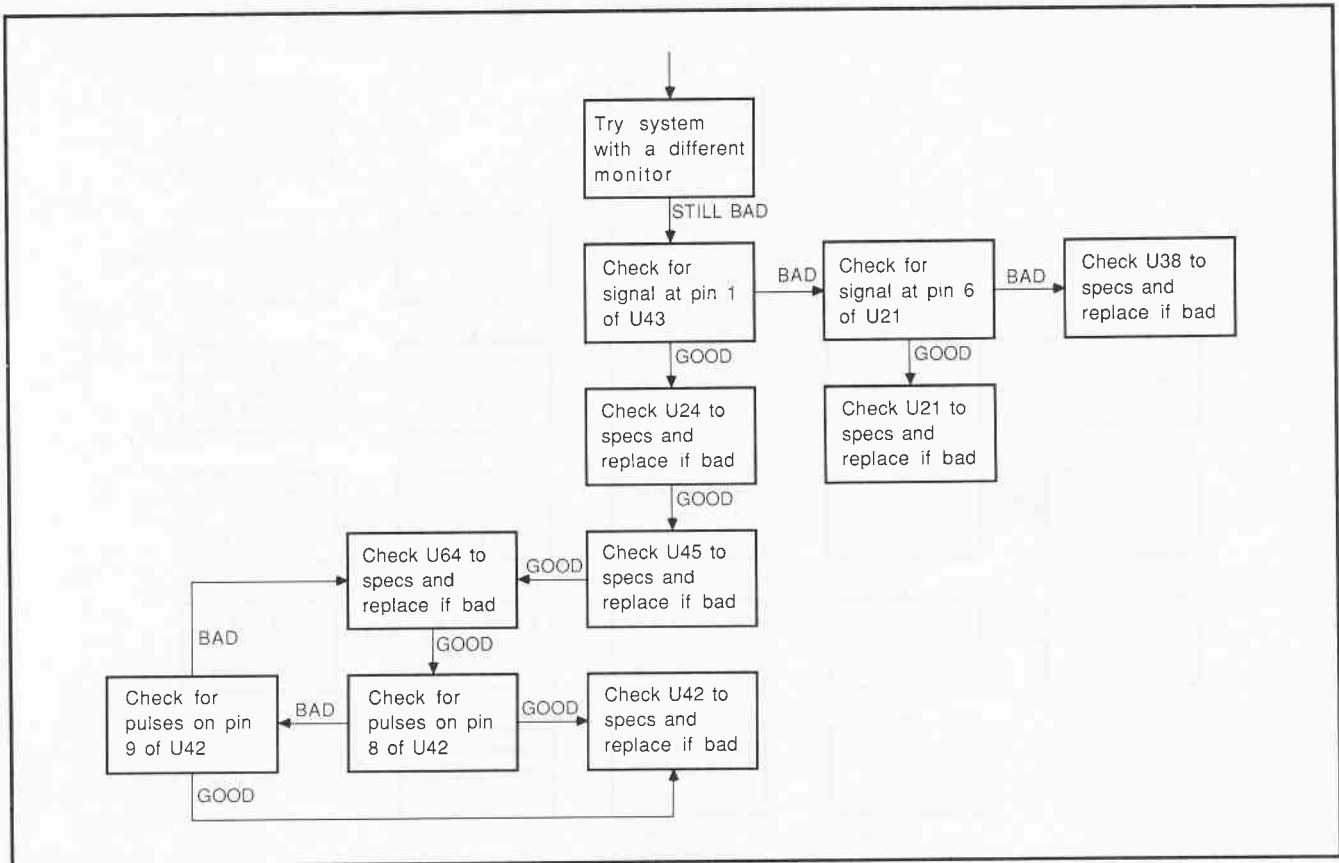
Flowchart 5-26.

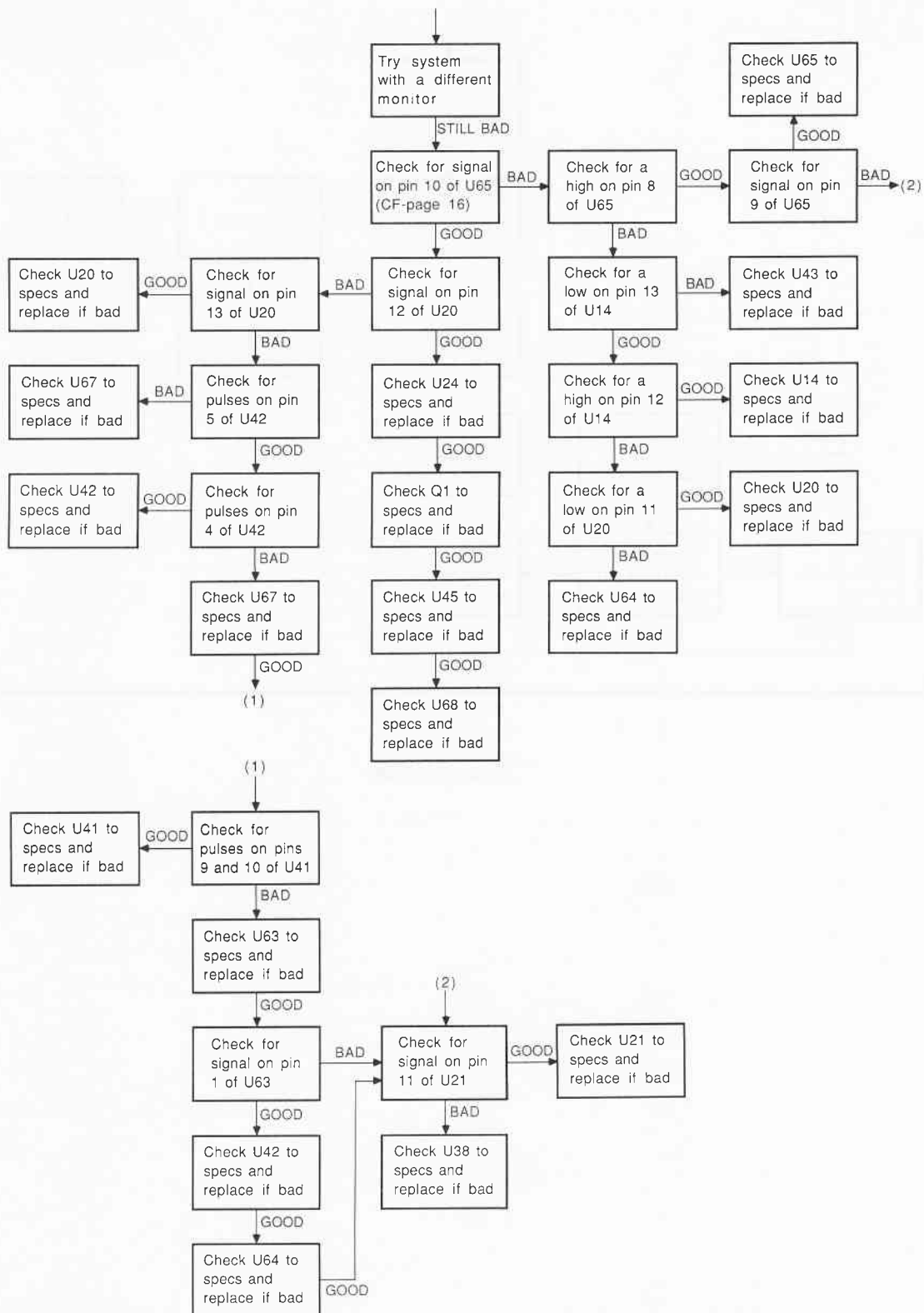


Flowchart 5-26. "cont."

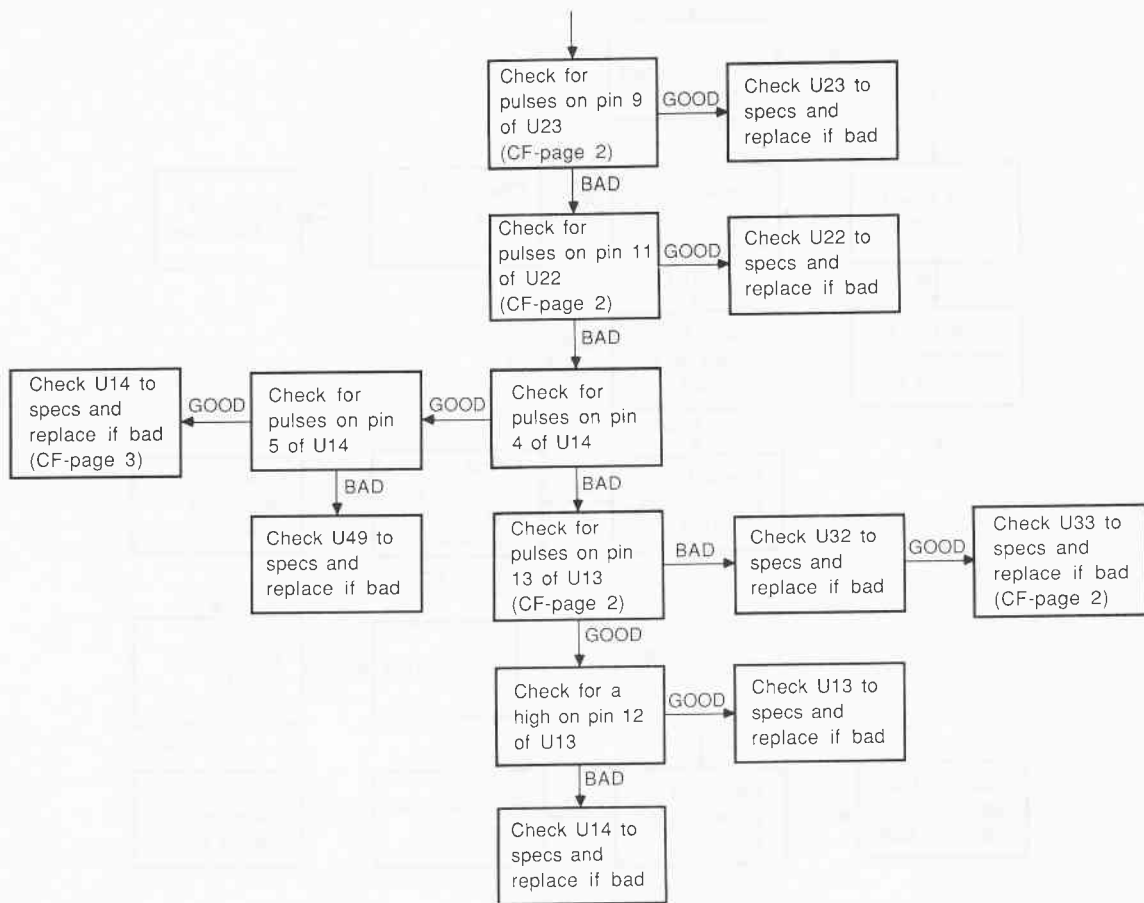


Flowchart 5-27.

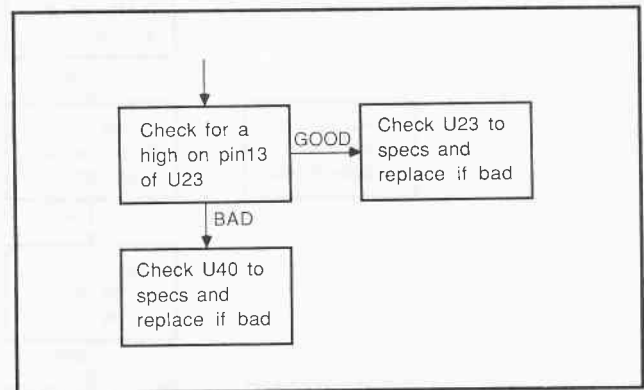
**Flowchart 5-28.**



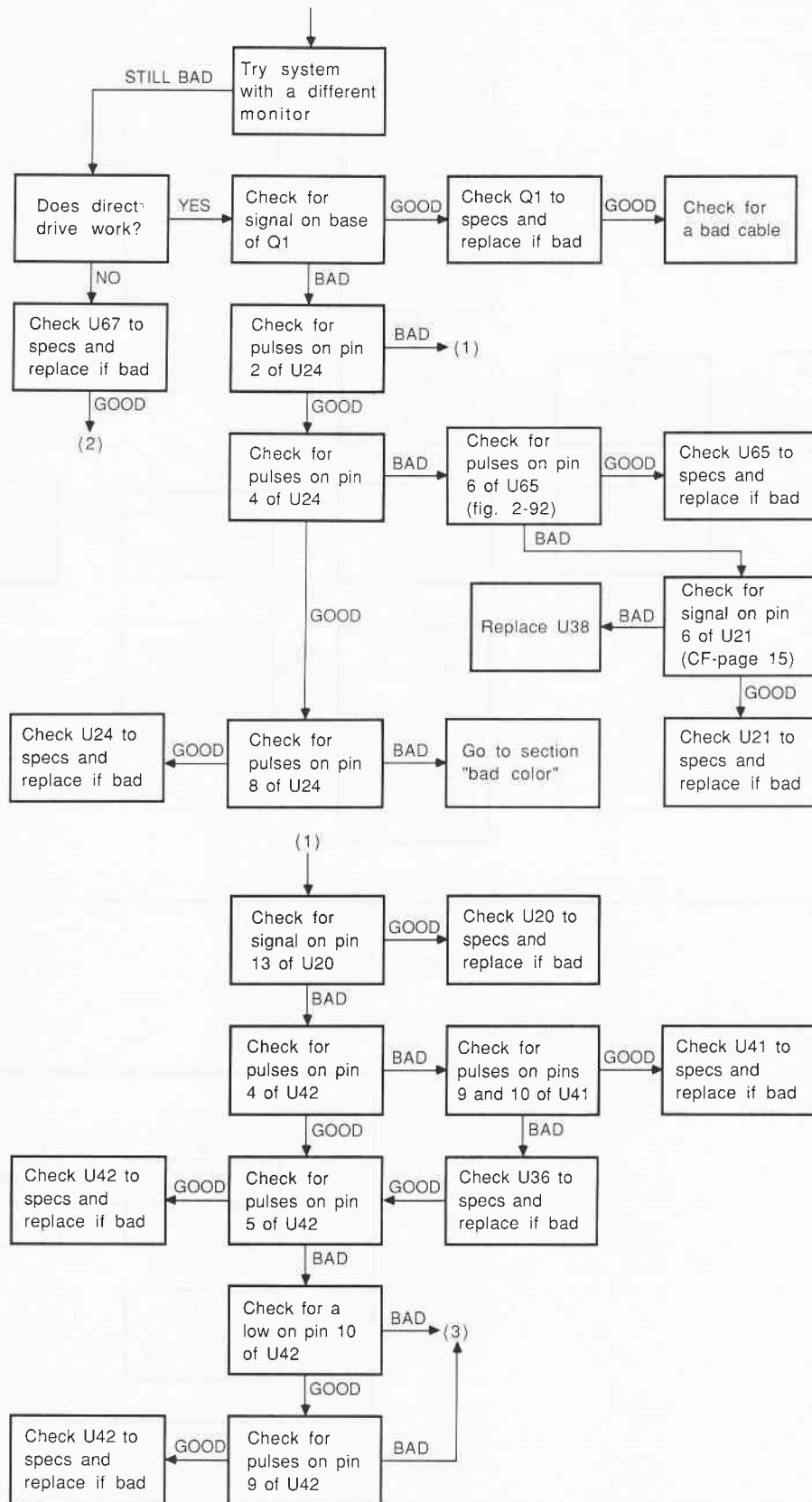
Flowchart 5-29.



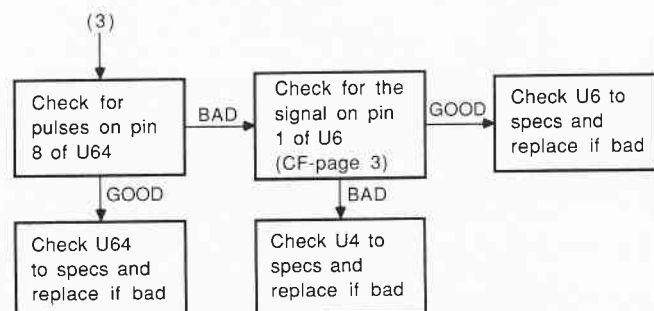
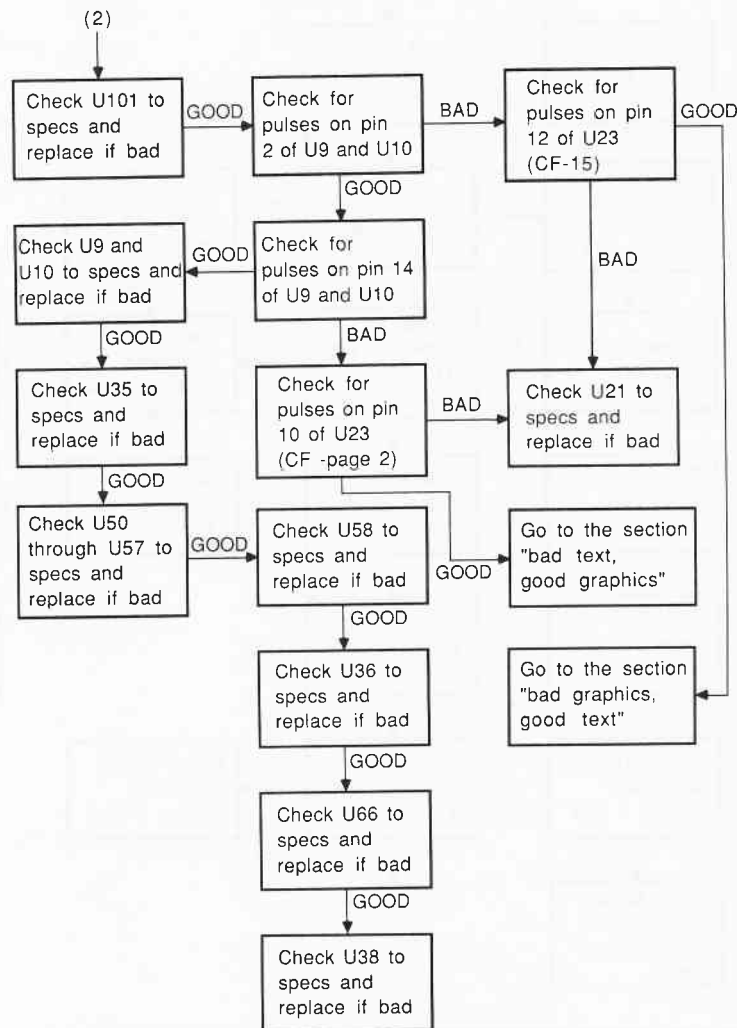
Flowchart 5-30.



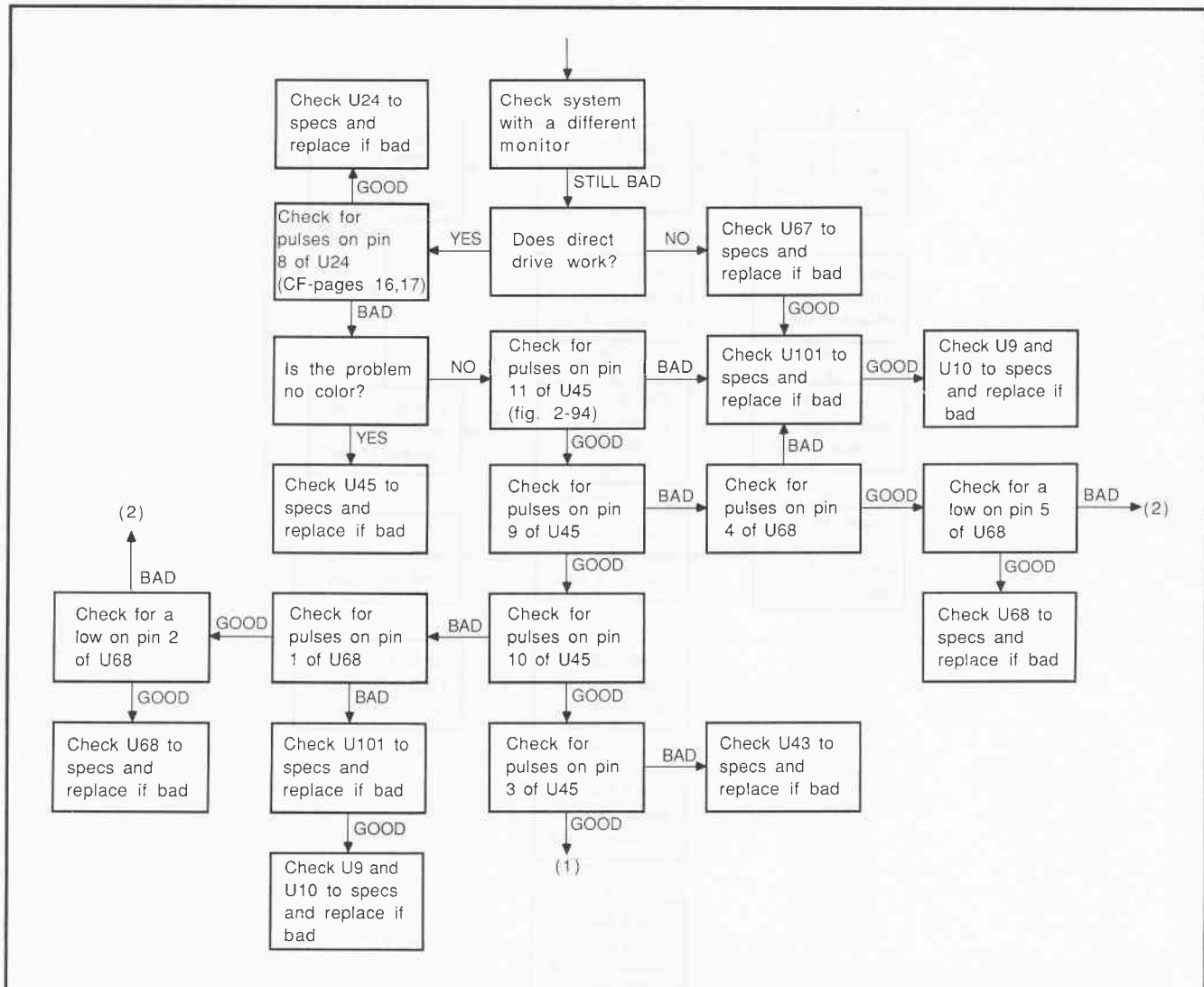
Flowchart 5-31.



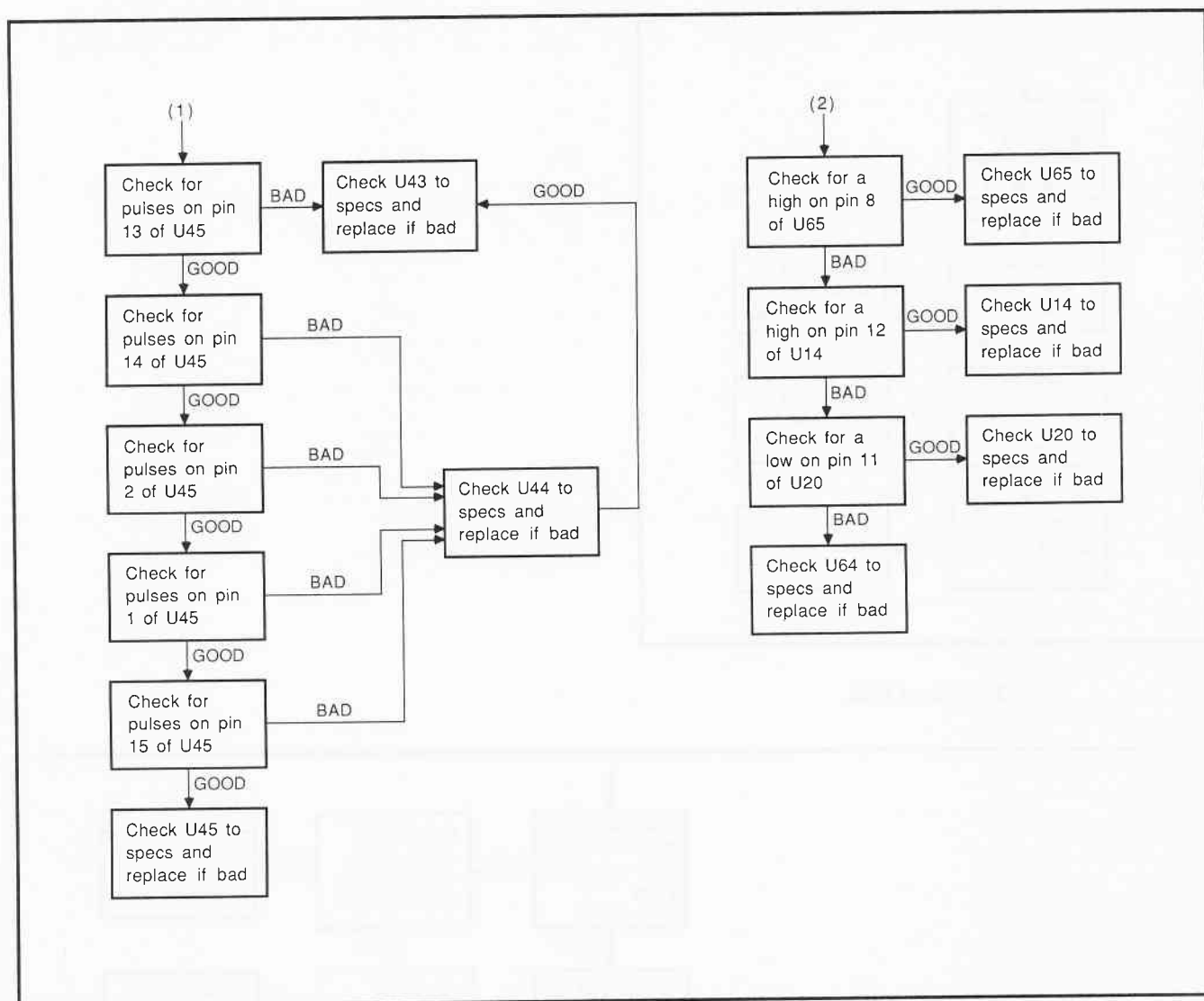
Flowchart 5-32.



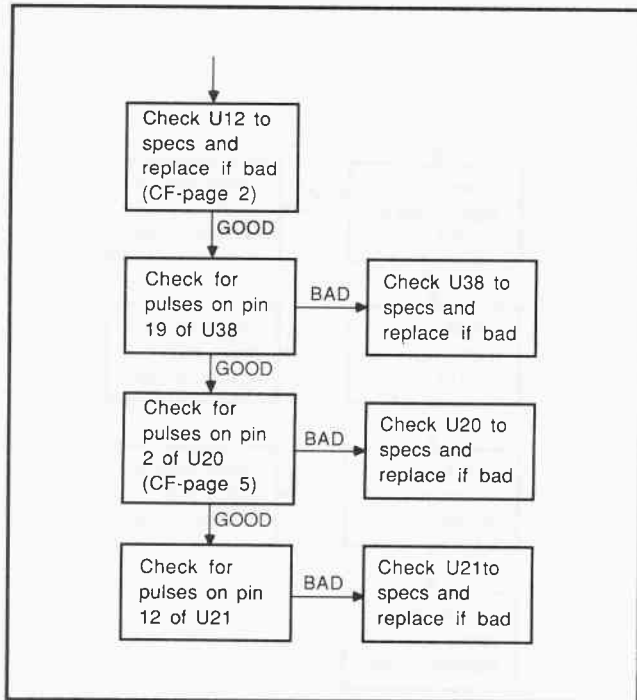
Flowchart 5-32. "cont."



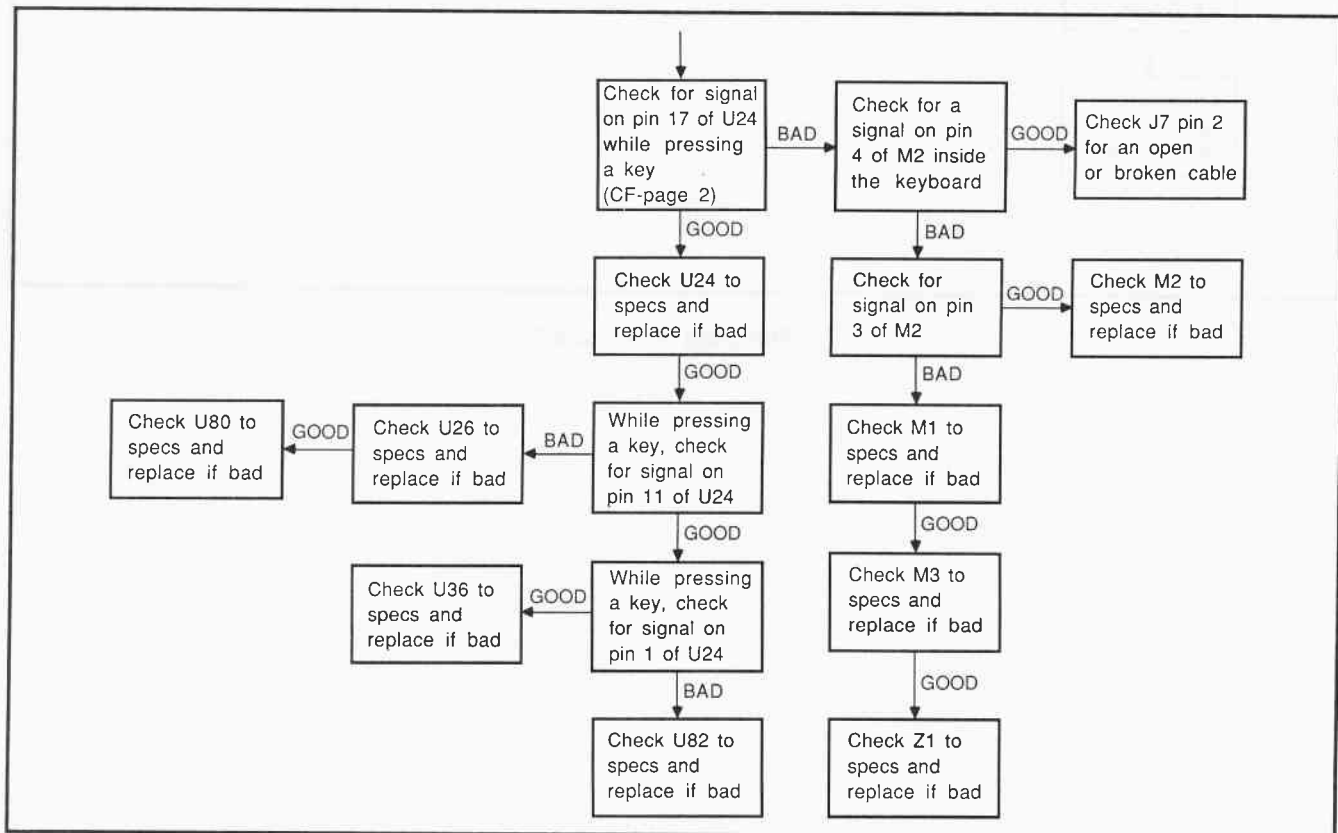
Flowchart 5-33.



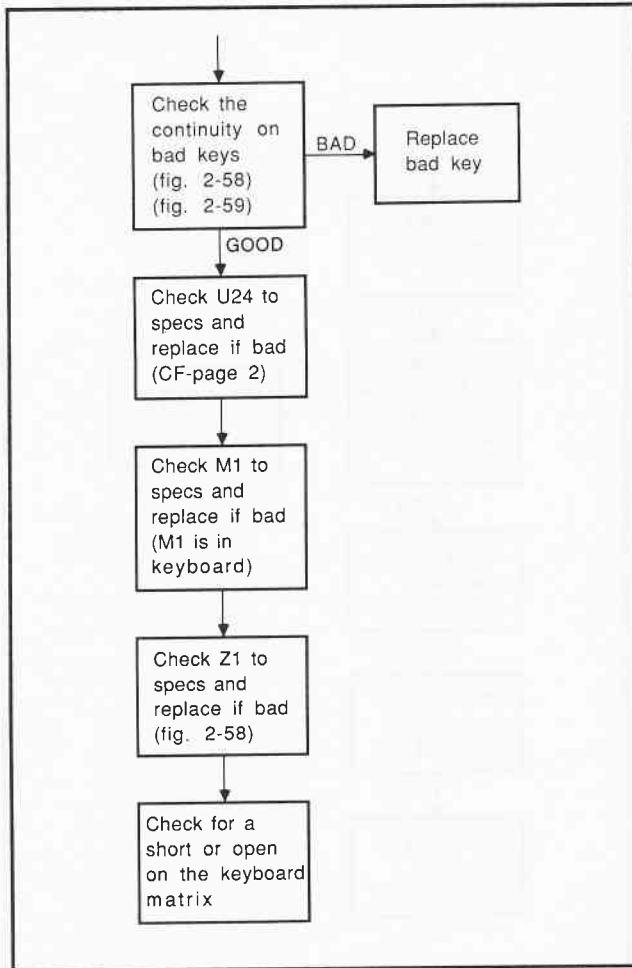
Flowchart 5-33. "cont."



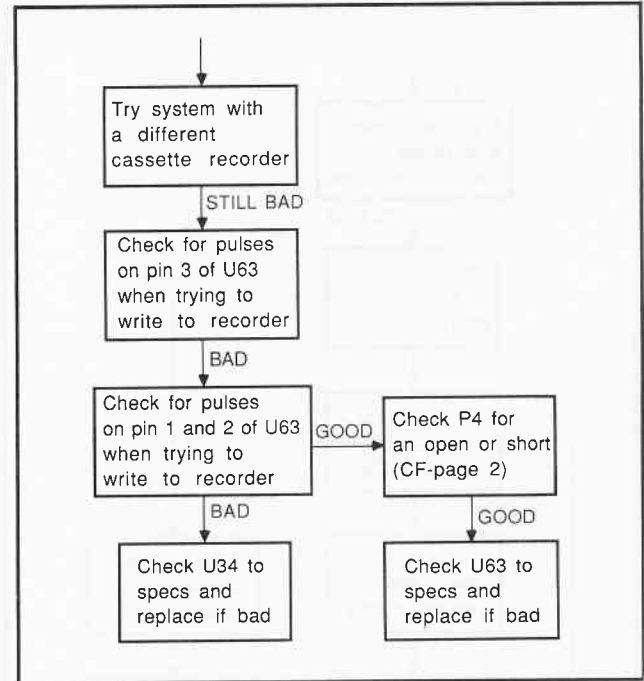
Flowchart 5-34.



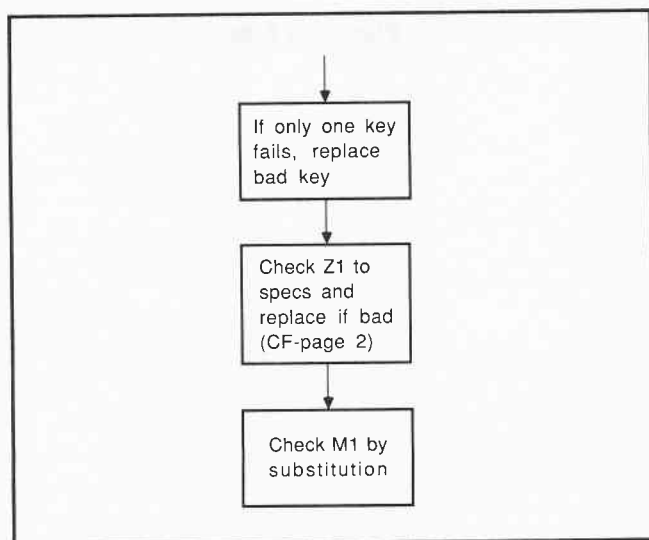
Flowchart 5-35.



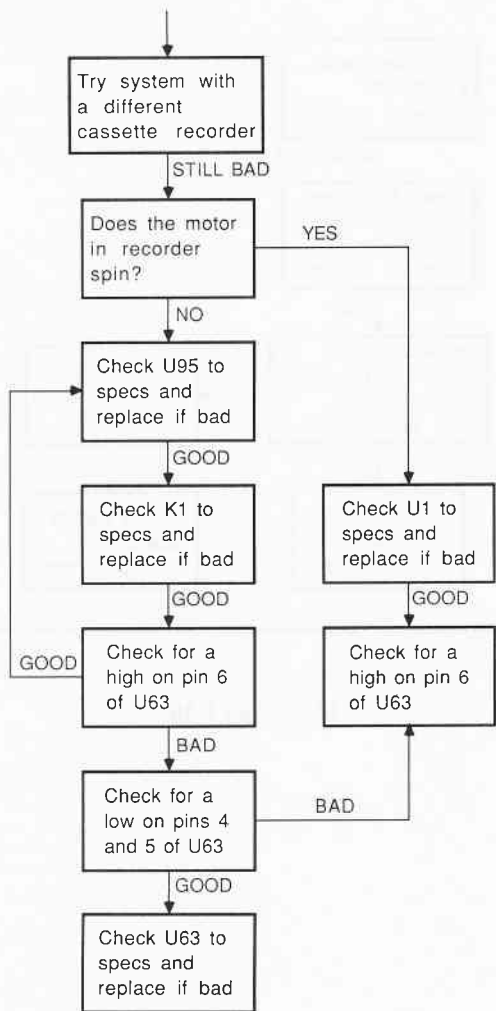
Flowchart 5-36.



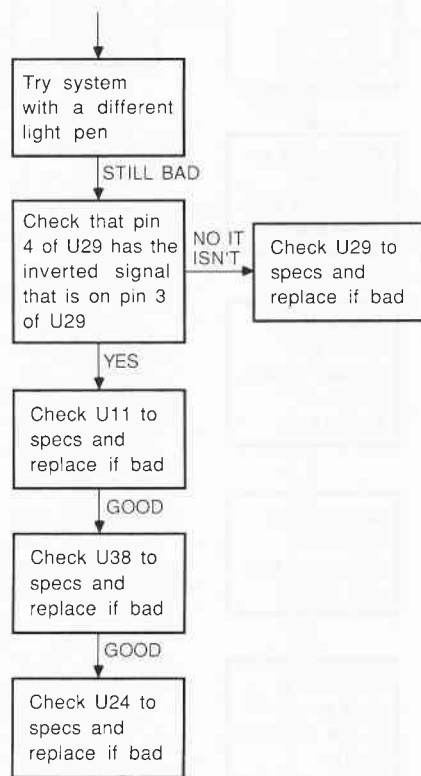
Flowchart 5-38.



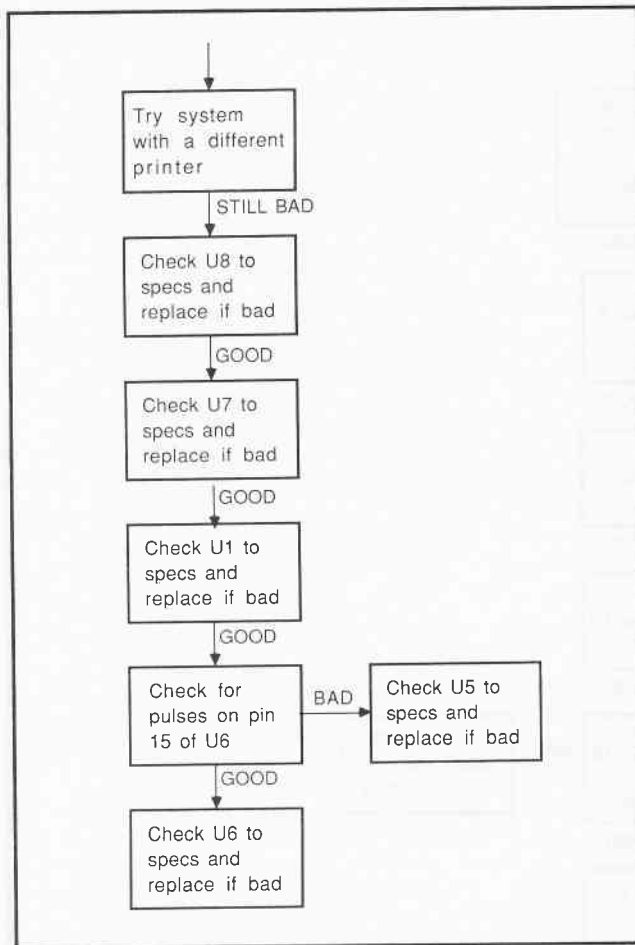
Flowchart 5-37.



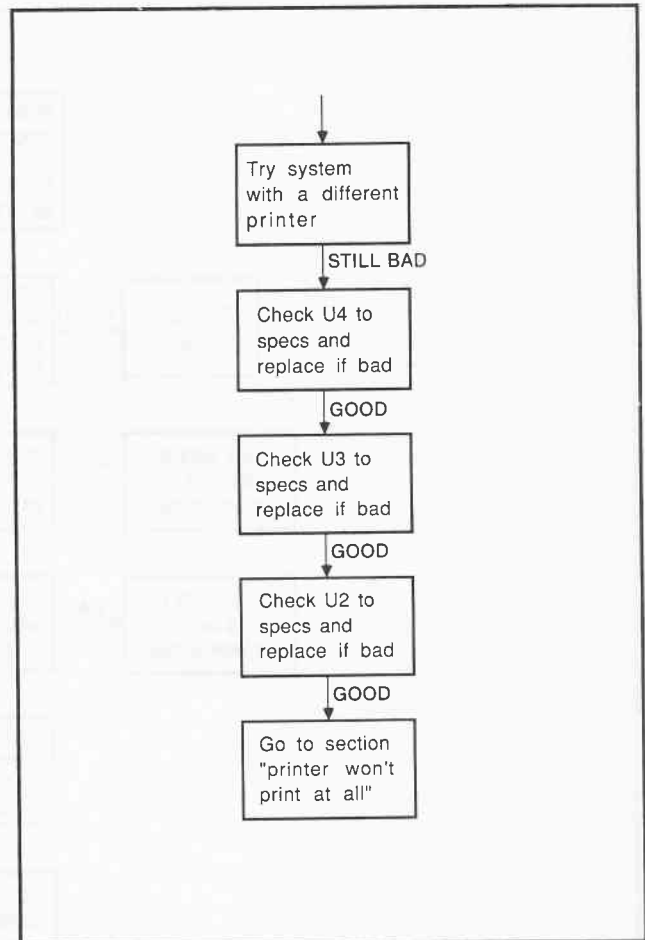
Flowchart 5-39.



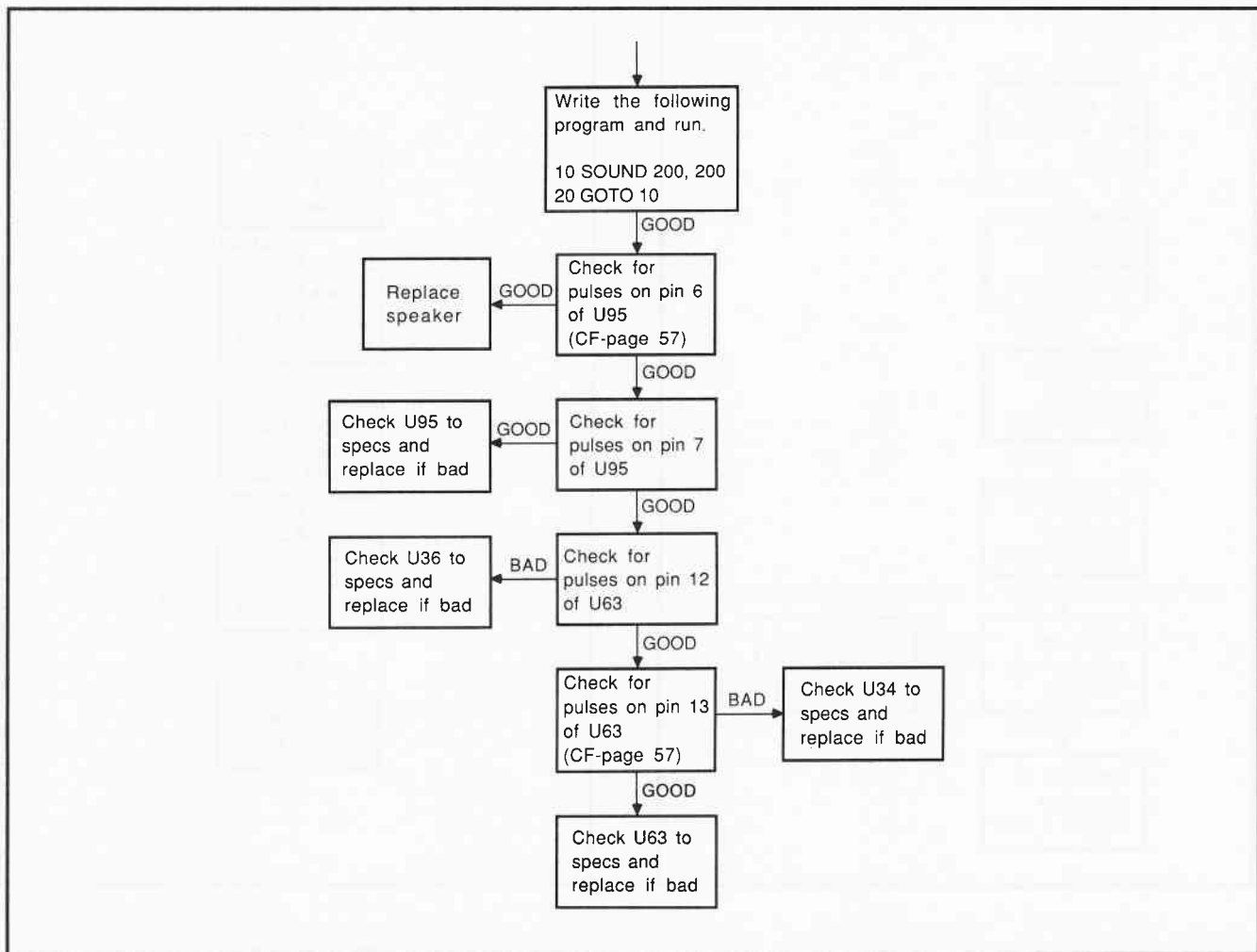
Flowchart 5-40.



Flowchart 5-41.



Flowchart 5-42.



Flowchart 5-43.