VIDEO RECAP

SOUND & SPEECH BOARD

SERVICING SERIES

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SOUND AND SPEECH BOARD SERVICING

Welcome to Williams Electronics Video Based servicing series. This Recap Sheet contains the most important points covered in the accompanying video tape. This Recap Sheet covers troubleshooting of Sound Boards and Speech Modules, using a logic probe and a multimeter.

The flow charts provided at the back of this Recap Sheet give you step-by-step instructions on checking power supply voltages . . . logic operation . . . audio signal flow . . . and how to put it all together to locate and troubleshoot Sound Board and Speech Module problems.

BASIC OPERATION

The video tape began by describing the basic operation of the Sound Board and Speech Module. Sound and speech selections are always made by pulling one or more normally high input buffer lines down to ground. The inputs are tied, through buffer amplifiers, to a Peripheral Interface Adapter, or PIA, which generates an interrupt request to the Microprocessor, or MPU. The MPU reads the input and determines that a sound or speech selection has been made.

Based on the sound selection, the digital equivalent of the sound is selected from the Sound ROM, and placed on the Data Bus.

The PIA interfaces the Sound ROM with the Digital-to-Analog or D/A Converter, IC-13, which converts the digital form of the sound into a low level analog wave form.

This low-level audio signal is then amplified by IC-1, and fed to the game speaker, producing the selected sound output.

In addition to the components just described, the Sound Board has an on-board power supply, including input fuses, a bridge rectifier, and a voltage regulator. The supply provides reference and operating power for both the Sound Board and, where used, the Speech Module. Notice the test points for the Bridge and the various supply voltages.

Other circuits of interest on the Sound Board include the Clock and reset circuits. The Clock provides a common time base for Sound Board and Speech Module operation, while the Reset circuit ensures that all MPU and PIA registers are reset to zero during power up or circuit reset.

Finally, the board also contains a Scratchpad RAM, and a BCD to DEC decoder to provide chip select signals to the Speech Module and Sound ROMs, as well as the Scratchpad RAM and the PIA.

The Speech Module is a Sound Board add-on containing four Speech ROMs, one of which, IC-6, contains the main speech program.

In addition to the Speech ROMs, the Speech Module contains a chip, IC-1, that converts digital speech data to a staircase waveform. This chip is similar to a digital-to-analog converter. The output of IC-1 is filtered and amplified by IC-3 and IC-2.

Putting it all together, a Sound Board buffer input causes the PIA to interrupt the MPU. The MPU reads Speech Program information from IC-6 on the Speech Module. The chip select and memory location information is read, and the resulting words or parts of words are read in a digital form from the Speech ROMs.

The PIA converts the speech data on the Data Bus to a serial form, and returns it to the Speech Module, at pin 12 of the D-to-A converter, IC-1. IC-1 converts the serial digital form of the Speech Data to a staircase waveform plus a sampling frequency.

The output of the D-to-A converter is filtered by two sections of IC-3, then further amplified and mixed with electronic sounds in IC-2, then fed back to the Sound Board, where it is further amplified and fed to the game speaker.

With that background the video tape next covered what it takes to locate a particular problem in the Sound Board or Speech Module of a typical game.

DETERMINE SOURCE OF PROBLEM

The first thing to determine is whether the problem is in the Sound Board or Speech Module — or whether it is really in the game itself. To find out, first run the game self-diagnostic program, selecting that part of the program which tests for sound and speech outputs.

When you run the sound portion of the game diagnostics, you'll hear the appropriate sound effects.

It's important to know what to listen for in the self-test. Each game instruction booklet contains a listing of the sounds you'll hear at each step of the self-test.

As you listen to the self-test, make a note of any missing or incorrect sounds.

If there **are** any missing or incorrect sounds, you should refer to the flow charts at the end of this Recap Sheet to localize the component fault. This first flow chart, labeled "SOUND BOARD / SPEECH MODULE FLOW CHART #1" shows you how to determine whether the fault is in the Sound Board, the Speech Module, or in one of the other game boards.

For example, if the test produces the correct electronic sounds, but no Speech sounds, Flow Chart #1 refers you to Flow Chart #2, which shows you how to locate faults in the Speech Module. Other parts of Flow Chart #1 help you spot faults in the game, faults in the Sound Board Input Buffer Circuits, as well as audio and digital faults in both old and new Sound Boards.

The video tape next followed a technician as he checked out a game which produced no sounds or speech at all.

REPLACE MAIN CONNECTOR

Since the problem could be in the main game, one of the first steps is to pull and then replace the main connector between the game and the Sound Board. If the problem **is** in the game, this usually produces some type of sound as the stuck input lines are disconnected and re-connected.

If no sounds are produced as the connector is pulled and replaced, the connector is pulled again and left off, and the Sound Board Self-Test switch, SW-1, is pressed to start the board self-test routine.

The self-test routine bypasses the buffer inputs of the Sound Board. If sounds are produced during this test — but not earlier — then a faulty input buffer circuit should be suspected.

CHECK POWER SUPPLY INPUTS AND OUTPUTS

If no sounds are produced during the Sound Board Self-Test, then the next check is at the power supply inputs and outputs using the schematic found in the schematic manual.

If the power is OK, then the next step is to pull the MPU and Sound ROM and replace them with known good IC's.

If replacing the MPU and Sound ROM doesn't cure the problem, then the next step is to confirm that the audio amplifier is OK. To do this, find Jumper W-15 on the sound board and touch it with your finger. A good audio amplifier circuit will produce a click and a low humming sound.

CHECK AUDIO CIRCUIT

Checkout of the audio circuit is the last decision point on the first flow chart. If the audio amplifier circuit checks out OK, then the problem must be a digital fault. In the case of a digital problem, continue with the correct flow chart, either five or six, for the type of board being tested.

TROUBLESHOOTING FLOW CHARTS

Troubleshooting flow charts for each section of the Sound/Speech boards are included at the end of this Recap Sheet.

In each flow chart, actions you should take are enclosed in a box. Decisions to be made, based on your tests, are enclosed in a diamond, and the conclusions you should reach, based on your tests and decisions, are enclosed in circles or "bubbles."

In addition, you should have the correct schematics for the game being serviced, as well as component level troubleshooting manuals, where these are available.

Instruments you will need as you use the Flow charts include an accurate multimeter and a three-state logic probe.

This concludes the video tape recap introducing you to the Flow Charts you will need to troubleshoot Sound Boards and Speech Modules.

TIPS ON USING THE FLOW CHARTS

GENERAL INFORMATION

Flow charts can either be helpful or confusing, depending on how you use them.

You'll get the most out of the Sound Board/Speech Module flow charts if you will:

- **Start by becoming familiar with the basic flow of control, address and data signals through the Sound Board and Speech Module.** It isn't necessary for you to understand the fine points of the programming, but you must understand the general way in which these boards operate. The video tape, the recap sheet, and the circuit schematics are the best references here.

- **Use the flow charts in the order in which they are presented.** Always start with Flow Chart #1, and go through the steps in the order they appear on the flow charts. Each action and decision is necessary in order for the next action or decision to make sense. Taking shortcuts seldom saves time.

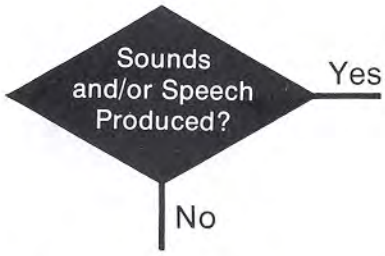
- **Use the recommended test instruments.** A reliable multimeter, a three-state logic probe and some means of checking an audio path are essential. A list of recommended tools is given at the end of this section.

FLOW CHART SYMBOLS

The symbols used in the troubleshooting flow charts mean:

- **Rectangles** describe some type of action you must take. Usually it is some type of test. For example, if a diagnostic step requires that you pull and replace a connector, it might look like this:

- **Diamonds** are decisions you must make, based on the results of a test. For example, once you have pulled and replaced a connector, you must decide whether that action has, or has not, produced sounds. Such a decision would look like this:



- **Large circles or "bubbles"** — always enclose some kind of conclusion, based on the actions and decisions to that point. For example, if pulling and replacing a plug (in this case, 10-P3) produced a game sound, you would conclude:

- **Small circles or "connectors"** are used to connect one part of a flow chart with another, distant, part. Usually, connectors are used to indicate that you should skip some part of the flow chart, or that you should turn to the next page. For example, if you will look at Flow Chart #1, you will see a connector under the decision "Sounds only-Missing or Incorrect Speech?". In this case, the connector means that you should go to a later part of the flow chart.

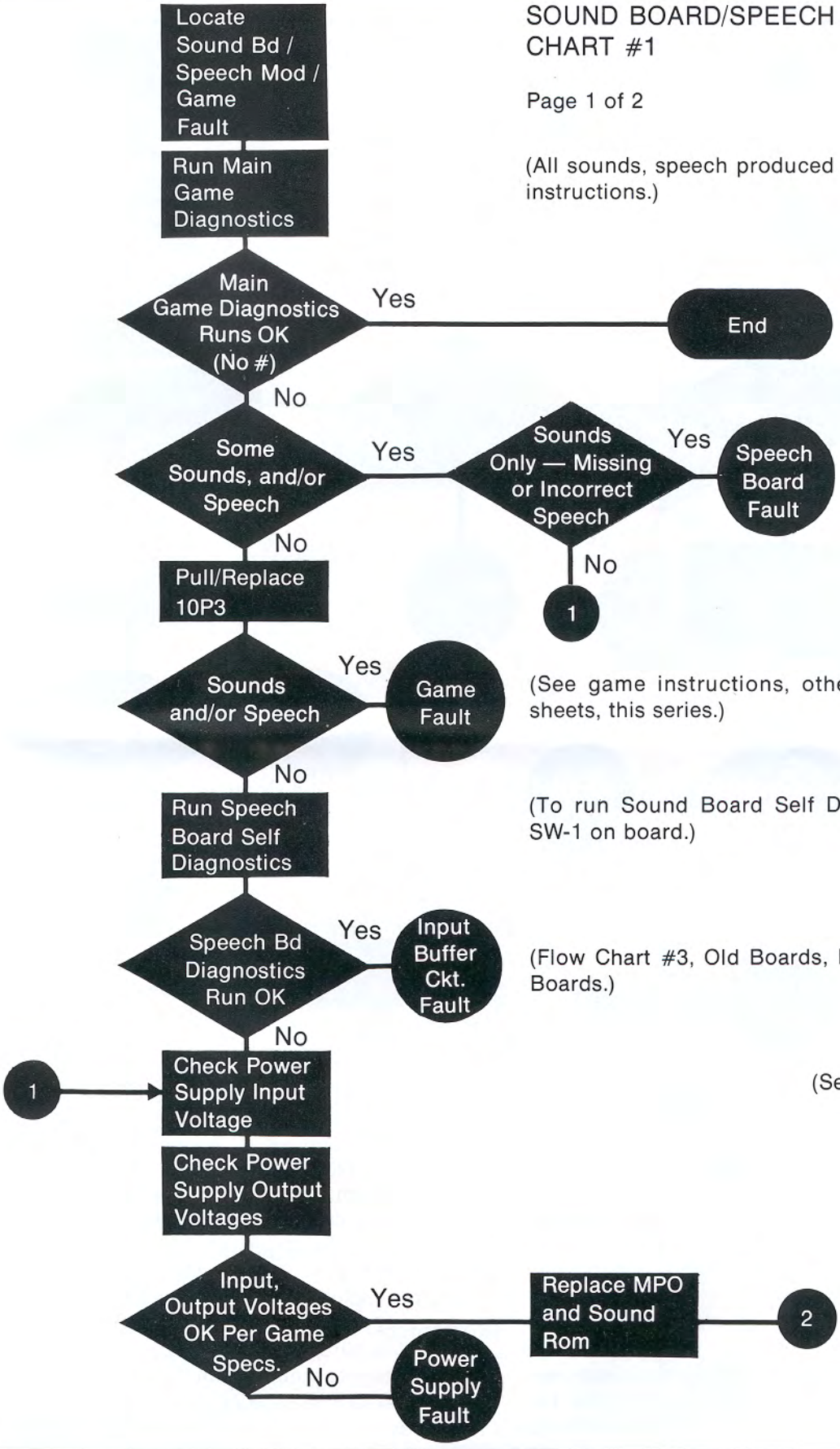
At the bottom of the page, you will see another connector 2 which directs you to continue with the flow chart on the next page.

- **An oval shape** is always used to indicate the end of a particular line of testing in a flow chart. For example, if your first tests of a game included correct operation of the game sound diagnostics, there would be no further need to check for problems in the sound board.

TEST INSTRUMENTS

You must have a reliable multimeter and a three-state logic probe to check out Sound Boards and Speech Modules in the field. The only alternative would be a 'scope fast enough to see the timings.

SOUND BOARD/SPEECH MODULE FLOW CHART #1



(All sounds, speech produced correctly, per game instructions.)

(Flow Chart #2)

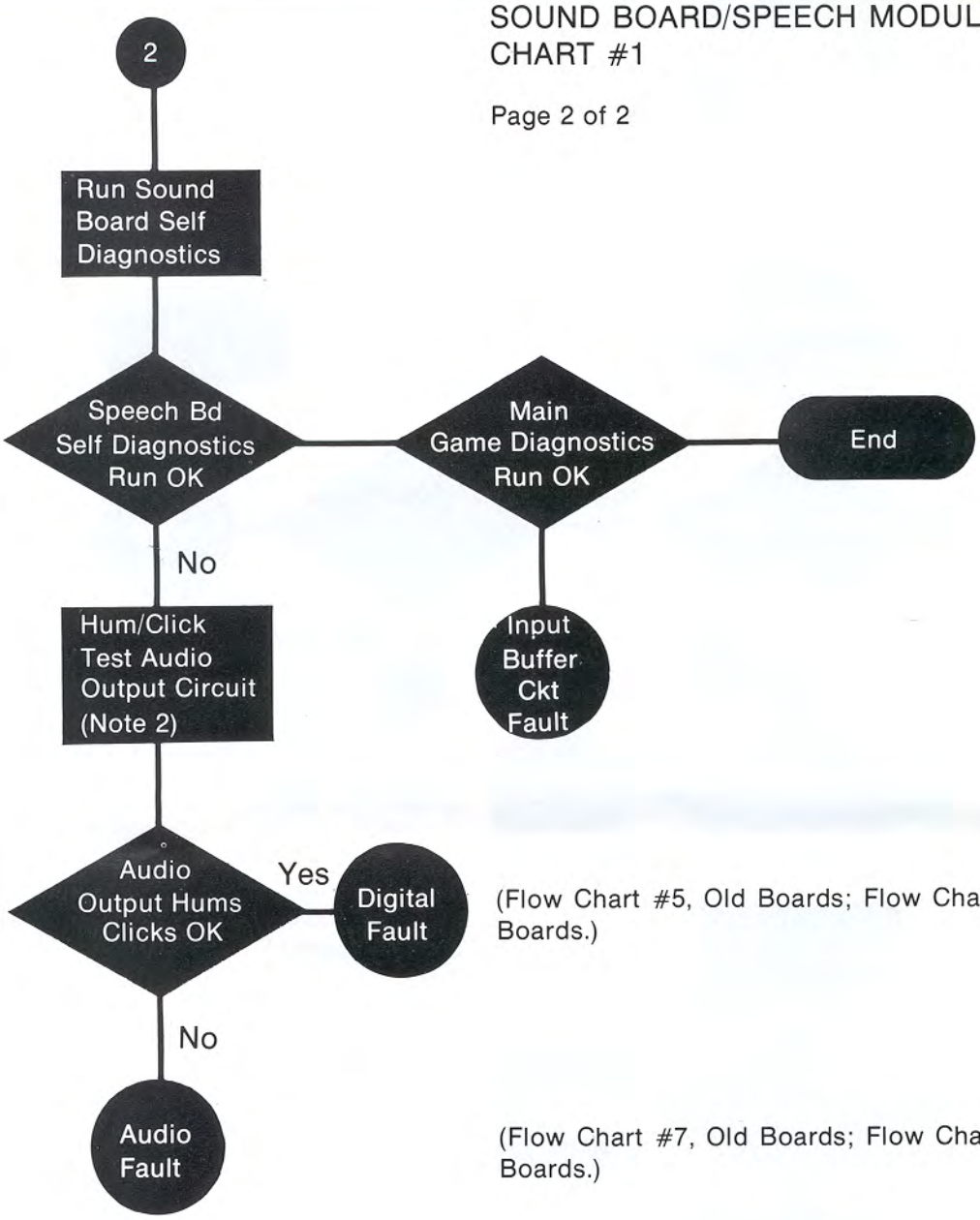
(See game instructions, other tapes and recap sheets, this series.)

(To run Sound Board Self Diagnostics, depress SW-1 on board.)

(Flow Chart #3, Old Boards, Flow Chart #4, New Boards.)

(See board schematic.)

SOUND BOARD/SPEECH MODULE FLOW CHART #1



(Flow Chart #5, Old Boards; Flow Chart #6, New Boards.)

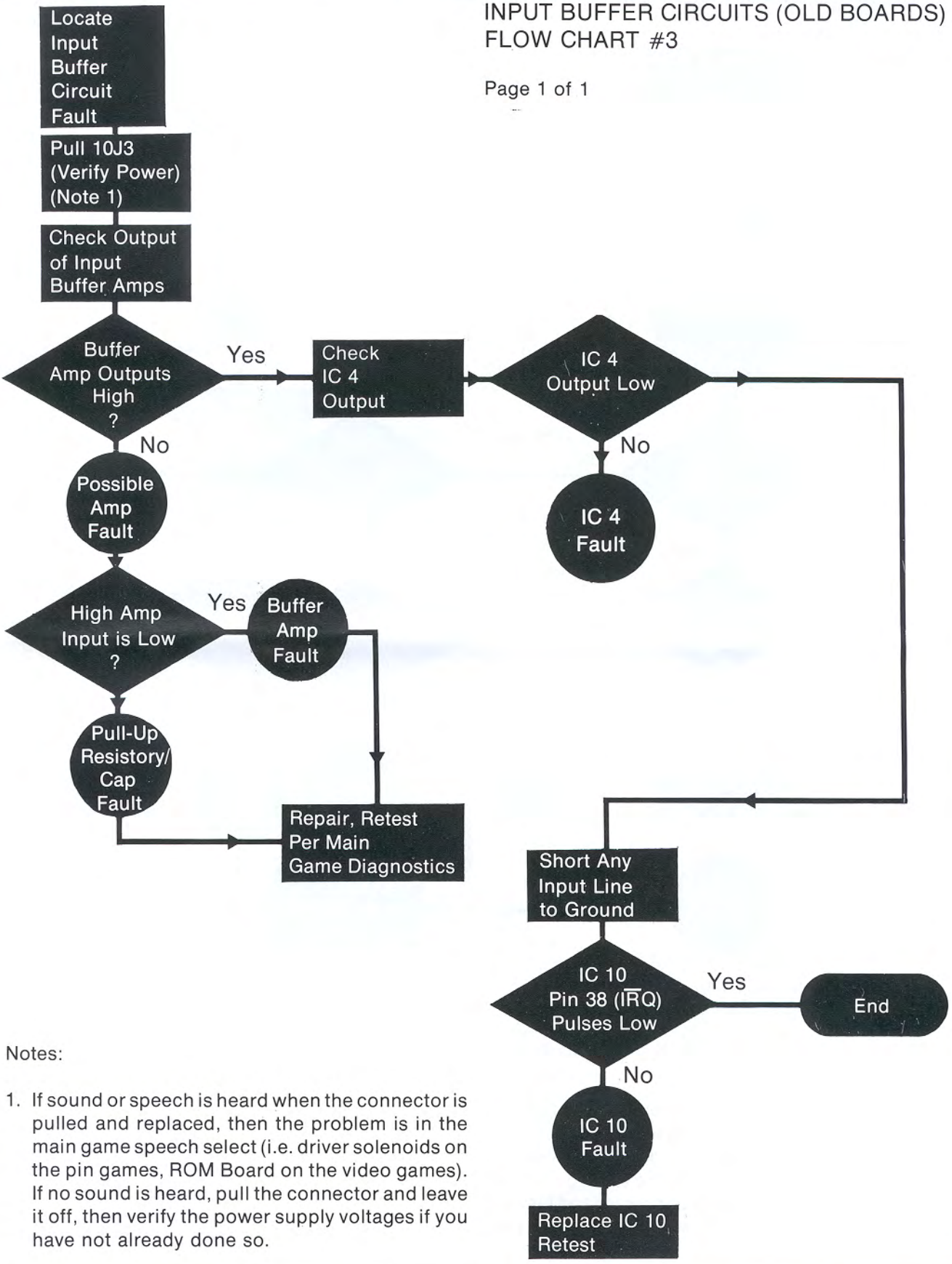
(Flow Chart #7, Old Boards; Flow Chart #8, New Boards.)

Notes:

1. Some games include a diagnostic chart for quick location of sound/speech board faults according to missing or incorrect sounds picked up on the main game and/or Sound Board diagnostic programs. Be sure to review the game instructions to locate this information.

2. To hum/click test an old sound board, pull connector 10-P4, and touch pin 1 of jack 10-J4. For new boards, locate and touch jumper wire W-15. In either case, you should hear a click, followed by a low hum. As an alternative, a source of AC test voltage can be obtained on a pin game by connecting any large resistor (100K ohm is a good value) to a test lead, and use this combination to jumper between either side of the power supply 12 VAC input and the points described earlier (J4, pin 1, or W-15). For the video games, it is necessary to jumper from the main power supply to get low voltage AC, since DC is normally supplied to the Sound Board Power supply.

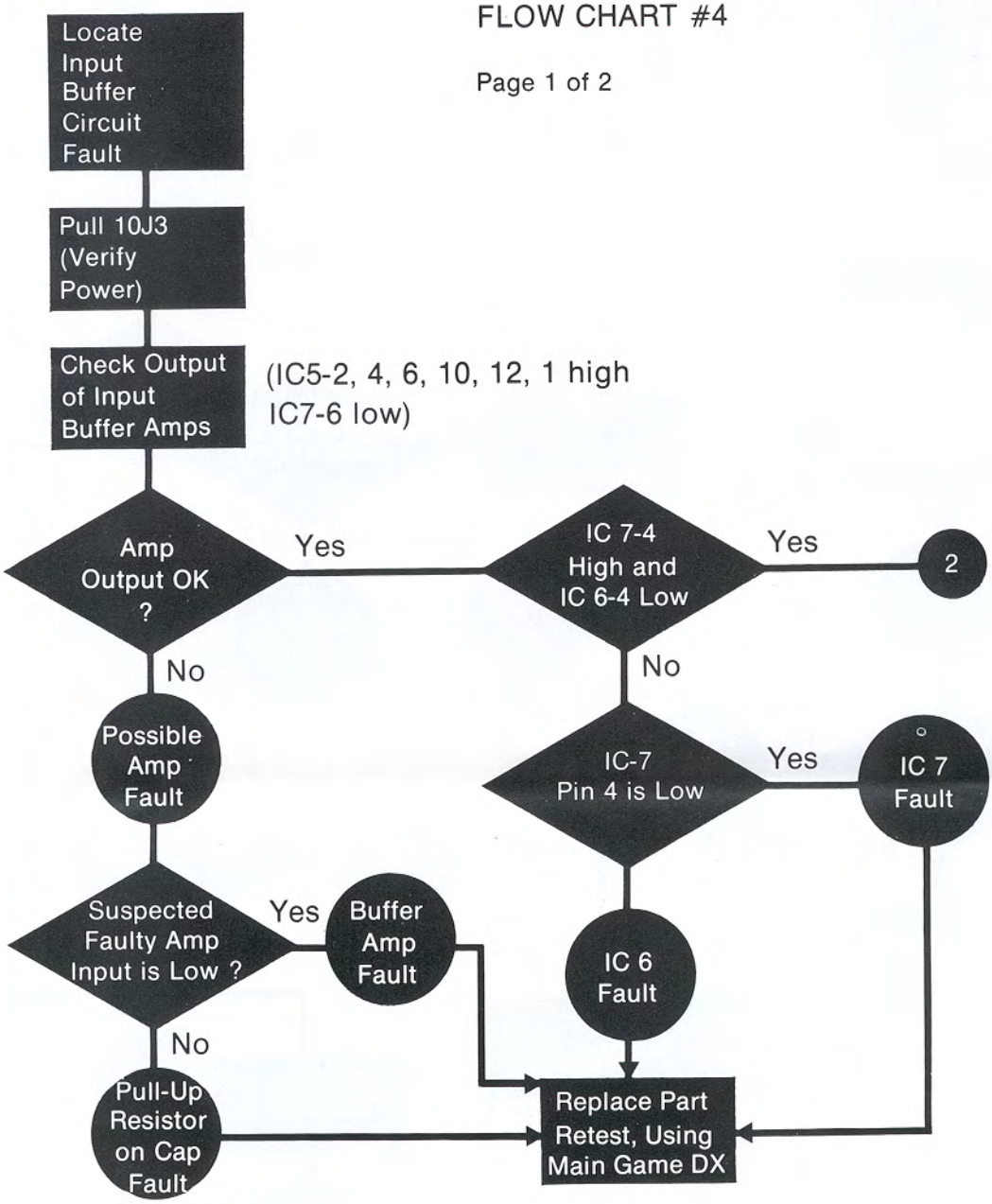
INPUT BUFFER CIRCUITS (OLD BOARDS) FLOW CHART #3



Notes:

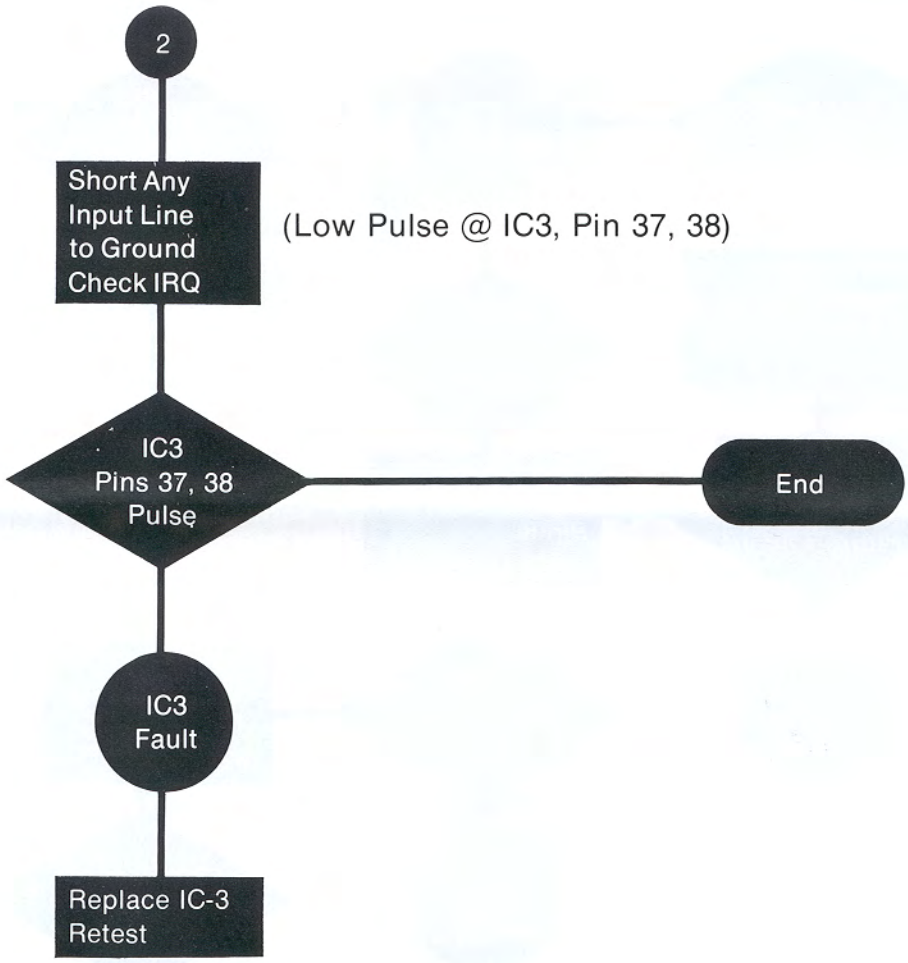
1. If sound or speech is heard when the connector is pulled and replaced, then the problem is in the main game speech select (i.e. driver solenoids on the pin games, ROM Board on the video games). If no sound is heard, pull the connector and leave it off, then verify the power supply voltages if you have not already done so.

INPUT BUFFER CIRCUITS (NEW BOARDS)
FLOW CHART #4



Notes:

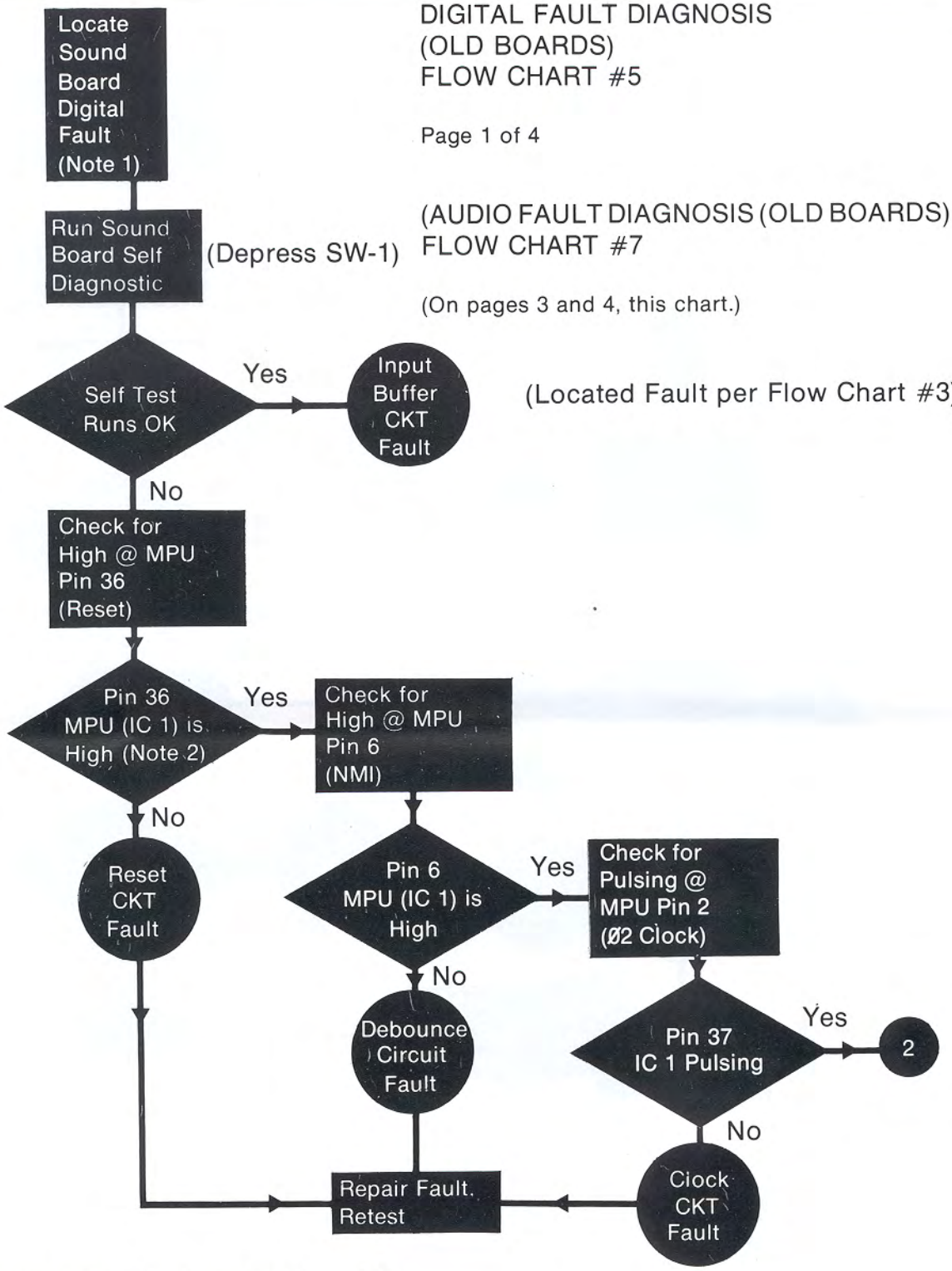
1. If sound or speech is heard when the connector is pulled and replaced, then the problem is in the main game speech select (i.e. driver solenoids on the pin games, ROM board in the video games.) If no sound is heard, pull the connector and leave it off, then verify the power supply voltages if you have not already done so.


2
Short Any Input Line to Ground Check IRQ
(Low Pulse @ IC3, Pin 37, 38)
IC3 Pins 37, 38 Pulse
End
IC3 Fault
Replace IC-3 Retest

DIGITAL FAULT DIAGNOSIS (OLD BOARDS) FLOW CHART #5

(AUDIO FAULT DIAGNOSIS (OLD BOARDS) FLOW CHART #7

(On pages 3 and 4, this chart.)

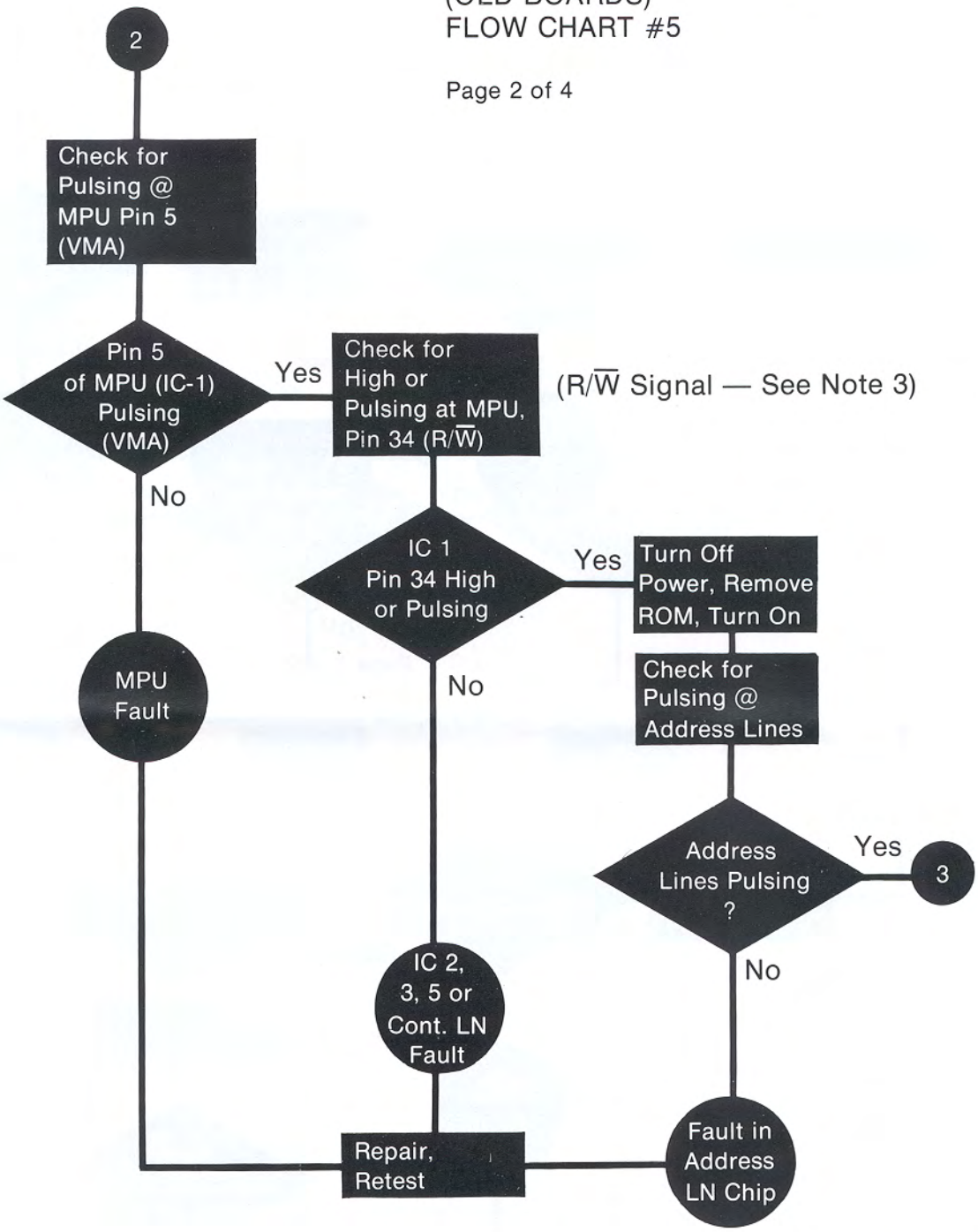


Notes:

1. Assumes that audio output amp has been click/hum tested OK, that power is known good, and that MPU and Sound ROM have been replaced with known good IC's.

2. Allow for short warmup.

DIGITAL FAULT DIAGNOSIS
(OLD BOARDS)
FLOW CHART #5

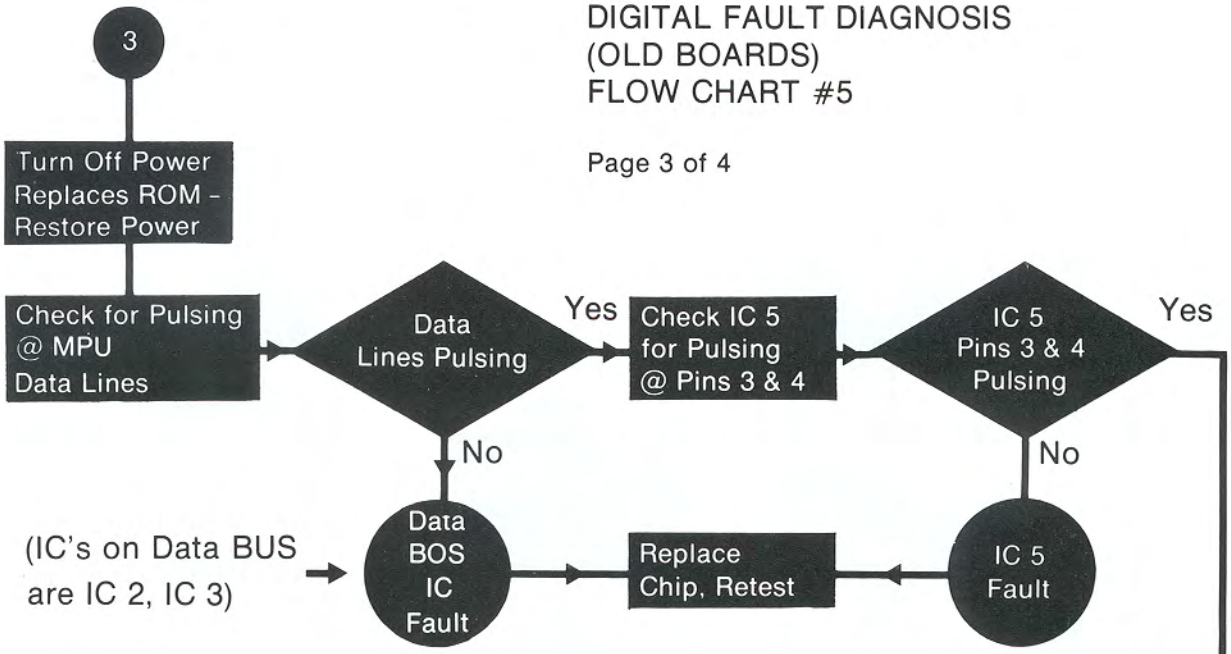


Notes:

3. R/$\overline{W}$ is high with no sound inputs, but pulses with an input, when SW-1 is depressed, and on Self-Test running.

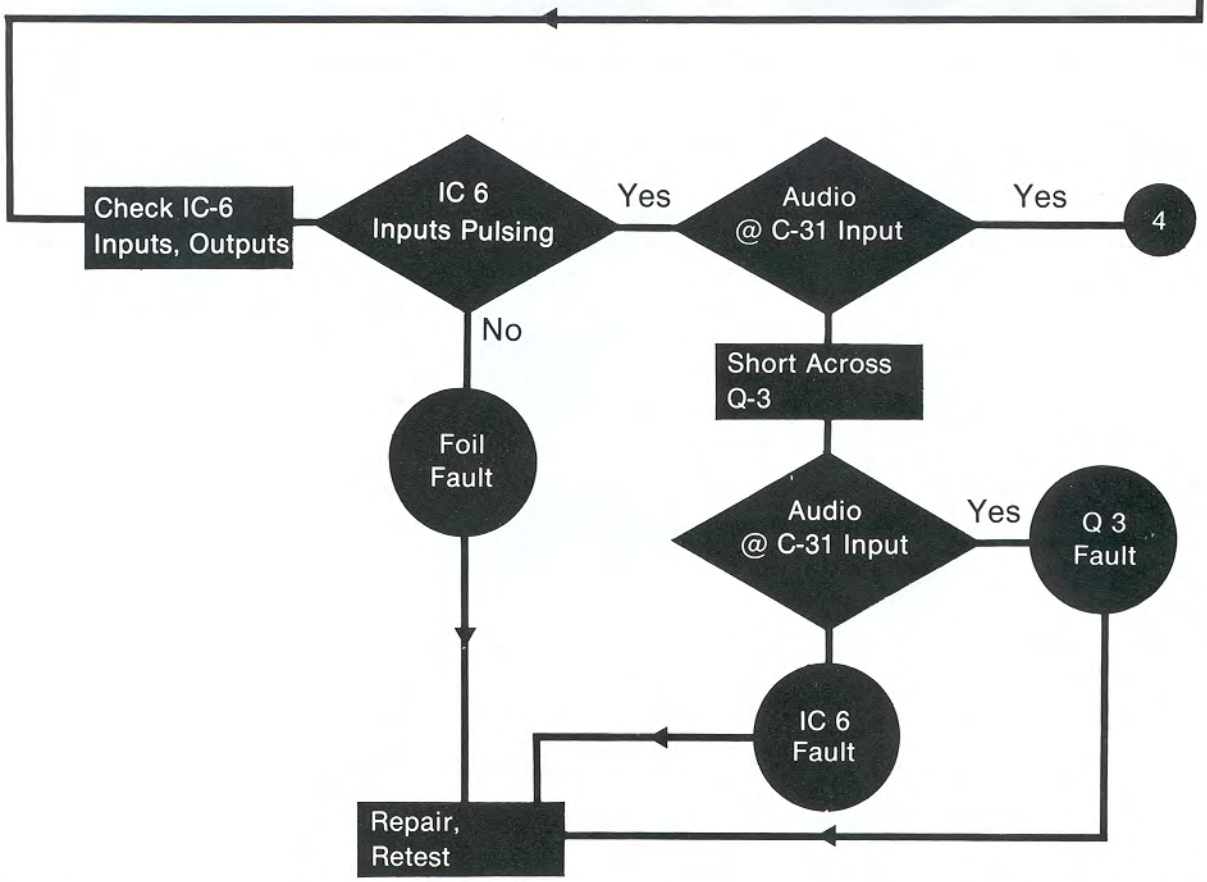
DIGITAL FAULT DIAGNOSIS (OLD BOARDS) FLOW CHART #5

Page 3 of 4



AUDIO FAULT DIAGNOSIS (OLD BOARDS) FLOW CHART #7

Page 1 of 2

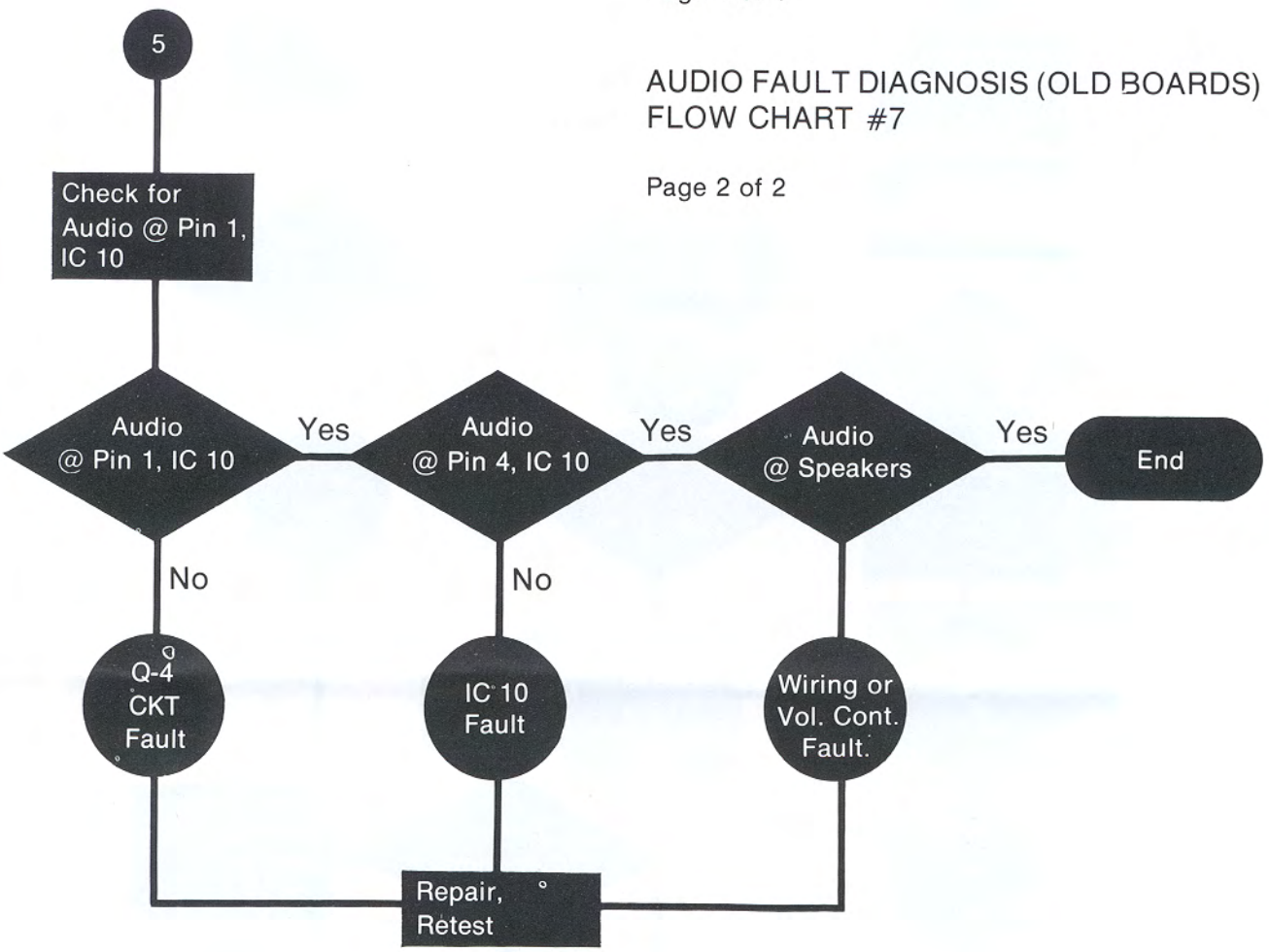


DIGITAL FAULT DIAGNOSIS
(OLD BOARDS)
FLOW CHART #5

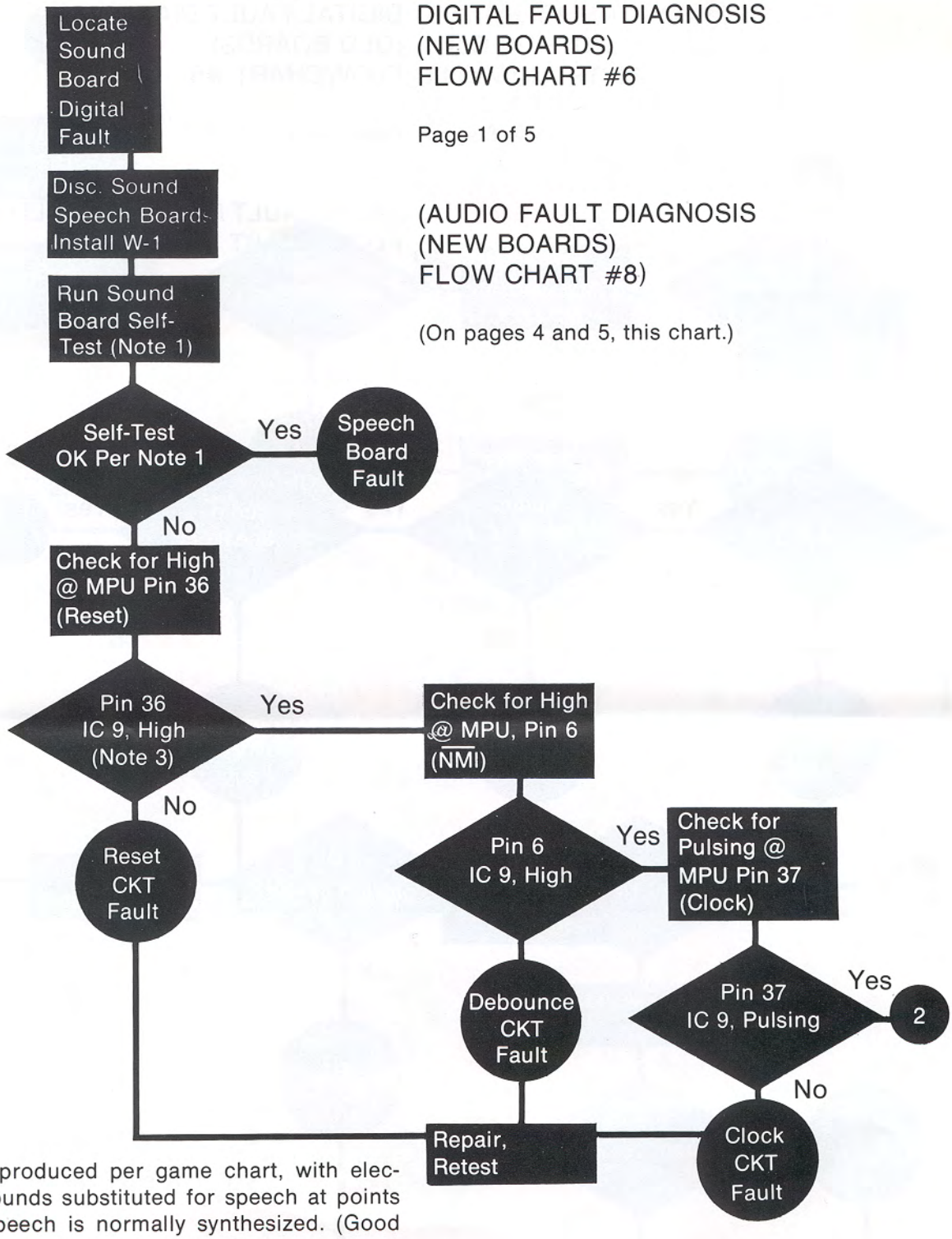
Page 4 of 4

AUDIO FAULT DIAGNOSIS (OLD BOARDS)
FLOW CHART #7

Page 2 of 2



DIGITAL FAULT DIAGNOSIS (NEW BOARDS) FLOW CHART #6



(AUDIO FAULT DIAGNOSIS (NEW BOARDS) FLOW CHART #8)

(On pages 4 and 5, this chart.)

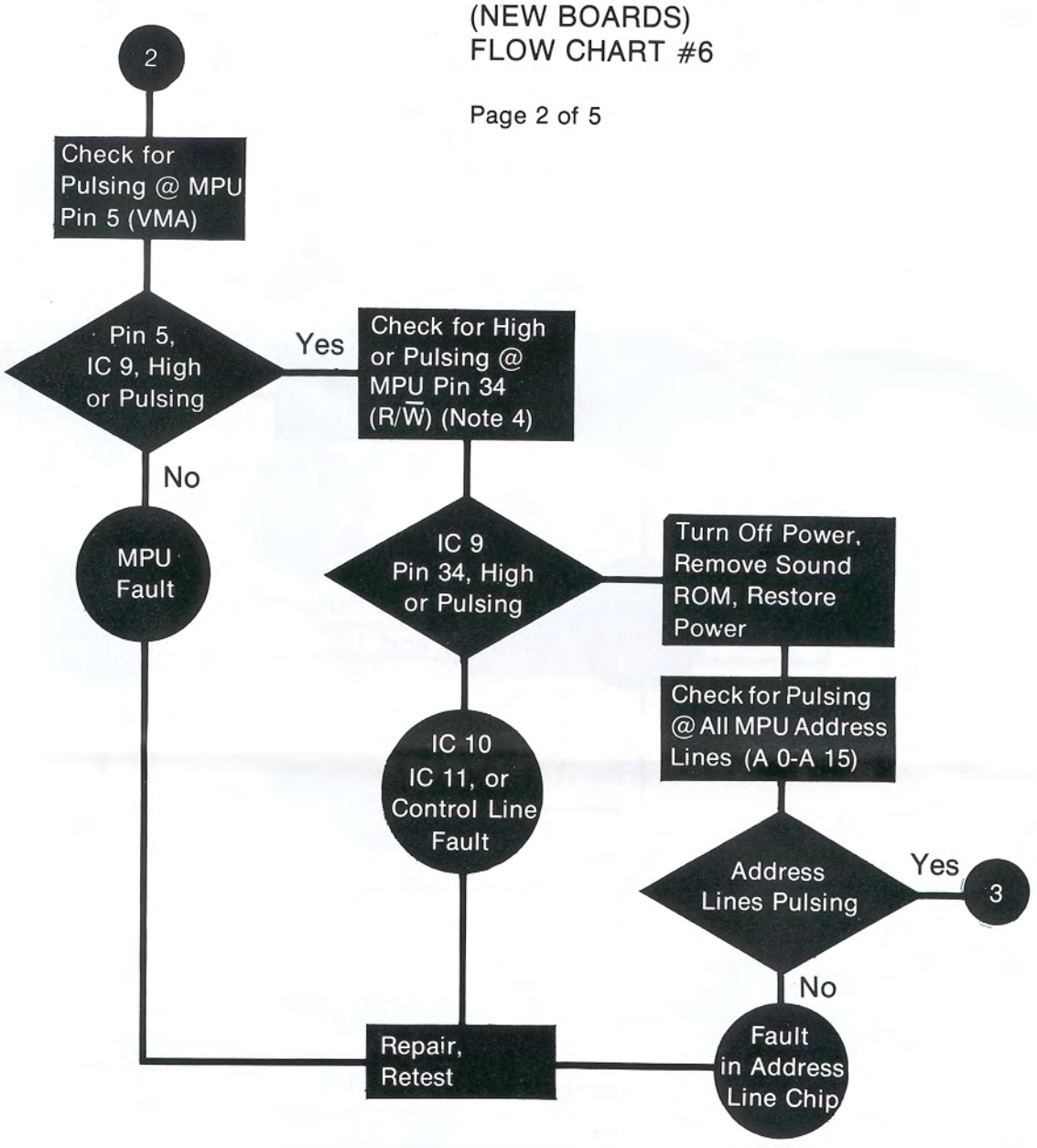
Notes:

1. Sounds produced per game chart, with electronic sounds substituted for speech at points where speech is normally synthesized. (Good board should make this change.)

2. This flow chart assumes a known good MPU and Speech ROM, audio click tested, and known good power supply voltages.

3. Allow short time for warmup.

DIGITAL FAULT DIAGNOSIS (NEW BOARDS) FLOW CHART #6



(Chips on Address Line Are IC 2, IC 3, IC 10, IC 11)

Notes:

4. R/$\overline{W}$ is high with no sound select inputs, but pulses low with an input, when depressing SW-1, and when Self-test is running.

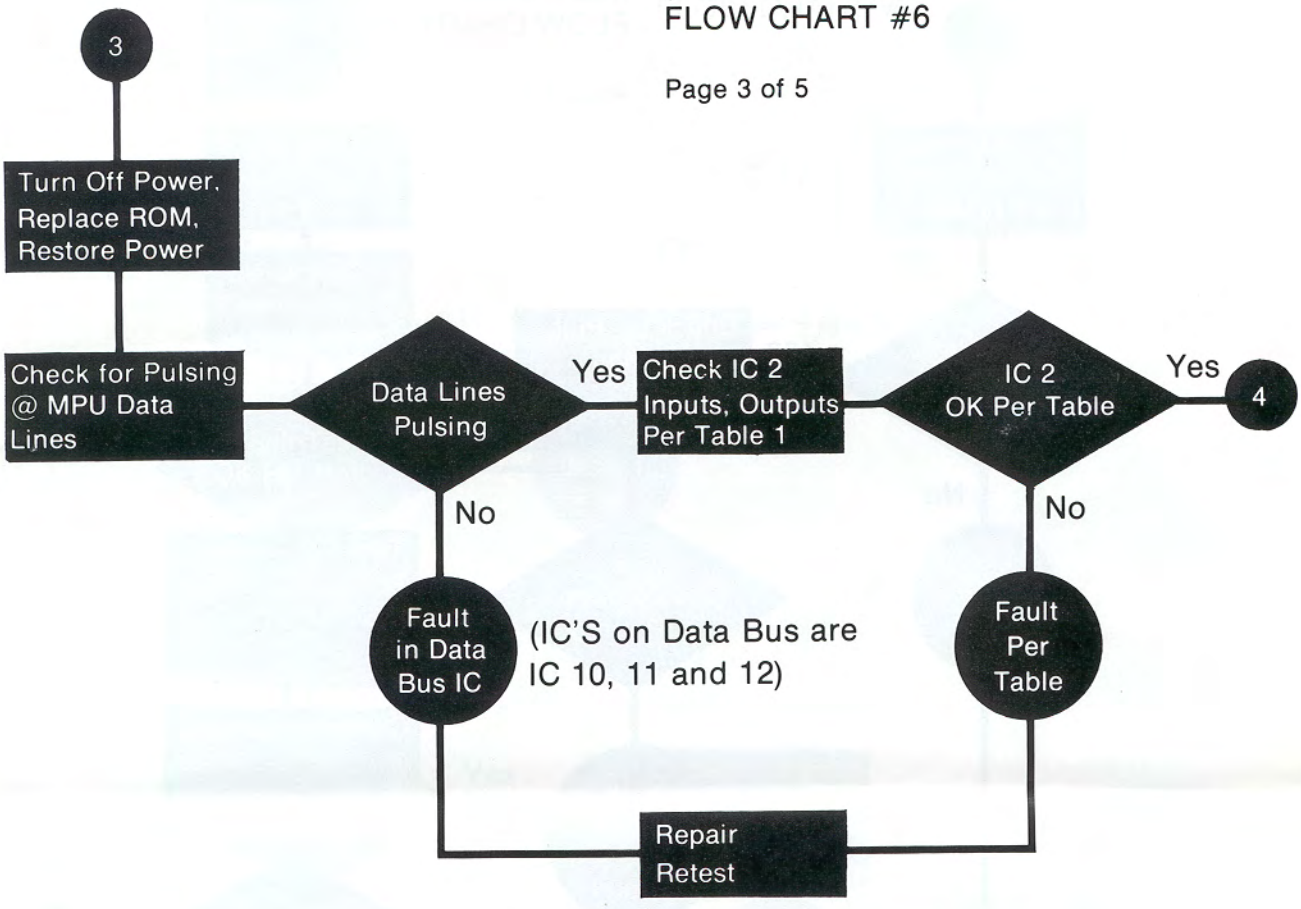


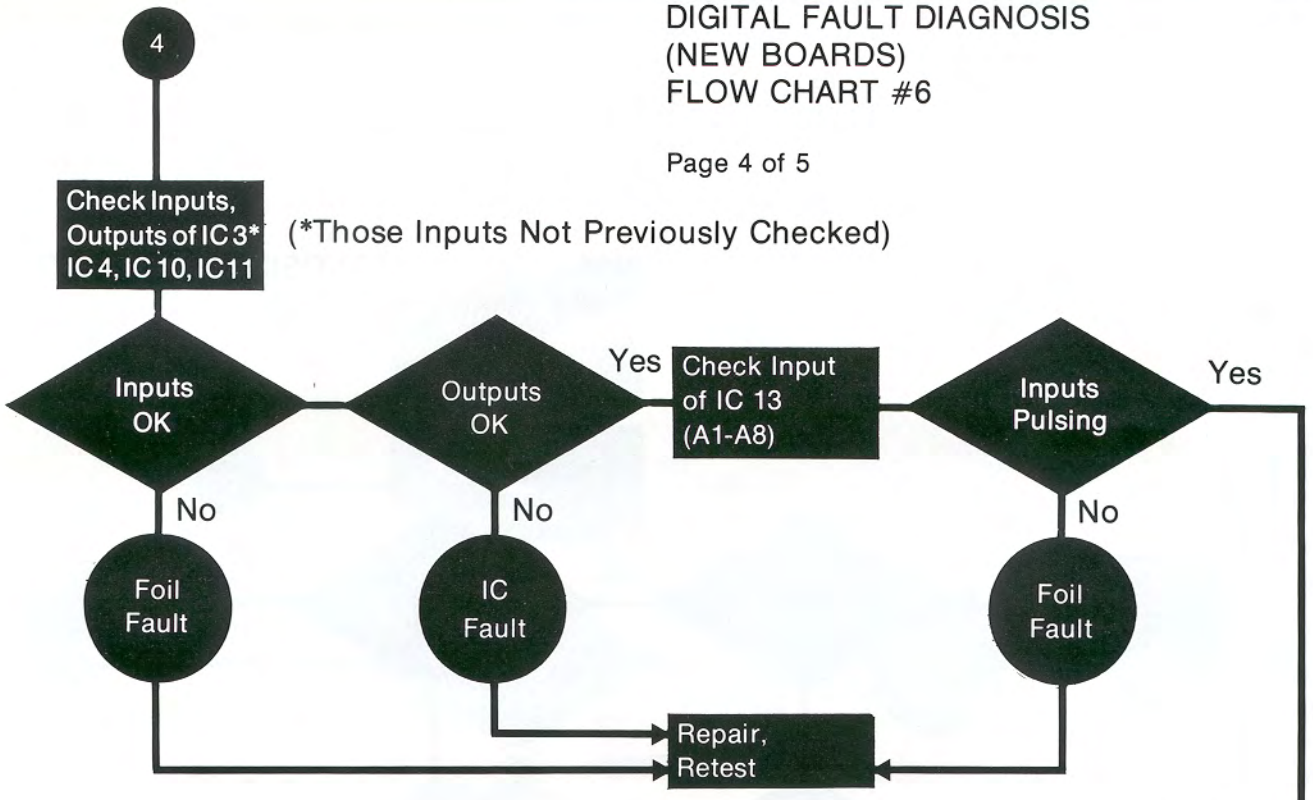
TABLE 1

IC 2 (BCD/DEC Decoder) Inputs/Outputs

Pins	Should Be	If pins are not as they should be: Check/Repair/Replace
12	Pulsing	Check IC3-12, 13 input, Pin 11 output; lift connections as required to determine fault, then repair or replace, retest.
13-15	Pulsing	Repair foil fault
8,9,10	Pulsing	Replace IC2
3-7	Pulsing	Replace IC2

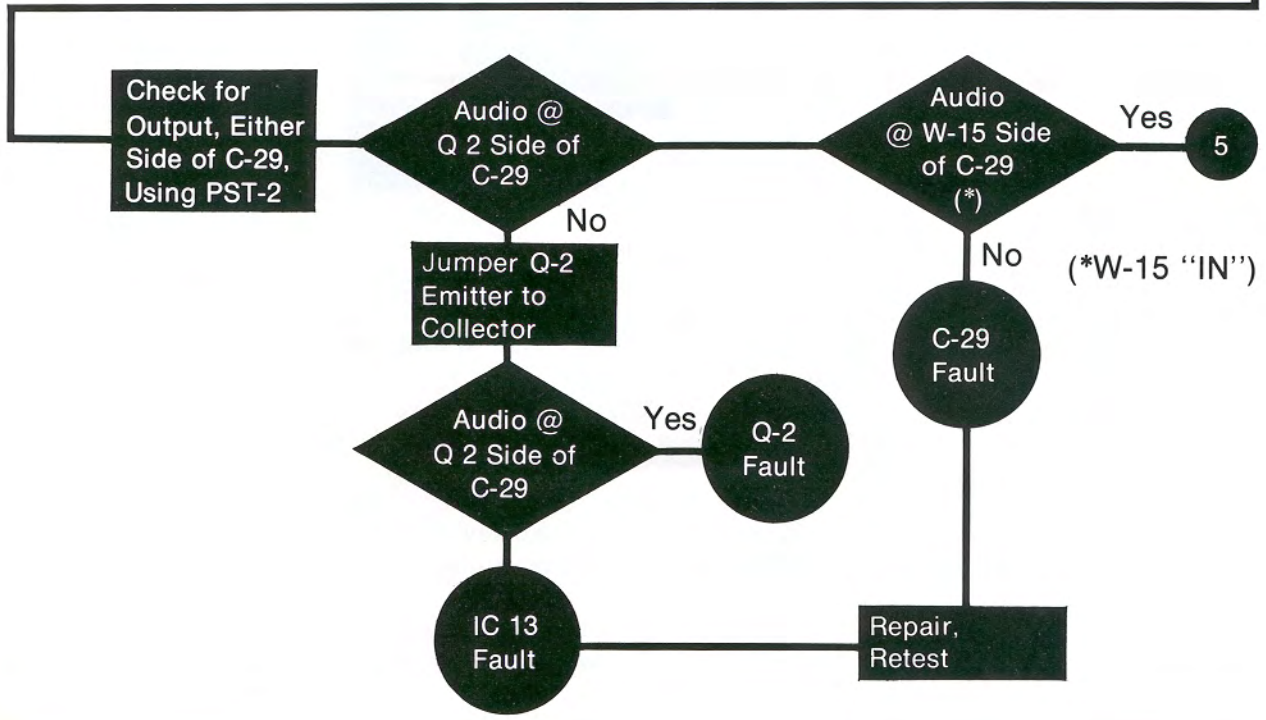
DIGITAL FAULT DIAGNOSIS (NEW BOARDS) FLOW CHART #6

Page 4 of 5



AUDIO FAULT DIAGNOSIS (NEW BOARDS) FLOW CHART #8

Page 1 of 2

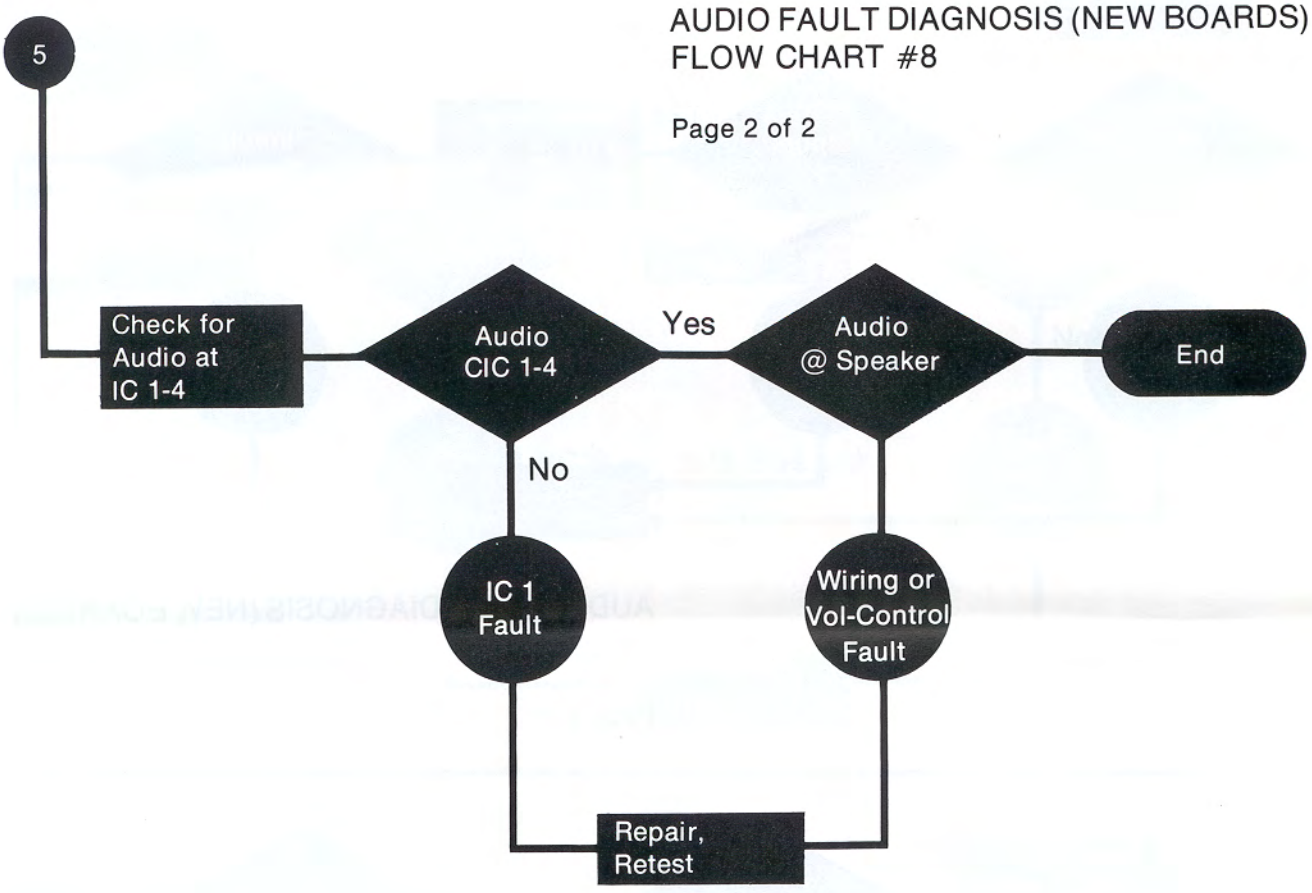


DIGITAL FAULT DIAGNOSIS
(NEW BOARDS)
FLOW CHART #6

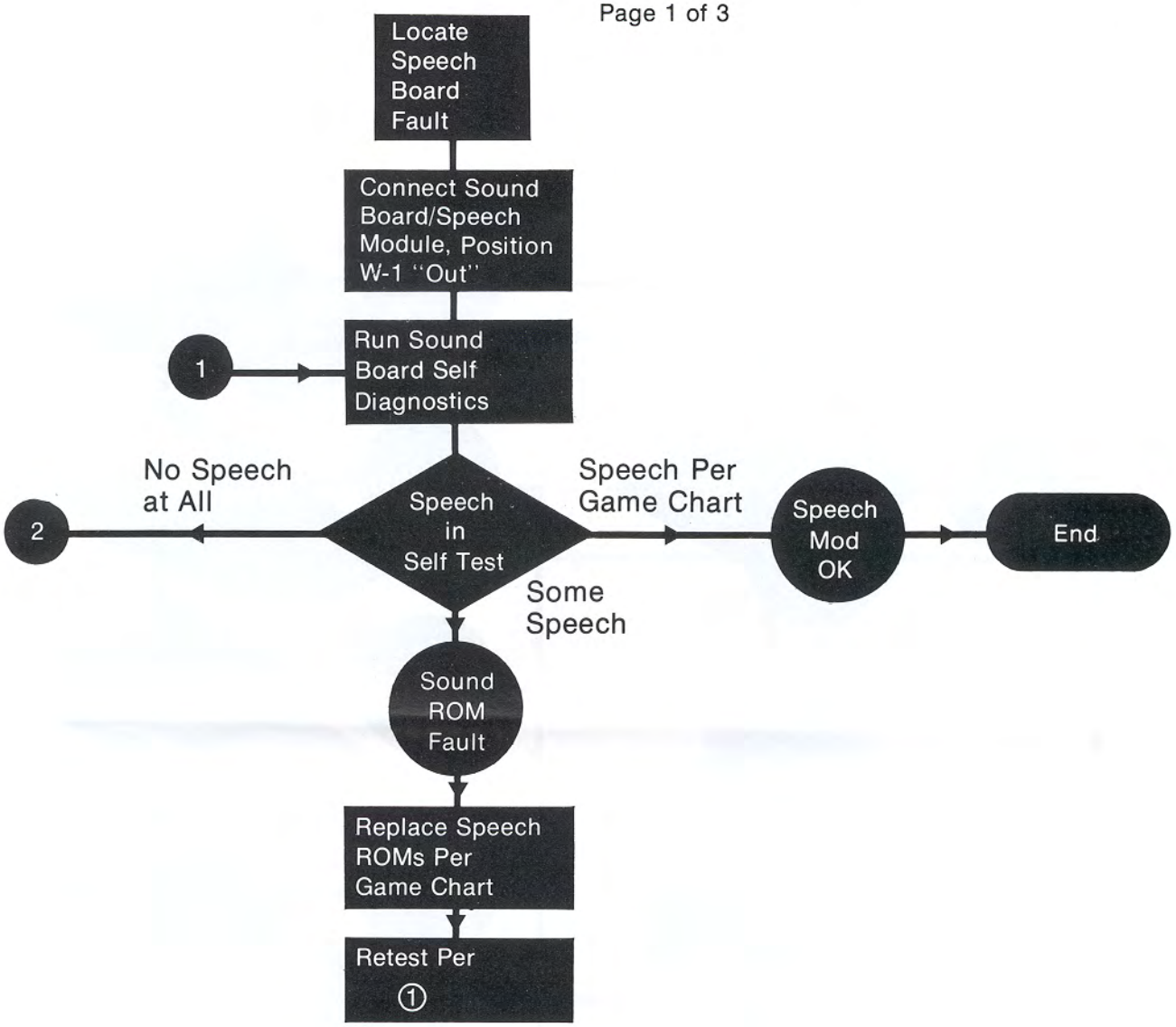
Page 5 of 5

AUDIO FAULT DIAGNOSIS (NEW BOARDS)
FLOW CHART #8

Page 2 of 2



SPEECH BOARD FLOW CHART #2



NOTES:

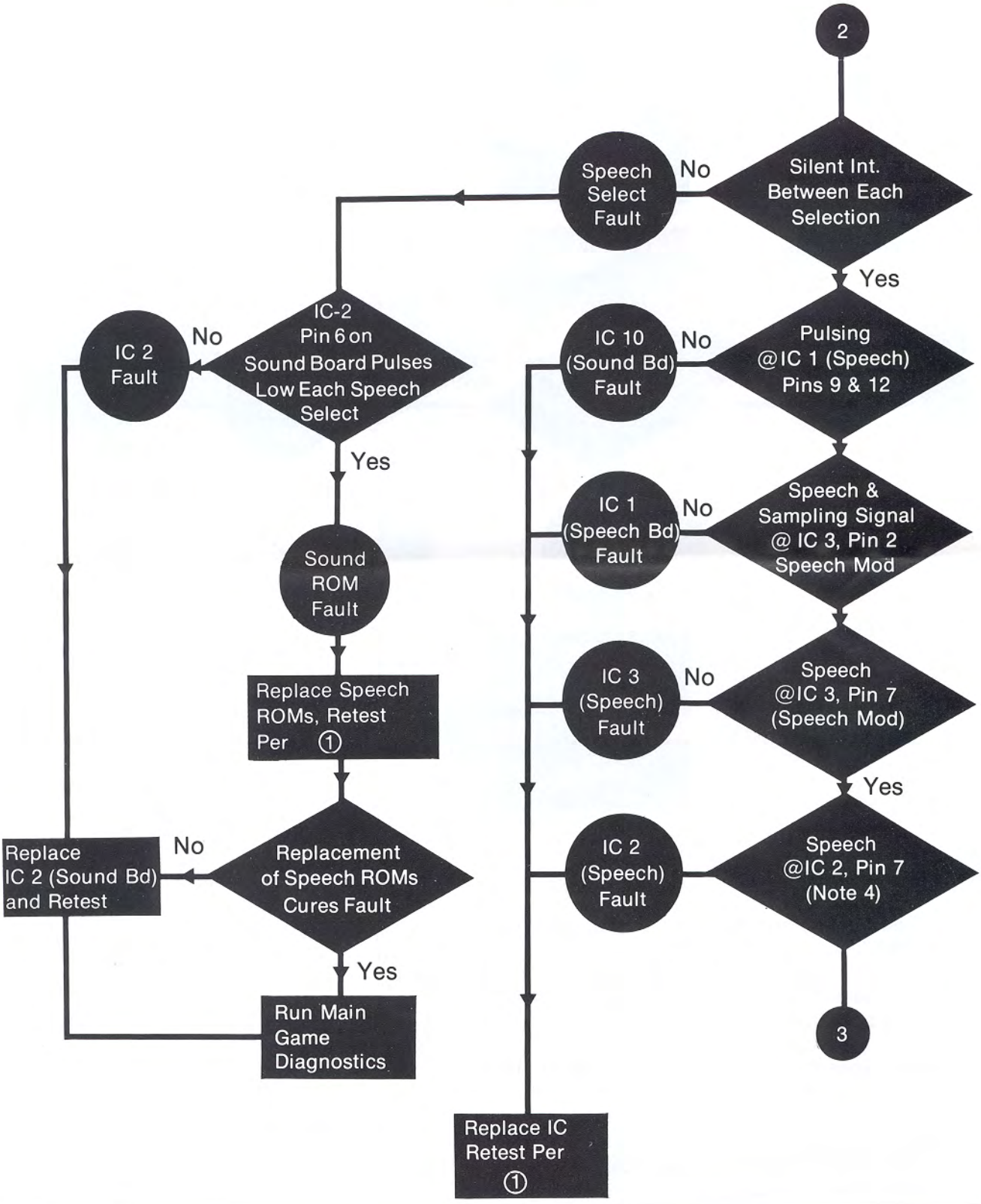
1. Depress SW-1 to start self-test; turn off game to stop self test.

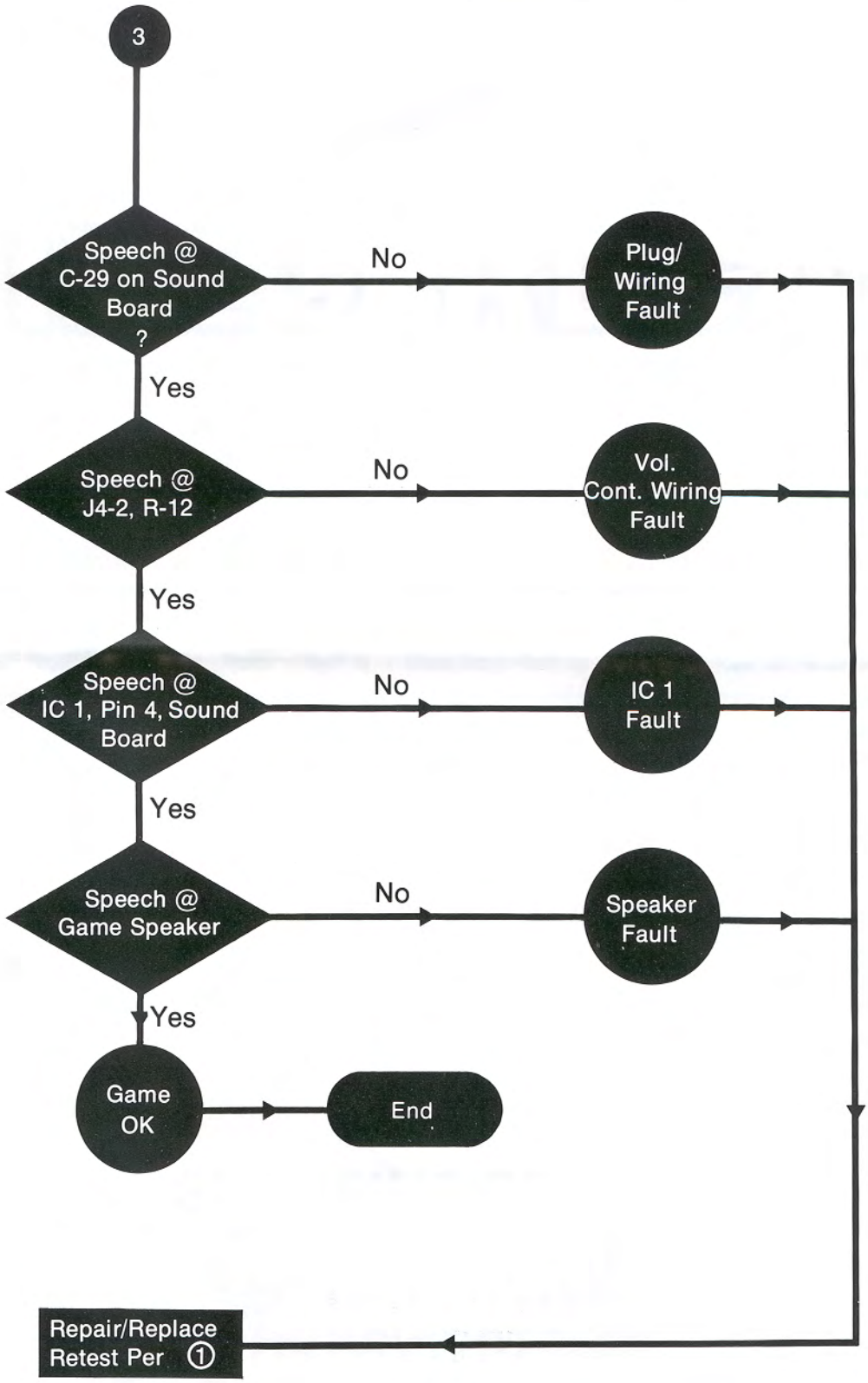
2. Consult game chart for speech ROM location of missing speech sounds.

3. Replace Speech ROMs one at a time; when problem clears, retest failed ROM to confirm fault.

4. Set balance control at mid-point (you may have to try various settings of the R-8 control to achieve balance on an operating game.)

SPEECH BOARD FLOW CHART #2




3
Speech @ C-29 on Sound Board ?
No
Plug/ Wiring Fault
Yes
Speech @ J4-2, R-12
No
Vol. Cont. Wiring Fault
Yes
Speech @ IC 1, Pin 4, Sound Board
No
IC 1 Fault
Yes
Speech @ Game Speaker
No
Speaker Fault
Yes
Game OK
End
Repair/Replace Retest Per ①