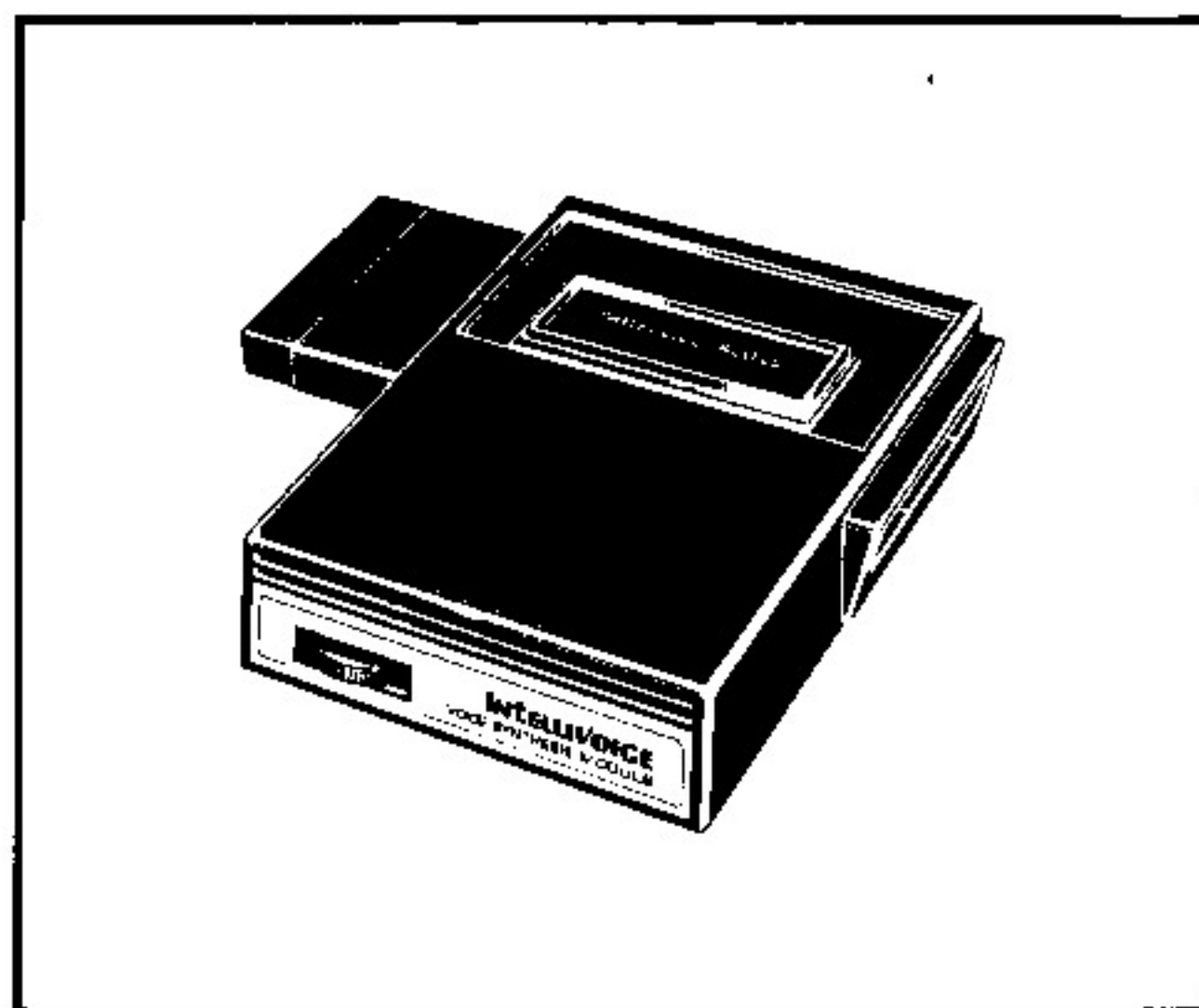


# MATTEL ELECTRONICS®

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## SERVICE MANUAL



**IntelliVoice™**  
VOICE SYNTHESIS MODULE

MODEL 3330

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**MATTEL ELECTRONICS**

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Hawthorne, California 90250

# INTELLIVOICE SERVICE MANUAL

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## TOOLS AND EQUIPMENT REQUIRED

- Intellivision Master Component
- Color TV Receiver
- Basic Electronic Hand Tools
- 20 MHz Triggered Oscilloscope
- Digital Multimeter (DMM)
- Intellivoice Game Cartridge

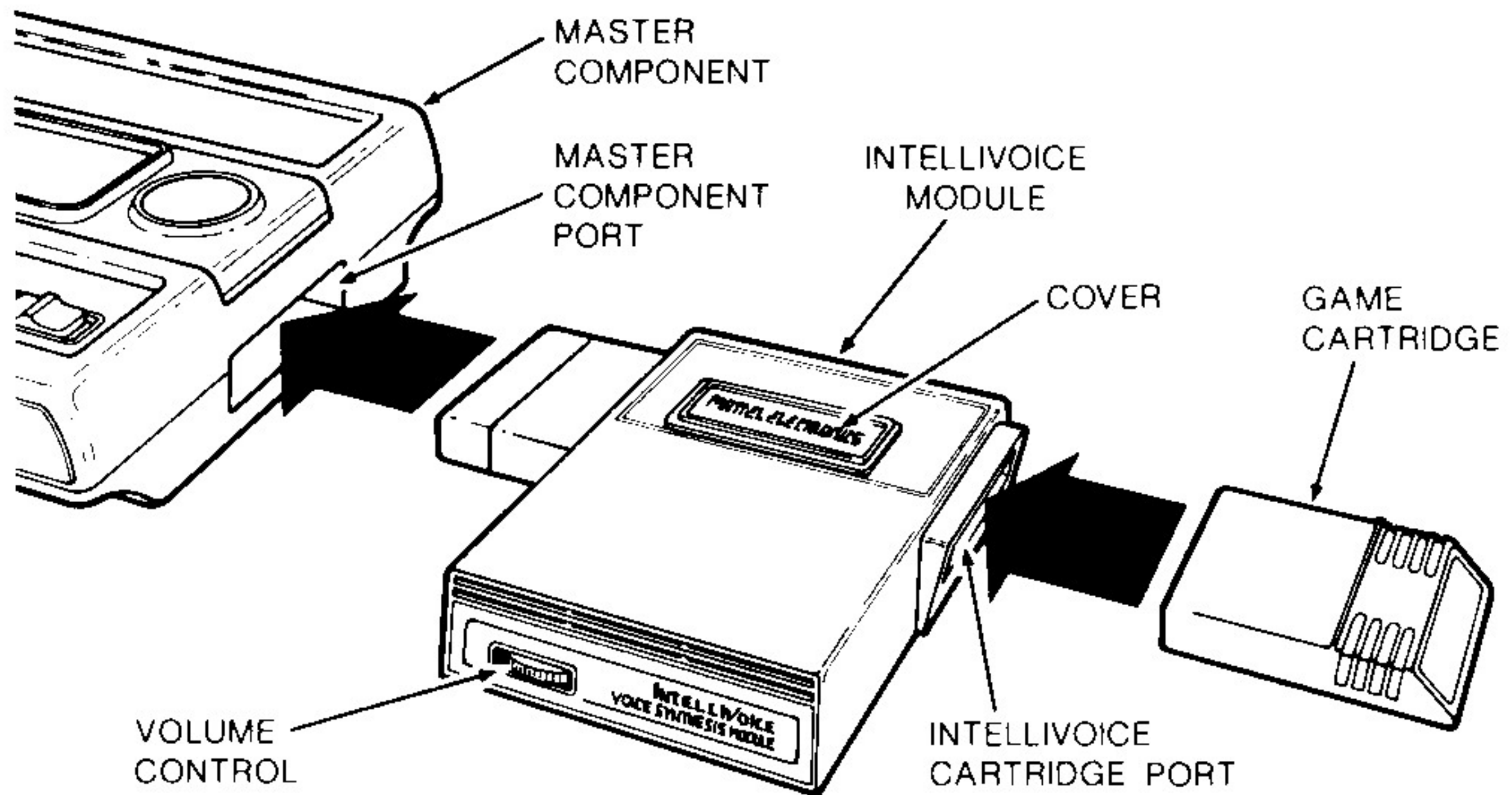


Figure 1 — Intellivoice Module

## OPERATION

1. Insert Intellivoice module into the Master Component Port (as if it were a game cartridge) as shown in Figure 1. Be sure it is plugged in all the way.
2. Insert an Intellivoice game cartridge into the Intellivoice Game Port. Standard Intellivision cartridges will provide the same gameplay as if they were plugged directly into the Master Component. Only specially marked Intellivoice cartridges include commands that operate the Intellivoice unit and add human voices electronically to the gameplay.
3. Use the volume control on the TV set to adjust the level of the game's sound effects. Then use the thumbwheel volume control on the Intellivoice unit to set the voice sound level (counterclockwise to increase, clockwise to decrease).

# TECHNICAL DESCRIPTION

The Intellivoice voice synthesis module produces audio speech signals when used in conjunction with the Intellivision Master Component (M/C) and a Voice Synthesis game cartridge. Standard Intellivision (non-voice) game cartridges may be operated with the Intellivoice module but no voices will be heard. The volume control adjusts the voice loudness level. This control does not affect game sound effects — only voice. The volume level is increased by rotating the knob counterclockwise.

Referring to the Intellivoice schematic (Figure 5), the Intellivoice module is placed between a game cartridge and the M/C. Data/Address Bus Lines DB0-DB15 (carrying game information) and Bus Control Lines BC1, BC2 and BDIR (Bus Direction) go directly from the game cartridge to the M/C. This is how the M/C is able to utilize both Voice and non-Voice cartridges through the Intellivoice module.

In observing human speech on an oscilloscope, it is seen as a complex combination of sine waves. Digital circuits, however, know only digital ones and zeros, a high or a low voltage. Digital circuitry cannot store speech in its analog form. Speech synthesis circuitry, then, must be able to generate the complex speech waveforms from a digital code. If a spoken word were divided into, say, a hundred parts then we could assign each part a digital code which would correspond to its pitch, volume, and other variables. Digital circuitry, in this case, could generate speech from this digitally-encoded signal.

The digitally-encoded speech segments can come from the M/C or from memory within the Speech Synthesizer IC (U3) itself. Speech segments stored in U3 are in permanent Read Only Memory (ROM), each segment addressable when the proper address code is presented to the chip. Custom speech segments from the M/C change with each different game cartridge used.

Buffer/Interface IC U2 will allow addresses of speech segments to pass onto D0-D7 (called the Peripheral Data Bus) when Control Lines BC1, BC2, and BDIR are in the correct state. When custom speech segments are presented from the M/C, U2 first converts them from parallel (multi-wire bus) to serial (single-wire bus). The serial data output is then loaded into U3, the Speech Synthesis IC. This part is controlled by control lines C1, C2, and C3, originating in U3.

Regardless of whether the digitally-encoded speech segments come from U2 (and the M/C) or from the ROM within U3, the speech segments are presented to the Vocal Tract Model. The Vocal Tract Model consists of electronic circuitry designed to imitate human speech patterns, utilizing 17 different parameters to generate speech.

The output of Speech Synthesizer U3 is not conventional audio, but is Pulse Width Modulated (PWM). When viewed on an oscilloscope, this appears to be a square wave whose edges rapidly expand and contract as speech generation takes place. The signal is then sent to a series of filters. First in line is C3, which acts as a high-pass filter. This helps to limit low frequency response to 150Hz.

Next in line are two active filters U4C/D and U4A/B, and their associated components. These two active filters attenuate frequencies above 5KHz. Capacitor C8 is another low-pass filter, and is responsible for removing most of the "hash" sound from the PWM. The Volume Control is next, which feeds U5A, a buffer amplifier. Capacitor C14, connecting the output of U5A to its inverting input, composes a low-pass filter, further limiting the response above 5kHz. C9 and R25 comprise the final high-pass filter, allowing signals above 150Hz to pass.

U5B and its circuitry is used to generate the +1.8VDC bias used as an artificial ground reference by the active filter networks. R7 and R8 are connected as a standard resistor divider network so that 5V input yields 1.8 V output at TP17. The current drain through the divider is only 10 $\mu$ A, so even a small current drain at TP17 will upset the voltage at this point. Since an OP Amp has a very high input impedance, the non-inverting (+) input will not affect the voltage at TP17.

The voltage at the + input of U5B (1.8VDC from the resistor divider) will force the output voltage to +1.8VDC. The output voltage is then fed back to the inverting (-) input. In an OP Amp, if the inverting input voltage changes (such as more positive) then the output will change in the opposite direction (less positive). Also, the output voltage will change, trying to force the - input to equal the + input. Say, for example, the output voltage of U5B decreases. A corresponding decrease at the - input will force the output voltage to increase until the voltage at the - input equals the voltage at the + input.

# PRELIMINARY CHECKLIST

Before you refer to the TROUBLESHOOTING section which follows, look at this list of possible quick solutions. Then, if any problem persists, you should be able to find it in TROUBLESHOOTING.

## CHECK

1. Check that the Master Component and television operate properly.
2. Check that jumper block is properly connected.
3. Check operation of Intellivoice unit.

## PROCEDURE

Insert the Diagnostic Test Cartridge directly into Master Component and run Diagnostic Routine. Make sure that the Master Component, RF cable, Switchbox and Television are functioning properly.

Remove Port Cover on top of Intellivoice unit. Jumper block should attach to stacking connector as shown in Figure 2.

Plug a known-good Intellivoice game cartridge into Intellivoice game slot. Game play should be normal and voices heard when appropriate keypad buttons are depressed.

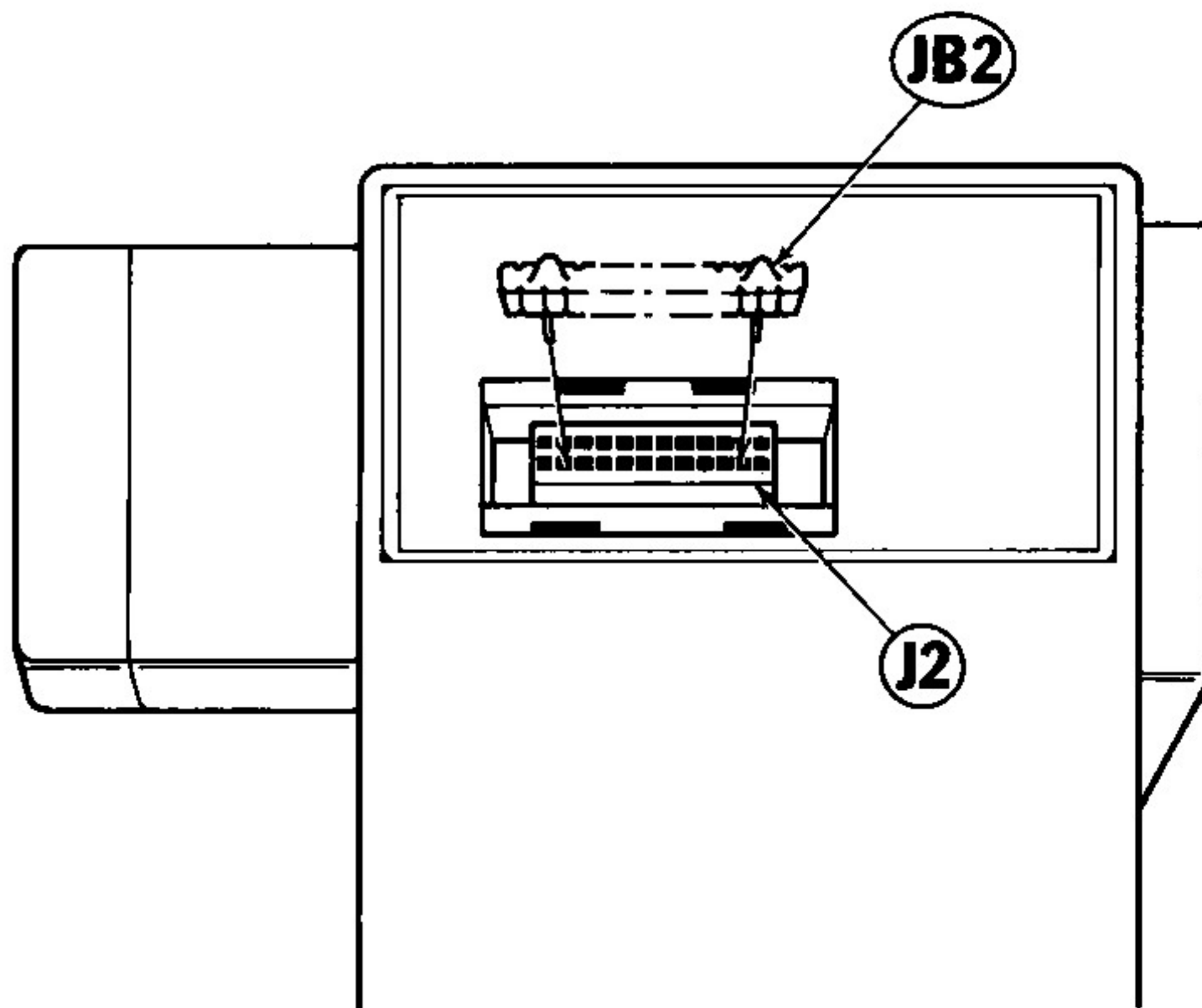
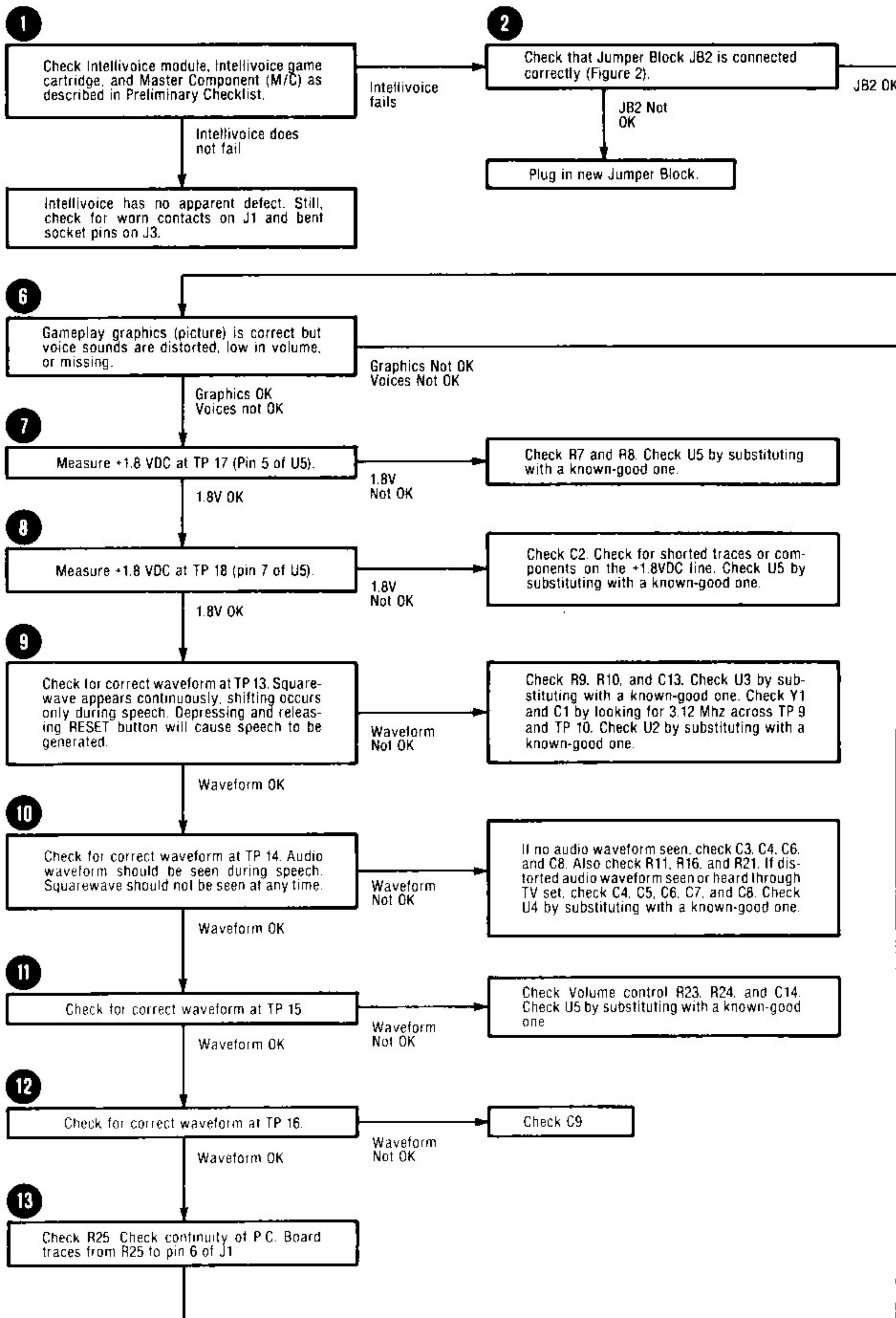
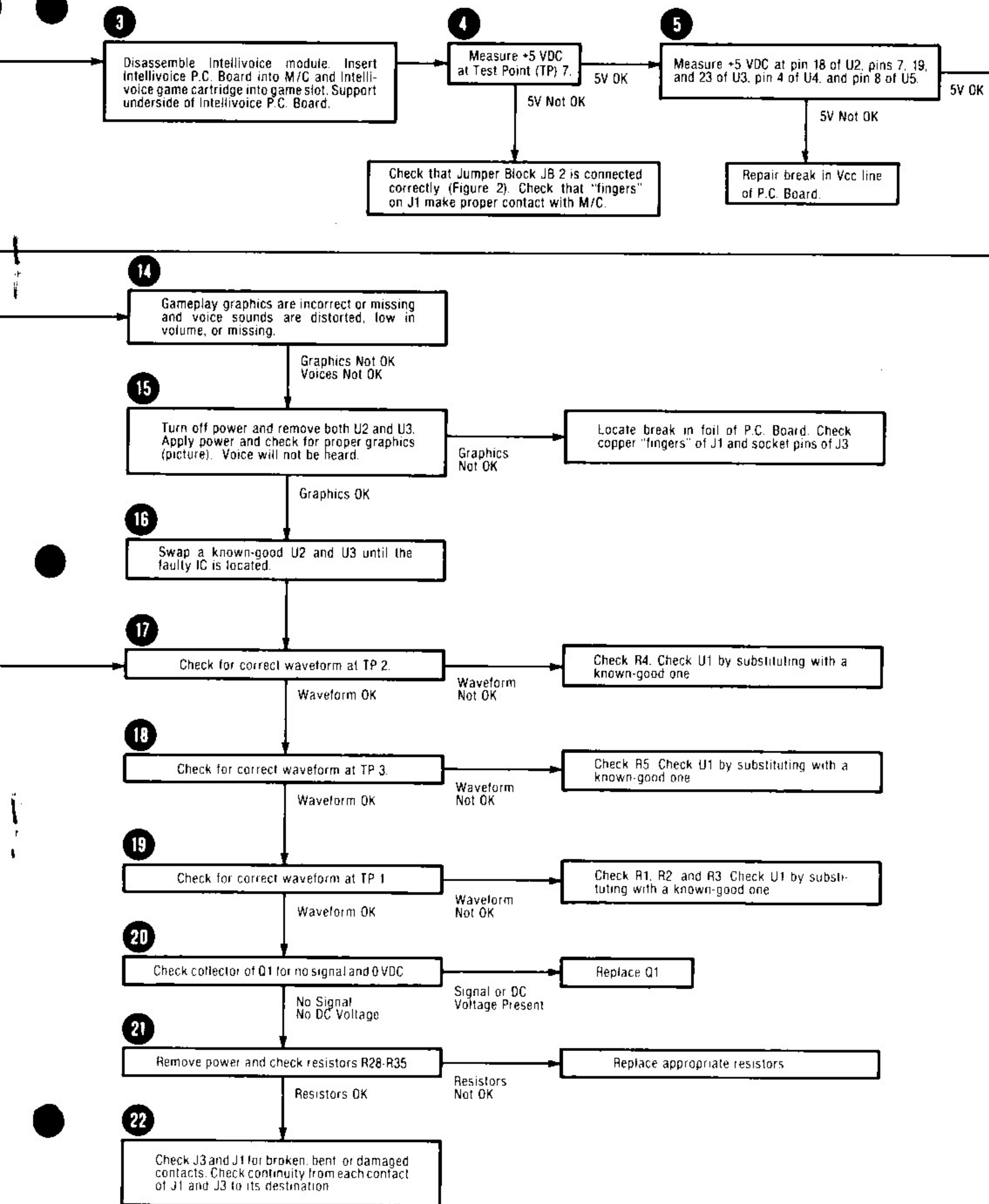


Figure 2 — Inserting Jumper Block JB2

## TROUBLESHOOTING PROCEDURE:

Instructions: Starting at step 1, follow each test in numerical order. The correct voltage or waveform being measured will lead you to the next step; an incorrect measurement will lead you to the defective component.





# **DISASSEMBLY**

**WARNING:**  
**PRECAUTIONS AGAINST STATIC DISCHARGE MUST**  
**BE TAKEN WHEN HANDLING THE INTELLIVOICE**  
**P.C. BOARD AND INTEGRATED CIRCUITS.**

1. Turn Intellivoice unit upside down and remove three Phillips head screws.
2. Turn unit right-side up and remove top housing.
3. Remove three Phillips head screws securing P.C. board and metal shields to lower housing.
4. Remove P.C. board and metal shields from lower housing. Carefully slide nosepiece of P.C. board away from lower housing.
5. Remove upper and lower metal shields from P.C. board. If metal shields are soldered in place, unsolder tabs and remove metal shields.

## **DISASSEMBLY NOTES:**

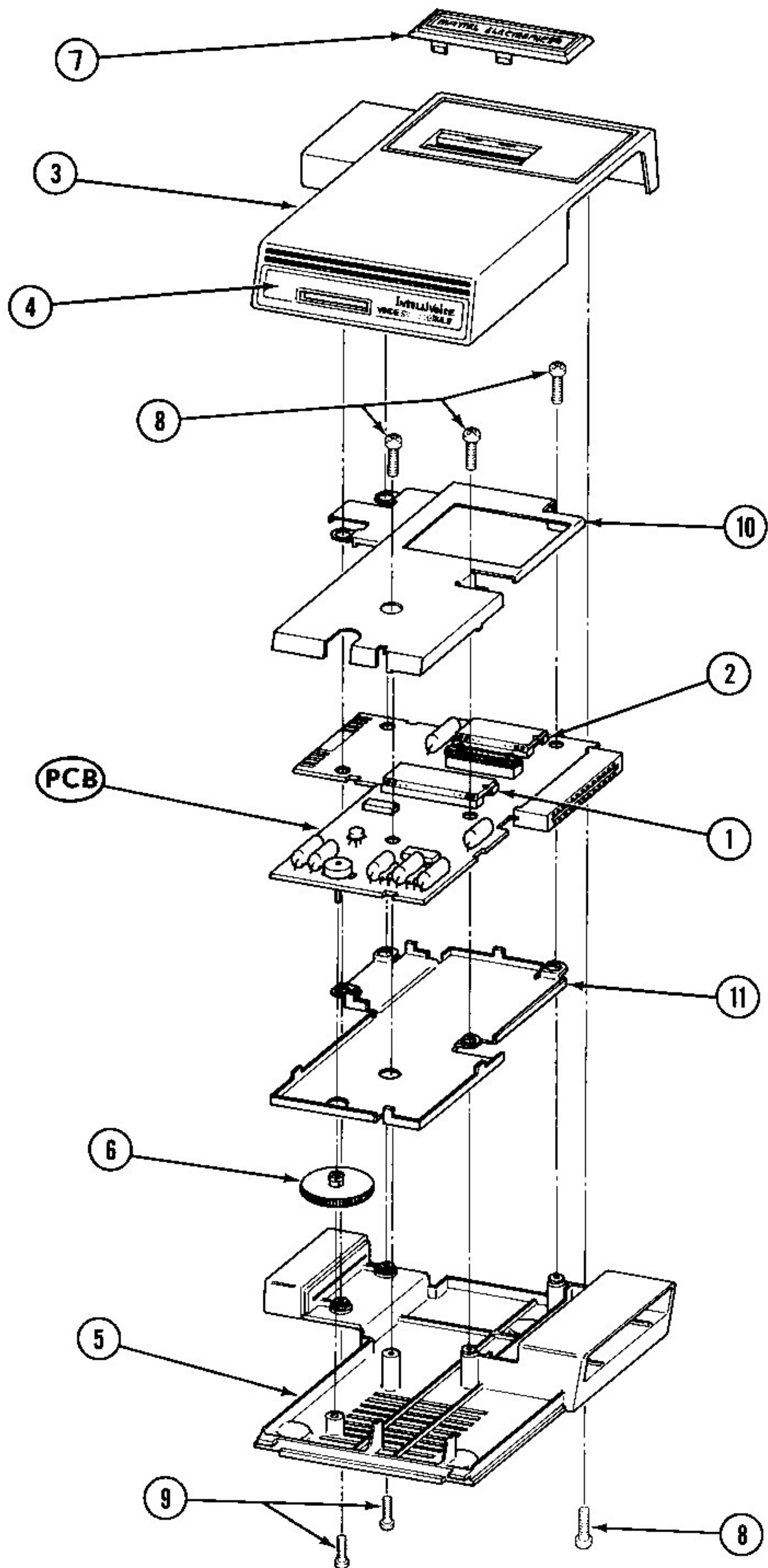


Figure 3 — Exploded View

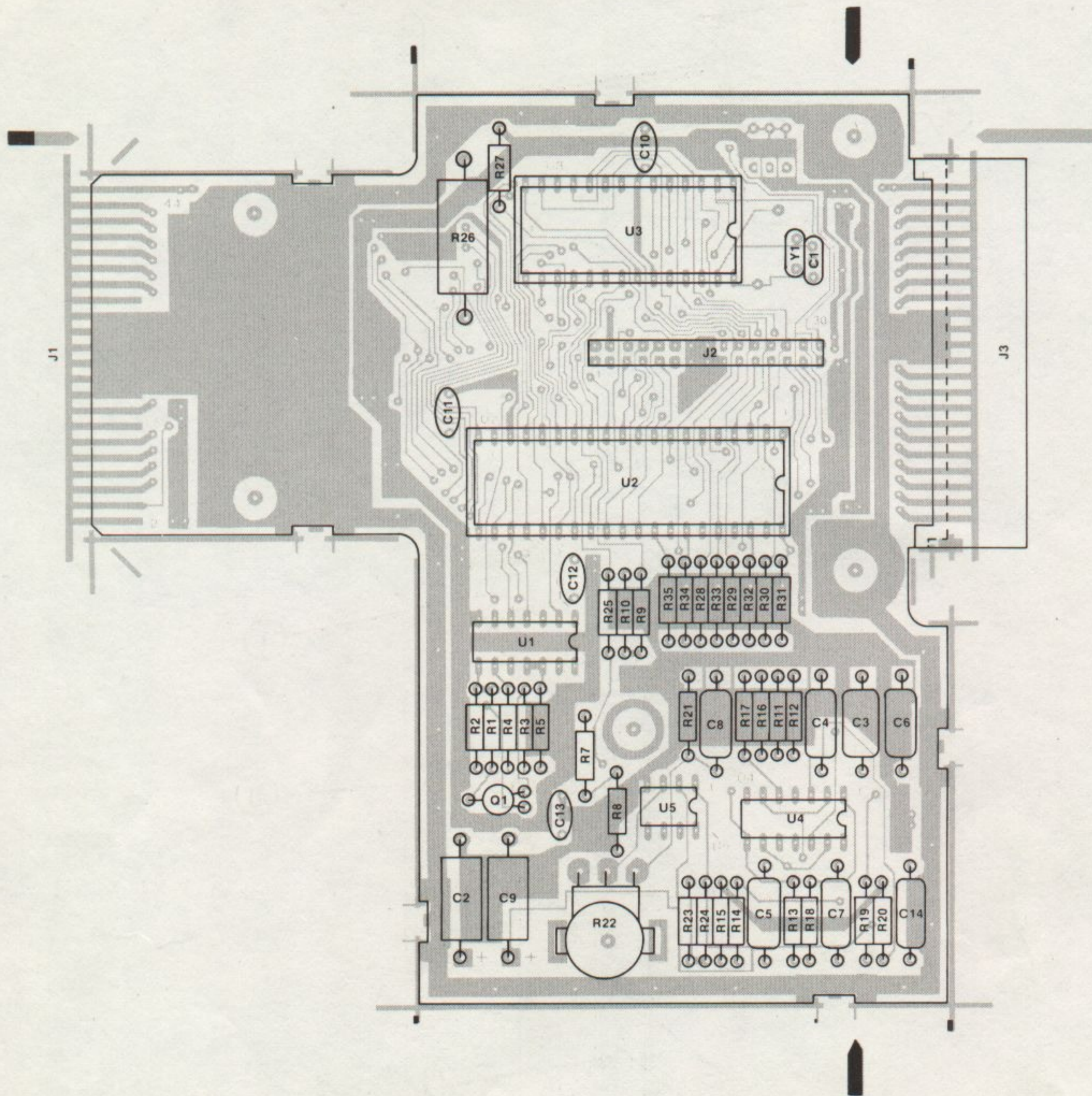


Figure 4 — PCB Component Layout



# PARTS LIST

REFERENCE DESIGNATION	DESCRIPTION	PART NUMBER
PCB	P.C. Board Assy. with all parts	3330-9229
U1	IC, Triple 3-input NAND 74LS12	0086-0171
U2	IC, Buffer/Interface SPB-640	0086-0173
U3	IC, Speech Synthesizer SP-0256	0086-0172
U4	IC, Quad OP Amp LM-324C	0098-1210
U5	IC, Dual OP Amp LM-358C	0086-0170
Q1	Transistor, PN 2906	0086-0330
R1	Resistor, 1K Ohm 5% 1/4W CF	0095-0781
R2, R4, R5	Resistor, 2.2K Ohm 5% 1/4W CF	0095-0861
R3	Resistor, 180 Ohm 5% 1/4W CF	0095-0601
R7	Resistor, 180K Ohm 5% 1/4W CF	0095-0322
R8	Resistor, 100K Ohm 5% 1/4W CF	0095-0262
R9, R10	Resistor, 330 Ohm 5% 1/4W CF	0095-0661
R11, R16	Resistor, 16K Ohm 2% 1/4W CF	0084-0405
R12	Resistor, 3.9K Ohm 2% 1/4W CF	0084-0345
R13, R15, R18, R20	Resistor, 8.2K Ohm 2% 1/4W CF	0084-0377
R14	Resistor, 6.34K Ohm 1% 1/4W MF	0084-0923
R17	Resistor, 12K Ohm 2% 1/4W CF	0084-0393
R19	Resistor, 3.83K Ohm 1% 1/4W MF	0084-0924
R21, R27	Resistor, 12K Ohm 5% 1/4W CF	0095-0996
R22	Potentiometer, 200K Ohm	3330-0030
R23	Resistor, 5.6K Ohm 5% 1/4W CF	0095-0961
R24	Resistor, 22K Ohm 5% 1/4W CF	0095-0102
R25	Resistor, 430 Ohm 5% 1/4W CF	0095-0691
R26	Resistor, 8.2 Ohm 5% 2W CF	0084-0927
R28-R35	Resistor, 47K Ohm 5% 1/4W CF	0095-0182
C3-C8, C14	Capacitor, 0.0047uF 100V Polypropylene	0085-2630
C2	Capacitor, 10uF 10V Elect	0085-0003
C1	Capacitor, 100pFx2 Network	0086-0705
C9	Capacitor, 4.7uF 25V Elect.	0085-0025
C10-C13	Capacitor, 0.01uF 12V Cer. Disc.	0096-4020
Y1	Ceramic Resonator 3.12MHz	0089-0818
JB2	Jumper Block	3330-9609
J2	Connector, Stacking 30 pin	0089-0021
J3	Connector, Edge 44 pin	0089-0022
1	40 pin low profile IC socket	0099-0260
2	28 pin low profile IC socket	0099-1530
3	Upper Housing Assy. incl. inlay	3330-9199
4	Inlay, Upper Housing	3330-6449
5	Lower Housing Assy. incl. label	3330-9109
6	Wheel, Volume Control	1149-2039
7	Port Cover	3330-2059
8	Screw 8-18 x 3/8"	0405-0176
9	Screw 5-20 x 7/16"	0405-0842
10	Upper Shield	3330-4169
11	Lower Shield	3330-4179
	Packing Carton, Individual	3330-0910
	Packing Material	3330-0660
	Instruction Book	3330-0920