The RegulatorAudio PCB has the dual functions of regulating the +5 VDC logic power to the game PCB and amplifying the audio from the game PCB.

**Regulator Circuit**

The regulator consists of voltage regulator Q1, current source power transistor Q2 and Q3's base transistor Q4. The regulator accurately regulates the logic power input to the game PCB by monitoring the voltage through high impedance inputs +SENSE and -SENSE. The inputs are directly from the +5 VDC and ground inputs to the game PCB. Therefore, the regulator regulates the voltage on the game PCB. This eliminates a reduced voltage due to IR buildup on the wire harness between the regulator and the game PCB. Variable resistor RB is adjusted for the +5 VDC on the game PCB. Once adjusted, the voltage at the input of the game PCB will remain constant at this voltage.

**Regulator Adjustment**

1. Connect a voltmeter between +5 V and GND test points of the game PCB.
2. Adjust variable resistor RB on the RegulatorAudio PCB for +5 VDC reading on the voltmeter.
3. Connect a voltmeter between +5 V REG and GND on the RegulatorAudio PCB. Voltage reading shall not be greater than +5.5 VDC. If greater, try cleaning edge connectors on both the game PCB and the RegulatorAudio PCB.
4. If cleaning PCB edge connectors doesn't decrease voltage difference, connect minus lead of voltmeter to GND test point of RegulatorAudio PCB and plus lead to GND test point of game PCB. Note the voltage. Now connect minus lead of voltmeter to +5 V REG test point on RegulatorAudio PCB and plus lead to +5 V test point on game PCB. From this you can see which harness circuit is dropping the voltage. Troubleshoot the appropriate harness wire or harness connector.

**Audio Circuit**

The audio circuit contains two independent audio amplifiers. Each consists of a TDA2003AV amplifier with a gain of ten.
The Auxiliary PCB Math Box Circuit

The Math Box Circuitry of the Ballotize Analyzer is
connected to the Analog Vector-Generator PCB via a
terminator. The Math Box Circuitry receives all of
EAB7 (external address bus 0 thru 4) and provides
EDBF that results in the three-dimensional video
game.

A second connector on the Auxiliary PCB connects
to the signature analyzer (SA). This header
cares the connector that makes signature analysis.

Figure 1

Figure 2A

PORTION OF AUXILIARY PCB

Figure 2B

PORTION OF AUXILIARY PCB

Sheet 1, Side B
DP-156-01  2nd printing
Signature Analysis of the Math Box Circuitry

During the self-test procedure, the Math Box Circuitry is quizzed. T displayed in the upper right-hand corner of the self-test video display indicates that the Math Box Circuitry does not answer the question in the amount of time expected. Therefore, T indicates a Math Box Circuitry failure.

Due to the complexity of this circuitry, we offer signature analysis as a simple means of isolating failing circuits. Signatures for this circuitry are presented in two forms:
1) at the actual test points in the Auxiliary PCB Math Box Circuitry schematic diagram on Sheet 3, Side B; and
2) for your convenience, on the detail drawing of the Auxiliary PCB to the left of this text.

Since the Analog Vector-Generator PCB must be connected to the Auxiliary PCB, you may take signatures while the PCB's are instaled in the game.

The following is the procedure for signature analysis of the Math Box Circuitry of the Auxiliary PCB.

A. Equipment Required:
1. Signature Analyzer (one of the following: Atari CXXAT Computer-Assisted Troubleshooter. This is a signature analyzer and a RAM/RAM tester combined. For more information contact Atari, Inc., Field Service/Com-Op Division, P.O. Box 427, Sunnyvale, CA 94086.
   OR
   Kurz-Kasch Signature II signature analyzer. For more information contact Kurz-Kasch, 711 Hunter Drive, Wilmington, Ohio 45117.
   OR
   Hewlett-Packard Model 5064A signature analyzer. For more information contact Hewlett-Packard, Scientific Instruments Div., 1501 Page Mill Road, Palo Alto, CA 94304.
   For local dealers, check the Yellow Pages under "Electronic Equipment and Supplies."

2. SA Harness Assembly:
   Atari part number A009366-01. You can make one of these yourself. Above is an Illustration of its construction.
   OR
   Three jumper wires with "hook" connectors on each end.
   OR
   Pullup resistor as follows: 1k to 1.5k ohm, 1/4 watt resistor.

B. Signature Analysis Setup Procedure

1. Connect Signature Analyzer to the matching pins of SA connector on the SA Harness assembly. In other words, GND should match up with GND, etc.

2. Set Test-Test Switch of Battletee™ game to ON. After approximately three seconds, the TV monitor should display the self-test pattern.

3. Jumper top end of 1k-ohm resistor R129 (located immediately between and below C10 and L7 (left COIN test points)) of Analog Vector-Generator PCB to ground five times, or until video display is blank. You will hear a short beep after the fifth grounding, also, the screen will display only a tiny dot in its center. NOTE: Avoid accidentally turning off the game by brushing against the interlock switch, we recommend putting tape over the switch.

   Alternate: Jumper pin 5 of Analog Vector-Generator PCB edge connector J20 to ground five times, or until video display is blank.

C. Signature Analysis Test #1 Procedure

1. Plug SA Harness Assembly Test #1 connector on Signature Analyzer header on Auxiliary PCB (the white wire on the connector should be at the top).

2. Connect a jumper between pin 1 of IC B6 on the Analog Vector-Generator PCB and ground. This places a continuous reset to the microprocessor on the Analog Vector-Generator PCB.

3. Set Signature Analyzer START to ..., STOP to ..., and CLOCK to ... .

4. Connect a jumper wire to each of pin 1 IC B6. Return to G. Signature Analyzer Setup Procedure and once again do step 3.

5. Verify that setup procedure was correct by probing (touching probe to the +5V test point) the Signature Analyzer should indicate CC34. If not CC34, remove the jumper from pin 1 of IC B6. Return to B. Signature Analyzer Setup Procedure and once again do step 3.

6. Probe for signature as shown in Figure 1 to the left. If all signatures are correct, continue with D. Signature Analysis Test #2A Procedure. If any signatures are incorrect, probe for signature of CC34 on +5V test point. If not CC34, remove jumper from pin 1 of IC B6. Return to B. Signature Analyzer Setup Procedure and once again do step 3. If +5V is CC34, refer to G. Isolating a Failing Circuit.

D. Signature Analysis Test #2A Procedure

1. Remove 1k to 1.5k-ohm jumper wire from Signature Analyzer probe.

2. Plug SA Harness Assembly Test #2 connector on Signature Analyzer header on Auxiliary PCB.

3. Remove jumper from pin 1 of IC B6 on the Analog Vector-Generator PCB.

4. Set Signature Analyzer START to ..., STOP to ..., and CLOCK to ... .

5. Verify that setup procedure was correct by probing +5V for a signature of 3951. If not 3951, return to B. Signature Analyzer Setup Procedure and once again do step 3, then return to this step.

6. Probe for signatures as shown in Figure 2A to the left. If all signatures are correct, continue with E. Signature Analysis Test #2B Procedure. If a signature is incorrect, refer to G. Isolating a Failing Circuit.

E. Signature Analysis Test #2B Procedure

1. Make sure the SA Harness Assembly Test #2 connector is plugged onto Signature Analyzer header on Auxiliary PCB.

2. Make sure jumper is removed from pin 1 of IC B6 on the Analog Vector-Generator PCB.

3. Set Signature Analyzer START to ..., STOP to ..., and CLOCK to ... .

4. Verify that setup procedure was correct by probing +5V for a signature of 3951. If not 3951, return to B. Signature Analyzer Setup Procedure and once again do step 3, then return to this step.

5. Probe for signatures as shown in Figure 2B to the left. If all signatures are correct, continue with F. Signature Analysis Test #3 Procedure. If a signature is incorrect, refer to G. Isolating a Failing Circuit.

F. Signature Analysis Test #3 Procedure

1. Plug SA Harness Assembly Test #3 connector on Signature Analyzer header on Auxiliary PCB.

2. Make sure jumper is removed from pin 1 of IC B6 on the Analog Vector-Generator PCB.

3. Set Signature Analyzer START to ..., STOP to ..., and CLOCK to ... .

4. Verify that setup procedure was correct by probing +5V for a signature of 3951. If not 3951, return to B. Signature Analyzer Setup Procedure and once again do step 3, then return to this step.

5. Probe for signatures as shown in Figure 3 to the left. If all signatures are correct, then Math Box Circuitry of Analog Vector-Generator PCB is OK.

G. Isolating a Failing Circuit

If you find an incorrect signature, find the signature test point of the Math Box Circuitry on Sheet 3, Side B. Locate the IC from which the signature is being output. Check all inputs of that IC.

If all input signatures are correct: Remove the Auxiliary PCB from the circuit. Check the circuit traces common to the failing IC pin on both the top and bottom of the PCB for shorts to another circuit trace. If the circuit traces are not shorted, then replace the failing IC.

If an input signature is incorrect: Locate on the schematic the IC source of the failing signature. Check the input signatures of that IC. If all input signatures are correct, then that is the failing IC. If this IC has a falling input signature, then continue "upstream" in the circuit flow until the failing IC is isolated.
Adjustment of R73 and R74

If you replace the Battlezone™ Analog Vector-Generator PCB, you may have to adjust two controls on this board. Follow this procedure:

Enter the self-test. Locate the two potentiometers at R73 and R74 on the Analog Vector-Generator PCB. These control X and Y distortion. Turn the controls in either direction until the diagonal lines on all four sides of the screen touch or barely overscan outside the horizontal and vertical frame lines.
Adjustment of R11

If you replace the Battlezone™ Auxiliary PCB, you may have to adjust the control on this board. Follow these steps:

1. Turn the play mode on. Listen to the tank idle sound. It should be at a moderate speed—not too slow (as in an engine about to stall) or too fast.
2. Adjust the potentiometer at R11 on the Auxiliary PCB. This is just about in the center of the PCB. Also check that the speed is properly adjusted by driving the tank forward; the speed should increase.