# Operation, Maintenance, and Service Manual

Complete with Schematics and Illustrated Parts Lists

If reading through this manual does not lead to solving a certain maintenance problem, call TELEHELP® at the Atari Customer Service office in your geographical area, as shown below.





## **Notice Regarding Non-ATARI Parts**



You may void the game warranty (printed on the inside back cover of this manual) if you do any of the following:

- substitute non-ATARI parts in the game
- modify or alter any circuits in the game by using kits or parts not supplied by Atari.



to licensed communications services is not permitted by the Federal Communications Commission (FCC).

If you suspect interference from an ATARI® game at your location, check the following:

- all green ground wires in the game are properly connected as shown in the the game wiring diagram
- the power cord is properly plugged into a grounded 3-wire outlet
- the game PCB is properly installed within the Electromagnetic Interference (EMI) cage
- the EMI Shield PCB is properly installed and in series with the game PCB harness.

Refer to Figure 4-10 to make sure that the game PCB and the Shield PCB are correctly installed.

If you are still unable to solve the interference problem, please contact ATARI Customer Service. See the inside front cover for service in your area.

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# **Set-Up Procedures**



## How to Use this Manual

This manual, written for game operators and service technicians, describes the Quantum game. The manual contains information about the *Upright* cabinet.

Chapter 1 describes new features, game setup, settings of option switches, and game play.

Chapter 2 contains self-test procedures.

Chapter 3 has maintenance and repair information.

Chapter 4 contains illustrated parts lists.

Figures 1-1 and 4-1 illustrate the game cabinet. Italicized lettering on these figures refers you to other places in the manual for information about specific cabinet parts.

In addition, schematic diagrams of the game circuitry are included with this manual.









+ Item with a serial number label



## A. New Features

The Quantum game has three new features. Even if you are familiar with ATARI® games, you should note these important differences:

- Control Panel. The control panel is designed to allow a player greater range of movement when using the Midi Trak-Ball.<sup>TM</sup>
- Front Panel Graphics. Graphics are added to the front panel to attract more players.
- Electromagnetic Interference (EMI) Cage. The game printed-circuit board (PCB) is mounted inside this cage. The EMI cage reduces interference from the game to television and radio receivers.

New features and all other major parts of the game are illustrated in Figure 1-1. Throughout this manual, wherever one of these new features is mentioned, you will see this symbol:

## **B.** Inspecting the Game

Please inspect your game carefully to ensure that it was delivered to you in good condition.



- 1. Examine the exterior of the game cabinet for dents, chips, or broken parts.
- Remove the screws from the rear access panel. Unlock and open this panel and the coin door; inspect the interior of the game as follows:
  - a. Ensure that all plug-in connectors (on the game harnesses) are firmly plugged in. Replug any connectors found unplugged. Do not force connectors together. The connectors are keyed so they only fit in the proper orientation. A reversed edge connector may damage a PCB and will void your warranty.
  - b. Ensure that all plug-in integrated circuits on the PCB are firmly plugged into their sockets.
  - c. Remove the tie-wrap that secures the coiled power cord inside the cabinet. Inspect the power cord for any cuts or dents in the insulation. Repair or replace it as required.

Place the square black plastic strain-relief plate in the wood slot at the bottom of the rear panel opening.

- d. Note the game serial number. It is printed on a label on the back of the cabinet. Verify that the same serial number is also on the game PCB, Regulator/Audio II PCB, power supply, and video display. See *Figure 1-1* for locations of the serial-numbered components. Please mention this serial number whenever you call your distributor for service.
- e. Inspect major subassemblies, such as the power supply, control panel, and video display. Make sure they are mounted securely, and that the green ground wires are connected.

### C. Space and Power Requirements warning shock hazard

This game should only be connected to a grounded 3-wire outlet. If you have only a 2-wire outlet, we recommend you hire a licensed electrician to install a grounded outlet. *Players may receive an electrical shock* if this game is not properly grounded!

#### 1. Installation Requirements

250 W
0° to +38°C (+32° to +100°F)
Not over 95% relative
64 x 80 cm (25½ x 31½ in.)
184 cm (72½ in.)

#### 2. Selecting the Voltage Plug

The power supply used in this game operates on the line voltage of almost any country in the world. The power supply comes with either one, two, or three separate voltage-selection plugs. Plug voltages and wire colors are 100 VAC (violet wire color), 120 VAC (yellow wire color), 220 VAC (blue wire color), and 240 VAC (brown wire color).

Before plugging in your game, check your line voltage. Next, check the wire color on the voltageselection plug that is plugged into the game's power supply. Make sure the voltage-selection plug is correct for the voltage of your location (see *Figure 4-14*).

Now plug the game into a grounded 3-wire outlet.

## **D.** Switch Locations

#### 1. Power On/Off Switch

The power on/off switch is located on the back of the cabinet on the lower left side (see *Figure 1-2*).

#### 2. Utility Panel Switches

The volume control, self-test switch, coin counter(s), and auxiliary coin switch are on the utility panel. The utility panel is located inside the upper coin door (see *Figure 1-2.*) The volume control adjusts the level of sound produced by the game. The

self-test switch is used to enter and exit the Self-Test Mode. The coin counter(s) records the number of coins entered into the game. The auxiliary coin switch is used to credit the game without activating a coin counter.

#### 3. Option Switches

Game price option switches are located on the game PCB at location 4C/D (see *Figure 1-2*).



Figure 1-2 Switch Locations



Please see CO-221-01, supplement to TM-221, for information on this section.

### F. Game Play

Quantum is a one- or two-player game with a color X-Y video display. The game action takes place in a subatomic world. The player tries to capture deadly atomic particles without being destroyed by them.

To capture particles, the player uses the Midi Trak-Ball<sup>™</sup> to control a comet that sparkles. When the player rotates the Midi Trak-Ball<sup>™</sup>, the comet leaves a tail (or line) behind it. The player must draw a complete circle around the deadly particle to destroy it.

Quantum has five possible modes of operation: Attract, Select, Play, High-Score, and Self-Test. Self-Test is a special mode for checking the game switches and computer functions. You may enter the Self-Test Mode from any other mode.

#### 1. Attract Mode

The Attract Mode begins when you turn the power on/off switch *on*, or after a Play, High-Score, or Self-Test Mode.

The Attract Mode consists of a series of five screens. In the first screen the word *QUANTUM* appears in the center of the screen and increases in size. Credits (if any) appear at the bottom of the screen.

The second screen instructs the player how to play the game.

The third screen gives the player a chance to actually play the game without inserting a coin! The screen displays *TRY CAPTURING THIS ATOM* and *MOVE THE TRAKBALL*.

The fourth screen displays the day's top score and the high-score table.

The fifth screen displays the word *QUANTUM*, the highest score, and previous game score(s) at the top of the screen. A simulated game is in the center of the screen. If the game has no credits, the words *IN-SERT COINS* appear. If the game has credit(s), a message instructs a player to press the appropriate start button. The Atari copyright message, number of lives, credits, and level of game play appear at the bottom of the screen.

When enough credit(s) is inserted for a 1- or 2-player game, the appropriate 1- or 2-player LED flashes. When the player presses the flashing LED start button, the Select Mode begins.

#### 2. Select Mode

This mode begins when an LED start button is pressed. The player has 30 seconds to select the starting level. He can start a game at an advanced level of play and receive bonus points for starting play at that level. The starting levels appear at the bottom of the screen. The player chooses the starting level by circling it, using the Midi Trak-Ball<sup>TM</sup>.

#### 3. Play Mode

The Play Mode begins when the Select Mode ends and ends when the player's last comet is destroyed. The player's score(s) and highest score are displayed at the top of the screen. The number of remaining comets and the level of play are displayed at the bottom of the screen.

In the first level of play, various particles appear on the screen. When a player captures a particle, it explodes and its point value appears on the screen. Some particles, such as electrons, change into positrons and are worth extra points if captured. If a player captures more than one particle at a time, he earns double points. The first level of play ends when the player captures all of the nuclei.

Game play becomes more difficult as the game progresses. Particles are closer together and move faster. More particles appear on the screen at one time. Nuclei may appear tied together by a rope-like bond. Players may capture one or both nuclei in a bond. The player's comet may cross over the bond until it changes to red. If the comet tries to cross over a red bond, the comet is destroyed.

During a later wave, pulsars appear. The pulsar travels toward the comet and pulses its arms in and out as it moves. The player's comet is destroyed if it comes in contact with any part of the pulsar. Splitters also appear in a later wave. A splitter multiplies if it is not destroyed.

The comet is destroyed when it hits a particle or the red bond between nuclei. The game ends when all of the player's comets are destroyed.

Table 1-2 lists Quantum particles and their point values.

#### 4. High-Score Mode

The High-Score Mode begins when a player has earned one of the eleven highest scores.

If a player has earned the highest score, a special option allows him to sign his name using the Midi Trak-Ball<sup>™</sup>, as well as enter his initials into the high-score table.

Characters of the alphabet appear on the screen. The player rotates the Midi Trak-Ball<sup>™</sup> to locate his initial. He circles his initials and they appear in the center of the screen. Then the initials and score are transfered into the high-score table.

To reset the high-score table, refer to Chapter 2.

#### 5. Hints for Game Play

- Circle two or more objects for double points.
- Capture all the nuclei to advance to the next wave.
- Move the Midi Trak-Ball<sup>™</sup> quickly to keep the comet's tail from disintegrating and to produce a longer tail.
- Avoid deadly red bonds between nuclei.

Pa	rticle	cle Description	
Electron	•	Rotates slowly around Nucleus.	20
Triphon	Ô	Moves slowly and flashes colors. Leaves Tryd in its trail.	100
Splitter	永	Travels in a random pattern. Flashes color, splits into 3, and splits into 3 again.	100
Photon	$\bigtriangleup$	Enters from the edge of the screen, spins across the screen, and exits from the other side.	200
Positron	╊	Made of stray electrons after a nucleus explodes. Moves to the edge of the screen rapidly.	200
Tryd	$\diamond$	Slowly shrinks away and disappears.	300
Nucleus	•	Moves slowly and bounces off screen edge. Cuts off the end of a comet's tail when the nucleus crosses over tail.	300
Pulsar	$\frown$	Pulses as it travels toward comet.	400

#### Table 1-2 Quantum Scoring

## **Self-Test Procedure**





This game will test itself and provide data to show that the game's circuitry and controls are operating properly. The data is provided on the video display and speaker. No additional equipment is necessary.

We suggest you perform the self-test procedure when you first set up the game, any time you collect money from the game, when you change game options, or when you suspect game failure.





## A. Comments on Troubleshooting

When troubleshooting, first determine the symptom(s) of the failure. After determining the symptom, look over the wiring diagram and determine what assemblies could cause the failure. Could it be caused by the power supply, Regulator/Audio II printed-circuit board (PCB), or the video display?

The next step is to check all harness wires and connectors to the suspected assembly. If you do not find a harness or connector problem, substitute an assembly known to be good for the suspected failing assembly. If the game functions properly, you have successfully isolated the failure. If it doesn't, repeat the procedure with another assembly.

When you have isolated the failing assembly, you must troubleshoot that assembly and make the necessary repairs. If the video display fails, we suggest that a qualified video-display technician handle the troubleshooting and repair.

Be sure to refer to *The Book—A Guide to Electronic Game Operation and Servicing*, published by Atari, Inc., whenever you need help with the techniques, tools, and terminology associated with coin-operated electronic games.

To effectively troubleshoot a game PCB, learn as much as you can about the PCB. The diagrams in the *Schematic Package* (included with the game) show the functions of the circuitry. Again, while troubleshooting a PCB, first determine the symptom of the failure, then locate the suspected area on the schematic diagram.

# B. Performing the Self-Test

Please see CO-221-01, supplement to TM-221, for information on this section.

# Maintenance and Repair

This chapter details maintenance and repair information. Step-by step procedures show you how to disassemble, repair, or replace major assemblies in the game. For parts information, refer to Chapter 4.







### Figure 3-1 Fluorescent Tube and Speaker

## A. Replacing the Fluorescent Tube



- 1A. Remove the three sets of hardware that secure the upper attraction-panel retainer to the cabinet (see *Figure 3-1*). Loosen the three sets of hardware that secure the lower retainer to the cabinet.
- 2A. Lift the attraction panel out of its lower retainer.
- 3A. Remove the cardboard locking tab at each end of the tube. Slightly rotate the tube up or down and carefully remove it from the tube holders.
- 4A. Replace with a new tube. Do not snap the tube in vigorously—you may break it, causing an implosion! Replace the locking tabs.
- 5A. Check that the green ground wire is securely attached to the large metal bracket and the ballast transformer on the board. If the tube is not grounded, it may not start. Reassemble in reverse order.

# B. Replacing the Speakers

- 1 B. **Upper speaker (located above the video display).** Follow steps 1A and 2A for replacing the fluorescent tube (see *Figure 3-1*). Remove the hardware that secures the tube and speaker board to the cabinet.
- 2B.Slide the tube and speaker board partially out of the cabinet. Turn it sideways to unplug the 5-pin harness connector. Remove the board from the cabinet.
- 3B.Unplug the two plug-in connectors on the speaker. (Note that the white wire (+) connects on the side marked with a painted dot.) Remove the hardware that attaches the speaker to the board. Replace the speaker and reinstall the tube and speaker board in reverse order.
- 4B.Lower speaker (located below the control panel—not shown). Open the rear access panel. Unplug the two plug-in connectors on the speaker. (Note that the white wire (+) connects on the side marked with a painted dot.) Remove the hardware that attaches the speaker to the cabinet. Replace the speaker and reassemble in reverse order.



#### Quantum



#### 

The following procedure should only be performed by a *qualified service technician.* Before removing or repairing the video display, **unplug the game.** 

High voltages may exist in any video display, even with power disconnected. Use extreme caution and do not touch electrical parts of the display yoke area with your hands or with metal objects in your hands!

**Discharge the high-voltage** from the cathode ray tube as follows: Attach one end of a large, well-insulated, 20-kV jumper to ground. Momentarily touch the free end of the grounded jumper to the anode by sliding it under the anode cap. Wait two minutes and discharge the anode again.

#### **IMPLOSION HAZARD**

If you drop the display and the picture tube breaks, *it will implode!* Shattered glass and the yoke can fly six feet or more from the implosion. Use care when replacing any display.

Your game has either an Amplifone or a Wells-Gardner 19-Inch Color X-Y cathode ray tube (CRT). Use the following procedures to remove and reinstall your CRT. Refer to Figures 4-3 and 4-4 for parts information.

The **Amplifone Color X-Y Display** consists of the following three assemblies:

- 19-inch Amplifone cathode-ray tube (CRT)
- Deflection printed-circuit board (PCB) calibrated to match the CRT
- High-Voltage PCB (To adjust FOCUS and BRIGHTNESS, refer to TM-194, the Amplifone 19-Inch Color X-Y Display manual.)

#### **Removing the Amplifone CRT:**

- 1. Open the rear access panel. Disconnect the 15-pin harness connector wired to the Deflection PCB (see *Figure 3-2C*).
- 2. Discharge the high-voltage from the CRT (refer to the preceding **WARNING** for this procedure).
- 3. Carefully disconnect the high-voltage anode connector from the CRT (see Figure 3-2A).

- 4. Unplug the socket from the rear of the CRT.
- 5. Unplug the degaussing coil 2-pin connector from the Deflection PCB.
- 6. Unplug the 5-pin connector from the Deflection PCB.
- 7. Unplug the 2-pin connector to the DAG spring that goes across the back of the CRT.
- 8. From the front of the game, open the control panel (see Figure 3-4).
- 9. Securely grasp the metal retainer that supports the display shield (see *Figure 3-2A*). Remove the retainer and shield by sliding them down and out of the cabinet.
- 10. Remove the cardboard bezel.
- 11. Remove the four sets of hardware that secure the CRT to the wood frame.
- 12. Carefully remove the CRT out through the front of the cabinet. Place it on a soft mat in a protected location.
- 13. To install an Amplifone CRT, reverse the order of this procedure.

#### Removing the Amplifone High-Voltage PCB:

- 1. Discharge the high-voltage from the CRT (refer to the preceding **WARNING** for this procedure).
- 2. Carefully disconnect the high-voltage anode connector from the CRT (see Figure 3-2B).
- 3. Unplug the socket from the rear of the CRT.
- 4. Unplug 9-pin connector P109 from the Deflection PCB.
- 5. Unplug the 2-pin connector from the DAG spring.
- 6. Remove the hardware that secures the High-Voltage PCB and two harnesses to the game cabinet.
- 7. Slide the High-Voltage PCB from the wood retainers.
- 8. To install a High-Voltage PCB, reverse the order of this procedure.

#### **Removing the Amplifone Deflection PCB:**

- 1. Unplug the four connectors from the Deflection PCB (see *Figure 3-2C).*
- 2. Remove the hardware that secures the Deflection PCB to the game cabinet.
- 3. Slide the Deflection PCB from the wood retainers.
- 4. To install the Deflection PCB, reverse the order of this procedure.

#### Wells-Gardner Video Display:



#### Removing the Wells-Gardner Color X-Y Display:

- 1. Open the rear access panel and unplug the interconnect harness from the main harness. Remove the hardware that secures the display chassis to the metal bracket (see *Figure 3-3*).
- 2. Open the control panel (see Figure 3-4).
- 3. Securely grasp the metal retainer that supports the display shield. Remove the retainer and shield by sliding them out and down from the cabinet.
- 4. Remove the cardboard bezel.
- 5. Remove the four sets of hardware that secure the display chassis to the wood frame.
- Carefully remove the video display through the front of the cabinet. Place it on a soft mat in a protected location.
- 7. To install the display, reverse the order of this procedure.



Figure 3-3 Wells-Gardner Video Display

## **D.** Control Panel

#### **Opening the Control Panel:**

- 1. Unlock and open the coin door (see Figure 3-4).
- 2. Reach up through the opening to the sides of the control panel and release the spring-drawn latches.
- 3. Lift the control panel at the top edge and tilt it toward you.
- 4. Make sure the foam tape on the lower edge of the display shield is in good condition. This tape prevents liquids from entering the interior of the cabinet.



Figure 3-4 Opening the Control Panel



#### Testing the LED Start Switch\*:

These switches have a very low failure rate. If you suspect switch failure, test it using the following directions:

- 1. Disconnect the wires from the switch.
- 2. Zero an ohmmeter. Set the ohmmeter switch range at x10. Attach the leads of the ohmmeter to the normally open and common contacts (refer to *Figure 3-5*).
- 3. Check the contacts for closed and open continuity. Close the switch and the ohmmeter

\*Not illustrated

should read zero. Release the switch and the ohmmeter should read infinity.

4. If the contacts do not operate sharply or always remain closed or open, replace the switch.

#### **Replacing the LED Start Switch:**

- 1. Disconnect the wires from the switch.
- 2. Turn the switch counterclockwise while holding the black cone-shaped switch bezel on the outside of the control panel (See *Figure 3-5*).
- 3. Install a new switch using the reverse procedure.
- 4. Reconnect the wires as shown in Figure 3-5.





E. Midi Trak-Ball™

Circled numbers match numbered instructions. Disassemble in the order indicated.



Figure 3-6 Midi Trak-Ball™





#### Lubricating the Midi Trak-Ball<sup>™</sup> Assembly:

- 1. Remove the entire Midi Trak-Ball<sup>™</sup> assembly from the control panel (see *Figure 3-5*). Remove the six screws that secure the upper and lower frames together (see *Figure 3-6*).
- 2. Lift off the upper frame.
- 3. Lubricate each of the six ball bearings with two drops of a light-duty oil, such as 3-in-One oil. Lubricate the bearings approximately every three months or 6,000 credits (credits are counted on the coin counter).

## Removing the Midi Trak-Ball<sup>™</sup>, Coupler PCB, and Encoding Wheel:

- Perform steps 1 and 2. Remove the Midi Trak-Ball<sup>™</sup>.
- 5. Lift the Coupler PCB out of its slot. Carefully disconnect the red connector and remove the PCB.

- 6. Remove the screw, flat washer, and split-lock washer that secure the encoding wheel.
- 7. Remove the encoding wheel. Reassemble and reinstall in reverse order.

#### – NOTE –

When you replace the Coupler PCB, make sure that the metal encoding wheel is not bent or damaged. It should turn freely between the two halves of the optical coupler.

#### Adjusting the Midi Trak-Ball<sup>™</sup> control:

- 8. When you tighten the encoding wheel, rotate the socket-head screw on the end of the roller shaft until a hole in the shaft is visible through the hole in the upper frame.
- 9. Insert a %-inch diameter pin or screwdriver through the hole in the shaft.
- 10. Tighten the socket-head screw with an Allen wrench.



Figure 3-6 Midi Trak-Ball<sup>™</sup>, continued

## F. Game and Regulator/Audio II Printed-Circuit Boards







#### **Removing the Game Printed-Circuit Board:**

- 1. Open the rear access panel.
- 2. The game printed-circuit board (PCB) is located inside the electromagnetic interference (EMI) cage (see *Figure 3-7)*. Unplug the harness connector on the EMI Shield PCB.
- 3. To remove the game PCB, pull the eight nylon snap-in fasteners on the EMI Shield PCB to the unlocked position.
- 4. Carefully slide the Shield PCB and the attached game PCB straight out of the guide. Be careful not to twist the boards, as this may loosen connections or components. Replace or repair as required. Reinstall the game and Shield PCBs in reverse order.

### Removing the EMI Shield PCB from the Game PCB:

- 5. Remove the pan-head screws that connect the EMI Shield PCB to the spacers.
- 6. Push the EMI Shield PCB off the game PCB by applying pressure with your thumbs to the edge connector.

## Removing the Regulator/Audio Printed-Circuit Board:

- 7. Disconnect the five small harness connectors on this board (see Figure 3-7).
- Remove the hardware that secures the Regulator/Audio II PCB to the cabinet, and carefully remove the board from its retainers. Do not twist the board, as this may loosen connections or components. Replace or repair as required, and reinstall the PCB.

#### - CAUTION -

Make sure that the connectors on each PCB are properly plugged in. Note that they are keyed to fit only one way. If they do not slip on easily, do not force them. A reversed connector may damage your game and void the warranty.

- 9. Close and lock the rear access panel.
- 10. **Important:** Perform the self-test after repairing or replacing a printed-circuit board.

## G. Power Supply Fuses



Before replacing any fuse, turn the game off.

Fuse cover must be in place during game operation.

The power supply in this game contains six fuses. The fuse at location F1 protects the power supply. When you replace a fuse, use the identical type fuse with the same electrical rating (see *Figure 3-8*).

Refer to the color X-Y display manual for display fuse information.



Fuse cover not shown.

Figure 3-8 Power Supply Fuses

## **Illustrated Parts Lists**

This chapter provides information you need to order parts for your game. Common hardware (screws, nuts, washers, etc.) has been deleted from most of the parts lists. However, there is a parts list for the hardware needed to mount the game and Regulator/Audio II PCBs to the cabinet.

The PCB parts lists are arranged in alphabetical order by component. Each component subsection is arranged alphanumerically by reference designator.

Other parts lists are arranged alphanumerically by Atari part number. In these parts lists, all A-prefix numbers come first. Following these are numbers in sequence evaluated up to the hyphen, namely 00through 99-, then 0005980- through approximately 201000-.

When ordering parts, please give the part number, part name, number of this manual, and serial number of your game. This will aid in filling your order rapidly and correctly. We hope the results will be less downtime and more profit from your game.

Atari Customer Service numbers are listed on the inside front cover of this manual.







Figure 4-1 Cabinet-Mounted Assemblies A039519-01 A

#### Cabinet-Mounted Assemblies Parts List

Part No.	Description
A037453-03	Strain-Relief Power Cord (U.S. and Canada)
A037455-03	Strain-Relief Power Cord (Australia and New Zealand)
A037470-01	Power On/Off Switch Mounting Plate Assembly
A037701-02	Electromagnetic Interference (EMI) Cage Assembly
A037784-03	Strain-Relief Power Cord (United Kingdom, Ireland, Lebanon, Saudi Arabia, India, Hong Kong, Singapore, Egypt, Nigeria, Republic of South Africa, Zimbabwe)
A038588-01	Power Harness Assembly
A038881-01	Lock Assembly (for rear access panel) Acceptable substitute is part no. A038881-03
A039518-01	Cabinet Assembly (includes glides and PCB retainers, but not the rear access panel)
A039551-01	Main Harness Assembly
A039579-01	EMI Shield PCB Assembly
A200000-01	Amplifone 19-Inch Color X-Y Display Kit Assembly Acceptable substitute is 19-Inch Wells- Gardner Display part no. A038590-01.
	The following five items are the technical information supplements to this game:
CO-221-01	Supplement to TM-221
SP-221	Quantum Schematic Package
ST-221-01	Quantum Label with Self-Test Procedure and Option Switch Settings
TM-194	Service Manual for 19-Inch Amplifone Color X-Y Display (use with part no. A200000-01) Acceptable substitute is TM-183, for use with part no. A038590-01
TM-221	Quantum Operation, Maintenance, and Service Manual
78-3201	Adjustable Glide
009992-01	On/Off Switch Cover
037308-01	Speaker Grille
037332-01	Ventilation Grille
037419-02	Rear Access Panel (does not include lock)
038091-01	Molded Coin Box (not shown)
038870-01	Coin Box Enclosure
039521-01	Video Display Shield
178013-001	Spring Draw Latch (not shown)
178034-024	34-Inch Black Plastic T-Molding
178048-001	2-Inch Rigid Caster

## **B.** Fluorescent Tube and **Speaker Assembly**



#### Fluorescent Tube and Speaker Assembly Parts List

Part No.	Description
A037457-01	Tube and Speaker Harness Assembly
A037540-01	Ground Wire with Ring Lug
70-304	18-Inch, 15-Watt, Cool White Fluorescent Tube
78-6900404	Vinyl Foam Single-Coated Adhesive Tape, ¼-Inch Wide x ¼ Inch Thick (48 inches required)
79-561816P	Spring-Connector Wire Nut for 16- to 18-Gauge Wires
99-11003	Fluorescent Tube Starter
99-11006	Fluorescent Tube Locking Tab <i>(consists of two pieces)</i>
99-11009	Starter Socket
037304-01	Lower Attraction Panel Retainer
037309-01	Upper Attraction Panel Retainer
037469-01	Steel Tube Bracket
038151-01	15-Inch Jumper Wire
039525-01	Attraction Panel with Graphics
142028-001	60 Hz, 118 V, Ballast Transformer <i>(used on A038161-01 assembly)</i>
142028-002	50 Hz, 118 V, Ballast Transformer <i>(used on A038161-02 assembly)</i>
148001-017	6 x 9-Inch Oval, 8 Ω, 6-Ounce, Shielded High-Fidelity Speaker
179035-001	2-Pin Fluorescent Tube holder

## C. Video Display Assemblies

NOTE Amplifone CRT (A201001-01) and Deflection PCB (A201014-01) are shipped as a matched, calibrated pair and should be used as such.



Figure 4-3 Amplifone Video Display Assembly A200000-01 B



#### Figure 4-3 Amplifone Video Display Assembly, continued A200000-01 B Parts List

Part No.	Description
A201001-01 A201012-01	19-Inch Amplifone Color X-Y CRT
A201012-01	High-Voltage PCB Deflection PCB
034536-01	Foam Pad (used with Deflection and High Voltage PCBs)
038184-01	Static Shield
039521-01	Display Shield
039523-01	Display Shield Retainer
039530-01	Display Bezel



#### Figure 4-4 Wells-Gardner Video Display Assembly A038590-01 A Parts List

Part No.	Description
A038593-01	Wells-Gardner Interconnect Harness Assembly
92-053	19-Inch Wells-Gardner Color X-Y Video Display
039521-01	Display Shield
039530-01	Display Bezel
039523-01	Display Shield Retainer
039531-01	Metal Support Bracket

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#### Figure 4-5 Control Panel Assembly A039514-01 A Parts List

Part No.	Description	
A038038-01	Midi Trak-Ball™ Assembly	
A039512-01	Control Panel with Decal	
A039513-01	Control Panel	
A039552-01	Control Panel Harness Assembly	
039511-04	Control Panel Decal (not shown)	
62-039	SPDT Momentary Pushbutton Start Switch with Red Light-Emitting Diode	
75-941S	#10-24 Self-Locking Nut	
75-5148B	#10-24 Black Carriage Bolt	
036895-01	Black Molded Switch Bezel	



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### Midi-Trak-Ball™ Assembly Parts List

Part No.	Description	
A035220-02	Coupler PCB Assembly (includes Radial Optical Coupler)	
A036096-01	Harness Assembly	
72-8406	#4-40 x %-Inch, Hex Socket-Head Steel Machine Screw	
75-014S	#4 Flat SAE-Standard, Zinc-Plated Steel Washer	
75-044S	#4 Split-Lock, Zinc-Plated Steel Washer	
034168-01	Label with Lubrication Instructions (not shown)	
035937-01	Ball Bearing (6 per assembly)	
035938-01	Etched Encoding Wheel	
038039-01	Upper Black Plastic Frame	
38040-01	Lower Black Plastic Frame	
38041-01	Boller Shaft	
38042-01	Idler Shaft	
038043-01	Midi-Trak-Ball (3-inch diameter)	
39002-001	Radial Optical Coupler (located on the Coupler PCB Assembly)	
76010-106	#8 x %-Inch Cross-Recessed, Pan-Head, Zinc-Plated Steel Screw	
107013-001	3-In-One Oil lubricant	

# F. Utility Panel Assembly

#### NOTE -

Only the Ireland-Built cabinet has two coin counters.



### Figure 4-7 Utility Panel Assembly A038002-01 & -02 F Parts List

Part No.	Description	
A002465-01 A038004-01 19-9032 62-041	6 V Coin Counter Utility Panel Harness Volume Control SPDT Momentary-Contact Pushbutton Auxiliary Coin Switch with Black Cap	
69-001 038003-01 178070-001	DPDT Self-Test Switch Utility Panel Volume Control Knob	

## G. Coin Door Assemblies







171034-001 — U.S. 25¢/25¢ Coin Door 171034-003 — Canadian 25¢/25¢ Coin Door 171034-005 — U.K. 10 P/50 P Coin Door

171034-006 — U.K. 20 P/50 P Coin Door 171034-009 — German 2 M/1 M Coin Door 171034-010 — German 2 M/5 M Coin Door

171034-011 — German 1 M/5 M Coin Door 171034-015 — French 2 F/1 F Coin Door



### Vertically Mounted Coin Door Assembly Parts List

Part No.	Description	
A037542-01 72-1414S 75-056 75-914S	Harness Assembly #4-40 × ¼-Inch Cross-Recessed Pan-Head Steel Machine Screw #6 Internal-Tooth Zinc-Plated Steel Lock Washer #4-40 Steel Machine Hex Nut	
75-3414S 99-15001 99-15002 99-15003	#4-40 × %-Inch 82° Cross-Recessed Flat-Head Steel Machine Screw Coin Return Button with U.S. 25¢ Price Plate Coin Return Button with U.S. \$1 Price Plate Coin Return Button with German 1 DM Price Plate	
99-15004 99-15005 99-15006 99-15007	Coin Return Button with German 2 DM Price Plate Coin Return Button with German 5 DM Price Plate Coin Return Button with Belgian 5 Fr Price Plate Coin Return Button with French 1 Fr Price Plate	
99-15008 99-15009 99-15010 99-15011	Coin Return Button with Japanese 100 Yen Price Plate Coin Return Button with British 10 Pence Price Plate Coin Return Button with Australian 20¢ Price Plate Coin Return Button with Italian 100 Lire Price Plate	
99-15023 99-15025 99-15026 99-15027	Base Plate Left Half of Coin Inlet Right Half of Coin Inlet Side Plate of Coin Return Box	
99-15028 99-15029 99-15036 99-15038	Base Plate of Coin Return Box Switch Bracket Metal Coin Return Cover Bezel for Coin Return Button	
99-15039 99-15040 99-15042 99-15052	Metal Bezel for Coin Return Cover Coin Return Lever Coin Switch for U.S. 25¢ Spring for Coin Return Button	
99-15054 99-15055 99-15056 99-15060	Pivot for Coin Return Lever Retaining Screw #4-40 $\times \frac{5}{6}$ -Inch Cross-Recessed Pan-Head Steel Machine Screw Switch Cover	
99-15063 99-15066 99-15067 99-15070	Screw for Hinge Screw for Clamp Lock Assembly Doors and Frame	
99-15071 99-15072 99-15073 99-15074	Clamp for Frame Door Frame Upper Door Lower Door	
99-15075 038091-01 170000-001 171006-035 179047-001	Switch Adjuster Coin Box (Not included in assembly) Acceptable substitute is part number A037491-01 6.3 V Miniature Wedge-Base Incandescent Lamp Metal Coin Mechanism Lamp Base	







Figure 4-9 American-Made Coin Door Assembly, continued 171027-001 A

### American-Made Coin Door Assembly Parts List

Part No.	Description
171006-035	Metal Coin Mechanism for U.S. \$.25
65-441C	Coin Switch
70-11-47	Miniature Bayonet Lamp
72-9406S	#4-40 x %-Inch Truss-Head Screw
72-HA1404C	#4-40 x 1/4-Inch Pan-Head Screw
72-JA1405B	#4-40 x .31-Inch Pan-Head Screw
75-1412S	#4-40 x <sup>3</sup> / <sub>4</sub> -Inch Pan-Head Screw
75-994S	#4-40 Lock Nut
99-10008	Retainer
99-10042	Coin Switch Assembly for Belgium 5 Fr and U.S. \$.25
<del>99</del> -10043	Coin Switch Assembly for German 1 DM, Japanese 100 Yen, Swiss 1 Fr
99-10044	Coin Switch Assembly for German 2 DM, Italian 100 L, U.S. \$1.00
99-10045	Coin Switch Assembly for Australian \$.20, German 5 DM, British 10 P
99-10068	Coin Return Chute
99-10075	Switch wire (included in coin switch assembly) Switch wire (included in coin switch assembly)
99-10076	
99-10077	Switch wire (included in coin switch assembly)
99-10078	Switch wire (included in coin switch assembly)
99-10080	Lamp socket
99-10081	Key holder
99-10096	Fastener
99-10104	Bar retainer
99-10105	Bar
99-10115	Spring
99-10116	Plastic Coin Return Lever
99-10117	Steel Coin Return Door
99-10118	Amber Coin Return Button
99-10119	Amber Coin Button for U.S. \$.25
99-10134	Coin Button Cover
99-10139	Coin Door
99-10140	Coin Door Inner-Panel Assembly Diecast Coin Return Cover
99-10141	Diecast Com Return Cover
99-10142	Diecast Button Housing
99-10143	Coin Door Frame
99-10144	Coin Door Channel Clip
99-10145	Offset Cam (includes 99-10148—Lock)
99-10146	Coin Inlet Chute Assembly
99-10147	American-Made Coin Door Harness
99-10149	Service Door
99-10150	Switch Cover
99-10151	Left Coin Inlet
99-10152	Right Coin Inlet
99-10153	Coin Return Box
99-10154	Bracket Assembly

# H. Printed-Circuit Boards



Figure 4-10 Electromagnetic Interference (EMI) Cage Assembly and Printed-Circuit Board Mounting Hardware



### Figure 4-10 Electromagnetic Interference (EMI) Cage Assembly and Printed-Circuit Board Mounting Hardware, continued Parts List

Part No.	Description	
A037701-02	EMI Cage (includes guide)	
A037430-03	EMI Shield PCB	
72-1404F	#4-40 x 1/4-Inch Cross-Recessed Steel Screw	
72-1604F	#6-32 x 1/4-Inch Cross-Recessed Steel Screw	
037873-01	Spacer	
175009-221	Plastic Washer	
176015-110	#10 x %-Inch Cross-Recessed Pan-Head Screw	
178045-442	Snap-In Fastener	
034536-02	Foam Pad (not shown)	
175004-708	#8 Flat Fiber Washer	

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Figure 4-12 Quantum Game Printed Circuit Board Assembly A039297-21 A

Designator	Description	Part No.
	Capacitors	
C2, C3	0.1 µF, +80, -20%, 50 V, Ceramic Capacitor	122002-104
C4	0.01 µF, 100 V, Radial-Lead Mylar Capacitor	21-101103
C8	0.047 µF, ± 10%, 50 V, Axial-Lead Polycarbon Capacitor	122010-473
C9-C11	0.1 µF, +80, -20%, 50 V, Ceramic Capacitor	122002-104
C12	39 pF, $\pm 5\%$ , 100 V, Axial-Lead Ceramic Capacitor	128002-390
C14-C20	0.1 µF, +80, -20%, 50 V, Ceramic Capacitor	122002-104
C21	0.0018 $\mu$ F, $\pm$ 10%, 1 kV, Ceramic Capacitor	27-102182
C25	0.047 $\mu$ F, ± 10%, 50 V, Axial-Lead Polycarbon Capacitor	122010-473
C26-C28	0.1 µF, +80, -20%, 50 V, Ceramic Capacitor	122002-104
C29	39 pF, ±5%, 100 V, Axial-Lead Ceramic Capacitor	128002-390
C31	0.1 µF, +80, -20%, 50 V, Ceramic Capacitor	122002-104
C32	100 pF, $\pm$ 5%, 100 V, AxIal-Lead Ceramic Capacitor	122016-101
C33-C36	0.1 µF, +80, -20%, 50 V, Ceramic Capacitor	122002-104
C37	150 pF, ±5%, 100 V, Axial-Lead Ceramic Capacitor	122016-151
C38	39 pF, ±5%, 100 V, Axial-Lead Ceramic Capacitor	128002-390
C39, C40	0.1 µF, +80, -20%, 50 V, Ceramic Capacitor	122002-104
C41	0.01 $\mu$ F, + 80, -20%, 25 V, Axial-Lead Ceramic Capacitor	122005-103
C42	10 pF, ±5%, 100 V, Axial-Lead Ceramic Capacitor	122016-100
C44	100 µF 35 V Aluminum Electrolytic Axial-Lead Capacitor	24-350107
C45	22 $\mu$ F 25 V Aluminum Electrolytic Axial-Lead Capacitor	24-250226
C46	100 µF 35 V Aluminum Electrolytic Axial-Lead Capacitor	24-350107
C47	22 µF 35 V Aluminum Electrolytic Axial-Lead Capacitor	24-350226
C48	22 µF 25 V Aluminum Electrolytic Axial-Lead Capacitor	24-250226
C49	0.1 µF, +80, -20%, 50 V, Ceramic Capacitor	122002-104
C51	1000 pF, ±5%, 100 V, Axial-Lead Ceramic Capacitor	122016-102
C52-C60	1.0 $\mu$ F 50 V Aluminum Electrolytic Axial-Lead Capacitor	24-500105
C61	1000 pF, $\pm$ 5%, 100 V, Axial-Lead Ceramic Capacitor	122016-102
C62	1.0 µF 50 V Aluminum Electrolytic Axial-Lead Capacitor	24-500105
C63	2220 pF, ±5%, 100 V, Axial-Lead Ceramic Capacitor	122016-221
C64, C65	0.1 µF, +80, -20%, 50 V, Ceramic Capacitor	122002-104
C67-C73	0.1 µF, +80, -20%, 50 V, Ceramic Capacitor	122002-104
C74	1.0 µF 50 V Aluminum Electrolytic Axial-Lead Capacitor	24-500105
C75	0.1 µF, +80, -20%, 50 V, Ceramic Capacitor	122002-104
C76	100 pF, $\pm$ 5%, 100 V, Axial-Lead Ceramic Capacitor	122016-101
C77	39 pF, $\pm$ 5%, 100 V, Axial-Lead Ceramic Capacitor	128002-390
C78, C79	0.1 $\mu$ F, +80, -20, %50 V, Ceramic Capacitor	122002-104
C80	0.022 µF, 100 V, Radial-Lead Mylar Capacitor	21-101223
C81	0.1 µF, +80, -20,%50 V, Ceramic Capacitor	122002-104
C82	100 µF 25 V Aluminum Electrolytic Axial-Lead Capacitor	24-250107
C83-C90	0.01 µF, +80, -20%, 25 V, Axial-Lead Ceramic Capacitor	122005-103
C91-C129	0.1 µF, +80, -20%, 50 V, Ceramic Capacitor	122002-104

Designator	Description	Part No.
	Diodes	
CR1	Type-1N914, 250 mW, 100 V Switching Diode	31-1N914
CR3, CR4	Type-1N100, 20 mA, 80 V Diode	31-1N100
CR5	Type-1N754A, 400 mW, 6.8 V Zener Diode	131002-001
R6	Type-1N100, 20 mA, 80 V Diode	31-1N100
R7	Type-MV5053 Light-Emitting Diode	38-MV5053
	Inductors	
1	100 $\mu$ H, ± 10% Inductor	141002-001
2–4	1 $\mu$ H, 1/2 W Inductor	141007-001
	Integrated Circuits	
R1	Voltage Regulator Integrated Circuit	37-7815
R2	Voltage Regulator Integrated Circuit	37-7915
3	Programmable Array Logic Integrated Circuit	137290-001
)	Type-74LS138 Integrated Circuit	137177-001
E, 1F	Type-74LS244 Integrated Circuit	37-74LS244
(/L	Type-MC68000LC Integrated Circuit	137289-001
l	Type-74LS245 Integrated Circuit	37-74LS245
,	Type-74LS245 Integrated Circuit	37-74LS245
3B, 2/3D	Audio I/O N-Channel MOS/LSI Custom Integrated Circuit	C012294-01
	Type-74LS245 Integrated Circuit	37-74LS245
2	Type-74LS74 Integrated Circuit	37-74LS74
N .	Type-LM324 Integrated Circuit	37-LM324
	Type-LM324 Integrated Circuit	37-LM324
•	Type-74LS245 Integrated Circuit	37-74LS245
)/E	Type-74LS245 Integrated Circuit	37-74LS245
/F	Type-74LS245 Integrated Circuit	37-74LS245
7H	Type-74S04 Integrated Circuit	37-74LS04
ł/J	Type-74LS138 Integrated Circuit	137177-001
	Type-74LS02 Integrated Circuit	37-74LS02
	Type-74LS08 Integrated Circuit	37-74LS08
	Type-74LS74 Integrated Circuit	37-74LS74
1	Type-7406 Integrated Circuit	37-7406
l	Type-74S32 Integrated Circuit	37-74S32
1	Type-74LS00 Integrated Circuit	37-74LS00
-5C	Type-74LS393 Integrated Circuit	37-74LS393
-50	Type-74LS157 Integrated Circuit	37-74LS157
1	Type-74LS32 Integrated Circuit	37-74LS32
	Type-74LS174 Integrated Circuit	37-74LS174
	Type-74S74 Integrated Circuit	37-74874
, 5M	Type-74LS27 Integrated Circuit	37-74LS27
	Type-74LS161 Integrated Circuit Type-74LS273 Integrated Circuit	37-74LS161
		37-74LS273

Designator	Description	Part No.
_		
5P	Type-74LS74 Integrated Circuit	23 741 074
5 <b>R</b>	Type-74LS393 Integrated Circuit	37-74LS74
6B	Vector Generator Integrated Circuit	37-74LS393
3F	Type-74S00 Integrated Circuit	127179-001
	syperadoo integrated Circuit	37-74800
3J	Type-74LS42 Integrated Circuit	27 741 840
SK	Type-74LS109 Integrated Circuit	37-74LS42
SL.	Type-74LS14 Integrated Circuit	37-74LS109
6M	Type-74LS161 Integrated Circuit	37-74LS14 37-74LS161
iN		01-1420101
iP	Type-74S02 Integrated Circuit	37-74502
	Type-74S02 Integrated Circuit	37-74S02
R	Type-74LS161 Integrated Circuit	37-74LS161
A-7C	Type-74LS194 Integrated Circuit	37-74LS101
D	Type 741 S175 Integrated Circuit	0
Ē	Type-74LS175 Integrated Circuit	37-74LS175
F	Type-74LS157 Integrated Circuit	37-74LS157
H	Type-82S25 Integrated Circuit	90-7005
п	Type-74LS00 Integrated Circuit	37-74LS00
J	Type-74LS175 Integrated Circuit	
К	Type-74LS32 Integrated Circuit	37-74LS175
L	Type 745260 Integrated Circuit	37-74LS32
- M	Type-74S260 Integrated Circuit	37-74S260
11	Type-74LS161 Integrated Circuit	37-74LS161
N	Type-74LS164 Integrated Circuit	
P	Type-74S163 Integrated Circuit	37-74LS164
A-8C	Type-74LS194 Integrated Circuit	137274-001
D	Type-74LS273 Integrated Circuit	37-74LS194
	Type recorronnegrated circuit	37-74LS273
=	Type-74LS175 Integrated Circuit	27 741 6175
4	Type-74LS399 Integrated Circuit	37-74LS175
)	Type-74LS175 Integrated Circuit	37-74LS399
<	Type-74LS32 Integrated Circuit	37-74LS175
	spot alloca magnated on dat	37-74LS32
-	Type-74S02 Integrated Circuit	37-74S02
M, 8N	Type-74LS191 Integrated Circuit	37-74LS191
	Type-74S04 Integrated Circuit	37-74504
3	12-Bit DAC Integrated Circuit	137158-002
)	8-Bit DAC Integrated Classifi	
/H	8-Bit DAC Integrated Circuit	137159-001
711	12-Bit DAC Integrated Circuit	137158-002
	Type-74S260 Integrated Circuit	37-74\$260
ζ.	Type-74LS109 Integrated Circuit	37-74LS109
	Type-74LS175 Integrated Circuit	
1, 9N		37-74LS175
	Type-74LS244 Integrated Circuit	37-74LS244
A	Type-74LS191 Integrated Circuit	37-74LS191
	Type-TL082 Integrated Circuit	37-TL082CP
В	Quad Analog Switch Integrated Circuit	
D	Type-TL082 Integrated Circuit	37-13201
Ē	Ouad Analog Switch Interacted Of an	37-TL082CP
J	Quad Analog Switch Integrated Circuit	37-13201
,	Type-74LS04 Integrated Circuit	37-74LS04

Top       Summer ingget meterated Circuit       37.44         TOP       Type-74LS75 / Integrated Circuit       37.74         TOR       Type-74LS74 Integrated Circuit       37.74         TIB, 11C       Multiplier Integrated Circuit       37.74         TID/E       Type-74LS74 Integrated Circuit       37.74         TID/E       Type-7L082 Integrated Circuit       37.74         TID/E       Type-TL082 Integrated Circuit       37.74         T2B, 12C       Multiplier Integrated Circuit       37.74         T2D/E       Type-TL082 Integrated Circuit       37.71	art No.	Description	Designator
10N       Schmitt Trigger Integrated Circuit       37.42         10P       Type-74LS75 Integrated Circuit       37.74         10R       Type-74LS74 Integrated Circuit       37.74         11B, 11C       Multiplier Integrated Circuit       37.74         11D/E       Type-74LS75 Integrated Circuit       37.74         11D/E       Type-74LS76 Integrated Circuit       37.74         11D/E       Type-74LS76 Integrated Circuit       37.74         11D/E       Type-7L082 Integrated Circuit       37.74         12B, 12C       Muitiplier Integrated Circuit       37.74         12D/E       Type-7L082 Integrated Circuit       37.71         12D/E       Test Point Acceptable substitute is part no. 020670-01       13.430		Type-74LS86 Integrated Circuit	
IVP       Ivpe-74LS157 Integrated Circuit       37.74         IDR       Type-74LS74 Integrated Circuit       37.74         IIDE       Type-74LS74 Integrated Circuit       37.74         IIDE       Type-7L082 Integrated Circuit       37.74         IIDE       Type-TL082 Integrated Circuit       37.74         IIDE       Type-TL082 Integrated Circuit       37.74         I2B, 12C       Muitiplier Integrated Circuit       37.74         I2B, 12C       Muitiplier Integrated Circuit       37.74         I2D/E       Type-TL082 Integrated Circuit       37.74         I2M/N       Type-TL082 Integrated Circuit       37.74 <td< td=""><td>-74LS86</td><td>Schmitt Trigger Integrated Circuit</td><td>10N</td></td<>	-74LS86	Schmitt Trigger Integrated Circuit	10N
10H       Type74LS74 Integrated Circuit       37.74         11B, 11C       Multiplier Integrated Circuit       37.14         11D/E       Type7L082 Integrated Circuit       37.14         11D/E       Type7L082 Integrated Circuit       37.14         11D/E       Schmitt Trigger Integrated Circuit       37.14         11D/E       Type7L082 Integrated Circuit       37.14         12B, 12C       Multiplier Integrated Circuit       37.14         12D/E       Type7L082 Integrated Circuit       37.14         12D/F       Type7L082 Integrated Circuit       37.14         12D/F       Type7L082 Integrated Circuit       37.14         12D/F       Type7L082 Integrated Circuit       37.14         12M/N       Type7L082 Integrated Circuit       37.14         12D/F       Type7L082 Integrated Circuit       37.14         12D/F       Type7L082 Integrated Circuit       37.14         12D/F       Type7L082 Integrated Circuit       37.14         14	-4584B	Type-74LS157 Integrated Circuit	10P
11B, 11C       Multiplier Integrated Circuit       37-14         11D/E       Type-TL082 Integrated Circuit       37-14         12B, 12C       Multiplier Integrated Circuit       37-14         12B, 12C       Multiplier Integrated Circuit       37-14         12D/E       Type-TL082 Integrated Circuit       37-14         12D/E       Type-TL082 Integrated Circuit       37-14         12D/E       Type-TL082 Integrated Circuit       37-14         12M/N       Type-TL082 Integrated Circuit       37-14         12D/E       Type-TL082 Integrated Circuit       37-14         12D/E       Type-TL082 Integrated Circuit       37-14         14       12.096 MHz Crystal       37-14         15       8-Station Single-Throw Dual-Inline Package Bit Switch       66-111         16       B-Station Single-Throw Dual-Inline Package Bit Switch       66-111         17       Electrically Programmable Read-Only Memory       13601         18       B-Station Single-Throw Dual-Inline Package Bit Switch       66-111         19       Electrically Programmable Read-Only Memory       13601         19       Electrically Programmable Read-Only Memory       13601         19       Electrically Programmable Read-Only Memory       13601         19 <td>-74LS157</td> <td>Type-74LS74 Integrated Circuit</td> <td>10R</td>	-74LS157	Type-74LS74 Integrated Circuit	10R
11D/E       Type-TL082 Integrated Circuit       37-14         11P       Schmitt Trigger Integrated Circuit       37-14         12P       Schmitt Trigger Integrated Circuit       37-14         22P, 12C       Multiplier Integrated Circuit       37-14         22P, 12C       Multiplitintegrated Circuit	-74LS74	iypo recore integrated Gilcult	
Appendix Display Control (Construction)       3711         3745       3745         28, 12C       Multiplier Integrated Circuit       3745         20/E       Type-TL082 Integrated Circuit       3711         20/E       Type-TL082 Integrated Circuit       3711         20/F       Test Point       Acceptable Station Circuit       3711         21       12.006 MHz       Mitz       66111       14400         21       12.096 MHz       Fead-Only Memory       13601       14400         22       Electrically Programmable Read-Only Memory       13601       13601	1405	Multiplier Integrated Circuit	
12B, 12C       Dominit ingge integrated Circuit       37-45         12B, 12C       Multiplier integrated Circuit       37-14         12D/E       Type-TL082 Integrated Circuit       37-14         12D/E       Type-TL082 Integrated Circuit       37-14         12D/E       Mylon Snap-in Fastener       81-43         14       12.096 MHz Crystal       14400         15       8-Station Single-Throw Dual-Inline Package Bit Switch       66-118         12D96 MHz Crystal       14400         12D97 Mz Station Single-Throw Dual-Inline Package Bit Switch       66-118         12D97 Mz Station Single-Throw Dual-Inline Package Bit Switch       66-118         12D98 Mz Station Single-Throw Dual-Inline Package Bit Switch       13601         12D94 Mz Station Single-Throw Dual-Inline Package Bit Switch       13601         12D95 Mz Station Single-Throw Dual-Inline Package Bit Switch	TL082CP	Type-TL082 Integrated Circuit	
125, 120       Multiplier Integrated Circuit       37-14         12D/E       Type-TL082 Integrated Circuit       37-11         12M/N       Type-TL082 Integrated Circuit       37-11         Miscellaneous         Miscellaneous         Nylon Snap-in Fastener Test Point Acceptable substitute is part no. 020670-01       17905         1       12.096 MHz Crystal       14400         B       8-Station Single-Throw Dual-Inline Package Bit Switch       66-111         C/D       8-Station Single-Throw Dual-Inline Package Bit Switch       66-111         Programmable Read-Only Memory       13601         F       Electrically		Schmitt Trigger Integrated Circuit	
2D/E       Type-TL082 Integrated Circuit       37TL         Miscellaneous         Miscellaneous         Nylon Snap-in Fastener         Test Point Acceptable substitute is part no. 020670-01         11         Test Point Acceptable substitute is part no. 020670-01         B         B         B         B         Acceptable substitute is part no. 020670-01         11         Test Point Acceptable substitute is part no. 020670-01         B         Colspan="2">B         B         Colspan="2">B         Programmable Read-Only Memory         B         Colspan="2">Programmable Read-Only Memory         B         Programmable Read-Only Memory         B         E         Electrically Programmable Read-Only Memory         B         E         Electrically Programmable Read-Only Memory         E         Electrically Programmable Read-Only Memory		Multiplier Integrated Circuit	12B, 12C
Image: Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601 <td></td> <td>Type-TI 082 Integrated Circuit</td> <td>12D/E</td>		Type-TI 082 Integrated Circuit	12D/E
Miscellaneous         Miscellaneous         Nylon Snap-in Fastener Test Point Acceptable substitute is part no. 020670-01       81433         12.096 MHz Crystal       17900         B       8-Station Single-Throw Dual-Inline Package Bit Switch       66-114         C/D       8-Station Single-Throw Dual-Inline Package Bit Switch       66-114         Programmable Read-Only Memories         E         Electrically Programmable Read-Only Memory       13601         Liectrically Programmable Read-Only Memory       13601         Liectrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         H/J       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         H/J       Electrically Programmab	TL082CP	Type-TL082 Integrated Circuit	2M/N
Nylon Snap-In Fastener       81-43         Test Point       Acceptable substitute is part no. 020670-01       17905         12.096 MHz Crystal       14400         8-Station Single-Throw Dual-Inline Package Bit Switch       66-118         C/D       8-Station Single-Throw Dual-Inline Package Bit Switch       66-118         Programmable Read-Only Memories         Programmable Read-Only Memory       13601         Electrically Programmable Read-Only Memory       13601         K         Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         HJ       Electrically Programmable Read-Only Memory       13601         HJ       Electrically Programmable Read-Only Memory       13601         HJ       Electrically Programmable Read-Only Memory       13601	TL082CP		
Test Point Acceptable substitute is part no. 020670-01       11905         1       12.096 MHz Crystal       14400         B       8-Station Single-Throw Dual-Inline Package Bit Switch       66-118         CD       8-Station Single-Throw Dual-Inline Package Bit Switch       66-118         Programmable Read-Only Memories         E         Electrically Programmable Read-Only Memory       13601         H/J         Electrically Programmable Read-Only Memory       13601         H/J       Electrically Programmable Read-Only Memory       13601         H/J       Electrically Programmable Read-Only Memory       13601         K         Electrically Programmable Read-Only Memory       13601         H/J       Electrically Programmable Read-Only Memory       13601         K         Electrically Programmable Read-Only Memory       13601         F       Electrically Programmable Read-Only Memory       13601         Electrically Programmable Read-Only Memory       13601         Electrically Programmable Read-Only Memory       13601         F       Electrically Programmable Read-Only Memory       13601		Miscellaneous	
1       12.096 MHz Crystal       14400         B       8-Station Single-Throw Dual-Inline Package Bit Switch       66-112         C/D       8-Station Single-Throw Dual-Inline Package Bit Switch       66-112         Programmable Read-Only Memories         E         E       Electrically Programmable Read-Only Memory       13601         F       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         F       Electrically Programmable Read-Only Memory       13601         F       Electrically Programmable Read-Only Memory       13601         H/J       Electrically Programmable Read-Only Memory       13601         F       Electrically Programmable Read-Only Memory       13601         H/J       Electrically Program	4303	Nylon Snap-In Fastener	
Interpretendent       12,096 MH2 Crystal       14400         Bastation Single-Throw Dual-Inline Package Bit Switch       66-118         Bastation Single-Throw Dual-Inline Package Bit Switch       66-118         Programmable Read-Only Memory         Bastation Single-Throw Dual-Inline Package Bit Switch         Bastation Single-Throw Dual-Inline Package Bit Switch         Programmable Read-Only Memory         Bastation Single-Throw Dual-Inline Package Bit Switch         Bastation Single-Throw Dua		Test Point Acceptable substitute is part no 020670-01	
C/D       B-Station Single-Throw Dual-Inline Package Bit Switch       66-114         B-Station Single-Throw Dual-Inline Package Bit Switch <td></td> <td>12.096 MHz Crystal</td> <td></td>		12.096 MHz Crystal	
Action       8-Station Single-Throw Dual-Inline Package Bit Switch       66-118         Programmable Read-Only Memories       13601         PF       Electrically Programmable Read-Only Memory       13601         H/J       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         L       Electrically Programmable Read-Only Memory       13601         E       Electrically Programmable Read-Only Memory       13601         F       Electrically Programmable Read-Only Memory       13601         F       Electrically Programmable Read-Only Memory       13601         F       Electrically Programmable Read-Only Memory       13601         H/J       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         H/J       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         H/J       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         H       Programmable Read-Only Memory		8-Station Single-Throw Dual-Inline Package Bit Switch	
Programmable Read-Only Memories       13601         E       Electrically Programmable Read-Only Memory       13601         H/J       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         L       Electrically Programmable Read-Only Memory       13601         E       Electrically Programmable Read-Only Memory       13601         E       Electrically Programmable Read-Only Memory       13601         E       Electrically Programmable Read-Only Memory       13601         H/J       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         H/J       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         H       Programmable Read-Only Memory       136001         M       A		8-Station Single-Throw Dual-Inline Package Bit Switch	C/D
E Electrically Programmable Read-Only Memory 13601 F Electrically Programmable Read-Only Memory 13601 H/J Electrically Programmable Read-Only Memory 13601 K Electrically Programmable Read-Only Memory 13601 E Electrically Programmable Read-Only Memory 13601 F Electrically Programmable Read-Only Memory 13601 F Electrically Programmable Read-Only Memory 13601 F Electrically Programmable Read-Only Memory 13601 K Electrically Programmable Read-Only Memory 13601 H Programmable Read-Only Memory 137211 A andom-Access Memory 137211 A Random-Access Memory 137211 A Random-Access Memory 137211 A Random-Access Memory 137211 A Random-Access Memory 137211	118P It		
F       Electrically Programmable Read-Only Memory       13601         H/J       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         E       Electrically Programmable Read-Only Memory       13601         E       Electrically Programmable Read-Only Memory       13601         F       Electrically Programmable Read-Only Memory       13601         F       Electrically Programmable Read-Only Memory       13601         H/J       Electrically Programmable Read-Only Memory       13601         F       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         H/J       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         H       Programmable Read-Only Memory       13601         H       Programmable Read-Only Memory       13601         H       Programmable Read-Only Memory       137211 </td <td></td> <td>Programmable Read-Only Memories</td> <td></td>		Programmable Read-Only Memories	
F       Electrically Programmable Read-Only Memory       13601         H/J       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         L       Electrically Programmable Read-Only Memory       13601         E       Electrically Programmable Read-Only Memory       13601         F       Electrically Programmable Read-Only Memory       13601         F       Electrically Programmable Read-Only Memory       13601         F       Electrically Programmable Read-Only Memory       13601         H/J       Electrically Programmable Read-Only Memory       13601         F       Electrically Programmable Read-Only Memory       13601         H/J       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         H       Programmable Read-Only Memory       137211         R </td <td></td> <td>Electrically Programmable Read-Only Memory</td> <td>E</td>		Electrically Programmable Read-Only Memory	E
H/J       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         L       Electrically Programmable Read-Only Memory       13601         E       Electrically Programmable Read-Only Memory       13601         F       Electrically Programmable Read-Only Memory       13601         F       Electrically Programmable Read-Only Memory       13601         H/J       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         L       Electrically Programmable Read-Only Memory       13601         L       Electrically Programmable Read-Only Memory       13601         H       Programmable Read-Only Memory       137211         M, 3N       Random-Access Memory       137211         R       Rando		Electrically Programmable Read-Only Memory	F
N       Electrically Programmable Read-Only Memory       13601         L       Electrically Programmable Read-Only Memory       13601         E       Electrically Programmable Read-Only Memory       13601         F       Electrically Programmable Read-Only Memory       13601         F       Electrically Programmable Read-Only Memory       13601         H/J       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         H       Programmable Read-Only Memory       13601         H       Programmable Read-Only Memory       136001         K       Random-Access Memory       137211         N       Random-Access Memory       137211         N       Random-Access Memory       137211         O, 6E       Random-Acc	016-002	Electrically Programmable Read Only Memory	H/J
Licertically Programmable Read-Only Memory       13601         Electrically Programmable Read-Only Memory       13601         Electrically Programmable Read-Only Memory       13601         H/J       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         H       Programmable Read-Only Memory       137211         M, 3N       Random-Access Memory       137211         A       Random-Access Memory       137211         A       Random-Access Memory	016-003	Electrically Programmable Read-Only Memory	K
E       Electrically Programmable Read-Only Memory       13601         F       Electrically Programmable Read-Only Memory       13601         H/J       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         H       Programmable Read-Only Memory       137211         M, 3N       Random-Access Memory       137211         R       Random-Access Memory       137211	016-004	Electrically Programmable Read-Only Memory	
E       Electrically Programmable Read-Only Memory       13601         F       Electrically Programmable Read-Only Memory       13601         H/J       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         L       Electrically Programmable Read-Only Memory       13601         H       Programmable Read-Only Memory       13601         H       Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         H       Programmable Read-Only Memory       13601         H       Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         H       Programmable Read-Only Memory       136001         H       Programmable Read-Only Memory       136001         K       Electrically Programmable Read-Only Memory       13601         K       Random-Access Memory       137211         M, 3N       Random-Access Memory       137211         R       Random-Access Memory       137211         O, 6E       Random-Access Memory       137211	018-005	Electrically Programmable Read-Only Memory	
F       Electrically Programmable Read-Only Memory       13601         H/J       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         L       Electrically Programmable Read-Only Memory       13601         L       Electrically Programmable Read-Only Memory       13601         H       Programmable Read-Only Memory       13601         H       Programmable Read-Only Memory       13600         M       Random-Access Memory       137211         M, 3N       Random-Access Memory       137211         P, 5E       Random-Access Memory       137211         D, 6E       Random-Access Memory       137211	+	Electrically Programmable Read-Only Memory	
H/J       Electrically Programmable Read-Only Memory       13601         K       Electrically Programmable Read-Only Memory       13601         Electrically Programmable Read-Only Memory       13601         Electrically Programmable Read-Only Memory       13601         H       Programmable Read-Only Memory       13601         H       Programmable Read-Only Memory       13601         H       Programmable Read-Only Memory       13601         M, 2N       Random-Access Memory       137211         M, 3N       Random-Access Memory       137211         Random-Access Memory       137211       137211         A       Random-Access Memory		Electrically Programmable Read-Only Memory	
K       Electrically Programmable Read-Only Memory       13601         Electrically Programmable Read-Only Memory       13601         Programmable Read-Only Memory       13600         Random-Access Memory       13600         M, 2N       Random-Access Memory       137211         M, 3N       Random-Access Memory       137211         A, 3N       Random-Access Memory       137211         A, 5E       Random-Access Memory       137212         A, 6E       Random-Access Memory       137211	016-007	Electrically Programmable Read-Only Memory	⊣/J
L       Electrically Programmable Read-Only Memory       13601         H       Programmable Read-Only Memory       13600         Random-Access Memory       13600         Random-Access Memory       13600         M, 2N       Random-Access Memory       137211         M, 3N       Random-Access Memory       137211         R       Random-Access Memory       137288         A       Random-Access Memory       137288         D, 5E       Random-Access Memory       137211         D, 6E       Random-Access Memory       137211		Electrically Programmable Read Only Moment	ĸ
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M, 2N       Random-Access Memories         M, 2N       Random-Access Memory         M, 3N       Random-Access Memory         Random-Access Memory       137211         Random-Access Memory       137212         Random-Access Memory       137211         Random-Access Memory       137216         D, 5E       Random-Access Memory       137211         D, 6E       Random-Access Memory       137211	017-010	Programmable Read-Only Memory	
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M, 3NRandom-Access Memory137211RRandom-Access Memory137211D, 5ERandom-Access Memory137288D, 6ERandom-Access Memory137211137211137211		Random-Access Memories	
M, 3N Random-Access Memory 137211 R Random-Access Memory 137212 D, 5E Random-Access Memory 137212 D, 6E Random-Access Memory 137211		Random-Access Memory	M, 2N
RRandom-Access Memory13/211D, 5ERandom-Access Memory137218D, 6ERandom-Access Memory137211137211137211		Random-Access Memory	M, 3N
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D, 6E Random-Access Memory 137211 137211	288-001	Random Access Memory	
137211	211-001	Random Access Memory	
Resistors	211-001	nation Access Memory	, <b>.</b> .
		Resistors	
26, R27 820 Ω, ±5%, ¼ W Resistor 110000		820 Q. + 5% 1/4 W Resistor	26, R27
30. B31 75 k9 + 1% // W Bosistor 110000		$75 k_{0} + 1\% V$ M Projector	30. R31
	03-752	$7.0$ Nz, $\pm 1/0$ , $\frac{1}{8}$ VV nesistor $470.0 \pm 5\%$ 14 M/ Decident	
	00-471	$770 \times$ , $\pm 5\%$ , $\frac{1}{4}$ VV Mesistor 27 kO $\pm 5\%$ 1/ M Desists	
$2.7 \text{ k}\Omega, \pm 5\%, 1/4 \text{ W Resistor}$ 110000 110000	00-272	LI NX, I U 70, 74 W HESISTOF	· ·

Designator	Description	Part No.
335	680 Ω, ±5%, ¼ W Resistor	110000 691
₹36	2.2 k $\Omega$ , ±5%, 1/4 W Resistor	110000-681
737	3.9 k $\Omega$ , ±5%, ¼ W Resistor	110000-222
738	470 $\Omega$ , ±5%, ¼ W Resistor	110000-392
		110000-471
739 740	3.9 k $\Omega$ , ±5%, ¼ W Resistor	110000-392
	10 k $\Omega$ , ±5%, 1/4 W Resistor	110000-103
R41	5.6 k $\Omega$ , ±5%, 1/4 W Resistor	110000-562
344, R45	2.2 k $\Omega$ , ±5%, ¼ W Resistor	110000-222
146	10 k $\Omega$ , ± 5%, ¼ W Resistor	110000-103
347	2 kΩ Horizontal Potentiometer	119002-202
150	2.2 kΩ, ±5%, ¼ W Resistor	
51	470 $\Omega$ , ±5%, ¼ W Resistor	110000-222
		110000-471
52 53	$3.9 \text{ k}\Omega, \pm 5\%, 14 \text{ W}$ Resistor	110000-392
154	1 k $\Omega$ , ± 5%, ¼ W Resistor	110000-102
	$680 \Omega$ , $\pm 5\%$ , $\frac{1}{4}$ W Resistor	110000-681
55	820 $\Omega$ , ±5%, ¼ W Resistor	110000-821
58	7.5 kΩ, ±1%, ½ W Resistor	110003-752
59	470 Ω, ±5%, ¼ W Resistor	110000-471
60	2.7 kΩ, ±5%, ¼ W Resistor	
61	680 Ω, ±5%, ¼ W Resistor	110000-272
		110000-681
62, R63	470 Ω, $\pm$ 5%, 1⁄4 W Resistor	110000-471
64 65 DCC	2.2 k $\Omega$ , ± 5%, ¼ W Resistor	110000-222
65, R66	3.9 k $\Omega$ , ± 5%, 1/4 W Resistor	110000-392
67	10 k $\Omega$ , ± 5%, 1/4 W Resistor	110000-103
69	2.2 kΩ, ±5%, ¼ W Resistor	110000-222
70	2.2 k $\Omega$ , ±5%, ¼ W Resistor	110000-222
71	5.6 k $\Omega$ , ±5%, ¼ W Resistor	110000-562
73	10 k $\Omega$ , ± 5%, 1/4 W Resistor	110000-382
74	2 kO Hevizentel Detertion der	
76	2 kΩ Horizontal Potentiometer	119002-202
77	$1.2 \text{ k}\Omega, \pm 5\%, 14 \text{ W}$ Resistor	110000-122
	$2.2 \text{ k}\Omega, \pm 5\%, 14 \text{ W}$ Resistor	110000-222
78, R79	3.9 kΩ, ±5%, ¼ W Resistor	110000-392
30	1 kΩ, ±5%, ¼ W Resistor	110000-102
31	15 kΩ, ± 5%, ¼ W Resistor	110000-153
32	$1 \text{ k}\Omega, \pm 5\%, \frac{1}{4} \text{ W} \text{ Resistor}$	110000-102
33	10 kΩ, ±5%, ¼ W Resistor	110000-102
A		
34	560 $\Omega$ , ±5%, ¼ W Resistor	110000-561
35-R87	7.5 k $\Omega$ , $\pm 1\%$ , $\frac{1}{6}$ W Resistor	110003-752
38	200 $\Omega$ Horizontal Potentiometer	119002-201
39	7.5 k $\Omega$ , ± 1%, ½ W Resistor	110003-752
90	100 Ω, ±1%, ¼ W Resistor	110000-101
91	7.5 kΩ, ± 1%, ¼ W Resistor	110003-752
2	200 $\Omega$ Horizontal Potentiometer	119002-201
93	7.5 k $\Omega$ , ± 1%, $\frac{1}{8}$ W Resistor	110003-752
		10000-132

Designator	Description	Part No.
R94	100 Ω, ±1%, ½ W Resistor	
R95, R96	$75 k_0 + 1\% = 1/0$	110000-101
R97	7.5 kΩ, $\pm$ 1%, $\frac{1}{2}$ W Resistor	110003-752
R106	3.9 kΩ, $\pm$ 5%, 1/4 W Resistor	110000-392
100	7.5 k $\Omega$ , ± 1%, ½ W Resistor	110003-752
108	270 kΩ, ±5%, 1/2 W Resistor	110000 074
R110-R117	3.3 k $\Omega$ , ± 5%, ¼ W Resistor	110000-271
R118	10 k $\Omega$ , ±5%, ¼ W Resistor	110000-332
8119	1 k $\Omega$ , ±5%, ¼ W Resistor	110000-103 110000-102
1120-R128	10 kΩ, ±5%, ¼ W Resistor	10000-102
129	1 k $\Omega$ , ±5%, ¼ W Resistor	110000-103
130	$18 k_{O} + 59 (-1) M D = 1 + 1$	110000-102
1131	1.8 kΩ, $\pm$ 5%, ¼ W Resistor	110000-182
	2.2 k $\Omega$ , ±5%, ¼ W Resistor	110000-222
132	1.8 kΩ, ±5%, ¼ W Resistor	110000 182
133	2.2 kΩ, ±5%, ¼ W Resistor	110000-182
134	$3.3 \text{ k}\Omega, \pm 5\%, 14 \text{ W}$ Resistor	110000-222
135	2.2 kΩ, ±5%, ¼ W Resistor	110000-332 110000-222
136	6.8 kΩ, ±5%, ¼ W Resistor	
137-R139	470 $\Omega$ , ±5%, ¼ W Resistor	110000-682
140	$1.2 \text{ k}\Omega, \pm 5\%, 14 \text{ W Resistor}$	110000-471
141	$2.2 \text{ k}\Omega, \pm 5\%, 14 \text{ W Resistor}$	110000-122
	Z.Z. K.S., 1078, VA W RESISTOR	110000-222
142	4.7 kΩ, ±5%, ¼ W Resistor	110000-472
143	10 k $\Omega$ , ± 5%, 1/4 W Resistor	110000-103
144	22 k $\Omega$ , ±5%, ¼ W Resistor	
145	3.3 kΩ, ±5%, ¼ W Resistor	110000-223 110000-332
146	510 Ω, ±5%, ¼ W Resistor	
147, R148	$1 \text{ k}\Omega, \pm 5\%, 14 \text{ W}$ Resistor	110000-511
149	470 $\Omega$ , ±5%, 1⁄4 W Resistor	110000-102
151-R152	$470 \Omega, \pm 5\%, 14$ W Resistor	110000-471
		110000-471
53	1 k $\Omega$ , ±5%, 1/4 W Resistor	110000-102
155-R159	$1 \text{ k}\Omega$ , ±5%, ¼ W Resistor	110000-102
60-R162	470 Ω, ±5%, ¼ W Resistor	110000-471
63	10 kΩ, ±5%, ¼ W Resistor	110000-103
64, R165	220 Ω, ±5%, ¼ W Resistor	
66-R172	$1 \text{ k}\Omega, \pm 5\%, 14 \text{ W}$ Resistor	110000-221
73	$10 \text{ k}\Omega, \pm 5\%, 14 \text{ W Resistor}$	110000-102
74	$68 \text{ k}\Omega, \pm 5\%, 14 \text{ W Resistor}$	110000-103
		110000-683
75 76	15 k $\Omega$ , ±5%, 1/4 W Resistor	110000-153
	$1 \text{ k}\Omega, \pm 5\%, 14 \text{ W}$ Resistor	110000-102
77, R178	10 k $\Omega$ , ±5%, ¼ W Resistor	110000-102
79	220 $\Omega$ , ±5%, ¼ W Resistor	110000-103
80-R187	100 kΩ, ±5%, ¼ W Resistor	
88-R203	4.7 k $\Omega$ , ±5%, ¼ W Resistor	110000-104
04	290 k $\Omega$ , ±5%, ¼ W Resistor	110000-472
05	1 k $\Omega$ , ±5%, ¼ W Resistor	110000-224
		110000-102

### Quantum Game Printed-Circuit Board Assembly, continued Parts List

Designator	Description	Part No.		
206-R209	290 kΩ, ±5%, ¼ W Resistor	110000-224		
210	$1 \text{ k}\Omega, \pm 5\%, \frac{1}{4} \text{ W}$ Resistor	110000-102		
211-R213	220 k $\Omega$ , $\pm$ 5%, 1/4 W Resistor	110000-224		
214	150 Ω, ±5%, ¼ W Resistor	110000-151		
215	10 kΩ, ±5%, ¼ W Resistor	110000-103		
216, R217	4.7 k $\Omega$ , ±5%, ¼ W Resistor	110000-472		
218-R222	$1 \text{ k}\Omega, \pm 5\%, \frac{1}{4} \text{ W Resistor}$	110000-102		
223	220 $\Omega$ , ± 5%, 1⁄4 W Resistor	110000-221		
224-R226	100 Ω, ±5%, ¼ W Resistor	110000-101		
RV1, RV2	8 V Variable Resistor	110004-001		
	Sockets			
K/L	64-Contact Medium-Insertion-Force Integrated Circuit Socket	79-42C64		
/3B, 2/3D	40-Contact Medium-Insertion-Force Integrated Circuit Socket	79-42C40		
E, 2F	28-Contact Medium-Insertion-Force Integrated Circuit Socket	79-42C28		
H/J	28-Contact Medium-Insertion-Force Integrated Circuit Socket	79-42C28		
K, 2L	28-Contact Medium-Insertion-Force Integrated Circuit Socket	79-42C28		
M, 2N	24-Contact Medium-Insertion-Force Integrated Circuit Socket	79-42C24		
E, 3F	28-Contact Medium-Insertion-Force Integrated Circuit Socket	79-42C28		
H/J	28-Contact Medium-Insertion-Force Integrated Circuit Socket	79-42C28		
K, 3L	28-Contact Medium-Insertion-Force Integrated Circuit Socket	79-42C28		
M, 3N	24-Contact Medium-Insertion-Force Integrated Circuit Socket	79-42C24		
D, 5E	24-Contact Medium-Insertion-Force Integrated Circuit Socket	79-42C24		
В	40-Contact Medium-Insertion-Force Integrated Circuit Socket	79-42C40		
D, 6E	24-Contact Medium-Insertion-Force Integrated Circuit Socket	7 <del>9</del> -42C24		
	Transistors			
27	Type-2N3904, 350 mW, 60 V NPN Transistor	34-2N3904		
8	Type-2N3906, 1 W, 40 V PNP Transistor	33-2N3906		
9-Q11	Type-2N3904, 350 mW, 60 V NPN Transistor	34-2N3904		
12	Type-2N3906, 1 W, 40 V PNP Transistor	33-2N3906		
13, Q14	Type-2N3904, 350 mW, 60 V NPN Transistor	34-2N3904		
15, Q16	Type-2N6044, 8 A, 80 V NPN Transistor	34-2N6044		
17	Type-2N3904, 350 mW, 60 V NPN Transistor	34-2N3904		

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### Figure 4-13 Regulator/Audio II PCB Assembly A035435-04 C

### Regulator/Audio II Printed-Circuit Board Assembly Parts List

Designator	Description	Part No.
	Capacitors	
C1	470 $\mu$ F, 25 V, Aluminum Electrolytic Fixed Axial-Lead Capacitor	24-250477
C2	0.001 µF, 50 V, Ceramic-Disc Axial-Lead Capacitor	122002-102
C3	0.1 µF, 50 V, Ceramic-Disc Axial-Lead Capacitor	. –
C4	470 μF, 25 V, Aluminum Electrolytic Fixed Axial-Lead Capacitor	122002-104
		24-250477
25	0.01 μF, 25 V Minimum, Ceramic-Disc Axial-Lead Capacitor Acceptable substitute is part no. 122005-103	100015-103
26	0.22 µF, 25 V, Ceramic-Disc Axial-Lead Capacitor	122004-224
7	0.001 µF, 50 V, Ceramic-Disc Axial-Lead Capacitor	122002-102
8	0.22 µF, 25 V, Ceramic-Disc Axial-Lead Capacitor	122004-224
	·	122004 224
29, C10	3300 µF, 35 V, Aluminum Electrolytic Fixed Axial-Lead Capacitor	24-350338
211	0.1 µF, 50 V, Ceramic-Disc Axial-Lead Capacitor	122002-104
12	470 μF, 25 V, Aluminum Electrolytic Fixed Axial-Lead Capacitor	24-250477
13	1000 µF, 25 V, Aluminum Electrolytic Fixed Axial-Lead Capacitor	24-250108
4.4		2720000
14	0.01 $\mu$ F, 25 V Minimum, Ceramic-Disc Axial-Lead Capacitor	100015-103
16	Acceptable substitute is part no. 122005-103	
15	0.22 µF, 25 V, Ceramic-Disc Axial-Lead Capacitor	122004-224
16	0.001 µF, 50 V, Ceramic-Disc Axial-Lead Capacitor	122002-102
17	0.22 $\mu$ F, 25 V, Ceramic-Disc Axial-Lead Capacitor	122004-224
18, C19	3300 $\mu$ F, 35 V, Aluminum Electrolytic Fixed Axial-Lead Capacitor	24-350338
20, C21	0.1 µF, 50 V, Ceramic-Disc Axial-Lead Capacitor	
,		122002-104
	Diodes	
0R1, C4 0R5-CR8	Type-1N4002, 1 A, 100 V Silicon Rectifier Diode Type-1N5401, 3 A, 100 V Silicon Rectifier Diode	31-1N4002 31-1N5401
	Integrated Circuits	
01	Type-LM305, 5 V, Linear Voltage Regulator	27   14205
25	Type-TDA2002A, 8 W, Linear Audio Amplifier Integrated Circuit	37-LM305
7	Type-TDA2002A, 8 W, Linear Audio Amplifier Integrated Circuit Type-TDA2002A, 8 W, Linear Audio Amplifier Integrated Circuit	137151-002
	THE TRACTOR OF THE THE AUDIO AND THE INTEGRATED CITCUIT	137151-002
	Resistors	
1	270 Ω, ±5%, ¼ W Resistor	110000-271
3	$33 \Omega$ , $\pm 5\%$ , <sup>1</sup> / <sub>4</sub> W Resistor	110000-330
	100 $\Omega$ , ±5%, ¼ W Resistor	110000-101
4	$2.7 \Omega, \pm 5\%, 1 W$ Resistor	110009-027
		110000-021
5		
5 3	3.9 k $\Omega$ , ±5%, ¼ W Resistor	110000-392
5 5 7	3.9 k $\Omega$ , ±5%, ¼ W Resistor 7.5 k $\Omega$ , ±5%, ¼ W Resistor	110000-392 110000-752
5 3 7	3.9 k $\Omega$ , ±5%, ¼ W Resistor 7.5 k $\Omega$ , ±5%, ¼ W Resistor	110000-752
5 6 7	3.9 k $\Omega$ , ±5%, ¼ W Resistor	
4 5 6 7 8 9	3.9 k $\Omega$ , ±5%, ¼ W Resistor 7.5 k $\Omega$ , ±5%, ¼ W Resistor 1 k $\Omega$ Horizontal PCB-Mounting Cermet Potentiometer Acceptable	110000-752
5 6 7 8 9	3.9 k $\Omega$ , ±5%, ¼ W Resistor 7.5 k $\Omega$ , ±5%, ¼ W Resistor 1 k $\Omega$ Horizontal PCB-Mounting Cermet Potentiometer Acceptable substitute is part no. 19-315102 220 $\Omega$ , ±5%, ½ W Resistor	110000-752 119002-102 110001-221
5 7 3 9	<ul> <li>3.9 kΩ, ±5%, ¼ W Resistor</li> <li>7.5 kΩ, ±5%, ¼ W Resistor</li> <li>1 kΩ Horizontal PCB-Mounting Cermet Potentiometer Acceptable substitute is part no. 19-315102</li> <li>220 Ω, ±5%, ½ W Resistor</li> <li>1 Ω, ±5%, ¼ W Resistor</li> </ul>	110000-752 119002-102 110001-221 110000-010
5 7 3 9 10 11	<ul> <li>3.9 kΩ, ±5%, ¼ W Resistor</li> <li>7.5 kΩ, ±5%, ¼ W Resistor</li> <li>1 kΩ Horizontal PCB-Mounting Cermet Potentiometer Acceptable substitute is part no. 19-315102</li> <li>220 Ω, ±5%, ½ W Resistor</li> <li>1 Ω, ±5%, ¼ W Resistor</li> <li>10 Ω, ±5%, ¼ W Resistor</li> </ul>	110000-752 119002-102 110001-221 110000-010 110000-100
5 3 3 9	<ul> <li>3.9 kΩ, ±5%, ¼ W Resistor</li> <li>7.5 kΩ, ±5%, ¼ W Resistor</li> <li>1 kΩ Horizontal PCB-Mounting Cermet Potentiometer Acceptable substitute is part no. 19-315102</li> <li>220 Ω, ±5%, ½ W Resistor</li> <li>1 Ω, ±5%, ¼ W Resistor</li> </ul>	110000-752 119002-102 110001-221 110000-010

Regulator/Audio II PCB Assembly
Parts List, continued

Designator	Description	Part No.
R19	1 $\Omega$ , ±5%, ¼ W Resistor	110000-010
R20	10 $\Omega$ , ±5%, ¼ W Resistor	110000-100
R21	220 $\Omega$ , ±5%, ½ W Resistor	110001-221
R22	100 $\Omega$ , ±5%, ¼ W Resistor	110000-101
R24	0.1 $\Omega$ , ±3%, 7 W Wirewound Resistor	19-100P1015
R27, R28	1 k $\Omega$ , ±5%, ¼ W Resistor	110000-102
R29, R30	10 $\Omega$ , ±5%, ¼ W Resistor	110000-100
R32, R33	5.6 k $\Omega$ , ±5%, ¼ W Resistor	110000-562
	Transistors	
Q2	Type-TIP32 PNP Power Transistor	33-TIP32
Q3	Type-2N3055 NPN Silicon Transistor	34-2N3055
	Mechanical Parts	
J6	6-Position Connector Receptacle	79-58306
J7	9-Position Connector Receptacle	79-58308
J8	4-Position Connector Receptacle	79-58354
J9	6-Position Connector Receptacle	79-58306
J10	12-Position Connector Receptacle	79-58346
Q2	#6-32 x ¼-Inch Binder-Head Nylon Screw	75-F60405
Q3	#6-32 Nut/Washer Assembly	75-99516
Q3	Thermally Conductive Silicon Insulator	78-16008
Q5 Q5, Q7	Thermally Conductive Silicon Insulator #6 x %-Inch Cross-Recessed Pan-Head Thread-Forming Type-AB Zinc- Plated-Steel Screw	78-16008 72-6606S
	Heat Sink Test Point Acceptable substitute is part no. 020670-01	034531-01 179051-001

#### **Color X-Y Power Supply Assembly** I. 💁 WARNING 🚽 A037395-01 Fuse cover must be in place during (Transformer Assy.) Q game operation. A021084-xx (Volt. Plugs) 29-053 (Capacitor) 034554-01 (Fuse Cover) 79-4411001 Q (Fuse Post) 78-70501SC (Cap. Bracket) 10 46-2017002 (Fuse) Ĝ A035891-02 (Fuse Harness) 034482-02 Ŀн (Chassis) 46-301203 \_ (Fuse) 037639-01 (Label) zr < 0 $\sim$ <° 78-2708 (Bushing) 79-3206 A034630-01 (Fuse Block) (Filter Assy.) 037641-01 (Label) 46-2014002 (Fuses) 79-15021001 ٩ A035890-01 (Term. Block) (Pwr. Harness) A034629-01 3A-MDA3501 9 (A.C. Harn.) (Rectifier) Figure 4-14 Color X-Y Power Supply Assembly A037396-xx D

### Color X-Y Power Supply Assembly Parts List

Part No.	Description (Reference Designations in Bold)	
A021084-01	Voltage Plug for 100 V (violet)	
A021084-02	Voltage Plug for 120 V (vellow)	
A021084-04	Voltage Plug for 220 V (blue)	
A021084-05	Voltage Plug for 240 V (brown)	
A034629-01	AC Harness Assembly	
A034630-01	RFI Filter Assembly (FL1)	
A035890-01	Power Harness Assembly	
A035891-02	Fuse Harness Assembly	
A037395-01	Color X-Y Transformer Assembly (T1)	
29-053	27,000 µF 15 VDC Electrolytic Capacitor (C1)	
3A-MDA3501	Type-MDA 3501 Bridge Rectifier (CR1)	
46-2014002	4 A, 250 V, 3AG Slow-Blow Glass Cartridge-Type Fuse (F2, F4-F6)	
46-2017002	7 A, 250 V, 3AG Slow-Blow Glass Cartridge-Type Fuse (F1)	
46-301203	20 A, 32 V, 3AG Slow-Blow Glass Cartridge Type Fuse (F3)	
78-2708	Nylon Type 6/6 Hole Bushing with %-Inch Inside Diameter × %-Inch Outside Diameter × 14-Inch Thick	
78-70501SC	2-Inch Diameter Capacitor Mounting Bracket	
79-15021001	2-Circuit Single-Row Terminal Block	
79-3206	5-Position 3AG Fuse Block with 1/4-Inch Quick-Disconnect Terminals	
79-4411001	Panel-Mounting Non-Indicating 3AG Cartridge-Type Fuse Post	
034482-02	Power Supply Chassis Base	
034544-01	Fuse Block Cover	
037243-01	Metal Base Plate (not shown in illustration)	
037639-01	Label for Fuse Value (F1)	
037641-01	Label for Fuse Values (F2-F6)	

### - NOTE 🗕

A037396-01 power supply assembly has the 120 V plug A037396-02 has the 100 V, 220 V, and 240 V plugs A037396-03 has the 220 V and 240 V plugs

Line Voltage Range 90-110 VAC (100) Violet 105-135 VAC (120) Yellow 200-240 VAC (220) 220-260 VAC (240) Blue Brown

Voltage Selection Plug Wire Color

# **Glossary of Terms**

#### AC

Alternating current; from zero it rises to a maximum positive level, then passes through zero again to a maximum negative level.

#### ACTIVE STATE

The true state of a signal. For example: The active state for START is low.

#### ADDRESS

A value that identifies a specific location of data in memory; normally expressed in hexadecimal notation.

#### ANALOG

Measurable in an absolute quantity (as opposed to on or off). Analog devices are volume controls, light dimmers, stereo amplifiers, etc.

#### ANODE

The positive (arrow) end of a diode.

#### AMPLIFIER

A device used to increase the strength of an applied signal.

#### AMPLITUDE

The maximum instantaneous value of a waveform pulse from zero.

#### ASTABLE

Having no normal state. An astable device will free-run or oscillate as long as operating voltage is applied. The oscillation frequency is usually controlled by external circuitry.

#### **AUXILIARY COIN SWITCH**

A momentary-contact pushbutton switch with a black cap located on the utility panel. The auxiliary coin switch adds credits to the game without activating the coin counter.

#### BEZEL

A cut, formed, or machined retention device, such as the conical device used to mount a pushbutton switch to a control panel, or the formed device used to frame the video display screen.

#### BIDIRECTIONAL

Able to send or receive data on the same line (e.g., the data bus of a microprocessor).

#### **BINARY**

A number system that expresses all values by using two digits (0 and 1).

#### BIT

A binary digit; expressed as a 1 or a 0.

#### BLANKING

Turning off the beam on a cathoderay tube during retrace.

#### **BLOCK DIAGRAM**

A drawing in which functional circuitry units are represented by blocks. Very useful during initial troubleshooting.

#### BUFFER

1. An isolating circuit designed to eliminate the reaction of a driven circuit on the circuits driving it (e.g., a buffer amplifier).

2. A device used to supply additional drive capability.

#### BUS

An electrical path over which information is transferred from any of several sources to any of several destinations.

#### CAPACITOR

A device capable of storing electrical energy. A capacitor blocks the flow of DC current while allowing AC current to pass.

#### CATHODE

The negative end of a diode.

#### CHIP

An integrated circuit comprising many circuits on a single wafer slice.

#### CLOCK

A repetitive timing signal for synchronizing system functions.

#### COINCIDENCE

Occurring at the same time.

#### COIN COUNTER

A 6-digit electro-mechanical device that counts the coins inserted in the coin mechanism(s).

#### **COIN MECHANISM**

A device on the inside of the coin door that inspects the coin to determine if the correct coin has been inserted.

#### COMPLEMENTARY

Having opposite states, such as the outputs of a flip-flop.

#### COMPOSITE SYNC

Horizontal and vertical synchronization pulses that are bused together into a single signal. This signal provides the timing necessary to keep the display in synchronization with the game circuitry.

#### **COMPOSITE VIDEO**

Complete video signal from the game system to drive the display circuitry, usually comprising H SYNC, V SYNC, and the video.

#### CREDIT

One play for one person based on the game switch settings.

#### CRT

Cathode-ray tube.

#### DATA

General term for the numbers, letters, and symbols that serve as input for device processing.

#### DARLINGTON

A two-transistor amplifier that provides extremely high gain.

#### DC

Direct current, meaning current flowing in one direction and of a fixed value.

#### **DEFLECTION YOKE**

Electro-magnetic coils around the neck of a cathode-ray tube. One set of coils deflects the electron beam horizontally and the other set deflects the beam vertically.

#### DIAGNOSTICS

A programmed routine for checking circuitry. For example: the self-test is a diagnostic routine.

#### DIODE

A semiconductor device that conducts in only one direction.

#### DISCRETE

Non-integrated components, such as resistors, capacitors, and transistors.

#### DMA

Direct memory access. DMA is a process of accessing memory that bypasses the microprocessor logic. DMA is normally used for transferring data between the input/output ports and memory.

#### DOWN TIME

The period during which a game is malfunctioning or not operating correctly due to machine failure.

#### EAROM

Electrically alterable read-only memory (see ROM). The EAROM is a memory that can be changed by the application of high voltage.

#### FLYBACK

A step-up transformer used in a display to provide the high voltage.

#### GATE

1. A circuit with one output that responds when and only when a certain combination of pulses is present at the inputs.

2. A circuit in which one signal switches another signal on and off.

3. To control the passage of a pulse or signal.

#### HARNESS

A prefabricated assembly of insulated wires and terminals ready to be attached to a piece of equipment.

#### HEXADECIMAL

A number system using the equivalent of the decimal number 16 as a base. The symbols 0-9 and A-F are usually used.

#### IMPLODE

To burst inward; the inward collapse of a vacuum tube.

### 1/0

Input/Output.

#### IRQ

Interrupt request. IRQ is a control signal to the microprocessor that is generated by external logic. This signal tells the microprocessor that external logic needs attention. Depending on the program, the processor may or may not respond.

#### LED

The abbreviation for a light-emitting diode.

#### LOCKOUT COIL

Directs coins into the coin return box when there is no power to the game.

#### LOGIC STATE

The binary (1 or 0) value at the node of a logic element or integrated circuit during a particular time. Also called the logic level. The list below shows the voltage levels corresponding to the logic states (levels) in a TTL system.

Logic 0, Low = 0 VDC to +0.8 VDC Grey Area (Tri-State Level) = +0.8VDC to +2.4 VDC Logic 1, High = +2.4 VDC to +5VDC

#### MULTIPLEXER

A device that takes several lowspeed inputs and combines them into one high-speed data stream for simultaneous transmission on a single line.

#### NMI

Non-maskable interrupt. NMI is a request for service by the microprocessor from external logic. The microprocessor cannot ignore this interrupt request.

#### PAGE

A subsection of memory. A read-only memory device (see ROM) is broken into discrete blocks of data. These blocks are called pages. Each block has X number of bytes.

#### PCB

The abbreviation for a printed-circuit board.

#### PHOTOTRANSISTOR

A transistor that is activated by an external light source.

#### POTENTIOMETER

1. A resistor that has a continuously moving contact which is generally mounted on a moving shaft. Used chiefly as a voltage divider. Also called a *pot* (slang).

2. An instrument for measuring a voltage by balancing it against a known voltage.

#### RAM

Random-access memory. A device for the temporary storage of data.

#### RASTER-SCAN DISPLAY

A display system whereby images are displayed by continuously scanning the cathode-ray tube horizontally and vertically with an electron beam. The display system controls the intensity of the electron beam.

#### RETRACE

In a raster-scan display, retrace is the time during which the cathoderay tube electron beam is resetting either from right to left or from bottom to top.

#### RESISTOR

A device designed to have a definite amount of resistance. Used in circuits to limit current flow or to provide a voltage drop.

#### ROM

Read-only memory. A device for the permanent storage of data.

#### SIGNATURE ANALYSIS

A process of isolating digital logic faults at the component level by means of special test equipment called signature analyzers. Basically, signature analyzers (e.g., the ATARI® CAT Box) convert lengthy bit streams into four-digit hexadecimal signatures. The signature read by the analyzer at each circuit node is then compared with the known good signature for that node. This process continues until a fault is located.

#### TROUBLESHOOT

The process of locating and repairing a fault.

#### VECTOR

A line segment drawn between specific X and Y coordinates on a cathode-ray tube.

#### WATCHDOG

A counter circuit designed to protect the microprocessor from self-destruction if a program malfunction occurs. If a malfunction does occur, the counter applies continuous pulses to the reset line of the microprocessor, which causes the microprocessor to keep resetting.

#### X-Y DISPLAY

A display system whereby images are displayed with vectors.

#### ZENER DIODE

A special diode used as a regulator. Its main characteristic is breaking down at a specified reverse-bias (Zener) voltage.