SprintScan 45
Multi-Format Film Scanner

September 1996
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1. Functional Description

The SprintScan 45 (Figure 1-1) is a high-speed, high-resolution slide scanner that converts pictures on slide into binary code for further processing by a host computer.

![Simplified block diagram](image)

**Figure 1-1. Simplified block diagram**

The image is first converted into analog signals which vary in magnitude according to shading in the original document. In the second phase, the analog signals are digitized. The resulting binary codes can be stored in a video buffer and then transmitted via the SCSI interface. Individual functional blocks are described in the following sections of this Repair Manual.

**Photoelectric Converter**

The photoelectric converter (Figure 1-2) consists of a light source, lens, and linear-array CCD with associated driving circuitry.

![Photoelectric converter](image)

**Figure 1-2. Photoelectric converter**

As shown in Figure 1-2, the light from the lamp passes through the reflection of two mirrors onto the surface of the CCD, which generates electrical signals proportional to the intensity of the light. The CCD is operated so that the magnitude of the electrical signal is linearly
proportional to the intensity of received light. Since the CCD scans one line at a time, a stepping motor is used to move the slide so the CCD can scan the entire slide.

**Analog-to-Digital Converter**

Output from the CCD is fed to this module, and most of the scanned-data processing is done in this stage. The waveform output by the CCD is shown in Figure 1-3, where the magnitude of the output signal with respect to the bias voltage is a function of the intensity of the light incident upon the CCD.

![Figure 1-3. CCD output waveform](image)

Since output-signal bias voltage varies for different CCDs, and output notches degrade system response, the output-signal bias voltage is first restored to ground, and then a sample-and-hold operation is carried out to eliminate output notches. The resultant waveform is shown in Figure 1-4.

![Figure 1-4. CCD output signal after bias restored](image)

From Figure 1-4 it can be seen that the CCD signal is smoother and the bias voltage is independent of CCD characteristics. The digitized data can be stored in a buffer for transferral to the host via the SCSI interface.

The reference voltage is derived through a process called calibration. Because of the characteristics of lamp and lens, the magnitude of the CCD’s output is lower toward the beginning and end of a scan line than it is in the central portion, even when the input slide is uniformly white. Calibration is used to compensate for this spatial variation.
Data Transfer Modules

In the third phase of scanner operation, the scanned data are transferred to the host computer. The data is transmitted by SCSI interface.

Command and Message Transfer

The scanner accepts commands from, and sends messages to, the host computer via the SCSI interface. All commands and messages are transmitted in the form of records with a fixed syntax. Command format and record syntax are described detail in the SprintScan 45 Command Set Manual.
2. Adjustments and Testing

Required Tools and Equipment

Table 2-1 lists the necessary tools that are required to make adjustments to the Polaroid 45 Slide Scanner. It also describes the particular function that the tool is used for.

Table 2-1. Required Tools and Equipment

<table>
<thead>
<tr>
<th>TOOL</th>
<th>FUNCTION</th>
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<tr>
<td>Oscilloscope</td>
<td>Used for viewing the CCD output waveform.</td>
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<td>Scope-Probe with Ground Clip</td>
<td>Connects the oscilloscope to the CCD output ground and sync signal.</td>
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<td>3.0 mm HEX Screwdriver</td>
<td>Used to remove and reinstall the Scanner’s Upper Housing and Upper.</td>
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<tr>
<td>1.5 mm HEX Screwdriver</td>
<td>Used to loosen or retighten the Lens set screw.</td>
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<tr>
<td>Flat Screwdriver</td>
<td>Used to remove and reinstall the Lens Cap.</td>
</tr>
<tr>
<td>Knife</td>
<td>Used to scratch off the Green Glue that secures the lens to its mount.</td>
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<tr>
<td>Green Glue or equivalent</td>
<td>Used to secure (fix) the lens to its mount.</td>
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<td>Grayscale Target (P/N CPS Q60-E1)</td>
<td>Used for image quality testing</td>
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Lens Focus Adjustment

Cautions

Before making any adjustments to the scanner's lens:

- Make sure that the Mirrors and Mirror Clamps on the CCD Carriage are properly clamped. The lens focus will be affected if not properly clamped.

- Make sure that finger prints or dust are properly removed from the Mirrors, Lamp, Glass, Reflective Plate and Lens before attempting to focus the lens. Finger prints and dust may will seriously affect the scanning image.

The scanning image is highly dependent on the cleanliness of the Mirrors, Lamp, Glass, Reflective Plate and Lens.

1. Remove the Upper Housing as explained in Section 4 of this Repair Manual.

2. Set the SCSI ID to 6.

   This action allows you to view the CCD output waveform with the oscilloscope.

3. Connect the oscilloscope to output of the CCD board (Figure 2-1) as follows:

   - Probe to pin X4.
   - Ground Clamp to pin X2 (AG).
   - Trigger Probe to synce pulse (TP-SP)

Warning

Never connect ground clip to test point X4. Connecting ground clip to test point X4 will damage (blow) the CCD board.

4. Power up the scanner.
Figure 2-1. CCD board test points

5. Insert the test pattern target into the slide carriage (Figure 2-2).

Figure 2-2. Slide carriage
6. Manually rotate the scanner's lead screw to move the CCD carriage into position.

   **Note:** When the carriage is correctly positioned, the fluorescent lamp is positioned between the line pair pattern attached on the glass of the Focus Test Pattern.

   Once the CCD carriage is properly positioned, the RGB output waveform of the CCD board can be viewed.

7. If applicable, gently scratch off the green glue that secures the lens to its mount and then, using a flat screwdriver, loosen the lens setscrew (Figure 2-3).

![Figure 2-3. Lens focus adjustment](image)

8. Manually adjust the position of the lens until the output waveform (Figure 2-4) of the CCD board reaches its maximum amplitude. It should also be as flat as possible (fine waveform).

9. Tighten the lens setscrew being careful not to damage or change the position of the adjusted lens.
10. Secure the adjusted position of the lens by applying a small amount of green glue between the lens and its mount.

11. Power off the scanner.

12. Disconnect the oscilloscope’s test probe and ground clamp from the CCD board.

13. Remove the Focus Test Pattern from the scanner.

14. Install the Upper Housing as explained in Section 4 of this Repair Manual.

   **Note:** When installing the Upper Housing be careful not to damage the door sensor.

15. Power up the scanner again and then rescan and check the scanner’s image quality.

   **Note:** If the scanner’s image quality is not OK, repeat this procedure.
Streak Test

Note: This test is used to verify that the slide scanner is free of streaks caused by dust particles or CCD imperfections.

Required Tools and Equipment

- Test Target (exposed positive film in film holder)
- Adobe PhotoShop version 3.0.5 or later
- SprintScan 45 plug-in version 1.0.3 or later

Procedure

1. Setup scanning parameters as follows:

   **Settings Dialog Box**

   - Film Table: **Generic Negative**
   - Auto exposure: **OFF**
   - Gamma: **Linear**
   - Manual Exposure: **-1 Setting**
   - Resolution: **2000 dpi**
   - Scale Factor: **100%**

2. Insert the test target into the slide carriage (Figure 2-5).

3. Insert the slide carriage into the slide scanner.

   **Note:** Slide scanner cover should be removed when performing this procedure.

![Slide carriage](image)

*Figure 2-5. Slide carriage*
4. Scan the test slide using the Generic film table. An image of the test target will appear.

5. Examine the image for vertical bands across the selected area of interest.

**Notes:** Make sure:

- Defects on the test slide are not the cause for slide scanner failure.
  
  If in doubt, rotate the test target 90 degrees to see if the defect follows the test target.

- No clipping takes place when test target is scanned.
  
  If bands of color are clipped, streaks will not be visible.
Image Performance Quality (IPQ) Measurement

The following tests are used to measure the Image Performance Quality (IPQ) of the SS 45 slide scanner.

- Resolution and Sharpness (MTF Response)
- Step Transition
- Linearity
- Dynamic Range
- Motion

Each IPQ test described uses a Mac computer, assumes that the Adobe Photoshop application is open and that the slide scanner under test is connected and ready to perform a Preview scan.

Note: If a PC or PC compatible computer is used instead of a MAC, the dialog boxes displayed during each test procedure will be slightly different.

Required Tools and Equipment

- **Software**
  - Adobe Photoshop v3.0.5 or later
  - SprintScan 45 Software v1.0.3 or later

- **Computer**
  
  *Mac*
  - Macintosh 68k or Power PC
  - 24 bit Color Monitor
  - 24 Meg of RAM minimum (Photoshop v4.0 requires 40MB)
  - 160 Meg of free space on hard drive

  *PC or PC compatible*
  - 486 or newer processor
  - 24 bit Color Monitor
  - 24 Meg of RAM minimum (Photoshop v4.0 requires 40MB)
  - 160 Meg of free space on hard drive

- **Test Targets**
  - Microtek 45IQ (P/N CPS 509)
  - Kodak Q60 (P/N Q60-E1)

- **Documentation**
  - User’s Guide Mac and Windows (P/N 1F1951A)
  - SS 45 Repair Manual (P/N 1F1952A)
Test Procedures

Resolution and Sharpness (MTF)

Note: This IQP test measures the MTF response of the slide scanner. The Microtek 45IQ test target is used for this test.

1. Setup scanning parameters as follows:

Settings Dialog Box

- Type: 256 Shades of Grey
- Resolution: 2000 dpi
- Media Type: Positive Transparency
  (Path - Preview Dialog Box : Preferences : Media Type)
- More Options Box: Click on the More Options button
  - Use Linear Gamma Curve: On
- Auto Button: Off
- PhotoShop Info Palette: Viewable on Screen

2. Insert the test target (Microtek 45IQ) into the slide carriage with the Microtek name right reading and facing up (Figure 2-6).

3. Insert the slide carriage into the slide scanner.
Figure 2-6. Slide carriage

3. Click the **Preview** button in the Preview window to scan the entire test target. The Preview image of the test target is displayed.
4. Select the 500 lppi (line pairs per inch) horizontal parallel lines - Areas 2A (5), 2A (6).

**Note:** Test target areas are located by noting the ruler marks (graduated from 1 to 10) at the top and left sides of the test target area. The 500 lppi pairs are located at top ruler coordinates 5 and 6 and left side coordinates 2 and 3.

5. Click the **Scan** button in the Preview window. This action causes the slide scanner to scan the selected portion of the horizontal parallel line patterns.

The selected portion of the horizontal parallel line patterns is displayed.

6. Using the magnification tool, increase the magnification of the displayed image to 100%.

7. Select the 500 lppi vertical parallel line patterns in Area 2A.
8. From PhotoShop’s Image menu select **Histogram**. The Histogram window is displayed.

9. Use the crosshair pointer (Marquee tool selected) to measure the pixel level of the histogram by observing the number in the **Level**: field in the histogram dialog box.

10. Measure the **min** and **max** level at the widest point on the histogram.

   **Note:** In the histogram example, the lowest level is 22 and the highest level is 255.

11. Calculate the MTF for the lppi portion of the horizontal parallel line patterns in Area 2A (5) using following formula:

    \[
    MTF \ ( \text{in \%}) = \frac{\text{Max Level} - \text{Min Level}}{255}
    \]

    \[
    MTF = \frac{255 - 22}{255}
    \]

    \[
    MTF = 91\%
    \]

    **MTF specification is \geq 40\% at 500 lppi.**

12. Repeat steps 7 through 11 to calculate the MTF for Area 2A (6).

    **Note:** If either area is less than the MTF specification, readjust the slide scanner focus. Refer to the Focus Adjustment procedure in this section of the SS 45 Repair Manual.
**Step Transition**

**Note:** This IQP test measures the step response of the slide scanner. The Microtek 451Q test target is used for this test.

1. Setup scanning parameters as follows:

**Settings Dialog Box**

- Type: Millions of Colors
- Resolution: 2000 dpi
- Media Type: Positive Transparency (Path - Preview Dialog Box : Preferences : Media Type)
- More Options Box: Click on the More Options button.
- Use Linear Gamma Curve: On
- Auto Button: Off
- Color Correction: Off
- PhotoShop Info Palette: Viewable on Screen

2. Insert the test target (Microtek 45IQ) into the slide carriage with the Microtek name right reading and facing up (Figure 2-7).

3. Insert the slide carriage into the slide scanner.
3. Click the **Preview** button in the Preview window to scan the entire test target. The Preview image of the test target is displayed.

4. Select the solid black squares.
5. Click the **Scan** button in the Preview window. This action causes the slide scanner to scan the selected solid black squares. The selected solid black squares appears.

6. Using the magnification tool, magnify the area on the left side of solid black square 6A (top corner of the left side solid black square) to 16:1.

   **Note:** The light colored borders appearing at the edges of the solid black square become more visible as the magnification is increased.

7. Select the eyedropper tool from the Adobe PhotoShop toolbox.
8. Using the eyedropper as a pointer, look at the R (red), G (green) and B (blue) levels displayed on the Info Palette.

**Note:** The magnified image of the solid black square shows the crosshairs at approximately the center of one of the apparent step transitions at the left edge of the solid black square.

9. Begin in the area 6A. Slowly move the eyedropper to the left while watching the changing R (red) level on the Info Palette.

**Note:** The Info Palette shows a R (red) level of 37 (see example on previous page).

10. Move the pointer to the left until the R (red) value level goes above 51.

11. Continue moving the pointer to the left until the R (red) level reaches 205.

12. Count the number of visible steps in the image between the values of 51 and 205.

**Step Transition Specification** - \( \leq 3 \) steps in the R (red), G (green) and B (blue) channels.

**Notes:**
- The magnified image of the solid black square indicates where the step value is 1.

In the example, it visually appears that there are two steps. However, the first step does not count because its value is less than 51. The first visible step indicates a level less than 51.

- The white area surrounding the solid black square reads a value much higher than 204 so it does not count as a step.

13. Repeat steps 8 through 12 to evaluate the G (Green) and the B (Blue) channels. Even though the green and blue values differ slightly, they should yield the same step value.

14. Repeat procedure for area 6B.

15. If the step transition is out of specification, slide scanner failure could be caused by:

- Test target covered with too much dust, dirt, or fingerprints.
- Out of focus - perform focus adjustment
- Analog noise, caused by defective: Power Supply, Main Controller board or CCD board.
Linearity

**Note:** This IQP test insures that scanned images are not distorted by the slide scanner optics. The *Microtek 451Q test target is used for this test.*

1. Setup scanning parameters as follows:

**Settings Dialog Box**

- **Type:** 256 Shades of Grey
- **Resolution:** 2000 dpi
- **Media Type:** Positive Transparency
  (Path - Preview Dialog Box : Preferences : Media Type)
- **More Options Box:** Click on the **More Options** button
  - **Use Linear Gamma Curve:** On
- **Auto Button:** Off
- **PhotoShop Info Palette:** Viewable on Screen

![Settings Dialog Box](image1)

![More Options](image2)

2. From PhotoShop’s Edit menu, reset the ruler units to centimeters.

(Path - Edit menu: Preferences: Units.....)
3. Insert the test target (Microtek 45IQ) into the slide carriage with the Microtek name right reading and facing up (Figure 2-8).

4. Insert the slide carriage into the slide scanner.

Figure 2-8. Slide carriage

5. Click the **Preview** button in the Preview window to scan the entire test target. The Preview image of the test target appears.
6. Select area of the slide, horizontally and vertically to include to 0 to 10 graduations on the left and top sides of the slide.

7. Click the **Scan** button in the Preview window. This action causes the slide scanner to scan the selected portion of the image. The selected portion of the image appears.

8. Using the magnification tool, magnify the top left corner of the image.

**Note:** Just below point 1A is where the 0 to 10 horizontal and vertical graduations meet. This is the starting point to measure the vertical size.
9. Using the marquee tool, click and drag a thin square from the point where the graduation lines cross.

10. Continue dragging down to the 10 mark. and the 1 to 3 scale begins (just above point 1C).

![Image of a thin square tool being used to measure linearity.]

11. Observe the W value at the bottom of the Info palette to make sure it is in specification.

**Specification:**

- Vertical Linearity (W) - 10 cm ± .1 cm
- Horizontal Linearity (H) - 10 cm ± .1 cm

12. Repeat steps 9 through 11 to check horizontal linearity.

13. If the W (vertical) or H (horizontal) linearity values are out of specification, readjust the slide scanner focus. Refer to the Focus Adjustment procedure in this section of the SS 45 Repair Manual.
Dynamic Range

Note: This IQP test measures the slide scanner’s ability to distinguish gray scales. The Kodak Q60 test target is used for this test.

1. Setup scanning parameters as follows:

   **Settings Dialog Box**

   - **Type:** Millions of Colors
   - **Resolution:** 500 dpi
   - **Media Type:** Positive Transparency
     (Path - Preview Dialog Box : Preferences : Media Type)
   - **More Options Box:** Click on the More Options button
     - Use Linear Gamma Curve: On
   - **Auto Button:** Off
   - **PhotoShop Info Palette:** Viewable on Screen

2. Insert the test target (Kodak Q60) into the slide carriage with the Kodak logo facing up at the bottom right of the holder (Figure 2-9).

3. Insert the slide carriage into the slide scanner.
4. Click the **Preview** button in the Preview window to scan the entire test target. The Preview image of the test target appears.

4. Select the greyscale step wedges at the left side of the test target.
5. Click the **Scan** button in the Preview window. This action causes the slide scanner to scan the selected greyscale step wedges at the left side of the test target.

**Note:** The image will be scanned at the selected resolution.

6. After the image appears, rotate it 90 degrees CCW for easier viewing. Rotate choice found under Image menu.

7. Using the magnification tool, magnify the area, for easier viewing, to approximately 1:1.

8. Click the marquee tool in the toolbox. Use the crosshairs to look at the image values displayed in the Info palette.

9. Position the crosshairs in the middle of the No. 1 grayscale wedge. Observe the R (red), G (green) and B (blue) values in the area.

10. Move the crosshairs to the middle of the No. 2 grayscale wedge. Observe the R (red), G (green) and B (blue) values in that area.

**Note:** The example shows that grayscale wedge No. 1 has a value of 188 for the R (red).

11. Visually inspect grayscale wedges No. 19 and No. 20.

**Notes:**

- If the slide scanner is working correctly, the transition (line) between greyscale wedge No. 19 and No. 20 should be visible.

- If the transition (line) is clearly visible, the test is complete.

- If the line is not clearly visible, perform steps 12 through 14 to help see the step transition.
12. Select the **Levels** control in the Image menu.

   (Path - Image: Adjust: Levels…)

13. Select the **Preview** in the dialog box to view the brightness level as the slider is moved in the next step.

14. Move the center slider on the **Input levels** to lighten the image for easier viewing.

15. Place the cursor arrow on top of the slider and then click-drag it to the left until the transition between grayscale wedges No. 19 and No. 20 are visible.

16. Click **OK**. A lightened image is displayed.

   **Note:** If the transition is not visible, the slide scanner is out of specification.

   **Specifications:**

   · Grayscale step wedges No. 1 and No. 2 are not saturated. (Measured brightness less than 255.)

   · Grayscale step wedges No. 19 and No. 20 recognizable.
17. If either test is out of specification, the slide scanner is defective. It could be caused by:

- Test target covered with too much dust, dirt, or fingerprints.
- Out of focus - perform focus adjustment
- Analog noise, caused by defective: Fan, Main Controller board, CCD board, Power Supply.
Motion

Note: This IQP test checks for linear motion stability. The Microtek 451Q test target is used for this test.

1. Setup scanning parameters as follows:

   **Settings Dialog Box**
   - Type: 256 Shades of Grey
   - Resolution: 2000 dpi
   - Media Type: Positive Transparency
     (Path - Preview Dialog Box : Preferences : Media Type)
   - More Options Box: Click on the More Options button
     - Use Linear Gamma Curve: On
   - Auto Button: Off

2. Insert the test target (Microtek 451Q) into the slide carriage with the Microtek name right reading and facing up (Figure 2-10).

3. Insert the slide carriage into the slide scanner.
4. Click the **Preview** button in the Preview window to scan the entire test target. The Preview image of the test target appears.

5. Select the entire vertical length of the line pattern in area 7A.
6. Click the **Scan** button in the Preview window. This action causes the slide scanner to scan the selected portion of the image. The selected portion of the image appears.

7. Look closely at the scanned image for jagged lines (discontinuities).

   **Note:** The unmagnified image shows vibration problems. Even at low magnifications vibration problems can be seen as darker areas in the image pattern.

8. Using the magnification tool, magnify the image to about 300% to clearly show the black and white line pairs.
9. Using the horizontal and vertical scroll bars, observe all the line pairs looking for jaggedness (discontinuities).

   Notes:  
   · If no jaggedness (discontinuities) is seen, test is complete.
   · If jaggedness (discontinuities) is seen, perform step 10.

10. Magnify the area so that a single pixel width can be seen. Choose Pixels under Ruler Options: in the Info Palette Options.

   Note:  Magnified image shows pixel discontinuity caused by vibration. Most of black lines are uniform left to right and about 5 pixels high.

   The line in the middle shows distortions and is about six pixels high, one pixel taller than the standard black lines.

11. If linearity is out of specification, slide scanner failure could be caused by:

   · Problems in any of the moving parts of the slide carriage.
   · Drive belt too tight.
   · Drive belt worn.
   · Drive belt gears worn or loose setscrews.
3. Troubleshooting

Scanner failures can be divided into three major categories: electrical, optical and mechanical. Here are the functional inspection steps:

- Power up the scanner/host system.
- Wait for the scanner’s READY indicator to shine steadily.
- Establish communication between scanner and host.
- Inspect scan quality.

Electrical Problems

Figure 3-1 shows a simplified block diagram indicating the types of electrical problems that may cause the scanner to malfunction. The troubleshooting guide in Table 3-1 lists and describes each electrical problem that may cause the scanner to malfunction. Table 3-1 also indicates the recommended corrective action that should be taken to repair the scanner.

![Simplified troubleshooting diagram](image-url)

Figure 3-1. Simplified troubleshooting diagram
### Table 3-1. Troubleshooting Guide

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>POWER LED off after scanner powered up</td>
<td>• Incorrect voltage to power supply</td>
<td>Make sure voltage is correct.</td>
</tr>
<tr>
<td></td>
<td>• Burned out or broken fuse</td>
<td>Replace burned out or broken fuse. Refer to replacement procedure in Section 2 of this Repair Manual.</td>
</tr>
<tr>
<td></td>
<td>• Power supply failure</td>
<td>Check power supply output voltages. Refer to Power Supply test procedure in this Section of the Repair Manual.</td>
</tr>
<tr>
<td></td>
<td>• Short circuit on main PC board</td>
<td>Refer to Short Circuit test procedure in this Section of the Repair Manual.</td>
</tr>
<tr>
<td></td>
<td>• Power LED failure</td>
<td>Check for:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• +5 VDC at J3, Pin 1 (Power LED off)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• +5 VDC at J9, Pin 3.</td>
</tr>
<tr>
<td>Note:</td>
<td>If replacing fuse does not correct the problem, return scanner for repair.</td>
<td></td>
</tr>
<tr>
<td>Note:</td>
<td>If voltages are correct, replace Power LED or LED cable.</td>
<td></td>
</tr>
</tbody>
</table>
Table 3-1. Troubleshooting Guide (Con’t)

<table>
<thead>
<tr>
<th>Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>READY LED off after scanner powered up</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Possible Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Scanner lamp failure</td>
</tr>
<tr>
<td>• READY LED failure</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refer to Scanner Lamp test procedure in this Section of the Repair Manual.</td>
</tr>
<tr>
<td>Check for +5 VDC at J9, Pin 3. If voltage is correct, check voltage at J9, Pin 1.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1</th>
<th>Ready LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>LED GND</td>
</tr>
<tr>
<td>3</td>
<td>Power LED</td>
</tr>
</tbody>
</table>

**Figure 3-2. Connector J9**

**Note:** If voltage is TTL high, main PC board failure exists, otherwise, normal operating conditions exist, replace Ready LED.

<table>
<thead>
<tr>
<th>Problem</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCD module failure</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Possible Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>• CCD module failure</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>A failure in the CCD module affects the CCD output waveform.</td>
</tr>
</tbody>
</table>

**Figure 3-3. Preprocessing CCD output waveform at TP7 (R), TP6 (G), and TP5 (B).**
### Table 3-1. Troubleshooting Guide (Con’t)

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>READY LED off after scanner powered up</td>
<td>• Main PC board failure</td>
<td>If the LED fails to light up, a main board PC failure exist, replace it.</td>
</tr>
</tbody>
</table>

**Note:** When scanner is turned on, carriage moves to home position, the Ready LED (CR6) flashes briefly. After twenty (20) seconds, the LED should light up.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ready LED on after scanner powered up</td>
<td>Scanner does not respond to host computer Start command</td>
<td>Check SCSI ID port. Refer to Checking SCSI Port procedure in this Section of the Repair Manual.</td>
</tr>
</tbody>
</table>
Checking Power Supply Output Voltages (Figure 3-4)

1. Open the scanner housing as explained in Section 2 of this Repair Manual.

2. Disconnect the power supply output cable from main PC board connectors J2 and J3 and connector J2 of the CCD board.

   **Note:** The power supply provides the power (voltage range -15 VDC to +15 VDC) to the main PC board as well as the power to the CCD board.

   Before testing the power supply, unplug connectors J2 and J3 on the main PC board. Also unplug connector J2 on the CCD board.

3. Connect a load resistor (5-50 ohms, 10 W) between Pin 1 and Pin 2 and then apply power.

4. Check each power supply output voltage.

   If any output voltage differs from the specifications by + 5% or more, replace the power supply.

---

**Figure 3-4. Power supply output voltages**
Checking for Short Circuit on Main PC Board

1. If applicable, reconnect power supply to main PC board, and then unplug all connectors except the power connector.

2. Power up the scanner and then measure all power supply output voltage.

   **Notes:** • If any output voltage is incorrect, replace the main PC board.
   • If all output voltages are correct, proceed to step 3.

3. Turn power off and then connect J2.

4. Turn power on and then check voltage from connector J3, Pin 7 (+15 VDC) to Pin 6 (GND).

   **Notes:** • If the voltage is incorrect, replace the CCD module.
   • If the voltage is correct, proceed to step 5.

5. Turn power off and connect J9.

6. Turn power on and then check voltage from J3, Pin 1 (+5 VDC) to J3, Pin 2 (GND).

   **Notes:** • If the voltage is incorrect, replace the LED assembly.
   • If the voltage is correct, proceed to step 7.

7. Turn power off and then connect J1 of the main PC board.

8. Turn power on and then check voltage from J3, Pin 7 (+15 VDC) to J3, Pin 6 (+15 VR [GND]).

   **Note:** If the voltage is incorrect, replace the AC inverter.
Checking Scanner Lamp

Note: Scanner lamp failure may be caused by:

- burned out lamp,
- incorrect lamp installation, or
- AC inverter failure.

1. Check ends of lamp. If ends are black indicating a burned-out lamp, replace it.

2. Check lamp to make certain it is correctly installed.

3. Check voltage from J1, Pin 1 (+15 VDC) to J31, Pin 2 (GND).

   Notes: • If the voltage is correct, either the scanner lamp is faulty or burned-out or the connector is faulty. Replace either the lamp, the connector, or both.

   • If the voltage is incorrect, check the power supply.

4. If the lamp still does not light up after the lamp, the connector, and the power supply have been checked, replace the AC inverter.

Checking SCSI Port

If READY LED comes on but the scanner does not respond to a Start Scanning command from the host computer:

1. Check to see if the SCSI ID is correct for both software program and the scanner.

2. Set the SCSI ID number to 7 and power up the scanner to enter self-test mode. (Shortly after, the scanner carriage will traverse up and down at a slow speed.)

   Note: If the scanner fails to perform this routine, a main PC board malfunction occurred.

3. Power off and set the SCSI ID to its original settings.

   Note: When the SCSI bus is confirmed OK, replace the main PC board.
Optical Problems

Optical problems usually affect only image quality and not scanner operation. Once the scanner power-up, self-test and communications link-up are all successfully completed, images can be scanned, displayed on a monitor and inspected with the zoom function.

Checking Focus and Alignment

Notes:

• Refer to Section 2 of this Repair Manual for a detailed description of the Focus Adjustment procedure.

• If resolution is degraded across the entire image, the lens may be out of focus.

• An imbalance in shading or resolution between the left and right sides of the image may be caused by improper alignment of the CCD module or the lens.

Problems of focus and alignment can be most accurately analyzed by measuring CCD response at TP7 (R) or TP6 (G) or TP5 (B) on the main PC board.

1. Attach the scope’s probe to TP10 and its ground line to TP12, Analog GND (AGND).

2. Disconnect the stepper motor power cable from connector J7, making sure that all other cables are connected, and then power up the scanner.

3. Rest the test slide on the slide carriage.

4. Push the slide carriage down so that the CCD sees the black/white line pairs.

5. Set the oscilloscope’s vertical trace to 0.5 V/div.

   Figure 3-5 shows optimum CCD response as displayed on an oscilloscope and a logic analyzer.

   Figure 3-6 shows CCD response when lens focus, lens or CCD alignment, and both focus and alignment are incorrect.
Figure 3-5. CCD response (correct focus and alignment)
Improper focus

Figure 3-6. CCD response (incorrect focus and alignment)
Correcting Focus and Alignment Problems

Analyze incorrect focus and alignment problems as shown in Figure 3-6 and then correct them by following this procedure.

**Notes:**
- Refer to Section 2 of this Repair Manual for a detailed description of the Focus Adjustment procedure.
- If the lens or the CCD module is out of alignment, install a new CCD module and return the old one to Polaroid for repair.

1. With the scanner and oscilloscope set up as described in the preceding section, loosen the lens setscrew, and then break the contact adhesive (green glue) holding the lens in place.

2. Taking care not to touch the lens surface, rotate the lens or move it in or out until the correct waveform is displayed.

3. Holding the lens firmly in its new position with one hand, tighten the lens setscrew with the other.

4. Reseal the lens with a contact adhesive such as green glue.
Mechanical Problems

Limit Switch

The limit switch is a photo sensor mounted on the chassis strut. It is used to establish the carriage home position at power-up, and before and after scanning. Proper positioning of this switch ensures that scanning will not begin before the scanning window is within view of the CCD.

To determine whether the limit switch is functioning properly:

1. Block the photo sensor beam with an opaque object.

2. Measure the voltage level at J11, Pin 2. (This pin should be at TTL high when the beam is blocked.)

   **Note:** If voltage is not TTL high, replace the limit switch assembly.
4. Disassembly

This section of the Repair Manual describes SprintScan 45 disassembly procedures. Before carrying out any of the procedures described in this section, make sure that the scanner has been turned off and the power cord has been disconnected.

To prevent any chance of electric shock, the SprintScan 45 housing should only be opened by a qualified repair person, and only after the scanner has been disconnected from the power source.

Care should be taken throughout all disassembly and reassembly procedures never to smudge or soil the lens or either mirror.

Removing Scanner Housing

1. Turn off the power and unplug the power cord.

2. Remove the six (6) screws securing the bottom of the housing (Figure 4-1).

3. The dog for sensing the film holder is at the left corner of the front door. Carefully hold the upper housing, tilt up the rear part, then advance the upper housing until the dog is passed through.
4. Tilt the rear part of upper housing for half an inch, you can see the 3-pin (J9) LED indicator connector (Figure 4-2). Disconnect the 3-pin (J9) connector.

![Figure 4-2. Disconnecting LED indicator connector J9](image)

To put the scanner housing back on, take these steps:

5. Close the scanner housing, align the tabs on the bottom of the scanner cover with the slots at the front and rear of the base, reconnect the LED indicator connector.

6. Hold the upper housing, align the dog into the hole and advance it in. Snap the cover back on, then retighten the screws.
Removing Scanner Lamp

Notes: • The scanner lamp should be replaced if it begins to flicker or dim, or if the READY indicator fails to come on and a lamp failure.

• Only use replacement lamps obtained from Polaroid or an authorized distributor. Use of any other lamp may adversely affect scanning results.

1. Turn off the power and unplug the power cord.

2. Remove the upper housing (Figure 4-3).

3. Unscrew the two (2) screws (Figure 4-4) that holds the lamp assembly in place.

4. Remove the lamp assembly.

Figure 4-3. Upper housing removed
5. Insert the new lamp assembly into its housing (Figure 4-5).
Removing Main PC Board

1. Remove the four (4) screws from the bottom housing (Figure 4-6).

2. Disconnect connectors J1, J2, J3, J5, J7, J8, J10 and J11 from the main PC board after you lift the upper housing away.

3. Pull the main PC board out (Figure 4-7).

4. Remove the main PC board.
Removing Power Fuse

Notes: • If the POWER indicator, READY indicator and scanner lamp all fail to light up when the SprintScan 45 is turned on, first make sure that power exists at the source.

• If power availability can be confirmed and the unit’s lights still fail to come on, check the fuse.

1. Detach the power cord from the scanner.

2. Gently pry the fuse holder from the rear panel.

3. Replace a burned out or damaged fuse (Figure 4-8) with a 5 mm x 20 mm (0.97” x 0.787”) normal blow (fast-acting) fuse rated at 1.6A/250V.

Note: The fuse close to the rear panel is the spare.

![Figure 4-8. Replacing power fuse](image)
Removing Stepper Motor

1. Unfasten the four (4) screws (Figure 4-9) which holds the stepper motor.

![Figure 4-9. Stepper motor screws](image1.png)

2. Take the timing-belt (Figure 4-10) out.

3. Remove the stepper motor.

![Figure 4-10. Removing stepper motor](image2.png)
Removing AC Inverter

1. Disconnect connector J1.

2. Remove the AC inverter (Figure 4-11).

Note: There is a fuse (Figure 4-12) in the AC inverter assembly. If necessary, replace it.

Figure 4-11. Removing AC inverter

Figure 4-12. Replacing AC inverter fuse
Removing Power Supply

1. Unfasten the four (4) screws which holds the power supply (Figure 4-13).

2. Push the power supply forward and remove it from the bottom of the housing.

Figure 4-13. Removing power supply
Removing Mirror Assembly

Notes: There are two mirrors in the SprintScan 45. When changing mirrors, check to be sure the facing sides are correct.

1. Use your tool to snap the clips (Figure 4-14). Each mirror has two clips to hold it in place.

2. Remove and change the mirror.

    Notes: When mirror need to be changed, remember to remove the protective film of the new mirror.

Figure 4-14. Removing mirror