GS-900™ Calibrated Densitometer with Image Lab™ Software

Instrument Guide

Version 6.0

BIO·RAD

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Bio-Rad Technical Support Department

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Credits

1. Image Lab software is based in part on the work of the Qwt project (http://qwt.sf.net).

2. Image Lab software is based in part on the work of the CImg project (http://cimg.sourceforge.net/). See license for details at http://www.cecill.info/licences/Licence_CeCILL-C_V1-en.html.

3. Image Lab software is based in part on the work of the Independent JPEG Group (http://www.ijg.org/).

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Safety and Regulatory Compliance

Important Safety Information

Please read these instructions before attempting to operate the GS-900™ calibrated densitometer.

This instrument is suitable for research use only. It must be used, therefore, only by specialized personnel who know the health risks associated with the reagents that are normally used with this instrument.

Warranty

The GS-900™ calibrated densitometer is warranted against defects in materials and workmanship for one year. If any defect occurs in the instrument during this warranty period, Bio-Rad Laboratories, Inc. will repair or replace the defective parts at its discretion without charge. The following defects, however, are specifically excluded:

- Defects caused by improper operation

- Repair or modification done by anyone other than Bio-Rad Laboratories, Inc. or the company's authorized agent

- Use of spare parts supplied by anyone other than Bio-Rad Laboratories, Inc.

- Damage caused by accident or misuse

- Damage caused by disaster

- Corrosion caused by improper solvents or samples

General Precautions

- Read the user guide carefully.

- The instrument must be used only for the intended purpose of gel documentation in research laboratories.

- The instrument must be connected to a grounded power source line and protected by a circuit breaker.

- Do not pour liquids directly on or inside the instrument.

- Switch off all lights on the instrument immediately after use.

- Clean the transilluminator sample area after use.

Regulatory Notices

The GS-900 densitometer is designed and certified to meet EN 61010-1, the internationally accepted electrical safety standard, EMC regulations, and TUV requirements. Certified products are safe to use when operated in accordance with this user guide. Do not modify or alter this instrument in any way. Modification or alteration of this instrument will

- Void the manufacturer's warranty

- Void the regulatory certifications

- Create a potential safety hazard

Alert Icons

Alert icons call attention to caution and warning paragraphs in this guide. The icon indicates the type of hazard addressed.

Table 1. How alert icons are used in this guide

Icon	Explanation
	General Indicates a potential hazard requiring special attention. This icon appears when the hazard or condition is of a general nature.
	Electrical hazard Indicates a potential hazard requiring special attention when you are working with electricity or electrical equipment.
	Extreme heat and flammable materials Indicates a potential hazard requiring special attention when you are working with extreme heat and flammable materials.
	Radiation hazard Indicates a potential hazard requiring special attention when you are working with UV radiation.

Cautions

A caution alerts you to take or avoid a specific action that could result in loss of data or damage to the instrument. A caution can also indicate that, if the precaution against a potential hazard is not taken, minor or moderate injury might occur.

Example

 Caution: With the exception of cleaning or replacing light bulbs, refer all servicing to qualified Bio-Rad personnel or their agents.

Warnings

A warning precedes an action that, if not followed correctly, could cause serious injury or death to the operator, serious or total loss of data, or serious damage to the instrument.

Example

WARNING! This instrument must be connected to an appropriate AC voltage outlet that is properly grounded.

Instrument Safety Warnings

Before you operate the instrument, carefully read the contents of Table 2.

Table 2. Safety cautions and warnings for the instrument

Icon	Meaning
	Caution: With the exception of cleaning or replacing light bulbs, refer all servicing to qualified Bio-Rad personnel or their agents. If you experience technical difficulties with the instrument, contact Bio-Rad to schedule service. The instrument should not be modified or altered in any way. Alteration voids the manufacturer's warranty and might create a potential safety hazard for the user.
	WARNING! This instrument must be connected to an appropriate AC voltage outlet that is properly grounded.
	Note: This Bio-Rad product is designed and certified to meet EN 61010-1 safety standards. Certified products are safe to use when operated in accordance with the instrument guide. This instrument should not be modified or altered in any way. Alteration of this instrument will void the warranty, void the EN 61010-1 certification, and create a potential safety hazard. This safety certification does not extend to other equipment or accessories not EN61010-1 certified, even when connected to this product.

Notice

The GS-900™ densitometer is intended for laboratory use only. This device is meant for use by specialized personnel who know the health risks associated with reagents normally used in electrophoresis. Bio-Rad Laboratories, Inc. is not responsible for any injury or damage caused by use of this instrument for purposes other than those for which it is intended, or for instrument modifications not performed by Bio-Rad Laboratories, Inc. or an authorized agent.

Safety and Regulatory Compliance

1   Introduction

The GS-900™ calibrated densitometer acquires images of transparent and opaque electrophoretic samples. The GS-900 calibrates to an internal National Institutes of Standards and Technology (NIST)-traceable reference standard for optimal accuracy and reproducibility.

With Image Lab™ software, you control the instrument, analyze the resulting image, and produce a report in a format you choose.

Note: The GS-900 calibrated densitometer is supported with Image Lab running on a computer using the Microsoft Windows operating system only.

Main Features of the GS-900 Calibrated Densitometer

- Transmissive and reflective scanning modes

- Wide dynamic range:

    - Transmissive: 0.0–3.4 OD (specular)

    - Reflective: 0.0–2.7 OD (specular)

- Calibration to internal reference standards (NIST-traceable for transmissive scans)

- User-selectable scanning resolution from 36.3 to 127.2 μm

- Image acquisition with 16-bit depth

- Scanning area of 29 x 33 cm for positioning of large or multiple samples

Measurement of Optical Density

The GS-900 calibrated densitometer uses internal calibration standards to ensure accurate optical density measurements of scanned samples. The internal calibration standards consist of either a piece of photographic film (for transmissive scans) or a piece of photographic paper (for reflective scans) that have been exposed in order to generate several areas, or steps, with different optical densities. The optical densities of these steps are accurately measured before being installed into the instrument, and the instrument is preprogrammed with these values.

Prior to each scan of a sample, the appropriate calibration standard is scanned and the light intensity levels for each step of the standard are used to correlate the sample detected light intensity to a known optical density found on the calibration standard. This allows light intensity levels measured on the sample area to be correlated to a known optical density value and ensures accurate and reproducible optical density measurements of scanned samples.

During manufacture, the internal calibration standard is measured using an instrument capable of diffuse density measurements. However, the internal calibration standard diffuses light differently than protein bands on a Coomassie stained gel. Additionally, the light collection angles of the optics in the GS-900 make it unsuitable for diffuse density measurements. For these reasons, specular density measurements are more appropriate for Coomassie stained gels that are imaged with the densitometer, and Image Lab reports specular density values only.

Technical Specifications

Scannable Sample Types	
Transparent	■ Polyacrylamide gels ■ Film
Reflective	Blotting membranes
Software Specifications	
Supported file types	■ Import: .scn, .1sc ■ Export: .tif, .jpg, .bmp, .png
Hardware Specifications	
Image sensor type	Tri-linear CCD with three filters (red, green, blue)
Resolution	■ Spot size (μm): 36.3, 42.3, 63.5, 95.3, 127.0
Light source	LED
Scanning area	■ Transparent: 29.0 x 33.0 cm ■ Reflective: 29.0 x 33.0 cm
Dynamic range	■ Transmissive: 0.0–3.4 OD (specular) ■ Reflective: 0.0–2.7 OD (specular)
Bit depth	■ Input: 16-bit gray scale ■ Output: 16-bit gray scale
Calibration	■ Transmissive: To internal NIST-traceable transmissive reference standard ■ Reflective: To internal reflective reference standard
Connectivity	USB 2.0
Operating voltage	100–240 V AC, 47–63 Hz
Power consumption	54.0 watts
Operating temperature	10–28°C
Operating humidity	<70% noncondensing
Dimensions	■ Length: 63 cm ■ Height: 19 cm ■ Width: 38 cm
Weight	16 kg (35.4 lbs)

2 Setting Up the Imager

Calibrating the GS-900 Densitometer

Before you can use Image Lab^{TM} with the GS-900™ densitometer, Image Lab must calibrate and acquire the flat images.

Note: It can take up to 30 minutes to acquire a flat image.

When you first connect the instrument to the computer running Image Lab, the software prompts you to begin calibration.

After the densitometer has been in use for some time, it might require recalibration for one of the following reasons:

- Scheduled recalibration according to your institution's procedures

- Presence of visible artifacts such as a non-uniform background or streaks

To prepare the densitometer for initial calibration

1. Ensure that the following surfaces are clean and free of scratches:

    - Sample area

    - Calibration area (the narrow band of glass near the sample area)

    - Glass on the transmission module

2. Close the densitometer lid and turn on the densitometer.

3. Connect the densitometer to the computer running Image Lab.

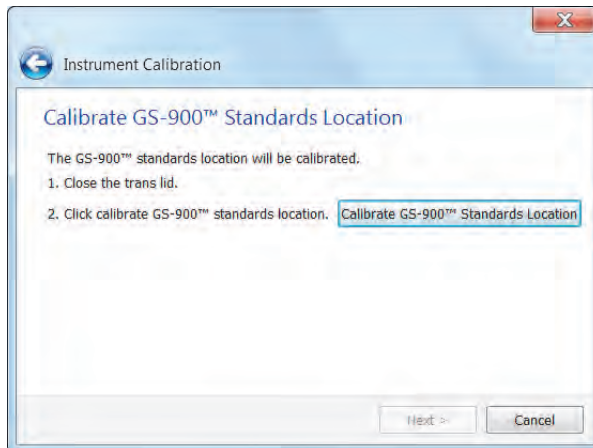**To calibrate the densitometer**

1. Start Image Lab.

   The Instrument Calibration dialog box appears. It identifies the instrument to which your computer is connected.
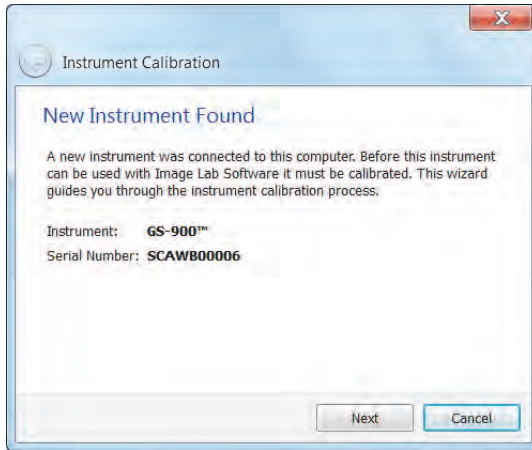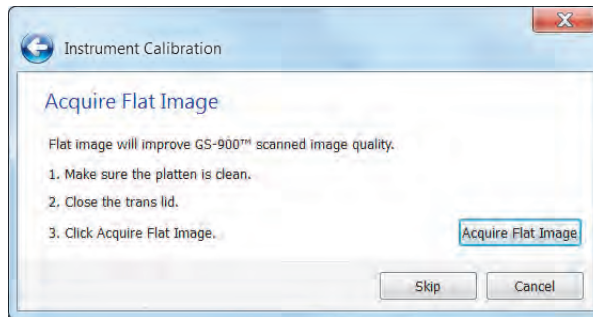

2. Click Next.

   The Calibrate GS-900 Standards Location screen appears.

3. Click Calibrate GS-900 Standards Location.

    A dialog box monitors the progress of the calibration. When the standards location is calibrated, the Acquire Flat Image dialog box appears.

4. Click Acquire Flat Image.

    A progress indicator monitors the acquisition. After the instrument acquires the flat image, the Setup Summary dialog box appears.
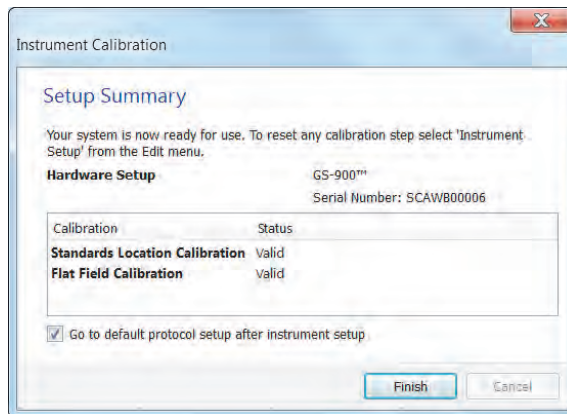
    By default, the Go to default protocol setup after instrument setup checkbox is selected.

5. If you do not want to set up a default protocol now, clear the checkbox and click Finish. You can set up the default protocol later. See Chapter 3, Acquiring Images for instructions.

3 Acquiring Images

Image Lab™ software runs configurable application-based protocols for sample imaging. In a single acquisition, a protocol runs a combination of settings for acquiring an image, analyzing it, and creating a customized report.

An image Lab protocol defines an application, its scan options, and analysis and reporting functions. You can run a default protocol by pressing the green Run button on the densitometer. The densitometer acquires the image using the default protocol application and settings. You can create a default protocol for the set of acquisition settings you use most often.

Protocols can be retrieved, revised, and reused. You can also save protocols with different settings and run them in Image Lab software.

Note: Images you scan at high resolution result in large files. For this reason, Bio-Rad recommends archiving images by exporting the files to a network file server or to removable storage media.

For more detailed information about protocols, see the Image Lab Software User Guide.

Creating a Protocol

Creating a protocol consists of configuring acquisition, analysis, and output settings. Analysis and output settings are optional.

To create a protocol, you configure these settings on the Protocol Setup screens. The title bar above the Protocol Setup screen displays the protocol name and imager type.Main steps appear as headings in the left pane of each screen. Numbered steps appear under these headings.
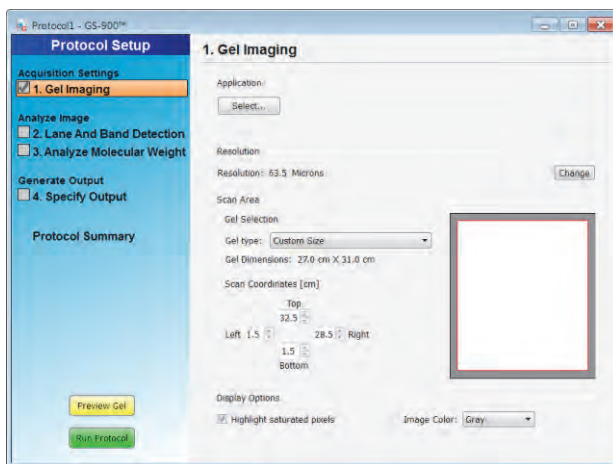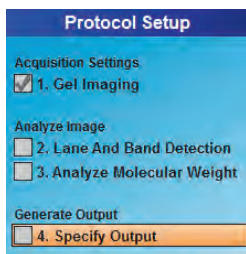

Analysis settings consist of the following:

- Detecting lanes and bands

- Analyzing molecular weight

Output settings consist of the following:

- Printing the image

- Printing the report

- Displaying the report

To choose options for a protocol step, select the checkbox to the left of the numbered step. To disable a numbered step, clear its checkbox.

Options for the selected step appear on the right side of the screen.

Accessing Protocol Setup Screens

To access the default Protocol Setup screen

1. Verify that the name of your imager appears on the status bar.

    A green check mark next to the imager name indicates that the imager is connected to the computer running Image Lab software and is communicating with Image Lab.
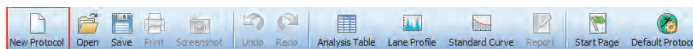
2. Click Default Protocols on the toolbar.

3. The Default Protocol Setup dialog box appears.Click Create.
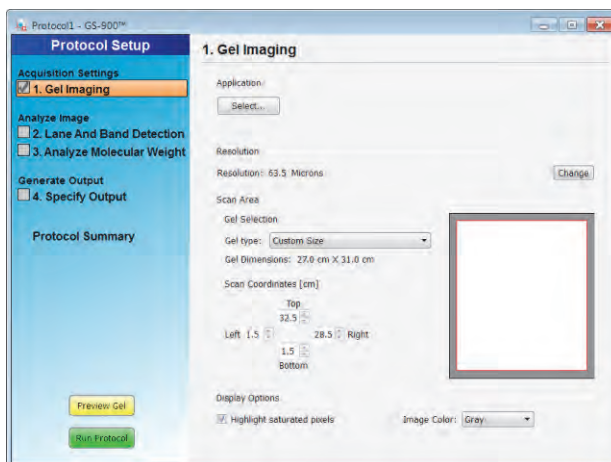
    The Default Protocol Setup screen appears.

To access the Protocol Setup screen for any other protocol

1. Verify that GS-900 appears on the status bar.

2. Click New Protocol on the toolbar.

The Protocol Setup screen appears with Gel Imaging selected. Acquisition options appear in the right pane.

The Protocol Setup screen appears. Gel Imaging is selected in the left pane.

Gel imaging options appear on the right side of the Protocol Setup screen. The protocol name appears in the title bar. You can change this name when you save the protocol.

Choosing an Application

The term *application* refers to sample type. The sample types consist of the following options:

- Nucleic acid gel, protein gel, or blot

- Detection reagent — dye or stain

In the Gel Imaging Protocol Setup screen, you can choose from a list of predefined applications for common sample types. Each sample type is predefined with optimal acquisition settings.

Note: To use a dye or stain not listed in the Application dropdown menus, you can choose the application type Custom and create a custom application. For more information, see Setting Up a Custom Application in this chapter.

To configure the acquisition settings

1. Under Applications, click Select and choose an application on the menu that appears
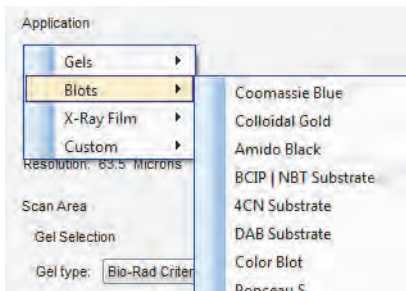
2. Under Resolution, click Change to set the resolution value.

Tip: Resolution is a measure of pixel size in microns. The default resolution value of 63.5 microns usually provides sufficient resolution to obtain a good quality image. Decreasing the resolution value increases the number of pixels scanned, which increases the resolution. Increasing the resolution also increases the scan time and the file size.

3. Under Scan Area, select the gel type you want to scan.
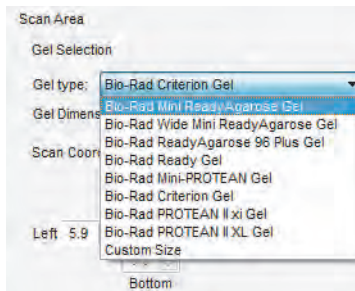
When you select a gel type, the values in the scan area automatically change to match the size of the selected gel.

4. Under Display Options, you can select the following:

- **Highlight saturated pixels** — to display saturated pixels in red, which indicates how much of the gel image is saturated. You can change this option at any time by selecting View > Image Transform.

- **Image color** — to select a color scheme for displaying the sample image. Viewing the image in a different color scheme can make all of its elements more visible. See the chapter, Viewing Images, in the Image Lab Software User Guide for more information.

5. Save the protocol and run it or go to the analysis or output settings.

To specify the scan area for custom size gels

1. Under Scan Coordinates, change the coordinate settings to increase or decrease the size of the scan area.

2. Save each coordinate setting when you change it.

The Protocol screen displays the scan area with the coordinate values you select.
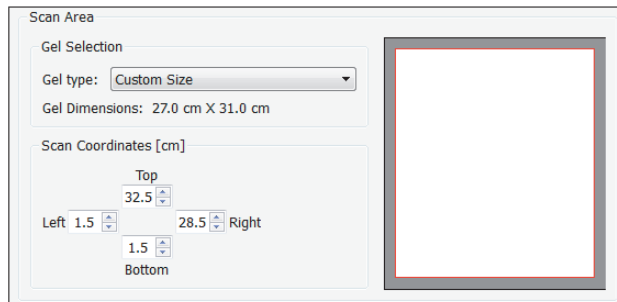
For more information about resetting scan coordinates, see Previewing the Gel in this chapter.

Configuring Analysis Settings

To analyze a gel or blot automatically, configure analysis settings in the following protocol setup tasks:

■ Detect Lanes and Bands

■ Analyze Molecular Weight

For information about these settings, see the chapter, Protocols, in the Image Lab Software User Guide.

Configuring Output Settings

When you display a report, a scrollable report screen appears in which you can view the image, acquisition settings, and analysis data. You can view or print a single image or report.

Note: You cannot print a report on a thermal printer.

To specify protocol output

1. Select Specify Output in the left pane of the Protocol Setup screen.

    Output options appear in the right pane.
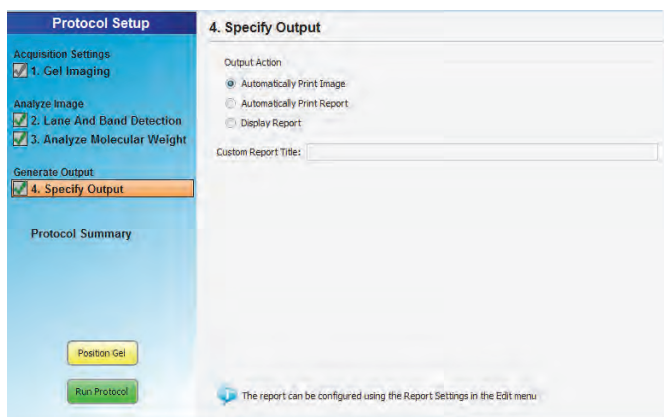
2. Choose one of the following:

- Automatically print the image

- Automatically print a report

- Display the report

Image Lab prints to the default printer unless you select another printer.

See the chapter, Generating Reports, in the Image Lab Software User Guide for information about customizing reports.

For more information about running a protocol, see the chapter, Protocols, in the Image Lab Software User Guide.

Positioning the Sample

To position a sample

1. Ensure that the sample area is clean and free of dust and other contaminants. Contamination can degrade the results.

2. Place the sample on the sample area.

3. Lower the lid.

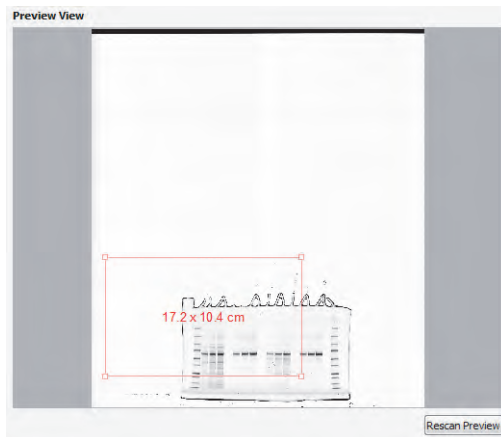For more information, see Cleaning the Imaging Surfaces on page 35.

Previewing the Gel

Preview the gel to ensure that the scan coordinates are set correctly.
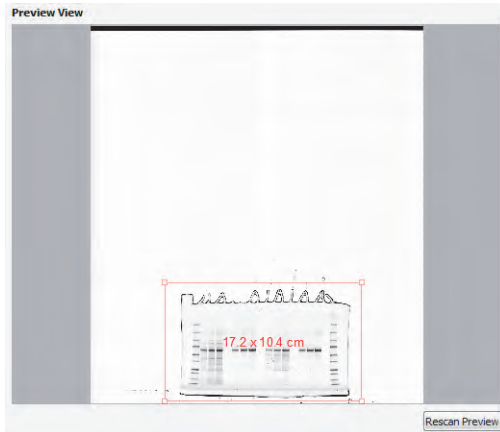
To preview a gel

1. Open the protocol.

2. In the left pane, click Preview Gel.

The densitometer scans the sample. As the scan progresses, Image Lab displays the scan in a scan area box outlined in red.

3. If the scan area box does not include the sample or bands of interest, do one of the following:

    ■ Click Cancel Run and reset the scan coordinates.

    ■ Place the pointer in the scan box and drag the corners of the box to include the area that contains the sample or bands of interest.

4. Click Rescan Preview and then examine the rescanned sample.

5. When the preview is acceptable, click Run Protocol in the left pane.

   All changes to preview scans are listed in the document log.

Running the Default Protocol

Save the default protocol and close the Profile Setup screen before you start the next procedure.

To run a default protocol for one sample

1. Open the densitometer lid.

2. Place a sample on the sample area.

3. Close the lid.

4. Press the green Run button on the front of the densitometer.

The Default Protocol screen opens and the default protocol runs automatically.The acquired image appears with the Protocol Setup screen open behind it.

**To run a default protocol for several samples**

1. Open the densitometer lid.

2. Place a sample on the sample area.

3. Close the lid.

4. Press the green Run button on the front of the GS-900 densitometer.

   The Default Protocol screen opens and the default protocol runs automatically.

5. Save the image that appears.

6. Open the lid.

7. Remove the sample and insert another sample.

8. Close the lid.

9. On the Protocol Summary screen, click the Run button.
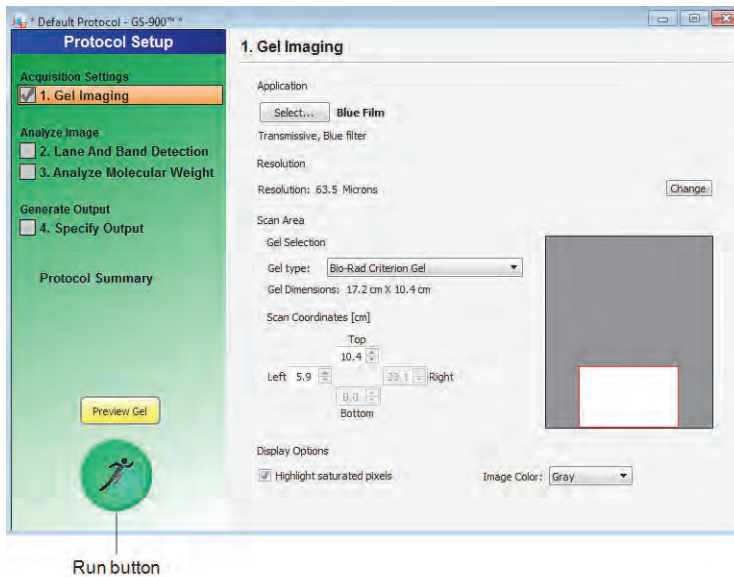
Run button

10. Save the image.

11. Repeat steps 6–10 to run each remaining sample.

Running Any Other Protocol

Only the default protocol can be run by pressing the Run button on the densitometer. All other protocols are run from Image Lab Software, as described in the next procedure.

To run a protocol

1. Position the sample on the sample area of the densitometer.

2. Close the lid.

3. On the toolbar, click Open.

4. Browse to the protocol, select it, and click Open.

   The Protocol Setup screen appears.

5. (Optional) If you are not certain that the scan coordinates are set correctly, click Preview Gel and evaluate the preview image.

6. Click Run Protocol in the left pane of the Protocol Setup screen.

After the protocol runs, the acquired image appears with the Protocol Setup screen open behind it.

Setting Up a Custom Application

When you create a protocol, Image Lab displays a list of application types and predefined applications for acquiring images. To use a dye or stain not listed in the Application dropdown menus, you can choose the application type Custom and create a custom application. Also choose Custom to do the following:

- Choose a previously saved custom application

- Edit or rename a custom application

Note: If you are not sure how to configure a custom application for a dye or stain, contact Bio-Rad Technical Support.

To create a custom application

1. On the Protocol Setup screen, select Gel Imaging.

2. Under Application, click Select and choose Custom on the menu that appears.

    The Manage Custom Applications dialog box appears.

3. Click New.

    The Create Custom Application dialog box appears.
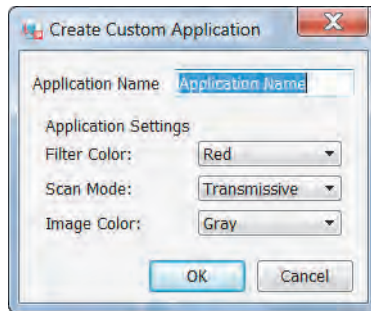
4. Enter a unique application name and select a filter color, scan mode, and image color.

5. Selecting the filter color conveys information to the instrument that ensures proper imager acquisition. Choose one of the following scan modes:

- **Transmissive** — light from the top of the densitometer passes through the gel. Choose this option to scan gels or transparent objects such as X-rays or film.

■ **Reflective** — light from the bottom of the densitometer reflects off the gel. Choose this option to scan blots or opaque objects such as paper or photographs.

6. Click OK.

Editing a Protocol

You can open a protocol, change its settings, and save it with another name. You can also disable a step in the saved protocol. When you edit a default protocol and save it with a new name, the default protocol is unaffected. See the chapter, Protocols, in the Image Lab Software User Guide for more information.

A   Maintaining the GS-900 Densitometer

Regular cleaning ensures that your GS-900™ calibrated densitometer will continue to perform optimally. This appendix explains proper care for the densitometer.

Caution: No user-serviceable parts are inside the densitometer. Refer servicing questions to Bio-Rad service personnel.

Cleaning the Imaging Surfaces

During normal operation, residue can build up on the three glass areas:

■   Sample area

■   Calibration area (the narrow band of glass near the sample area)

■   Transmission module on the lid

Use a nonabrasive, lint-free towelette and a 70% ethanol solution to clean the glass in these areas. Avoid using excessive liquid around the power switch and connector outlets located on the back side of the unit.

Note: Residual Coomassie stain on the sample and calibration areas can affect image data. The glass sample and calibration areas should be cleaned with a 70% solution of ethanol until no remaining stain is seen on the towelette.

Recalibrating the GS-900 Densitometer

When you first connect the GS-900 densitometer to the computer on which Image Lab™ is running, the instrument automatically begins initial calibration. When the densitometer has been in use for some time, it might require recalibration for one of the following reasons:

- Scheduled recalibration according to your institution's procedures

- Presence of visible artifacts such as a non-uniform background or streaks

Recalibrating the densitometer consists of three tasks:

- Preparing the instrument and Image Lab.

- Recalibrating standards locations, if necessary.

- Recalibrating flat field, if necessary.

You can recalibrate the standard locations or the flat field, or both.

To prepare for recalibrating the densitometer

1. Ensure that the sample glass, the glass on the transmission module, and the glass in the calibration area are clean and free of scratches.

2. Ensure that the lid on the densitometer is lowered.

3. Turn on the densitometer.

4. Connect the densitometer to the computer running Image Lab.

5. Start Image Lab on the computer.

6. On the Edit menu, click Instrument Setup.

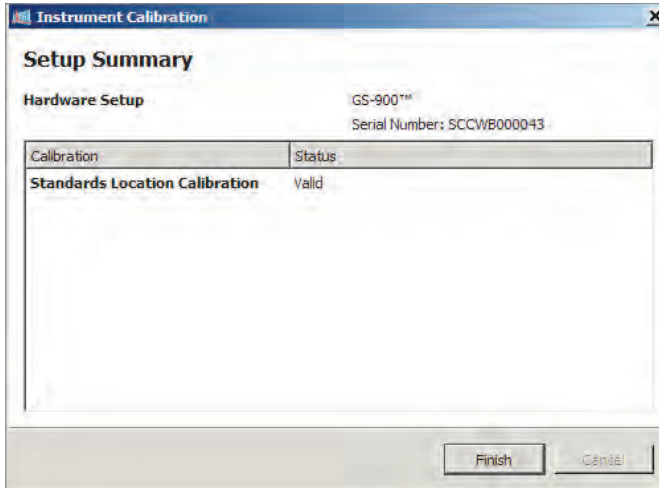The Instrument Setup dialog box appears.
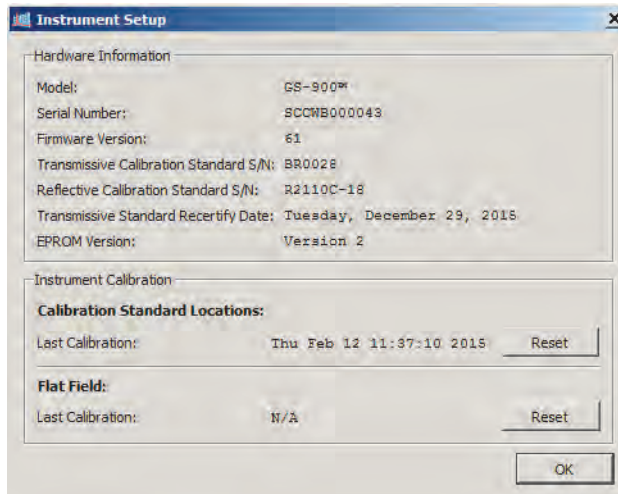
To recalibrate standard locations

1. Under Calibration Standard Locations, click Reset.

    The Calibrate GS-900 Standard Location dialog box appears.

2. Click Calibrate GS-900 Standard Locations.

    Calibration begins. A progress box monitors its progress. When calibration ends, the Setup Summary dialog box appears.

3. Check the Status entry to ensure that the calibration is valid.

4. Click Finish.

   The Instrument Setup dialog box reappears.

To recalibrate flat field

Note: Acquiring flat images can take up to 30 minutes.

1. In the Instrument Setup dialog box, Under Flat Field click Reset.

   The Acquire Flat Image dialog box appears.

2. Click Acquire Flat Image.

   A progress box monitors the calibration.

3. When calibration ends, the Setup Summary dialog box appears.

4. Check the Status entry to ensure that the calibration is valid.

5. Click Finish.

6. When the Instrument Setup dialog box appears, click OK.

Next Steps

If the standard locations or flat field recalibration fails, clean the sample glass and the glass on the transmission module and recalibrate again. If recalibration fails again, contact Bio-Rad Technical Support.

Recertifying the Calibration Standard

The internal transmissive calibration standard is certified to an NIST-traceable standard for two years. Two years after the last certification date of the internal transmissive calibration standard, a Bio-Rad service engineer must recertify or replace it. Two months before this date, Image Lab displays a message to this effect similar to the following:
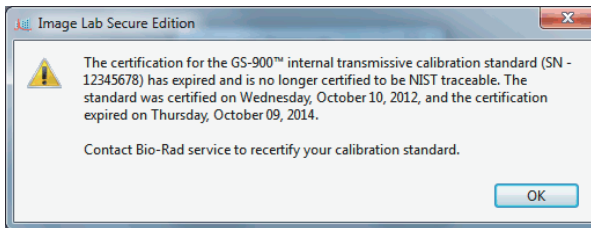
A second message appears on the date the certification expires. In Image Lab on the Edit menu, click Instrument Setup to access the Instrument Setup screen and verify the expiration date. Contact Bio-Rad technical support to replace or recertify the calibration standard.

For more information about the internal calibration standards, see Measurement of Optical Density on page 12.

B Troubleshooting

Follow these suggestions to troubleshoot your GS-900™ densitometer.

Problem	Possible Cause	Solution
Instrument does not scan and makes a loud clicking noise during attempted scan or during startup initialization.	Upper or lower carriage locking mechanisms are still locked.	Unlock carriage locking mechanisms.
Instrument fails to perform a scan and Image Lab reports that debris is on the imaging area.	Water or foreign matter is on the calibration area of the instrument.	Clean the calibration area and ensure that water drops are wiped up when transferring gels to the sample area. For more information, see Cleaning the Imaging Surfaces on page 35.
Streaks or other dark or light regions appear in the image (most apparent when the entire sample area is scanned and the resulting image is transformed to emphasize faint signal.)	Contamination or foreign object is on calibration or sample area.	Reset Flat Field calibration. For more information, see Recalibrating the GS-900 Densitometer on page 36. **Note:** Coomassie stain might build up during normal use. It is recommended that the calibration and sample area be thoroughly cleaned with 70% ethanol on a regular basis.

C   Accessories

Ordering Information

Table 3 lists catalog numbers and descriptions for the GS-900^{TM} densitometer and Image Lab^{TM} software. For more information, see the Bio-Rad catalog.

Table 3. Ordering information

Catalog #	Description
1707991	GS-900 Calibrated Densitometry System with Image Lab software
Image Lab Software	
1709690	Image Lab software, Windows
1709691	Image Lab software, Security Edition, Windows

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