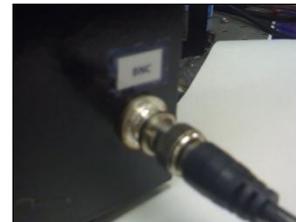


MSD P10541 Microgoniophotometer Operating Manual

1. Begin by setting device on a stable platform where it will not be disrupted or disturbed during data collection. It is important that the device is not moved, bumped, or experience vibration during data collection, or inaccurate data may result.
2. Remove lens cover from camera. Check to ensure power cable is connected to camera. Make sure BNC cable is connected between camera and the port inside the device. Connect the device to the computer through BNC cable. (Note: Frame grabbing computer card must be installed in the computer).



3. How to select appropriate LED color for sample:

[It does not matter if red or green is used for reference sample data collection. Typically, red is used for low gloss samples because it produces a more intense light, and green is used for high gloss samples because it is a less intense light. It is less likely to over-expose a high gloss sample when using the green LED.]

4. Select the LED light color to by moving the 3-way toggle switch to the position corresponding to desired light color.



Turn the device main power switch to the ON position, make sure the indication LED light located above the toggle switch is on, and check the LED light inside the device to be the same color selected using the toggle switch.

Make sure the fiber optics cable inside the device is connected to the chosen LED.



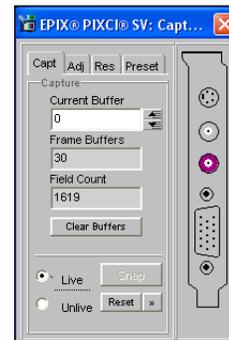
5. Turn on the computer. Start software program [“EPIX for Windows” located on the computer desktop] used to capture camera images. The live video feed window should pop-up automatically.

6. Adjust F-stop to fully open position (0.700 inches) and adjust zoom to smallest field of view, or the fully zoomed-in view. The zoom adjustment is located on the camera lens and is labeled with a W (wide view) and a T (tight or fully zoomed.)



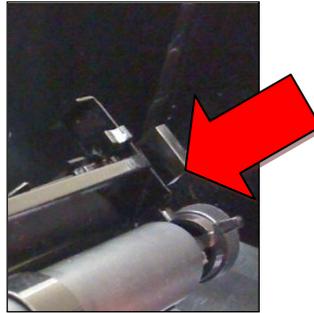
Move polarizer pull lever to the fully extended position so that all light is passing through it. There are two positions for the sliding polarizer to get the “bright” or “dark” image. Pulling the rod outward will be the “bright” position.

7. Check to make sure the camera is feeding a live image to the live feeding window. If no image appears, make certain the correct port is selected on the port selection interface by clicking on the port image. The correct port should be the one shown highlighted in purple. (See picture on the left.) If the device has been disconnected and a different port is being used, it may be necessary to select the other BNC port. Also, check that the “live” option has been selected as shown in the picture. The image has a tendency to freeze-up sometimes, but this can be corrected by clicking on “unlive” and back to “live” again. If the image still does not appear, check zoom and F-stop adjustments for correct settings, and recheck steps 2, 3 and 4.



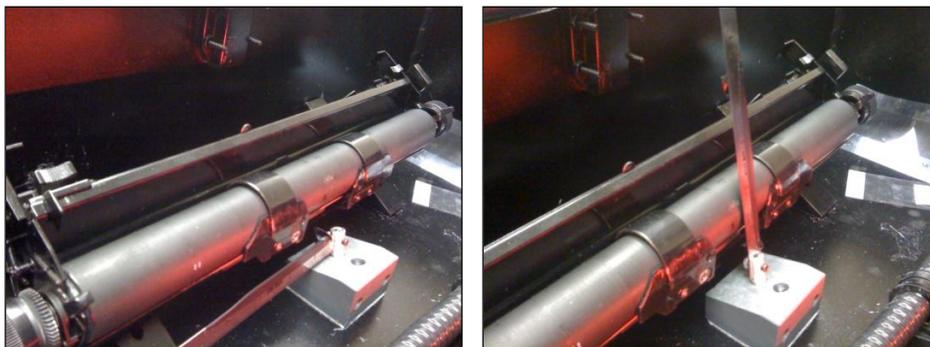
8. **Sample Loading:** *[This step should **first** be performed with the **reference sample** when initially setting-up the device, or when using the device after it has been previously powered down. This same procedure will apply for the actual **test sample(s)** after the reference sample image captures have been taken.]* Load reference sample (black electrical tape) into sample roller. Be careful not to touch the black reference sample surface. This will leave oily residue on the surface and could effect data collection. The sample should be **tight** against the roller and aligned so that the edges of the sample are perpendicular to the central axis of the roller. If the sample is skewed or improperly aligned, the data results will be inaccurate. Adjust (turn) sample roller knobs such that sample is facing camera lens. Adjust roller slide position so sample is aligned in front of camera lens by

pressing down on the black button located at end of roller, and slide roller to proper position. (Button is indicated in picture below.) At this point, the sample should be positioned in the center of the video window on the computer monitor.



9. Adjust zoom such that the video window on the computer monitor shows only the black reference sample image, and no part of the sample roller. Adjust focus on camera lens to bring sample into focus. Watch the video monitor as adjustment is being made to ensure correct focal adjustment.

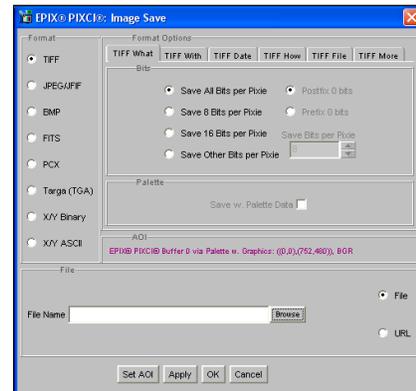
10. **Field of view measurement:** There is a small ruler located in front of the sample holder as shown in pictures below. Position the ruler so it is standing straight up and perpendicular to the device floor. Look at the video monitor window to help ensure the ruler is not leaning slightly to the left or right. Each small hash mark on the ruler indicates $1/64$ ". Count the number of hash marks to determine the width of view in inches, and then convert the inch value to millimeters (may need to use internet or unit conversion table for this.) Write down the width of field in millimeters as it will need to be used as an input value for the software.



11. **Image Capture and Saturation Testing:** Make sure the light source is on and then close the lid to the device. Take the first (bright) image after having completed the previous steps (loading the sample, adjusting zoom, focus, F-stop value and pulling the polarizer rod outwards.)

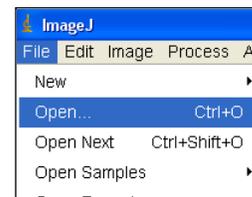


To save the image click:
(File > Save Image).



12. When the window appears, click on “Browse”, choose the appropriate image folder or desired save location, and name the image. It is suggested that the file name include the word “bright” and “ref” (for reference) to differentiate it from the next (dark) image capture (e.g. brightref001, brightref_image1, bright_refsamle.) Hit OK when finished.

Open the ImageJ software icon located on the computer desktop. Go to “File” and open the image you had just previously saved. Then, using the keyboard, press the buttons “Ctrl+M” simultaneously. A small window will appear giving you pixel values for the image. The maximum pixel value is on the right hand side of the window. If this value reads 255, then the image is over exposed. To correct this problem, follow the following step.



13. **F-stop Adjustment:** The purpose of this step is to adjust the F-stop on the camera lens such that no part of the sample image is over-saturated with light (the max pixel value in ImageJ should be less than 255). Note that 0.700” on the micrometer adjustment is fully open (most light) and 0.000” is closed (no light.) If the image tested previously in ImageJ had a max value of 255, then the F-stop will need to be turned down so less light passes through the lens. Turn the F-stop adjustment such that the number on the indicator is decreasing. It is recommended to adjust the F-stop in increments of 0.050” (or 50 on the digital readout.) For example, if an image tested over saturated at a reading of 0.700”, adjust the knob down to 0.650”. At this point, repeat steps 11,12, and 13 until the maximum pixel value is no longer 255. The maximum pixel value should fall somewhere between 200-254. If the value drops below 200, the image may be too dark, and the F-stop has been adjusted too far. Steps 11-13 will need to be repeated but while turning the F-stop in smaller increments and in the opposite direction as previously performed. Note: it is possible to use an image with a maximum pixel value below 200, however, higher pixel values will result in better image resolution.



14. Dark Image Capture

Once a “bright image” has been saved, and it has been determined that it is not over-saturated, a dark image must now be captured. Slide the polarizing lens inwards (see picture below) for the dark image capture. Using the camera software, click on the “unlive” and then “live” buttons again to ensure the image is live and not frozen (see step 7 if you need help on how to do this.) Save the image file in the same folder as the bright image, but use the word “dark” and “ref” in the file name (e.g. darkref001, darkref_image1, dark_refsample.)



15. **Preparation for Test Sample Procedures:** Remove the reference sample from the sample roller, being careful not to touch the black reference surface. You have now completed the image capture procedure for the reference sample. The following procedures will lead you through the process of capturing images for the “test” sample, or the sample you wish to measure. The procedure for capturing the test sample images are similar to the procedures for the reference sample.

16. **Gloss Sample Image Capture:** Pull the polarizing rod outward for the bright image.



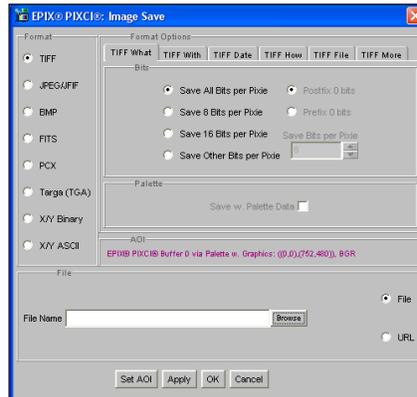
Make sure the device is ON and the light source is functioning. Load the test sample into the roller by centering it in the same position as the reference sample. Use **only** the **sample roller** adjustments to center the new sample on the viewing monitor, and do not make any adjustments to the lens at this time. Check to see if the sample is centered on the viewing monitor. If the monitor has frozen up, first click on the “unlive” and then “live” button to regain the live image, and again try to realign the sample image on the monitor. Once aligned, close the lid on the device.

17. Bright Image Capture



To save the image click:
(File > Save Image).

When the window appears, click on “Browse”, choose the appropriate image folder, and name the image. It is suggested that the file name include the word “bright” to differentiate it from the next (dark) image capture (e.g. bright001, bright_image1, bright_sample).



Slide the polarizing lens in to get the (dark) image. Save the image file in the same folder as the bright image, but use the word “dark” in the file name (e.g. dark001, dark_image1, dark_sample.)

This completes the procedure for the test sample image capture. The next step is to transfer the reference and test sample images to the computer with the new software for data analysis. Move the captured images to a folder and put the folder on a flash drive. Then move to the next computer and plug the flash drive into the front port.

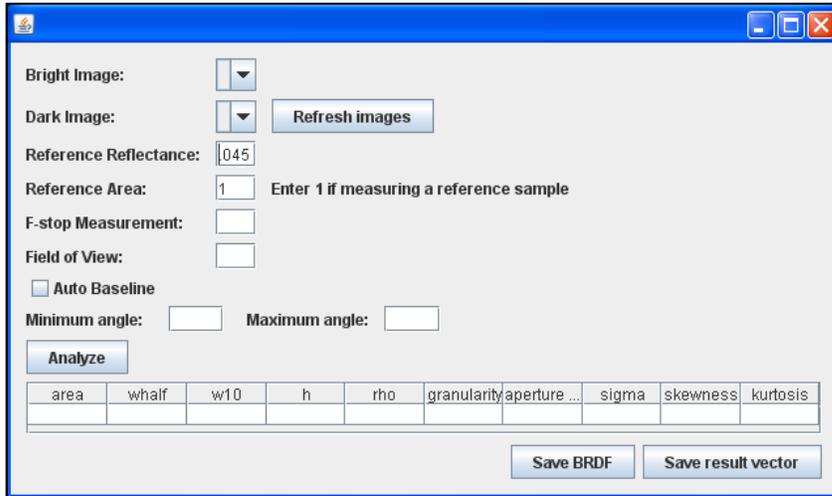
18. Reference Image Analysis:

Open ImageJ software located on the computer desktop. Open all of the images you just saved by clicking “File” → “Open...”:



Go to “Plugins” → “ritmgp” → “RITMGP Plugin”. In the plugin that opens, choose the two reference images from the dropdown menus (click “Refresh images” if they do not show). Use 0.045 for the reference reflectance. Use 1 for the reference area. Look up the F-stop measurement in the F-stop table for your device, and type in the corresponding

number for “F-stop Measurement”. Enter the field of view after converting the measured value to millimeters. Choose “Auto Baseline”. Then click on “Analyze”. The results will be shown in the same window, and a curve will be shown in a new window. If the red baseline shown on the curve does not connect the bottom of each side of the curve, undo the “Auto Baseline” option and change the angle range as needed.



Record the “area” value (given in the table at the bottom of the plugin window) in the “Reference Area” field.

19. Sample Image Analysis:

Select your sample images in the dropdown menus, and set the F-stop measurement or field of view as needed. If your sample images were not opened, you may open them in ImageJ as in the last step without closing the plugin. Simply click “Refresh images” if you need to do that. Click “Analyze” and check the baseline as before. Results can be saved using the buttons on the bottom of the plugin window. These buttons will open file chooser windows. “.txt” should be appended to the end of file names in these windows.

20. **Further Data Collection:** Other samples can be loaded and analyzed using the above procedure. It is not necessary to calibrate the device again with the reference sample; until such time that the device and software have been powered down.

21. Once all samples have been analyzed, the computer software should be closed and the device should be turned off using the power switch. Be sure to replace the lens cap on the camera to prevent debris from landing on it. Also be sure to close the lid on the device when finished. All steps will need to be completed (starting at step 1) the next time the device is to be used.