Version 7.0

Camera Guide:
Dage MTI Video Cameras

Imaging
Research Inc.

Contents

Introduction

MCID™ Basic supports the SPOT RT™ series of high-resolution digital cameras (RT Monochrome, RT Color and RT Slider). Each camera is cooled to 37°C below ambient temperature and provides exposure times ranging from 1 msec to 536 sec.

The SPOT RT Monochrome generates 12-bit monochrome images of 1600 x 1200 pixels. The SPOT RT Color generates 24-bit full color images. The SPOT RT Slider is equipped with an integrated, slide-mounted color filter that allows it to acquire both color (24-bit) and monochrome (12-bit) images.

This document describes the installation, use and adjustment of SPOT RT cameras. Most of the functions and features described here are exclusive to SPOT cameras. **MCID Basic**, however, provides many other features related to camera-based image acquisition in general (e.g., frame averaging for noise reduction, real-time image alignment). These are described in the online *MCID Basic Reference Manual (Chapter 2: Acquiring Images)*.

Installing SPOT RT Cameras

The basic procedure for installing any of the SPOT RT cameras in **MCID Basic** is as follows:

1. Install the SPOT RT driver from the **MCID Basic 7.0** CD-ROM.
2. Shut down the computer and install the camera controller card.
3. Connect all of the camera components together.
4. Re-start the computer and start **MCID Basic**.
5. Install the camera in **MCID Basic**.

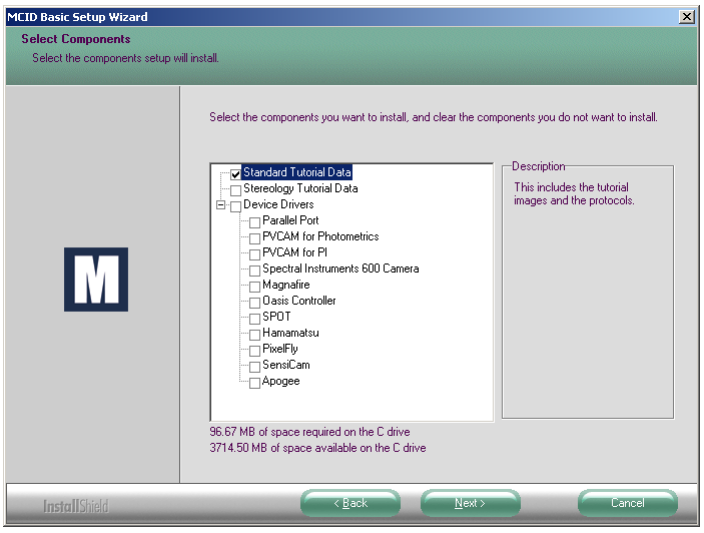
Installing SPOT RT Drivers

Drivers for all SPOT RT models are contained on the **MCID Basic 7.0** installation CD-ROM. If a driver has not been installed, do the following:

IF YOU ARE INSTALLING MCID BASIC 7.0 FOR THE FIRST TIME:

1. Log on to Windows® as an *Administrator* or as a User with administrative privileges.
2. Insert the **MCID Basic 7.0** installation CD into the CD-ROM drive.
3. Press **[Install MCID Basic]** and follow the instructions that appear.
4. When the *Select Components* installation dialog box appears (Figure 1), select the SPOT device driver (see below).
5. Press **[Next]** to complete the installation.

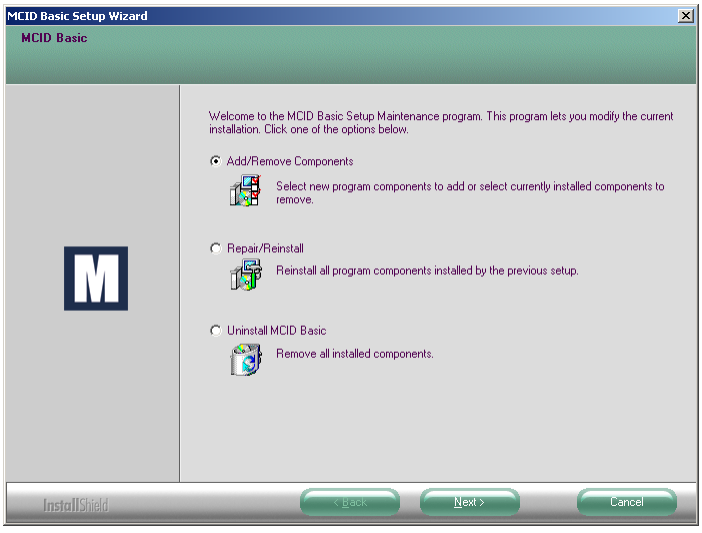
Figure 1: *Install SPOT drivers from the Select Components installation dialog box.*



IF MCID BASIC 7.0 IS ALREADY INSTALLED:

1. Log on to Windows as an *Administrator* or as a User with administrative privileges.
2. Open the Windows *Start* > *Settings* > *Control panel* folder.
3. Open *Add/Remove programs*.
4. Select **MCID Basic 7.0** from the list of applications and press the **[Change/ Remove]** button. This launches the *MCID Basic Setup Wizard* (Figure 2).
5. Select the *Add/Remove Components* option.
6. When the *Select Components* installation dialog box appears (Figure 1), select the **SPOT** device driver.
7. Insert the **MCID Basic 7.0** installation CD into the CD-ROM drive.
8. Press **[Next]** to complete the installation.

Figure 2: *The MCID Basic Setup Wizard.*



Connecting the Components

The SPOT RT is supplied with three major components: a camera head, a power supply/ control box, and a PCI controller card. Additional cables are included to connect the camera to the power supply/control box and to the PCI controller card. Plug the controller card into a vacant PCI slot in your computer. Plug one end of the 50-pin cable into the controller card, and the other end into the camera head. Connect one end of the 25-pin camera cable to the camera head, and the other end to the socket on the rear of the power supply.

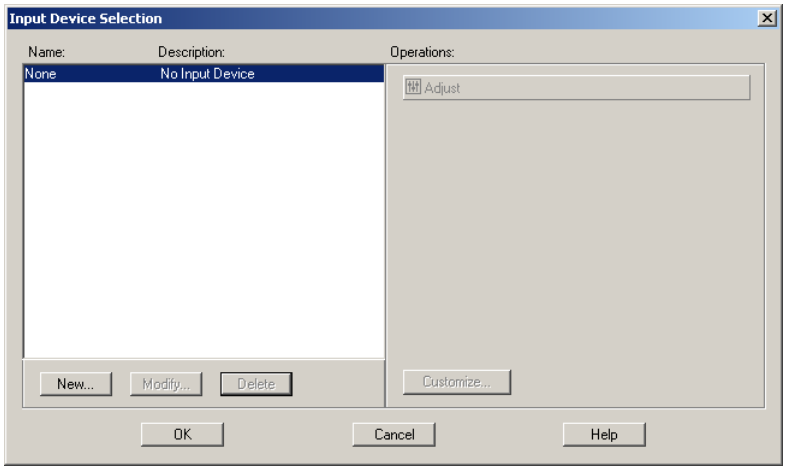
Installing in MCID Basic

The SPOT RT Monochrome can be installed in **MCID Basic** as a 12-bit monochrome input device (yielding 4096 gray levels). The SPOT RT Color should be installed as a 24-bit color input device. The SPOT RT Slider should be installed as a 12-bit monochrome input device and as a full-color 24-bit device.

Procedure

The **MCID Basic** imaging system's interface to cameras is controlled through the *Settings* > *Input select* menu command. The *Input Device Selection* dialog box (Figure 3) contains a list of every camera that you have already installed. You can select, add, or delete any camera input from the list. You can also edit the definition of a specific input, and assign specific operations and settings to it. See *Chapter 2: Acquiring Images* in the online *Reference Manual* for details.

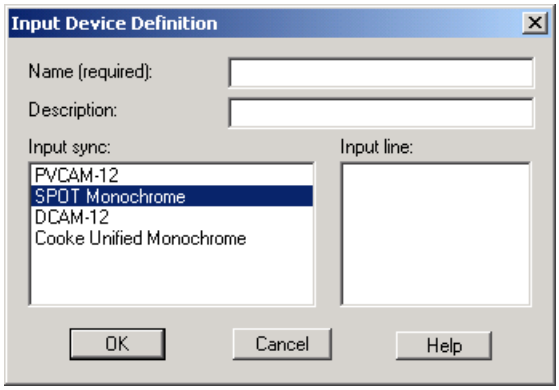
Figure 3: *The Input Device Selection dialog box lists all cameras installed in MCID Basic. It is also used to add new cameras to the list.*



1. Open the *Settings* menu and select *Display format*. Set the *Image Type* to the appropriate bit density (e.g., 12 bit).
2. Open the *Settings* menu again and select *Input select*. The *Input Device Selection* dialog box appears, which lists every camera that is currently installed in **MCID Basic**.

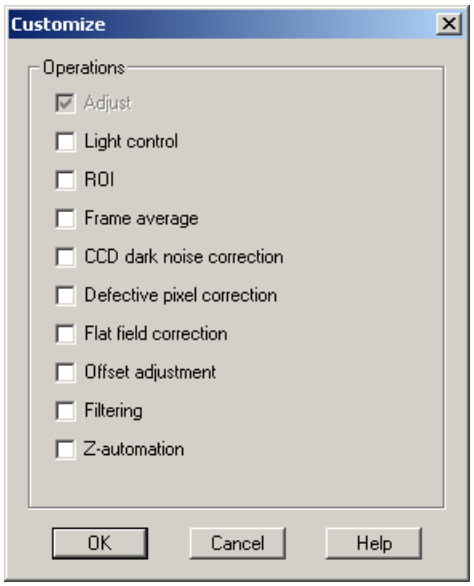
3. Click the **[New]** button. If another camera has been installed already, a *Create Input Device* dialog box will appear. Select the **New input device** option and click **[OK]** to proceed.
4. The *Input Device Definition* dialog box appears (Figure 4).

Figure 4: *The Input Device Definition dialog box is used to describe a camera and its Input sync.*



5. Select the **SPOT** input sync (e.g., **SPOT Monochrome**).
6. Enter a unique **Name** and **Description** in the appropriate entry fields (e.g., "SPOT RT" and "12 bit monochrome"). Press **[OK]** to exit the dialog box.
7. The *SPOT Camera Settings* dialog appears next. The dialog box lists information about the particular model you are using as well as a number of user-defined settings. For now, click **[OK]** to exit the dialog box. Refer to the Adjusting the Camera Response section to learn how to adjust the settings after the camera has been installed.
8. A *Customize* dialog box appears next (Figure 5), which allows you to assign various input device operations to this camera (e.g., frame averaging controls). You can select them now or assign them later (see *Chapter 2: Acquiring Images* in the online *Reference Manual* for details). Click **[OK]** to exit the dialog.

Figure 5: *The Customize dialog box is used to link controls for various camera operations to the camera.*



The camera is now installed in the list of input devices. When you exit the *Input Device Selection* dialog box, the camera (and all of the settings and operations associated with it) becomes the default input device.

Acquiring Images

The basic procedure for acquiring images with any SPOT RT based camera is as follows:

1. Select the desired **Display format** (12-bit or 24-bit).
2. Select the camera from the list of input devices, if necessary.
3. Press the **Digitize** icon to display a "live" image.
4. Make any necessary adjustments to the live image (e.g., focus or exposure time).
5. Press the **<Return>** key to complete digitization.

The image is now "frozen", and any **MCID Basic** function can be applied to it (e.g., the image can be processed, calibrated, sampled, or saved to disk as an image file).

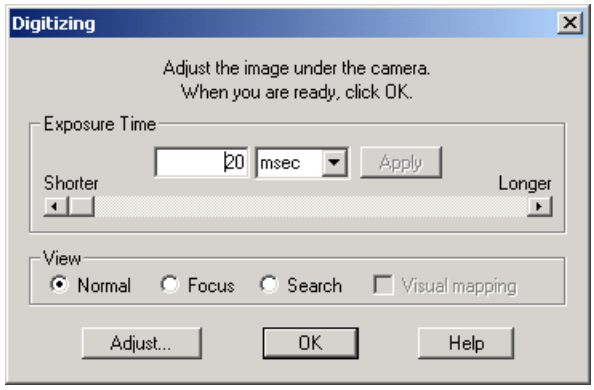
Digitizing

Click the **Digitize** icon to initiate digitization or press **<Ctrl - D>**. A dialog box appears to indicate that **MCID Basic** is digitizing continuously and a live image appears in the Image View window.

Note: You may need to adjust the Image View magnification in order to see the entire image. See *Chapter 3: Working with the Image View* in the online *Reference Manual* for details.

Light is accumulated as long as the shutter is open. Longer exposure yields higher sensitivity. The camera exposure is controlled by moving the **Exposure time** slider (Figure 6). For most purposes, an exposure of about 100 to 200msec is fine. Adjust lighting to give proper illumination. In low light situations, the exposure time can be increased to periods of up to about 5 sec with a gradual increase in background. With cooled SPOT RT cameras exposures of 20 sec and greater are possible with minimal increase in background.

Figure 6: *Clicking the Digitize icon initiates the digitization procedure and displays a dialog box. Move the slider along the Exposure Time bar to control the length of time the shutter remains open.*



Unlike video cameras, which show a "live" digitizing image, digital cameras tend to have a slower frame rate and the live image will appear jerky. With longer exposure times it may take a few seconds before the new frame is displayed. Color images take even longer. The **View** section of the *Digitizing* dialog box offers some options to help in positioning and focusing of images being acquired with digital cameras.

Normal

The **Normal** view will allow you to see the whole image during the digitizing process, as it will appear when you finish digitizing. Notice that the frame rate slows down to reflect the exposure time combined with the appropriate camera readout time.

Search

Search view displays a compressed view of the final image, but at a much faster refresh rate than would occur at the full resolution. This view is centered in the middle of the image display and is especially useful for locating and/or positioning features of interest. The image is displayed in full resolution when digitization is terminated.

If you are working with a color SPOT camera in **Search** mode, the image will be red, blue or green (see Focus Color, below). The full-color, full size image will appear when you stop digitizing or if you switch to **Normal** mode.

Focus

Focus view displays the central portion of the field at full resolution. As there are fewer pixels to read out, the refresh rate is much faster than would occur if the entire field of view was displayed. This helps with focusing the image during longer exposures. The image is displayed in full resolution when digitization is terminated.

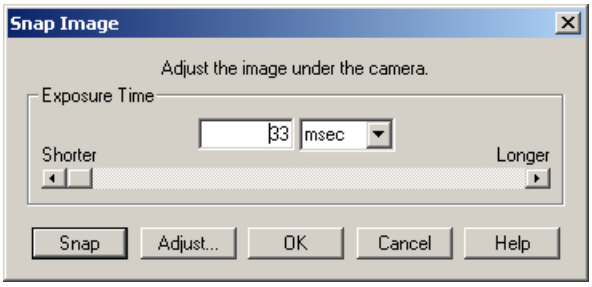
If you are working with a color SPOT camera in **Focus** mode, the image will be red, blue or green (see Focus Color, below). The full-color, full size image will appear when you stop digitizing or if you switch to **Normal** mode.

Snap Shots

In the previous section, clicking on the **Digitize** icon displayed a dialog box where you could make various adjustments to the live image before actually capturing it and displaying the result. The **Snap Shot** icon skips the display of the dialog box and simply snaps and captures a new image to the Image View. This function can be very useful if you are working with dim specimens and you have already chosen the correct exposure time. Clicking the **Snap Shot** icon will automatically snap a fresh image.

Holding down the **<Ctrl>** key while clicking on the **Snap Shot** icon will allow you to access an additional set of controls for the **Snap Shot** icon.

Figure 7: *The Snap Image dialog box.*



The *Snap Image* dialog box (Figure 7) allows you to adjust the camera exposure time as well as access the **[Adjust]** functions. The only difference between this and the *Digitize* dialog box is that there is no display of a live image during any of these procedures. To see the effects of any adjustments you must click on the **[Snap]** button.

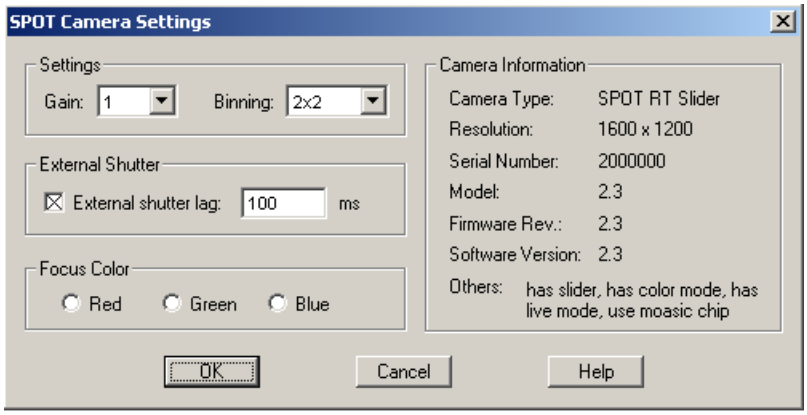
Adjusting the Camera Response

MCID Basic allows digital control over a number of SPOT RT camera settings. To access these controls, press the **[Adjust]** button while digitization is occurring.

General Settings

If you are working with the RT Monochrome or with the RT Slider in Monochrome mode, **MCID Basic** will display a dialog box like the one shown in Figure 8.

Figure 8: *The SPOT Camera Settings dialog box.*



Gain

The analog processor card in the camera control unit can be set at different gain. For bright signals, use a gain of "1" so that the camera electronics are set to have a reasonable SNR over a broad dynamic range. For dim signals, we usually set the gain at higher gain levels. This gives a larger gray level value and slightly better SNR for dim specimens, though dynamic range is compromised relative to the "1" gain setting. In general, dynamic range is not a major issue with very dim signals, while brighter signals may be easier to work with at "1".

Binning

Binning sums groups of individual camera pixels into a smaller number of output pixels. A binning factor of **2x2**, for example, sums a block of four pixels in the camera chip to yield a single output pixel. This yields greater sensitivity for use with low light levels, but creates a smaller image. Binning also results in shorter integration and readout periods.

In general, we prefer to use the highest binning factor that gives adequate resolution for the specimen. Too high a binning factor can result in specimen details merging into each other. Too low a binning factor yields high resolution, but much lower sensitivity.

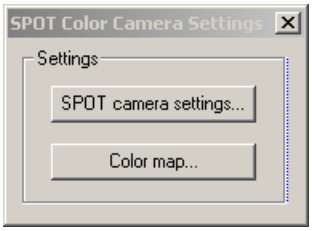
External Shutter Lag

External mechanical shutters exhibit a 'shutter lag'. This is the length of time it takes for the shutter to open to 100% after receiving the electronic trigger to 'open'. If you are working with an external shutter, the SPOT RT shutter (which opens almost instantaneously) needs to be delayed until the external shutter is completely open. Check the **External shutter lag** box and enter the lag time, in milliseconds. Refer to the external shutter's specifications guide to determine the correct value.

Color Settings

If your are working with the RT Color or with the RT Slider in Color mode, **MCID Basic** will display a dialog box like the one shown below in Figure 9.

Figure 9: *The SPOT Color Camera Settings dialog box.*



If you press the **[SPOT camera settings]** button, **MCID Basic** will display the dialog box shown in Figure 8. From here you can adjust the **Gain, Binning** and **External shutter lag** as described above.

Focus Color

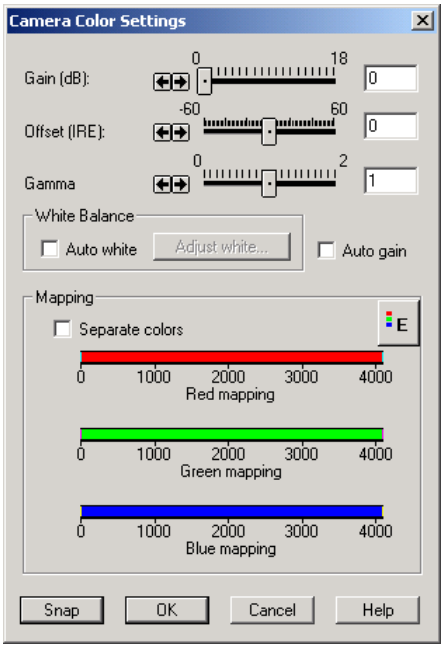
SPOT color cameras generate individual red, green and blue images that are combined during readout to produce a full-color image. Their refresh rates are consequently much slower than monochrome versions, which makes it particularly difficult to position and focus the specimen while digitizing.

Rather than using the full-color image for focusing, **MCID Basic** uses one of the red, green or blue substrate images. Select a **Focus color** and **MCID Basic** will display only the substrate image when digitizing in **Focus** and **Search** modes. This results in a faster readout rate and the image will appear less jerky. Be sure to select a color in which image features are clearly visible.

Adjusting Colors

Clicking on the **[Color map]** button on the *SPOT Color Camera Settings* dialog box (Figure 9) will display the *Camera Color Settings* dialog box (Figure 10).

Figure 10: *Various options for making adjustments to the color image.*



Gain

Increases or decreases the overall image gain relative to the level of input illumination. Move the slider controls to adjust.

Offset

Move sliders to adjust the size of the no-light (black level) signal.

Gamma

A gamma setting of 1.0 sets a linear camera response to input illumination. Numbers greater than 1.0 make the camera less sensitive to low illumination levels and gamma settings less than 1.0 makes the camera more sensitive to low illumination levels.

Auto gain

Placing a check mark in the **Auto gain** box will have the effect of carrying out an automatic gain adjustment each time an image is acquired.

Auto white

Allows automatic white balance adjustment (see instructions below). If disabled, white balance can be achieved by manually adjusting the **Red Green** and **Blue mapping** controls.

Adjust white

Perform automatic white balance adjustment. The procedure is as follows:

1. Place a checkmark in the **Auto white** checkbox.
2. Click on the **[Adjust white]** button.
3. A message box appears asking you to block all light to the camera. Press **[OK]** when this has been done.
4. Next, place a white object in front of the camera. If the camera is attached to a microscope, move to a blank field of view. Press **[OK]** when done.

The camera will automatically adjust the **Red** and **Blue mapping** levels relative to the **Green** level to set the white balance.

Mapping

SPOT RT color cameras produce individual 12-bit red, green and blue images that are combined during readout into a 36-bit full-color image (i.e., 3 x 12 bits). Unfortunately, **MCID Basic** is unable to handle or display 36-bit color images so this 36-bit color image has to be mapped in some way to fit into a 24-bit color image display. The mapping adjustments allow the user to have some control over how this mapping is to be carried out. By setting each of the sliders to their maximum range, the 12-bit red, green and blue image data (4096 levels for each color) are mapped to their corresponding 8 bits. The full 4096 levels are squashed into 256 levels. For dim fluorescent specimens the mapping can be set to the lower 8 bits (256 levels) for each color. This makes the camera more sensitive as there is a one to one relationship when mapping the actual levels.

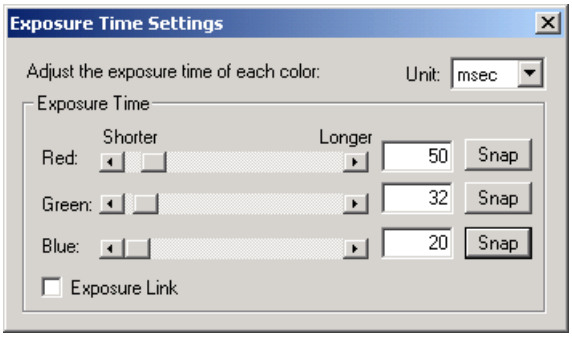
Placing a check mark in the **Separate colors** box allows the user to adjust each mapping color independently. Clicking on the **[Snap]** button allows you to refresh the digitized image.

Adjusting Exposure Times

By clicking on the **Exposure** control icon located to the side of the *Color Camera Settings* dialog box you can access the individual *Exposure Time Settings* dialog box (Figure 11). This additional control allows you to setup and adjust a different exposure for each separate color. For example, if your fluorescence signal is very strong in the blue, but fairly weak in the red, you can decrease the camera exposure time in the blue, while increasing the camera exposure time in the red. Clicking on the **[Snap]** button next to each color exposure slider will display the appropriate image for that color. These exposure controls are set up to work together with the color mapping features of the *Color Camera Settings* dialog box. They are also proportional to the main focusing color chosen from the **Focus color** section of the *SPOT Camera Settings* dialog box. (Figure 8).

Adjusting the main image exposure via the *Digitize* dialog box (Figure 6) will change the main focusing color exposure and adjust the two secondary color exposures proportionally. When you have finished making all your exposure and color adjustments, press the **[OK]** button to exit the *Color Camera Settings* dialog box.

Figure 11: *The Individual Color Exposure Time Settings dialog box.*



Maintenance and Troubleshooting

Cleaning the Camera

SPOT RT based cameras contain a solid state sensing element (a chip) covered by a thin glass window. The glass window attracts dirt like a magnet. Dirt will appear as dark blots on the image. To determine if dirt is on the chip window, move the camera a bit, while looking at an actively digitizing image. Dirt that does not move is on the chip. To avoid gathering dirt, we recommend that you remove the lens or microscope video adapter as little as possible.

The first step in cleaning the CCD chip window is to try blowing off dust with clean compressed air, of the type sold for cleaning camera lenses. Use canned air, not air from a lab tap, which often contains oil. Reassemble the camera and digitize an image to see if the dust is gone. If it is not, moisten a cotton swab or piece of lens paper with a glass or lens cleaner. Do not use alcohol or other solvents on optical surfaces (the optical coating and cements can be damaged by such solvents). Remove the lens and gently wipe the glass with the swab or

paper. Make sure that the swab or paper has not become dry. Then blow the chip dry with compressed air. Replace the lens and digitize an image to inspect for dust. You may have to repeat the cleaning process a few times to remove all dust.

You may also clean the chip window with “Prophot” cleaners, available from many camera stores. Do not use tissue paper, which often contains impurities. Do not use dry lens paper or swabs to clean the glass over the chip, either. Dry rubbing may produce static charges.

Cleaning the camera is one of those unpleasant and thankless tasks that everyone detests. The best way to avoid cleaning is to keep the camera sealed, so that dust does not enter.

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