SUMIX corporation

Megapixel USB2.0 CMOS

CAMERA

User Guide

SMX-11M5x Series USB2.0 Camera

SMX-11M5x Series USB2.0 Camera User Guide

Revision 2.1

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Chapter 1

INTRODUCTION

SMX-11M5x Series cameras are 5 megapixel CMOS cameras with USB2.0 interface suitable for scientific and industrial application. The cameras are designed for capturing, streaming and storing of high quality digital images.

There are the following models available:

- SMX-11M5M (5 megapixel, monochrome)
- SMX-11M5C (5 megapixel, color)

The SMX-11M5x cameras feature:

- USB2.0 communication interface
- Duralumin housing with C/CS - mount

The SMX-11M5x cameras have the following benefits:

- 2592 x 1944 active imaging pixels
- High speed: 8 fps at 2592 x 1944
- Pixel rate up to 96 MHz
- Rolling shutter
- External trigger input/output mode
- Low power consumption
- No external power supply required
- Adjustable frame rate
- External trigger input/output mode

Programmable functions include viewport window settings, adjustable exposure time and gain, selectable sensor clock frequency and image decimation, flipping image horizontally and vertically. The cameras can be used in microscopy, video conferencing, webcasting, surveillance and security systems, etc.

Chapter 2

Installation and Update

Before installing the camera software, install a USB2.0 adapter if needed. Install all required drivers. Installation of the USB2.0 adapter is beyond the scope of this document.

System Requirements

Operating System	XP SP1+/2003/Vista/2008/7, recommended: Windows 7 or XP SP1 and higher
Processor	Intel PIII or higher, recommended: Intel Core 2 Duo
Performance	Minimum 300 Mflops, recommended: 400 Mflops or higher
Memory	256 MP for XP (512 MB for 2008/Vista/7), recommended: 512 MB (1024 MB)
USB 2.0	Recommended: Intel integrated Host Controller, not recommended: VIA-based USB 3.0 Host Controller is also supported
Video	8 MB memory, recommended: GeForce 4xxx/Radeon 9xxx or higher

Installation

To install the SMX-11M5x camera application software:

1. Run the **SMX11MX-<version>.exe** file downloaded via the URL provided by Sumix Corporation.
2. **Welcome to the SMX-11Mx USB 2.0 Camera Software Setup Wizard** starts. The wizard will guide you through the software and hardware drivers installation. Close all other applications that are running on your computer and then click the **Next** button to continue the installation.

Figure 2-1 *Welcome to the SMX-11Mx Camera Setup Wizard*

3 In the **License Agreement** box, read the license. Then select **I accept the agreement** and click **Next**.

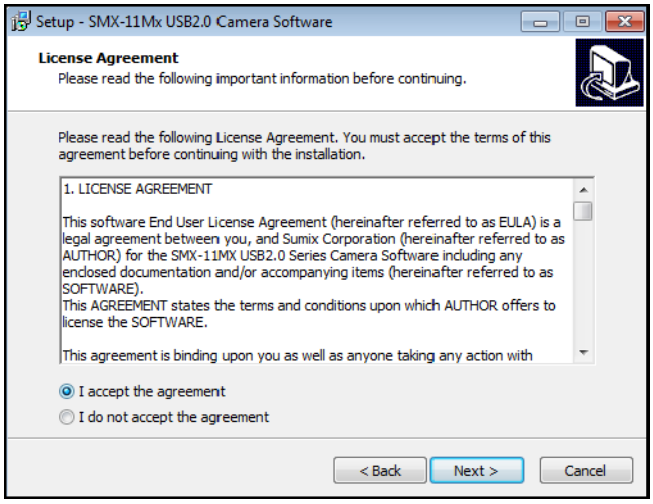


Figure 2-2 *License Agreement dialog box*

4 The wizard starts to check your system information. Upon completion, a table with check results is displayed in the **System Information** box.

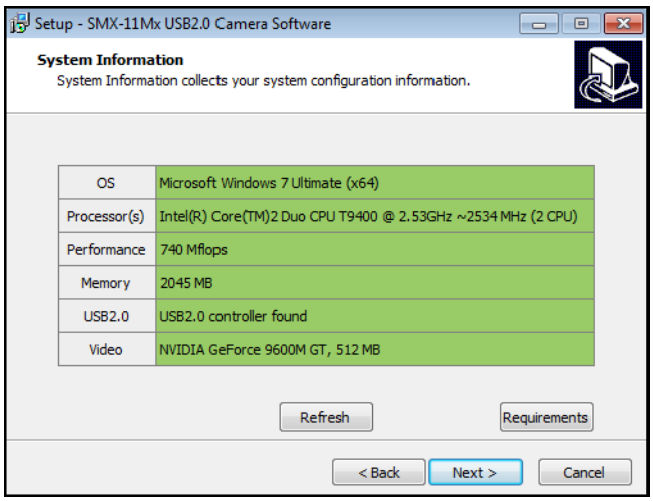


Figure 2-3 *System Information box*

5 Do one of the following, depending on the results of the check:

- click the **Next** button if all table cells with system parameters are green (the parameters satisfy the software requirements)
- update your system if at least one cell is red - such configuration is not recommended
- update your system if at least one cell is yellow, otherwise the technical characteristics declared for the camera will not be achieved.

To see the recommended system requirements, click the **Requirements** button in the **System Information** dialog box:

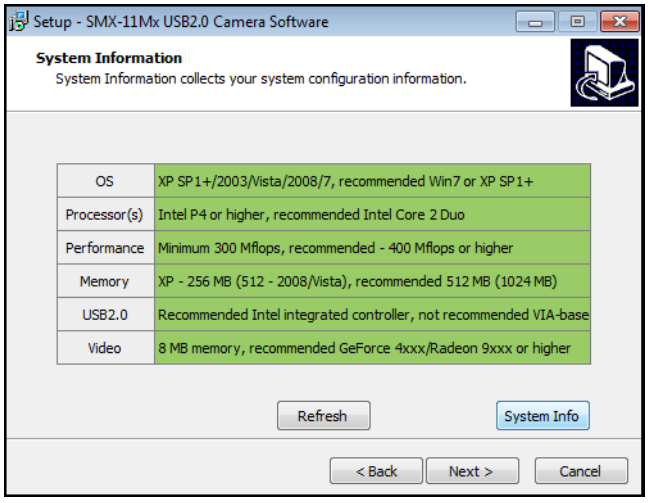


Figure 2-4 *Recommended system configuration*

6 In the **Select Destination Location** box, click **Browse** to change the folder in which the SMX-11Mx camera application software will be installed, or leave the one suggested by the wizard. Click **Next**.

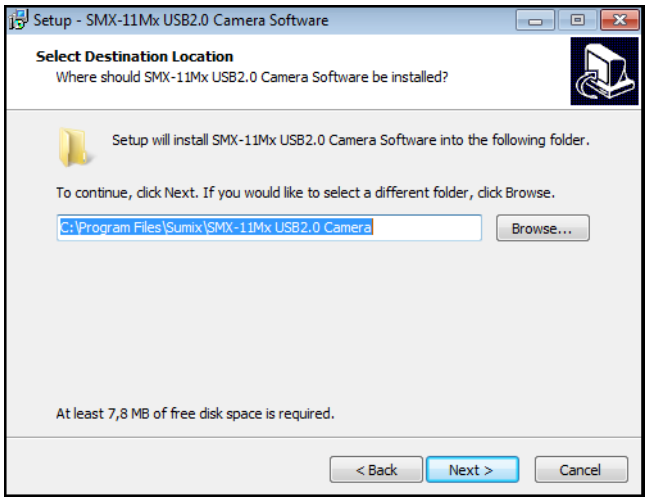


Figure 2-5 *Select Destination location box*

7 In the same way, in the **Select Start Menu Folder** box, leave the suggested location or specify the folder you wish. Click **Next**.

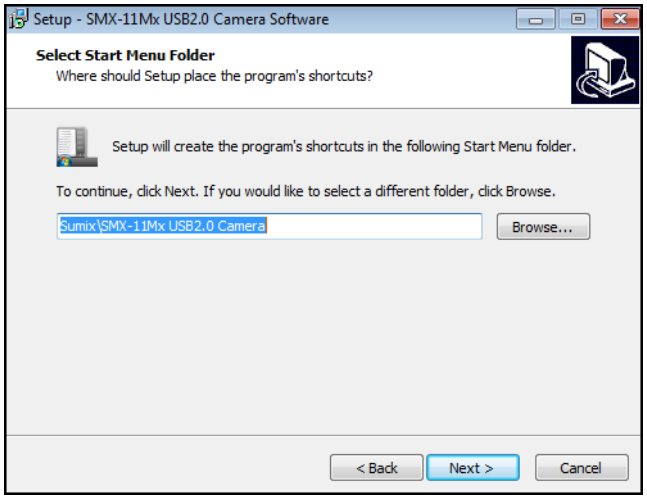


Figure 2-6 *Select Start Menu Folder box*

8 In the next wizard box select additional icon that you wish to create and choose whether you want to launch the application right after the installation, or not.

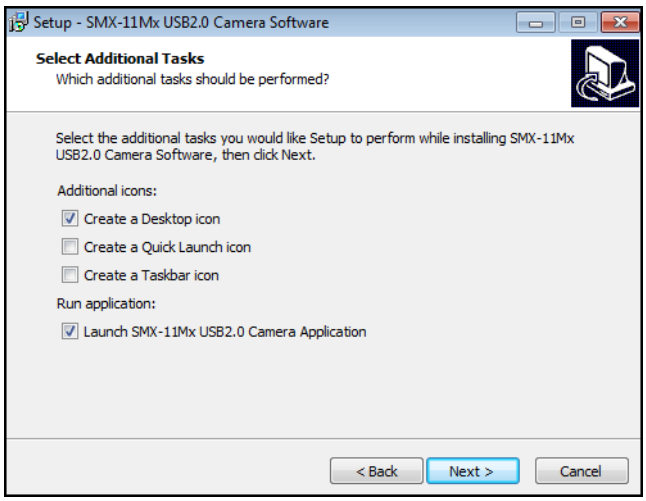


Figure 2-7 *Select Additional Tasks box*

9 In the **Ready to Install** step, view the options you selected and click **Install**.

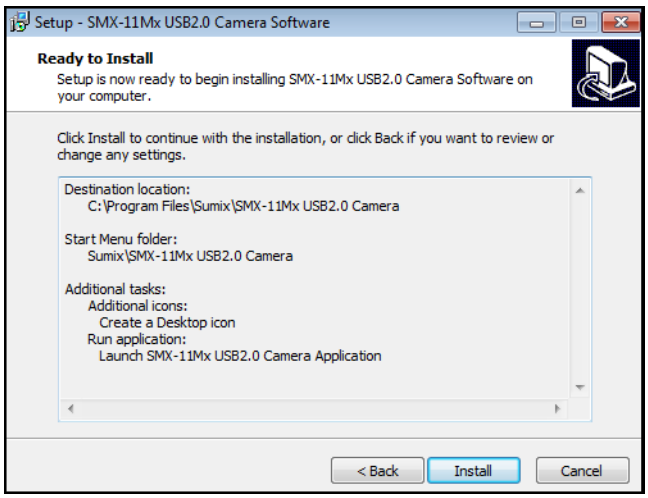


Figure 2-8 *Ready to Install box*

10 The wizard will start to install the application on your computer.

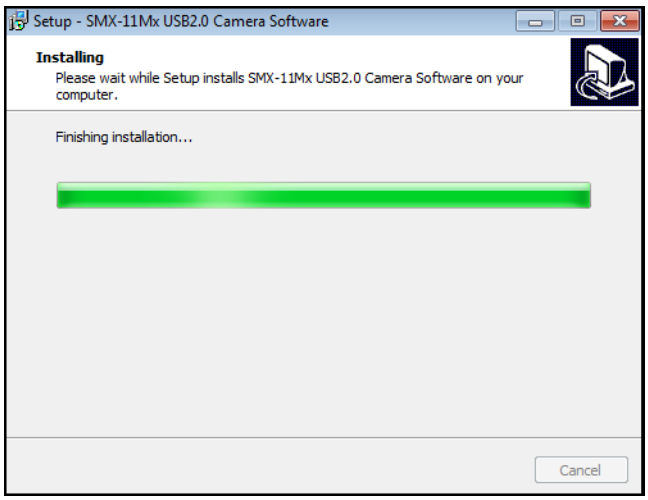


Figure 2-9 *Installing box*

During the installation, the system will ask you whether you want to install the device software. Press **Install** to proceed.

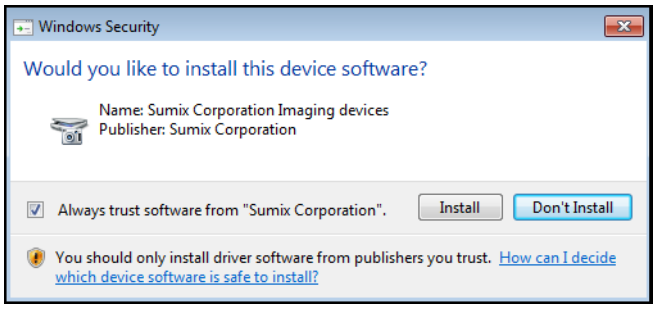


Figure 2-10 *Windows Security box*

11 Press **Finish** to exit the wizard.

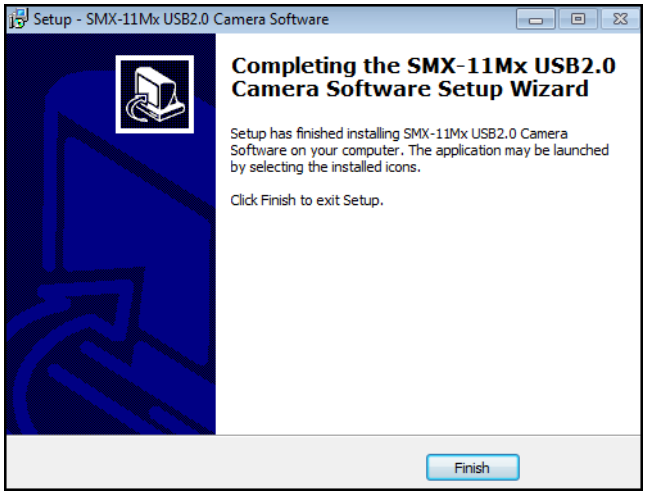


Figure 2-11 *The last installation step*

Note: *If you face problems during the camera installation, see* "Troubleshooter" on page 16.

The installation of the camera driver will be completed when you first connect the camera to the computer's USB port.

Update

The camera application software is constantly developed and improved. When a new version is available, the customers are notified and a new installer file is sent to them.

The update procedure is exactly the same as the installation described in the previous section. Simply run the new installer **SMX11MX-<version>.exe** and follow the wizard (see "Installation" on page 7).

Driver Update

When a new camera driver version is available, you can update it via the Windows device manage.

To update the camera driver:

1. Connect the camera to the computer.
2. Open the **Device Manager** window in the **Control panel** window.
3. Double-click **Imaging devices**.
4. Right-click **SMX-11MX Series USB2.0 Camera** and select **Update Driver Software...**

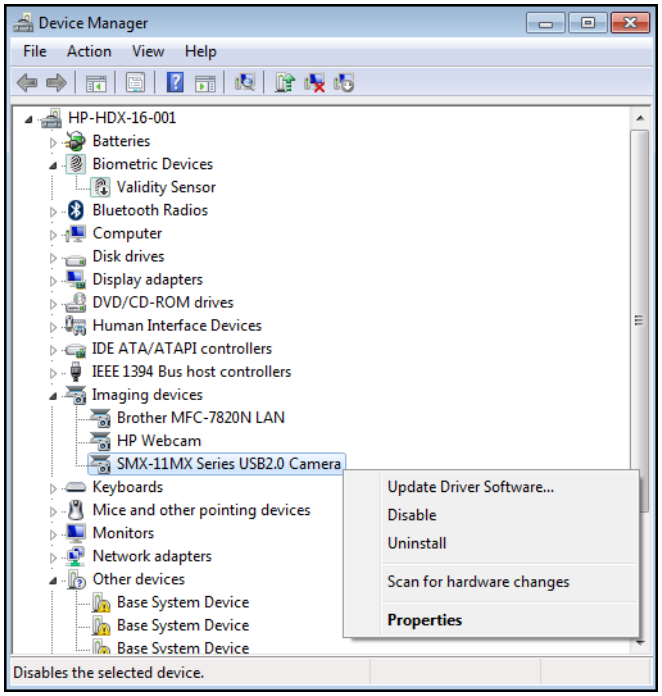


Figure 2-12 *Updating the camera driver*

5 Follow the easy-on-screen instructions. On the first step, select **Browse my computer for driver software**.

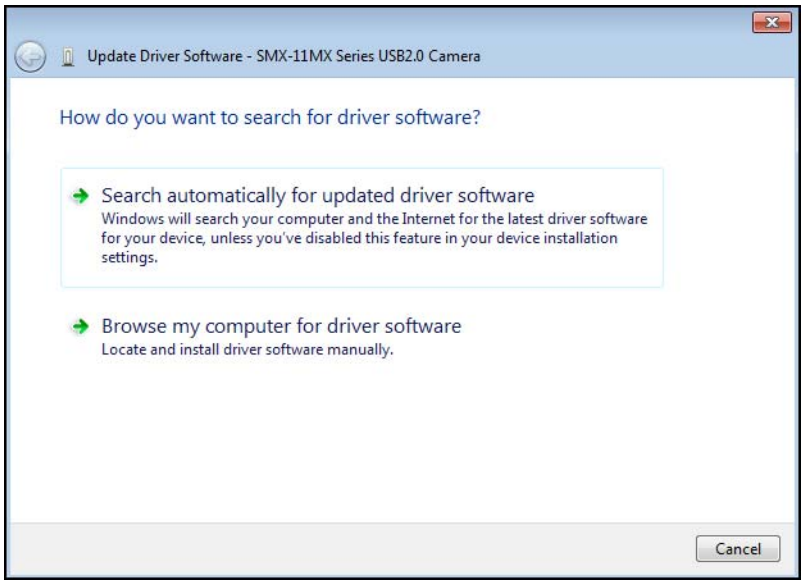


Figure 2-13 *Updating the camera driver: step1*

6 On the next step, browse for the location on your computer where the driver is saved and click **Next**.

Figure 2-14 *Updating the camera driver: step 2*

7 The system will start installing the driver. In the end, a message that the installation is successful will appear. Press **Close** to finish.

Removal

To remove the camera application software, use the **Add/Remove Programs** section in the **Windows Control Panel**. Remove the application according to the general Windows application uninstallation rules.

Alternatively, you can click the uninstallation shortcut in the application folder (**Start** > **All Programs** > **Sumix** > **SMX-11Mx USB2.0 Camera**> **Uninstall SMX-11Mx USB2.0 Camera Software**) and follow the uninstallation wizard.

After removing the software, you need also to remove the camera driver.

To remove the camera driver:

1 Connect the camera to the computer.

2 Open the **Device Manager** window in the **Control panel** window.

3 Double-click **Imaging devices**.

4 Right-click **SMX-11Mx Series USB2.0 Camera** and select **Uninstall**.

5 Confirm removing the driver: check the **Delete the driver software for this device** and click **OK**.

Figure 2-15 *Driver removal confirmation*

6 After the driver is uninstalled, the **SMX-11Mx Series USB2.0 Camera** will disappear from the **Imaging Devices** section of the **Device Manager**.

Troubleshooter

If you face problems with installation and detection of the camera, use this Troubleshooter. If you face problems that are not described below, contact Sumix Technical Department.

Note: *Tasks and problems in this section are demonstrated in Windows XP operating system.*

Camera Was Not Detected or Recognized

If after connecting the camera to your computer the system does not detect it: there is no icon on the Taskbar or the camera was not recognized by the system:

Try doing the following:

- Check if the device was installed successfully: open system folder *WINDOWS\system32\drivers* and check if there is the *SMX11MX.sys* file (normally it is located on the *C:* hard disk). If not, run the driver installation again. Be sure that no camera is connected during installation.
- If the problem still persists, manually save the *SMX11MX.sys* file to the *\WINDOWS\system32\drivers* folder (the *SMX11MX.sys* file is located in the *\Sumix\SMX-11Mx USB2.0 Camera\Drivers* folder).

If the problem still persists, try one of the following:

- Reconnect the camera.
- Use other USB2.0 port of your computer - the problem might be due to the USB2.0 port malfunction.
- Use another USB2.0 cable - the problem might be due to the USB2.0 cable malfunction.
- Connect other SMX-11Mxx camera (if any) to the same USB2.0 port - the problem might be due to the camera malfunction.
- Disconnect the camera and restart your computer.

If any of the above steps did not help and the device is not recognized yet, try the following:

1. Connect the problematical camera to the computer.
2. Open the **Device Manager** window (right-lick **My Computer** desktop icon, select **Properties**, select **Hardware** tab, and then click **Device Manager**). In **Device Manager**, double-click **Universal Serial Bus** controllers.
3. In **Device Manager**, select one of the following:

   - **Imaging devices> SMX-11Mx Series USB2.0 Camera** with Warning status, if it is available there:

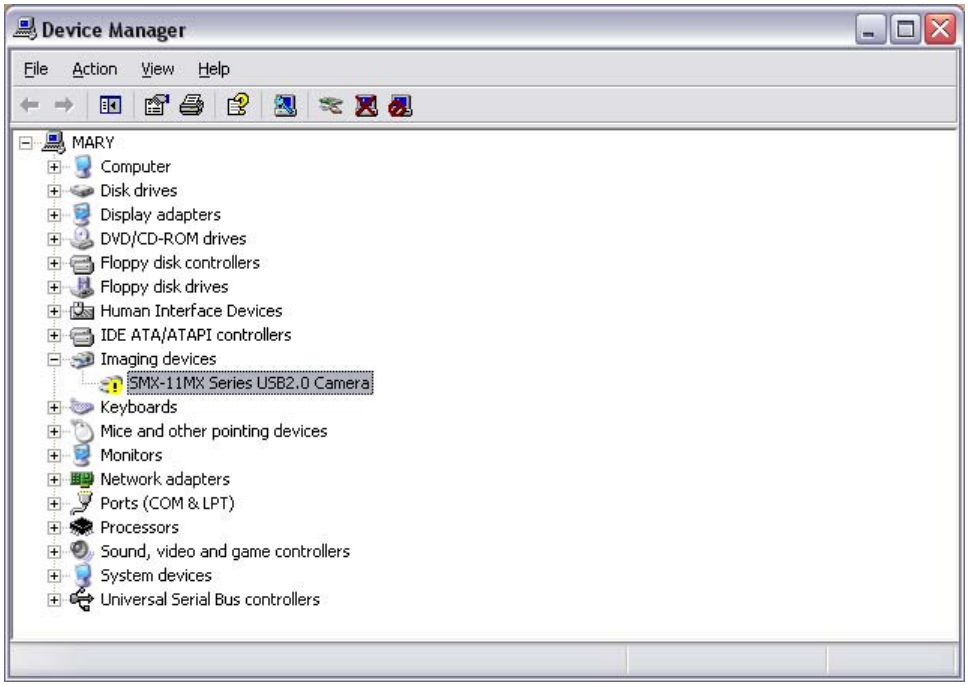


Figure 2-16 *Device Manager: the SMX-11Mx camera with Warning status*

   - **Universal Serial Bus controllers> Unknown device**:

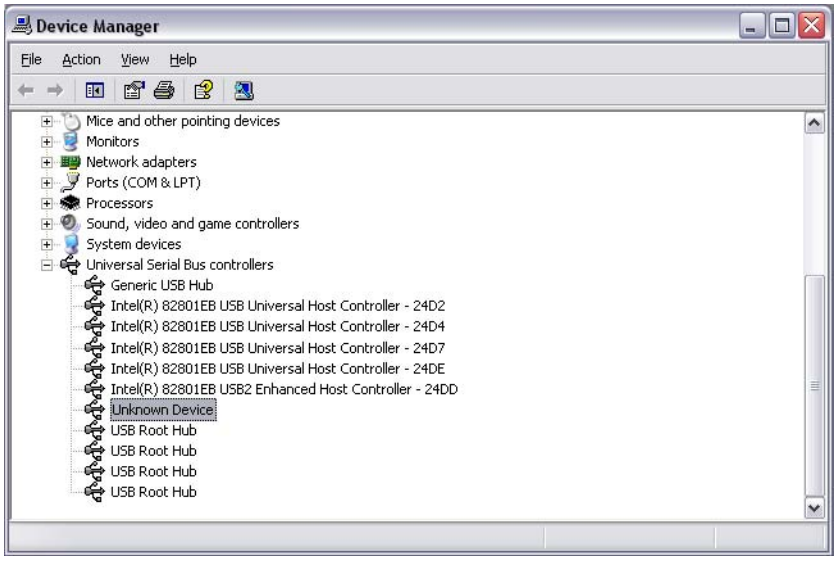


Figure 2-17 *Device Manager: the SMX-11Mx camera is detected as Unknown device*

4 Right-click and select **Update Driver…**:

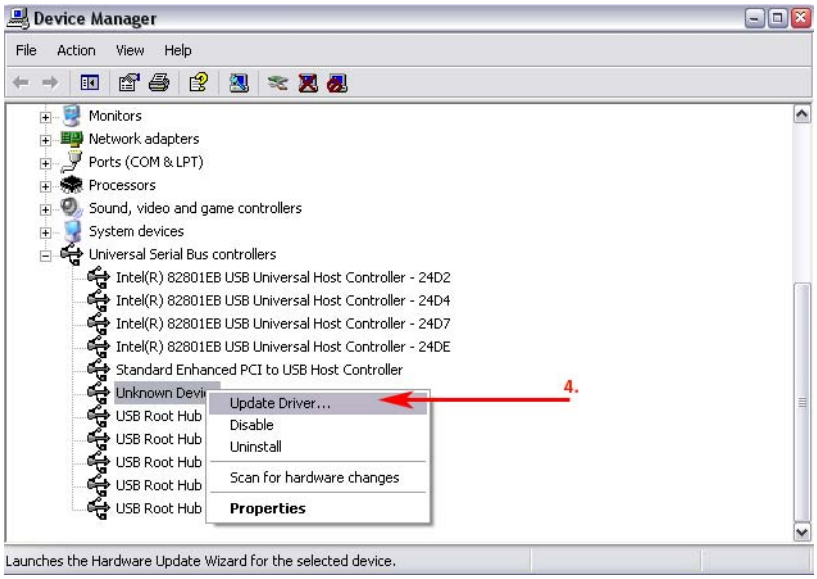


Figure 2-18 *Device Manager: Updating the SMX-11Mx camera driver*

5 Run the **Hardware Update Wizard** the same way as the **Found New Hardware Wizard** by choosing the **Install the software automatically (Recommended)** option.

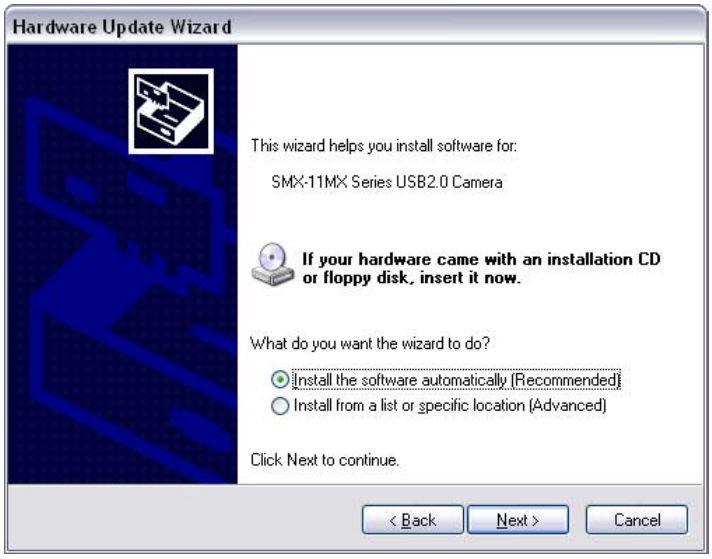


Figure 2-19 *Selecting to install the driver automatically*

6 If some problems occur during the manual hardware installation, read the next section of this Troubleshooter.

Cannot Install the Hardware

If the **Found New Hardware Wizard\Hardware Update Wizard** failed to install the hardware (the wizard that starts after the first connection of the camera or the **Wizard** that starts for updating the hardware; failure occurs after you browse to the files needed for the installing),

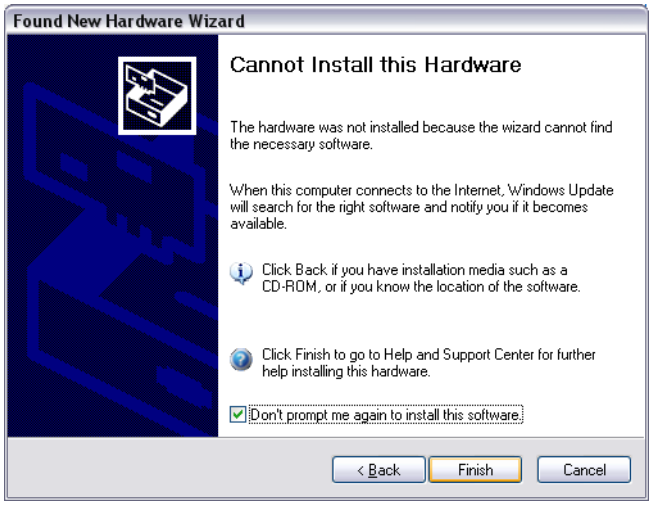


Figure 2-20 *Found New Hardware Wizard: Cannot install this Hardware*

try doing the following:

1 Click **Back** in the **Found New Hardware Wizard** and select **Install from a list or specific location (Advanced)**.

2 Click **Next**.

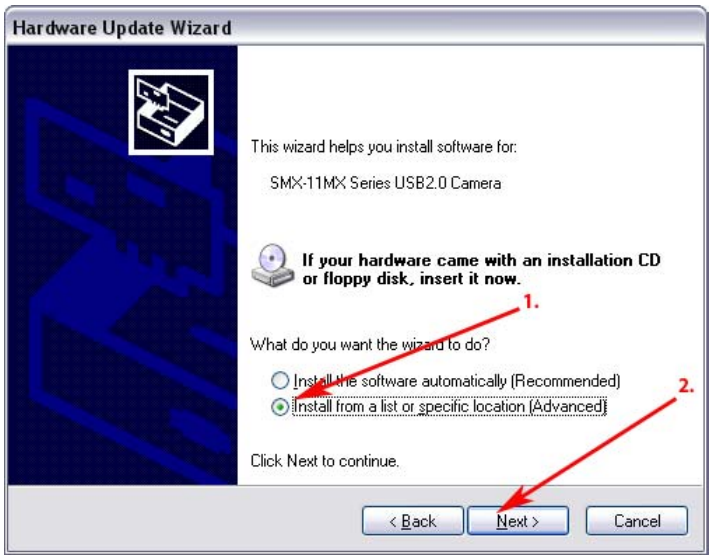


Figure 2-21 *Found New Hardware Wizard: Installing from a list or specific location (Advanced)*

3 Select **Search for the best driver in these locations**.

4 Check the **Include this location in the search box**.

5 Browse to the Drivers folder - on the SMX-M115x Camera CD or in the **Sumix\SMX-11Mx USB2.0 Camera** folder (located on the hard disk where you installed the SMX-11M5x Camera Software, normally it is the **C:\Program Files\Sumix\SMX-11Mx USB2.0 Camera**).

6 Click **Next**.

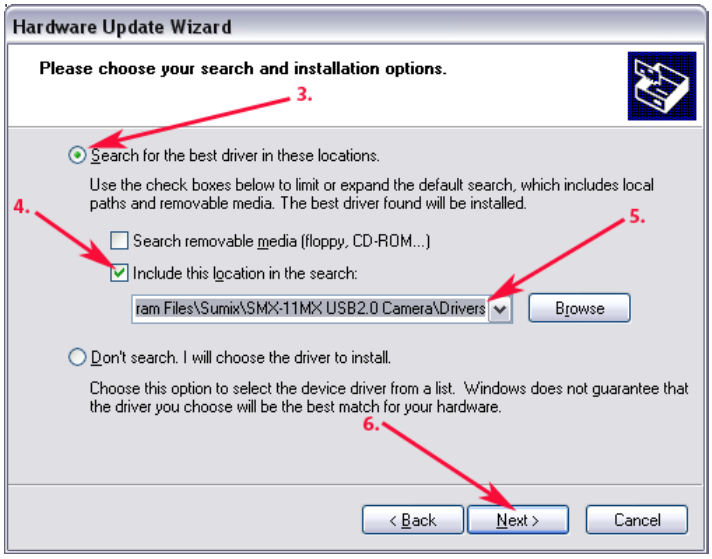


Figure 2-22 *Installing from a list or specific location: specifying location*

7 In the list, select the last item.

8 Click **Next**.

9 Wait till the wizard installs all files.

10 Click **Finish** if installation passed successfully.

Chapter 3

GETTING STARTED

Installing Lens

To use a lens with the camera, remove the cover from the camera and install a lens as described below.

It is recommended to remove the cover and install a lens (as well as remove a lens and put on the cover) when the camera is faced down, to prevent the sensor contamination.

To install a lens:

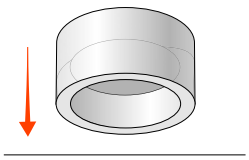
1. Face the camera down.
2. Remove the camera cover.
3. Screw the lens in.

To remove the lens

1. Face the camera down.
2. Screw the lens out.
3. Put on the cover.

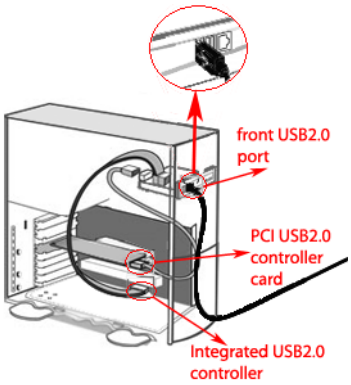
Note: *Before screwing the lens in or putting on the cover, make sure that the surfaces are free from dust.*

When you remove the cover, put it facing down to keep dust out.



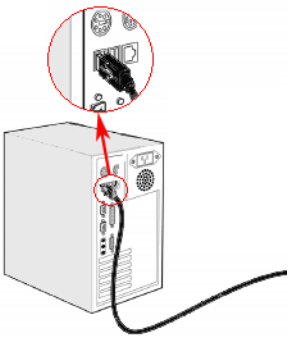
Recommendations on the Camera Connection

Most computers have both front and back USB2.0 ports location. We do not recommend using the front USB2.0 port of your computer since it is not directly connected to the computer's USB Host Controller.



As shown on the picture above, the front USB2.0 port is connected to the USB Host Controller by long cables inside computer, meanwhile back USB2.0 port is connected directly to its controller at the back panel of computer.

So, when connecting the camera to the front USB2.0 port the device might not work properly. We recommend to use the back USB2.0 port to avoid problems with the camera work (see the picture below).

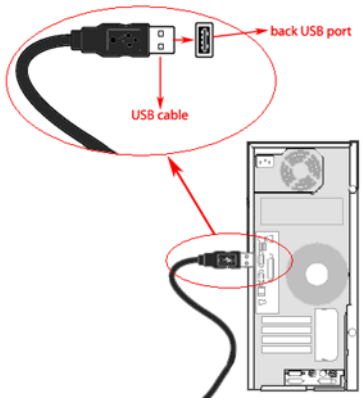


Note: *Design and configuration of the front USB2.0 port location shown on the pictures above might differ from yours. The pictures' goal is only to show how the front USB2.0 port is connected to its controller*

Plugging in the Camera

Connect SMX-11M5x camera with USB2.0 cable.

Connect the other end of the USB cable to the back USB2.0 port of your computer.



Installing Driver Software

After you connect the camera to the USB port of you computer, a **Found New Hardware** message will appear in the notification area of the task bar, and Windows will install the hardware driver. When the installation is finished, a message will appear in the notification area:

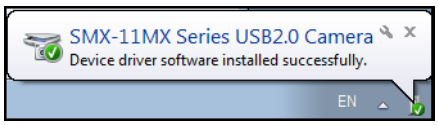


Figure 3-1 *Notification about successful camera installation*

Note *If you experience problems during the driver software installation, refer to the Installation Troubleshooter and learn how to fix such problems (See "Troubleshooter" on page 16).*

Starting the Application

After the camera hardware has been installed, you can start the application.

To start the camera application:

Click **Start** > **All Programs** > **Sumix** > **SMX-11Mx USB2.0 Camera** > **SMX-11Mx USB2.0 Camera Application Program**. If during the installation you chose to install a desktop icon and/or a quick launch icon, you can also click the icon to launch the application. The SMX-11M5x application will start with its main window.

The SMX-11M5x application consists of the following parts:

- Main window which contains the main functions. On the top of the main window, there is an application toolbar:

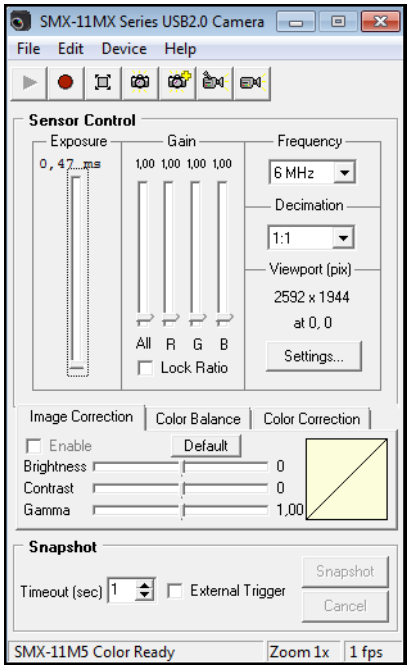


Figure 3-2 *SMX-11M5x application main window*

- **Histogram** which reflects all color settings of the camera.

To open the histogram:

Press the **h** button on the keyboard or select **Histogram** from the **Device** menu. Camera hardware histogram will appear showing signal for different colors.

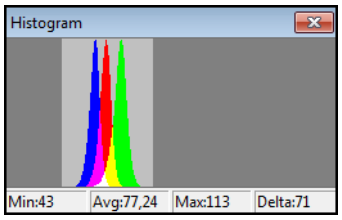


Figure 3-3 *Camera hardware histogram*

Click in the window, and the software histogram will appear instead.

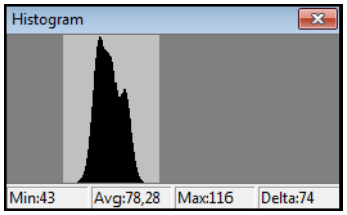


Figure 3-4 *Camera software histogram*

Note: *The histogram window is empty when the video is not started.*

- **Device Settings** window contains the camera settings.

To open the Device Settings window:

Select **Settings** from the **Device** menu or press **Alt+s** on the keyboard.

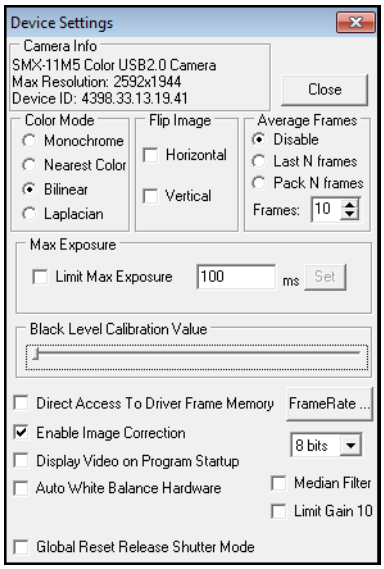


Figure 3-5 *Device Settings window*

- **Video mode** window which shows a live view from the camera and reflects all settings of the image

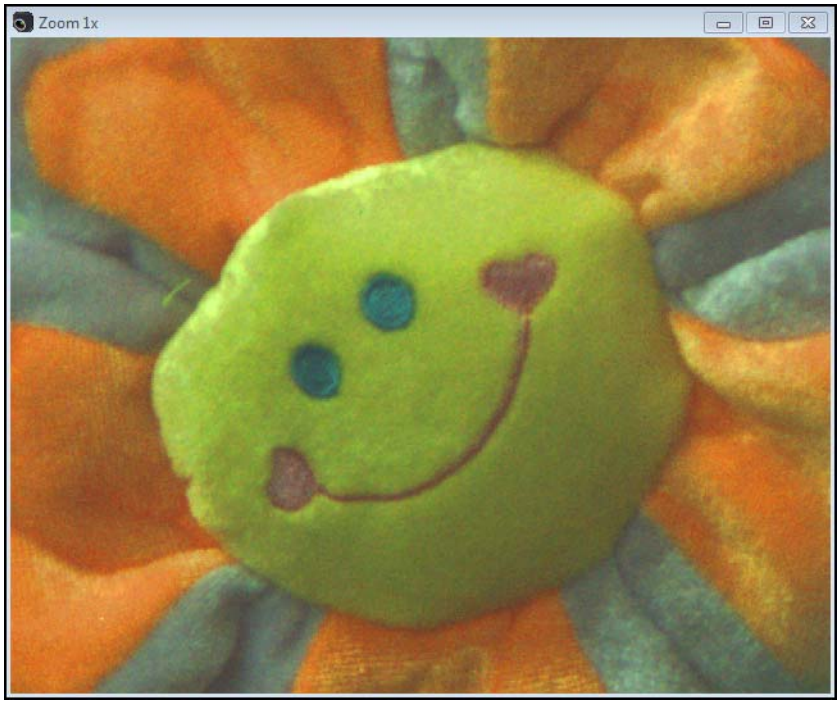


Figure 3-6 *Video mode window*

To start video from the camera:

Click the **Start Video** button in the toolbar:

OR

Select **Start Video** from the **Device** menu.

Note: *To display video right after you enter the application, select the* **Display Video on Program Startup** *check box in the* **Device Settings** *window. Then you will not need to click the* **Start Video** *button.*

If the **Start Video** button is not active, in the **SMX-11Mx Series USB2.0 Camera Software** main window, click **Device** menu, select **Switch Multiple…** and select the connected camera.

Switching Between Cameras

If you have more than one SMX-11M5x Series camera connected to your PC, the camera application allows you to switch between them.

To switch between multiple cameras:

1 In the **Device** menu of the application's main window, select the **Switch Multiple** command.

2 The **Choose a Camera** window will appear.

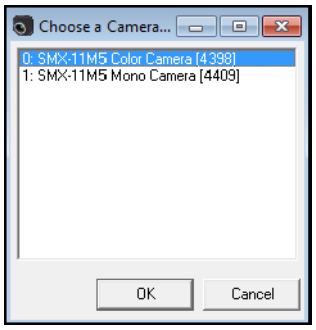


Figure 3-7 *Switching between cameras*

3 In the list of the present cameras, select the desired one and click **OK**.

Viewing Camera ID

The camera ID is shown on the top of the **Device Settings** window.

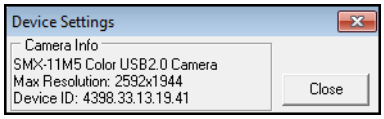


Figure 3-8 *Camera ID*

Reducing CPU Load

You can reduce CPU load by enabling the **Direct Access to Driver Frame Memory** option at the bottom of **Device Settings** window. See API documentation for the details on how to provide direct pointer to the driver frame memory instead of copying the frame to the user buffer.

Chapter 4 TUNING GUIDELINES

Initial Settings

Check if the **Start Video** button on the camera application's toolbar is enabled:

If it is not enabled, check the list of all available cameras in **Main menu > Device > Switch Multiple…** If the list is empty, check if the camera is connected and if the driver is installed correctly.

The illumination of the camera's image depends on the values of frequency, exposure, gain, the image dimensions (resolution) and decimation factor.

The recommended initial settings are:

- **Gain** and **Exposure** sliders are in the lowest position
- **Decimation** is 1:1
- **Viewport size** is 800 x 600 (the **Viewport settings** dialog box is activated with the button on the camera application toolbar or **Alt + v** on the keyboard)
- **Color Mode** is set to **Bilinear** (**Main Menu > Device > Settings...** dialog box, **Color Mode** section)
- **Histogram** is active (**Main menu >Device > Histogram** is selected or **h** is pressed)

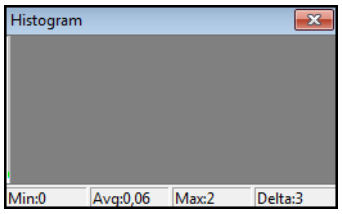


Figure 4-1 *Histogram of initial state*

- The **Image Correction** tab is selected
- The **Enable** check box is set
- The **Brightness**, **Contrast**, **Gamma** sliders of the **Image Correction** tab are in the central position (their values are 0, 1, 1, respectively). To reset the values for all sliders at one go, click the **Default** button. To reset one of them, double-click its value at the right end of the slider bar

- The **R**, **G**, **B** sliders of the **Color Balance** tab are in the central position (their values are 1, 1, 1, respectively). To reset the values for all sliders at one go, click the **Default** button. To reset one of them, double-click its value at right end of the slider bar
- The **Brightness**, **Contrast**, **Saturation** sliders of the **Color Correction** tab are in the central position (their values are 0, 1, 1 - respectively). To reset the values for all sliders at one go, click the **Default** button. To reset one of them, double-click its value at right end of the slider bar

*Note: The slider values will affect the image only if the **Enable** box is checked.*

Tuning Light in the Image

To tune illumination, install a lens (see "Installing Lens" on page 23).

To tune light in the image:

1. Use maximum diaphragm aperture of your lens.
2. Try to get enough light using the **Exposure** slider.
3. If the **Exposure** slider is at maximum and more light is needed, decrease frequency (it will enlarge the exposure interval).
4. If illumination is not enough, use the **Gain** group of sliders (**All, R, G, B**).
5. Press **e** on the keyboard to adjust the exposure automatically.

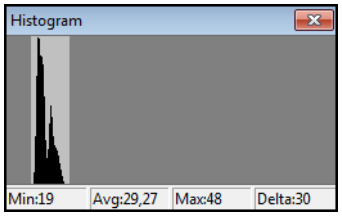


Figure 4-2 *Histogram after illumination is tuned*

6. If the image is still too dark, you can also change black level:
   a. Open the **Device Setting** window by pressing **Alt+s**.
   b. Go to the **Black Level Calibration Value** control and move the slider until the image becomes as bright as you need.

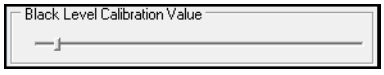


Figure 4-3 *Black Level Calibration control*

Color Tuning

To tune color of the image:

1. Put a white object (for example, a piece of paper) in front of the camera.
2. Perform **White Balance (Hard)**: select **Device > White Balance (Hard)** or press **Alt+w**. It will balance the **RGB** components of white at the hardware level.
3. Press **w** on the keyboard to perform White Balance on the software level.

To control the color components, use the **R, G, B** sliders of the **Color Balance** tab and the **Brightness**, **Contrast** and **Saturation** sliders of the **Color Correction** tab.

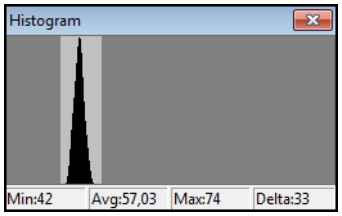


Figure 4-4 *Histogram after performing White Balance (Hard)*

Contrast Tuning

Activate the **Histogram (h)**, activate the **Image Correction** tab, set the **Enable** check box and use the **Contrast** slider to get the histogram as wide as possible (ideal min = 0, max = 255 provided there are no red points at the extremities of the histogram window).

Sensor Controls

The sensor control options are located in the **Sensor Control** section of the application main window. They are as follows.

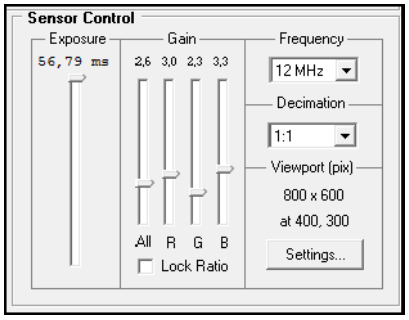


Figure 4-5 *Sensor controls*

Exposure

The exposure parameter defines time during which the sensor will consume light energy before starting to record data.

Use the **Exposure** slider to adjust the camera exposure time manually. The current exposure time in milliseconds is displayed above the control. This value depends on viewport height, decimation and sensor frequency.

If you need to set exposure even higher than the maximum slider value, uncheck the **Limit Max Exposure** control in the **Device Settings** window. The maximum slider value will become higher.

Figure 4-6 *Limit Max Exposure box*

To tune exposure automatically:

In the **Device** menu select the **Auto Exposure** command, or press **E** on the keyboard.

Gain

Gain can be controlled independently for **Red**, **Green** and **Blue** channels (**R**, **G**, **B**). All gain sliders control the camera's hardware gain amplifier. The **R, G** and **B** gain sliders control the software gain for each color channel.

Checking the **Lock Ratio** check box allows controlling gain on three channels simultaneously keeping the fixed **R**; **G**; **B** gain ratio.

Use the '**White balance (Hard)**' menu item (**Device> White Balance (Hard)** or **Alt+w** to balance the gain of all three channels so they are equally intense.

Note: ***Auto Exposure*** *is done automatically every time* ***White Balance (Hard)*** *is performed.*

In case of SMX-11M5M monochrome camera, set gain using the **All** slider.

You can limit the maximal set gain value to 10. Use the **Limit Gain 10** checkbox in the **Device Settings** window.

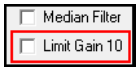


Figure 4-7 *Limit Gain control*

If this box is checked, you will not be able to set gain higher than 10.

Frequency

The **Frequency** drop-down box provides values for the pixel clock frequency of the sensor. The lower the frequency, the higher the maximum possible exposure time and

the less the frame rate is. This control defines the frequency of polling the camera for its image stream.

Decimation

Use the **Decimation** drop-down box to decimate (sub-sample) the picture by 2, 3, 4, 5, 6, 7 or 8. The decimation means excluding pixels and rows from the scan process (for example, every second pixel and second row for the 1:2 decimation). This mode thus allows viewing the picture at the higher frame rate.

The higher decimation can be used for preview, when 1600 x 1200 image can be displayed as 800 x 600 with the frame rate two times higher.

Viewport

Viewport is a rectangular area of the sensor on which the image is scanned. It can have variable size: from the full sensor field of view to the small area of 8 x 8 pixels. The smaller vertical size (in lines) of the viewport, the faster the scan process and the higher the frame rate is.

To change the viewport:

1 Press **Alt+v** on the keyboard

OR

Click the **Settings…** button below **Viewport (pix)**

OR

Click the **Viewport Settings** button on the toolbar:

2 The **Viewport Settings** window will open.

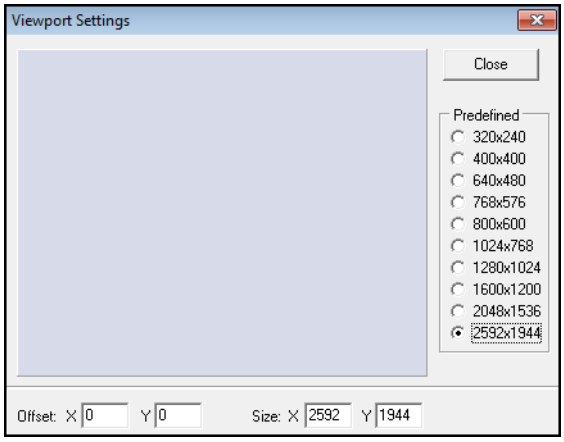


Figure 4-8 *Viewport Settings window*

3 You can select one of the predefined viewport options and then drag the rectangle across the full viewport resolution area for the viewport window. You will notice how the image in the **View Mode** window changes with the movement.

4 Alternatively, you can change values in the following fields:

- **Offset X, Y** fields with coordinates of the top left corner of the rectangle
- **Size X, Y** fields with coordinates of the bottom right corner of the rectangle

If the viewport size is smaller than maximum viewport size, you can also change it by dragging the video image in the **Video mode** window.

Image Correction

The **Image Correction** controls are designed for setting up the camera brightness, contrast and gamma. These corrections are programmable with the conversion (lookup) table of the values. They do not affect any electrical settings of the camera. The gamma correction is done by the camera hardware.

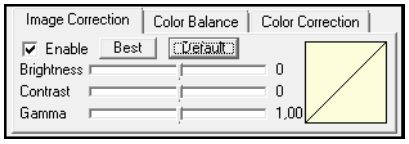


Figure 4-9 *Image correction controls*

Note *For 8-bit camera models, the **Image Correction** tab is disabled.*

To use these controls, check the **Enable** box - the **Brightness**, **Contrast** and **Gamma** sliders become editable. By default, the values of **Brightness**, **Contrast** and **Gamma** are set to **0; 0; 1, 00**, respectively.

You can restore the default values at any step, just click the **Default** button on the **Image Correction** tab.

Click the **Best** button to automatically achieve the optimal combination of brightness, contrast and gamma instead of setting them manually. As the result, the application will transform the look-up table of 8 and 10 bit to increase the dynamic range.

Note *The default values of **Image Correction** are the most suitable and recommended for performing **White Balance (Hard).***

*The SMX-11M5x cameras software do not display changes of the Image Correction look -up table when the **Best** button is pressed.*

With every change of any **Image Correction** control, you can view a graphical interpretation of dependence of the image's changes from the changes of the **Image Correction** controls.

Color Balance

The **Color Balance Controls** are designed for the SMX-11M2C color model to adjust the ratio of the main induced color components (**Red**, **Green** and **Blue**) of the image. This correction is performed on the software level and does not affect any electrical settings of the camera.

To use the **Color Balance Controls**, set the **Enable** check box on the **Color Balance** tab - **R**, **G** and **B** sliders become editable.

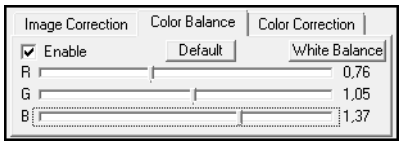


Figure 4-10 *Enabling the Color Balance Controls*

Use the **White Balance** button for white color balancing at the software level (the same can be done by pressing **w** on the keyboard). The **Default** button returns the color balance controls to their default values: 1.00; 1.00; 1.00, respectively.

Single step of the **Color Balance** controls is 10 times smaller than **R, G, B (Gain)** of the **Sensor Controls**, so all changes of **Color Balance** can be performed with more accuracy than it can be done using **R, G, B (Gain)** of **Sensor Controls**.

Note: *The difference between **White balance (Soft)** and **White Balance (Hard)** is as follows: the **White Balance (Soft)** operation is done only on the software level, so it changes the **Color Balance** controls. The **White Balance (Hard)** operation is done programmatically by the camera firmware, so it changes **R**, **G** and **B** (**Gain**) of **Sensor Controls**.*

Note: *It is not recommended to perform **White Balance (Hard)** when **White Balance (Soft)** is already performed. It may cause the image colors distortion.*

Color Correction

The **Color Correction Controls** are designed for the SMX-11M5C color model to adjust the intensity of the color properties (brightness, contrast and saturation) of the image. This correction is performed on the software level and does not affect any electrical settings of the camera.

Check the **Enable** check box on the **Color Correction** tab to make the **Color Correction Controls** available.

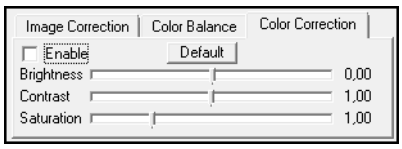


Figure 4-11 *Enabling the Color Correction tab*

Use the **Default** button to restore the default values of brightness, contrast and saturation - 0.0; 1.00; 1.00, respectively.

Advanced Sensor Controls

Apart of the controls in the main application window, you can also use controls available in the **Device Settings** window. To access the **Device Settings** window, press **Alt+s** on the keyboard or select **Settings** from the **Device** menu.

Color Mode

The **Color Mode** section defines the rules for decoding the stream of source pixels from the sensor and transforming it into the output image. This control is available for the SMX-11M5C color model.

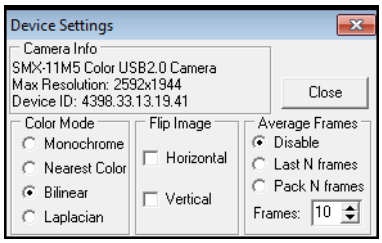


Figure 4-12 *Advanced sensor controls*

- The **Monochrome** mode forces the transformation of the sensor pixels data into monochrome stream.
- The **Nearest Color** mode: Bayer matrix from the sensor is transformed into destination stream using the Nearest Color algorithm (the fastest algorithm that gives the worst, compared to other algorithms, image quality).
- The **Bilinear** mode: Bayer matrix from the sensor is transformed into destination stream using the Bilinear algorithm (a slower algorithm that gives better quality).
- The **Laplacian** mode: Bayer matrix from the sensor is transformed into destination stream using the Linear Interpolation with Laplacian second-order correction terms (the slowest algorithm that gives the best quality).

Image Flip

You can flip the image in the **Video** mode window horizontally and/or vertically. Check the corresponding boxes in the **Flip Image** section of the **Device Settings** window. Using the flip controls, you can rotate the image without changing the camera position itself.

Increasing Image Quality

You can increase the image quality by compensating the random noise of the sensor. For this purpose, use the **Average Frames** controls in the **Device Settings** window.

There are two averaging modes:

- **Last N frames**: the currently displayed frame is the average of the last N frames set in the **Frames** box. The picture is updating every frame
- **Pack N Frames**: the currently displayed frame is the average of the last N frames set in the **Frames** box. The picture is updating every N-th frame.

Note *Use the averaging only for static pictures. Displaying moving objects in the average mode will lead to the image blurring.*

Frame Rate

You can change the frame rate for the current sensor parameters (for example, frequency or viewport) using the **FrameRate Control** button in the lower part of the **Device Settings** window.

To change frame rate:

1. Open the **Device Settings** window by pressing **Alt+s** on the keyboard.
2. Press the **FrameRate Control** button.

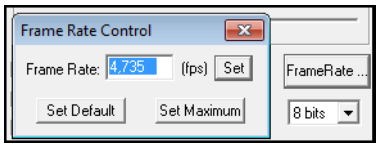


Figure 4-13 *The Frame Rate Control window*

3. The **Frame Rate Control** box opens. By default, it shows the maximum value for the current sensor parameters.
4. Type in the new value in the **Frame Rate** field, then press **Set**. You will not be able to set frame rate lower or greater than limits. To check the maximum limit, press the **Set Maximum** button.

The **Set Default** button - if applied, the default value of frame rate for the camera with current settings will be performed. The default value is flashed in every camera and is applied automatically when the camera's settings are changed.

As a result, the **Frame Rate** value will not be greater than the one you entered in the **Frame Rate Control** window. Check it when running video: frame rate value will be displayed at the bottom-right corner of the status bar in the application's main window.

Note: When running the camera on a system that does not meet the minimal requirements (see "System Requirements" on page 7), the frame rate value can be less than it is set with the **Frame Rate Control** *option, especially when running with full viewport and with high frequencies.*

Auto White Balance

Note: These controls are used for the SMX-11M5C color camera model.

Enable the **Auto White Balance Hardware** checkbox if you want to automatically balance white at the hardware level every time when the picture changes.

Figure 4-14 *Auto White Balance Hardware checkbox*

For more information on white balance, see "Color Balance" on page 37.

Output Bits per Pixel

You can select **10 bits** or **12 bits** if you want the software to transmit **10 bit** or **12 bit** images from the camera as opposed to regular **8 bit**.

Figure 4-15 *Bit mode drop-down box*

Filtering

The **Median Filter** option turns on pixel averaging. The brightness of every single pixel becomes affected by the brightness of its neighbor pixels and the whole image becomes smoother.

Figure 4-16 *Median Filter checkbox*

Saving and Loading Camera Profiles

The SMX-11M5x camera application automatically stores most of the camera settings on exit and restores them on startup. You can also store current settings in profile files (***.pro**) and load them whenever you need. Profiles store frequency, gain, exposure, viewport, flip, black level and column balancing, and other settings.

To save current camera settings into a profile:

1 Press **Ctrl+s**.

OR

In the **File** menu select the **Save Profile** command.

2 **Save Camera Profile** box appears. Type in profile title and select a folder where you want to save the file.

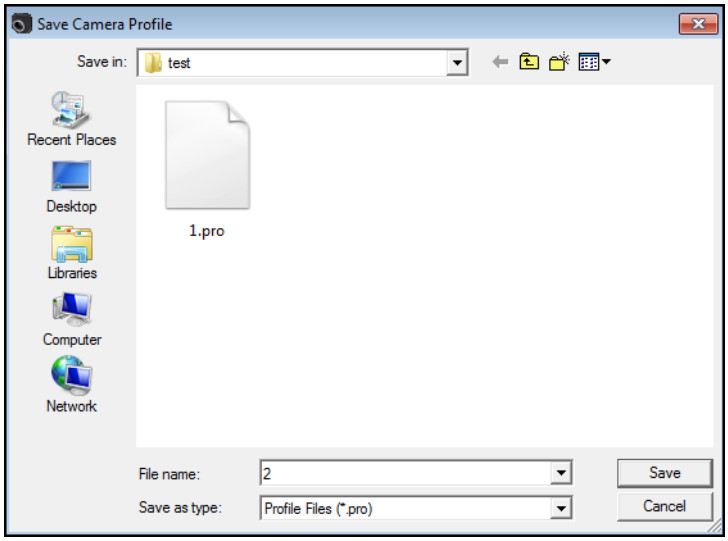


Figure 4-17 *Saving camera profile*

3 Press **Save**.

To load a profile:

1 Press **Ctrl+o** or in the **File** menu, select the **Open Profile** command.

2 **Load Camera Profile** box appears. Browse to a folder with profile files and select one you want to load.

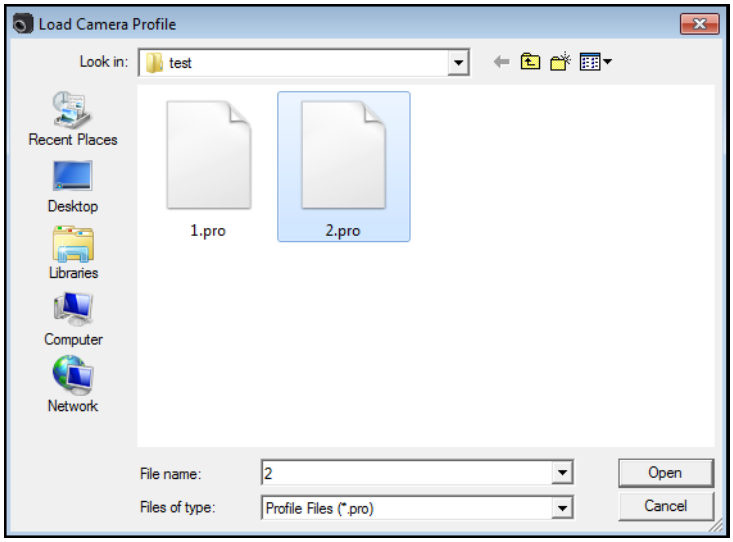


Figure 4-18 *Loading camera profile*

3 Press **Open**.

Chapter 5 CAPTURING

The SMX-11M5x camera application enables you to capture images from the camera and to store them in BMP or TIFF format files. You can also save files with video that you record.

Capturing Images

To capture frames:

1. Start video (press **F5** or the button **Start Video** in the toolbar).
2. You can capture a single frame or a frame sequence:
   - For a single frame press **F2** or the button in the toolbar
   - For a sequence press **F3** or the button in the toolbar.
3. The frame/frame sequence is captured immediately and saved in the folder specified in **Capture Options** (see "Saving Options" on page 45).

Capture Limits

The **Limits** section in the **Capture Options** dialog box allows controlling the capture parameters. To open the dialog box, press **Alt+c** on the keyboard.

You can lower the noise level in the frame being captured using the **Capture single frame as average** of box. Check the box and type in the number of frame you want to average.

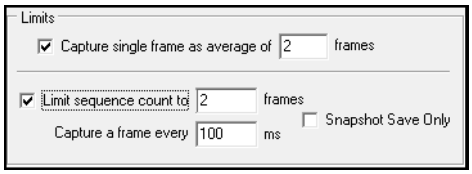


Figure 5-1 *Limits section of Capture Options*

By default, two frames are captured in a sequence. You can increase this value:

1. Check the **Limit sequence count to** box.
2. Type in the new value in the field near the checkbox.
3. Change the time period for capturing frames in the **Capture a frame every** field. The sequence capture interval cannot be less than current frame exposure time. If it is less, an error message will be displayed when you try to perform a sequence capture:

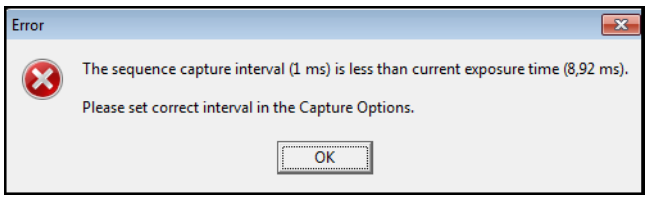


Figure 5-2 *Message about incorrect sequence capture interval*

4 Press **OK**.

Recording Video

To record a video:

1 Start video (press **F5** or the button **Start Video** in the toolbar).

2 To start video recording, press **F4** or the button in the toolbar.

3 Press **Shitf+F5** to stop the video stream or click the **Stop Video** button in the toolbar.

4 The video is recorded and saved in the folder specified in **Capture Options** (see "Saving Options" on page 45) as an **.avi** file.

Saving Video to Memory

You can save video or frames to the core memory. This is done without a delay between frames. Do the following:

1 Start video.

2 Press the **Save Video to Memory** button in the toolbar or press **Shift+F4** on the keyboard.

Number of frames in the video is set via the **Capture Options** box. Type in the required number in the **Capture Limit** field:

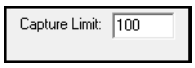


Figure 5-3 *Save Video to Memory section*

When you use the **Save to Memory** option, frames will be saved as image files similarly to the simple saving (see "Saving Options" on page 45). Video will be saved as a **.smx** file which can be replayed and converted to the **.avi** file with the **SMXView** utility that goes with the standard SMX-11M5x software package.

Saving video directly to memory can slow down the camera's output visualization, but this method insures that no frames are missing in the saved file.

Saving Options

When you capture frames or record a video, they are saved in directory and with file prefix specified in **Capture Options**.

To change options for saving frames/video:

1 Open the **Capture Options** dialog by pressing **Alt+c** on the keyboard or go to the **File** menu and select **Capture Options**.

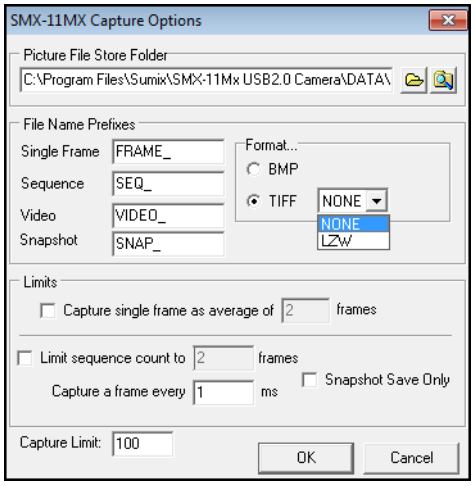


Figure 5-4 *Capture Options box*

2 Set the options:

a. In the **Picture File Store Folder** box, change the directory in which you want to save frames/video or leave the default one.

Note: *This folder will also store snapshots (see "Snapshots" on page 45).*

b. Change the prefix that will be assigned to all frame/frame sequence and video files or leave the default ones. Use the **Single Frame**, **Sequence** and **Video** fields. The files are named automatically by combining the corresponding **File Name Prefix** and numerical value that is calculated by the number of last captured file + 1.

c. Select image file format for frames:

- **BMP** - saves any 8 bit or 10 bit image as 8 bit BMP image.
- **TIFF** - saves 8 bit image as 8 bit TIFF image and 10 bit image as 10 bit TIFF image. Select also compression type: **NONE** (without compression) or **LZW** (Lemple-Zif-Welch - lossless type of compression).

Note: *The selected image format will also be used for snapshots.*

3 Press **OK**.

Chapter 6
SNAPSHOTS

Snapshots Basics

The SMX-11M5x Series cameras can work only in one of the two modes at the same time: **Video** or **Snapshot**. When the camera is not in the video mode, it is possible to take a snapshot - to capture a still image. A snapshot can be triggered by the software, or by external (with respect to the camera) hardware.

The Video mode is the normal mode when the camera is producing the image data. The Snapshot mode forces the camera to capture a still image (a single frame).

To take a snapshot from the camera, use the **Snapshot** section of the camera application main window. Remember that you need to stop video (**Shift+F5**) before you turn on the snapshot mode. To start the snapshot process, press the **Snapshot** button.

Taking Snapshots Using Software Trigger

To make a snapshot using the software trigger:

1. Turn the video mode on (press **F5** or the **Start Video** button in the toolbar).
2. Set exposure, gain, viewport, etc.
3. Turn the video mode off (press **Shift+F5** or the **Stop Video** button in the toolbar).
4. Click the **Snapshot** button in the **Snapshot** section of the main window.

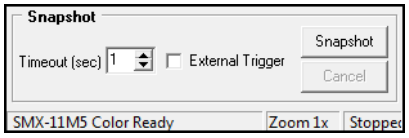


Figure 6-1 *Making a snapshot using software trigger*

5. The **Snapshot** window will open.

Note: *In the **Video** mode, the **Exposure** slider controls the exposure time for the video. When the video is stopped, the **Exposure** slider controls the exposure time of the snapshot.*

Global Reset Release Shutter Mode

If you want to make snapshots with global shutter, check also the **Global Reset Release Shutter Mode** box in the **Device Settings** dialog box. This mode is especially useful when you want to make snapshots of moving objects.

Figure 6-2 Global Reset Release Shutter Mode checkbox

Note: *For correct work of the global shutter mode, the SMX-11M5x camera needs to be equipped with a mechanical shutter stopping the light stream at the exposure time. Alternatively, the frame grabbing should take place when a flash light is on, while the rest of the time the camera is in darkness.*

Taking Snapshots Using Hardware Trigger

To take a snapshot using a hardware trigger:

1. Connect an external device (equipment).
2. Turn the video mode off (press **Shift+F5** or the **Stop Video** button in the toolbar).
3. Set exposure, gain, viewport, etc.
4. Set **Timeout** (seconds to wait for external triggering pulse).
5. Check the **External Trigger** box.
6. Click the **Snapshot** button.

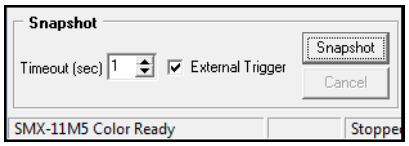


Figure 6-3 *Taking a snapshot using the hardware trigger*

7. Apply triggering pulse (see "External Trigger Connector Pinout" on page 49).
8. As a result, the **Snapshot** window will open if the camera has detected the external triggering pulse.
9. If it failed to detect the external triggering pulse, the **Snapshot** window will not open and a timeout message will be displayed in the application status bar.

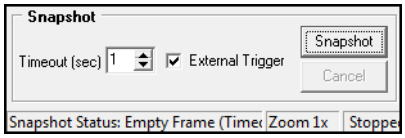


Figure 6-4 *Timeout message in the application status bar*

External Trigger Connector Pinout

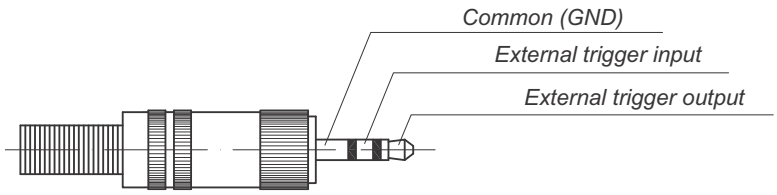


Figure 6-5 *External trigger connector pinout*

Saving Snapshots

When you take snapshots, they are saved in directory and with file prefix specified in **Capture Options**.

To change options for saving snapshots:

1 Open the **Capture Options** dialog by pressing **Alt+c** on the keyboard or go to the **File** menu and select **Capture Options**.

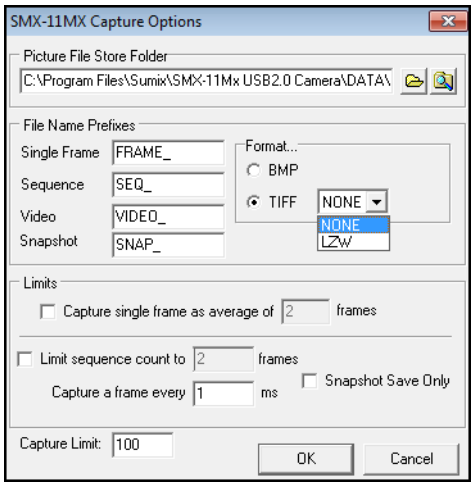


Figure 6-6 *Snapshot saving options*

2 Set the options:

a. In the **Picture File Store Folder** box, change the directory in which you want to save snapshots or leave the default one.

Note: This folder will also store captured videos and frames.

b. Change the prefix that will be assigned to all snapshot files or leave the default one. Use the **Snapshot** field. The files are named automatically by combining the corresponding **File Name Prefix** and numerical value that is calculated by the number of last captured file + 1.

c. Select image file format:

- **BMP** - saves any 8 bit or 10 bit image as 8 bit BMP image.
- **TIFF** - saves 8 bit image as 8 bit TIFF image and 10 bit image as 10 bit TIFF image.

Select also compression type: **NONE** (without compression) or **LZW** (Lemple-Zif-Welch - lossless type of compression).

Note: The selected image format will also be used for captured frames.

d. Check the **Snapshot Save Only** to save snapshots without showing them on the screen.

3 Press **OK**.

Chapter 7

USE OF ACCESSORIES

SMX-11M5x Series cameras can be supplied with the following accessories:

1. C-mount adapter
2. C-mount adapter with IR-cut filter
3. Tripod adapter
4. USB A to Mini B cable

This chapter will show you how to use the cameras with adapters.

Using C-mount Adapter with IR-cut Filter

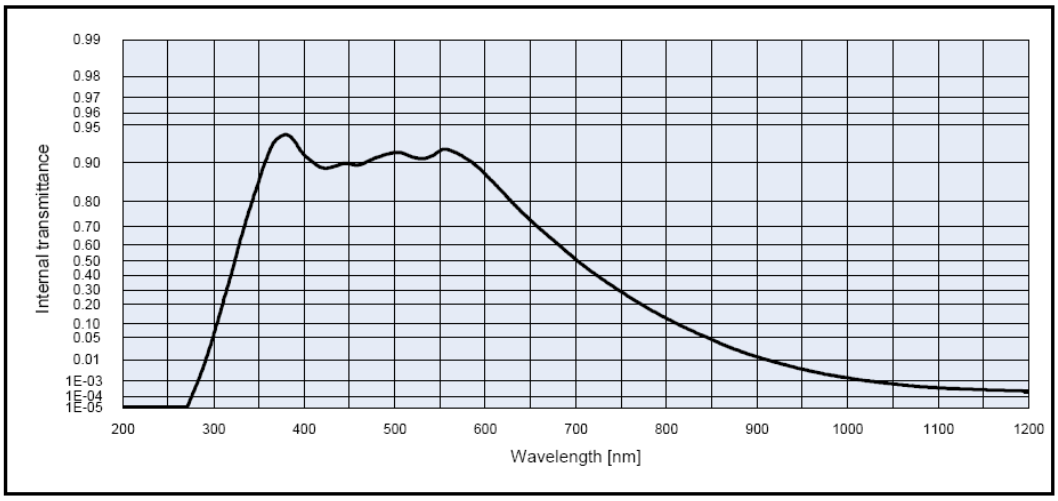
The SMX-11M5x Series cameras can be a C-mount (with the adapter/adapter with filter) or a CS-mount (without the adapter/adapter with filter).

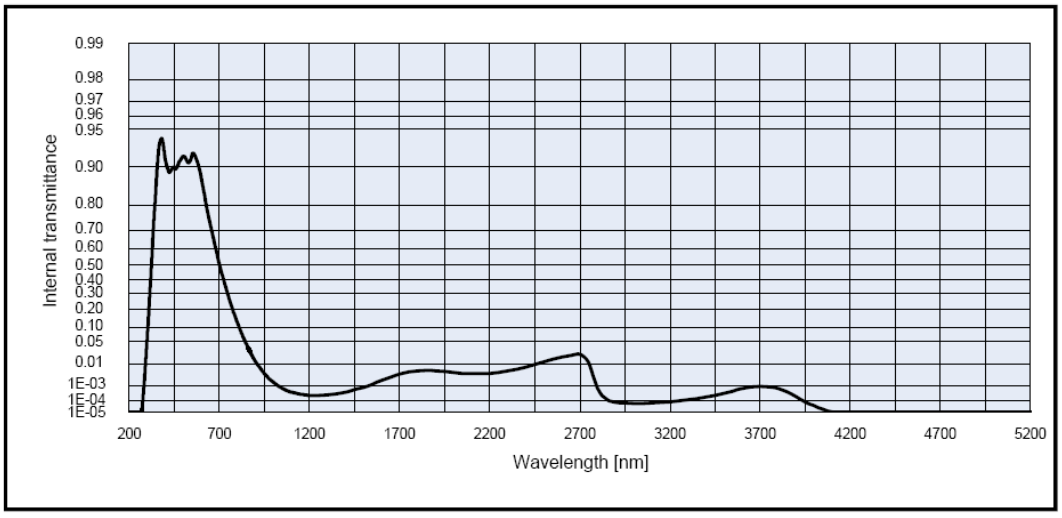
IR-cut Filter Characteristics

The IR-cut filter provided with the camera has the following characteristics:

- Diameter = 20mm
- Thickness = 2 mm

Chart of the IR-cut filter transmission characteristics:





C-mount

In this case, the camera is used with the C-mount adapter or with the C-mount adapter with IR-cut filter:

Using Adapter with Color Cameras. Since the SMX-11M5C color camera is sensitive to IR-light, use the C-mount adapter with IR-cut filter for the color camera models to make colors of the image more realistic.

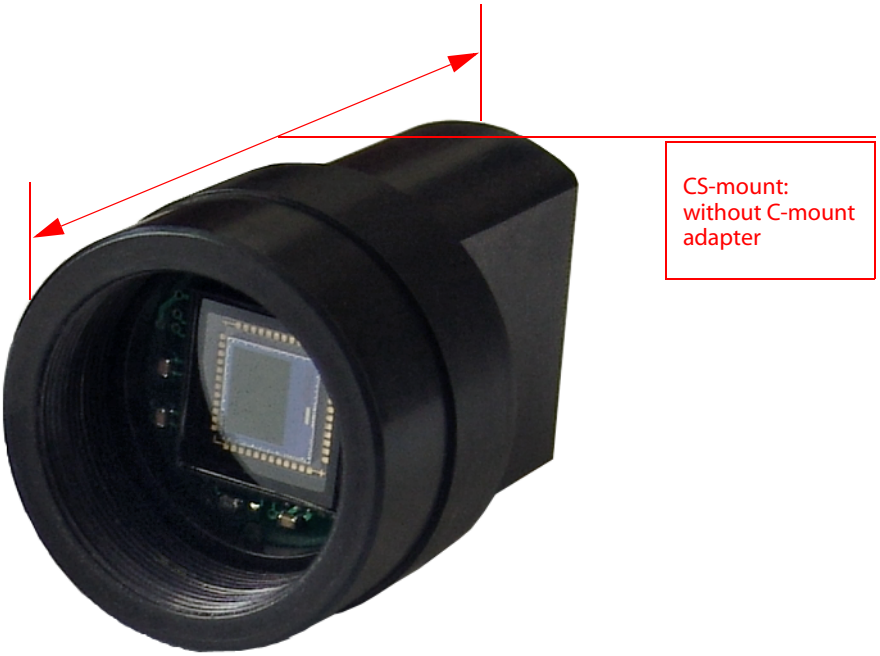
Many light sources, including the sun, emit infrared light, so the color camera in daylight will see a significant amount of infrared light without the IR-cut filter. As a result, strange, non-realistic colors appear.

Another reason for using the IR-cut filter is the limited color correction for many lenses. that have different depth of focus for the visible and infrared spectrum. The IR-cut filter cuts away a significant amount of the overall collected light and thereby affects the sensitivity in a negative way. In general, color cameras are one factor less sensitive compared to monochrome (depending on the sensor). This is primarily due to the IR-cut filter.

Using Adapter with Monochrome Cameras. SMX-11M5M monochrome camera is more sensitive to infrared light than the color model. Using the cameras in the environment rich for infrared light may result in highlighted images. To avoid this effect, use the C-mount adapter with IR-cut filter for monochrome cameras.

CS-mount

In this case, the camera is used without both C-mount adapter and C-mount adapter with IR-cut filter:



Converting the Camera from CS-mount to C-mount or from C-mount to CS-mount

Usually the SMX-11M5x camera goes with the C-mount adapter or C-mount adapter with IR-cut filter already screwed in.

- To use the SMX-11M5x camera as CS-mount, screw the C-mount adapter/C-mount adapter with IR-cut filter out.
- To use the SMX-11M5x camera as C-mount, screw the C-mount adapter/C-mount adapter with IR-cut filter in.

Note: *It is recommended to screw in (as well as screwing out) the C-mount adapter/C-mount adapter with IR-cut filter, lens or the camera's cover when the camera is facing down or when the camera is in horizontal position - to prevent the sensor contamination.*

Using Tripod Adapter

The SMX-11M5x camera may go with the Tripod adapter already put on:

To remove the tripod adapter from the camera:

1. Loosen the screw of the adapter.
2. Remove it from the camera:

To put the tripod adapter on the camera:

1 Loosen the screw of the adapter.

2 Put the Tripod adapter on the camera. Locate the tripod on the camera as shown in the image below:

Appendix 1

KEYBOARD SHORTCUTS

Keyboard shortcut	Description
F1	Help
F2	Captures a frame into bitmap file
F3	Captures a sequence of frames into bitmap files
F4	Captures a sequence of frames into AVI file
Shift + F4	Capture a sequence of frames into the memory
F5	Starts live video display in the View window
Shift+F5	Stops live video display and closes the View window
F9	Takes a snapshot
F12	Brings up the Main window when displaying the live video
Esc	The same as Shift + F5, stops the video
Ctrl + o	Opens Camera Profile
Ctrl + s	Stores Camera Profile
Ctrl+C	Copies an image from the camera to buffer
Alt + c	Brings up the Capture Options dialog box
Alt + s	Brings up the Device Settings dialog box
Alt + v	Brings up the Viewport Settings dialog box
h	Brings up the Histogram
Alt + w	Performs White Balance (Hard) using Gain Controls
Numpad +/-	Zoom In/Zoom Out the picture in the View window
Numpad *	Restores the picture in the View window to its original (100%) size

Appendix 2

Toolbar Overview

The most common menu commands are duplicated on the application toolbar:

Starts live video display in the View window

Stops live video display and closes the View window

Brings up the Viewport Setup dialog box

Captures a frame into BMP/TIFF file

Captures a sequence of frames into BMP/TIFF files

Starts saving Video to a file

Starts saving Video to memory

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FIGURES

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