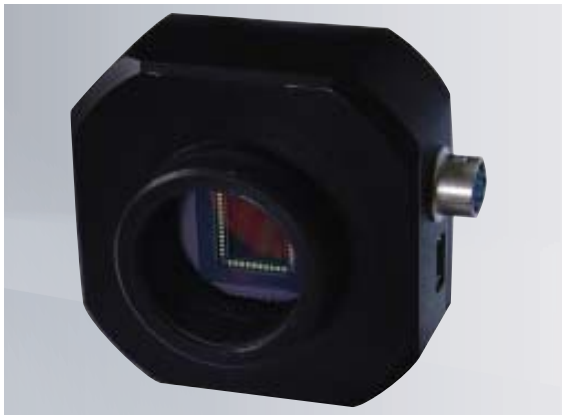
SUMIX corporation



Megapixel USB2.0 CMOS

CAMERA

User Guide

SMX-160 Series USB2.0 Cameras

SMX-160 Series USB2.0 Cameras User Guide

Revision 2.0

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Chapter 1

INTRODUCTION

The **SMX-160 Series USB2.0 Cameras** are 6.6 megapixel CMOS cameras designed for applications where high resolution quality images are critical.

The SMX-160 Series cameras provide the following benefits:

- Less than 5 minutes to install
- Plug and play
- USB2.0 interface (480 Mbps)
- Require no external power source

The SMX-160 Series USB2.0 cameras feature:

- 2208 x 3000 active imaging pixels
- Speed: 6 fps at 2208 x 3000 (48 MHz)
- Low image noise
- Rolling shutter
- Small size
- Cost effective

Programmable functions include the **Viewport settings** window, adjustable **Exposure** time and **Gain**, selectable sensor clock **Frequency** and image **Decimation**, flipping the image horizontally and vertically.

The SMX-160 Series cameras are available in two modifications:

- SMX-160M (6.6 Megapixel, monochrome)
- SMX-160C (6.6 Megapixel, color)

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-160 camera application software:

1. Run the **SMX160<version>.exe** file downloaded via the URL provided by Sumix Corporation.
2. **Welcome to the SMX-160 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.

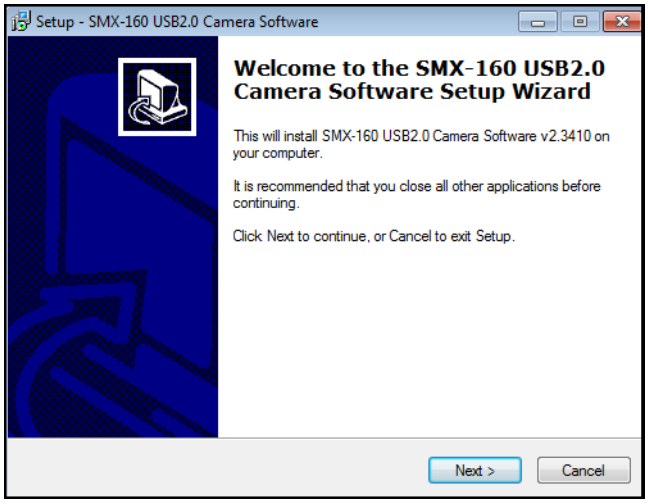


Figure 2-1 *Welcome to the SMX-160 Camera Setup Wizard*

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

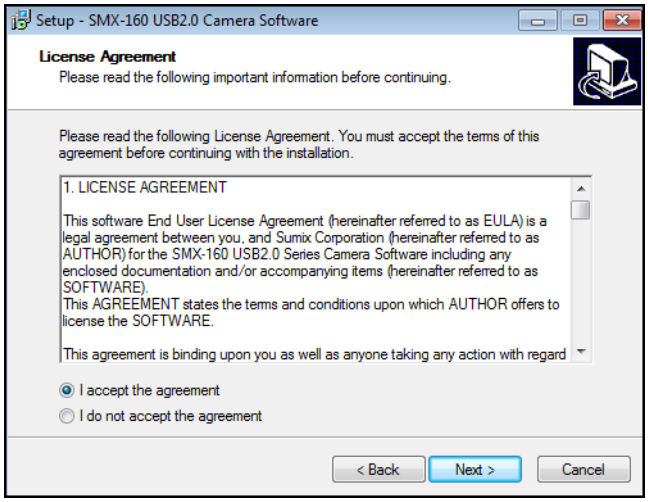


Figure 2-2 *License Agreement dialog box*

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

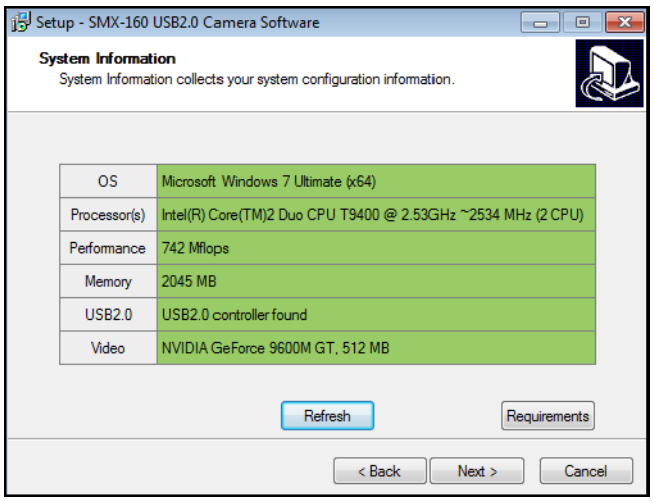


Figure 2-3 *System Information box*

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:

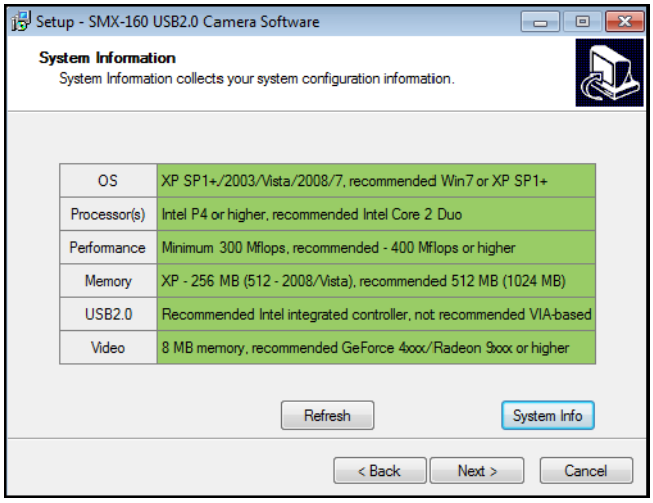


Figure 2-4 *Recommended system configuration*

6 In the **Select Destination Location** box, click **Browse** to change the folder in which the SMX-160 camera application software will be installed, or leave the one suggested by the wizard. Click **Next**.

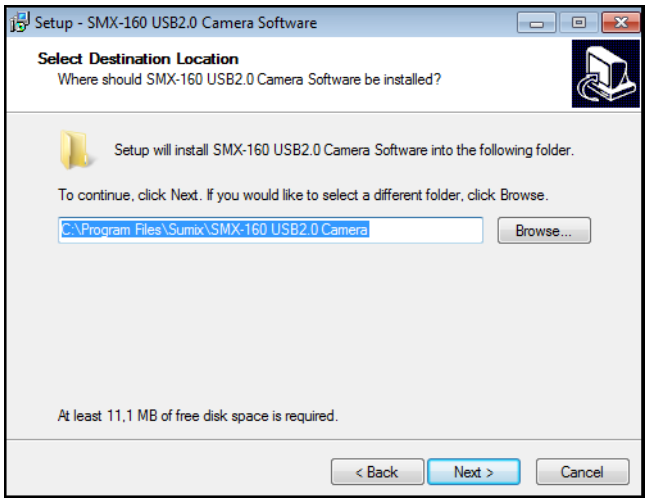


Figure 2-5 *Select Destination location box*

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

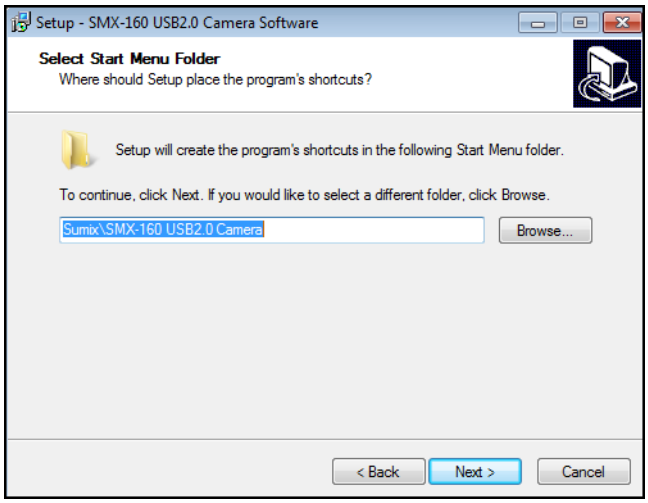


Figure 2-6 *Select Start Menu Folder box*

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.

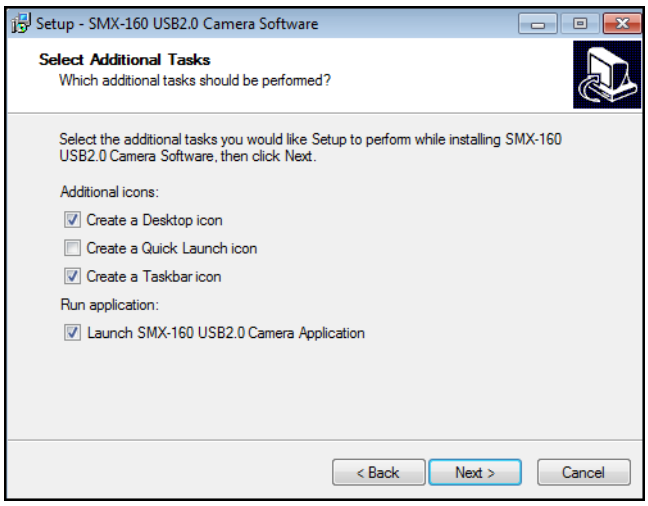


Figure 2-7 *Select Additional Tasks box*

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

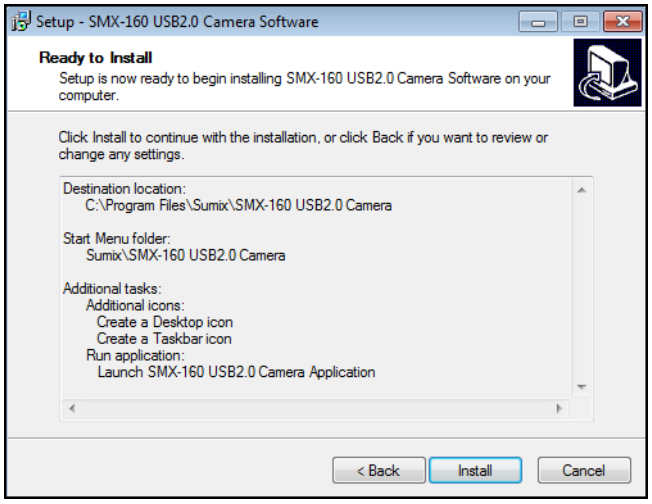


Figure 2-8 *Ready to Install box*

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

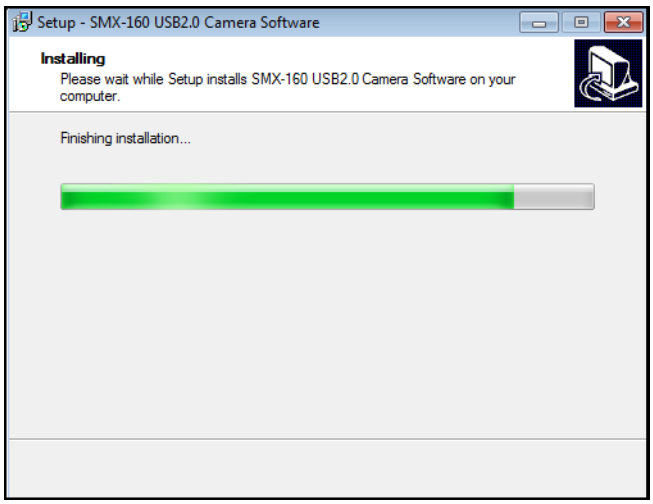


Figure 2-9 *Installing box*

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

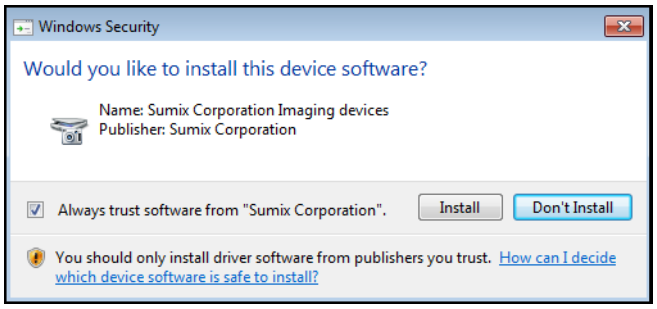


Figure 2-10 *Windows Security box*

11 When done, click **Finish**. The software has been successfully installed.

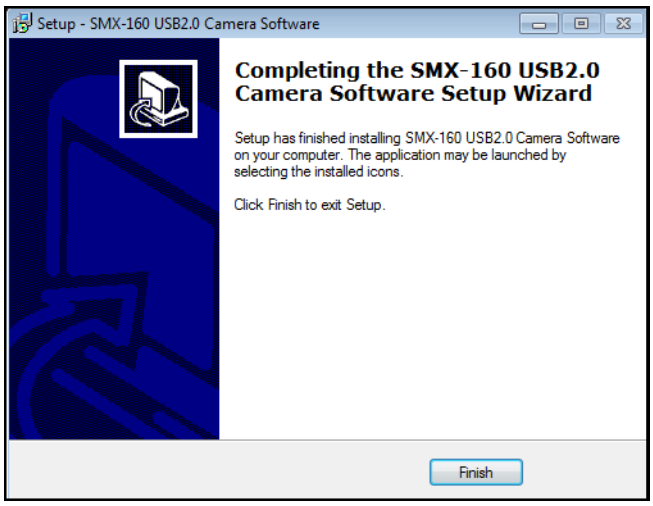


Figure 2-11 *The last installation step*

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 **SMX160<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-160 USB2.0 Camera** and select **Update Driver...**

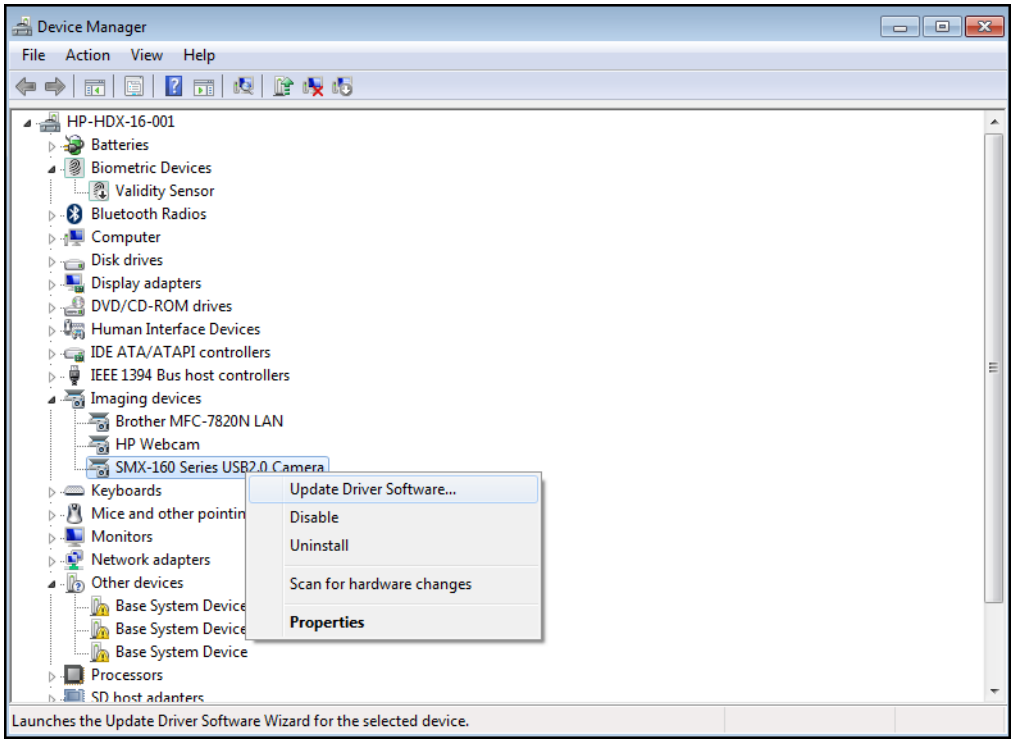


Figure 2-12 *Updating the camera driver*

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

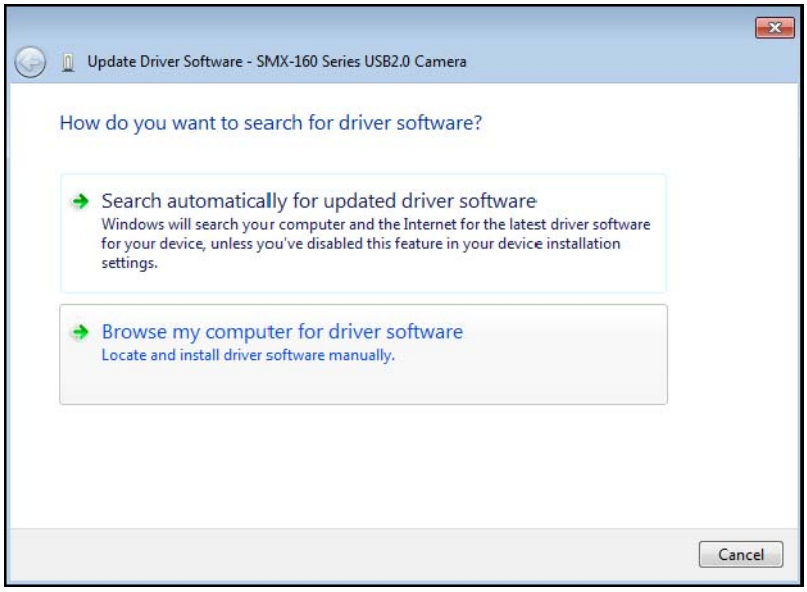


Figure 2-13 *Updating the camera driver: step1*

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

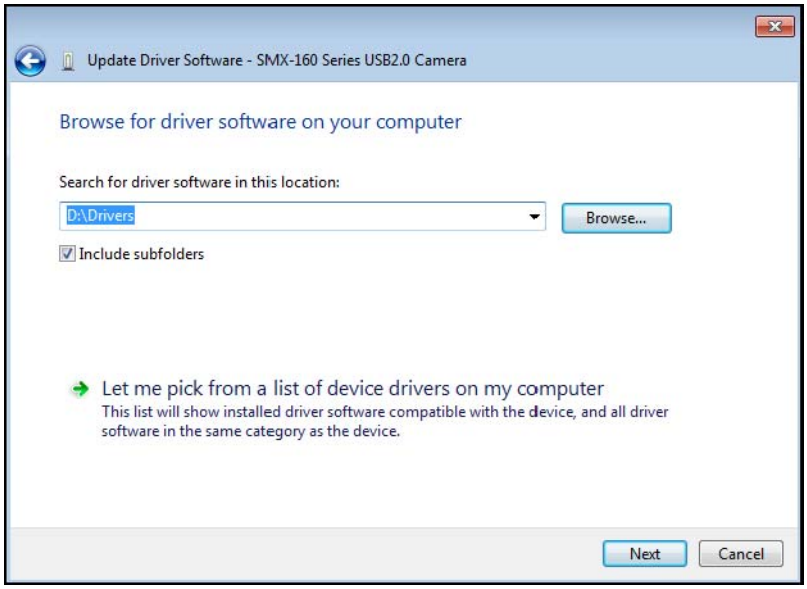


Figure 2-14 *Updating the camera driver: step 2*

7 The system will start installing the driver. In the end, a message that the installation is successful will appear:

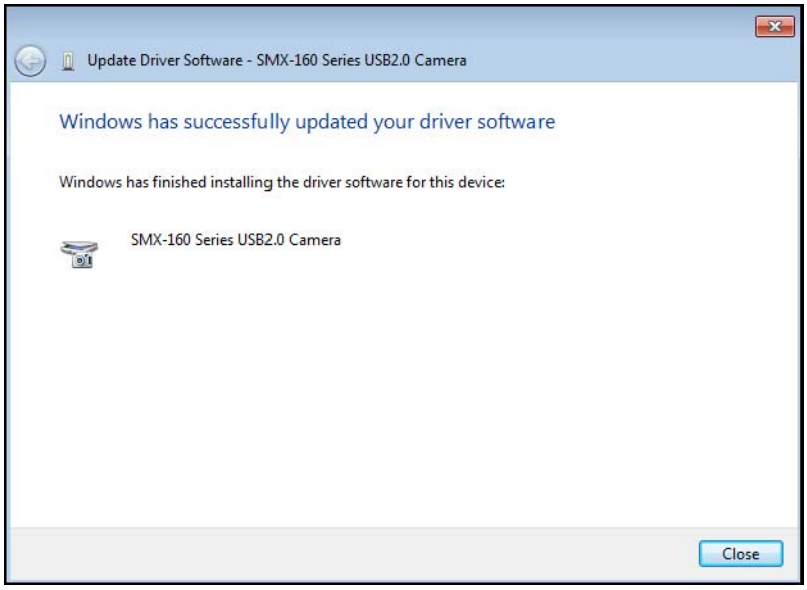


Figure 2-15 *Updating the camera driver: step 3*

8 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-160 USB2.0 Camera**> **Uninstall SMX160 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-160 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 2-16 *Driver removal confirmation*

6. After the driver is uninstalled, the **SMX-160 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 *SMX160A.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 *SMX160A.sys* file to the *\WINDOWS\system32\drivers* folder (the *SMX160A.sys* file is located in the *\Sumix\SMX160 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-160 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**).
3. In **Device Manager**, double-click **Universal Serial Bus** controllers.
4. In **Device Manager**, select one of the following:

   - **Imaging devices> SMX-160 Series USB2.0 Camera** with Warning status, if it is available there:

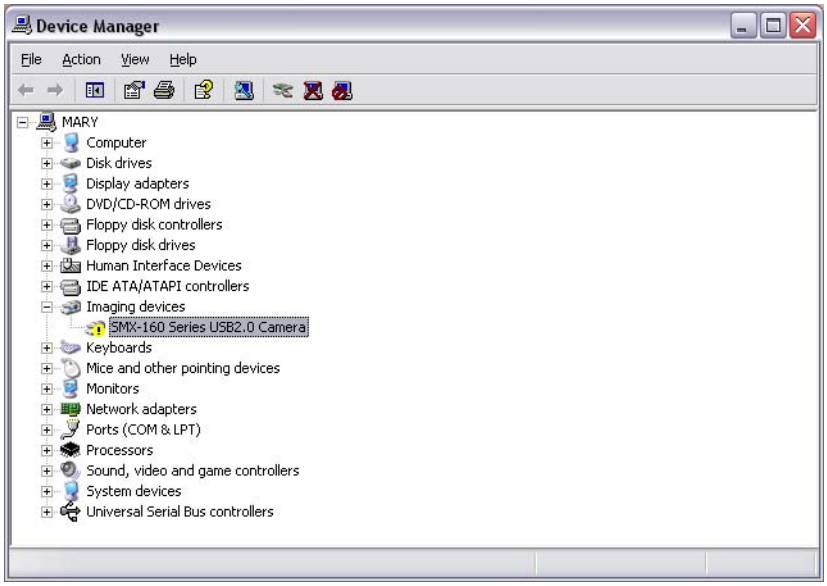


Figure 2-17 *Device Manager: the SMX-160 camera with Warning status*

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

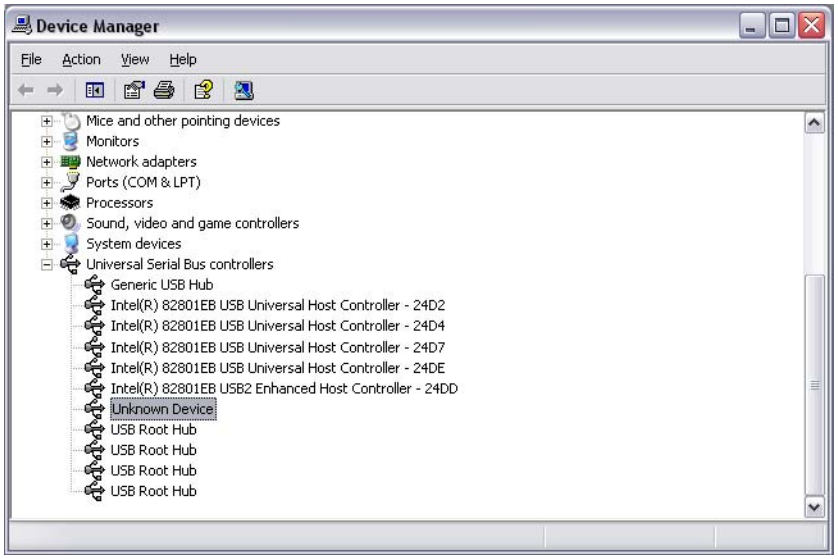


Figure 2-18 *Device Manager: the SMX-160 camera is detected as Unknown device*

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

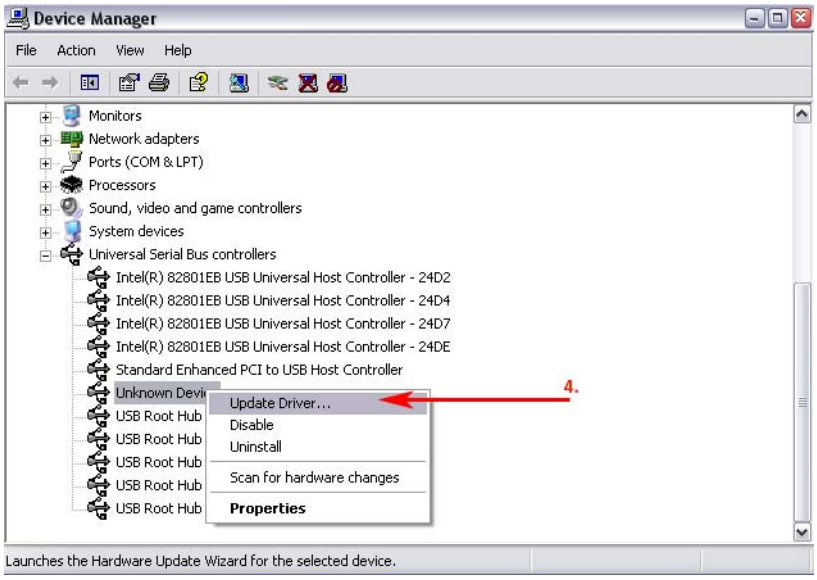


Figure 2-19 *Device Manager: Updating the SMX-160 camera driver*

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

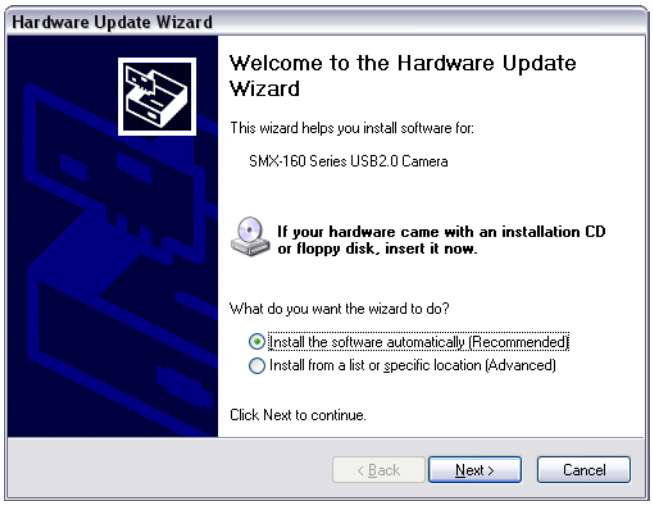


Figure 2-20 *Hardware Update Wizard: the Welcome window*

7 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),

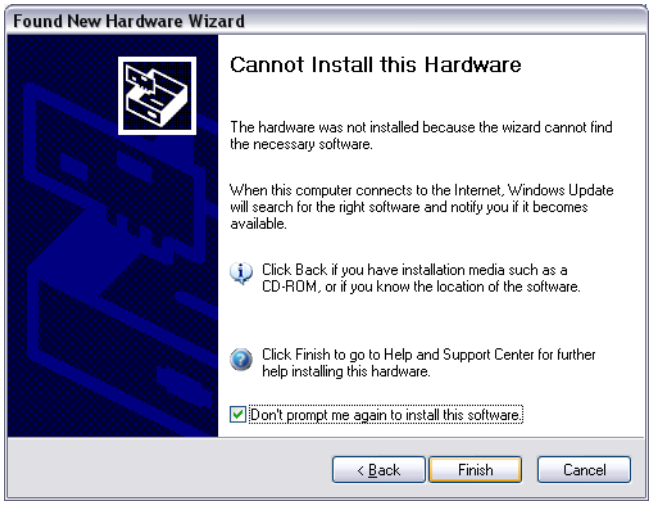


Figure 2-21 *Found New Hardware Wizard: Cannot install this Hardware*

try doing the following:

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

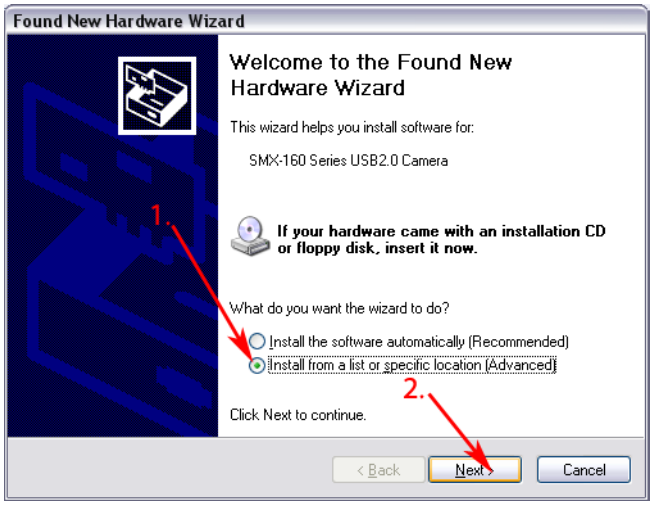


Figure 2-22 *Found New Hardware Wizard: Installing from a list or specific location (Advanced)*

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-160 Camera CD or in the **Sumix\SMX160 USB2.0 Camera** folder (located on the hard disk where you installed the SMX-160 Camera Software, normally it is the **C:\Program Files\Sumix\SMX160 USB2.0 Camera**).
6. Click **Next**.

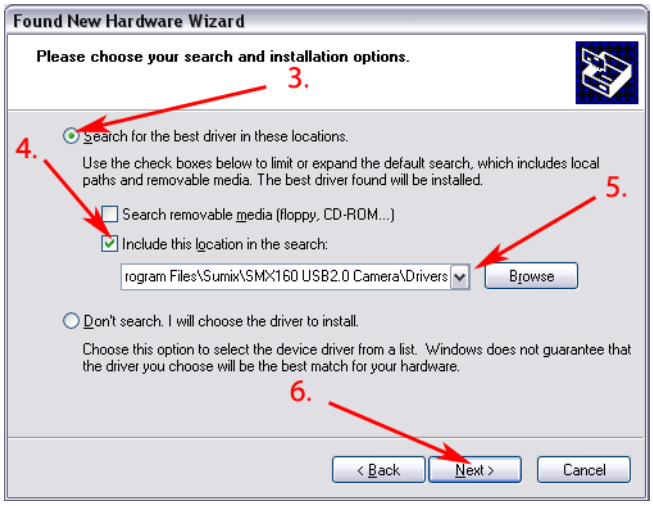


Figure 2-23 *Installing from a list or specific location (Advanced): specifying locastion*

7 In the list, select the last item.

8 Click **Next**.

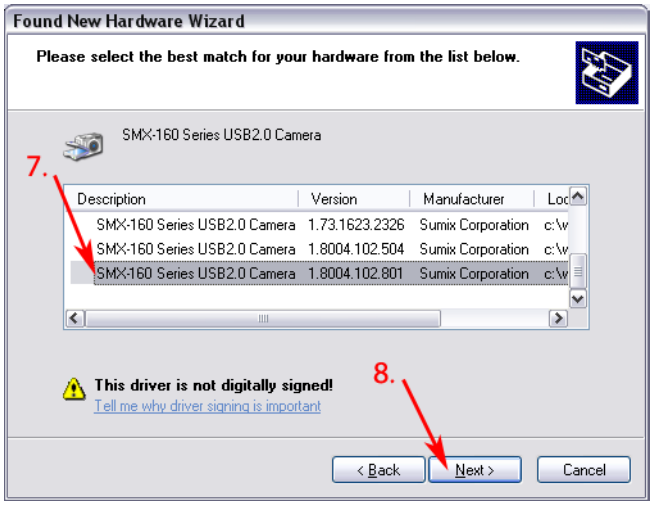


Figure 2-24 *Install from a list or specific location (Advanced): selecting file among the Wizards's search results*

9 Wait till the wizard installs all files.

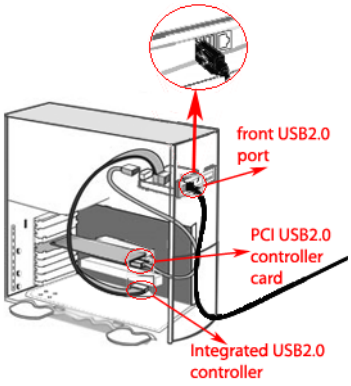
10 Click **Finish** if installation passed successfully.

Chapter 3

GETTING STARTED

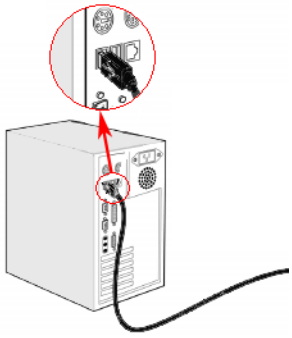
Recommendations on the Camera Connection

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.

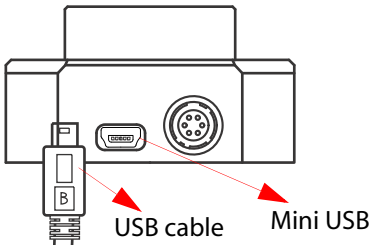
So, when connecting the camera to the front USB2.0 port the device might not work properly. We recommend to use the back USB2.0 port to avoid problems with the camera work (see the picture below).



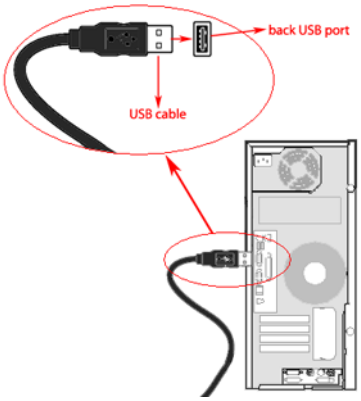
Note: *Design and configuration of the front USB2.0 port location shown on the pictures above might differ from yours. The pictures' goal is only to show how the front USB2.0 port is connected to its controller*

Plugging in the Camera

Connect SMX-160 camera with USB2.0 cable.



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



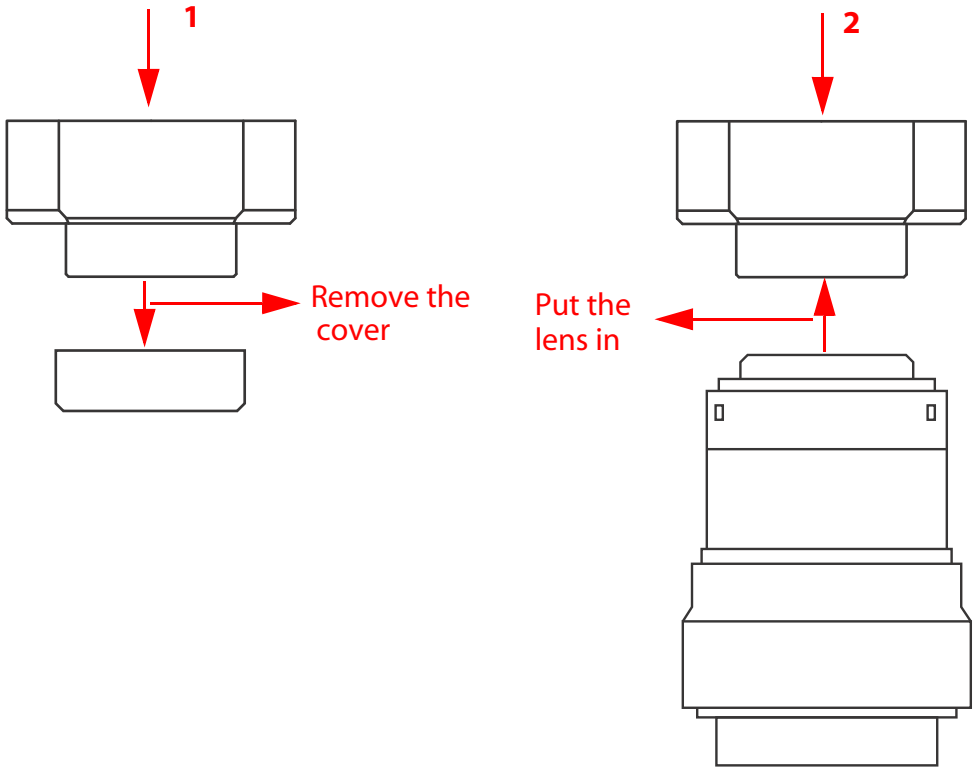
Installing Lens

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.

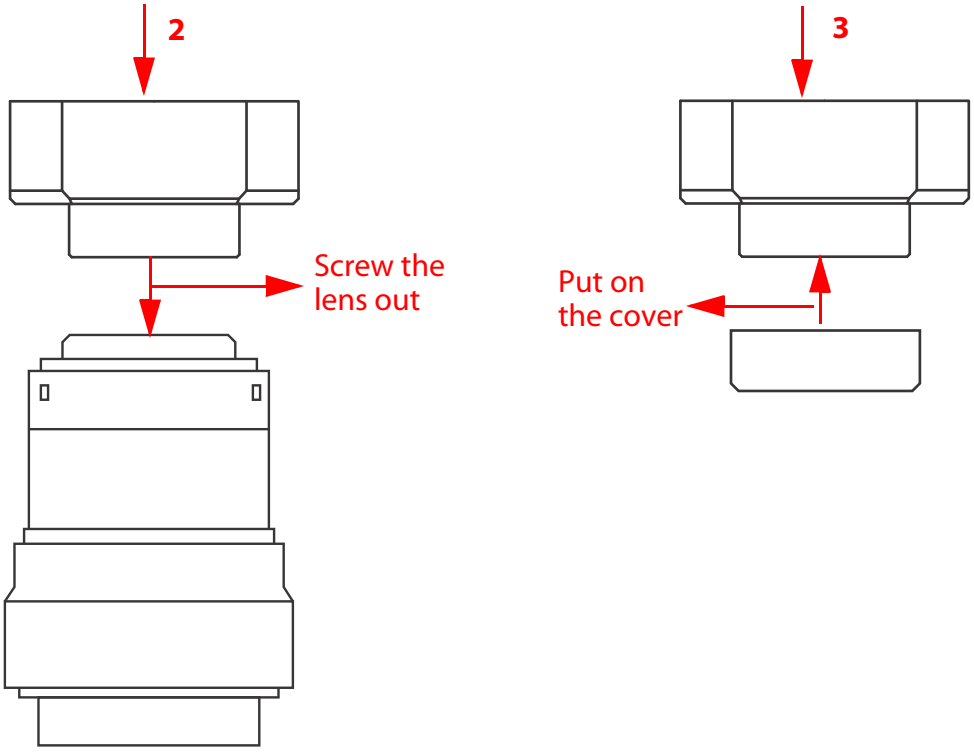
To install a lens:

1. Face the camera down.
2. Remove the camera cover.
3. Screw the lens in (see the picture below):



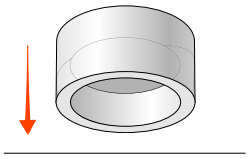
To remove the lens

1. Face the camera down.
2. Screw the lens out.
3. Put on the cover (see the picture below):



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



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:

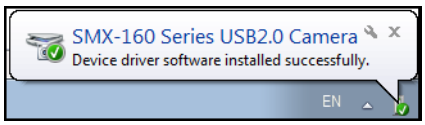


Figure 3-1 *Notification about successful camera installation*

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-160 USB2.0 Camera** > **SMX160 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-160 camera application will start with its main window.

The SMX-160 camera 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:

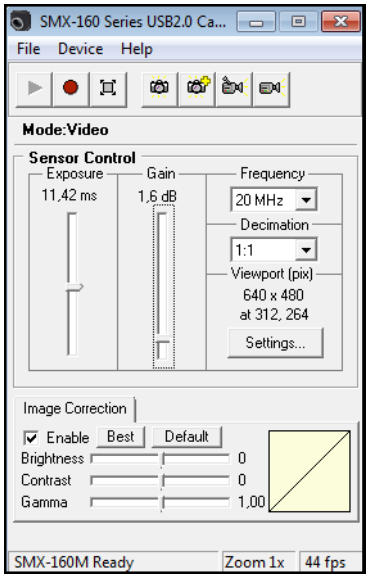


Figure 3-2 *SMX-160 application main window*

- **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.

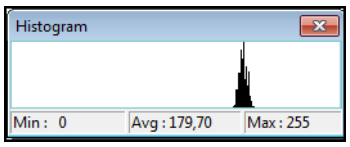


Figure 3-3 *Camera histogram*

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.

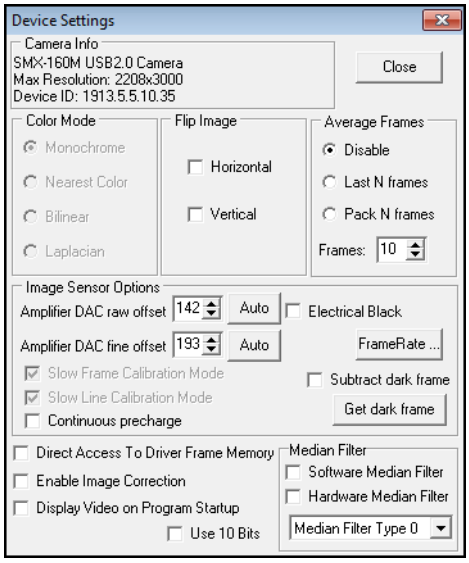


Figure 3-4 *Device Settings window*

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

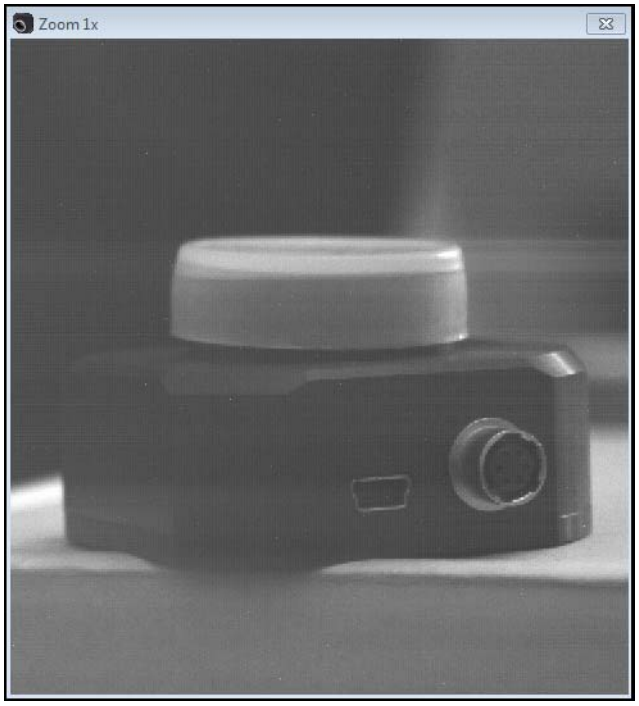


Figure 3-5 *Video mode window*

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 **SMX160 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-160 camera connected to your PC, the camera application allows you to switch between them or make sure the application operates the required camera.

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.

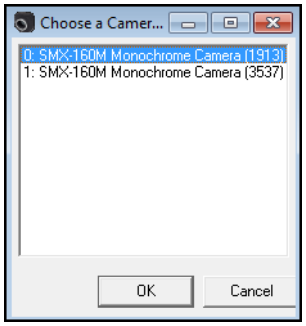


Figure 3-6 *Switching between cameras*

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

Note: When two or more cameras run on the same computer, frame rate of each camera decreases.

Viewing Camera ID

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

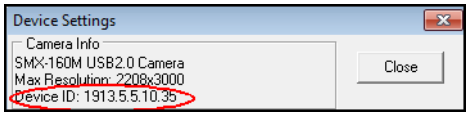


Figure 3-7 *Camera ID*

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.

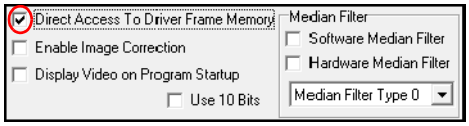


Figure 3-8 *Direct Access to Driver Frame Memory checkbox*

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

Before you start working with a SMX-160 Series camera, some initial tuning should be done to remove distortions and noise from the video view.

It is convenient to have camera histogram opened while tuning the image because you can observe how your changes are reflected in the histogram.

Quality of the image directly depends on such parameters:

- Black level (Amplifier DAC raw offset)
- Column balancing (Amplifier DAC fine offset)
- White Balance for the SMX-160C (color) model

These parameters should be always tuned at the beginning of the camera work. Besides, each time when the Black level and Column balancing are changed, the White Balance should be tuned as well.

Concerning the environment conditions, day lighting is the best condition for the colors and image tuning. Otherwise, use additional fluorescent light or its equivalent.

Tuning the Black Level and Column Balancing

To adjust Black level and Column balancing:

1. Start video by pressing the **Start Video** button in the toolbar.
2. Activate histogram by pressing **h** on the keyboard.

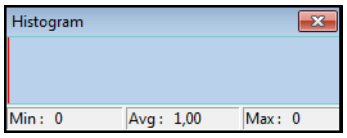


Figure 4-1 *Histogram view before tuning image*

3. Go to the **Sensor Control** section of the main window and set:
   a. frequency to 40 MHz
   b. exposure to its maximal value
   c. gain to 0 dB

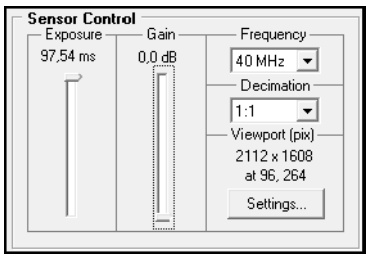


Figure 4-2 *Setting sensor controls*

4 Press the Settings button in the Viewport section of the main window and set viewport to 800x600.

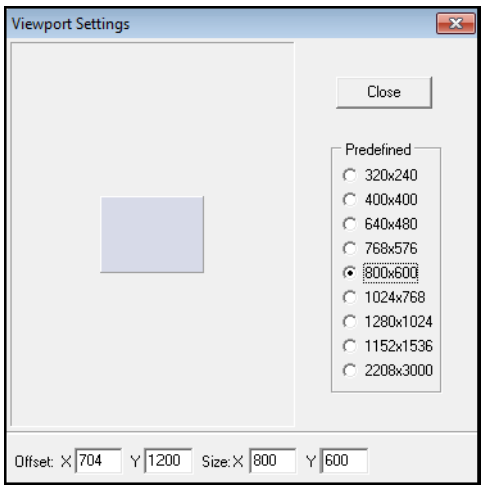


Figure 4-3 *Setting viewport*

5 For the SMX-160C camera, set **Bilinear** color mode.

6 Open the **Device Settings** window by pressing **Alt+s** on the keyboard.

7 Put the camera to a dark place (cover by hand or put into a dark box).

8 In the **Image Sensor Options** of the **Device Settings** window, click the **Auto** button near the **Amplifier DAC raw offset** field to adjust the level of black for the camera.

Figure 4-4 *Adjusting Black level and Column balancing*

Check the **Electrical Black** box if you want the sensor to output its electrical black level. Use this check box to get the hardware-generated electrical black image for calibrating the black level offset. The option is useful for various sensor parameters calibration. It

does not depend on lightning conditions and provides stable and reliable way to tune these parameters.

9 increase gain to **5 dB** or higher, so that at least part of the histogram is visible.

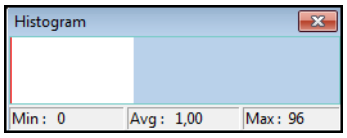


Figure 4-5 *Histogram view before setting Column balancing*

10 Click the **Auto** button near the **Amplifier DAC fine offset** field to balance the columns.

Note: During Black level and Column balancing adjustment do not expose the camera to extra light as this may cause an interruption. Leave the camera untouched until these processes are completed.

Note: You need to adjust the Black level and Column balancing each time you start using the camera and/or change the Frequency and Viewport parameters.

Tuning White Balance

For the SMX-160C (Color) camera**,** after tuning Amplifier DAC raw offset and Amplifier DAC fine offset also balance white among R, G and B colors of the camera.

To tune white balance:

Press **w** on the keyboard or go to the **Device** menu and select **White Balance**.

Note White balance should be performed each time after the camera settings are changed according to user needs.

Reading Histogram

Most of the image distortions are reflected in the histogram.

To load camera histogram:

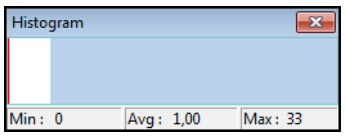
Press **h** on the keyboard.

OR

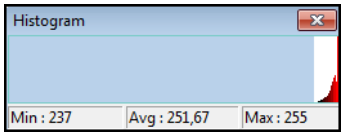
Select **Histogram** in the **Device** menu.

Note: The images with Histogram below were taken when exposure was set to its maximal value, frequency - to 40 MHz.

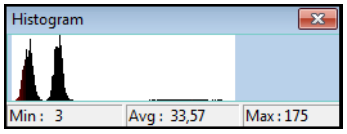
- When the Amplifier DAC raw offset is incorrect and close to 0, illumination is poor, the gain value is close to its maximum, the histogram may be out of its left edge:



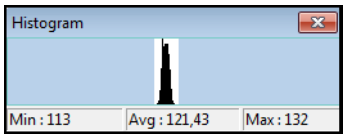
- When the Amplifier DAC raw offset is incorrect and close to 255 (the maximum), illumination is bright, the gain value is close to 0, the histogram may be out of its right edge:



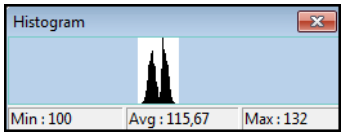
- When the Amplifier DAC fine offset is distorted, the Histogram may be divided on two or, in case of the color camera, three parts:



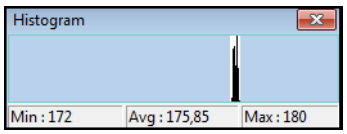
- When the level of black is tuned and columns are balanced, and in case of the color camera, white is balanced, the histogram gets its normal view:



- For the color cameras, when the level of the black is tuned, columns are balanced and White balance is not performed yet, the histogram can stay divided:

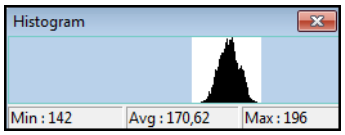


- When the dynamic range is poor, the histogram is thin:



Increasing of the dynamic range may be done by clicking the **Best** button on the **Image Correction** tab of the main application window.

- The histogram after increasing the dynamic range gets spread:



Note: *In the case when the **Best** button is applied, the Histogram view may differ from the histogram shown in the image above. It depends on the initial view of the histogram.*

Hardware Histogram

When the camera is running in the 10 bit mode, it is possible to activate a histogram that is done by the camera hardware such as exposure, gain, frequency, environment lighting, etc. This RAW histogram allows you to do fine tuning of dynamic range.

To open the hardware histogram:

1. Check the **Use 10 Bits** check box in the bottom of **Device Settings** window.

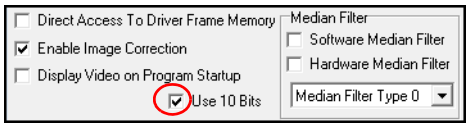


Figure 4-6 *The Use 10 Bit check box*

2. Press the **h** key on the keyboard twice.
3. The RAW histogram opens in a new window.

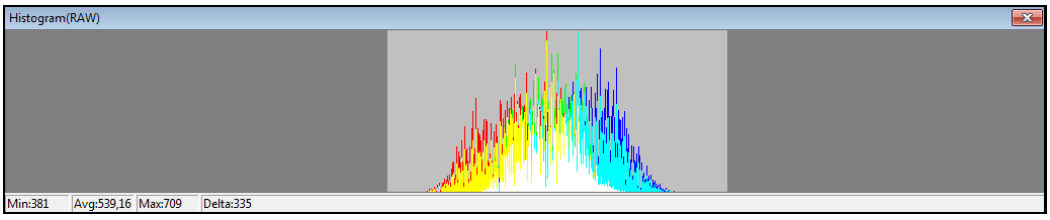


Figure 4-7 *Hardware Histogram*

Tuning Light in the Image

To tune illumination, install a lens (see "Installing Lens" on page 24).

Illumination of image from the camera depends on the **Frequency**, **Exposure**, **Gain**, image **Viewport** (resolution), and **Decimation** values, which you can control using the main application's window, and on the lighting conditions of your environment.

Recommended initial settings:

- Amplifier DAC raw offset and Amplifier DAC fine offset are tuned; in the case of the color camera the White Balance is performed
- Gain and Exposure sliders are in low position
- Decimation is 1:1
- Viewport size is set according to your needs
- In the case of the SMX-160C (color camera), **Color Mode** is set to **Bilinear** (the **Device Settings** window)
- Histogram is active
- Image correction is enabled
- The **Brightness**, **Contrast**, and **Gamma** sliders of the **Image Correction** section are in their default positions (0, 0, 1 - respectively). To reset the values for all sliders at one go, click the **Default** button

To tune light in the image:

1. For light tuning in the image, use maximum diaphragm aperture of your lens. Try to get enough light using the **Exposure** slider. If the slider is at maximum but the image is not bright enough, decrease frequency (it enlarges the exposure interval) and/or increase gain but not more than 6 dB.
2. The **Image Correction** tab can also be used. Double-click its graphic area, **Brightness**, **Contrast** and **Gamma** will take the values that are assumed as the maximal recommended; this will also increase the illumination of the image.

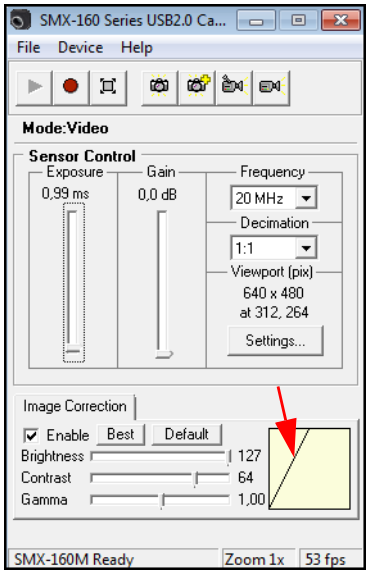


Figure 4-8 *The maximal recommended Image Correction settings*

Color Tuning

You can tune color after the image has been adjusted and the light in the image has been tuned.

To tune color:

1. Set **Brightness** to 127 and **Contrast** to 64 (double-click on the graphic of the **Image Correction** tab).
2. Drag the **R**, **G** and **B** sliders of the **Color Balance** tab, perform **White Balance**. Click the **Best** button of the **Image Correction** tab, then press **w** on the keyboard for the **White Balance**. This will increase the dynamic range and balance current color settings.
3. For the hue, lightness and saturation tuning of **R**, **G** and **B** colors, enable and drag the corresponding sliders of the **Color Correction** tab.

For the SMX-160C camera, it is recommended to balance columns and then perform **White Balance** every time when camera's settings are changed.

Sensor Controls

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

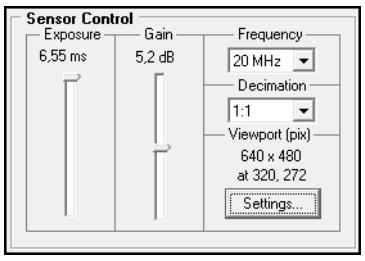


Figure 4-9 *Sensor controls*

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.

To tune exposure automatically:

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

Gain

Use the **Gain** slider to change the signal gain of the sensor. Increasing the gain is reasonable in case when the light condition is poor and increasing the exposure time does not help.

Note: Increasing the Gain parameter adds noise to the video from the camera.

The **Gain** slider controls the camera hardware gain amplifier.

For the SMX-160 color cameras the **Gain** slider contain **R**, **G** and **B** color channels, which change simultaneously each time when the gain is changed.

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 or 6. 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 the full 1280 x 1024 image can be displayed as 640 x 512 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.

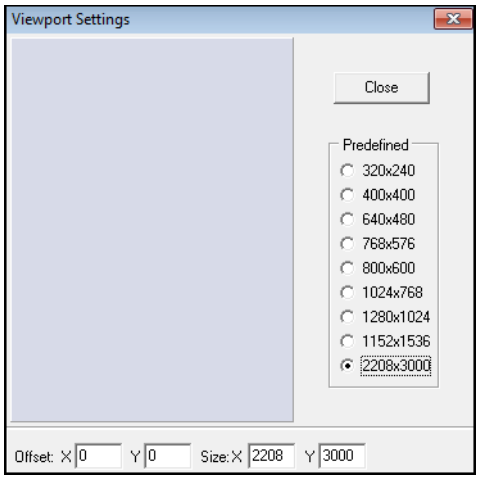


Figure 4-10 *Viewport Settings window*

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 2208x3000, 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.

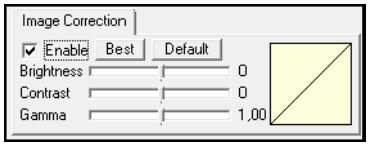


Figure 4-11 *Image correction controls*

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***

*The SMX-160 camera software does 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-160C (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.

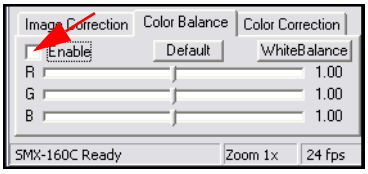


Figure 4-12 *Enabling the Color Balance Controls*

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

Color Correction

The **Color Correction Controls** are designed for the SMX-160C (color) model to adjust the intensity of the color properties (hue, lightness 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.

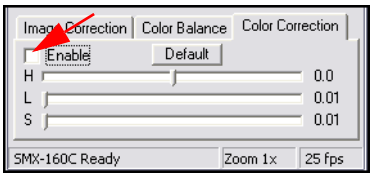


Figure 4-13 *Enabling the Color Correction tab*

Use the **Default** button to restore the default values of hue (H), lightness (L) and saturation (S)- 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-160C model.

- 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.

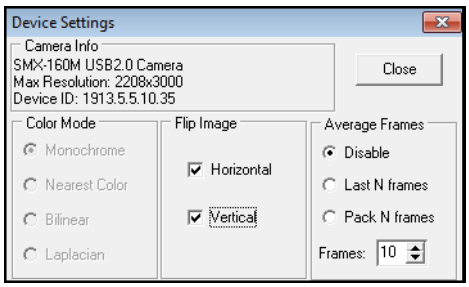


Figure 4-14 *Flipping image*

Using the flip controls, you can rotate the image without changing the camera position itself.

Note: *Flipping the image horizontally and/or vertically can cause distortions - horizontal lines can periodically appear on the image.*

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.*

To increase the image quality, you can also try enabling the following controls in the **Image Sensor Options** section of the **Device Settings** window:

Figure 4-15 *Increasing image quality*

- **Slow Frame Calibration Mode** and **Slow Line Calibration Mode** - these boxes are always checked to reduce the image noise.
- **Subtract Dark Frame** - this option is available for the Video mode to reduce the fixed pattern noise by subtracting the static dark frame from the picture. The dark frame is obtained by clicking the **Get Dark Frame** button and is stored in a temporary buffer.
- **Continuous precharge** - checking this box this disables reset of the image sensor making it to continuously accumulate light from frame to frame.

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.

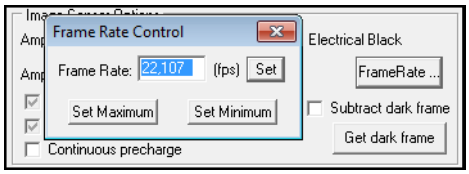


Figure 4-16 *The Frame Rate Control window*

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 limits, press the **Set Maximum** or **Set Minimum** buttons.

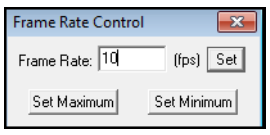


Figure 4-17 *Decreasing frame rate*

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.*

Output Bits per Pixel

If the **Use 10 bits** box is checked, it enables the software to transmit **10 bit** images from the camera as opposed to regular **8 bit**.

Figure 4-18 *10 bit mode check box*

Median Filter

The median filter is a technique of removing noise from an image. The SMX-160 camera has two median filters:

- The **Software Median Filter** which 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.
- The **Hardware Median Filter** which detects and corrects isolated missing pixels in the output stream of an image sensor. It is based on the prediction of the allowed range of gray values for a pixel, from the gray values of the neighborhood of that pixel.

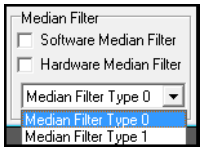


Figure 4-19 *Median Filter control*

There are two types of the hardware median filter:

- **Median Filter Type 0**, which reduces speckle noise and salt and pepper noise.
- **Median Filter Type 1**, which preserves edges and is useful when edge blurring is undesirable.

Note: *By default, when you start the camera, the* ***Hardware Median Filter*** *is already on.*

Saving and Loading Camera Profiles

The SMX-160 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.

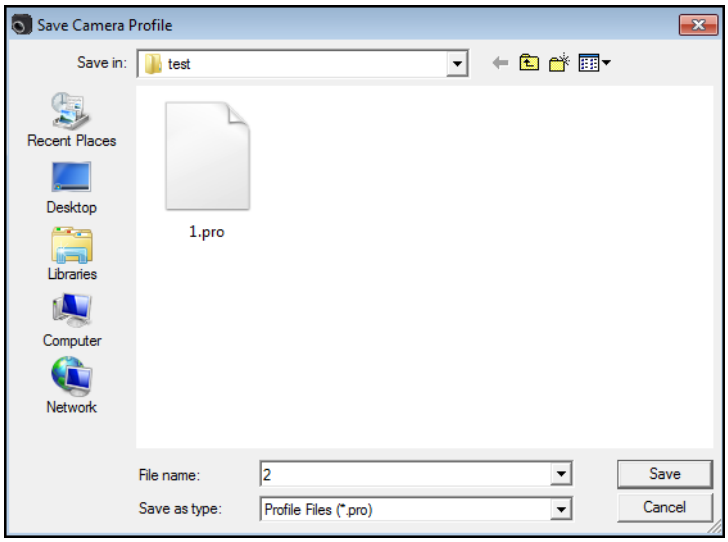


Figure 4-20 *Saving camera profile*

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.

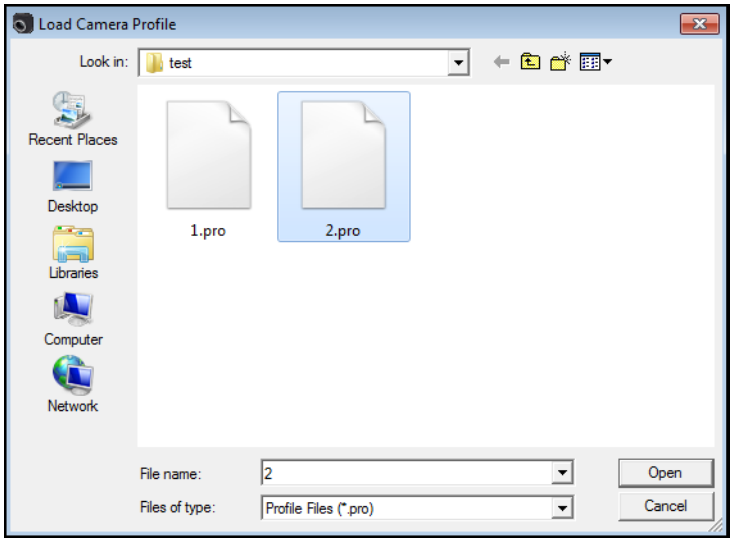


Figure 4-21 *Loading camera profile*

3 Press **Open**.

Chapter 5
CAPTURING

The SMX-160 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 49).

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.

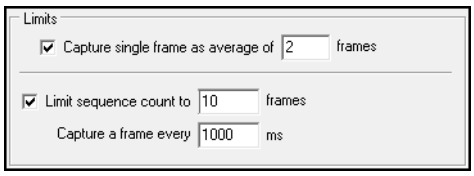


Figure 5-1 *Limits section*

You can change the number of frame in a sequence:

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:

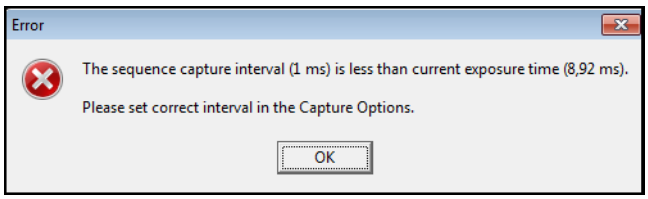


Figure 5-2 *Message about incorrect sequence capture interval*

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 49) as an **.avi** file.

Saving Video/Frames to Memory

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

- Press the **Save Video to Memory** button in the toolbar or press **Shift+F4** on the keyboard.
- Select **Save Frames to Memory** command from the **File** menu.

The number of single frames or 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 49). 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-160 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 a 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**.

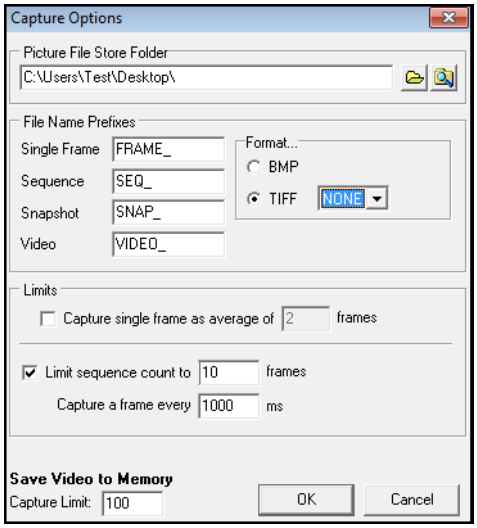


Figure 5-4 *Capture Options box*

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 *C:\Users\<User>\Desktop*.

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:

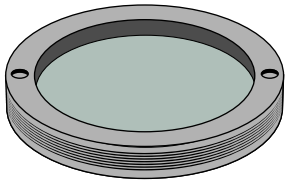
- **BMP** - saves any 8 bit or 10 bit image as 8 bit BMP image.
- **TIFF** - saves 8 bit image as 8 bit TIFF image and 10 bit image as 10 bit TIFF image. Select also compression type: **NONE** (without compression) or **LZW** (Lemple-Zif-Welch - lossless type of compression).

3 Press **OK**.

Chapter 6

IR-CUT FILTER

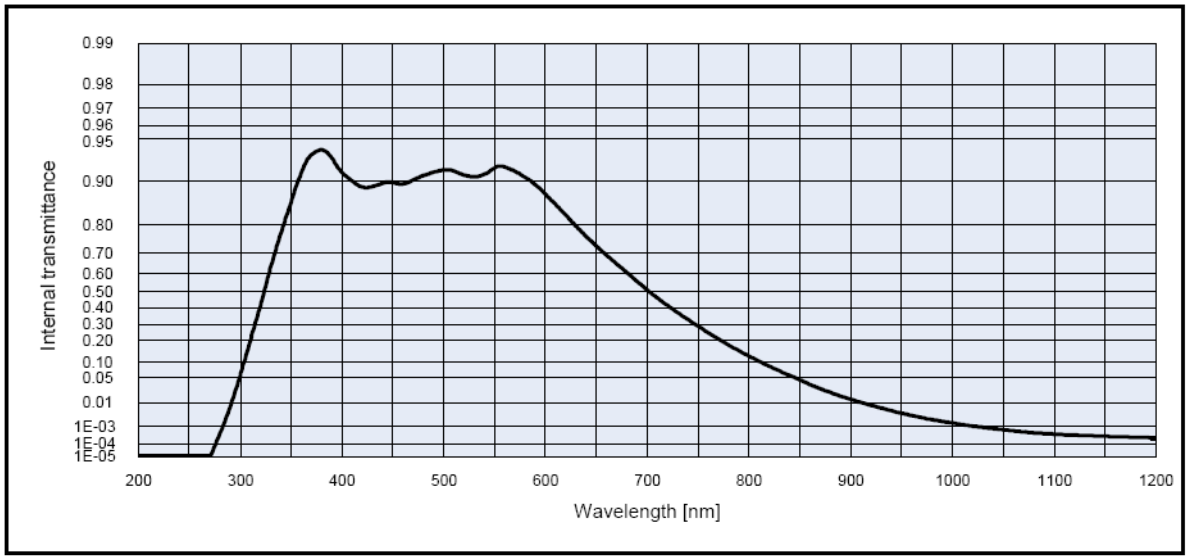
SMX-160C (color) cameras can be supplied with an IR-cut filter:

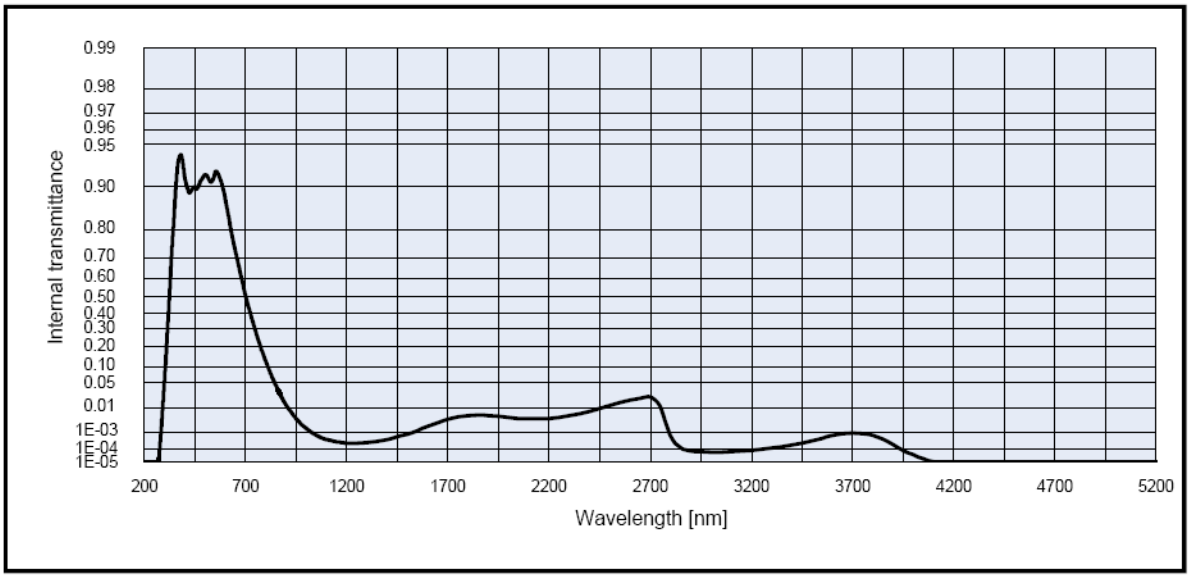


The IR-cut filter has the following characteristics:

- Diameter = 20 mm
- Thickness = 2 mm

Chart of the IR-cut filter transmission characteristics:





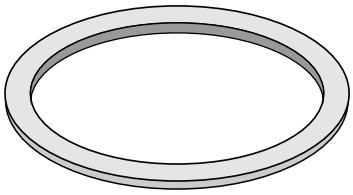
When to Use

The IR-cut filter is meant for color cameras but can be used for monochrome models as well. It is a color filter that blocks infrared light. Since the SMX-160C cameras are sensitive to the IR light, use the filter with color cameras to make image colors more realistic.

Many light sources, including the sun, emit infrared light, so the color camera in daylight will “see” 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 some lenses. A lot of lenses 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.

Note: *When the camera is used with an IR-cut filter, the focus distance is increased to 0.66 mm. To restore the focus distance to the original value (when the camera is used without IR-cut filter ring and a ring-adapter) we suggest using a ring-adapter:*

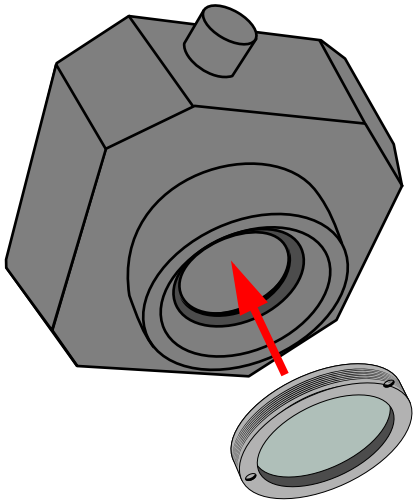


How to Use

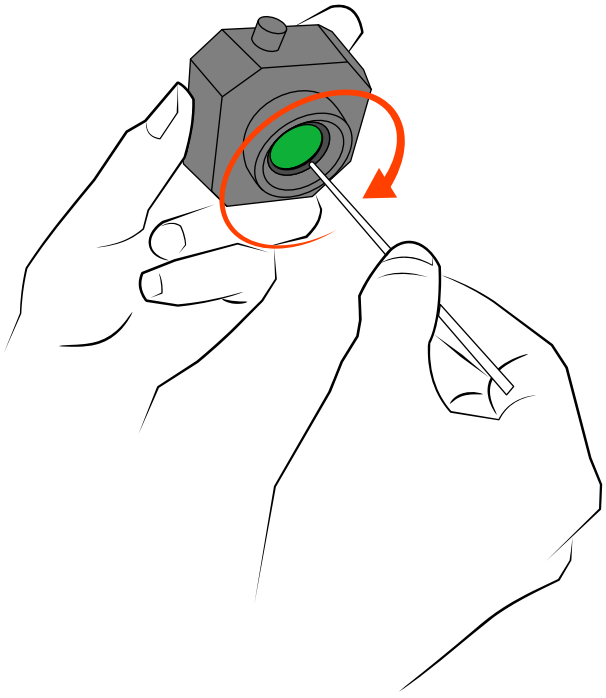
Usually the camera is supplied with the IR-cut filter screwed in. The procedure of screwing the IR-cut filter in and using the ring-adapter is described below.

Screw the IR-cut filter in as follows:

1. Remove the cover from the camera.
2. Put the IR-cut filter to the camera so that the two holes on the filter are faced up - see the picture below.

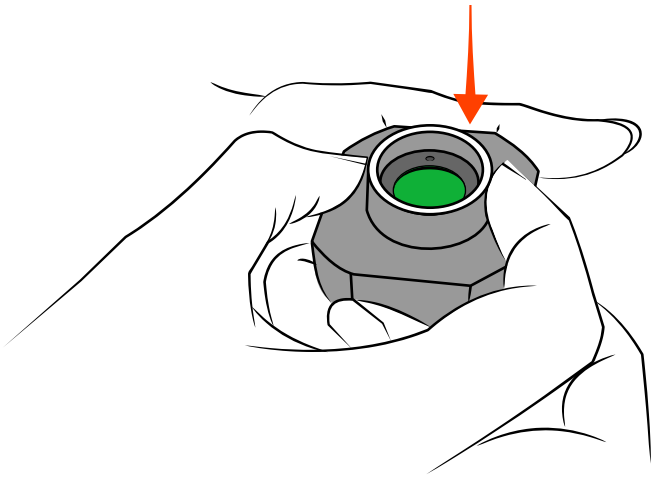


3 Use a needle-like tool (e.g. tweezers) and screw the IR-cut filter in, as shown on the picture below.

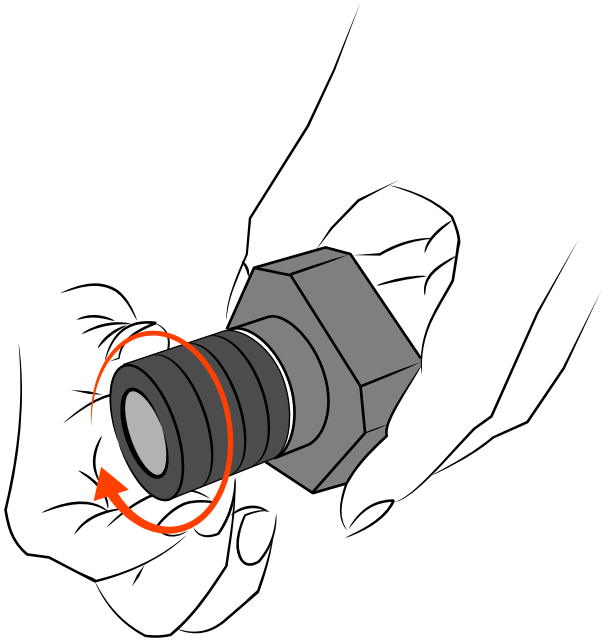


Note: *The latest SMX-160C cameras have blocking elements on their inner thread to prevent the IR-cut filter from falling on the sensor. Previously manufactured cameras do not have these blocking elements, so when screwing the IR-cut filter in these cameras, do not make more than 10 - 11 full turns.*

4 Once the IR-cut filter is screwed in, put the ring-adapter as shown on the picture below.



5 Screw the lens in as shown on the picture below.

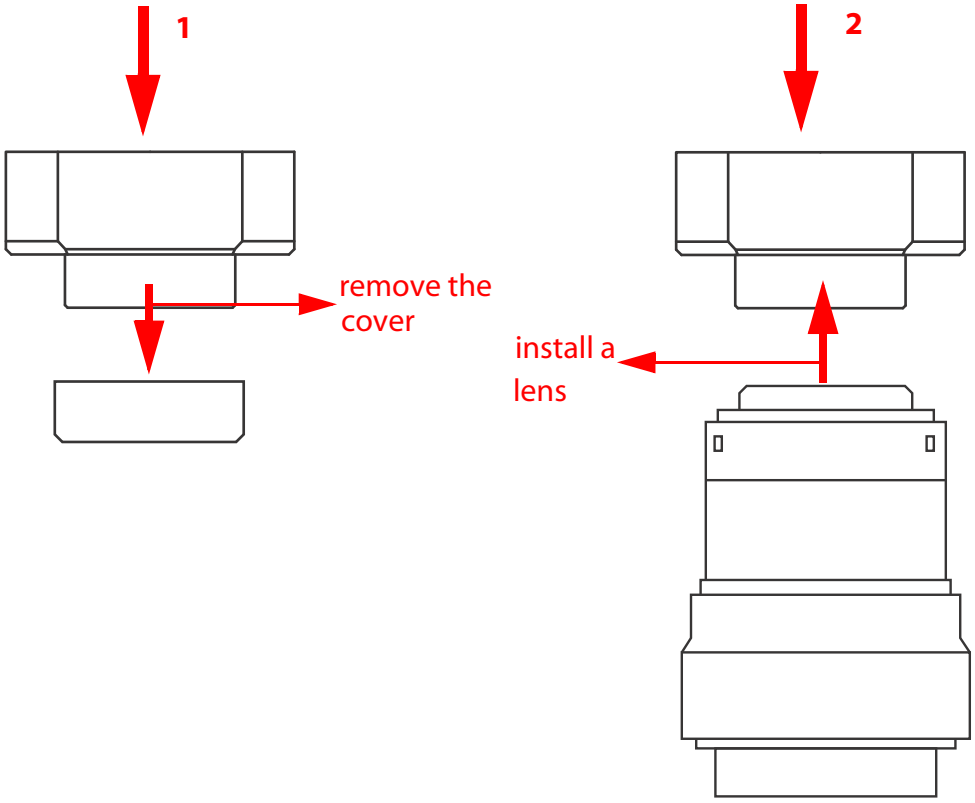


Note: *To avoid contamination of the sensor or filter, it is recommended to remove the cover and install a lens (as well as to remove a lens and put on the cover) with the camera faced down.*

To install a lens to the camera that contains no IR-cut filter, face the camera down and do the following:

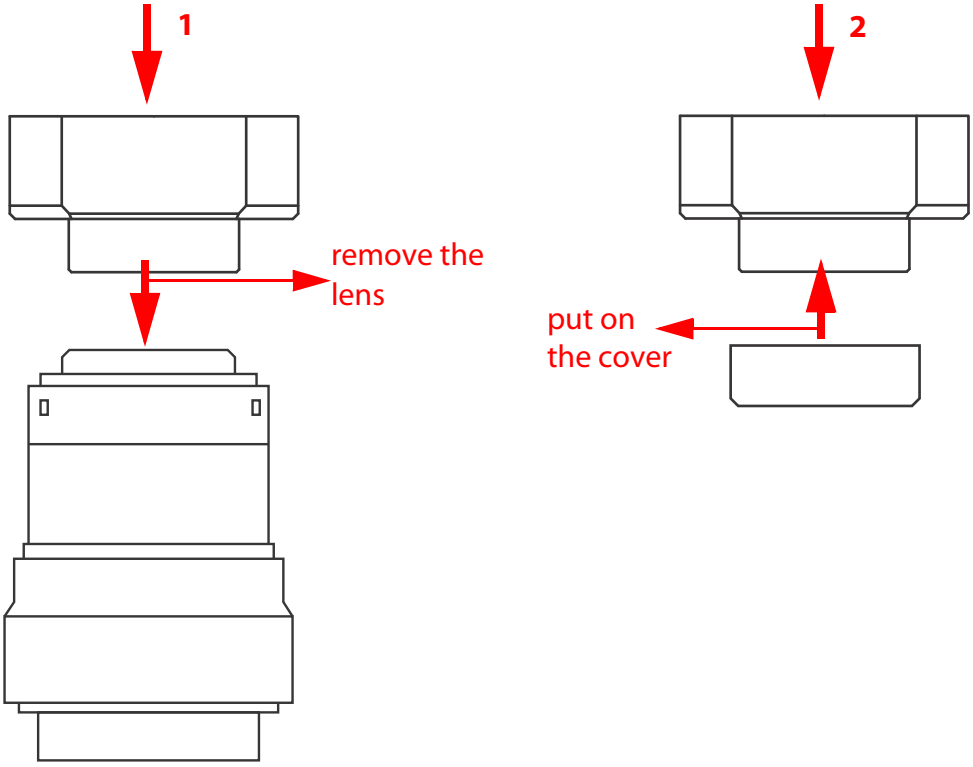
1 Remove the cover from the camera.

2 Install lens as shown on the picture below.

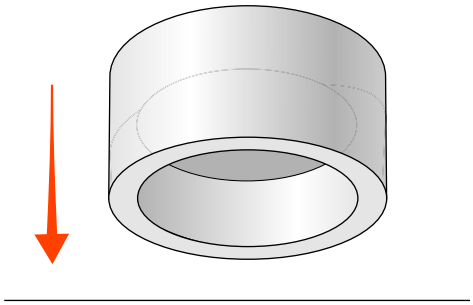


To remove a lens from the camera that contain no IR-cut filter, face the camera down and do the following:

1. Screw lens out.
2. Put on the cover (see the picture below).



Note: *Before screwing a 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.*



Chapter 7

Trigger Connector

This chapter describes how to use a Hirose trigger connector and cable with a SMX-160 Series camera. Hirose trigger connector is included in the standard camera kit. Since a cable is not included in the standard connector package, this document will guide on how to use the connector with a cable.

Connector Pinout

A cable should be soldered to the connector according to the pin layout, which is described in the table below.

Pin#	Direction	Signal	Polarity
1	Input	External trigger input	Positive
2	Output	Delayed synchronous shutter start	Positive
3	Output	User programmed output	-
4	Input	External trigger input	Negative
5	Output	Synchronous shutter start	Positive
6	-	Common (ground)	-

Note: When soldering, any combination of pins can be used according to one's specific needs.

- **External trigger input (#1)** - an input used to trigger a snapshot by applying a positive pulse (3.3V TTL, duration is not less than one period of clock frequency).
- **Delayed synchronous shutter start (#2)** - the same as Pin# 5 but delayed by the time specified in the application program. Can be used to activate a flash.
- **User programmed output (#3)** - a user programmed output.
- **External trigger input (#4)** - the same as Pin# 1 but for negative triggering pulse.
- **Synchronous shutter start (#5)** - a pulse occurs at this output when camera is in snapshot mode and snapshot control sequence begins. It can be used to trigger another camera for synchronous operation or to activate a flash.

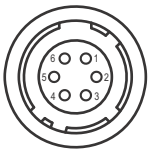


Figure 7-1 *Camera Connector View, as mounted on the camera*

Soldering of Connector with Cable

Prepare a standard (6-core) cable with already opened contacts for soldering with the connector.

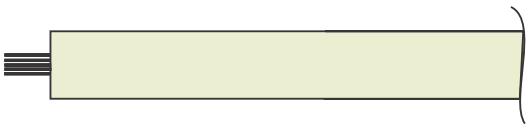


Figure 7-2 *A cable for soldering with the connector*

Prepare a tweezers-like tool for the connector assembling.

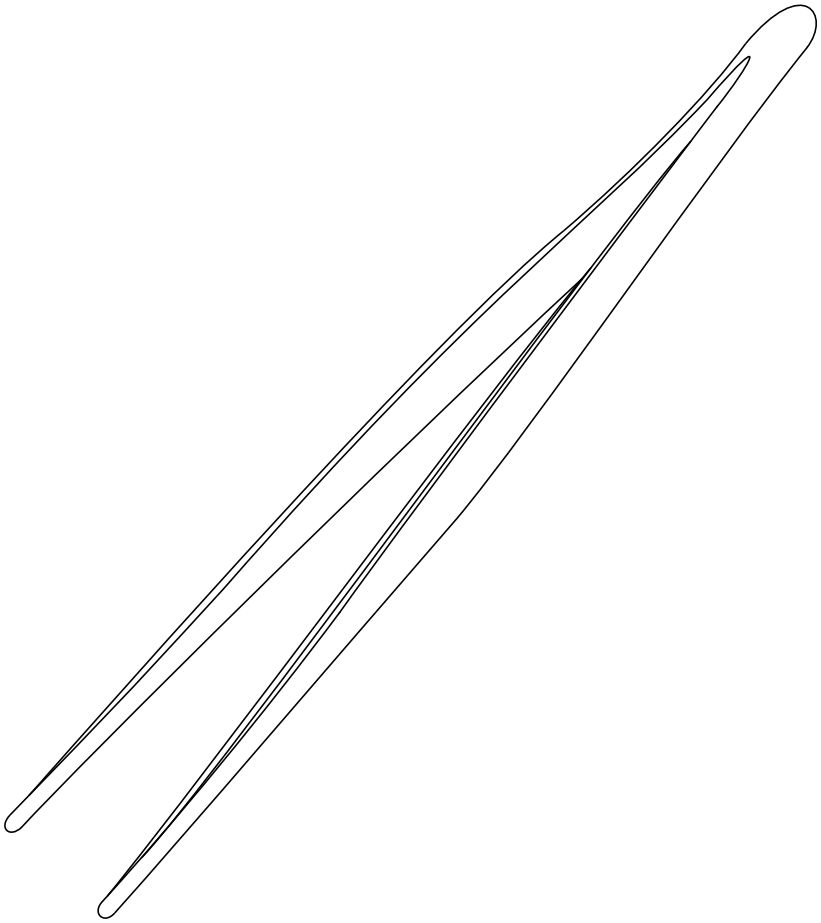


Figure 7-3 *Tweezers tool for the connector modifying*

Unscrew the rear part of the connector.

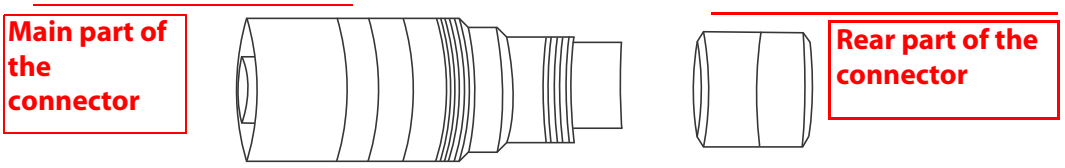


Figure 7-4 *The rear part and the main part of the connector*

Use tweezers and remove it from the main part in the following way:

1 Fix the inner part of the connector with tweezers.

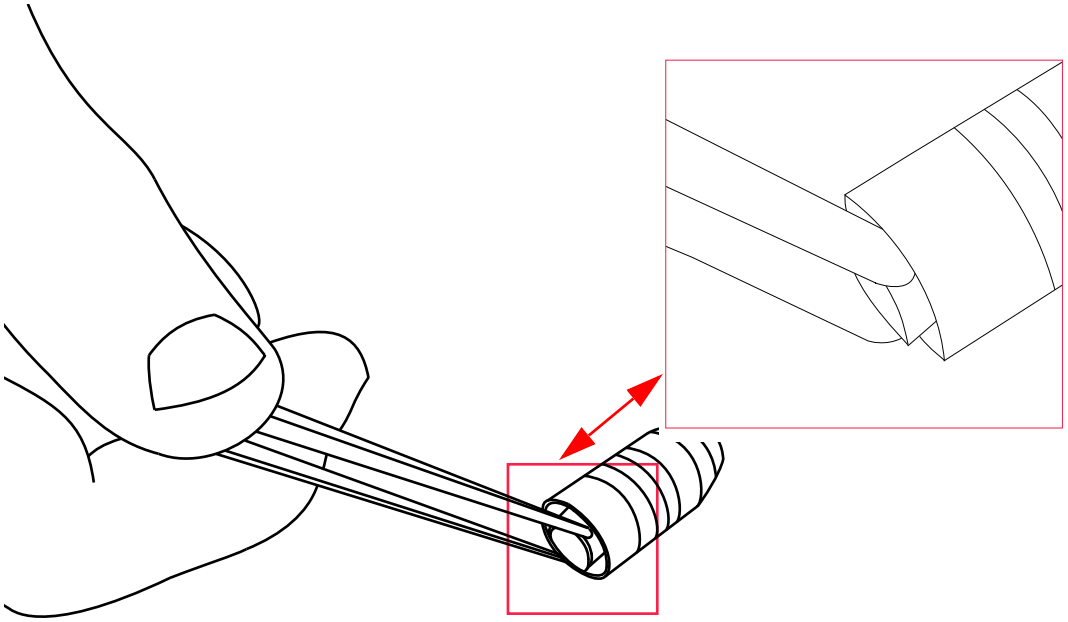


Figure 7-5 *Fixing of the inner part of the connector with tweezers*

2 Unscrew the rear part of the connector with fingers clockwise.

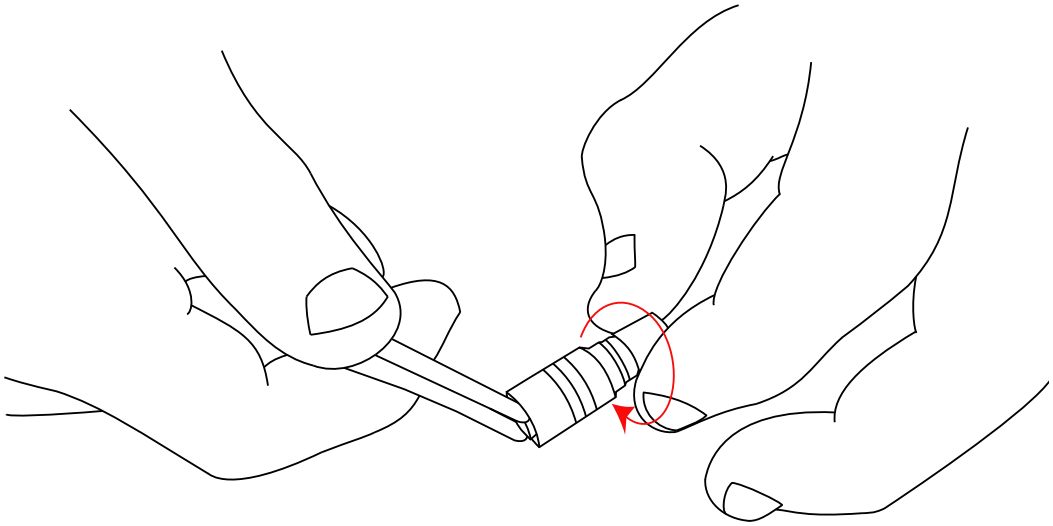


Figure 7-6 *Unscrewing of the rear part of the connector*

3 Remove the rear part of the connector from the main part.

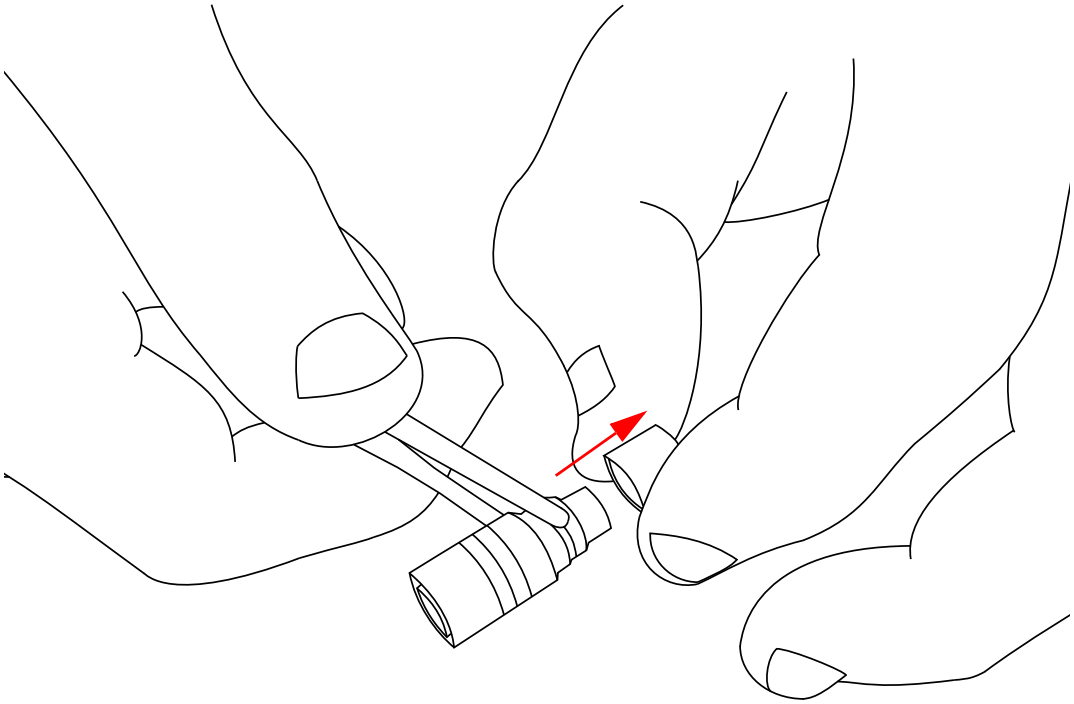


Figure 7-7 *Removing of the rear part of the connector from the main part*

Unscrew the inner part of the connector:

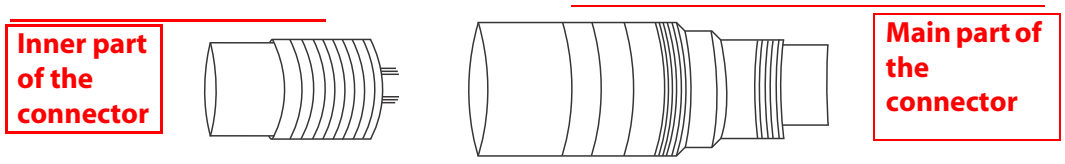


Figure 7-8 *The inner part and the main part of the connector*

To unscrew, perform the following steps:

1 Hold the main part of the connector with your fingers.

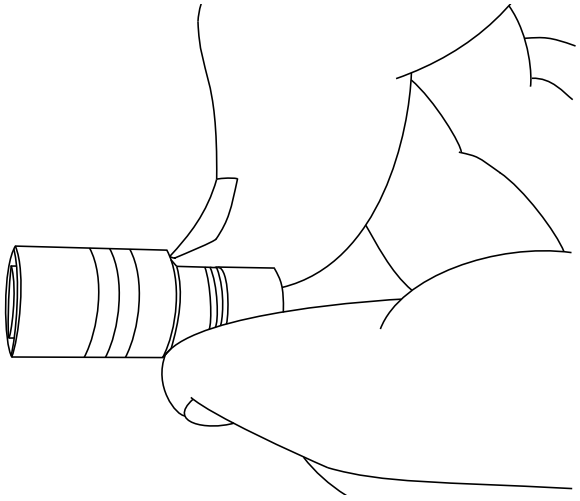


Figure 7-9 *Gripping the main part of the connector with fingers*

2 Fix the inner part of the connector with tweezers (see Figure 7-5 Fixing of the inner part of the connector with tweezers).

3 Rotate tweezers counterclockwise.

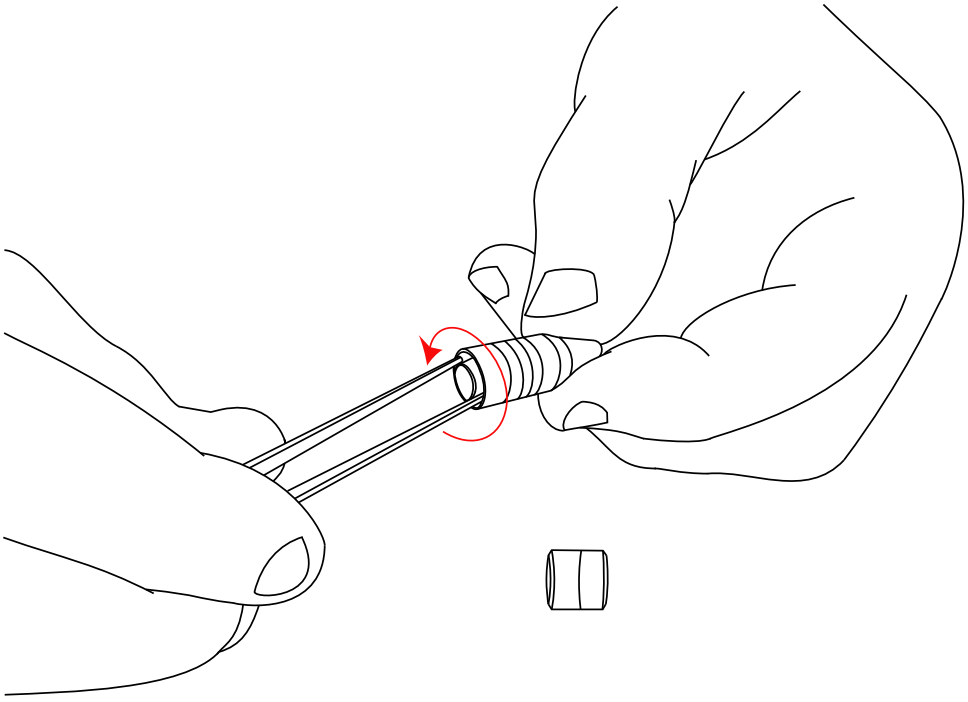


Figure 7-10 *Unscrewing the inner part of the Connector from the main part*

4 Remove the inner part of the connector from the main part.

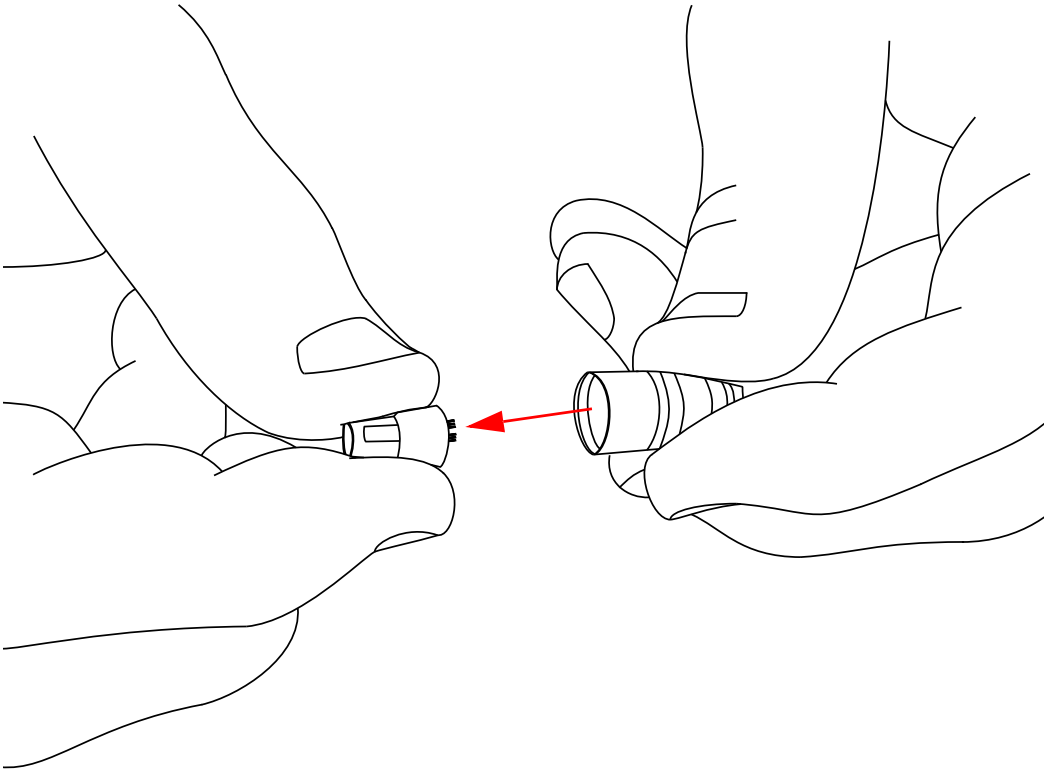


Figure 7-11 *Removing the inner part of the connector from the main part*

As a result, all connector parts will be disassembled:

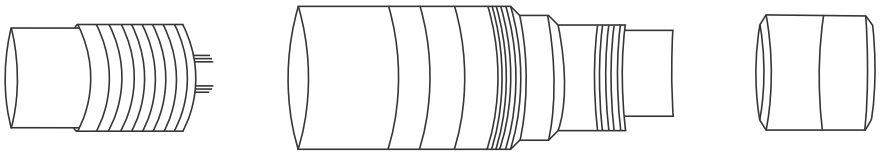


Figure 7-12 *All parts of the connector are disassembled*

Insert a cable into the rear part of the connector.

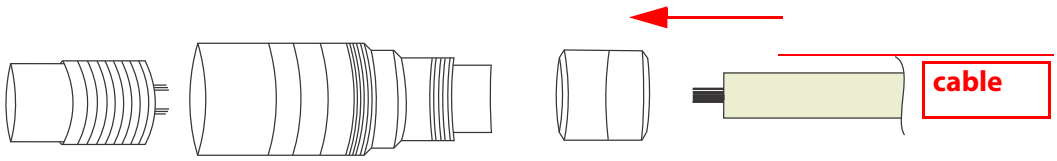


Figure 7-13 *Inserting of a cable in the rear part of the connector*

Then insert it into the main part.

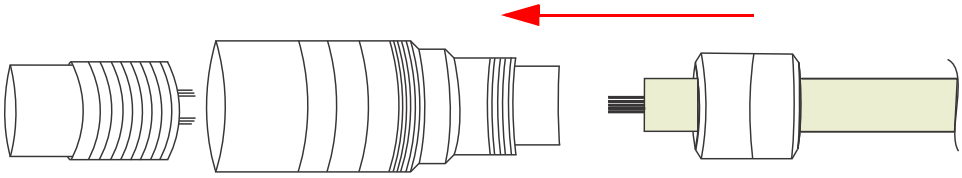


Figure 7-14 *Inserting of a cable in the main part of the connector*

When a cable is inserted into the rear part and the main part correspondingly, solder each pin of the connector with opened contacts of a cable according to the layout (see "Connector Pinout" on page 59) and your specific needs:

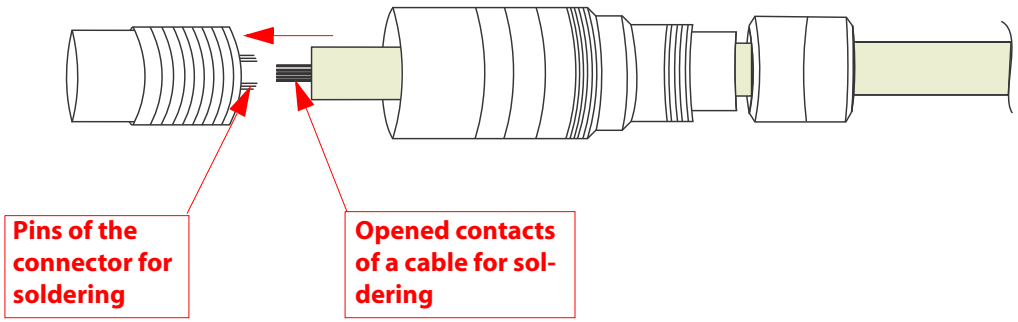


Figure 7-15 *Inserting and soldering of a cable to the inner part of the connector*

Please note that each pin is marked with a number according to the pin layout (see "Connector Pinout" on page 59). The pins numbering is located at the internal side of the inner part of the connector.

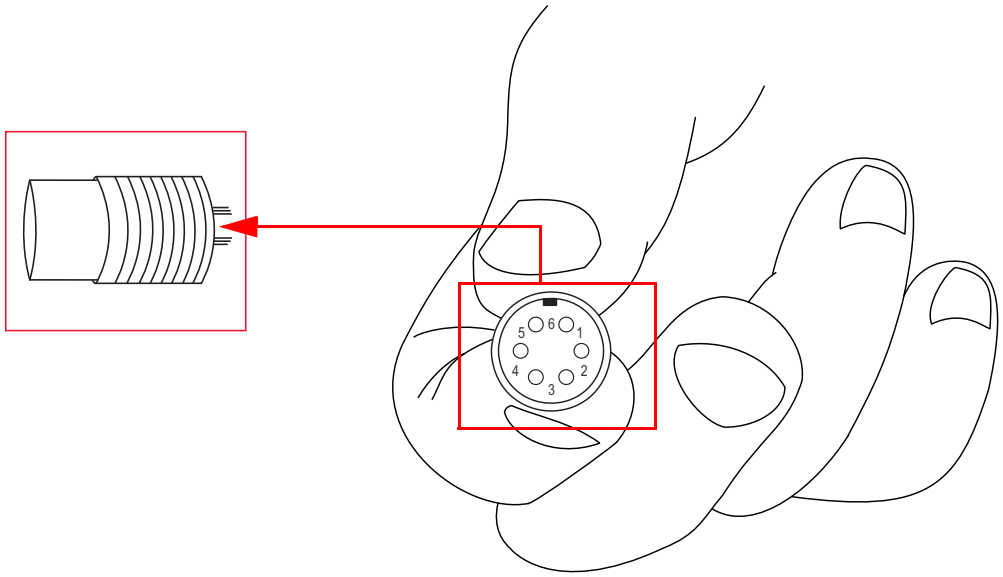


Figure 7-16 *Connector pinout outlook*

Note also that direction of pin numbering is done clockwise starting from the key at the upper edge of the inner part of the connector.

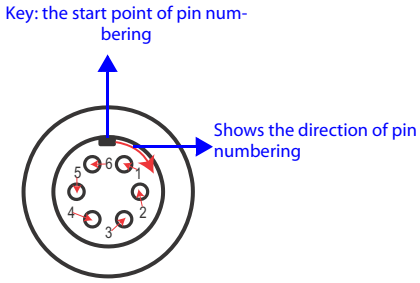


Figure 7-17 *The pin numbering direction*

When the soldering is done, insert the inner part of the connector in the main part.

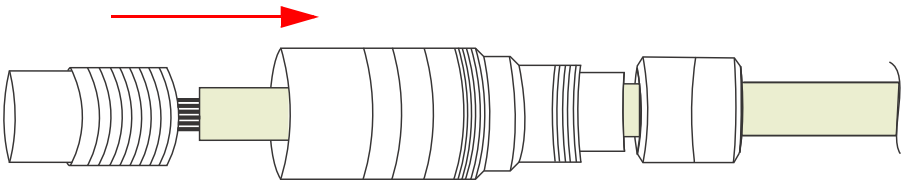


Figure 7-18 *Inserting of the inner part of the connector in the main part*

Screw in the inner part of the connector in the following way:

1 Fix the inner part of the connector with tweezers (see Figure 7-5 Fixing of the inner part of the connector with tweezers).

2 Hold the main part of the connector with fingers.

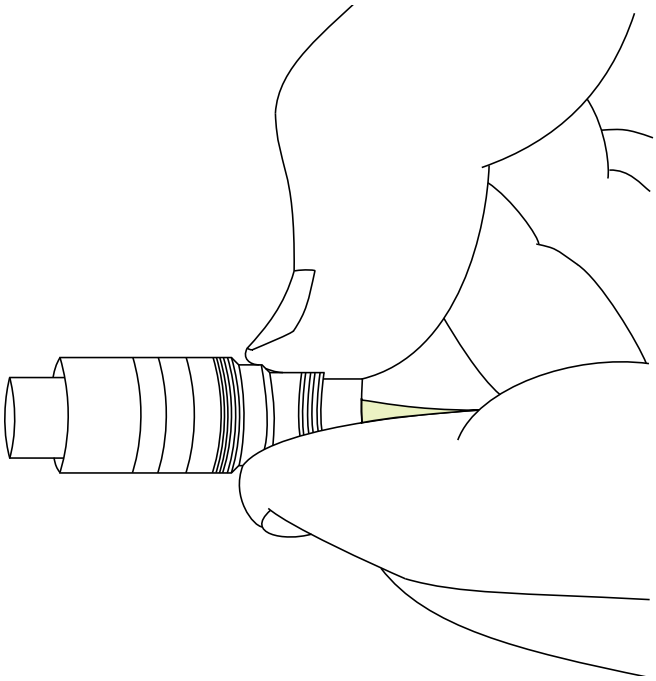


Figure 7-19 *Gripping of the main part of the connector with fingers*

3 Screw the main part of the connector in counterclockwise.

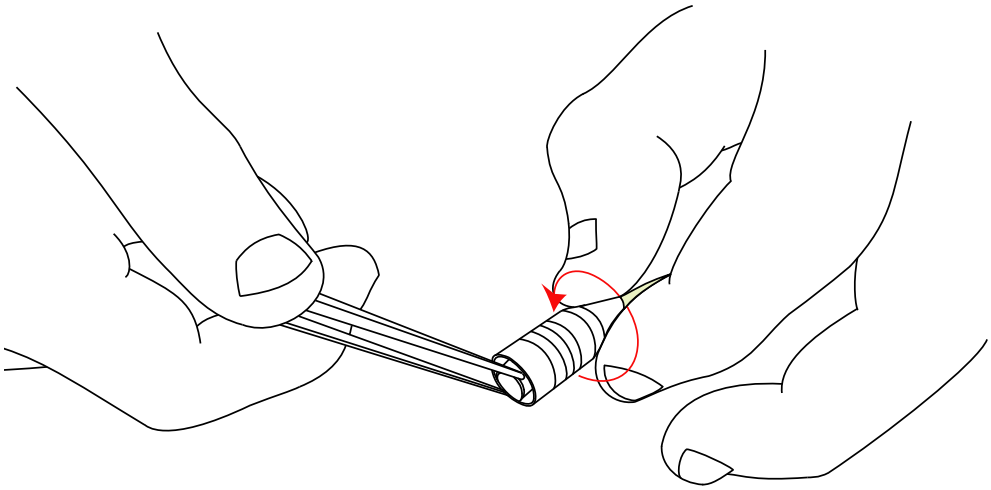


Figure 7-20 *Screwing the inner part of the connector in*

Insert the main part of the connector into the rear part.

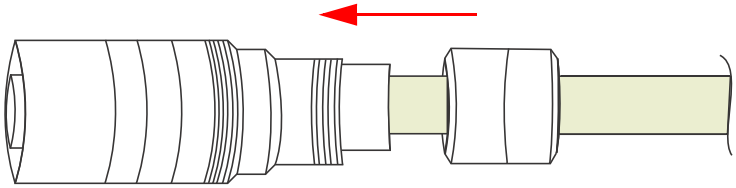


Figure 7-21 *Inserting of the main part of the connector into the rear*

Screw the rear part in using tweezers in the following way:

1. Fix the inner part of the connector with tweezers (see Figure 7-5 Fixing of the inner part of the connector with tweezers).
2. Screw the rear part of the connector in with your fingers counterclockwise.

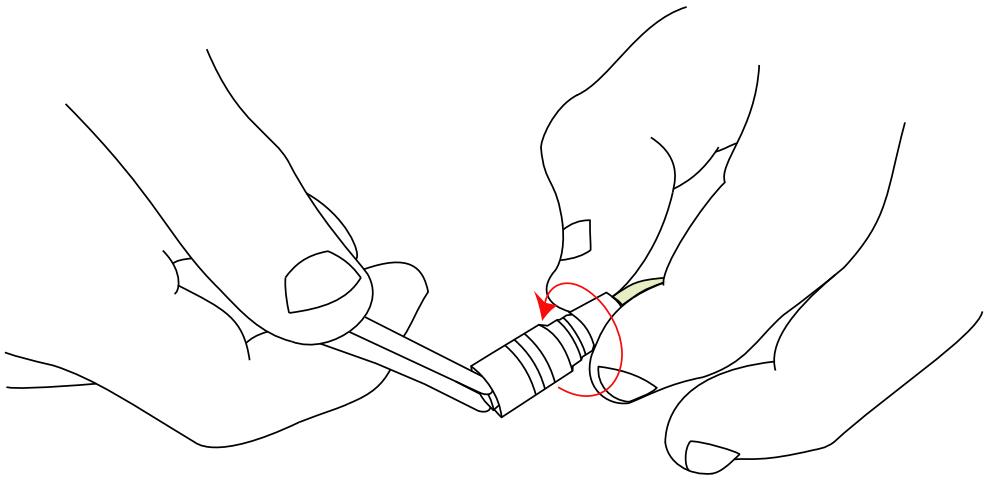


Figure 7-22 *Screwing of the rear part of the connector in to the main part*

Connector is ready to be used.

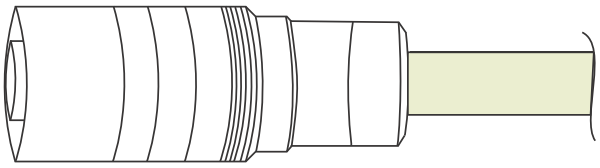


Figure 7-23 *Soldered connector with a cable*

Appendix 1

KEYBOARD SHORTCUTS

Keyboard shortcut(s)	Description
F2	Captures Frame into bitmap file
F3	Captures a Sequence frames into bitmap files
F4	Captures a sequence of frames into AVI file
F5	Starts live video display in the View window
Shift+F5	Stops live video display and close the View window
F12	Brings up the Main window when displaying the live video
Shift+F4	Saves Video to Memory
Ctrl+o	Opens Camera Profile
Ctrl + s	Stores Camera Profile
Alt +c	Brings up a Capture Options Dialog
Alt + s	Brings up a Device Settings Dialog
Alt+v	Opens Viewport Settings… window
E	Performs Auto Exposure
W	Performs Whit e Balance
H	Brings up a Histogram
F	Fine
Num+/-	Zooming In/Out
Num*	Returns original Size
F9	Makes a Snapshot
F1	Brings up a Help window
Esc	Exit

Appendix 2

Toolbar Overview

The most frequently used menu commands are duplicated on the application toolbar:

Button Command	Description
	Starts live video display in the View window. Disabled when Video is running or no camera is connected
	Stops live video display and close the View window. Disabled when Video is stopped or no camera is connected
	Brings up a Viewport Setup Dialog. Disabled when no camera is detected
	Captures a frame into BMP or TIFF file. Disabled when no camera is detected or video is stopped
	Captures a sequence of frames into BMP or TIFF files. Disabled when no camera is detected or video is stopped
	Saves Video to AVI File. Disabled when no camera is detected or video is stopped
	Saves Video to Memory. Disabled when no camera is detected or video is stopped

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