

Megapixel USB2.0 CMOS

# CAMERA

# Data Sheet

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SMX-M7xx Series USB2.0 Cameras

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SMX-M7xx Series USB2.0 Cameras Data Sheet

Revision 3.0

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## Introduction

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**SMX-M7xx Series Cameras** are high speed megapixel CMOS cameras with USB2.0 interface suitable for scientific and industrial applications, designed for capturing, streaming and storing high quality digital images.

The SMX-M7xx Series Cameras are available in three modifications:

- **SMX-M71M** camera has a monochrome 1/2 inch 1.3 megapixel CMOS sensor and features high sensitivity and high speed of 30 fps (48 MHz) at 1280 x 1024 resolution
- **SMX-M72** camera has a color 1/2 inch 2 megapixel CMOS sensor and features frame rate of 20 fps (48 MHz) at 1600 x 1200 resolution
- **SMX-M73** camera has a color 1/2 inch 3 megapixel CMOS sensor and features frame rate of 12 fps (48 MHz) at 2048 x 1536 resolution

Rolling shutter, External trigger output mode are available with the SMX-M7xx Series Cameras.

Capturing initial live streaming video images and still images are provided via USB 2.0 digital interface - no additional frame grabber is needed.

The cameras are supplied with Software package, all needed drivers and API library allowing quick integration of camera functions into user's applications.

## Key Features

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- Rolling shutter
- External trigger output mode
- Video and snapshot operations
- Low image noise
- Plug and play
- USB2.0 interface
- C-Mount
- No external power supply required
- Selectable pixel data: 8 bit or 10 bit
- Complete SDK available

## Specifications

**Table 1-1** Camera Specification

<b>Output video and camera control characteristics</b>			
	<b>SMX-M71M</b>	<b>SMX-M72</b>	<b>SMX-M73</b>
Maximum resolutions of output window	1280 x 1024, full resolution mode	1600 x 1200, full resolution mode	2048 x 1536, full resolution mode
Frame rate at resolution (48MHz)*	30 fps at 1280 x 1024, full resolution 48 fps at 1024 x 768 74.6 fps at 800 x 600 80 fps at 768 x 576 109 fps at 640 x 480 179 fps at 400 x 400 332 fps at 320x240	20 fps at 1600 x 1200, full resolution 28 fps at 1280 x 1024 45 fps at 1024 x 768 69 fps at 800 x 600 74 fps at 768 x 576 100 fps at 640 x 480 159 fps at 400 x 400	12 fps at 2048 x 1536, full resolution 20 fps at 1600 x 1200 28 fps at 1280 x 1024 44 fps at 1024 x 768 66 fps at 800 x 600 71 fps at 768 x 576 96 fps at 640 x 480 150 fps at 400 x 400
Output bits per pixel	Selectable, 8 bits or 10 bits	Selectable, 8 bits or 10 bits	Selectable, 8 bits or 10 bits
Lookup table	Downloadable for user selected 8 bits mode: converts 10 bits of imaging chip's ADC to 8 bits of output	Downloadable for user selected 8 bits mode: converts 10 bits of imaging chip's ADC to 8 bits of output	Downloadable for user selected 8 bits mode: converts 10 bits of imaging chip's ADC to 8 bits of output
Pixel rates	3.33 MHz, 6.66 MHz, 8 MHz, 10 MHz, 12 MHz, 13.33 MHz, 16 MHz, 20 MHz, 24 MHz, 32 MHz, 40 MHz, 48 MHz	3.33 MHz, 6.66 MHz, 8 MHz, 10 MHz, 12 MHz, 13.33 MHz, 16 MHz, 20 MHz, 24 MHz, 32 MHz, 40 MHz, 48 MHz	3.33 MHz, 6.66 MHz, 8 MHz, 10 MHz, 12 MHz, 13.33 MHz, 16 MHz, 20 MHz, 24 MHz, 32 MHz, 40 MHz, 48 MHz
Exposure range (at highest resolution), ms	Minimal: 0.0 3ms (48 MHz, 1280 x 1024 , 1:1) Maximal: 236.52 ms (6.66 MHz 1280 x 1024 , 1:1)	Minimal: 0.04 ms (48 MHz, 1600 x 1024, 1:1) Maximal: 348.88 ms (6.66 MHz, 1600 x 1024, 1:1)	Minimal: 0.05 ms (48 MHz, 2048 x 1536, 1:1) Maximal: 564.91 ms (6.66 MHz, 2048 x 1536, 1:1)
Pixel gain control	Programmable (Hardware): 48 gain levels from 1 to 15	Programmable (Hardware): 48 gain levels from 1 to 15 Gain controls for R, G, B: 48 gain levels from 1 to 15	Programmable (Hardware):161 gain levels from 1 to 128 Gain controls for R, G, B: 161 gain levels from 1 to 128

**Table 1-1** Camera Specification

Output window modes	View port (from 1280 x 1024 to 8 x 8 with 2 pixels/ 2 lines step positioning) Frame Decimation (1:1, 1:2, 1:4, 1:8) Horizontal mirroring, hardware Vertical flipping, hardware	View port (from 1600 x 1200 to 8 x 8 with 2 pixels/ 2 lines step positioning) Frame Decimation (1:1, 1:2, 1:4, 1:8) Horizontal mirroring, hardware Vertical flipping, hardware	View port (from 2048 x 1536 to 8 x 8 with 2 pixels/ 2 lines step positioning) Frame Decimation 1:1, 1:2, 1:3, 1:4, 1:5, 1:6, 1:7, 1:8 Frame Binning: 1:1, 1:2, 1:3, 1:4 Horizontal mirroring, hardware Vertical flipping, hardware
Gamma, brightness and contrast control	Programmable with lookup table, software gamma correction	Programmable with lookup table, software gamma correction	Programmable with lookup table, software gamma correction

\* Listed frame rate values at the defined resolutions are not the maximal possible. Increasing of frame rate can be done by reducing of the current Exposure value (the lower Exposure the higher frame rate), hiding of the active video window from the display, running the camera with a fast speed computer, etc.

### Imaging chip characteristics

Type	Monochrome 1/2 inch 1.3 megapixel CMOS sensor manufactured by Micron Technology, Inc	Color 1/2 inch 2 megapixel CMOS sensor manufactured by Micron Technology, Inc	Color 1/2 inch 3 megapixel CMOS sensor manufactured by Micron Technology, Inc
Pixel size	5.2 $\mu\text{m}$ x 5.2 $\mu\text{m}$	4.2 $\mu\text{m}$ x 4.2 $\mu\text{m}$	3.2 $\mu\text{m}$ x 3.2 $\mu\text{m}$
Image array size	8.4 mm diagonal	8.4 mm diagonal	8.4 mm diagonal
Shutter	Rolling	Rolling	Rolling (Optional Global Reset)
Scanning mode	Progressive	Progressive	Progressive
ADC resolution	10 bit	10 bit	10 bit
Sensitivity	2.1 V/lux-sec	1.2 V/lux-sec (550nm)	> 1.0 V/lux-sec (550nm)
Dynamic Range	68.2dB	> 61dB	61dB

### Camera electrical characteristics

Supply voltage	5 V supplied by USB2.0 interface	5 V supplied by USB2.0 interface	5 V supplied by USB2.0 interface
Supply current	456 mA (at 5.0 V)	456 mA (at 5.0 V)	456 mA (at 5.0 V)
Maximum power consumption	2.28 W	2.28 W	2.28 W

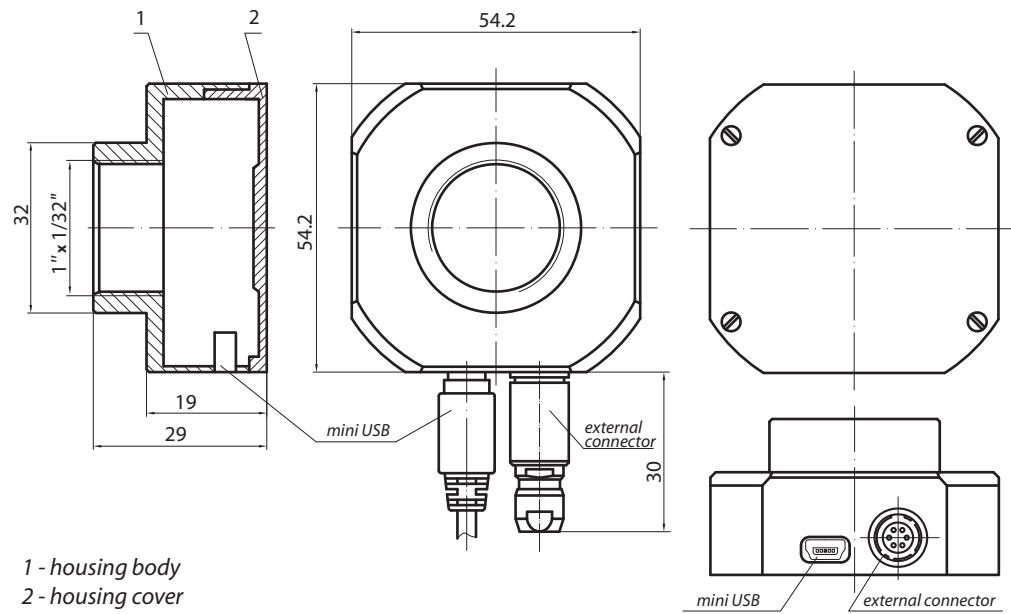
### Camera interface characteristics

**Table 1-1** Camera Specification

Interface Type	USB2.0, 480 Mbps	USB2.0, 480 Mbps	USB2.0, 480 Mbps
Connector Type	USB mini-B, 5 pin	USB mini-B, 5 pin	USB mini-B, 5 pin
<b>System requirements</b>			
Operating System	Windows XP SP1+/2003/ Vista/2008/7 recommended: Windows 7 or XP 1+	Windows XP SP1+/2003/ Vista/2008/7 recommended: Windows 7 or XP 1+	Windows XP SP1+/2003/ Vista/2008/7 recommended: Windows 7 or XP 1+
Processor	Intel P4 or higher recommended: Intel Core 2 Duo	Intel P4 or higher recommended: Intel Core 2 Duo	Intel P4 or higher recommended: Intel Core 2 Duo
RAM	256 MB for XP (512 MB for 2008/Vista) recommended: 512 MB (1024 MB for W7)	256 MB for XP (512 MB for 2008/Vista) recommended: 512 MB (1024 MB for W7)	256 MB for XP (512 MB for 2008/Vista) recommended: 512 MB (1024 MB for W7)
Hard Disk Space	About 15 MB for installation plus additional space for captured images	About 15 MB for installation plus additional space for captured images	About 15 MB for installation plus additional space for captured images
Video	8 MB memory, recommended GeForce 4xxx/Radeon 9xxx or higher	8 MB memory, recommended GeForce 4xxx/Radeon 9xxx or higher	8 MB memory, recommended GeForce 4xxx/Radeon 9xxx or higher
Hardware Interface	USB 2.0 Host Controller: recommended Intel integrated Host Controller (VIA-based USB Controller not recommended) USB 3.0 Host Controller is also supported at least one USB 2.0 port for connection	USB 2.0 Host Controller: recommended Intel integrated Host Controller (VIA-based USB Controller not recommended) USB 3.0 Host Controller is also supported at least one USB 2.0 port for connection	USB 2.0 Host Controller: recommended Intel integrated Host Controller (VIA-based USB Controller not recommended) USB 3.0 Host Controller is also supported at least one USB 2.0 port for connection
<b>Camera physical characteristics</b>			
Operating temperature	0 to +50°C	0 to +60°C	0 to +60° C
Lens mount type	C-mount	C-mount	C-mount
Weight (without lens)	108 g	108 g	108 g
Dimensions (W x L x H)	54.2 x 54.2 x 32.6 mm	54.2x 54.2 x 32.6 mm	54.2x 54.2 x 32.6 mm
Camera housing material	Duralumin	Duralumin	Duralumin



## Camera Mechanicals

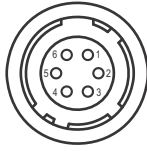


**Figure 1-1** Camera drawing



**Figure 1-2** SMX-M7x camera outlook

## External connector pinout



**Figure 1-3** Pinout

1. Trigger / 'Time stamp' input positive
2. Programmable output
3. Programmable output
4. Trigger / 'Time stamp' input negative
5. Programmable output
6. Common (Ground)

## SMX-M71M camera

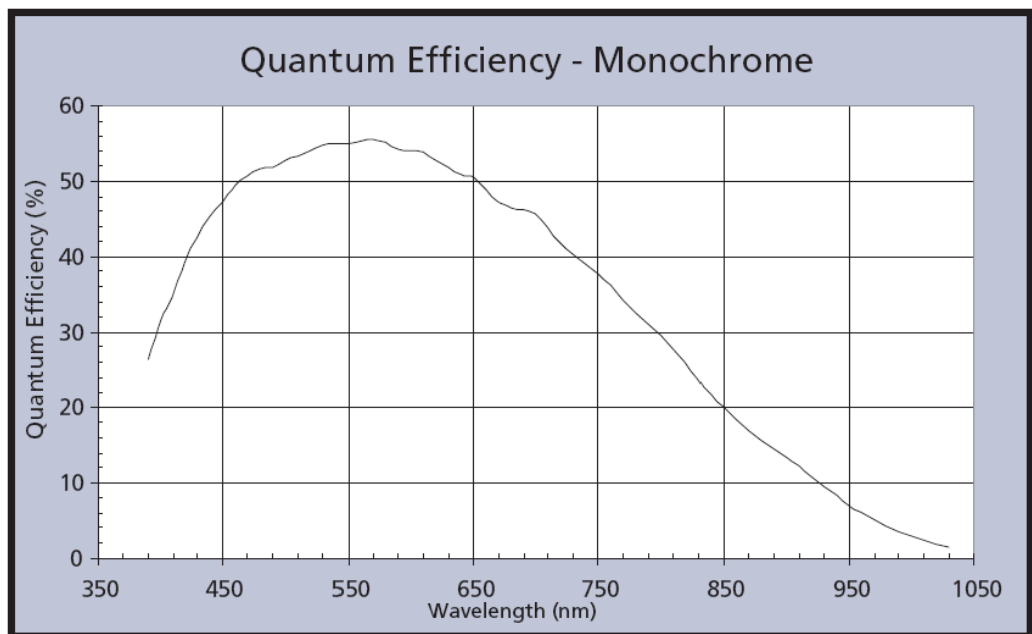
The **SMX-M71M** camera uses the Micron® Imaging MT9M001 which is an SXGA-format with a 1/2-inch CMOS active-pixel digital image sensor. The active imaging pixel array is of 1,280 H x 1,024 V.

The sensor is operated for frame size, exposure, gain setting, and other parameters.

The default mode outputs an SXGA-size image at 30 frames per second (fps).

### Quantum efficiency

The Quantum efficiency is described in the [Figure 1-4](#).



**Figure 1-4** Quantum efficiency-monochrome

### SMX-M72 camera

The SMX-M72 camera uses a Micron® Imaging MT9D001 which is a UXGA-1/2-inch format CMOS active-pixel digital image sensor. The active imaging pixel array is 1,600H x 1,200V.

The default mode outputs a UXGA-size image at 20 frames per second (fps).

### SMX-M73 camera

The SMX-M73 camera uses a Micron® Imaging MT9T001 which is a QXGA-format with a 1/2-inch CMOS active-pixel digital image sensor. The active imaging pixel array is 2,048 H x 1,536 V. The default mode outputs a QXGA image at 12 frames per second (fps).

All the Micron® CMOS image sensors feature Digital-Clarity - a low-noise CMOS imaging technology that achieves CCD image quality (based on signal-to-noise ratio and low-light sensitivity) while maintaining the inherent size, cost, and integration advantages of CMOS.

It incorporates sophisticated camera functions on-chip such as windowing, column and row skip mode.

The sensor is operated in its default mode and programmed for frame size, exposure, gain setting and other parameters.

An on-chip analog-to-digital converter (ADC) provides 10 bits per pixel.

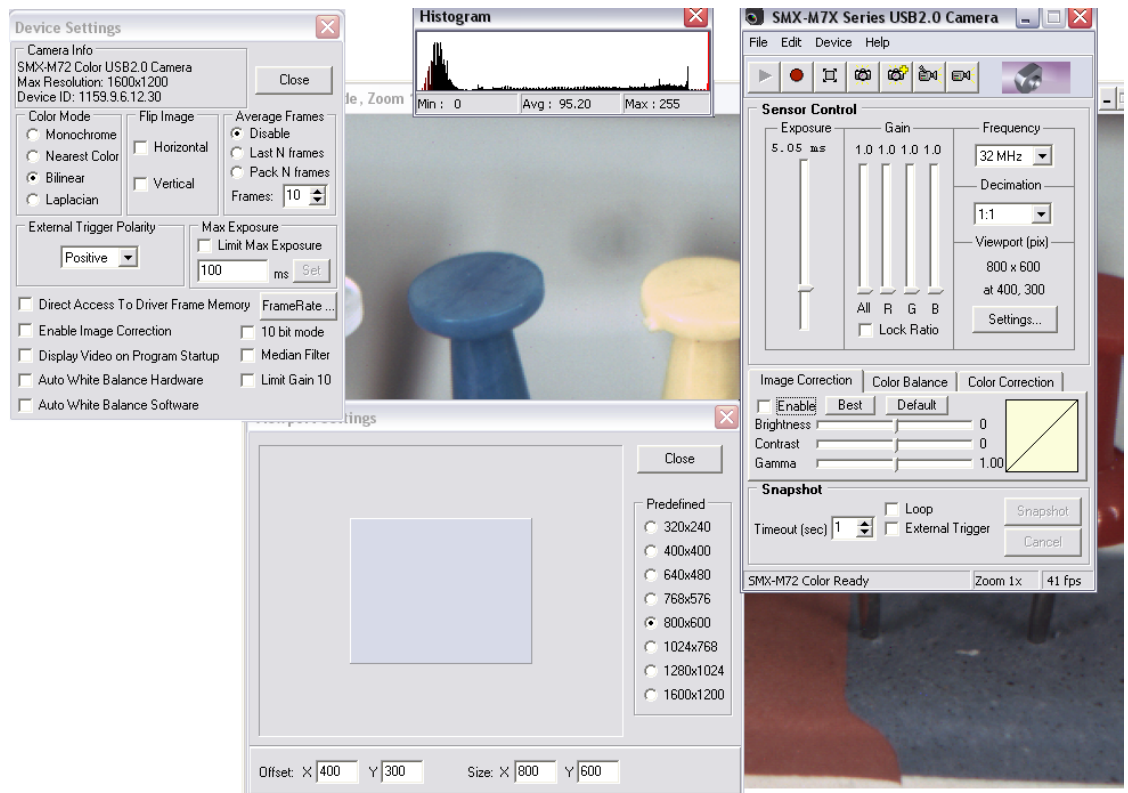
## SMX-M7xx Software Package

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The SMX-M7xx cameras usually go with its software package that contains a Standard Application, Drivers, User Guide and SDK (API, examples, documentation).

Standard Application provides control of various set-up commands demonstrating cameras performance.

API allows a full control of all camera features and along with examples and documentation enable easy integration of the camera into the customers' applications.



**Figure 1-5** SMX-M7C camera application

## Drivers

- WDM compatible
- Direct Show compatible
- Twain included
- Linux (upcoming)

## System requirements

- Windows 7 or XP 1 and higher

For more information see [“System requirements”](#) on page 8.

## API function categories

- Get camera info
- Get/Set camera features
- Video stream controls (Start/Stop)
- Image grabbing
- Image correction controls (brightness, contrast, gamma)

- Snapshot controls (Exposure)
- Open /Close camera

### Camera application controls

- Image correction (brightness, contrast, gamma)
- Color Balance (R, G, B, for color models only)
- Color Correction (Brightness, Contrast, Saturation, for color models only)
- Viewport
- Image capture
- Video capture
- Color Bayer algorithm selection
- Selectable Exposure, Gain and Frequency (sensor controls)
- Decimation
- Auto Exposure
- Horizontal and Vertical flipping
- Averaging frames
- Limit Gain (10)
- Limit Exposure
- Histogram
- External trigger polarity
- Software zoom
- Selectable (8 bits or 10 bits) mode output
- Frame rate control

A set of examples included into SDK serve as tutorial in developing new applications.

## Third-Party IDE/Software Compatibility

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The SMX-M7xx Series USB2.0 Cameras are compatible with the next programming environments & software:

- Visual Studio 6.0 (2002, 2003, 2005, 2008, 2010) (SDK)
- Delphi/Builder C++ (SDK)
- C# (SDK)
- C# 2003, 2008
- C++ Net

- HALCON (SDK) (upcoming)
- LabVIEW (SDK)
- MATLAB (SDK)
- Streampix (SDK)
- Visual Basic 6.0 (SDK)

## Assistance and Help

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Our developers are ready to advise and assist with integration of the SDK into relevant applications.

## Camera Customization

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Sumix Corporation offers hardware and software customization services to meet customers' specific needs. Recent camera custom development examples:

- Camera case mechanical modification
- External trigger output mode customization
- Unique sensor modification

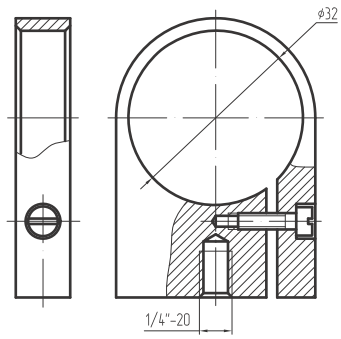
## Camera Accessories

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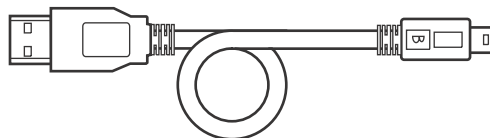
The SMX-M7xx Series USB2.0 Cameras usually go with:

- 1 Tripod adapter: the lightweight duralumin adapter allows quick and easy camera fixing to the tripod, offering additional protection to the camera



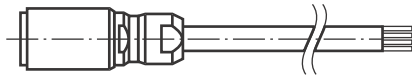


**2** USB A to Mini B cable, 1.75 m long



**3** 6 pin Hirose trigger connector (without a cable)





#### 4 IR-cut Filter and Ring-adapter

IR-cut filter can be used for both color and monochrome SMX-M7x camera models.

The SMX-M7x color cameras are sensitive to IR-light. IR-cut filter will block the (near) infrared light and make the colors of the image more realistic.

SMX-M7x monochrome cameras are more sensitive to the infrared light than color models. Using the camera in an environment rich for infrared light may result in highlighted images. In order to avoid highlighted images use the IR-cut filter for the SMX-M7x monochrome cameras.

When the camera is used with the IR-cut filter, the focus distance is increased to 0.66 mm. To restore the original value of the focus distance (when the camera is used with no IR-cut filter ring and no ring-adapter), the ring-adapter is used:





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