Product Document

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User Guide

UG001036

NanEye

Evaluation Kits

Fiber Optic Box 2.0 and NanoUSB2.2

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Content Guide

1 Introduction

NanEye is a family of miniature sized image sensors for vision applications where size is a critical factor. The ability of the camera head to drive a signal through long cables makes this the ideal component for minimal diameter endoscopes.

The sensor has been specially designed for medical endoscopic applications where high SNR is mandatory. The sensor includes a 10-bit ADC and a bit serial LVDS data interface. The sensors are able to drive the signal through a cable length of up to 3 m.

The data line is semi duplex, such that configuration can be communicated to the sensor in the frame brake. The exposure time, dark level, analog gain and frame rate can be programmed over the serial configuration interface.

The Fiber Optic Box and NanoUSB2 evaluation kits are able to communicate with the NanEye sensors. The NanEye Viewer software enables the user to send the sensor register values, as well as grab the RAW images to store or add image processing. Additional features are referred along the document.

Information

For more information about the NanEye family specifications, please see its datasheets on the webpage.

1.1 Ordering Information

Ordering Code	Description
NANO_FIB_BOX_2.0	Fiber Optic Box 2.0 Evaluation Kit(1)
NANOUSB2.2	NanoUSB2.2 Evaluation Kit(1)

(1) Please note that the sensors do not come with the Evaluation Kit. The sensors need to be ordered separately, according to each respective ordering code, in the respective NanEye datasheets.

2 Hardware Description

2.1 Fiber Optic Box 2.0

2.1.1 Out of the Box

NanEye Fiber Optic Box 2.0 (FOB2.0) is a fully embedded all in one image processing unit that interfaces the NanEye® micro camera head signals and provides an output of 1080p/60 format HDMI video signal which can be directly plugged to a HDMI compatible monitor, which in this mode no additional PC or image processing is required.

The USB3 interface allows the connection to the NanEye Viewer running on a PC to get access to the sensor's raw images and control settings.

The main body of the demo kit measures only 17 cm x 17 cm x 5.6 cm and provides all necessary video processing and display driving plus the adjustable illumination.

Figure 1:
Fiber Optic Box 2.0 Demo Kit With LEMO Connector (Legacy)(1)

Figure 2:
Fiber Optic Box 2.0 Demo Kit Without LEMO Connector (Current)(2)

(1) This hardware has the LEMO connector and LED illumination for the legacy NanEye Fiber product (NanEye2D with fiber illumination within a plastic tube). Please note that NanEye2D sensor is still in mass production. Only the NanEye Fiber product is discontinued. Moreover, NanEye2D version with LED ring, despite discontinued, is supported on port 1.

(2) This is the latest hardware revision, without the LEMO connector, therefore the legacy NanEye Fiber product is not supported anymore. NanEye2D version with LED ring, despite discontinued, is still supported on port 1.

Attention

The Fiber Optic Box 2.0 Demo Kit is intended solely for evaluation purposes, has no EMI approval and is not advisable for medical use. ams OSRAM therefore is not liable for any damage or harm resulting from its use.

Figure 3:
Fiber Optic Box 2.0 Benefits/Features

Benefits	Features
Easy to use plug and play solution	Supports up to two NanEye® 2D, XS and M
Stand alone video output via HDMI (no PC required)	Integrated adjustable current source for illumination
High quality image output	HDMI 1080p/60 video output
All-in-one eval kit with illumination	USB3 PC interface to NanEye Viewer
Raw image data access and sensor control via USB3 and NanEye Viewer	Image processing, correction and enhancements

Figure 4:
Fiber Optic Box 2.0 Pinout Description

Front Side	Rear Side
JST Connector	**HDMI Output**
• 2 x NanEye2D/M/XS	• 1080P60 to display NanEye
• 1 x Current source up to 22.7 mA (channel 1)	• No additional PC needed
Rotary Switch	**USB3.0**
• Light mode and intensity control	• Display NanEye channel 1 & 2 with NanEye Viewer software
	• Adjust light intensity of distal LED ring(1)
	• Adjust image processing
Dual Color Status LED	
LEMO Connector(2)	**Power Supply**
• 1 x NanEye Fiber	• 12 V DC, 1.5 A minimum

(1) Illumination only available on port 1 for the legacy NanEye2D with LED ring.
(2) Only available in previous FOB hardware version (Figure 1), for the legacy NanEye Fiber product. Does not support other NanEye products.

Attention

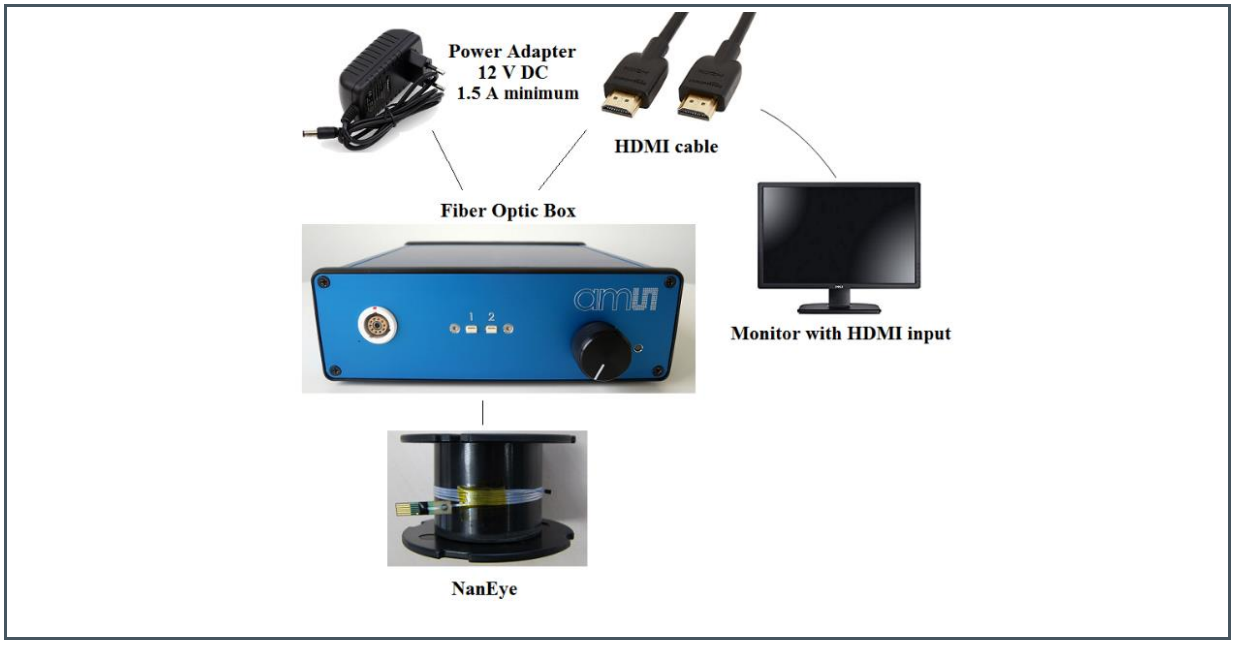
Do not connect the NanEye2D simultaneously with NanEyeM or NanEyeXS. NanEye2D works with a lower voltage range than NanEyeXS and NanEyeM. A higher voltage on NanEye2D will cause irreversible damage to the sensor. Also do not connect a NanEyeXS simultaneously with NanEyeM.

2.1.2 Plug and Play

Recommended Connection

The following image shows the necessary equipment for a direct connection to a monitor.

Figure 5:
Fiber Optic Box Plug and Play Equipment Connection(1)



(1) The connection above is also applicable for the new hardware version (Figure 2).

1. Firstly, connect the NanEye module to the box.
2. Then connect the box to the monitor using a HDMI cable.
3. Plug in the 12 V DC power adapter and wait for the Fiber Optic Box to power up.

Fiber Optic Box Operation

- Dual Color Status LED
  - Constant Green → Status ok, no sensor connected, test pattern output via HDMI
  - Blinking Green → Sensor data transmission, sensor is working successfully
  - Blinking Amber (pulse > 1 second) → at least one error during sensor data decoding detected
  - Blinking Amber (pulse < 250 ms) → Flash programming (more details on section 2.1.4)

Figure 6:
Fiber Optic Box Rotary Switch

Rotary Switch			
	Push Button		Rotate
	Action	Function	Function
Default Mode	Press during one second	White balance optimized for fiber light color temperature(1)	Adjusts light intensity(1)
		Optimized white balance for LED ring color temperature(2)(3)	Adjusts light intensity
		Neutral color temperature. No tuning of white balance(3)	N/A
User Mode	Double click	Histogram Stretching Mode	On/Off
	Additional Long Press	White Balance Mode	Default Values/ Keep Values / Calibration
	Additional Long Press	Back to Histogram Stretching Mode	On/Off
	Double click	Back to Default Mode	Depends on chosen function

(1) NanEye2D with fiber illumination is a discontinued product. Moreover, the latest FOB version no longer have the fiber optic hardware. The illumination feature only works for previous versions of the FOB (Figure 1).
(2) NanEye2D version with LED ring is a discontinued product.
(3) In the new hardware version (Figure 2), only these two modes are available, once there is not LEMO connector anymore.

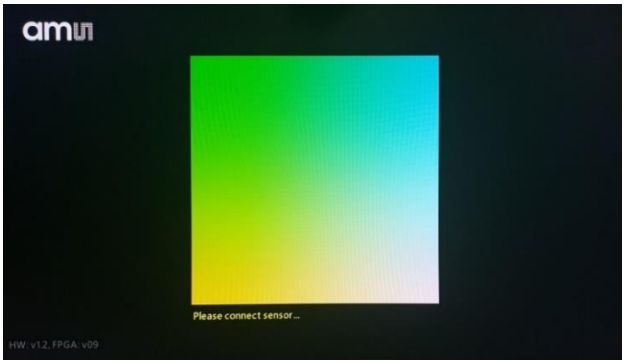
When entering the User Mode for White Balancing:

- **Keep Values:** No changes relative to the White Balance set previously. This is for the case the 'White Balance' menu is entered the but actually is not intended to modify the current settings
- **Default Values:** Sets the default values, i.e. 1.0 for RGB in case of no illumination, LED dependent in case of illumination
- **Calibrating:** Shows a ROI into which the white target has to be placed. Calibration is performed in real time, so the results will be seen immediately. It can be set back to 'keep values', or exit the menu by a long press or exit user mode by a double click. To calibrate properly, please point the sensor to a white surface/object (homogeneous illumination)

Image Viewing

The following image shows the Fiber Optic Box layout on the monitor. The coloured screensaver represents the mode when there is no NanEye module connected, where the status LED is constant green. In the bottom left corner, it is possible to observe the hardware and firmware version.

Figure 7:
Fiber Optic Box Plug and Play Layout

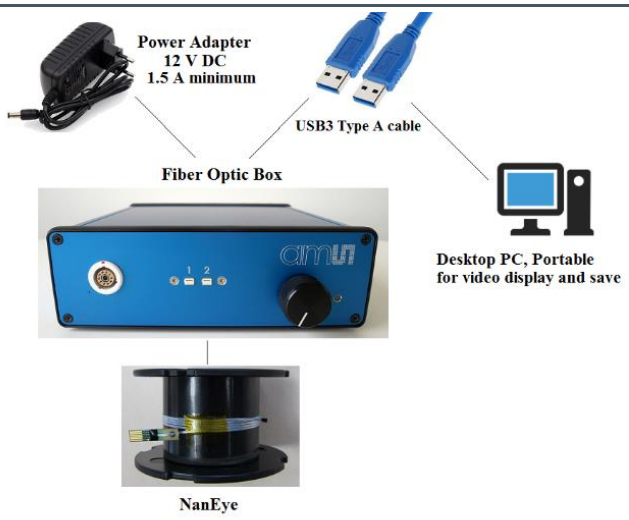


2.1.3 Operation with PC

Recommended Connection

The following image shows the necessary equipment for a direct connection to a PC.

Figure 8:
Fiber Optic Box NanEye Viewer Equipment Connection(1)

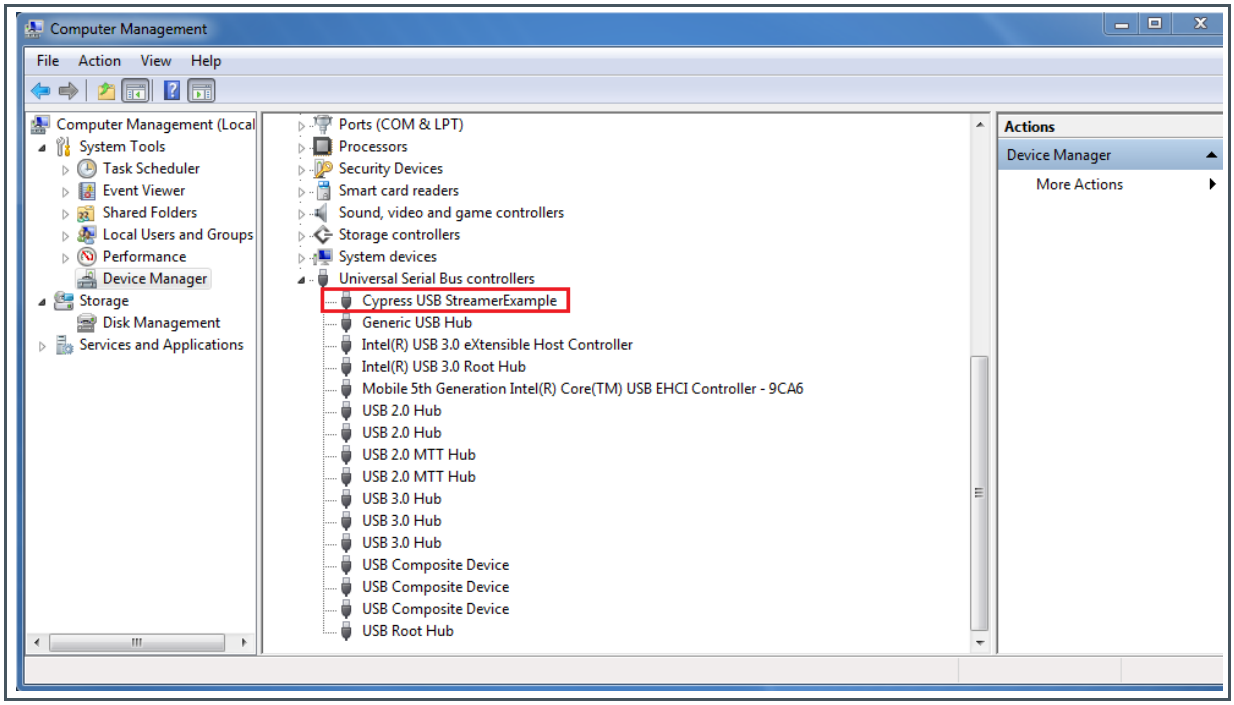


(1) The connection above is also applicable for the new hardware version (Figure 2).

Please take the following steps to perform the correct connection:

1. Please ensure that the NanEye Viewer software has been correctly installed, refer to section 3.2.
2. Plug the USB3 type A cable to the Fiber Optic Box and the PC.
3. Plug in the 12 V DC power adapter and wait for the Fiber Box to power up.
4. Wait for it to be automatically recognized. Please check on the **Device Manager** if your device is recognized as **Cypress FX3 USB StreamerExample Device** as shown in Figure 9.
5. Connect the sensor to the respective port and wait for the green LED to be blinking.
6. The NanEye Viewer can be started choosing the **Camera**, **Board** and **Viewer,** following the suitable combination available on Figure 32. If the board is not recognised correctly please check next sections Installing FX3 Driver Manually and How to Debug Fiber Optic Box.

Figure 9:
Fiber Optic Box Device Connection



Installing FX3 Driver Manually

If the driver is not correctly installed after installing NanEye Viewer, please go to:

- **Program Files (x86)\ams OSRAM\NanEye Viewer vx.x.x.x\driver\FX3_Driver**

Then, according to the operating system, run the respective Drive Package Installer (**dpinst_x86/x64**).

How to Debug Fiber Optic Box

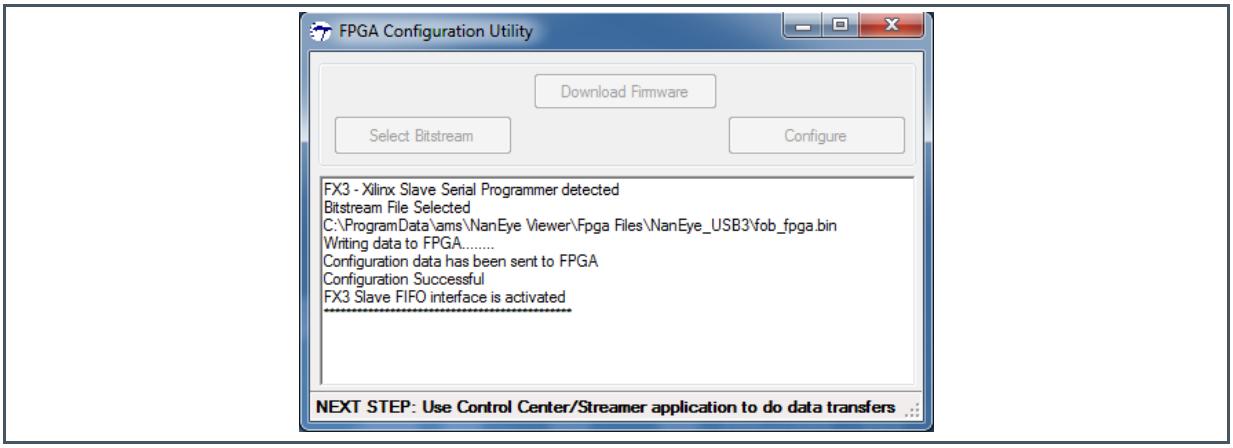
If the NanEye Viewer does not run, this section can help to debug the board.

When the NanEye Viewer is installed, the programs included inside the folder **Program Files (x86)\ams OSRAM\NanEye Viewer vx.x.x.x\application\debug\Usb3**, can be used to debug any occurring issues.

In order to reprogram the FPGA, start FPGA Configuration Utility (Template.exe), follow the instructions on that window and use the .bin file (for instance, **fob_fpga_vxx.bin**). This .bin file can be found at **C:\ProgramData\ams OSRAM\NanEye Viewer\Fpga Files\NanEye_USB3**.

When this task is completed, the information is displayed as below. This means that the FPGA is programming correctly.

Figure 10:
Fiber Optic Box FPGA Configuration



If the NanEye Viewer still does not open, please reinstall the software.

Information

If the issues are still not solved, please contact the Technical Support team.

2.1.4 Permanent Flash Programming

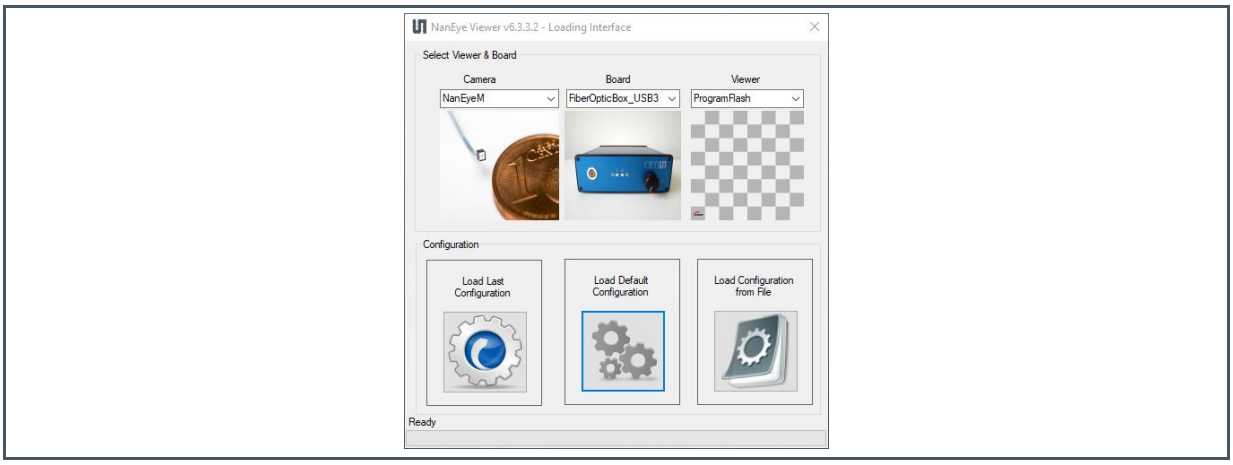
From production, the FOB already comes with a firmware stored in the flash, in order to use Plug and Play mode. However, there may be a need to update to use the new features.

There are different ways to program the FOB2.0. One way is to use procedure on step 6 of Recommended Connection section. The drawback of this solution is that, as soon as the system is power cycled, it returns to the previous firmware in the flash, therefore a temporary solution.

To permanently store the programming file in the flash, it can be done via JTAG. However, this procedure is not so elegant at user's side, once the box needs to be opened.

To overcome this situation, the system was upgraded to permanently program the flash via USB3. This procedure is performed via NanEye Viewer Software (only available from version v6.3.x.x on). The user needs to choose the **Board** as FiberOpticBox_USB3 and, in the **Viewer** section, will show "ProgramFlash", independently of the **Camera** chosen. Before initiating this process, please make sure that the FOB is connected to both power supply and USB3 port.

Figure 11:
Flash Programming – NanEye Viewer Layout

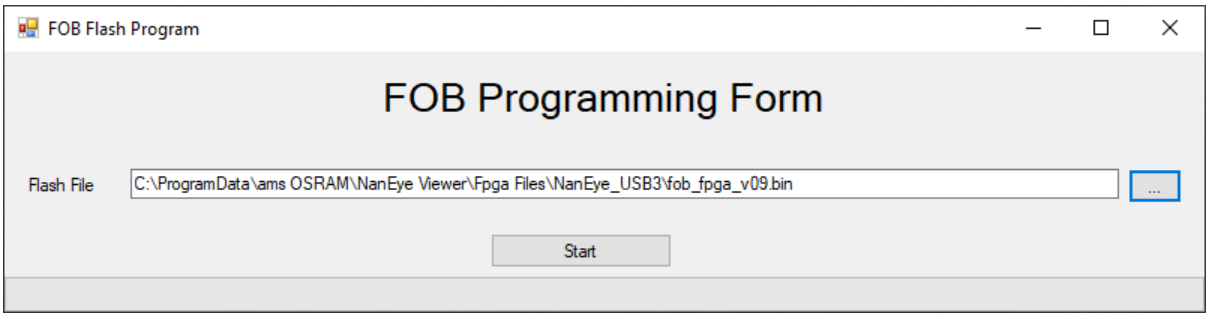


Information

This process can be done with or without a HDMI screen connected. However, is recommended to use a monitor to easily follow and observe the programming steps.

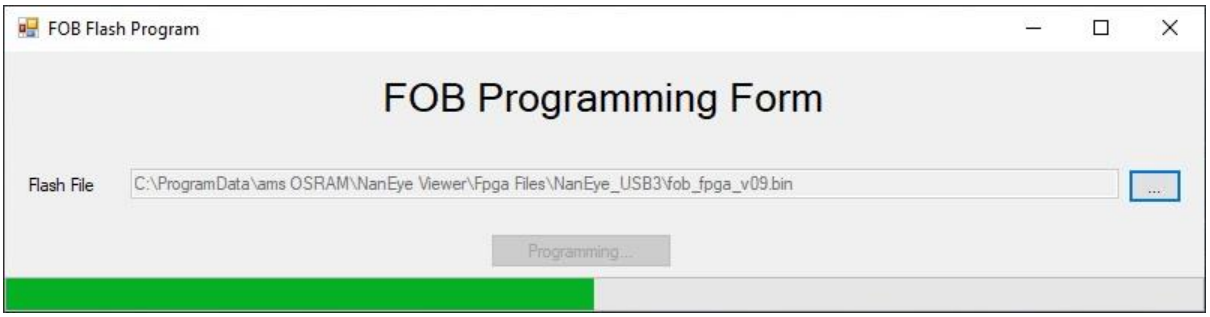
After pressing "Load Default Configuration", the programming section will show as Figure 12. Please click on the three dots box on the most right and it will automatically open the respective folder to upload the firmware. Please make sure to choose the latest fob_fpga_vXX.bin file. Below is presented the v09. The next version follows in hexadecimal order (for instance, the following would be v0A).

Figure 12:
Programming Layout Folder Directory



After choosing the respective programming file, the user can Start the programming, as show below. This step basically transfers the file into the FOB.

Figure 13:
Programming File Upload Process



Once the programming data is transferred to the EVK, the NanEye Viewer will notify to disconnect the USB3 cable, as shown below. Click OK and the NanEye Viewer will close. Simultaneously, the same notification is shown on the monitor. Also note that the FOB LED will be blinking with amber color and it will maintain this state until the end of the full programming.

Figure 14:
USB3 Disconnection Step – NanEye Viewer

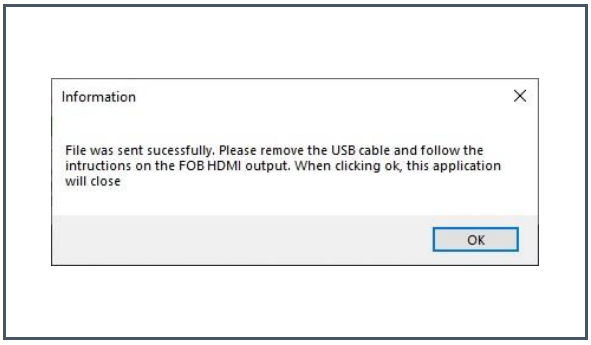
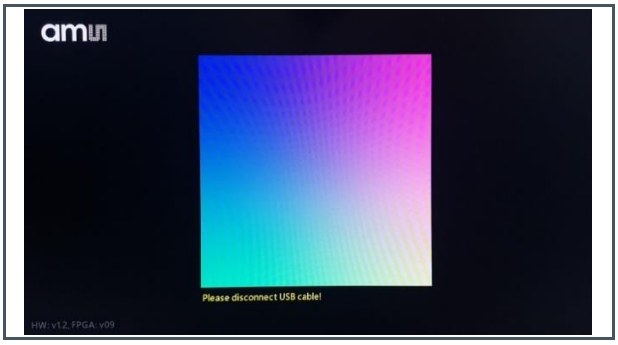


Figure 15:
USB3 Disconnection Step – HDMI Monitor



After disconnecting the USB3 cable, the system will start to erase the flash, which can take up to two minutes. Right after, it will start flash programming, as shown below.

Figure 16:
Flash Erasing

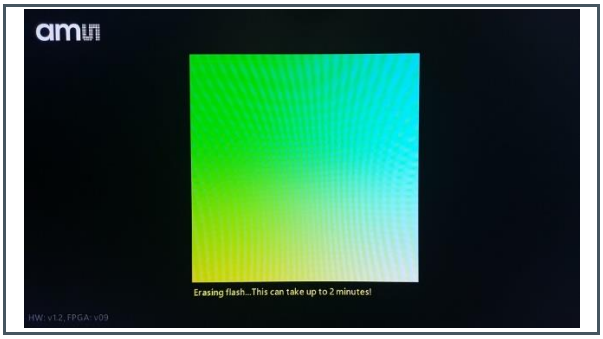


Figure 17:
Flash Programming

Once programmed, to conclude the process it will perform a flash verification. Finally, the flash update is finished. As the programming is done, the LED becomes constant green. Now the user can now power cycle the system, to then observe the layout as in Figure 7.

Figure 18:
Flash Verification

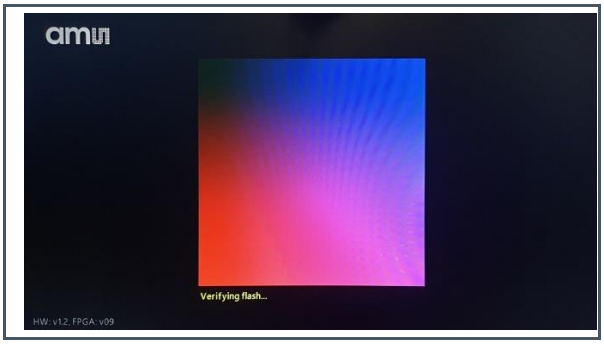
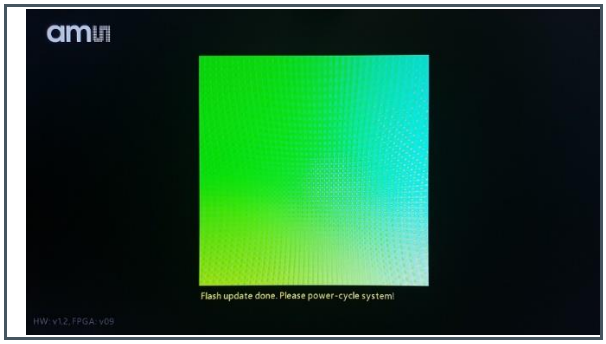


Figure 19:
Programming Done – Power Cycle



2.2 NanoUSB2.2

2.2.1 Out of the Box

The NanoUSB2 demo kit is the ideal basis for customers that intent to develop a video processing engine. It is the hardware between the camera and the PC and it does the deserialisation of the data stream that comes from the NanEye® camera. It allows to control one NanEye2D camera along with

the LED illumination, if available on the camera module. The base station is powered over the USB port, 5 V supply, and creates a regulated power supply for the sensor.

Figure 20:
NanoUSB2 Specifications

Specifications	
Programmable unit	FPGA – Xilinx Spartan 3D
Power supply	Via USB 5 V
Housing dimensions	5.8 cm x 3.7 cm x 1.4 cm
Board dimensions	5.2 cm x 3.04 cm
LED supply	12-bit DAC, 50 mA max @16 V max – Controlled FPGA register

Attention

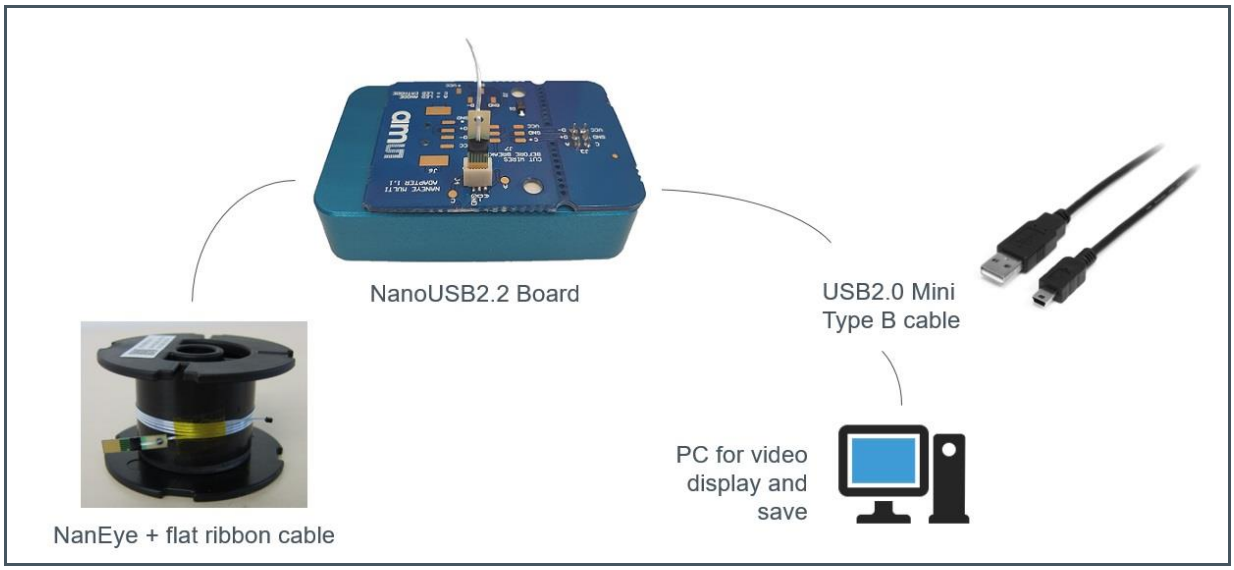
The NanoUSB2 Demo Kit is intended solely for evaluation purposes, has no EMI approval and is not advisable for medical use. ams OSRAM therefore is not liable for any damage or harm resulting from its use.

2.2.2 Operation with PC

Recommended Connection

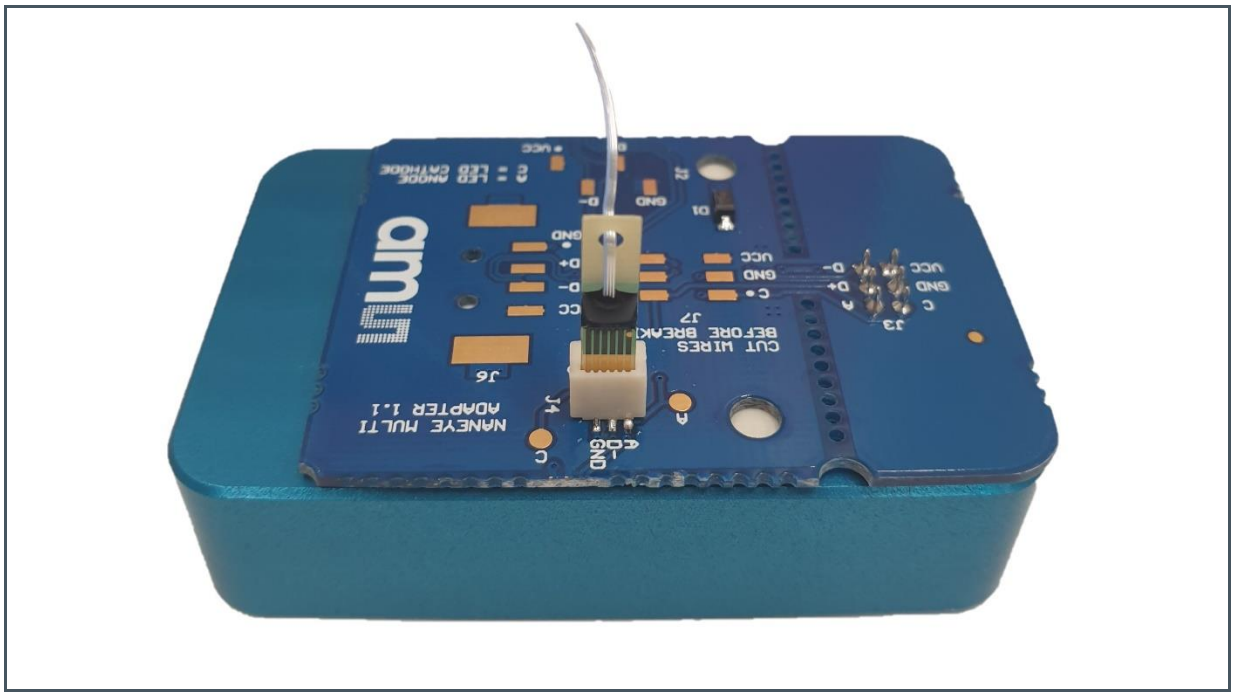
The following image shows the necessary equipment for a direct connection to a PC.

Figure 21:
NanoUSB2 Demo Kit Connection Material



The NanEye2D sensor FlexPCB connector should be connected as shows in Figure 22, where the pcb tracks and epoxy are facing outwards the NanoUSB2.

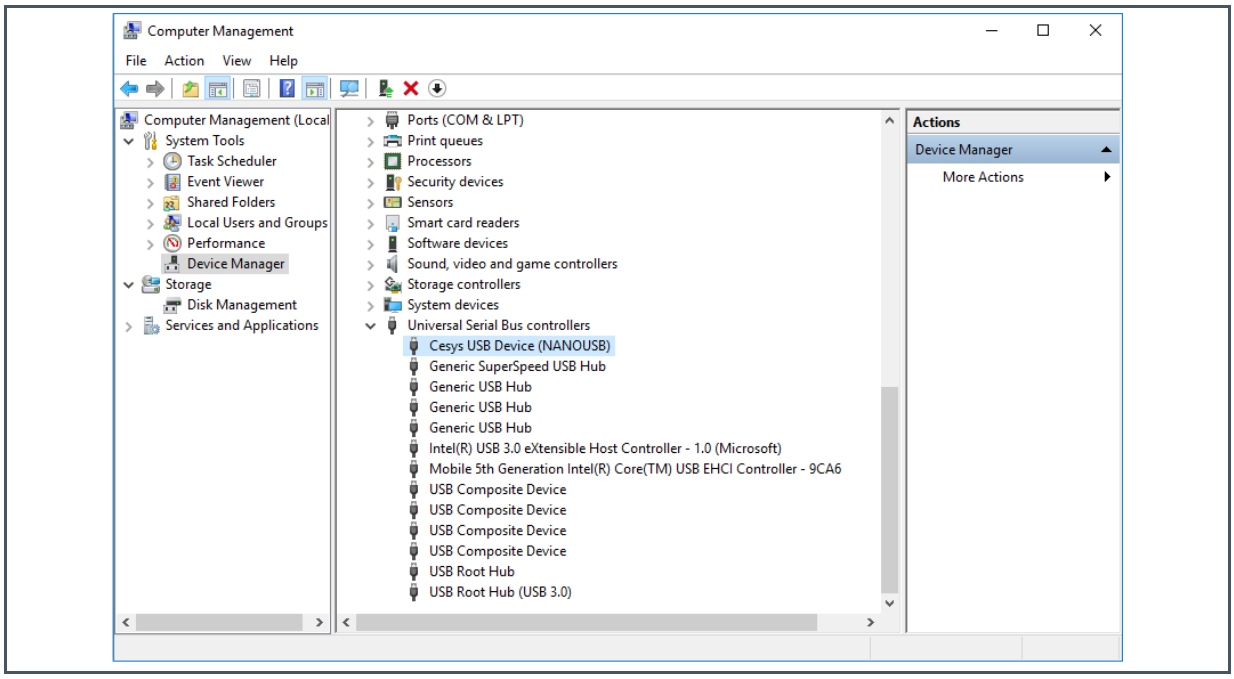
Figure 22:
NanEye2D Sensor Placed On NanoUSB2 Connector



Please take the following steps to perform the correct connection:

1. Please check if the NanEye Viewer software has been correctly installed, refer to section 3.2
2. Plug the sensor male connector in the NanoUSB2 female connector as in Figure 22
3. Plug the USB2 type mini-B connector to the NanoUSB2 and the end USB type A to the PC
4. Wait for it to be automatically recognized. Please check on **Device Manager** if your device is recognized as **Cesys USB Device (NANOUSB)** as shown in Figure 23

Figure 23:
NanoUSB2 Device Connection to PC



Installing Cesys Drivers Manually

If in Device Manager, the NanoUSB2.2 is not recognized in Figure 23 and shows:

- Cesys Device (NANOUSB, loading stage…) → Install or reinstall the driver (udk3usb-drivers-windows-1.3)
  - Go to **C:\Program Files (x86)\ams OSRAM\NanEye Viewer vx.x.x.x\driver\cesys**
- CeusbUni → Update the driver

How to Debug NanoUSB2 Board

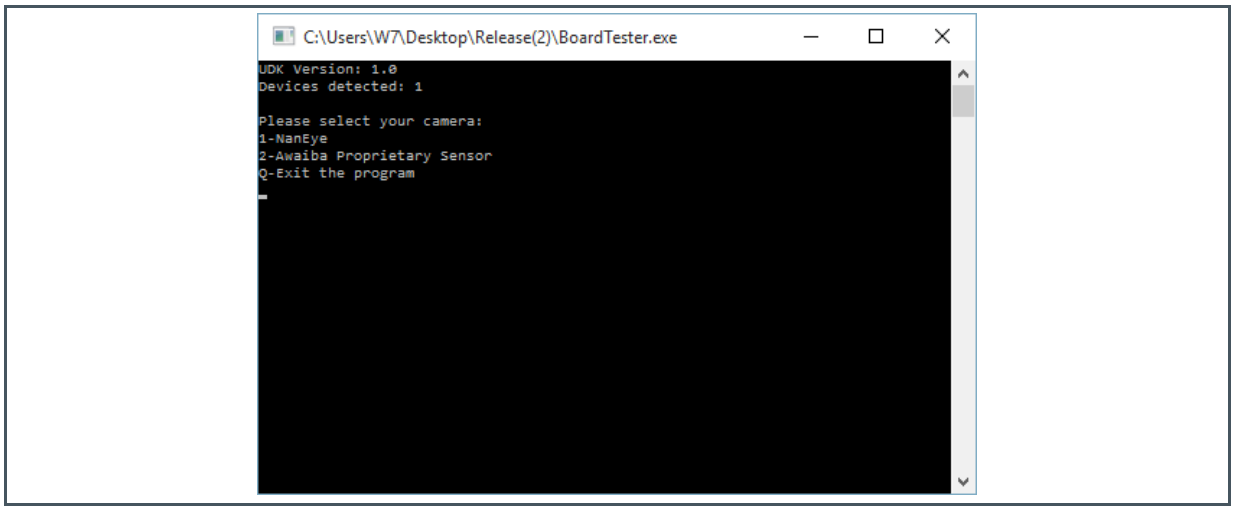
If the viewer is not programming the NanoUSB2 FPGA, please run the Board Tester program located at **C:\Program Files (x86)\ams OSRAM\NanEye Viewer vx.x.x.x\application\debug\Usb2.** This will check if there is a problem with the board or sensor.

Attention

Please make sure that, before running BoardTester.exe, the NanEye Viewer application is closed and/or an API is not running.

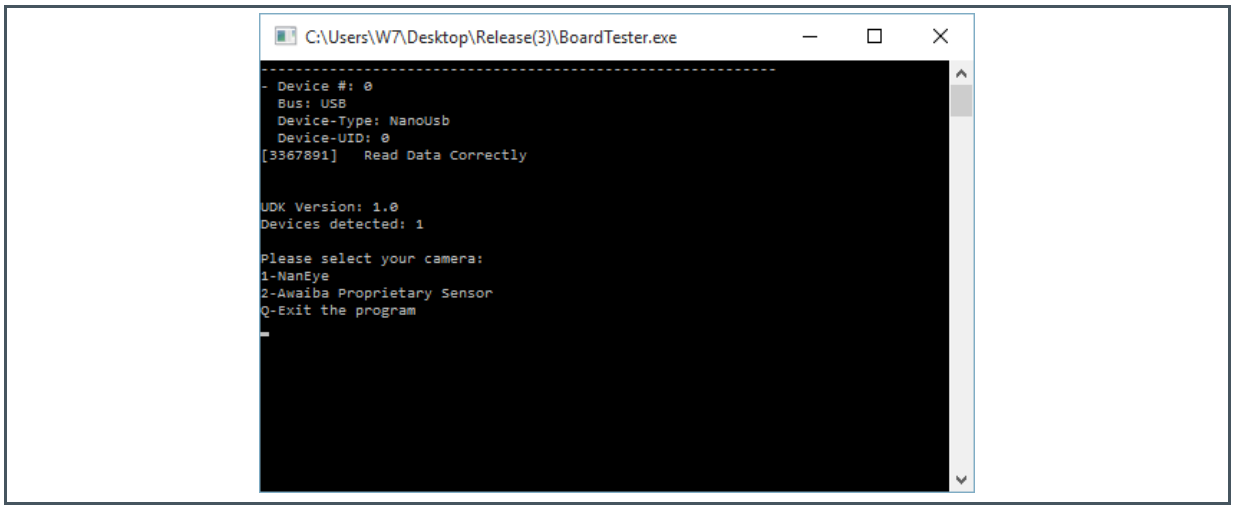
After executing the program, a window like Figure 24 should appear. If the NanoUSB2.2 is well connected and identified in Device Manager, “Devices detected” throws the value ‘1’. Otherwise, will show a ‘0’.

Figure 24:
Board Tester Layout – NanoUSB2 Detected



The next step is to get the NanEye2D data, pressing ‘1’. The result should be as shown below, where is received data correctly. In this case, NanEye Viewer and API should also work.

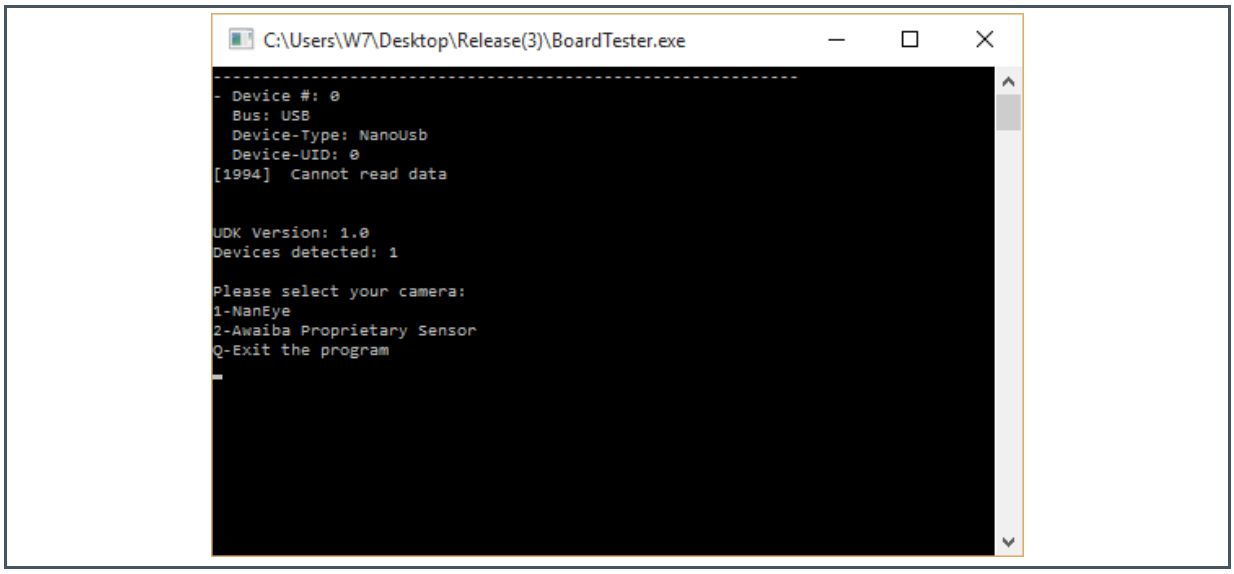
Figure 25:
Board Tester Layout – Sensor Data Read Successfully



If the NanoUSB2.2 is correctly identified, but cannot read data from the sensor, as shown in Figure 26, it can be a sensor related issue. Therefore, in order to find the root cause, please see below the possible situations, such as:

- NanEye2D connector may not be placed correctly (check section Recommended Connection)
  - Check Figure 22
- USB2 communication issue
  - Power cycle the NanoUSB2.2
  - Try a different USB port, cable or machine
- NanoUSB2.2 female connector may be damaged
- NanEye2D module may be damaged (connector/cable /sensor)
  - Check NanEye Handling Manual AN000493

Figure 26:
Board Tester Layout – Cannot Read Sensor Data



Information

If the issues are still not solved, please contact the Technical Support team.

3 NanEye Viewer Software

3.1 General Description

NanEye Viewer is a software that allows the user to grab data from the NanEye® sensors with its respective evaluation board.

The **Viewer Software** has the following features:

- Possibility to save directly to .avi streams of the processed image, or save the raw data in the awvideo format
- Possibility to save snapshots in PNG and in PGM (saving the 10-bit raw data)
- Possibility to display the pixel graphic
- Dynamic gain, offset and exposure switching
- Possibility to acquire black and white gain masks
- Possibility to apply the algorithm automatic exposure control
- Possibility to adjust white balance automatically
- Perform permanent flash programming via USB3

This software also contains some image processing algorithms:

- Colour reconstruction
- Adjust colour saturation
- Gamma correction (only for colour version)
- Adjust brightness
- Contrast stretching

3.2 Software Installation

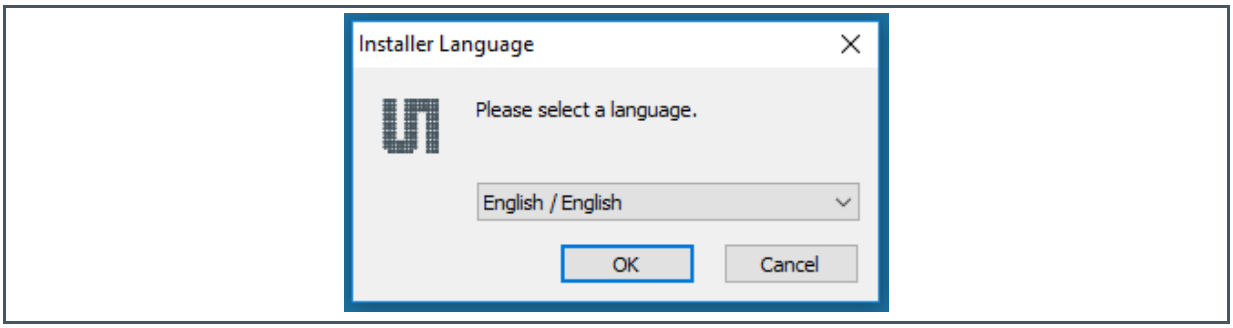
This section describes how to install the NanEye Viewer software.

NanEye Viewer is compatible with Windows 7, 8, 8.1 and 10. Please download the software available on the ams webpage.

For correct installation, please perform the following steps:

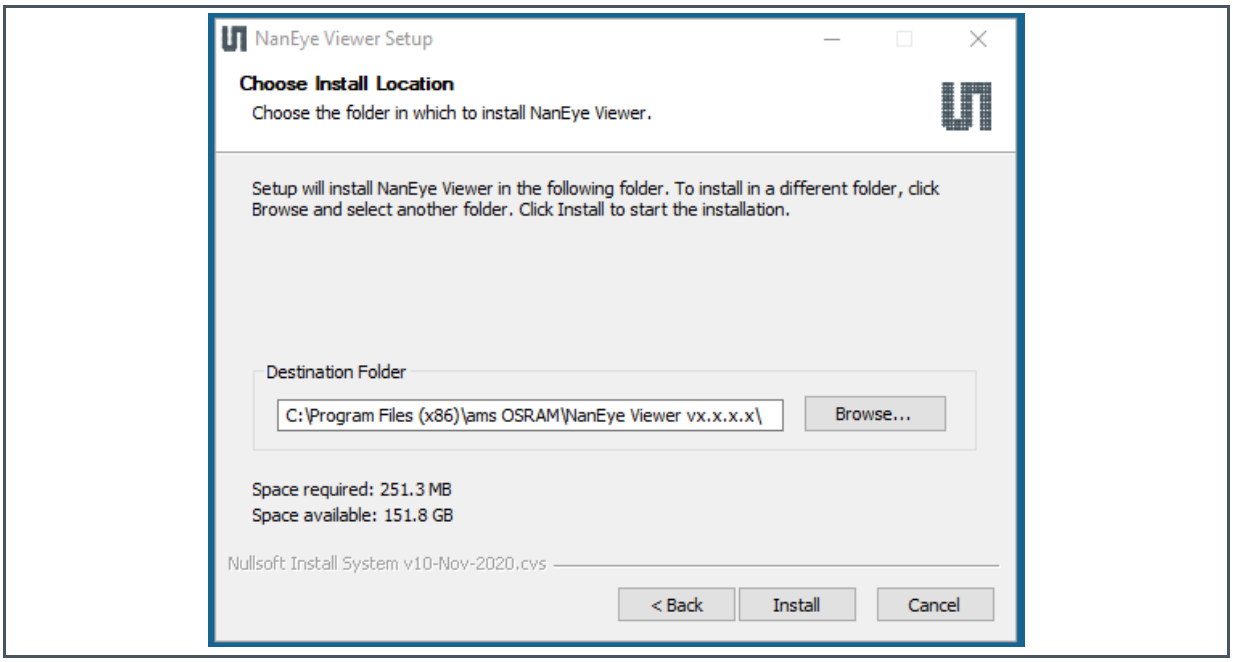
1. Start the setup - NanEye_EvalSW_Viewer_pWin_Vx-x-x-x.exe
2. Choose the most suitable setup language between the following options:
    - English/Japanese/Korean

Figure 27:
NanEye Viewer Installer Language



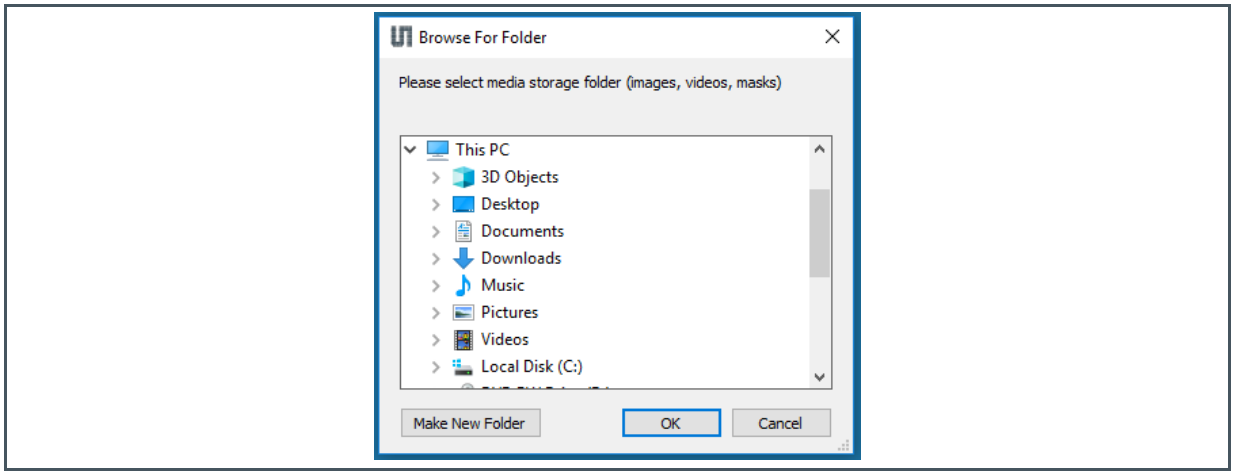
3. Select the installation folder

Figure 28:
NanEye Viewer Installation Folder



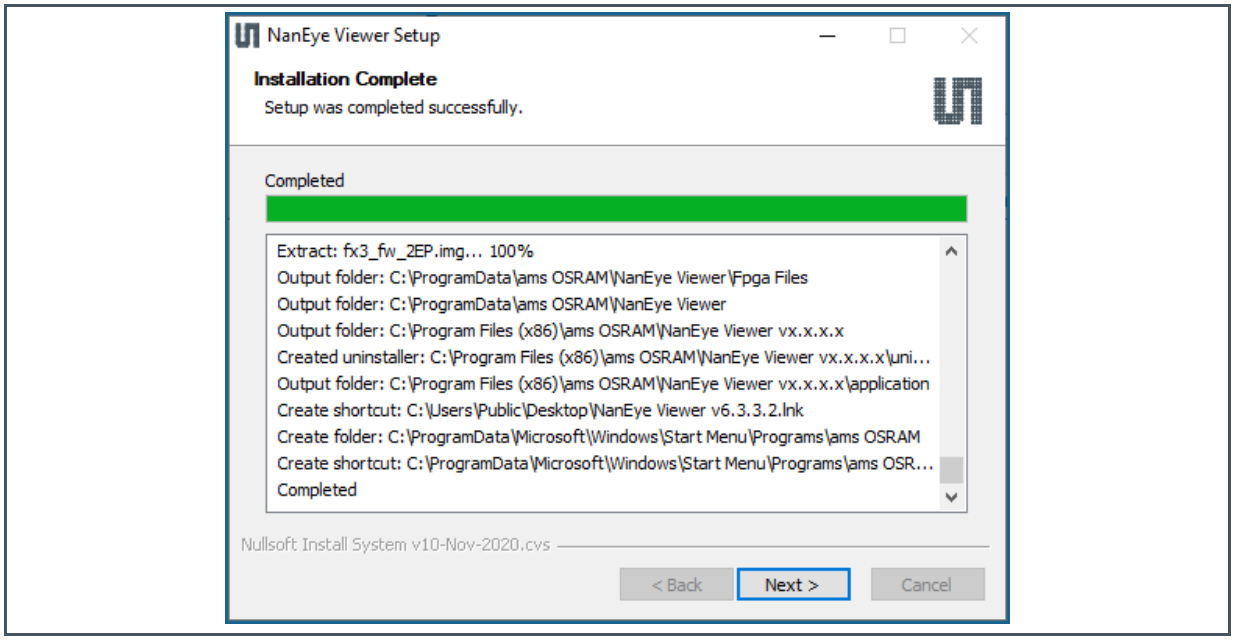
4. Select the media folder (where correction masks and other files will be saved)

Figure 29:
NanEye Viewer Media Folder Selection



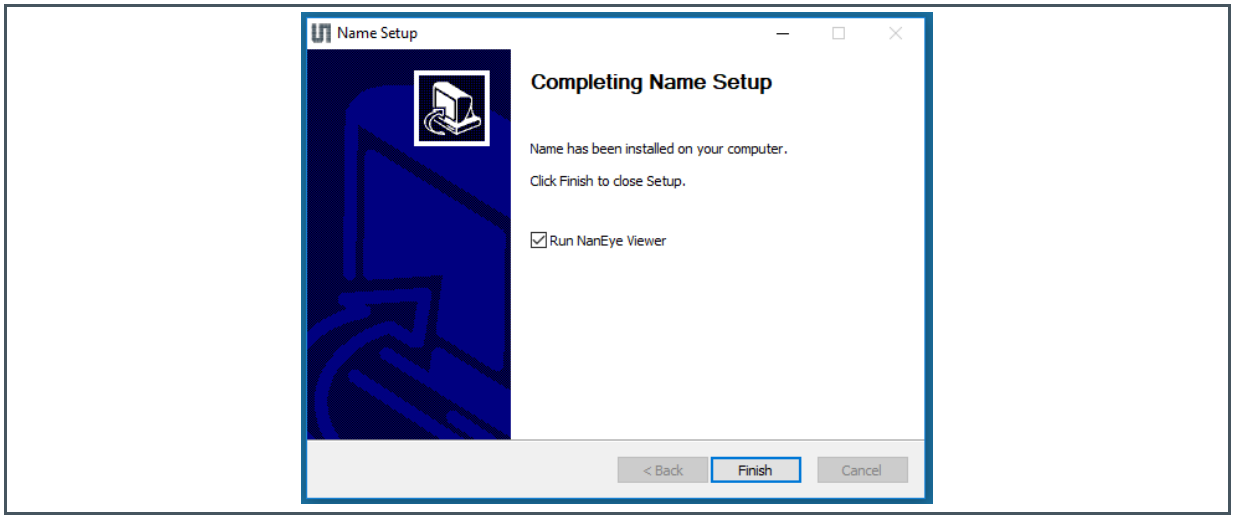
5. Installs the drivers for all the boards

Figure 30:
NanEye Viewer Installing



6. Installation completed

Figure 31:
NanEye Viewer Completed Installation



3.3 Start the Application

3.3.1 Choosing the Sensor and Board

If the board is correctly recognised on Device Manager, then the NanEye Viewer can be started choosing the **Sensor**, **Board** and **Viewer,** following the suitable combination available on Figure 32. If the board is not recognised correctly, please check sections 2.1.3 and 2.2.2.

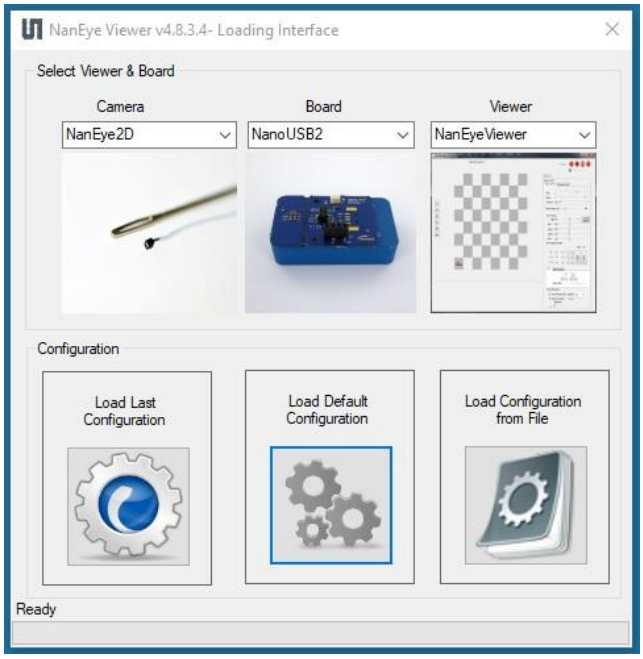
Figure 32:
Sensor and Board Selection

Camera	Board	Viewer	Connector
NanEye2D(1)	NanoUSB2	NanEye Viewer	Sensor 1
NanEyeXS	FiberOpticBox_USB3	NanEye/Stereo Viewer(2)	Sensor 1, Sensor 2
NanEyeM			

(1) Please note that NanEye2D version with LED ring and NanEye Fiber are discontinued products.
(2) The stereo feature, on the Fiber Optic Box, does not perform “real” syncing of the frame rates between the two sensors. It is used a memory buffer to synchronize the video stream from port 2 to port 1.

Before entering the Viewer main interface, there are three different configurations: **Last**, **Default** or **From File** as represented in Figure 33. For the first time initiating the software, please choose **Load Default**. Load Last Configuration option will open the NanEye Viewer with the previous configuration after closing the software. Load Configuration from file option the user can select a specific saved configuration.

Figure 33:
NanEye Viewer Initial Interface

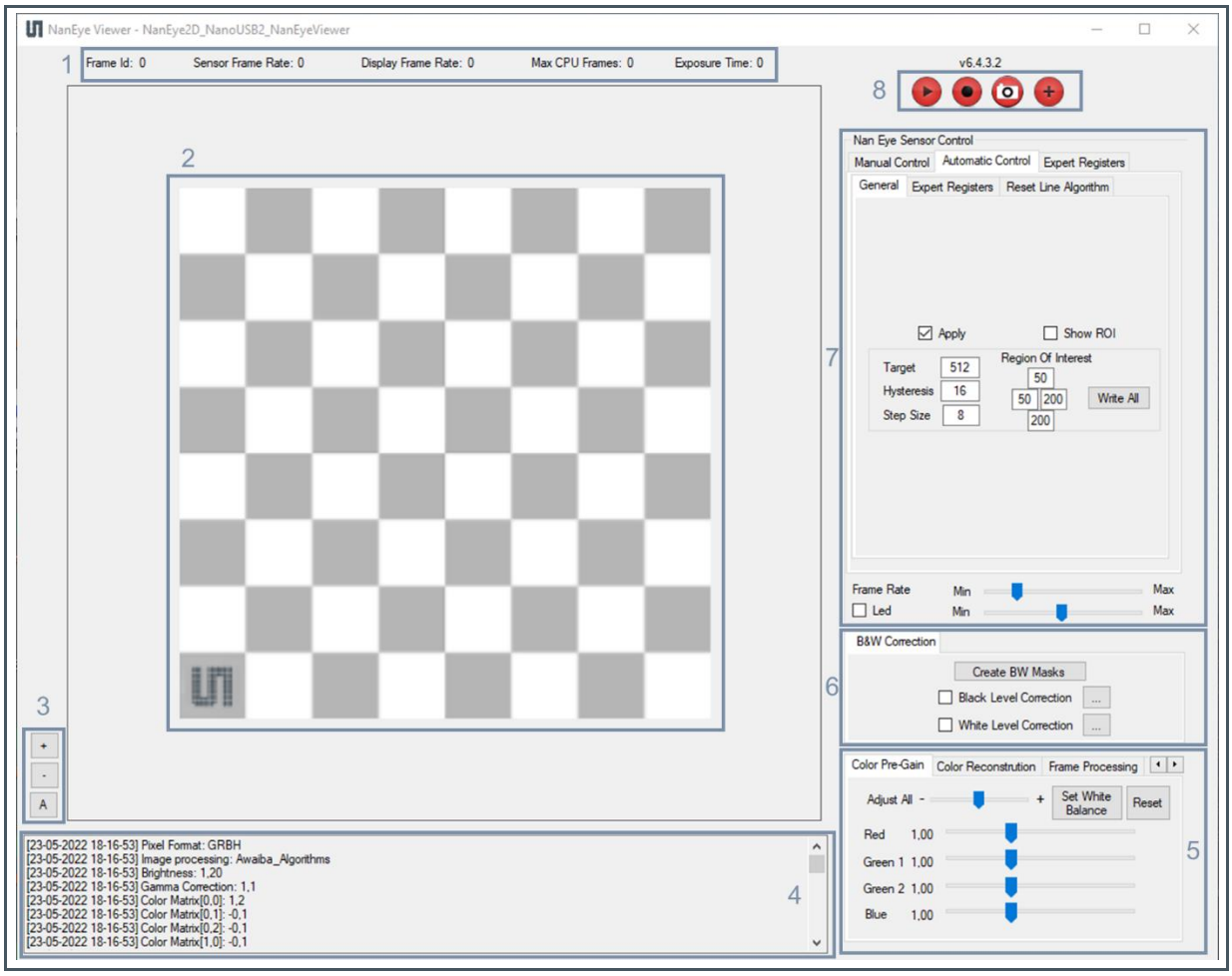


3.3.2 Graphical User Interface Description

Main Interface

The NanEye Viewer interface is displayed as exemplified in Figure 34. The description of each NanEye Viewer interface section is shown below for NanoUSB2. Please note that the layout may change depending on sensor and board choice.

Figure 34:
NanEye Viewer Main Interface



1	Frame Rate and Exposure Time	**5**	Image Processing
2	Display Image	**6**	FPN Correction
3	Zoom	**7**	Sensor/FPGA Registers
4	History	**8**	Fast Menu

Fast Menu

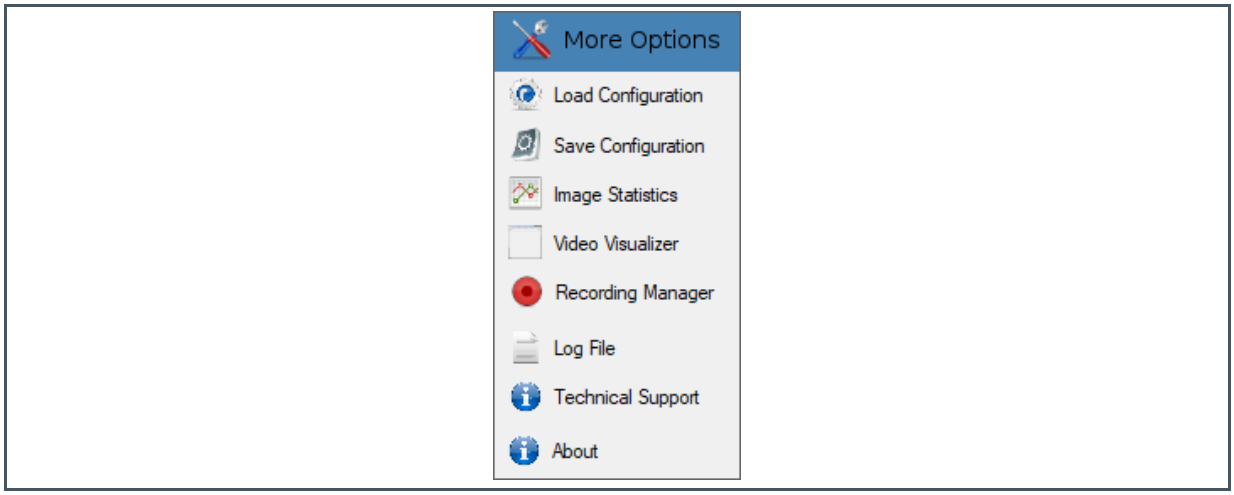
Figure 35:
NanEye Viewer Fast Menu

Function of icons from left to right:

- Play/Stop Grabbing Images

- Record Videos
- Take Snapshots
- Menu More Options

Figure 36:
NanEye Viewer More Options Menu



The More Options Menu presents different features:

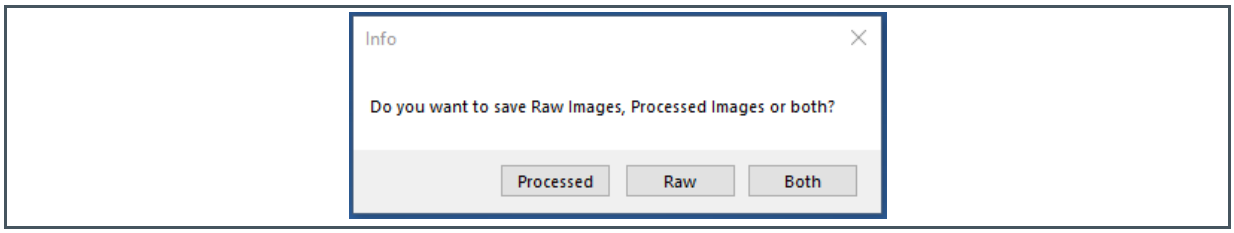
- Load/Save configurations of the NanEye Viewer
- Image Statistics
- Video Visualizer to play RAW videos and convert to AVI
- Recording Manager
- Log File in order to follow the different Viewer actions
- Technical Support webpage
- About section

The pixel intensity can be analysed through the histogram by choosing “Image Statistics” from “More Options” menu.

Figure 37:
NanEye Viewer Histogram Pixel Graphic

To record a video, the user should hit record button, as described in Figure 35. A directory and a name for the file should be chosen (if no name is inserted, or the cancel button is pressed, the video is cancelled). After that, a message is displayed to choose Raw Images, Processed Images or both (Figure 38). To conclude the recording, the user should hit the same record button. The Recording Manager in Figure 36, shows detailed information about the recorded file.

Figure 38:
Video Format Option



Processed Video:

- Saves in **AVI** format;
- Recommendation: Use **VLC** program to open it.

Raw Video:

- Saves in **awvideo** format;
- Saves raw 10-bit pixels.

Saving a snapshot, will save the Raw Image (10 bits) as it comes from the sensor and also the Processed Image (the image as the user see on your screen, after all the algorithms applied).

Processed Image:

- **PNG** format;
- 24 bits per pixel.

Raw Image:

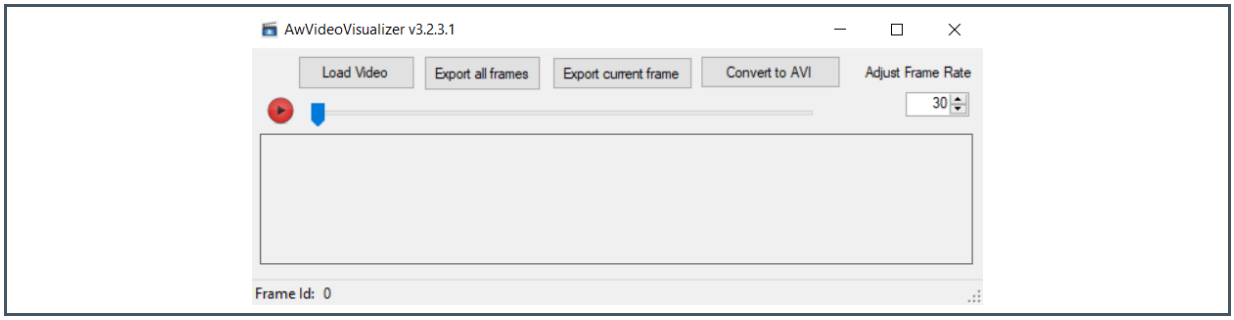
- **PGM** format;
- 10-bit raw pixels.

The images are saved in user data folder selected by the user. It saves as **Raw_Sen[x]** for the Raw Image and as **Processed_Sen[x]** to the Processed Image. The letter “x” represents the sensor ID.

To watch the raw video, the user can use the **Video Visualizer** tool (Figure 39), available in “More Options” menu. This tool can also be used to export all the video frames, or the current frame when the video is paused (both PGM and PNG formats).

When converting to AVI, the user must chose the target frame rate value (it only accepts whole numbers between 1 and 100), which should be close to the actual sensor frame rate.

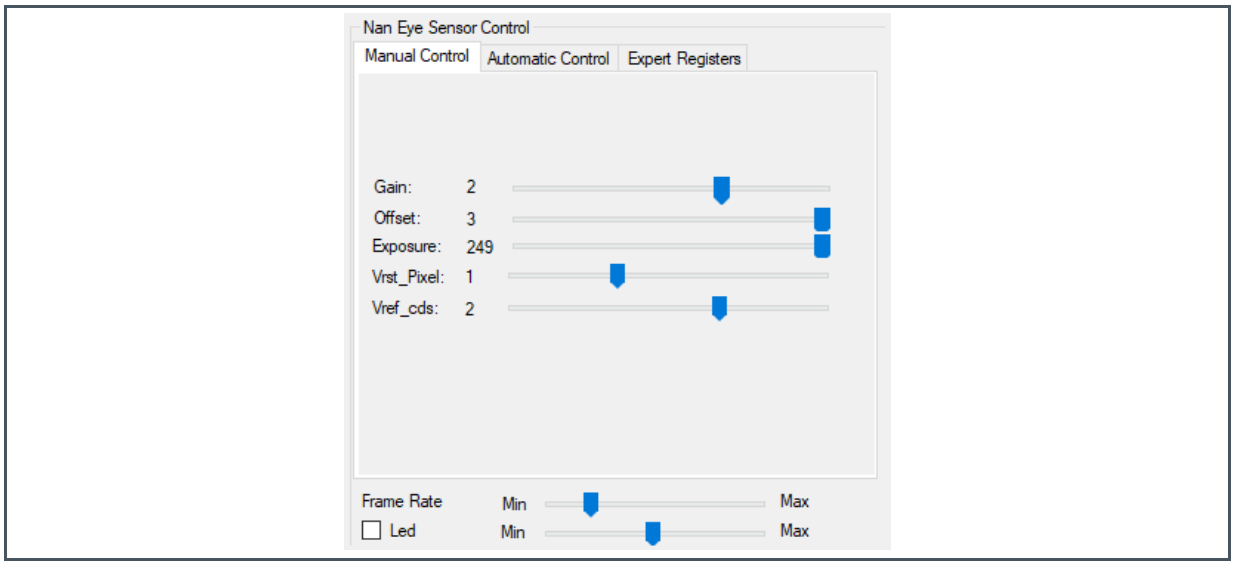
Figure 39:
AwVideo Visualizer



NanEye2D Sensor Control

Figure 40 shows the NanEye2D default registers that can be changed by the user, in the Manual Control tab.

Figure 40:
NanEye2D Manual Register Control

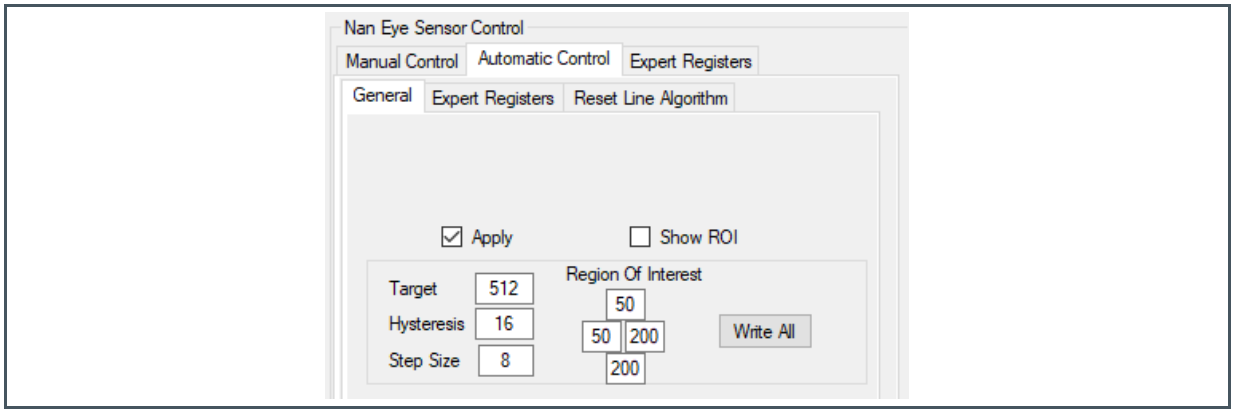


- Gain
  - ADC ramp gain
    - Has four different values between ‘0’ (darkest) and ‘3’ (brightest)
- Offset
  - ADC ramp offset
    - Has four different values between ‘0’ (darkest) and ‘3’ (brightest)
- Exposure
  - Sensor integration time
    - Has 250 different values between ‘0’ (darkest) and ‘249’ (brightest)
- Vrst_Pixel
  - Pixel reset voltage
    - Has four different values between ‘0’ and ‘3’
    - Is recommended to use default value as ‘1’ or ‘0’.
- Vref_CDS
  - CDS stage reference voltage
    - Has four different values between ‘0’ and ‘3’
    - Works as second programmable offset. Should be lower than ADC Offset value, to not clip in dark, maintaining high dynamic range.
- Supply Voltage/Frame Rate
  - Slider adjusts the voltage between 1.6 V and 2.4 V, also changing Frame Rate

- LED
  - Switch on/off
  - Slider adjust the LED intensity

The Viewer allows the possibility of having the Exposure and ADC Gain auto controlled according to the illumination.

Figure 41:
NanEye2D Automatic Register Control



- Apply AEC
  - The Automatic Exposure Control (AEC) is activated.
  - When the sensor is saturated, Exposure and Gain will decrease until the image is not saturated. On the other hand, if the image is too dark, Exposure and Gain will increase until the image is bright enough, not saturating.
- Show ROI
  - When enabled, shows the area in which the AEC retrieves the DN values to perform the algorithm.
  - On the bottom of the image there are four blue lines, which represents the Gain (each line a Gain step value, where the top one represents the highest value), and a yellow line Exposure value (increasing from left to right).
- Region of Interest
  - These values represent the area (rows and columns) that the algorithm uses to check if there is a need to update the sensor registers.
- Target
  - Algorithm's DN target value. The lower it is, the darker the image will be. The higher it is, the brighter the image will be.
- Hysteresis
  - Defines the thresholds (superior and inferior limits) where the AEC algorithm works. Each time the region of interest reaches an average DN value higher/lower than the limits, the algorithm will converge to the target DN value.

- Step Size
  - The speed that the algorithm will converge to the target value. If this value is high, then the algorithm will converge faster, but if the value is too high, the system can become unstable, due to a high overshoot. If the value is too low, it will become very slow to converge to the current illumination conditions.
  - A compromise must be performed between this value and Hysteresis.

Figure 42 and Figure 43 presents an example of images where the target value is 250 DN and 395 DN, respectively, having the same Region of Interest, Hysteresis and Step Size values presented in Figure 41. When AEC is deactivated, the sensor gain and exposure values, from the algorithm, are maintained.

Figure 42:
AEC with Gain 1 and Exposure 200

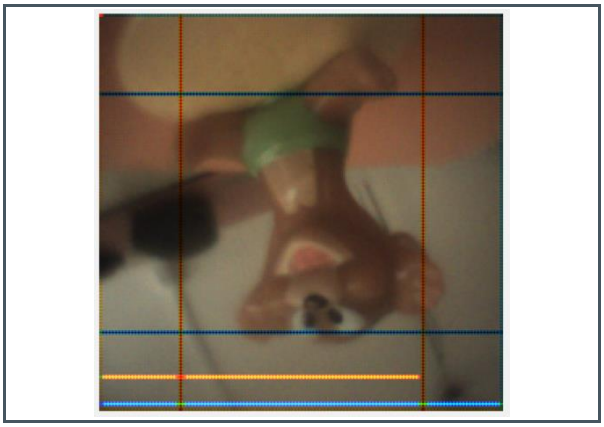
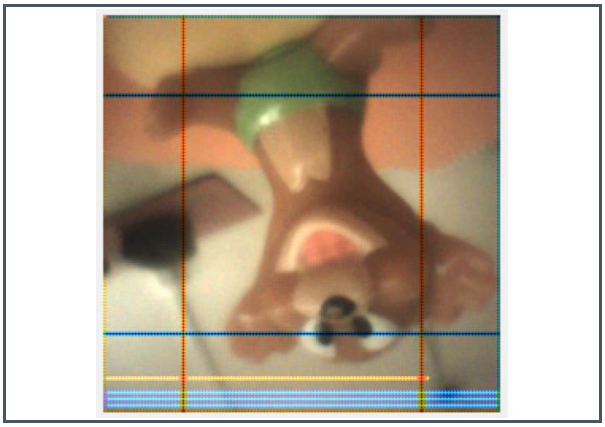


Figure 43:
AEC with Gain 3 and Exposure 222

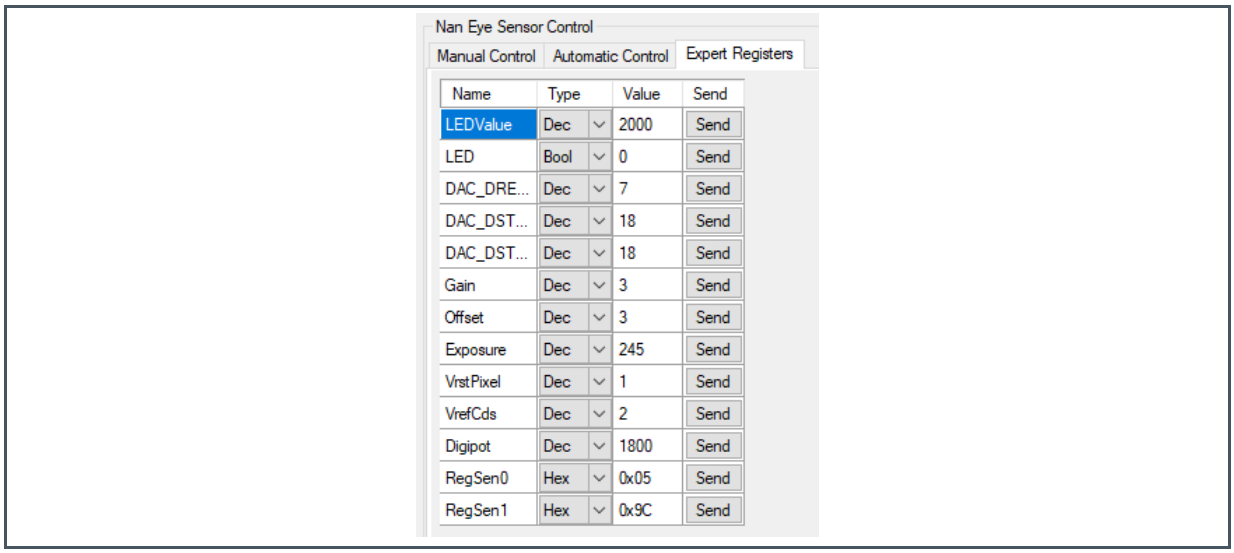


Attention

Gain and Exposure registers cannot be changed manually if Automatic Exposure Control (AEC) is selected in Automatic Control tab.

The NanEye2D (please refer to NanEye Datasheet – NanEye_DS000501) and Evaluation Kit registers can also be changed on Expert Registers tab, setting directly the respective value.

Figure 44:
NanEye2D Expert Registers



- Expert Registers
  - Digipot: Supply Voltage in mV – changes Frame Rate
  - DAC_DSTEP1/2 and DAC_DREGEN_REG
    - Relates to the “Reset Line Algorithm”. Please refer to NanEye_NanEyeStereo_AN000447.
  - RegSen0 – 8 LSB of NanEye2D 16-bit register
  - RegSen1 – 8 MSB of NanEye2D 16-bit register

NanEyeXS/M Sensor Control

Figure 45 and Figure 46 shows respectively the NanEyeXS and NanEyeM default registers that can be changed by the user, in the Manual Control tab.

The NanEyeM/NanEyeXS sensor control layout is very similar to the NanEye2D, differing on the register setting, which can be verified on its respective datasheets (NanEyeXS_DS000592, NanEyeM_DS001033).

Figure 45:
NanEyeXS Manual Register Control

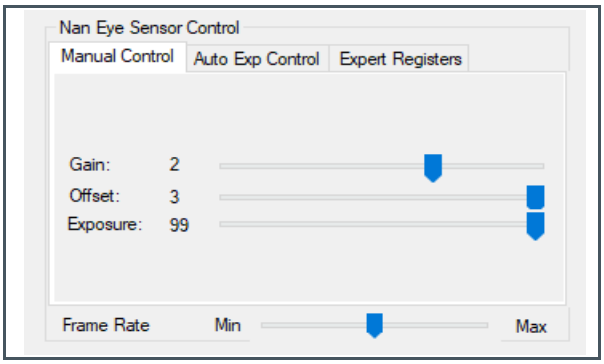
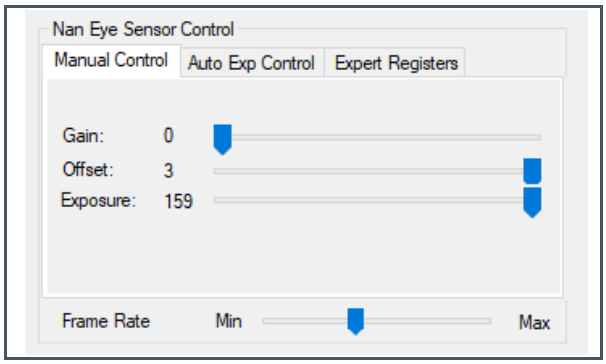


Figure 46:
NanEyeM Manual Register Control

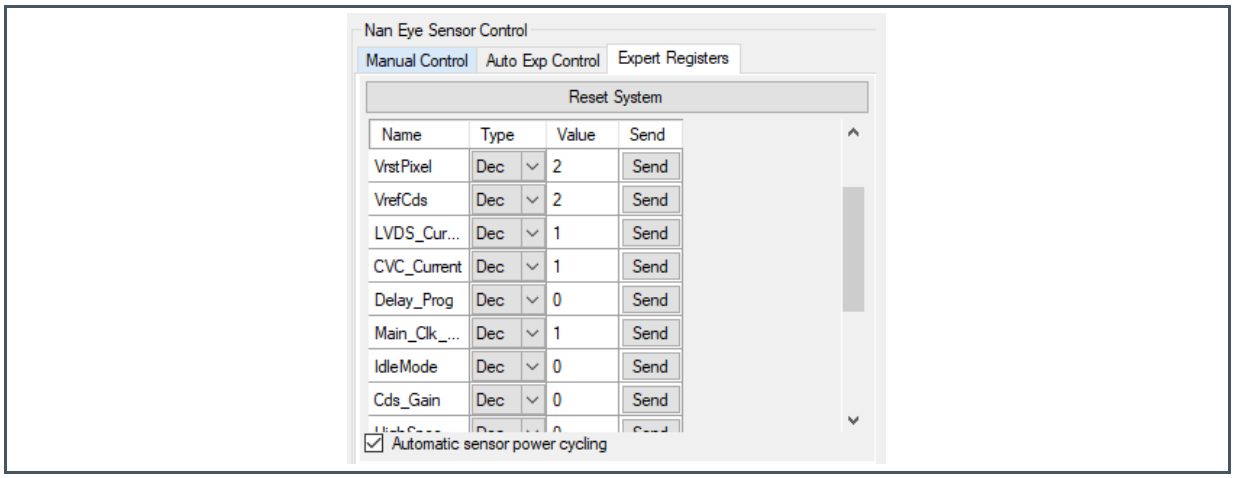


The NanEyeM/XS Expert Registers tab (Figure 47) shows the different registers. To configure the sensor to idle mode, the user needs to first deactivate the “Automatic sensor power cycling” and then insert the value 1 into IdleMode register. The inverse procedure will remove the sensor of the idle mode. Please note that this feature is not available in the NanEye2D sensor.

Information

The “Automatic sensor power cycling” option is a unique feature of the Fiber Optic Box evaluation kit and specifically developed to NanEyeM/NanEyeXS, once these sensors have the Idle Mode feature. It is not available for the NanEye2D sensor and NanoUSB2.2 evaluation kit.

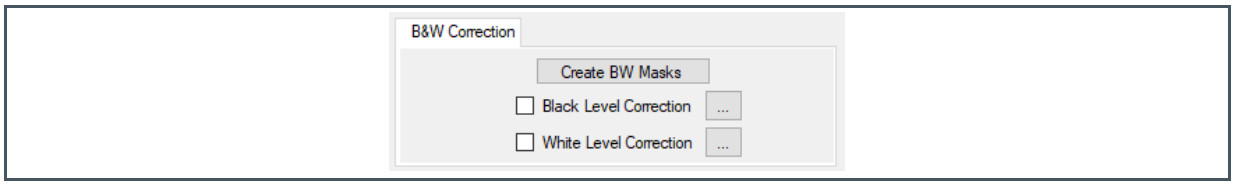
Figure 47:
NanEyeM/NanEyeXS Idle Mode



Black and White Mask

To improve image quality, the user can create a Black Mask to reduce DSNU and a White Mask to reduce PRNU.

Figure 48:
Create Black/ White Masks



- How to Create Black Masks
  - Press the Create BW Masks button
  - Choose the File name
  - Put the sensor in a dark environment to have a fully black image and then the software will create the mask
    - To confirm the image DN value, the user can check with the histogram
  - When finished, a message is displayed “Black Mask created successfully”
- How to Create White Masks
  - Choose the File name
  - Use a homogeneous light to reach 90% of saturation in the center (ROI of 50x50 pixels)
  - When finished, a message is displayed “White Mask created successfully”

The files are created with the extension .awblc and .awwlc for Black and White masks, respectively. To load the files please press “…” button. To apply the respective mask, check the “checkbox”.

Image Processing

- Color Pre-Gain / White Balancing

The NanEye Bayer Pattern used are shown in Figure 49, Figure 50 and Figure 51. Please note that the NanEye2D has a pixel format of GRBG, while NanEyeXS and NanEyeM is BGGR.

Figure 49:
NanEye2D Bayer Pattern

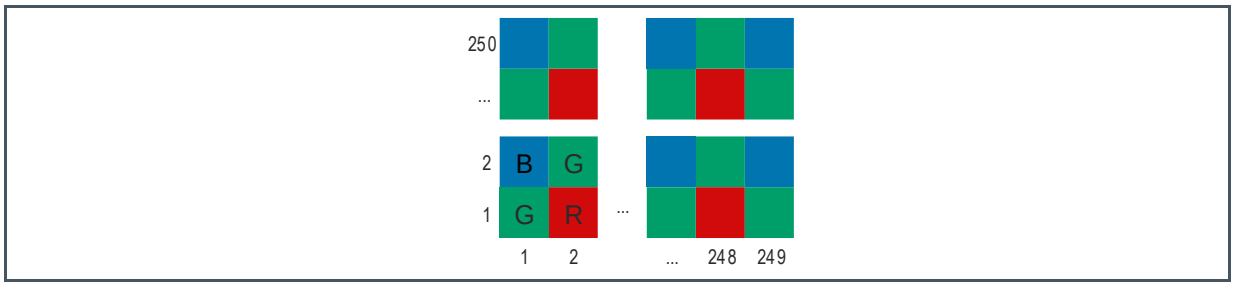


Figure 50:
NanEyeXS Bayer Pattern

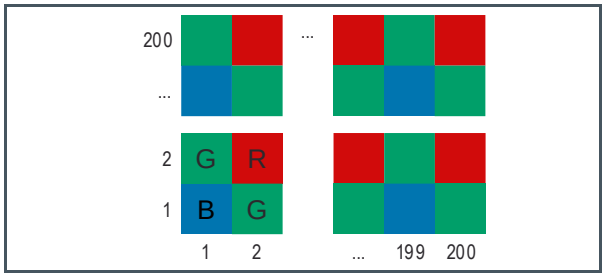


Figure 51:
NanEyeM Bayer Pattern

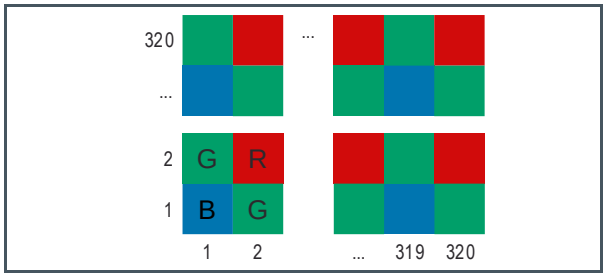
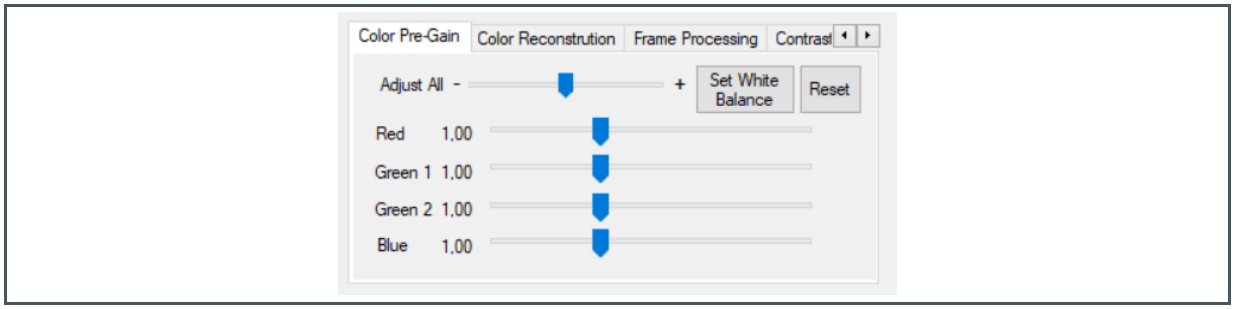


Figure 52 shows the color pre-gain options for the sensors. Please note that the adjustment of pixel colors factor will depend on the ambient light, therefore there is not a fixed standard adjustment for all situations. The default value is '1' but it can vary between 0.5 and 2. Reset button resets all color gains to 1 (default).

Figure 52:
Color Pre-Gain / White Balancing



- How to do White Balancing:
  - Point the sensor to a white surface/object (homogeneous illumination)
  - Press the button "Set White Balancing"

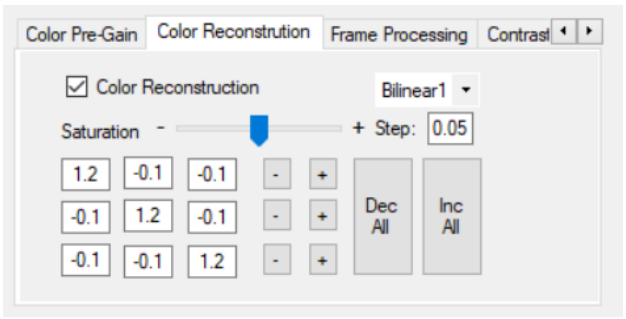
- The algorithm will adjust the values automatically

- Color Reconstruction

The color reconstruction options are shown in Figure 53. In order to have a colorful image, please check the Color Reconstruction checkbox. This will enable the demosaic algorithm, performing the transformation of a gray to RGB image.

When using a B&W sensor, please uncheck Color Reconstruction feature. Both Color Reconstruction and Color Pre-Gain ribbons are greyed out and the user will be able to observe a 10-bit image.

Figure 53:
Color Reconstruction



It is possible to tune the image saturation with a slider or through a color matrix for Red (1st column), Green (2nd column) and Blue (3rd column) channels.

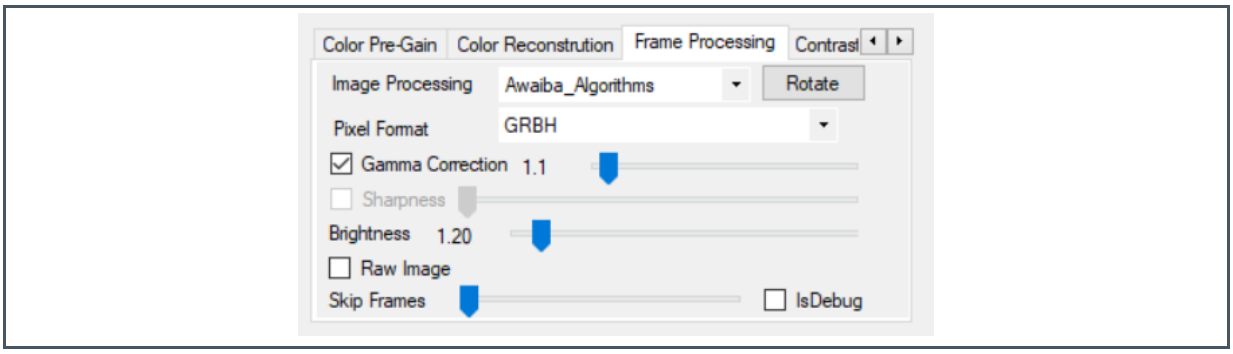
- Color Adjustment Matrix
  - The default value is 1.2 (does not change the gain of each channel). The sum of the three boxes values, of each component, is equal to 1, to not change the image overall brightness
  - To saturate the Red channel, the first row should be changed, increasing the first value and decreasing the other two values (Green and Blue). These changes can be performed by pressing “+” and “-” buttons
  - The same procedure can be done for the Green and Blue channels

It also possible to choose the color reconstruction algorithm: *Bilinear1*, *Bilinear2* and *llp*.

- Frame Processing

Figure 54 shows the Frame Processing tab options.

Figure 54:
Frame Processing

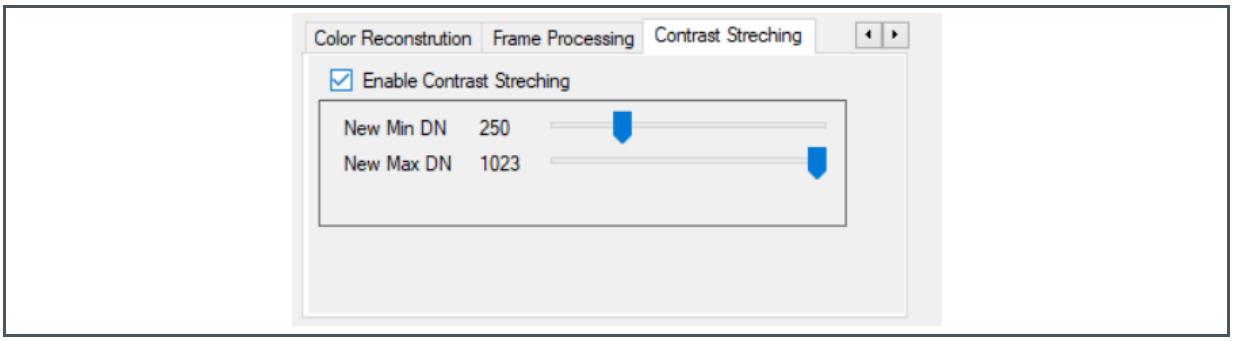


This menu shows different options, explained below:

- Image Processing
  - The user can choose the processing algorithm: Awaiba or Open CV
- Rotate
  - Performs a 90-degree image rotation
- Pixel Format
  - RGBH, GRBH, GBRH and BGHR. “H” represents the second green filter
- Gamma Correction
  - Applies a nonlinear gain to the image
- Brightness
  - Applies a linear gain to the image
- Sharpness
  - Allow to clean the image. Only available on Open CV algorithm
- RAW Image
  - Disables the image processing to only get RAW images. Only masks are used, when applied
- Skip Frames
  - Used when the machine cannot handle all the frames that the sensor is sending. Increasing the slider allows to skip more frames
- IsDebug
  - Observe all FPGA commands
- Contrast Stretching

This feature (Figure 55) allows the user to improve the image contrast of the image, where the minimum and maximum values are used to adjust the histogram stretching.

Figure 55:
Contrast Stretching



3.4 Common Issues

3.4.1 Evaluation Kit Is Not Correctly Connected or Not Successfully Programmed

Figure 56:
NanEye Viewer Connection Error Message

- If the Fiber Optic Box is powered and does not show on Device Manager (Figure 9) please try a different:
  - USB3 cable (shorter the better)
  - USB3 port
  - Machine
- If the Fiber Optic Box is powered and does show in Device Manager:
  - Verify if the sensor is correctly connected to the respective port. The green LED should be blinking if a sensor is connected
  - Verify if Sensor, Board and Viewer choices, in NanEye Viewer initial layout, are selected with the correct combination to program the FPGA
  - If it is not solved, please check section 2.1.3

3.4.2 NanEye Viewer Microsoft .NET Framework Error

Figure 57:
NanEye Viewer Framework Error Message

This error occurs when libraries are missing. Therefore, to load them:

- Go to C:\Program Files (x86)\ams OSRAM\NanEye Viewer vx.x.x.x\libraries
- Run vcredist_x86_15.exe

3.4.3 Error Message "Can't read from bulk pipe. System Error: 0x00000079/ Not receiving images from the sensor"

- This indicates that the communication between sensor and EVK may have problems. Therefore:
  - Check the sensor cable wires condition and its connector soldering
    - If the sensor wires on connector are loose, if possible, please solder it
      (1) Check NanEye Handling Manual (NanEye_AN000493)
    - If the wires are disconnected near the sensor head zone, no repair is possible
  - Check EVK connectors status (visual inspection)

3.4.4 Error Message "There is no NanoUSB connected / Camera not connect"

- Go to NanoUSB2 section 2.2.2

3.4.5 Error Message "External component has thrown an exception"

- Check sensor cable wires condition and its connector soldering
- Go to NanoUSB2 section 2.2.2
- Go to FOB2.0 section 2.1.3

3.4.6 NanEye Viewer Gets Sensor Images with Only Light and Dark Levels

- May not write successfully the register values for offset and gain configuration
  - Possible poor electrical contact from the camera to the readout board.
  - One of the sensor data/clock wires has a bad contact.

Information

If the issues are still not solved, please contact Technical Support team..

4 Schematics and Source Code

For more info regarding the Evaluation Kits schematics and source code, please contact the Technical Support team.

5 Revision Information

Changes from previous version to current revision v4-00	Page
Added Figure 1 - FOB 2.0 Demo Kit Without LEMO Connector	4
Updated Figure 4 - Fiber Optic Box 2.0 Pinout Description	5
Updated Figure 21 and Figure 22– NanoUSB2 Connection	15

- Page and figure numbers for the previous version may differ from page and figure numbers in the current revision.
- Correction of typographical errors is not explicitly mentioned.

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