

## Imperx Toolkit User Manual

**Imperx** thanks you for purchasing the Imperx Toolkit User Manual. We are certain that the program's many advanced features and easy-to-use format will meet and exceed your expectations.

This Imperx Toolkit User Manual is provided as an additional service to guide you in using our program optimally. Our staff is available to answer any questions or concerns you may have. We can be reached at:

**Email:** [support@imperx.com](mailto:support@imperx.com)

**Toll Free** 1 (866) 849-1662 or (+1) 561-989-0006

**Fax:** (+1) 561-989-0045

**Visit our Web Site:** [www.imperx.com](http://www.imperx.com)

**Imperx** designs and manufactures high performance cameras, frame grabbers and industrial imaging systems used in the machine vision, medical, military, surveillance and automation markets. Our multi-service brand is recognized for superior performance, reliability, accuracy, and cutting-edge design. Headquartered in Boca Raton, FL, with offices and distributors worldwide, Imperx international standards registrations are:

Quality Management System ISO 9001:2015 Registered

Environmental Management System ISO 14001:2015 Registered

DDTC Registered (Directorate of Defense Trade Controls, US Department of State)

## Revision History

Revision History			
Rev 1.0	May-2-2014	N. Bitkin, M. Bokov, K. Meshkov, M. Zabawa	Initial Release
Rev.1.1	September-3-2020	I. Barabanova N. Bitkin	Updated screen grabs

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## 1 General Information

The Imperx Toolkit application provides a set of functions to view and analyze images acquired from the Imperx equipment.

The following table specifies the Imperx equipment that can be used to acquire images:

<b>Imperx Equipment</b>
Framelink Express, a Camera Link frame grabber
HD-SDI Express, a frame grabber
Imperx GigE Vision cameras
Imperx USB3 cameras
Imperx Camera Link cameras, used with Framelink Express frame grabbers
Imperx HD-SDI cameras, used with HD-SDI Express frame grabbers

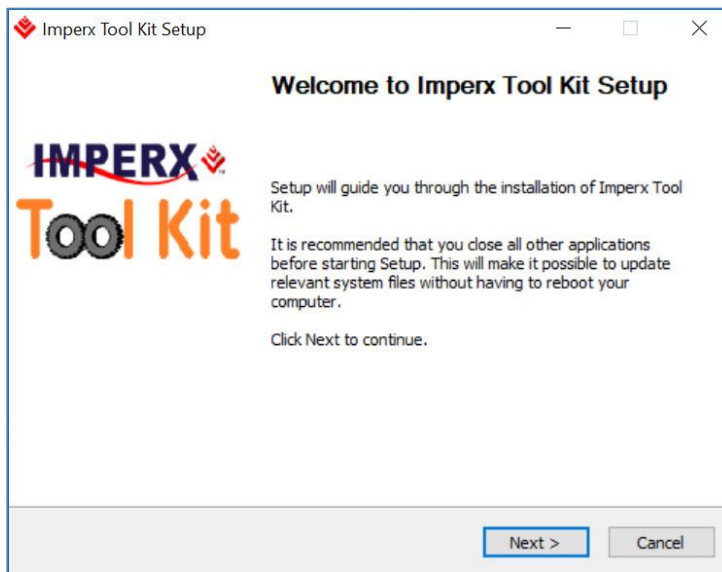
It is not guaranteed the image file, created with other software and hardware can be opened by Imperx Toolkit.

## 2 Installation

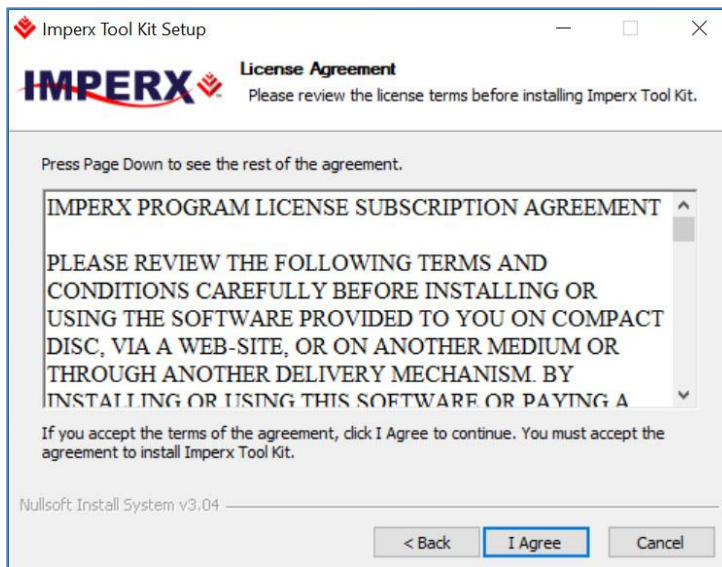
The Imperx Toolkit Application can be installed as follows. Please use the Windows Explorer to change directories to the location of where the IpxTK\_X\_X\_X\_X.exe has been downloaded.

1. Double click the IpxTK\_X\_X\_X\_X.exe.

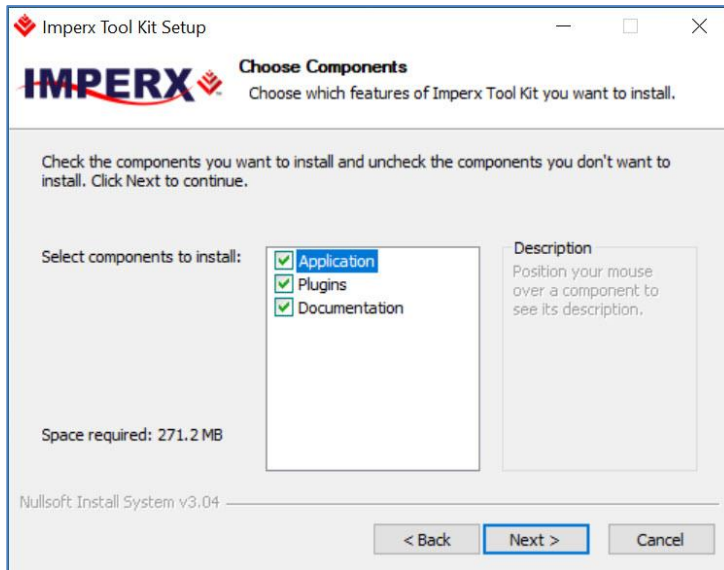
An initial Imperx Toolkit Setup Wizard opens. Note the recommendation to close other applications and then click **Next** to continue with the installation process.



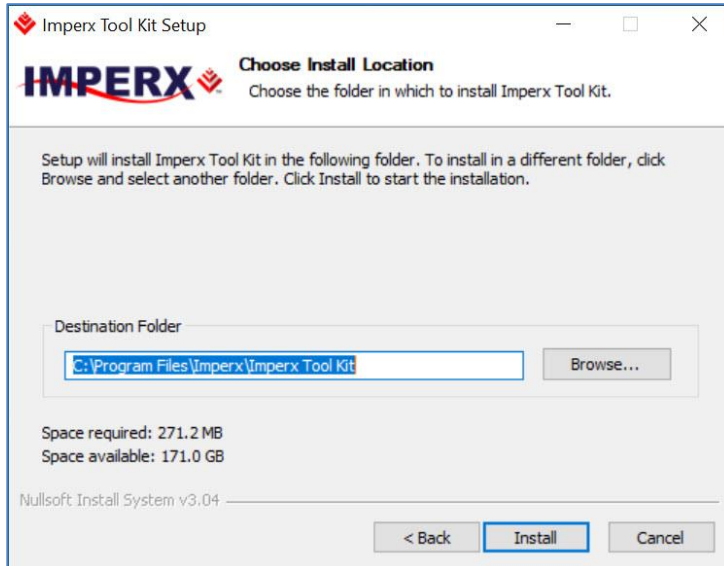
2. When the License Agreement screen appears, read the agreement and click **I Agree**.



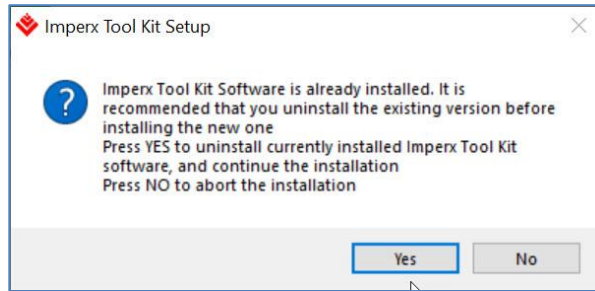
3. On the Choose Components screen, select all the Imperx Tool Kit components and click **Next**.



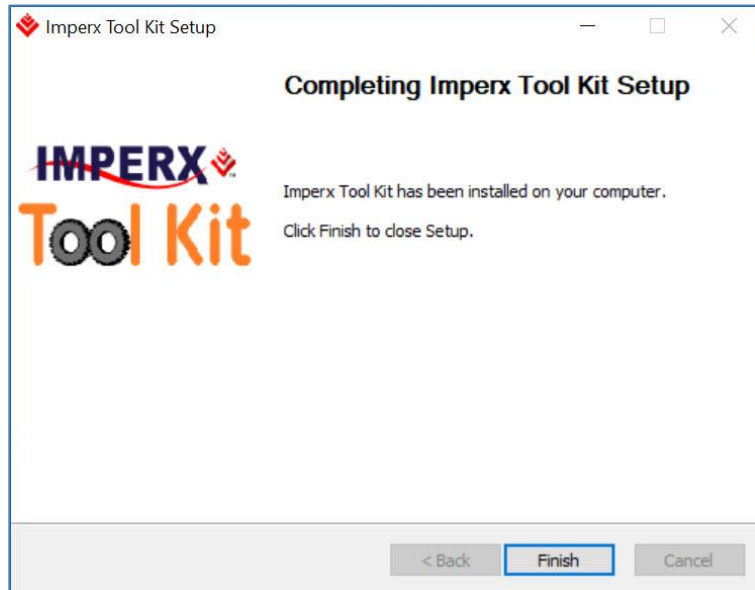
4. On the Choose Install Location screen, accept the default destination folder or click **Browse** and select a different location, click **Next** and then **Install**.



The installer prompts you to uninstall any existing versions of the software from your computer before continuing the installation.



5. Click **Finish** to complete the installation procedure.  
Two icons—IpxToolKit and IpxToolKit (32b)—appear on your desktop.



## 3 Main Window

The Imperx Toolkit application graphic user interface allows the user to view and analyze images.

### 3.1 Overview

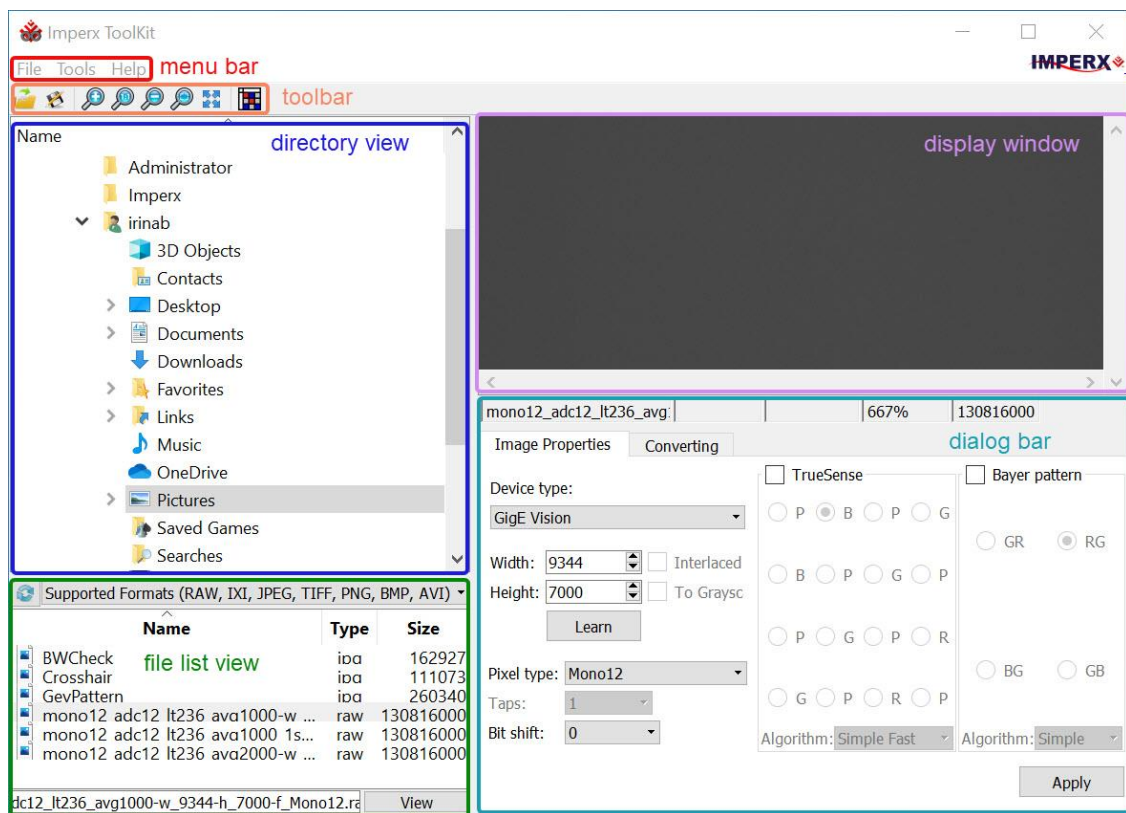
The Imperx Toolkit application can be launched by double clicking on the shortcut icon



The following Imperx Toolkit application main window opens.

The Imperx Toolkit main window consists of the:

- Menu bar
- Toolbar
- Directory view window
- File list view window
- Display window
- Dialog bar



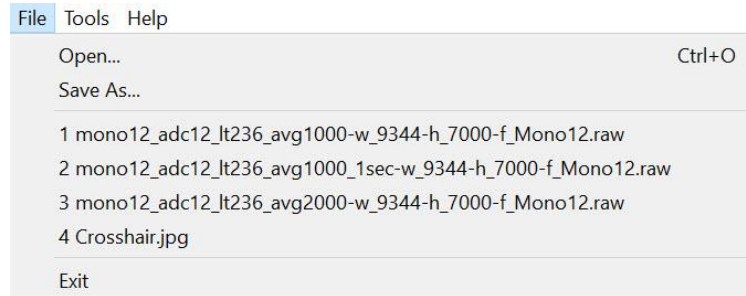
## 3.2 Menu Bar

The menu bar consists of the menus: File, Tools, and Help.

### 3.2.1 File Menu

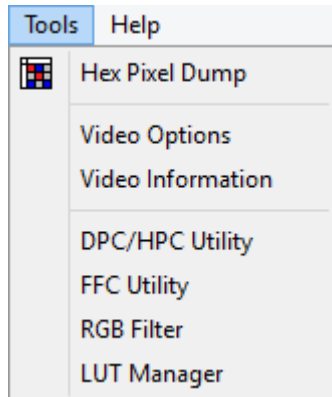
The **File** popup menu includes the options to open or save image files:

- **Open** Opens the image or movie file from the hard drive.
- **Save As** Saves the image file to the hard drive.
- **Recent files list** Displays a list of most recently opened files. Click on recent file to open.
- **Exit** Closes the application.



### 3.2.2 Tools Menu

The **Tools** popup menu includes the options to open a specific tool to analyze opened image or create a service file (DPM, HPM, FFC, LUT) that can be used by the Imperx cameras or frame grabbers

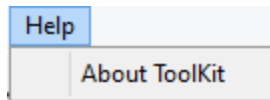


- **Hex Pixel Dump** Opens the Hex Pixel Dump panel to analyze the image pixels.
- **Video Options** Opens the Video Options dialog box to view and modify the options for Movie Viewer.

- **Video Information** Opens the Record Info dialog box to view information about currently opened movie
- **DPC/HPC Utility** Opens the DPC/HPC utility to create Defect Pixel Map or Hot Pixel Map files. See section DPC/HPC Utility for details.
- **FFC Utility** Opens the FFC utility to create Flat Field Correction file. (See FFC Utility for details.)
- **RGB Filter** Opens the RGB Filter panel. This panel provides White Balance and Color Correction options.
- **LUT Manager** Opens the LUT Manager utility to create or modify Look Up Table. See section [5 LUT Manager](#) for details.

### 3.2.3 Help Menu

The **Help** popup menu includes the option About Toolkit.










Clicking on the **About ToolKit** menu item opens the About Imperx Toolkit dialog and shows information about the software version and technical support contact information.



### 3.3 Toolbar

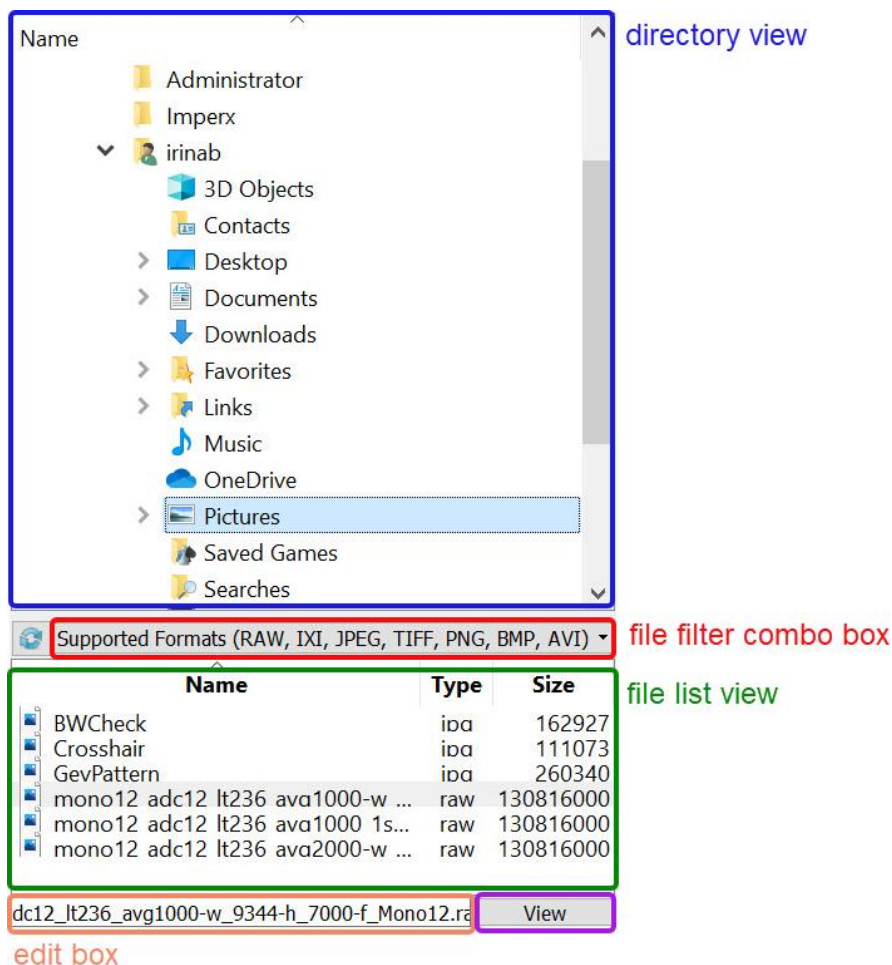
The **Toolbar** is composed of the following buttons. Each option is described below.



-  **Open.** Open image or movie file from hard drive
-  **Save As.** Save image file to hard drive
-  **Zoom In.** Increases the scale of image display
-  **Zoom 1:1.** Sets the 1:1 scale of image display
-  **Zoom Out.** Decreases the image display scale
-  **Full Screen.** Opens the Display window to full screen. You can press the <Esc> key to go back to normal mode.
-  **Hex Pixel Dump.** Opens the Hex Pixel Dump panel to analyze the image pixels.

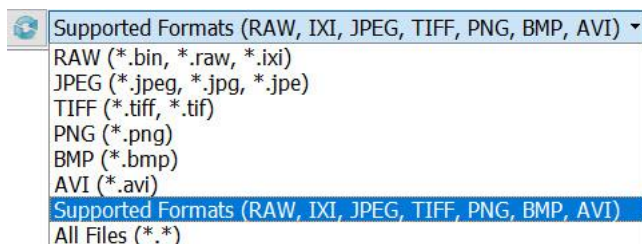
### 3.4 Directory and File List View

A **Directory View** tree-control window, File Filter Combo Box, File List Window, Edit Box, and View button are shown below:




The **Directory View** includes a tree-control window that allows you to explore and change the current folder where the target image files are located. After selecting the folder, the files located inside the folder will be displayed in the **File List Window**.

The **File Filter Combo Box** will only display the file format(s) selected in the File List Window.



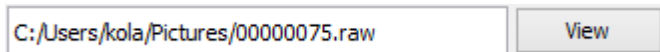
The supported file types for the **File Filter Combo Box** are the following:

- RAW (\*.bin, \*.raw, \*.ixi)
- JPEG (\*.jpeg, \*.jpg, \*.jpe)
- TIFF (\*.tiff, \*.tif)
- PNG (\*.png)
- BMP (\*.bmp)
- AVI (\*.avi)
- Supported Formats (RAW, IXI, JPEG, TIFF, PNG, BMP, AVI)
- All Files (\*.\*)

The **Refresh Button**  is used to update the **File List Window** with the corresponding supported file formats located in the selected folder.

The **Edit Box** displays the file name from the **File List Window** that has been selected by the mouse click or last viewed image.

The **View** button enables you to view the selected image file from the File List Window or last viewed image entered in the edit box on the Display Window. For example,

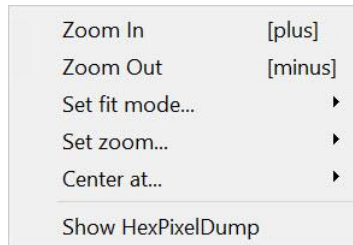


**ATTENTION!** Only the images and movie files, saved in the BobcatGEVPlayer, IpxPlayer, Framelink Express, and HD-SDI Express applications are guaranteed to be opened.

## 3.5 Display Window

The **Display Window** shows the currently opened image file or movie. It is possible to drag the view by pressing the left mouse button and zooming with the mouse wheel. The scroll bars can be used to move the view in the vertically and horizontally direction. The Right mouse button click calls the Display popup menu.

The Display popup menu includes following options:



- **Zoom In** [Hotkey '+']. Increases the display view scale
- **Zoom Out** [Hotkey '-']. Decreases the display view scale
- **Set fit mode...** Selects whether the image is fully or partially visible.



- **Fit to Window** [Hotkey '0'] Sets the scale to fit the currently opened image in the display window. The full image will be visible on the display view.
- **Fill Window** [Hotkey '2'] Sets the scale to fit the currently opened image to display window in one dimension (horizontally or vertically). The image will be partially visible on the display view, depending on display view and image dimensions.

- **Set zoom...** Changes the image display view scale.



- **25%** Sets the display view scale 1:4.
- **50%** Sets the display view scale 1:2.
- **100%** [Hotkey '1']. Sets the display view scale 1:1.
- **200%** Sets the display view scale 2:1.

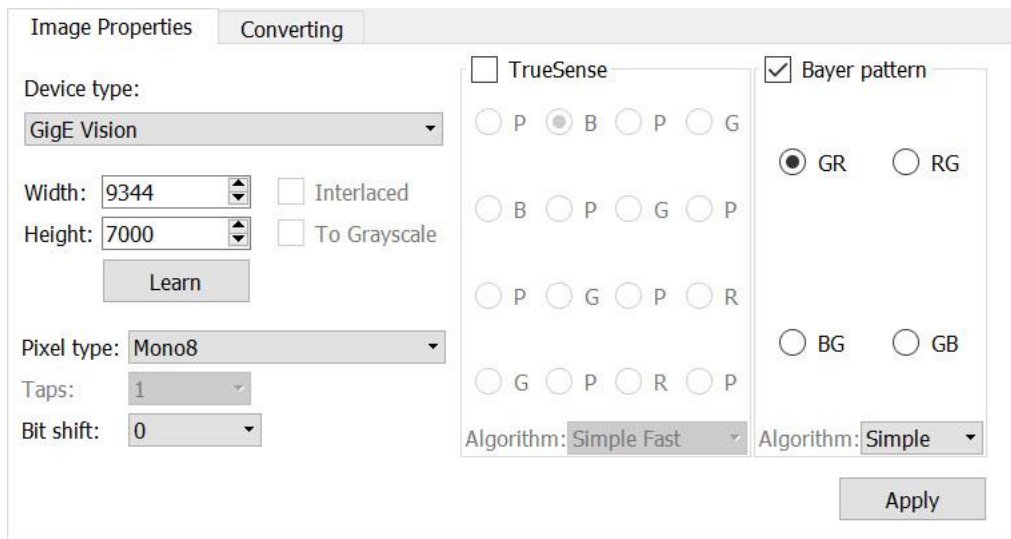
- Center at...** Changes the image display view center point
  - 
  - Image Center [Hotkey 'C']** Sets the display window center to center of image.
  - Here [double click]** Sets the display window center to mouse pointer position.
- Show HexPixelDump** Opens the Hex Pixel Dump panel to analyze the image pixels.

## 3.6 Dialog bar. Image Viewer

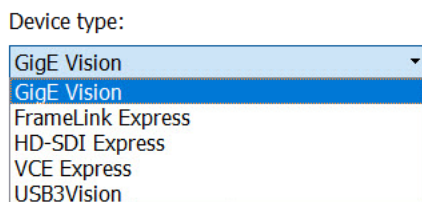
If the image file is opened, the dialog bar displays options to control the parameters for image loading, displaying and conversion. This consists of three panels—status bar, Image Properties, and Converting.

### 3.6.1 Image Properties Panel

The **Image Properties** panel provides options to control the parameters used for image displaying.



- Device Type** Selects the type of device where the image was acquired.



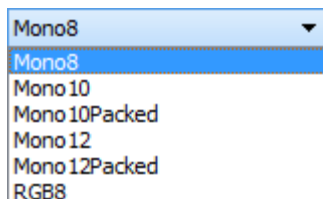


**ATTENTION!** Images acquired from Imperx CameraLink and HD-SDI cameras are guaranteed to be loaded and displayed properly only if the Imperx frame grabber (FrameLink Express or HD-SDI Express) was used.

- **Width and Height** Set the RAW image horizontal and vertical size.
- **Learn** Returns width and height of the image.
- **Interlaced** Allows to analyze interlaced images from the analog VCE Express and HD-SDI Express frame grabber.
- **To Grayscale** Makes the color image to be displayed as grayscale.
- **Pixel type** Defines the way how the pixels are stored in the RAW file.

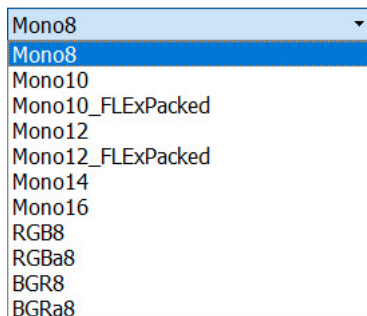
Each device type has its own set of pixel type:

- For GigE Vision camera:



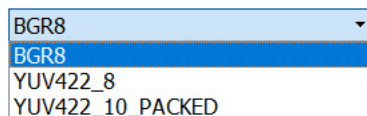
Please see a camera's user manual for details about the listed pixel types.

- For FrameLink Express frame grabber:



Please see the FrameLink Express Hardware user manual for details about the listed pixel types.

- For HD-SDI Express frame grabber:



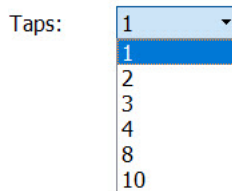
Please see the HD-SDI Express Hardware user manual for details about the listed pixel types

- For VCE-Express frame grabber:



Please see HD-SDI Express Hardware user manual for details about the listed pixel types.

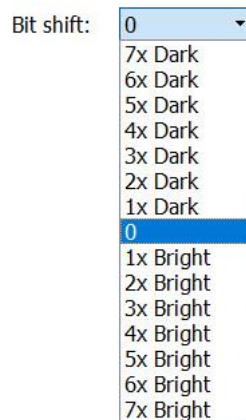
- **Taps**



Specifies the number of camera sensor taps.

This option is active only for the images acquired from FrameLink Express frame grabber.

- **Bit Shift**



Shifts each pixel value left or right to make the image darker or brighter.

This option can be important for images with 10, 12, 14 bits per pixel.

In the case that the image is non-normalized (pixel value is located in less valuable bits of 16 bit word), then it is necessary to use the bit shift option to have the image display properly.

- **TrueSense**

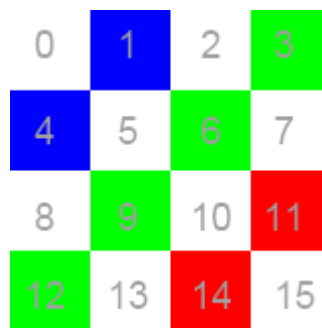
Check the **TrueSense** option for RAW images acquired from the Imperx color camera with TrueSense Sparse Color Filter Array (CFA).

TrueSense

P  B  P  G  
 B  P  G  P  
 P  G  P  R  
 G  P  R  P

Algorithm: **Simple Fast**

- Simple Fast
- Simple Quality
- Bayer Like Fast
- Medium
- Quality



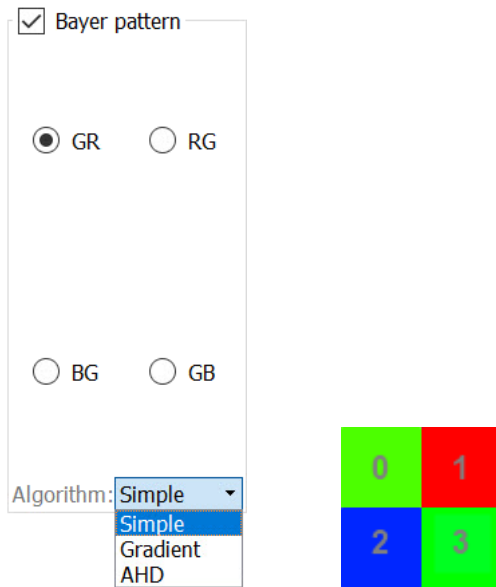
The Radio buttons P, B, G, R represents the TrueSense Sparse CFA start pixel—Panchromatic, Blue, Green, Red—for the sensor’s left-top pixel.

It is set to the first Panchromatic component by default, that is correct for all Imperx cameras with TrueSense Sparse CFA. However, if the image was acquired in the AOI mode, then the pattern start should be set according to the AOI Left, Top positions.

The **Algorithm** combo box provide options to modify the demosaicing algorithm type. It includes:

- **Simple Fast**                      Simplest and fastest algorithm. Provides average quality and best time performance.
- **Simple quality**                      Quality and fast algorithm. Provides good quality and good time performance.
- **Bayer Like Fast**                      Algorithm, based on Bayer CFA demosaicing. Provides good quality and good time performance.
- **Medium**                              High quality algorithm. Provides high quality and average time performance.
- **Quality**                                Highest quality. Provides highest quality and low time performance.

- Bayer pattern** Check **Bayer pattern** option for RAW images acquired from Imperx color camera with Bayer Color Filter Array (CFA).



The Radio buttons GR, RG, BG, GB represent the Bayer Sparse CFA start pixel—Green-Red, Red-Green, Blue-Green, Green-Blue—for the sensor’s left-top pixel.

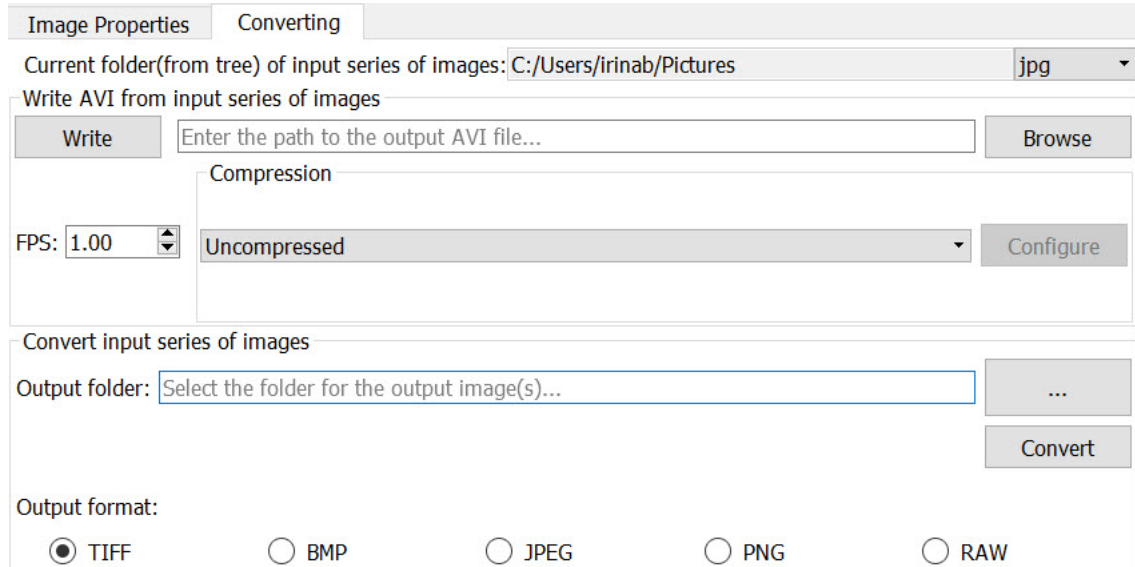
It is set to GR by default. That is the default for all the Imperx cameras with Bayer CFA. However, if the image was acquired in AOI mode, the pattern start should be set according to the AOI Left/Top positions.

The **Algorithm** combo box provide options to modify the demosaicing algorithm type. It includes:

- Simple** High quality linear interpolation algorithm. Provides good quality and best time performance.
- Gradient** Gradient-based algorithm. Provides high quality, and good time performance.
- AHD** Adaptive Homogeneity-Directed Interpolation algorithm. Provides the best quality, but poor time performance.

## 3.6.2 Converting Panel

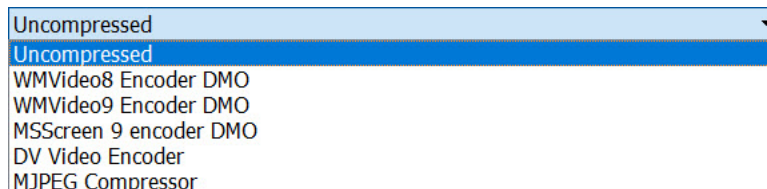
The converting panel provides options for batch conversion of series of images to commonly used format (TIFF, BMP, JPEG, PNG) and AVI movie file.



The current folder of the input image files is indicated in the text field at the top of the panel. The current folder can be changed from the Directory View window.

The group **Write AVI from input series of images** includes the options for batch AVI creation:

- **Path to result AVI file** Browse button opens the dialog box to set the AVI file path and name.
- **Write.** Starts the AVI conversion procedure
- **FPS** Value of Frames Per Second of result AVI file
- **Compression** Allows to select the AVI compressor and configure it.

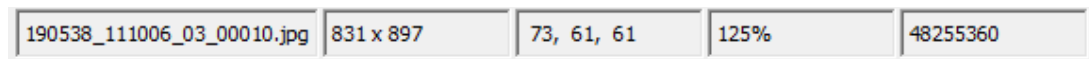


The group **Convert input series of images** includes the options for batch image file conversion:

- **Path to result files folder** Browse button opens the dialog box to set the output files folder.
- **Output image file format**
  - **TIFF** 8bpp TIFF for 8bpp input images, 16bpp TIFF for 10,12,14,16bpp input images
  - **BMP** 24bpp Bitmap for color images or 8bpp grayscale for mono images
  - **JPEG** Default JPEG quality is 85%
  - **PNG**
  - **RAW**
- **Convert** Starts the image file conversion procedure

### 3.6.3 Status Bar

The Status bar displays the following information:

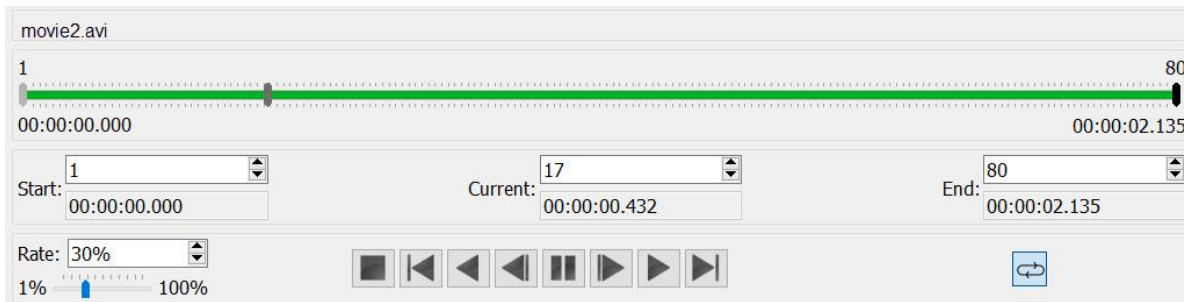


- | <b>File name</b>                 | <b>Cursor position</b>                | <b>Pixel value</b>                              | <b>Scale</b>                          | <b>Size</b>                     |
|----------------------------------|---------------------------------------|---|---------------------------------------|---------------------------------|
| • <b>File name</b>               | • <b>Cursor position</b>              | • <b>Pixel value</b>                            | • <b>Scale</b>                        | • <b>Size</b>                   |
| Currently opened image file name | Position of cursor on displayed image | Value of displayed image pixel under the cursor | Current value of display window scale | Opened image file size in bytes |

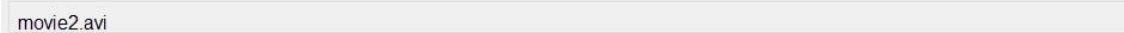
### 3.7 Dialog Bar. Movie Viewer

If the movie file is open, the dialog bar provides options to view and inspect the movie. The dialog bar includes the options:

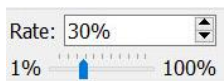
- view movie properties
- play the movie forward/backward
- add/remove markers and crop the interested part of the movie



- **File name** This field displays the currently opened file name.



- **Rate** The rate option allows you to change the playing frame rate of viewing movie. It can be decreased from actual value 100% down to 1%, and allows to slowdown the playing of high-speed records.



The rate can be changed using the slider as well as the spin button editing the box.



**ATTENTION!** It is possible to experience with the lagging and jerking while movie playing, if the movie file read speed (for example if the PC hard drive is slow) is slower than playback speed. To prevent the lagging and jerking, please decrease the playing frame rate.

- **Playback controls** The Playback control includes the controls to play and inspect the movie.



The Track slider allows the user to view the current position of the movie being played, set the playing start position (light-gray marker), and set the playing end position (dark marker).










The user can drag the markers to change the current, start and finish positions. The values under the slider indicate the first and last frame numbers of the opened movie. The values below the slider show the start and end time in ‘hh:mm:ss:ms’ format. The green progress line indicates the loading.

Start: <input type="text" value="1"/>	Current: <input type="text" value="17"/>	End: <input type="text" value="80"/>
<input type="text" value="00:00:00.000"/>	<input type="text" value="00:00:00.432"/>	<input type="text" value="00:00:02.135"/>

The Start, Current, End edit fields allows the user to view and modify the markers position.

The upper fields are editable and user can set frame number for each marker. The lower fields are read-only and show marker time in ‘hh:mm:ss:ms’ format.

- **Movie view control buttons**      The movie control buttons shown below:

	Stop	Stops the movie playing.
	Go to Beginning	Moves the playback marker to first frame of the movie.
	Play Backward	Plays the movie in backward direction.
	Step Backward	Moves the playback marker one frame backward.
	Pause	Pauses the movie playing.
	Step Forward	Moves the playback marker one frame forward.
	Play Forward	Plays the movie in forward direction.
	Go to End	Moves the playback marker to last frame of the movie.
	Loop	When pressed, the movie playing will be started automatically repeat after finishing.



## 4 Hex Pixel Dump

The **Hex Pixel Dump** panel shows pixel values in the table in hex format. The Active area is highlighted with the yellow frame on the Display window.

The row number of the table is image line number.

The column number is the line's pixel number.

	81	82	83	84	85	86	87	88	89	90	91	92
424	R: 1Ah = 26 G: 2Fh = 47 B: 35h = 53		A F 1	R 19 G 2E B 35	R 1B G 30 B 39	R 1D G 31 B 3B	R 1D G 31 B 3C	R 1D G 31 B 3B	R 1C G 32 B 39	R 1B G 32 B 3B	R 1B G 34 B 3C	R 1C G 36 B 3E
425	R 1C G 34 B 44	R 1D G 38 B 49	R 1D G 3C B 4E	R 1C G 39 B 4E	R 1D G 35 B 4F	R 1D G 36 B 4F	R 1E G 36 B 50	R 1F G 36 B 50	R 1E G 35 B 51	R 1C G 37 B 54	R 1F G 39 B 57	R 22 G 3C B 59
426	R 3A G 58 B 52	R 3F G 62 B 5E	R 43 G 6A B 6A	R 47 G 71 B 67	R 44 G 6D B 64	R 41 G 68 B 64	R 40 G 67 B 63	R 40 G 66 B 66	R 43 G 6F B 68	R 46 G 78 B 6D	R 4A G 7C B 72	R 4F G 80 B 73
427	R 58 G BE B A9	R 61 G CF B AF	R 69 G DF B B5	R 71 G E8 B B3	R 6B G F0 B B2	R 64 G E6 B B1	R 62 G DC B B1	R 60 G DF B B2	R 68 G E2 B B4	R 6F G EE B B6	R 75 G F9 B B9	R 7B G FC B B9
428	R 80 G FF B FF	R 86 G FF B FF	R 8A G FF B FF	R 8E G FF B FF	R 89 G FF B FF	R 85 G FF B FF	R 85 G FF B FF	R 85 G FF B FF	R 89 G FF B FF	R 8D G FF B FF	R 90 G FF B FF	R 93 G FF B FF
429	R A8 G FF B FF	R AA G FF B FF	R AB G FF B FF	R AB G FF B FF	R A8 G FF B FF	R A5 G FF B FF	R A7 G FF B FF	R A9 G FF B FF	R AA G FF B FF	R AA G FF B FF	R AB G FF B FF	R AB G FF B FF

The pixel value for the color images is shown in RGB values for color images, and in Y (luminosity) values for monochrome image.

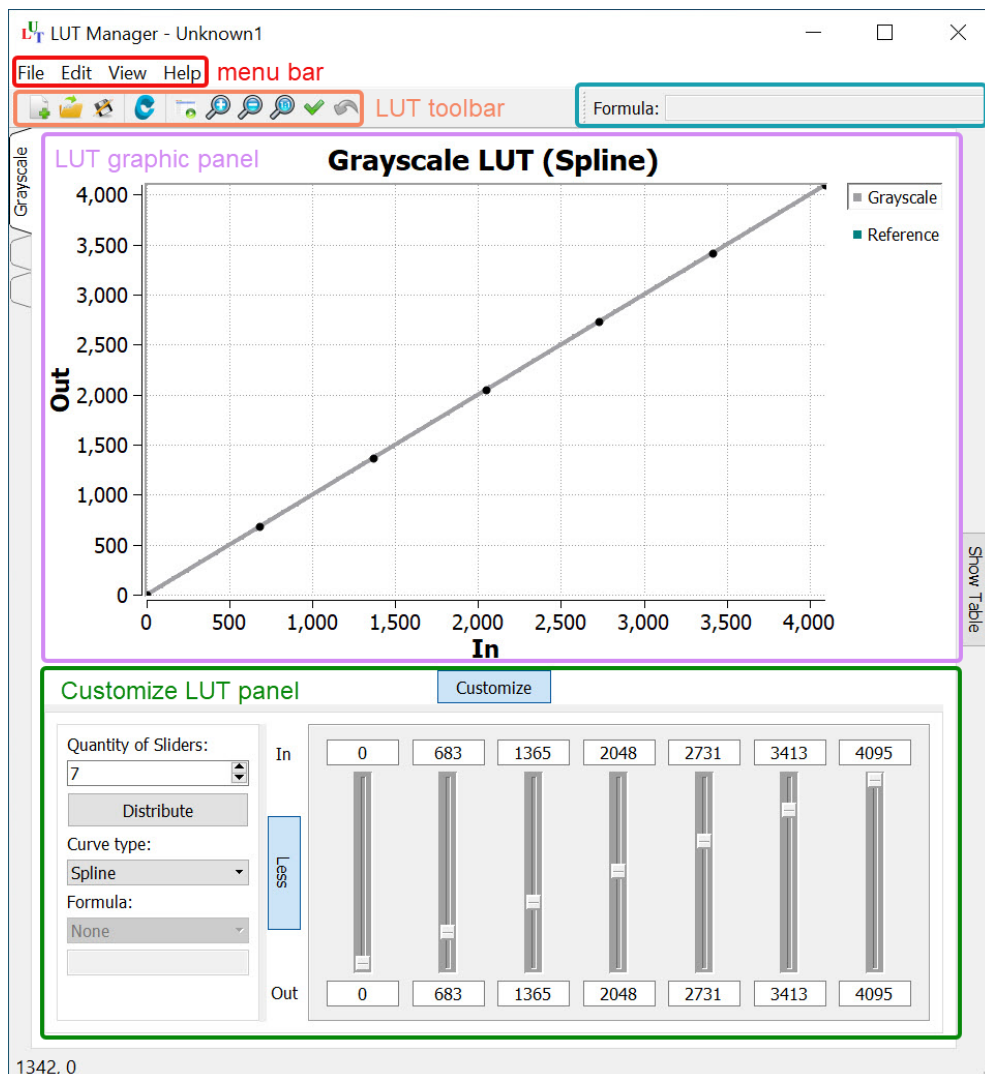
The visibility of the Pixel Hex Dump panel can be changed by the button on the Toolbar or menu option **Tools-> Hex Pixel Dump**.

## 5 LUT Manager

The LUT Manager Window opens up tools to create or modify the LUT tables.

The LUT Manager consists of the:

- Menu bar
- LUT toolbar
- Formula edit box
- LUT graphic panel
- Customize LUT panel
- Shortcut key combinations

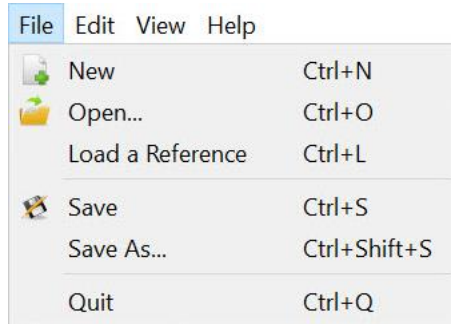


## 5.1 LUT Menu Bar

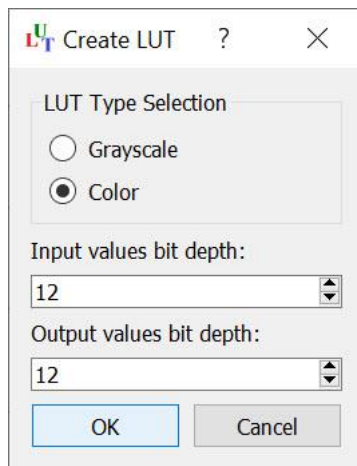
The Menu bar contains of the menus: File, Edit, View, and Help.

### 5.1.1 LUT File Menu

The **File** menu includes options to open or save image files:



- **New** Opens a **Create LUT** dialog box. The dialog box looks as follows:



- **LUT Type Selection** Selects the LUT type: Grayscale LUT or Color LUT.
- **Input values bits depth** Selects the number of input values bit depth ranging from 1 to 16.
- **Output values bits depth** Selects the number of output values bit depth ranging from 1 to 16.
- **OK** Creates LUT for the selected input/output bit depth relationship.
- **Cancel** Cancels the LUT.
- **Open** Opens an existing LUT file for the file formats (.lut, .lutx, and .csv).

- Load a Reference**

Opens an existing LUT file. In this mode, the file reference signal cannot be edited. However, one is capable of displaying the reference curve when clicking on the **Reference** legend.
- Save**

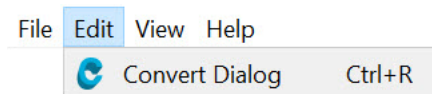
Saves the LUT file to a user defined path.
- Save As...**

Saves the LUT file to a user defined path.
- Quit**

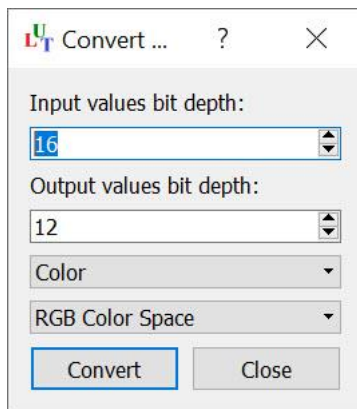
Closes the LUT Manager dialog box.

## 5.1.2 LUT Edit Menu

The **Edit** menu includes the option convert dialog as shown below:



The **Convert Dialog** option opens a Convert LUT dialog box:



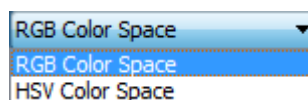
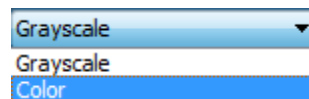
- Input values bit depth**

Selects the number of input values bit depth ranging from 1 to 16.
- Output values bit depth**

Selects the number of output values bit depth ranging from 1 to 16.
- Color Option**

Grayscale or Color
- Color**

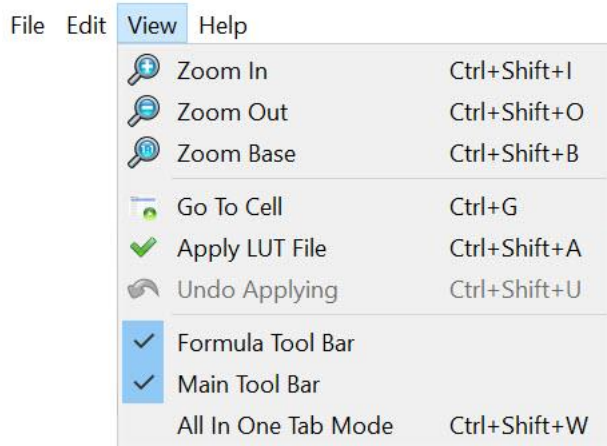
RGB Color Space or HSV Color Space



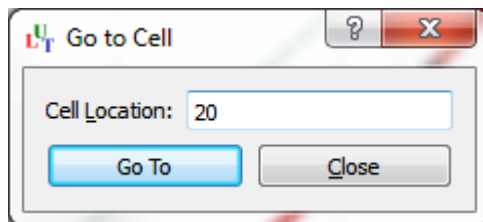
- **Convert** Converts existing open LUT to corresponding color space.
- **Close** Closes the **Convert LUT** dialog box.

### 5.1.3 LUT View Menu

The **View** menu includes the following options:



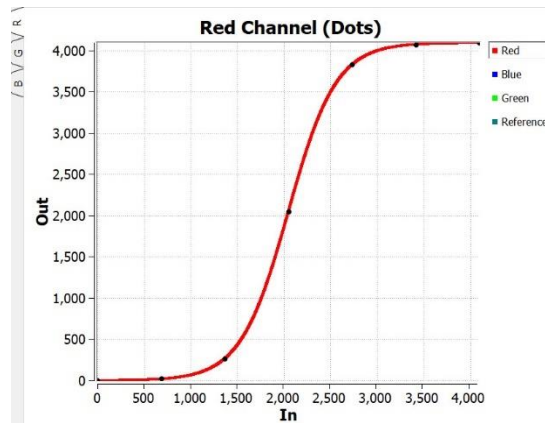
- **Zoom In** Increases the scale of LUT display image.
- **Zoom Out** Decreases the scale of LUT display image.
- **Zoom Base** Sets the 1:1 scale of the LUT display image.
- **Go To Cell** Opens a **Go to Cell** dialog box.



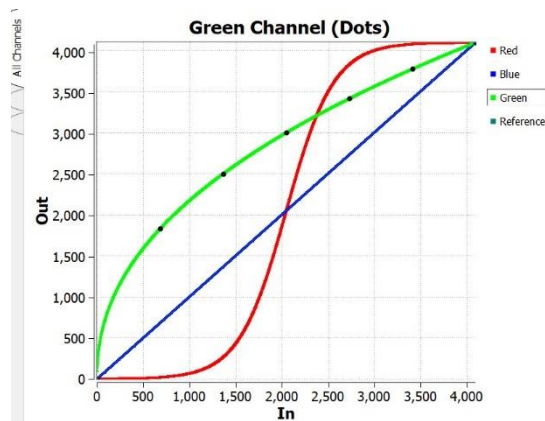
- **Cell Location** Cell location (index) within LUT.
- **Go To** Opens LUT and places blinking cursor on corresponding cell location.
- **Close** Closes the **Go to Cell** dialog box.
- **Apply LUT File** Applies the LUT displayed on LUT graphic panel to the image opened in the display window.
- **Undo Applying** Removes changes made by the applied LUT.

- Formula Tool Bar** Toggles between showing/hiding the **Formula** edit box.
- Main Tool Bar** Toggles between showing/hiding the LUT toolbar.
- All In One Tab Mode** Toggles between showing LUT individual tabs components versus all in one tab mode toolbar.

The LUT **Individual Tab** mode displays each color component in different tabular graph representation:

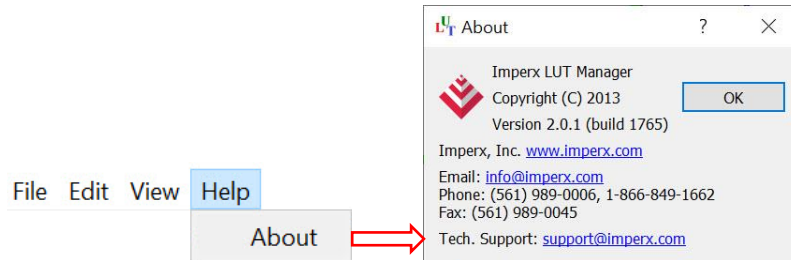


The LUT **All In One Tab** mode is capable of display all color components and reference on one graphic representation:



## 5.1.4 LUT Help Menu









The **Help** menu includes the option **About** that opens **About Imperx LUT Manager** dialog, and shows information about software version and technical support contacts.



## 5.2 LUT Toolbar

The LUT Toolbar contains the following options:



-  **Create LUT**                      Open the **Create LUT** dialog box.
-  **Open**                                      Opens the **File Open** dialog BOX. This dialog box is used to open the LUT file.
-  **Save As...**                              Opens the File Save Dialog Box. This dialog box is used to save the LUT file.
-  **Convert**                                      Opens the **Convert** dialog box.
-  **Go To Cell**                                      Opens the **Go to Cell** dialog box.
-  **Zoom In**                                      Increases the scale of LUT display image.
-  **Zoom Out**                                      Decreases the scale of LUT display image.
-  **Zoom 1:1**                                      Sets the 1:1 scale of the LUT display image.

### 5.3 Formula Edit Box

The **Formula** edit box can only be used when **Curve type** is set to **Dots**. The **Curve type** setting will be described later. The user is able to customize the formula.

Formula:

In the formula, you can use the following operations:

Operations	Description
+	Addition
-	Subtraction
*	Multiplication
/	Division
^	Raised to the power of
cos	Cosine function
sin	Sine function
tan	Tangent function
acos	Arc-Cosine function
asin	Arc-Sine function
atan	Arc-Tangent function
sqrt	Square root
ln	Log natural
exp	Exponent
X	x-value
Pi	Pi mathematical constant approximately 3.1415926535897932
[lower_limit:upper_limit]	Set up a range for a formula by using brackets before a formula expression

**Example using range:**

$$[0:255](x + 100) / x[256:511]x ^ 2.$$

If there are no brackets, then the formula expression will be calculated on the entire range from 0 to maximum Input value.

**Example using Sine function:**

$$(4095/2) * (\sin((x/(4095/4))*(2*pi)) + 1)$$

This example represents a sine with period of 4095 / 4 (approximately 1021) points.

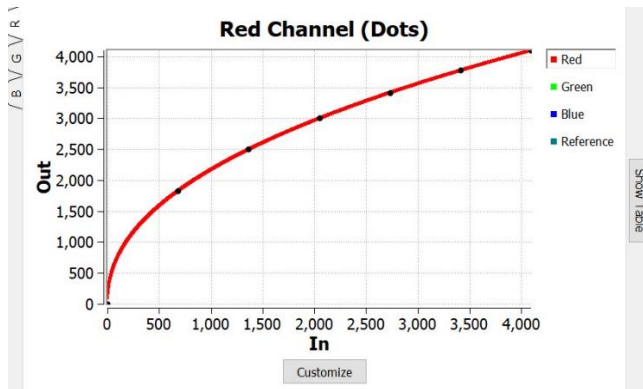
Example programming Gamma function:

$$(4095 / (4095^{0.45})) * (x^{0.45})$$

This example represents the gamma function  $y = K * (x^{\text{gamma}})$

## 5.4 LUT Graphic Panel

The LUT graphic panel displays the LUT plot. An example is shown below:



### 5.4.1 LUT Panel Window

The x-axis represents the Input values of incoming pixels. The y-axis represents the Output values of the pixels. The bottom left corner of the LUT graphic panel shows location of the pixel coordinate in relationship to the graph. You will see a cursor that looks like a cross **+** on the curve.

- **Component Tabs**

The tabs will let you load either the Grayscale, R, G, or B components of the LUT. These are located in the top left corner side of the panel window. When pressed, the corresponding component will display the corresponding LUT channel or Grayscale LUT in the panel window.

- **LUT title**

The title bar above the LUT graphic curve describes the type of curve being displayed as well as corresponding component. The possible graphic type of curves are as follows: Grayscale LUT (Spline), Grayscale LUT(Line), Grayscale LUT (Dot), Red Channel (Dots), Red Channel (Line), Red Channel (Spline), Green Channel (Dots), Green Channel(Line), Green Channel(Spline), Blue Channel(Dots), Blue Channel(Line), and Blue Channel (Spline).

- Show Table**

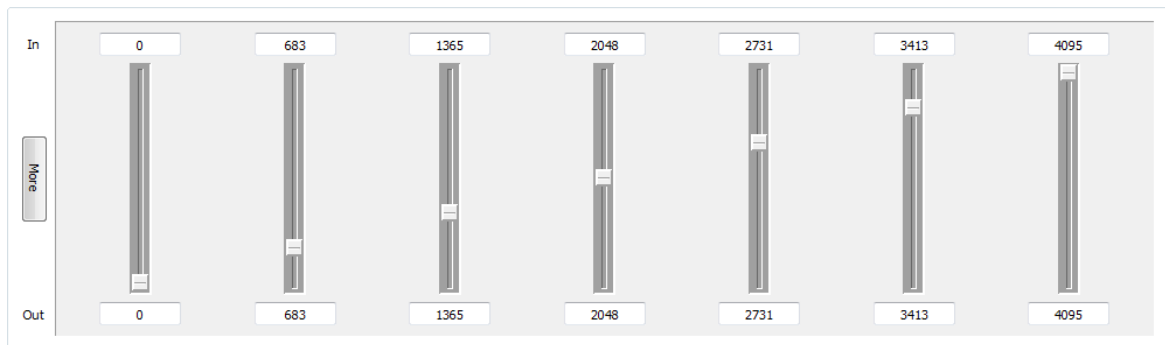
Toggles between showing/hiding the LUT. It shows the input/output pixel data value mapping.
- Legend**

Interactive Legend of Color and Reference components. By default, either the Red color component (Color LUT only) or the grayscale component (Grayscale LUT) is displayed. Clicking on the Legend Color or Reference field causes corresponding LUT channel or reference to be displayed.
- Customize**

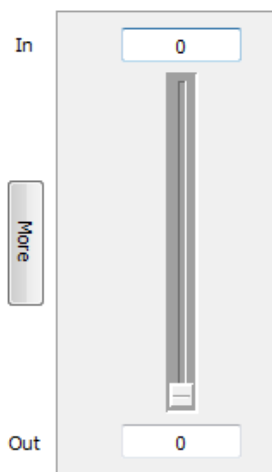
Toggles between the showing/hiding of the Customize LUT panel.

## 5.5 Customize LUT Panel


The Customize LUT panel allows the user to modify or create custom LUT. The default panel window has vertical sliders as shown below:



- Vertical Sliders**



The vertical slider works as follows. The Edit Box located on the top of the slider corresponds to the Input pixel coordinate on the curve line. The Edit Box located on the bottom of the slider corresponds to the Output pixel coordinate on the curve line. The input/output coordinate is represented as a black point on the curve

line . We can move the input location of the point on the graphic by editing the top Edit Box. The Slider moves the output point value. You can see the point on the curve move to a new output location.

- **Curve Point**

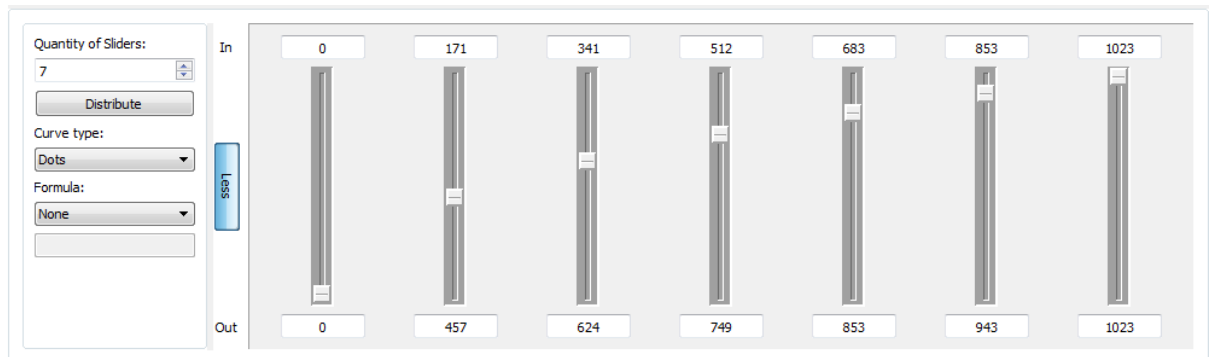


The point maps the input/output coordinate on the LUT curve.

**Note:** The multiple slider represents multiple input/output points on the graphic. These points can be altered by either editing the input/output edit box or moving the sliders.

- **More**

Displays additional custom parameters.



- **Quantity of Sliders**

Creates the corresponding number of sliders on the Customize LUT panel window. The range of sliders allowed are from 1 to 30 sliders.

- **Distribute**

Distributes the exact number of points entered in the quantity of sliders.

- **Curve Type**

The curve type supported are Dots, Lines, and Spline. In Dots mode, the user is allowed to change every point (x value) by using the table representation on the right or moving a slider at the bottom, that was connected (referenced) with desired x-axis value. Also, the Output values can be altered by dragging, moving and dropping. In Line and Spline modes, the user can only change x values that have been referenced before (shown as big black point on a plot) by the same ways as in Dots. In these modes if the user modify one value, some other values will be changed indirectly due to calculation of line or spline values.

- **Formula**

The Formula combo box is only valid in the **Dots** Curve Type mode. The user is able to use None, Gamma, Linear, or User defined formula.

  - **None**

No formula
  - **Gamma**

Gamma formula, for example

Formula:  $(4095/(4095^{0.45})) * (x^{0.45})$
  - **Linear**

Linear formula, for example

Formula:  $(4095/4095) * (x)$
  - **User**

User defined formula. Refer to the section [5.3 Formula Edit Box](#) for available operands
  
- **Less Button**

Hides the additional parameters the user is able to customize. Only shows the sliders.

## 5.6 Shortcut Key Combinations

The following are a table list shortcuts for the LUT Manager:

Shortcut Key Combination	Description
Mouse Left Button + Mouse Move	to move the plot
Ctrl + Mouse Left Button + Mouse Move	to select a zoom rectangle
Ctrl + Mouse Right Button	to zoom to the base
Ctrl + Shift + Mouse Left Button	to zoom in one position on the zoom stack
Ctrl + Shift + Mouse Right Button	to zoom out one position on the zoom stack
Ctrl + Shift + B	to zoom to original size (base)
Ctrl + Shift + I	to zoom in
Ctrl + Shift + O	to zoom out
Alt + Mouse Left Button	to set reference value (add a slider)

**Note:** You can change reference value by moving a slider, changing value in a edit box or you can just drag and drop a reference value that is displayed as a point on the plot.

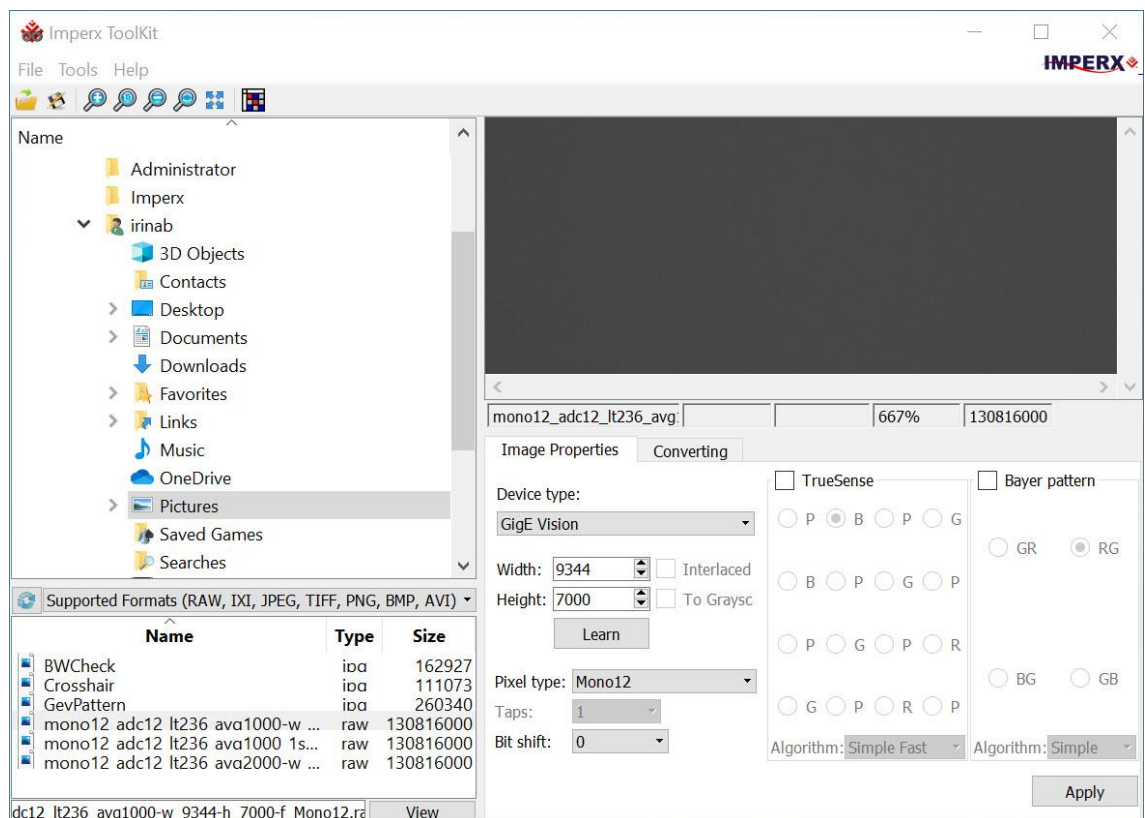
## 6 DPC/HPC Utility

The **DPC/HPC Utility** Window provides the tools to create the files for Defect Pixel Correction (DPC) and Hot Pixels Correction (HPC). These Utility allows to create the Defect Pixel Map (DPM) and Hot Pixel Map (HPM) files.

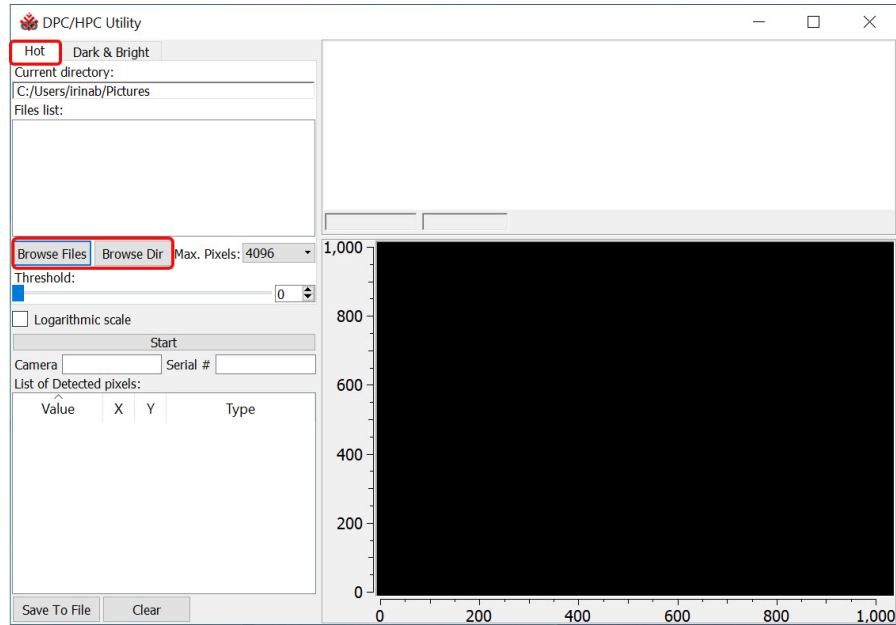
### 6.1 Hot Pixels Map

To create the HPM file, please prepare the series of test RAW or IXI image files, acquired from the Imperx camera with long exposure (about 1 second or more), with dark grey or even black image.

1. Make sure that the camera resolution is set to maximum, and Hot Pixel Correction is Off, and Defect Pixel Correction is On.
2. Set the longest exposure time and slowest frame rate expected.
3. Cover a lens with a lens cap or dismount the lens and put a dust cap on the camera.
4. Run the camera for at least 45 minutes at ambient temperature around 18–22 °C or higher.
5. Capture an image (or series of images) and save it in RAW or IXI format.  
It is preferable to save 12 bpp test RAW or IXI images.
6. Open the test RAW or IXI images with Imperx Toolkit.



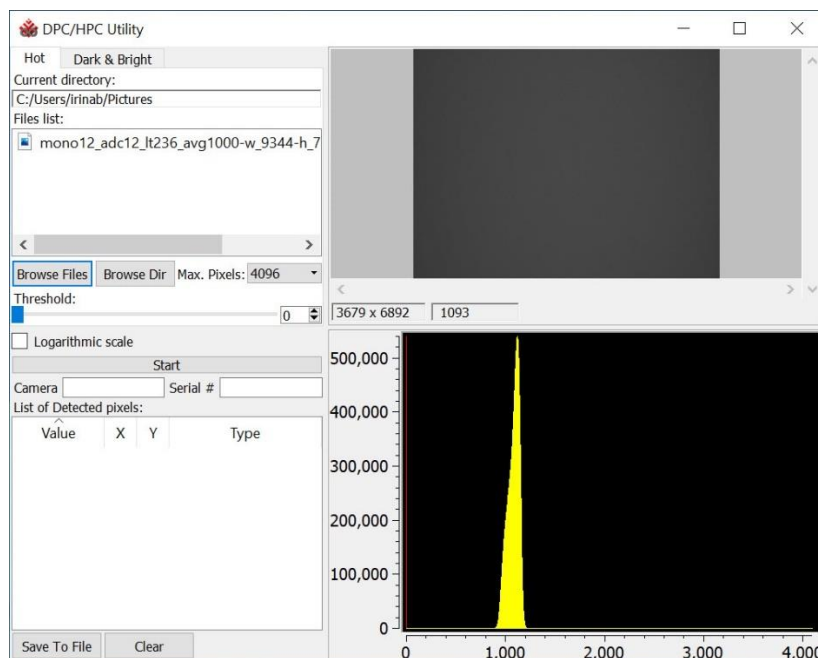
7. Select **Tools->DPC/HPC Utility** menu option.  
The **DPC/HPC Utility** window appears.
8. Select the **Hot** tab to start the Hot Pixel analysis.



9. Click **Browse Files** to open a single RAW file or **Browse Dir** to open a series of RAW files from the selected folder.

The opened file or files should be the same or from the same series (i.e. acquired from the same camera with the same pixel type) that was opened before in the Imperx Toolkit.

After the files appear in the **Files list**, the histograms of files included to the list appear in the histogram window. The files are loaded in cycle, one by one with rate about one image per second.



10. Set **Max. Pixels** to a value appropriate for your camera.

Camera model	Max. Pixels in HPM
CLF-C4180, CLF-C4181, CLF-C5180 GEV-C4180, GEV-C4181, GEV-C5180 10G-C4180, 10G-C4181, 10G-C5180 POE-C1911, POE-C2000, POE-C2010, POE-C2400, POE-C2410, POE-C3210, POE-C4010, POE-C4110 P67-C1911, P67-C2010, P67-C2410, P67-C3210, P67-C4010, P67-C4110. POE-C4410, POE-C5410, POE-C6410 CLF-C1921, CLF-C2020, CLF-C2420, CLF-C3220, CLF-C4020, CLF-C4120, CLF-C4420, CLF-C5420, CLF-C6420	4096
U3V-C4180, U3V-C4181, U3V-C5180	8192

11. Move the **Threshold** slider to the value that you want to be the minimum.  
 The pixels with higher luminosity will be treated as hot

You also can set the threshold value with the mouse left button click on the histogram window.

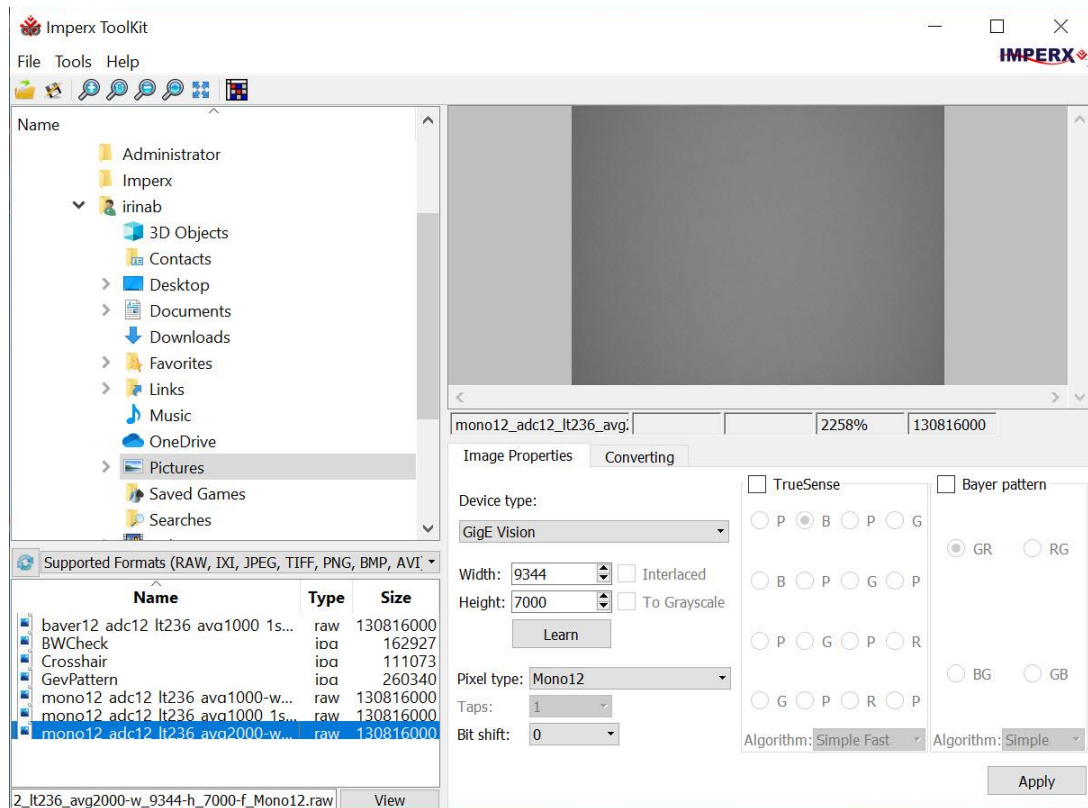
12. Click **Start** to start the analysis of the images for hot pixels.



## 6.2 Defect Pixels Map

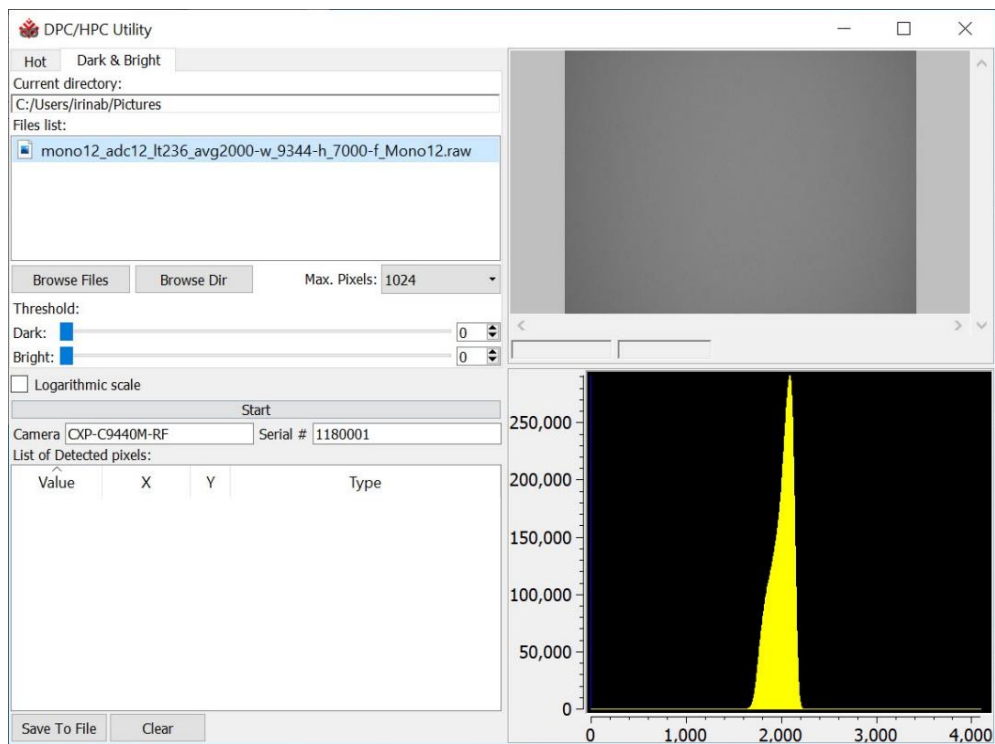
To create the DPM file, please prepare the series of test RAW or IXI image files, acquired from the Imperx camera with regular free run exposure, with grey image. It is recommended to use uniformly ambient light source, connected to the camera lens mount. In the case, if you do not have such a light source, you can dismount the lens, and cover the lens mount hole with paper.

1. Make sure that Trigger Mode and Exposure Mode are set to Off, the camera resolution is set to maximum, and Defect Pixel Correction is Off, and Hot Pixel Correction is On.
2. Capture an image (or series of images) with a uniform light source illuminating the sensor at about 50% ADU capacity (~2000 for 12-bit, ~500 for 10-bit, ~130 for 8-bit modes) and Save the image(s) in RAW or IXI format.  
It is preferable to save 12 bpp test RAW images.
3. Open the test RAW or IXI images with Imperx Toolkit.



4. Select **Tools->DPC/HPC Utility** menu option.  
The **DPC/HPC Utility** window appears.
5. Select **Dark & Bright** tab to start the defect pixel analysis.
6. Click **Browse Files** to open a single RAW file or click **Browse Dir** to open the series of RAW files from selected folder.  
The opened file or files should be the same or from the same series (i.e. acquired from the same camera with the same pixel type) that was opened before in the Imperx Toolkit.

After the files appear in the **Files list**, the histograms of files included in the list appear in the histogram window. The files are loaded in cycle, one by one with rate about one image per second.



7. Set **Max. Pixels** to a value appropriate for your camera.

Camera model	Max. Pixels in DPM
CLF-C4180, CLF-C4181, CLF-C5180 GEV-C4180, GEV-C4181, GEV-C5180 10G-C4180, 10G-C4181, 10G-C5180	512
U3V-C4180, U3V-C4181, U3V-C5180 POE-C1911, POE-C2000, POE-C2010, POE-C2400, POE-C2410, POE-C3210, POE-C4010, POE-C4110 P67-C1911, P67-C2010, P67-C2410, P67-C3210, P67-C4010, P67-C4110 POE-C4410, POE-C5410, POE-C6410 CLF-C1921, CLF-C2020, CLF-C2420, CLF-C3220, CLF-C4020, CLF-C4120, CLF-C4420, CLF-C5420, CLF-C6420	1024

8. Move the **Dark** slider to the values that you want to be the maximum for dark pixels. The pixels are treated as dark if their luminosity is lower than the Dark limit.

9. Move the **Bright** slider to be the minimum for bright pixels.  
The pixels are treated as bright if their luminosity is higher than the Bright limit.

You also can set the threshold values with the left mouse button click for dark pixels and right mouse button for bright pixels on the histogram window.

10. Click **Start** to start the analysis of images for dark and bright pixels.

	Value	X	Y	Type
1	1053	6632	3837	D
2	1101	6631	3839	D
3	1138	146	1401	D
4	1166	6633	3838	D
5	1228	1455	6050	D
6	1258	8702	6202	D
7	1264	6633	3839	D
8	1330	4542	707	D

The bright and dark pixels are added to the **List of Detected Pixels** table. The table includes the following columns:

- **Number** Detected pixel number
- **Value** Pixel Luminosity. If multiple images are used for calculation, the minimum value is shown here for Bright pixels, and maximum value for Dark pixels.
- **X, Y** Pixel coordinates.
- **Type** Pixel type. B – bright defect pixel, D – dark defect pixel.

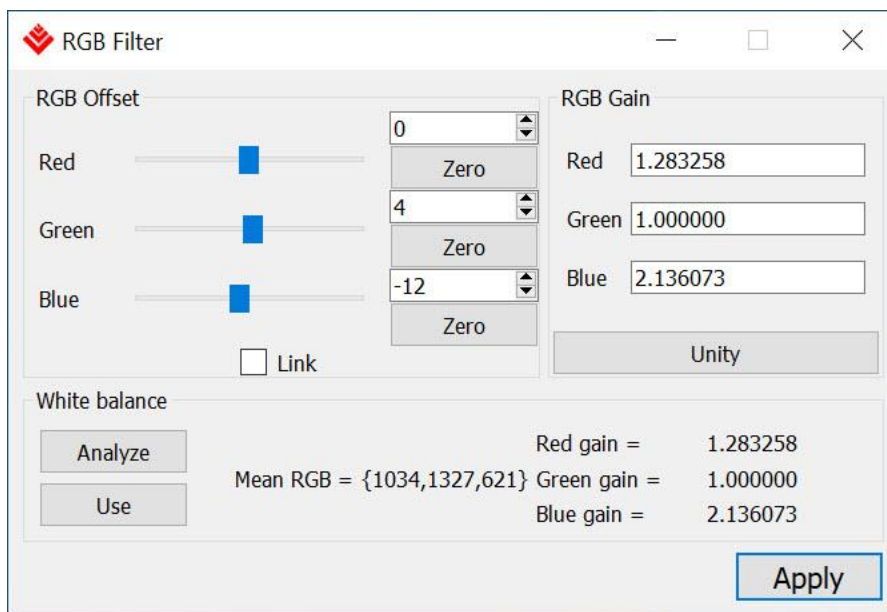
11. Fill the **Camera** and **Serial #** fields and click **Save To File** to save calculated data to the DPM file.



**ATTENTION!** Pixels that present in **List of Detected Pixels** table as Hot and Bright at the same time, will be treated as Hot.

## 7 RGB Filter

The **RGB Filter** window provides options for the white balance calculation and color correction:



- RGB Offset**

Group of controls that allows you to modify the offset value for **Red**, **Green** and **Blue** components of the loaded image. You can modify the values by slider and Edit field or click **Zero** to reset the value to zero. Check the **Link** check-box to link the **Red**, **Green** and **Blue** values together, so change of one component will cause the same change on all the color components.
- RGB Gain**

Provides options to change the Gain coefficient value for **Red**, **Green** and **Blue** components. You can modify the values by editing the field. Clicking **Unity** resets the values to 1.0.
- White balance**

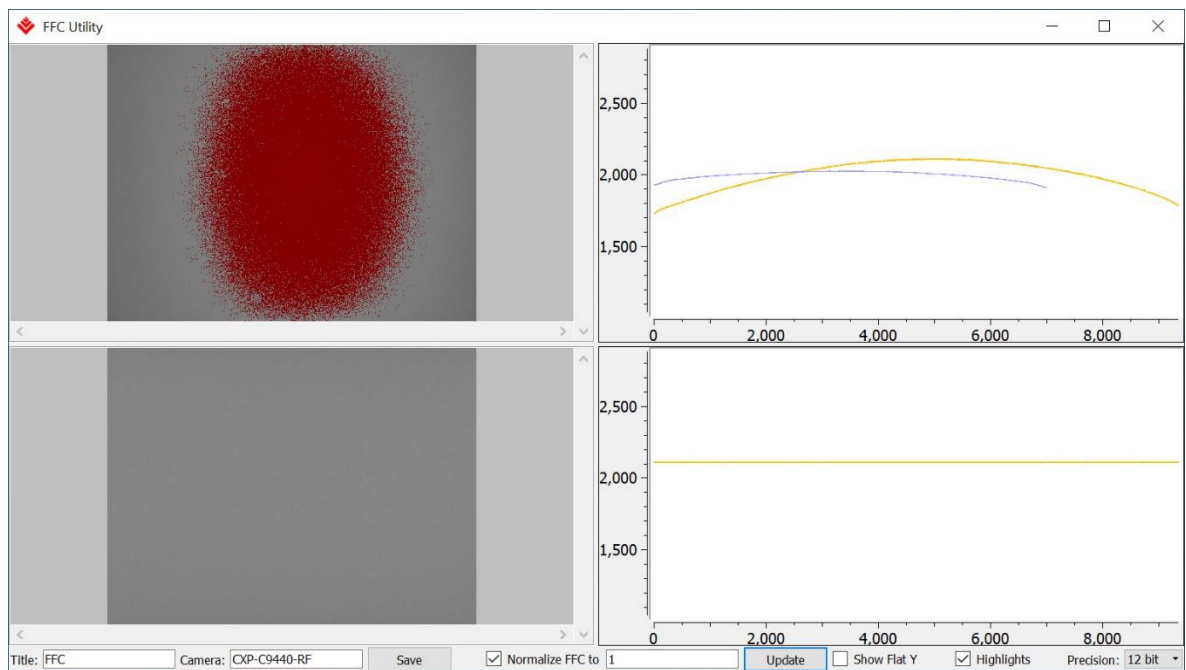
Calculates the Red, Green, and Blue gain values for White balance. Click **Analyze** to calculate the gain values. Click **Use** to assign the calculated values to RGB Gain group.
- Apply**

Applies the currently set values to the image currently loaded in the Imperx Toolkit

## 8 FFC Utility

The **FFC Utility** provides the tools to create the files for Flat Field Correction (FFC). To start the image analysis for Flat Field, please prepare the sample files, acquired by the target Imperx camera with environment specific to your task. It is recommended to acquire 12 bit per pixel RAW image with average pixel luminosity about 2000-3000.

Before you call the FFC Utility, open the created sample image in the Toolkit application, and then select **Tools-> FFC Utility** menu item.



The display window on the left top side shows the original image. The image with the applied FFC is shown on left bottom side.

Right top graphs show the vertical (blue, calculated for columns) and horizontal (yellow, calculated for lines) average luminosity. The right bottom shows average luminosity graphs after the applied FFC.

- **Title** FFC title
- **Camera** Camera model number
- **Save** Saves the FFC to file
- **Normalize FFC to** If **Normalize FFC to** check-box is not set, the average luminosity of columns and lines of result image is the same as average luminosity of columns and lines of source image.

If **Normalize FFC to** check-box is set and the coefficient is specified, the peak luminosity of the columns and lines of the result image equals the peak luminosity of columns and lines of source image, multiplied by specified coefficient.

- **Update**  
Applies changes made to the **Normalize FFC to** box, **Show flat Y** check box, and **Precision** drop-down list.
- **Show Flat Y**  
Shows vertical (blue, calculated for columns) average luminosity graph and image after the FFC applied to columns.
- **Highlights**  
Highlights pixels with maximum luminosity value for the test image bit depth.
- **Precision**  
Sets the bit depth of the tested image.