FirePackage

Operating AVT cameras with SmartView

V2.0.0

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ALLIED Vision Technologies

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Introduction

Document history

Version	Date	Remarks
V2.0.0	28.08.2007	New Manual - RELEASE status

Table 1: Document history

Conventions used in this manual

To give this manual an easily understood layout and to emphasize important information, the following typographical styles and symbols are used:

Styles

Style	Function	Example
Bold	Programs, inputs or highlighting important things	**bold**
Courier	Code listings etc.	`Input`
Upper case	Register	REGISTER
Italics	Modes, fields	*Mode*
Parentheses and/or blue	Links	(Link)

Table 2: Styles

Symbols

Note This symbol highlights important information.

Caution This symbol highlights important instructions. You have to follow these instructions to avoid malfunctions.

www

This symbol highlights URLs for further information. The URL itself is shown in blue.

Example:

http://www.alliedvisiontec.com

Before operation

We place the highest demands for quality on our software. The FirePackage SmartView Manual is the guide to the installation of the software and the operation of AVT cameras with SmartView.

Note

Please read through this manual carefully before operating AVT cameras with SmartView.

AVT SmartView for FirePackage

Hardware conditions

- PC or laptop with built-in IEEE 1394 interface
- IEEE 1394 adapter (OHCI) card for PCI bus or PCI Express bus or PC card or ExpressCard with IEEE 1394 port(s)

Note

AVT offers a wide range of IEEE 1394 adapters, both 1394a or 1394b for different requirements.

FireWire hot plug precautions

Note

Although FireWire devices can be hot-plugged without powering down equipment, we recommend turning the computer power off, before connecting a digital camera to it via a FireWire cable.

Operating system conditions

- Windows NT4
- Windows 2000
- Windows XP (32 and 64 bit)
- Windows VISTA (32 bit)

Software conditions

- Windows NT4/2000/XP/VISTA: **AVT FirePackage**

Note

The AVT FirePackage includes a special IEEE 1394 device driver from INTEK suitable for all AVT cameras which replaces the MS 1394 driver stack completely.

Overview FirePackage

- Install IEEE 1394 adapter (if PC or laptop does not have an IEEE 1394 port)
- Install FirePackage (incl. SmartView)
- Start SmartView or other viewer (FireView)
- Connect camera to PC or laptop and ensure that the camera is powered
- License will automatically be read out from your AVT camera (in case of problems, contact AVT support)
- Get your first image with SmartView
- Problems? Read Chapter Troubleshooting on page 18.

Installing IEEE 1394 adapter

1. PC: Install the IEEE 1394 adapter according to the instructions you got from your adapter manufacturer.
   Laptop: Insert the IEEE 1394 PC Card into your laptop. Connect external power supply to the adapter to power the camera or power the camera via Hirose connector.

   Windows 2000/XP(VISTA will detect the hardware automatically and installs a Windows 1394 driver.

   Windows NT4 requires that you install the driver manually via a service install tool.

Installing FirePackage (incl. SmartView program)

Note

Before installing FirePackage, open the following directory:

<CD ROM>:\products\AVTFirePackage...\

Read the documents you find in this directory:

- AVT_FirePackage_x_y_Release_notes.pdf
- AVT_FirePackage_Overview.pdf
- AVT_SmartView_x.y.z_Release_notes.pdf

Note

When you install FirePackage the SmartView program will automatically be installed.

Alternatively you can install the Direct FirePackage (then a special Viewer will be installed: see HTML-Help from this viewer).

1. Insert the Camera Support CD in the CD ROM drive of your PC or laptop.

   An html page will open if the autostart function of your PC or laptop is enabled.

   If the html page does not open, enter the root directory of the CD and doubleclick **index.htm**.
2. Scroll down to the software section **AVT FirePackage.**
3. Click the following links to **read the corresponding documents**:
   - AVT FirePackage Overview
   - Release Notes FirePackage
   - Release Notes SmartView
4. To start the installation of FirePackage click on **AVT FirePackage x.y.zip**

   A window opens.
5. Choose **Save to Disk** and click **OK**.
6. In the next window choose a directory and click **Save**.
7. Unzip the file.
8. Doubleclick on **setup.exe**.

   A wizard will guide you through the installation. To go on click **Next** in each window.
9. You are asked to choose a directory: Accept the option shown or type another one. Click **Next**.
10. Activate all 3 check boxes. Click **Next** to start installation.

    AVT FirePackage is being installed.

    The INTEK window appears.
11. Now install the driver for the IEEE 1394 adapter: for each card to be used with **FirePackage**, activate the check box.
12. Click **Install**.
13. Ignore the message box (Microsoft non-certified driver) and continue the installation.

    A wizard will guide you through the installation. To continue click **Next** in each window.

    A window appears: FirePackage has been successfully installed.
14. Click **Close**.

Now the **FirePackage** and the **SmartView** Program are installed on your PC or laptop.

Starting SmartView

The **SmartView** program:

- enables access to all connected IEEE 1394 cameras
- supports almost all smart features of the AVT cameras.

1. Click **Start → Programs → Allied Vision Technologies → FirePackage → AVT_SmartView**

   The **SmartView** window opens.

2. Here you can see all 1394 buses and PCI slots (e.g. 0x040800).

Connecting camera to PC or laptop

1. Insert one end of the FireWire cable into your 1394 adapter or 1394 PC card.
2. Insert the other end of the FireWire cable into your camera.
3. Check that the camera is powered (green LED ON)

Licensing

You need a license to run the FirePackage. This license is embedded in each AVT camera. It will be read out with the help of the license file **LICENSE.TXT**.

Note

- **LICENSE.TXT** and **FCTLMAIN.DLL** always have to be in the same directory.
- By default the DLLs are used from the Windows System32 directory.
- If **FCTLMAIN.DLL** is not in the Windows System32 directory, then FirePackage will look in the directory where the Viewer (SmartView) is installed.

A typical license file for AVT cameras looks like this:

```
* FireControl License File
1EEAF9B450220075 Devicecontained Offset=F1000008 (AVT)
...
...
```

After the top line starting with *, each line contains one license. The line after the top line is exactly as shown above.

The license file will be read from top to bottom until a valid license is found.

Note

Newer versions of AVT FirePackage (> 2V6) use additional registry keys for supplying alternative names and positions for the license file to be stored.

For further information on licensing read the following:

<install dir>\Allied Vision Technologies\FirePackage\Doc\Licensing.pdf

or ask your local dealer.

First steps with SmartView

1. After connecting the camera with your PC or laptop, start **SmartView** program. In the **SmartView** entry window you see all FireWire adapters or cards installed in your PC.
2. In the **SmartView** entry window open all trees by clicking on the [+] button. Search for your camera and doubleclick on the camera entry.

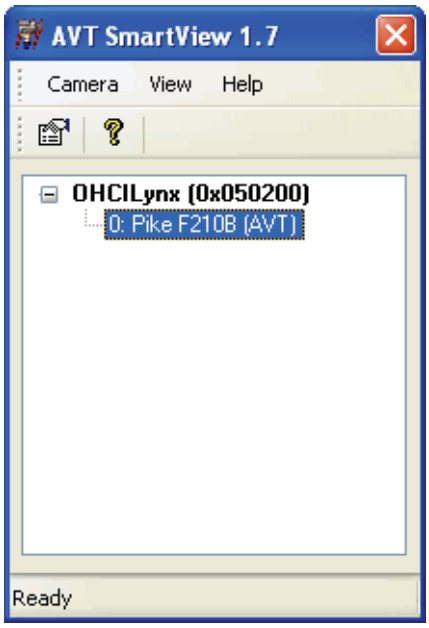


Figure 1: SmartView entry window: example of Pike F-210B

3. The **SmartView** main window opens and usually one first image is shot automatically.

Overview: SmartView entry window

The menus and icons of the SmartView entry window are explained in the following tables:

Icon	Function	Description
	General settings	Opens the **General settings** window (see Table 5: SmartView entry window: General settings on page 16) Here you can adjust settings for connecting 1394 cards to the 1394 bus, image type settings and camera view settings.
	Information	Shows version and copyright information of AVT SmartView for FirePackage

Table 3: SmartView entry window: toolbar

Menu	Submenu	Shortcut	Description
Camera	Open/Close view	Ctrl+O, Enter	Opens or closes a viewer window (main window)
	Initialize the camera		Initializes the selected camera
	Soft reset		Resets the selected camera
	Update firmware...		Updates the firmware of the Guppy/Pike camera via 1394 bus Read the application note: **How to update Guppy/Pike firmware** at AVT website. For other cameras: Read the chapter **Firmware update** of the **Technical Manual** or contact your local dealer.
	Format 7 mapping...		Only PIKE: Allows mapping of all possible Format_7 settings to F7M1..F7M7 (see **PIKE Technical Manual**, Chapter **Binning and subsampling access**)
	 Settings...	Alt+E	Opens the **General settings** window (see Table 5: SmartView entry window: General settings on page 16) Here you can adjust settings for connecting 1394 cards to the 1394 bus, image type settings and camera view settings.
	Exit	Alt+X	Quits the application

Table 4: SmartView entry window: **menus**

Menu	Submenu	Shortcut	Description
View	Toolbar		Shows or hides the toolbar (see Table 3: SmartView entry window: toolbar on page 15)
	Status bar		Shows or hides the status bar
Help	About AVT SmartView...		Shows version and copyright information of AVT SmartView for FirePackage

Table 4: SmartView entry window: **menus**

In SmartView entry window click on **Camera** → **Settings.**

The **General settings** window opens.

Section	Check box / combo box/ list	Description
Enable initial card states	☐ Enable initial card states	This function is useful, if you have more than one card installed and several cameras. Activate this check box and disable cards you don't use and set your *working* card to **False**, so that connected cameras are shown automatically.
	Card ID list	Lists all 1394 cards (connected to your PC/Laptop) with their ID number. To disable a card, set the **Disabled** parameter to **True**. To open the bus when SmartView is started, set the **AutoOpen** parameter to **True**. All connected 1394 cameras of this card will be searched and opened automatically.

Table 5: SmartView entry window: **General settings**

Section	Check box / combo box/ list	Description
Camera	☐ Automatically open camera views on startup	Activate this check box to view all connected cameras automatically, when corresponding card is opened.
	☐ Selected cameras only	Activate this check box to show only selected cameras from the list, when SmartView is started. The list shows all cameras, that have been connected to your PC/laptop and have been opened with Smart-View. Select one or more cameras by clicking on the camera name.
Image file type	Default type used by 'Save' & 'Save as'	Choose your standard image file type for the **Save** and **Save as** operation. The following types are available: bmp, jpg, gif, tif, png
	☐ Override extension entered by the user	If you activate this check box, all settings made within the **Save** and **Save as** command are ignored.
Camera view settings	☐ Always scale image to view size	Standard setting for each window. Activating this check box will scale the camera image to the SmartView viewer window size. Otherwise the camera image size is not scaled to the viewer window size.
	☐ Resize camera view on resolution changes	Standard setting for each window. Activate this check box to adapt the viewer window to each resolution change of the image size (fixed modes) or the AOI size (Format 7 settings).

Table 5: SmartView entry window: **General settings**

Troubleshooting

If the image is completely black, completely white or the image quality is poor, then try the following steps:

- If not done yet, remove the lens cap.
- If the image is black, open the aperture. If the image is white, close the aperture.
- If the image quality is poor, try changing the focus.

If you still don't get any image at all, then try the following steps:

- Check the FireWire plug of your camera and PC/laptop.
- Check the LEDs on the back of the camera.

Icon bar of SmartView (main window)

The following table shows all functions of **SmartView (main window)** available via the icon bar.

Icon	Function	Description
	Save	Saves the image(s) to the file you have previously set with **Save as...** command.
	Edit Settings	Opens a settings window Here you can adjust the settings for the standard registers, e.g. exposure time or gain (IIDC specification) and the settings for advanced AVT features. The following tabs are available: • Format • Ctrl 1 • Ctrl 2 • Ctrl 3 (only for certain color cameras) • Trig/IO • LUT/Shdg. • Adv 1 • Adv 2 • Adv 3 (not all cameras) • CMOS (only for cameras with CMOS sensor) Some settings can only be changed when the camera is in idle mode.

Table 6: Functions of SmartView available via **icon bar**

Icon	Function	Description
	Direct register access	Opens a window (Direct Access dialog box) For an example see Figure 3: SmartView: example of DirectAccess dialog (Marlin F-080C-30fps) on page 22. Enables you to access all features by their address and to change the register of the AVT camera directly. All settings can be changed while the camera is running, although some features will only take effect after you stop and restart the camera.
	Start iso	Acquires **images continuously**
	Multi-shot	Acquires multi images as set in the **Edit Settings → TriggerI/O** tab → **Multishot counter** combo box
	One-shot	Acquires **only one image**
	Stop	Stops acquiring images (free-run or multi-shot)
	Record	Records images to individual file names you have set under **File → Recording options...**
	Display image coordinates	Displays the image coordinates in a yellow bubble box on top of mouse cursor 
	Display image coordinates and image values	Displays the image coordinates and the image values (intensity) in a yellow bubble box on top of mouse cursor  color image  b/w image

Table 6: Functions of SmartView available via **icon bar**

Icon	Function	Description
	Display format options in status bar	Displays the format options in the status bar. Example: 2080x1540x8 (RAW8)
	Increase zoom factor	Increases the image zoom factor
	Decrease zoom factor	Decreases the image zoom factor
	Quick read settings from file	Reads settings from file to which you have written your settings.
	Quick write settings to file	Writes settings to the file you have choosen.
	About	Shows version number, copyright information and link to Allied Vision Technologies: http://www.alliedvisiontec.com/

Table 6: Functions of SmartView available via **icon bar**

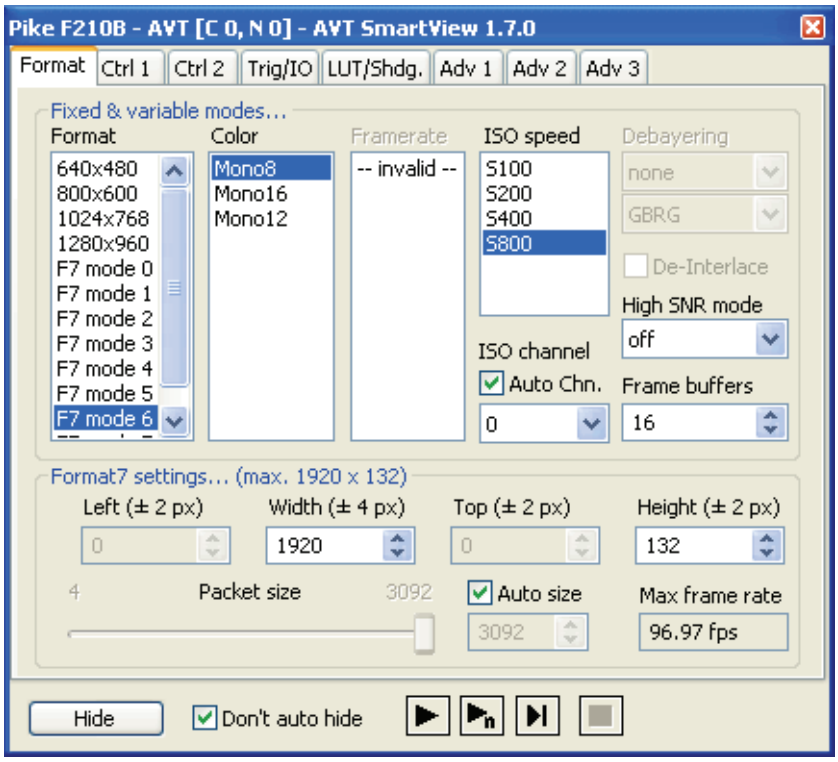


Figure 2: SmartView: example of **Edit Settings** dialog (PIKE F-210B)

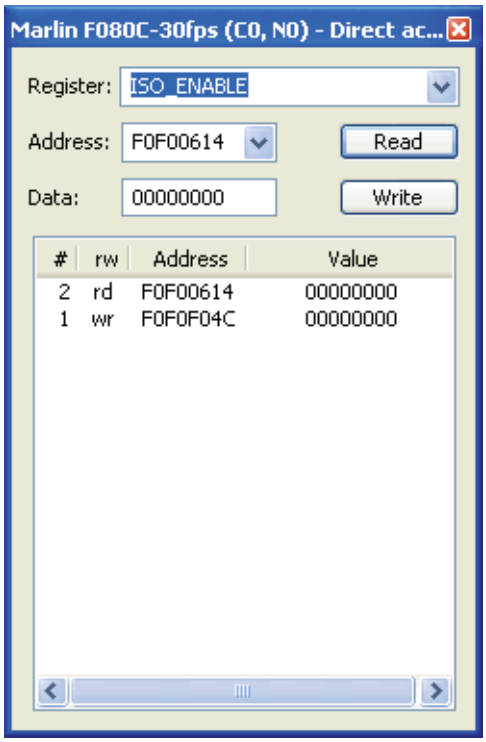


Figure 3: SmartView: example of **DirectAccess** dialog (Marlin F-080C-30fps)

Menu structure of SmartView (main window)

Menu	Submenu	Description
File	Save Ctrl+S	Saves the image(s) to the file you have previously set with **Save as...** command.
	Save as... F12	Click here to save an image to hard disk or network drive. Choose file format (BMP, JPEG, GIF, TIFF, PNG) and directory. After that you can save an image to this file by clicking on **Save**.
	Recording options...	Click here to configure the recording options. After that your are able to save images in streaming format, that means one file with a successive numbering per image. See Chapter Streaming images: recording options on page 57.
	Use deep images Ctrl+Shift+P	Allows to use images with more than 8 bit (depending on camera model). See Chapter Using deep images (only MONO16 mode or RAW16 color mode) on page 58.
	Exit Alt+X	Click here to exit main window of SmartView.

Table 7: Functions of SmartView available via **menu**

Menu	Submenu	Description
Camera	Free-run Alt+R	Acquire continuous images.
	Multi-shot Alt+M	Acquire n images.
	One-shot Alt+G	Acquire one image.
	Stop Esc	Stop the free-run or multi-shot modus.
	Record Ctrl+R	Record individual images according to the settings you have made in **File → Recording options...** See Chapter Saving and streaming images on page 55.
	Settings → Settings dialog Alt+E	Opens the **Settings** dialog. • For **short overview** see Chapter Edit settings window (for specialists) on page 28. • For **deep description** on complex, difficult to understand settings see Chapter Operating AVT cameras with SmartView on page 50.
	Settings → Quick Read settings Ctrl+Shift+R	Reads settings from file to which you have written your settings.
	Settings → Quick Write settings Ctrl+Shift+W	Writes settings to the file you have choosen.
	Settings → Select Settings file...	Choose a file where your settings will be stored.
	Settings → Read Settings from external file...	Choose an external file from which the stored settings will be read.
	Settings → Write Settings to external file...	Choose an external file to which your settings will be stored.
	Settings → Search for camera by GUID	Searches by camera ID; Default: activated
	Direct access dialog Alt+D	Opens a window (Direct Access dialog box) Enables you to access all features by their address and to change the register of the AVT camera directly. All settings can be changed while the camera is running, although some features will only take effect after you stop and restart the camera.
	Options → Automatically load settings on camera open	Activate check box to load settings automatically when the camera is opened.
	Options → Automatically save settings on camera close	Activate check box to save settings automatically when camera is closed.
	Options → Start Free-Run automatically on camera open	Activate check box to start free-run automatically when the camera is opened.
	Options → Start One-Shot on camera open	Activate check box to start one-shot when the camera is opened.
	Options → Set shutter, gain and white balance automatically	Activate check box to set shutter, gain and white balance automatically.
	Options → Start with display maximized on camera open	Activate check box to start with the SmartView display maximized when the camera is opened.

Table 7: Functions of SmartView available via **menu**

Menu	Submenu	Description
View	☑ Toolbar	Activate check box to display the toolbar.
	☑ Status bar	Activate check box to display the status bar.
	Set display size to ▸	Current AOI Alt+9 Current image size Alt+8 Ratio-corrected image size Ctrl+Shift+A 160x120 Alt+1 320x240 Alt+2 640x480 Alt+3 800x600 Alt+4 1024x768 Alt+5 1280x960 Alt+6 1600x1200 Alt+7 User size... Alt+0 The listed formats set the display size of the window and are independent from camera types. If the display of your monitor is smaller than the chosen display size, then the display format is resized automatically to fit to your monitor.
	Additional information ▸	The following information is available: Coordinates Coordinates/Pixel values Image info Ctrl+Shift+I Histogram Ctrl+Shift+H Secure Image Stamp Info (only Marlin, Pike)
	☑ Disable display of image	Activate check box to disable the display of an image.
	Zoom in Alt+"+"	Click here for zooming in an image.
	Zoom out Alt+"-"	Click here for zooming out an image.
	Set zoom=1 Alt+Ctrl+"-"	Click here for setting zoom to 1.
	Set maximum zoom Alt+Ctrl+"+"	Click here for setting maximum zoom.
	☑ Resize view on format change	Standard setting for each window. Activate this check box to adapt the viewer window to each resolution change of the image size (fixed modes) or the AOI size (Format 7 settings).
	☑ Always scale image to window Alt+S	Standard setting for each window. Activating this check box will scale the camera image to the SmartView viewer window size. Otherwise the camera image size is not scaled to the viewer window size.
	Reset position of settings dialog	Click here for to reset the position of the settings dialog. Use this if you cannot see the settings windows after starting SmartView.

Menu	Submenu	Description
Extras	Set async speed	The following values are available: S100, S200, S400, S800 (only 1394b cameras). Use manual settings if you want to limit async. communication with camera to lower speed. Helpful in the case of longer cables (e.g. 20 m at S200) or needed for communication over up to 100 m using network cable at S100. ☑ AUTO (activate check box for auto-detection of max. async speed)
	☑ Allow async block transfer	Disabling async. block transfer may be helpful for the communication with third party cameras.
	☑ Drop faulty frames	Activate check box for dropping defective frames. A frame is called defective, if during transmission of the frame an error occurred.
	Auto-flush logging file	Activate check box for logging messages immediately into logging file. If check box not activated, messages will only be logged when buffer full. For more information see Chapter Using logging functionality of SmartView (*.cmd file) on page 81. Default: not activated
	Adjust channels... Alt+Ctrl+A	Only Pike cameras: see **PIKE Technical Manual**, Chapter: **Channel balance**
	View Secure Image Stamp info...	Only Marlin, Pike cameras: see Chapter Secure image signature (SIS) (MARLIN, PIKE) on page 108
	Sequence dialog...	Only Pike cameras: see Chapter Sequence mode (PIKE) on page 105

Table 7: Functions of SmartView available via **menu**

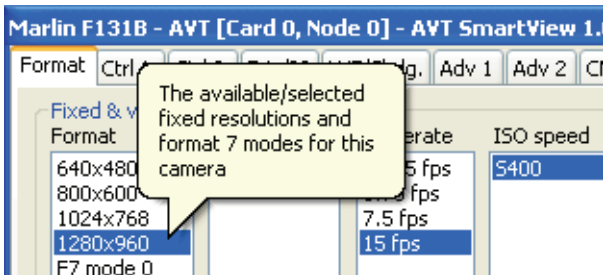
Menu	Submenu	Description
Help	About AVT SmartView...	Shows version number, copyright information and link to Allied Vision Technologies: http://www.alliedvisiontec.com/
	Tooltip help for settings	Activate **Tooltip help for settings** to get help when moving mouse cursor over window elements (buttons, lists, check boxes etc. of main window and **Edit settings** window). You will get tooltips in form of bubble help. Example: 

Table 7: Functions of SmartView available via **menu**

Edit settings window (for specialists)

Where to find

SmartView (main window):  **Edit settings**

Overview: Edit settings window

Note

Display of tabs depends on camera types.

If a camera does not have tab-specific features implemented, the corresponding tab will not be displayed.

Depending on camera type the following tabs may be displayed:

- **Format** tab
- **Ctrl 1** tab
- **Ctrl 2** tab
- **Ctrl 3** tab
  (only PIKE/DOLPHIN color cameras and GUPPY interlaced color cameras)
- **Trig/IO** tab
- **LUT/Shdg.** tab
- **Adv 1** tab
- **Adv 2** tab
- **Adv 3** tab
- **CMOS** tab (only CMOS cameras)

Format tab descriptions

Section	Check box/combo box/list/slider	Description
Fixed & variable modes... [to be continued on next page]	Format	Lists the **fixed resolutions** and **Format_7 modes** of the camera model. Depending on the camera model the following formats may be available: • Fixed formats – 320x240 – 640x480 – 800x600 – 1024x768 – ... • Format_7 modes – F7 mode 0 – F7 mode 1 – ...
	Color	Lists the available **color modes** of the selected fixed format / Format_7 mode. Depending on the camera model and the selected resolution / F7 mode the following color modes may be available: Mono8, YUV411, YUV422, RGB8, RAW8, RAW16, RAW12...
	Framerate	Lists available **frame rates in fixed modes**. List is invalid for Format_7 modes.
	ISO speed	Lists available **ISO speeds**. 1394a: S100, S200, S400 1394b: additional S800 The camera will use this speed for the video data transmission, async. communication may use another speed. See Submenue Set async speed on page 26.
	Debayering	See Chapter Debayering algorithms on page 50.
	High SNR mode	Choose number of images for **High SNR mode**. This is an image averaging function. See **PIKE Technical Manual**, Chapter **High SNR mode (High Signal Noise Ratio)**

Table 8: SmartView Edit settings: **Format** tab

Section	Check box/combo box/list/slider	Description
Fixed & variable modes... [continued]	ISO channel 	Set no. of ISO channels. (This is a 4-bit address to identify the source of a video data stream). Normally set to **Auto Chn.** Otherwise all cameras connected to one bus must have a **different** ISO channel.
	Frame buffers 	By default SmartView reserves 16 **frame buffers** per camera in main memory. You can change that to a max. limit, which is dependant on your system and OS. After changing, SmartView displays how many buffers it currently uses (e.g. 2/786) so as not having to drop any frames coming from the camera. The minimum of 3 ensures that normally no image from camera is to be discarded because of no available memory.
Format7 settings... (max. abcd x efgh)	Left/Width/Top/Height 	These are the **AOI settings** (only available in Format_7 modes) For more information see Chapter Setting AOI (Format_7 settings) on page 94. Adjust **width** and **height** of camera image. For images smaller than maximum image dimensions: adjust upper left corner via **left** and **top** position of camera image on image sensor.
	Packet size 	To change packet size first deactivate **Auto size** check box.
	☐ Auto size 	Deactivate check box to adjust **packet size for isochronous packets** (via slider or combo box).
	Max frame rate 	Shows the **maximum theoretical frame rate**. See Chapter Calculating frames per second on page 97.

Table 8: SmartView Edit settings: **Format** tab

Ctrl 1 tab descriptions

If available, you can do the following:

- Switch on/off the feature, by activating/deactivating the **On** check box.
- Switch on/off auto function, by activating/deactivating the **Auto** check box.
- Do one-push action, by clicking  button.
- Adjust the feature manually by moving the slider or changing the values directly (entering numbers or clicking up/down arrows.)

Check box/combo box/list/slider	Description
Target grey level 	This is the **auto exposure**. Works in conjunction with auto shutter and auto gain. Target grey level corresponds to **Auto_exposure** register 0xF0F00804 (IIDC). Increasing the **auto exposure** value (aka **target grey** value) increases the average brightness in the image and vice versa.
Shutter 	Adjust the electronic shutter **manually**. The set value is to be multiplied by the time base, which can be set here: Check box Timebase on page 40
Gain 	Adjust the gain **manually.** Gain will change on the fly. The possible range depends on the camera model. The value is to be multiplied by a constant factor which is dependant on the camera model. A higher gain produces greater image noise. This reduces image quality. For this reason, try first to increase the brightness, using the aperture of the camera optics and/or longer shutter settings.
Brightness 	Adjusting the **brightness** manually changes the IIDC register brightness at offset 800h. This effectively changes the offset in the image. The range is multiplied by a factor, dependant on the camera model.

Table 9: SmartView Edit settings: **Ctrl 1** tab

Check box/combo box/list/slider	Description
Gamma 	Switch **Gamma** off/on 0 = Gamma off 1 = Gamma on This is a nonlinear stretching of the darker parts and compression of the brighter parts in the image to accommodate certain human and display non-linearities. The actual function used is described in the camera manual. When using the LUT feature and the gamma feature pay attention to the following: • gamma ON → look-up table is switched ON also • gamma OFF → look-up table is switched OFF also • look-up table OFF → gamma is switched OFF also • look-up table ON → gamma is switched OFF
White balance 	Only color cameras Here you can do manual and automatic white balance. White balance is applied so that non-colored image parts are displayed non-colored. From the user's point, the white balance settings are made in register 80Ch of IIDC V1.3 or IIDC V1.31 (depending on camera model). The values in the U/B_Value field produce changes from green to blue; the V/R_Value field from green to red.
Sharpness 	Only available for DOLPHIN, OSCAR, MARLIN and PIKE The color models are equipped with a two-step sharpness control, applying a discreet horizontal high pass in the green/Y channel. See **OSCAR/MARLIN/PIKE Technical Manual**, Chapter **Sharpness**.

Table 9: SmartView Edit settings: **Ctrl 1** tab

Ctrl 2 tab descriptions

If available (hue/saturation), you can do the following:

- Switch on/off the feature, by activating/deactivating the **On** check box.
- Switch on/off auto function, by activating/deactivating the **Auto** check box.
- Do one-push action, by clicking  button.
- Adjust the feature manually by moving the slider or changing the values directly (entering numbers or clicking up/down arrows.)

Check box / combo box/ list / slider	Description
Hue 	Adjust **Hue** manually. Hue performs a (slight) global shift of all colors in the image.
Saturation 	Adjust **Saturation** manually. Saturation changes the amount of the coloring from nominal down to zero or up to 200%.
Auto-function AOI	This is a feature to limit the area in which parameters for the auto functions (auto gain, auto shutter, auto white balance) are calculated to a fraction of the image size. Can be used to exclude e.g. the sky from the gain/shutter regulations or perform auto white balance in only a specific subarea of the image. Switch on/off **auto-function AOI** by activating/deactivating **Enable** check box. Off uses the whole image size for auto function parameters. Enter values: AOI width/height/left (coordinate) and top (coordinate). Allowed steps are shown in the fields X-Unit/Y-Unit. To highlight the AOI in the image, activate **Show AOI** checkbox.
Auto shutter range	Choose standard (Std.) or extended (Extd.) **auto shutter range**. Change lower and upper limit to restrict the auto shutter to operate between these limits and **not** the whole range. Useful for applications where a too long shutter time would cause e.g. motion blurring in the image.
Auto gain range	Change **lower and upper limit**. Change lower and upper limit to restrict the auto gain to operate between these limits and **not** the whole range. Useful for applications where a too high gain would cause noise in the image.

Table 10: SmartView Edit settings: **Ctrl 2** tab

Ctrl3 tab descriptions (only color progressive)

Ctrl3 tabs have 2 variants:

- Description for color progressive cameras see below
- Description for color interlaced see Chapter Ctrl3 tab descriptions (only color interlaced) on page 35

Progressive cameras

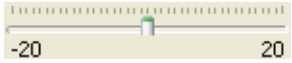
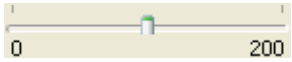
Check box / combo box/ list / slider	Description
Extra features during debayering	These two features (hue/saturation) are only available if camera transmitting RAW image and SmartView doing the debayering process, using one of the following algorithms: • 2x2 YUV422 • 2x2 LCAA • 2x2 LCAA+V It effectively changes both hue and saturation during debayering on the PC. See Chapter Additional adjustment of hue and saturation (only Marlin/Guppy) on page 52.
Hue 	Adjust **Hue** during debayering on the PC manually. (values in degrees)
Saturation 	Adjust **Saturation** during debayering on the PC manually. (values in percent)

Table 11: SmartView Edit settings: **Ctrl 3** tab (**progressive cameras**)

Ctrl3 tab descriptions (only color interlaced)

Ctrl3 tabs have 2 variants:

- Description for color progressive cameras see Chapter Ctrl3 tab descriptions (only color progressive) on page 34
- Description for color interlaced see below

Interlaced cameras

Check box / combo box/ list / slider	Description
Advanced white balance	For the interlaced color GUPPYs (GUPPY F-038/038 NIR/044/044 NIR) using complementary color filters (Cy, Mg, Gr, Ye) there is a non-standard (non-IIDC) register for white balance (0xF10080C4 and 0xF10080C8). This register is similar to the standard white balance CSR: here each of the four colors can be controlled independently. See the four sliders in this table. **Note:** One-push white balance is **not available.**
Green/Cyan 	Adjust **advanced white balance** manually for • **Green** in **Format_7 Mode_1** or • **Green/Cyan** in **Format_7 Mode_0**
Magenta/Yellow 	Adjust **advanced white balance** manually for • **Magenta** in **Format_7 Mode_1** or • **Magenta/Yellow** in **Format_7 Mode_0**
Cyan/Magenta 	Adjust **advanced white balance** manually for • **Cyan** in **Format_7 Mode_1** or • **Cyan/Magenta** in **Format_7 Mode_0**
Yellow/Green 	Adjust **advanced white balance** manually for • **Yellow** in **Format_7 Mode_1** or • **Yellow/Green** in **Format_7 Mode_0**

Table 12: SmartView Edit settings: **Ctrl 3** tab (**interlaced cameras**)

Trig/IO tab descriptions

Section	Check box / combo box/ list / slider	Description
Trigger	Mode 	The following trigger modes may be available (depending on camera model): • Internal (continuous output) • Edge mode(0) • Level mode(1) • Progr. mode(15) aka Trigger_Mode_15 Beside **Internal** the other modes require a signal at the trigger pin of the I/O (HIROSE) connector to get an image.
	Polarity 	Polarity of trigger signal (depending on camera model and mode) Edge mode(0) and Progr. mode(15): • Falling • Rising Level mode(1): • Low act. • High act.
Multishot counter		Choose number of images the camera will take.
Trigger delay	☐ On	Delay between trigger signal and image acquisition On/off only available, when Edge mode(0)
	 µs	Delay time in µs for exposure start after trigger signal
Integration enable delay	☐ On	Delay between integration (shutter) and output signal integration enable (IntEna)
	 µs	Time in µs for delay of integration enable event (IntEna)

Table 13: SmartView Edit settings: **Trig/IO** tab

Section	Check box / combo box/ list / slider	Description
Input/Output pins	List of all inputs and outputs of a camera.	The number of inputs and outputs depend on the camera model.
	Mode column	For each pin you can choose one of the following modes: Input ⇨ (Off/Trigger) Output ⇨ (Off/Direct/IntegrationEnable/ FrameValid/Busy/FollowInp). Query the camera manual for details on the signals.
	Invert column	This is the **polarity bit**. The former **Polarity** column for the input/output pins is now called **Invert** to clarify the use of this bit. A polarity of **low** in former SmartView versions is now read as Invert:No, meaning the same.
	State column	Lists the status of the input/output pin (**Low** or **High**).
	☐ Poll the I/O state continually	Activate check box to update the state of pins every 200 ms.

Table 13: SmartView Edit settings: **Trig/IO** tab

LUT/Shdg. tab descriptions

Note

- For a detailed description on **LUT** see Chapter Working with LUTs on page 71.
- For a detailed description on **shading** see Chapter Working with shading on page 64.

Section	Check box / combo box/ list / slider	Description
Lookup tables	☐ LUT operation on	Camera-internal LUT on/off
	using LUT #	Choose camera-internal LUT
	Display LUT	Displays the uploaded LUT in an extra window.
	Upload	Uploads the selected data into the chosen LUT number.
	into LUT #	Choose LUT number for data upload.
	LUT file ...	Only available when choosing **data from the file below** Choose directory and file for upload process.
	Import data from column starting at	Only available when choosing **data from the file below** Choose column where LUT is stored and choose row number where LUT starts.

Table 14: SmartView Edit settings: **LUT/Shdg.** tab

Section	Check box / combo box/ list / slider	Description
Shading correction	☐ Shading correction on	Shading correction on/off
	☐ Show shading data as image	Select shading image as camera output.
	Build shading data from	Builds camera-internal shading image. Choose number of images to be averaged (in order to reduce noise...) for building the shading image.
	Flash Save to flash	Use option **Flash** to save/load shading image in user sets (inside camera).
	Load from flash	Loads a shading image stored in user sets (inside camera).
	Clear flash	Clears shading image stored in user sets (inside camera).
	File Download & save as file	Use option **File** to save/load shading image to/from an external file.
	Upload from file	Uploads an external stored shading image.
	Shading data file ...	Choose different external files for uploading/saving. The combo box lists recently used shading files (for upload/save operations).

Table 14: SmartView Edit settings: **LUT/Shdg.** tab

Adv 1 tab descriptions

Section	Check box / combo box/ list / slider	Description
Extended shutter	µs	**Absolute time of exposure** in µs. Settings override the standard shutter settings (and vice versa). Max. settings depend on camera model.
Std. shutter timebase	Timebase	AVT timebase controls the base factor for the standard shutter register. Camera needs to be stopped for changes in this register. Shutter value (Slider Shutter on page 31) is multiplied with time base.
Test images	Active image	Choose one of the camera-internal images as image source. Depending on the camera model you can choose between different test images. See AVT **Technical Manuals**.
Mirror image	☐ Horizontal ☐ Vertical	Depending on the camera model you can flip the image horizontally/vertically. This is done in hardware in the camera.

Table 15: SmartView Edit settings: **Adv 1** tab

Section	Check box / combo box/ list / slider	Description
Deferred transport	☐ Hold images	Deferred image transport is available for PIKE, MARLIN, DOLPHIN, OSCAR cameras. Activate **Hold images** to stop image transfer to the viewer (SmartView) and store the image in FIFO.
	☐ Fast capture	Activates **FastCapture** mode of AVT deferred image transport. The sensor is read out at its maximum speed. Alternatively the sensor is read out at a speed according to the transmission settings.
	# of images to send	Choose number of images which will be sent when clicking on Send images. Set to 0 to send all images in FIFO.
	FIFO size	Displays size of internal image FIFO in terms of frames.
	FIFO used	Lists number of images currently held in FIFO.
	Send images	Read(s) image(s) from FIFO and send images over bus to SmartView.
	☐ Lock image capture	Prevents AVT SmartView from sending ISO-enable/one-shot command to the camera when using the black arrows on bottom of window.  With **Lock image capture** activated the above buttons prepare SmartView viewer window without starting the camera (ISO enable).
		With **Lock image capture** on, clicking on red arrows (free-run, one-shot) starts camera and images are captured into FIFO.  Capture images into the FIFO using free-run mode.  Capture images into the FIFO using one-shot mode.

Table 15: SmartView Edit settings: **Adv 1** tab

Section	Check box / combo box/ list / slider	Description
Version information	Microcontroller/Order Number/ FPGA/Serial number	Lists the version numbers and IDs of firmware (microcontroller/FPGA), the order number of the camera and the serial number of the camera.

Table 15: SmartView Edit settings: **Adv 1** tab

Adv 2 tab descriptions

Section	Check box / combo box/ list / slider	Description
Serial port (IIDC-1.31)	Bitrate 	Choose **bit rate for camera's RS232 serial port**. It can be used to send and receive data to and from an external device, connected to the camera.
	Char length 	Choose **character length for serial input/ output**: • 7 bits • 8 bits
	Parity 	Choose **parity for serial input/output** • none • odd • even
	Stop bits 	Choose **number of stop bits for serial input/output** • 1 stop bit • 1.5 stop bits • 2 stop bits
	Serial port off Transmitter on Receiver on Both on	Disable serial input/output of camera Enable only serial sending Enable only serial receiving Enable bidirectional serial input/output
	Transmit 	Enter text to be transmitted to camera.
	Receive	Any data which is received by the camera via RS232 will be displayed here until the buffer is full.

Table 16: SmartView Edit settings: **Adv 2** tab

Section	Check box / combo box/ list / slider	Description
Image stamp & counters	☐ Enable	**Only MARLIN or PIKE CCD cameras**: available with firmware V3.03 or newer See **MARLIN** or **PIKE Technical Manual**, Chapter **Secure image signature (SIS)** Activate check box for writing time stamp (a very precise clock), frame counter and trigger counter data directly into image (PIKE: also additional SIS data). After activating check box these data are stamped at a selectable row position left in the image.
	Row	Choose where these data are put into the image: Row 0: top of image Row 1,2,...: rows below top of image Row -1: bottom of image Row -2,-3,...: rows above bottom of image
	Show SIS...	Click to **display SIS information** (secure image signature)
	User value	Only PIKE: Enter a user value which will be written into the camera.
	Frame Counter Reset Trigger Counter Reset Display ☑	Frame counter and trigger counter can also be read out asynchronously from registers (i.e. not out of image). Activate **Display** check box for displaying frame/trigger counter numbers. **Frame counter** field displays number of images taken since clicking on Reset. **Trigger counter** field displays number of external trigger events since clicking on Reset.

Table 16: SmartView Edit settings: **Adv 2** tab

Section	Check box / combo box/ list / slider	Description
Color	☐ Color correction	Depending on camera model: Activate check box for using built-in color correction matrix. For certain camera models the matrix coefficients can be modified using **Adv3** tab. **Note**: It is **not** an intuitive procedure to change the coefficients of a 3 x 3 matrix in the RGB color domain!
	☐ Local color anti-aliasing	Only **Dolphin F-145C**: Activate check box for less horizontal color fringe.
Camera reset	Soft reset Initialize	Soft reset: camera feature Click Soft reset for rebooting the internal logic in the camera (FPGA) and forcing the 1394 bus to reset. Click Initialize for setting FPGA back to default values. No reset of the 1394 bus.
User sets (Memory channels)		See **Technical Manuals**, Chapter **User profiles**. Used to store/recall custom settings in/from camera.
	Save	Saves current settings in chosen user set (1..3).
	Load	Loads settings from chosen user set (1..3) without rebooting camera.
	Set as default	Starts the chosen user set (1..3) on next camera start automatically.
	Set No.	Choose desired user set number for save/load/set as default action. User Set No. 0 = factory setting (can not be changed) User Set No. 1..3 = save/load/set as default actions possible

Table 16: SmartView Edit settings: **Adv 2** tab

Adv 3 tab descriptions

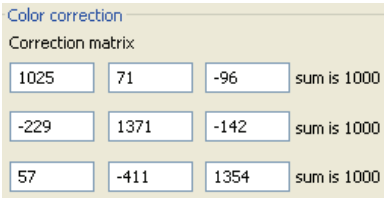
Section	Check box / combo box/ list / slider	Description
Color correction	Correction matrix  Example shows Pike F-210C	Only cameras with color correction and correction matrix feature implemented See **PIKE Technical Manual**, Chapter **Color correction** To change matrix elements first activate **color correction** check box on **Adv 2** tab. Change value in each of the nine fields of correction matrix manually. Enter values between -1000 and +2000. 1000 means a factor of 1.0 The row sum is displayed: Pay attention to the following: • The sums of all rows should be equal to each other. If not, you get tinted images. • In order for white balance to work properly ensure that the row sum equals 1000. • Each row should sum up to 1000. If not, images are less or more colorful.

Table 17: SmartView Edit settings: **Adv 3** tab

CMOS tab descriptions

(only Guppy F-036 and Marlin F-131)

Note To use this feature number of knee points must be greater 0.

Section	Check box / combo box/ list / slider	Description
High dynamic range mode **(only Guppy F-036)**	**(only Guppy F-036)** ☐ HDR mode on Voltage #1 Voltage #2 Knee points	For Guppy F-036 see **GUPPY Technical Manual**, Chapter **HDR (high dynamic range) (GUPPY F-036 only)** To use this feature first change number of knee points to value greater 0. Then activate **HDR mode on** check box. **Guppy F-036**: In **Knee points** choose 1 or 2 and enter Voltage value in **Voltage #1** (and **Voltage #2**).

Table 18: SmartView Edit settings: **CMOS** tab

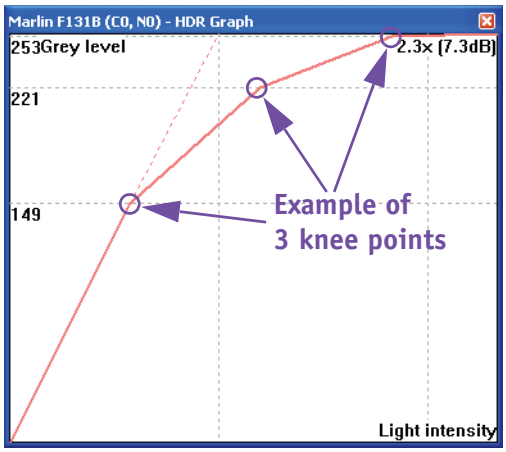
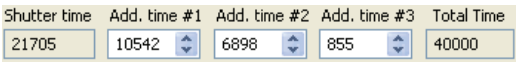
Section	Check box / combo box/ list / slider	Description
High dynamic range mode **(only Marlin F-131)**	**(only Marlin F-131)** Knee points	For Marlin F-131 see MARLIN Technical Manual, Chapter **High dynamic range mode (MARLIN F-131B/C only)** To use this feature first change number of knee points to value greater 0. Choose number of knee points: 1, 2 or 3.
	HDR mode on	Then activate **HDR mode on** check box. **Marlin F-131**: Choose **Easy mode** or **Expert mode** by clicking on the radio button.
	Display graph	For a graphical on-the-fly representation of the HDR mode activate **Display graph** check box. 
	Easy mode	In **Easy mode** put slider in the desired position (the knee point values will be set automatically). An Easy mode value for the dynamic gain increase in dB will be shown (7.4 dB in our example). Example:  Control your setting in the graph.
	Expert mode	In **Expert mode** enter values for Add.time #1 (#2, #3) manually. Example:  Shutter time and Total time are displayed. Control your settings in the graph.

Table 18: SmartView Edit settings: **CMOS** tab

Section	Check box / combo box/ list / slider	Description
DSNU/Blemish pixel correction **(only Marlin F-131B)**	**(only Marlin F-131B)** ☐ DSNU correction on	See **MARLIN Technical Manual**, Chapter **DSNU & blemish correction (MARLIN F-131B only)** DSNU = Dark signal non-uniformity Close the lens or the aperture so that no light hits the sensor for DSNU and blemish correction procedures. Activate check box to use DSNU.
	☐ Blemish correction on	Activate check box to use blemish correction. This will identify and compensate for defective pixels by using intact neighbors.
	☐ Show correction data image	Activate check box for displaying correction data as image.
	Build Correction data using	Builds DSNU/blemish pixel correction image from the number of images you have chosen (possible numbers are 1, 2, 4, 8, 16).
	Save data to flash	Saves the correction data into the correction data storage.
	Load data from flash	Loads the factory settings into the correction data storage.
	Delete correction data	Empties the correction data storage.

Table 18: SmartView Edit settings: **CMOS** tab

Direct register access window

Note The height of this window can be adjusted, but not the width (although double arrows are shown).

Definition **Direct access** window is a tool to write data into registers directly and read out data from registers directly (in hex code).

Check box / combo box / list		Description
Register		Lists all accessible registers by the clear names.
Address		The address of the chosen register is displayed immediately. Alternatively you can enter an address in hex code manually.
Data		Lists the data that is read from or written to the chosen register.
Read	Read	Reads data from chosen register.
Write	Write	Writes data in chosen register.
List	**#** column	Counts the number of read/write actions.
	rw column	Displays type of action: rd=read wr=write
	Address column	Displays the address of read/ write action in hex code.
	Value column	Displays the value of read/write action in hex code.

Table 19: Smart View **Direct access** window: descriptions

Operating AVT cameras with SmartView

In this chapter you will find descriptions how to operate AVT cameras with the **SmartView** software. The most important camera functions are explained and you learn how to use these functions effectively with **SmartView**.

Debayering algorithms

Conditions

- Only PC debayering (via SmartView)
- Only color cameras
- Works only in RAW8/RAW12/RAW16/Mono8 mode (depending on specific camera type); in RAW12/RAW16 mode only 2x2 algorithm available

Where to find

SmartView: **Edit settings → Format** tab

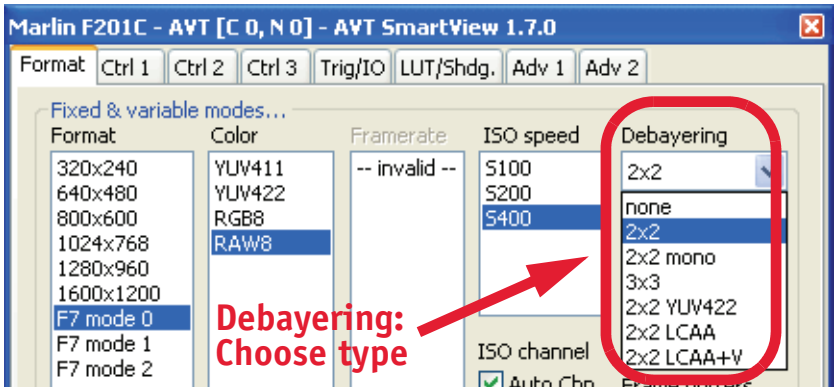


Figure 4: Debayering: Example of choosing type (Marlin F-201C)

Only Marlin/Guppy (progressive): additional adjustment of hue and saturation possible (using methods YUV422/LCAA/LCAA+V):

SmartView: **Edit settings → Ctrl3** tab (color **progressive**)

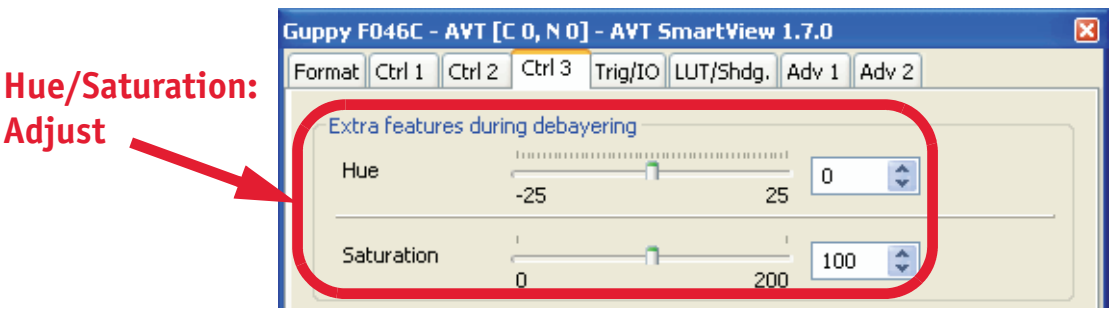


Figure 5: Hue and saturation: Example of additional adjustment (Guppy F-046C)

Description

The following Debayering algorithms are available (depending on specific camera type):

Debayering algorithm	Choose type	Description	Advantages (+) and disadvantages (-)
none	**none**	No Debayering	
2x2	**2x2**	Debayering is done on a 2x2 pixel basis	+ fastest (lowest CPU consumption) algorithm - color fringe
	2x2 mono	Showing only mono image (luminance Y only) of 2 x 2 Debayering	+ no color fringe (b/w image) - no color information
3x3	**3x3**	Debayering is done on a 3x3 pixel basis	+ less color fringe - less resolution - more CPU consumption
2x2	**2x2 YUV422**	Same algorithm as in AVT Marlin or Dolphin cameras (produces the same color output as Marlin or Dolphin in YUV422 mode). Color low-pass filtering with two horizontally neighboring pixels	+ faster algorithm compared to LCAA an LCAA+V - more horizontal color fringe than LCAA
	2x2 LCAA	LCAA = local color anti-aliasing Color low-pass filtering with four horizontally neighboring pixels	+ less horizontal color fringe - vertical color fringe
	2x2 LCAA+V	LCAA+V = local color anti-aliasing including vertical color smoothing Color low-pass filtering with a window of four horizontal and two vertical pixels	+ less horizontal and less vertical color fringe - slowest algorithm (highest CPU consumption)

Table 20: Description of Debayering algorithms

The following Bayer patterns are available (depending on specific camera type):

Bayer pattern	Description
auto. pattern	Default
RGGB	Use one of these patterns, if e.g. older SmartView versions use the wrong Bayer pattern. The first two letters are of 1st row of sensor, the last two letters are of 2nd row of sensor. R=red; G=green; B=blue
GRGB	
GBRG	
BGGR	

Table 21: Description of Bayer patterns

Additional adjustment of hue and saturation (only Marlin/ Guppy)

- The following three types (YUV422, LCAA, LCAA+V) convert the transported RAW8 image to the YUV space.
- Here the (different) low-pass filtering of the color information (U and V values) is done to reduce color fringe at edges.
- Hue and saturation require intensive computations in YUV. If hue is 0 (no hue rotation) and saturation 100 (=100%) a more efficient back transformation is done.
- After that conversion to BGR space (Windows RGB) is done.

Advanced white balance (only Guppy color interlaced)

Conditions

- Only Guppy color interlaced cameras
- Only Format_7 Mode_0 and Mode_1

Where to find

Only Guppy (interlaced): adjustment of advanced white balance possible:

SmartView: Main window: **Edit settings → Ctrl3** tab

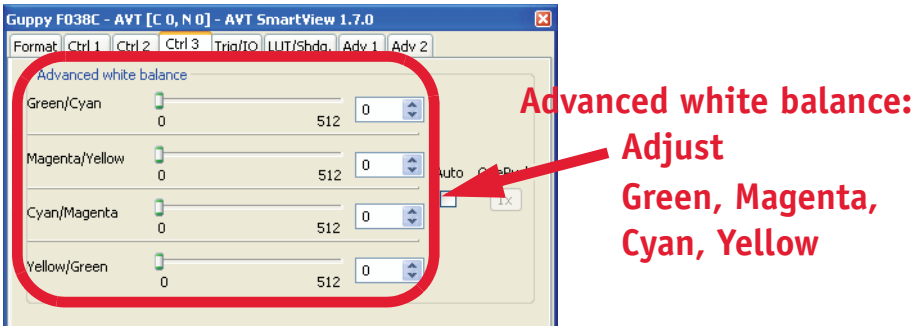


Figure 6: Advanced white balance: Example of adjustment G, Mg, Cy, Ye (Guppy F-038C)

Description

Guppy interlaced cameras use color sensors with complementary color filters (Green, Magenta, Cyan and Yellow). This sensor type is **not** covered by IIDC specification.

White balance requires a set of advanced registers to allow adjustments. In addition, there are two different Format_7 modes available:

- Mode_0 which effectively bins two rows and
- Mode_1 which is a frame integration mode

Thus Mode_0 and Mode_1 perform differently from the point of white balancing.

Format_7 Mode_0

In Format_7 Mode_0 (**field integration**, two lines are binned during sensor readout) advanced white balance is adjustable for each of the individual (binned-) pairs:

- Green/Cyan
- Magenta/Yellow
- Cyan/Magenta
- Yellow/Green

Format_7 Mode_1

In Format_7 Mode_1 (**frame integration**, two lines are binned in the software) advanced white balance is adjustable for each of the individual complementary colors:

- Green
- Magenta
- Cyan
- Yellow

There is **no** one-push function. Set the camera to auto to perform continuously white balance or switch auto off after the correct white balance is achieved.

Saving and streaming images

Conditions

- Hard disk or network drive with enough space
- Recording: Make one or more images. Then the recording options are available.
- Use deep images: only available with camera models having MONO16 (monochrome models) or RAW16 (color models)

Where to find

SmartView: Main window: File → Save

SmartView: Main window: File → Save as...

SmartView: Main window: File → Recording options

SmartView: Main window: File → Use deep images

Figure 7: Where to find: Saving and streaming images

Description

Saving images to hard disk or network drive

To save a single image to hard disk or network drive, use the **File → Save as...** command, choose directory and file name on your hard disk or network drive and choose the file format. The following file formats are available:

- BMP (*.BMP, *.DIB, *.RLE)
- JPEG (*.JPG, *.JPEG, *.JPE, *.JFIF)
- GIF (*.GIF)
- TIFF (*.TIF, *.TIFF)
- PNG (*.PNG)

File format	Compressed/lossless	Description
BMP	Uncompressed, lossless	Best file format for all your applications. All image processing tools can open BMP files.
JPEG	Compressed, lossy	JPEG is a lossy format and file size is much smaller than bmp. Be aware that you may loose details in the image.
GIF	Uncompressed, lossless	Use GIF only if it is acceptable to store image only with 256 colors.
TIFF	Uncompressed, lossless	Tagged image file format, used in the printing industry. Use TIFF only if required; e.g. your image processing tool works only with TIFF format.
PNG	Compressed, lossless	PNG has compression and works lossless.

Table 22: Description of file formats

When the file exists, you can choose **File** → **Save** or just click on the button to overwrite the file.

Streaming images: recording options

Note

Precondition: First make one or more images, otherwise the **Recording options** menu is not available.

Streaming is **not** meant in the sense of a video file. You will have to use third party software to do offline conversion from the streamed images to a video file.

Alternatively **Streampix** software from **www.norpix.com** can be recommended for directly recording to a video file.

To continuously save images to hard disk or network drive in a streaming format, use the **File → Recording options** and configure your recording in the **Recording options** window (seeTable 23: Recording options window: Descriptions on page 58).

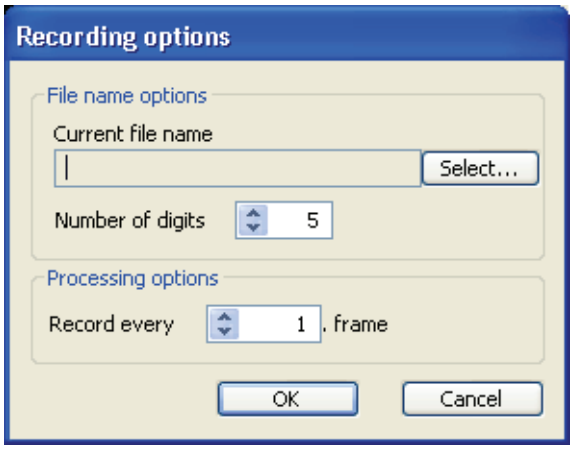


Figure 8: **Recording options** window

Note

Be aware that it is **not** guaranteed that each and every image from the camera is finally recorded to disk. SmartView is not optimized for unlimited recording.

You may improve the performance by setting the Frame buffers in **Format** tab of SmartView (seeFrame buffers on page 30) to the maximum your system (and main memory) allows. Usually this amount of images can be recorded without loss of frames.

Section	Check box / combo box/ list / slider	Description
File name options	Current file name 	After choosing number of digits click Select... , choose directory, enter file name, file format and click on **Save**.
	Number of digits 	First choose number of digits for file name of all images in streaming format. Default: 5 Example: recording_test**00000**.bmp recording_test**00001**.bmp ... recording_test**99999**.bmp
Processing options	Record every  . frame	Choose if you want to record: • every frame (1) • every second (2) • every third (3) • ... • every nth (n)

Table 23: **Recording options** window: Descriptions

To start recording click on  .

Using deep images (only MONO16 mode or RAW16 color mode)

Definition Deep images means: more than 8 bits. Images with a bit depth greater than 8 are always transported in 16 bit, due to the definition of the standard. Only certain Pike models are able to transport images in a AVT specific **Packed 12-Bit Mode**. Depending on the camera the significant bits will be between 8 and 16 bits. The bit depth is MSB aligned, that means a 10-bit image in the 16-bit format appears to have the same brightness as a 12-bit image, but the 12-bit image contains 2 more LSBs important for the finer grey level details in an image.

Availability depending on camera model:

Camera model	Deep images available?	Advantages (+) and disadvantages (-)
Dolphin b/w	Yes	Deep images have the following advantages (+) and disadvantages (-) + images with enhanced dynamic - Windows operating system is unable to display more than 8 bit. For display in SmartView the images are reduced to the upper 8 bit. Other image processing tools must be able to handle images with more than 8 bit.
Oscar	Yes	
Marlin b/w	Yes	
Pike b/w and color	Yes	
Guppy	No	

Table 24: Which cameras can use deep images?

For cameras with available deep images (MONO16 or RAW16) click on **File** → ☑ **Use deep images** to use images with more than 8 bits.

Activating/deactivating deep images is stored automatically when closing the window.

Enhancements during deep-image support are:

- Extended histogram: activating/deactivating deep images changes display of histogram instantaneously
- Tooltip pixel values are adjusted.
- Saving 16-bit images is possible: with **Save as...** command the ending *.raw is set automatically (although you can choose bmp, jpeg, gif, tiff, png only in the dialog) to the file name.
- Recording with 16-bit images is also possible.

Note

Saving images in deep image format, the file format is RAW, which means without header or trailer, as coming from the camera.

The higher byte comes first (the so called **big endian format**) and the assembled pixel value is **MSB-aligned**. That means: Unused lower bits are zero.

Example: a sequence of two 16-bit pixel „7F F0 FE 50“ of a 12-bit image refers to „07FF 0FE5“ (equals „2047 4069“ in decimal) values of the ADC.

Caution

Working with **deep images**, more processor power is needed:

The viewer may be slower leading to dropped frames.

Loading and saving camera settings as XML files

Conditions

- To save and load camera settings to and from an XML (e**X**tensible **M**arkup **L**anguage) configuration file, the MSXML parser must be installed on your system.
- Msxml3ger.msi: Installation file for the MSXML parser, version 3 service pack 4, German. For information or other languages see http://www.microsoft.com/downloads
- For quick read/write settings you first must create/save an xml file as standard xml file (**Select Settings file...** see below)

Where to find

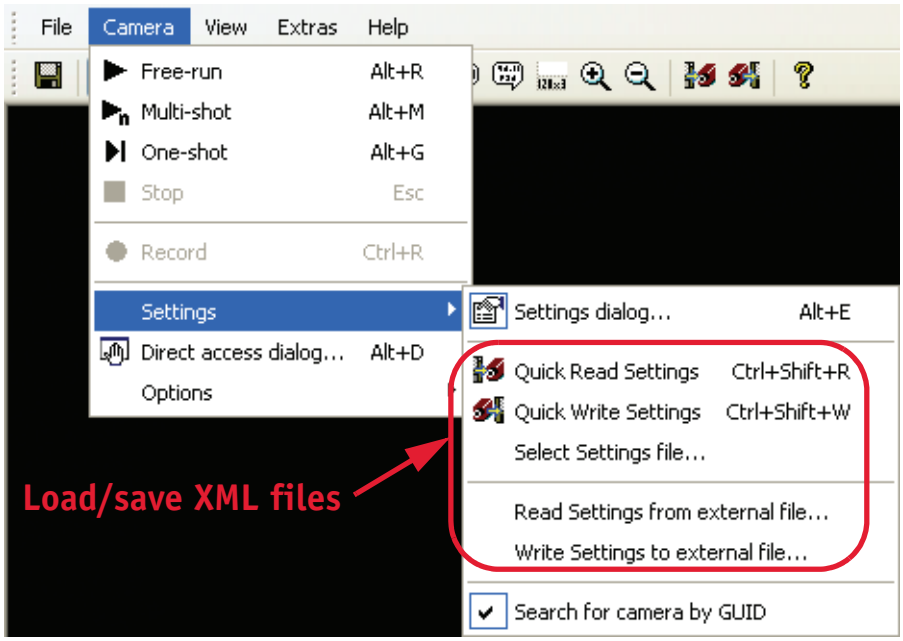


Figure 9: Where to find: Loading and saving camera settings as XML files

Camera → Settings → Read settings from external file...

Camera → Settings → Write settings to external file...

Camera → Settings → Select Settings file...

Camera → Settings → Quick Read Settings

Camera → Settings → Quick Write Settings

Description

Most of the configurations of cameras and features in SmartView can be saved on your computer in an XML file. Save your most used configurations in different XML files. This gives you the advantage to choose quickly between different settings.

For very quick loading/saving of one special setting you can use the **Select Settings file...** command and then the

- **Quick Read Settings**  button or
- **Quick Write Settings**  button

As an alternative save your camera settings as user settings in the camera.

Working with the histogram function

Conditions

- Minimum size of histogram window is 256x128.
- Using deep images, histogram will show values up to 16 bit.

Where to find

View → Additional information → ☑ **Histogram**

(or use short key: **Ctrl+Shift+H**)

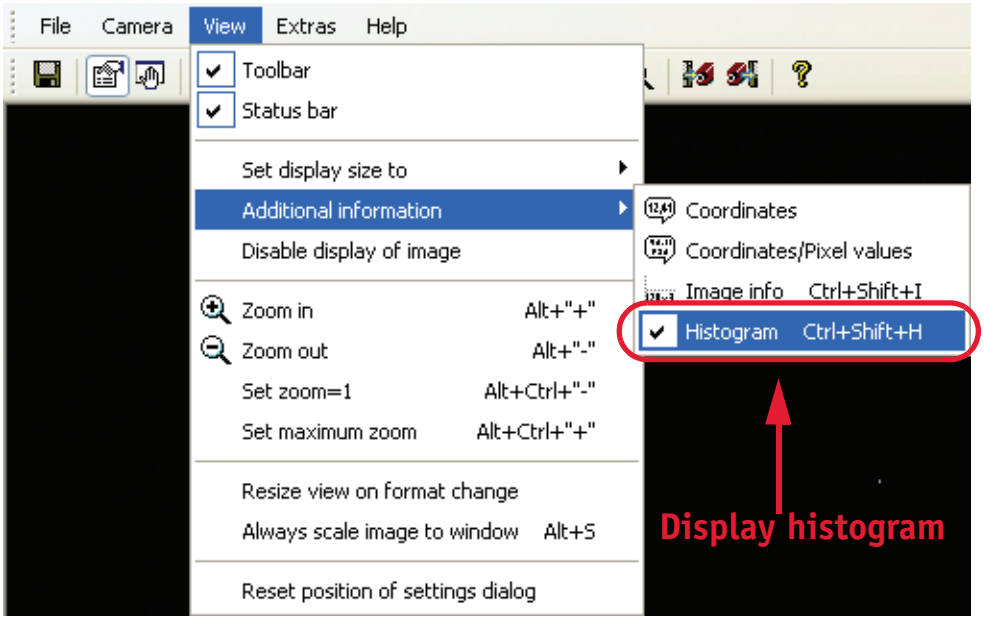


Figure 10: Where to find: Histogram

Description

A histogram shows the brightness distribution of an image (e.g. in an 8-bit image there will be 256 levels of brightness ranging from 0...255 with 0 as darkest and 255 as brightest value). The sum under the curve is equal to the total amount of pixels. Use the histogram for analyzing and optimizing brightness distributions.

- **Monochrome** cameras show one red curve in the histogram
- **Color** cameras show three curves (red, green, blue) in the histogram
- **Interlaced** cameras show four curves (red, green, blue, yellow) in RAW mode and three curves with debayering (red, green, blue)

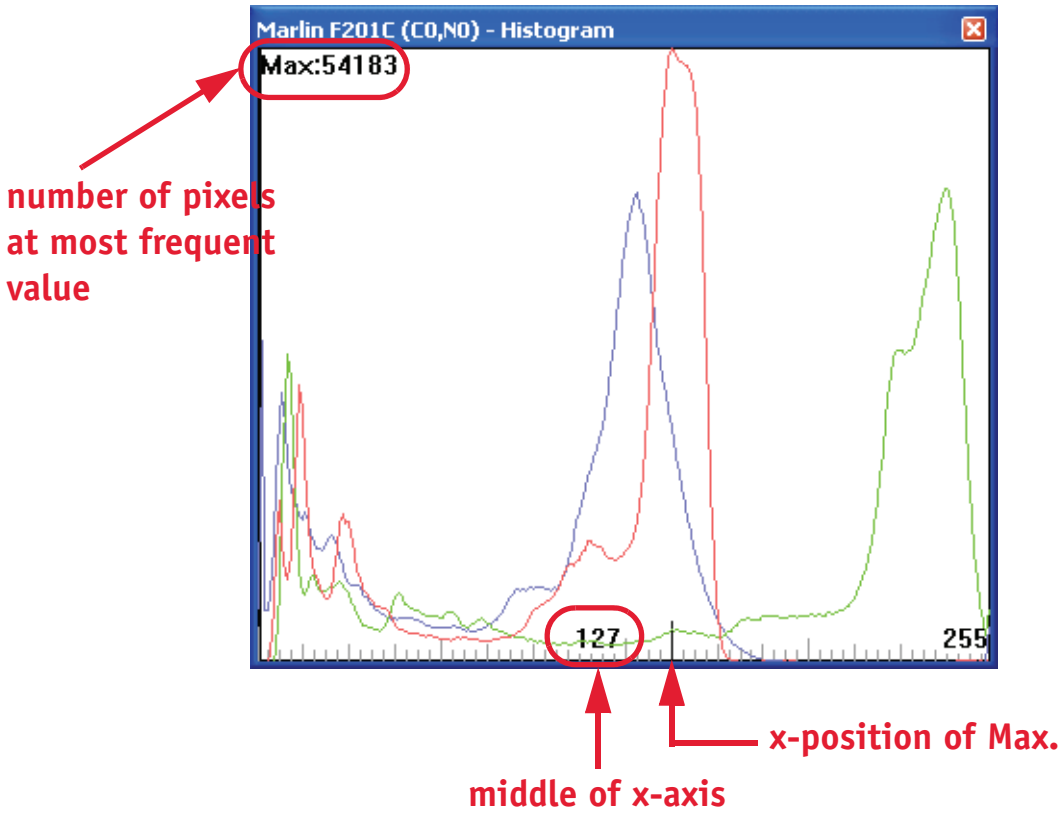


Figure 11: Example of histogram (Marlin F-201C)

Histogram element	Description
x axis	Available values: 8-bit image: 0...255 12-bit image: 0...4095 (Oscar) 14-bit image: 0...16383 (e.g. PIKE Mono16) 16-bit image: 0...65535 (e.g. Oscar with 16 images or PIKE with 4 images; both in HSNR mode)
y axis	Number of pixels with value at x axis
Max:	Number of pixels at most frequent value (the corresponding x value is marked with an additional vertical black line: x-position of Max.)
127 (8-bit)	Middle of x-axis
255 (8-bit)	Maximum x value

Table 25: Description of histogram

Using histogram

The following 3 examples illustrate how to use the histogram function:

1. Experiment how the histogram changes on **opening/closing aperture**:
   - Open aperture: curve(s) move to right side
   - Closing aperture: curve(s) move to left side
2. **Manual white balance** (e.g. single-color/monochrome surface):
   - Consider green curve as reference
   - Adjust UB slider of white balance so that blue curve overlaps green curve
   - Adjust VR slider of white balance so that red curve overlaps green curve
   - Manual white balance done
3. To get a feeling for **contrast of image**:
   - If an image has little contrast, histogram will show Gaussian like curve(s) very likely.
   - If an image has very high contrast, histogram will show much more irregular curve(s).

Working with shading

Definition

Shading correction is also known as **flat-field correction**. It is effectively a multiplicative correction of each pixel. The cameras perform this task in hardware, thus not consuming any CPU power or delaying the image. In order to generate the correction factors per pixel, only an offline task in the camera does all the job.

Upon generation of the shading image in the camera, it can be uploaded to the host computer for non-volatile storage purposes.

With the Pike, you are now able to store your generated shading data in flash memory inside the camera, allowing you to calibrate your imaging setup once under controlled conditions and then just load the stored shading data with one command after camera startup without having to transfer data from the PC to the camera.

For this, you are now able to switch the external source/destination from “file” (like it was possible before) to “flash”, allowing you to store to flash, load from flash and to clear the flash instead of downloading and saving shading data to a file or uploading from a file.

Additional information

For additional information on the **shading correction** feature read the following chapters:

- **DOLPHIN Technical Manual**, Chapter **Shading correction**
- **OSCAR Technical Manual**, Chapter **Shading correction**

- **MARLIN Technical Manual**, Chapter **Shading correction**
- **PIKE Technical Manual**, Chapter **Shading correction**

Conditions

- Dolphin cameras (only Dolphin F-145B and Dolphin F-201B)
- Oscar cameras
- Marlin cameras
- Pike cameras
- (Guppy cameras have no shading correction)

Where to find

SmartView: **Edit settings → LUT/Shdg.** tab

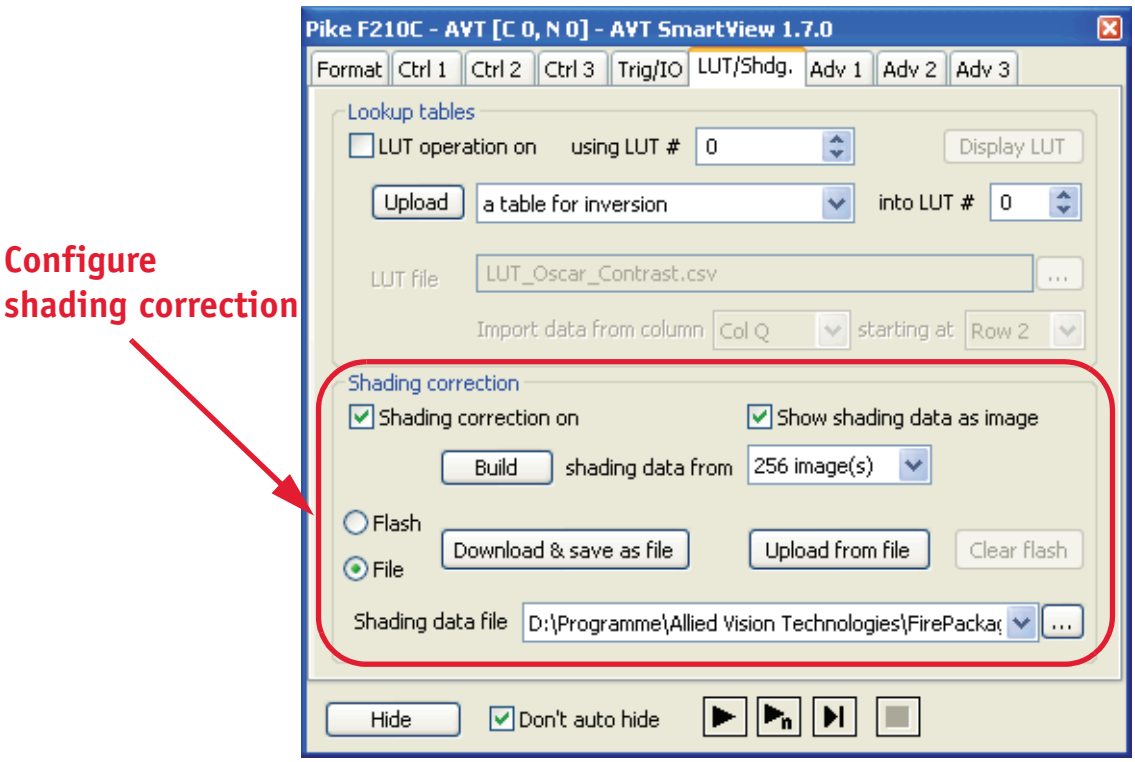


Figure 12: Shading correction: Example (PIKE F-210C)

Description

Usage Shading correction is used to compensate for non-homogeneities caused by lighting or optical characteristics within specified ranges.

To correct a frame, a multiplier from 1...2 is calculated for each pixel in 1/256 steps: this allows for shading to be compensated by up to 50%.

Besides generating shading data off-line and downloading it to the camera, the camera allows correction data to be generated automatically in the camera itself.

Note

For conditions and special features depending on the camera family/model see the **Technical Manuals** listed in Chapter Additional information on page 64.

There are two storing possibilities:

- After generating the shading image in the camera, it can be uploaded to the host computer for nonvolatile storage purposes.
- The shading image can be stored in the camera itself. (Pike only)

The following pictures describe the process of automatic generation of correction data (PIKE F-032C). Surface plots and histograms were created using the **ImageJ** program.

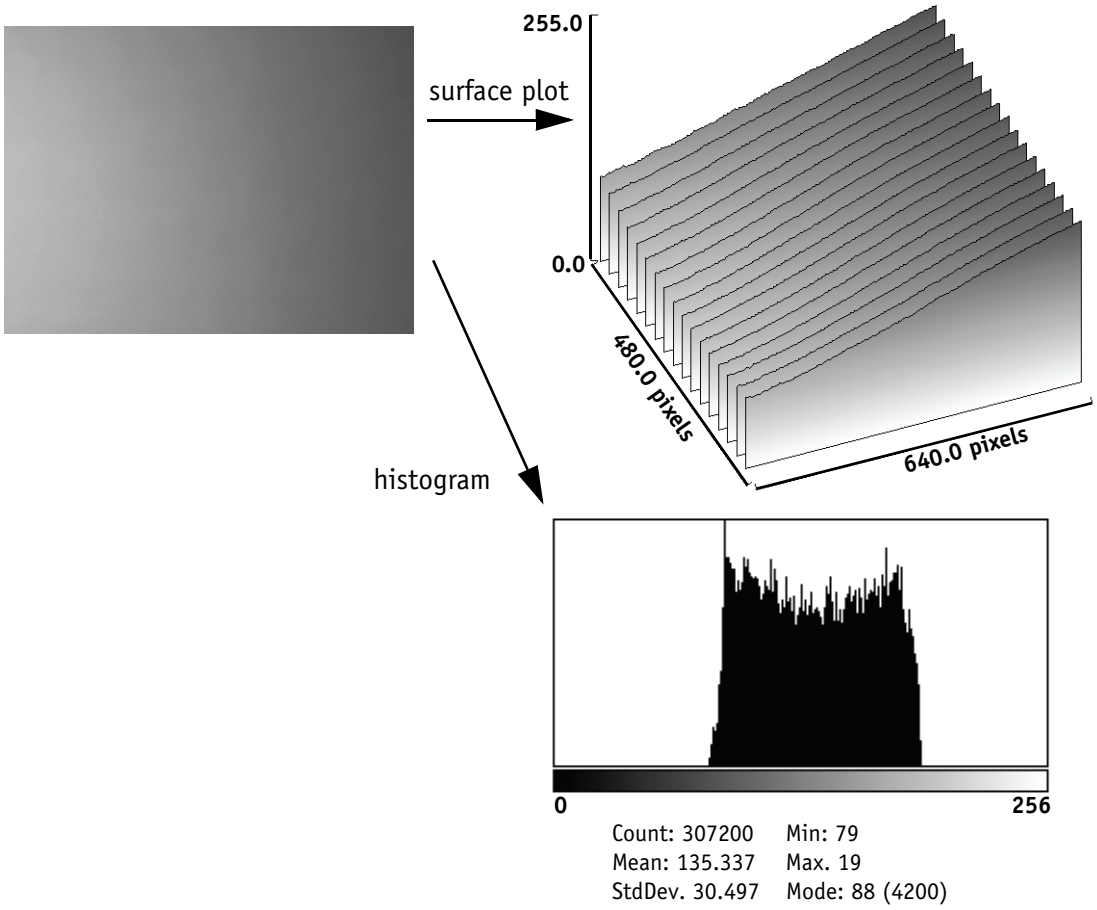


Figure 13: Shading correction: Source image with non-uniform illumination

- On the left you see the source image with non-uniform illumination.
- The surface plot on the right clearly shows a gradient of the brightness (0: brightest → 255: darkest pixels).
- The histogram shows a wide band of gray values.

By defocusing the lens, high-frequency image data is removed from the source image, therefore its not included in the shading image.

How to prepare for shading image

Shading correction compensates for non-homogeneities by giving all pixels the same gray value as the brightest pixel. This means that only the background must be visible and the brightest pixel has a gray value of less than 255 when automatic generation of shading data is started.

It may be necessary to use a neutral white reference, e.g. a piece of paper, instead of the real image.

To generate a correction image do the following:

1. In SmartView main window click  **Edit settings → LUT/Shdg.** tab
2. In the Shading correction section activate ☑ **Shading correction on** check box.
3. Activate ☑ **Show shading data as image** check box.
4. Choose the number of images  to use for building the shading image (shading data). The recommended number of images for shading correction is listed in the table below.

Camera type	Recommended number of images for shading correction
Dolphin	4, 8, 16
Oscar	4, 8, 16
Marlin	4, 8, 16
Pike	2, 4, 8, 16, 32, 64, 128, 256

Table 26: Recommended number of images for shading data

5. Click on  .

   The automatic generation of shading data is started. The camera pulls in the number of images which were set in the combo box. An arithmetic mean value is calculated from them (to reduce noise).

   After this, a search is made for the brightest pixel in the mean value frame. The brightest pixel(s) remain unchanged. A factor is then calculated for each pixel to be multiplied by, giving it the gray value of the brightest pixel.

   All of these multipliers are saved in a **shading reference image**. The time required for this process depends on the number of frames to be calculated and on the resolution of the image.

Note

For conditions and special features depending on the camera family/model see the **Technical Manuals** listed in Chapter Additional information on page 64.

How to load a shading image out of the camera

Two saving mechanisms are possible:

- Saving shading reference image **to flash** (currently only Pike family)
- Saving shading reference image **to file** (all camera models with shading correction)
- Shading images can also be generated or modified with image processing software. You can use this mechanism to overlay symbols or generate a cross hair in the image by simply generating a „synthetic shading image“ with the symbol or the cross hair.

For saving to flash ...	For saving to file...
• Choose ◉ Flash. • Click [Save to flash] .	• Choose ◉ File. • Click [Download & save as file] . • Click [...] , choose directory and enter file name.
The shading reference file is saved...	
internal into flash memory	in an external file

Table 27: Saving shading reference image to flash or data file

6. Focus the lens again.

   The image below will be seen, but now with a considerably more uniform gradient.

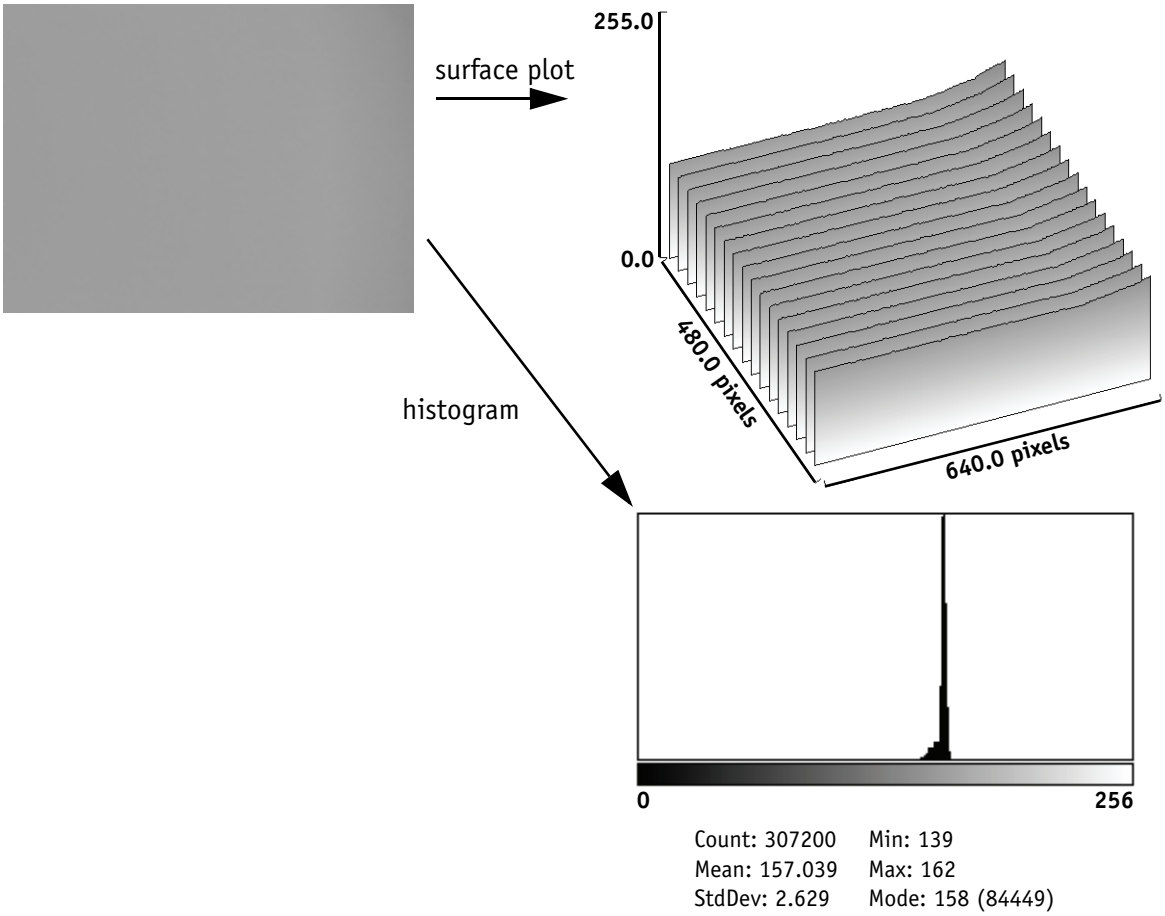


Figure 14: Example of shaded image

- On the left you see the image after shading correction.
- The surface plot on the right clearly shows nearly no more gradient of the brightness (0: brightest → 255: darkest pixels). The remaining gradient is related to the fact that the source image is lower than 50% on the right hand side.
- The histogram shows a peak with very few different gray values.

How to load a shading image into the camera

To load a generated correction image back into the camera do the following:

1. In SmartView main window click  **Edit settings → LUT/Shdg.** tab.

For loading from flash ... (inside camera)	For loading from file... (outside camera)
In the Shading correction section choose ...	
• Choose ◉ Flash. • Click [Load from flash] .	• Choose ◉ File. • Click [Upload from file] . • Click [...] , choose directory and enter file name.
The shading reference file is uploaded...	
from flash memory inside camera	from external file outside camera

Table 28: Saving shading reference image to flash or data file

Working with LUTs

Definition In image processing, look-up tables are often called LUTs, and they link index numbers to output values.

Conditions

- All AVT cameras have LUT feature.

Where to find

SmartView: Main window: **Edit settings → LUT/Shdg.** tab

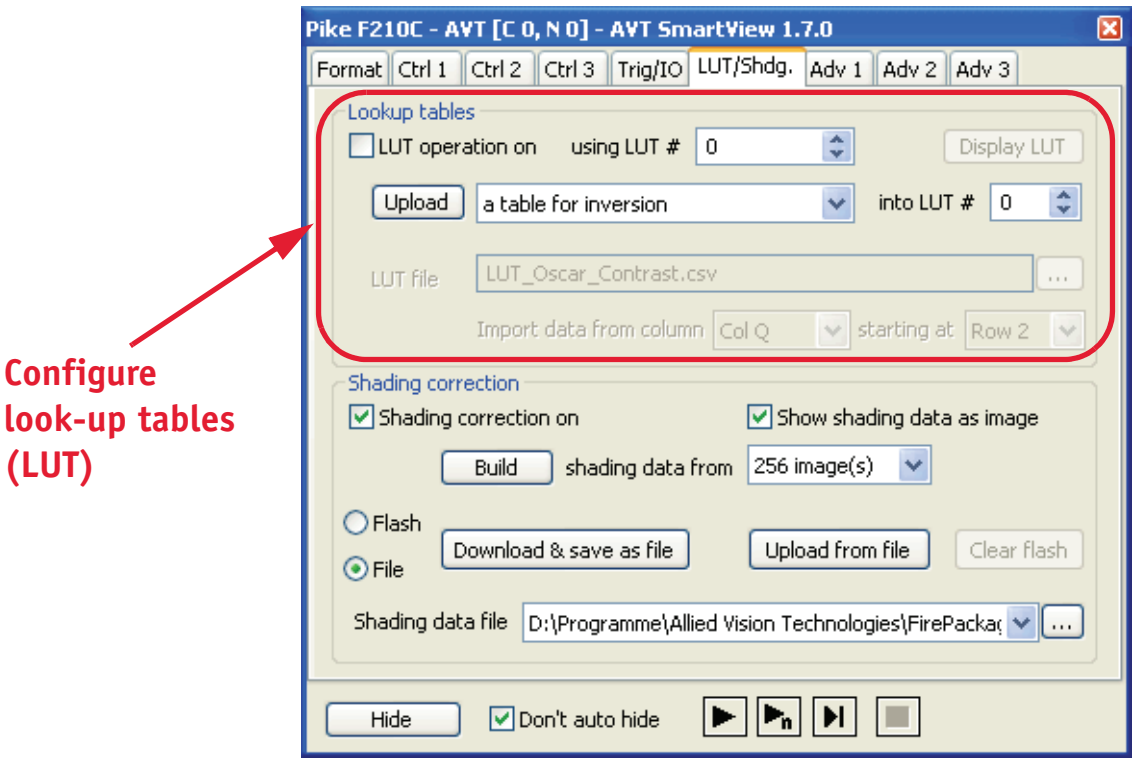


Figure 15: Look-up tables (LUT): Example (PIKE F-210C)

Description

How many? Depending on the model AVT cameras provide from 1 up to 63 user-defined look-up tables (LUT).

Camera type	... has how many LUTs?	Description
PIKE	16 (# 0-15)	The LUT # starts always with 0. Camera types having only one LUT: the LUT # cannot be changed.
GUPPY	1	
MARLIN	1	
OSCAR	1	
DOLPHIN	64 (# 0-63)	

Table 29: Number of LUTs depending on camera type

Usage The use of one LUT allows any function (in the form Output = F(Input)) to be stored in the camera's RAM and to be applied on the individual pixels of an image at run-time.

The address lines of the RAM are connected to the incoming digital data, these in turn point to the values of functions which are calculated offline, e.g. with a spreadsheet program.

This function needs to be loaded into the camera's RAM before use.

Example One example of using an LUT is the gamma LUT: see Chapter Using SmartView's built-in LUTs on page 74.

Gamma LUT The gamma LUT is known as compensation for the nonlinear brightness response of many displays e.g. CRT monitors. The look-up table converts the incoming bits from the digitizer to outgoing bits (for values see following table).

Camera type	incoming ... bits	outgoing ... bits
PIKE	14	up to 14
GUPPY	10	8
MARLIN	10	8
OSCAR	12	8
DOLPHIN	12	8, 10 or 12 (depending on model, video format and mode)

Table 30: Gamma LUT: incoming/outgoing bits

Using AVT's spreadsheet LUTs (camera family dependent)

For each camera family AVT delivers specialized spreadsheets with a variety of LUTs which you can use immediately.

To use AVT's spreadsheet LUTs do the following:

1. Choose **data from the file below** in the combo box after Upload , click ... and choose directory and LUT file you like to use. (Example: **LUT_Pike_Gamma_040_150.csv**. Description: see table below. Or use your own *.csv file.).
   - All functions in the delivered AVT **...Gamma_040_150.csv** file start in row 2 (first row = header row). The first look-up table with gamma=0.4 is **Col B**. The steps between two columns is 0.05. So gamma=0.9 for example is **Col L**.
   - All functions in the delivered AVT **...Contrast.csv** file start in row 2 (first row = header row). The first contrast table with 0.25 is **Col B** and the last contrast table with 4 is **Col Q**.
2. From the two combo boxes choose column (example: **Col B**) and row (example: **Row 2**) for the function to be applied.
3. Click Upload .

   The chosen LUT is uploaded to the camera.
4. To get a feeling how the LUT looks like click Display LUT .

   A graph of the chosen LUT is displayed.

Note

Because AVT camera families have different bit depths there is a need for different LUT files (see the following table).

As examples AVT delivers spreadsheet LUTs for each camera family:

- Gamma tables
- Contrast tables

Camera type	... is delivered with LUT files	Description
PIKE	LUT_Pike_Gamma_040_150.csv LUT_Pike_Contrast.csv	**...Gamma_40_150.csv** provides gamma tables (gamma functions with gamma 0.4 up to 1.5, using steps of 0.05) **...Contrast.csv** provides LUTs for increasing or decreasing the contrast for an image. Each of them has 16 tables with contrast values ranging from factor 0.25 to factor 4. A factor of 4 means that the gradient in the middle of the LUT is steeper by a factor of 4.
GUPPY	LUT_Guppy_Gamma_040_150.csv LUT_Guppy_Contrast.csv	
MARLIN	LUT_Marlin_Gamma_040_150.csv LUT_Marlin_Contrast.csv	
OSCAR	LUT_Oscar_Gamma_040_150.csv LUT_Oscar_Contrast.csv	
DOLPHIN	LUT_Dolphin_Gamma_040_150.csv LUT_Dolphin_Contrast.csv	

Table 31: Description of LUTs depending on camera type

Using SmartView's built-in LUTs

SmartView has the following LUTs for using without any (external) *.csv files:
See Table 32: Description of LUTs available in SmartView on page 75.

To use them do the following:

1. Choose any of the built-in LUTs (**a table for...**) in the combo box after Upload and choose a LUT # where this LUT will be written to.
2. Click Upload .

   The chosen LUT is uploaded to the camera.
3. To get a feeling how the LUT looks like click Display LUT .

   A graph of the chosen LUT is displayed. In the following table you find example graphs (Pike F-210C) for SmartView's built-in LUTs.

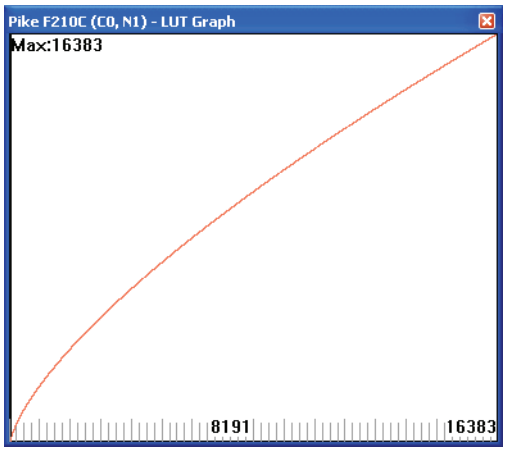
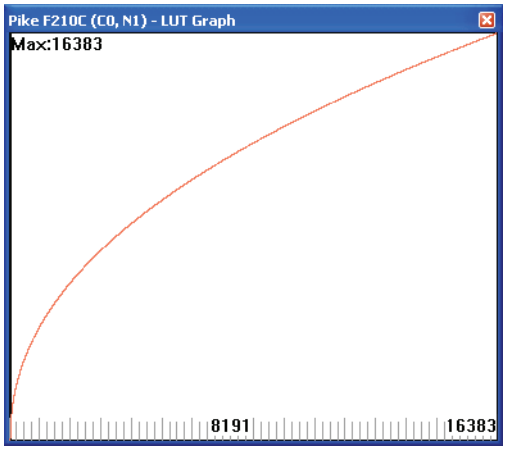
Name of LUT (SmartView)	Description	Display LUT
a table for gamma = 0.7	Table with the following function: Output=(Input)$^{0.7}$	
a table for gamma = 0.45	Table with the following function: Output=(Input)$^{0.45}$	

Table 32: Description of LUTs available in SmartView

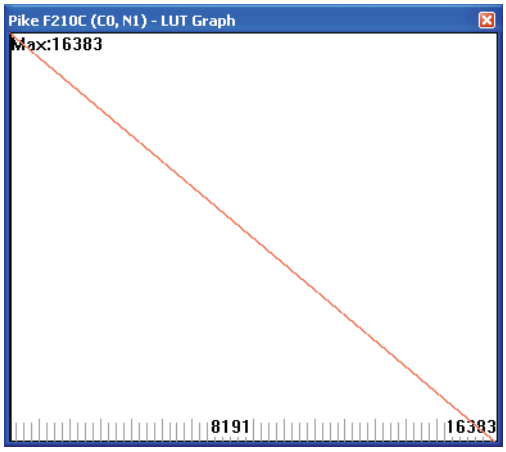
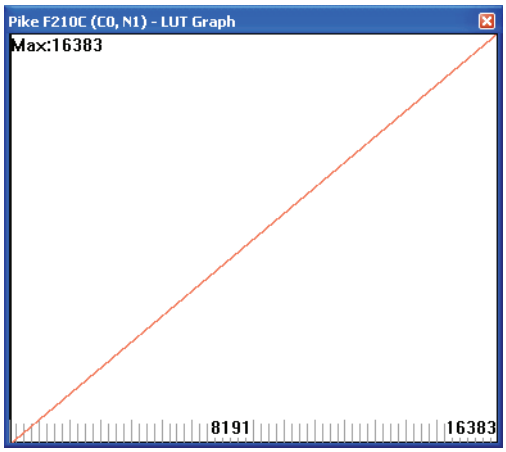
Name of LUT (SmartView)	Description	Display LUT
a table for inversion	Table with the following function: The identity graph is mirrored at the middle axis.	
a table for identity	Table with the following function: Output=Input	

Table 32: Description of LUTs available in SmartView

Working with trigger

Conditions

- During HDR mode level mode trigger (Trigger_Mode_1) is not possible.
- The multi-shot counter also controls the number of shots in Trigger_Mode_15.

Where to find

SmartView: Main window: **Edit settings → Trig/IO** tab

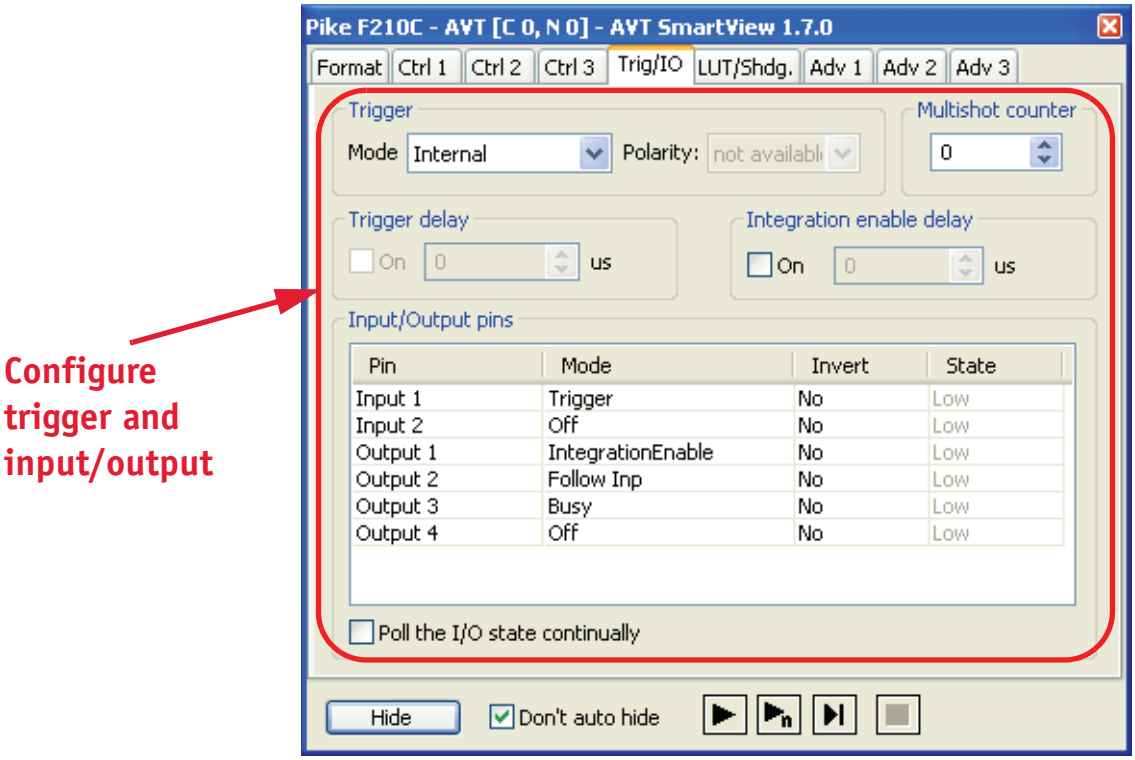


Figure 16: Trigger and Input/Output: Example (PIKE F-210C)

Description

All AVT cameras support IIDC conforming Trigger_Mode_0 and Trigger_Mode_1 and special Trigger_Mode_15 (bulk trigger).

Trigger mode	...also known as	Description
Internal	Continuous mode	The camera runs with an internally generated trigger. The camera sets the shutter time according to the value set in the shutter (or extended shutter) register.
Trigger_Mode_0	Edge mode	The camera triggers one image precisely (aka asynchronously) with a voltage edge received via trigger pin of the I/O connector. The camera sets the shutter time according to the value set in the shutter (or extended shutter) register.
Trigger_Mode_1	Level mode	The camera triggers one image precisely (aka asynchronously) with a voltage edge received via trigger pin of the I/O connector. The camera sets the shutter time according to the active low time of the pulse applied (or active high time in the case of an inverting input). The trigger signal thus serves **dual** purposes: • First to set the trigger moment and • secondly to instruct the camera how long to shutter (integrate). Use this mode for overriding the 67 seconds long time integration limit or if you need to adapt to brightness changes but without using the shutter register and software calls.
Trigger_Mode_15	Programmable mode	Is a **bulk trigger**, combining one external trigger event with continuous or one-shot or multi-shot internal trigger.

Table 33: Description of trigger modes

Configuring trigger modes

Perform steps To configure the trigger modes do the following:

1. In Trigger section choose your desired mode (Internal, Edge mode(0), Level mode(1), Progr. mode(15)).
2. For Edge mode(0) or Progr. mode(15) choose the **Polarity** of the trigger signal (**Falling** or **Rising**). For level mode(1) choose the **Polarity** of the trigger signal (**Low act.** or **High act.**).

3. In Multishot counter section set the number of images for the camera to take in succession.
4. If you choose Edge mode(0): In Trigger delay section you can set a trigger delay (activate **On** check box) and a delay time in µs for the trigger signal to become effective.
5. In Integration enable delay section you can switch on/off (**On** check box) the delay of the integration enable event. Enter the delay time in µs. Use this e.g. if you fire a flash with IntEna and want to delay when the flash is fired relative to the trigger.

Scenarios for trigger modes

The following scenarios show some examples when the three trigger modes are useful.

Trigger mode	Typical scenario	Additional information
Trigger_Mode_0	Moving objects to be triggered precisely at the same position.	Motion blur (the amount of movement during the shutter is open) may also affect the image quality. Thus a controlled and bright illumination (or flash driven by IntEna signal of camera) with a proper and short shutter time may be required.
Trigger_Mode_1	• Moving objects to be triggered precisely at the same position. • Brightness changes to be controlled via the trigger signal itself.	This mode emulates the behavior of popular analog cameras.
Trigger_Mode_15	• Grabbing exactly one image based on the first external trigger. • Filling the camera's internal image buffer with one external trigger without overriding images. (By setting Multi_shot counter = #frames fitting in internal memory) • Grabbing an unlimited amount of images after one external trigger (surveillance)	The **Technical Manuals** of the cameras have in depth examples how to set up these three examples.

Table 34: Typical scenarios for trigger modes

Configuring input/output pins

Each input pin and each output pin can be configured individually to your needs for example the above mentioned triggering of the cameras.

Perform steps To configure the input/output pins do the following:

1. In Input/Output pins section choose for every input and output pin the desired mode. To change a mode, click on the mode field. A combo box opens: click on the desired mode.

   For each pin you can choose one of the following modes:

   Input ⇨ (Off/Trigger)

   Output ⇨
   (Off/Direct/IntegrationEnable/FrameValid/Busy/FollowInp)

2. Choose the Polarity bit in the **Invert** column. To change an Invert entry, click on the invert field. A combo box opens: click on **No** or **Yes** to change the Polarity bit.

Note

The former **Polarity** column for the input/output pins is now called **Invert** to clarify the use of this bit. A polarity of **low** in former SmartView versions is now read as Invert:No, meaning the same.

If you set more than one input for trigger, all inputs are logically ANDed.

The **State** column lists the status of the input/output pin (**Low** or **High**).

3. Activate ☑ **Poll the I/O state continually** to update the state of pins every 200 ms.

Using logging functionality of SmartView (*.cmd file)

Conditions

- Appropriate start option must be supplied.
- Log file is created in folder of viewer executable.

Where to find

Has to be done manually. See Description.

Description

SmartView provides a logging facility for errors that might have occurred during the operation of the program. This is helpful if you want to debug problems in cooperation of the software with the cameras and the associated hardware in question.

- The logging file is created only if an appropriate start option is supplied.
- The log file is created in the same folder as the viewer executable.

There are two options for the log file:

- It is only flushed every 8000 characters or after closing SmartView.
- It is auto-flushed when needed.

Setting via **Extras → Auto-flush logging file** (May slow down system). See Submenue Auto-flush logging file on page 26.

The following log levels are listed in decreasing severity and include all the log levels above them:

- "-f":fatal
- "-e":error
- "-w":warning
- "-i":info

There are two ways to use the logging functionality:

First way Place a link to SmartView on the desktop and modify the properties of the link accordingly.

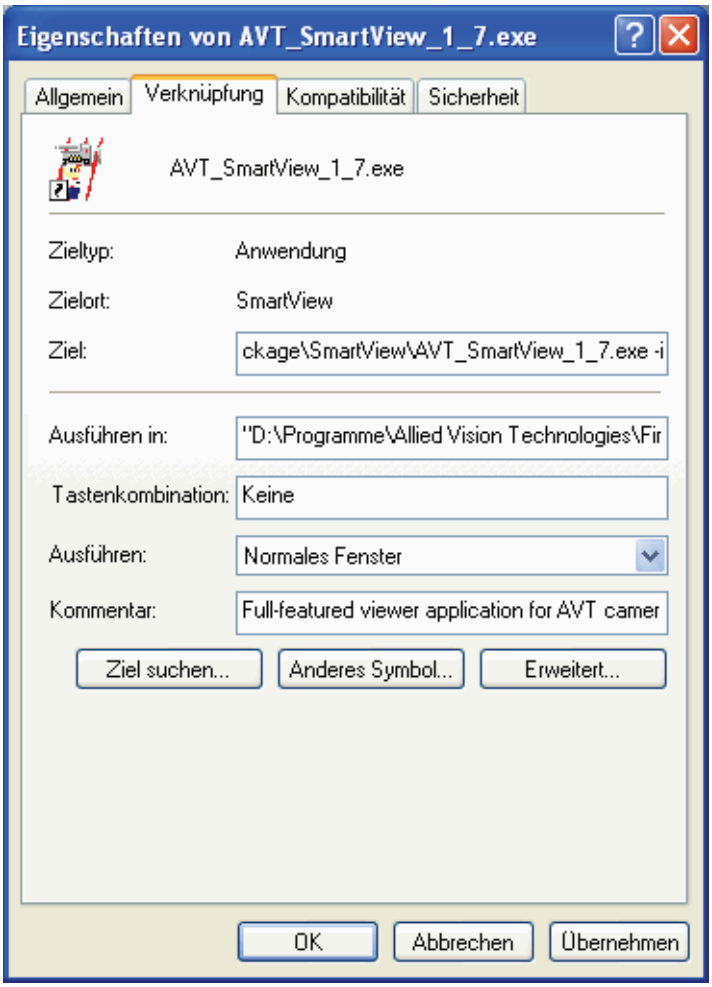


Figure 17: Properties dialog of SmartView

Second way Alternatively create a ***.cmd** file with the options (e.g. SmartView.exe -i) in the SmartView directory.

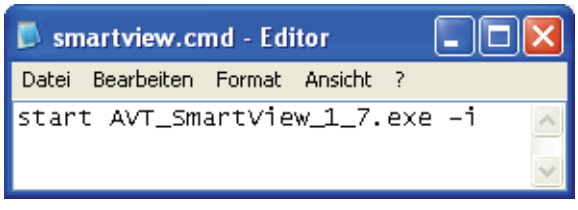


Figure 18: SmartView.cmd file

Channel balance (only PIKE)

Conditions

- ALL KODAK PIKE sensors: channel balance
  (color cameras: Format_7 mode and RAW mode/no Debayering)
  (b/w cameras: Format_7 mode and Mono mode)

Where to find

Channel balance: Extras → Adjust channels

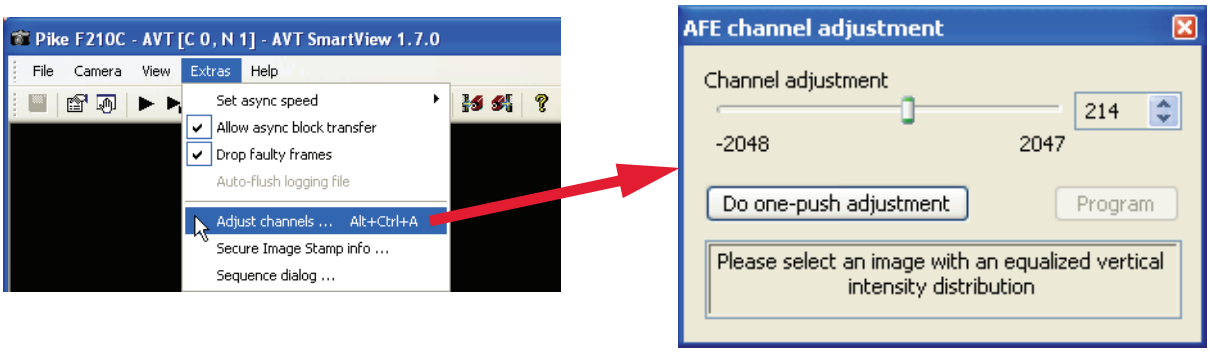


Figure 19: Channel balance: Example (Pike F-210C)

Description

PIKE channel balance

Technical background

To achieve more speed, the Kodak sensors of the Pikes are read out horizontally via two separate channels, so two ADCs are involved which may have to be configured differently. A standard adjustment between the channels is done at production time, but under certain circumstances, an intensity step might still be visible from left to right.

Perform steps

To be able to make the step disappear, there is an extra dialog available from the viewer window.

1. Click **Extras → Adjust channels** or press **Alt+Ctrl+A**.

   For using this dialog, the camera must be in Format_7 and in RAW (color cameras) or MONO (monochrome cameras) modes. If you are using RAW modes, make sure not to use the viewer debayering because the pure sensor data is needed.

2. Using a pattern that has the full range of intensity values along a vertical line in the middle of the image, start image capturing and either select the channel adjustment value manually (by slider or by value) or click **Do one-push adjustment**, possibly multiple times.

The final value will only be active as long as the camera is powered and may be stored (among others) in user sets. (The original value may always be retrieved when loading factory set 0).

Note

For more information read **PIKE Technical Manual**, Chapter **Channel balance**.

Using HDR mode (CMOS cameras)

Conditions

- Guppy F-036: HDR mode of Micron MV022 sensor
- Marlin F-131: HDR mode of FillFactory IBIS5B sensor
- For HDR mode: number of knee points must be greater 0.

Where to find

HDR: **Edit settings** → **CMOS** tab, Section High dynamic range mode

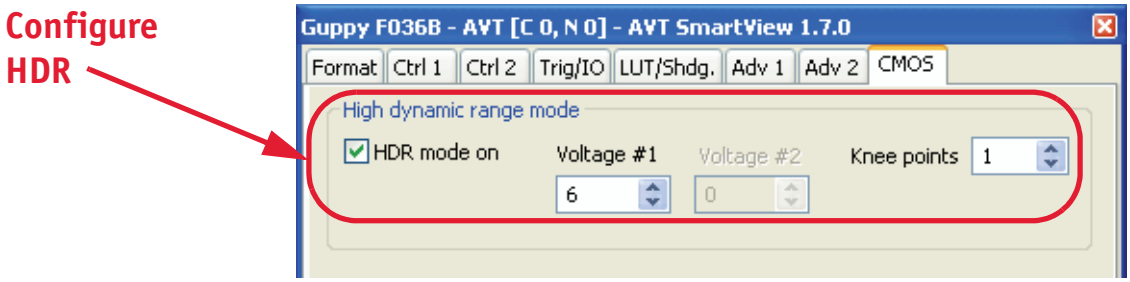


Figure 20: HDR mode: Example (Guppy F-036B)

Description

Guppy F-036: Micron MV022 HDR mode

Technical background

The **HDR mode** of the **Micron MV022** sensor allows for **two** knee points. They are controllable in an **easy mode**, which means that the draining voltage may be set for both knee points (measured from the minimum voltage) and the time is assigned automatically by the sensor.

Perform steps

On **CMOS** tab:

1. Enter voltage levels from 0 to 31.

   A value of 0 means 0.5625 Volt (each step meaning an increase of 0.0625 Volt).

2. If you select two knee points, the second value must be less than or equal to the first value.

Note

For more information read:

- Chapter CMOS tab descriptions on page 46, Section **High dynamic range mode (only Guppy F-036)**
- **GUPPY Technical Manual**, Chapter **HDR (high dynamic range) (GUPPY F-036 only)** [approx. 5 pages]

Marlin F-131: IBIS5B HDR mode

The **HDR mode** of the **IBIS5B** sensor allows for **three** knee points. This enables the high dynamic range of the sensor to be compressed into 8 bit, preserving interesting details of the image. This mode is also known as multiple slope (dual slope).

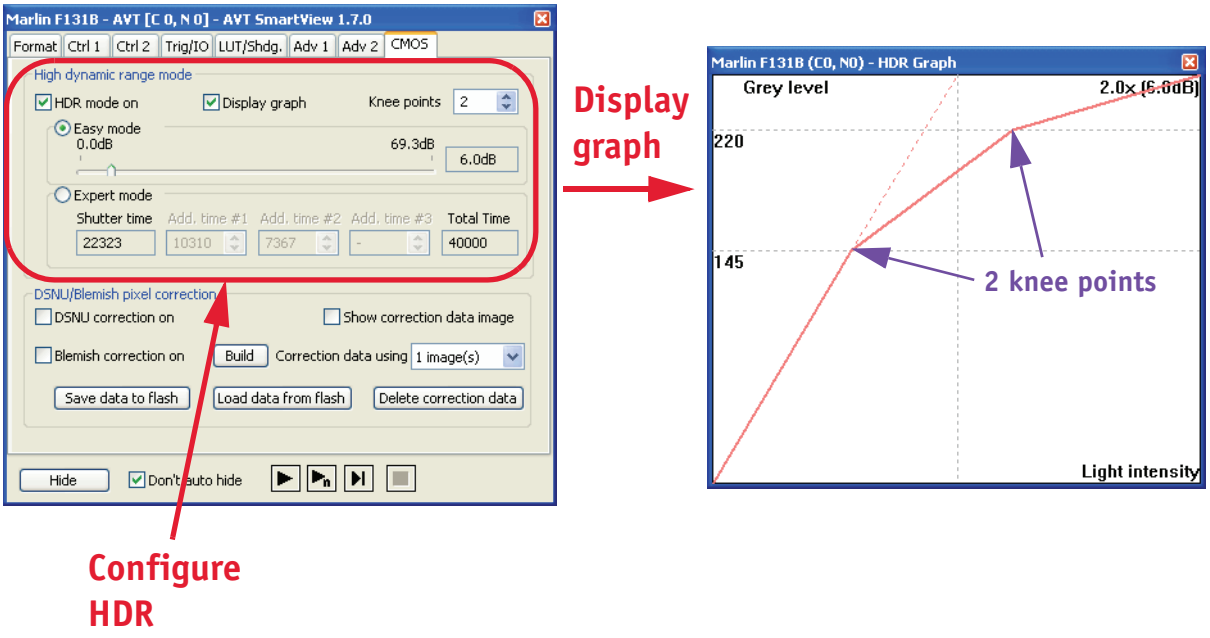


Figure 21: HDR mode of Marlin F-131B (2 knee points + Easy mode + Display graph)

Perform steps

On **CMOS** tab:

1. Change number of knee points to value greater 0 (Example: 2).
2. Activate **HDR mode on** check box.
3. In **Easy mode** put slider in the desired position (the knee point values will be set automatically.
   In **Expert mode** enter values for **Add.time #1** (#2, #3) manually.
4. Activate **Display graph** check box to display the **HDR Graph** window.

Note

For more information read:

- Chapter CMOS tab descriptions on page 46, Section **High dynamic range mode (only Marlin F-131)**
- **MARLIN Technical Manual**, Chapter **IBIS5A multiple slope (High Dynamic Range mode)**.

Error Messages and FirePackage Error Flags

We analyze and discuss the data flow from an AVT camera (e.g Marlin) to the main memory of a PC under Windows™ using **AVT FirePackage** assuming a **FireGrab** or **FireStack** based implementation like e.g. SmartView. First we notice a frame buffer in the camera, which can hold usually more than one image in the camera. The frame memory is constructed as a FIFO (first in first out) memory. Frame buffer(s) in a camera are beneficial for the sensor handling as well as for additional features (such as deferred image transfer). A frame buffer in the camera is not primarily intended or needed for secure data flow aspects.

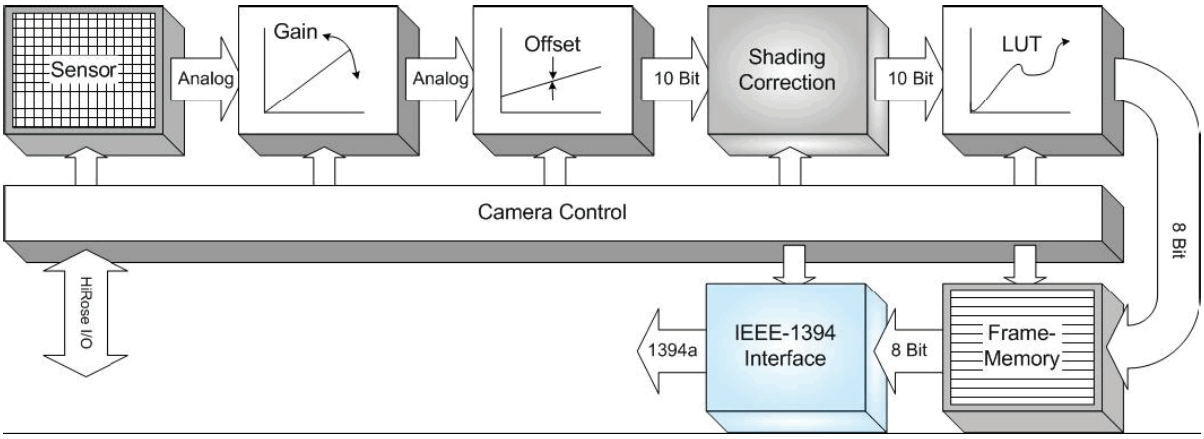


Figure 22: Block diagram Marlin b/w camera

The frame memory is followed by a much smaller FIFO buffer (size of 4 kByte) in the 1394 interface (link chip) to buffer the data prepared to send of about one 1394 cycle.

Data then is sent via a DMA mechanism to the corresponding 1394 receive buffer in the PC, which has also usually the size of 4 kByte.

Speed of the PCI (express) bus is high enough and latency of it is usually very low so that no overflow or underflow of Receive-FIFO is occurring.

A block diagram of the incoming receive OHCI chip (by TI) interface shows the details:

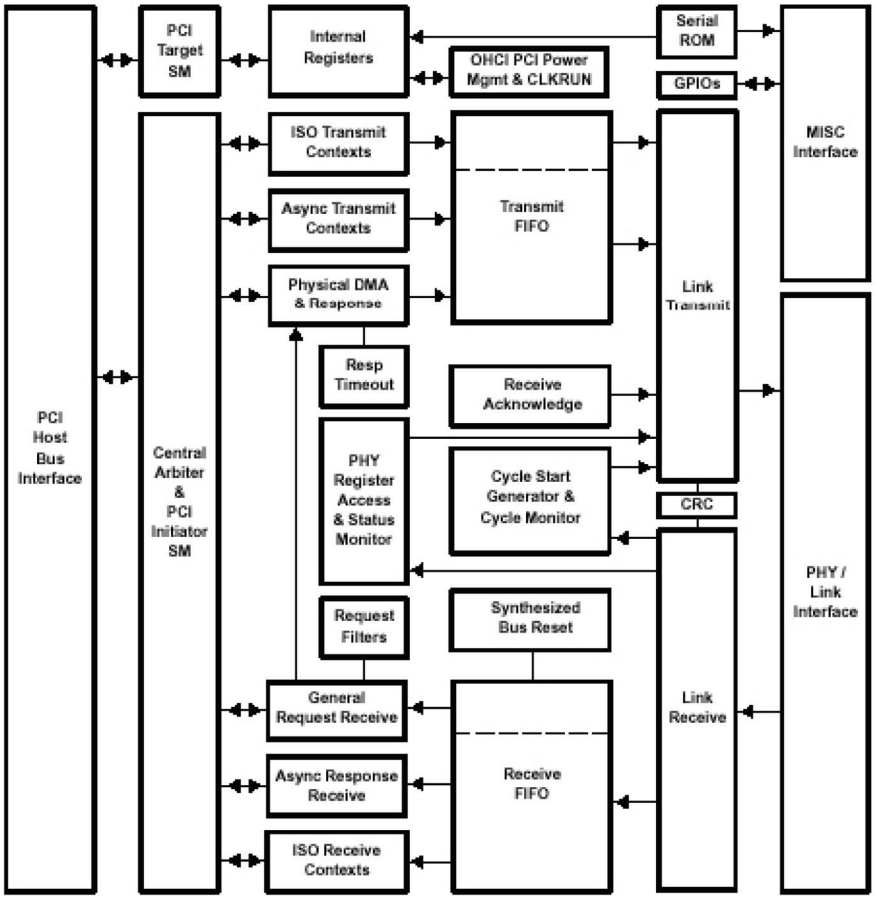


Figure 23: Block diagram of incoming receive OHCI chip (by TI)

If an error occurs, the Receive FIFO is most probably the critical section.

Other devices of the PC, such as network adapter or USB or peripheral devices may also occupy the PCI bus so that the performance for the 1394 part can be negatively influenced or becomes too low.

Debugging this situation requires the temporal deactivation of these peripheral devices accompanied by lowering the packet payload of the 1394 device.

With the use of **MS low level device driver for 1394 ports**, errors in the low level data flow which are created by the hardware such as Receive-FIFO overflows are **not** reported to the application.

FirePackage on the other hand replaces the MS device driver by a specific (monolithic) driver for the 1394 device class which fully reports errors to the application. The following is a list of the various error messages, generated by the driver and the associated dlls.

Note

While it is not the purpose of this document to explain each and every theoretically possible error, it might be helpful in the event of debugging to communicate the exact error messages to the support staff.

Error codes returned by functions

Every function returns a 32-bit error code that contains additional information about the error.

The module differs between upper layer error codes (that start with FCE_xxx) and low level error codes that start with (HALER_xxx).

The following two tables show the coding and describes each error.

HALER_xxx codes

Error name	Number	Error description
HALER_NOERROR	0	No error.
HALER_NOCARD	1	No hardware found.
HALER_NONTDEVICE	2	No logical device could be created for the card (memory problem).
HALER_NOMEM	3	Not enough memory for this operation.
HALER_MODE	4	Wrong mode for this operation.
HALER_TIMEOUT	5	Time-out occurred.
HALER_ALREADYSTARTED	6	Device was already started and cannot be started twice.
HALER_NOTSTARTED	7	Device was not started.
HALER_BUSY	8	Device is busy at present.
HALER_NORESOURCES	9	Not enough resources (no more interrupts, no threads etc.).
HALER_NODATA	10	There is no data to acquire.
HALER_NOACK	11	No acknowledge received from the target.
HALER_NOIRQ	12	Expected an interrupt but there was none.
HALER_NOBUSRESET	13	Expected a firewire bus reset but there was none.
HALER_NOLICENSE	14	No license to perform this action.
HALER_RCODEOTHER	15	Response code of target for actual requested subaction other then RCODE_COMPLETE (response code is also returned).

Table 35: HALER_xxx codes

Error name	Number	Error description
HALER_PENDING	16	Something has been started and is in a pending state.
HALER_INPARMS	17	Error in input parameter (mostly range error).
HALER_CHIPVERSION	18	Wrong chip version for this function.
HALER_HARDWARE	19	Hardware error.
HALER_NOTIMPLEMENTED	20	Function is not implemented.
HALER_CANCELLED	21	A waiting function was cancelled by another user call.
HALER_NOTLOCKED	22	A device is unlocked and needs to be locked for this action.
HALER_GENERATIONCNT	23	A function for asynchronous communication was called after a bus reset without having called <FCTLGetBus-Info> in order to get the new addresses of all existing nodes.
HALER_NOISOMANAGER	24	Function requires an isochronous resource manager but there is none.
HALER_NOBUSMANAGER	25	Function requires a bus manager but there is none.
HALER_UNEXPECTED	26	Internal processing error, unexpected value detected.
HALER_REMOVED	27	Target for command was removed.
HALER_NOBUSRESOURCES	28	Either no isochronous channel or isochronous bandwidth available.
HALER_DMAHALTED	29	An isochronous receive DMA has been halted.

Table 35: HALER_xxx codes

FCE_xxx codes

Error name	Number	Error description
FCE_NOERROR	0	No error
FCE_ALREADYOPENED	1001	Device is already open and cannot be opened twice.
FCE_NOTOPENED	1002	Device must be opened before.
FCE_NODETAILS	1003	No details for this error
FCE_DRVNOTINSTALLED	1004	Kernel mode driver not installed.
FCE_MISSINGBUFFERS	1005	Not enough buffers for the requested isochronous communication.
FCE_INPARMS	1006	Error in input parameters (mostly range error).
FCE_CREATEDEVICE	1007	Error creating a logical device to connect to the kernel mode driver.
FCE_WINERROR	1008	Internal windows error.

Table 36: FCE_xxx codes

Error name	Number	Error description
FCE_IOCTL	1009	Error while calling kernel mode driver.
FCE_DRVRETURNLENGTH	1010	Data returned from kernel mode driver has wrong length (version problem).
FCE_INVALIDHANDLE	1011	Handle has invalid value.
FCE_NOTIMPLEMENTED	1012	Function is not implemented.
FCE_DRVRUNNING	1013	Kernel mode driver runs already.
FCE_STARTERROR	1014	Kernel mode driver could not be started.
FCE_INSTALLERROR	1015	Kernel mode driver could not be installed.
FCE_DRVVERSION	1016	Wrong version of kernel mode driver.
FCE_NODEADDRESS	1017	Error in node address specified.
FCE_PARTIAL	1018	User supplied buffer was only filled partially (buffer was too small).
FCE_NOMEM	1019	Not enough memory for this request.
FCE_NOTAVAILABLE	1020	The requested function is not available.
FCE_NOTCONNECTED	1021	The object is not connected to a real target.
FCE_ADJUSTED	1022	One of the parameters had to be adjusted.

Table 36: FCE_xxx codes

Error flags in global error field

Error codes are returned when a function is called. Error flags are something different. During processing in the background there is a potential risk that an error occurs. This error can not be assigned to any function. So these is handled by the error flags. One or more error flags are set when an error occurs and are stored within a 32-bit field.

When an application wants to be notified this bit field is posted to the application with an WPARAM_ERROR message. In the 32-bit field each bit has a specific meaning. The following table shows the bit values and explains their meaning.

HALERF_xxx

Error name	Value	Error description
HALERF_RXHLTISO0	0x00000001	Isochronous RXDMA0 had to be stopped.
HALERF_RXHLTISO1	0x00000002	Isochronous RXDMA1 had to be stopped.
HALERF_RXHLTISO2	0x00000004	Isochronous RXDMA2 had to be stopped.
HALERF_RXHLTISO3	0x00000008	Isochronous RXDMA3 had to be stopped.

Table 37: HALERF_xxx

Error name	Value	Error description
HALERF_RXHLTISO4	0x00000010	Isochronous RXDMA4 had to be stopped.
HALERF_RXHLTISO5	0x00000020	Isochronous RXDMA5 had to be stopped.
HALERF_RXHLTISO6	0x00000040	Isochronous RXDMA6 had to be stopped.
HALERF_RXHLTISO7	0x00000080	Isochronous RXDMA7 had to be stopped.
HALERF_ISORXACK	0x00000100	Isochronous DMA reported error in packet ACK
HALERF_ISORX	0x00004000	Unspecified isochronous receive error.
HALERF_TXRESPONSE	0x00008000	Could not send a response for a request (Read or Write).
HALERF_ASYRX	0x00010000	Error during asynchronous reception.
HALERF_ASYTX	0x00020000	Error during asynchronous transmission.
HALERF_PHYTIMEOUT	0x00040000	The Phy took to long to transfer an information to the Linklayer chip.
HALERF_HDRERROR	0x00080000	A packet with an unknown header was received.
HALERF_TCERROR	0x00100000	Packet with unknown TCode was received.
HALERF_ATSTUCK	0x00200000	Asynchronous transmit FIFO stucked.
HALERF_GRFOVERFLOW	0x00400000	General receive FIFO overflowed (access to PCI bus too slow)
HALERF_ITFUNDERFLOW	0x00800000	Isochronous transmit FIFO underflow (access from PCI bus too slow)
HALERF_ATFUNDERFLOW	0x01000000	Asynchronous transmit FIFO underflow (access from PCI bus too slow)
HALERF_PCIERROR	0x02000000	Error while accessing PCI bus.
HALERF_ASYRXRESTART	0x04000000	Error in asynchronous transmit state machine. Transmission had to be restarted.
HALERF_NOACCESSINFO	0x08000000	No access info could be allocated while an external access occurred.
HALERF_SELFID	0x10000000	Error while receiving SelfIds.
HALERF_DMPORT	0x20000000	Error in data mover port (GP-Lynx only)
HALERF_ISOTX	0x40000000	Error in isochronous transmission.

Table 37: HALERF_xxx

Setting AOI (Format_7 settings)

Definition **AOI** = area of interest

Area of interest readout (AOI) refers to a camera function whereby only a portion of the available pixels are read out from the camera. For example, it is possible to read out a 640 x 480 pixel area of pixels from a camera that has a total resolution of 1628 x 1236. The result is a much faster frame rate and less data to be processed. This is also referred to as partial scan. Various autofunctions (auto shutter, auto gain, auto white balance) act on the AOI.

Conditions

- Camera has to be in **Format_7** mode

Where to find

SmartView: **Edit settings** → **Format** tab (Section Format7 settings)

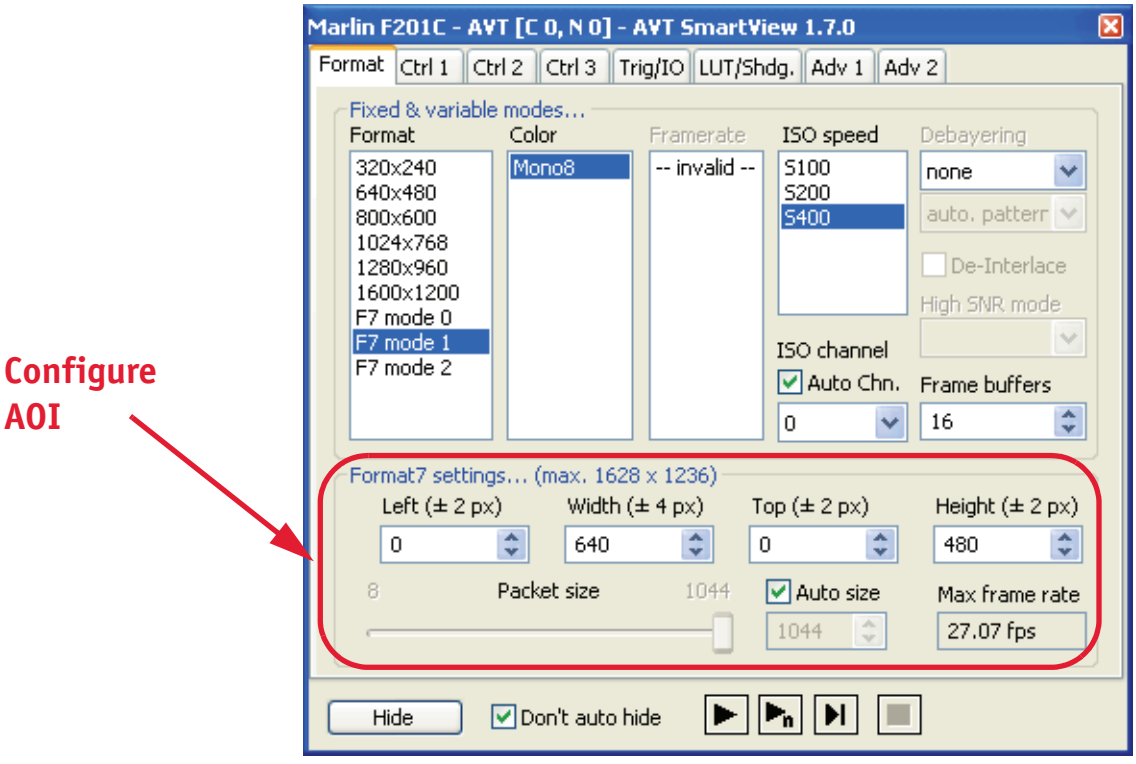


Figure 24: Setting AOI (Format_7 settings): Example Marlin F-201C

Description

The image sensor on the camera has a defined resolution. This indicates the maximum number of lines and pixels per line that the recorded image may have.

However, often only a certain section of the entire image is of interest. The amount of data to be transferred can be decreased by limiting the image to a section when reading it out from the camera. At a lower vertical resolution the sensor can be read out faster and thus the frame rate is increased.

Note The setting of AOIs is supported only in video **Format_7**.

While the size of the image read out for most other video formats and modes is fixed by the IIDC specification, thereby determining the highest possible frame rate, in Format_7 mode the user can set the **upper left corner** and **width and height** of the section (AOI=area of interest) he or she is interested in to determine the size and thus the highest possible frame rate.

SmartView offers a convenient procedure for the selection of an AOI in the **Format** tab.

After selecting a Format_7 mode the selection is available. You can choose a subwindow and its position according to your needs. IIDC specifies for Format_7 that the transferred packet size has to be adjustable. This is reflected in the packet size slider which allows to limit the packet size (the amount of image data, which is transmitted from the camera every 125 microseconds). Lowering this packet size leads to a lower max. frame rate as displayed in the box.

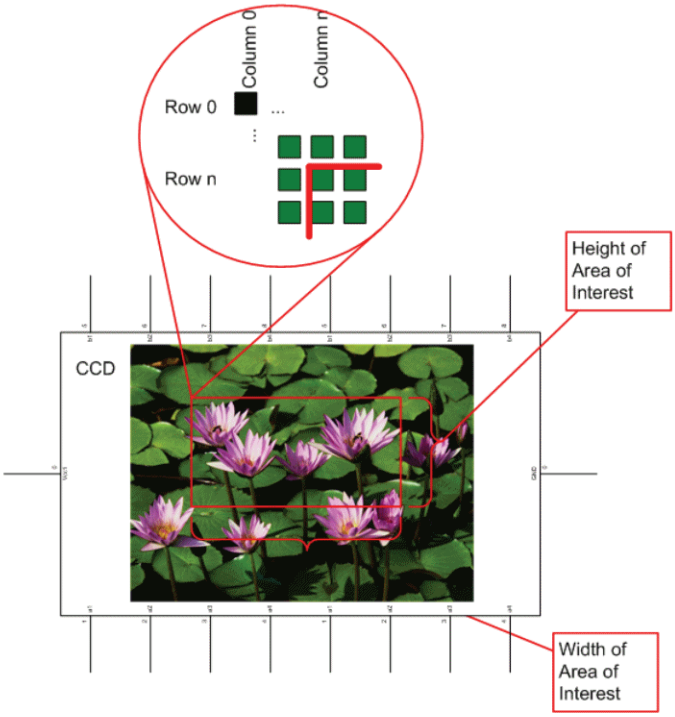


Figure 25: Area of interest (AOI)

In addition to the area of interest, some other parameters have an effect on the maximum frame rate:

- Time for reading the image from the sensor and transporting it into the FRAME_BUFFER
- Time for transferring the image over the FireWire™ bus
- Length of the exposure time

Calculating frames per second

Conditions

- Acquiring images (one-shot, multi-shot, continuous)

Where to find

View → Status bar

The current frame rate is displayed in the status bar.

Figure 26: Status bar: display of frame rate

Description

AVT implemented a new frame rate calculation. The following chapter explains the difference between theoretical and displayed frame rate.

New Frame rate calculation

In order to transfer the possible frame rate there is a new way to calculate the MaxBPP.

The maximum number of packets to be transferred with MaxFPS is determined. From this MaxBPP is calculated.

It is possible, that one cycle is dropped between two images. Nevertheless the frame rate formula can be used (**Technical Manual**, Chapter **Frame rates Format_7**). MaxFPS of sensor will be reached.

Example: calculation of frame rate (SmartView vs. Camera)

Calculation of MaxPPF: PPF = 1 / (MaxFPS x 125µs) = 38.29

Round off ⇨ PPF = 38

Calculation MaxBPP: MaxBPP = 640 x 480 / 38 = 8084.21

This value will be rounded up to N-quadlets: MaxBPP = 8088

Caution

SmartView calculates frame rate always according to the formula:

frame rate = 1 / ((PPF + 0.5) x 125µs)

Therefore SmartView will show a frame rate of

frame rate = 207.79 fps

whereas the camera reaches a frame rate of approx. ~208.5

Note

If you choose other BPP than MaxBPP, then the calculated frame rate is the same as the former calculating method. So both calculating methods are compatible.

Pike F-032B, 640 x 480, Mono8, MaxFPSccd=208.93

Status bar counters

Usually there is one counter to be seen at the bottom right hand side in the status bar of the viewing window which counts all frames sent from camera. Under practical circumstances it can happen that SmartView could not process and display all images from the camera or that even the driver could not reassemble all images from the camera.

Conditions

This usually indicates problems in the hardware or the software such as

- Problems with the cabling (transmission errors)
- Bandwidth over the 1394 bus(es) exceeded
- PCI (Express) bus bandwidth exceeded
- PCI latency problems
- Problems with power consumption reduction options like **Intel Speed Stepping** or **AMD PowerNow** or **Cool'nQuiet**, resulting in overflows of receiving FIFO
- CPU resources problems

Where to find

View → Status Bar

Description

If there are three numbers displayed, not all frames arriving on the card could be processed and displayed.

- The **first** (left) **number** now shows the number of frames arrived at the card. (5077 in figure below)

- The **second number** shows the number of frames lost on driver level (e.g. due to receive FIFO overflows) (0 in figure below)
- The **third number** shows the number of frames lost due to poor processing capability. (37 in figure below).

The frame rates shown still show the frame rate at the card and, if there is a second frame rate, the right one shows the processed frame rate.

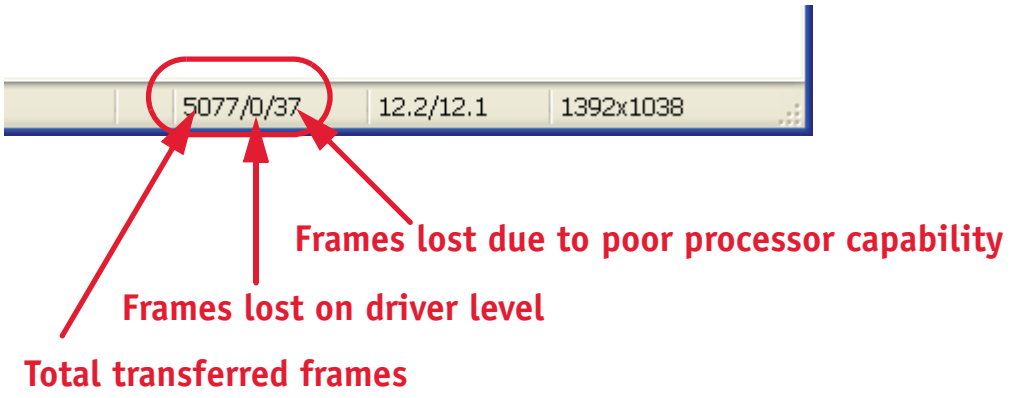


Figure 27: SmartView counters

Note

The screenshot shows one example which was produced in a **multi-camera environment** leaving the Bayer demosaicing to the PC and forcing it to the most challenging algorithms. As a consequence SmartView was not able on this PC to keep up with all the frames from the cameras.

Format_7 mode mapping (only PIKE)

In Pike cameras, you can customize your Format_7 layout with respect to binning (only b/w) or sub-sampling (b/w and color) via the so-called **Format_7 mapping**.

Format_7 Mode_0 is factory setting (full resolution) and cannot be changed.

Note

For a detailed description of mapping to Format_7 Mode_1 ... Mode_7 see **PIKE Technical Manual**, Chapter **Binning and sub-sampling access**.

Conditions

- Binning: PIKE b/w camera
- Sub-sampling: PIKE b/w or color camera

Where to find

SmartView entry window: Menu **Camera → Format 7 mapping...**

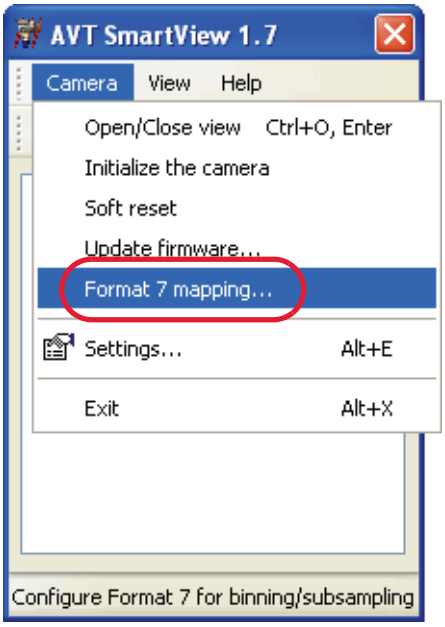


Figure 28: Format_7 mode mapping

Description

To map one or more modes to F7M1 ... F7M7 do the following:

1. In SmartView entry window click on **Camera → Format 7 mapping...**
   The following window opens:

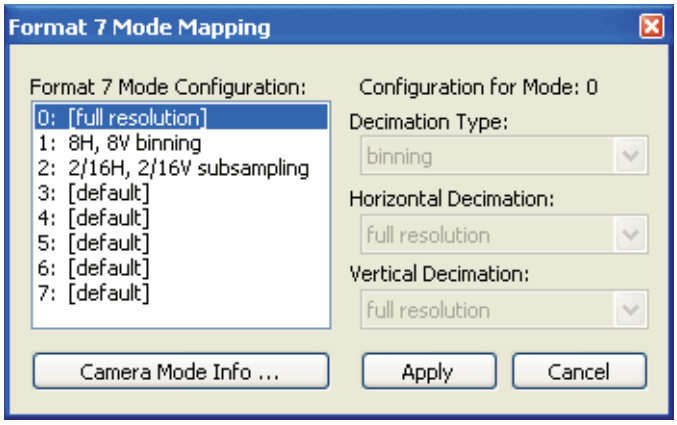


Figure 29: Format_7 mode mapping window

2. Choose your mappings and click on **Apply.**

Note

Examples for abbreviations:

H means horizontal; **V** means vertical

2H binning means 2 x horizontal binning

2/4 H sub-sampling means 2 out of 4 horizontal sub-sampling

F7M1 means Format_7 Mode_1

Decimation Type	Description
Disabled	Chosen mode disappears from the Format_7 mode list.
Default	Factory settings are used: Pike cameras: F7M1: 2H binning F7M2: 2V binning F7M3: 2H, 2V binning F7M4: 2/4 H sub-sampling F7M5: 2/4 V sub-sampling F7M6: 2/4 H, 2/4 V sub-sampling
Binning	Choose binning factors from combo boxes below. • full resolution • 2 • 4 • 8
Sub-sampling	Choose sub-sampling factor from combo boxes below. • full resolution • 2/4 • 2/8 • 2/16

Table 38: Decimation types

For an overview of the available modes, click on **Camera mode info**.

For PIKE cameras the following window opens:

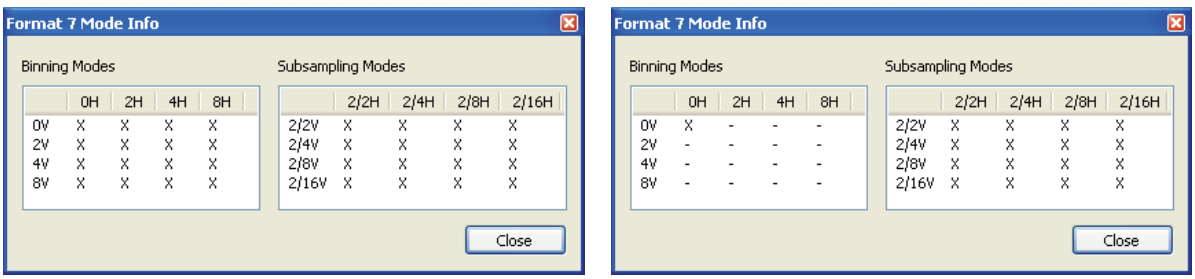


Figure 30: Camera mode info window (left: b/w; right: color PIKE cameras)

When saving settings to an XML file, a hash value is calculated and stored for each Format_7 mode, so that it is not possible to read illegal settings for a re-mapped mode. This has of course no impact on old settings files. In this case, illegal settings could be re-read.

Packed 12-Bit Modes (only PIKE)

For PIKE cameras special **Packed 12-Bit modes** are available.

Conditions

- PIKE b/w camera: MONO12 (color ID 132)
- PIKE color camera: RAW12 (color ID 136)

Where to find

SmartView: **Edit settings** → **Format** tab (b/w: MONO12; color: RAW12)

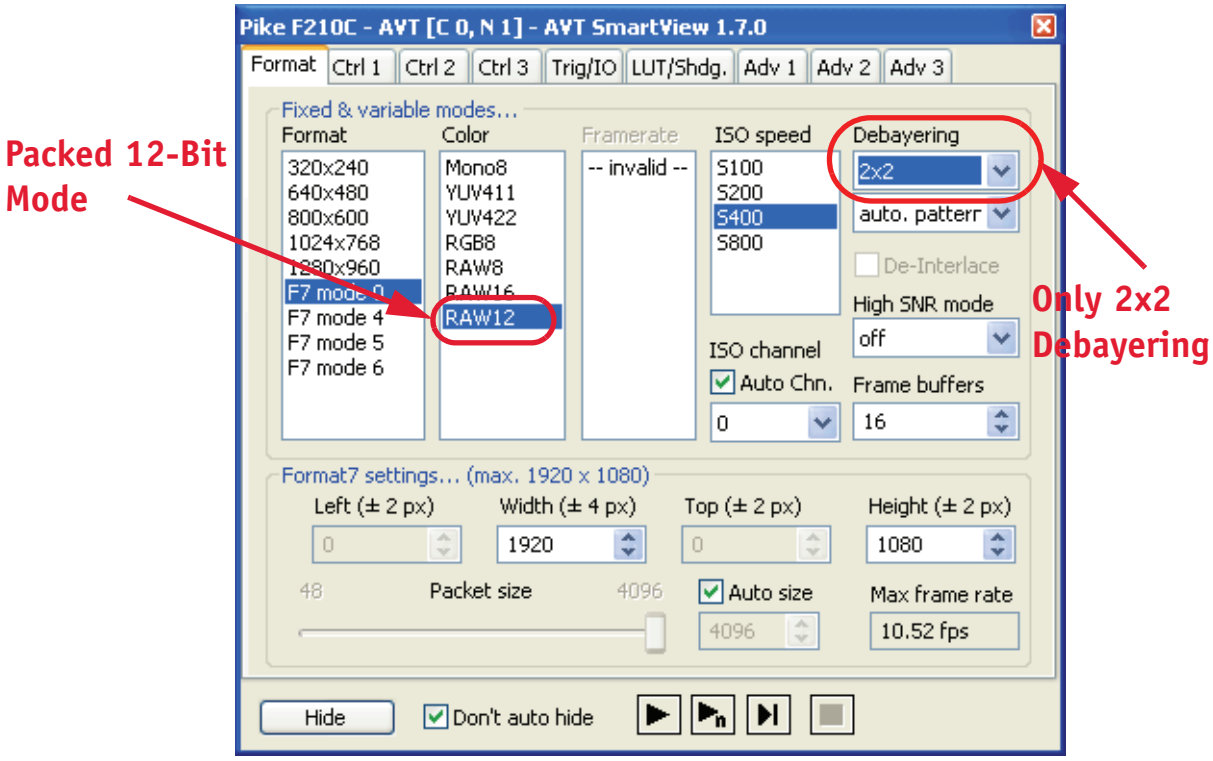


Figure 31: Format tab: Packed 12-bit Mode (PIKE F-210C: RAW12)

Description

The new **Packed 12-Bit Modes** are only available in Format_7. At RAW12 color mode there is only 2x2 debayering available. For a detailed description see **PIKE Technical Manual**, Chapter **Packed 12-bit Mode**.

Sequence mode (PIKE)

Definition **Sequence mode** is a concept where the camera holds a set of different image parameters for a sequence of images. The parameter set is stored volatile in the camera for each image to be recorded. This sequence of parameter sets is simply called a sequence. The advantage is that the camera can easily synchronize this parameter set with the images so that no uncertainty can occur.

Additional information

For additional information on the **sequence mode** feature read the following chapters:

- **PIKE Technical Manual**, Chapter **Sequence mode**

Conditions

- PIKE camera

Where to find

Extras → Sequence dialog...

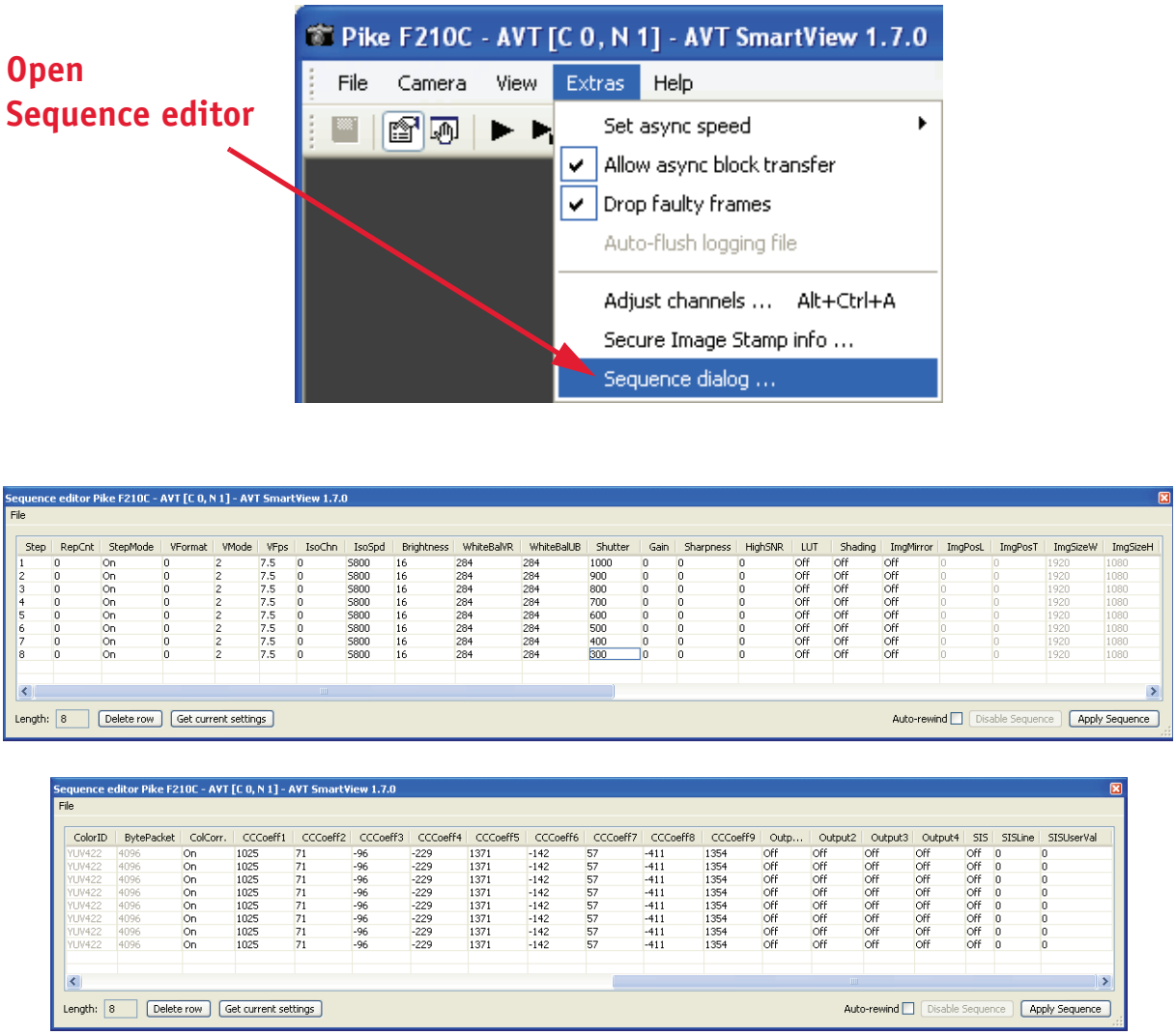


Figure 32: Sequence editor: example for eight different image settings

Description

Perform steps

We show you an **example** how to work with the sequence editor (see screenshots above). Our aim is to set up a sequence with eight different image settings (varying shutter from 1000...300 in steps of 100).

1. In SmartView main window click **Extras → Sequence dialog...**

   The **sequence editor** opens.

2. Click **Get current settings**.

   The currently valid camera settings are gathered and put:
   - into the row, in which the mouse cursor is currently positioned or
   - after the last row (if no row element is selected)

3. Click 7x **Get current settings**.

   You now have a list of 8 identical rows, named Step 1...8 (first column). All parameters that are part of sequence steps are listed in the header row of the table (Step, RepCnt, StepMode, ... , Output4). Scroll to the right to see all parameters.

4. Go to **Shutter** column, click the second entry and type 900, click the third entry and type 800 ... click the 8th entry and type 300.

   You have now set up a sequence going from shutter value 1000 ... 300 in steps of 100.

   Changing parameters that are part of sequence steps do not change the settings inside the camera immediately, but in case of clicking **Apply Sequence** button.

Note

With SmartView do not try out steps altering parameters concerning the transfer via 1394.

Use only steps that do not alter the image format or bandwidth.

5. Click **Apply Sequence** to start the sequence.

   The whole list of settings is sent to the camera and the sequence mode is started. 

   is displayed in the status bar of the viewer window.

6. If you want to disable the current sequence click **Disable Sequence**. If you want to enable the sequence again click **Apply Sequence**.

7. Only PIKE: To determine the behavior of the sequence mode with external control additionally to triggering: Go to **I/O** tab and change the Mode of Input 1 or 2 to **SeqStep** or **SeqReset**. For more information see **PIKE Technical Manual**, Chapter **Which new sequence mode features are available?**

Secure image signature (SIS) (MARLIN, PIKE)

Definition **Secure image signature (SIS)** is the synonym for data, which is inserted into an image to improve or check image integrity.

Additional information

For additional information on the **secure image signature (SIS)** feature read the following chapters:

- **MARLIN Technical Manual**, Chapter **Secure image signature (SIS)**
- **PIKE Technical Manual**, Chapter **Secure image signature (SIS)**

Conditions

- MARLIN camera (cycle time, trigger count, frame count)
- PIKE camera (additional SIS features compared to MARLIN)

Where to find

SmartView: Edit settings → Adv2 tab (Image stamp & counters ☑ **Enable**)

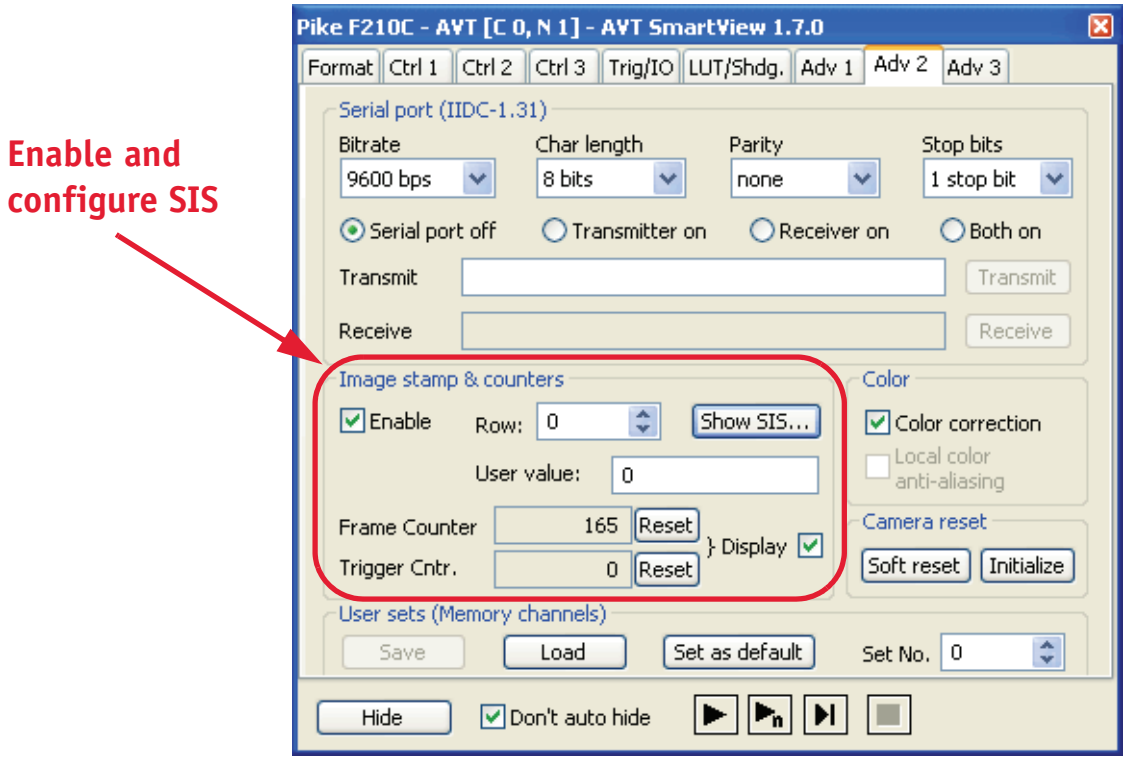


Figure 33: Format tab: Packed 12-bit Mode (PIKE F-210C: RAW12)

Description

To activate secure image signature (SIS) perform the following steps:

1. In SmartView window click **Adv2** tab.
2. In Image stamp & counters section activate ☑ **Enable** check box.
3. For displaying frame/trigger counter numbers activate **Display** ☑ check box.

For more information see Image stamp & counters on page 43.

Smear reduction (only PIKE)

Definition Smear is an undesirable CCD sensor artefact creating a vertical bright line that extends above and below a bright spot in an image.

Implementation **Smear reduction** is a new feature of PIKE cameras: it is a function implemented in hardware in the camera itself to compensate for smear.

Additional information

For additional information on the **smear reduction** feature read the following chapter:

- **PIKE Technical Manual**, Chapter **Smear reduction**

Conditions

- PIKE camera: Use only if smear appears in your images.

Where to find

SmartView: Edit settings → Adv3 tab (Smear reduction ☑ **Enable**)

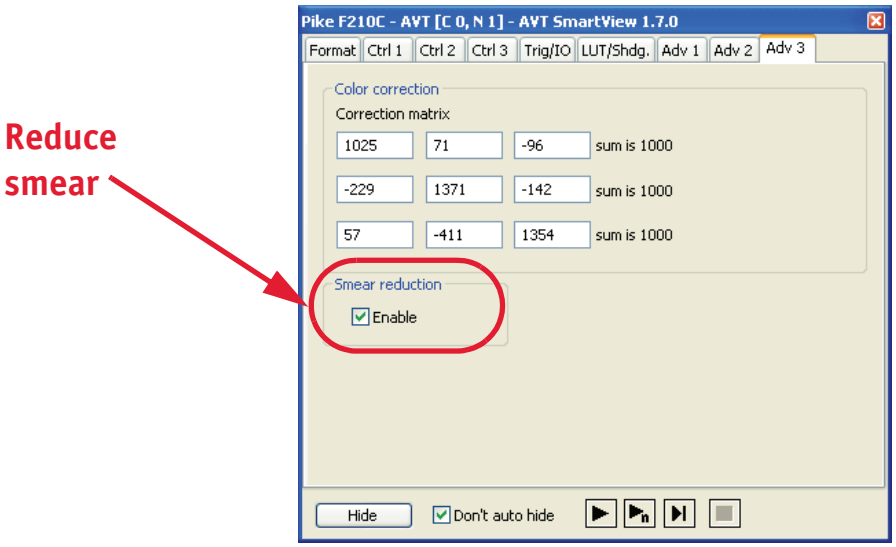


Figure 34: Format tab: Packed 12-bit Mode (PIKE F-210C: RAW12)

Description

Use this function only if smear appears in your images. To activate smear reduction, perform the following steps:

1. In SmartView (Edit settings) window click **Adv3** tab.
2. In Smear reduction section activate ☑ **Enable** check box.

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