

Technical Note

Zyla Spectroscopy Release

The Zyla Spectroscopy features are available on Zyla 4.2 and 5.5 Megapixel camera types with –S suffix. A summary of the released feature set is shown below (**Table 1**).



Figure 1: Zyla sCMOS Camera

NOTE: Spectroscopy features are supported only with SDK3 & FPGA versions as below.

FPGA	4.2MP CL	150806.0 or greater
	4.2MP USB3	150812.0 or greater
	5.5MP CL	150807.0 or greater
	5.5MP USB3	150812.0 or greater
SDK3	Windows	3.11.30001.0 or greater
	Linux	3.11.30002.0 or greater

Table 1: Zyla Spectroscopy Feature Set

Feature
Asymmetric binning options
User definable bit depth
Multi-track mode
Manual External Shutter Control
User Configurable External Trigger Delay
Enhanced Frame Rate option for Small ROIs
Automatic External Shutter Control

Asymmetric Binning Options

The Zyla Spectroscopy feature set allows users to configure any combination of vertical and horizontal binning. This will allow users to avail of full vertical binning for their spectroscopy applications. For horizontal binning the user can select up to 36 horizontally binned pixels. An additional restriction in the horizontal direction means that a user cannot select a horizontal bin number which is greater than $\frac{1}{4}$ of the AOI width. The binning parameter space is described in Table 2.

Table 2 Table providing example binning range options for different ROI settings

AOI Height	AOI width	Maximum Vertical Binning	Maximum Horizontal Binning
2160	2560	2160	36
2048	2048	2048	36
512	512	512	36
128	128	128	32
H	W	H	Lower of: 36 or W/4

SDK3 Feature Reference

It is typical for a user to configure their required binning options in conjunction with Area of Interest. Shown below is a list of all Area Of Interest features which include vertical and horizontal binning control. Please refer to **section 4.6** of the **SDK3 Manual** for a more detailed description of how to set up AOIs and binning. New or modified features are underlined.

Feature	Type	Description
<u>AOIHBin</u>	Integer	Configures the Horizontal Binning of the sensor area of interest.
AOIHeight	Integer	Configures the Height of the sensor area of interest in super-pixels.
AOILeft	Integer	Configures the left hand coordinate of the sensor area of interest in sensor pixels.
AOITop	Integer	Configures the top coordinate of the sensor area of interest in sensor pixels.
<u>AOIVBin</u>	Integer	Configures the Vertical Binning of the sensor area of interest.
AOIWidth	Integer	Configures the Width of the sensor area of interest in super-pixels.

User Definable Bit Depth

In previous Zyla versions, pixel encoding options were 12-Bit (Low Noise) or 12-Bit (High Well Capacity) and 16-Bit (Low Noise & High Well Capacity). This limited the options for bit depth digitised on head and transmitted over the camera interface. In these configurations the bit depth is optimized to preserve dynamic range for 1x1 binning. However if a user for example chooses 2x2 binning this results in situations where the sum of the pixel count values exceed the maximum digital value transmitted. For example if a user is running in 16-bit mode in 1x1 binning, imaging at half well depth, then a given pixel will transmit 30,000 counts of data per pixel which is below the 16-bit digitization range. If they then select 2x2 binning then the binned superpixel will contain 120,000 counts of data. If the digitization is capped to 16-bit then this super pixel will be saturated at 16-bit (65,536 counts), this means that the dynamic range of the camera is not preserved.

The Zyla Spectroscopy feature set allows the user to select any bit depth to be transmitted over the camera interface (up to 32-bits) independent of the SimplePreAmpGainControl selection. This allows the user to select any binning combination and still preserve the dynamic range of the camera.

SDK3 Feature Reference

In previous SDK3 versions, the features **PixelEncoding** and **SimplePreAmpGainControl** were linked such that when changing **SimplePreAmpGainControl**, the **PixelEncoding** feature would automatically adjust to a valid bit depth setting if the previous setting is no longer valid. These features have now been decoupled and the user can separately define the gain setting through **SimplePreAmpGainControl** and the transmitted bit depth via **PixelEncoding**. The table below shows a list of relevant SDK3 features.

Feature	Type	Description
SimplePreAmpGainControl	Enumerated	<u>Options:</u> <ul style="list-style-type: none">• 12-bit (high well capacity)• 12-bit (low noise)• 16-bit (low noise & high well capacity)
PixelEncoding	Enumerated	Configures the format of data stream. <u>Options:</u> <ul style="list-style-type: none">• Mono12 (Note: This option is not available in 16-bit mode)• Mono12Packed (Note: This option is not available in 16-bit mode)• Mono16 (now selectable in 12-bit mode)• Mono32 (now selectable in 12-bit and 16-bit modes)

Multi-Track Mode

Multi-track mode allows creation of one or more individual acquisition tracks that can be defined (in rows) by the height and position of each track. In this way, the position of the tracks can be adjusted to match a light pattern produced on the sensor, for example by a fiber-optic bundle. Only the sections of the sCMOS image chip that are selected in Multi-track mode are transmitted across to the PC. All the selected tracks are transmitted as a single frame for each acquisition. Users can define up to 256 individual of any height. Each track can be individually set up to have either 1x1 binning or fully vertically binned. Users cannot define the width of each track individually but can globally set the transmitted track width. Figure 2 shows a schematic of the Multi-track mode configurations.

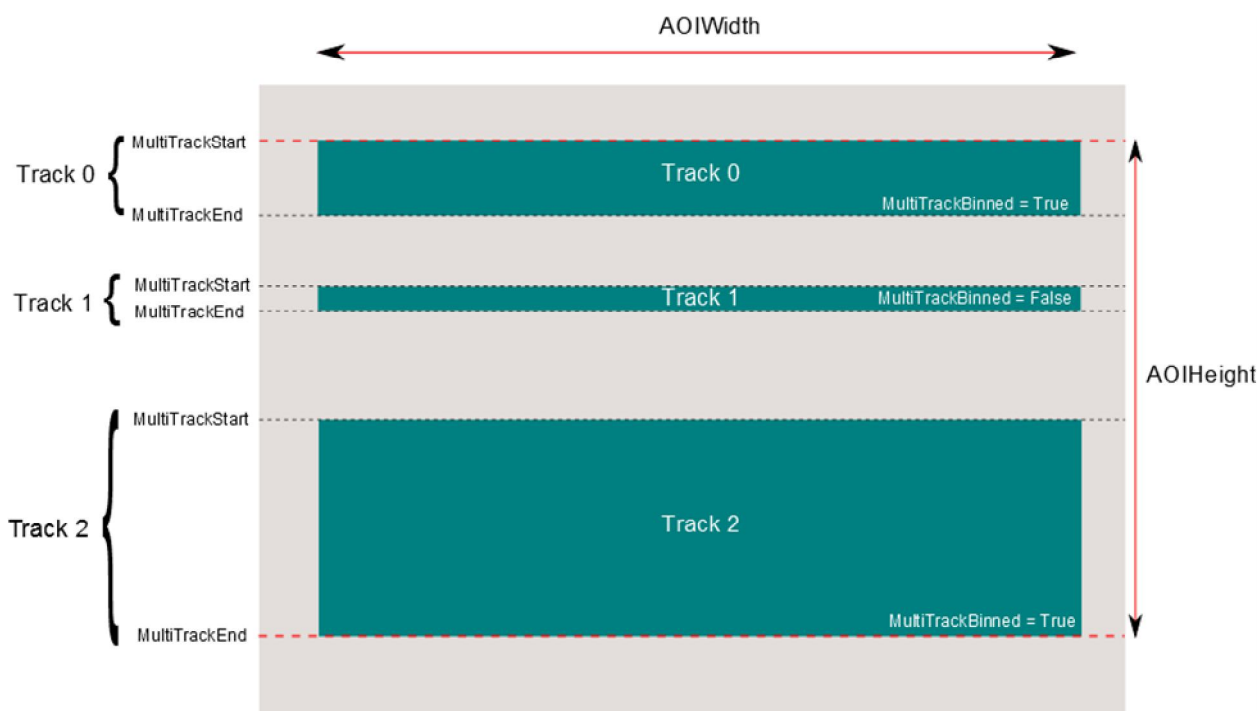


Figure 2 Multi-track setup schematic

It should be noted that the AOI Height is not settable in Multi-track mode. Instead, the total AOI height and position will be determined by the start position of Track 0 and end position of track N-1 where N is the number of tracks.

SDK3

The table below shows all the SDK3 features used to set up multi-track mode. New or modified features are underlined.

Feature	Type	Description
<u>AOILayout</u>	Enumerated	<u>Options:</u> <ul style="list-style-type: none"> Image Kinetics Multitrack
<u>MultitrackCount</u>	Integer	It is in the range 0-256. When set to 0, multitrack is disabled.
<u>MultitrackSelector</u>	Integer	Selects multitrack index. It is in the range 0-(MultitrackCount-1).
<u>MultitrackBinned</u>	Boolean	Configures whether the currently selected multitrack will be binned or not. Default state is set to true.
<u>MultitrackStart</u>	Integer	Configures the row at which the currently selected multitrack begins.
<u>MultitrackEnd</u>	Integer	Configures the row at which the currently selected multitrack ends.

Manual External Shutter Control

This feature enables the user to configure the Aux_Out_2 TTL I/O output (see section 1.6.3 in Zyla Hardware Manual) to be used as an external shutter control. Once configured the Aux_Out_2 output can be switched to **high** (+5V) or **low** (0V) or **Automatic** via an SDK3 command. The default configuration of Aux_Out_2 is set to External Shutter Control.

Automatic Shutter Output

In Automatic shutter control is selected the Aux_Out_2 TTL signal will go high for the duration of an acquisition or acquisition sequence. The user can also define a **Shutter Transfer Time** which delays the time between the Aux_Out_2 signal going high and the start of the 1st acquisition in an acquisition sequence. Figure 3 shows a timing diagram for Automatic Shutter Output. Table 2 shows the available Shutter Transfer Time range.

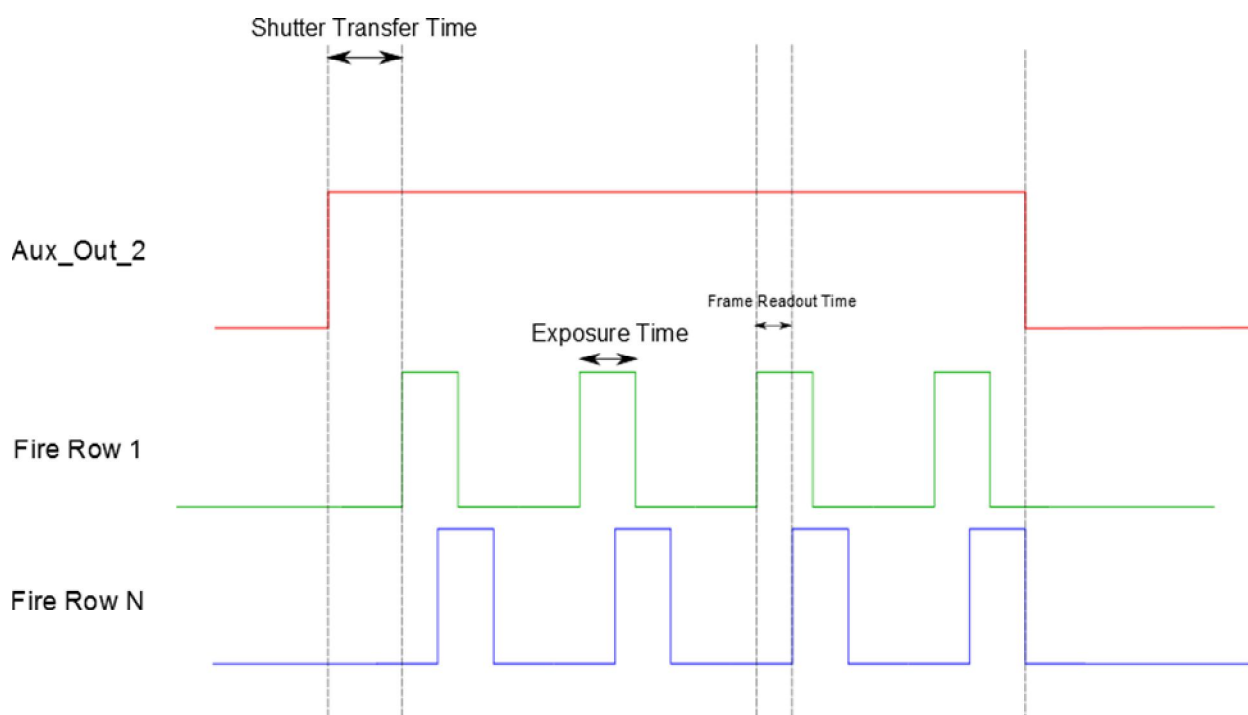


Figure 3 Timing diagram describing the Aux_Out_2 signal output when configured in Automatic Shutter Output mode for a kinetic sequence of 4 frames. Timing diagram also illustrates the user configurable shutter transfer time.

Table 2 Shutter Transfer Time range depending on Sensor Readout Rate

Sensor Readout Rate	Available Shutter Transfer Time Range
540MHz	0 - 7.95 seconds
200MHz	0 - 20.79 seconds

SDK3

The table below shows all the SDK3 features used to set up manual external shutter control. New or modified features are underlined.

Feature	Type	Description
<u>AuxOutSourceTwo</u>	Enumerated	AuxOutSourceTwo is a configurable output available to the user on the D-type. <u>Options:</u> <ul style="list-style-type: none">• ExternalShutterControl• FrameClock• RowClock
<u>ShutterOutputMode</u>	Enumerated	Controls the mode the external trigger will run in. External Shutter signal can either be set to high (open) or low (closed). ShutterOutputMode can be triggered by setting AuxOutSourceTwo to ExternalShutterControl. <u>Options:</u> <ul style="list-style-type: none">• Open• Closed• Automatic
<u>ShutterTransferTime</u>	Float	Defines the delay, in seconds, between the shutter signal going high and the start of exposure of frame 1 in a kinetic series.

User Configurable External Trigger Delay

This feature allows the user, when using external or software trigger modes, to define a delay time between the camera receiving an external trigger and the acquisition start. Table 3 shows a summary of the parameter space for this feature. Note that “Cycle Time” in table 3 refers to the standard cycle time as can be found in the Zyla Hardware Guide.

Table 3 User Configurable External Trigger Delay parameter space

Trigger Mode	External Trigger Delay Available	Sensor Readout Rate	Available Trigger Delay Range (Delay)	Min Cycle Time
Internal	No	540MHz	N/A	Cycle Time
		200MHz	N/A	Cycle Time
External	Yes	540MHz	0 - 7.95 seconds	Delay + Cycle Time
		200MHz	0 - 20.79 seconds	Delay + Cycle Time
External Start	Yes	540MHz	0 - 7.95 seconds	Cycle Time
		200MHz	0 - 20.79 seconds	Cycle Time
Software	Yes	540MHz	0 - 7.95 seconds	Delay + Cycle Time
		200MHz	0 - 20.79 seconds	Delay + Cycle Time
External Exposure	No	540MHz	N/A	Cycle Time
		200MHz	N/A	Cycle Time

The granularity of External Trigger Delay control is set to 1us although it should be noted the jitter between external trigger and exposure start is up to one row readout time. The values of row readout times for different scan speed can be found in the Zyla Hardware Manual.

Feature	Type	Description	Availability
ExternalTriggerDelay	Floating Point	Configures the delay, in seconds, between external/SW trigger and exposure start	Zyla

Improved Rolling Shutter Exposure Time Control

An additional feature in this release, although not directly related to Spectroscopy is that the exposure time control in all Rolling shutter modes is now more flexible. Table 4 shows a summary of the configurable exposure times in different Rolling shutter configurations. Timings for Row Readout Times and Frame readout times are given in tables 2 and 4.

Table 4 User Configurable Exposure Times

Overlap Mode	Trigger Mode	Available Exposure Range	Min Cycle Time
Off	Internal	1 Row to 30s	Exposure + 1 Frame + 3 Rows
Off	External/Software	3 Rows to 30s	Exposure + 1 Frame + 3 Rows
Off	External Start	1 Row to 30s	Exposure + 1 Frame + 3 Rows
Off	External Exposure	3 Rows to 30s	Exposure + 1 Frame + 3 Rows
On	Internal	1 Row to 30s	1 Frame + 1 Row or Exposure (greater of the two)
On	External/Software	3 Rows to 30s	1 Frame + 1 Row or Exposure (greater of the two)
On	External Start	1 Row to 30s	1 Frame + 1 Row or Exposure (greater of the two)
On	External Exposure	3 Rows to 30s	1 Frame + 1 Row or Exposure (greater of the two)

Release Known Issues

Known Issue Reference	Description