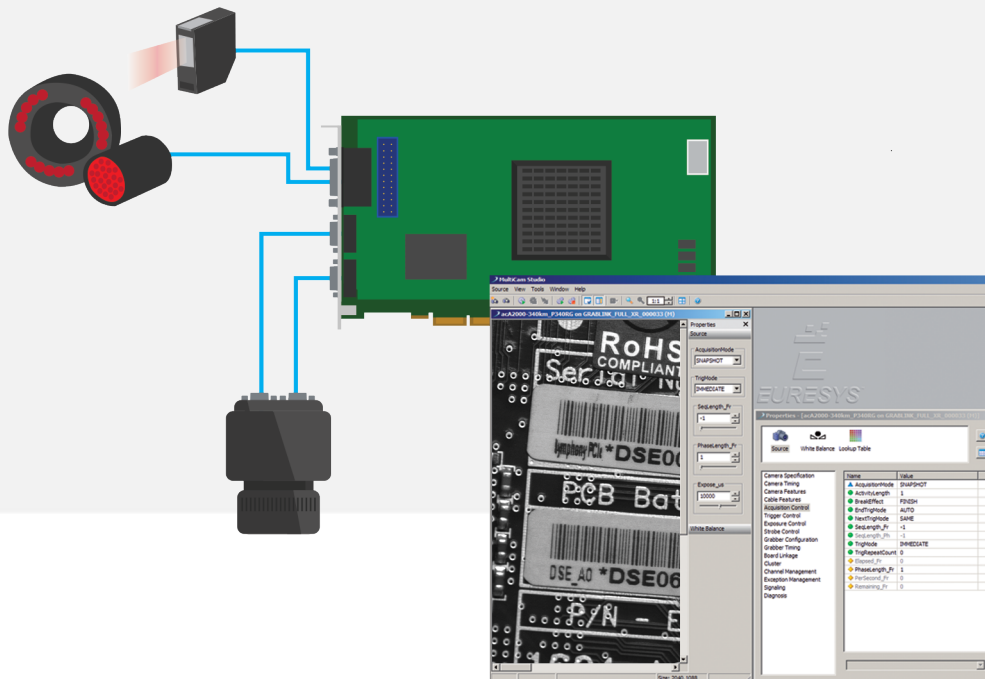


Grablink

Documentation Update



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About This Document

Products Scope

This document applies to the following products:

Product Code	Product Designation
1624	Grablink Base
1623	Grablink DualBase
1622	Grablink Full
1626	Grablink Full XR

Purpose & Summary

This document complements the MultiCam Boards Documentation that was provided with MultiCam 6.7. It provides the documentation addendum for all features that were introduced or enhanced after MultiCam 6.7.

Main sections of the document:

[Cluster Mechanism](#) on page 6

[Description of the MultiCam surface cluster mechanism](#)

[Pixel Processing Chain](#) on page 8

[Structure of the pixel processing chain](#)

[White Balance](#) on page 13

[Detailed description of the White Balance Operator](#)

[Metadata Insertion](#) on page 19

[Insertion of real-time metadata on the Camera Link data stream](#)

[Interleaved Acquisition](#) on page 30

[Image acquisition from grabber-controlled exposure asynchronous reset cameras driven alternatively by two different camera cycle programs](#)

[Two-line Synchronized Line-scan Acquisition](#) on page 45

[Acquisition, in a single scanning operation, of images from 2 \(or more\) Basler Sprint bi-linear Bayer CFA color line-scan cameras with 2 illumination devices turned on alternatively](#)

Cluster Mechanism

Description of the MultiCam surface cluster mechanism

Surface states

To implement the cluster mechanism, MultiCam uses the state of the surface, which is available through the MultiCam parameter `SurfaceState`.

Any instantiated surface is necessarily in one of the five following states:

Surface State	Description
FREE	The surface is unconditionally able to receive image data from the grabber.
FILLING	The surface is presently receiving or ready to receive image data from the grabber.
FILLED	The surface has finished receiving image data from the grabber, and thus is ready for processing.
PROCESSING	The surface is being processed by the host processor.
RESERVED	The surface is removed from the standard state transition mechanism.

The state of the surface is unique in the sense that, at a given instant, a surface belonging to several clusters is perceived in a consistent state by all associated channels.

Surface state transitions

State transitions table

State origin	State destination	Initiator	Occurrence and applicability
Not applicable	FREE	User application	On creation of a new surface.
FREE	FILLING	MultiCam Driver	On Start Acquisition Sequence and End of Transfer Phase events: <ul style="list-style-type: none">When <code>MaxFillingSurfaces</code> = <code>MAXIMUM</code>: applies to all (up to 512) FREE surfaces in the clusterOtherwise applies to only one FREE surface
FILLING	FILLED	MultiCam Driver	On End of Transfer Phase event: <ul style="list-style-type: none">When <code>MaxFillingSurfaces</code> = <code>MAXIMUM</code>: applies to all (up to 512) FILLING surfaces in the cluster that have finished receiving image data from the grabber, and thus are ready for processingOtherwise applies to the unique FILLING surface
FILLED	PROCESSING	User application or Operating System	Applies to the oldest FILLED surface (if any) when the cluster contains no more PROCESSING surface and <ul style="list-style-type: none">on Execution of the <code>McGetSignalInfo</code> function oron release (exit) of the <code>McWaitSignal(SurfaceProcessing)</code> function oron entry of the "Surface Processing" callback function.

State origin	State destination	Initiator	Occurrence and applicability
PROCESSING	FREE	User application or Operating System	Applies to the unique PROCESSING surface (if any) when: <ul style="list-style-type: none"> setting the parameter <code>MC_SurfaceState</code> to the value <code>MC_SurfaceState_FREE</code> or automatically when exiting the "Surface Processing" callback function.
FILLED RESERVED	FREE	User application	Applies to any FILLED or RESERVED surface when setting the parameter <code>MC_SurfaceState</code> to the value <code>MC_SurfaceState_FREE</code> .
FILLED PROCESSING	RESERVED	User application	Applies to any FILLED or PROCESSING surface when setting the parameter <code>MC_SurfaceState</code> to the value <code>MC_SurfaceState_RESERVED</code> .
FILLED	FREE	MultiCam Driver	Applies to the oldest FILLED surface (if any) when the cluster contains no more FREE surfaces

The following drawing shows a simplified state transition diagram applying to any surface in the cluster:

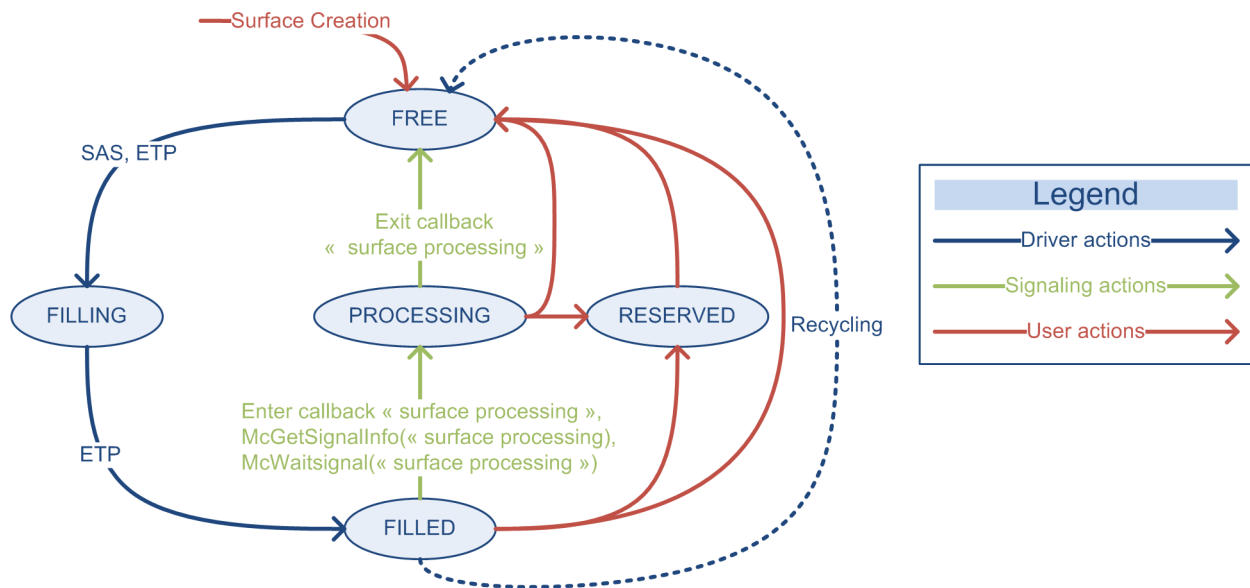


Figure 1: Surface state diagram

For a cluster having a total of N registered surfaces:

- 0 up to N surfaces can be in the FREE state
- 0 up to N (limited to 512) surfaces can be in the FILLING state when the parameter `MaxFillingSurfaces` = MAXIMUM
- 0 or 1 surface can be in the FILLING state when the parameter `MaxFillingSurfaces` = MINIMUM
- 0 up to N surfaces can be in the FILLED state
- 0 or 1 surface can be in the PROCESSING state
- 0 to (N-2) surfaces can be in the RESERVED state



Note: There is at most one surface in the PROCESSING state per cluster!



Note: At least 2 surfaces should be left outside the RESERVED state to maintain a minimal operability of the cluster mechanism.

Pixel Processing Chain

Structure of the pixel processing chain

The acquisition channels of Grablink Base, Grablink DualBase, Grablink Full, and Grablink Full XR implement a pixel processing chain. It is made of the following processing elements:

- A Bayer CFA Decoder
- A White Balance Operator
- A Look-Up table Operator

The pixel processing chain is configurable; each element can be individually configured, enabled or disabled. However the order of the elements cannot be modified!

Related Information

[Bayer CFA to RGB configurations](#) on page 8

[RGB to RGB configurations](#) on page 10

[White Balance Operator](#) on page 11

Bayer CFA to RGB configurations

In the Bayer CFA to RGB configurations, the pixel processing chain uses the following elements:

- Bayer CFA Decoder
- White Balance operator (Optional)
- Look-Up-table operator (Optional)

The Look-Up-table operator is configured for RGB color processing.

The processing chain outputs one RGB pixel for each RAW pixel of the input buffer.

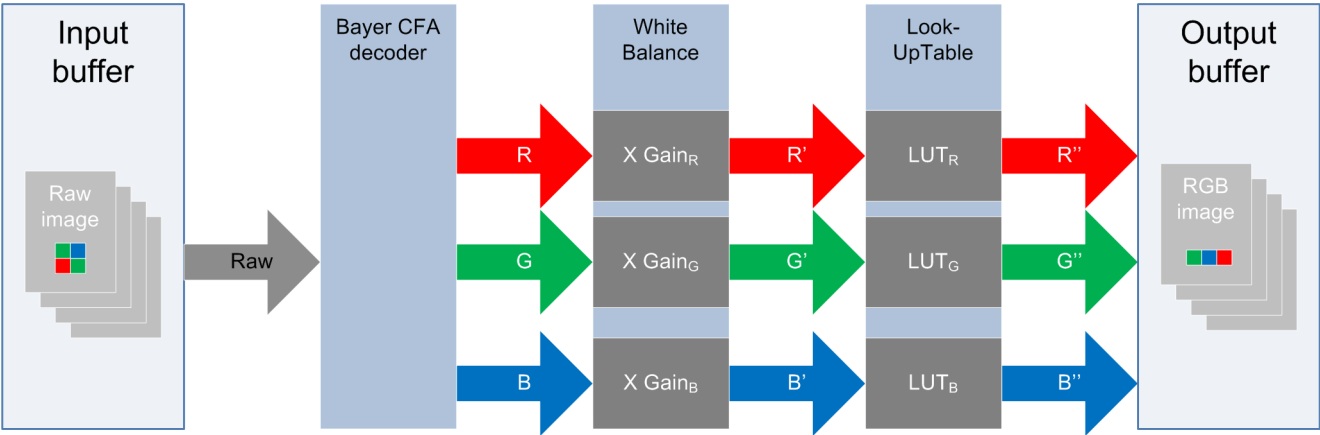


Figure 2: Pixel Processing Chain - Bayer CFA => RGB Configuration

Bayer CFA to RGB Configurations - Availability and Performance

Pixel Input Format	WBO	LUT	Pixel Output Format(s)	Compatible products and peak pixel rate (Megapixels/sec)
Bayer8	Optional	8-bit to 8-bit RGB	RGB24 Packed RGB32 Packed RGB24 Planar	Grablink Base: 125 Grablink DualBase: 125 Grablink Full: 250 Grablink Full XR: 250
Bayer10	Optional	10-bit to 8-bit RGB	RGB24 Packed RGB32 Packed RGB24 Planar	Grablink Base: 125 Grablink DualBase: 125 Grablink Full: 250 Grablink Full XR: 250
Bayer10	Optional	10-bit to 10-bit RGB	RGB30 Planar	Grablink Full: 125 Grablink Full XR: 125
Bayer10	Optional	10-bit to 16-bit RGB	RGB48 Planar	Grablink Full: 125 Grablink Full XR: 125
Bayer12	Optional	12-bit to 8-bit RGB	RGB24 Packed RGB32 Packed RGB24 Planar	Grablink Base: 125 Grablink DualBase: 125 Grablink Full: 250 Grablink Full XR: 250
Bayer12	Optional	12-bit to 12-bit RGB	RGB36 Planar	Grablink Full: 125 Grablink Full XR: 125
Bayer12	Optional	12-bit to 16-bit RGB	RGB48 Planar	Grablink Full: 125 Grablink Full XR: 125
Bayer14	Optional	12-bit to 8-bit RGB	RGB24 Packed RGB32 Packed RGB24 Planar	Grablink Base: 125 Grablink DualBase: 125 Grablink Full: 250 Grablink Full XR: 250
Bayer14	Optional	12-bit to 14-bit RGB	RGB42 Planar	Grablink Full: 125 Grablink Full XR: 125
Bayer14	Optional	12-bit to 16-bit RGB	RGB48 Planar	Grablink Full: 125 Grablink Full XR: 125
Bayer16	Optional	12-bit to 8-bit RGB	RGB24 Packed RGB32 Packed RGB24 Planar	Grablink Base: 125 Grablink DualBase: 125 Grablink Full: 250 Grablink Full XR: 250
Bayer16	Optional	12-bit to 16-bit RGB	RGB48 Planar	Grablink Full: 125 Grablink Full XR: 125

RGB to RGB configurations

In the RGB to RGB configurations, the pixel processing chain uses the following elements:

- White Balance operator (Optional)
- Look-Up-table operator (Optional)

The Look-Up-table Operator is configured for RGB color processing.

The processing chain outputs one RGB pixel for each RGB pixel of the input buffer.

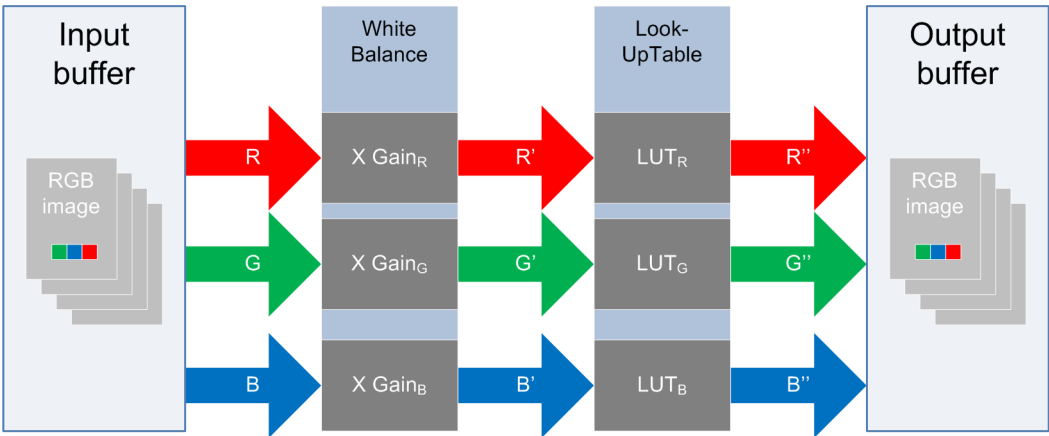


Figure 3: Pixel Processing Chain - RGB => RGB Configuration

RGB to RGB Configurations - Availability and Performance

Pixel Input Format	WBO	LUT	Pixel Output Format(s)	Compatible products and peak pixel rate (Megapixels/sec)
RGB24	Optional	8-bit to 8-bit RGB	RGB24 Packed RGB32 Packed RGB24 Planar	Grablink Base: 125(85*) Grablink DualBase: 125(85*) Grablink Full: 250(170*) Grablink Full XR: 250(170*)
RGB30	Optional	10-bit to 8-bit RGB	RGB24 Packed RGB32 Packed RGB24 Planar	Grablink Full: 250(85*) Grablink Full XR: 250(85*)
RGB30	Optional	10-bit to 10-bit RGB	RGB30 Planar	Grablink Full: 125(85*) Grablink Full XR: 125(85*)
RGB30	Optional	10-bit to 16-bit RGB	RGB48 Planar	Grablink Full: 125(85*) Grablink Full XR: 125(85*)
RGB36	Optional	12-bit to 8-bit RGB	RGB24 Packed RGB32 Packed RGB24 Planar	Grablink Full: 250(85*) Grablink Full XR: 250(85*)

Pixel Input Format	WBO	LUT	Pixel Output Format(s)	Compatible products and peak pixel rate (Megapixels/sec)
RGB36	Optional	12-bit to 10-bit RGB	RGB36 Planar	Grablink Full: 125(85*) Grablink Full XR: 125(85*)
RGB36	Optional	12-bit to 16-bit RGB	RGB48 Planar	Grablink Full: 125(85*) Grablink Full XR: 125(85*)



Note: (xx*) indicates the highest pixel rate achievable by Camera Link for the targeted board.

White Balance Operator

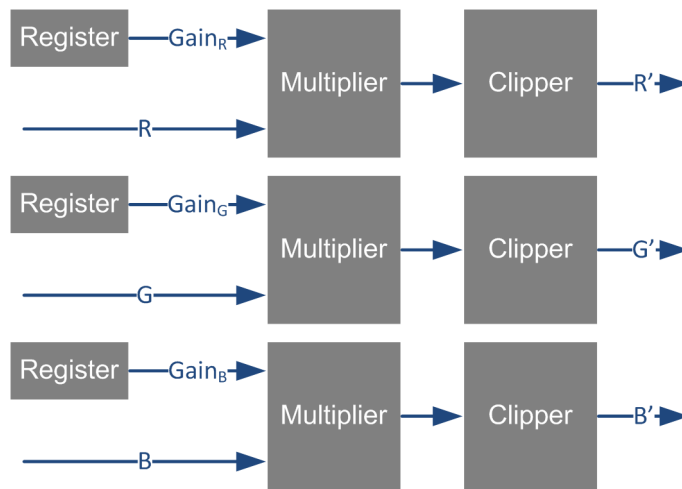


Figure 4: White Balance Operator - Block Diagram

The White Balance Operator is an element of the pixel processing chain. It is composed with 3 identical processing blocks, one for each color component. Each processing block contains 3 elements:

- One register
- One multiplier
- One clipper

The register element holds the gain correction factor. The gain value is registered as a 16-bit unsigned binary value allowing gain correction factors to be accurately defined.

The multiplier computes the product of the gain correction factor and the color component value. It is capable to handle components having 8-bit, 10-bit, 12-bit, 14-bit and 16-bit bit depth.

The multiplier output is clipped to the maximum value of the digital output scale. The digital output scale is in all cases identical to the digital input scale; itself identical to the digital output scale of the camera. For instance, for a camera delivering 10-bit components, the digital scale is [0..1023].

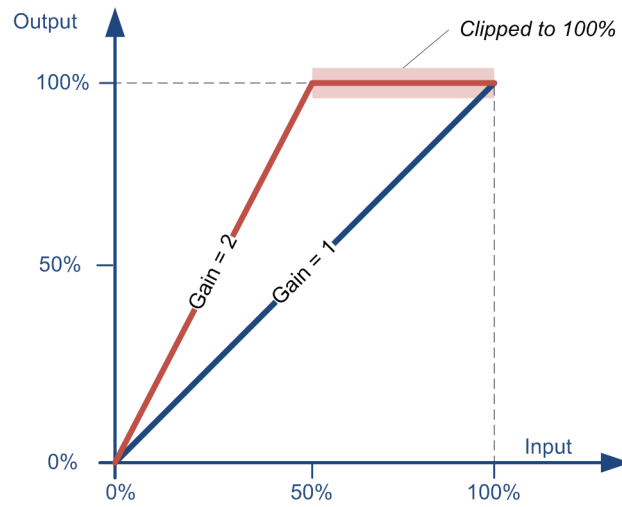


Figure 5: White Balance Operator - Transfer Function

The above drawing shows 2 transfer functions of one component of the White Balance Operator:

- The blue line corresponds to a gain setting of 1.000; i.e., the minimal allowed gain value.
- The red line corresponds to a gain setting of 2.000. The output remains proportional to the input until the 100% full-scale output is reached; for greater input values, the output is clipped to 100% full-scale!

White Balance

[Detailed description of the White Balance Operator](#)

What Is White Balance?

Color image acquisition

A color image acquisition involves the use of three color filters on the camera sensor. Each color filter restricts the light source to a range of wavelengths of the light spectrum, either red (R), green (G), or blue (B).

An ideal capture system renders a white object as a white image. A white stimulation should yield the same signal for R, G and B filters. But practically, there are always unavoidable defects on the signals that introduce a **white imbalance**.

White imbalance factor

Several factors, due to the camera and to the capture conditions, are responsible for the white imbalance:

- Object illumination. The color of an object is a combination of its reflectivity and the spectral contents of the illuminating light.
- Camera optical filters response.
- Sensor sensitivity, which is not the same for the three ranges of wavelength.
- Different gain coefficients applied to each color signal before digitization.

White balance correction

MultiCam can correct the white imbalance of the capture system. The operation is called the **white balance**:

- The **white balance operator** applies correcting coefficients (R, G, and B gains) to each color signal, so, for a white object, the combination of the R, G, and B signals renders a white image.
- The **white balance calibration** is the computation of the three R, G, and B gains. It is performed on a representative image area, prior to the image capture. It can be automatic or manual.

Related Information

[White Balance Operator](#) on page 11

[Automatic Calibration Description](#) on page 13

Automatic Calibration Description

The color calibration process takes place during the first acquisition phase of a MultiCam acquisition sequence when the `WBO_Mode` is set to `ONCE`.

The color calibrator analyzes a rectangular area (`AWB_AREA`) of one uncorrected image and computes a correcting gain factor for each RGB color component.

The correction factor for the color component having the strongest response is always 1; the correction factors for the weakest color components are greater than 1.

Providing that the requirements of the **color source equipment**, the **calibration target** and the **acquisition channel settings** are fulfilled, the calibrator estimates the gain factors with an accuracy better than 1/1000.

Applying the calculated gain correction factors to the White Balance Operator for subsequent image acquisitions allows on-the-fly color balancing of the acquired images.

The calibrator returns a NOT_OK status in the following cases:

- Excessive color imbalance.
- Not enough pixels satisfying the calibration target requirements in the AWB_AREA.

Automatic Calibration Requirements

This topic describes the requirements that must be fulfilled to obtain optimal calibration results.

Image Source Equipment Requirements

The image source equipment including: the camera, the lighting and the optical elements, must exhibit:

- A linear response: The digital value of each color component must be proportional to the light intensity of the corresponding color.
- A moderate color imbalance: The ratio between the response of the strongest color component and the weakest color component must be less than 5.

Calibration Target Requirements

The calibration target is a neutral color object located in the field of view of the camera during the calibration process.

The form of the target can be either:

- Clustered light gray pixels located in a specific area of the camera field of view.
- Non-clustered-light gray pixels located in a specific area of the camera field of view.
- Non-clustered-light gray pixels located anywhere in the camera field of view.

The calibration target can be:

- In the object to inspect.
- A specific object placed in the camera field of view during the calibration phase.

The appearance of the target must be:

- A neutral light gray color.
- The level of the brightest component within 75% to 90% of the full scale.
- The level of the darkest component above 15% of the full scale.

The target must contain at least 256 pixels satisfying the appearance requirements.

Acquisition Channel Settings

The parameter `WBO_Mode` must be set to `ONCE`.

The parameters defining the position and the size of the `AWB_AREA` must be configured such that:

- It includes at least 256 pixels satisfying the calibration target appearance requirements.
- It contains at least 1 line and 32 columns of pixels.
- It is located entirely within the Camera Active Area.

Specifically on Grablink Base, Grablink DualBase, Grablink Full, and Grablink Full XR:

- The LUT Operator must be disabled.
- The position and the size of the cropping area must be configured such that it encompasses the `AWB_AREA`

Automatic Calibration Timing

The color calibration process takes place during the first acquisition phase of a MultiCam acquisition sequence when the `WBO_Mode` is set to `ONCE`.

The White Balance Operator is disabled before the sequence starts.

The calibration process begins when the DMA transfer of the first acquisition phase is completed. The first `MC_SIG_SURFACE_PROCESSING` signal of the sequence is delayed until the completion of the calibration process.

At the completion of a successful calibration process:

- The value of the parameter `WBO_Status` is set to `OK`.
- The values of parameters `WBO_GainR`, `WBO_GainG`, and `WBO_GainB` are updated with the calibration results.
- The White Balance Operator is reconfigured with the new settings.

At the completion of an unsuccessful calibration process:

- The value of the parameter `WBO_Status` is set to `NOT_OK`.
- The original values of parameters `WBO_GainR`, `WBO_GainG`, and `WBO_GainB` are restored.
- The White Balance Operator is reconfigured with the original settings.

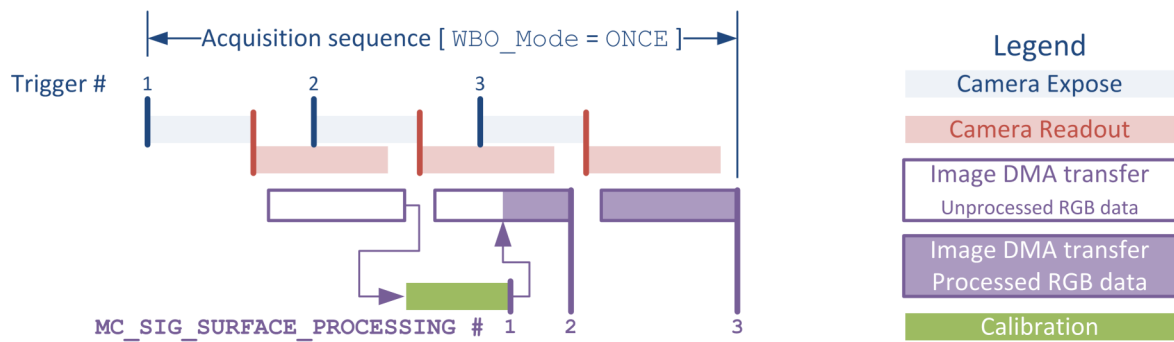


Figure 6: Calibration Timing Diagram

AWB_AREA Settings Description

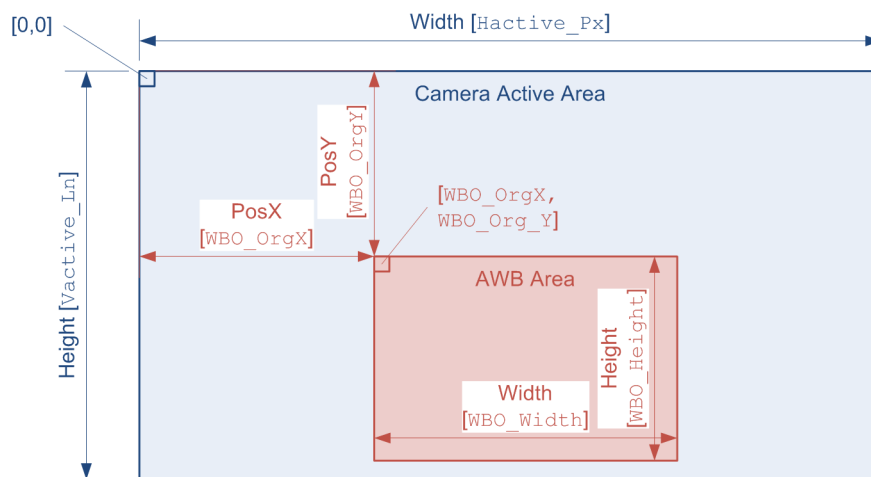


Figure 7: AWB_AREA layout

The AWB_AREA is a rectangular area within the Camera Active Window that is analyzed by the color balancing calibrator.

The size and the position of the AWB_AREA within the Camera Active Area is defined by the following parameters: WBO_Width, WBO_Height, WBO_OrgX, and WBO_OrgY.

The default size of the AWB_AREA is the whole Camera Active Area.

Image Geometrical Operators

Image Cropping

The image cropping operator - **ICO** - selects a subset of the pixels delivered by the camera to build the image delivered to the Host PC; this subset is named **Window Area**:

- For area-scan cameras, the **Window Area** is a single rectangular region of the 2D image sensor.
- For line-scan cameras, the **Window Area** is a single segment of the 1D image sensor.

ICO parameters

The ICO is controlled through the following Channel Class parameters of the Grabber Timing category:

- GrabWindow: the main control parameter.
- WindowX_Px, WindowY_Ln: integer parameters defining the size of the Window Area.
- OffsetX_Px, and OffsetY_Ln: integer parameters defining the position of the Window Area within the Camera Active Area.

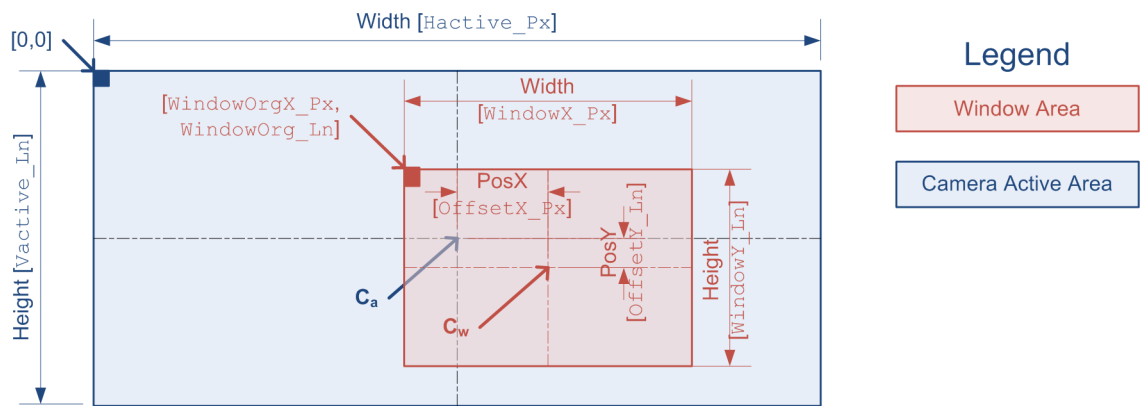


Figure 8: Window Area Parameters for Area-Scan cameras

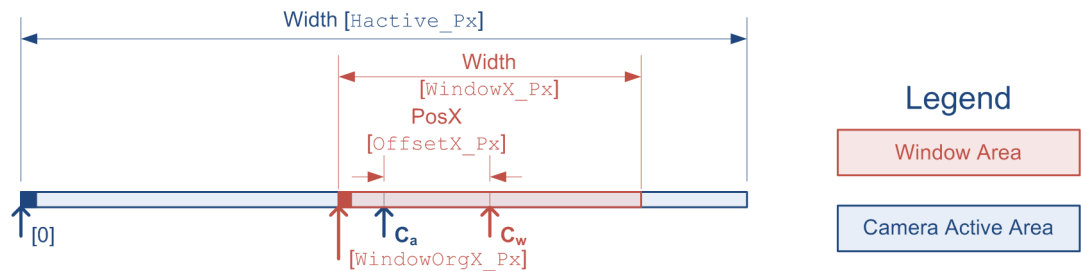


Figure 9: Window Area Parameters for Line-Scan cameras



Note: The position of the Window Area within the Camera Active Window is expressed as the difference of coordinates between Cw, the center of the Window Area, and Ca, the center of the Camera Active Area.



Note: The range of allowed values of `OffsetX_Px` and `OffsetY_Ln` parameters is automatically adjusted to force the Window Area to stay within the boundaries of the Camera Active Area.



Note: `WindowOrgX_Px` reports the X-coordinate in the Camera Active Area of the leftmost pixels of the Window Area: $\text{WindowOrgX_Px} = (\text{Hactive_Px} - \text{WindowX_Px}) / 2$



Note: For area-scan cameras only: `WindowOrgY_Ln` reports the Y-coordinate in the Camera Active Area of the topmost pixels of the Window Area: $\text{WindowOrgY_Ln} = (\text{Vactive_Ln} - \text{WindowY_Ln}) / 2$

Configuring the Image Cropping Operator

By default, `GrabWindow` is set to `NOBLACK` disabling the ICO: the acquired image includes all active pixels delivered by the camera without any surrounding weak or blind pixels on the image edges.

To enable image cropping, proceed as follows:

- Enable ICO by setting `GrabWindow` to `MAN`.
- Adjust the width of the Window Area using `WindowX_Px`. Any integer value ranging from **8** up to `Hactive_Px` is allowed.
- For area-scan cameras only: Adjust the height of the Window Area using `WindowY_Ln`. Any integer value ranging from **1** up to `Vactive_Ln` is allowed.
- Move horizontally the Window Area using `OffsetX_Px`. Increasing the value moves the Window Area towards the right of the Camera Active Area and vice-versa, decreasing the value moves the Window Area towards the left of the Camera Active Area.
- For area-scan cameras only: Move vertically the Window Area using `OffsetY_Ln`. Increasing the value moves the Window Area towards the top of the Camera Active Area and vice-versa, decreasing the value moves the Window Area towards the bottom of the Camera Active Area.

Conditions of applicability

ICO is applicable to the following camera classes:

- Monochrome, RGB color, and Bayer CFA color **area-scan cameras**: any valid combination of `TapConfiguration` and `TapGeometry` is allowed except when `TapGeometry = *_2YE`
- Monochrome, and RGB color **line-scan cameras**.

Image Flipping Operators

The image flipping operator - **IFO** - performs mirroring of the image delivered to the Host PC:

- For area-scan cameras, the IFO is capable to perform left/right and top/bottom mirroring.
- For line-scan camera, the IFO is capable to perform left/right mirroring only.

The IFO is controlled through the following Channel Class parameters of the Cluster Category:

- `ImageFlipX` enables the left/right mirroring
- `ImageFlipY` enables the top/bottom mirroring.

By default, both operators are OFF disabling any mirroring.



Figure 10: Image Flipping Operations

Conditions of applicability

IFO is applicable to the following camera classes:

- Monochrome, RGB color, and Bayer CFA color **area-scan cameras**
- Monochrome, and RGB color **line-scan cameras**

Metadata Insertion

Insertion of real-time metadata on the Camera Link data stream

Description

When the Metadata Insertion feature is enabled, the frame grabber inserts real-time metadata into the Camera Link image data stream.

Metadata Insertion Methods

There are two distinct metadata insertion methods in the Grablink series.

METHOD 1: "Replace, on all taps, the pixel component data of the first Camera Link time slot."

The pixel(s) data conveyed during the first Camera Link time slot after an LVAL are replaced by metadata.

The quantity of metadata is defined by the number of taps.

The 3 configurations using this method are named, **1-field**, **2-field**, and **3-field**, according to the quantity of metadata they contain.

This method is invoked when `MetadataLocation=LVALRISE`.

METHOD 2: "Insert metadata on an unused tap, during several Camera Link time slots."

This method is invoked by setting `MetadataLocation=TAP10`.

There is only one configuration using this method: **TAP10**.

In the Tap10 configuration, the 3-field of metadata are effectively inserted on Tap10 during the first 10 Camera Link Clock cycles of every line after the LVAL rising edge. For the other clock cycles, the frame grabber inserts bytes of '0'.

Metadata Configurations

The metadata combines 1, 2, or 3 fields using the following 4 configurations:

Field Name	1-field configuration	2-field configuration	3-field configuration	Tap10 configuration
I/O State	OK	OK	OK	OK
LVAL Count	-	OK	OK	OK
Q Count	-	-	OK	OK

The enumerated parameter `MetadataContent` reports the metadata configuration.

Metadata Fields Content

Field Name	Description
I/O State	A 6-bit field reporting the logical state of all System I/O input lines belonging to the Channel
LVAL Count	A 32-bit field reporting the current value of the LVAL pulse counter
Q Count	A 32-bit field reporting the current value of the motion encoder pulse counter (Q)

Feature Availability

The 1-field, 2-field and 3-field configurations of the Metadata Insertion feature, are available since version 6.9.4 of MultiCam on the following products:

Supported Products	Supported BoardTopology Values
PC1626 Grablink Full XR	All values: MONO, MONO_SLOW and MONO_DECA
PC1622 Grablink Full	All values: MONO, MONO_SLOW and MONO_DECA
PC1623 Grablink DualBase	All values: DUO and DUO_SLOW
PC1624 Grablink Base	All values: MONO and MONO_SLOW

The Tap10 configuration of the Metadata Insertion feature, is available since version 6.11 of MultiCam on the following products:

Supported Products	Supported BoardTopology Values
PC1626 Grablink Full XR	MONO_DECA
PC1622 Grablink Full	MONO_DECA

Compatible Camera Interface Configurations

The following camera configurations allow to enable the metadata insertion feature and provide at least one field of metadata:

Camera Interface Characteristic	Supported cases
Image sensor geometry	<ul style="list-style-type: none">Line-scan (including bi-linear and TDI)Area-scan cameras
Pixel type	<ul style="list-style-type: none">MonochromeColor (Bayer CFA and RGB)
Camera Link configurations	BASE, MEDIUM, FULL, and 80-BIT
Pixel bit depth	<ul style="list-style-type: none">8-/10-/12-/14-/16-bit monochrome and Bayer CFA24-/30-/36-/42-/48-bit RGB
Tap geometries	<p>All tap geometries except:</p> <ul style="list-style-type: none">2XR, 2XR_1Y, 2XR_1Y2, 2XR_2YE2XM, 2XM_1Y, 2XM_1Y2, 2XM_2YE2X2M, 2X2M_1Y, 2X2M_1Y2, 2X2M_2YE4XR, 4XR_1Y, 4XR_1Y2, 4XR_2YE8XR, 8XR_1Y

The following camera interface configurations provide **3-field metadata**:

Imaging	TapConfigurat	TapGeomet	Description
LINE or TDI	FULL_8T8	1X8	8-bit 8-tap, single X region, monochrome line-scan or TDI line-scan camera
	MEDIUM_2T24	1X2	24-bit 2-tap, single X region, RGB color line-scan or TDI-line-scan camera
	MEDIUM_6T8	1X3_1Y2	8-bit 6-tap, single X region, bilinear monochrome or Bayer CFA line-scan camera

The following camera interface configurations provide **3-field metadata**:

Imaging	TapConfigurat	TapGeomet	Description
LINE or TDI	DECA_10T8	1X10	8-bit 10-tap, single X region, monochrome line-scan camera

Usage Restriction

Using the Metadata Insertion feature is NOT compatible with the following frame grabber pixel processing options:

- Look-up table transformation
- On-board Bayer CFA to RGB color conversion
- Pixel bit depth reduction

Feature Control

MetadataInsertion Parameter

The activation of the Metadata Insertion feature is controlled through the MultiCam Channel parameter `MetadataInsertion`.

Parameter Value	Description
ENABLE	The Metadata Insertion feature is enabled.
DISABLE	The Metadata Insertion feature is disabled. Default value.

The feature is disabled by default. To activate the feature, set the parameter to ENABLE at the channel creation. The setting takes effect at the first channel activation.

An error is reported when setting to ENABLE if the camera interface configuration is not compatible.

MetadataContent Parameter

The description of the content inserted by the Metadata Insertion feature is reported through the get-only MultiCam Channel parameter `MetadataContent`.

Parameter Value	Description
NONE	There are no metadata content.
ONE_FIELD	The metadata content includes one single field: I/O state.
TWO_FIELD	The metadata content includes two fields: I/O state and LVAL pulse counter

Parameter Value	Description
THREE_FIELD	The metadata content includes three fields: I/O state, LVAL pulse counter, and Encoder pulse counter.

MetadataLocation Parameter

The location of the metadata in the Camera Link data stream is specified by the MultiCam Channel parameter MetadataLocation.

By default, MetadataLocation=LVALRISE. The second option, MetadataLocation=TAP10 is available only for 10-tap 8-bit line-scan cameras.

Parameter Value	Description
LVALRISE	The metadata content is located into all taps of the first Camera Link time slot following the rising edge of the Camera Link LVAL signal. Default value.
TAP10	The metadata content is inserted into the 10 th tap during 10 consecutive Camera Link time slots following the rising edge of the Camera Link LVAL signal.

Metadata Fields

System I/O Input State

The reported state is the logical state measured right at the input stage of the Grablink card.

 **Note:** As the measurement takes place before any glitch removal filters, spurious state transitions may occur!

Sampling Time

The state of System I/O input lines and the values of the counters are sampled at each rising edge of the Camera Link LVAL signal. The sampling time is not adjustable.

LVAL Pulse Counter

This 32-bit binary counter counts the Camera Link LVAL pulses.

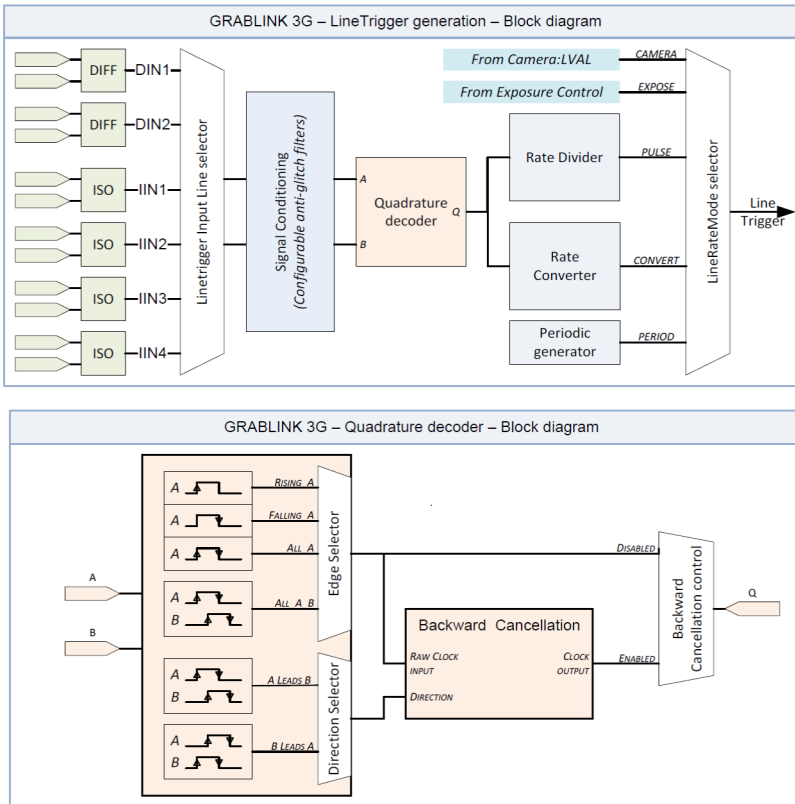
The counter is not resettable:

- It is set to 0 at the driver initialization.
- As soon as the Camera Link de-serializers are initialized, it increments by 1 at every LVAL cycle whatever the acquisition conditions, i.e. whether the corresponding line data is acquired or not.
- It wraps around to 0 when it reaches the maximum count 4,294,967,295 (=2³² -1).

 **Note:** The counter is incremented before its value is inserted as metadata: the first line cycle is marked 1.

Motion Encoder Pulse Counter

This 32-bit binary counter counts the pulses at the Q output of the Quadrature Decoder:



Note: Depending on the Quadrature Decoder settings, the counter increments by 0, 1, 2, or 4 units every encoder cycle.

The counter is not resettable:

- It is set to 0 at the driver initialization.
- It increments by 1 at every Q cycle.
- It wraps around to 0 when it reaches the maximum count 4,294,967,295 ($=2^{32}-1$).

Memory Layout for 1-/2-/3-field Configurations

Memory layout of the metadata as delivered in the MultiCam surface

The memory layout vary according to the:

- The metadata configuration: 1-field, 2-field or 3-field
- The pixel type: monochrome, Bayer CFA or RGB
- The pixel bit depth
- The ImageFlipX setting

The following rules are applicable:

- Metadata are replacing entirely all bytes of one or several pixels. Gaps, if any are filled with 0
- When ImageFlipX=OFF the metadata replaces the first pixel(s) of the image line

- When ImageFlipX=ON the metadata replaces the last pixel(s) of the image line

Notice also that:

- When ImageFlipY = ON, the first line with metadata appears at the bottom side of the image (i.o. the top side)
- When TapGeometry = *_1Y2, only one line every two contains metadata.
- When TapGeometry = *_2YE, only the lines belonging to the upper (ImageFlipX = Off) or the lower (ImageFlipY=ON) half region contain metadata.

8-bit monochrome and Bayer CFA

Beginning-of-line memory layout when ImageFlipX = OFF

Byte offset	1-field	2-field	3-field
0	Bit[3:0]: IIN[4:1] Bit[5:4]: DIN[2:1] Bit[7:6]: 00b	Bit[3:0]: IIN[4:1] Bit[5:4]: DIN[2:1] Bit[7:6]: 00b	Bit[3:0]: IIN[4:1] Bit[5:4]: DIN[2:1] Bit[7:6]: 00b
1	Pixel #2	00h	00h
2	Pixel #3	LVAL[7:0]	QCNT[7:0]
3	Pixel #4	LVAL[15:8]	QCNT[15:8]
4	Pixel #5	LVAL[23:16]	QCNT[23:16]
5	Pixel #6	LVAL[31:24]	QCNT[31:24]
6	Pixel #7	Pixel #7	LVAL[7:0]
7	Pixel #8	Pixel #8	LVAL[15:8]
8	Pixel #9	Pixel #9	LVAL[23:16]
9	Pixel #10	Pixel #10	LVAL[31:24]

End-of-line memory layout when ImageFlipX = ON

Byte offset	1-field	2-field	3-field
last-9	Pixel #10	Pixel #10	LVAL[31:24]
last-8	Pixel #9	Pixel #9	LVAL[23:16]
last-7	Pixel #8	Pixel #8	LVAL[15:8]
last-6	Pixel #7	Pixel #7	LVAL[7:0]
last-5	Pixel #6	LVAL[31:24]	QCNT[31:24]
last-4	Pixel #5	LVAL[23:16]	QCNT[23:16]
last-3	Pixel #4	LVAL[15:8]	QCNT[15:8]
last-2	Pixel #3	LVAL[7:0]	QCNT[7:0]
last-1	Pixel #2	00h	00h

Byte offset	1-field	2-field	3-field
last	Bit[3:0]: IIN[4:1] Bit[5:4]: DIN[2:1] Bit[7:6]: 00b	Bit[3:0]: IIN[4:1] Bit[5:4]: DIN[2:1] Bit[7:6]: 00b	Bit[3:0]: IIN[4:1] Bit[5:4]: DIN[2:1] Bit[7:6]: 00b



Note: last= address offset of the last byte of the rightmost active pixel of the line

10-/12-/14-/16-bit monochrome and Bayer CFA

Beginning-of-line memory layout when ImageFlipX = OFF

Byte offset	n-bit => n-bit n = {10, 12, 14, 16}	10-bit => 16-bit	12-bit => 16-bit	14-bit => 16-bit
0	Bit[3:0]: IIN[4:1] Bit[5:4]: DIN[2:1] Bit[7:6]: 00b	Bit[5:0]: 000000b Bit[7:6]: IIN[2:1]	Bit[3:0]: 0000b Bit[7:4]: IIN[4:1]	Bit[1:0]: 00b Bit[5:2]: IIN[4:1] Bit[7:6]: DIN[2:1]
1	00h	Bit[1:0]: IIN[4:3] Bit[3:2]: DIN[2:1] Bit[7:4]: 0000b	Bit[1:0]: DIN[2:1] Bit[7:2]: 000000b	00h
2	Pixel #2: LSB	Pixel #2 <<6: LSB	Pixel #2 <<4: LSB	Pixel #2 <<2: LSB
3	Pixel #2: MSB	Pixel #2 <<6: MSB	Pixel #2 <<4: MSB	Pixel #2 <<2: MSB

End-of-line memory layout when ImageFlipX = ON

Byte offset	n-bit => n-bit n = {10, 12, 14, 16}	10-bit => 16-bit	12-bit => 16-bit	14-bit => 16-bit
last-3	Pixel #2: LSB	Pixel #2 <<6: LSB	Pixel #2 <<4: LSB	Pixel #2 <<2: LSB
last-2	Pixel #2: MSB	Pixel #2 <<6: MSB	Pixel #2 <<4: MSB	Pixel #2 <<2: MSB
last-1	Bit[3:0]: IIN[4:1] Bit[5:4]: DIN[2:1] Bit[7:6]: 00b	Bit[5:0]: 000000b Bit[7:6]: IIN[2:1]	Bit[3:0]: 0000b Bit[7:4]: IIN[4:1]	Bit[1:0]: 00b Bit[5:2]: IIN[4:1] Bit[7:6]: DIN[2:1]
last	00h	Bit[1:0]: IIN[4:3] Bit[3:2]: DIN[2:1] Bit[7:4]: 0000b	Bit[1:0]: DIN[2:1] Bit[7:2]: 000000b	00h



Note: last= address offset of the last byte of the rightmost active pixel of the line

24-bit RGB packed (RGB24)

Beginning-of-line memory layout when ImageFlipX = OFF

Byte offset	1-field	2-field
0	Bit[3:0]: IIN[4:1] Bit[5:4]: DIN[2:1] Bit[7:6]: 00b	Bit[3:0]: IIN[4:1] Bit[5:4]: DIN[2:1] Bit[7:6]: 00b
1	00h	00h
2	00h	LVAL[7:0]
3	Pixel #2: Blue	LVAL[15:8]
4	Pixel #2: Green	LVAL[23:16]
5	Pixel #2: Red	LVAL[31:24]
6	Pixel #3: Blue	Pixel #3: Blue

End-of-line memory layout when ImageFlipX = ON

Byte offset	1-field	2-field
last-6	Pixel #3: Red	Pixel #3: Red
last-5	Pixel #2: Blue	LVAL[15:8]
last-4	Pixel #2: Green	LVAL[23:16]
last-3	Pixel #2: Red	LVAL[31:24]
last-2	Bit[7:6]: 00b Bit[5:4]: DIN[2:1] Bit[3:0]: IIN[4:1]	Bit[7:6]: 00b Bit[5:4]: DIN[2:1] Bit[3:0]: IIN[4:1]
last-1	00h	00h
last	00h	LVAL[7:0]



Note: last= address offset of the last byte of the rightmost active pixel of the line

24-bit RGB planar (RGB24PL)

Beginning-of-line memory layout when ImageFlipX = OFF

Plane	Byte offset	1-field	2-field
B	0	Bit[3:0]: IIN[4:1] Bit[5:4]: DIN[2:1] Bit[7:6]: 00b	Bit[3:0]: IIN[4:1] Bit[5:4]: DIN[2:1] Bit[7:6]: 00b
G	0	00h	00h

Plane	Byte offset	1-field	2-field
R	0	00h	LVAL[7:0]
B	1	Pixel #2: Blue	LVAL[15:8]
G	1	Pixel #2: Green	LVAL[23:16]
R	1	Pixel #2: Red	LVAL[31:24]
B	2	Pixel #3: Blue	Pixel #3: Blue

End-of-line memory layout when ImageFlipX = ON

Plane	Byte offset	1-field	2-field
R	last-2	Pixel #3: Red	Pixel #3: Red
B	last-1	Pixel #2: Blue	LVAL[15:8]
G	last-1	Pixel #2: Green	LVAL[23:16]
R	last-1	Pixel #2: Red	LVAL[31:24]
B	last	Bit[7:6]: 00b Bit[5:4]: DIN[2:1] Bit[3:0]: IIN[4:1]	Bit[7:6]: 00b Bit[5:4]: DIN[2:1] Bit[3:0]: IIN[4:1]
G	last	00h	00h
R	last	00h	LVAL[7:0]



Note: last= address offset of the last byte of the rightmost active pixel of the line

30-/36-/42-/48-bit RGB planar

Beginning-of-line memory layout when ImageFlipX = OFF

Plane	Byte offset	n-bit => n-bit n = {30, 36, 42, 48}	30-bit => 48-bit	36-bit => 48-bit	42-bit => 48-bit
B	0	Bit[3:0]: IIN[4:1] Bit[5:4]: DIN[2:1] Bit[7:6]: 00b	Bit[5:0]: 000000b Bit[7:6]: IIN[2:1]	Bit[3:0]: 0000b Bit[7:4]: IIN[4:1]	Bit[1:0]: 00b Bit[5:2]: IIN[4:1] Bit[7:6]: DIN[2:1]
B	1	00h	Bit[1:0]: IIN[4:3] Bit[3:2]: DIN[2:1] Bit[7:4]: 0000b	Bit[1:0]: DIN[2:1] Bit[7:2]: 000000b	00h
G	0	00h	00h	00h	00h
G	1	00h	00h	00h	00h
R	0	00h	00h	00h	00h
R	1	00h	00h	00h	00h

Plane	Byte offset	n-bit => n-bit n = {30, 36, 42, 48}	30-bit => 48-bit	36-bit => 48-bit	42-bit => 48-bit
B	2	Pixel #2 Blue LSB	Pixel #2 Blue<<6: LSB	Pixel #2 Blue<<4: LSB	Pixel #2 Blue<<2: LSB
B	3	Pixel #2 Blue MSB	Pixel #2 Blue<<6: MSB	Pixel #2 Blue<<4: MSB	Pixel #2 Blue<<2: MSB
G	2	Pixel #2 Green LSB	Pixel #2 Green<<6: LSB	Pixel #2 Green<<4: LSB	Pixel #2 Green<<2: LSB
G	3	Pixel #2 Green MSB	Pixel #2 Green<<6: MSB	Pixel #2 Green<<4: MSB	Pixel #2 Green<<2: MSB
R	2	Pixel #2 Red LSB	Pixel #2 Red<<6: LSB	Pixel #2 Red<<4: LSB	Pixel #2 Red<<2: LSB
R	3	Pixel #2 Red MSB	Pixel #2 Red<<6: MSB	Pixel #2 Red<<4: MSB	Pixel #2 Red<<2: MSB

End-of-line memory layout when ImageFlipX = ON

Plane	Byte offset	n-bit => n-bit n = {30, 36, 42, 48}	30-bit => 48-bit	36-bit => 48-bit	36-bit => 48-bit
B	last-3	Pixel #2 Blue LSB	Pixel #2 Blue<<6: LSB	Pixel #2 Blue<<4: LSB	Pixel #2 Blue<<2: LSB
B	last-2	Pixel #2 Blue MSB	Pixel #2 Blue<<6: MSB	Pixel #2 Blue<<4: MSB	Pixel #2 Blue<<2: MSB
G	last-3	Pixel #2 Green LSB	Pixel #2 Green<<6: LSB	Pixel #2 Green<<4: LSB	Pixel #2 Green<<2: LSB
G	last-2	Pixel #2 Green MSB	Pixel #2 Green<<6: MSB	Pixel #2 Green<<4: MSB	Pixel #2 Green<<2: MSB
R	last-3	Pixel #2 Red LSB	Pixel #2 Red<<6: LSB	Pixel #2 Red<<4: LSB	Pixel #2 Red<<2: LSB
R	last-2	Pixel #2 Red MSB	Pixel #2 Red<<6: MSB	Pixel #2 Red<<4: MSB	Pixel #2 Red<<2: MSB
B	last-1	Bit[3:0]: IIN[4:1] Bit[5:4]: DIN[2:1] Bit[7:6]: 00b	Bit[5:0]: 000000b Bit[7:6]: IIN[2:1]	Bit[3:0]: 0000b Bit[7:4]: IIN[4:1]	Bit[1:0]: 00b Bit[5:2]: IIN[4:1] Bit[7:6]: DIN[2:1]
B	last	00h	Bit[1:0]: IIN[4:3] Bit[3:2]: DIN[2:1] Bit[7:4]: 0000b	Bit[1:0]: DIN[2:1] Bit[7:2]: 000000b	00h
G	0	00h	00h	00h	00h
G	1	00h	00h	00h	00h
R	0	00h	00h	00h	00h
R	1	00h	00h	00h	00h



Note: last= address offset of the last byte of the rightmost active pixel of the line

Memory Layout – Tap10 Configuration

Memory layout of the metadata as delivered in the MultiCam surface for the Tap10 configuration

Beginning-of-line memory layout when ImageFlipX = OFF

Byte offset	Field Name	Metadata
9		00h

Byte offset	Field Name	Metadata
19	I/O State	Bit[7:6]: 00b; Bit[5:4]: DIN[2:1]; Bit[3:0]: IIN[4:1]
29	Q Count	QCNT[7:0]
39		QCNT[15:8]
49		QCNT[23:16]
59		QCNT[31:24]
69	LVAL Count	LVAL[7:0]
79		LVAL[15:8]
89		LVAL[23:16]
99		LVAL[31:24]

End-of-line memory layout when ImageFlipX = ON

Byte offset	Field Name	Metadata
last-99	LVAL Count	LVAL[31:24]
last-89		LVAL[23:16]
last-79		LVAL[15:8]
last-69		LVAL[7:0]
last-59	Q Count	QCNT[31:24]
last-49		QCNT[23:16]
last-39		QCNT[15:8]
last-29		QCNT[7:0]
last-19	I/O State	Bit[7:6]: 00b; Bit[5:4]: DIN[2:1]; Bit[3:0]: IIN[4:1]
last-9		00h

Interleaved Acquisition

Image acquisition from grabber-controlled exposure asynchronous reset cameras driven alternatively by two different camera cycle programs

When Interleaved Acquisition is enabled, the Camera and Illumination Controller is configured with two different programs named P1 and P2.

Each program defines entirely a *camera and illumination cycle* including:

- One Reset pulse controlling the start-of-exposure and the end-of-exposure of the camera.
- One Strobe pulse on any of the 2 strobe outputs.

The programs are executed alternatively, starting with P1.

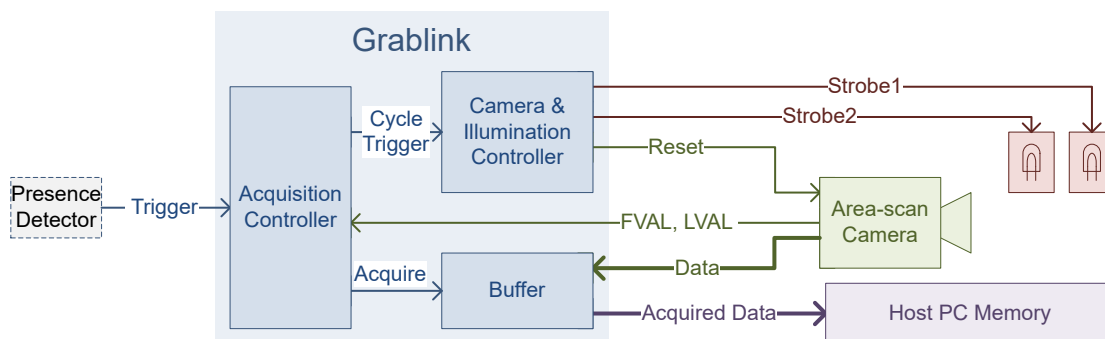
This feature is available for *line-scan cameras* on 1624 Grablink Base, 1623 Grablink DualBase, 1622 Grablink Full and, 1626 Grablink Full XR since MultiCam 6.9.7. For more information, refer to [Interleaved Line-scan Acquisition Principles](#) on page 31.

This feature is available for *area-scan cameras* on 1624 Grablink Base, 1623 Grablink DualBase, 1622 Grablink Full and, 1626 Grablink Full XR since MultiCam 6.13. For more information, refer to [Interleaved Area-scan Acquisition Principles](#) on page 30.

Interleaved Area-scan Acquisition Principles

System Description

The following drawing shows the main elements of an area-scan acquisition system configured for *Interleaved Area-scan Acquisition*:



The system is composed of:

- One asynchronous reset grabber-controlled exposure area-scan camera.
- One acquisition channel of a compatible Grablink frame grabber configured for Interleaved Area-scan acquisition.
- Two illumination devices, each being controlled by a specific strobe output of the frame grabber.

Usually, the Trigger event is delivered by a presence detector.

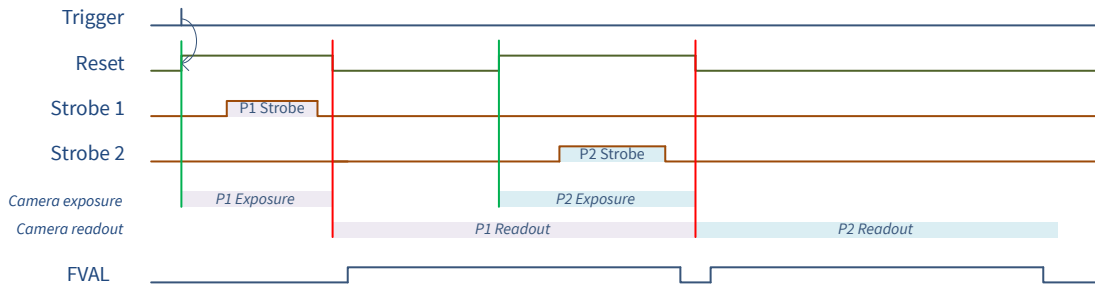
All area-scan acquisition modes (SNAPSHOT and HFR) are compatible with Interleaved Area-scan Acquisition.

Operation

The *Interleaved Acquisition* feature allows to capture, with a time-optimized sequence of two camera cycles, two images with different exposure time, strobe duration, strobe delay and strobe output settings.

The first cycle of the sequence uses the settings defined by P1, the second cycle uses the settings defined by P2.

The following drawing shows an acquisition sequence of two overlapping cycles where the exposure time is smaller than the readout time for both cycles:

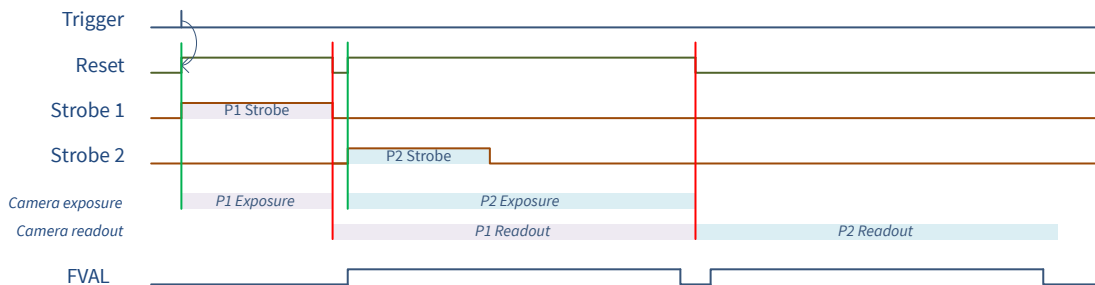


The above sequence is time-optimized:

- The exposure of the second cycle overlaps the readout of the first cycle.
- The exposure of the second cycle terminates exactly when the readout of the first cycle terminates.

Double Exposure Mode Emulation

The following drawing shows a particular Interleaved Area-scan Acquisition sequence of two overlapping cycles where the second exposure time matches the readout time:



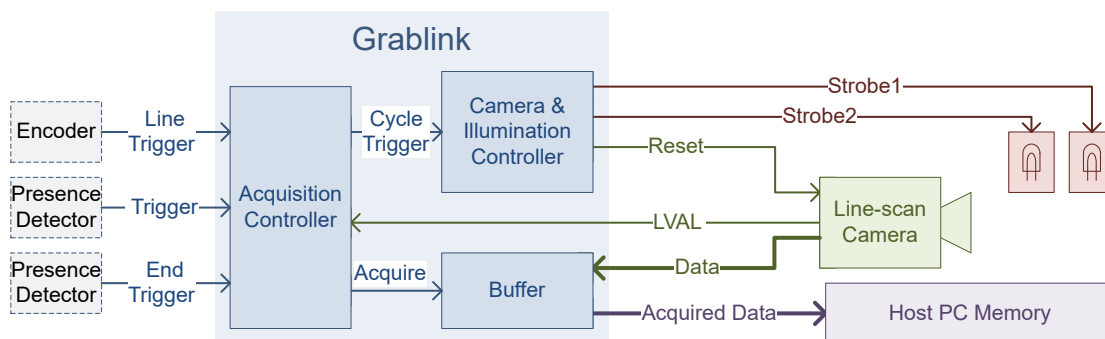
The exposure time of the second cycle is increased to become equal to the readout time. This allows the second strobe to be issued immediately after the first strobe.

This emulates the *double exposure mode*.

Interleaved Line-scan Acquisition Principles

System Description

The following drawing shows the main elements of a line-scan acquisition system configured for *Interleaved Line-scan Acquisition*:



The system is composed of:

- One asynchronous reset grabber-controlled exposure line-scan camera.
- One acquisition channel of a compatible frame grabber configured for Interleaved Line-scan acquisition.
- Two illumination devices, each being controlled by a specific strobe output of the frame grabber.

Usually, the Line Trigger event is obtained by processing signals delivered by a motion encoder. As for any line-scan imaging systems, it can be processed by the rate converter or the rate divider.

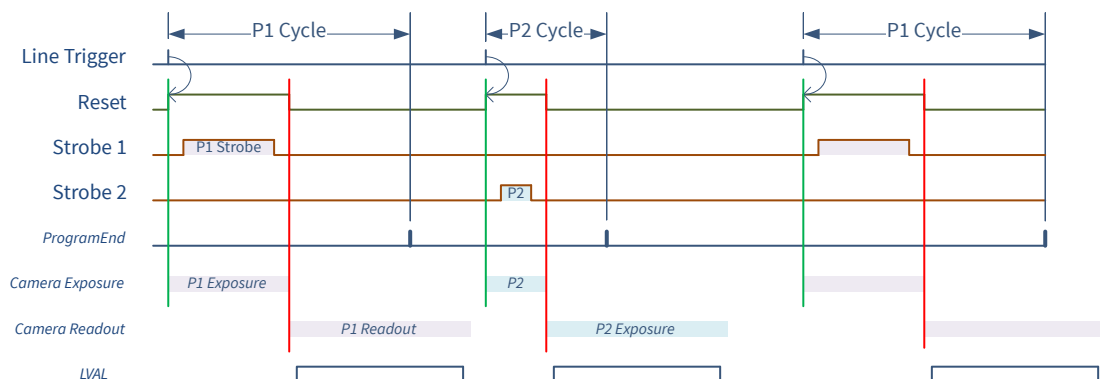
Usually, the Trigger and the EndTrigger events are delivered by a presence detector.

All line-scan acquisition modes (WEB, PAGE and LONGPAGE) are compatible with Interleaved Line Acquisition.

Operation

The *Interleaved Acquisition feature* allows to capture, in a single scanning operation, a composite image where the odd and even lines are captured with different exposure time, strobe duration, strobe delay and strobe output settings.

As shown on the following diagram, the Camera and Illumination Controller executes both programs alternatively: P1 then P2 then P1 ... :



Note: In this example, the line trigger interval is larger than the minimum allowed.

The toggling program sequence is reset at every start-of-scan to ensure that the first captured image line of a scanned object is always built using P1.

In WEB acquisition mode, a reset occurs only once at the beginning of the acquisition sequence.

In PAGE acquisition mode, a reset occurs at the beginning of every acquisition phase.

In LONGPAGE acquisition mode, a reset occurs at the beginning of the first acquisition phase of every acquisition sequence. No reset occurs at the beginning of the subsequent phases of the same sequence.

Reset and Strobe Signals Routing

The reset pulses of both programs are merged into a common Reset signal; the Reset signal can be sent to one or more of the 4 Camera Link Control lines CC1 ... CC4.

The strobe pulse of each program can be routed individually to IOUT1, to IOUT2 or left unused.



Note: When routed to the same output line, the two pulses are merged!

Interleaved Camera and Illumination Control

This section describes the operation of the Camera and Illumination Controller – CIC – when Interleaved Acquisition is enabled.



Note: This section is common for line-scan and area-scan interleaved acquisition.



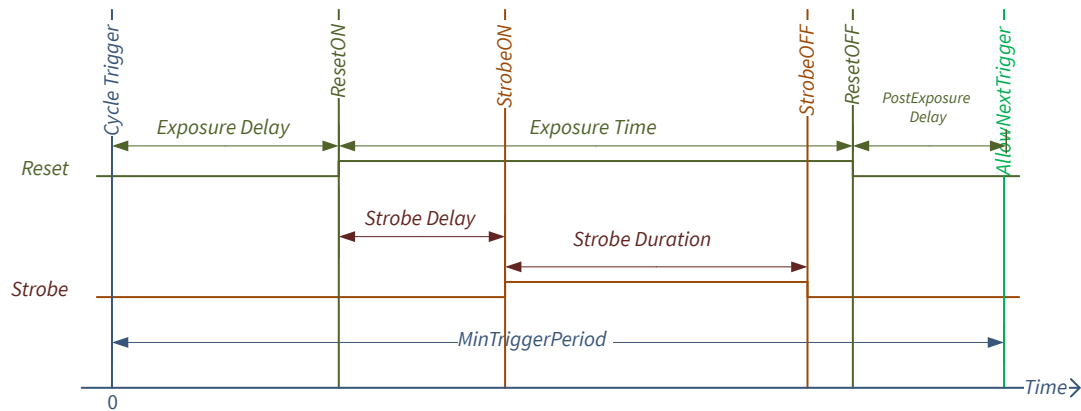
Note: Cycle Trigger designates the event that initiates a CIC cycle: a Line Trigger event in case of line-scan cameras or a Trigger event in case of area-scan cameras.

CIC Cycle Programs

When Interleaved Acquisition is enabled, the Camera and Illumination Controller is configured with two, usually different, camera and illumination cycle programs. These programs are named P1 and P2 respectively.

Each camera and illumination cycle program defines five events on a timeline beginning with a Cycle Trigger event.

- *ResetON*: turn ON time of the Reset pulse and Start of Exposure
- *ResetOFF*: turn OFF time of the Reset pulse and End of Exposure
- *StrobeON*: turn ON time of the Strobe pulse and Start Of Illumination
- *StrobeOFF*: turn OFF time of the Strobe pulse and End Of Illumination
- The *AllowNextTrigger* event: the last event of a program indicating that a new cycle may be initiated.



Each program defines two pulses: one Reset pulse and one Strobe pulse. Their timing is user configurable:

- Exposure Time is the time interval between the *ResetON* and the *ResetOFF* events.
- Strobe Duration is the time interval between the *StrobeON* and the *StrobeOFF* events.
- Exposure Delay is the time interval between the Trigger and *ResetON* events.
- Strobe Delay is the time interval between the *ResetON* and *StrobeON* events. This value can be positive, null, or negative allowing the Strobe pulse to be positioned anywhere relatively to the start of exposure.

The following restrictions apply on the position order of the events on the timeline:

- $0 \leq \text{ResetON} < \text{ResetOFF} \leq \text{AllowNextTrigger}$
- $0 \leq \text{StrobeON} < \text{StrobeOFF} \leq \text{AllowNextTrigger}$

MultiCam Camera Trigger Overrun Protection Principle

At acquisition channel configuration time:

- MultiCam checks if the exposure time user setting can be achieved by the camera. If the user setting of the exposure time is out of bounds, MultiCam corrects its value. The effective exposure time will be set to the nearest boundary.
- MultiCam calculates the position on the timeline of the *AllowNextTrigger* event of P1 and P2 programs. This calculation takes into account the camera operating limits and the user-defined exposure and strobe timing settings for P1 and P2 programs.

At acquisition channel run time, MultiCam reports a "trigger violation" error if a Cycle Trigger event is issued before the *AllowNextTrigger* event during the execution of a program.

Camera Operating Limits

The following camera operating limits are considered:

- Exposure time range

- Minimum time interval between two consecutive Exposure
- Maximum line rate

In MultiCam, the following parameters describe the operating limits of a camera:

- `ExposeMin_us`: declares the minimum exposure time, expressed in microseconds (i.e. the minimum duration of a Reset pulse).
- `ExposeMax_us`: declares the maximum exposure time, expressed in microseconds (i.e. the maximum duration of a Reset pulse).
- `ResetDur`: for line-scan cameras only, declares the minimum time interval between two consecutive Reset pulses.
- `ExposeRecovery_us`: for area-scan cameras only, declares the minimum time interval between two consecutive Reset pulses.
- `LineRate_Hz`: for line-scan cameras only, declares the highest line rate supported by the camera (i.e. the reciprocal of the readout time)
- `FrameRate_mHz`: for area-scan cameras only, declares the highest frame rate supported by the camera (i.e. the reciprocal of the readout time)
- `ExposeOverlap`: declares that the camera allows or forbids the next exposure to begin before the completion of the current readout.

Allow Next Trigger Rules

MultiCam applies the following rules when it calculates the position of the *AllowNextTrigger* event.

RULE 1a – Readout time limitation (Expose Overlapping forbidden)

This rule applies only when `ExposeOverlap = FORBID!`

The **start of exposure** of the next cycle may not occur before the end of the current camera readout.

The diagram shows a timeline with five signals: Cycle Trigger (blue), Reset (red), AllowNextTrigger (green), Camera Exposure (orange), and Camera Readout (purple). The 'Current Cycle' is defined by the first two Reset pulses. The 'Next Cycle' begins with the third Reset pulse. A delay 'a' is shown between the end of the first readout and the start of the second exposure. The 'Readout time' is indicated by a double-headed arrow under the first readout pulse.

Note: If there is any exposure delay (a) in the next cycle, the *AllowNextTrigger* event may be generated anticipatively

RULE 1b - Readout time limitation (Expose Overlapping allowed)

This rule applies only when `ExposeOverlap = ALLOW!`

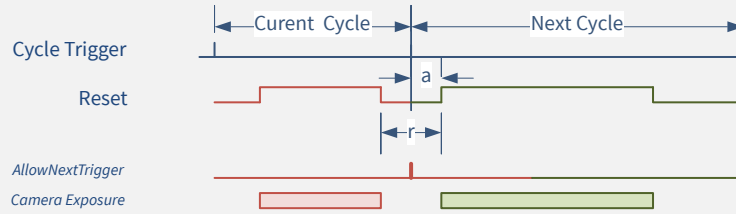
The **end of exposure** of the next cycle must not occur before the end of the current camera readout.

The diagram shows a timeline with five signals: Cycle Trigger (blue), Reset (red), AllowNextTrigger (green), Camera Exposure (orange), and Camera Readout (purple). The 'Current Cycle' is defined by the first two Reset pulses. The 'Next Cycle' begins with the third Reset pulse. A delay 'a' is shown between the end of the first readout and the start of the second exposure. The 'Readout time' is indicated by a double-headed arrow under the first readout pulse.

Note: If there is any exposure delay (a) in the next cycle, the *AllowNextTrigger* event may be generated anticipatively

RULE 2 – Reset interval limitation

The time interval (r) between consecutive Reset pulses may not be shorter than the value specified by `ResetDur`.



Note: If there is any exposure delay (a) in the next cycle, the *AllowNextTrigger* event may be generated anticipatively

RULE 3 – Next Cycle

The next cycle after P1 is undetermined, it can be either P2 or P1. The next cycle after P2 is always P1.

For the calculation of the position of the *AllowNextTrigger* event of P1, MultiCam evaluates both hypothesis (P1 and P2) and keeps the worst case.

For the calculation of the position of the *AllowNextTrigger* event of P2, MultiCam assumes that the next cycle is P1.



Note: This rule applies only to line-scan interleaved acquisition!

Exposure Delay

By default, MultiCam configures P1 and P2 with the smallest possible value:

- 0 if `StrobeDelay_P<1, 2>_us` ≥ 0
- $(-\text{StrobeDelay_P<1, 2>_us})$ if `StrobeDelay_P<1, 2>_us` < 0

If required, the exposure delay can be configured using any of the following methods:

Manual Method

This method is invoked when `ExposureDelayControl` is set to `MANUAL`. This is the default method.

With this method, the user may specify the exposure delay for P1 and P2 with:

`ExposureDelay_MAN_P1_us` and `ExposureDelay_MAN_P2_us`.

By default, these parameters are set to 0.

MultiCam calculates the smallest possible value for each program separately as follows:

- `ExposureDelay_MAN_P<1,2>_us` if $\text{StrobeDelay_P<1,2>_us} \geq (-\text{ExposureDelay_MAN_P<1,2>_us})$
- $(-\text{StrobeDelay_P<1,2>_us})$ if $\text{StrobeDelay_P<1,2>_us} < (-\text{ExposureDelay_MAN_P<1,2>_us})$

Automatic method 1 (Same Start of Exposure)

Select this method by setting `ExposureDelayControl` to `SAME_START_EXPOSURE`.

MultiCam calculates, the smallest value ensuring that the start of exposure occurs at the same position on the program timeline.


Automatic method 2 (Same End of Exposure)

Select this method by setting `ExposureDelayControl` to `SAME_END_EXPOSURE`.

MultiCam calculates the smallest values ensuring that the end of exposure occurs at the same position on the program timeline.

Effective Exposure Time


The effective exposure time values are reported by `ExposureTime_P1_Effective_us` and `ExposureTime_P2_Effective_us`.

 **Note:** In general, the effective values are very close to the user settings, the slight differences can be explained by rounding issues to the nearest timer tick period.

 **Note:** Large differences can be observed in the case of an out-of-bound user setting.


Effective Strobe Duration and Strobe Delay

The effective strobe duration and strobe delay values are reported by `StrobeDuration_P1_Effective_us`, `StrobeDuration_P2_Effective_us`, `StrobeDelay_P1_Effective_us` and, `StrobeDelay_P2_Effective_us`.

 **Note:** The effective values are, in any case, very close to the user settings, the slight differences can be explained by rounding issues to the nearest timer tick period.

Effective Exposure Delay

The effective exposure delay values are reported by `ExposureDelay_P1_Effective_us` and `ExposureDelay_P2_Effective_us`.

 **Note:** When `ExposureDelayControl = MANUAL`, the effective values are very close to the user settings, the slight differences can be explained by rounding issues to the nearest timer tick period.

 **Note:** Large differences can be observed in the case of negative strobe delay values.

Effective Minimum Trigger Period

The run time of each program is reported by `MinTriggerPeriod_P1_us` and `MinTriggerPeriod_P2_us`.



Note: The values can be different. Considering that programs are executed alternatively, the user should only consider the larger value as the minimum time interval between line triggers.

Interleaved Area-scan Acquisition Channel Setup

PxxRG_IA CAM File Template

```

;*****
; Camera Manufacturer: Templates
; Camera Model: MyCameraLink
; Camera Configuration: Interleaved Area-Scan Acquisition, Asynchronous Reset, Grabber-
; Controlled Exposure
; Board: Grablink
;*****
; This CAM file template is suitable for the following camera configuration:
; - Progressive area-scan camera
; - Asynchronous Reset
; - Pulse-Width grabber-controlled exposure
; This CAM file template is suitable for the following system configuration:
; - SNAPSHOT and HFR Acquisition Modes
; - Interleaved Acquisition
;
; *****
; ** CAUTION: **
; ** This file is a template, it can be further customized! **
; ** The lines that can be edited are marked with an arrow followed by the most **
; ** popular alternate values for that parameter. **
; ** For a complete list of possible values; refer to MultiCam Studio and/or to **
; ** the MultiCam Reference documentation. **
; *****
;
; *****
; ==Begin of "Camera properties Section"==
;
; -Camera Specification category-
;   Camera = MyCameraLink;
;   CamConfig = PxxRG;
;   Imaging = AREA;
;   Spectrum = BW; <== BW COLOR ...
;
; -Camera Features category-
;   TapConfiguration = BASE_1T8; <== BASE_1T8 BASE_1T10 BASE_1T24 ...
;   TapGeometry = 1X_1Y; <== 1X_1Y 1X2_1Y 2X_1Y ...
;   Expose = WIDTH;
;   Readout = INTCTL;
;   ColorMethod = NONE; <== NONE PRISM BAYER RGB
;   ColorRegistration = BG; <== GB BG RG GR (when ColorMethod=BAYER)
;   ExposeOverlap = FORBID; <== FORBID ALLOW
;
; --Downstream signals--
;   FvalMode = FA;
;   LvalMode = LA;
;   DvalMode = DN; <== DN DG
;
; --Upstream signals--
;   ResetCtl = DIFF;
;   ResetEdge = GOHIGH; <== GOHIGH GOLOW
;   CC1Usage = RESET; <== LOW HIGH RESET SOFT
;   CC2Usage = LOW; <== LOW HIGH RESET SOFT
;   CC3Usage = LOW; <== LOW HIGH RESET SOFT
;   CC4Usage = LOW; <== LOW HIGH RESET SOFT
;
; -Camera Timing category-

```

```

Hactive_Px =      640;          <==
Vactive_Ln =      480;          <==
HSyncAft_Tk =      0;          <==
VSyncAft_Ln =      0;          <==
FrameRate_mHz =   30000;        <==
ExposeRecovery_us = 10;         <==
ReadoutRecovery_us = 10;        <==
ExposeMin_us =     10;          <==
ExposeMax_us =    1000000;       <==
;
; ==End of "Camera properties Section"==
;*****
; ==Begin of "System properties Section"==
;
; -Acquisition Control category-
AcquisitionMode =   SNAPSHOT;    <== SNAPSHOT HFR
TrigMode =          IMMEDIATE;    <== IMMEDIATE HARD SOFT COMBINED
NextTrigMode =      SAME;         <== SAME HARD SOFT COMBINED REPEAT
ActivityLength =     1;           <== 1
SeqLength_Fr =       2;           <== -1 1..65534
PhaseLength_Fr =     1;           <== 1 (when AcquisitionMode = SNAPSHOT)
                                   <== 1..255 (when AcquisitionMode = HFR)
;
; -Trigger Control category-
;   The following 5 parameters are relevant only when EndTrigMode = HARD:
TrigCtl =           ISO;          <== ISO DIFF
TrigEdge =           GOHIGH;      <== GOHIGH GOLOW
TrigFilter =         MEDIUM;      <== OFF ON MEDIUM STRONG
TrigDelay_us =       0;           <==
TrigLine =           NOM;         <== NOM ...
;   The following 2 parameters are controlling the Trigger Decimation circuit.
;   Remove the leading semi-column on both parameters if the function is required!
TrigDelay_Pls =      0;           <== 0..65536
NextTrigDelay_Pls = 0;           <== 0..65536
;
; -Interleaved Acquisition category-
InterleavedAcquisition = ON;      <== Enable interleaved acquisition
;   Define the exposure time for P1 and P2 (= RESET signal pulse width)
ExposureTime_P1_us = 7000.0;      <== Float (0.16 up to 5000000)
ExposureTime_P2_us = 35000.0;     <== Float (0.16 up to 5000000)
;   Define the strobe duration for P1 and P2 (= STROBE1 and STROBE2 signals pulse width)
StrobeDuration_P1_us = 7000.0;     <== Float (0.16 up to 5000000)
StrobeDuration_P2_us = 10000.0;    <== Float (0.16 up to 5000000)
;   Define the strobe delay for P1 and P2 (relative time offset from RESET going ON
to STROBEx going ON)
;   The time offset can be positive, null or negative
StrobeDelay_P1_us = 0.0;           <== Float (-10000 up to 5000000)
StrobeDelay_P2_us = 0.0;           <== Float (-10000 up to 5000000)
;   Select the Exposure delay control method
ExposureDelayControl = MANUAL;     <== MANUAL SAME_END_EXPOSURE SAME_START_EXPOSURE
;   When ExposureDelayControl is MANUAL, select the minimum delay from the trigger
;   to the start of exposure (RESET signal going on)
ExposureDelay_MAN_P1_us = 0;       <== Float (0 up to 5000000)
ExposureDelay_MAN_P2_us = 0;       <== Float (0 up to 5000000)
StrobeLine_P1 = IOUT1;             <== IOUT1 IOUT2 NONE
StrobeLine_P2 = IOUT2;             <== IOUT1 IOUT2 NONE
StrobeOutput_P1 = ENABLE;          <== ENABLE DISABLE
StrobeOutput_P2 = ENABLE;          <== ENABLE DISABLE
;
; ==End of "System properties Section"==
;*****
; ==Begin of "Grabber properties Section"==
;
; -Grabber Configuration, Timing & Conditioning categories-
GrabWindow =        NOBLACK;      <== NOBLACK MAN ...
;   The following 4 parameters are relevant only when GrabWindow = MAN:
WindowX_Px =         640;          <==
WindowY_Ln =         480;          <==
OffsetX_Px =          0;           <==
OffsetY_Ln =          0;           <==
;   The following parameter configures the Bayer CFA Decoder.
;   If the default value is not adequate for your application, it is then necessary
;   to edit the value and to remove the leading semi-column of the following line:
CFD_Mode =           ADVANCED;     <== ADVANCED, LEGACY
;

```

```
; -Look-Up Tables category-
;   LUT configuration parameters can be inserted here if required by the application
;
; -Cluster category-
;   ColorFormat =      Y8;                <== Y8 Y10 RGB24 RGB24PL ...
;   ImageFlipX  =      OFF;              <== OFF ON
;   ImageFlipY  =      OFF;              <== OFF ON
;
; End of "Grabber properties Section"
;*****
; End of File
;=====
```

Customizing Camera Parameters

The following camera parameters must be set according to the selected camera model:

Spectrum, TapConfiguration, TapGeometry, ColorMethod, DvalMode, ResetEdge, CC1Usage, CC2Usage, CC3Usage, CC4Usage, Hactive_Px, Vactive_Ln, HSyncAft_Tk and, VSyncAft_Ln.

For correct operation of the camera trigger overrun protection mechanism it is mandatory to carefully set the following parameters: FrameRate_mHz, ExposeMin_us, ExposeMax_us and, ExposeRecovery_us.

Customizing Acquisition Control Parameters

AcquisitionMode can optionally be set to HFR.

In that case PhaseLength_Fr can be set to any value in 1 ... 255 range.

The other parameters are not customizable.

Customizing Trigger Control Parameters

The following trigger parameters must be set according to the application needs: TrigCtl, TrigEdge, TrigFilter, TrigLine.

The trigger decimation circuit can optionally be activated using TrigDelay_Pls and NextTrigDelay_Pls.

Customizing Interleaved Acquisition parameters

Enable Interleaved Acquisition by assigning the value ON to InterleavedAcquisition.

Customizing Interleaved Acquisition – Exposure and Strobe Timing Parameters

When Interleaved Acquisition is enabled, the following exposure and strobe parameters are irrelevant:

Expose_us, ExposeTrim, StrobeMode, StrobeDur and, PreStrobe_us.

Instead, the exposure and strobe timings must be defined for P1 and P2 using the following parameter set:

ExposureTime_P1_us, ExposureTime_P2_us, StrobeDuration_P1_us, StrobeDuration_P2_us, StrobeDelay_P1_us and, StrobeDelay_P2_us.

Customizing Interleaved Acquisition – Exposure Delay Parameters

By default, MultiCam configures P1 and P2 with the smallest possible Exposure Delay value. This setting is satisfactory for the use cases where the exposure time is shorter than the readout time.

Optionally, keeping ExposureDelayControl set to MANUAL, you may manually change the minimum exposure delay value of P1 and/or P2 using the ExposureDelay_MAN_P1_us and ExposureDelay_MAN_P2_us parameters.

Alternatively, you may also change ExposureDelayControl to one of the automatic control methods: SAME_START_EXPOSURE or SAME_END_EXPOSURE.

With SAME_START_EXPOSURE, the start of exposure is delayed by the same amount of time for both programs: both exposure delay values are equal.

With `SAME_END_EXPOSURE` the end of exposure is delayed by the same amount of time for both programs.



Note: In case of asymmetric exposure times, when at least one exposure time is greater than the readout time, the minimal line trigger period can be achieved when:

- Assigning the longest exposure time to P2
- Inserting an exposure delay prior to the lowest one

Customizing Interleaved Acquisition – Strobe Control Parameters

The `StrobeLine_P1` and `StrobeLine_P2` parameters designate the I/O lines used as strobe outputs for P1 and P2 respectively. The default values are `IOUT1` for P1 and `IOUT2` for P2.

Setting `StrobeLine_P2` to `IOUT1` or `NONE` disconnects the `IOUT2` output from the P2 Strobe and makes it available for another usage (Software controlled I/O).

Setting `StrobeLine_P1` and `StrobeLine_P2` to the same output `IOUT1` merges the two strobe pulses.

The `StrobeOutput_P1` and `StrobeOutput_P2` parameters control the delivery of the strobe pulse for P1 and P2 respectively. The delivery is enabled by default. Assigning the `DISABLE` value, inhibits the delivery of the strobe pulse.

Customizing Grabber Timing Parameters

As for any are-scan application, the following grabber configuration, timing and conditioning parameters must be set according to the application needs: `GrabWindow`, `WindowX_Px`, `WindowY_Ln`, `OffsetX_Px` and `OffsetY_Ln`.

Customizing Cluster Parameters

As for any area-scan application, the following cluster parameters must be set according to the application needs: `ColorFormat`, `ImageFlipX` and `ImageFlipY`.

Interleaved Line-scan Acquisition Channel Setup

LxxxxRG_IA CAM File Template

```
; *****
; Camera Manufacturer: Templates
; Camera Model: MyCameraLink
; Camera Configuration: Interleaved Line-Scan Acquisition, Grabber-Controlled Rate and Exposure
; Board: Grablink
; *****
; This CAM file template is suitable for the following camera configuration:
;   - Line-scan camera
;   - Grabber-controlled rate
;   - Pulse-Width grabber-controlled exposure
; This CAM file template is suitable for the following system configuration:
;   - WEB, PAGE, or LONGPAGE Acquisition Modes
;   - Take all lines
;   - Interleaved Acquisition
;
; *****
; ** CAUTION: **
; ** This file is a template, it can be further customized! **
; ** The lines that can be edited are marked with an arrow followed by the most **
; ** popular alternate values for that parameter. **
; ** For a complete list of possible values; refer to MultiCam Studio and/or to **
; ** the MultiCam Reference documentation. **
; *****
;
; *****
; ==Begin of "Camera properties Section"==
;
; -Camera Specification category-
;   Camera = MyCameraLink;
```



```

    CamConfig =      LxxxxRG;
    Imaging =        LINE;
    Spectrum =        BW;                <== BW COLOR ...
;
; -Camera Features category-
    TapConfiguration = BASE_1T8;        <== BASE_1T8 BASE_1T10 BASE_1T24 ...
    TapGeometry =     1X;                <== 1X 1X2 2X ...
;
    Expose is         WIDTH;
;
    Readout is         INTCTL;
;
    ColorMethod =      NONE;             <== NONE PRISM TRILINEAR RGB
;
; --Downstream signals--
    FvalMode =         FN;
    LvalMode =          LA;
    DvalMode =          DN;              <== DN DG
;
; --Upstream signals--
    ResetCtl =          DIFF;
    ResetEdge =          GOHIGH;         <== GOHIGH GOLOW
    CC1Usage =           RESET;          <== LOW HIGH RESET SOFT
    CC2Usage =           LOW;            <== LOW HIGH RESET SOFT
    CC3Usage =           LOW;            <== LOW HIGH RESET SOFT
    CC4Usage =           LOW;            <== LOW HIGH RESET SOFT
;
; -Camera Timing category-
    Hactive_Px =         4096;           <==
    HSyncAft_Tk =         0;            <==
    LineRate_Hz =         5000;          <== Max. line rate (= reciprocal of readout duration)
    ExposeMin_us =        1;            <== Min. exposure time (= RESET signal pulse width)
    ExposeMax_us =        10000;         <== Max. exposure time (= RESET signal pulse width)
    ResetDur =            3000;          <== Min. time interval, in ns, between
consecutive RESET pulses
;
; ==End of "Camera properties Section"==
; *****
; ==Begin of "System properties Section"==
;
; -Acquisition Control category-
    AcquisitionMode =     WEB;           <== WEB PAGE LONGPAGE
    TrigMode =            IMMEDIATE;     <== IMMEDIATE HARD SOFT COMBINED
    NextTrigMode =        REPEAT;        <== REPEAT (when AcquisitionMode = WEB or LONGPAGE)
;                                           <== SAME REPEAT HARD SOFT COMBINED
;
    (when AcquisitionMode = PAGE)
        EndTrigMode =      AUTO;         <== AUTO HARD (when AcquisitionMode = LONGPAGE)
;                                           <== AUTO (when AcquisitionMode = WEB or PAGE)
;
    BreakEffect =         FINISH;        <== FINISH ABORT
    SeqLength_Pg =         -1;           <== -1 1 .. 65534 (when AcquisitionMode = PAGE)
    SeqLength_Ln =         -1;           <== -1 1 .. 65534 (when AcquisitionMode = WEB or LONGPAGE)
    PageLength_Ln =        500;          <== 1 .. 65535
;
; -Trigger Control category-
    TrigCtl =             ISO;           <== ISO DIFF
    TrigEdge =            GOHIGH;        <== GOHIGH GOLOW
    TrigFilter =           MEDIUM;       <== OFF ON MEDIUM STRONG
    TrigLine =             NOM;          <== NOM ...
;
;
    The following 4 parameters are relevant only when EndTrigMode = HARD!
    EndTrigCtl =           ISO;          <== ISO DIFF
    EndTrigEdge =          GOLOW;        <== GOHIGH GOLOW
    EndTrigFilter =        MEDIUM;       <== OFF ON MEDIUM STRONG
    EndTrigLine =          NOM;          <== NOM ...
;
; -Interleaved Acquisition category-
    InterleavedAcquisition = ON;         <== Enable interleaved acquisition
;
    Define the exposure time for P1 and P2 (= RESET signal pulse width)
    ExposureTime_P1_us =    64.0;         <== Float (0.16 up to 5000000)
    ExposureTime_P2_us =    64.0;         <== Float (0.16 up to 5000000)
;
    Define the strobe duration for P1 and P2 (= STROBE1 and STROBE2 signals pulse width)
    StrobeDuration_P1_us =   32.0;         <== Float (0.16 up to 5000000)
    StrobeDuration_P2_us =   32.0;         <== Float (0.16 up to 5000000)
;
    Define the strobe delay for P1 and P2 (relative time offset from RESET going ON
to STROBEx going ON)
;
    The time offset can be positive, null or negative
    StrobeDelay_P1_us =     16.0;         <== Float (-10000 up to 5000000)
    StrobeDelay_P2_us =     16.0;         <== Float (-10000 up to 5000000)

```

```

;      Select the Exposure delay control method
ExposureDelayControl =      MANUAL;      <== MANUAL SAME_END_EXPOSURE SAME_START_EXPOSURE
;      When ExposureDelayControl is MANUAL, select the minimum delay from the trigger
;      to the start of exposure (RESET signal going on)
ExposureDelay_MAN_P1_us =    0;           <== Float (0 up to 5000000)
ExposureDelay_MAN_P2_us =    0;           <== Float (0 up to 5000000)
StrobeLine_P1 =              IOUT1;       <== IOUT1 IOUT2 NONE
StrobeLine_P2 =              IOUT2;       <== IOUT1 IOUT2 NONE
StrobeOutput_P1 =            ENABLE;      <== ENABLE DISABLE
StrobeOutput_P2 =            ENABLE;      <== ENABLE DISABLE
;
; -Encoder Control category-
LineCaptureMode =            ALL;
LineRateMode =               PERIOD;      <== PERIOD PULSE CONVERT
;      The following 2 parameters are relevant only when LineRateMode = PERIOD:
Period_us =                   1000;       <==
PeriodTrim =                  0;          <==
;      The following 5 parameters are relevant only when LineRateMode = CONVERT:
LinePitch =                   100;        <==
EncoderPitch =                100;        <==
ConverterTrim =               0;          <==
OnMinSpeed =                  IDLING;      <== IDLING MUTING
;      The following 4 parameters are relevant only when LineRateMode = PULSE or CONVERT:
LineTrigCtl =                 DIFF_PAIRIED; <== ISO DIFF ISO_PAIRIED DIFF_PAIRIED
;      If the default value is not adequate for your application, it is then necessary
to edit the value and
;      to remove the leading semi-column of the following line
;      LineTrigEdge =          GOHIGH;      <== GOHIGH GOLOW RISING_A FALLING_A ALL_A
;      (when LineTrigCtl = ISO or DIFF)
;                                     <== ALL_A_B (when LineTrigCtl = ISO_PAIRIED or DIFF_PAIRIED)
;                                     <== GOHIGH GOLOW (when LineTrigCtl = TTL ITTL I12V or LVDS)
LineTrigFilter =              MEDIUM;      <== OFF ON MEDIUM STRONG
LineTrigLine =                NOM;          <== NOM ...
;      The following parameter controls the Rate divider circuit that is available
;      exclusively when LineRateMode = PULSE.
;      Remove the leading semi-column if the function is required!
RateDivisionFactor = 1;          <== 1..512
;      The following 2 parameters are controlling the Backward Motion Cancellation circuit
that is available
;      exclusively when LineTrigCtl = ISO_PAIRIED or DIFF_PAIRIED.
;      Remove the leading semi-column on both parameters if the function is required!
ForwardDirection = A_LEADS_B;      <== A_LEADS B B_LEADS_A
BackwardMotionCancellationMode = OFF; <== OFF FILTERED COMPENSATE
;
; ==End of "System properties Section"==
; *****
; ==Begin of "Grabber properties Section"==
;
; -Grabber Configuration, Timing & Conditioning categories-
GrabWindow =                  NOBLACK;     <== NOBLACK MAN ...
;      The following 2 parameters are relevant only when GrabWindow = MAN:
WindowX_Px =                  2048;        <==
OffsetX_Px =                   0;          <==
;
; -Look-Up Tables category-
;      LUT configuration parameters can be inserted here if required by the application
;
; -Cluster category-
ColorFormat =                  Y8;          <== Y8 Y10 RGB24 RGB24PL ...
ImageFlipX =                   OFF;         <== OFF ON
;
; End of "Grabber properties Section"
; *****
; End of File
; =====

```

Customizing Camera Parameters

As for any line-scan camera, the following camera parameters must be set according to the selected camera model:

Spectrum, TapConfiguration, TapGeometry, ColorMethod, DvalMode, ResetEdge, CC1Usage, CC2Usage, CC3Usage, CC4Usage, Hactive_Px and, HSyncAft_Tk.

For correct operation of the camera trigger overrun protection mechanism it is essential to carefully set the following parameters:

LineRate_Hz, ExposeMin_us, ExposeMax_us and, ResetDur.

Customizing Acquisition Control Parameters

As for any line-scan application, the following acquisition control parameters must be set according to the application needs: AcquisitionMode, TrigMode, NextTrigMode, EndTrigMode, BreakEffect, SeqLength_Pg, SeqLength_Ln and, PageLength_Ln.

Customizing Trigger Control Parameters

As for any line-scan application, the following trigger and end trigger control parameters must be set according to the application needs: TrigCtl, TrigEdge, TrigFilter, TrigLine, EndTrigCtl, EndTrigEdge, EndTrigFilter and, EndTrigLine.

Customizing Interleaved Acquisition parameters

Enable Interleaved Line-scan Acquisition by assigning the value ON to InterleavedAcquisition.

Customizing Interleaved Acquisition – Exposure and Strobe Timing Parameters

When Interleaved Line-scan Acquisition is enabled, the following exposure and strobe parameters are irrelevant:

Expose_us, ExposeTrim, StrobeMode, StrobeDur and, PreStrobe_us.

Instead, the exposure and strobe timings must be defined for P1 and P2 using the following parameter set:

ExposureTime_P1_us, ExposureTime_P2_us, StrobeDuration_P1_us, StrobeDuration_P2_us, StrobeDelay_P1_us and, StrobeDelay_P2_us.

Customizing Interleaved Acquisition – Exposure Delay Parameters

By default, MultiCam configures P1 and P2 with the smallest possible Exposure Delay value. This setting is satisfactory for the use cases where the exposure time is shorter than the readout time.

Optionally, keeping ExposureDelayControl set to MANUAL, you may manually change the minimum exposure delay value of P1 and/or P2 using the ExposureDelay_MAN_P1_us and ExposureDelay_MAN_P2_us parameters.

Alternatively, you may also change ExposureDelayControl to one of the automatic control methods: SAME_START_EXPOSURE or SAME_END_EXPOSURE.

With SAME_START_EXPOSURE, the start of exposure is delayed by the same amount of time for both programs: both exposure delay values are equal.

With SAME_END_EXPOSURE the end of exposure is delayed by the same amount of time for both programs.



Note: In case of asymmetric exposure times, when at least one exposure time is greater than the readout time, the minimal line trigger period can be achieved when:

- Assigning the longest exposure time to P2
- Inserting an exposure delay prior to the lowest one

Customizing Encoder Control Parameters

As for any line-scan application, the following encoder control parameters must be set according to the application needs: LineCaptureMode, LineRateMode, Period_us, PeriodTrim, LinePitch, EncoderPitch, ConverterTrim, OnMinSpeed, LineTrigCtl, LineTrigEdge, LineTrigFilter, LineTrigLine, RateDivisionFactor, ForwardDirection and, BackwardMotionCancellationMode.

Customizing Interleaved Acquisition – Strobe Control Parameters

The `StrobeLine_P1` and `StrobeLine_P2` parameters designate the I/O lines used as strobe outputs for P1 and P2 respectively. The default values are `IOUT1` for P1 and `IOUT2` for P2.

Setting `StrobeLine_P2` to `NONE` disconnects the `IOUT2` output from the P2 Strobe and makes it available for another usage (Software controlled I/O).

The `StrobeOutput_P1` and `StrobeOutput_P2` parameters control the delivery of the strobe pulse for P1 and P2 respectively. The delivery is enabled by default. Assigning the `DISABLE` value, inhibits the delivery of the strobe pulse.

Customizing Grabber Timing Parameters

As for any line-scan application, the following grabber configuration, timing and conditioning parameters must be set according to the application needs: `GrabWindow`, `WindowX_Px` and, `OffsetX_Px`.

Customizing Cluster Parameters

As for any line-scan application, the following cluster parameters must be set according to the application needs: `ColorFormat` and, `ImageFlipX`.

Two-line Synchronized Line-scan Acquisition

Acquisition, in a single scanning operation, of images from 2 (or more) Basler Sprint bi-linear Bayer CFA color line-scan cameras with 2 illumination devices turned on alternatively

The *Two-line Synchronized Line-scan Acquisition* feature takes advantage of a specificity of the BASLER Sprint bilinear CMOS camera that, when operating in the so-called "Exsync controlled operation – Level controlled Mode – Enhanced Raw Line A" exposes light **once every two Exsync cycle**. For a full description of such camera cycle, refer to [Camera Cycles](#) on page 45.

This feature extends the capability of Grablink cards to synchronize multiple line-scan acquisition channels using the 2-signal SyncBus. For an architectural description, refer to [System Architecture](#) on page 46. For a description of the hardware layer and the SyncBus wiring, refer to [SyncBus Wiring](#) on page 50.

This feature supports two line capture modes: **Take-All-Lines** and **Tag-A-Line**.

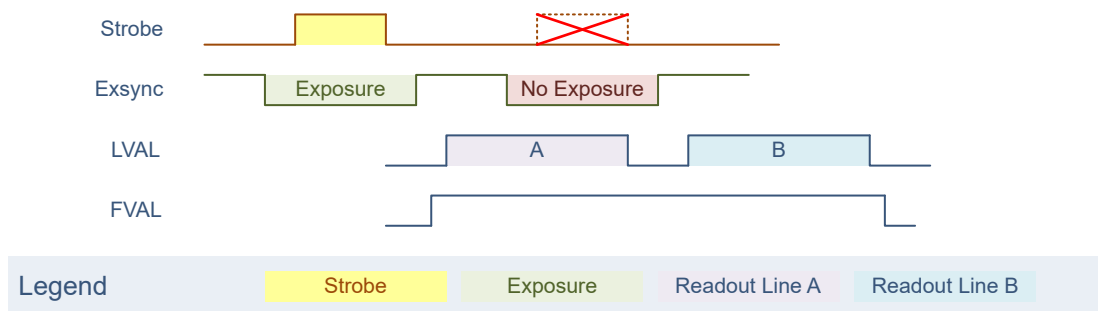
The "two-line synchronized acquisition" feature is available since MultiCam 6.9.8 for 1624 Grablink Base, 1623 Grablink DualBase, 1622 Grablink Full and 1626 Grablink Full XR.

The **Tag-A-Line** mode is available since MultiCam 6.12.

Camera Cycles

Basler Sprint Camera Cycle

A single camera cycle of a Basler Sprint CMOS bilinear line-scan camera operating in the "Exsync controlled operation – Level controlled Mode – Raw Line A" requires **two consecutive Exsync pulses** to be completed:



The leading (=falling) edge of the first Exsync pulse initiates a new exposure.

The trailing (=rising) edge of the first Exsync terminates the exposure and initiates the readout of the first line (line A) of the sensor.

The leading (=falling) edge of the second Exsync pulse has no function.

The trailing (=rising) edge of the second Exsync pulse initiates the readout of the second line (line B) of the sensor.

The sensor integrates light for all pixels simultaneously during the time interval between the leading and the trailing edge of the first Exsync pulse. The strobe light must be fired during that time interval.

The sensor doesn't integrate light during the low period of the second Exsync pulse. Firing the strobe during that interval has no effect on the acquired data.

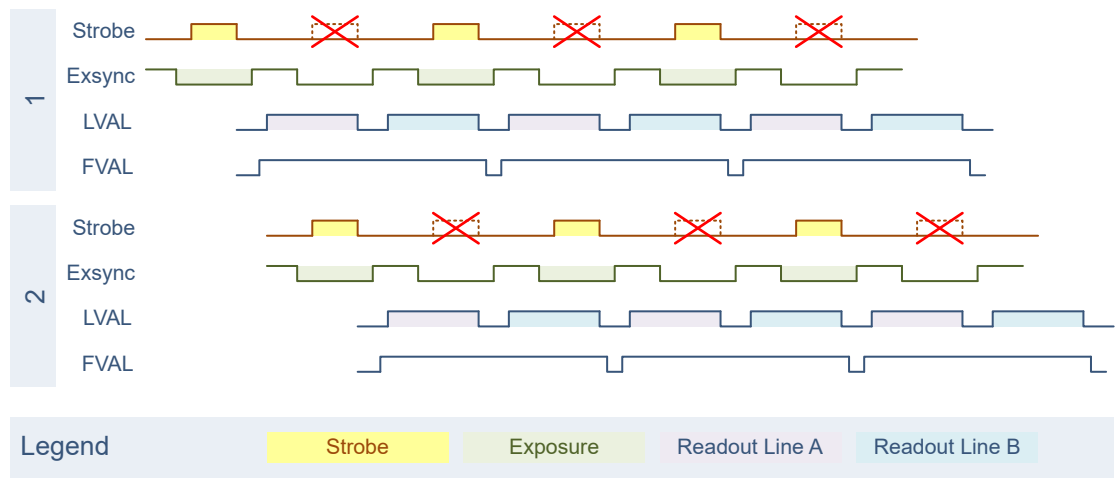
The camera qualifies each line of image data by the LVAL signal.

The camera delivers also an FVAL pulse surrounding the two LVAL pulses belonging to the same camera cycle. This allows the frame grabber to unambiguously identify the "line parity"(A or B).



Note: The FVAL Length CSR parameter of the Basler Sprint camera must be set to 2.

Phase-shifted Camera Cycles

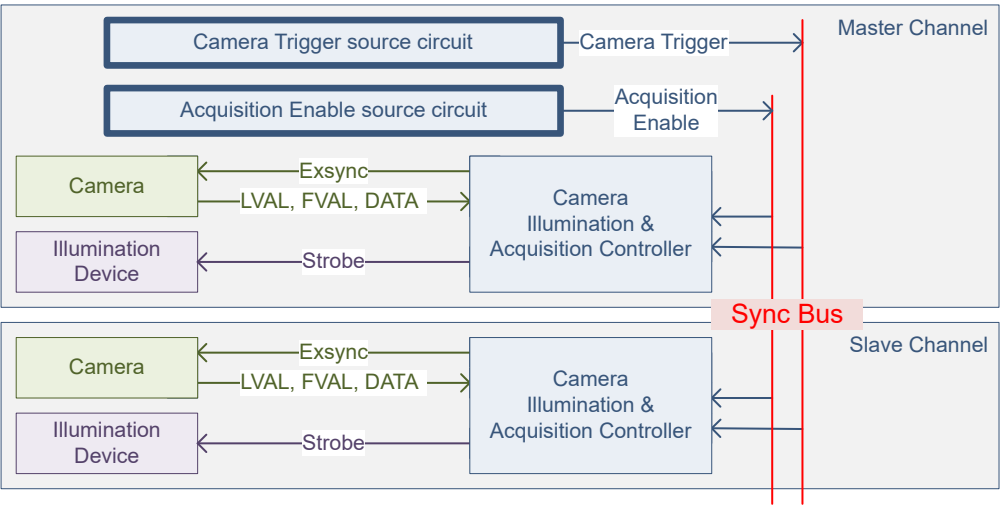


The drawing shows the camera cycles of two Basler Sprint cameras where the Exsync periods are synchronized with a phase shift of one period of the Exsync signal.

Notice that:

- The 2 cameras are never exposing simultaneously!
- Firing the illumination during the exposure time interval of a camera will not affect the other camera.

System Architecture



A **two-line synchronized line-scan acquisition system** is composed of at least 2 MultiCam acquisition channels:

- One "Master Channel"
- One or more "Slave Channels"

Each MultiCam acquisition channel includes:

- 1 Basler Sprint bilinear color line-scan camera
- 1 Strobed illumination device
- 1 Camera, Illumination and Acquisition controller (CIAC).

The Master channel includes:

- 1 Camera Trigger Source circuit that generates the *SyncBus:Camera Trigger* signal.
- 1 Acquisition Enable source circuit that generates the *SyncBus:Acquisition Enable* signal.

The SyncBus distributes the two signals to the Camera, Illumination and Acquisition Controller of all participating channels.

The leading edge of the *SyncBus:Camera Trigger* signal triggers simultaneously all camera and illumination controllers. Each controller sends an Exsync pulse (MultiCam reset signal) having a specified width to the camera. It generates also a strobe pulse once every two Exsync.

The leading edge of the *SyncBus:Acquisition Enable* signal initiates the image data capture on all channels. The image data capture effectively begins on the next occurrence of a line A ensuring that the image data capture begins always on a boundary of the 2x2 Bayer CFA pattern.

The falling edge of the *SyncBus:Acquisition Enable* signal terminates the image data capture on all channels. The image data capture effectively terminates after the next occurrence of a line B ensuring that the image data capture terminates always on a boundary of the 2x2 Bayer CFA pattern.

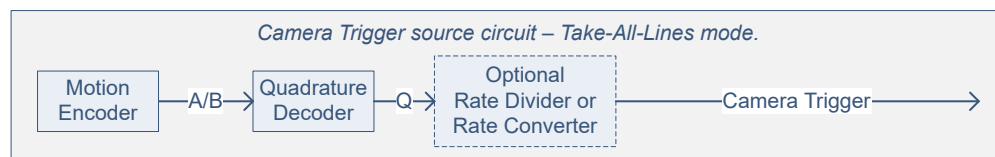
Line Capture Modes

Two line capture modes are available: **Take-All-Lines** and **Tag-A-Line**.

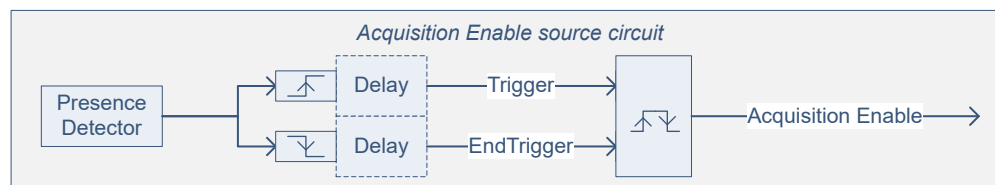
The following table summarizes the characteristics:

Characteristics	Take-All-Lines	Tag-A-Line
Camera line rate	Variable, linked to web speed	Fixed, defined by the frame grabber
Captured image data	All lines	All lines
Line tagging	No	Yes, linked to web speed
Image resampling	Not required	Required to be done by the application using tag metadata

Take-All-Lines Line Capture Mode

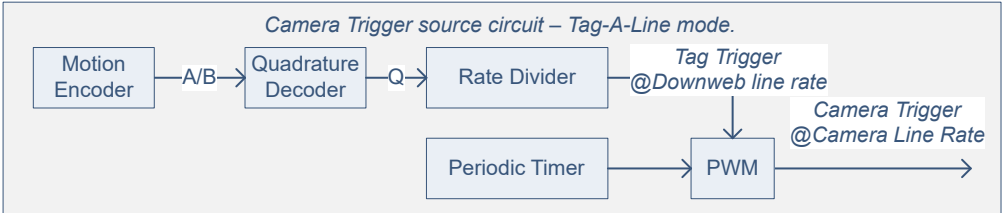


The **camera line rate** is proportional to the web speed to maintain a fixed pitch along the downweb web direction. Therefore, the Master Channel elaborates a *Camera Trigger signal* from the A/B signals using the Quadrature Decoder and, when necessary, the Rate Divider or the Rate Converter.



All lines are captured by the frame grabber when the acquisition is enabled. Therefore, the Master channel elaborates the *Acquisition Enable signal* from both edges of the position detector signal.

Tag-A-Line Line Capture Mode



The **camera line rate** is fixed. Therefore, the Master Channel elaborates a *Camera Trigger signal* using the Periodic Timer.

The **downweb line rate** is proportional to the web speed to obtain, after resampling by the application , a fixed pitch along the downweb web direction. The Master channel elaborates also a *Tag Trigger signal* from the A/B signals using the Quadrature Decoder and the Rate Divider. This signal will be used by all acquisition controllers to tag the lines of image data lines to be kept during the downweb resampling process.

The Master channel combines both Tag Trigger and Camera Trigger signals for transmission on the SyncBus.

All lines are tagged and captured by the frame grabber when the acquisition is enabled. Therefore, the Master channel elaborates the *Acquisition Enable signal* from both edges of the position detector signal in the same way as for the Take-All-Lines mode.

The RGB components data of the first pixel of each image line are replaced by a tag indicating if the line was preceded by a Tag Trigger or not.

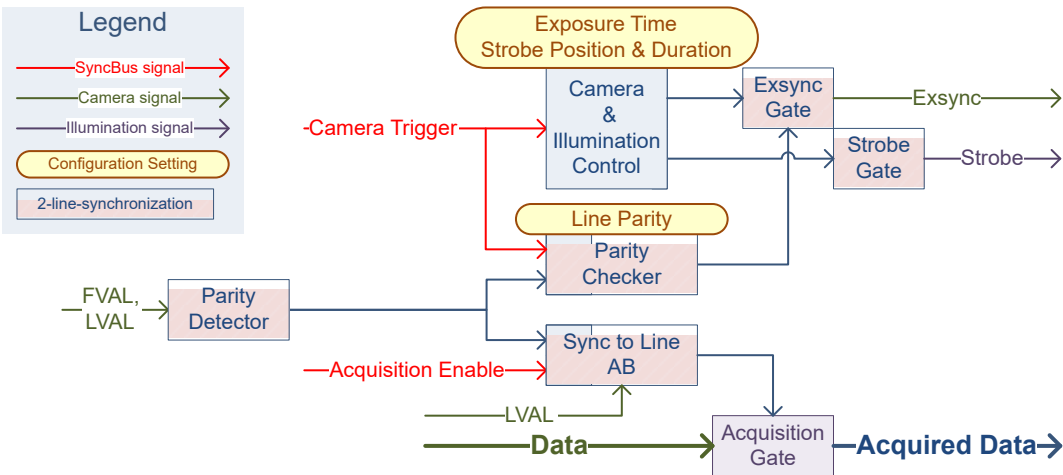
- All data bits of R,G and B components are set to 1 when a Tag Trigger occurred during the preceding line interval.
- All data bits of R,G and B components are set to 0 when no Tag Trigger occurred during the preceding line interval.

Note: When *ColorFormat* is set to *RGB32*, the *alpha* component is not tagged!

All image data lines are delivered to the application. The application has to perform downweb resampling using tags to obtain an undistorted image with a constant downweb line pitch.

Camera, Illumination and Acquisition controller

Block Diagram



Camera and Illumination Controller

On every Camera Trigger event, the Camera and Illumination Controller generates:

- One single Exsync pulse, having a duration set by the MultiCam parameter `Expose_us`
- One single Strobe pulse, having a duration and a position set by the MultiCam parameters `StrobeDur` and `StrobePos`.

The width of the Exsync pulse determines the exposure time of the camera. The strobe pulse duration is entirely located within the exposure time interval. Its position, and its duration are defined as a percentage of the exposure time.

Two-line Synchronization Mode

The two-line synchronization mode of the CIAC must be enabled by setting the value `ENABLE` to the MultiCam Parameter `MultiCam Parameter TwoLineSynchronization`.

This mode of synchronization ensures that the acquisition gate opens and closes at a line-pair boundary. It provides also the capability to control the "Line Parity" of the camera by means of the `TwoLineSynchronizationParity` parameter:

- When set to "EVEN", the camera line parity of the local camera is such that the camera cycle begins at an even line trigger count boundary.
- When set to "ODD", the camera line parity of the local camera is such that the camera cycle begins at an odd line trigger count boundary.

Line Parity Control

The line parity control is composed of three function blocks:

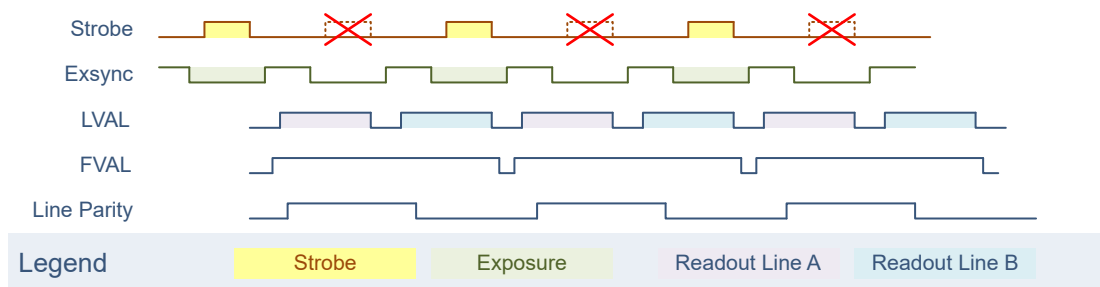
- Parity Detector
- Parity Checker
- Exsync Gate

The "Parity Detector" function block analyzes the FVAL and the LVAL signal of the camera and generates the Camera Line Parity signal. This signal identifies unambiguously the row A and the row B of the image sensor.

The "Parity Checker" function block checks whether the Camera Line Parity signal is as expected according to the "Line Parity" settings.

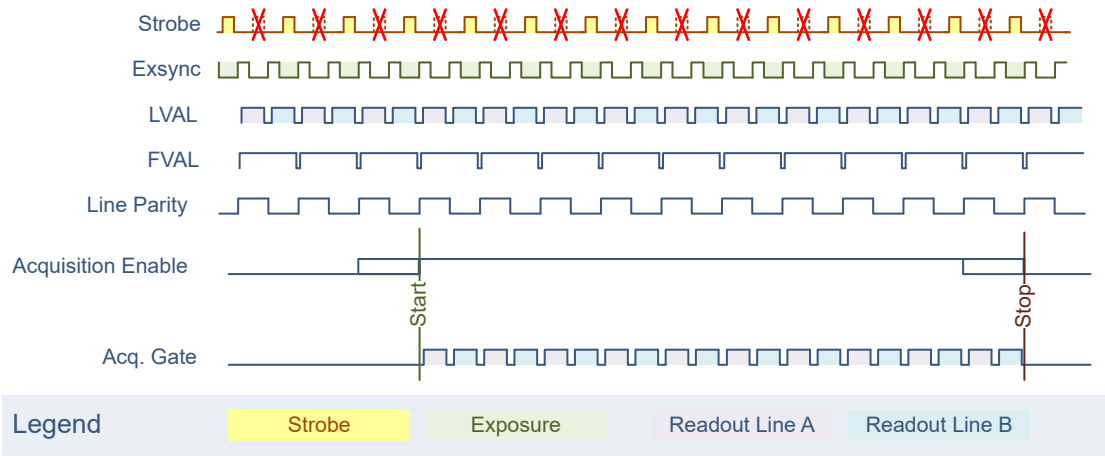
If the Camera Line Parity is incorrect, the Exsync gate removes the next Exsync pulse. This action restores the appropriate line parity.

Strobe Gating



The Strobe Gate removes one strobe pulse every two. It keeps only, the strobe corresponding to the Exsync cycle where the local camera exposes.

Acquisition Gating

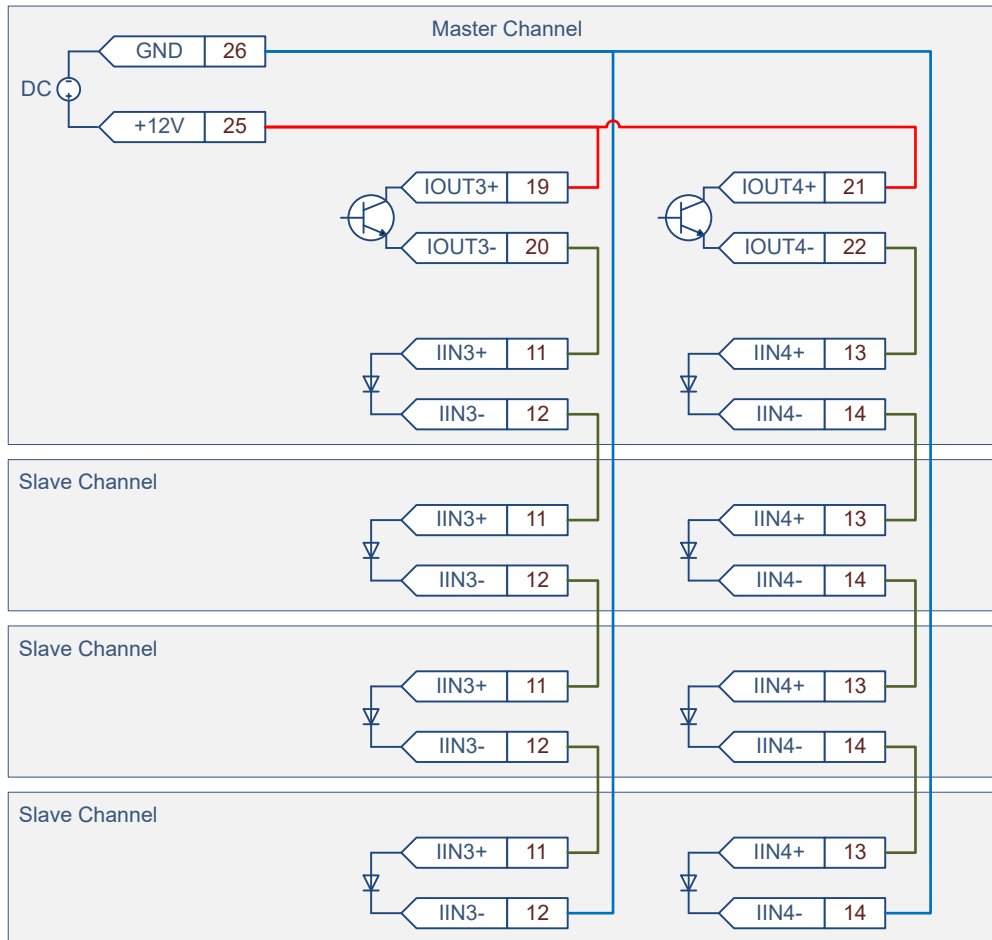


The acquisition gate opens and closes at line-pair boundaries to ensure that buffers always start with a line A and ends with a line B.

SyncBus Wiring

The SyncBus is implemented with a custom made wiring interconnecting a selected set of I/O pins of the internal I/O connector of each MultiCam Channel.

The following diagram shows the interconnections for a 4-channel SyncBus:



Camfile Template – Take-All-Lines mode

The following section highlights the additions to the generic MyCameraLink_LxxxxRG.cam camfile for configuring the Master MultiCam Channel of a two-line synchronized line-scan acquisition system using the **Take-All-Lines** line capture mode.

```
;*****
; Camera Manufacturer: Templates
; Camera Model: MyCameraLink
; Camera Configuration: Line-Scan, Grabber-Controlled Rate and Exposure
; Board: Grablink
;*****
; This CAM file template is suitable for the following camera configuration:
;   - Line-scan camera
;   - Grabber-controlled rate
;   - Pulse-Width grabber-controlled exposure
; This CAM file template is suitable for the following system configuration:
;   - WEB, PAGE, or LONGPAGE Acquisition Modes
;   - Take all lines
;
; *****
; ** CAUTION: **
; ** This file is a template, it can be further customized! **
; ** The lines that can be edited are marked with an arrow followed by the most **
; ** popular alternate values for that parameter. **
; ** For a complete list of possible values; refer to MultiCam Studio and/or to **
; ** the MultiCam Reference documentation. **
```

```

; *****
; *****
; ==Begin of "Camera properties Section"==
;
; -Camera Specification category-
;   Camera =           MyCameraLink;
;   CamConfig =        LxxxxRG;
;   Imaging =          LINE;
;   Spectrum =         BW;                                <== BW COLOR ...
;
; -Camera Features category-
;   TapConfiguration = BASE_1T8;                          <== BASE_1T8 BASE_1T10 BASE_1T24 ...
;   TapGeometry =      1X;                                <== 1X 1X2 2X ...
;   Expose is          WIDTH;
;   Readout is         INTCTL;
;   ColorMethod =      NONE;                              <== NONE PRISM TRILINEAR RGB
;   TwoLineSynchronization = ENABLE;
;   TwoLineSynchronizationParity = EVEN;              <== EVEN ODD
;
; --Downstream signals--
;   FvalMode =         FN;
;   LvalMode =         LA;
;   DvalMode =         DN;                                <== DN DG
;
; --Upstream signals--
;   ResetCtl =         DIFF;
;   ResetEdge =        GOHIGH;                            <== GOHIGH GOLOW
;   CC1Usage =         RESET;                             <== LOW HIGH RESET SOFT
;   CC2Usage =         LOW;                               <== LOW HIGH RESET SOFT
;   CC3Usage =         LOW;                               <== LOW HIGH RESET SOFT
;   CC4Usage =         LOW;                               <== LOW HIGH RESET SOFT
;
; -Camera Timing category-
;   Hactive_Px =       4096;                               <==
;   HSyncAft_Tk =      0;                                 <==
;   LineRate_Hz =      5000;                              <==
;   ExposeMin_us =     1;                                 <==
;   ExposeMax_us =     10000;                             <==
;   ResetDur =         3000;                              <==
;
; ==End of "Camera properties Section"==
; *****
; ==Begin of "System properties Section"==
;
; -Acquisition Control category-
;   SynchronizedAcquisition = MASTER;                  <== MASTER, SLAVE, LOCAL_MASTER, LOCAL_SLAVE
;   AcquisitionMode =   WEB;                              <== WEB PAGE LONGPAGE
;   TrigMode =         IMMEDIATE;                         <== IMMEDIATE HARD SOFT COMBINED
;   NextTrigMode =     REPEAT;                             <== REPEAT (when AcquisitionMode = WEB or LONGPAGE)
;                                                         <== SAME REPEAT HARD SOFT COMBINED
;   (when AcquisitionMode = PAGE)
;     EndTrigMode =     AUTO;                              <== AUTO HARD (when AcquisitionMode = LONGPAGE)
;                                                         <== AUTO (when AcquisitionMode = WEB or PAGE)
;   BreakEffect =      FINISH;                             <== FINISH ABORT
;   SeqLength_Pg =     -1;                                 <== -1 1 .. 65534 (when AcquisitionMode = PAGE)
;   SeqLength_Ln =     -1;                                <== -1 1 .. 65534 (when AcquisitionMode = WEB or LONGPAGE)
;   PageLength_Ln =    500;                                <== 1 .. 65535
;
; -Trigger Control category-
;   The set of values and the default value assigned by MultiCam for the parameter
;   TrigCtl are board specific!
;   If the default value is not adequate for your application, it is then necessary
;   to edit the value and
;   to remove the leading semi-column of one of the following 3 lines
;   TrigCtl =          ISO;                                <== Full/DualBase/Base: ISO DIFF
;   TrigCtl =          ITTL;                               <== Avenue/Express: TTL ITTL I12V LVDS
;   TrigCtl =          ITTL;                               <== Value/Expert 2: TTL ITTL I12V
;   TrigEdge =         GOHIGH;                             <== GOHIGH GOLOW
;   TrigFilter =       MEDIUM;                             <== OFF ON MEDIUM STRONG
;   TrigLine =         NOM;                                <== NOM ...
;
;   The following 4 parameters are relevant only when EndTrigMode = HARD!
;   The set of values and the default value assigned by MultiCam for the parameter
;   EndTrigCtl are board specific!

```

```

;      If the default value is not adequate for your application, it is then necessary
to edit the value and
;      to remove the leading semi-column of one of the following 3 lines
;      EndTrigCtl =      ISO;                <== Full/DualBase/Base: ISO DIFF
;      EndTrigCtl =      ITTL;               <== Avenue/Express: TTL ITTL I12V LVDS
;      EndTrigCtl =      ITTL;               <== Value/Expert 2: TTL ITTL I12V
;      EndTrigEdge =      GOLOW;              <== GOHIGH GOLOW
;      EndTrigFilter =    MEDIUM;            <== OFF ON MEDIUM STRONG
;      EndTrigLine =      NOM;                <== NOM ...
;
; -Exposure & Strobe Control categories-
;      Expose_us =        90;                <==
;      ExposeTrim =       0;                <==
;      StrobeMode =       NONE;             <== To free the Strobe Output IO port
;
; -Encoder Control category-
;      LineCaptureMode =  ALL;
;      LineRateMode =     PERIOD;            <= PERIOD PULSE CONVERT
;      The following 2 parameters are relevant only when LineRateMode = PERIOD:
;      Period_us =        1000;             <=
;      PeriodTrim =       0;                <=
;      The following 5 parameters are relevant only when LineRateMode = CONVERT:
;      LinePitch =         100;             <=
;      EncoderPitch =      100;             <=
;      ConverterTrim =     0;                <=
;      OnMinSpeed =        IDLING;          <= IDLING MUTING
;      The following 4 parameters are relevant only when LineRateMode = PULSE or CONVERT:
;      The set of values and the default value assigned by MultiCam for the parameter
LineTrigCtl are board specific!
;      If the default value is not adequate for your application, it is then necessary
to edit the value and
;      to remove the leading semi-column of one of the following 3 lines
;      LineTrigCtl =      DIFF PAIRED;       <== Full/DualBase/Base: ISO DIFF ISO PAIRED DIFF_PAIRED
;      LineTrigCtl =      ITTL;              <== Avenue/Express: TTL ITTL I12V LVDS
;      LineTrigCtl =      ITTL;              <== Value/Expert 2: TTL ITTL I12V
;      The set of values and the default value assigned by MultiCam for the parameter
LineTrigEdge are board specific!
;      If the default value is not adequate for your application, it is then necessary
to edit the value and
;      to remove the leading semi-column of the following line
;      LineTrigEdge =      GOHIGH;           <== GOHIGH GOLOW RISING_A FALLING_A ALL_A
;      (when LineTrigCtl = ISO or DIFF)
;      <== ALL_A B (when LineTrigCtl = ISO_PAIRED or DIFF_PAIRED)
;      <== GOHIGH GOLOW (when LineTrigCtl = TTL ITTL I12V Or LVDS)
;      LineTrigFilter =    MEDIUM;           <== OFF ON MEDIUM STRONG
;      LineTrigLine =      NOM;               <== NOM ...
;      The following parameter controls the Rate divider circuit that is available
;      exclusively on Grablink Full/DualBase/Base boards when LineRateMode = PULSE.
;      Remove the leading semi-column if the function is required!
;      RateDivisionFactor = 1;                <== 1.512
;      The following 2 parameters are controlling the Backward Motion Cancellation circuit
that is available
;      exclusively on Grablink Full/DualBase/Base boards when LineTrigCtl = ISO_PAIRED or
DIFF_PAIRED.
;      Remove the leading semi-column on both parameters if the function is required!
;      ForwardDirection =  A_LEADS_B;         <== A_LEADS_B B_LEADS_A
;      BackwardMotionCancellationMode = OFF;  <== OFF FILTERED COMPENSATE
;
; ==End of "System properties Section"==
; *****
; ==Begin of "Grabber properties Section"==
;
; -Grabber Configuration, Timing & Conditioning categories-
;      GrabWindow =        NOBLACK;          <== NOBLACK MAN ...
;      The following 2 parameters are relevant only when GrabWindow = MAN:
;      WindowX_Px =        2048;             <==
;      OffsetX_Px =         0;                <==
;
; -Look-Up Tables category-
;      The Look-Up Table operator is available exclusively on Grablink Full/DualBase/Base boards.
;      LUT configuration parameters can be inserted here if required by the application
;
; -Cluster category-
;      ColorFormat =       Y8;                <== Y8 Y10 RGB24 RGB24PL ...
;      ImageFlipX =        OFF;               <== OFF ON

```

```
;
; End of "Grabber properties Section"
; *****
; End of File
; =====
```

Camfile Template – Tag-A-Line mode

The following section highlights the additions to the generic MyCameraLink_LxxxxRG.cam camfile for configuring the Master MultiCam Channel of a two-line synchronized line-scan acquisition using the **Tag-A-Line** line capture mode.

```
; *****
; Camera Manufacturer: Templates
; Camera Model: MyCameraLink
; Camera Configuration: Line-Scan, Grabber-Controlled Rate and Exposure
; Board: Grablink
; *****
; This CAM file template is suitable for the following camera configuration:
;   - Line-scan camera
;   - Grabber-controlled rate
;   - Pulse-Width grabber-controlled exposure
; This CAM file template is suitable for the following system configuration:
;   - WEB, PAGE, or LONGPAGE Acquisition Modes
;   - Take all lines
;
; *****
; ** CAUTION: **
; ** This file is a template, it can be further customized! **
; ** The lines that can be edited are marked with an arrow followed by the most **
; ** popular alternate values for that parameter. **
; ** For a complete list of possible values; refer to MultiCam Studio and/or to **
; ** the MultiCam Reference documentation. **
; *****
;
; *****
; ==Begin of "Camera properties Section"==
;
; -Camera Specification category-
;   Camera = MyCameraLink;
;   CamConfig = LxxxxRG;
;   Imaging = LINE;
;   Spectrum = BW; <== BW COLOR ...
;
; -Camera Features category-
;   TapConfiguration = BASE_1T8; <== BASE_1T8 BASE_1T10 BASE_1T24 ...
;   TapGeometry = 1X; <== 1X 1X2 2X ...
;   Expose is WIDTH;
;   Readout is INTCTL;
;   ColorMethod = NONE; <== NONE PRISM TRILINEAR RGB
;   TwoLineSynchronization = ENABLE;
;   TwoLineSynchronizationParity = EVEN; <== EVEN ODD
;
; --Downstream signals--
;   FvalMode = FN;
;   LvalMode = LA;
;   DvalMode = DN; <== DN DG
;
; --Upstream signals--
;   ResetCtl = DIFF;
;   ResetEdge = GOHIGH; <== GOHIGH GOLOW
;   CC1Usage = RESET; <== LOW HIGH RESET SOFT
;   CC2Usage = LOW; <== LOW HIGH RESET SOFT
;   CC3Usage = LOW; <== LOW HIGH RESET SOFT
;   CC4Usage = LOW; <== LOW HIGH RESET SOFT
;
; -Camera Timing category-
;   Hactive_Px = 4096; <==
;   HSyncAft_Tk = 0; <==
;   LineRate_Hz = 5000; <==
```

```

ExposeMin_us =      1;                <==
ExposeMax_us =    10000;              <==
ResetDur =        3000;              <==
;
; ==End of "Camera properties Section"==
;*****
; ==Begin of "System properties Section"==
;
; -Acquisition Control category-
SynchronizedAcquisition = MASTER      <== MASTER, SLAVE, LOCAL_MASTER, LOCAL_SLAVE
AcquisitionMode = WEB;                <== WEB PAGE LONGPAGE
TrigMode = IMMEDIATE;                 <== IMMEDIATE HARD SOFT COMBINED
NextTrigMode = REPEAT;                <== REPEAT (when AcquisitionMode = WEB or LONGPAGE)
;                                     <== SAME REPEAT HARD SOFT COMBINED
; (when AcquisitionMode = PAGE)
EndTrigMode = AUTO;                  <== AUTO HARD (when AcquisitionMode = LONGPAGE)
;                                     <== AUTO (when AcquisitionMode = WEB or PAGE)
; BreakEffect = FINISH;               <== FINISH ABORT
SeqLength_Pg = -1;                   <== -1 1 .. 65534 (when AcquisitionMode = PAGE)
SeqLength_Ln = -1;                   <== -1 1 .. 65534 (when AcquisitionMode = WEB or LONGPAGE)
PageLength_Ln = 500;                 <== 1 .. 65535
;
; -Trigger Control category-
; The set of values and the default value assigned by MultiCam for the parameter
TrigCtl are board specific!
; If the default value is not adequate for your application, it is then necessary
to edit the value and
; to remove the leading semi-column of one of the following 3 lines
; TrigCtl = ISO;                     <== Full/DualBase/Base: ISO DIFF
; TrigCtl = ITTL;                    <== Avenue/Express: TTL ITTL I12V LVDS
; TrigCtl = ITTL;                    <== Value/Expert 2: TTL ITTL I12V
TrigEdge = GOHIGH;                   <== GOHIGH GOLOW
TrigFilter = MEDIUM;                 <== OFF ON MEDIUM STRONG
TrigLine = NOM;                      <== NOM ...
;
; The following 4 parameters are relevant only when EndTrigMode = HARD!
; The set of values and the default value assigned by MultiCam for the parameter
EndTrigCtl are board specific!
; If the default value is not adequate for your application, it is then necessary
to edit the value and
; to remove the leading semi-column of one of the following 3 lines
; EndTrigCtl = ISO;                  <== Full/DualBase/Base: ISO DIFF
; EndTrigCtl = ITTL;                 <== Avenue/Express: TTL ITTL I12V LVDS
; EndTrigCtl = ITTL;                 <== Value/Expert 2: TTL ITTL I12V
EndTrigEdge = GOLOW;                 <== GOHIGH GOLOW
EndTrigFilter = MEDIUM;              <== OFF ON MEDIUM STRONG
EndTrigLine = NOM;                   <== NOM ...
;
; -Exposure & Strobe Control categories-
Expose_us = 90;                      <==
ExposeTrim = 0;                      <==
StrobeMode = NONE;                   <== To free the Strobe Output IO port
;
; -Encoder Control category-
LineCaptureMode = TAG;
LineRateMode = PERIOD;                <= PERIOD
; The following 2 parameters are relevant when LineCaptureMode = TAG:
Period_us = 1000;                     <=
PeriodTrim = 0;                       <=
; The following 5 parameters are relevant when LineCaptureMode = TAG:
LinePitch = 100;                      <=
EncoderPitch = 100;                   <=
ConverterTrim = 0;                    <=
OnMinSpeed = IDLING;                  <= IDLING MUTING
; The following 4 parameters are relevant only when LineCaptureMode = TAG:
; The set of values and the default value assigned by MultiCam for the parameter
LineTrigCtl are board specific!
; If the default value is not adequate for your application, it is then necessary
to edit the value and
; to remove the leading semi-column of one of the following 3 lines
; LineTrigCtl = DIFF_PAIRED;          <== Full/DualBase/Base: ISO DIFF ISO PAIRED DIFF_PAIRED
; LineTrigCtl = ITTL;                 <== Avenue/Express: TTL ITTL I12V LVDS
; LineTrigCtl = ITTL;                 <== Value/Expert 2: TTL ITTL I12V
; The set of values and the default value assigned by MultiCam for the parameter
LineTrigEdge are board specific!

```

```

;      If the default value is not adequate for your application, it is then necessary
;      to edit the value and
;      to remove the leading semi-column of the following line
;      LineTrigEdge =          GOHIGH;          <== GOHIGH GOLOW RISING_A FALLING_A ALL_A
;      (when LineTrigCtl = ISO or DIFF)
;      <== ALL A B (when LineTrigCtl = ISO_PAURED or DIFF_PAURED)
;      <== GOHIGH GOLOW (when LineTrigCtl = TTL ITTL I12V or LVDS)
;      LineTrigFilter =      MEDIUM;          <== OFF ON MEDIUM STRONG
;      LineTrigLine =        NOM;             <== NOM ...
;      The following parameter controls the Rate divider circuit that is available when
LineCaptureMode = TAG:
;      RateDivisionFactor = 1;                 <== 1..512
;      The following 2 parameters are controlling the Backward Motion Cancellation circuit
;      that is available
;      exclusively on Grablink Full/DualBase/Base boards when LineTrigCtl = ISO_PAURED or
DIFF_PAURED.
;      Remove the leading semi-column on both parameters if the function is required!
;      ForwardDirection = A_LEADS_B;          <== A LEADS B B LEADS A
;      BackwardMotionCancellationMode = OFF;   <== OFF FILTERED COMPENSATE
;
; ==End of "System properties Section"==
;*****
; ==Begin of "Grabber properties Section"==
;
; -Grabber Configuration, Timing & Conditioning categories-
;      GrabWindow =          NOBLACK;          <== NOBLACK MAN ...
;      The following 2 parameters are relevant only when GrabWindow = MAN:
;      WindowX_Px =          2048;             <==
;      OffsetX_Px =          0;                 <==
;
; -Look-Up Tables category-
;      The Look-Up Table operator is available exclusively on Grablink Full/DualBase/Base boards.
;      LUT configuration parameters can be inserted here if required by the application
;
; -Cluster category-
;      ColorFormat =          Y8;               <== Y8 Y10 RGB24 RGB24PL ...
;      ImageFlipX =          OFF;              <== OFF ON
;
; End of "Grabber properties Section"
;*****
; End of File
;=====

```

Camfile Customization

Camera Parameters

As for any line-scan camera, the following camera parameters must be set according to the selected camera model:

Spectrum, TapConfiguration, TapGeometry, ColorMethod, DvalMode, ResetEdge, CC1Usage, CC2Usage, CC3Usage, CC4Usage, Hactive_Px and, HSyncAft_Tk.

For correct operation of the camera trigger overrun protection mechanism it is essential to carefully set the following parameters:

LineRate_Hz, ExposeMin_us, ExposeMax_us and, ResetDur.

To operate with bilinear line-scan cameras:

- The 2-line synchronization mode must be enabled by setting TwoLineSynchronization to ENABLE.
- The 2-line synchronization parity must be selected by setting TwoLineSynchronizationParity to ODD or EVEN. There is a phase-shift of 1 Exsync cycle between cameras set to ODD and cameras set EVEN.

Acquisition Control Parameters

As for any line-scan application, the following acquisition control parameters must be set according to the application needs: AcquisitionMode, TrigMode, NextTrigMode, EndTrigMode, BreakEffect, SeqLength_Pg, SeqLength_Ln and, PageLength_Ln.

The synchronized acquisition feature must be enabled on all synchronized channels:

- On the master Channel: set `SynchronizedAcquisition` to `MASTER`.
- On the slave Channels: set `SynchronizedAcquisition` to `SLAVE`.

In the particular case of Grablink DualBase, use the values `LOCAL_MASTER` and `LOCAL_SLAVE` instead of `MASTER` and `SLAVE` to use the built-in SyncBus interconnect between the two channels.

Trigger Control Parameters

As for any line-scan application, the following trigger and end trigger control parameters must be set according to the application needs: `TrigCtl`, `TrigEdge`, `TrigFilter`, `TrigLine`, `EndTrigCtl`, `EndTrigEdge`, `EndTrigFilter` and, `EndTrigLine`.

Exposure and Strobe Timing Parameters

As for any line-scan application, the following exposure and strobe control parameters must be set according to the application needs:

`Expose_us`, `ExposeTrim`, `StrobeMode`, `StrobeDur` and, `PreStrobe_us`.

Encoder Control Parameters

As for any line-scan application, the following encoder control parameters must be set according to the application needs: `LineCaptureMode`, `LineRateMode`, `Period_us`, `PeriodTrim`, `LinePitch`, `EncoderPitch`, `ConverterTrim`, `OnMinSpeed`, `LineTrigCtl`, `LineTrigEdge`, `LineTrigFilter`, `LineTrigLine`, `RateDivisionFactor`, `ForwardDirection` and, `BackwardMotionCancellationMode`.

Grabber Timing Parameters

As for any line-scan application, the following grabber configuration, timing and conditioning parameters must be set according to the application needs: `GrabWindow`, `WindowX_Px` and, `OffsetX_Px`.

Cluster Parameters

As for any line-scan application, the following cluster parameters must be set according to the application needs: `ColorFormat` and, `ImageFlipX`.