

Matrox Helios eCL/XCL

Camera Interface Application Note

BASLER spL4096-70kc

January 6, 2009

Basics about the
camera

Camera Descriptions

- Effective resolution: Up to 4096 pixels/line @ up to 70k line per second.
- Camera Link FULL interface (2 to 8 taps, and 8, 10 or 12-bit).
- Sensor: Linear CMOS with Bayer color filter.
- Color RGB or RAW camera modes.
- External and internal sync.
- External or internal exposure control.
- 40 or 80 MHz pixel clock rate.

Note that an update (M800EF42 or M900EF03) is required in order to use the Bayer (...RAWColor...) modes. Refer to the DCF Comments section or contact Technical Support for more information. For enhanced RAW DCFs, update (M900EF02) is also required - contact Matrox Imaging at techmark.imaging@matrox.com

Interface Mode

- Fixed line scan rate¹
- Variable line scan rate²
- Variable line scan rate using the Rotary Encoder²
- Fixed line scan rate with frame trigger¹
- Variable line scan rate with frame trigger²
- Variable line scan rate using the Rotary Encoder with frame trigger²
- Fixed line scan rate with variable frame size¹
- Variable line scan rate with variable frame size²
- Variable line scan rate using the Rotary Encoder with frame trigger²
- Fixed line scan rate with area (AOI) mode¹
- Variable line scan rate with area (AOI) mode²
- Variable line scan rate using the Rotary Encoder with area (AOI) mode²

Camera Interface Briefs

Mode 1: Fixed line scan rate

- Up to 4096 pixels/line.
- Camera Link FULL interface (Raw - line first: two 12-bit taps, four 12-bit taps, eight 8-bit taps and RGB: three RGB 10-bit taps, six RGB 8-bit taps).
- DCF configured for 1000 lines per virtual frame.
- Matrox Helios eCL/XCL sending periodic EXPOSURE1 (EXSYNC) signal to camera.
- Matrox Helios eCL/XCL receiving LVAL, PIXEL CLOCK (@ 80 MHz) and video data from camera.
- DCF used: [SpL4096_70kc_4096_12bit2tapsRawColorFLS.DCF](#)

Continued...

Mode of operations as
per Matrox Imaging (in
parentheses as per
camera manufacturer)

Basics about the
interface modes

¹ EXSYNC, level-controlled or Free Run programmable

² EXSYNC, level-controlled

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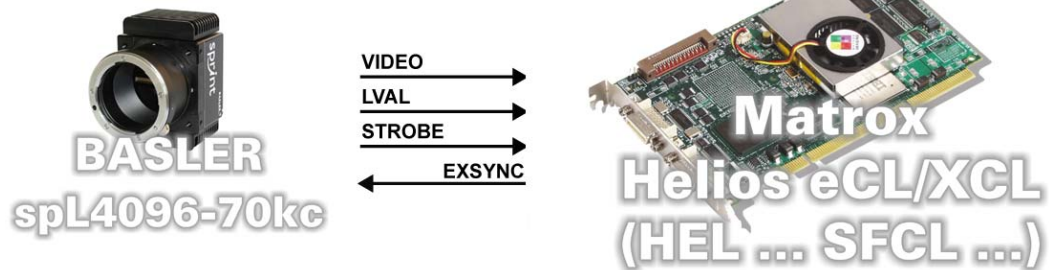
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Basics about the
interface modes

Camera Interface Briefs (cont.)

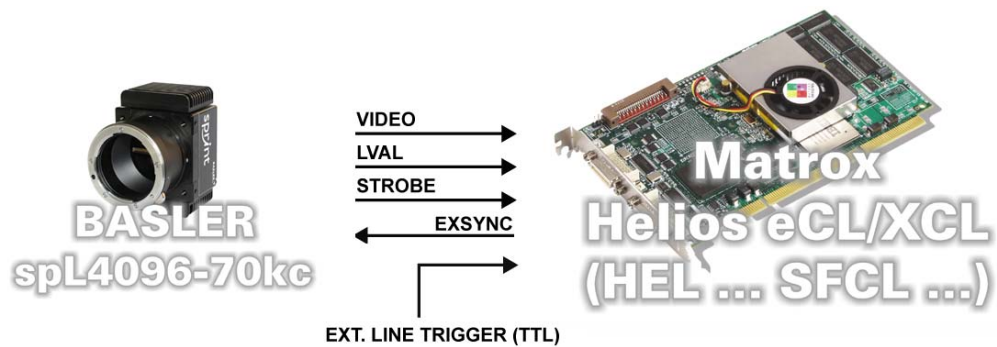
Mode 1: Fixed line scan rate

- DCF used: [SpL4096_70kc_4096_12bit4tapsRawColorFLS.DCF](#)
- DCF used: [SpL4096_70kc_4096_8bit8tapsRawColorFLS.DCF](#)
- DCF used: [SpL4096_70kc_2048_10bitRGBFLS.DCF](#)
- DCF used: [SpL4096_70kc_2048_8bit2tapsRGBFLS.DCF](#)



Mode 2: Variable line scan rate

- Up to 4096 pixels/line.
- Camera Link FULL interface (Raw - line first: two 12-bit taps, four 12-bit taps, eight 8-bit taps and RGB: three RGB 10-bit taps, six RGB 8-bit taps).
- DCF configured for 1000 lines per virtual frame.
- Matrox Helios eCL/XCL receiving external TTL line trigger signal.
- Matrox Helios eCL/XCL sending EXPOSURE1 (EXSYNC) signal to camera.
- Matrox Helios eCL/XCL receiving LVAL, PIXEL CLOCK (@ 80 MHz) and video data from camera.
- DCF used: [SpL4096_70kc_4096_12bit2tapsRawColorVLS.DCF](#)
- DCF used: [SpL4096_70kc_4096_12bit4tapsRawColorVLS.DCF](#)
- DCF used: [SpL4096_70kc_4096_8bit8tapsRawColorVLS.DCF](#)
- DCF used: [SpL4096_70kc_2048_10bitRGBVLS.DCF](#)
- DCF used: [SpL4096_70kc_2048_8bit2tapsRGBVLS.DCF](#)



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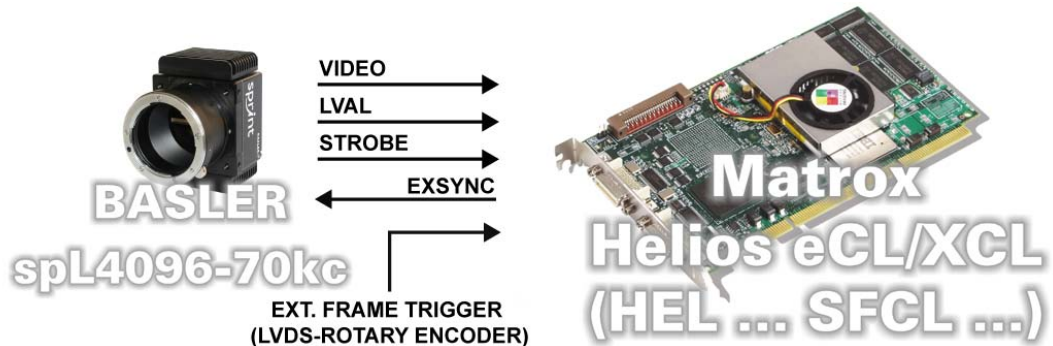
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Basics about the
interface modes

Camera Interface Briefs (cont.)

Mode 3: Variable line scan rate with rotary encoder

- Up to 4096 pixels/line.
- Camera Link FULL interface (Raw - line first: two 12-bit taps, four 12-bit taps, eight 8-bit taps and RGB: three RGB 10-bit taps, six RGB 8-bit taps).
- DCF configured for 1000 lines per virtual frame.
- Matrox Helios eCL/XCL receiving external LVDS (Rotary Encoder) line trigger signal.
- Matrox Helios eCL/XCL sending EXPOSURE1 (EXSYNC) signal to camera.
- Matrox Helios eCL/XCL receiving LVAL, PIXEL CLOCK (@ 80 MHz) and video data from camera.
- DCF used: [SpL4096_70kc_4096_12bit2tapsRawColorVLSRE.DCF](#)
- DCF used: [SpL4096_70kc_4096_12bit4tapsRawColorVLSRE.DCF](#)
- DCF used: [SpL4096_70kc_4096_8bit8tapsRawColorVLSRE.DCF](#)
- DCF used: [SpL4096_70kc_2048_10bitRGBVLSRE.DCF](#)
- DCF used: [SpL4096_70kc_2048_8bit2tapsRGBVLSRE.DCF](#)



Mode 4: Fixed line scan rate with frame trigger

- Up to 4096 pixels/line.
- Camera Link FULL interface (Raw - line first: two 12-bit taps, four 12-bit taps, eight 8-bit taps and RGB: three RGB 10-bit taps, six RGB 8-bit taps).
- DCF configured for 1000 lines per virtual frame.
- Matrox Helios eCL/XCL receiving external TTL frame (virtual) trigger signal.
- Matrox Helios eCL/XCL sending periodic EXPOSURE1 (EXSYNC) signal to camera.
- Matrox Helios eCL/XCL receiving LVAL, PIXEL CLOCK (@ 80 MHz) and video data from camera.
- DCF used: [SpL4096_70kc_4096_12bit2tapsRawColorFLSFT.DCF](#)
- DCF used: [SpL4096_70kc_4096_12bit4tapsRawColorFLSFT.DCF](#)

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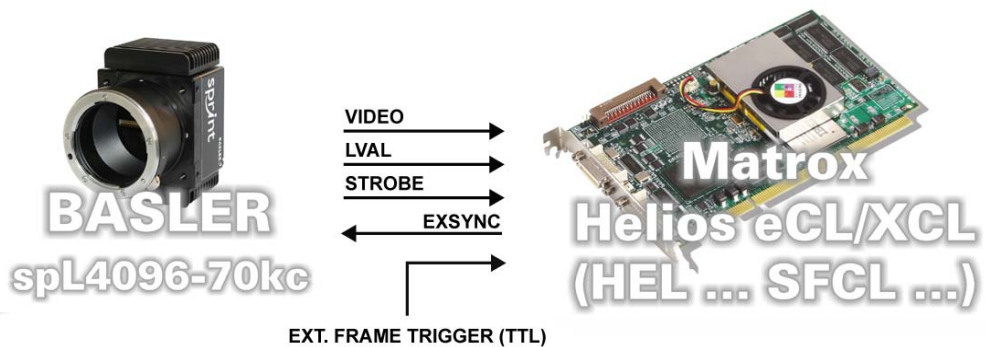
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*Basics about the
interface modes*

Camera Interface Briefs (cont.)

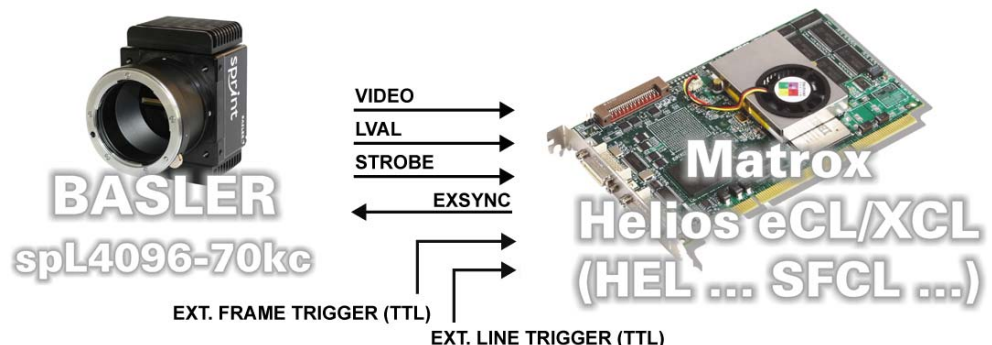
Mode 4: Fixed line scan rate with frame trigger

- DCF used: [SpL4096_70kc_4096_8bit8tapsRawColorFLSFT.DCF](#)
- DCF used: [SpL4096_70kc_2048_10bitRGBFLSFT.DCF](#)
- DCF used: [SpL4096_70kc_2048_8bit2tapsRGBFLSFT.DCF](#)



Mode 5: Variable line scan rate with frame trigger

- Up to 4096 pixels/line.
- Camera Link FULL interface (Raw - line first: two 12-bit taps, four 12-bit taps, eight 8-bit taps and RGB: three RGB 10-bit taps, six RGB 8-bit taps).
- DCF configured for 1000 lines per virtual frame.
- Matrox Helios eCL/XCL receiving external TTL frame (virtual) and line trigger signals.
- Matrox Helios eCL/XCL sending EXPOSURE1 (EXSYNC) signal to camera.
- Matrox Helios eCL/XCL receiving LVAL, PIXEL CLOCK (@ 80 MHz) and video data from camera.
- DCF used: [SpL4096_70kc_4096_12bit2tapsRawColorVLSFT.DCF](#)
- DCF used: [SpL4096_70kc_4096_12bit4tapsRawColorVLSFT.DCF](#)
- DCF used: [SpL4096_70kc_4096_8bit8tapsRawColorVLSFT.DCF](#)
- DCF used: [SpL4096_70kc_2048_10bitRGBVLSFT.DCF](#)
- DCF used: [SpL4096_70kc_2048_8bit2tapsRGBVLSFT.DCF](#)



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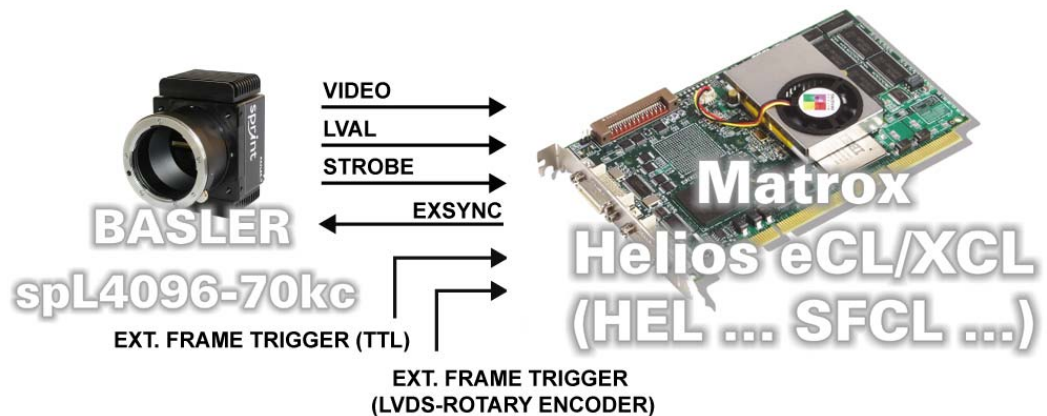
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Basics about the
interface modes

Camera Interface Briefs (cont.)

Mode 6: Variable line scan rate with rotary encoder and frame trigger

- Up to 4096 pixels/line.
- Camera Link FULL interface (Raw - line first: two 12-bit taps, four 12-bit taps, eight 8-bit taps and RGB: three RGB 10-bit taps, six RGB 8-bit taps).
- DCF configured for 1000 lines per virtual frame.
- Matrox Helios eCL/XCL receiving external TTL frame (virtual) and LVDS (Rotary Encoder) line trigger signals.
- Matrox Helios eCL/XCL sending EXPOSURE1 (EXSYNC) signal to camera.
- Matrox Helios eCL/XCL receiving LVAL, PIXEL CLOCK (@ 80 MHz) and video data from camera.
- DCF used: [SpL4096_70kc_4096_12bit2tapsRawColorVLSREFT.DCF](#)
- DCF used: [SpL4096_70kc_4096_12bit4tapsRawColorVLSREFT.DCF](#)
- DCF used: [SpL4096_70kc_4096_8bit8tapsRawColorVLSREFT.DCF](#)
- DCF used: [SpL4096_70kc_2048_10bitRGBVLSREFT.DCF](#)
- DCF used: [SpL4096_70kc_2048_8bit2tapsRGBVLSREFT.DCF](#)



Mode 7: Fixed line scan rate with variable frame size

- Up to 4096 pixels/line.
- Camera Link FULL interface (Raw - line first: two 12-bit taps, four 12-bit taps, eight 8-bit taps and RGB: three RGB 10-bit taps, six RGB 8-bit taps).
- DCF configured for 1000 lines per virtual frame.
- Matrox Helios eCL/XCL receiving external TTL frame (virtual) trigger signal.
- Matrox Helios eCL/XCL sending periodic EXPOSURE1 (EXSYNC) signal to camera.
- Matrox Helios eCL/XCL receiving LVAL, PIXEL CLOCK (@ 80 MHz) and video data from camera.

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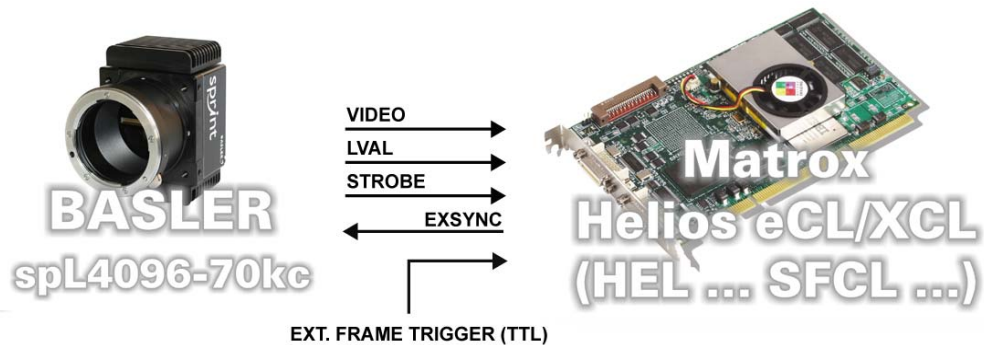
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Basics about the
interface modes

Camera Interface Briefs (cont.)

Mode 7: Fixed line scan rate with variable frame size

- DCF used: [SpL4096_70kc_4096_12bit2tapsRawColorFLSVF.DCF](#)
- DCF used: [SpL4096_70kc_4096_12bit4tapsRawColorFLSVF.DCF](#)
- DCF used: [SpL4096_70kc_4096_8bit8tapsRawColorFLSVF.DCF](#)
- DCF used: [SpL4096_70kc_2048_10bitRGBFLSVF.DCF](#)
- DCF used: [SpL4096_70kc_2048_8bit2tapsRGBFLSVF.DCF](#)



Mode 8: Variable line scan rate with variable frame size

- Up to 4096 pixels/line.
- Camera Link FULL interface (Raw - line first: two 12-bit taps, four 12-bit taps, eight 8-bit taps and RGB: three RGB 10-bit taps, six RGB 8-bit taps).
- DCF configured for 1000 lines per virtual frame.
- Matrox Helios eCL/XCL receiving external TTL frame (virtual) and line trigger signals.
- Matrox Helios eCL/XCL sending EXPOSURE1 (EXSYNC) signal to camera.
- Matrox Helios eCL/XCL receiving LVAL, PIXEL CLOCK (@ 80 MHz) and video data from camera.
- DCF used: [SpL4096_70kc_4096_12bit2tapsRawColorVLSVF.DCF](#)
- DCF used: [SpL4096_70kc_4096_12bit4tapsRawColorVLSVF.DCF](#)
- DCF used: [SpL4096_70kc_4096_8bit8tapsRawColorVLSVF.DCF](#)
- DCF used: [SpL4096_70kc_2048_10bitRGBVLSVF.DCF](#)
- DCF used: [SpL4096_70kc_2048_8bit2tapsRGBVLSVF.DCF](#)

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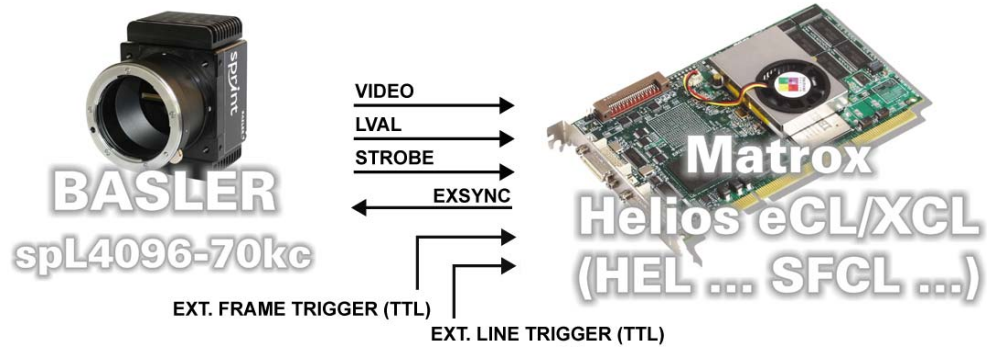
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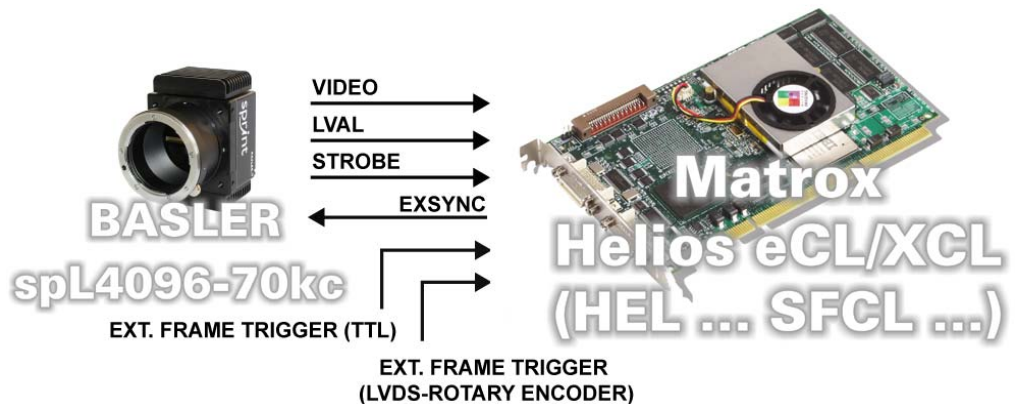
Camera Interface Briefs (cont.)

Mode 8: Variable line scan rate with variable frame size



Mode 9: Variable line scan rate with rotary encoder and variable frame size

- Up to 4096 pixels/line.
- Camera Link FULL interface (Raw - line first: two 12-bit taps, four 12-bit taps, eight 8-bit taps and RGB: three RGB 10-bit taps, six RGB 8-bit taps).
- DCF configured for 1000 lines per virtual frame.
- Matrox Helios eCL/XCL receiving external TTL frame (virtual) and LVDS (Rotary Encoder) line trigger signals.
- Matrox Helios eCL/XCL sending EXPOSURE1 (EXSYNC) signal to camera.
- Matrox Helios eCL/XCL receiving LVAL, PIXEL CLOCK (@ 80 MHz) and video data from camera.
- DCF used: [SpL4096_70kc_4096_12bit2tapsRawColorVLSVFRE.DCF](#)
- DCF used: [SpL4096_70kc_4096_12bit4tapsRawColorVLSVFRE.DCF](#)
- DCF used: [SpL4096_70kc_4096_8bit8tapsRawColorVLSVFRE.DCF](#)
- DCF used: [SpL4096_70kc_2048_10bitRGBVLSVFRE.DCF](#)
- DCF used: [SpL4096_70kc_2048_8bit2tapsRGBVLSVFRE.DCF](#)



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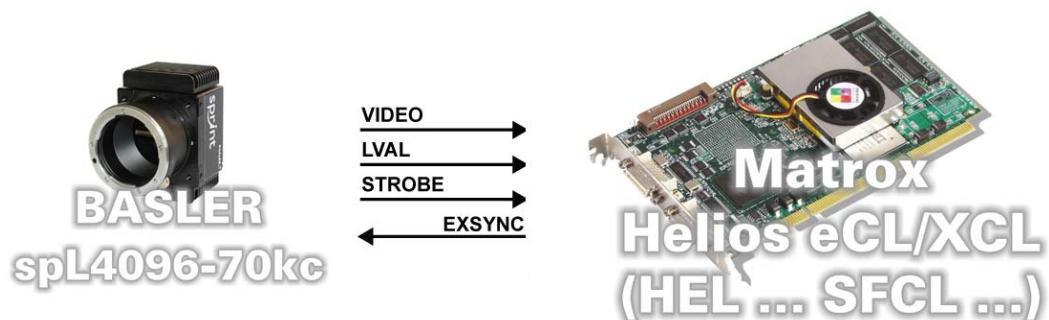
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Basics about the
interface modes

Camera Interface Briefs (cont.)

Mode 10: Fixed line scan rate with area (AOI) mode

- Up to 4096 pixels/line.
- Camera Link FULL interface (Raw - line first: two 12-bit taps, four 12-bit taps, eight 8-bit taps).
- DCF configured for 1000 lines per virtual frame.
- Matrox Helios eCL/XCL sending periodic EXPOSURE1 (EXSYNC) signal to camera.
- Matrox Helios eCL/XCL receiving FVAL, LVAL, PIXEL CLOCK (@ 80 MHz) and video data from camera.
- DCF used: [SpL4096_70kc_4096_12bit2tapsRawColorFLS_AREA.DCF](#)
- DCF used: [SpL4096_70kc_4096_12bit4tapsRawColorFLS_AREA.DCF](#)
- DCF used: [SpL4096_70kc_4096_8bit8tapsRawColorFLS_AREA.DCF](#)



Mode 11: Variable line scan rate with area (AOI) mode

- Up to 4096 pixels/line.
- Camera Link FULL interface (Raw - line first: two 12-bit taps, four 12-bit taps, eight 8-bit taps).
- DCF configured for 1000 lines per virtual frame.
- Matrox Helios eCL/XCL receiving external TTL line trigger signals.
- Matrox Helios eCL/XCL sending EXPOSURE1 (EXSYNC) signal to camera.
- Matrox Helios eCL/XCL receiving FVAL, LVAL, PIXEL CLOCK (@ 80 MHz) and video data from camera.
- DCF used: [SpL4096_70kc_4096_12bit2tapsRawColorVLS_AREA.DCF](#)
- DCF used: [SpL4096_70kc_4096_12bit4tapsRawColorVLS_AREA.DCF](#)
- DCF used: [SpL4096_70kc_4096_8bit8tapsRawColorVLS_AREA.DCF](#)

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Camera Interface Application Note

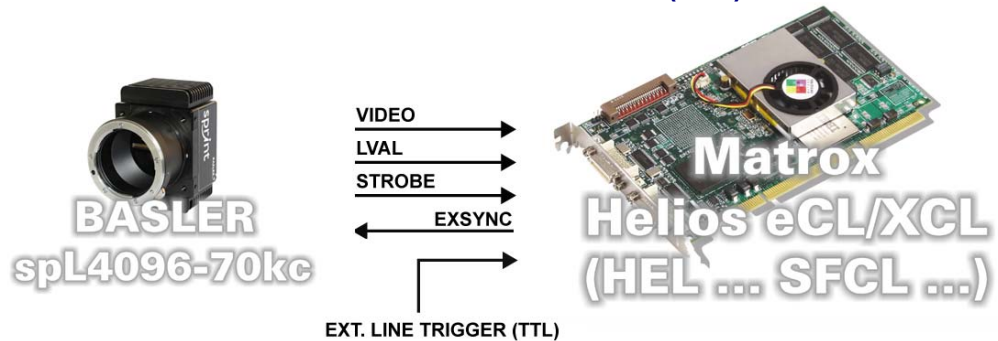
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interface modes

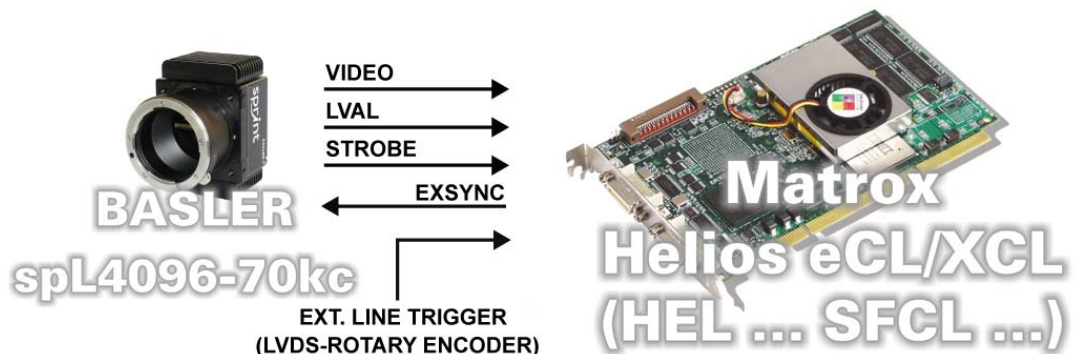
Camera Interface Briefs (cont.)

Mode 11: Variable line scan rate with area (AOI) mode



Mode 12: Variable line scan rate with rotary encoder and area (AOI) mode

- Up to 4096 pixels/line.
- Camera Link FULL interface (Raw - line first: two 12-bit taps, four 12-bit taps, eight 8-bit taps).
- DCF configured for 1000 lines per virtual frame.
- Matrox Helios eCL/XCL receiving external LVDS (Rotary Encoder) line trigger signal.
- Matrox Helios eCL/XCL sending EXPOSURE1 (EXSYNC) signal to camera.
- Matrox Helios eCL/XCL receiving FVAL, LVAL, PIXEL CLOCK (@ 80 MHz) and video data from camera.
- DCF used: [SpL4096_70kc_4096_12bit2tapsRawColorVLSRE_AREA.DCF](#)
- DCF used: [SpL4096_70kc_4096_12bit4tapsRawColorVLSRE_AREA.DCF](#)
- DCF used: [SpL4096_70kc_4096_8bit8tapsRawColorVLSRE_AREA.DCF](#)



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Specifics about the
interface modes

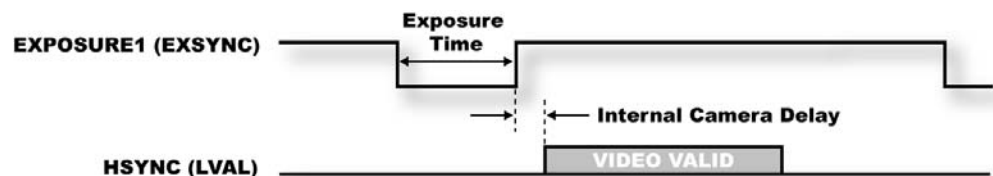
Camera Interface Details

Mode 1: Fixed line scan rate

- **Line rate:** The frequency of the periodic EXPOSURE1 (EXSYNC) signal determines the camera's line rate. The maximum line rate for this camera equals **70 kHz**.
- **Exposure time:** For **EXSYNC, level-controlled** mode the exposure time is the inactive (low level) period between the falling and rising edges of the EXPOSURE1 (EXSYNC) signal. The default exposure time for this DCF is **25 µs**. Maximum/minimum exposure time per line for this DCF is **210 ms** and **12.5 ns** respectively. The exposure time can be modified in the DCF using Matrox Intellicam or with the MIL MdigControl() function. Consult the respective manual for more information.
- **Camera communication:** This DCF will work with all **Free Run** and **EXSYNC** modes however **EXSYNC, Level controlled** is the recommended mode for use with this DCF. Set the mode using the Basler Camera Configuration Tool Plus (CCT+). Refer to the camera manual for additional information.

Parameter	Setting
Video Data Output Mode	2 taps, 12-bits or 4 taps, 12-bits, or 8 taps, 8-bits or 6 taps RGB, 8-bits, or 3 tap RGB, 10-bits
Camera Link Clock	80 MHz or 40 MHz
Line Acquisition Mode	Raw – Line First or RGB
Exposure Time Control Mode	EXSYNC or Free Run

- **Bayer Color Filter:** Color information (for the "...RawColor..." DCFs only) is generated by a Bayer color mosaic filter mounted on the sensor. Refer to the MIL online Help for information on using buffers with the Bayer color filter.
- **Timing diagram:**



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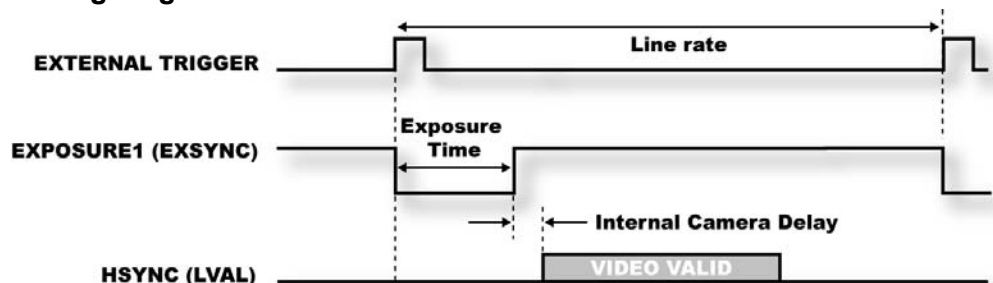
Camera Interface Details (cont.)

Mode 2: Variable line scan rate

- **Line rate:** The line rate is controlled by the frequency of the external TTL line trigger signal. The line trigger signal period must be larger than the total duration of the exposure time (low level duration of the timer), the internal delay of the camera ($\approx 3.5 \mu\text{s}$) or slower than the maximum line rate of the camera.
- **Exposure time:** Refer to Mode 1: Fixed line scan rate.
- **Camera communication:** This DCF works with all **EXSYNC** modes however **EXSYNC, Level-controlled** is the recommended mode for use with this DCF. Set the mode using the Basler Camera Configuration Tool Plus (CCT+). Refer to the camera manual for additional information.

Parameter	Setting
Video Data Output Mode	2 taps, 12-bits or 4 taps, 12-bits, or 8 taps, 8-bits or 6 taps RGB, 8-bits, or 3 tap RGB, 10-bits
Camera Link Clock	80 MHz or 40 MHz
Line Acquisition Mode	Raw – Line First or RGB
Exposure Time Control Mode	EXSYNC, Level-controlled

- **Bayer color filter:** Refer to Mode 1: Fixed line scan rate.
- **Timing diagram:**



Mode 3: Variable line scan rate with rotary encoder

- **Line/frame rate:** The line rate is controlled by the frequency of the external LVDS line trigger signal with a Rotary Encoder format. With the Rotary Encoder approach, it is possible to force a certain decimation value to grab a line every x number of pulses from the line trigger (combination of the A and B signals). The line trigger signal controlled by the decimation value must be larger than the total duration of the exposure time (low level duration of the timer), the internal delay of the camera ($\approx 3.50 \mu\text{s}$) or slower than the maximum line rate of the camera. The DCF is done for a forward direction from the Rotary Encoder.

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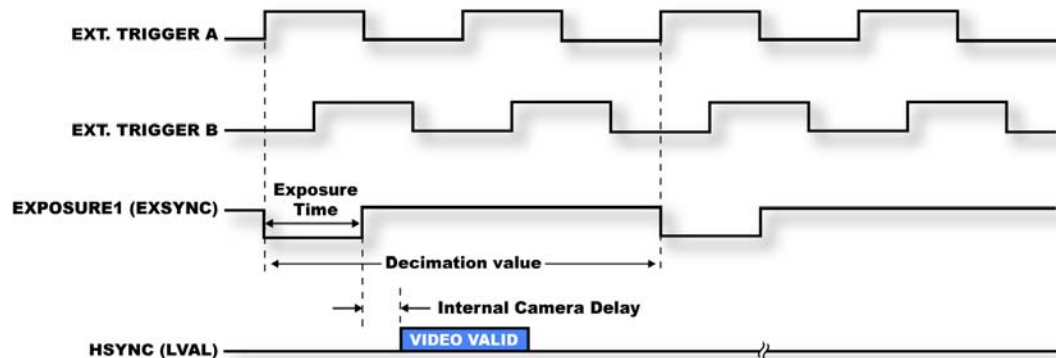
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Specifics about the
interface modes

Camera Interface Details (cont.)

Mode 3: Variable line scan rate with rotary encoder

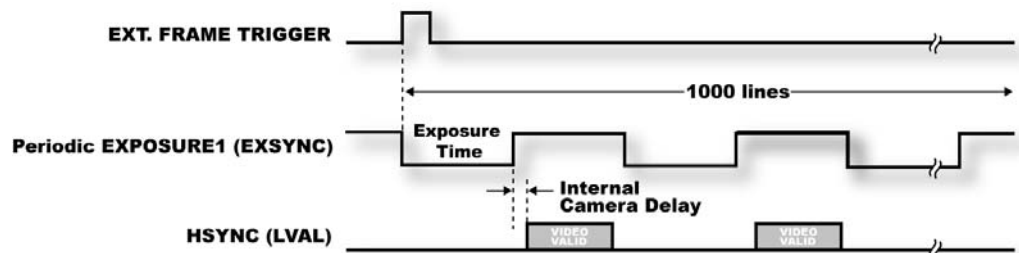
- **Exposure time:** Refer to Mode 1: Fixed line scan rate.
- **Camera communication:** Refer to Mode 2: Variable line scan rate.
- **Bayer color filter:** Refer to Mode 1: Fixed line scan rate.
- **Timing diagram:**



* The decimation value showed in this timing diagram is eight (8).

Mode 4: Fixed line scan rate with frame trigger

- **Line/frame rate:** The line rate is fixed and controlled by the frequency of EXPOSURE1 (EXSYNC) signal. The default exposure time for this DCF is **25 μ s**. The virtual frame rate is variable and controlled by the period of the external frame trigger signal, however the external frame trigger period must always be greater than the total time of the number of lines captured. The number of lines per virtual frame (maximum of 1000 for this DCF) is fixed and controlled by the vertical timing of the DCF. Capture of the lines will start with the rising edge of the frame trigger signal.
- **Exposure time:** Refer to Mode 1: Fixed line scan rate.
- **Camera communication:** Refer to Mode 1: Fixed line scan rate.
- **Bayer color filter:** Refer to Mode 1: Fixed line scan rate.
- **Timing diagram:**



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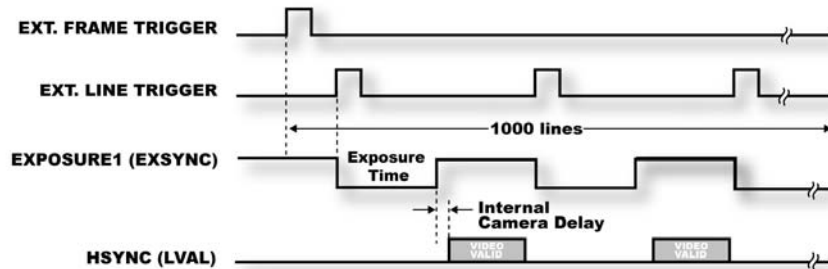
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Specifics about the
interface modes

Camera Interface Details (cont.)

Mode 5: Variable line scan rate with frame trigger

- **Line/frame rate:** The line rate is controlled by the frequency of the external TTL line trigger signal. The line trigger signal period must be larger than the total duration of the exposure time (low level duration of the timer), the internal delay of the camera ($\approx 3.5 \mu\text{s}$) or slower than the maximum line rate of the camera. The default exposure time for this DCF is **25 μs** . The virtual frame rate is variable and controlled by the period of the external frame trigger signal, however the external trigger period must always be greater than the total time of the number of lines captured. The number of lines per virtual frame (1000 for this DCF) is fixed and controlled by the vertical timing of the DCF. Capture of the lines will start with the rising edge of the frame trigger signal.
- **Exposure time:** Refer to Mode 1: Fixed line scan rate.
- **Camera communication:** Refer to Mode 2: Variable line scan rate.
- **Bayer color filter:** Refer to Mode 1: Fixed line scan rate.
- **Timing diagram:**



Mode 6: Variable line scan rate with rotary encoder and frame trigger

- **Line/frame rate:** The line rate is controlled by the frequency of the external LVDS line trigger signal with a Rotary Encoder format. With the Rotary Encoder approach, it is possible to force a certain decimation value to grab a line every x number of pulses from the line trigger (combination of the A and B signals). The line trigger signal controlled by the decimation value must be larger than the total duration of the exposure time (low level duration of the timer), the internal delay of the camera ($\approx 3.50 \mu\text{s}$) or slower than the maximum line rate of the camera. The DCF is done for a forward direction from the Rotary Encoder. The number of lines per virtual frame (maximum of 1000 for this DCF) is variable and controlled by the frame trigger signal. Matrox Helios eCL/XCL captures lines during the high level of the frame trigger signal. To modify the maximum amount of lines captured, change the active vertical timing period in the DCF. Capture of the lines will start with the rising edge of the frame trigger signal.

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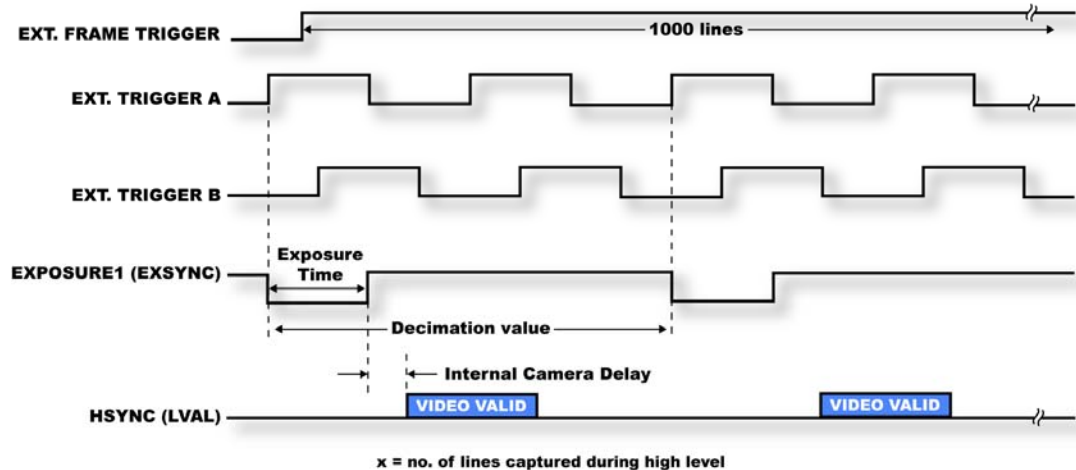
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Specifics about the
interface modes

Camera Interface Details (cont.)

Mode 6: Variable line scan rate with rotary encoder and frame trigger

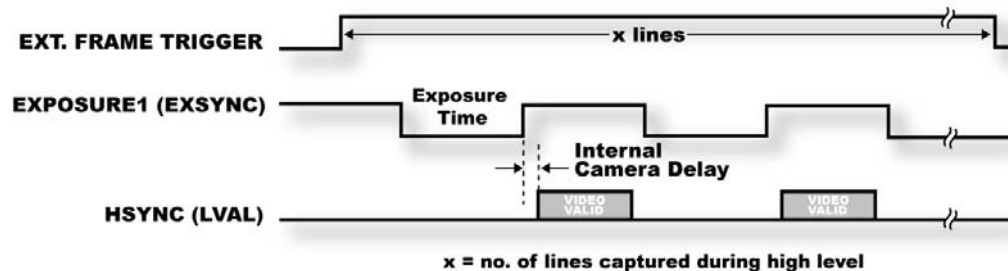
- **Exposure time:** Refer to Mode 1: Fixed line scan rate.
- **Camera communication:** Refer to Mode 2: Variable line scan rate.
- **Bayer color filter:** Refer to Mode 1: Fixed line scan rate.
- **Timing diagram:**



* The decimation value shown in this timing diagram is eight (8).

Mode 7: Fixed line scan rate with variable frame size

- **Line/frame rate:** The line rate is fixed and controlled by the frequency of EXPOSURE1 (EXSYNC) signal. The default exposure time for this DCF is 25 μ s. The number of lines per virtual frame (maximum of 1000 for this DCF) is variable and controlled by the frame trigger signal. Matrox Helios eCL/XCL captures lines during the high level of the frame trigger signal. To modify the maximum amount of lines captured, change the active vertical timing period in the DCF. Capture of the lines will start with the rising edge of the frame trigger signal.
- **Exposure time:** Refer to Mode 1: Fixed line scan rate.
- **Camera communication:** Refer to Mode 1: Fixed line scan rate.
- **Bayer color filter:** Refer to Mode 1: Fixed line scan rate.
- **Timing diagram:**



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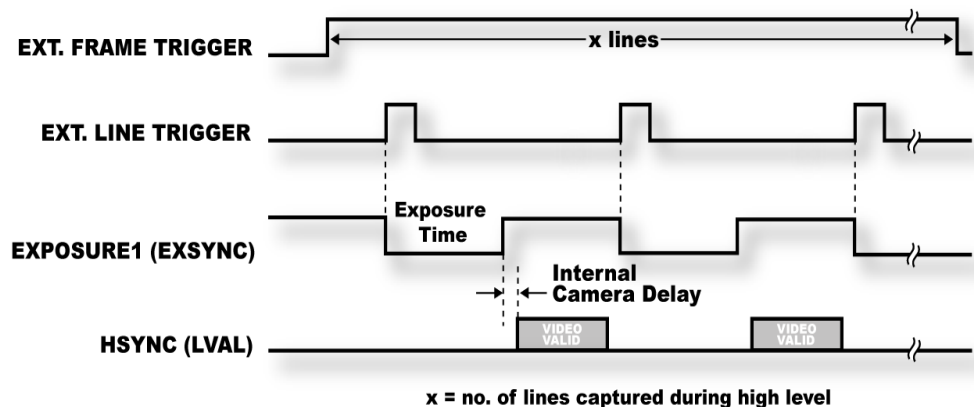
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Specifics about the
interface modes

Camera Interface Details (cont.)

Mode 8: Variable line scan rate with variable frame size

- **Line/frame rate:** The line rate is variable and controlled by the external line trigger frequency. The line trigger signal period must be larger than the total duration of the exposure time (low level duration of the timer), the internal delay of the camera ($\approx 3.50 \mu\text{s}$) or slower than the maximum line rate of the camera. The default exposure time for this DCF is **25 μs** . The number of lines per virtual frame (maximum of 1000 for this DCF) is variable and controlled by the frame trigger signal. Matrox Helios eCL/XCL captures lines during the high level of the frame trigger signal. To modify the maximum amount of lines captured, change the active vertical timing period in the DCF. Capture of the lines will start with the rising edge of the frame trigger signal.
- **Exposure time:** Refer to Mode 1: Fixed line scan rate.
- **Camera communication:** Refer to Mode 2: Variable line scan rate.
- **Bayer color filter:** Refer to Mode 1: Fixed line scan rate.
- **Timing diagram:**



Mode 9: Variable line scan rate with rotary encoder and variable frame size

- **Line/frame rate:** The line rate is controlled by the frequency of the external LVDS line trigger signal with a Rotary Encoder format. With the Rotary Encoder approach, it is possible to force a certain decimation value to grab a line every x number of pulses from the line trigger (combination of the A and B signals). The line trigger signal controlled by the decimation value must be larger than the total duration of the exposure time (low level duration of the timer), the internal delay of the camera ($\approx 3.50 \mu\text{s}$) or slower than the maximum line rate of the camera.

Continued...

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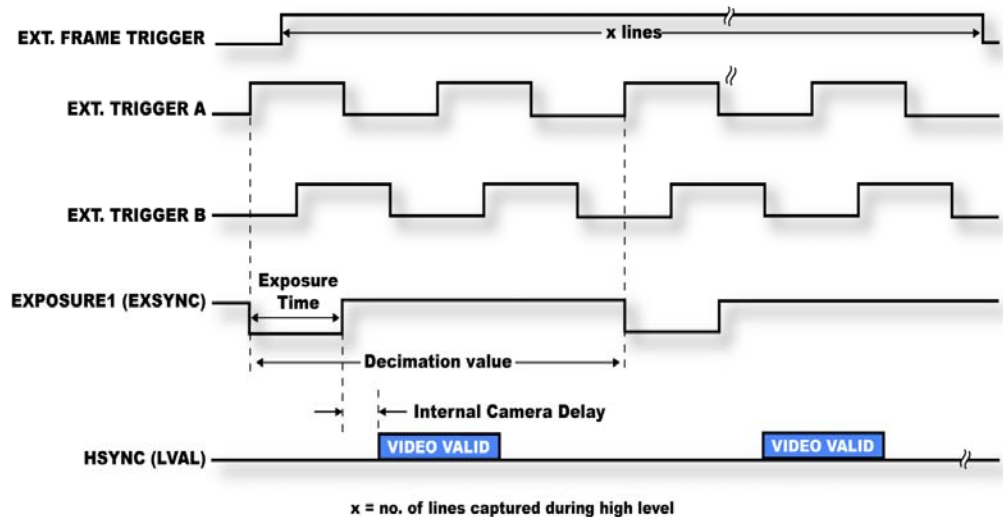
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Specifics about the
interface modes

Camera Interface Details (cont.)

Mode 9: Variable line scan rate with rotary encoder and variable frame size

- **Line/frame rate:** The DCF is done for a forward direction from the Rotary Encoder. The number of lines per virtual frame (maximum of 1000 for this DCF) is variable and controlled by the frame trigger signal. Matrox Helios eCL/XCL captures lines during the high level of the frame trigger signal. To modify the maximum amount of lines captured, change the active vertical timing period in the DCF. Capture of the lines will start with the rising edge of the frame trigger signal.
- **Exposure time:** Refer to Mode 1: Fixed line scan rate.
- **Camera communication:** Refer to Mode 2: Variable line scan rate.
- **Bayer color filter:** Refer to Mode 1: Fixed line scan rate.
- **Timing diagram:**



* The decimation value showed in this timing diagram is eight (8).

Mode 10: Fixed line scan rate with area (AIO) mode

- **Line/frame rate:** The line rate is fixed and controlled by the frequency of EXPOSURE1 (EXSYNC) signal. The default exposure time for this DCF is 25 μ s. The frame rate is fixed and controlled from the camera using the Basler Camera Configuration Tool Plus (CCT+). In this case, the number of lines per frame is determined by the value chosen in the "Output Mode \ Fval Length" section in the Basler Camera Configuration Tool Plus (CCT+). Also, this value (i.e. 1000 lines for this DCF) must match the "Image Size Y" value in the "Video Timing" tab of the DCF.

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Specifics about the
interface modes

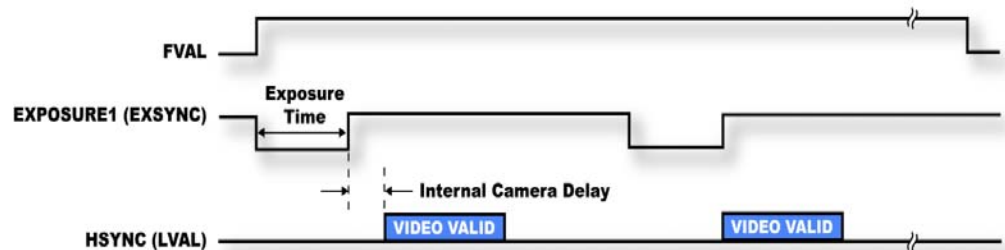
Camera Interface Details (cont.)

Mode 10: Fixed line scan rate with area (AIO) mode

- **Exposure time:** Refer to Mode 1: Fixed line scan rate.
- **Camera communication:** This DCF works with all **EXSYNC** modes however **EXSYNC, Level-controlled** is the recommended mode for use with this DCF. Set the mode using the Basler Camera Configuration Tool Plus (CCT+). Refer to the camera manual for additional information.

Parameter	Setting
Video Data Output Mode	2 taps, 12-bits or 4 taps, 12-bits, or 8 taps, 8-bits
Camera Link Clock	80 MHz or 40 MHz
Line Acquisition Mode	Raw – Line First
Exposure Time Control Mode	EXSYNC or Free Run
FVAL Length	1000

- **Bayer color filter:** Refer to Mode 1: Fixed line scan rate.
- **Timing diagram:**



Mode 11: Variable line scan rate with area (AIO) mode

- **Line/frame rate:** The line rate is controlled by the frequency of the external TTL line trigger signal. The line trigger signal period must be larger than the total duration of the exposure time (low level duration of the timer), the internal delay of the camera ($\sim 3.50 \mu\text{s}$) or slower than the maximum line rate of the camera. The default exposure time for this DCF is $25 \mu\text{s}$. The frame rate is fixed and controlled from the camera using the Basler Camera Configuration Tool Plus (CCT+). In this case, the number of lines per frame is determined by the value chosen in the "Output Mode \ Fval Length" section in the Basler Camera Configuration Tool Plus (CCT+). Also, this value (i.e. 1000 lines for this DCF) must match the "Image Size Y" value in the "Video Timing" tab in the DCF.
- **Exposure time:** Refer to Mode 1: Fixed line scan rate.

Continued...

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Camera Interface Application Note

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Specifics about the
interface modes

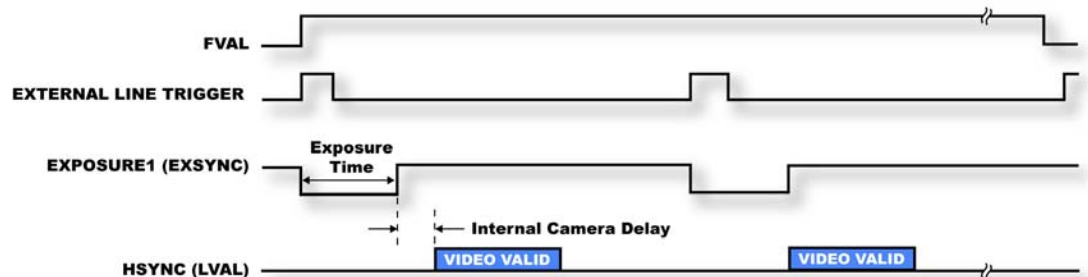
Camera Interface Details (cont.)

Mode 11: Variable line scan rate with area (AIO) mode

- **Camera communication:** This DCF works with all **EXSYNC** modes however **EXSYNC, Level-controlled** is the recommended mode for use with this DCF. Set the mode using the Basler Camera Configuration Tool Plus (CCT+). Refer to the camera manual for additional information.

Parameter	Setting
Video Data Output Mode	2 taps, 12-bits or 4 taps, 12-bits, or 8 taps, 8-bits
Camera Link Clock	80 MHz or 40 MHz
Line Acquisition Mode	Raw – Line First
Exposure Time Control Mode	EXSYNC, Level-controlled
FVAL Length	1000

- **Bayer color filter:** Refer to Mode 1: Fixed line scan rate.
- **Timing diagram:**



Mode 12: Variable line scan rate using the rotary encoder with area (AIO) mode

- **Line/frame rate:** The line rate is controlled by the frequency of the external LVDS line trigger signal with a Rotary Encoder format. With the Rotary Encoder approach, it is possible to force a certain decimation value to grab a line every x number of pulses from the line trigger (combination of the A and B signals). The line trigger signal controlled by the decimation value must be larger than the total duration of the exposure time (low level duration of the timer), the internal delay of the camera ($\approx 3.50 \mu\text{s}$) or slower than the maximum line rate of the camera. The DCF is done for a forward direction from the Rotary Encoder. The frame rate is fixed and controlled from the camera using the Basler Camera Configuration Tool Plus (CCT+). In this case, the number of lines per frame is determined by the value chosen in the "Output Mode \ Fval Length" section in the Basler Camera Configuration Tool Plus (CCT+). Also, this value (i.e. 1000 lines for this DCF) must match the "Image Size Y" in the "Video Timing" tab in the DCF.

Continued...

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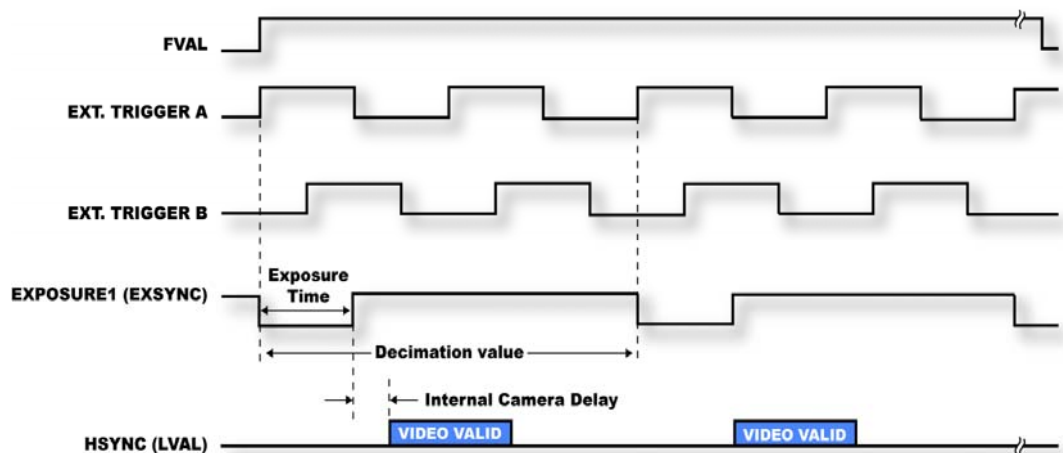
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Specifics about the
interface modes

Camera Interface Details (cont.)

Mode 12: Variable line scan rate using the rotary encoder with area (AIO) mode

- **Exposure time:** Refer to Mode 1: Fixed line scan rate.
- **Camera communication:** Refer to Mode 11: Variable line scan rate with....
- **Bayer color filter:** Refer to Mode 1: Fixed line scan rate.
- **Timing diagram:**



* The decimation value showed in this timing diagram is eight (8).

Cabling details for the
interface modes

Cabling Requirements

Mode 1: Fixed line scan rate

- **Cable and Connection:** Standard Camera Link cable.

Mode 2: Variable line scan rate

- **Cable and Connection:** Standard Camera Link.
- **External trigger:** External line trigger should be connected to the OPTO TRIG input of the 9-pin connector on the External I/O adapter bracket:

EXTERNAL I/O BRACKET (9-pin connector)

Pin Name	Pin no.	External Trigger Source
OPTO_AUX_IN0 +	07	← LINE TRIGGER (TTL FORMAT)
OPTO_AUX_IN0 -	02	← LINE TRIGGER (GROUND)

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Cabling details for the
interface modes

Cabling Requirements

Mode 3: Variable line scan rate with rotary encoder

- **Cable and Connection:** Standard Camera Link.
- **External trigger:** External line trigger should be connected to the OPTO TRIG input of the 9-pin and 44-pin connectors on the External I/O adapter bracket:

EXTERNAL I/O BRACKET (9-pin connector)

Pin Name	Pin no.		External Trigger Source Pin Name
P0_LVDS_AUX_IN0 +	08	←	Line TRIGGER A + (LVDS FORMAT)
P0_LVDS_AUX_IN0 -	03	←	Line TRIGGER A - (LVDS FORMAT)

(44-pin connector)

Pin Name	Pin no.		External Trigger Source Pin Name
P0_LVDS_AUX_IN1 +	37	←	Line TRIGGER B + (LVDS FORMAT)
P0_LVDS_AUX_IN1 -	23	←	Line TRIGGER B - (LVDS FORMAT)

Mode 4: Fixed line scan rate with frame trigger

- **Cable and Connection:** Standard Camera Link.
- **External trigger:** External frame trigger should be connected to the OPTO TRIG input of the 9-pin connector on the External I/O adapter bracket:

EXTERNAL I/O BRACKET (9-pin connector)

Pin Name	Pin no.		External Trigger Source Pin Name
OPTO_AUX_IN1 +	04	←	FRAME TRIGGER (TTL FORMAT)
OPTO_AUX_IN1 -	05	←	FRAME TRIGGER (GROUND)

Mode 5: Variable line scan rate with frame trigger

- **Cable and Connection:** Standard Camera Link.
- **External trigger:** External frame/line triggers should be connected to the OPTO TRIG inputs of the 9-pin connector on the External I/O adapter bracket:

EXTERNAL I/O BRACKET (9-pin connector)

Pin name	Pin no.		External Trigger Sources Pin name
OPTO_AUX_IN1 +	04	←	FRAME TRIGGER (TTL FORMAT)
OPTO_AUX_IN1 -	05	←	FRAME TRIGGER (GROUND)
OPTO_AUX_IN0 +	07	←	LINE TRIGGER (TTL FORMAT)
OPTO_AUX_IN0 -	02	←	LINE TRIGGER (GROUND)

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Cabling details for the
interface modes

Cabling Requirements

Mode 6: Variable line scan rate with rotary encoder and frame trigger

- **Cable and Connection:** Standard Camera Link.
- **External trigger:** External frame/line triggers should be connected to the OPTO TRIG inputs of the 9-pin and 44-pin connectors on the External I/O adapter bracket:

EXTERNAL I/O BRACKET (9-pin connector)

Pin name	Pin no.		External Trigger Sources Pin name
OPTO_AUX_IN1 +	04	←	FRAME TRIGGER (TTL FORMAT)
OPTO_AUX_IN1 -	05	←	FRAME TRIGGER (GROUND)
P0_LVDS_AUX_IN0 +	08	←	Line TRIGGER A + (LVDS FORMAT)
P0_LVDS_AUX_IN0 -	03	←	Line TRIGGER A - (LVDS FORMAT)

(44-pin connector)

Pin name	Pin no.		External Trigger Sources Pin name
P0_LVDS_AUX_IN1 +	37	←	Line TRIGGER B + (LVDS FORMAT)
P0_LVDS_AUX_IN1 -	23	←	Line TRIGGER B - (LVDS FORMAT)

Mode 7: Fixed line scan rate with variable frame size

- **Cable and Connection:** Standard Camera Link.
- **External trigger:** External frame trigger should be connected to the OPTO TRIG input of the 9-pin connector on the External I/O adapter bracket:

EXTERNAL I/O BRACKET (9-pin connector)

Pin name	Pin no.		External Trigger Sources Pin name
OPTO_AUX_IN1 +	04	←	FRAME TRIGGER (TTL FORMAT)
OPTO_AUX_IN1 -	05	←	FRAME TRIGGER (GROUND)

Mode 8: Variable line scan rate with variable frame size

- **Cable and Connection:** Standard Camera Link.
- **External trigger:** External frame/line triggers should be connected to the OPTO TRIG inputs of the 9-pin connector on the External I/O adapter bracket:

EXTERNAL I/O BRACKET (9-pin connector)

Pin name	Pin no.		External Trigger Sources Pin name
OPTO_AUX_IN1 +	04	←	FRAME TRIGGER (TTL FORMAT)
OPTO_AUX_IN1 -	05	←	FRAME TRIGGER (GROUND)
OPTO_AUX_IN0 +	07	←	LINE TRIGGER (TTL FORMAT)
OPTO_AUX_IN0 -	02	←	LINE TRIGGER (GROUND)

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Cabling details for the
interface modes

Cabling Requirements

Mode 9: Variable line scan rate with rotary encoder and variable frame size

- **Cable and Connection:** Standard Camera Link.
- **External trigger:** External frame/line triggers should be connected to the OPTO TRIG inputs of the 9-pin and 44-pin connectors on the External I/O adapter bracket:

EXTERNAL I/O BRACKET

(9-pin connector)

Pin name	Pin no.		External Trigger Sources Pin name
OPTO_AUX_IN1 +	04	←	FRAME TRIGGER (TTL FORMAT)
OPTO_AUX_IN1 -	05	←	FRAME TRIGGER (GROUND)
P0_LVDS_AUX_IN0 +	08	←	Line TRIGGER A + (LVDS FORMAT)
P0_LVDS_AUX_IN0 -	03	←	Line TRIGGER A - (LVDS FORMAT)

(44-pin connector)

Pin name	Pin no.		External Trigger Sources Pin name
P0_LVDS_AUX_IN1 +	37	←	Line TRIGGER B + (LVDS FORMAT)
P0_LVDS_AUX_IN1 -	23	←	Line TRIGGER B - (LVDS FORMAT)

Mode 10: Fixed line scan rate with area (AIO) mode

- **Cable and Connection:** Standard Camera Link cable.

Mode 11: Variable line scan rate with area (AIO) mode

- **Cable and Connection:** Standard Camera Link.
- **External trigger:** External line trigger should be connected to the OPTO TRIG input of the 9-pin connector on the External I/O adapter bracket:

EXTERNAL I/O BRACKET

(9-pin connector)

Pin Name	Pin no.		External Trigger Source Pin Name
OPTO_AUX_IN0 +	07	←	LINE TRIGGER (TTL FORMAT)
OPTO_AUX_IN0 -	02	←	LINE TRIGGER (GROUND)

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Cabling details for the
interface modes

Cabling Requirements

Mode 12: Variable line scan rate using the rotary encoder with area (AIO) mode

- **Cable and Connection:** Standard Camera Link.
- **External trigger:** External line trigger should be connected to the OPTO TRIG input of the 9-pin and 44-pin connectors on the External I/O adapter bracket:

EXTERNAL I/O BRACKET (9-pin connector)

Pin Name	Pin no.		External Trigger Source Pin Name
P0_LVDS_AUX_IN0 +	08	←	Line TRIGGER A + (LVDS FORMAT)
P0_LVDS_AUX_IN0 -	03	←	Line TRIGGER A - (LVDS FORMAT)

(44-pin connector)

Pin Name	Pin no.		External Trigger Source Pin Name
P0_LVDS_AUX_IN1 +	37	←	Line TRIGGER B + (LVDS FORMAT)
P0_LVDS_AUX_IN1 -	23	←	Line TRIGGER B - (LVDS FORMAT)

The DCFs mentioned in this application note are also attached (embedded) to this PDF file – use the Adobe Reader's View File Attachment to access the DCF files. The information furnished by Matrox Electronics System, Ltd. is believed to be accurate and reliable. Please verify all interface connections with camera documentation or manual. Contact your local sales representative or Matrox Sales office or Matrox Imaging Applications at 514-822-6061 for assistance. © Matrox Electronic Systems Ltd, 2009-2011.

Matrox Electronic Systems Ltd.

1055 St. Regis Blvd.
Dorval, Quebec H9P 2T4
Canada
Tel: (514) 685-2630
Fax: (514) 822-6273

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