

Matrox Radient eCL

Camera Interface Application Note

DALSA SC-3x-02k80

January 3, 2011

Basics about the camera	Camera Descriptions ▪ Effective resolution: up to 2048 pixels/line@ 18k lines per second. ▪ Camera Link BASE interface (GREEN_8bits_1tap, GREEN_12bits_1tap, Mono_8bits_2taps, Mono_12bits_2taps, RGB_8bit_3taps). ▪ Bilinear RGB line scan ▪ External and internal sync. ▪ External or internal exposure control. ▪ 40 MHz pixel clock rate.
Mode of operations as per Matrox Imaging (in parentheses as per camera manufacturer)	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
Basics about the interface modes	Camera Interface Briefs <i>Mode 1: Fixed line scan rate</i> ▪ Up to 2048 pixels/line. ▪ Camera Link BASE interface (RGB 8-bit). ▪ DCF configured for 1000 lines per virtual frame. ▪ Matrox Radient eCL sending periodic EXPOSURE 1 (EXSYNC) signal to camera. ▪ Matrox Radient eCL receiving HSYNC (LVAL), PIXEL CLOCK (STROBE @ 40 MHz) and video data from camera. ▪ DCF used: SC3x02k80_2048_8bitRGB_FLS.DCF

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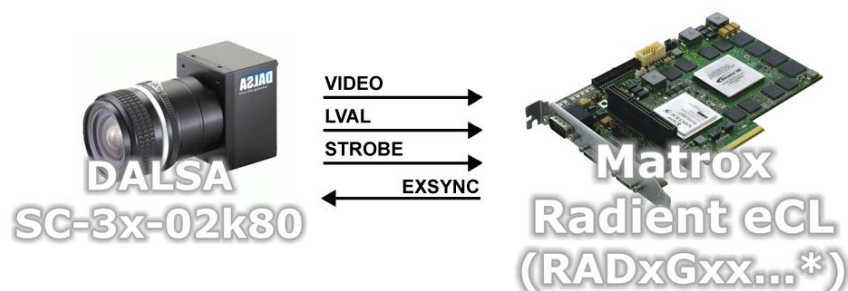
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Basics about the interface modes

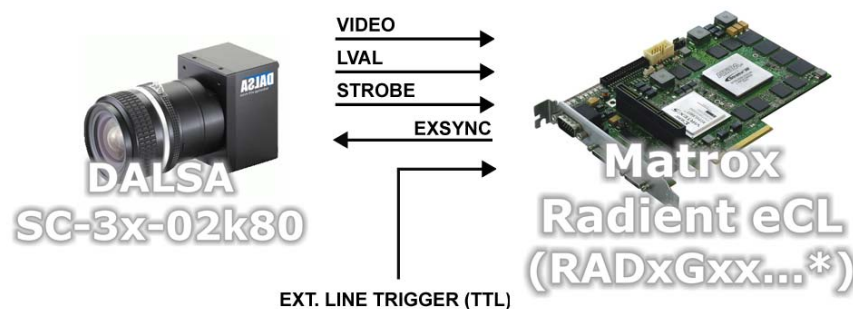
Camera Interface Briefs (cont.)

Mode 1: Fixed line scan rate



Mode 2: Variable line scan rate

- Up to 2048 pixels/line.
- Camera Link BASE interface (RGB 8-bit).
- DCF configured for 1000 lines per virtual frame.
- Matrox Radiant eCL receiving external TTL line trigger signal.
- Matrox Radiant eCL sending periodic EXPOSURE 1 (EXSYNC) signal to camera.
- Matrox Radiant eCL receiving HSYNC (LVAL), PIXEL CLOCK (STROBE @ 40 MHz) and video data from camera.
- DCF used: [SC3x02k80_2048_8bitRGB_VLS.DCF](#)



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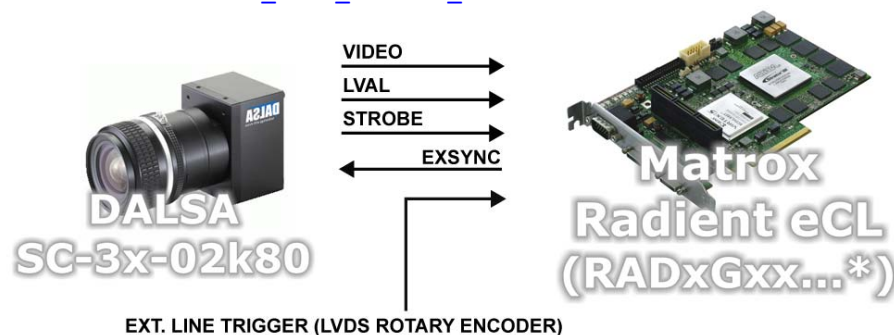
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Basics about the interface modes

Camera Interface Briefs (cont.)

Mode 3: Variable line scan rate with rotary encoder

- Up to 2048 pixels/line.
- Camera Link BASE interface (RGB 8-bit).
- DCF configured for 1000 lines per virtual frame.
- Matrox Radient eCL receiving external LVDS line trigger (ROTARY ENCODER) signal.
- Matrox Radient eCL sending periodic EXPOSURE 1 (EXSYNC) signal to camera.
- Matrox Radient eCL receiving HSYNC (LVAL), PIXEL CLOCK (STROBE @ 40 MHz) and video data from camera.
- DCF used: [SC3x02k80_2048_8bitRGB_VLSRE.DCF](#)



Mode 4: Fixed line scan rate with frame trigger

- Up to 2048 pixels/line.
- Camera Link BASE interface (RGB 8-bit).
- DCF configured for 1000 lines per virtual frame.
- Matrox Radient eCL receiving external TTL frame (virtual) trigger signal.
- Matrox Radient eCL sending periodic EXPOSURE 1 (EXSYNC) signal to camera.
- Matrox Radient eCL receiving HSYNC (LVAL), PIXEL CLOCK (STROBE @ 40 MHz) and video data from camera.
- DCF used: [SC3x02k80_2048_8bitRGB_FLSFT.DCF](#)

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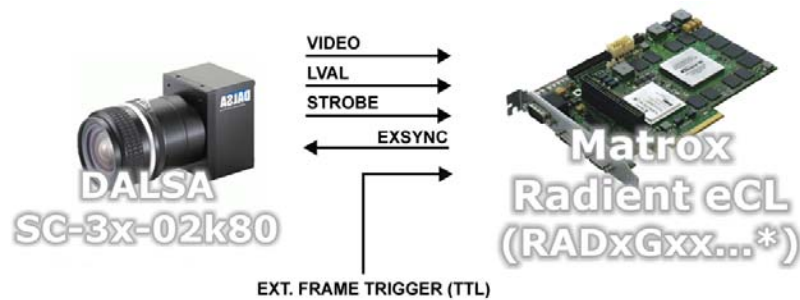
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Basics about the interface modes

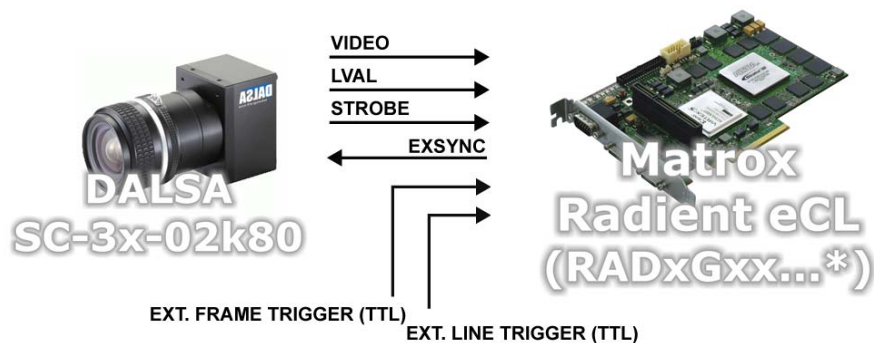
Camera Interface Briefs (cont.)

Mode 4: Fixed line scan rate with frame trigger



Mode 5: Variable line scan rate with frame trigger

- Up to 2048 pixels/line.
- Camera Link BASE interface (RGB 8-bit).
- DCF configured for 1000 lines per virtual frame.
- Matrox Radiant eCL receiving external TTL frame (virtual) and line trigger signal.
- Matrox Radiant eCL sending periodic EXPOSURE 1 (EXSYNC) signal to camera.
- Matrox Radiant eCL receiving HSYNC (LVAL), PIXEL CLOCK (STROBE @ 40 MHz) and video data from camera.
- DCF used: [SC3x02k80_2048_8bitRGB_VLSFT.DCF](#)



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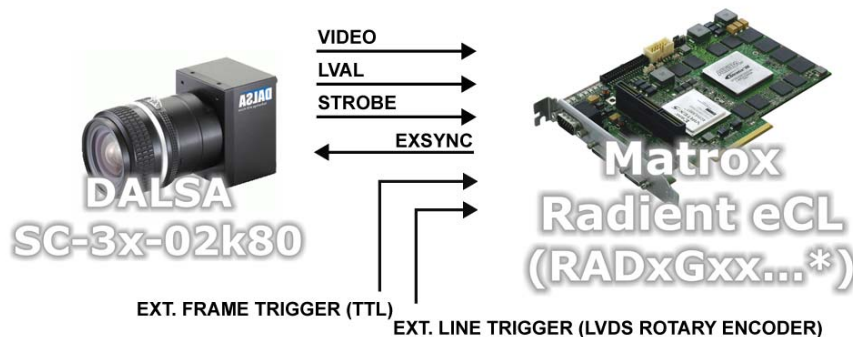
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Basics about the interface modes

Camera Interface Briefs (cont.)

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

- Up to 2048 pixels/line.
- Camera Link BASE interface (RGB 8-bit).
- DCF configured for 1000 lines per virtual frame.
- Matrox Radient eCL receiving external TTL frame (virtual) and LVDS line trigger (ROTARY ENCODER) signal.
- Matrox Radient eCL sending periodic EXPOSURE 1 (EXSYNC) signal to camera.
- Matrox Radient eCL receiving HSYNC (LVAL), PIXEL CLOCK (STROBE @ 40 MHz) and video data from camera.
- DCF used: [SC3x02k80_2048_8bitRGB_VLSFTRE.DCF](#)



Mode 7: Fixed line scan rate with variable frame size

- Up to 2048 pixels/line.
- Camera Link BASE interface (RGB 8-bit).
- DCF configured for 1000 lines per virtual frame.
- Matrox Radient eCL receiving external TTL frame (virtual) trigger signal.
- Matrox Radient eCL sending periodic EXPOSURE 1 (EXSYNC) signal to camera.
- Matrox Radient eCL receiving HSYNC (LVAL), PIXEL CLOCK (STROBE @ 40 MHz) and video data from camera.
- DCF used: [SC3x02k80_2048_8bitRGB_FLSVF.DCF](#)

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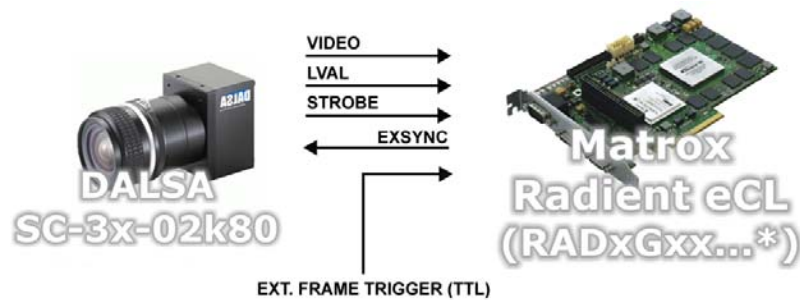
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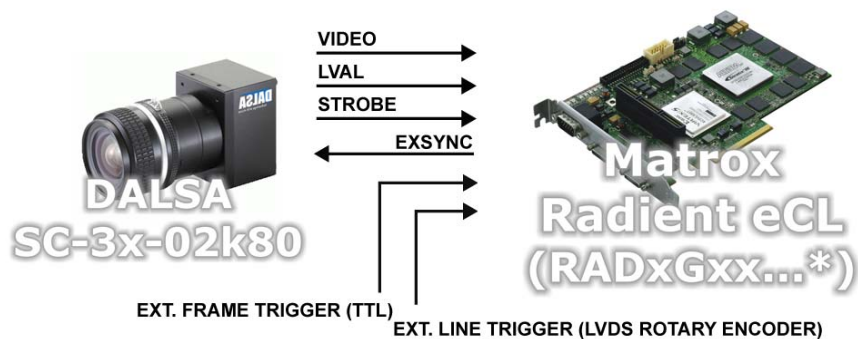
Camera Interface Briefs (cont.)

Mode 7: Fixed line scan rate with variable frame size



Mode 8: Variable line scan rate with variable frame size

- Up to 2048 pixels/line.
- Camera Link BASE interface (RGB 8-bit).
- DCF configured for 1000 lines per virtual frame.
- Matrox Radiant eCL receiving external TTL frame (virtual) and line trigger signal.
- Matrox Radiant eCL sending periodic EXPOSURE 1 (EXSYNC) signal to camera.
- Matrox Radiant eCL receiving HSYNC (LVAL), PIXEL CLOCK (STROBE @ 40 MHz) and video data from camera.
- DCF used: [SC3x02k80_2048_8bitRGB_VLSVF.DCF](#)



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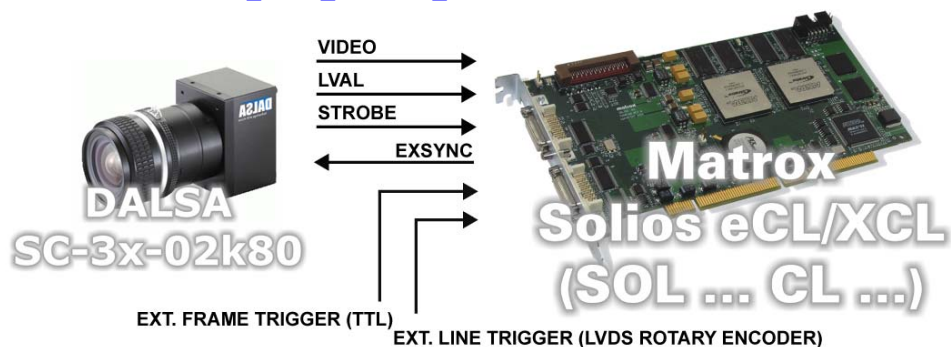
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Basics about the interface modes

Camera Interface Briefs (cont.)

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

- Up to 2048 pixels/line.
- Camera Link BASE interface (RGB 8-bit).
- DCF configured for 1000 lines per virtual frame.
- Matrox Radiant eCL receiving external TTL frame (virtual) and LVDS line trigger (ROTARY ENCODER) signal.
- Matrox Radiant eCL sending periodic EXPOSURE 1 (EXSYNC) signal to camera.
- Matrox Radiant eCL receiving HSYNC (LVAL), PIXEL CLOCK (STROBE @ 40 MHz) and video data from camera.
- DCF used: [SC3x02k80_2048_8bitRGB_VLSVFRE.DCF](#)



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. For the RGB 8-bit DCF used for the Smart EXSYNC mode, the EXPOSURE1 (EXSYNC) signal period is set to 75 μ s which translates into a 13 kHz line rate. The maximum line rate for this camera equals 18 kHz.
- **Exposure time:** The exposure time is the inactive (high level) period between the rising and falling edges of the EXPOSURE1 (EXSYNC) signal. The default exposure time for the RGB 8-bit DCF used for Smart EXSYNC mode equals 50 μ s. Maximum/minimum exposure time per line for this DCF is 420 ms and 25 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.

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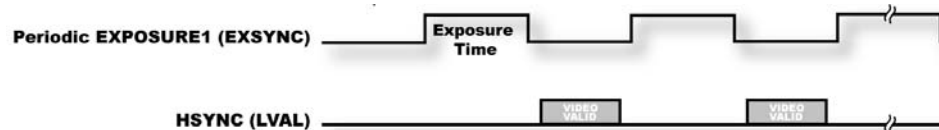
Camera Interface Details (cont.)

Mode 1: Fixed line scan rate

- **Camera communication:** These DCFs will work with Free Run and Smart EXSYNC modes. Set the mode (as shown in table below) via the Camera Link communication. Refer to the camera manual for additional information.

Command	Short Form	Parameter	Description
Set_exposure_mode	sem	2	Free Run
Set_exposure_mode	sem	4	Smart EXSYNC mode
Camera_link_mode	clm	5	RGB, 8bit

- **Timing diagram:**

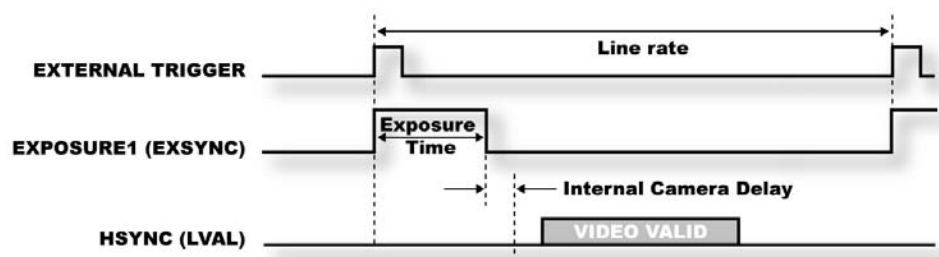


Mode 2: Variable line scan rate

- **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 (high level duration of the timer), the internal delay of the camera ($\approx 2.5 \mu\text{s}$) or slower than the maximum line read of the camera.
- **Exposure time:** Refer to Mode 1: Fixed line scan rate.
- **Camera communication:** Set the mode (as shown in table below) via the Camera Link communication. Refer to the camera manual for additional information.

Command	Short Form	Parameter	Description
Set_exposure_mode	sem	4	Smart EXSYNC mode
Camera_link_mode	clm	5	RGB, 8bit

- **Timing diagram:**



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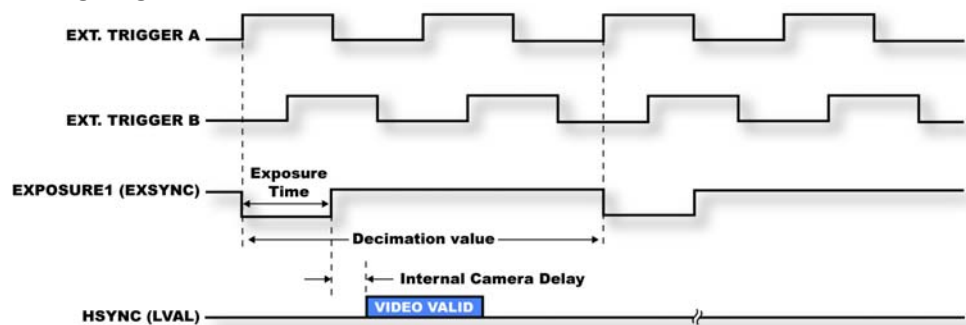
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Specifics about the interface modes

Camera Interface Details (cont.)

Mode 3: Variable line scan rate with rotary encoder

- **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 (high level duration of the timer), the internal delay of the camera ($\approx 2.50 \mu\text{s}$) or slower than the maximum line rate of the camera. The DCF is designed for a forward direction from the Rotary Encoder.
- **Exposure time:** Refer to Mode 1: Fixed line scan rate.
- **Camera communication:** Refer to Mode 2: Variable 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 period of EXPOSURE1 (EXSYNC) signal. 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 (maximum of 1000 for the DCFs) 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.

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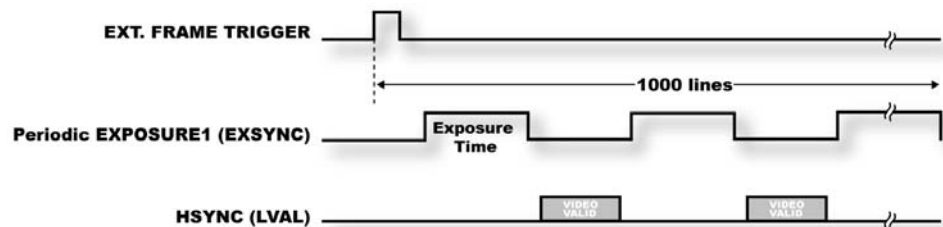
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Specifics about the interface modes

Camera Interface Details (cont.)

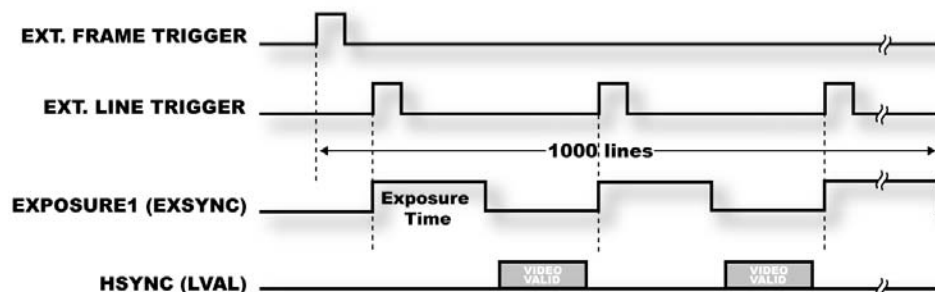
Mode 4: Fixed line scan rate with frame trigger

- **Timing diagram:**



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 (high level duration of the timer), the internal delay of the camera ($\approx 2.5 \mu\text{s}$) or slower than the maximum line read of the camera. 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 (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 2: Variable line scan rate.
- **Timing diagram:**



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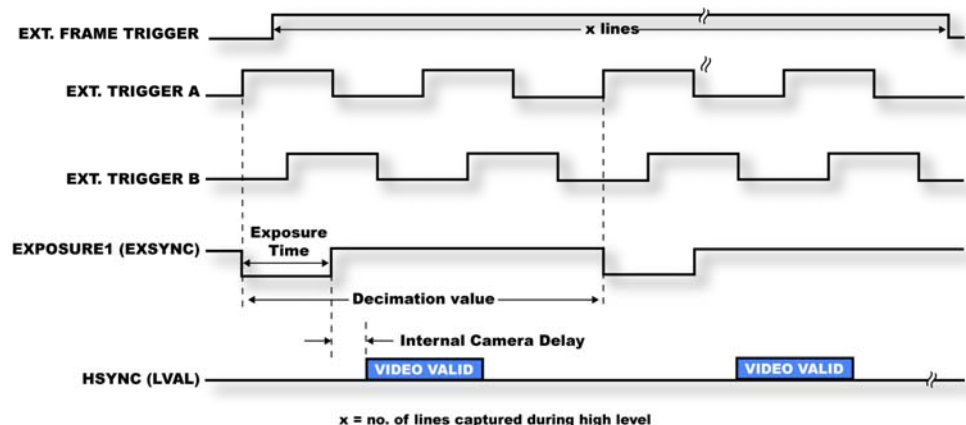
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Specifics about the interface modes

Camera Interface Details (cont.)

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

- **Line/frame rate:** The line rate is controlled by the frequency of the external TTL 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 (high level duration of the timer), the internal delay of the camera ($\approx 2.50 \mu\text{s}$) or slower than the maximum line rate of the camera. The DCF is designed 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 Radiant eCL 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.
- **Timing diagram:**



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

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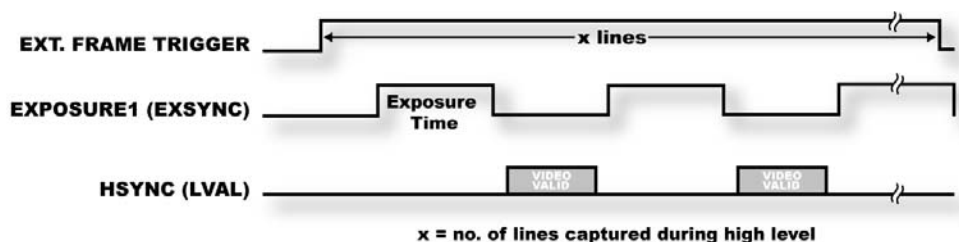
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Specifics about the interface modes

Camera Interface Details (cont.)

Mode 7: Fixed line scan rate with variable frame size

- **Line/frame rate:** The line rate is fixed and controlled by the period of EXPOSURE1 (EXSYNC) signal. The number of lines per virtual frame (maximum of 1000 for this DCF) is variable and controlled by the frame trigger signal. Matrox Solios 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.
- **Timing diagram:**



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 (high level duration of the timer), the internal delay of the camera ($\approx 2.5 \mu\text{s}$) or slower than the maximum line read of the camera. The number of lines per virtual frame (maximum of 1000 for this DCF) is variable and controlled by the frame trigger signal. Matrox Solios 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.

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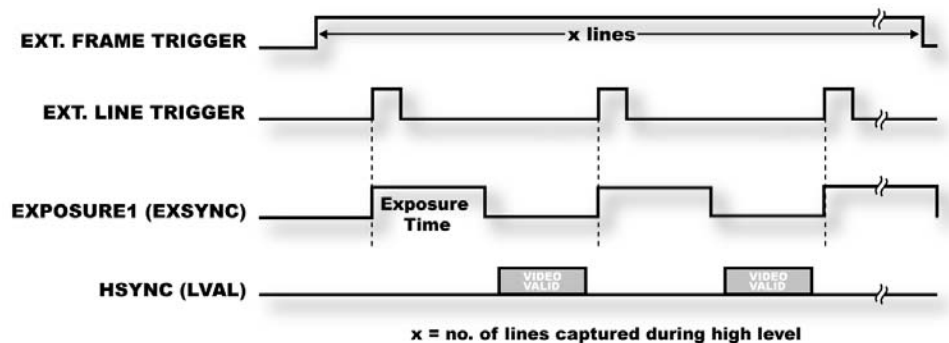
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Specifics about the interface modes

Camera Interface Details (cont.)

Mode 8: Variable line scan rate with variable frame size

▪ **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 (high level duration of the timer), the internal delay of the camera ($\approx 2.50 \mu\text{s}$) or slower than the maximum line rate of the camera. The DCF is designed 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 Radient eCL 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.

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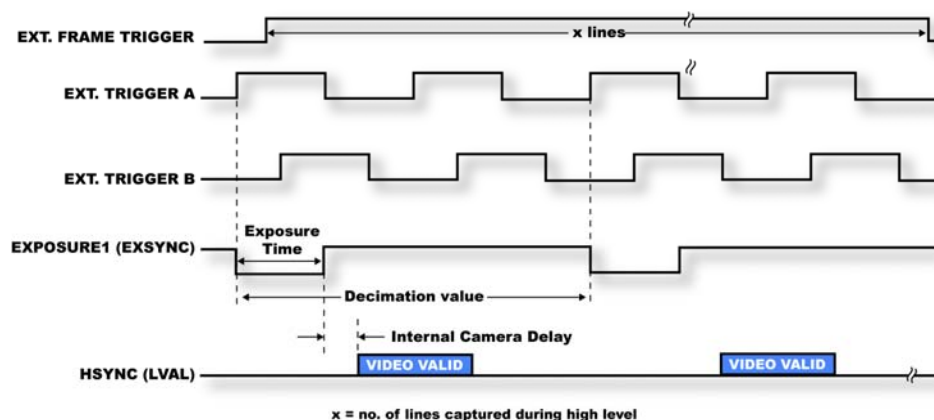
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Specifics about the interface modes

Camera Interface Details (cont.)

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

▪ 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:** One standard Camera Link cable.

Mode 2: Variable line scan rate

- **Cable and Connection:** One standard Camera Link cable.
- **External trigger:** External trigger should be connected to the external auxiliary I/O (connector A on Matrox Radiant eCL bracket).

**EXTERNAL AUX. I/O
(connector A)**

		External Trigger Source	
PIN NAME	PIN NO.		PIN NAME
OPTO_AUX_IN0 +	15	←	LINE TRIGGER (TTL FORMAT)
OPTO_AUX_IN0 -	09	←	LINE TRIGGER (GROUND)

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Cabling details for the interface
modes

Cabling Requirements (cont.)

Mode 3: Variable line scan rate with rotary encoder

- **Cable and Connection:** One standard Camera Link cable.
- **External trigger:** External trigger should be connected to the external auxiliary I/O (connector A on Matrox Radiant eCL bracket).

EXTERNAL AUX. I/O

(connector A)

PIN NAME	PIN NO.		External Trigger Source
LVDS_AUX_IN2 +	04	←	LINE TRIGGER A + (LVDS FORMAT)
LVDS_AUX_IN2 -	05	←	LINE TRIGGER A - (LVDS FORMAT)
LVDS_AUX_IN3 +	06	←	LINE TRIGGER B + (LVDS FORMAT)
LVDS_AUX_IN3 -	08	←	LINE TRIGGER B - (LVDS FORMAT)

Mode 4: Fixed line scan rate with frame trigger

- **Cable and Connection:** One standard Camera Link cable.
- **External trigger:** External trigger should be connected to the external auxiliary I/O (connector A on Matrox Radiant eCL bracket).

EXTERNAL AUX. I/O

(connector A)

PIN NAME	PIN NO.		External Trigger Source
OPTO_AUX_IN1 +	12	←	FRAME TRIGGER (TTL FORMAT)
OPTO_AUX_IN1 -	11	←	FRAME TRIGGER (GROUND)

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Cabling details for the interface
modes

Cabling Requirements (cont.)

Mode 5: Variable line scan rate with frame trigger

- **Cable and Connection:** One standard Camera Link cable.
- **External trigger:** External trigger should be connected to the external auxiliary I/O (connector A on Matrox Radiant eCL bracket).

EXTERNAL AUX. I/O

(connector A)

PIN NAME	PIN NO.		External Trigger Source
OPTO_AUX_IN1 +	12	←	FRAME TRIGGER (TTL FORMAT)
OPTO_AUX_IN1 -	11	←	FRAME TRIGGER (GROUND)
OPTO_AUX_IN0 +	15	←	LINE TRIGGER (TTL FORMAT)
OPTO_AUX_IN0 -	09	←	LINE TRIGGER (GROUND)

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

- **Cable and Connection:** One standard Camera Link cable.
- **External trigger:** External trigger should be connected to the external auxiliary I/O (connector A on Matrox Radiant eCL bracket).

EXTERNAL AUX. I/O

(connector A)

PIN NAME	PIN NO.		External Trigger Source
OPTO_AUX_IN1 +	12	←	FRAME TRIGGER (TTL FORMAT)
OPTO_AUX_IN1 -	11	←	FRAME TRIGGER (GROUND)
LVDS_AUX_IN2 +	04	←	LINE TRIGGER A + (LVDS FORMAT)
LVDS_AUX_IN2 -	05	←	LINE TRIGGER A - (LVDS FORMAT)
LVDS_AUX_IN3 +	06	←	LINE TRIGGER B + (LVDS FORMAT)
LVDS_AUX_IN3 -	08	←	LINE TRIGGER B - (LVDS FORMAT)

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Cabling details for the interface modes

Cabling Requirements (cont.)

Mode 7: Fixed line scan rate with variable frame size

- **Cable and Connection:** One standard Camera Link cable.
- **External trigger:** External trigger should be connected to the external auxiliary I/O (connector A on Matrox Radient eCL bracket).

EXTERNAL AUX. I/O

(connector A)

PIN NAME	PIN NO.		External Trigger Source
OPTO_AUX_IN1 +	12	←	FRAME TRIGGER (TTL FORMAT)
OPTO_AUX_IN1 -	11	←	FRAME TRIGGER (GROUND)

Mode 8: Variable line scan rate with variable frame size

- **Cable and Connection:** One standard Camera Link cable.
- **External trigger:** External trigger should be connected to the external auxiliary I/O (connector A on Matrox Radient eCL bracket).

EXTERNAL AUX. I/O

(connector A)

PIN NAME	PIN NO.		External Trigger Source
OPTO_AUX_IN1 +	12	←	FRAME TRIGGER (TTL FORMAT)
OPTO_AUX_IN1 -	11	←	FRAME TRIGGER (GROUND)
OPTO_AUX_IN0 +	15	←	LINE TRIGGER (TTL FORMAT)
OPTO_AUX_IN0 -	09	←	LINE TRIGGER (GROUND)

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

- **Cable and Connection:** One standard Camera Link cable.
- **External trigger:** External trigger should be connected to the external auxiliary I/O (connector A on Matrox Radient eCL bracket).

EXTERNAL AUX. I/O

(connector A)

PIN NAME	PIN NO.		External Trigger Source
OPTO_AUX_IN1 +	12	←	FRAME TRIGGER (TTL FORMAT)
OPTO_AUX_IN1 -	11	←	FRAME TRIGGER (GROUND)
LVDS_AUX_IN2 +	04	←	LINE TRIGGER A + (LVDS FORMAT)
LVDS_AUX_IN2 -	05	←	LINE TRIGGER A - (LVDS FORMAT)

Continued...

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Cabling details for the interface modes

Cabling Requirements (cont.)

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

- **Cable and Connection:** One standard Camera Link cable.
- **External trigger:** External trigger should be connected to the external auxiliary I/O (connector A on Matrox Radiant eCL bracket).

EXTERNAL AUX. I/O

(connector A)

PIN NAME	PIN NO.		External Trigger Source
LVDS_AUX_IN3 +	06	←	LINE TRIGGER B + (LVDS FORMAT)
LVDS_AUX_IN3 -	08	←	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, 2010-2011.

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