

Matrox Helios eCL/XCL

Camera Interface Application Note

BASLER L402K

August 15, 2006

Basics about the
camera

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

Basics about the
interface modes

Camera Descriptions

- Effective resolution: Up to 4080 pixels/line @ up to 14.1k line per second.
- Camera Link BASE interface (two 8 or 10-bit taps).
- External and internal sync.
- External or internal exposure control.
- 30 MHz pixel clock rate.

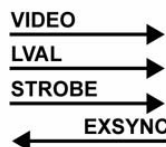
Interface Mode

- Fixed line scan rate (EXSYNC, level-controlled or Free Run programmable)
- Variable line scan rate (EXSYNC, level-controlled)
- Fixed line scan rate with frame trigger (EXSYNC, level-controlled)
- Variable line scan rate with frame trigger (EXSYNC, level-controlled)
- Fixed line scan rate with variable frame size (EXSYNC, level-controlled)
- Variable line scan rate with variable frame size (EXSYNC, level-controlled)

Camera Interface Briefs

Mode 1: Fixed line scan rate

- 4080 pixels/line.
- Camera Link BASE interface (two 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 (@ 30 MHz) and video data from camera.
- DCF used: [L402k_4080_8bit2tapsFLS.DCF](#)



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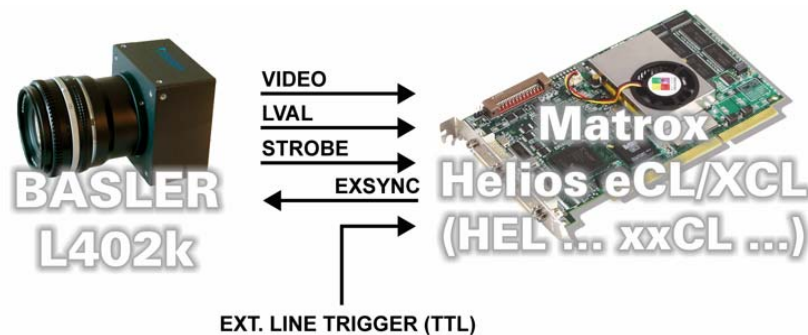
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Basics about the
interface modes

Camera Interface Briefs (cont.)

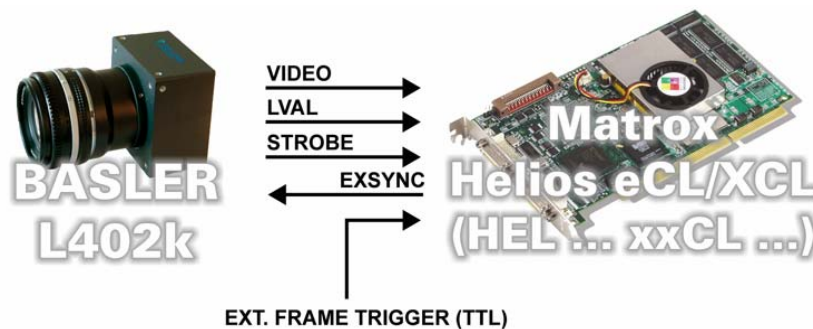
Mode 2: Variable line scan rate

- 4080 pixels/line.
- Camera Link BASE interface (two 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 (@ 30 MHZ) and video data from camera.
- DCF used: [L402k_4080_8bit2tapsVLS.DCF](#)



Mode 3: Fixed line scan rate with frame trigger

- 4080 pixels/line.
- Camera Link BASE interface (two 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 (@ 30 MHZ) and video data from camera.
- DCF used: [L402k_4080_8bit2tapsFLSFT.DCF](#)



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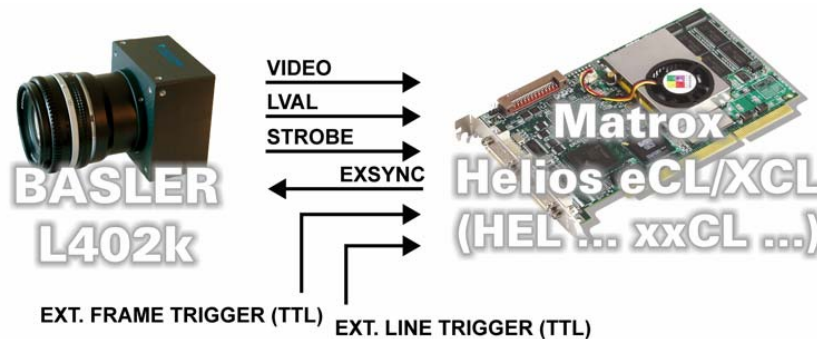
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Basics about the
interface modes

Camera Interface Briefs (cont.)

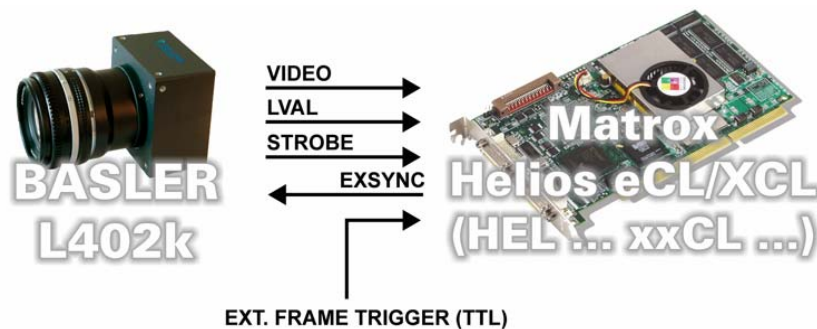
Mode 4: Variable line scan rate with frame trigger

- 4080 pixels/line.
- Camera Link BASE interface (two 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 (@ 30 MHZ) and video data from camera.
- DCF used: [L402k_4080_8bit2tapsVLSFT.DCF](#)



Mode 5: Fixed line scan rate with variable frame size

- 4080 pixels/line.
- Camera Link BASE interface (two 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 (@ 30 MHZ) and video data from camera.
- DCF used: [L402k_4080_8bit2tapsFLSVF.DCF](#)



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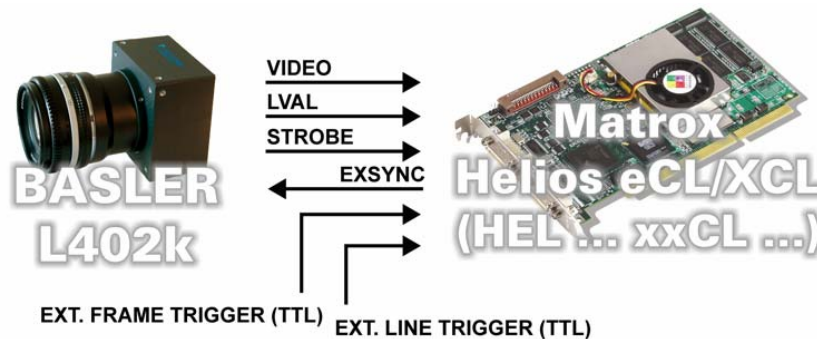
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Basics about the
interface modes

Camera Interface Briefs (cont.)

Mode 6: Variable line scan rate with variable frame size

- 4080 pixels/line.
- Camera Link BASE interface (two 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 (@ 30 MHZ) and video data from camera.
- DCF used: [L402k_4080_8bit2tapsVLSVF.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. The maximum line rate for this camera equals **14.10 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 **100 µs**. Maximum/minimum exposure time per line for this DCF is **559 ms** and **33.3 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 **Free Run** and **EXSYNC, Level-controlled** modes. Set the mode (as shown in table below) using the Basler Camera Configuration Tool Plus (CCT+). Refer to the camera manual for additional information.

Parameter	Setting
Video Data Output Mode	Dual 8-bits
Exposure Time Control Mode	EXSYNC, Level-controlled

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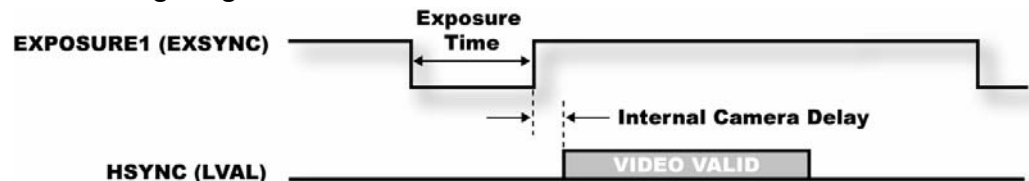
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Specifics about the
interface modes

Camera Interface Details (cont.)

Mode 1: Fixed line scan rate (cont.)

▪ Timing diagram:

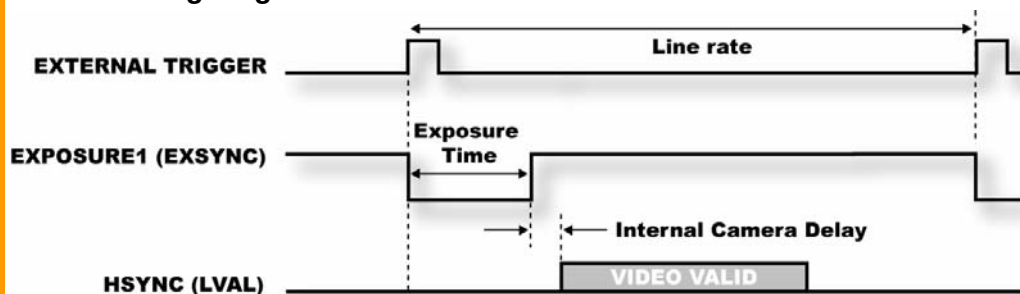


Mode 2: Variable line scan rate

- **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 (low level duration of the timer), the internal delay of the camera ($\approx 2.5 \mu\text{s}$) and the line read out ($68 \mu\text{s}$).
- **Exposure time:** Refer to Mode 1: Fixed line scan rate.
- **Camera communication:** This DCF works with the **EXSYNC, Level-controlled** mode. Set the mode (as shown in table below) using the Basler Camera Configuration Tool Plus (CCT+). Refer to the camera manual for additional information.

Parameter	Setting
Video Data Output Mode	Dual 8-bits
Exposure Time Control Mode	EXSYNC, Level-controlled

▪ Timing diagram:



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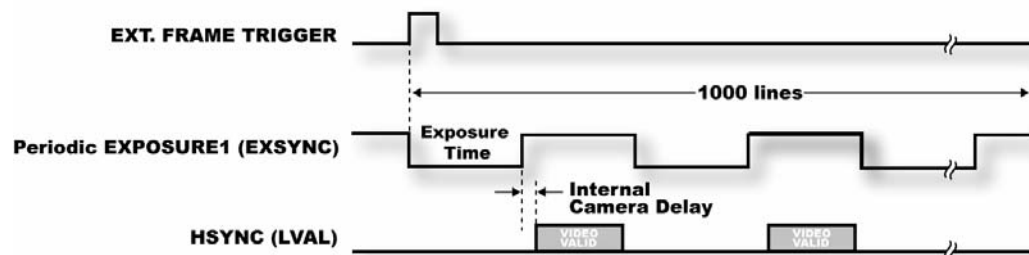
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Specifics about the
interface modes

Camera Interface Details (cont.)

Mode 3: 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 **100 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 2: Variable line scan rate.
- **Timing diagram:**



Mode 4: 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 (**$\approx 2.50 \mu$ s**) and the line read out (**68 μ s**). The default exposure time for this DCF is **100 μ s**. 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.

Continued....

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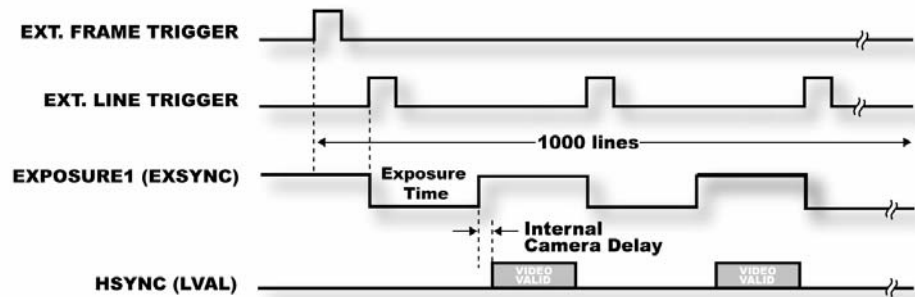
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Specifics about the
interface modes

Camera Interface Details (cont.)

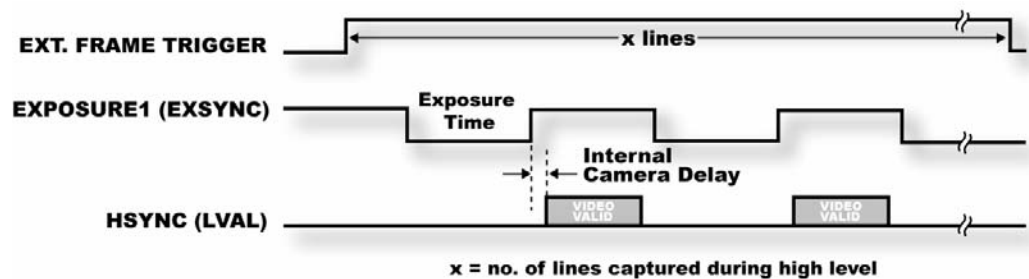
Mode 4: Variable line scan rate with frame trigger

▪ Timing diagram:



Mode 5: 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 **100 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 2: Variable line scan rate.
- **Timing diagram:**



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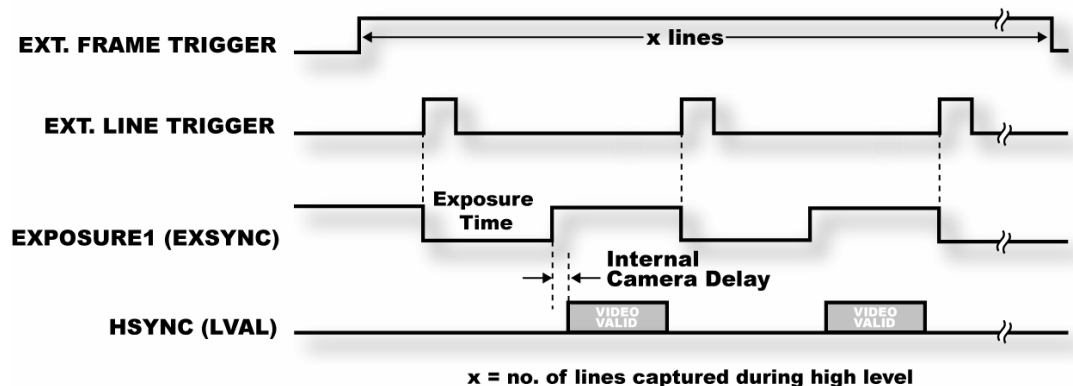
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Specifics about the
interface modes

Camera Interface Details (cont.)

Mode 6: Variable line scan rate with variable frame size

- **Line/frame rate:** The line rate is variable and controlled by the external line trigger frequency. The default exposure time for this DCF is **100 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 2: Variable line scan rate.
- **Timing diagram:**



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 (pins 7 and 2) 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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Specifics about the
interface modes

Cabling Requirements

Mode 3: Fixed line scan rate with frame trigger

- **Cable and Connection:** Standard Camera Link.
- **External trigger:** External line trigger should be connected to the OPTO TRIG input of the 9-pin connector (pins 4 and 5) 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 4: Variable line scan rate with frame trigger

- **Cable and Connection:** Standard Camera Link.
- **External trigger:** External frame and 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)

Mode 5: Fixed line scan rate with variable frame size

- **Cable and Connection:** Standard Camera Link.
- **External trigger:** External trigger should be connected to the OPTO TRIG input (pins 4 and 5) 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)

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Cabling details for the
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Cabling Requirements

Mode 6: Variable line scan rate with variable frame size

- **Cable and Connection:** Standard Camera Link.
- **External trigger:** External frame and 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)

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, 2006-2011.

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