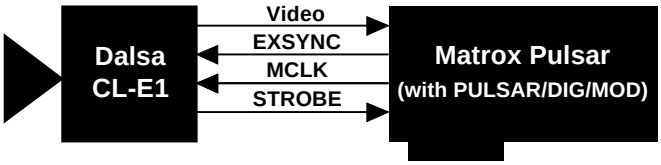
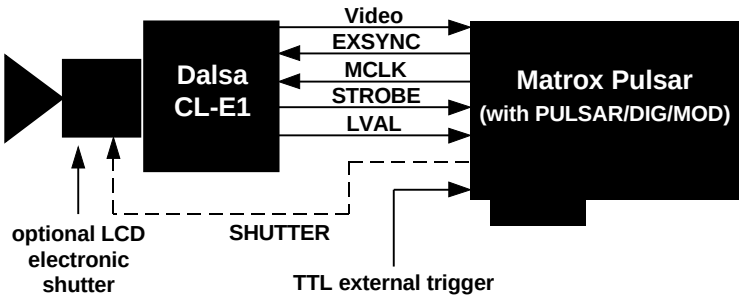
Application Note:
Interfacing non-standard cameras to Matrox Pulsar

DALSA CL-E1-2048A **May 29, 1996**

Camera Interface Overview	• 2048 x 1 x 8-bit • Digital video output (RS-422) • External sync required • 2 modes of operation: fixed line scan rate, variable line scan rate
Camera Interface Details	**Mode 1: Fixed line scan rate**  • 2048 x 1 x 8-bit • Digital video output (RS-422) • DCF configured for 480 lines per virtual frame • Line scan rate is fixed and is determined by frequency of hsync signal • Exposure time is inversely proportional to line scan rate • Continuous video • Matrox Pulsar sending RS-422 hsync (EXSYNC) and RS-422 pixel clock (MCLK) signals to camera; the hsync signal initiates line readout • Matrox Pulsar receiving RS-422 pixel clock (STROBE @ 7.159Mhz) signal from camera • DCF used: CLE1_L.DCF **Mode 2: Variable line scan rate**  • 2048 x 1 x 8-bit • Digital video output (RS-422) • DCF configured for 480 lines per virtual frame • Line scan rate is variable and is controlled by external trigger signal • Exposure time is inversely proportional to line scan rate unless an LCD electronic shutter is used • Matrox Pulsar receiving TTL external trigger • Matrox Pulsar sending RS-422 EXPOSURE2 (EXSYNC) and RS-422 reference clock (MCLK) signals to camera; the EXPOSURE2 signal initiates line readout • Matrox Pulsar receiving RS-422 pixel clock (STROBE @ 7.159MHz) and RS-422 vsync (LVAL) signals from camera • With optional LCD electronic shutter: Matrox Pulsar sending RS-422 EXPOSURE1 signal to camera; the EXPOSURE1 signal controls the optional LCD electronic shutter and therefore the exposure time • DCF used: CLE1_LS.DCF • In addition to the DCF, PSG FPGA version 3.01 or newer is required; if this version is not on your release of the MIL driver for Pulsar, the newest version can be found on the BBS or at the FTP site

Application Note:
Interfacing non-standard cameras to Matrox Pulsar

DALSA CL-E1-2048A **May 29, 1996**

Cabling Requirements

Mode 1: Fixed line scan rate

- PULSAR/DIG/MOD required for digital data, syncs and control signals in RS-422 format
- The connections between the 20-pin dual row connector (labeled OS1) of the camera and the 68-pin SCSI-2 connector of the PULSAR/DIG/MOD are as follows:

DALSA CL-E1-2048A (20-pin dual row connector - OS1)			PULSAR/DIG/MOD (68-pin SCSI-2 connector)	
Pin name	**Pin no.**		**Pin name**	**Pin no.**
D7	1	→	DATA7+	10
D7B	2	→	DATA7-	44
D6	3	→	DATA6+	11
D6B	4	→	DATA6-	45
D5	5	→	DATA5+	13
D5B	6	→	DATA5-	47
D4	7	→	DATA4+	14
D4B	8	→	DATA4-	48
D3	9	→	DATA3+	15
D3B	10	→	DATA3-	49
D2	11	→	DATA2+	16
D2B	12	→	DATA2-	50
D1	13	→	DATA1+	19
D1B	14	→	DATA1-	53
D0	15	→	DATA0+	20
D0B	16	→	DATA0-	54
STROBE	17	→	CLKIN+	29
STROBEB	18	→	CLIKIN-	63

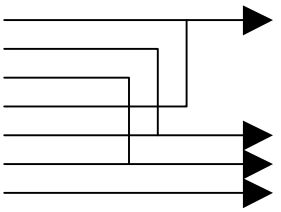
- The connections between the DB-25 connector on the rear panel of the camera and the 68-pin SCSI-2 connector of the PULSAR/DIG/MOD are as follows:

DALSA CL-E1-2048A (DB-25 male connector)			PULSAR/DIG/MOD (68-pin SCSI-2 connector)	
Pin name	**Pin no.**		**Pin name**	**Pin no.**
MCLK	6	←	CLKOUT+	24
MCLK	19	←	CLKOUT-	58
EXSYNC	17	←	HSYNC+	26
EXSYNC	4	←	HSYNC-	60
FOR/REV	5	←	CTRL1+	23
FOR/REV	18	←	CTRL1-	57
GROUND	7		GROUND	1
GROUND	11		GROUND	12
GROUND	20		GROUND	34
GROUND	24		GROUND	35
POWER SUPPLY GROUND			GROUND	46
POWER SUPPLY GROUND			GROUND	68

NOTE: it is very important that all the GROUNDs of the camera be connected together to the POWER SUPPLY GROUND, which in turn must be connected to the GROUND of the Pulsar

- The connections between the DB-25 connector on the rear panel of the camera and the power supply are as follows:

DALSA CL-E1-2048A (DB-25 male connector)		POWER SUPPLY
Pin no.	**Pin name**	
8	+5V	+5V
9	+15V	
12	-5V	
13	+5V	
21	+15V	+15V
22	-5V	-5V
23	-15V	-15V



Mode 2: Variable line scan rate

- IMG-7W2-TO-5BNC cable required for TTL external trigger source and PULSAR/DIG/MOD required for digital data, syncs and control signals in RS-422 format
- The connections between the 20-pin dual row connector (labeled OS1) of the camera and the 68-pin SCSI-2 connector of the PULSAR/DIG/MOD are as in Mode 1: fixed line scan rate with the exception of the following:

DALSA CL-E1-2048A (20-pin dual row connector - OS1)			PULSAR/DIG/MOD (68-pin SCSI-2 connector)	
Pin name	**Pin no.**		**Pin name**	**Pin no.**
LVAL	19	→	HSYNC+	26
LVAL	20	→	HSYNC-	60

- The connections between the DB-25 connector on the rear panel of the camera and the 68-pin SCSI-2 connector of the PULSAR/DIG/MOD are as in Mode 1: fixed line scan rate with the exception of the following:

DALSA CL-E1-2048A (DB-25 male connector)			PULSAR/DIG/MOD (68-pin SCSI-2 connector)	
Pin name	**Pin no.**		**Pin name**	**Pin no.**
EXSYNC	17	←	EXPOSURE2+	28
EXSYNC	4	←	EXPOSURE2-	62
optional LCD elec. shutter BNC+		←	EXPOSURE1+	30
optional LCD elec. shutter BNC-		←	EXPOSURE1-	64

- The connections between the DB-25 connector on the rear panel of the camera and the power supply are as in Mode 1: fixed line scan rate
- TTL external trigger source should be connected to the TTL Trigger Input of the IMG-7W2-TO-5BNC cable

Special Considerations	**Mode 1: Fixed line scan rate** • Matrox Pulsar sends the RS-422 hsync (EXSYNC) signal to the camera; the camera awaits the rising edge of the signal and after a short (constant) delay initiates line readout. The line rate is fixed and is determined by the frequency of the hsync signal. The exposure time is inversely proportional to the line rate • The hsync parameter in the DCF specifies the line rate of the camera and therefore the exposure time. The total line time is currently set to 2149 pixels; this figure includes the total number of active (2048) and blanking (101) pixels in one line of data. The clock rate is 7.159Mhz; the line rate is therefore 3.33Khz. The line rate of the camera, and therefore the exposure time, can be modified in the DCF using Matrox Intellicam. Consult the Matrox Intellicam User Guide for more information • The virtual frame rate for the current settings of the DCF is 6.88Hz. In each virtual frame there are 484 lines, 480 of which are active. Both the number of active video lines and the number of blanking lines can be altered by using Matrox Intellicam to modify the DCF; the virtual frame rate will be altered accordingly. The number of blanking lines can be reduced to no less than 1. The host buffer of the Matrox Pulsar can grab images of up to 2048 x 2048 (4MB) and the display buffer can grab images of up to 2048 x 1024 (2MB) **Mode 2: Variable line scan rate** • PSG FPGA version 3.01 or newer is required • The line rate is variable and is controlled by the external trigger signal; the exposure time is inversely proportional to the line rate • Once it has received the external signal to trigger, the Pulsar sends the RS-422 EXPOSURE2 (EXSYNC) signal to the camera. The camera awaits the rising edge of the signal; a short (variable) delay thereafter, the camera sends the RS-422 LVAL signal to the Pulsar to initiate line readout. The LVAL signal is high for the period during which a line of data is being read out • Trigger rate can vary between 0Hz and 0.68Khz • Virtual frame size is 2048 x 480, with 4 lines of vertical blanking; therefore an effective 480 lines out of every 484 lines are acquired • With an optional LCD electronic shutter, the exposure time can be controlled independently of the external trigger signal and is set in the DCF at the hardware register level. A hardware register editor is provided by running Intellicam with the -hwreg option (specifically by running INTELCAM -hwreg). An additional menu item, “HW REGISTER EDITOR”, appears on the main menu screen. The following registers are used to define exposure timings: CTRL_SET1CNTL CTRL_SET1CNTH CTRL_T1STARTL CTRL_T1STARTH

These last are two 16-bit registers that have been split in two: the low byte and the high byte. To set these registers, note first that CTRL_SET1CNTL must be equal to CTRL_T1STARTL and that CTRL_SET1CNTH must be equal to CTRL_T1STARTH; this minimizes the delay between the time the Pulsar receives the external trigger signal and the time it sends the hsync or EXPOSURE1 signal to the camera. These values must be in pixels and must be set in hexadecimal; the value of each 16-bit register can vary between 0 (0000 in Hex) and 65 535 (FFFF in Hex). The default width of the EXPOSURE1 pulse for use of this camera with an optional LCD electronic shutter is 8192 pixels, which in hexadecimal is 2000; at a clock rate of 7.159mhz, this corresponds to an exposure time of 1.14ms. Here the low byte corresponds to 0H and the high byte to 20H. The registers are set in the following way:

CTRL_SET1CNTL	0H
CTRL_SET1CNTH	20H
CTRL_T1STARTL	0H
CTRL_T1STARTH	20H

When computing the hardware registers, the following question may be asked: “Some registers have been manually edited. Ok to overwrite them all? (y/n)”. Answer “no” to this question and to all questions that follow.

IMPORTANT! Please consult Matrox Imaging Applications at 514-822-6061 before using Matrox Intellicam in this manner.

- An RS-422 external trigger input may also be used once the following connections between the 68-pin SCSI-2 connector of the PULSAR/DIG/MOD and the external trigger source are made:

PULSAR/DIG/MOD (68-pin SCSI-2 connector)			**External trigger source**
Pin name	**Pin no.**		**Pin name**
TRIGGER+	27	←	“RS-422 TRIGGER+”
TRIGGER-	61	←	“RS-422 TRIGGER-”

Use Matrox Intellicam in order to modify the DCF for an RS-422 external trigger input. Consult the Matrox Intellicam User Guide for more information

Corporate Headquarters: Canada and U.S.A.
Matrox Electronic Systems Ltd.
1055 St.Regis Blvd.
Dorval, Quebec, Canada
H9P 2T4
Tel: (514) 685-7230
Fax: (514) 822-6273

MATROX IMAGING