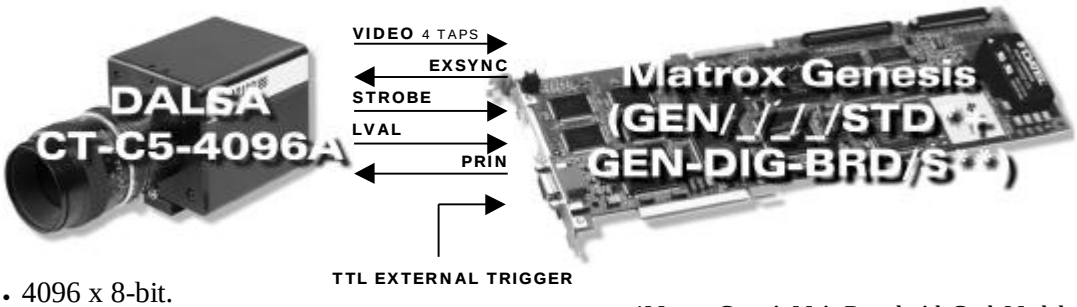
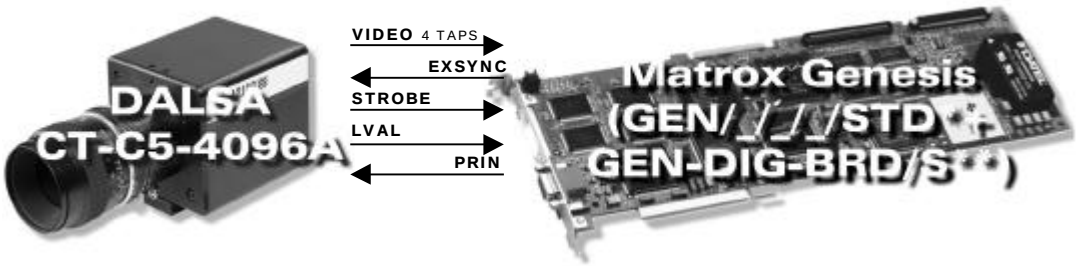
Application Note:
Interfacing non-standard cameras to Matrox Genesis

MATROX GENESIS

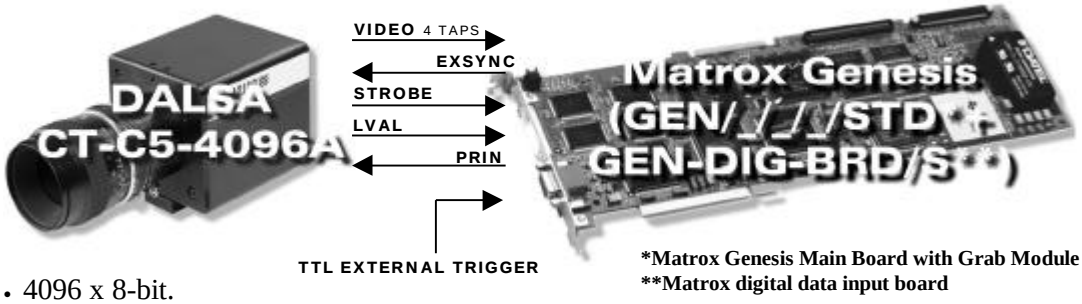
DALSA CT-C5-4096A

April 23, 1998

Camera Descriptions	• 4096 x 8-bit. • 4-channel RS-422 digital video output. • Exposure control. • Maximum data rate per output: 15 MHz.
Interface Modes	• Variable, fixed line scan rate , and fixed line scan rate with variable frame size (with programmable delay)
Camera Interface Briefs	**Mode 1: Variable line scan rate mode**  ***Matrox Genesis Main Board with Grab Module** ****Matrox digital data input board** • 4096 x 8-bit. • 4-channel RS-422 digital video. • DCF configured for 400 lines per virtual frame. • Line scan rate is variable and controlled by external trigger signal. • Matrox Genesis receiving TTL external trigger. • Matrox Genesis sending RS-422 EXPOSURE1 (EXSYNC) and RS-422 EXPOSURE2 (PRIN); the EXPOSURE1 (EXSYNC) signal initiates line readout. • Matrox Genesis receiving RS-422 pixel clock (STROBE @ 15 MHz), RS-422 HSYNC (LVAL) and RS-422 video signals from camera. • DCF used CTC5DQ1.DCF **Mode 2: Fixed line scan rate mode**  ***Matrox Genesis Main Board with Grab Module** ****Matrox digital data input board** • 4096 x 8-bit. • 4-channel RS-422 digital video. • DCF configured for 400 lines per virtual frame. • Line scan rate is programmable and controlled through Matrox Intellicam. • Matrox Genesis sending RS-422 EXPOSURE1 (EXSYNC) and RS-422 EXPOSURE2 (PRIN); the EXPOSURE1 (EXSYNC) signal initiates line readout. • Matrox Genesis receiving RS-422 pixel clock (STROBE @ 15 MHz), RS-422 HSYNC (LVAL) and RS-422 video signals from camera. • DCF used CTC5DQ2.DCF

Camera Interface Briefs (continued)

Mode 3: Fixed line scan rate with variable frame size (with programmable delay)



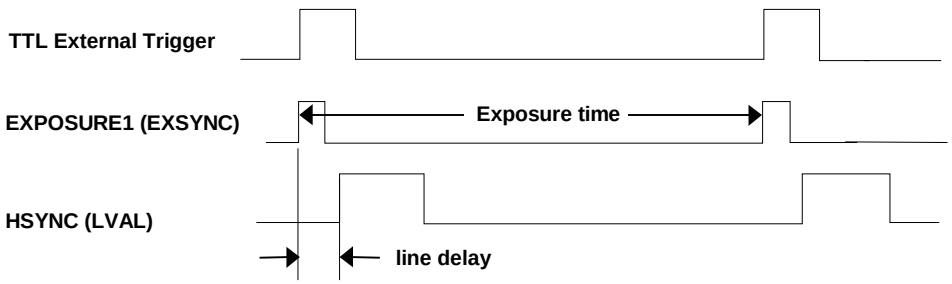
***Matrox Genesis Main Board with Grab Module**
****Matrox digital data input board**

- 4096 x 8-bit.
- 4-channel RS-422 digital video.
- Number of lines per virtual frame is determined by external trigger period (lines are grabbed only when trigger is active).
- Fixed line scan rate, exposure control and programmable delay can be changed via Matrox Intellicam, Genesis Native Library or MIL digitizer control functions.
- Matrox Genesis receiving TTL external trigger.
- Matrox Genesis sending RS-422 HSYNC OUTPUT (EXSYNC) and RS-422 USER OUTPUT (PRIN); the RS-422 HSYNC OUTPUT (EXSYNC) signal initiates line readout.
- Matrox Genesis receiving RS-422 pixel clock (STROBE @ 15 MHz) and RS-422 HSYNC INPUT (LVAL) and RS-422 video signals from camera.
- DCF used: CTC5MOD5.DCF

Camera Interface Details

Mode 1: Variable line scan rate mode

- The line scan rate is variable and controlled by the external trigger signal period.
- The external trigger is input on the Genesis via the analog video input connector trigger pin.
- Once an external trigger is received, the Genesis generates a pulse on EXPOSURE1 (EXSYNC) which in turns initiates the line readout. A fixed delay period exist between the rising edge of EXPOSURE1 and the rising edge of the video valid period (LVAL).
- The exposure time is equal to the period between the rising edges of the EXPOSURE1 (EXSYNC) pulses.
- The exposure time is variable and controlled by the external trigger period.
- Note, in this DCF the PRIN signal is connected on EXPOSURE 2 of the Matrox Genesis and is always active.



Camera Interface Details (continued)

Maximum line rate : the maximum occurrence of the external trigger. It is important that the period of the external trigger signal is longer than the video valid output delay + the video valid output time, therefore:

$$Maximum\ Trigger\ Frequency = \frac{1}{EXPOSURE1\ period}$$

$$Video\ Valid = 1024x\frac{1}{512} = 68ms$$

$$Delay = 4ms + 11mclk + 400ns = 4ms + 0.73ms + 0.26ms + 400ns = 5.39ms$$

Minimum exposure time : for proper operation of Genesis hardware, exposure signal must remain inactive for a minimum of 8 clock periods before being asserted. Therefore:

$$Minimum\ Exposure\ Time = EXPOSURE\ 1\ min.\ low\ time$$

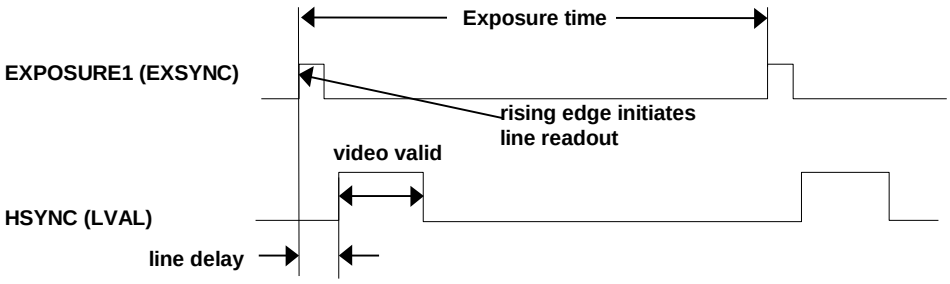
$$= 8\ clock\ periods\ x\ \frac{1}{15MHz} = 5.3ns$$

Smallest exposure time increments : The pixel clock is the base clock that the exposure time is being set by. The smallest increments of the exposure time can be calculated by:

$$Smallest\ Exposure\ Time\ Increments = \frac{1}{pixel\ clock} = \frac{1}{15MHz} = 66.6ns$$

Mode 2: Fixed line scan rate mode

- The line scan rate is programmable and controlled by changing the Timer1 setting in the EXPOSURE SIGNAL menu in Matrox Intellicam.
- The exposure time is the period between the rising edges of the EXPOSURE1 (EXSYNC) pulses.
- The default exposure time for this DCF is ≅ 1 ms.



- To modify the exposure time, reduce or increase the inactive period of the EXPOSURE1. **Note**, it is important that the period of EXPOSURE1 signal be longer than the video valid output + the video valid output time. The exposure pulses can be easily changed with either Matrox Intellicam, Genesis Native Library function **imCamControl()** or with the MIL digitizer control function **MdigControl()**. Refer to the appropriate manual or user guide for additional information.

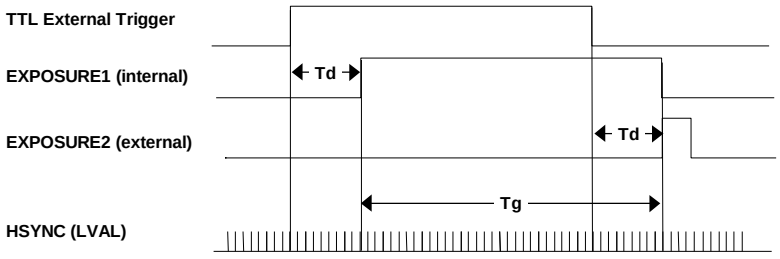
Camera Interface Details (continued)

Maximum line rate, Minimum exposure time, and Smallest exposure time increments: are the same as for Mode 1

- Note, in this DCF the PRIN signal is connected on EXPOSURE 2 of the Matrox Genesis and is always active.

Mode 3: Fixed line scan rate with variable frame size (with programmable delay)

- Number of lines per virtual frame is determined by external trigger period. To change the number of lines per virtual frame, reduce or increase the active period of the TTL external signal; lines are grabbed only when trigger is active. Virtual frame size is 500 lines maximum for this DCF and is dependent upon the trigger active (high) period.
- The line scan rate is fixed and controlled through Matrox Intellicam.
- The exposure time is the period between both rising edges of the HSYNC OUTPUT (EXSYNC).
- The default exposure time for this DCF is ≅ 100µs.
- To modify the exposure time, reduce or increase the ***FPorch*** setting within the VIDEO TIMINGS menu of Matrox Intellicam. Note, it is important that the period of the HSYNC OUTPUT (EXSYNC) signal be longer than the video valid output delay + the video valid output time.
- The pixel clock supplied by the camera is 15 MHz.
- The TTL external trigger is input on the Matrox Genesis via the analog video input connector trigger pin. The rising edge of this trigger signal starts Timer1. Following the programmable delay period (Td = delay between the TTL external trigger and EXPOSURE1 signal), EXPOSURE1 will become active. The falling edge of the trigger signal will start Timer2. Following the programmable delay period, Exposure2 will be come active and thereby clear EXPOSURE1 and end the grab period.
- To modify the programmable delay time, reduce or increase the inactive period of EXPOSURE1 and EXPOSURE2 signals in the ***Delay*** setting found in the EXPOSURE SIGNAL sub-menu (Timer1 and Timer2).



Td = Programmable delay time (for this DCF, the delay is 10 HSYNC)
Tg= Matrox Genesis grab time

Maximum line rate, Minimum exposure time, and Smallest exposure time increments: are the same as for Mode 1: *Variable line scan rate mode*

DALSA CT-C5-4096A

April 23, 1998

Cabling Requirements

Mode 1: Variable line scan rate

- IMG-7W2-TO-5BNC cable required for TTL external trigger source and GEN-DIG-BRD/S required for digital data, syncs and control signals in RS-422 format.
- TTL external trigger source should be connected to the TTL trigger input of the IMG-7W2-TO-5BNC cable.
- Matrox cable kit (GEN-TO-DALSA/32) is available for this mode as an alternative to custom cable development based on the pin-outs listing below.
- Connections between the 40-pin dual row connector (**OS1/OS2**) of the camera and the 100-pin connector of the GEN-DIG-BRD/S are as follows:

DALSA CT-C5-4096A (40-pin dual row connector - OS1/OS2)			**GEN-DIG-BRD/S (GEN/CBL/OPEN connector)**	
Pin name	***Pin no.***		***Pin name***	***Pin no.***
D7	1	→	DATA, INPUT, 15+	31
D7B	2	→	DATA, INPUT, 15-	32
D6	3	→	DATA, INPUT, 14+	29
D6B	4	→	DATA, INPUT, 14-	30
D5	5	→	DATA, INPUT, 13+	27
D5B	6	→	DATA, INPUT, 13-	28
D4	7	→	DATA, INPUT, 12+	25
D4B	8	→	DATA, INPUT, 12-	26
D3	9	→	DATA, INPUT, 11+	23
D3B	10	→	DATA, INPUT, 11-	24
D2	11	→	DATA, INPUT, 10+	21
D2B	12	→	DATA, INPUT, 10-	22
D1	13	→	DATA, INPUT, 9+	19
D1B	14	→	DATA, INPUT, 9-	20
D0	15	→	DATA, INPUT, 8+	17
D0B	16	→	DATA, INPUT, 8-	18
FUTUR	17		not connected	
FUTURB	18		not connected	
USER_EN	19		not connected	
USER_ENB	20		not connected	
D7	21	→	DATA, INPUT, 7+	15
D7B	22	→	DATA, INPUT, 7-	16
D6	23	→	DATA, INPUT, 6+	13
D6B	24	→	DATA, INPUT, 6-	14
D5	25	→	DATA, INPUT, 5+	11
D5B	26	→	DATA, INPUT, 5-	12
D4	27	→	DATA, INPUT, 4+	09
D4B	28	→	DATA, INPUT, 4-	10
D3	29	→	DATA, INPUT, 3+	07
D3B	30	→	DATA, INPUT, 3-	08
D2	31	→	DATA, INPUT, 2+	05
D2B	32	→	DATA, INPUT, 2-	06
D1	33	→	DATA, INPUT, 1+	03
D1B	34	→	DATA, INPUT, 1-	04
D0	35	→	DATA, INPUT, 0+	01
D0B	36	→	DATA, INPUT, 0-	02

(Pin-out continued)

Cabling Requirements (continued)

STROBE	37	→	CLOCK, INPUT, -	40
STROBEB	38	→	CLOCK, INPUT, +	39
LVAL	39	→	HSYNC, INPUT, +	33
LVALB	40	→	HSYNC, INPUT, -	34

- The connections between the 40-pin dual row connector (**OS3/OS4**) of the camera and the 100-pin connector of the GEN-DIG-BRD/S are as follows:

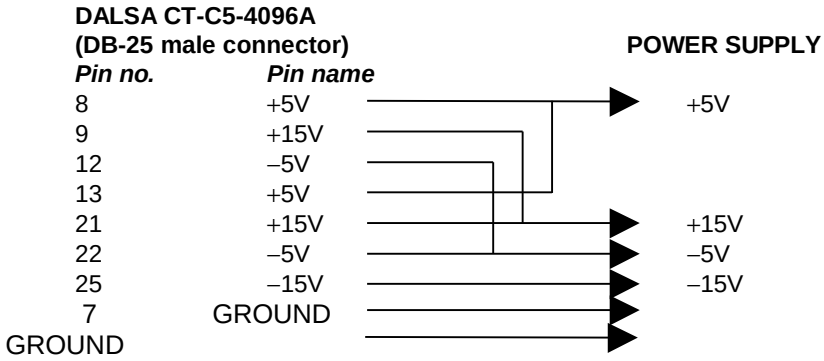
DALSA CT-C5-4096A (40-pin dual row connector - OS3/OS4)			**GEN-DIG-BRD/S (GEN/CBL/OPEN connector)**	
Pin name	***Pin no.***		***Pin name***	***Pin no.***
D7	1	→	DATA, INPUT, 31+	81
D7B	2	→	DATA, INPUT, 31-	82
D6	3	→	DATA, INPUT, 30+	79
D6B	4	→	DATA, INPUT, 30-	80
D5	5	→	DATA, INPUT, 29+	77
D5B	6	→	DATA, INPUT, 29-	78
D4	7	→	DATA, INPUT, 28+	75
D4B	8	→	DATA, INPUT, 28-	76
D3	9	→	DATA, INPUT, 27+	73
D3B	10	→	DATA, INPUT, 27-	74
D2	11	→	DATA, INPUT, 26+	71
D2B	12	→	DATA, INPUT, 26-	72
D1	13	→	DATA, INPUT, 25+	69
D1B	14	→	DATA, INPUT, 25-	70
D0	15	→	DATA, INPUT, 24+	67
D0B	16	→	DATA, INPUT, 24-	68
FUTUR	17		not connected	
FUTURB	18		not connected	
USER_EN	19		not connected	
USER_ENB	20		not connected	
D7	21	→	DATA, INPUT, 23+	65
D7B	22	→	DATA, INPUT, 23-	66
D6	23	→	DATA, INPUT, 22+	63
D6B	24	→	DATA, INPUT, 22-	64
D5	25	→	DATA, INPUT, 21+	61
D5B	26	→	DATA, INPUT, 21-	62
D4	27	→	DATA, INPUT, 20+	59
D4B	28	→	DATA, INPUT, 20-	60
D3	29	→	DATA, INPUT, 19+	57
D3B	30	→	DATA, INPUT, 19-	58
D2	31	→	DATA, INPUT, 18+	55
D2B	32	→	DATA, INPUT, 18-	56
D1	33	→	DATA, INPUT, 17+	53
D1B	34	→	DATA, INPUT, 17-	54
D0	35	→	DATA, INPUT, 16+	51
D0B	36	→	DATA, INPUT, 16	52
STROBE	37		not connected	
STROBEB	38		not connected	
LVAL	39		not connected	
LVALB	40		not connected	

Cabling Requirements (continued)

- The connections between the DB-25 connector on the rear panel of the camera and the 100-pin connector of the GEN-DIG-BRD/S are as follows:

DALSA CT-C5-4096A (DB-25 male connector)			GEN-DIG-BRD/S (GEN/CBL/OPEN connector)	
Pin name	***Pin no.***		***Pin name***	***Pin no.***
MCLK	06		not connected	
MCLKB	19		not connected	
EXSYNC	17	←	EXPOSURE, OUTPUT, 1+	95
EXSYNCB	04	←	EXPOSURE, OUTPUT, 1-	96
PRIN	05	←	EXPOSURE, OUTPUT, 2+	97
PRINB	18	←	EXPOSURE, OUTPUT, 2-	98
LVAL	02		not connected	
LVALB	15		not connected	

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



NOTE: it is very important that all the GROUNDs of the camera be connected together to the POWER SUPPLY GROUND, and to the GROUND of the Matrox Genesis. Do not use the cable shield as a ground, instead always use the ground pin of the power supply.

Mode 2: Fixed line scan rate

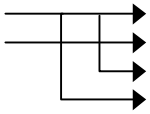
- All connections, except IMG-7W2-TO-5BNC cable (no TTL external trigger), are as in Mode 1: *variable line scan rate.*
- Matrox cable kit (GEN-TO-DALSA/32) is available for this mode as an alternative to custom cable development based on the pin-outs listing.

Mode 3: Fixed line scan rate with variable frame size (with programmable delay)

- IMG-7W2-TO-5BNC cable required for TTL external trigger source and GEN-DIG-BRD/S required for digital data, syncs and control signals in RS-422 format.
- TTL external trigger source should be connected to the TTL trigger input of the IMG-7W2-TO-5BNC cable

Cabling Requirements (continued)

- The connections between the 40-pin dual row connector (**OS1/OS2**) of the camera and the 100-pin connector of the GEN-DIG-BRD/S are as follows:

DALSA CT-C5-4096A (40-pin dual row connector - OS1/OS2)			**GEN-DIG-BRD/S (GEN/CBL/OPEN connector)**	
Pin name	***Pin no.***		***Pin name***	***Pin no.***
D7	1	→	DATA, INPUT, 15+	31
D7B	2	→	DATA, INPUT, 15-	32
D6	3	→	DATA, INPUT, 14+	29
D6B	4	→	DATA, INPUT, 14-	30
D5	5	→	DATA, INPUT, 13+	27
D5B	6	→	DATA, INPUT, 13-	28
D4	7	→	DATA, INPUT, 12+	25
D4B	8	→	DATA, INPUT, 12-	26
D3	9	→	DATA, INPUT, 11+	23
D3B	10	→	DATA, INPUT, 11-	24
D2	11	→	DATA, INPUT, 10+	21
D2B	12	→	DATA, INPUT, 10-	22
D1	13	→	DATA, INPUT, 9+	19
D1B	14	→	DATA, INPUT, 9-	20
D0	15	→	DATA, INPUT, 8+	17
D0B	16	→	DATA, INPUT, 8-	18
FUTUR	17		not connected	
FUTURB	18		not connected	
USER_EN	19		not connected	
USER_ENB	20		not connected	
D7	21	→	DATA, INPUT, 7+	15
D7B	22	→	DATA, INPUT, 7-	16
D6	23	→	DATA, INPUT, 6+	13
D6B	24	→	DATA, INPUT, 6-	14
D5	25	→	DATA, INPUT, 5+	11
D5B	26	→	DATA, INPUT, 5-	12
D4	27	→	DATA, INPUT, 4+	09
D4B	28	→	DATA, INPUT, 4-	10
D3	29	→	DATA, INPUT, 3+	07
D3B	30	→	DATA, INPUT, 3-	08
D2	31	→	DATA, INPUT, 2+	05
D2B	32	→	DATA, INPUT, 2-	06
D1	33	→	DATA, INPUT, 1+	03
D1B	34	→	DATA, INPUT, 1-	04
D0	35	→	DATA, INPUT, 0+	01
D0B	36	→	DATA, INPUT, 0-	02
STROBE	37	→	CLOCK, INPUT, -	40
STROBEB	38	→	CLOCK, INPUT, +	39
LVAL	39		TRIGGER, INPUT, +	47
LVALB	40		TRIGGER, INPUT, -	48
			HSYNC, INPUT, +	33
			HSYNC, INPUT, -	34

Cabling Requirements (continued)

- The connections between the 40-pin dual row connector (**OS3/OS4**) of the camera and the 100-pin connector of the GEN-DIG-BRD/S are as follows:

DALSA CT-C5-4096A (40-pin dual row connector - OS3/OS4)			**GEN-DIG-BRD/S (GEN/CBL/OPEN connector)**	
Pin name	***Pin no.***		***Pin name***	***Pin no.***
D7	1	→	DATA, INPUT, 31+	81
D7B	2	→	DATA, INPUT, 31-	82
D6	3	→	DATA, INPUT, 30+	79
D6B	4	→	DATA, INPUT, 30-	80
D5	5	→	DATA, INPUT, 29+	77
D5B	6	→	DATA, INPUT, 29-	78
D4	7	→	DATA, INPUT, 28+	75
D4B	8	→	DATA, INPUT, 28-	76
D3	9	→	DATA, INPUT, 27+	73
D3B	10	→	DATA, INPUT, 27-	74
D2	11	→	DATA, INPUT, 26+	71
D2B	12	→	DATA, INPUT, 26-	72
D1	13	→	DATA, INPUT, 25+	69
D1B	14	→	DATA, INPUT, 25-	70
D0	15	→	DATA, INPUT, 24+	67
D0B	16	→	DATA, INPUT, 24-	68
FUTUR	17		not connected	
FUTURB	18		not connected	
USER_EN	19		not connected	
USER_ENB	20		not connected	
D7	21	→	DATA, INPUT, 23+	65
D7B	22	→	DATA, INPUT, 23-	66
D6	23	→	DATA, INPUT, 22+	63
D6B	24	→	DATA, INPUT, 22-	64
D5	25	→	DATA, INPUT, 21+	61
D5B	26	→	DATA, INPUT, 21-	62
D4	27	→	DATA, INPUT, 20+	59
D4B	28	→	DATA, INPUT, 20-	60
D3	29	→	DATA, INPUT, 19+	57
D3B	30	→	DATA, INPUT, 19-	58
D2	31	→	DATA, INPUT, 18+	55
D2B	32	→	DATA, INPUT, 18-	56
D1	33	→	DATA, INPUT, 17+	53
D1B	34	→	DATA, INPUT, 17-	54
D0	35	→	DATA, INPUT, 16+	51
D0B	36	→	DATA, INPUT, 16	52
STROBE	37		not connected	
STROBEB	38		not connected	
LVAL	39		not connected	
LVALB	40		not connected	

Application Note:
Interfacing non-standard cameras to Matrox Genesis

MATROX GENESIS

DALSA CT-C5-4096A

April 23, 1998

Cabling Requirements (continued)

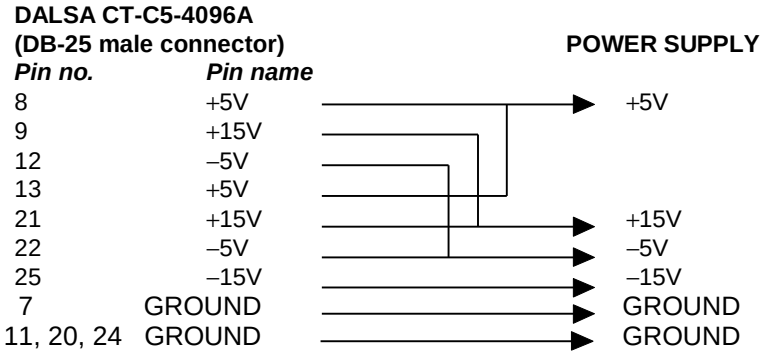
- The connections between the DB-25 connector on the rear panel of the camera and the 100-pin connector of the GEN-DIG-BRD/S are as follows:

DALSA CT-C5-4096A (DB-25 male connector)			**GEN-DIG-BRD/S (GEN/CBL/OPEN connector)**	
Pin name	***Pin no.***		***Pin name***	***Pin no.***
MCLK	06		not connected	
MCLKB	19		not connected	
EXSYNC	17	←	HSYNC, OUTPUT, +	83
EXSYNCB	04	←	HSYNC, OUTPUT, -	84
PRIN	05	←	USER, OUTPUT, 0+	91
PRINB	18	←	USER, OUTPUT, 0-	92
LVAL	02		not connected	
LVALB	15		not connected	

- The connections on the GEN/CBL/OPEN cable are as follows:

GEN-DIG-BRD/S (GEN/CBL/OPEN connector)			**GEN-DIG-BRD/S (GEN/CBL/OPEN connector)**	
Pin name	***Pin no.***		***Pin name***	***Pin no.***
USER, INPUT, 0+	41	←	EXPOSURE2, OUTPUT, +	97
USER, INPUT, 0-	42	←	EXPOSURE2, OUTPUT, -	98
USER, INPUT, 1+	43		EXPOSURE1, OUTPUT, +	95
USER, INPUT, 1-	44		EXPOSURE1, OUTPUT, -	96
			VSYNC, INPUT, +	35
			VSYNC, INPUT, -	36

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



NOTE: it is very important that all the GROUNDs of the camera are connected together to the POWER SUPPLY GROUND, which in turn must be connected to the GROUND of the Matrox Genesis. Do not use the cable shield as a ground, instead always use the ground pin of the power supply.

The DCF(s) mentioned in this application note can be found on the MIL and Native Library CD, or our FTP site (ftp.matrox.com). 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.

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MATROX IMAGING