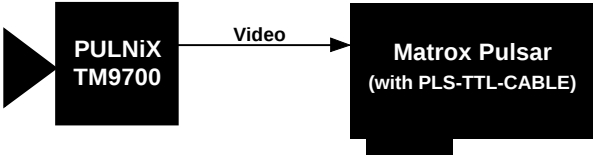
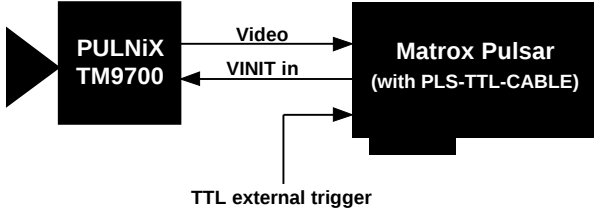


Application Note:

Interfacing non-standard cameras to Matrox Pulsar

PULNiX TM-9700/TM-9701

June 25, 1996

Camera Interface Overview	• 768 x 484 x 8-bit @ 30fps • Analog or digital video output (RS-422) • Non-interlaced (progressive scan) • Internal sync • 14.318MHz pixel clock rate • Internal or external exposure control • 4 modes of operation (analog or digital video output): continuous mode, internal fast reset mode, internal slow reset mode, double pulse mode
	1. Continuous mode (analog video output)  • 768 x 484 x 8-bit @ 30fps • Analog (composite) video output • Non interlaced (progressive scan) • Continuous video • Shutter control switch on rear panel of camera set to position 0 • DCFs used: 9700N.DCF (TM-9700); 9701N.DCF (TM-9701) 2. Internal fast reset mode (analog video output)  • 768 x 484 x 8-bit @ 30fps (max) • Analog (composite) video output • Non interlaced (progressive scan) • Internal exposure control: exposure time set with shutter control switch on rear panel of camera (positions 1-4) • Matrox Pulsar receiving TTL external trigger • Matrox Pulsar sends TTL_EXPOSURE1 (VINIT in) signal to camera to initiate exposure • DCFs used: 9700AFN.DCF (TM-9700); 9701AFN.DCF (TM-9701)

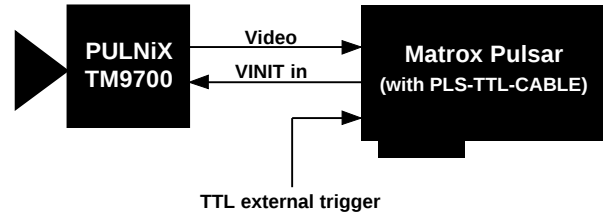
Application Note:

Interfacing non-standard cameras to Matrox Pulsar

PULNiX TM-9700/TM-9701

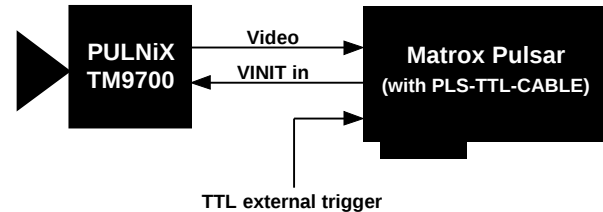
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3. Internal slow reset mode (analog video output)



- 768 x 484 x 8-bit @ 30fps (max)
- Analog (composite) video output
- Non interlaced (progressive scan)
- Internal exposure control: exposure time set with shutter control switch on rear panel of camera (positions 5-8)
- Matrox Pulsar receiving TTL external trigger
- Matrox Pulsar sends TTL_EXPOSURE1 (VINIT in) signal to camera to initiate exposure
- DCFs used: [9700ASN.DCF](#) (TM-9700); [9701ASN.DCF](#) (TM-9701)

4. Double pulse mode (analog video output)



- 768 x 484 x 8-bit @ 30fps (max)
- Analog (composite) video output
- Non interlaced (progressive scan)
- External exposure control: shutter control switch on rear panel of camera set to position 9
- Matrox Pulsar receiving TTL external trigger
- Matrox Pulsar sends TTL_EXPOSURE2 (VINIT) signal to camera; the TTL_EXPOSURE2 signal both initiates exposure and controls exposure time
- DCFs used: [9700A2N.DCF](#) (TM-9700); [9701A2N.DCF](#) (TM-9701)

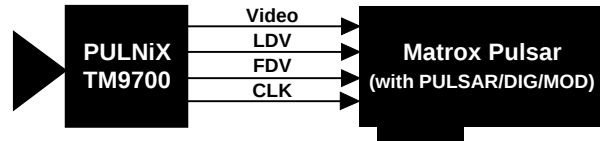
Application Note:

Interfacing non-standard cameras to Matrox Pulsar

PULNiX TM-9700/TM-9701

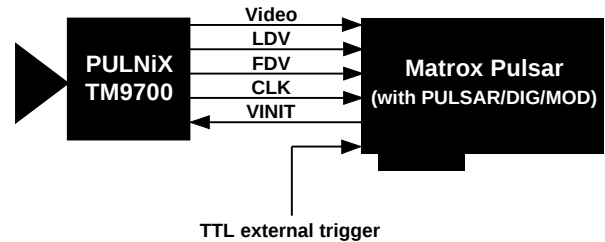
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5. Continuous mode (digital video output)



- 768 x 484 x 8-bit @ 30fps
- Digital video output (RS-422)
- Non-interlaced (progressive scan)
- Continuous video
- Shutter control switch on rear panel of camera set to position 0
- Camera sending RS-422 hsync (Line Data Valid or LDV), vsync (Frame Data Valid or FDV) and pixel clock (CLK @ 14.318MHz) signals to Matrox Pulsar
- DCFs used: [9700DN.DCF](#) (TM-9700); [9701DN.DCF](#) (TM-9701)

6. Internal fast reset mode (digital video output)



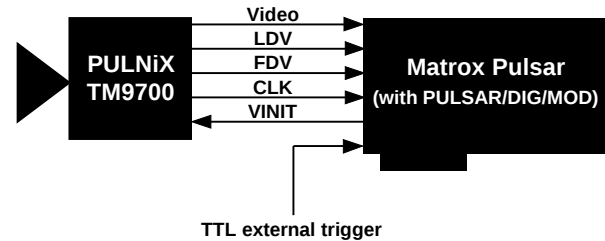
- 768 x 484 x 8-bit @ 30fps (max)
- Digital video output (RS-422)
- Non-interlaced (progressive scan)
- Internal exposure control: exposure time set with shutter control switch on rear panel of camera (positions 1-4)
- Matrox Pulsar receiving TTL external trigger
- Matrox Pulsar sends TTL_EXPOSURE1 (VINIT) signal to camera to initiate exposure
- Camera sending RS-422 hsync (Line Data Valid or LDV), vsync (Frame Data Valid or FDV) and pixel clock (CLK @ 14.318MHz) signals to Matrox Pulsar
- DCFs used: [9700DAFN.DCF](#) (TM-9700); [9701DAFN.DCF](#) (TM-9701)

Application Note: Interfacing non-standard cameras to Matrox Pulsar

PULNiX TM-9700/TM-9701

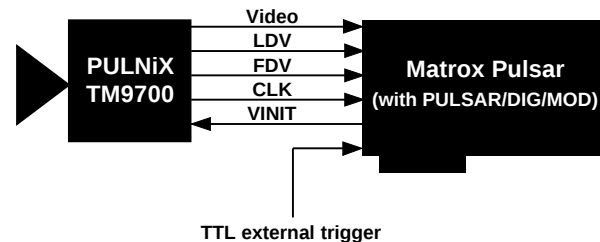
June 25, 1996

7. Internal slow reset mode (digital video output)



- 768 x 484 x 8-bit @ 30fps (max)
- Digital video output (RS-422)
- Non-interlaced (progressive scan)
- Internal exposure control: exposure time set with shutter control switch on rear panel of camera (positions 5-8)
- Matrox Pulsar receiving TTL external trigger
- Matrox Pulsar sends TTL_EXPOSURE1 (VINIT) signal to camera to initiate exposure
- Camera sending RS-422 hsync (Line Data Valid or LDV), vsync (Frame Data Valid or FDV) and pixel clock (CLK @ 14.318MHz) signals to Matrox Pulsar
- DCFs used: [9700DASN.DCF](#) (TM-9700); [9701DASN.DCF](#) (TM-9701)

8. Double pulse mode (digital video output)



- 768 x 484 x 8-bit @ 30fps (max)
- Digital video output (RS-422)
- Non-interlaced (progressive scan)
- External exposure control: shutter control switch on rear panel of camera set to position 9
- Matrox Pulsar receiving TTL external trigger
- Matrox Pulsar sends TTL_EXPOSURE2 (VINIT) signal to camera; the TTL_EXPOSURE2 signal both initiates exposure and controls exposure time
- camera sending RS-422 hsync (Line Data Valid or LDV), vsync (Frame Data Valid or FDV) and pixel clock (CLK @ 14.318MHz) signals to Matrox Pulsar
- DCFs used: [9700DA2N.DCF](#) (TM-9700); [9701DA2N.DCF](#) (TM-9701)

Application Note:

Interfacing non-standard cameras to Matrox Pulsar

PULNiX TM-9700/TM-9701

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1. Continuous mode (analog video output)

- IMG-7W2-TO-1BNC cable required for video signal
- Video input BNC of IMG-7W2-TO-1BNC cable should be connected to VIDEO OUT BNC connector of camera
- The two switches on the rear of the camera must be set respectively to *ASY* (asynchronous shutter mode) and *NON* (non-interlaced); these switches may be internal to the camera. The shutter control switch on the rear of the camera must be set to position 0

2. Internal fast reset mode (analog video output)

- IMG-7W2-TO-5BNC cable required for video signal and TTL external trigger source; PLS-TTL-CABLE required for TTL control signals
- Video input BNC of IMG-7W2-TO-5BNC cable should be connected to VIDEO OUT BNC connector of camera
- The two switches on the rear of the camera must be set respectively to *ASY* (asynchronous shutter mode) and *NON* (non-interlaced); these switches may be internal to the camera. The shutter control switch on the rear of the camera must be set to a position between 1 and 4
- The connections between the DB-37 connector of the PLS-TTL-CABLE, the 12-pin connector of the camera and the power supply are as follows:

PLS-TTL-CABLE (DB-37 connector)			PULNiX TM-9700/9701 (12-pin connector)		POWER SUPPLY
Pin name	Pin no.		Pin name	Pin no.	
TTL_EXPOSURE1	9	→	VINIT in	6	
GROUND	7		GND	1, 3, 5, 8, 10, 12	GND
			12V DC in	2	+12V

TTL external trigger source should be connected to the TTL Trigger Input of the IMG-7W2-TO-5BNC cable

Application Note:

Interfacing non-standard cameras to Matrox Pulsar

PULNiX TM-9700/TM-9701

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3. Internal slow reset mode (analog video output)

- IMG-7W2-TO-5BNC cable required for video signal and TTL external trigger source; PLS-TTL-CABLE required for TTL control signals
- Video input BNC of IMG-7W2-TO-5BNC cable should be connected to VIDEO OUT BNC connector of camera
- The two switches on the rear of the camera must be set respectively to *ASY* (asynchronous shutter mode) and *NON* (non-interlaced); these switches may be internal to the camera. The shutter control switch on the rear of the camera must be set to a position between 5 and 8
- The connections between the DB-37 connector of the PLS-TTL-CABLE and the 12-pin connector of the camera are as in *internal fast reset mode*
- TTL external trigger source should be connected to the TTL Trigger Input of the IMG-7W2-TO-5BNC cable

4. Double pulse mode (analog video output)

- IMG-7W2-TO-5BNC cable required for video signal and TTL external trigger source; PLS-TTL-CABLE required for TTL control signals
- Video input BNC of IMG-7W2-TO-5BNC cable should be connected to VIDEO OUT BNC connector of camera
- The two switches on the rear of the camera must be set respectively to *ASY* (asynchronous shutter mode) and *NON* (non-interlaced); these switches may be internal to the camera. The shutter control switch on the rear of the camera must be set to position 9
- The connections between the DB-37 connector of the PLS-TTL-CABLE, the 12-pin connector of the camera and the power supply are as follows:

PLS-TTL-CABLE (DB-37 connector)			PULNiX TM-9700/9701 (12-pin connector)		POWER SUPPLY
Pin name	Pin no.		Pin name	Pin no.	
TTL_EXPOSURE2	27	→	VINIT in	6	
GROUND	7		GND	1, 3, 5, 8, 10, 12	GND
12V DC in	2	+12V			

- TTL external trigger source should be connected to the TTL Trigger Input of the IMG-7W2-TO-5BNC cable

Application Note:

Interfacing non-standard cameras to Matrox Pulsar

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5. Continuous mode (digital video output)

- PULSAR/DIG/MOD required for digital data and syncs in RS-422 format
- The two switches on the rear of the camera must be set respectively to *ASY* (asynchronous shutter mode) and *NON* (non-interlaced); these switches may be internal to the camera. The shutter control switch on the rear of the camera must be set to position 0
- The connections between the 68-pin SCSI-2 connector of the PULSAR/DIG/MOD and the 31-pin connector of the camera are as follows:

PULSAR/DIG/MOD (68-pin SCSI-2 connector)			PULNiX TM-9700/9701 (31-pin DC connector)	
<i>Pin name</i>	<i>Pin no.</i>		<i>Pin name</i>	<i>Pin no.</i>
CLKIN+	29	←	CLK+	1
HSYNC+	26	←	LDV+	2
VSINC+	25	←	FDV+	3
GROUND	34		GND	4
DATA0+	20	←	D0+	8
DATA1+	19	←	D1+	9
DATA2+	16	←	D2+	10
DATA3+	15	←	D3+	11
DATA4+	14	←	D4+	12
DATA5+	13	←	D5+	13
DATA6+	11	←	D6+	14
DATA7+	10	←	D7+	15
GROUND	12		GND	16
CLKIN-	63	←	CLK-	17
HSYNC-	60	←	LDV-	18
VSINC-	59	←	FDV-	19
TTL_EXPOSURE1	66	→	VINIT	20
GROUND	68		GND	23
DATA0-	54	←	D0-	24
DATA1-	53	←	D1-	25
DATA2-	50	←	D2-	26
DATA3-	49	←	D3-	27
DATA4-	48	←	D4-	28
DATA5-	47	←	D5-	29
DATA6-	45	←	D6-	30
DATA7-	44	←	D7-	31

- NOTE: although connected, the TTL_EXPOSURE1 signal is not used in this mode

6. Internal fast reset mode (digital video output)

- IMG-7W2-TO-5BNC cable required for TTL external trigger source; PULSAR/DIG/MOD required for digital data and syncs in RS-422 format, and for TTL control signals

Application Note:

Interfacing non-standard cameras to Matrox Pulsar

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- The two switches on the rear of the camera must be set respectively to *ASY* (asynchronous shutter mode) and *NON* (non-interlaced); these switches may be internal to the camera. The shutter control switch on the rear of the camera must be set to a position between 1 and 4
- The connections between the 68-pin SCSI-2 connector of the PULSAR/DIG/MOD and the 31-pin connector of the camera are as in *continuous mode (digital video output)*
- TTL external trigger source should be connected to the TTL Trigger Input of the IMG-7W2-TO-5BNC cable

7. Internal slow reset mode (digital video output)

- IMG-7W2-TO-5BNC cable required for TTL external trigger source; PULSAR/DIG/MOD required for digital data and syncs in RS-422 format, and for TTL control signals
 - The two switches on the rear of the camera must be set respectively to *ASY* (asynchronous shutter mode) and *NON* (non-interlaced); these switches may be internal to the camera. The shutter control switch on the rear of the camera must be set to a position between 5 and 8
 - The connections between the 68-pin SCSI-2 connector of the PULSAR/DIG/MOD and the 31-pin connector of the camera are as in *continuous mode (digital video output)*
- TTL external trigger source should be connected to the TTL Trigger Input of the IMG-7W2-TO-5BNC cable

8. Double pulse mode (digital video output)

- IMG-7W2-TO-5BNC cable required for TTL external trigger source; PULSAR/DIG/MOD required for digital data and syncs in RS-422 format, and for TTL control signals
- TTL external trigger source should be connected to the TTL Trigger Input of the IMG-7W2-TO-5BNC cable
- The two switches on the rear of the camera must be set respectively to *ASY* (asynchronous shutter mode) and *NON* (non-interlaced); these switches may be internal to the camera. The shutter control switch on the rear of the camera must be set to position 9
- The connections between the 68-pin SCSI-2 connector of the PULSAR/DIG/MOD and the 31-pin connector of the camera are as in *continuous mode (digital video output)* with the exception of the following:

PULSAR/DIG/MOD (68-pin SCSI-2 connector)			PULNiX TM-9700/9701 (31-pin DC connector)	
<i>Pin name</i>	<i>Pin no.</i>		<i>Pin name</i>	<i>Pin no.</i>
TTL_EXPOSURE2	67	→	VINIT	20

Application Note:

Interfacing non-standard cameras to Matrox Pulsar

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Internal fast and slow reset modes (analog and digital video outputs)

- Positions 1 through 8 of the shutter control switch on the rear of the camera correspond to the following exposure times:

Shutter control switch positions

Internal fast reset mode

<i>position</i>	<i>exposure time (s)</i>	
1	1/32000	1H
2	1/16000	2H
3	1/8000	4H
4	1/4000	8H

Internal slow reset mode

<i>position</i>	<i>exposure time (s)</i>	
5	1/2000	16H
6	1/1000	32H
7	1/500	64H
8	1/250	128H

- The camera is reset upon the falling edge of the TTL_EXPOSURE1 (VINIT IN) pulse and will expose for the amount of time as set on the shutter control switch
- In internal *fast* reset mode, the time between external trigger signals must be greater than 34ms; this number is the sum of the frame transfer time (33ms) and 572μs (9 line times)
- In internal *slow* reset mode, the time between external trigger signals must be greater than the sum of the exposure time and 34ms

Double pulse mode (analog and digital video outputs)

- In order to operate in double pulse mode, the Pulsar requires a PROM 843-03 or newer
- The duration, X, from the falling edge of the first VINIT pulse to the falling edge of the second VINIT pulse controls the exposure time:

$$\text{exposure time} = (X - 9) \text{ lines},$$

where each line is 63.55μs. The exposure time must be specified at the hardware register level; in terms of the hardware registers, the duration X is expressed as follows:

$$X = \text{CTRL_SET2CNT} - \text{CTRL_T2START} + 4 \text{ lines (delay)}.$$

Since CTRL_T2START is currently set in the DCF to 3 lines and needs no further modification, the expression for the exposure time becomes:

$$\text{exposure time} = \text{CTRL_SET2CNT} - 8 \text{ lines (508}\mu\text{s)}.$$

Application Note:

Interfacing non-standard cameras to Matrox Pulsar

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Special Considerations	Thus the exposure time is adjusted simply by selecting a value for CTRL_SET2CNT; this value must be an integer number of lines, where each line is 63.55µs, and must be set in hexadecimal. To modify the setting of CTRL_SET2CNT in the DCF, run Intellicam with the <i>-hwreg</i> option (type <i>INTELCAM -hwreg</i>). Select the menu item entitled <i>HW REGISTER EDITOR</i> that appears on the main menu screen. The CTRL_SET2CNT register is a 16-bit register that is split in two: the low byte and the high byte; to demonstrate, CTRL_SET2CNT is currently set in the DCF to 20 lines, which is 14 in hexadecimal: CTRL_SET2CNTL = 14H CTRL_SET2CNTH = 0H The default exposure time is thus 12 lines or 0.76ms. 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 flo'to this question and to all questions that follow. IMPORTANT! These instructions must be followed very carefully; <i>the only registers that should be modified are those mentioned above.</i> Please consult Matrox Imaging Applications at (514) 822-6061 if assistance is required. • The minimum length of time for the duration X is 10 lines, which corresponds to a minimum exposure time of 1 line (63.55µs). Thus, the minimum setting of CTRL_SET2CNT is 9 lines (9hex). The maximum exposure time is one frame or 33ms • The time between external trigger signals must be greater than the sum of the exposure time, the frame transfer time (33ms) and 16 linetimes (1ms): maximum trigger rate = 1/(exposure time + 34ms)
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The DCF(s) mentioned in this application note can be found on the MIL and MIL-Lite CD, or our FTP site ([ftp.matrox.com](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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