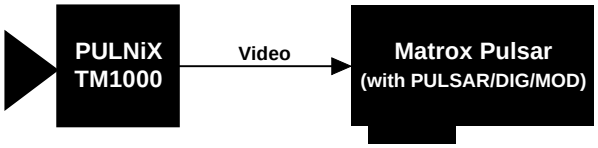
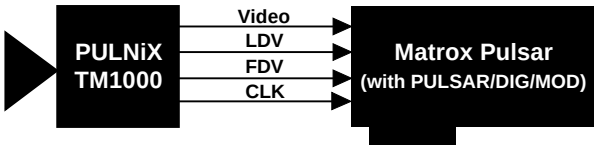
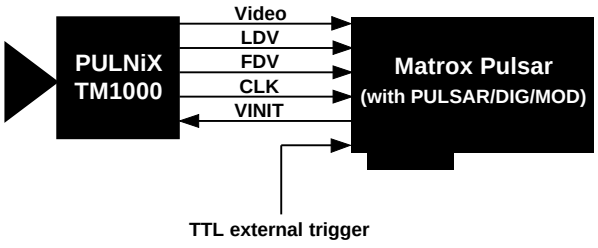
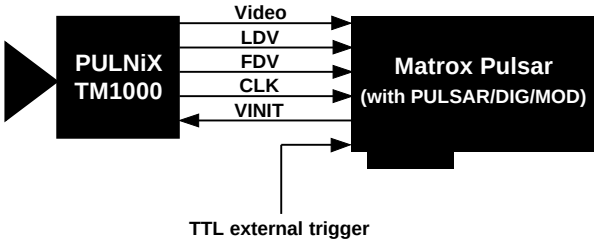
Application Note:
Interfacing non-standard cameras to Matrox Pulsar

PULNiX TM-1000/TM-1001 **March 8, 1996**

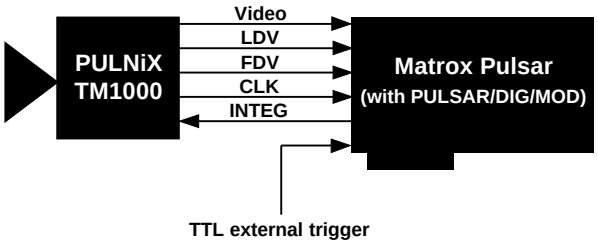
Camera Interface Overview	• 1008 x 1016 x 8-bit • Digital video output (RS-422) @ 15fps; analog video output @ 15 fps • Non-interlaced (progressive scan) • Internal hsync, vsync and pixel clock signals (all RS-422) supplied externally • 20MHz pixel clock rate • Internal or external exposure control • 5 modes: continuous mode (analog video output), continuous mode (digital video output), asynchronous reset mode (internal fast and slow reset modes), control mode (external pulse width control mode), long exposure mode (integration mode)
Camera Interface Details	**1. Continuous mode (analog video output)** • 1008 x 1016 x 8-bit @ 15fps • Analog video output • Non-interlaced (progressive scan) • Continuous video • Internal (composite) sync • DCF used: TM1001N.DCF  **2. Continuous mode (digital video output)** • 1008 x 1016 x 8-bit @ 15fps • Digital video output (RS-422) • Non-interlaced (progressive scan) • Continuous video • Camera sending RS-422 hsync (Line Data Valid or LDV), vsync (Frame Data Valid or FDV) and pixel clock (CLK @ 20 MHz) signals to Matrox Pulsar • DCF used: TM1001ND.DCF  **3. Asynchronous shutter mode (internal fast and slow reset modes)** • 1008 x 1016 x 8-bit @ 15fps • Digital video output (RS-422) • Non-interlaced (progressive scan) • Internal exposure control: exposure time set with Shutter Control Switch on rear panel of camera • Camera sending RS-422 hsync (Line Data Valid or LDV), vsync (Frame Data Valid or FDV) and pixel clock (CLK @ 20 MHz) signals to Matrox Pulsar • Matrox Pulsar receiving TTL external trigger • Matrox Pulsar sends TTL_EXPOSURE1 (VINIT) signal to camera to initiate exposure • DCF used: TM1001A.DCF 

4. Control mode (external pulse width control mode)



- 1008 x 1016 x 8-bit @ 15fps
- Digital video output (RS-422)
- Non-interlaced (progressive scan)
- External exposure control
- Camera sending RS-422 hsync (Line Data Valid or LDV), vsync (Frame Data Valid or FDV) and pixel clock (CLK @ 20 MHz) signals to Matrox Pulsar
- Matrox Pulsar receiving TTL external trigger
- Matrox Pulsar sends TTL_EXPOSURE1 (VINIT) signal to camera; the TTL_EXPOSURE1 signal both initiates exposure and controls exposure time
- DCF used: TM1001AE.DCF

5. Long exposure mode (integration mode)



- 1008 x 1016 x 8-bit @ 15fps
- Digital video output (RS-422)
- Non-interlaced (progressive scan)
- External exposure control with times starting at 66.6ms
- Camera sending RS-422 hsync (Line Data Valid or LDV), vsync (Frame Data Valid or FDV) and pixel clock (CLK @ 20 MHz) signals to Matrox Pulsar
- Matrox Pulsar receiving TTL external trigger
- Matrox Pulsar sends TTL_EXPOSURE1 (INTEG) signal to camera; the TTL_EXPOSURE1 signal both initiates exposure and controls exposure time
- DCF used: TM1001I.DCF

Cabling Requirements

1. Continuous mode (analog video output)

- IMG-7W2-TO-1BNC required
- 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 NRM (normal mode) and NSP (normal speed); the Shutter Control Switch on the rear of the camera must be set to 0 (no shutter)

2. 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 NRM (normal mode) and NSP (normal speed); the Shutter Control Switch on the rear of the camera must be set to 0 (no shutter)
- 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-1000 (31-pin DC connector)**	
Pin name	**Pin no.**		**Pin name**	**Pin no.**
CLKIN+	29	←	CLK+	1
CLKIN–	63	←	CLK–	17
HSYNC+	26	←	LDV+	2
HSYNC–	60	←	LDV–	18
VSYNC+	25	←	FDV+	3
VSYNC–	59	←	FDV–	19
GROUND	34		GND	4
GROUND	12		GND	16
GROUND	68		GND	23
DATA0+	20	←	D0+	8
DATA0–	54	←	D0–	24
DATA1+	19	←	D1+	9
DATA1–	53	←	D1–	25
DATA2+	16	←	D2+	10
DATA2–	50	←	D2–	26
DATA3+	15	←	D3+	11
DATA3–	49	←	D3–	27
DATA4+	14	←	D4+	12
DATA4–	48	←	D4–	28
DATA5+	13	←	D5+	13
DATA5–	47	←	D5–	29
DATA6+	11	←	D6+	14
DATA6–	45	←	D6–	30
DATA7+	10	←	D7+	15
DATA7–	44	←	D7–	31
TTL_USR0	31	→	EN INTEG	22

3. Asynchronous shutter mode (internal fast and slow reset modes)

- 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 NSP (normal speed); the Shutter Control Switch on the rear of the camera must be set to a position between 1 and 8. Positions 1 through 4 on the Shutter Control Switch correspond to internal fast reset mode; positions 5 through 8 correspond to internal slow reset mode

- 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-1000 (31-pin DC connector)	
Pin name	**Pin no.**		**Pin name**	**Pin no.**
TTL_EXPOSURE1	66	→	VINIT	20

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

4. Control mode (external pulse width control mode)

- 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 NSP (normal speed); the Shutter Control Switch on the rear of the camera must be set to 9 (external pulse width control mode)
- 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-1000 (31-pin DC connector)	
Pin name	**Pin no.**		**Pin name**	**Pin no.**
TTL_EXPOSURE1	66	→	VINIT	20

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

5. Long exposure mode (integration mode)

- 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 NSP (normal speed); the Shutter Control Switch on the rear of the camera must be set to 0 (no shutter)
- 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-1000 (31-pin DC connector)	
Pin name	**Pin no.**		**Pin name**	**Pin no.**
TTL_EXPOSURE1	66	→	INTEG	6

- 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-1000/TM-1001 March 8, 1996

Special Considerations

NOTE: the TM-1000 and the TM-1001 are exactly the same except that the TM-1001 has a built-in micro lens

Asynchronous reset mode

- Positions 1 through 8 of the Shutter Control Switch on the rear of the camera correspond to the following exposure times:

Shutter Control Switch position		exposure time (s)
internal fast reset mode	1	1/16000
	2	1/8000
	3	1/4000
4	1/2000	
internal slow reset mode	5	1/1000
	6	1/500
	7	1/250
8	1/125	

- The time between external trigger pulses must be greater than 67ms

Control mode (external pulse width control mode)

- The exposure time is the width of the TTL_EXPOSURE1 pulse; the exposure time can be set by modifying 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 TTL_ EXPOSURE1 signal to the camera. These values must be multiples of one linetime H, where 1H = 63.49µs, 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 TTL_EXPOSURE1 pulse for this mode is 32 linetimes, which in hexadecimal is 20; since each linetime is 63.49µs, this corresponds to an exposure time of 2.03ms. Here the low byte corresponds to 20H and the high byte to 0H. The registers are set in the following way:

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

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.

- The maximum exposure time for this mode is 66.6ms
- The external trigger pulse must have a width greater than 63.49µs (1H); the time between external trigger pulses must be greater than the sum of the exposure time and the frame transfer time (66.6ms)

Long exposure mode (integration mode)

- The exposure time is the width of the TTL_EXPOSURE1 pulse; the exposure time can be set by modifying the DCF at the hardware register level in the same manner as in control mode. The default width of the TTL_EXPOSURE1 pulse for this mode is 0.52s
- The minimum exposure time for this mode is 66.6ms
- The external trigger pulse must have a width greater than 63.49µs (1H); the time between external trigger pulses must be greater than the sum of the exposure time and the frame transfer time (66.6ms)

Asynchronous reset mode, control mode and long exposure mode

- 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

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). 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.

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