

**Digital Monochrome (b/w)
Progressive Scan Camera**

System: **Gigabit Ethernet**

Baumer TXG04 v2

Revision 2.1

Art. No: 11078246

- Gigabit Ethernet progressive scan CCD camera
- 656 x 494 pixel
- Up to 93 full frames per second
- GigE Vision® standard compliant
- Outstanding image quality
- High sensitivity and dynamic range
- High quality mode for lowest readout noise
- Binning and true partial scan function (ROI) for increased frame rates
- External synchronization via industrial compliant process interface (trigger / flash)
- Integrated supplementary function for flexible integration
- Sequence function up to 2³¹-1 frames per sequence
- Jumbo frames supported
- Integrated 32 MByte RAM for temporarily image data buffering
- Camera parameter programmable in real-time
- Ultra compact and lightweight aluminum housing
- Standard RJ45 connector
- Screw-lock type industrial connector
- Baumer-GAPI: Flexible, generic software interface for Windows / Linux



1. Overview

Model Name	TXG04 v2
Sensor	1/2" interline progressive scan CCD
Shutter / readout mode	global shutter / progressive scan readout
Number of pixel	656 x 494
Scan area	6.5 mm x 4.9 mm
Pixel size	9.9 µm x 9.9 µm
Color filter	-
Operation modes	
Trigger mode	yes, overlapped operation
Free running mode	yes, overlapped operation
Signal processing	real-time software programmable
Pixel clock	40 MHz
A/D converter	14 bit
Exposure control (t _{exp})	total: 4 µsec .. 60 sec step: 1 µsec
Gain control	0 .. 20 dB
Offset (black level)	0 .. 1023 LSB (14 bit)
Image data buffer	max. 31 images

Technical specifications subject to change

Image acquisition							
Camera image format modes	Format (pixel)	Gen<math>\lt;/math>Cam standard	Format ID	Pixel format	Pixel clock MHz	Frames per sec. *)	t _{readout}
Full frame fast	656 x 494	yes	01	Mono8 **)	40	93	10.6 msec
				Mono12			
				Mono12 Packed			
Binning 2x2 fast	328 x 247	yes	03	Mono08 **)	40	176	5.65 msec
				Mono12			
				Mono12 Packed			
Binning 1x2 fast	656 x 247	yes	05	Mono08 **)	40	176	5.65 msec
				Mono12			
				Mono12 Packed			
Binning 2x1 fast	328 x 494	yes	07	Mono08 **)	40	93	10.6 msec
				Mono12			
				Mono12 Packed			
Standard features							
Image size controls							
Binning horizontal	yes, 1 or 2						
Binning vertical	yes, 1 or 2						
Pixel format	Mono8, Mono12, Mono12Packed						
Test image selector	yes, in all modes Off, GreyHorizontalRamp, GreyVerticalRamp, HorizontalLineMoving, VerticalLineMoving HorizontalAndVerticalLineMoving						
Partial scan	yes, format freely programmable in all modes (binning on partial scan ok)						
Analog controls							
Gain	yes						
Black Level (Off set)	yes						
Gamma	yes, user programmable ***) (available if LUT is enable) ****) total: 0.001 .. 2						
Brightness correction (custom)	yes, in all binning modes						
Acquisition and Trigger							
Acquisition mode	Continuous						
Acquisition frame rate	yes, ON / OFF (only in freerunning mode) 0 .. 716 Hz, step: 0.01 Hz						
Trigger source	HardwareTrigger (Line0), SoftwareTrigger, CommandTrigger (ActionCommand), All or Off						
Trigger delay	0 .. 2 sec, 512 trigger can be tracked, step: 1 µsec						
Sequencer	Up to 2 ³¹ -1 frames per sequence / one exposure time and gain value for each parameter set max. set of sequences: Up to 2 ³¹ -1 frames x 256 parameter sets						
Digital I/O							
Lines	Input: Line0, Output: Line1						
Line source (outputs only)	Line1: Off, ExposureActive, Timer1, ReadoutActive, User0, TriggerReady, TriggerOverlapped, TriggerSkipped						
Line debouncer	yes, low and high signal separately selectable 0 .. 5 msec step: 1 µsec						
Event Generation							
Events	GigEVisionError, Heartbeattimeout, EventLost, Line0RisingEdge, Line0FallingEdge, Line1RisingEdge, Line1FallingEdge, ExposureStart, ExposureEnd, FrameStart, FrameEnd, TriggerReady, TriggerOverlapped, TriggerSkipped						
Event Notification	yes, ON / OFF						

Counters and Timers			
Framecounter	yes, 2 ³² can be set by user		
Timer	yes, TimerSelector: Timer1 TimerTriggerSource: Off, Input: Line0, SoftwareTrigger, CommandTrigger (ActionCommand), ExposureStart, ExposureEnd, FrameStart, FrameEnd, TriggerSkipped TimerDelay: 0 µsec .. 2 sec, step: 1 µsec TimerDuration: 10 µsec .. 2 sec, step: 1 µsec		
LUT Controls			
LUT selector	1 LUT: Luminance (12 bit) ON / OFF		
Defect pixel correction (custom)	yes, ON / OFF		
Defect pixel list (custom)	yes, max. 256 pixel coordinates (x, y) can be stored		
GigEVisionTransportLayer			
PayLoadsize	4 Byte .. 648.400 Byte		
TransmissionDelay (custom)	0 .. 2 ³² -1 ticks		
UserSets			
User set selector	Default (factory settings / read only) UserSet1, UserSet2, UserSet3 (read and write)		
UserSetDefaultSelector	yes, define the start up "UserSet"		
Advanced features			
Time stamp function	yes, 64 bit tick = 32 nsec		
Asynchronous message channel	yes		
Concatenation function	yes		
User defined identifier	yes, user programmable permanent identifier		
ActionCommand	yes, ID 0 = Trigger		
DeviceTemperature	yes, internal camera temperature range: -25 °C .. +100 °C accuracy: ±1 K		
Data quality			
at 20 °C, gain = 1, exposure time = 32 msec, full frame mode			
Readout noise	σ < 0.5 LSB (8 bit) typical		
Dynamic range	typical > 54 dB		
Optical interface			
C-Mount on request: CS-Mount			
Optical filter	dust protection on request: super polished, IR cut filter, daylight filter or no filter		
Process interface functions			
Async. Trigger	yes, trigger mode operation, "Off", "software trigger", "hardware trigger", "command trigger" or "all" separately selectable (overtriggered signals and trigger signals during the readout time will be notified in the received image header)		
Exposure Active (External flash sync)	yes, delay_value (t _{delay flash}) ≤ 4 µsec, duration_value (t _{duration}): slow mode = t _{exp} + n.b. µsec fast mode = t _{exp} + 21 µsec		
User Output	yes, ON / OFF		
Timer	yes, Timer1		
Trigger Ready	yes		
Trigger Overlapped	yes		
Trigger Skipped	yes		
Software reset	yes, delay up to 65 msec		
Asynchronous reset	Full frame / Binning 2x1	slow	delay up to n.b. msec
		fast	2.6 msec msec
	Binning 2x2 / Binning 1x2	slow	delay up to n.b. msec
		fast	2.25 msec msec
Image info header	yes		

Electrical interface	
Data / control	standard single cable 1000 Base-T, Cat6 recommended / minimum Cat5e option: screw lock type connector
Power	VCC: 8 VDC .. 30 VDC I: 450 mA .. 135 mA
Power consumption	approx. 4 Watt
Digital input	Line0: trigger signal, opto decoupled $U_{IN(low)} = 0 .. 4.5 \text{ VDC}$, $U_{IN(high)} = 11 .. 30 \text{ VDC}$ $I_{IN} = 6 .. 10 \text{ mA}$ / 7 mA typical rising edge (invert = false) ****) min. impulse length (t_{min}): 2 μsec trigger delay out of $t_{readout}$ ($t_{delay \text{ trigger}}$): 4 μsec max. trigger delay during $t_{readout}$ ($t_{delay \text{ trigger}}$): slow mode = n.b. μsec fast mode = 21 μsec
Digital output	Line 1: opto decoupled $U_{EXT} = 5 .. 30 \text{ VDC}$ / 24 VDC typical, $I_{OUT} = \text{max. } 16 \text{ mA}$ high active (invert = false) ****)
LED	1: green: Power on yellow: Readout active 2: green: Link Phy (1 GBit) green flash: Ethernet RX yellow: Ethernet TX yellow/red flash: Ethernet RX/TX
Environmental	
Storage temperature	-10 °C .. +70 °C
Operating temperature	+5 °C .. +50 °C between +39 °C .. +50 °C, note the max. housing temperature
Housing operating temperature	max. +50 °C ****) (measurement point, see item 4)
Humidity	10 % .. 90 % non condensing
Conformity	CE, FCC Part 15 class B, UL, RoHS compliant
Housing	
Dimensions	aluminum, IP40 36 x 36 x 48 mm ³
Weight	< 90 g
Network interface	
Ethernet IP configuration	1000BASE-T (1000 Mbit / sec) persistent IP / DHCP / LLA
Stream channel packet size	576 Byte (default) .. 65535 Byte jumbo frames supported
Interpacketgap	0 .. 2 ³² -1 ticks
Multicast function	yes
Resend function	yes

Software	Baumer-GAPI SDK with supported OS socket driver and Baumer filter driver / SDK for Windows XP (32 bit) / Windows Vista (32 bit / 64 bit) / Windows 7 (32 bit / 64 bit) / Linux Kernel 2.6.xx (64 bit / 32 bit)
	GigE Vision [®] compatible programs and image processing libraries supported Windows / Linux depending on the actually driver software is used

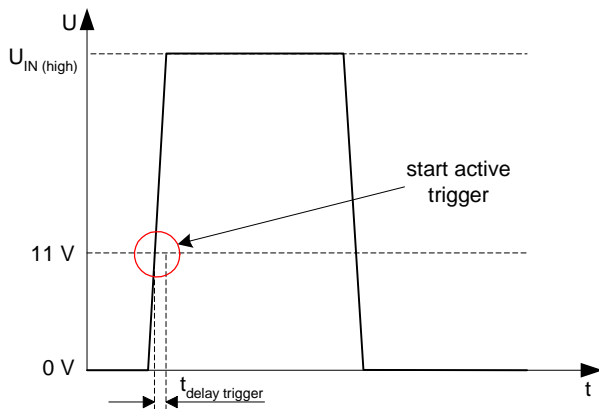
- *) maximum frame rate in free running mode, effective frame rate depending on camera image format mode settings and set exposure time ($t_{exp} < t_{readout}$)
- **) default pixel format
- ***) the LUT function will be used for the gamma value and the calculation time of the internal used LUT need app. 2 sec, if the gamma value changed
- ****) can be inverted via software
- *****) housing temperature is limited by CCD sensor specification

2. Camera Factory Settings after Camera Start-up

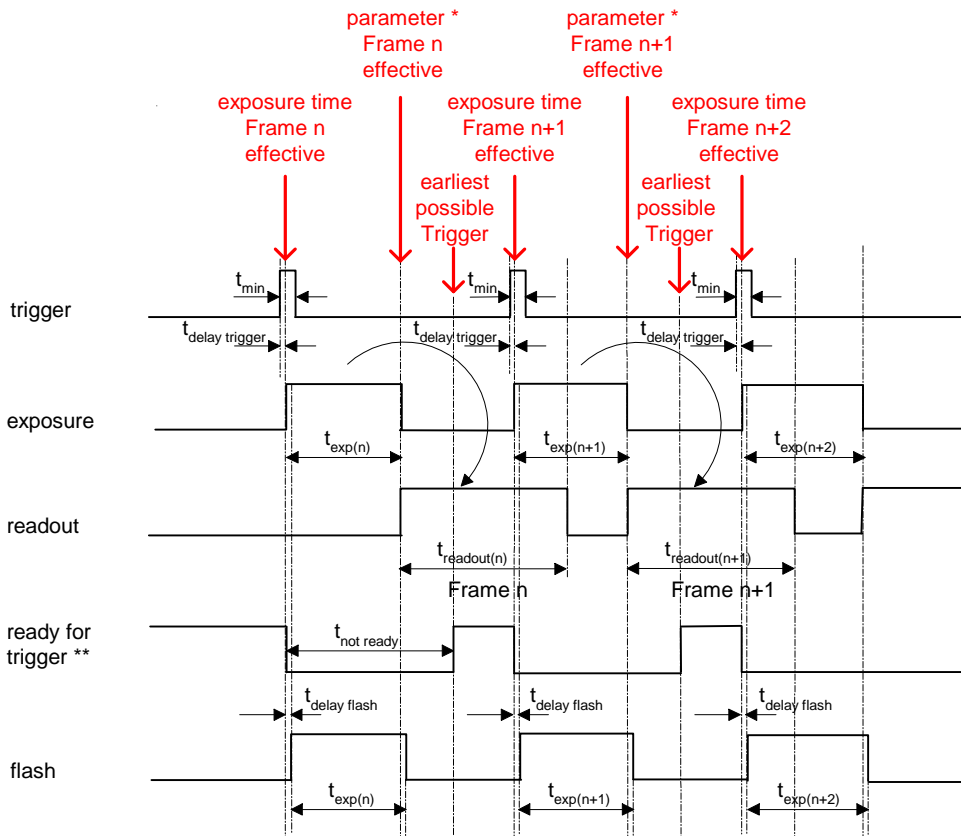
Camera factory settings after camera start-up	
Operation modes	free running mode
Signal processing	
Exposure control	32 msec
Gain control	factor 1 = 0 dB
Offset (black level)	0
Image acquisition	
Camera image format mode	mode id = 01, full frame Mono8
Partial scan function	not active
Acquisition frame rate	Off
Timer	Off
Transmission delay	0 ticks
Test image selector	Off
Defect pixel correction	On
Electrical interface	
Digital input	1: Line0 disabled, digital output set to low status (high impedance) invert = false trigger source = Line0
Digital output	1: Line1 disabled invert = false line source = Exposure Active

3. Timing Operation Modes

Trigger Mode: start up time



Trigger Mode: trigger mode 0, overlapped trigger



$$t_{exp} < t_{readout}: t_{\text{earliest possible trigger (n+1)}} = t_{readout(n)} - t_{exp(n+1)}$$

$$t_{exp} > t_{readout}: t_{\text{earliest possible trigger (n+1)}} = t_{exp(n)}$$

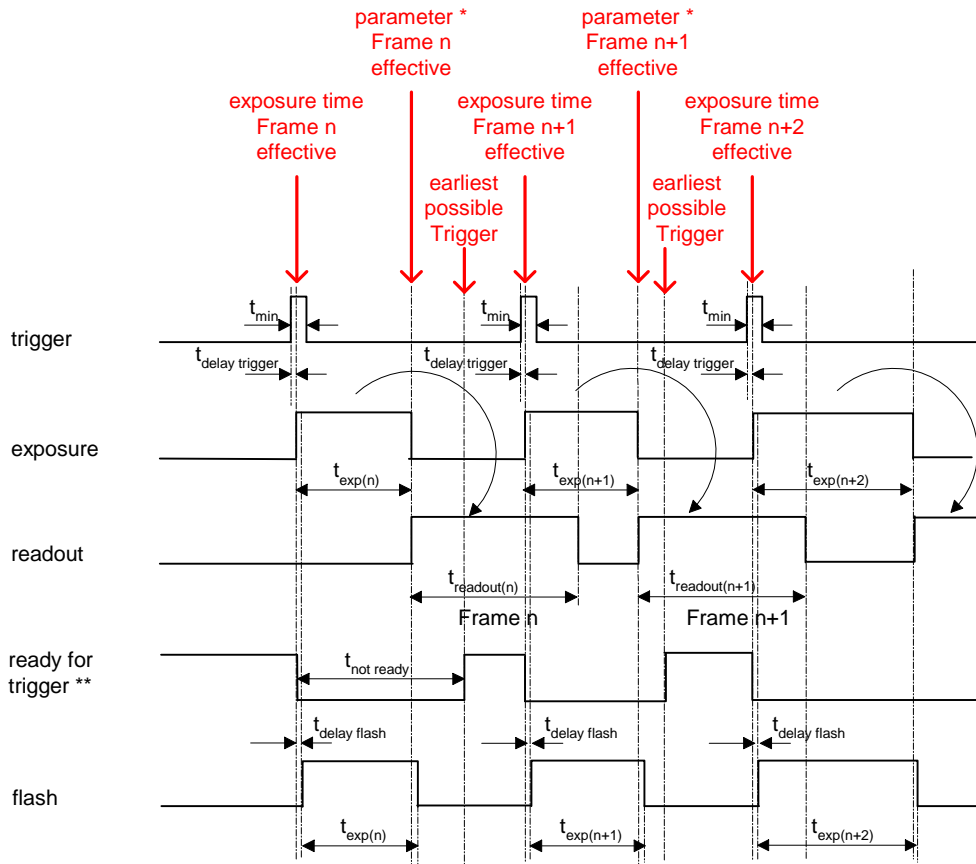
$$t_{exp} < t_{readout}: t_{\text{not ready (n+1)}} = t_{exp(n)} + t_{readout(n)} - t_{exp(n+1)}$$

$$t_{exp} > t_{readout}: t_{\text{not ready (n+1)}} = t_{exp(n)}$$

* image parameter: offset
 global gain
 mode
 partial scan

** signal will be notified as event "TriggerReady"

Trigger Mode: trigger mode 0, overlapped trigger , when $t_{exp(n+2)} > t_{exp(n+1)}$



$$t_{exp} < t_{readout}: t_{earliest\ possible\ trigger\ (n+1)} = t_{readout(n)} - t_{exp(n+1)}$$

$$t_{exp} > t_{readout}: t_{earliest\ possible\ trigger\ (n+1)} = t_{exp(n)}$$

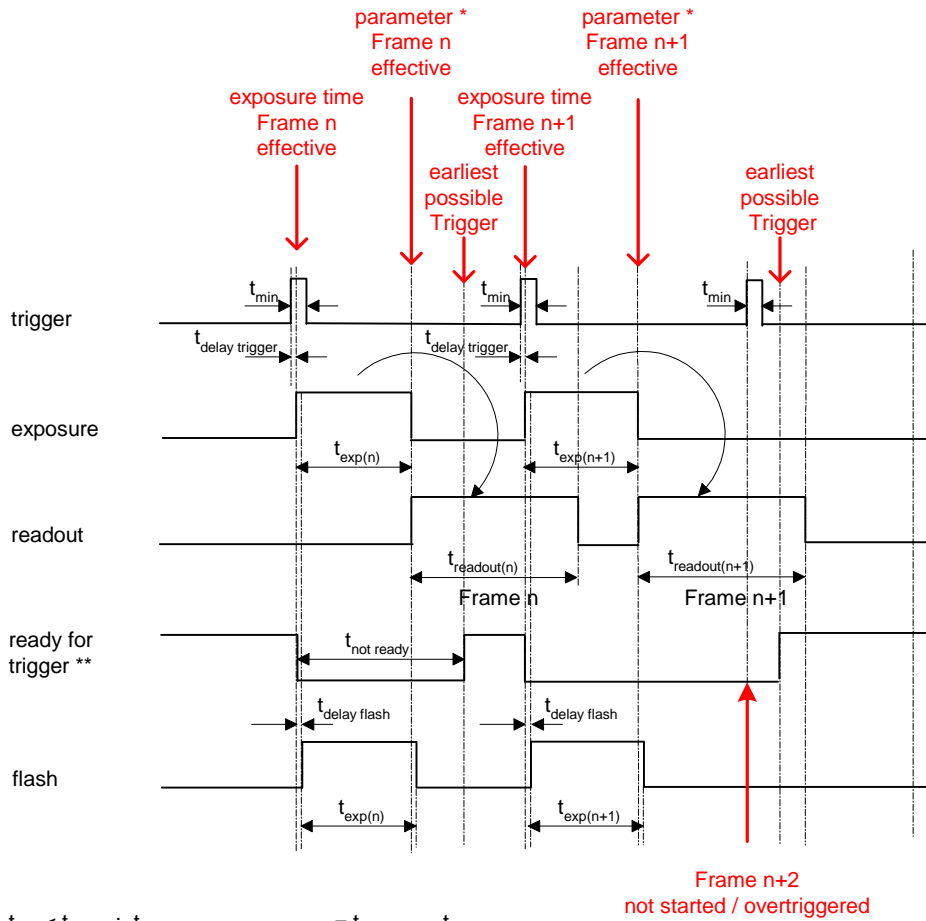
$$t_{exp} < t_{readout}: t_{not\ ready\ (n+1)} = t_{exp(n)} + t_{readout(n)} - t_{exp(n+1)}$$

$$t_{exp} > t_{readout}: t_{not\ ready\ (n+1)} = t_{exp(n)}$$

* image parameter: offset
 global gain
 mode
 partial scan

** signal will be notified as event "TriggerReady"

Trigger Mode: trigger mode 0, overlapped trigger , when $t_{exp(n+2)} < t_{exp(n+1)}$



$$t_{exp} < t_{readout} : t_{earliest\ possible\ trigger\ (n+1)} = t_{readout(n)} - t_{exp(n+1)}$$

$$t_{exp} > t_{readout} : t_{earliest\ possible\ trigger\ (n+1)} = t_{exp(n)}$$

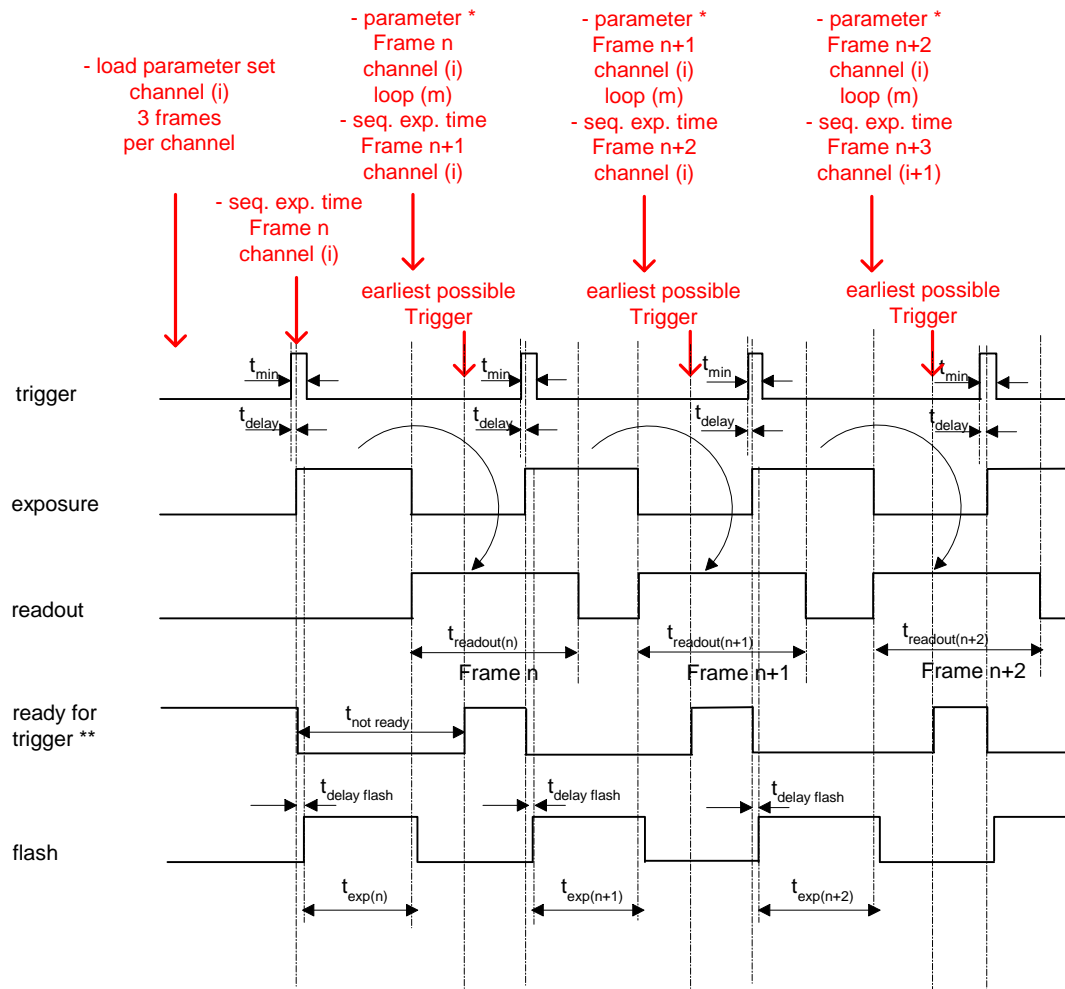
$$t_{exp} < t_{readout} : t_{not\ ready\ (n+1)} = t_{exp(n)} + t_{readout(n)} - t_{exp(n+1)}$$

$$t_{exp} > t_{readout} : t_{not\ ready\ (n+1)} = t_{exp(n)}$$

* image parameter: offset
global gain
mode
partial scan

** signal will be notified as event "TriggerReady"

Trigger Mode: overlapped trigger sequence (example for 3 frames per channel with hardware trigger)



$$t_{exp} < t_{readout}: t_{earliest\ possible\ trigger\ (n+1)} = t_{readout(n)} - t_{exp(n+1)}$$

$$t_{exp} > t_{readout}: t_{earliest\ possible\ trigger\ (n+1)} = t_{exp(n)}$$

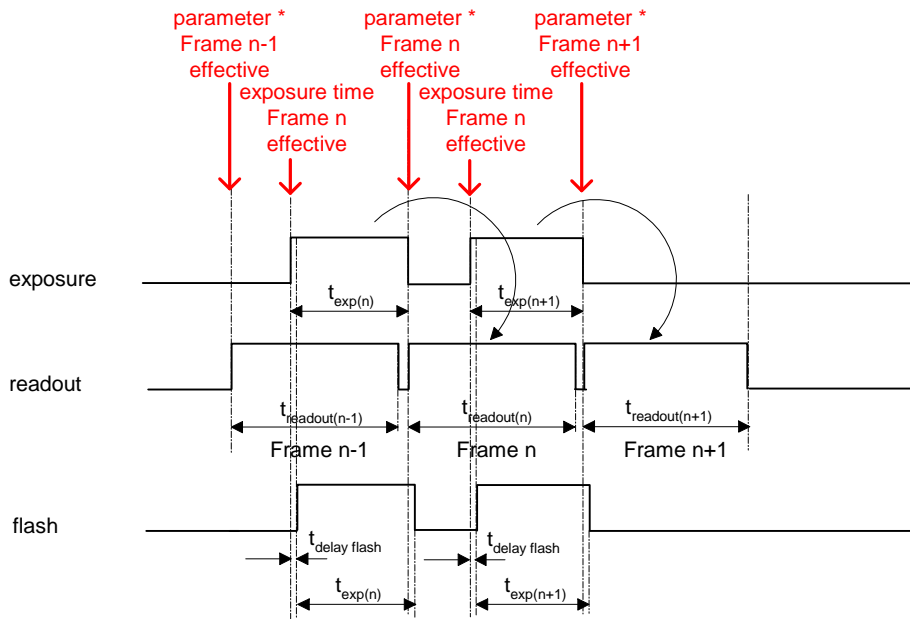
$$t_{exp} < t_{readout}: t_{not\ ready\ (n+1)} = t_{exp(n)} + t_{readout(n)} - t_{exp(n+1)}$$

$$t_{exp} > t_{readout}: t_{not\ ready\ (n+1)} = t_{exp(n)}$$

* image parameter: offset
sequence global gain
mode

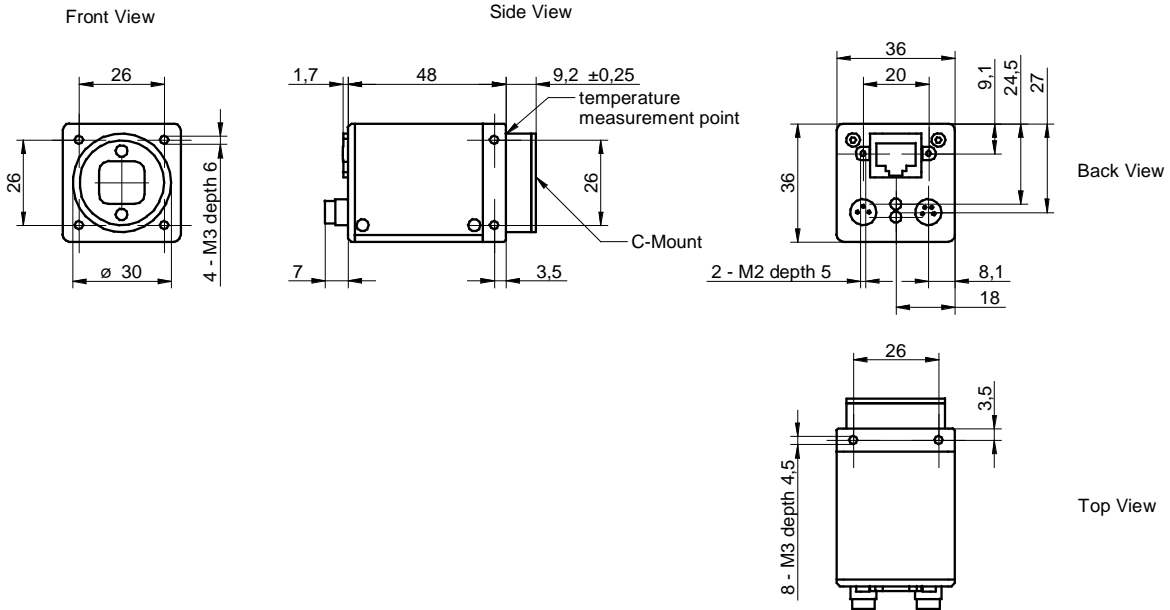
** signal will be notified as event "TriggerReady"

Free Running Mode: overlapped operation



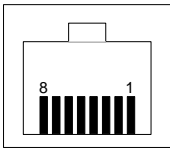
* image parameter: offset
global gain
mode
partial scan


4. Housing


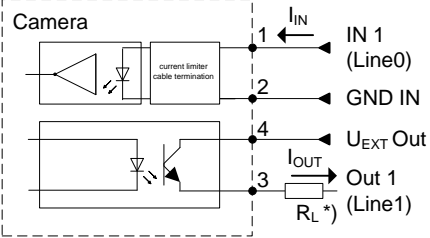


5. Connectors / Electrical Interfaces

5.1 Pin assignment:

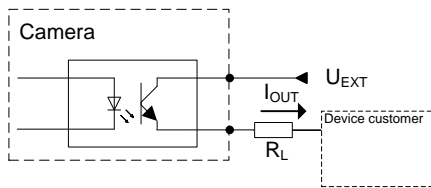
Data / Control 1000 Base-T	Type: RJ45 8P8C mod jack
	<ul style="list-style-type: none"> 1: MX1+ 2: MX1- 3: MX2+ 4: MX3+ 5: MX3- 6: MX2- 7: MX4+ 8: MX4-

Power	Type: Lumberg RSMESD / 3 pin
	<ul style="list-style-type: none"> 1: Power VCC+ 3: Power GND 4: not used
	Power cable wires color: 1 = brown 3 = blue 4 = black

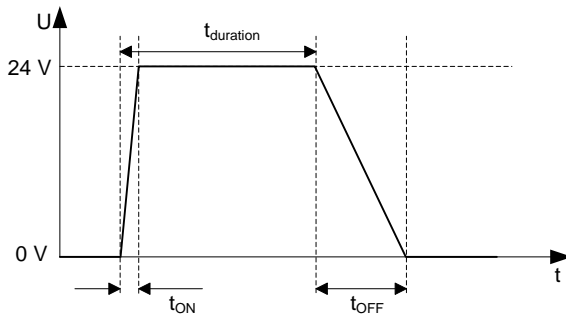
Trigger / Flash	Type: Lumberg RSMESD 4pin.
	
	*) resistor must be used, $I_{OUT} = 16 \text{ mA}$ by $U_{EXT} = 24 \text{ VDC}$ recommended, drawing shown above example for using high active signal
	Trigger / Flash cable wires color *): 1 = brown 2 = white 3 = blue 4 = black

*) shielded trigger / flash cable should be used and ordered separately

5.2 Flash sync sample $U_{EXT} = 24\text{ VDC}$ high active:

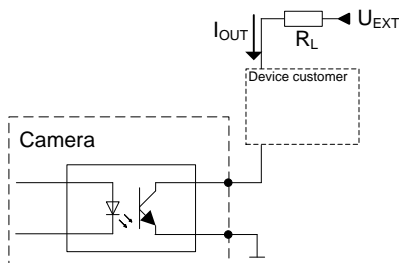


Timing example:
 measurement condition $U_{EXT} = 24\text{ VDC} / I_{OUT} = 16\text{ mA}$
 $R_L = 1.5\text{ kOhm}$

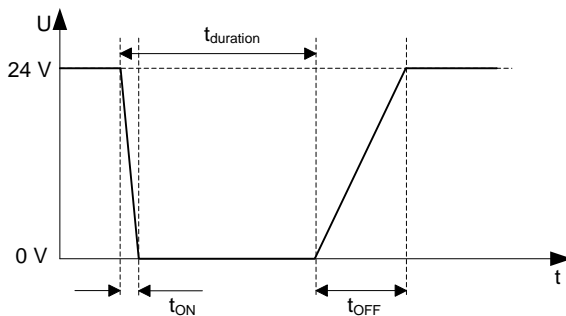


t_{ON} time = typ. $2\ \mu\text{sec}$
 t_{OFF} time = typ. $40\ \mu\text{sec}$

5.3 Flash sync sample $U_{EXT} = 24\text{ VDC}$ low active:



Timing example:
 measurement condition $U_{EXT} = 24\text{ VDC} / I_{OUT} = 16\text{ mA}$
 $R_L = 1.5\text{ kOhm}$



t_{ON} time = typ. $2\ \mu\text{sec}$
 t_{OFF} time = typ. $40\ \mu\text{sec}$

End of Document

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