

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

 System: **Gigabit Ethernet**

# Baumer TXG50-P

Revision 2.1

**Art. No: 11008685 (OD108707)**

- Gigabit Ethernet progressive scan CCD camera
- 2448 x 2050 pixel
- Up to 15 full frames per second
- GigE Vision® standard compliant
- Supported Power over Ethernet
- Outstanding image quality
- High sensitivity and dynamic range
- High quality slow scan 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  $2^{31}-1$  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	TXG50
<b>Sensor</b>	2/3" interline progressive scan CCD
Shutter / readout mode	global shutter / progressive scan readout
Number of pixel	2448 x 2050
Scan area	8.45 mm x 7.07 mm
Pixel size	3.45 µm x 3.45 µm
Color filter	-
<b>Operation modes</b>	
Trigger mode	yes, overlapped operation
Free running mode	yes, overlapped operation
<b>Signal processing</b>	Camera parameter programmable in real-time
Pixel clock	60 MHz fast scan / 30 MHz high quality (HQ) scan
A/D converter	14 bit
Exposure control ( $t_{exp}$ )	total: 4 µsec .. 2 sec step: 1 µsec
Gain control	0 .. 20 dB
Offset (black level)	0 .. 1023 LSB (14 bit)
Image data buffer	max. 1 image

Technical specifications subject to change

Image acquisition								
Camera image format modes		Format (pixel)	Gen<math>\times</math>Cam standard	Format ID	Pixel format	Pixel clock MHz	Frames per sec. *)	$t_{\text{readout}}$
Full frame HQ	slow	2448 x 2050	Vendor specific	00	Mono8 **)	30	7.5	133 msec
					Mono12			
					Mono12 Packed			
Full frame	fast	2448 x 2050	yes	01	Mono8 **)	60	15	67 msec
					Mono12 ***)			
					Mono12 Packed			
Binning 2x2 HQ	slow	1224 x 1025	Vendor specific	02	Mono8 **)	30	15	67 msec
					Mono12			
					Mono12 Packed			
Binning 2x2	fast	1224 x 1025	yes	03	Mono8 **)	60	30	34 msec
					Mono12			
					Mono12 Packed			
Binning 1x2 HQ	slow	2448 x 1025	Vendor specific	04	Mono8 **)	30	15	67 msec
					Mono12			
					Mono12 Packed			
Binning 1x2	fast	2448 x 1025	yes	05	Mono8 **)	60	30	34 msec
					Mono12			
					Mono12 Packed			
Binning 2x1 HQ	slow	1224 x 2050	Vendor specific	06	Mono8 **)	30	7.5	133 msec
					Mono12			
					Mono12 Packed			
Binning 2x1	fast	1224 x 2050	yes	07	Mono8 **)	60	15	67 msec
					Mono12			
					Mono12 Packed			
<b>Standard features</b>								
<b>Image size controls</b>								
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)							
<b>Analog controls</b>								
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							

Technical specifications subject to change

<b>Acquisition and Trigger</b>	
Acquisition mode	Continuous
Acquisition frame rate	yes, ON / OFF (only in freerunning mode) 0 .. 91 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 <sup>31</sup> -1 frames per sequence / one exposure time and gain value for each parameter set max. set of sequences: Up to 2 <sup>31</sup> -1 frames x 256 parameter sets
<b>Digital I/O</b>	
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
<b>Event Generation</b>	
Events	GigEVisionError, Heartbeattimeout, TemperatureExceeded, EventLost, Line0RisingEdge, Line0FallingEdge, Line1RisingEdge, Line1FallingEdge, ExposureStart, ExposureEnd, FrameStart, FrameEnd, TriggerReady, TriggerOverlapped, TriggerSkipped
Event Notification	yes, ON / OFF
<b>Counters and Timers</b>	
Framecounter	yes, 2 <sup>32</sup> 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
<b>LUT Controls</b>	
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
<b>GigEVisionTransportLayer</b>	
PayLoadsize	4 Byte .. 10.037.100 Byte
TransmissionDelay (custom)	0 .. 2 <sup>32</sup> -1 ticks
<b>UserSets</b>	
User set selector	Default (factory settings / read only) UserSet1, UserSet2, UserSet3 (read and write)
UserSetDefaultSelector	yes, define the start up "UserSet"
<b>Advanced features</b>	
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 (temperature value is notified as asynchronous message event)
<b>Data quality</b>	
	at 20 °C, gain = 1, exposure time = 32 msec, full frame mode, slow scan
Readout noise	σ < 0.5 LSB (8 bit) typical
Dynamic range	typical > 54 dB
<b>Optical interface</b>	
	C-Mount on request: CS-Mount
Optical filter	dust protection on request: super polished, IR cut filter, daylight filter or no filter



<b>Software</b>	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

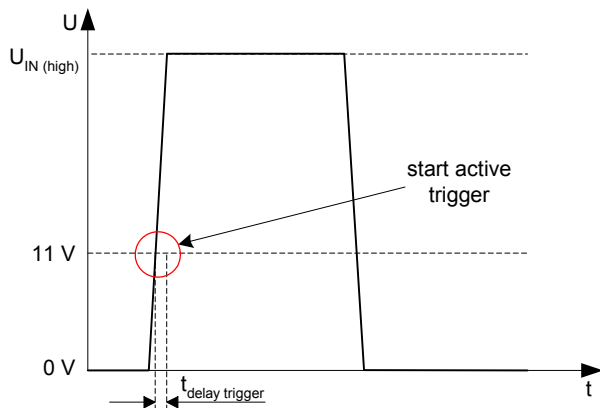
- \*) maximum frame rate in free running mode, effective frame rate depending on camera image format mode settings and set exposure time ( $t_{exp} < t_{readout}$ )
- \*\*\*) default pixel format
- \*\*\*\*) bandwidth of GigE interface is limiting frame rate
- \*\*\*\*\*) the LUT function will be used for the gamma value and the calculation time of the internal used LUT need app. 2 sec, if the gamma value changed
- \*\*\*\*\*) between 38 VDC and 57 VDC IEEE802.3 clause 33 conform
- \*\*\*\*\*) can be inverted via software
- \*\*\*\*\*) housing temperature is limited by CCD sensor specification

## 2. Camera Factory Settings after Camera Start-up

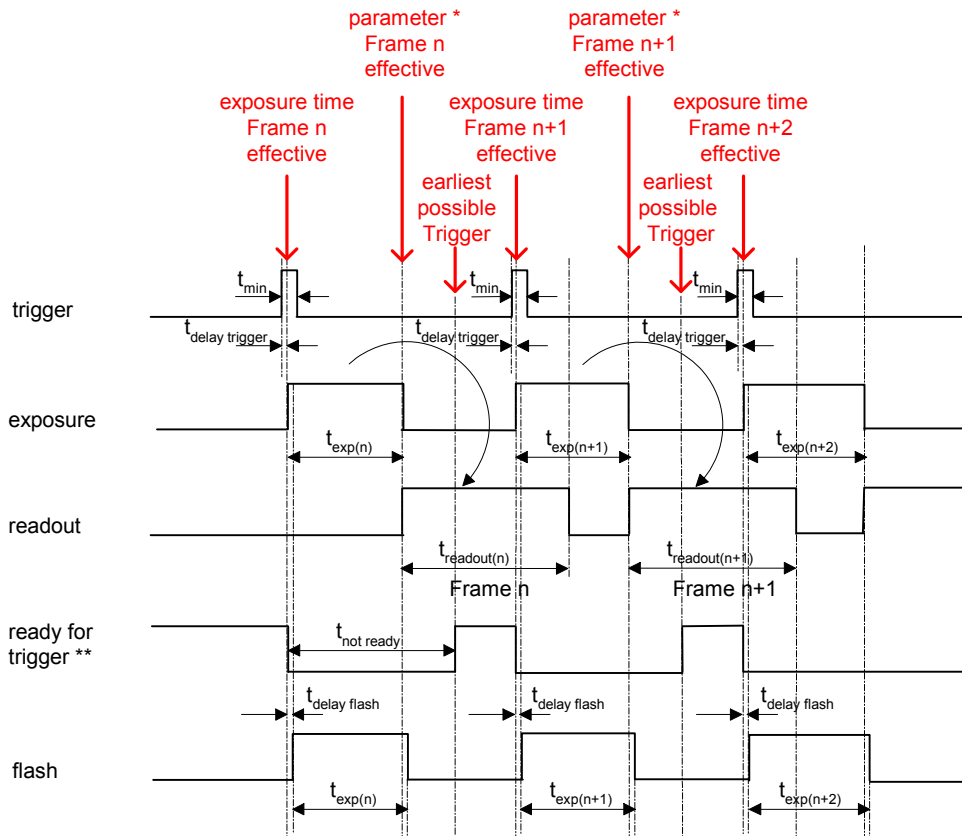
Camera factory settings after camera start-up	
<b>Operation modes</b>	free running mode
<b>Signal processing</b>	
Exposure control	32 msec
Gain control	factor 1 = 0 dB
Offset (black level)	0
<b>Image acquisition</b>	
Camera image format mode	mode id = 01, full frame Mono8
Partial scan function	not active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

## 3. Timing Operation Modes

Trigger Mode: start up time



Trigger Mode: trigger mode 0, overlapped trigger



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

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

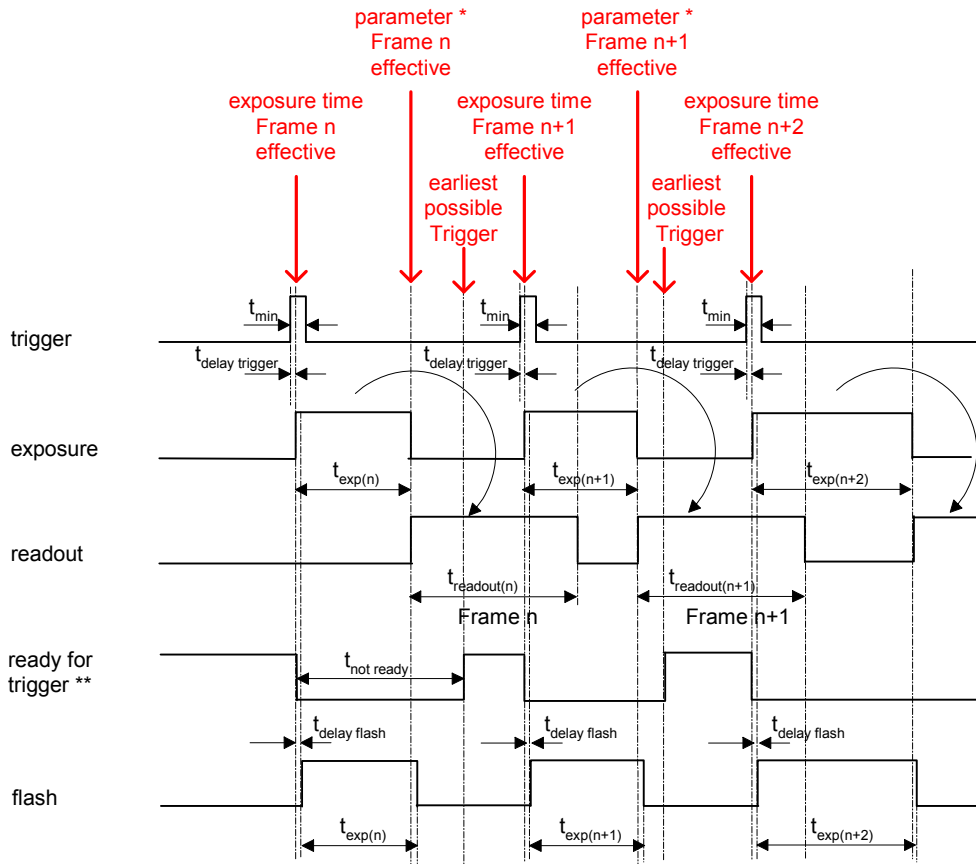
$$t_{exp} < t_{readout}: t_{\text{not ready (n+1)}} = t_{exp(n)} + t_{readout(n)} - t_{exp(n+1)}$$

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

\* image parameter:    offset  
                               global gain  
                               mode  
                               partial scan

\*\* signal will be notified as event "TriggerReady" and is not available as digital output

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



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

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

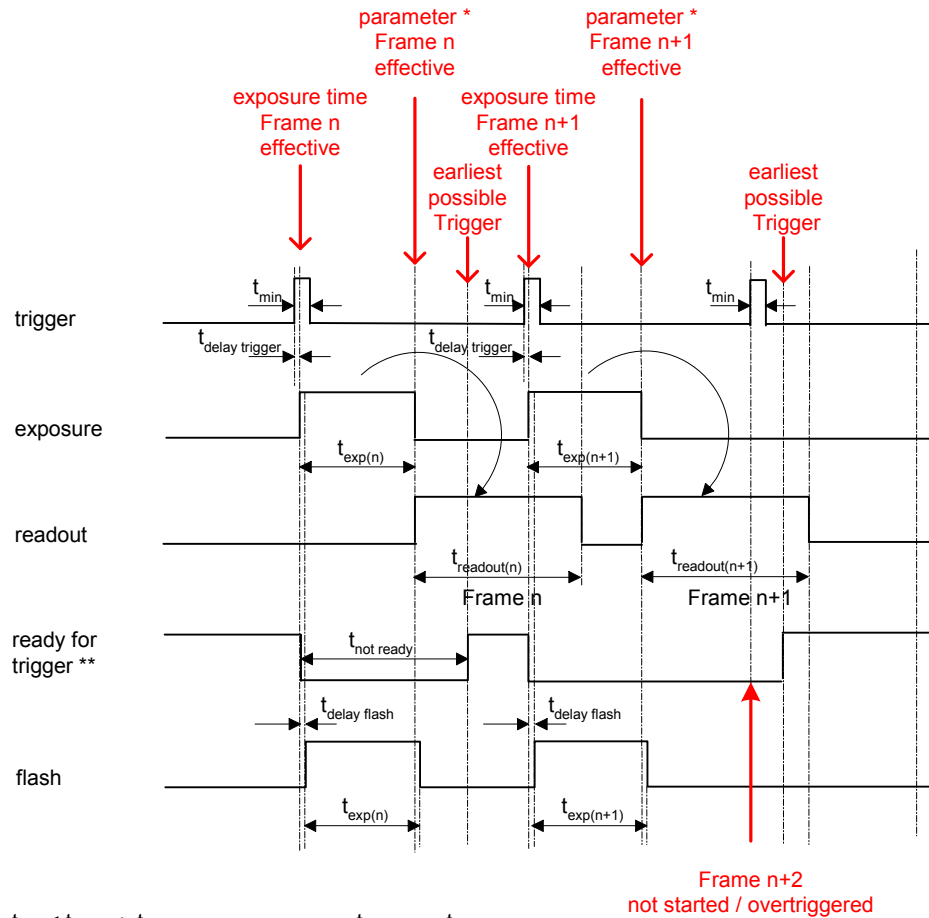
$$t_{exp} < t_{readout}: t_{not\ ready\ (n+1)} = t_{exp(n)} + t_{readout(n)} - t_{exp(n+1)}$$

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

\* image parameter: offset  
global gain  
mode  
partial scan

\*\* signal will be notified as event "TriggerReady" and is not available as digital output

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



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

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

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

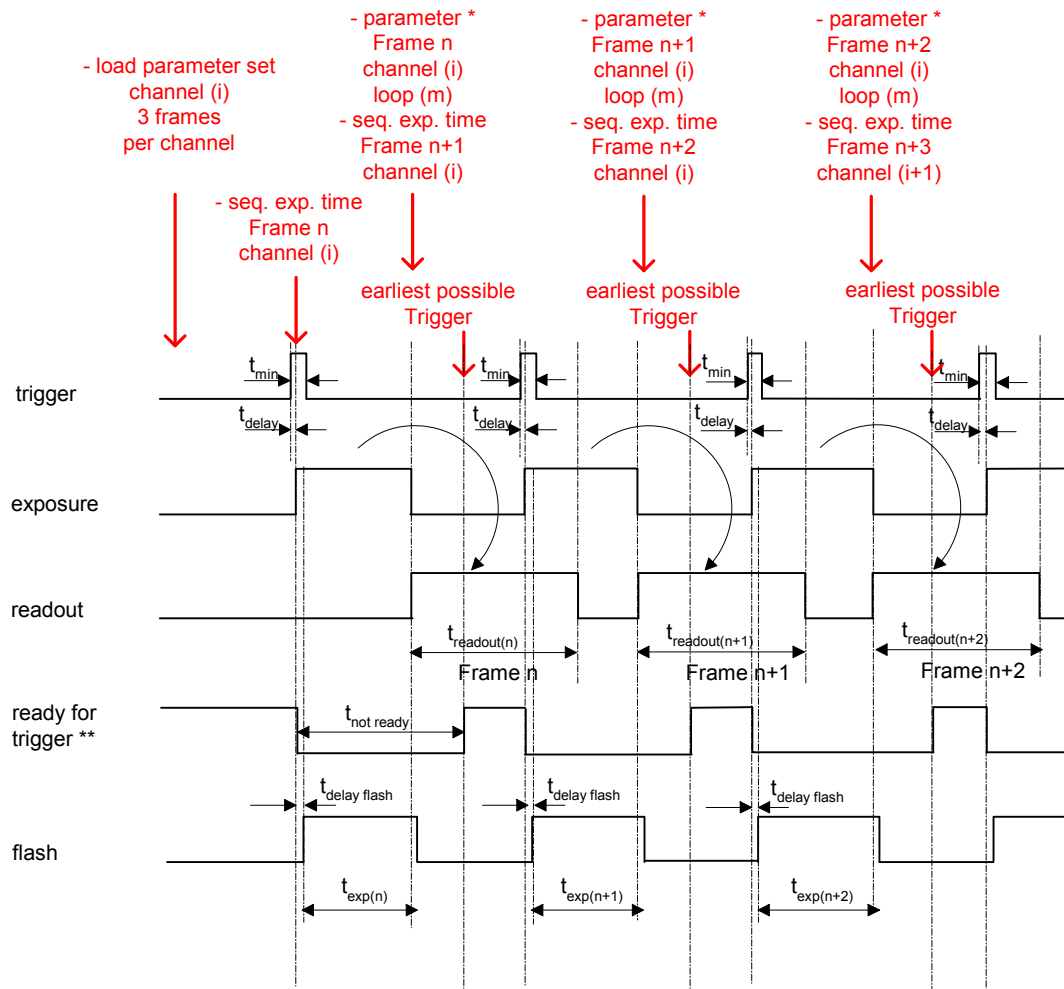
$$t_{exp} > t_{readout}: t_{not\ ready\ (n+1)} = t_{exp(n)}$$

\* image parameter: offset  
global gain  
mode  
partial scan

\*\* signal will be notified as event "TriggerReady" and is not available as digital output



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



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

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

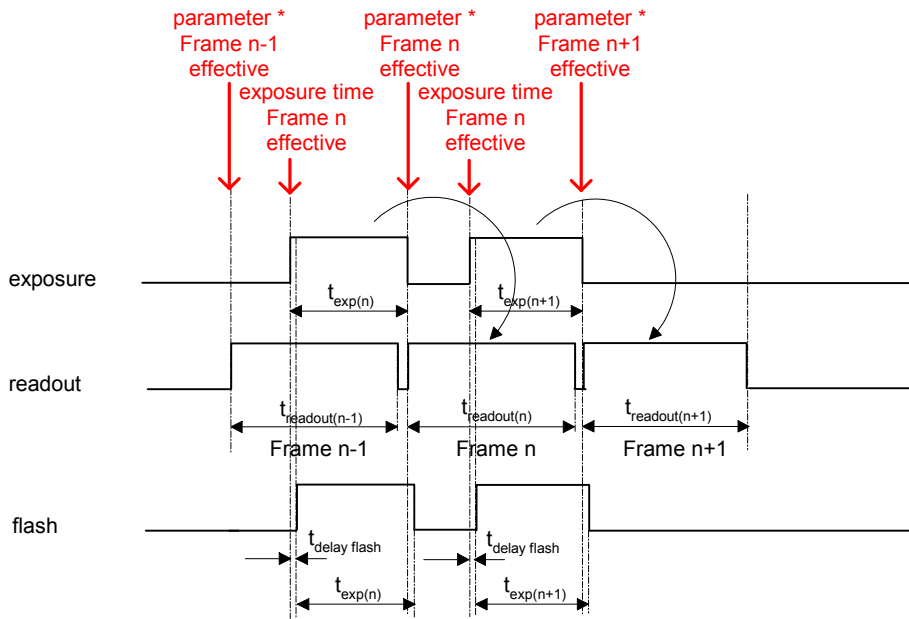
$$t_{exp} < t_{readout}: t_{not\ ready\ (n+1)} = t_{exp(n)} + t_{readout(n)} - t_{exp(n+1)}$$

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

\* image parameter: offset  
sequence global gain  
mode

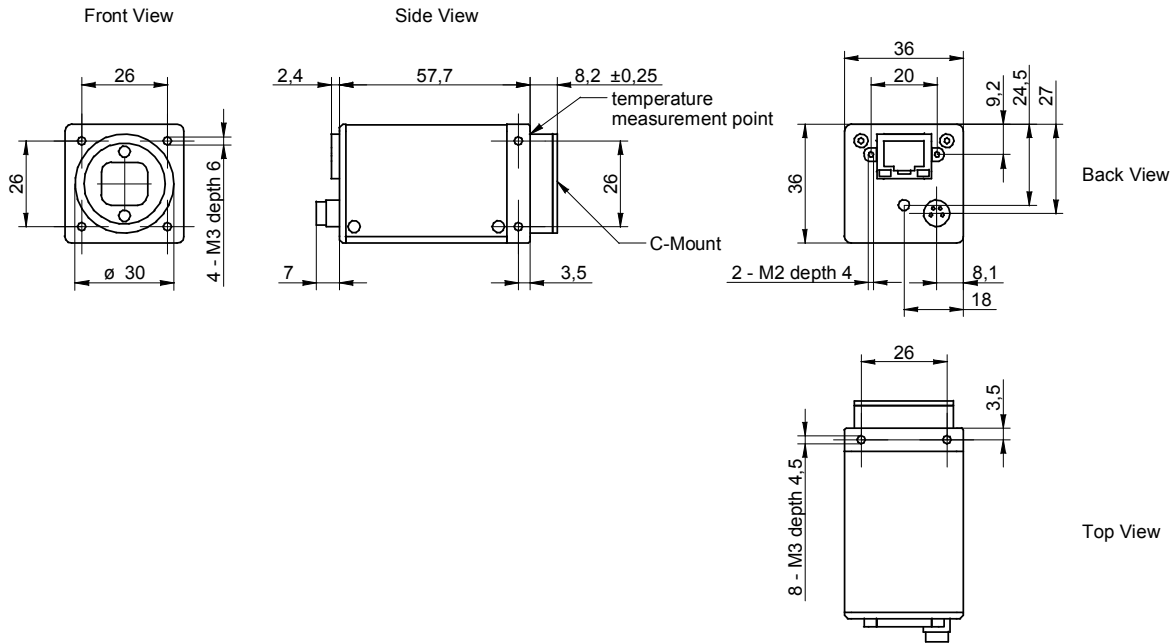
\*\* signal will be notified as event "TriggerReady" and is not available as digital output

Free Running Mode: overlapped operation



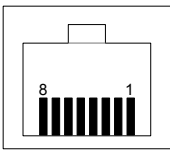
\* image parameter: offset  
 global gain  
 mode  
 partial scan

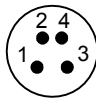
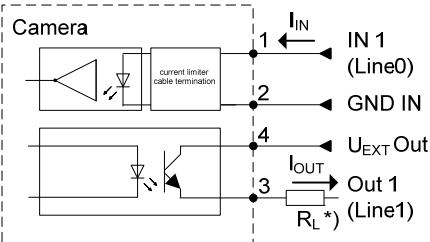
### 4. Housing



### 5. Connectors / Electrical Interfaces

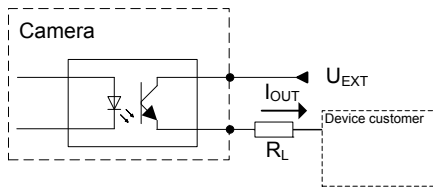
#### 5.1 Pin assignment:

<b>Data / Control</b> <b>1000 Base-T</b>	Type: RJ45 8P8C mod jack
	<p>1: MX1+ (negative / positive <math>V_{port}</math>)</p> <p>2: MX1- (negative / positive <math>V_{port}</math>)</p> <p>3: MX2+ (positive / negative <math>V_{port}</math>)</p> <p>4: MX3+</p> <p>5: MX3-</p> <p>6: MX2- (positive / negative <math>V_{port}</math>)</p> <p>7: MX4+</p> <p>8: MX4-</p>

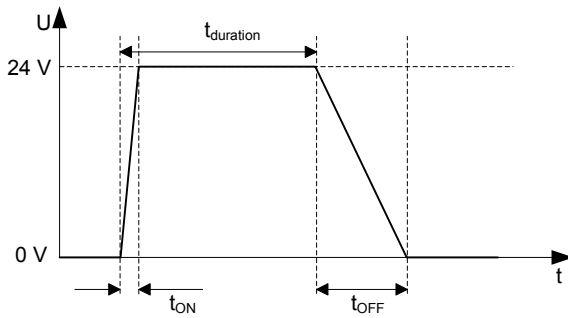
<b>Trigger Flash</b>	Type: Lumberg RSMESSD 4pin.
	 <p>*) resistor must be used, <math>I_{OUT} = 16 \text{ mA}</math> by <math>U_{EXT} = 24 \text{ VDC}</math> recommended, drawing shown above example for using high active signal</p> <p>Trigger / Flash cable wires color *):</p> <ul style="list-style-type: none"> <li>1 = brown</li> <li>2 = white</li> <li>3 = blue</li> <li>4 = black</li> </ul>

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

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

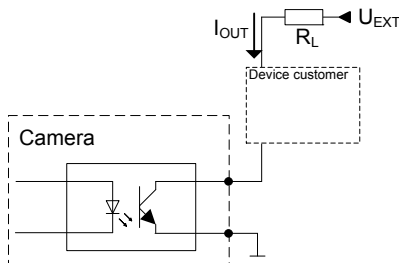


Timing example:  
 measurement condition  $U_{EXT} = 24 \text{ VDC} / I_{OUT} = 16 \text{ mA}$   
 $R_L = 1.5 \text{ kOhm}$

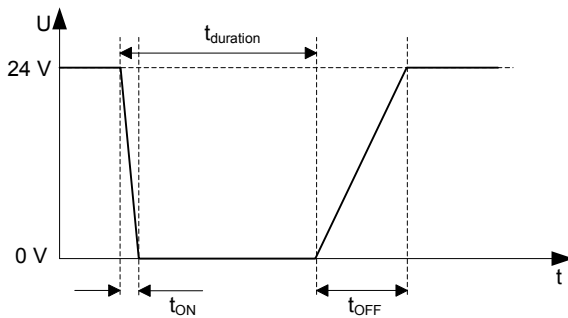


$t_{ON}$  time = typ.  $2 \mu\text{sec}$   
 $t_{OFF}$  time = typ.  $40 \mu\text{sec}$

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.  $40 \mu\text{sec}$

## 6. Application Note

- Baumer recommends that the camera should not be used unmounted.
  - The camera should be mounted on a metal rack for using in warm environment. It is necessary to note the max. housing temperature of the camera.
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