

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

 System: **Gigabit Ethernet**
Baumer TXG50-I7

Revision 2.1

Art. No: 11008686

- Gigabit Ethernet progressive scan CCD camera
- 2448 x 2050 pixel
- Up to 15 full frames per second
- GigE Vision® standard compliant
- 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 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
- IP67 camera housing design based on EHEDG recommendation
- Standard M12 industrial connector
- Baumer-GAPI: Flexible, generic software interface for Windows / Linux



shown tubes need to be ordered separately

1. Overview

Model Name	TXG50
Sensor	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	-
Operation modes	
Trigger mode	yes, overlapped operation
Free running mode	yes, overlapped operation
Signal processing	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\leftrightarrowCam standard	Format ID	Pixel format	Pixel clock MHz	Frames per sec. *)	t_{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	Mono08 (**)) (**))	60	30	34 msec
					Mono12			
					Mono12 Packed			
Binning 1x2 HQ	slow	2448 x 1025	Vendor specific	04	Mono08 (**)) (**))	30	15	67 msec
					Mono12			
					Mono12 Packed			
Binning 1x2	fast	2448 x 1025	yes	05	Mono08 (**)) (**))	60	30	34 msec
					Mono12			
					Mono12 Packed			
Binning 2x1 HQ	slow	1224 x 2050	Vendor specific	06	Mono08 (**)) (**))	30	7.5	133 msec
					Mono12			
					Mono12 Packed			
Binning 2x1	fast	1224 x 2050	yes	07	Mono08 (**)) (**))	60	15	67 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							
Trigger source	HardwareTrigger (Line0), SoftwareTrigger, CommandTrigger (ActionCommand), All or Off							
Trigger delay	0 .. 2 sec, 512 trigger can be tracked, step: 1 μ sec							
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, TemperatureExceeded, 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
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 .. 10.037.100 Byte
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
Data quality	
Readout noise	at 20 °C, gain = 1, exposure time = 32 msec, full frame mode, slow scan $\sigma < 0.5$ LSB (8 bit) typical
Dynamic range	typical > 54 dB
Optical interface	
Optical filter	C-Mount 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 ($t_{\text{delay flash}}$) ≤ 4 µsec, duration_value (t_{duration}): slow mode = $t_{\text{exp}} + 64$ µsec fast mode = $t_{\text{exp}} + 32$ µsec
User Output	yes, ON / OFF
Software reset	yes, delay up to 133 msec
Asynchronous reset	Full frame / Binning 2x1 slow delay up to 45 msec fast 24 msec
	Binning 2x2 / Binning 1x2 slow delay up to 23 msec fast 12 msec
Image info header	yes

Electrical interface				
Data / control	standard single cable 1000 Base-T with M12 connector, Cat6 recommended / minimum Cat5e			
Power	VCC: 8 VDC .. 30 VDC I: 615 mA .. 190 mA			
Power consumption	approx. 5.2 Watt			
Digital input	Line 0: trigger signal, opto decoupled $U_{IN(low)} = 0 .. 4.5$ VDC, $U_{IN(high)} = 11 .. 30$ VDC $I_{IN} = 6 .. 10$ mA / 7 mA typical rising edge (invert = false) ***** min. impulse length (t_{min}): 2 μ sec trigger delay out of $t_{readout}$ ($t_{delay trigger}$): 3 μ sec max. trigger delay during $t_{readout}$ ($t_{delay trigger}$): slow mode = 64 μ sec fast mode = 32 μ sec			
Digital output	Line 1: opto decoupled $U_{EXT} = 5 .. 30$ VDC / 24 VDC typical, $I_{OUT} = \text{max. } 16$ 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 +37 °C .. +50 °C, note the max. housing temperature see application note			
Housing operating temperature	max. +50 °C ***** (measurement point, see item 4)			
Humidity	10 % .. 90 % non condensing			
Conformity	CE, FCC Part 15 class B, RoHS compliant			
Housing				
Dimensions	aluminum, IP67 $\varnothing 65$ mm x 50 mm			
Weight camera	< 380 g			
Weight tube	52 mm	62 mm	71 mm	94 mm
	< 120 g	< 140 g	< 150 g	< 200 g
1000 Base-T 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			
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			

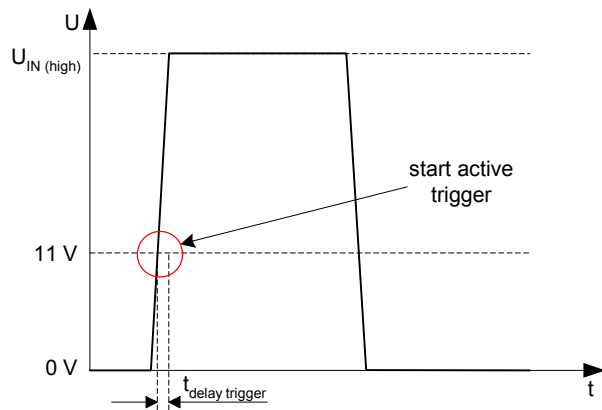
- *) maximum frame rate in free running mode, effective frame rate depending on camera image format mode settings and set exposure time ($t_{exp} < t_{readout}$)
- ***) default pixel format
- ****) bandwidth of GigE interface is limiting frame rate
- *****) the LUT function will be used for the gamma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

2. Camera Factory Settings after Camera Start-up

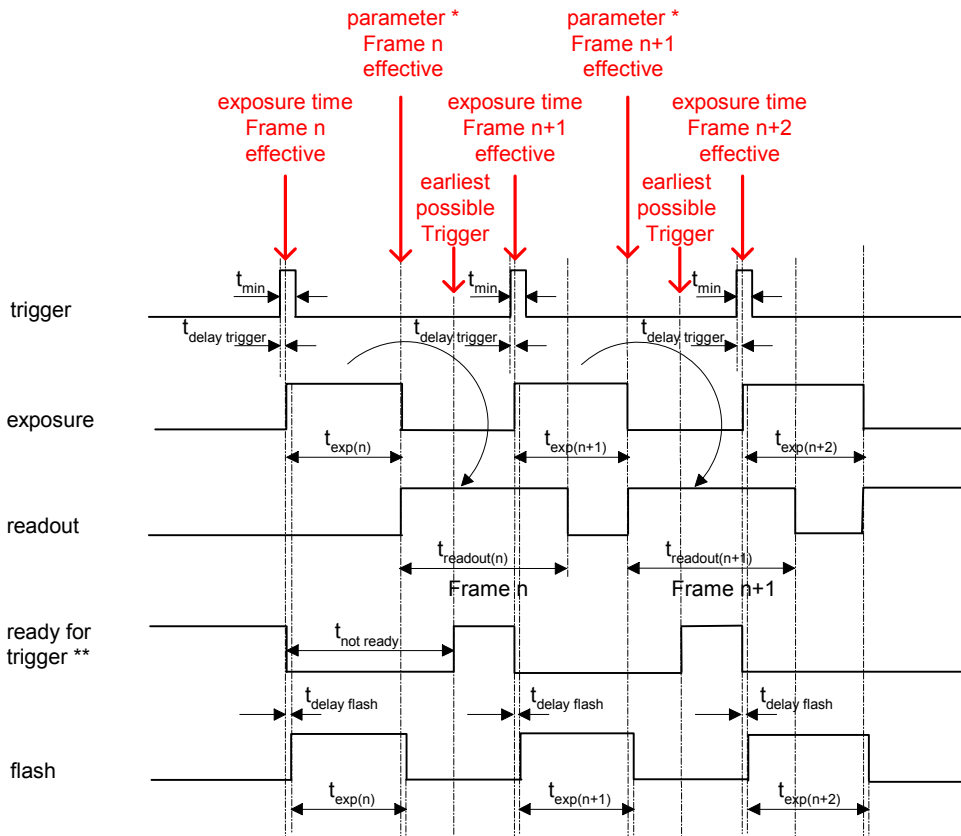
Camera factory settings after camera start-up	
Operation modes	free running mode
Signal processing	
Exposure control	32 msec
Gain control	factor 1 = 0 dB
Offset (black level)	0
Image acquisition	
Camera image format mode	mode id = 01, full frame Mono8
Partial scan function	not active
Test image selector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

3. Timing Operation Modes

Trigger Mode: start up time



Trigger Mode: trigger mode 0, overlapped trigger



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

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

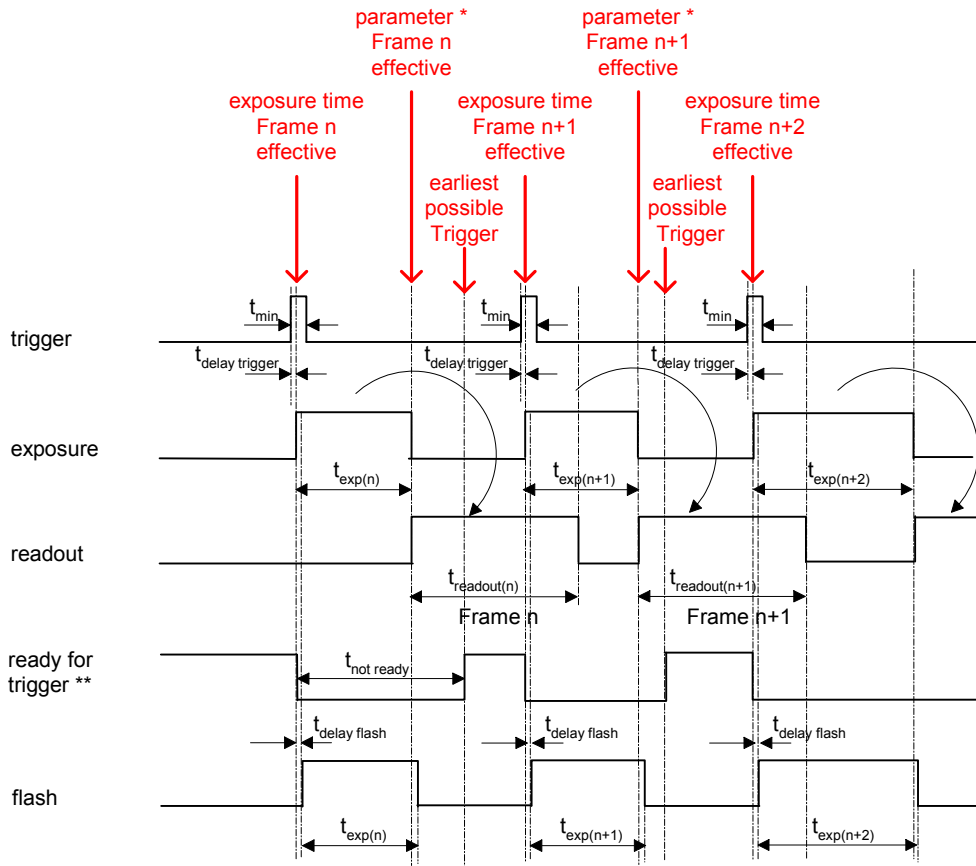
$$t_{exp} < t_{readout}: t_{not\ ready\ (n+1)} = t_{exp(n)} + t_{readout(n)} - t_{exp(n+1)}$$

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

* 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 $t_{exp(n+2)} > t_{exp(n+1)}$



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

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

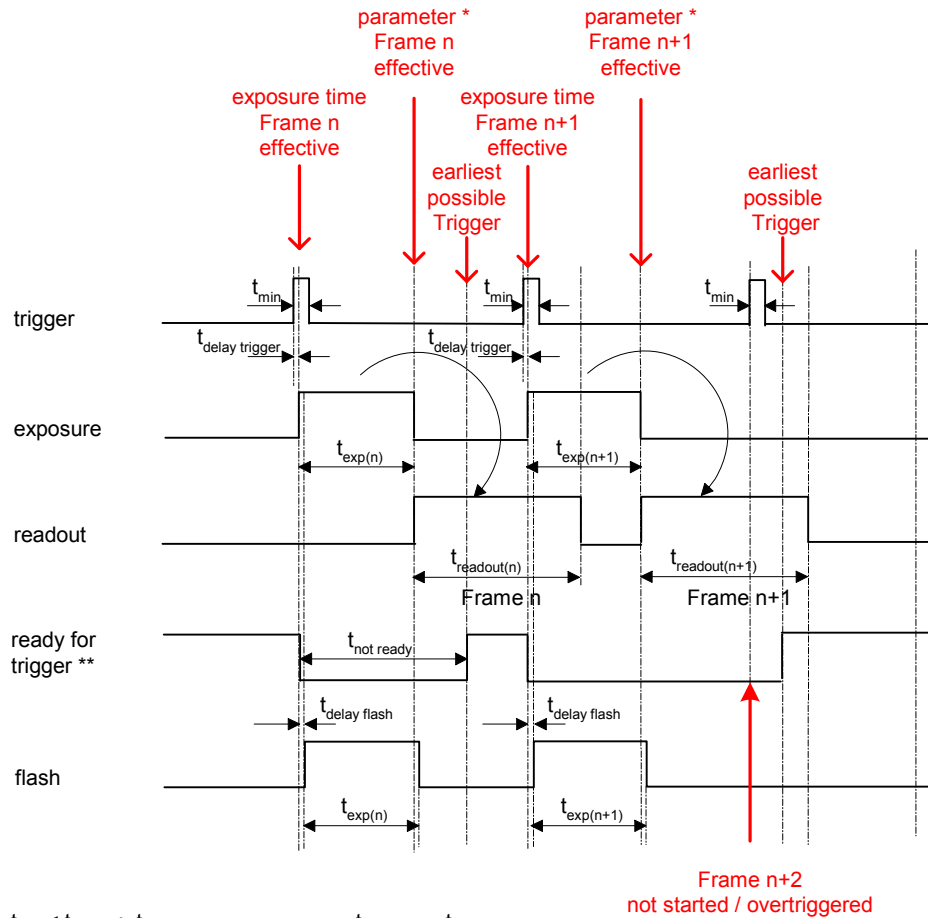
$$t_{exp} < t_{readout}: t_{not\ ready\ (n+1)} = t_{exp(n)} + t_{readout(n)} - t_{exp(n+1)}$$

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

* image parameter: offset
global gain
mode
partial scan

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

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



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

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

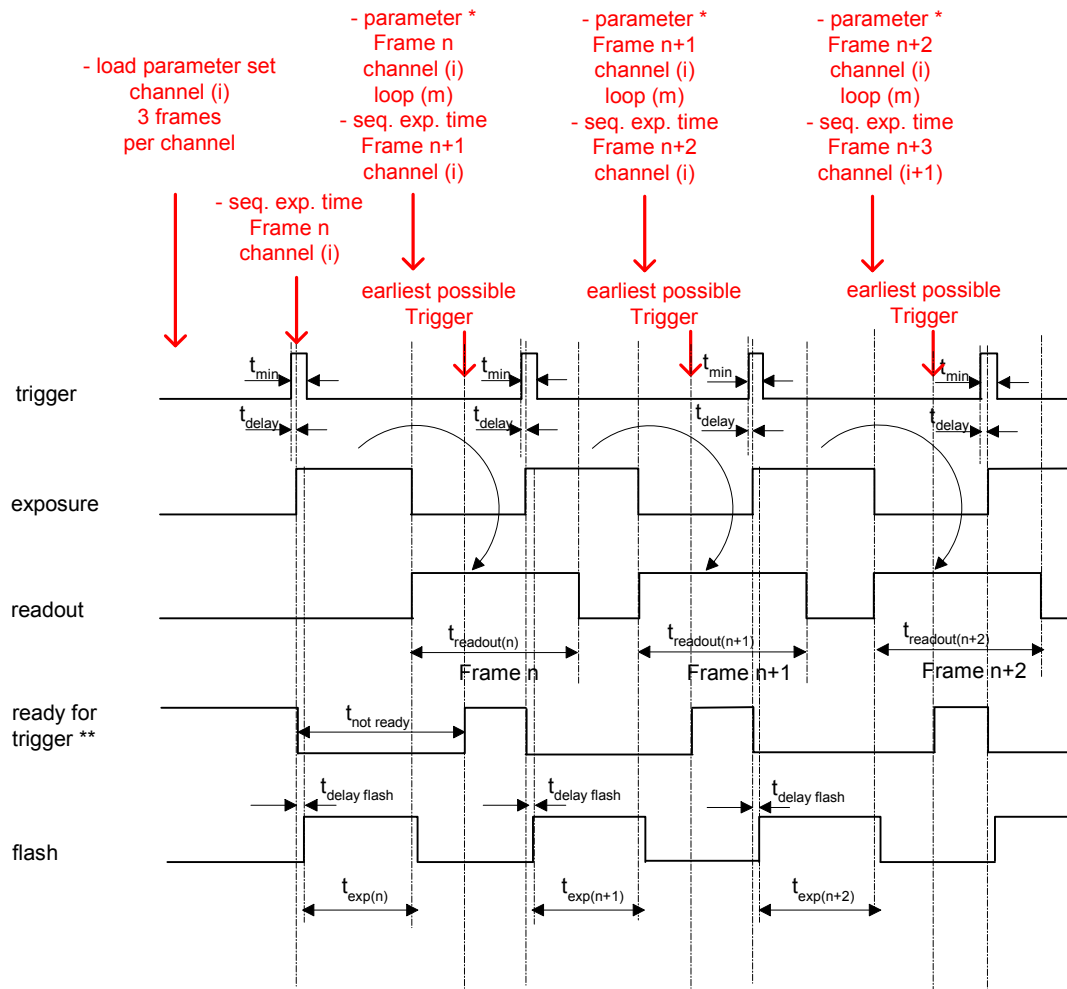
$$t_{exp} < t_{readout}: t_{not\ ready\ (n+1)} = t_{exp(n)} + t_{readout(n)} - t_{exp(n+1)}$$

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

* 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)

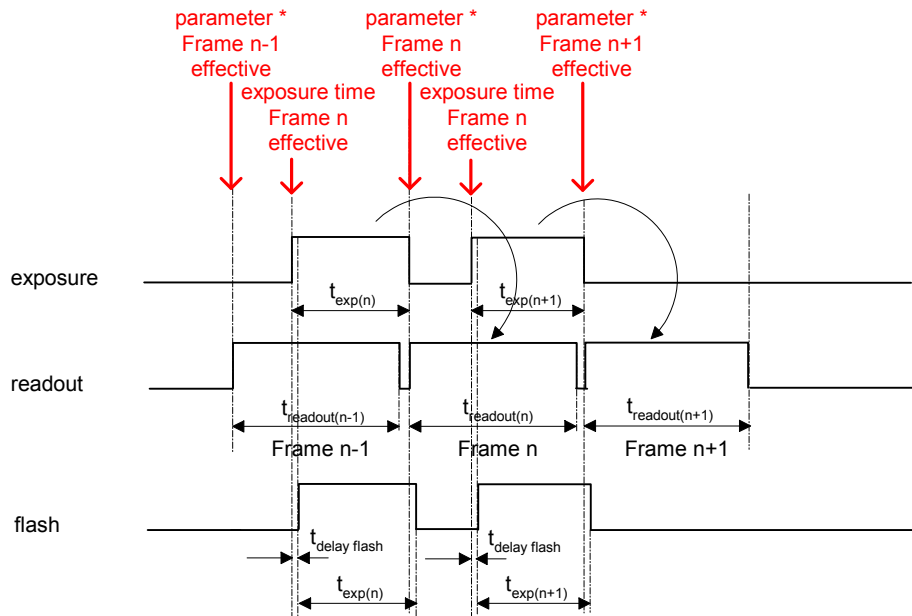


$$\begin{aligned}
 t_{exp} < t_{readout}: t_{earliest\ possible\ trigger\ (n+1)} &= t_{readout(n)} - t_{exp(n+1)} \\
 t_{exp} > t_{readout}: t_{earliest\ possible\ trigger\ (n+1)} &= t_{exp(n)} \\
 t_{exp} < t_{readout}: t_{not\ ready\ (n+1)} &= t_{exp(n)} + t_{readout(n)} - t_{exp(n+1)} \\
 t_{exp} > t_{readout}: t_{not\ ready\ (n+1)} &= t_{exp(n)}
 \end{aligned}$$

* image parameter: offset
sequence global gain
mode

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

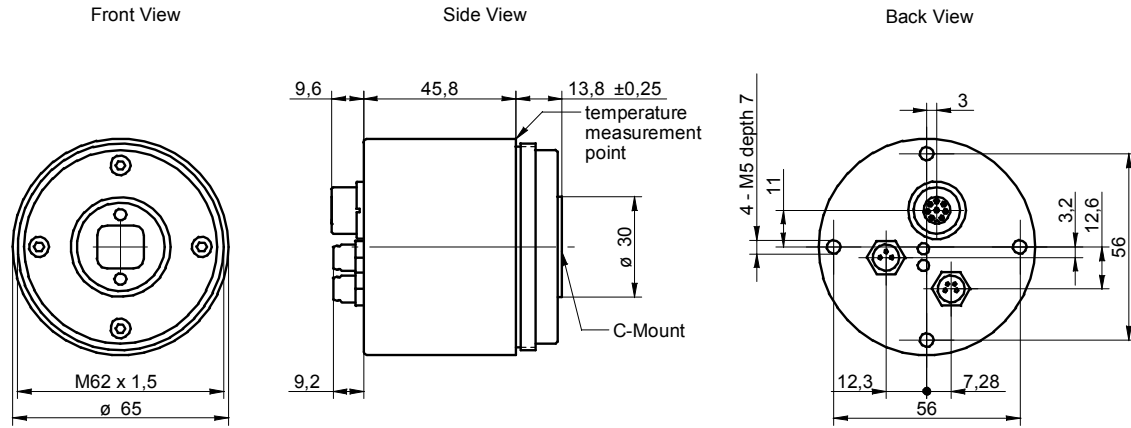
Free Running Mode: overlapped operation



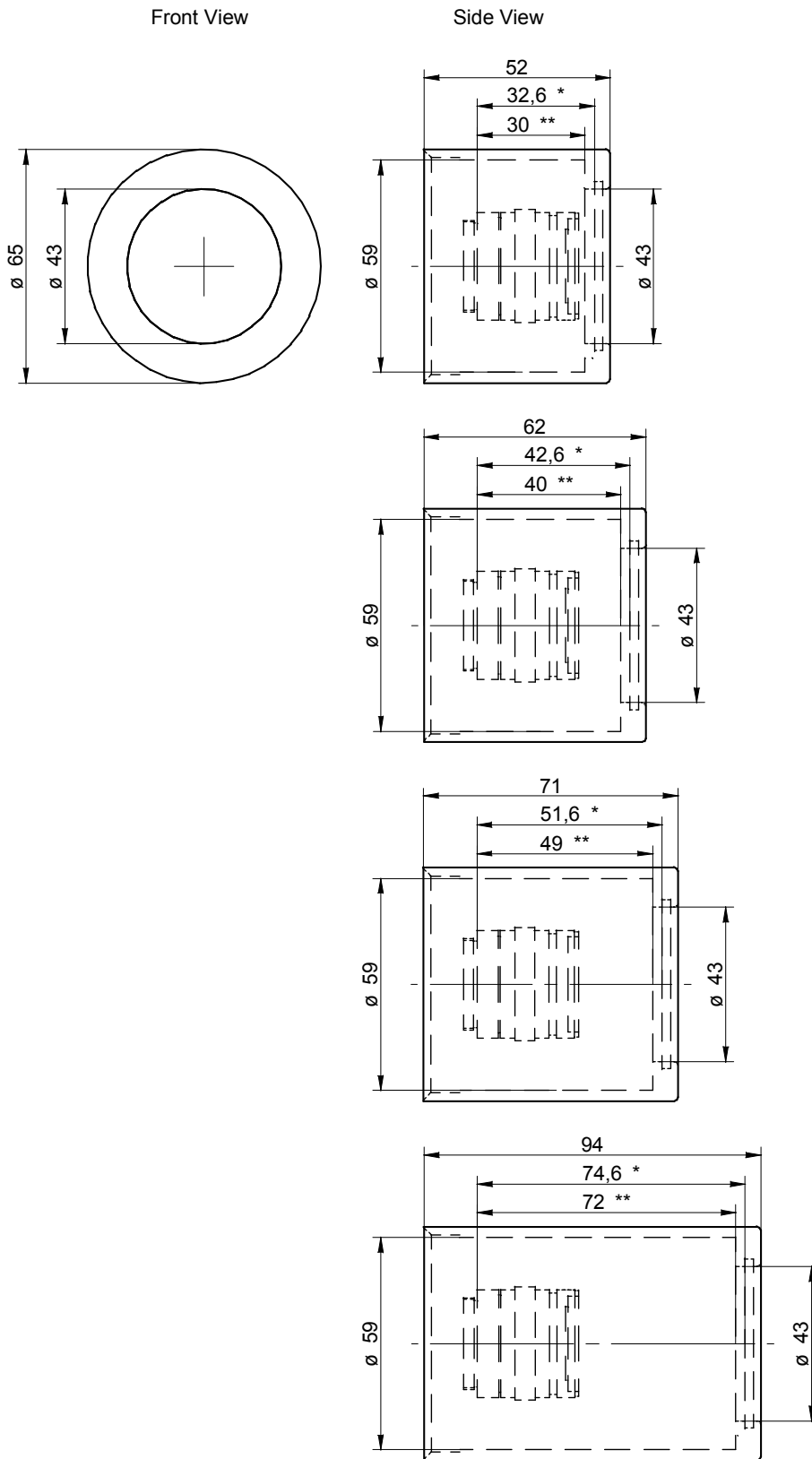
* image parameter: offset
global gain
mode
partial scan

4. Housing

4.1 Camera



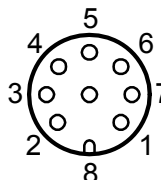
4.2 Tube

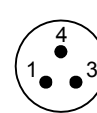



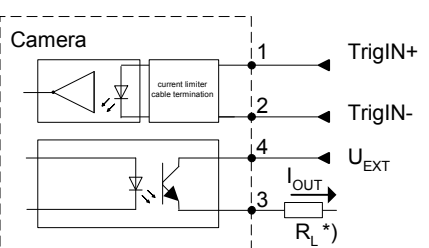
* max. installation space between C-mount and glass
 ** max. installation space between C-mount and cylinder bottom

5. Connectors / Electrical Interfaces

5.1 Pin assignment:

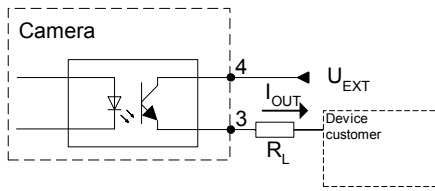
Data / Control 1000 Base-T	Type: female M12 / 8 pin A cod.
	1: MX3- 2: MX4+ 3: MX4- 4: MX1- 5: MX2+ 6: MX1+ 7: MX3+ 8: MX2-

Power	Type: Lumberg RSME5D / 3 pin
	1: Power VCC+ 3: GND 4: not used
	Power cable wires color: 1 = brown 3 = blue 4 = black

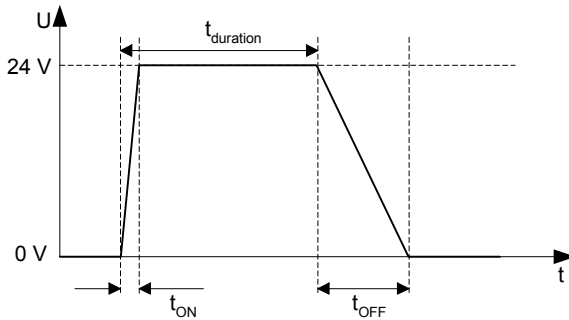
Trigger Flash	Type: Lumberg RSME5D 4pin.
	 <p>*) resistor must be used, $I_{OUT} = 16 \text{ mA}$ by $U_{EXT} = 24 \text{ VDC}$ recommended, drawing shown above example for using high active signal</p>
	Trigger / Flash cable wires color *): 1 = brown 2 = white 3 = blue 4 = black

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

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

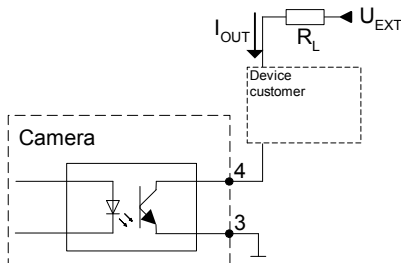


Timing example:
 measurement condition $U_{EXT} = 24\text{ VDC} / I_{OUT} = 16\text{ mA}$
 $R_L = 1.5\text{ kOhm}$

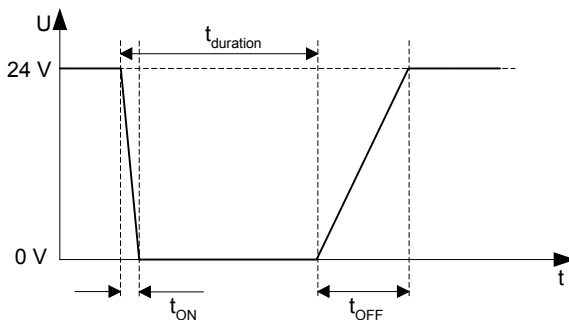


t_{ON} time = typ. $2\ \mu\text{sec}$
 t_{OFF} time = typ. $40\ \mu\text{sec}$

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. $40\ \mu\text{sec}$

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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