

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

 System: **Gigabit Ethernet**
**Baumer TXG03-I7**

Revision 2.1

**Art. No: 11008764**

- Gigabit Ethernet progressive scan CCD camera
- 656 x 494 pixel
- Up to 90 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 2<sup>31</sup>-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	TXG03
Sensor	1/3" interline progressive scan CCD HAD technology
Shutter / readout mode	global shutter / progressive scan readout
Number of pixel	656 x 494
Scan area	4.85 mm x 3.65 mm
Pixel size	7.4 µm x 7.4 µm
Color filter	-
<b>Operation modes</b>	
Trigger mode	yes, overlapped operation
Free running mode	yes, overlapped operation
<b>Signal processing</b>	real-time software programmable
Pixel clock	40 MHz fast scan / 20 MHz high quality (HQ) scan
A/D converter	12 bit
Exposure control (t <sub>exp</sub> )	total: 4 µsec .. 60 sec step: 1 µsec
Gain control	0 .. 20 dB
Offset (black level)	0 .. 255 LSB (12 bit)
Image data buffer	max. 31 images

Technical specifications subject to change

Image acquisition								
Camera image format modes		Format (pixel)	Gen<math>\leftrightarrow</math>Cam standard	Format ID	Pixel format	Pixel clock MHz	Frames per sec. *)	$t_{\text{readout}}$
Full frame HQ	slow	656 x 494	Vendor specific	00	Mono8 (**)) (**))	20	46	22 msec
					Mono12			
					Mono12 Packed			
Full frame	fast	656 x 494	yes	01	Mono8 (**)) (**))	40	90	11 msec
					Mono12			
					Mono12 Packed			
Binning 2x2 HQ	slow	328 x 247	Vendor specific	02	Mono8 (**)) (**))	20	86	12 msec
					Mono12			
					Mono12 Packed			
Binning 2x2	fast	328 x 247	yes	03	Mono08 (**)) (**))	40	166	6 msec
					Mono12			
					Mono12 Packed			
Binning 1x2 HQ	slow	656 x 247	Vendor specific	04	Mono08 (**)) (**))	20	86	12 msec
					Mono12			
					Mono12 Packed			
Binning 1x2	fast	656 x 247	yes	05	Mono08 (**)) (**))	40	166	6 msec
					Mono12			
					Mono12 Packed			
Binning 2x1 HQ	slow	328 x 494	Vendor specific	06	Mono08 (**)) (**))	20	46	22 msec
					Mono12			
					Mono12 Packed			
Binning 2x1	fast	328 x 494	yes	07	Mono08 (**)) (**))	40	90	11 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							
<b>Acquisition and Trigger</b>								
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 $\mu$ 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							

Technical specifications subject to change

<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, 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
<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 .. 648.400 Byte
<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
<b>Data quality</b>	
	at 20 °C, gain = 1, exposure time = 32 msec, full frame mode, slow scan
Readout noise	$\sigma < 0.5$ LSB (8 bit) typical
Dynamic range	typical > 54 dB
<b>Optical interface</b>	
Optical filter	dust protection on request: super polished, IR cut filter, daylight filter or no filter
<b>Process interface functions</b>	
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 ( $t_{\text{delay flash}}$ ) $\leq 4$ µsec, duration_value ( $t_{\text{duration}}$ ): slow mode = $t_{\text{exp}} + 41$ µsec fast mode = $t_{\text{exp}} + 21$ µsec
User Output	yes, ON / OFF
Software reset	yes, delay up to 102 msec
Asynchronous reset	Full frame / Binning 2x1    slow    delay up to 4.9 msec fast    2.5 msec
	Binning 2x2 / Binning 1x2    slow    delay up to 2.7 msec fast    1.3 msec
Image info header	yes

<b>Electrical interface</b>									
Data / control	standard single cable 1000 Base-T with M12 connector, Cat6 recommended / minimum Cat5e								
Power	VCC: 8 VDC .. 30 VDC I: 370 mA .. 120 mA								
Power consumption	approx. 3.5 Watt								
Digital input	Line 0: 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 $\mu\text{sec}$ trigger delay out of $t_{readout}$ ( $t_{delay \text{ trigger}}$ ): 3 $\mu\text{sec}$ max. trigger delay during $t_{readout}$ ( $t_{delay \text{ trigger}}$ ): slow mode = 41 $\mu\text{sec}$ fast mode = 21 $\mu\text{sec}$								
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								
<b>Environmental</b>									
Storage temperature	-10 °C .. +70 °C								
Operating temperature	+5 °C .. +50 °C								
Housing operating temperature	between +40 °C .. +50 °C, note the max. housing temperature max. +50 °C *****) (measurement point, see item 4)								
Humidity	10 % .. 90 % non condensing								
Conformity	CE, FCC Part 15 class B, RoHS compliant								
<b>Housing</b>									
Dimensions	Ø 65 mm x 50 mm								
Weight camera	< 380 g								
Weight tube	<table border="1"> <tr> <td>52 mm</td> <td>62 mm</td> <td>71 mm</td> <td>94 mm</td> </tr> <tr> <td>&lt; 120 g</td> <td>&lt; 140 g</td> <td>&lt; 150 g</td> <td>&lt; 200 g</td> </tr> </table>	52 mm	62 mm	71 mm	94 mm	< 120 g	< 140 g	< 150 g	< 200 g
52 mm	62 mm	71 mm	94 mm						
< 120 g	< 140 g	< 150 g	< 200 g						
<b>1000 Base-T interface</b>									
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								
<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									

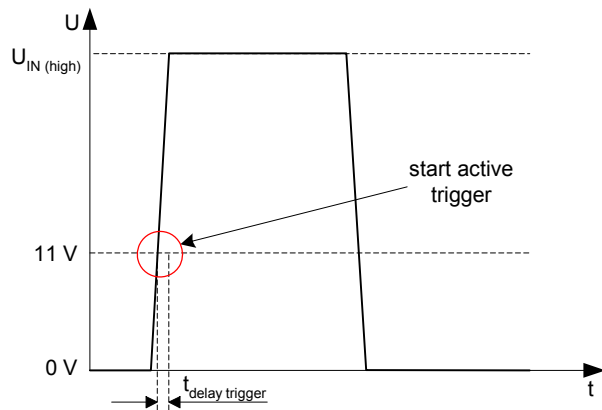
- \*) maximum frame rate in free running mode, effective frame rate depending on camera image format mode settings and set exposure time ( $t_{exp} < t_{readout}$ )
- \*\*) default pixel format
- \*\*\*) the LUT function will be used for the gamma value and the calculation time of the internal used LUT 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

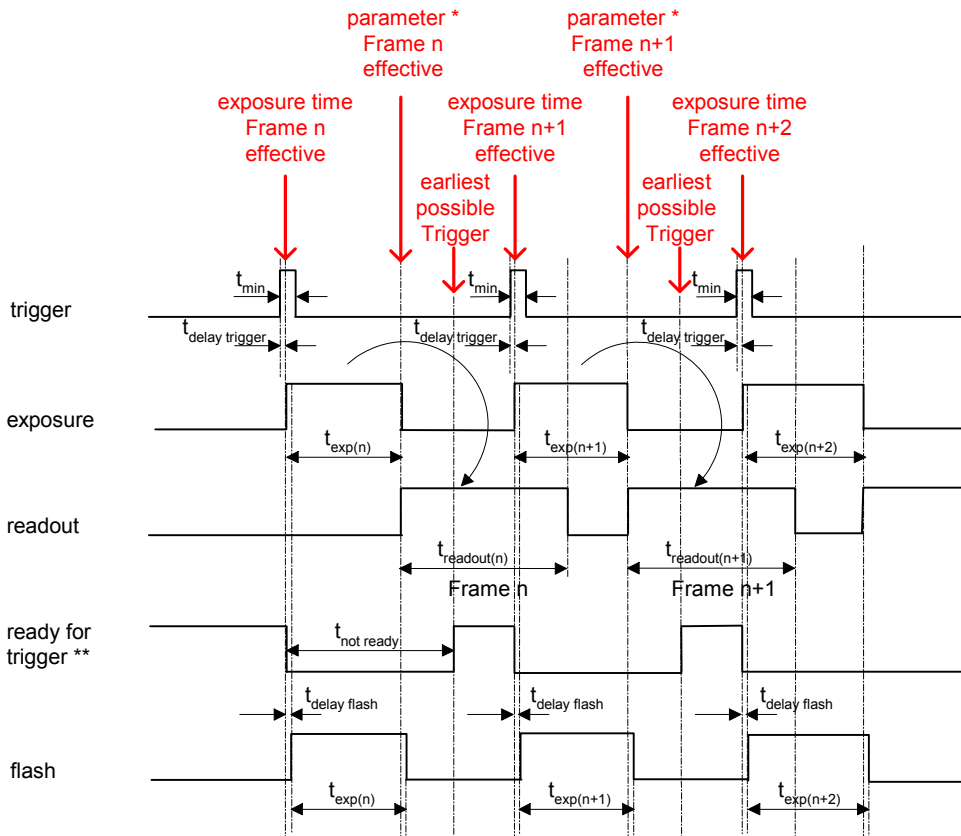
Camera factory settings after camera start-up	
<b>Operation modes</b>	free running mode
<b>Signal processing</b>	
Exposure control	32 msec
Gain control	factor 1 = 0 dB
Offset (black level)	0
<b>Image acquisition</b>	
Camera image format mode	mode id = 01, full frame Mono8
Partial scan function	not active
Test image selector	Off
Defect pixel correction	On
<b>Electrical interface</b>	
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



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

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

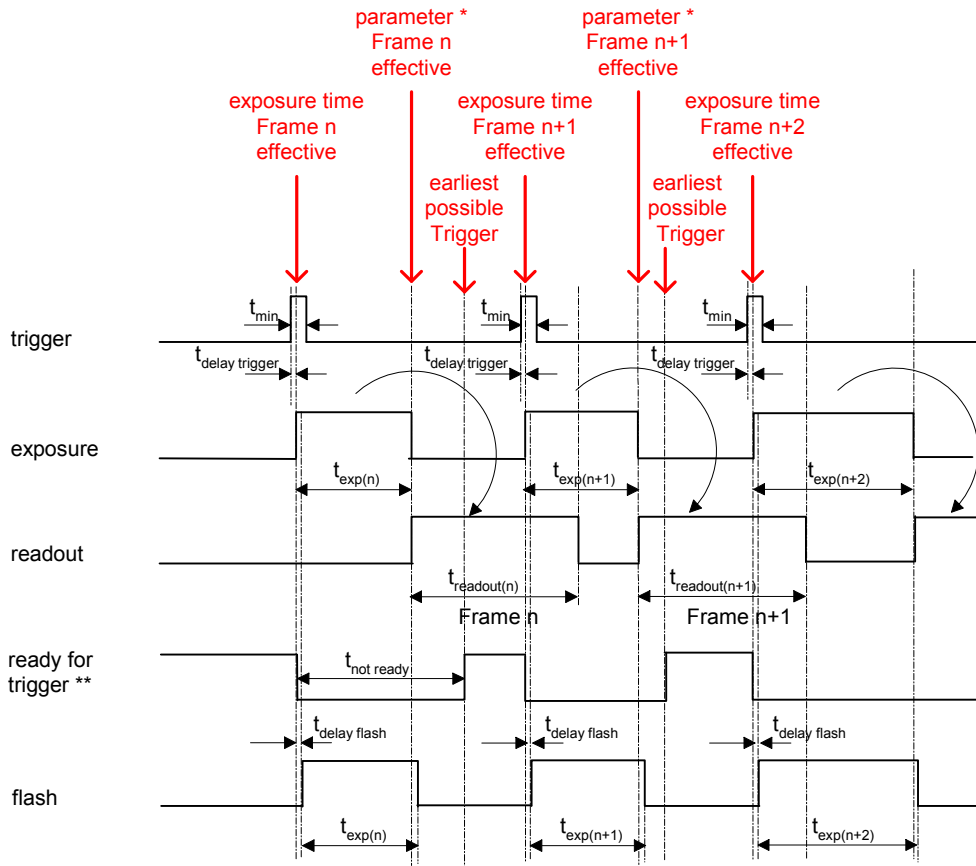
$$t_{exp} < t_{readout}: t_{not\ ready\ (n+1)} = t_{exp(n)} + t_{readout(n)} - t_{exp(n+1)}$$

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

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



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

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

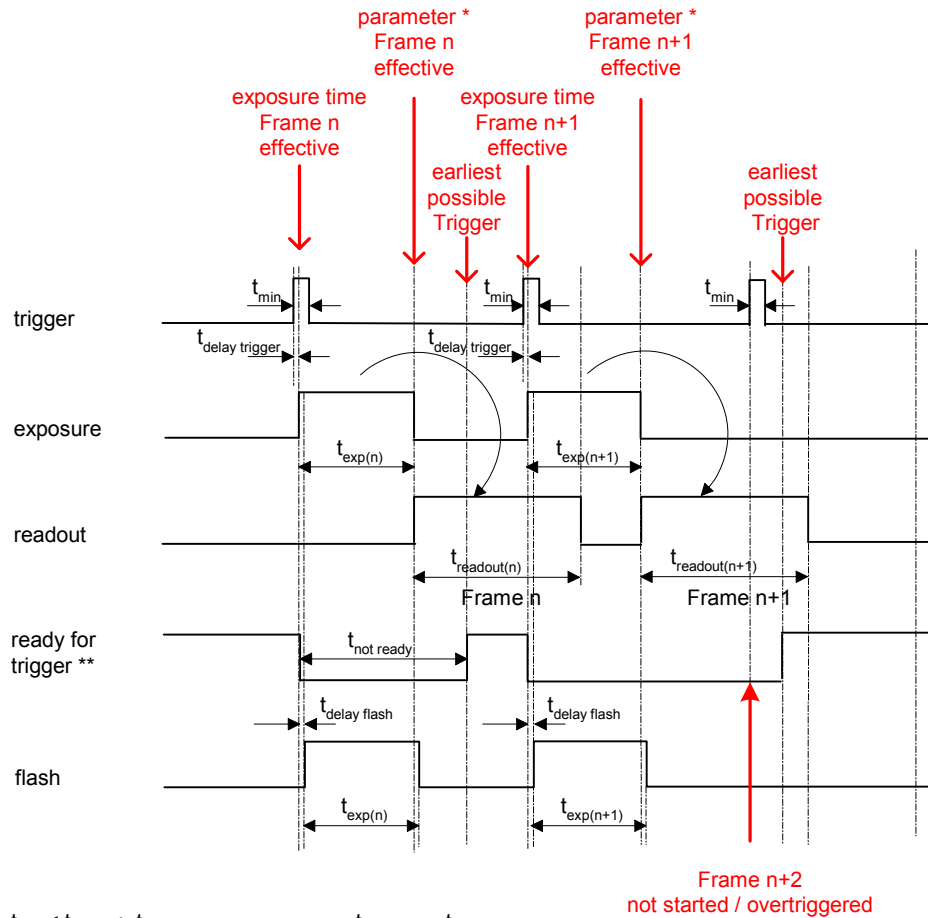
$$t_{exp} < t_{readout}: t_{not\ ready\ (n+1)} = t_{exp(n)} + t_{readout(n)} - t_{exp(n+1)}$$

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

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



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

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

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

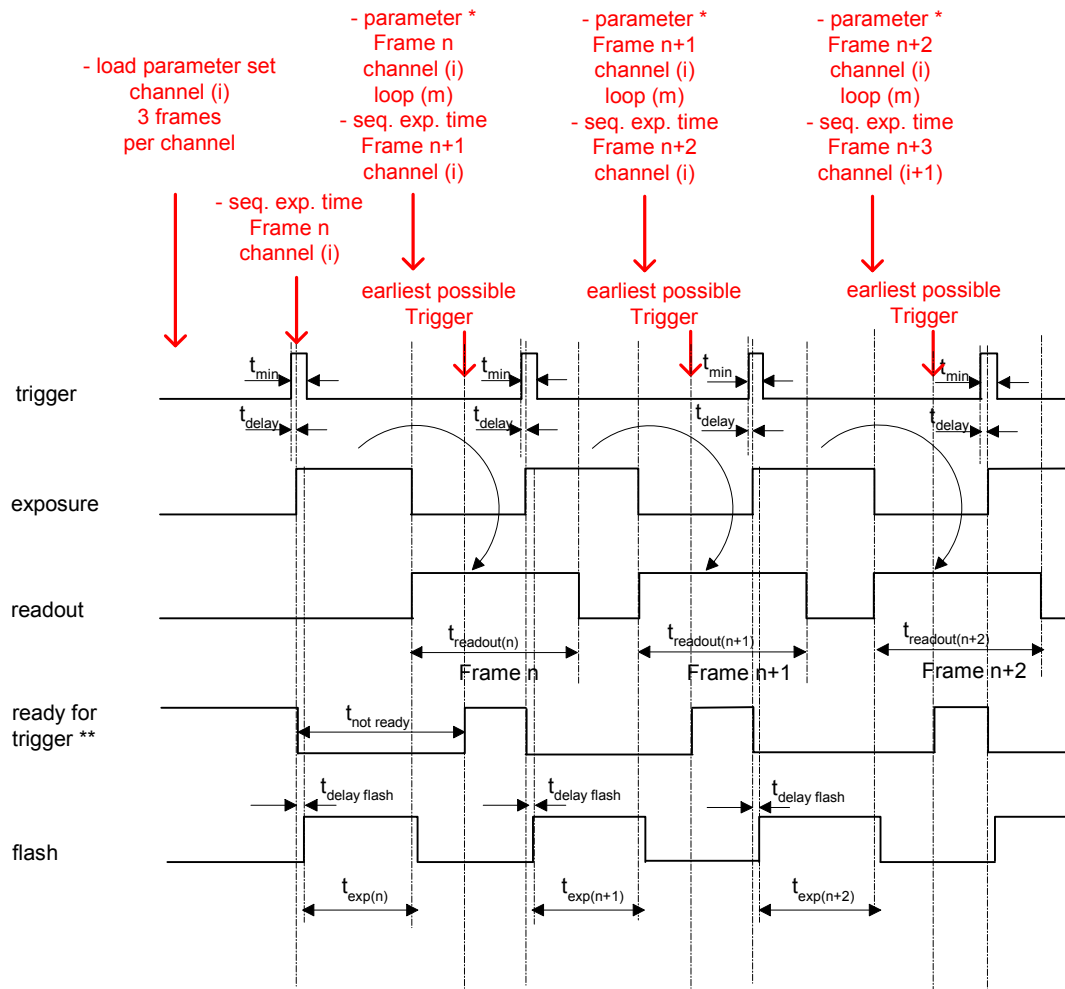
$$t_{exp} > t_{readout}: t_{not\ ready\ (n+1)} = t_{exp(n)}$$

\* 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)



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

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

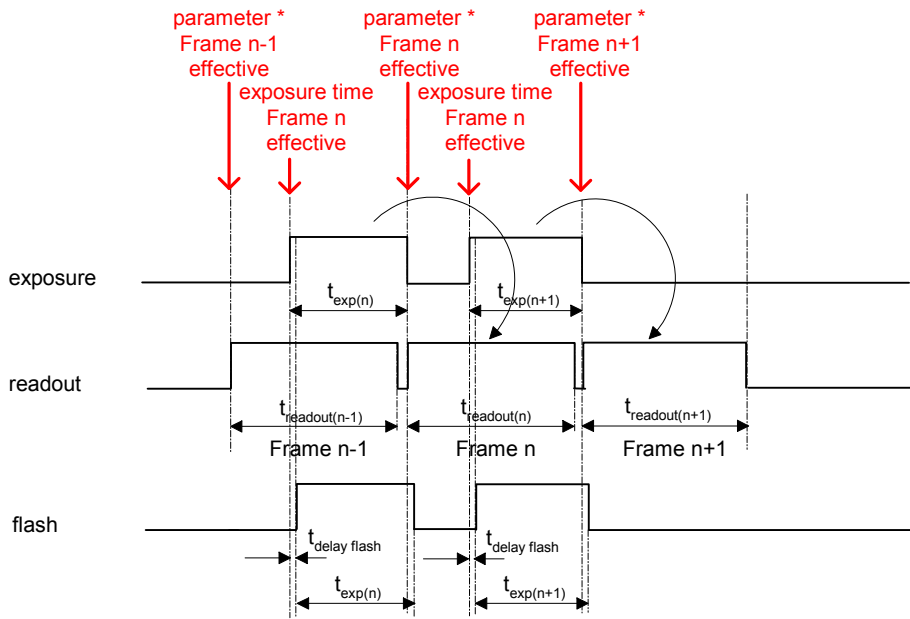
$$t_{exp} < t_{readout}: t_{not\ ready\ (n+1)} = t_{exp(n)} + t_{readout(n)} - t_{exp(n+1)}$$

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

\* image parameter: offset  
sequence global gain  
mode

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

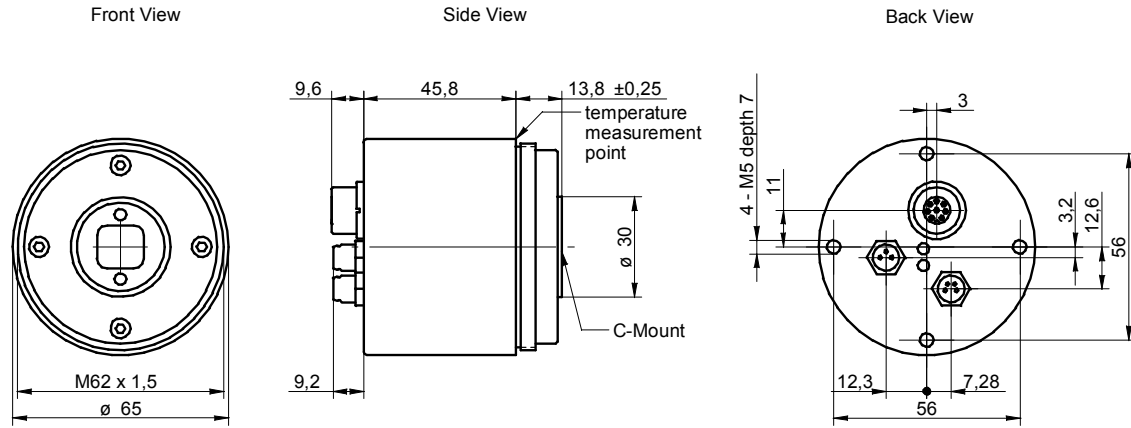
Free Running Mode: overlapped operation



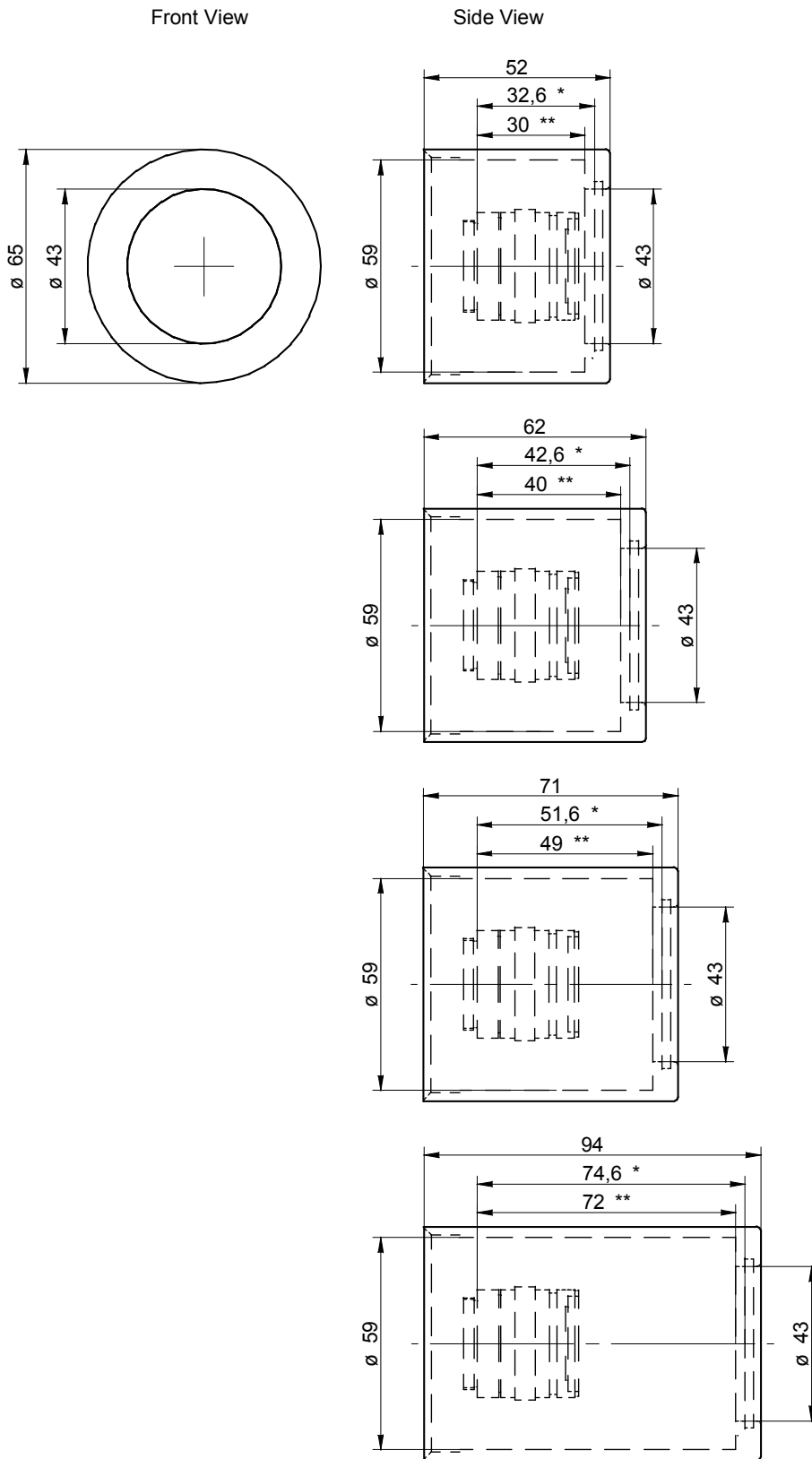
\* image parameter: offset  
 global gain  
 mode  
 partial scan

## 4. Housing

### 4.1 Camera



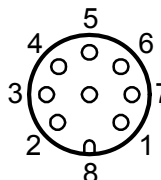
4.2 Tube

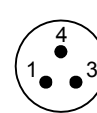



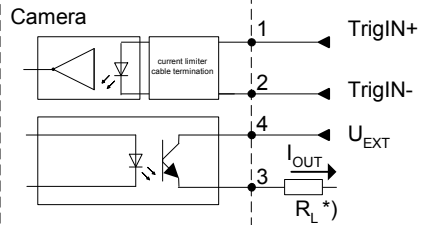
\* max. installation space between C-mount and glass  
 \*\* max. installation space between C-mount and cylinder bottom

5. Connectors / Electrical Interfaces

5.1 Pin assignment:

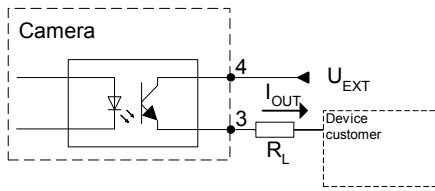
Data / Control 1000 Base-T	Type: female M12 / 8 pin A cod.
	1: MX3- 2: MX4+ 3: MX4- 4: MX1- 5: MX2+ 6: MX1+ 7: MX3+ 8: MX2-

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

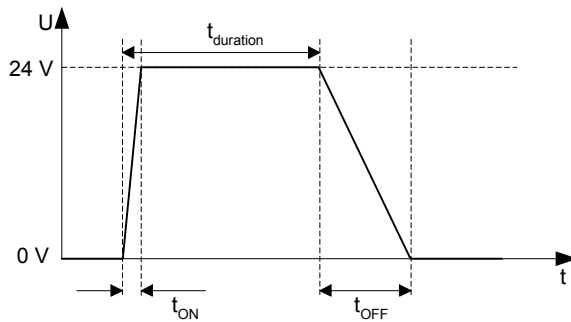
Trigger Flash	Type: Lumberg RSMEED 4pin.
	 <p>*) resistor must be used, <math>I_{OUT} = 16 \text{ mA}</math> by  <math>U_{EXT} = 24 \text{ VDC}</math> recommended,            drawing shown above example            for using high active signal</p>
	Trigger / Flash cable wires color *): 1 = brown 2 = white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

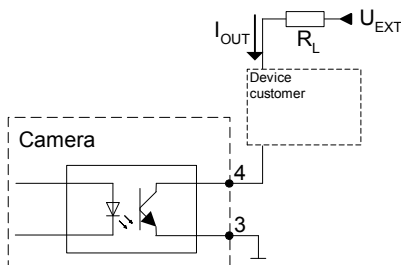


Timing example:  
 measurement condition  $U_{EXT} = 24\text{ VDC} / I_{OUT} = 16\text{ mA}$   
 $R_L = 1.5\text{ kOhm}$

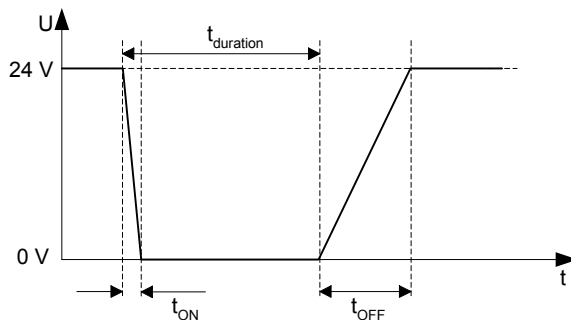


$t_{ON}$  time = typ.  $2\ \mu\text{sec}$   
 $t_{OFF}$  time = typ.  $40\ \mu\text{sec}$

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

Technical specifications subject to change