

**Digital Color
Progressive Scan Camera**

 System: **Gigabit Ethernet**

Baumer TXG03c-I7

Revision 2.1

Art. No: 11008766 (OD108733)

- Gigabit Ethernet progressive scan CCD camera
- 656 x 490 pixel
- Up to 90 full frames per second
- GigE Vision® standard compliant
- On board integrated color processor for high quality color calculation
- Outstanding image quality
- High sensitivity and dynamic range
- High quality slow scan mode for lowest readout noise
- True partial scan function (ROI) for increased frame rates
- External synchronization via industrial compliant process interface (trigger / flash)
- Integrated supplementary function for flexible integration
- 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	TXG03c
Sensor	1/3" interline progressive scan CCD HAD technology
Shutter / readout mode	global shutter / progressive scan readout
Number of pixel	656 x 490
Scan area	4.85 mm x 3.63 mm
Pixel size	7.4 µm x 7.4 µm
Color filter	RGB Bayer mosaic
Operation modes	
Trigger mode	yes, overlapped operation
Free running mode	yes, overlapped operation
Signal processing	real-time software programmable
Pixel clock	40 MHz fast scan / 20 MHz high quality (HQ) scan
A/D converter	12 bit
Exposure control (t _{exp})	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)	GenCam standard	Format ID	Pixel format	Pixel clock MHz	Frames per sec. *)	t _{readout}
Full frame HQ slow	656 x 490	Vendor specific	00	BayerRG8	20	46	22 msec
				BayerRG12			
				Mono8			
				YUV411 Packed			
				YUV422 Packed **)			
				YUV444 Packed			
				RGB8 Packed			
Full frame fast	656 x 490	yes	01	BayerRG8	40	90	11 msec
				BayerRG12			
				Mono8			
				YUV411 Packed			
				YUV422 Packed **)			
				YUV444 Packed			
				RGB8 Packed			
BGR8 Packed							
Standard features							
Image size controls							
Pixel format	BayerRG8, BayerRG12, Mono8, YUV411 Packed, YUV422 Packed, YUV444 Packed, RGB8 Packed, BGR8 Packed						
Test image selector	yes, in all modes Off, GreyHorizontalRamp, GreyVerticalRamp, HorizontalLineMoving, VerticalLineMoving, HorizontalAndVerticalLineMoving						
Partial scan	yes, format freely programmable in all modes						
Analog controls							
Gain	yes						
Black Level (Off set)	yes						
Gamma	no						
Acquisition and Trigger							
Acquisition mode	Continuous						
Acquisition frame rate	yes, ON / OFF (only in freerunning mode) 0 .. 718 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	no						
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	no	
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 .. 964.592 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	no	
Data quality		
	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	
Optical interface		
	C-Mount	
Optical filter	Hoya E-CM500S on request: dust protection, 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 μ sec, duration_value (t_{duration}): slow mode = $t_{\text{exp}} + 41$ μ sec fast mode = $t_{\text{exp}} + 21$ μ sec	
User Output	yes, ON / OFF	
Timer	yes, Timer1	
Software reset	yes, delay up to 102 msec	
Asynchronous reset	Full frame	slow fast
		delay up to 4.9 msec 2.5 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: 370 mA .. 120 mA	
Power consumption	approx. 3.5 Watt	
Digital input	Line 0: trigger signal, opto decoupled $U_{\text{IN(LOW)}} = 0 \dots 4.5$ VDC, $U_{\text{IN(HIGH)}} = 11 \dots 30$ VDC $I_{\text{IN}} = 6 \dots 10$ mA / 7 mA typical rising edge (invert = false) *** min. impulse length (t_{min}): 2 μ sec trigger delay out of t_{readout} ($t_{\text{delay trigger}}$): 3 μ sec max. trigger delay during t_{readout} ($t_{\text{delay trigger}}$): slow mode = 41 μ sec fast mode = 21 μ sec	
Digital output	Line 1: opto decoupled $U_{\text{EXT}} = 5 \dots 30$ VDC / 24 VDC typical, $I_{\text{OUT}} = \text{max. } 16$ 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	

Technical specifications subject to change

Environmental				
Storage temperature	-10 °C .. +70 °C			
Operating temperature	+5 °C .. +50 °C ****) between +40 °C .. +50 °C, note the max. housing temperature			
Housing operating temperature	max. +50 °C			
Humidity	10 % .. 90 % non condensing			
Conformity	CE, FCC Part 15 class B, UL, RoHS compliant			
Housing				
Dimensions	aluminum, IP67 Ø 65 mm x 50 mm			
Weight Camera	< 380 g			
Weight Tubes	52 mm < 120 g	62 mm < 140 g	71 mm < 150 g	94 mm < 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			
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				

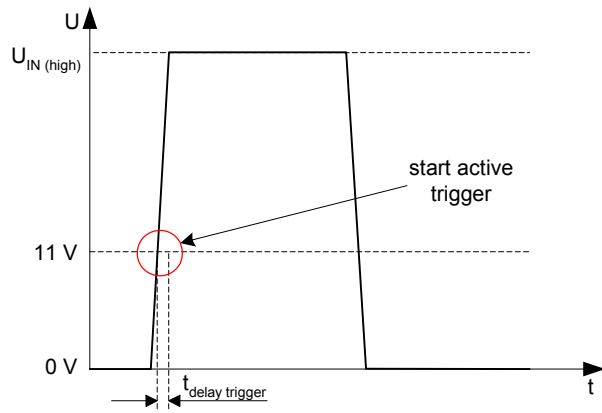
- *) maximum frame rate in free running mode, effective frame rate depending on camera image format mode settings and set exposure time ($t_{exp} < t_{readout}$)
- **) default pixel format
- ***) can be inverted via software
- ****) housing temperature is limited by CCD sensor specification

2. Camera Factory Settings after Camera Start-up

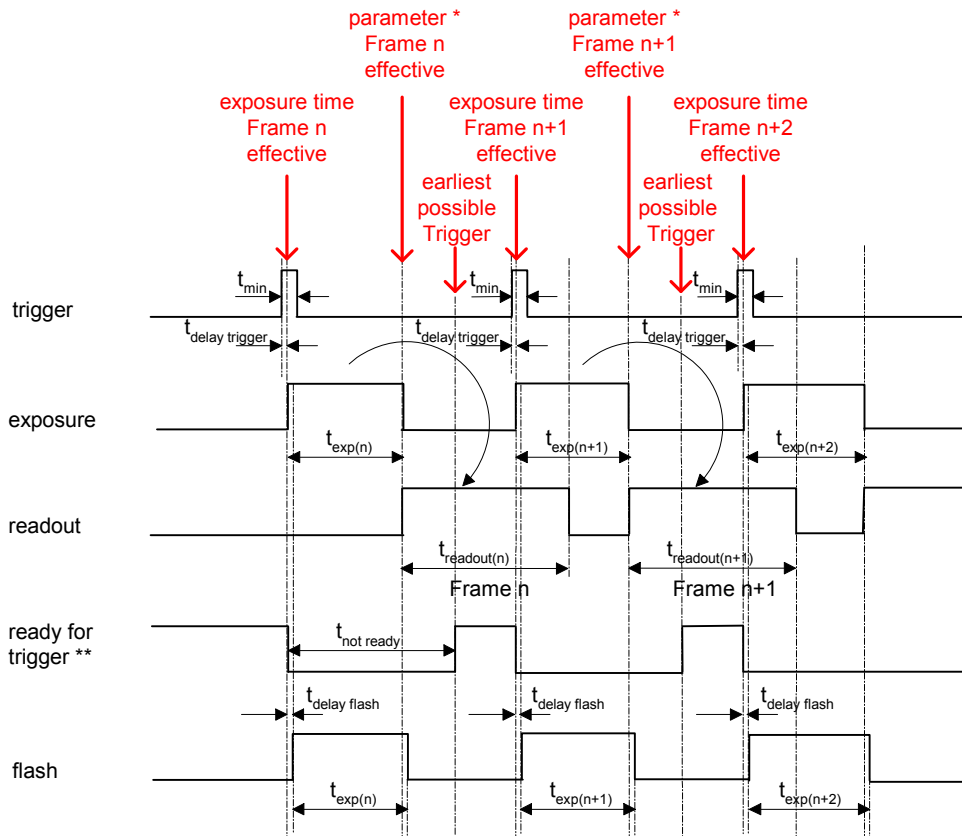
Camera factory settings after camera start-up	
Operation modes	free running mode
Signal processing	
Exposure control	32 msec
Gain control	factor 1 = 0 dB
Offset (black level)	0
Image acquisition	
Camera image format mode	mode id = 01, full frame YUV422 Packed
Partial scan function	not active
Acquisition 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 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



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

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

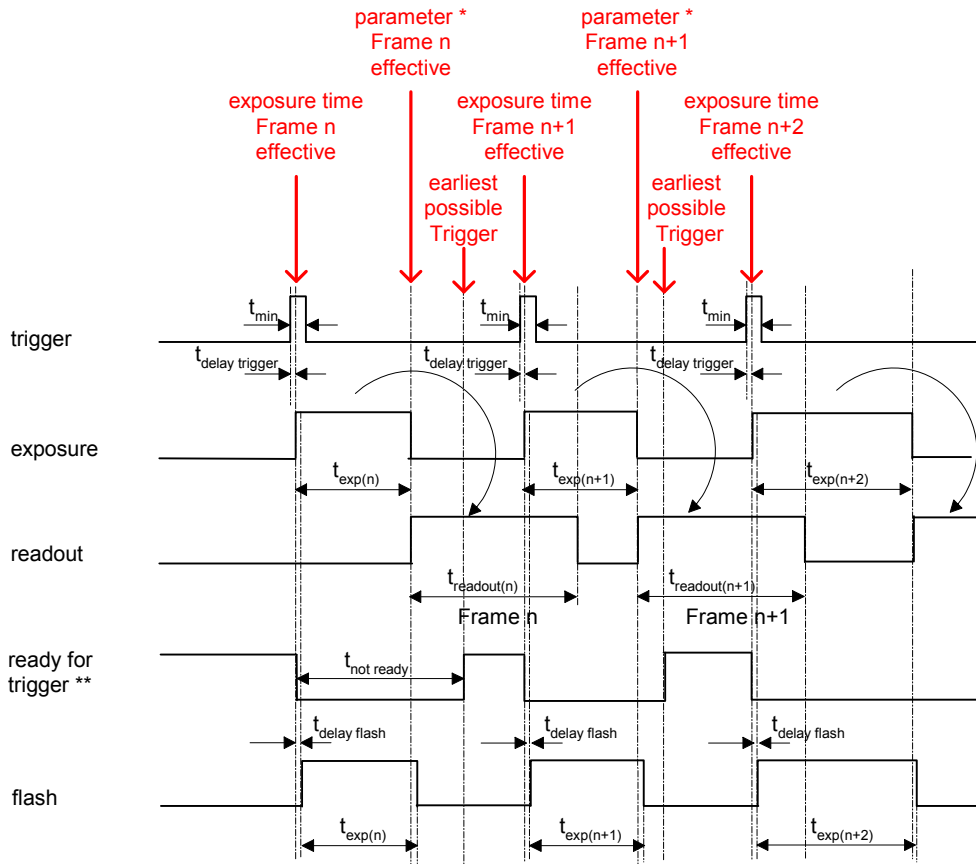
$$t_{exp} < t_{readout}: t_{\text{not ready (n+1)}} = t_{exp(n)} + t_{readout(n)} - t_{exp(n+1)}$$

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

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



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

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

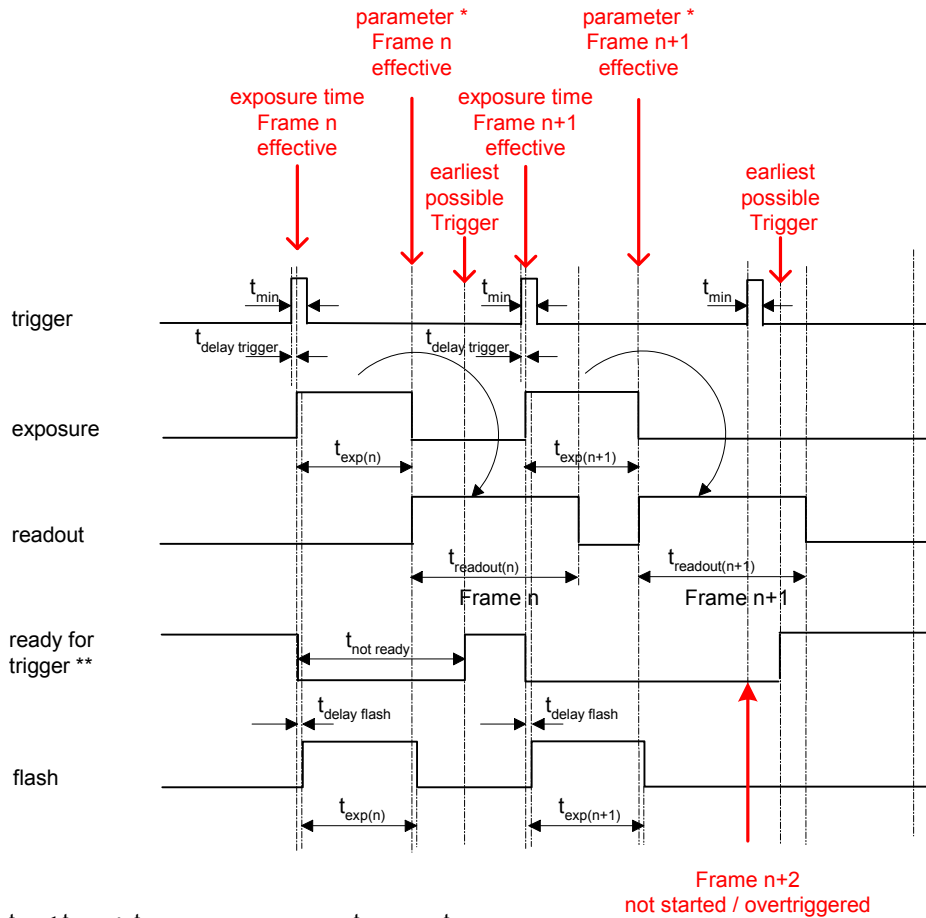
$$t_{exp} < t_{readout}: t_{not\ ready\ (n+1)} = t_{exp(n)} + t_{readout(n)} - t_{exp(n+1)}$$

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

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



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

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

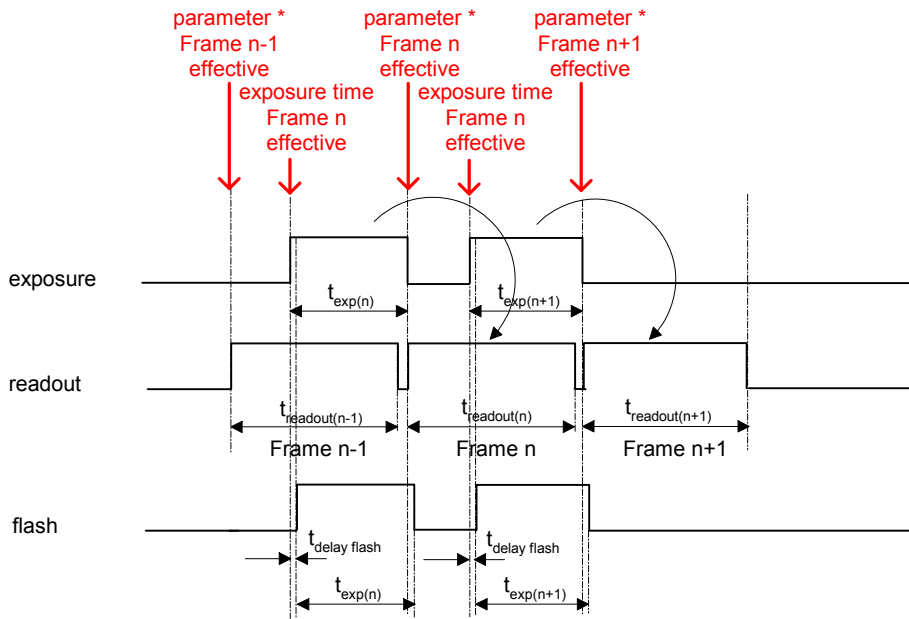
$$t_{exp} < t_{readout}: t_{not\ ready\ (n+1)} = t_{exp(n)} + t_{readout(n)} - t_{exp(n+1)}$$

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

* image parameter: offset
global gain
mode
partial scan

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

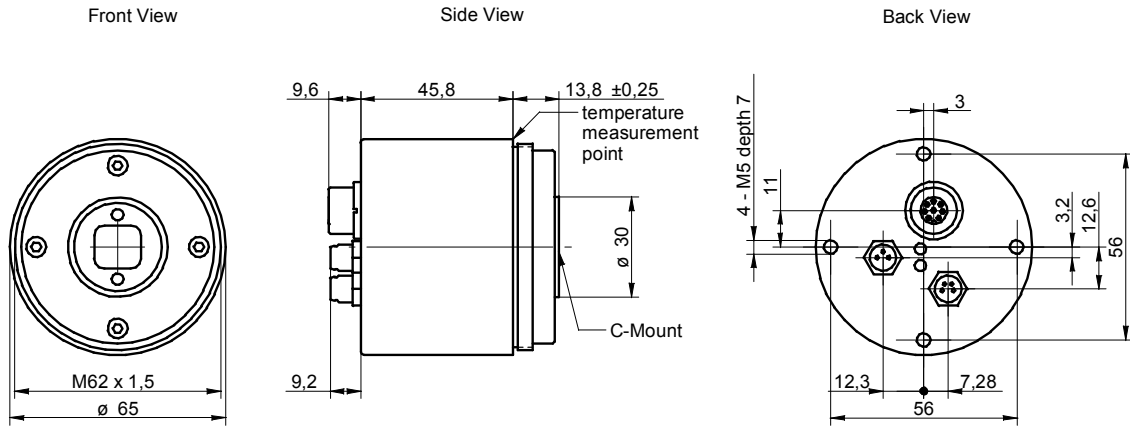
Free Running Mode: overlapped operation



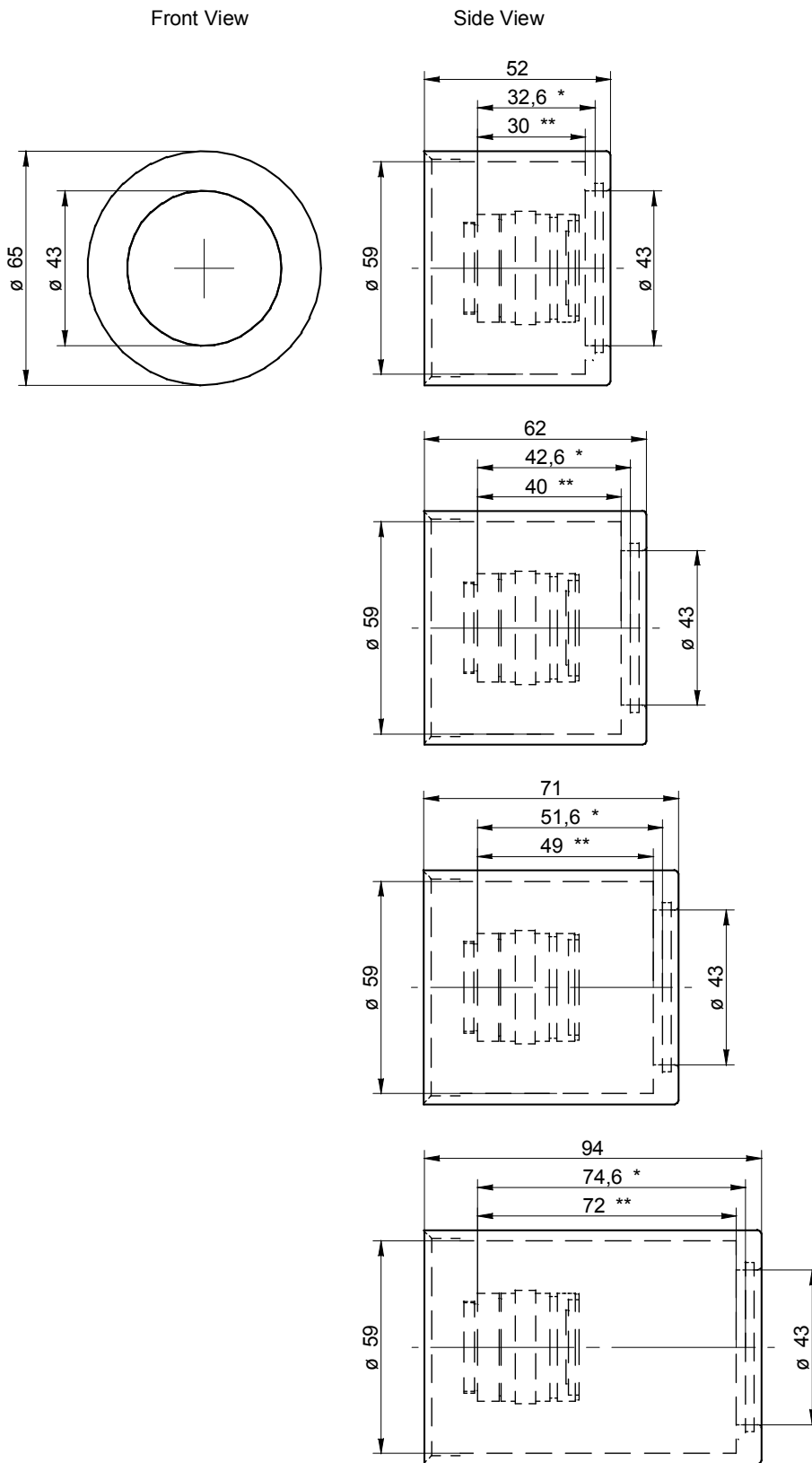
* image parameter: offset
 global gain
 mode
 partial scan

4. Housing

4.1 Camera



4.2 Tubes



* 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:

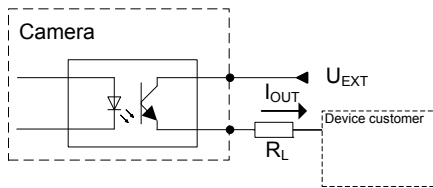
Data / Control 1000 Base-T	Type: female M12 / 8 pin A cod.
	1: MX3- 2: MX4+ 3: MX4- 4: MX1- 5: MX2+ 6: MX1+ 7: MX3+ 8: MX2-

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

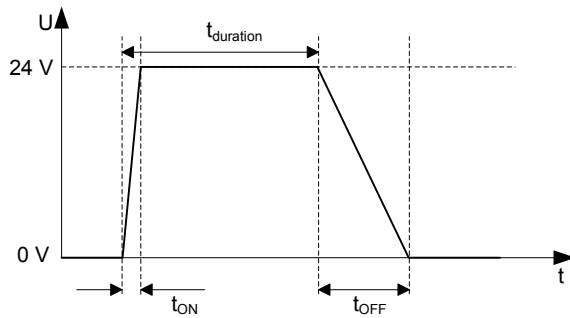
Trigger / Flash	Type: Lumberg RSMEED 4pin.
	<p>*) resistor must be used, $I_{OUT} = 16 \text{ mA}$ by $U_{EXT} = 24 \text{ VDC}$ recommended, drawing shown above example for using high active signal</p>
	Trigger / Flash cable wires color *): 1 = brown 2 = white 3 = blue 4 = black

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

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

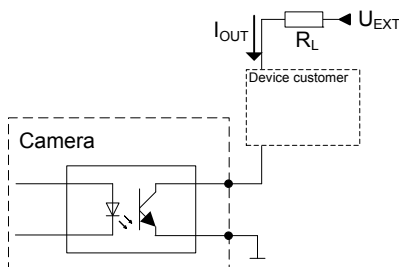


Timing example:
 measurement condition $U_{EXT} = 24 \text{ VDC} / I_{OUT} = 16 \text{ mA}$
 $R_L = 1.5 \text{ kOhm}$

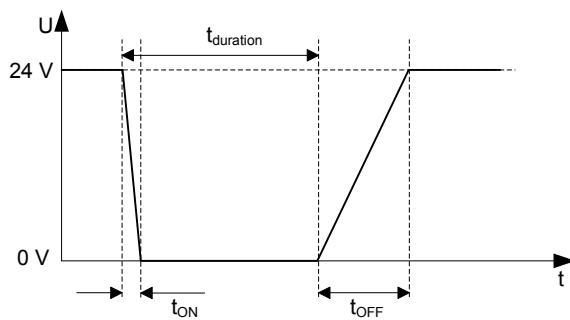


t_{ON} time = typ. 2 μsec
 t_{OFF} time = typ. 40 μsec

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 μsec
 t_{OFF} time = typ. 40 μsec