

**Digital Color
Progressive Scan Camera**

 System: **IEEE1394b**
Baumer TXF50c

 Art. No: **OD108177**

- FireWire™ – IEEE1394b (800 Mbit / sec) progressive scan CCD-camera
- 2440 x 2042 pixel
- Up to 15 full frames per second
- On board integrated color processor for high quality color calculation
- Outstanding image quality and color fidelity
- 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 32 MByte RAM for temporarily image data buffering
- Camera parameter programmable in real-time
- Ultra compact and lightweight aluminum housing
- Bilingual: FireWire™ – IEEE1394b and IEEE1394a compatible
- Screw-lock type industrial connector
- Baumer-GAPI: Flexible, generic software interface for Windows / Linux
- User-friendly Baumer TWAIN compatible image capture and camera control software



shown lens needs to be ordered separately

1. Overview

Sensor	2/3" interline progressive scan CCD
Shutter / readout mode	global shutter / progressive scan readout
Number of pixel	2448 x 2050
Scan area	8.5 mm x 7.1 mm
Pixel size	3.45 µm x 3.45 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	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	32 MByte
Image acquisition	
Data format	YUV , RGB , Mono8 or Raw image data from camera

Technical specifications subject to change

Camera image format modes (see item 3)	Format (pixel)	Color coding	Bit per pixel	Pixel clock MHz	Frames per sec. *)	t _{readout}		
Full frame Raw	slow	2448 x 2050	Raw	12 **) / 8	30	7.5	133 msec	
	fast						67 msec	
Full frame Mono	slow	2440 x 2042	Mono8	8 **)	30	7.5	133 msec	
	fast						67 msec	
Full frame YUV	slow	2440 x 2042	4:1:1 YUV	12 **)	30	7.5	133 msec	
			4:2:2 YUV	16 **)				7.5
			4:4:4 YUV	24 **)				
	fast	4:1:1 YUV	12 **)	60	11 ***)	67 msec		
4:2:2 YUV	16 **)	8 ***)						
Full frame RGB	slow		2440 x 2042	RGB8	24 **)	30	5.5 ***)	133 msec
Partial scan function	yes, format freely programmable in all modes (binning on partial scan ok)							
Look up table function	on request: user programmable (input 12 bit, output 12 bit / 8 bit) or Gamma							
Test pattern function	yes, in all modes							
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 on request: CS-Mount							
Optical filter	Hoya E-CM500S on request: super polished, dust protection, daylight filter or no filter							
Process interface functions								
Async. trigger	yes, trigger mode operation, software trigger and external trigger separately selectable external trigger in trigger mode 0 (overtriggered signals and trigger signals during the readout time will be notified in the received image header)							
External flash sync	yes, delay_value ≤ 4 μ sec duration_value (t _{duration}): slow mode = t _{exp} + 64 μ sec fast mode = t _{exp} + 32 μ sec							
Software reset	yes, delay up to 125 msec							
Asynchronous reset	Full frame	slow fast	delay up to 45 msec 24 msec					
Image info header	yes							
User defined identifier	on request: user programmable permanent identifier							
Electrical interface								
Data / control / power	standard single cable IEEE1394b bilingual / 9 pins option: screw lock type connector							
Digital input	1: trigger signal, opto decoupled U _{IN(low)} = 0 .. 4.5 VDC, U _{IN(high)} = 11 .. 30 VDC I _{IN} = 20 mA (typical) rising edge (invert value = true) *****) min. trigger 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	1: flash sync signal, opto decoupled U _{EXT} = 5 .. 30 VDC / 24 VDC typical, I _{OUT} = 16 mA *****) high active (invert value = true) *****) flash delay (t _{delay flash}): ≤ 4 μ sec							
LED	green: power on / yellow: data transmission active							
Power consumption	VCC: 8 .. 33 V I: 415 mA .. 135 mA approx. 4.5 Watt							

Environmental	
Storage temperature	-10 °C .. +70 °C
Operating temperature	+5 °C .. +50 °C between +30 °C .. + 50°C, note the max. housing temperature
Housing operating temperature	max. +50 °C ***** (measurement point, see item 5)
Humidity	10 % .. 90 % non condensing
Conformity	CE, FCC Part 15 class B, RoHS
Housing	aluminum
Dimensions	36 x 36 x 48 mm ³
Weight	< 90 g
IEEE1394 interface	800 / 400 / 200 / 100 Mbit / sec
Software	Baumer FCAM1394 driver / Baumer OHCI driver SDK for Windows 2000 / Windows XP / Windows Vista (32 bit) / Linux Kernel 2.4.>22, 2.6.xx supported .net platform Baumer TWAIN image capture and camera control software

- *) maximum frame rate in free running mode, effective frame rate depending on camera image format mode settings, set exposure time ($t_{exp} < t_{readout}$) and used IEEE1394 interface
- **) maximum frame rate only available with IEEE1394b (800 Mbit / sec) interface
- ***) bandwidth of IEEE1394b interface is limiting frame rate
- ****) can be inverted via software
- *****) necessary for optimal timing specification
- *****) 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 = 08: Full frame YUV (4:2:2) HQ (see item 3)
White balance	active, adjusted on light source value = 5000 K (D50)
Partial scan function	not active
Electrical interface	
Flash sync signal	disabled, digital output set to low status invert value = true
Async. Trigger	disabled invert value = true

3. Supported Image Formats via Baumer API (Baumer FCAM driver)

3.1 Supported Image Format

Camera name		TXF50c			
Camera mode		SDK image mode			
	Bit per pixel	Mode ID	Image format	Description	Functions / State
Full Frame slow	8	00	2448 x 2050	Full Frame HQ Raw 8 bit	PS, T, F, Color
Full Frame slow	12	01	2448 x 2050	Full Frame HQ Raw 12 bit	PS, T, F, Color
Full Frame fast *)	8	02	2448 x 2050	Full Frame Raw 8 bit	PS, T, F, Color
Full frame Mono slow	8	03	2440 x 2042	Full Frame HQ Mono	PS, T, F, Mono
Full frame Mono fast *)	8	04	2440 x 2042	Full Frame Mono	PS, T, F, Mono
Full frame YUV (4:1:1) slow	12	05	2440 x 2042	Full Frame HQ YUV (4:1:1)	PS, T, F, Color
Full frame YUV (4:1:1) fast *)	12	06	2440 x 2042	Full Frame YUV (4:1:1)	PS, T, F, Color
Full frame YUV (4:2:2) slow	16	07	2440 x 2042	Full Frame HQ YUV (4:2:2)	PS, T, F, Color
Full frame YUV (4:2:2) fast *)	16	08	2440 x 2042	Full Frame YUV (4:2:2)	PS, T, F, Color
Full frame YUV (4:4:4) slow *)	24	09	2440 x 2042	Full Frame HQ YUV (4:4:4)	PS, T, F, Color
Full frame RGB slow *)	24	10	2440 x 2042	Full Frame HQ RGB	PS, T, F, Color

*) maximum frame rate only available with IEEE1394b (800 Mbit / sec) interface

3.2 Software supported / Calculated Color Coding

		Supported / calculated color coding via software							
Baumer-GAPI		Bayer RG8	Bayer RG12	BGR8 Packed	BGR12 Packed	RGB8 Planar	RGB12 Planar	Mono8	Mono12
API Fxlib		Bayer8	Bayer12	Color 3x8x1	Color 3x12x1	Color 1x8x3	Color 1x12x3	Mono8	Mono12
Pixel coding camera	Raw8	x *)		x		x		x	
	Raw12	x	x *)	x	x	x	x	x	x
	Mono8							x *)	
	YUV (4:1:1)			x		x		x	
	YUV (4:2:2)			x		x		x	
	YUV (4:4:4)			x		x		x	
	RGB8			x *)		x		x	

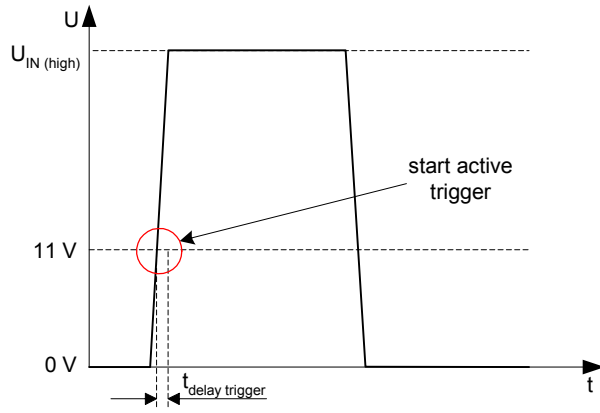
*) original camera format

3.3 Abbreviation / Description

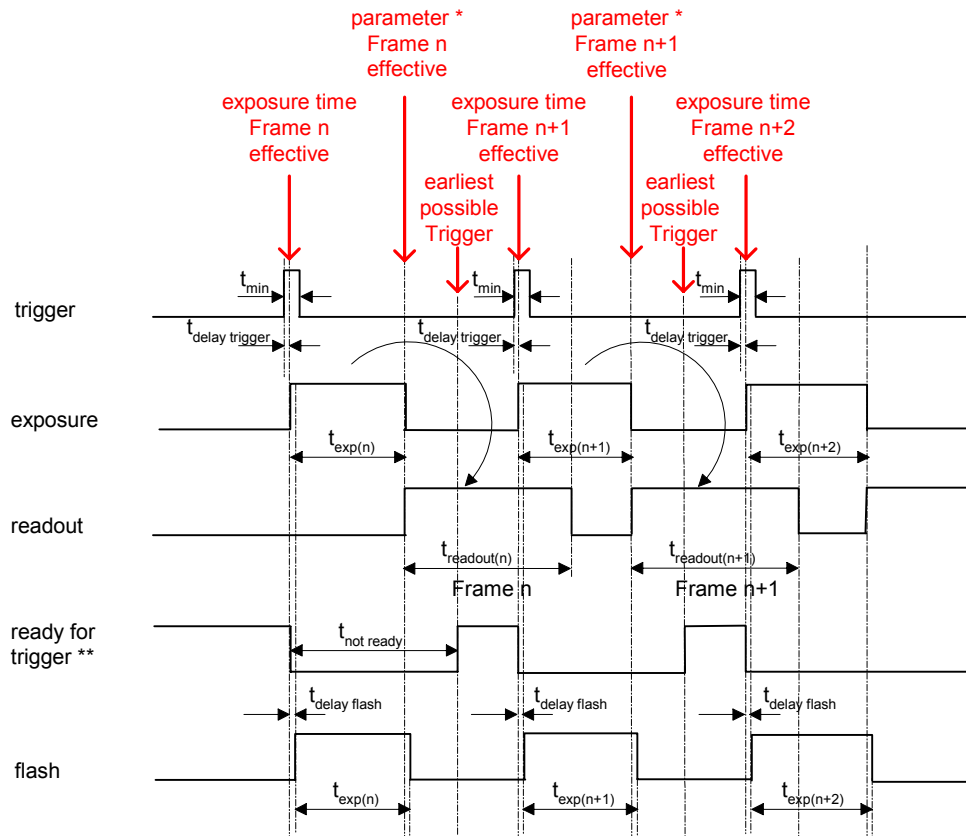
SDK	- Software Development Kit
PS	- partial scan
T	- trigger
F	- flash
Mono	- monochrome mode
Color	- color mode
Raw8[12] / Bayer8[12] / BayerRG8[12]	- unmanipulated pixel data in Bayer filter pattern in 8 [12] bit
Color3x8[12] / RGB8[12] Packed	- software corrected image data for color camera modes in the color data arrangement BGR in 24[36] bit
Color1x8[12]x3 / RGB8[12] Planar	- software corrected image data for color camera modes in the color data arrangement RRR...GGG...BBB in 3x8[12] bit
RGB8	- camera calculated image data for color camera modes in the color data arrangement RGB in 24 bit
YUV (4:1:1)	- camera calculated image data for color camera modes in the color data arrangement YUV (4:1:1) in 12 bit
YUV (4:2:2)	- camera calculated image data for color camera modes in the color data arrangement YUV (4:2:2) in 16 bit
YUV (4:4:4)	- camera calculated image data for color camera modes in the color data arrangement YUV (4:4:4) in 24 bit
Mono8[12]	- camera or software calculated image data for monochrome camera modes in 8[12] bit

4. Timing Operation Modes

Trigger Mode: start up time



Trigger Mode: trigger mode 0, overlapped trigger



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

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

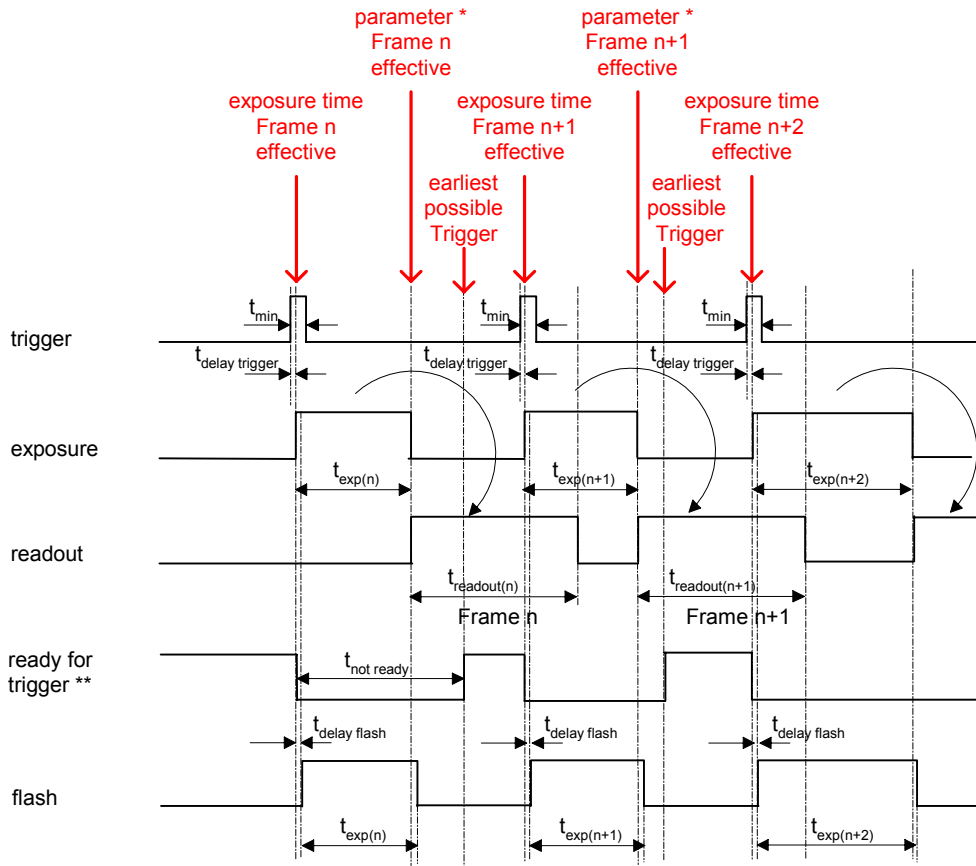
$$t_{exp} < t_{readout}: t_{\text{not ready (n+1)}} = t_{exp(n)} + t_{readout(n)} - t_{exp(n+1)}$$

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

* image parameter: offset
 global gain
 mode
 partial scan

** signal is not available as digital output

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



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

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

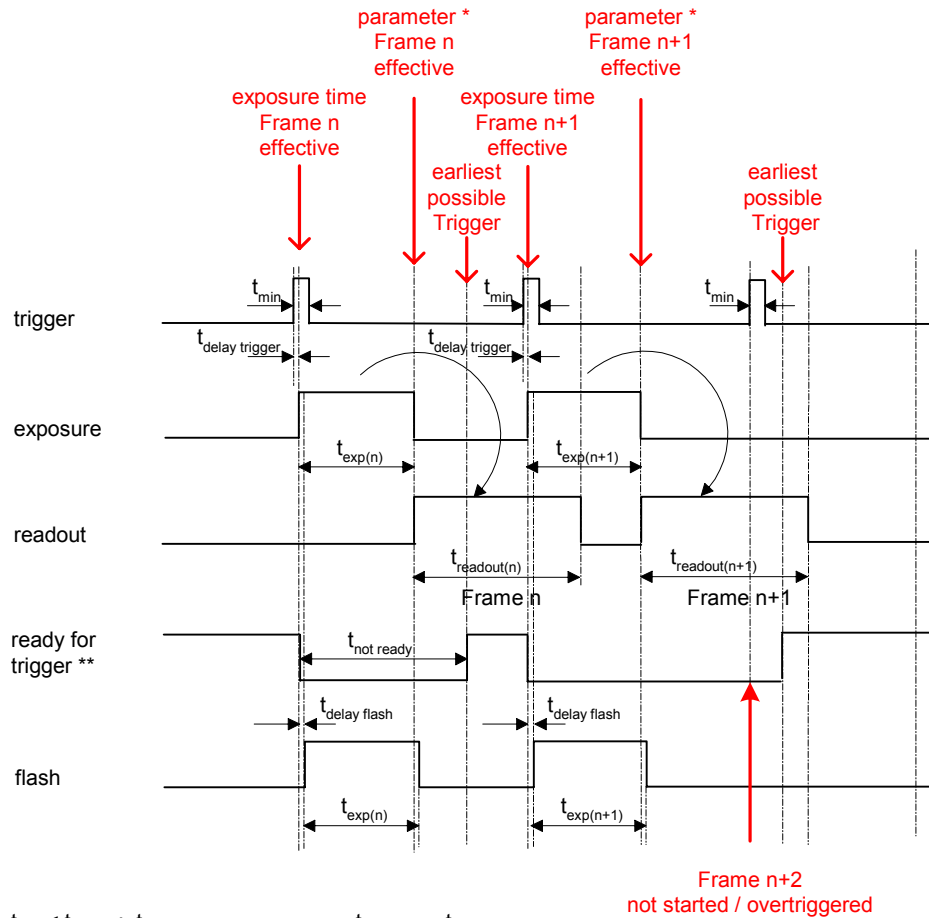
$$t_{exp} < t_{readout}: t_{not\ ready\ (n+1)} = t_{exp(n)} + t_{readout(n)} - t_{exp(n+1)}$$

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

* image parameter: offset
 global gain
 mode
 partial scan

** signal is not available as digital output

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



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

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

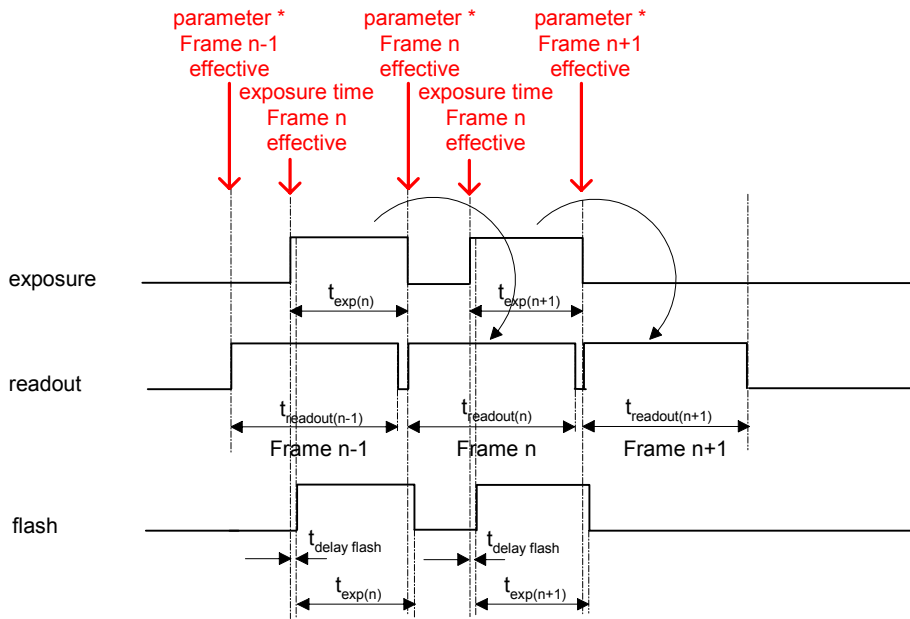
$$t_{exp} < t_{readout}: t_{not\ ready\ (n+1)} = t_{exp(n)} + t_{readout(n)} - t_{exp(n+1)}$$

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

* image parameter: offset
 global gain
 mode
 partial scan

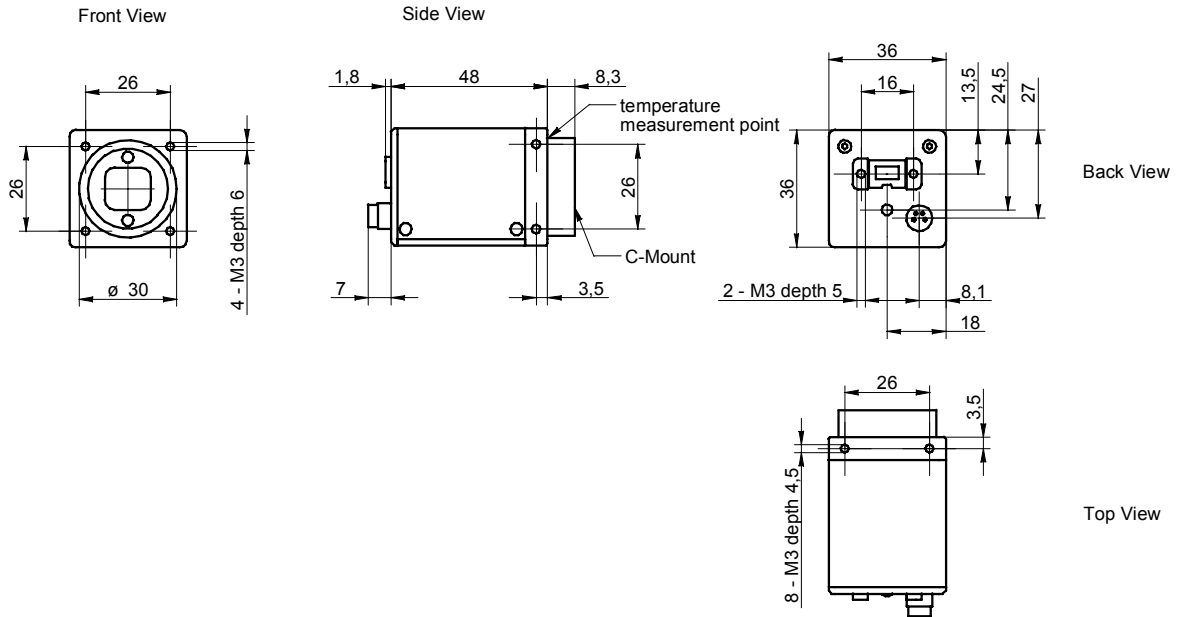
** signal is not available as digital output

Free Running Mode: overlapped operation



* image parameter: offset
 global gain
 mode
 partial scan

5. Housing



6. Connectors / Electrical Interfaces

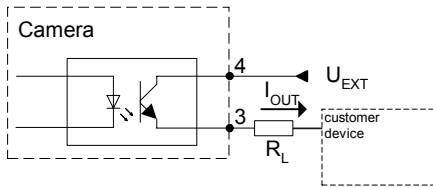
6.1 Pin assignment:

IEEE1394b	Pin
	1: TPB- 2: TPB+ 3: TPA- 4: TPA+ 5: GND A 6: GND Power 7: not used 8: Voltage Power 9: GND B

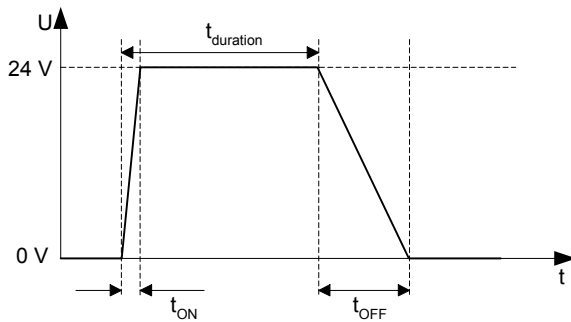
Trigger Flash	Type: Lumberg RSMESD 4pin.
	<p>*) resistor must be used, $I_{OUT} = 16 \text{ mA}$ by $U_{EXT} = 24 \text{ VDC}$ recommended, drawing shown above example for using high active signal</p>
	<p>Trigger / Flash cable wires color *): 1 = brown 2 = white 3 = blue 4 = black</p>

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

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

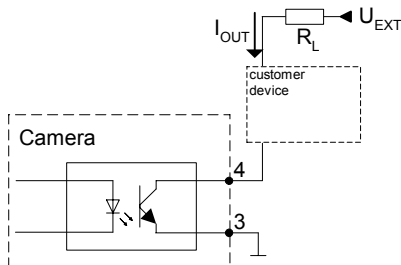


Timing example:
 measurement condition $U_{EXT} = 24\text{ VDC} / I_{OUT} = 16\text{ mA}$

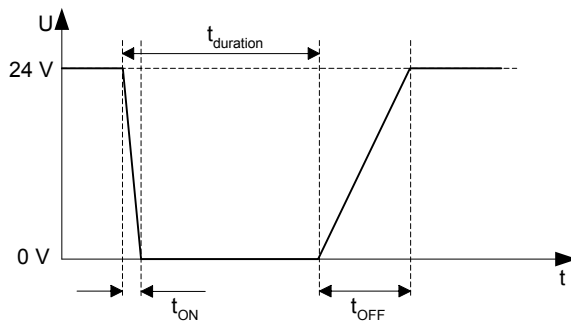


t_{ON} time = typ. 2 μsec
 t_{OFF} time = typ. 40 μsec

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



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



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

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