

**Digital Color
Progressive Scan Camera**

 System: **IEEE1394b**
Baumer TXD06c

 Art. No: **OD107735**

- FireWire™ – IEEE1394b (800 Mbit / sec) progressive scan CCD camera
- 768 x 574 pixel
- Up to 64 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
- 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
- DCAM (IIDC V1.31) compatible Baumer driver / Baumer OHCI driver



shown lens needs to be ordered separately

1. Overview

| | |
|---|--|
| Sensor | 1/2" interline progressive scan CCD |
| Shutter / readout mode | global shutter / progressive scan readout |
| Number of pixel | 776 x 582 |
| Scan area | 6.47 mm x 4.83 mm |
| Pixel size | 8.3 µm x 8.3 µm |
| Color filter | RGB Bayer mosaic |
| Operation modes | |
| Trigger mode | yes, overlapped operation |
| Free running mode | yes, overlapped operation |
| Signal processing | 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 | manual control: 0 .. 20 dB |
| Offset (black level) / brightness control | manual control: 0 .. 255 LSB (12 bit) |
| Image data buffer | 32 MByte |
| Image acquisition | |
| One / multi shot function | yes |
| Data format / color coding | YUV , RGB , Mono8 , Raw8 or Raw16 image formats |

Technical specifications subject to change

| Camera image format modes | Resolution / description | Color coding | Bit per pixel | Pixel clock MHz | Frames per sec. *) | t _{readout} |
|------------------------------------|---|--------------|---------------|-----------------|--|----------------------|
| Format 0 Mode 2 | 640 x 480 center scan fast scan | YUV (4:1:1) | 12 | 40 | 120 (74) **, 60, 30, 15, 7.5, 3.75, 1.875 | 13.5 msec |
| Format 0 Mode 3 | 640 x 480 center scan high quality scan | YUV (4:2:2) | 16 | 20 | 60 (37.5) **, 30, 15, 7.5, 3.75, 1.875 | 26.5 msec |
| Format 0 Mode 5 | 640 x 480 center scan fast scan | Mono8 | 8 | 40 | 120 (74) **, 60, 30, 15, 7.5, 3.75, 1.875 | 13.5 msec |
| Format 7 Mode 0 | 776 x 582 full frame high quality scan | Raw8 ***) | 8 | 20 | 32 block size 4 .. 3760 Byte | 31 msec |
| | | Raw16 ***) | 16 | | | |
| Format 7 Mode 1 | 776 x 582 full frame fast scan | Raw8 ***) | 8 | 40 | 64 block size 4 .. 7520 Byte | 15.5 msec |
| | | Raw16 ***) | 16 | | | |
| Format 7 Mode 2 | 768 x 574 full frame high quality scan | Mono8 | 8 | 20 | 32 block size 4 .. 5544 Byte | 31 msec |
| | | 4:1:1 YUV8 | 12 | | | |
| | | 4:2:2 YUV8 | 16 | | | |
| | | 4:4:4 YUV8 | 24 | | | |
| Format 7 Mode 3 | 768 x 574 full frame fast scan | Mono8 | 8 | 40 | 64 block size 4 .. 7392 Byte | 15.5 msec |
| | | 4:1:1 YUV8 | 12 | | | |
| | | 4:2:2 YUV8 | 16 | | | |
| | | 4:4:4 YUV8 | 24 | | | |
| Partial scan function | yes, format freely programmable in all Format 7 modes | | | | | |
| Advanced feature | | | | | | |
| Look up table | on request: user programmable (input 12 bit, output 12 bit / 8 bit) or Gamma | | | | | |
| Test pattern function | yes | | | | | |
| Image info header | no | | | | | |
| Start / stop camera | yes | | | | | |
| Data quality | at 20 °C, gain = 0 dB, exposure time = 32 msec, Format 7 Mode 0 | | | | | |
| 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 in trigger mode 0 | | | | | |
| External flash sync / Strobe_0 | yes delay_value ≤ 4 μ sec, duration_value (t _{duration}): slow mode = t _{exp} + 49 μ sec fast mode = t _{exp} + 25 μ sec | | | | | |
| Software reset / initialize camera | yes, delay up to 102 msec | | | | | |
| 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 (polarity bit = "1") ****) min. trigger impulse length (t _{min}): 2 μ sec trigger delay out of t _{readout} (t _{delay trigger}): 4 μ sec max. trigger delay during t _{readout} (t _{delay trigger}): slow mode = 49 μ sec fast mode = 25 μ sec | | | | | |
| Digital output | 1: flash sync signal, opto decoupled U _{EXT} = 5 .. 30 VDC / 24 VDC typical, I _{OUT} = 16 mA *****) high active (polarity bit = "1") *****) flash delay (t _{delay flash}): ≤ 4 μ sec | | | | | |

| | |
|-------------------------------|--|
| LED | green: power on / yellow: data transmission active |
| Power consumption | VCC: 8 .. 33 V I: 300 mA .. 100 mA approx. 3 Watt |
| Environmental | |
| Storage temperature | -10 °C .. +70 °C |
| Operating temperature | +5 °C .. +50 °C between +39 °C .. +50 °C, note the max. housing temperature |
| Housing operating temperature | max. +50 °C ***** (measurement point, see item 6) |
| 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 | IIDC V1.31 (DCAM) compatible Baumer FCAM1394 driver (Baumer OHCI driver) / Software Development Kit (SDK) for Windows 2000 / Windows XP / Windows Vista IIDC V1.31 (DCAM) compatible IEEE1394 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, set block size and set exposure time (texp < treadout)
- ***) possible frame rates which can be achieved in the selected mode, see item 2.
- ****) raw color data can be used via the mono color coding ID
- *****) can be inverted via software
- *****) necessary for optimal timing specification
- ******) housing temperature is limited by CCD sensor specification

2. Selectable Frame Rates depending on the used IEEE1394 Interface

| Format | Mode | IEEE1394 interface | 240 fps | 120 fps | 60 fps | 30 fps | 15 fps | 7.5 fps | 3.75 fps | 1.875 fps |
|--------|------|--------------------|---------|-----------|-----------|--------|--------|---------|----------|-----------|
| 0 | 2 | 800 Mbit / sec | | x (76) *) | x | x | x | x | x | x |
| | | 400 Mbit / sec | | | x | x | x | x | x | x |
| | | 200 Mbit / sec | | | | x | x | x | x | x |
| | | 100 Mbit / sec | | | | | x | x | x | x |
| | 3 | 800 Mbit / sec | | | x (38) *) | x | x | x | x | x |
| | | 400 Mbit / sec | | | | x | x | x | x | x |
| | | 200 Mbit / sec | | | | | x | x | x | x |
| | | 100 Mbit / sec | | | | | | x | x | x |
| | 5 | 800 Mbit / sec | | x (76) *) | x | x | x | x | x | x |
| | | 400 Mbit / sec | | | x | x | x | x | x | x |
| | | 200 Mbit / sec | | | | x | x | x | x | x |
| | | 100 Mbit / sec | | | | | x | x | x | x |

- *) possible frame rates which can be achieved in the selected mode

3. 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) / brightness control | 0 |
| Image acquisition | |
| Camera image format mode | Format 0 Mode 3 / 15 fps |
| White balance | active, adjusted on light source value = 5000 K (D50) |
| Partial scan function | not active |
| Electrical interface | |
| Flash sync signal / Strobe_0 | disabled, digital output set to low status (high impedance) polarity bit = "1" |
| Async. Trigger | disabled polarity bit = "1" |

4. Supported Image Formats via fxlib.dll (Baumer FCAM driver)

4.1 Supported Image Format

| Camera name | | TXD06c | | | |
|-----------------|--------------|----------------|--------------|---|-------------------|
| Camera mode | | SDK image mode | | | |
| | Color coding | Mode ID | Image format | Description | Functions / State |
| Format 0 Mode 2 | YUV (4:1:1) | 02 | 640 x 480 | center scan fast scan | T, F |
| Format 0 Mode 3 | YUV (4:2:2) | 03 | 640 x 480 | center scan high quality scan | T, F |
| Format 0 Mode 5 | Mono8 | 05 | 640 x 480 | center scan fast scan | T, F |
| Format 7 Mode 0 | Raw8 *) | 070 | 776 x 582 | full frame Raw8 high quality scan | PS, T, F |
| | Raw16 *) | 570 | 776 x 582 | full frame Raw16 high quality scan | PS, T, F |
| Format 7 Mode 1 | Raw8 *) | 071 | 776 x 582 | full frame Raw8 fast scan | PS, T, F |
| | Raw16 *) | 571 | 776 x 582 | full frame Raw16 fast scan | PS, T, F |
| Format 7 Mode 2 | Mono8 | 072 | 768 x 574 | full frame Mono8 high quality scan | PS, T, F |
| | 4:1:1 YUV8 | 172 | 768 x 574 | full frame 4:1:1 YUV high quality scan | PS, T, F |
| | 4:2:2 YUV8 | 272 | 768 x 574 | full frame 4:2:2 YUV high quality scan | PS, T, F |
| | 4:4:4 YUV8 | 372 | 768 x 574 | full frame 4:4:4 YUV high quality scan | PS, T, F |
| | RGB8 | 472 | 768 x 574 | full frame RGB8 high quality scan | PS, T, F |
| Format 7 Mode 3 | Mono8 | 073 | 768 x 574 | full frame Mono8 fast scan | PS, T, F |
| | 4:1:1 YUV8 | 173 | 768 x 574 | full frame 4:1:1 YUV fast scan | PS, T, F |
| | 4:2:2 YUV8 | 273 | 768 x 574 | full frame 4:2:2 YUV fast scan | PS, T, F |

*) raw color data can be used via the mono color coding ID

4.2 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 *) | | | | | | | |
| | Raw16 | x | x *) | | | | | | |
| | Mono8 | | | | | | | x *) | |
| | YUV (4:1:1) | | | x | | | | x | |
| | YUV (4:2:2) | | | x | | | | x | |
| | YUV (4:4:4) | | | x | | | | x | |
| | RGB8 | | | x *) | | | | x | |

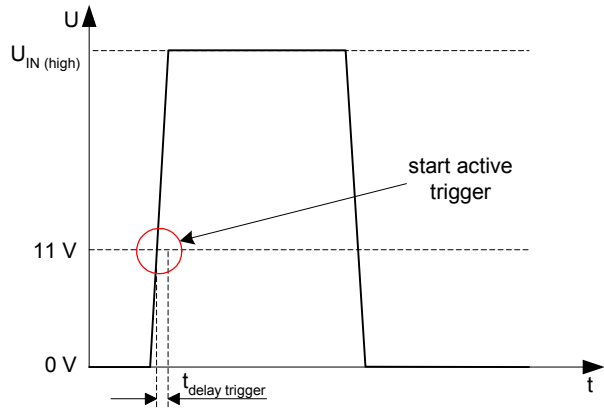
*) original camera format

4.3 Abbreviation / Description

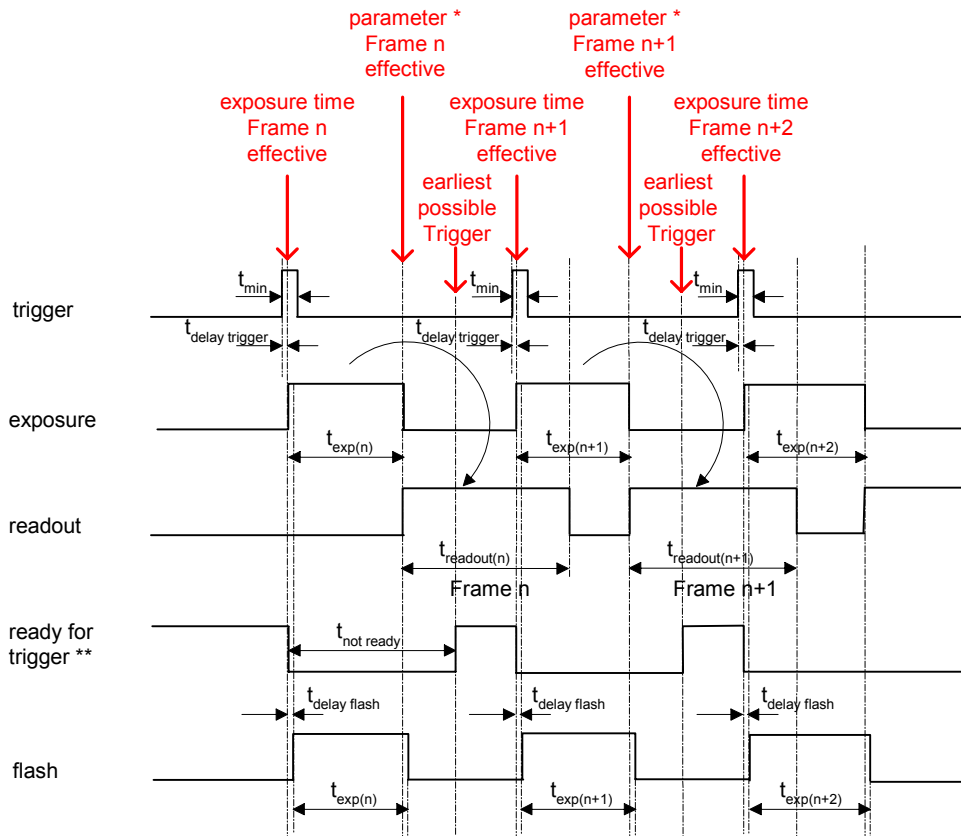
| | |
|----------------------------------|---|
| SDK | - Software Development Kit |
| PS | - partial scan |
| T | - trigger |
| F | - flash |
| Mono | - monochrome mode |
| Color | - color mode |
| Raw8[16] | - unmanipulated pixel data in Bayer filter pattern in 8 [16] bit |
| Bayer8[12] / BayerRG8[12] | - 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[16] bit |

5. Timing Operation Modes

Trigger Mode: start up time



Trigger Mode: trigger mode 0, overlapped trigger



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

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

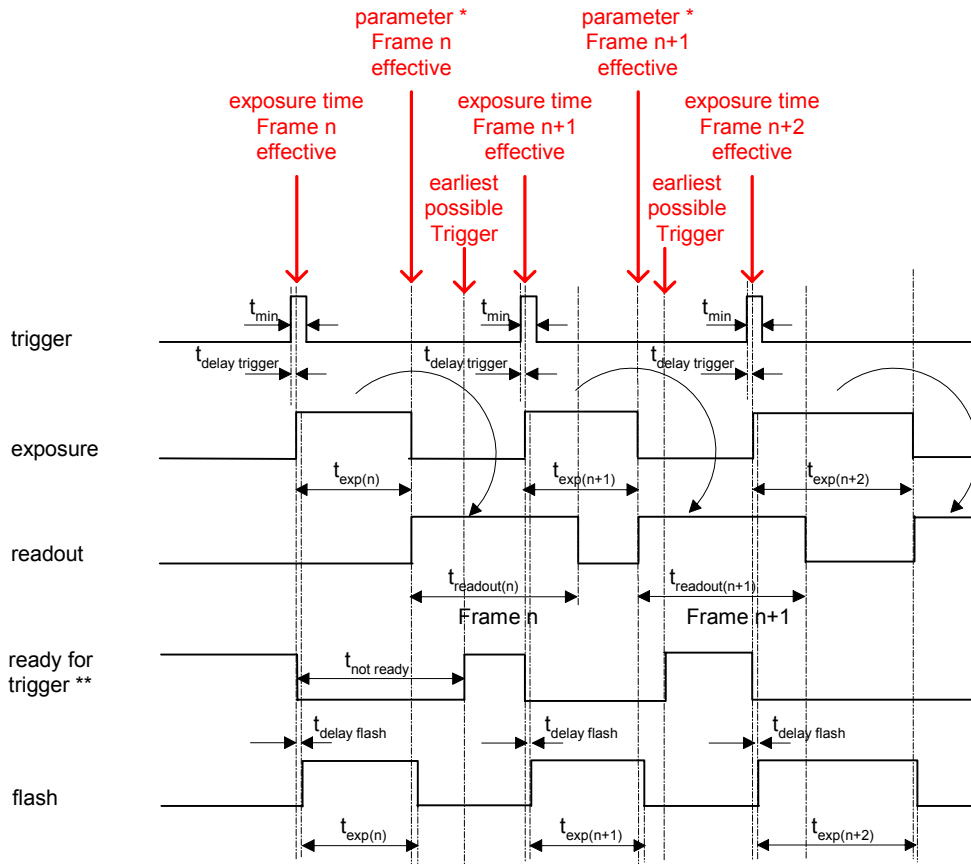
$$t_{exp} < t_{readout}: t_{\text{not ready (n+1)}} = t_{exp(n)} + t_{readout(n)} - t_{exp(n+1)}$$

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

* image parameter: offset
 global gain
 mode
 partial scan

** signal is not available as digital output

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



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

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

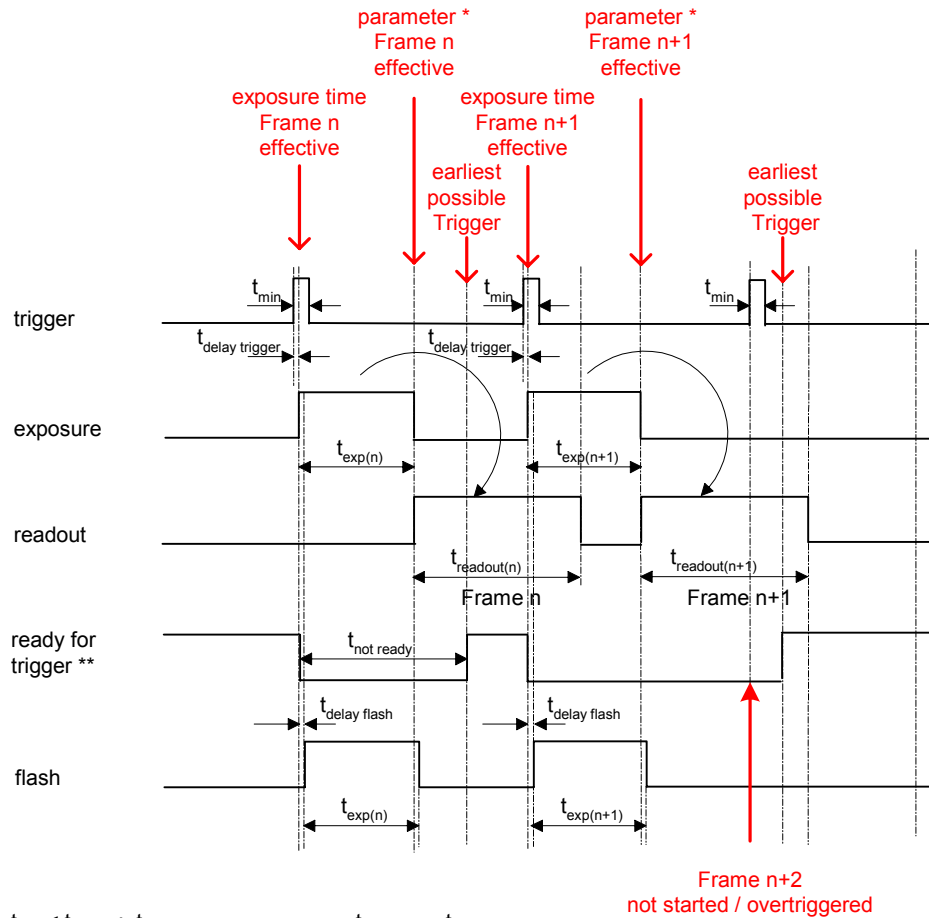
$$t_{exp} < t_{readout}: t_{not\ ready\ (n+1)} = t_{exp(n)} + t_{readout(n)} - t_{exp(n+1)}$$

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

* image parameter: offset
 global gain
 mode
 partial scan

** signal is not available as digital output

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



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

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

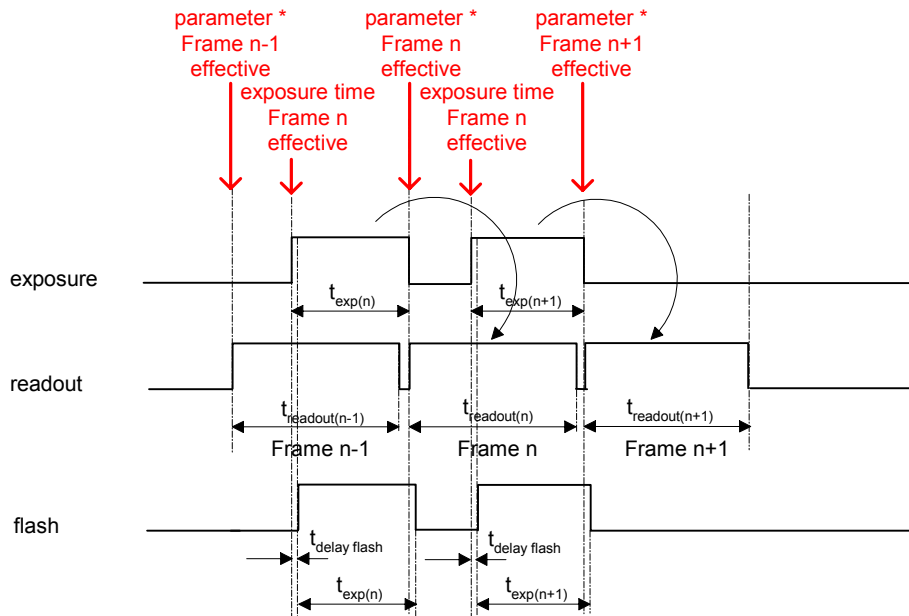
$$t_{exp} < t_{readout} : t_{not\ ready\ (n+1)} = t_{exp(n)} + t_{readout(n)} - t_{exp(n+1)}$$

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

* image parameter: offset
global gain
mode
partial scan

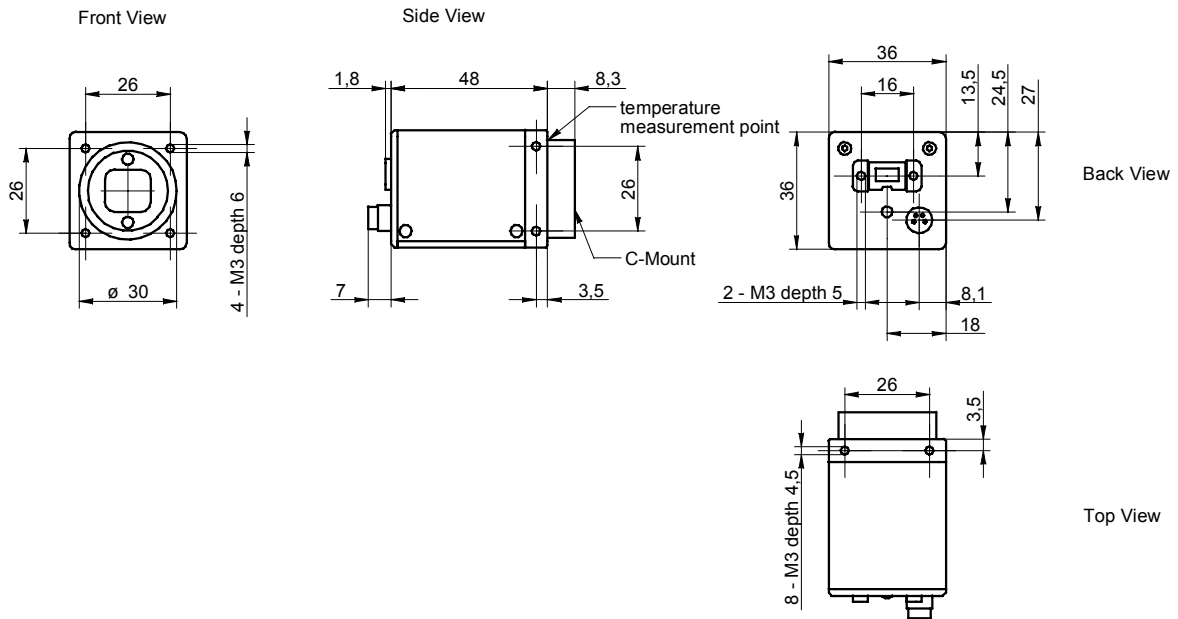
** signal is not available as digital output

Free Running Mode: overlapped operation



* image parameter: offset
 global gain
 mode
 partial scan

6. Housing



7. Connectors / Electrical Interfaces

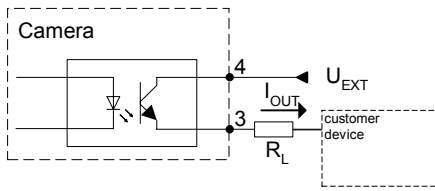
7.1 Pin assignment:

| 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 |

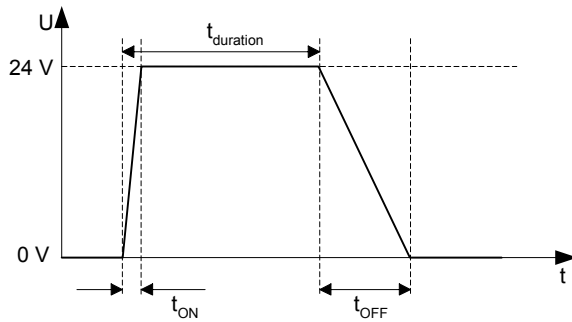
| Trigger Flash | Type: Lumberg RSMESD 4pin. |
|---------------|--|
| | <p>*) resistor must be used, $I_{OUT} = 16 \text{ mA}$ by $U_{EXT} = 24 \text{ VDC}$ recommended, drawing shown above example for using high active signal</p> <p>Trigger / Flash cable wires color *): 1 = brown 2 = white 3 = blue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

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

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

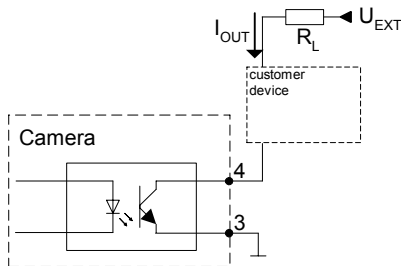


Timing example:
 measurement condition $U_{EXT} = 24\text{ VDC} / I_{OUT} = 16\text{ mA}$

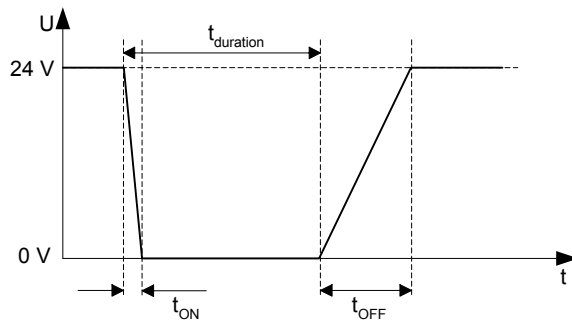


t_{ON} time = typ. 2 μsec
 t_{OFF} time = typ. 40 μsec

7.3 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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