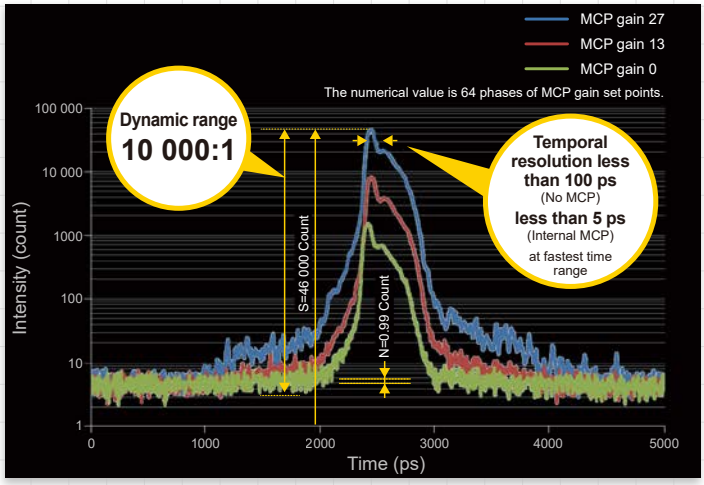
High dynamic range streak camera

C13410 series

Dynamic range

10 000:1



Single shot streak image with laser diode
(Equipment used: C13410-01A/V12303-01/ORCA®-Flash4.0)

Dynamic range of 10 000 : 1 of ultra fast phenomena under single-shot operation!

HAMAMATSU

PHOTON IS OUR BUSINESS

High dynamic range up to 10 000 : 1 enables to capture a wide range of light intensities from a single-shot event

The C13410 is a high dynamic range streak camera that can handle a large number of photo-electrons. This feature enables single-shot measurements of ultra fast phenomena with a dynamic range as high as 10 000 : 1.
This system is suitable for high-precision simultaneous measurement of high-intensity and weak intensity pulse light.

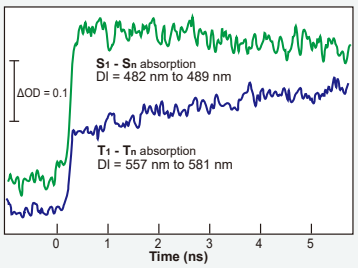
Features

- **High dynamic range of 10 000 : 1 (at temporal resolution 100 ps)**
- **Temporal resolution of 5 ps***
- **Effective photo cathode size: 17 mm**
- **Simultaneous measurement of light intensity on temporal and spatial (wavelength) axis**

* The dynamic range of the streak camera is 1000:1 at the fastest time range with temporal resolution of 5 ps.
Image intensifier is required to detect single photo-electron.

Applications

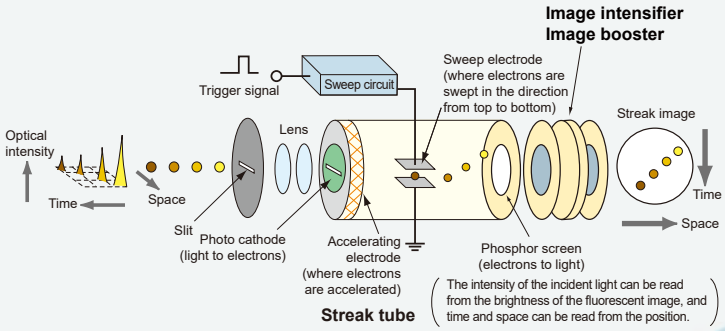
- **Research involving laser fusion lasers, free electron lasers and various other types of pulsed lasers**
- **Plasma light emission, radiation, laser ablation, combustion and explosion**
- **Picosecond transient absorption measurement**
  (Time dependence of absorption is shown on the right.)
- **LIDAR Thomson scattering, time-of-flight laser ranging**
- **Fluorescence lifetime measurement, time-resolved raman spectroscopy**



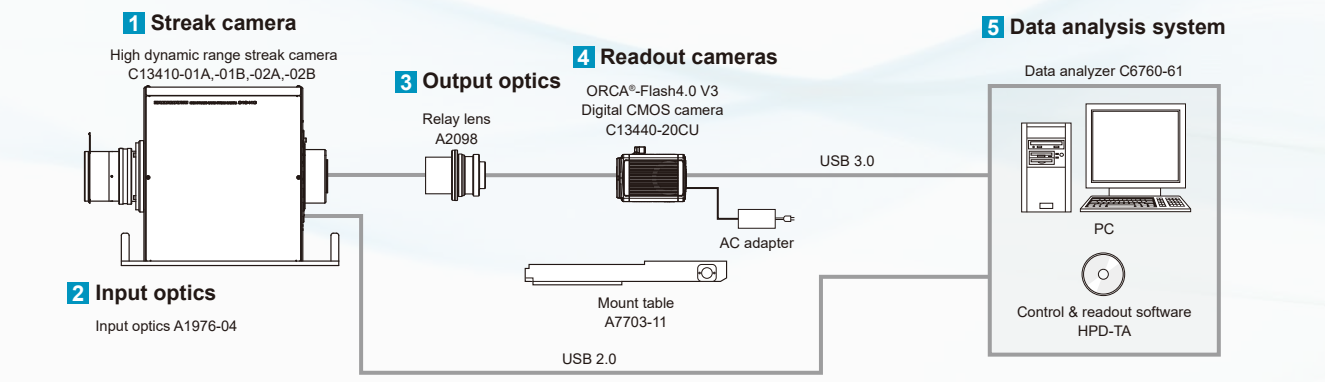
The 266 nm excitation (25 ps, 0.2 mJ, φ2 mm focused, single shot) of Chrysene in THF (0.5 m mol/l)

Operating principle

The light pulse to be measured is focused onto the photo cathode of the streak tube through the slit, where the photons are converted into a number of electrons proportional to the intensity of the incident light. These electrons are accelerated and conducted towards the phosphor screen, and a high-speed voltage which is synchronised to the incident light is applied. The electrons are swept at high speed from top to bottom, after which they are bombarded against the phosphor screen of the streak tube and converted to an optical image.
When the light intensity of the streak image is very weak, an image intensifier or an image booster amplifies the low light level streak image.



System configuration



Specifications

1 Streak camera

High dynamic range streak camera C13410-01A, -01B, -02A, -02B

Type number		C13410-01A	C13410-01B	C13410-02A	C13410-02B
Photocathode		S-20		S-1	
Spectral response		200 nm to 850 nm		300 nm to 1060 nm	
Effective photocathode size		7.0 mm × 17.48 mm			
Phosphor screen		P-43, φ25 mm, Fiberoptic output			
Spatial resolution		18 lp/mm or more (center of photocathode, wavelength 530 nm)			
Image enhancement part		Image Intensifier (I.I.) / Image Booster (I.B.) Outside attachment			
Focus		Magnetic focus			
Temporal resolution		Better than 5 ps (at the fastest sweep range)			
Sweep time / full screen 1,2,5 step		0.5 ns to 1 ms	0.5 ns to 10 ms	0.5 ns to 1 ms	0.5 ns to 10 ms
Trigger jitter		Less than ±20 ps (at the fastest sweep range)			
Trigger Delay		Approx. 30 ns (at the fastest sweep range)			
Maximum sweep repetition frequency		1 kHz at OPEN FIXED mode, 100 Hz at NORMAL mode			
Operation mode		FOCUS / OPERATE			
Streak trigger input	Maximum input voltage	±5 V / 50 Ω			
	Trigger level	±4 V Adjustable			
Monitor out signal		LVCMOS 10 kΩ			
Gate mode		NORMAL / GATE / OPEN FIXED			
Gate method		Photocathode gate			
Maximum gate repetition frequency		100 Hz			
Extinction ratio		More than $1:10^5$			
Input signal		+3.5 V to +5.0 V 50 Ω, rising edge			
Gate delay time		1 µs			
Interface		USB 2.0			
Power supply		AC 100 V to AC 240 V, 50 Hz/60 Hz			
Power consumption		Approx. 100 VA			

Spectral response characteristics (typ.)

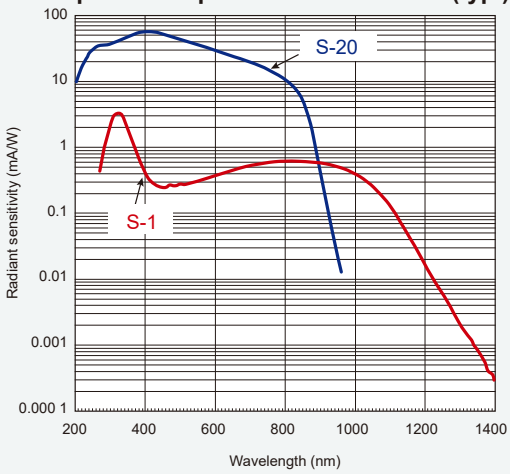


Image Intensifier V12303-01, -11

Type number	V12303-01	V12303-11
Photocathode	Bi-alkali	Multi-alkali
Effective Photocathode size	25 mm	
Luminous gain	Variable max.1000 (typ.)	Variable 10 (typ.)
Single photon detection	Yes	No
MCP	Internal	No

About a dynamic range

The maximum dynamic range of the streak camera essence is set to 1000:1 by the measurement condition of temporal resolution 5 ps, and is set to 10 000:1 by the measurement condition of temporal resolution 100 ps. However, the dynamic range of the entire system may be restricted depending on the setting of sweep range and MCP gain. Furthermore, a read-out camera may also restrict the dynamic range of the measurement system.

	Temporal resolution 5 ps	Temporal resolution 100 ps
V12303-01	1000:1	2000:1 (10 000:1 *)
V12303-11	-	10 000:1

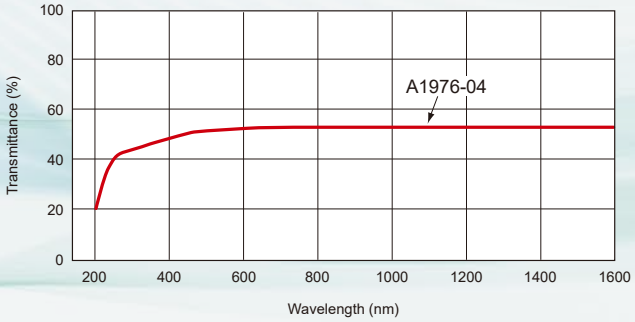
*With low MCP gain (< 32 at Max.64).

2 Input optics

Input optics A1976-04

Spectral transmission	200 nm to 1060 nm
Image multiplication ratio	1 : 1
Effective F value	3.5
Slit width	0 mm to 5 mm
Slit width reading precision	5 µm
Overall length (excluding the fitting part)	98.2 mm

Spectral transmittance of input optics



3 Output optics

Relay lens A2098

Magnification	2 : 1
Effective F value	2.5
Lens mount	C-mount
Corresponding camera	ORCA®-Flash4.0 V3 Digital CMOS camera C13440-20CU

4 Readout camera

ORCA®-Flash4.0 V3 Digital CMOS camera C13440-20CU

Effective number of pixels	2048(H) × 2048(V)
Pixel size	6.5 µm(H) × 6.5 µm(V)
Effective area	13.312 mm(H) × 13.312 mm(V)
Number of pixels on working area	1344(H) × 1016(V)
Working area on phosphor screen	17.47 mm(H) × 13.21 mm(V)
Exposure time	1 ms to 10 s
Frame rate	60 frames/s (USB 3.0, 1344(H) × 1016(V))
Digital output	16 bit
Power supply	AC 100 V to AC 240 V, 50 Hz/60 Hz
Power consumption	Approx. 120 VA

5 Data analysis system

Data analyzer C6760-61

Component	PC, Liquid crystal display, Cable
	Extension board
System	Windows® 10 (64 bit)
Interface	USB 3.0

<Control & readout software HPD-TA>

*Included in the Data analyzer

Data acquisition	Live mode, analog integration, photon counting, sequence recording
Device control	Streak camera, readout camera, spectrograph, delay units
Profile functions	Real-time display, Min./Max., FWHM, Gauss fit
Data corrections	Background, sensitivity, curvature, jitter
Axis calibration	Channel, time, wavelength
File formats (images)	Binary (up to 32 bit), TIFF, ASCII
File format (profiles)	ASCII

Options

Delay unit C15936

This passive delay unit provides convenient timing adjustment.

Variable delay range	0 ns to 31.96 ns
Delay setting range	30 ps, 60 ps, 120 ps, 250 ps, 500 ps, 1 ns, 2 ns, 4 ns, 8 ns, 16 ns
Minimum delay time	Approx.12 ns
Maximum input signal voltage	10 V
Interface	USB 3.0
Power supply	AC 100 V to AC 240 V, 50 Hz/60 Hz
Power consumption	Approx. 30 VA
Dimensions / weight	262 mm(W) × 82 mm(H) × 333 mm(D) / Approx. 3.2 kg

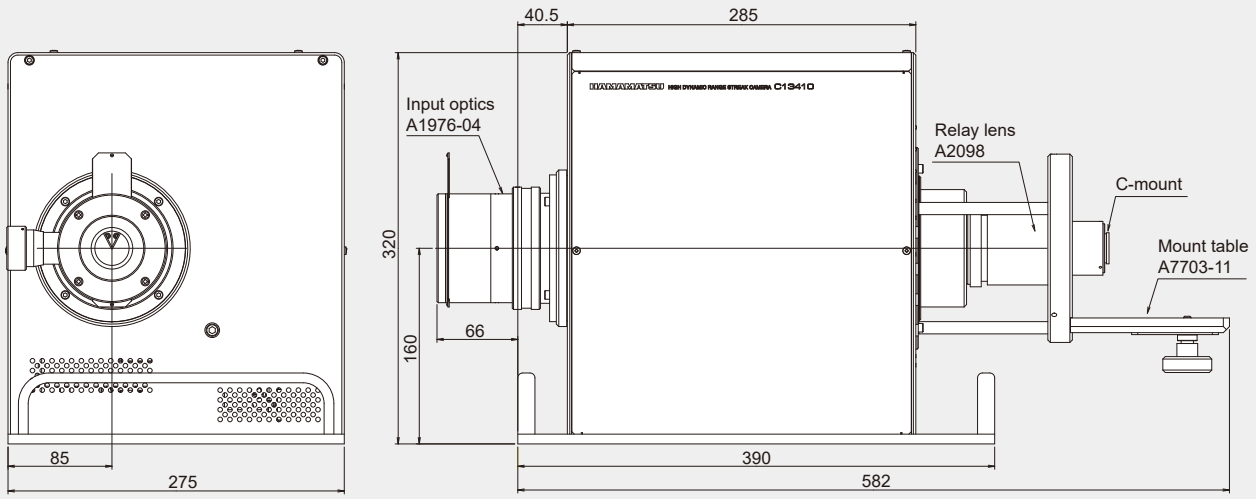
PIN diode head C1083-01

Converts low-repetition light pulses to an electronic trigger for streak sweep.

Spectral response		320 nm to 1000 nm
Risetime		0.8 ns
Power supply		+18 V (battery)
Dimensions / weight	Head	100 mm(W) × 156 mm to 220 mm(H) × 50 mm(D) / Approx. 400 g
	Power supply unit	98.5 mm(W) × 35 mm(H) × 112 mm(D) / Approx. 400 g

Dimensional outlines (Unit : mm)

High dynamic range streak camera C13410 main unit (Approx. 26 kg)



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