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XXRapidFrame

Fastest multi-framing ICCD camera system

Standard Features

- Three or Four intensified CCD channels (4 Picos or 4 Quik E)
- Perfectly spectral flat image splitter
- Gating times from 1.2ns - DC (0.2ns DC optional)
- Fastest shutter down to 0.2ns (based on 4 Picos ICCD cameras) in single mode
- Jitter less than 0.01ns
- Single Photon detection
- Ultra fast recording of up 4 full frame resolution images with 0.01ns interframing time
- Spectral Sensitivity of photocathodes from UV - NIR (220 - 1300nm)
- Double shutter and multiple exposures (each module)
- USB2.0 or analog output
- High Dynamic Range: 14 Bit (21 Bit with 4 Spec E spectroscopy software)
- Effortless Image/Data storage and retrieval
- Internal or external trigger
- Free Terminal software ready-to-use

PRELIMINARY

Specifications

Unique Features	XXRF based on 4 Picos	XXRF based on 4 Quik E
Shortest gating time each module	0.2ns	1.2 ns
Jitter	< 0.01ns	< 0.01ns
Multiple exposures, dead time between exposures	any sequence 0.3μm	
Gate repetition rate	3.3MHz burst, 200kHz continuous (each)	
Intensifier output coupling	customized distortion free f/0.8 relay lens	
Image Splitter	Spectrally flat mirror system	

The XXRapidFrame ultra high speed digital imaging system opens a new range of timing capabilities.
The timing precision (jitter) is four times more accurate than that of dedicated delay generators (e.g. DG535) the minimum gate/times and gate/delay time step are up to 100 times or more faster, compared to the previous state of the art of other systems.
Exact reproducible digital setting of delay and exposure times is standard.

Very high system integration permits small physical size of the XXRapidFrame camera.
Distortion free imaging due to advanced proximity focused MCP (Micro Channel Plate) image intensifier and use of highest quality CCD array for best sensitivity and resolution.

14 Bit High Dynamic Range (theoretical limit 16 bit),
with 4 Spec E Spectroscopy PC Software up to 21 Bit/ Spectrum with all lines integrated.

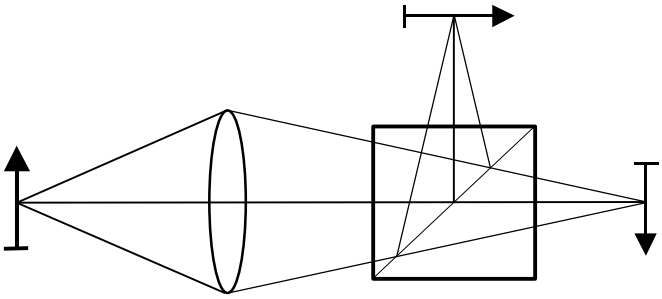
Rear view of the multi framing camera XXRapidFrame

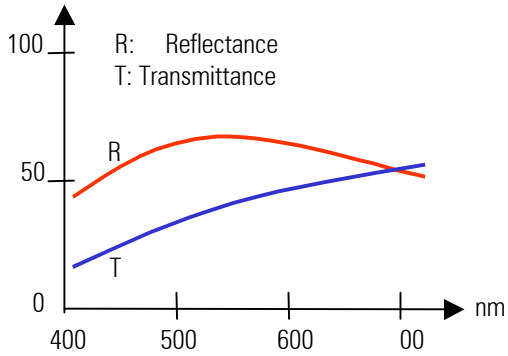
Field 1: RS 232 Interface)
Field 2: Power and Remote I/O
Field 3: Analog I/O Connectors)

PRELIMINARY

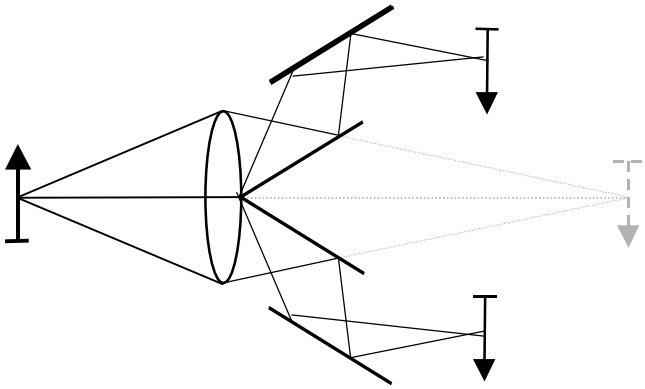
Comparison of image splitting concepts.

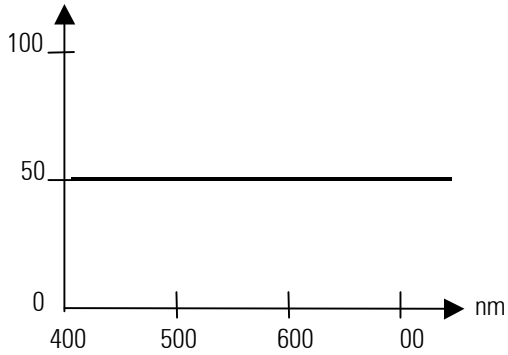
Semi transparent image splitter





Mirror image splitter





The typical semitransparent image splitting setup does not provide equal spectral distribution to both channels. ur spectrally flat Mirror Image Splitter does have identical amount of light of all wave length to all channels.

Image Intensifier

Image Intensifier specifications	
Image intensifier type (proximity focused MCP)	single stage (standard), dual stage (optional)
Phosphor material	P43, P46
Image intensifier diameter (mm)	18mm, 25mm
Image area of the relay lens	25mm MCP: 20 x 15mm, 18mm MCP: 14.4 x 10.8mm
avelength range, subject to window design	165 20nm (quartz, standard), 220 1300nm (optional)
Spectral Sensitivity of MCP (nm)	220..1300nm, depends on the type of the photocathode
Quantum Efficiency (Q.E.) (see curves below)	depends on the type of the MCP, up to 35
Gain (4k steps) (V_{MCP} ..1000V) control via RS 232 digital setup	single stage MCP: 4 x 10^4 dual stage MCP: 4 x 10^6
Signal to noise (db μ x)	46dB min 0.5μ x
Coupling phosphor (MCP → CCD)	customized 6 element f/0.8 relay lens **No distortion! No vignetting! No pin cushion!**

Spectral Sensitivity of Photocathodes (Wavelength in nm)					
Standard 18 mm			**Optional 25 mm**		
S20UV	B	approx. 165 - 820nm	Solar Blind (CsTe)	G	approx. 180 - 340nm
S25 IR (Super S25)	H	approx. 350 - 20nm	Bialkali		approx. 165 - 600nm
Optional 18 mm			Enhanced S20	D	approx. 165 - 820nm
S20 UV(MgF2)		approx. 110 - 820nm	Enhanced S25 (glass)	I	approx. 2 0 - 00nm
Broadband	J	approx. 1 0 - 20nm	ideband S25 B		approx. 200 - 00nm
Standard 25 mm			S1	E	approx. 00 - 1300nm
S20	C	approx. 165 - 820nm	Enhanced S20	D	approx. 165 - 820nm
S25	F	approx. 200 - 840nm			

Deviations of up to 25 from the above typical spectral sensitivity curves are possible. The position of the curves can vary 20nm.
The input window material limits the spectral response of the photocathode in the shorter wavelengths.
The window materials and their transmission limits are:
quartz (165nm), MgF2 (110nm).

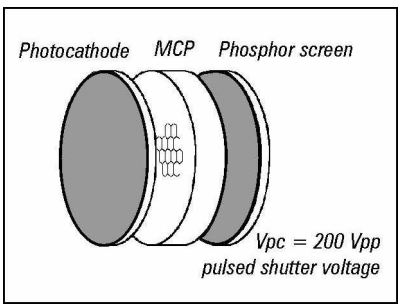
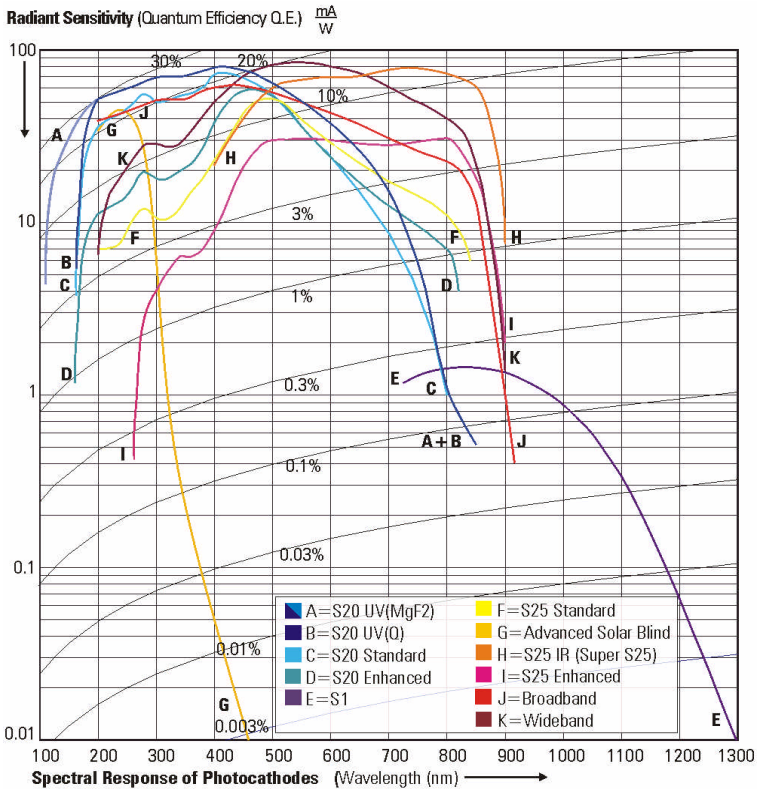


Image intensifier and shutter (schematic)



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PRELIMINARY

CCD-Readout Unit

CCD Video Chip	Analog Output USA, Japan	Analog Output Elsewhere	Progressive Scan CCD	Standard Resolution CCD	High Resolution CCD
nalog or digital output	analog EI (RS 1 0)	analog CCIR	analog, VG 30/60Hz or 60/120Hz	digital 10, 12, or 14 Bit	digital 10, 12 or 14 bit
Resolution (pixel)	68 x 4 4	52 x 582	640 x 480	82 x 582	1368 x 1020
Pixel size (μm)	8.4 x .8	8.6 x 8.3	.8 x .8	8.6 x 8.6	4.8 x 4.8
Imaging frequency (analog) Frame rate (digital)	30/60Hz	25/50Hz	30/60 (30/60Hz) 60/120/200/240/350 (60/120Hz)	10bit: 32/62/108fps 12bit: 32/62/108fps 14bit: 16/31/54fps	10bit: 10/20/35fps 12bit: 10/20/35fps 14bit: 5/10/18fps
Video Gain	0...25dB, automatic or manually adjustable through computer RS 232 interface			10bit/12bit: 0..10dB 14bit: 0..25dB	
Binning vertical (pixel)	Software			1,2 pixel, R I	
Binning horizontal (pixel)	Software			1,2 pixel, R I	
Dynamic Range /D (Bit)	14 Bit, up to 21 Bit (with 4 Spec E spectroscopy software)				
Chip Readout	Correlated double sampling, dark current corrected				
utput	1V_{pp} (5 Ω), composite video, RS 1 0/EI , CCIR or VG				
Internal Synchronization	Free run mode				
External Synchronization	by negative edge TT pulse (Vinit)				
Signal to noise	46dB min 0.5μ x				
Cooling of CCD (optional)	Regulated cooling of CCD camera unit to 14 C to minimize dark current by a factor of 10 for exposure times above 100 ms. Provides single photon sensitivity. No condensation eliminates need for vacuum or special nitrogen atmosphere.				

Mechanical & Environmental Data, Power Requirements

XXRapidFrame (based on 4 Picos or 4 Quik E)	Three Channels	Four Channels
Camera dimensions, without lens (l x w x h)	480 x 300 x 350 mm	650 x 350 x 380mm
Camera weight (all in one) (kg / lb)	25kg / 55lb	30kg / 66lb
Camera mount (at the bottom plate of the camera)	3/8 x 20 and M8 mounting hole	
perating Humidity ( )	25.. 5 , non condensing	
perating temperature (C / F)	0 C 50 C / 32 F 122 F	
Performance specification	10 C 40 C / 50 F 104 F	
perating limits	-10 C 50 C / 14 F 122 F	
Shock and Vibration	60 g accel. shock, g Vibration (11 200Hz)	
Voltage	0..260V C	

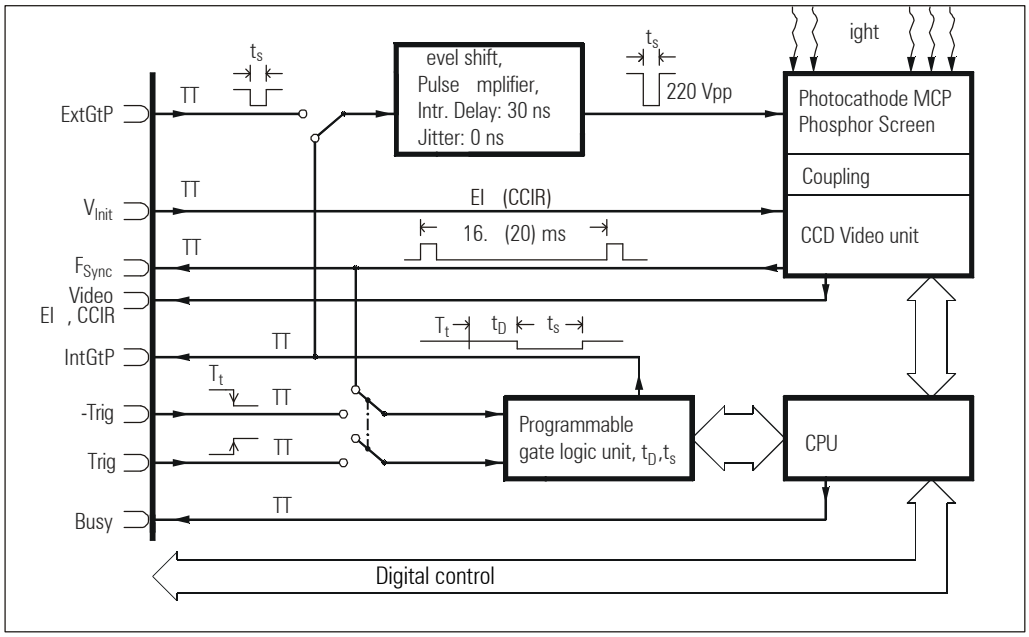
PRELIMINARY

Shutter control

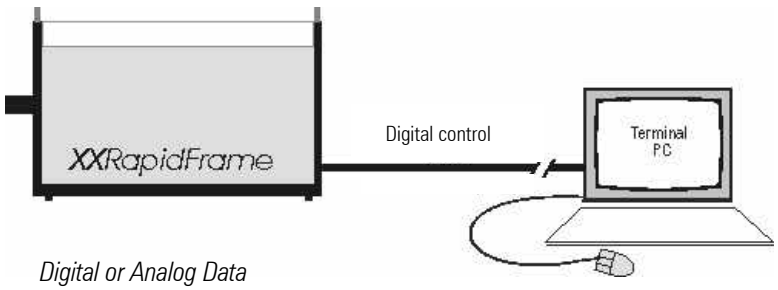
The advanced, digitally controlled shutter delay feature is the perfect match for your laser, range gating, flow analysis, or many other high speed applications. It is operational in scattered light environments, underwater or for highest speed multi-instrument sequential image acquisition. Multiple direct images with a repetition/ delay time setting as short as 0.3 µs can be synchronized with ease to any external TT source.

Internal exposure control	XXRapidFrame P	XXRapidFrame E
Time (t_S) and delay (t_D) of the gate pulse, or multiple exposure with CPU internally digital programmable	t_S 0.2ns ... 80s, min. steps 0.01ns t_D 0 ... 80s, min. increments 10ps	t_S 1.2ns ... 80s, min. steps 0.1ns t_D 0 ... 80s, min. increments 0.1ns
Trigger propagation delay	<65ns, less than 0.01ns jitter	
Initializing	-Trig, Trig, or FSync	
Multiple Exposure	ny sequence, 0.3µs dead time between exposures	

External exposure control	XXRapid Frame P	XXRapidFrame E
Control of the camera internal Pulse E amplifier via ExtGtP (TT Pulse) input: Shutter continuous from:	t_S 0.2ns ... ∞, t_D, ∞ t, t_D determined by external device	t_S 1.2ns ... ∞, t_D, ∞ t, t_D determined by external device
Trigger propagation delay	<45ns, no jitter	



Analog shutter control (schematic)



Digital or Analog Data

XXRapid Frame

analog or digital output

25mm Standard: S20 or S25 18mm Standard: S20 or Super S25 ptional: Bialkali/Fused Silica, dvanced Solar Blind (CsTe), Enhanced S25, Enhanced Blue-UV S20, ideband S25 B Two photocathode window materials may be ordered depending upon the required response.	**XXRF-E** (4QuikE)	**XXRF-Edig** (4QuikE/dig)		**XXRF-P** (4Picos)	**XXRF-Pdig** (4Picos/dig)					
Standard											
Gating Speeds from 1.2ns /1.5ns → ∞	■	■									
Gating Speeds from 0.2ns → ∞				■	■						
Image Intensifier with 18mm MCP	■	■		■	■						
Image Intensifier with 25mm MCP	□	□		□	□						
Image Intensifier with Single stage MCP	■	■		■	■						
Image Intensifier with V-stack dual stage MCP	□	□		□	□						
Jitter 0.01ns	■	■		■	■						
ens Coupling	■	■		■	■						
High Efficiency customized f/0.8 relay lens	■	■		■	■						
Multiple Exposures	■	■		■	■						
Shutter dead time 0.3µs	■	■		■	■						
Integrated Single Trigger Discriminator (STD)	■	■		■	■						
nalog CCD video output EI , 68 x 4 4 pixel or CCIR, 52 x 582 pixel	■			■							
Progressive Scan CCD, VG , 640 x 480 pixel	□			□							
Standard Resolution CCD, 10bit, 52 x 582 pixel		■			■						
Standard Resolution CCD, 12bit, 52 x 582 pixel		□			□						
Standard Resolution CCD, 14bit, 52 x 582 pixel		□			□						
High resolution CCD, 10bit, 1368 x 1020 pixel		□			□						
High resolution CCD, 12bit, 1368 x 1020 pixel		□			□						
High resolution CCD, 14bit, 1368 x 1020 pixel		□			□						
Terminal Software and printed manual	■	■		■	■						
Comfortable case for shipment storage for free	■	■		■	■						
Additional Options											
Peltier Cooling	□	□		□	□						
Special Spectrograph dapters	□	□		□	□						
utomatic Exposure Control	□	□		□	□						
Image Intensifier with Special Photocathodes	□	□		□	□						
Nikon F-mount dapter	□	□		□	□						

■ standard □ optional

PRELIMINARY

Applications

Physical Sciences
Plasma temperature and density analysis
Plasma flow analysis
Combustion analysis
Synchrotron radiation
aser induced fluorescence

Biological Sciences
Cancer research
Fundus imaging spectroscopy
X-ray detection
uminescence
Time resolved fluorescence

High Speed Imaging
Dynamic Schlieren Phenomena
Shock tubes
Range gating

Low Light Imaging
Thomson Scattering
Raman Spectroscopy
Glow Discharge Spectroscopy
Semiconductor failure analysis