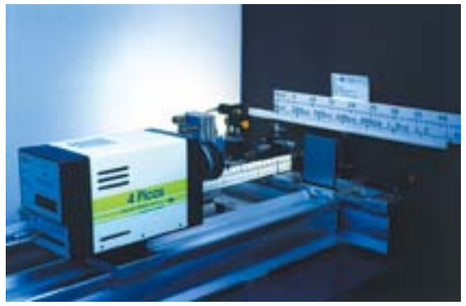
TSC
www.toptical.com.tw 02-2346-1510 toptical@ms17.hinet.net

4 Picos

The most compact intelligent ICCD picos-fast camera system
(digital or analog output)



Features

- Fastest shutter down to 0.2ns
- Gating times from 0.2ns → DC
- 18mm standard, 25 mm image intensifier optional
- Spectral Sensitivity of photocathode from UV - NIR (110 - 1300nm)
- Multiple Exposures
- Single Photon detection
- Analog (EIA/CCIR) or digital output (12, or 14 Bit with Standard or High Resolution)
- Customized f/0.8 distortion free lens coupling between image intensifier and CCD
- High Dynamic Range: 14 Bit (21 Bit with 4 Spec E spectroscopy software)
- Effortless Image/Data storage and retrieval
- Single Trigger Discriminator integrated
- Internal or external trigger
- Free Terminal software and printed manual

SPECIFICATIONS

Unique Features	4 Picos
Shortest gating time	Shortest gating time 200ps
Intensifier output coupling	customized distortion free f/0.8 relay lens
Optical input	c-mount (standard), Nikon F-mount (optional)
Optical input window	fused silica
Sensitivity corresponding to conventional film	1 x 10^{12}fc = 50 x 5^{7} ASA
Multiple exposures, „dead“ time between exposures	any sequence 0.3µm
Gate repetition rate	3.3MHz burst, 200kHz continuous
TTL pulse (incorporated)	standard
Remote control	RS 232 (digital set up)
CE certified	yes

Adaptation to in situ light level variations by internal digital programmable brightness control of the electronic shutter action, with exact reproducible digital setting of delay and exposure times.

Very high system integration permits small physical size of the total unit (all in one) — even very difficult surveillance jobs are mastered easily by remote control.
Programmable control parameter entry via RS 232 (digital set up), remote control software included.

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.

Automatic Exposure Control and Automatic Gain, for unattended operation under greatly varying light conditions (optional). Effortless Image/Data storage and retrieve via system interface RS 170 to an external VCR (standard), frame grabber or optical disk (optional).

Switches and Connections

No.	Item	Function
A	Switch	Power Switch ON/OFF
B	Socket	Power Supply Socket (12V)
1	Video	Camera output signal (RS170 or CCIR)
2	Busy	Synchronization Signal (TTL), e.g. Frame Grabber
3	V_{Init}	Asynchronous reset of CCD camera
4	F_{Sync}	TTL output for synchronization purposes
5	-Trig	Trigger input, negative edge TTL
6	+Trig	Trigger input, positive edge TTL
7	IntGtP	Output of internal time delay gate pulse generator
8	ExtGtP	Input for control of HV MCP pulse (TTL)

Rear view of 4 Picos with legend

For control by internal time/delay generator, 7 and 8 are shorted internally. Camera will free run when 4 to 5, and 7 to 8 are internally connected. These settings are both under RS 232 control. Camera may be externally driven through 8 by external pulse delay generator when 7 and 8 are disconnected. Pulse monitoring is provided by 7 and camera master sync ouput is available at 4.

Image Intensifier

Image Intensifier specifications	
Image intensifier type (proximity focused MCP)	single stage (standard), dual stage (optional)
Phosphor material	P43 (standard), P46 (optinal)
Image intensifier diameter (mm)	18mm standard, 25mm optional
Image area of the relay lens	25mm MCP: 20 x 15mm, 18mm MCP: 14.4 x 10.8mm
Wavelength range, subject to window design	165 – 920nm (quartz, standard), 110 – 1300nm (optional)
Spectral Sensitivity of MCP (nm)	110..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
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 - 920nm	Bialkali		approx. 165 - 600nm
Optional 18 mm			Enhanced S20	D	approx. 165 - 820nm
S20 UV (MgF2)	A	approx. 110 - 820nm	Enhanced S25 (glass)	I	approx. 270 - 900nm
Broadband	J	approx. 190 - 920nm	Wideband S25 WB	K	approx. 200 - 900nm
Standard 25 mm			S1	E	approx. 700 - 1300nm
S20	C	approx. 165 - 820nm	Enhanced S20	D	approx. 165 - 820nm
S25	F	approx. 200 - 840nm			

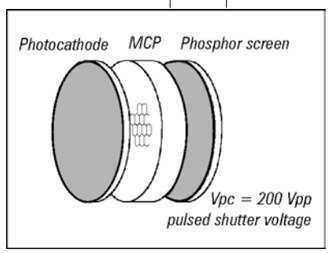
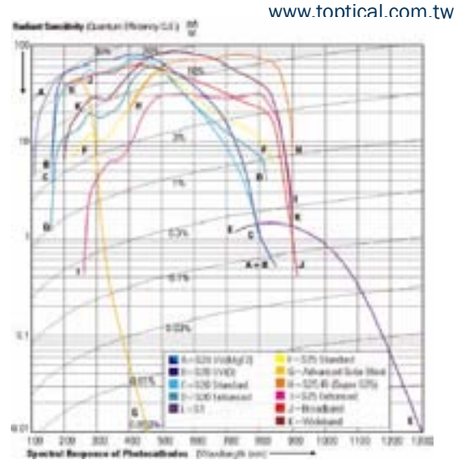


Image intensifier and shutter (schematic)

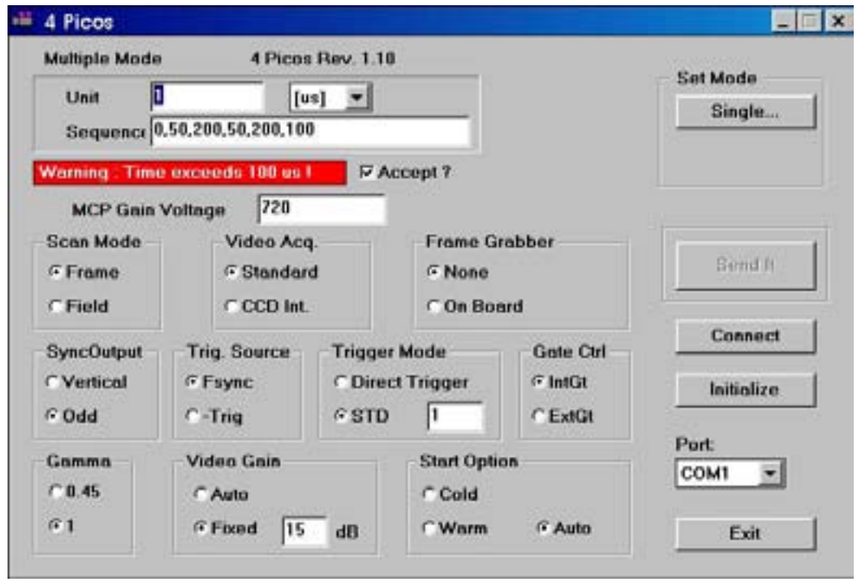
Deviations of up to ±25% from the above typical spectral sensitivity curves are possible. The position of the curves can vary ±20nm. The input window material limits the spectral response of the photocathode in the shorter wavelengths. The window materials and their transmission limits are: quartz (165nm),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



CCD-Video Unit

CCD Video Chip	Analog Output		Standard	High
	USA, Japan	Elsewhere	Resolution CCD	Resolution CCD
Analog or digital output	analog EIA (RS 170)	analog CCIR	digital 12 or 14 Bit	digital 12 or 14 bit
Resolution (pixel)	768 x 494	752 x 582	780 x 580	1360 x 1024 (1x1) 580 x 512 (2x2) 456 x 342 (ROI)
Pixel size (µm)	8.4 x 9.8	8.6 x 8.3	8.3 x 8.3	4.7 x 4.7
Imaging frequency (analog) Frame rate (digital)	30/60Hz	25/50Hz	12bit/14bit: 33.8/60.8/67.0 fps	12bit/14bit: 10.6/17.9/20.9 fps
Dynamic Range A/D (Bit)	14 Bit, up to 21 Bit (with 4 Spec E spectroscopy software)			
Video Gain	0…25dB, automatic or manually adjustable through computer RS 232 interface		Full Frame, ROI: 0..20dB Binning: 0..25dB	
Binning vertical (pixel)	Software		1 (full frame) ,2 (Binning) pixel, ROI	
Binning horizontal (pixel)	Software		1 (full frame) ,2 (Binning) pixel, ROI	
Image Sensor	ICX..AL			
Chip Readout	Correlated double sampling, dark current corrected			
Output	$1V_{PP}$ (75 Ω), composite video, RS 170/EIA, CCIR or VGA			
Scan Mode	Field/Frame, selectable through computer RS 232 interface. ICCD camera 4 Picos or 4 Quik E may be Genlocked or supply Fsync-pulse to operate as master clock.			
Gamma	1 or .45, selectable through computer RS 232 interface			
Internal Synchronization	Free run mode			
External Synchronization	by negative edge TTL pulse (Vinit)			
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 100ms. Provides single photon sensitivity. No condensation; eliminates need for vacuum or special nitrogen atmosphere.			

4 Picos control window



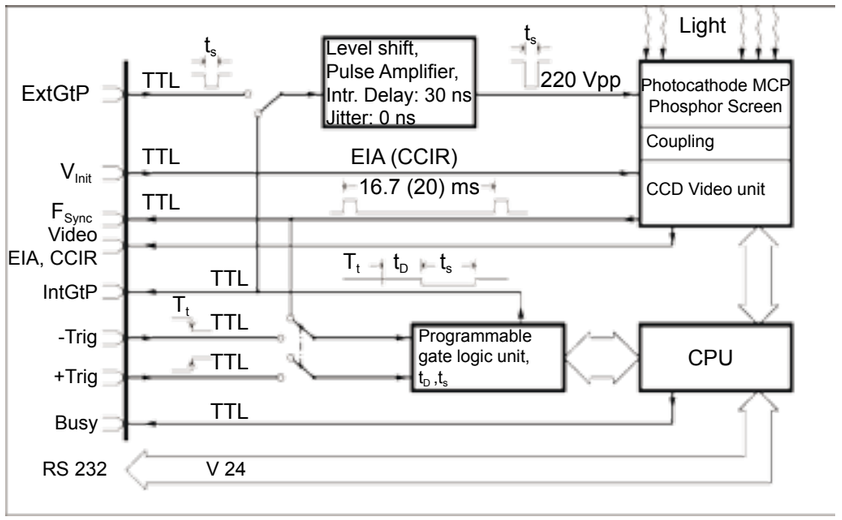
Shutter control

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 0.3µs can be synchronized with ease to any external TTL source.

Internal exposure control	4 Picos
Time (t_S) and delay (t_D) of the gate pulse, or multiple exposure with CPU internally digital programmable	t_S = 200ps ... 80s, min. steps 10ps t_D = 0 ... 80s, min. increments 10ps
Trigger propagation delay	<65ns, less than 10ps jitter
Initializing	-Trig, +Trig, or FSync
Multiple Exposure	Any sequence, 0.3µs "dead time" between exposures

External exposure control	4 Picos
Control of the camera internal Pulse E amplifier via ExtGtP (TTL Pulse) input: Shutter continuous from:	t_S = 200ps ... , t_D, t, t_D determined by external device
Trigger propagation delay	<45ns, no jitter

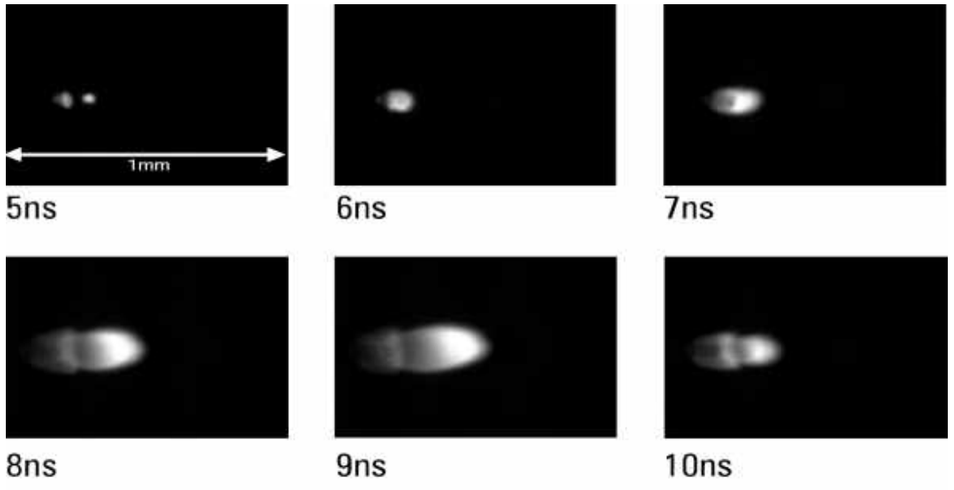
External exposure control	4 Picos
Pixel by pixel exposure analysis providing automatic light level control by instantaneous adjustment of camera shutter speed and intensifier gain for very wide range of lighting conditions (up to 12 orders of magnitude).	200ps ... 15 (18) ms, Shutter time and MCP gain automatically adjusted, in response to scene illumination.



Analog shutter control (schematic)

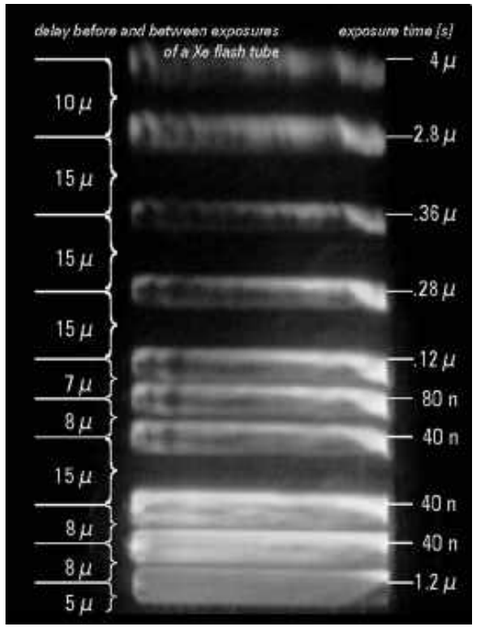
Mechanical & Environmental Data

Mechanical & Environmental Data, Power Requirements	
Camera dimensions, without lens (mm, inch)	248 x 110 x 135mm (l x w x h) $9^3/4$ x $4^3/8$ x $5^4/16$" (l x w x h)
Camera weight (all in one) (kg / lb)	3kg / 6.6lb
Camera mount (at the bottom plate of the camera)	¼" x 20 and M8 mounting hole
Operating Humidity (%)	25..95%, non condensing
Operating temperature (°C / °F)	0°C – 50°C / 32°F – 122°F
Performance specification	10°C – 40°C / 50°F – 104°F
Operating limits	-10°C – 50°C / 14°F – 122°F
Shock and Vibration	60g accel. shock, 7g Vibration (11 – 200Hz)
Voltage	12 V +5%/-2%

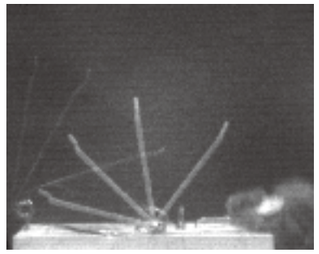


Analysis of plasma development with 4 Picos camera: single beam set up. Plasma images of water droplets . Shutter time: 200ps. Laser Pulse: 50mJ, 8ns

© 2003 with courtesy of Ch. Janzen, Fraunhofer Institut Aachen, Germany



Multiple 16 bit exposures of Xe flash tube, single discharge, 10 exps during 120µs, continuously swept by scanning mirror.



Multiple exposures (Mouse trap)

4 Picos/... intelligent ICCD Camera Family

analog or digital output

■ standard □ optional

*25mm Standard: S20 or S25 **18mm Standard: S20 or Super S25 Optional: Bialkali/Fused Silica, Advanced Solar Blind (CsTe), Enhanced S25, Enhanced Blue-UV S20, Wideband S25 WB Two photocathode window materials may be ordered depending upon the required response.	4 Picos/0.2-18**	4 Picos/0.2-18**/dig		4 Picos0.2-25*	4 Picos/0.2-25*/dig			
Standard Features and Alternatives								
Gating Speeds from 0.2ns → ∞	■	■		■	■			
Image Intensifier with 18mm MCP (standard)	■	■						
Image Intensifier with 25mm MCP				■	■			
Integrated, gateable system	■	■		■	■			
Image Intensifier with Single stage MCP	■	■		■	■			
Image Intensifier with V-stack dual stage MCP	□	□		□	□			
Lens Coupling	■	■		■	■			
High Efficiency customized f/0.8 relay lens	■	■		■	■			
Multiple Exposures	■	■		■	■			
Shutter dead time 0.3µs	■	■		■	■			
Integrated Single Trigger Discriminator (STD)	■	■		■	■			
Analog CCD video output EIA, 768 x 494 pixel or CCIR, 752 x 582 pixel	■			■				
SR12, Standard Resolution CCD, 12bit, 780 x 580 pixel		■			■			
SR14, Standard Resolution CCD, 14bit, 780 x 580 pixel		□			□			
HR12, High resolution CCD, 12bit, 1360 x 1024 pixel		□			□			
HR14, High resolution CCD, 14bit, 1360 x 1024 pixel		□			□			
Terminal Software and printed manual	■	■		■	■			
Comfortable case for shipment & storage for free	■	■		■	■			
Digital output CameraLink		■			■			
Digital output USB 2.0		□			□			
Additional Options								
Peltier Cooling	□	□		□	□			
Special Spectrograph Adapters	□	□		□	□			
Automatic Exposure Control	□			□				
Image Intensifier with Special Photocathodes	□	□		□	□			
Nikon F-mount Adapter	□	□		□	□			

Applications

Physical Sciences

Plasma temperature and density analysis
Plasma flow analysis
Combustion analysis
Synchrotron radiation
Laser induced fluorescence

Engineering Research

Particle Tracking Velocimetry (PTV)
Particle Imaging Velocimetry (PIV)
Automative Fuel Injection
Spray analysis
Wind tunnel studies
Stress analysis of ceramics materials

Biological Sciences

Cancer research
Fundus imaging spectroscopy
X-ray detection
Luminescence
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

4 Picos and XXrapid Frame

Nitrogen-laser-based system for oral cancer diagonis developed at Center for Advanced Technology, Indore, India © with courtesy of CAT, Indore, India

4 Quik E

The most compact intelligent ICCD nano-fast camera system (digital or analog output)

Features

- Fastest shutter down to 1.2ns typically
- Gating times from 1.2ns typically → DC
- 18 or 25 mm Image intensifier (to be specified)
- Spectral Sensitivity of photocathode from UV - NIR (110 - 1300nm)
- Multiple Exposures
- Single Photon detection
- Analog (EIA/CCIR) or digital output (12, or 14 Bit Standard or High Resolution)
- Customized f/0.8 distortion free lens coupling between image intensifier and CCD
- High Dynamic Range: 14 Bit (21 Bit with 4 Spec E spectroscopy software)
- Effortless Image/Data storage and retrieval
- Single Trigger Discriminator integrated
- Internal or external trigger
- Free Terminal software and printed manual

SPECIFICATIONS

Unique Features	4 Picos
Shortest gating time	Shortest gating time 200ps
Intensifier output coupling	customized distortion free f/0.8 relay lens
Optical input	c-mount (standard), Nikon F-mount (optional)
Optical input window	fused silica
Sensitivity corresponding to conventional film	1×10^{12}fc = 50×5^{7} ASA
Multiple exposures, „dead“ time between exposures	any sequence 0.3µm
Gate repetition rate	3.3MHz burst, 200kHz continuous
TTL pulse (incorporated)	standard
Remote control	RS 232 (digital set up)
CE certified	yes

*Actual performance may vary with manufacturer and specimen, please ask for details.

Adaptation to in situ light level variations by internal digital programmable brightness control of the electronic shutter action, with exact reproducible digital setting of delay and exposure times.

Very high system integration permits small physical size of the total unit (all in one) — even very difficult surveillance jobs are mastered easily by remote control.
Programmable control parameter entry via RS 232 (digital set up), remote control software included.

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.

Automatic Exposure Control and Automatic Gain, for unattended operation under greatly varying light conditions (optional). Effortless Image/Data storage and retrieve via system interface RS 170 to an external VCR (standard), frame grabber or optical disk (optional).

Switches and Connections

No.	Item	Function
A	Switch	Power Switch ON/OFF
B	Socket	Power Supply Socket (12V)

1	Video	Camera output signal (RS170 or CCIR)
2	Busy	Synchronization Signal (TTL), e.g. Frame Grabber
3	V_{Init}	Asynchronous reset of CCD camera
4	F_{Sync}	TTL output for synchronization purposes
5	-Trig	Trigger input, negative edge TTL
6	+Trig	Trigger input, positive edge TTL
7	IntGtP	Output of internal time delay gate pulse generator
8	ExtGtP	Input for control of HV MCP pulse (TTL)

Rear view of 4 Picos with legend

For control by internal time/delay generator, 7 and 8 are shorted internally. Camera will free run when 4 to 5, and 7 to 8 are internally connected. These settings are both under RS 232 control. Camera may be externally driven through 8 by external pulse delay generator when 7 and 8 are disconnected. Pulse monitoring is provided by 7 and camera master sync ouput is available at 4.

Image Intensifier

Image Intensifier specifications	
Image intensifier type (proximity focused MCP)	single stage (standard), dual stage (optional)
Phosphor material	P43 (standard), P46 (optinal)
Image intensifier diameter (mm)	18mm standard, 25mm optional
Image area of the relay lens	25mm MCP: 20 x 15mm, 18mm MCP: 14.4 x 10.8mm
Wavelength range, subject to window design	165 – 920nm (quartz, standard), 110 – 1300nm (optional)
Spectral Sensitivity of MCP (nm)	110..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
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 - 920nm	Bialkali		approx. 165 - 600nm
Optional 18 mm			Enhanced S20	D	approx. 165 - 820nm
S20 UV (MgF2)	A	approx. 110 - 820nm	Enhanced S25 (glass)	I	approx. 270 - 900nm
Broadband	J	approx. 190 - 920nm	Wideband S25 WB	K	approx. 200 - 900nm
Standard 25 mm			S1	E	approx. 700 - 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).

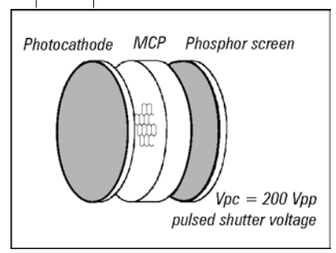
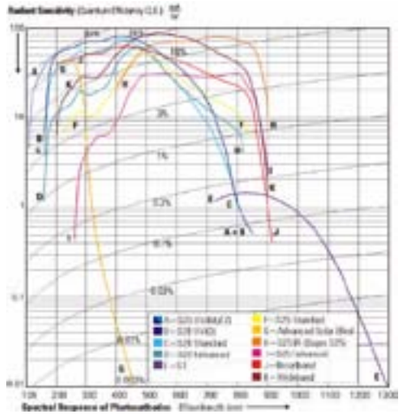


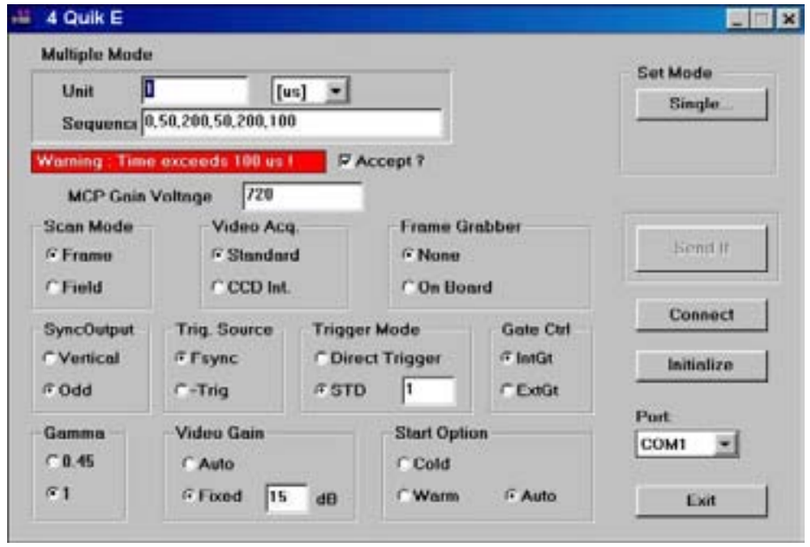
Image intensifier and shutter (schematic)



CCD-Video Unit

CCD Video Chip	Analog Output		Standard	High
	USA, Japan	Elsewhere	Resolution CCD	Resolution CCD
Analog or digital output	analog EIA (RS 170)	analog CCIR	digital 12 or 14 Bit	digital 12 or 14 bit
Resolution (pixel)	768 x 494	752 x 582	780 x 580	1360 x 1024 (1x1) 580 x 512 (2x2) 456 x 342 (ROI)
Pixel size (µm)	8.4 x 9.8	8.6 x 8.3	8.3 x 8.3	4.7 x 4.7
Imaging frequency (analog) Frame rate (digital)	30/60Hz	25/50Hz	12bit/14bit: 33.8/60.8/67.0 fps	12bit/14bit: 10.6/17.9/20.9 fps
Dynamic Range A/D (Bit)	14 Bit, up to 21 Bit (with 4 Spec E spectroscopy software)			
Video Gain	0…25dB, automatic or manually adjustable through computer RS 232 interface		Full Frame, ROI: 0..20dB Binning: 0..25dB	
Binning vertical (pixel)	Software		1 (full frame) ,2 (Binning) pixel, ROI	
Binning horizontal (pixel)	Software		1 (full frame) ,2 (Binning) pixel, ROI	
Image Sensor	ICX..AL			
Chip Readout	Correlated double sampling, dark current corrected			
Output	$1V_{PP}$ (75 Ω), composite video, RS 170/EIA, CCIR or VGA			
Scan Mode	Field/Frame, selectable through computer RS 232 interface. ICCD camera 4 Picos or 4 Quik E may be Genlocked or supply Fsync-pulse to operate as master clock.			
Gamma	1 or .45, selectable through computer RS 232 interface			
Internal Synchronization	Free run mode			
External Synchronization	by negative edge TTL pulse (Vinit)			
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 100ms. Provides single photon sensitivity. No condensation; eliminates need for vacuum or special nitrogen atmosphere.			

4 Quik E control window



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 0.3µs can be synchronized with ease to any external TTL source.

Internal exposure control	4 Picos
Time (t_S) and delay (t_D) of the gate pulse, or multiple exposure with CPU internally digital programmable	t_S = 1.2ns typical* ... 80s, min. steps 100ps t_D = 0 ... 80s, min. increments 100ps
Trigger propagation delay	<50ns, less than 0.01ns jitter
Initializing	-Trig, +Trig, or FSync
Multiple Exposure	Any sequence, 0.3µs “dead time” between exposures

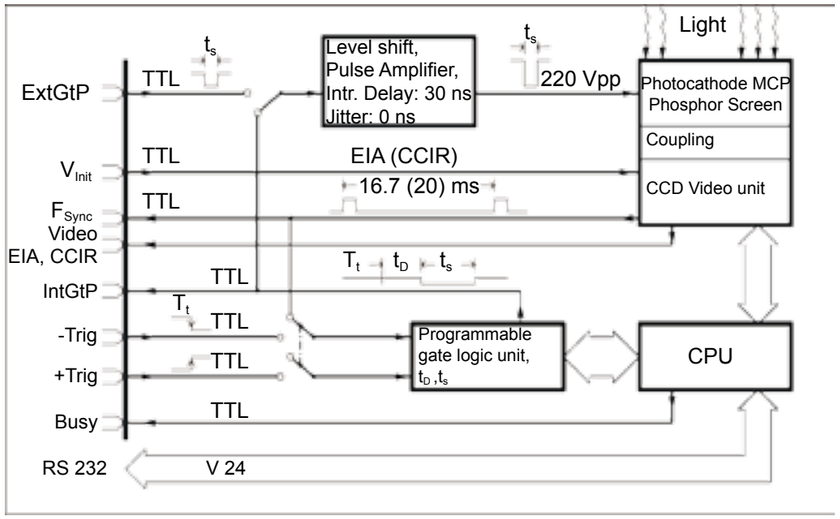
External exposure control	4 Quik E
Control of the camera internal Pulse E amplifier via ExtGtP (TTL Pulse) input: Shutter continuous from:	t_S = 1.2ns typical* ... DC, $t_D = D_C$ t, t_D determined by external device
Trigger propagation delay	<45ns, no jitter

Automatic exposure control (optional) 4 Quik E

Pixel by pixel exposure analysis providing automatic light level control by instantaneous adjustment of camera shutter speed and intensifier gain for very wide range of lighting conditions (up to 12 orders of magnitude).

1.2ns typical* ... 15 (18) ms,
Shutter time and MCP gain automatically adjusted, in response to scene illumination.

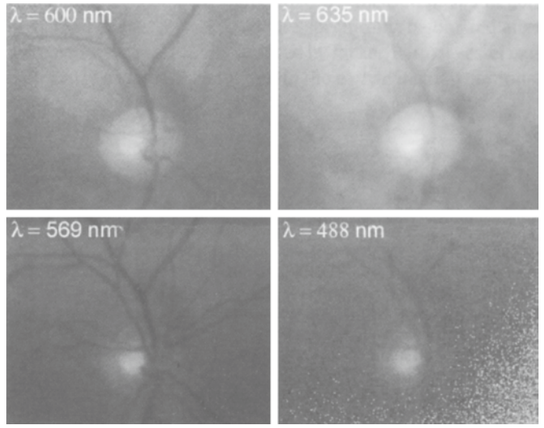
**Actual performance may vary with manufacturer and specimen, please ask for details.*



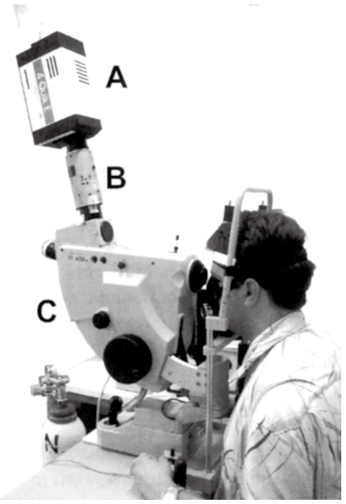
Analog shutter control (schematic)

Mechanical & Environmental Data

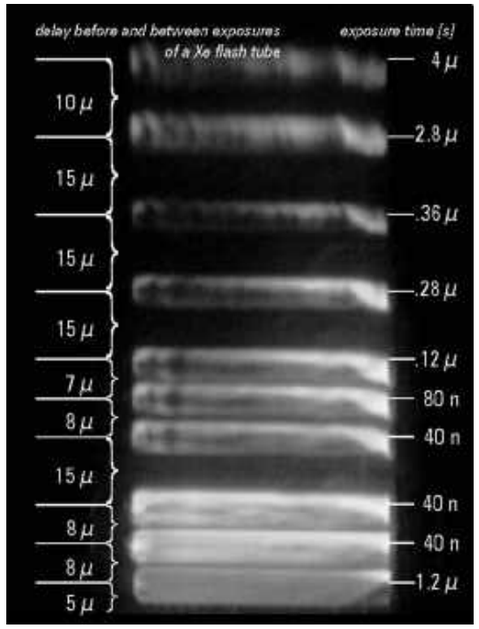
Mechanical & Environmental Data, Power Requirements	
Camera dimensions, without lens (mm, inch)	248 x 110 x 135mm (l x w x h) $9^3/4$ x $4^3/8$ x $5^4/16$“ (l x w x h)
Camera weight (all in one) (kg / lb)	3kg / 6.6lb
Camera mount (at the bottom plate of the camera)	¼“ x 20 and M8 mounting hole
Operating Humidity (%)	25..95%, non condensing
Operating temperature (°C / °F)	0°C – 50°C / 32°F – 122°F
Performance specification	10°C – 40°C / 50°F – 104°F
Operating limits	-10°C – 50°C / 14°F – 122°F
Shock and Vibration	60g accel. shock, 7g Vibration (11 – 200Hz)
Voltage	12 V +5%/-2%



Sequence of images for oximetry evaluation
© Courtesy M. Crittin et al.
IRO, Switzerland 2002



Photgraphy of the retinal oximeter
A = ICCD camera
B = image splitter
C = fundus camera
© Courtesy Courtesy M. Crittin et al.
IRO, Switzerland 2002



Multiple 16 bit exposures of Xe flash tube, single discharge, 10 exps during 120µs, continuously swept by scanning mirror.

4 Quik E/... intelligent ICCD Camera Family

digital or analog output

■ standard □ optional

* Standard: S20 or Super S25 ** Actual performance may vary with manufacturer and specimen, please ask for details. Optional: Bialkali/Fused Silica, Advanced Solar Blind (CsTe), Enhanced S25, Enhanced Blue-UV S20, Wideband S25 WB Two photocathode window materials may be ordered depending upon the required response.	4 Quik E/01-18**/dig	4 Quik E/01-18**		4 Quik E/01-25**/dig	4 Quik E/01-25**			
Standard Features and Alternatives								
18mm Image Intensifier*, Image area 14.4 x 10.8mm (standard)	■	■						
25mm Image Intensifier*, Image area 20 x 15mm				■	■			
Minimum Gating Speeds up from 1.2ns typical**				■	■			
Integrated, gateable system	■	■		■	■			
Image Intensifier with Single stage MCP	■	■		■	■			
Image Intensifier with V-stack dual stage MCP	□	□		□	□			
Relay Lens Coupling (Image intensifier → CCD)	■	■		■	■			
High Efficiency customized f/0.8 relay lens	■	■		■	■			
Multiple Exposures	■	■		■	■			
Shutter dead time 0.3µs	■	■		■	■			
Integrated Single Trigger Discriminator (STD)	■	■		■	■			
Analog CCD video output EIA, 768 x 494 pixel or CCIR, 752 x 582 pixel		■			■			
SR12, Standard Resolution CCD, 12bit, 780 x 580 pixel	■			■				
SR14, Standard Resolution CCD, 14bit, 780 x 580 pixel	□			□				
HR12, High resolution CCD, 12bit, 1360 x 1024 pixel	□			□				
HR14, High resolution CCD, 14bit, 1360 x 1024 pixel	□			□				
Terminal Software and printed manual	■	■		■	■			
Comfortable case for shipment & storage for free	■	■		■	■			
Digital Output CameraLink with frame grabber	■			■				
Digital output USB 2.0	□			□				
Additional Options								
Peltier Cooling	□	□		□	□			
Special Spectrograph Adapters	□	□		□	□			
Automatic Exposure Control		□			□			
Image Intensifier with Special Photocathodes	□	□		□	□			
Nikon F-mount Adapter	□	□		□	□			

Applications

Physical Sciences

Plasma temperature and density analysis
Plasma flow analysis
Combustion analysis
Synchrotron radiation
Laser induced fluorescence

Engineering Research

Particle Tracking Velocimetry (PTV)
Particle Imaging Velocimetry (PIV)
Automative Fuel Injection
Spray analysis
Wind tunnel studies
Stress analysis of ceramics materials

Biological Sciences

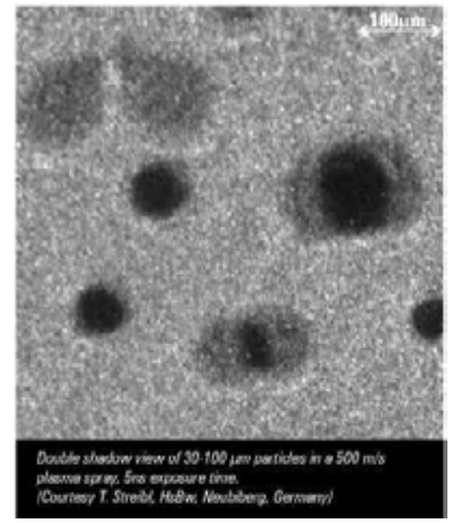
Cancer research
Fundus imaging spectroscopy
X-ray detection
Luminescence
Time resolved fluorescence

High Speed Imaging

Dynamic Schlieren Phenomena
Shock tubes
Range gating

Low Light Imaging

Thomson Scattering
Raman Spectroscopy
Glow Discharge Spectroscopy
Semiconductor failure analysis



Double shadow view of 30-100 µm particles in a 500 m/s plasma spray, 5ns exposure time.
(Courtesy T. Streibl, HoBw, Neubiberg, Germany)

Specifications are subject to change without notice.
No responsibility is assumed for errors or omissions.

Nitrogen-laser-based system for oral cancer diagonis developed at Center for Advanced Technology, Indore, India
© with courtesy of CAT, Indore, India

XX Rapid Frame

Fastest multi-framing ICCD camera system

Features

- Three or Four intensified CCD channels (4 Picos or 4 Quik E)
- Total of 3/6 or 4/8 frames from one trigger
- Fastest shutter down to 0.2ns (based on 4 Picos ICCD cameras) in single mode
- Jitter <10ps
- Ultra fast recording of up to 4 full frame resolution images with 0.01ns interframing time
- Double shutter/frame and multiple exposures (each module)
- Perfectly spectral flat image splitter
- Single Photon detection
- Spectral Sensitivity of photocathodes from UV - NIR (220 - 1300nm)
- USB2.0 or analog output
- High Dynamic Range: 14 Bit (>36 Bit with 4 Spec E spectroscopy software)
- Effortless Image/Data storage and retrieval
- Internal or external trigger
- Free Terminal software “ready-to-use”

SPECIFICATIONS

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

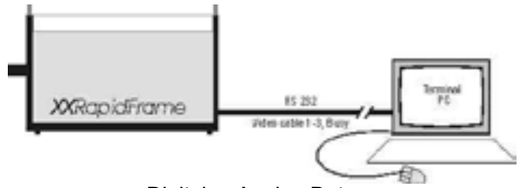
* Minimum gate time 1.2ns typically (depends on manufacturer and specimen)

Special emphasis was laid on the utmost precision of the timing control of the 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/delay times and gate/delay time steps are 100 times shorter than previous “state of the art” systems.
Exact reproducible digital setting of delay and exposure times is standard.

Very high system integration permits compact physical size of the XXRapidFrame camera.
Distortion free imaging due to advanced proximity focused MCP (Micro Channel Plate) image intensifier, a optimized custom designed f0.8 relay coupling lens, and the use of highest quality CCD array for best sensitivity and resolution results in superior total optical performance.

14 Bit High Dynamic Range can be increased with 4 Spec E Spectroscopy PC Software up to >36 Bit (11 orders of magnitude) with multiple frames integrated.

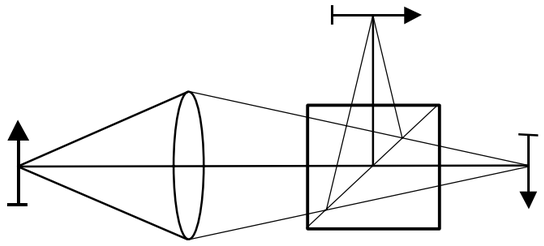


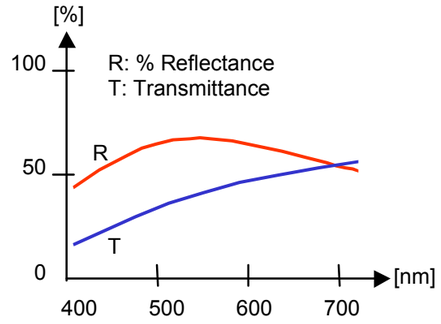
Digital or Analog Data

Image Splitting Concepts

The wide spread semitransparent image splitting setup does not provide equal spectral distribution to both channels. Our spectrally flat Mirror Image Splitter does have identical amount of light of all wavelengths to all channels.

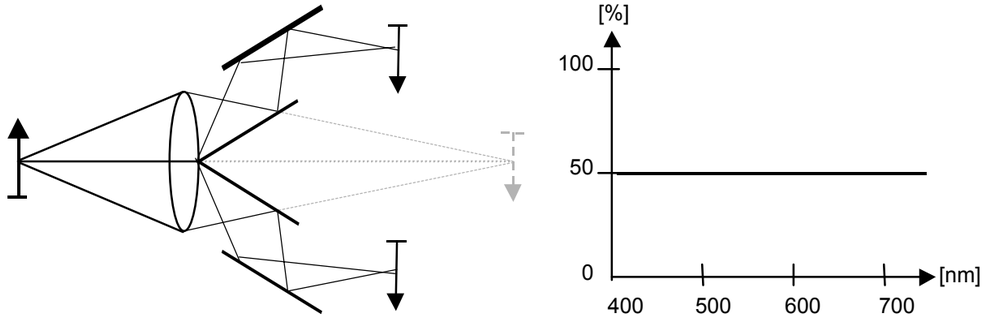
Semi transparent image splitter





The “conventional” method used to split an image into two identical secondary images of both lower intensity uses a cubic or pellicle beam splitter. It leads to a non predictable intensity ratio because the original image is usually not monochromatic. Therefore the photon flux at every single pixel is determined by the ratio of the integrals of the spectral distribution weighted with the R/T ratio of the beam splitter.
Any wavelength change in between frames, e.g. as a function of temperature, will modify the splitting ratio. Such resulting images cannot be numerically corrected

Mirror image splitter



Using totally reflective mirrors for all sub images yields the intensity division in between the subs being only a function of the geometry of the mirrors. This approach is easily extended into the UV spectral region. A filter placed in each channel's optical path to produce e.g. a three-color image of an experiment. With different delay times in the various channels it could also be used to retrieve 3-D spatial information.

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	18mm MCP: 14.4 x 10.8mm, 25mm MCP: 20 x 15mm
Wavelength range, subject to window design	165 – 920nm (quartz, standard), 165 – 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 @ µLx)	46dB min @ 0.5µLx
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			Standard 25 mm		
S20UV	B	approx. 165 - 820nm	S20	C	approx. 165 - 820nm
S25 IR (Super S25)	H	approx. 350 - 920nm	S25	F	approx. 200 - 840nm
Optional 18 mm			Optional 25 mm		
S20 UV (MgF2)	A	approx. 110 - 820nm	Enhanced S20	D	approx. 165 - 820nm
Broadband	J	approx. 190 - 920nm	S1	E	approx. 700 - 1300nm
			Solar Blind (CsTe)	G	approx. 180 - 340nm
			Enhanced S25 (glass)	I	approx. 270 - 900nm
			Wideband S25 WB	K	approx. 200 - 900nm

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).

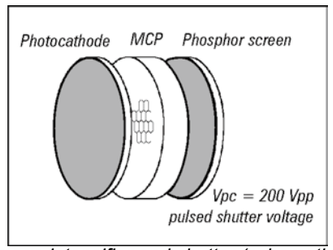
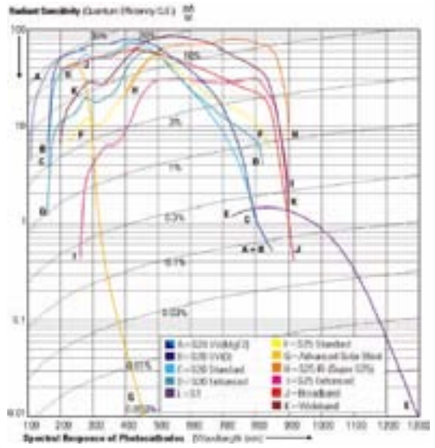


Image intensifier and shutter (schematic)



CCD-Video Unit

CCD Video Chip	Analog Output		Progressive	Standard	High
	USA, Japan	Elsewhere	Scan CCD	Resolution CCD	Resolution CCD
Analog or digital output	analog EIA	analog CCIR	analog, VGA 30/60Hz or 60/120Hz	digital 12 or 14 Bit	digital 12 or 14 bit
Resolution (pixel)	768 x 494	752 x 582	640 x 480	780 x 580	1360 x 1024 (1x1) 580 x 512 (2x2) 456 x 342 (ROI)
Pixel size (µm)	8.4 x 9.8	8.6 x 8.3	9.8 x 9.8	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)	12bit/14bit: 33.8/ 60.8/ 67.0 fps	12bit/14bit: 10.6/17.9/20.9 fps
Video Gain	0...25dB, automatic or manually adjustable through computer RS 232 interface			Full Frame, ROI: 0..20dB Binning: 0..25dB	
Binning vertical (pixel)	Software			1 (full frame) , 2 (Binning) pixel, ROI	
Binning horizontal (pixel)	Software			1 (full frame) , 2 (Binning) pixel, ROI	
Output	$1V_{PP}$ (75 Ω), composite video, RS 170/EIA, CCIR or VGA			USB 2.0	
Dynamic Range A/D (Bit)	14 Bit, up to 21 Bit (with 4 Spec E spectroscopy software)				
Chip Readout	Correlated double sampling, dark current corrected				
Internal Synchronization	Free run mode				
External Synchronization	by negative edge TTL pulse (Vinit)				
Signal to noise	46dB min @ 0.5µLx				
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 100ms. 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	
Operating Humidity (%)	25..95%, non condensing	
Operating temperature (°C / °F)	0°C – 50°C / 32°F – 122°F	
Performance specification	10°C – 40°C / 50°F – 104°F	
Operating limits	-10°C – 50°C / 14°F – 122°F	
Shock and Vibration	60g accel. shock, 7g Vibration (11 – 200Hz)	
Voltage	12 V +5%/-2%	

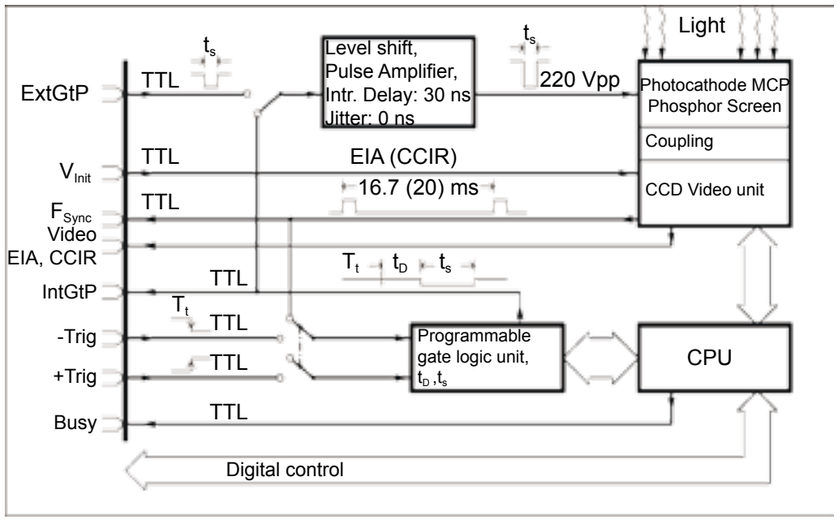
Shutter control

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 0.3µs can be synchronized with ease to any external TTL 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 10ps t_D = 0 ... 80s, min. increments 10ps	t_S = 1.2ns* typically... 80s, min. steps 100ps t_D = 0 ... 80s, min. increments 0.1ns
Trigger propagation delay	<65ns, less than 10ps jitter	
Initializing	-Trig, +Trig, or FSync	
Multiple Exposure	Any sequence, 0.3µs “dead time” between exposures	

* mimimum gate time 1.2ns typically, depends on manufacturer and specimen.

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



Analog shutter control (schematic)

Applications

Physical Sciences

Plasma temperature and density analysis
Plasma flow analysis
Combustion analysis
Synchrotron radiation
Laser induced fluorescence

Biological Sciences

Cancer research
Fundus imaging spectroscopy
X-ray detection
Luminescence
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

XXRapid Frame

digital or analog output

■ standard □ optional

*25mm Standard: S20 or S25, minimum gating time 1.5 ns typically (depends on manufacturer and specimen) **18mm Standard: S20 or Super S25, minimum gating time 1.2 ns typically (depends on manufacturer and specimen) Optional: Bialkali/Fused Silica, Advanced Solar Blind (CsTe), Enhanced S25, Enhanced Blue-UV S20, Wideband S25 WB 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 typically → ∞	■	■						
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	■	■		■	■			
Lens Coupling	■	■		■	■			
High Efficiency customized f/0.8 relay lens	■	■		■	■			
Multiple Exposures	■	■		■	■			
Shutter dead time 0.3µs	■	■		■	■			
Integrated Single Trigger Discriminator (STD)	■	■		■	■			
Analog CCD video output EIA, 768 x 494 pixel or CCIR, 752 x 582 pixel	■			■				
Progressive Scan CCD, VGA, 640 x 480 pixel	□			□				
Standard Resolution CCD, 12bit, 750 x 580 pixel		■			■			
Standard Resolution CCD, 14bit, 750 x 580 pixel		□			□			
High resolution CCD, 12bit, 1360 x 1024 pixel		■			■			
High resolution CCD, 14bit, 1360 x 1024 pixel		□			□			
USB 2.0		■			■			
Terminal Software and printed manual	■	■		■	■			
Comfortable aluminum case for storage for free	■	■		■	■			
Additional Options								
Peltier Cooling	□	□		□	□			
Special Spectrograph Adapters	□	□		□	□			
Image Intensifier with Special Photocathodes	□	□		□	□			
Nikon F-mount Adapter	□	□		□	□			

Quantum Leap

The modular high speed image intensifier module continuous or gated operation (e.g. with Time Gain Module, optional)

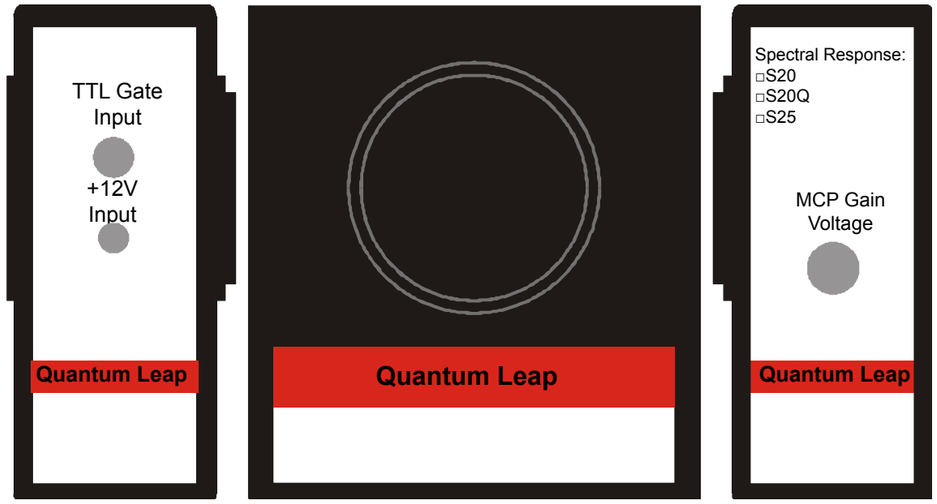
Features

- Compact module with built-in image intensifier optimized relay optics
- Gated or continuous operation
- Gated System: Gating times from 0.2 – DC (with TGE) or 1.2ns or (with TGN)
- 18 or 25 mm Image intensifier
- Spectral Sensitivity of photocathode from UV - NIR (110 - 1300nm)
- Very compact high voltage power supply and pulse amplifier
- Photonic gain up to 106, 0 – 1000V, 10-turn potentiometer or remotely controlled
- Single Photon detection
- Improves image contrast and S/N ratio
- Customized 6-element distortion free lens coupling between image intensifier and CCD
- Distortion free imaging
- Needs only 12V, 300mA electrical power
- Precision adjustment rings for back focusing to video camera

SPECIFICATIONS

Unique Features	Quantum Leap	Quantum Leap N/E (gated) Shortest gating	
Shortest gating time	non gateable	1.2 ns typically*	E: 0.2ns
Remote control	not applicable	RS 232 (standard)	
Optical input	c-mount (standard), Nikon F-mount (optional)		
Optical input window	quartz		
Sensitivity corresponding to conventional film	1 x 10^{12}fc = 50 x 5^{7} ASA		
Multiple exposures, „dead“ time between exposures	any sequence 0.3µm		
Gate repetition rate	3.3MHz burst, 200kHz continuous		
Intensifier output coupling	customized distortion free f/0.8 relay lens		
CE certified	yes		

Programmable control parameter entry via RS 232 (with Time & Gain Module), or 10-turn potentiometer
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.



left side / front / right side of Quantum Leap

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
Wavelength range, subject to window design	180 – 1300nm quartz window (standard) 110 – 850nm MgF2-window (S20UV optional)
Spectral Sensitivity of MCP (nm)	110..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 (standard): 4 x 10^{4} dual stage MCP (optional): 4 x 10^{6}
Signal to noise (db @ µLx)	46dB min @ 0.5µLx
Coupling phosphor (MCP → CCD)	customized 6 element f/0.8 relay lens

Spectral Sensitivity of Photocathodes (Wavelength in nm)					
Standard 25 mm			Optional 25 mm		
S20	C	approx. 165 - 820nm	S20 UV(MgF2)	A	approx. 110 - 820nm
S25	F	approx. 200 - 840nm	Solar Blind (CsTe)	G	approx. 180 - 340nm
Standard 18 mm			Bialkali		approx. 165 - 600nm
S20UV	B	approx. 165 - 820nm	Enhanced S25 (glass)	D	approx. 165 - 820nm
S25 IR (Super S25)	H	approx. 350 - 920nm	Enhanced S25 (glass)	I	approx. 270 - 900nm
Optional 18 mm			Wideband S25 WB	K	approx. 200 - 900nm
Broadband	J	approx. 190 - 920nm	S1	E	approx. 700 - 1300nm

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).

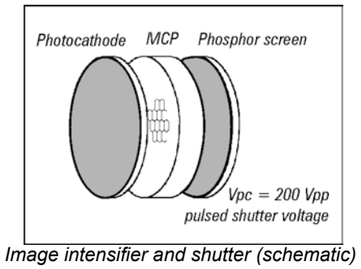
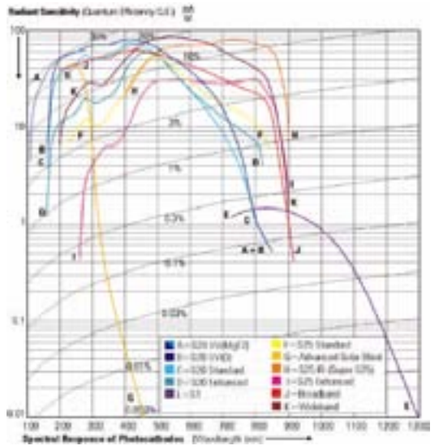


Image intensifier and shutter (schematic)

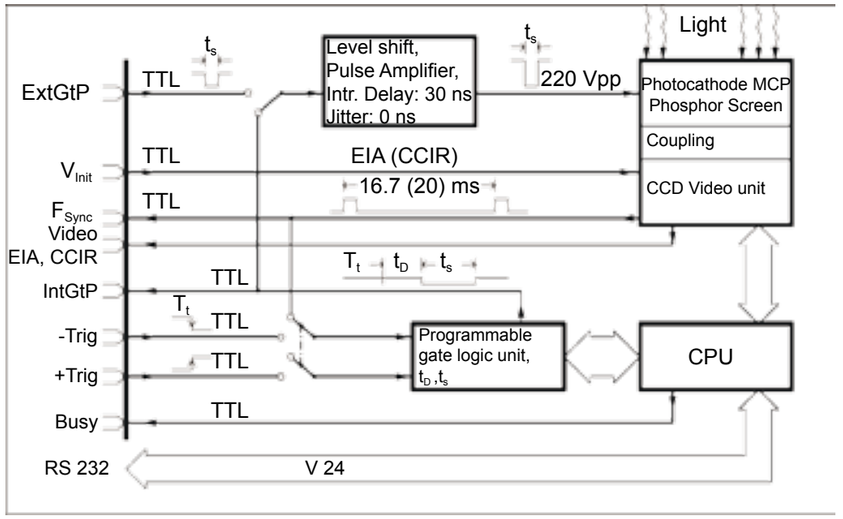


Shutter control (with optional Time & Gain Module)

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 0.3µs can be synchronized with ease to any external TTL source.

Internal exposure control	Quantum Leap N/01-18	Quantum Leap N/01-18
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 10ps t_D = 0 ... 80s, min. increments 10ps	t_S = 1.2ns ... 80s, min. steps 100ps t_D = 0 ... 80s, min. increments 100ps
Trigger propagation delay	<65ns, less than 10ps jitter	
Initializing	-Trig, +Trig, or FSync	
Multiple Exposure	Any sequence, 0.3µs "dead time" between exposures	

External exposure control	Quantum Leap E/0.2-18	Quantum Leap N/01-18
Control of the camera internal Pulse E amplifier via ExtGtP (TTL Pulse) input: Shutter continuous from:	t_S = 0.2ns ... ∞, t_D, ∞ t, t_D determined by external device	t_S = 1.2ns* typically. ∞, t_D, ∞ t, t_D determined by external device
Trigger propagation delay	<45ns, no jitter	



Analog shutter control (schematic)

Mechanical & Environmental Data

Mechanical & Environmental Data, Power Requirements	
Camera dimensions (l x b x h), without lens	60 x 236 x 150mm, 2 3/8 x 5 3/8 x 5 7/8”
Camera weight (all in one) (kg / lb)	1.7kg
Camera mount (at the bottom plate of the camera)	¼“ x 20 and M8 mounting hole
Operating Humidity (%)	25..95%, non condensing
Operating temperature (°C / °F)	0°C – 50°C / 32°F – 122°F
Performance specification	10°C – 40°C / 50°F – 104°F
Operating limits	-10°C – 50°C / 14°F – 122°F
Shock and Vibration	60g accel. shock, 7g Vibration (11 – 200Hz)
Voltage	12 V +5%/-2%

Applications

Physical Sciences

Plasma temperature and density analysis
Plasma flow analysis
Combustion analysis
Synchrotron radiation
Laser induced fluorescence

Engineering Research

Particle Tracking Velocimetry (PTV)
Particle Imaging Velocimetry (PIV)
Automative Fuel Injection
Spray analysis
Wind tunnel studies
Stress analysis of ceramics materials

High Speed Imaging

Dynamic Schlieren Phenomena
Shock tubes
Range gating

Biological Sciences

Fundus imaging spectroscopy
X-ray detection
Luminescence
Time resolved fluorescence

Low Light Imaging

Thomson Scattering
Raman Spectroscopy
Glow Discharge Spectroscopy
Semiconductor failure analysis

Quantum Leap, modular screw on Module

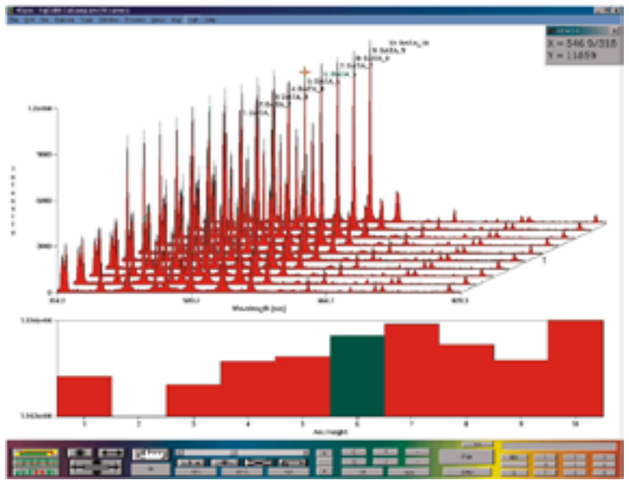
■ standard □ optional

*25mm Standard: S20 or S25 **18mm Standard: S20 or Super S25 Optional: Bialkali/Fused Silica, Advanced Solar Blind (CsTe), Enhanced S25, Enhanced Blue-UV S20, Wideband S25 WB Two photocathode window materials may be ordered depending upon the required response.	Quantum Leap continuous	Quantum Leap gateable		Quantum Leap E (with TGE Module)	Quantum Leap N (with TGN Module)			
Standard								
Gated system		■		■	■			
Gating Speeds from 1.2ns → ∞ (18mm MCP)		□			■			
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	□	□		□	□			
Lens Coupling	■	■		■	■			
High Efficiency customized relay lens	■	■		■	■			
Two c-Mount outputs	■	■		■	■			
Programmable control parameter via RS232		□		■	■			
Multiple Exposures	■	■		■	■			
Shutter dead time 0.3µs	■	■		■	■			
Terminal Software and printed manual	■	■		■	■			
Comfortable case for shipment & storage for free	■	■		■	■			
Additional Options								
Nikon F-mount Adapter (for 25mm MCP)	□	□		□	□			
Image Intensifier with Special Photocathodes	□	□		□	□			

Specifications are subject to change without notice. No responsibility is assumed for errors or omissions.

4 Spec E

Spectra Acquisition Software for pulsed and time resolved Spectroscopy



4 Spec E is a software application for the PCs with Pentium or subsequent microprocessor. It is designed for use with a frame grabber and any video camera for video imaging spectroscopy, where image data is grouped into bands that run either parallel or perpendicular to the video scan lines. Intensity data from each band may be plotted as intensity graphs, as pseudo-color or grayscale 16- bit/pixel images, or as a superimposition of image and intensity plots.

4 Spec E is designed to run under Windows 9x, ME or NT/2000/XP or subsequent on the IBMPC. Analysis of stored curve data highresolution plots as well as grayscale or full-color images can be printed to any IBM-compatible printer. Graphics can alternatively be achieved to a TIFF file for export to drawing or publishing programs. Data may also be exported as text or binary integers for entry into spreadsheets, image processing software, etc. The Data can also be output as real-time video into the Image Pro Sequence files (*.SEQ).

4 Spec E also supports Dynamic Data Exchange (DDE) protocol as a DDE server for curve data.

Intensity data from an image may be grouped and summed for plotting into a maximum of 8000 different 16 bit per pixel linear arrays, called curve memories. Curve length is adjustable up to 8000 pixels. 4 Spec E lets you choose the specific image rows to include in each curve, and supports arithmetic processing of curves and images.

4 Spec E offers a full range of camera-control and data-acquisition functions. Data for the full frame grabber image or a grouped image array can be acquired and viewed as grayscale or pseudo-color images, or as curves in a variety of 2D and 3D plot modes. Any type of image or plot can be repetitively scanned in live mode, yielding convenient, real-time data presentation. Real-time feature include automatic darkbackground image subtraction, automatic image flat-fielding, and live display of image pixel position and intensity.

4 Spec E is designed for real-time data acquisition with a PC or compatible computer incorporating a Pentium, or subsequent processor. 4 Spec E communicates with the installed hardware via a MS-Windows software driver which is included on the same disk. These drivers are available for a growing number of frame grabbers and slow scan data acquisition systems. If you wish to use a device which is not yet supported, please let us know. Not only are we continually adding additional drivers, we can also provide special drivers upon

Specifications

Sensitivity	more than 1 count/photoelectron/ pixel. Up to 80 seconds integration time on CCD detector
Image configuration	1 line scan to 582 lines horizontal and vertical binning
Dynamic Range (with cooled detector)	More than 21 Bit (2 Mio:1),all lines integrated (binned), dynamic expansion active.
Display options	Stores up to 30,000 curve memories in RAM, 32 Bit/pixel curve memories; 256 level gray scale or 256 level pseudocolor; 2-D and 3-D overlays; peak finder; wave length, wave number, and photon energy calibration image function for laser profile displays.

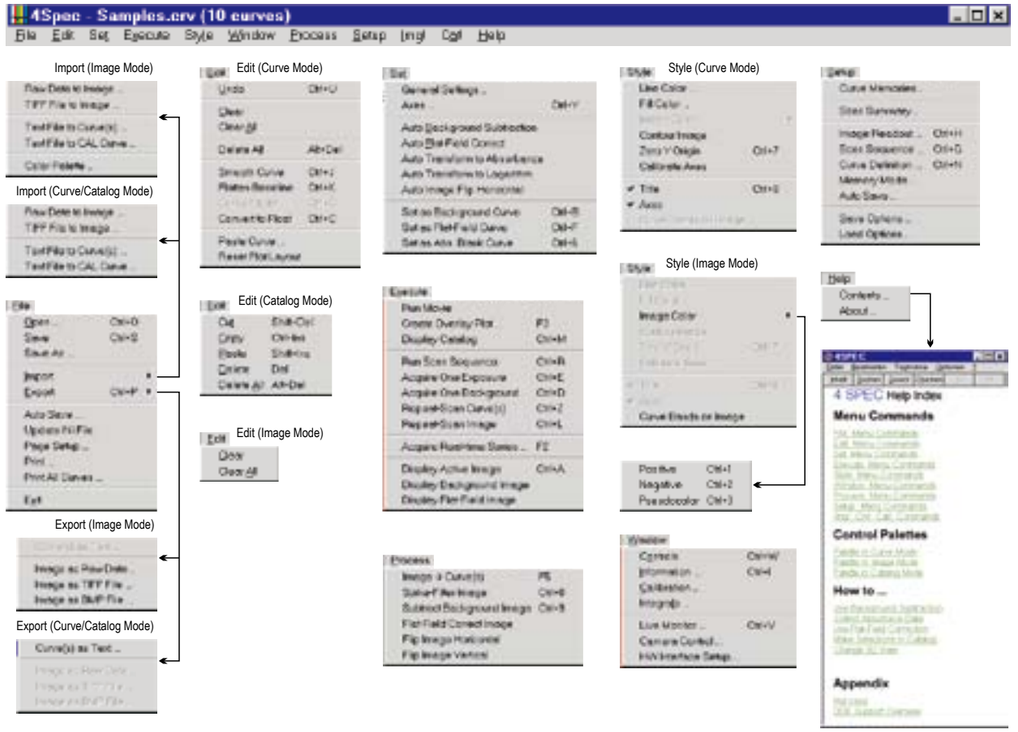
Data Acquisition

From an 8-bit per pixel frame grabber image, rows and columns are selected for reading inti a 16 bit/ pixel computer image having 65.000:1 dynamic range. The exposure sequence is programmed by choosing the number of image frames (from one to many thousands) to be accumulated into 32bit/ pixel curve memories for plotting. Any exposure may be externally triggered.

The user can include automatic static- or dynamic background subtraction, flat-field correction, and conversion to logarithmic or absorbance scales.

Depending upon computer speed and image size, up to 15 - 30 frames per second may be captured.

Acquire Real-time series . This command enables the scanning of a series of frames at video rate. All images, images segments, curves, etc. may be automatically saved to disk or RAM disk in real time.



Versatile and Adaptable

Plotting

Two- and three dimensional overlay plots of curves may be generated with a single mouse click. The 3D plots have handles for dragging to resize the image and change the perspective. In addition, a Channel Profile plot which graphs intensity along a slice parallel to the Z axis may be added. Various plot choices available include line, bar scatter, and cityscape styles, with optional color fill.

Displays

Images may be shown in real time with 256 levels of gray or in 256 level pseudo color and may be viewed in actual size or resized to fit the display window. The option, contour Image, transforms curve data into patterned, pseudo color image. In addition, 4 Spec E features a live laser-beam profiler display.

Focusing

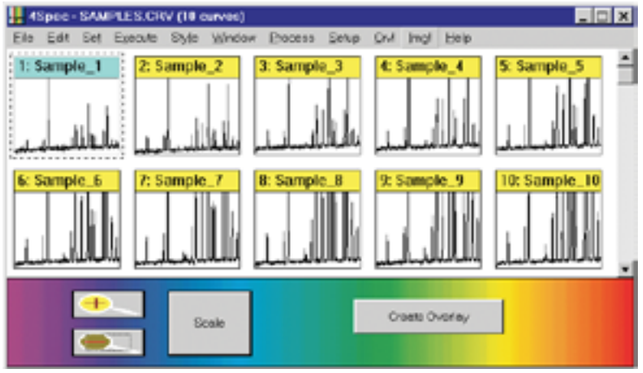
Adjustments to focus are simply done by using live-image or repeat-scan curve plot displays. The user is able to monitor the intensity of any pixel in real time in any image or plot with the moveable cursor. 4 Spec E employs a peak finder feature which can automatically monitor the positions, widths and areas of peaks in a curve during scanning.

Super Zoom

Super Zoom uses the mouse to zoom and pan the curve plot displays in camera live action (even in 3D). This allows the user to zoom in and out and pan the display while scanning in real-time with the camera.

Curve Catalog

This feature makes use of Curve Icons to give a single window view of all curve memories. A curve icon may be plotted by double-clicking a curve icon. To erase, drag to ‘curve trash’ and click. Curve icons may be cut, copied, and pasted to edit memories.



Automatic Spike Filter

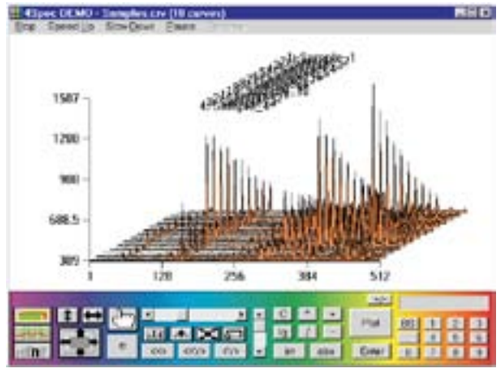
The automatic spike filter removes high energy events (electrical discharges and other interferences) fro images acquired during long exposure.

Export curve data

Export curve data may be in ASCII text format. Images may be exported in 16-bit binary or TIFF formats. Images may be imported from TIFF, or binary-integer-data files.

Calibration

Spectra may be calibrated in wavelength, Raman cm-1 shift or other units with linear or cubic-spline-fits. Peak positions and widths are located with the ‘intelligent’ peak finder. Spectral sensitivity may be calibrated with a tungsten lamp.

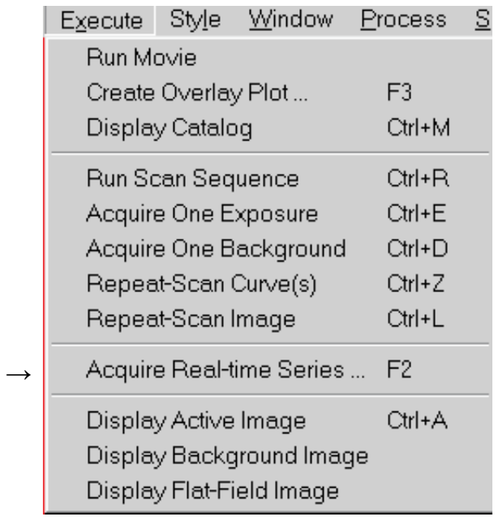


Movies and live scans

may be run as animated 3D waterfall graphs which dramatically show spatial or time evolution of spectral data.

Acquire Real-time series

This command enables the scanning of a series of frames at video rate. The frames are stored in the frame grabber buffer. Selected frames can then be transferred into the active image.



Plots

Plots may be printed on any PC compatible printer, including color ink-jet printers. Plots may be pasted to the clipboard for copying into other documents.

Frame grabber

Drivers for the following frame grabbers are available: MV-Gamma (4 Quik E/4 Picos, analog), MV-Titan (XXRapid Frame) and .he MV-CL CameraLink for digital ICCD cameras are available.

USB 2.0

For digital ICCD cameras with USB 2.0 no frame grabber is needed.