Princeton Instruments

PI-MAX®4: 2048f

The PI-MAX4:2048f from Princeton Instruments is the next generation, fully-integrated scientific intensified CCD camera (ICCD) system featuring a 2k x 2k full-frame CCD fiberoptically coupled to a variety of Gen II and Gen III filmless intensifiers. The intensifiers provide the highest possible sensitivity from UV to NIR and offer resolution that is ideally matched to the CCD. An integrated programmable timing generator (SuperSynchro) built into the camera makes these ICCD cameras ideal for time-resolved imaging and spectroscopy applications. **PI-MAX4:2048f is the only ICCD camera on the market today to offer high frame rate at 6 MHz/16-bit digitization, 1 MHz sustained gating repetition rate and exceptional sensitivity.**

FEATURES	BENEFITS
2048 x 2048 Imaging Array	Highest resolution imaging and spectroscopy
8 MHz* / 16-bit digitization	High frame rates to efficiently synchronize with high repetition rate lasers
Kinetics mode	Allows high speed images / spectra capture

Wide selection of intensifiers
    Gen II
    Gen III filmless
	Best sensitivity and gate speed in the desired wavelength range
	Provides wide spectral coverage with SB, RB and SR intensifiers from UV - NIR
	Offers highest sensitivity

Fiberoptic coupling	Highest optical throughput; No vignetting
Super HV - Built-in high voltage pulser	Rugged design without a bulky external controller, for high repetition rate gating and minimal insertion delay
SuperSynchro - Built-in programmable timing generator	Built-in, fully software controlled gate timing; Controls gate widths and delays in linear, or exponential increments; Low insertion delay (~ 27 ns). *See page 3 for more info.*
SyncMaster I and II	Provides continuous TTL signals to control external instruments such as a laser; Eliminates need for external timing generater in most experiments
Bracket pulsing	Preserves high ON/OFF ratio of the Gen II intensifier in the UV - No sync pulse required
GigE interface	Industry standard for fast data transfer over long distances, up to 50 M
Optional: LightField® (for Windows 8/7, 64-bit) Or WinView/Spec (for Windows 8/7/XP, 32-bit)	Flexible software packages for data acquisition, display and analysis; LightField offers intuitive, cutting edge user interface, IntelliCal® and more.
PICAM (64-bit) / PVCAM (32-bit) software development kits (SDKs)	Compatible with Windows 8/7/XP, and Linux; Universal programming interfaces for easy custom programming.
LabVIEW™ Scientific Imaging Tool Kit (SITK®)	Pre-defined LabView vis provide easy integration of camera into complex experiment setup

* With dual port readout at 4 MHz/port
Detector shown with a C-mount nose and lens, sold separately

Applications:

Shock Wave Physics | Neutron Research | Combustion | Planar Laser Induced Fluorescence (PLIF)

CCD	PI-MAX4:2048f	
Image sensor	e2v CCD 42-40 scientific grade full-frame CCD	
CCD format	2048 x 2048 imaging pixels; 13.5 x 13.5 μm pixels; 27.6 x 27.6 (39 mm diagonal)	
System read noise (e- rms)	Typical	Maximum
@ 1 MHz digitization @ 2 MHz digitization @ 8 MHz digitization	12.0 16.0 35.0	15.0 18.0 45.0
Pixel full well	100 ke-	
Dark current @ -25° C (typical)	< 0.75 e-/p/sec	

CCD temperature
    @ + 23° C room temperature
    @ + 20° C ambient
	-20° C (Air), -30° C (Liquid assist), Guaranteed
	-25° C (Air), -35° C (Liquid assist)	

Vertical shift rate*	20.0 μs/row	

INTENSIFIER					
Intensifiers available	25 mm - Gen II, Gen III filmless				
Method of coupling to the CCD	1:1 fiber optic				
Intensifier type	Gen II			Gen III *Filmless*	
	SB	RB	SR	HBf	HRf
Wavelength range	See QE curves, pages 4 & 5				
Min. Gate Width (Optical FWHM) Fast Gate	~ 4 ns (typical), 8 ns (guaranteed)			~ 4 nsec (typical), 8 nsec (guaranteed)	
Repetition rate: Sustained	1 MHz				
Resolution limit of the intensifier	40 to 64 lp/mm			57 to 64 lp/mm	
Equivalent Background Illumination (EBI) Photo e-/pixel/sec @ room temp (with photocathode cooling)	0.05 - 0.2 (0.005 - 0.02)			0.02 (0.002)	
Phosphor	P43 (P46, P47 optional)				
Operating environment	+5° C to +30° C non-condensing				
Storage environment	-25° C to +55° C				
Certification	CE				

*Please refer to user's manual for more accurate timing calculations.
All specifications subject to change.

The PI-MAX4's integrated SuperSYNCHRO Timing Generator lets researchers set gate pulse widths and delays under GUI software control. The closed coupled SuperSYNCHRO significantly reduces the system delay inherent in the timing generator of *em*ICCD cameras. The integrated timing generator means there is no need for an additional external timing generator, and a built-in Super HV high voltage pulser eliminates the requirement for an external high-voltage supply, making the PI-MAX4 camera one of the most advanced ICCD cameras on the market.

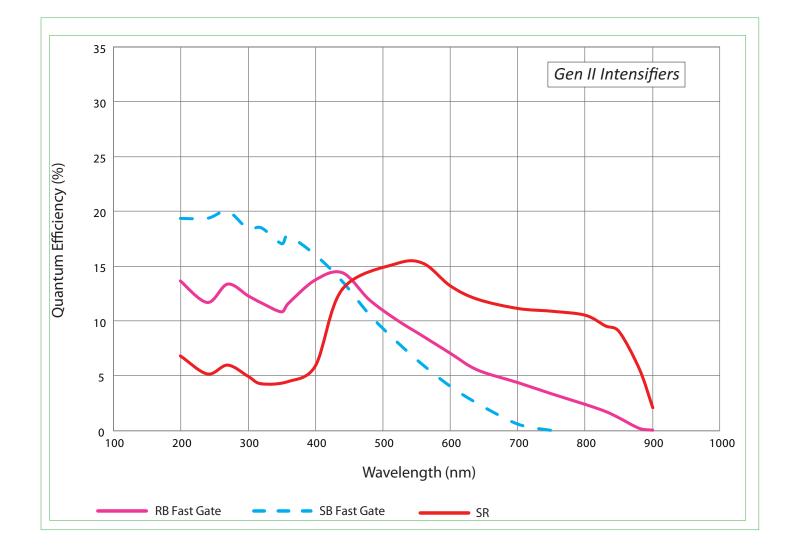| FEATURE	BENEFITS
Closed Coupled Design	Short signal paths for minimum insertion delays
On-board memory	Store and execute complex gate width/delay sequences with no software overhead
Internal oscillator *	Drive an external event and initiate repetitive experiments.
SyncMASTER Pulses	Independent continuous TTL outputs to trigger pulsed external devices, e.g. laser and Q-switch; Minimum experiment jitter
Configurable Trigger inputs	Synchronizes camera to a wide variety of standard and non-standard trigger sources.
Full Software Control	Easy setup and execution of complex gate width/delay sequences

SuperSYNCHRO Specifications

Internal Timing Generator	0.05 Hz - 1 MHz
Gate Delay + Width Range*	~ 10 ns (~ 20 ns with MCP bracket pulsing) to 21 sec (from T0)
Timing resolution/ Timing jitter	10 ps / 35 ps rms
Insertion delay	~ 27 ns (trigger in to intensifier opening), ~ 35 ns (with picosecond gating option)
TRIGGER INPUTS	
External Sync (Trigger In)	-5 v to +5 v (including TTL); AC/DC coupling: 50 ohm / High Z Variable Threshold; +ve or -ve edge
TRIGGER OUTPUTS	
SyncMASTER$_1$	Programmable continuous frequency output to synchronize external devices with PI-MAX4, e.g. Laser
SyncMASTER$_2$	Programmable continuous frequency output (delay from SyncMASTER$_1$- 100 ns - 6.55 msec) synchronize external devices with PI-MAX4, e.g. Q-switch
T0	TTL Signal: T0 indicates start of timing sequence
Monitor**	TTL signal to monitor gate timing
Ready	TTL signal. Represents camera status. It changes state when ready just before the exposure.
Aux	DC coupled programmable delay (Delay from T0 > 2ns - 1 sec) trigger output to synchronize external devices with PI-MAX4
Logic	Software programmable: Select one of the following signals: Acquiring, Image Shift, Logic 1, Readout, Shutter or Wait for trigger. *See users' manual for detailed signal descriptions.*

* Software programmable
** Please refer to user's manual for more
accurate timing calculations.

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Gen III Intensifiers

Quantum Efficiency (%) vs Wavelength (nm)

HBf ——— HRf

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4.50 [114.3]

4.50 [114.3]

1.94 [49.3]

CATHODE COOLING INPUT

NIKON "F" MOUNT ADAPTER
SEE NOTES 1 AND 2.

3.50 [88.9]

ϕ 2.30 [58.4]

8.85±0.03 [224.7±0.8]

1.865 [47.38]
1.536 [39.02] INTENSIFIER DEPENDANT

1.26 [32.0]

MOUNTING FACE
SEE NOTE 1.

AIR INTAKE VENTS

AIR EXHAUST VENTS

AIR INTAKE VENTS

PI-MAX 4

MONITOR   I.I.T. PWR
AUX OUT   ERROR   ON
            OFF
POWER   TRIGGER IN
            OUT
            IN
LOGIC OUT   AUX I/O   READY OUT

REMOVABLE EXTENDER BRACKET

50.0mm

1.00 [25.4]

18.3mm

0.52

M6x1.0 ↧ 6.5mm

2.00 [50.8]

2.80 [71.1]

1/4-20 THREAD ↧ 0.25

2X ϕ 0.129 [3.26] ↧ 0.25 [6.4]

1/4-20 THREAD ↧ 0.25

0.20 [5.1]

225.0

9.00

NOTES:
1. MOUNTING FACE TO IMAGE PLANE IS FACTORY PRESET
   TO OPTICAL DISTANCE OF 1.831 ±0.010 [46.50 ±0.25].

2. LENS RELEASE TRIGGER ORIENTATION CAN BE
   ROTATED IN 180° INCREMENTS.

3X 0.20[5.2] RADIAL SLOT
ON Ø3.60 BOLT CIRCLE
SEE NOTE 2.

4.50[114.3]

1.94[49.3]

4.50[114.3]

CATHODE COOLING INPUT

3X #10-32 THREAD
ON Ø3.88 BOLT CIRCLE
SEE NOTE 2.

0.928[23.57]
0.599[15.21] INTENSIFIER DEPENDANT

0.15[3.8]
0.06[1.5]

8.85±0.03[224.7±0.8]

1.26[32.0]

Ø4.250[107.95]
Ø2.600[66.04]

MOUNTING FACE
SEE NOTE 1.

AIR INTAKE VENTS

AIR EXHAUST VENTS

PI-MAX 4

AIR INTAKE VENTS

REMOVEABLE EXTENDER BRACKET

18.3mm
0.52

1.969[50.00]
1.000[25.40]

M6x1.0▽6.5mm

1/4-20 THREAD▽0.25

2X Ø0.129[3.26]▽0.25[6.4]

2.00[50.8]
2.80[71.1]

1/4-20 THREAD▽0.25

225.0

0.20[5.1]

9.00

NOTES:
1. MOUNTING FACE TO IMAGE PLANE IS FACTORY PRESET
   TO OPTICAL DISTANCE OF 0.894 ±0.010 [22.71 ±0.25].

2. MOUNTING FLANGE ORIENTATION CAN BE ROTATED
   IN 180° INCREMENTS.