Princeton Instruments

PI-MAX®4: 512 EM

The PI-MAX4: 512 EM from Princeton Instruments is the ultimate in ICCD technology. This innovative intensified EMCCD camera (***em*ICCD**) features front-illuminated or back-illuminated 512 x 512 frame transfer EMCCD fiberoptically coupled to a variety of Gen II and Gen III filmless intensifiers. The advantages of intensifiers and the benefits of EMCCD packed in one camera delivers single-photon sensitivity and quantitative performance for scientific imaging and spectroscopy research. The higest linearity, high sensitivity, ultrafast subnanosecond gating, dual gain control, programmable timing generator as well as other built in features makes these ***em*ICCD** cameras ideal for the most demanding research!

FEATURES	BENEFITS
Intensified EMCCD (***em*ICCD**) with Dual Gain mechanism	Dual Gain Mechanism allows single photon sensitivity and improves linearity
512 x 512 FT (frame transfer) Imaging Array	Allows higher frame rates with 100% duty cycle
10 MHz / 16-bit digitization	Video frame rates and higher to efficiently synchronize with high repetition rate lasers
Thermoelectric cooling	Reduces CCD dark current to negligible levels
Kinetics Mode	Allows high speed burst mode sub-frame (ROI) imaging and spectroscopy based on the window size
A selection of Intensifiers *Gen II* *Gen III filmless*	Best sensitivity and gate speed in the desired wavelength range; Best combination of UV-Blue sensitivity and fast gating (SB); RB provides wide spectral coverage Offers highest sensitivity and fastest gate speed
Fiberoptic coupling	Highest optical throughput; No vignetting
Sub-nanosecond gating	Provides <500 ps gate width with standard fast gate intensifiers while preserving QE for high temporal resolution; For effective background discrimination, kinetics imaging and spectroscopy
Super HV - Built-in high voltage pulser	Rugged design for high rep 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 (25 nsec). *See page 3 for more info.*
GigE interface	Industry standard for fast data transfer over long distances
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 the camera into complex experiment setup

Applications:

Fluorescence Lifetime Imaging Microscopy (FLIM) | Time Resolved Imaging & Spectroscopy | Combustion
Planar Laser Induced Fluorescence (PLIF)

Princeton Instruments | 3660 Quakerbridge Rd | Trenton, NJ 08619 USA | +1 609-631-4000 | www.princetoninstruments.com | info@princetoninstruments.com

CCD	PIMAX4:512 EM				PIMAX4:512 EMB		
CCD Image Sensor	e2v CCD97; scientific grade; front-illuminated, frame transfer CCD				e2v CCD97; scientific grade; back-illuminated, frame transfer CCD		
CCD Format	512 x 512 imaging pixels; 16.0 x 16.0 µm pixels Effective image size: 500 x 500 pixels, 8.0 x 8.0 (11.314 mm diagonal)						
	EM mode				Normal CCD mode		
System read noise (typical)	25 e- rms @ 5 MHz 50 e- rms @ 10 MHz Read noise effectively reduced to <1 e- rms with on-chip multiplication gain enabled				6 - 8 e- rms @ 500 kHz 16 - 18 e- rms @ 5 MHz		
Pixel full well (typical)	800 ke- (output node)				130 ke- (single pixel)		
Dark current @ -25° C (typical)	2 e-/p/sec						
Deepest cooling temperature @ 20° C ambient	-25° C (Air) -30° C (Water assist)						
Vertical Shift Rate	600 nanoseconds/row						
INTENSIFIER							
Intensifiers available	18 mm - Gen II, Gen III filmless						
Method of coupling to the CCD	1.48:1 fiber optic						
Intensifier type	Gen II				Gen III *Filmless*		
	SB	RB	SR	UV	HR*f*	HB*f*	InGaAs
Wavelength Range	See QE curves						
Min. Gate Width (Optical FWHM) *							
Sub-nanosecond Gate	< 500 ps (for Fast Gate tubes only)				< 500 ps (for Fast Gate tubes only)		
Fast Gate	~ 2 nsec (Typ), 3 nsec (Guar)				~ 2 nsec (Typ), 3 nsec (Guar)		
Repetition Rate: Sustained	1 MHz; 100 kHz with Picosecond gating; 6.25 kHz with MCP bracket pulsing						
Resolution limit	40 to 64 lp/mm				57 to 64 lp/mm		
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 and P47 optional)						
Operating Environment	+5° C to +30° C non-condensing						
Storage Environment	-25° C to +55° C						
Certification	CE						

All specifications subject to change. Contact your local sales representative for more information.

* Measured with 18 mm intensifier

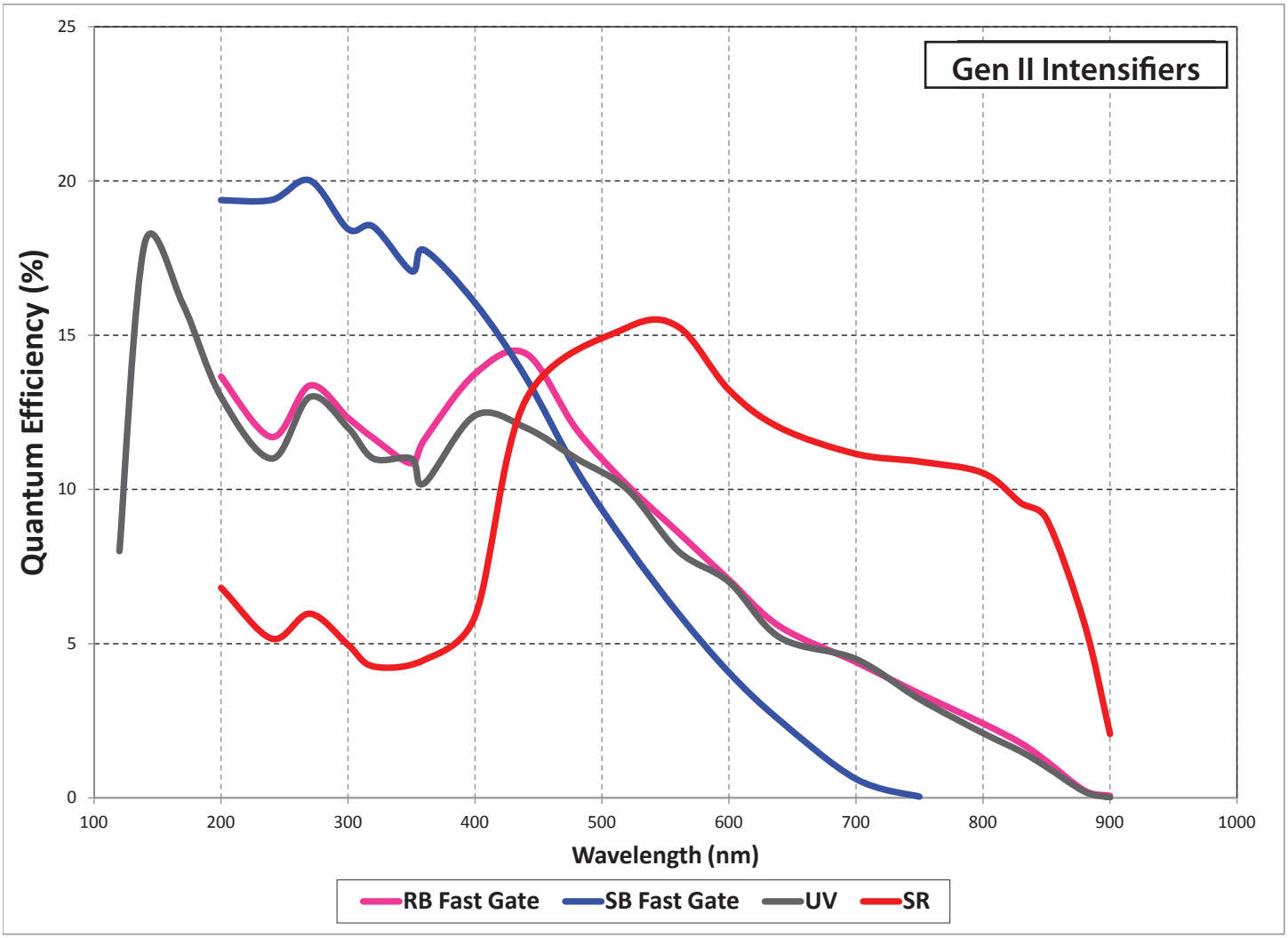
The PI-MAX4's integrated SuperSYNCHRO Timing Generator lets researchers set gate pulse widths and delays under GUI software control. The closed coupled SuperSYNCHRO significantly reduces the system delay inherent in the timing generator of *em*ICCD cameras. The integrated timing generator means there 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.

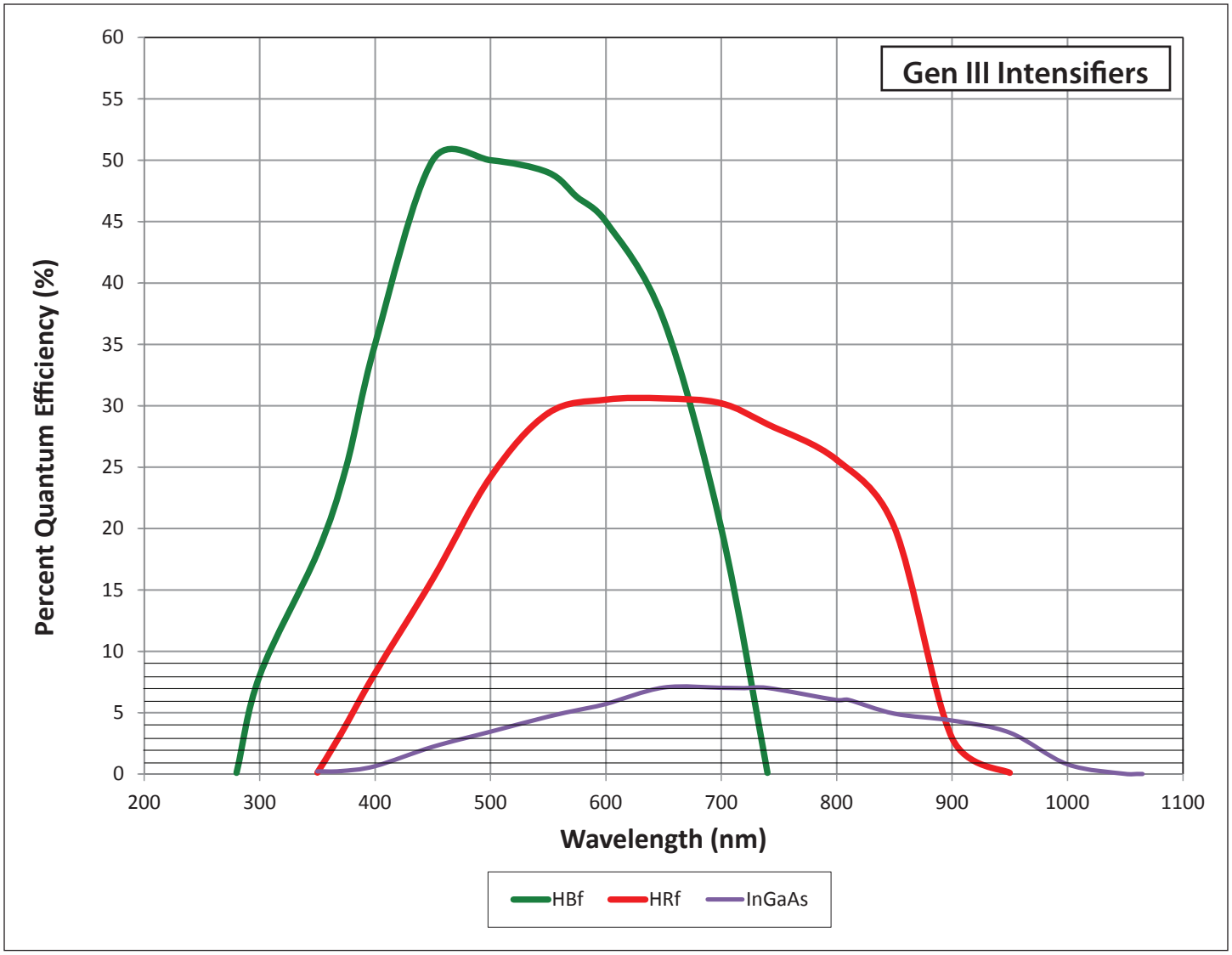
FEATURE	BENEFITS
Closed Coupled Design	Short signal paths for minimum insertion delays
On-board memory	Store and execute complex gate width/delay sequences with no software overhead
Internal oscillator *	Drive an external event and initiate repetitive experiments.
SyncMASTER Pulses	Independent continuous 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*	~0.01 ns to 21 sec (from T0)
Timing resolution/ Timing jitter	10 ps / 35 ps rms
Insertion delay	< 27 ns (trigger in to intensifier opening)
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
Pre Trigger In	TTL input. A rising edge will stop CCD Cleans and set camera to wait for the external trigger for fastest response. User selectable option.
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 actual 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 - 0.01ns - 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


Gen II Intensifiers
Quantum Efficiency (%)
25
20
15
10
5
0
100
200
300
400
500
600
700
800
900
1000
Wavelength (nm)
RB Fast Gate
SB Fast Gate
UV
SR

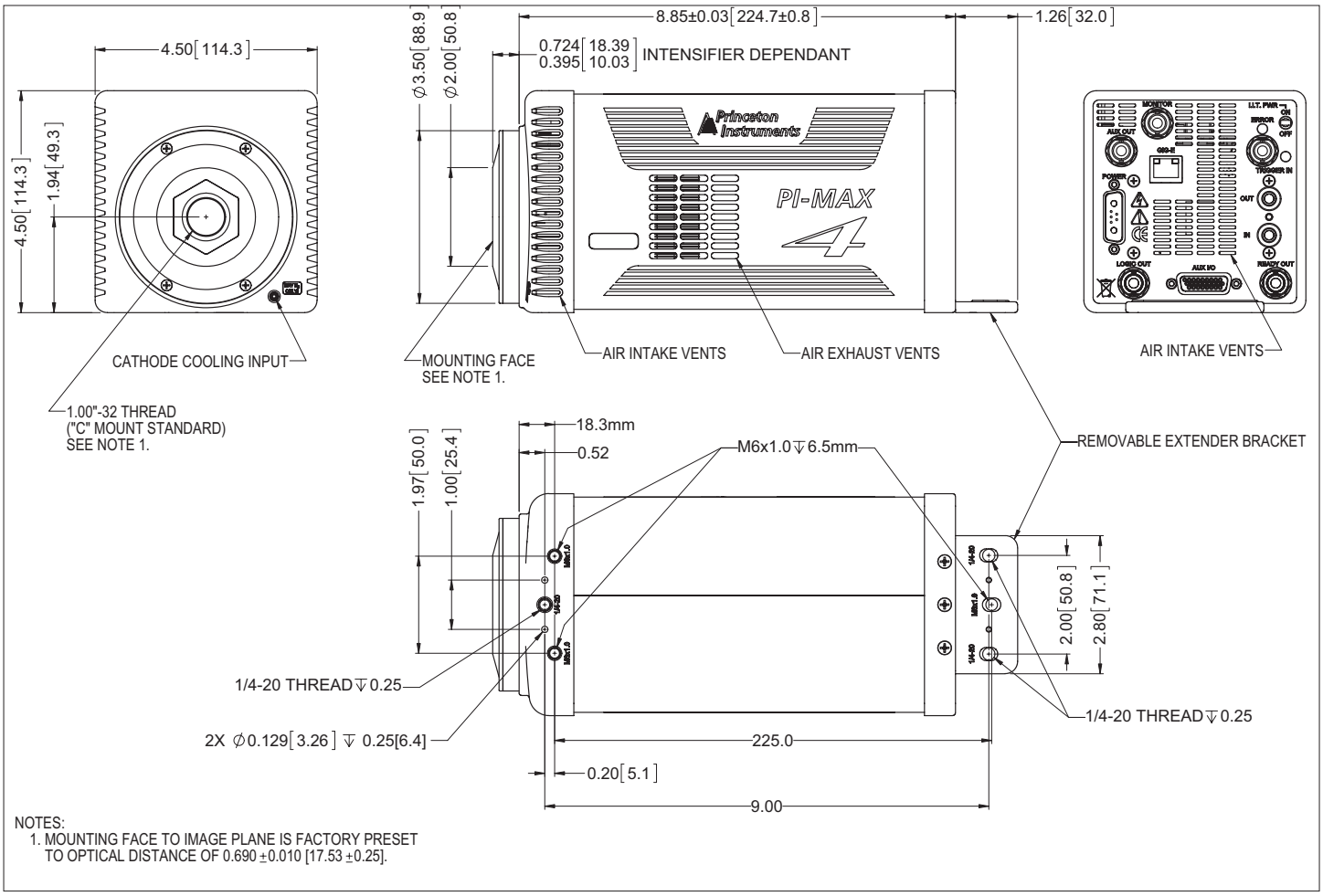


Frame Rate (fps)

ROI/Bin	512 x 512	256 x 256	128 x 128	64 x 64	32 x 32
1 x 1	32	60	109	184	279
2 x 2	61	109	184	279	377
4 x 4	113	184	279	377	456
8 x 8	196	279	377	456	510

NOTE: Frame rate measured at 10 MHz digitization and 600 nsec/row vertical shift. "Custom chip" mode increases frame rate at reduced ROI by 2x to 4x.

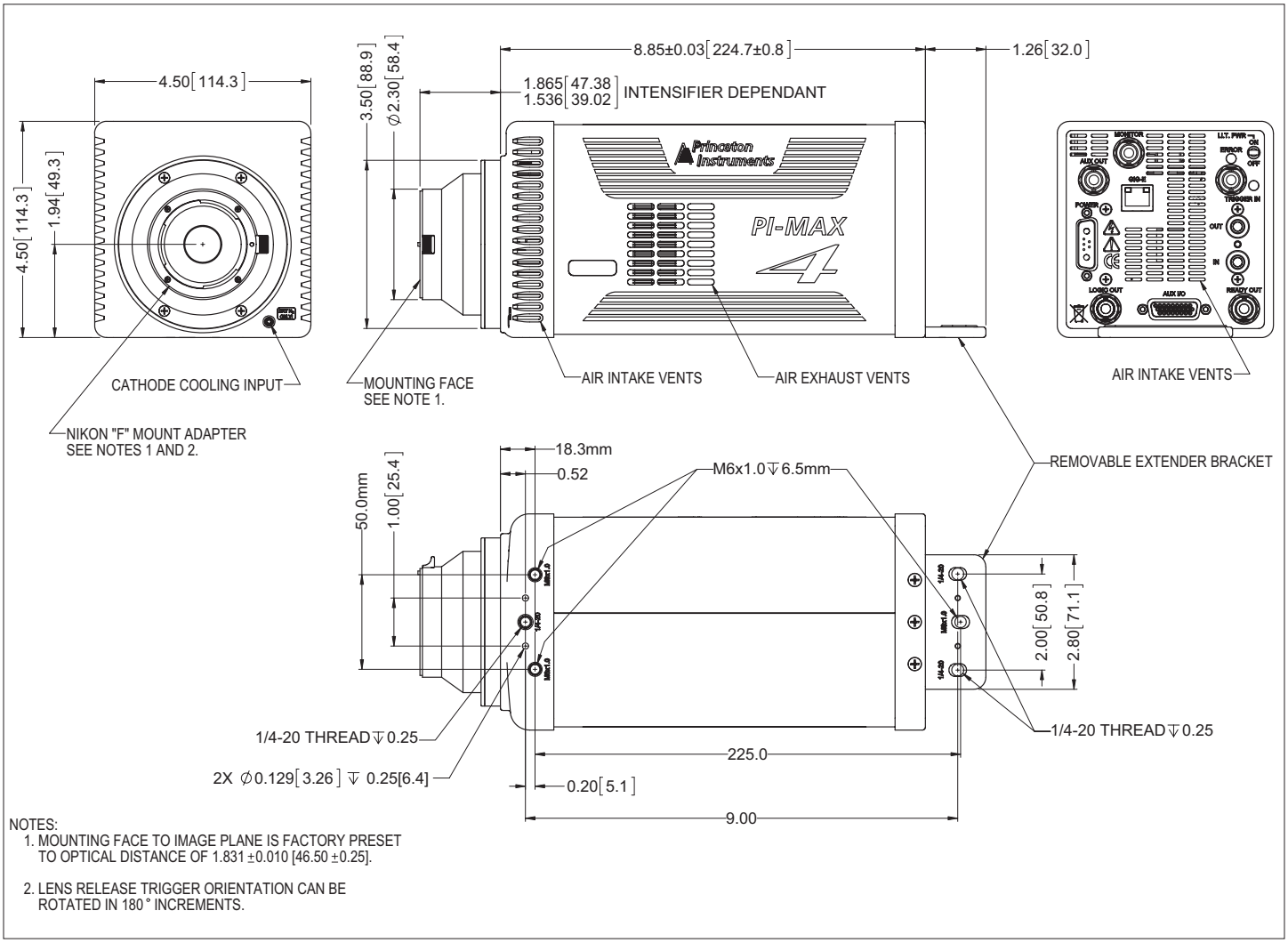
OUTLINE DRAWING
"C" MOUNT



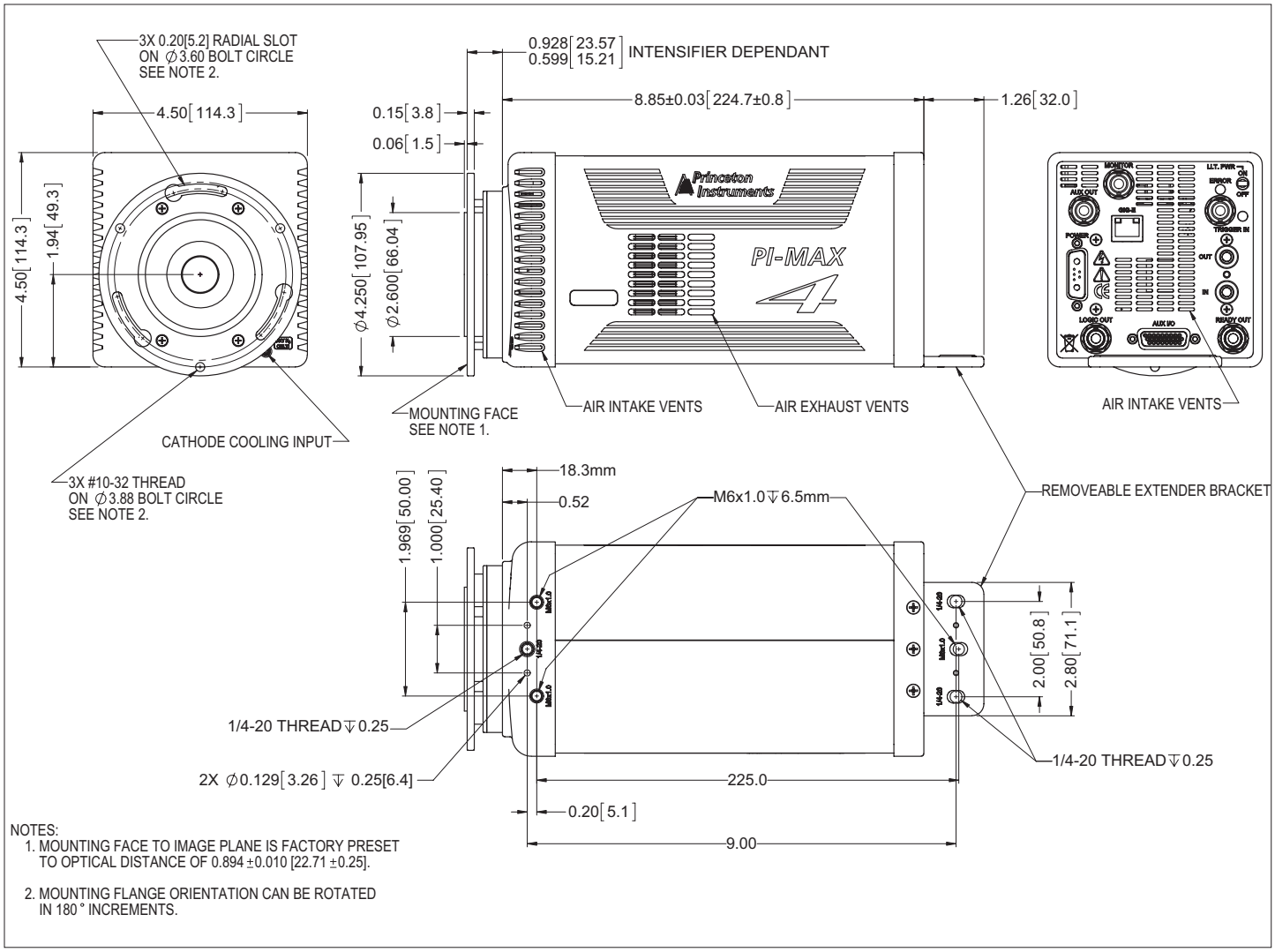
NOTES:
1. MOUNTING FACE TO IMAGE PLANE IS FACTORY PRESET TO OPTICAL DISTANCE OF 0.690 ±0.010 [17.53 ±0.25].

Princeton Instruments | 3660 Quakerbridge Rd | Trenton, NJ 08619 USA | +1 609-631-4000 | www.princetoninstruments.com | info@princetoninstruments.com

OUTLINE DRAWING
"F" MOUNT



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.



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.