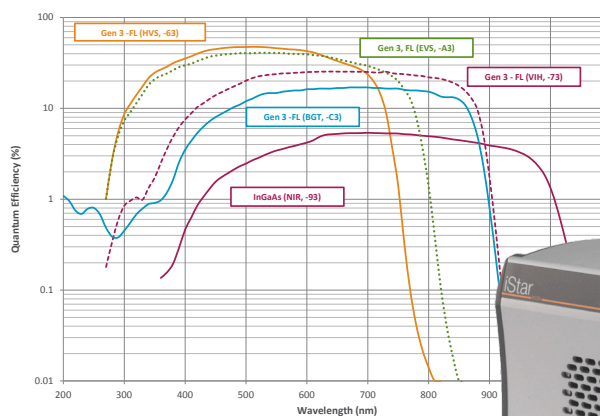


Example of TR Combustion Analysis



Time-Resolved

## Features and Benefits

- **USB 2.0 connection**  
Simple Plug & Play connection
- **Multi-MHz Readout speeds**  
Rapid image capture for fast transition phenomena analysis
- **Integrated Digital Delay Generator**  
With comprehensive software controls
- **Close-Coupled Gating**  
< 2 ns true optical gating speeds - ultimate temporal resolution
- **Lowest insertion delay**  
As low as 19 ns
- **Fibre-optic coupling**  
High optical throughput without vignetting
- **IntelliGate™\*1**  
MCP gating for On/Off ratios >10<sup>8</sup> in the UV
- **Photocathode gating rate up to 500 kHz**  
Increased Signal to Noise ratio for high speed laser-based experiments
- **Cropped sensor mode**  
Specialised acquisition mode to achieve fastest image acquisition rate
- **High resolution Gen 2 and 3 intensifiers**  
Highest available intensifier resolution with QE > 50% and sensitivity options from 120 nm to 1,100 nm
- **Thermo-Electric cooling down to -40°C**  
Ideal for low-light applications
- **Real-time control**  
Intuitive Windows user interface for real-time acquisition optimization
- **Photocathode dry gas purge port**  
Provides further EBI reduction for low-light applications

## Industry's most integrated platform for rapid, nanosecond, Time-Resolved Imaging

Andor's iStar DH312T intensified CCD camera series is designed for rapid, ns-scale time-resolved Imaging. The 512 x 512 array is ideally suited for PLIF-based combustion analysis as well as Plasma plume analysis with ns time-resolution. It offers Multi-MHz readout for acquisition in excess of 15 frames per second, along with laptop-friendly, USB 2.0 connectivity and a fully integrated, software-controlled Digital Delay Generator (DDG™). This allows seamless integration of complex experiments at the touch of a button, with full timing and gain control through a single interactive interface. Gen 2 & 3 image intensifiers with entrance input window and phosphor options are available to match wavelength range requirements from 120 nm to 1,100 nm .

## Specifications Summary

	Ø 18 mm
Effective active area of CCD (mm)	12.3 x 12.3
Active pixels	512 x 512
Fibre optic taper magnification	1:1
Effective CCD pixel size	24 x 24 µm (100% fill factor)
Read noise	As low as 5.4 e <sup>-</sup>
Frame rate (image/sec, max)	15.8 (28.5 with 2 x 2 binning)
Useful photocathode spectral range	120 - 1,100 nm*
Photocathode QE	Up to 50%*
Minimum optical gate width	< 2 ns*
Digitization	16-bit

\* Dependant on intensifier type

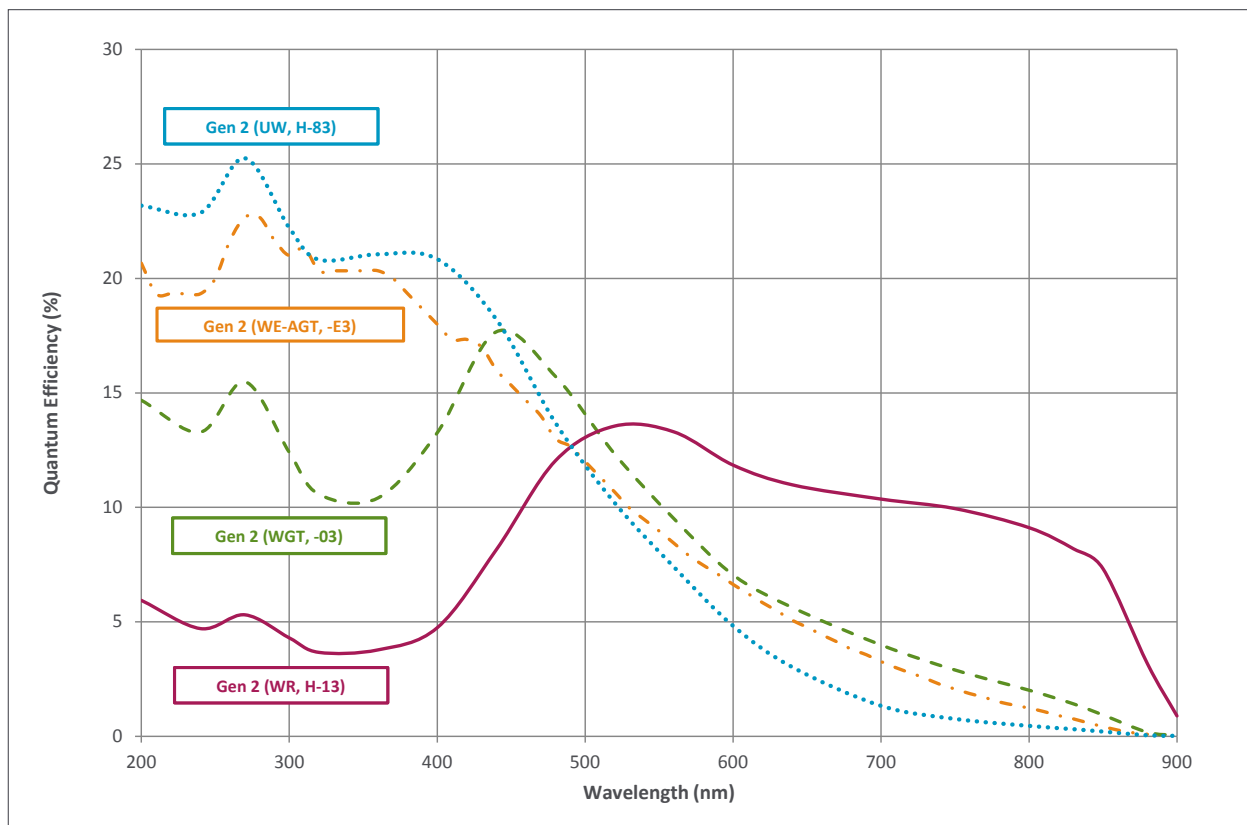
Specifications - Gen 2 Image Intensifiers \*2

Photocathode model	18*-03	18*-04	18*-05 †	18H-13	18H-83	18*-E3*1
Useful aperture	Ø18 mm					
Input window	Quartz	Quartz	MgF <sub>2</sub>	Quartz	Quartz	Quartz
Photocathode type	W-AGT	W-AGT	W-AGT	WR	UW	WE-AGT
Minimum guaranteed peak QE @ room temperature *3	18	18	15	13.5	25	22
Wavelength range	180 - 850 nm	180 - 850 nm	120 - 850 nm	180 - 920 nm	180 - 850 nm	180 - 850 nm
Image intensifier resolution limit *4	25 µm	30 µm	25 µm	25 µm	25 µm	25 µm
Phosphor type [decay time to 10%]	P43 [2 ms]	P46 [200 ns]	P43 [2 ms]	P43 [2 ms]	P43 [2 ms]	P43 [2 ms]
Minimum optical gate width (ns) *5, 6						
U (Ultrafast)	< 2	< 2	< 5	-	-	< 2
F (Fast)	< 5	< 5	< 10	-	-	< 5
H (High QE)	-	-	-	< 50	< 100	-
Maximum relative gain *7	> 1000	> 500	> 1000	> 850	> 500	> 300
Maximum photocathode repetition rate (with Intelligate™ OFF)	500 kHz (continuous)					
Maximum photocathode repetition rate (with Intelligate™ ON)	5 kHz (continuous)					
Equivalent Background Illuminance (EBI)	< 0.2 e <sup>-</sup> /pix/sec		< 0.4 e <sup>-</sup> /pix/sec		< 0.2 e <sup>-</sup> /pix/sec	

\* Substitute with appropriate gate width option, e.g. 18F-03 (please refer to page 5 for detailed ordering information)

† Available with VUV-compatible spectrograph interface

Quantum Efficiency Curves for Gen 2 Image Intensifiers \*\*3

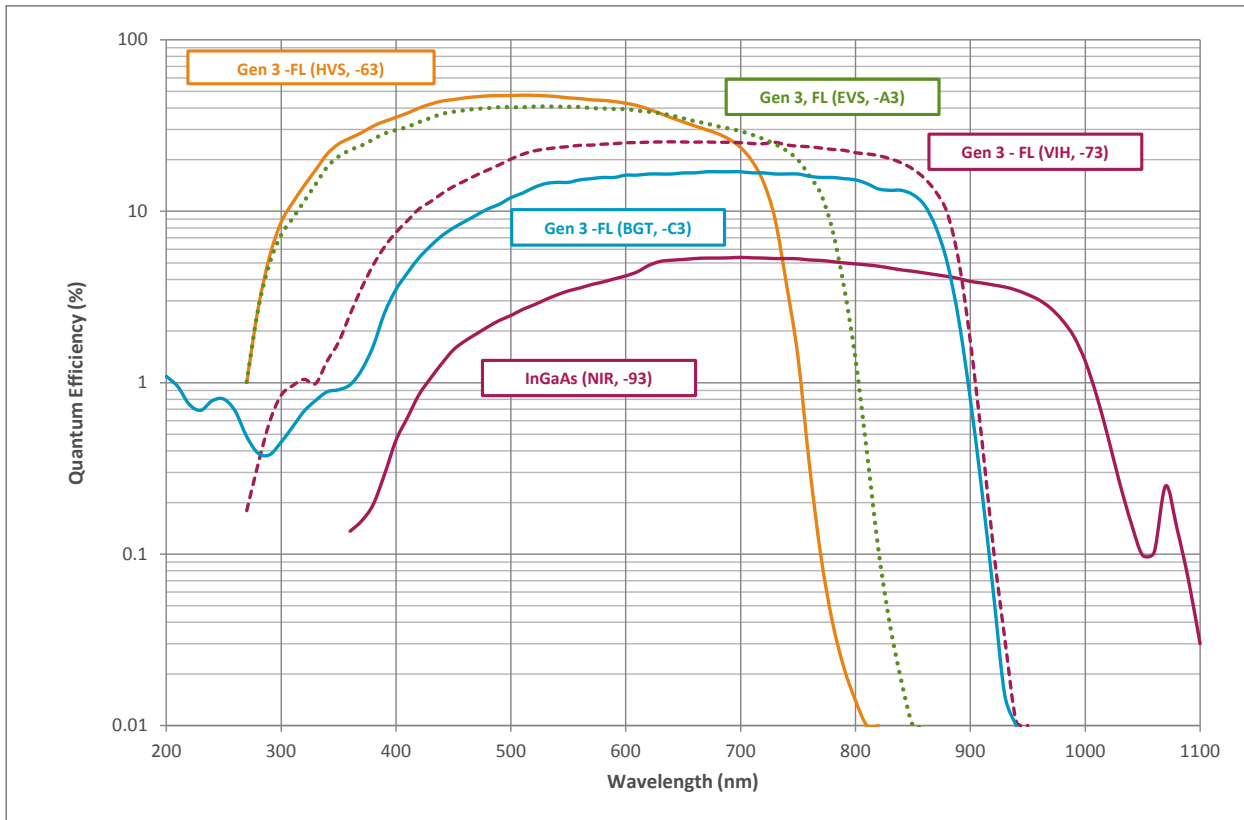


Specifications - Gen 3 Image Intensifiers \*2

Photocathode model	18*-63	18*-73	18*-93	18*-A3	18*-C3
Useful aperture	Ø 18 mm				
Input window	Glass	Glass	Glass	Glass	MgF <sub>2</sub> + F/O + Lumogen
Photocathode type	HVS	VIH	NIR	EVS	BGT
Peak QE @ room temperature *3	> 47.5	> 25.5	> 5	> 40	> 17
Wavelength range	280 - 760 nm	280 - 910 nm	380 - 1090 nm	280 - 810 nm	< 200 - 910 nm
Image intensifier resolution limit *4	30 µm	30 µm	30 µm	30 µm	40 µm
Phosphor type [decay time to 10%]	P43 [2 ms]				
Minimum optical gate width (ns) *6					
U (Ultrafast)	< 2	< 2	< 3	< 2	< 2
F (Fast)	< 5	< 5	< 5	< 5	< 5
Maximum relative gain *7	> 200				
Maximum photocathode repetition rate (with Intelligate™ OFF)	500 kHz (continuous)				
Maximum photocathode repetition rate (with Intelligate™ ON)	5 kHz (continuous)				
Equivalent Background Illuminance (EBI)	< 0.1 e/pix/sec	< 0.3 e/pix/sec	< 2 e/pix/sec	< 0.2 e/pix/sec	< 0.3 e/pix/sec

\* Substitute with appropriate gate width option, e.g. 18U-63 (please refer to page 5 for detailed ordering information)

Quantum Efficiency Curves for Gen 3 Image Intensifiers \*3, \*8



## CCD Specifications \*2

<b>Total CCD matrix size</b>	512 x 512			
<b>Fibre optic taper magnification</b>	Ø 18 mm 1:1			
<b>Effective CCD pixel size</b>	24 x 24 µm			
<b>Effective active area</b>	12.3 x 12.3 mm			
<b>Pixel well depth</b>	320,000 e <sup>-</sup>			
<b>Output node capacity</b>	480,000 e <sup>-</sup>			
<b>Read noise e<sup>-</sup> *9</b>	50 kHz	1 MHz	3 MHz	5 MHz
<b>Typical</b>	5.4	10	16	24
<b>Maximum</b>	7	14	20	50
<b>Vertical shift speeds</b>	6.5 to 25.7 µs			
<b>Maximum frame and spectral rates</b>	<b>Frame</b>	<b>FVB</b>	<b>Crop Mode (10 rows)</b>	<b>Fast Kinetics</b>
	15.8 full fps 28.5 fps (2x2 binning)	291 sps	633 fps 5,556 sps	32,150 Hz (4 rows) 55,250 Hz (2 rows)
<b>Sensitivity</b>	2.2 to 8.7 e <sup>-</sup> /count (software selectable)			
<b>Linearity *10</b>	Better than 99%			
<b>Minimum temperature air cooled [dark current, e<sup>-</sup>/pixel/sec]</b>	-30°C [0.25]			
<b>Coolant chiller, coolant @ 10°C, 0.75 l/min [dark current, e<sup>-</sup>/pixel/sec]</b>	-40°C [0.12]			

## Internal Digital Delay Generator (DDG™) Key Functions

<b>Gate pulse delay &amp; width</b>	<ul style="list-style-type: none"> <li>Adjustable from 0 ns to 10 s in 10 ps steps</li> <li>Software controlled, pre-programmed or real-time</li> </ul>
<b>Trigger Outputs</b>	
<b>Output A, B and C</b>	<ul style="list-style-type: none"> <li>3x output, +5V CMOS level with 50 Ω source impedance; can drive 5V into a non-terminating load or 2.5V into 50 Ω load; output synchronized triggers for auxiliary equipment, e.g. lasers, flash lamps, National Instrument™ hardware</li> <li>Individual delays control from 0 ns to 10 s in 10 ps steps</li> <li>Configurable Polarity</li> <li>Software controlled, pre-programmed or real-time</li> </ul>
<b>Fire</b>	<ul style="list-style-type: none"> <li>5V CMOS level reference signal for beginning and end of individual CCD exposure</li> </ul>
<b>Arm monitor</b>	<ul style="list-style-type: none"> <li>5V CMOS level reference signal to indicate when system is ready to accept external triggers. Signal goes high when system is ready to accept external triggers (after a readout has finished) and goes low when the exposure is finished</li> </ul>
<b>Gate &amp; output A, B and C jitter</b>	<ul style="list-style-type: none"> <li>35 ps rms (relative to external trigger signal)</li> </ul>
<b>Trigger Inputs</b>	
<b>External trigger</b>	<ul style="list-style-type: none"> <li>Trigger input for CCD and Digital Delay Generator</li> <li>Up to 500 kHz for Integrate-On-Chip mode</li> <li>Software-configurable Polarity, Termination and Trigger Threshold</li> <li>Fast external software option for most rapid camera response to external trigger (CCD keep clean interruption) – no need for pre-trigger pulse</li> </ul>
<b>Direct gate</b>	<ul style="list-style-type: none"> <li>TTL input for exact external control of photocathode width and timing with smallest insertion delay.</li> </ul>
<b>Additional Controls</b>	
<b>Gate monitoring</b>	<ul style="list-style-type: none"> <li>AC coupling from photocathode to monitor exact photocathode on/off switching and timings</li> </ul>
<b>Insertion delay</b>	< 19 ns in direct gate operation

## Have you found what you are looking for?

**Need higher resolution?** The DH334T series cameras offers 13.5 x 13.5 µm pixels for higher resolution imaging & spectroscopy.

**Need a faster response phosphor for Fast Kinetics?** P46 phosphor is available as an option for all intensifier models.

**Need a wider sensor format?** The DH320T & high resolution DH340T series offer up to 25 mm field of view when combined with Ø 25 mm image intensifier options.

**Need a customized version?** Please contact us to discuss our Customer Special Request options (CSR).

## Creating The Optimum Product for You

How to customize the iStar DH312T:

### Step 1.

Select the minimum gating speed option that best suits your needs. For the available combinations please refer to the image intensifier tables on pages 2 and 3.

### Step 2.

Select the image intensifier type that best suits your needs.

### Step 3.

Please indicate which software you require.

### Step 4.

For compatibility, please indicate which accessories are required.



DH312T-18- **F** - **03**

example shown

### Step 1.

Choose minimum gating speed

**H:** High QE, slow gating  
**F:** Fast gating  
**U:** Ultra fast gating

### Step 2.

Choose image intensifier option (Gen 2):

**03:** W-AGT photocathode, P43 phosphor  
**04:** W-AGT photocathode, P46 phosphor  
**05:** W-AGT photocathode, MgF<sub>2</sub> window, P43 phosphor  
**13:** WR photocathode, P43 phosphor  
**83:** UW photocathode, P43 phosphor  
**E3:** WE-AGT photocathode, P43 phosphor

Choose image intensifier option (Gen 3):

**63:** HVS photocathode, P43 phosphor  
**73:** VIH photocathode, P43 phosphor  
**93:** NIR photocathode, P43 phosphor  
**A3:** EVS photocathode, P43 phosphor  
**C3:** BGT photocathode, P43 phosphor

### Step 4.

The New iStar ICCD also requires at least one of the following software options:

**Solis for Time-Resolved** A 32-bit and fully 64-bit enabled application for Windows (XP, Vista, 7 and 8) offering rich functionality for data acquisition and processing. AndorBasic provides macro language control of data acquisition, processing, display and export.

**Andor SDK** A software development kit that allows you to control the Andor range of cameras from your own application. Available as 32 and 64-bit libraries for Windows (XP, Vista, 7 and 8) and Linux. Compatible with C/C++, C#, Delphi, VB6, VB.NET, LabVIEW and Matlab.

### Step 5.

The following accessories are available:

**LM-C** C-mount lens adaptor  
**LM-NIKON-F** F-mount lens adaptor  
**ACC-XW-CHIL-160** Oasis 160 Ultra compact chiller unit  
**ACC-6MM-TUBING-2xxxxM** 6 mm tubing option for ACC-XW-CHIL-160  
**ELC-05323** i<sup>2</sup>c to BNC cable for Shamrock shutter control  
**ACC-ISTAR-METRIC ADP** Metric Bracket

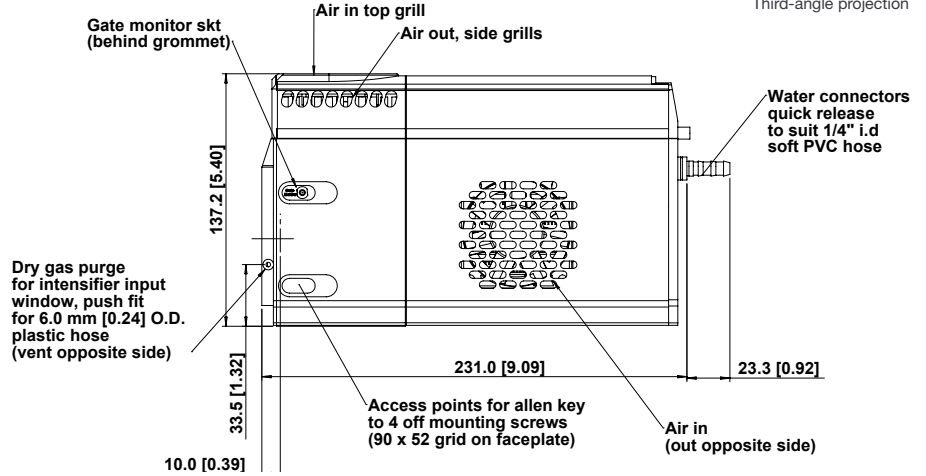
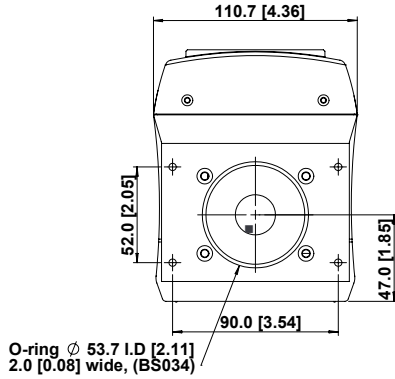
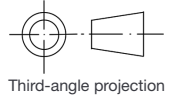
In addition to the accessories listed the following special options are also available:

**90° USB connection**  
**UV or visible lenses or adapter extension tubes**

Please contact your local Sales representative for details of how to order any of these items.

### Product Drawings

Dimensions in mm [inches]



Weight: 4.2 kg [9 lb 4 oz]

■ = position of pixel 1,1

### Connecting to the iStar

#### Camera Control

Connector type: USB 2.0

#### Logic Input / Output

Connector type: SMA, provided with SMA - BNC cable

5x outputs: FIRE pulse, Output A, B, C from DDG™ and ARM

2x inputs: Camera trigger from 3<sup>rd</sup> party source & direct gate for complete, direct external control of intensifier gating

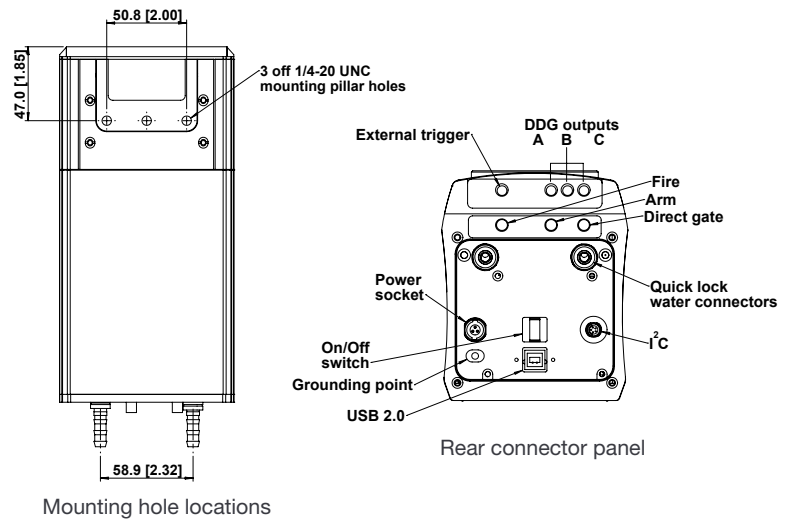
#### I<sup>2</sup>C connector

Compatible with Fischer SC102A054-130, pin-outs as follow:

1 = Shutter (5V CMOS level with 50 Ω impedance), 2 = I<sup>2</sup>C Clock (5V), 3 = I<sup>2</sup>C Data (5V), 4 = +5 Vdc, 5 = Ground

#### Gate Monitor

1x output: AC coupling to photocathode



Mounting hole locations

### Applications Guide

	Gen 2	Gen 2 UV Enhanced (-05, -83, -E3)	Gen 3*	InGaAs
Plasma Studies	✓	✓	✓	✓
Laser Induced Fluorescence (LIF, PLIF)	✓	✓	✓	
Time Resolved Luminescence Imaging	✓	✓	✓	
Transient Absorption Imaging	✓	✓	✓	✓
Time Resolved Photoluminescence Imaging			✓	✓
Particle Image Velocimetry (PIV)	✓	✓	✓	

\* Gen 3 typically do not exhibit any UV response - Andor -C3 is constructed with an additional input phosphor interface to provide this UV response.

✓ = Suitable  
✓ = Optimum



# Order Today

Need more information? At Andor we are committed to finding the correct solution for you. With a dedicated team of technical advisors, we are able to offer you one-to-one guidance and technical support on all Andor products. For a full listing of our local sales offices, please see: [andor.com/contact](http://andor.com/contact)

Our regional headquarters are:

### Europe

Belfast, Northern Ireland  
Phone +44 (28) 9023 7126  
Fax +44 (28) 9031 0792

### Japan

Tokyo  
Phone +81 (3) 3518 6488  
Fax +81 (3) 3518 6489

### North America

Connecticut, USA  
Phone +1 (860) 290 9211  
Fax +1 (860) 290 9566

### China

Beijing  
Phone +86 (10) 5129 4977  
Fax +86 (10) 6445 5401

### Items shipped with your camera

Power Brick, 12V, 120W single line  
2x 2m BNC to SMA cable  
1x Gate Monitor cable  
3 Metre USB cable A to B type, shielded (1off)  
1x Quick launch guide  
1x CD containing Andor user guides  
1x Individual system performance booklet

### Regulatory Compliance

Compliant with the requirements of the EU EMC and LV Directives through testing to EN 61326-1 and EN 61010-1.  
External power supply PSE-approved

### Footnotes: Specifications are subject to change without notice

1. The On/Off ratio for the 'E3' image intensifier in the UV with MCP gating is typically  $10^5$ .
2. Figures are typical unless otherwise stated.
3. Typical photocathode Quantum Efficiency and standard quartz input window transmission as measured by the tube manufacturer.  $MgF_2$  window allows extended operation down to 120 nm.
4. Typical resolution of the image intensifier tube only, not the overall resolution of the system. As a rough guide, the smallest resolvable FWHM feature will be approximately 2x the CCD pixel size. This is a very important consideration for optical resolution calculations in spectrograph-based systems.
5. Gen 2 High QE (H) option – Photocathode QE is inherently linked to the gating speed of the intensifier. High QE option (H) offers higher peak QE than Ultrafast (U) or Fast (F) intensifiers, while exhibiting minimum gating speed one order of magnitude slower.
6. Actual measured minimum optical gating of the photocathode, reflecting not only the electrical pulse width applied to the photocathode but also its inherent iris time.
7. Gain is software-selectable through a 12-bit DAC and varies exponentially with DAC setting. Value refers to the ratio of max to min intensifier gain as measured for individual cameras. Actual optical gain (counts/photon) for a DAC setting is accessed by the multiplication of the relative gain (at that DAC value) by the minimum system gain (at DAC = 0,  $CCD e^-/photon$ ) and divided by the sensitivity ( $CCD e^-/count$ ) at a given CCD PAG. Sensitivities are individually measured and reported for each system.
8. Combination of -73 GaAsP photocathode with a lumogen-coated fibre-optic plate and protective  $MgF_2$  window. The latter additional optical interfaces are the reason for the lowered QE in the visible NIR region, for the -C3 model.
9. Measured for the entire system. Combination of CCD readout noise and A/D noise - measurement is for single pixel readout with  $-30^\circ C$  CCD cooling and at minimum exposure time under dark conditions. Values quoted are measured with highest available PAG setting.
10. Linearity is measured from a plot of counts vs exposure time under constant photon flux up to the saturation point of the system.

### Minimum Computer Requirements:

- 3.0 GHz single core or 2.4 GHz multi core processor
- 2 GB RAM
- 100 MB free hard disc to install software (at least 1 GB recommended for data spooling)
- USB 2.0 High Speed Host Controller capable of sustained rate of 40 MB/s
- Windows (XP, Vista, 7 and 8) or Linux

### Operating & Storage Conditions

- Operating Temperature:  $0^\circ C$  to  $40^\circ C$  ambient
- Relative Humidity: < 70% (non-condensing)
- Storage Temperature:  $-25^\circ C$  to  $50^\circ C$

### Power Requirements

- 110 - 240 VAC, 50 - 60 Hz



Windows is a registered trademark of Microsoft Corporation.  
Labview is a registered trademark of National Instruments.  
Matlab is a registered trademark of The MathWorks Inc.

TiStar312TSS 0514 R1