ANDOR

an Oxford Instruments company

The iStar ICCD

Fast Gated Intensified CCD Solutions

The iStar ICCD –

Scientific-grade Intensified CCDs from Andor Technology

Fast gated ICCDs

Building on more than 16 years of Excellence in the development of world-class, fast-gated Intensified CCD cameras (ICCD), Andor redefines the standard of rapid, nanosecond time-resolved imaging and spectroscopy with the introduction of the iStar family.

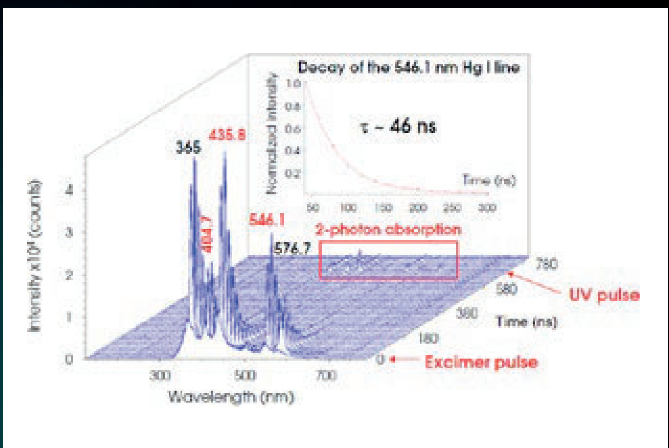
Andor's iStar extracts the very best from CCD sensor and gated image intensifier technologies, achieving a superior combination of rapid acquisitions rates and ultra-high sensitivity down to single photon. Exceptional detection performances are accessed through high quantum-efficiency image intensifiers, thermo-electric cooling to -40ºC, 500 kHz photocathode gating rates and enhanced intensifier EBI noise reduction.

Low jitter, low insertion delay gating electronics and nanosecond-scale optical gating provide excellent timing accuracy down to a few 10's of picoseconds, allowing ultra-precise synchronization of complex experiments through iStar's comprehensive range of input/output triggering options.

The iStar stands for...

- ✓ High sensitivity
- ✓ Rapid spectral and imaging rates
- ✓ Highest timing resolution and accuracy
- ✓ Most compact design
- ✓ Ease of integration
- ✓ Ease of use

Features	Benefits
USB 2.0 connectivity	Industry-standard plug-and-play, lockable and rugged interface Seamless multi-camera control from single PC or laptop.
5 MHz readout platform	Rapid frame and spectral rates for superior characterization of dynamic phenomena. Single readout amplifier for best image digitization uniformity.
Comprehensive binning options - Crop & Fast Kinetic mode	Fully software-customizable binning sequences for highest spectral and image rates. Greater than 6,667 spectra/s continuous rates, up to 55,250 spectra/s in burst mode.
High-resolution sensors and image intensifiers	Sharpest images and spectrum definition, 100% fill factor for maximum signal collection efficiency.
High QE Gen 2 & 3 image intensifiers	Superior photon capture, with peak QE up to 50% and spectral coverage from 120 to 1,100 nm.
True optical gating < 2 ns	Billionth of a second time-resolution for accurate transient phenomena study.
Low jitter, on-board Digital Delay Generator (DDG™)	Highest gating timing accuracy with lowest propagation delay.
Insertion delay as low as 19 ns	Minimum delay between experiment signal generation and actual image intensifier triggering.
Comprehensive triggering interface	Software-controlled 3x triggering outputs with 10 ps setup accuracy for complex experiment integration.
Intelligate™	Intelligent and accurate MCP gating for better than 1:10^8 shuttering efficiency in the UV.
500 kHz sustained photocathode gating	Maximizes signal-to-noise ratio in high repetition rate laser-based applications.
Photocathode EBI minimization	Dry gas purge interface for further efficient EBI reduction.
TE-cooling to -40°C	Efficient minimization of CCD dark current and pixel blemishes.
Real-time control interface	On-the-fly software control of intensifier gain, gating and 3x outputs trigger parameters for real-time detection optimization.
2 year warranty	Reliability and guaranteed performance.



"Kinetics investigation of a laser-induced ablation plume of mercury as a nonlinear medium for Vacuum UltraViolet generation"
Courtesy of Laurent Philippet, Laboratoire de Physique des Lasers, CNRS, Paris 13 University

Application focus

- Plasma studies
- Laser Induced Fluorescence (LIF / PLIF)
- Time-resolved luminescence & photoluminescence
- Laser Induced Breakdown Spectroscopy (LIBS)
- Transient absorption
- Combustion Studies

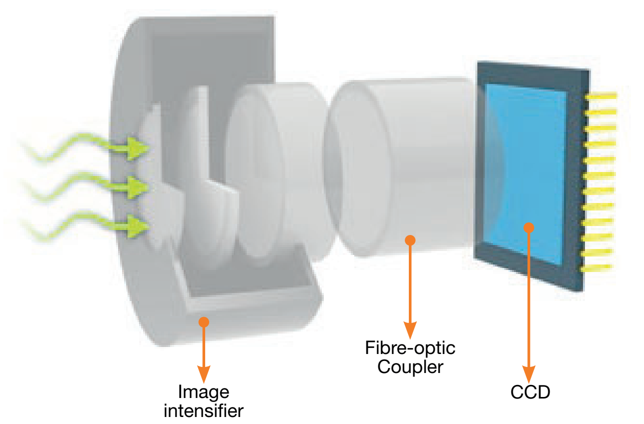
User publication database at andor.com/spectroscopy

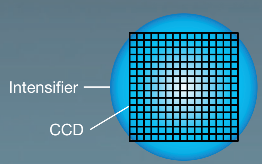
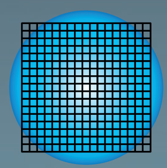
Ten reasons to choose the iStar ICCD

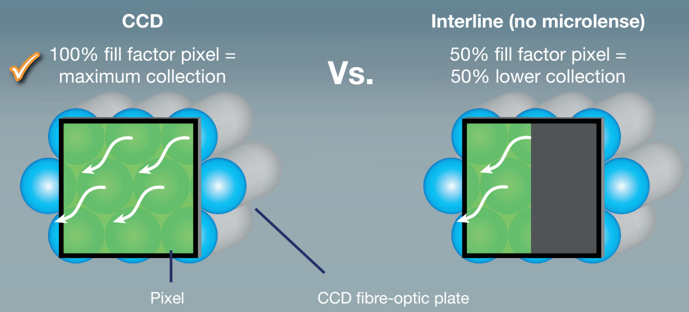
1 High resolution spectroscopy and imaging sensors

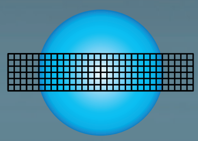
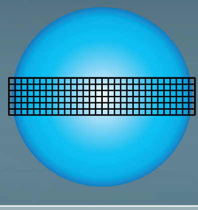
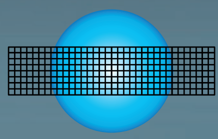
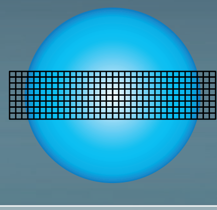
The iStar family features a range of high resolution sensors for the sharpest nanosecond time-resolved images and spectral signatures acquisition, with no compromise in collection efficiency. All sensors feature pixels exhibiting 100% fill factor, unlike microlense-less interline sensors where ~ 50% of the incoming signal will be blocked.

High well-depth options – i.e. 312T and 320T platforms – also offer greater dynamic range for applications such as Transient Absorption or Plasma Spectroscopy with a broad range of spectral features intensity. All CCDs in the iStar platform are Front-Illuminated types, and use a fibre-coupling arrangement to the image intensifiers for maximum collection efficiency, unlike lens-coupled configurations that would suffer from lower throughput, image vignetting and distortion.



Imaging platforms	312T	334T
Array format	512 x 512	1024 x 1024
Pixel size	24 x 24 µm	13 x 13 µm
Effective area (vs. image intensifier Ø)	**Ø 18 mm intensifier** 12.3 x 12.3 mm 	**Ø 18 mm intensifier** 13.3 x 13.3 mm 
Recommended applications	Ultrafast, high dynamic range imaging Ultrafast, narrowband spectroscopy Ultra-fast kinetics & multi-track	High resolution imaging High resolution, narrowband spectroscopy Extended fast kinetics series & multi-track



	320T		340T	
Array format	1024 x 255		2048 x 512	
Pixel size	26 x 26 µm		13.5 x 13.5 µm	
Effective area (vs. image intensifier Ø)	**Ø 18 mm intensifier** 18 x 6.6 mm 	**Ø 25 mm intensifier** 25 x 6.6 mm 	**Ø 18 mm intensifier** 18 x 6.9 mm 	**Ø 25 mm intensifier** 25 x 6.9 mm 
Recommended applications	Rapid, broadband spectroscopy Ultrafast, broadband multi-track spectroscopy		High resolution, broadband spectroscopy Broadband, multi-track spectroscopy	

2 Driving the absolute best acquisition speed

The 5 MHz digitization and microsecond-range vertical clock shift speeds extract the very best frame rate and spectral rate from these sensors, providing outstanding rapid transient phenomena study capabilities.

	312T	320T	334T	340T
Sensor array size	512 x 512	1024 x 255	1024 x 1024	2048 x 512
Pixel size	24 x 24 µm	26 x 26 µm	13 x 13 µm	13.5 x 13.5 µm
Max. readout speed	5 MHz	5 MHz	5 MHz	3 MHz
Frame rates				
1x1 full frame	15.8 fps	15.9 fps	4.2 fps	2.5 fps
2x2 binning	28.5 fps	28.9 fps	7.3 fps	5.6 fps
Spectral rates (FVB)	291 sps	323 sps	145 sps	135 sps

1995 - InstaSpec V

First ultra-compact Research ICCD with on-board gain control for time-resolved imaging and spectroscopy.

2000 - iStar

First scientific-grade ICCD with on-board, fully integrated digital delay generator (no external controller), MCP gating for enhanced on/off ratio in the UV, 'Gen 3' film-less intensifiers and single window design for maximum throughput.

2011 - New iStar

First USB 2.0 ICCD with 2nd generation of on-board DDG for enhanced interfacing functionalities and timing accuracies. Fastest platform with deepest TE cooling for high sensitivity, time-resolved spectroscopy.

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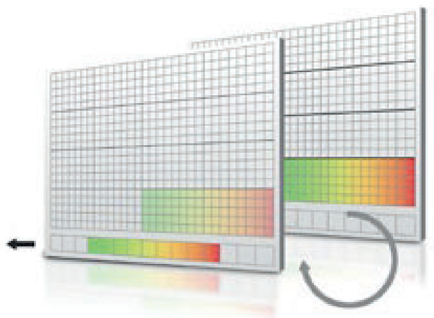
3 Crop mode: Pushing frame and spectral rate further...



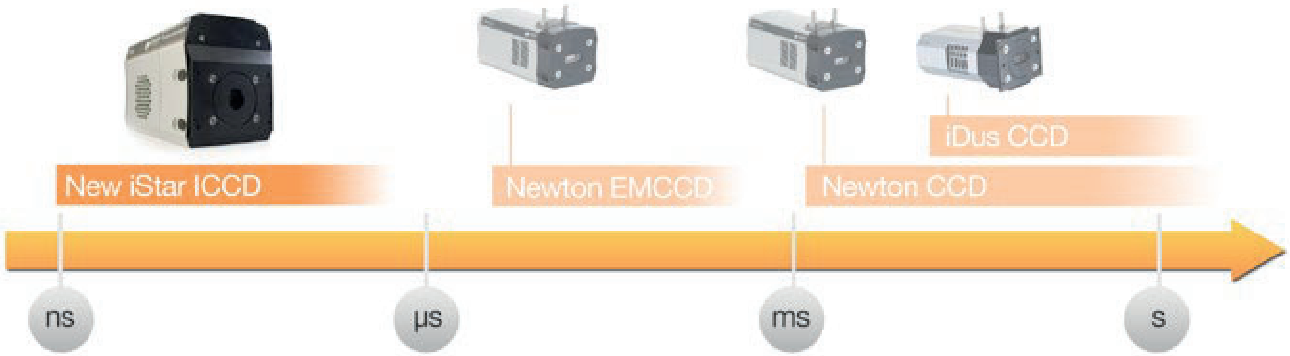
The active imaging area of the sensor is defined in a way that only a small section of the entire chip is used for imaging or spectral acquisition.

The remaining area has to be optically masked to prevent light leakage and charge spill-over that would compromise the signal from the imaging area.

By cropping the sensor, one achieves faster frame and spectral rates because the temporal resolution will be dictated only by the time it requires to read out the small section of the sensor.

	312T	320T	334T	340T
Sensor array size	512 x 512	1024 x 255	1024 x 1024	2048 x 512
Pixel size	24 x 24 µm	26 x 26 µm	13 x 13 µm	13.5 x 13.5 µm
Max. readout speed	5 MHz	5 MHz	5 MHz	3 MHz
Crop mode rates (imaging) *[number of rows equivalent to a 130 µm high channel]*	1,031 fps [5 rows]	526 fps [5 rows]	333 fps [10 rows]	184 fps [10 rows]
Crop mode rates (spectral, binned) *[number of rows equivalent to a 130 µm high channel]*	6,667 sps [5 rows]	3,571 sps [5 rows]	3,450 sps [10 rows]	1,825 sps [10 rows]

Different platforms for different time resolution needs



Check out the Andor website for more information on all Spectroscopy and Imaging platforms

andor.com

... and beyond with fast kinetic mode

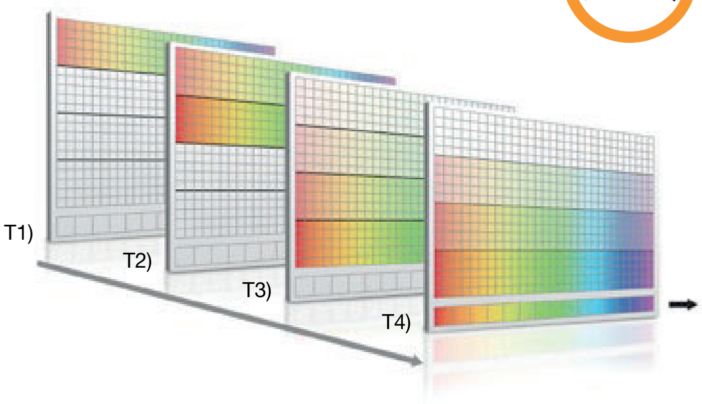
This readout mode uses the actual sensor as a temporary storage medium, allowing extremely fast sequences to be captured. By using the fastest vertical clock speeds as advised by the manufacturer, the iStar achieves the highest sustained acquisition rates on the market.

T1) CCD "Keep Clean" sequence is interrupted, and useful signal builds-up on the user-defined top portion of a sensor

T2) At the end of the exposure time, signal is rapidly shifted down by a pre-defined number of rows, and a second exposure takes place

T3) This process is repeated until the number of acquisitions equals the series length set by user

T4) The sequence moves into the readout phase by shifting in turn the individual acquisitions to the readout register, which is then read out



Even lower vertical clock shift speeds are available on the iStar, but may yield to loss of well-depth and Charge Transfer Efficiency (CTE, i.e. smearing). The iStar offers a unique software-controlled clock amplitude adjustment to compensate for these drawbacks.

	312T	320T	334T	340T
Sensor array size	512 x 512	1024 x 255	1024 x 1024	2048 x 512
Pixel size	24 x 24 µm	26 x 26 µm	13 x 13 µm	13.5 x 13.5 µm
Max. readout speed	5 MHz	5 MHz	5 MHz	3 MHz
Fast kinetics rates vs. channel heights				
26 µm	86,210 Hz [1 row]	37,990 Hz [1 row]	48,780 Hz [2 rows]	30,030 Hz [2 rows]
50 µm	55,250 Hz [2 rows]	26,590 Hz [2 rows]	29,850 Hz [4 rows]	16,920 Hz [4 rows]
100 µm	32,150 Hz [4 rows]	16,615 Hz [4 rows]	16, 805 Hz [8 rows]	10,225 Hz [8 rows]
200 µm	17, 510 Hz [8 rows]	9,495 Hz [8 rows]	9,525 Hz [15 rows]	4,975 Hz [15 rows]

4 Lowest sensor dark current

One would intuitively think that dark current in ICCDs is not typically an issue, as intensifier gain can be applied to overcome this noise prior to reaching the CCD, and time scales involved - e.g. the nanosecond scale – mean that very little CCD dark current will build-up.

So for which scenarios is extreme dark current essential?

- Experiments involving multi-kHz lasers and extremely weak sample emission, where multiple photocathode gatings can be set within a single CCD exposure. This exposure is typically set to a few seconds to allow for hundreds of thousands of accumulations to occur. During these extended CCD exposures, sensor deep cooling is of the greatest importance.

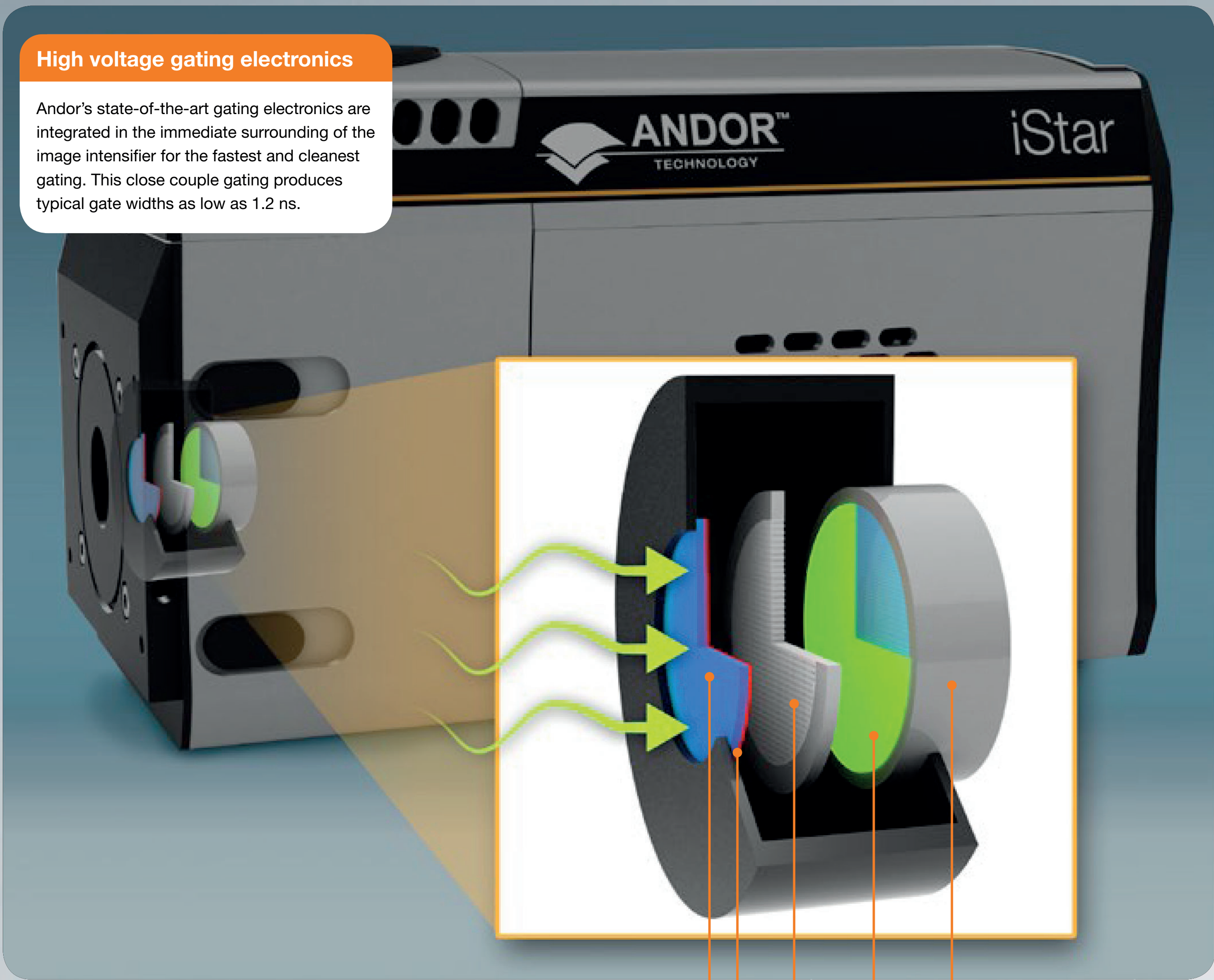
- Photon counting, where any noise contribution from any element of the ICCD has to be minimized to allow access to the lowest detection threshold. As Image Intensifiers are fibre coupled to the CCD, the photocathode will see some degree of conductive cooling, which will contribute to minimize the EBI. Further thermal noise reduction can be achieved through the iStar's dry gas purge interface.

5 Pushing the limits of nanosecond time-resolved detection

Originally develop for night vision applications, image intensifiers can also act as ultra-fast (nanosecond-scale) optical shutters, as well as provide signal amplification up to x1,000 proved invaluable in the world of research for studies of short-lived events, e.g. fluorescence decay time measurements, or ultrafast dynamic behaviour studies, e.g. plasma or combustion kinetics.

High voltage gating electronics

Andor's state-of-the-art gating electronics are integrated in the immediate surrounding of the image intensifier for the fastest and cleanest gating. This close couple gating produces typical gate widths as low as 1.2 ns.

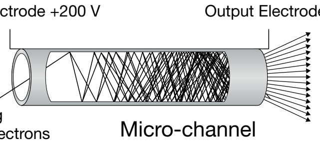


Input window

- Typically made of quartz for 'Gen 2' photocathodes - optional MgF_2 for VUV detection down to 120 nm.
- 'Gen 3' photocathodes are typically deposited on glass substrate, limiting UV response below 300 nm

Micro-Channel Plate (MCP)

Honeycomb glass micro-structure providing adjustable photo-electron multiplication (gain) through impact ionization



Fibre-optic plate

Output interface to CCD for maximum throughput

- No vignetting
- Extremely low distortion when compared to lens-coupled systems.

Photocathode

- Ø18 mm and Ø25 mm photo-sensitive element, converting incident photons to photo-electrons.
- High resolution, high QE multi-alkali 'Gen 2' and GaAs-based 'Gen 3 filmless' options for detection from 120 to 1,100 nm
- < 2 ns optical shuttering.

Phosphor

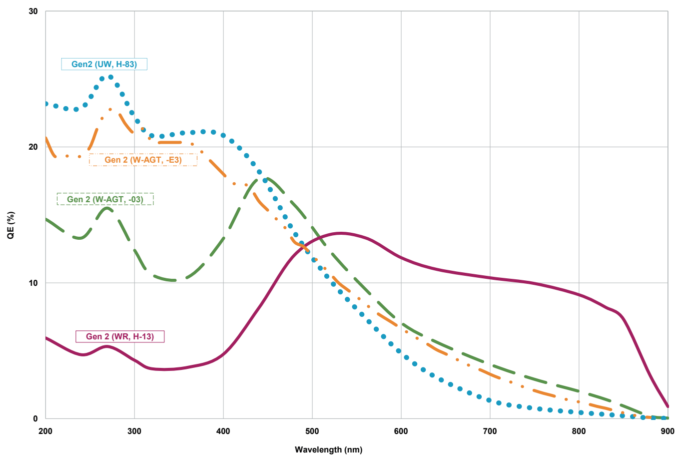
Converts photo-electrons to photons for final detection by CCD.

- Standard P43-type with 2 ms decay time (to 10%).
- Optional faster P46-type with 200 ns decay time (to 10%) available on request for ultra-fast kinetic application

The response of an ICCD is governed by the Quantum Efficiency (QE) of the intensifier tube, which is determined by the combination of the input window and the photocathode. The input window usually determines the lower wavelength limit while the photocathode determines the long wavelength response.

Andor iStar integrates the latest generation of market-leading intensifiers with ultrafast response, high resolution and low-noise multi alkali-based Gen 2 and filmless GaAs-based Gen 3 types, gating down to the nanosecond regime, response from VUV (129 nm) to SWIR (1,100 nm) and peak QE up to 50%.

Gen 2 photocathodes



Gen 3 photocathodes

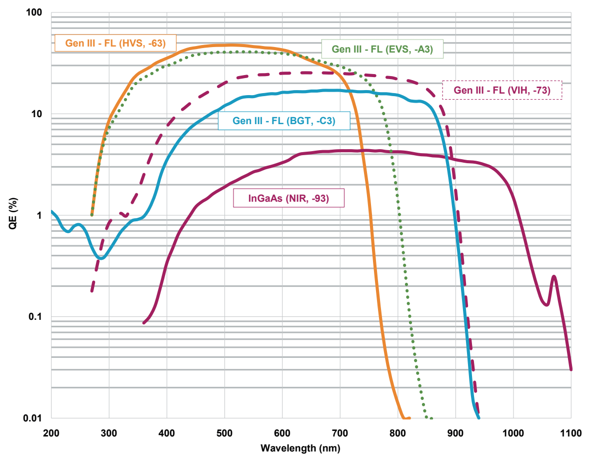
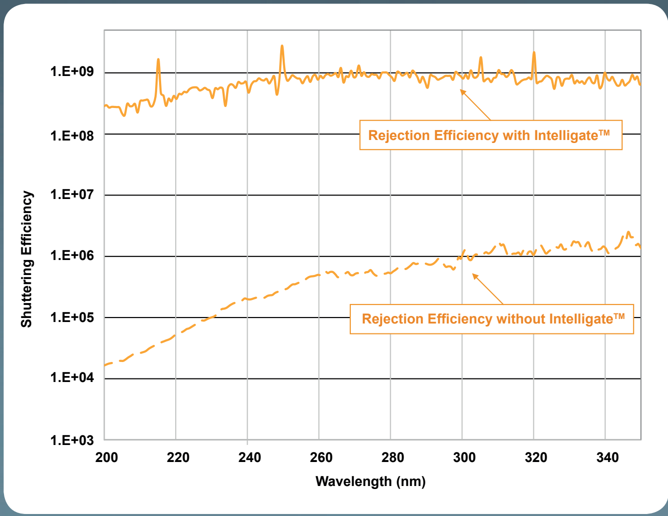


Photo-cathode	Type	Coverage	Peak QE (typical)	Minimum gating speed	Recommendations
-03	Gen 2	180 – 850 nm	18%	< 2 ns	Plasma imaging, LIBS, transient luminescence and absorption, combustion (LIF/PLIF)
-04	Gen 2	180 – 850 nm	18%	< 2 ns	P46 phosphor for ultrafast kinetics
-05	Gen 2	120 – 850 nm	16%	< 5 ns	MgF_2 window for VUV spectroscopy
-13	Gen 2	180 – 920 nm	13.5%	< 50 ns	NIR transient photoluminescence
-63	Gen 3	280 – 760 nm	48%	< 2 ns	Best sensitivity for VIS transient luminescence, plasma studies and photon counting
-73	Gen 3	280 – 910 nm	26%	< 2 ns	Best NIR sensitivity for VIS-IR transient luminescence, plasma studies and photon counting
-83	Gen 2	180 – 850 nm	25%	< 100 ns	Slow transient studies with maximum UV collection
-93	Gen 3	180 – 850 nm	4%	< 3 ns	NIR to IR transient photoluminescence
-A3	Gen 3	280 – 810 nm	40%	< 2 ns	Best sensitivity for VIS-NIR transient luminescence, plasma studies and photon counting
-C3	Gen 3	< 200 – 910 nm	17%	< 3 ns	Broadband UV-NIR transient luminescence and plasma studies
-E3	Gen 2	180 – 850 nm	22%	< 2 ns	Best compromise between high QE in the UV and ns gating - ideal for LIBS, transient luminescence and absorption, plasma studies, combustion (LIF/PLIF)

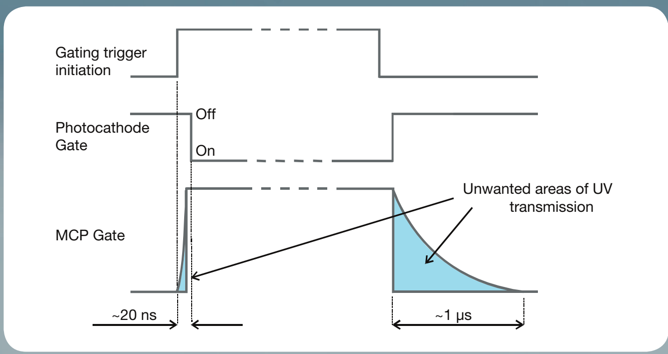
6 Intelligate™: Superior gating in the UV-VUV region

One of the key functions of an image intensifier is to provide high optical shuttering (ON/OFF) ratio.
By switching photocathode voltage to a higher or lower level relative to the MCP voltage, photo-electrons can be either directed towards or repelled from the MCP to avoid detection. ON/OFF values of 1:10^8 are typically measured for Visible/NIR incident light on the photocathode.

However photocathode "leakage" becomes more pronounced in the UV-VUV region (< 300 nm), where more energetic photons have a greater probability to go through the photocathode turned "OFF", reach the MCP to generate an electron that can be detected. This can lead to shuttering efficiency as low as 1:10^4.



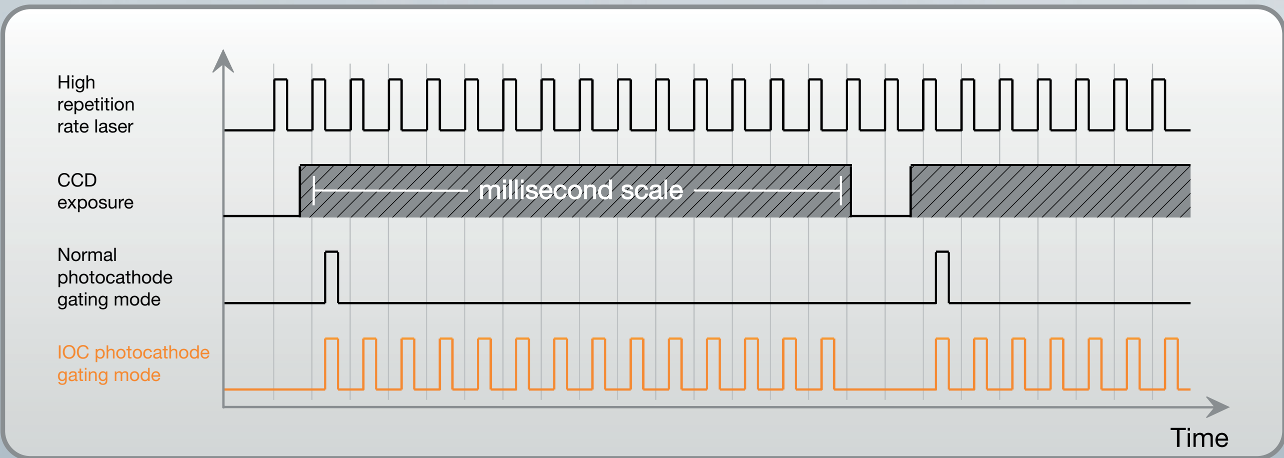
Andor's exclusive Intelligate™ simultaneously gates the photocathode and the MCP. The ultra fast rising edge of the MCP gate pulse switches on the correct potential in a nanosecond timeframe, coinciding precisely with the photocathode gating pulse. This enables ON/OFF ratios as high as 10^8 in the UV-VUV region.



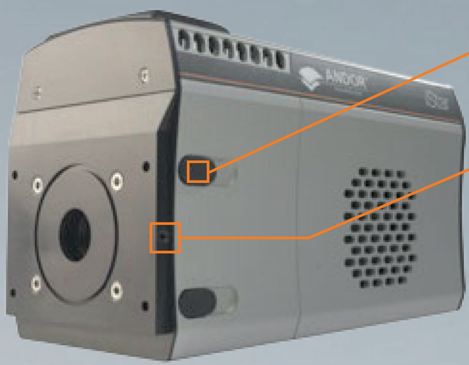
7 Integrate-On-Chip : 500,000 times more signal per 1 s CCD exposure

The iStar's Integrate-On-Chip (IOC) mode enables accumulation of useful signal from laser-induced phenomena at frequencies up to 500 kHz, providing greatly improved signal-to-noise, and minimising experiment time. The latter greatly benefits setups where photobleaching-sensitive biological samples are probed. This translates into the possibility to accumulate 500,000 times more signal per 1 second CCD exposure time.

Integrate-On-Chip is fully software-configurable and can be used through extensive kinetic series involving up to 1,000 pre-programmed incremental delays from laser trigger for unrivalled combination of sensitivity and ultra-precise transient phenomena analysis.



8 Featuring the most comprehensive user-friendly interface on the market



Gate monitor

Located directly beside the image intensifier – provides the most reliable timing information on actual gating occurrence

Dry-gas vortex for efficient EBI reduction

Electron Background Illumination noise (EBI) and shot noise set the ultimate detection limit for ICCDs. EBI is thermally-generated at the photocathode, resulting in the release of unwanted photo-electrons. Andor provides a conveniently located dry gas-purge interface that generates a vortex directly onto the window & photocathode interface, hence greatly improving EBI reduction and detection threshold.

Comprehensive on-board Digital Delay Generator (DDG™)

The iStar integrates the latest generation of ultra low-jitter, ultra-low insertion delay electronics for accurate timing and synchronization of CCD, image intensifier gating and external hardware.

- Gate width and steps setting with 10 ps accuracy
- Fully configurable external trigger, accepting up to 500 kHz rates
- 3 triggering outputs adjustable with 10 ps accuracy
- On-board storage of comprehensive gate delay sequences - for extended kinetic series

Quick-Lock coolant connectors

Convenient 'clic'-type connectors for easy and reliable interfacing.

Direct gate

Allows access to the shortest delay between external source trigger and photocathode opening

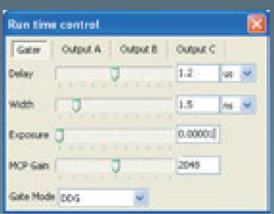
Plug-and-Play USB 2.0

Convenient interface for laptops and integration of multiple cameras on one single computer. Used alongside Andor's fiber-optic-based extender, Andor's iStar can be remotely controlled over distances up to 100 m.

i²c interface

For advanced users requiring more complex setup integration

9 Control at the touch of a button



Solis Software

A unique real-time control interface allows users to minimise setup time by giving permanent on-screen access to all iStar's key functionalities, such as a 12-bit DAC-controlled MCP gain, gate width & delay and three individually configurable output triggers. Used in conjunction with Andor's Shamrock state-of-the-art control interface, Solis allows researchers to truly focus on their own experimental challenges.

Software Development Kit (SDK)

Featuring a comprehensive library of camera & spectrograph controls, ideally suited for complex experiment including 3rd party hardware integration and user specific data analysis protocols.

Available as 32 and 64-bit libraries for Windows (XP, Vista and 7) and Linux, and compatible with C/C++, C#, Delphi, VB6, VB.NET, Labview and Matlab.

10 Seamless integration to Spectroscopy instruments

The iStar provides the most compact platform on the market, seamlessly interfacing to Andor’s range of high-end spectrographs to provide best-in-class, fully integrated, pre-aligned and pre-calibrated detection solutions for the most challenging spectroscopy applications.

The Shamrock 303i, 500i and 750 Czerny-Turner spectrograph feature USB 2.0-controlled, triple grating-based, multi input / output imaging platforms with excellent resolution and multi-track capabilities. The Shamrock 163 is Andor’s most compact research-grade spectrograph for general, everyday lab spectroscopy. It is well suited for applications such as time-resolved luminescence spectroscopy where resolution is not typically a pre-requisite.

andor.com/calculators

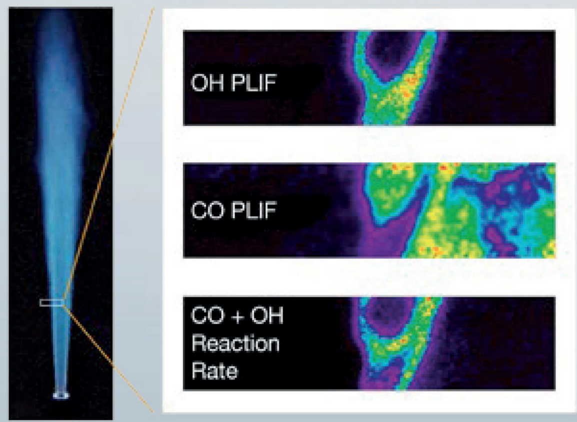
The Mechelle 5000 is Andor’s dedicated detection solution for LIBS, offering a unique combination of 750 nm band-pass with high optical resolution up to 6,000 in one single acquisition.

andor.com/spectroscopy

Imaging setups

Check out Andor’s range of seamlessly integrate-able C-mount and F-mount interfaces and UV-Vis-NIR lenses.

andor.com/lenses



Simultaneous OH PLIF and CO PLIF measurements are used to measure the forward reaction rate $CO + OH \rightleftharpoons CO_2 + H$ in a turbulent methane-air jet flame.

Courtesy of Dr. J. H. Frank abd R. Sigurdsson of Sandia National Laboratories, Livermore, CA and Profe. M. B. Long and S. A. Kaiser of Yale University, New Haven, CT

Application Focus

LIBS: a detection technique for material characterization

Laser-induced breakdown spectroscopy (LIBS) is a technique used routinely for the analysis of the elemental composition of materials.

LIBS is relatively simple to use and allows for rapid, real-time analysis. A pulsed laser is focused down to a high intensity spot on the material where it produces a short-lived high temperature micro-plasma or 'spark' which produces copious amounts of light emission. The atomic line emissions from such plasmas facilitates the identification of the elements within the material. The main components of a LIBS setup includes a pulsed laser, typically an Nd-YAG 1064 nm laser, a spectrograph such as Shamrock 500i with an ICCD, such as iStar DH340T-18U-03, as well as focusing and collection optics and software for control and analysis. LIBS systems can be configured for both the laboratory environment or in the field, including 'stand-off' configurations when working with hazardous materials or in challenging environments.

A key challenge when acquiring 'clean' atomic emission spectra is the rejection of the extremely bright broadband emission which occurs during and just after the laser interaction with the target. Figure 1 shows a series of spectra and images of the plasma captured with varying delay relative to the laser pulse after interaction with a copper target e.g. a 2 pence coin. The early dominance of the broadband emission and the emergence of the atomic emission lines later in time is evident, hence the necessity to control the delay on the order of 10's of ns. Gatewidth of the ICCD was chosen to be 20 ns.

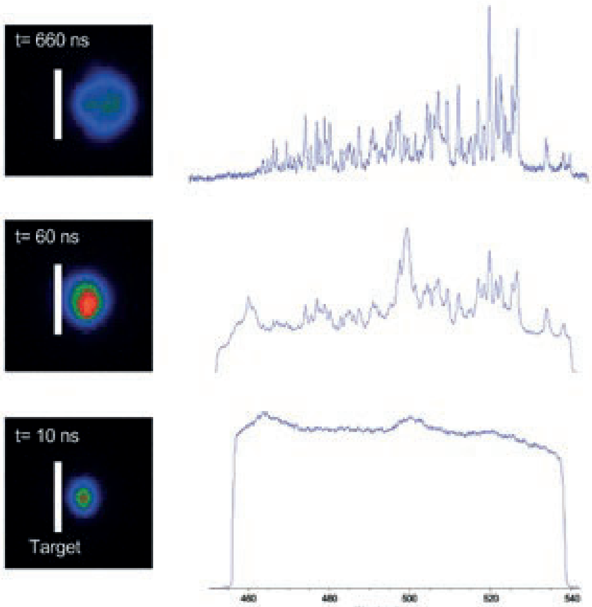


Figure 1: Temporal evolution of a LIBS signal from a copper target.

Time-Resolved Photoluminescence (TR-PL)

TR-PL is a powerful technique for probing the dynamics of excitonic transitions within semiconductor materials such as those used in thin-film based photovoltaics.

Dr Enrico De Como and co-workers at the Ludwig-Maximilians-University Munich, Germany, are using the technique to investigate the efficiency of organic solar cells. Organic solar cells may offer key benefits such as high efficiencies, low costs and ease of production. Such cells typically consist of thin films of conjugated polymer with a fullerene layer. They rely upon photo-induced charge transfer occurring between the light harvesting conjugated polymer and the strong acceptor fullerene layer. The charge transfer excitons (CTEs) formed in this process have a limited lifetime. Photoluminescence from de-excitation of excitons is one of the most important recombination mechanisms that occurs; recombination impacts directly on the efficiency of such structures.

The decay dynamics of the CTE of the cells were investigated by analysing the photoluminescence with an iStar ICCD camera coupled to a Shamrock 500i spectrometer. A pulsed laser (Ti-Sapphire at 540 nm, rep rate 90 kHz) was used to excite the sample and trigger the iStar. Figure 2 shows a kinetic series captured by the DH340T-18U-03 camera of the photoluminescence spectra in the visible region. Each photoluminescence spectrum was aquired with a 5 ns gatewidth and a linear step delay of 5 ns. Signal for each delay was accumulated at the frequency of the laser i.e. 90 kHz. By considering a time slice of integrated intensity through the profiles, the decay characteristics can be plotted and lifetimes determined from power-law models. Decay time between 20 ns and 40 ns were measured during this experiment.

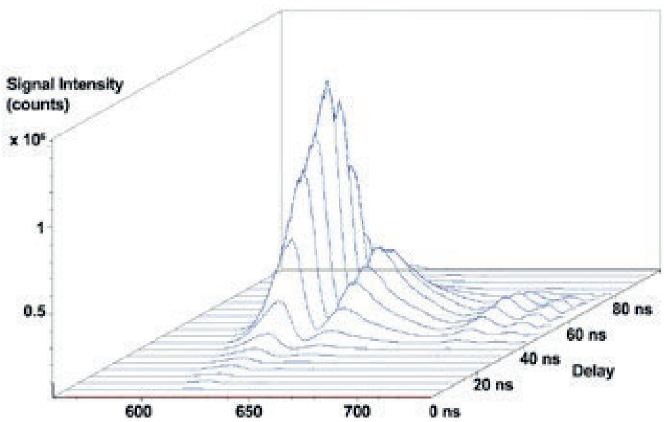


Figure 2: Kinetic series of PL spectra taken with iStar model DH340T-18U-03 mounted on a Shamrock 500i. Laser excitation was from a pulsed laser.

Part Numbers

Cameras

DH312T - 512x512 CCD

DH312T-18F-03	Ø18 mm, Gen 2 Broad, 5 ns, Intelligate
DH312T-18U-03	Ø18 mm, Gen 2 Broad, 2 ns, Intelligate
DH312T-18F-04	Ø18 mm, Gen 2 Broad, 5 ns, P46, Intelligate
DH312T-18U-04	Ø18 mm, Gen 2 Broad, 2 ns, P46, Intelligate
DH312T-18F-05	Ø18 mm, Gen 2 Broad, 10 ns, MgF_2, Intelligate
DH312T-18U-05	Ø18 mm, Gen 2 Broad, 5 ns, MgF_2, Intelligate
DH312T-18H-13	Ø18 mm, Gen 2 Red, 50 ns, Intelligate
DH312T-18F-63	Ø18 mm, Gen 3 Vis, 5 ns, Intelligate
DH312T-18U-63	Ø18 mm, Gen 3 Vis, 2 ns, Intelligate
DH312T-18F-73	Ø18 mm, Gen 3 Nir, 5 ns, Intelligate
DH312T-18U-73	Ø18 mm, Gen 3 Nir, 2 ns, Intelligate
DH312T-18H-83	Ø18 mm, Gen 2 UV, 100 ns, Intelligate
DH312T-18F-93	Ø18 mm, Gen 3 InGaAs, 5 ns, Intelligate
DH312T-18U-93	Ø18 mm, Gen 3 InGaAs, 2 ns, Intelligate
DH312T-18F-A3	Ø18 mm, Gen 3 Vis-Nir, 5 ns, Intelligate
DH312T-18U-A3	Ø18 mm, Gen 3 Vis-Nir, 2 ns, Intelligate
DH312T-18F-C3	Ø18 mm, Gen 3 Nir + UV coating, 5 ns, Intelligate
DH312T-18U-C3	Ø18 mm, Gen 3 Nir + UV coating, 2 ns, Intelligate
DH312T-18F-E3	Ø18 mm, Gen 2 UV, 5 ns, Intelligate
DH312T-18U-E3	Ø18 mm, Gen 2 UV, 2 ns, Intelligate

DH320T - 1024x255 CCD

DH320T-18F-03	Ø18 mm, Gen 2 Broad, 5 ns, Intelligate
DH320T-18U-03	Ø18 mm, Gen 2 Broad, 2 ns, Intelligate
DH320T-18F-04	Ø18 mm, Gen 2 Broad, 5 ns, P46, Intelligate
DH320T-18U-04	Ø18 mm, Gen 2 Broad, 2 ns, P46, Intelligate
DH320T-18F-05	Ø18 mm, Gen 2 Broad, 10 ns, MgF_2, Intelligate
DH320T-18U-05	Ø18 mm, Gen 2 Broad, 5 ns, MgF_2, Intelligate
DH320T-18H-13	Ø18 mm, Gen 2 Red, 50 ns, Intelligate
DH320T-18F-63	Ø18 mm, Gen 3 Vis, 5 ns, Intelligate
DH320T-18U-63	Ø18 mm, Gen 3 Vis, 2 ns, Intelligate
DH320T-18F-73	Ø18 mm, Gen 3 Nir, 5 ns, Intelligate
DH320T-18U-73	Ø18 mm, Gen 3 Nir, 2 ns, Intelligate
DH320T-18H-83	Ø18 mm, Gen 2 UV, 100 ns, Intelligate
DH320T-18F-93	Ø18 mm, Gen 3 InGaAs, 5 ns, Intelligate
DH320T-18U-93	Ø18 mm, Gen 3 InGaAs, 2 ns, Intelligate
DH320T-18F-A3	Ø18 mm, Gen 3 Vis-Nir, 5 ns, Intelligate
DH320T-18U-A3	Ø18 mm, Gen 3 Vis-Nir, 2 ns, Intelligate
DH320T-18F-C3	Ø18 mm, Gen 3 Nir + UV coating, 5 ns, Intelligate
DH320T-18U-C3	Ø18 mm, Gen 3 Nir + UV coating, 2 ns, Intelligate
DH320T-18F-E3	Ø18 mm, Gen 2 UV, 5 ns, Intelligate
DH320T-18U-E3	Ø18 mm, Gen 2 UV, 2 ns, Intelligate
DH320T-25F-03	Ø25 mm, Gen 2 Broad, 3 ns, Intelligate
DH320T-25U-03	Ø25 mm, Gen 2 Broad, 7 ns, Intelligate

DH334T - 1024x1024 CCD

DH334T-18F-03	Ø18 mm, Gen 2 Broad, 5 ns, Intelligate
DH334T-18U-03	Ø18 mm, Gen 2 Broad, 2 ns, Intelligate
DH334T-18F-04	Ø18 mm, Gen 2 Broad, 5 ns, P46, Intelligate
DH334T-18U-04	Ø18 mm, Gen 2 Broad, 2 ns, P46, Intelligate
DH334T-18F-05	Ø18 mm, Gen 2 Broad, 10 ns, MgF_2, Intelligate
DH334T-18U-05	Ø18 mm, Gen 2 Broad, 5 ns, MgF_2, Intelligate
DH334T-18H-13	Ø18 mm, Gen 2 Red, 50 ns, Intelligate
DH334T-18F-63	Ø18 mm, Gen 3 Vis, 5 ns, Intelligate
DH334T-18U-63	Ø18 mm, Gen 3 Vis, 2 ns, Intelligate
DH334T-18F-73	Ø18 mm, Gen 3 Nir, 5 ns, Intelligate
DH334T-18U-73	Ø18 mm, Gen 3 Nir, 2 ns, Intelligate
DH334T-18H-83	Ø18 mm, Gen 2 UV, 100 ns, Intelligate
DH334T-18F-93	Ø18 mm, Gen 3 InGaAs, 5 ns, Intelligate
DH334T-18U-93	Ø18 mm, Gen 3 InGaAs, 2 ns, Intelligate
DH334T-18F-A3	Ø18 mm, Gen 3 Vis-Nir, 5 ns, Intelligate
DH334T-18U-A3	Ø18 mm, Gen 3 Vis-Nir, 2 ns, Intelligate
DH334T-18F-C3	Ø18 mm, Gen 3 Nir + UV coating, 5 ns, Intelligate
DH334T-18U-C3	Ø18 mm, Gen 3 Nir + UV coating, 2 ns, Intelligate
DH334T-18F-E3	Ø18 mm, Gen 2 UV, 5 ns, Intelligate
DH334T-18U-E3	Ø18 mm, Gen 2 UV, 2 ns, Intelligate
DH334T-25F-03	Ø25 mm, Gen 2 Broad, 3 ns, Intelligate
DH334T-25U-03	Ø25 mm, Gen 2 Broad, 7 ns, Intelligate

DH340T - 2048x512 CCD

DH340T-18F-03	Ø18 mm, Gen 2 Broad, 5 ns, Intelligate
DH340T-18U-03	Ø18 mm, Gen 2 Broad, 2 ns, Intelligate
DH340T-18F-04	Ø18 mm, Gen 2 Broad, 5 ns, P46, Intelligate
DH340T-18U-04	Ø18 mm, Gen 2 Broad, 2 ns, P46, Intelligate
DH340T-18F-05	Ø18 mm, Gen 2 Broad, 10 ns, MgF_2, Intelligate
DH340T-18U-05	Ø18 mm, Gen 2 Broad, 5 ns, MgF_2, Intelligate
DH340T-18H-13	Ø18 mm, Gen 2 Red, 50 ns, Intelligate
DH340T-18F-63	Ø18 mm, Gen 3 Vis, 5 ns, Intelligate
DH340T-18U-63	Ø18 mm, Gen 3 Vis, 2 ns, Intelligate
DH340T-18F-73	Ø18 mm, Gen 3 Nir, 5 ns, Intelligate
DH340T-18U-73	Ø18 mm, Gen 3 Nir, 2 ns, Intelligate
DH340T-18H-83	Ø18 mm, Gen 2 UV, 100 ns, Intelligate
DH340T-18F-93	Ø18 mm, Gen 3 InGaAs, 5 ns, Intelligate
DH340T-18U-93	Ø18 mm, Gen 3 InGaAs, 2 ns, Intelligate
DH340T-18F-A3	Ø18 mm, Gen 3 Vis-Nir, 5 ns, Intelligate
DH340T-18U-A3	Ø18 mm, Gen 3 Vis-Nir, 2 ns, Intelligate
DH340T-18F-C3	Ø18 mm, Gen 3 Nir + UV coating, 5 ns, Intelligate
DH340T-18U-C3	Ø18 mm, Gen 3 Nir + UV coating, 2 ns, Intelligate
DH340T-18F-E3	Ø18 mm, Gen 2 UV, 5 ns, Intelligate
DH340T-18U-E3	Ø18 mm, Gen 2 UV, 2 ns, Intelligate
DH340T-25F-03	Ø25 mm, Gen 2 Broad, 3 ns, Intelligate
DH340T-25U-03	Ø25 mm, Gen 2 Broad, 7 ns, Intelligate

Accessories

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^2c to BNC cable for Shamrock shutter control

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Andor has customer support teams located across North America, Asia and Europe, allowing us to provide local technical assistance and advice. Requests for support can be made at any time by contacting our technical support team at andor.com/support.

Andor offers a variety of support under the following format:

- On-site product specialists can assist you with the installation and commissioning of your chosen product
- Training services can be provided on-site or remotely via the Internet
- A testing service to confirm the integrity and optimize the performance of existing equipment in the field is also available on request.

A range of extended warranty packages are available for Andor products giving you the flexibility to choose one appropriate for your needs. These warranties allow you to obtain additional levels of service and include both on-site and remote support options, and may be purchased on a multi-year basis allowing users to fix their support costs over the operating life cycle of the products.

Front page picture: *In situ investigation of the spatial and temporal evolution of C2 in Single-Walled Carbon Nanotubes (SWCNTs) through laser-induced plasma spectroscopy.* Courtesy of Mathew Moodley, CSIR Materials Science and Manufacturing, National Centre for Nano Structured Materials, South Africa

Head Office
7 Millennium Way
Springvale Business Park
Belfast BT12 7AL
Northern Ireland
Tel: +44 (0)28 9023 7126
Fax: +44 (0)28 9031 0792

North America
425 Sullivan Avenue
Suite 3
South Windsor, CT 06074
USA
Tel: +1 860-290-9211
Fax: +1 860-290-9566

Japan
4F TK Sarugakucho Building
2-7-6 Sarugaku-Cho
Chiyoda-Ku
Tokyo 101-0064
Japan
Tel: +81 (0)3-3518-6488
Fax: +81 (0)3-3518-6489

China
Room 1213, Building B
Luo Ke Time Square
No. 103 Huizhongli
Chaoyang District
Beijing 100101
China
Tel: +86 (0)10-5129-4977
Fax: +86 (0)10-6445-5401

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