



Purchase Contract

(hereafter the "**Contract**")

1. CONTRACTUAL PARTIES

1.1 Fyzikální ústav AV ČR, v. v. i.,

with seat: Na Slovance 1999/2, 182 21 Praha 8,
represented by: RNDr. Michael Prouza, Ph.D., Director,
registered in the Register of public research institutions of the Ministry of Education, Youth and
Sports of the Czech Republic.

Bank: [REDACTED]
Account No. IBAN: [REDACTED]; SWIFT (BIC): [REDACTED]
ID No.: 68378271
Tax ID No.: CZ68378271

(hereinafter the "**Buyer**")

and

1.2 OptiXs, s.r.o.,

with seat: Křivoklátská 37/3, 199 00 Praha 9,
represented by: Ing. Aleš Jandík, CEO,
registered at Municipal court in Prague, C212818.

Bank: [REDACTED]
Account No. IBAN: [REDACTED]; SWIFT (BIC): [REDACTED]
ID No.: 02016770
Tax ID No.: CZ02016770

(hereinafter the "**Seller**"),

(the Buyer and the Seller are hereinafter jointly referred to as the "**Parties**" and each of them
individually as a "**Party**").



2. **FUNDAMENTAL PROVISIONS**

- 2.1 The Buyer is a public research institution whose primary activity is scientific research in the area of physics, especially elementary particles physics, condensed systems, plasma and optics.
- 2.2 The Buyer wishes to acquire the subject of performance hereof in order to obtain fluorescence spectra of individual molecules in low temperature (1-4K) UHV STM / AFM instrument, achieving nm to sub-nm spectral resolution in the given range.
- 2.3 The Seller was selected as the winner of a public procurement procedure for the public contract called "**Sensitive CCD camera with spectrograph**" (hereinafter the "**Procurement Procedure**").
- 2.4 The documentation necessary for the execution of the subject of performance hereof consist of
- 2.4.1 Technical specifications of the subject of performance hereof attached as **Annex No. 1** hereto.
- 2.4.2 The Seller's bid submitted within the Procurement Procedure in its parts which describe the subject of performance in technical detail (hereinafter the "**Sellers's Bid**"); the Sellers's Bid forms **Annex No. 2** to this Contract and is an integral part hereof.

In the event of a conflict between the Contract's Annexes the technical specification / requirement of the higher level / quality shall prevail.

- 2.5 The Seller declares that he has all the professional prerequisites required for the supply of the subject of performance under this Contract, is authorised to supply the subject of performance and there exist no obstacles on the part of the Seller that would prevent him from supplying the subject of this Contract to the Buyer.
- 2.6 The Seller acknowledges that the Buyer considers him capable of providing performance under the Contract with such knowledge, diligence and care that is associated and expected of the Seller's profession, and that the Seller's potential performance lacking such professional care would give rise to corresponding liability on the Seller's part. The Seller is prohibited from misusing his qualities as the expert or his economic position in order to create or exploit dependency of the weaker Party or to establish an unjustified imbalance in the mutual rights and obligation of the Parties.
- 2.7 The Seller acknowledges that the Buyer is not in connection to the subject of this Contract an entrepreneur and also that the subject of this Contract is not related to any business activities of the Buyer.
- 2.8 The Seller acknowledges that the production and delivery of the subject of performance within the specified time and of the specified quality, as shown in Annexes No. 1 and 2 of this Contract (including invoicing), is essential for the Buyer.
- 2.9 The Parties declare that they shall maintain confidentiality with respect to all facts and information,



which they learn in connection herewith and / or during performance hereunder, and whose disclosure could cause damage to either Party. Confidentiality provisions do not prejudice obligations arising from valid legislation.

3. SUBJECT-MATTER OF THE CONTRACT

3.1 The subject of this Contract is the obligation on the part of the Seller to deliver and transfer into the Buyer's ownership:

the Sensitive CCD camera with spectrograph

(hereafter the **"Equipment"**)

and the Buyer undertakes to take delivery of the Equipment and to pay to the Seller the agreed upon price.

3.2 The following activities form an integral part of the performance to be provided by the Seller:

3.2.1 Transport of the Equipment incl. all accessories specified in Annexes 1 and 2 of the Contract to the place of delivery, un-packaging and control thereof;

3.2.2 Installation of the Equipment including connection to installation infrastructure at the site;

3.2.3 Execution of the acceptance tests of the Equipment in order to verify its functionality - ie.

- a. functionality of the whole unit consisting of spectrograph and CCD camera, achieving the lowest temperature with water cooling, acquisition of the spectrum of the calibration lamp in the spectral range 400-900 nm, achieving best resolution with the given grid, using ferrule-terminated slit fiber bunches provided on-site,
- b. functionality of single-photon detectors and dark current evaluation;

3.2.4 Delivery of detailed instructions and manuals for operation and maintenance, including list of spare parts, vacuum, gas and electrical connection schemes - all in Czech or English language, in electronic or hardcopy (printed) versions;

3.2.5 Free-of-charge warranty service including service inspections;

3.2.6 Provision of technical support in the form of consultations.

3.3 The subject of performance (Equipment) is specified in detail in Annexes No. 1 and No. 2 hereto.

3.4 The Seller shall be liable for the Equipment and related services to be in full compliance with this Contract, its Annexes and all valid legal regulation, technical and quality standards and that the Buyer will be able to use the Equipment for the defined purpose. In case of any conflict between applicable standards it is understood that the more strict standard or its part shall always apply.



3.5 The delivered Equipment and all its parts and accessories must be brand new and unused.

4. PERFORMANCE PERIOD

4.1 The Seller undertakes to manufacture, deliver, install and handover the Equipment to the Buyer within **15 (fifteen) weeks** of the conclusion of this Contract.

4.2 The Seller shall notify the Buyer of the delivery and installation of the Equipment at least 3 working days in advance.

4.3 The performance period shall be extended for a period during which the Seller could not perform due to obstacles on the part of the Buyer.

5. PURCHASE PRICE, INVOICING, PAYMENTS

5.1 The purchase price is based on the Seller's submitted bid and amounts to **1 710 000,- CZK** (in words: one million seven hundred and ten thousand Czech Crowns) excluding VAT (hereinafter the "**Price**"). VAT shall be paid by the Buyer and settled in accordance with the valid Czech regulation.

5.2 The Price represents the maximum binding offer by the Seller and includes any and all performance provided by the Seller in connection with meeting the Buyer's requirements for the proper and complete delivery of the Equipment hereunder, as well as all costs that the Seller may incur in connection with the delivery, and including all other costs of expenses that may arise in connection with creation of an intellectual property and its protection.

5.3 The Seller is entitled to invoice the Price after the handover protocol in accordance with Section 9.4 will have been signed. In case the Equipment will be delivered with minor defects and / or unfinished work, the Price shall be invoiced after removal of these minor defects and / or unfinished work.

5.4 All invoices issued by the Seller must contain all information required by the applicable laws of the Czech Republic. Invoices issued by the Seller in accordance with this Contract shall contain in particular following information:

5.4.1 name and registered office of the Buyer,

5.4.2 tax identification number of the Buyer,

5.4.3 name and registered office of the Seller,

5.4.4 tax identification number of the Seller,

5.4.5 registration number of the tax document (invoice),

5.4.6 scope of the performance (including the reference to this Contract),



- 5.4.7 the date of the issue of the tax document (invoice),
- 5.4.8 the date of the fulfilment of the Contract,
- 5.4.9 purchase Price,
- 5.4.10 registration number of this Contract, which the Buyer shall communicate to the Seller based on Seller's request before the issuance of the invoice

and must comply with the double taxation agreements, if applicable.

- 5.5 The Buyer prefers electronic invoicing, with the invoices being delivered to efaktury@fzu.cz. All issued invoices shall comply with any international double taxation agreements, if applicable.
- 5.6 Invoices shall be payable within thirty (30) days of the date of their delivery to the Buyer. Payment of the invoiced amount means the date of its remittance to the Seller's account.
- 5.7 If an invoice is not issued in conformity with the payment terms stipulated by the Contract or if it does not comply with the requirements stipulated by law, the Buyer shall be entitled to return the invoice to the Seller as incomplete, or incorrectly issued, for correction or issue of a new invoice, as appropriate, within five (5) business days of the date of its delivery to the Buyer. In such a case, the Buyer shall not be in delay with the payment of the Price or part thereof and the Seller shall issue a corrected invoice with a new and identical maturity period commencing on the date of delivery of the corrected or newly issued invoice to the Buyer.
- 5.8 The Buyer shall be entitled to unilaterally set off any of his payments against any receivables claimed by the Seller due to:
 - 5.8.1 damages caused by the Seller,
 - 5.8.2 contractual penalties.
- 5.9 The Seller shall not be entitled to set off any of his receivables against any part of the Buyer's receivable hereunder.

6. OWNERSHIP TITLE

- 6.1 The ownership right to the Equipment shall pass to the Buyer by handover. Handover shall be understood as delivery and acceptance of the Equipment duly confirmed by Parties on the Handover Protocol in accordance with Section 9.4.

7. PLACE OF DELIVERY AND HANDOVER OF THE EQUIPMENT

- 7.1 The place of delivery and handover of the Equipment shall be the room No. C204.2 in the building C of the Fyzikální ústav AV ČR, v. v. i. at Cukrovarnická 112/10, 162 00 Praha 6, Czech Republic.



8. COOPERATION OF THE PARTIES

- 8.1 The Seller undertakes to notify the Buyer of any obstacles on his part, which may negatively influence proper and timely delivery of the Equipment.
- 8.2 The Seller is obliged to notify the Buyer of the unsuitable condition of the place of delivery and installation.

9. DELIVERY, INSTALLATION, HANDOVER AND ACCEPTANCE

- 9.1 The Seller shall transport the Equipment at his own cost to the place of delivery and handover. If the shipment is intact, the Buyer shall issue delivery note for the Seller.
- 9.2 The Seller shall perform and document the installation of the Equipment at the place of delivery and handover and then launch experimental tests in order to verify whether the Equipment is functional and meets the technical requirements of Annexes No. 1 and 2 hereof.
- 9.3 Handover procedure includes handover of any and all technical documentation pertaining to the Equipment, user manuals and certificate of compliance of the Equipment and all its parts and accessories with approved standards.
- 9.4 The handover procedure shall be completed by handover of the Equipment confirmed by the Handover Protocol containing specifications of all performed tests. The Handover Protocol shall contain the following mandatory information:
 - 9.4.1 Information about the Seller, the Buyer and any subcontractors;
 - 9.4.2 Description of the Equipment including description of all components and their serial numbers;
 - 9.4.3 Description of executed tests according to Section 3.2.3 of the Contract: type of test, duration and achieved parameters;
 - 9.4.4 List of technical documentation including the manuals;
 - 9.4.5 Eventually reservation of the Buyer regarding minor defects and unfinished work including the manner and deadline for their removal and
 - 9.4.6 Date of signature of the Equipment Handover Protocol.
- 9.5 Handover of the Equipment does not release the Seller from liability for damage caused by its defects.
- 9.6 The Buyer shall not be obliged to accept Equipment, which would show defects or unfinished work and which would otherwise not form a barrier, on their own or in connection with other defects, to using the Equipment. In this case, the Buyer shall issue a record containing the reason for his



refusal to accept the Equipment.

- 9.7 Should the Buyer not exercise his right not to accept the Equipment with defects or unfinished work, the Seller and the Buyer shall list these defects or unfinished work in the Handover Protocol, including the manner and deadline for their removal. Should the Parties not be able to agree in the Handover Protocol on the deadline for removal of the defects, it shall be understood that any defects shall be removed / rectified within 10 days from the handover of the Equipment.

10. TECHNICAL ASSISTANCE - CONSULTATIONS

- 10.1 The Seller shall be obliged to provide to the Buyer free-of-charge technical assistance by phone or e-mail relating to the subject-matter hereof during the entire term of the warranty period. The Seller undertakes to provide to the Buyer paid consultations and technical assistance relating to the subject-matter hereof also after the warranty period expires.

11. REPRESENTATIVES, NOTICES

- 11.1 The Seller authorized the following representatives to communicate with the Buyer in all matters relating to the Equipment delivery:

[REDACTED]

- 11.2 The Buyer authorized the following representatives to communicate with the Seller in all matters relating to the Equipment delivery:

[REDACTED]

- 11.3 The above-mentioned contact persons may be changed by an unilateral written declaration of the Party delivered to the other Party.

- 11.4 All notifications to be made between the Parties hereunder must be made out in writing and delivered to the other Party by hand (with confirmed receipt) or by registered post (to the Buyer's or Seller's address), or in some other form of registered post or electronic delivery incorporating electronic signature (qualified certificate) to epodatelna@fzu.cz in case of the Buyer and to info@optixs.cz in case of the Seller.

- 11.5 In all technical and expert matters (discussions on the Equipment testing and demonstration, notification of the need to provide warranty or post-warranty service, technical assistance etc.) electronic communication between technical representatives of the Parties will be acceptable using e-mail addresses defined in Sections 11.1 and 11.2.



12. TERMINATION

- 12.1 This Contract may be terminated early by agreement of the Parties or withdrawal from the Contract on the grounds stipulated by law or in the Contract.
- 12.2 The Buyer is entitled to withdraw from the Contract without any penalty from the Seller in any of the following events:
- 12.2.1 The Seller is in delay with the delivery of the Equipment longer than 2 weeks after the date pursuant to Section 4.1 hereof.
 - 12.2.2 Technical parameters or other conditions required in the technical specification defined in Annexes No. 1 and 2 hereto and in the relevant valid technical standards will not be achieved by the Equipment at acceptance.
 - 12.2.3 The Seller fails to remove the defects or unfinished work in time, pursuant to Section 9.7.
 - 12.2.4 Facts emerge bearing evidence that the Seller will not be able to deliver the Equipment.
- 12.3 The Seller is entitled to withdraw from the Contract in the event of the Buyer being in default with the payment for more than 2 months with the exception of the cases when the Buyer refused an invoice due to defect on the delivered Equipment or due to breach of the Contract by the Seller.
- 12.4 Withdrawal from the Contract becomes effective on the day the written notification to that effect is delivered to the other Party. The Party which had received performance from the other Party prior to such withdrawal shall duly return such performance.
- 12.5 In case of an early termination of the Contract, the Seller shall ensure the removal of the Equipment from the place of performance within 30 days from the date on which the withdrawal from the Contract became effective. The Buyer shall provide the Seller with the necessary cooperation similar to the cooperation within the installation of the Equipment. The costs of removal shall be borne by the Contracting Party which caused the early termination by breach of the Contract.

13. INSURANCE

- 13.1 The Seller undertakes to insure the Equipment against all risks, in the amount of the Price of the Equipment for the entire period commencing when transport of the Equipment starts until duly handed over to the Buyer. In case of breach of this obligation, the Seller shall be liable to the Buyer for any damage that may arise.
- 13.2 The Seller is liable for the damage that he has caused. The Seller is also liable for damage caused by third parties undertaken to carry out performance or its part under this Contract.

14. WARRANTY TERMS

- 14.1 The Seller shall provide warranty for the quality of the Equipment for a period of **12 months**. The



warranty term shall commence on the day following the date of signing of the Handover Protocol pursuant to Section 9.4 hereof. The warranty does not cover consumable things.

- 14.2 The Seller undertakes to provide free service through authorized technicians at the place of performance to the extent specified by the manufacturer for the entire warranty period under this Contract, including repairs, delivery of spare parts, transport and work of an authorized service technician.
- 14.3 Should the Buyer discover a defect, he shall notify the Seller to rectify such defect using the e-mail address: servis@optixs.cz. The Seller is obliged to notify the Buyer without delay about any change of this email address. The Seller shall be obliged to review any warranty claim within 3 business days from its receipt and to propose solution, unless agreed otherwise by the Parties.
- 14.4 During the warranty period the Seller shall be obliged to rectify any claimed defects within 30 days from receipt of the Buyer's notification. In cases of unusual defects, the Seller shall be obliged to rectify the defect in the period corresponding to the nature of the defect and to define the deadline for the handover of the rectified Equipment.
- 14.5 During the warranty period, any and all costs associated with defect rectification / repair including transport and travel expenses of the Seller shall be always borne by the Seller.
- 14.6 The repaired Equipment shall be handed over by the Seller to the Buyer on the basis of a protocol confirming removal of the defect (hereinafter the "**Repair Protocol**") containing confirmations of both Parties that the Equipment was duly repaired and is defect-free.
- 14.7 The repaired portion of the Equipment shall be subject to a new warranty term in accordance with Section 14.1 which commences to run on the day following the date when the Repair Protocol was executed. However, the aggregate warranty period shall not exceed 48 months.
- 14.8 If the Equipment show defects for which it cannot be demonstrably used in full for more than 60 days (defect period) within six or less consecutive months of the warranty period, the Seller is obliged to remove the defect by delivering new Equipment without defect within 30 days from the date of dispatch of the invitation to deliver, unless the Parties agree otherwise.
- 14.9 The Seller declares that he shall ensure paid post-warranty [out-of-warranty] service for the period of 10 years after the expiration of the warranty; the service terms shall be identical to those of Sections 14.3 and 14.4.

15. CONTRACTUAL PENALTIES

- 15.1 The Buyer shall have the right to a penalty in the amount of 0.1 % of the Price for each commenced day of delay with the performance pursuant to Sections 4.1 and 14.8 hereof.
- 15.2 The Buyer shall have the right to a penalty in the amount of 1.500,- CZK for each commenced day of delay with rectifying of defects claimed within the warranty period.



- 15.3 In the event of the Seller's delay in performing the out-of-warranty repair, the Buyer shall be entitled to impose a contractual penalty of 1.000,- CZK for the Seller for each commenced day of delay.
- 15.4 In case of default in payment of any due receivables (monetary debt) under the Contract, the defaulting Buyer or Seller (the debtor) shall be obliged to pay a contractual penalty in the amount of 0.1 % of the owed amount for each commenced day of delay with the payment.
- 15.5 The Buyer shall be entitled to claim a contractual penalty against the Seller in the amount of 30 % of the Price, in case it will subsequently take advantage of the opportunity to withdraw from the Contract pursuant to Section 12.2.1 and 12.2.2.
- 15.6 Contractual penalties are payable within 30 days of notification demanding payment thereof.
- 15.7 Payment of the contractual penalty does not prejudice the rights of the Parties to claim damages.

16. DISPUTES

- 16.1 Any and all disputes arising out of this Contract or the legal relationships connected with the Contract shall be resolved by the Parties by mutual negotiations. In the event that any dispute cannot be resolved by negotiations within sixty (60) days, the dispute shall be resolved by the competent court in the Czech Republic based on application of any of the Parties; the court having jurisdiction will be the court where the seat of the Buyer is located. Disputes shall be resolved exclusively by the law of the Czech Republic.

17. FINAL PROVISIONS

- 17.1 This Contract represents the entire agreement between the Buyer and the Seller. The relationships between the Parties not regulated in this Contract shall be governed by the Act No. 89/2012 Coll., the Civil Code, as amended (hereinafter the "**Civil Code**").
- 17.2 In the event that any of the provisions of this Contract shall later be shown or determined to be invalid, ineffective or unenforceable, then such invalidity, ineffectiveness or unenforceability shall not cause invalidity, ineffectiveness or unenforceability of the Contract as a whole. In such event the Parties undertake without undue delay to subsequently clarify any such provision or replace after mutual agreement such invalid, ineffective or unenforceable provision of the Contract by a new provision, that in the extent permitted by the laws and regulations of the Czech Republic, relates as closely as possible to the intentions of the Parties to the Contract at the time of creation hereof.
- 17.3 This Contract may be changed or supplemented solely by means of numbered amendments in writing, furnished with the details of time and place and signed by duly authorised representatives of the Parties. The Parties expressly reject modifications to the Contract in any other manner.
- 17.4 The Parties expressly agree that the Contract as a whole, including all attachments and data on the Parties, subject-matter of the Contract, numerical designation of this Contract, the Price and the



date of the Contract conclusion, will be published in accordance with Act No. 340/2015 Coll. on special conditions for the effectiveness of some contracts, publication of these contracts and Contract Register, as amended (hereinafter the "**CRA**"). The Parties hereby declare that all information contained in the Contract and its Annexes are not considered trade secrets under § 504 of the Civil Code and grant permission for their use and disclosure without setting any additional conditions.

17.5 The Parties agree that the Buyer shall ensure the publication of the Contract in the Contract Register in accordance with CRA.

17.6 This Contract becomes effective as of the day of its publication in the Contract Register.

17.7 The following Annexes form an integral part of the Contract:

Annex No. 1: Technical specification on the subject of performance

Annex No. 2: Technical description of the Equipment as presented in Seller's bid

17.8 The Parties, manifesting their consent with the entire contents of this Contract, attach their signature hereunder.

In Prague

In Prague

For the Buyer:

For the Seller:

30. 3. 2020

30. 3. 2020

RNDr. Michael Prouza, Ph.D.
Director

Ing. Aleš Jandík
CEO



Annex No. 1 - Technical specification on the subject of performance

The Equipment is a combination of a sensitive CCD camera with high quantum efficiency and low noise for the measurement of weak optical signals and a spectrograph, complemented by a time resolution photon detection system. It must meet the technical conditions and include components listed in this table.

No.	Description and minimum specification of the Equipment as defined by the Buyer	Description and specification of the Equipment offered by the Seller	Complies YES/NO
1	Sensitive CCD camera for photon detection in 400-1000 nm wavelength range		
	Back-illuminated CCD Anti-fringing technology Quantum efficiency at operating temperature (<-90C): > 80% in wavelength range 400-830 nm > 10% at 1000 nm wavelength Typical product readout noise $\leq 5 e^-$ (max. 8) Chip dimensions: height ≥ 6 mm, width ≥ 26 mm 100% fill factor Pixel size at least $20 \times 20 \mu m$ and no more than $30 \times 30 \mu m$ Dark current $< 0.005 e^- / pix/sec$ Thermoelectric water cooling with reachable temperature < -90 C (with coolant $T=15$ C) Cooling water push-in connectors for 6 mm plastic tubes Triggerable exposition by NIM, suitable BNC-terminated trigger cabling Power supply for the camera and thermoelectric cooler Cabling Full camera documentation and test sheet - PDF and printed manual	Back-illuminated CCD Anti-fringing technology Quantum efficiency at operating temperature (<-90C): > 80% in wavelength range 400-830 nm > 10% at 1000 nm wavelength Typical product readout noise $4 e^-$ (max. 8) Chip dimensions: height 6,7 mm, width 26,7 mm 100% fill factor Pixel size $26 \times 26 \mu m$ Dark current $< 0.003 e^- / pix/sec$ Thermoelectric water cooling with reachable temperature < -90 C (with coolant $T=15$ C) Cooling water push-in connectors for 6 mm plastic tubes Triggerable exposition by NIM, suitable BNC-terminated trigger cabling Power supply for the camera and thermoelectric cooler Cabling Full camera documentation and test sheet - PDF and printed manual	YES
2	Spectrograph with direct output to CCD camera		
	Fully compatible with the CCD camera, adapter flange if necessary Focal length 300-350 mm Output: two paths, switchable by a motorized mirror - first output adapted for the CCD camera - second output equipped with manual slit and blanked Input: one path, prepared for exchangeable components - no-slit adapter for 11 mm outer-diameter	Fully compatible with the CCD camera, adapter flange if necessary Focal length 328 mm Output: two paths, switchable by a motorized mirror - first output adapted for the CCD camera - second output equipped with manual slit and blanked Input: one path, prepared for exchangeable components - no-slit adapter for 11 mm outer-diameter	YES



	<p>ferrules, with setscrew</p> <ul style="list-style-type: none"> - optional exchangeable input adapter with a manual slit 20-400um <p>Adaptive focus (by motorized mirrors)</p> <p>Silver-coated optical elements (mirrors) for enhanced QE in infrared region</p> <p>Motorized turret for 4 gratings</p> <p>Full spectrograph documentation and test sheet - PDF and printed manual</p>	<p>ferrules, with setscrew</p> <ul style="list-style-type: none"> - optional exchangeable input adapter with a manual slit 20-400um <p>Adaptive focus (by motorized mirrors)</p> <p>Silver-coated optical elements (mirrors) for enhanced QE in infrared region</p> <p>Motorized turret for 4 gratings</p> <p>Full spectrograph documentation and test sheet - PDF and printed manual</p>	
3	Accessories – silver coated gratings fitting in the turret		
	<p>Grating 150 grooves/mm blaze 800 nm (QE >50% in 500-1000 nm range)</p> <p>Grating 1200 grooves/mm blaze 500 nm (QE >40% in 400-900 nm range)</p>	<p>Grating 150 grooves/mm blaze 800 nm (QE >50% in 500-1000 nm range)</p> <p>Grating 1200 grooves/mm blaze 500 nm (QE >40% in 400-900 nm range)</p>	YES
4	Software		
	<p>Fully-integrated software for coordinated control of the Camera and Spectrograph</p> <p>Software development kit for Labview allowing identical functionality</p> <p>Required functions (for both software and SDK):</p> <ul style="list-style-type: none"> - configurable CCD readout, exposition, averaging parameters, amplification gain, camera timings - triggerable exposition start/end - control of spectrograph mirrors, gratings, focus - spectra acquisition in single, averaging and time-series modes - file saving of the spectra and acquisition parameters (of CCD and spectrograph) in a human-readable and/or publicly documented format - Readout in full-vertical and custom binning modes <p>Programmable I/O: TCP/IP, RS232</p> <p>Full documentation - PDF and printed manual</p>	<p>Fully-integrated software for coordinated control of the Camera and Spectrograph</p> <p>Software development kit for Labview allowing identical functionality</p> <p>Required functions (for both software and SDK):</p> <ul style="list-style-type: none"> - configurable CCD readout, exposition, averaging parameters, amplification gain, camera timings - triggerable exposition start/end - control of spectrograph mirrors, gratings, focus - spectra acquisition in single, averaging and time-series modes - file saving of the spectra and acquisition parameters (of CCD and spectrograph) in a human-readable and/or publicly documented format - Readout in full-vertical and custom binning modes <p>Programmable I/O: TCP/IP, RS232</p> <p>Full documentation - PDF and printed manual</p>	YES
5	Single-photon avalanche photodiode modules for time-resolution measurements		
	<p>Two units of stand-alone photon-detection modules</p> <p>optimized for 400-1000 nm wavelengths</p> <p>quantum efficiency: >40% at 600 nm</p> <p>>25% at 700nm</p> <p>>10% at 800nm</p> <p>Dark count <=25cps</p> <p>Jitter (time resolution) <=50ps FWHM</p>	<p>Two units of stand-alone photon-detection modules</p> <p>optimized for 400-1000 nm wavelengths</p> <p>quantum efficiency: >40% at 600 nm</p> <p>>25% at 700nm</p> <p>>10% at 800nm</p> <p>Dark count <=25cps</p> <p>Jitter (time resolution) <=50ps FWHM</p>	YES



<p>Dead time <80ns Gateable Built-in protection against overexposure After pulse probability max. 3% Active area at least 100x100um² 105um FC/PC fibre coupling (typical NA: 0.22) NIM output standard (digital, negative, 0 to -700mV) NIM-SMA cabling Internal thermoelectric cooling Power supply Full camera documentation and test sheet - PDF and printed manual</p>	<p>Dead time <80ns Gateable Built-in protection against overexposure After pulse probability max. 3% Active area at least 100x100um² 105um FC/PC fibre coupling (typical NA: 0.22) NIM output standard (digital, negative, 0 to -700mV) NIM-SMA cabling Internal thermoelectric cooling Power supply Full camera documentation and test sheet - PDF and printed manual</p>	
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Annex No. 2

The Seller's bid in the extent it describes technical parameters of the Equipment

Technical description

1. Sensitive CCD camera for photon detection in 400-1000 nm wavelength range

CCD sensor Newton 920 (manufacturer Andor) with product number DU920P-BEX2-DD. Modified with quick release connectors for water cooling according to tender requirements.

Detailed specification are in attached datasheet (Newton CCD).

2. Spectrograph with direct output to CCD camera

Spectrograph Kymera 328i (manufacturer Andor) with product number KYMERA-328I-B1-SIL with fixed ferrule adapter for entrance port to use without entrance slit (product number SR-ASM-8001) and ferrule adapter for entrance port to use with entrance slit (product number SR-ASM-8054).

Detailed specification are in attached datasheet (Kymera 328 i).

3. Accessories – silver coated gratings fitting in the turret

Grating turret for Kymera spectrograph with two grating mounted:

Grating 150 grooves/mm blaze 800 nm, silver coated: product number SR-GRT-0150-0800-SIL

Grating 1200 grooves/mm blaze 500 nm, silver coated: product number SR-GRT-1200-0500-SIL

Detailed specification are in attached datasheet (Kymera 328 i).

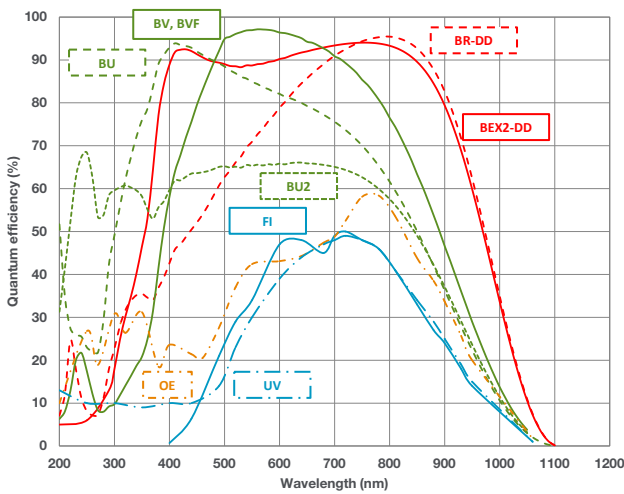
4. Software

Software Solis to control spectrograph Kymera and CCD detector Newton
SDK for Labview

5. Single-photon avalanche photodiode modules for time-resolution measurements

Single photon detector PDM series (manufacturer MPD) with product number \$PD-100-CTE-FC.
NIM – SMA cabling. Power supply.

Detailed specification are in attached datasheet (MPD PMD series).



Available with
Anti-Fringing & **Dual AR**
Back-Thinned Extended Range
Technology



Spectroscopy

Features and Benefits

- **Peak QE up to 95%**
Visible-optimized 'BV/BVF', infrared-optimized 'BR-DD' and broadband UV-NIR 'BEX2-DD' model
- **Fringe suppression technology as standard**
Fringing greatly reduced (Deep-Depletion) or minimized (Back-Thinned 'BVF')
- **Extended range dual-AR option**
Superior UV-NIR broadband QE
- **TE cooling down to -100°C**
Critical for elimination of dark current detection limit - no inconvenience associated with LN₂
- **Ultravac™**
Critical for sustained vacuum integrity and to maintain unequalled cooling and QE performance, year after year
- **Multi-Megahertz Readout**
High repetition rates achievable with low noise electronics
- **Crop Mode Operation**
Up to 1,600 spectra per second rates
- **Single UV-grade fused silica window**
Best UV-NIR throughput performance, specific AR coating and wedge options available
- **Down to 13.5 x 13.5 µm pixels**
Optimized format for high resolution spectroscopy
- **Software-selectable pre-amplifier gain**
Choice of best SNR performance or dynamic range at the touch of a button
- **USB 2.0 connection**
Ideal for laptop operation
Seamless operation alongside USB-based Shamrock spectrograph family
- **Solis software for Spectroscopy**
Comprehensive, user-friendly interface for simultaneous detector & spectrograph control
- **Software Development Kit (SDK)**
Ease of control integration into complex setups: Matlab, Labview, Visual Basic or C/C++

Spectroscopy at Pace

The high-end USB 2.0 Newton CCD series brings together Andor's ultra fast, low-noise electronics platform and market-leading deep thermo-electric cooling to -100°C, complemented by Andor's Ultravac™ technology with its un-matched reliability track record in the scientific and industrial communities.

Broadband detection rates of up to 1,600 spectra per second are enabled with intelligent Crop Mode operation. The Newton CCD is an ideal tool for ultrafast UV, VIS or NIR spectroscopy (or all the above with the Dual AR-coating BEX2-DD technology), such as 2D chemical mapping, online process monitoring or non-invasive medical diagnosis.

The Newton 940 series offers 13.5 x 13.5 µm pixels for the highest UV to VIS resolution spectroscopy, while the 920 series and its 26 x 26 µm offers the highest dynamic range for UV to NIR applications. Both > 6.6 mm high sensors are ideally suited for multi-track spectroscopy or hyper-spectral imaging.

Specifications Summary *1

Active pixels	1024 x 255 (1024 x 256 for Bx-DD model) or 2048 x 512
Pixel size (W x H)	26 x 26 or 13.5 x 13.5 µm
Image area	Up to 27.6 x 6.9 mm
Register well depth:	
Standard mode	1,000,000 e ⁻
High Capacity mode	600,000 e ⁻
High Sensitivity mode	150,000 e ⁻
Maximum cooling	-100°C
Maximum spectra per sec	1,612
Read noise	As low as 2.5 e ⁻
Dark current	As low as 0.0001 e ⁻ /pixel/sec

Key Specifications *1

Model number	DU920P	DU920P Bx-DD	DU940P
Sensor options	<ul style="list-style-type: none"> • BU: Back Illuminated CCD, UV-Enhanced, 350 nm optimized • BU2: Back Illuminated CCD, UV-Enhanced, 250 nm optimized • BVF: Back Illuminated CCD, Vis-optimized and anti-fringing • OE: Open Electrode CCD 	<ul style="list-style-type: none"> • BR-DD: Back Illuminated, Deep Depletion CCD with anti-fringing • BEX2-DD: Back Illuminated, Deep Depletion CCD with anti-fringing, extended range dual AR coating 	<ul style="list-style-type: none"> • BU: Back Illuminated CCD, UV-Enhanced, 350 nm optimized • BU2: Back Illuminated CCD, UV-Enhanced, 250 nm optimized • BV: Back Illuminated CCD, Vis-optimized • FI: Front Illuminated CCD • UV: Front Illuminated CCD with UV coating
Active pixels *2	1024 x 255	1024 x 256	2048 x 512
Pixel size	26 x 26 µm	26 x 26 µm	13.5 x 13.5 µm
Image area	26.7 x 6.7 mm with 100% fill factor	26.7 x 6.7 mm with 100% fill factor	27.6 x 6.9 mm with 100% fill factor
Minimum temperatures *3			
Air cooled		-80°C	
Coolant recirculator		-95°C	
Coolant chiller, coolant @ 10°C, 0.75 l/min		-100°C	
Max spectra per second *4	144 (OE - Full Vertical Bin) 273 (Full Vertical Bin) 1,149 (OE - Crop Mode - 20 rows) 1,612 (Crop Mode - 20 rows)	272 (Full Vertical Bin), 1,587 (Crop Mode - 20 rows)	122 (Full Vertical Bin), 943 (Crop Mode - 20 rows)
System window type	BV, BVF, FI, UV, UVB, OE sensors: UV-grade fused silica, 'Broadband VUV-NIR', unwedged BR-DD sensor: UV-grade fused silica, 'VIS-NIR enhanced', wedged BEX2-DD sensor: UV-grade fused silica, 'Broadband VUV-NIR', wedged (Various AR coatings & MgF ₂ options available)		
Blemish specifications	Grade 1 sensor from supplier. Camera blemishes as defined by Andor Grade A http://www.andor.com/learning-academy/ccd-blemishes-and-non-uniformities-black-pixels-and-hot-pixels-on-a-ccd-sensor		

Advanced Specifications *1

Dark current, e⁻/pixel/sec @ max cooling									
FI, OE, UV	0.0003			-			0.0001		
BU, BU2, BV, UVB	0.0003			-			0.0002		
BVF	0.0002			-			-		
Bx-DD	-			0.003			-		
Register well depth									
Standard mode	1,000,000 e ⁻			1,000,000 e ⁻			-		
High Sensitivity mode	-			-			150,000 e ⁻		
High Capacity mode	-			-			600,000 e ⁻		
Active area pixel well depth *5	BU, BU2, BVF: 400,000 e ⁻ OE: 300,000 e ⁻			650,000 e ⁻			BU, BU2, BV: 100,000 e ⁻ FI, UV: 140,000 e ⁻		
Read noise (e⁻) *6	50 kHz	1 MHz	3 MHz	50 kHz	1 MHz	3 MHz	50 kHz	1 MHz	3 MHz
Standard mode: Typ (Max)	4 (8)	12 (18)	20 (30)	4 (8)	12 (15)	15 (30)	-	-	-
High Sensitivity mode: Typ (Max)	-	-	-	-	-	-	2.5 (4)	7 (12)	11 (15)
High Capacity mode: Typ (Max)	-	-	-	-	-	-	9 (12)	27 (32)	40 (56)
Sensitivity (e⁻/count)									
Standard mode	Adjustable from 2.5 - 10			Adjustable from 2.5 - 10			-		
High Sensitivity mode	-			-			Adjustable from 1 - 4		
High Capacity mode	-			-			Adjustable from 4 - 16		
Linearity *7	Better than 99%								
Digitization	16 bit								
Vertical clock speed *8	Software selectable between 2 - 179 µs								

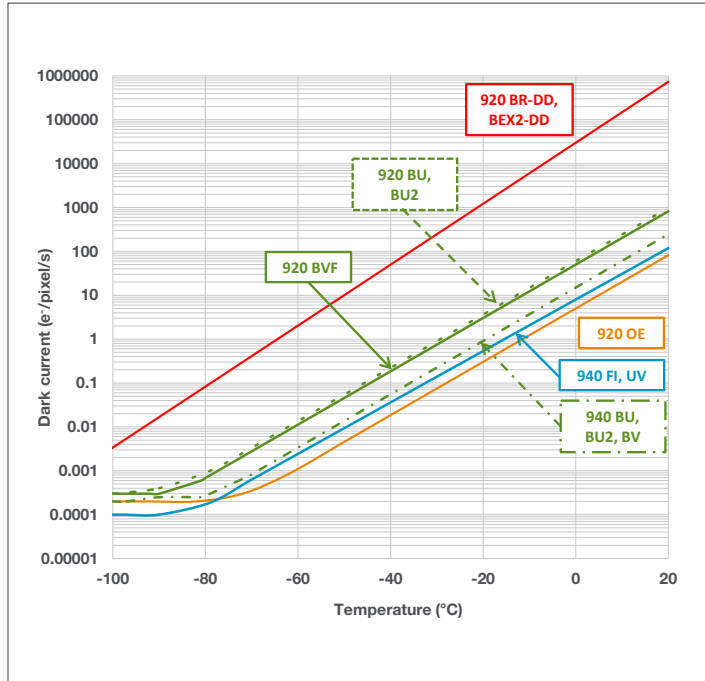
Have you found what you are looking for?

Need to work further into the NIR? The iDus InGaAs series, with up to 1024 pixel linear array with transmission to 2.2 µm.

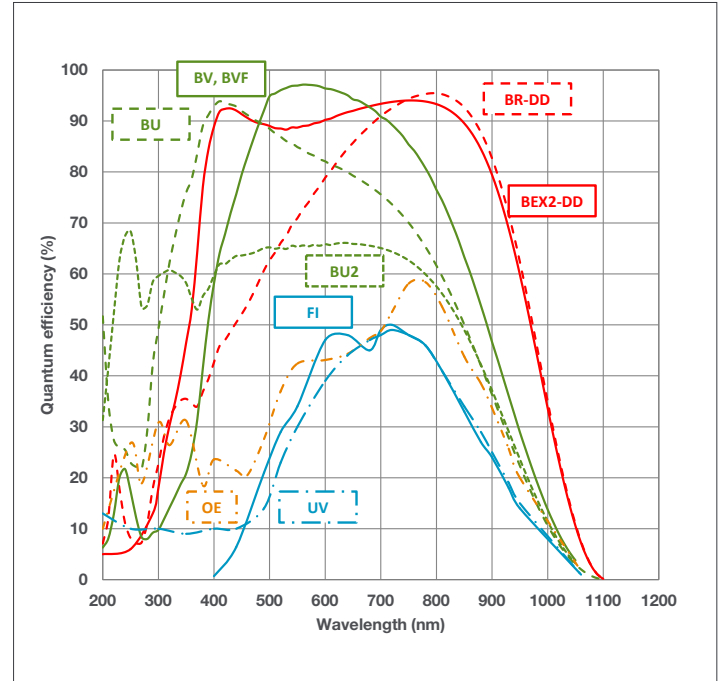
Need a customized version? Please contact us to discuss our Customer Special Request options.

The Newton series combines seamlessly with Andor's research grade Kymera and Shamrock Czerny-Turner spectrographs.

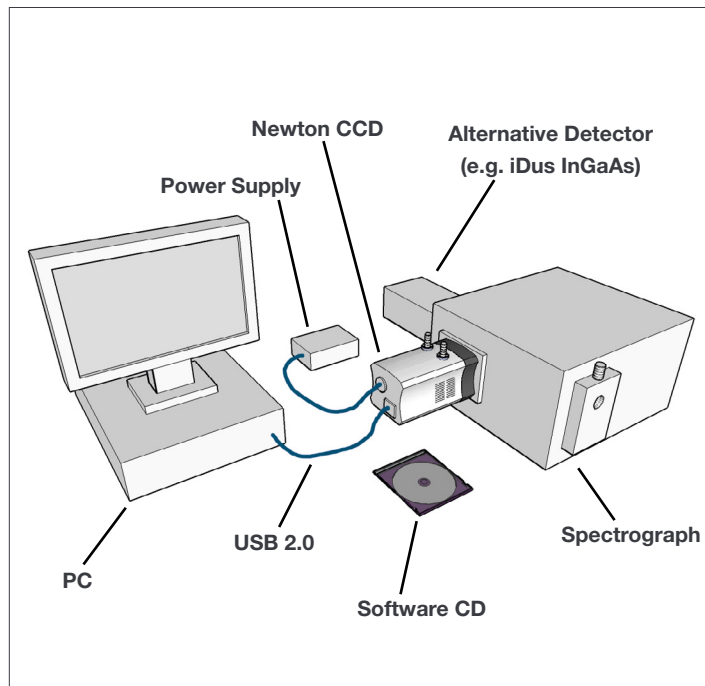
Dark Current ^{*9}



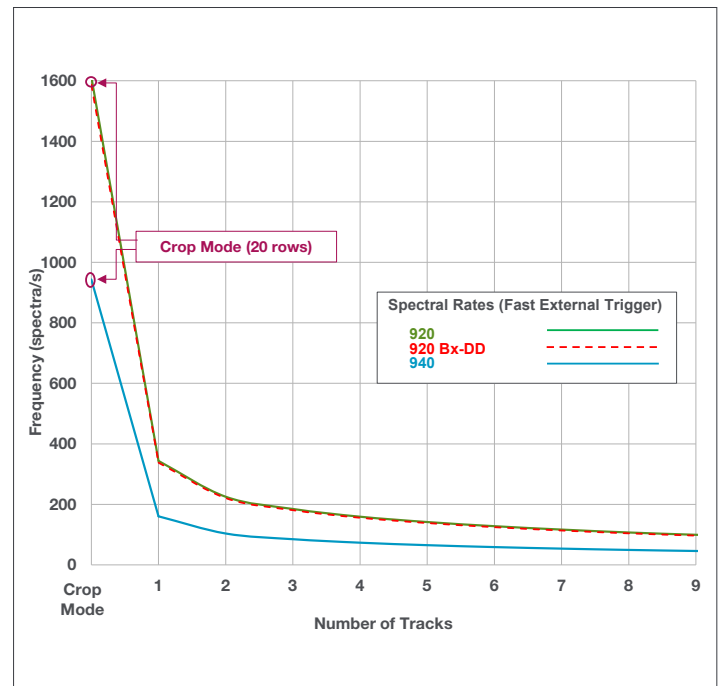
Quantum Efficiency Curves ^{*10} 25°C



Typical Setup



Readout Rate & Speed ^{*11}



Creating the Optimum Product for you



Step 1. Choose the sensor array size

Array Size

Description	Code
1024 x 255 array 1024 x 255 array (BxDD)	920
2048 x 512 array	940

Step 2. Choose the sensor type option

CCD

Sensor Type

Description	Code
Back Illuminated CCD, Vis-optimized	BV
Back Illuminated CCD, Vis-optimized and anti-fringing	BVF
Back Illuminated, Deep Depletion CCD with fringe suppression and extended range dual AR coating	BEX2-DD
Back Illuminated, Deep Depletion CCD with fringe suppression	BR-DD
Front Illuminated CCD	FI
Back Illuminated CCD, Blue optimized AR coating	BU
Back Illuminated CCD, AR coated for optimized performance in the 250 nm region	BU2
Front Illuminated CCD with UV coating	UV
Open Electrode CCD	OE

Step 3. Select an alternative camera window (optional)

Camera Window

The standard window has been selected to satisfy most applications. However, other options are available. The alternative camera window code must be specified at time of ordering.

To view and select other window options please refer to the '[Camera Windows Supplementary Specification Sheet](#)' which gives the transmission characteristics, product codes and procedure for entering the order. Further detailed information on the windows can be found in the Technical note – '[Camera Windows: Optimizing for Different Spectral Regions](#)'.

Step 4. Select the required accessories and adapters

Accessories & Adapters

Description	Order Code
Coolant re-circulator for enhanced cooling performance	XW-RECR
Oasis 160 Ultra Compact Chiller Unit (tubing to be ordered separately)	ACC-XW-CHIL-160
6 mm tubing options for ACC-XW-CHIL-160 (2x2.5 m or 2x5 m lengths)	ACC-6MM-TUBING-2X2.5/ ACC-6MM-TUBING-2X5M
C-mount lens adaptor	LM-C
F-mount lens adaptor	LM-NIKON-F
Nikon F-mount lens adaptor with shutter	LMS-NIKON-F-NS25B
Shutter Driver for NS25B Bistable Shutter (<u>not</u> needed for Kymera/Shamrock spectrographs)	ACC-SD-VED24
Bistable Shutter, Standalone (<u>not</u> needed for Kymera/Shamrock spectrographs)	ACC-SHT-NS25B

Spectrograph Compatibility

The Newton series is fully compatible with Andor's Kymera and Shamrock spectrographs (163 - 750 nm focal lengths). Spectrograph mounting flanges and software control are available for a wide variety of 3rd party spectrographs including, McPherson, JY/Horiba, PI/Acton, Chromex/Bruker, Oriol/Newport, Photon Design, Dongwoo, Bentham, Solar TII and others.

Step 5. Select the required software

Software

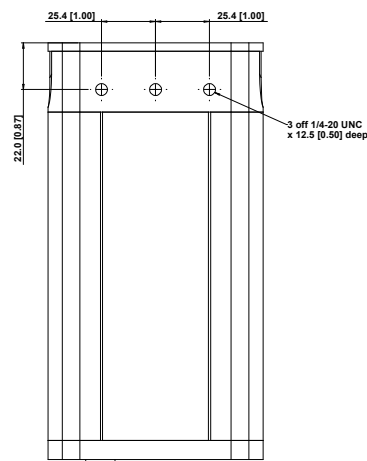
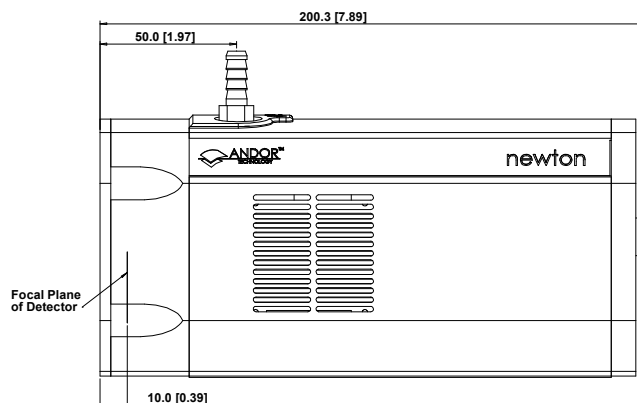
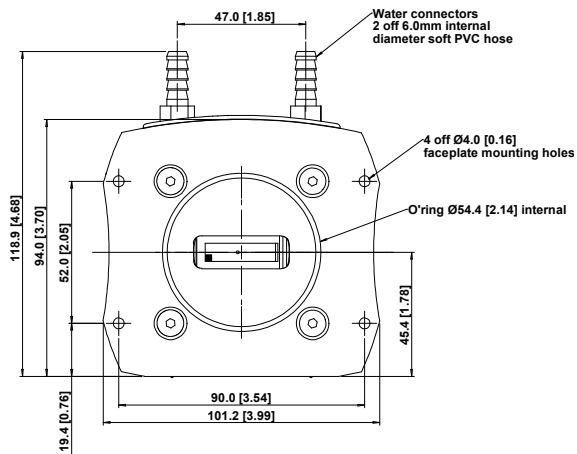
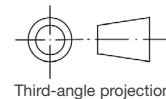
The Newton CCD requires at least one of the following software options:

Solis for Spectroscopy A 32-bit and fully 64-bit enabled application for Windows (7, 8, 8.1 and 10) offering rich functionality for data acquisition and processing. AndorBasic provides macro language control of data acquisition, processing, display and export. Control of Andor Kymera and Shamrock spectrographs and a very wide range of 3rd party spectrographs is also available, see list in step 4 above.

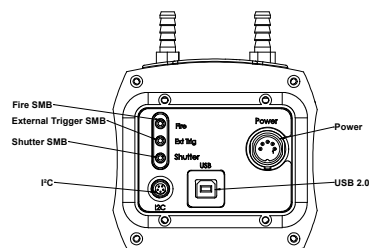
Andor SDK A software development kit that allows you to control the Andor range of cameras from your own application. Available as 32/64-bit libraries for Windows (7, 8, 8.1 and 10) and Linux. Compatible with C/C++, C#, Delphi, VB.NET, LabVIEW and Matlab.

Product Drawings

Dimensions in mm [inches]



Mounting hole locations



Rear connector panel

■ = position of pixel 1,1

Weight: 2.7 kg [5 lb 15 oz]

Connecting to the Newton

Camera Control

Connector type: USB 2.0

TTL / Logic

Connector type: SMB, provided with SMB - BNC cable

1 = Fire (Output), 2 = External Trigger (Input), 3 = Shutter (Output)

I²C connector

Compatible with Fischer SC102A054-130

1 = Shutter (TTL), 2 = I²C Clock, 3 = I²C Data, 4 = +5 Vdc, 5 = Ground

Minimum cable clearance required at rear of camera

90 mm

Applications Guide

	BU/ BU2 models	BV models	BVF models	BR-DD models	BEX2-DD models	FI models	OE models	UV models
Absorption/Transmittance/Reflection	○	●	●	○	○	○	○	○
Atomic Emission Spectroscopy	○	●	●	○	○	○	○	○
Fluorescence & Luminescence	○	●	●	○	○	○	○	○
NIR Spectroscopy				●	○	○	○	○
Raman Spectroscopy (244 – 488 nm)	●	○	○				○	○
Raman Spectroscopy (514, 531, 633 nm)	○		●	○	○	○	○	○
Raman Spectroscopy (785, 830 nm)				●	○	○	○	○
UV-VIS-NIR broadband spectroscopy					●		○	○

○ = Suitable

● = Optimum



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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

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Fax +81 (3) 6732 8939

North America

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

China

Beijing
Phone +86 (10) 8271 9066
Fax +86 (10) 8271 9055

Items shipped with your camera:

- 1x 2m BNC - SMB connection cable
- 1x 3m USB 2.0 cable Type A to Type B
- 1x Set of hex keys (7/64", 3/32" & 3 mm)
- 1x Power supply with mains cable
- 1x CD containing Andor user guides
- 1x Individual system performance booklet
- 1x CD containing either Solis software or SDK (if ordered)

Footnotes: Specifications are subject to change without notice

1. Figures are typical unless otherwise stated.
2. Edge pixels may exhibit a partial response.
3. Cooling is provided by the use of an external mains driven power supply. Minimum temperatures listed are typical values with ambient temperature of 20°C. Systems are specified in terms of minimum dark current achievable rather than absolute temperature.
4. Based on horizontal pixel readout rate of 3 MHz and a vertical shift speed of 12.9 μ s (920 models), 14.5 μ s (940 models) and 25.7 μ s (OE model). Achievable spectral rates will vary with selected trigger mode. Due to the nature of the Open Electrode sensor, the minimum Vertical Shift Speed (VSS) available is 25.7 μ s, which will produce a lower maximum spectral rate compared to other models in the series.
5. Shown for High Capacity mode. For high sensitivity mode the measurable well depth value will be lower, as a result of the combination of higher sensitivity values and A/D 16 bits digitization.
6. Readout noise is for the entire system. It is a combination of CCD readout noise and A/D noise. Measurement is for Single Pixel readout with the CCD at a temperature of -80°C and minimum exposure time under dark conditions. Noise values will change with readout mode.
7. Linearity is measured from a plot of counts vs exposure time under constant photon flux up to the saturation point of the system.
8. Vertical speeds are software selectable. All sensors are designed to give optimum Charge Transfer Efficiency (CTE) at 12.9 μ s (920 models), 14.5 μ s (940 models) and 25.7 μ s (OE model) vertical pixel shift, some decrease in CTE may be observed at faster shift speeds.
9. The graph shows typical dark current level as a function of temperature. The dark current measurement is averaged over the CCD area excluding any regions of blemishes.
10. Quantum efficiency of the sensor as supplied by the sensor manufacturer
11. The chart shows the maximum possible readout rates available when using Multi-track mode, each track being defined as 20 rows. Crop mode is a specific single-track readout method optimized for rapid kinetic-type acquisition.



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 (7, 8, 8.1 and 10) or Linux

Operating & Storage Conditions

- Operating Temperature: 0°C to 30°C ambient
- Relative Humidity: < 70% (non-condensing)
- Storage Temperature: -25°C to 50°C

Power Requirements

- 100 - 240 VAC, 50 - 60 Hz
- Power consumption: 48W max



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.

NEW Kymera 328i

Imaging spectrograph

Intelligent and multi-modal spectroscopy platform for **Physical** and **Life** science

Key Features

- ✓ Adaptive Focus (patented)
- ✓ Quad grating turret & eXpressID™
- ✓ Dual input and dual outputs
- ✓ TruRes™ spectral resolution enhancement
- ✓ μ -Manager software for microspectroscopy

Key Applications

- ✓ Raman
- ✓ Luminescence
- ✓ LIBS
- ✓ Absorption
- ✓ SHG and SFG
- ✓ Transient spectroscopy
- ✓ Microspectroscopy
- ✓ Material Science
- ✓ Chemistry
- ✓ Biomedical
- ✓ Plasma Studies



1 Adaptive Focus*

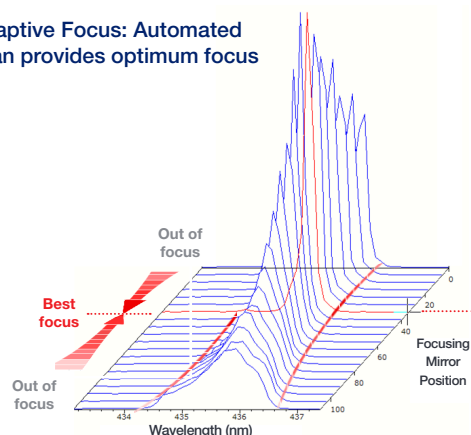


Automated optimization for the best quality of focus:

- Ensures the best resolution at any wavelength
- Automatic optimization when changing between gratings, or cameras
- Software-controlled, easy to switch on and off when required
- No need for tedious adjustment of camera position at the exit ports

*Adaptive Focus Technology, patent WO2016012794 A3

Adaptive Focus: Automated scan provides optimum focus



2 TruRes™

True spectral resolution enhancement option

- **Better than 30% spectral resolution improvement** without the need to change grating or slit width
- Expands the range of spectral resolutions accessible on a single setup at the touch of a button
- Superior discrimination of complex spectral features from UV to SWIR
- No mathematical spectral deconvolution required

3 Quad Turret with RFID



Expand your system's flexibility

Combine up to 4 gratings for greater flexibility in one single setup:

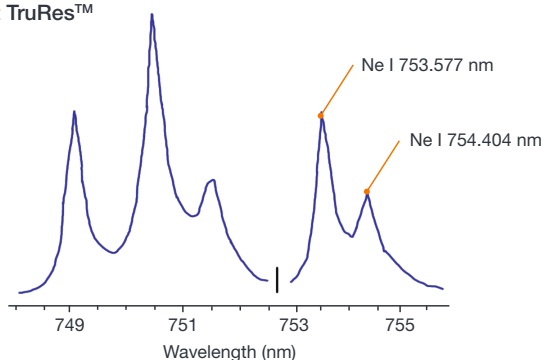
- Spectral resolution: Choice of high, medium or low options
- Blaze: Choice of UV, Visible, NIR or SWIR options
- Mirror for microspectroscopy



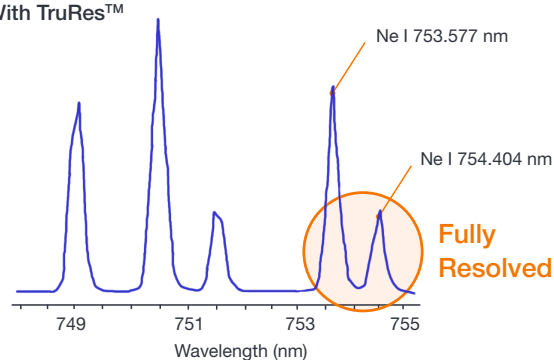
eXpressID™: RFID –based intelligence ensures automatic recognition and upload of all important turret parameters to the spectrograph.

TruRes™: Delivers enhanced spectral resolution

Without TruRes™



With TruRes™



Kymera 328i with 300 l/mm grating, iVac 316 with high resolution 15 µm pixels, full vertical binning.

4 Dual Input and Output Options



Convenient interfacing to complex experiments with multiple light paths, greatly minimizes switching time between setups.

Dual port setups include various combinations of:

- CCD cameras for UV, Vis and NIR spectroscopy
- ICCD cameras for time-resolved measurements from UV to NIR
- Exit slits for monochromator tunable light source
- Fibre coupling at exit port to deliver output light/signal to another part of experiment



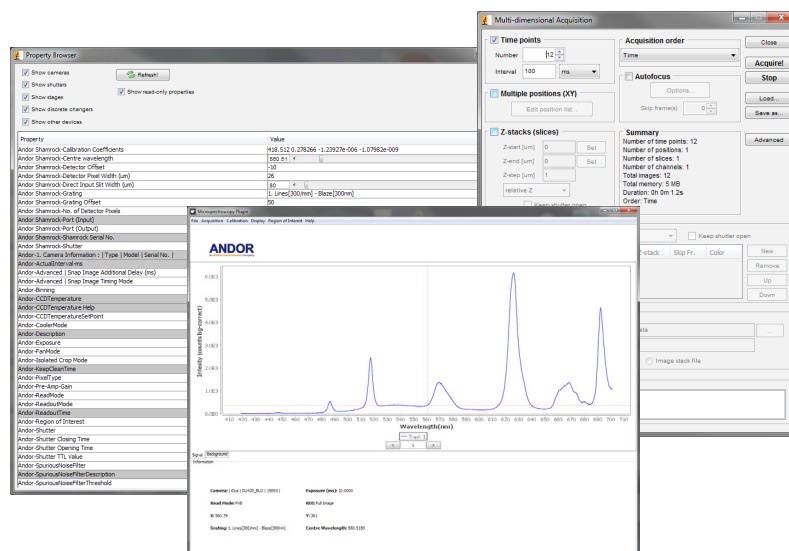
Features and Benefits

Feature	Benefit
328 mm focal length, F/4.1 aperture	Ideal combination for a wide range of applications ranging from luminescence/ photoluminescence spectroscopy to more demanding, higher resolution Raman spectroscopy or plasma studies.
Adaptive Focus (patented)	Intelligent and user-friendly interface for uncompromised spectral resolution performance.
TruRes™	Intuitive, rapid and fully user-controlled option for greater than 30% true spectral resolution enhancement at the touch of a button. Enhance the discrimination power of your spectrograph without tedious grating or grating turret change.
Quad-grating turret with eXpressID™ RFID technology	Seamless field-upgradability with precise indexing interface and user-friendly hatch access. Automatic gratings recognition with embedded RFID tags - minimum user interaction. Maximum resolution and band-pass flexibility.
Astigmatism-corrected optical design	Toroidal optics enable multi-track fiber detection and excellent sample image relay from a microscope at the grating '0' order.
Robust on-axis wavelength drive	High accuracy direct-drive delivers superb single-grating and grating-to-grating center wavelength repeatability down to 4 and 10 pm respectively.
Dual outputs	Extended wavelength coverage when combining Andor UV-NIR CCD, EMCCD, ICCD and InGaAs cameras. Slit option for monochromator operation.
Dual input ports	Great setup flexibility for complex, multi-samples or multi-light path experiments based on spectroscopy modalities combining for example Raman, Fluorescence, Optical Emission Spectroscopy (OES), Absorption or Second Harmonic Generation (SHG).
USB interface	Plug-and-play connectivity, ideal for laptop operation alongside Andor USB cameras.
Seamless connection to microscopes	Adjustable height feet and choice of direct, lens relay, or cage system-based interfaces. 15 mm wide-aperture input slit for extended sample image relay and spectral analysis through the same optical path.
Protected silver-coated optics option	Most efficient for NIR/SWIR detection when used in conjunction with Andor InGaAs cameras.
Pre-aligned, pre-calibrated instrument	Individually characterized spectrograph-detector systems for out-of-the box operation.
High repetition rate shutter	10 Hz continuous operation and 40 Hz burst mode for ultrafast acquisition.
µ-Manager software integration	Simultaneous control of Andor cameras, spectrographs and a wide range of microscopes and accessories through 1 single software platform. Dedicated, user-friendly spectrum handling interface.
Monochromator capabilities	Extract best optical resolution while allowing use of single point detectors with sensitivity up to 12 µm (Labview SDK-based solution only).
Integrated in EPICS *20	Integration and operation at EPICS-based large research facilities.

µ-Manager and Microspectroscopy

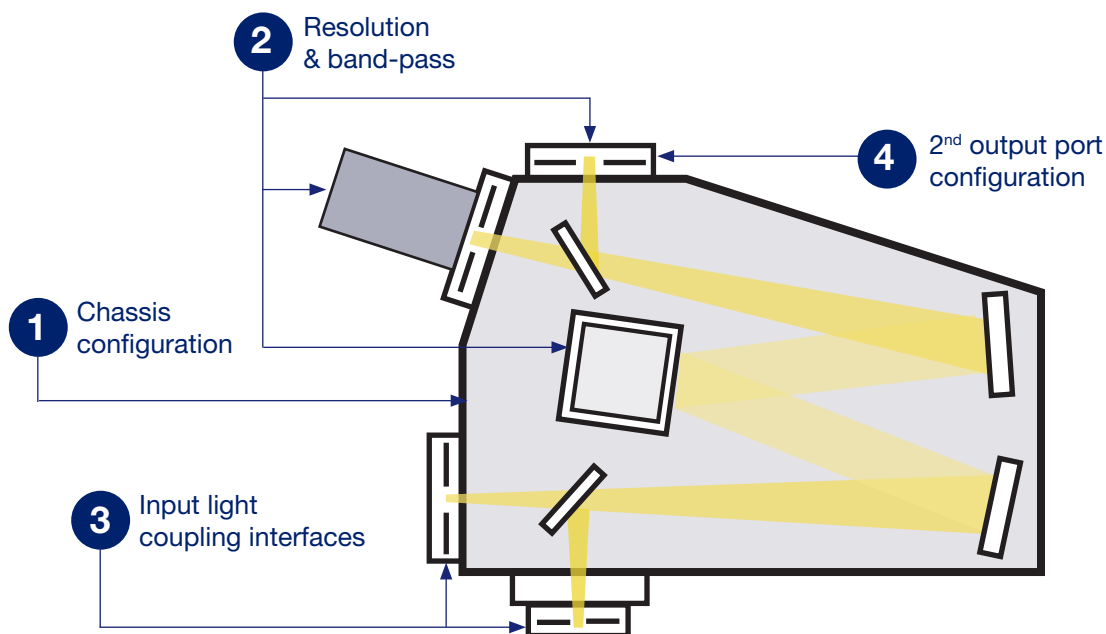
User-friendly simultaneous access to Andor Kymera spectrographs, low-light spectroscopy cameras and a wide range of microscopes and microscope accessories.

Andor's dedicated interface allows seamless spectral acquisition, display and manipulation, as well as facilitating 'spectral' mapping sequences with advanced metadata handling.



Step-by-Step System Configuration

How to customize the Kymera 328i:



1 Chassis configuration

- Select combination of input and output ports (see page 5 for available options).
- Select type of optics coating required (aluminium + MgF_2 is standard, protected silver-coated optics available on request for NIR detection).
- Select purge port option (for improved detection down to 180 nm). Shutter for background acquisition and protection of the detector.

2 Resolution & band-pass

Select gratings and detector to fulfil resolution and wavelength requirements.

3 Input light coupling interface

Refer to accessory tree for available configurations (direct coupling, fibre coupling or 3rd party hardware connectivity).

4 2nd exit port configuration

Refer to accessory tree for available configurations, including camera flanges.

5 Software interface

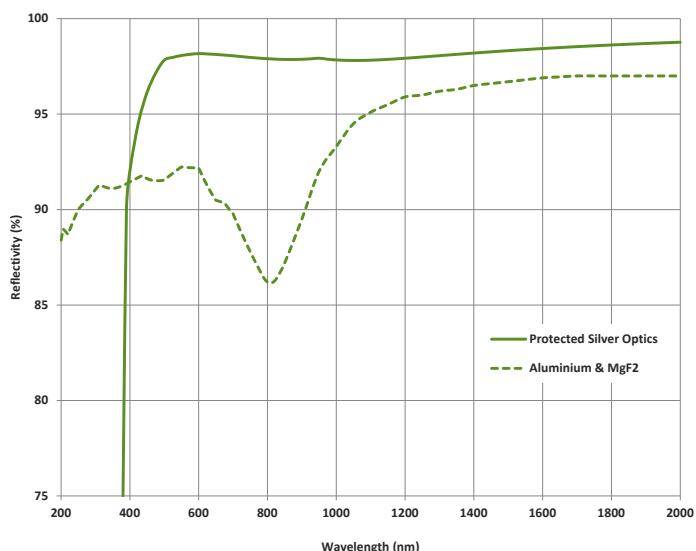
Select either state-of-the-art Solis software or Software Development Kit (SDK) option – please refer to the appropriate section for further information.

Step 1 - Chassis Configuration

Ordering Information

Model	Side input port	Direct input port	Direct output port	Side output port	Motorized port selection
KYMER-328i-A	Manual slit	-	Camera	-	-
KYMER-328i-B1	Manual slit	-	Camera	Manual slit	√
KYMER-328i-B2	Manual slit	-	Camera	Camera	√
KYMER-328i-C	Manual slit	Manual slit	Camera	-	√
KYMER-328i-D1	Manual slit	Manual slit	Camera	Manual slit	√
KYMER-328i-D2	Manual slit	Manual slit	Camera	Camera	√
KYMER-328i-xx-SIL	Protected silver-coated optics options for models shown above (replace x with relevant model number)				

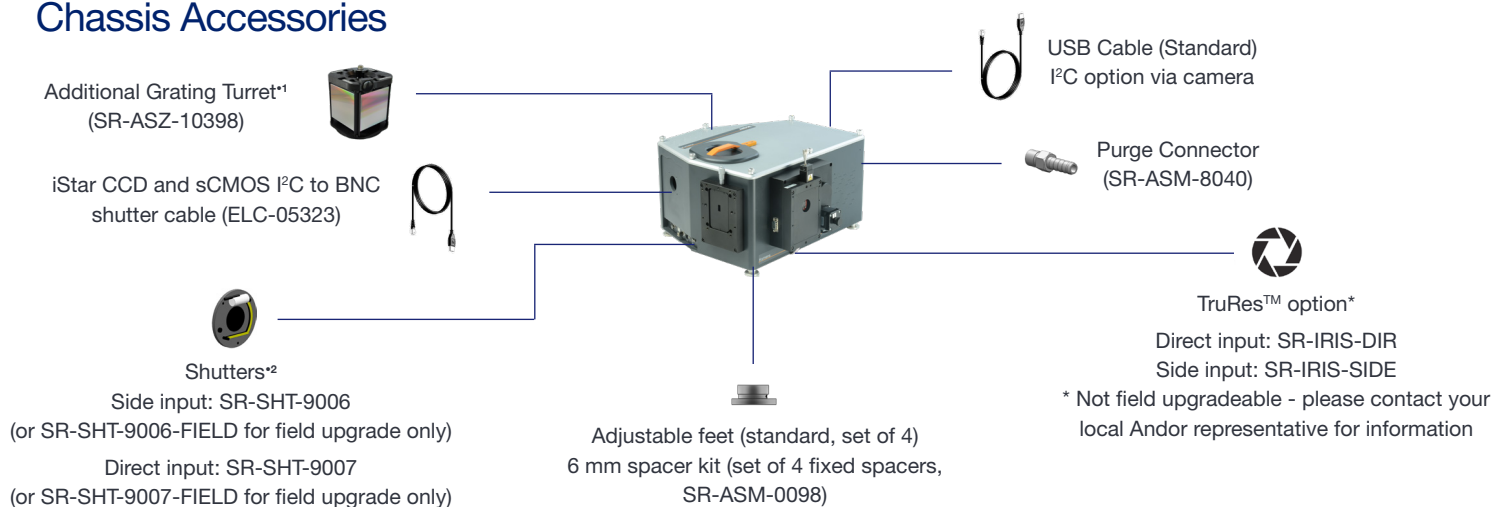
Optical Coatings Reflectivity Graph



Standard systems use Al + MgF₂ coated optics. Protected silver optics are also available on request for maximum efficiency in the NIR region - recommended for working with Andor iDus InGaAs detectors or IR single-point detectors, such as MCT, PbS and InSb.

When choosing protected silver coatings, it is strongly recommended to also order **protected silver-coated gratings** for maximum efficiency throughout the system.

Chassis Accessories



Nominal optical height	Optical height adjustment range	Adjustable feet set
142.6 mm	142.6 – 148.6 mm (standard feet)	SR-ASM-0098: 6 mm spacer set

Step 2a - Choosing The Right Platform vs Dispersion Requirements



Resolution calculator

andor.com/calculators

Green

Aberration-free region

Orange

Possible impact on system resolution

Red

Likely impact on system resolution

Czerny-Turner spectrographs are designed to provide the best optical performance for a range of grating angles as reflected on the green parts of the graph above. Outside this range, the spectral lines may exhibit a degree of optical aberration (such as coma), which will become more prominent at the steeper angles. These configurations are reflected by the orange to red scales on the graph. In these regions, consideration should be given to higher spectrograph focal length models with lower groove density gratings to achieve the desired resolution.

	Grating (1/mm)					
	150	300	600	1200	1800 (Holo)	2400 (Holo)
Kymera 193i						
Bandpass (nm) ^{*3,5}	902	445	215	98	56	46 ^{*6}
Resolution (nm) ^{*4,5}	1.96	0.96	0.47	0.21	0.12	0.10 ^{*6}
NEW Kymera 328i						
Bandpass (nm) ^{*3,5}	542	268	131	61	41	29 ^{*6}
Resolution (nm) ^{*4,5}	0.88→0.62	0.44→0.31	0.21→0.15	0.10→0.07	0.06→0.04	0.05→0.04 ^{*6}
Shamrock 500i						
Bandpass (nm) ^{*3,5}	357	177	86	40	26	19 ^{*6}
Resolution (nm) ^{*4,5}	0.52	0.26	0.13	0.06	0.04	0.03 ^{*6}
Shamrock 750						
Bandpass (nm) ^{*3,5}	242	120	59	28	18	14 ^{*6}
Resolution (nm) ^{*4,5}	0.35	0.18	0.09	0.04	0.03	0.02 ^{*6}

Where aberration is a concern for a particular experimental set-up, the table above shows resolution and band-pass performance for a variety of alternative configurations. This should be used in conjunction with the graph above to assist in selecting the most appropriate spectrograph platform to meet resolution and band-pass needs, whilst minimising the risk of potential aberration.

Step 2b - Choosing The Right Grating vs Resolution and Band-pass

The Kymera 328i features an on-axis, quadruple grating turret, designed to offer flexibility and control over your choice and interchange of gratings. The 'Quad' grating turret can be easily and speedily removed, and replaced by an alternative turret with new gratings. The intelligent design of the 328i with xPressID™ RFID technology, means that only a simple offset adjustment is required once the new turret and gratings are added. The 328i is shipped with the grating turret already in place, ensuring your system is ready for use straight out of the box. Additional grating turrets are available with up to four pre-installed gratings (see below for details). If the grating you require is not on the list, please contact Andor for further details. Additional grating turrets (part number SR-ASZ-10398) can also be supplied on request.



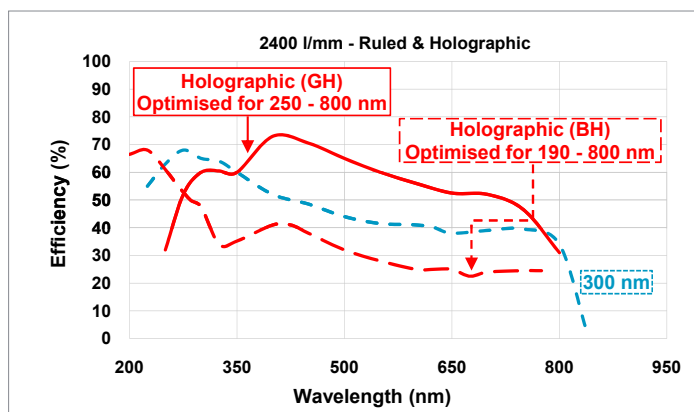
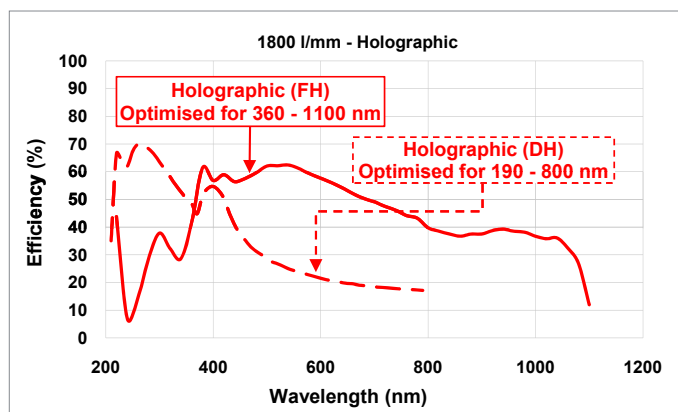
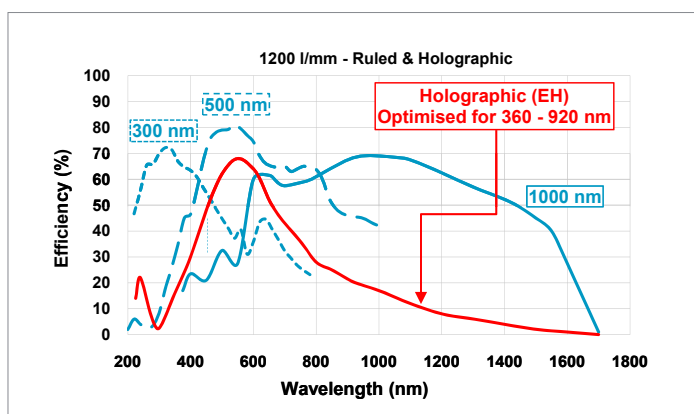
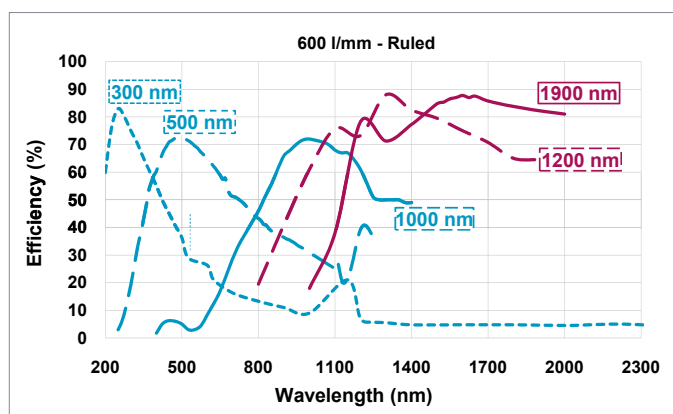
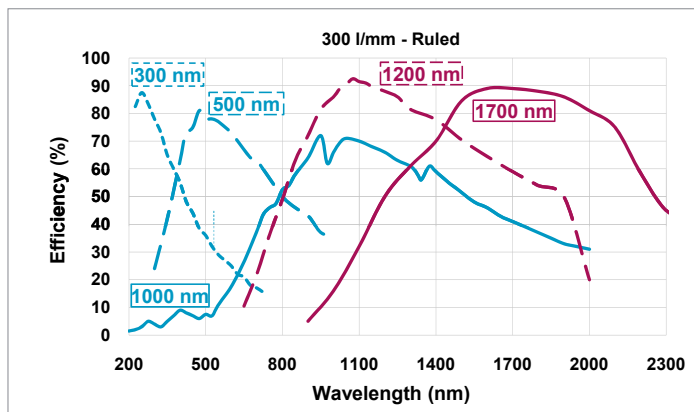
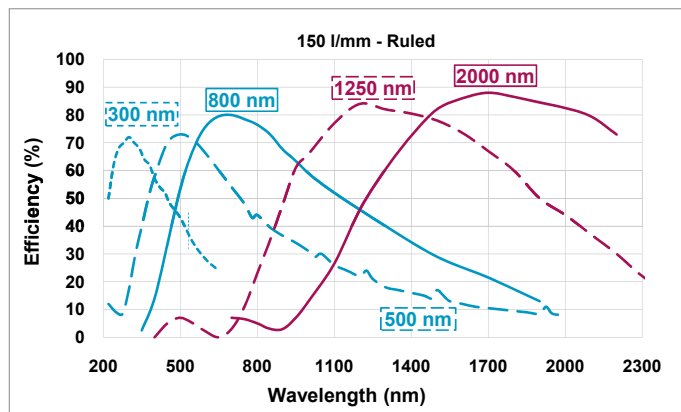
Lines/mm	Blaze (nm)	Nominal dispersion (nm/mm) ^{*7}	Bandpass (nm) ^{*3,*7}	Resolution (nm) ^{*4,*7,*10}	Peak efficiency (%)	Andor part number	Maximum recommended wavelength (nm)
150	300	19.70	545	0.89→0.62	72	SR-GRT-0150-0300	6820
150	500	19.60	542	0.88→0.62	73	SR-GRT-0150-0500	
150	800	19.50	539	0.88→0.62	80	SR-GRT-0150-0800	
150	1250	19.30	534	0.87→0.61	84	SR-GRT-0150-1250	
150	2000	18.90	523	0.85→0.60	88	SR-GRT-0150-2000	
300	300	9.80	271	0.44→0.31	88	SR-GRT-0300-0300	3410
300	500	9.71	268	0.44→0.31	81	SR-GRT-0300-0500	
300	1000	9.46	262	0.43→0.30	72	SR-GRT-0300-1000	
300	1200	9.34	258	0.42→0.29	92	SR-GRT-0300-1200	
300	1700	9.00	249	0.41→0.29	89	SR-GRT-0300-1700	
600	300	4.83	134	0.22→0.15	84	SR-GRT-0600-0300	1705
600	500	4.73	131	0.21→0.15	72	SR-GRT-0600-0500	
600	1000	4.38	121	0.20→0.14	72	SR-GRT-0600-1000	
600	1200	4.20	116	0.19→0.13	88	SR-GRT-0600-1200	
600	1900 (@1600) ^{*8}	3.39 3.78	94 105	0.15→0.11 ^{*9} 0.17→0.12	88	SR-GRT-0600-1900	
830	820	3.08	85	0.14→0.10	87	SR-GRT-0830-0820	1230
830	1200	2.68	74	0.12→0.08	83	SR-GRT-0830-1200	
1200	300	2.33	64	0.10→0.07	72	SR-GRT-1200-0300	850
1200	500	2.19	61	0.10→0.07	81	SR-GRT-1200-0500	
1200	1000 (@ 800) ^{*8}	1.62 1.89	45 52	0.07→0.05 ^{*9} 0.09→0.06	69 69	SR-GRT-1200-1000	
1200	Holographic (500 nm peak)	2.19	61	0.10→0.07	81	SR-GRT-1200-EH*	
1800	Holographic (250 nm peak)	1.30	36	0.06→0.04	70	SR-GRT-1800-DH	
1800	Holographic (380 nm peak)	1.52	42	0.07→0.05	62	SR-GRT-1800-FH	570
2400	300	1.05	29	0.05→0.04	68	SR-GRT-2400-0300	425
2400	Holographic (220 nm peak)	1.12	31	0.05→0.04	68	SR-GRT-2400-BH	
2400	Holographic (400 nm peak)	0.95	26	0.04→0.03	73	SR-GRT-2400-GH	

*Option for minimized scattered light.

Need to have maximum collection efficiency in the NIR/SWIR? All gratings are also available with protected silver coating. Please contact your local representative for further information.

Step 2c - Selecting The Correct Grating Efficiency Option

All graphs shown below represent efficiency for 45° polarisation

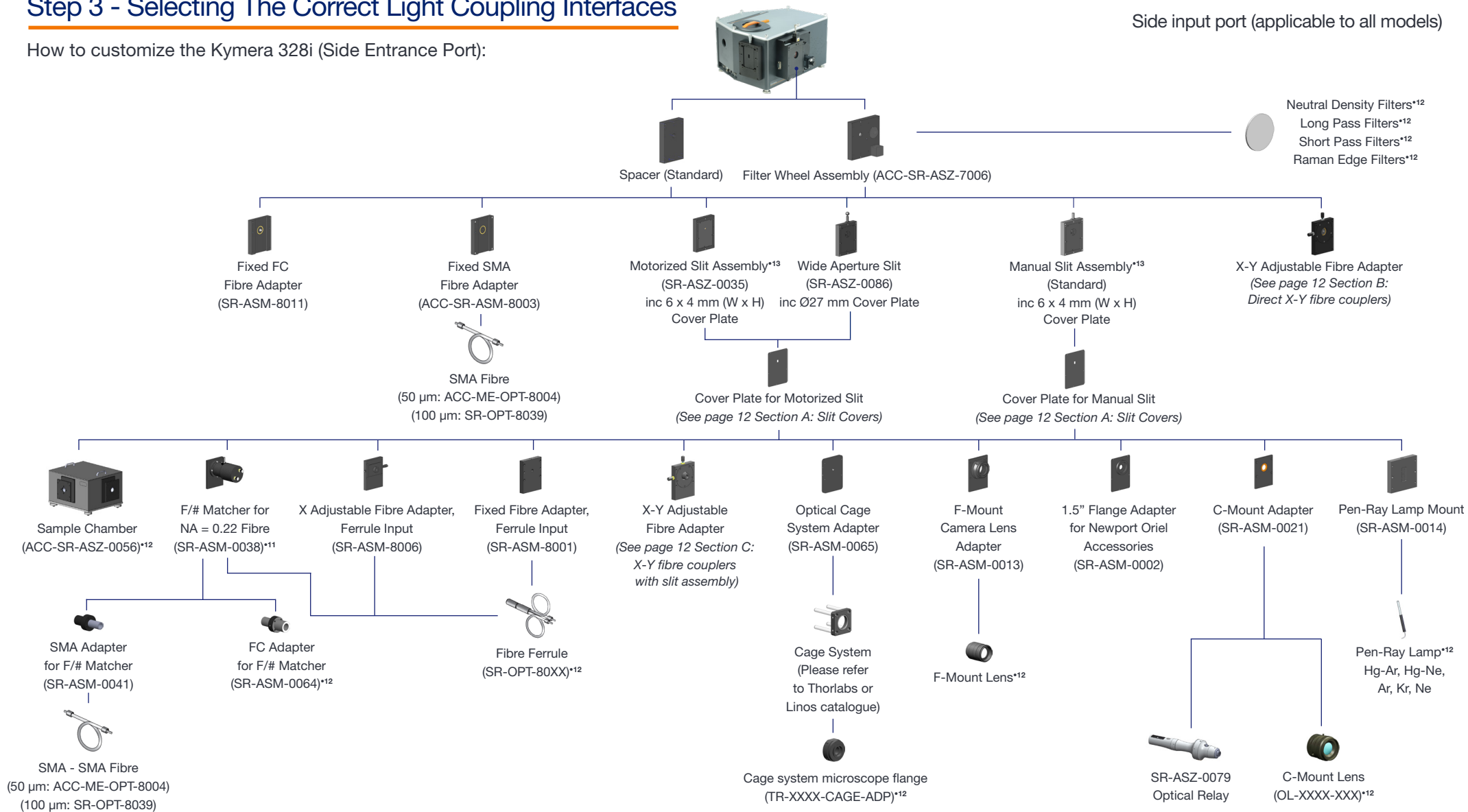


Important Consideration

System throughput is dependent on the grating's angle of operation and may decrease with higher grating operating angles.

Step 3 - Selecting The Correct Light Coupling Interfaces

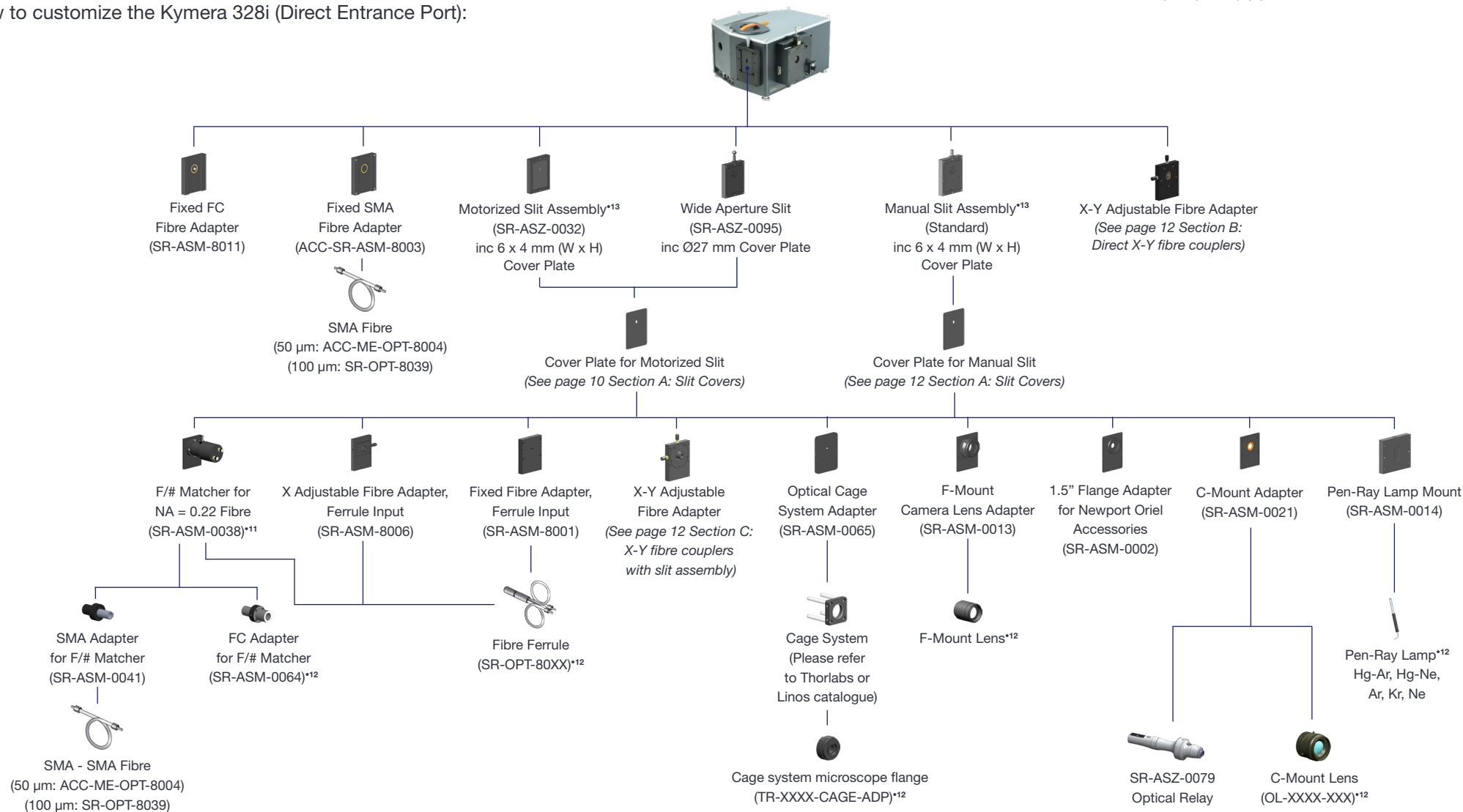
How to customize the Kymera 328i (Side Entrance Port):



Step 3 - Selecting The Correct Light Coupling Interfaces

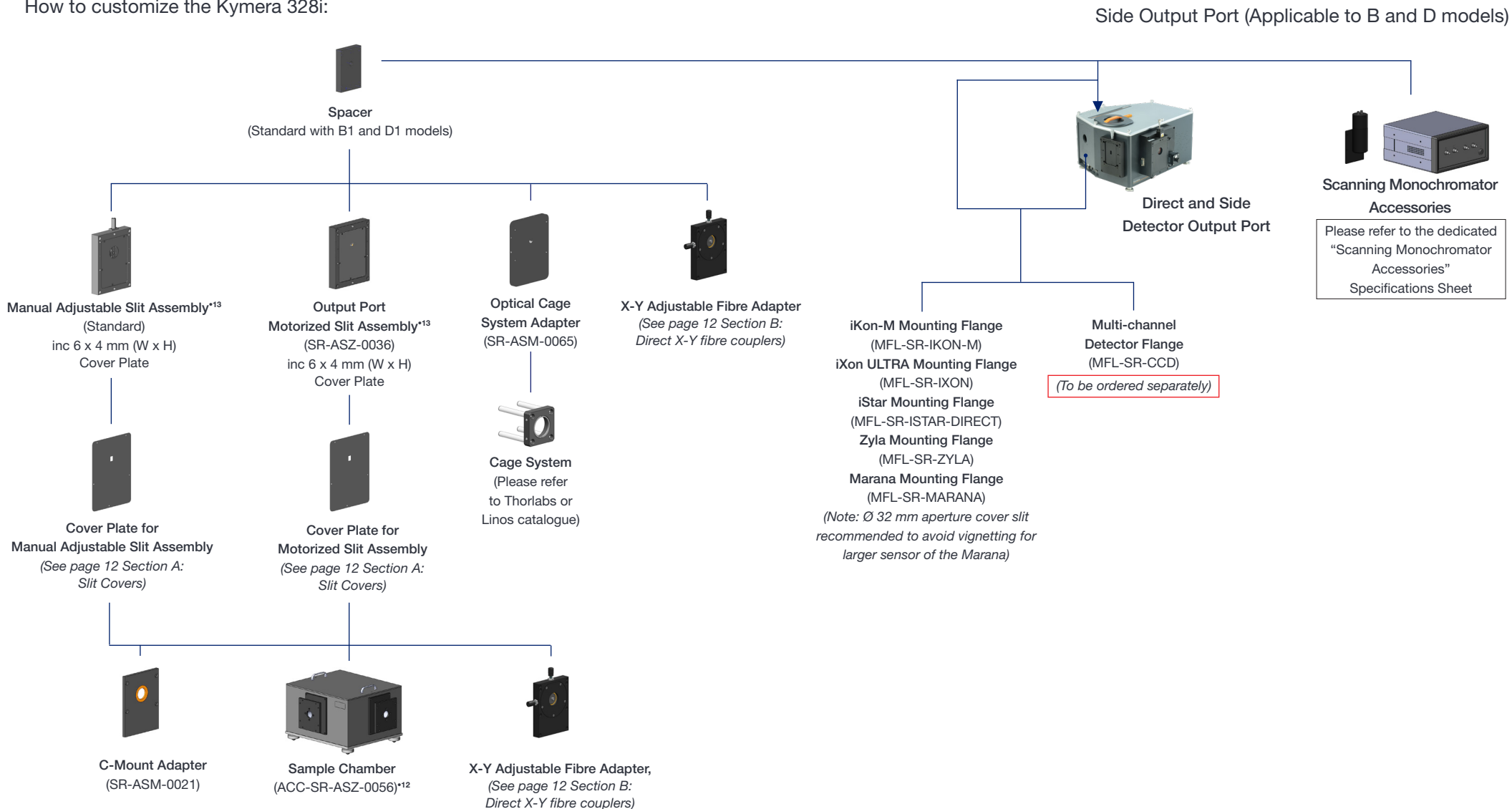
How to customize the Kymera 328i (Direct Entrance Port):

Direct input port (applicable to C & D models)



Step 4 - Cameras and Output Port Flanges

How to customize the Kymera 328i:



A: Slit Covers

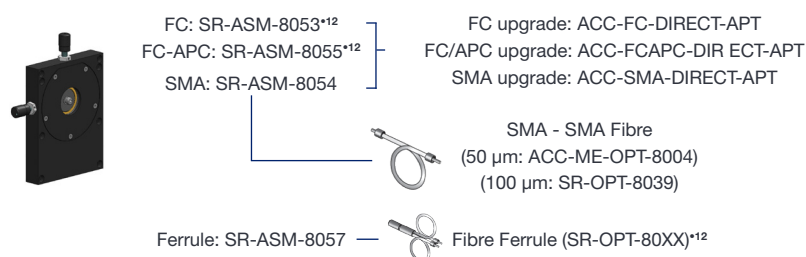
Cover Plate Apertures for Motorized Slit

Part No.	Size
SR-ASM-0016 ^{*14}	6 x 4 mm (W x H)
SR-ASM-0017	6 x 6 mm (W x H)
SR-ASM-0010	6 x 8 mm (W x H)
SR-ASM-0011	6 x 14 mm (W x H)
SR-ASM-0072 ^{*15}	Ø 27 mm
SR-ASM-0107	(Ø 32 mm aperture)

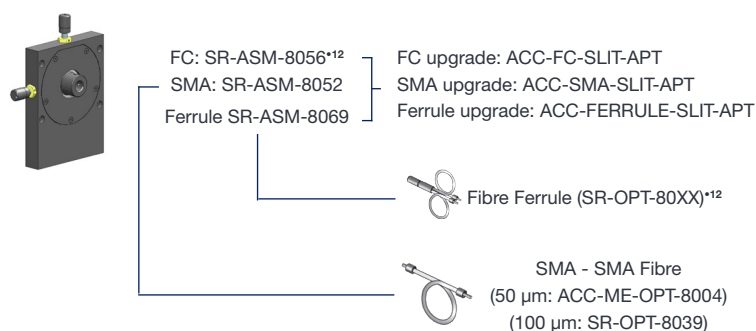
Cover Plate Apertures for Manual Slit

Part No.	Size
SR-ASM-0025	6 x 4 mm (W x H)
SR-ASM-0026	6 x 6 mm (W x H)
SR-ASM-0027	6 x 8 mm (W x H)
SR-ASM-0028	6 x 10 mm (W x H)
SR-ASM-0029 ^{*14}	6 x 14 mm (W x H)
SR-ASM-0100 ^{*15}	Ø 27 mm
SR-ASM-0106	(Ø 32 mm aperture)

B: Direct X-Y Fibre Couplers



C: X-Y Fibre Couplers (with Slit Assembly)



Notes:

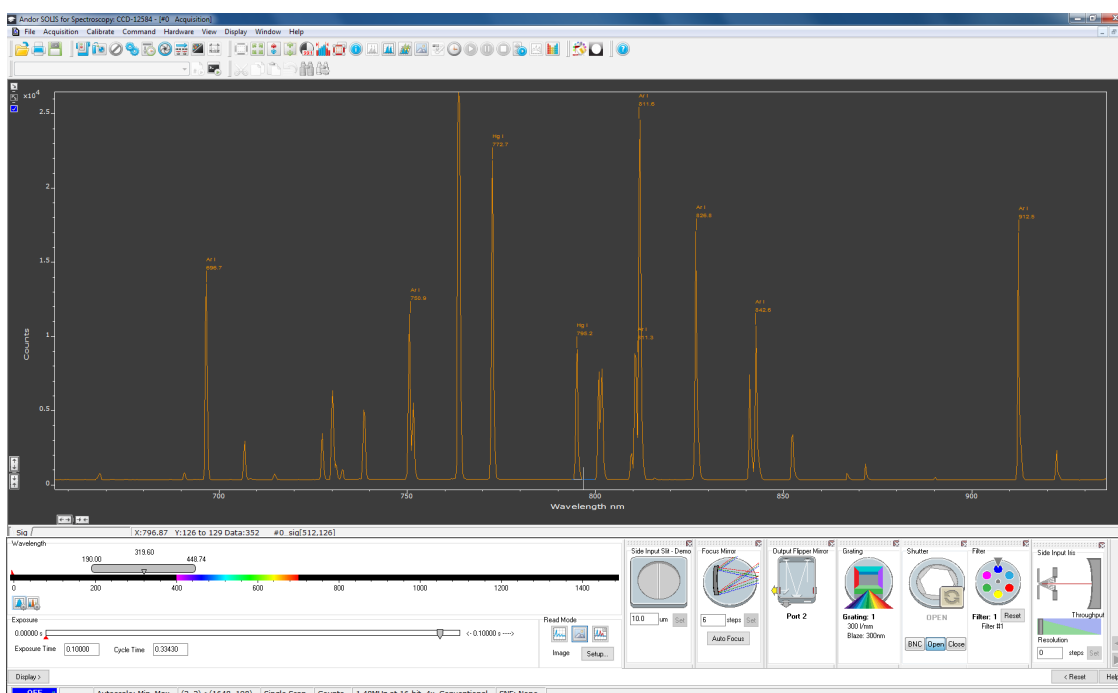
- For connection to manual slits, please also order Ø27 mm slit cover plate SR-ASM-0100
- For connection to motorized slits, please also order Ø27 mm slit cover plate SR-ASM-0072
- For connection to manual slits, please also order Ø32 mm slit cover plate SR-ASM-0106 (Marana sCMOS)
- For connection to motorized slits, please also order Ø32 mm slit cover plate SR-ASM-0107 (Marana sCMOS)

Step 5 - Selecting A Software Option

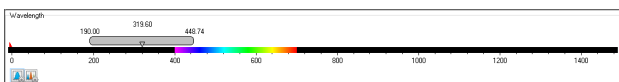
The Kymera 328i requires at least one of the following software options:

- 1 - **Solis Spectroscopy A** 32-bit and fully 64-bit enabled application for Windows (7, 8, 8.1 and 10) offering rich functionality for data acquisition and processing, as well as Andor cameras, spectrograph and motorized accessories simultaneous control. AndorBasic provides macro language control of data acquisition, processing, display and export.
- 2 - **Standalone Solis Spectroscopy GUI** for standalone spectrograph operation.
- 3 - **Kymera and Shamrock SDK** A software development kit that allows you to control the Andor range of Kymera and Shamrock spectrographs from your own application. Compatible as 32-bit and 64-bit libraries for Windows (7, 8, 8.1 and 10). Compatible with C/C++, C#, VB.NET and LabVIEW for Windows/Linux.

Solis Spectroscopy: Dedicated spectroscopy acquisition software

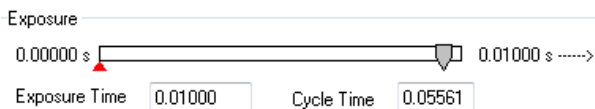


Wavelength selection and step-and-glide



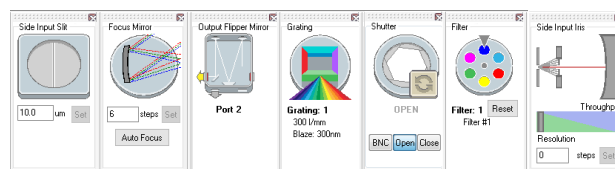
Set the wavelength of interest by dragging slider or typing the desired value. For step-and-glide, select wavelength range for extended bandpass and high resolution acquisition.

Exposure time



Set the exposure time for the detector - quick access for easy acquisition optimization.

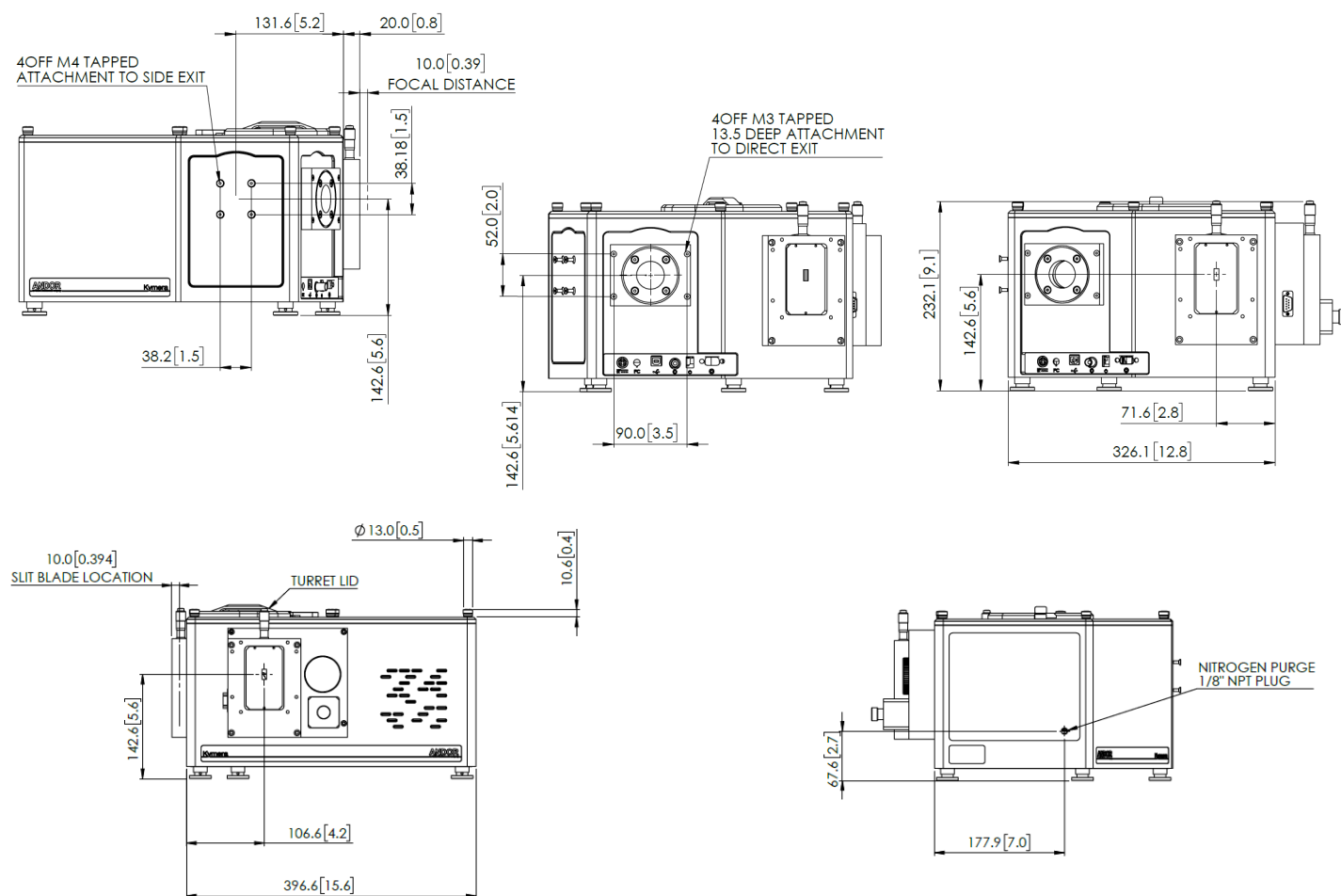
Real Time Control



- (a) **Slit drive:** Control the spectrograph slit width - drag blades on icon or type in required slit width
- (b) **Adaptive focus:** Used for automatic fine focus optimization
- (c) **Turning mirror:** Used to select the appropriate exit port
- (d) **Grating turret:** Used for setting grating turret to a new position and bringing desired grating in the optical path - just click on the desired grating
- (e) **Shutter:** Synchronization mode selection for shutter operation
- (f) **Filter wheel:** Used to select a particular filter on the filter wheel - just click on the desired filter position
- (g) **TruRes™:** Used for spectral resolution enhancement - simply type in the setting that is best suited to the resolution target.

Product Dimensions

Dimensions in mm [inches]



Standard configuration shown with manual slit on input, CCD flange on straight output.

Weight: 18 kg [39.7 lbs] approx

Optical Axis

Standard feet: Nominal optical axis height: 142.6 - 148.6 mm, increments of 6 mm with stackable spacer kit (SR-ASM-0098).

Connecting to the Kymera 328i

USB Control

Connector type: USB 'B' type

I²C Connector

For connection to camera/detector via I²C connection (replaces USB cable connection to spectrograph).

Shutter Control

Connector type: BNC Female, 50 Ω

Shutter Specifications

Maximum repetition rate	40 Hz - burst; 10 Hz - sustained
Minimum open/close time	6 ms
Minimum lifetime	1 Million cycles

Optical Property

Focal plane size (mm, W x H)	30 x 14	
Grating size (mm)	68 x 68	
Stray light *16	1 nm from laser	3.8×10^{-4}
	10 nm from laser	4.7×10^{-5}
	20 nm from laser	8.9×10^{-6}
Magnification	1.1:1	

Wavelength Drive Performance

Wavelength accuracy center *17	0.04 nm	
Wavelength repeatability *18	Single grating	4 pm
	Grating-to-grating	10 pm

Wavelength Side Accuracy

Wavelength side accuracy *19	0.2 nm
------------------------------	--------



Order Today

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Fax +86 (10) 8271 9055

Items shipped with your spectrograph:

- 1x 3 m USB 2.0 cable Type A to Type B
- 1x Power supply (+24V, 5A) with 3 m mains cable
- 1x I²C to I²C cable
- 1x CD containing Andor user guides
- 1x Individual system performance booklet
- 1x CD containing either Solis software or SDK (if requested at time of order)
- 1x hex key set (2 mm, 3 mm and 5 mm)

Regulatory Compliance

Compliant with the requirements of the EU EMC and LVD Directives, compliant with the international EMC and safety standards IEC 61326-1 and IEC 61010-1, and Machinery Directive 2006/42/EC.

Footnotes: Specifications are subject to change without notice

1. In the case of a multiple grating turret order, please specify desired grating configuration for each turret.
2. Shutter operation can be achieved directly through the I²C interface between cameras and spectrograph, or through a BNC-to-SMB cable when the spectrograph is operated through USB.
3. Typical values quoted with 27.6 mm wide CCD, e.g. Newton DU940.
4. Typical values quoted with 10 μm slit and 13.5 μm pixel CCD, e.g. Newton DU940. Illustrates resolutions achievable with iris opening range (optional).
5. Typical values quoted at 500 nm centre wavelength.
6. Typical values quoted at 300 nm centre wavelength.
7. Typical values quoted at maximum efficiency wavelength or blaze wavelength unless otherwise stated.
8. Wavelength within the recommended operating spectral region.
9. Indicative values; the working range of these gratings is principally in the region where optical aberrations may alter the system resolution performance quoted.
10. Useful signal is assumed to be imaged on the entire height of a 6.9 mm sensor (i.e. Newton DU940) and fully vertically binned.
11. Please refer to F/# matcher specification sheet for magnification considerations.
12. Please refer to the local sales representative or website for further information on available options and complimentary accessories.
13. Slit widths range from 10 μm to 2.5 mm.
14. Provided as standard.
15. Recommended for use with fibre-optics and C-mount accessories.
16. Measured with a 633 nm laser and a 1200 l/mm grating for Full Vertical Binning (FVB) on a 6.9 mm high sensor, and a 1 mm strip vertically centred on the optical axis.
17. Average measurements using > 30 calibration lines, covering the recommended grating angle operating range with a 1200 l/mm grating.
18. The standard deviation of 20 measurements of a peak's centre-of-mass position: - each measurement is taken after switching back and forth between a given centre wavelength and a lower or higher centre wavelength (single grating) or between two gratings set at the same centre wavelength (grating-to-grating).
19. Side accuracy measured using a 27.6 mm wide sensor, reflecting the dispersion calibration and step-and-glue accuracy.
20. Only Andor CCD platforms (e.g. Newton, iDus, iKon) can be controlled in conjunction with Kymera and Shamrock spectrographs in EPICS software.



Minimum Computer Requirements:

- 3.0 GHz single core or 2.4 GHz multi core processor
- 2 GB RAM
- 250 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 (7, 8, 8.1 and 10)

Operating and Storage Conditions

- Operating Temperature: stable ambient between 0°C to 30°C
- Relative Humidity: < 70% (non-condensing)
- Storage Temperature: -25°C to 50°C

Power Requirements

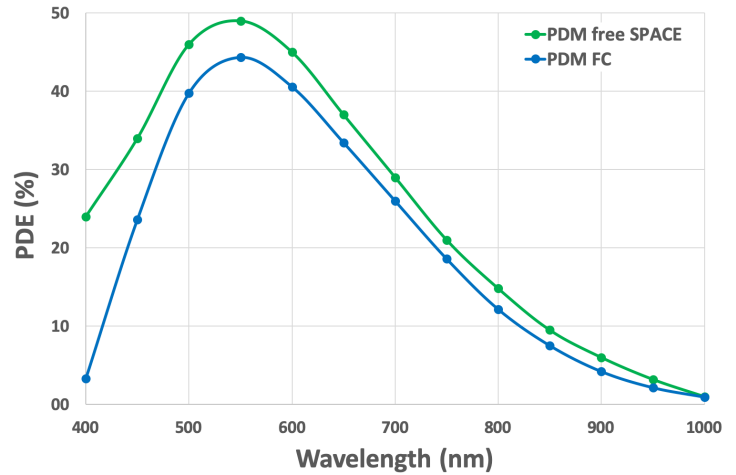
- 100 - 240 VAC 50 - 60 Hz
- Max. power consumption: 21 W (10 Hz shutter and grating turret operation)



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



PDM Series



The PDM series photon counting detector modules are all solid-state instruments. They have high photon detection efficiency and generate an output pulse per detected photon with better than 50ps FWHM photon timing resolution. A version with an optical FC connector, able to couple SingleMode or MultiMode fibers, is available.

- ▶ **High Photon Detection Efficiency**
up to 49% @ 550nm
- ▶ **Best-in class Timing Accuracy**
Typ. 35 ps FWHM
- ▶ **Low Dark Count Rate**
as low as 1 cps, depending on detector diameter
- ▶ **High performance uniformity**
across detector area

MODULE FEATURES

- 20µm, 50µm, 100µm and 200µm active sensing area diameter
- Window and Fiber Receptacle versions available
- Available in different Grade depending on Dark Counts specifications
- Peltier-cooled
- FC connector with coupling efficiency $\geq 80\%$
- Low power consumption
- Robust and low cost

BIOMEDICAL APPLICATION

- Confocal Microscopy
- Single Molecule Spectroscopy
- Ultra-Sensitive Fluorescence
- Time-correlated single photon counting
- DNA & Drug Discovery

INDUSTRIAL APPLICATION

- Particle Sizing
- Optical testing of integrated circuits
- Metrology by Time of Flight measurements

QUANTUM APPLICATION

- Quantum Cryptography
- Single-photon source characterisation

ASTRONOMY APPLICATION

- Optical Range Finding, LIDAR & LADAR
- Astronomy Observations & Adaptive Optics

Overview

The PDM photon counting detector series are all solid-state instruments that detect light from 375 nm to 1000 nm wavelength range. They have a peak photon detection efficiency of 49% at 550 nm and generate a TTL output pulse per detected photon. Standard TTL pulses provide better than 250 ps timing resolution. Anyway, they also generate an additional output pulse, according to the NIM standard, able to provide better than 50 ps FWHM photon timing resolution.

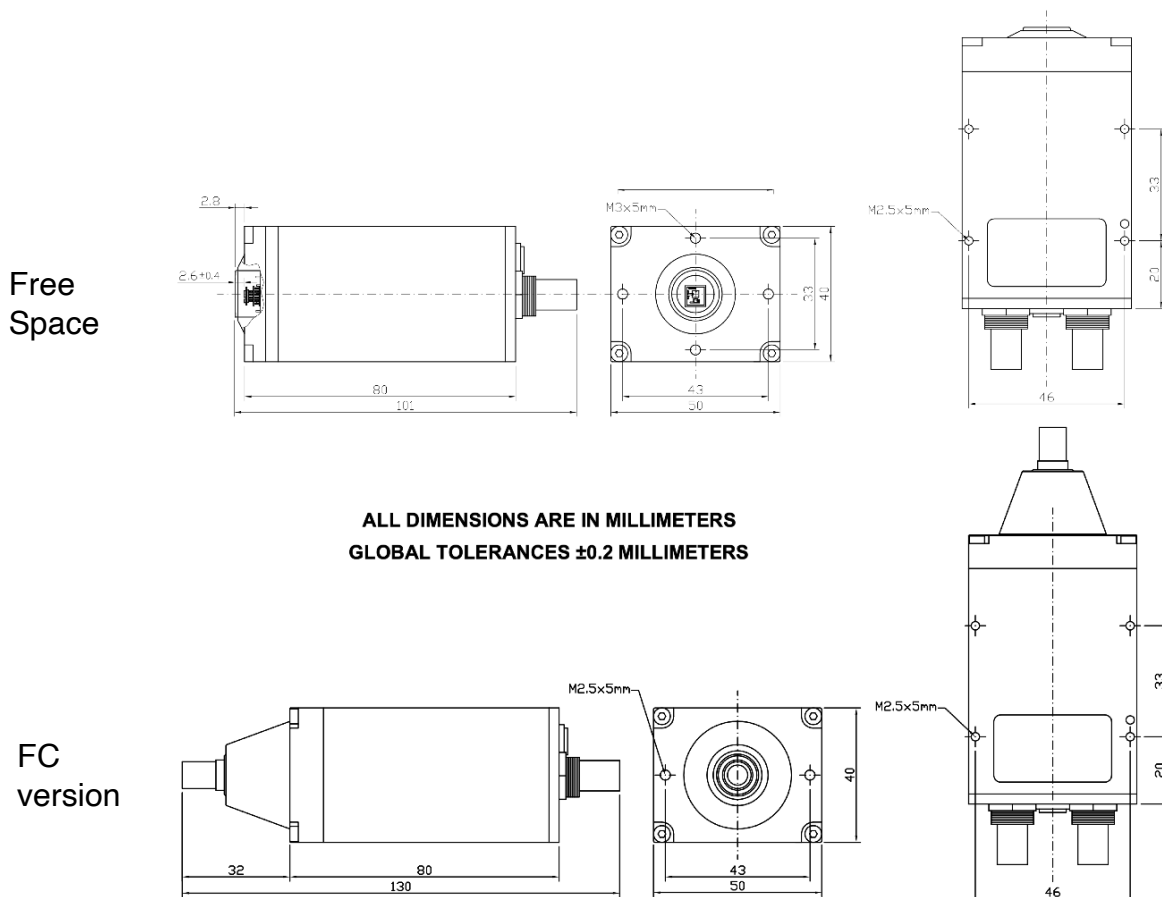
The excellent photon detection efficiency and superior timing resolution is obtained through the use of custom epitaxial silicon Single Photon Avalanche Diodes (SPAD), an integrated Active Quenching Circuits (iAQC), specifically designed and optimized for photon counting applications which generates the positive TTL pulses, and a fast timing circuit board, always installed in PDM modules, which generates the negative NIM pulses. The SPAD is thermoelectrically (TEC) cooled and its temperature controlled, ensuring stabilized performance despite ambient temperature changes.

Thanks to the use of an AQC, it is also possible to gate on or off the detector. The PDM GATE IN input is thus very useful for switching on the detector only during specific time windows for better noise rejection and increased signal-to-noise ratio. The GATE IN input is very useful also to be used as an interlock input whenever the user wants to switch off the detector if an event occurs. The PDM GATE IN input is also not designed to be used as a fast-gated module. In the scientific literature, a fast-gated detector is a detector that can be switched from the OFF state to the ON state very precisely and in very short periods of times, with falling or rising times in the order of few hundreds of ps. In this case the MPD FastGATED SPAD should be purchased. The PDM GATE IN input, indeed, is not designed to accept high repetition external trigger signals and should be used to gate ON or OFF the SPAD with minimum gate ON or GATE OFF times in the orders of few tens of microseconds or longer.

The PDM maximum saturated count rate is the reverse of the deadtime, and it is 12-13 Mc/s. Of course, in order to avoid non-linearity errors in counting applications, a maximum count rate of at least four or five times smaller than the saturation level is recommended. At request custom deadtime can set for specific user needs. The module is fully protected against light overload.

The PDM series is available with two optical interfaces: a free space optical window and a fibre connectorized version that guarantees > 80% coupling efficiency with selected fibres (see below for technical details).

Mechanical drawings



Specifications

Specifications @ 25°C

	Min	Typ	Max	Units
Photon Detection Efficiency (free space) @ 400nm @ 550nm @ 650nm	21 45 34	24 49 37		%
Fiber Receptacle coupling efficiency (CE) 20 μm active area diam. - (wavelength > 470nm) 50 μm and 100 μm active area diam. - (wavelength > 470nm)	70 80	≥ 80		%
Single Photon Timing Resolution (FWHM) TTL Counting Output NIM Timing Output - (wavelength > 470nm)		35	250 50	ps
After-pulsing probability	0.1		3	%
Dead Time		77		ns
Supply voltage connector	5		12	V
	Standard 3.5mm supply socket			
Outputs Pulse rise and fall times Output pulse duration Required Termination Pulse Characteristics - TTL Pulse Characteristics - NIM	$< 2\text{ns}$ 20ns typical 50 Ω Digital, Positive, 0 to +3.3V Digital, Negative, 0 to -700mV			
Gating input	5V CMOS control (0V, detector off) 50 Ω AC terminated, Internal 10k Ω pull-up			

Grades Specifications

		Dark Counts (cps) – TEC cooled SPADs						
Grade		X	A	B	C	D	E	F
Active Area Diameter		< 1000	< 500	< 250	< 100	< 50	< 25	< 5
20 μm							√	√
50 μm				√	√	√	√	
100 μm			√	√	√	√	√	
200 μm		√						

Not cooled SPADs with higher dark counts can be supplied to meet special OEM requirements





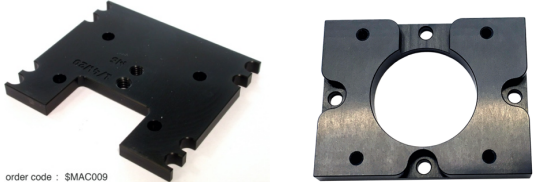
FC table guideline

Fiber types for getting specified CE	SM	MM	MM
Active Area Diameter	MFD: < 10 μm Numerical Aperture: ≤ 0.20	Core $\leq 62.5 \mu\text{m}$ Numerical Aperture: ≤ 0.275	Core: $\leq 105 \mu\text{m}$ Numerical Aperture: ≤ 0.22
20 μm	√		
50 μm	√	√	
100 μm	√	√	√

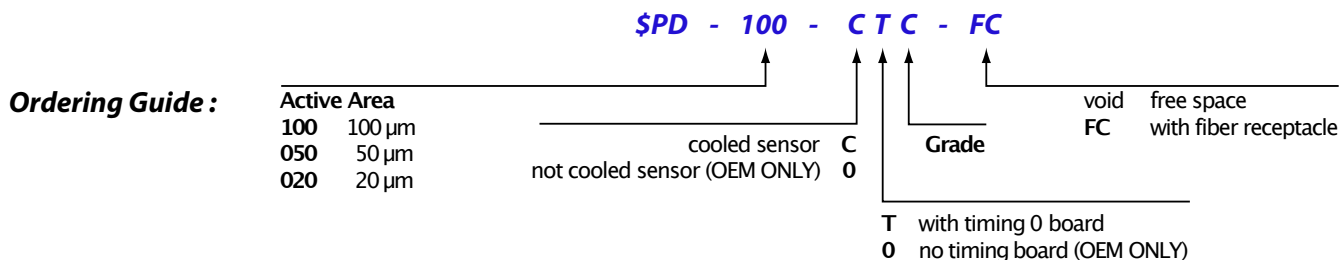
Using other types of fibers is surely possible but coupling efficiency may vary depending on chosen one.

Accessories list

MPD provides also many different and very useful accessories. Please contact us or your local reseller for more information. The main ones are here below described.

Part Number	Description	Picture
\$MAC001	Cable Lemo 00 - SMA 3m	
\$MAC003	12V-15W universal wall mount power supply	
\$MAC004 \$MAC005 \$MAC006	Mains plug Europe type Mains plug US/JP type Mains plug UK/Ireland type	
\$MAC008	Lemo 00 - SMA adaptor	
\$MAC009	Optical Table Universal Adaptor (to the left)	 <small>order code : \$MAC009</small>
\$MAC024	PDM Th. Cage 30 mm adaptor (to the right)	

Ordering Information



Products can be ordered directly from Micro Photon Devices or its representatives. For a complete list of representatives, visit our website at www.micro-photon-devices.com. Custom designed products are also available upon request.

Designed and built compliant with the European Union Directive 2011/65/CE (also known as RoHS 2)

Warranty

A standard legal warranty according to local legislation applies following shipment. Any warranty is null and void if the module case has been opened or if the absolute maximum ratings are exceeded. Specifications are subject to change without any notice. Document version 4.5 – November 2019