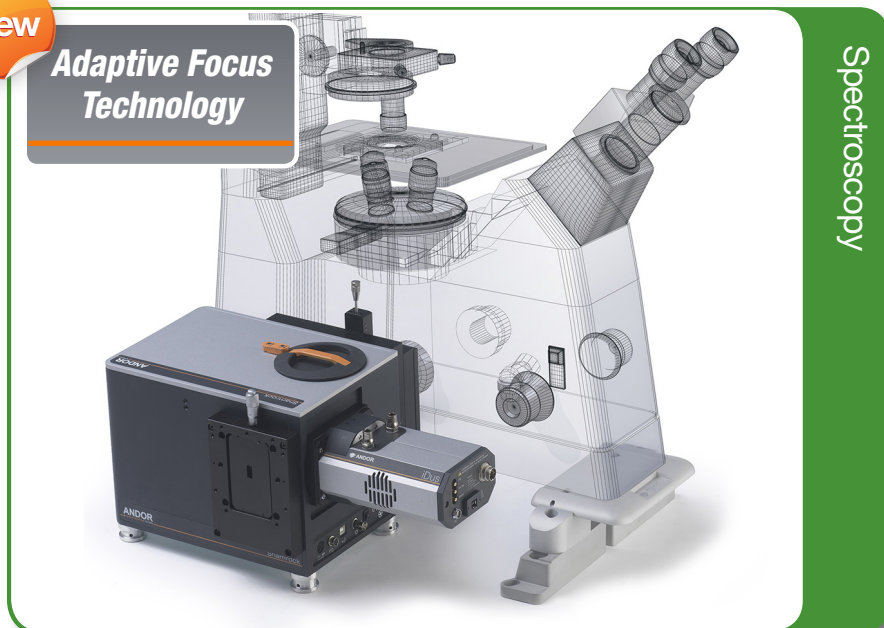


Features and Benefits

- Adaptive Focus (patent pending)**
 Intelligent and user-friendly interface for uncompromised high spectral resolution performance
- Dual-grating turret with RFID technology**
 Seamless field-upgradability with precise indexing interface and user-friendly hatch access. Automatic gratings recognition and setup with embedded RFID tags - minimum user interaction
- Astigmatism-corrected optical design**
 Toroidal optics enable multi-track fiber detection and excellent sample image relay from a microscope at the grating '0' order
- Dual detector outputs**
 Extended wavelength coverage when combining Andor UV-NIR CCD, EMCCD, ICCD and InGaAs cameras. Slit option for monochromator operation
- USB interface**
 Plug-and-play connectivity, ideal for laptop operation alongside Andor USB cameras
- Silver-protected coated optics options**
 Most efficient for NIR/SWIR detection when used in conjunction with Andor InGaAs cameras or PbS, InSb, and MCT single point detectors
- Pre-aligned, pre-calibrated instrument**
 Individually characterized spectrograph-detector systems for out-of-the box operation
- 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
- Compact and rugged design**
 Ideal for integration into OEM instruments or space constrained setups
- µManager software integration**
 Simultaneous control of Andor cameras and spectrographs and a wide range of microscopes and accessories through 1 single software platform.
 Dedicated, user-friendly spectrum handling interface
- High repetition rate shutter**
 10 Hz continuous operation and 40 Hz burst mode for ultrafast background acquisition and detector protection
- Monochromator capabilities**
 Extract best optical resolution while allowing use of single point detectors with sensitivity up to 12 µm

New

Adaptive Focus Technology



Intelligent, modular, and compact imaging spectrograph

Andor's Shamrock 193i spectrograph has been designed with research-grade performance, versatility and ease of use in mind.

The 'intelligent' motorized adaptive focusing allows access to the very best spectral resolution performance in any configuration with unmatched repeatability. Its F/3.6 aperture, combined with Andor's world-class range of ultra-sensitive UV-NIR and SWIR detectors, offers a 'workhorse' spectroscopy platform with superb photon collection efficiency; ideal for challenging low-light micro-fluorescence / Raman applications, or routine spectral acquisitions.

The indexed grating turret, dual output port and extensive accessories range provides a highly configurable platform to best match Academic and OEMs specific performance requirements. Dedicated micro-spectroscopy interfaces - including modular 'cage systems' - allow seamless integration into microscopy setups. The Shamrock spectrograph and accessories, user-friendly control in µManager allows for the quick and easy setup of complex micro-spectroscopy acquisitions including chemical mapping.

Astigmatism-correction toroidal optics enable multi-track fibre-optic acquisitions, while also offering high fidelity sample image relay to the detector in micro-spectroscopy setups.

Specifications Summary

Resolution with Newton DU940 CCD 1200 //mm @ 500 nm 2400 //mm @ 300 nm	0.21 nm 0.10 nm
Aperture	F/3.6
Focal length	193 mm
Magnification (Vertical @ centre of CCD)	1.07
Gratings	Interchangeable dual on-axis RFID-tagged turret for easy swapping
Communication	USB 2.0
Wavelength accuracy center	0.15 nm
Wavelength repeatability	75 pm

1 Dual Exit Ports

Versatile and flexible configurations for wide range of spectroscopy measurements.

Dual port setups include various combinations of:

- CCD cameras for UV, Vis and NIR spectroscopy
- ICCD cameras for UV to NIR and Time Resolved measurements
- Single Point Detectors (SPDs) for scanning spectroscopy solutions from UV to SWIR
- SPDs for time resolved, lifetime measurements
- Exit slits for monochromator tunable light source
- Fiber coupling to deliver output light/signal to another part of experiment

The ports are easily selected through the software and integrity of calibration for each port is independent and well maintained.



iDus 416 CCD

Newton EMCCD

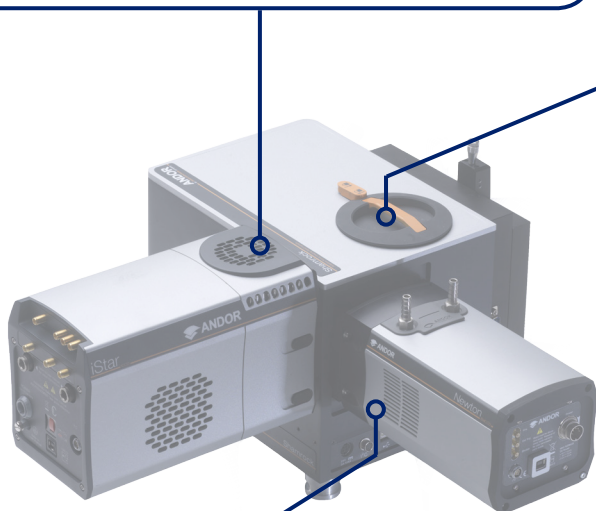
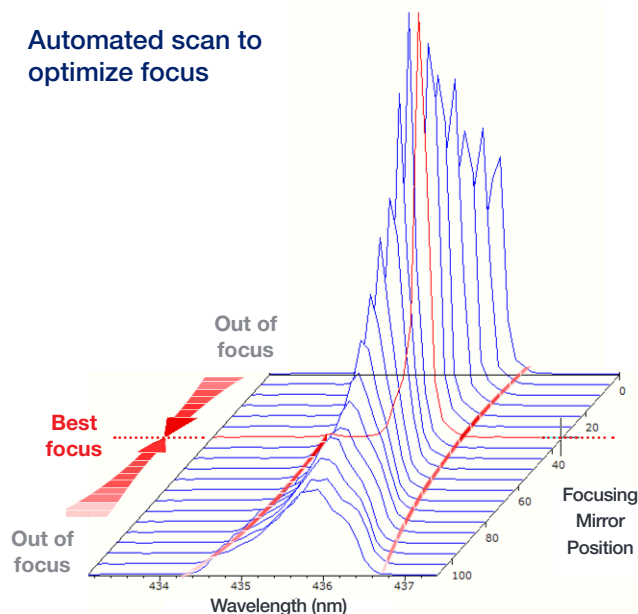
iStar ICCD

2 Adaptive Focusing

Automated optimization for the best quality of focus:

- Ensures the best resolution at any wavelength
- Easy optimization when changing between gratings, or cameras
- Software controlled- easy to switch on and off when required
- No need for manual adjustment of camera position at the exit port
- No need for multiple flange variants at the exit port

Automated scan to optimize focus



3 µManager Control

User-friendly simultaneous access to Andor Shamrock 193i, 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.

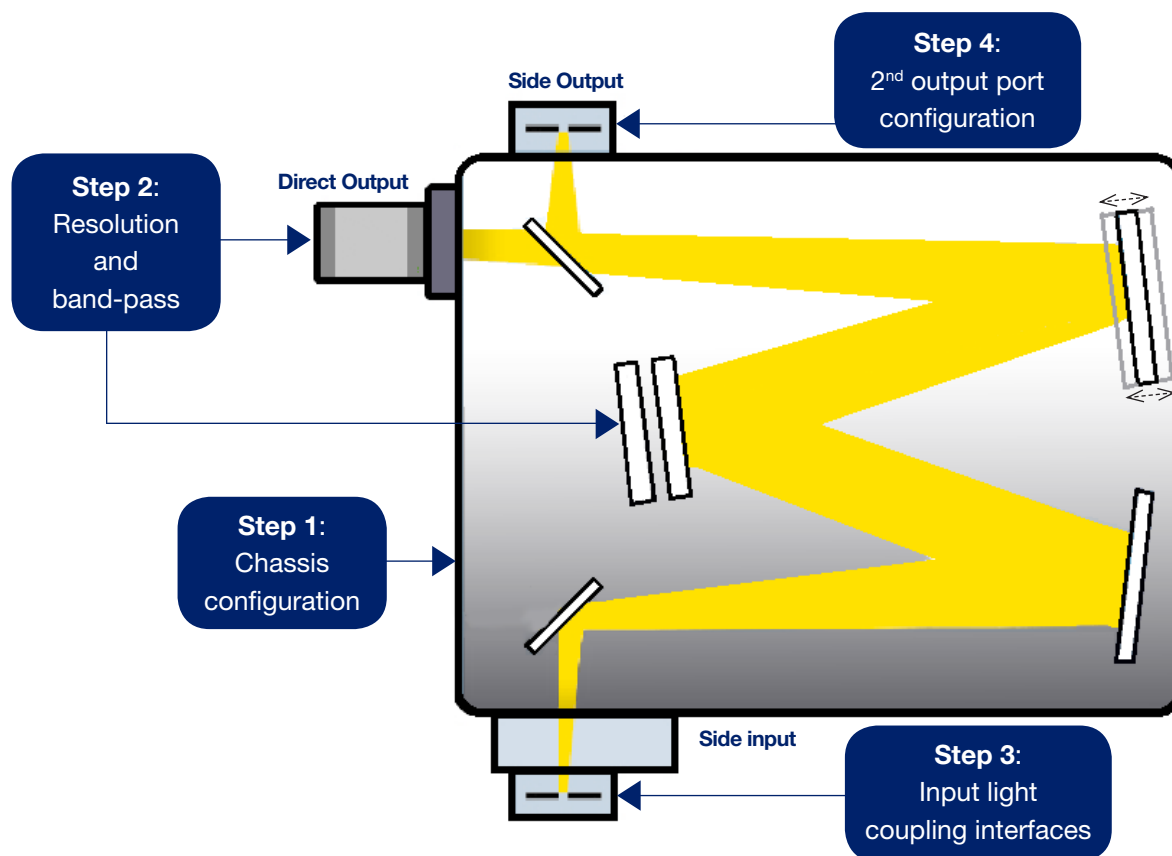
5 simple steps to set up your micro-spectroscopy experiment

1. Set up spectrograph
2. Set up camera
3. Set up microscope
4. Set up experiment e.g. X-Y-Z chemical mapping
5. Display spectral data in real time & save acquisition series

The screenshot shows the µManager software interface. On the left is the 'Property Browser' with a 'Refresh' button and checkboxes for 'Show cameras', 'Show shutters', 'Show stages', 'Show discrete changes', and 'Show other devices'. The 'Property' section lists various instrument parameters like 'Andor Shamrock-Calibration Coefficients', 'Andor Shamrock-Centre wavelength', 'Andor Shamrock-Detector Offset', 'Andor Shamrock-Detector Pixel Width (µm)', 'Andor Shamrock-Direct Input Slit Width (µm)', 'Andor Shamrock-Grating', 'Andor Shamrock-Grating Offset', 'Andor Shamrock-No. of Detector Pixels', and 'Andor Shamrock-Port (Input)'. The main window is titled 'Multi-dimensional Acquisition' and contains several panels: 'Time points' (Number: 12, Interval: 100 ms), 'Acquisition order' (Time), 'Multiple positions (XY)', 'Z-stacks (slices)' (Z-start: 0, Z-end: 0, Z-step: 1), 'Channels', and a 'Summary' panel (Number of time points: 12, Number of positions: 1, Number of channels: 1, Total images: 12, Total memory: 5 MB, Duration: 0h 0m 1.2s, Order: Time). At the bottom, a 'Spectral' plot shows 'Intensity (counts/µm²)' vs 'Wavelength (nm)' with a prominent peak at approximately 630 nm. The interface also includes 'Acquire!', 'Stop', 'Load...', and 'Save as...' buttons.

Step-by-Step System Configuration

How to customize the Shamrock 193i:



Step 1: Chassis configuration

- Select combination of input and output ports (see page 4 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), and shutter for background acquisition and detectors protection.

Step 2: Resolution and band-pass

- Select the appropriate Shamrock spectrograph platform, giving due consideration to bandpass and spectral range requirement.
- Select gratings and detector to fulfil resolution requirements.
- Select gratings for suitable wavelength coverage.

Step 3: Input light coupling interface

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

Step 4: 2nd exit port configuration

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

Step 5: Software interface

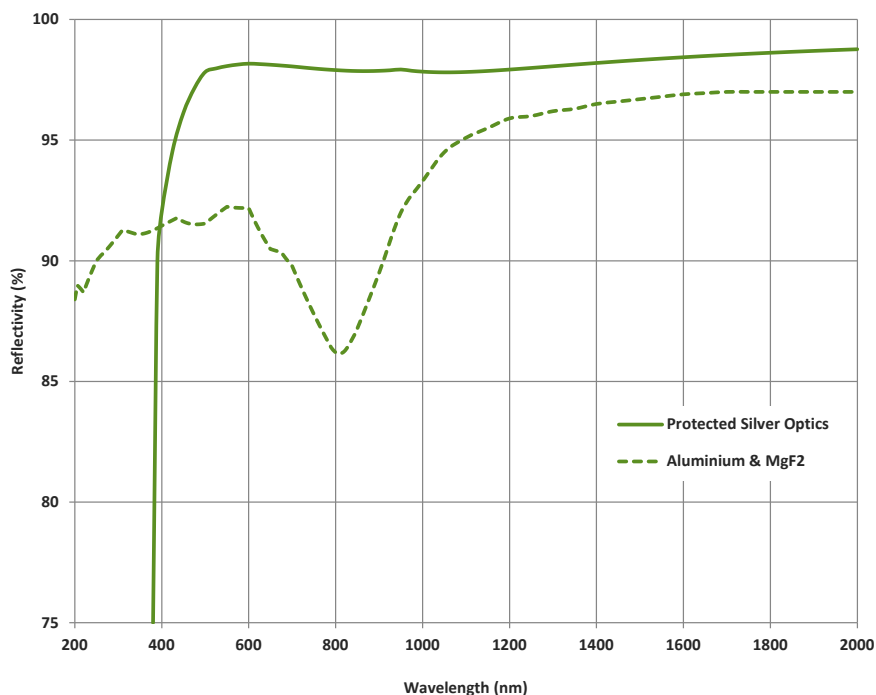
Select either state-of-the-art Solis software or Software Development Kit (SDK) option – please refer to appropriate section for further information.

Step 1 - Chassis Configuration

Ordering Information

Model	Side input port	Direct output port	Side output port	Motorized flipper mirror
SR-193i-A	Manual slit	Camera	-	-
SR-193i-B1	Manual slit	Camera	Manual slit	✓
SR-193i-B2	Manual slit	Camera	Camera	✓
SR-193i-XX-SIL	Protected silver coated optics options for models shown above (replace X with relevant model number)			

Optics Coatings Reflectivity Graph

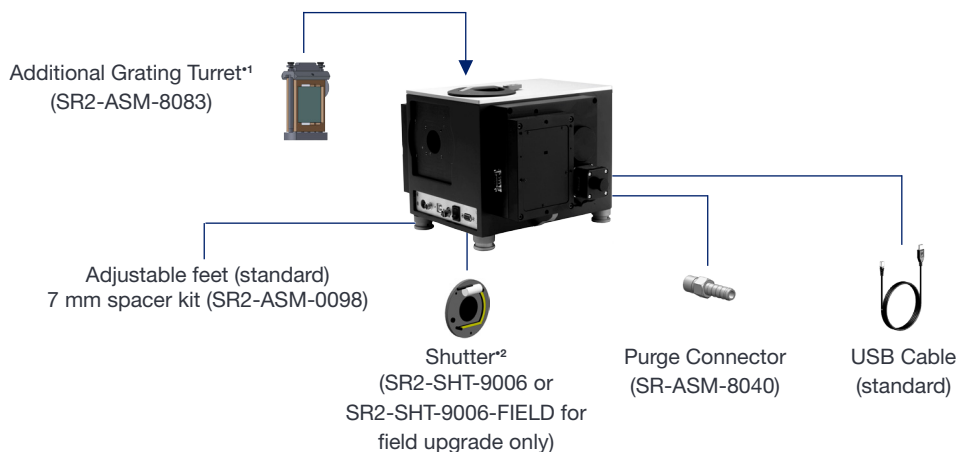


The graph shows the standard Al + MgF₂ optics coatings reflection efficiency versus wavelength.

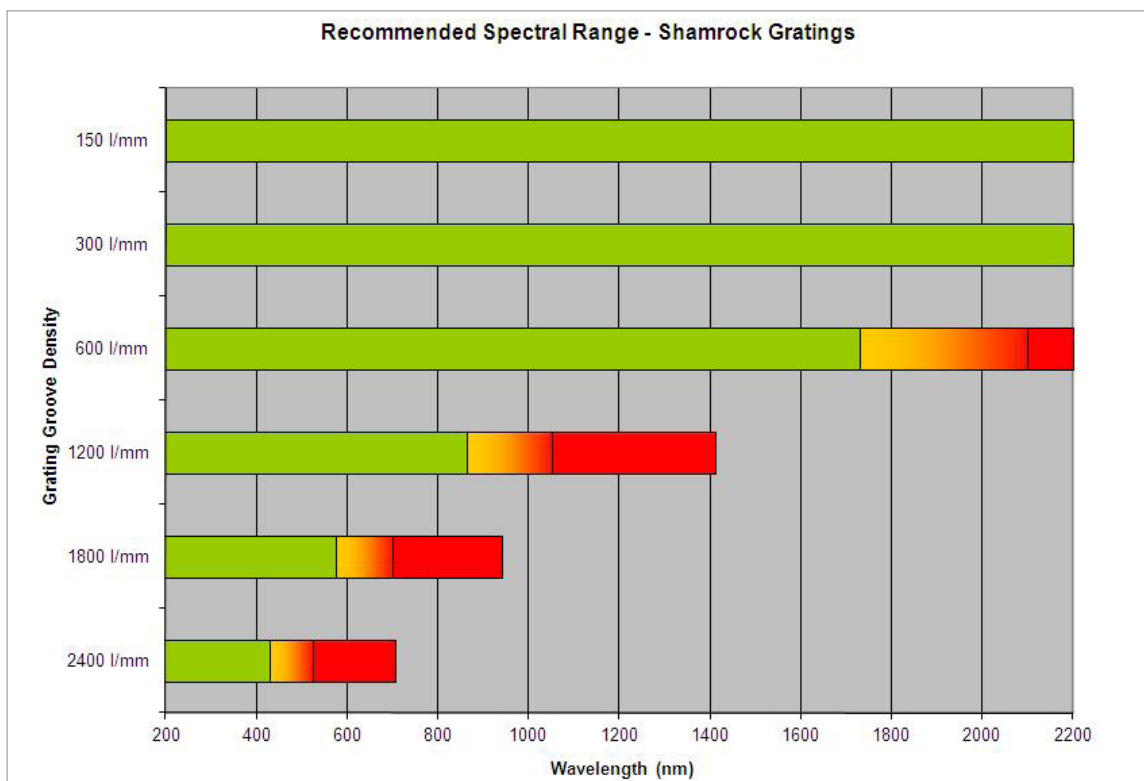
Protected silver coated optics option is also available on request for maximum efficiency in the NIR region and is recommended for working with Andor iDus InGaAs detectors or IR single-point detectors, such as MCT, PbS and InSb.

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

Chassis Accessories



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 (l/mm)					
	150	300	600	1200	1800 (Holo)	2400 (Holo)
Shamrock 163						
Bandpass (nm) ^{*3,*5}	1072	529	256	117	68	56 ^{*6}
Resolution (nm) ^{*4,*5}	2.33	1.15	0.55	0.25	0.15	0.13 ^{*6}
Shamrock 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}
Shamrock 303i						
Bandpass (nm) ^{*3,*5}	600	297	144	67	39	32 ^{*6}
Resolution (nm) ^{*4,*5}	0.88	0.43	0.21	0.10	0.06	0.05 ^{*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 Shamrock spectrograph platform to meet resolution and band-pass needs, whilst minimising the risk of potential aberration.

Have you found what you are looking for?

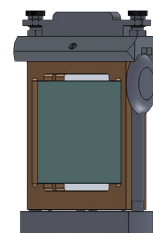
Need higher spectral resolution? The Shamrock spectrograph family also offers half and three-quarter meter focal length motorized platform

Need extended multi-track capabilities? The HoloSpec offers unique high-density multi-fibre acquisition with ultra-low crosstalk

Need higher collection efficiency? The HoloSpec offers a unique F/1.8 aperture and high transmission optics for maximum throughput

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

The Shamrock 193i features a dual grating turret, designed to offer flexibility and control over your choice and interchange of gratings. The dual grating turret can be easily and speedily removed, and replaced by an alternative turret with new gratings. The intelligent design of the 193i means that only a simple offset adjustment is required once the new turret and gratings are added. The 193i 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 two 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-ASM-8083) can also be supplied on request.



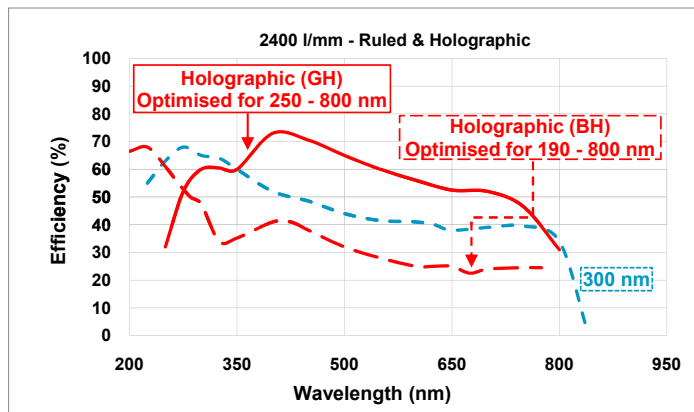
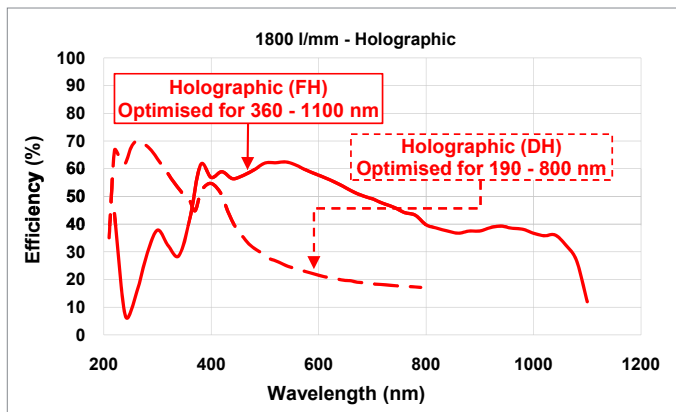
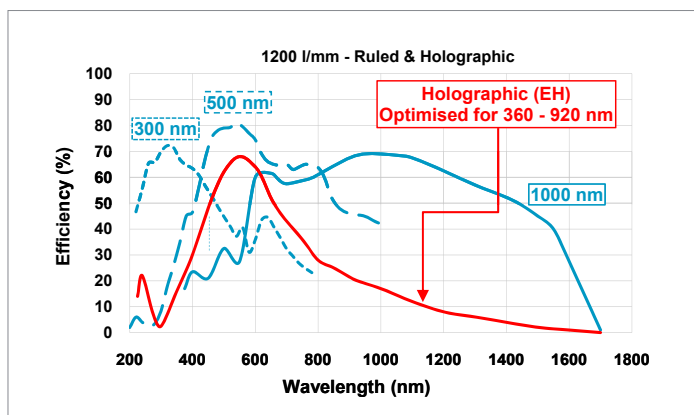
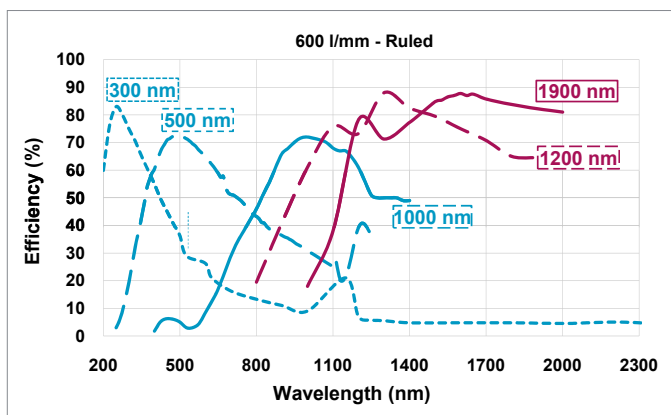
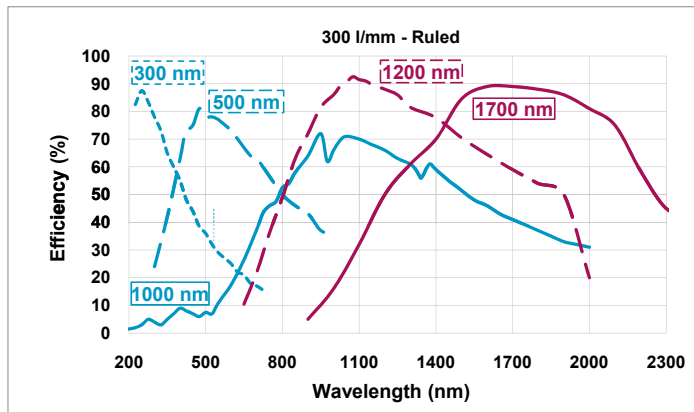
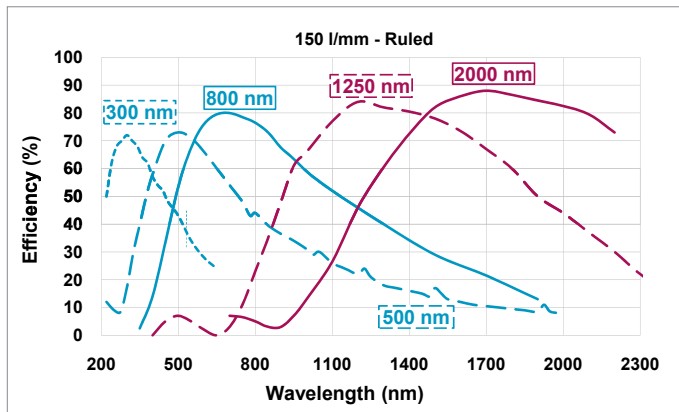
Lines/mm	Blaze (nm)	Nominal dispersion (nm/mm) ^{*7}	Bandpass (nm) ^{*3,*7}	Resolution (nm) ^{*4,*7,*10}	Peak efficiency (%)	Andor part number	Maximum recommended wavelength [nm] ^{*9}	Maximum attainable wavelength [nm]
150	300	32.80	907	1.97	72	SR2-GRT-0150-0300	6820	11150
150	500	32.63	902	1.96	73	SR2-GRT-0150-0500		
150	800	32.35	894	1.94	80	SR2-GRT-0150-0800		
150	1250	31.90	882	1.91	84	SR2-GRT-0150-1250		
150	2000	31.07	859	1.86	88	SR2-GRT-0150-2000		
300	300	16.27	450	0.98	88	SR2-GRT-0300-0300	3410	5575
300	500	16.08	445	0.96	81	SR2-GRT-0300-0500		
300	1000	15.53	429	0.93	72	SR2-GRT-0300-1000		
300	1200	15.29	423	0.92	92	SR2-GRT-0300-1200		
300	1700	14.59	403	0.88	89	SR2-GRT-0300-1700		
600	300	7.99	221	0.48	84	SR2-GRT-0600-0300	1705	2790
600	500	7.77	215	0.47	72	SR2-GRT-0600-0500		
600	1000	7.06	195	0.42	72	SR2-GRT-0600-1000		
600	1200	6.72	186	0.40	88	SR2-GRT-0600-1200		
600	1900 (@1600) ^{*8}	5.17 5.91	143 163	0.31 0.35	88	SR2-GRT-0600-1900		
830	820	4.98	138	0.30	87	SR2-GRT-0830-0820	1230	2015
830	1200	4.17	115	0.25	83	SR2-GRT-0830-1200		
1200	300	3.82	106	0.23	72	SR2-GRT-1200-0300	850	1390
1200	500	3.53	98	0.21	81	SR2-GRT-1200-0500		
1200	1000 (@ 800) ^{*8}	2.45 2.95	68 82	0.15 0.18	69 -	SR2-GRT-1200-1000		
1200	Holographic (500 nm peak)	3.53	98	0.21	81	SR2-GRT-1200-EH*		
1800	Holographic (250 nm peak)	2.48	69	0.15	70	SR2-GRT-1800-DH	570	930
1800	Holographic (380 nm peak)	2.28	63	0.14	62	SR2-GRT-1800-FH		
2400	300	1.68	46	0.10	68	SR2-GRT-2400-0300	425	695
2400	Holographic (220 nm peak)	1.81	50	0.11	68	SR2-GRT-2400-BH		
2400	Holographic (400 nm peak)	1.48	41	0.09	73	SR2-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

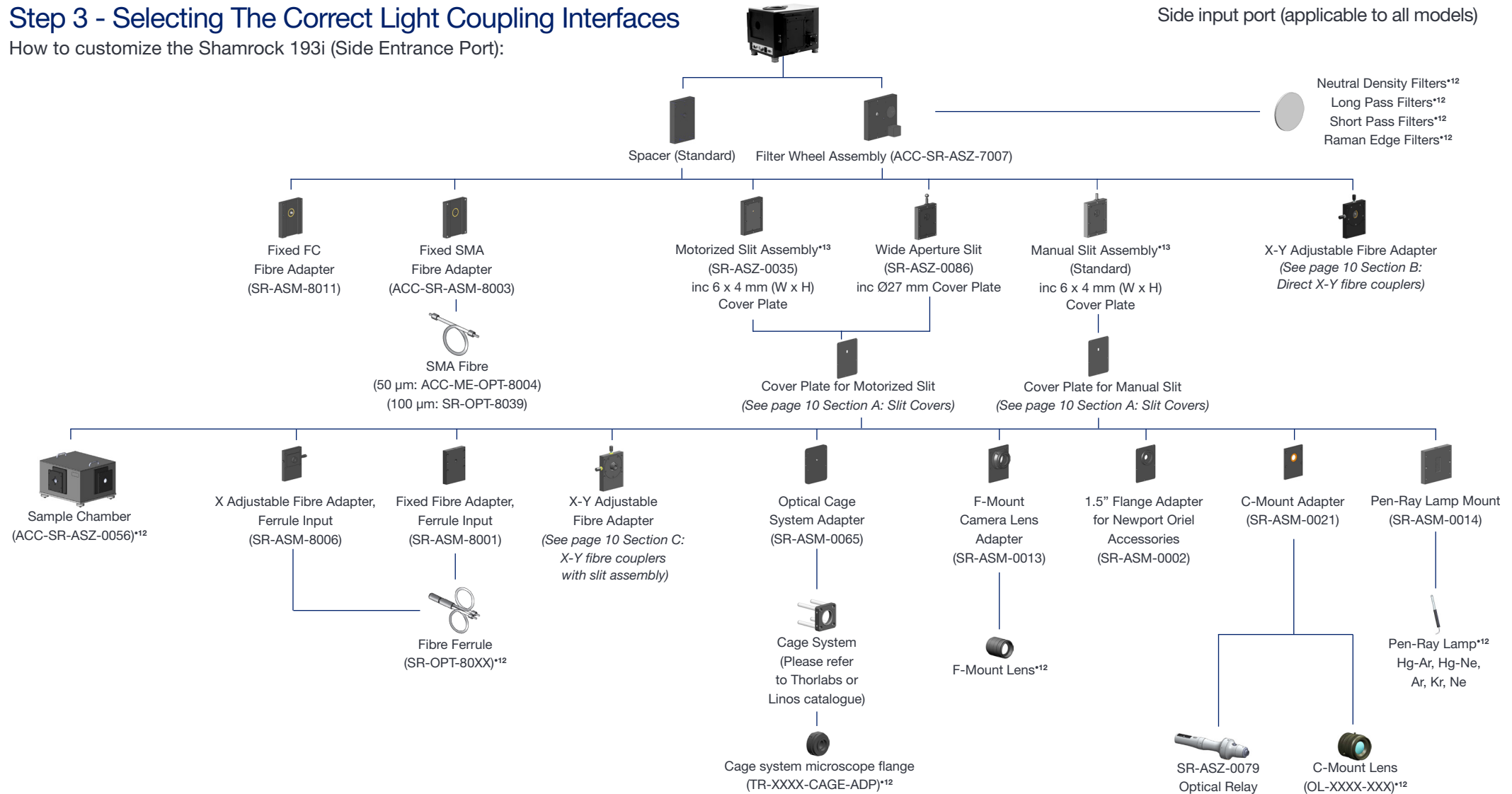


Important Consideration

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

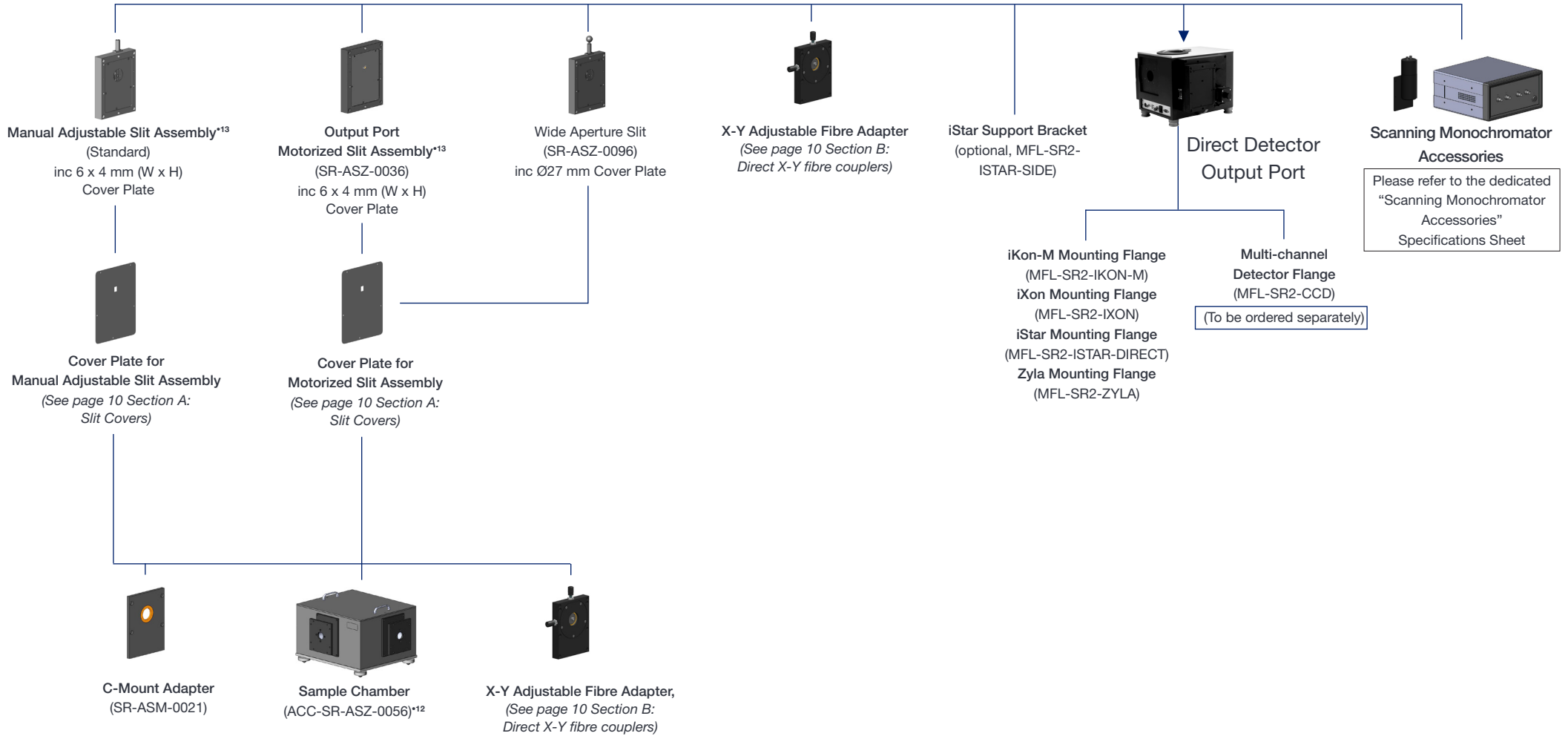
How to customize the Shamrock 193i (Side Entrance Port):



Step 4 - Cameras and Output Port Flanges

How to customize the Shamrock 193i:

Side Output Port (Applicable to B models)



A: Slit Covers

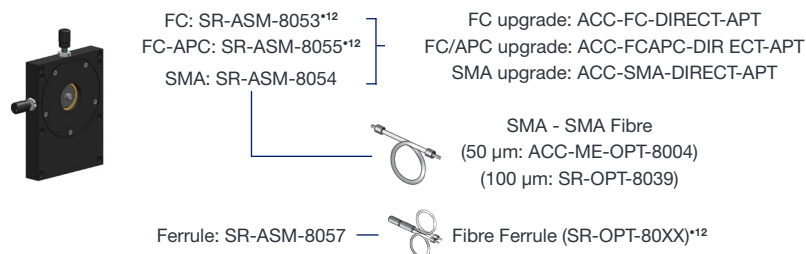
Cover Plate Apertures for Motorized Slit

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-0015 ^{*15}	Ø 15 mm

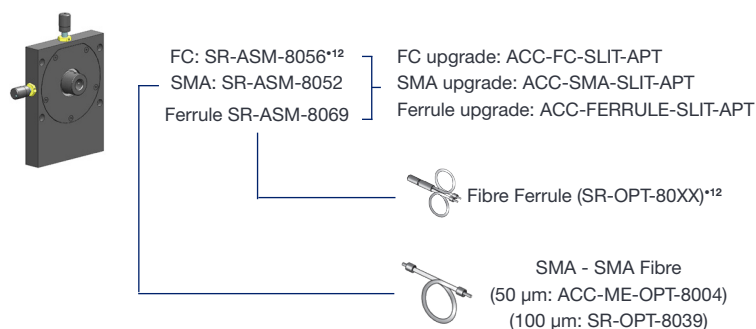
Cover Plate Apertures for Manual Slit

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-0067 ^{*15}	Ø 15 mm

B: Direct X-Y Fibre Couplers



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

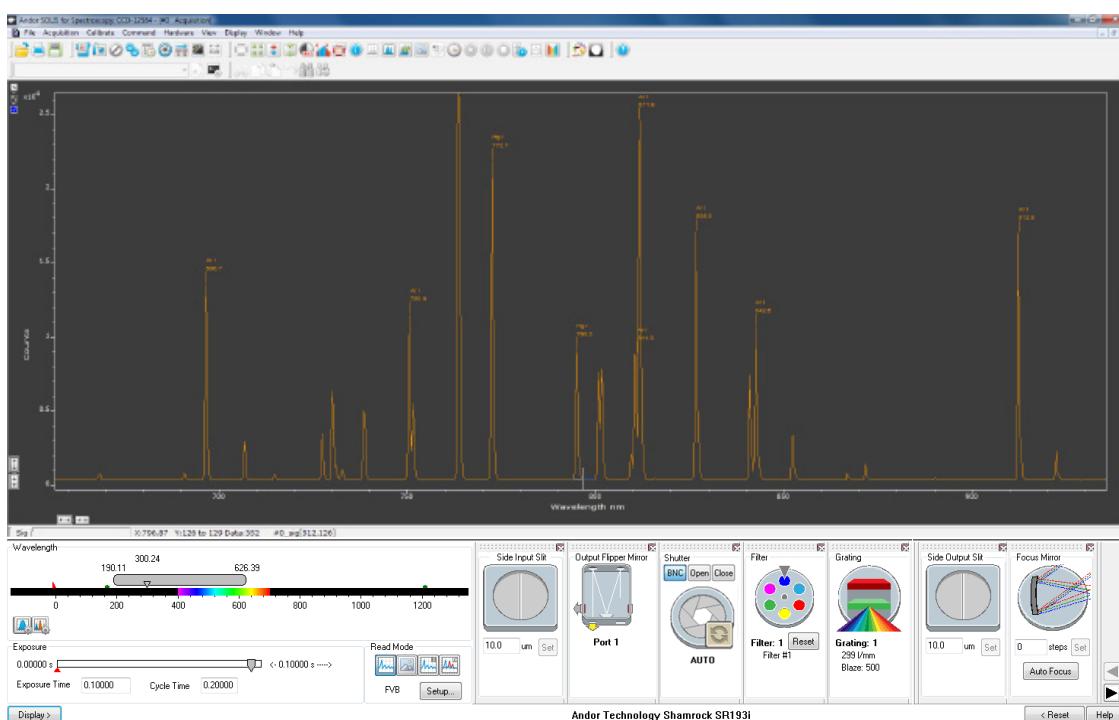


Step 5 - Selecting A Software Option

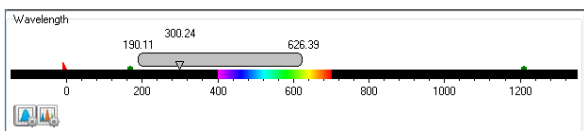
The Shamrock 193i requires at least one of the following software options:

- 1 - **Solis Spectroscopy** A 32-bit and fully 64-bit enabled application for Windows (Vista, 7 and 8) 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 - **Shamrock SDK** A software development kit that allows you to control the Andor range of Shamrock spectrographs from your own application. Compatible as 32 bit libraries for Windows (Vista, 7 and 8). Compatible with C/C++, C#, VB6 and LabVIEW.
- 4 - **Solis Scanning** Dedicated interface for scanning monochromator acquisitions, including comprehensive experimental set-ups builder. Simultaneous control of single point detector Shamrock monochromator and motorized accessories.

Solis Spectroscopy: Dedicated spectroscopy acquisition software

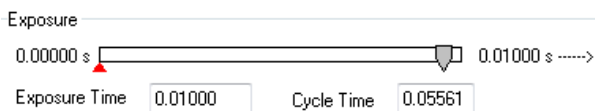


Wavelength drive



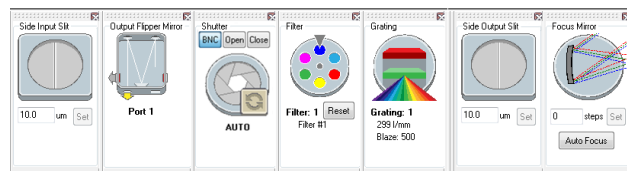
Set the wavelength range for the current grating - drag slider to desired wavelength or just type in appropriate value

Exposure time



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

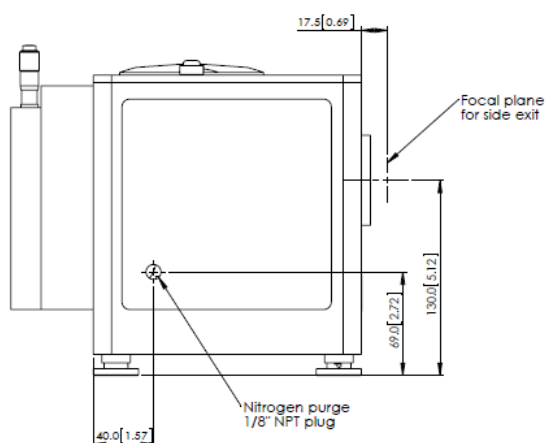
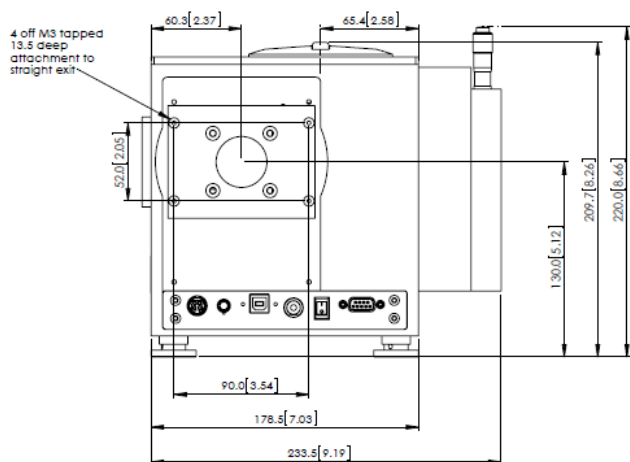
Real Time Control



- (a and f) Slit drive: Control the spectrograph slit width - drag blades on icon or type in required slit width
- (b) Flipper motor: Used to select the appropriate exit port
- (c) Shutter: Synchronization mode selection for shutter operation
- (d) Filter wheel: Used to select a particular filter on the filter wheel - just click on the desired filter position
- (e) 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
- (g) Adaptive focus: Used for automatic focus or user-controlled fine focus optimisation

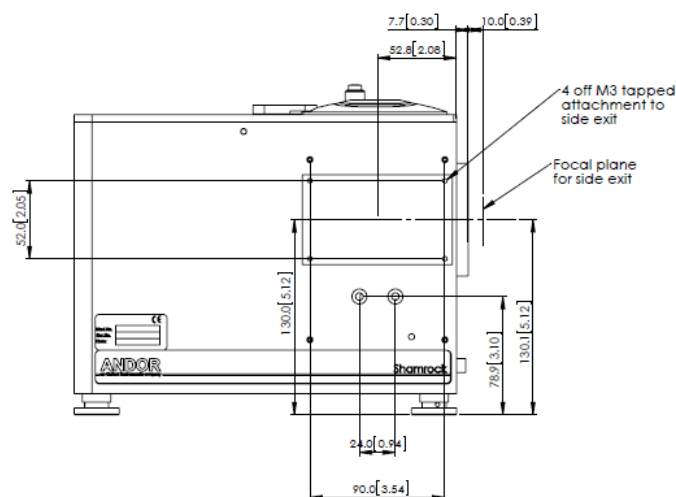
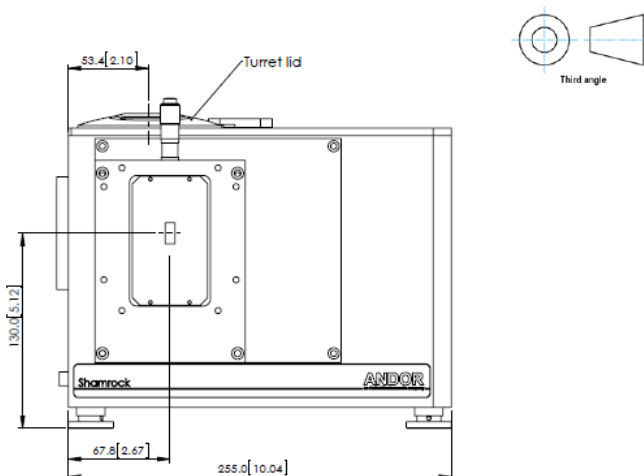
Product Dimensions

Dimensions in mm [inches]



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

Weight: 7.5 kg [16.5 lbs approx]



Optical Axis

Standard feet: Nominal optical axis height: 130 - 136 mm, increments of 6 mm with stackable spacer kit (SR2-ASM-0098).

Connecting to the Shamrock 193i

USB Shamrock Control

Connector type: USB 'B' type

Shutter Control

Connector type: BNC Female, 50 Ω

Applications Guide

- Micro-Spectroscopy
- Absorption-Transmission-Reflection
- Raman (Stimulated, Resonance, CARS, SERS, SORS, TERS)
- Fluorescence -Luminescence
- Photon Counting
- Single Molecule Spectroscopy
- Plasma Studies and LIBS
- Plasmonics

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 16
Grating size (mm)	50 x 50
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}

Wavelength Drive Performance

Wavelength accuracy center ^{*17}	0.15 nm
Wavelength repeatability ^{*18}	75 pm

Wavelength Side Accuracy

Wavelength side accuracy ^{*19}	0.2 nm
-----------------------------------------	--------



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Japan

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

China

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

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 Allen 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.
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: between each measurement the drive is moved 10x including both wavelength and grating changes to reflect typical use.
19. Side accuracy measured using a 27.6 mm wide sensor, reflecting the dispersion calibration and step-and-glue accuracy.

Minimum Computer Requirements:

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

Operating and 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
- Max. power consumption: 21W
(10 Hz shutter and grating turret operation)



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