

## Features and Benefits

- Pre-aligned, pre-calibrated detector & spectrograph**  
 Motorized, individually factory-calibrated systems – out-of-the-box operation and seamless integration to experimental set-ups
- Image astigmatism correction**  
 Optimized toroidal optics enabling high density multi-track capabilities
- USB 2.0 interface**  
 Plug and play connectivity, ideal for laptop operation alongside Andor USB cameras
- Motorized, indexed triple grating turret**  
 Easily upgradable in-the-field
- Dual detector outputs**  
 For extended wavelength coverage when combining Andor UV-Visible CCD and InGaAs cameras  
 Compatible with Andor's range of CCD, ICCD & EMCCD cameras
- Wide range of accessories available**  
 The ultimate in modular set-up and in-field upgradability, including:
  - Motorized slits & filter wheel
  - Microscope interfaces
  - Shutters
  - Fibre-optic & lens couplers
  - Multi-way fibre-optic bundles
  - Light sources and optics
- Silver-protected coated optics option**  
 Most efficient for Near-Infrared detection when used in conjunction with Andor InGaAs cameras

## Research-grade high performance spectrograph

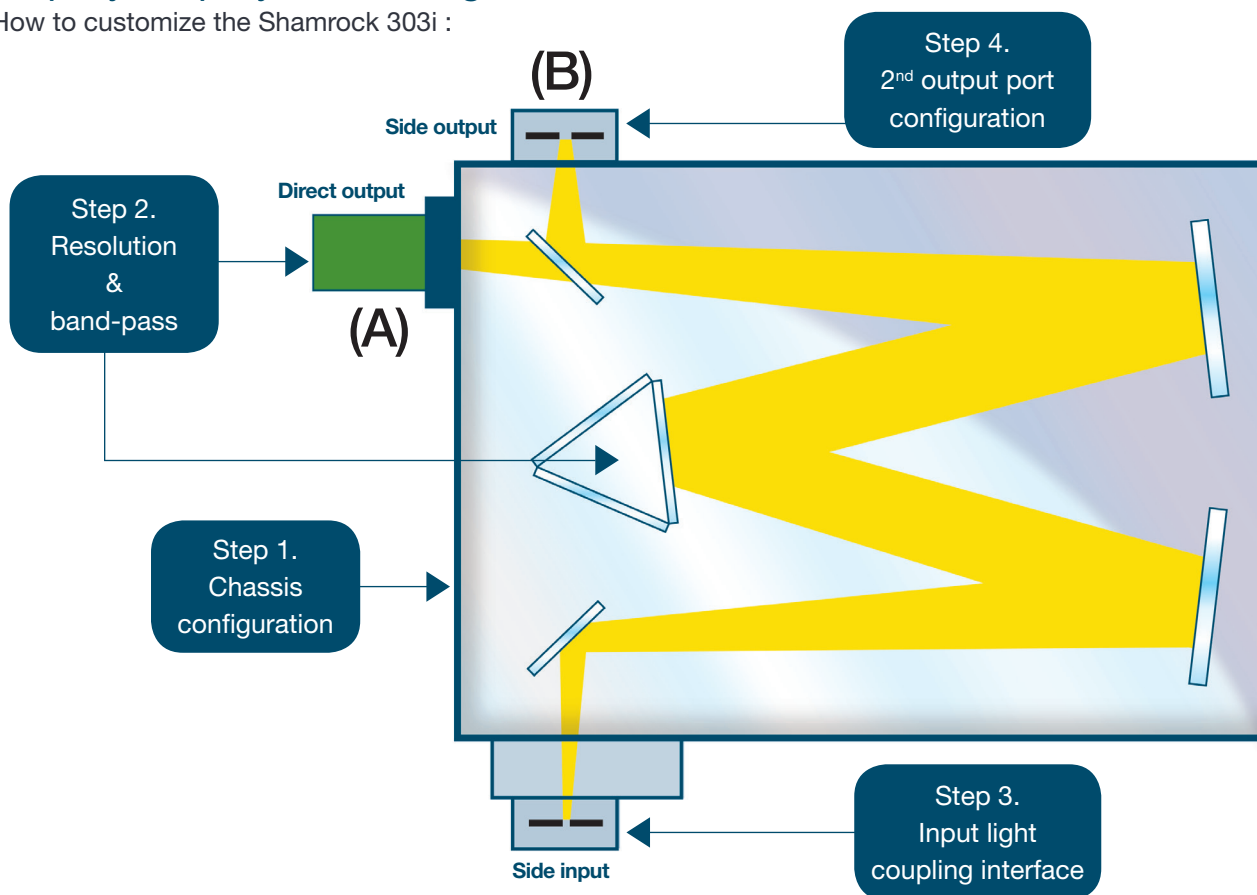
The Shamrock 303i spectrograph is a research-grade, high performance and rugged platform designed for working with demanding low-light applications, but equally suited to day-to-day routine measurements. It is a highly versatile platform configurable seamlessly with a wide range of light coupling interfaces and gratings upgradeable in-the-field. The Shamrock 303i can be seamlessly integrated with Andor's world-class range of CCDs, Electron-Multiplying CCDs, InGaAs and Intensified CCDs to offer a versatile, yet most sensitive modular solutions on the market. Andor Solis software offers the most user-friendly and state-of-the-art real-time control of detectors, spectrograph and motorized accessories at the touch of a button.

## Specifications Summary

<b>Resolution with Newton DU940 CCD</b>	
1200 l/mm @ 500 nm	0.10 nm
2400 l/mm @ 300 nm	0.05 nm
<b>Aperture</b>	F/4
<b>Focal length</b>	303 mm
<b>Magnification @ centre of CCD</b>	
Vertical, spectral flange	1
Vertical, multi-track flange	1
<b>Gratings</b>	Interchangeable indexed triple turret
<b>Slit width range (input/output)</b>	Motorized 10 µm to 2.5 mm Wide aperture option to 12 mm
<b>Communication</b>	USB 2.0
<b>Wavelength accuracy</b>	0.04 nm
<b>Wavelength repeatability</b>	4 pm
<b>Stray light</b>	2.2 x 10 <sup>-5</sup>

## Step-by-Step System Configuration

How to customize the Shamrock 303i :



### Step 1. - Chassis configuration

- Select either a single output port (model A) or dual output port (model B) option.
- Select type of optics coating required (aluminium +  $\text{MgF}_2$  is standard, protected silver coated optics available on request for NIR detection).
- Select purge port option (for extended detection below 180 nm), and shutter for background acquisition and detectors protection.

### Step 2. - Resolution & band-pass

- Select the appropriate Shamrock spectrograph platform, giving due consideration to bandpass and spectral range requirement.
- Select gratings and detector to fulfill 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 3<sup>rd</sup> party hardware connectivity).

### Step 4. - 2<sup>nd</sup> exit port configuration

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

### Step 5. - Software interface

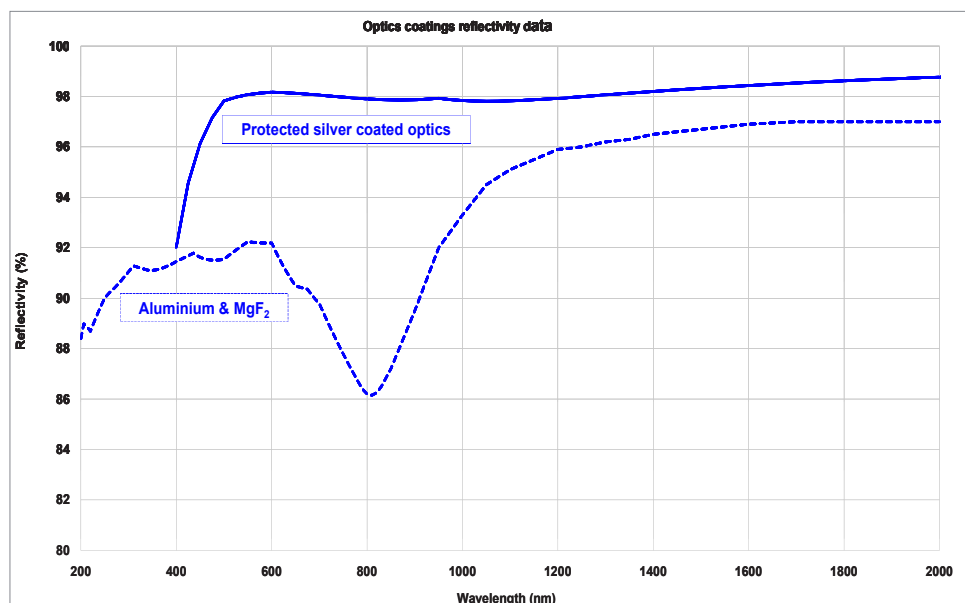
Select either state-of-the-art Solis software or Software Development Kit (SDK) option – please refer to appropriate section for further information.

## Step 1 - Chassis Configuration

### Ordering Information

Model	Side input port	Direct output port	Side output port	Motorized flipper mirror
SR-303i-A	Motorized slit	Camera	-	-
SR-303i-B	Motorized slit	Camera	Camera (standard) Optional motorized slit	✓
SR-303i-X-SIL	Protected silver coated optics for models shown above (replace X with relevant model number)			

### Optics Coatings Reflectivity Graph

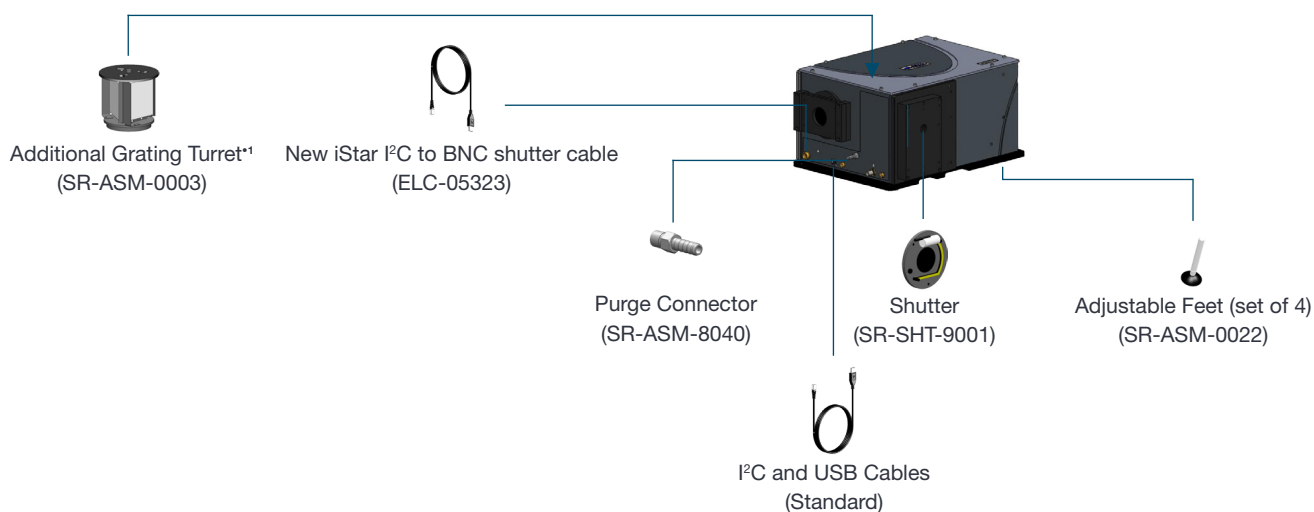


The graph shows the standard Al + MgF<sub>2</sub> optics coatings reflection efficiency versus wavelengths.

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.

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](http://andor.com/calculators)

Czerny-Turner spectrographs are designed to provide the best optical performance for a range of grating angles as indicated by 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 indicated 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)
<b>Shamrock 163</b>						
Bandpass (nm) <sup>*2,*4</sup>	1072	529	256	117	68	56 <sup>*5</sup>
Resolution (nm) <sup>*3,*4</sup>	1.57	0.77	0.37	0.17	0.10	0.08 <sup>*5</sup>
<b>Shamrock 303i</b>						
Bandpass (nm) <sup>*2,*4</sup>	600	297	144	67	39	32 <sup>*5</sup>
Resolution (nm) <sup>*3,*4</sup>	0.88	0.43	0.21	0.10	0.06	0.05 <sup>*5</sup>
<b>Shamrock 500i</b>						
Bandpass (nm) <sup>*2,*4</sup>	357	177	86	40	26	19 <sup>*5</sup>
Resolution (nm) <sup>*3,*4</sup>	0.52	0.26	0.13	0.06	0.04	0.03 <sup>*5</sup>
<b>Shamrock 750</b>						
Bandpass (nm) <sup>*2,*4</sup>	242	120	59	28	18	14 <sup>*5</sup>
Resolution (nm) <sup>*3,*4</sup>	0.35	0.18	0.09	0.04	0.03	0.02 <sup>*5</sup>

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.

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

The Shamrock 303i features an innovative triple grating turret, designed to offer flexibility and control over your choice and interchange of gratings. The triple grating turret can be easily and speedily removed, and replaced by an alternative turret with new gratings. The intelligent design of the 303i means that only a simple offset adjustment is required once the new turret and gratings are added. The 303i 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 three pre-installed gratings per turret (see below for details). If the grating you require is not on the list, please contact Andor for further details. Additional grating turret(s) (part number SR-ASM-0003) can also be supplied on request.



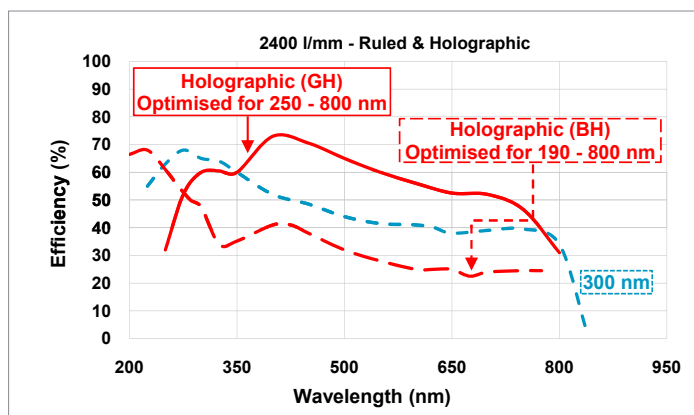
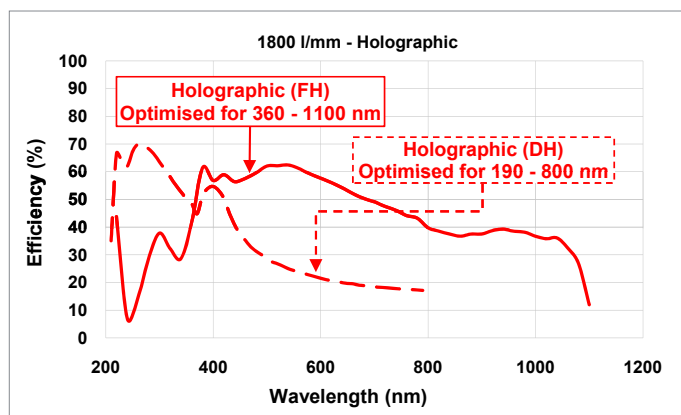
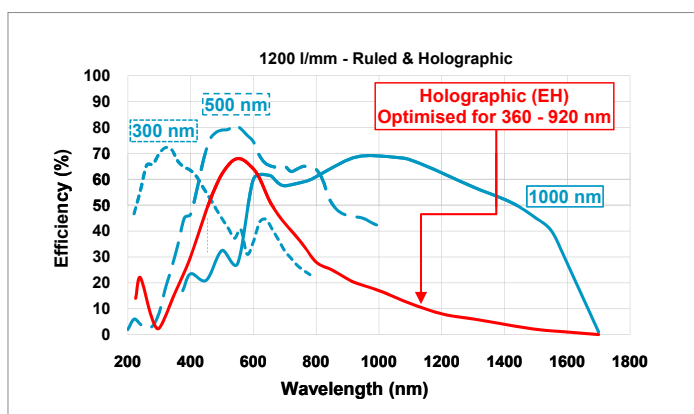
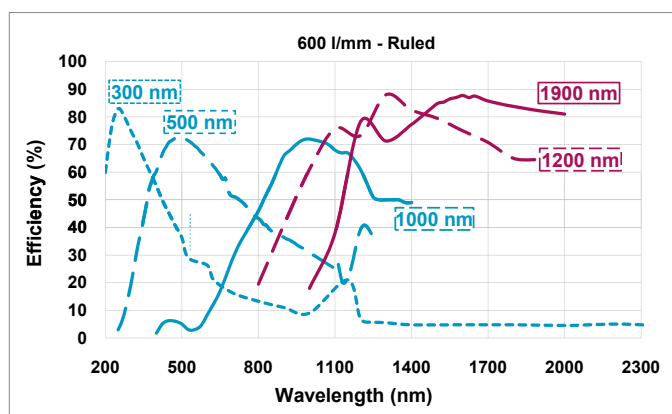
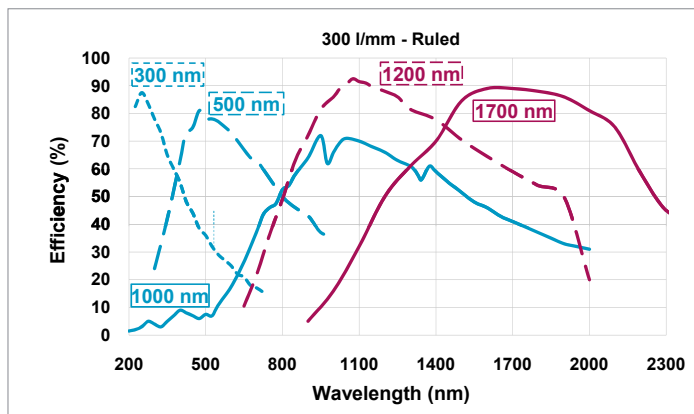
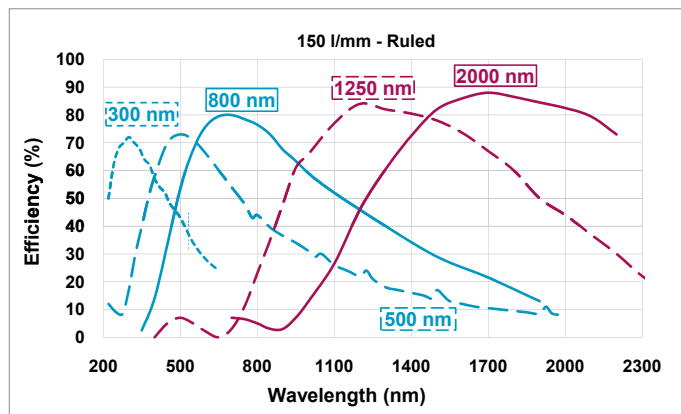
Lines/mm	Blaze (nm)	Nominal dispersion (nm/mm)* <sup>6</sup>	Bandpass (nm)* <sup>2,6</sup>	Resolution (nm)* <sup>3,6,9</sup>	Peak efficiency (%)	Andor part number	Maximum recommended wavelength (nm)	Maximum attainable wavelength (nm)
150	300	21.79	603	0.89	72	SR3-GRT-0150-0300	6910	11300
150	500	21.70	600	0.88	73	SR3-GRT-0150-0500		
150	800	21.56	596	0.87	80	SR3-GRT-0150-0800		
150	1250	21.32	589	0.86	84	SR3-GRT-0150-1250		
150	2000	20.87	577	0.85	88	SR3-GRT-0150-2000		
300	300	10.83	299	0.44	88	SR3-GRT-0300-0300	3455	5650
300	500	10.73	297	0.43	81	SR3-GRT-0300-0500		
300	1000	10.43	288	0.42	72	SR3-GRT-0300-1000		
300	1200	10.30	285	0.42	92	SR3-GRT-0300-1200		
300	1700	9.91	274	0.40	89	SR3-GRT-0300-1700		
600	300	5.34	148	0.22	84	SR3-GRT-0600-0300	1730	2825
600	500	5.22	144	0.21	72	SR3-GRT-0600-0500		
600	1000	4.82	133	0.20	72	SR3-GRT-0600-1000		
600	1200	4.62	128	0.19	88	SR3-GRT-0600-1200		
600	1900 (@1600)* <sup>7</sup>	3.71 4.15	102 115	0.15* <sup>8</sup> 0.17	88	SR3-GRT-0600-1900		
1200	300	2.58	71	0.10	72	SR3-GRT-1200-0300	865	1410
1200	500	2.41	67	0.10	81	SR3-GRT-1200-0500		
1200	1000 (@ 800)* <sup>7</sup>	1.77 2.07	49 57	0.07* <sup>8</sup> 0.08	69 69	SR3-GRT-1200-1000		
1200	Holographic (500 nm peak)	2.41	67	0.10	81	SR3-GRT-1200-EH*		
1800	Holographic (250 nm peak)	1.68	46	0.07	62	SR3-GRT-1800-DH	575	940
1800	Holographic (380 nm peak)	1.43	39	0.06	70	SR3-GRT-1800-FH		
2400	300	1.16	32	0.05	68	SR3-GRT-2400-0300	430	705
2400	Holographic (220 nm peak)	1.23	34	0.05	68	SR3-GRT-2400-BH		
2400	Holographic (400 nm peak)	1.04	29	0.04	73	SR3-GRT-2400-GH		
Mirror	UV-VIS	-	-	-	-	SR3-GRT-MR-AL-MGF2	-	-
Mirror	VIS-NIR	-	-	-	-	SR3-GRT-MR-SILVER		

\*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



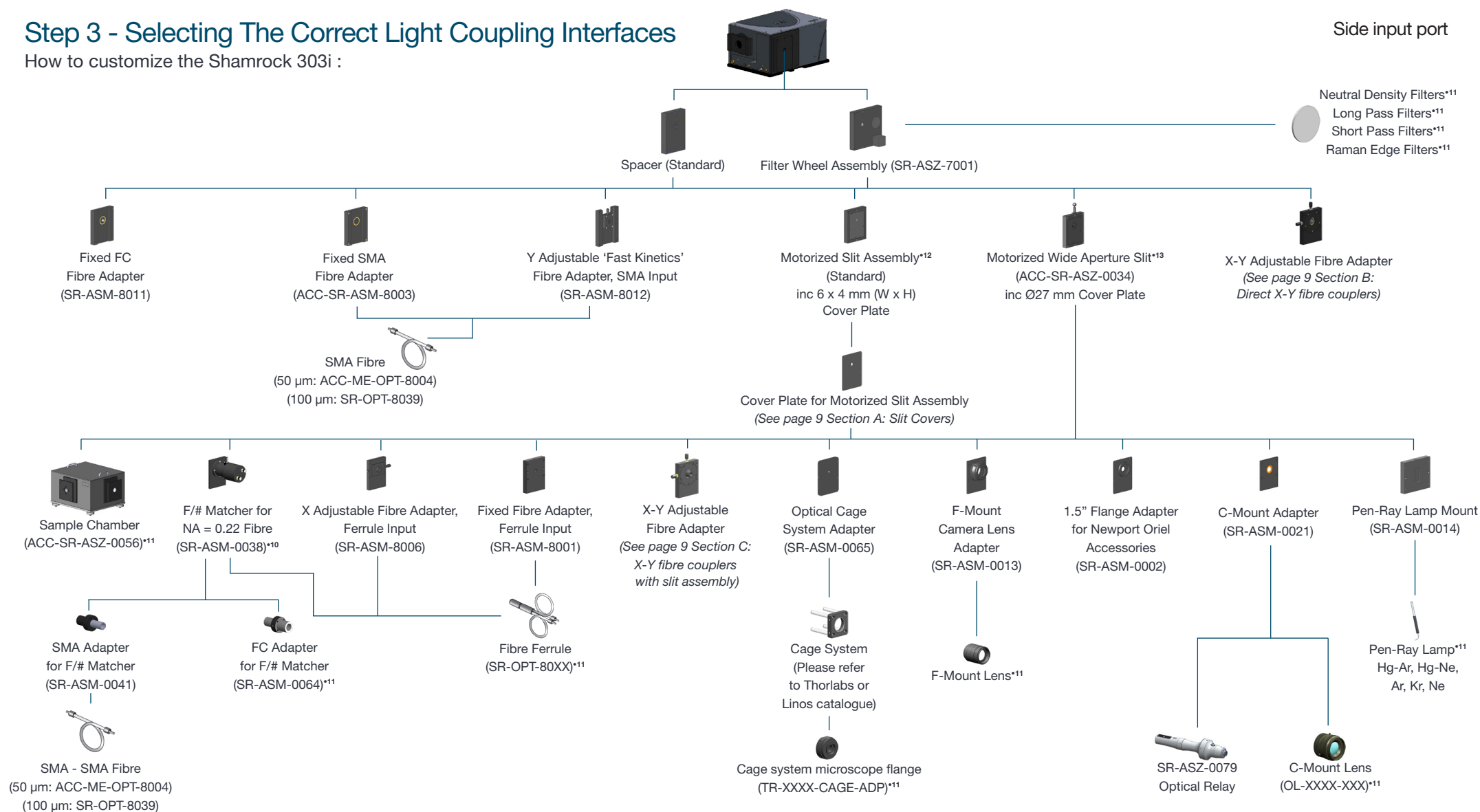
## Important Consideration

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



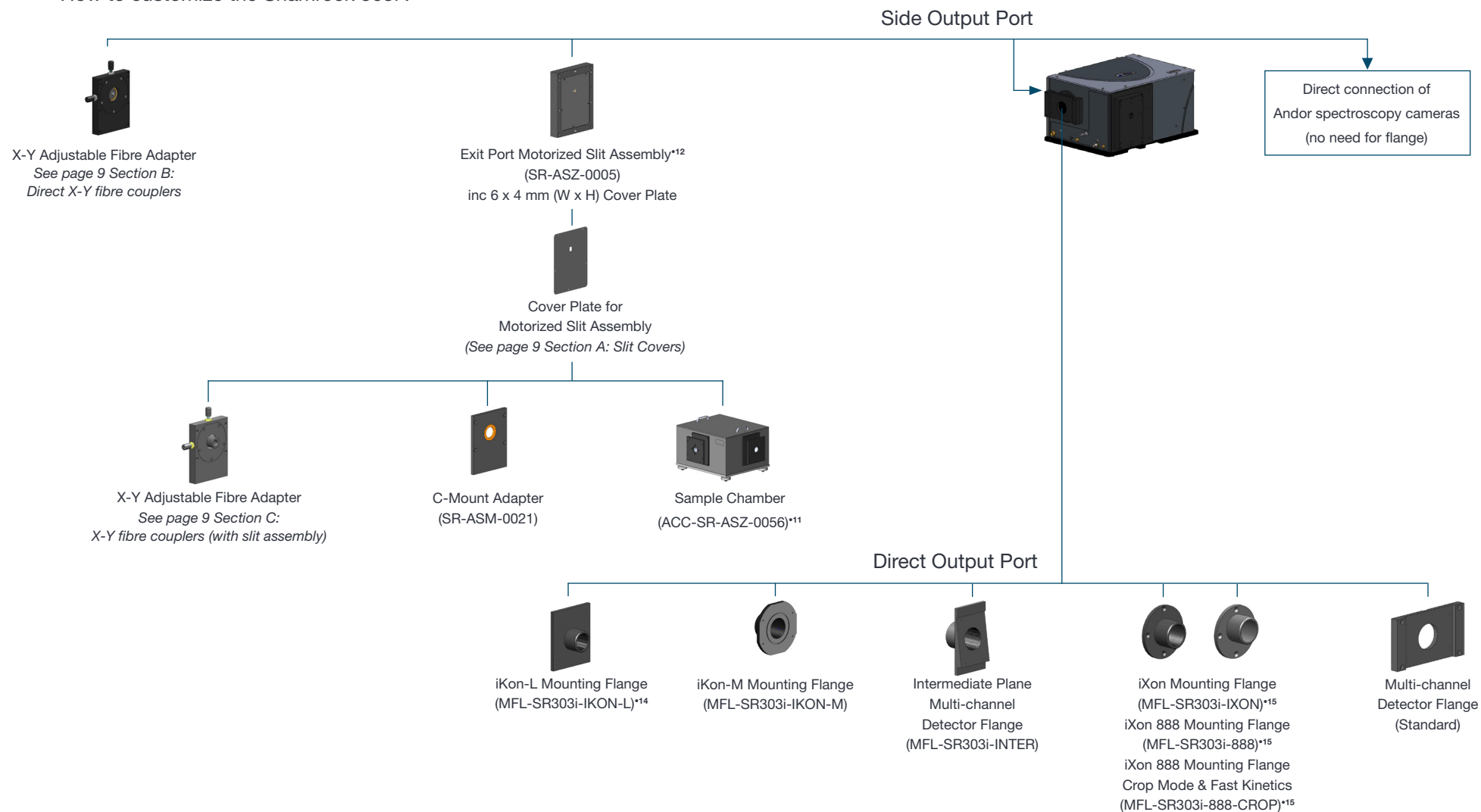
## Step 3 - Selecting The Correct Light Coupling Interfaces

How to customize the Shamrock 303i :



## Step 4 - Cameras & Output Port Flanges

How to customize the Shamrock 303i :



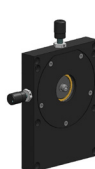


## A: Slit Covers

Cover Plate Apertures for Motorized Slit

Part No.	Size
SR-ASM-0010	6 x 8 mm (W x H)
SR-ASM-0011	6 x 14 mm (W x H)
SR-ASM-0015* <sup>16</sup>	Ø 15 mm
SR-ASM-0016* <sup>17</sup>	6 x 4 mm (W x H)
SR-ASM-0017	6 x 6 mm (W x H)

## B: Direct X-Y Fibre Couplers



FC: SR-ASM-8053\*<sup>11</sup>  
 FC-APC: SR-ASM-8055\*<sup>11</sup>  
 SMA: SR-ASM-8054

FC upgrade: ACC-FC-DIRECT-APT  
 FC/APC upgrade: ACC-FCAPC-DIRECT-APT  
 SMA upgrade: ACC-SMA-DIRECT-APT

SMA - SMA Fibre  
 (50 µm: ACC-ME-OPT-8004)  
 (100 µm: SR-OPT-8039)

Ferrule: SR-ASM-8057 — Fibre Ferrule (SR-OPT-80XX)\*<sup>11</sup>

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



FC: SR-ASM-8056\*<sup>11</sup>  
 SMA: SR-ASM-8052  
 Ferrule SR-ASM-8069

FC upgrade: ACC-FC-SLIT-APT  
 SMA upgrade: ACC-SMA-SLIT-APT  
 Ferrule upgrade: ACC-FERRULE-SLIT-APT

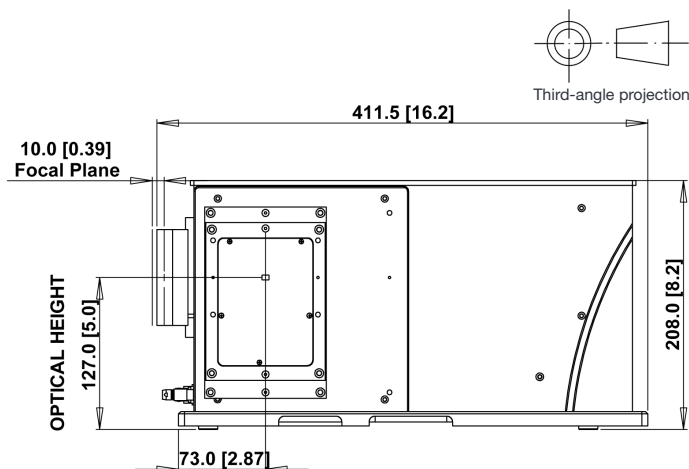
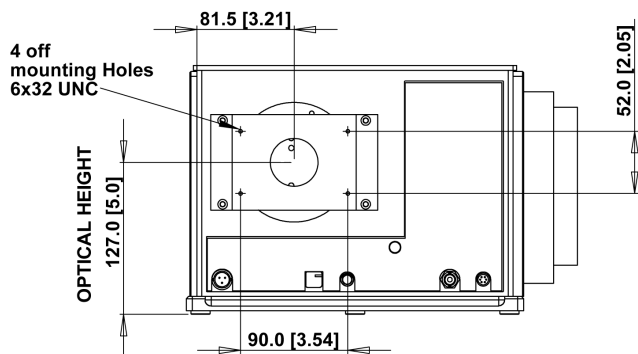
Fibre Ferrule (SR-OPT-80XX)\*<sup>11</sup>

SMA - SMA Fibre  
 (50 µm: ACC-ME-OPT-8004)  
 (100 µm: SR-OPT-8039)



## Product Drawings

Dimensions in mm [inches]



### Optical Axis

127 mm [5"] with pad feet

The optical path height is shown with standard feet attached. The height with adjustable feet SR-ASM-0022 varies from 143 mm [5.6"] to 173 mm [6.8"]

### Screw Type Requirements

CCD flange to Spectrograph flange	4 off, M4 x 16
Camera to CCD flange	4 off, M3 x 10
iXon camera to iXon flange	4 off, M5 x 10, countersunk, hex head

## Connecting to the Shamrock 303i

### USB Shamrock Control

Connector type: USB 'B' type

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

Connector type: 5-pin, 1 = I<sup>2</sup>C data, 2 = I<sup>2</sup>C clock, 3 = Earth, 4 = Shutter TTL, 5 = 5 V

### Shutter Control

Connector type: BNC Female, 50 Ω

## Wavelength Drive Performance

Wavelength accuracy * <sup>18</sup> Center	0.04 nm
Wavelength repeatability * <sup>19</sup>	4 pm

## Shutter Specifications

Maximum repetition rate	2 Hz
Minimum open/close time	15 ms
Minimum lifetime	Better than 100K cycles

## Optical Properties

Focal plane size (mm, W x H)	28 x 14
Stray light * <sup>20</sup>	
FVB (1 nm from laser)	$8.3 \times 10^{-4}$
FVB (10 nm from laser)	$2.2 \times 10^{-5}$
1 mm strip (1 nm from laser)	$6.1 \times 10^{-4}$
1 mm strip (10 nm from laser)	$2.2 \times 10^{-5}$

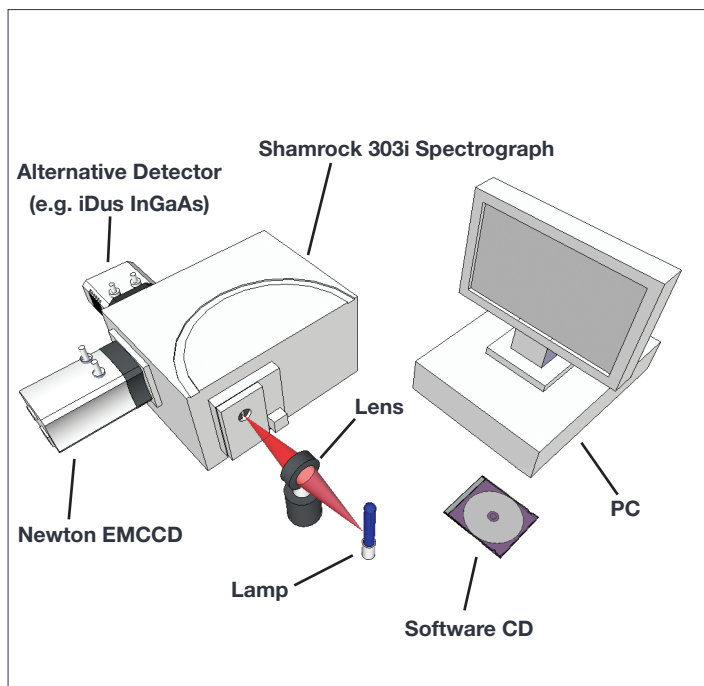
## Wavelength Side Accuracy

Wavelength side accuracy * <sup>21</sup>	0.08 nm
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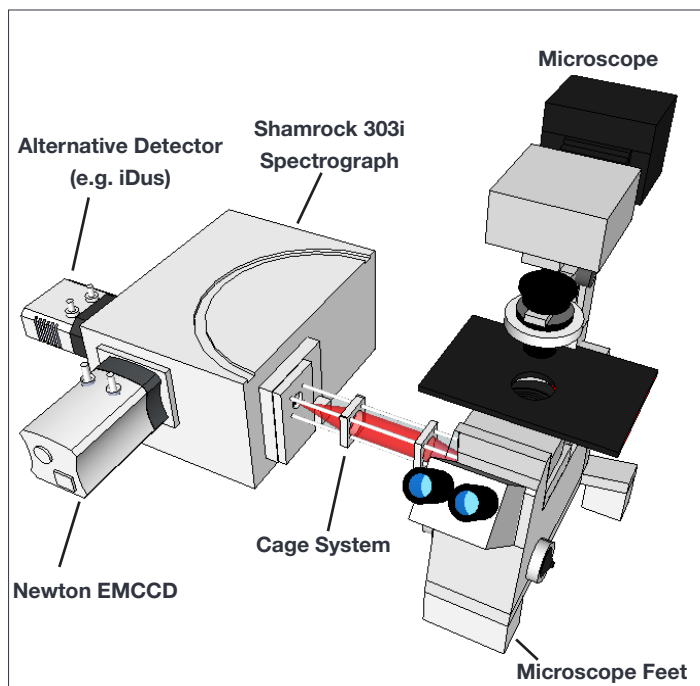
## Applications Guide

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

## Typical Setup - Spectroscopy



## Typical Setup - Microspectroscopy





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 Phone +86 (10) 5129 4977  
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### Items shipped with your spectrograph

- 1x 3 m USB 2.0 cable Type A → Type B
- 1x Power supply with 3 m mains cable
- 1x PCI / I<sup>2</sup>C cable
- 1x Camera / spectrograph I<sup>2</sup>C 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 & 5 mm)

### Regulatory Compliance

Compliant with the requirements of the EU EMC and LV Directives, compliant with the international EMC and safety standards IEC 61326-1 and IEC 61010-1.

### 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. Typical values quoted with 27.6 mm wide CCD, e.g. Newton DU940.
3. Typical values quoted with 10 µm slit and 13.5 µm pixel CCD, e.g. Newton DU940.
4. Typical values quoted @ 500 nm centre wavelength.
5. Typical values quoted @ 300 nm centre wavelength.
6. Typical values quoted at maximum efficiency wavelength or blaze wavelength unless otherwise stated.
7. Wavelength within the recommended operating spectral region.
8. Indicative values; the working range of these gratings is principally in the region where optical aberrations may alter the system resolution performance quoted.
9. Values shown are representative of a triple grating system, where resolution has been optimised to give the best performance for the three gratings and across the full recommended wavelength range. 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.
10. Please refer to F/# matcher specification sheet for magnification considerations.
11. Please refer to the local sales representative or website for further information on available options and complimentary accessories.
12. Slit widths range from 10 µm to 2.5 mm motorized.
13. Slit widths range from 10 µm to 2.5 mm motorized (full opening at 12 mm manually for wide aperture slit. Standard slit cover aperture is Ø 27 mm.
14. Require shutterless camera models. Please contact your local representative for further information.
15. Additional I<sup>2</sup>C cable (ELC-00648) is required when operating Shamrock 303i with these cameras.
16. Recommended for use with fibre-optics and C-mount accessories.
17. Provided as standard.
18. Average measurements using > 30 calibration lines, covering the recommended grating angle operating range with a 1200 l/mm grating.
19. 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.
20. 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.
21. 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 and 7)

### 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

110 - 240 Vac, 50 - 60 Hz



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 Matlab is a registered trademark of The MathWorks Inc.

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