DOUBLE DISPERSIVE AUTOMATED MONOCHROMATOR-SPECTROGRAPH **M833**

M833 is a unique high-aperture double dispersive monochromator-spectrograph whose compact design combines high spectral resolution intrinsic for long-focus instruments and extremely low stray light that is an essential requirement for Raman spectroscopy, as well as for any other low-light-level applications.



FEATURES

The compact high-aperture (F# 1:5.5) long-focus instrument allows you solving tasks demanding high spectral resolution, yet occupies little space in your laboratory and, besides, is mobile.

Extremely low stray light due to the unique double-dispersion scheme and absence of re-reflections greatly extends your opportunities in working with low signals. You will be able to register Stokes and anti-Stokes components within 20 cm-1 from the excitation line (for 1200 gr/mm gratings) without using notch or edge filters.

M833i in the Imaging mode (optional) ensures absolute astigmatism compensation and extraordinary resolution along the exit slit while maintaining ideal line quality. IMAGING version is arranged by an automated folding mirror switching radiation between two output ports. This allows obtaining Imaging effect at the lateral output port, keeping the standard configuration of the axial output port.

Three pairs of gratings (grating type and blaze are at Customer's choice) are supplied in a standard set and ensure the widest range of applications.

Two input and two output ports can be completed with the full set of accessories manufactured by SOLAR LS: standard and crossed entrance slits, order separating filter wheels, aperture matching units and optical fibers, CCD detectors and adapters for them.

Two output slits in M833 feature precise slit focusing units.

Detector adapters in M833 feature ability for fine through focus adjustment.

Fully automated computer control: slits, grating turrets and filter wheels, input/output port switching is controlled via Full-Speed USB interface.

The SolarLS.LAB software provides automated control over the M833 and its detector. It allows to stitch spectra obtained by several diffraction grating scans in order to get a panoramic spectrum. Many possibilities of spectra processing and analysis are provided as well.

At your request, **DLL and\or VI program modules** are supplied for controlling the instrument via the individually designed software or LabVIEW.

APPLICATIONS

- Raman spectroscopy
- Emission and fluorescent spectroscopy
- Multi-channel & imaging spectroscopy
- Analytical tasks in the range from UV to IR

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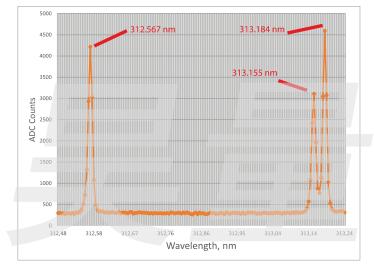
M833 ADVANTAGES

The M833 is a unique double dispersive monochromator-spectrograph consisting of two Czerny-Turner monochromators. Its key difference from any conventional double monochromator is that the M833 features the (30x10) mm flat field and allows attaching not only a single detector (PMT), but also a multichannel array for simultaneous detection of a wide spectrum range.

The optical matching system provides an optical coupling between the two monochromators-spectrographs located one above the other in a two-level optical design. Thus, we achieve compactness and mobility of the long-focus monochromator-spectrograph M833.

The optical matching system ensures the complete coma compensation for any wavelength in the center of the exit slit (or in the center of a multichannel array). As a result the M833 does not have the spectral region of primary coma compensation. The M833 demonstrates its unique spectral resolution and high spectral line quality for any wavelength within the spectral range of gratings diffraction efficiency.

The M833 optical layout and design completely exclude the possibility of re-reflections in specified spectral regions of the device operation, and reduce



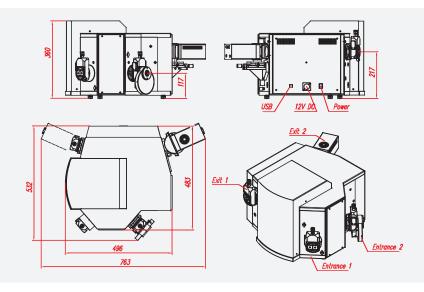
stray light by two orders of magnitude as compared to single monochromators having similar dispersion/focal length.

The M833 astigmatic segment is 7.7 mm in the center of the flat field, and respectively 7.4 mm and 8.2 mm at the edges of the field. Astigmatism does not usually impair the instrument resolution, but, depending on the height of the detector used, can affect the overall sensitivity of the system:

M833 magnification	Horizontal	Vertical
without astigmatism compensation	1.08	1.08
with astigmatism compensation	1.08	0.8

Mercury lamp lines (312.567 nm, 313.155 nm, 313.184 nm) registered with the M833 (diffraction grating 1800 gr/mm) demonstrate high optical quality of the instrument.

Monochromator-spectrograph M833 is fully compatible with all Solar LS optics & accessories and detectors. Possible types of detectors and PMT for monochromator-spectrograph M833 are listed on the page 53.



M833 dimensions.

M833 SPECIFICATIONS

Spectral range- Typical 180-4800 nm (refer to the specifications below) - Up to 40µm when the apportate gratings are usedImagingOptical ports. Available for the steral output to the specification outputsOptical portsCoptical portsF/NumberCoptical length, mmEffective focal length, mmCoptical portsFlat field, mmCoptical portsDiffraction gratingsCoptical portsGrooves/mmQado1800Itel action gratingsOptical portsGrooves/mmQado18002000600000Glaze wavelength, nmSection outputSection outputSection outputColspan="4">Coptical portsSection outputSection outputFlat field, mmSection outputSection outputOptical portsSection outputSection outputFlat field, mmSection outputSection outputGrooves/mmSection outputSection outputGrooves/mmSection outputSection output	Ontiral ashama		Ontin	aired Creany Turn		arcian			
Speed any operation of the segment of a segmen	optical scheme		Optimized Czerny-Turner with double dispersion						
Optical portsImport and two pointsFNumber155Effection for legith, run283Fak field, run28001200900600300Bace wavelength, run240018001200900600300Bace wavelength, run28544060060010002000Bace wavelength, run2860850980-100560000560 <td< th=""><th>Spectral range</th><th></th><th colspan="5"></th></td<>	Spectral range								
FNumberISUBLEEffective focal length, mmISUBLEBar field, mmISUBLEDiffication gardingsISUBLEGrancer, mmAdditionISUBLEDiffication gardingsISUBLEGrancer, mmAdditionISUBLEBia wavelength, mmAdditionAdditionISUBLEBia wavelength, mmAdditionISUBLEISUBLEISUBLEBia wavelength, mmAdditionAdditionAdditionAdditionISUBLE <th colsp<="" th=""><th>Imaging</th><th></th><th colspan="6">Option. Available for the lateral output port</th></th>	<th>Imaging</th> <th></th> <th colspan="6">Option. Available for the lateral output port</th>	Imaging		Option. Available for the lateral output port					
Effective focal length, nmSUBJECT SUBJECT	Optical ports		2 inputs and two outputs						
Indication gratingSubstrate Substrate S	F/Number		1:5.5						
Diffaction gratingsTUT-WIT with with with with with with with with	Effective focal length, mm		833						
Grooves/mm 2400 1800 1200 900 600 300 Baze workengh, nm 225 400 600 600 100-00 200-4800 Mechanical scanning range 0-640 0-850 6-1280 0-1710 0-2560 150-4800 Mechanical scanning range 0-640 0-850 6-1280 0-1710 0-2560 0-5120 Mechanical scanning range 0-640 0-630 0-92-54 122-072 184-108 368-216 Mechanical scanning range 0-4600 11.28 0-69-58 39-932 25-13.8 470-27.6 Mechanical scanning range 0.015-000 002-001 0-04-0024 0.02.9 0.03 0.04-0024 0.02.9 0.02 0.02 0.02 0.02 0.02 0.02 0.02.9	Flat field, mm		30 x 10						
Blaze wavelength, nm 225 400 600 600 1000 2000 Effective spectral range? 190-600 253-800 380-1200 566-1600 760-2400 1500-4600 Mechanical scaming range 0-640 0-850 0-1700 0-1700 0-550 0-5100 Reciporal liner dispersion on the edges of the spectral range, nm 0.39 0.52 0.78 1.0 1.56 312 Output bandwidth on the edges of the spectral range, nm 0.39 0.52 0.39 0.34.4 0.56 32.5 0.32.4 0.99-23.7 2.51.18 47.0-2.76 Average value, nm 0.015 0.09 0.02.001 0.04.044 0.032.4 0.03.44 0.032.4 0.03.44 0.032.4 0.03.44 0.032.4 0.03.4 0.04.4 <t< th=""><th>Diffraction gratings</th><th>70></th><th colspan="6">70x70x10mm, automated turret with three pairs of gratings from the list belo $^{\mbox{\tiny 1)}}$</th></t<>	Diffraction gratings	70>	70x70x10mm, automated turret with three pairs of gratings from the list belo $^{\mbox{\tiny 1)}}$						
Iffective spectral range [®] 190-600 233-800 380-1200 566-1600 760-200 1500-4800 Mechanical scanning range 0-640 0-650 0-1280 0-1710 0-256 0-5120 Reciprocal liner dispersion on the edges of the spectral range, mm/mm 0.04 0.032 0.07 0.128 1.04 1.56 3.12 Output bandwidth on the edges of the spectral range, nm 13.3-79 19.95-11.8 26.6-15.8 39.9-23.7 23.5-13.8 47.0-27.6 Average value, nm 0.05.009 0.02-00 0.00-0024 0.00107 0.04-0024 0.01-004 0.02-007 0.02-07 0.02-07 0.02-07 0	Grooves/mm	2400	1800	1200	900	600	300		
Mechanical samming range 0-6440 0-850 0-1280 0-1710 0-2560 0-5120 Reciprocal liner dispersion on the edges of the spectral range, nm/mm 0.46-0.27 0.61-0.36 0.92-0.54 1.22-072 1.84-1.08 3.68-2.16 Average value, nm/mm 0.37 0.37 1.97-118 26.6-15.8 39.9-237 2.5-13.8 47.0-27.6 Average value, nm 0.015-000 0.02-0012 0.03-0017 0.04-0024 0.03-0017 0.04-0024 0.012-00 0.02-0012 0.03-0017 0.04-0024 0.02-0012 0.03-0017 0.04-0024 0.02-0012 0.03-0017 0.04-0024 0.02-0012 0.02-0012 0.03-0017 0.04-0024 0.02-0012 0.02-0012 0.03-0017 0.03-0017 0.04-0024 0.02-0012 0.00-0014 0.02-0012 0.00-0014 0.02-0012 0.00-0014 0.02-0012 0.02-0012 0.02-0012 0.02-0012 0.02-0014 0.02-0012 0.02-0014 0.02-0014 0.02-0014 0.02-0014 0.02-0014 0.02-0014 0.02-0014 0.02-0014 0.02-0014 0.02-0014 0.02-0014	Blaze wavelength, nm	225	400	600	600	1000	2000		
Reciprocal liner dispersion on the edges of the spectral range, mm/mm 0.46-0.27 0.61-0.36 0.92-0.54 1.22-0.72 1.84-1.08 3.68-2.16 Nerage value, mm/mm 0.39 0.52 0.78 1.04 1.56 3.12 Output bandwidth on the edges of the spectral range, mm 113.3-79 1995-118 266-158 39.9-237 23.5-13.8 47.0-27.6 Nerage value, nm 112.8 1692.4 22.57.4 33.84.4 20.9 40.9 Spectral resolution on the edges of the spectral range, mm 0.015.009 0.02.012 0.03.0017 0.04.024 0.12.00 0.24.94 Weetage value, cx ⁻¹ 0.88 0.057.9 0.44 0.032.4 0.033.4 0.035.4 0.036.4 0.032.4 0.033.4 0.032.4 0.032.4 0.033.4 0.032.4	Effective spectral range 2)	190-600	253-800	380-1200	506-1600	760-2400	1500-4800		
Average value, nm/mm 0.39 0.52 0.78 1.04 1.56 3.12 Output bandwidth on the edges of the spectral range, nm 13.3-79 19.95-11.8 26.6-15.8 39.9-23.7 23.5-13.8 47.0-27.6 Average value, nm 11.28 " 16.52 " 22.57 " 33.84 " 20.8" 40.9" Average value, nm 0.015 -0.009 0.02-0.012 0.03-0.017 0.04-0.024 0.12-0.07 0.24-0.14 Average value, nm 0.012 " 0.016 " 0.004 " 0.033 " 0.040.9 0.033 " 0.012 " 0.23 " 0.13 " 0.23 " Average value, nm 0.017 " 0.033 " 0.046 " 0.033 " 0.033 " 0.033 " 0.033 " 0.033 " 0.033 " 0.033 " 0.033 " 0.033 " 0.033 " 0.033 " 0.033 " 0.033 " 0.033 " 0.033 " 0.033 " 0.033 " 0.033 " 0.033 " 0.043 " 0.043 " 0.043 " 0.043 " 0.043 " 0.043 " 0.043 " 0.043 " 0.047 " 0.048 " 50.044 " <	Mechanical scanning range	0-640	0-850	0-1280	0-1710	0-2560	0-5120		
Output bandwidth on the edges of the spectral range, mm 13.3-79 19.95-11.8 26.6-15.8 39.9-27.7 23.5-13.8 47.0-27.6 Average value, nm 11.28 ** 16.692 ** 22.57 ** 33.84 ** 20 ** 40 ** Average value, nm 0.015 -0009 0.02-0012 0.03-0017 0.04-024 0.12 • 00 0.24 • 04 Average value, nm 0.012 ** 0.016 ** 0.034 ** 0.032 ** 0.032 ** 0.018 ** 0.024 ** 0.032 ** 0.018 ** 0.024 ** 0.032 ** 0.018 ** 0.032 ** 0.018 ** 0.032 ** 0.031 ** 0.024 ** 0.032 ** 0.031 ** 0.24 ** 0.24 ** Average value, nm 5.007 ** 0.43 ** 0.43 ** 0.43 ** 0.24 ** 0.43 ** 0.43 ** 0.24 ** 0.43 ** 0.43 ** 0.43 ** 0.43 ** 0.24 ** Wavelengh tuning accuracy, nm ±0.001 ** ±0.001 ** ±0.004 ** ±0.004 ** ±0.024 ** ±0.048 ** ±0.014 ** ±0.048 ** ±0.048 ** ±0.048 ** ±0.048 ** ±0.048 ** <td< th=""><th>Reciprocal liner dispersion on the edges of the spectral range, nm/mm</th><th>0.46-0.27</th><th>0.61-0.36</th><th>0.92-0.54</th><th>1.22-0.72</th><th>1.84-1.08</th><th>3.68-2.16</th></td<>	Reciprocal liner dispersion on the edges of the spectral range, nm/mm	0.46-0.27	0.61-0.36	0.92-0.54	1.22-0.72	1.84-1.08	3.68-2.16		
Average value, nm 112.8 ° 16.9 ° 22.5 ° 33.8 ° 20 ° 40 ° Spectral range, nm 0015-0009 002-0012 003-0017 0.04-0.024 0.12-0.07 0.24-0.14 Average value, nm 0015° 0001°° 0.016°° 0.016°° 0.004°° 0.032° 0.1 ° 0.2° ° Average value, nm 0.012 ° 0.016°° 0.004°° 0.032° 0.1 ° 0.2° ° Average value, nm 0.012 ° 0.016°° 0.004°° 0.032° 0.1 ° 0.2° ° Wavelength tuning accuracy, nm ±.0.08 ±.0.08 ±.0.08 ±.0.08 ±.0.12 ±.0.2° Wavelength tuning repeatability, nm ±.0.06 ±.0.008 ±.0.01 ±.0.08 ±.0.12 ±.0.2° Step of grating rotation, nm 0.0017 0.0023 0.0035 0.0046 0.007 0.0014 Stanting rate, nm/s 3.2 4.3 6.5 8.6 1.30 2.60 Flatesee, pm .0.001 0.0023 0.0035 0.0046 0.001	Average value, nm/mm	0.39	0.52	0.78	1.04	1.56	3.12		
Spectral resolution on the edges of the spectral range, nm 0.015-0.009 0.02-0.012 0.03-0.017 0.04-0.024 0.12-0.07 0.24-0.14 Average value, nm 0.012 ³ 0.016 ³ 0.016 ³ 0.024 ³ 0.032 ³ 0.13 0.23 ³ Average value, cM ³ 0.024 ³ 0.016 ³ 0.024 ³ 0.032 ³ 0.032 ³ 0.033 ⁴ 0.032 ³ 0.03 0.13 0.23 ³ Average value, cM ³ 0.024 ³ 0.016 ³ 0.016 ³ 0.016 ⁴ 0.032 ³ 0.033 ⁴ 0.033 ³ 0.033 ⁴ 0.033 ⁴ 0.033 ⁴ 0.033 ⁴ 0.033 ⁴ 0.033 ⁴ 0.43 ³ 0.23 ³ Wavelength tuning accuracy, nm ± 0.036 ± 0.037 0.03	Output bandwidth on the edges of the spectral range, nm	13.3-7.9	19.95-11.8	26.6-15.8	39.9-23.7	23.5-13.8	47.0-27.6		
Average value, nm 0.012 ³ 0.024 9 0.016 ³ 0.033 4 0.024 ° 0.033 4 0.032 ° 0.048 4 0.032 ° 0.066 4 0.1 ° 0.066 4 0.1 ° 0.03 3 0.2 ° Average value, cxr1 0.8 ° 0.057 ° 0.048 4 0.4 ° 0.038 6 0.4 ° 0.038 6 0.4 ° 0.03 ° 0.046 6 0.4 ° 0.03 ° 0.2 ° Wavelength tuning accuracy, nm ± 0.03 ± 0.04 ± 0.06 ± 0.08 ± 0.12 ± 0.024 ± 0.048 Wavelength tuning repetability, nm ± 0.006 ± 0.008 ± 0.012 ± 0.016 ± 0.024 ± 0.048 Step of grating rotation, nm 0.0017 0.0023 0.0035 0.0046 0.007 0.014 Step of grating rotation, nm 0.0017 0.0023 0.035 0.046 0.007 0.014 Step of grating rotation, nm 0.0017 0.0023 0.035 0.046 0.007 0.014 Step of grating rotation, nm 0.0017 0.0023 0.035 0.046 0.007 0.014 Stating rise, pm 0.5 10 10 10 10 10 10 10 <	Average value, nm	11.28 3)	16.92 ³⁾	22.57 3)	33.84 ³⁾	20 5)	40 5)		
Average value, nm 0.024 o 0.033 o 0.048 o 0.066 o 0.13 o 0.23 o Average value, cxr ⁻¹ 0.88 o 0.57 o 0.43 o 0.33 o 0.43 o 0.29 o Wavelength tuning accuracy, nm ±0.03 ±0.04 ±0.06 o ±0.08 o ±0.12 o ±0.24 o Wavelength tuning accuracy, nm ±0.09 ±0.006 ±0.008 o ±0.010 o ±0.010 o ±0.024 o ±0.048 o Step of grating rotation, nm 0.0017 o 0.0023 o 0.0046 o 0.007 o 0.014 o Scanning rate, nm/s 32 43 o 65 o 86 o 130 o 260 o Entrance/Exit slits Turomaticand matrix Tur	Spectral resolution on the edges of the spectral range, nm	0.015-0.009	0.02-0.012	0.03-0.017	0.04-0.024	0.12-0.07	0.24-0.14		
Average value, CA ^{F*} 1.56 ⁴ 1.77 ⁴ 0.78 ⁴ 0.6 ⁴ 0.43 ⁴ 0.24 ⁴ Wavelength tuning accuracy, nm ± 0.03 ± 0.04 ± 0.06 ± 0.08 ± 0.12 ± 0.24 ± 0.04 Wavelength tuning repeatability, nm ± 0.006 ± 0.006 ± 0.001 ± 0.016 ± 0.016 ± 0.024 ± 0.048 ± 0.016 ± 0.024 ± 0.048 ± 0.016 ± 0.024 ± 0.048 ± 0.016 ± 0.024 ± 0.048 ± 0.016 ± 0.024 ± 0.048 ± 0.016 ± 0.024 ± 0.048 ± 0.016 ± 0.024 ± 0.048 0.017 0.0023 0.0035 0.0046 0.007 0.014 Step of grating rotation, nm 0.0017 0.0023 0.0035 0.0046 0.007 0.014 Step size, µm 0.5 8 10 20 20 21 <th>Average value, nm</th> <th></th> <th></th> <th></th> <th></th> <th>0.1 5)</th> <th>0.2 5)</th>	Average value, nm					0.1 5)	0.2 5)		
Wavelength tuning repeatability, nm ± 0.006 ± 0.008 ± 0.012 ± 0.016 ± 0.024 ± 0.018 Step of graing rotation, nm 0.0017 0.0023 0.0035 0.0046 0.007 0.014 Scanning rate, nm/s 32 43 65 86 130 260 Entrance/Exit slits OUTON	Average value, см ⁻¹					0.43 5)	0.2 5)		
Step of grating rotation, nm 0.0017 0.0023 0.0035 0.0046 0.007 0.014 Scanning rate, nm/s 32 43 65 86 130 260 Entrance/Exit slits	Wavelength tuning accuracy, nm	± 0.03	± 0.04	± 0.06	± 0.08	±0.12	± 0.24		
Scanning rate, nm/s 32 43 65 86 130 260 Entrance/Exit slits Automatic and manual adjustment 0-2	Wavelength tuning repeatability, nm	± 0.006	± 0.008	± 0.012	±0.016	±0.024	± 0.048		
Entrance/Exit slitsAutomatic and manual adjustmentSlit width, mm0-2Slit height, mm0-2Slit height, mm12Parallelism, µm± 1Step size, µm0,5Precision, µm± 10Shutter %Integrated, software-controlledFilter wheelAutomatic and manual adjustmentMax number of filters8Filter size, mm20Light aperture, mm18Computer interfaceFull Speed USBDimensions, mm496 x 483 x 360	Step of grating rotation, nm	0.0017	0.0023	0.0035	0. 0046	0.007	0.014		
Slit width, mm0-2Slit height, mm0Parallelism, µm12Parallelism, µm±1Step size, µm0,5Precision, µm±10Shutter ®Integrated, software-controlledFilter wheelAutomatic and manual adjustmentMax number of filters8Filter size, mm20Light aperture, mm18Computer interfaceFull Speed USBDimensions, mm496 x 483 x 360	Scanning rate, nm/s	32	43	65	86	130	260		
Slit height, mm12Parallelism, µm± 1Step size, µm0,5Precision, µm± 10Shutter %Integrated, software-controlledFilter wheelAutomatic and manual adjustmentMax number of filters8Filter size, mm20Light aperture, mm18Computer interfaceFull Speed USBDimension, mm496 x 483 x 360	Entrance/Exit slits		Automatic and manual adjustment						
Parallelism, µm± 1Step size, µm0,5Precision, µm± 10Shutter %Integrated, software-controlledFilter wheelAutomatic and manual adjustmentMax number of filters8Filter size, mm20Light aperture, mm18Computer interfaceFull Speed USBDimensions, mm496 x 483 x 360	Slit width, mm		0-2						
Step size, µm0,5Precision, µm± 10Shutter IIntegrated, software-controlledFilter wheelAutomatic and manual adjustmentMax number of filters8Filter size, mm20Light aperture, mm18Computer interfaceFull Speed USBDimension, mm496 x 483 x 360	Slit height, mm		12						
Precision, µm± 10Shutter ®Integrated, software-controlledFilter wheelAutomatic and manual adjustmentMax number of filters8Filter size, mm20Light aperture, mm18Computer interfaceFull Speed USBDimensions, mm496 x 483 x 360	Parallelism, μm		±1						
Shutter IIIIntegrated, software-controlledFilter wheelAutomatic and manual adjustmentMax number of filters8Filter size, mm20Light aperture, mm18Computer interfaceFull Speed USBDimensions, mm496 x 483 x 360	Step size, µm		0,5						
Filter wheelAutomatic and manual adjustmentMax number of filters8Filter size, mm20Light aperture, mm18Computer interfaceFull Speed USBDimensions, mm496 x 483 x 360	Precision, µm		± 10						
Max number of filters8Filter size, mm20Light aperture, mm18Computer interfaceFull Speed USBDimensions, mm496 x 483 x 360	Shutter ⁶⁾		Integrated, software-controlled						
Filter size, mm20Light aperture, mm18Computer interfaceFull Speed USBDimensions, mm496 x 483 x 360	Filter wheel		Automatic and manual adjustment						
Light aperture, mm18Computer interfaceFull Speed USBDimensions, mm496 x 483 x 360	Max number of filters				8				
Computer interfaceFull Speed USBDimensions, mm496 x 483 x 360	Filter size, mm		20						
Dimensions, mm 496 x 483 x 360	Light aperture, mm		18						
	Computer interface		Full Speed USB						
Weight, kg 53	Dimensions, mm		496 x 483 x 360						
	Weight, kg		53						

1) A set of installed diffraction gratings is confirmed while placing the order. Upon your request, diffraction gratings with another number of grooves per mm and another blaze wavelength can be used.

²⁾ Effective spectral range of the grating covers the range with diffraction efficiency 40% of the peak efficiency.
³⁾ For detector with 8 um pixel size and 29.1 mm active area (resolution is 4 pixels).

⁴⁾ For detector with 25 um pixel size and 25.6 mm active area (resolution is 2.5 pixels).

⁵⁾ For detector with 25 um pixel size and 12.8 mm (resolution is 2.5 pixels).

⁶⁾ Designed to measure background automatically and to protect a detector against zero-order light.

