M833

High-Resolution High-Performance Raman Spectrometer

- **Raman spectroscopy**
- **emission and fluorescent spectroscopy**
- **analytical tasks in the range from UV to IR**
- **multi-channel & imaging spectroscopy**

M833 Standard version 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 which is an essential requirement for Raman spectroscopy as well as for any other case of collecting of weak optical signals.

The M833i version (Imaging) 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.

Extremely low stray light due to the unique double-dispersion scheme and absence of re-reflections allows you to simultaneously acquire both Stokes and Anti-Stokes components at the distance up to 20 cm-1 from the excitation line (1200 l\mm gratings) without using any Notch or Edge-filters.

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.

M833i in the Imaging mode provides high spatial resolution along the output slit . This feature provides a possibility to effectively collect all Raman signal from the widest spatial angle to the height -limited detector which may be usable while working with optical fiber or fiber band.

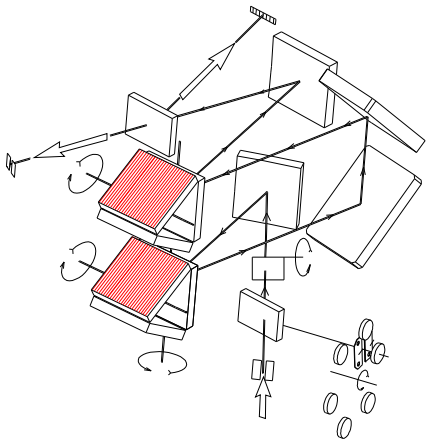
Three pairs of gratings (grating type and blaze are at Customer's choice) are supplied in a standard set and ensure the widest range of applications.

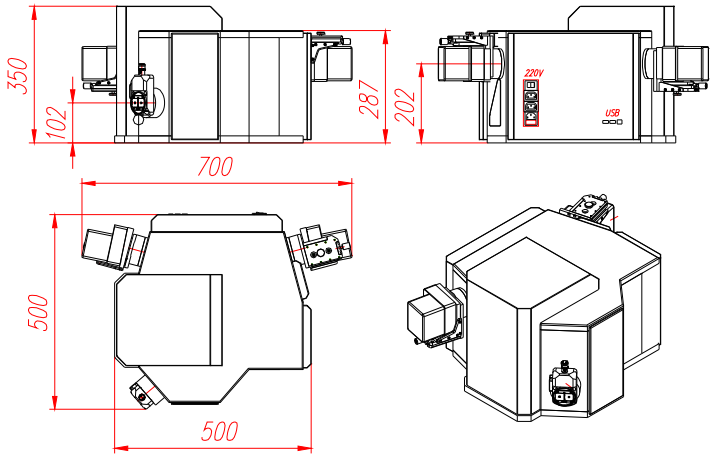
Two input and two output ports (option) can be completed with the full set of accessories manufactured by SOLAR LS: standard and crossed slits, filter wheels, aperture matching units and optical fibers, detectors and adapters for them.

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

The InstrumentManipulator software arranges automated operation of the system including input and output slits, order separating filters, gratings scanning and change. **The SSPLine software** acquires spectra, shows a panoramic spectrum, provides matching of spectra, their mathematical processing, printing and saving. Also, it provides wide possibilities for processing and analysis of the spectrum: intensity calibration, automatic search and analysis of peaks, spectra calculator, axonometric spectrum, etc.

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





Specifications of the Automated monochromator/spectrograph M833

Optical scheme	optimized Czerny-Turner with double dispersion					
Spectral range	- typical 180 – 4800 nm (refer to the specifications below), - up to 40 mkm when the appropriate gratings are used					
F/Number	1 : 5.5					
Effective focal length	833 mm					
Ports	two inputs and two outputs					
Flat field	30 x 10 mm					
Imaging	Option. Available for the lateral output port.					
Diffraction gratings	70 x 70 x 10 mm, automated turret with three pairs of gratings from the list below [1]					
- lines/mm[1]	2400	1800	1200	900	600	300
- blaze wavelength, nm	225	400	600	600	1000	2000
- spectral range, nm	190 - 600	253 - 800	380 -1200	506 - 1600	760 - 2400	1500 - 4800
- scanning range, nm	0 - 640	180 - 850	0 - 1280	0 - 1710	0 - 2560	0 - 5120
- reciprocal linear dispersion average, nm/mm	0.39	0.52	0.78	1.04	1.56	3.12
- multichannel array bandpass, average, nm	11.28[2]	16.92[2]	22.57[2]	33.84[2]	20[3]	40[3]
- spectral resolution, average, nm	0.012 [2] 0.024 [3]	0.016 [2] 0.033 [3]	0.024 [2] 0.048 [3]	0.032 [2] 0.066 [3]	0.1[4]	0.2[4]
- spectral resolution, average, cm-1	0.8 [2] 1.56 [3]	0.57 [2] 1.17 [3]	0.4 [2] 0.78 [3]	0.3 [2] 0.6 [3]	0.43[4]	0.2[4]
Integrated shutter	automatically controlled, serves for measuring dark signal					
Computer interface	Full-Speed USB					
Dimensions	500 x 700 x 350 mm,					

1) upon your request diffraction gratings differing from the above can be used.
2) for detector with 8 um pixel size and 29.1 mm length of active area (resolution is 4 pixels)
3) for detector with 25 um pixel size and 25.6 mm length of active area (resolution is 2.5 pixels)
4) for detector with 25 um pixel size and 12.8 mm length of active area (resolution is 2.5 pixels)

Dispersion depending on Wavelength, nm/mm (cm-1/ mm)

Grating	at 300nm	at 500nm	at 800nm	at 1100nm
2400	0.42 nm/mm 47.4 cm-1/mm	0.34 nm/mm 13.5 cm-1/mm	-	-
1800	0.6 nm/mm 66.6 cm-1/mm	0.53 nm/mm 21.25 cm-1/mm	0.36nm/mm 5.7cm-1/mm	-
1200	-	0.88nm/mm 35.4cm-1/mm	0.77nm/mm 12.1cm-1/mm	0.616nm/mm 5.1cm-1/mm
900	-	-	1.14nm/mm 17.8cm-1/mm	1.0nm/mm 8.4cm-1/mm
600	-	-	1.83nm/mm 28.5cm-1/mm	1.74nm/mm 14.4cm-1/mm

Options and accessories for the Automated Monochromator/Spectrograph M833:

- Standard & crossed spectral slits
- Filter wheel
- Optical fibers
- Aperture matching adapter
- Light collecting adapters
- Array detectors & adapters
- Cassegrain objective

Below are **Raman spectra acquired with the M833i**.
Diode Pumped Nd:LSB Solid State Micro Laser, Model STA-01-OEM (532nm, TEM00, 10mW) was used as an excitation source.
Registration was performed by S7031-1006 Hamamatsu sensor (24ᴎᴍ x24ᴎᴍ pixel size, 24,6mm x1,4mm sensor size, ACD 16bit, one-stage Peltier cooling –10 C, binning mode). The breadboarding block-scheme is shown in Fig.3.

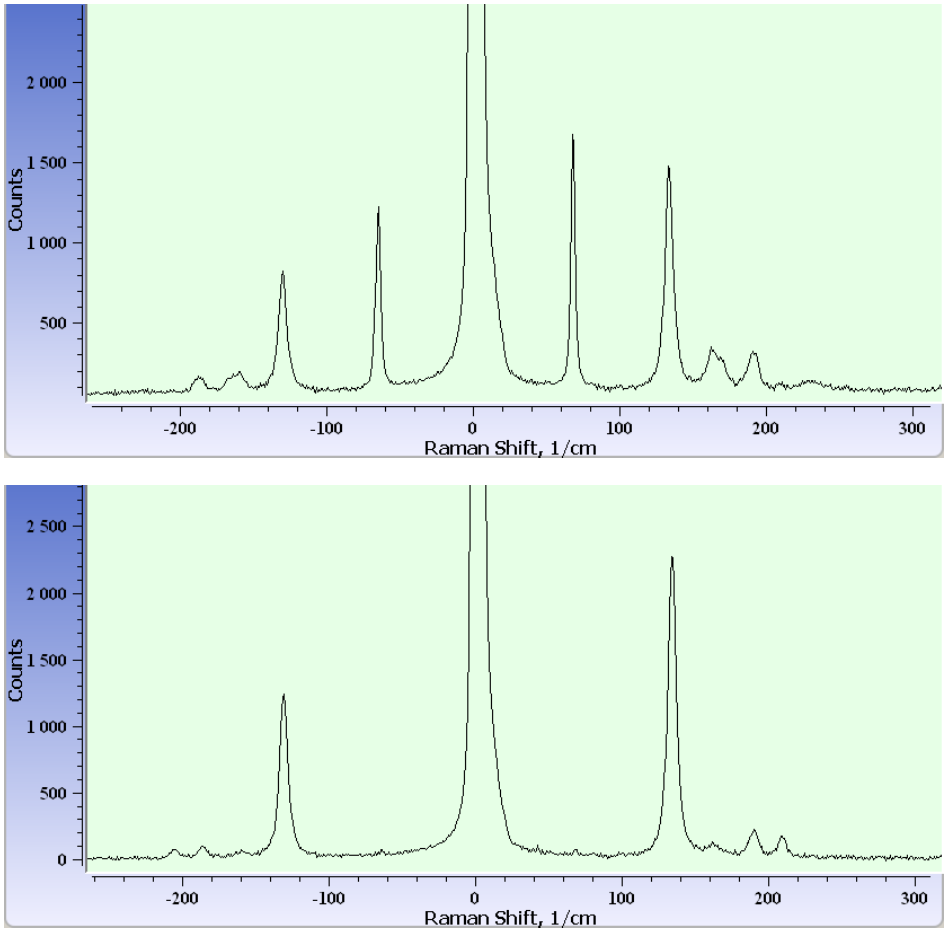


Fig. 1a, b. TeO2 Raman spectra depending on a crystal orientation. The M833 is a unique instrument allowing to simultaneously observe both Stokes and Anti-Stokes components at the distance up to 20 cm-1 from the Rayleigh line.

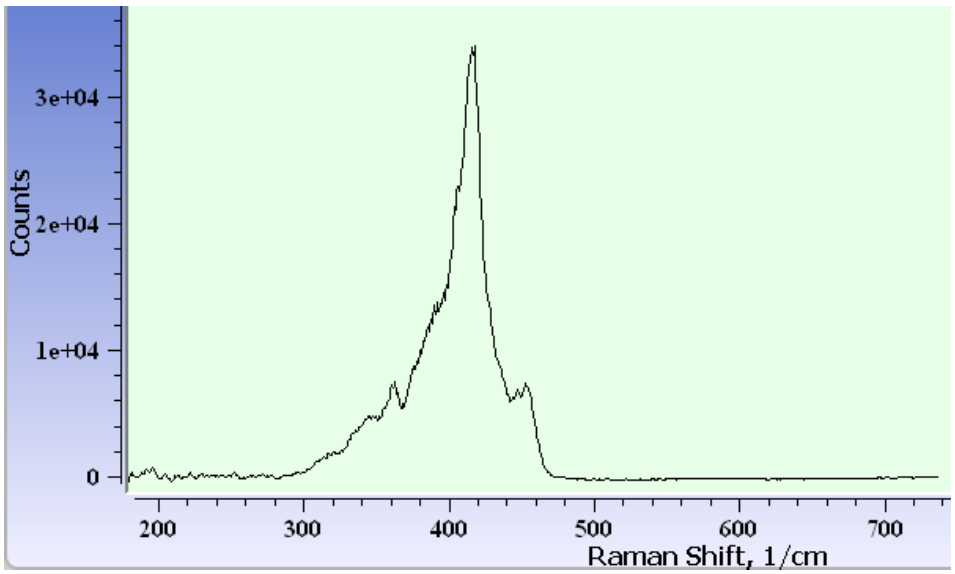


Fig. 2. Raman spectrum of a single nitron fiber *demonstrates characteristic peaks in the range of 300...480 cm-1 with the maximum at 405 cm-1.*

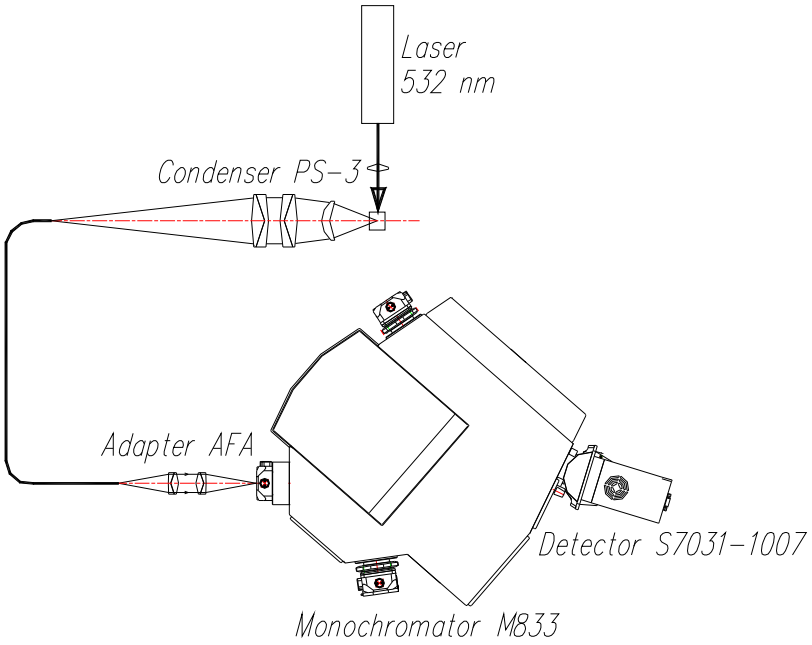
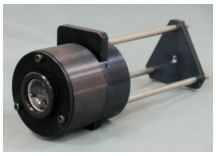


Fig.3. Breadboarding block-scheme of Raman spectra acquiring.
Raman spectra were collected at 90 deg to the excitation beam using the PS-3 wide-aperture achromatic condenser, 600 um dia. optical fiber and the M833i monochromator (1200 l\mm gratings and S7031-1006 Hamamatsu sensor) equipped with the AFA aperture matcher.

Sub nanosecond (<1 ns) single longitudinal mode passive Q-switched Nd:LSB diode pumped micro laser STA-01-OEM is able to provide output peak power up to 50 kW, high pulse repetition rates up to 120 kHz and excellent beam profile M2<1.2.

The AFA aperture matching system is designed to match the output angle of a fiber (NA 0.2) to the input angle of the monochromator (F/ 5.5) in order to reduce stray light and to optimize light throughput.



The PS-3 wide-aperture condenser collects light from a sample within a wide aperture angle and transmits into an optical fiber.
The PS-3 consists of a meniscus and two achromatic objectives and provides as wide light collecting angle as 37 deg.