

Monolithic compact

The extremely compact design is a characteristic feature of the spectrometers in the MMS family. Small designs are possible because high repeatability, not high resolving power is required for many applications.

Optical components of the MMS family

- imaging grating
- cross-section converter as optical input
- diode array as opto-electronic output

are arranged around a central body and are attached to it. Depending on the version, the central bodies may have different designs. The two components important for the interfaces – the cross-section converter and detector – are common to all.

Central body

In the MMS 1, the central body contains a glass element similar to a lens. The imaging grating has been directly replicated on this glass element; the grating is thus permanently fixed and optimally protected against dust and gases. The use of an optically denser medium and the resultant larger aperture allows the use of small gratings. This leads to fewer aberrations. For reasons of transmission, the solid glass element has been replaced in the UV-sensitive modules by a hollow shell to which the grating and the detector have been cemented. The overall stability is not impaired by the tube design; the temperature-induced drift of the wavelength has even been reduced.

Gratings

The gratings for the MMS family itself consist of so-called holographic blazed, flat field gratings. The same grating design is used for the VIS and the UV-VIS versions. The master grating has its efficiency maximum at approx. 220 nm. Due to the higher optical density, the efficiency curve of the VIS module is shifted by the factor of the refractive index.

Cross-section converter

A fiber bundle, cross-section converter is used to further optimize the light sensitivity of the module. Single fibers in a linear configuration form the entrance slit.

The diameter has been adapted to the pixel size of the diode array used and the imaging and dispersive properties of the flat field grating. Thus, light intensities near the theoretical limit are achieved. The cross-section converter is an integral component of the spectrometer design and is therefore not easy to modify. There is a possibility, however, of modifying the length of the fibers and the design of the input. In addition, it must be taken into account that quartz fibers which are used in older MMS UV-(VIS-) modules form so-called solarization centers when they are exposed to deep UV light below 220 nm. That means that the transmission of the fibers is reduced when they are exposed to high-energy light. The shorter the wavelength of the light (higher photon energy) and the higher the intensity and the longer the exposure time, the stronger and sooner this effect occurs. This means that the transmission can even be restricted in the range of more than 220 nm to 250 nm. This solarisation effect can only be partly cancelled by heating, but it is possible to correct it by means of frequent reference measurements. For measurements below 225 nm, it is possible to equip the MMS modules with solarization stabilized fibers. In the standard modules, the use of a Schott WG225 filter with a thickness of 3 mm is definitely recommended.

Detector

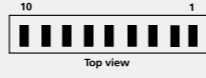
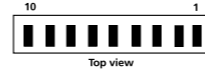

The silicon diode array S3904-256Q from Hamamatsu is incorporated in the MMS family. The MMS 1 NIR enhanced uses the Hamamatsu type S8381-256Q. This array is packed in a shorter special housing which results in a very small split-off angle, allowing an efficient grating design. When changing to a different detector, this angle and the approximate spectrum length of 6 mm must be taken into account. To suppress the second order, the diode array has been directly coated with a dielectric cut-off filter.

Detector	MMS 1	MMS UV-VIS I / UV-VIS II	MMS UV
Dimensions of pixels	25 x 2500 µm	25 x 2500 µm	25 x 2500 µm
Clock-Rate	2 MHz	2 MHz	2 MHz

Preamplifier

Output	3 V	3 V	3 V
Sensitivity	40 µA/V	40 µA/V	40 µA/V
Rise time	35 V/ms	35 V/ms	35 V/ms
Frequency range	< 400 KHz	< 400 KHz	< 400 KHz
Power consumption	50 mW	50 mW	50 mW

Interface

Video-output	SMB-Socket	SMB-Socket	SMB-Socket
Diode array	Micromodul connection MICS-D 10	Micromodul connection MICS-D 10	Micromodul connection MICS-D 10
Connector assignment			
	Pin 1, 3, 5: 0 V – Digital ground Pin 2: Start Pin 4: Phi 2 – clock-rate Pin 6: EOS – End of Scan Pin 7, 9: Analogue ground Pin 8: -5 V Pin 10: +5 V	Pin 1, 3, 5: 0 V – Digital ground Pin 2: Start Pin 4: Phi 2 – clock-rate Pin 6: EOS – End of Scan Pin 7, 9: Analogue ground Pin 8: -5 V Pin 10: +5 V	Pin 1, 3, 5: 0 V – Digital ground Pin 2: Start Pin 4: Phi 2 – clock-rate Pin 6: EOS – End of Scan Pin 7, 9: Analogue ground Pin 8: -5 V Pin 10: +5 V

System data

Realised with	15-Bit-AD-conversion, integration time 10 ms, Clock-Rate 200 KHz	15-Bit-AD-conversion, integration time 10 ms, Clock-Rate 200 KHz	15-Bit-AD-conversion, integration time 10 ms, Clock-Rate 200 KHz
Dynamic range	2 ¹⁴	≈ 2 ¹⁴	2 ¹⁴
Noise	≤ 1,5 count standard deviation of dark signal	≤ 1,5 count standard deviation of dark signal	≤ 1,5 count standard deviation of dark signal

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Information subject to change.
Printed on environmentally friendly paper
bleached without chlorine.
72-1-0013/d – printed 03.11

MMS Family Monolithic compact



Monolithic Miniature Spectrometer from ZEISS



MMS Monolithic Miniature Spectrometer

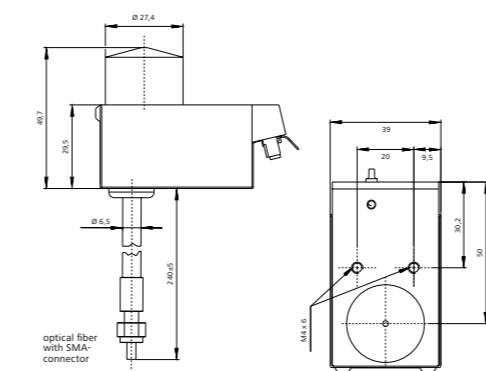
MMS 1 (310 nm – 1100 nm)
 MMS UV-VIS I (190 nm – 720 nm)
 MMS UV-VIS II (250 nm – 780 nm)
 MMS UV (195 nm – 390 nm)



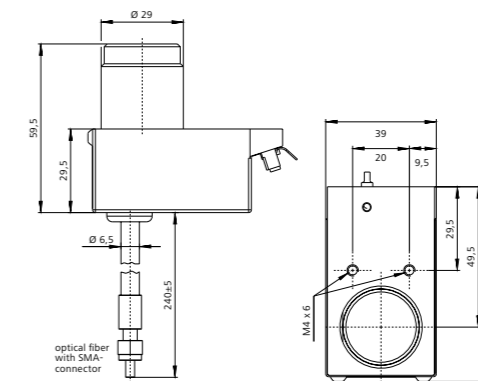
Technical Specifications

		MMS 1	MMS UV-VIS I / UV-VIS II	MMS UV
Optical entrance	input round	Fiber bundle consisting of approx. 30 quartz glass fibers with 70 µm core diameter each, designed as a cross section converter Diameter: 0.5 mm NA = 0.22 (has to be filled for full specification) mounted in SMA-coupling	Fiber bundle consisting of approx. 30 quartz glass fibers with 70 µm core diameter each, designed as a cross section converter Diameter: 0.5 mm NA = 0.22 (has to be filled for full specification) mounted in SMA-coupling	Fiber bundle consisting of approx. 15 quartz glass fibers with 70 µm core diameter each, designed as a cross section converter Diameter: 0.4 mm NA = 0.22 (has to be filled for full specification) mounted in SMA-coupling
	output linear	70 µm x 2500 µm (optical entrance)	70 µm x 2500 µm (optical entrance)	70 µm x 1250 µm (optical entrance)
Grating		Flat-field, 366 l/mm (center)	Flat-field, 366 l/mm (center), blazed for approx. 220 nm	Flat-field, 1084 l/mm (center) blazed for approx. 220 nm
Diode array		Producer: Hamamatsu Type: S3904-256Q in a special housing (S5713) (S8381-256Q for MMS 1 NIR enhanced) Number pixels: 256	Producer: Hamamatsu Type: S3904-256Q in a special housing (S5713) Number pixels: 256	Producer: Hamamatsu Type: S3904-256N in a special housing (S5713) Number pixels: 256
Spectral range		310 nm – 1100 nm specifications for the range 360 nm – 900 nm (UV-VIS enhanced) 400 nm – 1000 nm (NIR enhanced)	UV-VIS I 190 nm – 720 nm specifications for the range 220 nm – 720 nm UV-VIS II 250 nm – 780 nm specifications for the range 250 nm – 780 nm	195 nm – 390 nm specifications for the range 220 nm – 390 nm
Wavelength accuracy		0.3 nm	0.5 nm	0.2 nm
Temperature drift		< 0.01 nm/K	≤ 0.006 nm/K	< 0.005 nm/K
Mean spectral pixel pitch		$\Delta\lambda_{\text{Pixel}} \approx 3.3 \text{ nm}$	$\Delta\lambda_{\text{Pixel}} \approx 2.2 \text{ nm}$	$\Delta\lambda_{\text{Pixel}} \approx 0.8 \text{ nm}$
Resolution		$\Delta\lambda_{\text{FWHM}} \approx 10 \text{ nm}$	$\Delta\lambda_{\text{FWHM}} \approx 7 \text{ nm}$	$\Delta\lambda_{\text{FWHM}} \approx 3 \text{ nm}$
Sensitivity		$\approx 10^3 \text{ Vs/J}$	$\approx 10^3 \text{ Vs/J}$	$\approx 10^3 \text{ Vs/J}$
Straylight		≤ 0.8 % with Halogen lamp for UV-VIS enhanced as transmission at 450 nm with filter GG 495 ≤ 0.2 % with Halogen lamp for NIR enhanced as transmission at 650 nm with filter RG 695	≤ 0.3 % with Deuterium lamp as transmission at 310 nm with NaNO ₂ -solution (50 g/l)	≤ 0.3 % Deuterium lamp as transmission at 240 nm with NaJ-solution (10 g/l)
Dimensions	total (with case)	70 x 50 x 40 mm ³	67 x 60 x 40 mm ³	70 x 60 x 40 mm ³
	cross section converter (external length)	240 mm standard, up to 1 m available	240 mm standard, up to 1 m available	240 mm standard, up to 1 m available

Dimensional drawing MMS 1



Dimensional drawing MMS UV-VIS I / UV-VIS II



Dimensional drawing MMS UV

