

LEICA TCS SP8

Technical Documentation



SPECIFICATIONS

MICROSCOPES	Microscope stand	Options
	Upright	Leica DM6 CS Leica DM6 CFS Leica DM6 CFS w/o TL axis
	Inverted	Leica DMI8 CS Leica DMI8 CEL Compact Leica DMI8 CEL Advanced
VIBRATION ISOLATION	Isolation options	Specifications
	Anti-vibration table	Yes (active/passive)
MICROSCOPE STAGE	Stage options	Specifications
	Autofocus	Optional reflection-based Adaptive Focus Control (AFC) for Leica DMI8 CS with 15 Hz sampling rate Image Based Autofocus for transmission light and fluorescence images. Can be combined with AFC
	Motorfocus	Travel range depending on mechanics of microscope/ minimum step size 50 nm, adjustable in increments of < 4 nm
	Z galvanometer	Selectable z modes (Galvo Flow/discrete steps) available, 1500 μ m range/minimum step size 20 nm, adjustable in increments of < 1.5 nm Unique xzy scan mode for real-time xz slices, for setup of correction collar and for quick assessment of axial resolution
CONTINUOUS WAVE LASERS	Laser type	Specifications
	VIS	Solid state laser 40 mW: 448 nm
		Solid state laser 20 mW: 488 nm
		Solid state laser 20 mW: 514 nm
		Solid state laser 20 mW: 552 nm
		Solid state laser 30 mW: 638 nm
		Diode 40 mW: 442 nm
		Ar 65 mW: 458, 476, 488, 496, 514 nm
		HeNe, 2 mW: 594 nm
		HeNe, 10 mW: 633 nm
	DPSS, 20 mW: 561 nm	
	UV	UV OPSSL 80 mW: 355 nm
		Diode, 50 mW: 405 nm
PULSED LASERS	Laser type	Specifications
	IR	Power and tuning range depending on selected model. Full integration of Coherent Chameleon and Discovery and Newport MaiTai and Insight lasers with and without precompensation, gap free tuning from 680 – 1300 nm.
	CARS laser picoEmeraldS	Stokes wavelength/power: >500 mW @ 1031 nm, pump wavelength tuning range/power: >500 mW @ 720 – 940 nm, pulse width: 2 ps, spectral bandwidth: 0.3 – 0.4 nm, repetition rate: 80 MHz
VIS		WLL2, avg. power 1.5 mW: 470 – 670 nm, 78 MHz; with integrated pulse picker: 78, 39, 19.5, 9.75 MHz
		WLL E, avg. power 1.0 mW: 470 – 670 nm, 78 MHz; with integrated pulse picker: 78, 39, 19.5, 9.75 MHz
		Diode, 10 mW: 640 nm; 40, 20, 10, 5, 2.5, 1.25, 0.62, 0.31 MHz
		Diode, 4 mW: 470 nm; 40, 20, 10, 5, 2.5, 1.25, 0.62, 0.31 MHz
		Diode, 4 mW: 440 nm; 40, 20, 10, 5, 2.5, 1.25, 0.62, 0.31 MHz
	UV	Diode, 3 mW: 405 nm; 40, 20, 10, 5, 2.5, 1.25, 0.62, 0.31 MHz

SUPER-RESOLUTION	STED 3X CW	592 STED: Vortex donut (FWHM): $xy < 80 \text{ nm}$; $z = \text{confocal}$	
		592 STED: Z donut (FWHM): $xy < 150 \text{ nm}$; $z < 175 \text{ nm}$	
		660 STED: Vortex donut (FWHM): $xy < 80 \text{ nm}$; $z = \text{confocal}$	
	STED ONE/STED 3X gated	660 STED: Z donut (FWHM): $xy < 150 \text{ nm}$; $z < 175 \text{ nm}$	
		592 STED: Vortex donut (FWHM): $xy < 50 \text{ nm}$; $z = \text{confocal}$	
		592 STED: Z donut (FWHM): $xy < 130 \text{ nm}$; $z < 130 \text{ nm}$	
	STED 3X pulsed	660 STED: Vortex donut (FWHM): $xy < 50 \text{ nm}$; $z = \text{confocal}$	
		660 STED: Z donut (FWHM): $xy < 130 \text{ nm}$; $z < 130 \text{ nm}$	
		775 STED: Vortex donut (FWHM): $xy < 50 \text{ nm}$; $z = \text{confocal}$	
EXCITATION MODULATION	Modulation type	Specifications	
	AOTF VIS	Up to 8 channels	
	AOTF UV	Up to 3 channels	
	AOM IR	Yes	
	AOTF CARS	Up to 2 channels	
	Pulsed laser driver	Optional	
	Direct modulation	For 405 nm	
	OPTICS	Number of laser ports	Up to 4 (UV-VIS-IR-STED)
Number of VIS lasers		Up to 8 channels	
Excitation – emission splitting		Acousto-Optical Beam Splitter (AOBS) or Low Incident Angle dichroic beam splitters (LIAchroics)	
Simultaneous visible laser lines (AOBS)		max. 8 (both in fluorescence and reflection mode)	
Detection range		400 – 800 nm	
UV and IR imaging		Sequential (line/frame) or simultaneous	
Field upgradable		Yes (most options, e.g. STED, multiphoton)	
UV correction		Unified concept with CS2 optics	
Pinhole		Stable single pinhole (maintenance-free)	
Pinhole-diameter control		Motorized by software, wavelength-dependent automatic mode available	
Notch filters		Fluorifier disk with numerous options	
SCANNERS		Scanner design	Specifications
		Scanning concept	X2Y-scanner with optically correct scanning at low inertia
	Switch FOV-scanner-resonant scanner	FOV and resonant scanner in one system (opt)	
	Field-of-view scanner	Specifications	
	Maximal line frequency	3600 Hz (bidirectional)	
	Minimal line frequency	1 Hz	
	Line frequency	Freely selectable in steps of 1 Hz (unidirectional), 2 Hz (bidirectional)	
	Maximal frame rate 512 x 512	7 fps	
	Maximal frame rate 512 x 16	112 fps	
	Beam park	Yes	
	Maximal frame resolution	8192 x 8192 (FLIM: up to 4096 x 4096)	
	Scan zoom	0.75 – 48x	
	Panning	Yes	
	Field rotation	200° optical	
	Field diameter	22 mm	

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SCANNERS	Resonant scanner 8kHz	Specifications
	Maximal line frequency	16 kHz (bidirectional)
	Minimal line frequency	8 kHz
	Maximal frame rate 512 x 512	28 fps
	Maximal frame rate 512 x 16	290 fps
	Maximal frame resolution	2496 x 2496 pixel
	Scan zoom	1.25 – 48x
	Panning	Yes
	Field rotation	200° optical
	Field diameter	13mm
	Resonant scanner 12kHz	Specifications
	Maximal line frequency	24 kHz (bidirectional)
	Minimal line frequency	12 kHz
	Maximal frame rate 512 x 512	40 fps
	Maximal frame rate 512 x 16	428 fps
	Maximal frame resolution	1664 x 1664 pixel
	Scan zoom	2 – 48x
	Panning	Yes
	Field rotation	200° optical
	Field diameter	8mm
SCAN MODES	Scan options	Available
	xyz, xt, xyt, xyzt, xyλ, xyλt, xyzλ, xyzλt	Real-time z sectioning with SuperZ Galvanometer at all scan speeds
	xzy, xzt, xzyt, xzλ, xzλt	Yes
ADVANCED SCAN MODES	xy, xz, xyz, xy t, xyλ, xzλ	WLL, IR and CARS
INTERNAL CONFOCAL DETECTION	Hybrid detection for imaging	Specifications
	Emission separation	Highly sensitive prism spectral detector (HyD SP) or filter cube (HyD RLD)
	Time gated detection	Yes
	Maximum number of detectors	4 (+ 1 PMT)
	Tunability of emission bands	Yes
	Spectral detection range	400 – 750 nm
	Typical quantum efficiency	45% (@500 nm)
	Simultaneously tunable spectral detection channels	max. 5
	Spectral tuning resolution	1 nm across full spectrum of 400 – 750 nm
	Minimal detection range	5 nm
	Photon counting	Linear signal response in Photon Counting mode max. 60 Mcounts/s, in Standard Mode max. 300 Mcounts/s
	Sensors	GaAsP hybrid detectors
	Digitization	12 or 16 bit per channel
	Read out frequency (dig oversampling)	> 600 MHz
	Max gray value resolution	16 bit
	Gated detection	Yes (in combination with white light laser)
	FLIM capability	Yes
	Hybrid detection for imaging and SMD	Specifications
	Emission separation	Highly sensitive prism spectral detector (HyD SP) or filter cube (HyD RLD)
	Time gated detection	Yes

INTERNAL CONFOCAL DETECTION	Tunability of emission bands	Yes
	Spectral detection range	400 – 750 nm
	Typical quantum efficiency	45% (@500 nm)
	Spectral tuning resolution	1 nm across full spectrum of 400 – 750 nm
	Minimal detection range	5 nm
	Photon Counting	Up to 60 Mcounts/s in Photon Counting mode, Up to 300 Mcounts/s in Standard Mode with linear signal response
	Sensors	GaAsP hybrid detectors
	Digitization	12 or 16 bit per channel
	Read out frequency (dig oversampling)	> 600 MHz (for imaging)
	Max gray resolution	16 bit
	Gated detection	Yes (in combination with white light laser)
	FCS capability	Yes
	FLIM capability	Yes
	FLCS	Yes
	Active cooling	Yes
	Dark noise	< 400 counts per second at 18° C
	PMT detection for Imaging	Specifications
	Emission separation	Highly sensitive prism spectral detector
	Maximum number of detectors	Up to 5
	Tunability of emission bands	Yes
	Spectral detection range	400 – 800 nm
	Quantum efficiency	30% (@ 500 nm)
	Spectral tuning resolution	1 nm across full spectrum of 400 – 800 nm
Minimal detection range	5 nm	
Sensors	High sensitive low noise, selected PMT	
Digitization	12 or 18 bit per channel	
Read out frequency	40 MHz oversampling	
Maximum gray resolution	16 bit	
LIGHTNING	Number of spectral channels	5 spectral detectors w/o sequential scanning
	Lateral resolution	120 nm
	Lateral resolutiuon increase	1.5 x
	Axial resolution increase	2 x
EXTERNAL CONFOCAL DETECTION	Detector types	Applications
	PE APDs	2, for FCS and imaging
	MPD APDs	2, for FCS, FLCS, FLIM and imaging

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NON-CONFOCAL DETECTION	Detection types	For Imaging
	Transmitted light detector	Optional, allowing BF, Ph, Dodt contrast (MP), etc.
	Non-descanned transmitted light channels	Up to 4 (multiphoton)
	Non-descanned reflected light channels	Up to 4 (multiphoton)
	Non-descanned reflected light HyD detection	Up to 4 (multiphoton), for imaging and FLIM
	Maximum number of detectors	8 NDDs, 1 BF-TLD
	Tunability of emission bands	Yes
	Spectral detection range	380 – 800 nm
	Spectral tuning resolution	1 nm across full spectrum of 380 – 800 nm
Minimal detection range	10 nm	
ELECTRONICS	Devices	For Imaging
	Scanner control	Digital (FPGA, field programmable gate arrays)
	Trigger in/out	Yes
	Auxiliary data input channels	Up to 2
	Computer	Premium HP workstation for real 64 bit processing
	Monitor	32" high brilliance monitor
	Software control	Programmable control panel with LCD function and value display
EXTENSIONS	Devices	For Imaging
	Auxiliary emission port	Optional
	Environmental control	Various options and accessories

SOFTWARE	Ergonomy	GUI optimized for dark rooms and image processing	
		Scalable user interface for maximum flexibility	
		Fully modular and flexible arrangement of functions	
	Image acquisition	Multidimensional acquisition, full control of motorized hardware	
	Mosaicking/Stitching	Algorithm based stitching functionalities	
	Online dye separation	Fast online dye separation for VIS and MP imaging	
	Photon statistics	Read out of photon counts (HyD)	
	LightGate	Detection in user defined time window (HyD)	
	2D/3D deconvolution	Integrated deconvolution algorithms	
	Data exchange LAS X/Huygens	Exchange of Confocal, STED and MP images between LAS X and Huygens deconvolution software	
	Dye assistant	Software-aided hardware configuration based on fluorophores used	
	Lambda scan	Acquisition of emission spectrum using spectral detectors	
	Lambda-lambda scan	Acquisition of full excitation-emission spectrum (WLL and CARS)	
	Z intensity compensation	Laser power and/or detector gain adjustments within z stacks	
	Leica HCS A	High content screening and automated microscopy	
	LAS X 3D Visualization	Fast, GPU-based processing of large 3D stacks, unique clipping tool	
	LAS X 2D/3D Analysis	2D/3D multi channel analysis and classification	
	LAS X Measurements	2D measurements	
	LAS X Environmental Control	Setting up, logging and monitoring of climate conditions	
	LAS X FLIM offline analysis	Processing of FLIM measurement series	
	LAS X FCS offline analysis	Processing of FCS measurement series	
	Intuitive software wizards		
	LAS X MicroLab	FRAP, FLIP, photoconversion, FRET (acceptor photobleaching, sensitized emission)	
	LAS X Live Data Mode	Recording of manual and automated workflows, trigger functions, complex timelapse series	
	LAS X Electrophysiology	Live Data Mode combined with the recording of electrical data	
	LAS X SmartSTED	Workflow for STED 3X operation	

SPECIFICATIONS

DLS (DIGITAL LIGHTSHEET MODULE)	Microscope stand	DMi8 CS Bino DLS (new system)
		DMi8 CS Bino (upgradable)
		DMi8 CS Trino (upgradable)
		DMi8 CEL Advanced (upgradable)
		DMI6000 CS Bino (upgradable)
		DMI6000 CS Trino (upgradable)
		DMI6000 CS AFC Bino (upgradable)
		DMI6000 CS AFC Trino (upgradable)
Synergies	Confocal TCS SP8 (included)	
	STED (optional)	
	MP/CARS (optional)	
	FALCON/FCS (optional)	
	HCS A (optional)	
Illumination	HC PL FLUOTAR 2.5x/0.07	
	HCX PL FLUOTAR 5x/0.15	
	L 1.6x/0.05 DLS	
Detection	HC FLUOTAR L25x/0.95 W DLS working distance = 2.5 mm, water immersion	
	HC APO L10x/0.30 W DLS working distance = 3.6 mm, water immersion	
	5x/0.15 IMM DLS working distance = 4.95 mm, water to BABB immersion	
Mirror	TwinFlect 5 mm (specimen size: max. 2.0 mm, short axis)	
	TwinFlect 2.5 mm (specimen size: max. 1.0 mm, short axis)	
	TwinFlect 7.8 mm (specimen size: max. 3.5 mm, short axis)	
Cameras	Leica DFC9000 GTC	
	PCO Edge 5.5 sCMOS camera	
	Hamamatsu Orca Flash 4.0 V3 camera	
Wide field imaging	Transmitted and incident illumination for sample positioning	
Lasers (for light sheet generation)	All VIS lasers (WLL included), see page 2	
	UV: 405nm, see page 2	
IR lasers	Not for light sheet generation, suitable for combined laser manipulations	
Filter	Filter DLS 455-495 (BP = bandpass filter)	
	Filter DLS 504-545 (BP)	
	Filter DLS 575-615 (BP)	
	Filter DLS 575-635 (BP)	
	Filter DLS 405/488/561/633 (NF = notch filter)	
	Filter DLS 405/488/552/638 (NF)	
	Filter DLS 405/488/561 (NF)	
	Filter DLS 405/488/552 (NF)	
	Filter DLS 458/514 (NF)	
	Filter DLS 488/561 (NF)	
	Filter DLS 405/488 (NF)	
Software	LightSheet Wizard fully integrated in LAS X	
	3D Visualisation and Processing Pipeline	
	Environmental Control	

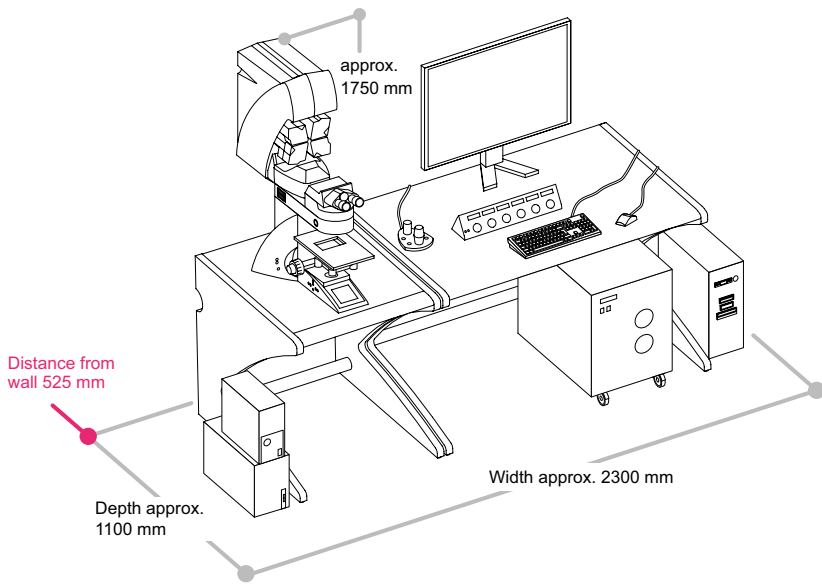
Workstation	WS Expert HPZ840 CPU: 2x Xeon E5-2637v3 Quad Core 3.5 GHz Memory: 128 GB Storage: 1.862 TB SSD RAID, 10.914 TB HDD RAID NIC: Intel X520 10GbE Dual Port Adapter C3N52AA NVIDIA Quadro M4000
Recommended requirements for offline workstation	CPU: 2x Xeon E5-2637v3 Quad Core 3,5 GHz or higher Memory: min. 128 GB or higher Storage: 2 TB or larger SSD RAID 0 and/or 10 TB or larger HDD RAID 5 NIC: Intel X520 10GbE Dual Port Adapter C3N52AA NVIDIA Quadro K4200 4GB
Incubation	Environmental chamber, transparent (incubation) Environmental chamber, black (incubation and laser safety) Heating Device Stage Top Incubation System
Physical Dimensions	Identical to TCS SP8 specifications
Spectral range of detection	420 – 800 nm
Multi-channel acquisition	Fast sequential scan via AOTF
Field of view	Field of view Max. image diagonal up to 2075 μ m with the 5x detection objective
Specimen size	Diameter of sample (short axis) \leq 3.5 mm, diameter long axis determined by the mounting dish
Two-sided illumination	With one illumination objective via TwinFlect mirrors
Sample mounting	Sample mounting in standard glass bottom dishes (recommended cover slip thickness 170 μ m +/- 20 μ m), mounting in aqueous solutions, or solutions with RI up to 1.47 depending on optics used, specimen elevated ~500 μ m from cover slip, multiposition experiments supported
Light sheet thickness	1.7 – 15 μ m
Camera properties	
Pixel size	6.5 μ m
Maximum pixel format	2048 x 2048
Bit depth	16 bit
Max frame rate DFC9000 GTC	Up to 64 fps at 2048 x 2048 in xyt format Up to 94 fps at 1000 x 1000 in xyt format Up to 41 fps at 2048 x 2048 in xyz format Up to 50 fps at 1000 x 1000 in xyz format
Max frame rate PCO	Up to 66 fps at 2048 x 2048 in xyt format Up to 93 fps at 1000 x 1000 in xyt format Up to 41 fps at 2048 x 2048 in xyz format Up to 50 fps at 1000 x 1000 in xyz format
Max frame rate ORCA Flash 4	Up to 60 fps at 2048 x 2048 in xyt format Up to 93 fps at 1000 x 1000 in xyt format Up to 41 fps at 2048 x 2048 in xyz format Up to 50 fps at 1000 x 1000 in xyz format
Max write speed SSD RAID	Up to 880 Mbyte/sec
Max write speed HDD RAID	Up to 820 Mbyte/sec

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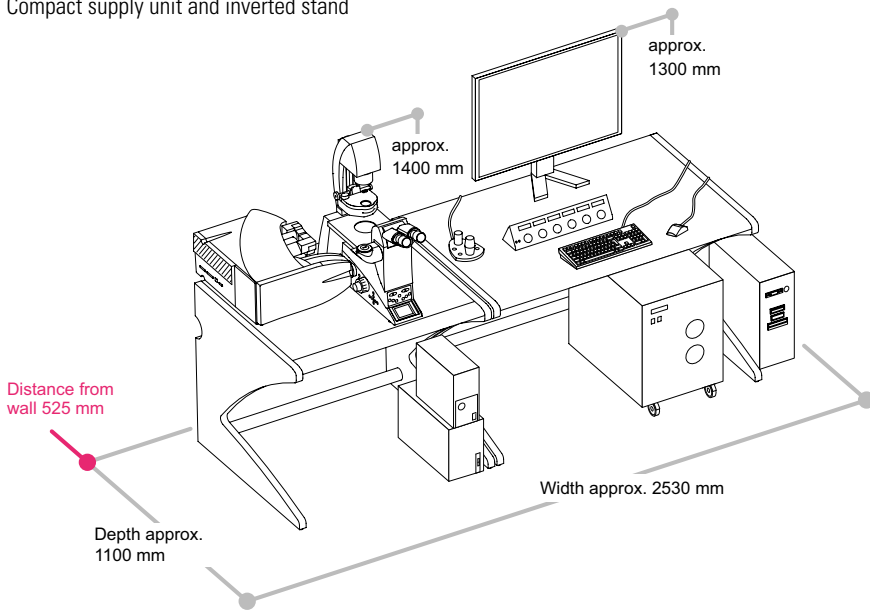
WEIGHT OF BASIC SYSTEM		Maximum 330 kg (728 lbs)
HEAT LOAD MAX.		VIS: 1.7 kW (CSU); 3.2 kW (FSU) UV: 0.5 kW IR: 2.0 kW
ELECTRICAL SPECIFICATIONS	Min. number of phases	2 (CSU systems); 3 (FSU systems); some options may require additional electrical connections
	Supply voltage	100 V~ to 240 V~ ± 10%, grounded
	Power consumption	FSU: 2x 1600 VA (incl. peripheral devices connected to flexible supply unit's multiple socket outlet) CSU: 700 VA
	Fuse	FSU: automated process CSU: 2x T8AH, 250 V AC
	Protection class	I
	Type of protection	Covered design
	Overvoltage category	II
	Frequency	50/60 Hz
	Permitted relative humidity	20% to 60% (non-condensing)
	Max. location elevation	2000 m above sea level
	Pollution degree	2 (protect system from dust)
	Max. tolerable vibrations	Frequency range [5 Hz – 30 Hz]: less than 30 µm/s root mean square Frequency range [> 30 Hz]: less than 60 µm/s root mean square Internet access for advanced remote diagnostics Room must comply with country specific regulations for laser class 3b and 4 Room darkening recommended
	OPERATION TEMPERATURE	Temperature for operation
Opt. optical behavior at		22 °C ± 1 °C (72 °F ± 1.8 °F)
LASER SAFETY MEASURES	Laser class	3B/ IIIb, 4/IV

SYSTEM DIMENSIONS

Compact supply unit and upright stand



Compact supply unit and inverted stand



visible and ultraviolet radiation:

LASER RADIATION
 VISIBLE AND INVISIBLE - CLASS 3B
 AVOID DIRECT EXPOSURE TO BEAM
 < 500mW 350-700nm
 IEC 60825-1: 2007

infrared radiation:

LASER RADIATION
 VISIBLE AND INVISIBLE - CLASS 4
 AVOID EYE OR SKIN EXPOSURE TO
 DIRECT OR SCATTERED RADIATION
 P < 4W 350-1600nm > 80fs
 IEC 60825-1: 2007

Figures are for illustrative purposes only. The system you purchase may deviate from the illustrations shown here, and Leica Microsystems CMS GmbH reserve the right to change the specification without prior notice.

SPECIFICATIONS



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