

# Technical Data LSM 710 NLO

## MICROSCOPES

<b>Stands</b>	Upright: Axio Imager.Z1, Axio Imager.M1, Axio Examiner*, with rear port   (*available summer 2008)
<b>Z drive</b>	Smallest increments: Axio Imager.Z1: < 25 nm; Axio Imager.M1: < 25 nm; Axio Observer.Z1: < 25 nm; Axio Examiner*: < 30 nm; fast Piezo objective or stage focus accessory; Definite Focus unit for inverted stand   (*available summer 2008)
<b>XY stage (option)</b>	Motorized XY-scanning stage, with Mark & Find function (xyz) and Tile Scan (mosaic scan); smallest increments 1 $\mu\text{m}$ (Axio Observer) or 0.2 $\mu\text{m}$ (Axio Imager)
<b>Accessories</b>	Digital microscope camera AxioCam; integration of incubation chambers

## SCANNING MODULE

<b>Models</b>	Scanning module with 2, 3 or 34 spectral detection channels; high QE, 3 $\times$ lower dark noise; up to 10 individual, adjustable digital gains; prepared for lasers from V (405) to IR
<b>Scanners</b>	Two independent, galvanometric scan mirrors with ultra-short line and frame flyback
<b>Scan resolution</b>	4 $\times$ 1 to 6144 $\times$ 6144 pixels; also for multiple channels; continuously variable
<b>Scanning speed</b>	14 $\times$ 2 speed stages; up to 12.5 frames/sec with 256 $\times$ 256 pixels; 5 frames/sec with 512 $\times$ 512 pixels (max. 77 frames/sec 512 $\times$ 32); min 0.38 ms for a line of 512 pixels; up to 2619 lines per second
<b>Scan zoom</b>	0.6 $\times$ to 40 $\times$ ; digital variable in steps of 0.1 (on Axio Examiner 0.67 $\times$ to 40 $\times$ )
<b>Scan rotation</b>	Free rotation (360 degrees), in steps of 1 degree variable; free xy offset
<b>Scan field</b>	20 mm field diagonal (max.) in the intermediate plan, with full pupil illumination
<b>Pinholes</b>	Master-pinhole pre-adjusted in size and position, individually variable for multi-tracking and short wavelengths (e.g. 405 nm)
<b>Beam path</b>	Exchangeable TwinGate main beam splitter with up to 50 combinations of excitation wavelengths and outstanding laser light suppression; optional laser notch filters for fluorescence imaging on mirror-like substrates (on request); outcoupling for external detection modules (e.g., FCS, B&H FLIM); low-loss spectral separation with Recycling Loop for the internal detection
<b>Spectral detection</b>	Standard: 2, 3 or 34 simultaneous confocal fluorescence channels with highly sensitive low dark noise PMTs; spectral detection range freely selectable (resolution down to 3 nm); additionally two incident light channels with APDs for imaging and single photon measurements; transmitted light channel with PMT; cascaded non-descanned detectors (NDD) with PMT and GaAsP NDD unit for Axio Examiner
<b>Data depth</b>	8-bit, 12-bit or 16-bit selectable; up to 37 channels simultaneously detectable

## LASER INSERTS

<b>Laser inserts (VIS, V)</b>	Pigtail-coupled lasers with polarization preserving single-mode fibers; stabilized VIS-AOTF for simultaneous intensity control; switching time < 5 $\mu\text{s}$ , or direct modulation; up to 6 V/VIS-laser directly mountable into the scanhead; diode laser (405 nm, CW/pulsed) 30 mW; diode laser (440 nm, CW+pulsed) 25 mW; Ar-laser (458, 488, 514 nm) 25 mW or 35 mW; HeNe-laser (543 nm) 1 mW; DPSS-laser (561 nm) 20 mW; HeNe-laser (594 nm) 2 mW; HeNe-laser (633 nm) 5 mW (pre-fiber manufacturer specification)
<b>External lasers (NLO, VIS, V)</b>	Prepared laser ports for system extensions; direct coupling of pulsed NIR lasers of various makes (incl. models with prechirp compensation); fast intensity control via AOM; NIR-optimized objectives and collimation; fiber coupling (single-mode polarization preserving) of external manipulation lasers of high power in the VIS range 488–561 nm (e.g., LSM 7 DUO-systems)

## ELECTRONICS MODULE

<b>Realtime electronics</b>	Control of the microscope, the lasers, the scan module and other accessory components; control of the data acquisition and synchronization by real-time electronics; over-sampling read out logic for best sensitivity and 2 $\times$ better SNR; data communication between real-time electronics and user PC via Gigabit-Ethernet interface with the possibility of online data analysis during image acquisition
<b>User PC</b>	Workstation PC with abundant main and hard disk memory space; ergonomic, high-resolving 16:10 TFT flat panel display; various accessories; operating system Windows XP or VISTA (depending on availability); multi-user capable

## STANDARD SOFTWARE (ZEN)

<b>System configuration</b>	Workspace for comfortable configuration of all motorized functions of the scanning module, the lasers and the microscope; saving and restoring of application-specific configurations (ReUse)
<b>System self-test</b>	Calibration and testing tool for the automatic verification and optimal adjustment of the system
<b>Acquisition modes, Smart Setup</b>	Spot, line / spline, frame, z-stack, lambda stack, time series and all combinations (xyz λ t); online calculation and display of ratio images; averaging and summation (line / framewise, configurable); step scan (for higher frame rates); smart acquisition setup by selection of dyes
<b>Crop function</b>	Convenient and simultaneous selection of scanning areas (zoom, offset, rotation)
<b>RealROI scan, spline scan</b>	Scanning of up to 99 arbitrarily shaped ROIs (Regions of Interest); pixel-precise switching of the laser; ROI definition in z (volume); scan along a freely defined line
<b>ROI bleach</b>	Localized bleaching of up to 99 bleach ROIs for applications such as FRAP (Fluorescence Recovery After Photobleaching) or uncaging; use of different speeds for bleaching and image acquisition; use of different laser lines for different ROIs
<b>Multitracking</b>	Fast change of excitation lines at sequential acquisition of multicolor fluorescence for reduction of signal crosstalk
<b>Lambda scan</b>	Parallel or sequential acquisition of image stacks with spectral information for each pixel
<b>Linear unmixing</b>	Generation of crosstalk-free multifluorescence images with simultaneous excitation; spectral unmixing – online or offline, automatically or interactively; advanced logic with reliability figure
<b>Visualization</b>	XY, orthogonal (xy, xz, yz); cut (3D section); 2.5D for time series of line scans; projections (maximum intensity); animations; depth coding (false colors); brightness; contrast and gamma settings; color selection tables and modification (LUT); drawing functions
<b>Image analysis and operations</b>	Colocalization and histogram analysis with individual parameters; profile measurements on any line; measurement of lengths, angles, surfaces, intensities etc; operations: addition, subtraction, multiplication, division, ratio, shift, filtering (low pass, median, high-pass, etc; also customizable)
<b>Image archiving, exporting &amp; importing</b>	Functions for managing of images and respective recording parameters; multi-print function; over 20 file formats (TIF, BMP, JPG, PSD, PCX, GIF, AVI, Quicktime, etc) for export

## OPTIONAL SOFTWARE

<b>LSM Image VisArt plus</b>	Fast 3D and 4D reconstruction; animation (different modes: shadow projection, transparency projection, surface rendering); package 3D for LSM with measurement functions upon request
<b>3D deconvolution</b>	Image restoration on the basis of calculated point-spread function (modes: nearest neighbor, maximum likelihood, constraint iterative)
<b>Physiology / Ion concentration</b>	Extensive analysis software for time series images; graphical mean of ROI analysis; online and off-line calibration of ion concentrations
<b>FRET plus</b>	Recording of FRET (Fluorescence Resonance Energy Transfer) image data with subsequent evaluation; supports both the methods acceptor photobleaching and sensitized emission
<b>FRAP</b>	Wizard for recording of FRAP (Fluorescence Recovery After Photobleaching) experiments with subsequent analysis of the intensity kinetics
<b>Visual macro editor</b>	Creation and editing of macros based on representative symbols for programming of routine image acquisitions; package multiple time series with enhanced programming functions upon request
<b>VBA macro editor</b>	Recording and editing of routines for the automation of scanning and analysis functions
<b>Topography package</b>	Visualization of 3D surfaces (fast rendering modes) plus numerous measurement functions (roughness, surfaces, volumes)
<b>StitchArt plus</b>	Mosaic scan for large surfaces (multiple XZ profiles and XYZ stacks) in brightfield mode
<b>ICS image correlation spectroscopy (PMT)</b>	Single molecule imaging and analysis for all LSM 710 systems with PMT detectors (publ. by Gratton)