



# FEMTO-1

## Femtosecond Laser Simulation System

**FEMTO-1 Laser Simulation System** is intended for single event effects (SEEs) investigations in integrated circuits (ICs) and semiconductor devices (SDs). In particular, ultra-short laser pulses are used to simulate the ultrafast transient effects of energetic particles striking SDs. By varying pulse energy, femtosecond laser source allows to simulate ionization tracks produced by particles with various linear energy transfer (LET).

FEMTO-1 includes the source of a femtosecond pulsed radiation (Ti:Sapphire femtosecond laser with an integrated diode-pumped solid state (DPSS) pump source, diffraction grating stretcher, regenerative and multipass amplifiers pumped by frequency doubled DPSS Nd<sup>3+</sup>:YAG laser, multi-functional Pockels cell pulse picker, tunable pulse compressor), high precision computer controlled XYZ translation stage and specialized industrial high-resolution microscope. FEMTO-1 produces a train of pulses with 870 nm wavelengths at a max. 100 Hz repetition rate or operates in a single-shot mode.

Laser pulses are focused through a microscope onto the device under test (DUT). A camera attached to the microscope shows the position of the laser beam. Various Mitutoyo® high resolution microobjectives with large working distance (having magnifications between 5× and 100×) can be used, and the spot size of the incident laser beam on DUT surface can be varied between approximately 1.2 and 200 microns.

Devices are scanned under the laser beam to locate sensitive nodes. High-speed digital oscilloscopes, transient digitizers and logic analyzers (not included in the system) capture the response of devices to charges generated in the semiconductor material by the incident laser pulse. The thresholds for SEE can be determined using local laser irradiation technique.

### Features

- Modern and reliable ultra-short laser pulses source
- Up to 100 Hz laser pulse repetition rate and single-shot mode
- Variable pulse duration from 70 fs to 10 ps
- Excellent beam quality (TEM<sub>00</sub>) M<sup>2</sup><1.3
- Integrated pulse monitoring system (pulse wavelength and duration)
- High precision object scanning system
- High-resolution Mitutoyo® microobjectives with extra large working distances
- Accurate synchronization of scanning, irradiation and registration
- Mounted on 1200×1800 mm breadboard
- Fully controlled by PC software with user-friendly interface

### Applications

- Investigation of:
  - single event upsets (SEU)
  - single event latchup (SEL)
  - ultrafast single event transients (SET) in UHF electronics
- Validating of radiation-hardening techniques
- Testing of radiation hardened designs
- Determination of the most radiation sensitive IC area and operation mode
- Debugging technique for IC testing under ion beam
- On-PCB ICs testing
- Investigation of destructive failures in ICs due to SEL
- Micromachining



## Specifications

Parameter	Unit	Value
Laser source type	–	femtosecond Ti:Sapphire
Wavelength	nm	870±10
Max. laser pulse energy on DUT ( )	μJ	20
Laser pulse duration (FWHM)	fs	70 ... 10 <sup>4</sup>
Laser pulse energy stability	%	± 3
Min. laser spot size (1/e <sup>2</sup> ) for 20×microobjective	μm	< 2
Attenuation coefficient	–	1 ... 5·10 <sup>4</sup> , PC controlled
Pulse repetition rate	Hz	0...100
Video camera:		
Type	–	Color CCD progressive
Resolution	pixels	1392×1040
Max frame rate at full resolution	Hz	17
Spatial resolution	μm/pix.	0.3 (for 20× microobjective)
Interface type	–	IEEE 1394a
Microobjectives (standard set):		
Type		Mitutoyo Plan APO NIR
Magnification:		
5×	pcs.	1
20×	pcs.	1
Device positioning system:		
XYZ stage	–	motorized, PC controlled
Min. step (horizontal; vertical)	μm	0.156; 0.125
Travel range (horizontal; vertical)	mm	100; 25
Max. linear speed	μm/s	500
Special mounting / alignment constraints:		
Max. device/PCB size	mm	400
Objective working distance	mm	20 (for 20× microobjective)
Cooling/heating:		
Ti:Sapphire femtosecond laser		thermostat-circulator (cooling agent R134a)
DPSS pump		thermoelectric temperature control system (water)
Total dimensions (excl. power supply)	mm	1800×1200×1700
Power supply:		
Mains type	–	~ 220 V, 50 Hz
Max. power consumption (not incl. PC)	kW	1
PC software interface	–	English

*NOTE: All specifications are subject to change without notice*