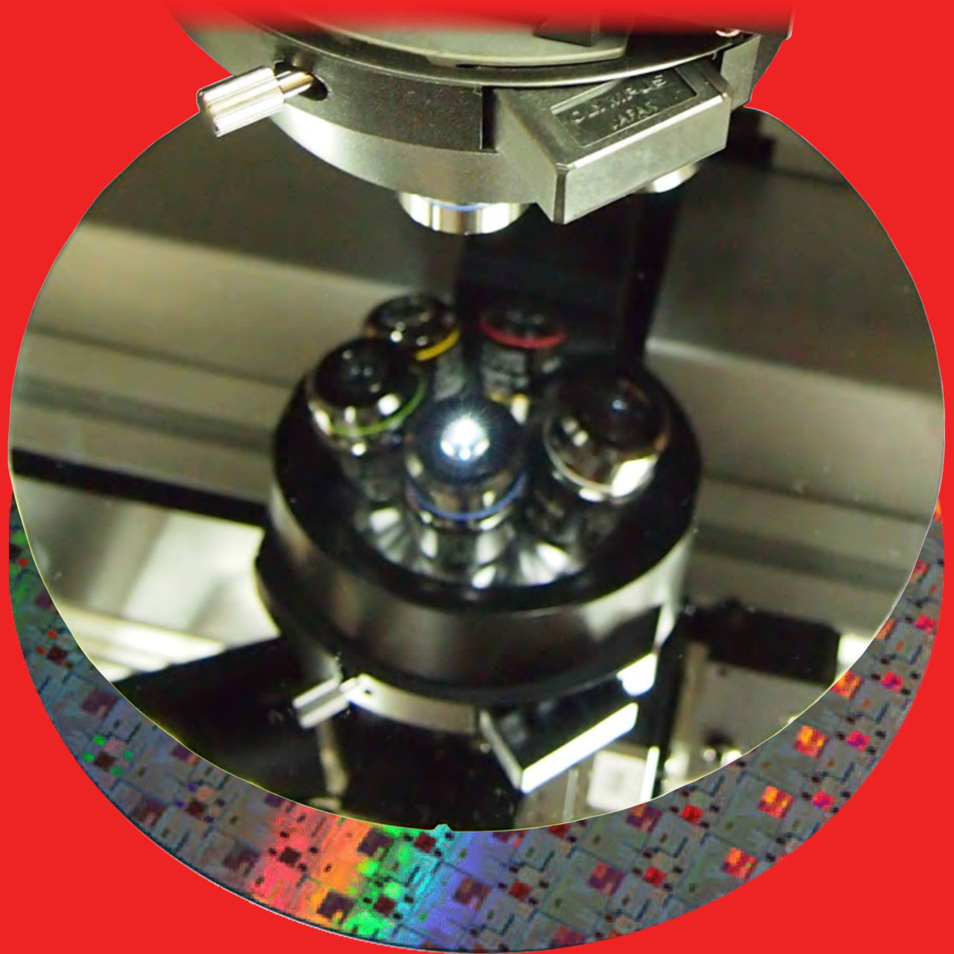
NIR LASER SCANNING CONFOCAL MICROSCOPY



is a world leader in the design, manufacture and integration of OEM and complete microscopy automation solutions for the biomedical, metrology, electronics, semiconductor, and flat panel display markets.

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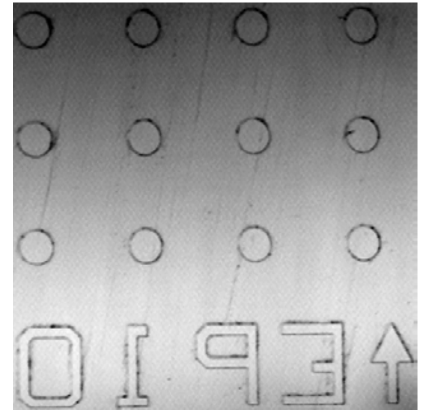
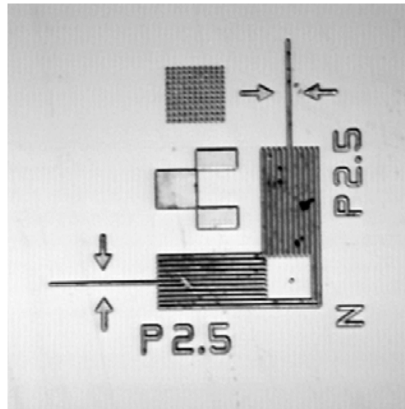
CONFOCAL MICROSCOPY

WDI's IRLC and LSCM systems employ a near-infrared (NIR) laser, specialized infrared optics, and confocal imaging technology to create the ideal non-destructive, semiconductor subsurface imaging tool. The combination of a NIR laser and optics with a scanning confocal microscope offers several advantages over conventional widefield infrared microscopy systems. First and foremost is the ability to acquire clear, high resolution images from deep within Si and other similar materials. NIR laser scanning confocal technology also permits deeper imaging through heavily doped substrates, improved spatial resolution, and faster data acquisition.

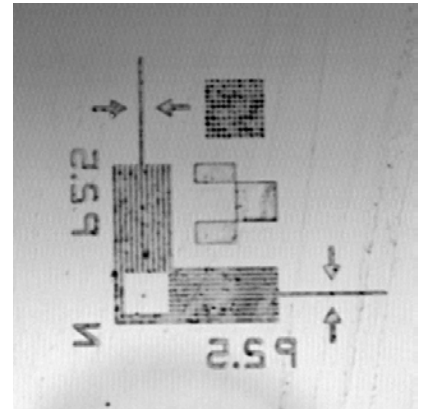
10X image of wafer pattern imaged at the surface



10X image of wafer pattern imaged through 700 µm from the backside



20X image of wafer pattern imaged at the surface



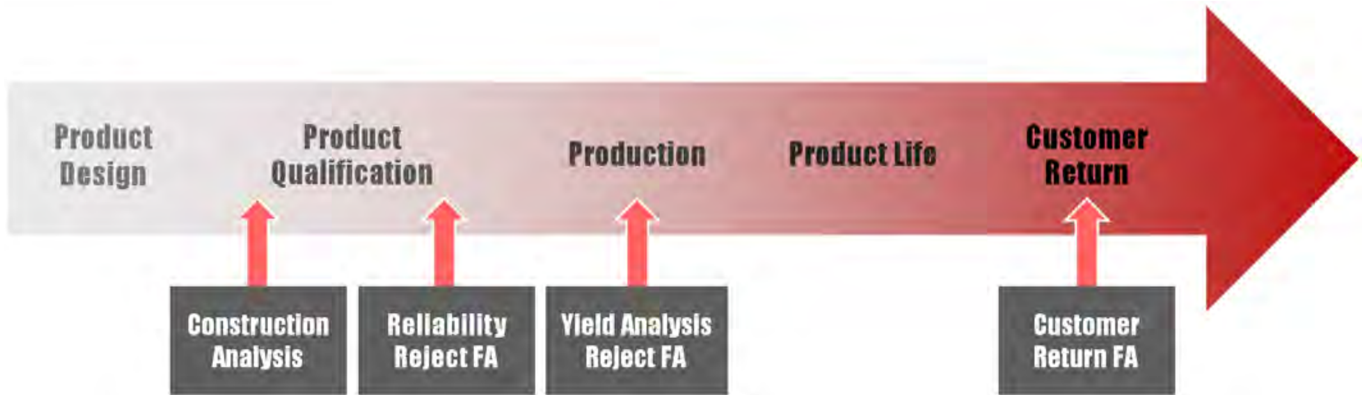
20X image of wafer pattern imaged through 700 µm from the backside

OPTIMIZED FOR SILICON

To ensure the highest resolution and sharpest images, all system components, optical elements, and objectives have been designed and selected for optimal transmission of NIR wavelengths and imaging through Si. Features such as advanced photo detection and unique objective "correction collars", coupled with component automation for precision motorization of the objectives, XY stage, ND filters, Z position, and illumination, ensure accurate, fast and simple image collection.

NIR INSPECTION FOR FAILURE ANALYSIS

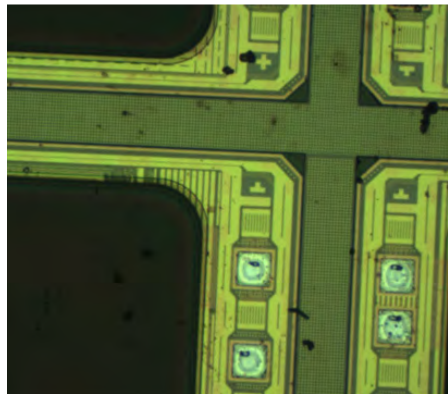
NIR confocal microscopy is ideally suited for use at various points within the failure analysis (FA) workflow because it is non-destructive and allows inspection of both Si bulk integrity and active level/layer areas. The imaging technique has been applied to Flip Chip, WLCSP, and doped wafers. Other applications include integrity inspection after bonding, sacrificial oxide layer inspection after etching, inspection for chipping and cracks after grinding or dicing, and inspecting SIP (system in package), 3D mounting, or CSP (chip scale packages).



VERSATILE AND ADAPTABLE

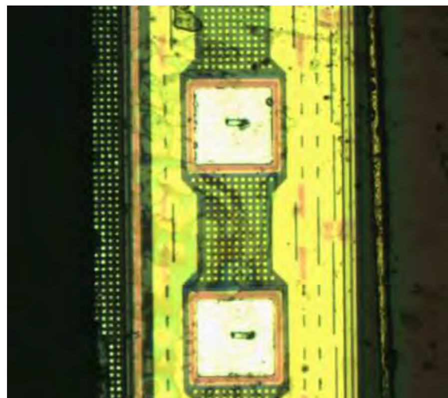
CMOS imaging sensors (CIS) often have a protective film or colour filter layer over the pixel area. With conventional brightfield techniques, only the surface detail is visible. However, using NIR confocal microscopy, the structures beneath these areas are clearly visualized.

Frontside imaging through the metal pad of a device is not possible, and backside imaging can be difficult due to heavy doping and depth of the active layer. NIR confocal microscopy permits rendering from the back-side, resulting in high resolution subsurface images.

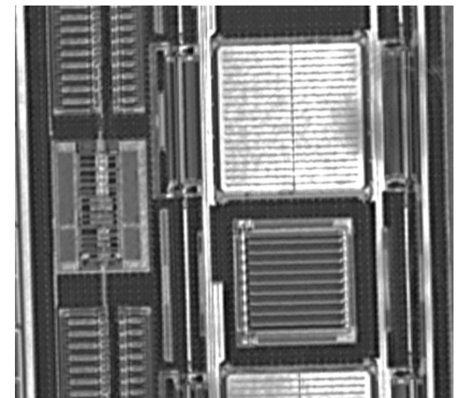


5X brightfield image of CIS device (front)

20X NIR confocal image of CIS device (front)



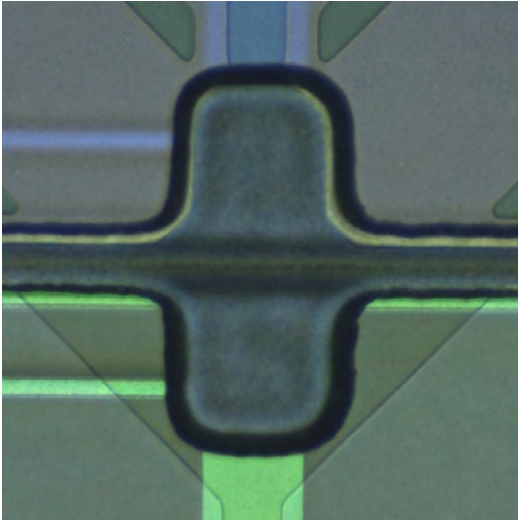
10X brightfield image of doped device (front)



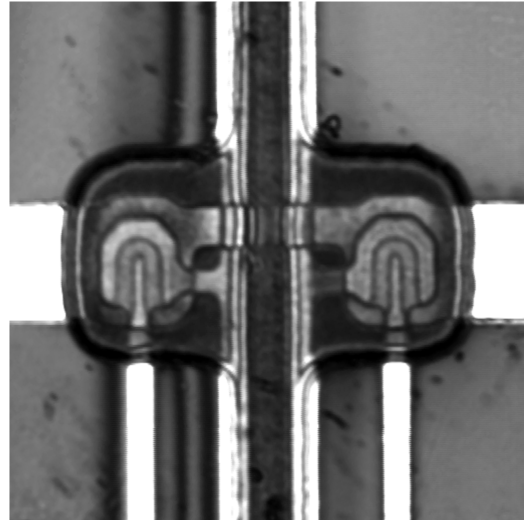
20X NIR confocal image of doped device (back)

DUAL OBSERVATION

IRLC and LCSM systems include both a colour CMOS camera and NIR laser scanning confocal microscope. This combination allows imaging both at the surface and deep within a wafer or device. Switching between these observation methods is a one-click process. Since the systems utilize WDI's advanced autofocus (ATF), OOA (optical offset adjuster), and ZAA (Z-axis actuator) technology, the wafer or sample remains in constant focus regardless of changes in observation method or surface metrology, even during movement.



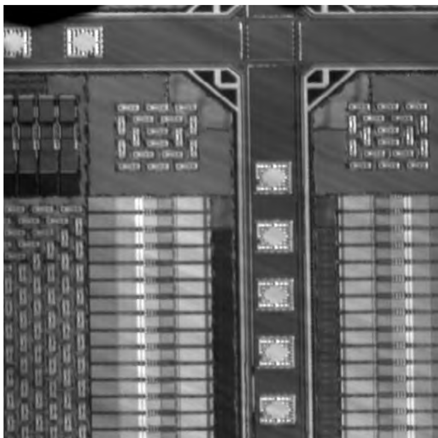
20X brightfield surface image of a thin film transistor (TFT) array with transistors hidden under the black matrix



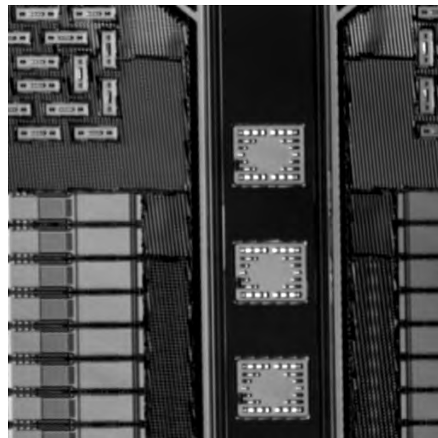
20X NIR confocal image of the TFT array revealing the transistor structure beneath the black matrix

IMAGING OF DOPED DEVICES

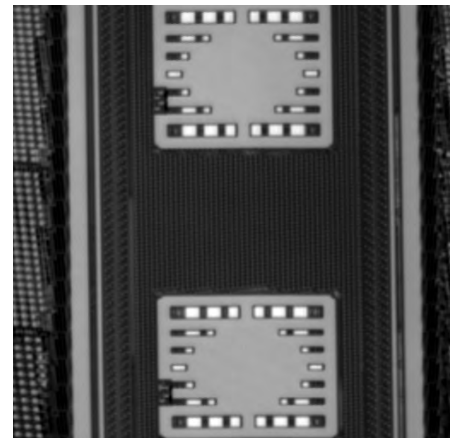
Due to light scattering, heavily doped wafers and devices may be difficult and often impossible to image with conventional widefield IR techniques, particularly if the active layer is deep. WDI's systems are dedicated to overcoming this issue, providing superior high quality, high resolution, subsurface images at all magnifications.



10X NIR confocal image of doped silicon device taken approx. 400 μm below the surface



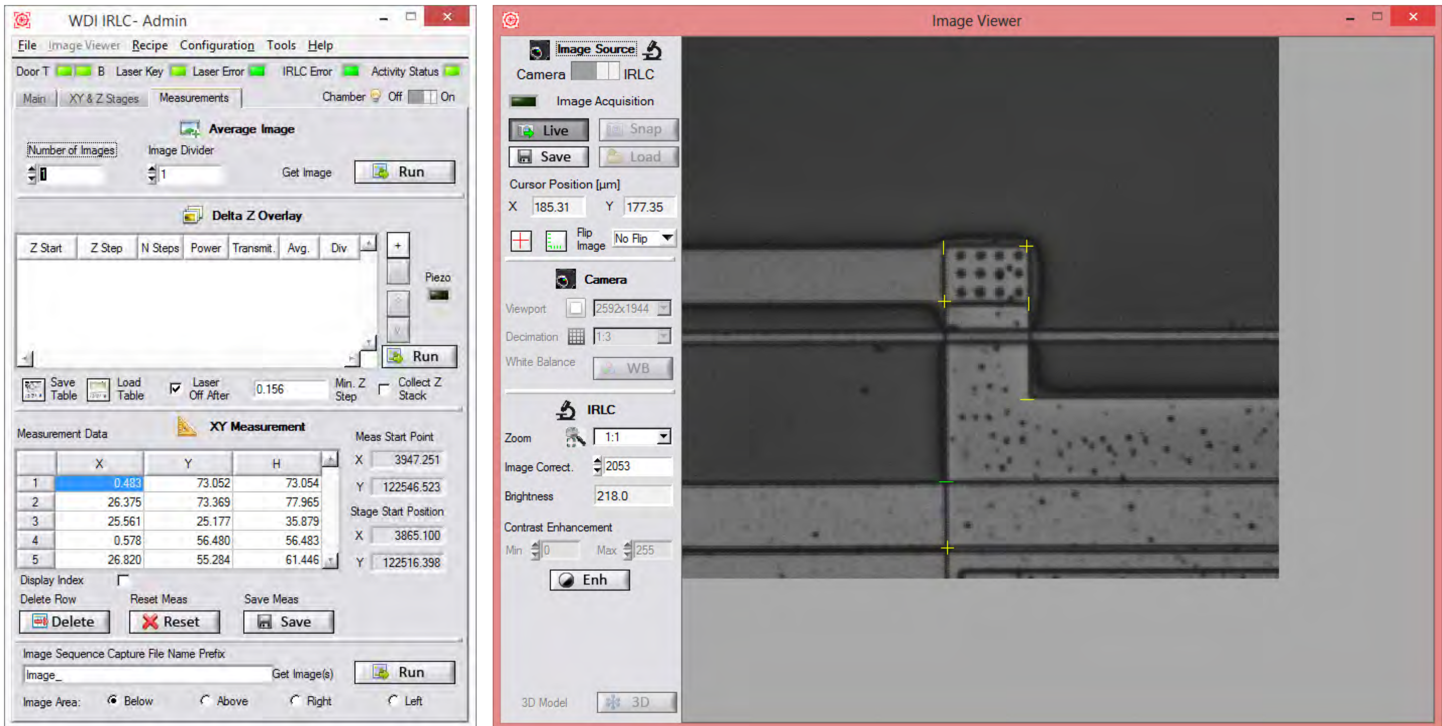
20X NIR confocal image of doped silicon device taken approx. 400 μm below the surface



50X NIR confocal image of doped silicon device taken approx. 400 μm below the surface

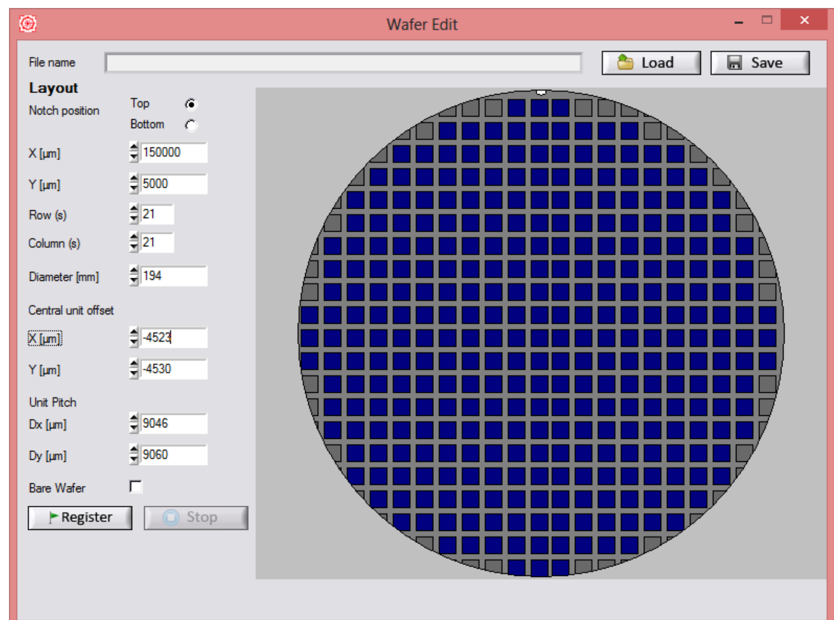
INTUITIVE SOFTWARE

All systems feature powerful yet intuitive software permitting efficient data collection. Operation of the system, including system adjustments for illumination, magnification, XYZ stage position, and focus offset, are easily made. The software also features advanced image acquisition options, such as maximum Z projection, image stacking and image sequences. Data can be easily exported to popular imaging processing software such as ImageJ and Matlab.



AUTOMATED ACQUISITION

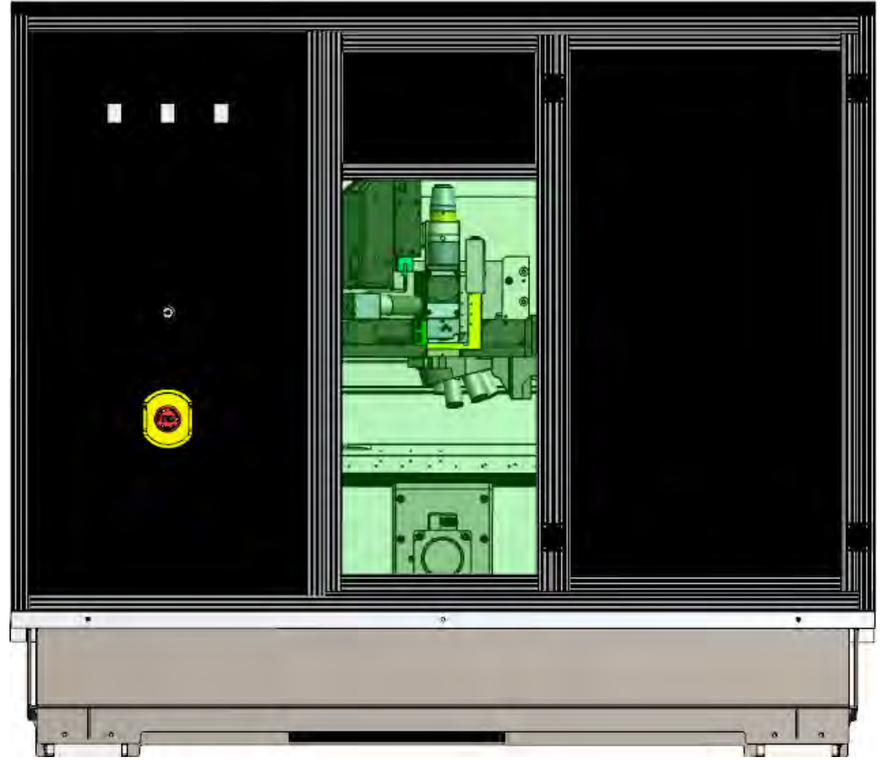
By combining integrated motorization and autofocus with optional software, the systems can run automated acquisition routines. These routines may be applied to a single die or multiple dies, permitting the complete automation of the imaging process. The creation and execution of imaging recipes for wafers and both IC strip and tray packages is also possible. Once created, recipes can be executed against other individual samples or entire trays or strips of devices, ensuring accurate and repeatable inspection and greater overall efficiency.



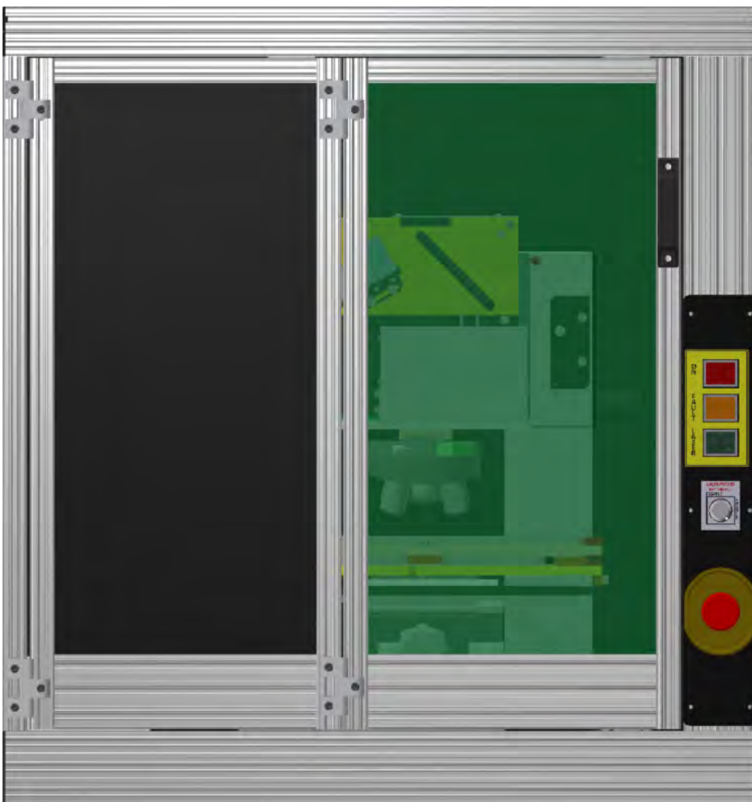
IRLC IMAGING SYSTEMS

The IRLC is a NIR confocal imaging system designed for applications that require support for 300 mm wafers, 100X magnifications, and complete autonomous operation. Built on a solid granite foundation, the IRLC is the ultimate tool for subsurface imaging.

- ✓ Confocal scanner (500 mW, 1155 nm)
- ✓ Motorized variable beam attenuator
- ✓ Motorized Z jack course focus
- ✓ Motorized ZAA fine focus ± 5 mm
- ✓ ATF 6 sensor, 660 nm with OOA
- ✓ Motorized objective turret
- ✓ 5X, 10X, 20X, 50X, 100X
- ✓ Motorized XY 300 mm linear stage
- ✓ Colour CMOS camera
- ✓ IRLC standalone software
- ✓ Laser safety enclosure



LSCM IMAGING SYSTEMS



The LSCM NIR confocal imaging system offers the capability of the larger IRLC in a smaller tabletop platform. Flexible and adaptable to many applications, it can be configured as a fully automated system, a semi-automated system with a manual stage, or even as an OEM component to be integrated into an existing tool.

- ✓ Confocal scanner (300 mW, 1178 nm)
- ✓ Manual Z jack course focus
- ✓ Motorized ZPS fine focus ±5 mm
- ✓ ATF 6 sensor, 660 nm with OOA
- ✓ Motorized objective turret
- ✓ 5X, 10X, 20X, 50X
- ✓ Motorized XY 200 mm linear stage
- ✓ Colour CMOS camera
- ✓ LSCM standalone software
- ✓ Laser safety housing

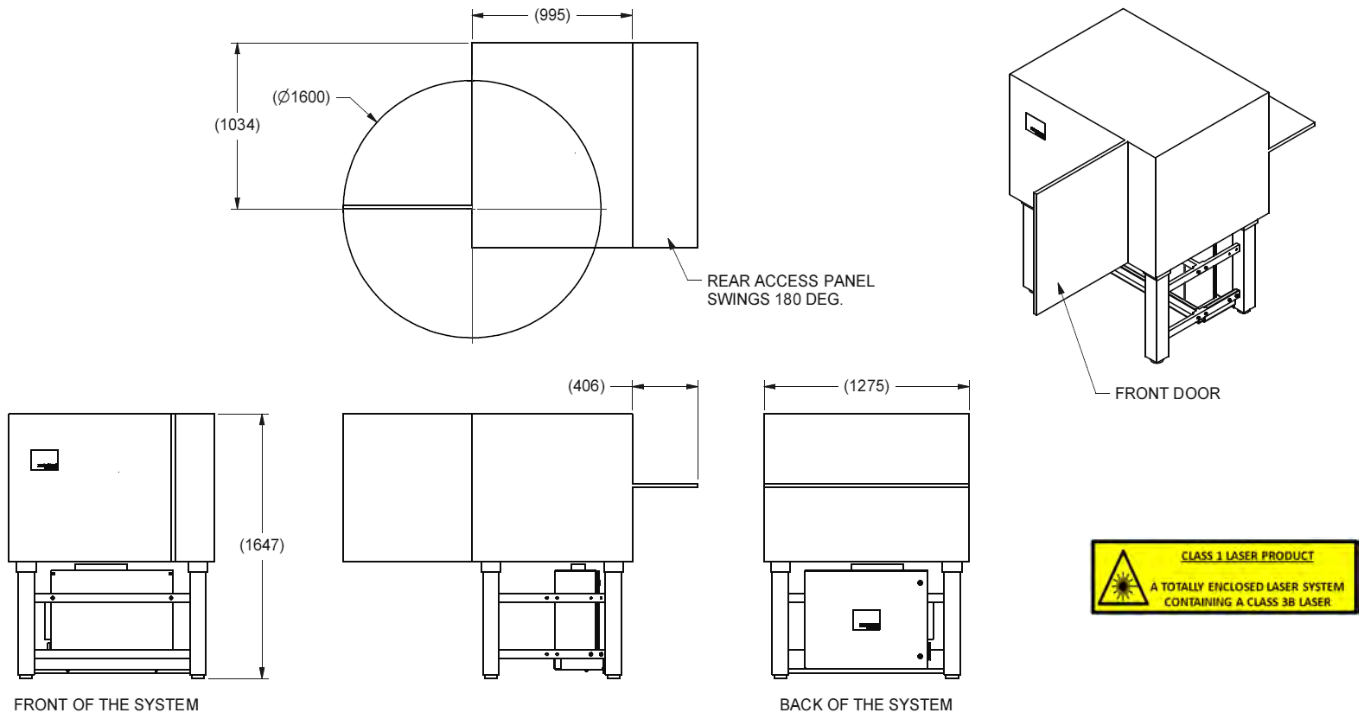
SYSTEM SPECIFICATIONS

CATEGORY	SPECIFICATION	IRLC SYSTEM	LSCM SYSTEM
General System	System class	Class 1	
	Observation methods	NIR laser scanning confocal, conventional brightfield	
	Electrical	3 separate AC outlets, 100-240 V, 50/60 Hz, single phase	
	Current	13.0 A total system	
	Operating temperature	10°C to 30°C ambient	
	Operating humidity	< 70% non-condensing	
	Weight (main unit)	900 kg	175 kg
Lens Changer	Motorized turret	6 lens capacity	
Z Stage Jack	Stroke	Motorized, 50 mm stroke	Manual, 75 mm stroke
Motorized Z Actuator (Hybrid ZAA also available for high speed IRLC)	Type	1/32 stepper motor	
	Travel	10 mm	
	Resolution	0.157 μm	0.250 μm
	Maximum speed	10 mm/sec	
	Maximum load	3.5 kg	
Motorized XY Stage (Manual stage also available for LSCM)	Type	Linear encoder stepper motor	
	Travel	300 mm x 300 mm	200 mm x 200 mm
	Resolution	0.1 μm	
	Maximum speed	120 mm/sec	
	Accuracy	20 μm/300 mm	
	Repeatability	1 μm	
	Maximum load	1 kg	
Autofocus	Structured light pattern	Line segment	
	Sensor wavelength	658 nm	
	Image detector	Area scan CMOS	
Motorized OOA	Depth range	0 to 800 μm	
Brightfield Illumination	Type	Super bright white LED	
Brightfield CMOS Camera	Size	1/2 inch 2 MP CMOS	
	Resolution	1600 X 1200	
	Frame rate	10 FPS full resolution	
	Bit depth	10 bits	
	Pixel size	4.2 μm X 4.2 μm	
Confocal Illumination	Type	Single mode laser diode	
	Maximum laser power	500 mW	300 mW
	Wavelength	1155 nm	1178 nm
	Typical spectral width	5.0 nm	2.3 nm
Confocal Photodetector	Spectral response range	900 nm ~ 1700 nm	
	Resolution	496 x 500	512 x 512
	Bit depth	8 bits	
	Virtual pixel size	7.5 μm standard	

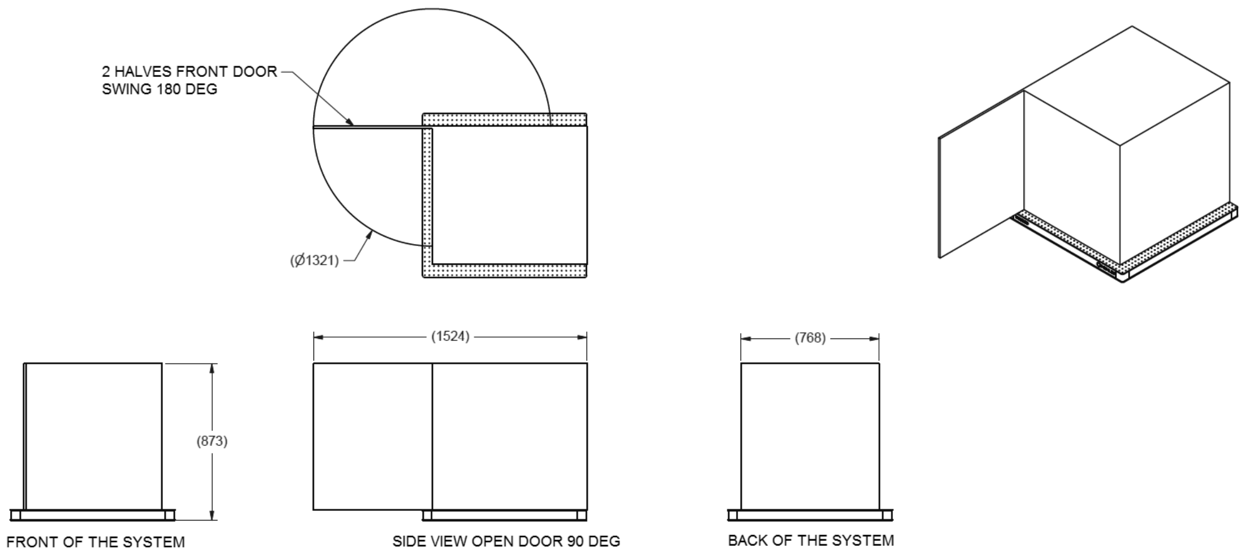
	5X	10X	20X	50X	100X[a]
Numerical Aperture	0.1	0.3	0.45	0.65	0.85
Working Distance	23 mm	18 mm	8.3 mm	4.5 mm	1.2 mm
Field Number	22	22	22	22	22
Correction Collar			Yes	Yes	Yes
Glass Thickness Correction			0~1.2 mm	0~1.2 mm	0~0.7 mm

a 100X objective is optional on LSCM.

IRLC SYSTEM DIMENSIONS



LSCM SYSTEM DIMENSIONS



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