

# Got Sensitivity?

## IREM-II

The industry standard in Infrared Emission Microscopy.

- The industry's highest sensitivity InGaAs detector.
- Superior ultra low noise read electronics
- Precision fault localization
- Inverted microscope for direct docking of ATE
- Custom Optimized Optics, 2.6 NA SIL available
- High performance 3-axis positioning system
- Advanced InfraRed Imaging Software (AIRIS)
- CAD navigation capabilities



**IRLabs**  
Infrared Laboratories

### IREM Product Sales

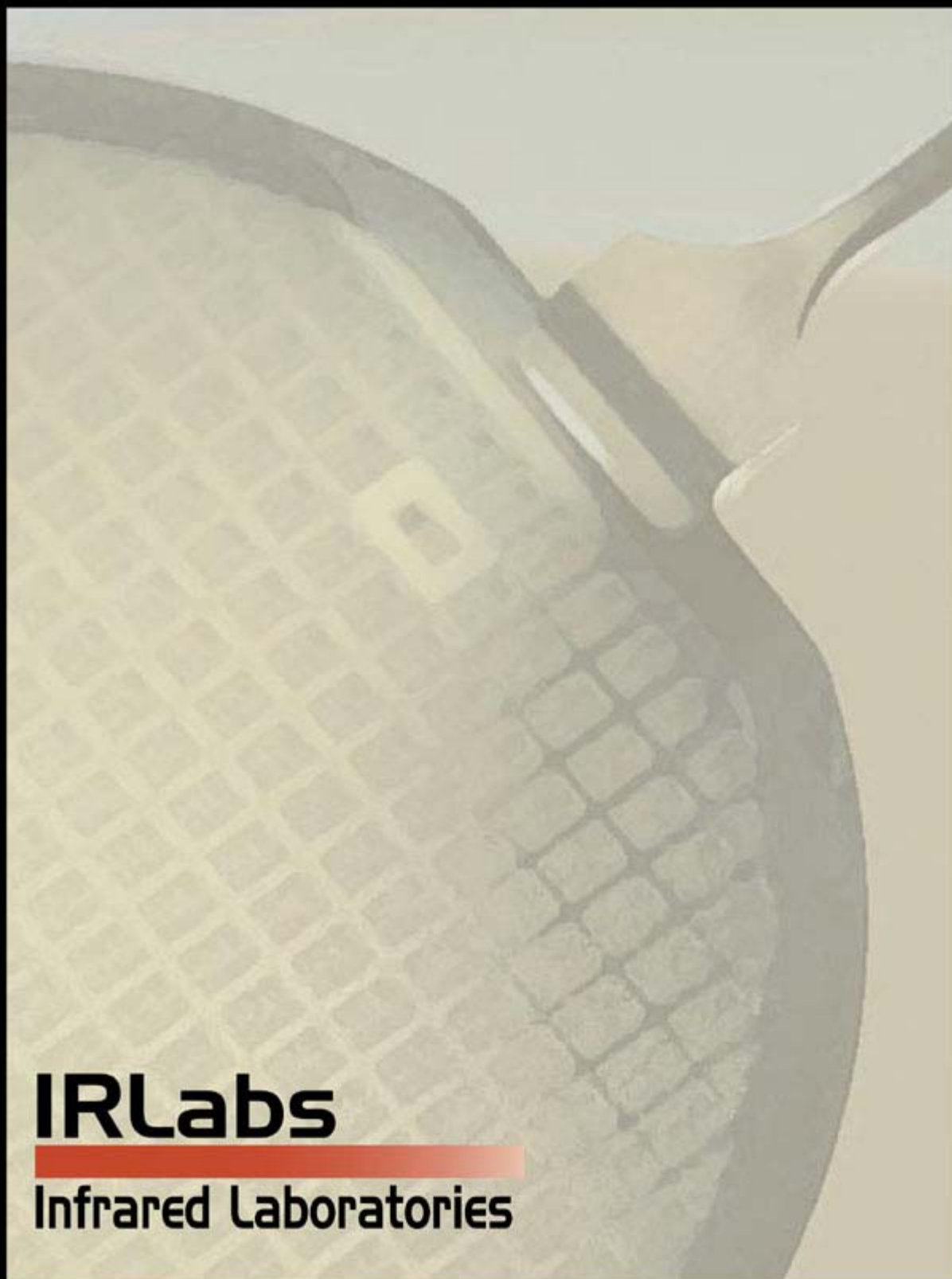
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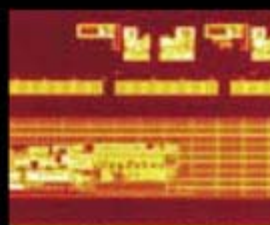
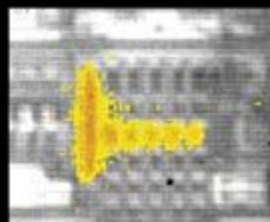
# IREM-II™

## Looking Up into the Future



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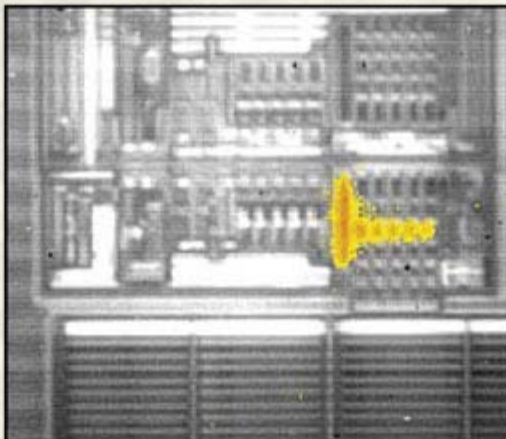
# IREM-II™

## THE BENCHMARK OF EMISSION MICROSCOPES

Infrared Laboratories leads the market in developing new emission microscopy solutions for the semiconductor industry. The IREM-II™ (originally introduced as the NG-IREM) provides backside failure analysis, yield enhancement and debug with unprecedented visibility to the faintest levels of near-IR emission. While optimized for photoemission applications, the IREM-II™ allows for easy "swapping" to thermal emission microscopy applications utilizing the IREM-I™ MCT detection system.

Smaller transistors and lower voltages demand higher sensitivity and higher spatial resolution if individual transistors are to be isolated via their photo-emission. Utilizing a proprietary high sensitivity InGaAs focal plane array and high numerical aperture optics, the IREM-II™ dramatically shortens the time required and increases the precision of fault localization.

An illuminated 100x emission image superposed over the emission image is shown here, illustrating a convenient way to locate failures and analyze the emission site. Here the overlaid emission image uses color to easily identify the critical results generated by the faulty devices. The defect was detected by an IREM-II™ and processed using AIRIS™, IRLabs' Advanced Infrared Imaging Software.



### Using InGaAs Technology

For the IREM-II™ photoemission Camera, IRLabs designed an ultra low-noise InGaAs Focal Plane Array using unique cryogenic electronics. This unique detector was designed

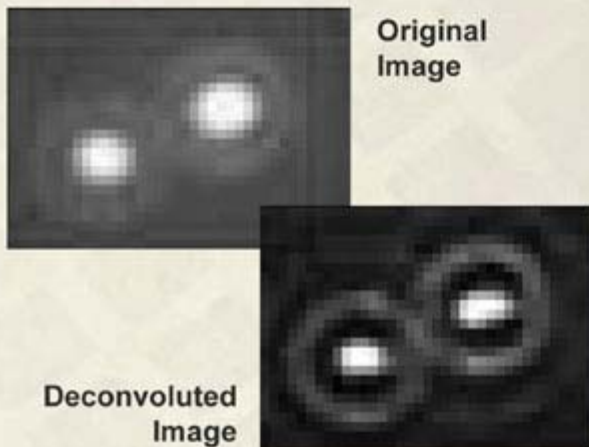
specifically for detection and location of design errors and component failures at extremely low voltages. Optimized for photoemission applications between 1 $\mu$ m and 1.5  $\mu$ m emission wavelength, the IREM-II™ has an unmatched signal-to-noise ratio and sensitivity. Faint emissions of sub 1-volt devices can be detected within a very short integration time. Working in the band where hot-carrier emission peaks, these sites are detected in seconds and their centroids are located to sub-micron precision relative to on-chip fiducials or CAD alignment.

The IREM-II™ is fully integrated with both Knights and Schlumberger CAD systems for navigation and for precision measurement of locations in chip coordinates.

Cryogenic cooling of the IR detector and associated cooled optics is provided by a 1-liter capacity liquid nitrogen Dewar maintained by an automatic-fill system for unattended continuous operation.

## AIRIS™ Software

The IREM-II™ is fully supported by IRLabs' imaging software, AIRIS™. All of the IREM's various hardware operations are well integrated, and image processing functions are designed to optimize signal-to-noise along with real-time image conditioning such as precision flat-fielding and bad-pixel removal. The built in image processing is based on a number of key astronomical techniques and algorithms that enhance spatial resolution and fault localization. High magnification IR images are blurred by diffraction and often by imperfect optics. Powerful deconvolution techniques are built into AIRIS™ in order to compensate for this problem.



## MX Positioning System

The flexibility of the IREM-II™ extends beyond its unique detector technology. A high quality, high performance 3-Axis Positioning System designed by Motion X Corporation utilizes an open frame architecture to insure the highest "in position" stability and lowest possible long-term drift. Unlike traditionally stacked stage systems, the use of the open frame design allows for

mounting of the IREM camera symmetrically to all three axes of motion. In doing so the overall height of the stage is kept to a minimum and the effects of a counter-lever associated with traditional stacked stage configurations are completely eliminated. Refer to the Motion X Internet site for an in-depth look at Motion X Corporation, ([www.motionx.org](http://www.motionx.org)).

## Additional Options

The IREM-II™ may optionally include a cooled 6-position filter wheel with staggered overlapping short-pass filters to measure spectral energy distributions (SEDs) at all magnifications. SEDs can be used to classify emissions based on their spectral characteristics. With only 3 images, a color versus color plot can be created to identify specific defects and other physical properties.

## IREM-II™ Customers

The IREM-II™ is used by semiconductor manufacturers around the world. Many of our customers rely on our infrared emission microscopes for debug and failure analysis in more than one location. These systems are in continuous operation and have achieved greater than 90% up-time availability including all normal maintenance.

The IREM product line is once again available directly from IRLabs, Incorporated. Interested parties are invited to visit IRLabs where our IREM engineers will give a full demonstration of the capabilities of our Infrared Emission Microscope. To speak with our IREM engineers or to receive price and delivery information, please contact us by email or call IRLabs directly.

# IREM-II™ SPECIFICATIONS

## IR Microscope – InGaAs FPA

- 320 x 256 array with 30  $\mu\text{m}$  pixels
- 1.0 - 1.54  $\mu\text{m}$  response with average QE above 60%
- Ultra Low-Noise readout
- Readnoise < 3 electrons
- Integration times from 0.215 to > 500 seconds
- Operating Temperature ~80 K

## Optics

- Custom designs & A/R coatings using optimized glasses and infrared crystals
- 1x & 25x (optional 100x)
- Cryogenic baffles and cold stop
- Infrared LED illuminators built into objectives

## Positioning Stage from Motion X Corporation

- 100 mm x 100 mm x 100 mm Travel
- 50 nm Resolution
- Open Frame Design
- Light Tight Enclosure with Active Air Isolation

## AIRIS™ Software

- Windows 2000, NT, or XP (Mid 2006) installed on rack-mounted PC
- Graphical user interface
- xyz-Stage control
- Camera control and 16-bit image acquisition
- Custom image processing

## AutoFill Storage Cabinet (optional)

- Maintains cryogenic performance of microscope when not in use
- Swap out between IREM-I™ and IREM-II™
- Independent AutoFill electronics
- Stand alone EPO

## Multi Spectral Analyzer (optional)

- Cryogenically cooled six-position filter wheel
- 1200 nm, 1300 nm, 1450 nm, 1550 nm, open, and blank positions
- Characterization of emission failure mechanisms by measuring spectral energy distributions
- 'Color' imaging using any three filters

# IREM-II

The Industry Standard in Infrared Emission Microscopy

**IRLabs**  
Infrared Laboratories

The IREM-II infrared microscopy system from IRLabs lets you perform semiconductor failure analysis and debug faster, with more accuracy and reliability.



# IREM-II

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## Standard IREM-II Lenses



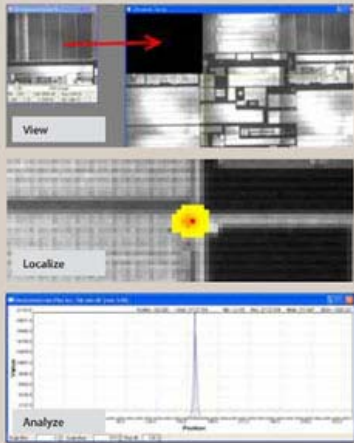
### Superior Optics

The IREM-II is available with custom 1x, 25x, or 100x lenses. The optical quality of these lenses is the highest in the industry, giving you unmatched precision in locating potential faults. Custom optics, such as the Liquid and Solid Immersion Lenses are available to meet specialized needs.



Liquid Immersion Optic

## AIRIS



### State of the Art Software

IREM-II is fully supported by AIRIS, our Advanced Infrared Emission Imaging Software, which includes image-processing functions based on techniques originally developed for astronomical applications. These algorithms enhance spatial resolution and localization to help optimize signal-to-noise along with real-time image conditioning such as precision flat-fielding. Hardware operations are well integrated with the software to yield optimum results.

### Display Functions

- Mosaic: Increase effective field of view at high resolution - map an entire device.
- Overlay: Overlay Emission images, illuminated device images, and CAD data/polygons to find problems faster.
- Region of Interest (ROI): Select and analyze a device area or sub-field.
- Post-processing tools
- Image analysis tools

### Navigation Functions

- Third party CAD SW navigation
- Panning, absolute move, relative move, reference points, point database, chip profile

### Image Enhancement Functions

- Sub-stepping
- Deconvolution
- Digital Zoom

## Service



### IRLabs: at Your Service

The best technology in the world doesn't do you much good if the company behind it isn't responsive to your needs. IRLabs is the leader in Infrared emission microscopy because we offer both superior, proven technology and a "can do" approach to meeting customers' needs. We will respond quickly and intelligently to your requests, by helping you develop a system tailored to your applications and providing prompt, knowledgeable service when you need it. Let us know how we can best serve you!

### Infrared Laboratories Offers:

- Close cooperation with customer to design and fabricate Custom Mechanical and Opto-mechanical assemblies and fixtures
- "One-off" interfaces to your devices
- User-driven software development
- Highly personalized service

## IREM-II Camera



### Most Sensitive Camera

Available only from Infrared Laboratories, the IREM-II's proprietary InGaAs-based focal plane array (FPA) with unmatched signal-to-noise ratio, makes this the most sensitive Infrared Emission camera in the industry. Combined with IRLabs' high numerical aperture, near IR optimized lenses, it allows you to detect and localize even the faintest emission sites indicative of defects, faster and more accurately.



## IREM-II System

The IREM-II Failure Analysis System, using proven, superior, InGaAs technology; high-resolution optics optimized for the NIR; and a suite of software tools offers the best performance in detecting and locating faults in semiconductor devices with 45nm design rules and beyond. As VLSI circuits continue to shrink, the ability to detect flaws early in the manufacturing process, both quickly and accurately, assumes increasing importance. This is where IRLabs' technology excels.

## Motion Control System



### Ultra-Precise Motion Control

Using an open frame architecture, this system drives the moving mass at the center of gravity, minimizing residual vibration for rapid "in-position" settling. High resolution encoders allow for extremely small, controlled camera motions. In addition, the system features pneumatic Vibration Isolation with a low, well-damped resonant frequency, ensuring that vibrations are not transmitted to the DUT or camera.

## IREM-II Specifications

### CAMERA

Temperature: 78K  
 Wavelength Band: 900-1600nm  
 Pixels: 320 x 256  
 Pixel Size: 30 microns  
 A/D Converter: 16 bits  
 Read Noise: <10e- (absolute)  
 Dark Current: <1e-/s  
 Cryo Hold Time: 18 hrs

### MOTION SYSTEM

Motion Resolution: 25nm STD  
 (6.25nm available)  
 Motion Range (x/y/z): 100mm/100mm/100mm  
 Isolation Frequency: <2Hz  
 Isolation Damping: Q<5

### OVERALL SYSTEM

810mm x 876mm x 813mm  
 160 kg

### Electronic Rack

609.6mm x 1282.7mm x 762mm  
 90 kg

### Desk Console

1219.2mm x 812.8mm x 812.8mm  
 90 kg

### Auto Fill Tank

508mm x 1168.4mm x 508mm  
 50 liter capacity  
 1.02 atm (15 psi)  
 65 kg

### Power Requirements

1 kVAmx (International power configurations available)

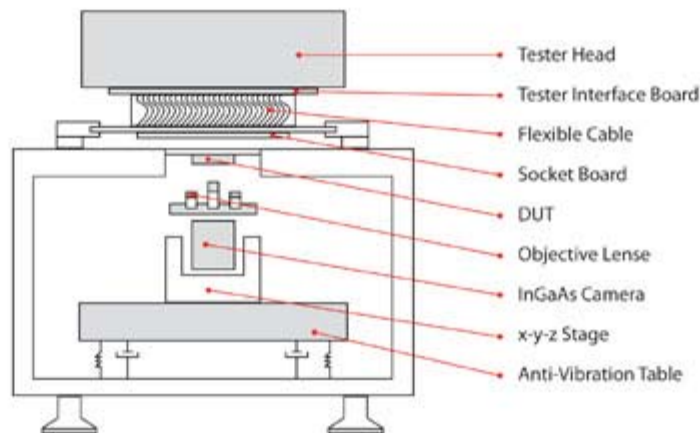
### LN2 Requirements

1 liter per 18 hours of operation

## Features

- High Resolution, High Sensitivity Image Acquisition with Liquid Immersion Optic (LIO) and Solid Immersion Lens (SIL)
- AIRIS Software with 3rd Party Software Interfaces
- Highest SNR InGaAs Camera Based on Infrared Laboratories' Proprietary FPA Allows observation of faintest signals in devices that are: heavily doped, low voltage, small features, thicker substrates
- Highly Stable, Highly Reliable System, Very High Up-time  
Customers use our systems continuously
- Tester Docking Design  
Allows docking with almost all testers for improved flexibility
- Upgradable

## Tester Docking



## Optical Specifications

| Magnification | Numerical Aperture | Design Wavelength | Working Distance | Resolution   | Manufacturer | Illumination       | Crash Protection | SA Correction |
|---------------|--------------------|-------------------|------------------|--------------|--------------|--------------------|------------------|---------------|
| 1x            | 0.25               | 1.00-1.50 microns | 12 mm            | 2.93 microns | IRLabs       | IRLED-Coax         |                  |               |
| 10x           | 0.26               | 0.48-1.80 microns | 30.5 mm          | 2.82 microns | Mitutoyo     | Ring               |                  |               |
| 25x           | 0.5                | 1.00-1.40 microns | 12 mm            | 1.46 microns | IRLabs       | IRLED-Coax         |                  |               |
| 50x           | 0.65               | 0.48-1.80 microns | 10 mm            | 1.13 microns | Mitutoyo     | Ring               |                  |               |
| 100x          | 0.7                | 0.48-1.80 microns | 10 mm            | 1.05 microns | Mitutoyo     | Ring               |                  |               |
| 100x          | 0.75               | 0.90-1.50 microns | 10 mm            | 0.98 microns | Seiwa        | IRLED-Coax, Kohler |                  | ✓             |
| 100x          | 0.85               | 1.20-0.85 microns | 1.0 mm           | 0.86 microns | Nikon        | IRLED-Coax         | ✓                | ✓             |
| 200x (LIO)    | 1.4                | 1.00-1.50 microns | 0 mm             | 0.52 microns | IRLabs       | IRLED-Coax, Kohler | ✓                | ✓             |
| 350x (SIL)    | 2.5                | 1.00-1.50 microns | 0 mm             | 0.29 microns | IRLabs       | IRLED-Coax, Kohler | ✓                | ✓             |





# Detect the Faintest Emissions with IRLabs' IREM-II™

Contact our Applications Engineers about an evaluation measurement of your device



## The IREM-II™ Delivers

- The industry's highest sensitivity InGaAs detector
- Superior ultra low noise read electronics
- Precision fault localization
- Inverted microscope for direct docking of ATE
- Custom optimized optics, NA up to 1.4
- High performance 3-axis positioning system
- Advanced InfraRed Imaging Software (AIRIS)
- CAD navigation capabilities - Enhance fault localization by importing component polygons to overlays
- Ergonomic workstation
- Extremely high tool uptime
- Rapid return on investment

## IRLabs Infrared Laboratories

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