



Pearl[®] Impulse

SMALL ANIMAL IMAGING SYSTEM

FLUORESCENT OPTICAL IMAGING

NEAR-INFRARED DETECTION

UNIFORM ILLUMINATION

EXCEPTIONAL SENSITIVITY

LI-COR[®]
Biosciences



Pearl[®] Impulse

SMALL ANIMAL IMAGING SYSTEM



Fluorescent Optical Imaging

Visualize biological processes in living animals

Near-Infrared Detection

Detect smaller and deeper targets
with increased signal-to-noise

Uniform Illumination

Even laser excitation over full field of view and
consistent readings for entire image area

Exceptional Sensitivity

Get clear, accurate data earlier with laser excitation
and FieldBrite™ Xi innovative optical design

NIR Optical Imaging

In disease research, infrared optical imaging rapidly delivers exceptional, comprehensive data collection from test animals *in vivo*, saving researchers time and money.

The optical imaging instrument and fluorophores you choose will have long-term impact on the quality and reliability of your results. You need an instrument that will deliver on all key considerations: imaging wavelength, sensitivity, reproducibility, and simplicity.

The Pearl[®] Impulse is optimized for tracking biological processes and disease progression in live animals. The Pearl Impulse is specifically designed for analysis of structural features and disease biomarkers such as receptors or transporters.

By imaging each animal at multiple time points throughout your study, instead of relying on tissue or organ removal, you can track changes – even very small or very early ones – in the same animal. This reduces both data variability and the number of animals you need to complete the study.

Near-Infrared Detection

Pearl Impulse employs the optimal near-infrared (NIR) spectral region for optical fluorescent imaging. By operating in the near-infrared spectrum, Pearl Impulse delivers increased overall sensitivity. It has been reported that NIR light penetrates tissue to greater depths (Roy, R. et al. J. Biomed. Optics 11, 4, 044007 July/August 2006). In addition, tissue autofluorescence is decreased, improving the signal-to-noise ratio (Figures 1 and 2). Visualizing targets with better sensitivity enables you to follow disease progression from its earliest stages. Using the



Pearl Impulse with LI-COR® IRDye® optical probes, and the LI-COR Odyssey® Infrared Imaging System, you can maximize data consistency by using the same fluorescent label throughout your experiments – for cell-based assays, animal imaging, histology, and even microscopy.

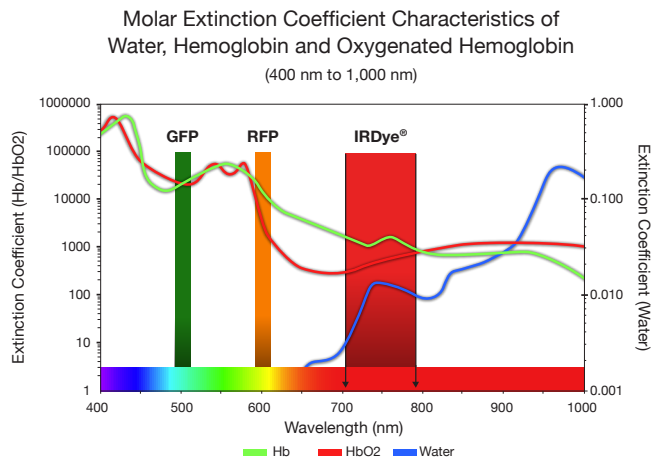


Figure 1. Overall spectral region (400-1000 nm). Hemoglobin in tissue strongly absorbs light in the visible spectrum. For most visible fluorescent dyes, this limits the penetration of excitation light and the escape of fluorescence. IRDye infrared dyes absorb and emit near the absorption minimum of hemoglobin and below wavelengths where water absorption increases.

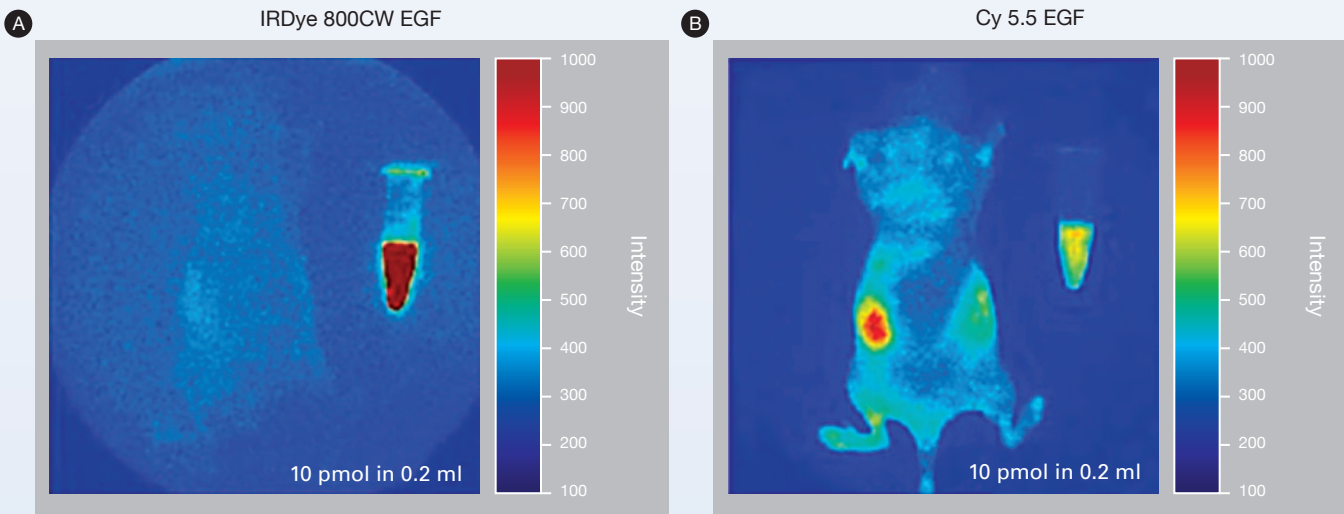


Figure 2. A and B: Comparison of pre-injection mice illuminated with 785 nm (Figure A) and 660 nm (Figure B) light. Also shown is a vial of IRDye 800CW EGF or Cy5.5 EGF in respective panels. Autofluorescent signals in Figure A are significantly lower than Figure B, allowing for much higher signal to background ratios.

* Data courtesy of Dr. E.M. Sevick-Muraca, Baylor College of Medicine, Houston, TX. Comparison of visible and near-infrared wavelength excitable dyes for molecular imaging of cancer. Journal of Biomedical Optics 12 024017 (2007).

Uniform Laser Illumination

Reproducibility is crucial for *in vivo* imaging studies. To consistently produce a coefficient of variation (CV) of less than 5%, Pearl® Impulse employs laser modules (Figure 3) that deliver uniform illumination over the entire imaging area. Illumination is stable over the course of your study – with weeks, months, even years between exposures (Figure 4)

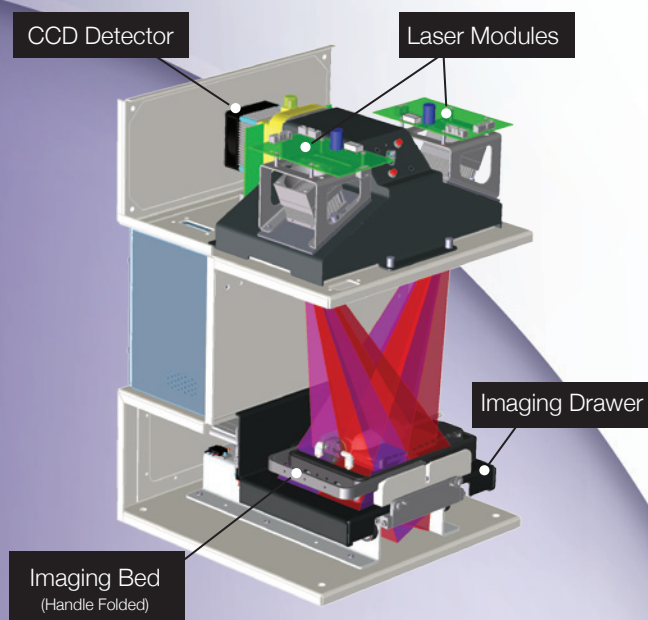


Figure 3. Each laser module contains a 685 nm laser, a 785 nm laser, and an LED source that produces white light. FieldBrite™ Xi technology ensures even illumination of the sample, low coefficient of variation (CV%) and exceptional reproducibility.

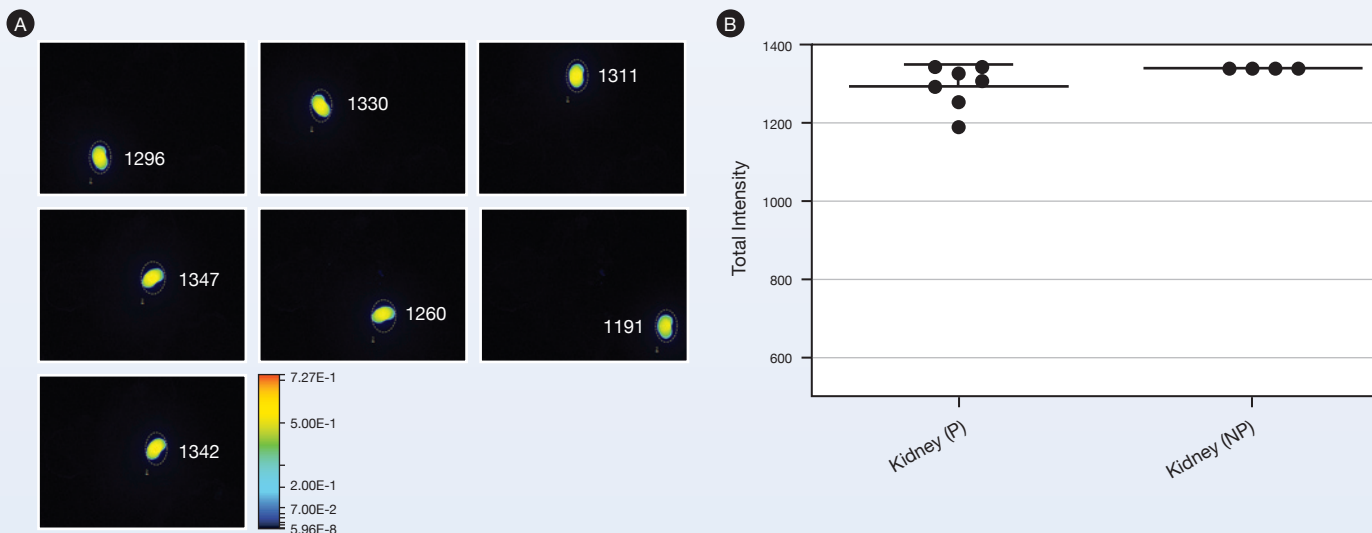


Figure 4. FieldBrite™ Xi technology provides uniform illumination over the entire sample area resulting in low CV% for reproducible and reliable results. A) A kidney imaged and repositioned seven times to illustrate the precision of the Pearl® Impulse. B) Total intensity data for a kidney imaged and repositioned seven times (P) or imaged four times with no change in position (NP). P = 1296.0; CV = 4.3%, NP = 1341.0; CV = 0.18%.

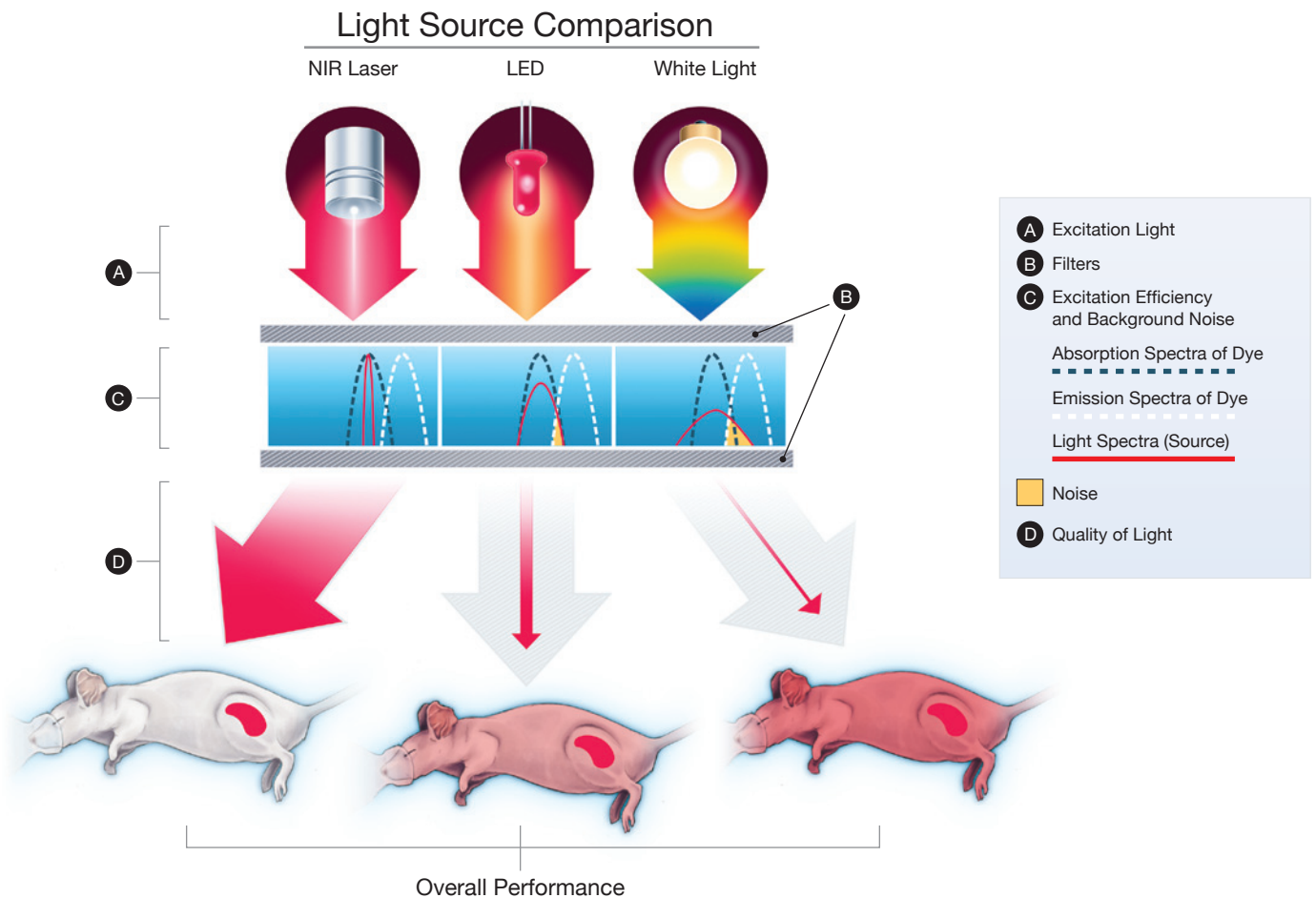


Figure 5. Pearl Laser illumination is efficiently filtered, allowing virtually all the photons to reach the subject without contributing additional background noise. This results in excellent limits of detection. Unwanted wavelengths are inefficiently filtered on both LED and white light illumination, reducing overall photons reaching the subject while contributing excess background noise due to inefficient filtering (yellow). This leads to poor limits of detection.

Exceptional Sensitivity

Achieve exceptional sensitivity without lengthy exposure times with the Pearl Impulse's proprietary and patented FieldBrite™ Xi optical system. With laser illumination (Figure 5), you get high signal to background ratios, allowing for detection of targets such as orthopedic tumors, bone fine structure, and neovascular blood vessels.

The Pearl Impulse offers:

- Two laser wavelengths (685 and 785 nm) for excitation, each matched to an IRDye fluorophore, to detect and discriminate multiple targets.
- Proprietary CCD-based optical system optimized for the NIR spectral region.
- Patented FieldBrite™ Xi filtering design dramatically reduces noise, for superior imaging sensitivity.

Simplified Operation

Pearl® Impulse delivers high performance and makes the complex process of *in vivo* imaging easy with a simplified user interface. It features an exceptionally wide dynamic range - six logs (22 bits) - that eliminates the need for manipulating exposure settings and taking multiple exposures. Pearl Impulse can capture both weak and strong signals in a single image, without signal saturation (Figure 6). Plus, the innovative optical design produces a high quality image every time.

Whether you are new to optical imaging or highly experienced, Pearl Impulse offers a number of unique, user-friendly features:


- Single button image acquisition
- No manually adjustable filters
- No requirement for spectral unmixing or image optimization
- Uniform illumination
- Wide dynamic range removes risk of saturation and need for modifying the exposure settings
- One click normalizes all images, making visual comparison of time points more meaningful

High Resolution, Real-Time Image Acquisition

Only the Pearl Impulse provides the capability to visualize and create movies of lymphatic flow (Figure 7). NIR agents such as IRDye® 800CW PEG, can be used to visualize lymphatic and blood vessel structure and location. Agents, taken up by the lymphatic system can be observed as they pulse to the nearest lymph nodes.

- The Pearl Impulse yields high resolution and NIR performance
- Acquires single-channel fluorescent images as often as every 500 milliseconds
- Acquires optimized multi-channel images (700 nm, 800 nm, and white light) in about 30 seconds.

The speed and accuracy of Pearl Impulse can help improve the efficiency and productivity of your lab, enhancing the return on your investment.

 Experience Real-Time Imaging at
www.licor.com/impulsemovie

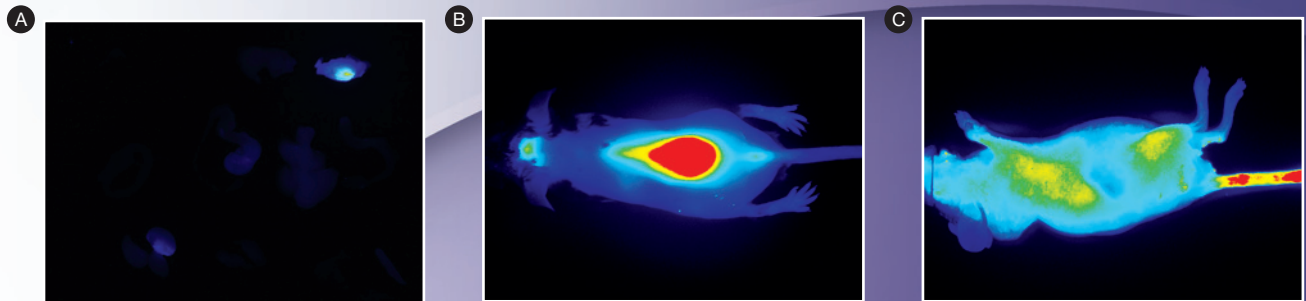


Figure 6. Look up tables are linked enabling normalization and simultaneous display of all images without saturation: A) Organs with the brightest signal found in the muscle at the injection site, B) Exposure of an animal with dye circulating throughout the body, C) missed tail vein injection 2 minute post injection. The maximum signal seen in each case is illustrated in the chart. Saturation point for the FieldBrite™ Xi technology is 800 Relative Fluorescent Units (RFUs), ensuring a perfect, non-saturated image every time.

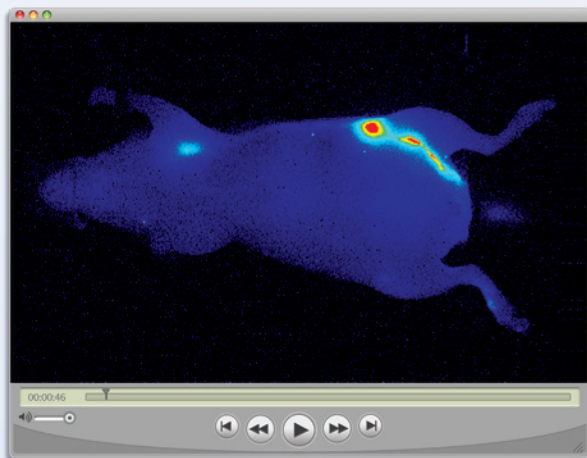
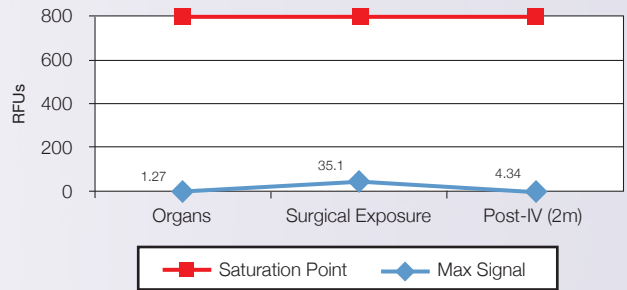
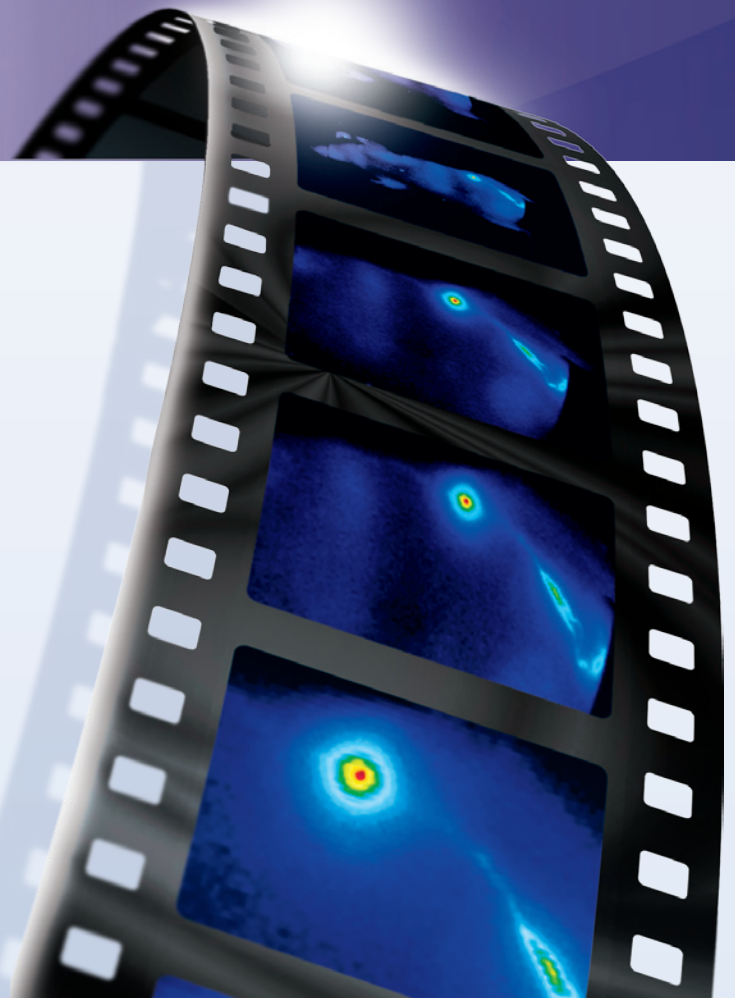


Figure 7. An intradermal injection of IRDye 800CW PEG as it collects in the lymphatic system and moves to the lymph node.



Application Versatility

Pearl® Impulse is useful from day one and is optimized for use with IRDye® reagents. However, when you need to create your own agents, Pearl Impulse is versatile enough to image a variety of contrast agents, including many other NIR dyes and targeted agents.

A growing line of validated fluorescent targeting agents extends the Pearl Impulse's versatility to a wide range of imaging applications, including:

- Receptor targeting (Figure 8A, 8B)
- Transporter targeting (Figure 8C)
- Vasculature structure imaging (Figure 8D)
- Lymphatic imaging (Figure 8E)
- Structural imaging (Figure 8B, 8F)

Pearl Impulse's ability to image different dye-labeled targeting agents, combined with its utility for numerous applications, makes it a powerful performer in any laboratory.

Exclusive Accessories Promote Animal Health

For any well-run lab, animal health is a key consideration. The Pearl Impulse minimizes animal stress and handling:

- Detachable imaging beds feature temperature-controlled surfaces to maintain body temperature and facilitates gas anesthesia (Figure 9).
- Stand-alone Pearl Docking Station provides temperature and anesthesia gas control to an imaging bed at a secondary location, and will fit in traditional laminar flow hoods. Shown with optional Clean Box, which allows immunocompromised mice to be transported from docking station clean area to the Pearl Impulse in a HEPA-filtered environment (Figure 10).
- Fully compatible anesthesia system is available. Simple operation minimizes animal loss. (Figure 11).



Figure 9. Imaging Bed

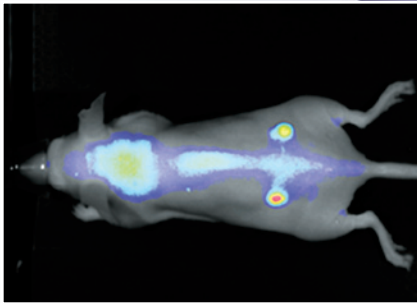


Figure 8A. IRDye 800CW RGD

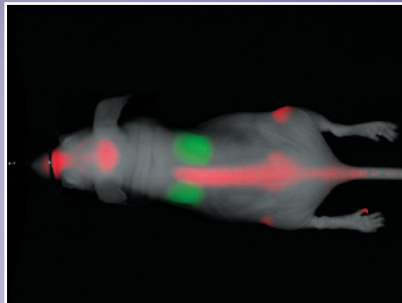


Figure 8B. IRDye 800CW EGF (Green),
IRDye 680 BoneTag™ (Red)



Figure 8C. IRDye 800CW 2DG



Figure 8D. IRDye 800CW PEG

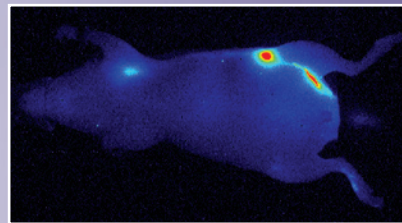


Figure 8E. IRDye 800CW PEG

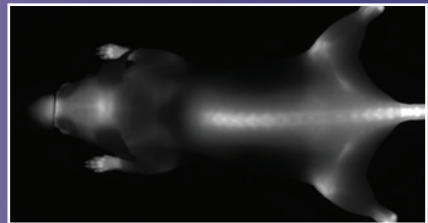


Figure 8F. IRDye 800CW BoneTag



Figure 10. Docking Station and Clean Box



Figure 11. Anesthesia System

www.licor.com/pearl

- IRDye® infrared dye technical and product information
- Broad range of applications and products
- Technical Support
- Educational Resources
- Relevant Publications
- On-line Ordering and Customer Support



LI-COR® Translational Research

LI-COR Translational Research is seeking to facilitate the use of IRDye 800CW-labeled imaging agents in clinical studies for detection of disease, its progression, and for monitoring treatment and drug efficacy.

We have performed a study examining the toxicity of IRDye 800CW in Sprague-Dawley rats. The study was performed in a manner compatible with that needed for a Phase 0/eIND. These data have been published in Molecular Imaging and Biology (M. Marshall et al. 2010).

Contact us for more information.

Translational.Research@licor.com

Products and Applications Guide

Check out the LI-COR Biosciences Products and Applications Guide for a list of instruments, reagents and accessories designed for your infrared imaging needs.

Available online at:
www.licor.com/bio



System Specifications

Detector Type:

CCD. Thermoelectrically cooled

Acquisition Speed:

~20-40 sec (multiple colors)

~500 msec - 10 sec (single color real-time)

Wavelength Maxima (Ex/Em):

700 nm Channel Excitation 685 nm, Emission 720 nm

800 nm Channel Excitation 785 nm, Emission 820 nm

White Channel Excitation white, Emission NA

Dyes:

IRDye® 680, IRDye 700DX, IRDye 800RS, IRDye 800CW, Alexa Fluor® 680, Alexa Fluor 750, Cy 5.5, Cy 7, and others

Resolution:

85, 170 and 255 micron

Image Display Options:

Pseudocolor, grayscale, single color (red, green or blue), or two colors with overlapping fluorescence displayed in a third color

Capacity:

One animal, with linked look-up tables for image normalization

Imaging Bed:

16.8 cm W x 12 cm D (6.6" W x 4.75" D). Vertical clearance to top of drawer is 3.8 cm (1.5")

Field of View:

11.2 cm W x 8.4 cm D (4.4" W x 3.3" D) at surface of imaging bed

Imaging Bed Temperature Range:

32-42°C

Gas Anesthesia:

Inlet and outlet ports flow anesthesia gas through nose cone in imaging drawer. Rotameter controls flow rate

Size:

41 W x 41 D x 66 cm H (16" W x 16" D x 26" H). Depth with imaging drawer open is 63.5 cm (25")

Weight:

23 kg (50 lb)

Locations WorldWide

U.S.

LI-COR® Biosciences
4647 Superior Street
Lincoln, NE 68504
Phone: 402-467-0700
Phone: 888-645-7242
Fax: 402-467-0819
Email: biosales@licor.com

LI-COR GmbH, Germany

Serving Europe, Africa and the Middle East

LI-COR Biosciences GmbH
Siemensstraße 25A
D-61352 Bad Homburg
Germany
Phone: +49 (0) 6172 17 17 771
Fax: +49 (0) 6172 17 17 799
Email: gmbh@licor.com

LI-COR Ltd., UK

Serving UK, Ireland and Scandinavia

LI-COR Biosciences UK Ltd
St. John's Innovation Centre
Cowley Road
Cambridge
CB4 0WS
United Kingdom
Phone: +44 (0) 1223 422104
Fax: +44 (0) 1223 422105
Email: UK@licor.com

View a complete list of our international distributors at:
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The LI-COR board of directors would like to take this opportunity to return thanks to God for His merciful providence in allowing LI-COR to develop and commercialize products, through the collective effort of dedicated employees, that enable the examination of the wonders of His works.

“Trust in the LORD with all your heart and do not lean on your own understanding. In all your ways acknowledge Him, and He will make your paths straight.”

— Proverbs 3:5,6

