ImageQuant™ LAS 4000 biomolecular imager

ImageQuant LAS 4000 (Fig 1) is a digital imaging system for sensitive, quantitative imaging of gels and blots, by chemiluminescence and fluorescence. A flexible combination of light sources and filters can be incorporated into the imager according to your needs.

ImageQuant LAS 4010 is a model that is fully equipped with light sources for ultraviolet (UV) and visible (RGB) imaging. Both 4000 and 4010 models can be upgraded to perform infrared (IR) fluorescence imaging.

ImageQuant LAS 4000 delivers:

- **Wide linear dynamic range:** Capture and precisely quantitate weak and strong signals over four orders of magnitude in the same image, avoiding time-consuming multiple film exposures.
- **High resolution:** Accurate quantitation of gels and films up to 21 × 14 cm in size. Up to 6.3 Mpixel image resolution is achieved via a unique diagonal pixel configuration.
- **Low noise:** The camera is typically cooled to -25°C (maximum -35°C) enabling longer exposure times giving less background, which is especially important for precise quantitation of very weak signals in chemiluminescent Western blotting.
- **High sensitivity:** ImageQuant LAS 4000 captures fluorescent and chemiluminescent signals on a Western blot down to picogram levels of target protein. Sensitivity may be increased by binning of up to 8 x 16 pixels.
- **Uniform quantitation:** Distortion, dark frame, and flat frame corrections are applied to each imaging mode for optimal precision.
- **Multifluorescence detection:** ImageQuant LAS 4010 extends functionality to image a wide range of UV- and RGB-excited labels and stains.

Fig 1. ImageQuant LAS 4000 is a highly sensitive, CCD camera-based quantitative biomolecular imager.

Description

ImageQuant LAS 4000 is a sensitive imager for chemiluminescence, UV transillumination, and white epi-illumination imaging applications. ImageQuant LAS 4010 is additionally equipped for epifluorescent UV and RGB applications, as well as white transillumination. The system consists of an intelligent dark box, camera, lens, and automated five-position filter wheel with a standard filter for EtBr and open positions for the filters delivered with the optional fluorescent light sources. The system is simple to operate. Focusing, filters, illuminators, and exposure time are remotely controlled by a computer without having to open the cabinet.

High resolution and precise quantitation of low signals are achieved using a multipurpose 16-bit, 3.2 Mpixel camera fitted with a large aperture F0.85 lens. The system has an automated iris, and responds rapidly when changing focus and settings. Chemiluminescent and colorimetric signals can be captured without changing the lens.

Technical features

Sensitive chemiluminescence detection: The system is optimal for quantitation of chemiluminescent Western blots.

Gel documentation and quantitation: colorimetric-stained samples are easily imaged.

Easily exchangeable light sources and filters: The system can image a wide range of fluorophores, and is easily adapted for use in multiple applications; filters and light sources are exchangeable in seconds. UV, red, green, blue, and IR light sources for epifluorescence as well as white light are available. Two transillumination sources, white light and UV, are available for imaging gels stained with Coomassie™ Blue, silver stain, ethidium bromide (EtBr), and Deep Purple™ Total Protein Stain.

Camera lens and CCD chip: A bright, wide aperture FUJINON™ F0.85 lens, specially developed for chemiluminescent imaging, projects sharp images onto a uniquely patterned CCD chip (Fig 2). By diagonally aligning octagonal pixels, the gap between pixels in the horizontal and vertical planes is reduced. This pattern gives an effective image resolution of 6.3 Mpixels, a substantial increase from the 3.2 Mpixel resolution of the CCD array. Lenses and system specifications are shown in Tables 1 and 2, respectively.

User-friendly image capture software: ImageQuant LAS 4000 control software performs several capture modes for achieving optimal sensitivity and dynamic range including increment, repetition, and program modes. For image analysis and quantitation, the flexible ImageQuant TL software is available separately. It comprises a dedicated suite of analysis tools to provide high levels of automation and accuracy in the analysis of gels and blots, with manual possibilities.

User safety: The UV and white light transilluminators and optional epifluorescent light sources are housed inside the cabinet. To protect the user from UV exposure, a sensor ensures that the door is closed before the light can be switched on.

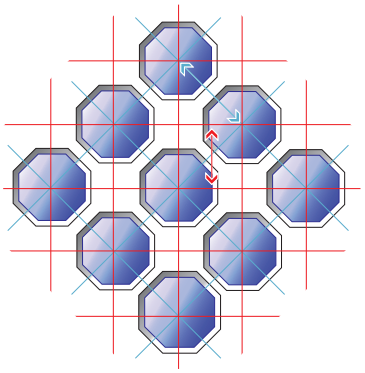


Fig 2. The unique octagonal interwoven pixel layout offers a denser matrix for more efficient capture of light compared to a standard square pixel layout, giving an effective image resolution of 6.3 Mpixels.

Table 1. Lenses

	Field of view
F0.85 43 mm LAS high sensitivity lens	21 × 14 cm
F1.8 24 mm SIGMA™ wide view lens	25 × 25 cm

Table 2. ImageQuant LAS 4000 specifications

CCD model	Fujifilm™ Super CCD Area Type chip (15.6 × 23.4 mm)
Lens model	FUJINON Lens F0.85 43 mm
Cooling	Two-stage thermoelectric module with air circulation
Cooling temperature	Down to -35°C (at room temp. -28°C)
Dynamic range	16-bit, 4 orders of magnitude
Chip resolution	2048 × 1472, 3.2 Mpixels
Image resolution	Maximum 3072 × 2048, 6.3 Mpixels
Pixel size	Approximately 11 µm
Focusing and aperture	Automatic, remote operation
Capture modes	Automatic, manual (normal/incremental/ repetitive/program)
Exposure time	Automatic, manual (1/100 s to 30 h)
Pixel correction	Dark frame correction, flat frame correction, and distortion correction
Image quality correction	Binning, smoothing
Binning modes	1 × 2, 2 × 4, 4 × 8, 8 × 16
Image size	Up to 12 MB (.GEL and .TIF)
Sample size	21 × 14 cm (25 × 25 cm with SIGMA wide view lens)
Interface	USB 2.0
Dimensions (W × H × D)	510 × 900 × 480 mm
Weight	60 kg
Line frequency	50 to 60 Hz
Temperature	15°C to 28°C
Humidity	30% to 70% (no condensation)
Supply voltage	100 to 240 V
Power consumption	Approx. 0.3 kVA

Imaging applications

ImageQuant LAS 4000 is a single platform for multiple imaging applications.

Quantitative Western blotting

The high sensitivity of the system is designed to capture the chemiluminescent signals from Amersham™ ECL™, ECL Plus (Fig 3), and ECL Advance™ Western blotting reagents for quantitative purposes.

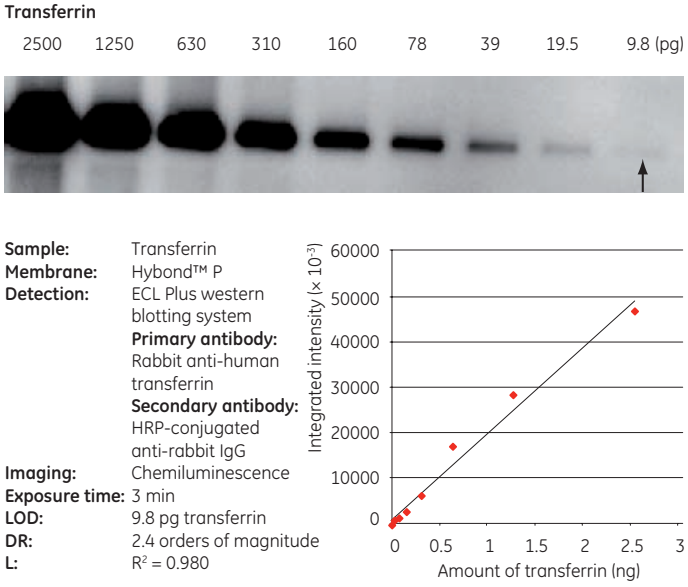


Fig 3. A dilution series of transferrin starting at 2.5 ng was subjected to Western blotting and detected with Amersham ECL Plus chemiluminescence. Limit of detection (LOD; arrow), dynamic range (DR), and linearity (L) were determined. ImageQuant LAS 4000 showed a linear response for chemiluminescent detection with low noise and a wide dynamic range.

UV fluorescence

The UV transilluminator for fluorescence detection of reagents such as EtBr (Fig 4), Deep Purple Total Protein Stain, and epi light sources for fluorescence detection of reagents such as SYPRO™ Rose and Qdot™ are provided as standard features.

Infrared fluorescence

Several infrared (IR) fluorophores can be imaged with the optional epi-infrared light and filter set (Fig 5).

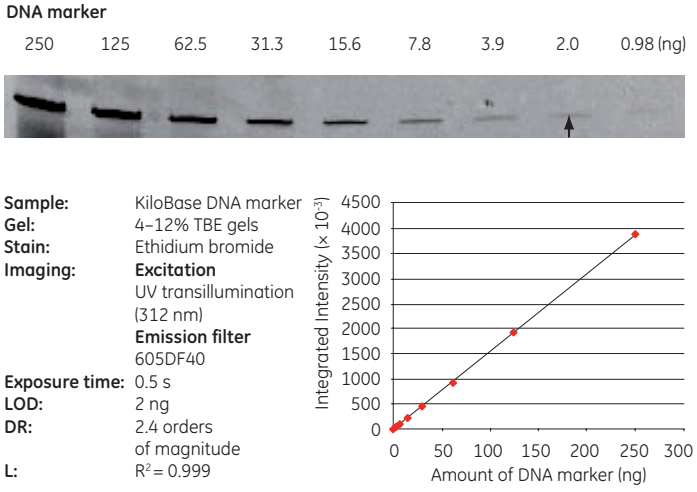


Fig 4. A dilution series of a KiloBase DNA marker starting at 250 ng was subjected to gel electrophoresis and stained with ethidium bromide. The gel was imaged using the UV transilluminator. LOD (arrow), DR, and L were calculated for the 3 kb band. ImageQuant LAS 4000 showed a linear response with a limit of detection of 2 ng DNA marker.

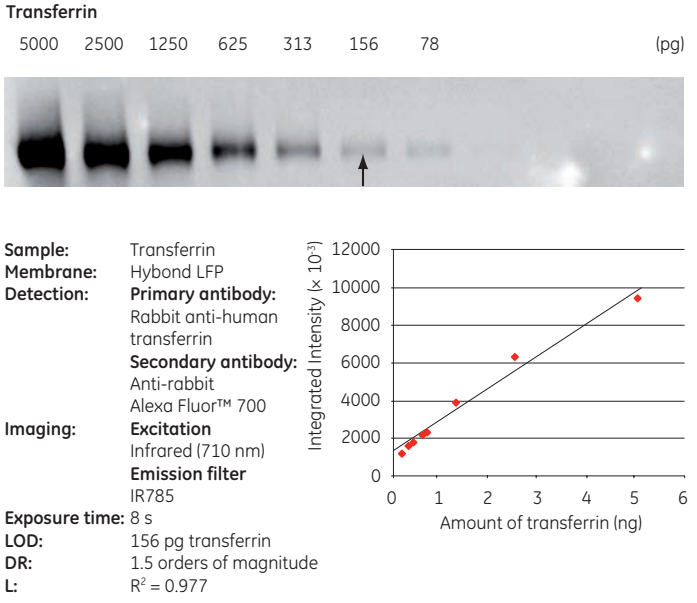


Fig 5. A dilution series of transferrin starting at 5 ng was subjected to Western blotting and detected with a rabbit anti-transferrin primary antibody and anti-rabbit Alexa Fluor 700 secondary antibody. The blot was imaged using the optional epi-IR light. LOD (arrow), DR, and L were calculated. ImageQuant LAS 4000 showed a linear response with a limit of detection of 156 pg transferrin.

Gel documentation

Imaging of opaque stains such as Coomassie Blue, silver stain, and Amersham Rainbow™ markers and colorimetric Western blotting applications is achieved by standard epi-white illumination or optional white transillumination (Fig 6).

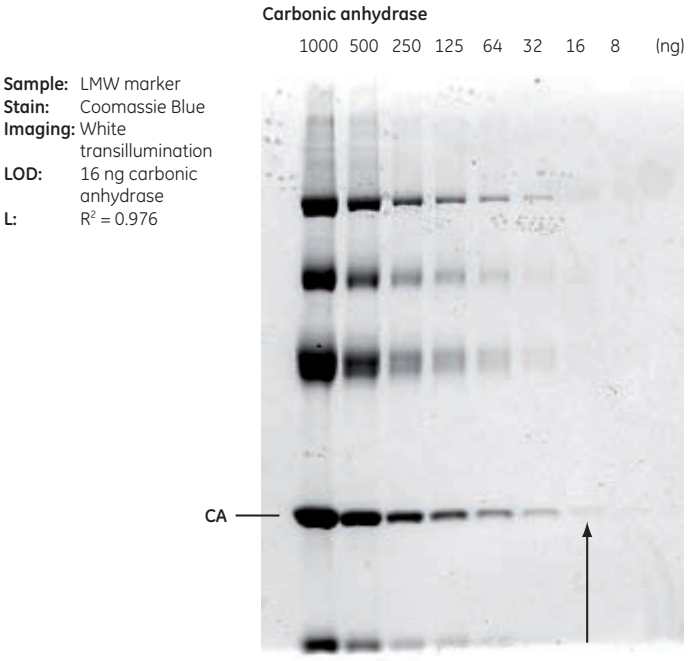


Fig 6. Gel documentation of a Coomassie Blue-stained low molecular weight (LMW) marker, containing carbonic anhydrase (CA), using white transillumination. Arrow indicates the LOD.

Red, green, and blue fluorescence

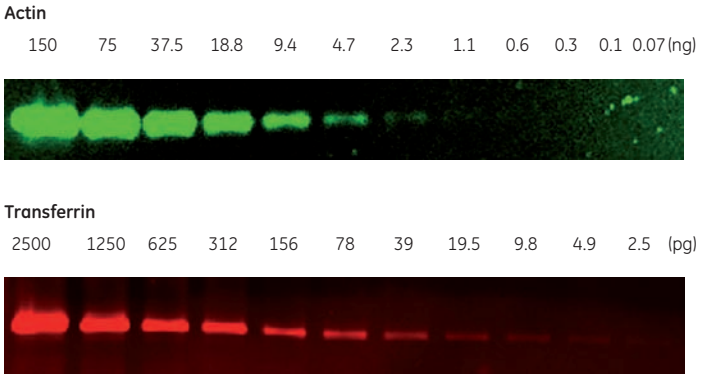
A wide range of visible fluorescent dyes can be imaged via optional red, green and blue epi-illumination with the use of appropriate filter sets (Table 3). ImageQuant LAS 4010 can also be used to capture multiplexed images detected on a single membrane using the Amersham ECL Plex™ Western blotting system (Fig 7).

Large gels

With the optional SIGMA F1.8 wide view lens, gels up to 25 × 25 cm can be imaged. Each imaging mode has individual settings for flat frame and dark frame corrections for uniform field imaging.

Table 3. Optional filters for fluorescence

Filter	For use with
L41 UV	UV LED
Y515 Cy™2	Blue LED
510DF10 GFP	GFP detection
605DF40 EtBr	EtBr detection
575DF20 Cy3	Green LED
R670 Cy5	Red LED
IR785 Alexa 700	IR LED



Sample: Actin and transferrin
Membrane: Hybond LFP
Detection: **Primary antibodies:** Rabbit anti-human transferrin and mouse anti-actin
Secondary antibodies: ECL Plex goat anti-mouse IgG-Cy3, ECL Plex goat anti-rabbit IgG-Cy5
Imaging:

Excitation	Emission filter
Epi-green (Cy3, 520 nm), epi-red (Cy5, 630 nm)	575DF20 (Cy3), R670 (Cy5)

Exposure time: 4 s (Cy3), 17 s (Cy5)
LOD: 2.3 ng actin, 4.9 pg transferrin
DR: 1.8 (Cy3) and 2.7 (Cy5) orders of magnitude
L: R^2 = 0.998 (Cy3) and 0.994 (Cy5)

Fig 7. Dilution series of actin and transferrin were subjected to Western blotting and targeted with primary antibodies mouse anti-actin and rabbit anti-transferrin, and secondary antibodies ECL Plex goat anti-mouse IgG-Cy3 and ECL Plex goat anti-rabbit IgG-Cy5. Fluorescence signals were detected using the epi-RGB fluorescence module. Results demonstrate zero crosstalk, which is essential for multiplex detection of two target proteins in the same blot.

Imager performance

	ImageQuant LAS 4010	ImageQuant LAS 4000	ImageQuant LAS 4000 mini
Chemiluminescence			
Amersham ECL	+	+	+
Amersham ECL Plus	+	+	+
Amersham ECL Advance	+	+	+
Fluorescence via UV transilluminator (312 nm)			**optional**
EtBr	+	+	+
Deep Purple	+	+	+
SYBR Green I & II	+	+	+
SYBR Gold	+	+	+
Fluorescence via UV epi-illuminator (365 nm)		**optional**	**optional**
EtBr	+	+	+
SYPRO Rose	+	+	+
Qdot 605, 655, 705, 800	+	+	+
Fluorescence via blue epi-illuminator (460 nm)		**optional**	**optional**
Alexa Fluor 488	+	+	+
Cy2	+	+	+
SYBR™ Green I & II	+	+	+
SYBR Gold	+	+	+
SYPRO Ruby	+	+	+
SYPRO Orange	+	+	+
FITC	+	+	+
FAM™	+	+	+
EGFP	+	+	+
ECFP	+	+	+
AttoPhos™	+	+	+
ECL Plus	+	+	+
Pro-Q™ Emerald 488	+	+	+
Fluorescence via green epi-illuminator (520 nm)		**optional**	**–**
SYPRO Red	+	+	
Cy3	+	+	
TAMRA™	+	+	
5-ROX™	+	+	
HEX™	+	+	
Alexa Fluor 532, 546, 555	+	+	
Deep Purple	+	+	
Pro-Q Diamond	+	+	
BODIPY™ 576/589	+	+	
R-phycoerythrin	+	+	
RFP	+	+	
HNPP	+	+	
Fluorescence via red epi-illuminator (630 nm)		**optional**	**–**
Alexa Fluor 633, 635	+	+	
Alexa Fluor 647, 700	+	+	
Cy5	+	+	
BODIPY 650/665	+	+	
DiD	+	+	
TOTO™ 3	+	+	
DDAO Phosphate	+	+	
Fluorescence via IR epi-illuminator (710 nm)	**optional**	**optional**	**–**
Dy676	+	+	
Alexa Fluor 700, 750	+	+	
Gel documentation	**standard white transilluminator**	**standard epi-white illuminator**	**standard epi-white illuminator**
Silver, CBB, NBT/BCIP, X-ray film	+	+	+

+ Compatible – Not compatible

ImageQuant LAS 4000 can be upgraded in your lab to attain the same imaging performance as ImageQuant LAS 4010.
ImageQuant LAS 4000 mini can be upgraded with epi-blue, epi-UV fluorescence, and UV transillumination.

Ordering information

System	Quantity	Code no.
ImageQuant LAS 4000*	1	28-9558-10
ImageQuant LAS 4010†	1	28-9558-11

* For chemiluminescence, UV transillumination, and white epi-illumination imaging applications. Includes intelligent dark box, camera head, F0.85 43 mm LAS high sensitivity lens, calibration plates DI and FL (green), AC cable (EU and USA), USB cable, operation manual, auto filter changer, UV transmitted light source, white epi-light source, EtBr detection filter, EPI tray, UV transmission tray, and 10 gel sheets.

† For chemiluminescence, blue, green and red fluorescence, UV and white light transillumination, and white epi-illumination imaging applications. Includes intelligent dark box, camera head, F0.85 43 mm LAS high sensitivity lens, calibration plates DI, FL (green), GR (pink), AC cable (EU and USA), USB cable, operation manual, auto filter changer, UV and white transmitted light sources, blue (460 nm), green (520 nm) and red (630 nm), and white epi-light sources, Y515 filter, 575DF20 filter, R670 filter, EtBr detection filter, EPI tray, UV transmission tray, white transmission tray, and 10 gel sheets.

Upgrades and accessories	Quantity	Code no.
UV-Trans2020 Set (LAS) *UV transilluminator (312 nm), calibration plate FL, 605 EtBr filter, UV transmission tray, and gel sheets*	1	28-9589-16
EPI-BGR LS FL Set 4000 *Epi-BGR light, Y515 filter, 575DF20 Cy3 filter, R670 Cy5 filter, calibration plate FL (green), calibration plate GR (pink)*	1	28-9564-72
White Trans Set (LAS) *White light table and white light tray*	1	28-9589-18
Epi-B Set (LAS) *Blue Epi light (460 nm), calibration plate FL (green), and Y515 filter*	1	28-9589-19
Epi-G Set (LAS) *Green Epi light (520 nm), calibration plate GR (pink), and 575DF20 Cy3 filter*	1	28-9589-21
Epi-R Set (LAS) *Red Epi light (630 nm), calibration plate GR (pink), and R670 Cy5 filter*	1	28-9589-22
Epi-IR Set (LAS) *NIR Epi light (710 nm), calibration plate GR (pink), and IR785 Alexa filter*	1	28-9589-23
Epi-UV Set (LAS) *UV Epi light (365 nm), calibration plate FL (green), and L41 UV filter*	1	28-9589-25

For local office contact information, visit
www.gelifesciences.com/contact

www.gelifesciences.com/quantitative_imaging

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imagination at work

Upgrades and accessories	Quantity	Code no.
White EPI (2) for 4000 *White light set, 1 pair*	1	28-9564-71
W-Lens Set (LAS) *F1.8 24 mm SIGMA wide view lens and F-mount adapter*	1	28-9589-28
UV-Trans Tray Set *UV transmission tray and 10 gel sheets*	1	28-9589-27
Gel sheet (LAS) *Pack of 10, for use when imaging gels in UV transmission mode*	1	28-9564-51
Epi tray (LAS) *Sample tray for imaging in epi-illumination mode*	1	28-9564-44
White Trans Tray (LAS) *Sample tray for imaging in white light transmission mode*	1	28-9564-48
NP tray *Sample tray for imaging titer plates*	1	28-9564-49
F-holder T4 *Filter holder for custom filters*	1	28-9590-17
510DF10 GFP filter *Band pass filter for imaging GFP, eliminating cross-talk and autofluorescence*	1	28-9564-62

Related literature	Code no.
ImageQuant LAS 4000 mini biomolecular imager, Data file	28-9610-75

Minimum computer requirement

OS: Windows™ XP™ SP3 (32-bit) or Windows Vista™ Business SP1 (32-bit), RAM: more than 1 GB, Processor: Intel™ Core 2 Duo processors, Hard disk: more than 80 GB, USB Ports: USB 2.0, Optical drive: DVD-ROM or Super Multi Drive, Monitor: 1280 × 1024 pixel resolution or higher

Please contact your local GE Healthcare representative for the latest recommended computer configuration.

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