Amersham™ Imager 680

Amersham Imager 680 (Fig 1) series is a new range of sensitive and robust imagers for the capture and analysis of high resolution digital images of protein and DNA samples in gels and membranes. These multipurpose imagers bring high performance imaging to chemiluminescence, fluorescence, and colorimetric applications. The design of Amersham Imager 680 combines our Western Blotting application expertise with optimized CCD technology and exceptional optics from Fujifilm™. The system has an integrated analysis software and intuitive workflow, which you can operate from an iPad™ or alternative touch screen device, to generate and analyze data quickly and easily.

Amersham Imager 680 delivers:

• **Intuitive operation:** You can operate the instrument from a tablet computer with an intuitive design and easy-to-use image analysis software. You do not need prior imager experience or training to obtain high-quality results. Use the automatic capture mode for convenient exposure

• **Excellent performance:** The system uses a super-honeycomb CCD and a large aperture f/0.85 FUJINON™ lens, which consistently delivers high-resolution images, high sensitivity, broad dynamic range (DR), and minimal cross-talk

• **Robustness:** Combining minimal maintenance with our proven expertise in Western blotting and electrophoresis makes the imager well suited for multiuser laboratories. Amersham Imager 680 is an upgradable series of imagers that can grow with your imaging needs

Description

Amersham Imager 680 series is equipped with a dark sample cabinet, a camera system, filter wheel, light sources, and a built-in computer with control and analysis software. Network connection and USB ports are standard (Fig 2). Settings such as focus, filter, illuminator, and exposure type are automatically controlled by the

Fig 1. Amersham Imager 680 series is a range of robust and easy-to-use systems for chemiluminescent, colorimetric, and fluorescent image capture.

integrated software. You will obtain high resolution images and precise quantitation of low signals with the multipurpose 16-bit 3.2 megapixel camera fitted with a large aperture lens. The detector is cooled to reduce noise levels for high sensitivity and wide dynamic range. Rapid cooling leads to a short startup time, which makes the instrument ready to use in less than 5 min.

You can place the sample tray at one of two different heights in the sample compartment to produce image-acquisition areas of 220 × 160 mm and 110 × 80 mm, respectively.

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The system can be used for a wide range of applications and it is fully upgradable between four different configurations (Table 1). Each configuration can be used for chemiluminescent detection and nonquantitative gel documentation. The different configurations are equipped with light sources and filters for UV and white light trans-illumination, and red, green and blue epi-illumination for multiple fluorescence detection. Optical density (OD) measurements are calibrated for quantitation in colorimetric staining applications.

You can operate the system via an integrated computer, controlled from a wireless iPad, a USB-connected touch screen, or a traditional monitor with a mouse and keyboard.

Table 1. Amersham Imager 680 series comprises four different configurations. Amersham Imager 680 QC is designed for QC applications

	Amersham Imager 680	Amersham Imager 680UV	Amersham Imager 680RGB	Amersham Imager 680QC
Colorimetric Epi-White	×	×	×	×
Chemiluminescence with colorimetric marker	×	×	×	×
Fluorescence Trans-UV	o	×	×	×
Fluorescence Epi-RGB	o	o	×	o
Colorimetric Trans-White calibrated OD measurements	o	o	×	×

× Standard
O Optional

Fig 2. Amersham Imager 680 is ready to capture images within 5 min after startup. The imager is equipped with USB ports and a network connection.

Labels: USB ports, Touchscreen, Cabinet door, Sample tray, Power switch, USB ports, Network connection

Imaging performance

A bright, wide aperture FUJINON f/0.85 lens developed for chemiluminescent imaging projects sharp images onto a specially patterned CCD (Fig 3).
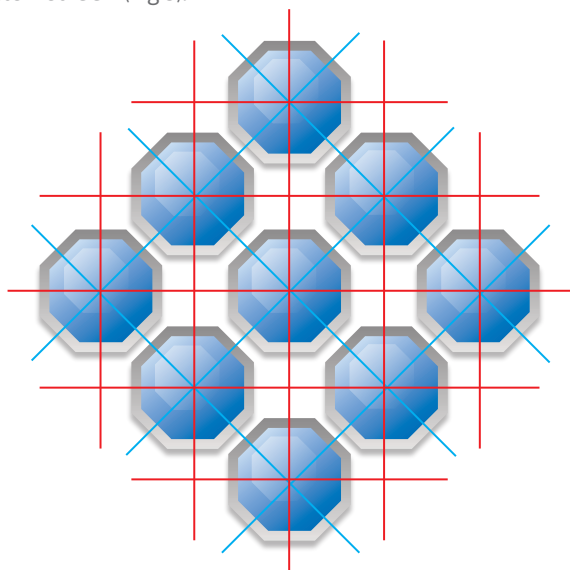

Fig 3. The special octagonal interwoven pixel layout offers a dense matrix for a more efficient capture of light compared to a standard, square-pixel layout.

Amersham Imager 680 has high sensitivity, which allows you to detect very weak signals in chemiluminescence and fluorescence applications for both protein and nucleic acids. Moreover, the wide dynamic range of the imagers—over four orders of magnitude—allows weak and strong signals to be quantitated accurately at the same time. The camera is cooled to -25°C to reduce dark noise giving less background noise during longer exposure times, which is especially important for the precise quantitation of very weak signals in chemiluminescent Western blotting. The images are automatically corrected for both geometric and intensity distortion (radial, dark frame, and flat frame) in each imaging mode. This provides images that need minimal post-processing for publication.

Sharper images

Binning is a method of combining several pixels into a larger pixel during readout of the CCD chip. The greater light receiving area of a combined pixel enhances sensitivity. The Amersham Imager 680 is capable of no binning (1x), 2x, 8x, and 32x binning. The most commonly used binning option is set as default for both upper (8x) and lower (2x) tray positions.

Higher binning settings increase sensitivity but can compromise picture quality (Fig 4). By choosing the new "No Binning" option on Amersham Imager 680 it is possible achieve higher resolution and better separation of close bands when this is a requirement for your experiment. Binning settings can be easily changed (Fig 5).

Robustness

Amersham Imager 680 is a highly robust series of instruments, making it suitable for multi-user environments. The imagers do not require calibration. Short exposure times and a fast analysis workflow means that several researchers can use the system in the course of a day. The camera system is designed for simple operation.

Intuitive operation and analysis

Amersham Imager 680 can be controlled from either an iPad or an alternative touch screen device. The user interface is intuitive and the workflow is easy to follow. The system is fully automated, which means that after startup, you do not need to perform focusing, insertion of light sources, changing of filters, calibrations, or other adjustments.

When the system is in automatic image capture mode, it performs a short pre-exposure of the whole sample to determine the optimum exposure time for the strongest signal without saturating the image so that an accurate quantitation of the sample can be attained. In semi-automatic image capture mode, an automated exposure is made based on an area of interest defined by you. Exposure times are also easy to set manually.

After image acquisition, the seamless workflow allows you to detect and quantitate bands, determine molecular weight, and perform normalization. The results are presented in both tabular and graphical formats so that you can easily and quickly analyze your data. For additional flexibility during data analysis, we offer ImageQuant™ TL software.

You can use the system to obtain images of colorimetric markers and stains, such as Coomassie™ Blue or silver. Moreover, white light imaging can be combined with chemiluminescence and fluorescence imaging to generate overlay images of marker and sample. This feature allows quick molecular weight estimation and simplified documentation.

The images can be stored in the system, on a USB memory stick or external hard drive, or in a network folder.

Examples of imaging applications

The following examples of applications illustrate the performance and flexibility of Amersham Imager 680.

Chemiluminescent Western blotting detection

Quantitative Western blotting requires a signal response that is proportional to the amount of protein. A broad dynamic range with linear response allows you to simultaneously quantitate both high and low levels of proteins. The combination of Amersham Imager 680 with either Amersham ECL™ Prime or Amersham ECL Select™ results in a limit of detection in the picogram range and a dynamic range covering three orders of magnitude.
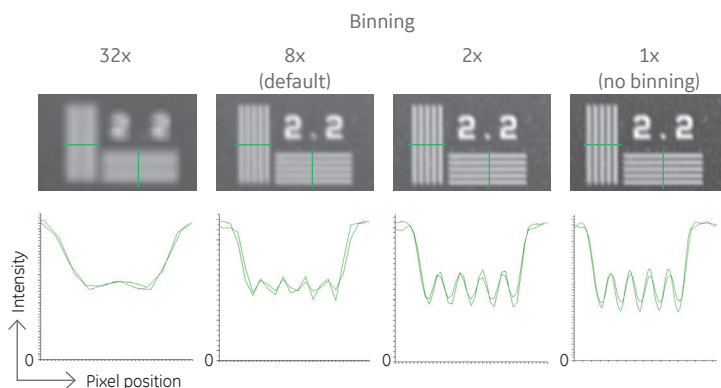
Binning

32x	8x (default)	2x	1x (no binning)

Fig 4. A resolution test chart (NBS 1963A, R2L2S1P, Thorlabs) was placed on top of a luminescent plate. After focus adjustment, the different binning options of Amersham Imager 680 were used to capture chemiluminescence images in the upper tray position. The figure shows horizontal and vertical line-profiles for the 2.2 line-pairs per mm pattern. Less binning significantly improves image resolution.
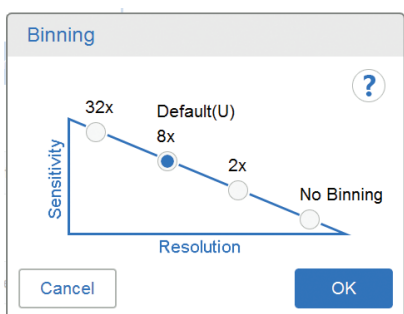

Fig 5. Binning options can be changed easily when needed by selecting from the Binning chart.

Sample: NIH/3T3 cell lysate two-fold dilution series starting at 5 µg
Membrane: Amersham Hybond™ P
Blocking: Amersham ECL Prime blocking agent 2% in PBS-T
Primary antibody: Rabbit anti-ERK1/2 1:10 000
Secondary antibody: ECL Anti-rabbit IgG horseradish peroxidase 1:100 000
Detection: Amersham ECL Select
Imaging method: Chemiluminescence
Binning: Default
Dynamic range: 2.7 orders of magnitude
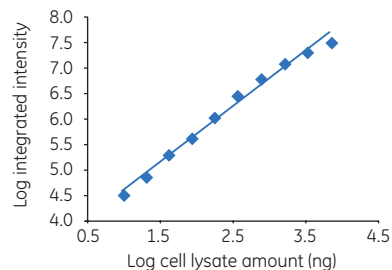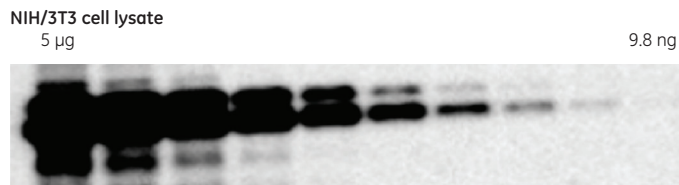
NIH/3T3 cell lysate

Fig 6. A two-fold dilution series of NIH/3T3 cell lysate starting at 5 µg total protein was subjected to chemiluminescent Western blotting and ERK was detected with Amersham ECL Select. Dynamic range and linearity were determined. ERK could be detected in a cell lysate with 9.8 ng of total protein. Amersham Imager 680 showed a linear response for chemiluminescent detection with low noise, high sensitivity, and a wide dynamic range.

Sample: Two-fold dilution series of transferrin from 625 pg to 2.5 pg
Membrane: Amersham Hybond P
Blocking: 3% BSA in PBS-T
Primary antibody: Rabbit anti-transferrin 1:1000
Secondary antibody: ECL Anti-rabbit IgG horseradish peroxidase 1:75 000
Detection: Amersham ECL Select
Imaging method: Chemiluminescence
Binning: Default
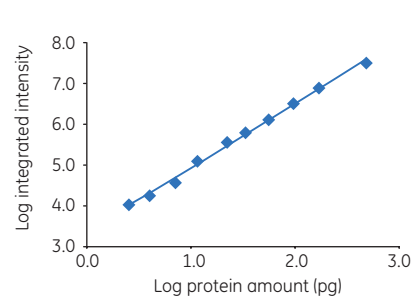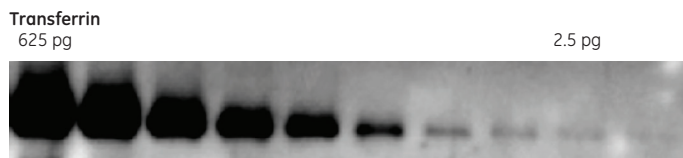Limit of detection (LOD): 2.5 pg transferrin

Transferrin

Fig 7. Evaluation of limit of detection with Amersham Imager 680 for chemiluminescence using a two-fold dilution series of transferrin from 625 pg.

Amersham Imager 680 offers chemiluminescence imaging with an automatic overlay function. This allows simultaneous imaging of a chemiluminescent sample and a colored molecular weight marker. The overlay image retains the marker color.

Sample: *E. coli* lysate
Membrane: Amersham Hybond ECL
Blocking: 3% BSA in PBS-T
Marker: Full range ECL Plex Fluorescent Rainbow Marker
Primary antibody: Rabbit anti DHFR C-terminal 1:1000
Secondary antibody: ECL Anti-rabbit IgG horseradish peroxidase 1:100 000
Detection: Amersham ECL Select
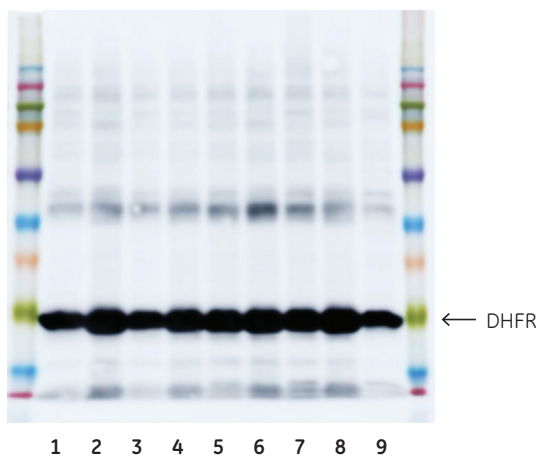Imaging method: Chemiluminescence with colorimetric marker
Binning: Default

Fig 8. The chemiluminescence mode allows simultaneous imaging of chemiluminescent samples and colored molecular weight markers. This image was taken from experiments for optimizing the expression of the protein DHFR in E. coli grown under different conditions.

Fluorescent imaging

Amersham Imager 680 combined with Amersham ECL Plex™ provides high-quality data in applications that demand high sensitivity over a wide dynamic range. Furthermore, the minimal crosstalk of Amersham Imager 680, and the spectrally resolved dyes Cy™2, Cy3, and Cy5, makes it a suitable system for a wide range of multiplexing applications, such as the detection of several proteins at the same time or different proteins of similar size.

Sample:	Two-fold dilution series of LMW marker with Phophorylase b starting at 200 ng
Prelabeling:	Cy5
Imaging method:	Fluorescence Cy5
Binning:	Default
Limit of detection:	98 pg phosphorylase b
Dynamic range:	3.3 orders of magnitude
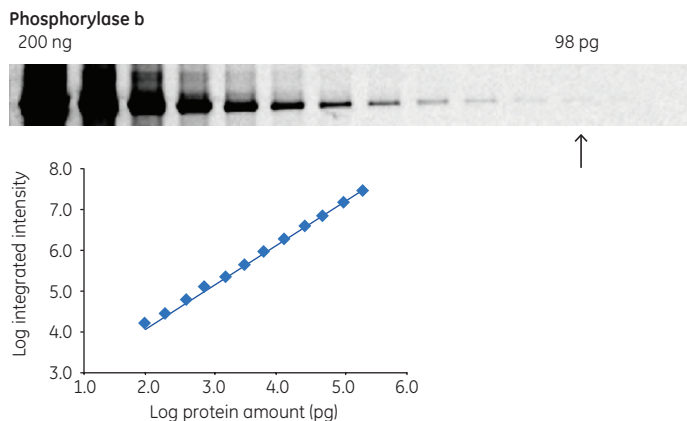
Phosphorylase b

Fig 9. Evaluation of linearity, dynamic range, and limit of detection for fluorescence detection with Amersham Imager 680. A two-fold dilution series of phosphorylase b prelabeled with Cy5 shows a dynamic range of 3.3 orders of magnitude.

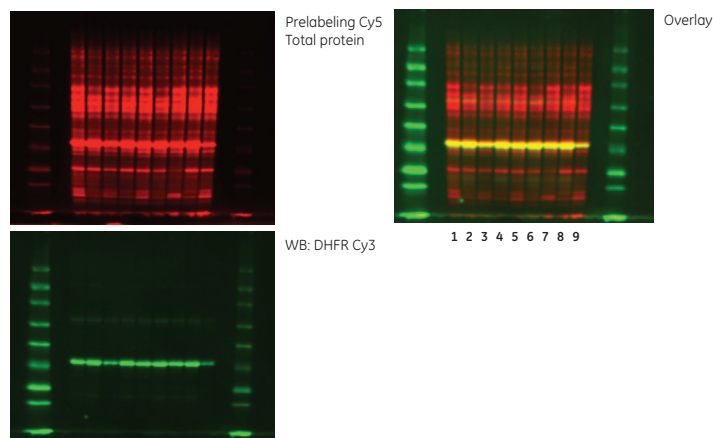|	
Sample:	*E. coli* lysates
Blocking:	3% BSA in PBS-T
Primary antibody:	Rabbit anti DHFR C-terminal 1:1000
Secondary antibody:	ECL Plex Goat anti rabbit-Cy3 IgG 1:2500
Imaging method:	Fluorescence Cy3, Cy5
Binning:	Default

Fig 10. Multiplex detection of total protein and target protein with Amersham ECL Plex and Amersham Imager 680. Detection of DHFR (Cy3 green) in nine different samples from a growth optimization of *E. coli*. Total protein in the samples was prelabeled with Cy5 (red). The overlay image shows the DHFR band in yellow. Crosstalk between Cy5 and Cy3 was minimal for Amersham Imager 680, which makes it suitable for multiplex applications.

Sensitive imaging of total protein stains

Proteins may be visualized by treating a gel with a total protein stain after performing 1D or 2D electrophoresis. The most commonly used stains are Coomassie Blue or silver staining. Fluorescent staining methods such as SYPRO™ Ruby protein gel stain have the advantage of being more sensitive.

(A)

Sample:	*E. coli* lysates
Marker:	Full range ECL Plex Fluorescent Rainbow Marker
Post staining:	Coomassie Brilliant Blue
Imaging method:	Colorimetiric, white light epi-illumination
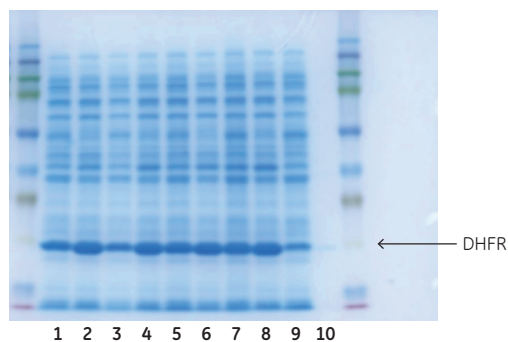
(B)

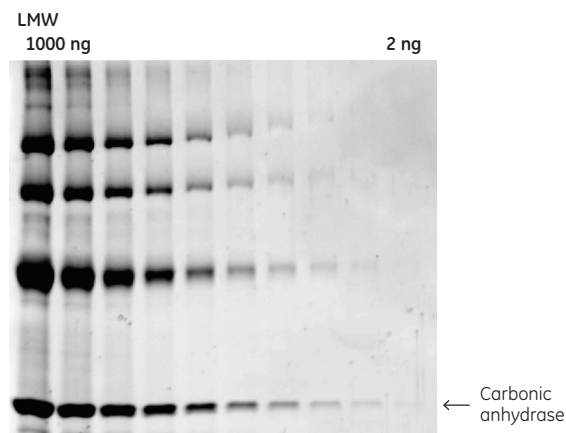|	
Sample:	Two fold dilution seires of LMW marker starting at 1000 ng
Post staining:	Sypro Ruby
Imaging method:	Fluorescence Blue Epi excitation
Binning:	Default
Limit of detection:	2 ng of carbonic anhydrase

Fig 11. (A) Proteins stained with Coomassie Brilliant Blue and detected with Amersham Imager 680. The illustration shows nine different samples of *E. coli* lysates, from a growth optimization experiment for the expression of DHFR. Purified DHFR was used as a reference (sample 10). (B) Two-fold dilution series of the LMW-SDS Marker stained with SYPRO Ruby and detected with Amersham Imager 680.

DNA imaging

Electrophoretic separation of DNA is a common technique that is typically used for the analysis of vector cleavages, DNA purification, and verification of successful PCR. Traditionally, ethidium bromide (EtBr) has been used for visualizing DNA, but today there are many alternative DNA stains available, such as SYBR™ Green.

Sample:	Three-fold dilution series of KiloBase DNA Marker
Post staining:	Sybr Green I nucleic acid gel stain
Imaging method:	Fluorescence Cy2
Binning:	Default
Limit of detection:	0.3 ng of total DNA
Dynamic range:	2.9 orders of magnitude

KiloBase DNA Marker
250 ng
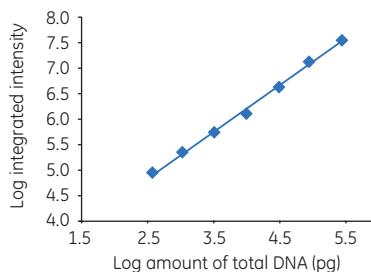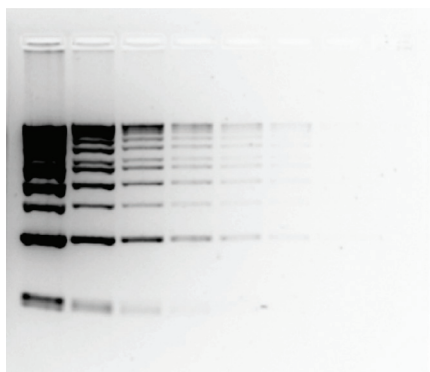
Fig 12. Three-fold dilution series of KiloBase DNA Marker in agarose gel stained with SYBR Green and detected with Amersham Imager 680.

Quantitative OD measurement

Amersham Imager 680 QC is a dedicated configuration for densitometry applications in a QC environment. The system contributes to a reliable control of products because it is equipped with highly sensitive optics that can detect trace amounts of impurities accurately. Amersham Imager 680 QC is available with IQ/OQ and validation support.

Amersham Imager 680 is autocalibrated for accurate and reliable measurements of optical density of proteins stained with colorimetric stains such as Coomassie or silver.

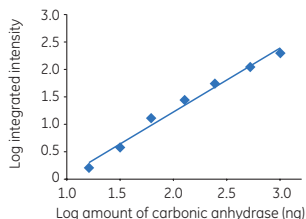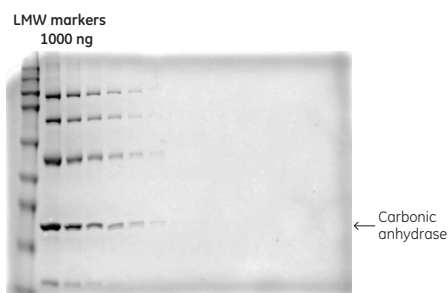|	
Sample:	Two fold dilution series of LMW marker
Post staining:	Coomassie Brilliant Blue
Imaging method:	Colorimetric white transillumination
Limit of detection:	16 ng of carbonic anhydrase
Dynamic range:	1.8 orders of magnitude

LMW markers
1000 ng

Fig 13. Image of a two-fold dilution series of LMW-SDS Marker in a gel stained with Coomassie Brilliant Blue. The image was recorded on Amersham Imager 680 in trans-illumination mode, which allows you to measure the optical density of protein bands without calibration.

Installation and Operational Qualification (IQ/OQ) validation services

GE Healthcare offers validation services to support your equipment throughout its entire life cycle. Our validation tests and protocols are developed and approved by validation experts and performed by trained and certified service engineers. Our approach is in alignment with GAMP5, ICH Q8-10 and ASTM E2500, whereby validation activities and documentation focus on what is critical for end-product quality, and are scaled according to risk, complexity, and novelty. Our validation offering includes Installation and Operational Qualification (IQ/OQ), Requalification, and Change Control Protocols (CCP).

Technical features

Table 2. Amersham Imager 680 RGB specifications

CCD model:	Peltier cooled Fujifilm Super CCD
Pixel area	15.6 × 23.4 mm
Lens model:	FUJINON Lens f/0.85 43 mm
Cooling:	Two-stage thermoelectric module with air circulation
CCD Operating temperature	-25°C
Cooling down time:	< 5 min
Dynamic range:	16-bit, 4.8 orders of magnitude
CCD resolution:	2048 × 1536, 3.2 Mpixel
Image resolution:	Maximum 2816 × 2048, 5.8 Mpixel
Operation:	Fully automated (auto exposure, no focus or other adjustment or calibration needed)
Capture modes:	Automatic, semi-automatic, manual, incremental and advanced
Exposure time:	1/100 s to 10 h
Pixel correction:	Dark frame correction, flat frame correction, and distortion correction
Image output:	Gray scale 16 bit tif, Color image jpg, Gray scale jpg
Sample size:	160 × 220 mm
Light sources:	Blue Epi light: 460 nm
	Green Epi light: 520 nm
	Red Epi light: 630 nm
	UV transillumination light: 312 nm
	White light: 470 to 635 nm
Emission filters:	Cy2: 525BP20
	Cy3/EtBr: 605BP40
	Cy5: 705BP40
Interface:	USB 2.0 and Ethernet port
Dimensions (W × H × D):	360 × 785 × 485 mm
Weight:	43.6 kg (Amersham Imager 680 RGB)
Input voltage:	100 to 240 V
Voltage variation:	±10%
Frequency:	50/60 Hz
Max power:	250 W
Operating temperature:	18°C to 28°C
Humidity:	20% to 70% (no dew condensation)

Ordering information

Product	Code number
Amersham Imager 680	29270769
Amersham Imager 680UV	29270770
Amersham Imager 680QC	29270771
Amersham Imager 680RGB	29270772

Accessories included (depending on configuration)

	Code number
Amersham Imager Black Tray	29083417
Amersham Imager UV Trans Tray	29083419
Amersham Imager White Trans Tray	29083418
Amersham Imager White Insert	29088060
Amersham Imager Diffuser Board	29083420

Additional Accessories

	Code number
Gel sheets (for UV trans tray)	29083457
iPad with AC Adapter Kit	29177985
Touch Screen Monitor with Stand	29093966
Wireless adapter ASUS USB-N13	29177984
10 Inch Touchscreen Accessory Kit*	29258317

* The 10" Touchscreen Accessory kit (Cat no: 29-2583-17) is only available in certain countries. Please contact a GE representative for further details.

Additional Software

	Code number
ImageQuant TL 8.2, Node-locked license*	29291744
ImageQuant TL 8.2 Node-locked license, 5 pack*	29291746

* External computer needed. Cannot be installed on Amersham Imager 680.

Upgrade options

Part/Description	Relevant for configuration	Code number
AI 600/680 upgrade to UV	600UV & 680UV	29083422
AI 600/680 upgrade UV to QC	600QC & 680QC	29083424
AI 600/680 upgrade QC to RGB	600RGB & 680RGB	29083425
AI 600/680 upgrade UV to RGB	600RGB & 680RGB	29083426

IQ/OQ Validation service

Description	Service type	Code number
IQOQ Amersham Imager	Documents	29098345
	Performance	28992654
Requalification	Documents	28956204
	Performance	28992654
CCP minor change	Documents	28920512
	Performance	28992654

Extended Warranty Options

We offer extended warranty options for different lengths of time, with or without an annual preventive maintenance (PM) visit.

Description	Code number
Amersham Imager 24 Month Warranty (12 Month Ext.) No PM	29098958
Amersham Imager 24 Month Warranty (12 Month Ext.) 1 PM included	29139844
Amersham Imager 36 Month Warranty (24 Month Ext.) No PM	29098959
Amersham Imager 36 Month Warranty (24 Month Ext.) 2 PMs included	29139845
Amersham Imager 60 Month Warranty (48 Month Ext.) No PM	29098960
Amersham Imager 60 Month Warranty (48 Month Ext.) 4 PMs included	29139846

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