

LI- μ CAM

DIGITAL INTENSIFIED CCD CAMERA



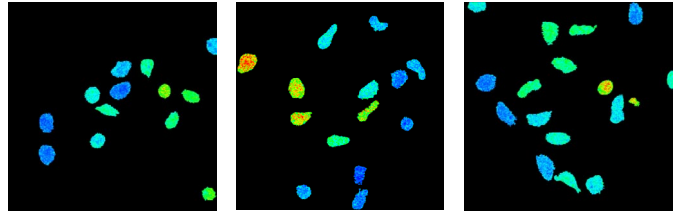
The perfect tool for your demanding Imaging Applications:

- High speed imaging
- Low Light Level imaging
- Microscopy
- Fluorescence Microscopy
- Ratio imaging
- Time resolved imaging

The *LI- μ CAM* is a computer controlled, completely digital low light level CCD camera. Its high sensitivity and the full control of the image intensifier, image integration, acquisition and readout parameters make this camera extremely useful for the most demanding scientific applications. Furthermore the CCIR/RS170 compatible video format ensures easy integration of the *LI- μ CAM* with existing hard- and software.

The *LI- μ CAM* uses an image intensifier, fibre optically coupled to a frame transfer CCD sensor (774x580 pixels) to achieve an unmatched performance at high speed and low light level operation. The *LI- μ CAM* can be equipped with several types of image intensifiers. Depending on the specific application an image intensifier can be selected for spectral sensitivity, resolution, gain, linearity, gating and other specific requirements. The camera is controlled from a PC using a GPIB interface and the comprehensive C-library or Windows compatible LI- μ WIN software that can be integrated in the users own software.





Calcium in white bloodcells (eosinophiles). (by courtesy of: Hart Long Instituut, Academisch Ziekenhuis Utrecht, The Netherlands

Camera Head and Control Unit.

Background: Image of laser-beam after passing through Non-linear Optical medium taken with LI-μCAM with gated Image Intensifier (by courtesy of: Institut für Angewandte Physik der Universität der Universität Münster. Germany.

Operation Modes

In the Standard Video Mode 25 frames/s (CCIR*) are produced, each frame consisting of 2 interlaced fields of 290 lines. Alternatively a mode can be selected in which only odd or even fields at a rate of 50 fields/s are acquired.

Besides the standard video mode several other modes are available that can be used separately or combined. For each mode or combination the analogue video output signal is compatible with the standard TV format and can be displayed on a video monitor or grabbed with a video frame grabber.

Short Time Integration mode

The integration time in standard video is 18.5ms per field. In the Short Time Integration mode the integration time can be varied in 64μs and 18.5ms while the frame rate maintains at 25 frames/s.

Long Time Integration (LTI) mode

The sensitivity can be increased by extending the time of image integration on the CCD chip. The integration time is variable in 20ms steps between 38.5ms and 20s. The camera frame memory is used to provide standard video output of the last integrated image.

Region of Interest (ROI) mode

A selected region of the image can be readout at a high frame/field rate. The size and the position of the region is adjustable. The field rate increases when a smaller number (between 1 and 286) of image lines is selected. For example at 50 lines the field rate is 250 fields/s. The camera frame memory is used to provide standard video output containing as many images of the ROI as fit within a standard video frame.

Binning mode (2,4,8 and 16 lines binning)

Binning of pixels allows an increase of sensitivity by merging the charge of 2, 4, 8 or 16 adjacent pixels in a column at the cost of image resolution. As the number of image lines decreases with the binning factor, the image rate increases correspondingly and 2, 4, 8 or 16 images fit within a standard video frame.

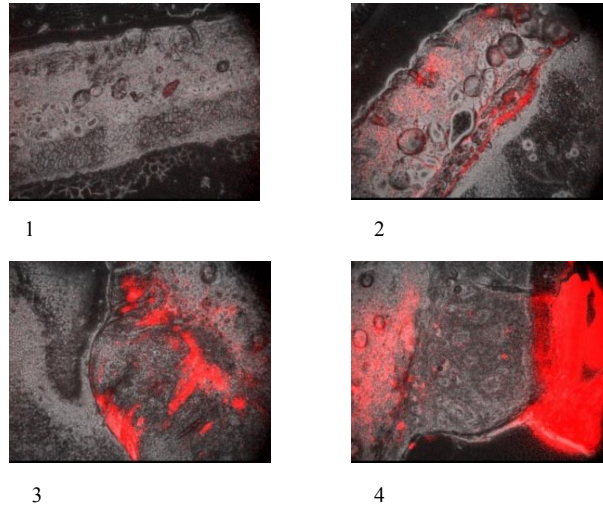
Trigger mode

The capture of a single random event is started by giving a software trigger or by supplying an external TTL signal.

* Note: All modes described for CCIR are also available for RS170 standard.



Fluorescent dyes can be used as a diagnostic marker for tumour tissue. Mice with artificially induced altered skin and tumours were injected with the dye D9. From 20µm thick sections of the skin, a separate phase contrast and fluorescence image (excitation 425 nm, fluorescence detection 630-670nm) was recorded with the LI-µCAM camera coupled to a microscope. Next, the fluorescence image was superimposed on the phase contrast image.



Images. (1) altered skin without ED9; (2) altered skin with ED9; (3) tumour skin with ED9; (4) tumour with crust with ED9 (by courtesy PDT Research Laboratory, Daniel den Hoed Cancer Center, University Hospital Rotterdam, The Netherlands)

Image Intensifier

Gen I, Gen II, Gen III or hybrid

To make full use of all camera features, including an extremely wide dynamic range and nanosecond shuttering, a proximity focussed Micro Channel Plate (MCP) Intensifier, Gen II or Gen III can be selected. The gain of this intensifier is adjustable over a wide range by changing the MCP voltage. The intensifier is gated by supplying gate pulses to the photocathode. Extremely high gain for photon counting applications can be obtained by using a combination of Gen II and Gen I intensifier (2-stage hybrid). For applications that do not require gating and adjustable gain, the application of a single stage Gen I image intensifier, that does not make use of a MCP, offers specific advantages.

Gain and Gating control

Gain and gating of the image intensifier are digitally controlled via the GPIB interface. Gating the image intensifier enables the use of the LI-µCAM as an ultrafast shuttered camera. The camera allows a minimum gate-on time of 5ns.

The gating can be controlled both internally as well as externally.

- Internally

The camera contains a programmable pulse generator. The gate on time can be programmed with a user defined pulse width and delay within the integration period of the CCD.

- Externally

In the *follow external* mode the gate pulse will follow an external signal.

In the *external trigger* mode the gate pulse with programmable delay and pulse width is triggered by the external signal.

Video Signal

The video signal is available in three different formats:

As an analogue CCIR/RS170 compatible output

This allows displaying the image on a standard TV monitor, recording images on a VCR and using standard analogue input framegrabbers.

As a 10 bit digital output in combination with pixel, line and frame valid signals

The video signal is present as a 10 bit digital signal at video rate, 14.5 MHz. The digitisation in the camera ensures the highest image quality. A framegrabber with a digital input can be used to acquire this high quality image at high speed.

Through the GPIB interface as a 10 bit digital image

The camera frame memory is accessible via the GPIB interface. This allows a high quality 10 bits image readout without the need for an additional framegrabber to be installed in the PC. The readout speed depends on the GPIB interface card installed in the PC and can reach 1Mb/s.



LI-μCAM specifications:

Camera:

- CCIR/RS170 analogue output
- GPIB interface
- Digital control of all camera settings
- 10 bits digital output (14.5MHz)
- Internal 10 bits frame buffer
- Digital black level control (8 bits)
- Gamma: 1.0 or 0.45

- Operating modes:
 - **Standard Video mode**
 - **Short Time Integration mode:**
Integration time programmable in 64μs steps from 64μs up to 18.5ms.
 - **Long Time Integration mode:**
Integration time programmable in 20ms steps from 38.5ms up to 20s.
 - **Region Of Interest mode:** 1-290 lines.
 - **Binning mode:** 2,4,8 or 16 lines.
 - **Trigger mode:**
software or external TTL trigger for single shot image.

- Gain control:
 - Automatic Gain Control (AGC) or
 - Manual digital gain control (8bits)
 - Image Intensifier gain control (8 bits)

- Intensifier gating control modes:
 - **Follow Integration:**
The gate follows CCD integration period.
 - **Internal Trigger:**
Synchronised with CCD integration, the gate pulse width and delay are programmable in 70ns steps up to 20ms.
 - **Follow External:**
The gate follows an external signal down to a minimum pulse width of 5ns.
 - **External Trigger:**
Triggered by an external signal, the gate pulse width and delay are programmable in 70ns steps up to 20ms.

- Dimensions (mm): 228 x 115 x 85
- Lens mount: C-mount, others on request,

Image Intensifier

Typical specifications of the available types:

Type	Gen I	Gen II	Hybrid (2-stage)	Gen III
input window	fiber optic	f.o./glass/quartz	f.o./glass/quartz	glass
input diameter (mm)	18	18	18	18
useful image area (mm ²)	10.5x7.9	14x10.5	14x10.5	14x10.5
cathode sensitivity				
@2850K (μA/lm)	300	600	600	1000
@800nm (mA/W)	25	55	55	140
@850nm (mA/W)	15	45	45	100
gain (cd/m ² .lx)	150 (fixed)	6000 (variable)	300,000 (var.)	8000 (var.)
camera sensitivity (lx)	10 ⁻⁴	5 x 10 ⁻⁶	10 ⁻⁷	10 ⁻⁶
camera resolution (TV lines)	500	450	400	450
optional gating	no	yes	yes	Yes
min. pulse width (ns)		5	5	100
phosphor	P20	P43	P43	P20
decay time to 1% (ms)	60	3	3	60
options	-	different photocathodes UV response P46,P47 short decay phosphors		

CCD sensor: - Frame transfer CCD sensor

- 774 x 580 pixels

- 100% fill factor

Software: C-library, LI-μWIN and driver for ImagePro Plus available.

