L3Vision – Low Light Level Level Cameras Overview
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How sensitive is a CCD?

Three key factors determine the low light sensitivity of a CCD:

- **Number of photons / pixel / unit time**
  - Dependent on pixel area
    - With all else equal, a 16\(\mu\)m square pixel gathers 4x more light than an 8\(\mu\)m square pixel

- **How well light is converted to signal electrons**
  - High quantum efficiency
    - Back illuminated CCDs convert over 90% of 550 nm light to signal electrons

- **Maximum open area ratio**
  - Frame transfer CCDs are 100% fill factor
  - Interline transfer CCDs are not 100% fill factor

- **How low the noise floor is**
  - Noise sets the limit to the minimum detectable signal
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Maximizing Signal to Noise

Main Sources of Noise

• Shot Noise on the Dark Signal
  ▪ Cool sensor to eliminate dark current

• Noise from the CCD Output Amplifier
  ▪ Reduce readout rate

• Noise added by the video chain electronics
  ▪ Optimise design of electronics

Benefit from L3Vision Technology

Reduce the noise = Improve the CCD Sensitivity

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What L3Vision is…

- **Low Light Level Technology**
  
  - A CCD technology that provides <1 photo-electron equivalent read noise at video frame rates or higher
  
  - An impact ionisation gain process within the CCD that amplifies signal electrons up to 1000 times so that they may be detected above the CCD output and camera electronics noise.
  
  - A unique technology developed by e2v technologies
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What L3Vision is NOT…

- L3Vision CCDs do NOT use image intensifiers
- L3Vision CCDs are NOT electron bombarded CCDs (EBCCDs).
- L3Vision CCDs are NOT CMOS image sensors

... L3Vision CCDs are simply CCDs

... and are sometimes known as EMCCDs (Electron Multiplying CCDs)
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L3Vision CCDs vs ICCDs

ICCD Advantages
- Gated operation
- Mature and accepted technology
- Low power consumption

ICCD Disadvantages
- Poor daylight performance
- Susceptible to damage
- Poor resolution
- High excess noise factor
L3Vision CCD Advantages

- Increased spatial resolution & SNR giving greater dynamic range
- No halo from bright sources allowing visible detail in adjacent pixels
- Not susceptible to damage from bright lights
- No scintillations giving improved image quality
- High photo-sensitivity (QE up to ~95%)
- Solid state giving lower life-cycle cost
- No high voltages required
- Excellent for day and night operation

L3Vision CCD Disadvantages

- Moderate power consumption
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Example Camera Features

- High Dynamic Range
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Example Camera Features

- Spot light performance is far superior to Gen III ICCD
Electron Multiplication allows even the smallest signals to be seen

Back-illumination means superb quantum efficiency
- ~95% QE at 550 nm

L3Vision Cameras fully exploit the L3vision technology, and feature
- Automatic gain control
- Digital image enhancement (filtering, dynamic gamma)
- Digital & analogue outputs
- Ultra-low light level performance

L3Vision CCD Sensors also available
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Video Camera Products

L3C60
- 128(H) x 128(V)
- 500 frames per second
- Analog video output
- Internally cooled CCD for reduction of dark current
- IMO for reduced dark current
- Automatic gain control adjusts to varied lighting

L3C65
- 576(H) x 488(V) or 576(H) x 576(V)
- Analog video output
- Internally cooled CCD for reduction of dark current
- Automatic gain control adjusts to varied lighting

L3C95 / L3C85
- 768(H) x 488(V) or 768(H) x 576(V)
- Analog or Digital video output
- Internally cooled CCD for reduction of dark current
- Digital control of operating modes – USB2.0 or RS232
- Real time digital image enhancement
- Extremely low minimum usable light level (10x lower than L3C65)
- Fully automatic operation over NINE decades of illumination.

Customization available
L3Vision Technology
Video Camera Products

L3C216 (Due for release May 2008)
- 768(H) x 488(V) or 768(H) x 576(V)
- Analog or Digital video output
- Internally cooled CCD for reduction of dark current (fan-less)
- Back-thinned L3Vision CCD with QE up to ~95%
- Digital control of operating modes – Camera Link or RS232
- Real time digital image enhancement
- Extremely low minimum usable light level (10x lower than L3C65)
- Fully automatic operation over NINE decades of illumination.
- Reduced power consumption (12W max)
- Reduced size (and modular design version available)
- RoHS Compliant

Customization available
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Video Camera Customization

• Camera customisation to meet military specifications and airborne applications

• Also available as a driver board-set and as CCD sensors

Please send us your requirements!
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Application areas

Surveillance and Reconnaissance
- TV format
- Airborne & Ground-based surveillance
- Underwater Imaging
- Driver view enhancement
- Commander’s night-sight
- Pushbroom imagers

Scientific imaging
- Single molecule fluorescence
- High throughput screening
- Adaptive optics / wave-front sensing
- Photon counting
- Ground based astronomy
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The End