# L3Vision Technology

## 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

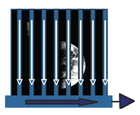
**Reduce the noise = Improve the CCD sensitivity**

## 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 µm square pixel gathers 4x the light of an 8 µm 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

Frame transfer



Interline transfer

## 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**

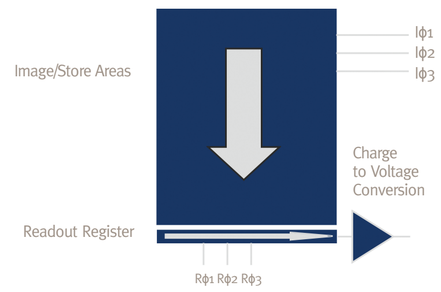
... and are sometimes known as EMCCDs (Electron Multiplying CCDs)

## What L3Vision is...

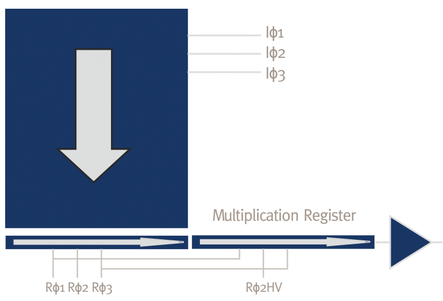
**Low Light Level Technology**

- A CCD technology that provides <1 photo-electron equivalent read noise at video 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 electronics noise
- A unique technology developed by e2v technologies

## Conventional CCD




## L3Vision CCD



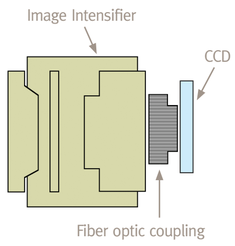

## L3Vision CCDs vs ICCDs

**ICCD Advantages**

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

**ICCD Disadvantages**

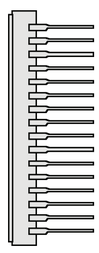
- Poor daylight performance
- Susceptible to damage
- Poor resolution
- High excess noise factor




## L3Vision CCDs vs ICCDs

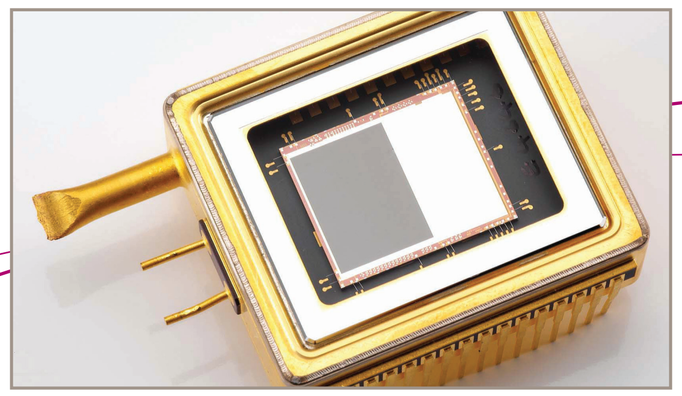
**L3Vision CCD Advantages**

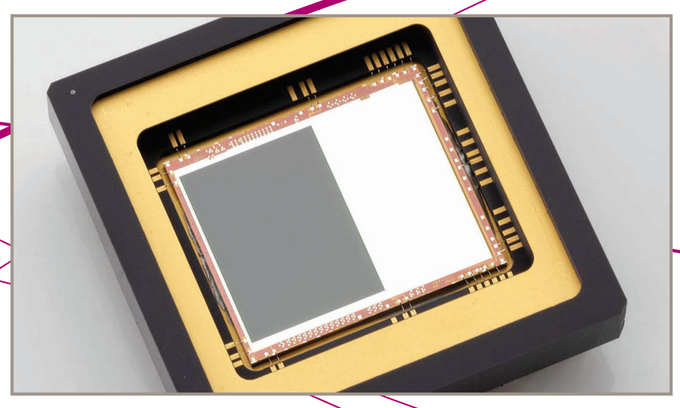
- Increased spatial resolution & SNR giving greater dynamic range
- No halo from bright sources allowing visible detail in adjacent pixels
- Not susceptible to damage from bright lights
- No scintillations giving improved image quality
- High photo-sensitivity (QE up to ~95%)
- Solid state giving lower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



**L3Vision CCD Disadvantages**

- Moderate power consumption



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