

# ESPROS Photonics Corporation

## Key Technology of the 21st Century

### Introduction to epc technology

**Confidential and Proprietary**

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Sept 15<sup>th</sup>, 2014

# Outline

- **Company overview**
- **Technology concept**
- **Development models**
- **Technical performance**
- **Product examples**

# Company



- **Established 2006**
- **Locations:**
  - Sargans (head quarters)**
  - Shanghai (chip design)**
- **Headquarters**
- **Technology development**
- **Chip design**
- **Test & Assembly**
- **Administration & Sales**

## Facilities: Clean Rooms

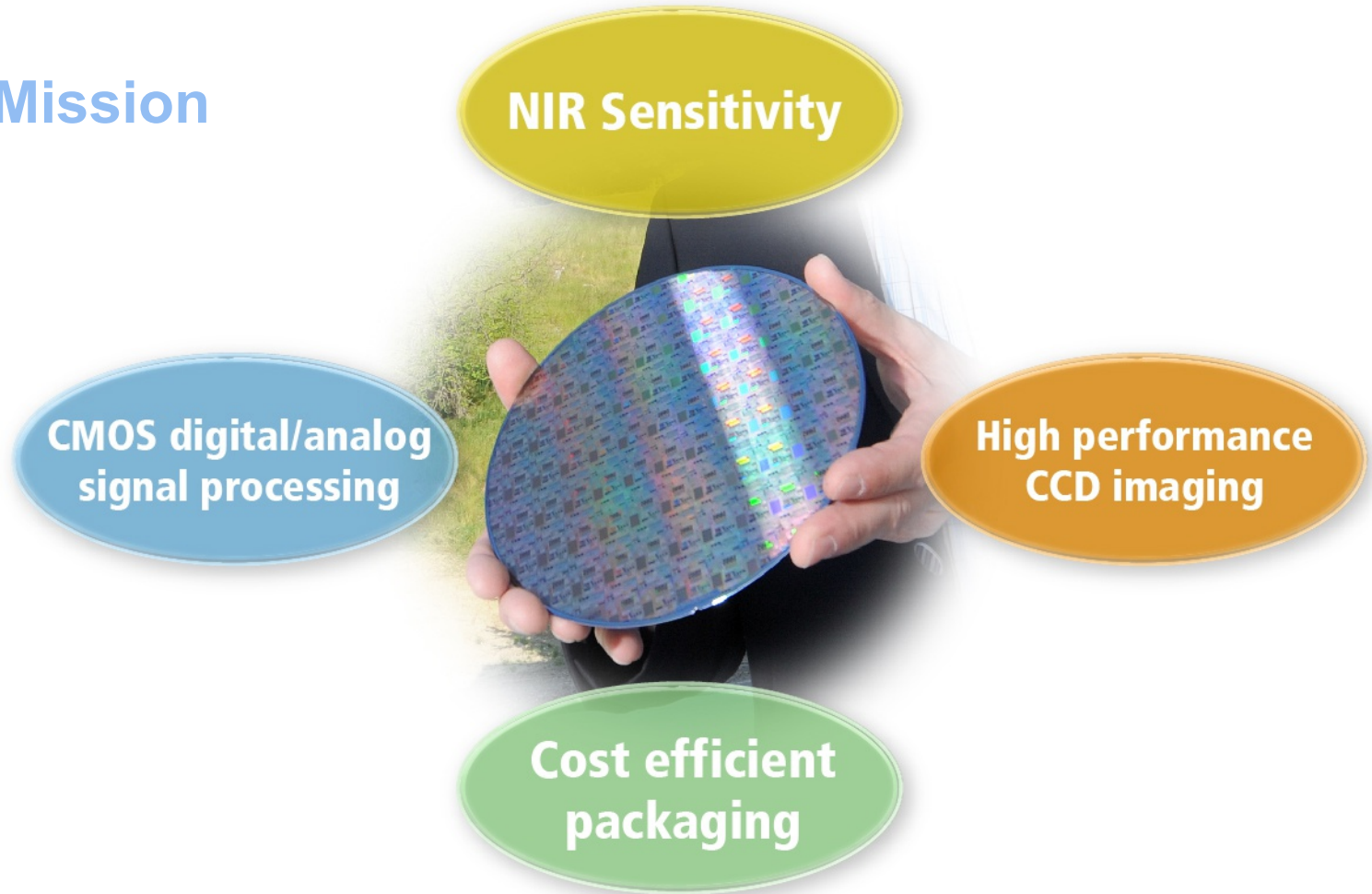


- 600m<sup>2</sup> class 1 cleanroom for backside processing
- 360m<sup>2</sup> class 1000 cleanroom for testing & backend

# Technology concept

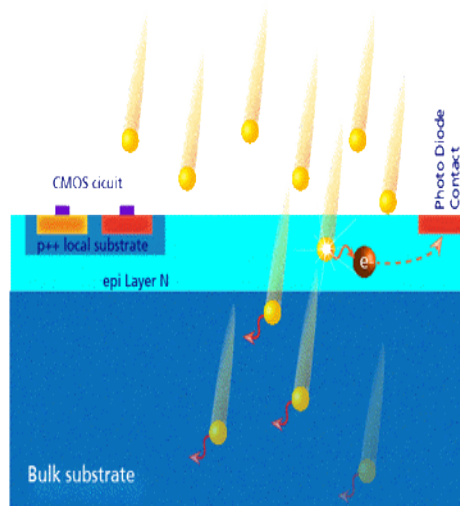


## Mission



**epc provides superior UV, VIS, and NIR photonics system on chip technology. Our combination of CCD and CMOS process technology delivers best in class performance for complex low light, high speed, hyperspectral imaging applications.**

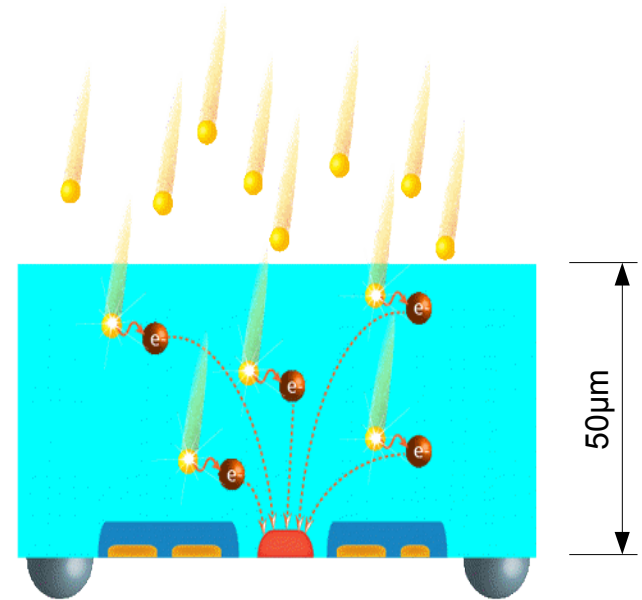
# Central issue depletion



**Conventional CMOS imaging**  
**Partial depletion**  
**Charge loss**

**fi good for visible, poor for NIR**  
**Significant portion of insensitive material**

3-5 $\mu$ m

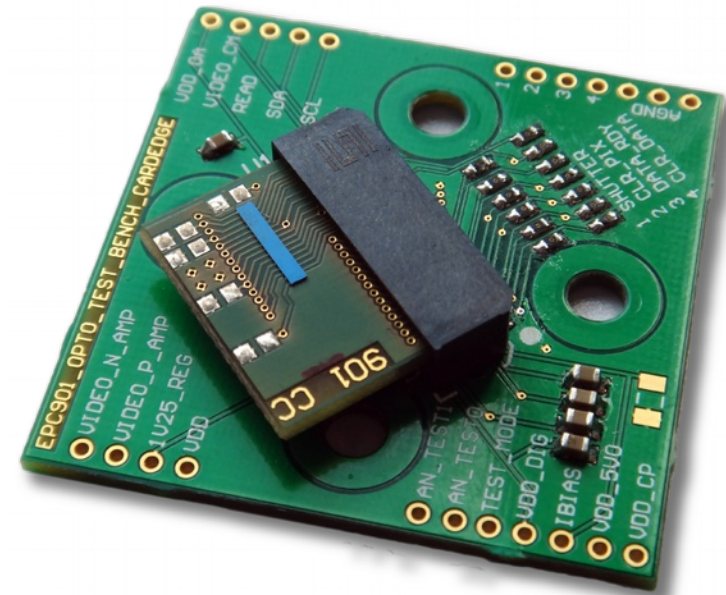
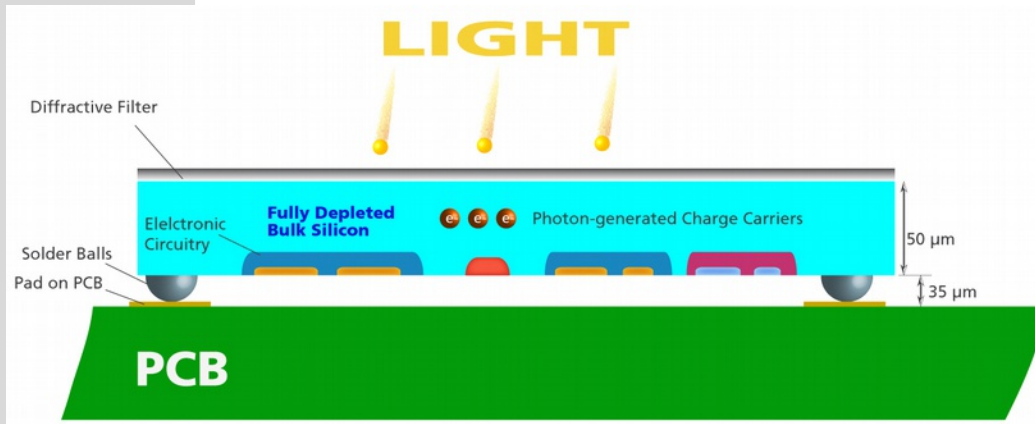
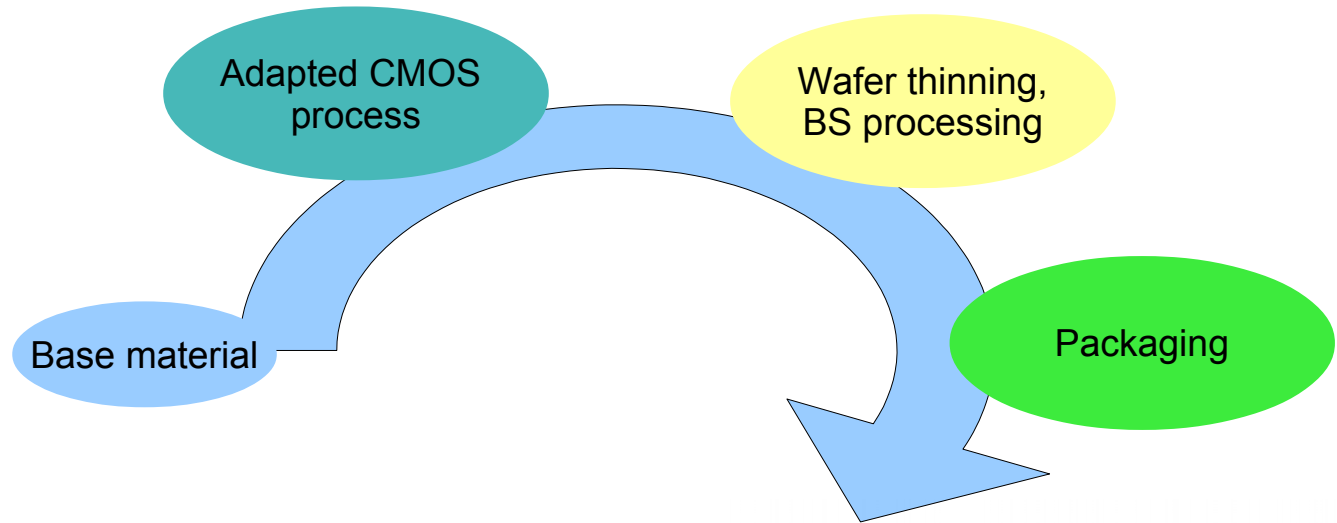


**ESPROS Photonic CMOS™**  
**Quasi-full depletion of bulk**  
**No charge loss**

**fi excellent for visible and NIR**  
**Nearly no insensitive material**

50 $\mu$ m

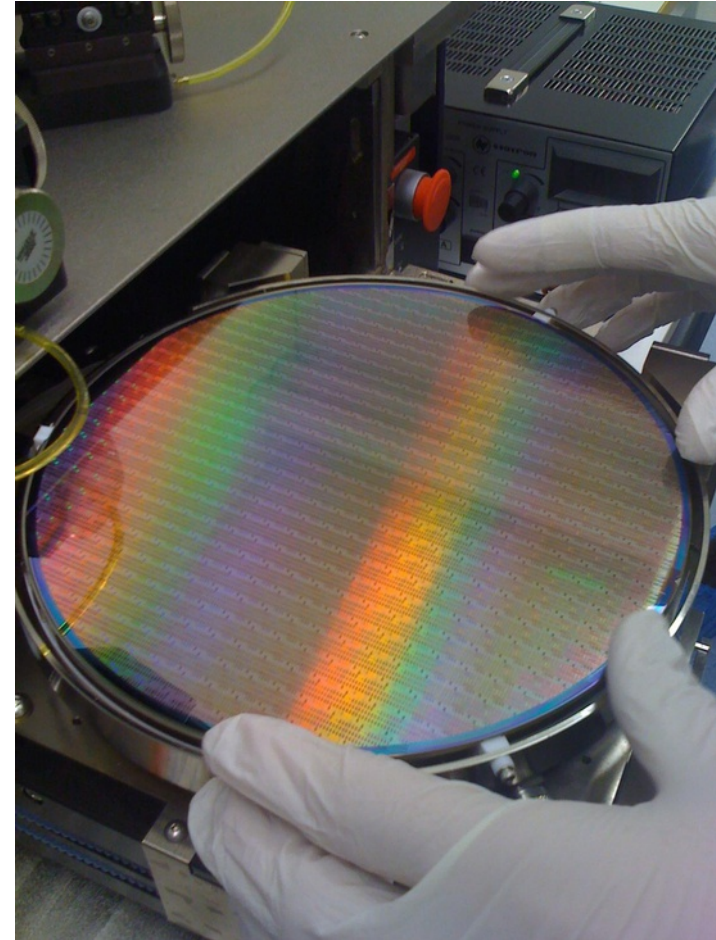
# Our approach





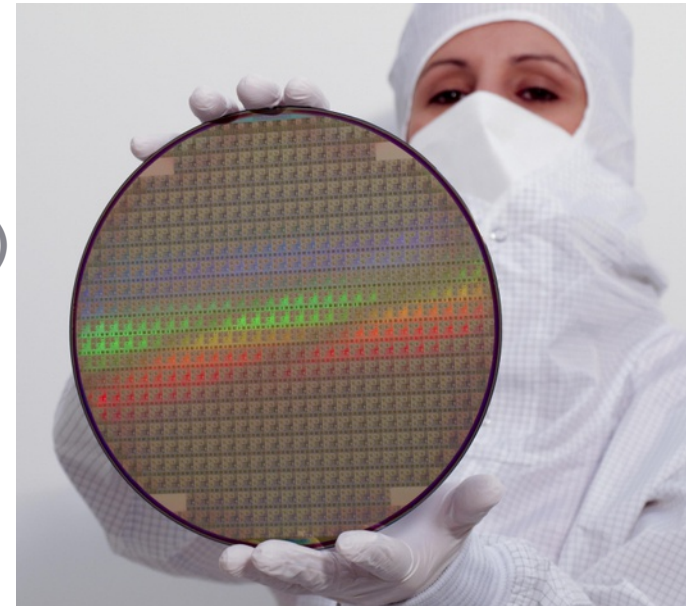
## Baseline Technology

- 150nm CMOS Process
- Wafer size 8"
- Up to 6 metal layers
- 1 Poly layer + CCD
- Isolated wells
- Voltages up to 12 V
- Photonics and mixed-signal circuitry on the same chip, backside illuminated
- Full coverage by TCAD simulation environment



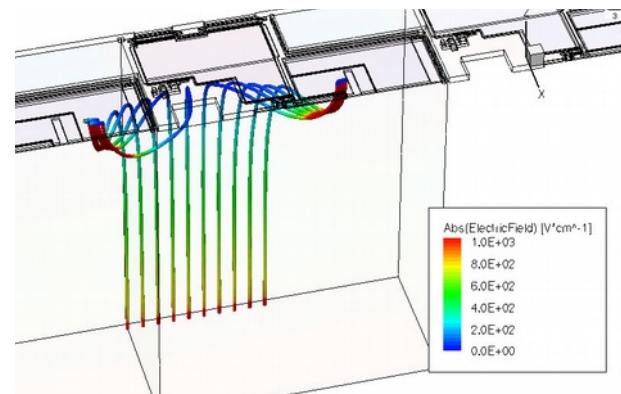
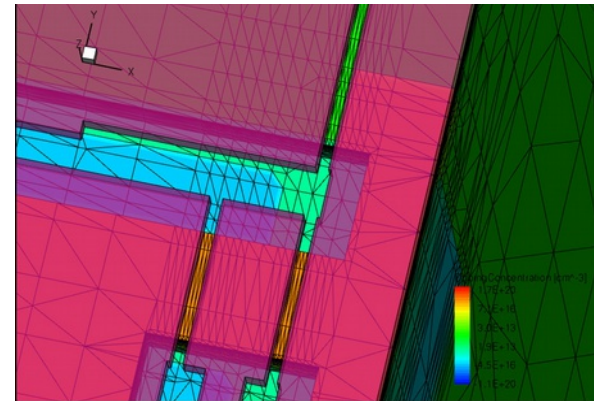
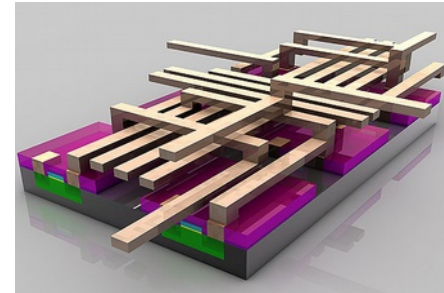
## Foundry Services

- Full process 36 masks
- Mask Size 25x32 mm
- Multi-layer masks (9 masks 12x15 mm)
- Fast process run 12-14 weeks
- Start every week possible
- MPW possible
- Testing
- Dicing
- Bumping
- Packaging (CSP, QFN, prototyping)
- Die sort
- Tape on reel



# IP, building blocks

- Photo diodes
- Buried-channel CCD
- 3D-TOF pixel structures
- Amplifiers (Various types)
- Comparators
- Bandgap references
- Voltage regulators
- Charge pumps
- Current sources
- Oscillators
- Temperature sensors
- ADC, DAC
- High current LED drivers
- PLL, DLL
- Digital interfaces (I<sup>2</sup>C, SPI, DVI ..)
- EEPROM
- ...



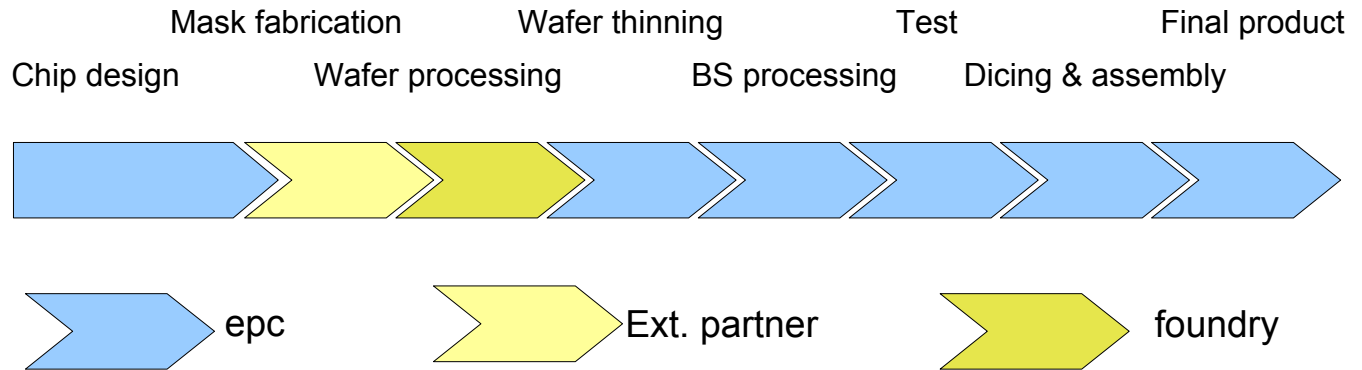
# Foundry Capabilities

## Services



- **PDK available for Cadence and Tanner tools**

# Setup of Fabrication Flow



**Established and reliable wafer-processing cooperation**

**Established optical backend**

**Fast processing at foundry, established BS process**

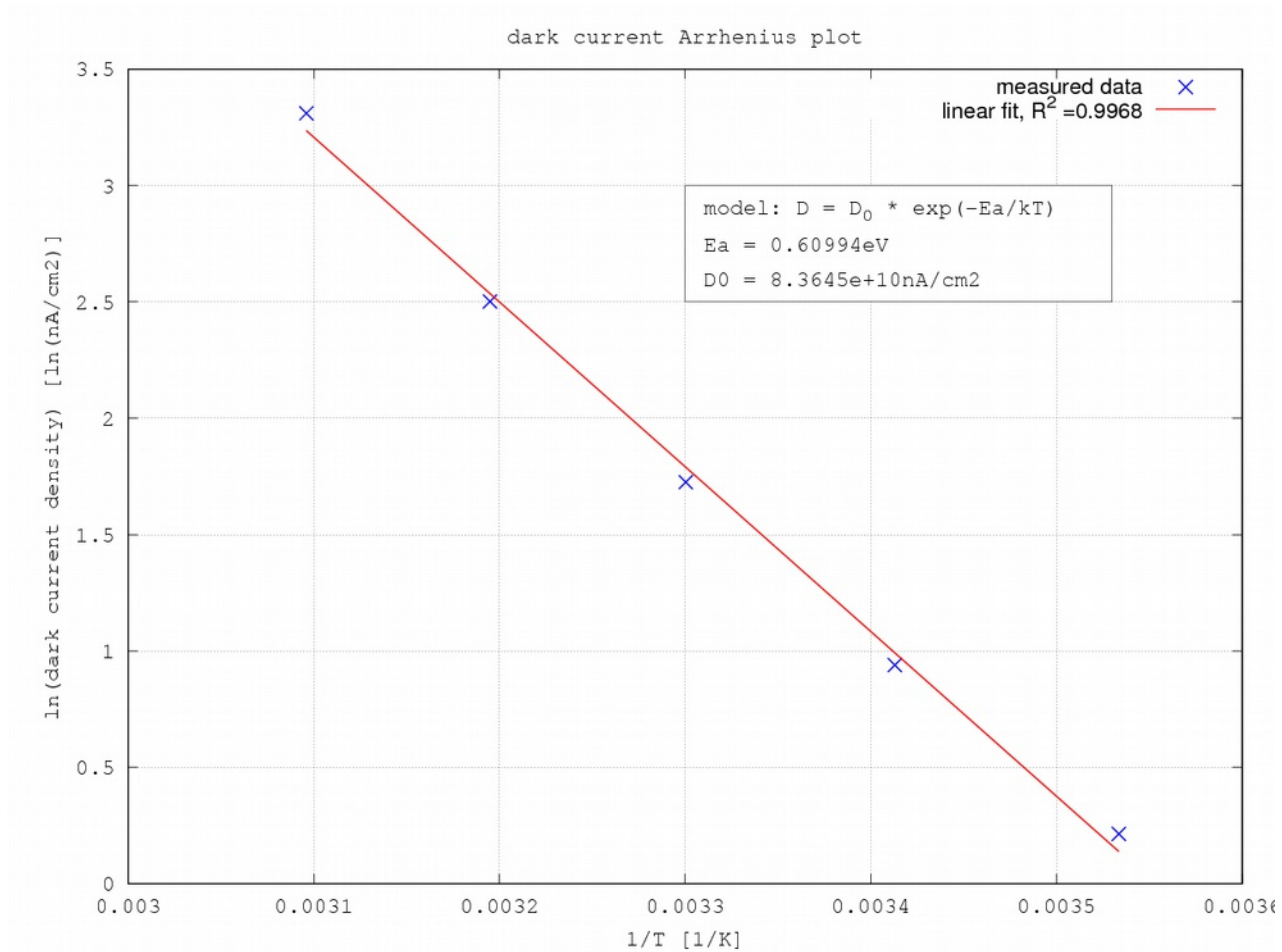
**TAT Mask TO – Samples available in 14 weeks is achievable**

→ **fast & efficient learning cycles possible**



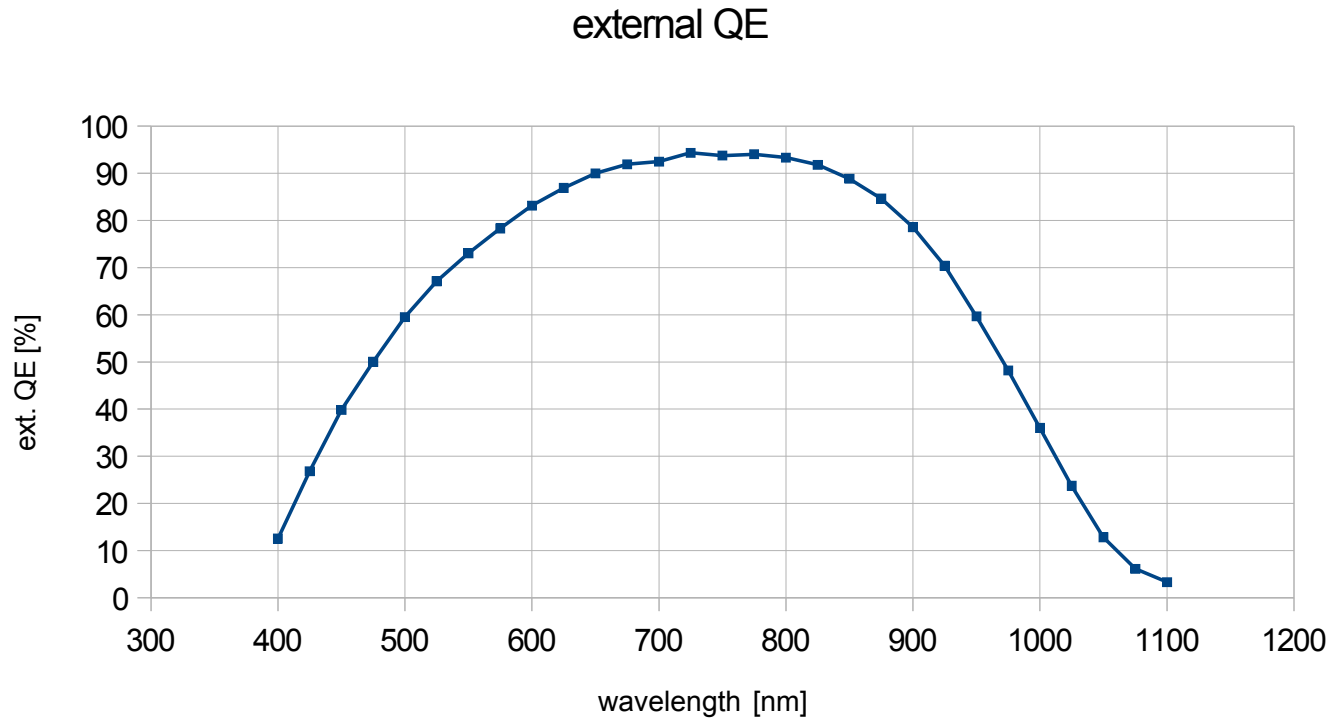
# Technical performance

# Dark current



**The dark current follows the Arrhenius law. The activation energy is about 0.6eV.**

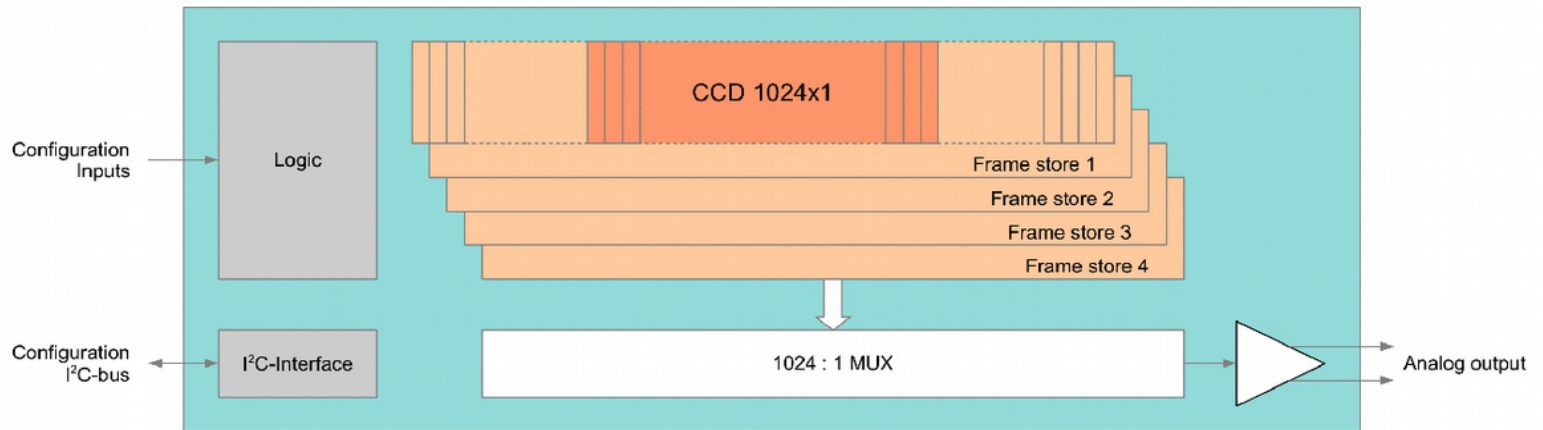
# Quantum Efficiency



**A quantum efficiency up to 90% could be measured. For wavelengths from 600 to 900nm a QE of more than 80% is achieved. Biggest uncertainty factor is the conversion gain.**

# Product examples

# epc901: CCD-based line imager



## Key requirements:

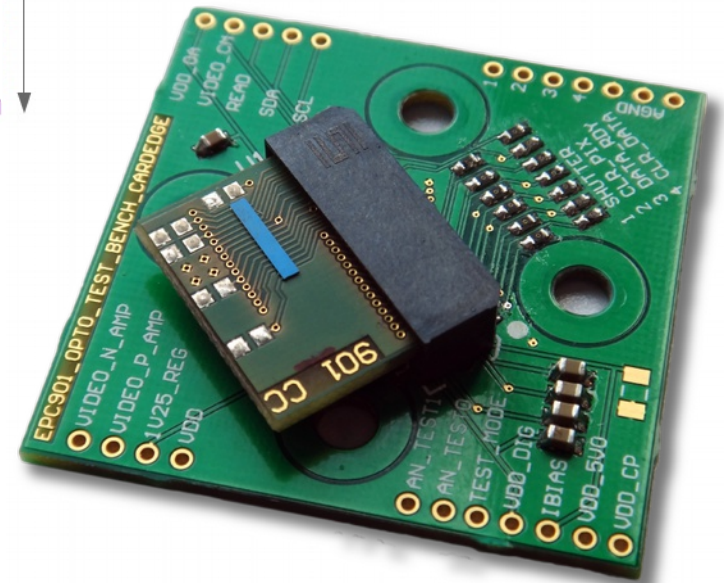
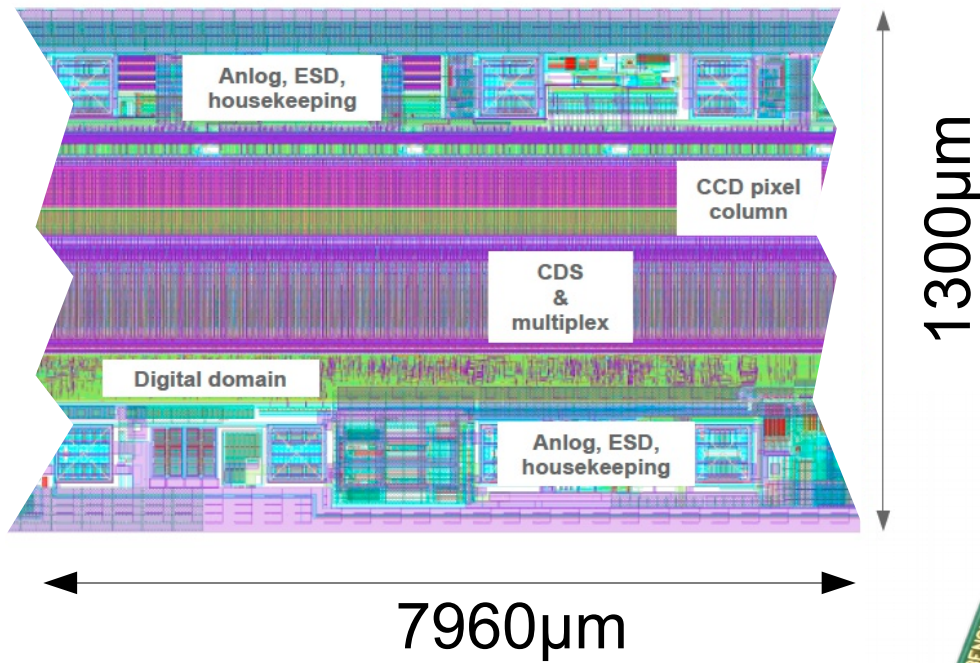
1024 pixels: 7.5 $\mu$ m x 120 $\mu$ m

Single analog video out up to 50klines/s

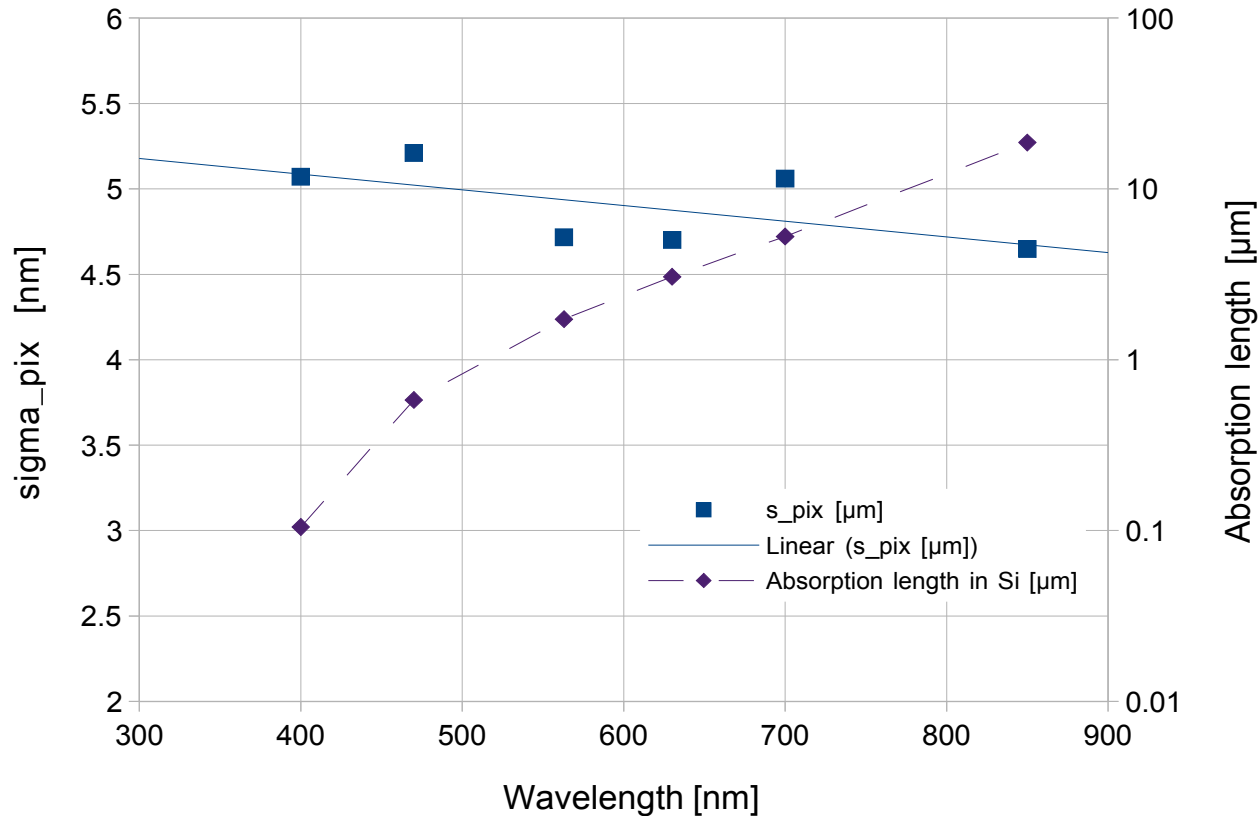
High-speed frame store: burst rate 500klines/s



# epc901: CCD-based line imager

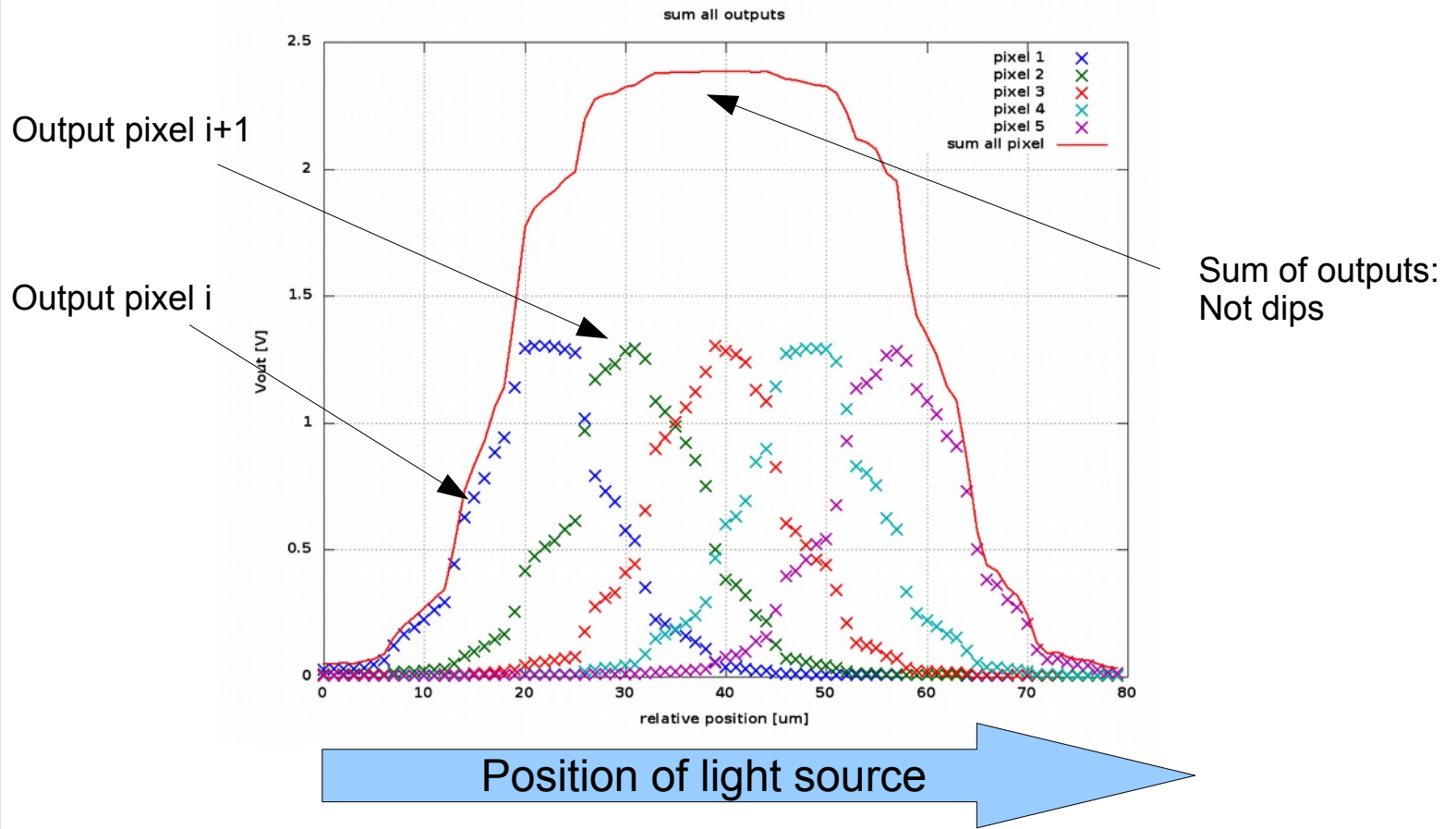


# epc901: resolution vs. wavelength



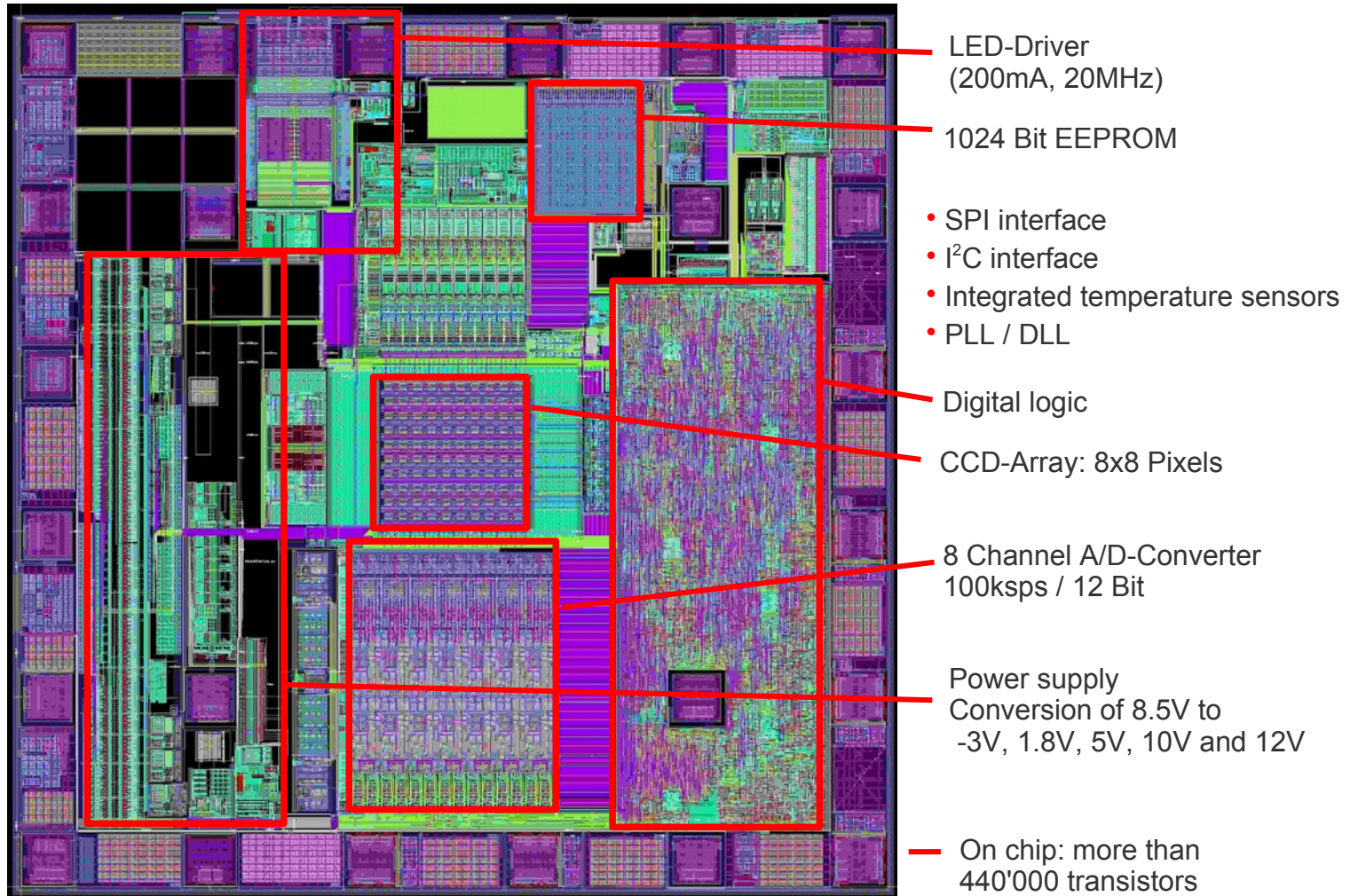
Spatial resolution is constant over wide wavelength range  
 → high-res NIR imaging becomes possible

# The Pixel: Fill factor



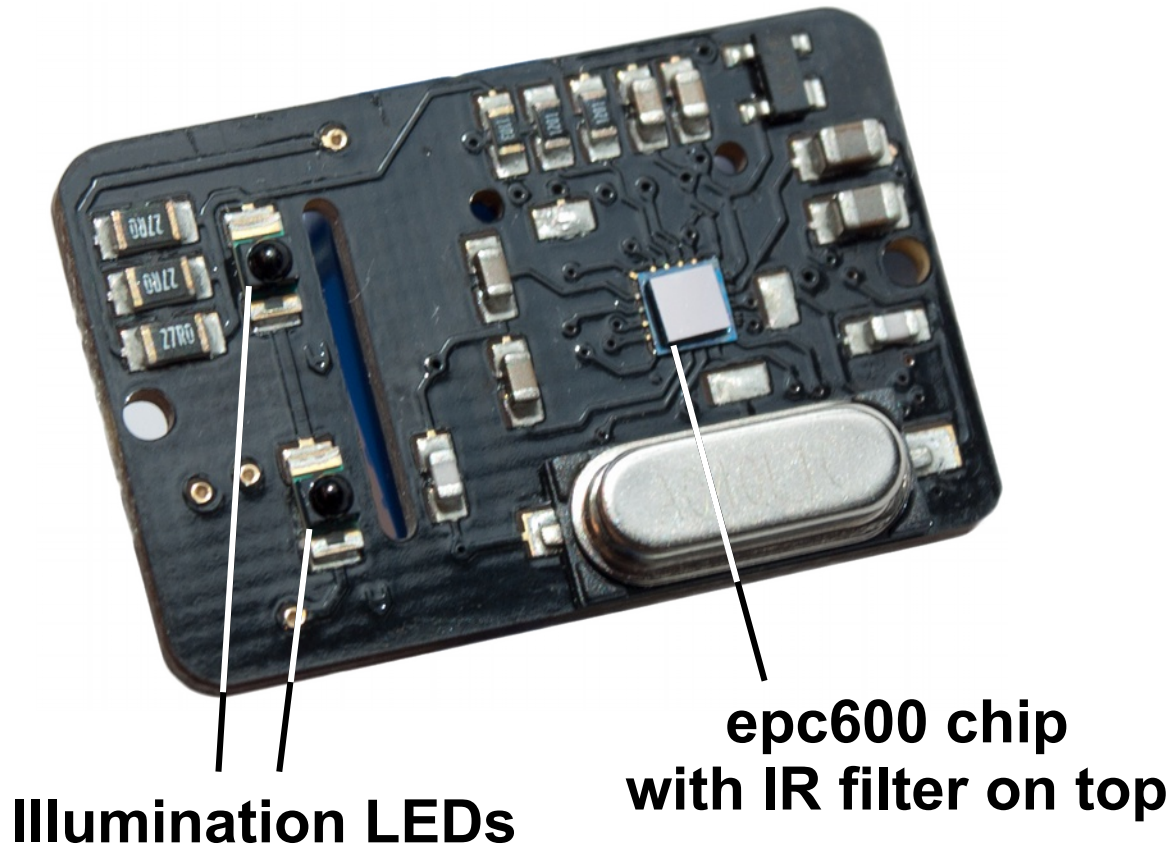
Scan point light source across pixel field:  
 No dips in summed intensity observed  
 ==> 100% fill factor

# epc600: ToF Camera on Chip





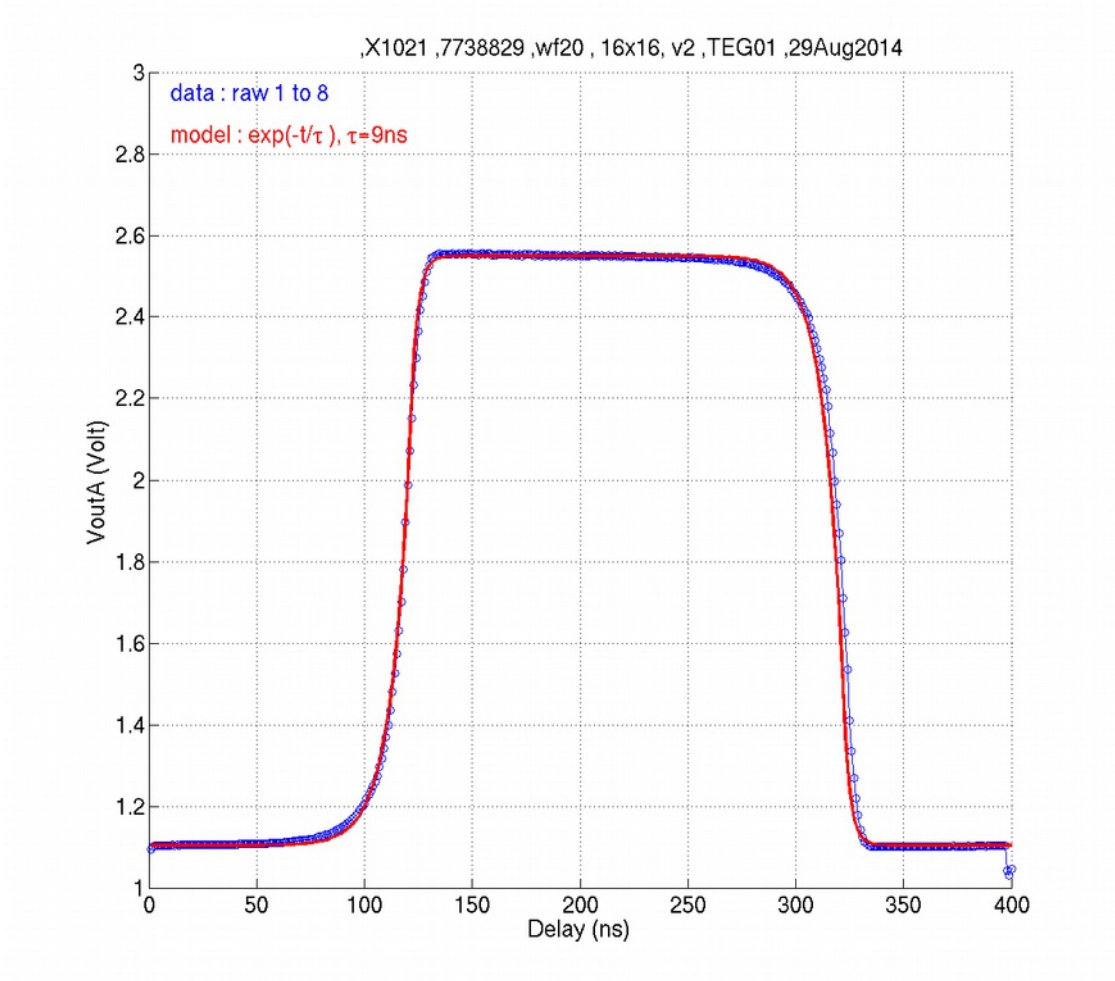
# epc600 Range Finder Camera





# ToF time resolution example

## Rise and fall time for step response on LED illumination



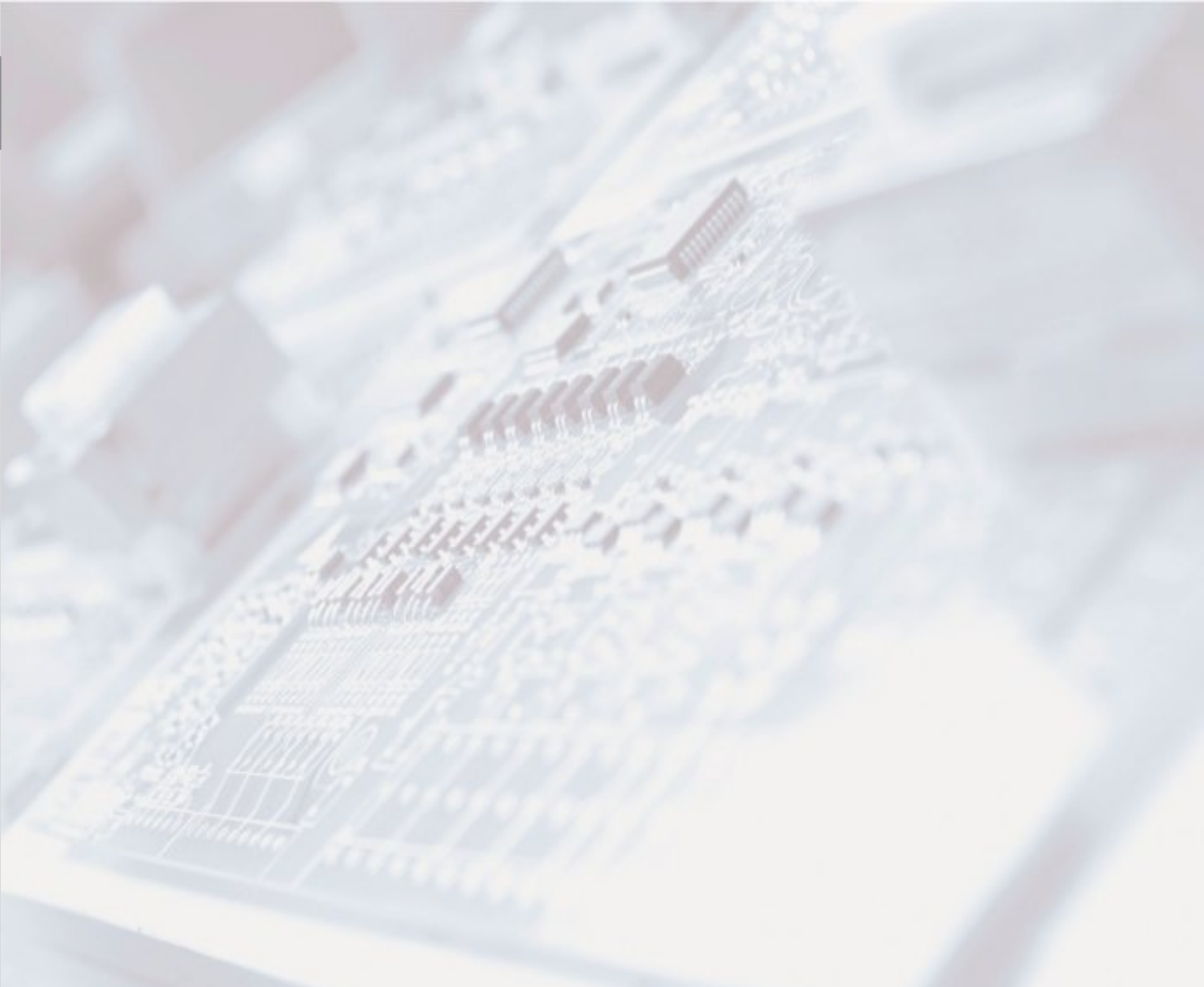
# Thank you for your attention

# Thank you

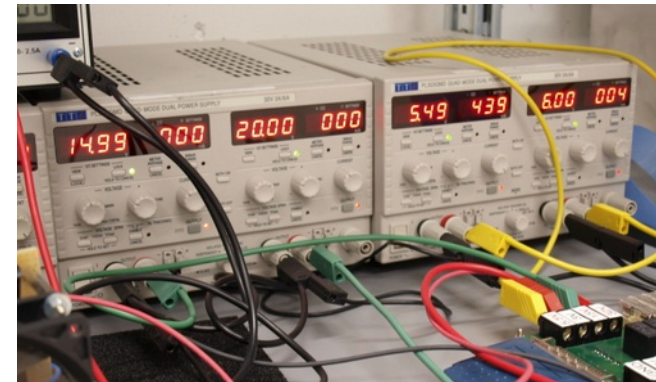
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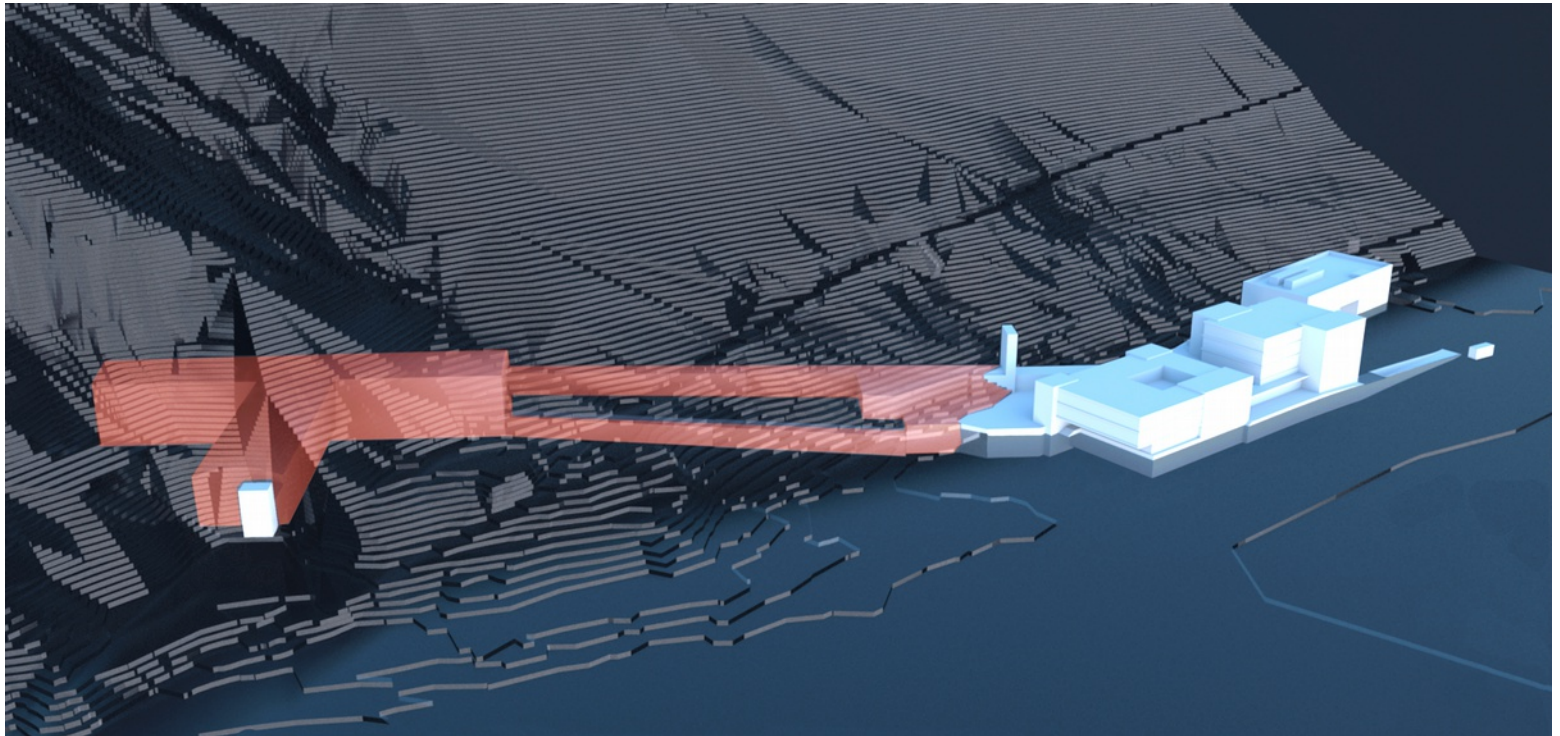
## Facilities: Quality Lab



- 80m<sup>2</sup> testing facilities
- All applicable codes and standards for Q-testing



## Facilities: The Mountain Fab



- 60'000m<sup>3</sup> built into solid rock for further expansion
- Completely isolated from vibrations
- Constant climate throughout the year