

# Flash LiDAR Detectors for Industry Automation and Traffic Monitoring

## CMOS Integrated Spad (CSPAD) Detectors Enabling Smart Direct Time-Of-Flight (dToF) LiDAR Sensors

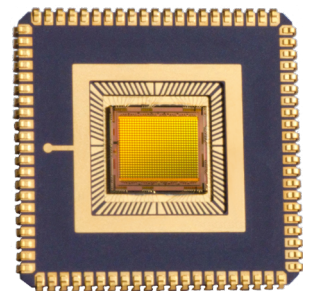
We unite highly sensitive and efficient SPAD sensors with advanced read-out electronics to achieve high timing resolution and efficient data processing on-chip. Are you looking for customized backside-illuminated (BSI) solutions? We offer developments in external or internal provided technologies. An 8" in-house technology for 3D integration by direct wafer bonding is on hand for prototyping of BSI CSPAD detectors.

### Read-Out Modules

- Active Quenching Circuit (AQC)
- Adaptive coincidence
- High resolution Time-to-Digital-Converter (TDC)
- Time gating
- Photon timing and counting modules
- Multi-event detection
- High-speed data interface (e.g., LVDS)

### Future Perspectives

- R&D in advanced CMOS nodes
- Digital neuromorphic data processing
- Embedded data compression
- Novel applications (Quantum Imaging, Non-Line-of-sight NLOS, multispectral LiDAR, Photonic Integrated Circuits PICs)



SPAD sensor CSPAD3k in ceramic package

### Examples from CSPAD family

	CSPAD3k	CSPAD12k (under development)
<b>Technology</b>	0.35 $\mu\text{m}$ + 0.35 $\mu\text{m}$ CMOS, BSI	0.35 $\mu\text{m}$ + 0.18 $\mu\text{m}$ CMOS, BSI
<b>Resolution</b>	64 px x 48 px	112 px x 112 px
<b>PDP</b>	32 % (@ 450 nm) 4 % (@ 905 nm)	60 <sup>1</sup> % (@ 550 nm) 20 <sup>1</sup> % (@ 905 nm)
<b>Fill factor</b>	3.6 % / 25 % (MLA)	9.6 % / > 90 % (MLA)
<b>Additional Features</b>	TDC monitoring	TDC monitoring, flexible resolution (Region of Interest)

# Our Know-How Develops and Improves Your Individual LiDAR Detector

LiDAR detectors based on direct ToF measurement enable automation, traffic monitoring, distance measurement and much more in industry. By scanning the environment and measuring the ToF of the laser pulse, a 3D depth map is created.

A good example for the map's reliable support, is the safe navigation of cleaning

robots through the house and of industrial robots to identify human workers to avoid harmful interactions.

We are your competent development partner for dToF and Flash LiDAR detectors. Our experience in the complete value chain sets a high-quality standard on the way to implement them into your application.

With our expertise and know-how, we develop your application-specific LiDAR detector and new ROIC modules for, e.g., very precise distance measurements or integrated information processing with high resolution.

## We Offer You:

Our CSPAD approach enables highly integrated LiDAR sensors using optimized SPAD and CMOS technologies. This allows us to design and realize your full custom BSI LiDAR sensor.

### dTOF LiDAR Detectors

- Scalable 8" Technology for CMOS combined BSI LiDAR detectors (CSPAD)
  - High NIR and very high UV sensitivity
  - On-chip spherical microlens array (MLA)
  - Available array detectors from CSPAD family
- Custom design of LiDAR array detectors

### LiDAR ROIC Modules

- Specification, design concepts and simulations
- Mixed signal IC design
- ROIC and module verification
- FPGA prototyping for the digital designs
- Application support

## Contact

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