



# Infrared lasers for industrial LiDAR applications

## Selection guide and product portfolio

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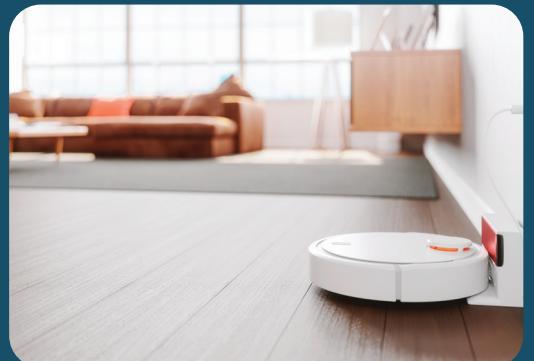
Sense the power of light

am u OSRAM

# Strongest LiDAR portfolio with Edge Emitting Laser (EEL) and Vertical Cavity Surface Emitting Laser (VCSEL)

LiDAR (Light Detection and Ranging) systems in industry applications enable industrial automation, traffic control, range finders and many more. Those systems are based on different measurement techniques such as structured light, direct and indirect time of flight (ToF). For direct time of flight a very short laser pulse is emitted, reflected by an object and detected. By scanning the environment and measuring the travel time of the laser pulse a 3D depth map is obtained. With the help of the created map e.g. cleaning robots can safely navigate throughout your apartment and industrial robots can identify human workers to prevent harmful interactions.

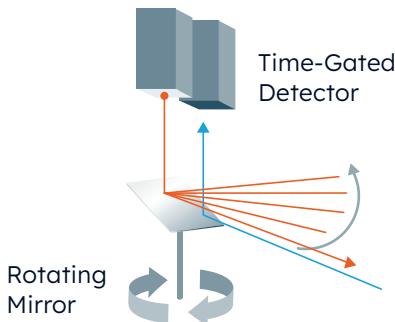
ams OSRAM offers the strongest LiDAR portfolio on the market with VCSELs and EELs. ams OSRAM's Nanostack technology offers the highest optical output power from a single edge emitting laser. The variety of EEL package designs (TO, Plastic, SMT) allows application flexibility and serves a great spectrum of different power classes. The existing VCSEL portfolio by ams OSRAM is offering various power levels and illumination patterns. Additionally ams OSRAM's new PowerBoost VCSEL Technology is delivering market leading optical power and efficiency, increased power densities as game changer for future LiDAR developments.



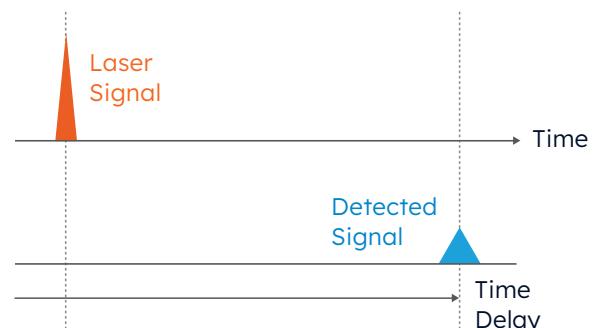
# Measurement techniques for LiDAR

## Direct Time of Flight (dToF)

- Infrared source generates an extremely narrow pulse with high power limited by eye safety standards
- A time-gated determines when the signal returns from the source to calculate object distance

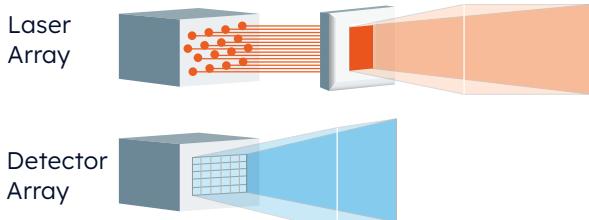


- Varying detectors are used (PIN, APD, SPAD) for many different technologies to scan an illuminated field
- Resolution is dependent on pulse width

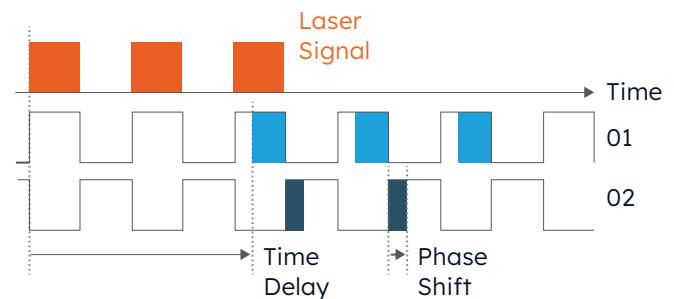


## Indirect Time of Flight (iTof)

- Illumination source is pulsed continuously with a 50% duty cycle (pulse train)
- Diffuser converts beam shape into uniform illumination over target

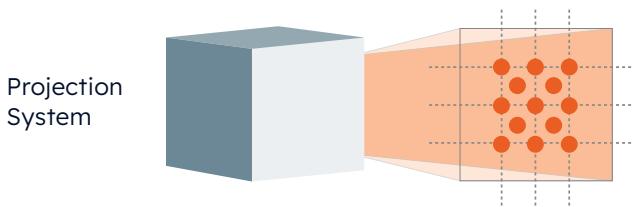


- Specialized detector array finds the temporal phase shift between two phase-locked detectors
- Detector measures both delay and shift in pulse train with resolutions smaller than the pulse width

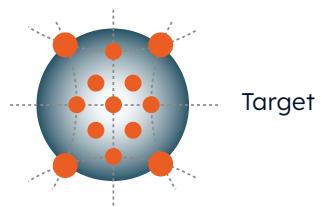


## Structured Light

- IR source projects a known illumination structure into the environment (dots, stripes, pattern)
- High resolution camera is coated with a high-resolution IR bandpass filter to only image dot structure

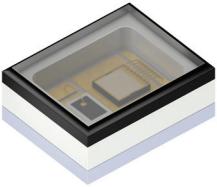


- Captured image triangulates object depth with high resolution with conventional imaging sensors (kHz)



# Selection guide: VCSEL or EEL

## LiDAR emitter comparison

	VCSEL	EEL
	Fast and Stable	Powerful Solutions
		
Power [ns Pulsed]	~ 120 W	~ 120 W
Emitting Area	Large Area	Point Source
Power Density	Mid	High
Beam quality	Symmetric / Low divergence *	Asymmetric / Medium divergence
Temperature shift	0.07 nm/K	0.25 nm/K
Spectral width	1-2 nm	3-8 nm
Switching time	Few ns	Few ns
Direction of emission	Top looker	Side looker

\* symmetric on chip level, asymmetric distribution possible on package level

### Edge Emitting Lasers (EELs)

- The Nanostack technology with three vertical emitters offers the highest optical output power
- Narrow rectangular design results in asymmetric beam profile requiring (corrective) optics

### Vertical Cavity Surface Emitting Lasers (VCSELs)

- Stable light with a short cavity height
- Multiple lasers (apertures) are built on a VCSEL chip to increase power
- Large quantity of apertures reduce speckle in IR illumination

# Selection guide: VCSEL or EEL

## "The right choice for your needs"

### Direct time of flight

Application Requirement	Laser Feature	VCSEL	EEL
Ability to project a high power density pulse for long range	High power density	✓	
High resolution in wide variety of environments	High speed	✓	✓
Optimized package design	Narrow spectrum	✓	✓
	Stable spectrum	✓	
	Low inductance	✓	✓
	High thermal conductivity	✓	

### Indirect time of flight

Application Requirement	Laser Feature	VCSEL	EEL
Ability to project a clean pulse train for scanning	High speed	✓	✓
High resolution in wide variety of environments	Pulse consistency	✓	
Compact, efficient solution for low power monitoring	Narrow spectrum	✓	✓
	Temperature stable	✓	
	High efficiency	✓	✓
	Monitoring diode	✓	

### Structured Light

Application Requirement	Laser Feature	VCSEL	EEL
Ability to build on a light pattern with the use of diffractive optical elements (DOE)	Narrow spectrum	✓	✓
Multiple point sources to improve resolution in a structured light pattern	Narrow beam	✓	✓
Optics can be integrated or closely placed to compact	Die layout customizable	✓	
	2D source layout	✓	
	Top emission	✓	
	Integrated optics	✓	

# LiDAR emitter product portfolio

## EEL Portfolio for industrial applications

### Nanostack pulsed laser diodes

Laser diodes in a variety of package designs (TO56, Plastic, SMT)									
Part No.	Wave-length	Emitter	Aperture	Output power	Forward current *	Operating voltage	Threshold current	Beam divergence	Operating range
	[nm]	#	[μm]	[W]	[A]	[V]	[A]	[FWHM]	[°C]
 SPL PL90AT03-25W	905	1	110	25	8	6	0.3	12° x 25°	-40 ... +85
 SPL PL90AT03-50W	905	1	110	50	16	6	0.3	12° x 25°	-40 ... +85
 SPL PL90AT03-75W	905	1	110	75	25	6	0.3	12° x 25°	-40 ... +85
 SPL TL90AT03 SPL UL90AT03	905	1	110	65	20	9.5	0.3	10° x 25°	-40 ... +85
 SPL TL90AT08 SPL UL90AT08	905	1	220	125	40	10.8	0.6	10° x 25°	-40 ... +85
 SPL S1L90H_3	905	1	110	65	20	9	0.3	10° x 25°	-40 ... +85
 SPL S1L90A_3 AEC Q102 Qualification	905	1	220	125	40	10.8	0.6	10° x 25°	-40 ... +105
 SPL S4L90A_3 AEC Q102 Qualification	915	4	220	500	160	10.8	1	11° x 25°	-40 ... +105

\* <100 ns width at 1 kHz rate>  
<12 ns width at 1 kHz rate>

### Edge Emitting Lasers (EELs)

#### Benefits

- Produce high power from a single spot due to the long cavity length
- Narrow rectangular design results in asymmetric beam profile requiring collimation
- Robust Package (TO)
- Very good cost & performance ratio and long history in serving the market with outstanding quality (plastic)
- Industry Grade qualification
- Easy to use within pick & place and reflow soldering processes (SMT)
- AM Grade qualification for SMT and Smart Lasers

#### Features

- Different package designs available (TO, Plastic, SMT)
- Serving a great variety of different power classes
- Well established wavelength of 905 nm
- Leading-edge in EEL chip (Nanostack Technology)
- Optimized for short pulsed ToF applications

#### Applications

- Home Automation
- Industrial Sensing
- Last Mile Delivery
- Laser Rangefinder
- Pulsed Laser LiDAR application

#### Characteristics

- Highest peak power and highest average power in the market
- High power within a small area
- High efficiency
- Low Cost in high volumes (plastic)
- Outstanding Rth and inductance optimized package (SMT)

## VCSEL Portfolio for Time-of-Flight / 3D Sensing

### High-Power Flood Illuminator VCSELs

#### BIDOS® P2433 Q

Part No.	Wave-length [nm]	FOI [°]	Eye Safety	Recommended max. Peak Power 100µs, 1% DC [W]	Operating Range [°C]
				[W]	[°C]
 V105Q121A-850	850	63 x 50	PD	3	-20-85
 V105Q121A-940	940	63 x 50	PD	3	-20-85
 V105Q131A-940	940	74 x 61	PD	3	-20-85
 V205Q121A-940	940	66 x 53	PD	6.5	-20-85
 V205Q131A-940	940	78 x 65	PD	6.5	-20-85

#### BIDOS® P4040 Q

 EGA2000 850-N	850	58 x 41	-	4.2	-40-105
 EGA2000 850-W	850	79 x 56	-	4.2	-40-105
 EGA2000 850-UW	850	104 x 84	-	4.2	-40-105
 EGA2000 940-N	940	58 x 41	-	3.7	-40-105
 EGA2000 940-W	940	79 x 56	-	3.7	-40-105
 EGA2000 940-UW	940	102 x 83	-	3.7	-40-105

### Low-Power 680 nm VCSEL with 3020 PLCC Package

Part No.	Wave-length [nm]	Emitter #	Optics [°]	Eye Safety	Recommended max. Peak Power 100µs, 1% DC [W]
 V100P000A-680	680	1	60 x 45	-	5.5

#### Vertical Cavity Surface Emitting Lasers (VCSELs)

##### Benefits

- Stable light with a short cavity height
- Multiple lasers (apertures) are build on a VCSEL chip to increase power
- Large quantity of apertures reduce speckle in IR illumination
- In addition to packaged VCSELs, bare die VCSELs are also available

##### Features

- Compact footprint with superior mechanical robustness and leading-edge VCSEL technology inside

##### Applications

- 3D Sensing for Mobile Devices and Industry
- Robotics and Automated Guided Vehicles
- Smart Access and Payment Authentication

##### Characteristics

- Optimal power density in compact package
- Integrated optics for delivering desired field of view (FoV), eliminating the need for secondary optics
- Versions with integrated photodiode to detect loss of diffusor and imperfect diffraction grading

# Infrared lasers for industrial LiDAR applications

- Leading performance for 3D sensing VCSELs
- Strongest LiDAR portfolio with VCSELs & EEL
- Variety of EEL package designs (TO, Plastics, SMT) allows application flexibility
- Leading peak power & efficiency performance for EEL & VCSEL
- Local support with global reach
- ams OSRAM advantage: EEL, VCSEL, IRED



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