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Infrared lasers for industrial LiDAR applications

Selection guide and product portfolio

Light is OSRAM

OSRAM
Opto Semiconductors

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

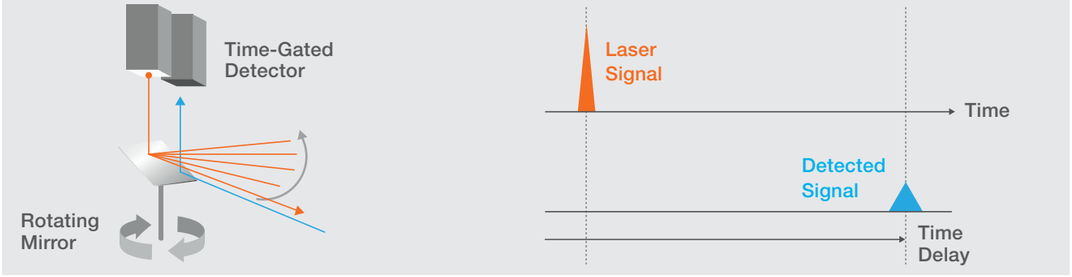
LiDAR (Light Detection and Ranging) systems in industry applications enable industrial automation, traffic control, range finders and many more. Those systems are based on different measurement techniques such as structured light, direct and indirect time of flight (ToF). For direct time of flight a 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 savely navigate throughout your apartment and indutrial robots can identify human workers to prevent harmful interactions.

OSRAM Opto Semiconductors offers the strongest LiDAR portfolio on the market with VCSELs and EELs. OSRAMs 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 OSRAM Opto Semiconductors is offering various power levels and illumination patterns. Additionally OSRAMs 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

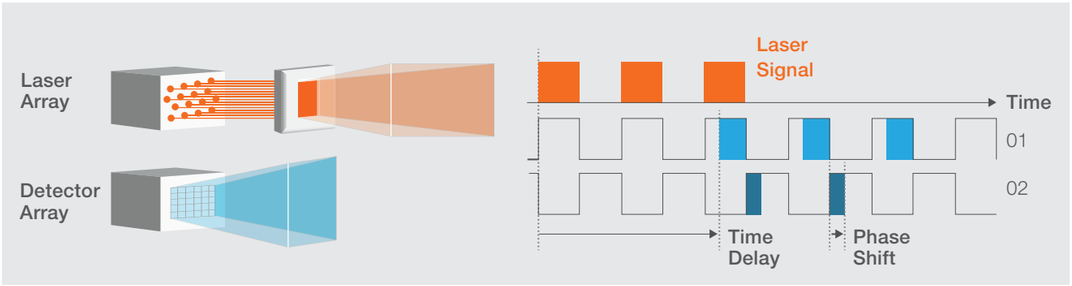
Direct Time of Flight (dToF)

- Infrared source generates an extremely narrow pulse with high power limited by eye safety standards
- A time-gated detector 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



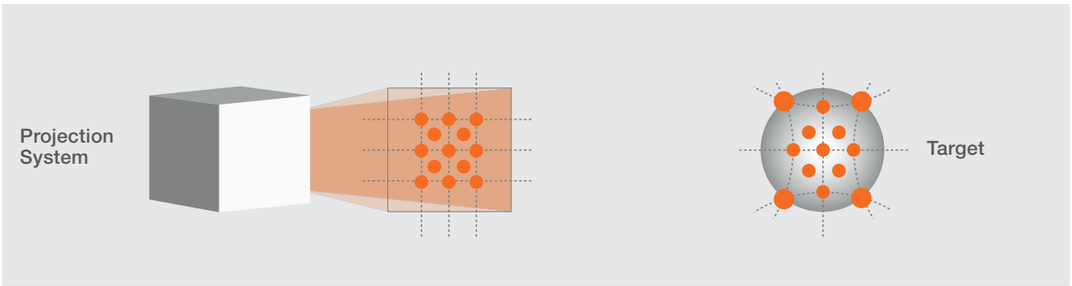
Indirect Time of Flight (iToF)

- 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

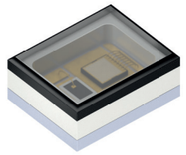
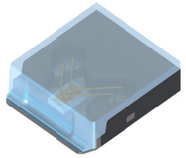


Structured Light

- IR source projects a known illumination structure into the environment (dots, stipes, 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 Fast and Stable	**EEL** 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 speed	✓	✓
High resolution in wide variety of environments	Narrow spectrum	✓	✓
	Stable spectrum	✓	
Optimized package design	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	✓	✓
	Pulse consistency	✓	
High resolution in wide variety of environments	Narrow spectrum	✓	✓
	Temperature stable	✓	
Compact, efficient solution for low power monitoring	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	✓	✓
	Narrow beam	✓	✓
Multiple point sources to improve resolution in a structured light pattern	Die layout customizable	✓	
	2D source layout	✓	
Optics can be integrated or closely placed to compact	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.	Stack	Wave-length	Emitter	Aperture	Output power	Forward current*	Operating voltage	Threshold current	Beam diver-gence	Operating range
	#	[nm]	#	[µm]	[W]	[A]	[V]	[A]	[FWHM]	[°C]
SPL PL90	1	905	1	200	25	30	4.3	0.75	9° x 25°	-40…+85
SPL PL90_3E	3	905	1	200	50	20	9	0.75	9° x 25°	-40…+85
SPL PL90_3	3	905	1	200	75	30	9	0.75	9° x 25°	-40…+85
SPL LL90_3	3	905	3	200	70	–	20	–	15° x 30°	-40…+85
SPL TL 90AT08 SPL UL 90AT08	3	905	1	220	125	40	10.8	0.6	10° x 25°	-40…+85
SPL S1L90A_3 SPL S4L90A_3	3	905	1 or 4	220	125	40	10.8	0.6	10° 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
BIDOS® P 2835 C

High-Power VCSEL with 2835 ceramic packaging

Part No.	Wave-length	Emitter	Optics	Eye Safety	Recommended max. Peak Power CW, 100% DC	Recommended max. Peak Power 100µs, 1% DC	Recommended max. Peak Power 5ns, 0.1% DC
	[nm]	#	[°]		[W]	[W]	[W]
V102C021A-850	850	281	60 x 45	–	1.5	5.5	32
V102C121A-850	850	281	60 x 45	MPD	1.5	5.5	32
V00100	850	281	72 x 58	–	1.5	5.5	32
V107C021A-850	850	770	60 x 45	–	3.5	10	52
V00129	850	770	72 x 58	–	3.5	10	52
V107C000A-850	850	770	None	–	3.5	12	62
V102C021A-940	940	281	60 x 45	–	1.5	5.5	32
V102C121A-940	940	281	60 x 45	MPD	1.5	5.5	32
V00065	940	550	60 x 45	–	2.5	7	44
V105C121A-940	940	550	60 x 45	MPD	2.5	7	44
V105C131A-940	940	550	72 x 58	MPD	2.5	7	44
V105C141A-940	940	550	110 x 80	MPD	2.5	7	44
V00075	940	770	60 x 45	–	3.5	10	52
V00130	940	770	72 x 58	–	3.5	10	52

Low-Power VCSEL with 3020 PLCC packaging by VIXAR®

V00002	680	1	None	–	0.007	0.015	–
V00013			None	–	0.0015	0.003	–
V00147	850	3	None	–	0.070	0.150	0.330

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

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

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