OSRAM OS Infrared in AR/VR

September 2019 | Sunnyvale | Ann Russell

OSRAM
Opto Semiconductors

OSRAM – Technology Leader in optical AR / VR / MR applications

3D sensing

- Multimode laser for TOF illumination
- Single mode laser for structured light and gesture sensing
- VCSEL for TOF illumination
- IR illumination for stereoscopic camera based 3D sensing

Display technologies

- High power projection LED
- Green / blue LASER TO can package
- RGB LASER SMT package
- Photodiodes for power monitoring

Eye tracking

- Miniature IR LEDs for camera based eye tracking
- Optical sensors for laser scan based eye tracking

Position Tracking

- Single mode laser scanning systems
- Optical sensors for laser scanning tracking
- IR LED for camera based position tracking
- IR LED illumination (passive controller tracking)

OSRAM products enable key functionalities in AR/VR

IR LEDs
IR illumination
IR LASER / VCSEL
TOF –
structured light

IR LEDs
IR illumination for camera based systems
Optical sensors
Sensors for MEMs based systems

3D sensing

Display

Eye Tracking

Position Tracking

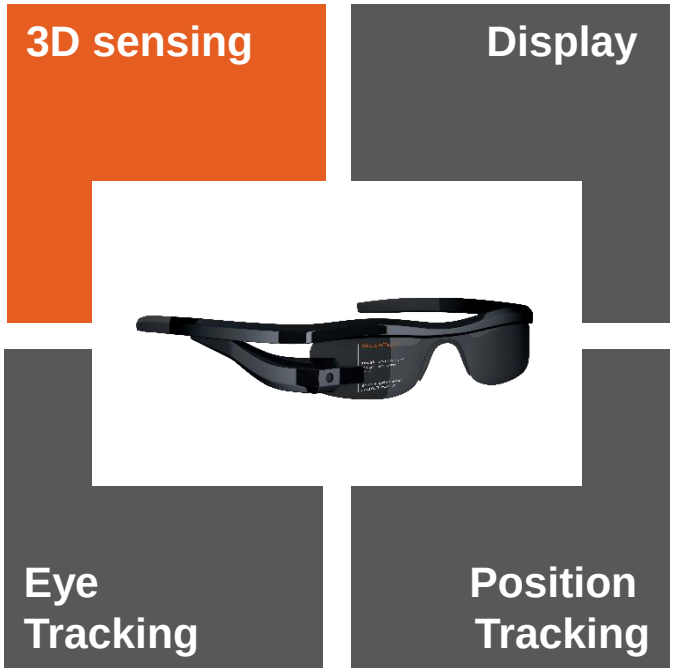
Visible Lasers
Near-to-eye projection for AR glasses
Photo diodes
Near-to-eye projection for AR glasses

Optical sensors
Precise position tracking
IR LEDs
IR illumination

OSRAM products enable key functionalities in AR/VR

IR LEDs
IR illumination
IR LASER / VCSEL
TOF –
structured light

IR LEDs
IR illumination for camera based systems
Optical sensors
Sensors for MEMs based systems



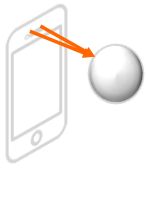
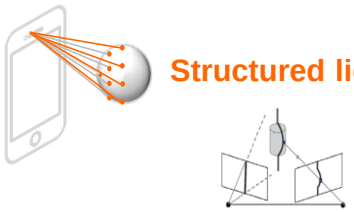
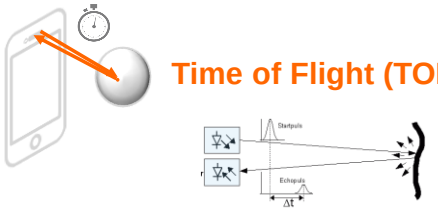
Visible Lasers
Near-to-eye projection for AR glasses
Photo diodes
Near-to-eye projection for AR glasses

Optical sensors
Precise position tracking
IR LEDs
IR illumination

OSRAM
Opto Semiconductors

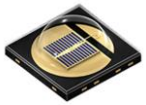
Different sensing principles available to assess the environment

Comparison*

	Stereo Vision	Structured light	Time of Flight (TOF)
	 Depth through disparity measurement**)	 Analyzing distortion of known pattern	 Measuring time between emis./detection
Size	- (increases with range)	- (increases with range)	++
Cost	++	-	+
Software complexity	-	+	++
Sunlight robustness	++	-	+
Depth accuracy	-	++	+
Power consumption	++	Increase with range	Increase with range
Range	-	Scalable	Scalable
Low-Light Performance	-	++	++

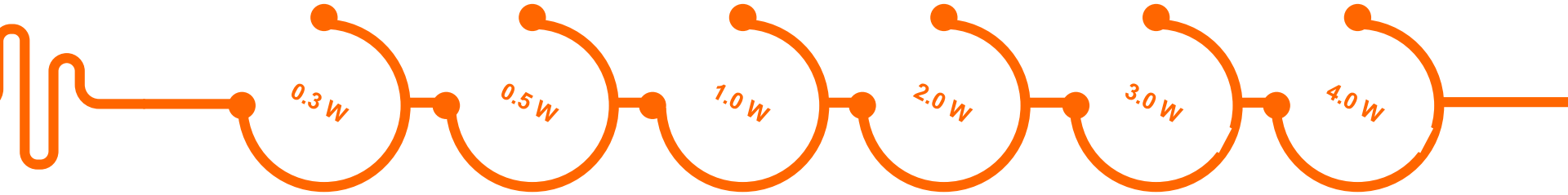
*) based on TI SLOA190B and OSRAM assessment
**) camera based, optional with IR illumination possible

VCSELs possess advantages over both conventional LEDs and edge-emitting lasers

	 **IRED** Well known and cost optimized	 **VCSEL** Scalable, flexible and compact	 **EEL (FP)** Powerful and well known
Optical Power	Up to 4.5 W	0.1 W up to 10 W	Up to 600 W (4 channel)
Beam quality	Poor (Lambertian)	Best round low divergence	Medium Asymmetric
Wavelength	810 nm, 850 nm, 940nm	850 nm, 940 nm	850 nm, 905 nm, 940 nm (in future)
Temperature stability	0.25 nm/K	0.07 nm/K	0.25 nm/K
Spectral width	20-30 nm	3 nm	1-2 nm
Speckle	Low	Low in an array	High
Switching time	Low speed	High speed	High speed
Packaging	Simple	Medium	Complex
Cost	Best	Good	Medium

Outstanding chip portfolio in 940 nm
Different options for your design providing you maximum flexibility

Fact sheet for multi-mode VCSEL power arrays

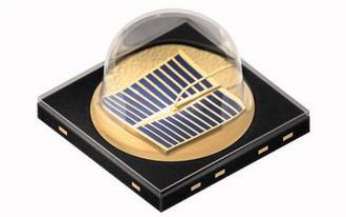
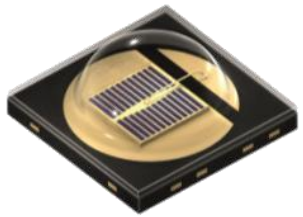


	940 nm	940 nm	940 nm	940 nm	940 nm	940 nm
Apertures	100	150	225	281	538	770
Current	450 mA	700 mA	1500 mA	2600 mA	3500 mA	5300 mA
I_{th}	110 mA	125 mA	200 mA	250 mA	400 mA	650 mA
Efficiency	40 %	40 %	40 %	38 %	45%	38 %
Chip size	0.52 x 0.52 x 0.1 mm	0.62 x 0.62 x 0.15 mm	0.72 x 0.72 x 0.1 mm	0.87 x 0.87 x 0.15 mm	1.00 x 0.90 x 0.1 mm	1.26 x 1.26 x 0.1 mm
Status	available	available	available	available	samples available MP CQ2 2019	available
VX PN	K0-0940M-0000-00009	K0-0940M-0000-00012	K0-0940M-0000-00010	K0-0940M-0000-00011	on request	K0-0940M-0000-00018

*) Recommended operating condition 100us pulse width, 1% duty cycle, T = 25°C, pulse train of 5
All values are typical values

Vixar OSRAM Opto Semiconductors

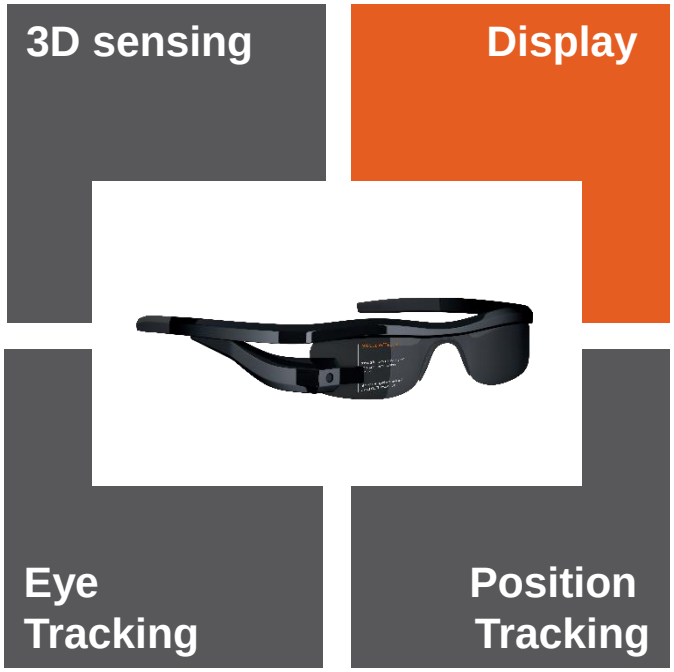
IR High Power Illumination for stereoscopic camera

SFH 47xx	SFH 47xxS	SFH 47xx
		
OSLON Black 90°	**IR SYNIOS P2720**	**OSLON Black 150°**
▪ OSRAM IR double stack ThinFilm chip technology ▪ 90°emission pattern	▪ OSRAM IR double stack ThinFilm chip technology ▪ 120°lambertian emitter	▪ OSRAM IR double stack ThinFilm chip technology ▪ High power output at superior homogeneity accross typical FOV
▪ **850nm / 940nm** ▪ **5 different power levels available – 0.5W – 2W optical output**	▪ **850nm / 940nm** ▪ **Up to 3A peak pulse current** ▪ **Small footprint 2.0 x 2.7mm² (<40% compared to OSLON)**	▪ **850nm / 940nm** ▪ **4 different power levels available – 0.5W – 2W optical output**

OSRAM products enable key functionalities in AR/VR

IR LEDs
IR illumination
IR LASER / VCSEL
TOF –
structured light

IR LEDs
IR illumination for camera based systems
Optical sensors
Sensors for MEMs based systems



Visible Lasers
Near-to-eye projection for AR glasses
Photo diodes
Near-to-eye projection for AR glasses

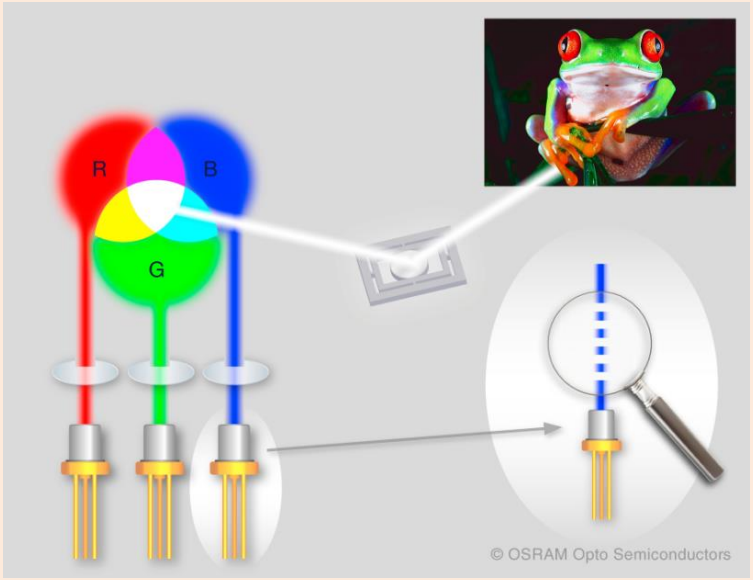
Optical sensors
Precise position tracking
IR LEDs
IR illumination

OSRAM
Opto Semiconductors

Scanning Beam Technology

Scanning beam projectors (laser diodes with MEMS mirror) enables small form factors, high contrast and brilliant color.

Scanning Beam Projection-



-Technology

High speed modulated **lasers** with **MEMS scanner:**

- Image is built sequentially pixel by pixel
- Colors are generated by mixing of intensity modulated RGB-beams
- Lasers are intensity modulated at pixel frequency to achieve “grey level”

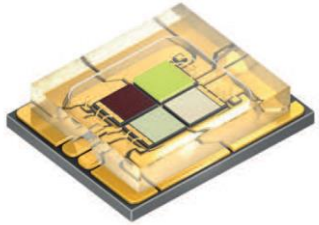
Benefits:

- ✓ High contrast
- ✓ Brilliant colors (200% NTSC)
- ✓ High efficiency, low power consumption
- ✓ Extremely small form factor (h < 6mm)
- ✓ Image always remains in focus

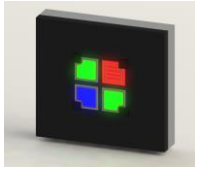
OSRAM
Opto Semiconductors

OSRAM illumination alternatives

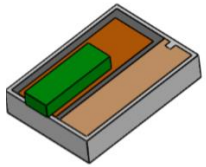
- Conventional LEDs:
  - Image generated by LCOS
  - Large size result in low coupling efficiency
  - Low technological barrier therefore substantial competition



- Pico LEDs:
  - Image generated by LCOS
  - Small size therefore 4X more efficient
  - Early development gave head start over competition
  - Medium technical barrier therefore competition expected
  - **Applicable to existing products**



- Lasers:
  - Image generated by MEMs or LCOS
  - Very high coupling efficiency will extract best performance of waveguides
  - Substantial technological head-start over competition
  - **Value proposition to AR strongly dependent on efficiency of packaging**



Blue & Green Single Mode Laser Diodes for Pico Projection/ HuD/ AR

Scanning beam projectors (laser diodes with MEMS mirror) enables small form factors, high contrast and brilliant color.

→ OS offers blue and green laser diodes with unique performance

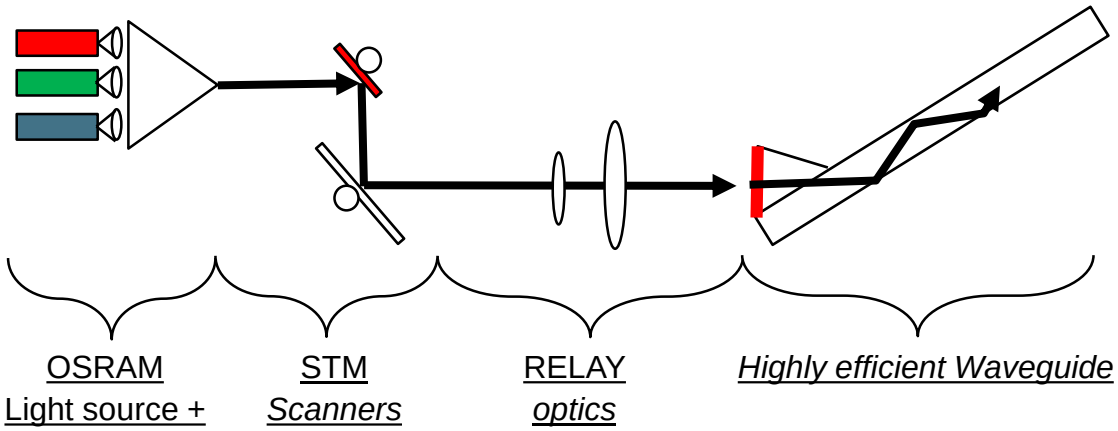
Features – Blue & Green Laser

- Transversal **single mode laser**
- Superior beam quality
- **High temperature stability**
- Different power classes available from **10mW to 100mW**
- Wavelength ranges from 440 – 460 nm and λ = **515 - 530 nm**
- **TO38icut** and **TO56** packages **available**
- **Future: RGB Package!**

TO38icut package

TO56 package

AR building blocks: Lasers-waveguide synergy



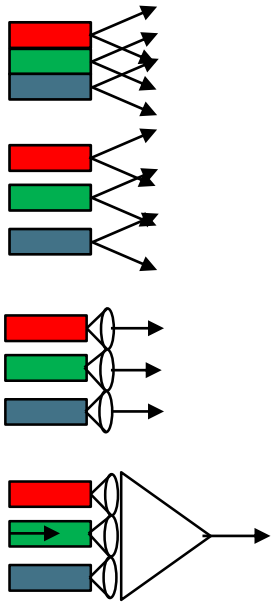
Illumination as *enabling* technology

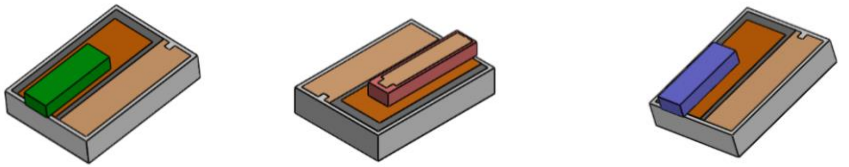
1. Coupling into waveguide dictates the optical requirements of the optical engine
2. Scanning mirrors are enable fulfilling these requirements (100 mm degrees ex.)
3. **OSRAM light source can elevate this technology** thereby utilizing waveguide potential:
   I. Large image field
   II. High brightness

Laser Packaging configurations: small size with high beam quality

CONFIDENTIAL

- Close-placement: small but diverging
- Separated-placement: large and diverging
- Separated-placement and micro-lens: large and narrow
- Separated-placement, micro-lens and combiner: narrow and small





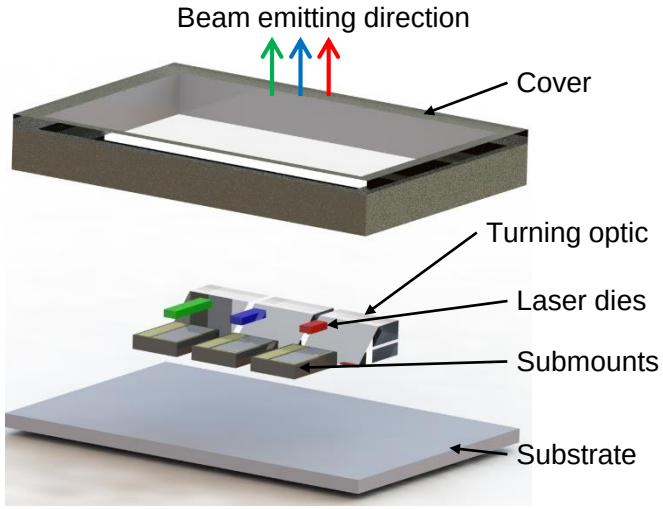
Optimize COSA riser for best footprint

Bonding

Beam location

OSRAM
Opto Semiconductors

OS has strong USP for pico/mobile projection and augmented/mixed reality



Laser chip technology	Unique laser portfolio ranging from blue & green to IR Edge Emitting Lasers / red VCSELs and in-depth production know-how
Optical capabilities	Strong in-house capabilities for design and simulation and partners for manufacturing
Module assembly	Extensive internal package design and manufacturing know-how as well as broad network of external partners

Optical sensor technology concept

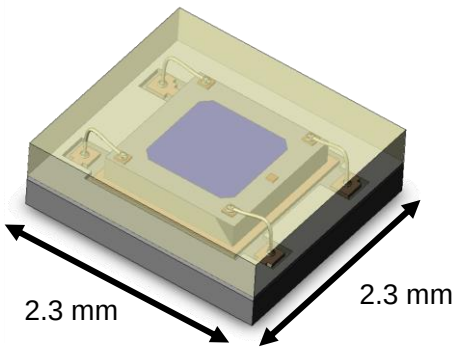
Application

- LASER beam power monitoring
- Eye safety feedback monitoring

Technology concept

Features

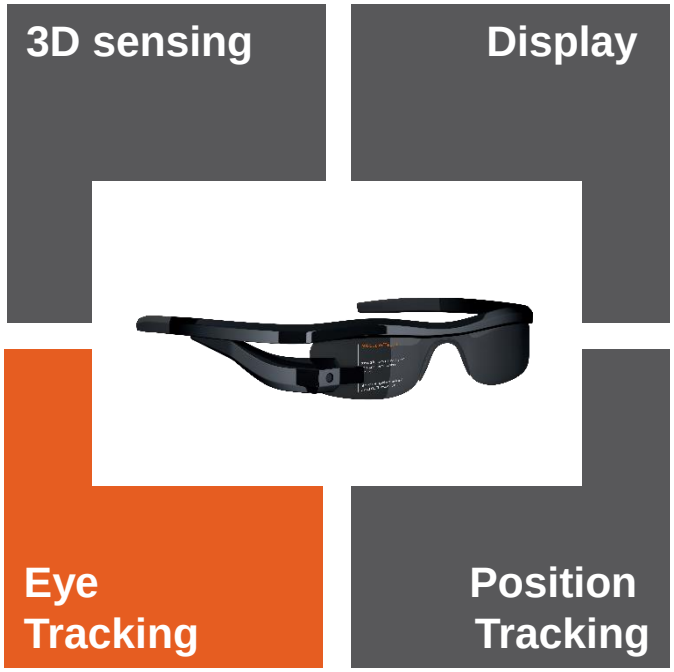
- Integrated photodiode and signal conditioning in one package
- Three / Four pins: GND, VDD, OUTL (low gain output) and optionally OUTH (high gain output)
- Analog output
- Large bandwidth (100 Hz to 70 MHz)
- Sensitivity enhanced at 940nm



OSRAM products enable key functionalities in AR/VR

IR LEDs
IR illumination
IR LASER / VCSEL
TOF –
structured light

IR LEDs
IR illumination for camera based systems
Optical sensors
Sensors for MEMs based systems

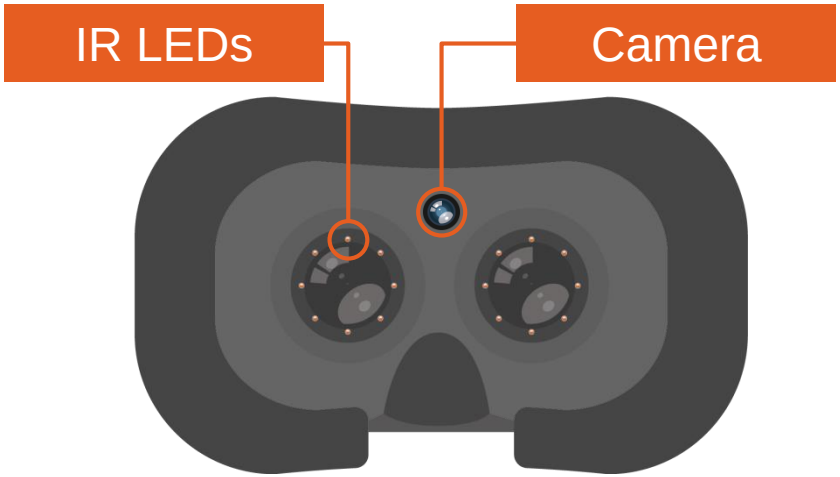


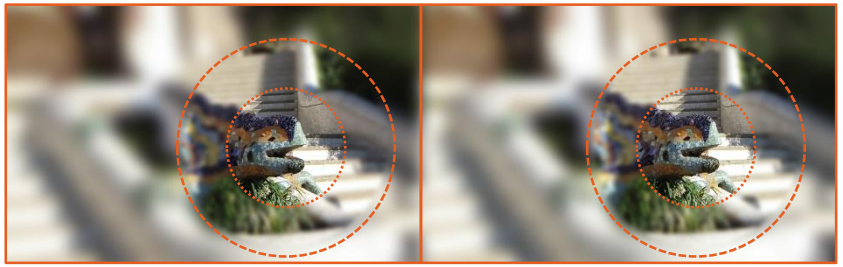
Visible Lasers
Near-to-eye projection for AR glasses
Photo diodes
Near-to-eye projection for AR glasses

Optical sensors
Precise position tracking
IR LEDs
IR illumination

OSRAM
Opto Semiconductors

Gaze Tracking for e.g. Foveated Rendering
Camera based





Resolution

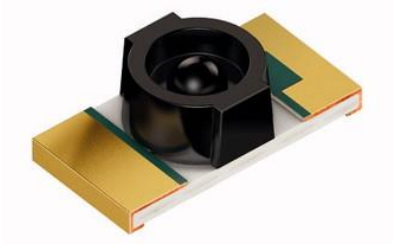
High Medium Low

Foveated rendering is one of the most important use cases for Eye Tracking technology in VR.

Foveated rendering works by only rendering the specific part of the screen where the user is currently looking. This will lower GPU load and power consumption significantly, allowing manufacturers to increase screen resolutions and refresh rates.

IR Miniature Packages for Gaze Tracking

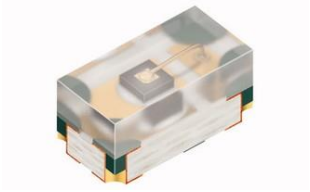
SFH 4056



CHIPLED 1206

- OSRAM IR ThinFilm chip technology
- Narrow beam for engery efficient operation
- High center intensity
- Low height burried lens design
- Reverse mountable

SFH 4053



CHIPLED 0402

- OSRAM IR ThinFilm chip technology
- High power output
- Tiny footprint for most compact product design
- Low height package design
- Low forward voltage

SFH 4060

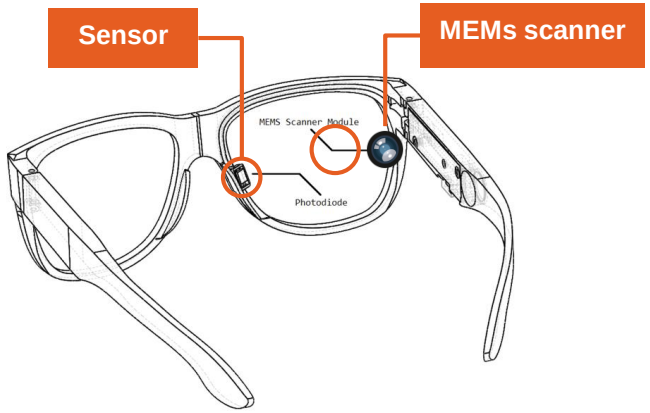
IR FIREFLY

- OSRAM IR ThinFilm chip technology
- High power output
- Smallest IR side-emitter for flexible product design
- Ultra low height package design
- Low forward voltage

Integrated Light Sensor – SFH575X
Proposed features and specs (In Definition)

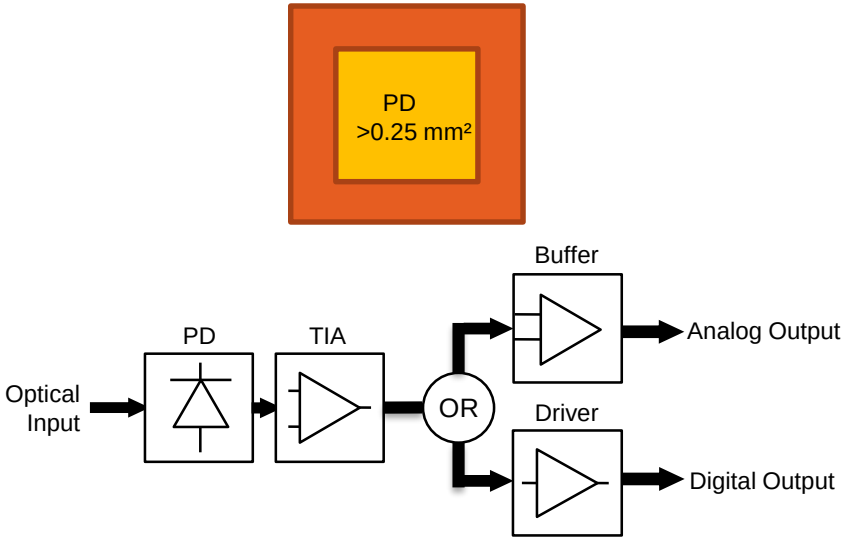
Features:

- The fast monolithic sensor converts modulated IR light pulses
- Analog Output or Digital Output
- Low power consumption < 1.5mA @ 3V
- High bandwidth TIA up to ~ 50MHz
- Small size and height
- Device configurable mode
- Simple 4 pins: Vdd, Gnd, Standby, Output



Applications:

- Positional and eyes tracking
- Gesture recognition
- Laser monitoring for display
- Free-space optical communication receiver



OSRAM
Opto Semiconductors

Thanks.