



# IR LEDs or VCSEL – When and where to use them



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# Overview



- **Introduction**
  - VCSEL & IR LED technology
  
- **Application**
  - Basic application guidelines
  
- **Detailed application overview**
  - Biometrics
  - Sensing
  - Detection
  
- **Portfolio overview**
  
- **Q&A session**





# Technology Introduction

# VCSEL and LED



## IR LEDs

### ▪ Light Emitting Diode

- Spontaneous emission
- Output – around 1 W
  
- Emission wavelength 850 and 940nm
- Spectral width – 40-50nm
  
- Switching - ~10ns
  
- Beam divergence – high / lambertian – 120°

## VCSEL

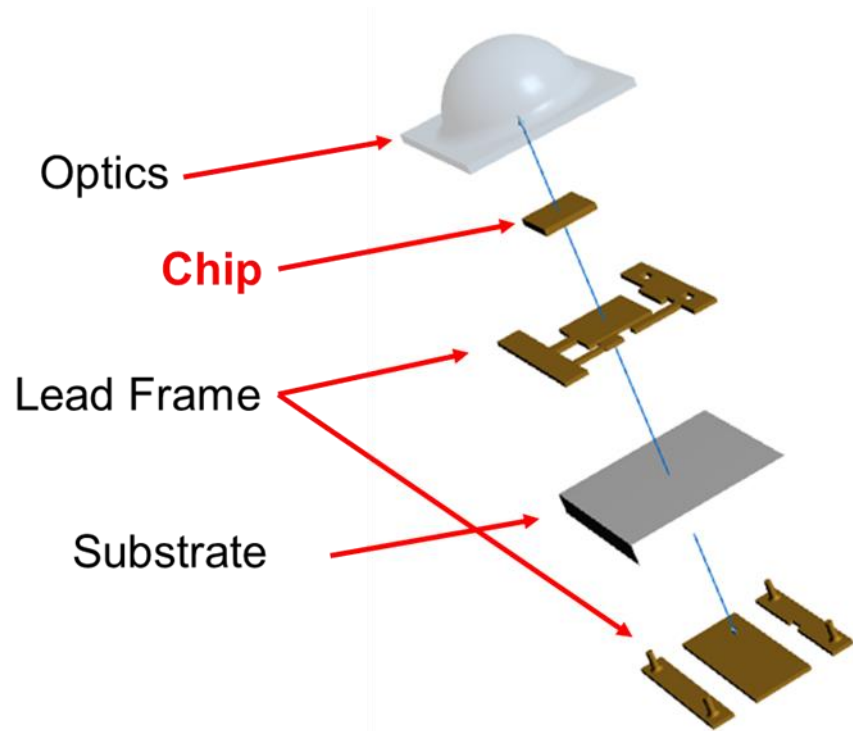
### ▪ Vertical Cavity Surface Emitting Laser

- Stimulated emission
- Output – up to few W
  
- Emission wavelength 850 and 940 nm
- Spectral width – 2-5nm
  
- Switching ~1ns
  
- Beam divergence – low – 20°  
(homogeneous wide beam)

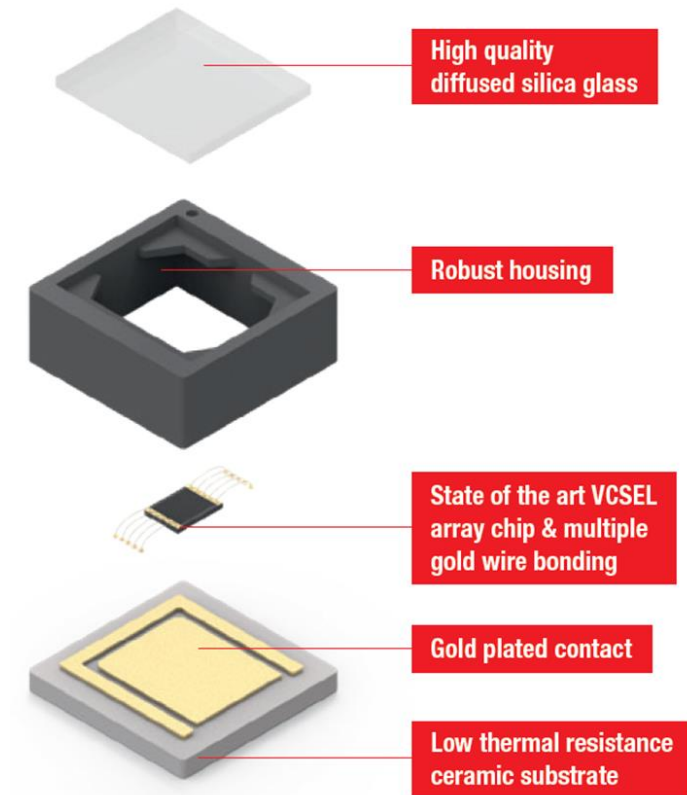
# VCSEL and LED



## IR LEDs Structure Design



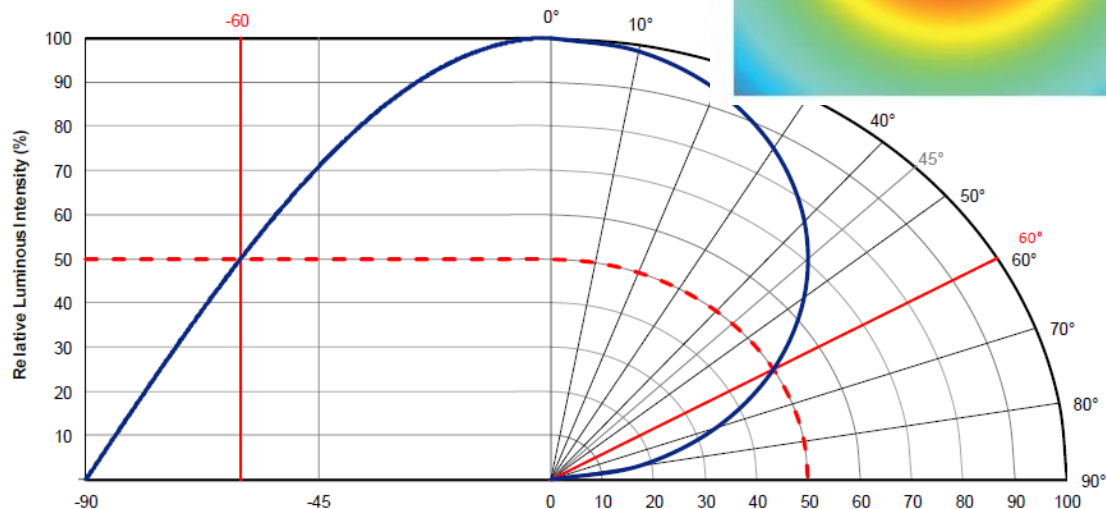
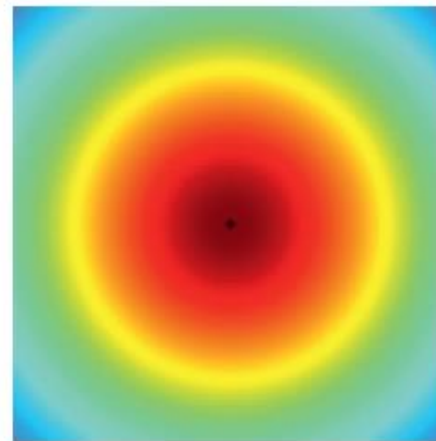
## VCSEL Structure Design



# VCSEL and LED

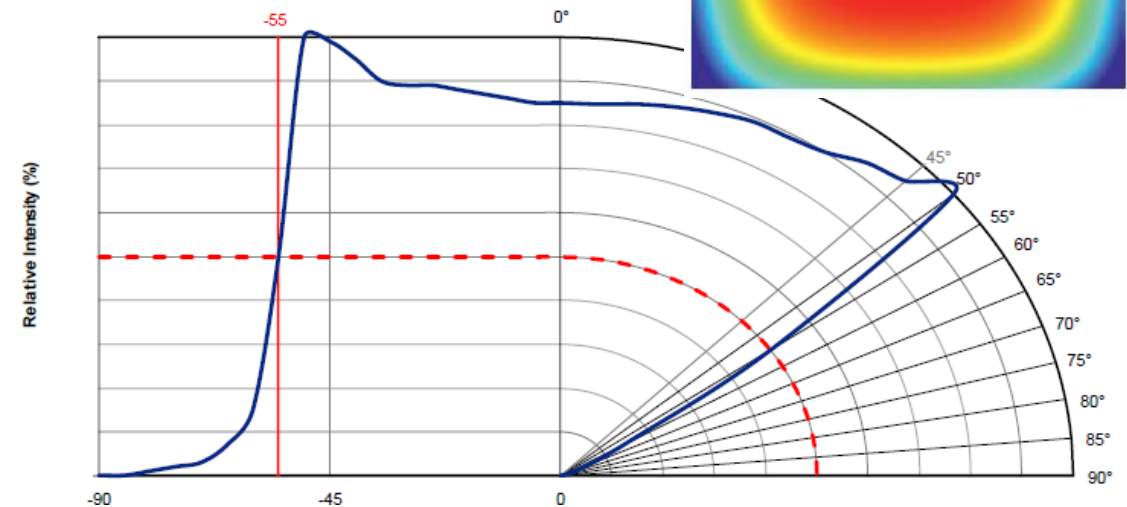
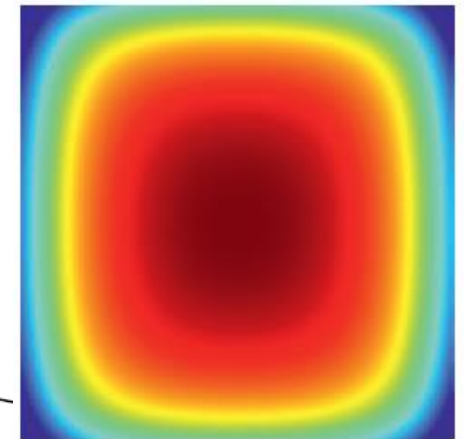
## IR LEDs Emission pattern

- Lambertian emission
- Point source and decrease flanks



## VCSEL Emission Pattern

- Diffuser for homogenous light distribution



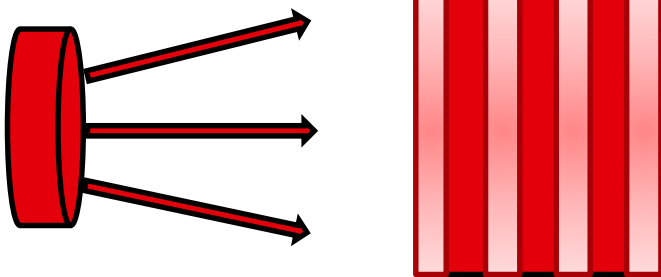


# Application details

# 3D sensing

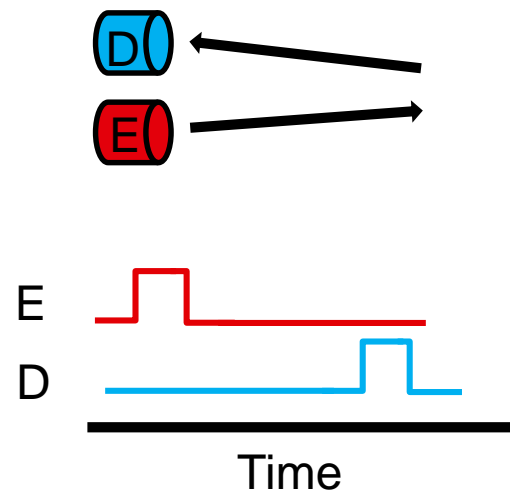
## Structure Light

- Complex emitter systems
- Pattern light design
- Camera detection and complex picture estimation



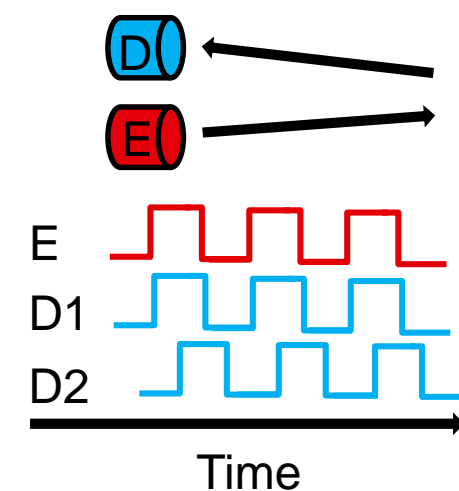
## Direct Time of Flight

- Direct Time of Flight
- Single pulse emission
- Time delay detection



## Indirect Time of Flight

- Indirect Time of Flight
- Pulse train emission
- Measurement of phase shift

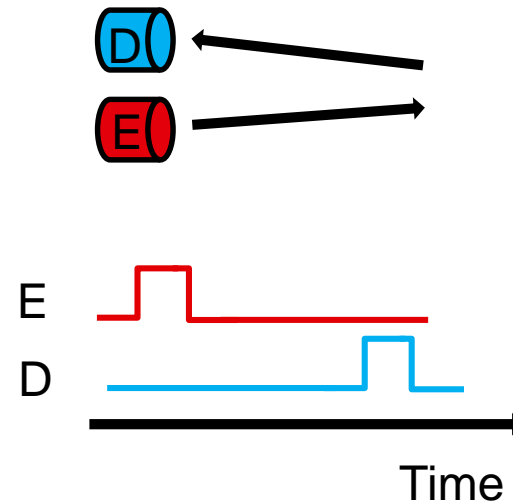




# Time of Flight

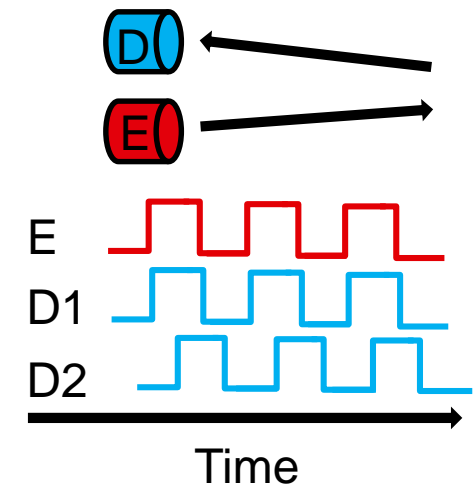
## Direct Time Of Flight

- Short pulse output as sender
- Very fast detector
- Fast acquisition
- Good precision – distinguish different reflections
- Great range
- Reduced pixel detection
- Large data volume



## Indirect Time of Flight

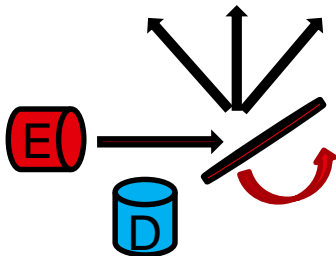
- Send pulse trains from emitter
- Depth calculation from multiple pixel counts
- Long integration time
- Small data volume
- Fine pixel resolution
- Bigger ambiguity –
  - shadows and reflections
- Lower detection range



# Time of Flight

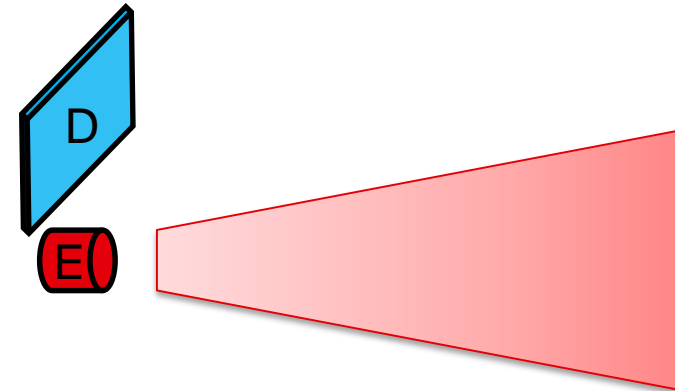
## Scanning LiDAR

- Single ray output
- Scanning MEMS mirror
- Single detector
  
- Wide range of detection
- Simple and precise solution
  
- Mostly applicable with dToF



## Flash LiDAR

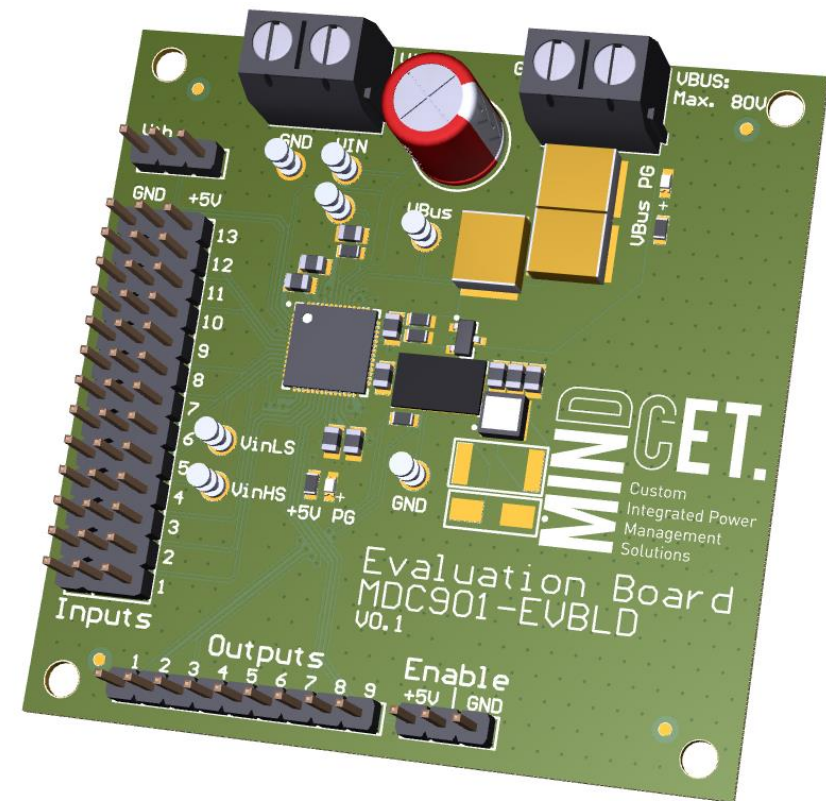
- Illumination of the whole scanned area
- Image sensor with multiple pixels
- No moving part – detection of whole scene
  
- Simple construction
- Range is lower than Scanning LiDAR
  
- Mostly used for iToF



# LDD driver development

## Design of LDD driver

- Ongoing development
- GaN driver – MindCET MDC901
- WL-VCEL – Würth Elektronik VCSEL package
- Driver for short pulse generation
  - Train pulses
  - Single pulses
- Reference design for ToF and LiDAR applications



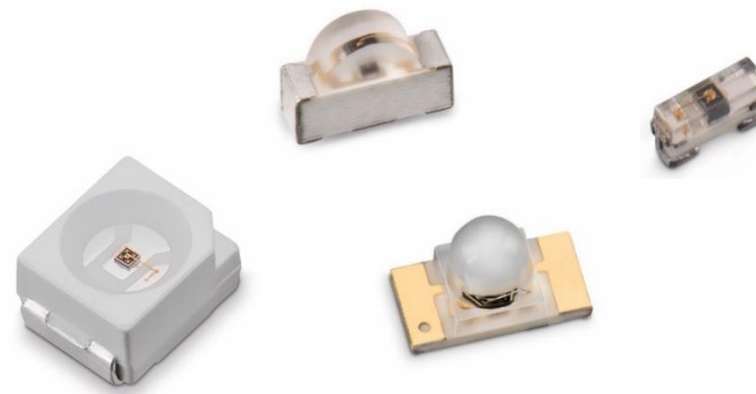


# Examples from the field

# Biometrics



- Health monitoring systems
- Pulse measurement
- Oximetry
- Wearable devices



# Recognition



- **Biometrical recognition**
- **Face recognition solutions**
  - Iris scanning
  - 2D Face recognition
  - 3D Face recognition
- **Hand recognition solutions**
  - Fingerprint scanning
  - Veins pattern scanning

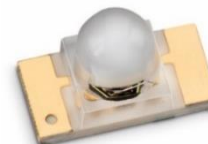




# Detection



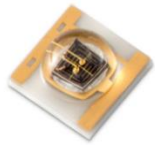
- **Smoke detectors**
- **Remote controls**
- **Automatic dispensers**



# Further applications



- Smart home applications
- Security and night camera observation



- Presence and sunlight sensors

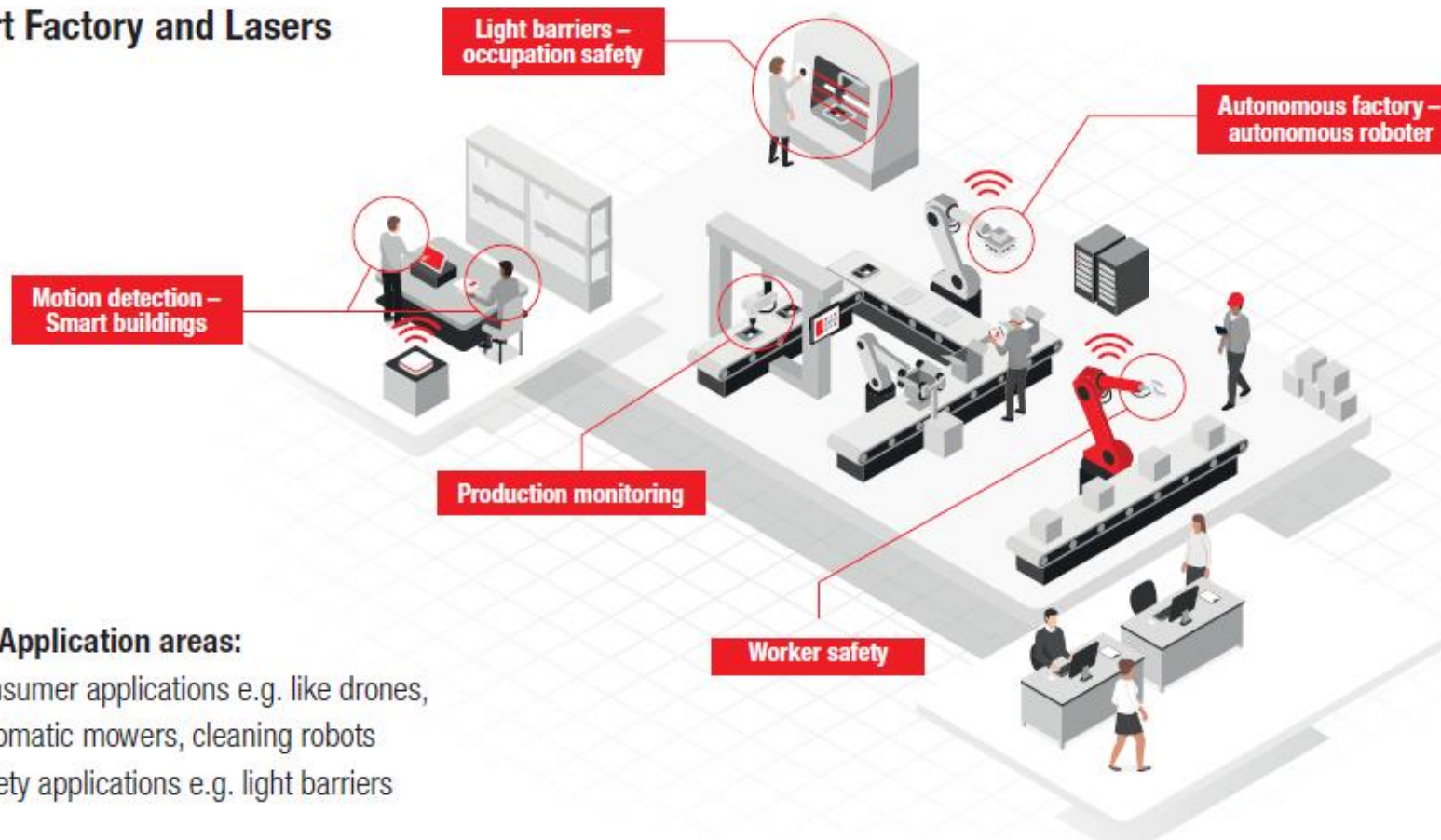




# VCSEL Applications



## Smart Factory and Lasers



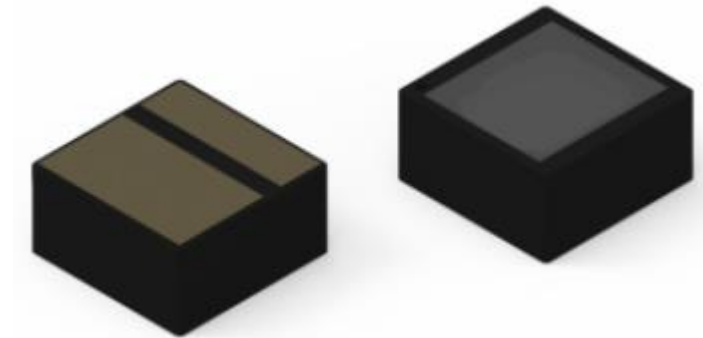


# Product Portfolio

# Laser – Portfolio (WL-VCSL)

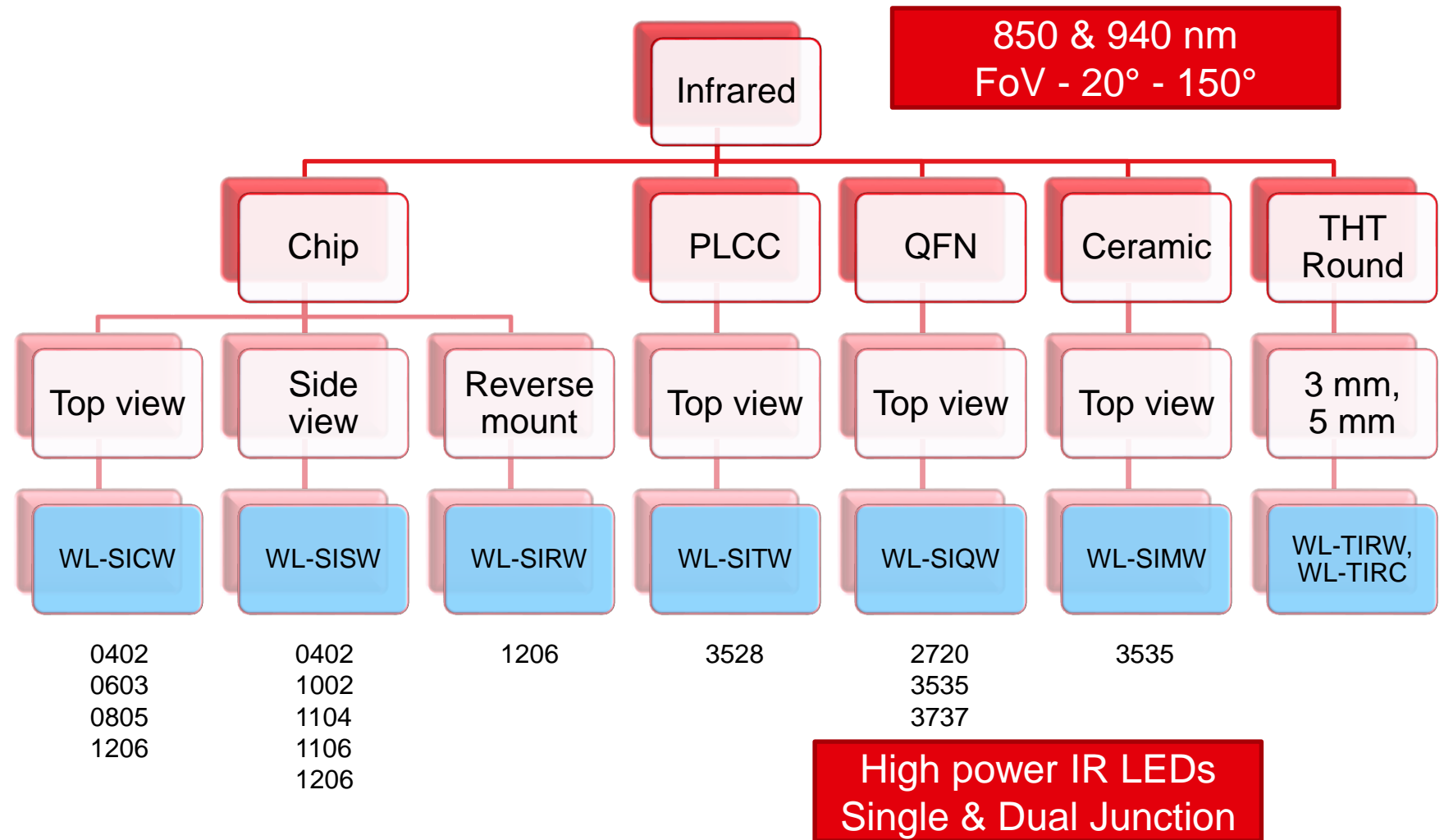


- Vertical Cavity Surface Emitting Laser (VCSEL)
- Size: 3535
- Wavelength: 940 nm
- Power dissipation: 6,6 W
- Radiant flux: 2 W
- Viewing angle:  $60^\circ \times 45^\circ$ ,  $110^\circ \times 85^\circ$

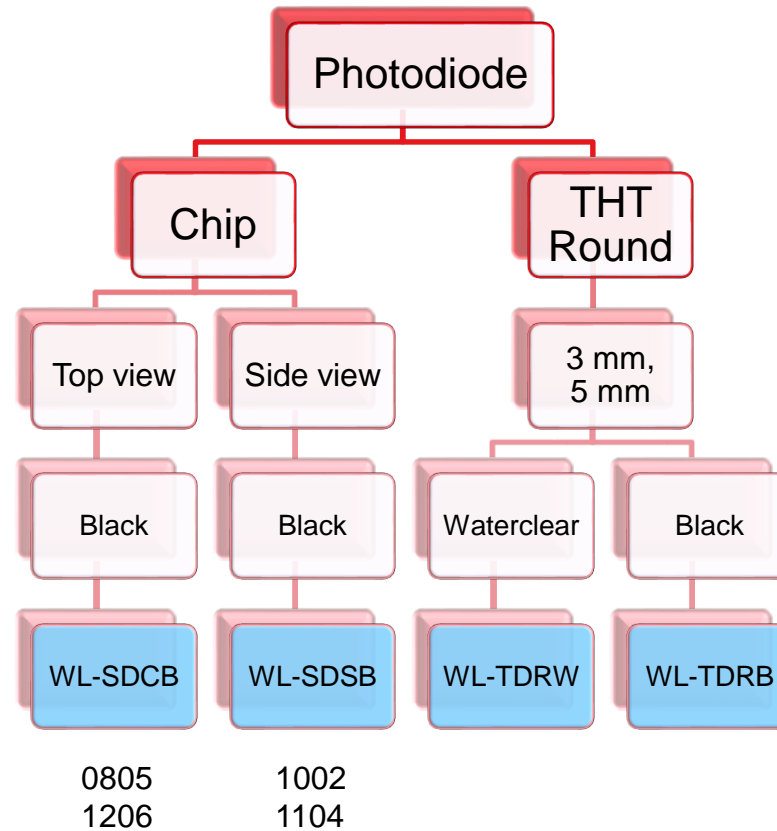
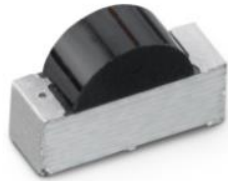
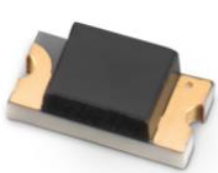




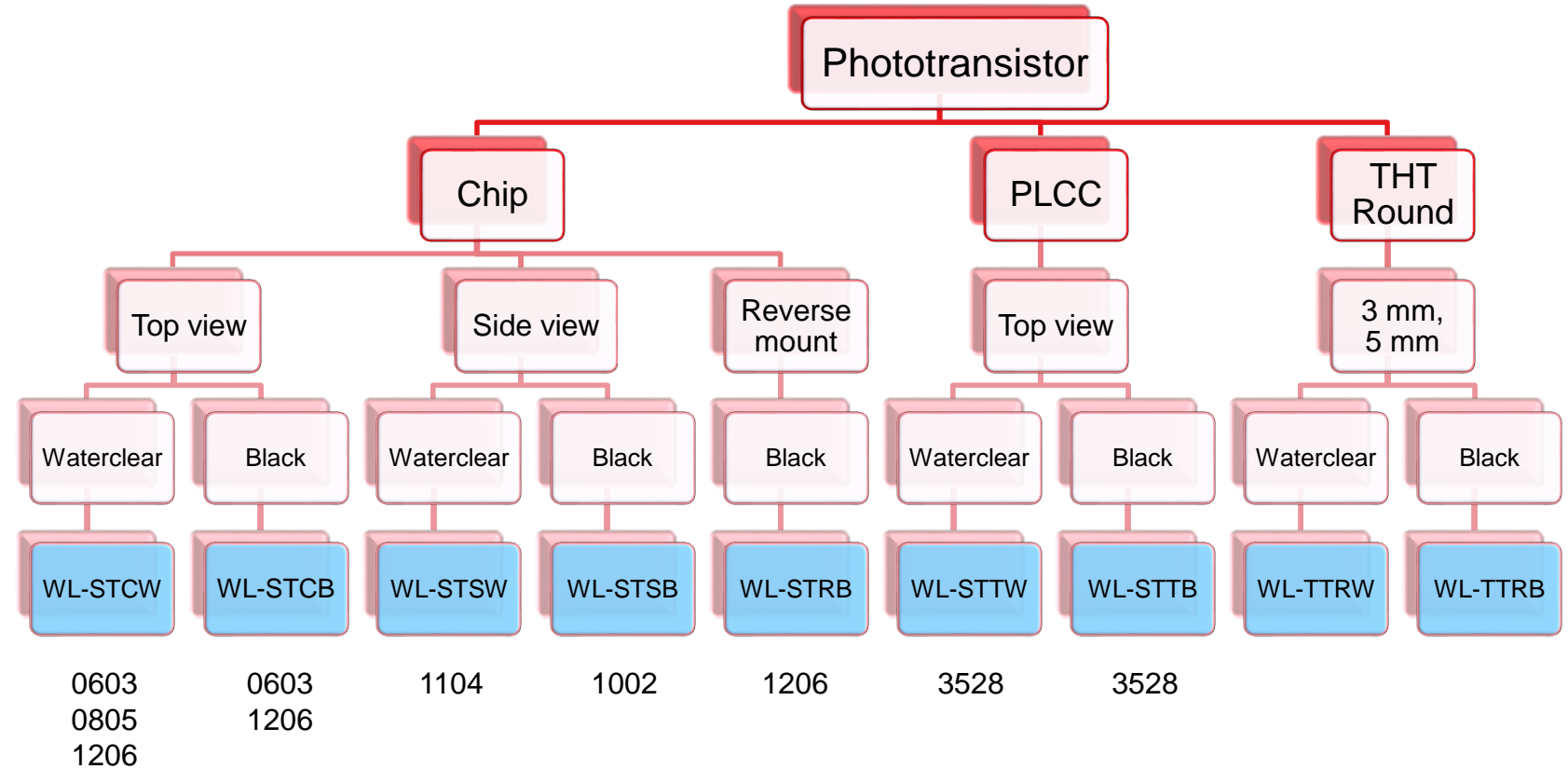
# Infrared LED – Portfolio



# Photodiode – Portfolio



# Phototransistor – Portfolio





# Thank you for your attention!

## Questions

& Answers



**We are here for you now! .**