

# **Lextar Products for Industry 4.0 Applications**

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- **Introduction**
- **Key Points of Industry 4.0**
  - **VR/AR display technology**
  - **3D camera technologies**
    - **ToF system light sources**
- **Applications**
- **future applications**
- **Lextar services**

# Lextar in Brief

Lextar



## Company

### Establishment

May, 2008

### Capital

US 180 M

### Workforce

1,400 Taiwan

2,000 China

**3,400 Total**

## Product

### Semiconductor component and module

- Display
- Professional Lighting
- Automotive
- Leading-edge  
Optoelectronics

## Major shareholders

**AUO**

**CREE** 

## Revenue

**2020**

USD 332 Million

# Ennostar Group

Lextar and Epistar established Ennostar Inc. via share swap in Jan/2021

# Ennostar

2020 Group Revenue : ~ USD 830 Million

Product

Epi / Chip

Package / Module

Advanced Compound  
Semiconductor

Group  
Company

**EPISTAR**

**Lextar**

**Unikorn**

Chairman : Dr. B. J. Lee  
President : Patrick Fan

Dr. David Su  
Dr. Terry Tang

Dr. B. J. Lee  
Wayne Shih

Application

**Mini / Micro LED**

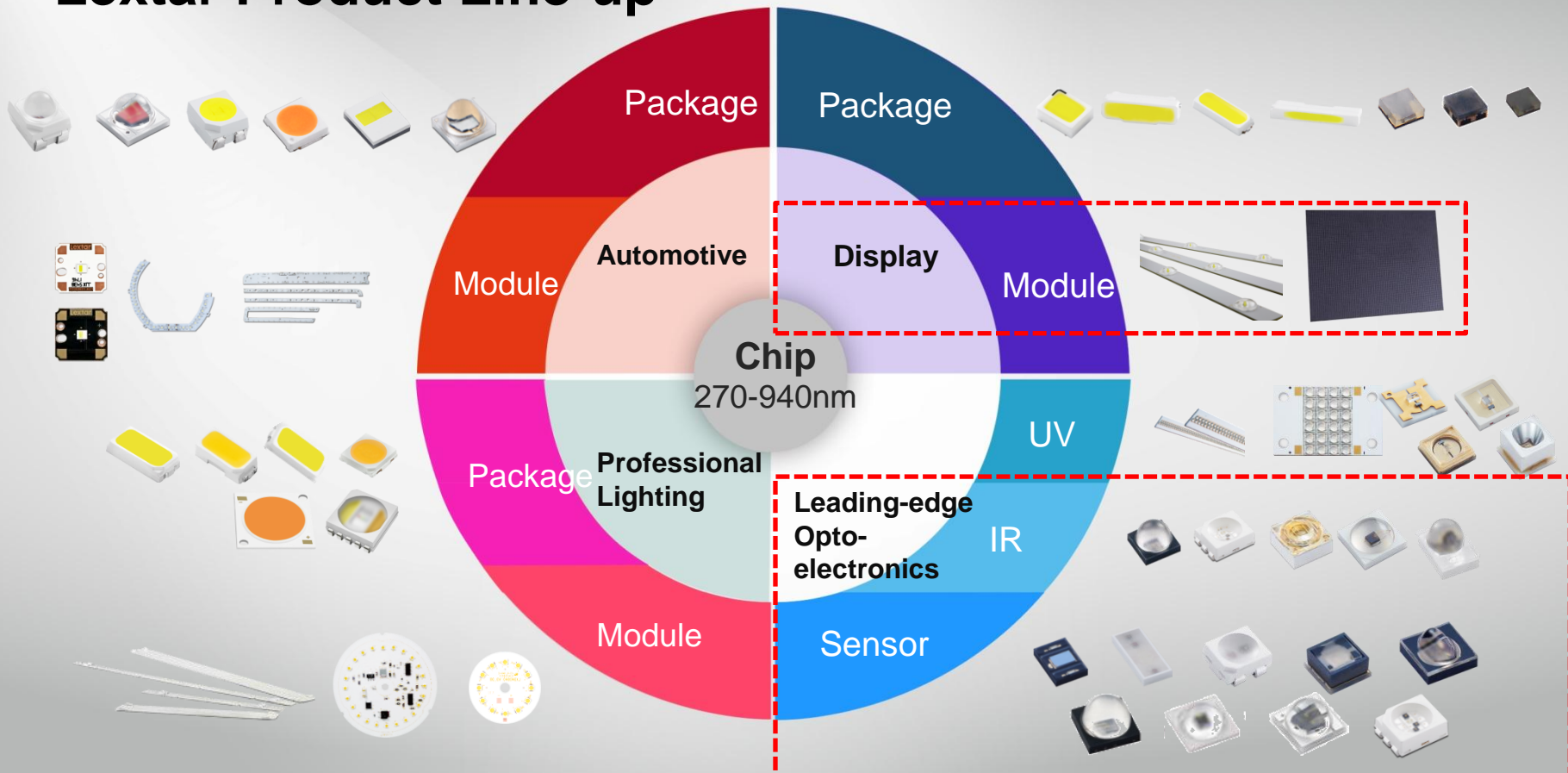
**Sensing**

**Automotive**

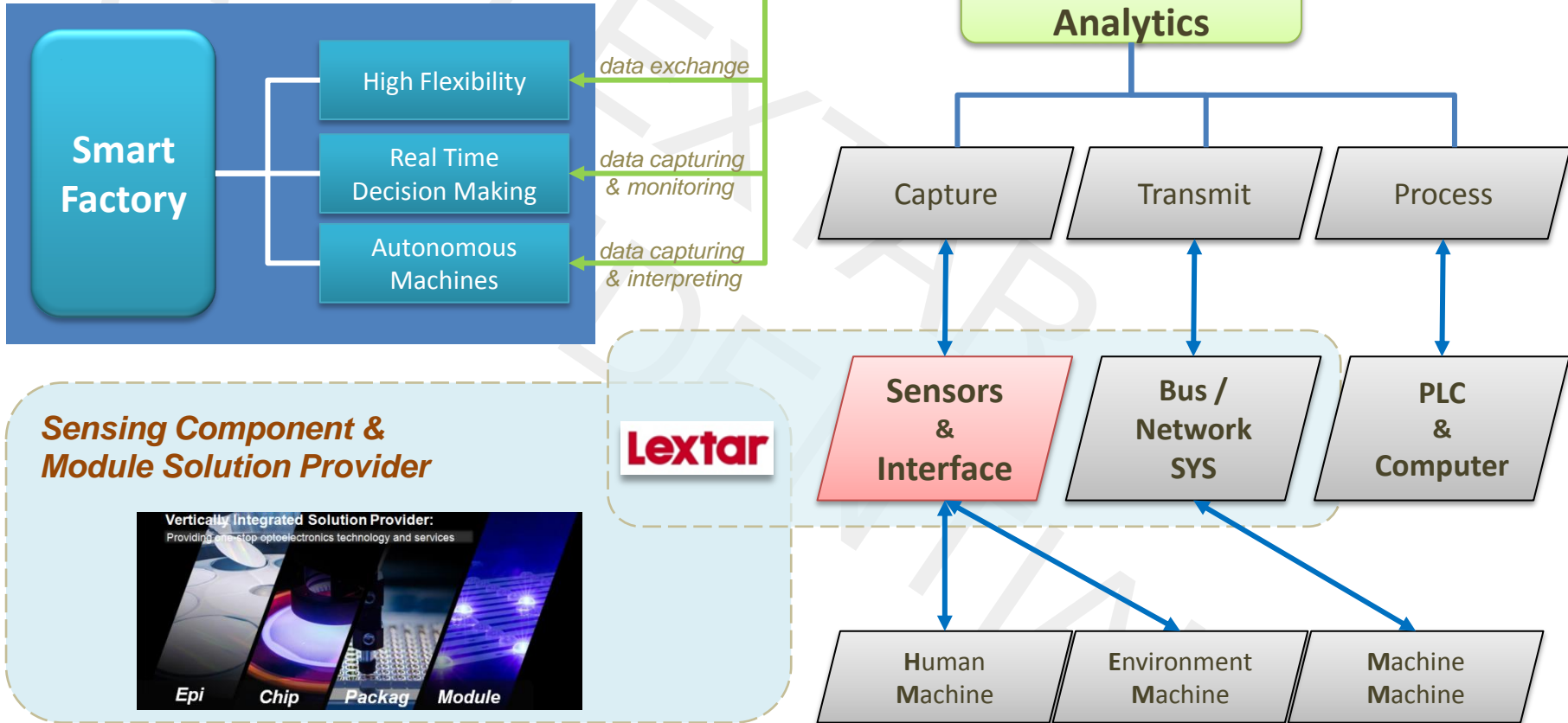
**Power Device**

**5G**

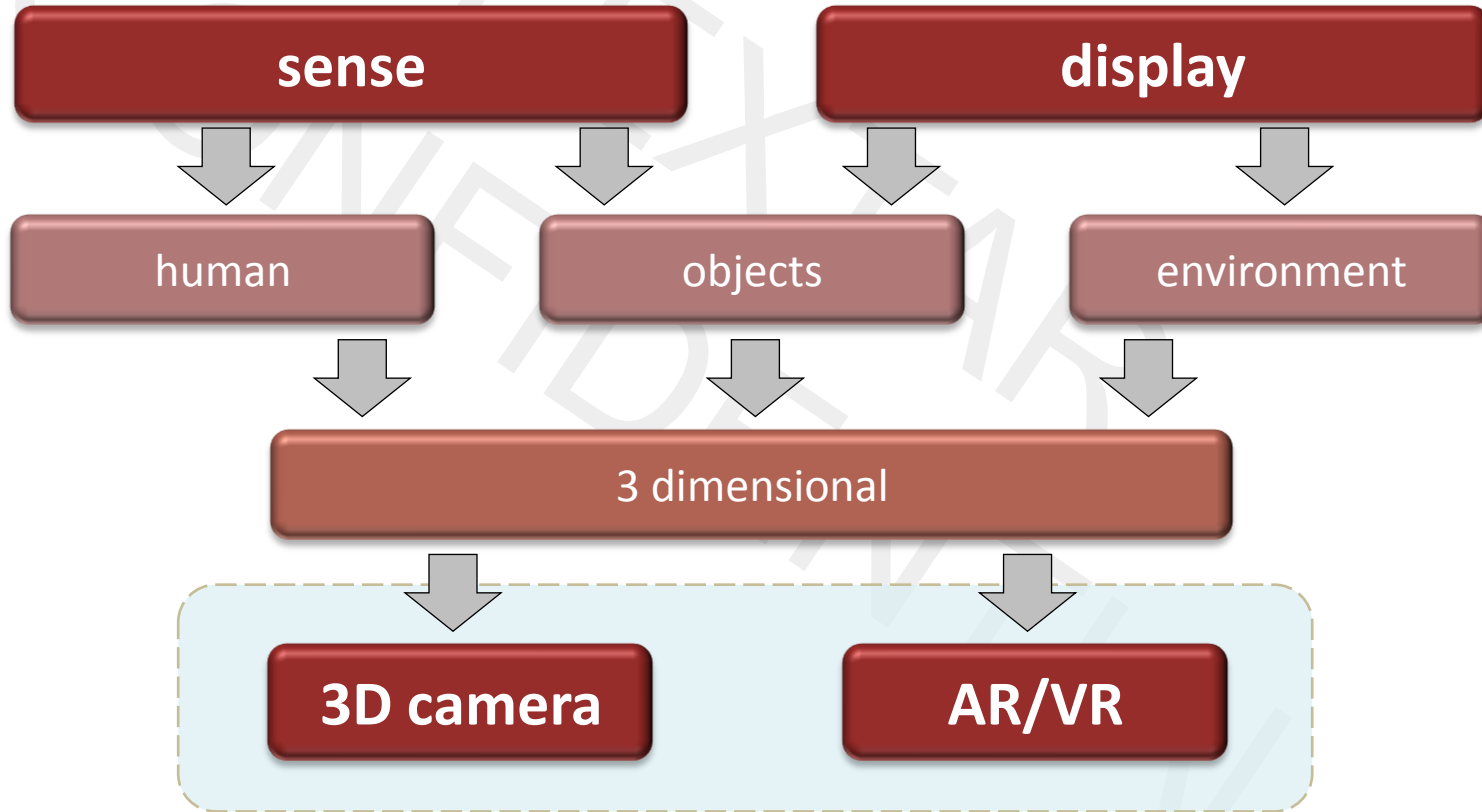
# Lextar Product Line-up



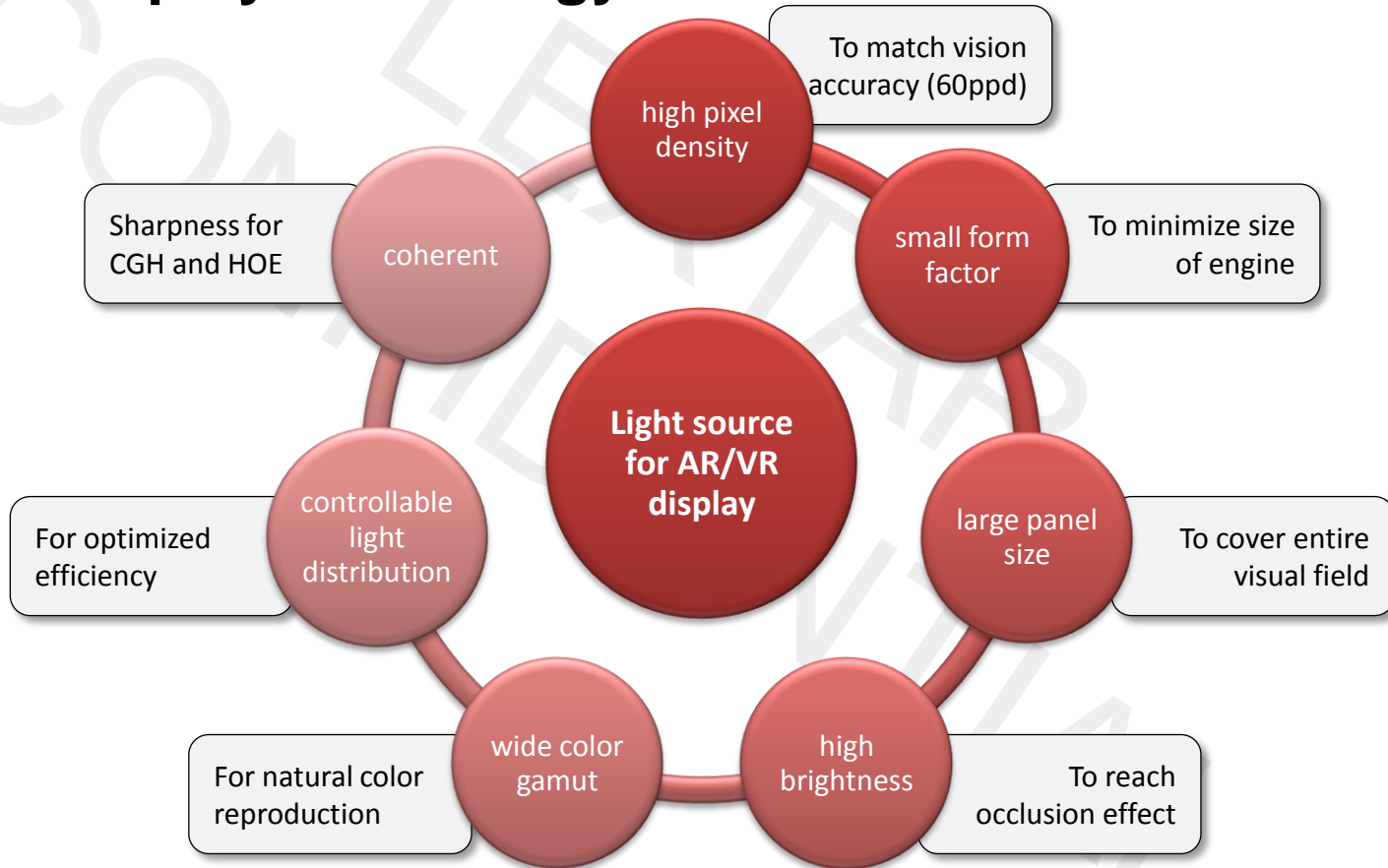
# Key Points of Industry 4.0



# Key Points of Industry 4.0

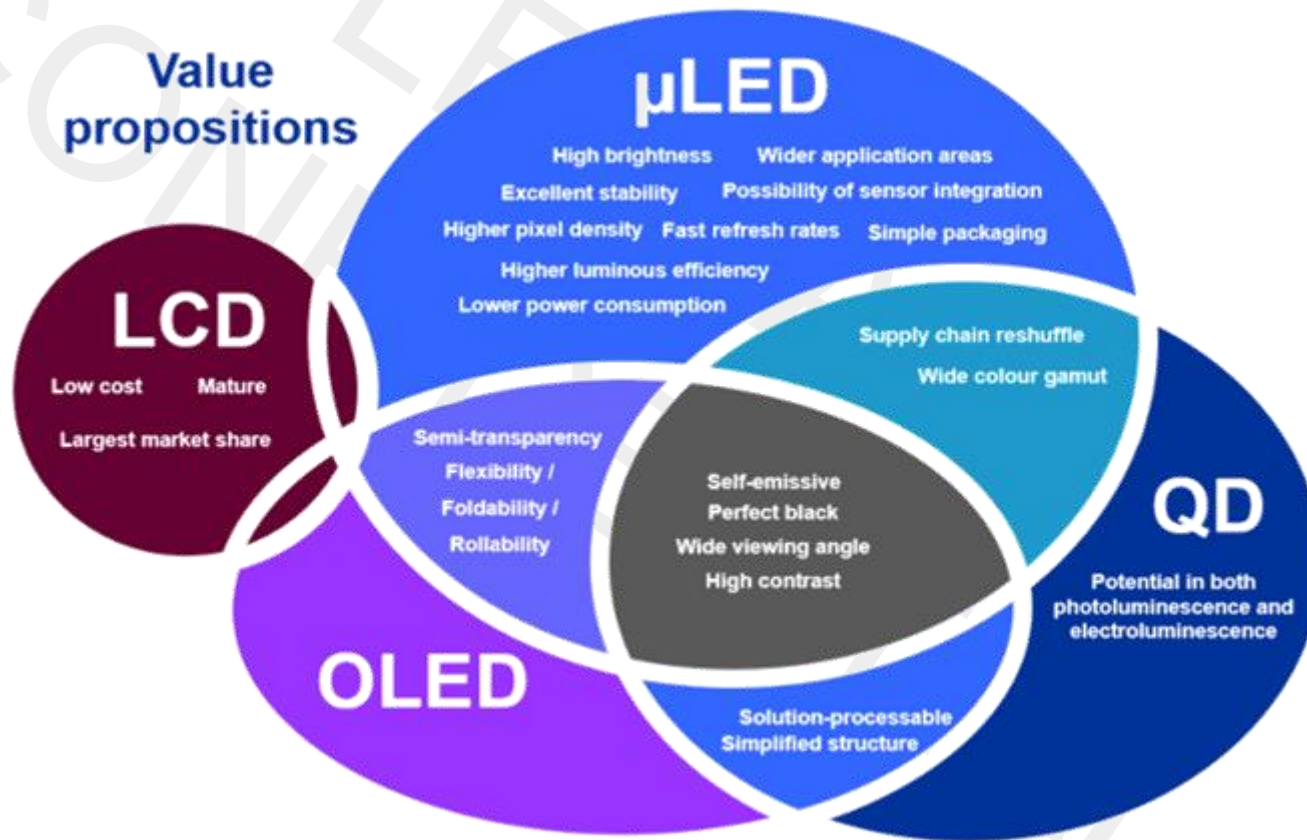


# VR/AR Display technology





# VR/AR Display technology



# VR/AR Display technology

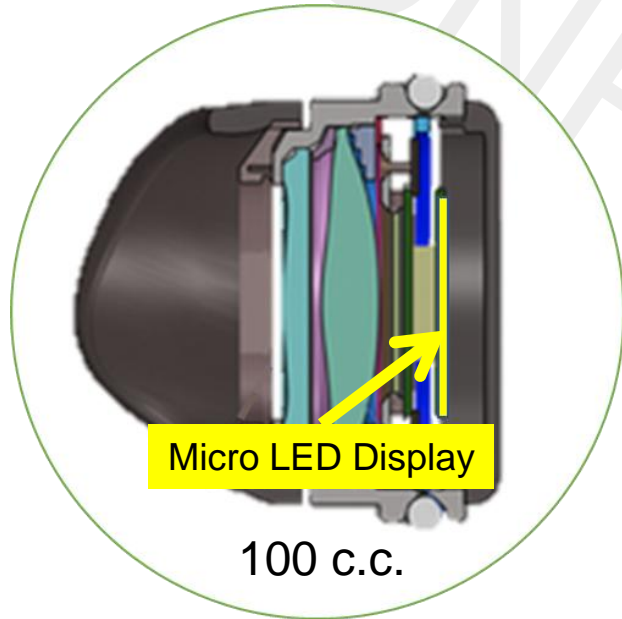
Viewing distance	10mm	20mm	50mm	100mm	300mm
Retina resolution	8700 PPI	4400 PPI	1700 PPI	870 PPI	290 PPI



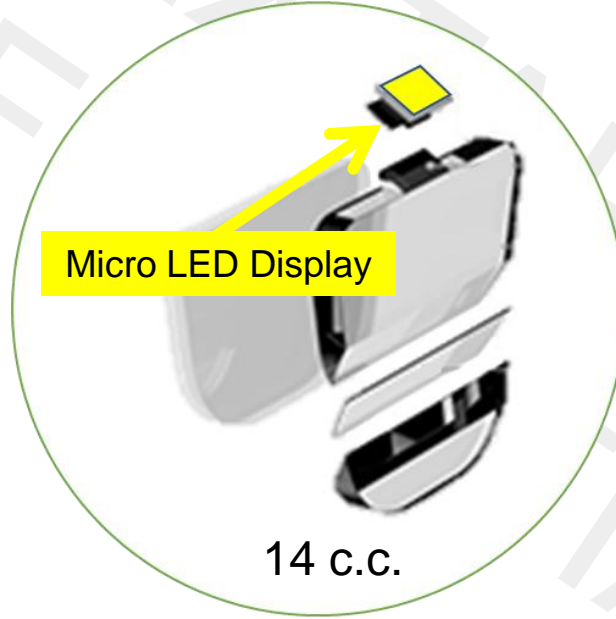
Optics type	Waveguide AR	Birdbath AR	VR
magnification	>300	~150	~100
Required pixel density	6000PPI	3000PPI	2000PPI

# VR/AR Display technology

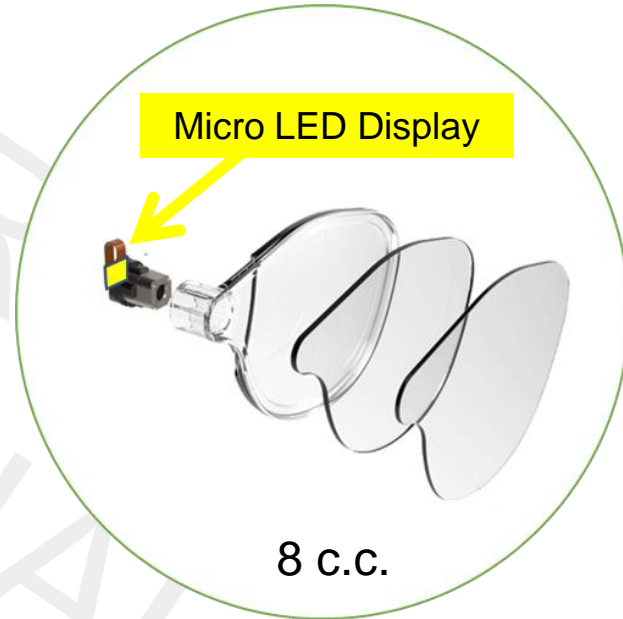
## VR Engine



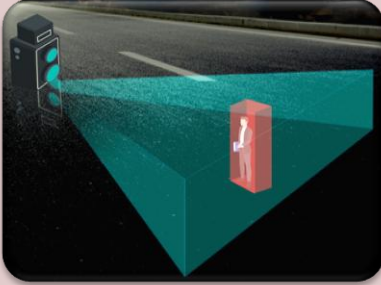
## Birdbath Engine



## Waveguide Engine



# 3D camera technologies



## Time-of-Flight

- Fast (over 100fps)
- Low cost
- Low computing requirement
- Less accuracy
- Suitable for long distances



## Stereovision

- high accuracy
- High costs
- High computing requirement



## Scanning Triangulation

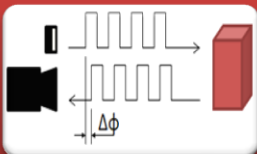
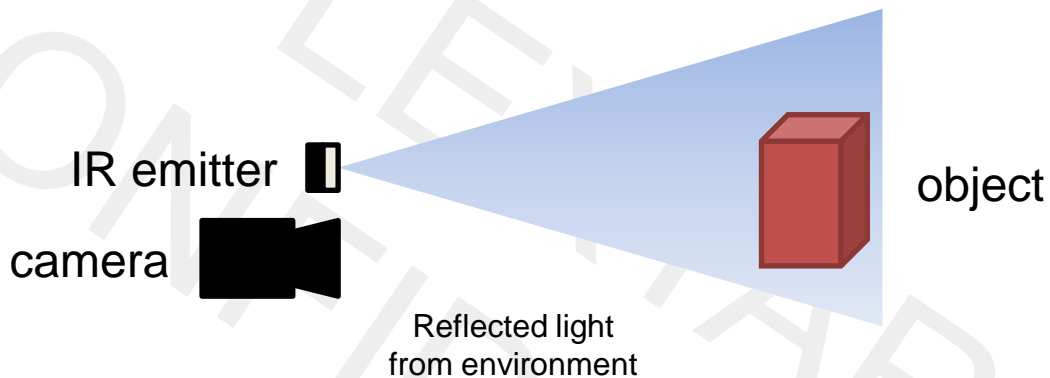
- Very high accuracy
- High computing requirement
- slow



## Structured light

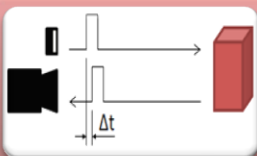
- High accuracy
- Complex optics
- High computing requirement

# 3D camera Technologies



## indirect ToF (iToF)

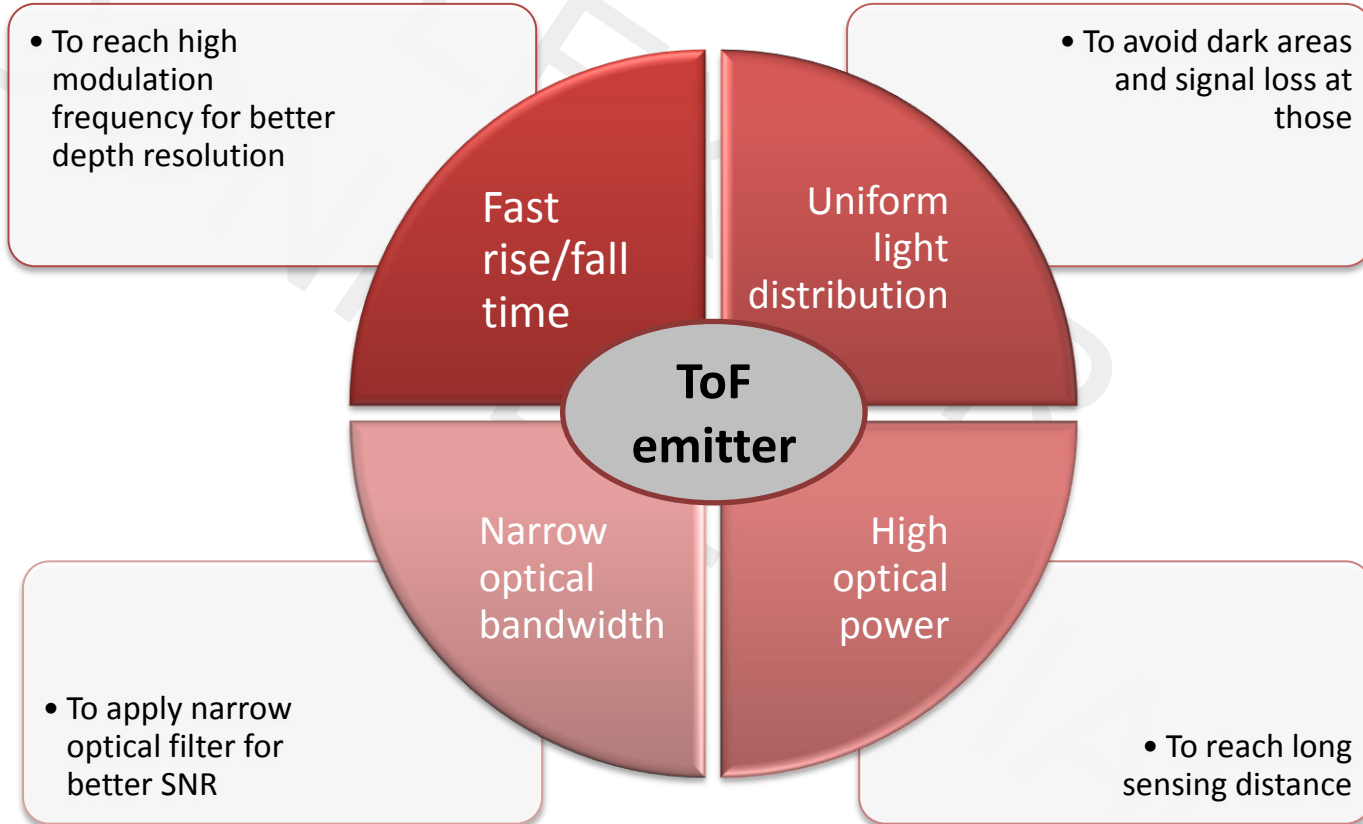
- Measures phase shift of burst modulated signal



## direct ToF (dToF)

- Measures direct time delay of single light pulse

# ToF system light sources



# ToF system light sources



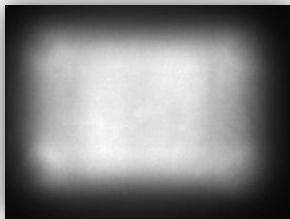
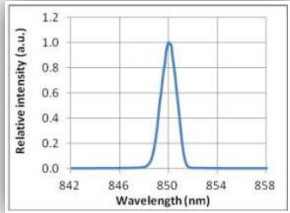
## VCSEL

Rise/fall time <1ns

Optical bandwidth <2nm

Wavelength shift 0.07nm/C

Homogeneous, almost rectangular radiation



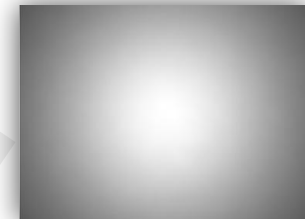
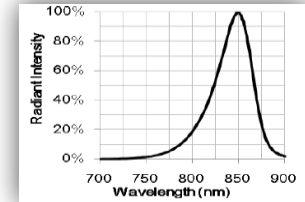
## LED

Rise/fall time >10ns

Optical bandwidth 30~50nm

Wavelength shift 0.25nm/C

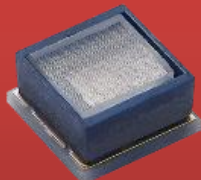
Spherical radiation



# ToF system light sources

## PV88M

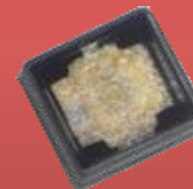
- FoV 60x45, 72x58  
86x68, 110x85
- 850/940nm
- CW up to 5W



**Industrial**  
(Ta = -20° to 85 °C)

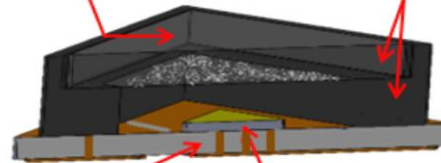
## PV85D

- FoV 60x45, 72x58 -  
110x85, 120x90
- 940nm -
- CW up to 5W-



High Uniformity

Process & Material



Thermal Solution

VCSEL

**Eye  
safety**

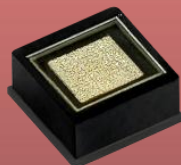


- CW up to 5W -
- 850/940 nm -

- FoV 50x45, 60x45 -  
110x85, 130x100

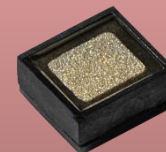
- CW up to 5W
- 940nm
- FoV 110x85

## PV88Q



**Automotive**  
(Ta = -40° to 105 °C)

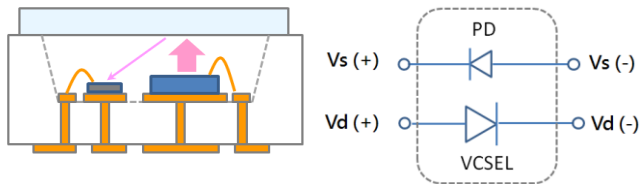
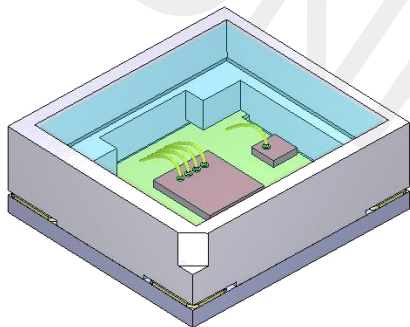
## PV85Q

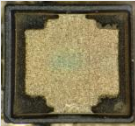

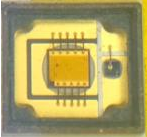


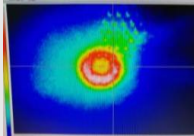




# ToF system light sources

## Eye safety function



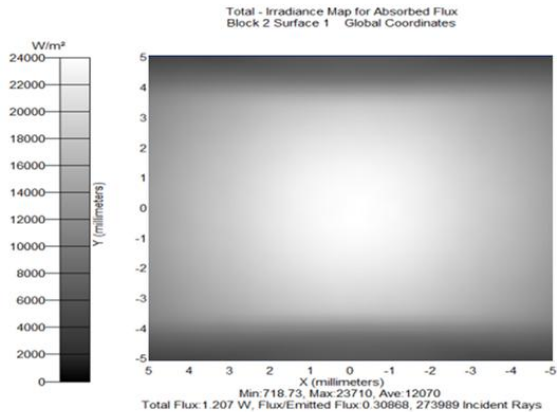
Diffuser condition	Photo diode current
 Normal diffuser	 $\sim 300\mu\text{A}$
 De-attached diffuser	 $< 10\mu\text{A}$
 Broken diffuser	 $< 200\mu\text{A}$ $> 400\mu\text{A}$

# ToF system light sources

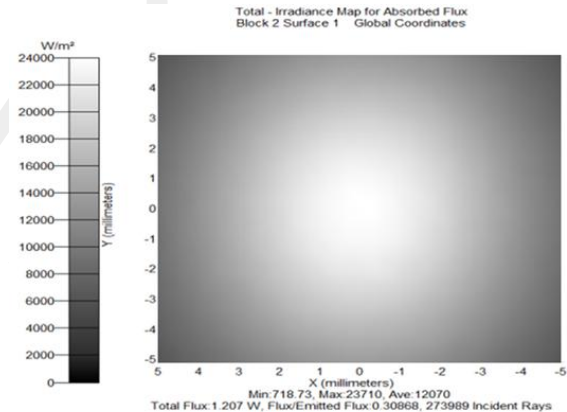
asymmetric



standard



Reduced center hot spot and dark corners



# Applications



HMI

VR/AR



Machine  
vision

Worker  
safety



# Applications

## HMI with gesture control to ensure traditional 2D touch panel

### VCSEL

- **PV85DC4 V4**
  - 940nm, 130°x100°
  - eye safety
- **PV88M95 V4**
  - 850nm, 86°x68°
- **PV88MB5 V4**
  - 850nm, 110°x85°



### IR LED

- **PR35V11-D60**
  - 850nm, 60°
- **PR35V11-D90**
  - 850nm, 90°
- **PR35V11-D130**
  - 850nm, 130°x80°



### VCSEL

- **PV85D64 V4**
  - 940nm, 60°x45°
  - eye safety
- **PV88M64 V4**
  - 940nm, 60°x45°
- **PV88M65 V4**
  - 850nm, 60°x45°



### IR LED

- **PR35V11-D60**
  - 850nm, 60°



Access control with face ID to enable different function (operator, engineer)

## AR for product simulation in real environment

### VCSEL

- **PV88MB5 V4**
  - 850nm, 110 x85
- **PV85DC4 V4**
  - 940nm, 130 x100°
  - eye safety



### IR LED

- **PR35V11-D130**
  - 850nm, 130 x80°



# Applications

## Machine vision for robots (pick up objects, human robot interaction)

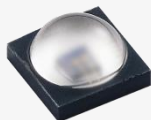
### VCSEL

- **PV88M75 V4**  
• 850nm, 72° x 58°
- **PV88M95 V4**  
• 850nm, 86° x 68°
- **PV88MB5 V4**  
• 850nm, 110° x 85°



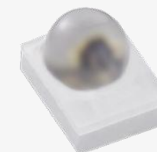
### IR LED

- **PR35V11-D90**  
• 850nm, 90°
- **PR35V11-D130**  
• 850nm, 130° x 80°



### IR LED

- **PA5WHA0**
- **PA5WRA**
- **PA28HX0**
- **PA28RX0**



### PS

- **PN21PT1.0**  
• 940nm VCSEL
- Compact size
- High noise immunity
- I<sup>2</sup>C interface



## 2D Optical inspection, Object detection

## Accident monitoring with 3D camera

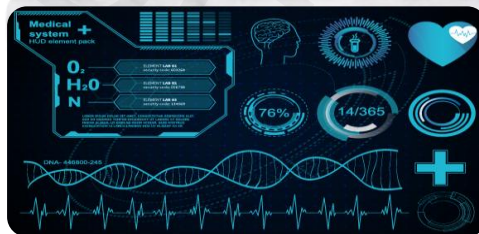
### VCSEL

- **PV88M75 V4**
  - 850nm, 72°x58°
- **PV88M95 V4**
  - 850nm, 86°x68°
- **PV88MB5 V4**
  - 850nm, 110°x85°
- **PV85DC4 V4**
  - 940nm, 130°x100°
  - eye safety



### IR LED

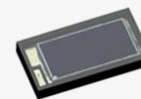
- **PR35V11-D90**
  - 850nm, 90°
- **PR35V11-D120**
  - 850nm, 120°
- **PR35V11-D130**
  - 850nm, 130°x80°



## Work health monitoring with heart rate and blood oxygen sensor

### PD

- **PP52ZN2 V0**
  - Low dark current
  - High efficiency



### LED

- **PI20H01 V0**
- **PI24H01 V0**
- **PI24H01 V1**
  - High efficiency
  - Green, red, IR (940nm)



# Future applications

## LiFi for local communication



### Advantages:

- EMI immunity
- Suitable for explosion sensitive areas
- Locally limited
- Very high data rates possible

## LiFi Transmitter

### VCSEL

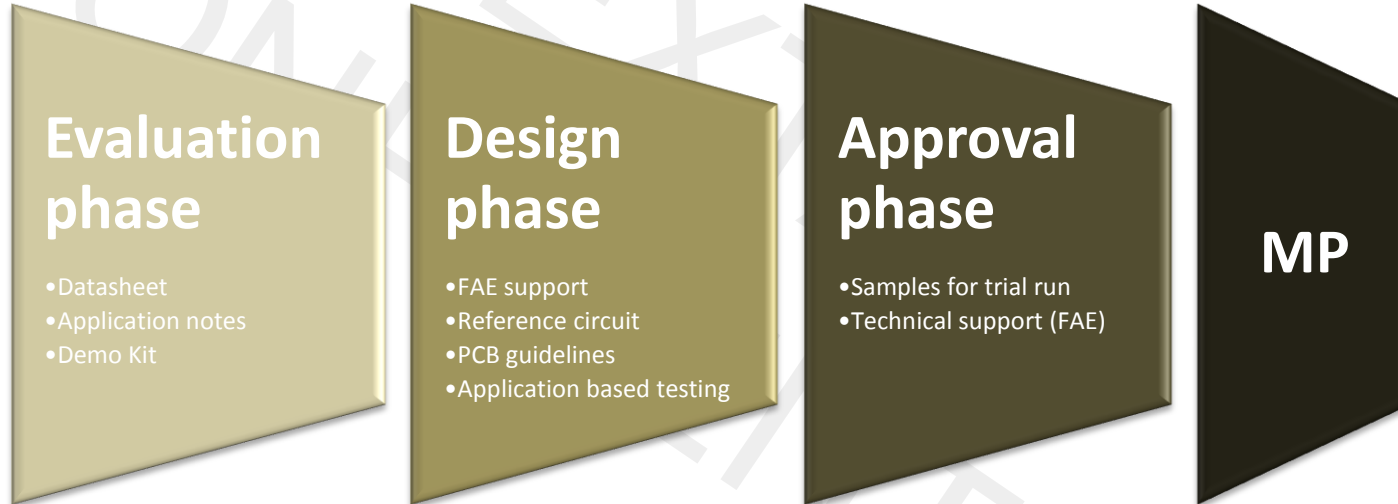
- high modulation possible (>100MHz)
- Narrow spectrum (<2nm)
- Multi channel with different wavelengths
- Beam shaping flexibility





# Lextar Service

Lextar



# Lextar services

## 2D to 3D sensing development in Lextar

### 2D

**Iris + face recognition (2D Face ID)**  
Wide angle IR LED

Wp:850nm/940nm  
Power: 3-5.8W  
FOV: 90 degree

Wp:850nm/940nm  
FOV: 80 degree  
Size: 3.5x3.5x1.6mm

**Iris**

Wp:810nm  
FOV: 26 degree  
Size: 3.5x3.5x2.4mm

Thinner version  
Wp:810nm  
FOV: 36 degree  
Size: 3.5x3.5x1.4mm

### 3D

**Face recognition VCSEL ToF solution**

Wp:850nm/940nm  
Radiation power: 2-5W  
FOV: 60x45/110x85/120x90

Face ID

Autopilot

Drone

Gesture sensing

Companion robot



# Lextar services

## Module Design

### LED & Optical source



IR Component



Secondary Lens

### PCB source & Thermal Management



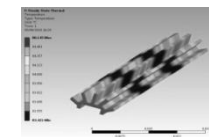
RPCB



FPCB



Others



### DMC code, product label

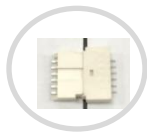
### Connector suggestion



Top



Back



Board to Board

### E & E technical support

- ◆ Design suggestion – protection diode, resistors, and related electric component
- ◆ PCB design Optimization – creepage distance, line width, line spacing and etc.
- ◆ Driving & Safety suggestion for many kinds of module/system product design



# Lextar services

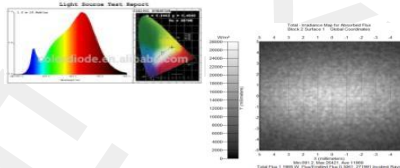
## Secondary lens development

### Select LED



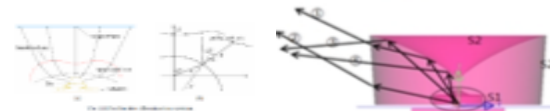
- **Select LED**
  - Depends on efficiency requirement

### Data Gathering



- **Data for simulation**
  - Ray data for light trace
  - Data for sheet & films

### Basic Design & Analysis



- **Lens design for display**
  - Concept design & simulation

### Evaluation



- **Evaluate the sample**
  - Distribution of Luminance & Chromaticity

### Tooling & Injection molding



- **Making sample under each condition**
  - Temperature
  - Pressure
  - Time

# Lextar services

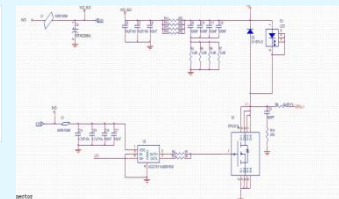
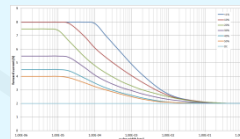
## Reference Design

Product Phase



## Module Product

- ✓ Main module elec. circuit in system design
- ✓ Driver Board Suggestion (ex: VCSEL product)
- ✓ Demo Kit for system reference design (optional)
- ✓ PCB/SMT related design guideline.
- ✓ Circuit Design Improvement
- ✓ Safety and certifications considering by request



## Optional for Component Product

- ✓ Module (customer) main elec. circuit review and suggestion (Ex: VF binning, rank selection,...)
- ✓ Demo Kit & Driver Board Suggestion (VCSEL)



Flexible and Professional Design Suggestion

## Thermal test and simulation

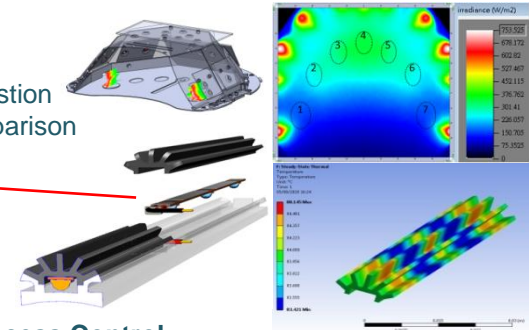
### Component Design

1. Low Rth structure design with robust materials.
2. De-rating curve definition



### Simulation

1. Design review / Suggestion
2. Experiment /Test comparison



### Related RA test

1. TST / PTC (components)
2. Solder joint judgment for module

### Module (SMT) Process Control

1. Voiding control (material/reflow...)
2. In-line/Off-line inspection (optional)

### Solder Joint Integrity (SMT)



#### Environments

- Power Cycle (On/Off)
- Thermal Shock
- Operating Temperature

#### Processing

- Reflow Soldering Profile
- Voiding Control

#### Materials

- Solder Paste Material
- PCB Structure

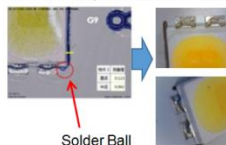
Test Level	Module (LB)
TST (Robust)	-40°C ~ 100°C /30min, transfer <5min -40°C ~ 125°C /30min, transfer <5min 2592 cycles
Power Temp. Cycle (PTC)	(High Temp.) Tj@105°C 30s ON/30s OFF 30K Cycles

Process Capability		Paste	Stencil	Reflow	PCB PAD finish	PCB Precision	Spec.
Void Control	Control Factor	⊙	⊙	⊙	⊙		Void under 30%, special application can under 20%
	Design		Base on PCB surface finish	Base on Paste Type			
Solder Ball Control	Control Factor	⊙				⊙	Solder Ball no visual at Microscope 8X
	Design		Base on PCB surface finish	Base on Paste Type			

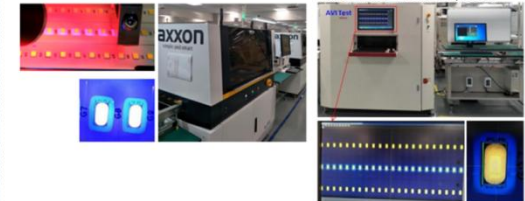
Void : <30% in general, <20% achievable



Solder Ball : Unperceivable under microscope 8X



### Automated Visual Inspection



**Design considering from component to module system and includes process control for better thermal performance.**





**Lextar**



*Smart Innovation, Amazing Life*