# NEW ILLUMINATORS: WAVELENGTH EXTENSION, ADDED FUNCTIONALITY AND HIGH-POWER DENSITY

# **VCSELs and EELs**

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### **INTRODUCTION**

- Since photonics consumer applications adoption, VCSELs have become the main laser source in consumer devices
  - Shipped more than 200Bu emitters
  - For SWIR wavelength, EELs have so far been the only choice and Coherent has been supplying large volume (>600Mu shipped)
  - Breadth of technology to supply the right solution to specific applications



- New applications are emerging that require technological advancements
  - Extending wavelength range; 1060-1130nm, 1380nm
  - Higher integration: Monolithic optics, modules
  - Scaling power density: Multi Junction





## **30+ YEARS OF EXPERIENCE IN DIODE LASER TECHNOLOGY**



## **CHOICE OF WAVELENGTH**





## **1130NM VCSELS**

- Window in low solar background present at 1130nm
- Can be used as a differential signal (with 13xxnm) to detect skin
- Development of VCSELs using the proven 6" GaAs manufacturing platform
- Demonstrated polarization lock
  - >10dB Polarization Extinction Ratio up to 150kA/cm2 in short pulse (limited by setup).
- At 70°C junction temperature, Time to 1% failure: 1Mh



HEKENI

## 1380nm VCSEL



- Using COHR expertise in GaAs and InP
- For low power compact sources at 1380nm, VCSEL development
  - Lasing at 1380nm, can be used for water absorption, eye safety, differential signal for skin
  - 2.9mW of power, 10% max PCE







## $HIGH-POWER \ \textbf{1.3} \mu \textbf{M} \ \textbf{DFB} \ \textbf{SINGLE-MODE} \ \textbf{LASERS}$

- Designed for uncooled operation CW application
  - 100 mW-class lasers
- High power conversion efficiency at elevated temperatures
- Distributed Feed-Back design single longitudinal mode





# **1380NM EDGE EMITTER LASER-BASED MODULE**

- High power EEL at 13xx nm to be used in ToF systems
  - 2-3W at 1380nm at 25°C
  - Beam orated by mirror optical emission from surface
- Advantages
  - Eye safety
  - Better outdoor operation (no solar spectrum)
  - Humidity detection









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# **HIGHER POWER DENSITY**



## **MULTI JUNCTION**

- Multi-junction technology allows
  - Higher power density
    - reduction of chip size or extended reach
  - Operation at low current, high voltage
    - Reduction of driver costs
    - Reduction of EMI
  - More efficient usage of carriers (share mirror losses over several 1gain regions)
    - Higher PCE
- Enables
  - Long reach dToF system (xR, ADAS)
  - EMI reduction in compact system (mobile phones)





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# **HIGHER INTEGRATION**



# **BACK SIDE EMITTING VCSEL WITH INTEGRATED COLLIMATED LENS**

- Critical in size: small pitch and integrated optics
- Platform development
  - Back Side Emitter
  - 940nm
  - Single mode
  - Integrated collimating lens
    - Grey scale lithography
  - Cu pillar / other connectivity

#### Features:

- High PCE
- Collimated (simplified optics design)
- Single mode emission possible



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- Divergence without lens is ~18deg.
- With lens, collimation achieved (3°)

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Current (mA)

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## **HYBRID FUNCTIONALITY INCREASE**

- Module Platform integrating all Tx components and feature for 3D sensing applications:
  - VCSEL+Driver+Optical management (FOV, Profile, Dot Projectors,..)+ PD
  - Eye Safety trough driver feedback
  - EMI shielding
  - <u>Compatible with flood / Dot / Dot+ Flood</u>
  - Example Spot performances:
    - # Spots: 4k-10k (depends on Customer spec)

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- Spot Size: 0.2deg
- Wide Field of Illumination for natural vision
  - Flood illuminators developped up to 150°







## **CONCLUSION: LASER INNOVATIONS ENABLE NEW APPLICATIONS**

Feature	Technology	Application
Eye safe Illumination	SWIR	
Outdoor robust operation	SWIR	
Additional spectral information	SWIR	
Compact illumination	BSE, 3in1	
Added functionality	BSE, 3in1	
Longer reach / Wider illumination	Multijunction, Module	







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