Compact RGB Laser Module for AR Smart Glasses

SPIE. AR|VR|MR | 31st March 2021 | Stefan Morgott

Light is OSRAM
Laser Beam Scanning (LBS)

Laser Beam Scanning requires

➢ Set of R/G/B single mode laser diodes
➢ Beam forming optics
➢ MEMS scanning mirror(s)
Prio #1 is Size / Weight / Esthetics

Compact RGB Laser Module for AR Smart Glasses

Display Performance
- FOV: 20°, 40°, 60°

Optical Engine Size
- 1cc: Laser Beam Scanning
- 5cc: New LED + LCoS/DLP
- 10cc: LED + LCoS/DLP

Sugar Cube Size Optical Engine

- Necessary for Consumer Glasses
- Acceptable for Professional/Industrial/Enterprise Glasses & Headsets

AR Smart Glasses

Compactness

Optical Engine

OSRAM

2021 S. Morgott
RGB Laser Module
Optical Engine Size <1cc

3 discrete R/G/B TO38 Lasers
Optical engine size: L-21mm, W-16mm, H-5mm

1.7cc

Single RGB Laser Module
Optical engine size: L-10mm, W-11mm, H-6mm

0.7cc

significant size benefit
VEGALAS™ RGB Laser Module Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package Type</td>
<td>SMD Top-looker Hermetically sealed</td>
</tr>
<tr>
<td>Dimensions</td>
<td>7.0 x 4.6 x 1.2 mm</td>
</tr>
<tr>
<td>Laser diodes</td>
<td>1 Chip-on-Submount per color</td>
</tr>
<tr>
<td>Wavelength for R/G/B</td>
<td>640nm / 520nm / 450nm</td>
</tr>
<tr>
<td>Optical power for R/G/B</td>
<td>100mW / 50mW / 80mW</td>
</tr>
<tr>
<td>Laser diode spacing</td>
<td>2.3mm</td>
</tr>
<tr>
<td>Beam divergence (FWHM)</td>
<td>7° x 22° per color</td>
</tr>
<tr>
<td>Optics</td>
<td>• Prisms to reflect beams to the top</td>
</tr>
<tr>
<td></td>
<td>• AR-coated glass lid</td>
</tr>
<tr>
<td></td>
<td>• Beam collimation &amp; combination outside of module</td>
</tr>
</tbody>
</table>

Image: Diagram showing the dimensions of the laser module with labels for 7.0mm, 4.6mm, and 1.2mm.
VEGALAS™ RGB
Prepared for various Power Classes

Required laser optical power depends on optical display architecture

Non-Pupil Forming / Virtual Retina Scanning
HOE Reflector Combiner

- Reflective mirror / HOE
- RGB laser module
- MEMS scanner
- Pupil
- Human eye
- Retina

Laser power 1-5mW per color

Pupil Forming (intermediary image)
Waveguide Combiner with EPE

- In-coupler
- Image source
- Out-coupler

Laser power 10-100mW per color
VEGALAS™ RGB
Display Brightness – Laser Optical Power

Laser Optical Power per Color?

17 lm
Laser out
Projector in

10 lm
Projector out
Combiner in

60%

1500 nits
Combiner out

150 nits/ lm

150 nits/ lm

10 lm

60%

Laser Optical Power per Color?
VEGALAS™ RGB
Display Brightness – Laser Optical Power

The optical power per color is defined by
- RGB laser primaries
- Target Whitepoint
- Luminous White Flux @ Target Whitepoint

<table>
<thead>
<tr>
<th>Laser Wavelength (Laser Primaries)</th>
<th>Red</th>
<th>Green</th>
<th>Blue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser Wavelength (Laser Primaries)</td>
<td>640nm</td>
<td>520nm</td>
<td>450nm</td>
</tr>
<tr>
<td>Target Whitepoint</td>
<td>D65</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optical Power Ratio</td>
<td>50%</td>
<td>32%</td>
<td>18%</td>
</tr>
<tr>
<td>Luminous Flux Ratio</td>
<td>27%</td>
<td>71%</td>
<td>2%</td>
</tr>
</tbody>
</table>

Example:
Optical Power for 17lm
- Red: 39mW
- Green: 25mW
- Blue: 14mW
- Total: 78mW

VEGALAS™ RGB
Display Brightness – Laser Optical Power

0.8W_{el}
Laser in

21lm/W_{el}

78mW
Laser out

60%

17lm
Projector in

1500nits
Combiner out

150nits/lm

1500nits
Waveguide Combiner

10lm
Projector out
Combiner in

Display Luminance: Full White D65
Projector 60%, Combiner 150nits/lm

Laser Electrical Power, W

0.4
0.6
0.8
1
1.2

0
500
1000
1500
2000
2500
3000
VEGALAS™ RGB Schedule

➢ Current Status
  - Design Verification Phase
  - Samples Available
  - Participation in LaSAR Alliance

➢ SOP planned for mid 22

Thank you!