DLP® Auto Dynamic Ground Projection EVM Reference Design

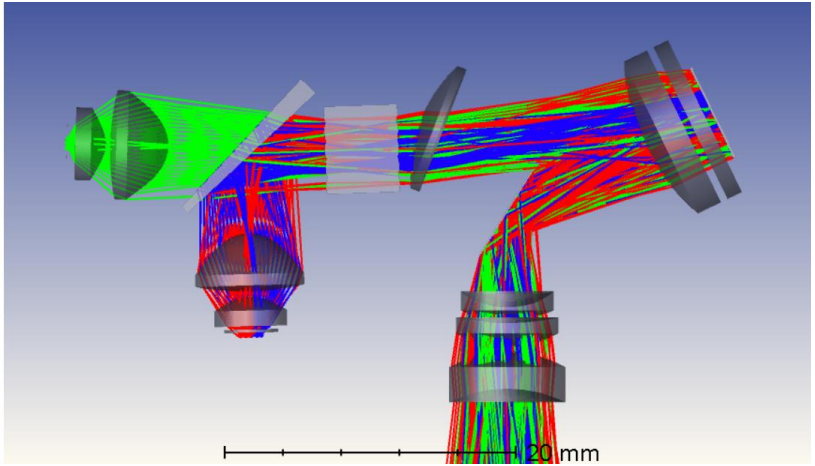
04/05/2021

Disclaimer

- Please use this document as a reference design only, changes might apply to a later version.
- No Tolerance Analysis or Thermal analysis has been done on this design.

Optical Specification Requirement

- 0.3” WVGA – DLP3021
- Throw Ratio: 3
  - Projection distance: 850-1150mm
  - Image Diagonal:
    - 282 mm(projection distance 850 mm)
    - 332 mm(projection distance 1000 mm)
    - 381 mm(projection distance 1150 mm)
- Power to the LED : ~1.5 W
- Brightness: 15 lm/W
- Size: 47mm x 25mm x 15mm
- Resolution: 2 Pixels length
  - (grouping 2x2 pixels as the smallest fixture to be resolved, since it will be projected on concrete ground, image quality does not need to be high)



LED Spec

- LED emitting Size
  - Green: 0.72mm x 0.72mm
  - Red: 0.65mm x 0.65mm
  - Blue: 0.65mm x 0.65mm

OSRAM H9RM

https://www.osram.com/ecat/OSRAM%20OSTAR%C2%AE%20Projection%20Cube%20LCG%20H9RM/com/en/class_pim_web_catalog_103489/prd_pim_device_2190826/

OSRAM Q7WM

https://www.osram.com/ecat/OSRAM%20OSTAR%C2%AE%20Projection%20Compact%20LE%20BR%20Q7WM/com/en/class_pim_web_catalog_103489/prd_pim_device_2191191/

LED source: OSRAM H9RM+Q7WM

Features:

- Package: SMD epoxy package
- Chip technology: UX:3
- Typ. Radiation: 120° (Lambertian emitter)
- Color: Cx = 0.318, Cy = 0.642 acc. to CIE 1931 (● converted green)
- Corrosion Robustness Class: 3B
- ESD: 8 kV acc. to ANSI/ESDA/JEDEC JS-001 (HBM, Class 3B)

Ordering Information

Type	Luminous Flux [1] I_F = 350 mA Φ_V	Ordering Code
LCG H9RM-LXMX-2	112 ... 210 lm	Q65112A6831

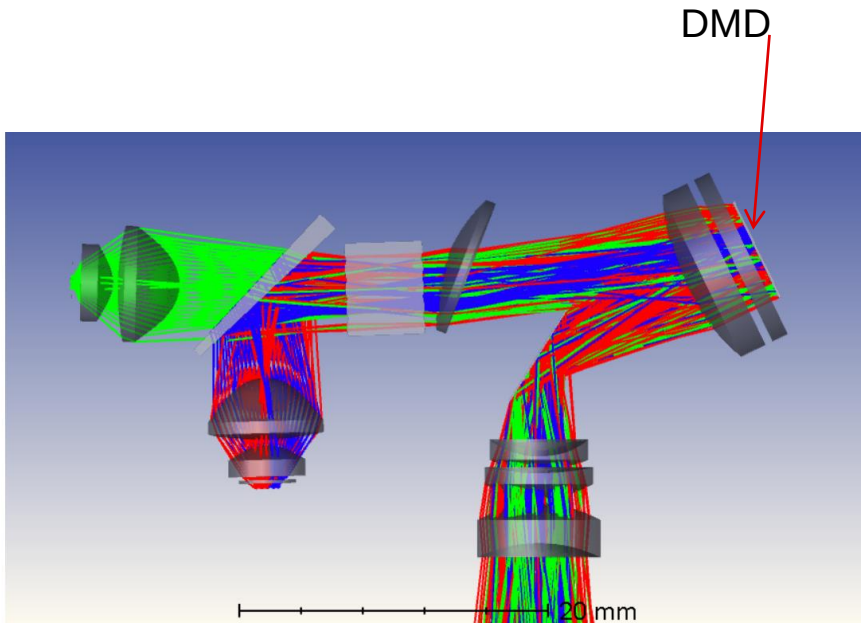
Features:

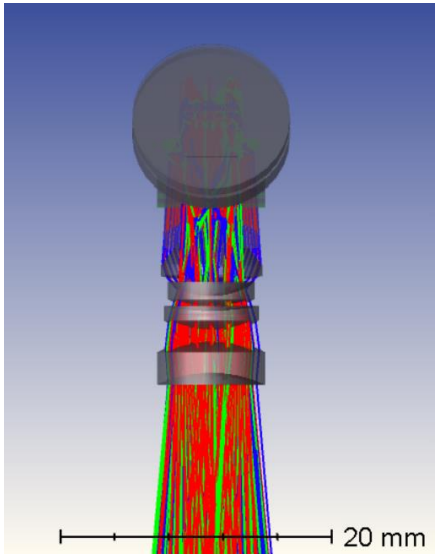
- Package: compact lightsource in SMT technology with glass window on top
- Chip technology: Thinfilm / ThinGaN
- Typ. Radiation: 120° (Lambertian emitter)
- Color: λ_{dom} = 460 nm (● blue); λ_{dom} = 617 nm (● red)
- Corrosion Robustness Class: 3B
- ESD: 2 kV acc. to ANSI/ESDA/JEDEC JS-001 (HBM)

Ordering Information

Type	Brightness [1]	Ordering Code
LE BR Q7WM-TGTI-24+JXJZ-23		Q65112A7832
● blue	● Φ_E = 280 ... 450 mW (I_F = 350 mA)	
● red	● Φ_V = 45 ... 71 lm (I_F = 350 mA)	

System layout

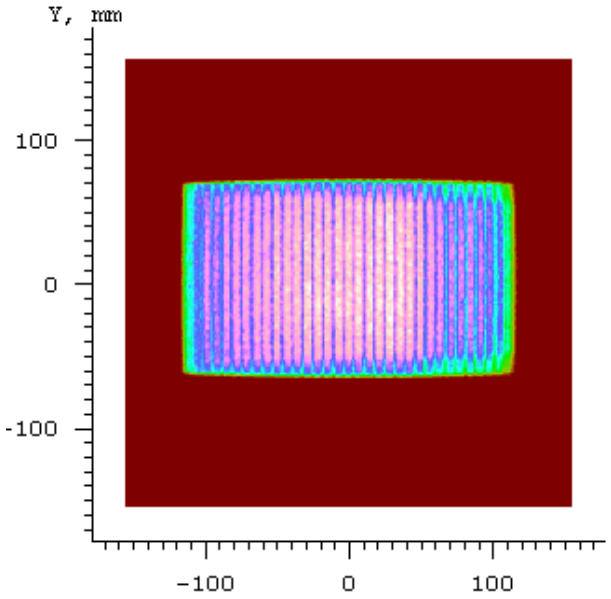




47mm x 25mm x 15mm
17.6cc

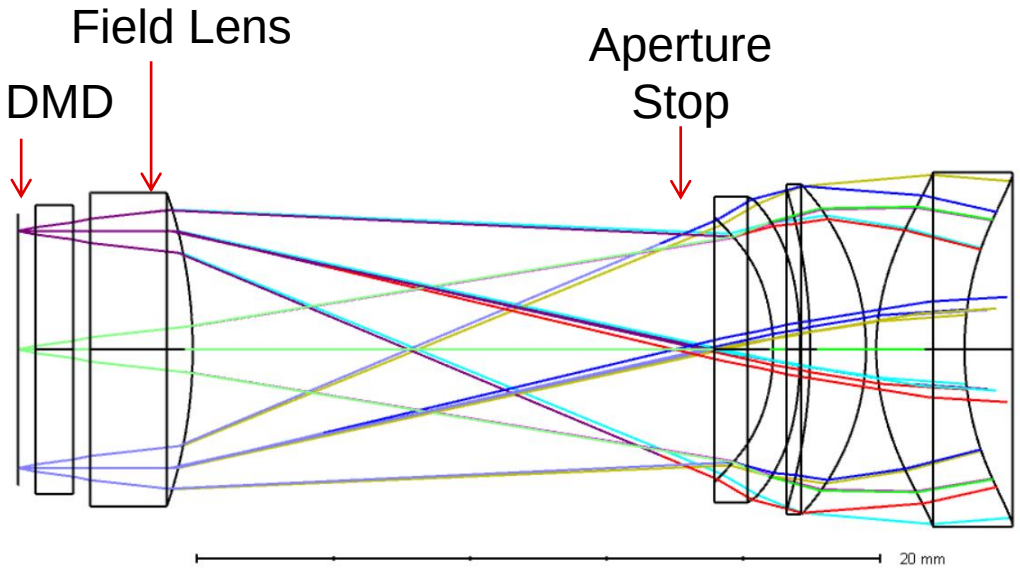
Optical System Performance

Uniformity at image plane



- System Efficiency 31%
- Emax@850mm:2160lx

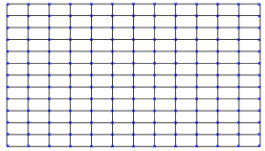
Projection Lens



- All lenses are spherical except the one on the right is aspheric.
- Material Used left to right (Schott Preferred)
  - H-ZLAF52
  - E48R
  - D-ZK3
  - E48R
- Telecentric @ DMD

Distortion & MTF-Glass Version

0.84%

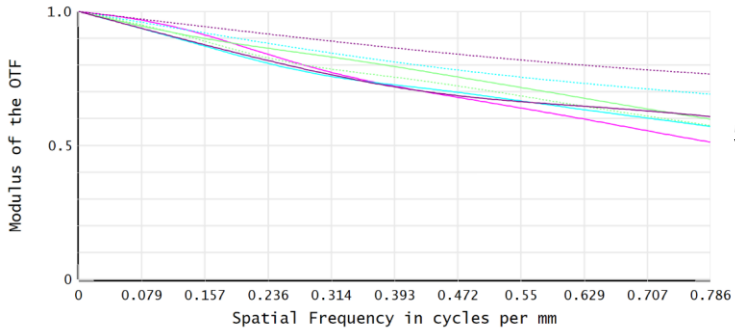


4/6/2021
Field: 5.61 w 3.15 h Millimeters
Image: 289.20 w 162.68 h Millimeters
Maximum distortion: -0.8418% SMIA TV distortion: -0.6821%
Scale: 1.000X, Wavelength: 0.5876 µm

Zemax
Zemax OpticStudio 19.4 SP1
Ground projector EVN projector lens 0803.zax
Configuration 3 of 5

1000mm

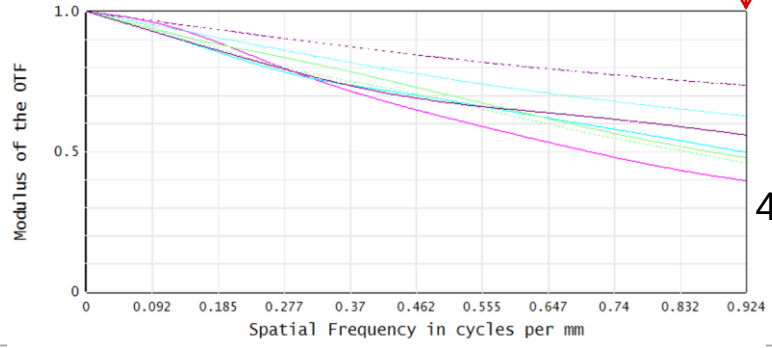
2 pixels



51%

850mm

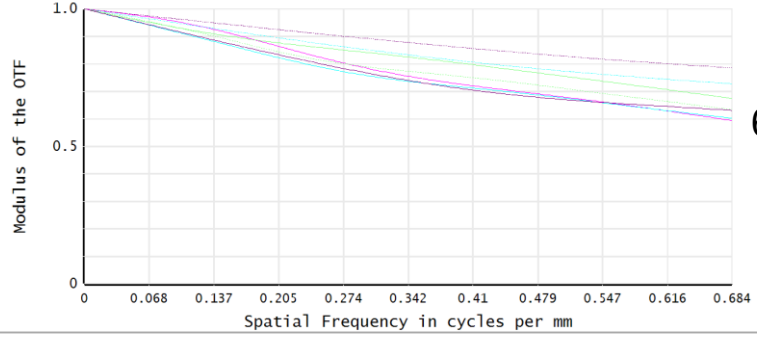
2 pixels



40%

1150mm

2 pixels

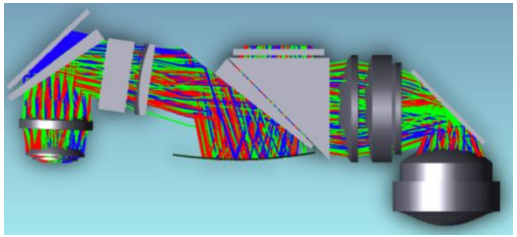
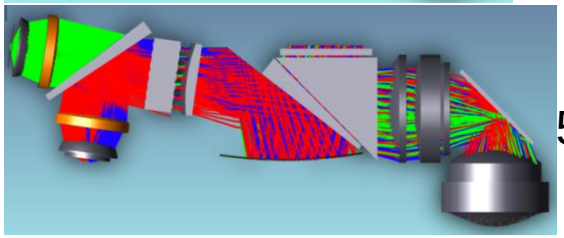
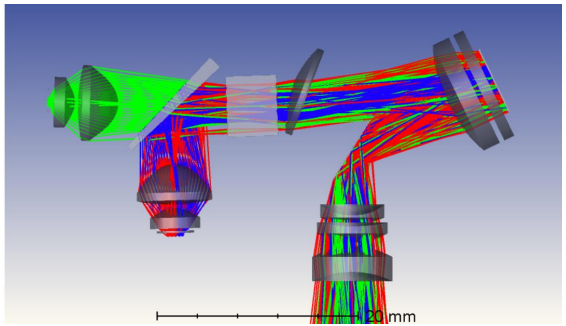


60%

Estimated Lumens Budget

Illumination	H9RM+Q7WM		
DMD	0.3 WVGA		
	TI assumption		
	Efficiency factor	Lumens	Comments
Lumens out of color balanced LED		86	Estimated White lumens at 1.5W LED Electrical Power
Transmission			
Collimator lenses	0.96	83	Transmission – AR coating losses
Dichroic Wedge	0.91	75	Losses due to filtering
Fly's Eye	0.93	70	Light tunnel estimated transmission
Illumination relay lens	0.98	68	AR coating loss
Field Lens	0.96	66	Two path, illumination + projection
Avg DMD efficiency	0.68	45	DMD efficiency (Mirror reflectivity + diffraction + fill + Transmission)
Projection Fold	0.97	43	
Projection lens (3 lenses)	0.94	41	Transmission of projection lens from coatings, field lens loss already calculated above
transmission overall efficiency (avg)	0.47		
geometric overall efficiency	0.65	26	
sequence efficiency	0.87	23	Automotive sequence ~87% due to multipulse
overall efficiency (avg)	0.27		
Total Lumens		23	Max brightness achievable (estimated)
System efficiency achieved (lm/Welec)		15 lm/W	Efficiency may be higher at lower lumen levels

Comparison Table

		Optical Size	System efficiency	Lumen output	Element Count
3-in-1		49 x 20 x 11 mm	31%	5.2 lm/W	15
2 channel Traditional		54 x 20 x 11 mm	28%	16 lm/W	16
2 channel Field lens		38 x 23 x 12 mm	27%	16 lm/W	12

Detailed element count

- 3-in-1:
  - 2 collimator lenses(1 channel), 1 wedged dichroic, 1 fly-eye, 1 illumination relay lens, 5 projection lens, 2 fold mirrors, 3 prisms(2 large and 1 wedged).
  - Total count: 15
- 2 channel traditional:
  - 4 collimator lenses(2 channel), 1 wedged dichroic, 1 fly-eye, 1 illumination relay lens, 5 projection lens, 1 fold mirrors, 3 prisms(2 large and 1 wedged).
  - Total count: 16
- **2 channel field lens:**
  - 4 collimator lenses(2 channel), 1 wedged dichroic, 1 fly-eye, 1 illumination relay lens, 4 projection lens(includes field lens), 1 fold mirrors.
  - Total count: 12