

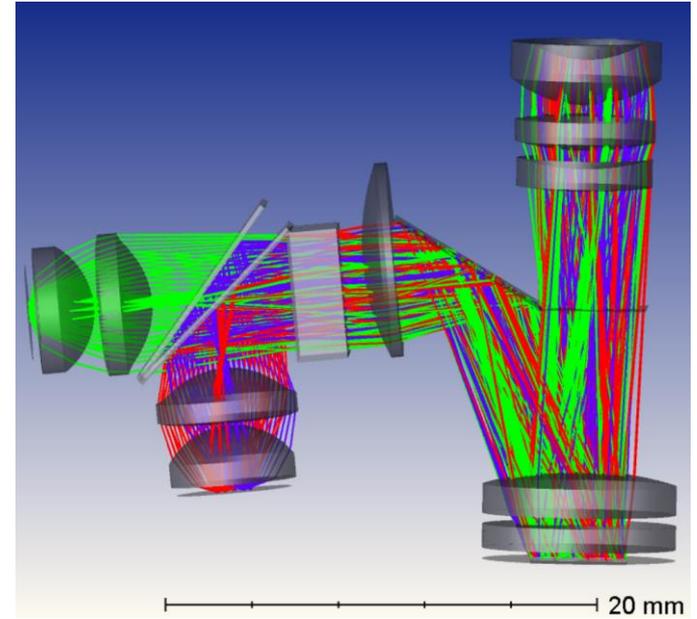
# DLP2021LEWQ1EVM Optical Design Overview

# Disclaimer

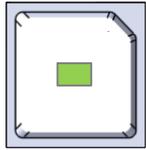
- Please use this document as a reference design only, changes might apply to a later version.
- No Tolerance Analysis or Thermal analysis has been done on this design.

# Optical Specification Target

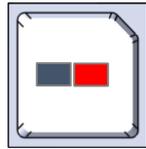
- 0.2" DLP chip (588x330) – DLP2021-Q1
- Throw Ratio: 2.4~
  - Image Diagonal:
    - 400 mm (projection distance 850 mm)
    - 470 mm (projection distance 1000 mm)
    - 540 mm (projection distance 1150 mm)
- F/3 - for no focus adjustment through projection distance 850-1150mm
- Power to the LED : ~1.5 W
- Engine Efficiency: 23.8lm/W (estimated with current preliminary data)
- Size: 30.8mm x 24.5mm x 9mm
- 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)



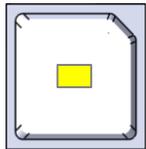
# Luminus SFT/SFM-03X Chipset Overview



**SFT-03X-CG**



**SFM-03X-RB**



**SFT-03X-W**

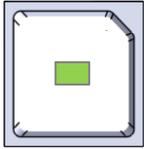
- Emitting area  $0.75 \times 0.46 \text{ mm}^2$  ( $0.345 \text{ mm}^2$ ) for all colors
- Etendue-matched to DLP2021 Automotive DMD at f/3.0
- Engine configurations:
  - Full color RGB engine (2 channels)
  - White (1 channel)
  - Monochromatic Red for future consideration (contact Luminus)
- Large dynamic range: CG, B up to 1.75A; RA, White up to 1.4A
  - Typical drive current in DGP applications: ~ 500 mA (1.5W)
- Package: Prototypes in 3.0 mm x 3.0 mm SMT package.
  - Isolated thermal pad with high thermal conductivity
- Automotive Qualification in progress

# SFT/SFM-03X Performance

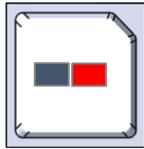
	 CG	 RA	 B	 W
Optical Output @ 0.5A	205 lm	72 lm	0.65W	150 lm
Forward Voltage @ 0.5A	3.10V	2.5V	3.10V	3.10V
Dom. Wavelength (W: CCT)	554 nm	612 nm	453 nm	6000K typ

*All parametric values are typical values for initial engineering samples at single 20 ms pulse, 25C ambient test condition*

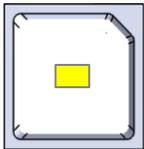
# Luminus SFT/SFM-03X Chipset Introduction



**SFT-03X-CG**



**SFM-03X-RB**



**SFT-03X-W**

- Emitting area  $0.75 \times 0.46 \text{ mm}^2$  ( $0.345 \text{ mm}^2$ ) for all colors
- Etendue-matched to DLP2021 Automotive DMD at f/3.0
- Engine configurations:
  - Full color RGB engine (2 channels)
  - White (1 channel)
  - Monochromatic Red for future consideration (contact Luminus)
- Large dynamic range: CG, B, White up to 1.75A; RA: up to 1.4A
  - Typical drive current in DGP applications: ~ 500 mA (1.5W)
- Package: Engineering samples in 3.0 mm x 3.0 mm EMC package.
  - Isolated thermal pad with high thermal conductivity
  - Production package: TBD
- Automotive Qualification in progress

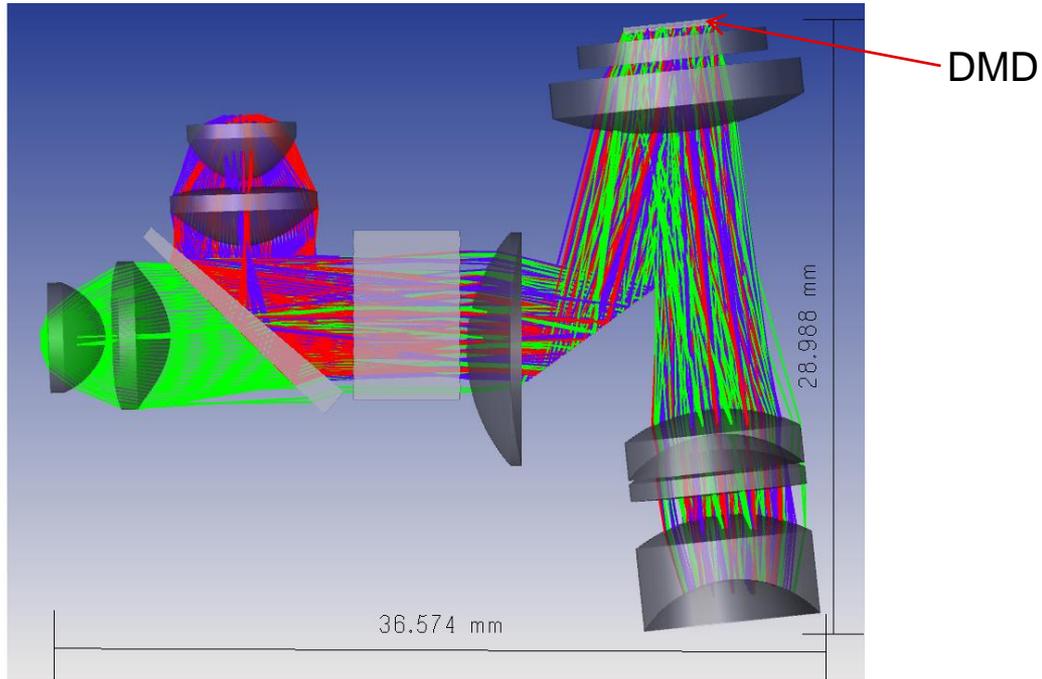
# SFT-03X Performance



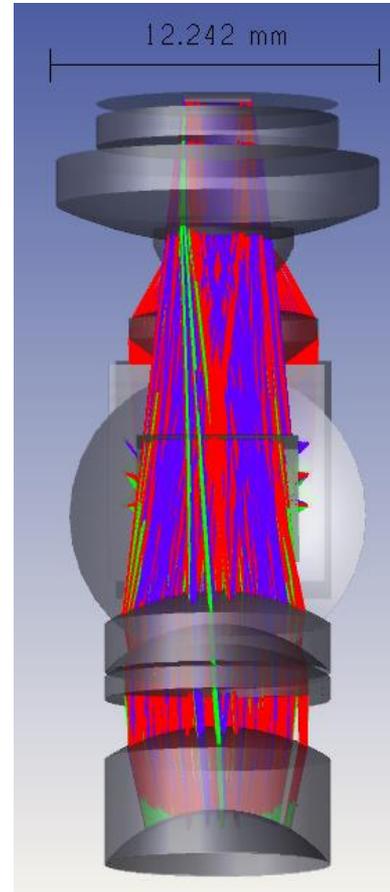
	 CG	 RA	 B	 W
Optical Output @ 0.5A	205 lm	72 lm	0.65W	150 lm
Forward Voltage @ 0.5A	3.10V	2.5V	3.10V	3.10V
Dom. Wavelength (W: CCT)	554 nm	612 nm	453 nm	6000K typ

*All parametric values are typical values for initial engineering samples at single 20 ms pulse, 25C ambient test condition*

# System layout

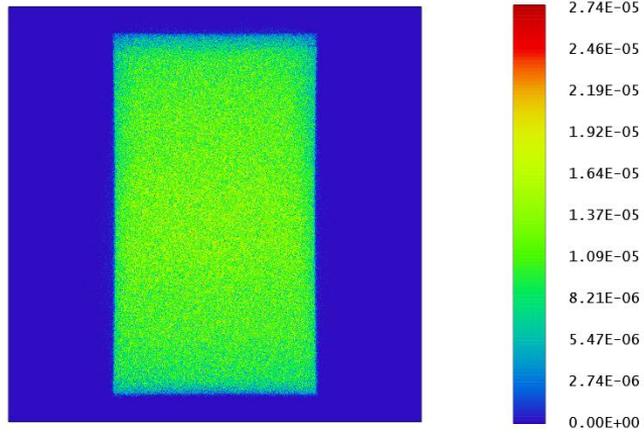


$29.0\text{mm} \times 36.6\text{mm} \times 12.2\text{mm} = 12.9\text{cc}$



# Optical System Performance

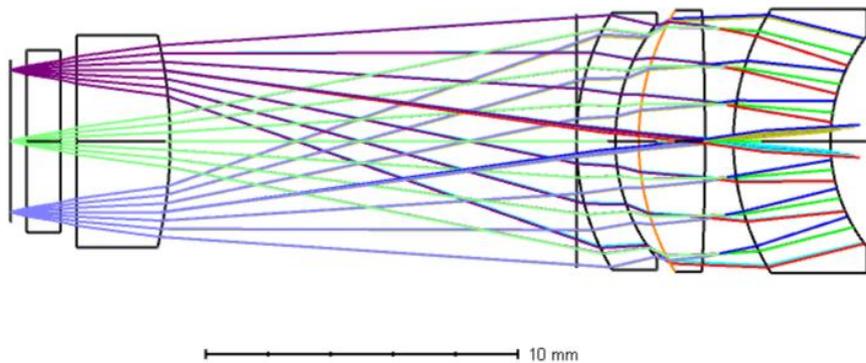
## Uniformity at image plane



- Geometric Efficiency
- RGB 73% / 74.9% / 69%

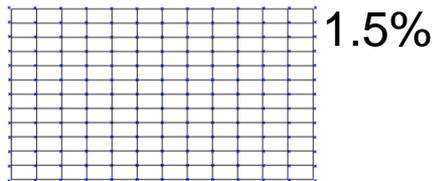
Image Diagram	
11/16/2021 Image Width = 400.0000 Millimeters, 500 x 500 pixels Field position: 0.0000, 0.0000 mm Percent efficiency: 72.376%, 7.238E-01 Watts	Zemax Zemax OpticStudio 19.4 SP1
Surface: 61. Units are watts per Millimeters squared.	20210621 02inch Ground projector EVM-2.zmx Configuration: All 3

# Projection Lens

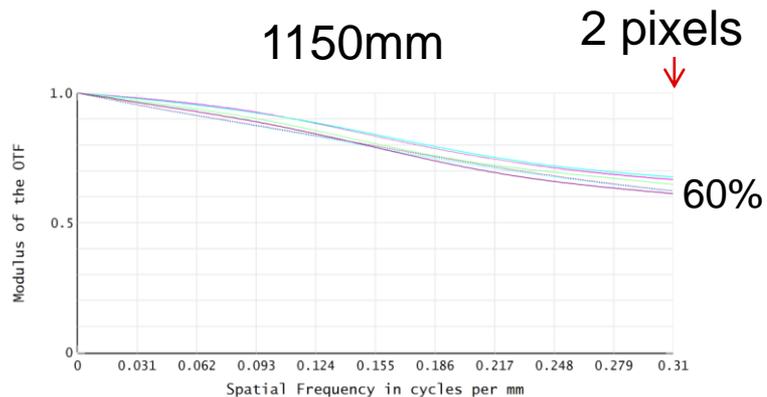
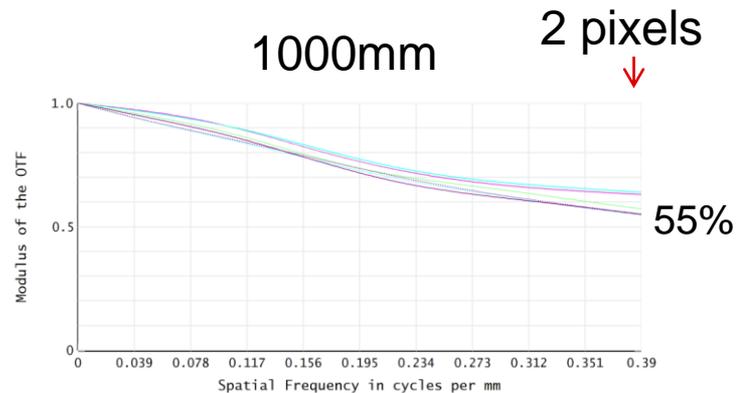
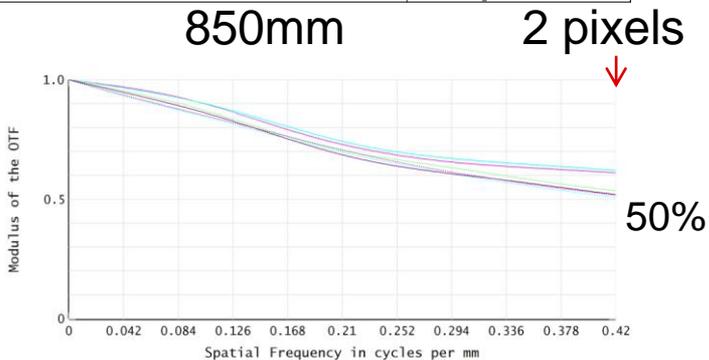


- All surfaces are spherical
- Material Used left to right (Schott Preferred)
  - H-ZLAF52
  - H-ZF52
  - H-LAK53B
  - H-ZF52
  - Telecentric @ DMD

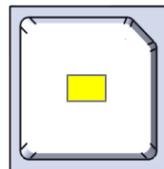
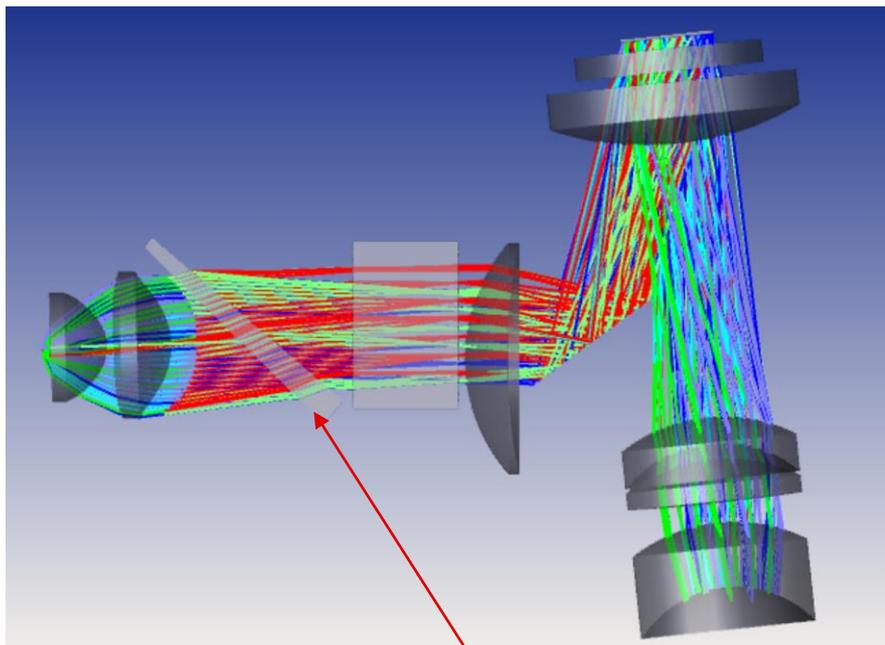
# Distortion & MTF



11/16/2021 Field: 3.65 w 2.05 h Millimeters Image: 281.39 w 158.28 h Millimeters Maximum distortion: 1.5167% SMIA TV distortion: 1.1582% Scale: 1.000X, wavelength: 0.5876 $\mu\text{m}$	Zemax Zemax OpticStudio 19.4 SP1 20210621 02Inch Ground projector lens.zos Configuration 1 of 3
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# White System Modified from RGB Version



SFT-03X-W

Same Size White LED  
from Luminus (more  
info in slide 5)

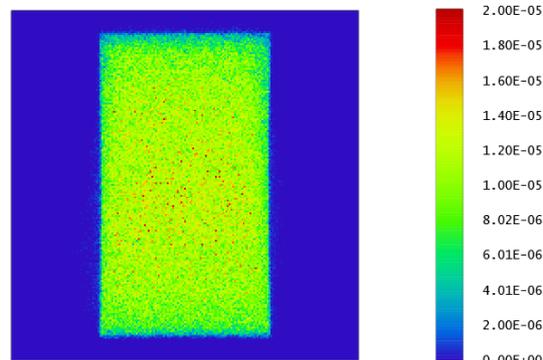


Image Diagram	
11/23/2021 Image width = 400.0000 Millimeters, 201 x 201 pixels Field position: 0.0000, 0.0000 mm Percent efficiency: 69.161%, 6.916E-01 Watts Surface: 61. Units are watts per Millimeters squared.	Zemax Zemax OpticStudio 19.4 SP1 20210821 021inch Ground projector white LED.ewm.aax Configuration 1 of 1

Note: Dichroic wedge could be removed.

# Estimated Lumens Budget White

Illumination	Luminus SFT-03X-W		
DMD	DLP2021-Q1 (0.2" 588x330 )		
	TI assumption		
	Efficiency factor	Lumens	Comments
Lumens out of color balanced LED		140	Estimated White lumens at 1.5W LED Electrical Power, 60C board.
Transmission			
Collimator lenses	0.96	134	Transmission – AR coating losses
<del>Dichroic Filters</del>	<del>0.91</del>		<del>Losses due to filtering</del>
Fly's Eye	0.93	125	Fly's eye estimated transmission
Illumination relay lens	0.98	123	AR coating loss
Field Lens	0.96	118	Two path, illumination + projection
Avg DMD efficiency	0.67	79	DMD efficiency (Mirror reflectivity + diffraction + fill + Transmission)
Projection Fold	0.97	76	
Projection lens (3 lenses)	0.94	72	Transmission of projection lens from coatings, field lens loss already calculated above
<b>transmission overall efficiency (avg)</b>	<b>0.51</b>	72	
<b>geometric overall efficiency</b>	<b>0.69</b>	50	
<del>sequence efficiency</del>	<del>0.87</del>		<del>Automotive sequence ~87% due to multipulse</del>
<b>overall efficiency (avg)</b>	<b>0.35</b>		
<b>Total Lumens</b>		<b>33</b>	Max brightness achievable (estimated)
System efficiency achieved (lm/Welec)		33 lm/W	Efficiency may be higher at lower lumen levels