

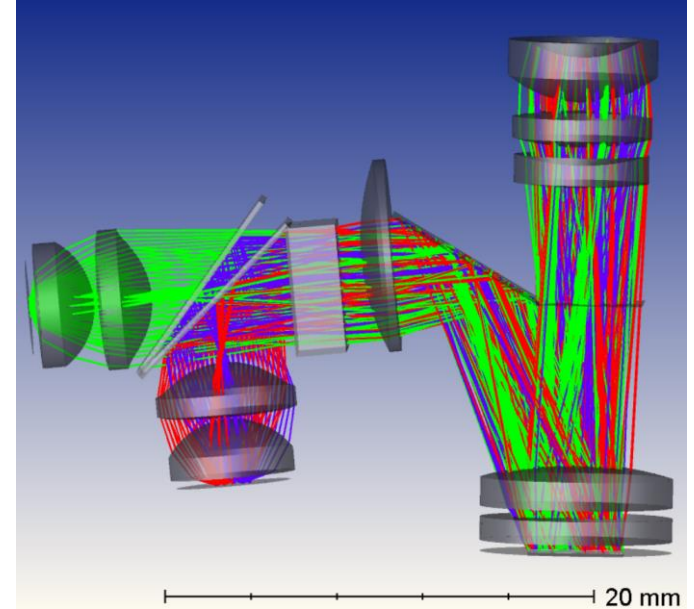
DLP2021LEWQ1EVM Optical Design Overview

Disclaimer

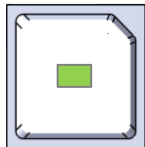
- Please use this document as a reference design only, changes might apply to a later version.
- No Tolerance Analysis or Thermal analysis has been done on this design.

Optical Specification Target

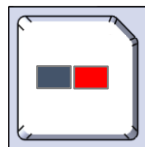
- 0.2" DLP chip (588x330) – DLP2021-Q1
- Throw Ratio: 2.4~
 - Image Diagonal:
 - 400 mm (projection distance 850 mm)
 - 470 mm (projection distance 1000 mm)
 - 540 mm (projection distance 1150 mm)
- F/3 - for no focus adjustment through projection distance 850-1150mm
- Power to the LED : ~1.5 W
- Engine 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)



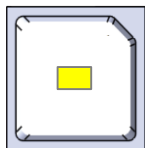
Luminus SFT/SFM-03X Chipset Overview



SFT-03X-CG



SFM-03X-RB






SFT-03X-W

- Emitting area $0.75 \times 0.46 \text{ mm}^2$ (0.345 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: $\sim 500 \text{ mA}$ (1.5W)
- Package: Prototypes in $3.0 \text{ mm} \times 3.0 \text{ mm}$ SMT package.
 - Isolated thermal pad with high thermal conductivity
- Automotive Qualification in progress

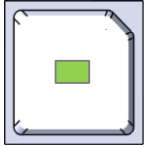
SFT/SFM-03X Performance



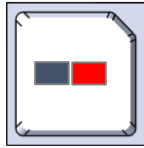
	 CG	RA	 B	 W
Optical Output @ 0.5A	205 lm	72 lm	0.65W	150 lm
Forward Voltage @ 0.5A	3.10V	2.5V	3.10V	3.10V
Dom. Wavelength (W: CCT)	554 nm	612 nm	453 nm	6000K typ

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

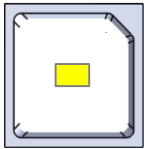
Luminus SFT/SFM-03X Chipset Introduction



SFT-03X-CG



SFM-03X-RB






SFT-03X-W

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- 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

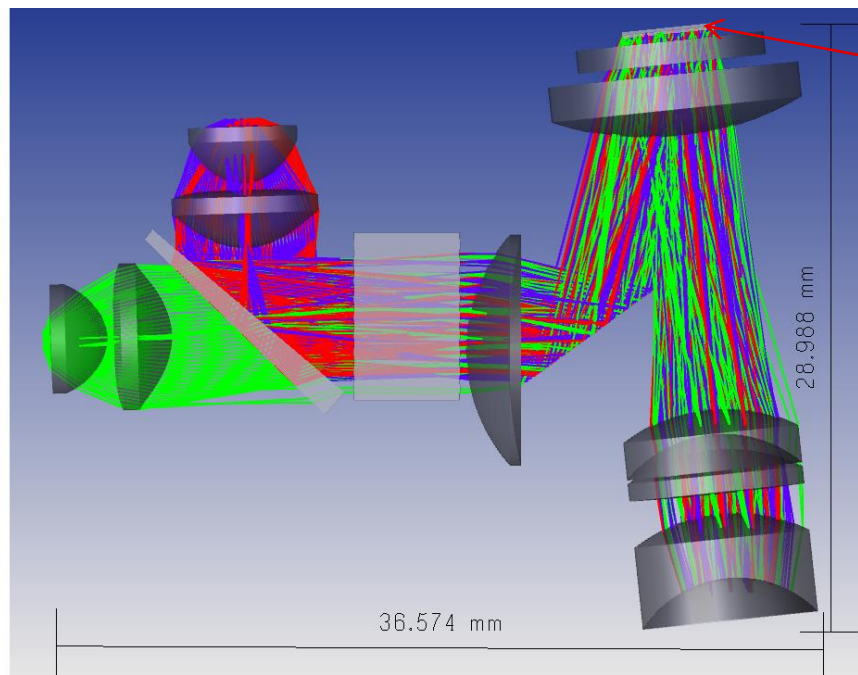
SFT-03X Performance



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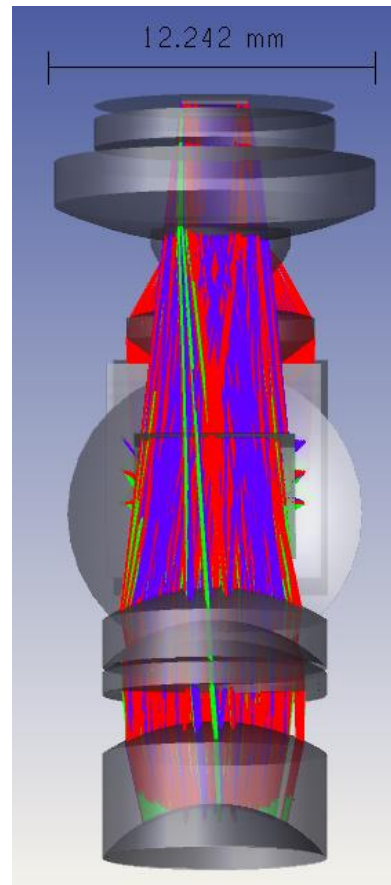
All parametric values are typical values for initial engineering samples at single 20 ms pulse, 25C ambient test condition

System layout



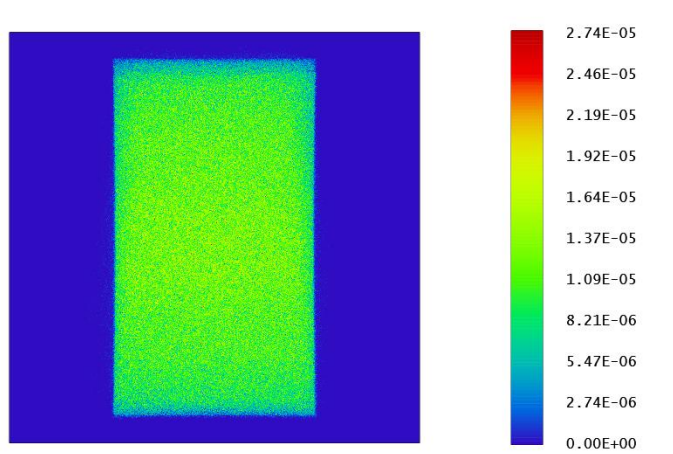
DMD

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



Optical System Performance

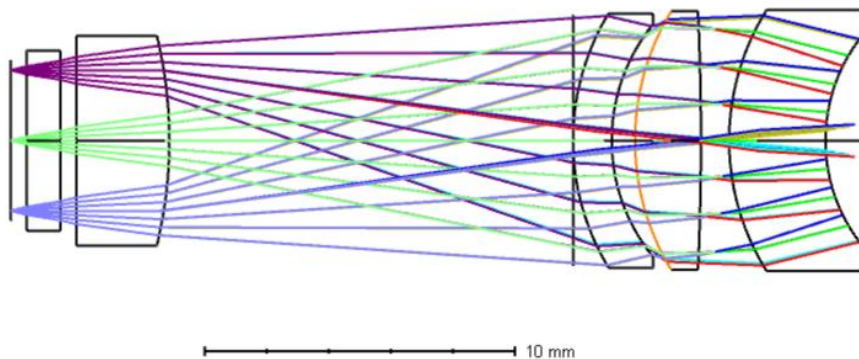
Uniformity at image plane



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

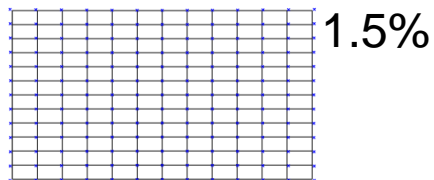
Image Diagram	
11/16/2021 Image Width = 400.0000 Millimeters, 500 x 500 pixels Field position: 0.0000, 0.0000 mm Percent efficiency: 72.376%, 7.238E-01 Watts Surface: 61. Units are watts per Millimeters squared.	Zemax Zemax OpticStudio 19.4 SP1 20210621 02inch Ground projector EVM-2.zmx Configuration: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

Projection Lens

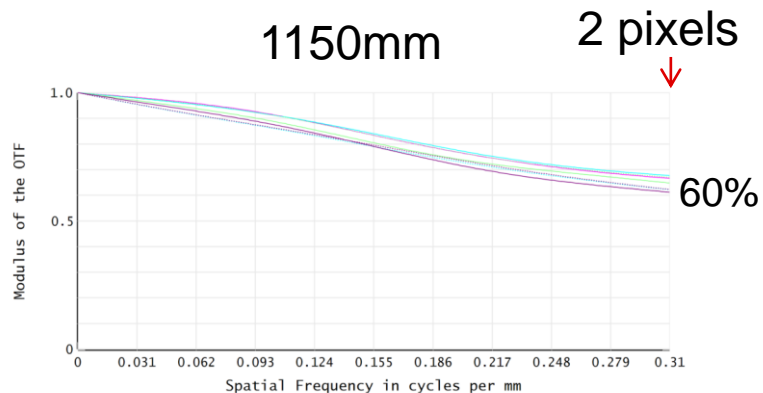
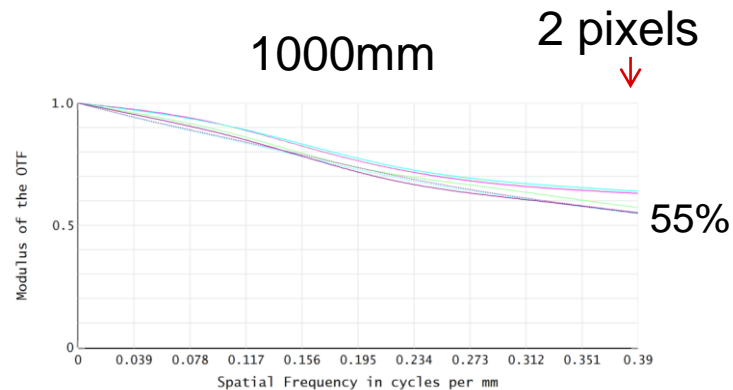
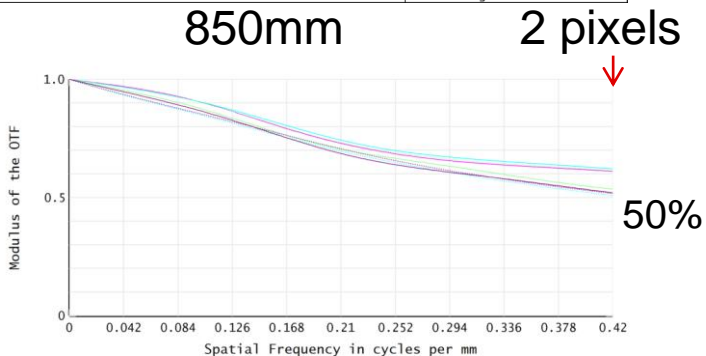


- All surfaces are spherical
- Material Used left to right (Schott Preferred)
 - H-ZLAF52
 - H-ZF52
 - H-LAK53B
 - H-ZF52
 - Telecentric @ DMD

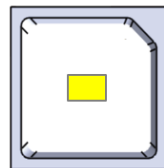
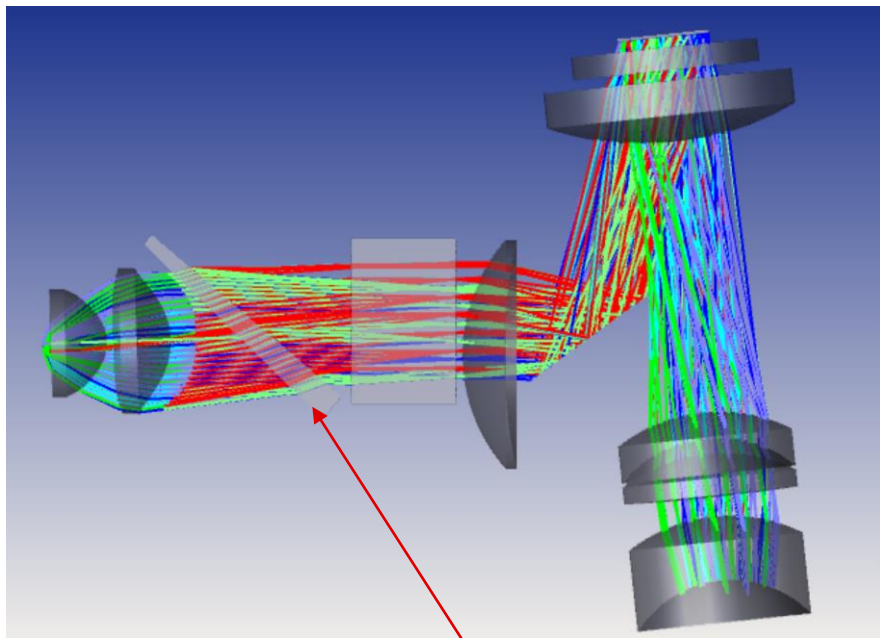
Distortion & MTF



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 μm	Zemax Zemax OpticStudio 19.4 SP1 20210621 02Inch Ground projector lens.zos Configuration 1 of 3
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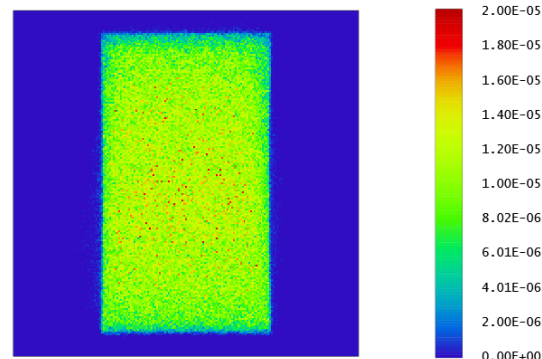


White System Modified from RGB Version



SFT-03X-W

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



Note: Dichroic wedge could be removed.

Image Diagram	
11/22/2021 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 20210621 021inch Ground projector white LED ESW.max Configuration 1 of 1

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
Dichroic Filters	0.91		Losses due to filtering
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
transmission overall efficiency (avg)	0.51	72	
geometric overall efficiency	0.69	50	
sequence efficiency	0.87		Automotive sequence ~87% due to multipulse
overall efficiency (avg)	0.35		
Total Lumens		33	Max brightness achievable (estimated)
System efficiency achieved (lm/Welec)		33 lm/W	Efficiency may be higher at lower lumen levels