

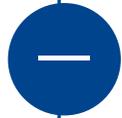


Popular Lighting System in China

=10K pixels level lighting or 1M pixels lighting

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The trends of lighting system in China market



10K pixels and 1M pixels lighting introduction



Summary and Outlook

>>>> Generalized Pixel lighting in life

Very common pixel lighting scenes in China :

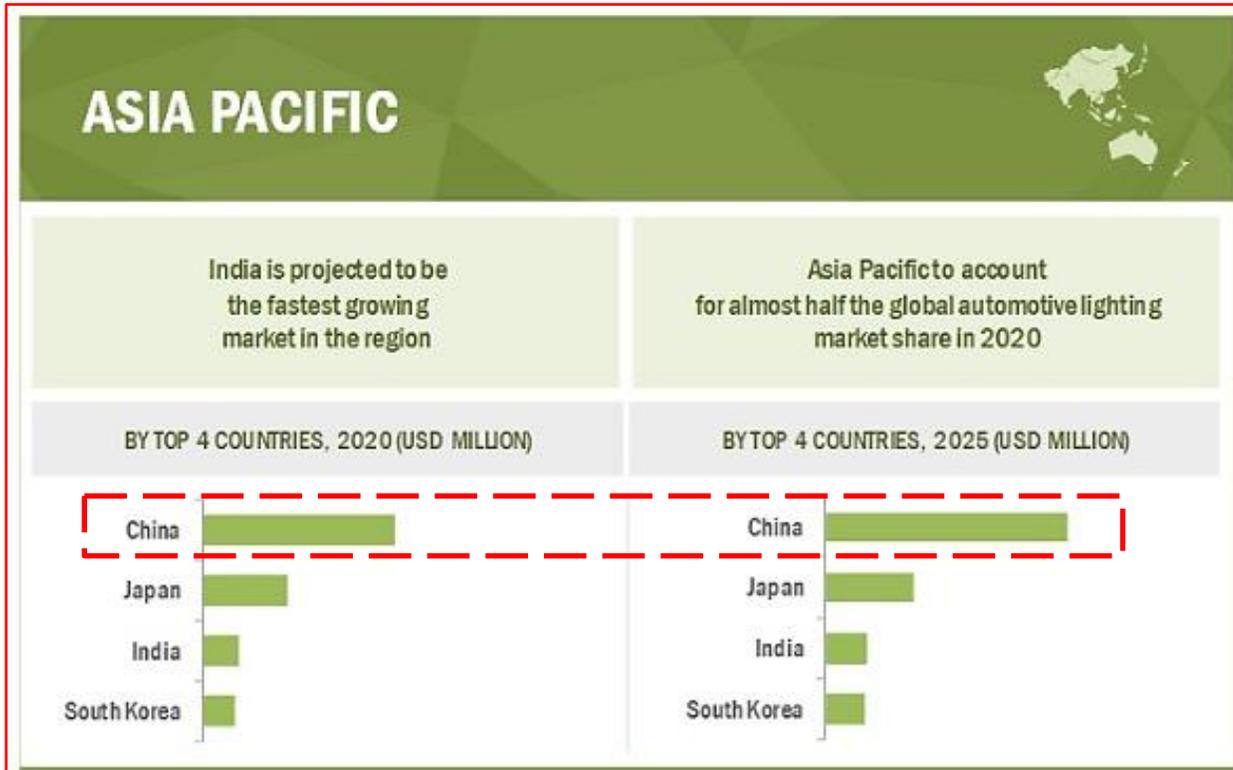


National flag lighting show on building wall



Chinese characters projection on the ground in the National Museum

>>>>> The Largest Lighting Market

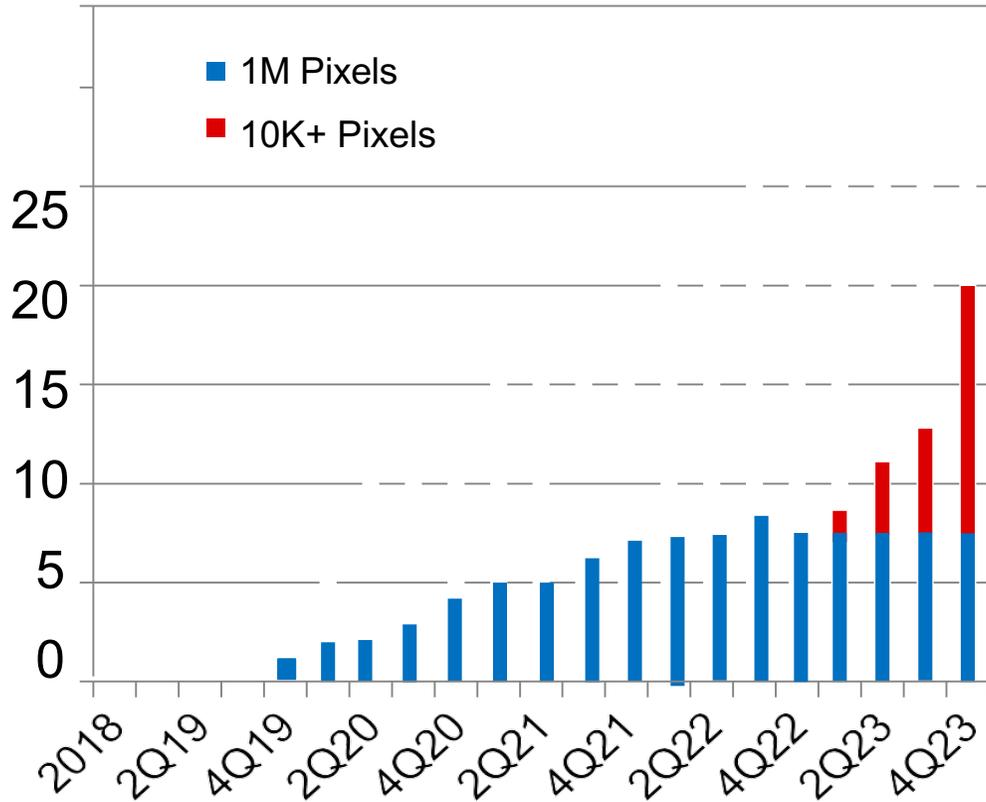


- China is **the largest market** in the global automotive lighting market
- China also got **the largest shares** within the market due to the high production & sales of vehicles domestically
- Domestic and foreign manufacturers have **increased their investment** in China's automobile lamp market, especially Full LED lamp

Source from <https://www.marketsandmarkets.com/Market-Reports/automotive-lighting-market-1133.html>

>>>>> Pixel lighting Market

Car Model Ramps in China with HD Pixel Lighting Headlight



- 20 car models on the road by 2023
- The application of HD Pixel lighting has just started
- 1M pixels solution is on the slow rise
- 10K+ pixels solution shows rapid development

>>>>>> Pixel lighting Styling

The current style of pixel headlight in mass production:



- Diversified style: circular lens, special-shape lens(concave shape), rectangle lens
- Bezel with different color to highlight “pixel”

>>>>> New Functions of pixel lighting

- China OEM's are very interested in new lighting technologies. Very dynamic market.
- The introduction of new functions and technologies is faster than in the traditional markets.

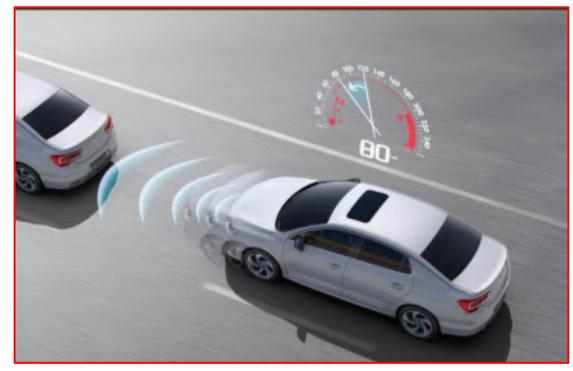
Headlight with entertainment
HiPhi X



Digital light/ Commination



AI & Connectivity



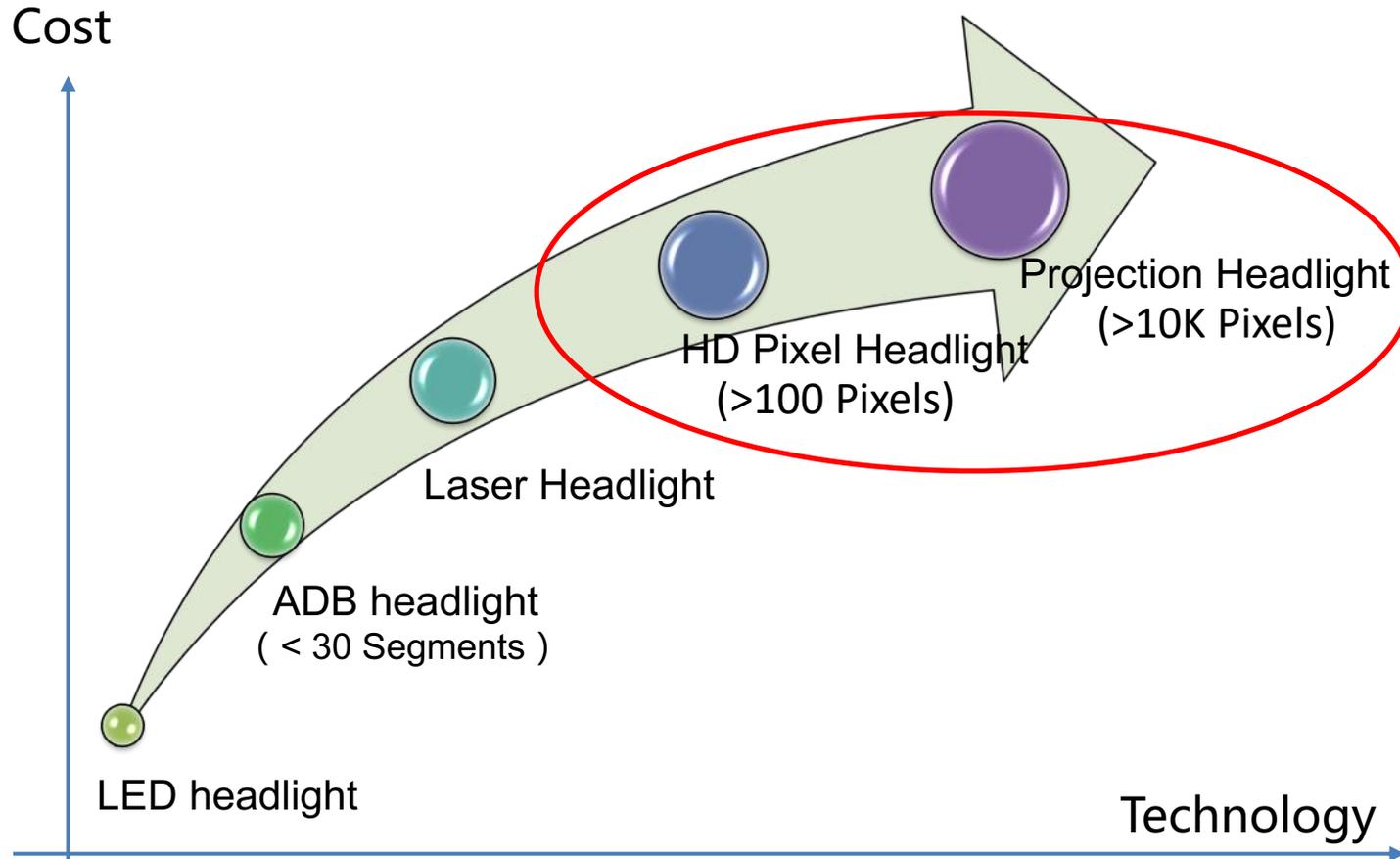
EV carmakers are relatively radical in the application of the new headlights technology.

EV cars are achieving an important percentage (5.4%) in the market share of new cars in China **with growth of 11%**.

Projections, illuminated logos, illuminated grills, **HD lighting** are getting higher popularity among Chinese EV OEM's.

>>>>>> Pixel headlight Cost

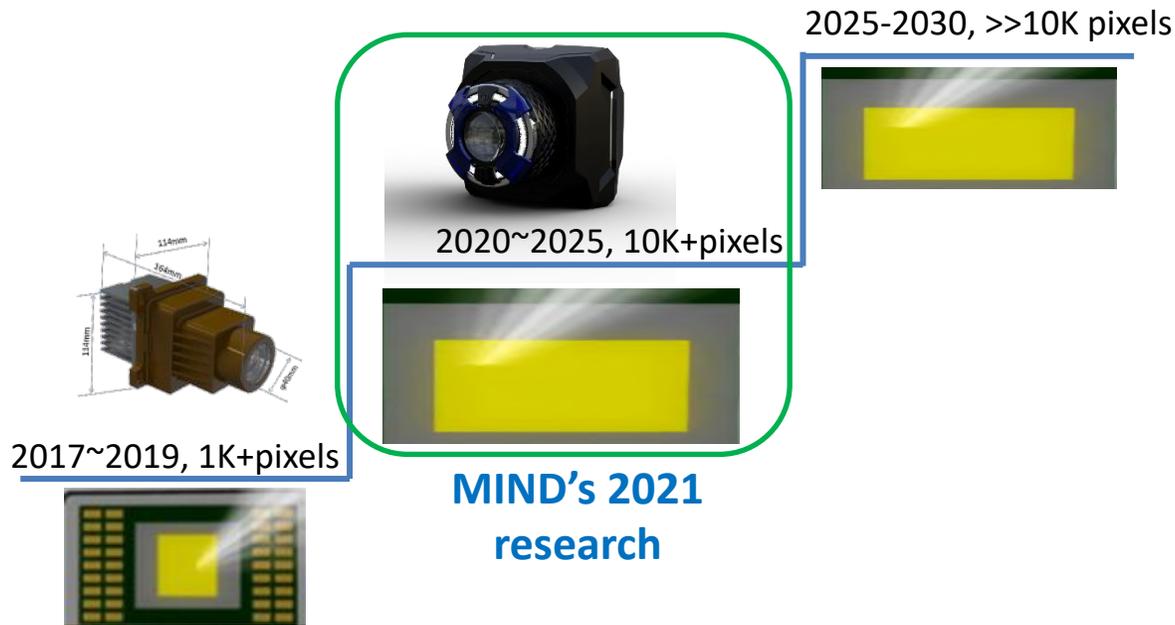
- The cost of pixel headlamp is a significant proportion in the final price of the whole vehicle.



- The high cost of HD-pixel is one of the limitations in the mainstream range cars.
- The regulation is other bottleneck in the popular introduction of HD-pixel.
- The supplier chain supporting HD-pixel lighting product has just begun to emerge.

>>>>> 10K pixels lighting

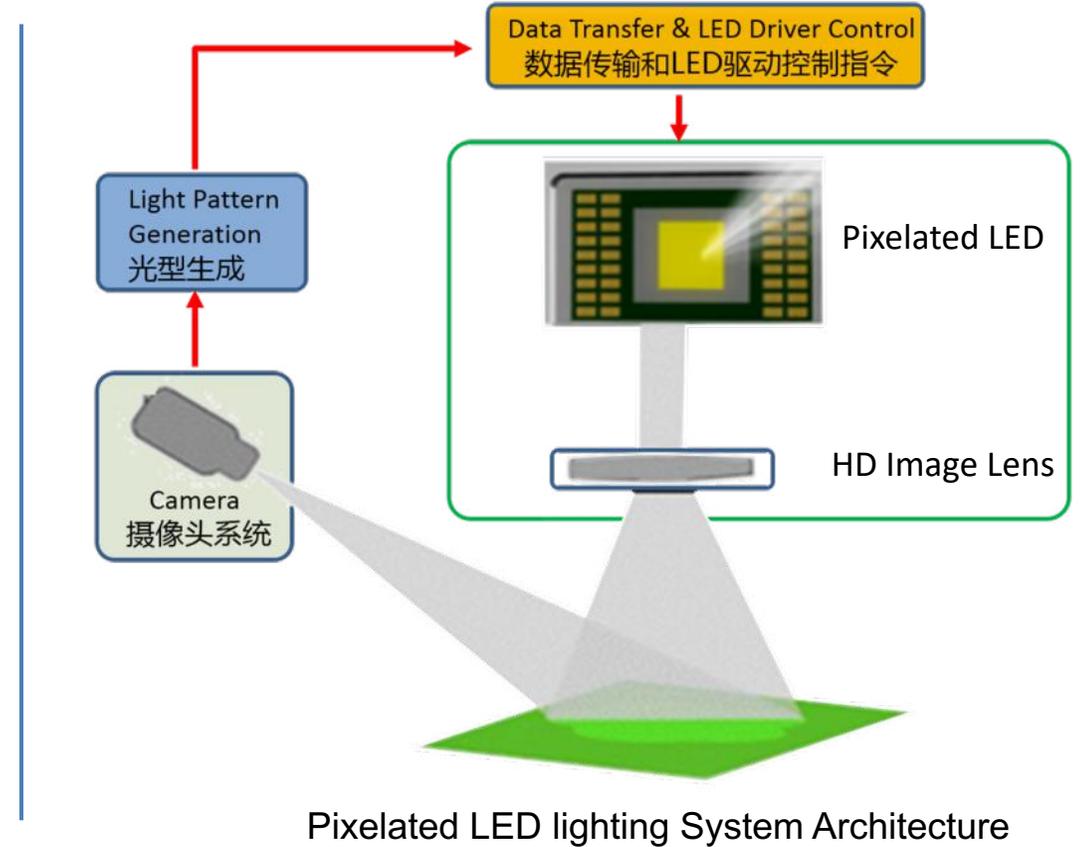
➤ Pixelated LED Technology trends



Target

- More Pixels in Only One LED Chip
- Large Aspect Ratio of LED is suitable for full LB & HB
- Same **System Architecture** for different pixel number

System Architecture



10K pixels lighting nowadays (2021-2025), is more suitable in terms of brightness and beam width.

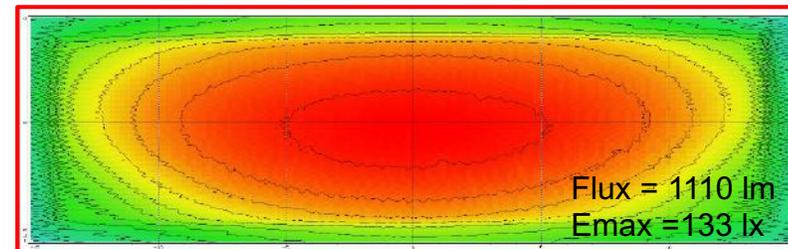
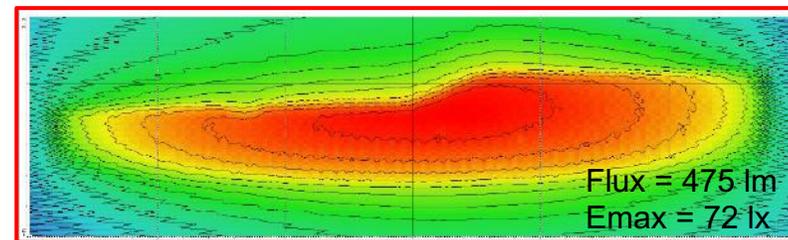
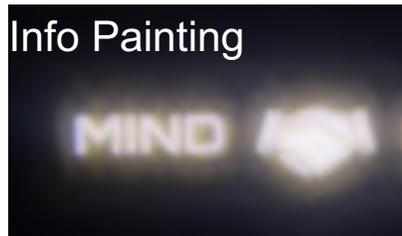
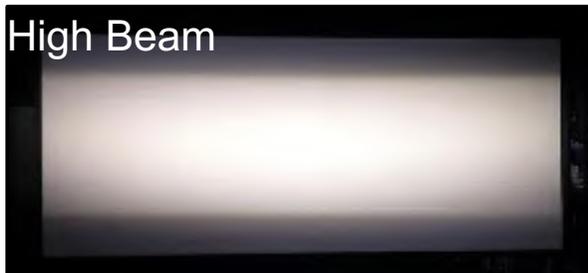
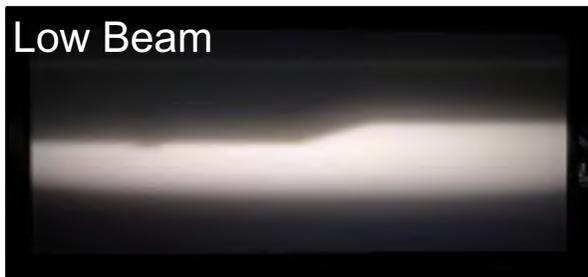
>>>>> 10K pixels lighting

- MIND's 10K pixels lighting prototype with HD pixel LED



10K Pixels Module	
Functionalities	LB, Full ADB & Projection
Power	50W
Aspect Ratio	4:1
Resolution	0.08° for H20°
Lens Size	D40mm
Lenses Material	x2 PC, x1 PMMA, x1 PMMI
Cooling	Active
Efficiency	> 30%

Light Pattern Lit



High Flux output and Large Aspect Ratio makes Wider FOV, suitable for LB/HB functions

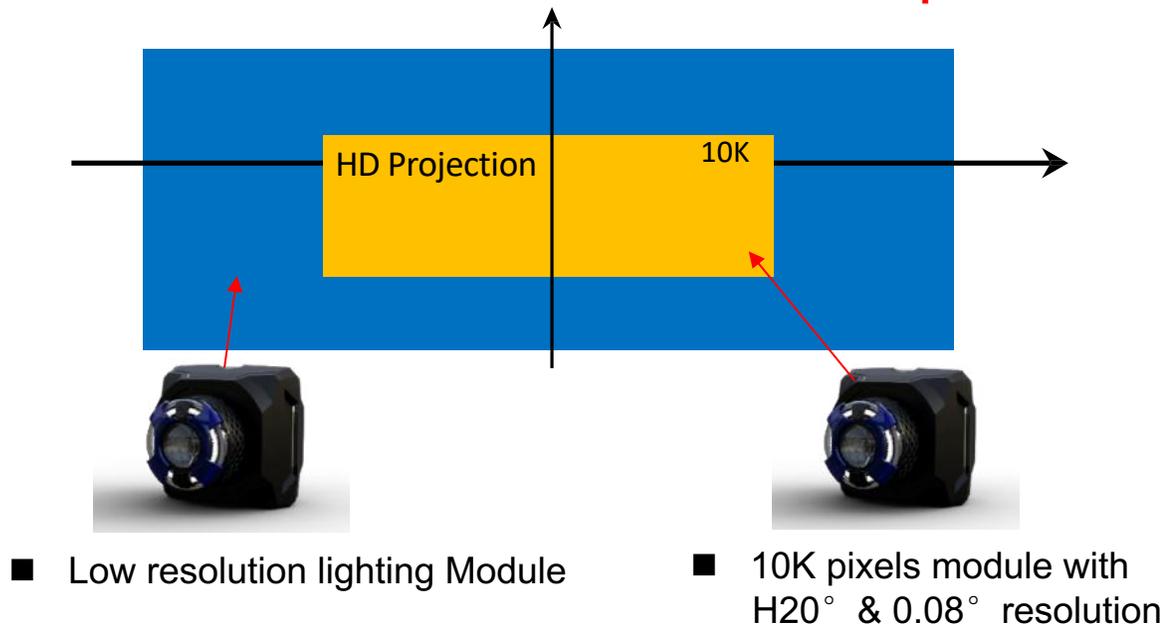
>>>>> 10K pixels lighting

➤ MIND 10K pixels headlight application with HD pixel LED

- HR ADB and Projection Application

1. Full HD Headlight: 2 X 10K pixels modules + LB Foreground Lighting

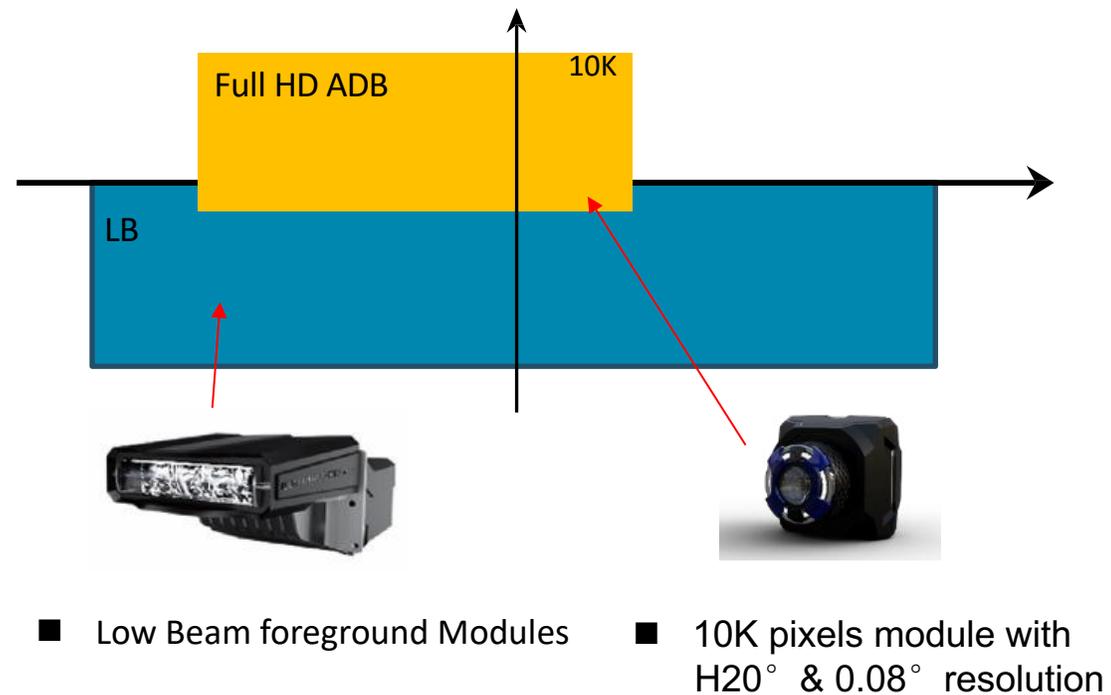
Two 10K HD Module / Headlamp



2. Economical Solution : 10K HD module + ADB (1 row) + Low Beam

One 10K HD Module / Car

- Full HR ADB Application



One 10K HD Module / Headlamp

>>>>>> 1M pixels lighting

- For symbol projection with higher resolution and detail, we need even more than 10K pixels, thus, 1M pixel is a current available option.
- Series 1M-Pixel lighting for MIND OE – SOP Q4.2019



1.3M DLP Module parts



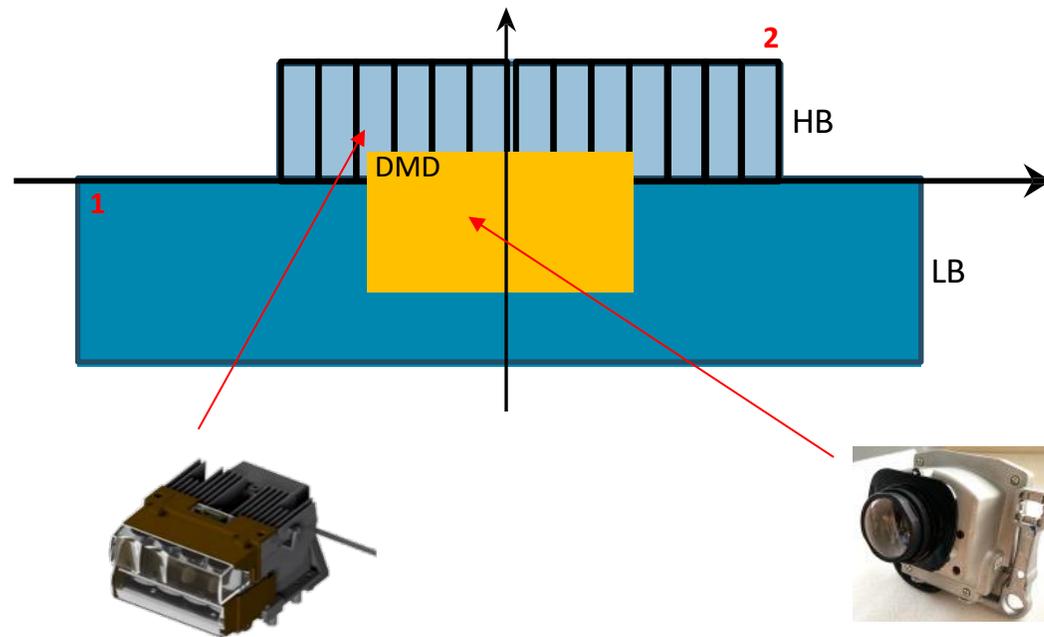
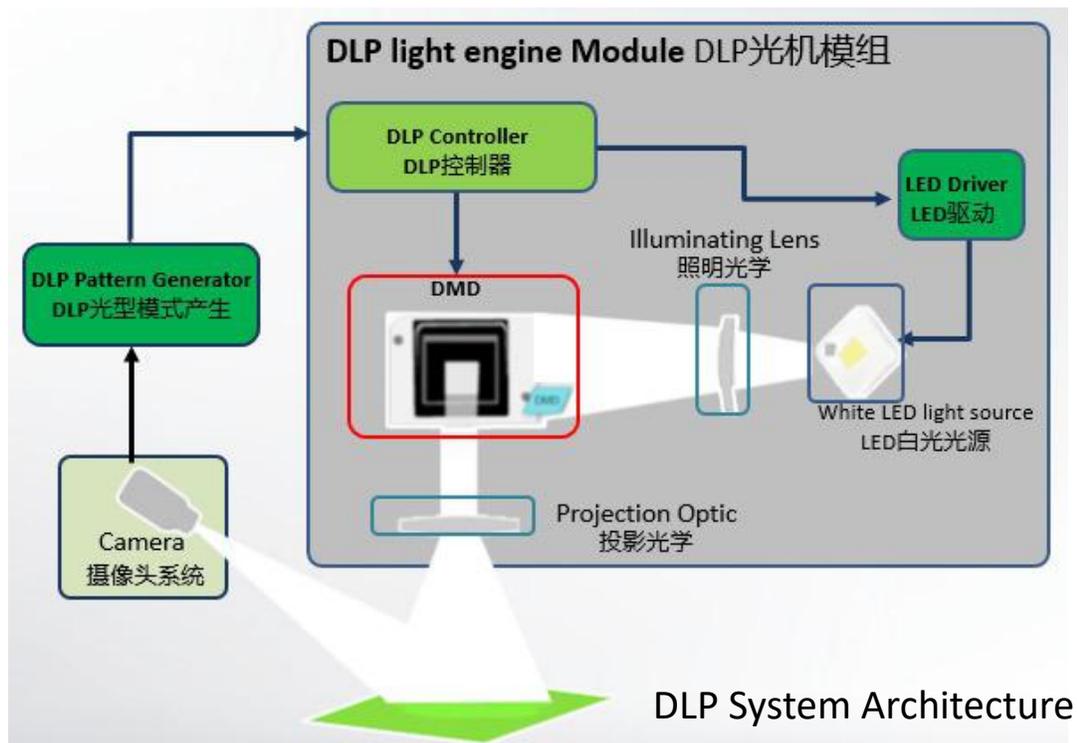
VV6 DLP Headlight with 1.3M pixels

1M pixels DLP Module	
Functionalities	HB ADB/Ground Painting/ Dynamic Cut-off Line of LB
Flux (@25° c)	1045 LM
E _{max} (@25° c)	91 LX
Power	55 W
Resolution	0.03°
Lens size	Φ36 MM
Cooling	ACTIVE
Maturity	2019 Q4 SOP

>>>>>>

1M pixels lighting

➤ 1M pixels lighting system based DLP Technology



■ Auxiliary Lighting Modules

■ 1M Pixel Module

1. ADB (1 row) + LB foreground

Main Challenges: Cost reduction & Electric control system simplification

>>>>>> 1M pixels lighting

➤ Headlight application case : Projection and illumination combination or Only road Projection

❑ Projection & illumination case Requires :



1. High contrast
2. Illumination requires Wider FOV
3. High luminance for ADB function
4. Light Pattern Fusion with aux LB/HB
5. Different control data for segment & 1M resolution ADB function
6. 2 DLP Module / Car



❑ Road Projection case Requires :



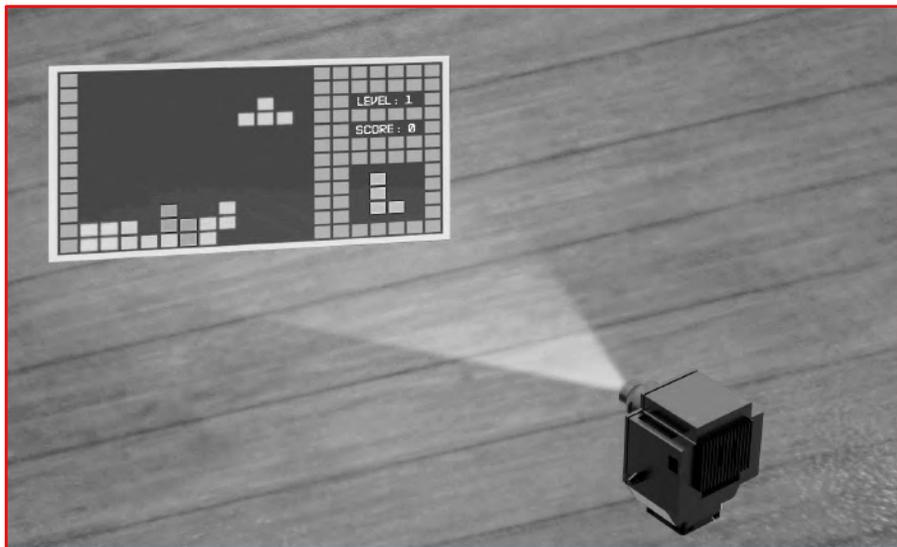
1. High contrast
2. Lower FOV and high brightness
3. Low complexity as only projection
4. Only one DLP Module / Car

Revert to the projection essence of DLP Technology makes high performance of road painting and System integration

>>>>>> 1M pixels lighting

- Special function requirements of OEM's in China

“Playable” pixel light



Play Tetris game with steering wheel

Customized projection contents



“I love you” Emotional expression by App

Create innovation lighting functions and dedicated “playable light or emotional light ” tag for China OEM is of great importance to some extent.

>>>>>> Lighting performance 10K VS 1M

➤ Brighter & Wider & Intelligent lighting: high score in IHS and C-NCAP assessments. Competitive lighting performance.

Item	Feature	10K pixels solution	1M pixels solution
1	Resolution	≈0.08°	≈0.03°
2	FOV	[20°H, 5°V]	[16°H , 8°V]
3	E _{max} @25m	>133 lx	≈100 lx
4	Functionalities	Full ADB	Require Aux. lighting for Full ADB
5	Headlight Application	①x1 10K HD LB e.g. [40°H , 10°V] ②x1 10K Full ADB	①Auxiliary Full ADB ②Auxiliary Low Beam ③1M pixel
6	Power consumption	50w	55w
7	Cost	++	++++

10K Pixel lighting module seems to be more suitable as HD lighting Trend regarding “lighting performance” for OEM’s in China

>>>>> Road surface projection 10K VS 1M

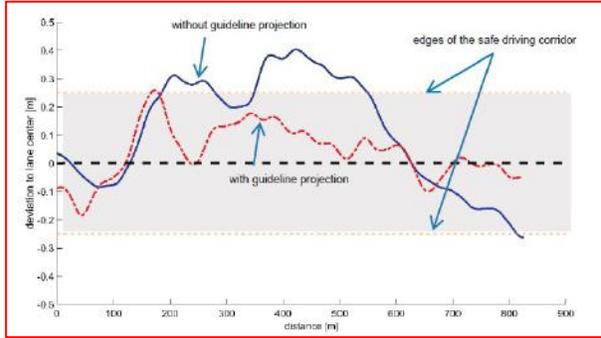
Limited Projection symbols on the road surface that have been verified to be able to assist driving at present.

- Guidelines Projection by 1M Pixels Module

Source from ISAL 2019



guideline in the construction zone projected by a DMD module



Deviation of the car axis to the center of the lane with and without guideline projections

That lines symbols(e.g. Guidelines) do not need high resolution pixels



10K pixels Guidelines projection



Logo Info by 10K pixels prototype

The drivers center their own car better to the center of the own lane with guidelines projected to the road in front of the car by a high resolution lighting module.

- That the projection of symbols on the road do not distract other drivers (TU Darmstadt)

**1M Pixels can provide highest resolution info on the road, but is necessary such a high resolution?
10K pixels can provide acceptable and lower cost symbols projection.**

>>>>>>>. MIND's Pixel Lighting Target 10K VS 1M

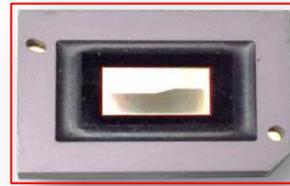
How can we combine the advantages of 10K and 1M pixel lighting?

Good illumination performance



10K Pixels with large AR
(256px*64px)

Good projection quality



1M Pixels
(1152px*576px)

- ✓ Preferred Pixelated LED technology as we are most familiar with LED lighting
- ✓ Keep the large AR(4:1) feature for illumination
- ✓ Improve the resolution to 0.03° in V-direction same as 1M pixel headlight
- ✓ Unified data interface for vehicle interface

- The rapid growth of the LED industry and strong market demands drives
- More Pixelated LED source companies are involved in the pixel lighting field
- Support good illumination and innovations functions

MIND's Pixel lighting Target: 100K pixels(720px*180px)

>>>>>>>> Regulations

Regulation status in China :

- Projection of the logo when the vehicle is stationary is allowed (such as Logo lamp, Welcome Carpet Lamp)
 - Headlight projection graphics and symbols for assisted driving and interactive functions are under discussion
 - The implementation of China's regulations generally lags behind ECE regulations by 2-3 years
-

Mind's thinking to regulation on pixel light application :

- Regulations should not become an obstacle for technology, innovation and application. Development and Innovations must be promoted by OEM / Tier1 / Regulation;
- Harmonization and Synchronization between UN Regulations and Chinese GB Standards;
- China's domestic Tier1 or OEMs must actively participate in the preliminary demonstration of regulations;
- The HD pixel lighting should be developed in a way that only with software updates would be able to follow the latest regulation changes.

OEM's and customer's expectation summary on pixel lighting in China:



- Providing new functions like road projection to improve user experience without sacrificing basic lighting performance will be the trends of pixel lighting in China.
- 10K pixel lighting would be the more promising pixel headlight solution in China currently.
- 1M pixels lighting would be the better choice in scenes that require high-definition and dynamic projection capabilities, even colorful lighting in areas around the vehicle.
- In headlight application, 100K pixel lighting will dominate the market after it comes out in the future
- 10K and 1M pixels lighting will coexist in the next 5 years.



谢谢！
Thank You !