BOE Live

Spotlight

Mini LED Backlight Technology & Product Introduction

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BOE Mini-LED BLU Solution

BOE MLED

2021/05/25

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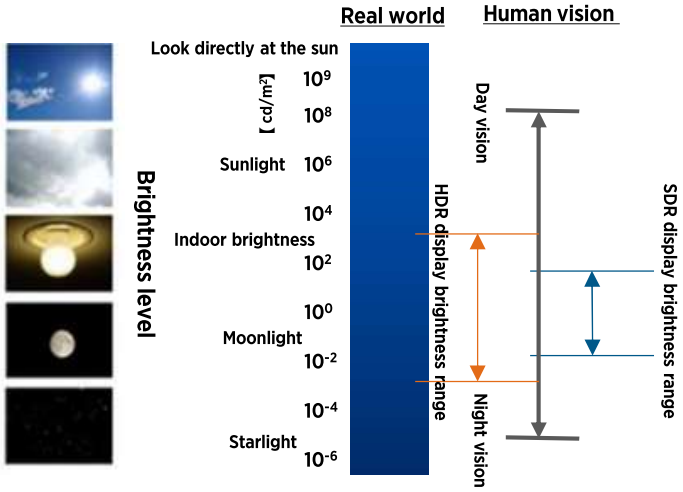
1. Why we need HDR?

Technical Background

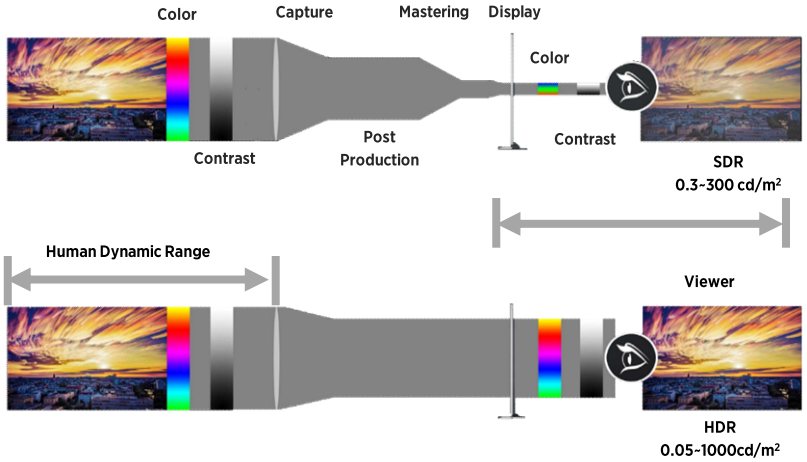
HDR (High Dynamic Range)

The purpose of the high dynamic range is to express more the range brightness of the image in the real world, show more bright and dark details, bring richer colors and more vivid and natural details to the picture, so that the display picture is closer to what we see.

- The dynamic range of brightness in nature is 10^{-6} ~10^{8} cd/m², and the adaptable range of human eyes is 10^{-5} – 10^{5} cd/m². The instantaneous contrast that can be felt can reach 10000:1. But SDR can't meet the needs of real presentation.



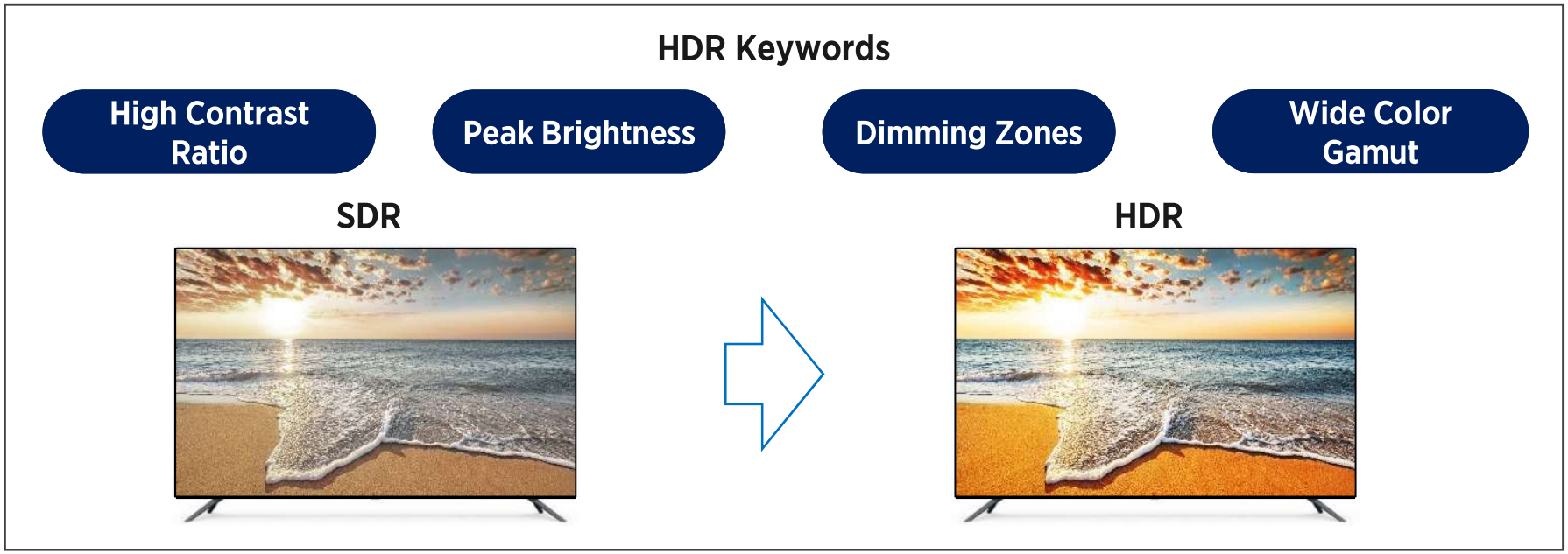
- Due to the image quality loss caused by the video system process (shooting → transmission→ compression→ processing→ display), the actual imaging is different from the display imaging. HDR can effectively reduce the image quality loss and present higher contrast and color gamut.



Technical Background

HDR (High Dynamic Range)

There are currently several standards for HDR, such as Display HDR, Dolby Vision, and HDR 10 released by VESA, and all have requirements for peak brightness, dynamic contrast, and color gamut. Therefore, Mini LED has become one of the current high-performance display solutions.



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2. Mini-LED BLU Tech. Introduction

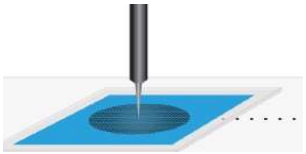
Mini-LED Introduction

Mini-LED means small-size LED，whose dimension is between conventional LED and Micro LED, commonly range from 100μm to 400μm. Currently, Mini LED is working as the direct unit which is integrated in BLU, meanwhile local dimming function is realized to achieve peak brightness 1000nits or higher and million level contrast ratio.

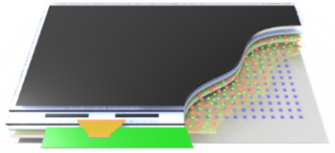
● Mini LED

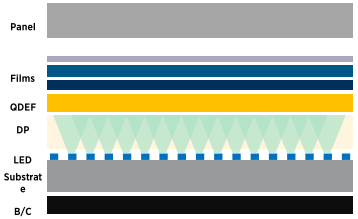
The LED Chip Size is 100~400μm

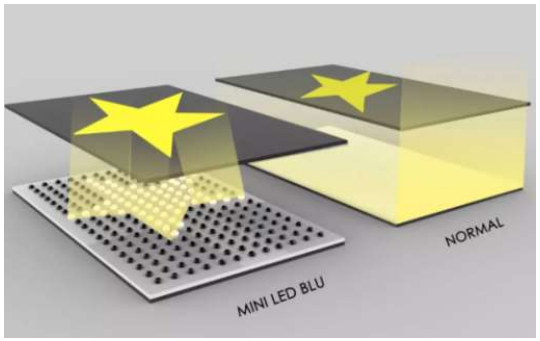
Flip Chip and COB process are required



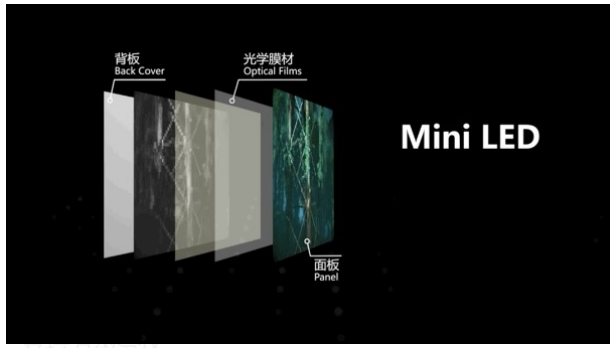
● Mini LED Module Stack up







Mini-LED Introduction



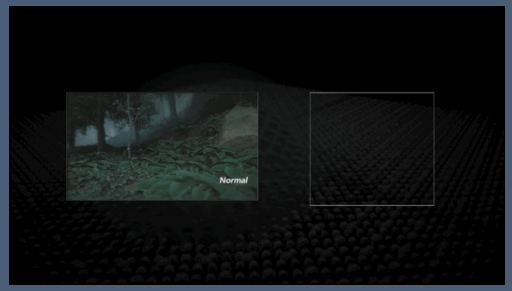
High Contras Ratio

Local Dimming Zones: > 1,000

Peak Brightness: > 1,000 nits

Dark Brightness: ~ 0.001 nits

Wide Color Gamut



DCI P3≥95%

BT2020≥80%

Slim MDL

Ultra Slim Substrate

Ultra Slim Films

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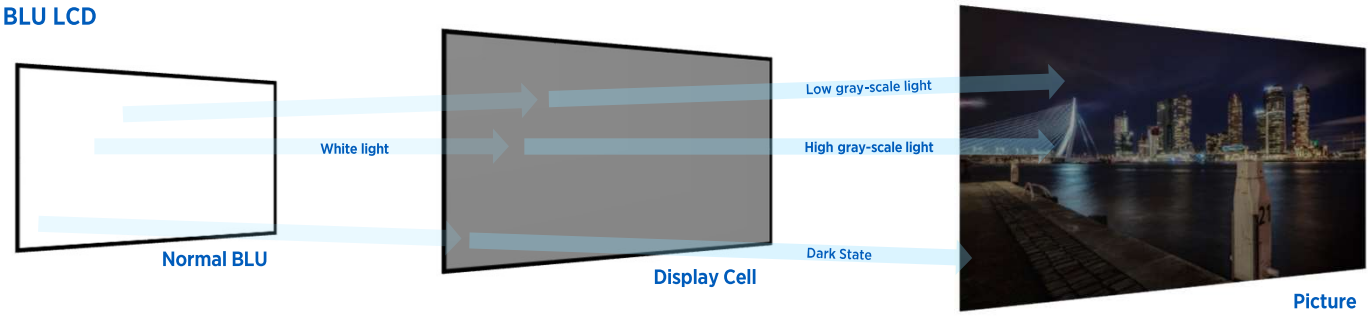
Mini-LED Introduction

Why Choose Mini LED BLU ---- Fine Dimming Zones(Local Dimming)

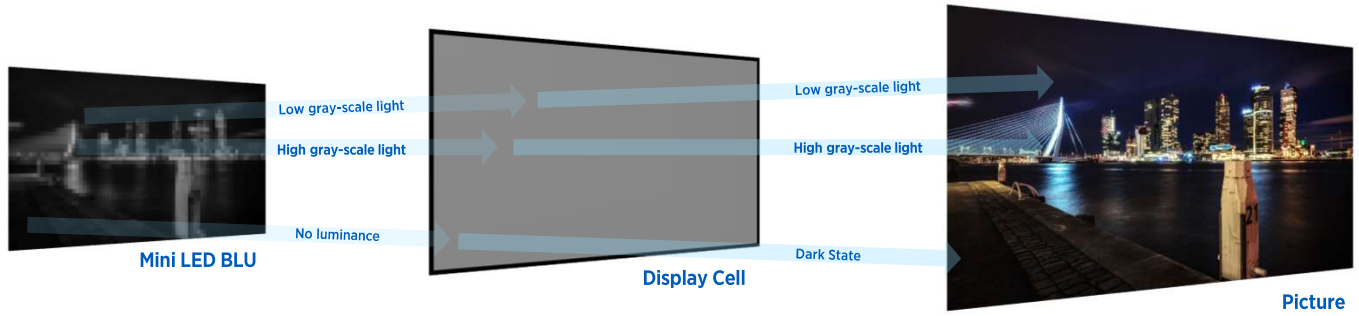
Normal BLU LCD



Peak Brightness：< 500 nits

Dark State Picture：> 0.1 nits

Mini LED BLU LCD



Fine Dimming Zones

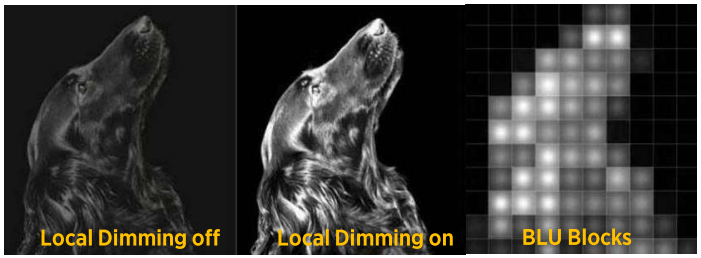
Peak Brightness：>1000 nits

Dark State Picture：~0.001 nits

Mini-LED BLU Advantages

As the ultimate display technology of LCD architecture, Mini-LED backlight has many advantages, such as high contrast, high brightness, high reliability, and ultra-thin design. Therefore, whether it is compared with traditional LCD or OLED, Mini-LED backlight has certain competitiveness.

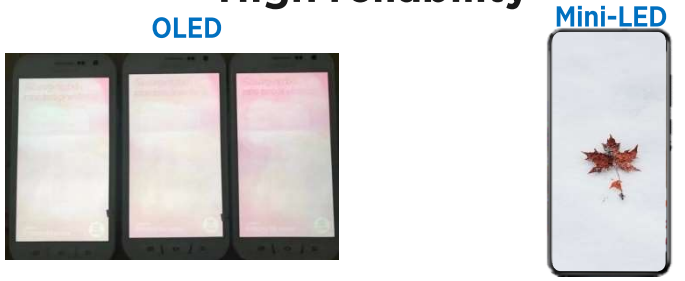
High Contrast Ratio: million level



More thinner

High brightness

High reliability



Mini-LED BLU Applications

Mini-LED has many advantages in terms of display image quality. It is mainly used in high-end product markets that require high image quality, such as e-sports displays, high-end TVs, car displays, etc. Mini LEDs can directly emit light and can also be used for video wall display.

Gaming

High quality display

More impactful

TV

High quality display

Car display

High CR

Readable in the sun

LED Display

Small LED pitch

High brightness

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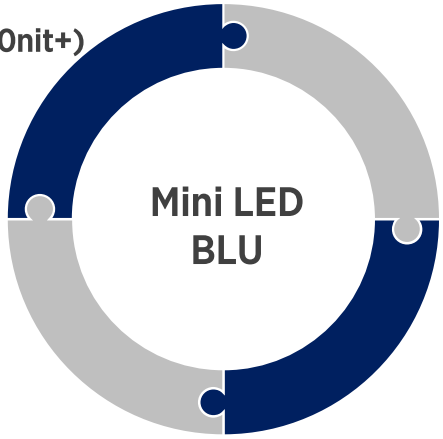
3. BOE Mini LED Technology Advantage

BOE Mini LED BLU Advantages

Technical advantages of BOE Mini LED BLU

Perfect picture quality

- Ultra-high brightness (1000nit+)
- Fine Local Dimming Zones (5k~10K Zones)
- HDR quality picture



Fashion design

- Ultra-thin integrated design
- No horizontal seams

Eye protection

- AM drive
- Flicker-free solution

High reliability

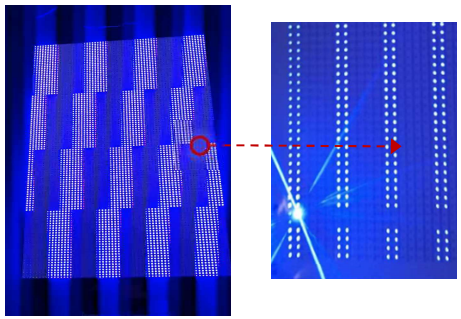
- High flatness of the whole page

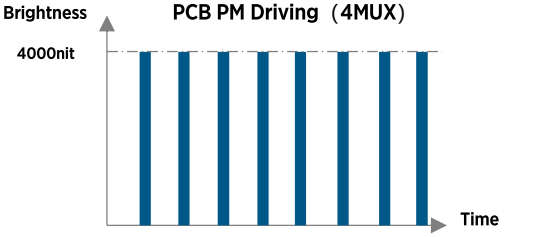
BOE Mini LED BLU Advantages

☐ Eye care technology

AM driving, Flicker free, and Eye care

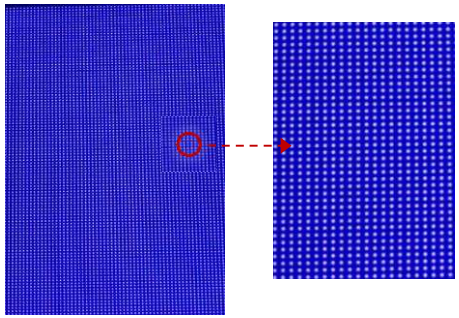
PM

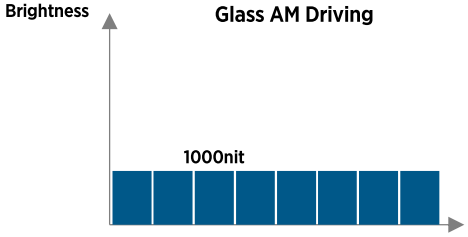




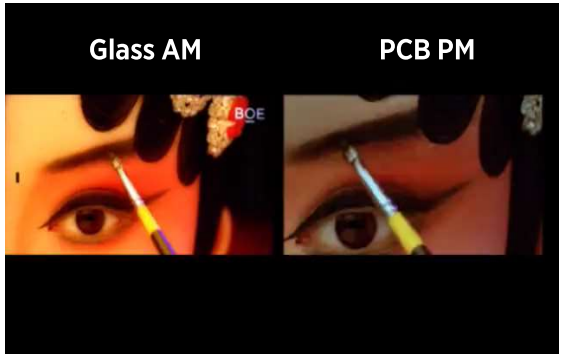
To achieve 1000nits performance, the instantaneous brightness should be 4000nits.

AM





LED lighted up constantly, to achieve 1000nit, the instantaneous brightness is just 1000nits.



BOE Mini LED BLU Advantages

- Glass substrate has better uniformity and flatness by reducing the number of splicing units, and the single-side cable outlet scheme ensures ultra-thin design;

34inch PCB 3*2 splicing

1. 6 pcs PCB board，lead to splicing mura
2. Heat dissipation is worse than glass

34inch One Glass Substrate

1. The entire board design, flatness is better
2. Without splicing mura
3. Single-side cable outlet ensures ID ultra slim design

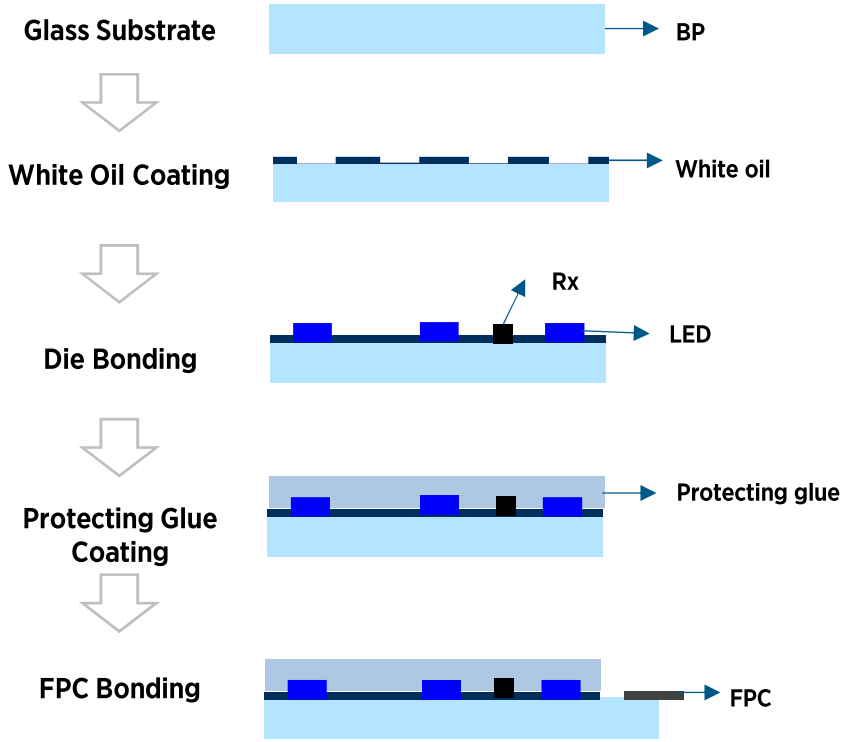
ID Ultra Slim Design

BOE Mini LED Process Flow

Mini LED In-house Solution

Glass substrate mini LED Module

Mini LED Board Process



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4. Mini LED Product Roadmap

BOE Mini-LED Product Roadmap

		2020	2021 Q1	2021 Q2	2021 Q3	2021 Q4
TV		75″ 8K 5k+ Zones 65″ 8K 3k+ Zones		86″ 4K 2k+ Zones 75″ 4K 2k+ Zones		
DID			55″ ≈700 Zones			
MNT		27″ UHD 1152 Zones			34″ WQHD 1152 Zones 31.5″ UHD 1152 Zones	
NB		15.6″ UHD 60Hz NB		15.6″ FHD 144Hz NB	16.0″ WQXGA 165Hz NB	
VR		3.2″ VR				2.48″ VR

Dev. Plan

BOE Mini-LED Solution for TV

Item	TV			
	86”	75”	75”	65”
Resolution	4K	8K	4K	8K
Drive mode	AM, no flicker	AM, no flicker	AM, no flicker	AM, no flicker
Brightness （Typ./Peak.)	600/1500nit	500/1300nit	600/1500nit	500/1000nit
OD	6.0mm	5.0mm	6.0mm	6.0mm
LCM Thickness	≈16.0mm	≈15.0mm	≈16.0mm	≈16.0mm
Tiling	1*4	1*2	1*4	1*1
HDR Blocks	2K+	5K+	2K+	3K+
Power Consumption	405W	350w	305w	330W
Status	Sample Ready @ 2021.6	Sample Ready	Sample Ready @ 2021.4	Sample Ready

BOE Mini-LED Solution for MNT

Item	27” PCB 1K Zone	31.5” PCB 1K Zone	31.5” PCB 2K Zone	34” Glass 1K Zone
Resolution	3840x2160	3840x2160	3840x2160	3440x1440
Refresh Rate	60Hz	60Hz	60Hz	165Hz
Luminance	HDR1000	HDR1000	HDR1000	HDR1000
Color Gamut	98% DCI-P3 & 99% Adobe	98% DCI-P3&99% Adobe	98% DCI-P3&99% Adobe	97% DCI-P3
Color Depth	8 bit+FRC	8 bit+FRC	8 bit+FRC	8 bit+FRC
Dimming Zone	1152	1152	2048	1152
LED quantity	10368	10368	8192	4608
Thickness	8.9mm	9.7mm	13mm	15mm
Border (L/R/U/D)	6/6/6/12.47mm	6/6/5.5/14.27mm	6/6/5.5/14.27mm	6.1/6.1/6.1/15.6mm
Schedule	MP	Kick off 6/E → 1st Sample 9/E → MP 12/M	Kick off D → 1st Sample D+90 → MP D+240	Kick off 5/E → 1st Sample 7/E → MP 9/E

BOE Mini-LED Solution for NB

Item	15.6”UHD Narrow	16.0”2.5K
Driving Mode	ADS	ADS
Resolution	3840x2160	2560x1600
Refresh Rate	60Hz	165Hz
Luminance	HDR 1000	1250 typ
Color Gamut	>90% DCI P3	Adobe Typ 98.2% DCI Typ 98.6%
Color Depth	8bit + 2FRC	8bit + 2FRC
Dimming Zone	1152	1152
Thickness (max.)	3.2mm	2.6mm
Border L/R/U	3.2/3.2/3.2mm	2.5/2.5/2.5mm
Power Consumption @600 nit full white	14.1W	13.2W

BOE Mini-LED Solution for TPC

Item		Specification
Size		10.95inch
Resolution		2560x1600
Substrate		FPC
MDL	Border(L/R/U/D)	2.55/2.55/2.55/5.85mm
	Thickness	1.77mm typ.
Optics	Color Gamut	DCI-P3 99.5%
	CR	100,000:1
	Luminance	HDR1000 (600/1000nit typ./peak)
EE	Interface	MIPI
	IC	BOE customized

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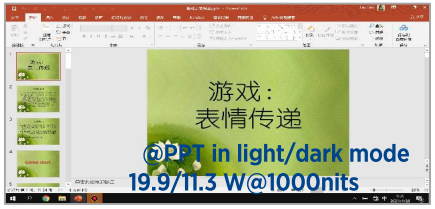
App. Mini LED Power Analysis

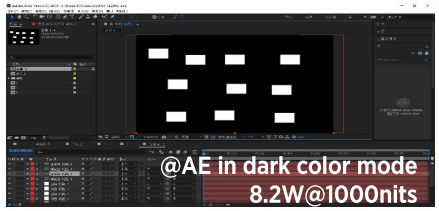
The power consumption of the Mini LED product is about 1.5 times higher than the normal product at 500nit full white pattern. But it's much lower at dark mode with local dimming.

49.8%Max
Normal : Mini
=1 : 0.75

45.3%Max
Normal : Mini
= 1 : 0.68

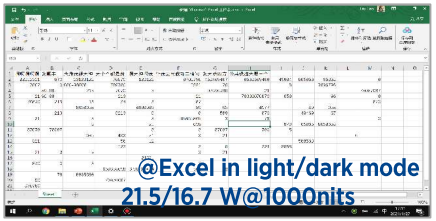


83.3%Max/47.3%Max
Normal : Mini
= 1 : 1.2/1:0.71



34.3%Max
Normal : Mini
= 1 : 0.51

41.4%Max
Normal : Mini
= 1 : 0.62



90.0%Max/69.9%Max
Normal : Mini
= 1 : 1.35/1:1.04

In most applications of notebook, Mini LED product shows better power performance than normal product, which can be further optimized through Dark Mode system.

- Comparison data is collected from the rough test between 15.6" UHD Oxide normal product and Mini LED Tech Dev. Demo

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Q & A