



# 2024 OLED Technology and Industry Trend Analysis Report for IT

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# 3. LTPO TFT Backplane

## 3.5 LTPO TFT manufacturing status

### China

- BOE and TCL CSOT, Visionox, Tianma etc. are operating the LTPO TFT production line.
- Although Chinese panel makers are not yet supplying LTPO TFT panels for the iPhone series, they are supplying LTPO TFT panels for high-end models of Chinese smartphone set makers such as Oppo, Vivo, Xiaomi, Honor, and One Plus, and are improving their LTPO TFT technology and production capacity.

LTPO TFT production capacity of Chinese panel companies .

Company	Fab. location	Gen.	Status	Capa.
BOE				
TCL CSOT				
Tianma				
Visionox				

Source: UBI Research DB

LTPO application status by smartphone by Chinese panel company

BOE	CSOT	Visionox
<b>Vivo X90 Pro</b>	<b>Xiaomi 13 Ultra</b>	<b>Honor 100</b>
6.78 inch	6.73 inch	6.7 inch
3200 x 1440(518ppi)	3200 x 1440(518ppi)	2664 x 1200 (436ppi)
1~120Hz	120Hz	120Hz
1,800nit	2,600nit	2,600nit peak
<b>OnePlus 12</b>	<b>Xiaomi 14</b>	<b>Honor Magic V2</b>
6.8 inch	6.73 inch	7.92 inch
3168 x 1440(512ppi)	2670 x 1200(460ppi)	2,344 x 2156(402ppi)
1~120Hz	1~120Hz	120Hz
2,600nit	3,000nit peak	1,600nit
<b>Huawei Mate 60</b>	<b>Xiaomi 14 Pro</b>	<b>Huawei Mate 60</b>
6.69 inch	6.73 inch	6.69 inch
2688 x 1216(441ppi)	3200 x 1440(522ppi)	2688 x 1216(441ppi)
1~120Hz	1~120Hz	1~120Hz
1,000nit	3,000nit peak	1,000nit

Source: UBI Research DB

# 3. LTPO TFT Backplane

## 3.6 LTPO TFT pixel circuit performance

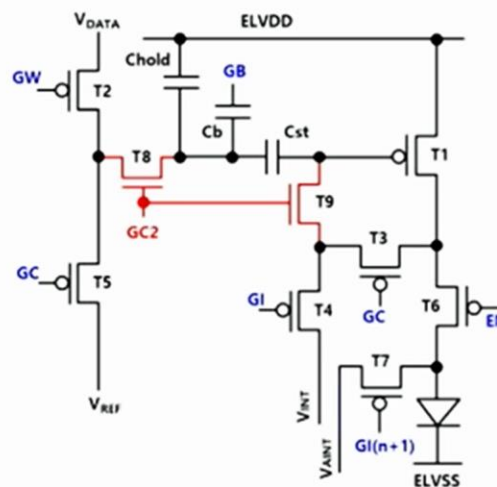
### ■ Samsung Display

- Samsung Display calls LTPO TFT as HOP (Hybrid Oxide Polysilicon) TFT.
- By applying Separate Compensation Drive (SCD), the compensation and data writing processes are separated to secure sufficient  $V_{th}$  compensation time and enable 240Hz high-speed operation.
- By using the 2 Stacked Caps structure that integrates two capacitors, Cst and Chold, the resolution is increased up to 500ppi.

SDC's high resolution & high speed compensation circuit

	HOP 7T1C	LTPS 9T2C	HOP 9T2C	HRS 9T2C
Comp. type	Simultaneous	Seperation		
Resolution [ppi]	~ 500	~ 410	~ 350	~ 500
Driving freq. [Hz]	≤ 120	240	240	240
TR (LTPS / Oxide) [EA]	7 (5/2)	9 (9/0)	9 (5/4)	9 (7/2)
TR hori. Wiring (LTPS / Oxide) [EA]	4 (2/2)	6 (6/0)	6 (3/3)	5 (4/1)

SDC's 9T2C LTPO TFT pixel circuit



SDC's 240Hz, 500ppi panel



Source: SDC, SID 2024

# 4. 8th Generation Substrate TFT Backplane

## 4.6 Internal compensation circuit of Oxide TFT for IT products

### BOE

- The compensation capability used in OLED TV is excellent, but there is a problem that the cost increases because a dedicated D-IC is required. Therefore, an internal compensation method is required to develop a low-cost IT OLED product.
- The internal compensation pixel circuit used in small panels compensates for the  $V_{th}$  fluctuation during the data input process. However, this method has a limitation in the charging time. In IT products with high resolution or large load, the compensation uniformity is not good when the internal compensation pixel circuit of a small panel is used. Therefore, a new internal compensation pixel circuit that is not limited by the charging time is required.

	Internal comp. @LTPS /LTPO	External comp. @ oxide	Internal comp. @ oxide
Panel size	small size	Big size	Medium size
PPI	high	low	medium
Frame rate	>60hz	0~480hz (or more)	←
Drive system cost	low	high	Low
Industrialization	Watch ,mobile, Note book .etc	Gaming Monitor、 TV .etc	Pad、 Note book、 Monitor .etc
challenge	<ol style="list-style-type: none"> <li>1. Bigger size panel</li> <li>2. Low frame rate</li> <li>3. Image sticking (hysteresis)</li> <li>4. others</li> </ol>	<ol style="list-style-type: none"> <li>1. Cost</li> <li>2. Higher PPI</li> <li>3. Integration degree</li> <li>4. others</li> </ol>	<ol style="list-style-type: none"> <li>1. Temperature rise effect</li> <li>2. <math>V_{th}</math> (+&amp;-) compensation</li> <li>3. Narrow bezel</li> <li>4. others</li> </ol>

Source: BOE SID 2024



# 5. RGB Tandem OLED

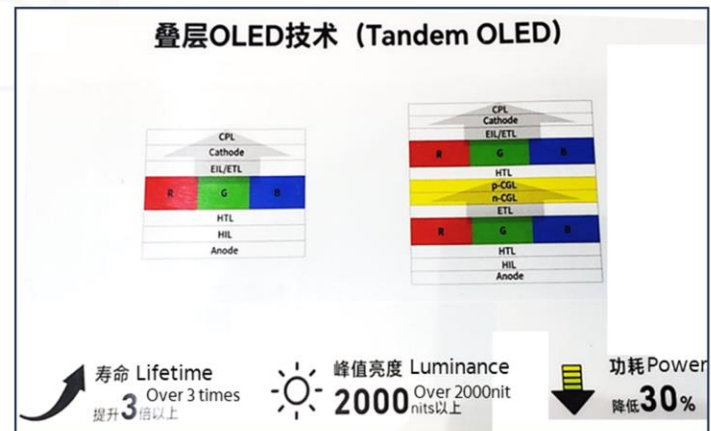
## 5.4 Tandem OLED device characteristic

### ■ Visionox

- Visionox announced at the 'Visionox 2022 New Technology Conference' and 'Display Innovation China 2023' that it is developing RGB 2stack tandem OLED technology to improve the lifespan, brightness, and power consumption of medium-sized displays.
- The RGB 2stacked tandem OLED being developed by Visionox has a luminous efficacy of 120cd/A and a lifespan of 40,000 hours based on LT80.
- It was reported that the luminous efficacy of RGB 2 stacked tandem OLED is doubled compared to single stack OLED, power consumption is reduced by 30%, and the lifespan is improved by 3-4 times, enabling brightness of over 2,000 nits.



器件 Device	单层 Single layer	叠层 Double stacks
器件结构 Structure		
寿命比较 Life span	10000hr (T80@25°C,200ppi)	40000hr (T80@25°C,200ppi)
性能比较 Performance	亮度600nit(Normal) Brightness 600nit (Normal) 发光效率60cd/A (@白光) Luminous efficiency 60cd/A (@ white light)	亮度1200nit Brightness 1,200nit 发光效率~120cd/A (@白光) Luminous efficiency ~120cd/A (@ white light) 屏体功耗降低~30% Display power consumption reduction: ~30%



Source: Visionox

# 6. Color Filter on Encapsulation

## 6.4 COE development status by panel company

### BOE

- BOE exhibited a 1.57-inch AMOLED and an 8-inch slideble OLED at SID 2021.
- The panel uses \*\*\* technology and \*\*\* technology, and has a power consumption reduction effect of \*\*\*% and \*\*\*%, respectively, for a total power consumption reduction effect of \*\*\*%.
- The material supplier candidates are as follows:
  - Low temperature BM: \*\*\*, \*\*\*, \*\*\*, Low temperature OC: \*\*\*, \*\*\*, \*\*\*, Low temperature Red: \*\*\*, \*\*\*, \*\*\*
  - Low temperature Green: \*\*\*, \*\*\*, \*\*\*, Low temperature Blue: \*\*\*, \*\*\*, Black PDL: \*\*\*, \*\*\*

BOE 's 8 inch slideble OLED



	Slidable OLED
Size [inch]	8
Resolution	2592 x 2176
ppi	423
Bending radius [mm]	4
Sliding number	200K
Sliding distance [mm]	36.8

Source: BOE, UBI Research DB

# 8. Photolitho OLED

## 8.3 Photolitho OLED development status by panel company

### ■ Visionox

- ViP technology can use a 2D conductive insulator structure that blocks current and moisture between subpixels. This structure significantly reduces the cathode resistance of the OLED display, which reduces the voltage drop (IR drop) and enables more uniform voltage distribution.
- Based on the power simulation results of a 14.2-inch display, it was announced that the single OLED and tandem OLED structures using ViP technology can save up to 37.5% and 50.7% of power, respectively, under 1,000nit conditions compared to the single OLED using FMM technology.

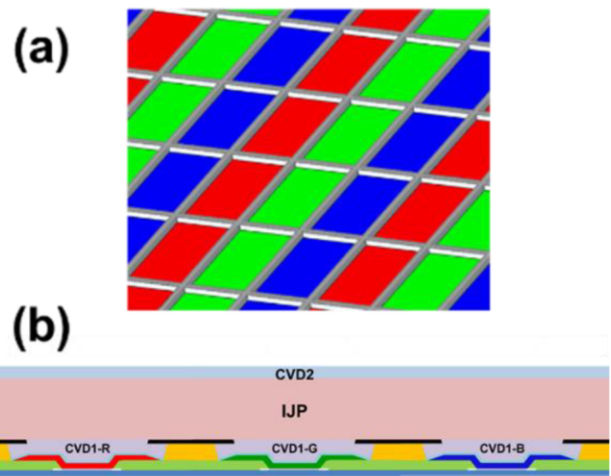


Figure 2. ViP™ isolator structure: (a) 2D network, and (b) Cross-sectional view

Table 2. EL Power Simulation (14.2" display)

No.	Item	FMM+ Single	ViP™+ Single	ViP™+ Tandem
1	PDL gap (μm)	20	10	
2	Aperture ratio	32.66%	61.06%	
3	EL Power (mW)	600 nits	7,502 (32.1%↓)	5,985 (42.0%↓)
4		800 nits	10,430 (34.5%↓)	8,254 (46.5%↓)
5		1,000 nits	13,530 (37.5%↓)	10,645 (50.7%↓)
6		1,600 nits	24,006 (43.2%↓)	18,224 (60.0%↓)

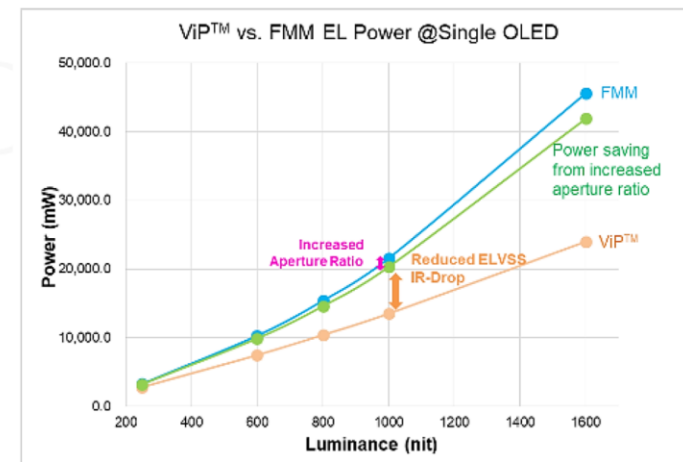


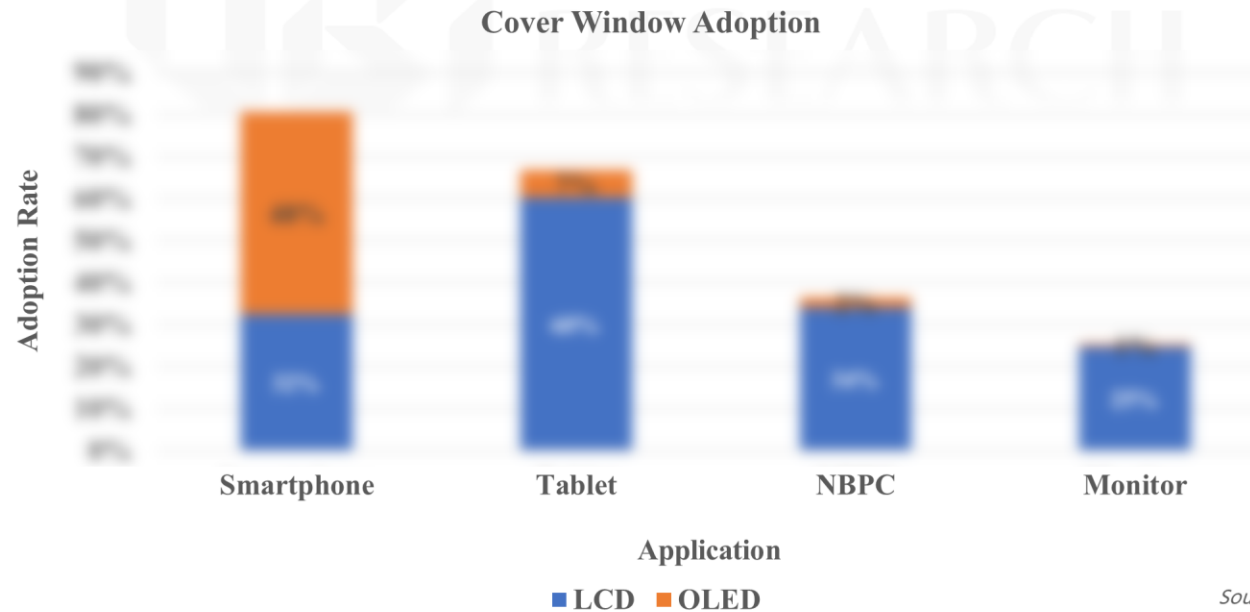
Figure 3. EL power vs. luminance (simulation)

Source: Visionox, SID 2024

# 9. Cover Window

## 9.1 Applying Cover Window to each product

- Cover windows used in IT products have the following properties: (i) Protect the screen from various external forces (pressing, scratching, impact, etc.) applied to the screen in the usage environment. (ii) Prevent contamination of the display screen and the inside of the product. (iii) Protect the substructure of the external area of the display module screen and supplement the electro-optical characteristics of the display. (iv) Provide high-quality design with various decorations and form factors.
- Cover windows are applied to \*\*\*% of smartphones, \*\*\*% of tablets, \*\*\*% of laptops, and \*\*\*% of monitors. OLEDs are mainly used in high-end products, and cover windows are applied to \*\*\*-\*\*\*% of products, unlike LCD products, to enhance product durability and maintain touchscreen sensitivity.
- As OLEDs are adopted more in IT products, the demand for cover windows is expected to increase.



Source: UBI Research DB



# 10. OLED Panel Company Mass Production Capacity Analysis and Forecast

## 10.6 IT line investment status

- Tablet PC, OLED display (6th generation line, LTPO TFT and Tandem RGB OLED)
- Samsung Display: Investment in \*\*\* line with \*\*\* and \*\*\* structure, \*\*\*
- BOE: Investment in \*\*\* line with \*\*\* and tandem \*\*\* structure, \*\*\*



		Samsung Display	LG Display (8.6G ND)	BOE	Visionox (8.7G ND)
6G	Type				
	TFT				
	OLED				
	Encapsulation				
	Mask				
8.6G	Glass				
	Type				
	TFT				
	OLED				
	Encapsulation				
	Mask				
	Glass(Evaporation)				



Source: UBI Research DB

Source: DNP

# 11. OLED Shipment Forecast

## 11.3 By panel company

- Samsung Display's OLED shipments for tablet PCs are expected to increase from \*\*\* million units in 2024 to \*\*\* million units in 2028, while OLED shipments for notebook PCs are expected to increase from \*\*\* million units in 2024 to \*\*\* million units in 2028.
- LG Display's OLED for tablet PCs is expected to increase from \*\*\* million units in 2024 to \*\*\* million units in 2028.
- BOE and Visionox are expected to mass-produce \*\*\* million and \*\*\* units of tablet PCs in 2024, and \*\*\* million and \*\*\* million units in 2028, respectively, on their 6th-generation lines.

IT OLED shipment forecast by panel company

(Million units)

Company	Application	2024	2025	2026	2027	2028
BOE	Tablet	100	150	200	250	300
LG Display	Automotive	100	150	200	250	300
	NB	100	150	200	250	300
	Tablet	100	150	200	250	300
Samsung Display	Automotive	100	150	200	250	300
	Monitor	100	150	200	250	300
	NB	100	150	200	250	300
	Tablet	100	150	200	250	300
Visionox	Tablet	100	150	200	250	300

Source: UBI Research DB