

TCL has a new low-cost mini LED backlight LCD TV with FALD technology

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Key findings

- Mini LED backlighting can vary from full array with local dimming (FALD) with a small number of LEDs (<1,000) to active-matrix driving with a large number of mini LEDs. An LTPS/oxide backplane may be required for active-matrix backlight unit (BLU) driving, which is estimated to cost around \$500 for a 65-inch mini LED backlight. However, a FALD mini LED backlight is a cost-effective solution.
- TCL has developed both FALD and active-matrix mini LED backlight LCD TVs with different picture performance features and they are targeted at different TV segments.

TCL introduced its new lineup of midrange 5-series and 6-series 4K LCD TVs for 2020. TCL indicated that this new LCD TV will incorporate a mini LED BLU and come with a lot of features, including a good design, four HDMI ports, and built-in Roku software which could eliminate the need for users to buy a streaming device.

More importantly, TCL is also including complete support for high dynamic range (HDR) standards. It features what TCL calls the “HDR Pro Pack,” with support for Dolby Vision, HDR10, and Hybrid Log-Gamma (HLG).

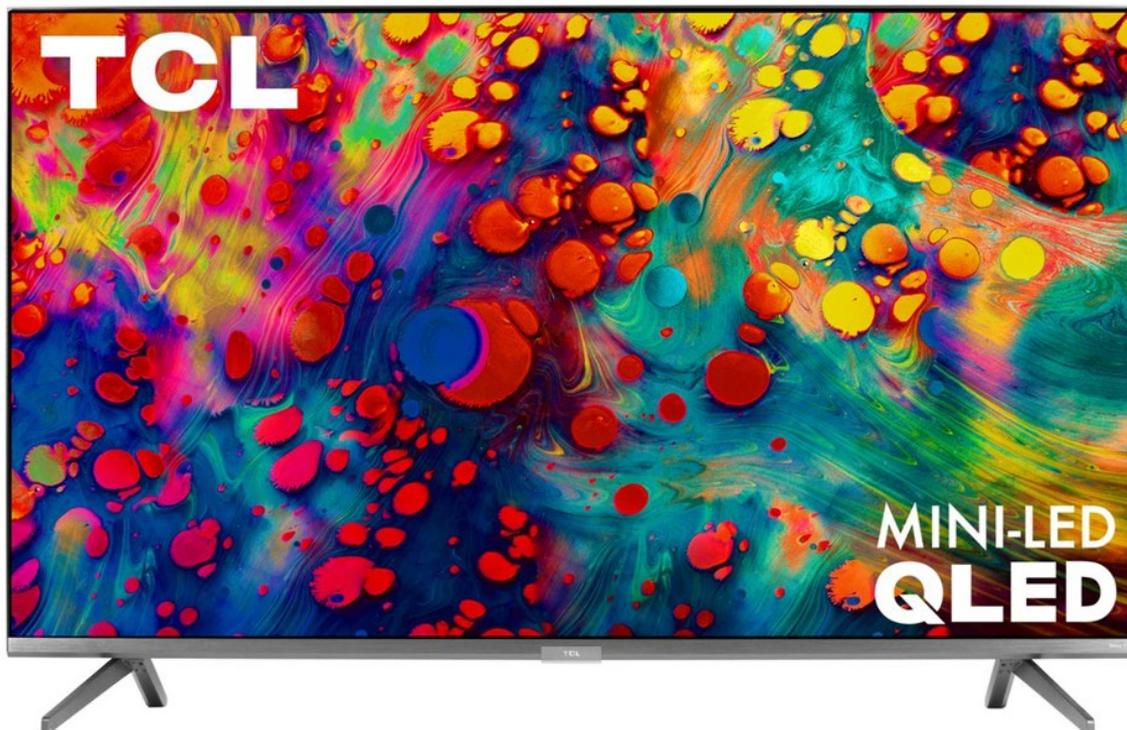
Furthermore, these new LCD TVs will have two premium features:

- A contrast-rich QLED screen, which means TCL has added quantum dot (QD) film in the LCD backlight.
- An affordable mini LED backlight, which will likely be FALD.

At the low end, the 50-inch 5-series TV (model 50S535) costs \$400 and has a QLED screen, a 60Hz refresh rate panel, and 40 local dimming zones.

TCL’s new 5-series also has a \$450 55-inch model and a \$630 65-inch model, each with a slight increase in local dimming zones to 48 and 56, respectively.

Figure 1: TCL mini LED and QLED LCD TV



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Source: TCL

The following are the two new series of TCL's new mini LED QLED TV:

- **The 5-series**
 - The 55-inch mini LED backlight LCD TV retail price is \$450, with 48 local dimming zones.
 - The 65-inch mini LED backlight LCD TV retail price is \$630, with 56 local dimming zones.
 - The 50-inch mini LED backlight LCD TV retail price is \$400, with 40 local dimming zones.
- **The 6-series**
 - The 55-inch mini LED backlight TV retail price is \$650, with 240 local dimming zones and QD.
 - The 65-inch mini LED backlight TV retail price is \$900, with 240 local dimming zones.
 - The 75-inch mini LED backlight TV retail price is \$1,400, with 240 local dimming zones.

As a result of the multiple mini LED chips, the cost of an active-matrix mini LED backlight is usually high; hence, the retail price of an LCD TV with a mini LED backlight will always be high. The Omdia

display cost model simulates that the cost of a mini LED backlight for a 65-inch 4K LCD module will be high at over \$1,500, as shown in the table below.

Table 1: Mini LED backlight LCD module - 65" 4K LCD TV

Items		Small number (<1,000 chips)	Large number (~25,000 chips)	
		FALD	Passive matrix	Active matrix
Material cost	Array materials	\$43	\$43	\$43
	Cell materials	\$17	\$17	\$17
	Module materials	\$273	\$1,469	\$1,469
	Active-matrix backplane (LTPS)			\$510
Overhead cost		\$140	\$259	\$259
Total manufacturing		\$472	\$1,788	\$2,298
Gap to FALD			X 3.8	X 5.9

Source: Omdia

Mini LED backlighting can vary from FALD with a small number of LEDs (<1,000) to active-matrix driving with a large number of mini LEDs.

An LTPS TFT or a-Si TFT backplane is required for active-matrix BLU driving, and is estimated to cost around \$500 for a 65-inch if manufactured at an in-house Gen 6 TFT-LCD fab.

The Omdia analysis indicates that the TCL 5-series and 6-series are using the FALD mini LED, rather than the active-matrix mini LED backlight, to achieve low costs. The details of the FALD backlight are analyzed as below:

- It has 1,000–1,500 mini LED chips, with a cost of presumably \$0.10–0.20 per mini LED chip including the surface mount technology (SMT) LED driving circuits.
- It has 4×4 pieces of printed circuit board (PCB) backplane.
- It has passive-matrix local dimming with FALD.
- Lens or an optical structure is required to perform FALD.

FALD is a cost-effective mini LED backlight solution.

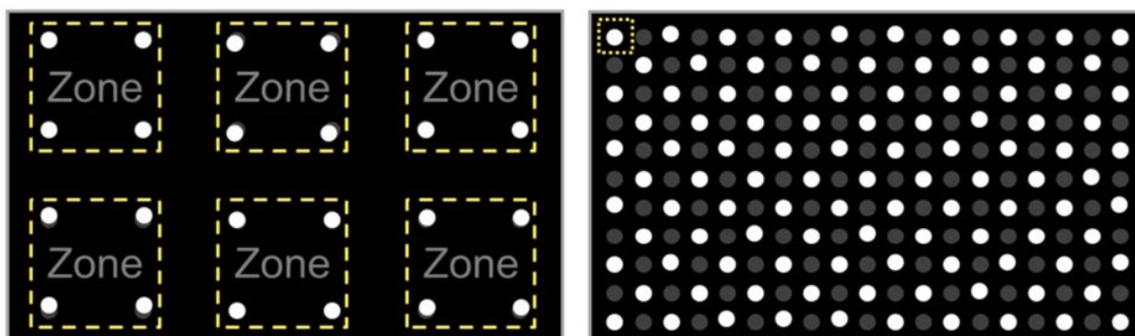
The following are several key points about FALD:

- TVs with FALD technology have multiple zones throughout the display and these LEDs or mini LEDs are placed behind the screen, like the direct backlit TVs.
- Full-array LED backlighting delivers hundreds of different LEDs or thousands of mini LEDs, resulting in light levels from many separate dimming zones.
- Thanks to these independently controlled light dimming zones, the viewers see enhanced black levels, better shadow detail, and a decreased level of “light bleed”—which can occur when the light is not completely blocked, allowing excess light to “bleed” out around the edges of the panel and thus, creating areas that are too light on a dark background. With light bleeding decreased, it ensures greater contrast and superior picture quality.

- Sony and LG Electronics are the pioneers of using FALD backlight technology in their high-end LCD TVs. They have dubbed FALD as the crème de la crème of local dimming technology—which achieves a great HDR.
- However, FALD is not like an active-matrix mini LED backlight in which each discrete mini LED chip is controlled with the dimming function individually. An active-matrix mini LED backlight can have the best dimming and contrast features, but FALD is based on local dimming rather than whole-area dimming.

The differences of FALD and active-matrix mini LED backlight are shown in the figure below. The biggest challenge for the active-matrix mini LED backlight is its high cost.

Figure 2: FALD backlight (left) vs. active-matrix mini LED backlight (right)



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Source: Omdia

Sony and LG are the early adopters of the FALD mini LED backlight LCD TV. However, TCL has been catching up rapidly as of late.

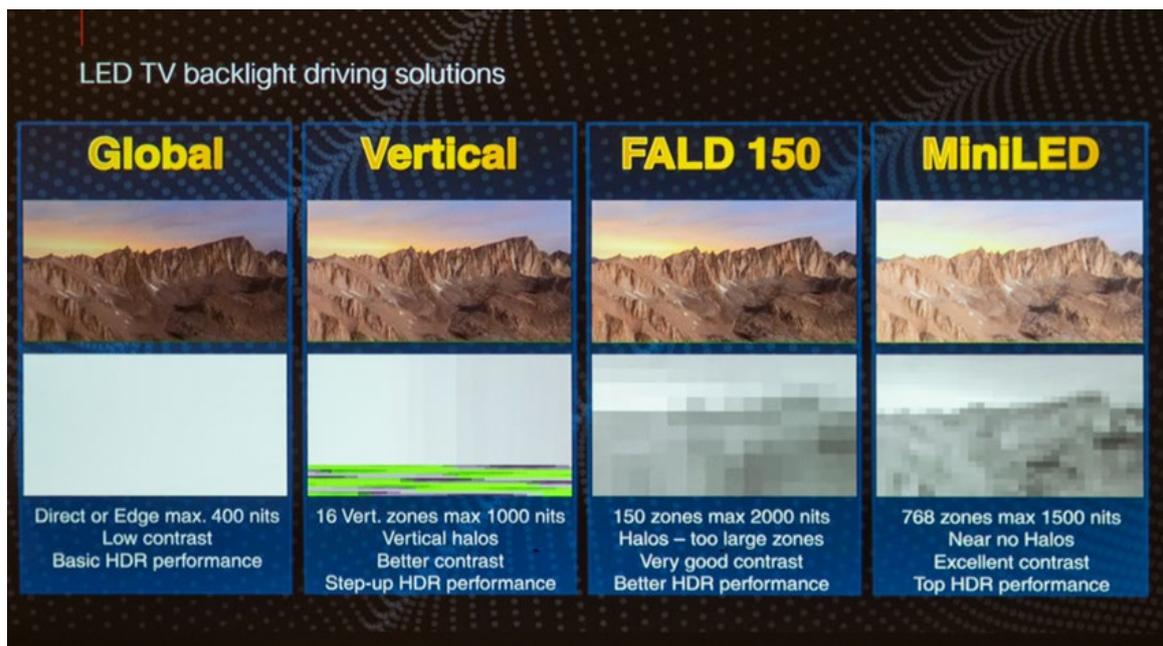
This is especially because of TCL's capability in integrating the following:

- TCL China Star's TFT-LCD open cell
- The mini LED backlight design, development, and manufacturing of TCL Optoelectronics
- The TCL in-house LED backlight assembly and LCD module assembly
- The TCL in-house LCD TV set OEM and ODM capabilities

In January 2020, TCL introduced the TCL 65X10 series; the 65-inch 4K LCD TV also has a mini LED backlight but it is aimed at the high-end segment with its active-matrix mini LED dimming functions and an over \$3,000 price tag.

The TCL 65X10 represents the extremely high end of the active-matrix mini LED backlight LCD TV. The comparison between a traditional LED backlight and FALD and active-matrix mini LED backlights are shown in the figure below.

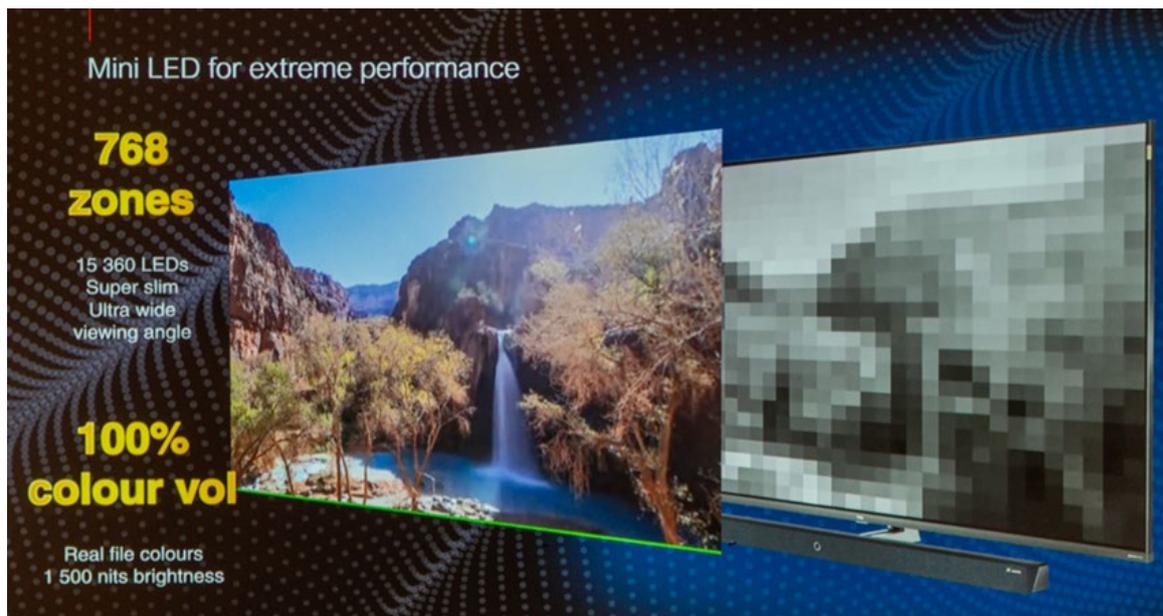
Figure 3: TCL's introduction on LED TV backlight driving solutions



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Source: TCL

Figure 4: TCL's mini LED for extreme performance – 768 zones of active-matrix mini LED dimming



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Source: TCL

The following are the TCL 65X10 active-matrix mini LED backlight LCD TV specifications:

- It is a 65-inch 4K with a mini LED backlight.
- It has 15,360 mini LEDs with 768 dimming zones and an active-matrix TFT array backplane
- The dimming contrast is 40,000:1.
- HDR: Dolby Vision, HDR10+, and HLG for all HDR content, as shown below.
- Extreme peak luminance: Over 2,000 nits.
- It has a 97% DCI-P3 color gamut.

Figure 5: The TCL 65X10 mini LED backlight LCD TV which can support all HDR formats



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Source: TCL

Meanwhile, TCL has shared its mini LED backlight roadmap as below:

- 2019
 - Active-matrix mini LED backlight + quantum dot enhancement film (QDEF)
 - Has 768 dimming zones with 15,360 mini LEDs, a 24×32 a-Si TFT array backplane, and 20 mini LEDs in each backplane
 - Has an 8.7mm mini LED pixel pitch, a 5mm optical distance, and 1,500 nits of peak brightness
 - Has a DCI-P3 100% color gamut and >80% Rec. 2020 color gamut
- 2021
 - Active-matrix mini LED backlight + QDEF
 - Will have 3,840 dimming zones with 15,360 mini LEDs, a 48×80 a-Si TFT array backplane, and 4 mini LEDs in each backplane

- Will have an 8.7mm mini LED pixel pitch, a 2mm optical distance, and 2,000 nits of peak brightness
- Will have a DCI-P3 100% color gamut and >90% Rec. 2020 color gamut
- 2023
 - Active-matrix mini LED backlight + QDEF
 - The mini LED will change from blue-white to RGB
 - Will have 15,360 dimming zones with 15,360 mini LEDs, a 90×160 a-Si TFT array backplane, and 1 mini LED in each backplane.
 - Will have an 8.7mm mini LED pixel pitch, a 1mm optical distance, and >2,000 nits of peak brightness
 - Will have a DCI-P3 100% color gamut and >95% Rec. 2020 color gamut

Regardless of FALD being targeted at entry-level TVs or the active-matrix mini LED backlight being targeted at the high-end segment, TCL is the most aggressive TV brand now with its specialization in the mini LED backlight while many TV brands are focusing on OLED TVs, such as LG and Sony, for the high-end segment.

Figure 6: TCL's roadmap for its mini LED backlight



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Source: TCL

Appendix

Further reading

[Display Backlight Market Tracker - Q1 2020](#) (August 2020)

[*Display cost analysis - LCD, OLED, Mini-LED, Micro-LED and Quantum Dot*](#) (February 2020)

[\[Display Dynamics\] Comparing displays for high-end desktop monitors - LCD, OLED, and mini LED](#) (March 2020)

[\[Display Dynamics\] Inkjet OLED is coming: CSOT plans to build a full-size IJP production line in Guangzhou, China](#) (July 2020)

[\[Display Dynamics\] Innolux showcases active matrix Mini LED at CES 2019](#) (January 2019)

[\[Display Dynamics\] Mini-LEDs allow more LED makers to enter the LED display market](#) (May 2020)

[\[Display Dynamics\] TFT glass can be an option as a backplane material for mini-LED backlights](#) (May 2020)

[\[Display Dynamics\] The new 12.9-inch iPad Pro may adopt a mini LED backlight LCD in 2021](#) (July 2020)

[Large Area Display Product Roadmap Tracker - Q2 2020](#) (August 2020)

[Display Technology & Trend - Micro/Mini LED, Curve, Gaming and New Notebook Display - 2020](#)

[Omdia Korea Display Conference](#) (August 2020)

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