Feasibility into High-end TN Monitor Development

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Abstract

Although LCD market has been divided so far into high-end market with S-IPS & SPVA and low-end market with TN mode, TN MNT has been striving towards bigger share in large and high-resolution wide display market as well. LG.Philips LCD has developed 20.1 inch and 22.0 inch WSXGA+ wide monitor mainly focusing on the low cost based on high brightness, fast R/T, high color gamut and wide viewing angle.

Introduction

The TN monitor is penetrating into mid-end area while strong demand increase is expected to continue in a large size and wide market. TN LCD monitor is a promising candidate for high-end LCD market as securing cost competence is desperately needed to survive under the fierce competition, which comes from oversupply largely due to supply increase by large fabs ramp-up. Therefore TN LCD market will continuously grow with its new market development having the advantage of low cost as well as high brightness, fast R/T and high color gamut.

TN monitor's high feasibility into high-end market

■ Brightness

TN is the best mode for accomplishing high transmittance performance because of its less chance for decreasing aperture ratio thanks to its simple pixel structure compared to VA Libs and IPS finger electrodes. Although efforts for higher transmittance has improved brightness in other LCD modes, still it is unlikely to catch up with its achievement in TN.

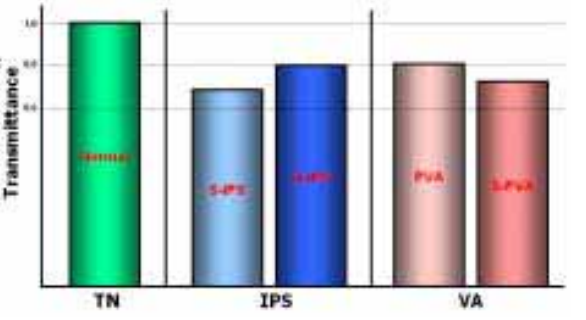

Figure 1. High transmittance performance in TN mode

■ Response Time

Liquid crystal development with △n increased has enabled its low cell gap, thereby achieving fast on/off response time of 5ms in TN monitor. Now LPL is developing 2ms TN panel even with ODC unapplied and even 1ms R/T is being expected to be realized in the near future through low viscosity liquid crystal development with △ε decreased.

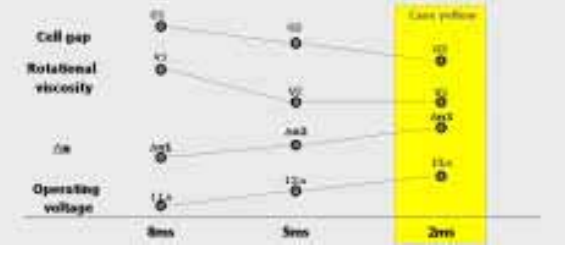

Figure 2. How to achieve 2ms?

■ Color gamut

While efforts for more-than-100% color gamut using LED has been made, 92% using CCFL is common for wide color gamut. Despite a trade-off relation between luminance and color gamut, TN has advantage over other modes because of its high aperture ratio.

■ Viewing angle

The current viewing angle level of 170/160 has been achieved since LPL successfully started to apply its 160/160 wide viewing angle technologies in manufacturing. It is highly likely that new polarizer development and processibility improvement would enable a wider viewing angle around 170/170 or wider.

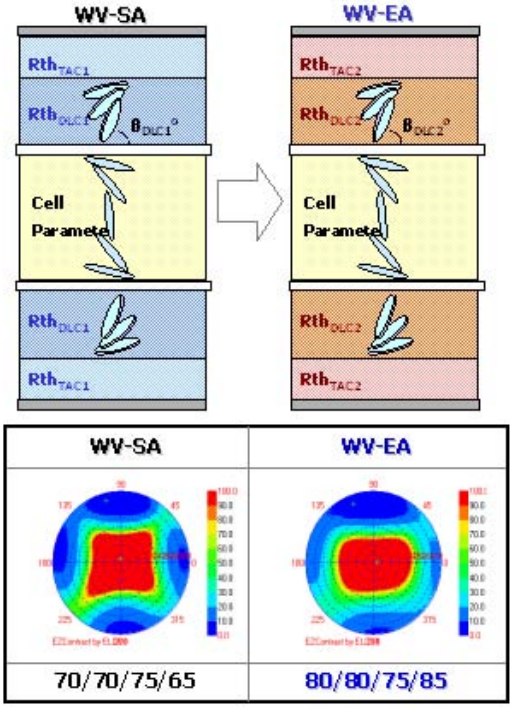

Figure 3. Wide viewing angle through POL development

Discussion

Having a good uniformity in the TFT charging property is the first priority, especially when TN monitor is about to make its way into a large-size and high-resolution market. Above all, solving the problem caused by gate or data line delay is essential to get the sufficient charging at the TFT array and it has a lot to do with electrode material with regard to resistivity.

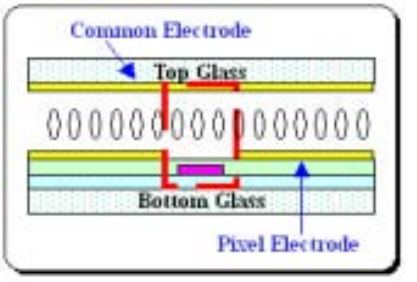

Figure 4. TN electrode structure

LPL has applied copper to an electrode material for lower resistivity since 2004, and also overcome many concerned issues. It is certain that signal delay problem of gate bus line cannot be an obstacle for TN monitor to enter a high-end market.

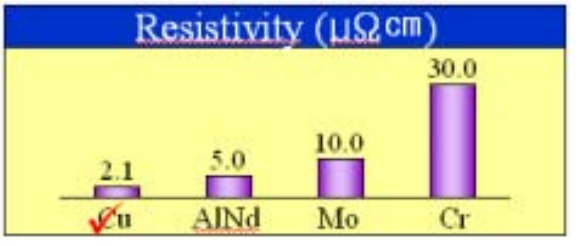

Figure 5. Relative resistivity comparison according to materials

Summary

Table 1. Display specification of a developed 20.1 inch WSXGA+

Item	Specification
Display size (diagonal)	558.673mm
Display pixel (Hor.×Ver.)	1680×1050 WSXGA+
Pixel pitch	0.282mm×0.282mm
Number of colors	16.7M (8bit/color)
Color Gamut	72% NTSC
Color coordinate (White)	0.313, 0.329
Contrast ratio	Typically 800
Brightness	300cd/㎡
Response time	5ms (on-off)
Viewing angle (CR ≥ 10″)	Ver. ≥ 160´ Hor. ≥ 160´

In this paper, we dealt with high feasibility into high-end TN monitor development, with TN having the advantage of low cost as well as high brightness, fast R/T and high color gamut.

LPL has already succeeded in developing high-spec 20.1W and 22W TN monitor, and we expect that over the trend for larger size and higher resolution, TN monitor can successfully enter the high-end market with its own strength we mentioned above.

Figure 6. 20.1W and 22W TN monitor

Reference

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