P-4 / S. J. Hong

Smart LCD using a-Si photo sensor

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ABSTRACT

Recently, the demands of the high quality LCD display device have increased. We have developed the smart LCD that photo sensor is integrated in. Amorphous silicon TFTs have photo leakage current characteristics when the channel of TFTs are lighted on. This characteristic has applied in our device. We expect that photo sensor integrated LCDs have lots of merits in mobile display device, note PC panel and LCD TV.

Introduction

Amorphous Si TFT has photo induced leakage current characteristics. When the channel of TFTs are lighted on , photo leakage current generates. This characteristic has been considered a drawback in switching device. However, We have applied this characteristic into LCD device for photo sensor. Intentionally the channel of TFT is located at open area to external light, as the external light intensity increase, photo current also increase. **[Figure.1]**We have integrated the circuit of photo sensor in LCD panel.

Amorphous Si Photo Leakage Current

As luminous intensity increases, the leakage current of a-Si TFT also increases.**[Figure.2]** The deviation of photo-leakage current has the maximum value at Vgs is -7v. It is possible to detect the condition of luminosity by detecting photo leakage current.



FIGURE 1 Mechanismof photo leakage current



FIGURE 2. Photo leakage current with luminous intensity.

Operating Circuit

We have composed the circuit of the photo sensor. [Figure3] There are sensor TFT array, Set TR, Reset TR and two capacitors in the circuit. The sensor TFT array consists of serial connection of TFT which is exposed to light.



FIGURE 3. The operating circuit of the photo sensor

It is need to decrease panel-to-panel deviation of sensor output. We have considered that the differential value between sensor TFT output and reference TFT output depends on *the external luminous intensity*. It is possible to reduce panel-to-panel deviation about 20%.

Applications of the Photo Sensor

The trans-reflective mode of LCD has a few merits in mobile display device. In indoor it works at transmission mode with BLU(Back-Light-Unit)on. As external light increase, it works at reflective mode. It is not necessary to turn on the BLU. However, generally BLU remains on state even though with external light. It is able to control the BLU dynamically with photo-sensor integrated LCD; smart LCD



(a) Reflective mode: BLU off
(b) transmission mode: BLU on
FIGURE 4. The Sample of photo sensor integrated LCD; operations at 2 mode

Conclusion

We have fabricated the sample of photo sensor integrated LCD: Smart LCD. It is possible to control the BLU by detecting the external light dynamically with no additional cost The operation of photo sensor is successful in LCD panel. Not only working in 1bit, but also multi bit operation: 8bit is also available with A-D converter. We have expected that photo sensor is applied in mobile display device, note PC and LCD TV.