Deformation Analysis on the Photospacers for TFT LCD

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Abstract: *The measurement system has been set up successfully for evaluating the luminance decay resulted from finger touch. Experimental result showed that in the same density design, larger photospacer will be with a better cell gap stability than that of smaller one and also with a satisfied one drop fill (ODF) margin.*

Keywords: photospacer, cell gap, ODF.

Introduction

In general, a liquid crystal display (LCD) device has a pair of substrates each having transparent electrodes and a liquid crystal sandwiched between these substrates. The space called "cell gap" between these two substrates plays an important role to affect optical characteristic of LCD device, especially the transmitting of light.

Therefore, the uniformity of cell gap through the entire panel would be very important. It is well known that any slight deviation in the cell gap will result in a noticeable and defective appearance in the display (so-called mura defect) [1]. This can readily be seen in a conventional LCD panel with a fingertip pressure on the surface. By applying a fingertip stress on the panel surface, the cell gap will be decreased for some extent due to the reduction of photospacer height. Because of the cell gap reduction, a black spot (or called touch mura) resulted from the decay of luminance can be easy observed. There are two cases for the black spot phenomena which need to be concerned. One is resulted from reversible deformation of the photospacer, another is resulted from plastic deformation of photospacer. For case one, the black spot will be recovered after the release of applied pressure, such as finger pressed loading from human and another case is that the black spot will not be disappeared after the release of applied pressure.

In order to reduce the plastic deformation of photospacer, usually a photospacer material with larger elastic module was employed to enhance the resistance to applied pressure. In contrast, there is also a side effect of bubble existed in the panel for a photospacer with a larger elastic module, which has been proposed by Lee et al. [2]. On the other hand, ODF margin (tolerance of liquid crystal injection amount in ODF process) is also an important parameter that should be taken into consideration in photospacer design. In other words, it is necessary to design a proper photospacer with a larger ODF margin and excellent resistance for touch mura.

Although much effort has been done to design a proper photospacer [3~5], seldom paper has mentioned to the test method or evaluate technology for touch mura specially for quantitative data on the luminance decay under different applied force or loading. In this paper the luminance decay for various designs of photospacers under various compressive stresses was investigated. In addition, however, most pressure applied on the panel is absorbed by bending of substrates and support members of backlight. Before the un-recovered touch mura appears, the panel might be destroyed by bending when the pressure is about 4 kgw/cm^2. For this reason, a new test method was proposed to estimate the ability of photospacer to resist touch mura. Since luminance is mainly related to cell gap and photospacer height, this new method was used to estimate damage of photospacer by luminance change measurement.

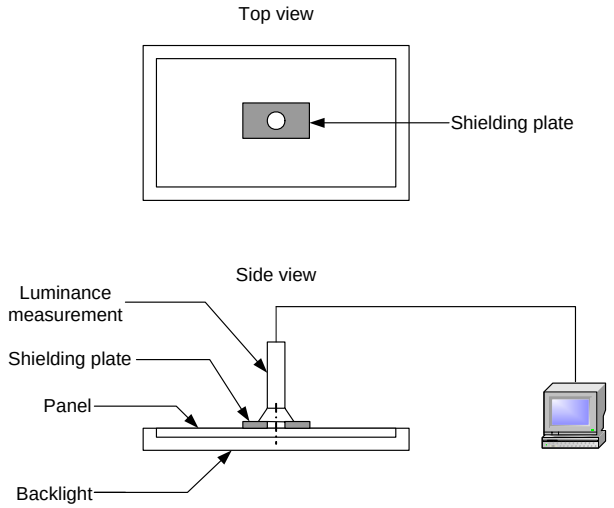

Figure 1. Schematic illustration of measurement method.