April 18, 2017

Using Nanowire Film in LCD Displays for Flexible Placement of Chip-on-Glass

Livius Chebeleu

Using Nanowire Film in LCD Displays for Flexible Placement of Chip-on-Glass

Livius Chebeleu

Abstract:

A transparent conducting film is used to attach chip-on-glass display drivers to the back of an electronic display. Transparent conducting films are electrically conductive and optically transparent. Thus, they can be used to make electrical connections across a wide area, such as an LCD screen, while still allowing light to pass through. In LCD applications, a transparent conducting film like silver nanowire film (SNF) may be used to connect display-driver integrated circuits to the main processor on a printed circuit board. Because SNF is very flexible, it can be wrapped around an edge (or multiple edges) of the display and the display drivers can be mounted on the back of the display, which reduces the need for a large display border for the chip-on-glass connections.

Keywords: transparent conducting film, silver nanowire film (SNF), flexible conductor, LCD display, chip-on-glass (COG), attach behind display, narrow frame, narrow bezel, symmetrical border

Background:

Developing a device display with narrow borders or bezels is difficult because of the space required by the electronics that drive the display. A liquid crystal display (LCD), and digital displays in general, typically have one or two large borders for attaching the display drivers in a chip-on-glass configuration. There also may be a strip of traces for an anisotropic conductive film (ACF) that is used to bond a flexible printed circuit to connect the display to the main processor of the device. These borders present the viewable area (active area) of the display as offset and asymmetrical relative to the display boundary and lead to a wide border, and therefore a wide

bezel, between the product edge and the active area. This presents a problem when the design calls for a symmetrical-looking device with similar or symmetrical borders all the way around the active area, because the border width is limited by the largest border of the display. This is even more of a challenge for watches and other wearable devices, where even a few millimeters of bezel width might conflict with the desired industrial design and aesthetics.

Description:

To address this problem, a transparent conducting film, such as silver nanowire film (SNF), is used to make the chip-on-glass attachment on the back of the display. Transparent conducting films are electrically conductive and optically transparent. Thus, they can be used to make electrical connections across a wide area, such as an LCD screen, while still allowing light to pass through. In LCD applications, a transparent conducting film like SNF can be used to connect the display drivers to the main processor on a printed circuit board. Because SNF is very flexible, it can be wrapped around an edge (or multiple edges) of the LCD, and the display drivers can be mounted on the back of the display, which reduces the need for a large display border for the chip-on-glass connections.

Figure 1 illustrates an example chip-on-glass configuration of a display without a transparent conducting film. As shown, the lower layer of the LCD glass is extended to allow for the LCD driver chip to be attached and to allow the flexible printed circuit attachment that connects the display to the main processor (*e.g.*, a separate printed circuit board). In this example, the bezel is offset, which causes an asymmetrical border around the active area of the LCD screen. In other configurations of this example, the border may be made symmetrical, but the border is then as wide as the bezel offset around the entire active area.

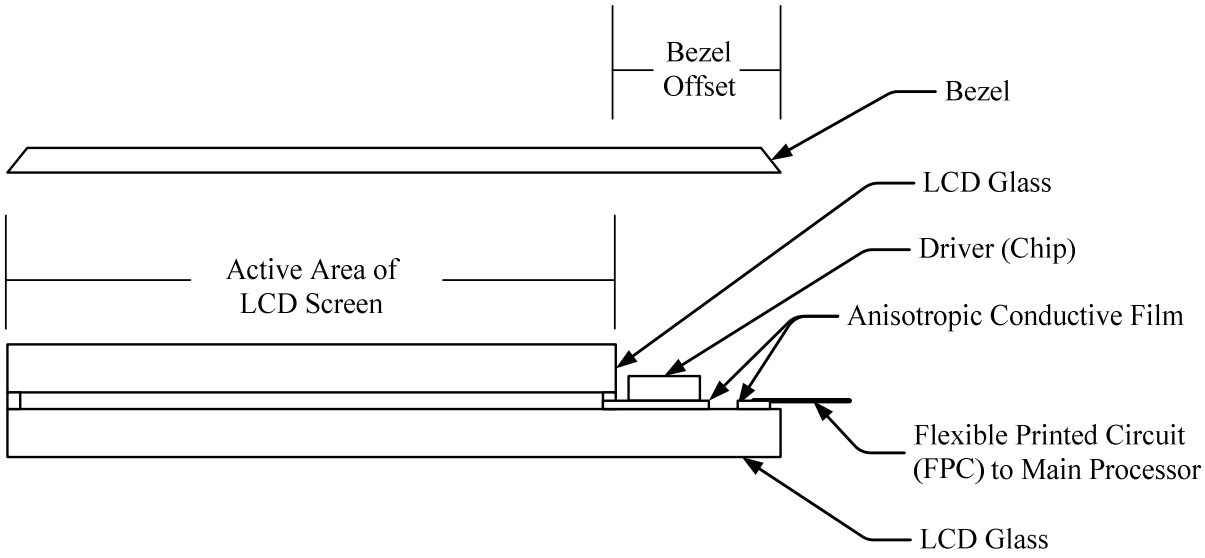

Figure 1

Figure 2 depicts an example application of a transparent conducting film to attach display drivers on the back of the display, which is described in further detail below. The items shown in Figure 2 are not to scale. In particular, the thickness of the transparent conducting film and the radius of the bend in the transparent conducting film are exaggerated to illustrate the concept.

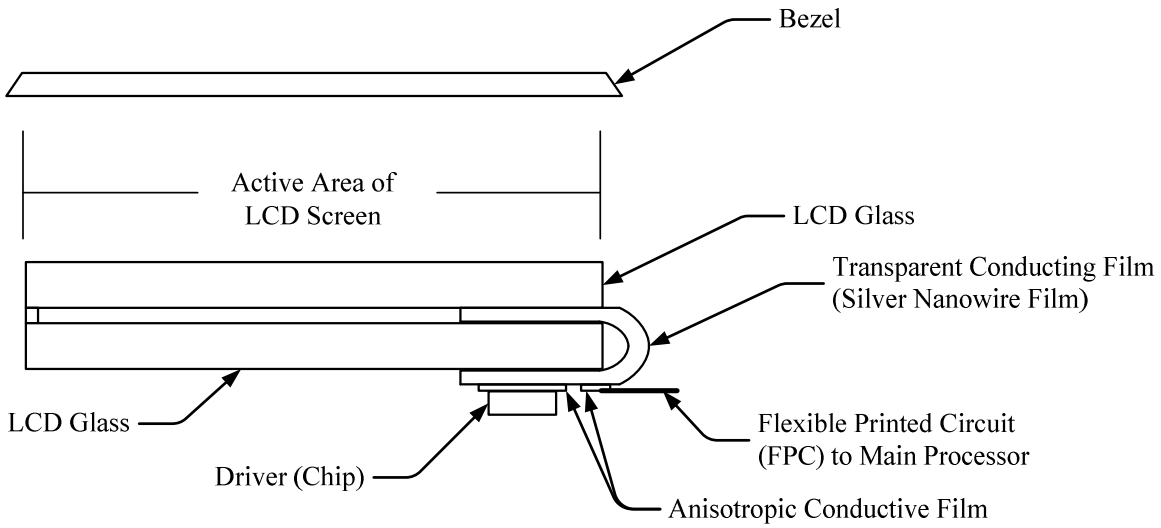

Figure 2

A variety of transparent conducting films may be used. Some commonly used transparent conducting films, however, may be brittle (*e.g.*, indium tin oxide). In contrast, SNF is durable and flexible enough to accommodate small-radius bends. In displays that use backlighting, including in many LCD screens, the display is lit from the side or the display drivers are attached behind the backlight so that they do not obstruct the transmission of light to the display (E-ink displays, and other displays that do not use backlighting, are not subject to this restriction).

Example:

Figures 3-1 and 3-2 depict another example display using a transparent conducting film to enable a chip-on-glass configuration with the display drivers on the back of the display. Figure 3-1 shows an example chip-on-glass configuration without a conducting transparent film.

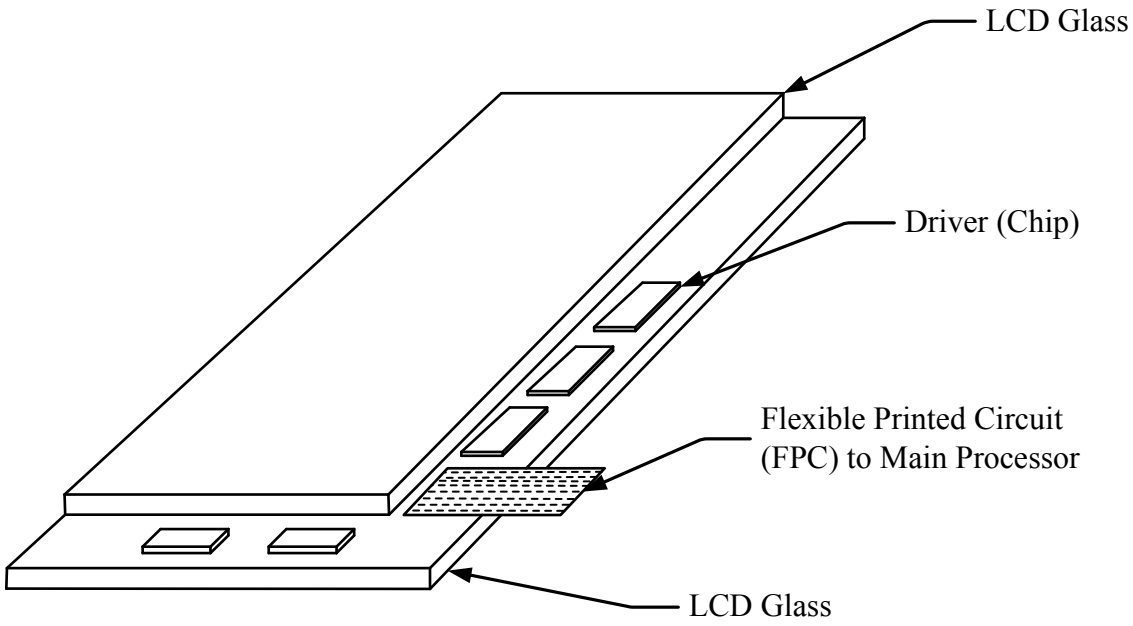

Figure 3-1

Figure 3-2 shows an example implementation LCD that includes a silver nanowire film (SNF) to mount the display drivers on the back of the display. In the example of Figure 3-2, the SNF is

between the glass layers of the LCD. While the example shows the SNF with three tabs that fold around three edges of the lower glass layer, other configurations are possible. The display drivers and flexible printed circuit are then connected via the SNF (for the sake of clarity, Figure 3-2 does not show the anisotropic conductive film). In the example, the viewable area of the screens (the active area) is the same, but the bezel used for the display illustrated in Figure 3-2 may have narrower and symmetrical borders.

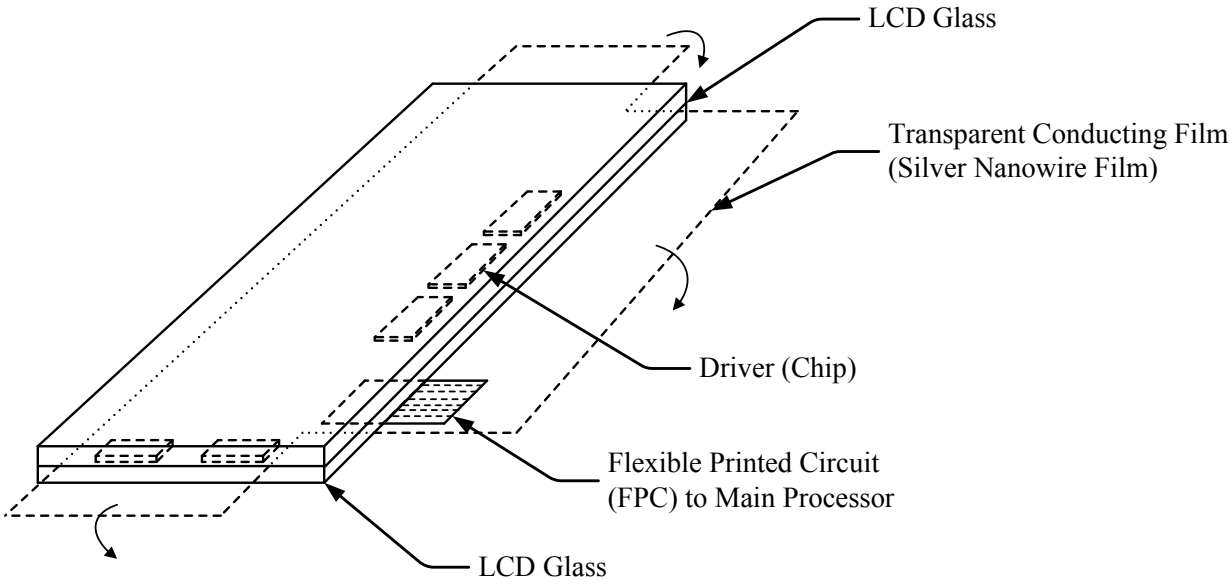

Figure 3-2

Figures 4-1 and 4-2 show the examples of Figures 3-1 and 3-2 from a different angle and include the bezel.

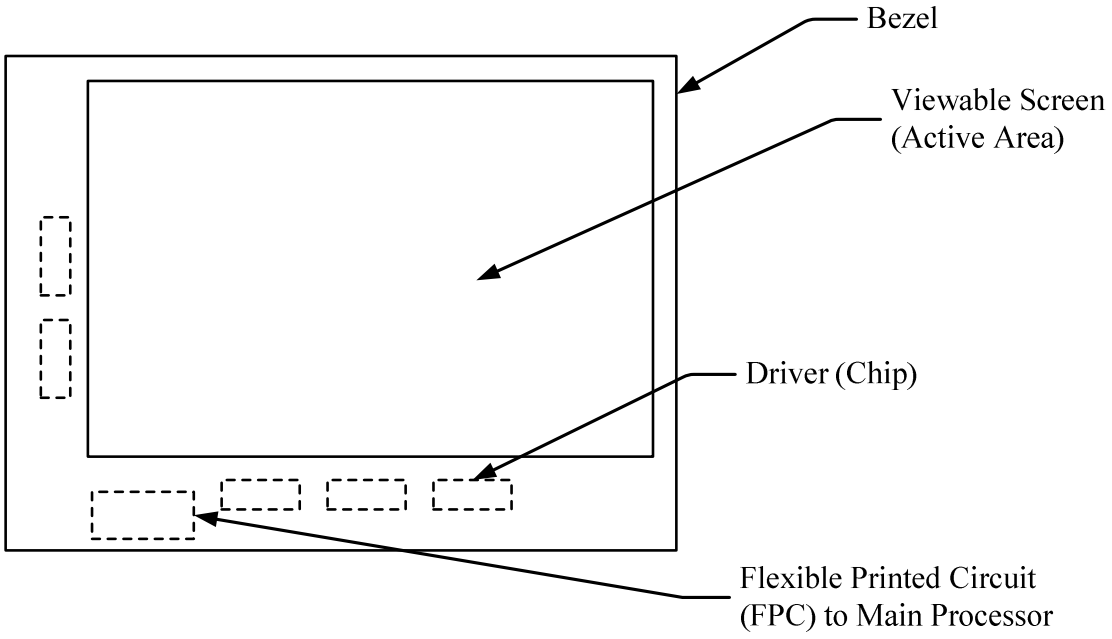

Figure 4-1

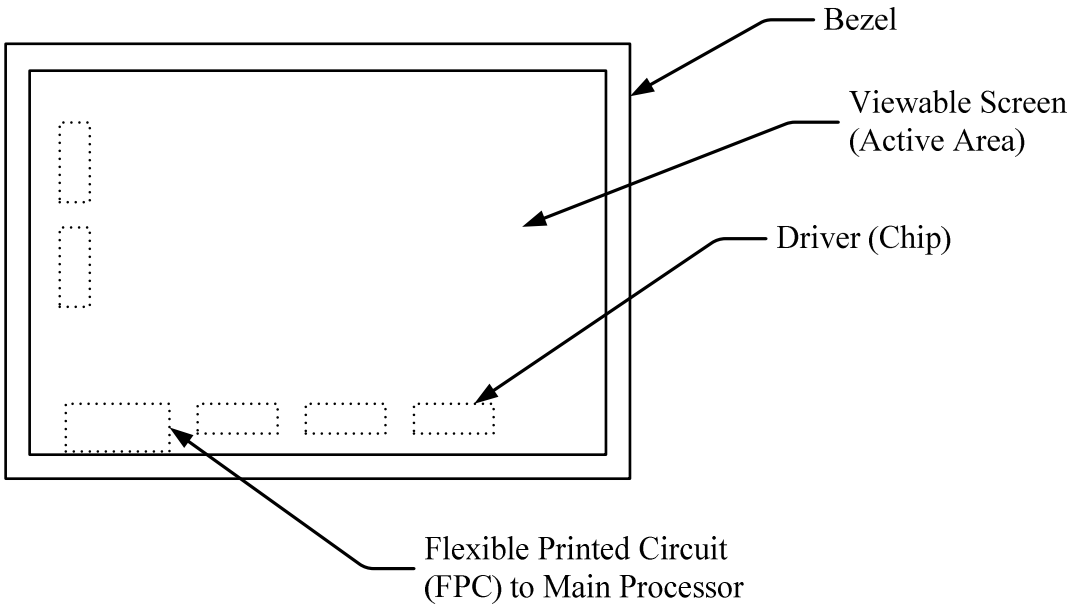

Figure 4-2