

Solomon Systech Drivers Enable Bistable Display

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Bistable display becomes one of the most contemporary display technologies to be given close attention among the industry. This is especially true when the end products start to adopt bistable display with high mass production volume. The cholesteric display is one kind of bistable display that is now applied in the memory thumb drive device to display the amount of memory left in the drive. It is also being implemented in electronic point of purchase (ePoP) systems, such as for the display of the price tag. Another bistable display, the electrophoretic display, has been used in different models of the Sony electronic book with SVGA display size. The Motorola mobile phone Motofone adopts electrophoretic for its main display and has a production volume of over millions. All of these applications show that bistable display is no more a novel technology. On the contrary, it is a proven display technology that has passed through the portable device mass production requirements.

Currently, there are many types of bistable display technologies emerging. Among them, electrophoretic and cholesteric liquid crystals displays are advanced and realized in end products with impressive mass production volumes after several tens of years of development and evolution. Let's take a look into these two technologies, and try to find out why they can compete with conventional displays like LCD and OLED and take a share as a solution of display devices.



Figure 1: Motofone, the first e-paper mobile phone from Motorola, uses Solomon Systech's Bistable Display Driver

Electrophoretic display

The electrophoretic display is basically composed of numerous small capsules between layers of films. Each capsule consists of dielectric fluid and charged pigmented particles. The common transparent cathode is placed on the top, while the segment anodes are made at the bottom of the capsule. When the positive or negative electrical signal is applied from the driver IC to the anodes, electrophoresis occurs and the charged particles are moved to either the top or bottom of the capsule, as shown in Figure 2.

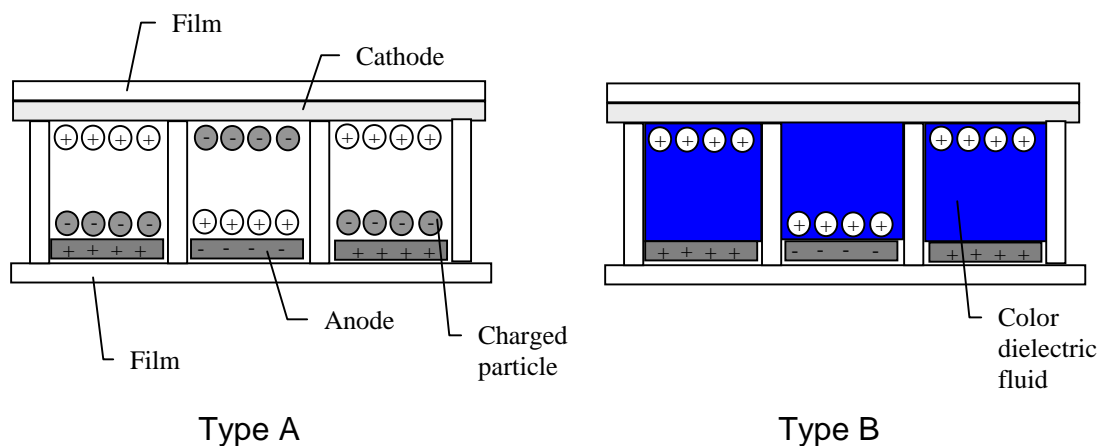


Figure 2: Electrophoretic Display Structure

The display has two different architectures to exhibit the dual colors. In type A, the charged particles have two kinds of pigment: one in white, and another one being light absorbing. When the white particles are on the top of the film to scatter white light, the display is in the bright state. It becomes dark state when the dark particles are on the top to absorb the light. In type B, the capsule contains white pigmented particles and colored fluid. The bright state is achieved with a similar mechanism as type A. However, it is turned to another color while the white particles are moved to the bottom, and the user sees the color scattered by dielectric fluid.

Cholesteric Liquid Crystals Display

Cholesteric liquid crystals display (ChLCD) has two stable states: planar and focal conic. In the planar state, the ambient light incident into ChLCD is split into two polarized lights. One passes through the display, while the other one is reflected through scattering of light, thus making the pixel bright. In the focal state, the incident light just passes through the display without reflection, and the pixel becomes dark. To change between these two stable states, an electrical pulse signal is supplied by driver IC to the ChLCD display.

Bistable Display Niche Features

A bistable display shows the image through scattering the light by particles, fluid or ChLCD. It doesn't need polarizers like the LCD, where the polarizers absorb a large portion of light. The bistable display reflective ratio is better and achieves high brightness and contrast. Also, light scattering results in a wide viewing angle of the image. Thus, the display provides high readability comparable to paper quality.

By using ambient light as the source in scattering to illuminate images, bistable display is a non-emissive technology, which uses less power than emissive displays like OLED, as the latter one takes much power to generate enough light brighter than the ambient so as to display images with good readability. Moreover, electrophoretic display shows bistability: power is applied only when the image is changed, and the image can be kept on display without power. On the other hand, LCD and OLED have to continuously use power to refresh the display in order to maintain the image. The bistable display is significantly more power saving than conventional display technologies.

As we have seen, the structure of electrophoretic display is very simple and consists of several layers of material only. There is no polarizer, backlight and light guide, which are needed in LCD. Therefore, it can be made much thinner, below 0.2mm thick. While the current LCD and OLED displays are made of rigid glass, the film substrate of the electrophoretic display is made of plastic and the backplane is made of flexible PCB. This enables the display to be twistable.

Because of its unique features – thin and flexible – the bistable display is able to explore some new end product markets in which the conventional displays cannot be deployed. For example, the electrophoretic display is applied in smart cards and memory cards. In these applications, they are thin, and the thickness is fixed to standard. There is no room to accommodate thick LCD/OLED glass. In addition, one of the requirements of smart cards is that they can be bent to a certain extent. It is unlikely that the LCD/OLED can fulfill this requirement. It is foreseeable that there are more applications, which cannot use displays before because of dimension and mechanical limitations, which will begin to adopt bistable displays.

Other advantages, such as good display readability with high contrast, wide viewing angle and ultra low power consumption, also enable the bistable display to be competitive in portable devices such as mobile phones, watches, electronic shelf labels, electronic books, etc., as these advantages are also the key factors to be considered in choosing display solutions for these applications.

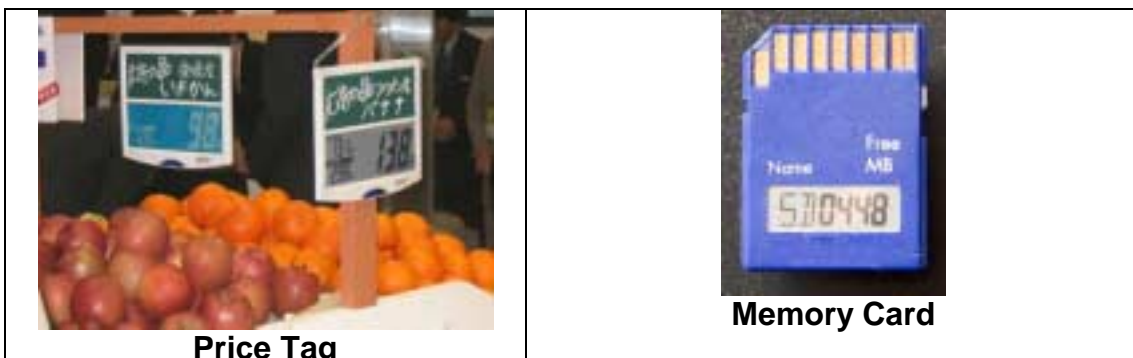




Figure 3: Application examples of electrophoretic display
 (Photo credit: SiPix Imaging Inc. and A-Data Technology Co., Ltd.)

The promising bistable display technology also has its weakness. The display requires very high driving voltage, around 30V to 40V, in order to move the material from one bistable state to another. Such a high voltage source is normally not available in portable device system. The driving waveform is different for each type of bistable display technology. In addition, usually the waveform is too complex and requires lots of effort if using a general microcontroller to output appropriate waveform to drive the display. In some bistable displays, their optimal performance driving parameters also change according to the temperature. Solomon Systech's bistable drivers are designed to address these issues so as to realize and release the best performance of bistable displays.

The Driver ICs

At this time, Solomon Systech has two highly integrated driver ICs designed for bistable display: SSD1615 and SSD1621.

SSD1615 is a driver with controller for passive matrix type cholesteric liquid crystals display, supporting maximum resolution 132 segments x 64 commons. While the SSD1621 is a driver with controller for direct drive segment/icon type electrophoretic display, it has 93 segments and one common with three voltage levels output. A single low voltage source 2.4V to 3.5V input into the driver is sufficient for the whole display operation. The on-chip internal DC-DC converter then converts the low input voltage into high voltage up to 30V (for SSD1621) and 36V (for SSD1615) to drive the bistable display. They also include built-in driving waveforms for bistable display. The users are hassle-free from handling complex waveforms, but simply input the image content into the internal display buffer; the drivers will output appropriate waveform automatically in changing the display content. The SSD1615 has an internal temperature sensor. Based on the environmental temperature, the driver adaptively tunes the driving waveforms parameters to ensure that the panel is driven in optimal performance. Both drivers support common MCU interface for internal configurations and image data access: SSD1621 supports SPI, while SSD1615 supports SPI, I2C and 8080/6800 8-bit parallel interface bus. The application circuit

of both drivers is simple, as shown in Figure 4. Only a few external capacitors are needed to operate the internal DC-DC converter and stabilize the voltages. This simplifies the circuit design and minimizes the circuit area to make the system more compact.

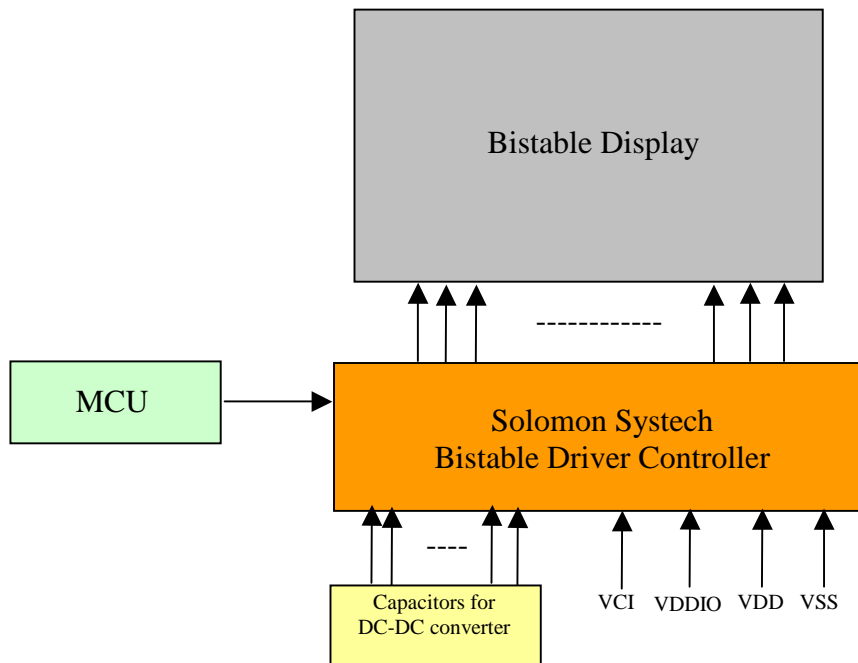


Figure 4: Solomon Systech Bistable Driver Application Circuit Diagram

Conclusion

The bistable display has become a reality, and is now used in applications. The industry attitude has changed from being sceptical to adopting this technology, as it has been proven in end products with impressive production volumes of over millions of units. Solomon Systech is committed to the bistable display industry, and has developed a series of driver ICs to enable the bistable displays to achieve their utmost performance.