How passive matrix OLED will change mobile displays and the role of SmartXtend driver technology

Displays manufactured using organic light emitting diodes (OLEDs) provide a cost effective, high performance alternative to liquid crystal displays (LCDs). OLED displays offer significant brightness, contrast and viewing angle advantages over LCD. Also, they are more efficient because there is no power draining backlight. As a result display manufacturers are ramping up investment in the equipment required to produce OLED displays.

There are two types of OLED display: passive matrix OLED (PMOLED) and active matrix OLED (AMOLED). PMOLEDs are much simpler to manufacture than AMOLEDs because there is no TFT substrate, and as a result fewer processing steps are required in the manufacturing line.

Today PMOLED is used in the sub displays of mobile devices because of their low power and superb colors and image quality compared with LCD TFT. On the other hand AMOLEDs are being used for the large area TV and monitor displays now being introduced because these larger displays require much longer row and column wires to drive each pixel.

The question is which technology is best suited for the high-resolution main displays of mobile devices. For example, many mobile phones being launched today have resolutions of QVGA (320x240) or up to WQVGA and vary in size from 1.6 to 4 inches in diagonal. SmartXtend™ was developed to enable passive matrix to serve this market.

Extends operating life time by reducing peak current

One major challenge with using PMOLED in high resolution displays is that the operating lifetime is limited. The reason for this is that the current must be injected into each pixel diode within one horizontal line period, during which each row is selected. This means that as the resolution is increased a higher current must be injected into the anode diode over a shorter period of time in order to achieve the desired brightness. This high current accelerates the aging process that occurs inside the diode, reducing the intensity of its light output over time.

Active matrix displays do not have this limitation to the same degree, since the current can be injected during the whole vertical frame period.

SmartXtend™ reduces peak current by driving more than one row at a time. In particular, each video frame is decomposed into two sub-frames. During the first of these sub-frames the rows are driven two at a time with the same data. That is, a lower peak current is applied over a longer period of time. During the other sub-frame ‘corrective’ data is added to each row to give each pixel its individual color.

Driving schemes like this have been studied in the past. However, Dialog Semiconductor is the first to have found a way to perform the necessary calculations in a cost effective manner suitable for application to low power, mobile devices. Other schemes require intensive computations that require significant processing power which consumes power and adds design complexity.
Using this driving scheme SmartXtend™ can reduce peak current through each diode by up to 30 percent. For example, a PMOLED panel driven with the conventional scheme requires about 150uA per anode, whereas only 100uA is required to drive the same panel when SmartXtend™ is used.

**Extends battery life by reducing average power**

Another challenge manufacturers face when designing high resolution PMOLED displays for mobile devices is the power consumption which must be minimized in order to make the batteries last as long as possible. With conventional driving schemes PMOLED consumes somewhat more power than AMOLED because the diode current is passed through longer column lines (resistive power) and a pre-charge cycle is required to prepare each pixel for turning on (capacitive power).

SmartXtend™ reduces average power consumption using a number of proprietary techniques that reduce the number of pre-charge cycles, the current and the voltage. Using these techniques SmartXtend™ can reduce power of the whole display subsystem by up to 30 percent. For example, a display that consumes about 600mW when driven with the conventional passive matrix driving scheme consumes about 400mW when SmartXtend™ is used to drive the same display.

As a class leader in low power design, Dialog Semiconductor’s engineering team has utilized a number of design principles to reduce the power consumption of the circuits needed to implement the SmartXtend™ driving scheme.

**Product availability**

Dialog Semiconductor currently has a prototype under evaluation with a number of customers. A highly integrated single-chip driver IC is under development. It will integrate all functions needed for the main display of a mobile phone. This includes the RGB interface from the system processor, the image memory, the column (anode) drivers and the row (cathode) drivers. As a single chip solution no additional ICs will be needed. The product is expected to sample by Q3’08 and be available for production in Q1’09.

The availability of driver ICs integrating SmartXtend™ will enable the use of PMOLED for the mobile phone main display.