A Reconfigurable, Low Power, Temperature Compensated IC for 8-segment Gamma Correction Curve in TFT, OLED and PDP Displays

Mauro Olivieri, Member, IEEE, Roberto Mancuso, and Friedbert Riedel

Abstract — In the market sector of consumer products based on TFT, OLED, PDP, and other displays, there is a demand for the capability of driving different displays by means of different gamma curves with the same driver circuit. Therefore, the display driver must have a built-in reconfigurable gamma correction circuitry able to correct the gamma curve of different types of displays. The presented solution proposes a reconfigurable gamma correction circuitry having high accuracy in the generated voltage levels and high flexibility in producing gamma correction curves. The configuration circuitry is digitally temperature compensated and the whole IC has a low power consumption with respect to the target product sector.

Index Terms — LCD, display drivers, gamma correction.

I. INTRODUCTION

Liquid crystal displays (LCD) are the most pervasive user interface technology in consumer portable electronic devices, and clearly represent a key point for the quality perceived by the user. As a consequence, cost-effective technical solutions for achieving an as-much-as-possible perfect perception of the colors in LCD images, are a key factor for the success of an entire product line. One of the most-common feature in LCD driving sub-systems is the gamma correction functionality. In TFT, OLED, PDT, and all other LCD types, the purpose of the gamma correction circuitry is to correct the gamma curve of the liquid used in the display: the gamma correction of the circuit multiplied by the gamma of the liquid must produce a monotonic nonlinear manipulation of the luminance codes (gray codes) of the RGB pixel components, so that the human eye can perceive the correct luminance of each RGB pixel.

Fig. 1 shows a typical static gamma correction circuitry for image processing, based on the concept of nonlinear distribution of the grey level voltages \(g_i\). The generation of the nonlinear voltage steps is made possible by a nonlinear voltage divider between a defined positive voltage level \(v_{sp}\) and the ground voltage \(v_{ss}\). (Similarly, the same circuitry is applied between the respective negative supply voltage \(v_{sn}\) and \(v_{ss}\).) Because of the high output load (due to the display columns) the voltage steps are properly buffered.

The choice of the \(k\) \(g_i\) voltage values defines the static gamma correction curve (Fig.2), that is the nonlinear translation of the grey codes to the \(k + 1\) voltage levels. A static gamma correction circuitry can correct only the gamma curve of an \(a\ priori\) known liquid, but cannot correct the gamma curve of a different liquid, as the latter generally has a different intrinsic gamma curve. The possibility of using the same IC for different liquids can be only given by a reconfigurable gamma correction circuitry. In this case the same integrated circuit (IC) can be suitable to many different panels using different liquids. This work presents a reconfigurable gamma correction circuit, characterized by extremely high accuracy of the voltage levels thanks to temperature compensation and designed to minimize the power consumption.

Fig.1 - Static gamma correction circuitry.