

Effects of DDLCD on the TFT-LCD panel

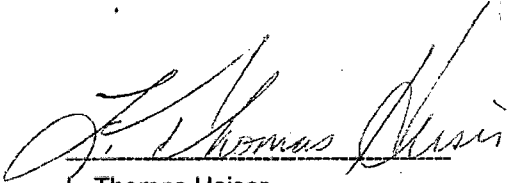
Extending the Vertical Blanking Time and Decreasing Frame Refresh Rate

Extending the vertical blanking time has no physical damaging effect on the TFT-LCD panels listed above. However, there may be an effect on image quality in the form of perceived "flicker" due to the resulting lower frame refresh rate. This flicker would be immediately apparent.

If flicker occurs, it is recommended that the DDLCD parameters are adjusted in MCU firmware to reach an appropriately small vertical blanking time which results in frame refresh rate high enough to eliminate flicker.

HITACHI is not ultimately responsible for image quality issues, and disclaims any liability for such image quality issues, which would result from operating the TFT-LCD panel at a frame refresh rate that is lower than the minimum frame refresh rate specified in the respective datasheets for the TFT-LCD panels listed above.

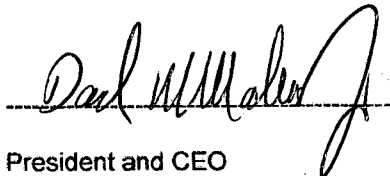
Hitachi Electronic Devices USA



L. Thomas Heiser
Sr. Vice President & GM

04-24-09

Date



President and CEO
Renesas Technology America, Inc

4/27/09

Date

To whom it may concern,

Below is a description of a method for driving a color TFT-LCD panel in an embedded application, and an advisory note on the effect it has on the operation of TFT-LCD panels manufactured by HITACHI, of the series:

- TX14D55VM1CAA

Background: Renesas, a global MCU supplier, offers a solution that is a combination of hardware and firmware, which can operate a color TFT-LCD panel. This solution is named Direct Drive LCD, or DDLCD.

The DDLCD system is made of three major hardware components, the MCU, an external frame buffer RAM, and the TFT-LCD panel itself. All three components are connected together by a common 16-bit data bus which is controlled by the MCU.

Operation 1 (refreshing a displayed image): Through the MCU's DMA mechanism, the MCU initiates a read of the external RAM device, and the MCU directs a write of the resulting RAM data (RGB) into the TFT-LCD panel by controlling the clock and synchronization input signals on the TFT-LCD panel.

This reading of RAM data and writing to the display panel occurs once for each pixel that is displayed on the panel, and this process continues until the entire panel is "painted" with all the pixels, known as one "frame". This process is repeated at a periodic rate, writing all the pixels to the panel at a given rate, known as the frame refresh rate.

Operation 2 (implementing image animation): In order for DDLCD to provide animation, or the appearance of moving images on the TFT-LCD panel, the MCU must extend the vertical blanking time (or vertical front porch) once per frame period to give the MCU enough time to write the new animated image data into the external frame buffer RAM before the next frame refresh occurs.

When Operation 2 is required for animation, extending the vertical front porch has a net effect of slowing down the frame refresh rate.

Two Key Parameters:

- **Frame Refresh Rate.** The rate at which the entire panel image is rewritten. If this rate drops too low, the display can appear to "flicker"
- **Vertical Blanking Time.** Extending this gives MCU time to make animation. The duration of vertical blanking is inversely proportional to frame refresh rate.

These two parameters may be adjusted in the MCU firmware to strike a balance between system requirements for the amount of animation, and optimum signal timing of specific LCD-TFT panel types.