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WHITEPAPER

LCD technology and image retention

This whitepaper discusses the image retention phenomenon, which can occur in any LCD-technology-based display. The document provides a number of guidelines for creating and displaying content, which reduces the risk of image retention occurrence.

1 What is Image Retention?

Image retention, temporary image retention (TIR), image sticking, image persistence, and image burn refer all to the same phenomenon. When an unchanging fixed image or repetitive sequence is displayed over a sufficiently long time interval, electrically charged particles (ions) that are always present in liquid crystal material can collect at the LCD panel electrodes. These ions cause a parasite electric field that affects the normal LCD behavior. The result is observed when the screen image is changed, and a residual image of the previous image can be seen – this is image retention. In most cases, image retention is temporary, and can be reversed by taking particular measures. However, when no measures are taken for long time, image retention can become permanent.

"Normal" picture	"Black"picture	Image Retention of "Normal" picture on black picture after being displayed for prolonged length of time
		

While all CRT, LCDs, and PDP displays are susceptible to image retention (in CRT and Plasma which are phosphor based, this is more commonly referred to as burn-in) at differing degrees, the time it takes for image retention to occur in LCD is longer. However, no LCD display is free from image retention. Fortunately, techniques exist to assist in reducing the risk of image retention in an LCD.

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2 What are ways to reduce the risk of Image Retention?

The best way to avoid image retention is not to use a fixed image and very frequently repeated clips. When this is not possible, a number of precautionary steps may be taken to reduce the risk of image retention.

2.1 Power Off / Standby

Turning off the display when not in use will help prolong the display life and minimize image retention. A few additional rules of thumb that can help preventing image retention when using a stationary pattern are as follows:

- Turn the power off for 8 hours after 24 hours in use;
- Turn the power off for 4 hours after 12 hours in use;
- Use screensavers whenever possible;
- Check regularly for image retention occurrence;
- Vary the video clips you are playing as much as possible.

2.2 Content creation

Displaying a static image and repetitive image patterns for extended periods of time is not recommended. Even a video of several minutes, which is played in a loop, is considered as repetitive. Using moving images is the ideal way to reduce the possibility of image retention. Scrolling text or images, or even alternating a fixed image with a moving image, will do the trick. Additionally, it is important to avoid using static bars at image boundaries. Typically, such bars are a result of difference in aspect ratio (e.g., playing 16:9 content on a 4:3 display).

High contrast colors such as black/white are not recommended to be positioned next to each other in a static image and frequently repeated content. High contrast in moving video is less of an issue, but repetition of the same image is not recommended as it can create a sense of blur. High contrast is acceptable when there is a gradient from one color to another.

Rules of thumb for content creation:

- Avoid using a combination of characters and background color with a large difference in luminance;
- Avoid colors with big difference in luminance (Black & White);
- Use colors with little difference in luminance;
- Alternate the characters color in a complementary manner (e.g., change color from green to red to blue);
- Alternate background color every 30 minutes whenever possible;
- Shift periodically static content/text with high contrast every 30 minutes to a new position;
- Insert moving videos between still images.

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2.3 High ambient temperature

Avoid exposing the displays to high ambient temperatures. Prolonged exposure to high temperatures very likely accelerates the degradation of the liquid crystal material, which would increase the risk of image retention occurrence.

3 Image retention – what to do?

Powering off the display or starting displaying non-repetitive content should alleviate the effects of image retention. It may require a few hours or a few days dependent on the intensity of the image retention. Once temporary image retention has occurred, no precise method exists to calculate how long it will take to remove the effect. Image design and pattern, temperature, ventilation and usage duration are all factors that contribute to the effect.

Please notice that if no measures are taken to remove temporary image retention at the early phase of its occurrence, it may become permanent.

Image retention is most visible typically with a full screen image with low brightness. Frequently changing the color of the background to one with high brightness can diminish the visibility of image retention.

4 Summary

Any LCD display exhibits the risk of image retention; image retention has no relation to 3D. Philips 3D Solutions recommends taking appropriate measures to prevent image retention. In case image retention is starting to occur please take immediate action.

Image retention is a topic being continuously under study. This application note reflects insights currently available and will likely be updated in the future.

Please note, that image retention is not covered under warranty.

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