



Image Retention in TFT-LCD Displays

Introduction

If a TFT-LCD displays the same, unchanging content for an extended period of time, a small residual DC component ("DC component") can build up in the liquid crystal layer. After the image changes, a faint afterimage may remain visible for a short time as a result.



What's happening? A brief explanation

This effect is particularly noticeable with medium gray tones. That is where the transmission-voltage characteristic curve is steepest, which is why even small voltage deviations cause a clearly visible change in brightness. With black or white, the same deviation is much less noticeable.

With proper drive, this so-called image sticking is normally reversible and disappears after some time. However, if the drive signal is incorrect or the DC balance is insufficient, the effect can develop much more quickly. Prolonged or intense DC loading—especially with still images—can ultimately lead to permanent image sticking that is no longer fully reversible (burn-in effect).

What You Can Do

- **Screensaver & Sleep Mode:** Whenever possible, activate a moving screensaver during periods of inactivity. Switch to sleep mode or turn off the display during prolonged inactivity.
- **Cyclic Image Change / Pixel Shift:** Periodically shift static elements such as logos, menu bars, or counters slightly, or display them in a rotating pattern. Avoid overlapping content during shifts and reduce critical mid-gray tones in permanently static areas as much as possible.
- **Minimize static display times:** Display unchanging image content for as short a time as possible and design the user interface to be dynamic where appropriate.
- **Optional: Refresh cycles:** Periodically changing image patterns can help dissipate incipient charge effects before image sticking becomes clearly visible.
- **Properly adjust VCOM and TCON:** The panel must be driven as symmetrically as possible between positive and negative polarity. An incorrectly set VCOM voltage or inappropriate TCON timing can cause a DC component and significantly accelerate image sticking. If using a custom driver board, VCOM and timing should therefore be tested for the specific panel in use and, ideally, verified according to the specifications before mass production begins.
- **Monitor operating temperature and consider thermal design:** Elevated temperatures can accelerate image sticking. Therefore, operate the display within the specified temperature range. Heat buildup caused by the backlight, electronics, or inadequate housing ventilation increases the panel temperature and thus the risk of image sticking and other temperature-dependent LCD effects.
- **Adjust test procedures:** During continuous operation or factory testing, do not display static images; instead, change the image content or test patterns regularly.

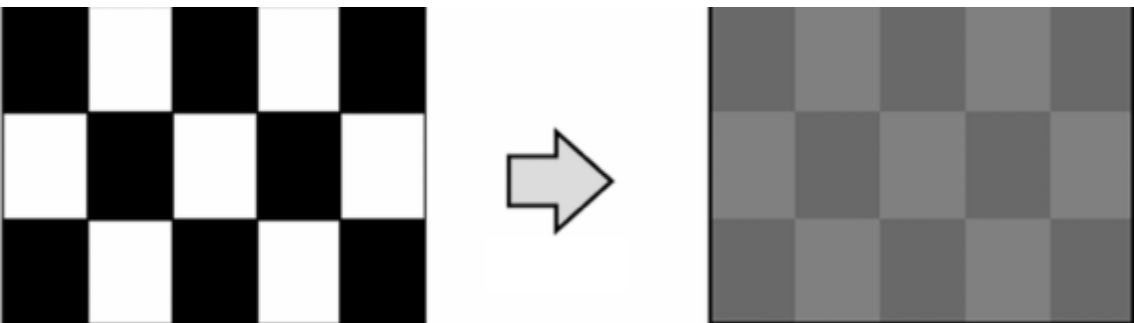


Conclusion

In practice, the most effective approach is to combine several of these measures, rather than relying on any one of them alone.

Test Methods

A checkerboard test pattern (5×5 checkers) is displayed for a specified period of time, after which the screen switches to a gray intermediate-tone image. The key criterion is that no afterimage remains visible after the respective observation period.”



Reference values from a large, well-known panel supplier:

Test Pattern Display Duration	Observation After Switching	Criterion
30 min	1 min	No afterimage visible
1 hr	3 min	No afterimage visible
2 hr	5 min	No afterimage visible
8 hr	30 min	No afterimage visible

Note: These values are examples. There is no uniform standard.

