

Inspection Standard for Pixel Defects – 04/11/2005

1. Scope

This manufacturing specification is for inspecting pixel defects on Landmark Sunlight Readable and VHB LCD modules.

This current version dated 04/11/2005 is largely based on the Sharp “Incoming Inspection Standard for TFT LCD Model No. LQ150X1LW71N”, file number LDI-15XRA01, issued on June 18, 2004. Section 9 of the Sharp Standard specifies the conditions, the test procedures, the definitions, and the acceptable levels of the pixel defects.

Landmark’s pixel defect inspection standard differs from the Sharp standard only in the definition of a “Bright Dot” as a defect. Basically, we must use a more stringent definition in testing very bright LCDs. For details, please refer to Section 8 of this manufacturing specification.

2. Inspection Conditions

The LCD screen is inspected with the naked eye for pixel defects under the following conditions:

Viewing distance	35 cm (13.8”) from the LCD screen
Ambient illumination	500 ± 200 Lux (46.4 ± 18.6 foot-candles)
Ambient light source positions	not causing significant glare on the LCD front surface
Ambient temperature	20 – 25 degrees C
LCD tilt angle	15 – 30 degrees from the vertical direction
LCD screen luminance	set at 50% of the maximum screen brightness of the LCD
LCD viewing direction	perpendicular to the LCD surface

3. Inspection Area

Pixel defects shall be inspected over the entire active area of the LCD.

4. Definition of Defects

4.1 Bright dots and Black dots – counts as a defect if a dot is visible under the test conditions specified in section 2 with the LCD displaying the proper test patterns specified in Section 5 below.

4.2 Scratches on the color filter – counts as a defect if it is visible over one half of a sub-pixel.

4.3 Scratches on the black mask – counts as a defect if it is visible and larger than 50 um in diameter.

5. Test Patterns

5.1 Bright dot defects shall be tested with the LCD displaying a “black” image on the screen.

5.2 Black dot defects shall be tested with the LCD displaying the “white”, “green”, “red”, and “blue” images on the screen in sequence.

6. Acceptable Level of Bright Dot Defects

- 6.1 Total number of acceptable bright dot defects – 4 maximum, in all primary colors (green, red, and blue).
- 6.2 Acceptable number of green bright dot defects – 2 maximum.
- 6.3 There shall be no more than two bright dot defects within a 10 mm diameter circle
- 6.4 Acceptable number of joint bright dot defects –
 - 6.4.1 If two defective bright dots are joined together, the maximum number of acceptable defects shall be 2 pairs.
 - 6.4.2 There shall be no 3 or more bright defective dots joined together.

7. Acceptable Level of Black Dot Defects

- 7.1 Total number of acceptable black dot defects – 4 maximum, in each test pattern (green, blue, red, and white images).
- 7.2 Two black dot defects joined together are considered as 1 defect.
- 7.3 There shall be no 3 or more black defect dots joint together.
- 7.4 There shall be no more than 2 black dot defects within a 10 mm diameter circle.

8. Notes

8.1 Section 9.3 of the Sharp “Incoming Inspection Standard for TFT LCD Model No. LQ150X1LW71N” defines a “Bright Dot” as a defect if it is visible through a 5% transparency of filter. If we follow this 5% transparency rule, then the observer will see a 1500 nits sunlight readable LCD through this 5% filter as a 75 nits LCD without the filter. Since it is a fact that the “white defect pixels” are more easily observed on a very bright display, therefore, we have modified Sharp’s standard by:

- 8.1.1 Setting the screen luminance at 50% of the maximum brightness.
- 8.1.2 The LCD is inspected for defects without using the 5% filter.

In essence, this is the equivalent of inspecting the defects through a filter with 50% transmission instead of a filter with 5% transmission.

8.2 The international organization VESA (Video Electronics Standard Association) issues a “Flat Panel Display Measurements Standard (FPDM)”, in which section 303-6 specifies the methodology of defective pixel analysis. If it is ambiguous to decide whether an observed dot should be counted as a defect or not, Landmark will refer to this VESA specification for the final decision.