

Display Elektronik GmbH

DATA SHEET

TFT MODULE

DEM 240240A1 VMH-PW-N

1,54" TFT

Product Specification

Ver.: 0

18.10.2022

Revise Records

| Rev. | Date | Contents | Written | Approved |
|------|------------|---------------------------|---------|----------|
| 0 | 18.10.2022 | Preliminary Specification | R | MH |
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1. General Description and Features

This TFT is a color active matrix LCD module incorporating amorphous silicon TFT (Thin Film Transistor). It is composed of a color TFT-LCD panel, driver IC, FPC and a back light unit. The module display area contains 240x240 pixels and can display up to 262K colors.

1.1. Features

- 240 x 240 pixels resolution.
- Display in 262k colors.
- SPI Interface
- RoHS Compliance

1.2. LCD Module

| Item | Specification | Unit |
|--------------------|----------------------|----------|
| Screen Size | 1.54 Inches | Diagonal |
| Display Resolution | 240 x RGB x 240 | Dot |
| Active Area | 27.72 x 27.72 | mm |
| Outline Dimension | 31.50 x 35.00 x 2.30 | mm |
| Display Mode | IPS | -- |
| Pixel Arrangement | RGB Stripe | -- |
| Pixel Size | 0.1155 x 0.1155 | mm |
| Surface Treatment | Anti-Glare | -- |
| Display Color | 262k | -- |
| Viewing Direction | Full-View | -- |
| Input Interface | 4-Wire-SPI | -- |

2. Mechanical Information

| Item | | Min. | Typ. | Max. | Unit | Note |
|-------------|----------------|-------|-------|-------|------|------|
| Module Size | Horizontal (H) | 31.30 | 31.50 | 31.70 | mm | -- |
| | Vertical (V) | 34.80 | 35.00 | 35.20 | mm | |
| | Thickness (T) | 2.20 | 2.30 | 2.40 | mm | (1) |
| Weight | | -- | TBD | -- | g | -- |

Note (1) Not include Component.

Refer to the Outline Dimension for further information.

3. Electrical Specifications

3.1 Absolute Max. Ratings

3.1.1 Absolute Ratings of Environment

If the operating condition exceeds the following absolute maximum ratings, the TFT LCD module may be damaged permanently. (Ta=25±2°C, VSS=GND=0)

| Item | Symbol | Min. | Max. | Unit | Note |
|-----------------------|------------------|------|------|------|---------|
| Storage Temperature | T _{STG} | -30 | 80 | °C | (1) |
| Operating Temperature | T _{OPR} | -20 | 70 | °C | (1,2,3) |

Note (1) 90 % RH Max. (40 °C ≥ Ta). Maximum wet-bulb temperature at 39 °C or less. (Ta > 40°C) No condensation.

Note (2) In case of below 0°C, the response time of liquid crystal (LC) becomes slower and the color of panel becomes darker than normal one. Level of retardation depends on temperature, because of LC's character

Note (3) Only operation is guaranteed at operating temperature. Contrast, response time, another display quality are evaluated at +25°C.

3.2 Electrical Absolute Rating

The following are maximum values which, if exceeded, may cause faulty operation or damage to the unit.

(VSS=GND=0)

| Item | Symbol | Min. | TYP | max | Unit | Note |
|-----------------------------|--------|-------|-------|-------|------|------|
| Interface Operation Voltage | IOVCC | 1.65v | +1.8v | +3.3v | V | |
| Input Current | IOICC | - | 6.0 | - | mA | |

4. Electrical Characteristics

4.1. TFT-LCD Module

| ITEM | SYMBOL | MIN | TYP | MAX | UNIT | NOTE |
|----------------------------|-----------------|---------------------|-----|--------------------|------|------|
| System Voltage | V _{CC} | 2.4 | 2.8 | 3.3 | V | |
| Input Current | I _{CC} | - | 6.0 | 7.5 | mA | |
| Input voltage ' H ' level | V _{IH} | 0.7V _{CC} | - | V _{CC} | V | |
| Input voltage ' L ' level | V _{IL} | V _{SS} | 0 | 0.3V _{CC} | V | |
| Output voltage ' H ' level | V _{OH} | 0.8 V _{CC} | -- | V _{CC} | V | |
| Output voltage ' L ' level | V _{IL} | 0 | 0 | 0.2V _{CC} | V | |

| Operation Mode | Image | Current Consumption | | | |
|----------------|-------|---------------------|-------------|---------------|-------------|
| | | Typical | | Maximum | |
| | | IOICC (mA) | ICC (mA) | IOICC (mA) | ICC (mA) |
| Normal Mode | Black | 0.005 | 6.0 | 0.01 | 7.5 |

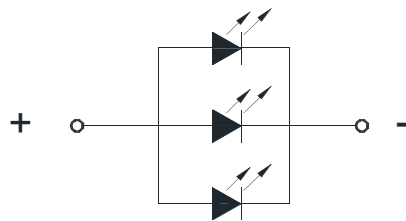
TYPICAL: IOVCC=1.8V, VCC=2.75V; MAXIMUM: IOVCC=1.65 TO 3.3V, VCC=2.4 TO 3.3V

4.2. Backlight Unit

(Ta=25±2°C)

| Item | Symbol | Value | | | Unit | Note |
|-------------------------|-----------------|-------|-------|------|------|------|
| | | Min. | Typ. | Max. | | |
| LED Total Input Voltage | V _L | 2.8 | 3 | 3.2 | V | |
| LED Total Input Current | I _L | - | 45 | - | mA | (1) |
| Power Consumption | P _{BL} | - | 135 | 144 | mW | (2) |
| Lifetime | - | 35000 | 50000 | - | Hrs | (3) |

Note (1) Circuit diagram



(2) Where $I_L = 45\text{mA}$, $V_L = 3$, $P_{BL} = V_B \times I_B$

(3) The environmental conducted under ambient air flow at $T_a = 25^\circ\text{C} \pm 2^\circ\text{C}$, $60\%RH \pm 5\%$

5. Input Terminal Pin Assignment

5.1. Pin Assignment (LCD)

| Pin No. | Symbol | Function | Remark |
|---------|---------|--|--------|
| 1 | LEDK | Backlight power supply negative | |
| 2 | LEDK | Backlight power supply negative | |
| 3 | GND | Ground | |
| 4 | GND | Ground | |
| 5 | FMARK | Synchronies MCU to frame rate | |
| 6 | SDA | 4w serial interface SDA | |
| 7 | WR(SCL) | 4w serial interface SCL | |
| 8 | RS(D/C) | 4w serial interface D/C | |
| 9 | CS | 4w serial interface CS | |
| 10 | RESET | -This signal will reset the device and it must be applied to properly initialize the chip. | |
| 11 | IOVCC | Power supply to interface pins (TYP 1.8V or 2.8V) | |
| 12 | IOVCC | Power supply to interface pins (TYP 1.8V or 2.8V) | |
| 13 | VCC | Power supply(TYP 2.8V) | |
| 14 | VCC | Power supply(TYP 2.8V) | |
| 15 | GND | Ground | |
| 16 | GND | Ground | |
| 17 | NC | NC | |
| 18 | NC | NC | |
| 19 | NC | NC | |
| 20 | NC | NC | |
| 21 | NC | NC | |
| 22 | NC | NC | |
| 23 | LEDA | Backlight power supply positive | |
| 24 | LEDA | Backlight power supply positive | |

6. Optical Characteristics

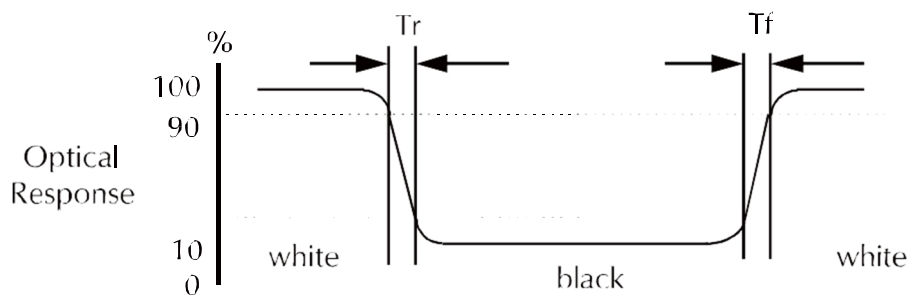
| Item | Symbol | Condition | Min | Type | Max | Unit | Note |
|-------------------------------|------------|----------------------------|-------|-------|-------|-------------------|-------|
| Brightness | B | | 320 | 400 | -- | cd/m ² | |
| Response Time (White - Black) | Tr +Tf | $\theta=0^\circ$ | -- | 30 | 40 | ms | |
| Contrast ratio | CR | At optimized viewing angle | 300 | 500 | -- | -- | |
| Luminance Uniformity | ΔL | | 80 | 85 | | % | |
| Color Chromaticity (CIE 1931) | White | Wx | 0.250 | 0.300 | 0.350 | -- | BM-7A |
| | | Wy | 0.260 | 0.310 | 0.360 | | |
| Viewing Angle | Ver. | θ_U | -- | 80 | -- | Degree | |
| | | θ_D | -- | 80 | -- | | |
| | Hor. | θ_R | -- | 80 | -- | | |
| | | θ_L | -- | 80 | -- | | |

a. Test equipment setup

After stabilizing and leaving the panel alone shall be warmed up for the stable operation of LCM, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. Optical specifications are measured by Topcon BM-7(fast) with a viewing angle of 1° at a distance of 50cm and normal direction.

b. Definition of response time: Tr and Tf

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".



c. Definition of contrast ratio:

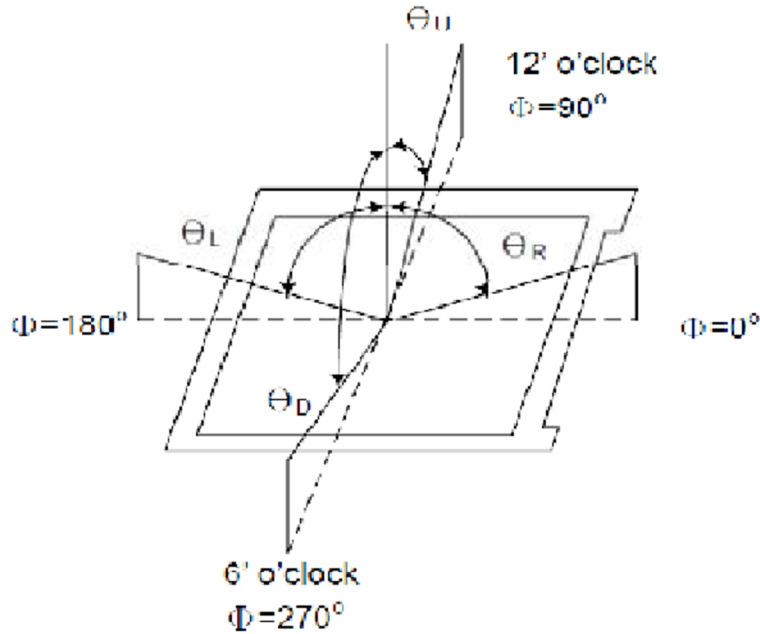
Brightness measured when LCD is at "white state"

Contrast Ratio (CR) =

—

Brightness measured when LCD is at "black state"

- d. Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.
- e. View Angle



- f. Definition of Luminance of White: Luminance of white at the center points

| | |
|---------------------------------|----------|
| Light Source of Back-Light Unit | LED Type |
|---------------------------------|----------|

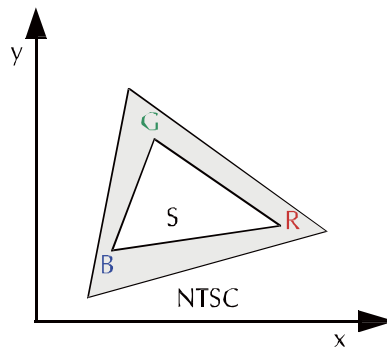
- g. Definition of White Uniformity

$$\text{White Uniformity} = \frac{\text{Min. luminance of white among 9-points}}{\text{Max. luminance of white among 9-points}} \times 100\%$$

- h. The definition of Color Gamut -Color Chromaticity CIE 1931

Color coordinate of white & red, green, blue at center point.

Color Gamut : NTSC(%) = (RGB Triangle Area / NTSC Triangle Area) x 100



7. Reliability Condition

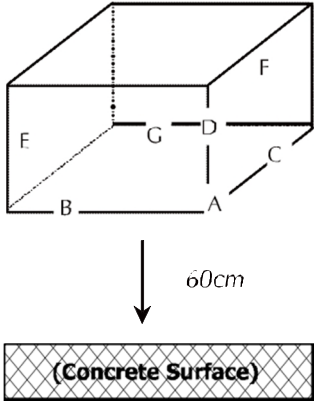
No change on display and in operation under the following test condition.

Condition: Unless otherwise specified, tests will be conducted under the following condition.

Temperature: 20°C ± 5°C

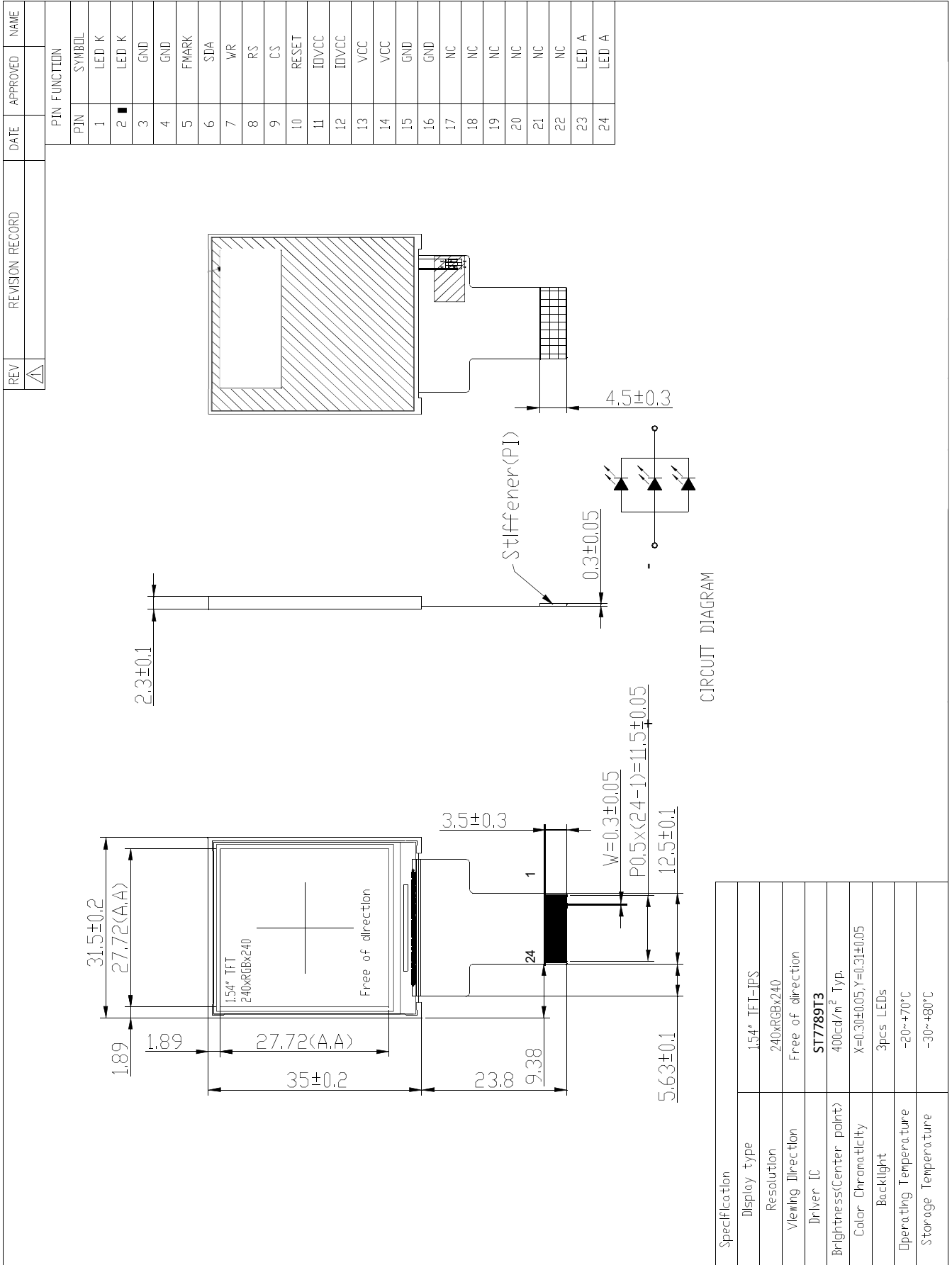
Humidity: 65%RH ± 5%

Tests will be not conducted under functioning state.

| No. | Parameter | Condition | Notes |
|-----|---|--|-------|
| 1 | High Temperature Operating | +70°C±2°C, 120hrs (Operation state). | |
| 2 | Low Temperature Operating | -20°C±2°C, 120hrs (Operation state). | 1 |
| 3 | High Temperature Storage | +80°C±2°C, 120hrs. | 2 |
| 4 | Low Temperature Storage | -30°C±2°C, 120hrs. | 1,2 |
| 5 | High Temperature and High Humidity Operation Test | +60°C±2°C, 90%, 120hrs. | 1,2 |
| 6 | Vibration Test | Total fixed amplitude: 1.5mm. Vibration Frequency: 10~55Hz. One cycle 60 seconds to 3 direction of X, Y, Z each 15 minutes. | 3 |
| 7. | Drop Test | To be measured after dropping from 60cm high on the concrete surface in packing state.  <i>Dropping method corner dropping:</i> <i>A corner: Once edge dropping.</i> <i>B, C, D edge: Once face dropping.</i> <i>E, F, G face: Once.</i> | |

- Notes:
1. No dew condensation to be observed.
 2. The function test shall be conducted after 4 hours storage at the normal temperature and humidity after removed from the test chamber.
 3. Vibration test will be conducted to the product itself without putting I in a container.

8. DIMANSIONAL OUTLINE

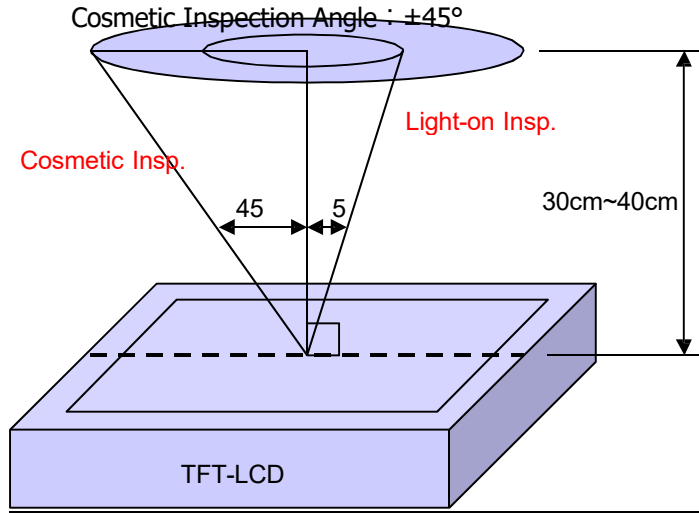


9. Incoming Inspection Standards

9.1. Inspection and Environment Conditions

9.1.1. Inspection Conditions:

- (1) Inspection Distance: 35 cm±5cm
- (2) View Angle : Light-on Inspection Angle : ±5°



(perpendicular to LCD panel surface)

9.1.2. Environment Conditions:

| | | |
|----------------------|-----------------------|-------------------|
| Ambient Temperature | | 23°C±5°C |
| Ambient Humidity | | 55%±10%RH |
| Ambient Illumination | Cosmetic Inspection | more than 600 Lux |
| | Functional Inspection | 300~500 Lux |

9.1.3. Sampling Conditions:

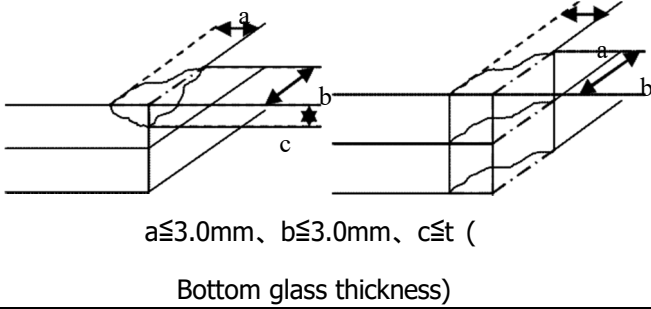
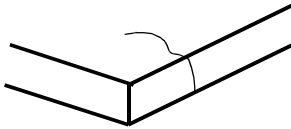
- (1) Lot Size: Quantity of shipment lot per model
- (2) Sampling Method:

| | | |
|---------------|--------------|------------------------------------|
| Sampling Plan | | MIL-STD-105E |
| | | Normal Inspection, Single Sampling |
| | | Level II |
| AQL | Major Defect | 1.0% |
| | Minor Defect | 1.5% |

- (3) The classification of Major (MA) and Minor (MI) defects is shown as 3. Inspection Criteria.

9.1.4. Inspection Criteria

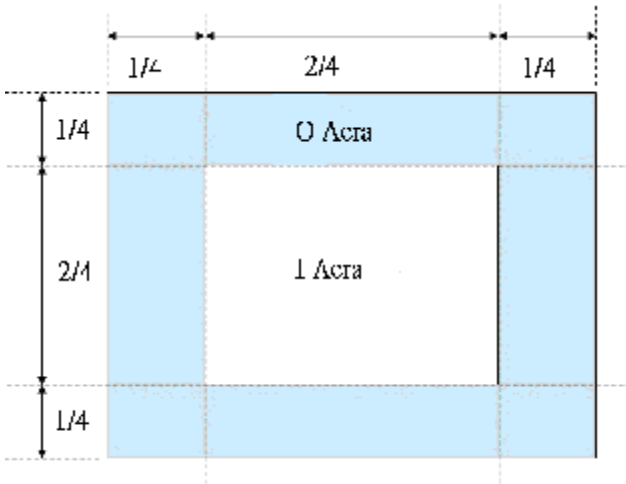
9.1.4.1. Cosmetic Inspection(Panel):

| Item | Judgment Criteria | Classification |
|---------------------------------------|---|----------------|
| Chipping on Panel |  <p>$a \leq 3.0\text{mm}$, $b \leq 3.0\text{mm}$, $c \leq t$ (Bottom glass thickness)</p> | MA |
| Scratch on Panel *Note-2 | <p>$W \leq 0.05\text{mm}$ or $L < 5\text{mm}$: Ignored</p> <p>$0.05\text{mm} < W \leq 0.1\text{mm}$ and $L \leq 5\text{mm}$: $N \leq 5$</p> | MI |
| Bubble or Dent on Panel *Note-3 | <p>$D \leq 0.2\text{mm}$: Ignored</p> <p>$0.2\text{mm} < D \leq 0.3\text{mm}$: $N \leq 5$</p> | MI |
| Panel Crack |  <p>Not Allowed crack</p> | MA |
| Bezel Deformation | Obvious deformation is not allowed. | MI |
| Bezel Oxidation | Not allowed if it rusts continuously over 1 cm (It is out of warranty with rusted tin plate) | MI |
| Bezel Scratch | $L \leq 20\text{mm}$, $W \leq 0.2$, $N \leq 3$ | MI |
| Metal Squash Dent /Flange(Front Side) | $D(W) \leq 1, L \leq 3, N \leq 3;$ | MI |
| B/L High Voltage Wire Denudation | Not allowed | MA |
| Polarizer flaw or leak out resin | Defect is defined as the active area. | MI |
| Outline Dimension | Must in Spec, refer to related product spec. | MI |

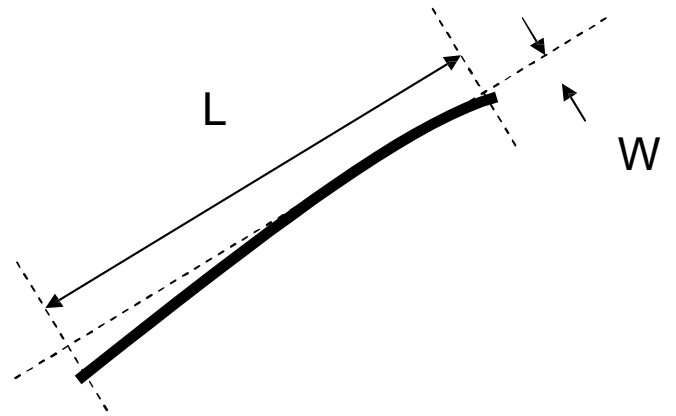
9.1.4.3. Functional Inspection:

| Item | Judgment Criteria | | | Classification |
|---|--|--|---------------------|----------------|
| | Area(Note1) | I | O | |
| Point Defect | Bright dot | Random | 1 | |
| | | 2 dots adjacent | 0 | 0 |
| | | 3 dots adjacent or more | 0 | 0 |
| | Dark dot | Random | 2 | |
| | | 2 dots adjacent | 0 | |
| | | 3 dots adjacent or more | 0 | 0 |
| | Total Dot Defect | | 3 | |
| | Distance | Distance between Bright and Bright dot | $L \geq 5\text{mm}$ | |
| | | Distance between Bright and Dark dot | $L \geq 5\text{mm}$ | |
| | | Distance between Dark dot | $L \geq 5\text{mm}$ | |
| | (1) It is defined as Point Defect if defect area $> 0.5\text{dot}$ (2) It is ignored if defect area $\leq 0.5\text{dot}$ (3) Weak point defect will be defined as Bright Dot if it can be observed through ND filter 5% (Full Screen Black Inspection) | | | |
| Line Defect | Obvious vertical or horizontal line defect is not allowed. | | | |
| Mura | Not allowed if it can be observed through ND Filter 5 % | | | |
| Foreign Material in spot shape *Note-3 | $D \leq 0.2\text{mm}$: Ignored $0.2\text{mm} < D \leq 0.3\text{mm}$: $N \leq 3$ | | | |
| Foreign Material in line or spiral shape *Note-4 | $W \leq 0.05\text{mm}$ or $L \leq 3\text{mm}$: Ignored $0.05\text{mm} < W \leq 0.1\text{mm}$ and $1.0\text{mm} < L \leq 2\text{mm}$: $N \leq 4$ $W > 0.1\text{mm}$ or $L > 5\text{mm}$: Not allowed | | | |
| Display Function Abnormal | No Malfunction can be allowed | | | |

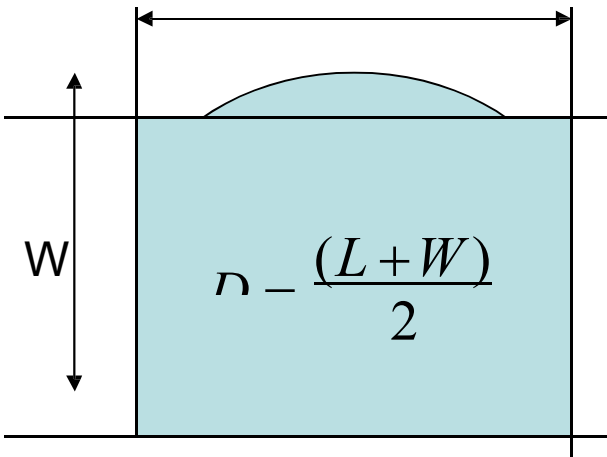
Note-1 : I/O Area Definition



Note-2 : Polarizer Scratch



Note-3 : Spot Foreign Material
($W \geq L / 4$)



Note-4 : Line or Spiral Foreign Material
($W < L / 4$)

