

Display Elektronik GmbH

DATA SHEET

TFT MODULE

DEM 480272B1 TMH-PW-N

4,3“ TFT

Product Specification

Ver.: 0

18.11.2019

Revise Records

| Rev. | Date | Contents | Written | Approved |
|------|------------|---------------------------|---------|----------|
| 0 | 28.02.2019 | Preliminary Specification | R | MHI |
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Special Notes

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Contents

| | | |
|-----------|---|-----------|
| 1 | General Description and Features | 4 |
| 1.1 | Features | 4 |
| 1.2 | LCD Module | 4 |
| 2 | Mechanical Information | 5 |
| 3 | Electrical Specifications | 5 |
| 3.1 | Absolute Max. Ratings | 5 |
| 3.2 | Electrical Absolute Rating | 5 |
| 4 | Electrical Characteristics | 6 |
| 4.1 | TFT-LCD Module | 6 |
| 4.2 | Backlight Unit | 6 |
| 5 | Block Diagram | 7 |
| 6 | Input Terminal Pin Assignment | 8 |
| 7 | Optical Characteristics | 9 |
| 8 | Basic Display Color and Gray Scale | 12 |
| 9 | AC Timing | 13 |
| 9.1 | AC Characteristics | 13 |
| 9.2 | Parallel RGB Input Timing Table (SYNC MODE) | 14 |
| 9.3 | POWER ON/OFF SEQUENCE | 15 |
| 9.3.1 | Power ON Sequence | 15 |
| 9.3.2 | Power OFF Sequence | 15 |
| 10 | Test | 16 |
| 11 | Dimensional Outlines | 17 |
| 12 | Incoming Inspection Standards | 18 |

1 General Description and Features

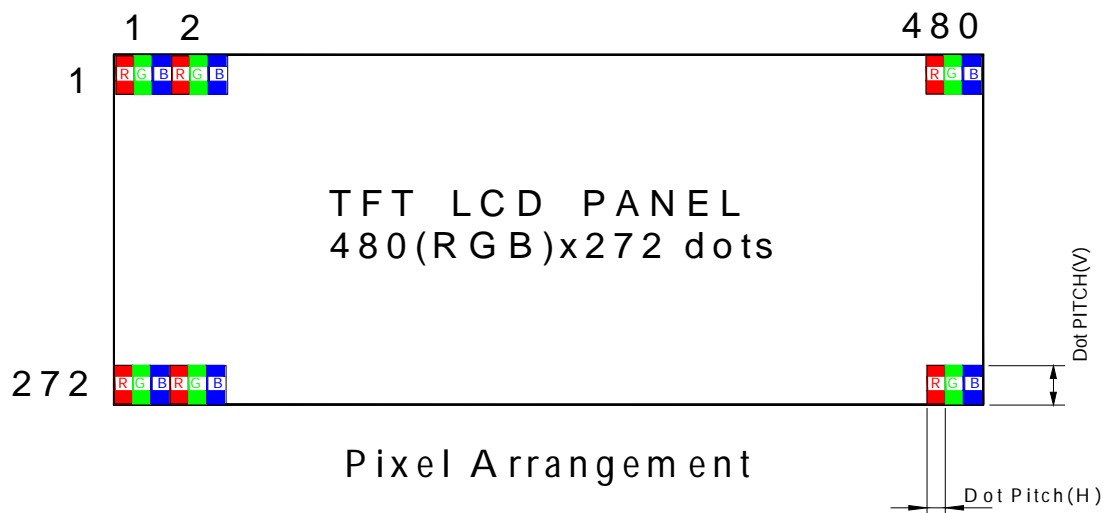
DEM 480272B1 TMH-PW-N is a TM (Transmissive) type color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching device. This model is composed of a TFT-LCD module, a driver circuit and a back-light unit. The resolution of a 4.3" contains 480(RGB) x 272 dots. The following table described the features of DEM 480272B1 TMH-PW-N.

1.1 Features

- Transmissive and back-light with 14 LEDs are available.
- TN mode.
- 24bit RGB Interface
- ROHS Compliance

1.2 LCD Module

| Item | Specification | Unit |
|---------------------|--------------------------------------|----------|
| Screen Size | 4.3 Inches | Diagonal |
| Display Resolution | 480 x RGB x 272 | Dot |
| Pixel Size | 0.198 x 0.198 | mm |
| Active Area | 95.040 x 53.856 | mm |
| Outline Dimension | 105.50 x 67.20 x 2.90 | mm |
| Display Mode | Normally <u>White</u> / Transmissive | -- |
| Pixel Arrangement | RGB Vertical-Stripe | -- |
| Surface Treatment | Anti-Glare (AG) | -- |
| Display Color | 16.7 Million | -- |
| Viewing Direction | 6 o'clock (Gray Inversion) | -- |
| Input Interface | Digital 24-Bits Parallel RGB | -- |
| Color Gamut (NTSC%) | NTSC 50% | -- |



2 Mechanical Information

| Item | | Min. | Typ. | Max. | Unit | Note |
|-------------|------------|------|--------|------|------|------|
| Module Size | Horizontal | -- | 105.50 | -- | mm | -- |
| | Vertical | -- | 67.20 | -- | mm | (1) |
| | Thickness | -- | 2.90 | -- | mm | (1) |
| Weight | | -- | TBD | -- | g | -- |

Note (1) Not include FPC.

Refer to the Dimensional Outlines 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) 95 % 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°, 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

3.2.1 TFT-LCD Module

(Ta=25±2°C, Vss=GND=0)

| Item | Symbol | Value | | Unit | Condition |
|----------------------|------------------|-------|------|------|-----------|
| | | Min. | Max. | | |
| Power Supply Voltage | DV _{DD} | -0.3 | 4.5 | V | |

3.2.2 Back-Light Unit

(Ta=25±2°C)

| Item | Symbol | Min. | Max. | Unit | Note |
|--------------------|----------------|------|------|------|------|
| Current of One LED | I _B | -- | (25) | mA | (1) |

Note (1) Permanent damage to the device may occur if maximum values are exceeded or reverse voltage is loaded. Functional operation should be restricted to the conditions described under normal operating conditions.

4 Electrical Characteristics

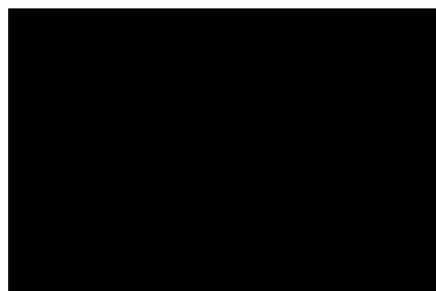
4.1 TFT-LCD Module

(Ta=25±2°C, V_{DD} =3.3V)

| Item | Symbol | Value | | | Unit | Condition |
|----------------------|-----------------|-------|------|------|------|-----------|
| | | Min. | Typ. | Max. | | |
| Power Supply Voltage | V _{DD} | 3.0 | 3.3 | 3.6 | V | |
| Digital Current | I _{DD} | - | (13) | (15) | mA | |

Note (1) The specified power consumption is under the conditions at V_{CC}=3.3V , F_V=60Hz, whereas a Power dissipation check pattern below is displayed.

Black Pattern / 0 Gray



Active Area

4.2 Backlight Unit

The back-light system is an edge-lighting type with white LED (Light Emitting Diode)s.

(Ta=25±2°C)

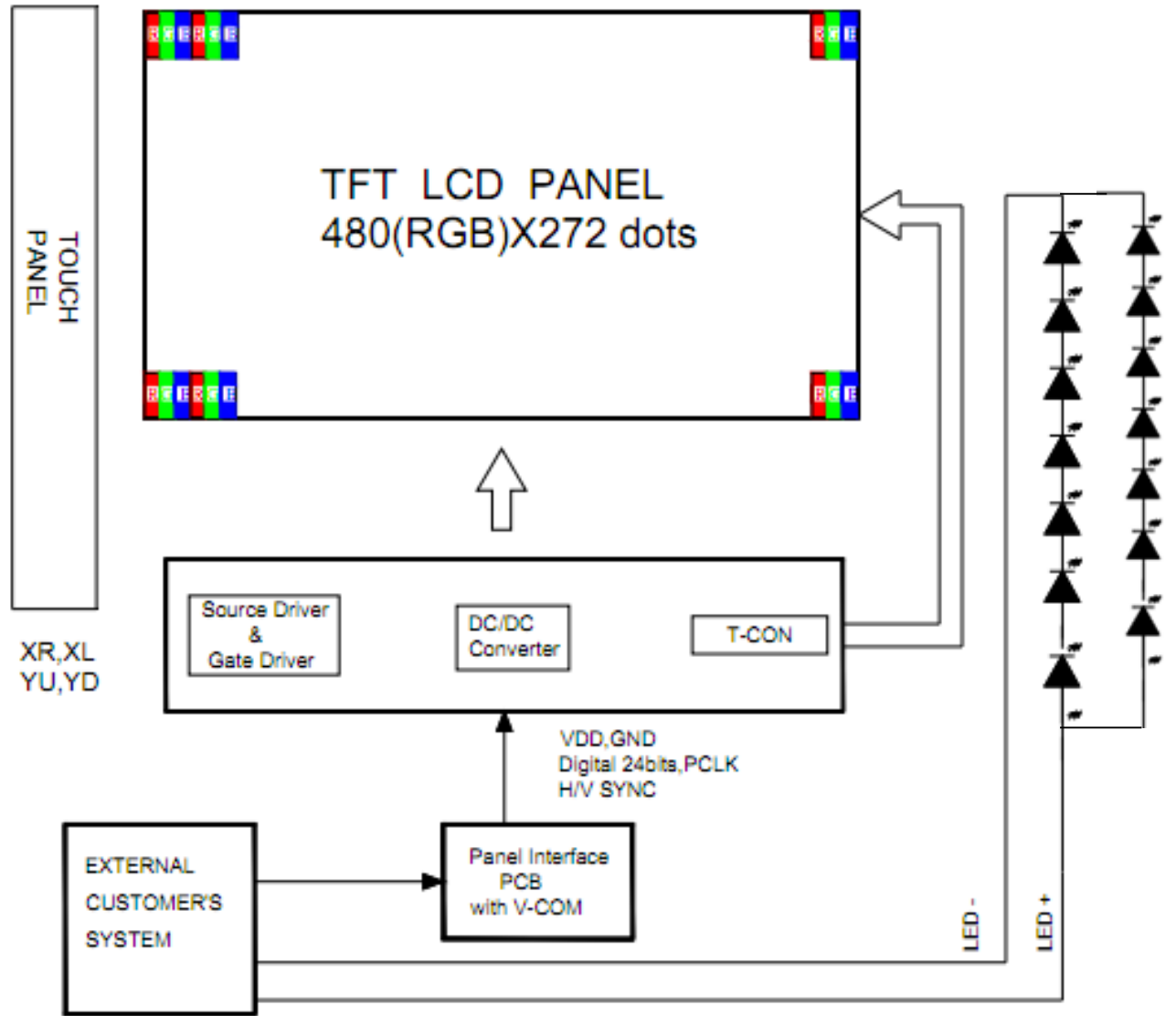
| Item | Symbol | Value | | | Unit | Condition |
|---------------------|------------------|-------|-------|------|------|-----------|
| | | Min. | Typ. | Max. | | |
| LED Voltage | V _L | - | 22.4 | | V | |
| LED Current | I _f | - | 40 | | mA | |
| Power Consumption | P _{LED} | - | 896 | | mW | |
| LED Lifetime (25°C) | - | 35000 | 50000 | - | hr | |

Note (1) 14 LEDs serial type.

(2) Where I_f = 40mA, V_L = 22.4V, P_{LED} = V_L × I_f

(3)The environmental conducted under ambient air flow ,at Ta=25±2°C,60%RH±5%

5 Block Diagram



6 Input Terminal Pin Assignment

6.1 CN1 Pin Assignment

(Reference Connector: Hirose:FH12A-40S-0.5SH(55) Top contact type)

| Pin No | Symbol | Description | Input/Output | Note |
|--------|--------|---|--------------|------|
| 1 | VLED- | Power for LED Backlight Cathode | P | |
| 2 | VLED+ | Power for LED Backlight Anode | P | |
| 3 | GND | Power Ground | P | |
| 4 | VDD | Power Supply For digital circuit | P | |
| 5 | R0 | Red Data (LSB) | I | |
| 6 | R1 | Red Data | I | |
| 7 | R2 | Red Data | I | |
| 8 | R3 | Red Data | I | |
| 9 | R4 | Red Data | I | |
| 10 | R5 | Red Data | I | |
| 11 | R6 | Red Data | I | |
| 12 | R7 | Red Data (MSB) | I | |
| 13 | G0 | Green Data(LSB) | I | |
| 14 | G1 | Green Data | I | |
| 15 | G2 | Green Data | I | |
| 16 | G3 | Green Data | I | |
| 17 | G4 | Green Data | I | |
| 18 | G5 | Green Data | I | |
| 19 | G6 | Green Data | I | |
| 20 | G7 | Green Data(MSB) | I | |
| 21 | B0 | Blue Data (LSB) | I | |
| 22 | B1 | Blue Data | I | |
| 23 | B2 | Blue Data | I | |
| 24 | B3 | Blue Data | I | |
| 25 | B4 | Blue Data | I | |
| 26 | B5 | Blue Data | I | |
| 27 | B6 | Blue Data | I | |
| 28 | B7 | Blue Data(MSB) | I | |
| 29 | GND | Power Ground | P | |
| 30 | DCLK | Dot Clock Signal | I | |
| 31 | DISP | Display On/off Mode Control H: Display On L: Display OFF | I | |
| 32 | HSYNC | Horizontal Synchronization Signal | I | (1) |
| 33 | VSNC | Vertical Synchronization Signal | I | (1) |
| 34 | DE | Input Data Enable Control | I | |

| | | | | |
|----|-----|-------------------------|-----|--|
| 35 | NC | No Connection | -- | |
| 36 | GND | Power Ground | P | |
| 37 | XR | Touch Panel Right Side | I/O | |
| 38 | YD | Touch Panel Bottom Side | I/O | |
| 39 | XL | Touch Panel Left Side | I/O | |
| 40 | YU | Touch Panel Top Side | I/O | |

Note:

(1). Default Use SYNC MODE.

7 Optical Characteristics

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room

Measuring equipment: BM-7A

(Ta=25±2°C , VDD =3.3V, If=40mA)

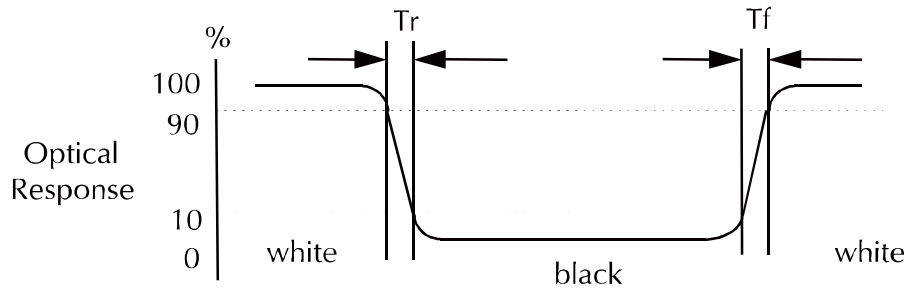
| Item | Symbol | Condition | Min | Type | Max | Unit | Note |
|--------------------|-----------------------------------|----------------------------|--------|--------|--------|-------------------|------|
| Brightness | -- | -- | 800 | 1000 | -- | cd/m ² | -- |
| Response Time | T _{on+} T _{off} | θ=0° | -- | 25 | 50 | ms | -- |
| Contrast Ratio | CR | At optimized viewing angle | 300 | 500 | -- | -- | -- |
| Color Chromaticity | Red | R _x | (0.57) | (0.62) | (0.67) | -- | -- |
| | | R _y | (0.29) | (0.34) | (0.39) | | |
| | Green | G _x | (0.29) | (0.34) | (0.39) | -- | |
| | | G _y | (0.52) | (0.57) | (0.62) | | |
| | Blue | B _x | (0.09) | (0.14) | (0.19) | -- | |
| | | B _y | (0.05) | (0.10) | (0.15) | | |
| | White | W _x | (0.27) | (0.32) | (0.37) | -- | |
| | | W _y | (0.29) | (0.34) | (0.39) | | |
| Viewing Angle (6H) | Hor. | θ _R | - | (70) | | Degree | -- |
| | | θ _L | - | (70) | | | |
| | Ver. | θ _U | - | (50) | | | |
| | | θ _D | - | (70) | | | |

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-5A/BM-7(fast) with a viewing angle of 2° 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".



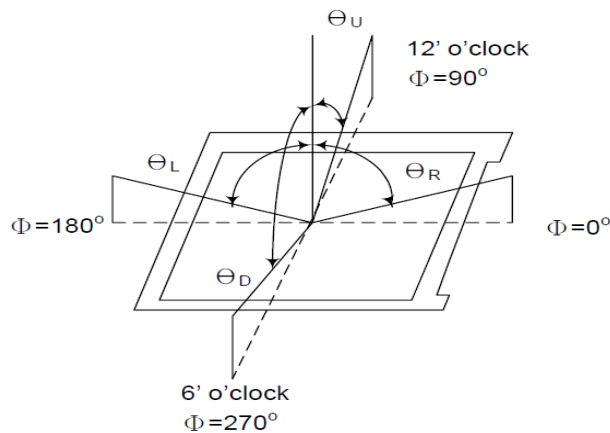
c. Definition of contrast ratio:

Brightness measured when LCD is at "white state"

$$\text{Contrast Ratio (CR)} = \frac{\text{Brightness measured when LCD is at "white state"}}{\text{Brightness measured when LCD is at "black state"}}$$

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 |
|---------------------------------|----------|

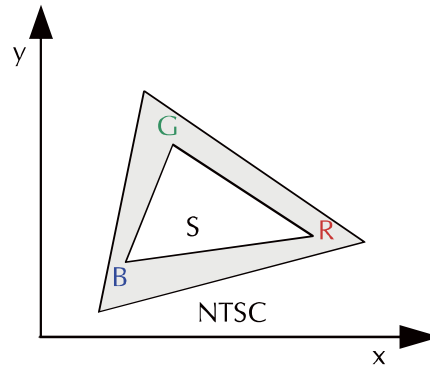
g. Definition of White Uniformity

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

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



8 Basic Display Color and Gray Scale

| | Color & Gray Scale | Data Signal | | | | | | | | | | | | | | | | | | | | | | | |
|-------------|--------------------|-------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| | | R7 | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G7 | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Color | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Red(0) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Green(0) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Blue(0) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| Red | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | Red(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | Red(2) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | | |
| | Red(127) | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | | |
| | Red(254) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | Red(255) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Green | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | Green(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | Green(2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | | |
| | Green(127) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | | |
| | Green(254) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | Green(255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Blue | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| | Blue(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | |
| | Blue(2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | | |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | | |
| | Blue(127) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | | |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | | |
| | Blue(254) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | | |
| | Blue(255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | | |

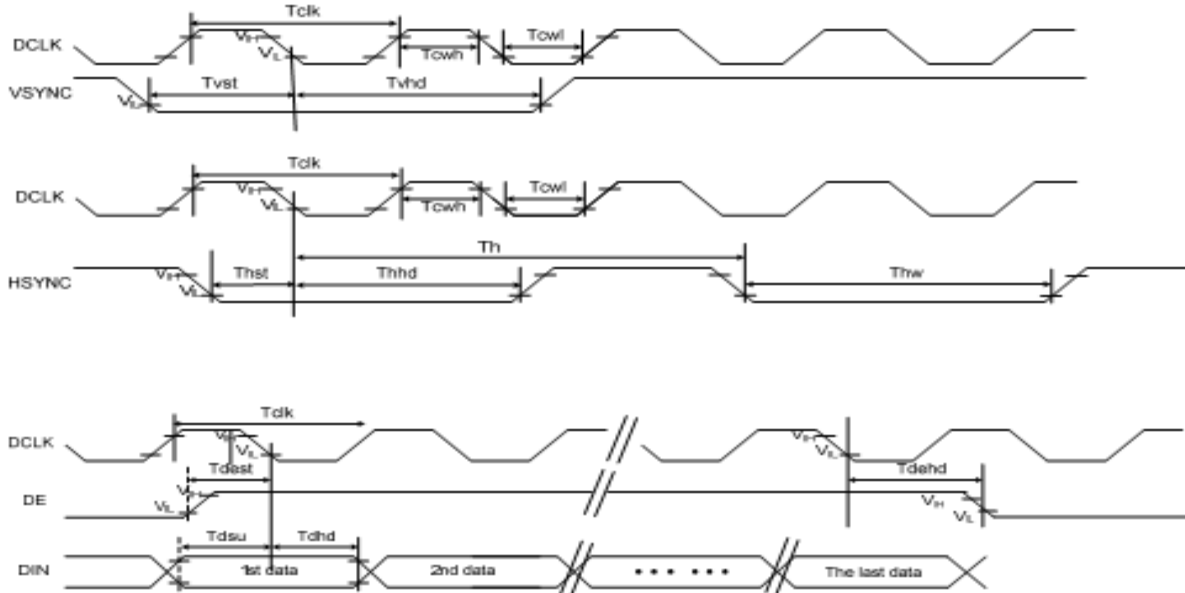
0 : Low level voltage, 1 :High level voltage

Each basic color can be displayed in 256 gray scales from 8 bit data signals. With the combination of total 24 bit data signals, the 16,777,216-color display can be achieved on the screen.

9 AC Timing

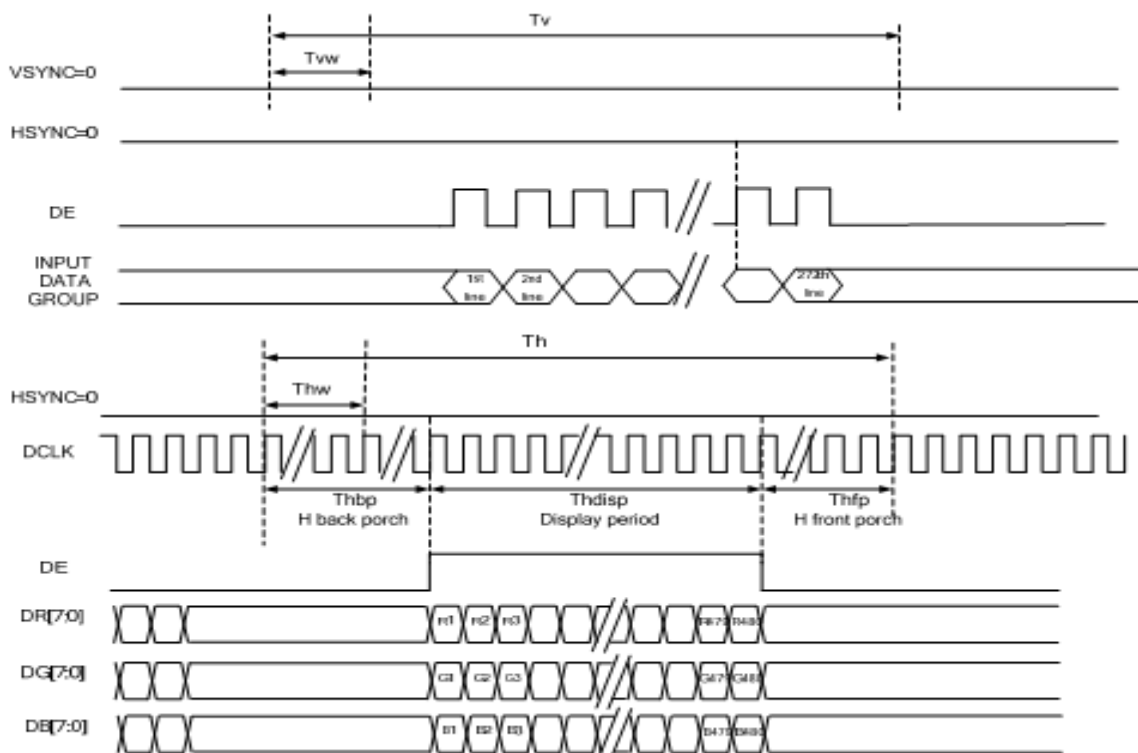
9.1 AC Characteristics

| Item | Symbol | Min. | Typ. | Max. | Unit | Conditions |
|----------------------------|--------|------|------|------|------|--------------------|
| System operation timing | | | | | | |
| VDD power source slew time | TPOR | - | - | 20 | ms | From 0V to 99% VDD |
| GRB pulse width | tRSTW | 10 | 50 | - | us | R=10Kohm, C=1uF |
| Input/ Output timing | | | | | | |
| CLK pulse duty | Tcw | 40 | 50 | 60 | % | |
| Hsync width | Thw | 2 | - | - | DCLK | |
| Hsync period | Th | 55 | 60 | 65 | us | |
| Vsync setup time | Tvst | 12 | - | - | ns | |
| Vsync hold time | Tvhd | 12 | - | - | ns | |
| Hsync setup time | Thst | 12 | - | - | ns | |
| Hsync hold time | Thhd | 12 | - | - | ns | |
| Data setup time | Tdsu | 12 | - | - | ns | |
| Data hold time | Tdhd | 12 | - | - | ns | |
| DE setup time | Tdest | 10 | - | - | ns | |
| DE setup time | Tdehd | 10 | - | - | ns | |



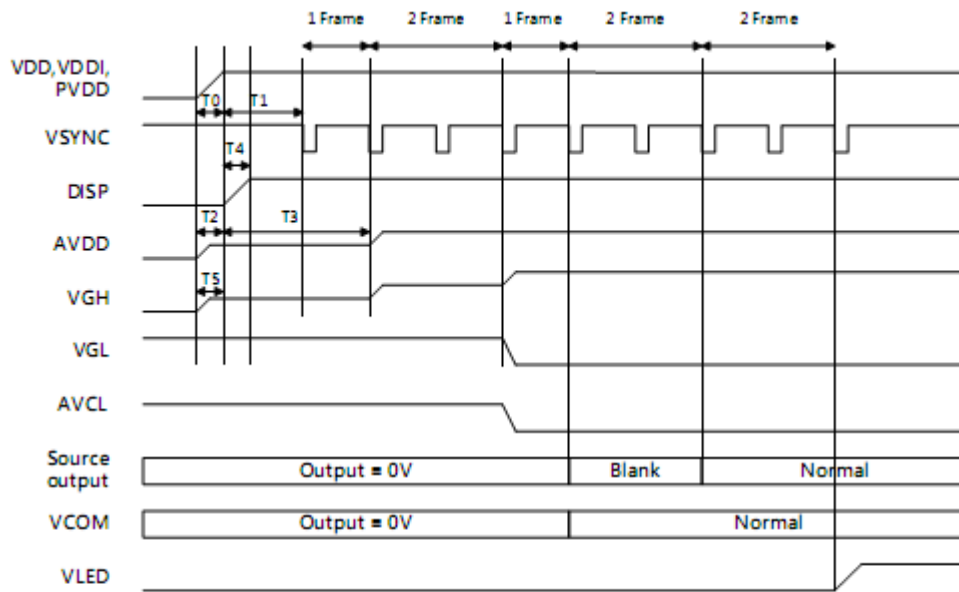
9.2 Parallel RGB Input Timing Table (SYNC MODE)

| Item | Symbol | Min. | Typ. | Max. | Unit | Remark | |
|----------------|----------------|--------|------|------|------|--------|-----------------------|
| DCLK Frequency | Fclk | 8 | 9 | 12 | MHz | | |
| DCLK Period | Tclk | 83 | 111 | 125 | ns | | |
| HSYNC | Period Time | Th | 485 | 531 | 598 | DCLK | |
| | Display Period | Thdisp | | 480 | | DCLK | |
| | Back Porch | Thbp | 3 | 43 | 43 | DCLK | By H_Blanking setting |
| | Front Porch | Thfp | 2 | 8 | 75 | DCLK | |
| | Pulse Width | Thw | 2 | 4 | 75 | DCLK | |
| VSYNC | Period Time | Tv | 276 | 292 | 321 | H | |
| | Display Period | Tvdisp | | 272 | | H | |
| | Back Porch | Tvbp | 2 | 12 | 12 | H | By V_Blanking setting |
| | Front Porch | Tvfp | 2 | 8 | 37 | H | |
| | Pulse Width | Tvw | 2 | 4 | 37 | H | |



9.3 POWER ON/OFF SEQUENCE

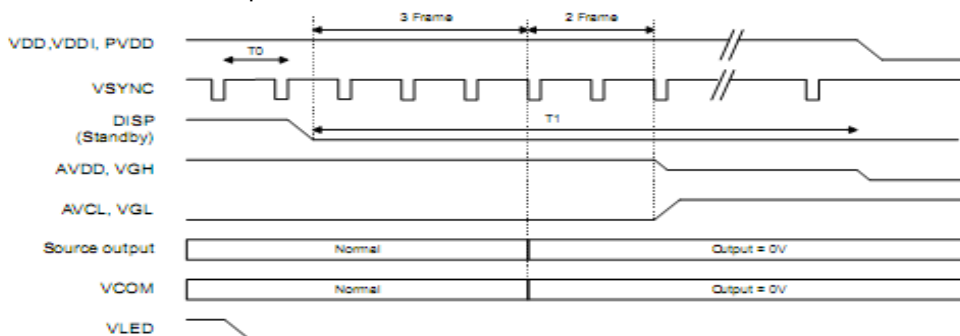
9.3.1 Power ON Sequence



| Item | Description | Min. Time |
|------|--|-------------------|
| T0 | Determined by the external power | |
| T1 | Time from stable VDD, VDDI, PVDD set-up to the first VSYNC | T1=0 |
| T2 | Time from AVDD=0V to AVDD=3.3V | T2=T0 |
| T3 | Time from AVDD=3.3V to AVDD=6.0V | T3=T1 + (1*Frame) |
| T4 | Time from stable VDD, VDDI, PVDD set-up to DISP asserted | T4=0 |
| T5 | Time from VGH=0V to VGH=3.3V | T5=T0 |

Note: Recommend the LCM power on rise time T0= 0~ 1ms.

9.3.2 Power OFF Sequence



| Item | Description | Min. Time |
|------|---|-----------|
| T0 | Time from backlight power off to DISP="L" | 1*Frame |
| T1 | Time from DISP="L" to LCM Power off | 5*Frame |

10 Test

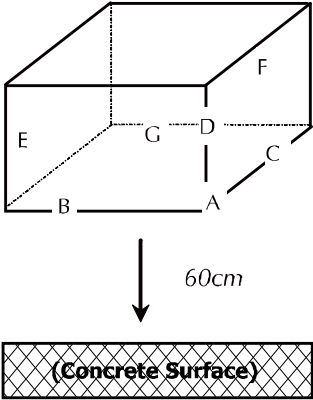
No change on display and in operation under the following test condition.

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

Temperature: 20±5°C.

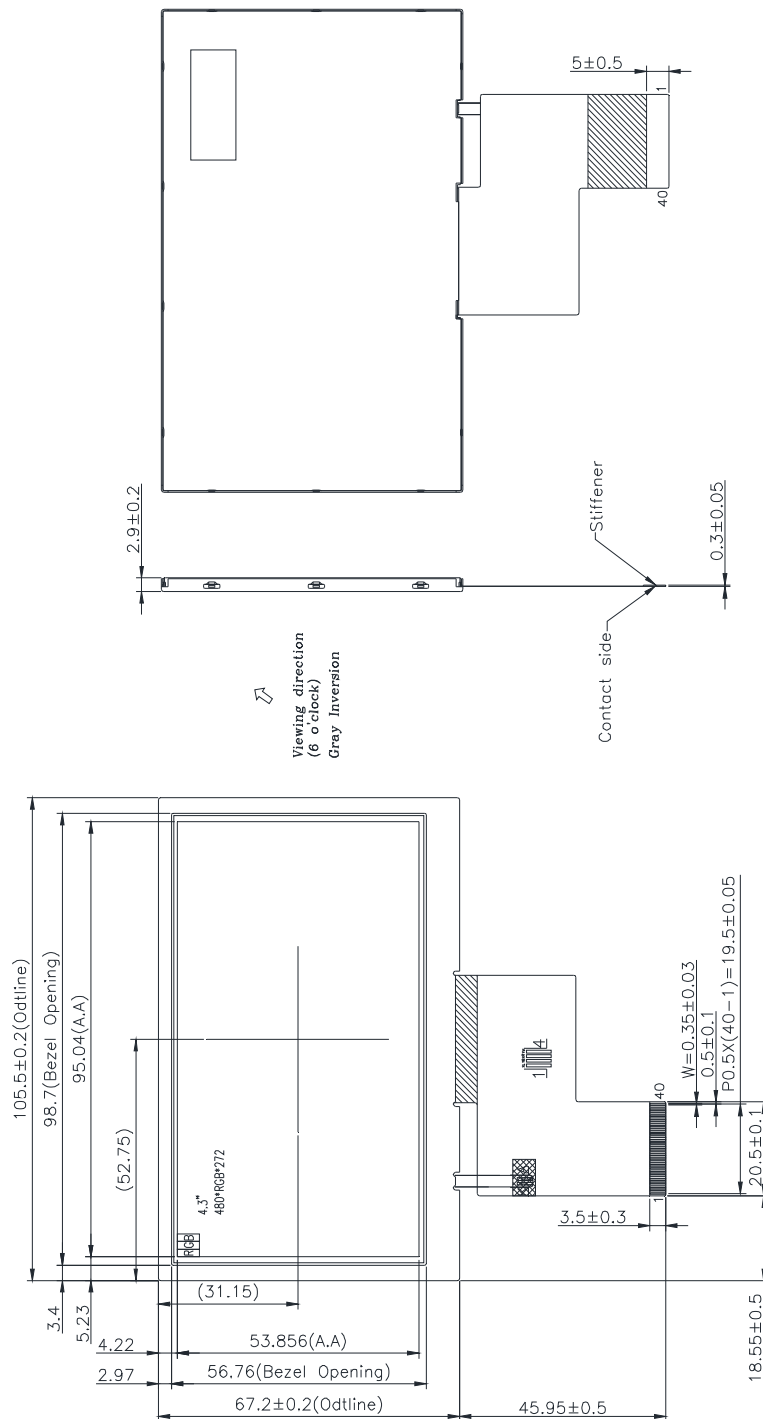
Humidity: 65±5%RH.

Tests will be not conducted under functioning state.

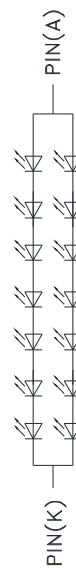
| No. | Parameter | Condition | Notes |
|-----|---|--|-------|
| 1 | High Temperature Operating | 70°C±2°C, 240hrs (Operation state). | |
| 2 | Low Temperature Operating | -20°C±2°C, 240hrs (Operation state). | 1 |
| 3 | High Temperature Storage | 80°C±2°C, 240hrs. | 2 |
| 4 | Low Temperature Storage | -30°C±2°C, 240hrs. | 1,2 |
| 5 | High Temperature and High Humidity Operation Test | 60°C±2°C, 90%, 240hrs | 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 | <p>To be measured after dropping from 60cm high on the concrete surface in packing state.</p>  <p><i>Dropping method corner dropping:</i></p> <p><i>A corner: Once edge dropping.</i></p> <p><i>B, C, D edge: Once face dropping.</i></p> <p><i>E, F, G face: Once.</i></p> | |

11 Dimensional Outlines

| PIN FUNCTION | | PIN | SYMBOL | PIN | SYMBOL |
|--------------|--------|-----|--------|-----|--------|
| 1 | VLED - | 21 | B0 | | |
| 2 | VLED + | 22 | B1 | | |
| 3 | GND | 23 | B2 | | |
| 4 | VDD | 24 | B3 | | |
| 5 | R0 | 25 | B4 | | |
| 6 | R1 | 26 | B5 | | |
| 7 | R2 | 27 | B6 | | |
| 8 | R3 | 28 | B7 | | |
| 9 | R4 | 29 | GND | | |
| 10 | R5 | 30 | DCLK | | |
| 11 | R6 | 31 | DISP | | |
| 12 | R7 | 32 | HSYNC | | |
| 13 | G0 | 33 | VSYNC | | |
| 14 | G1 | 34 | DE | | |
| 15 | G2 | 35 | NC | | |
| 16 | G3 | 36 | GND | | |
| 17 | G4 | 37 | NC(XR) | | |
| 18 | G5 | 38 | NC(YD) | | |
| 19 | G6 | 39 | NC(XL) | | |
| 20 | G7 | 40 | NC(YU) | | |



Circuit Diagram:

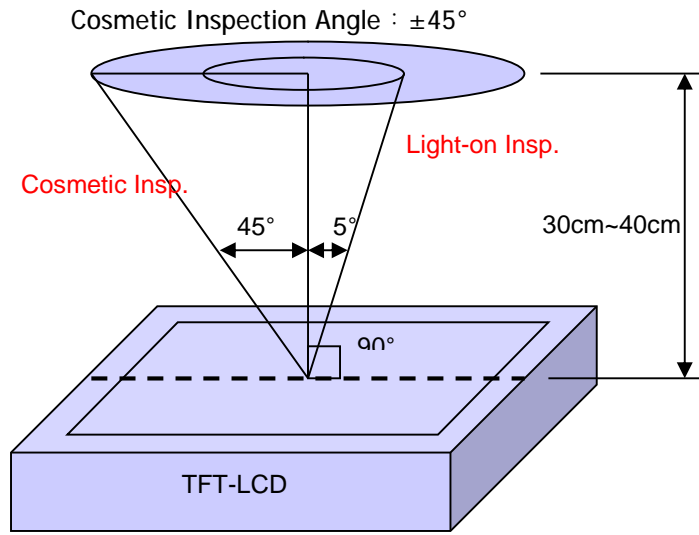


12 Incoming Inspection Standards

12.1 Inspection and Environment Conditions

12.1.1 Inspection Conditions:

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



(perpendicular to LCD panel surface)

12.1.2 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 |

12.1.3 Sampling Conditions:

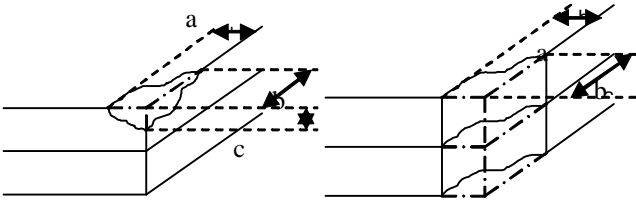
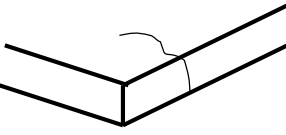
- (1) Lot Size: Quantity of shipment lot per model
- (2) Sampling Method:

| | | |
|---------------|--------------|--|
| 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.

12.1.4 Inspection Criteria

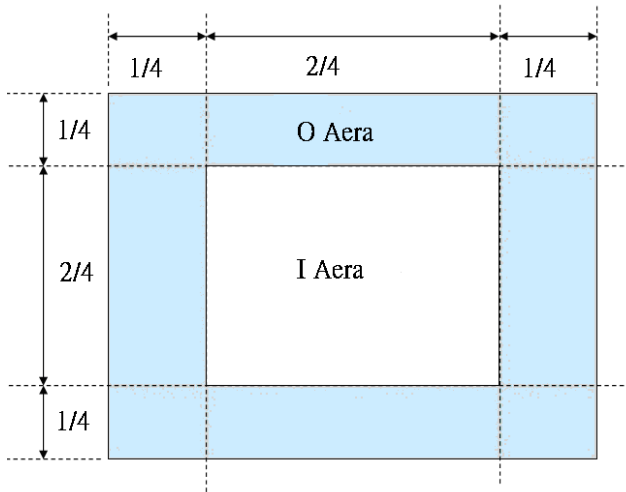
12.1.4.1 Cosmetic Inspection(Panel):

| 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 $0.05\text{mm} < W \leq 0.1\text{mm}$ and $L \leq 5\text{mm}$: $N \leq 5$ $W > 0.1\text{mm}$ or $L > 5\text{mm}$: Not allowed</p> | MI |
| Bubble or Dent on Panel *Note-3 | <p>$D \leq 0.2\text{mm}$: Ignored $0.2\text{mm} < D \leq 0.3\text{mm}$: $N \leq 5$ $D > 0.3\text{mm}$: Not allowed</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 |

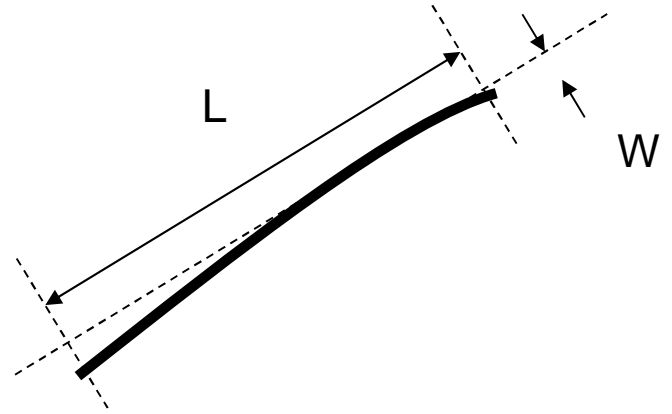
12.1.4.2 Functional Inspection:

| Item | Judgment Criteria | | | Classification |
|---|--|--|---------|----------------|
| | Area(Note1) | I | O | |
| Point Defect | Bright Dot | Random | 2 | |
| | | 2 dots adjacent | 0 | 0 |
| | | 3 dots adjacent or more | 0 | 0 |
| | Dark Dot | Random | 3 | |
| | | 2 dots adjacent | 0 | |
| | | 3 dots adjacent or more | 0 | 0 |
| | Total Dot Defect | | 5 | |
| | Distance | Distance between Bright and Bright dot | L ≤ 5mm | |
| | | Distance between Bright and Dark dot | L ≤ 5mm | |
| | | Distance between Dark dot | L ≤ 5mm | |
| (1) It is defined as Point Defect if defect area > 0.5dot (2) It is ignored if defect area ≤ 0.5dot (3) Weak point defect will be defined as Bright Dot if it can be observed through ND filter 5%(Full Screen Black Inspection) | | | | MI |
| 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 ≤ 0.2mm: Ignored 0.2mm < D ≤ 0.5mm: N ≤ 8 D > 0.5mm: Not allowed | | | |
| Foreign Material in line or spiral shape *Note-4 | W ≤ 0.05mm or L ≤ 5mm: Ignored 0.05mm < W ≤ 0.2mm and L 1.0mm ≤ 5mm: N ≤ 8 W > 0.2mm or L > 5mm: Not allowed | | | |
| Display Function Abnormal | No Malfunction can be allowed | | | |

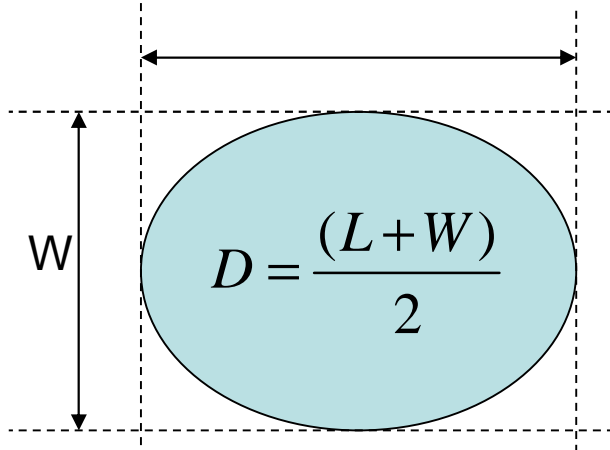
Note-1 : I/O Area Definition



Note-2 : Polarizer Scratch



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



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

