

DISPLAY Elektronik GmbH

DATA SHEET

TFT MODULE

DEM 240320T TTH-PW

2,4“ transflective TFT

Product Specification

Ver.: 3

25.11.2024

Revision History

| Revision | Date | Originator | Detail | Remarks |
|-----------------|-------------|-------------------|--|----------------|
| 0 | 12.01.2024 | LL | Initial Release | - |
| 1 | 16.01.2024 | LQ | Modfiy Package Drawing(B) | P22 |
| 2 | 02.02.2024 | LQ | Add Weight Add Current Consumption Add CIE Value | P4 P5 P6 |
| 3 | 25.11.2024 | DFG | Modify Outline Drawing | P22 |
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1. General Description

The specification is a transfective type color active matrix liquid crystal display (LCD) which uses amorphous thin film transistor (TFT) as switching devices. This product is composed of a TFT-LCD panel, driver ICs and a backlight unit.

2. Module Parameter

| Features | Details | Unit |
|-----------------------------|--|------------|
| Display Size(Diagonal) | 2.4" | - |
| Display Mode | Transfective / Normally White / Positive | - |
| Resolution | 240 x 320 DOTS | Pixels |
| View Direction | FULL VIEW | Best Image |
| Module Outline | 42.72 x 60.26 x 2.30 (Note1) | mm |
| Active Area | 36.72 x 48.96 | mm |
| Pixel Size | 0.1530 x 0.1530 | mm |
| Pixel Arrangement | RGB Vertical Stripe | - |
| Color | 262k | - |
| Interface | 4-Wire SPI | - |
| With or without touch panel | Without | - |
| Driver IC | ST7789T3 (Sitronix) | - |
| Operating Temperature | -20 ~ +70 | °C |
| Storage Temperature | -30 ~ +80 | °C |
| Weight | 11 | g |

Note 1: Exclusive hooks, posts, FFC/FPC tail etc.

3. Absolute Maximum Ratings

VSS=0V, Ta=25°C

| Item | Symbol | Min. | Max. | Unit |
|-----------------------|------------------|------|------|------|
| Supply Voltage | VDD | -0.3 | 4.6 | V |
| Storage Temperature | T _{STG} | -30 | +80 | °C |
| Operating Temperature | T _{OP} | -20 | +70 | °C |

Note 1: If Ta below 50°C, the maximal humidity is 90%RH, if Ta over +50°C, absolute humidity should be less than 60%RH.

Note 2: The response time will be extremely slow when the operating temperature is around -10°C, and the back ground will become darker at high temperature operating.

4. DC Characteristics

| Item | Symbol | Min. | Typ. | Max. | Unit |
|----------------------------------|-----------------|---------|------|---------|------|
| Supply Voltage | VDD | 2.4 | 2.8 | 3.3 | V |
| Logic Low input voltage | V _{IL} | GND | - | 0.3*VDD | V |
| Logic High input voltage | V _{IH} | 0.7*VDD | - | VDD | V |
| Logic Low output voltage | V _{OL} | GND | - | 0.2*VDD | V |
| Logic High output voltage | V _{OH} | 0.8*VDD | - | VDD | V |
| Current Consumption All Black | I _{DD} | - | 9 | - | mA |

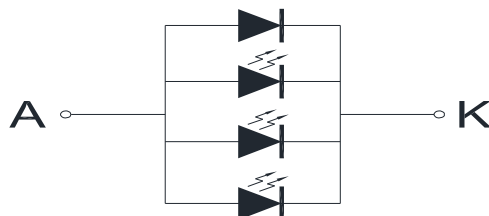
5. Backlightlight Characteristic

5.1. Backlight Characteristic

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit |
|---------------------|--------------------------|------------------------------------|-------|--------|------|------|
| Forward Voltage | V _F | Ta=25 °C, I _F =20mA/LED | 2.8 | 3.1 | 3.4 | V |
| Forward Current | I _F | Ta=25 °C, V _F =3.1V/LED | - | 80 | - | mA |
| Power Dissipation | P _D | | - | 248 | - | mW |
| Uniformity | Avg | | - | 80 | - | % |
| LED Lifetime (25°C) | - | - | 20000 | 30,000 | - | Hrs |
| Drive Method | Constant Current | | | | | |
| LED Configuration | 4 White LEDs in parallel | | | | | |

Note1: LED lifetime defined as follows: The final brightness is at 50% of original brightness.
The environmental conducted under ambient airflow, at Ta=25°C±2°C, 60%RH±5%, I_F=20mA/LED.

5.2. Backlight Characteristic



6. Optical Characteristics

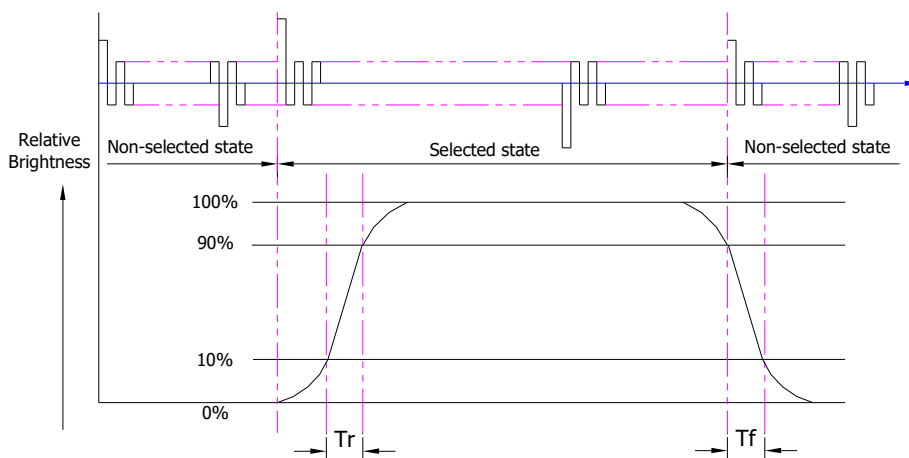
6.1. Optical Characteristics

Ta=25°C, VDD=2.8V

| | Item | Symbol | Condition | Specification | | | Unit | |
|-----------------------------------|---|----------------|--|---------------|-------|-------|-------------------|--|
| | | | | Min. | Typ. | Max. | | |
| Backlight On (Transflective Mode) | Luminance on TFT($I_f=20\text{mA/LED}$) | Lv | Normally viewing angle $\theta_x = \phi_y = 0^\circ$ | 130 | 150 | - | cd/m ² | |
| | Contrast ratio(See 6.3) | CR | | - | 15 | - | | |
| | Response time (See 6.2) | T _R | | - | 5 | 7 | ms | |
| | | T _F | | | | | | |
| | Chromaticity Transflective (See 6.5) | Red | X _R | Center CR>2 | 0.442 | 0.492 | 0.542 | |
| | | | Y _R | | 0.237 | 0.287 | 0.337 | |
| | | Green | X _G | | 0.270 | 0.320 | 0.370 | |
| | | | Y _G | | 0.434 | 0.484 | 0.534 | |
| | | Blue | X _B | | 0.121 | 0.171 | 0.221 | |
| | | | Y _B | | 0.081 | 0.131 | 0.181 | |
| | White | X _W | 0.245 | 0.295 | 0.345 | | | |
| | | Y _W | 0.267 | 0.317 | 0.367 | | | |
| | Viewing Angle (See 6.4) | Horizontal | θ_{x+} | - | 55 | - | Deg. | |
| θ_{x-} | | | - | 55 | - | | | |
| Vertical | | ϕ_{y+} | - | 60 | - | | | |
| | | ϕ_{y-} | - | 60 | - | | | |
| NTSC Ratio(Gamut) | | | | - | 13.79 | - | % | |

6.2. Definition of Response Time

6.2.1. Normally Black Type (Negative)

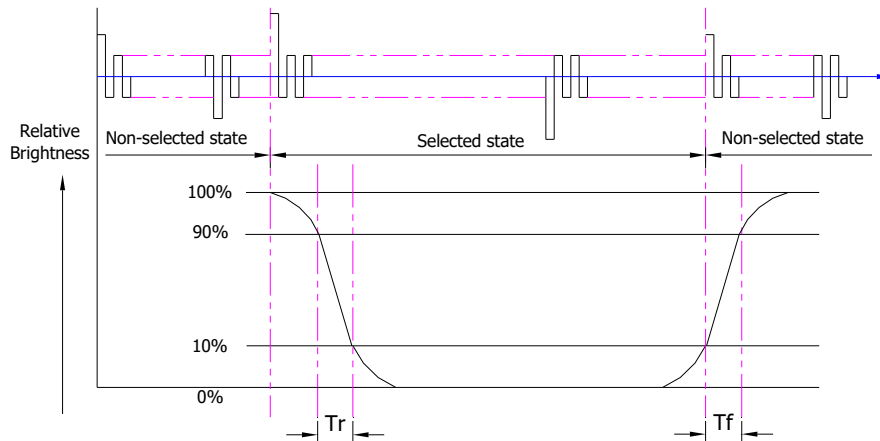


Tr is the time it takes to change from non-selected stage with relative luminance 10% to selected state with relative luminance 90%;

Tf is the time it takes to change from selected state with relative luminance 90% to non-selected state with relative luminance 10%.

Note : Measuring machine: LCD-5100

6.2.2. Normally White Type (Positive)



Tr is the time it takes to change from non-selected stage with relative luminance 90% to selected state with relative luminance 10%;

Tf is the time it takes to change from selected state with relative luminance 10% to non-selected state with relative luminance 90%;

Note: Measuring machine: LCD-5100 or EQUI

6.3. Definition of Contrast Ratio

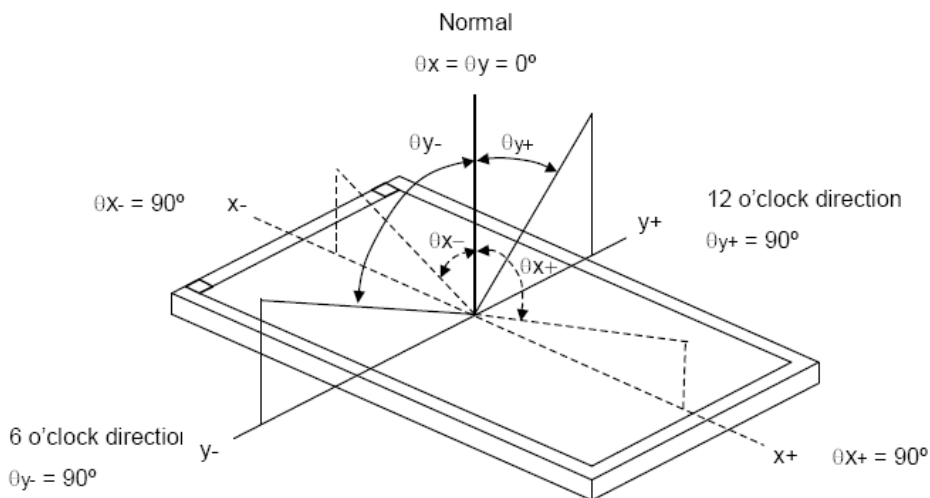
Contrast is measured perpendicular to display surface in reflective and transmissive mode.

The measurement condition is:

| | |
|--------------------------|--------------------------|
| Measuring Equipment | Eldim or Equivalent |
| Measuring Point Diameter | 3mm//1mm |
| Measuring Point Location | Active Area centre point |
| Test Pattern | A: All Pixels white |
| | B: All Pixel black |
| Contrast Setting | Maximum |

Definitions: CR (Contrast) = Luminance of White Pixel / Luminance of Black Pixel

6.4. Definition of Viewing Angles



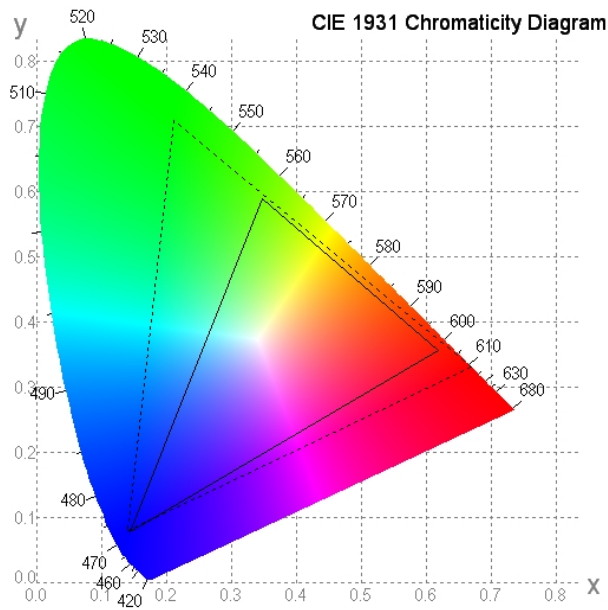
Measuring machine: LCD-5100 or EQUI

6.5. Definition of Color Appearance

R,G,B and W are defined by (x, y) on the IE chromaticity diagram

NTSC=area of RGB triangle/area of NTSC triangleX100%

Measuring picture: Red, Green, Blue and White (Measuring machine: BM-7)

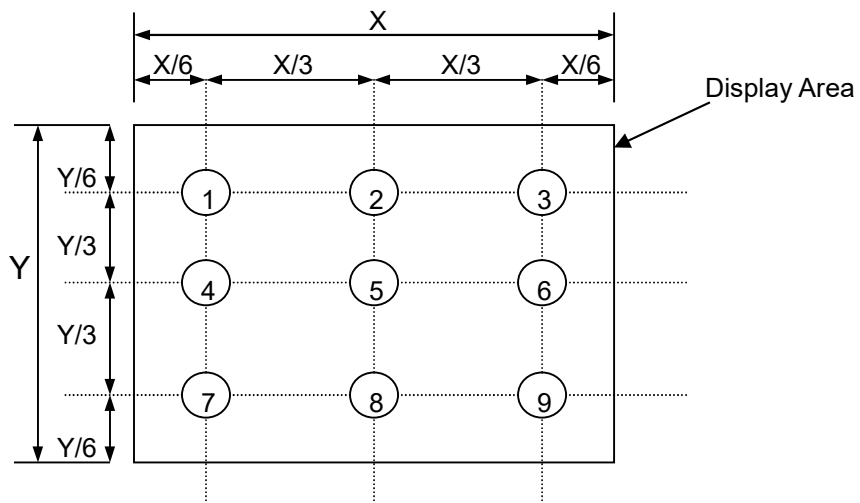


6.6. Definition of Surface Luminance, Uniformity and Transmittance

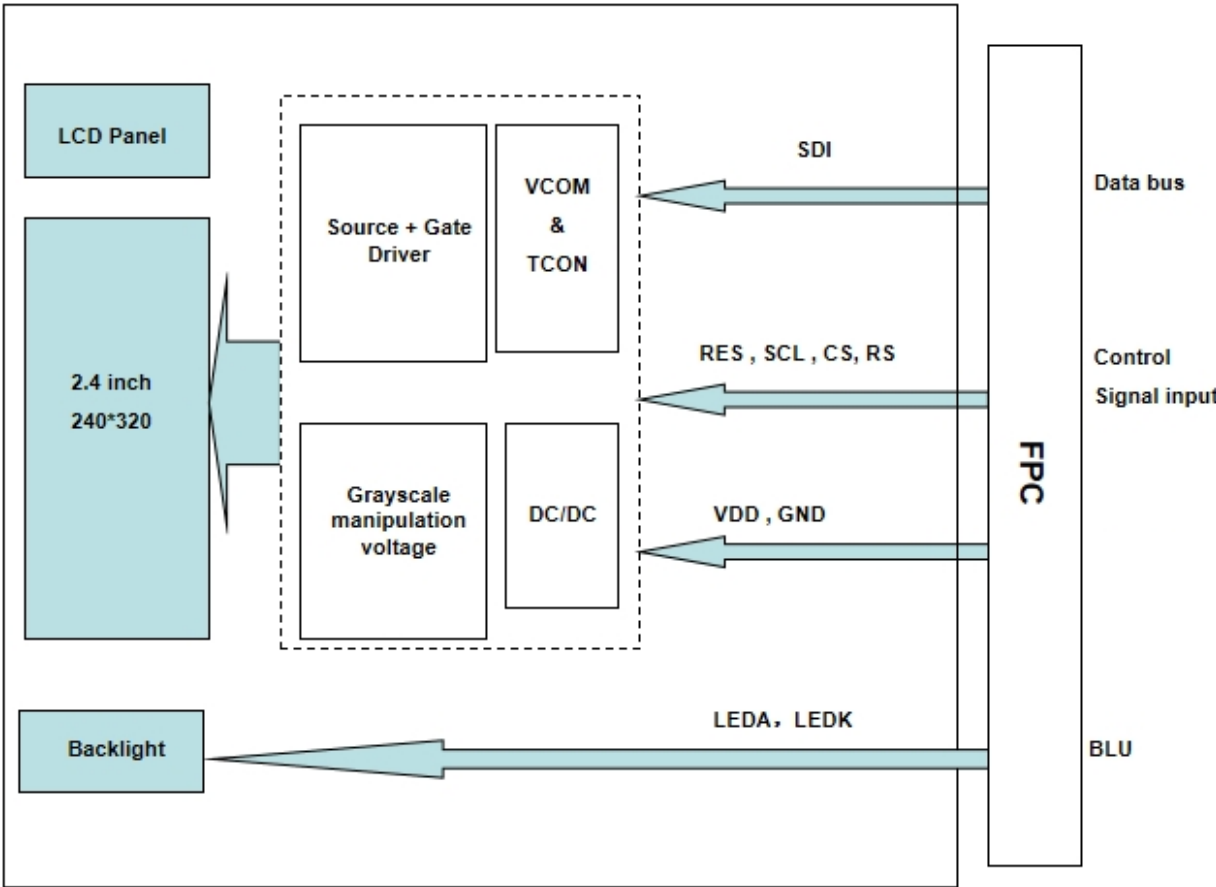
Using the reflective mode measurement approach, measure the white screen luminance of the display panel and backlight.

- 6.6.1. Surface Luminance: $L_v = \text{average} (L_{P1}:L_{P9})$
- 6.6.2. Uniformity = $\text{Minimal} (L_{P1}:L_{P9}) / \text{Maximal} (L_{P1}:L_{P9}) * 100\%$
- 6.6.3. Transmittance = $L_v \text{ on LCD} / L_v \text{ on backlight} * 100\%$

Note: Measuring machine: BM-7



7. Block Diagram and Power Supply

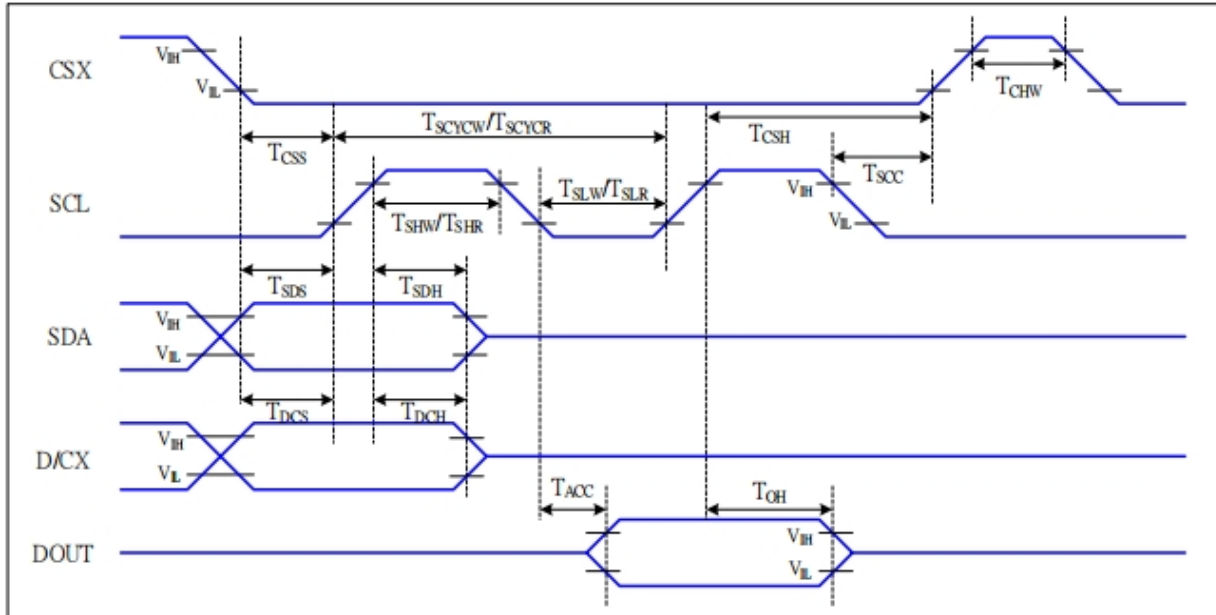


8. Interface Pins Definition

| No. | Symbol | Function |
|-----|--------|-----------------------|
| 1 | GND | Ground |
| 2 | RS | Data or Command pin |
| 3 | CS | Chip selection pin |
| 4 | SCL | Serial clock data pin |
| 5 | SDI | Serial data input pin |
| 6 | RES | Reset input pin |
| 7 | VDD | Power supply |
| 8 | GND | Ground |
| 9 | LEDA | LED Anode |
| 10 | LEDK | LED Cathode |

9. AC Characteristics

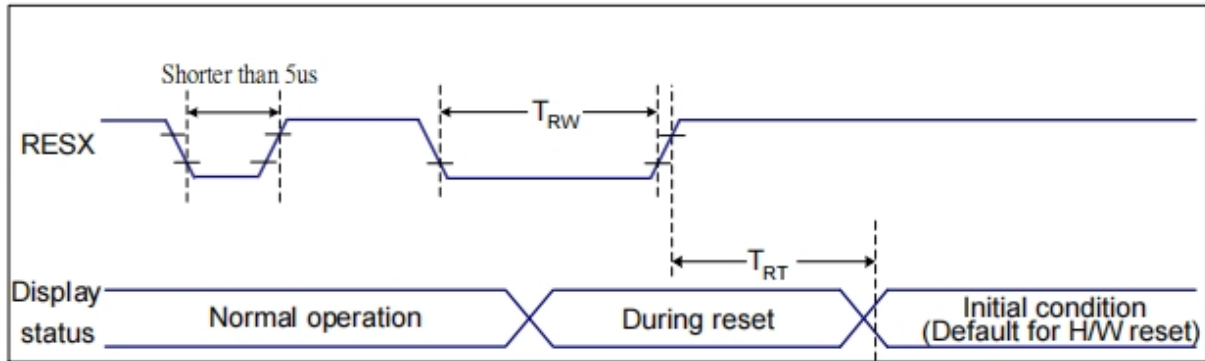
9.1. Serial Interface Characteristics (4-line serial)



VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=25°C

| Signal | Symbol | Parameter | MIN | MAX | Unit | Description |
|-----------|--------------------|--------------------------------|-----|-----|------|---------------------------|
| CSX | T _{css} | Chip select setup time (write) | 15 | | ns | |
| | T _{sch} | Chip select hold time (write) | 15 | | ns | |
| | T _{css} | Chip select setup time (read) | 60 | | ns | |
| | T _{scc} | Chip select hold time (read) | 65 | | ns | |
| | T _{chwh} | Chip select "H" pulse width | 40 | | ns | |
| SCL | T _{scywc} | Serial clock cycle (Write) | 16 | | ns | -write command & data ram |
| | T _{shw} | SCL "H" pulse width (Write) | 7 | | ns | |
| | T _{slw} | SCL "L" pulse width (Write) | 7 | | ns | |
| | T _{scyrc} | Serial clock cycle (Read) | 150 | | ns | -read command & data ram |
| | T _{shr} | SCL "H" pulse width (Read) | 60 | | ns | |
| | T _{slr} | SCL "L" pulse width (Read) | 60 | | ns | |
| D/CX | T _{dcs} | D/CX setup time | 10 | | ns | |
| | T _{dch} | D/CX hold time | 10 | | ns | |
| SDA (DIN) | T _{sdh} | Data setup time | 7 | | ns | |
| | T _{sdh} | Data hold time | 7 | | ns | |
| DOUT | T _{acc} | Access time | 10 | 50 | ns | For maximum CL=30pF |
| | T _{oh} | Output disable time | 15 | 50 | ns | For minimum CL=8pF |

9.2. Reset Timing



VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=25°C

| Related Pins | Symbol | Parameter | MIN | MAX | Unit |
|--------------|--------|----------------------|--------------------|---------------|------|
| RESX | TRW | Reset pulse duration | 10 | - | us |
| | TRT | Reset cancel | - | 5 (Note 1, 5) | ms |
| | | | 120 (Note 1, 6, 7) | ms | |

Notes:

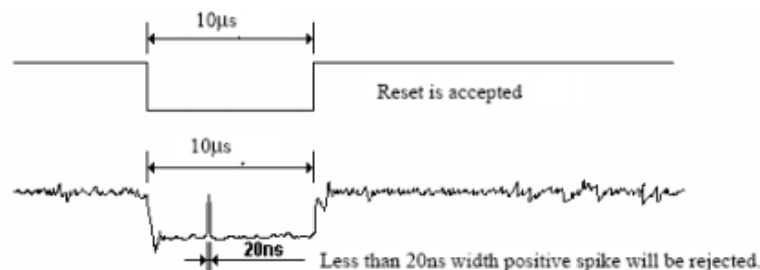
1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after a rising edge of RESX.

2. Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below:

| RESX Pulse | Action |
|---------------------|----------------|
| Shorter than 5us | Reset Rejected |
| Longer than 9us | Reset |
| Between 5us and 9us | Reset starts |

3. During the Resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In –mode.) and then return to Default condition for Hardware Reset.

4. Spike Rejection also applies during a valid reset pulse as shown below:



5. When Reset applied during Sleep In Mode.

6. When Reset applied during Sleep Out Mode.

7. It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

10. Quality Assurance

10.1.Purpose

This standard for Quality Assurance assures the quality of LCD module products supplied to customer.

10.2.Standard for Quality Test

10.2.1. Sampling Plan:

GB2828.1-2012

Single sampling, general inspection level II

10.2.2. Sampling Criteria:

Visual inspection: AQL 1.5

Electrical functional: AQL 0.65.

10.2.3. Reliability Test:

Detailed requirement refer to Reliability Test Specification.

10.3.Nonconforming Analysis & Disposition

10.3.1. Nonconforming analysis:

10.3.1.1. Customer should provide overall information of non-conforming sample for their complaints.

10.3.1.2. After receipt of detailed information from customer, the analysis of nonconforming parts usually should be finished in one week.

10.3.1.3. If cannot finish the analysis on time, customer will be notified with the progress status.

10.3.2. Disposition of nonconforming:

10.3.2.1. Non-conforming product over PPM level will be replaced.

10.3.2.2. The cause of non-conformance will be analyzed. Corrective action will be discussed and implemented.

10.4.Agreement Items

Shall negotiate with customer if the following situation occurs:

10.4.1. There is any discrepancy in standard of quality assurance.

10.4.2. Additional requirement to be added in product specification.

10.4.3. Any other special problem.

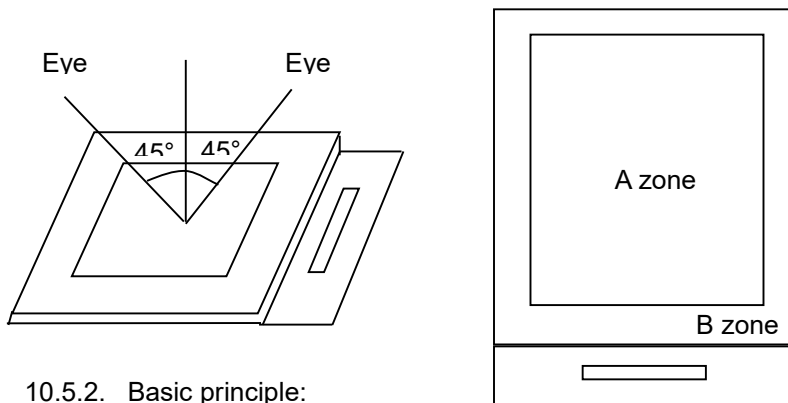
10.5.Standard of the Product Visual Inspection

10.5.1. Appearance inspection:

10.5.1.1. The inspection must be under illumination about 1000 – 1500 lx, and the distance of view must be at 30cm ± 2cm.

10.5.1.2. The viewing angle should be 45° from the vertical line without reflection light or follows customer's viewing angle specifications.

10.5.1.3. Definition of area: A Zone: Active Area, B Zone: Viewing Area,



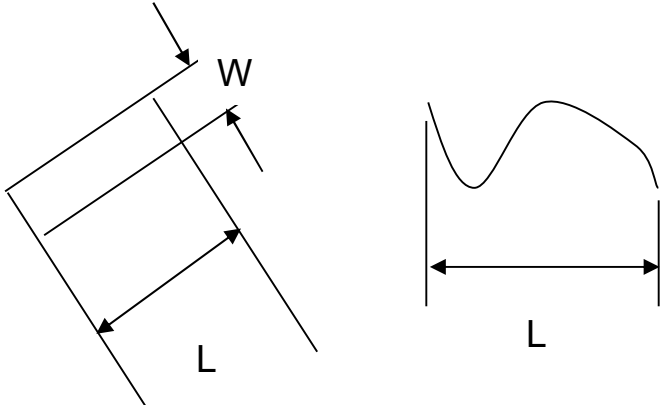
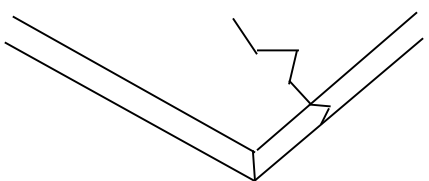
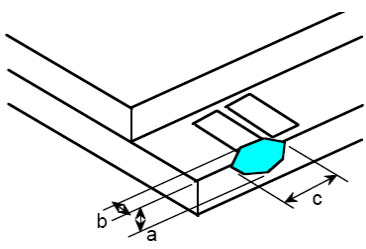
10.5.2. Basic principle:

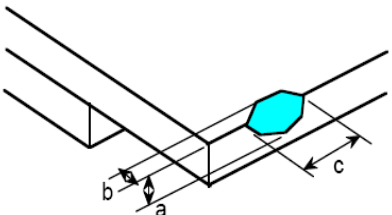
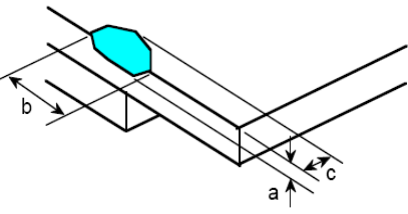
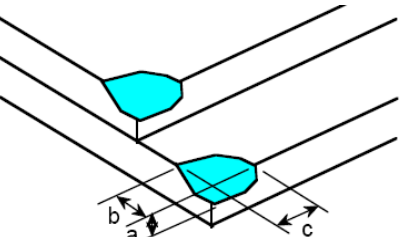
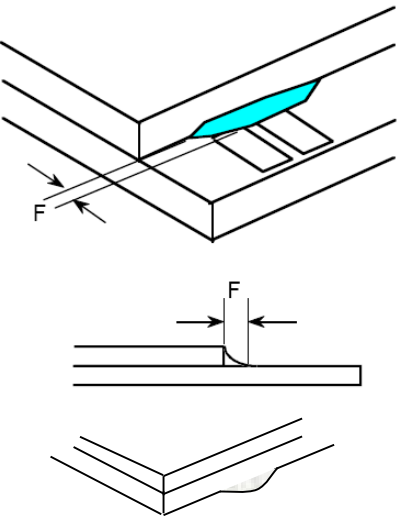
10.5.2.1. A set of sample to indicate the limit of acceptable quality level must be discussed by both us and customer when there is any dispute happened.

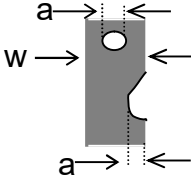
10.5.2.2. New item must be added on time when it is necessary.

10.6. Inspection Specification

| No. | Item | Criteria (Unit: mm) | | | | | | | | | | | | | | | | | | |
|-------------------------|---|--|-------------|--------------|------------------|--------|-------------------------|---|-------------------------|----------|---------------|------------|-----------|-------------------------------|------------|--|------|------------------------------------|--|-------|
| 01 | Black / White spot Foreign material (Round type) Pinholes Stain Particles inside cell. (Minor defect) | $\phi = (a + b) / 2$ Distance between 2 defects should more than 3mm apart. <table border="1" style="float: right;"> <thead> <tr> <th>Size \ Area</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$\phi \leq 0.10$</td> <td>Ignore</td> </tr> <tr> <td>$0.10 < \phi \leq 0.15$</td> <td>2</td> </tr> <tr> <td>$0.15 < \phi \leq 0.25$</td> <td>1</td> </tr> <tr> <td>$0.25 < \phi$</td> <td>0</td> </tr> <tr> <td>Total</td> <td>2 no include $\phi \leq 0.10$</td> </tr> </tbody> </table> | Size \ Area | Acc. Qty | $\phi \leq 0.10$ | Ignore | $0.10 < \phi \leq 0.15$ | 2 | $0.15 < \phi \leq 0.25$ | 1 | $0.25 < \phi$ | 0 | Total | 2 no include $\phi \leq 0.10$ | | | | | | |
| Size \ Area | Acc. Qty | | | | | | | | | | | | | | | | | | | |
| $\phi \leq 0.10$ | Ignore | | | | | | | | | | | | | | | | | | | |
| $0.10 < \phi \leq 0.15$ | 2 | | | | | | | | | | | | | | | | | | | |
| $0.15 < \phi \leq 0.25$ | 1 | | | | | | | | | | | | | | | | | | | |
| $0.25 < \phi$ | 0 | | | | | | | | | | | | | | | | | | | |
| Total | 2 no include $\phi \leq 0.10$ | | | | | | | | | | | | | | | | | | | |
| 02 | Electrical Defect (Minor defect) | <table border="1"> <thead> <tr> <th></th> <th>Display Area</th> <th>Total</th> <th rowspan="3">Note1</th> </tr> </thead> <tbody> <tr> <td>Bright dot</td> <td>0</td> <td>0</td> </tr> <tr> <td>Dark dot</td> <td>$N \leq 2$</td> <td>$N \leq 2$</td> </tr> <tr> <td>Total dot</td> <td>$N \leq 2$</td> <td>$N \leq 2$</td> <td></td> </tr> <tr> <td>Mura</td> <td colspan="2">Not visible through 5% ND filters.</td> <td>Note2</td> </tr> </tbody> </table> <p>Remark: 1. Bright dot caused by scratch and foreign object accords to item 1.</p> | | Display Area | Total | Note1 | Bright dot | 0 | 0 | Dark dot | $N \leq 2$ | $N \leq 2$ | Total dot | $N \leq 2$ | $N \leq 2$ | | Mura | Not visible through 5% ND filters. | | Note2 |
| | Display Area | Total | Note1 | | | | | | | | | | | | | | | | | |
| Bright dot | 0 | 0 | | | | | | | | | | | | | | | | | | |
| Dark dot | $N \leq 2$ | $N \leq 2$ | | | | | | | | | | | | | | | | | | |
| Total dot | $N \leq 2$ | $N \leq 2$ | | | | | | | | | | | | | | | | | | |
| Mura | Not visible through 5% ND filters. | | Note2 | | | | | | | | | | | | | | | | | |

| <p>03</p> | <p>Black and White line Scratch Foreign material (Line type) (Minor defect)</p> |  <table border="1" data-bbox="582 716 1204 1030"> <thead> <tr> <th>Length</th> <th>Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>/</td> <td>$W \leq 0.03$</td> <td>Ignore</td> </tr> <tr> <td>$L \leq 2.5$</td> <td>$0.03 < W \leq 0.05$</td> <td>3</td> </tr> <tr> <td>$L \leq 2.5$</td> <td>$0.05 < W \leq 0.10$</td> <td>2</td> </tr> <tr> <td>/</td> <td>$0.1 < W$</td> <td></td> </tr> <tr> <td colspan="2">Total</td> <td>3</td> </tr> </tbody> </table> <p>Distance between 2 defects should more than 3mm apart. Scratches not viewable through the back of the display are acceptable.</p> | Length | Width | Acc. Qty | / | $W \leq 0.03$ | Ignore | $L \leq 2.5$ | $0.03 < W \leq 0.05$ | 3 | $L \leq 2.5$ | $0.05 < W \leq 0.10$ | 2 | / | $0.1 < W$ | | Total | | 3 |
|------------------------------|--|---|------------------|----------|--------------------|---|--------------------|--------|------------------------------|----------------------|---|--------------|----------------------|---|---|-----------|--|-------|--|---|
| Length | Width | Acc. Qty | | | | | | | | | | | | | | | | | | |
| / | $W \leq 0.03$ | Ignore | | | | | | | | | | | | | | | | | | |
| $L \leq 2.5$ | $0.03 < W \leq 0.05$ | 3 | | | | | | | | | | | | | | | | | | |
| $L \leq 2.5$ | $0.05 < W \leq 0.10$ | 2 | | | | | | | | | | | | | | | | | | |
| / | $0.1 < W$ | | | | | | | | | | | | | | | | | | | |
| Total | | 3 | | | | | | | | | | | | | | | | | | |
| <p>04</p> | <p>Glass Crack (Minor defect)</p> |  <p>Crack is potential to enlarge, any type is not allowed.</p> | | | | | | | | | | | | | | | | | | |
| <p>05</p> | <p>Glass Chipping Pad Area: (Minor defect)</p>  | <table border="1" data-bbox="869 1568 1340 1747"> <thead> <tr> <th>Length and Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$c > 3.0, b < 1.0$</td> <td>1</td> </tr> <tr> <td>$c < 3.0, b < 1.0$</td> <td>3</td> </tr> <tr> <td colspan="2">$a < \text{Glass Thickness}$</td> </tr> </tbody> </table> | Length and Width | Acc. Qty | $c > 3.0, b < 1.0$ | 1 | $c < 3.0, b < 1.0$ | 3 | $a < \text{Glass Thickness}$ | | | | | | | | | | | |
| Length and Width | Acc. Qty | | | | | | | | | | | | | | | | | | | |
| $c > 3.0, b < 1.0$ | 1 | | | | | | | | | | | | | | | | | | | |
| $c < 3.0, b < 1.0$ | 3 | | | | | | | | | | | | | | | | | | | |
| $a < \text{Glass Thickness}$ | | | | | | | | | | | | | | | | | | | | |

| <p>06</p> | <p>Glass Chipping Rear of Pad Area: (Minor defect)</p>  | <table border="1"> <thead> <tr> <th>Length and Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$c > 3.0, b < 1.0$</td> <td>1</td> </tr> <tr> <td>$c < 3.0, b < 1.0$</td> <td>2</td> </tr> <tr> <td>$c < 3.0, b < 0.5$</td> <td>4</td> </tr> <tr> <td colspan="2">a < Glass Thickness</td> </tr> </tbody> </table> | Length and Width | Acc. Qty | $c > 3.0, b < 1.0$ | 1 | $c < 3.0, b < 1.0$ | 2 | $c < 3.0, b < 0.5$ | 4 | a < Glass Thickness | |
|---------------------|--|--|------------------|----------|--------------------|--------|---------------------|---|--------------------|---|---------------------|--|
| Length and Width | Acc. Qty | | | | | | | | | | | |
| $c > 3.0, b < 1.0$ | 1 | | | | | | | | | | | |
| $c < 3.0, b < 1.0$ | 2 | | | | | | | | | | | |
| $c < 3.0, b < 0.5$ | 4 | | | | | | | | | | | |
| a < Glass Thickness | | | | | | | | | | | | |
| <p>07</p> | <p>Glass Chipping Except Pad Area: (Minor defect)</p>  | <table border="1"> <thead> <tr> <th>Length and Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$c > 3.0, b < 1.0$</td> <td>1</td> </tr> <tr> <td>$c < 3.0, b < 1.0$</td> <td>2</td> </tr> <tr> <td>$c < 3.0, b < 0.5$</td> <td>4</td> </tr> <tr> <td colspan="2">a < Glass Thickness</td> </tr> </tbody> </table> | Length and Width | Acc. Qty | $c > 3.0, b < 1.0$ | 1 | $c < 3.0, b < 1.0$ | 2 | $c < 3.0, b < 0.5$ | 4 | a < Glass Thickness | |
| Length and Width | Acc. Qty | | | | | | | | | | | |
| $c > 3.0, b < 1.0$ | 1 | | | | | | | | | | | |
| $c < 3.0, b < 1.0$ | 2 | | | | | | | | | | | |
| $c < 3.0, b < 0.5$ | 4 | | | | | | | | | | | |
| a < Glass Thickness | | | | | | | | | | | | |
| <p>08</p> | <p>Glass Corner Chipping: (Minor defect)</p>  | <table border="1"> <thead> <tr> <th>Length and Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$c < 3.0, b < 3.0$</td> <td>Ignore</td> </tr> <tr> <td colspan="2">a < Glass Thickness</td> </tr> </tbody> </table> | Length and Width | Acc. Qty | $c < 3.0, b < 3.0$ | Ignore | a < Glass Thickness | | | | | |
| Length and Width | Acc. Qty | | | | | | | | | | | |
| $c < 3.0, b < 3.0$ | Ignore | | | | | | | | | | | |
| a < Glass Thickness | | | | | | | | | | | | |
| <p>09</p> | <p>Glass Burr: (Minor defect)</p>  | <table border="1"> <thead> <tr> <th>Length</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$F < 1.0$</td> <td>Ignore</td> </tr> </tbody> </table> <p>Glass burr don't affect assemble and module dimension.</p> | Length | Acc. Qty | $F < 1.0$ | Ignore | | | | | | |
| Length | Acc. Qty | | | | | | | | | | | |
| $F < 1.0$ | Ignore | | | | | | | | | | | |

| 10 | <p>FPC Defect: (Minor defect)</p>  | <p>10.1 Dent, pinhole width $a < w/3$. (w: circuitry width.) 10.2 Open circuit is unacceptable. 10.3 No oxidation, contamination and distortion.</p> | | | | | | | | | | |
|----------------------------|---|--|----------|----------|---------------------|--------|----------------------------|---|----------------------------|---|------------------|------|
| 11 | <p>Bubble on Polarizer (Minor defect)</p> | <table border="1"> <thead> <tr> <th>Diameter</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$\varphi \leq 0.20$</td> <td>Ignore</td> </tr> <tr> <td>$0.20 < \varphi \leq 0.30$</td> <td>4</td> </tr> <tr> <td>$0.30 < \varphi \leq 0.50$</td> <td>1</td> </tr> <tr> <td>$0.50 < \varphi$</td> <td>None</td> </tr> </tbody> </table> | Diameter | Acc. Qty | $\varphi \leq 0.20$ | Ignore | $0.20 < \varphi \leq 0.30$ | 4 | $0.30 < \varphi \leq 0.50$ | 1 | $0.50 < \varphi$ | None |
| Diameter | Acc. Qty | | | | | | | | | | | |
| $\varphi \leq 0.20$ | Ignore | | | | | | | | | | | |
| $0.20 < \varphi \leq 0.30$ | 4 | | | | | | | | | | | |
| $0.30 < \varphi \leq 0.50$ | 1 | | | | | | | | | | | |
| $0.50 < \varphi$ | None | | | | | | | | | | | |
| 12 | <p>Dent on Polarizer (Minor defect)</p> | <table border="1"> <thead> <tr> <th>Diameter</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>$\varphi \leq 0.20$</td> <td>Ignore</td> </tr> <tr> <td>$0.20 < \varphi \leq 0.30$</td> <td>4</td> </tr> <tr> <td>$0.30 < \varphi \leq 0.50$</td> <td>1</td> </tr> <tr> <td>$0.50 < \varphi$</td> <td>None</td> </tr> </tbody> </table> | Diameter | Acc. Qty | $\varphi \leq 0.20$ | Ignore | $0.20 < \varphi \leq 0.30$ | 4 | $0.30 < \varphi \leq 0.50$ | 1 | $0.50 < \varphi$ | None |
| Diameter | Acc. Qty | | | | | | | | | | | |
| $\varphi \leq 0.20$ | Ignore | | | | | | | | | | | |
| $0.20 < \varphi \leq 0.30$ | 4 | | | | | | | | | | | |
| $0.30 < \varphi \leq 0.50$ | 1 | | | | | | | | | | | |
| $0.50 < \varphi$ | None | | | | | | | | | | | |
| 13 | <p>Bezel</p> | <p>13.1 No rust, distortion on the Bezel. 13.2 No visible fingerprints, stains or other contamination.</p> | | | | | | | | | | |
| 14 | <p>PCB</p> | <p>14.1 No distortion or contamination on PCB terminals. 14.2 All components on PCB must same as documented on the BOM/component layout. 14.3 Follow IPC-A-600F.</p> | | | | | | | | | | |
| 15 | <p>Soldering</p> | <p>Follow IPC-A-610C standard</p> | | | | | | | | | | |
| 16 | <p>Electrical Defect (Major defect)</p> | <p>The below defects must be rejected. 16.1 Missing vertical / horizontal segment, 16.2 Abnormal Display. 16.3 No function or no display. 16.4 Current exceeds product specifications. 16.5 LCD viewing angle defect. 16.6 No backlight. 16.7 Dark backlight. 16.8 Touch Panel no function.</p> | | | | | | | | | | |

Remark: LCD Panel Broken shall be rejected. Defect out of LCD viewing area is acceptable.

10.7. Classification of Defects

- 10.7.1. Visual defects (Except no / wrong label) are treated as minor defect and electrical defect is major.
- 10.7.2. Two minor defects are equal to one major in lot sampling inspection.

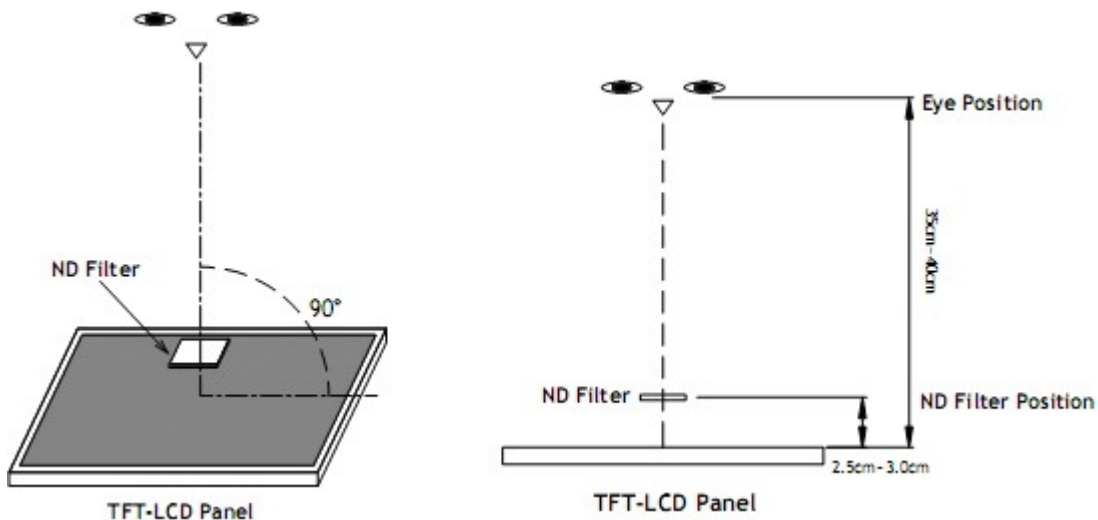
10.8. Identification/marketing criteria

Any unit with illegible / wrong /double or no marking/ label shall be rejected.

10.9. Packaging

- 10.9.1. There should be no damage of the outside carton box, each packaging box should have one identical label.
- 10.9.2. Modules inside package box should have compliant mark.
- 10.9.3. All direct package materials shall offer ESD protection.

Note1: Bright dot is defined as the defective area of the dot is larger than 50% of one sub-pixel area.



Bright dot: The bright dot size defect at black display pattern. It can be recognized by 2% transparency of filter when the distance between eyes and panel is $350\text{mm} \pm 50\text{mm}$.

Dark dot: Cyan, Magenta or Yellow dot size defect at white display pattern. It can be recognized by 5% transparency of filter when the distance between eyes and panel is $350\text{mm} \pm 50\text{mm}$.

Note2: Mura on display which appears darker / brighter against background brightness on parts of display area.

11. Reliability Specification

| No | Item | Condition | Quantity | Criteria |
|----|-----------------------------|---|----------|------------------|
| 1 | High Temperature Operating | 70°C, 96Hrs | 2 | GB/T2423.2-2008 |
| 2 | Low Temperature Operating | -20°C, 96Hrs | 2 | GB/T2423.1-2008 |
| 3 | High Humidity Storage | 50°C, 90%RH, 96Hrs | 2 | GB/T2423.3-2016 |
| 4 | High Temperature Storage | 80°C, 96Hrs | 2 | GB/T2423.2-2008 |
| 5 | Low Temperature Storage | -30°C, 96Hrs | 2 | GB/T2423.1-2008 |
| 6 | Thermal Cycling Test | -20°C, 60min~70°C, 60min, 20 cycles. | 2 | GB/T2423.22-2012 |
| 7 | Packing vibration | Frequency range:10Hz~50Hz Acceleration of gravity:5G X, Y, Z 30 min for each direction. | - | GB/T5170.14-2009 |
| 8 | Electrical Static Discharge | Air: ±4kV 150pF/330 Ω 5 times Contact: ±2KV 150pF/330 Ω 5 times | 2 | GB/T17626.2-2018 |
| 9 | Drop Test (Packaged) | Height:80 cm,1 corner, 3 edges, 6 surfaces. | - | GB/T2423.8-1995 |

Note1. No deflection cosmetic and operational function allowable.

Note2. Total current Consumption should be below double of initial value.

12. Precautions and Warranty

12.1.Safety

- 12.1.1. The liquid crystal in the LCD is poisonous. Do not put it in your mouth. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and water.
- 12.1.2. Since the liquid crystal cells are made of glass, do not apply strong impact on them. Handle with care.

12.2.Handling

- 12.2.1. Reverse and use within ratings in order to keep performance and prevent damage.
- 12.2.2. Do not wipe the polarizer with dry cloth, as it might cause scratch. If the surface of the LCD needs to be cleaned, wipe it swiftly with cotton or other soft cloth soaked with petroleum IPA, do not use other chemicals.

12.3.Storage

- 12.3.1. Do not store the LCD module beyond the specified temperature ranges.
- 12.3.2. Strong light exposure causes degradation of polarizer and color filter.

12.4.Metal Pin (Apply to Products with Metal Pins)

- 12.4.1. Pins of LCD and backlight
 - 12.4.1.1. Solder tip can touch and press on the tip of Pin LEAD during the soldering

12.4.1.2. Recommended Soldering Conditions

Solder Type: Sn96.3~94-Ag3.3~4.3-Cu0.4~1.1

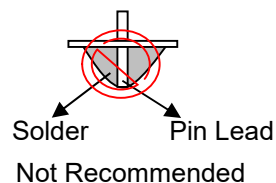
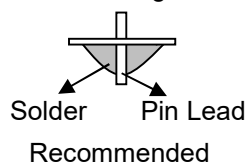
Maximum Solder Temperature: 370°C

Maximum Solder Time: 3s at the maximum temperature

Recommended Soldering Temp: 350±20°C

Typical Soldering Time: ≤3s

12.4.1.3. Solder Wetting



12.4.2. Pins of EL

- 12.4.2.1. Solder tip can touch and press on the tip of EL leads during soldering.
- 12.4.2.2. No Solder Paste on the soldering pad on the motherboard is recommended.

12.4.2.3. Recommended Soldering Conditions

Solder type: Nippon Alimit Leadfree SR-34, size 0.5mm

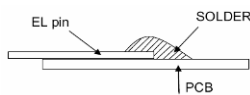
Recommended Solder Temperature: 270~290°C

Typical Soldering Time: ≤2s

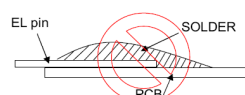
Minimum solder distance from EL lamp (body):2.0mm

- 12.4.2.4. No horizontal press on the EL leads during soldering.
- 12.4.2.5. 180° bend EL leads three times is not allowed.

12.4.2.6. Solder Wetting

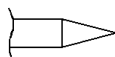


Recommended

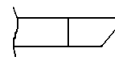


Not Recommended

12.4.2.7. The type of the solder iron:

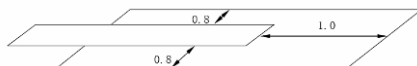


Recommended



Not Recommended

12.4.2.8. Solder Pad



12.5.Operation

- 12.5.1. Do not drive LCD with DC voltage
- 12.5.2. Response time will increase below lower temperature
- 12.5.3. Display may change color with different temperature
- 12.5.4. Mechanical disturbance during operation, such as pressing on the display area, may cause the segments to appear “fractured”.
- 12.5.5. Do not connect or disconnect the LCM to or from the system when power is on.
- 12.5.6. Never use the LCM under abnormal condition of high temperature and high humidity.
- 12.5.7. Module has high frequency circuits. Sufficient suppression to the electromagnetic interface shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.
- 12.5.8. *Do not display the fixed pattern for long time (we suggest the time not longer than one hour) because it will develop image sticking due to the TFT structure.*

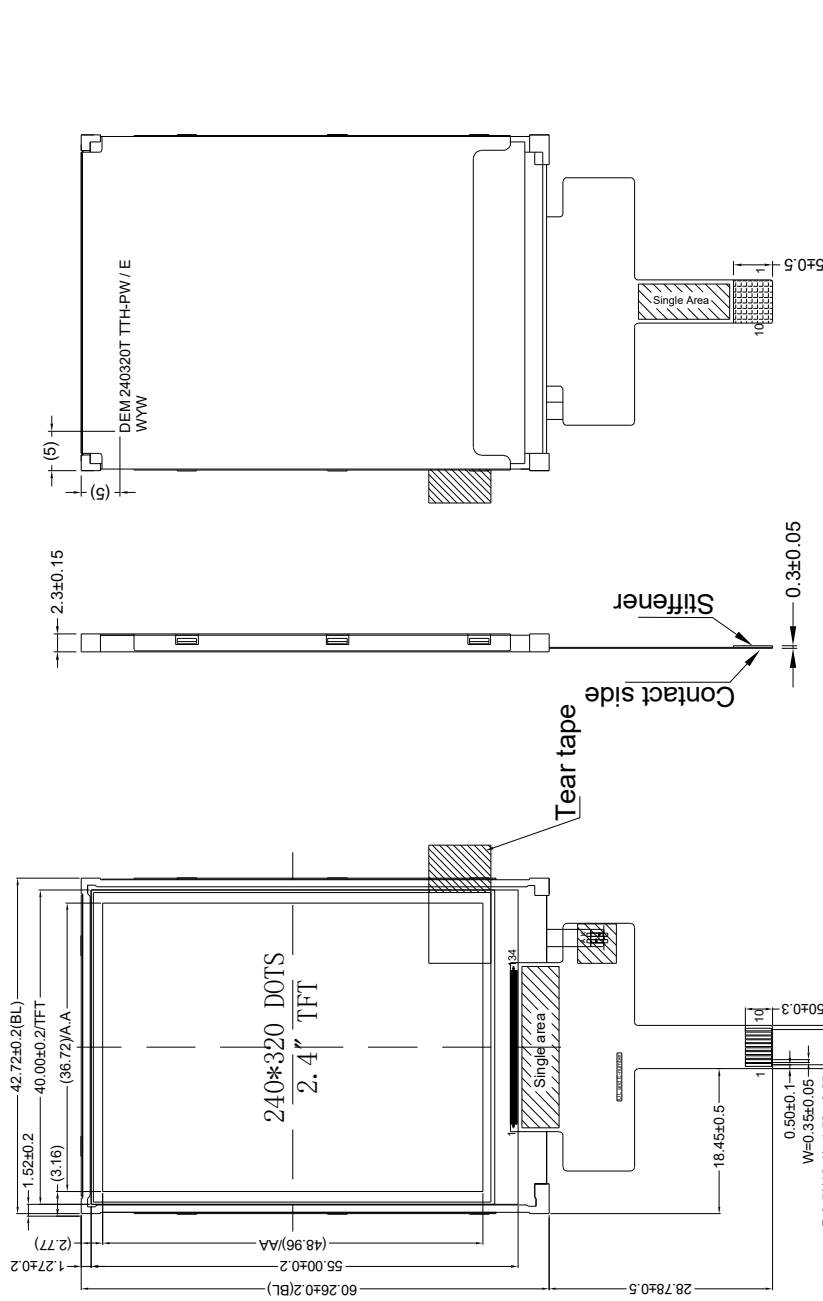
12.6.Static Electricity

- 12.6.1. CMOS LSIs are equipped in this unit, so care must be taken to avoid the electro-static charge, by ground human body, etc.
- 12.6.2. The normal static prevention measures should be observed for work clothes and benches.
- 12.6.3. The module should be kept into anti-static bags or other containers resistant to static for storage.

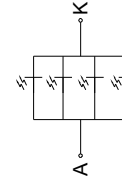
12.7.Limited Warranty

- 12.7.1. Our warranty liability is limited to repair and/or replacement. We will not be responsible for any consequential loss.
- 12.7.2. If possible, we suggest customer to use up all modules in six months. If the module storage time over twelve months, we suggest that recheck it before the module be used
- 12.7.3. . After the product shipped, any product quality issues must be feedback within three months, otherwise, we will not be responsible for the subsequent or consequential events.

13. Outline Drawing



| PIN | SYMBOL |
|-----|--------|
| 1 | GND |
| 2 | RS |
| 3 | CS |
| 4 | SCL |
| 5 | SDI |
| 6 | RES |
| 7 | VDD |
| 8 | GND |
| 9 | LEDA |
| 10 | LEDK |



Backlight LED Circuit: 4*1=4 (LED)

NOTES:

1. Display size: 2.4" TFT
2. Viewing direction: FULL VIEW
3. Display mode: Transflective/Normally White
4. Operation temperature: -20°C ~ +70°C
5. Storage temperature: -30°C ~ +80°C
6. Driver IC: ST7789T3
7. Power supply voltage: 2.8V
8. Backlight : White (4 LED) / 3.1V (TYP), I_f = 80mA
Brightness: 150 (TYP) cd/m²
9. ROHS must be complied

* The dimension with mark brackets "()" just for reference