

**SPECIFICATION
FOR
LCD Module
KD022C-2C-TP**

| | |
|------------------|---------------------|
| MODULE: | KD022C-2C-TP |
| CUSTOMER: | |

| REV | DESCRIPTION | DATE |
|------------|--------------------|-------------------|
| 1.0 | FIRST ISSUE | 2014.05.29 |
| | | |

| STARTEK | INITIAL | DATE |
|--------------------|----------------|-------------|
| PREPARED BY | | |
| CHECKED BY | | |
| APPROVED BY | | |

| CUSTOMER | INITIAL | DATE |
|--------------------|----------------|-------------|
| APPROVED BY | | |

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General Description

* Description

This is a color active matrix TFT (Thin Film Transistor) LCD (liquid crystal display) that uses amorphous silicon TFT as a switching device. This model is composed of a Transmissive type TFT-LCD Panel, driver circuit, back-light unit. The resolution of a 2.2" TFT-LCD contains 240x320 pixels, and can display up to 262K colors.

* Features

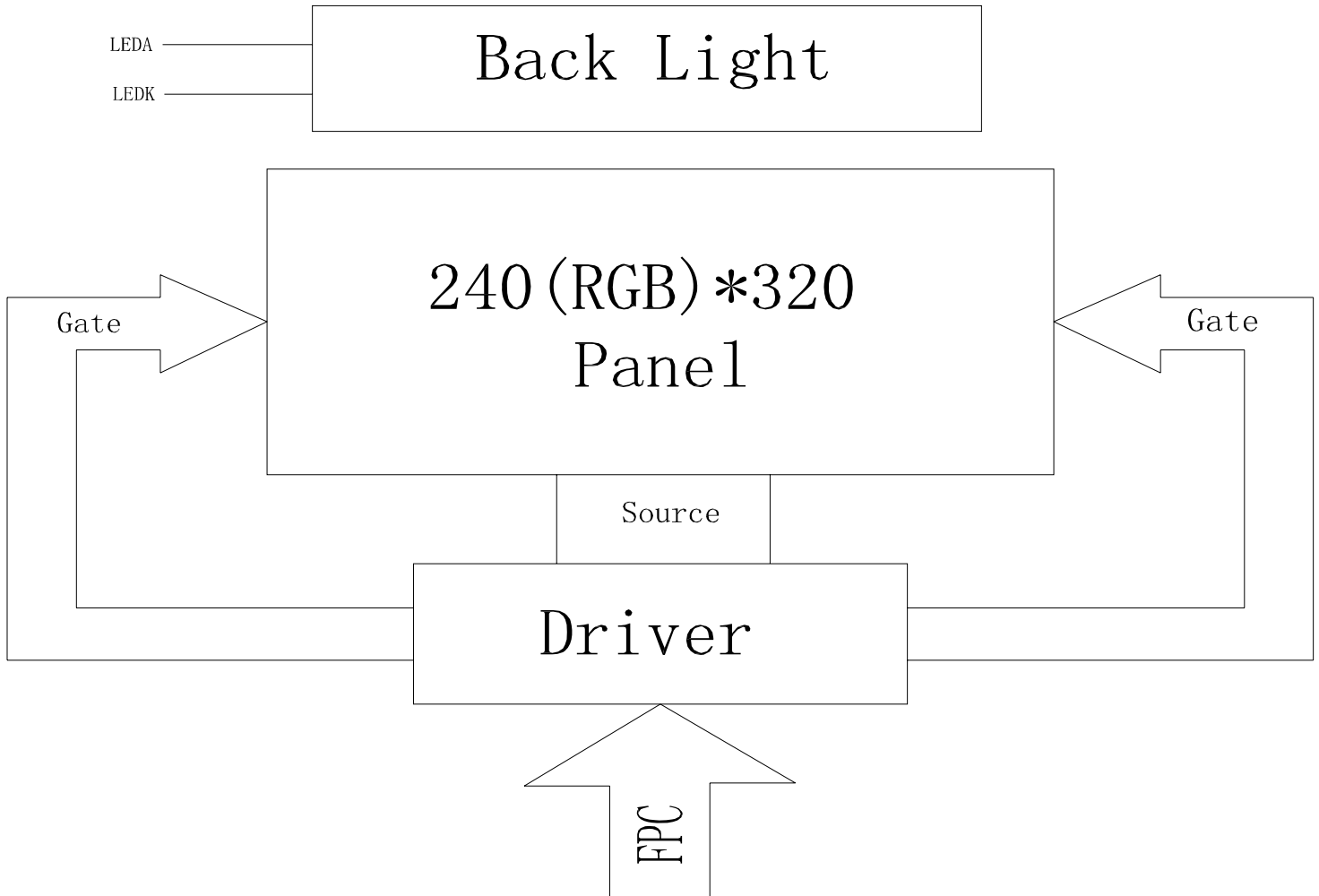
- Low Input Voltage: 3.3V(TYP)
- Display Colors of TFT LCD: 65/262Kcolors
- Interface: 4SPI+16/18 BIT RGB interface

| General Information Items | Specification | Unit | Note |
|---------------------------|------------------------------|---------|------|
| | Main Panel | | |
| Display area(AA) | 33.48(H)*44.64(V) (2.2inch) | mm | - |
| Driver element | TFT active matrix | - | - |
| Display colors | 65/262K | colors | - |
| Number of pixels | 240(RGB)*320 | dots | - |
| Pixel arrangement | RGB vertical stripe | - | - |
| Pixel pitch | 0.1395(H)*0.1395(V) | mm | - |
| Viewing angle | 12:00 | o'clock | - |
| Controller IC | ST7789V | - | - |
| Display mode | Transmissive/ Normally White | - | - |
| Operating temperature | -20~+70 | °C | - |
| Storage temperature | -30~+80 | °C | - |

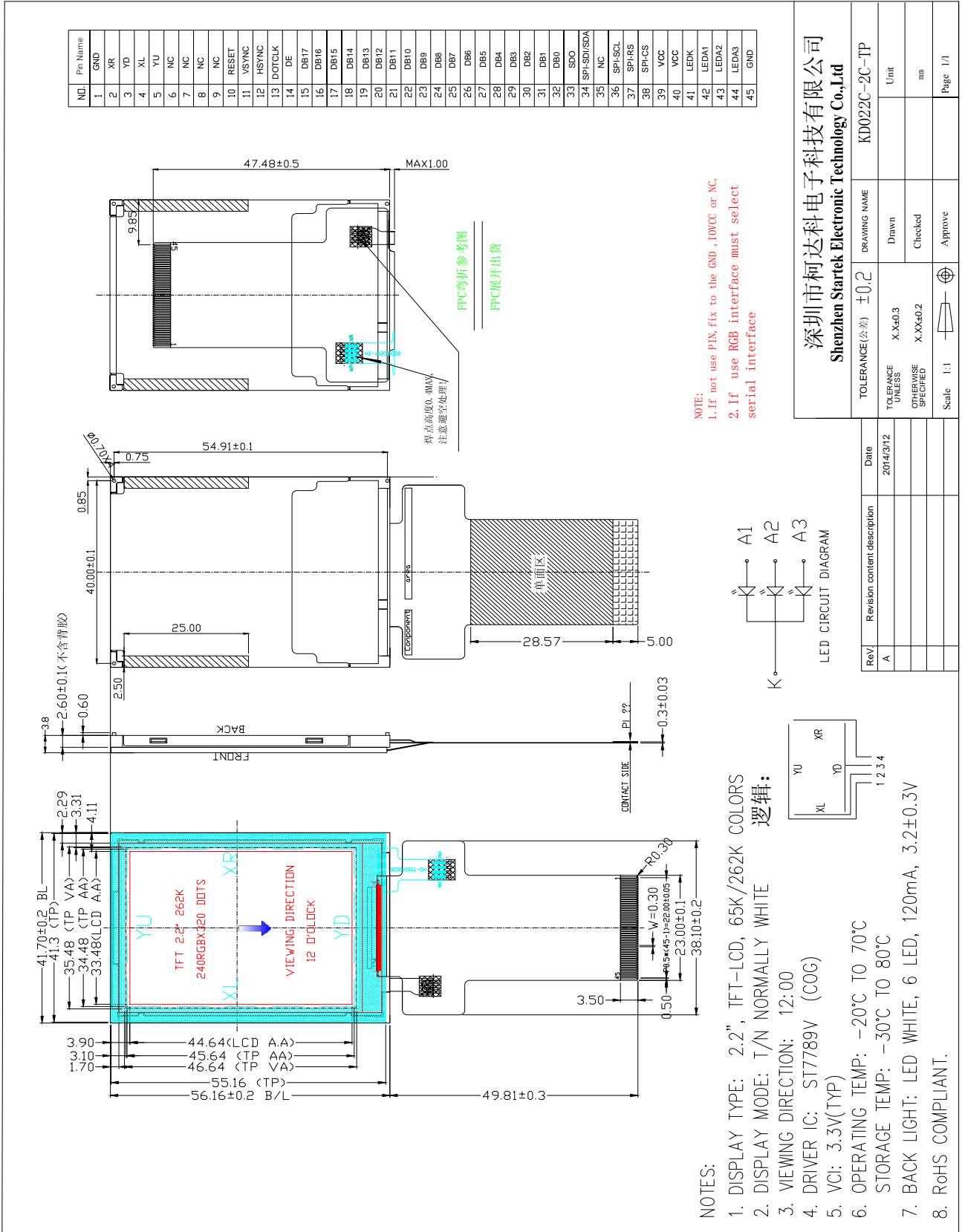
* Mechanical Information

| Item | | Min. | Typ. | Max. | Unit | Note |
|-------------|---------------|------|-------|------|------|------|
| Module size | Horizontal(H) | | 41.70 | | mm | - |
| | Vertical(V) | | 56.16 | | mm | - |
| | Depth(D) | | 3.8 | | mm | - |
| Weight | | | TBD | | g | - |

1. Block Diagram



2. Outline dimension



3. Input terminal Pin Assignment

| NO. | SYMBOL | DISCRIPTION | I/O |
|-------|-------------|---|-----|
| 1 | GND | Ground. | P |
| 2 | XR | Touch panel Right Glass Terminal. | |
| 3 | YD | Touch panel Bottom Film Terminal | |
| 4 | XL | Touch panel LEFT Glass Terminal | |
| 5 | YU | Touch panel Top Film Terminal | |
| 6 | NC | NC | |
| 7 | NC | NC | |
| 8 | NC | NC | |
| 9 | NC | NC | |
| 10 | RESET | Setting either pin low initializes the LSI. Must be reset after power is supplied. | I |
| 11 | VSYNC | Frame synchronizing signal for DPI I/F mode. If not use, please connect to GND. | I |
| 12 | HSYNC | Frame synchronizing signal for DPI I/F mode. If not use, please connect to GND. | I |
| 13 | DOTCLK | Pixel clock signal for DPI I/F mode. If not use, please connect to VCI. | I |
| 14 | DE | A DATA ENABLE signal for DPI I/F mode. If not use, please connect to GND. | I |
| 15-32 | DB17-DB0 | 18-bit parallel bi-directional data bus for RGB interface mode. Fix to GND level when not in use. | I/O |
| 33 | SDO | Serial data output pin in serial bus system interface. If not used, please open this pin. | O |
| 34 | SPI-SDI/SDA | Serial data input pin or input/output pin in serial bus system interface. The data is inputted on the rising edge of the SCL signal. If not used, please connect to GND. | I |
| 35 | NC | NC | |



| | | | |
|----|---------|---|---|
| 36 | SPI-SCL | DBI Type-B: Serves as a write signal and write data at the low level. DBI Type-C: it servers as SCL (Serial Clock). If not use, please connect to GND. | I |
| 37 | SPI-RS | Serves as command or parameter select. fix this pin at VCI or GND when not in use. | I |
| 38 | SPI-CS | Chip select input pin (“Low” enable). fix this pin at VCI or GND when not in use. | I |
| 39 | VCC | Supply voltage(3.3V). | P |
| 40 | VCC | Supply voltage(3.3V). | P |
| 41 | LEDK | Cathode pin of backlight | p |
| 42 | LEDA1 | Anode pin of backlight | p |
| 43 | LEDA2 | Anode pin of backlight | p |
| 44 | LEDA3 | Anode pin of backlight | p |
| 45 | GND | Ground. | P |

4. LCD Optical Characteristics

4.1 Optical specification

| Item | Symbol | Condition | Min. | Typ. | Max. | Unit | Note |
|--------------------------------------|------------|------------|-------|-------|-------|-------|--|
| Transmittance (without Polarizer) | T(%) | — | — | 13.5% | — | — | |
| Contrast Ratio | CR | $\Theta=0$ | 400 | 500 | — | — | (1)(2) |
| Response time | Rising | T_R | — | 2 | 4 | msec | (1)(3) |
| | Falling | T_F | — | 6 | 12 | | |
| Color gamut | S(%) | | | 60 | | % | |
| Color chromaticity (CIE1931) | White | W_x | | 0.283 | 0.303 | 0.323 | (1)(4) CF glass |
| | | W_y | | 0.305 | 0.325 | 0.345 | |
| | Red | R_x | | 0.606 | 0.626 | 0.646 | |
| | | R_y | | 0.314 | 0.334 | 0.354 | |
| | Green | G_x | | 0.257 | 0.277 | 0.297 | |
| | | G_y | | 0.529 | 0.549 | 0.569 | |
| | Blue | B_x | | 0.122 | 0.142 | 0.162 | |
| | | B_y | | 0.102 | 0.122 | 0.142 | |
| Viewing angle | Hor. | Θ_L | CR>10 | 60 | 70 | — | Viewing Angle base on using EWV Polarizer , Reference Only |
| | | Θ_R | | 60 | 70 | — | |
| | Ver. | Θ_U | | 60 | 70 | — | |
| | | Θ_D | | 45 | 55 | — | |
| Optima View Direction | 12 O'clock | | | | | | (5) |

4.2 Measuring Condition

- Measuring surrounding : dark room
- Ambient temperature : $25 \pm 2^\circ\text{C}$
- 15min. warm-up time

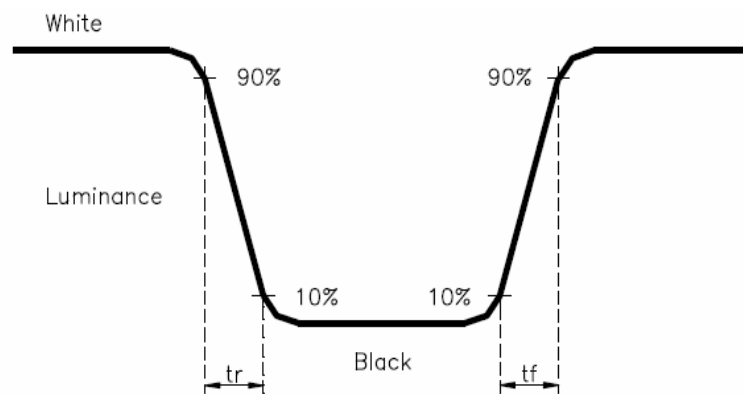
4.3 Measuring Equipment

FPM520 of Westar Display technologies, INC., which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics.

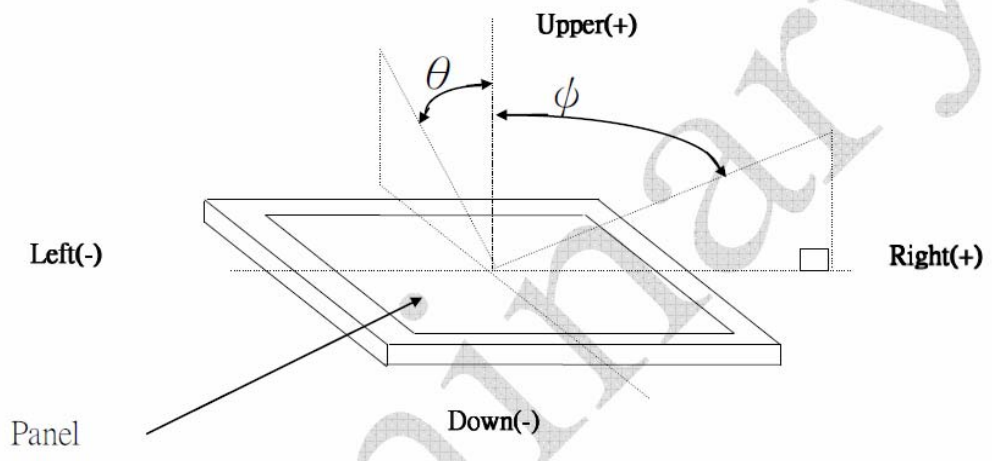
Note 3. Definition of Contrast Ratio :

$$\text{CR} = \text{White Luminance (ON)} / \text{Black Luminance (OFF)}$$

Note 4. Definition of response time : The response time is defined as the time interval between the 10% and 90% amplitudes.



Note 5. Definition of view angle(θ , ψ) :



5. Electrical Characteristics

5.1 Absolute Maximum Rating (Ta=25 VSS=0V)

| Characteristics | Symbol | Min. | Max. | Unit |
|----------------------------------|-----------------|------|------|------|
| Digital Supply Voltage | VDD | -0.3 | 4.6 | V |
| Digital interface supply Voltage | VDDIO | -0.3 | 4.6 | V |
| Operating temperature | T _{OP} | -20 | +70 | °C |
| Storage temperature | T _{ST} | -30 | +80 | °C |

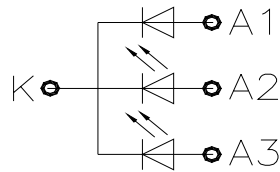
5.2 DC Electrical Characteristics

| Characteristics | Symbol | Min. | Typ. | Max. | Unit | Note |
|----------------------------------|-----------------|----------------------|------|----------------------|------|------|
| Digital Supply Voltage | VDD | 2.6 | 3.3 | 4.2 | V | |
| Digital interface supply Voltage | VDDIO | 1.65 | 3.3 | 4.2 | V | |
| Normal mode Current consumption | IDD | -- | 8 | -- | mA | |
| Level input voltage | V _{IH} | 0.7V _{DDIO} | | V _{DDIO} | V | |
| | V _{IL} | GND | | 0.3V _{DDIO} | V | |
| Level output voltage | V _{OH} | 0.8V _{DDIO} | | V _{DDIO} | V | |
| | V _{OL} | GND | | 0.2V _{DDIO} | V | |

5.3 LED Backlight Characteristics

The back-light system is edge-lighting type with 3 chips White LED

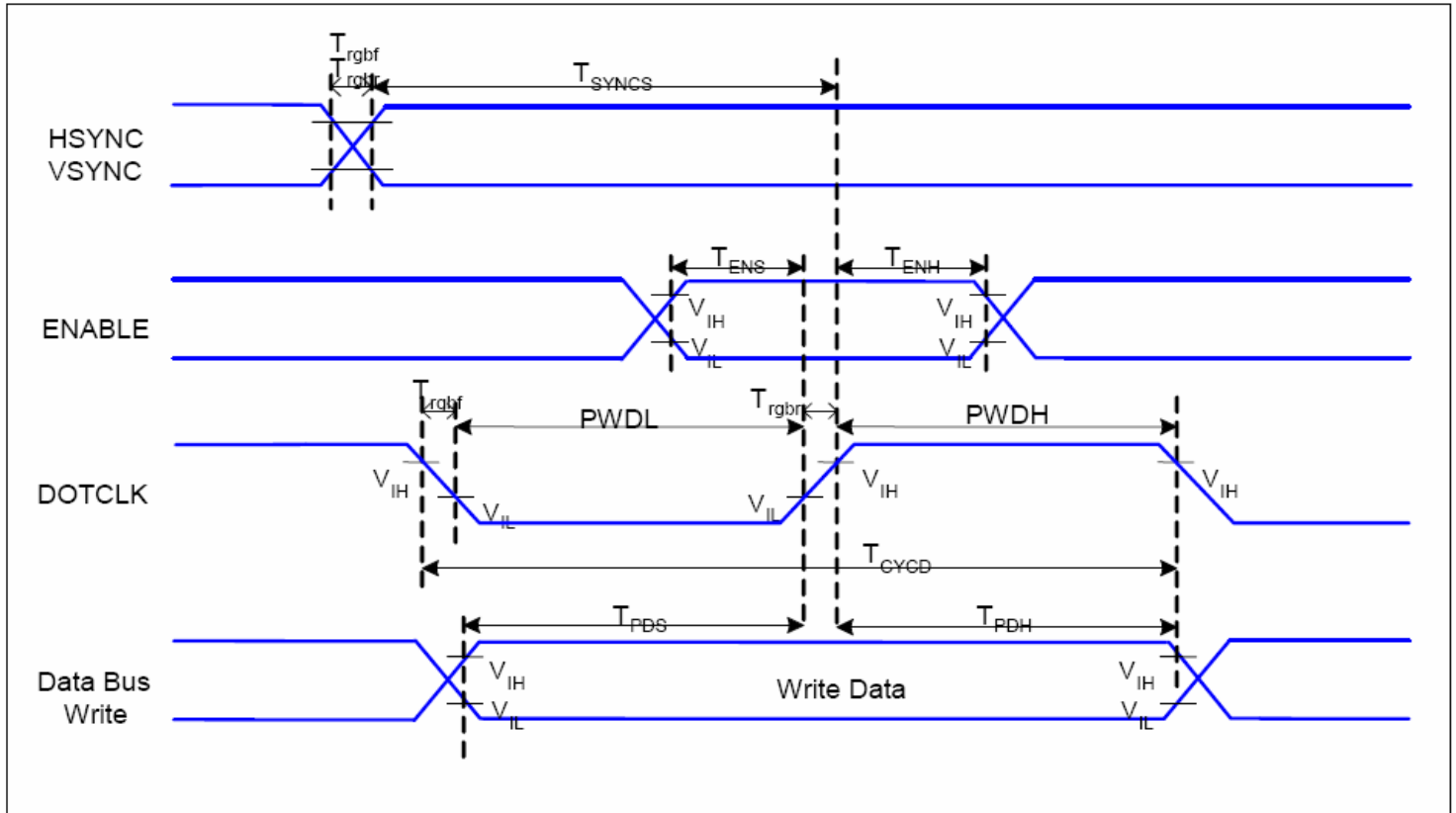
| Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|-----------------|--------|------|------|------|-------------------|------|
| Forward Current | I_F | 45 | 60 | -- | mA | |
| Forward Voltage | V_F | -- | 3.2 | -- | V | |
| LCM Luminance | L_V | 200 | -- | -- | cd/m ² | |
| Uniformity | AVg | 80 | -- | -- | % | |



BLU CIRCUIT DIAGRAM

6. AC Characteristic

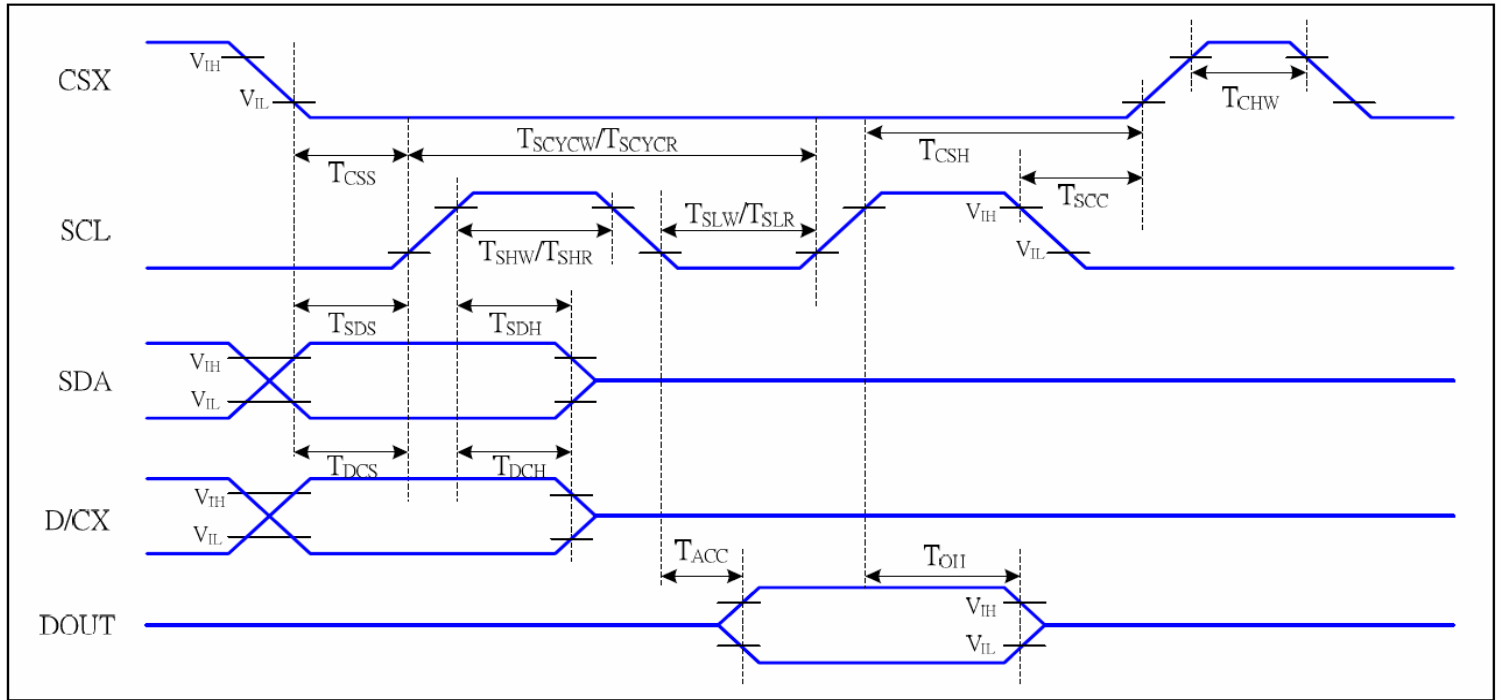
6.1 RGB Interface Characteristics:



$V_{DDI}=1.65$ to $3.3V$, $V_{DD}=2.4$ to $3.3V$, $AGND=DGND=0V$, $T_a=-30 \sim 70 \text{ } ^\circ\text{C}$

| Signal | Symbol | Parameter | MIN | MAX | Unit | Description |
|--------------|-------------------------|-------------------------------|-----|-----|------|-------------|
| HSYNC, VSYNC | T_{SYNCS} | VSYNC, HSYNC Setup Time | 30 | - | ns | |
| ENABLE | T_{ENS} | Enable Setup Time | 25 | - | ns | |
| | T_{ENH} | Enable Hold Time | 25 | - | ns | |
| DOTCLK | PWDH | DOTCLK High-level Pulse Width | 60 | - | ns | |
| | PWDL | DOTCLK Low-level Pulse Width | 60 | - | ns | |
| | T_{CYCD} | DOTCLK Cycle Time | 120 | - | ns | |
| | T_{rghf} , T_{rgbf} | DOTCLK Rise/Fall time | - | 20 | ns | |
| DB | T_{PDS} | PD Data Setup Time | 50 | - | ns | |
| | T_{PDH} | PD Data Hold Time | 50 | - | ns | |

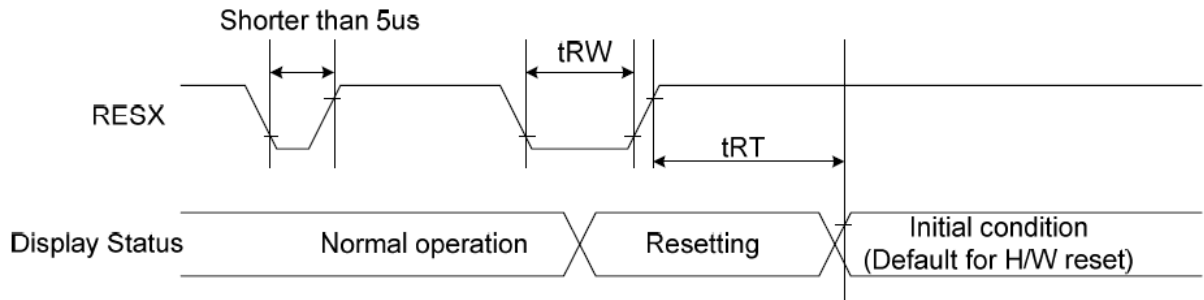
6.2 a1 Interface Characteristics (4-line serial):



VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=-30 to 70 °C

| Signal | Symbol | Parameter | MIN | MAX | Unit | Description |
|-----------|--------------------|--------------------------------|-----|-----|------|---------------------------|
| CSX | T _{CSS} | Chip select setup time (write) | 15 | | ns | |
| | T _{CSH} | 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 _{CHW} | Chip select "H" pulse width | 40 | | ns | |
| SCL | T _{SCYCW} | Serial clock cycle (Write) | 66 | | ns | -write command & data ram |
| | T _{SHW} | SCL "H" pulse width (Write) | 15 | | ns | |
| | T _{SLW} | SCL "L" pulse width (Write) | 15 | | ns | |
| | T _{SCYCR} | 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 _{SDS} | Data setup time | 10 | | ns | |
| | T _{SDH} | Data hold time | 10 | | 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 |

6.3 Reset Timing Characteristics



| Signal | 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 |

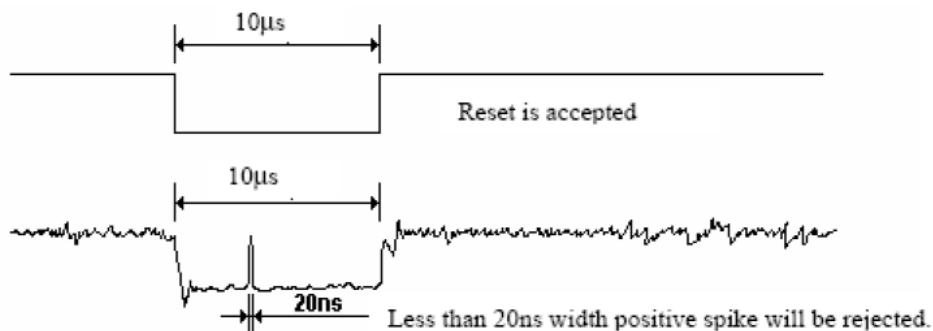
Note 1: The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from EEPROM to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after a rising edge of RESX.

Note 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 |

Note 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.

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



Note 5: When Reset applied during Sleep In Mode.

Note 6: When Reset applied during Sleep Out Mode.

Note7: It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

7. LCD Module Out-Going Quality Level

7.1 VISUAL & FUNCTION INSPECTION STANDARD

7.1.1 Inspection conditions

Inspection performed under the following conditions is recommended.

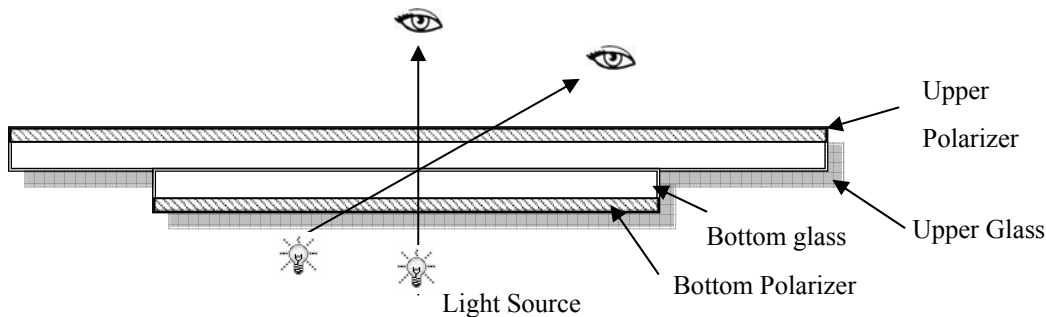
Temperature : $25 \pm 5^\circ\text{C}$

Humidity : $65\% \pm 10\% \text{RH}$

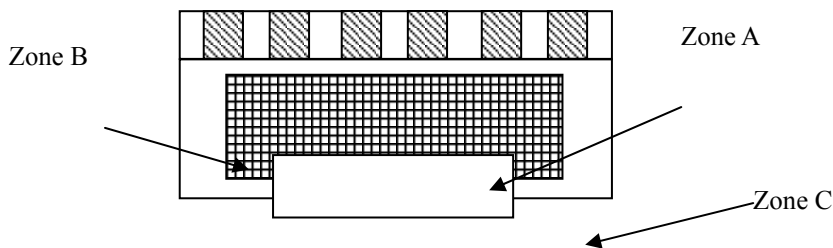
Viewing Angle : Normal viewing Angle.

Illumination: Single fluorescent lamp (300 to 700Lux)

Viewing distance: 30-50cm



7.1.2 Definition



Zone A : Effective Viewing Area(Character or Digit can be seen)

Zone B : Viewing Area except Zone A

Zone C : Outside (Zone A+Zone B) which can not be seen after assembly by customer .)

Note:

As a general rule ,visual defects in Zone C can be ignored when it doesn't effect product function or appearance after assembly by customer.

7.1.3 Sampling Plan

According to GB/T 2828-2003 ; , normal inspection, Class II

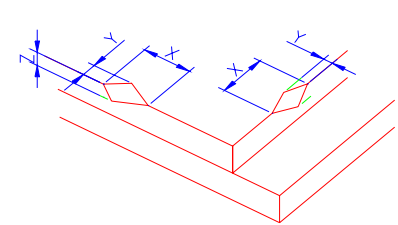
AQL:

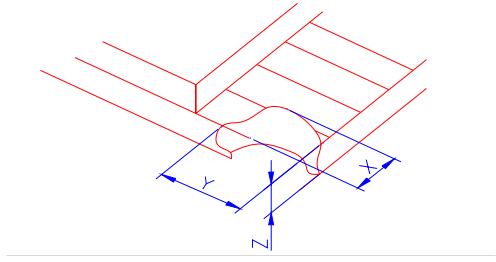
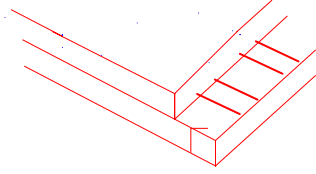
| | |
|--------------|--------------|
| Major defect | Minor defect |
| 0.65 | 1.5 |

LCD: Liquid Crystal Display , TP: Touch Panel , LCM: Liquid Crystal Module

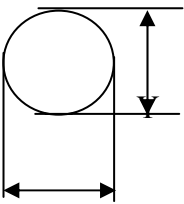
| No | Items to be inspected | Criteria | Classification of defects |
|----|-----------------------|---|---------------------------|
| 1 | Functional defects | 1) No display, Open or miss line 2) Display abnormally, Short 3) Backlight no lighting, abnormal lighting. 4) TP no function | Major |
| 2 | Missing | Missing component | |
| 3 | Outline dimension | Overall outline dimension beyond the drawing is not allowed | |
| 4 | Color tone | Color unevenness, refer to limited sample | Minor |
| 5 | Soldering appearance | Good soldering , Peeling off is not allowed. | |
| 6 | LCD/Polarizer/TP | Black/White spot/line, scratch, crack, etc. | |

7.1.4 Criteria (Visual)

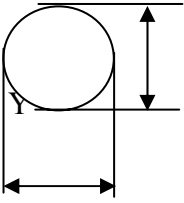
| Number | Items | Criteria(mm) | | | | | | |
|--|--------------------------------|--|---|---|---|--------|--------------------------------|----|
| 1.0 LCD Crack/Broken | (1) The edge of LCD broken |  <table border="1"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤3.0mm</td> <td><Inner border line of the seal</td> <td>≤T</td> </tr> </tbody> </table> | X | Y | Z | ≤3.0mm | <Inner border line of the seal | ≤T |
| X | Y | Z | | | | | | |
| ≤3.0mm | <Inner border line of the seal | ≤T | | | | | | |
| NOTE: X: Length Y: Width Z: Height L: Length of ITO, | | | | | | | | |

| | | | | | | | | |
|---------------------|--|---|---|---|---|---------------------|----------|----------|
| T: Height of LCD | (2)LCD corner broken |  <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">X</td> <td style="text-align: center;">Y</td> <td style="text-align: center;">Z</td> </tr> <tr> <td style="text-align: center;">$\leq 3.0\text{mm}$</td> <td style="text-align: center;">$\leq L$</td> <td style="text-align: center;">$\leq T$</td> </tr> </table> | X | Y | Z | $\leq 3.0\text{mm}$ | $\leq L$ | $\leq T$ |
| | X | Y | Z | | | | | |
| $\leq 3.0\text{mm}$ | $\leq L$ | $\leq T$ | | | | | | |
| (3) LCD crack |  <p style="text-align: center;">Crack Not allowed</p> | | | | | | | |



| Number | Items | Criteria (mm) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-------------------------|--|--|-------------------|----------------|----------------|--|---|---|---|------------------|------------------|--------|--------|-------------------------|----------------------------------|----------------------|--------------|------------------------|---|----------------------|--------------|--------------|---|------------|-----------------------|-------------------|----------------|--|--|---|---|---|-----------------|--------|--|--|-----------------------|----------------------------------|--|--|-----------------------|---|--|--|--------------|---|--|--|-------------------|----------------|--|--|---|---|---|-----------------|--------|--|--|-----------------------|----------------------------------|--|--|--------------|---|--|--|
| 2.0 | Spot defect  $\Phi = (X+Y)/2$ | <p>① light dot (LCD/TP/Polarizer black/white spot , light dot, pinhole, dent, stain)</p> <table border="1" data-bbox="359 309 1284 660"> <thead> <tr> <th rowspan="2">Zone Size (mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.10$</td> <td colspan="3">Ignore</td> </tr> <tr> <td>$0.10 < \Phi \leq 0.15$</td> <td colspan="3">3(distance $\geq 10\text{mm}$)</td> </tr> <tr> <td>$0.15 < \Phi \leq 0.2$</td> <td colspan="3">1</td> </tr> <tr> <td>$0.2 < \Phi$</td> <td colspan="3">0</td> </tr> </tbody> </table> <p>② Dim spot (LCD/TP/Polarizer dim dot, light leakage、 dark spot)</p> <table border="1" data-bbox="359 757 1311 1115"> <thead> <tr> <th rowspan="2">Zone Size (mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.1$</td> <td colspan="3">Ignore</td> </tr> <tr> <td>$0.1 < \Phi \leq 0.2$</td> <td colspan="3">2(distance $\geq 10\text{mm}$)</td> </tr> <tr> <td>$0.2 < \Phi \leq 0.3$</td> <td colspan="3">1</td> </tr> <tr> <td>$\Phi > 0.3$</td> <td colspan="3">0</td> </tr> </tbody> </table> <p>③ Polarizer accidented spot</p> <table border="1" data-bbox="359 1211 1311 1496"> <thead> <tr> <th rowspan="2">Zone Size (mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.2$</td> <td colspan="3">Ignore</td> </tr> <tr> <td>$0.2 < \Phi \leq 0.5$</td> <td colspan="3">2(distance $\geq 10\text{mm}$)</td> </tr> <tr> <td>$\Phi > 0.5$</td> <td colspan="3">0</td> </tr> </tbody> </table> | Zone Size (mm) | Acceptable Qty | | | A | B | C | $\Phi \leq 0.10$ | Ignore | | | $0.10 < \Phi \leq 0.15$ | 3(distance $\geq 10\text{mm}$) | | | $0.15 < \Phi \leq 0.2$ | 1 | | | $0.2 < \Phi$ | 0 | | | Zone Size (mm) | Acceptable Qty | | | A | B | C | $\Phi \leq 0.1$ | Ignore | | | $0.1 < \Phi \leq 0.2$ | 2(distance $\geq 10\text{mm}$) | | | $0.2 < \Phi \leq 0.3$ | 1 | | | $\Phi > 0.3$ | 0 | | | Zone Size (mm) | Acceptable Qty | | | A | B | C | $\Phi \leq 0.2$ | Ignore | | | $0.2 < \Phi \leq 0.5$ | 2(distance $\geq 10\text{mm}$) | | | $\Phi > 0.5$ | 0 | | |
| Zone Size (mm) | Acceptable Qty | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | A | B | C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $\Phi \leq 0.10$ | Ignore | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.10 < \Phi \leq 0.15$ | 3(distance $\geq 10\text{mm}$) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.15 < \Phi \leq 0.2$ | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.2 < \Phi$ | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Zone Size (mm) | Acceptable Qty | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | A | B | C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $\Phi \leq 0.1$ | Ignore | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.1 < \Phi \leq 0.2$ | 2(distance $\geq 10\text{mm}$) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.2 < \Phi \leq 0.3$ | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $\Phi > 0.3$ | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Zone Size (mm) | Acceptable Qty | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | A | B | C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $\Phi \leq 0.2$ | Ignore | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.2 < \Phi \leq 0.5$ | 2(distance $\geq 10\text{mm}$) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $\Phi > 0.5$ | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Line defect (LCD/TP /Polarizer black/white line, scratch, stain) | <table border="1" data-bbox="359 1547 1305 1912"> <thead> <tr> <th rowspan="2">Width(mm)</th> <th rowspan="2">Length(mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.03$</td> <td>Ignore</td> <td colspan="2">Ignore</td> <td rowspan="3">Ignore</td> </tr> <tr> <td>$0.03 < W \leq 0.05$</td> <td>$L \leq 3.0$</td> <td colspan="2">$N \leq 2$</td> </tr> <tr> <td>$0.05 < W \leq 0.08$</td> <td>$L \leq 2.0$</td> <td colspan="2">$N \leq 2$</td> </tr> <tr> <td>$0.08 < W$</td> <td colspan="4">Define as spot defect</td> </tr> </tbody> </table> | Width(mm) | Length(mm) | Acceptable Qty | | | A | B | C | $\Phi \leq 0.03$ | Ignore | Ignore | | Ignore | $0.03 < W \leq 0.05$ | $L \leq 3.0$ | $N \leq 2$ | | $0.05 < W \leq 0.08$ | $L \leq 2.0$ | $N \leq 2$ | | $0.08 < W$ | Define as spot defect | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Width(mm) | Length(mm) | Acceptable Qty | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | A | B | C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $\Phi \leq 0.03$ | Ignore | Ignore | | Ignore | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.03 < W \leq 0.05$ | $L \leq 3.0$ | $N \leq 2$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.05 < W \leq 0.08$ | $L \leq 2.0$ | $N \leq 2$ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.08 < W$ | Define as spot defect | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |



| Items | Criteria (mm) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|---|-------------------|----------------|--|--|---|---|---|------------------|--------|--|--|-------------------------|----------------------------------|--|--|------------------------|---|--|--|--------------|---|--|--|-------------------|----------------|--|--|---|---|---|-----------------|--------|--|--|-----------------------|----------------------------------|--|--|-----------------------|---|--|--|--------------|---|--|--|-------------------|----------------|--|--|---|---|---|-----------------|--------|--|--|-----------------------|----------------------------------|--|--|--------------|---|--|--|
| <p>Spot defect</p>  <p>X</p> <p>$\Phi=(X+Y)/2$</p> | <p>① light dot (LCD/TP/Polarizer black/white spot , light dot, pinhole, dent, stain)</p> <table border="1" data-bbox="359 694 1284 1048"> <thead> <tr> <th rowspan="2">Zone Size (mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.10$</td> <td colspan="3">Ignore</td> </tr> <tr> <td>$0.10 < \Phi \leq 0.15$</td> <td colspan="3">3(distance $\geq 10\text{mm}$)</td> </tr> <tr> <td>$0.15 < \Phi \leq 0.2$</td> <td colspan="3">1</td> </tr> <tr> <td>$0.2 < \Phi$</td> <td colspan="3">0</td> </tr> </tbody> </table> <p>②Dim spot (LCD/TP/Polarizer dim dot, light leakage、 dark spot)</p> <table border="1" data-bbox="359 1142 1316 1496"> <thead> <tr> <th rowspan="2">Zone Size (mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.1$</td> <td colspan="3">Ignore</td> </tr> <tr> <td>$0.1 < \Phi \leq 0.2$</td> <td colspan="3">2(distance $\geq 10\text{mm}$)</td> </tr> <tr> <td>$0.2 < \Phi \leq 0.3$</td> <td colspan="3">1</td> </tr> <tr> <td>$\Phi > 0.3$</td> <td colspan="3">0</td> </tr> </tbody> </table> <p>③ Polarizer accidented spot</p> <table border="1" data-bbox="359 1590 1173 1895"> <thead> <tr> <th rowspan="2">Zone Size (mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.2$</td> <td colspan="3">Ignore</td> </tr> <tr> <td>$0.2 < \Phi \leq 0.5$</td> <td colspan="3">2(distance $\geq 10\text{mm}$)</td> </tr> <tr> <td>$\Phi > 0.5$</td> <td colspan="3">0</td> </tr> </tbody> </table> | Zone Size (mm) | Acceptable Qty | | | A | B | C | $\Phi \leq 0.10$ | Ignore | | | $0.10 < \Phi \leq 0.15$ | 3(distance $\geq 10\text{mm}$) | | | $0.15 < \Phi \leq 0.2$ | 1 | | | $0.2 < \Phi$ | 0 | | | Zone Size (mm) | Acceptable Qty | | | A | B | C | $\Phi \leq 0.1$ | Ignore | | | $0.1 < \Phi \leq 0.2$ | 2(distance $\geq 10\text{mm}$) | | | $0.2 < \Phi \leq 0.3$ | 1 | | | $\Phi > 0.3$ | 0 | | | Zone Size (mm) | Acceptable Qty | | | A | B | C | $\Phi \leq 0.2$ | Ignore | | | $0.2 < \Phi \leq 0.5$ | 2(distance $\geq 10\text{mm}$) | | | $\Phi > 0.5$ | 0 | | |
| Zone Size (mm) | Acceptable Qty | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | A | B | C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $\Phi \leq 0.10$ | Ignore | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.10 < \Phi \leq 0.15$ | 3(distance $\geq 10\text{mm}$) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.15 < \Phi \leq 0.2$ | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.2 < \Phi$ | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Zone Size (mm) | Acceptable Qty | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | A | B | C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $\Phi \leq 0.1$ | Ignore | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.1 < \Phi \leq 0.2$ | 2(distance $\geq 10\text{mm}$) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.2 < \Phi \leq 0.3$ | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $\Phi > 0.3$ | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Zone Size (mm) | Acceptable Qty | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | A | B | C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $\Phi \leq 0.2$ | Ignore | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $0.2 < \Phi \leq 0.5$ | 2(distance $\geq 10\text{mm}$) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $\Phi > 0.5$ | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |


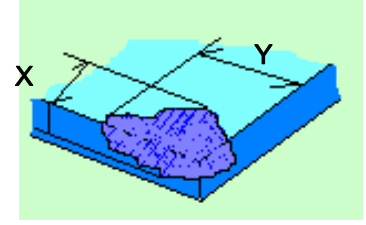
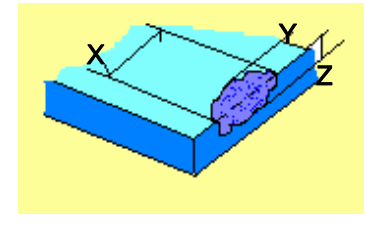


| | | | | | |
|---|-----------------------|--------------|----------------|---|--------|
| Line defect (LCD/TP /Polarizer black/white line, scratch, stain) | Width(mm) | Length(mm) | Acceptable Qty | | |
| | | | A | B | C |
| | $\Phi \leq 0.03$ | Ignore | Ignore | | Ignore |
| | $0.03 < W \leq 0.05$ | $L \leq 3.0$ | $N \leq 2$ | | |
| | $0.05 < W \leq 0.08$ | $L \leq 2.0$ | $N \leq 2$ | | |
| $0.08 < W$ | Define as spot defect | | | | |

| | | | | |
|---------------------|-----------------------|----------------------------------|---|--------|
| Polarizer Bubble | Zone | Acceptable Qty | | |
| | Size (mm) | A | B | C |
| | $\Phi \leq 0.2$ | Ignore | | Ignore |
| | $0.2 < \Phi \leq 0.4$ | 2 (distance $\geq 10\text{mm}$) | | |
| | $0.4 < \Phi \leq 0.6$ | 1 | | |
| $0.6 < \Phi$ | 0 | | | |

| | |
|-----|---|
| SMT | According to IPC-A-610C class II standard . Function defect and missing part are major defect ,the others are minor defect. |
|-----|---|

| | | | | |
|----------------------------------|---|----------------------------------|---|--------|
| TP bubble/ accidented spot | Size Φ (mm) | Acceptable Qty | | |
| | | A | B | C |
| | $\Phi \leq 0.1$ | Ignore | | Ignore |
| | $0.1 < \Phi \leq 0.2$ | 2 (distance $\geq 10\text{mm}$) | | |
| | $0.2 < \Phi \leq 0.3$ | 1 | | |
| $0.3 < \Phi$ | 0 | | | |
| Assembly deflection | beyond the edge of backlight $\leq 0.15\text{mm}$ | | | |

| 5.0 | TP Related | <p>Newton Ring</p> <p>Newton Ring area > 1/3 TP area NG</p> <p>Newton Ring area ≤ 1/3 TP area OK</p> |  | | | | | | |
|--|-----------------------|--|--|---|---|-----------------------|-----------------------|----------------------------|---|
| <p>TP corner broken</p> <p>X : length</p> <p>Y : width</p> <p>Z : height</p> | | <table border="1" data-bbox="526 1097 957 1254"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>$X \leq 3.0\text{mm}$</td> <td>$Y \leq 3.0\text{mm}$</td> <td>$Z < \text{LCD thickness}$</td> </tr> </tbody> </table> <p>* Circuitry broken is not allowed.</p> | X | Y | Z | $X \leq 3.0\text{mm}$ | $Y \leq 3.0\text{mm}$ | $Z < \text{LCD thickness}$ |  |
| X | Y | Z | | | | | | | |
| $X \leq 3.0\text{mm}$ | $Y \leq 3.0\text{mm}$ | $Z < \text{LCD thickness}$ | | | | | | | |
| <p>TP edge broken</p> <p>X : length</p> <p>Y : width</p> <p>Z : height</p> | | <table border="1" data-bbox="526 1388 957 1545"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>$X \leq 6.0\text{mm}$</td> <td>$Y \leq 2.0\text{mm}$</td> <td>$Z < \text{LCD thickness}$</td> </tr> </tbody> </table> <p>* Circuitry broken is not allowed.</p> | X | Y | Z | $X \leq 6.0\text{mm}$ | $Y \leq 2.0\text{mm}$ | $Z < \text{LCD thickness}$ |  |
| X | Y | Z | | | | | | | |
| $X \leq 6.0\text{mm}$ | $Y \leq 2.0\text{mm}$ | $Z < \text{LCD thickness}$ | | | | | | | |

Criteria (functional items)

| Number | Items | Criteria (mm) |
|--------|-----------------------|---------------|
| 1 | No display | Not allowed |
| 2 | Missing segment | Not allowed |
| 3 | Short | Not allowed |
| 4 | Backlight no lighting | Not allowed |
| 5 | TP no function | Not allowed |

8. Reliability Test Result

8.1 Condition

| Item | Condition | Sample Size | Test Result | Note |
|--------------------------------------|---|-------------|-------------|------|
| Low Temperature Operating Life test | -20℃, 96HR | 3ea | pass | - |
| Thermal Humidity Operating Life test | 60℃, 90%RH, 96HR | 3ea | pass | - |
| Temperature Cycle ON/OFF test | -20℃ ↔ 70℃, ON/OFF, 20CYC | 3ea | pass | (1) |
| High Temperature Storage test | 80℃, 96HR | 3ea | pass | - |
| Low Temperature Storage test | - 30℃, 96HR | 3ea | pass | - |
| Thermal Shock Resistance | The sample should be allowed to stand the following 5 cycles of operation: TSTL for 30 minutes -> normal temperature for 5 minutes -> TSTH for 30 minutes -> normal temperature for 5 minutes, as one cycle, then taking it out and drying it at normal temperature, and allowing it stand for 24 hours | 3ea | pass | |
| Box Drop Test | 1 Corner 3 Edges 6 faces, 66cm(MEDIUM BOX) | 1 box | pass | - |

Note (1) ON Time over 10 seconds, OFF Time under 10 seconds

9. Cautions and Handling Precautions

9.1 Handling and Operating the Module

(1) When the module is assembled, it should be attached to the system firmly.

Do not warp or twist the module during assembly work.

(2) Protect the module from physical shock or any force. In addition to damage, this may cause improper operation or damage to the module and back-light unit.

(3) Note that polarizer is very fragile and could be easily damaged. Do not press or scratch the surface.

(4) Do not allow drops of water or chemicals to remain on the display surface.

If you have the droplets for a long time, staining and discoloration may occur.

(5) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.

(6) The desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane.

Do not use ketene type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.

(7) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs, or clothes, it must be washed away thoroughly with soap.

(8) Protect the module from static; it may cause damage to the CMOS ICs.

(9) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.

(10) Do not disassemble the module.

(11) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.

(12) Pins of I/F connector shall not be touched directly with bare hands.

(13) Do not connect, disconnect the module in the "Power ON" condition.

(14) Power supply should always be turned on/off by the item 6.1 Power On Sequence & 6.2 Power Off Sequence

9.2 Storage and Transportation.

(1) Do not leave the panel in high temperature, and high humidity for a long time.

It is highly recommended to store the module with temperature from 0 to 35 °C and relative humidity of less than 70%

(2) Do not store the TFT-LCD module in direct sunlight.

(3) The module shall be stored in a dark place. When storing the modules for a long time, be sure to adopt effective measures for protecting the modules from strong ultraviolet radiation, sunlight, or fluorescent light.

(4) It is recommended that the modules should be stored under a condition where no condensation is allowed. Formation of dewdrops may cause an abnormal operation or a failure of the module.

In particular, the greatest possible care should be taken to prevent any module from being operated where condensation has occurred inside.

(5) This panel has its circuitry FPC on the bottom side and should be handled carefully in order not to be stressed.

10.Packing

---TBD---

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