# SPECIFICATION
# FOR
# LCD Module
# KD030WQTBD005

| | |
|---|---|
| MODULE: | KD030WQTBD005 |
| CUSTOMER: | |

| REV | DESCRIPTION | DATE |
|---|---|---|
| 1.0 | FIRST ISSUE | 2015.12.31 |
| 1.1 | Modify Drive IC | 2017.01.11 |
| | | |

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

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

## Revision History

| Data | Rev. No. | Page | Summary |
|---|---|---|---|
| 2015.12.31 | V1.0 | ALL | FIRST ISSUE |
| 2017.01.11 | V1.1 | 4 | Modify Drive IC |
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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 3.0'TFT-LCD contains 240x400 pixels, and can display up to 65K/262K colors.

*** Features**

-Low Input Voltage: 3.3V (TYP)

-Display Colors of TFT LCD: 65K/262K colors

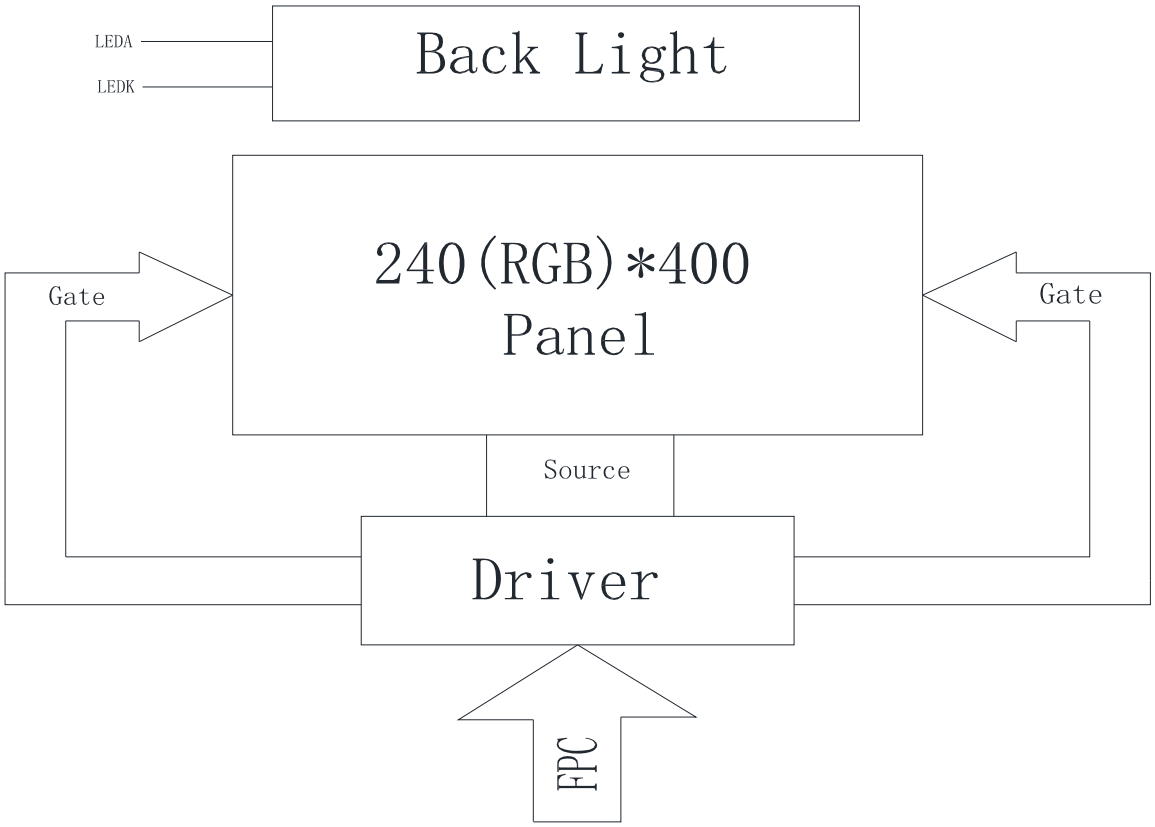
-Interface: 18/16/9/8 BIT MCU

| General Information Items | Specification | Unit | Note |
|---|---|---|---|
| | Main Panel | | |
| Display area(AA) | 38.88(H)*64.80(V) (3.0inch) | mm | - |
| Driver element | TFT active matrix | - | - |
| Display colors | 65K/262K | colors | - |
| Number of pixels | 240(RGB)*400 | dots | - |
| Pixel arrangement | RGB vertical stripe | - | - |
| Pixel pitch | 0.162(H)*0.162(V) | mm | - |
| Viewing angle | 6:00 | o'clock | - |
| Controller IC | ST7793 | - | - |
| Display mode | Transmissive/Normally White | - | - |
| Operating temperature | -20～+70 | ℃ | - |
| Storage temperature | -30～+80 | ℃ | - |

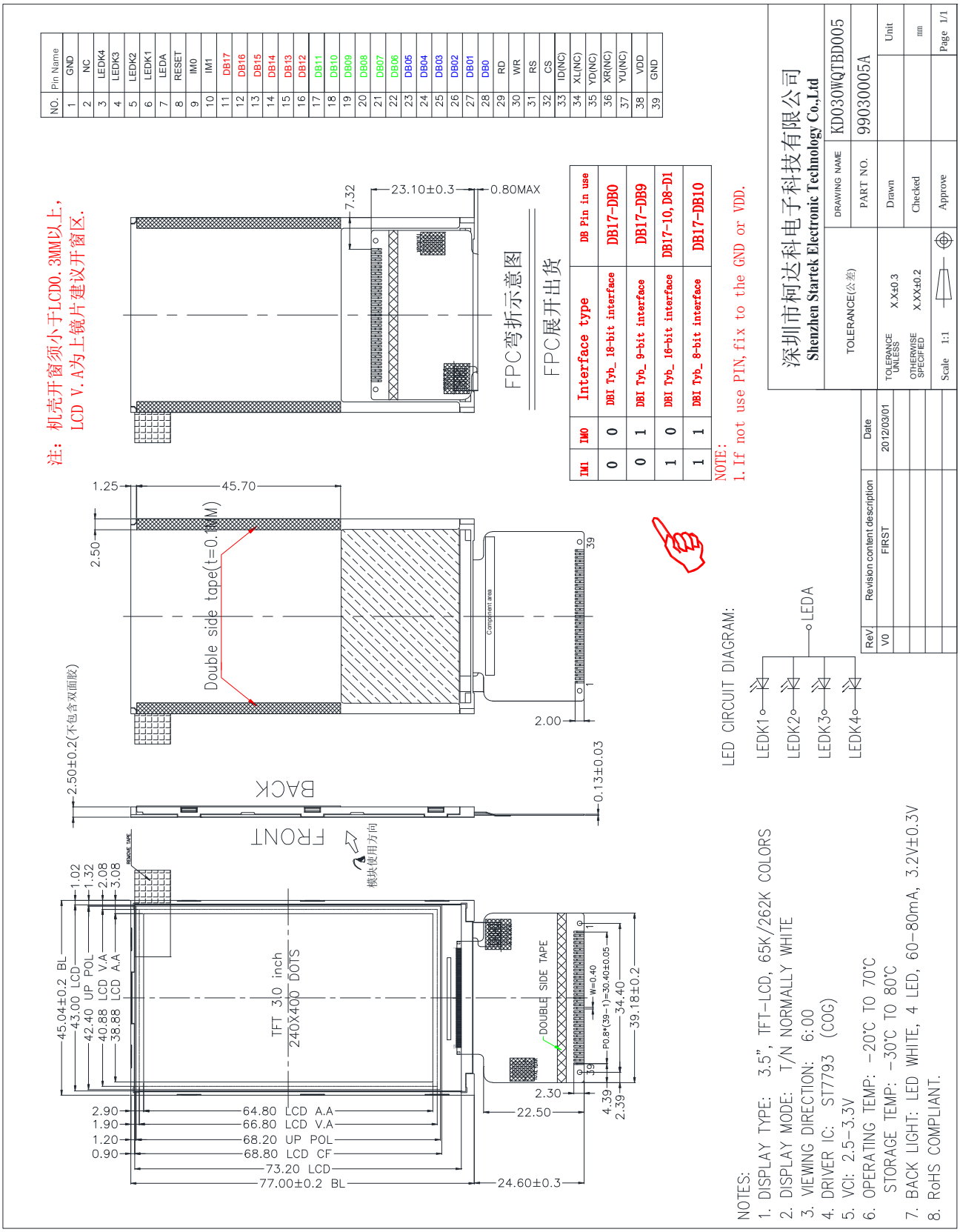
*** Mechanical Information**

| Item | | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Module size | Horizontal(H) | | 45.04 | | mm | - |
| | Vertical(V) | | 77.00 | | mm | - |
| | Depth(D) | | 2.50 | | 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 | NC | NC. | |
| 3 | LEDK4 | Cathode pin of backlight. | P |
| 4 | LEDK3 | Cathode pin of backlight. | P |
| 5 | LEDK2 | Cathode pin of backlight. | P |
| 6 | LEDK1 | Cathode pin of backlight. | P |
| 7 | LEDA | Anode pin of backlight. | P |
| 8 | RESET | This signal low will reset the device and must be applied to properly initialize the chip. Signal is low active. | I |
| 9 | IM0 | Interface selecting signal. | I |
| 10 | IM1 | | I |
| 11~28 | DB17~DB0 | These pins are data bus. | I/O |
| 29 | RD | If they are not used; please fix these pins as GND.<br>Read control pin for the DBI interface.<br>If not used, please connect this pin to VCC. | I |
| 30 | WR | Write control pin for the DBI interface.<br>If not used, please connect this pin to VCC. | I |
| 31 | RS | Display data / Command selection pin<br>RS='1': Display data.<br>RS='0': Command data. | I |
| 32 | CS | Chip select input pin ("Low" enable).<br>When it is not used, please fix this pin at VCC. | I |
| 33 | ID(NC) | NC | |
| 34 | XL(NC) | Touch panel LIFT Glass Terminal | |
| 35 | YD(NC) | Touch panel Bottom Film Terminal | |
| 36 | XR(NC) | Touch panel Right Glass Terminal | |
| 37 | YU(NC) | Touch panel Top Film Terminal | |
| 38 | VDD | Power supply voltage (VCI=2.5V-3.3V). | P |

| | | | |
|---|---|---|---|
| 39 | GND | Ground. | P |

# 4. LCD Optical Characteristics

## 4.1 Optical specification

| Item | | Symbol | Condition | Min. | Typ. | Max. | Unit. | Note |
|---|---|---|---|---|---|---|---|---|
| Transmittance | | T(%) | -- | 5.2 | 5.5 | -- | % | Note1 |
| Contrast Ratio | | CR | θ=0 Normal viewing angle | | 500 | | % | (1)(2) |
| Response time | Rising | $T_R$ | | -- | 8 | | msec | (1)(3) |
| | Falling | $T_F$ | | -- | 24 | | | |
| NTFS | | S(%) | | -- | 60 | -- | % | Note5 |
| Color Filter Chromacicity | White | $W_X$ | C-light | 0.288 | 0.308 | 0.328 | | (1)(4) CF glass (C-light) |
| | | $W_Y$ | | 0.322 | 0.342 | 0.362 | | |
| | Red | $R_X$ | | 0.633 | 0.653 | 0.673 | | |
| | | $R_Y$ | | 0.311 | 0.331 | 0.351 | | |
| | Green | $G_X$ | | 0.291 | 0.311 | 0.331 | | |
| | | $G_Y$ | | 0.554 | 0.574 | 0.594 | | |
| | Blue | $B_X$ | | 0.114 | 0.134 | 0.154 | | |
| | | $B_Y$ | | 0.114 | 0.134 | 0.154 | | |
| Viewing angle | Hor. | $\theta_L$ | CR>10 | 50 | 70 | -- | Degree | Note 2 |
| | | $\theta_R$ | | 50 | 70 | -- | | |
| | Ver. | $\theta_U$ | | 30 | 35 | -- | | |
| | | $\theta_D$ | | 55 | 75 | -- | | |
| Option View Direction | | 6 O'clock | | | | | | |

## 4.2 Measuring Condition

■ Measuring surrounding：dark room

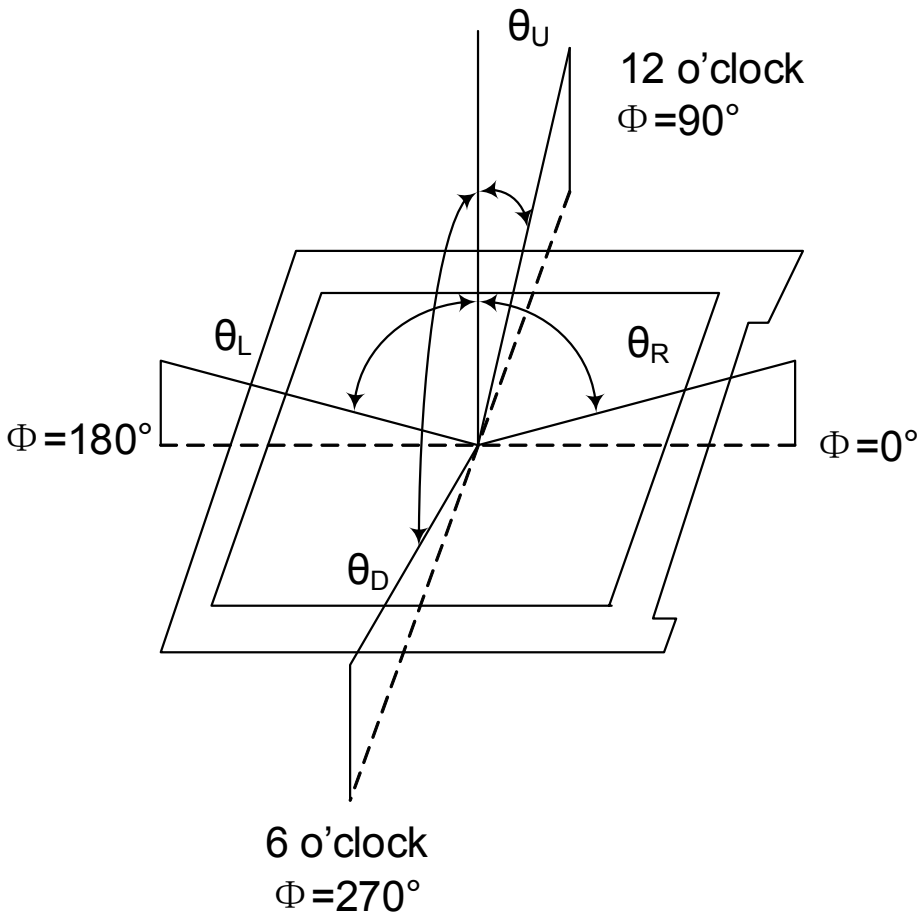
■ Ambient temperature：25±2℃

■ 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 (1)** Definition of Viewing Angle :

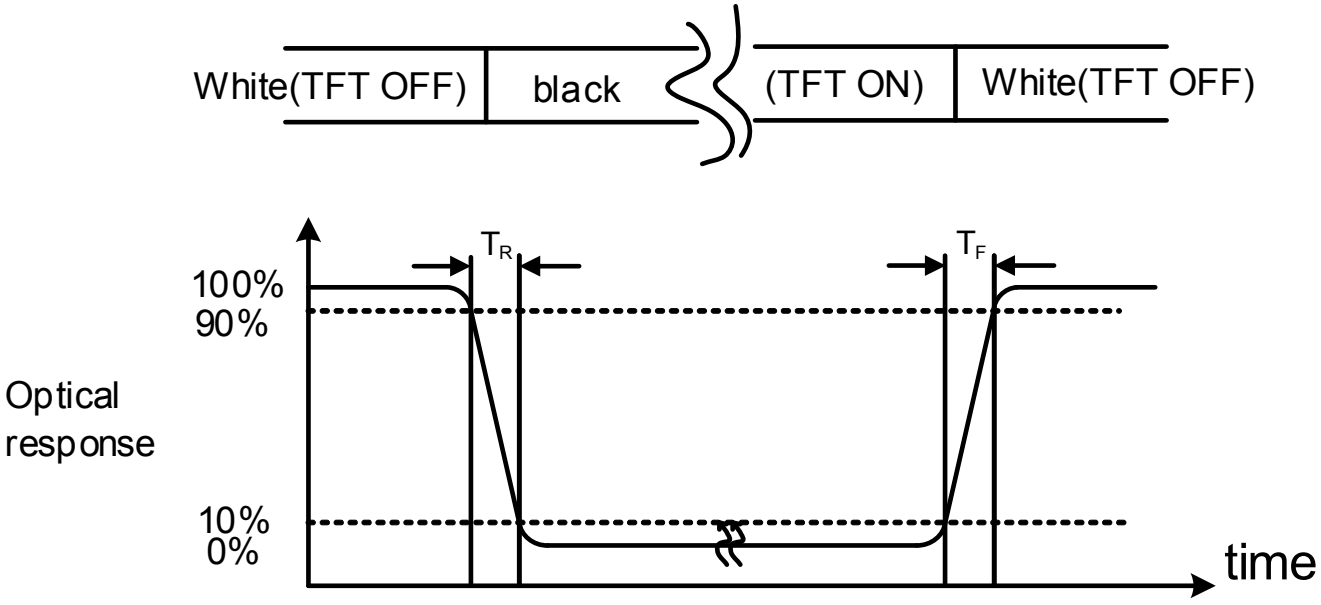



**Note (2)** Definition of Contrast Ratio (CR) :

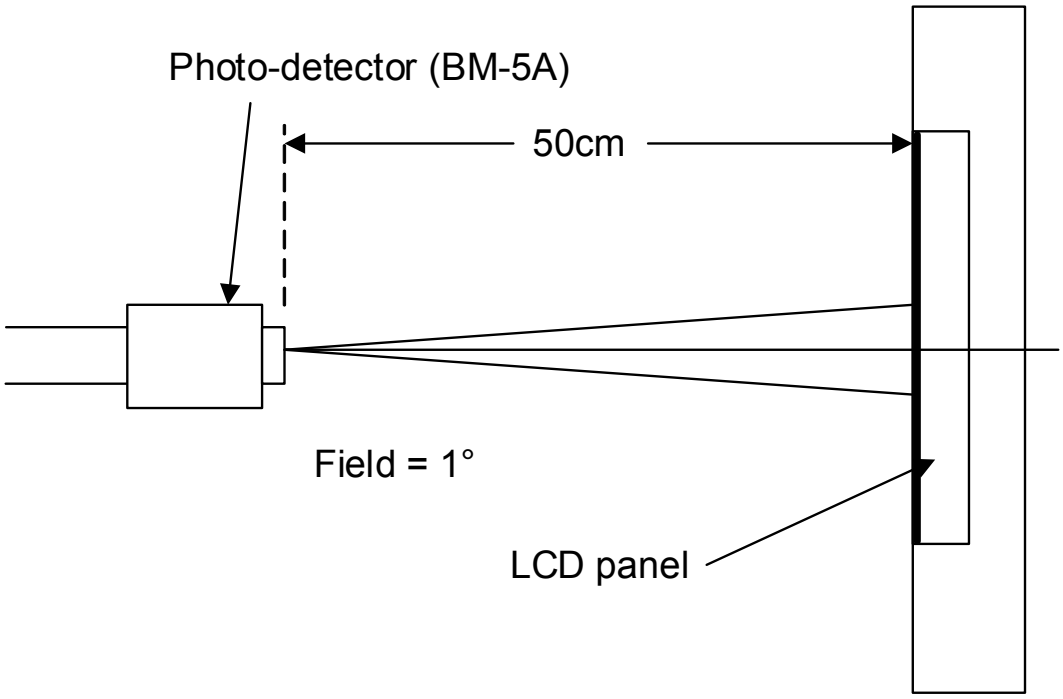
Measured at the center point of panel

$$CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$

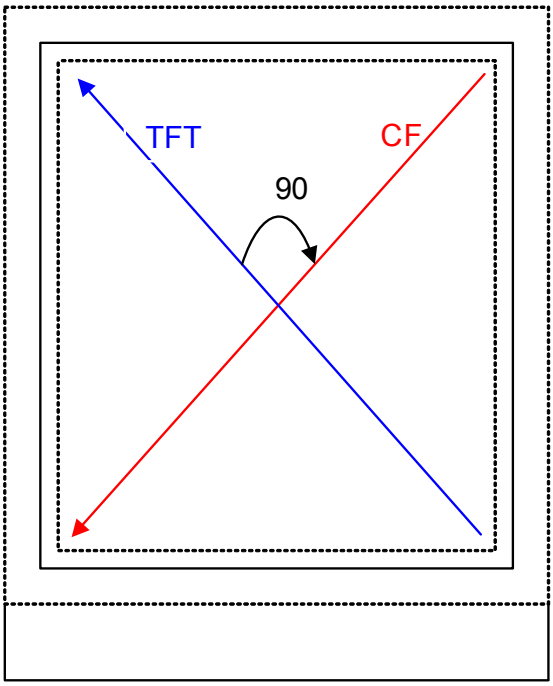
**Note (3)** Definition of Response Time: Sum of TR and TF




**Note (4)** Definition of optical measurement setup




**Note (5)** Rubbing Direction (The different Rubbing Direction will cause the different view direction.




TFT Face up

# 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 supple Voltage | VDDIO | -0.3 | 4.6 | **V** |
| Operating temperature | $T_{OP}$ | -20 | +70 | ℃ |
| Storage temperature | $T_{ST}$ | -30 | +80 | ℃ |

## 5.2 DC Electrical Characteristics

| Characteristics | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Digital Supply Voltage | VDD | 2.4 | 3.3 | 4.2 | V | |
| Digital interface supple Voltage | VDDIO | 1.65 | 3.3 | 4.2 | V | |
| Normal mode Current consumption | IDD | -- | 8 | -- | mA | |
| Level input voltage | $V_{IH}$ | 0.7$V_{DDIO}$ | | VDDIO | V | |
| | $V_{IL}$ | GND | | 0.3$V_{DDIO}$ | V | |
| Level output voltage | $V_{OH}$ | 0.8VDDIO | | VDDIO | V | |
| | $V_{OL}$ | GND | | 0.2VDDIO | V | |

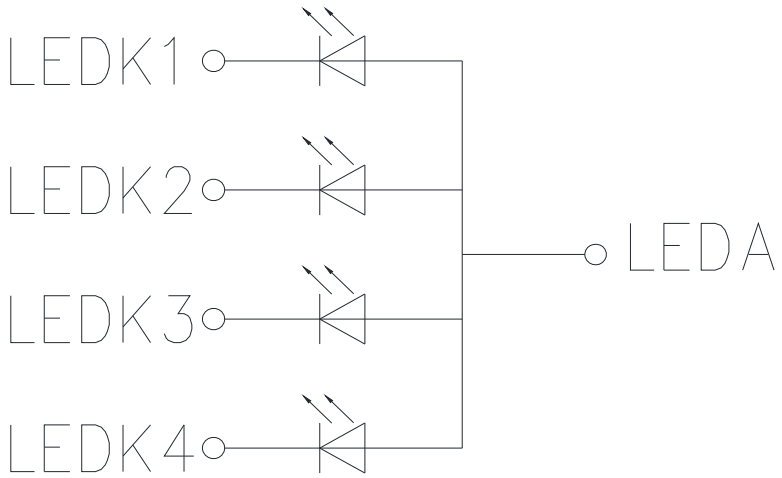
### 5.3 LED Backlight Characteristics

The back-light system is edge-lighting type with 4 chips White LED

| Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| Forward Current | $I_F$ | 60 | 80 | -- | mA | |
| Forward Voltage | $V_F$ | -- | 3.2 | -- | V | |
| LCM Luminance | $L_V$ | 250 | -- | -- | cd/m2 | If=80mA |
| LED life time | Hr | 50000 | -- | -- | Hour | Note1,2 |
| Uniformity | AVg | 80 | -- | -- | % | |

Note (1) LED life time (Hr) can be defined as the time in which it continues to operate under the condition: Ta=25±3 ℃, typical IL value indicated in the above table until the brightness becomes less than 50%.

Note (2) The “LED life time” is defined as the module brightness decrease to 50% original brightness at Ta=25℃ and IL=80mA. The LED lifetime could be decreased if operating IL is larger than 80mA. The constant current driving method is suggested.




LED CIRCUIT DIAGRAM:

# 6. AC Characteristic

## 6.1. 8080 Series MCU Parallel Interface Characteristics: 18/16/9/8-bit Bus:

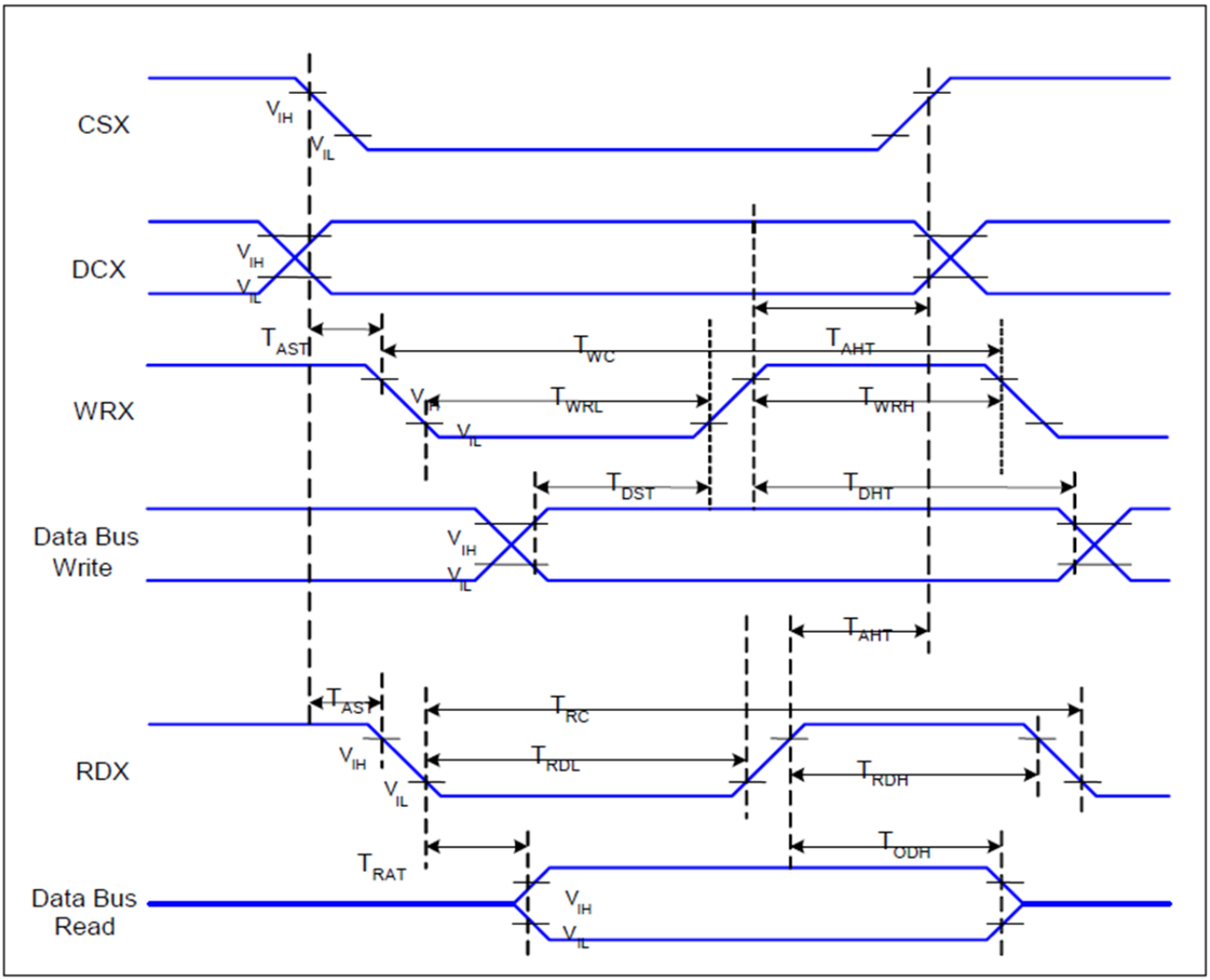



**Figure6-1-1 Parallel Interface Timing Characteristics (8080-Series MCU Interface)**

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

| Signal | Symbol | Parameter | Min | Max | Unit | Description |
|---|---|---|---|---|---|---|
| D/CX | $T_{AST}$ | Address setup time | 0 | | ns | |
| | $T_{AHT}$ | Address hold time (Write/Read) | 2 | | ns | |
| WRX | $T_{WC}$ | Write cycle | 75 | | ns | |
| | $T_{WRH}$ | Control pulse “H” duration | 25 | | ns | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | $T_{WRL}$ | Control pulse “L” duration | 30 | | ns | |
| RDX(ID) | $T_{RC}$ | Read cycle (ID) | 160 | | ns | When read ID data |
| | $T_{RDH}$ | Control pulse “H” duration (ID) | 90 | | ns | |
| | $T_{RDL}$ | Control pulse “L” duration (ID) | 45 | | ns | |
| DB[17:0] | $T_{DST}$ | Data setup time | 20 | | ns | TRAT, TRATFM: 3K ohm Pull up or Down and 30pF Parallel Cap. To GND.TODH: 3K ohm Pull up or Down. |
| | $T_{DHT}$ | Data hold time | 10 | | ns | |
| | $T_{RAT}$ | Read access time (ID) | | 150 | ns | |
| | $T_{ODH}$ | Output disable time | 10 | | ns | |

**Table6-1-1 8080 Parallel Interface Characteristics**

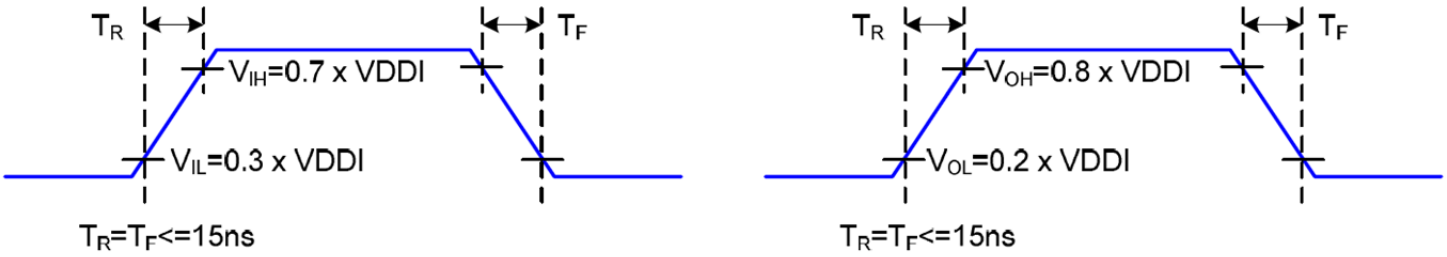
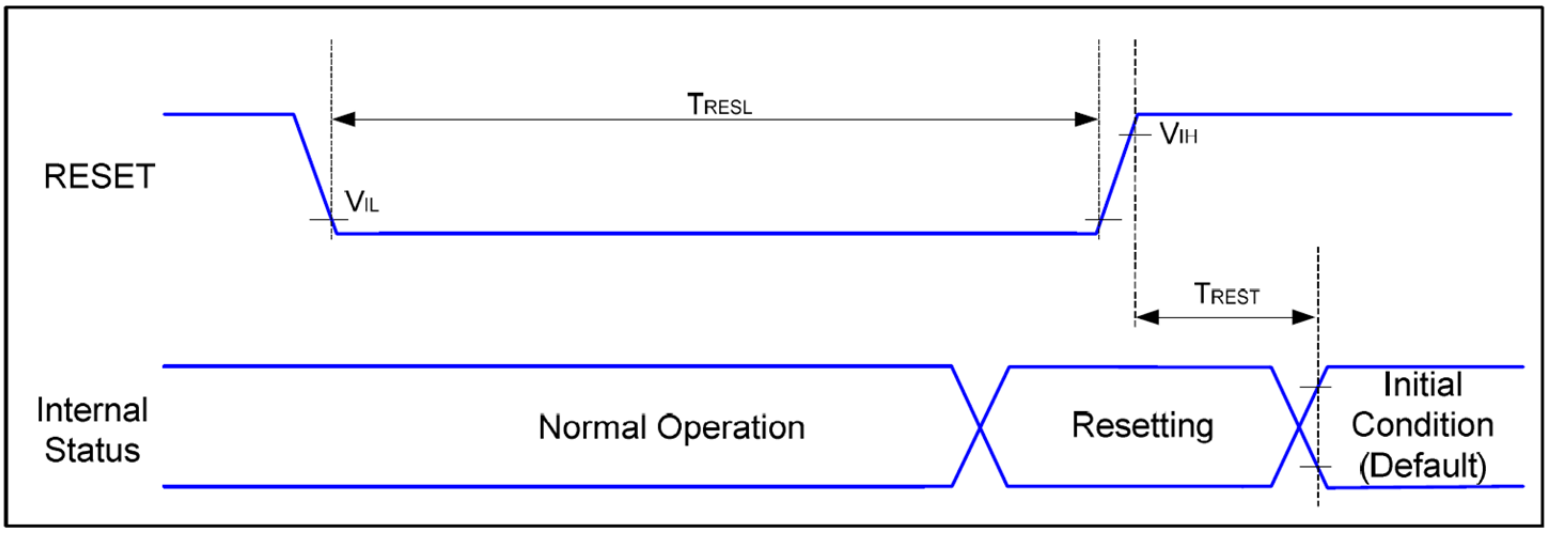



**Figure6-1-2 Rising and Falling Timing for I/O Signal**

*Note: The rising time and falling time (Tr, Tf) of input signal and fall time are specified at 15 ns or less. Logic high and low levels are specified as 20% and 80% of VDDI for Input signals.*

## 6.2 Reset Timing Characteristics




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

| Signal | Symbol | Parameter | Min | Max | Unit |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| RESX | $T_{RESL}$ | Reset Low Level Width | 1 | | ms |
| | $T_{REST}$ | Reset Complete Time | 1 | | ms |

# 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.

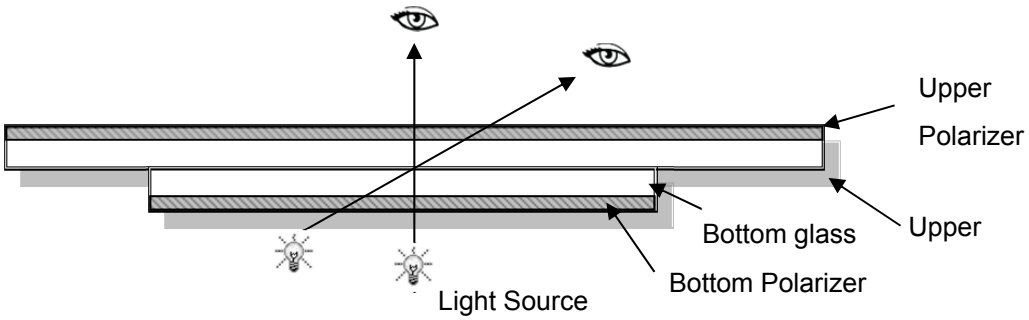
Temperature: 25±5℃

Humidity: 65%±10%RH

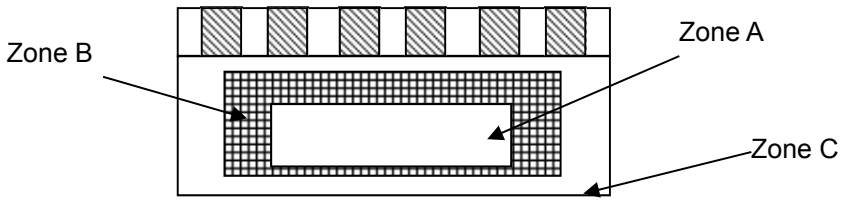
Viewing Angle: Normal viewing Angle.

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't be seen after assembly by customer.

Note:

As a general rule, visual defects in Zone C can be ignored when it doesn't effecting product function

or appearance after assembly by customer.

### 7.1.3 Sampling Plan

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

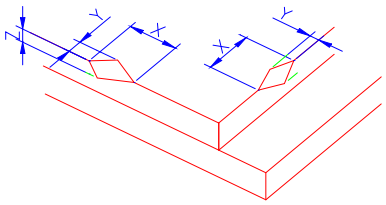
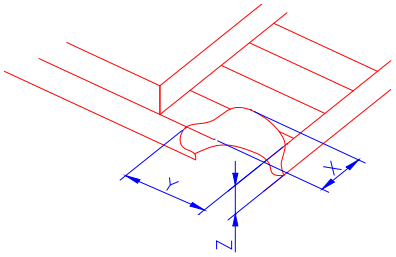
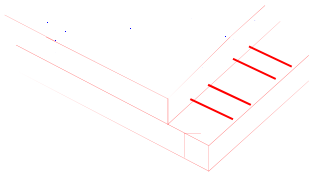
AQL:

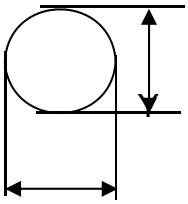
| Major defect | Minor defect |
|---|---|
| 0.65 | 1.5 |

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<br>2) Display abnormally, Short<br>3) Backlight no lighting, abnormal lighting.<br>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. | |

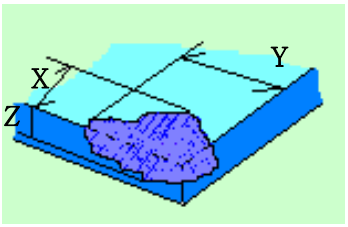
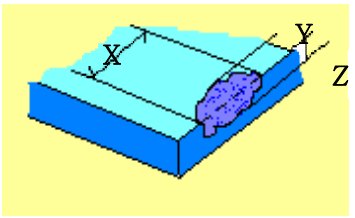
### 7.1.4 Criteria (Visual)

<table>
<tr><th>Number</th><th>Items</th><th>Criteria(mm)</th></tr>
<tr><td rowspan="3">1.0 LCD Crack/Broken<br><br>NOTE:<br>X: Length<br>Y: Width<br>Z: Height<br>L:Length of ITO<br>T:Height of LCD</td><td>(1) The edge of LCD broken</td><td> 
<table>
<tr><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>≤3.0mm</td><td><Inner border line of the seal</td><td>≤T</td></tr>
</table></td></tr>
<tr><td>(2)LCD corner broken</td><td> 
<table>
<tr><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>≤3.0mm</td><td>≤L</td><td>≤T</td></tr>
</table></td></tr>
<tr><td>(3) LCD crack</td><td>  <br>Crack<br>Not allowed</td></tr>
</table>

<table>
<tr><th>Number</th><th>Items</th><th>Criteria (mm)</th></tr>
<tr><td rowspan="2">2.0</td><td>Spot defect<br>  <br>X<br>Φ=(X+Y)/2</td><td>① light dot（LCD/TP/Polarizer black/white spot , light dot, pinhole, dent, stain）
<table>
<tr><th rowspan="2">Zone<br>Size (mm)</th><th colspan="3">Acceptable Quality</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Φ≤0.10</td><td colspan="2">Ignore</td><td rowspan="4">Ignor</td></tr>
<tr><td>0.10<Φ≤0.25</td><td colspan="2">3( distance≧10mm)</td></tr>
<tr><td>0.25<Φ≤0.40</td><td colspan="2">2</td></tr>
<tr><td>Φ＞0.40</td><td colspan="2">0</td></tr>
</table>
②Dim spot（LCD/TP/Polarizer dim dot, light leakage、dark spot）
<table>
<tr><th rowspan="2">Zone<br>Size (mm)</th><th colspan="3">Acceptable Quality</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Φ≤0.1</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.10<Φ≤0.25</td><td colspan="2">3( distance≧10mm)</td></tr>
<tr><td>0.25<Φ≤0.40</td><td colspan="2">2</td></tr>
<tr><td>Φ＞0.40</td><td colspan="2">0</td></tr>
</table>
③ Polarizer accidented spot
<table>
<tr><th rowspan="2">Zone<br>Size (mm)</th><th colspan="3">Acceptable Quality</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Φ≤0.2</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td>0.2<Φ≤0.5</td><td colspan="2">2( distance≧10mm)</td></tr>
<tr><td>Φ>0.5</td><td colspan="2">0</td></tr>
</table></td></tr>
<tr><td>Line defect (LCD/TP /Polarizer black/white line, scratch, stain)</td><td>
<table>
<tr><th rowspan="2">Width(mm)</th><th rowspan="2">Length(mm</th><th colspan="3">Acceptable Quality</th></tr>
<tr><th>A</th><th>B</th><th>C</th></tr>
<tr><td>Φ≤0.03</td><td>Ignore</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr>
<tr><td>0.03<W≤0.05</td><td>L≤3.0</td><td colspan="2">N≤2</td></tr>
<tr><td>0.05<W≤0.08</td><td>L≤2.0</td><td colspan="2">N≤2</td></tr>
<tr><td>0.08<W</td><td colspan="4">Define as spot defect</td></tr>
</table></td></tr>
</table>

<table>
<tr><td>3.0</td><td>Polarizer Bubble</td><td>
<table>
<tr><td rowspan="2">Zone<br>Size (mm)</td><td colspan="3">Acceptable Qty</td></tr>
<tr><td>A</td><td>B</td><td>C</td></tr>
<tr><td>Φ≤0.2</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.2<Φ≤0.4</td><td colspan="2">3(distance≧10 m)</td></tr>
<tr><td>0.4<Φ≤0.6</td><td colspan="2">2</td></tr>
<tr><td>0.6<Φ</td><td colspan="2">0</td></tr>
</table>
</td></tr>
<tr><td>4.0</td><td>SMT</td><td>According to IPC-A-610C class Ⅱ standard . Function defect and missing part are major defect ,the others are minor defect.</td></tr>
</table>

<table>
<tr><td rowspan="3">5.0</td><td rowspan="3">TP Related</td><td>TP bubble/ accidented spot</td><td>
<table>
<tr><td rowspan="2">Size Φ(mm)</td><td colspan="3">Acceptable Qty</td></tr>
<tr><td>A</td><td>B</td><td>C</td></tr>
<tr><td>Φ≤0.1</td><td colspan="2">Ignore</td><td rowspan="4">Ignore</td></tr>
<tr><td>0.1<Φ≤0.25</td><td colspan="2">3（distance≧</td></tr>
<tr><td>0.25<Φ≤0.3</td><td colspan="2">2</td></tr>
<tr><td>0.3<Φ</td><td colspan="2">0</td></tr>
</table>
</td></tr>
<tr><td>Assembly deflection</td><td>beyond the edge of backlight ≤0.15mm</td></tr>
<tr><td>Newton Ring</td><td>Newton Ring area>1/3 TP area NG<br>Newton Ring area≤1/3 TP area OK</td><td> 
</td></tr>
</table>

<table>
<tr>
<td></td>
<td></td>
<td>TP corner broken<br>X：length<br>Y：width<br>Z：height</td>
<td>
<table>
<tr><td>X</td><td>Y</td><td>Z</td></tr>
<tr><td>X≤3.0mm</td><td>Y≤3.0mm</td><td>Z<LCD thickness</td></tr>
</table>
* Circuitry broken is not allowed.
</td>
<td> 
</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TP edge broken<br>X：length<br>Y：width<br>Z：height</td>
<td>
<table>
<tr><td>X</td><td>Y</td><td>Z</td></tr>
<tr><td>X≤6.0mm</td><td>Y≤2.0mm</td><td>Z<LCD thickness</td></tr>
</table>
* Circuitry broken is not allowed.
</td>
<td> 
</td>
</tr>
</table>

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 | 70℃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 | - |
| ESD test | 150pF, 330Ω , ±6KV(Contact)/± 8KV(Air), 5 points/panel, 10 times/point | 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, 66㎝(MEDIUM BOX) | 1box | 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 ℃ 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----------