

|                     |                      |
|---------------------|----------------------|
| <b>Customer</b>     |                      |
| <b>Customer NO.</b> | <b>PV09705W0230E</b> |
| <b>Approve By</b>   |                      |

**For Solution ---9.7 inch ;1024(W)XRGBX768(H)**

**Owner:**

**Version: V01**

**Document ID: PV09705W0230E**

**Approved by**

## Record of Revisions

| Rev | Date                        | Sub-Model     | Description of change                               |
|-----|-----------------------------|---------------|---|
| V01 | July 6 <sup>th</sup> , 2020 | PV09705W0230E | Preliminary Product Specification was first issued. |

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# 1. General description

## 1.1 Introduction

PV09705W0230E is a color active matrix thin film transistor (TFT) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching device. This model is composed of a TFT LCD panel, a driving circuit and a back light system. This TFT LCD has a 9.7 inch 4:3 diagonally measured active display area with XGA (1024 horizontal by 768 vertical pixel) resolution.

## 1.2 Features

9.7 inch configuration

6bit LVDS interface

LED Backlight

RoHS Compliance

## 1.3 Applications

Personal Navigation Device

Multimedia applications and Others AV system

## 1.4 General information

| Item              | Specification                | Unit   |
|-------------------|------------------------------|--------|
| Outline Dimension | 210.2 x 162.7 x 2.8(Typ.)    | mm     |
| Display area      | 196.608(H) x 147.456(V)      | mm     |
| Number of Pixel   | 1024 RGB(H) x 768(V)         | pixels |
| Pixel pitch       | 0.192 (H) x 0.192(V)         | mm     |
| Pixel arrangement | RGB Vertical stripe          |        |
| Display mode      | Normally black               |        |
| Surface treatment | Antiglare, Hard-Coating(3H)  |        |
| Weight            | 250                          | g      |
| Back-light        | Single LED (Side-Light type) |        |
| Power Consumption | 3.36                         | w      |

## 1.5 Mechanical Information

| item        | Min.          | Typ.  | Max.  | Unit  |    |
|-------------|---------------|-------|-------|-------|----|
| Module Size | Horizontal(H) | 210.0 | 210.2 | 210.5 | mm |
|             | Vertical(V)   | 162.5 | 162.7 | 162.9 | mm |
|             | Depth(D)      | 2.6   | 2.8   | 3.0   | mm |

## 2.0 ABSOLUTE MAXIMUM RATINGS

### 2.1 Electrical Absolute Rating

#### 2.1.1 TFT LCD Module

| Item                     | Symbol | Min. | Max. | Unit. | Note  |
|--------------------------|--------|------|------|-------|-------|
| Power supply voltage     | Vcc    | -0.3 | 5.0  | V     | GND=0 |
|                          | Vin    | -0.5 | 5.0  | V     | GND=0 |
|                          |        |      |      |       |       |
|                          |        |      |      |       |       |
| Logic Signal Input Level |        |      |      |       |       |

#### 2.1.2 Back-Light Unit

| Item              | Symbol | MIN. | TYP. | MAX. | Unit | Note       |
|-------------------|--------|------|------|------|------|------------|
| Forward voltage   | Vf     | --   | 19.2 | 21.0 | V    | (1)(2)(3)  |
| Forward current   | If     | --   | 120  |      | mA   | (1)(2) (3) |
| Power Consumption | PBL    | --   | 2304 |      | mW   |            |

**Note:**

(1) Permanent damage may occur to the LCD module if beyond this specification. Functional operation should be restricted to the conditions described under normal operating conditions.

(2) Ta =25 ±2°C

(3) Test Condition: LED current 140 mA

### 2.2 Environment Absolute Rating

| Item                  | Symbol | Min. | Max. | Unit | Remarks |
|-----------------------|--------|------|------|------|---------|
| Operating Temperature | Topa   | -20  | +70  | °C   |         |
| Storage Temperature   | Tstg   | -30  | +80  | °C   |         |

## 3.0 OPTICAL CHARACTERISTICS

### 3.1 Optical specification:

| Item                              | Symbol   | Temp.        | Min.                                   | Typ.  | Max.   | Unit              | Condition  |
|-----------------------------------|----------|--------------|--|-------|--|-------------------|--|
| Response Time                     | Tg       | 25°C         | --                                     | 20    | 25   | msec              | $\theta = 0^\circ, \varphi = 0^\circ$ (Note 1,3)                 |
|                                   |          | 25°C         | --                                     |       |  |                   |  |
| Contrast Rate                     | Cr       | 25°C         | 700                                    | 900   | --   | --                | $\theta = 0^\circ, \varphi = 0^\circ$ LED:ON, LIGHT:OFF(Note1,2) |
| Brightness                        | YL       | 25°C         | 300                                    | 350   |  | Cd/m <sup>2</sup> | (IL=120mA)(Note1,4)  |
| Visual angle range front and rear | $\theta$ | 25°C         | ( $\theta$ L ) 85<br>( $\theta$ R ) 85 |       |  | De-gree           | $\phi = 0^\circ, CR \geq 10$ LED:ON LIGHT:OFF(Note 1,4)          |
| Visual angle range left and right | $\theta$ | 25°C         | ( $\theta$ U ) 85<br>( $\theta$ D ) 85 |       |  | De-gree           | $\phi = 90^\circ, CR \geq 10$ LED:ON LIGHT:OFF(Note 1,4)         |
| Brightness uniformity             | BUNI     |              | 70                                     |       |  | %                 | $\Theta = 0$ (Note5,7)   |
| Item                              | Symbol   | Transmissive |  |       | Conditions   |                   |  |
|                                   |          | Min.         | Typ.                                   | Max.  |  |                   |  |
| Red                               | XR       |              |  |       | Reference:<br>LCD Panel,<br>CIE (x, y)<br>chromaticity<br>(Note 1,4) |                   |  |
|                                   | YR       |              |  |       |  |                   |  |
| Green                             | XG       |              |  |       |  |                   |  |
|                                   | YG       |              |  |       |  |                   |  |
| Blue                              | XB       |              |  |       |  |                   |  |
|                                   | YB       |              |  |       |  |                   |  |
| White                             | XW       | 0.246        | 0.296                                  | 0.346 |  |                   |  |
|                                   | YW       | 0.286        | 0.336                                  | 0.386 |  |                   |  |

### 3.2 Measuring Condition

Measuring surrounding: dark room ,LED current IL : 120mA

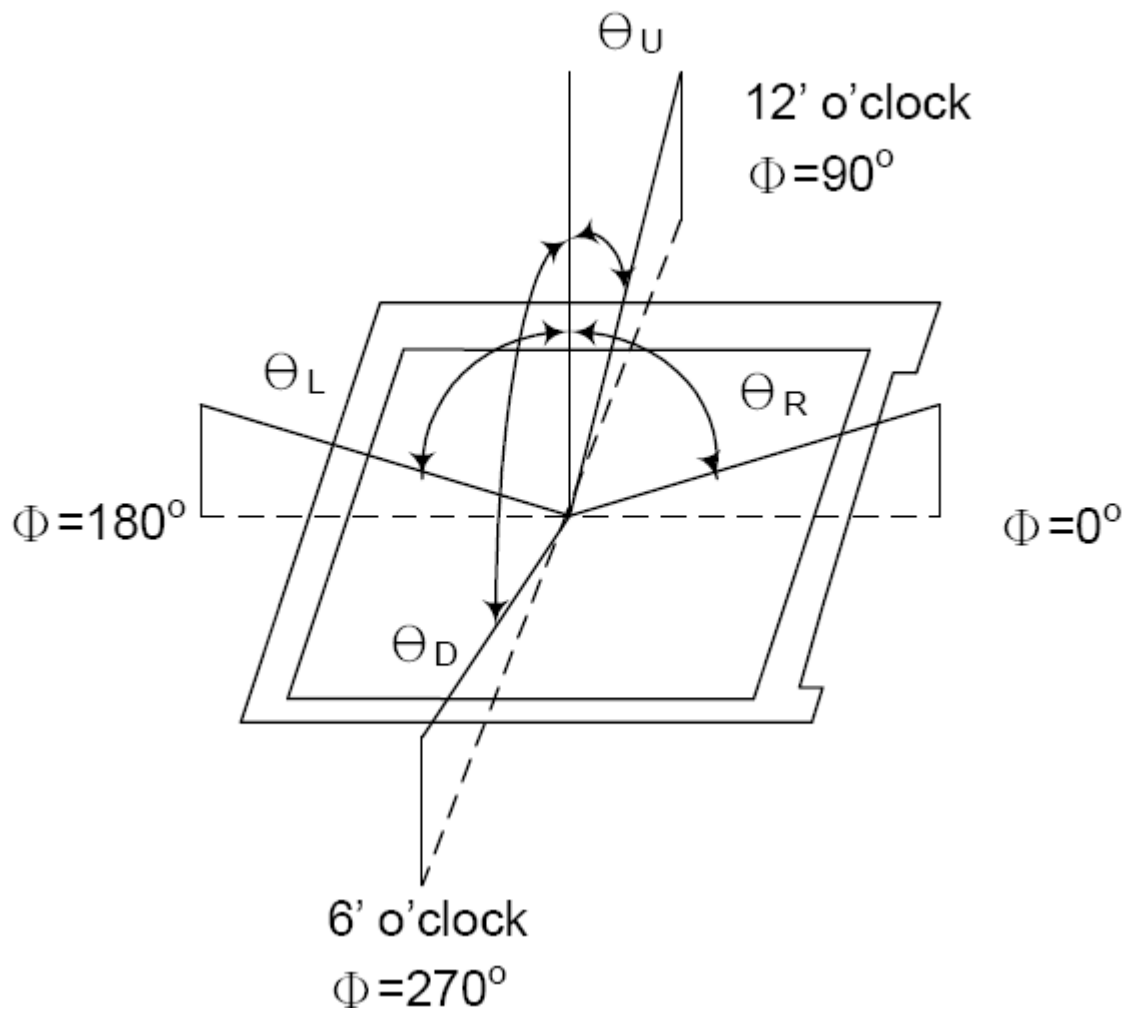
Ambient temperature: 25±2oC

15min. warm-up time.

### 3.3 Measuring Equipment

FPM520 of Westar Display technologies, INC., which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics. Measuring spot size: 20 ~ 21 mm

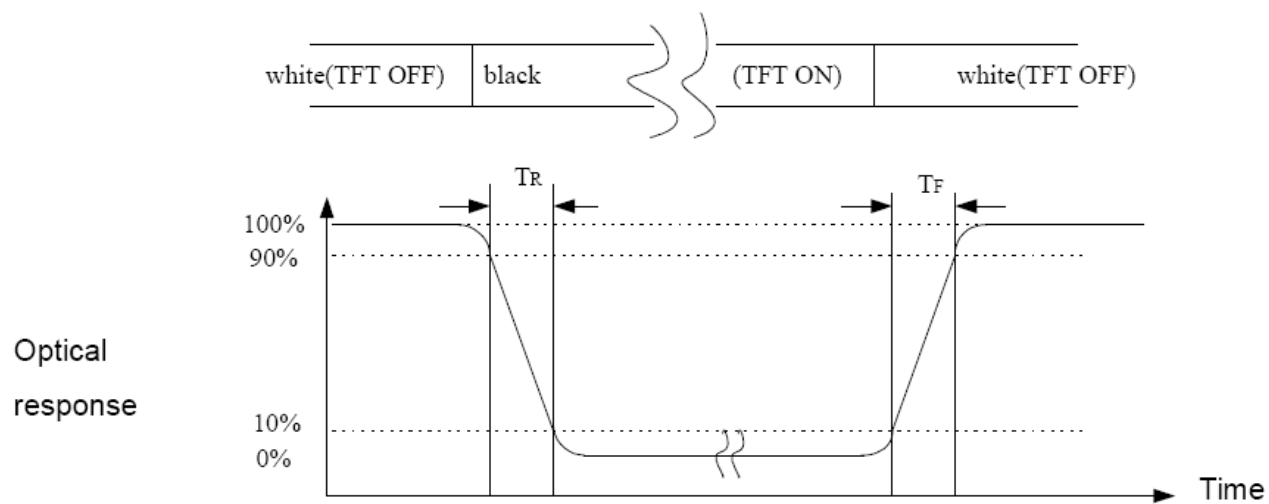
Note (1) Definition of Viewing Angle :



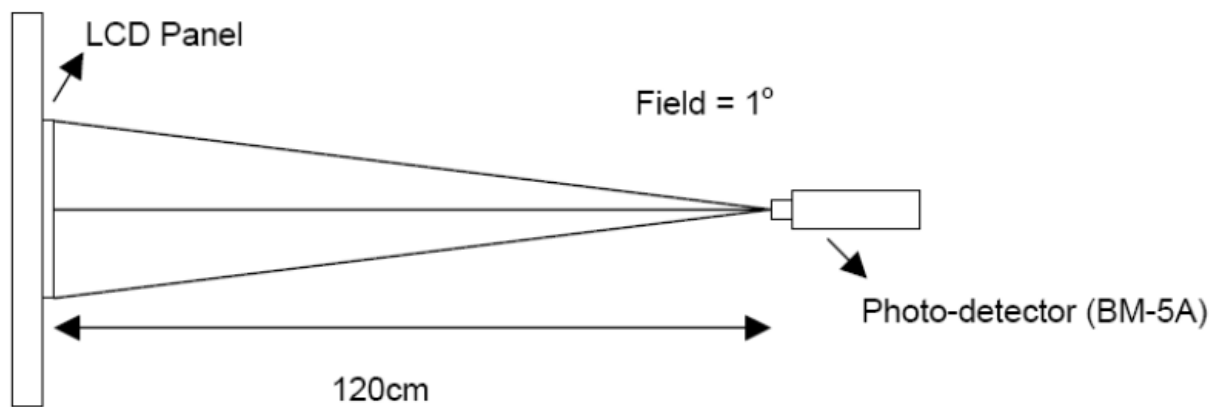
**Note (2) Definition of Contrast Ratio (CR):**  
**Measured at the center point of panel**

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

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

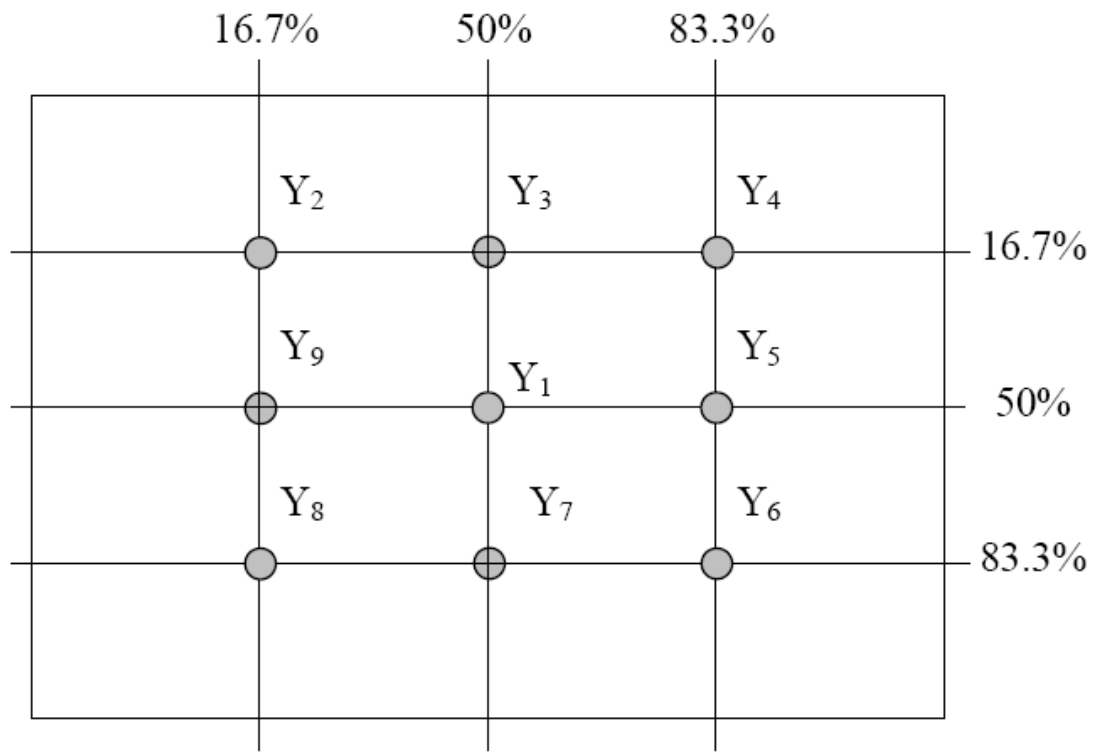


**Note (4) Definition of optical measurement setup**





**Note (5) Definition of brightness uniformity**



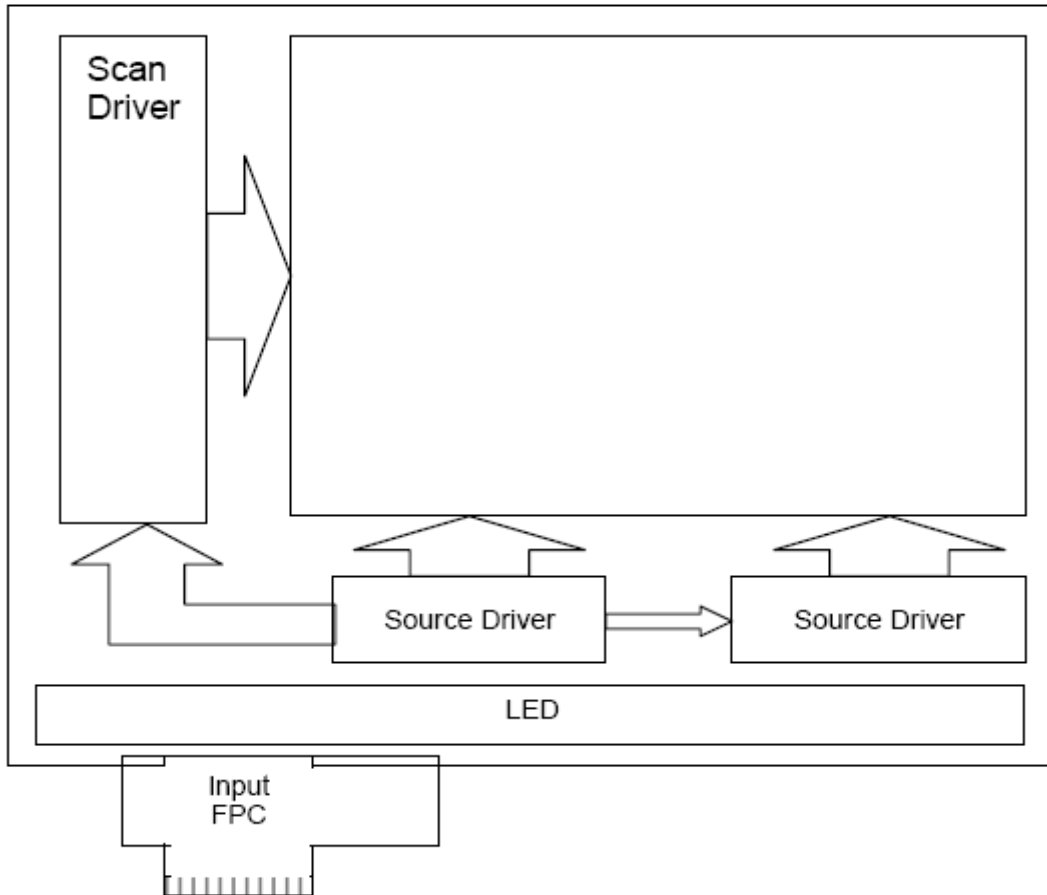
$$\text{Luminance uniformity} = \frac{(\text{Min Luminance of 9 points})}{(\text{Max Luminance of 9 points})} \times 100\%$$

**Note (6) Rubbing Direction (The different Rubbing Direction will cause the different optimal view direction).**

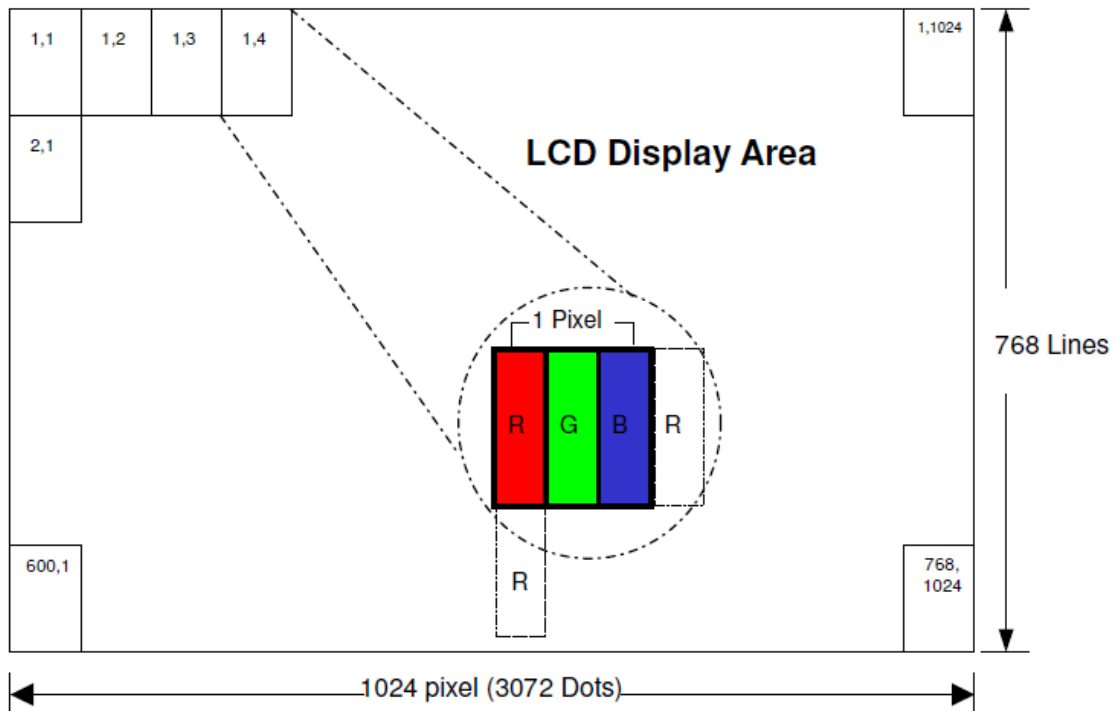
**Note (7) Measured at the brightness of the panel when all terminals of LCD panel are electrically open.**

## 4.0 BLOCK DIAGRAM

### 4.1 TFT LCD Module



### 4.2 Pixel Block



## 5.0 INTERFACE PIN CONNECTION

### 5.1 LVDS Pin assignment and the Connector type : MSAK240P30

| Pin No. | Symbol     | I/O | Function                          | Remark |
|---------|------------|-----|-----------------------------------|--------|
| 1       | GND        | P   | Ground                            |        |
| 2       | VCC        | P   | Power Voltage for digital circuit |        |
| 3       | VCC        | P   | Power Voltage for digital circuit |        |
| 4       | VEEDID     | P   | DDC 3.3V                          |        |
| 5       | GSP        | --  | Not connected                     |        |
| 6       | CLK EEDID  | I   | DDC clock                         |        |
| 7       | Data EEDID | I   | DDC data                          |        |
| 8       | RXIN0-     | I   | - LVDS differential data input    |        |
| 9       | RXIN0+     | I   | + LVDS differential data input    |        |
| 10      | GND        | P   | Power ground                      |        |
| 11      | RXIN1-     | I   | - LVDS differential data input    |        |
| 12      | RXIN1+     | I   | + LVDS differential data input    |        |
| 13      | GND        | P   | Power ground                      |        |
| 14      | RXIN2-     | I   | - LVDS differential data input    |        |
| 15      | RXIN2+     | I   | + LVDS differential data input    |        |
| 16      | GND        | P   | Ground                            |        |
| 17      | RXCLKIN-   | I   | - LVDS differential clock input   |        |
| 18      | RXCLKIN+   | I   | + LVDS differential clock input   |        |
| 19      | GND        | P   | Ground                            |        |
| 20      | NC         | -   | Not connected                     |        |
| 21      | LED+       | P   | LED Anode                         |        |
| 22      | LED+       | P   | LED Anode                         |        |
| 23      | NC         | --  | Not connect                       |        |
| 24      | LED-       | P   | LED cathode                       |        |
| 25      | LED-       | P   | LED cathode                       |        |
| 26      | LED-       | P   | LED cathode                       |        |
| 27      | LED-       | P   | LED cathode                       |        |

|    |      |    |               |  |
|----|------|----|---------------|--|
| 28 | LED- | P  | LED cathode   |  |
| 29 | LED- | P  | LED cathode   |  |
| 30 | NC   | -- | Not connected |  |

**Note1:**

**I :Input Pin, O: Output Pin, P: Power/Ground ,N: No connected**

Input voltage include  $R_{IN\ 0-}/R_{IN\ 0+}$ 、 $R_{IN\ 1-}/R_{IN\ 1+}$ 、 $R_{IN\ 2-}/R_{IN\ 2+}$ 、 $Clk_{IN-}/Clk_{IN+}$  .  
 Ta means the ambient temperature.  
 It is necessary to limit the relative humidity to the specified temperature range.  
 Condensation on the module is not allowed.

## 6.0 ELECTRICAL CHARACTERISTICS

### 6.1 TFT LCD Module

| Item                    | Symbol | Min.   | Type | Max.   | Unit. | Note            |
|-------------------------|--------|--------|------|--------|-------|-----------------|
| Power supply voltage    | VCC    | 3.0    | 3.3  | 3.6    | V     | GND=0           |
|                         |        |        |      |        |       | GND=0           |
|                         |        |        |      |        |       | GND=0           |
|                         |        |        |      |        |       |                 |
| Input signal voltage    | Vih    | 0.7Vcc |      | Vcc    | V     |                 |
|                         | Vil    | 0      |      | 0.3Vcc | V     |                 |
| Current of Power Supply | Idvdd  | --     | 271  | --     | mA    | Vcc=3.3V        |
|                         | Iadd   | --     |      | --     | mA    | AVdd=10V(Black) |
|                         | Igh    | --     |      | --     | mA    | Vgh=15V         |
|                         | Igl    | --     |      | --     | mA    | Vgl=-7V         |
| Input level of V1-V5    |        |        |      |        |       |                 |
| Input level of V6-V10   |        |        |      |        |       |                 |
| LED Reverse Voltage     | Vr     | -      |      | (5)    |       | Each LED        |
| LED Forward Current     | If     | -      |      | (35)   | V     | Each LED        |

## 6.2 Back-Light Unit

The backlight system is an edge-lighting type with 36 LED.

The characteristics of the LED are shown in the following tables.

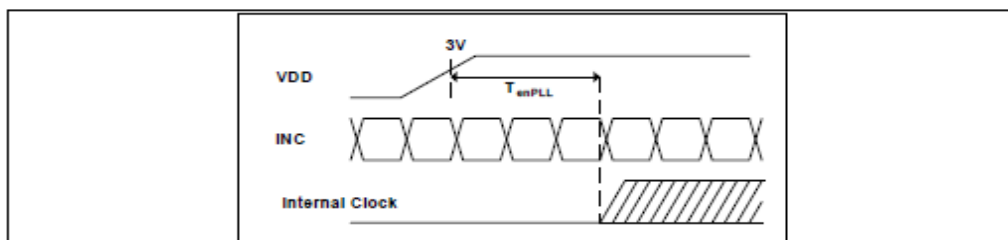
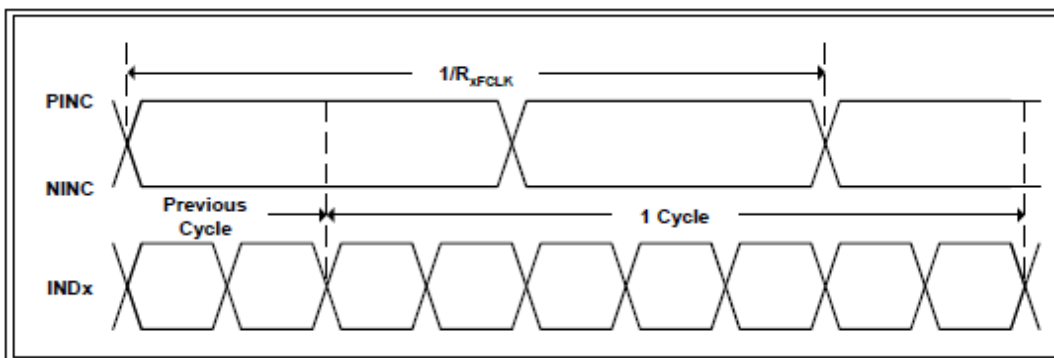
| Item                    | Symbol | Min.  | Typ. | Max. | Unit | Note   |
|-------------------------|--------|-------|------|------|------|--------|
| LED current             | IL     | -     | 120  | -    | mA   | (2)    |
| LED Voltage             | VL     | -     | 19.2 | 21.0 | V    |        |
| Operating LED life time | Hr     | 50000 | -    | -    | Hour | (1)(2) |

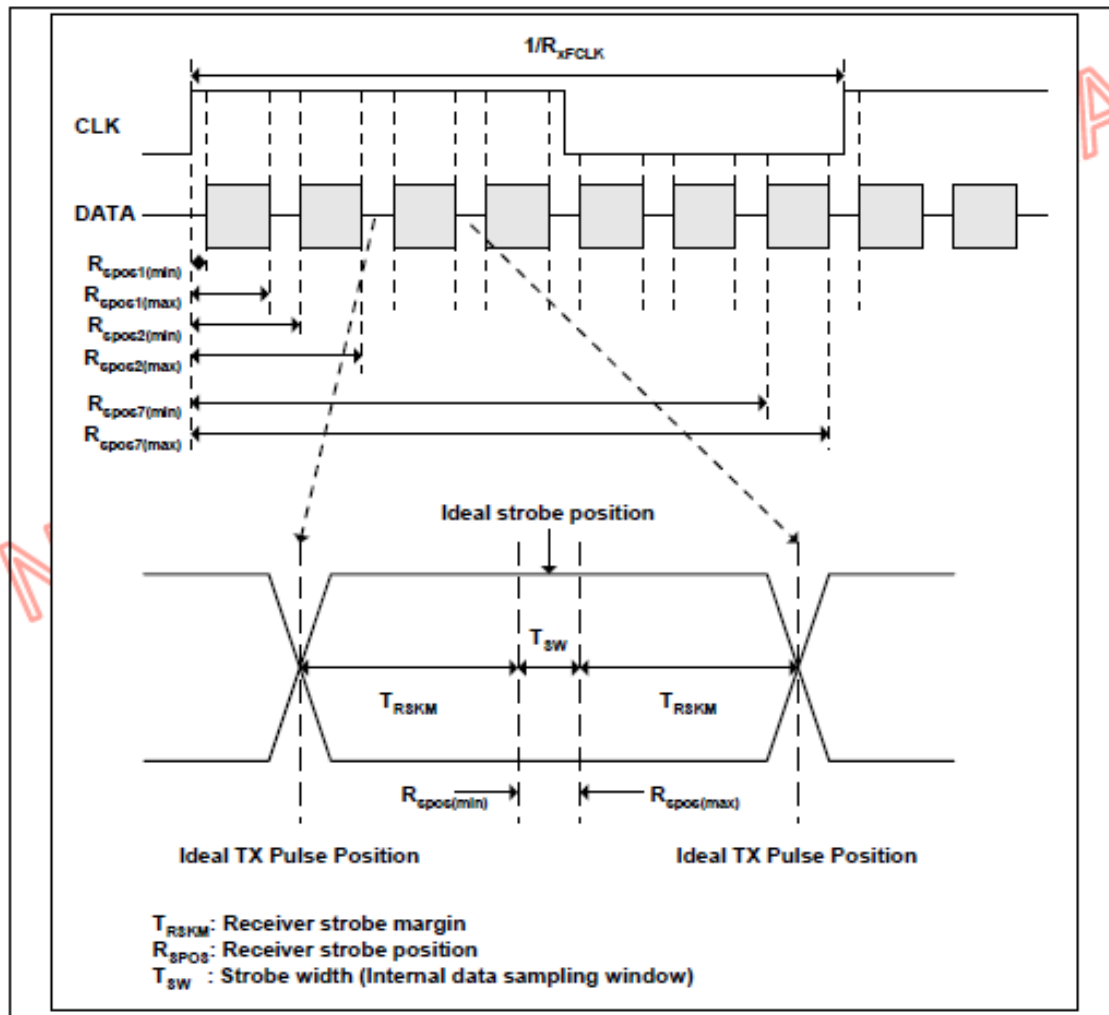
Note (1) LED life time (Hr) can be defined as the time in which it continues to operate under the condition:  $T_a=25\pm 3\text{ }^\circ\text{C}$ , typical IL value indicated in the above table until the brightness becomes less than 50%.

Note (2) The “LED life time” is defined as the module brightness decrease to 50% original brightness at  $T_a=25^\circ\text{C}$  and  $IL=140\text{mA}$ . The LED lifetime could be decreased if operating IL is larger than 140mA. The constant current driving method is suggested.

## 6.3 AC Electrical characteristics

| Parameter              | Symbol      | Min. | Typ.                | Max. | Unit | Condition   |
|------------------------|-------------|------|---------------------|------|------|---|
| Clock frequency        | $R_{xFCLK}$ | 20   |                     | 71   | MHz  |   |
| Input data skew margin | $T_{RSKM}$  | 500  |                     |      | pS   | $ V_{ID}  = 400\text{mV}$<br>$R_{XVCM} = 1.2\text{V}$<br>$R_{xFCLK} = 71\text{MHz}$ |
| Clock high time        | $T_{LVCH}$  |      | $4/(7 * R_{xFCLK})$ |      | ns   |   |
| Clock low time         | $T_{LVCL}$  |      | $3/(7 * R_{xFCLK})$ |      | ns   |   |
| PLL wake-up time       | $T_{enPLL}$ |      |                     | 150  | uS   |   |





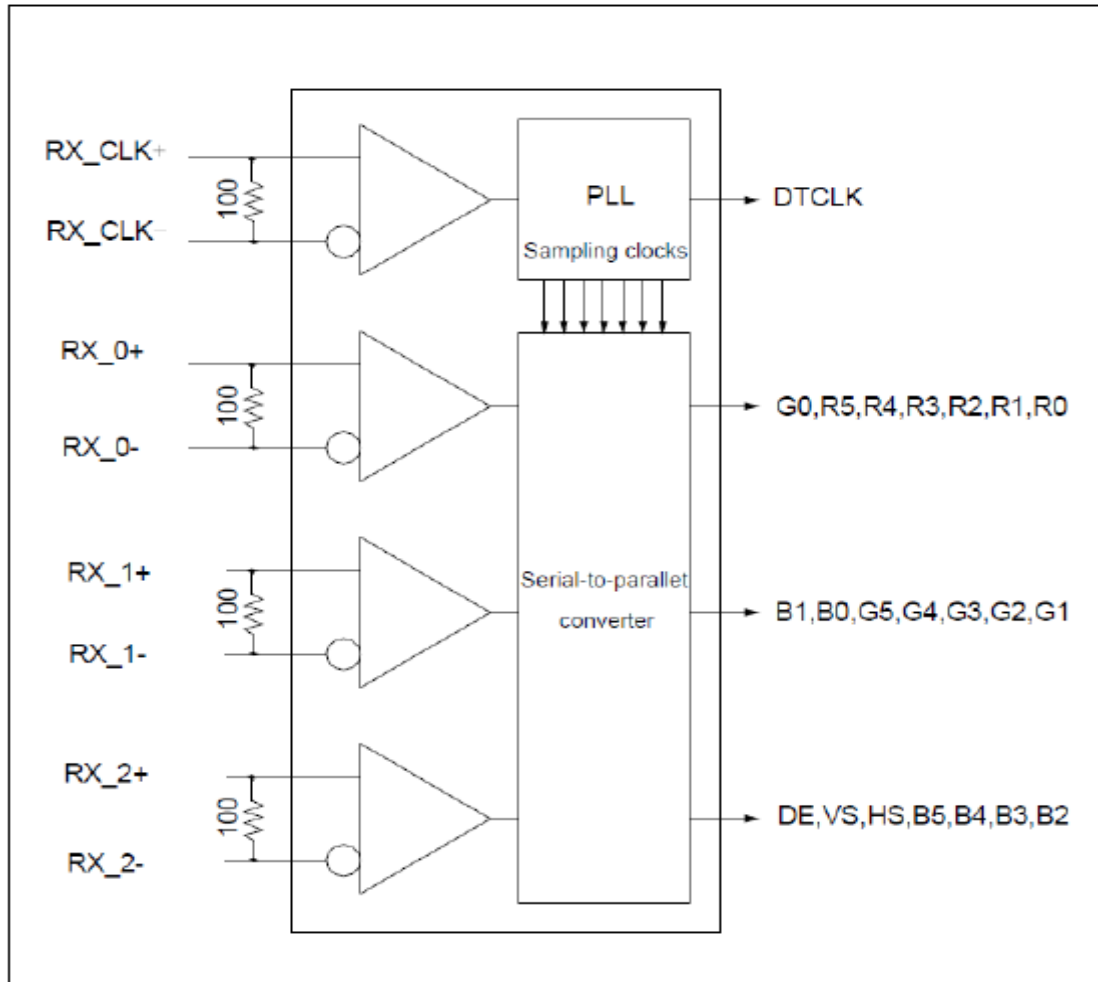
| SSC tolerance of LVDS receiver |                      |                                     |      |      |         |       |
|--------------------------------|----------------------|-------------------------------------|------|------|---------|-------|
| Symbol                         | parameter            | condition                           | Min. | Typ. | Max.    | Units |
| SSCMF                          | Modulation Frequency |                                     | 23   |      | 93      | KHz   |
| SSCMR                          | Modulation Rate      | LVDS clock = 71MHz<br>center spread |      |      | $\pm 3$ | %     |

## Output timing table

| Parameter                      | Symbol | Min. | Typ. | Max. | Unit | Conditions       |
|--------------------------------|--------|------|------|------|------|------------------|
| DCLK Frequency                 | Fclk   | -    | 65   | 71   | MHz  | VDD = 2.3V ~3.6V |
| DCLK Cycle Time                | Tclk   | 14.1 | 15.4 | -    | ns   |                  |
| DCLK Pulse Duty                | Tcwh   | 40   | 50   | 60   | %    | Tclk             |
| Time from HSD to Source Output | Thso   | -    | 64   | -    | DCLK |                  |
| Time from HSD to LD            | Thld   | -    | 64   | -    | DCLK |                  |
| Time from HSD to STV           | Thstv  | -    | 2    | -    | DCLK |                  |
| Time from HSD to CKV           | Thckv  | -    | 20   | -    | DCLK |                  |
| Time from HSD to OEV           | Thoev  | -    | 4    | -    | DCLK |                  |
| LD Pulse Width                 | Twld   | -    | 10   | -    | DCLK |                  |
| CKV Pulse Width                | Twckv  | -    | 66   | -    | DCLK |                  |
| OEV Pulse Width                | Twoev  | -    | 74   | -    | DCLK |                  |

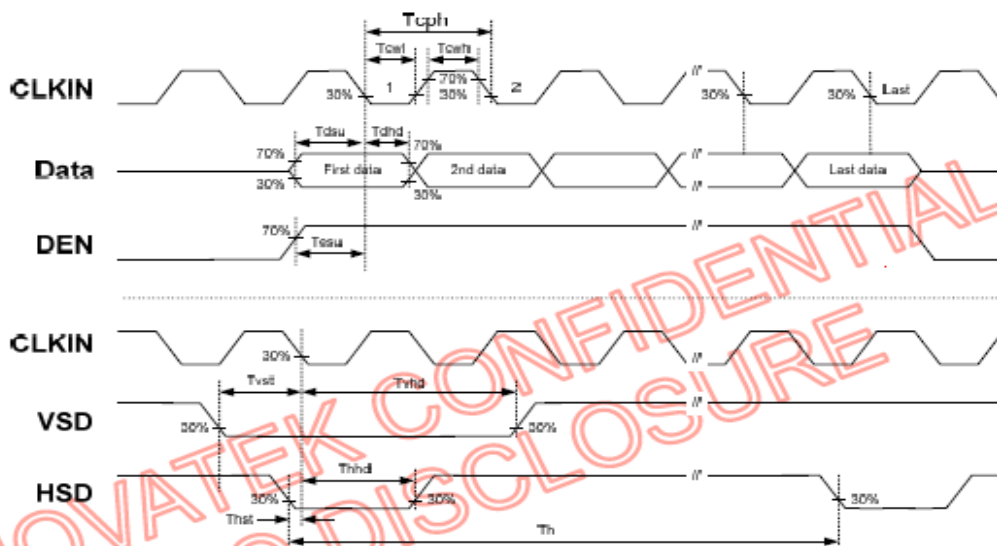
## Data Map

### LVDS Receiver internal Circuit



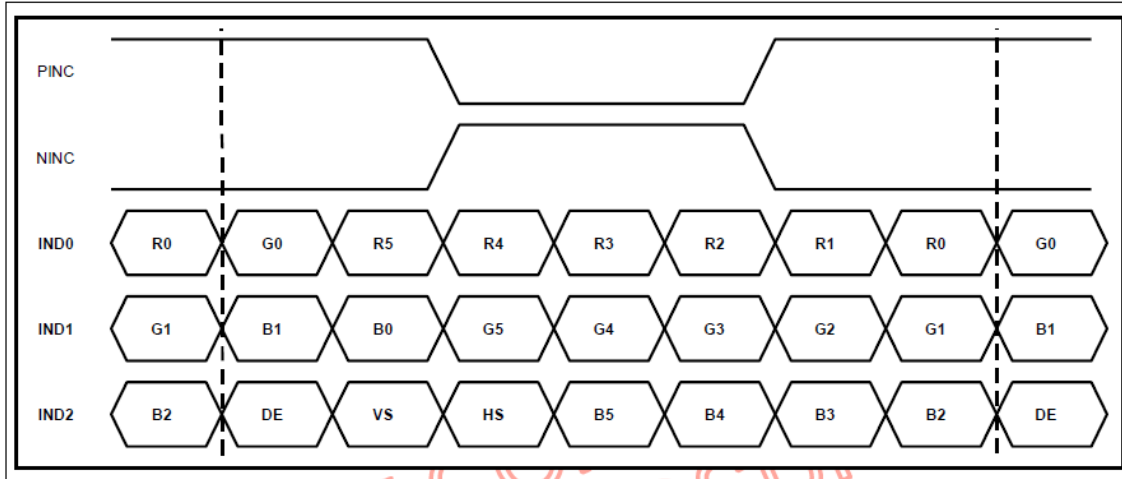
## 6.4 Timing Diagram

### Input Clock and Data Timing Diagram



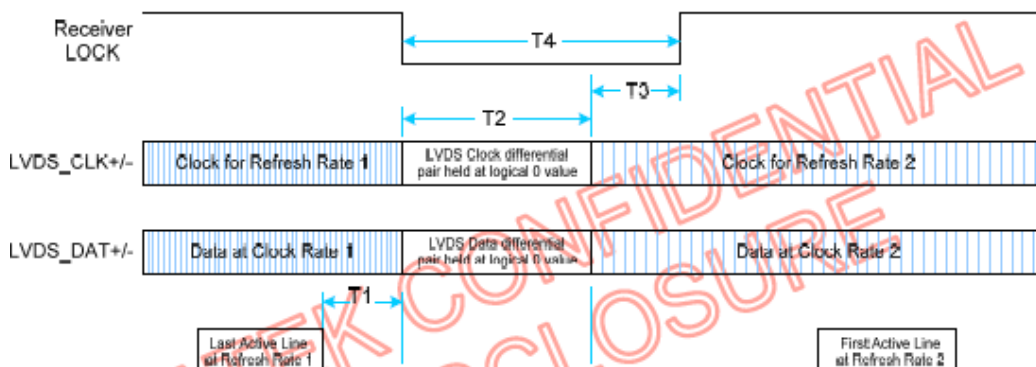
## 6.5: Data input format for LVDS.

### 6bit LVDS input



### SDRRS (seamless display refresh rate switching)

When Showing the still picture, it is accept to reduce the refresh rate from 60Hz to low refresh rate (for example 40Hz). The purpose is mainly for power saving. INTEL defined a timing chart switch between different refresh rate. Following this timing chart, the switch between different refresh rates is seamless for end user.



T1 - Min delay from start of vert blank to start of timing change: 2 lines (HSYNC periods)

T2 - Max delay for clock to transition to new frequency: 100us

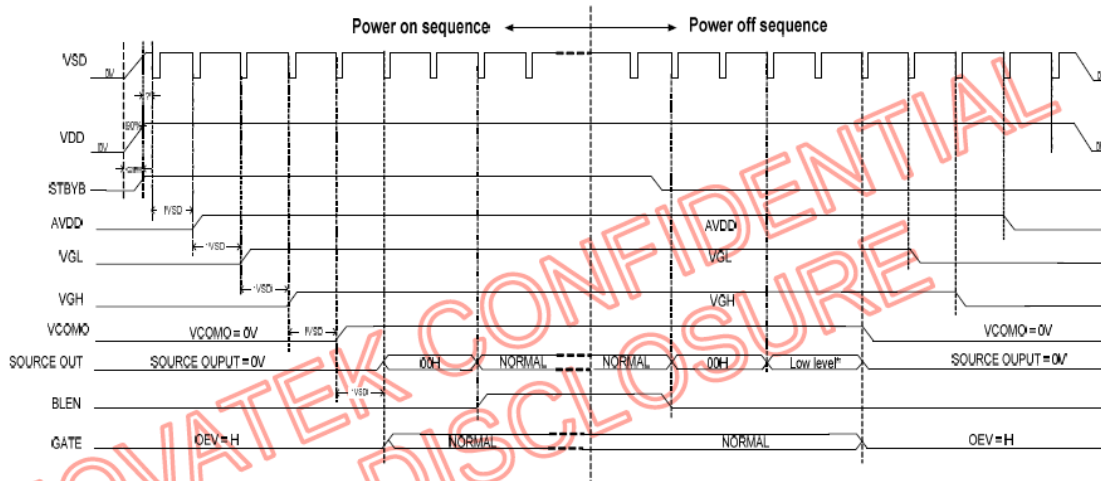
T3 - Max receiver lock delay from stable clock: Display specific (TBD)

T4 - Max period during which panel maintains display (T2+T3): Display specific (TBD)

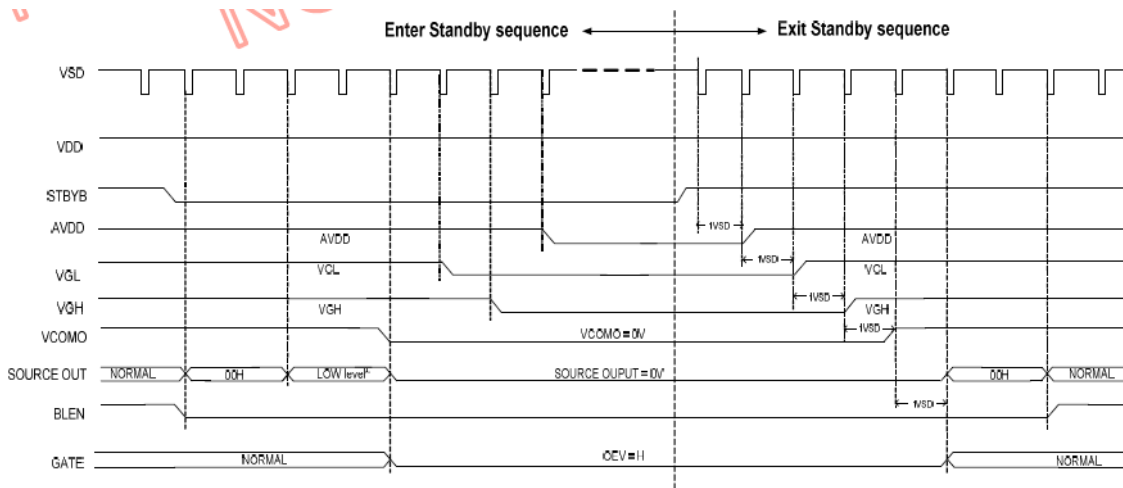


## 6.6 Power Sequence

### Power On/ Power off:



## 6.7 Enter and Exit standby mode sequence:



## 7.0 Reliability test items

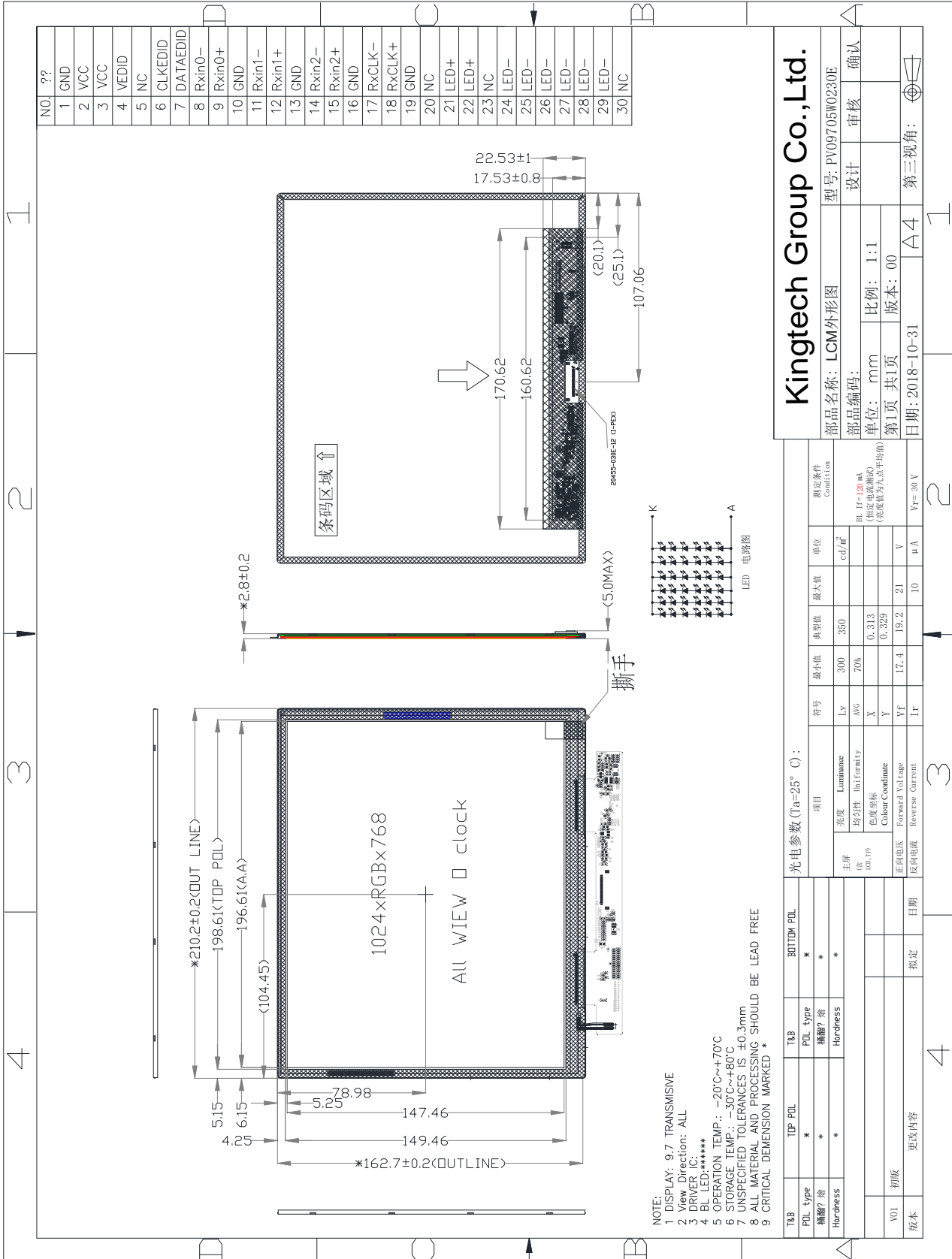
| NO. | Item  | Conditions  | Remark  |
|-----|---|---|---|
| 1   | High Temperature Storage                      | Ta=+80℃,240hrs  | <b>Inspection</b><br>after 2~4 hours storage at room temperature, the sample shall be free from defects<br>1. Air bubble in the LCD<br>2. Sealleak<br>3. non-display<br>4. missing segments<br>5. glass crack<br>6. current idd is twice higher than initial value. |
| 2   | Low Temperature Storage                       | Ta=-30℃,240hrs  |   |
| 3   | High Temperature Operation                    | Ta=+70℃,240hrs  |   |
| 4   | Low Temperature Operation                     | Ta=-20℃,240hrs  |   |
| 5   | High Temperature and High Humidity(Operation) | Ta=+60℃, 90%RH, 240hrs  |   |
| 6   | Thermal cycling Test (non operation)          | -20℃(30min)→+70℃(30min),100cycles   |   |
| 7   | Electrostatic discharge                       | 200V 200pf(0ohm) 1time/each terminal  |   |
| 8   | Vibration                                     | 1. Random:<br>1.04 Grms,5~500HZ,<br>X/Y/Z,30min/each direction<br>2. Sine:<br>Freq. Range:8~33.3hz<br>Stoke:1.3mm<br>Sweep:2.9G,33.3~400HZ<br>X/Z:2hr,Y:4hr,cyc:15min |   |
| 9   | Shock   | 100G,6ms,±X, ±Y, ±Z<br>3 times for each direction   | JIS C7021,A-10<br>(Condition)   |
| 10  | Vibration( with carton)                       | Random:0.015G <sup>2</sup> /HZ, 5~200HZ<br>-6dB/octave,200~400HZ<br>XYZ each dirction:2hr   |   |
| 11  | Drop (with carton)                            | Height:60cm<br>1corner,3edges,6surfaces   | JIS Z0202   |

### Note:

1. There is no display function NG issue occurred, all the cosmetic specification is judged before the reliability stress.
2. the test samples should be applied to only one test item
3. for damp proof test, Pure water(resistance>10M ohm)should be used
4. in case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judged as a good part
5. Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Charateristic, Optical Characteristic

# 8.0 OUTLINE DIMENSION

## Outline Dimension:



## **9.0 GENERAL PRECAUTION**

### **9.1 Use Restriction**

**This product is not authorized for use in life supporting systems, aircraft navigation control systems, military systems and any other application where performance failure could be life threatening or otherwise catastrophic.**

### **9.2 Disassembling or Modification**

**Do not disassemble or modify the module. It may damage sensitive parts inside LCD module, and may cause scratches or dust on the display. Kingtech does not warrant the module, if customers disassemble or modify the module.**

### **9.3 Breakage of LCD Panel**

**9.3.1. If LCD panel is broken and liquid crystal spills out, do not ingest or inhale liquid crystal, and do not contact liquid crystal with skin.**

**9.3.2. If liquid crystal contacts mouth or eyes, rinse out with water immediately.**

**9.3.3. If liquid crystal contacts skin or cloths, wash it off immediately with alcohol and rinse thoroughly with water.**

**9.3.4. Handle carefully with chips of glass that may cause injury, when the glass is broken.**

### **9.4 Electric Shock**

**9.4.1. Disconnect power supply before handling LCD module.**

**9.4.2. Do not pull or fold the LED cable.**

**9.4.3. Do not touch the parts inside LCD modules and the fluorescent LED's connector or cables in order to prevent electric shock.**

### **9.5 Absolute Maximum Ratings and Power Protection Circuit**

**9.5.1. Do not exceed the absolute maximum rating values, such as the supply voltage variation, input voltage variation, variation in parts' parameters, environmental temperature, etc., otherwise LCD module may be damaged. 9.5.2. Please do not leave LCD module in the environment of high humidity and high temperature for a long time. 11.5.3. It's recommended to employ protection circuit for power supply.**

### **9.6 Operation**

**9.6.1 Do not touch, push or rub the polarizer with anything harder than HB pencil lead.**

**9.6.2 Use fingerstalls of soft gloves in order to keep clean display quality, when persons handle the LCD module for incoming inspection or assembly.**

**9.6.3 When the surface is dusty, please wipe gently with absorbent cotton or other soft**

material.

**9.6.4 Wipe off saliva or water drops as soon as possible. If saliva or water drops contact with polarizer for a long time, they may causes deformation or color fading.**

**9.6.5 When cleaning the adhesives, please use absorbent cotton wetted with a little petroleum benzine or other adequate solvent.**

## **9.7 Mechanism**

**Please mount LCD module by using mouting holes arranged in four corners tightly.**

## **9.8 Static Electricity**

**9.8.1 Protection film must remove very slowly from the surface of LCD module to prevent from electrostatic occurrence.**

**9.8.2. Because LCD module use CMOS-IC on circuit board and TFT-LCD panel, it is very weak to electrostatic discharge. Please be careful with electrostatic discharge. Persons who handle the module should be grounded through adequate methods.**

## **9.9 Strong Light Exposure**

**The module shall not be exposed under strong light such as direct sunlight. Otherwise, display characteristics may be changed.**

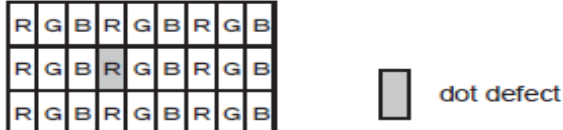
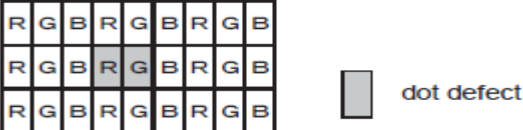
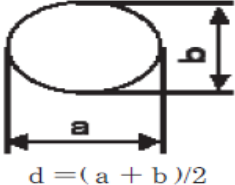
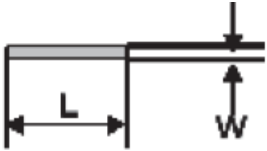
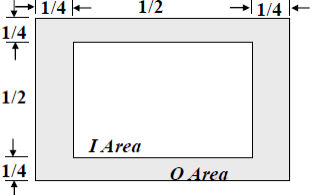
## **9.10 Disposal**

**When disposing LCD module, obey the local environmental regulations.**

## **10. Package Specification**

# 11. Visuals Specification:

## 1) Note

|   |   |  |   |
|---|---|--|---|
| <p><b>General</b></p>                       | <p>1. Customer identified anomalies not defined within this inspection standard shall be reviewed by LowKey, and an additional standard shall be determined by mutual consent.</p> <p>2. This inspection standard about the image quality shall be applied to any defect within the effective viewing area and shall not be applicable to outside of the area.</p> <p>3. Inspection conditions</p> <p>Luminance : 500 Lux min.</p> <p>Inspection distance : 300 mm.</p> <p>Temperature : 25±5°C</p> <p>Direction : Directly above</p> |  |   |
| <p><b>Definition of inspection item</b></p> | <p><b>Dot defect</b></p>  | <p><b>Bright dot defect</b></p>  | <p>The dot is constantly “on” when power applied to the LCD, even when all “Black” data sent to the screen. Inspection tool: 5% Transparency neutral density filter. Count dot: If the dot is visible through the filter. Don’t count dot: If the dot is not visible through the filter.</p>  |
|   |   | <p><b>Black dot defect</b></p>   | <p>The dot is constantly “off” when power applied to the LCD, even when all “White” data sent to the screen.</p>  |
|   |   | <p><b>Adjacent dot</b></p>   | <p>Adjacent dot defect is defined as two or more bright dot defects or black dot defects.</p>   |
| <p><b>External inspection</b></p>           | <p><b>Bubble ,scratch(foreign Particle polarizer, Cell, Backlight)</b></p>  | <p><b>Visible operating (all pixels “Black” or “White”)</b> and non operating.</p>         |   |
|   | <p><b>Appearance inspection</b></p>   | <p>Does not satisfy the value at the spec.</p>   |   |
| <p><b>Others</b></p>                        | <p><b>LED wires</b></p>   | <p>Damaged to the LED wires, connector, pin, functional failure or appearance failure.</p> |   |
| <p><b>Definition of Size</b></p>            | <p><b>Definition of circle :</b>  <b>definition of linear size</b>  <b>definition Area I/O</b> </p>   |  |   |

## 2) Standard

| Classification        |                 | Inspection item   |               | Judgment Standard   |                   |  |
|-----------------------|-----------------|---|---------------|---|-------------------|--|
| Defect (in LCD glass) | Dot defect      | Area  |               | I   | O                 |  |
|                       |                 | Bright dots(Note: Visible under:ND5%)<br>1:D≤0.15mm:No count); D>0.15mm acceptable: 2 |               | N≤2   |                   |  |
|                       |                 | Dark dots (0.15mm<D≤0.3mm), D>0.3mm Not allowable                                     |               | N≤4   |                   |  |
|                       |                 | Bright dot-2Adjacent  |               | N≤0   |                   |  |
|                       |                 | Dark dot-2Adjacent  |               | N≤0   |                   |  |
|                       |                 | Dark or bright dots-3 and more adjacent(note6)  |               | N≤0   |                   |  |
|                       |                 | Total bright and dark dots  |               | N≤4   |                   |  |
|                       |                 | Minimum distance between bright dots  |               | 15mm  |                   |  |
|                       |                 | Minimum distance between dark dots  |               | 5mm   |                   |  |
|                       |                 | Minimum distance between bright and bright dots                                       |               | 5mm   |                   |  |
|                       | Other           | White dot ,dark dot (circle)  | Size (mm)     |   | Acceptable number |  |
|                       |                 |   | d≤0.2         |   | Neglected         |  |
|                       |                 |   | 0.2mm<D≤0.3mm |   | N≤4               |  |
|                       |                 |   | 0.3mm<D≤0.4mm |   | N≤2               |  |
| D>0.4mm               |                 |   | Not allowable |   |                   |  |
| Visual defect         | Foreign partial | Circular foreign material:<br>dark/bright sport                                       |               | Visible under:ND5%<br>1:D≤0.15mm:No count<br>2:0.15mm<D≤0.3mm,N≤4<br>3:D>0.3mm:Not allowable                              |                   |  |
|                       |                 | Linear foreign material:<br>bright or dark line                                       |               | Invisible under ND5%<br>0.1mm<W≤0.3mm,<br>0.3mm<L≤1.5mm,N≤2<br>Visible under ND5%<br>0.05mm≤w≤0.1mm,<br>0.3mm≤L≤0.7mm,N≤1 |                   |  |
|                       | Polarizer       | Linear scratch  |               | 1:BM:No Count<br>2:Pixel area<br>0.05mm≤w≤0.2mm,<br>1.0mm≤L≤5.0mm,N≤2   |                   |  |
|                       |                 | Bubble peeling  |               | 1:BM:No Count<br>2:Pixel area<br>0.15mm≤D<0.3mm,N≤4   |                   |  |
|                       | Mura & leak     |   |               |   | ND5%              |  |