



# PHOENIX DISPLAY INTERNATIONAL, INC.

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## PHOENIX DISPLAY INTERNATIONAL, INC

### SPECIFICATION FOR LCD MODULE

|                    |                          |
|--------------------|--------------------------|
| <b>CUSTOMER</b>    |                          |
| <b>PART NUMBER</b> | PDI090WSI-01             |
| <b>DESCRIPTION</b> | 9.0" 1024 * 3(RGB) * 600 |
| <b>VERSION</b>     | V1.0                     |
| <b>ISSUE DATE</b>  | 10-Jul-17                |

**COMPANY ADDRESS:**

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## 1. OVERVIEW

PDI090WSIE-01 is a 9 inch color TFT-LCD(thin film transistor Liquid Crystal Display) module composed of LCD panel, driver ICs ,control circuit and LED backlight. By applying 1024×600 images are displayed on the 9" diagonal screen. Display 16.2M colors by R.G.B signal input.

General specification are summarized in the following table:

| ITEM                            | SPECIFICATION              |       |       |       |
|---------------------------------|----------------------------|-------|-------|-------|
| Display Area (mm)               | 196.608(W) x 114.15(H)     |       |       |       |
| Number of Pixels                | 1024(H) x 3 (RGB) x 600(V) |       |       |       |
| Pixel Pitch (mm)                | 0.192(W) x 0.19025(H)      |       |       |       |
| Color Pixel Arrangement         | RGB vertical stripe        |       |       |       |
| Display Mode                    | Normally white             |       |       |       |
| Number of Colors                | 16.2M                      |       |       |       |
| Brightness (cd/m <sup>2</sup> ) | 500nit(typ)                |       |       |       |
| Response Time (ms)              | 25ms(typ.)                 |       |       |       |
| Contrast Ratio                  | 500(typ)                   |       |       |       |
| Viewing Angle ( CR ≥ 10)        | 140degree (Horizontal.)    |       |       |       |
|                                 | 120degree (Vertical)       |       |       |       |
| Power Consumption (W)           | 2.943(typ.)                |       |       |       |
| Interface connection            | LVDS                       |       |       |       |
| Module Size (mm)                |                            | Min.  | Typ.  | Max.  |
|                                 | Horizontal (H)             | 210.9 | 211.1 | 211.3 |
|                                 | Vertical (V)               | 126.3 | 126.5 | 126.7 |
|                                 | Depth (D) w/o FPC          | 5.6   | 5.8   | 6.0   |
| Module Weight (g)               | TBD                        |       |       |       |
| Backlight Unit                  | LED                        |       |       |       |
| Surface Treatment               | Anti-Glare, 3H             |       |       |       |

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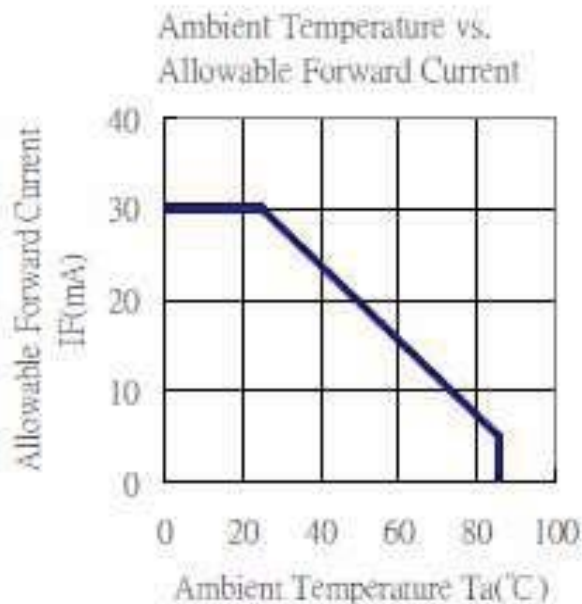
## 2. ABSOLUTE MAXIMUM RATINGS

The following are maximum values which, if exceeded, may cause faulty operation or damage to the unit.

| Item                               | Symbol                                  | Min. | Max.  | Unit | Note       |
|------------------------------------|---|------|-------|------|------------|
| Digital Supply Voltage             | VDD<br>VDD_LVDS                         | -0.3 | 3.96  | V    |            |
| Analog Supply Voltage              | AVDD                                    | -0.5 | 14.85 | V    |            |
| Gate On Voltage                    | VGH                                     | -0.3 | 40    | V    |            |
| Gate Off Voltage                   | VGL                                     | -20  | 0.3   | V    |            |
| Gate On-Gate Off Voltage           | VGH-VGL                                 | -0.3 | 40    | V    |            |
| Signal Input Voltage               | NIN0 ~ NIN3<br>PIN0 ~ PIN3<br>NINC,PINC | -0.5 | 5     | V    |            |
| Forward Current<br>(per LED)       | I <sub>f</sub>                          | -    | 30    | mA   |            |
| Reverse Voltage<br>(per LED)       | VR                                      | -    | 5     | V    |            |
| Pulse forward current<br>(per LED) | I <sub>fp</sub>                         | -    | 80    | mA   | Note 1 - 2 |
| Operation Temperature              | T <sub>op</sub>                         | -20  | 70    | °C   | Note 3     |
| Storage Temperature                | T <sub>stg</sub>                        | -30  | 80    | °C   | Note 3     |

Note 1 : I<sub>fp</sub> Conditions : Duty ≤ 1/10 @ Pulse Width ≤ 10msec

Note 2 : Each one of LED operation must be follow diagram of Ambient Temperature and Allowable Forward Current.



Note 3 : If users use the product out off the environmental operation range ( temperature and humidity ) , it will have visual quality concerns.

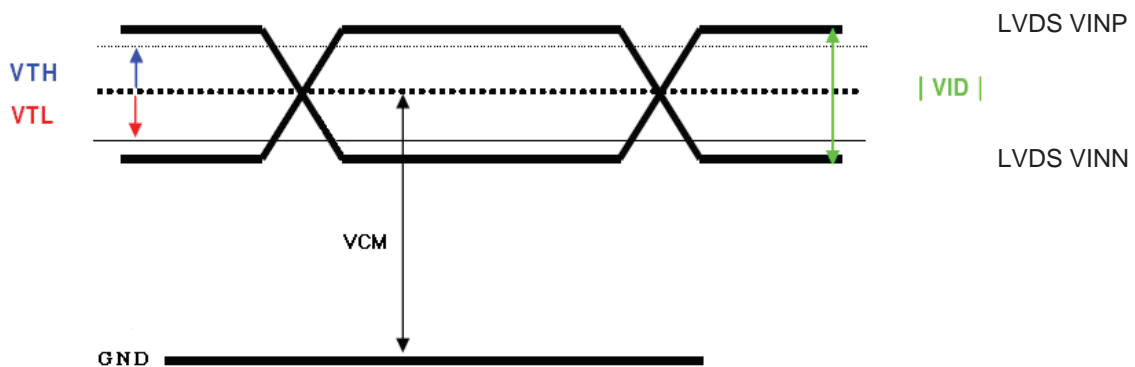
### 3. ELECTRICAL CHARACTERISTICS

#### 3.1 TFT LCD

Ta=25°C

| ITEM                                 | SYMBOL            | MIN               | TYP    | MAX                     | UNIT | NOTE              |
|--------------------------------------|-------------------|-------------------|--------|-------------------------|------|-------------------|
| Digital Power Supply Voltage For LCD | DVDD<br>DVDD_LVDS | 3                 | 3.3    | 3.6                     | V    |                   |
| Logic Input Voltage (LVDS:IN+,IN-)   | VCM               | $\frac{ VID }{2}$ | -      | $2.4 - \frac{ VID }{2}$ | V    | Note1             |
|                                      | VID               | 200               | -      | 600                     | mV   | Note1             |
|                                      | VTH               | -                 | -      | 100                     | mV   | VCM=1.2V<br>Note1 |
|                                      | VTL               | -100              | -      | -                       | mV   |                   |
| Analog Power Supply Voltage          | AVDD              | 8.9               | 9.2    | 9.5                     | V    |                   |
| Gate On Power Supply Voltage         | VGH               | 17                | 18     | 19                      | V    |                   |
| Gate Off Power Supply Voltage        | VGL               | -7                | -6     | -5                      | V    |                   |
| Common Power Supply Voltage          | VCOM              | (3.21)            | (3.41) | (3.61)                  | V    | Note2             |

Note1 : LVDS signal



Note2 : Please adjust VCOM to make the flicker level be minimum.

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### 3.2 TFT-LCD Current Consumption

| Item                    | Symbol | Condition   | Min. | Typ. | Max. | Unit | Note  |
|-------------------------|--------|-------------|------|------|------|------|-------|
| Gate on power current   | IVGH   | VGH =18V    | -    | 0.5  | 1    | mA   | Note1 |
| Gate off power current  | IVGL   | VGL= -6V    | -    | 0.5  | 1    | mA   | Note1 |
| Digital power current   | IVDD   | VDD = 3.3V  | -    | 30   | 40   | mA   | Note1 |
| Analog power current    | IAVDD  | AVDD = 9.2V | -    | 35   | 50   | mA   | Note1 |
| Total Power Consumption | PC     |             | -    | 447  | 636  | mW   | Note1 |

Note1 : Typical: Under 256 gray pattern  
Maximum: Under black pattern



256 gray pattern



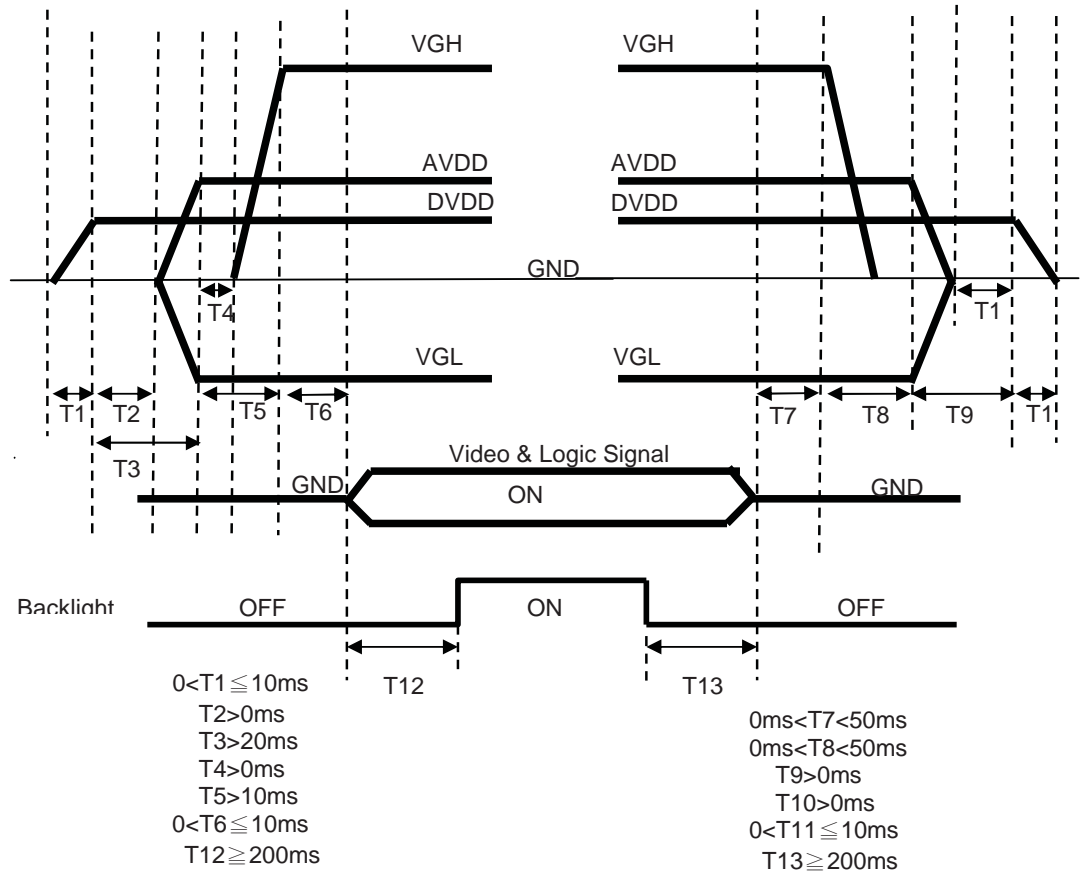
Black Pattern

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### 3.3 Power 、 Signal sequence

Power On : DVDD→AVDD/VGL→VGH→Video & Logic Signal→Backlight

Power Off : Backlight→Video & Logic Signal→VGH→AVDD/VGL→DVDD



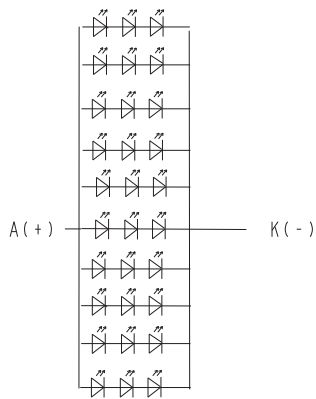
### 3.4 Backlight

Ta=25°C

| ITEM              | SYMBOL | CONDITIONS               | MIN   | TYP   | MAX  | UNIT | NOTE |
|-------------------|--------|--------------------------|-------|-------|------|------|------|
| LED current       | IL     | Ta=25°C<br>(20mA/serise) | --    | 260   | --   | mA   |      |
| LED voltage       | VL     | Ta=25°C<br>(20mA/serise) | 8.5   | 9.3   | 10.5 | V    |      |
| Power consumption | WL     | Ta=25°C<br>(20mA/serise) | --    | 2.418 | --   | W    |      |
| LED Lifetime      | -      | Ta=25°C<br>IF=20mA       | 20000 | --    | --   | Hr   |      |

Remarks :

\*1) LED Circuit Diagram



\*2) A : Anode(+) , K : Cathode(-)

\*3) Suggestion: Using the constant current control to avoid the leakage light and brightness quality issue.

\*4) Definition of Led lifetime : Luminance < Initial luminance 50%.

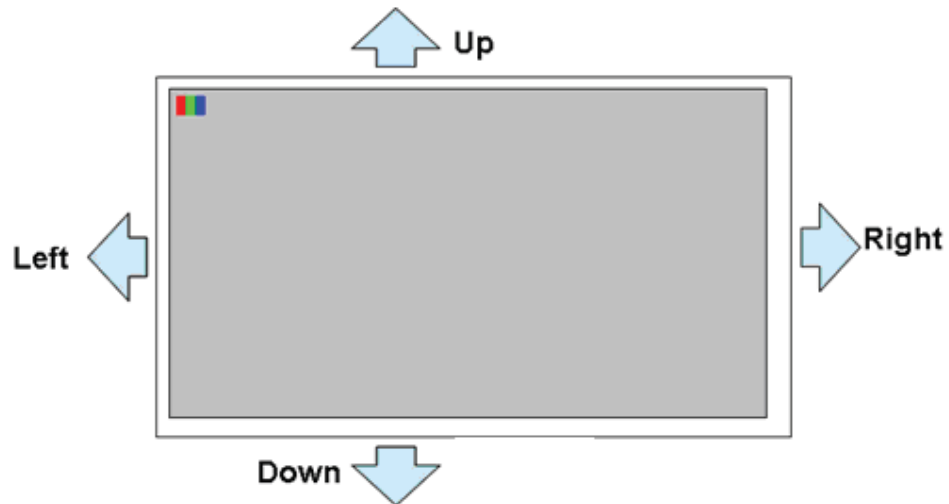


## 4. INTERFACE CONNECTION

### 4.1 CN1 (Input Signal)

| PIN NO | SYMBOL | DESCRIPTION   |
|--------|--------|---|
| 1      | VCOM   | Common voltage  |
| 2      | DVDD   | Digital power   |
| 3      | DVDD   | Digital power   |
| 4      | NC     | Not connect   |
| 5      | RESET  | Global reset pin. Active low to enter reset state.<br>Suggest to connecting with an RC reset circuit for stability.<br>Normally pull high. (R=10KΩ , C=1μF) |
| 6      | U/D    | Vertical inversion  |
| 7      | L/R    | Horizontal inversion  |
| 8      | STBYB  | Standby mode, normally pull high<br>STBYB="1", normal operation<br>STBYB="0", timing control, source driver will turn off, all output are high-Z            |
| 9      | GND    | Ground  |
| 10     | NINC   | Negative LVDS differential clock inputs   |
| 11     | PINC   | Positive LVDS differential clock inputs   |
| 12     | GND    | Ground  |
| 13     | NIND0  | Negative LVDS differential data inputs  |
| 14     | PIND0  | Positive LVDS differential data inputs  |
| 15     | GND    | Ground  |
| 16     | NIND1  | Negative LVDS differential data inputs  |
| 17     | PIND1  | Positive LVDS differential data inputs  |
| 18     | GND    | Ground  |
| 19     | NIND2  | Negative LVDS differential data inputs  |
| 20     | PIND2  | Positive LVDS differential data inputs  |
| 21     | GND    | Ground  |
| 22     | NIND3  | Negative LVDS differential data inputs  |
| 23     | PIND3  | Positive LVDS differential data inputs  |
| 24     | GND    | Ground  |
| 25     | SELB   | 6-bit/8-bit input select<br>SELB = L , 8-bit ; SELB = H , 6-bit   |
| 26     | GND    | Ground  |
| 27     | AVDD   | Power for Analog Circuit  |
| 28     | GND    | Ground  |
| 29     | VGH    | Positive power for TFT  |
| 30     | NC     | Not connect   |
| 31     | NC     | Not connect   |
| 32     | VGL    | Negative power for TFT  |
| 33     | GND    | Ground  |
| 34     | NC     | Not connect   |
| 35     | NC     | Not connect   |
| 36     | NC     | Not connect   |
| 37     | NC     | Not connect   |
| 38     | NC     | Not connect   |
| 39     | NC     | Not connect   |
| 40     | NC     | Not connect   |

| UD | LR | FUNCTION                                      |
|----|----|---|
| 0  | 1  | Normal display                                |
| 0  | 0  | Inverse Left and Right                        |
| 1  | 1  | Inverse Up and Down                           |
| 1  | 0  | Inverse Left and Right<br>Inverse Up and Down |



#### 4.2 CN2 (LED backlight)

| PIN NO | SYMBOL | FUNCTION |
|--------|--------|----------|
| 1      | A      | Anode    |
| 2      | K      | Cathode  |

Note :

Maker:JST

Input connector : SHR-02V-S AWG#28 1.0A

Outlet connector: SSH-003T-P0.2-H

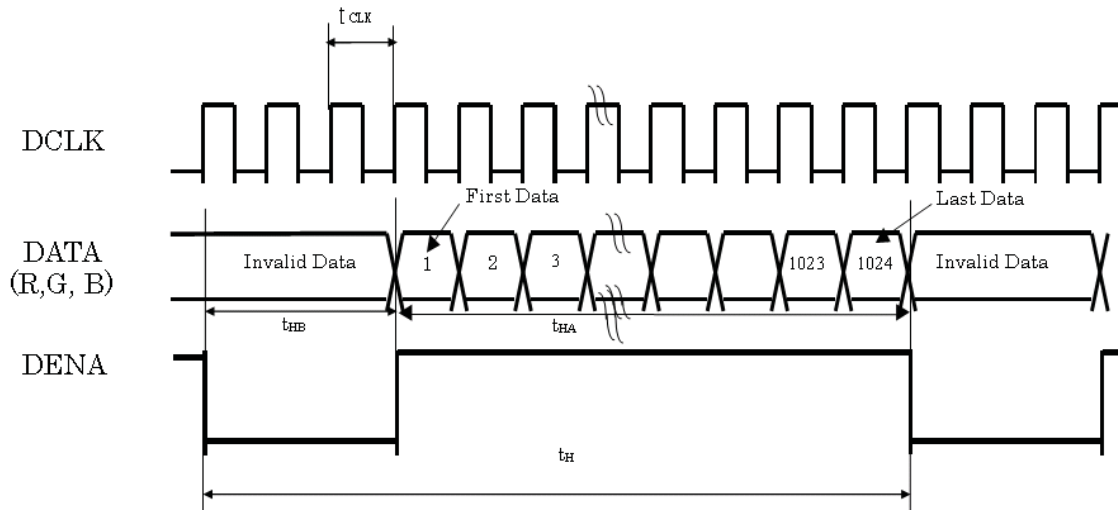
## 5. INPUT SIGNAL(DE ONLY MODE)

### 5.1 Timing Range

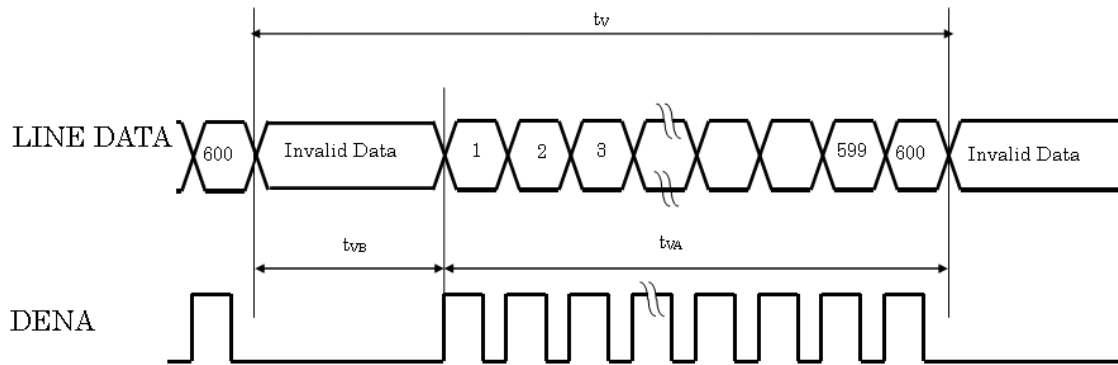
| Category        | Parameter                              | Unit   | Min    | Typ    | Max    |
|-----------------|--|--------|--------|--------|--------|
| Timings         | Frame Rate                             | Hz     | 55     | 60     | 65     |
| Scanning Method | Gate Scanning Method (single / double) | Double |        |        |        |
| Line Impedance  | Capacitive Load of a Signal Line       | pF     | 37.96  | 54.09  | 71.89  |
|                 | Capacitive Load of a Gate Line         | pF     | 178.78 | 190.99 | 207.43 |
|                 | Resistance Load of Signal Line         | KOhm   | 3.65   | 5.07   | 8.19   |
|                 | Resistance Load of Gate Line           | KOhm   | 2.87   | 3.32   | 3.95   |

### 5.2 Timing sequence(Timing chart)

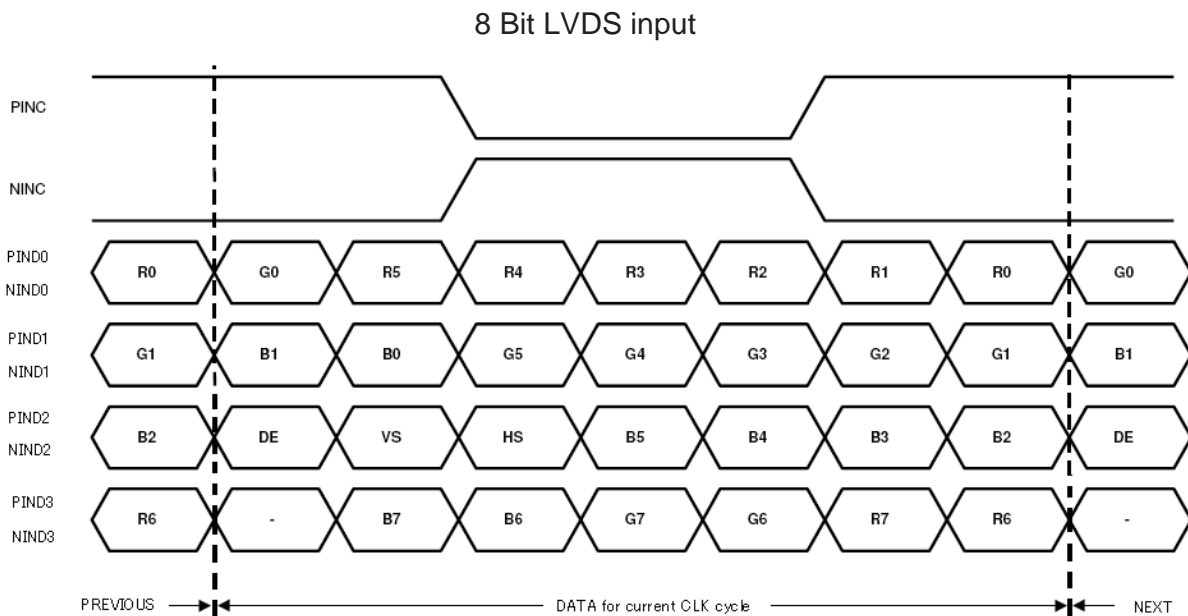
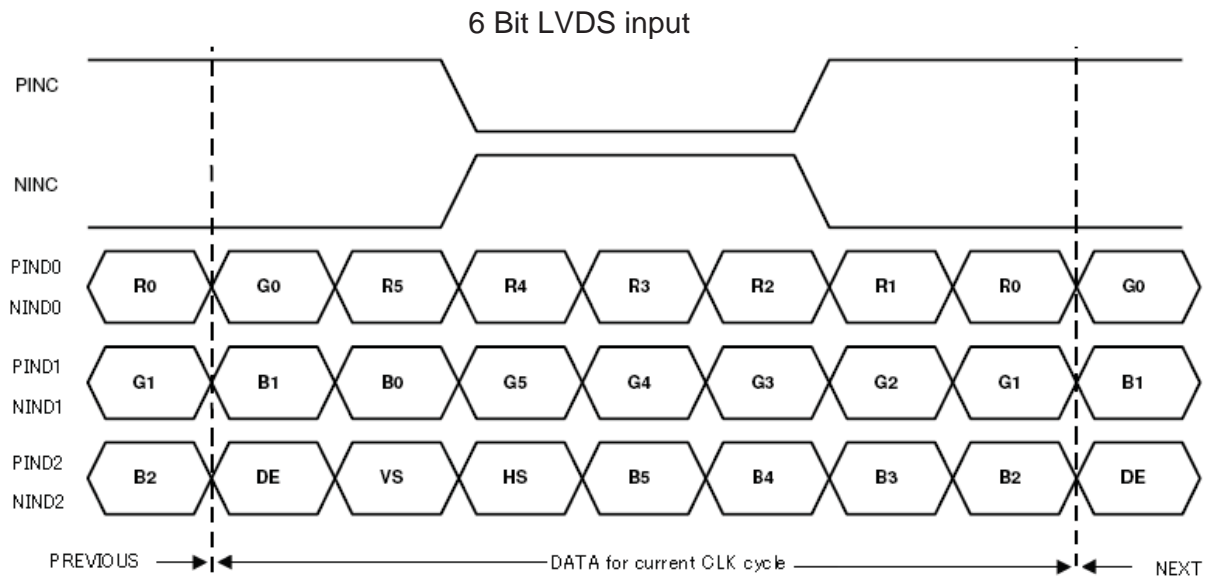
#### 5.2.1 Horizontal Timing Sequence



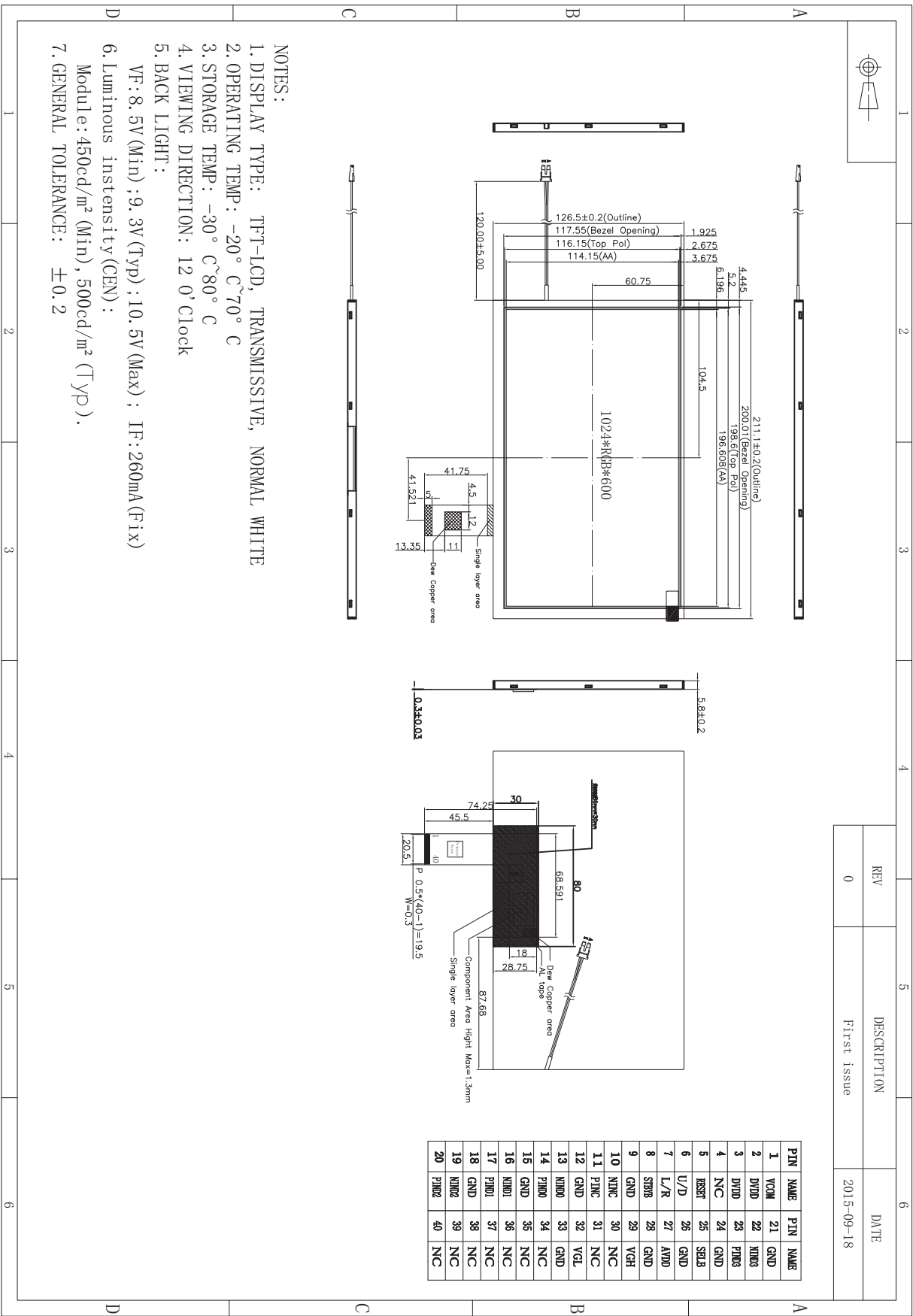
### 5.2.2 Vertical Timing Sequence



### 5.2.3 LVDS Input Data mapping



# 6. MECHANICAL DIMENSION



| REV | DESCRIPTION | DATE       |
|-----|-------------|------------|
| 0   | First issue | 2015-09-18 |

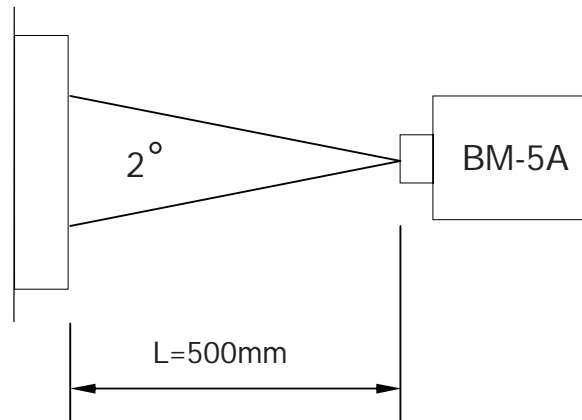
| PIN | NAME  | PIN | NAME |
|-----|-------|-----|------|
| 1   | VCOM  | 21  | GND  |
| 2   | DVDD  | 22  | MIND |
| 3   | DVDD  | 23  | PIND |
| 4   | NC    | 24  | GND  |
| 5   | RESST | 25  | SELB |
| 6   | U/D   | 26  | GND  |
| 7   | L/R   | 27  | ANDD |
| 8   | STDB  | 28  | GND  |
| 9   | GND   | 29  | VGH  |
| 10  | NINC  | 30  | INC  |
| 11  | PINC  | 31  | NC   |
| 12  | GND   | 32  | VGL  |
| 13  | MIND  | 33  | GND  |
| 14  | PIND  | 34  | INC  |
| 15  | GND   | 35  | NC   |
| 16  | MIND  | 36  | INC  |
| 17  | PIND  | 37  | NC   |
| 18  | GND   | 38  | INC  |
| 19  | MIND  | 39  | NC   |
| 20  | PIND  | 40  | INC  |

## 7. OPTICAL CHARACTERISTICS

Ta = 25°C, VCC=3.3V

| ITEM                             | SYMBOL     | CONDITIONS        | MIN                | TYP           | MAX            | UNIT              | NOTE    |         |
|----------------------------------|------------|-------------------|--------------------|---------------|----------------|-------------------|---------|---------|
| Constrast Ratio                  | CR         | Point-5           | ----               | 500           |                | --                | 1, 2, 3 |         |
| Luminance(CEN)                   | Lw         | Point-5           | 450                | 500           |                | cd/m <sup>2</sup> | 1, 3    |         |
| Luminance Uniformity             | ΔL         |                   | 70                 | 80            |                | %                 | 1, 3    |         |
| Response Time<br>(White - Black) | Tr +Tf     | Point-5           | -                  | 25            | 40             | ms                | 1, 3, 5 |         |
| Viewing<br>Angle                 | Horizontal | Left( $\phi$ )    | CR ≥ 10<br>Point-5 | 60            | 70             | --                | °       | 1, 3    |
|                                  |            | Right( $\phi$ )   |                    | 60            | 70             | --                | °       |         |
|                                  | Vertical   | Upper( $\theta$ ) |                    | 60            | 70             | --                | °       | 1, 2, 4 |
|                                  |            | Down( $\theta$ )  |                    | 60            | 70             | --                | °       |         |
| Color<br>Coordinate              | White      | Wx<br>Wy          | Point-5            | TYP.<br>-0.03 | 0.314<br>0.337 | TYP.<br>+ 0.03    | --      | 1, 3    |

Note1 : Measure condition: 25°C ±2°C, 60±10%RH, under 10 Lux in the dark room. BM-5A (TOPCON), viewing angle 2°, IL=260 mA ( Backlight current ) , measurement after lighting on 10 mins.



Note2 : Definition of contrast ratio :

$$\text{Contrast Ratio (CR)} = (\text{White}) \text{ Luminance of ON} \div (\text{Black}) \text{ Luminance of OFF}$$

Note3 : Definition of luminance : Measure white luminance on the point 5 as figure.7-1  
 Definition of Luminance Uniformity: Measure white luminance on the point1-9 as figure.7-1  
 $\Delta L = [L(\text{MIN})/L(\text{MAX})] \times 100$

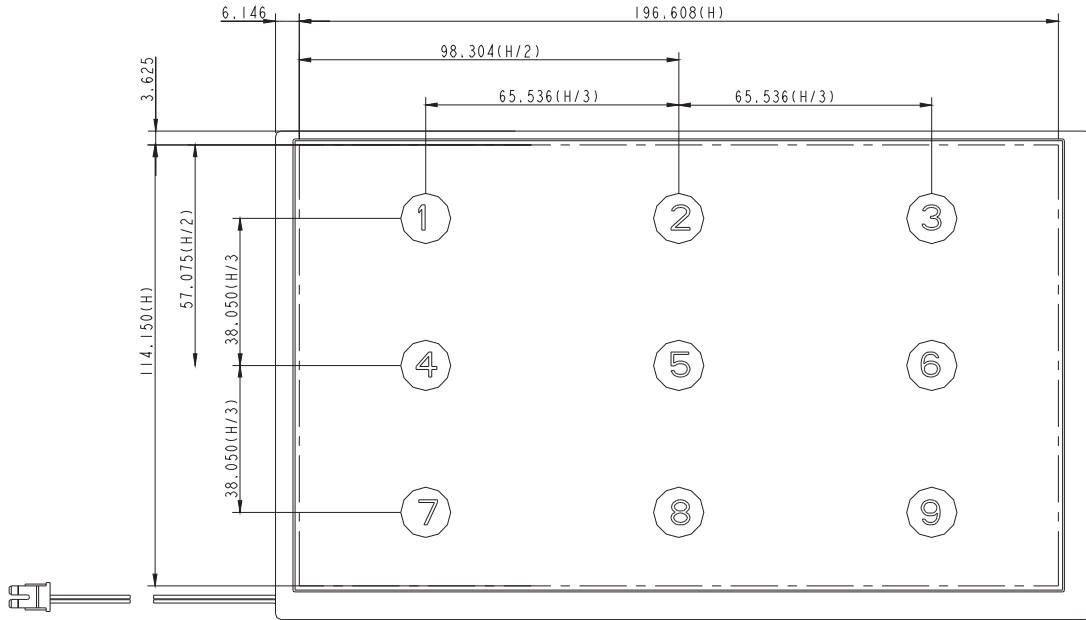


Fig.7-1 Measuring point

Note 4 : Definition of Viewing Angle( $\theta, \psi$ ), refer to Fig.7-2 as below :

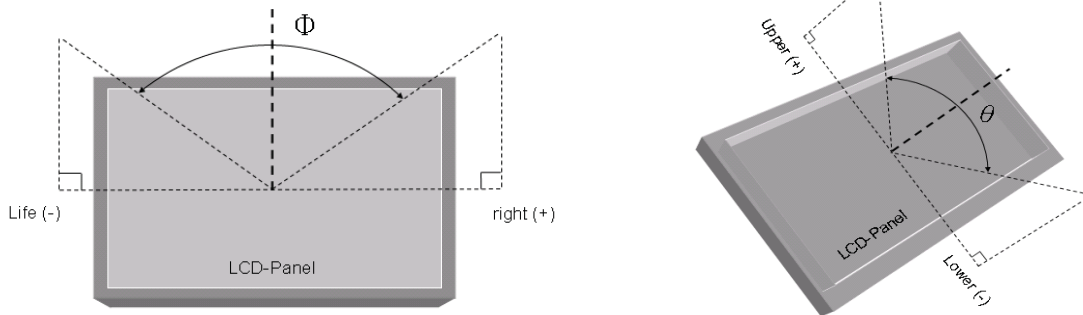


Fig.7-2 Definition of Viewing Angle

Note5 : Definition of Response Time.(White-Black)

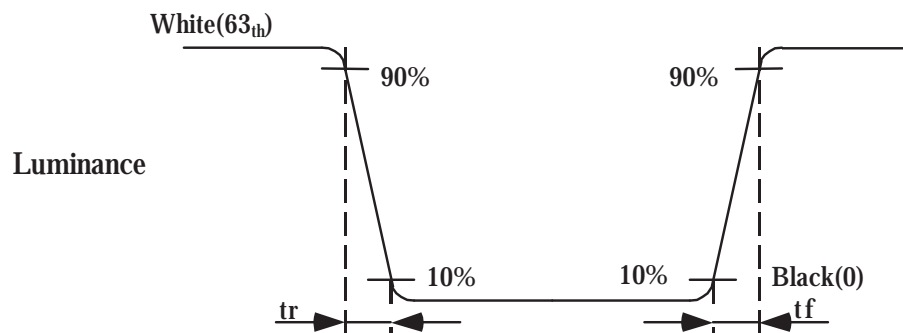


Fig.7-3 Definition of Response Time(White-Black)

## 8. RELIABILITY TEST

### 8.1 Temperature and humidity

| TEST ITEMS                               | CONDITIONS                                | NOTE                          |
|--|---|-------------------------------|
| High Temperature Operation               | 70°C ;240hrs                              |                               |
| High Temperature Storage                 | 80°C ; 240hrs                             |                               |
| High Temperature High Humidity Operation | 60°C ; 90%RH ;240hrs                      | No condensation               |
| Low Temperature Operation                | -20°C ; 240hrs                            | Backlight unit always turn on |
| Low Temperature Storage                  | -30°C ; 240hrs                            |                               |
| Thermal Shock                            | -20°C (0.5hr) ~ 70°C (0.5hr) ; 100 Cycles |                               |
| Image Sticking                           | 25°C ; 4hrs                               |                               |

Note 1 :

Condition of Image Sticking test : 25 °C ± 2 °C

Operation with test pattern sustained for 4 hrs, then change to mid-gray pattern immediately.

After 5 mins, the mura must be disappeared completely .

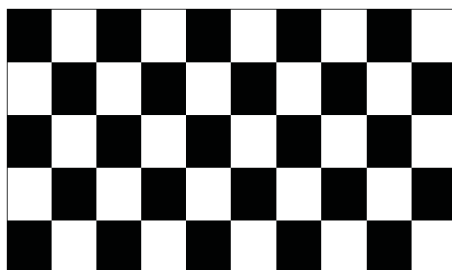
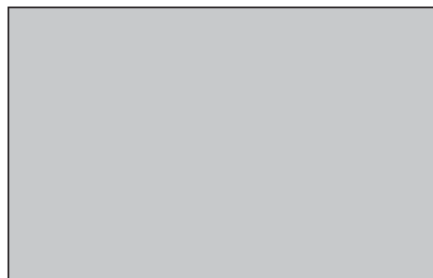


Image Sticking -pattern



Mid-Gray pattern

### 8.2 Shock and Vibration

| TEST ITEMS                   | CONDITIONS  |
|------------------------------|---|
| Shock<br>(Non-operation)     | <ul style="list-style-type: none"> <li>● Shock level: 980m/s<sup>2</sup>(equal to 100G).</li> <li>● Waveform: half sinusoidal wave,6ms.</li> <li>● Number of shocks: one shock input in each direction of three mutually perpendicular axes for a total of three shock inputs.</li> </ul> |
| Vibration<br>(Non-operation) | <ul style="list-style-type: none"> <li>● Frequency range:8~33.3Hz</li> <li>● Stoke : 1.3 mm</li> <li>● Vibration: sinusoidal wave, perpendicular axis(both x, y,z axis: 2Hrs).</li> <li>● Sweep: 2.9G,33.3 Hz -400 Hz</li> <li>● Cycle: 15 min</li> </ul>                                 |

### 8.3 Electrostatic Discharge

| TEST ITEM | CONDITIONS                                  | Note |
|-----------|---|------|
| ESD       | 150pF , 330Ω , ±8kV&±15kV air& contact test | 1    |
|           | 200pF , 0Ω , ±200V contact test             | 2    |

Note : Measure

1: LCD glass and metal bezel

2: IF connector pins



#### 8.4. Judgment standard

The Judgment of the above test should be made as follow:

Pass: Normal display image and no line defect.

Partial transformation of the module parts should be ignored.

Fail: No display image, Function NG, or line defects.

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# 9. PACKING

