深圳市拓普微科技开发有限公司
SHENZHEN TOPWAY TECHNOLOGY CO., LTD.

# LMT050DNCFWU-NBN

LCD Module User Manual

| Prepared by: | Checked by: | Approved by: |
|---|---|---|
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| Date: 2014-07-03 | Date: | Date: |

| Rev. | Descriptions | Release Date |
|---|---|---|
| 0.1 | Preliminary release | 2013-12-03 |
| 0.2 | Add section 5.1 $V_{TH}$ & $V_{TL}$ values | 2014-07-03 |
| | | |
| | | |
| | | |
| | | |

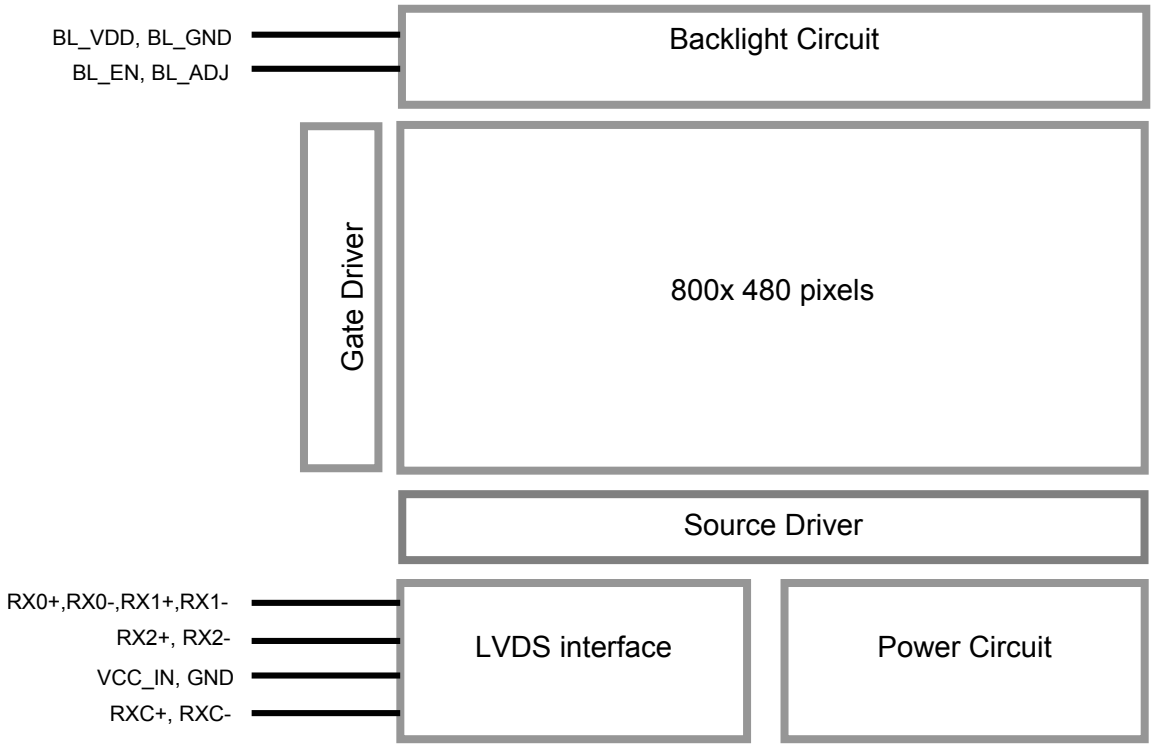
# Table of Content

# 1. General Specification

| | |
|---|---|
| Signal Interface : | LVDS |
| Display Mode : | Transmissive / Normal White |
| Screen Size(Diagonal) : | 5.0” |
| Outline Dimension : | 143.5 x 80.9x 14.6(mm)<br>(see attached drawing for details) |
| Active Area : | 108.0 x 64.8 (mm) |
| Color Depth: | 256K |
| Number of dots : | 800 x 3 (RGB) x 480 |
| Pixel Pitch : | 0.135 x 0.135 (mm) |
| Pixel Configuration : | RGB Stripe |
| Backlight : | LED |
| Surface Treatment : | Anti-Glare |
| Viewing Direction : | 6H (*1) (gray-scale inverse)<br>12H (*2) |
| Operating Temperature : | -20 ~ +70°C |
| Storage Temperature : | -30 ~ +80°C |

Note:
*1. For saturated color display content (eg. pure-red, pure-green, pure-blue, or pure-colors-combinations).
*2. For “color scales” display content.
*3. Color tone may slightly change by Temperature and Driving Condition.

# 2. Block Diagram



# 3. Terminal Function

## 3.1 K1 LVDS Terminal

| Pin No. | Pin Name | IO | Descriptions |
|---|---|---|---|
| 1 | NC | - | No connection,leave open |
| 2 | NC | | |
| 3 | NC | | |
| 4 | NC | | |
| 5 | NC | | |
| 6 | RXC+ | Input | LVDS receiver positive signal clock |
| 7 | NC | - | No connection |
| 8 | RXC- | Input | LVDS receiver negative signal clock |
| 9 | NC | - | No connection,leave open |
| 10 | RX2+ | Input | LVDS receiver positive signal channel 2 |
| 11 | NC | - | No connection,leave open |
| 12 | RX2- | Input | LVDS receiver negative signal channel 2 |
| 13 | GND | Power | Ground |
| 14 | RX1+ | Input | LVDS receiver positive signal channel 1 |
| 15 | GND | Power | Ground |
| 16 | RX1- | Input | LVDS receiver negative signal channel 1 |
| 17 | VCC_IN | Power | Positive Power Supply(3.3V) |
| 18 | RX0+ | Input | LVDS receiver positive signal channel 0 |
| 19 | VCC_IN | Power | Positive Power Supply(3.3V) |
| 20 | RX0- | Input | LVDS receiver negative signal channel 0 |

## 3.2 K2 Backlight Terminal

| Pin No. | Pin Name | IO | Descriptions |
|---|---|---|---|
| 1 | BL_VDD | Power | Positive Power Supply(5.0V) |
| 2 | BL_EN | Input | Backlight Driver Control<br>BL_EN=Hi, Backlight Driving Booster enable<br>BL_EN=Lo, Backlight Driving Booster disable |
| 3 | BL_ADJ | Input | Backlight dimming control<br>PWM may be used to adjust the output brightness |
| 4 | NC | - | No connection,leave open |
| 5 | NC | - | No connection,leave open |
| 6 | BL_GND | Power | Power Supply GND (0V) |

# 4. Absolute Maximum Ratings

| Items | Symbol | Min. | Max. | Unit | Condition |
|---|---|---|---|---|---|
| Power Supply voltage | VCC_IN | -0.3 | +3.6 | V | |
| Backlight Supply voltage | BL_VDD | -0.3 | +6.0 | V | |
| Operating Temperature | $T_{OP}$ | -20 | 70 | °C | No Condensation |
| Storage Temperature | $T_{ST}$ | -30 | 80 | °C | No Condensation |

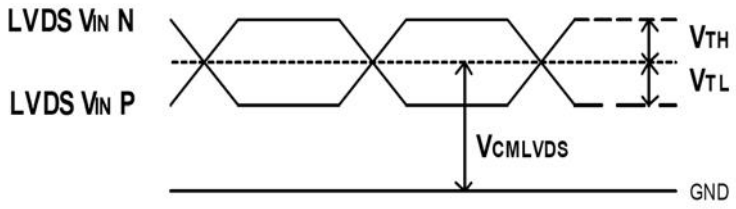
Note:
*1. This rating applies to all parts of the module. And should not be exceeded.
*2. The operating temperature only guarantees operation of the circuit. The contrast, response speed, and the other specification related to electro-optical display quality is determined at the room temperature, $T_{OP}$=25℃
*3. Ambient temperature when the backlight is lit (reference value)
*4. Any Stresses exceeding the Absolute Maximum Ratings may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

# 5. Electrical Characteristics

## 5.1 Driving TFT LCD Panel

Top=25℃, VCC_IN =3.3V ,GND=0V

| Items | Symbol | MIN. | TYP. | MAX. | Unit | Note |
|---|---|---|---|---|---|---|
| Supply Voltage | VCC_IN | 3.0 | 3.3 | 3.6 | V | |
| Common Electrode Driving Signal | $V_{CMLVDS}$ | - | 1.2 | - | V | Note1 |
| Differential Input High Threshold | $V_{TH}$ | - | - | 100 | mV | |
| Differential Input Low Threshold | $V_{TL}$ | -100 | - | - | mV | |
| Sync Frequency | FVD | - | 60 | 70 | Hz | |
| VDD Power Consumption | $I_{VCC\_IN}$ | - | 135 | 360 | mA | |




**LVDS DC timing diagram**

Note1: The value may be different for different LCM.

### 5.2 LED Backlight Circuit Characteristics

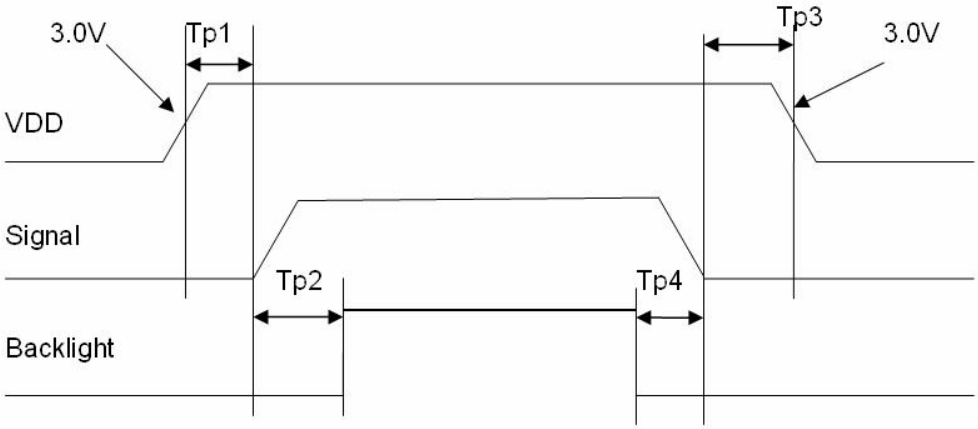
BL_GND=0V, $T_{OP}$=25°C

| Parameter | Symbol | MIN. | TYP. | MAX. | Unit | Note |
|---|---|---|---|---|---|---|
| Operating Voltage | $V_{BL\_VDD}$ | 4.7 | 5.0 | 5.3 | V | |
| Operating Current | $I_{BL\_VDD}$ | - | 190 | - | mA | Note1 |
| Input High Voltage | $V_{IH}$ | 0.8$V_{BL_VDD}$ | - | $V_{BL\_VDD}$ | V | BL_EN, BL_ADJ |
| Input Low Voltage | $V_{IL}$ | BL_GND | - | 0.3 | V | BL_EN, BL_ADJ |

Cautions:
Exceeding the recommended driving current could cause substantial damage to the backlight and shorten its lifetime.
Note:
*1: BL_EN=Hi, BL_ADJ=Hi;
*2. Recommended BL_ADJ PWM Freq. is 3kHz .

### 5.3 Power On/Off Sequence

| Items | Symbol | MIN. | TYP. | Max. | Unit | Note |
|---|---|---|---|---|---|---|
| VDD 3.0V to signal starting | Tp1 | 0 | - | 50 | ms | |
| Signal starting to backlight on | Tp2 | 150 | - | - | ms | |
| Signal off to VDD 3.0V | Tp3 | 0 | - | 50 | ms | |
| Backlight off to signal off | Tp4 | 150 | - | - | ms | |

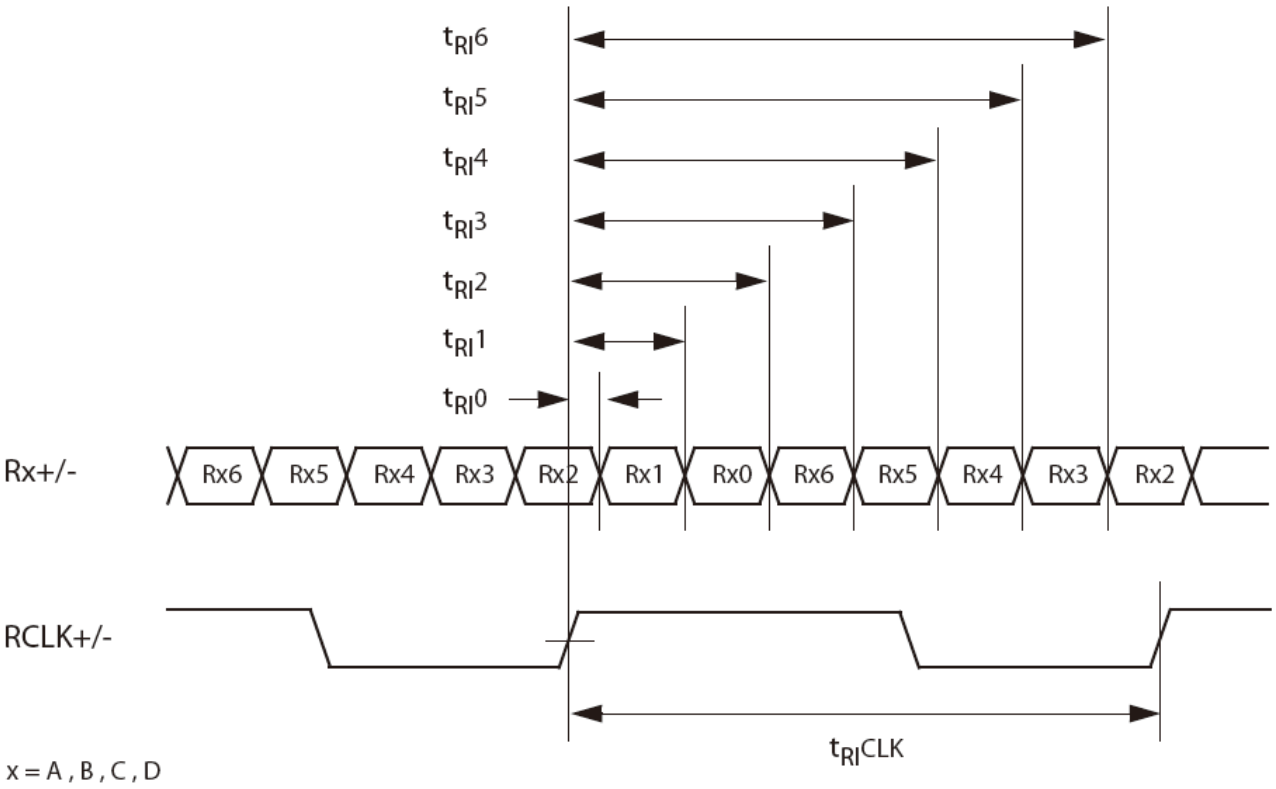



**Interface Power On/Off Sequence**

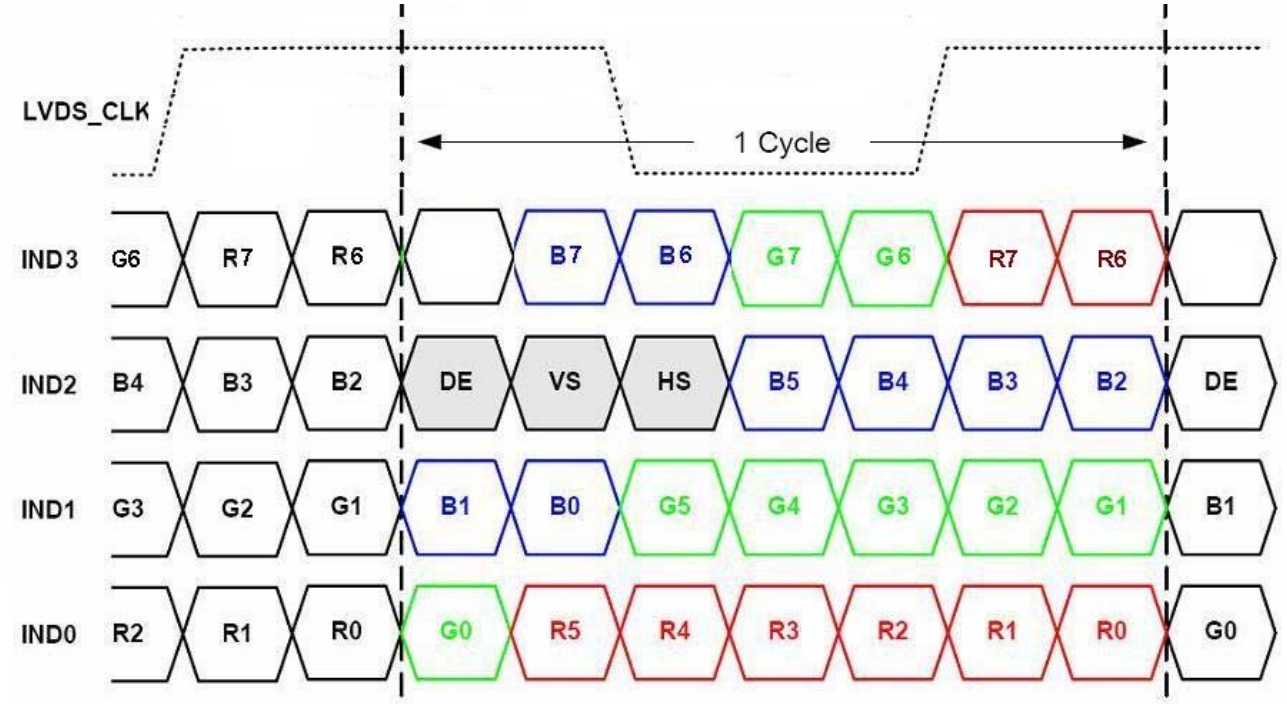
# 6. AC Characteristics

## 6.1 Timing Conditions

| Item | Symbol | MIN. | TYP. | MAX. | Unit | Condition |
|---|---|---|---|---|---|---|
| Input CLK period | tRICLK | 8.9 | - | 50 | ns | |
| Input Data Position 0 ( tRICLK = 8.9ns ) | tRI0 | -0.3 | - | +0.3 | ns | |
| Input Data Position 1 (tRICLK = 8.9ns ) | tRI1 | tRICLK/7-0.3 | tRICLK/7 | tRICLK/7+0.3 | ns | |
| Input Data Position 2 (tRICLK = 8.9ns ) | tRI2 | 2tRICLK/7-0.3 | 2tRICLK/7 | 2tRICLK/7+0.3 | ns | |
| Input Data Position 3 (tRICLK = 8.9ns ) | tRI3 | 3tRICLK/7-0.3 | 3tRICLK/7 | 3tRICLK/7+0.3 | ns | |
| Input Data Position 4 (tRICLK = 8.9ns ) | tRI4 | 4tRICLK/7-0.3 | 4tRICLK/7 | 4tRICLK/7+0.3 | ns | |
| Input Data Position 5 (tRICLK = 8.9ns ) | tRI5 | 5tRICLK/7-0.3 | 5tRICLK/7 | 5tRICLK/7+0.3 | ns | |
| Input Data Position 6 (tRICLK = 8.9ns ) | tRI6 | 6tRICLK/7-0.3 | 6tRICLK/7 | 6tRICLK/7+0.3 | ns | |



## 6.2 LVDS Timing Diagram

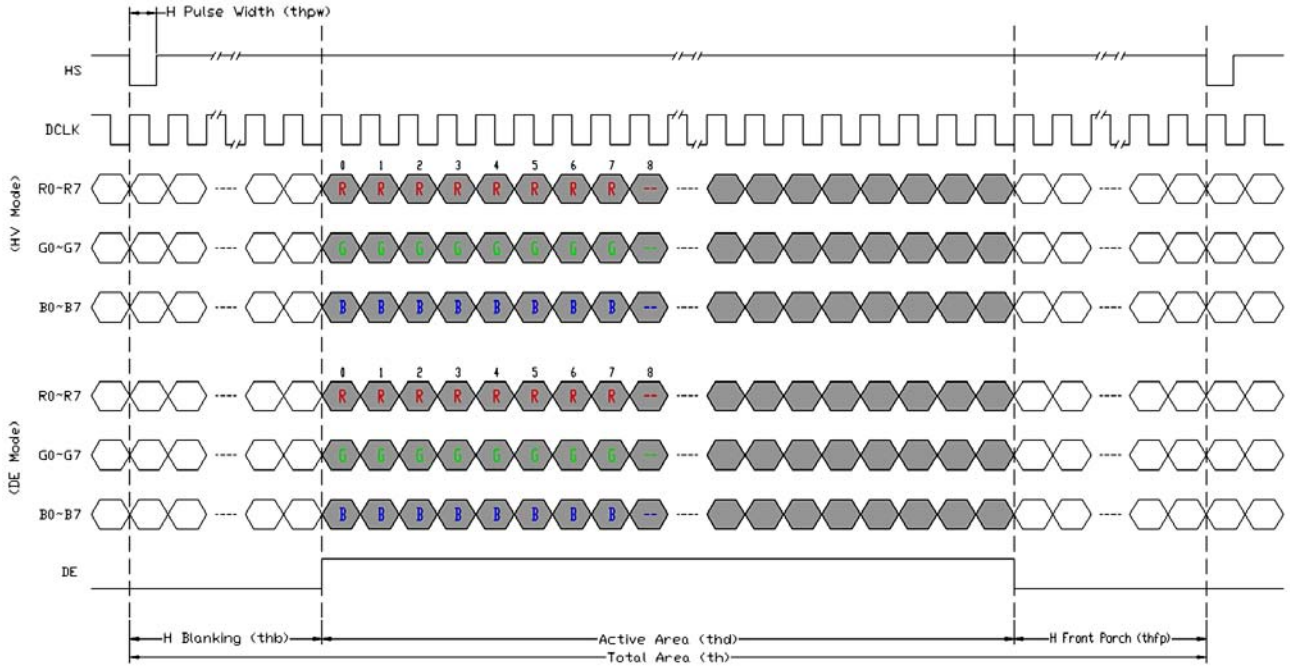


### 6.3 Data Input format

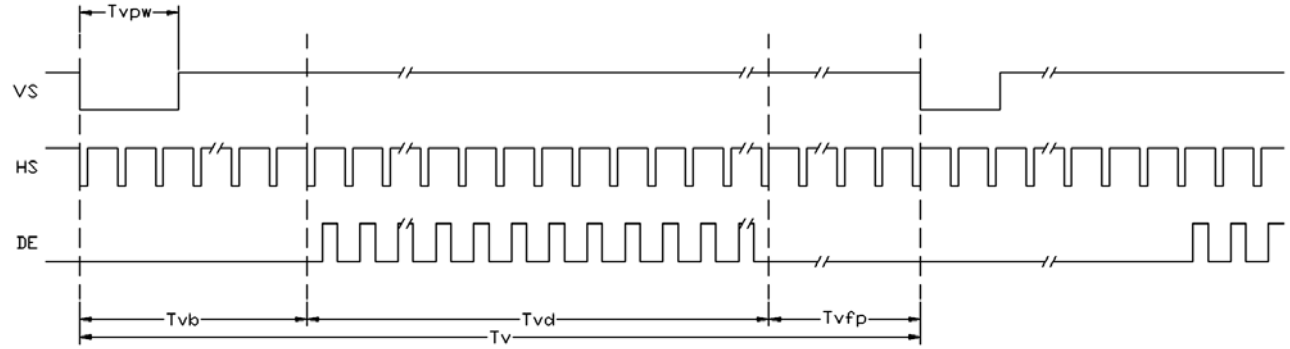
| Item | Symbol | MIN. | TYP. | MAX. | Unit | Remark |
|---|---|---|---|---|---|---|
| Horizontal Display Area | thd | | 800 | | DCLK | |
| CLKIN Frequency | fclk | - | 30 | 50 | MHz | |
| One Horizontal Line | th | 889 | 928 | 1143 | CLKIN | |
| HSD pulse width | thpw | 1 | 48 | 255 | CLKIN | |
| HSD Blanking | thb | | 88 | | CLKIN | |
| HSD Front Porch | thfp | 1 | 40 | 255 | CLKIN | |
| Vertical Display Area | tvd | | 480 | | TH | |
| VSD period time | tv | 513 | 525 | 767 | TH | |
| VSD pulse width | tvpw | 3 | 3 | 255 | TH | |
| VSD Blanking | tvb | | 32 | | TH | |
| VSD Front Porch | tvfp | 1 | 13 | 255 | TH | |

Note:

1. LVDS signal should carry SYNC mode signals




**Horizontal input timing diagram**




**Vertical input timing diagram**

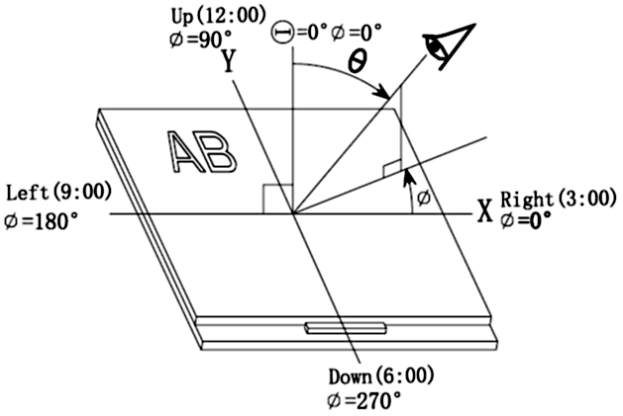
# 7. Optical Characteristics

| Item | | Symbol | Condition | MIN. | TYP. | MAX. | UNIT | Note. |
|---|---|---|---|---|---|---|---|---|
| Viewing angle | | $\theta_T$ | (CR≥10) | 40 | 50 | - | degree | Note 2 |
| | | $\theta_B$ | | 60 | 70 | - | | |
| | | $\theta_L$ | | 60 | 70 | - | | |
| | | $\theta_R$ | | 60 | 70 | - | | |
| Contrast ratio | | CR | θ=0° | 500 | 600 | - | - | Note 1,3 |
| Response Time | | $T_{on}$ | 25℃ | - | 20 | 30 | msec | Note 1,4 |
| | | $T_{off}$ | | | | | msec | |
| Chromaticlty | White | X | Backlight is on | 0.260 | 0.310 | 0.360 | | Note 1,5 |
| | | Y | | 0.280 | 0.330 | 0.380 | | |
| | Red | X | | 0.540 | 0.590 | 0.640 | | |
| | | Y | | 0.300 | 0.350 | 0.400 | | |
| | Green | X | | 0.298 | 0.348 | 0.398 | | |
| | | Y | | 0.520 | 0.570 | 0.620 | | |
| | Blue | X | | 0.095 | 0.145 | 0.195 | | |
| | | Y | | 0.060 | 0.110 | 0.160 | | |
| Luminance | | L | | 200 | 250 | - | $cd/m^2$ | Note 1,6 |
| NTSC | | | | - | 50 | | % | Note 5 |
| Luminance uniformity | | U | | 75 | 80 | - | % | Note 1,7 |

Test Conditions:
1. IF= 40mA, VF=21.7V, no touch panel, and the ambient temperature is 25 ℃.
2. The test systems refer to Note 1 and Note 2.

Note 1:
The data are measured after LEDs are turned on for 5 minutes. LCM displays full white. The brightness is the average value of 9 measured spots. Measurement equipment SR-3A (1°)
Measuring condition:
- Measuring surroundings: Dark room
- Measuring temperature: Ta=25℃.
- Adjust operating voltage to get optimum contrast at the center of the display.

Note 2:
The definition of viewing angle:
Refer to the graph below marked by $\theta$ and $\Phi$

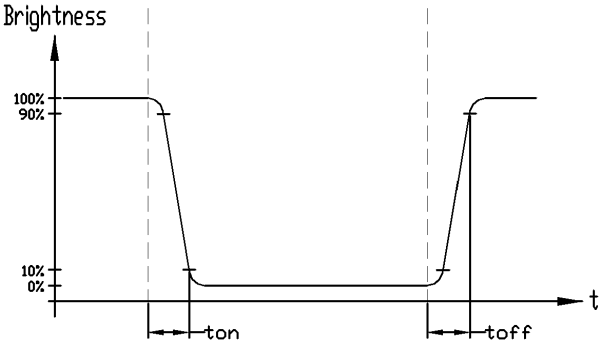



Note 3:
The definition of contrast ratio (Test LCM using SR-3A (1°)):

$$\text{Contrast Ratio(CR)} = \frac{\text{Luminance When LCD is at "White" state}}{\text{Luminance When LCD is at "Black" state}}$$

(Contrast Ratio is measured in optimum common electrode voltage)

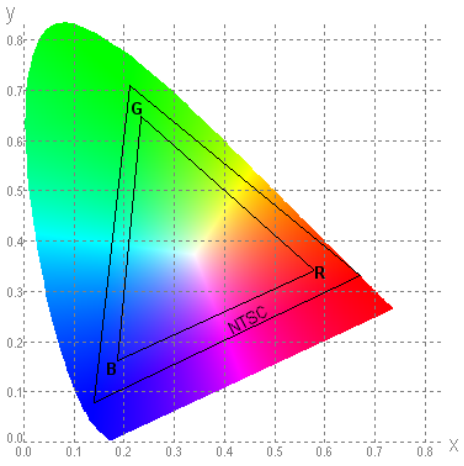
Note 4:
Definition of Response time. (Test LCD using BM-7A(2°)):
The output signals of photo detector are measured when the input signals are changed from "black" to "white"(falling time) and from "white" to "black"(rising time), respectively.
The response time is defined as the time interval between the 10% and 90% of amplitudes.Refer to figure as below.



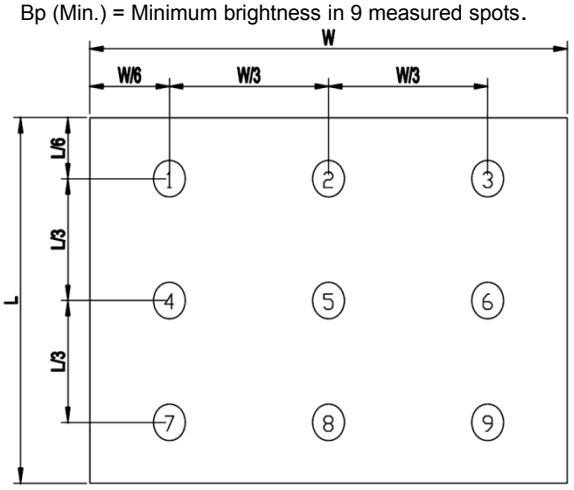

Note 5:
Definition of Color of CIE1931 Coordinate and NTSC Ratio.

Color gamut:

$$S = \frac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}} \times 100\%$$




Note 6:
The luminance uniformity is calculated by using following formula.
△Bp = Bp (Min.) / Bp (Max.)×100 (%)
Bp (Max.) = Maximum brightness in 9 measured spots
Bp (Min.) = Minimum brightness in 9 measured spots.




Note 7:
Measured the luminance of white state at center point

# 8. Precautions of using LCD Modules

**Mounting**

- Mounting must use holes arranged in four corners or four sides.
- The mounting structure so provide even force on to LCD module. Uneven force (ex. Twisted stress) should not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- It is suggested to attach a transparent protective plate to the surface in order to protect the polarizer. It should have sufficient strength in order to the resist external force.
- The housing should adopt radiation structure to satisfy the temperature specification.
- Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. Never rub with dust clothes with chemical treatment. Do not touch the surface of polarizer for bare hand or greasy cloth.(Some cosmetics deteriorate the polarizer.)
- When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzine. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer

**Operating**

- The spike noise causes the mis-operation of circuits. It should be within the ±200mV level (Over and under shoot voltage)
- Response time depends on the temperature.(In lower temperature, it becomes longer.)
- Brightness depends on the temperature. (In lower temperature, it becomes lower.) And in lower temperature, response time(required time that brightness is stable after turned on) becomes longer.
- Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- When fixed patterns are displayed for a long time, remnant image is likely to occur.
- Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimized the interference

**Electrostatic Discharge Control**

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

**Strong Light Exposure**

Strong light exposure causes degradation of polarizer and color filter.

**Storage**

When storing modules as spares for a long time, the following precautions are necessary.

- Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
- The polarizer surface should not come in contact with any other object. It is recommended that they be stored in the container in which they were shipped.

**Protection Film**

- When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
- The protection film is attached to the polarizer with a small amount of glue. If some stress is applied to rub the protection film against the polarizer during the time you peel off the film, the glue is apt tore main on the polarizer. Please carefully peel off the protection film without rubbing it against the polarizer.
- When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the polarizer after the protection film is peeled off.
- You can remove the glue easily. When the glue remains on the polarizer surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

**Transportation**

The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.