

# Specifications for LCD module

|                          |                             |
|--------------------------|-----------------------------|
| <b>Customer</b>          |                             |
| <b>Customer part no.</b> |                             |
| <b>Ampire part no.</b>   | <b>AM-19201080MTZQW-T50</b> |
| <b>Approved by</b>       |                             |
| <b>Date</b>              |                             |

☐ Preliminary Specification

☒ Formal Specification

| Approved by    | Checked by   | Organized by |
|----------------|--------------|--------------|
| <i>Patrick</i> | <i>Kokai</i> | <i>Mark</i>  |

\*This specification is subject to change without notice.

## RECORD OF REVISION

| Revision Date | Page | Contents    | Editor |
|---------------|------|-------------|--------|
| 2020/03/02    | --   | New Release | Mark   |

## 1.0 General Descriptions

### 1.1 Introduction

The LCM is a color active matrix TFT LCD module using amorphous silicon TFT's (Thin Film Transistors) as an active switching device. This module has a 21.5 inch diagonally measured active area with FHD resolutions (1920 horizontal by 1080 vertical pixel array). Each pixel is divided into red, green, blue dots which are arranged in vertical Stripe and this module can display 16.7M colors.

### 1.2 Product Summary

| Items                     | Specifications            | Unit   |
|---------------------------|---------------------------|--------|
| Screen Diagonal           | 21.5                      | Inch   |
| Pixel Format              | 1920 (H) X RGB X 1080 (V) | -      |
| Pixel Pitch               | 247.95 (H) X 247.95 (V)   | um     |
| Pixel Arrangement         | R.G.B. Vertical Stripe    | -      |
| Display Mode              | AHVA mode, Normally Black | -      |
| White Luminance           | 298 (Typ.)                | cd /m2 |
| Contrast Ratio            | 1000 (Typ.)               | -      |
| Nominal Input Voltage VDD | 5                         | V      |
| Support Color             | 16.7M                     | -      |

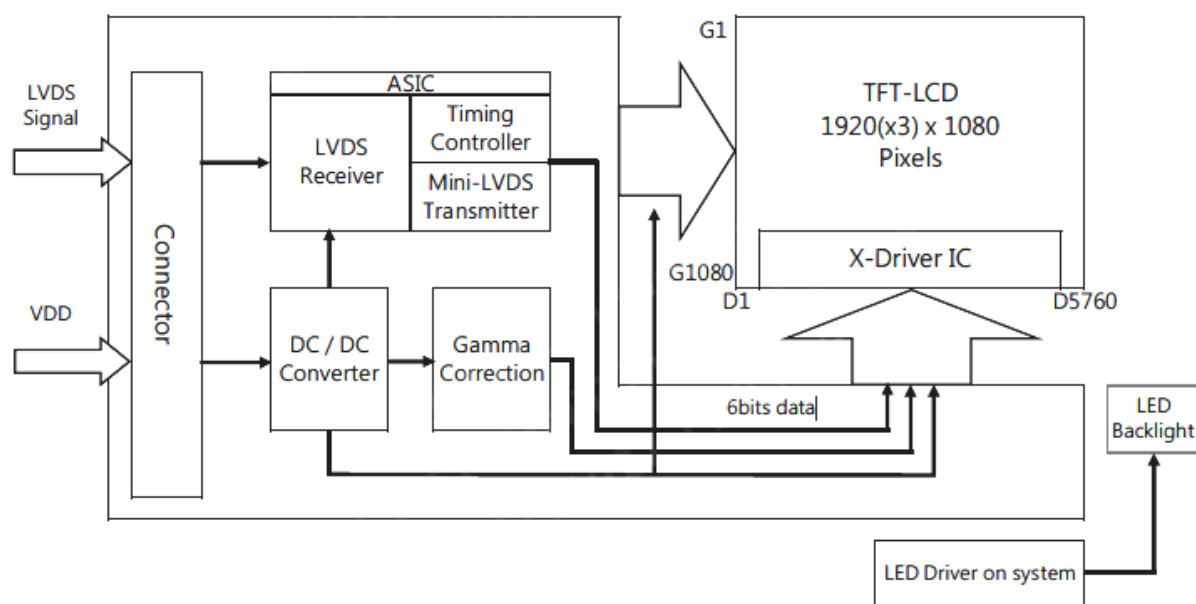
## 2.0 Absolute Maximum Ratings

| Item                     | Symbol | Values |      | Unit | Remark |
|--------------------------|--------|--------|------|------|--------|
|                          |        | Min.   | Max. |      |        |
| Logic Signal Input Level | VDD    | -0.3   | +5.5 | V    |        |
| Operation Temperature    | TOP    | 0      | 50   | °C   |        |
| Storage Temperature      | TST    | -20    | 60   | °C   |        |

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

Note(2)  $T_a = 25 \pm 2^\circ\text{C}$

### 3.0 LCD Functional Block Diagram



## 4.0 Electrical Specifications

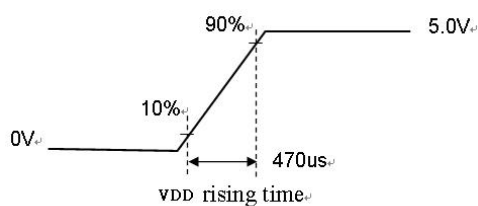
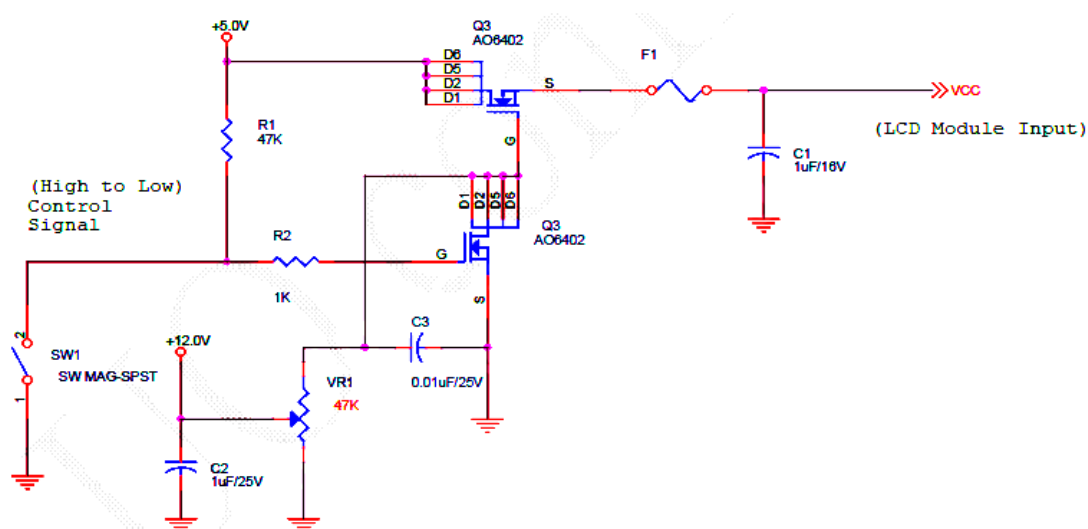
### 4.1 TFT LCD module

#### 4.1.1 Power Specification

| Symbol | Parameter                                | Min. | Typ. | Max. | Unit  | Conditions                           |
|--------|--|------|------|------|-------|--------------------------------------|
| VDD    | Logic/LCD Drive Voltage                  | 4.5  | 5.0  | 5.5  | V     | +/-10%                               |
| IDD    | Input Current                            | --   | 0.46 | 0.55 | A     | VDD= 5.0V, All White Pattern At 60Hz |
| PDD    | VDD Power                                | --   | 2.3  | 2.75 | Watt  | VDD= 5.0V, All White Pattern At 60Hz |
| IRush  | Inrush Current                           | --   | --   | 3.0  | A     | Note(1)                              |
| VDDrp  | Allowable Logic/LCD Drive Ripple Voltage | --   | --   | 500  | mVp-p | VDD= 5.0V, All White Pattern At 60Hz |

Note(1) Measurement conditions:

The duration of rising time of power input is 470us.



## 4.1.2 Signal Electrical Characteristics

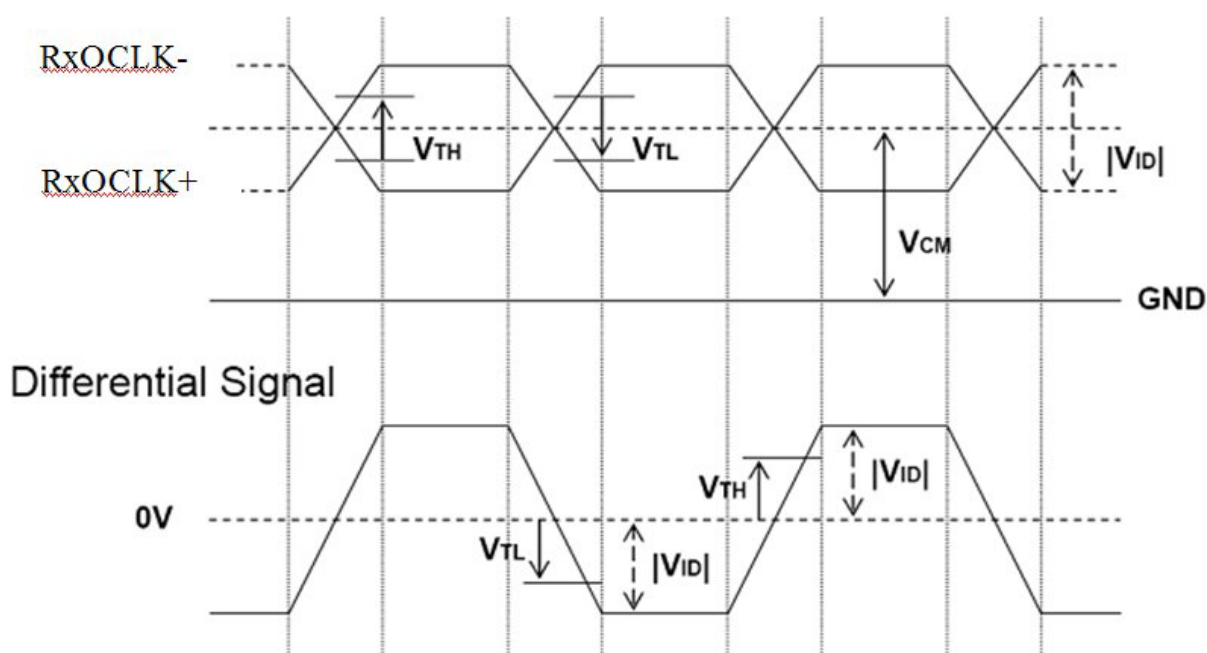
Characteristics of each signal are as follows:

| Symbol           | Parameter                              | Min. | Typ. | Max. | Units | Condition   |
|------------------|--|------|------|------|-------|---|
| V <sub>TH</sub>  | Differential Input High Threshold      | 100  | --   | --   | mV    | V <sub>ICM</sub> = 1.2V<br>Note(1)                        |
| V <sub>TL</sub>  | Differential Input Low Threshold       | --   | --   | -100 | mV    | V <sub>ICM</sub> = 1.2V<br>Note(1)                        |
| V <sub>ID</sub>  | Input Differential Voltage             | 100  | 400  | 600  | mV    | Note(1)   |
| V <sub>ICM</sub> | Differential Input Common Mode Voltage | 1.0  | 1.2  | 1.5  | V     | V <sub>TH</sub> -V <sub>TL</sub> = 200mV (max)<br>Note(1) |

Note(1) LVDS Signal Waveform

Use RxOCLK- & RxOCLK+ as example

### Single-End



## 5.0 Interface Timings

### 5.1 Timing Characteristics

| Signal     | Item       | Symbol             | Min  | Typ  | Max  | Unit |
|------------|------------|--------------------|------|------|------|------|
| V-section  | Period     | Tv                 | 1094 | 1130 | 1836 | Th   |
|            | Active     | Tdisp(v)           | 1080 | 1080 | 1080 | Th   |
|            | Blanking   | Tbp(v)+Tfp(v)+PWvs | 14   | 50   | 756  | Th   |
| H-section  | Period     | Th                 | 1000 | 1050 | 1678 | Tclk |
|            | Active     | Tdisp(h)           | 960  | 960  | 960  | Tclk |
|            | Blanking   | Tbp(h)+Tfp(h)+PWhs | 40   | 90   | 718  | Tclk |
| Clock      | Period     | Tclk               | 11.2 | 14   | 18.6 | ns   |
|            | Frequency  | Freq.              | 53.7 | 71.2 | 90   | MHz  |
| Frame Rate | Frame Rate | 1/Tv               | 49   | 60   | 76   | Hz   |

Note(1) Only DE mode operation.

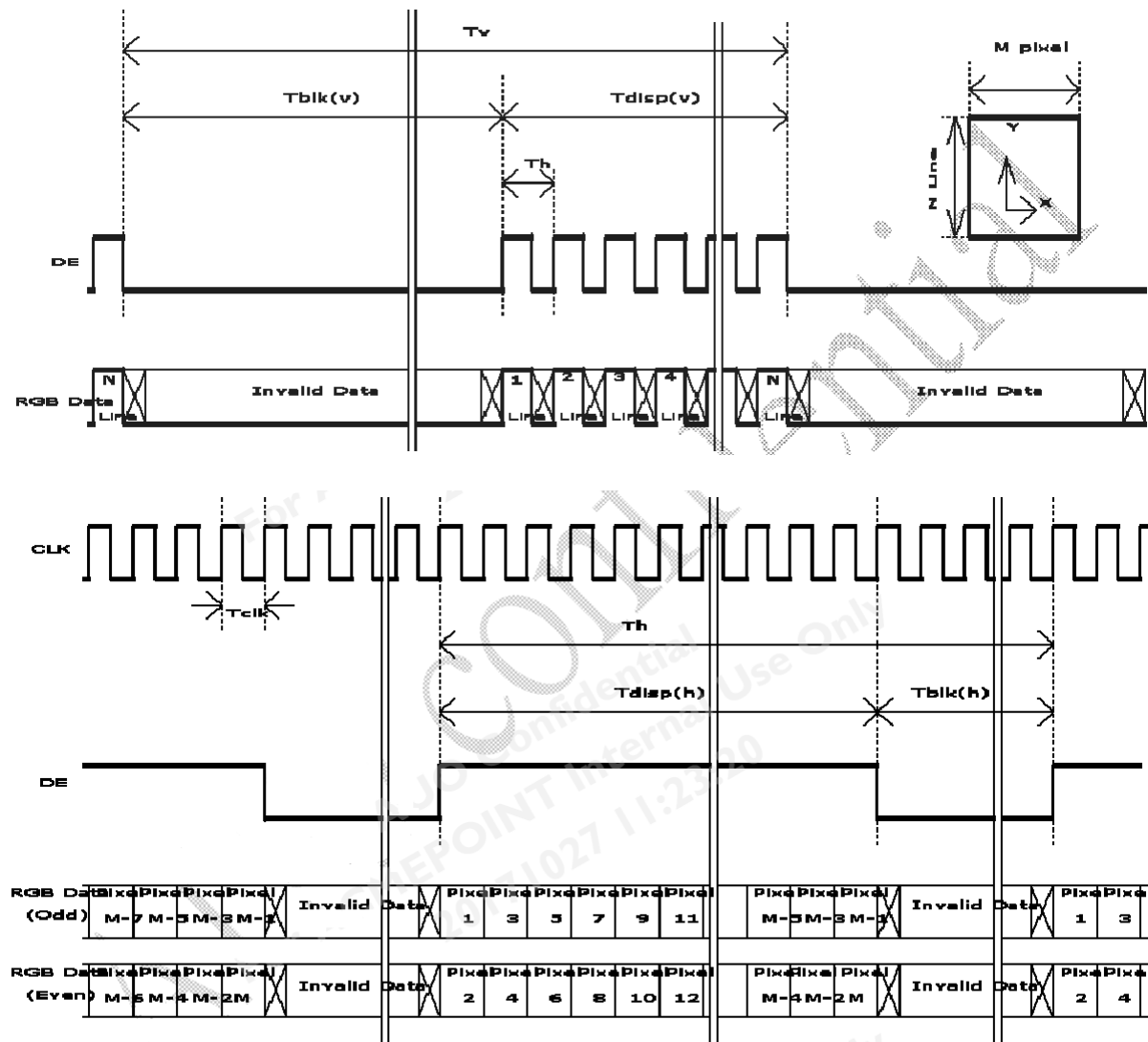
The input of Hsync & Vsync signal does not have an effect upon the LCD normal operation.

Note(2) The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rates.

Note(3) Horizontal period should be even.

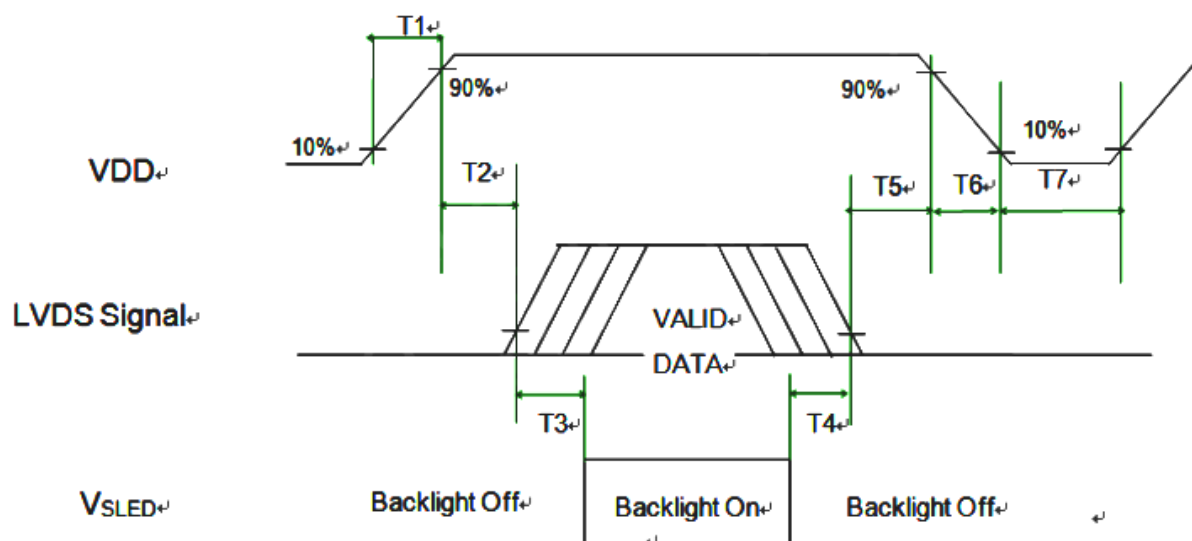


## 5.2 Timing diagram



### 5.3 Power Sequence

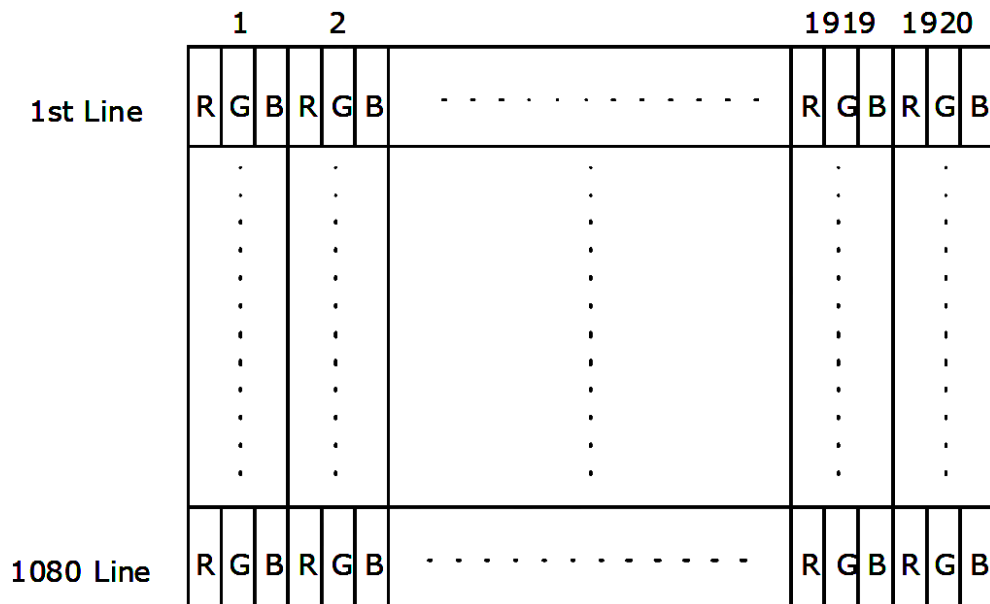
VDD power and LED on/off sequence are as follows. Interface signals are also shown in the chart.



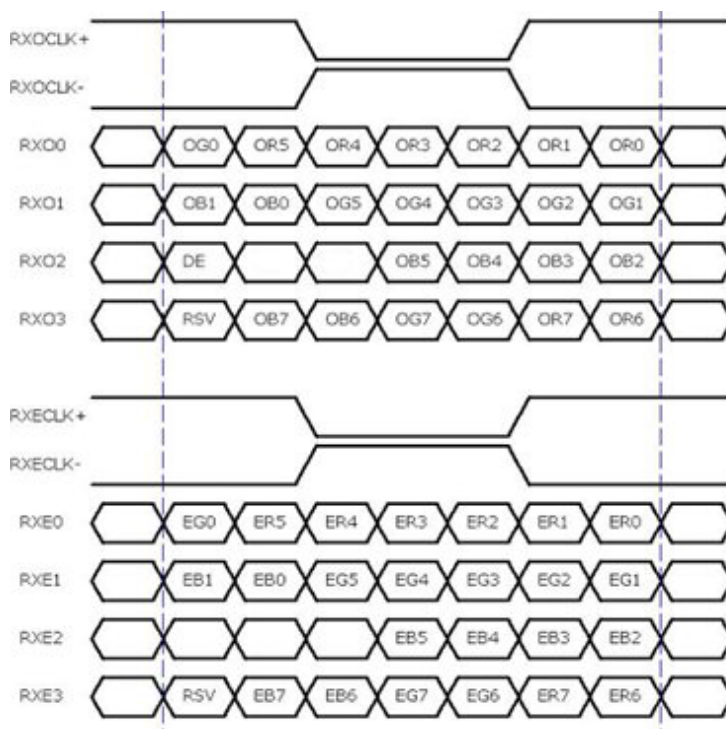
| Parameter | Value |      |      | Units |
|-----------|-------|------|------|-------|
|           | Min.  | Typ. | Max. |       |
| T1        | 0.5   | -    | 10   | [ms]  |
| T2        | 0     | -    | 50   | [ms]  |
| T3        | 500   | -    | -    | [ms]  |
| T4        | 100   | -    | -    | [ms]  |
| T5        | 0     | -    | 50   | [ms]  |
| T6        | 0     | -    | 200  | [ms]  |
| T7        | 1000  | -    | -    | [ms]  |

## 5.4 Pixel Format Image

Following figure shows the relationship of the input signals and LCD pixel format.



## 5.5 The input data format



| 8 Bit Color Bit Order |    |    |    |
|-----------------------|----|----|----|
| MSB                   | R7 | G7 | B7 |
|                       | R6 | G6 | B6 |
|                       | R5 | G5 | B5 |
|                       | R4 | G4 | B4 |
|                       | R3 | G3 | B3 |
|                       | R2 | G2 | B2 |
|                       | R1 | G1 | B1 |
| LSB                   | R0 | G0 | B0 |

Note(1) Normally DE mode only. VS and HS on EVEN channel are not used.

Note(2) Please follow VESA.

Note(3) 8-bits signal input.

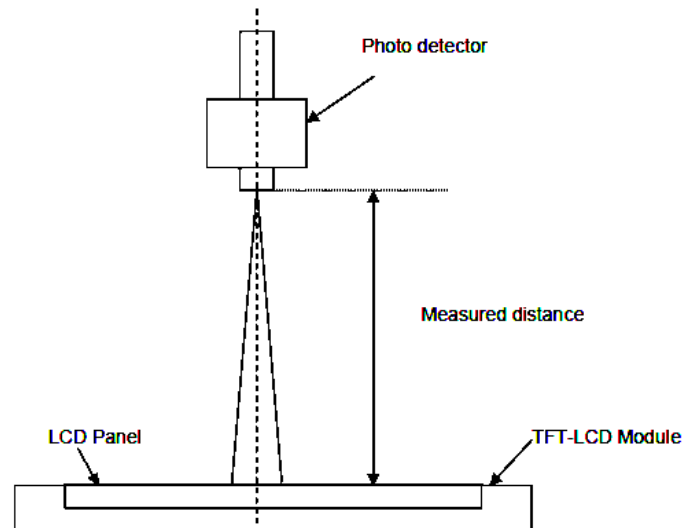
## 6.0 Optical Specifications

The optical characteristics are measured under stable conditions as following notes

| Item                            | Conditions       |            | Min.          | Typ.  | Max.          | Unit              | Note    |
|---------------------------------|------------------|------------|---------------|-------|---------------|-------------------|---------|
| Viewing Angle<br>(CR>10)        | Horizontal       | $\theta_L$ | --            | 89    | --            | degree            | Note(2) |
|                                 |                  | $\theta_R$ | --            | 89    | --            |                   |         |
|                                 | Vertical         | $\theta_T$ | --            | 89    | --            |                   |         |
|                                 |                  | $\theta_B$ | --            | 89    | --            |                   |         |
| Contrast Ratio                  | Center           |            | 800           | 1000  | --            | --                | Note(3) |
| Response Time                   | Rising + Falling |            | --            | 22    | 42            | ms                | Note(4) |
| Color Chromaticity<br>(CIE1931) | Red              | x          | Typ.<br>-0.05 | TBD   | Typ.<br>+0.05 | --                | Note(5) |
|                                 | Red              | y          |               | TBD   |               | --                |         |
|                                 | Green            | x          |               | TBD   |               | --                |         |
|                                 | Green            | y          |               | TBD   |               | --                |         |
|                                 | Blue             | x          |               | TBD   |               | --                |         |
|                                 | Blue             | y          |               | TBD   |               | --                |         |
|                                 | White            | x          |               | 0.313 |               | --                |         |
|                                 | White            | y          |               | 0.329 |               | --                |         |
| White Luminance                 | Center           |            | 238           | 298   | --            | cd/m <sup>2</sup> | Note(6) |
| Luminance Uniformity            | 9Points          |            | 75            | 80    | --            | %                 | Note(7) |
| Color Gamut                     | --               |            | --            | 72    | --            | %                 | --      |

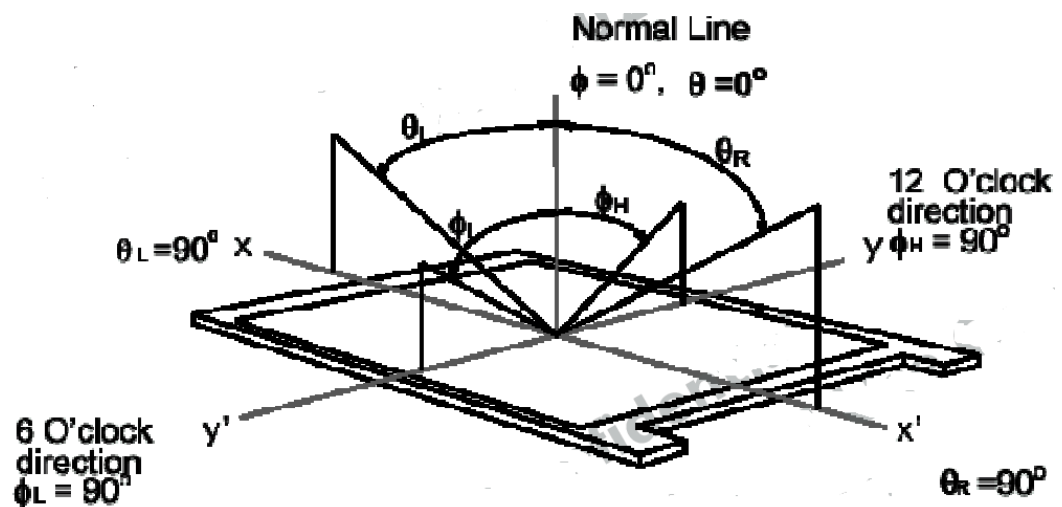
Note(1) Measurement method

The LCD module should be stabilized at given temperature for 30 minutes to avoid abrupt temperature change during measuring (at surface 35°C). In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 30 minutes in a stable, windless and dark room.



Note(2) Definition of viewing angle

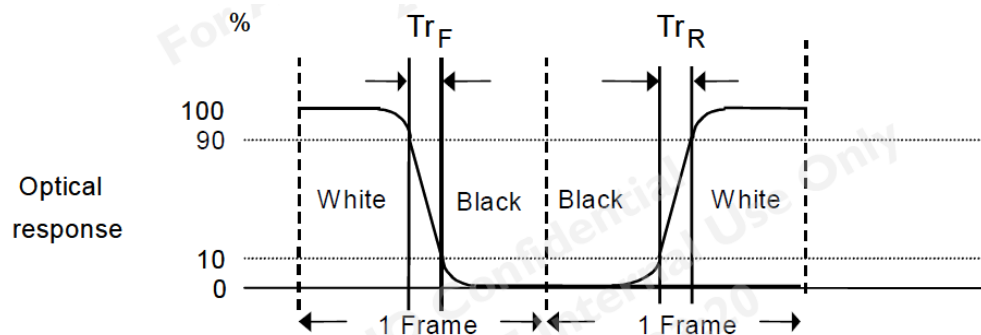
Viewing angle is the measurement of contrast ratio  $\geq 10$ , at the screen center, over a 180° horizontal and 180° vertical range (off-normal viewing angles). The 180° viewing angle range is broken down as follows; 90° ( $\theta$ ) horizontal left and right and 90° ( $\phi$ ) vertical, high (up) and low (down). The measurement direction is typically perpendicular to the display surface with the screen rotated about its center to develop the desired measurement viewing angle.



Note(3) Contrast ratio is measured.

Note(4) Definition of Response time

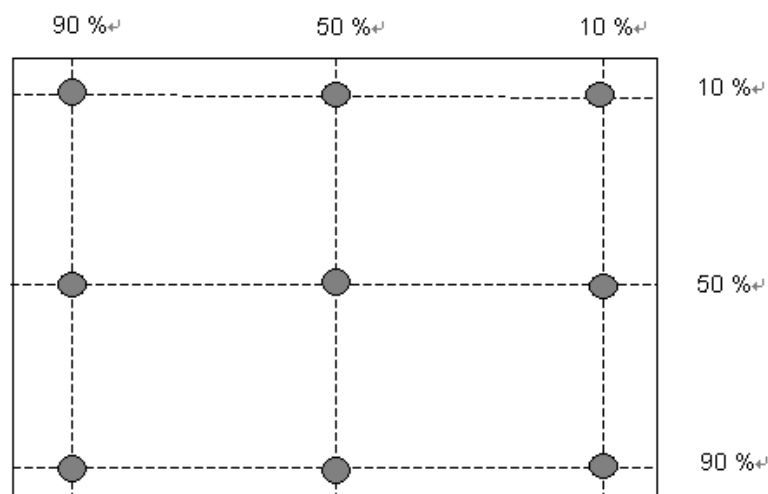
The output signals of photo detector are measured when the input signals are changed from “Full Black” to “Full White” (rising time,  $Tr_R$ ), and from “Full White” to “Full Black” (falling time,  $Tr_F$ ), respectively. The response time is interval between the 10% and 90% (1 frame at 60 Hz) of amplitudes.  $Tr_R + Tr_F = 5 \text{ msec (typ.)}$ .



Note(5) Color chromaticity and coordinates (CIE) is measured.

Note(6) Central luminance is measured.

Note(7) Luminance uniformity of these 9 points is defined as below and measured.



$$\text{Uniformity} = \frac{\text{Minimum Luminance in 9 points (1-9)}}{\text{Maximum Luminance in 9 Points (1-9)}}$$

## 7.0 Interface Connections

### 7.1 LCD interface

| Pin | Signal Name | Description   |
|-----|-------------|---|
| 1   | RxO0-       | Negative LVDS differential data input (Odd data)    |
| 2   | RxO0+       | Positive LVDS differential data input (Odd data)    |
| 3   | RxO1-       | Negative LVDS differential data input (Odd data)    |
| 4   | RxO1+       | Positive LVDS differential data input (Odd data)    |
| 5   | RxO2-       | Negative LVDS differential data input (Odd data)    |
| 6   | RxO2+       | Positive LVDS differential data input (Odd data)    |
| 7   | GND         | Ground  |
| 8   | RxOCLK-     | Negative LVDS differential clock input (Odd clock)  |
| 9   | RxOCLK+     | Positive LVDS differential clock input (Odd clock)  |
| 10  | RxO3-       | Negative LVDS differential data input (Odd data)    |
| 11  | RxO3+       | Positive LVDS differential data input (Odd data)    |
| 12  | RxE0-       | Negative LVDS differential data input (Even data)   |
| 13  | RxE0+       | Positive LVDS differential data input (Even data)   |
| 14  | GND         | Ground  |
| 15  | RxE1-       | Negative LVDS differential data input (Even data)   |
| 16  | RxE1+       | Positive LVDS differential data input (Even data)   |
| 17  | GND         | Ground  |
| 18  | RxE2-       | Negative LVDS differential data input (Even data)   |
| 19  | RxE2+       | Positive LVDS differential data input (Even data)   |
| 20  | RxECLK-     | Negative LVDS differential clock input (Even clock) |
| 21  | RxECLK+     | Positive LVDS differential clock input (Even clock) |
| 22  | RxE3-       | Negative LVDS differential data input (Even data)   |
| 23  | RxE3+       | Positive LVDS differential data input (Even data)   |
| 24  | GND         | Ground  |
| 25  | NC          | No connection                                       |
| 26  | NC          | No connection                                       |
| 27  | NC          | No connection                                       |
| 28  | VDD         | Power Supply Input Voltage                          |
| 29  | VDD         | Power Supply Input Voltage                          |
| 30  | VDD         | Power Supply Input Voltage                          |

| Connector Name / Designation | Interface Connector / Interface card |
|------------------------------|--------------------------------------|
| Manufacturer                 | STM                                  |
| Type Part Number             | MSBKT2407P30HB                       |
| Mating Housing Part Number   | FI-X30HL or FI-X30C2L-NPB            |

## 7.2 Backlight interface

| Pin | Signal Name | Description                               |
|-----|-------------|---|
| 1   | CH1         | LED Current Feedback Terminal (Channel 1) |
| 2   | CH2         | LED Current Feedback Terminal (Channel 2) |
| 3   | VSLED       | LED Power Supply Voltage Input Terminal   |
| 4   | VSLED       | LED Power Supply Voltage Input Terminal   |
| 5   | CH3         | LED Current Feedback Terminal (Channel 3) |
| 6   | CH4         | LED Current Feedback Terminal (Channel 4) |

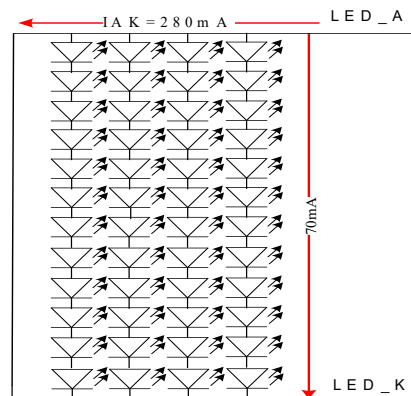
| Connector Name / Designation  | LED Connector  |
|-------------------------------|--|
| Manufacturer                  | ENTERY   |
| Connector Model Number        | 3707K-S06N-21R   |
| Mating Connector Model Number | H112K-P06N-00B (Non-Locking type)<br>H112K-P06N-13B (Locking type) |



## 8.0 LED Driving Conditions

| Item          | Symbol | Values |      |      | Unit | Note                     |
|---------------|--------|--------|------|------|------|--------------------------|
|               |        | Min.   | Typ. | Max. |      |                          |
| LED voltage   | VAK    | 32.4   | 33.5 | 34.6 | V    | IAK<br>=280mA<br>Ta=25°C |
| LED current   | IAK    | --     | 280  | 320  | mA   | Ta=25°C                  |
| LED Life Time | -      | --     | 50K  | --   | Hour | Note (2)                 |

Note(1) The constant current source is needed for white LED back-light driving.

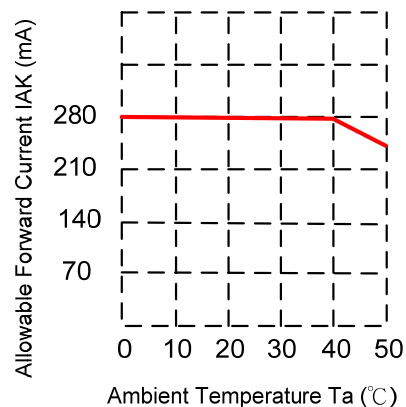


Note(2) Condition: Ta=25°C , continuous lighting

Life time is estimated data. Definitions of failure:

1. LCM brightness becomes half of the minimum value.
2. LED doesn't light normally.

When LCM is operated over 40°C ambient temperature, the IAK should follow :



## 9.0 Touch panel electrical specification

### 9.1 Electrical characteristics

| Item                   | Specification                     |
|------------------------|-----------------------------------|
| Type                   | Projective Capacitive Touch Panel |
| Activation             | Multi-fingers or Single-finger    |
| X/Y Position Reporting | Absolute Position                 |
| Touch Force            | No contact pressure required      |
| Calibration            | No need for calibration           |
| Report Rate            | TBD                               |
| Control IC             | ILI2510                           |

### 9.2 Optical Characteristic

| Item          | Specification |
|---------------|---------------|
| Transmittance | 80% (min)     |

### 9.3 Electrical Characteristic

| Item                             | Symbol | Min. | Typ. | Max  | Unit |
|----------------------------------|--------|------|------|------|------|
| Touch panel power supply         | VDD    | 4.75 | 5    | 5.25 | V    |
| Touch panel power supply current | IVDD   | --   | TBD  | --   | mA   |

### 9.4 Interface

| Pin No. | Symbol | Function          |
|---------|--------|-------------------|
| 1       | GND    | Power GND         |
| 2       | DA-    | USB Data -        |
| 3       | DA+    | USB Data +        |
| 4       | VIN    | Power supply 5.0V |
| 5       | NA     | No connection     |
| 6       | NA     | No connection     |

## 10.0 Reliability Test

The reliability test items and its conditions are shown below.

| Test Item                                | Test Conditions  | Note |
|--|--|------|
| High Temperature Operation               | 50±3°C , t=240 hrs   |      |
| Low Temperature Operation                | 0±3°C , t=240 hrs  |      |
| High Temperature Storage                 | 60±3°C , t=240 hrs   | 1,2  |
| Low Temperature Storage                  | -20±3°C , t=240 hrs  | 1,2  |
| Storage at High Temperature and Humidity | 40°C, 90% RH , 240 hrss  | 1,2  |
| Thermal Shock Test                       | -30°C (30min) ~ 60°C (30min) , 27 cycles   | 1,2  |
| Vibration Test (Packing)                 | Sweep frequency : 10~55~10 Hz/1min<br>Amplitude : 0.75mm<br>Test direction : X.Y.Z/3 axes<br>Duration : 30 min/each axis | 2    |

Note(1) Condensation of water is not permitted on the module.

Note(2) The module should be inspected after 1 hour storage in normal conditions (15-35°C, 45-65%RH).

Note(3) The module shouldn't be tested over one condition, and all the tests are independent.

Note(4) All reliability tests should be done without the protective film. Current drain should be smaller than the specific value.

Definitions of life end point:

- Current drain should be smaller than the specific value.
- Function of the module should be maintained.
- Appearance and display quality should not have degraded noticeably.
- Contrast ratio should be greater than 50% of the initial value.

## **11. General Precaution**

### **11.1 Use Restriction**

- (1) 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.

### **11.2 Disassembling or Modification**

- (1) Do not disassemble or modify the module. It may damage sensitive parts inside LCD module, and may cause scratches or dust on the display. AMPIRE does not warrant the module, if customers disassemble or modify the module.

### **11.3 Breakage of LCD Panel**

- (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.
- (2) If liquid crystal contacts mouth or eyes, rinse out with water immediately.
- (3) If liquid crystal contacts skin or cloths, wash it off immediately with alcohol and rinse thoroughly with water.

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

### **11.4 Electric Shock**

- (1) Disconnect power supply before handling LCD module.
- (2) Do not pull or fold the LED cable.
- (3) Do not touch the parts inside LCD modules and the fluorescent LED's connector or cables in order to prevent electric shock.

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

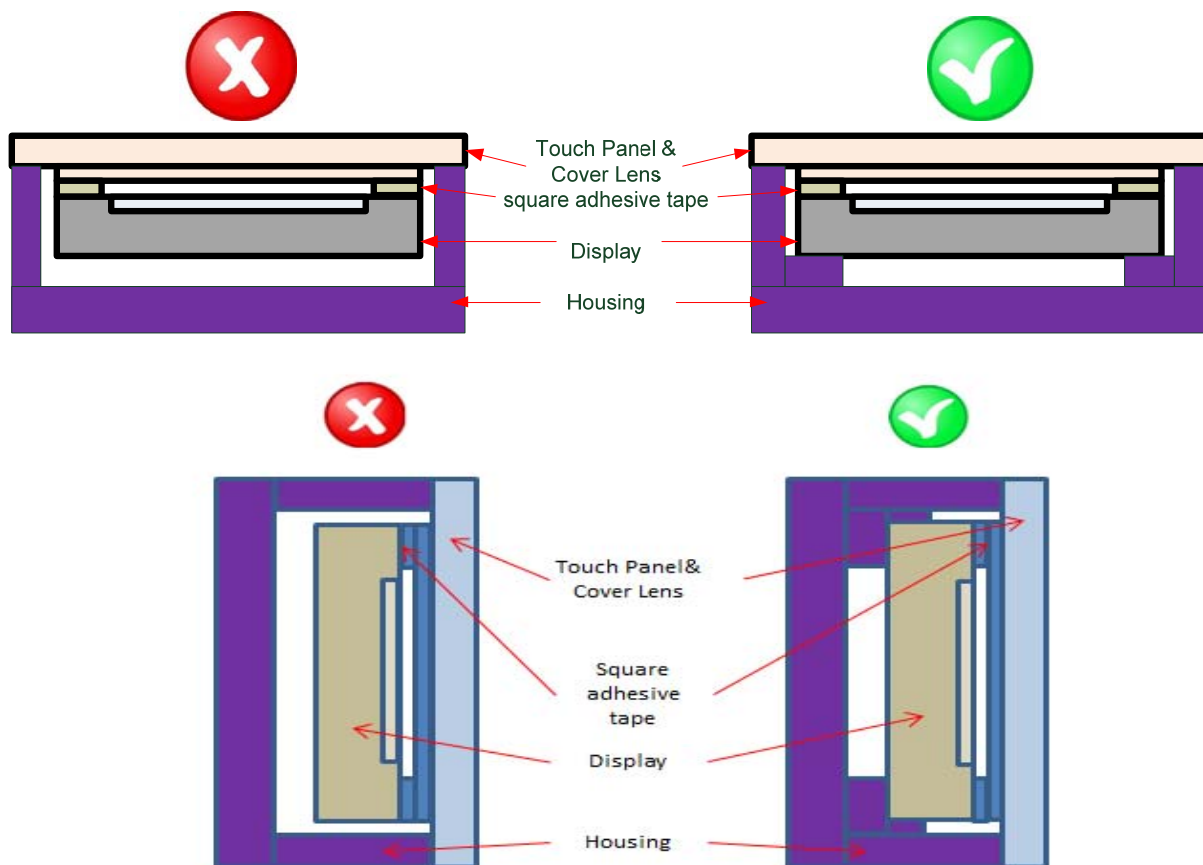
- (1) Do not exceed the absolute maximum rating values, such as the supply voltage variation, input voltage variation, variation in parts' parameters, environmental temperature, etc., otherwise LCD module may be damaged.
- (2) Please do not leave LCD module in the environment of high humidity and high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

## 11.6 Operation

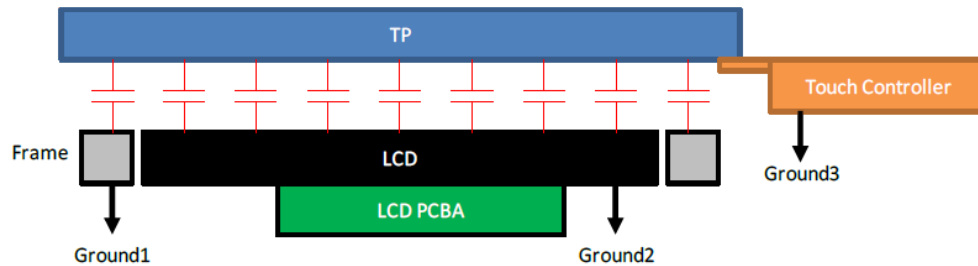
- (1) Do not touch, push or rub the polarizer with anything harder than HB pencil lead.
- (2) Use fingerstalls of soft gloves in order to keep clean display quality, when persons handle the LCD module for incoming inspection or assembly.
- (3) When the surface is dusty, please wipe gently with absorbent cotton or other soft material.
- (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 cause deformation or color fading.
- (5) When cleaning the adhesives, please use absorbent cotton wetted with a little petroleum benzene or other adequate solvent.

## 11.7 Mechanism

- (1) Please mount LCD module by using mounting holes arranged in four corners tightly.



- (2) TP needs to work in environment with stable stray capacitance. In order to minimize the variation in stray capacitance, all conductive mechanical parts must not be floating. Intermittent floating any conductive part around the touch sensor may cause significant stray capacitance change and abnormal touch function. It is recommended to keep all conductive parts having same electrical potential as the GND of the touch controller module.



GND1, GND2 and GND3 should be connected together to have the same ground

### 11.8 Static Electricity

- (1) Protection film must remove very slowly from the surface of LCD module to prevent from electrostatic occurrence.
- (2) Because LCD modules 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.

### 11.9 Strong Light Exposure

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

### 11.10 Disposal

- (1) When disposing LCD module, obey the local environmental regulations.

### 11.11 Others

- (1) AMIPRE will provide one year warrantee for all products and three months warrantee for all repairing products.
- (2) Do not keep the LCD at the same display pattern continually. The residual image will happen and it will damage the LCD. Please use screen saver.

