



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

LMT043DFFFWD-2

LCD Module User Manual

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|---|----------------------------------|-----------------------------------|
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|---|----------------------------------|-----------------------------------|

| Rev. | Descriptions | Release Date |
|------|--------------|--------------|
| 0.1 | Preliminary | 2016-11-23 |
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1. General Specification

| | |
|-------------------------|--|
| Screen Size(Diagonal) : | 4.3 inch |
| Resolution : | 480(RGB) x 272 |
| Signal Interface : | 24bit parallel interface |
| Color Depth : | 16.7M color (24bit) (*1) |
| Dot Pitch : | 0.198 x 0.198 (mm) |
| Pixel Configuration : | RGB Stripe |
| Display Mode : | Transmissive / Positive (normal white) |
| Surface Treatment : | Anti-Glare Treatment |
| Viewing Direction : | 12 o'clock (Gray Scale Inversion Direction) (*2) 6 o'clock (*3) |
| Outline Dimension : | 105.5 x 67.2 x 2.9 (mm) (exclude FPC/FFC, see attached drawing for details) |
| Active Area : | 95.04 x 53.86 (mm) |
| Backlight : | White LED |
| Operating Temperature : | -20 ~ +70°C |
| Storage Temperature : | -30 ~ +80°C |

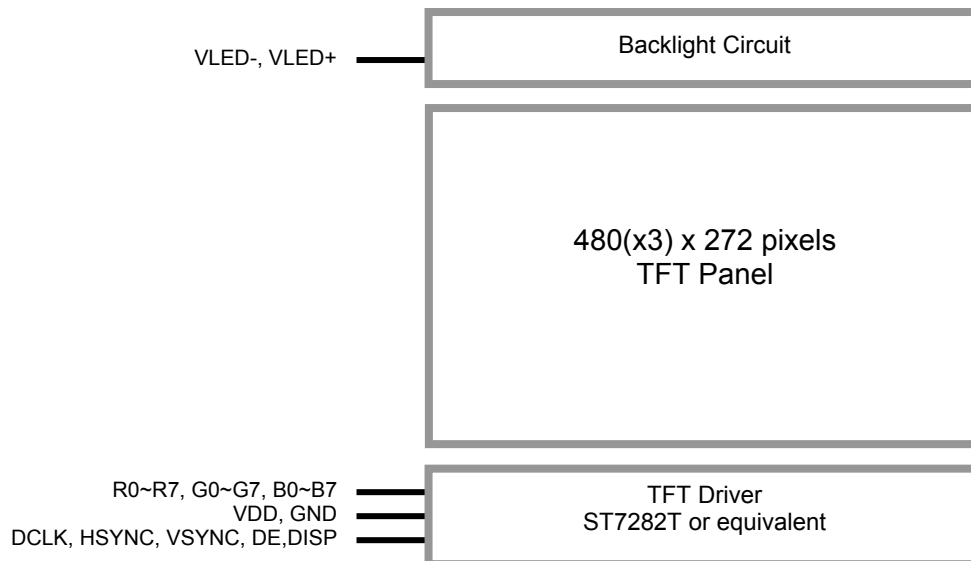
Note:

*1 Color tune may slightly changed by temperature and driving voltage.

*2 For saturated color display content (eg. pure-red, pure-green, pure-blue or pure-colors-combinations).

*3 For "color scales" display content.

2. Block Diagram



3. Terminal Functions

3.1 Interface

| Pin No. | Pin Name | I/O | Descriptions |
|---------|----------|-----|--|
| 1 | VLED- | P | Backlight LED Cathode supply |
| 2 | VLED+ | P | Backlight LED Anode supply |
| 3 | GND | P | Power Ground (0V) |
| 4 | VDD | P | Positive Power Supply |
| 5 | R0 | I | Red color data input |
| : | : | | |
| 12 | R7 | | |
| 13 | G0 | I | Green color data input |
| : | : | | |
| 20 | G7 | | |
| 21 | B0 | I | Blue color data input |
| : | : | | |
| 28 | B7 | | |
| 29 | GND | P | Power Ground (0V) |
| 30 | DCLK | I | Data clock signal input, rising edge trigger |
| 31 | DISP | I | Display on/of control (internally pull high) DISP=1: normal operation DISP=0: standby mode |
| 32 | HSYNC | I | Horizontal Sync signal input (negative polarity, internally pull high) (If not using, pull high) |
| 33 | VSYNC | I | Vertical Sync Signal Input (negative polarity, internally pull high) (If not using, pull high) |
| 34 | DE | I | Data Enable Signal Input (internal pull low) (If not using, pull low) |
| 35 | NC | - | No connection, leave open |
| 36 | GND | P | Power Ground (0V) |
| 37 | NC | - | No connection, leave open |
| 38 | NC | | |
| 39 | NC | | |
| 40 | NC | | |

Note:

The LMT043DFFFWD both supports DE mode and Sync mode timing.
 SYNC mode, DE pull-lo, HSYNC and VSYNC for timing control
 DE mode, HSYNC and VSYNC pull-hi, DE for timing control

4. Absolute Maximum Ratings

| Items | Symbol | Min. | Max. | Unit | Condition |
|-----------------------|----------|------|------|------|-----------------|
| Supply Voltage | V_{DD} | -0.3 | +4.6 | V | GND = 0V |
| Operating Temperature | T_{OP} | -20 | +70 | °C | No Condensation |
| Storage Temperature | T_{ST} | -30 | +80 | °C | No Condensation |

Cautions:

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 DC Characteristics (MCU terminal)

GND=0V, V_{DD} =3.3V, T_{OP} =25°C

| Items | Symbol | MIN. | TYP. | MAX. | Unit | Applicable Pin |
|------------------------|--------------|--------|------|--------|------|----------------|
| Operating Voltage | V_{DD} | 3.0 | 3.3 | 3.6 | V | VDD |
| Input High Voltage | V_{IH} | 0.7VDD | - | VDD | V | Input pins |
| Input Low Voltage | V_{IL} | GND | - | 0.3VDD | V | Input pins |
| Frame Freq | F_{FRAME} | - | 60 | - | Hz | |
| Dot Data Clock | f_{DOTCLK} | - | 9.0 | 15 | MHz | |
| Operating Current (*1) | I_{DD} | - | 18.4 | - | mA | VDD |
| Standby Current (*2) | I_{DD} | - | 15.2 | - | uA | VDD |

Note.

*1. test image is Black Mode, Frame Freq=60Hz

*2. DISP=0

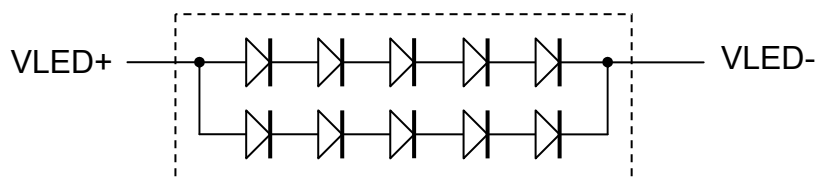
5.2 LED Backlight Circuit Characteristics

$I_{f_{VLED+}}$ =40mA, T_{OP} =25°C

| Items | Symbol | MIN. | TYP. | MAX. | Unit | Note |
|-----------------|-----------------|--------|----------|------|------|------|
| Forward Voltage | V_f | - | 16.0 | - | V | |
| Forward Current | $I_{f_{VLED+}}$ | - | 40 | 50 | mA | |
| Life Time | - | 10,000 | (20,000) | - | hr | |

Cautions:

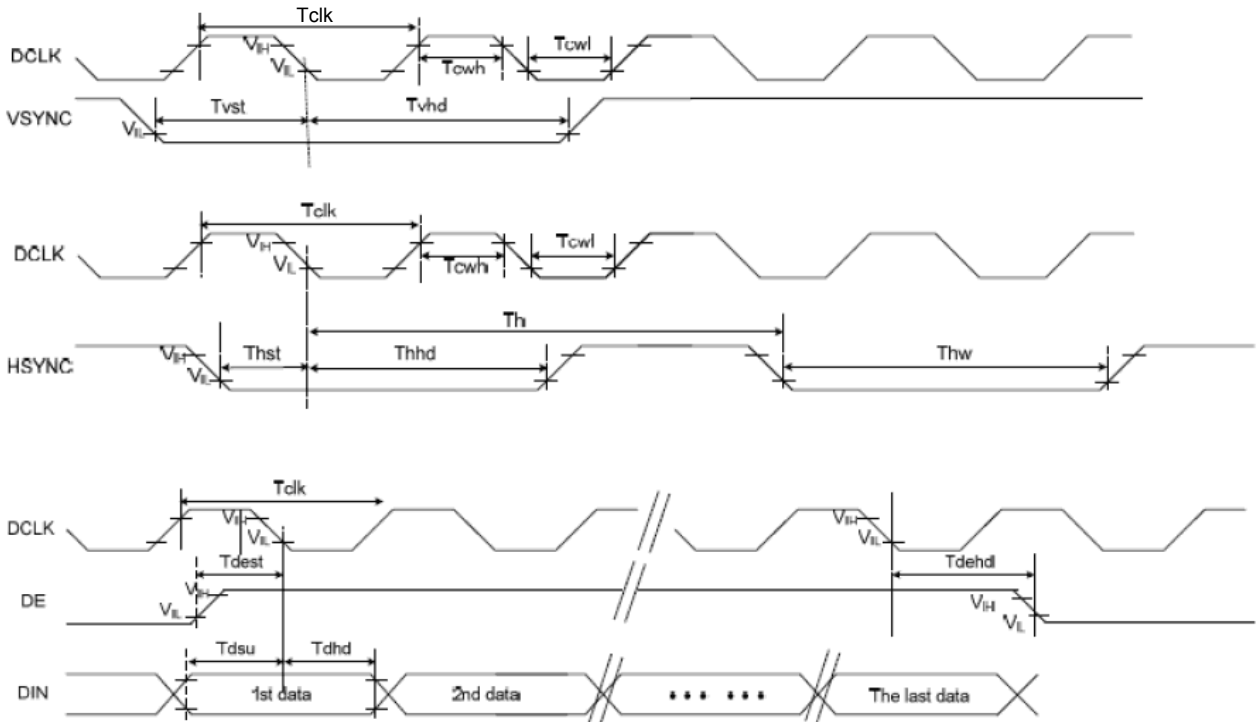
Exceeding the recommended driving current could cause substantial damage to the backlight and shorten its lifetime.



No. of LEDs = 2x5 pcs

5.3 AC Characteristics

5.3.1 Clock and Date Input Timing Diagram

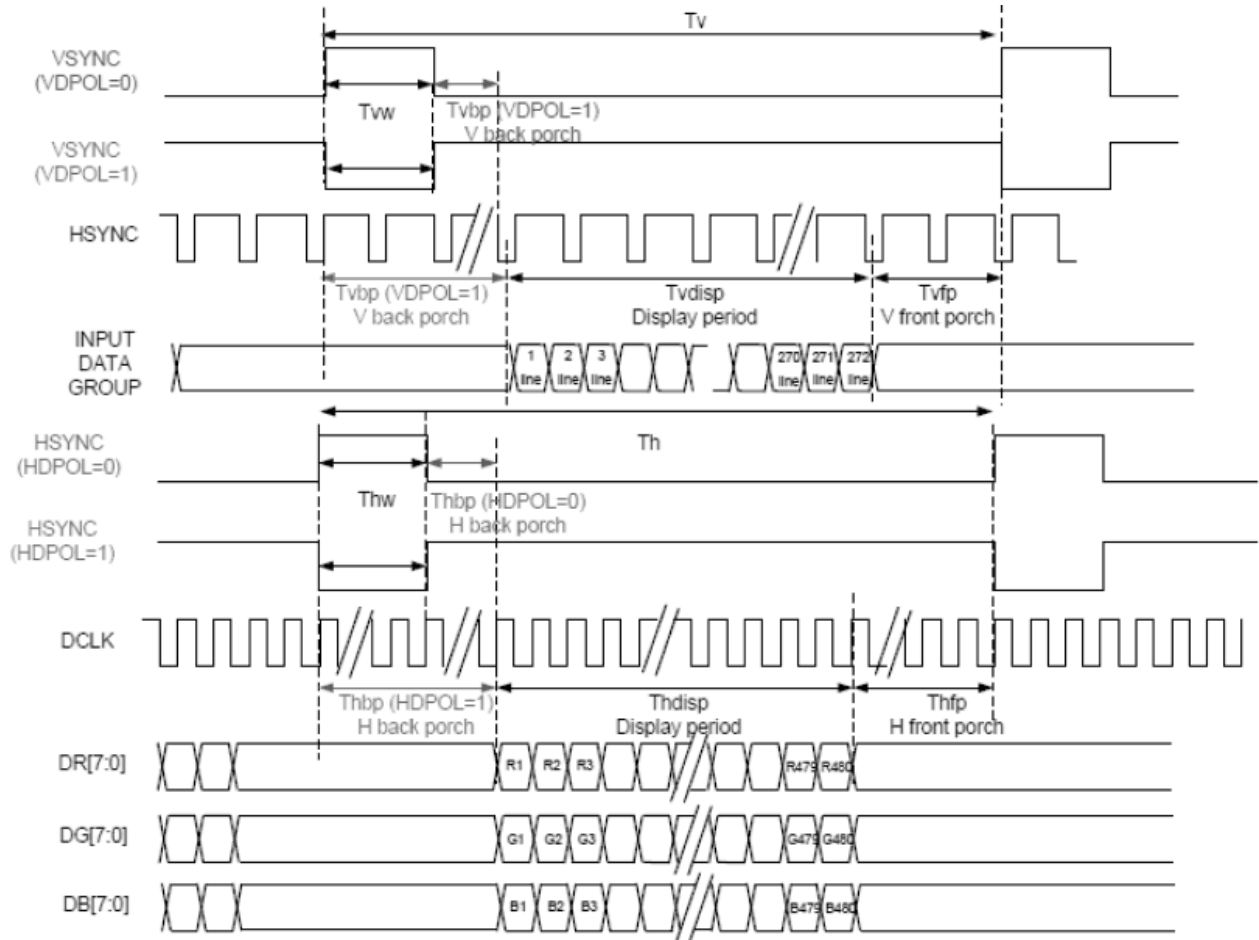


Timing Diagram

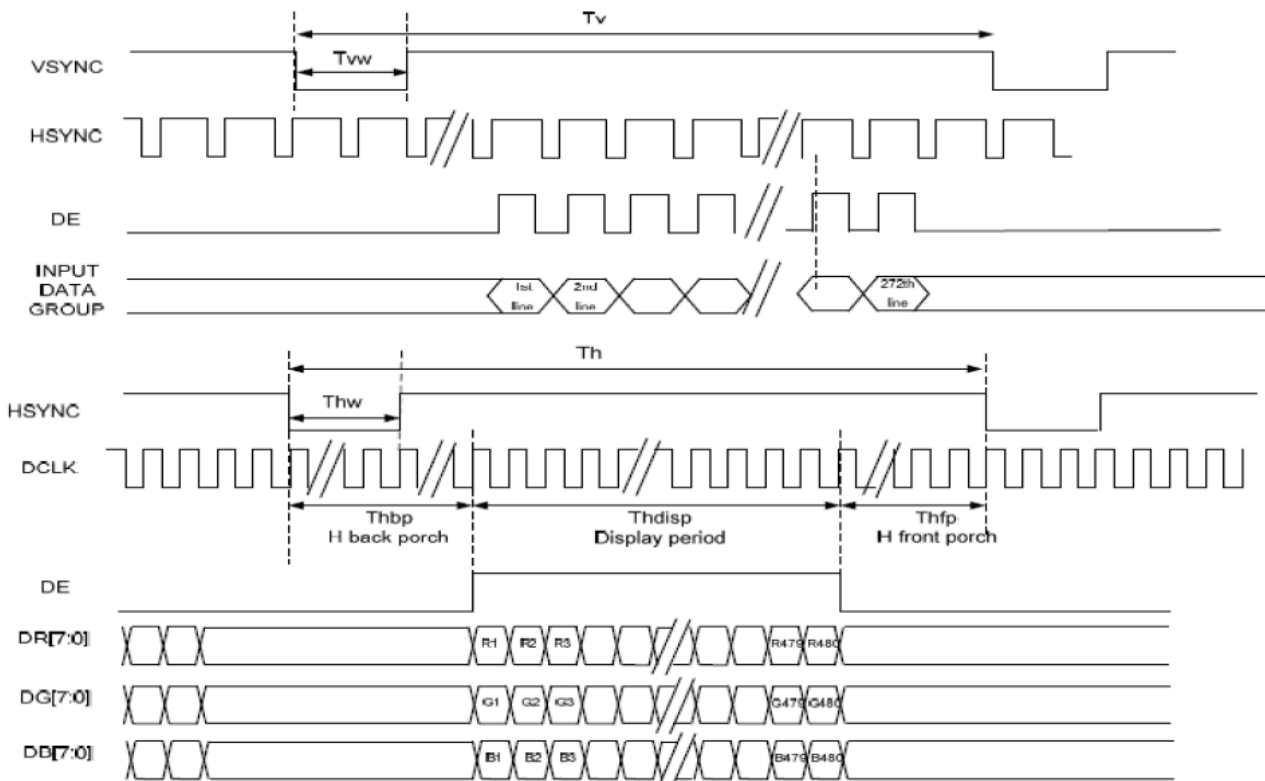
VDDI =3.3V, VDD=3.3V, AGND=0V, T_{OP} =25°C

| Item | Symbol | Min. | Typ. | Max. | Unit | Conditions |
|------------------------------|--------|------|------|------|------|--|
| System operation timing | | | | | | |
| VDD power source slew time | TPOR | - | - | 20 | ms | From 0V to 99% VDD |
| GRB pulse width | trSTW | 10 | 50 | - | us | R=10Kohm, C=1uF |
| Input/ Output timing | | | | | | |
| CLK pulse duty | Tcw | 40 | 50 | 60 | % | |
| Hsync width | Thw | 1 | - | - | DCLK | |
| Hsync period | Th | 55 | 60 | 65 | us | |
| Vsync setup time | Tvst | 12 | - | - | ns | |
| Vsync hold time | Tvhd | 12 | - | - | ns | |
| Hsync setup time | Thst | 12 | - | - | ns | |
| Hsync hold time | Thhd | 12 | - | - | ns | |
| Data setup time | Tdsu | 12 | - | - | ns | |
| Data hold time | Tdhhd | 12 | - | - | ns | |
| DE setup time | Tdest | 10 | - | - | ns | |
| DE hold time | Tdehd | 10 | - | - | ns | |
| SD output stable time | Tst | - | - | 12 | us | Output settled within +20mV Loading = 6.8k+28.2pF. |
| GD output rise and fall time | Tgst | - | - | 6 | us | Output settled (5%~95%), Loading = 4.7k+29.8pF |
| 3-wire serial communication | | | | | | |
| Delay between CSB and Vsync | Tcv | 1 | | | us | |
| CS input setup time | Ts0 | 50 | | | ns | |
| Serial data input setup time | Ts1 | 50 | | | ns | |
| CS input hold time | Th0 | 50 | | | ns | |
| Serial data input hold time | Th1 | 50 | | | ns | |
| SCL pulse high width | Twh1 | 50 | | | ns | |
| SCL pulse low width | Twl1 | 50 | | | ns | |
| CS pulse high width | Tw2 | 400 | | | ns | |

5.3.2 SYNC Mode Timing Diagram



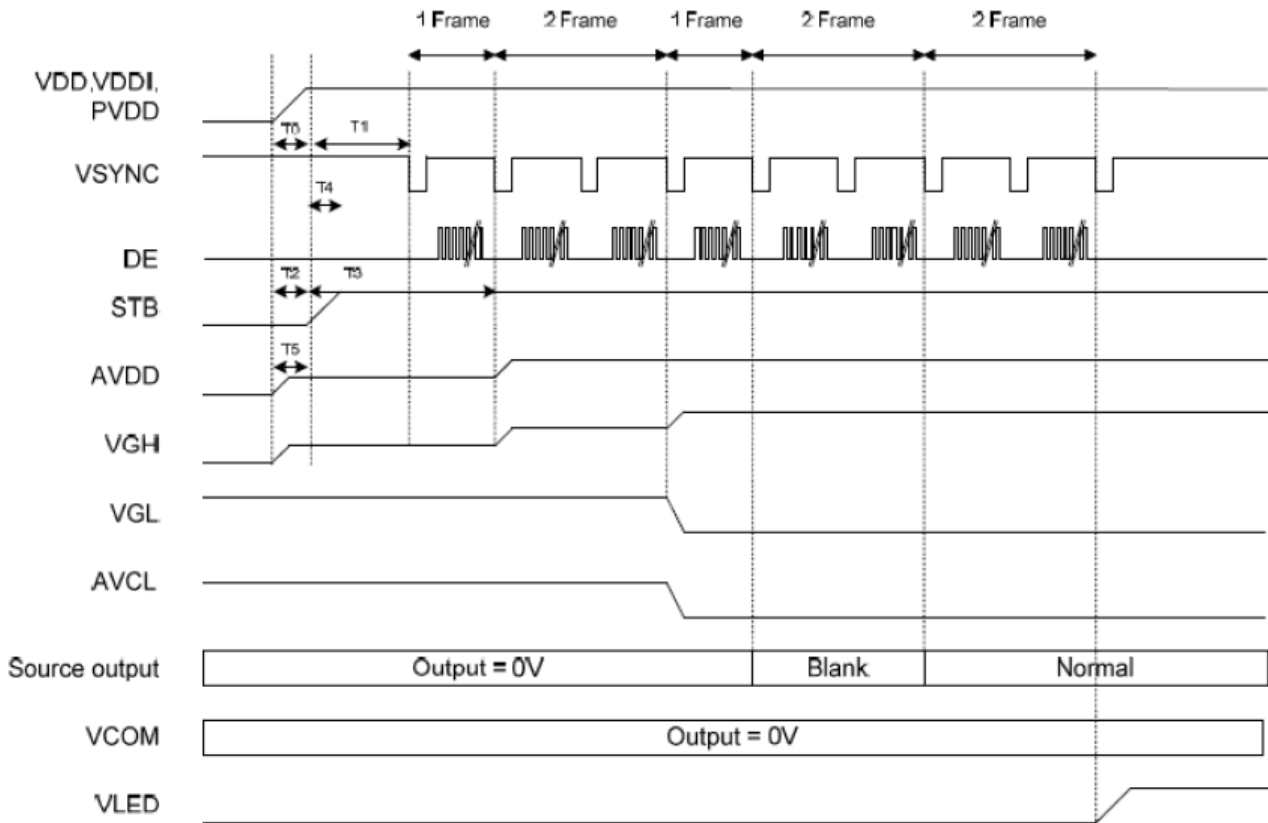
5.3.3 DE Mode Timing Diagram



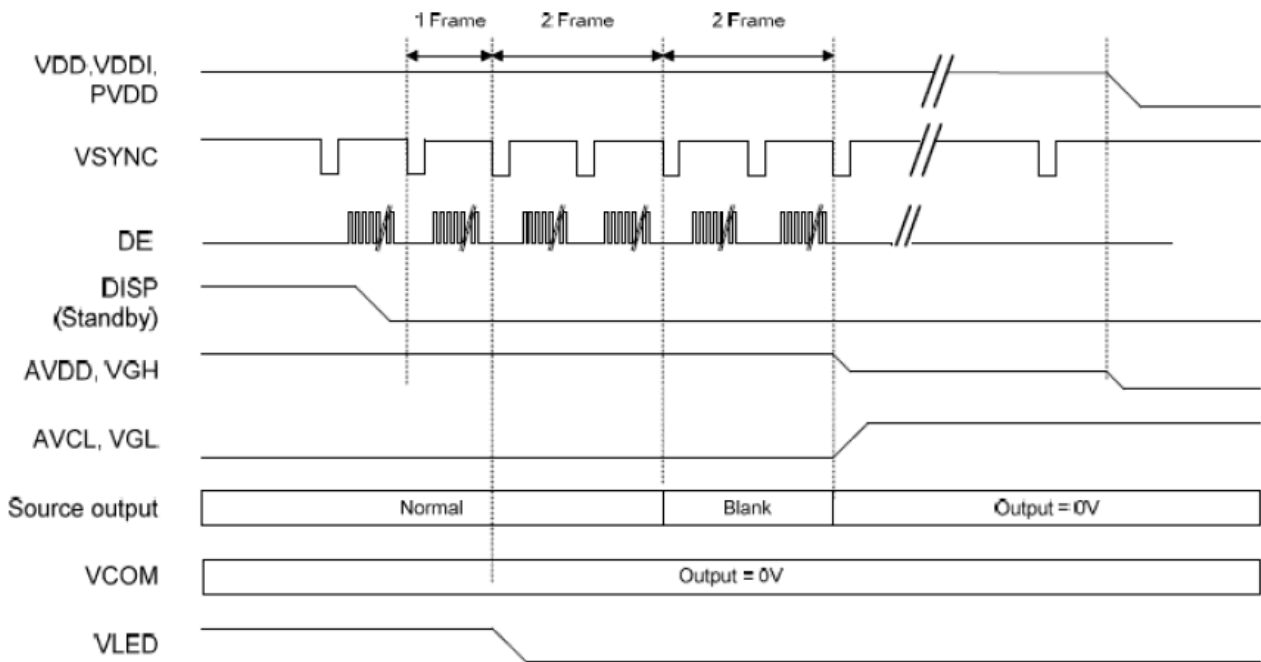
| Item | Symbol | Min. | Typ. | Max. | Unit | Remark |
|----------------|----------------|--------|------|------|------|-----------------------|
| DCLK Frequency | Fclk | 8 | 9 | 12 | MHz | |
| DCLK Period | Tclk | 83 | 111 | 125 | ns | |
| HSYNC | Period Time | Th | 485 | 531 | DCLK | |
| | Display Period | Thdisp | | 480 | DCLK | |
| | Back Porch | Thbp | 3 | 43 | DCLK | By H_Blanking setting |
| | Front Porch | Thfp | 2 | 8 | DCLK | |
| | Pulse Width | Thw | 2 | 4 | DCLK | |
| VSYNC | Period Time | Tv | 276 | 292 | H | |
| | Display Period | Tvdisp | | 272 | H | |
| | Back Porch | Tvbp | 2 | 12 | H | By V_Blanking setting |
| | Front Porch | Tvfp | 2 | 8 | H | |
| | Pulse Width | Tvw | 2 | 4 | H | |

Note: It is necessary to keep Tvbp =12 and Thbp =43 in sync mode. DE mode is unnecessary to keep it.

5.3.4 Power ON Sequence



5.3.5 Power Off Sequence



6. Optical Characteristics

| Item | Symbol | Condition | Min | Typ | Max | Unit | Remark |
|----------------|------------|--------------------|-----------------|-------|-------|-------------------|----------|
| View Angles | θT | $CR \geq 10$ | 70 | 80 | - | Degree | Note 2,3 |
| | θB | | 50 | 60 | - | | |
| | θL | | 70 | 80 | - | | |
| | θR | | 70 | 80 | - | | |
| Contrast Ratio | CR | $\theta = 0^\circ$ | 700 | 900 | - | | Note 3 |
| Response Time | T_{ON} | 25°C | - | 20 | 30 | ms | Note 4 |
| | T_{OFF} | | | | | | |
| Chromaticity | White | x | Backlight is on | 0.255 | 0.305 | 0.355 | Note 1,5 |
| | | y | | 0.277 | 0.327 | 0.377 | |
| | Red | x | | 0.534 | 0.584 | 0.634 | Note 1,5 |
| | | y | | 0.300 | 0.350 | 0.400 | |
| | Green | x | | 0.290 | 0.340 | 0.390 | Note 1,5 |
| | | y | | 0.543 | 0.593 | 0.643 | |
| | Blue | x | | 0.102 | 0.152 | 0.202 | Note 1,5 |
| | | y | | 0.040 | 0.090 | 0.140 | |
| Uniformity | U | | 75 | 80 | - | % | Note 6 |
| NTSC | | | 45 | 50 | - | % | Note 5 |
| Luminance | L | | 350 | 400 | - | cd/m ² | Note 7 |

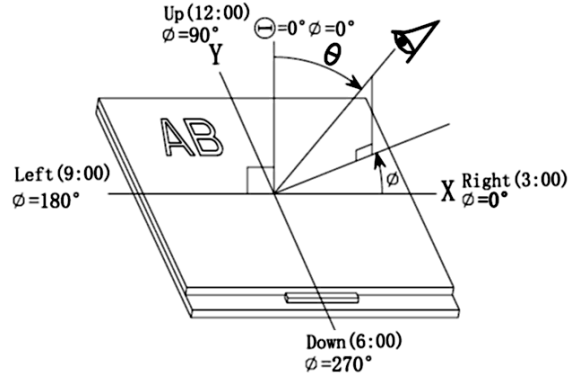
1. I_F = 40 mA, and the ambient temperature is 25°C.

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°C.
 - Adjust operating voltage to get optimum contrast at the center of the display.

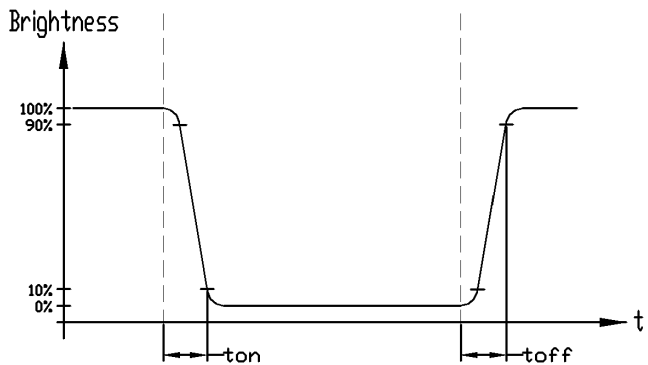
Note 2:
The definition of viewing angle:
Refer to the graph below marked by θ and ϕ



Note 3:
The definition of contrast ratio (Test LCD 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)

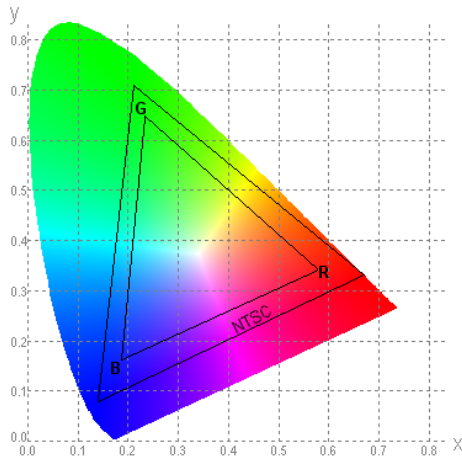
Note 4:
Definition of Response time. (Test LCD using BM-7A(2°)):
The output signals of photo detector are measured when the input signals are changed from "black" to "white"(falling time) and from "white" to "black"(rising time), respectively. The response time is defined as the time interval between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



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

Color gamut:

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

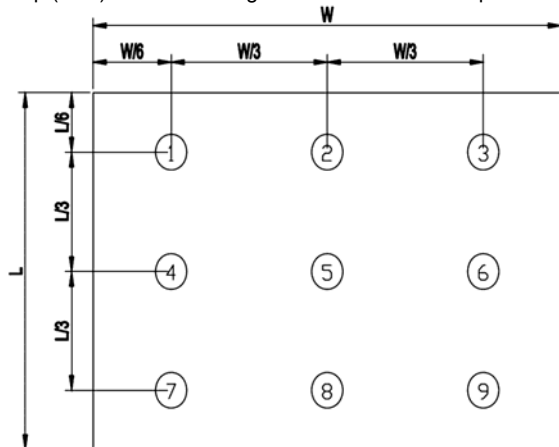


Note 6:
The luminance uniformity is calculated by using following formula.

$$\Delta B_p = B_p (\text{Min.}) / B_p (\text{Max.}) \times 100 (\%)$$

$$B_p (\text{Max.}) = \text{Maximum brightness in 9 measured spots}$$

$$B_p (\text{Min.}) = \text{Minimum brightness in 9 measured spots.}$$



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

7. 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 $\pm 200\text{mV}$ 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 to be 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.

8. Appendix A <Inspection items and criteria for appearance defect>

| Items | Criteria | | | |
|------------------------|---|--------|----------------|---------------------|
| Open Segment or Common | Not permitted | | | |
| Short | Not permitted | | | |
| Wrong Viewing Angle | Not permitted | | | |
| Decliners | Not permitted | | | |
| Contrast Ration Uneven | According to the limit specimen | | | |
| Crosstalk | According to the limit specimen | | | |
| White spots | X>1 pixel | A-area | Not permitted | Max 6 spots allowed |
| | | B-area | Max. 1 allowed | |
| | 1/2 pixel<X≤1 pixel | A-area | Not permitted | |
| | | B-area | Max. 2 allowed | |
| | X≤1/2 pixel | A-area | Max. 1 allowed | |
| | | B-area | Max. 4 allowed | |
| Black Sport | X>1 pixel | A-area | Not permitted | |
| | | B-area | Max. 2 allowed | |
| | X≤1/2 pixel | A-area | Max. 1 allowed | |
| | | B-area | Max. 4 allowed | |
| Line Defect | Apparent vertical horizontal line defects are not permitted | | | |

Note:

1. On Pixel include 3 dots (RedDot + GreenDot + BlueDot)
2. Definition of Panel "A-area" and "B-area"

