# TECHNICAL SPECIFICATION

## *CONTENTS*

## 1. Application

This data sheet applies to a color TFT LCD module

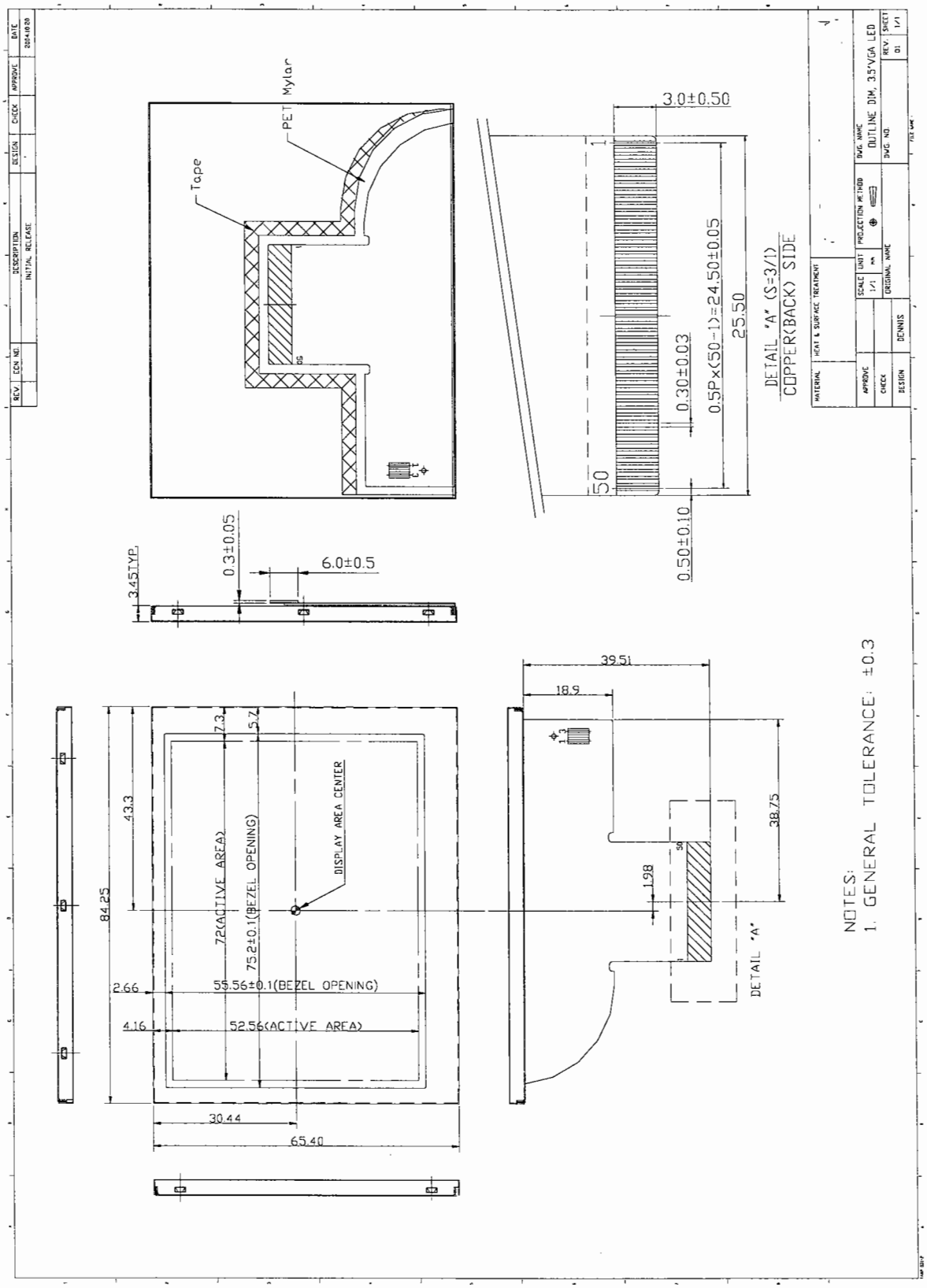
## 2. Features

. Amorphous silicon TFT LCD panel
. Pixel in stripe configuration
. Display Colors : 262,144 colors
. Optimum Viewing Direction : 6 o'clock
. TTL transmission interface

## 3.Mechanical Specifications

| Parameter | Specifications | Unit |
|---|---|---|
| Screen Size | 3.5 (diagonal) | inch |
| Display Format | 640×(R, G, B)×480 | dot |
| Display Colors | 262,144 | |
| Active Area | 72 (H)×52.56 (V) | mm |
| Pixel Pitch | 0.1125 (H)×0.1095 (V) | mm |
| Pixel Configuration | Stripe | |
| Outline Dimension | 84.25 (W)×65.40 (H)×3.45 (D) (Typ.) | mm |
| Weight | 40±5 | g |
| Surface treatment | AG | |
| Display mode | Normally white | |

## 4.Mechanical Drawing of TFT-LCD Module



## 5.Input / Output Terminals

**TFT-LCD Panel Driving**

| Pin No. | Symbol | I/O | Function | Remark |
|---|---|---|---|---|
| 1 | DIO1 | I/O | Horizontal Start Pulse Signal Input or Output 1 | Note5-1 |
| 2 | VSS2 | I | Ground | |
| 3 | VDD1 | I | Power Supply | |
| 4 | CLK | I | Horizontal Shift Clock | |
| 5 | R/L | I | Left/Right Selection | Note 5-1 |
| 6 | R0 | I | Red Data (LSB) | |
| 7 | R1 | I | Red Data | |
| 8 | R2 | I | Red Data | |
| 9 | R3 | I | Red Data | |
| 10 | R4 | I | Red Data | |
| 11 | R5 | I | Red Data (MSB) | |
| 12 | VSS2 | I | Ground | |
| 13 | G0 | I | Green Data (LSB) | |
| 14 | G1 | I | Green Data | |
| 15 | G2 | I | Green Data | |
| 16 | G3 | I | Green Data | |
| 17 | G4 | I | Green Data | |
| 18 | G5 | I | Green Data (MSB) | |
| 19 | B0 | I | Blue Data (LSB) | |
| 20 | B1 | I | Blue Data | |
| 21 | B2 | I | Blue Data | |
| 22 | B3 | I | Blue Data | |
| 23 | B4 | I | Blue Data | |
| 24 | B5 | I | Blue Data (MSB) | |
| 25 | LD | I | Load output signal | Note5-2 |
| 26 | REV | I | Data invert control | Note5-3 |
| 27 | POL | I | Polarity selection | Note5-4 |
| 28 | DIO2 | I/O | Horizontal Start Pulse Signal Input or Output | Note5-1 |
| 29 | VSS2 | I | Ground | |
| 30 | V3 | I | Gamma Voltage 3 | Note5-5 |
| 31 | V5 | I | Gamma Voltage 5 | Note5-5 |
| 32 | V7 | I | Gamma Voltage 7 | Note5-5 |
| 33 | V8 | I | Gamma Voltage 8 | Note5-5 |
| 34 | V10 | I | Gamma Voltage 10 | Note5-5 |
| 35 | V12 | I | Gamma Voltage 12 | Note5-5 |
| 36 | VSS2 | I | Ground | |
| 37 | VDD2 | I | Voltage for analog circuit | Note5-5 |
| 38 | VCOM | I | Common Voltage | |
| 39 | OE | I | Output Enable | Note5-6 |
| 40 | U/D | I | Up/Down Selection | Note 5-7 |
| 41 | CKV | I | Vertical Shift Clock | Note5-8 |
| 42 | STVU | I/O | Vertical Shift Pulse Signal Input or Output | Note5-7 |
| 43 | STVD | I/O | Vertical Shift Pulse Signal Input or Output | Note5-7 |
| 44 | VGG | I | Gate On Voltage | Note5-9 |
| 45 | VSS1 | I | Ground | |
| 46 | VCC | I | Voltage for logic circuit | |
| 47 | VEE | I | Gate Off Voltage | Note5-10 |
| 48 | VLED | - | Supply voltage for LED backlight | Note5-11 |
| 49 | GLED2 | - | Ground for LED backlight | |
| 50 | GLED1 | - | Ground for LED backlight | |

Note 5-1: Select left or right shift

| R/L | DIO1 | DIO2 | Shift |
|---|---|---|---|
| 1 | Input | Hi-Z | Left to right |
| 0 | Hi-Z | Input | Right to left |

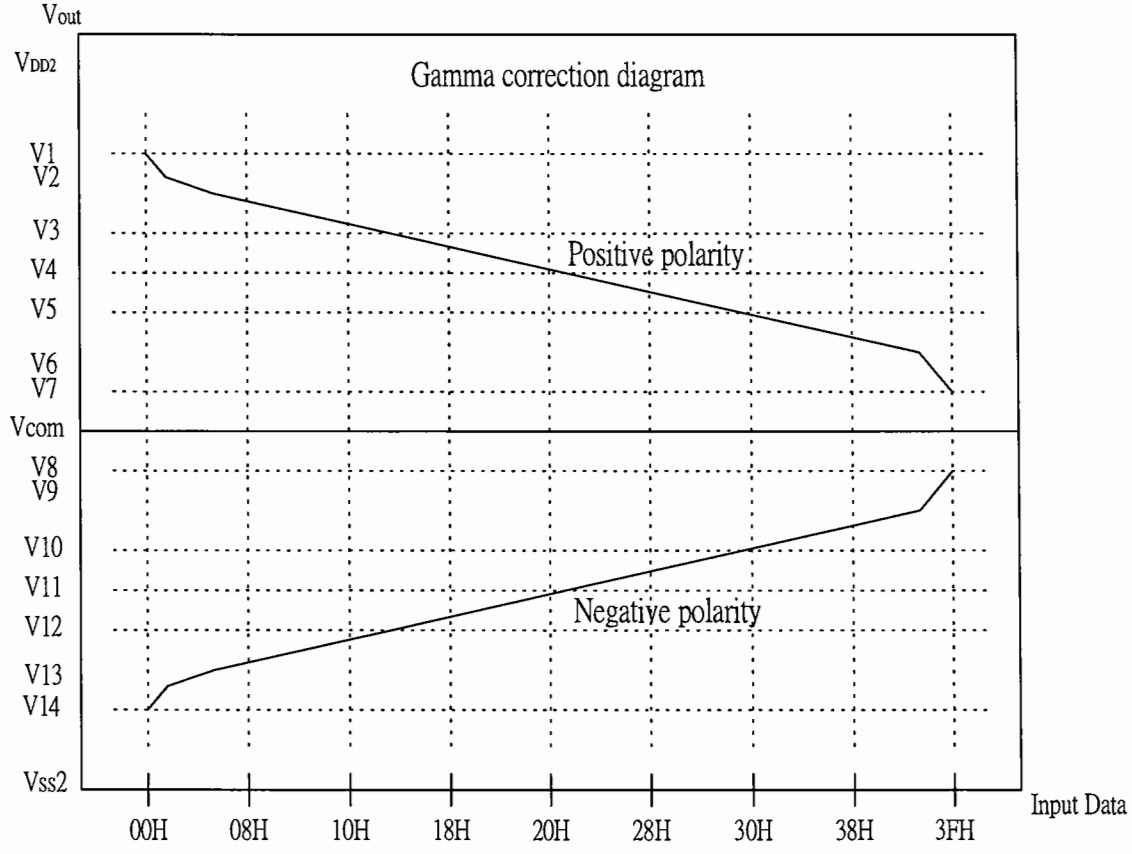
Note 5-2: Latch the polarity of outputs and switch the new data to outputs
At the rising edge (LD), latch the "POL" signal to control the polarity of the outputs.

Note 5-3: Control whether the Data R0~G5 are inverted or not. (PVI suggests connecting to GND)
When "REV=1", these data will be inverted.
EX: "00"→"3F", "07"→"38", "15"→"2A"

Note 5-4: Polarity selector for dot-inversion control. Available at the rising edge of LD.
When POL=1: Even outputs range from V1~V7, and Odd outputs range from V8~V14;
When POL=0: Even outputs range from V8~V14, and Odd outputs range from V1~V7.

Note 5-5:
1) Relationship between input data and output voltage

The figure below shows the relationship between the input data and the output voltage with the polarity. The range of V1~V7 is for positive polarity, and V8~V14 for negative polarity. Please refer to the following pages to get the related resister values and voltage calculation method.



2) Output voltage and input data

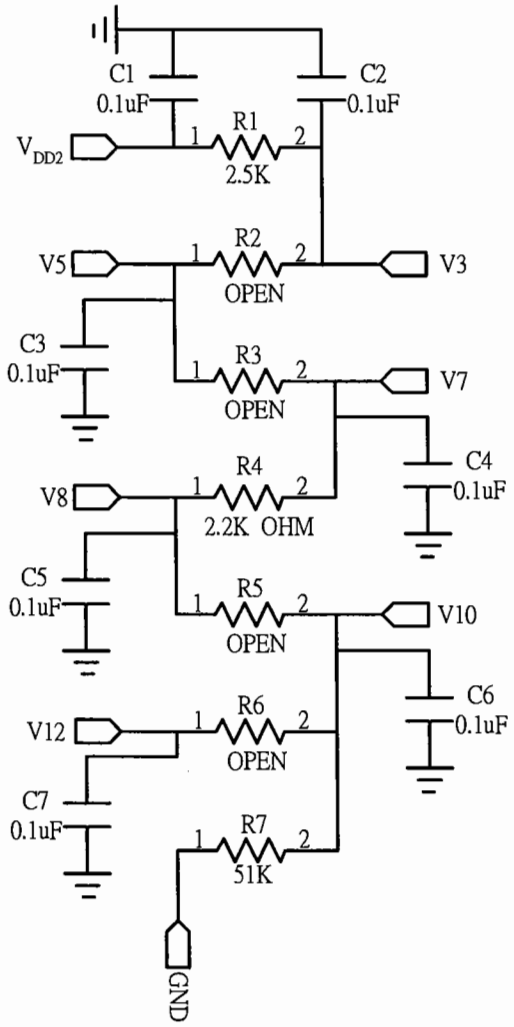
Output Voltage to Panel VS Input Data

| Data | Positive polarity Output Voltage | Negative polarity Output Voltage |
|---|---|---|
| 00H | V1 | V14 |
| 01H | V2=V3+(V1-V3) × 58 / 64.4 | V13=V14+(V12-V14) × 6.4 / 64.4 |
| 02H | V3+(V1-V3) × 52 / 64.4 | V14+(V12-V14) × 12.4 / 64.4 |
| 03H | V3+(V1-V3) × 46.4 / 64.4 | V14+(V12-V14) × 18 / 64.4 |
| 04H | V3+(V1-V3) × 41.2 / 64.4 | V14+(V12-V14) × 23.2 / 64.4 |
| 05H | V3+(V1-V3) × 36.4 / 64.4 | V14+(V12-V14) × 28 / 64.4 |
| 06H | V3+(V1-V3) × 32 / 64.4 | V14+(V12-V14) × 32.4 / 64.4 |
| 07H | V3+(V1-V3) × 27.6 / 64.4 | V14+(V12-V14) × 36.8 / 64.4 |
| 08H | V3+(V1-V3) × 23.6 / 64.4 | V14+(V12-V14) × 40.8 / 64.4 |
| 09H | V3+(V1-V3) × 19.6 / 64.4 | V14+(V12-V14) × 44.8 / 64.4 |
| 0AH | V3+(V1-V3) × 16.4 / 64.4 | V14+(V12-V14) × 48 / 64.4 |
| 0BH | V3+(V1-V3) × 13.2 / 64.4 | V14+(V12-V14) × 51.2 / 64.4 |
| 0CH | V3+(V1-V3) × 10.4 / 64.4 | V14+(V12-V14) × 54 / 64.4 |
| 0DH | V3+(V1-V3) × 7.6 / 64.4 | V14+(V12-V14) × 56.8 / 64.4 |
| 0EH | V3+(V1-V3) × 4.8 / 64.4 | V14+(V12-V14) × 59.6 / 64.4 |
| 0FH | V3+(V1-V3) × 2.4 / 64.4 | V14+(V12-V14) × 62 / 64.4 |
| 10H | V3 | V12 |
| 11H | V4+(V3-V4) × 19.6 / 22 | V12+(V11-V12) × 2.4 / 22 |
| 12H | V4+(V3-V4) × 17.6 / 22 | V12+(V11-V12) × 4.4 / 22 |
| 13H | V4+(V3-V4) × 15.6 / 22 | V12+(V11-V12) × 6.4 / 22 |
| 14H | V4+(V3-V4) × 13.6 / 22 | V12+(V11-V12) × 8.4 / 22 |
| 15H | V4+(V3-V4) × 12 / 22 | V12+(V11-V12) × 10 / 22 |
| 16H | V4+(V3-V4) × 10.4 / 22 | V12+(V11-V12) × 11.6 / 22 |
| 17H | V4+(V3-V4) × 8.8 / 22 | V12+(V11-V12) × 13.2 / 22 |
| 18H | V4+(V3-V4) × 7.6 / 22 | V12+(V11-V12) × 14.4 / 22 |
| 19H | V4+(V3-V4) × 6.4 / 22 | V12+(V11-V12) × 15.6 / 22 |
| 1AH | V4+(V3-V4) × 5.2 / 22 | V12+(V11-V12) × 16.8 / 22 |
| 1BH | V4+(V3-V4) × 4 / 22 | V12+(V11-V12) × 18 / 22 |
| 1CH | V4+(V3-V4) × 3.2 / 22 | V12+(V11-V12) × 18.8 / 22 |
| 1DH | V4+(V3-V4) × 2.4 / 22 | V12+(V11-V12) × 19.6 / 22 |
| 1EH | V4+(V3-V4) × 1.6 / 22 | V12+(V11-V12) × 20.4 / 22 |
| 1FH | V4+(V3-V4) × 0.8 / 22 | V12+(V11-V12) × 21.2 / 22 |

Output Voltage to Panel VS Input Data(continued)

| Data | Positive polarity Output Voltage | Negative polarity Output Voltage |
|---|---|---|
| 20H | V4 | V11 |
| 21H | V5+(V4-V5) × 12 / 12.8 | V11+(V10-V11) × 0.8 / 12.8 |
| 22H | V5+(V4-V5) × 11.2 / 12.8 | V11+(V10-V11) × 1.6 / 12.8 |
| 23H | V5+(V4-V5) × 10.4 / 12.8 | V11+(V10-V11) × 2.4 / 12.8 |
| 24H | V5+(V4-V5) × 9.6 / 12.8 | V11+(V10-V11) × 3.2 / 12.8 |
| 25H | V5+(V4-V5) × 8.8 / 12.8 | V11+(V10-V11) × 4 / 12.8 |
| 26H | V5+(V4-V5) × 8 / 12.8 | V11+(V10-V11) × 4.8 / 12.8 |
| 27H | V5+(V4-V5) × 7.2 / 12.8 | V11+(V10-V11) × 5.6 / 12.8 |
| 28H | V5+(V4-V5) × 6.4 / 12.8 | V11+(V10-V11) × 6.4 / 12.8 |
| 29H | V5+(V4-V5) × 5.6 / 12.8 | V11+(V10-V11) × 7.2 / 12.8 |
| 2AH | V5+(V4-V5) × 4.8 / 12.8 | V11+(V10-V11) × 8 / 12.8 |
| 2BH | V5+(V4-V5) × 4 / 12.8 | V11+(V10-V11) × 8.8 / 12.8 |
| 2CH | V5+(V4-V5) × 3.2 / 12.8 | V11+(V10-V11) × 9.6 / 12.8 |
| 2DH | V5+(V4-V5) × 2.4 / 12.8 | V11+(V10-V11) × 10.4 / 12.8 |
| 2EH | V5+(V4-V5) × 1.6 / 12.8 | V11+(V10-V11) × 11.2 / 12.8 |
| 2FH | V5+(V4-V5) × 0.8 / 12.8 | V11+(V10-V11) × 12 / 12.8 |
| 30H | V5 | V10 |
| 31H | V7+(V5-V7) × 26.8 / 27.6 | V10+(V8-V10) × 0.8 / 27.6 |
| 32H | V7+(V5-V7) × 26 / 27.6 | V10+(V8-V10) × 1.6 / 27.6 |
| 33H | V7+(V5-V7) × 25.2 / 27.6 | V10+(V8-V10) × 2.4 / 27.6 |
| 34H | V7+(V5-V7) × 24.4 / 27.6 | V10+(V8-V10) × 3.2 / 27.6 |
| 35H | V7+(V5-V7) × 23.6 / 27.6 | V10+(V8-V10) × 4 / 27.6 |
| 36H | V7+(V5-V7) × 22.4 / 27.6 | V10+(V8-V10) × 5.2 / 27.6 |
| 37H | V7+(V5-V7) × 21.2 / 27.6 | V10+(V8-V10) × 6.4 / 27.6 |
| 38H | V7+(V5-V7) × 20 / 27.6 | V10+(V8-V10) × 7.6 / 27.6 |
| 39H | V7+(V5-V7) × 18.4 / 27.6 | V10+(V8-V10) × 9.2 / 27.6 |
| 3AH | V7+(V5-V7) × 16.8 / 27.6 | V10+(V8-V10) × 10.8 / 27.6 |
| 3BH | V7+(V5-V7) × 14.8 / 27.6 | V10+(V8-V10) × 12.8 / 27.6 |
| 3CH | V7+(V5-V7) × 12.8 / 27.6 | V10+(V8-V10) × 14.8 / 27.6 |
| 3DH | V7+(V5-V7) × 10.4 / 27.6 | V10+(V8-V10) × 17.2 / 27.6 |
| 3EH | V7+(V5-V7) × 6.4 / 27.6 | V10+(V8-V10) × 21.2 / 27.6 |
| 3FH | V7 | V8 |

3) Typical Application Circuit




Note 5-6: When OE is connected to high "1", the driver outputs are disabled (Gate output = $V_{EE}$). Under this condition, the operation of registers will not be affected.

Note 5-7: Select up or down shift

| U/D | STVU | STVD | Shift |
|---|---|---|---|
| 1 | Hi-Z | Input | Down to Up |
| 0 | Input | Hi-Z | Up to Down |

Note 5-8: Gate driver shift clock

Note 5-9: Gate on voltage, $V_{GG}$= +17V.

Note 5-10: Gate off voltage, $V_{EE}$= -10V.

Note 5-11: $I_{LED}$ TYP.=20mA.

## 6.Absolute Maximum Ratings:

Vss1=Vss2=GND=0V, Ta=25℃

| Parameters | Symbol | MIN. | MAX. | Unit | Remark |
|---|---|---|---|---|---|
| Supply Voltage | $V_{DD1}$ | -0.3 | 2 | V | |
| | $V_{CC}$ | -0.3 | 5 | V | |
| | $V_{DD2}$ | -0.5 | 12.0 | V | |
| | $V_{GG}$ | -0.3 | 40.0 | V | |
| | $V_{GG}$-$V_{EE}$ | - | 40.0 | V | |
| | $V_{EE}$ | -20 | 0.3 | V | |
| Storage Temperature | $T_{ST}$ | -20 | 70 | ℃ | |
| Operating Temperature | $T_{OP}$ | 0 | 60 | ℃ | Notes 6-1 |

Notes 6-1 : Operating Temperature define that contrast, response time, other display optical character are Ta=+25.

## 7.Electrical Characteristics

**7-1) Recommended Operating Conditions:** Vss1=Vss2=GND = 0V，Ta = 25℃

| Item | Symbol | Min. | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|
| Supply Voltage for Source Driver | $V_{DD1}$ | 3.0 | 3.3 | 3.6 | V | |
| | $V_{DD2}$ | 9.5 | 10 | 10.5 | | |
| Supply Voltage for Gate Driver | $V_{GG}$ | - | 17 | - | V | |
| | $V_{EE}$ | - | -10 | - | V | |
| | $V_{CC}$ | 3.0 | 3.3 | 3.6 | V | |
| Digital Input Voltage | $V_{IH}$ | $0.8V_{DD1}$ | - | $V_{DD1}$ | V | |
| | $V_{IL}$ | 0 | - | $0.2V_{DD1}$ | V | |

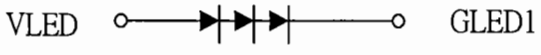
**7-2) Recommended driving condition for LED backlight**

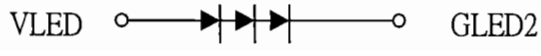
GND = 0 V， Ta = 25℃

| Parameter | Symbol | Min | TYP | MAX | Unit | Remark |
|---|---|---|---|---|---|---|
| Supply voltage of LED backlight | VLED | 9 | 9.6 | 11.4 | V | $I_L$ = 20 mA |
| Supply current of LED backlight | ILED1 | | 20 | | mA | Note 7-1 |
| | ILED2 | | | | | |
| Backlight Power Consumption | PLED | 360 | 384 | 456 | mW | Note 7-2 |

Note 7-1 : LED B/L applied information , please refer to the appendix at the end .

Note 7-2 : PLED = VLED * ILED1 + VLED * ILED2 .



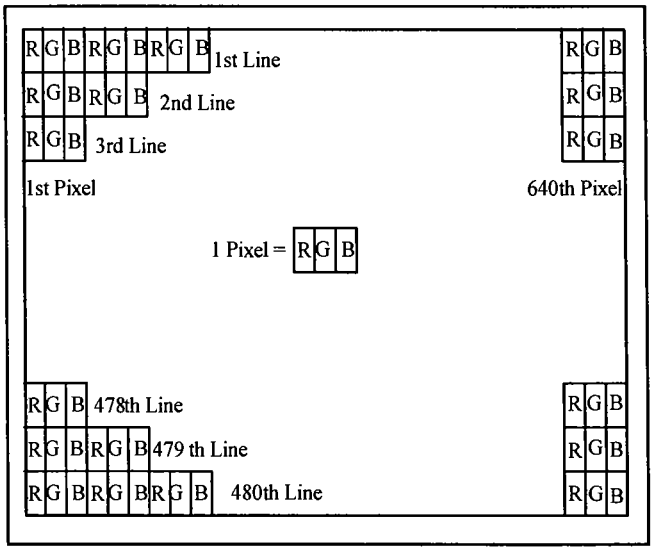



**7-3) Power Consumption**

| Parameter | Symbol | Condition | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|
| Supply Current for Gate Driver (Hi level) | $I_{GG}$ | $V_{GG}$=+17V | 0.12 | 0.15 | mA | |
| Supply Current for Gate Driver (Low level) | $I_{EE}$ | $V_{EE}$=-10V | 0.15 | 0.19 | mA | |
| Supply Current for Source Driver (Digital) | $I_{DD1}$ | $V_{DD1}$=+3.3V | 4.8 | 8.0 | mA | |
| Supply Current for Source Driver (Analog) | $I_{DD2}$ | $V_{DD2}$=+10V | 16.0 | 30.0 | mA | |
| Supply Current for Gate Driver (Digital) | $I_{CC}$ | $V_{CC}$=+3.3V | 0.17 | 0.21 | mA | |
| LCD Panel Power Consumption | | | 180 | 332 | mW | |
| Backlight Power Consumption | $P_{LED}$ | | 384 | 456 | mW | |
| Total Power Consumption | | | 564 | 788 | mW | |

## 8. Pixel Arrangement

The LCD module pixel arrangement is the stripe.

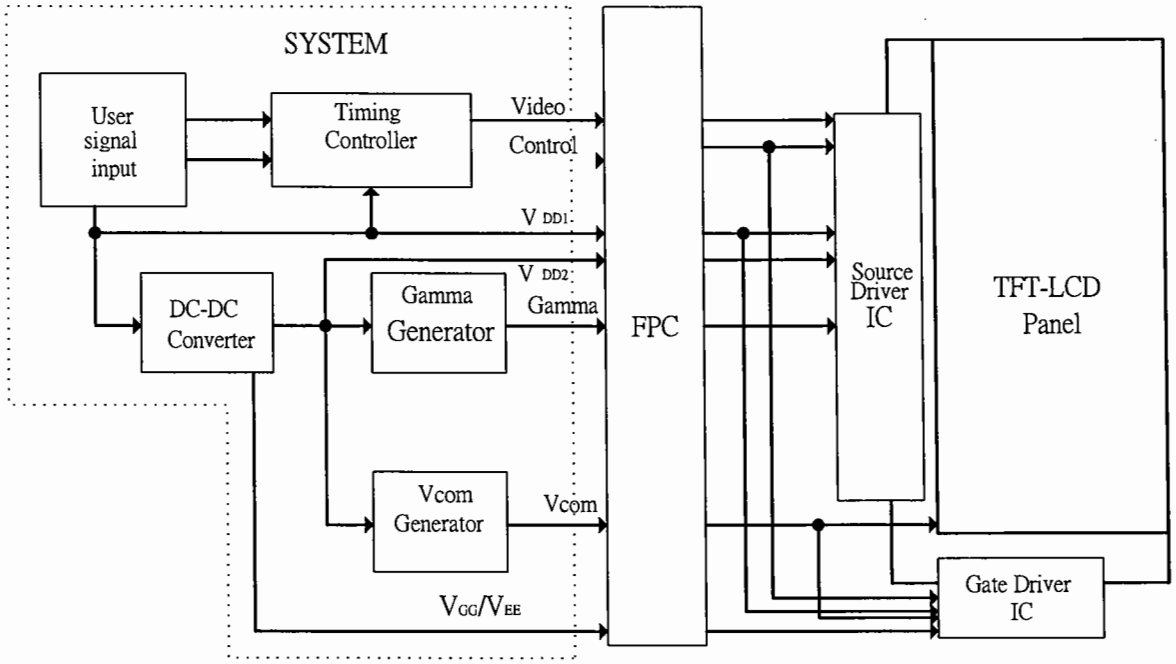


**9. Display Color and Gray Scale Reference**

| Color | | Input Color Data | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Red | | | | | | Green | | | | | | Blue | | | | | |
| | | R5 | R4 | R3 | R2 | R1 | R0 | G5 | G4 | G3 | G2 | G1 | G0 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Colors | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red (63) | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green (63) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue (63) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Yellow | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | White | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Red | Red (00) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red (01) | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red (02) | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Darker | | | | | | | | | | | | | | | | | | |
| | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| | Brighter | | | | | | | | | | | | | | | | | | |
| | Red (61) | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red (62) | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red (63) | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Green | Green (00) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green (01) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green (02) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Darker | | | | | | | | | | | | | | | | | | |
| | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| | Brighter | | | | | | | | | | | | | | | | | | |
| | Green (61) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green (62) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green (63) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| Blue | Blue (00) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue (01) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Blue (02) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | Darker | | | | | | | | | | | | | | | | | | |
| | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ | ↓ |
| | Brighter | | | | | | | | | | | | | | | | | | |
| | Blue (61) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 |
| | Blue (62) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Blue (63) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |

## 10. Block Diagram

### 10-1) TFT-module Block Diagram



## 11. Interface Timing

### 11.1) Timing Parameters

AC Electrical Characteristics ($V_{CC}$=$V_{DD1}$=3.3V, $V_{DD2}$=10V, GND=$V_{SS1}$=$V_{SS2}$=0V, Ta=25℃)

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| CLK Frequency | Fclk | - | 25 | 40 | MHz |
| CLK Pulse Width | $T_{CPH}$ | 25 | - | - | ns |
| Data Set-up Time | Tsu | 4 | - | - | ns |
| Data Hold Time | Thd | 2 | - | - | ns |
| Propagation Delay of DIO2/1 | Tphl | 6 | 10 | 15 | ns |
| Time That The Last Data to LD | Tld | 1 | - | - | $T_{CPH}$ |
| Pulse width of LD | Twld | 2 | - | - | $T_{CPH}$ |
| Time That LD to DIO1/2 | Tlds | 5 | - | - | $T_{CPH}$ |
| POL Set-up Time | Tpsu | 6 | - | - | ns |
| POL Hold Time | Tphd | 6 | - | - | ns |
| OE Pulse Width | $T_{OEV}$ | 1 | - | - | μs |
| CKV Pulse Width | $T_{CKV}$ | 500 | - | - | ns |
| STV Set-up Time | $T_{SUV}$ | 400 | - | - | ns |
| STV Hold Time | $T_{HDV}$ | 400 | - | - | ns |
| Horizontal Display Period | $T_{HDP}$ | - | 640 | - | $T_{CPH}$ |
| Horizontal Period Timing Range | $T_{HP}$ | - | 800 | - | $T_{CPH}$ |
| Horizontal Lines Per Field | $T_V$ | 520 | 525 | 640 | $T_{HP}$ |
| Vertical Display Timing Range | $T_{DV}$ | - | 480 | - | $T_{HP}$ |

**11.2) Timing Diagram**

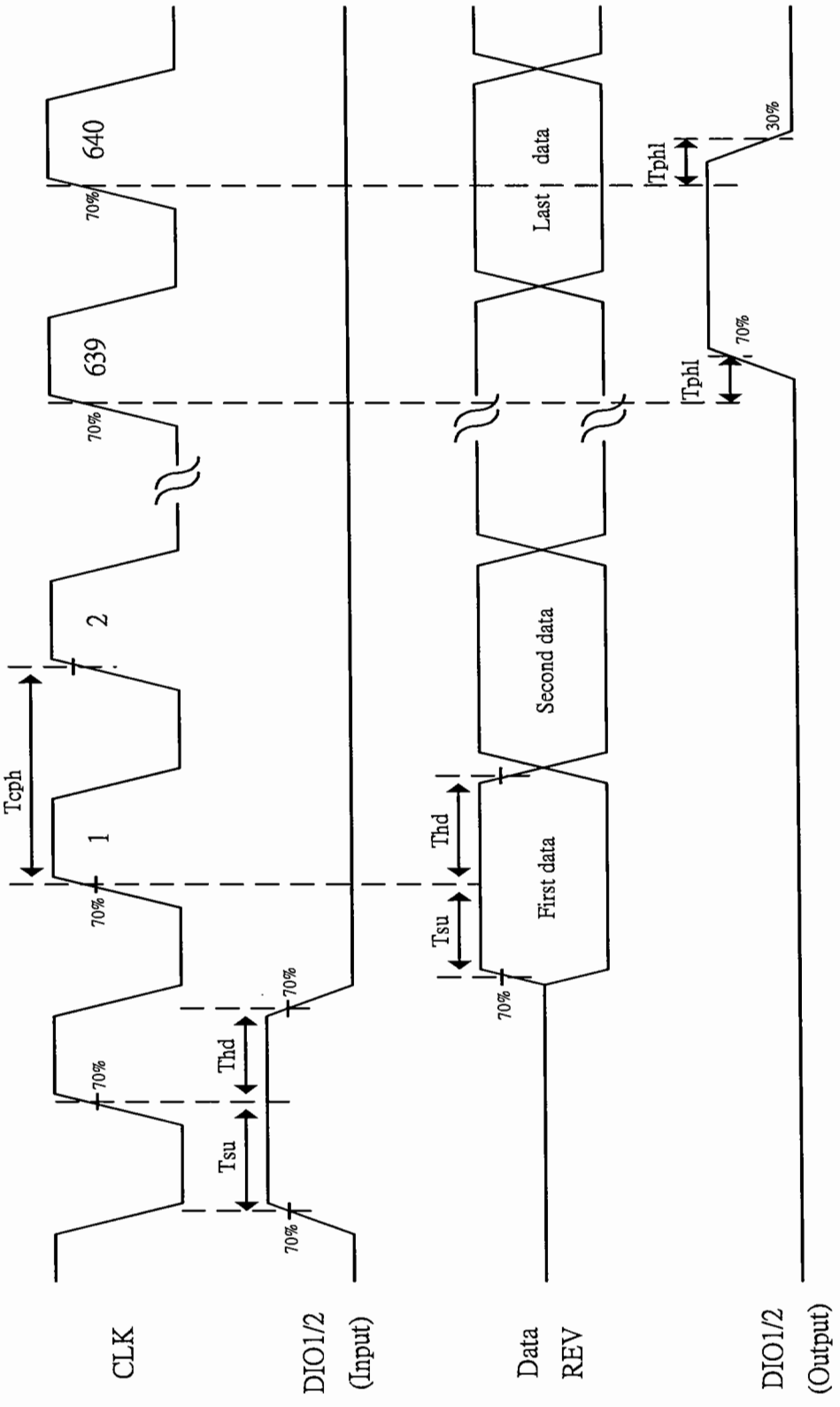



Fig. 11-1 Horizontal timing(1)

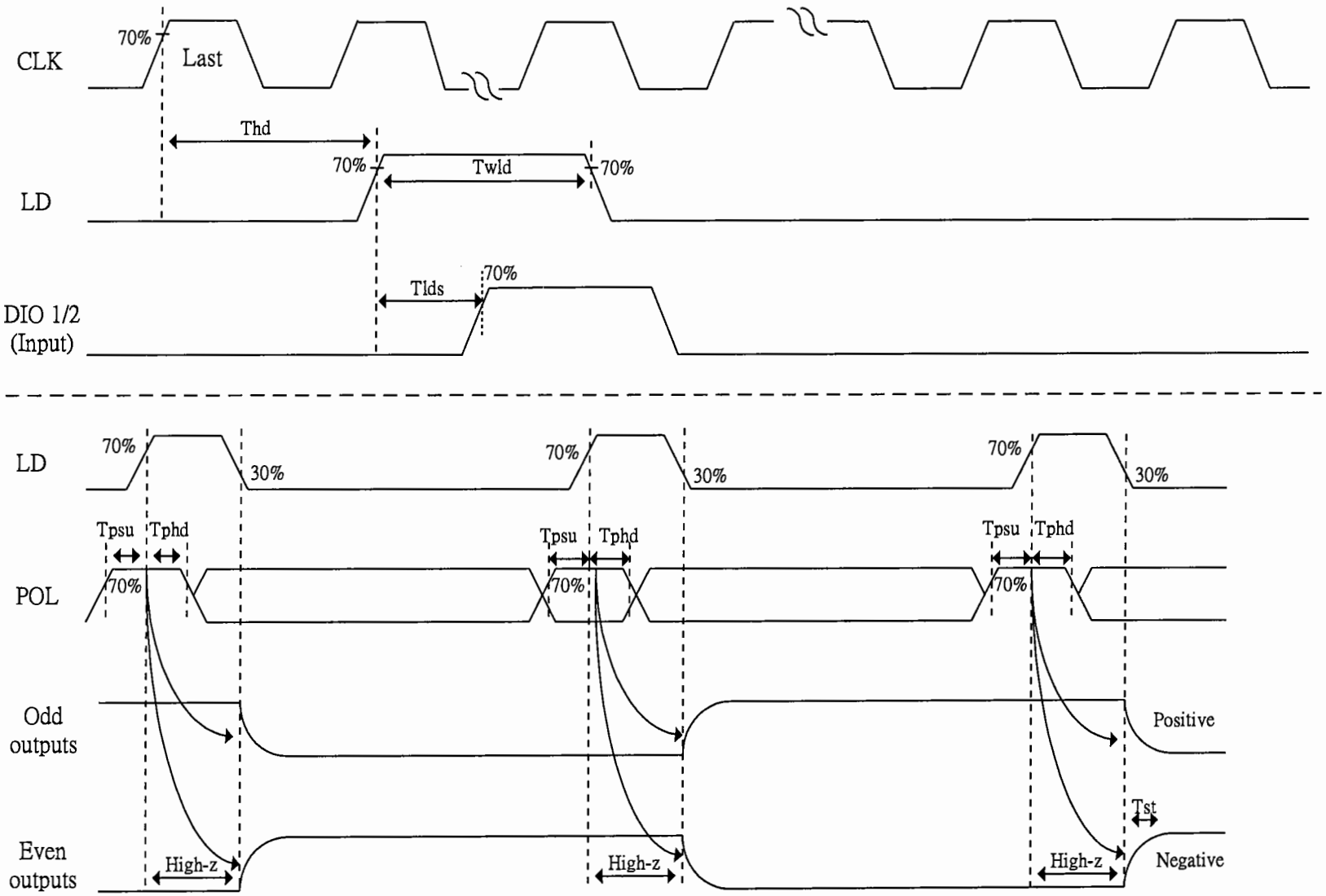



Fig. 11-2 Horizontal timing(2)

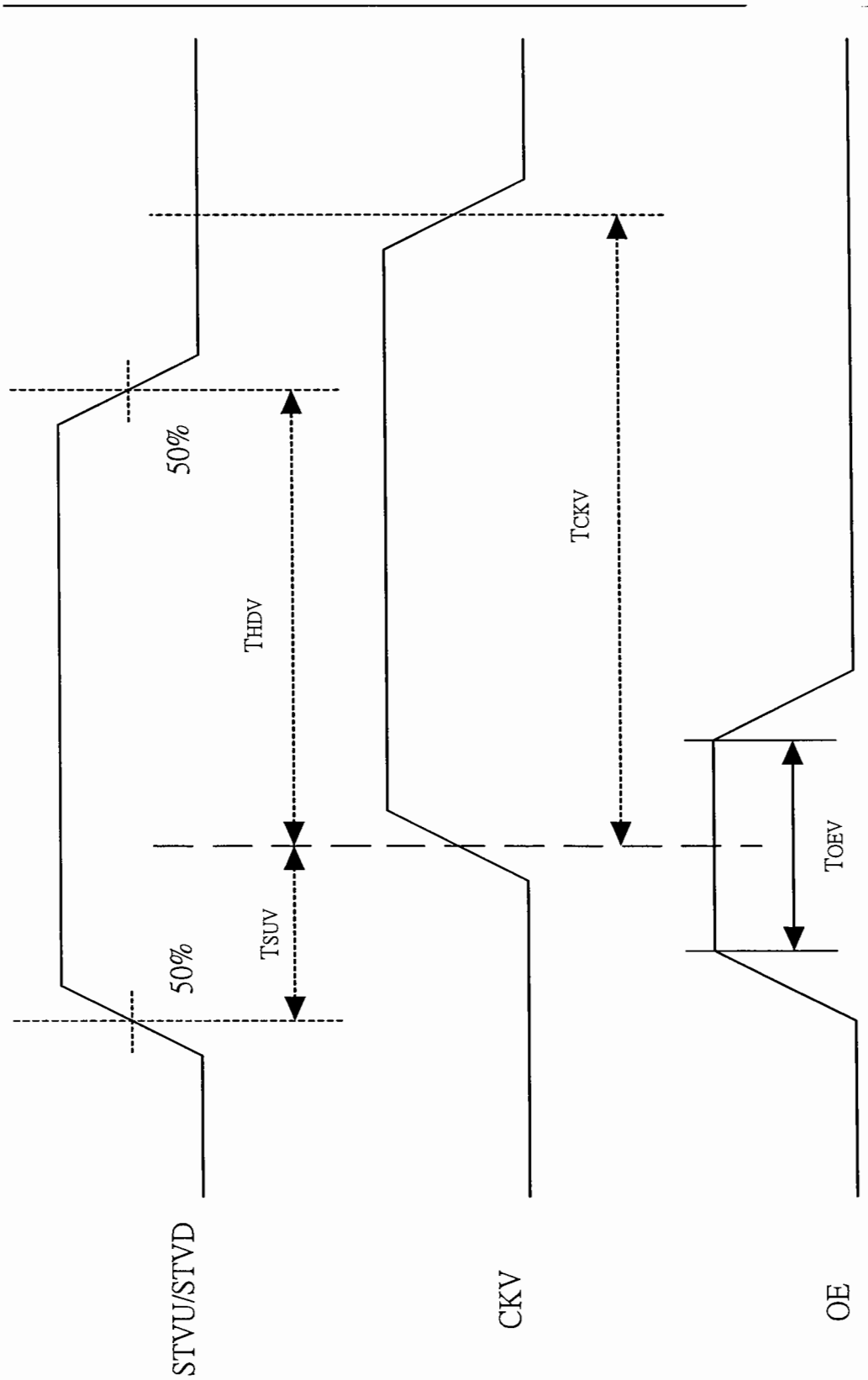



Fig. 11-3 Vertical shift clock timing

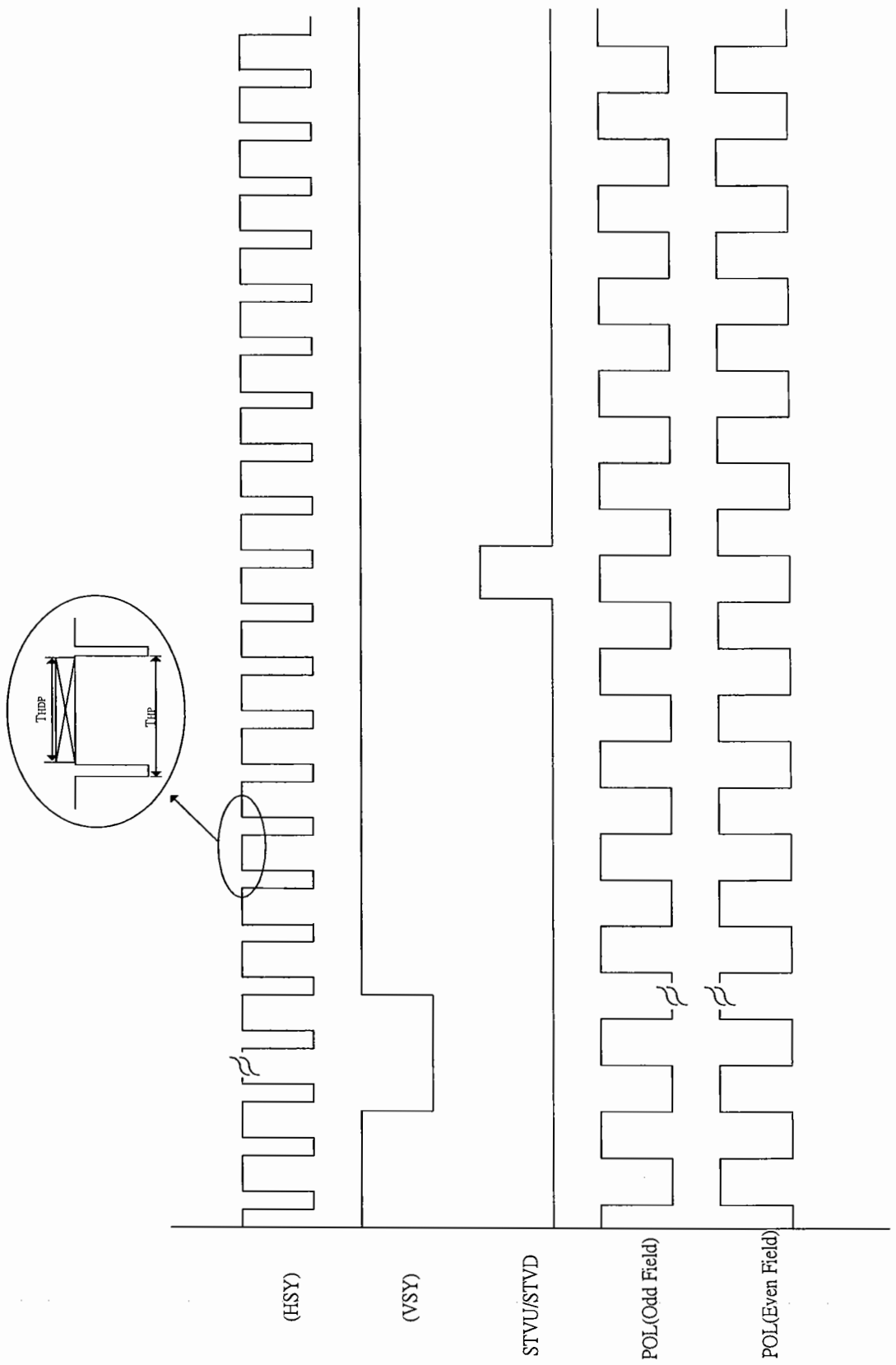
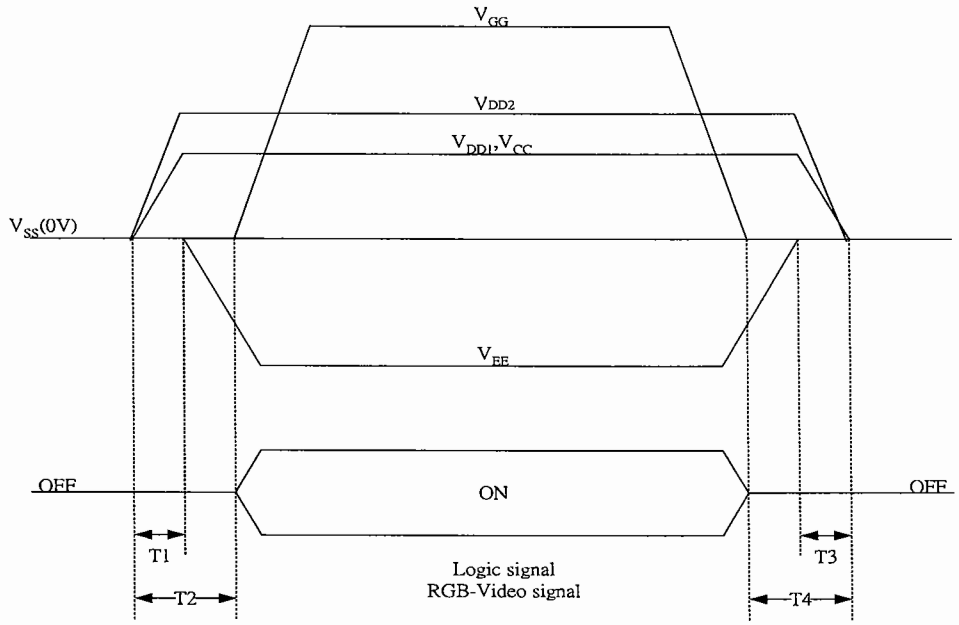



Fig. 11-4 Vertical timing

## 12. Power On Sequence




1) 10ms≦T1＜T2

2) 0ms＜T3≦T4≦10ms

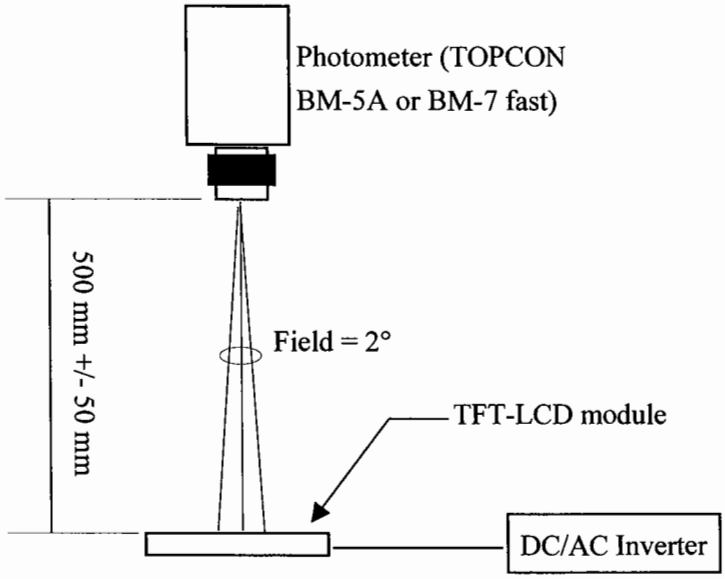
## 13. Optical Characteristics

### 13-1) Specification:

Ta=25℃

| Parameter | | Symbol | Condition | MIN. | TYP. | MAX. | Unit | Remarks |
|---|---|---|---|---|---|---|---|---|
| Viewing Angle | Horizontal | θ | CR＞10 | ±45 | ±50 | | deg | Note 13-2 |
| | Vertical | θ 12(to 12 o'clock) | | 10 | 15 | - | deg | |
| | | θ 11(to 6 o'clock) | | 30 | 35 | - | deg | |
| Contrast Ratio | | CR | | 200 | 400 | - | - | Note 13-4 |
| Response time | Rise | Tr | θ=0° | - | 15 | 30 | ms | Note 13-3 |
| | Fall | Tf | | - | 25 | 50 | ms | |
| Brightness | | | θ=0° | 200 | 250 | | cd/㎡ | Note 13-1 |
| Uniformity | | U | θ=0° | 70 | 75 | | % | Note 13-5 |
| Cross Talk | | | θ=0° | - | - | 3 | % | Note 13-6 |
| White Chromaticity | | x | | 0.28 | 0.310 | 0.34 | - | Note 13-1 |
| | | y | | 0.30 | 0.330 | 0.36 | - | |
| LED Life Time | Ta=25℃ | | | - | 10000 | - | hrs | |

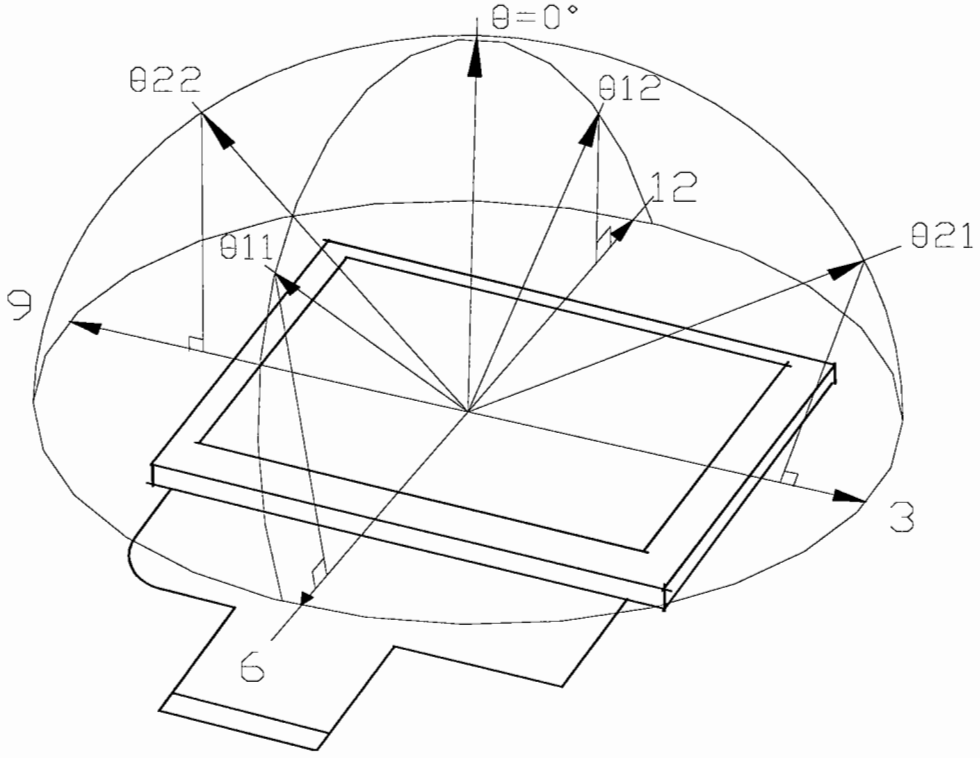
All the optical measurement shall be executed 1 minute after backlight being turn-on. The optical characteristics shall be measured in dark room (ambient illumination on panel surface less than 1 Lux). The measuring configuration shows as following figure.



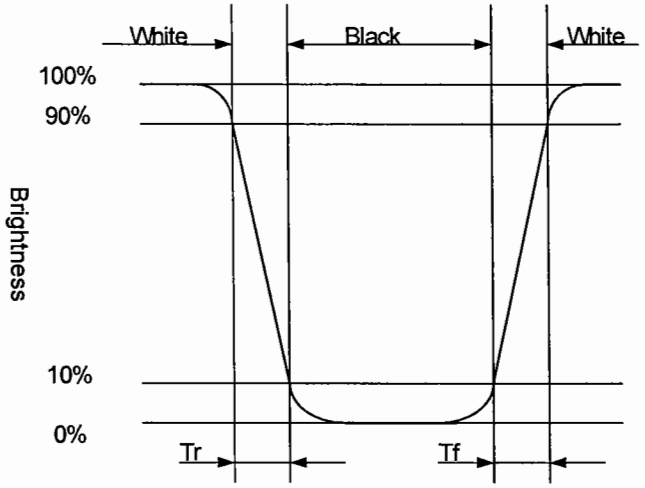

Optical characteristics measuring configuration

Note 13-1: 1.Topcon BM-5A or BM-7 fast luminance meter 1° field of view is used in the testing (after 1 minute operation).

Note 13-2: The definitions of viewing angles are as follow



Note 13-3: Definition of Response Time $T_r$ and $T_f$:



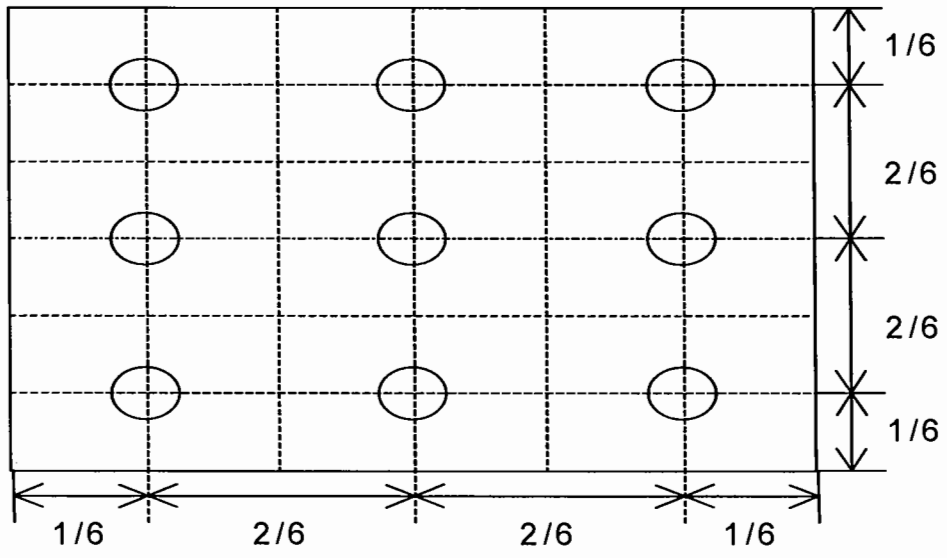

Note 13-4: The definition of contrast ratio $CR = \frac{\text{Luminance at gray level 63}}{\text{Luminance at gray level 0}}$

Note 13-5 : The uniformity of LCD is defined as

$$U = \frac{\text{The Minimum Brightness of the 9 testing Points}}{\text{The Maximum Brightness of the 9 testing Points}}$$

Luminance meter : BM-5A or BM-7 fast (TOPCON)
Measurement distance : 500 mm +/- 50 mm
Ambient illumination : < 1 Lux
Measuring direction : Perpendicular to the surface of module

The test pattern is white (Gray Level 63).



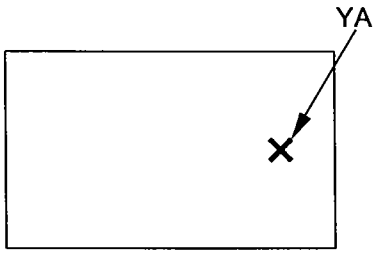
Note 13-6 : Cross Talk (CTK) = $\frac{|YA-YB|}{YA} \times 100\%$

YA : Brightness of Pattern A

YB : Brightness of Pattern B

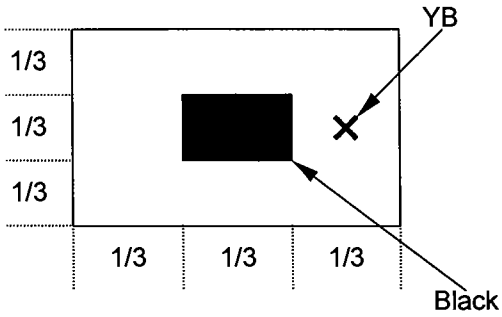
Pattern A

(Gray Level 31)




Pattern B

(Gray Level 31, central black box exclusive)




✕: Testing Point (A and B are at the same point.)

(Gray Level 0)

## 15. Reliability Test

| No | Test Item | Test Condition |
|---|---|---|
| 1 | High Temperature Storage Test | Ta = +70℃, 240 hrs |
| 2 | Low Temperature Storage Test | Ta = -20℃, 240 hrs |
| 3 | Low Temperature Operation Test | Ta = 0℃, 240 hrs |
| 4 | High Temperature & High Humidity Operation Test | Ta = +60℃, 90%RH, 240 hrs<br>(No Condensation) |
| 5 | Thermal Cycling Test<br>(non-operating) | -20℃→+70℃, 200 Cycles<br>30min 30min |
| 6 | Vibration Test<br>(non-operating) | Frequency : 10 ~ 55 Hz<br>Amplitude : 1.0 mm<br>Sweep time : 11 mins<br>Test Period : 6 Cycles for each direction of X, Y, Z |
| 7 | Shock Test<br>(non-operating) | 100G , 6ms<br>Direction : ±X , ±Y , ±Z<br>Cycle : 3 times |
| 8 | Electrostatic Discharge Test<br>(non-operating) | 200pF, 0Ω<br>±200V<br>1 time / each terminal |

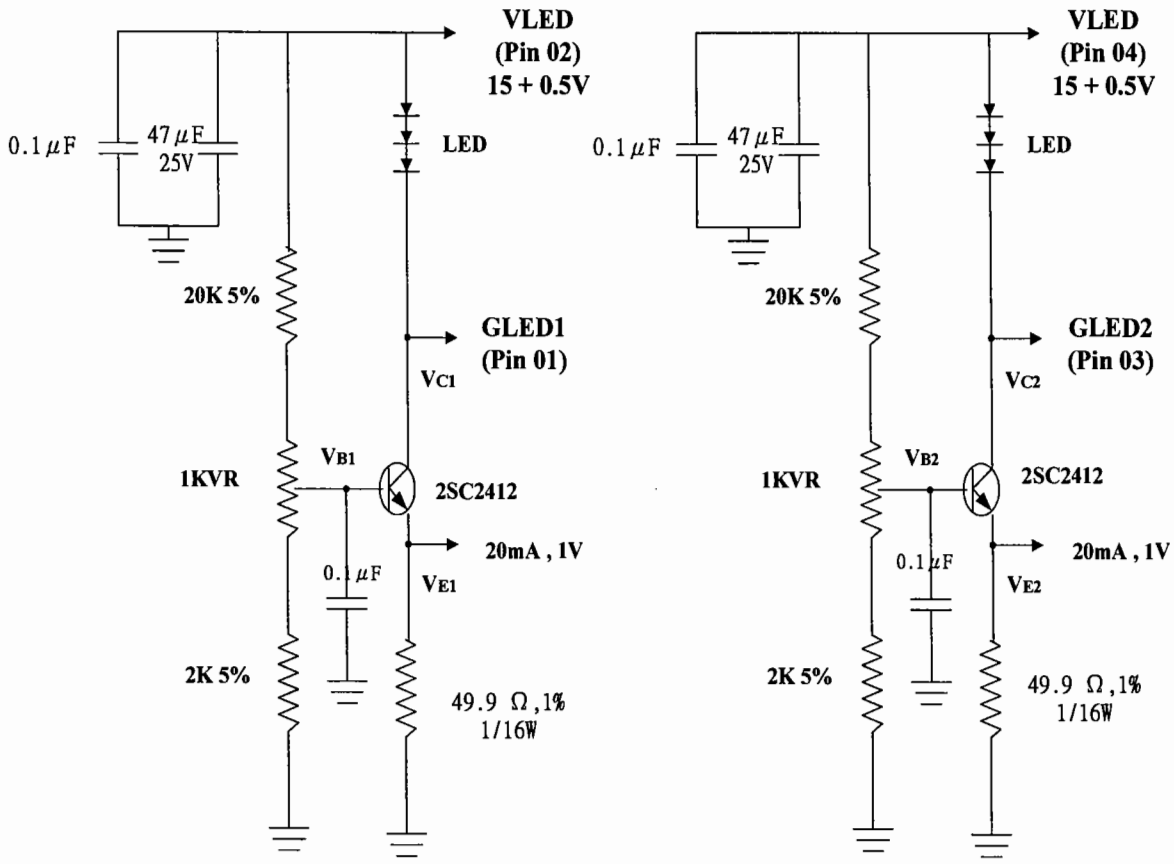
Ta: ambient temperature

Note : The protective film must be removed before temperature test.

[Judgement Criteria]

Under the display quality test conditions with normal operation state , there should be no change which may affect practical display function.

# Appendix


VLED
(Pin 02)
15 + 0.5V
0.1μF
47μF
25V
LED
20K 5%
GLED1
(Pin 01)
VC1
1KVR
VB1
2SC2412
20mA , 1V
0.1μF
VE1
2K 5%
49.9 Ω,1%
1/16W
VLED
(Pin 04)
15 + 0.5V
0.1μF
47μF
25V
LED
20K 5%
GLED2
(Pin 03)
VC2
1KVR
VB2
2SC2412
20mA , 1V
0.1μF
VE2
2K 5%
49.9 Ω,1%
1/16W