

Version : 0.5

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**TECHNICAL SPECIFICATION**

**MODEL NO. : PM102WX1**

Customer's Confirmation

Customer \_\_\_\_\_

By \_\_\_\_\_

PVI's Confirmation

Confirmed By \_\_\_\_\_

Prepared By \_\_\_\_\_

**PRIME VIEW INTERNATIONAL CO.,LTD.**  
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Date: Feb.16,2005

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## 1. Application

This data sheet applies to a color TFT LCD module, PM102WX1.

PM102WX1 module applies to OA product, car TV (must use Analog to Digital driving board), which requires high quality flat panel display. If you must use in severe reliability environment, please don't extend over PVI's reliability test conditions.

If you use PM102WX1, Prime View advises your systems use PVI's timing controller IC (PVI-2002A) which will generate proper timing signals to control PM102WX1.

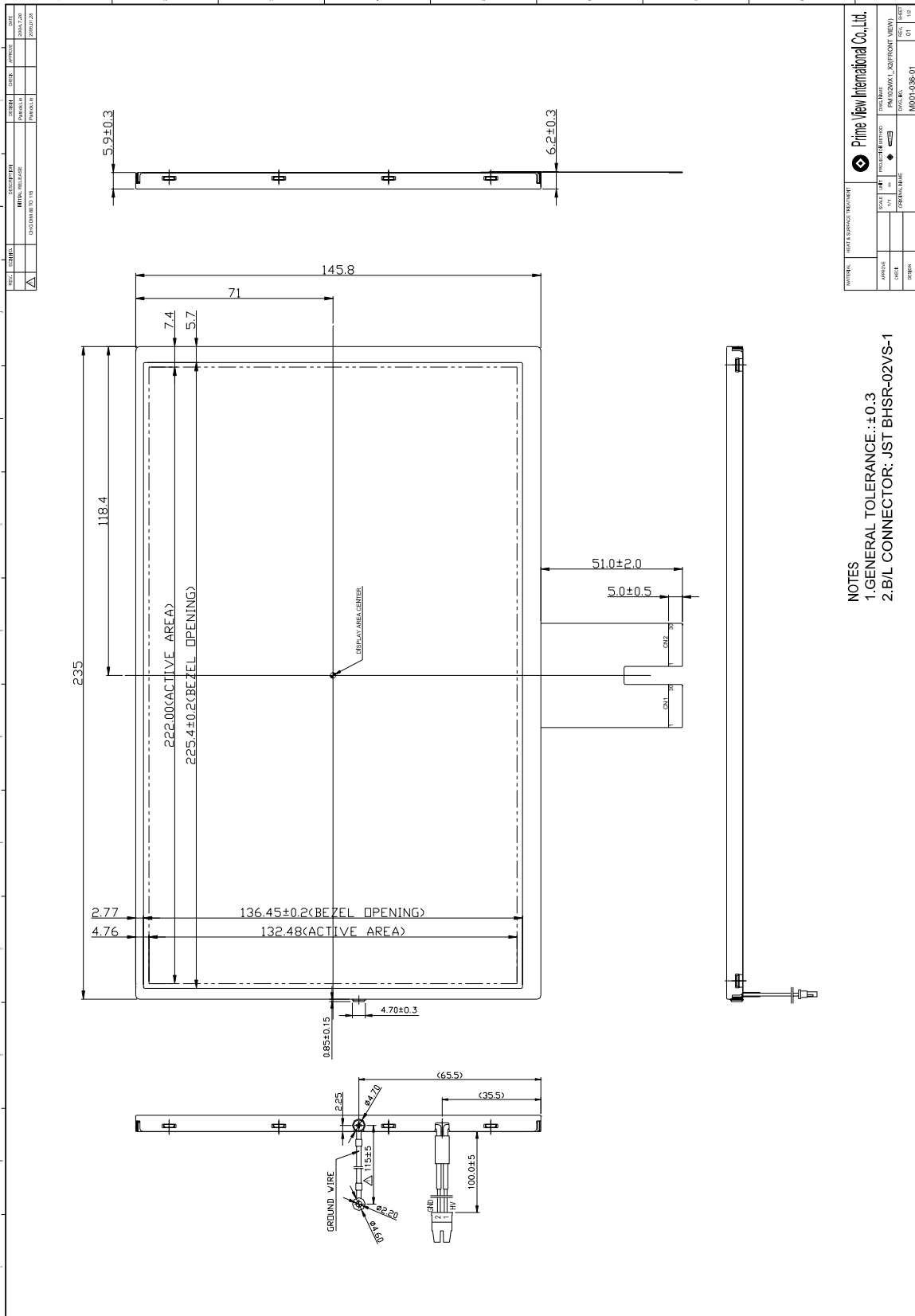
## 2. Features

- . Wide VGA (800\*480 pixels) resolution
- . Amorphous silicon TFT LCD panel with back-light unit
- . Pixel in stripe configuration
- . Thin and light weight
- . Display Colors : 262,144 colors
- . Optimum Viewing Direction : 6 o'clock
- . TTL interface
- . Wide viewing angle

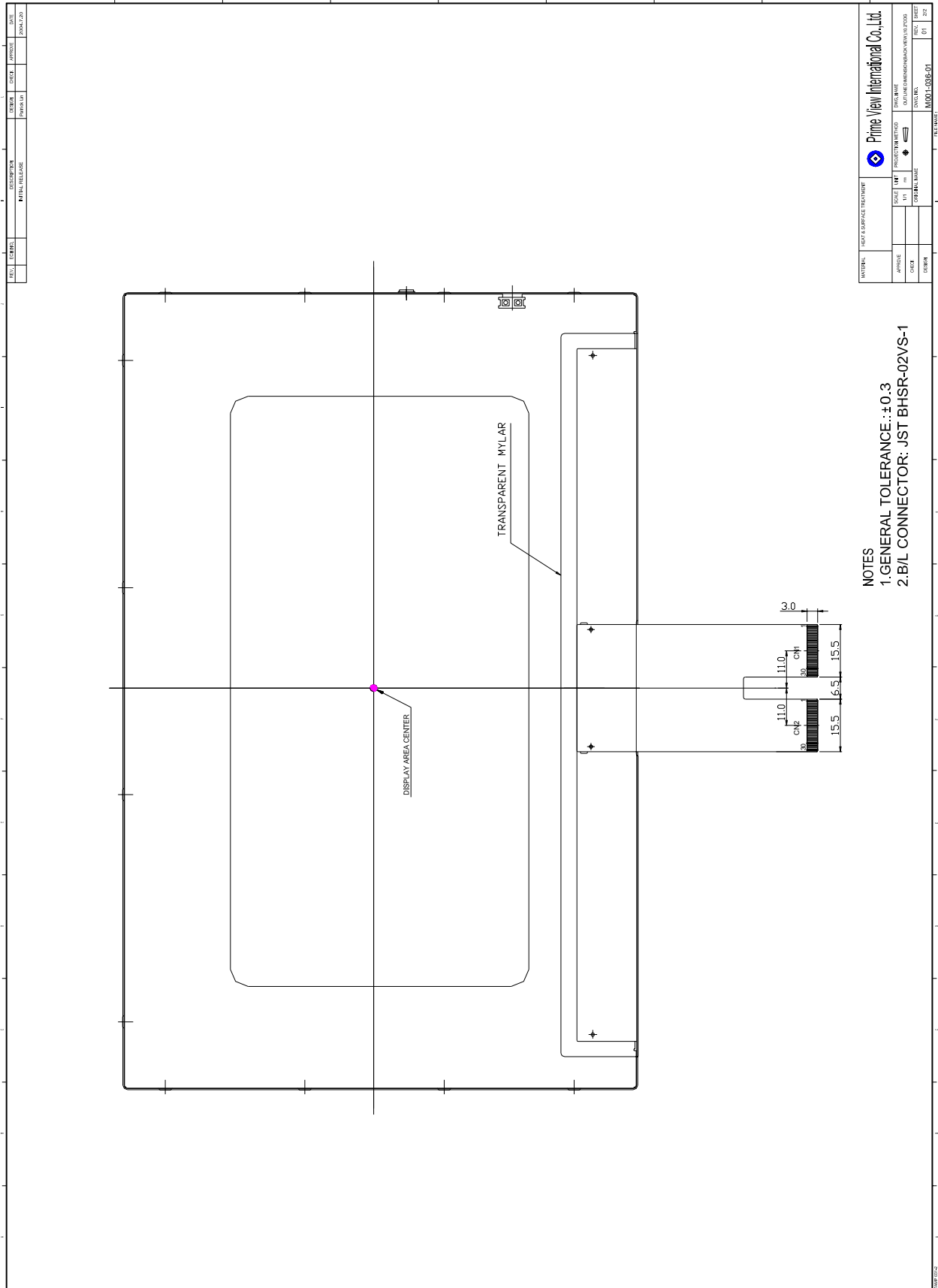
## 3. Mechanical Specifications

| Parameter           | Specifications                    | Unit |
|---------------------|-----------------------------------|------|
| Screen Size         | 10.2 (diagonal)                   | inch |
| Display Format      | 800×(R, G, B)×480                 | dot  |
| Display Colors      | 262,144                           |      |
| Active Area         | 222.0(H)×132.48(V)                | mm   |
| Pixel Pitch         | 0.2775(H)×0.276(V)                | mm   |
| Pixel Configuration | Stripe                            |      |
| Outline Dimension   | 235.0(W)×145.8 (H)×5.9 (D) (typ.) | mm   |
| Weight              | 312±10                            | g    |
| Back-light          | CCFL, 1 tube                      |      |
| Surface treatment   | Anti-glare and Wide View Film     |      |
| Display mode        | Normally white                    |      |

**4.Mechanical Drawing of TFT-LCD Module**  
**Outline Drawing : Front View (unit : mm)**



**Outline Drawing : Rear View (unit : mm)**



**5. Input / Output Terminals**
**5-1) TFT-LCD Panel Driving**

Connector type: ELCO, 6210-30PIN, PIN No 30 pins, pitch=0.5mm

**CN 1**

| Pin No. | Symbol | I/O | Function                                      | Remark   |
|---------|--------|-----|---|----------|
| 1       | DIO1   | I/O | Horizontal Start Pulse Signal Input or Output | Note 5-1 |
| 2       | VSS1   | I   | Ground  |          |
| 3       | VDD1   | I   | Power Supply                                  |          |
| 4       | CLK    | I   | Horizontal Shift Clock                        |          |
| 5       | VSS1   | I   | Ground  |          |
| 6       | R/L    | I   | Right / Left selection                        | Note 5-1 |
| 7       | R0     | I   | Red Data (LSB)                                |          |
| 8       | R1     | I   | Red Data                                      |          |
| 9       | R2     | I   | Red Data                                      |          |
| 10      | R3     | I   | Red Data                                      |          |
| 11      | R4     | I   | Red Data                                      |          |
| 12      | R5     | I   | Red Data (MSB)                                |          |
| 13      | VSS1   | I   | Ground  |          |
| 14      | G0     | I   | Green Data (LSB)                              |          |
| 15      | G1     | I   | Green Data                                    |          |
| 16      | G2     | I   | Green Data                                    |          |
| 17      | G3     | I   | Green Data                                    |          |
| 18      | G4     | I   | Green Data                                    |          |
| 19      | G5     | I   | Green Data (MSB)                              |          |
| 20      | VSS1   | I   | Ground  |          |
| 21      | B0     | I   | Blue Data (LSB)                               |          |
| 22      | B1     | I   | Blue Data                                     |          |
| 23      | B2     | I   | Blue Data                                     |          |
| 24      | B3     | I   | Blue Data                                     |          |
| 25      | B4     | I   | Blue Data                                     |          |
| 26      | B5     | I   | Blue Data (MSB)                               |          |
| 27      | LD     | I   | Load output signal                            | Note 5-2 |
| 28      | REV    | I   | Data invert control                           | Note 5-3 |
| 29      | POL    | I   | Polarity selection                            | Note 5-4 |
| 30      | DIO2   | I/O | Horizontal Start Pulse Signal Input or Output | Note 5-1 |

## CN 2

| Pin No. | Symbol | I/O | Function                                    | Remark    |
|---------|--------|-----|---|-----------|
| 1       | VSS2   | I   | Ground                                      |           |
| 2       | V1     | I   | Gamma Voltage 1                             | Note 5-10 |
| 3       | V2     | I   | Gamma Voltage 2                             | Note 5-10 |
| 4       | V3     | I   | Gamma Voltage 3                             | Note 5-10 |
| 5       | V4     | I   | Gamma Voltage 4                             | Note 5-10 |
| 6       | V5     | I   | Gamma Voltage 5                             | Note 5-10 |
| 7       | V6     | I   | Gamma Voltage 6                             | Note 5-10 |
| 8       | V7     | I   | Gamma Voltage 7                             | Note 5-10 |
| 9       | VSS2   | I   | Ground                                      |           |
| 10      | V8     | I   | Gamma Voltage 8                             | Note 5-10 |
| 11      | V9     | I   | Gamma Voltage 9                             | Note 5-10 |
| 12      | V10    | I   | Gamma Voltage 10                            | Note 5-10 |
| 13      | V11    | I   | Gamma Voltage 11                            | Note 5-10 |
| 14      | V12    | I   | Gamma Voltage 12                            | Note 5-10 |
| 15      | V13    | I   | Gamma Voltage 13                            | Note 5-10 |
| 16      | V14    | I   | Gamma Voltage 14                            | Note 5-10 |
| 17      | VSS2   | I   | Ground                                      |           |
| 18      | VDD2   | I   | Voltage for analog circuit                  | Note 5-10 |
| 19      | VCOM   | I   | Common Voltage                              |           |
| 20      | XON    | I   | NC  |           |
| 21      | OE     | I   | Output Enable                               | Note 5-5  |
| 22      | U/D    | I   | Up / Down Selection                         | Note 5-6  |
| 23      | CKV    | I   | Vertical Shift Clock                        | Note 5-7  |
| 24      | STVU   | I/O | Vertical Shift Pulse Signal Input or Output | Note 5-6  |
| 25      | STVD   | I/O | Vertical Shift Pulse Signal Input or Output | Note 5-6  |
| 26      | VGG    | I   | Gate On Voltage                             | Note 5-8  |
| 27      | GND    | I   | Ground                                      |           |
| 28      | VCC    | I   | Voltage for logic circuit                   |           |
| 29      | GND    | I   | Ground                                      |           |
| 30      | VEE    | I   | Gate Off Voltage                            | Note 5-9  |

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 (CLK), 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: 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 5-6: 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 5-7: Gate driver shift clock

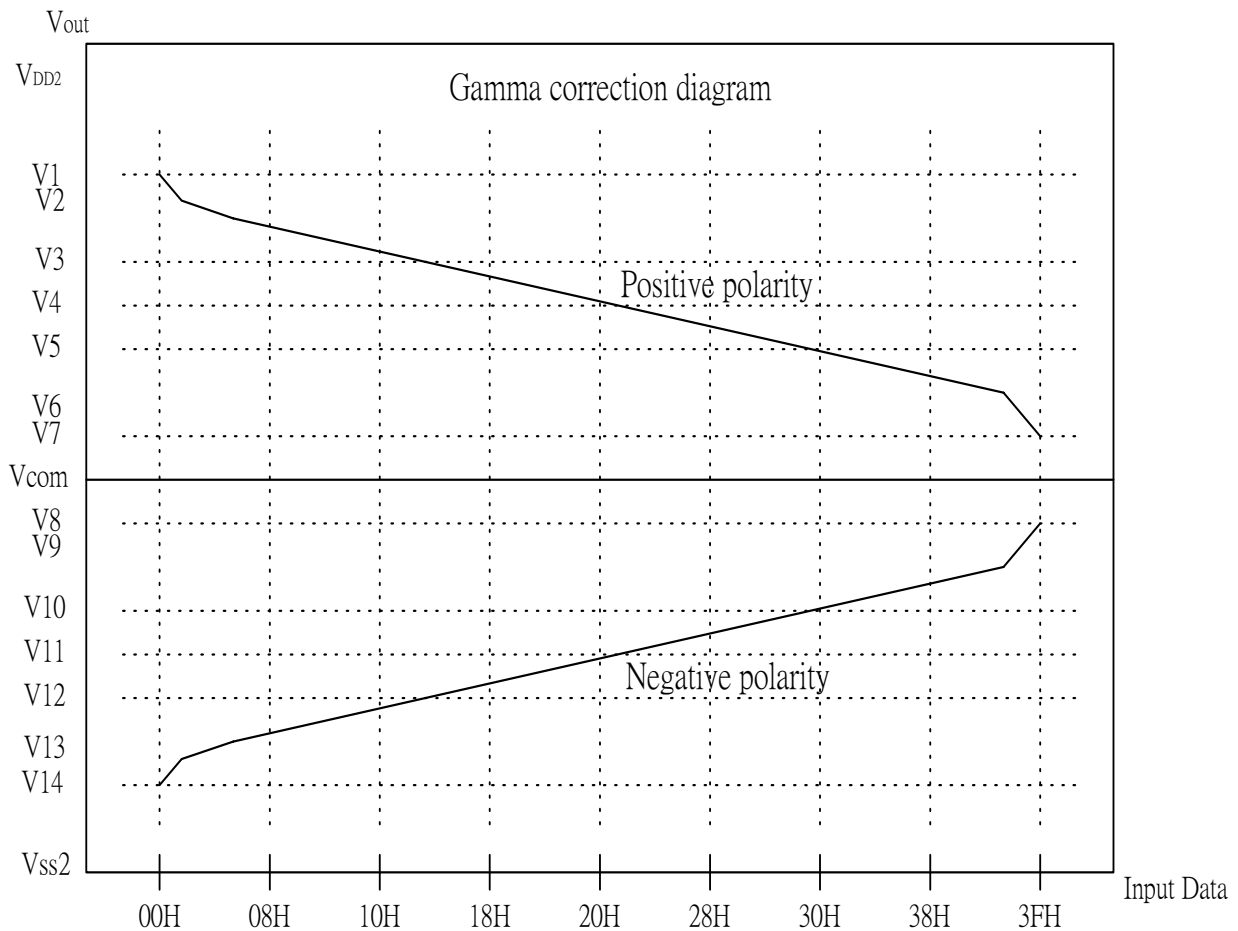
Note 5-8: Gate on voltage,  $V_{GG}=16V$ .

Note 5-9: Gate off voltage,  $V_{EE}=-9V$ .

Note 5-10:

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 resistor values and voltage calculation method.



Remark:  $V_{DD2}-0.1 \geq V1 \geq V2 \geq V3 \geq V4 \geq V5 \geq V6 \geq V7$ ;  $V8 \geq V9 \geq V10 \geq V11 \geq V12 \geq V13 \geq V14 \geq V_{SS2}+0.1V$ .



## 2) Output voltage and input data

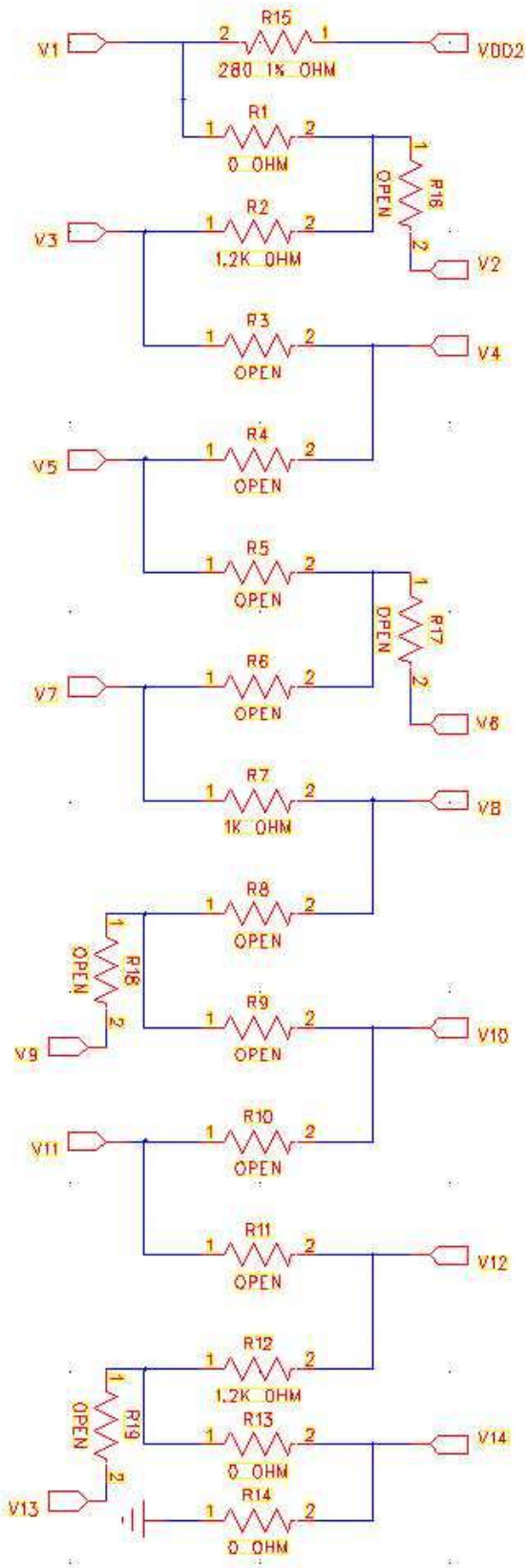
Output Voltage to Panel V.S. Input Data

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

Output Voltage to Panel V.S. Input Data (continued)

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

3) Typical Application Circuit (When V<sub>DD2</sub> = +8.8V)



**5-2) Backlight driving**

Connector type: JST BHR-02VS-1, PIN No 2 pins, pitch=3.5mm

| Pin No | Symbol | Description                       | Remark                          |
|--------|--------|-----------------------------------|---------------------------------|
| 1      | VL1    | Input terminal (Hi voltage side)  | Wire color : Pink               |
| 2      | VL2    | Input terminal (Low voltage side) | Wire color : White<br>Note 5-11 |

Note 5-11: Low voltage side of backlight inverter connects with ground of inverter circuits.

**6. Absolute Maximum Ratings:**
 $V_{SS1}=V_{SS2}=GND=0V, Ta=25^{\circ}C$ 

| Parameters                  | Symbol          | MIN. | MAX.         | Unit        | Remark |
|-----------------------------|-----------------|------|--------------|-------------|--------|
| Supply Voltage              | $V_{DD1}$       | -0.3 | 5.0          | V           |        |
|                             | $V_{CC}$        |      |              | V           |        |
|                             | $V_{DD2}$       | -0.5 | 12.0         | V           |        |
|                             | $V_{GG}$        | -0.3 | 40.0         | V           |        |
|                             | $V_{GG}-V_{EE}$ | -    | 40           | V           |        |
|                             | $V_{EE}$        | -20  | 0.3          | V           |        |
| Digital Input               | $V_{IN}$        | -0.5 | $V_{CC}+0.5$ | V           |        |
| Backlight Driving Voltage   | $V_L$           | -    | 2000         | V           |        |
| Backlight Driving Frequency | $F_L$           | 0    | 100          | KHz         |        |
| Storage Temperature         | $T_{ST}$        | -30  | 80           | $^{\circ}C$ |        |
| Operating Temperature       | $T_{OP}$        | -20  | 80           | $^{\circ}C$ |        |

**7. Electrical Characteristics**
**7-1) Recommended Operating Conditions:**
 $V_{SS1}=V_{SS2}=GND=0V, Ta=25^{\circ}C$ 

| Item                             | Symbol    | Min.         | Typ. | Max.         | Unit | Remark |
|----------------------------------|-----------|--------------|------|--------------|------|--------|
| Supply Voltage for Source Driver | $V_{DD1}$ | 3.0          | 3.3  | 3.6          | V    |        |
|                                  | $V_{DD2}$ | 8.2          | 8.8  | 9.2          | V    |        |
| Supply Voltage for Gate Driver   | $V_{GG}$  | -            | 16   | -            | V    |        |
|                                  | $V_{EE}$  | -            | -9   | -            | 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 Back Light**
 $Ta=25^{\circ}C$ 

| Parameter   | Symbol | Min. | Typ. | Max. | Unit | Remark    |
|---|--------|------|------|------|------|-----------|
| Lamp Voltage  | $V_L$  | 711  | 790  | 869  | V    | $I_L=6mA$ |
| Lamp Current  | $I_L$  | 4    | 6    | 8    | mA   | Note 7-1  |
| Lamp Frequency  | $P_L$  | 30   | 60   | 80   | KHz  | Note 7-2  |
| Starting Voltage (25 $^{\circ}C$ )<br>(Reference Value) | $V_s$  | -    | -    | 1270 | Vrms | Note 7-3  |
| Starting Voltage (0 $^{\circ}C$ )<br>(Reference Value)  | $V_s$  | -    | -    | 1650 | Vrms | Note 7-3  |

Note 7-1: In order to have proper operation of the B/L, no matter what kind of inverters, the output lamp current must be between Min. and Max. values to avoid the abnormal display image caused by B/L.

Note 7-2: The waveform of lamp driving voltage should be as close to a perfect sine wave as possible.

Note 7-3: This value is not the output voltage of inverter.  
 The voltage of inverter must be larger than the starting voltage.  
 The kick-off time must larger than 1 second.

**7-3) Power Consumption**

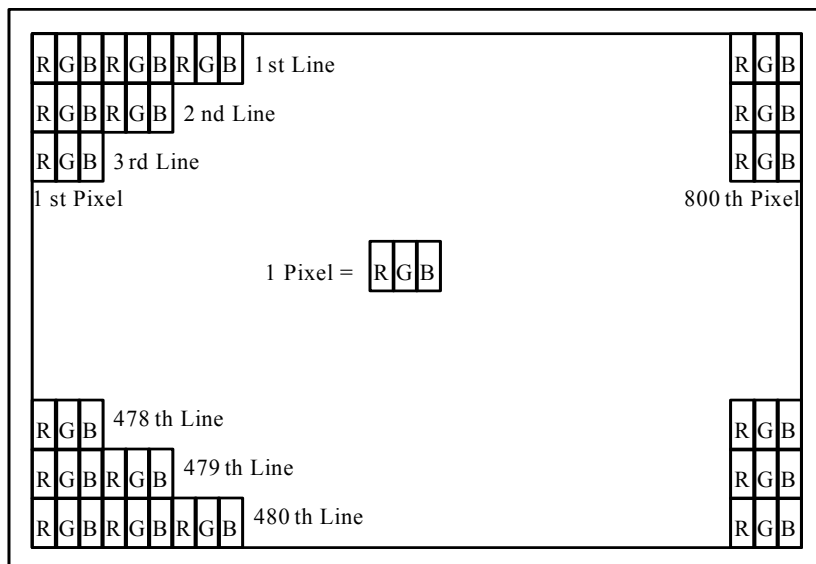
| Parameter                                  | Symbol    | Min.            | Typ.  | Max.  | Unit | Remark   |
|--|-----------|-----------------|-------|-------|------|----------|
| Supply Current for Gate Driver (Hi level)  | $I_{GG}$  | $V_{GH}=+27V$   | 0.37  | 0.56  | mA   |          |
| Supply Current for Gate Driver (Low level) | $I_{EE}$  | $V_{EE}=-10V$   | 2.67  | 4.0   | mA   |          |
| Supply Current for Source Driver (Digital) | $I_{DD1}$ | $V_{DD1}=+3.3V$ | 6.0   | 10    | mA   |          |
| Supply Current for Source Driver (Analog)  | $I_{DD2}$ | $V_{DD2}=+9.5V$ | 32.5  | 48.8  | mA   |          |
| Supply Current for Gate Driver (Digital)   | $I_{CC}$  | $V_{CC}=+3.3V$  | 0.012 | 0.017 | mA   |          |
| LCD Panel Power Consumption                |           |                 | 381.5 |       | mW   | Note 7-4 |
| Back Light Lamp Power Consumption          |           |                 | 4.74  |       | W    | Note 7-5 |

Note 7-4: The power consumption for back light is not included.

Note 7-5: Back light lamp power consumption is calculated by  $I_L \times V_L$ .

**8. Pixel Arrangement**

The LCD module pixel arrangement is stripe configuration.

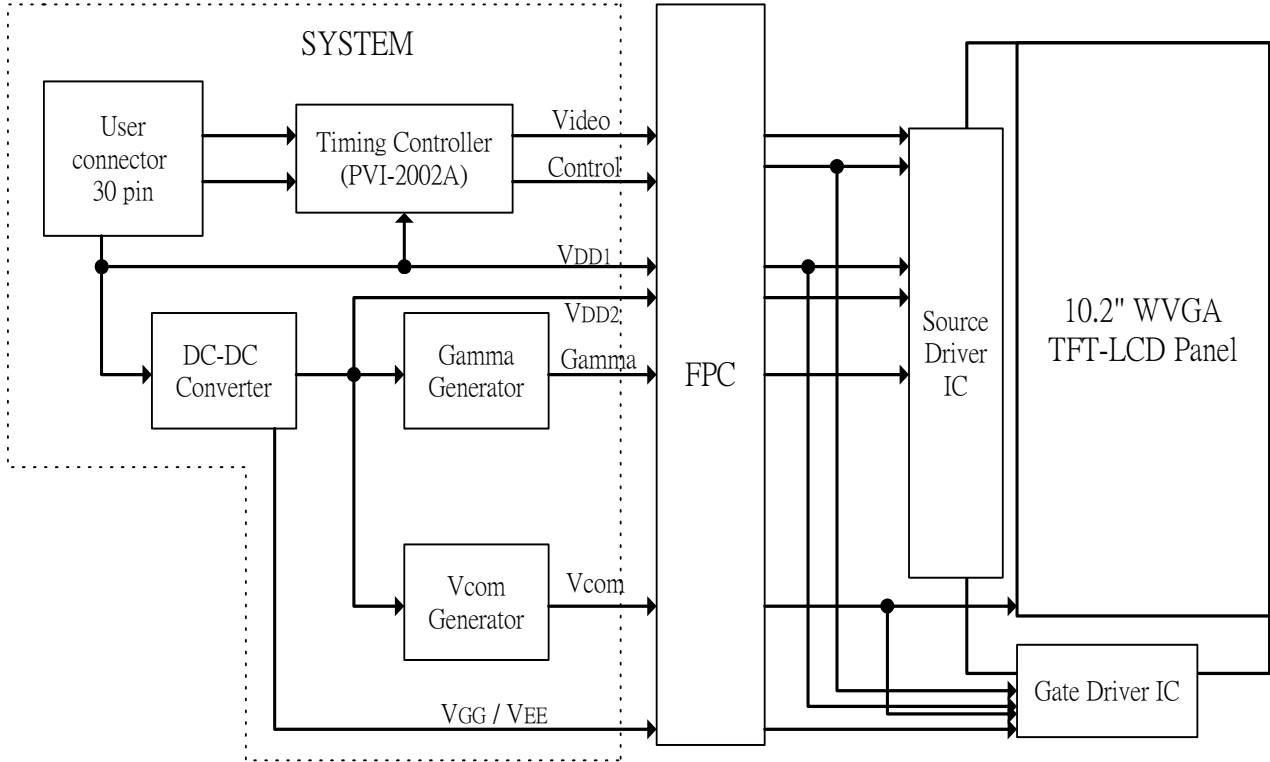


9. Display Color and Gray Scale Reference

| 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**



If you use PM102WX1, you can apply PVI-2002A(Timing controller) which will generate timing signals to support PM102WX1.

**11. Interface Timing**
**11.1) Timing Parameters**

AC Electrical Characteristics ( $V_{CC}=V_{DD1}=3.3V$ ,  $V_{DD2}=9.5V$ ,  $GND=V_{SS1}=V_{SS2}=0V$ ,  $T_a=25^{\circ}C$ )

| Parameter                      | Symbol            | Min. | Typ. | Max. | Unit            |
|--------------------------------|-------------------|------|------|------|-----------------|
| CLK Frequency                  | Fclk              | -    | 32   | 40   | MHz             |
| CLK Pulse Width                | Tew               | 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    | -    | -    | Tcw             |
| Pulse width of LD              | Twld              | 2    | -    | -    | Tcw             |
| Time That LD to DIO1/2         | Tlds              | 5    | -    | -    | Tcw             |
| POL Set-up Time                | Tpsu              | 6    | -    | -    | ns              |
| POL Hold Time                  | Tphd              | 6    | -    | -    | ns              |
| OE Pulse Width                 | T <sub>OE</sub> V | 1    | -    | -    | μs              |
| CKV Pulse Width                | T <sub>CKV</sub>  | 500  | -    | -    | ns              |
| STV Set-up Time                | T <sub>SUV</sub>  | 400  | -    | -    | ns              |
| STV Hold Time                  | T <sub>HDV</sub>  | 400  | -    | -    | ns              |
| Horizontal Display Period      | T <sub>HDP</sub>  | -    | 800  | -    | Tcw             |
| Horizontal Period Timing Range | T <sub>HP</sub>   | -    | 1056 | -    | Tcw             |
| Horizontal Lines Per Field     | T <sub>V</sub>    | 484  | 508  | 620  | T <sub>HP</sub> |
| Vertical Display Timing Range  | T <sub>DV</sub>   | -    | 480  | -    | T <sub>HP</sub> |



11.2) Timing Diagram

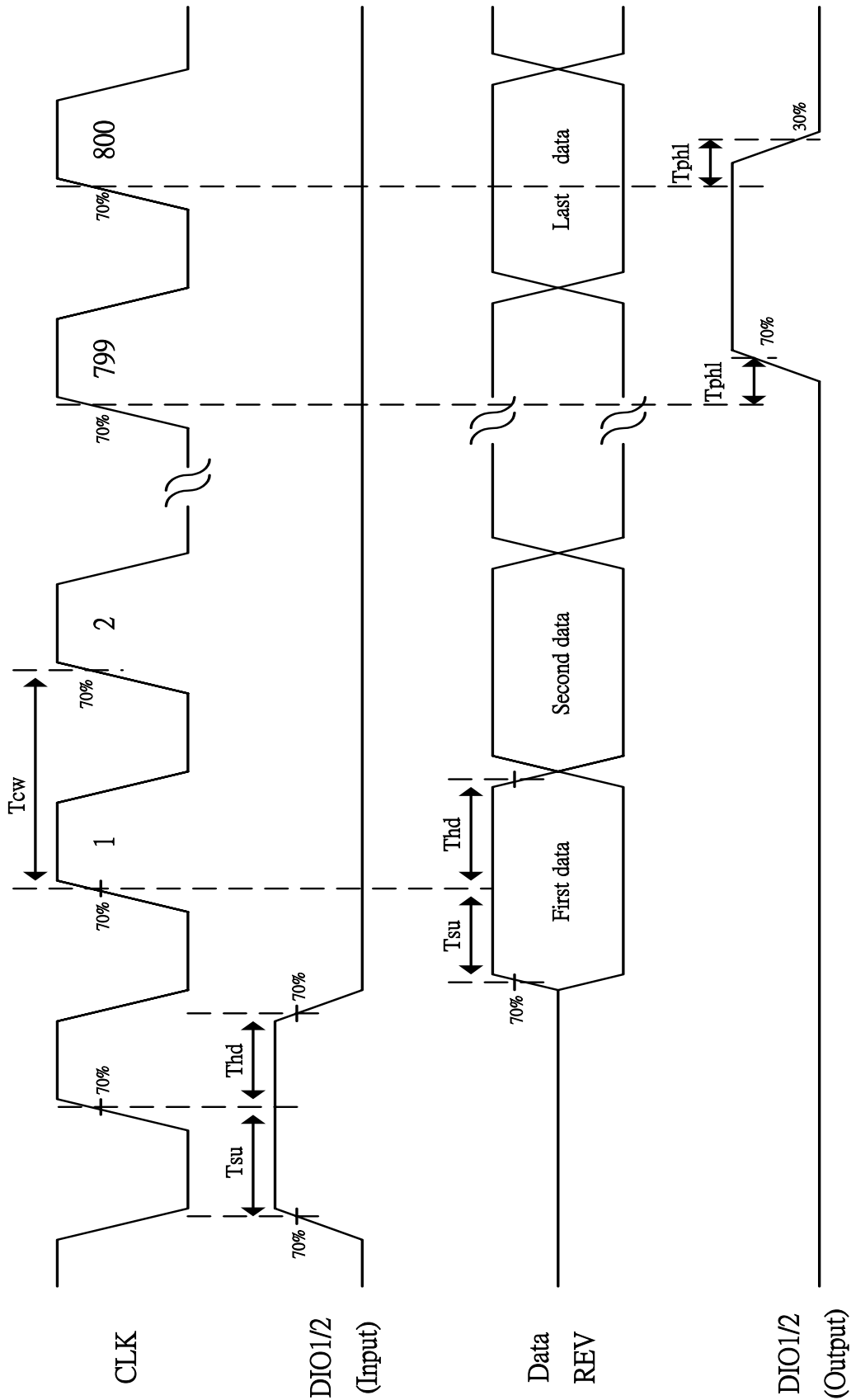


Fig. 11-1 Horizontal Timing(1)

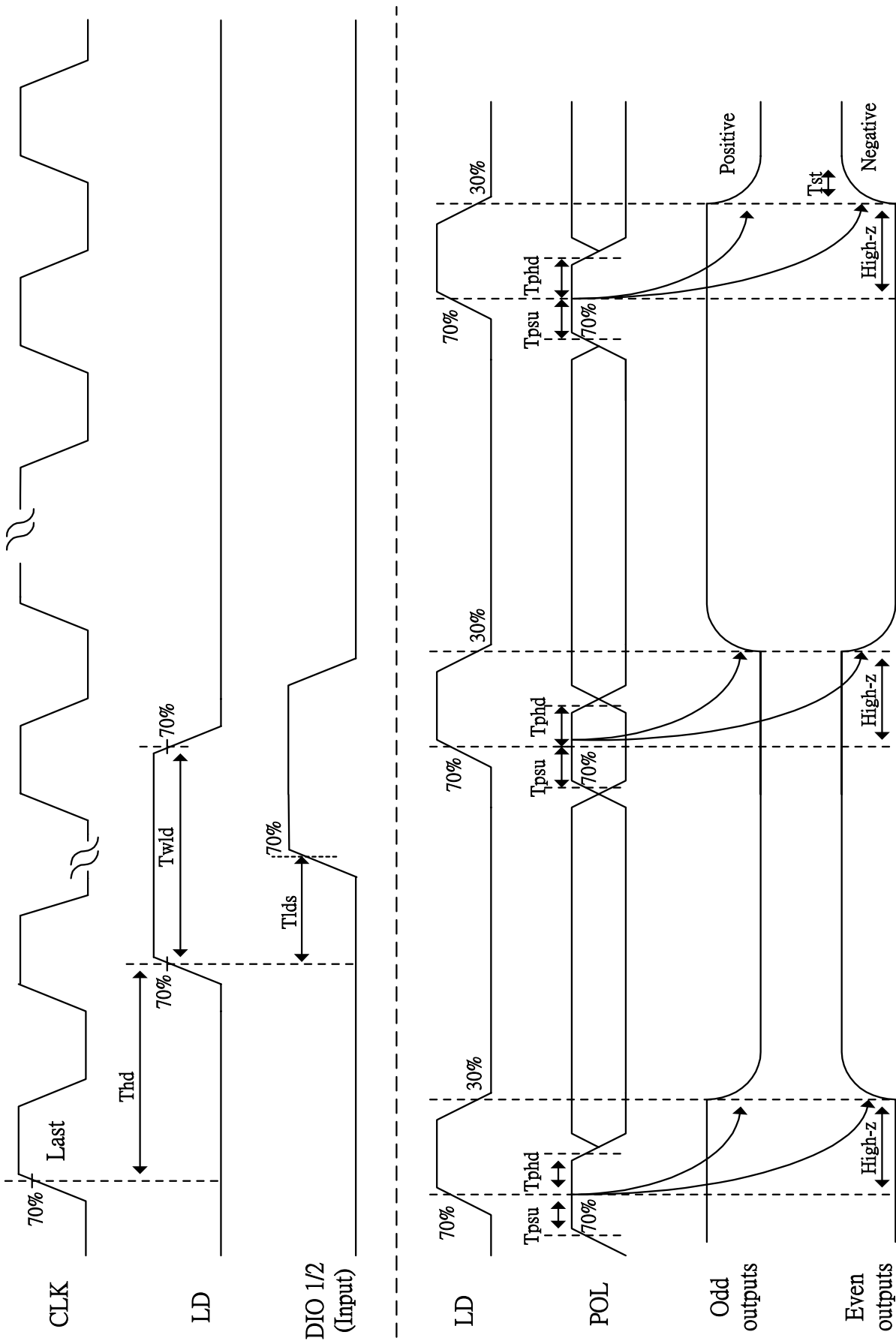


Fig. 11-2 Horizontal timing(2)

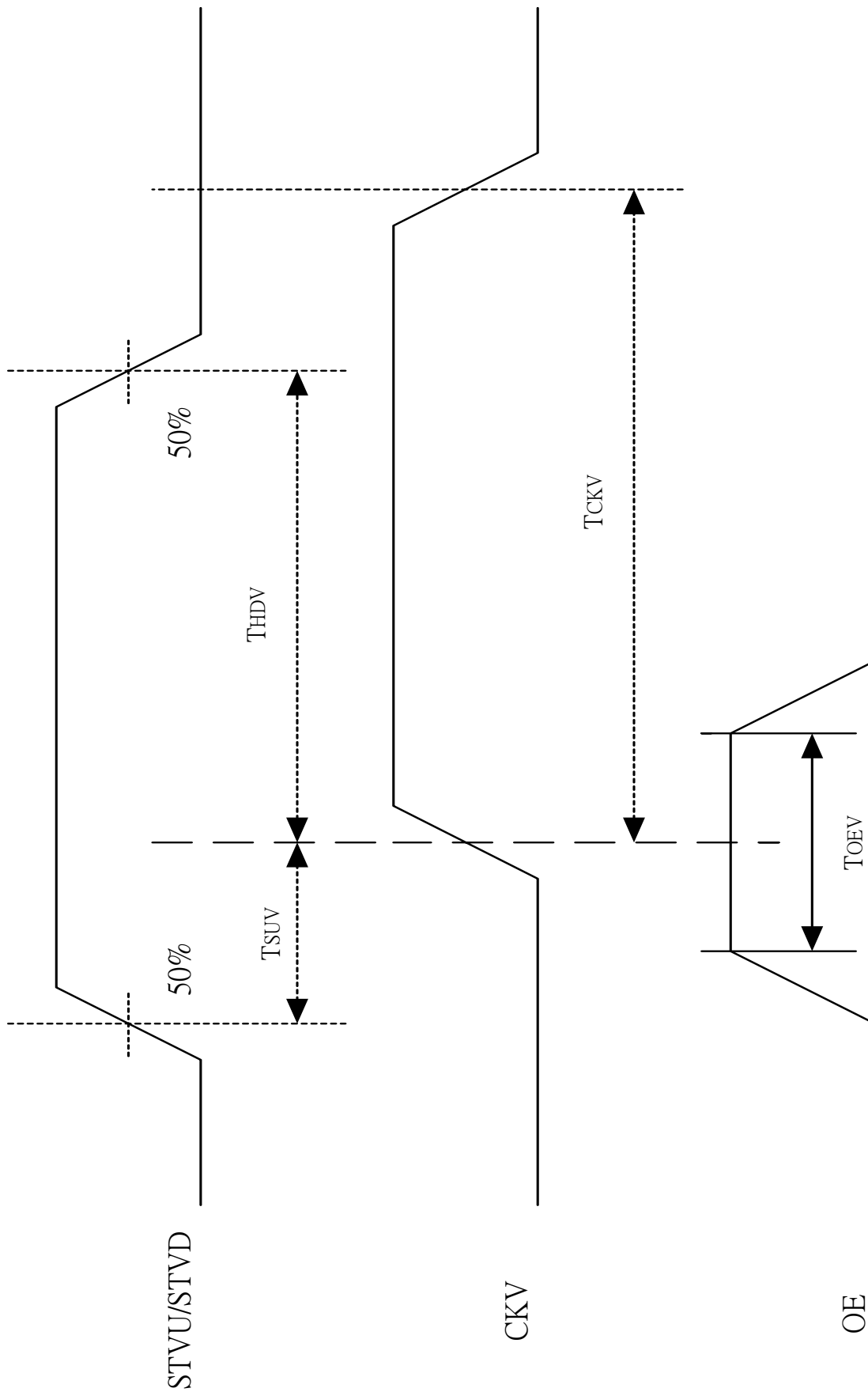


Fig. 11-3 Vertical shift clock timing

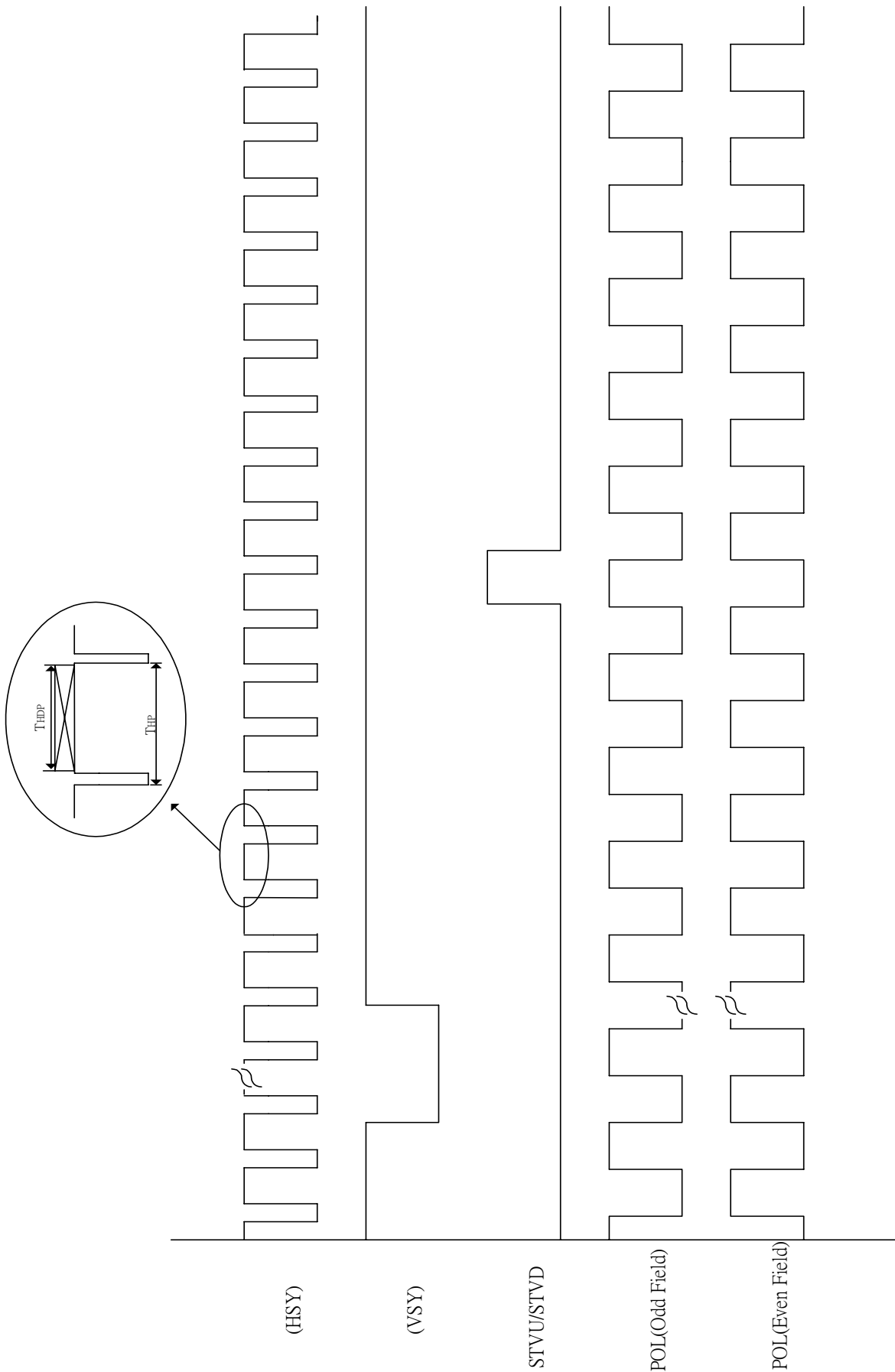
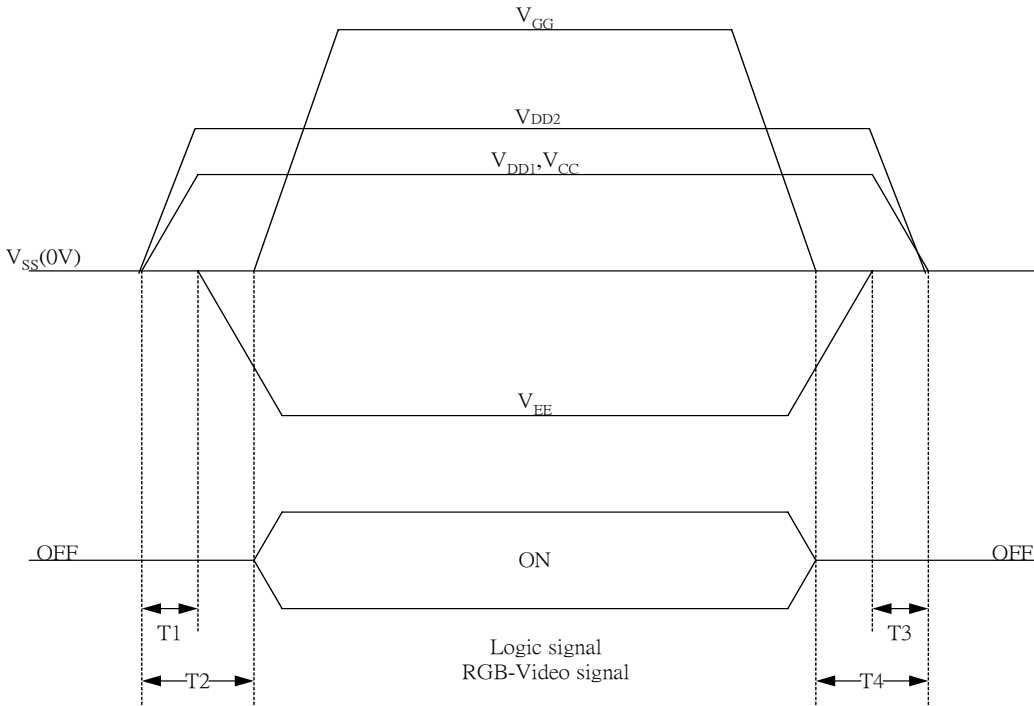


Fig. 11-4 Vertical timing

**12. Power On Sequence**



1.  $10\text{ms} \leq T1 < T2$
2.  $0\text{ms} < T3 \leq T4 \leq 10\text{ms}$

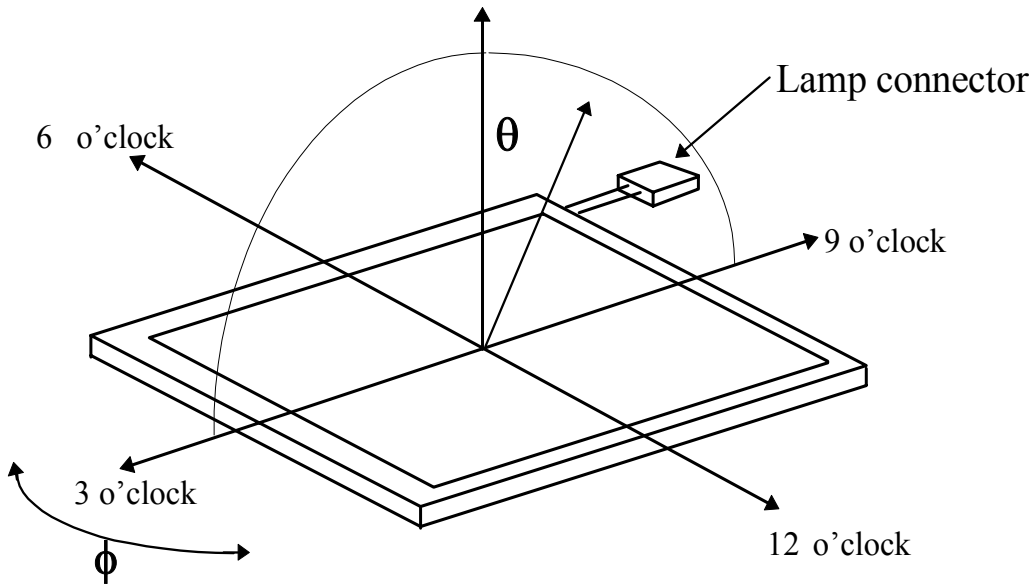
**13. Optical Characteristics**

**13-1) Specification:**

Ta=25°C

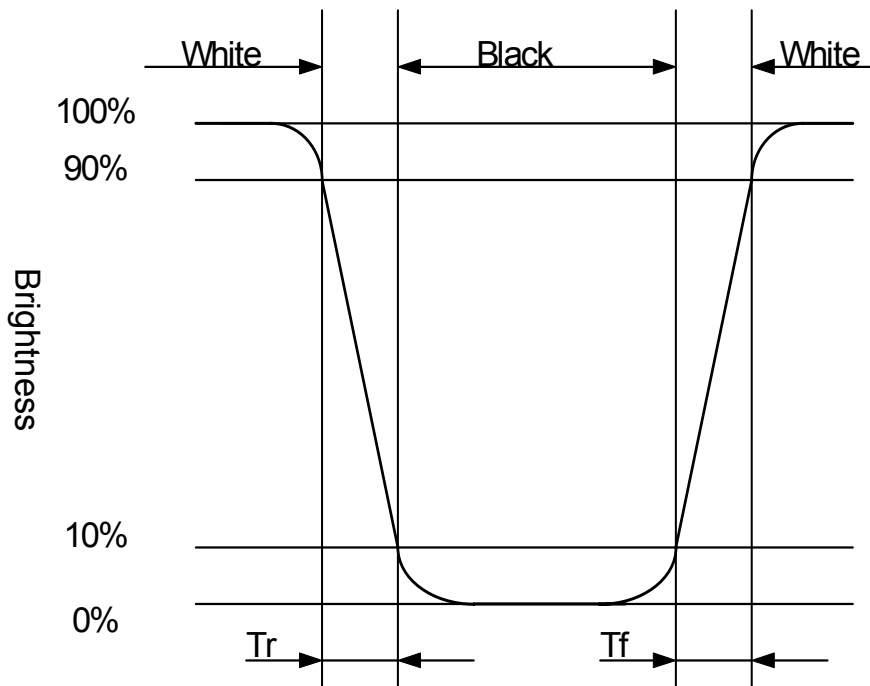
| Parameter            |            | Symbol                   | Condition                        | MIN. | TYP. | MAX. | Unit              | Remarks   |
|----------------------|------------|--------------------------|----------------------------------|------|------|------|-------------------|-----------|
| Viewing Angle        | Horizontal | $\theta$                 | CR > 10                          | ±55  | ±60  | -    | deg               | Note 13-1 |
|                      | Vertical   | $\theta$ (to 12 o'clock) |                                  | 50   | 55   | -    | deg               |           |
|                      |            | $\theta$ (to 6 o'clock)  |                                  | 35   | 40   | -    | deg               |           |
| Contrast Ratio       |            | CR                       | At optimized viewing angle       | 200  | 400  | -    | -                 | Note 13-2 |
| Response time        | Rise       | Tr                       | $\theta = 0^\circ$               | -    | 15   | 30   | ms                | Note 13-3 |
|                      | Fall       | Tf                       |                                  | -    | 25   | 50   | ms                |           |
| Brightness           |            |                          | $\theta = 0^\circ / \varphi = 0$ | 350  | 400  | -    | cd/m <sup>2</sup> | Note 13-4 |
| Luminance Uniformity |            | U                        |                                  | 75   | 80   | -    | %                 | Note 13-5 |
| White Chromaticity   |            | x                        |                                  | 0.28 | 0.31 | 0.34 | -                 |           |
|                      |            | y                        |                                  | 0.31 | 0.34 | 0.37 | -                 |           |
| Cross Talk           |            |                          | $\theta = 0^\circ$               | -    | -    | 3.5  | %                 | Note 13-6 |

Note 13-1: The definitions of viewing angles are as follow

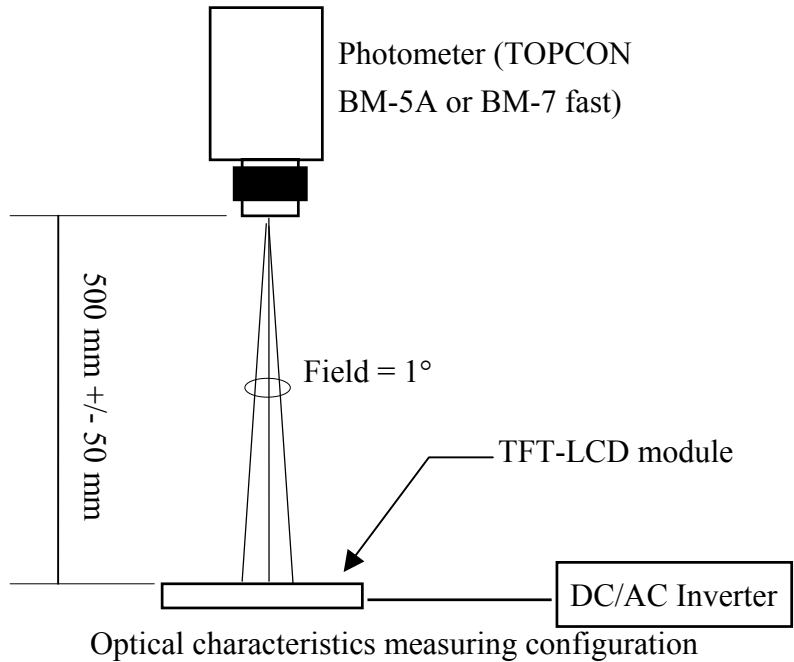


Note 13-2: The definition of contrast ratio  $CR = \frac{\text{Luminance at gray level 63}}{\text{Luminance at gray level 0}}$

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



Note 13-4: All optical measurements shall be performed after backlight being turned-on for 30 mins. 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.



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

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

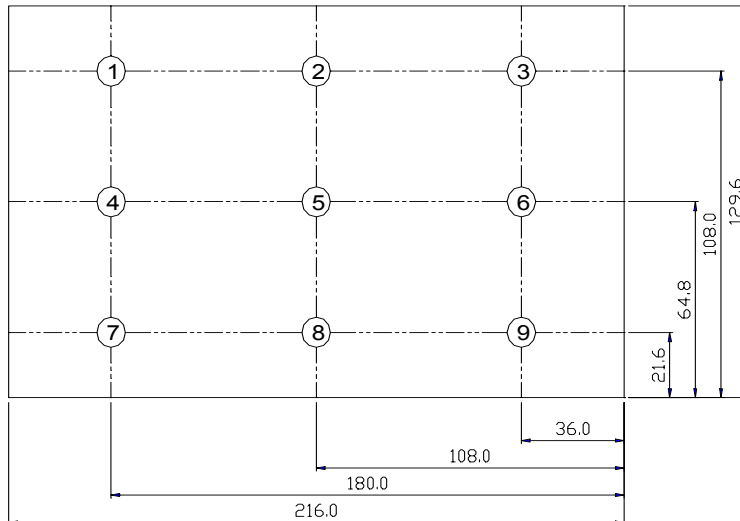
Luminance meter: BM-5A or BM-7 fast (TOPCON)

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

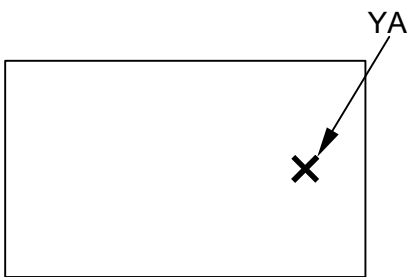
Luminance meter: BM-5A or BM-7 fast (TOPCON)

Measurement distance: 500 mm +/- 50 mm

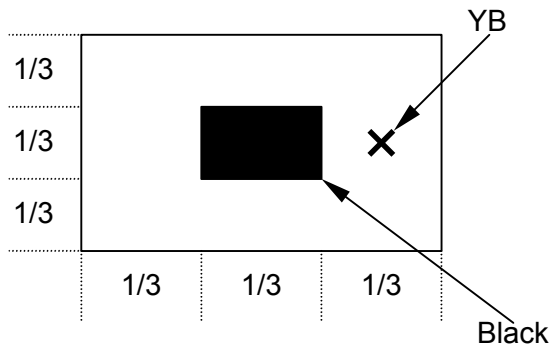
Ambient illumination: < 1 Lux

Measuring direction: Perpendicular to the surface of module

Pattern A  
(Gray Level 31)



Pattern B  
(Gray Level 31, except the black box in the center )



**X**: Measuring Point (A and B are at the same point.)

Black (Gray Level 0)

Note 13-7: Topcon BM-5A or BM-7 fast luminance meter 1° field of view is used in the testing (after 30 minutes' B/L power-on). The typical luminance value is measured at lamp current 6 mA.



## 14. Handling Cautions

### 14-1) Mounting of module

- a) Please power off the module when you connect the input/output connector.
- b) Please connect the ground pattern of the inverter circuit surely. If the connection is not perfect, some following problems may happen possibly.
  - 1. The noise from the backlight unit will increase.
  - 2. The output from inverter circuit will be unstable.
  - 3. In some cases a part of module will heat.
- c) Polarizer which is made of soft material and susceptible to flaw must be handled carefully.
- d) Protective film (Laminator) is applied on surface to protect it against scratches and dirt. It is recommended to peel off the laminator before use and taking care of static electricity.

### 14-2) Precautions in mounting

- a) When metal part of the TFT-LCD module (shielding lid and rear case) is soiled, wipe it with soft dry cloth.
- b) Wipe off water drops or finger grease immediately. Long contact with water may cause discoloration or spots.
- c) TFT-LCD module uses glass which breaks or cracks easily if dropped or bumped on hard surface. Please handle with care.
- d) Since CMOS LSI is used in the module. So take care of static electricity and earth yourself when handling.

### 14-3) Adjusting module

- a) Adjusting volumes on the rear face of the module have been set optimally before shipment.
- b) Therefore, do not change any adjusted values. If adjusted values are changed, the specifications described may not be satisfied.

### 14-4) Others

- a) Do not expose the module to direct sunlight or intensive ultraviolet rays for many hours.
- b) Store the module at a room temperature place.
- c) The voltage of beginning electric discharge may over the normal voltage because of leakage current from approach conductor by to draw lump read lead line around.
- d) If LCD panel breaks, it is possibly that the liquid crystal escapes from the panel. Avoid putting it into eyes or mouth. When liquid crystal sticks on hands, clothes or feet. Wash it out immediately with soap.
- e) Observe all other precautionary requirements in handling general electronic components.
- f) Please adjust the voltage of common electrode as material of attachment by 1 module.

### 14-5) Polarizer mark

The polarizer mark is to describe the direction of wide view angle film how to match up with the rubbing direction.

**15. Reliability Test**

| No | Test Item                                       | Test Condition   | Remark |
|----|---|--|--------|
| 1  | High Temperature Storage Test                   | Ta = +80°C, 240 hrs  |        |
| 2  | Low Temperature Storage Test                    | Ta = -30°C, 240 hrs  |        |
| 3  | High Temperature Operation Test                 | Ta = +80°C, 240 hrs  |        |
| 4  | Low Temperature Operation Test                  | Ta = -20°C, 240 hrs  |        |
| 5  | High Temperature & High Humidity Operation Test | Ta = +60°C, 90%RH, 240 hrs<br>(No Condensation)  |        |
| 6  | Thermal Cycling Test<br>(non-operating)         | 0°C → +60°C, 50 Cycles<br>1Hr 1Hr  |        |
| 7  | Vibration Test<br>(non-operating)               | Frequency : 10 ~ 57 Hz, Amplitude : 0.5 mm<br>58~500Hz, 1G<br>Sweep time: 11 min<br>Test Period: 3 hrs (1 hr for each direction of X,<br>Y, Z) |        |
| 8  | Shock Test<br>(non-operating)                   | 80G, 6ms, X,Y, Z<br>1 times for each direction   |        |
| 9  | Electrostatic Discharge Test<br>(non-operating) | 200pF, 0Ω<br>±200V<br>1 time / each terminal   |        |

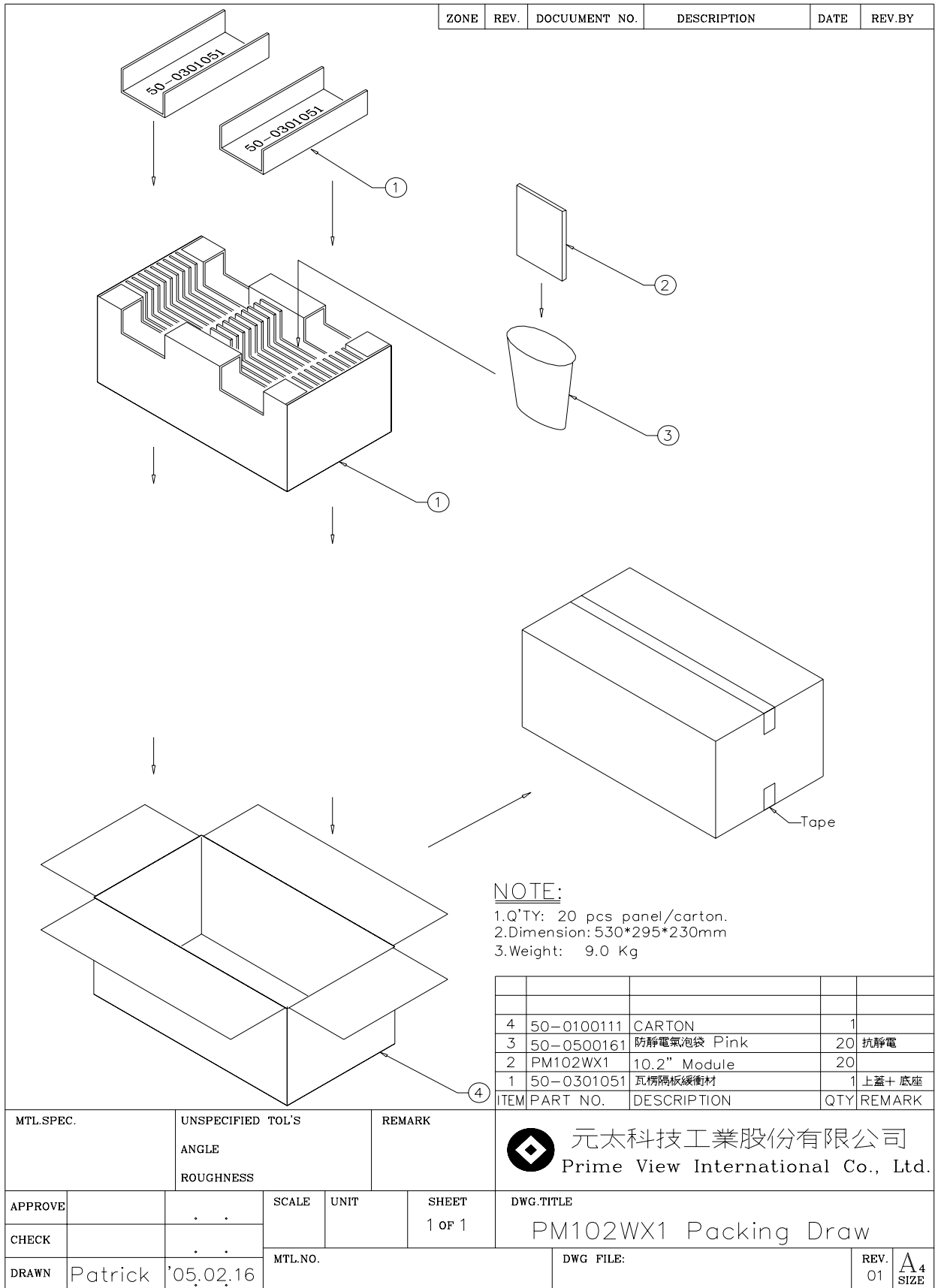
Ta: ambient temperature

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.

**16. Packing Diagram**



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## Revision History

| Rev. | Issued Date   | Revised Contents   |
|------|---------------|--|
| 0.1  | Jul. 21,2004  | New  |
| 0.2  | Aug. 13, 2004 | Page 16: Modify Interface Timing   |
| 0.3  | Dec.28,2004   | Updata<br>Page12: 7-2) Recommended Driving Condition for Back Light<br>Page 13:7-3) Power Consumption<br>Page 22:13-1) Specification |
| 0.4  | Jun.31,2005   | Page4: 4.Mechanical Drawing of TFT-LCD Module<br>(Change ground line form 45mm increase length to 100mm)                             |
| 0.5  | Fab.16,2005   | Updata<br>Page 21: 13. Optical Characteristics Luminance Uniformity<br>Page 27: 16. Packing Diagram                                  |