



# SmarterGlass

state-of-the-art display solutions

[www.smarterglass.com](http://www.smarterglass.com)  
978 465 6190  
[sales@smarterglass.com](mailto:sales@smarterglass.com)



Version :0.1

TECHNICAL SPECIFICATION

MODEL NO. : PM058OX1

The content of this information is subject to be changed without notice.  
Please contact EIH or its agent for further information.

☐ Customer's Confirmation

Customer

By

☐ EIH's Confirmation

| Dep  | FAE | Panel Design | Electronic Design | Mechanical Design | Product Verification | Prepared by |
|------|-----|--------------|-------------------|-------------------|----------------------|-------------|
| SIGN | 劉豐發 | 楊敬聖 7/16     | 李連發 7/16          | 陳佩珊               | 傅淑貞 11/16            | 侯采君         |



### Revision History

| Rev. | Issued Date   | Revised Contents |
|------|---------------|------------------|
| 0.1  | Feb. 15, 2011 | Preliminary      |



## TECHNICAL SPECIFICATION

### CONTENTS

| <i><b>NO.</b></i> | <i><b>ITEM</b></i>                     | <i><b>PAGE</b></i> |
|-------------------|----------------------------------------|--------------------|
| -                 | Cover                                  | 1                  |
|                   | Revision History                       | 2                  |
| -                 | Contents                               | 3                  |
| 1                 | Application                            | 4                  |
| 2                 | Features                               | 4                  |
| 3                 | Mechanical Specifications              | 4                  |
| 4                 | Mechanical Drawing of TFT-LCD module   | 5                  |
| 5                 | Input / Output Terminals               | 6                  |
| 6                 | Absolute Maximum Ratings               | 10                 |
| 7                 | Electrical Characteristics             | 10                 |
| 8                 | Pixel Arrangement                      | 11                 |
| 9                 | Display Color and Gray Scale Reference | 12                 |
| 10                | Block Diagram                          | 13                 |
| 11                | Interface Timing                       | 14                 |
| 12                | Power On Sequence                      | 18                 |
| 13                | Optical Characteristics                | 19                 |
| 14                | Handling Cautions                      | 22                 |
| 15                | Reliability Test                       | 24                 |
| 16                | Packing                                | 25                 |



### 1. Application

This data sheet applies to a color TFT LCD module, PM058OX1. The module applies to OA product, GPS, which require high quality flat panel display. If you must use in high reliability environment, the module can't over reliability test condition. If you use PM058OX1, E Ink Holding Inc. advises your system sides must use NT71355 which one generates signal to control PM058OX1.

### 2. Features

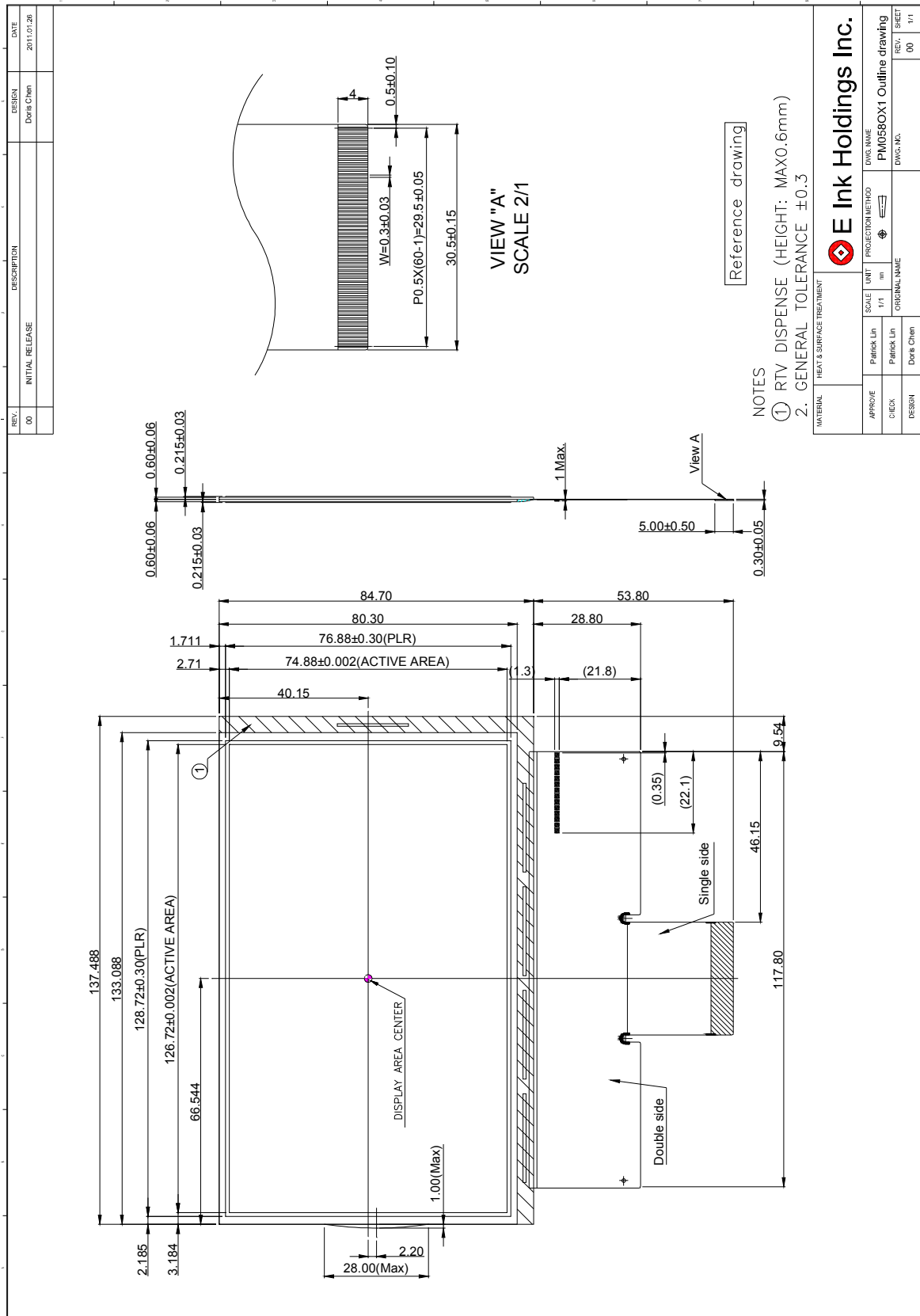
- . Amorphous silicon TFT LCD panel
- . Pixel in stripe configuration
- . Display Colors : 262,144 colors
- . Optimum Viewing Direction : 6 o'clock

### 3. Mechanical Specifications

| Parameter                      | Specifications                         | Unit |
|--------------------------------|----------------------------------------|------|
| Screen Size                    | 5.8(diagonal)                          | inch |
| Display Format                 | 1280×(R, G, B)×768                     | dot  |
| Display Colors                 | 262,144                                |      |
| Active Area                    | 126.720(H)×74.880(V)                   | mm   |
| Pixel Pitch                    | 0.0990(H)×0.0975(V)                    | mm   |
| Pixel Configuration            | Stripe                                 |      |
| Outline Dimension              | 137.488(W)×84.700 (H)×1.630 (typ.) (D) | mm   |
| Weight                         | TBD                                    | g    |
| Surface treatment              | Normal                                 |      |
| Display mode                   | Normally White                         |      |
| Gray scale inversion direction | 6 o'clock<br>[ref to Note13-1]         |      |



#### 4. Mechanical Drawing of TFT-LCD Module



**5. Input / Output Terminals**

TFT-LCD Panel Driving

| in No. | Symbol | I/O | Function                                    | Remark    |
|--------|--------|-----|---------------------------------------------|-----------|
| 1      | VCOM   | I   | Common Voltage                              |           |
| 2      | GND    | I   | Ground                                      |           |
| 3      | VCC    | I   | Voltage for digital circuit                 |           |
| 4      | GND    | I   | Ground                                      |           |
| 5      | VEE    | I   | Gate Off Voltage                            | Note 5-2  |
| 6      | GND    | I   | Ground                                      |           |
| 7      | VGG    | I   | Gate On Voltage                             | Note 5-1  |
| 8      | GND    | I   | Ground                                      |           |
| 9      | STVD   | I/O | Vertical Shift Pulse Signal Input or Output | Note 5-6  |
| 10     | STVU   | I/O | Vertical Shift Pulse Signal Input or Output | Note 5-6  |
| 11     | CKV    | I   | Vertical Shift Clock                        | Note 5-4  |
| 12     | UD     | I   | Up/Down Selection                           | Note 5-6  |
| 13     | OE     | I   | Output Enable                               | Note 5-5  |
| 14     | AVDD   | I   | Power Supply                                |           |
| 15     | GND    | I   | Ground                                      |           |
| 16     | VDD    | I   | Voltage for analog circuit                  |           |
| 17     | POL    | I   | Polarity selection                          | Note 5-9  |
| 18     | REV    | I   | Data invert control                         | Note 5-8  |
| 19     | LD     | I   | Load output signal                          | Note 5-7  |
| 20     | GND    | I   | Ground                                      |           |
| 21     | V14    | I   | Gamma Voltage 14                            | Note 5-10 |
| 22     | V13    | I   | Gamma Voltage 13                            |           |
| 23     | V12    | I   | Gamma Voltage 12                            |           |
| 24     | V11    | I   | Gamma Voltage 11                            |           |
| 25     | V10    | I   | Gamma Voltage 10                            |           |
| 26     | V9     | I   | Gamma Voltage 9                             |           |
| 27     | V8     | I   | Gamma Voltage 8                             |           |
| 28     | V7     | I   | Gamma Voltage 7                             |           |
| 29     | V6     | I   | Gamma Voltage 6                             |           |
| 30     | V5     | I   | Gamma Voltage 8                             |           |
| 31     | V4     | I   | Gamma Voltage 4                             |           |
| 32     | V3     | I   | Gamma Voltage 3                             |           |
| 33     | V2     | I   | Gamma Voltage 2                             |           |
| 34     | V1     | I   | Gamma Voltage 1                             |           |

The information contained herein is the exclusive property of E Ink Holdings Inc. and shall not be distributed, reproduced, or disclosed in whole or in part without prior written permission of E Ink Holdings Inc.



|    |         |     |                                               |          |
|----|---------|-----|-----------------------------------------------|----------|
| 35 | GND     | I   | Ground                                        |          |
| 36 | MLV5N   |     | Mini-LVDS data input                          |          |
| 37 | MLV5P   | I   | Mini-LVDS data input                          |          |
| 38 | GND     | I   | Ground                                        |          |
| 39 | MLV4N   | I   | Mini-LVDS data input                          |          |
| 40 | MLV4P   | I   | Mini-LVDS data input                          |          |
| 41 | GND     | I   | Ground                                        |          |
| 42 | MLV3N   | I   | Mini-LVDS data input                          |          |
| 43 | MLV3P   | I   | Mini-LVDS data input                          |          |
| 44 | GND     | I   | Ground                                        |          |
| 45 | MLVCLKN | I   | Mini-LVDS data input                          |          |
| 46 | MLVCLKP | I   | Mini-LVDS data input                          |          |
| 47 | GND     | I   | Ground                                        |          |
| 48 | MLV2N   | I   | Mini-LVDS data input                          |          |
| 49 | MLV2P   | I   | Mini-LVDS data input                          |          |
| 50 | GND     | I   | Ground                                        |          |
| 51 | MLV1N   | I   | Mini-LVDS data input                          |          |
| 52 | MLV1P   | I   | Mini-LVDS data input                          |          |
| 53 | GND     | I   | Ground                                        |          |
| 54 | MLV0N   | I   | Mini-LVDS data input                          |          |
| 55 | MLV0P   | I   | Mini-LVDS data input                          |          |
| 56 | GND     | I   | Ground                                        |          |
| 57 | SHL     | I   | Left/Right Selection                          | Note 5-3 |
| 58 | TTLRSDS | I   | Mini-LVDS 3/6 pair input mode                 |          |
| 59 | DIO1    | I/O | Horizontal Start Pulse Signal Input or Output | Note 5-3 |
| 60 | DIO2    | I/O | Horizontal Start Pulse Signal Input or Output | Note 5-3 |





Note 5-1 :  $V_{GG} = 18.0V$

Note 5-2 :  $V_{EE} = -6V$

Note 5-3 : 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 5-4 : Gate driver shift clock

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 : 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 5-8 : Control whether the Data D00~D25 are inverted or not.

When “REV=1”, these data will be inverted.

EX: “00”→”3F”, “07”→”38”, “15”→”2A”

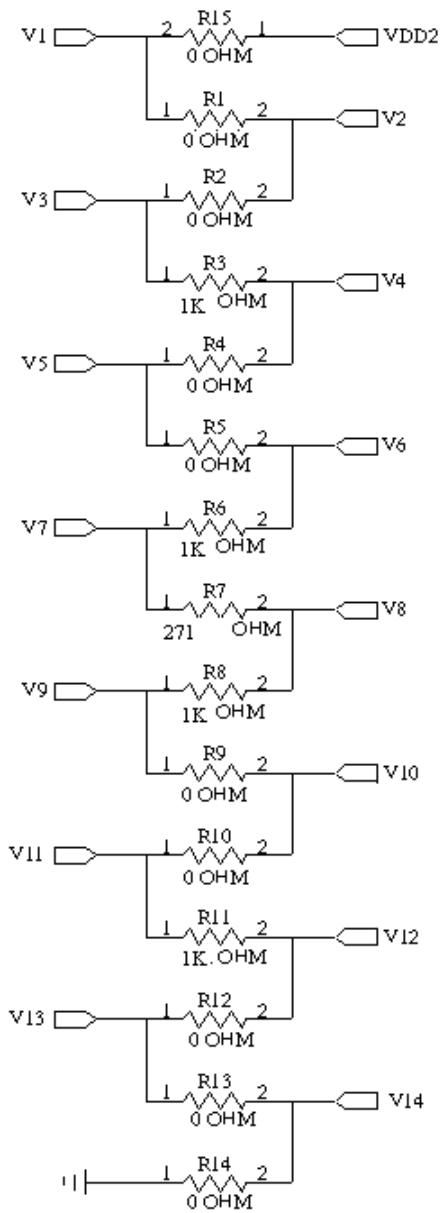
Note 5-9 : Polarity selector for dot-inversion control. Available at the rising edge of LD.

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 5-10: Typical Application Circuit(When VDD2=12.5V)



**6. Absolute Maximum Ratings :**
 $AVSS=GND=0V, T_a=25^{\circ}C$ 

| Parameters            | Symbol          | MIN. | MAX. | Unit        | Remark |
|-----------------------|-----------------|------|------|-------------|--------|
| Supply Voltage        | $V_{DD1}$       | -0.5 | 5.0  | V           |        |
|                       | $V_{CC}$        | -0.3 | 7.0  | V           |        |
|                       | $V_{DD2}$       | -0.5 | 15   | V           |        |
|                       | $V_{GG}$        | -0.3 | 42.0 | V           |        |
|                       | $V_{GG}-V_{EE}$ | -0.3 | 40.0 | V           |        |
|                       | $V_{EE}$        | -20  | 0.3  | V           |        |
| Operating Temperature | Top             | -20  | 70   | $^{\circ}C$ |        |
| Storage Temperature   | Tst             | -30  | 80   | $^{\circ}C$ |        |

**7. Electrical Characteristics**
**7-1) Recommended Operating Conditions**
 $AVSS=GND=0V, T_a=25^{\circ}C$ 

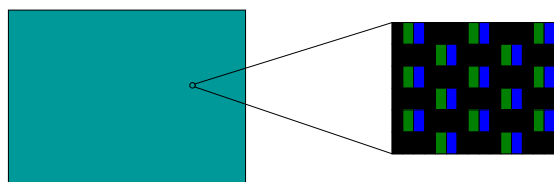
| Item                             | Symbol    | Min. | Typ. | Max. | Unit | Remark |
|----------------------------------|-----------|------|------|------|------|--------|
| Supply Voltage for Source Driver | $V_{DD1}$ | 3.0  | 3.3  | 3.6  | V    |        |
|                                  | $V_{DD2}$ | -    | 12.5 | -    | V    |        |
| Supply Voltage for Gate Driver   | $V_{GG}$  | -    | 18   | -    | V    |        |
|                                  | $V_{EE}$  | -    | -6.0 | -    | V    |        |
|                                  | $V_{CC}$  | 3.0  | 3.3  | 3.6  | V    |        |
| Supply Voltage for Vcom          | $V_{com}$ | -    | 4.5  | -    | V    |        |

**7-2) Power Consumption**

| Parameter                                  | Symbol    | Condition       | Typ. | Max. | Unit | Remark   |
|--------------------------------------------|-----------|-----------------|------|------|------|----------|
| Supply Current for Gate Driver (Hi level)  | $I_{GG}$  | $V_{GG}=18V$    | TBD  | TBD  | mA   | Note 7-2 |
| Supply Current for Gate Driver (Low level) | $I_{EE}$  | $V_{EE}=-6.0V$  | TBD  | TBD  | mA   |          |
| Supply Current for Source Driver (Digital) | $I_{DD1}$ | $V_{DD1}=3.3V$  | TBD  | TBD  | mA   |          |
| Supply Current for Source Driver (Analog)  | $I_{DD2}$ | $V_{DD2}=12.5V$ | TBD  | TBD  | mA   |          |
| Supply Current for Gate Driver (Digital)   | $I_{CC}$  | $V_{CC}=3.3V$   | TBD  | TBD  | mA   |          |
| LCD Panel Power Consumption                | -         | -               | TBD  | TBD  | mW   | Note 7-1 |

Note 7-1: The power consumption for back light is not included.

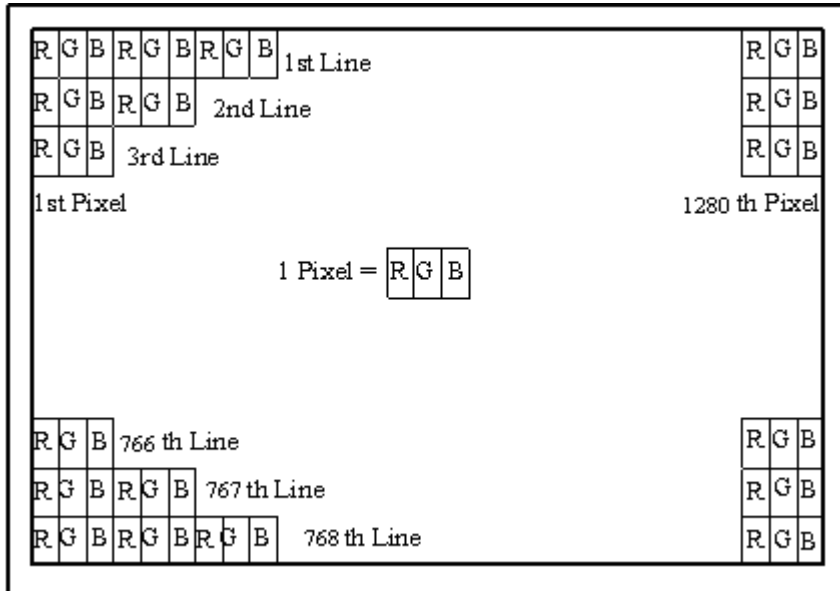
Note 7-2: Test pattern for dissipative current.





## 8. Pixel Arrangement

The LCD module pixel arrangement is the stripe.





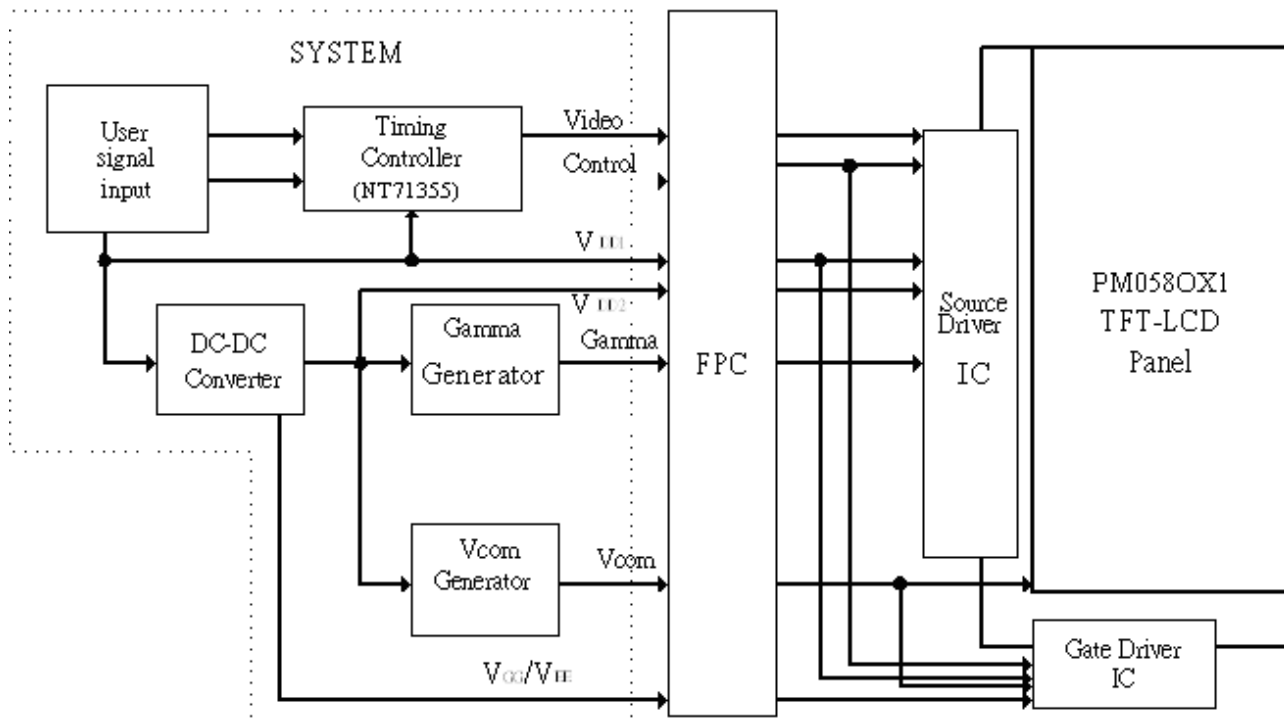
## 9. Display Color and Gray Scale Reference

| 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  | 1  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|              | Green (02) | 0                | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 1  | 0  | 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 PM058OX1 , you must apply NT71355 (Timing controller) which Will generate signal to support PM058OX1

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

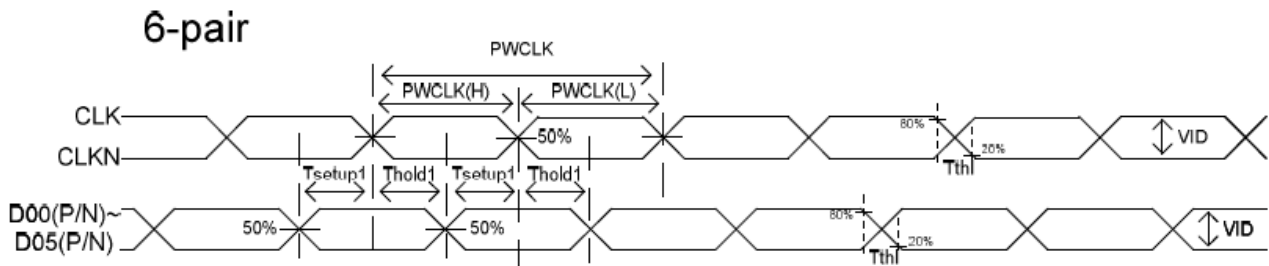
AVSS=GND = 0V , Ta = 25°C

| Parameter                             | Symbol   | Min. | Typ. | Max. | Unit | Condition               |
|---------------------------------------|----------|------|------|------|------|-------------------------|
| CLK Frequency                         | Fclk     | -    | 80   | 135  | MHz  |                         |
| CLK Pulse Width                       | PWCLK    | 7.41 | -    | -    | ns   | 3.0V~3.6V               |
| CLK Pulse Low Period                  | PWCLK(L) | 0.4  | -    | 0.6  | CLK  |                         |
|                                       | CLKN     | CLKN |      | CLKN |      |                         |
| CLK Pulse High Period                 | PWCLK(H) | 0.4  | -    | 0.6  | CLK  |                         |
|                                       | CLKN     | CLKN |      | CLKN |      |                         |
| Data Setup Time                       | Tsetup1  | 0.9  | -    | -    | ns   | PWCLK=7.41ns            |
| Data Hold Time                        | Thold1   | 0.9  | -    | -    | ns   | PWCLK=7.41ns            |
| DIO SETUP Time                        | Tsetup2  | 0    | -    | -    | ns   |                         |
| DIO Signal Delay Time                 | Tplh     | -    | -    | 3    | CLK  | Load=25pF               |
| DIO Pulse Width                       | Twd      | -    | -    | 6    | CLK  |                         |
| CLK, D00~D05, D10~D15<br>Rising Time  | Tthl     | -    | -    | 0.5  | ns   | PWCLK=7.41ns            |
| CLK, D00~D05, D10~D15<br>Falling Time | Ttlh     | -    | -    | 0.5  | ns   | PWCLK=7.41ns            |
| Reset(RST) High Period                | Thp-rst  | 3    | -    | -    | CLK  | >50ns                   |
| Receive Off to LD Timing              | Tro-ld   | 6    | -    | -    | CLK  |                         |
| LD High Pulse Width                   | PWLD     | 21   | -    | -    | CLK  |                         |
| POL Setup Time                        | Tsetup3  | 14   | -    | -    | ns   |                         |
| POL Hold Time                         | Thold3   | 10   | -    | -    | ns   |                         |
| LD to Reset Input Time                | Tld-rst  | 21   | -    | -    | CLK  | Also more than<br>200ns |
| Reset Low to LD Rising Time           | Trst-ld  | 0    | -    | -    | ns   |                         |

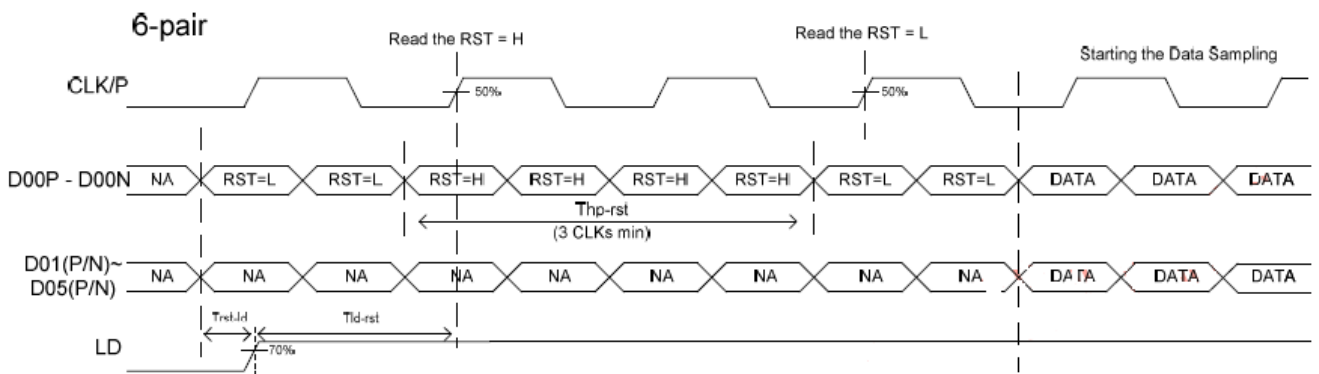


## 11.2) Timing Diagram

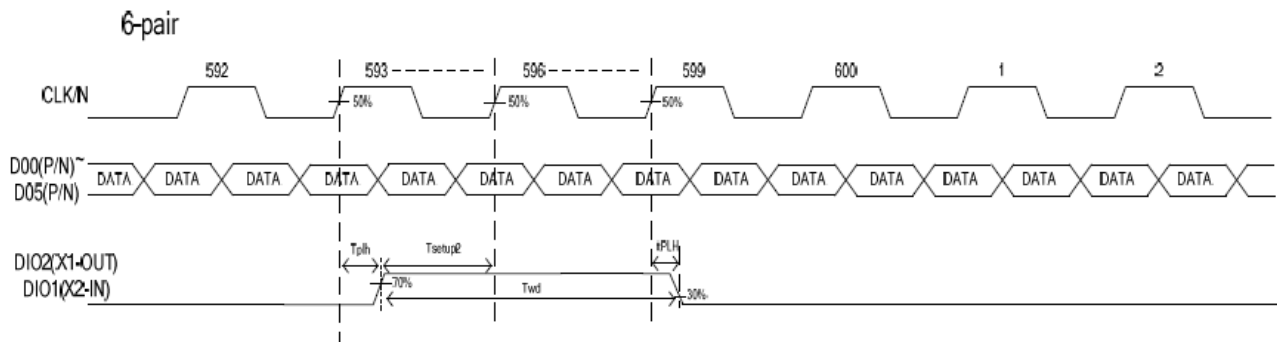
## ※Timing for receiving data



## ※ Input data timing



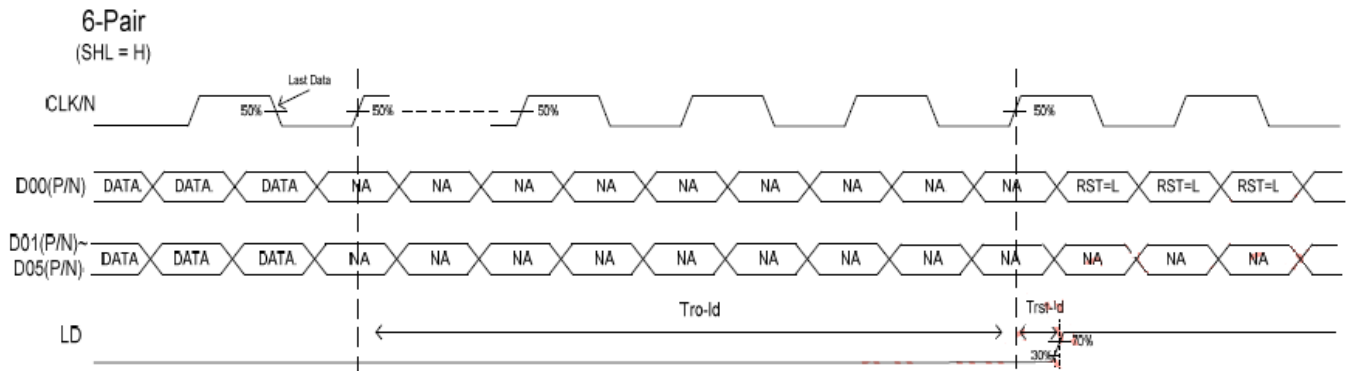
## ※ Input data timing(Cascade Chip)



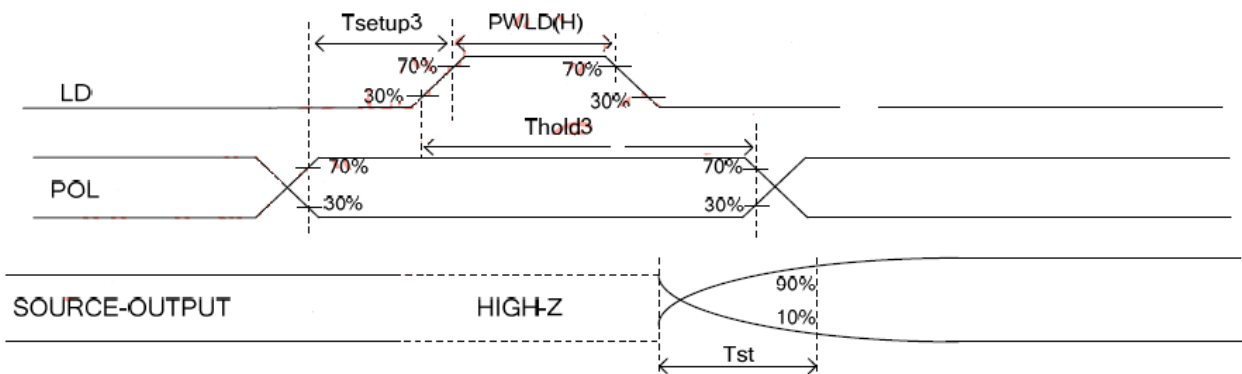




※ Last Data Sampling to LD Timing

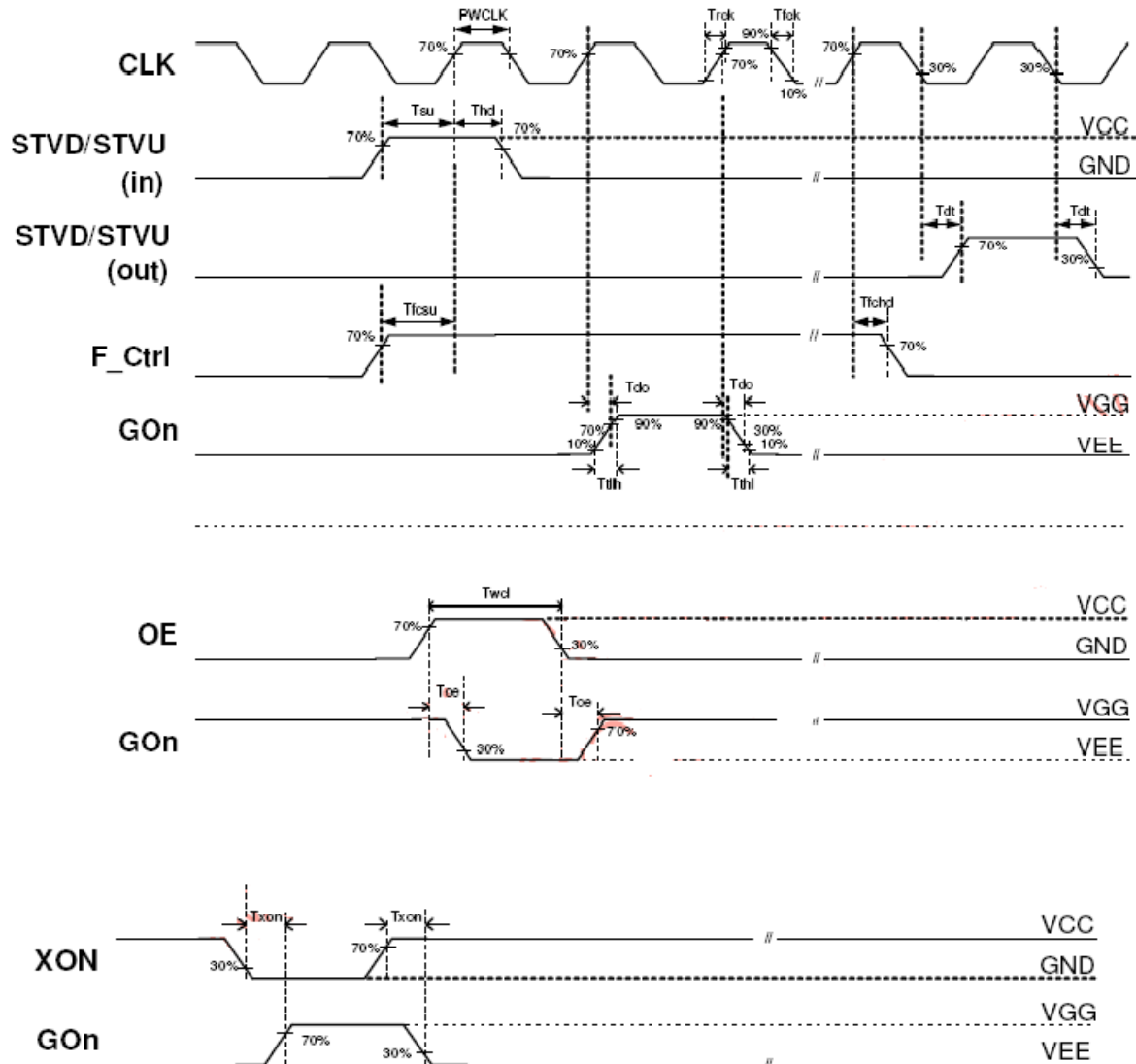


※ Output Timing



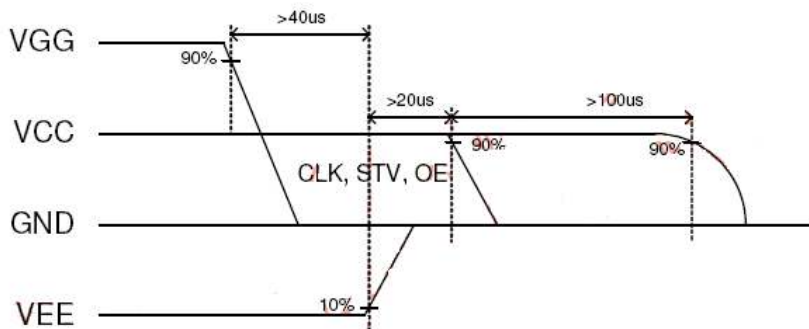
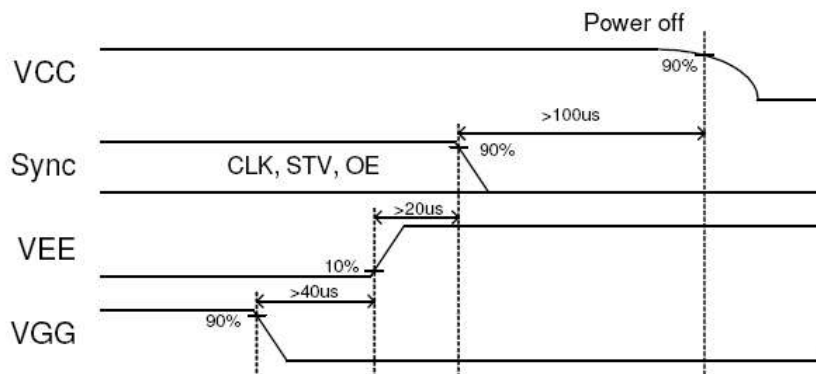
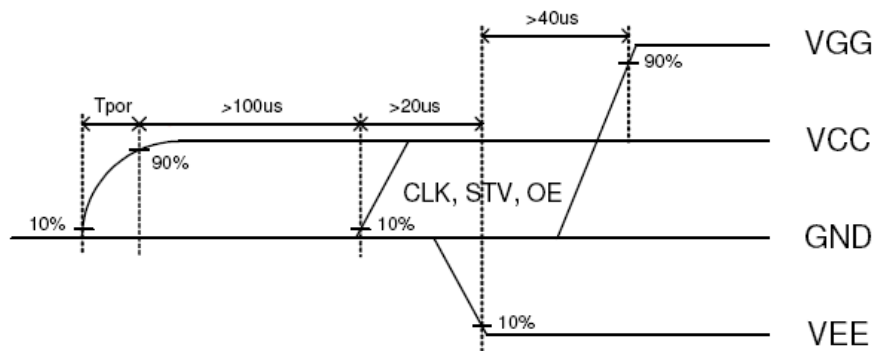
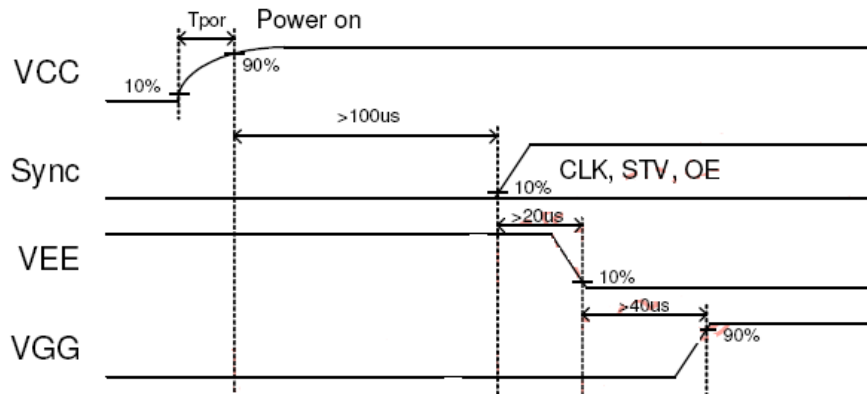


※Timing waveform





## 12. Power On Sequence



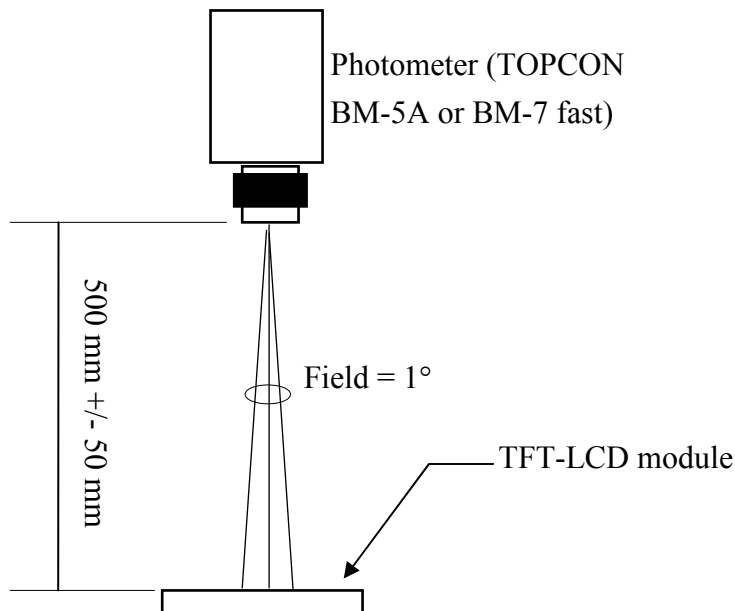
**13. Optical Characteristics****13-1) Specification :**

The backlight which EIH used is LED for optical measuring and the specification of average brightness is 10930(cd/m<sup>2</sup>).

Ta=25°C

| Parameter          |            | Symbol                     | Condition                  | MIN. | TYP. | MAX. | Unit | Remarks   |
|--------------------|------------|----------------------------|----------------------------|------|------|------|------|-----------|
| Viewing Angle      | Horizontal | $\theta$ 21, $\theta$ 22   | $CR \geq 10$               | 45   | 50   | -    | deg  | Note 13-1 |
|                    | Vertical   | $\theta$ 12(to 12 o'clock) |                            | 10   | 15   | -    | deg  |           |
|                    |            | $\theta$ 11(to 6 o'clock)  |                            | 30   | 35   | -    | deg  |           |
| Contrast Ratio     |            | CR                         | At optimized Viewing angle | TBD  | TBD  | -    | -    | Note 13-3 |
| Response time      | Rise       | Tr                         | $\theta = 0^\circ$         | -    | 15   | 30   | ms   | Note 13-2 |
|                    | Fall       | Tf                         |                            | -    | 25   | 50   | ms   |           |
| Transmission ratio |            | T                          | $\theta = 0^\circ$         | TBD  | TBD  | -    | -    | -         |
| Cross talk         |            |                            | $\theta = 0^\circ$         | -    | -    | 3.5  | %    | Note 13-4 |

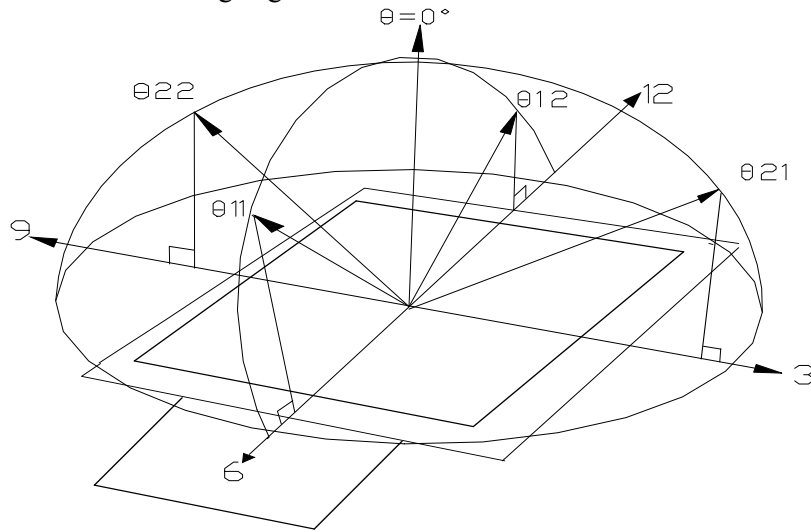
All the optical measurement shall be executed 30 minute after backlight being turn-on. The optical characteristics shall be measured in dark room (ambient illumination on panel surface less than 1 Lux). The measuring configuration shows as following figure.



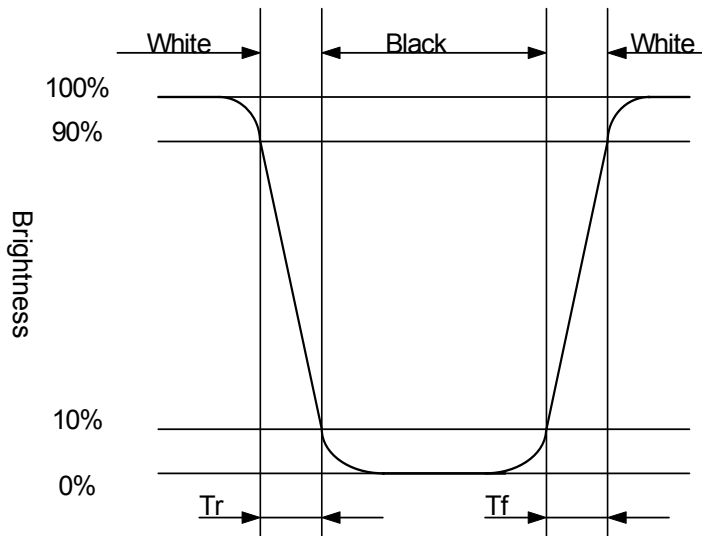
Optical characteristics measuring configuration



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



Note 13-2 : Definition of Response Time  $T_r$  and  $T_f$



Note 13-3 : The definition of contrast ratio  $CR = \frac{\text{Luminance at White Pattern}}{\text{Luminance at Black Pattern}}$



Note 13-4: Cross Talk (CTK) =  $\frac{|Y_A - Y_B|}{Y_A} \times 100\%$

Y<sub>A</sub>: Brightness of Pattern A

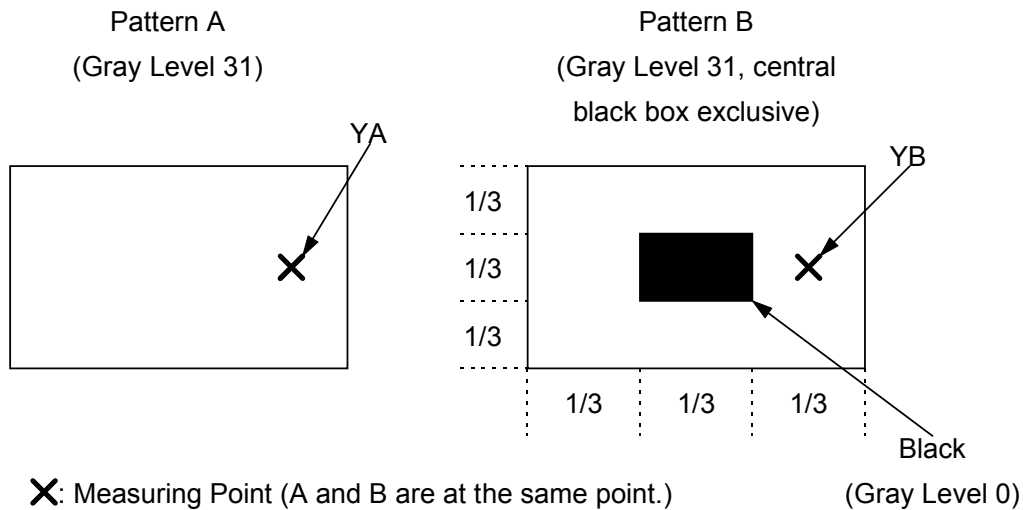
Y<sub>B</sub>: Brightness of Pattern B

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





### 14. Handling Cautions

#### 14-1) Mounting of module

- a) Please power off the module when you connect the input/output connector.
- b) Polarizer which is made of soft material and susceptible to flaw must be handled carefully.
- c) Protective film (Laminator) is applied on surface to protect it against scratches and dirt.
- d) Please following the tear off direction as figure14-1 to remove the protective film as slowly as possible, so that electrostatic charge can be minimized.
- e) After combining the plastic frame with the top chassis, user must reserve enough space to FPC to avoid FPC damage due to lack of space Figure 14-2.

#### 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 mach up with the rubbing direction.

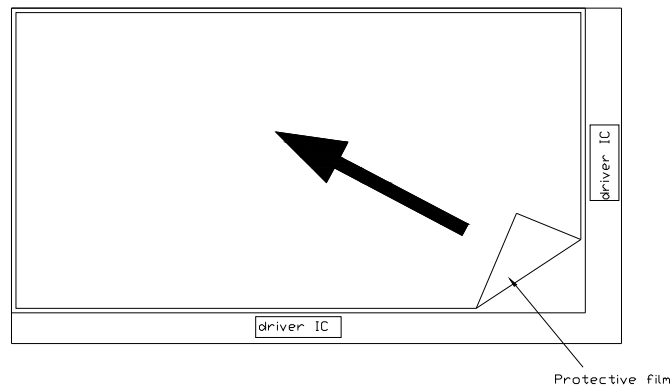


Figure 14-1 the way to peel off protective film

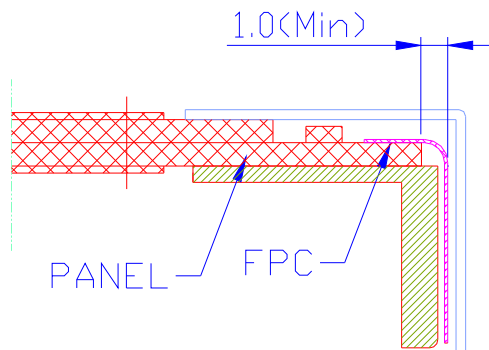


Figure 14-2





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 = +70°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)         | -20°C → +70°C , 200 Cycles<br>(30min – 30min)    |        |
| 7  | 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.

[Criteria]

In the standard conditions, there is not display function NG issue occurred. (including : line defect ,no image).All the cosmetic specification is judged before the reliability stress.



**16. Packing Diagram**

**TBD**