**MODEL NO. : TM028HBH26**

**ISSUED DATE: 2010-9-30**

**VERSION : Ver 1.0**

**■Preliminary Specification**

**□Final Product Specification**

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**Customer :**

| Approved by | Notes |
|---|---|
| | |

**SHANGHAI TIANMA Confirmed :**

| Prepared by | Checked by | Approved by |
|---|---|---|
| | | |

This technical specification is subjected to change without notice

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# Record of Revision

| Rev | Issued Date | Description | Editor |
|---|---|---|---|
| 1.0 | 2010-9-30 | First release | Kelly hu |
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# 1. General Specifications

| Feature | | | Spec |
|---|---|---|---|
| Display Spec. | Size | | 2.8” |
| | Resolution | | 240(RGB)x320 |
| | Interface | | CPU 8/16bit |
| | Color Depth | | 262k |
| | Technology type | | a-si TFT |
| | Pixel pitch (mm) | | 0.180x0.180 |
| | Display colors | | 262K |
| | Pixel Configuration | | RGB vertical Stripe |
| | Display Mode | | TM,NW |
| | Surface Treatment | | clear type |
| | Gray Scale inversion direction | | 12 o’clock |
| Mechanical Characteristics | DIM. | Pixel (H x V) (mm) | 0.180x0.180 |
| | | LCM (W x H x D) (mm) | 50.00x69.20x4.2 |
| | Active Area(mm) | | 43.2x57.6 |
| | With /Without TSP | | WITH TSP |
| | Weight (g) | | TBD. |
| | Driver IC | | ILI9335 |
| | LED Numbers | | 4 LEDs ( parallel) |

Note 1: Viewing direction for best image quality is different from TFT definition. There is a 180 degree shift.

Note 2: Requirements on Environmental Protection: Q/S0002

Note 3: LCM weight tolerance: ± 5%

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## 2. Input/Output Terminals

| No | Symbol | I/O | Description | Comment |
|---|---|---|---|---|
| 1 | D0 | I/O | Data input | |
| 2 | D1 | I/O | Data input | |
| 3 | D2 | I/O | Data input | |
| 4 | D3 | I/O | Data input | |
| 5 | GND | P | Ground | |
| 6 | VCC | P | Power Supply | |
| 7 | CS | I | A chip select signal | |
| 8 | RS | I | A register select signal | |
| 9 | WR | I | A write strobe signal and actives when the signal is low | |
| 10 | RD | I | A read strobe signal and actives when the signal is low | |
| 11 | IM0 | I | Mode selection | Note1 |
| 12 | XR | O | Touch panel pin | |
| 13 | YD | O | Touch panel pin | |
| 14 | XL | O | Touch panel pin | |
| 15 | YU | O | Touch panel pin | |
| 16 | LED-A | P | LED anode | |
| 17 | LED-K1 | P | LED cathode | |
| 18 | LED-K2 | P | LED cathode | |
| 19 | LED-K3 | P | LED cathode | |
| 20 | LED-K4 | P | LED cathode | |
| 21 | IM2 | I | Mode Selection(connect to GND) | |
| 22 | D4 | I/O | Data input | |
| 23 | D8 | I/O | Data input | |
| 24 | D9 | I/O | Data input | |
| 25 | D10 | I/O | Data input | |
| 26 | D11 | I/O | Data input | |
| 27 | D12 | I/O | Data input | |
| 28 | D13 | I/O | Data input | |
| 29 | D14 | I/O | Data input | |
| 30 | D15 | I/O | Data input | |
| 31 | RESET | I | A RESET signal | |
| 32 | VCI | P | Analog power supply | |

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| | | | | |
|---|---|---|---|---|
| 33 | VCC | P | Logic power supply | |
| 34 | GND | P | Ground | |
| 35 | D5 | I/O | Data input | |
| 36 | D6 | I/O | Data input | |
| 37 | D7 | I/O | Data input | |

Note1:

| IM0 | MCU Interface Mode | Data bus |
|---|---|---|
| 0 | 16bit | DB[15:0] |
| 1 | 8bit | DB[15:8] |

**Table 2.1 input terminal pin assignment**

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## 3. Absolute Maximum Ratings

Ta = 25℃

| Item | Symbol | MIN | MAX | Unit | Remark |
|---|---|---|---|---|---|
| Logic Supply Voltage | VCC | -0.3 | 4.6 | V | |
| Analog Supply Voltage | VCI | -0.3 | 4.6 | V | |
| Input voltage | D0~D15,CS,RS,WR,RD RESET,FMARK,IM0 | -0.3 | VCC+0.3 | V | |
| Back Light Forward Current | $I_{LED}$ | | 25 | mA | For each LED |
| Touch panel operating voltage | X+,Y+,X-,Y- | -- | 7 | V | |
| Operating Temperature | $T_{OPR}$ | -20 | 60 | ℃ | |
| Storage Temperature | $T_{STG}$ | -30 | 70 | ℃ | |

**Table 3.1 absolute maximum rating**

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# 4. Electrical Characteristics

## 4.1 LCD module

GND=0V,Ta=25℃

| Item | | Symbol | MIN | TYP | MAX | Unit | Remark |
|---|---|---|---|---|---|---|---|
| Logic Supply Voltage | | VCC | 1.6 | 1.8/2.8 | 3.6 | V | |
| Analog Supply Voltage | | VCI | 2.5 | 2.8 | 3.6 | V | |
| Input Signal Voltage | Low Level | $V_{IL}$ | -0.3 | | 0.2xVCC | V | |
| | High Level | $V_{IH}$ | 0.8xVCC | | VCC | V | |
| (Panel+LSI) Power Consumption | | Black Mode (60Hz) | - | - | - | mW | |
| | | 8 color Mode | | - | | mW | |
| | | Sleeping Mode | | - | | mW | |

**Table 4.1 LCD module electrical characteristics**

## 4.2 Backlight Unit

Ta=25℃

| Item | Symbol | MIN | TYP | MAX | Unit | Remark |
|---|---|---|---|---|---|---|
| Forward Current | $I_F$ | -- | 20 | 25 | mA | For One LED |
| Forward Current Voltage | $V_F$ | -- | 3.2 | -- | V | |
| Backlight Power Consumption | $W_{BL}$ | -- | 256 | -- | mW | |

**Table 4.2.1 backlight unit electrical characteristics**

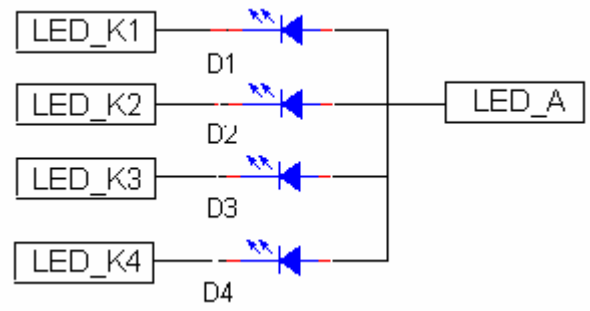


**Figure 4.2.2 LED driver circuit**

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## 4.3 BLOCK DIAGRAM

**LCD module diagram**

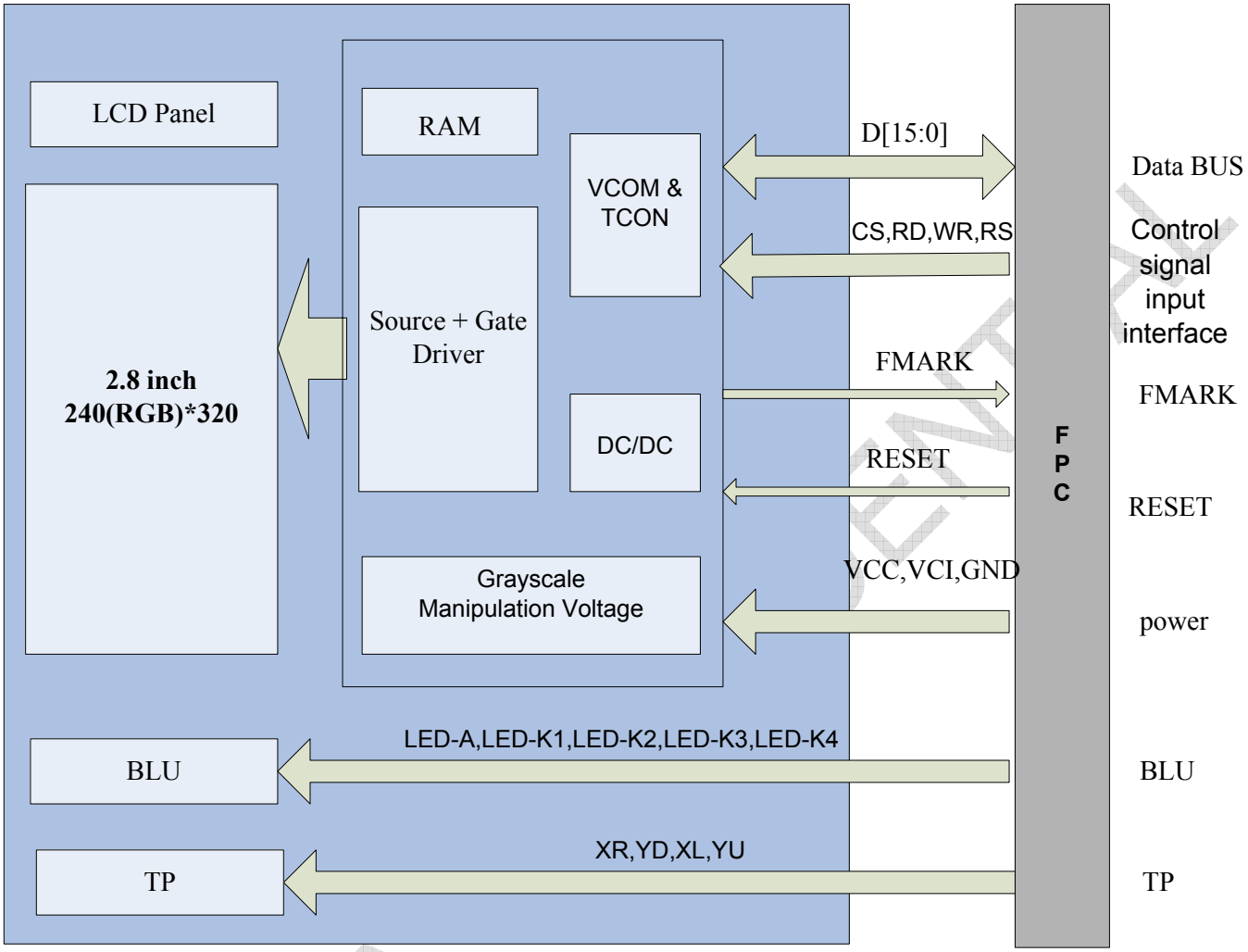


**Figure 4.3 LCD module diagram**

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# 5. Timing Chart

## 5.1 Interface Timing Parameters

**Normal Write Mode**

| Item | Symbol | Unit | Min | Typ | Max |
|---|---|---|---|---|---|
| Write bus cycle time | $t_{CYCW}$ | ns | (75) | - | - |
| Write low-level pulse width | $PW_{LW}$ | ns | (40) | - | - |
| Write high-level pulse width | $PW_{HW}$ | ns | (30) | - | - |
| Write rise / fall time | $t_{Wr}$ / $t_{Wf}$ | ns | - | - | 25 |
| Write Setup time ( RS to /CS, /WR ) | $t_{AS}$ | ns | 10 | - | - |
| Address hold time | $t_{AH}$ | ns | 5 | - | - |
| Write data set up time | $t_{DSW}$ | ns | 10 | - | - |
| Write data hold time | $t_H$ | ns | 15 | - | - |

**Table 5.1 timing parameter**

## 5.2 Interface Characteristics

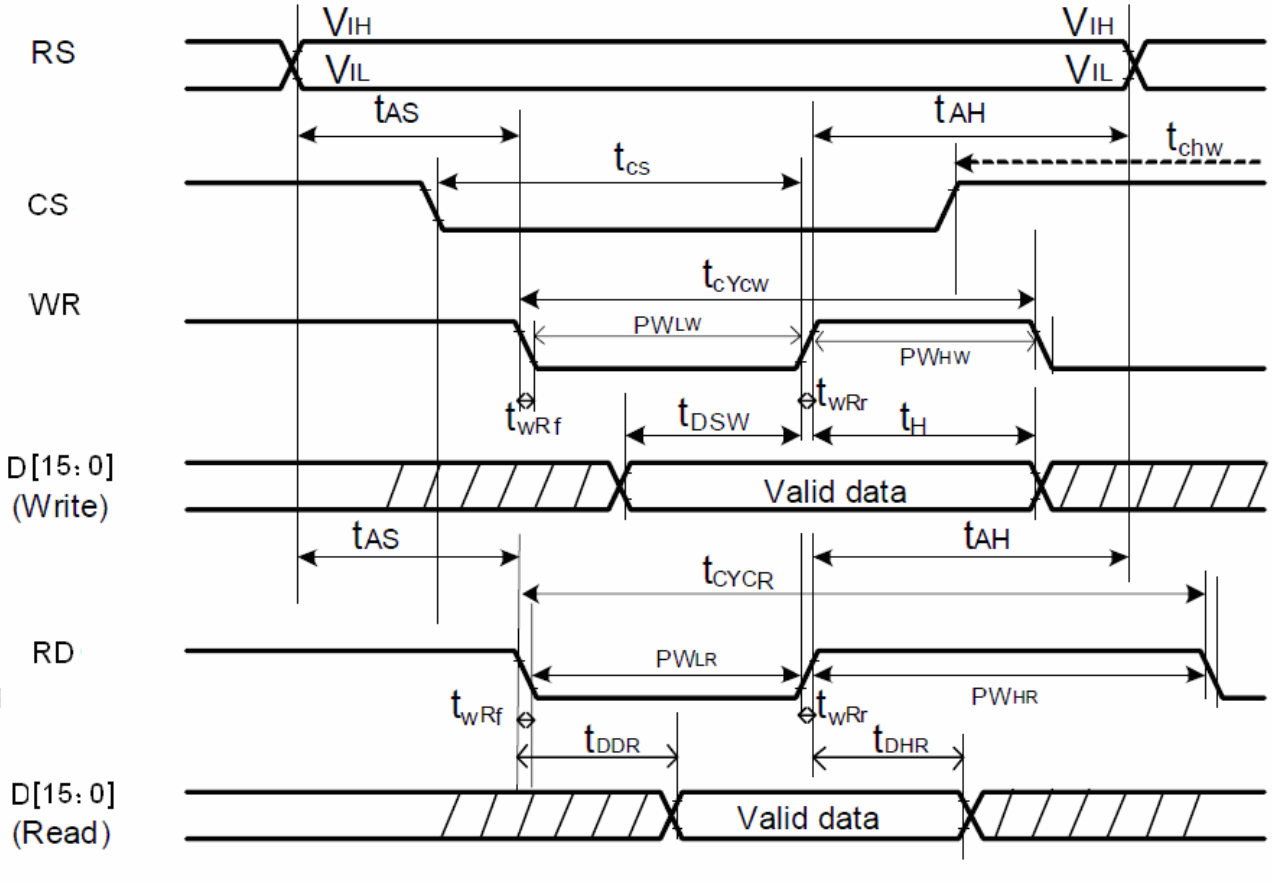


**Figure 5.2 CPU Interface Characteristics**

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## 5.3 Interface Register write/read timing

### 5.3.1 System Bus Interface Register Write Timing

**a) i80 8-bit System Bus Interface Timing**

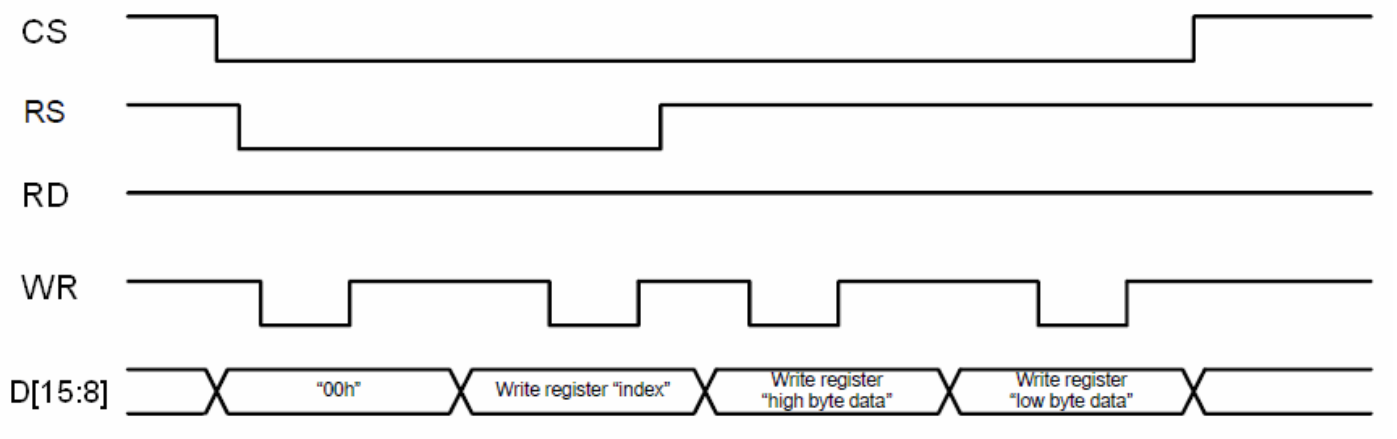


**Figure 5.3.1.1 i80 8-bit System Bus Interface Timing**

**b) i80 16-bit System Bus Interface Timing**

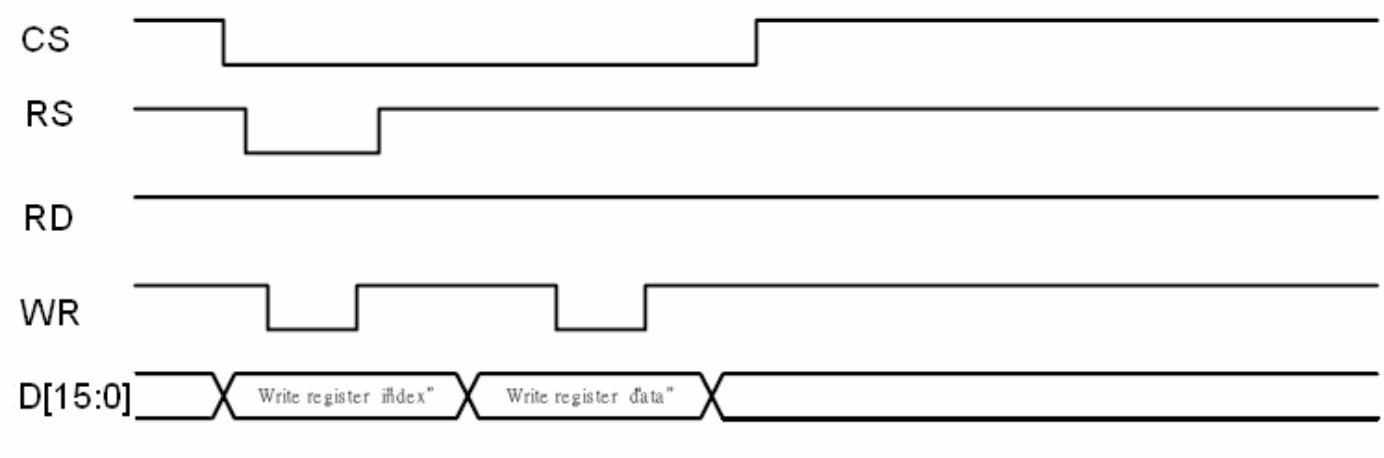


**Figure 5.3.1.2 i80 16-bit System Bus Interface Timing**

### 5.3.2 System Bus Interface Register Read Timing

**a) i80 8-bit System Bus Interface Timing**

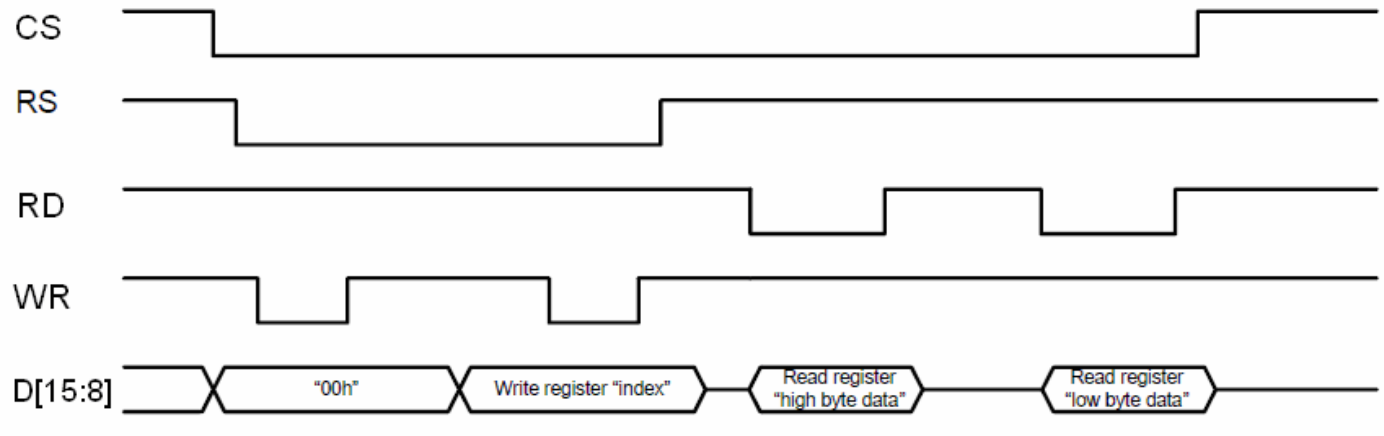


**Figure 5.3.2.1 i80 8-bit System Bus Interface Timing**

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**b) i80 16-bit System Bus Interface Timing**

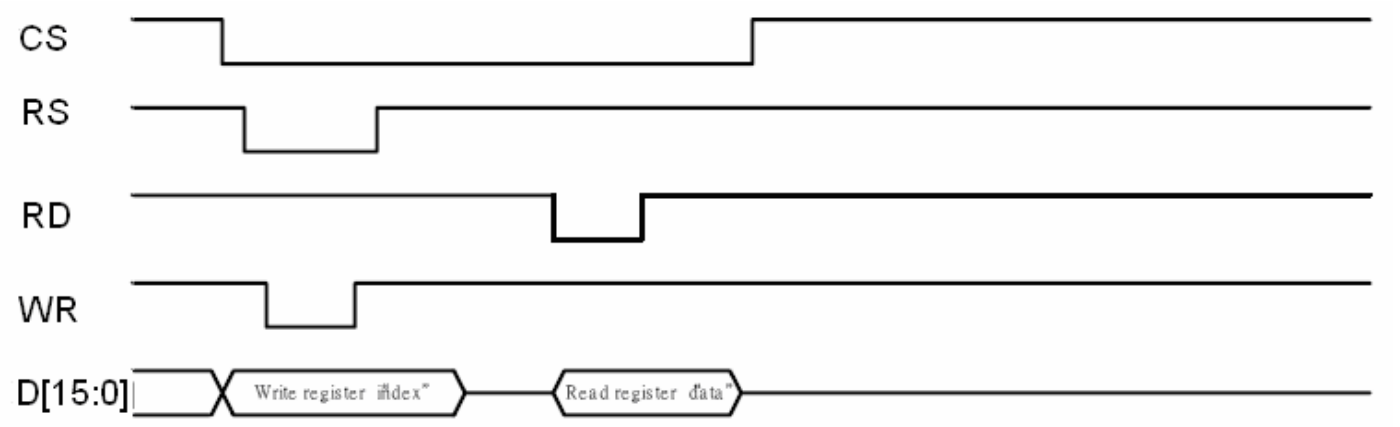


**Figure 5.3.2.2 i80 16-bit System Bus Interface Timing**

## 5.4 8-bit System interface Data Format

**a) i80-System Interface with 8-bit Data Bus**

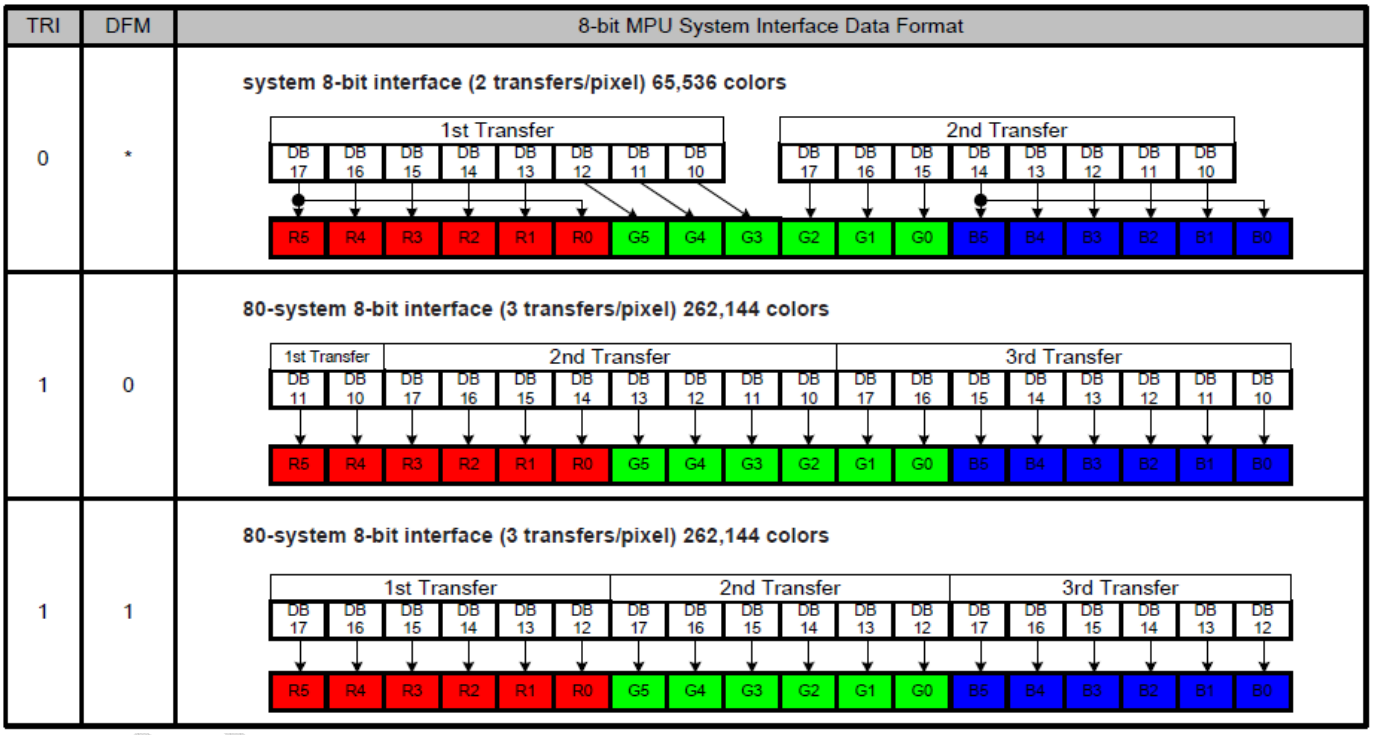


**Figure 5.4.1 i80-System Interface with 8-bit Data Bus**

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**b) i80-System Interface with 16-bit Data Bus**

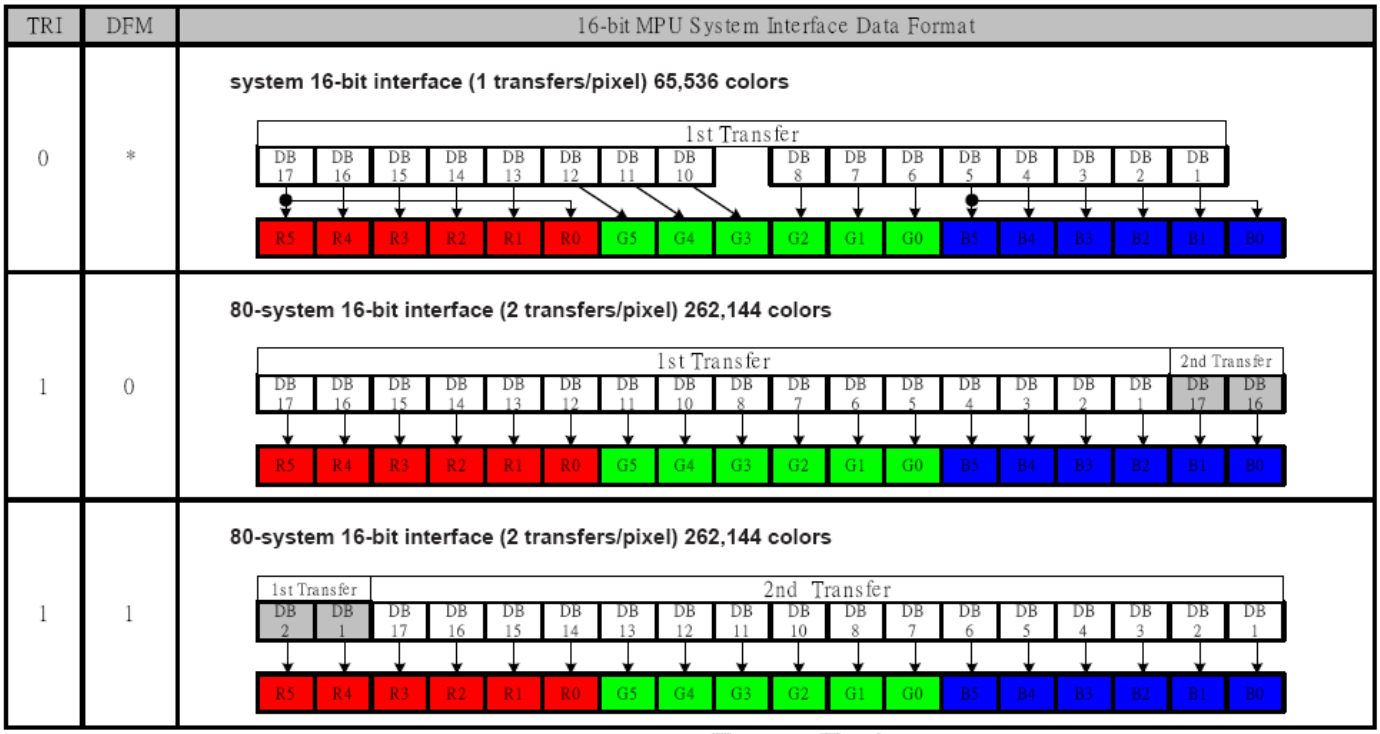


**Figure 5.4.2 i80-System Interface with 8-bit Data Bus**

## 5.5 Data Bus GRAM Write/Read Timing

### 5.5.1 GRAM Write Timing

**a) GRAM Write Timing of i80 8-bit System Interface**

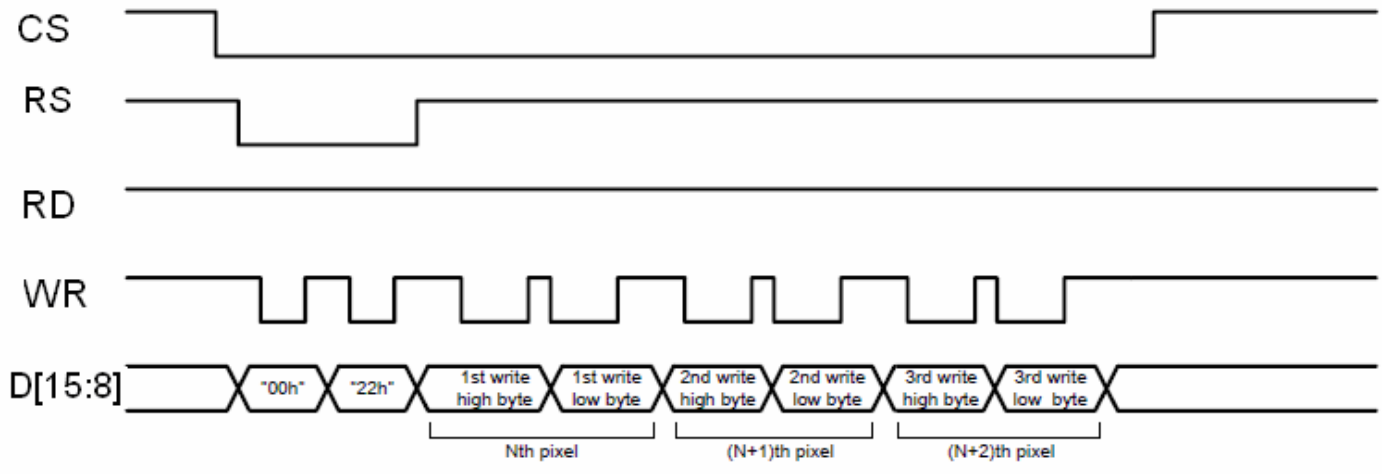


**Figure 5.5.1.1 GRAM Write Timing of i80 8-bit System Interface**

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**b) GRAM Write Timing of i80 16-bit System Interface**

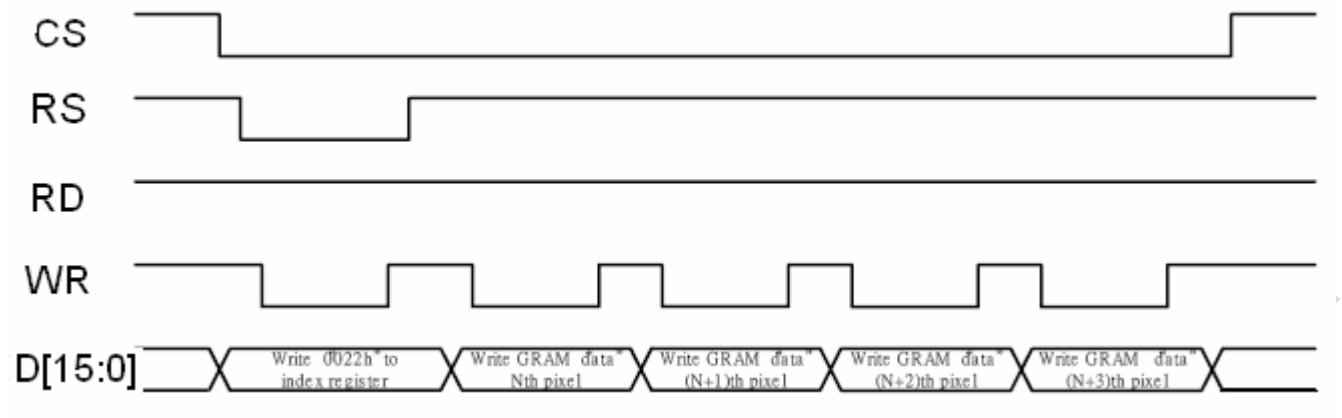


**Figure 5.5.1.2 GRAM Write Timing of i80 16-bit System Interface**

### 5.5.2 GRAM Read Timing

**a）GRAM Read Timing of i80 8-bit System Interface**

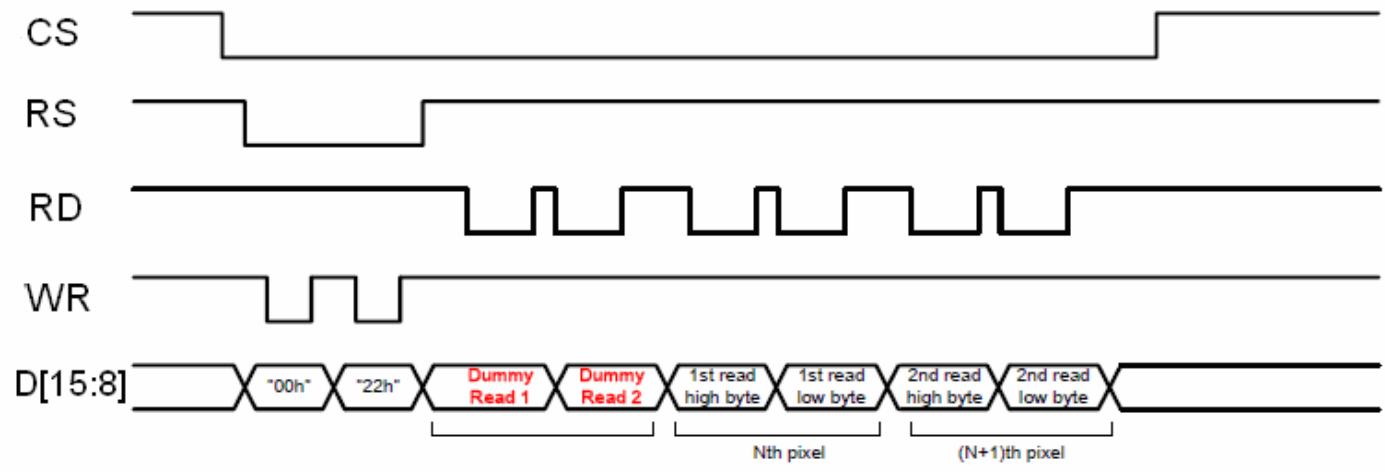


**Figure 5.5.2.1 GRAM Read Timing of i80 8-bit System Interface**

**b）GRAM Read Timing of i80 16-bit System Interface**

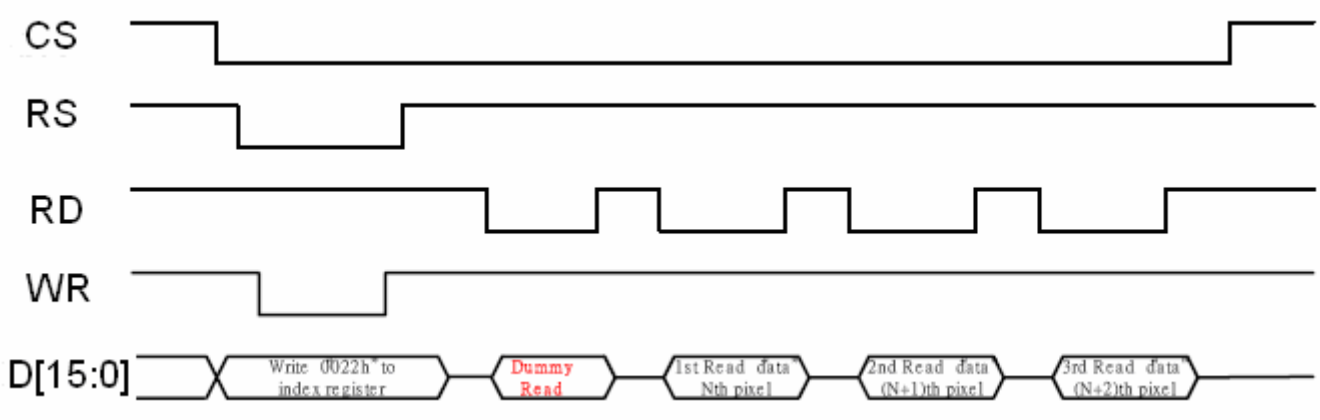


**Figure 5.5.2.2 GRAM Read Timing of i80 16-bit System Interface**

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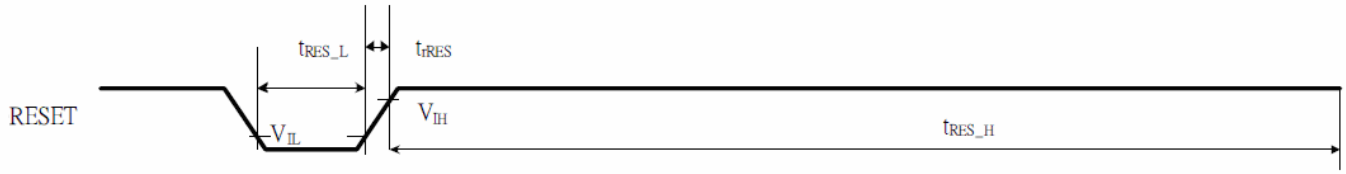
## 5.6 Reset Timing Characteristics

**Reset Timing Characteristics (VCC = 1.6 ~ 3.6 V)**

| Item | Symbol | Unit | Min. | Typ. | Max. |
|---|---|---|---|---|---|
| Reset low-level width | $t_{RES\_L}$ | ms | 1 | - | - |
| Reset rise time | $t_{rRES}$ | μs | - | - | 10 |
| Reset high-level width | $t_{RES\_H}$ | ms | 50 | - | - |

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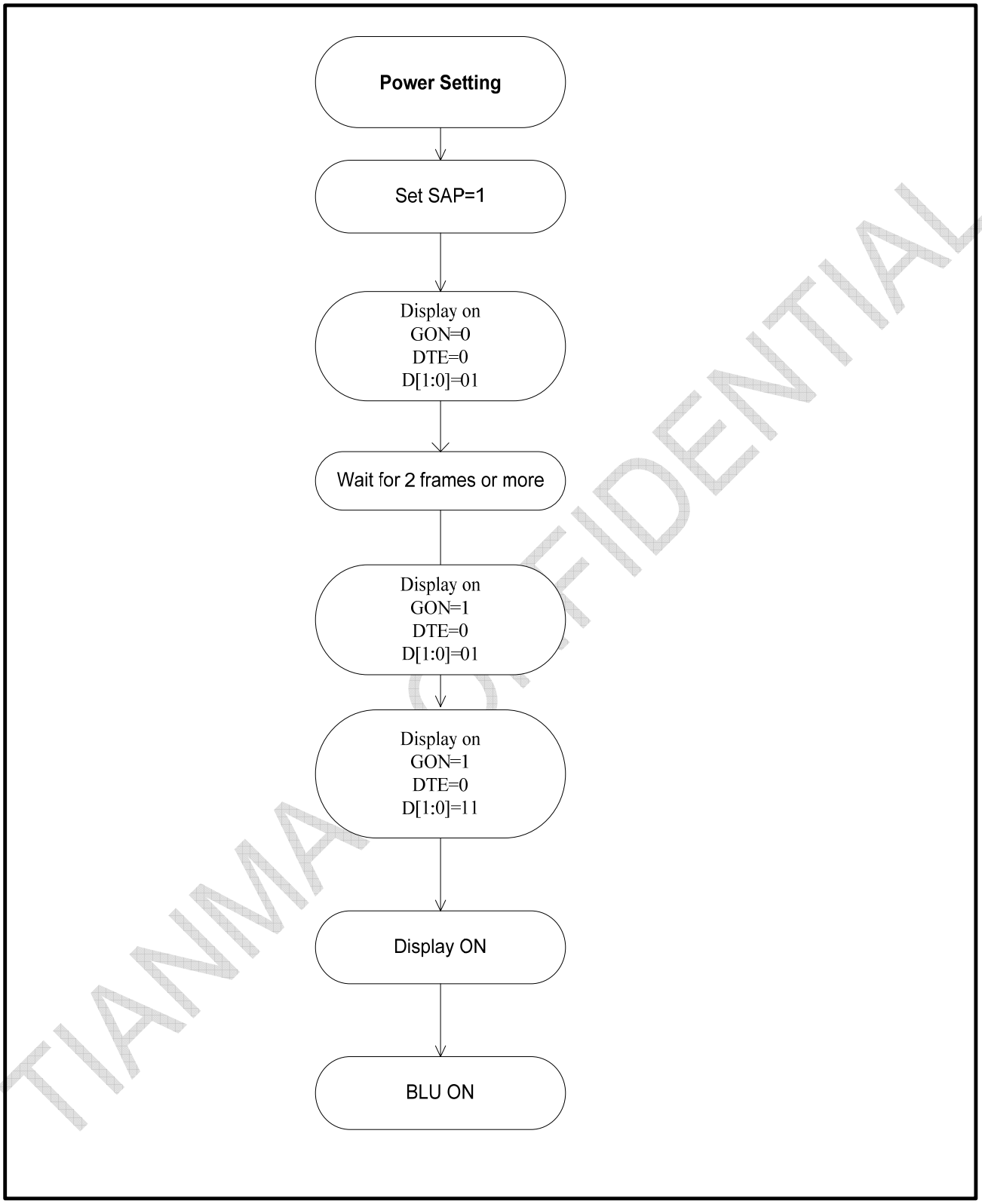
## 5.7 Power on Sequence

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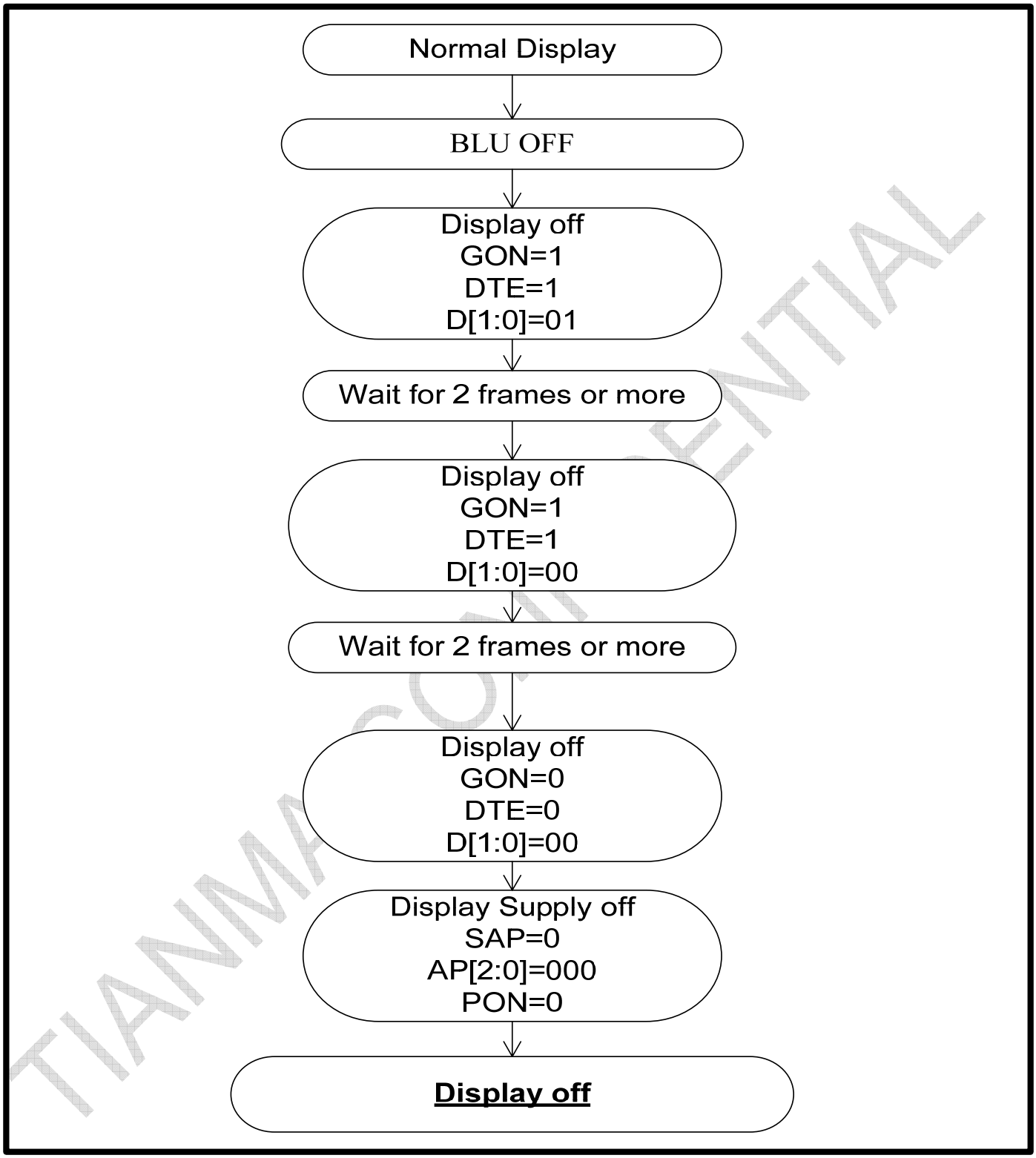
### 5.8 Power off Sequence

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## 6. Optical Characteristics

| Item | | Symbol | Condition | Min | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|---|---|
| View Angles | | θT | CR≧10 | 60 | 70 | - | Degree | Note 2 |
| | | θB | | 60 | 70 | - | | |
| | | θL | | 60 | 70 | - | | |
| | | θR | | 50 | 60 | - | | |
| Contrast Ratio | | CR | θ=0° | 300 | 350 | - | - | Note1,3 |
| Response Time | | Ton | 25℃ | - | 20 | 30 | ms | Note1,4 |
| | | Toff | | | | | | |
| Chromaticity | White | x | - | 0.250 | 0.300 | 0.350 | - | Note1,5 |
| | | y | | 0.267 | 0.317 | 0.367 | | |
| | RED | x | | 0.532 | 0.582 | 0.632 | | |
| | | y | | 0.297 | 0.347 | 0.397 | | |
| | GREEN | x | | 0.291 | 0.341 | 0.391 | | |
| | | y | | 0.514 | 0.564 | 0.614 | | |
| | BLUE | x | | 0.097 | 0.147 | 0.197 | | |
| | | y | | 0.045 | 0.095 | 0.145 | | |
| Uniformity | | U | - | - | 80% | - | % | Note1,6 |
| NTSC | | - | - | - | 50% | - | % | Note 5 |
| Luminance | | L | - | 190 | 210 | - | cd/m2 | Note1,7 |

Test Conditions:

1. VDD=3.3V, $I_L$=20mA(Backlight current), the ambient temperature is 25℃.
2. The test systems refer to Note 1 and Note 2.

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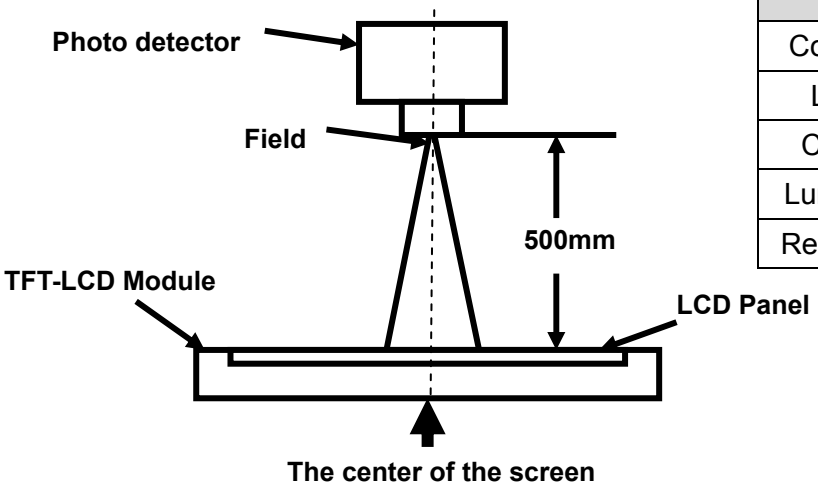
Note 1: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 5 minutes operation, the optical properties are measured at the center point of the LCD screen. All input terminals LCD panel must be ground when measuring the center area of the panel.




| Item | Photo Detector | Field |
|---|---|---|
| Contrast Ratio | SR-3A | 1° |
| Luminance | | |
| Chromaticity | | |
| Lum Uniformity | | |
| Response Time | BM-7A | 2° |

Note 2: Definition of viewing angle range and measurement system.

viewing angle is measured at the center point of the LCD by CONOSCOPE(ergo-80)。

## Note 3: Definition of contrast ratio

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD is on the "White" state}}{\text{Luminance measured when LCD is on the "Black" state}}$$

“White state “:The state is that the LCD should driven by Vwhite.

“Black state”: The state is that the LCD should driven by Vblack.

Vwhite: To be determined Vblack: To be determined.

## Note 4: Definition of Response time

The response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time (TON) is the time between photo detector output intensity changed from 90% to 10%. And fall time (TOFF) is the time between photo detector output intensity changed from 10% to 90%.

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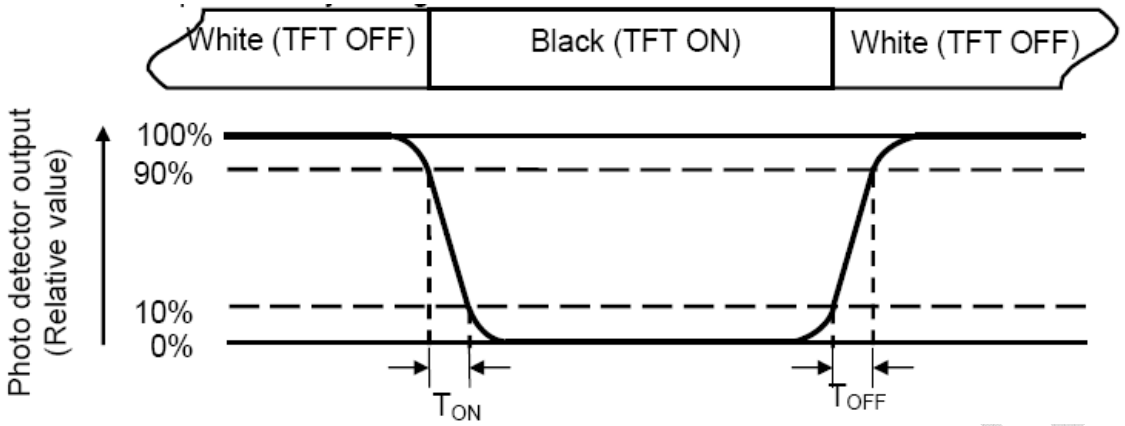


Note 5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.

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## Note 6: Definition of Luminance Uniformity

Active area is divided into 9 measuring areas (Refer Fig. 2). Every measuring point is placed at the center of each measuring area.

Luminance Uniformity(U) = Lmin/ Lmax

L-------Active area length W----- Active area width

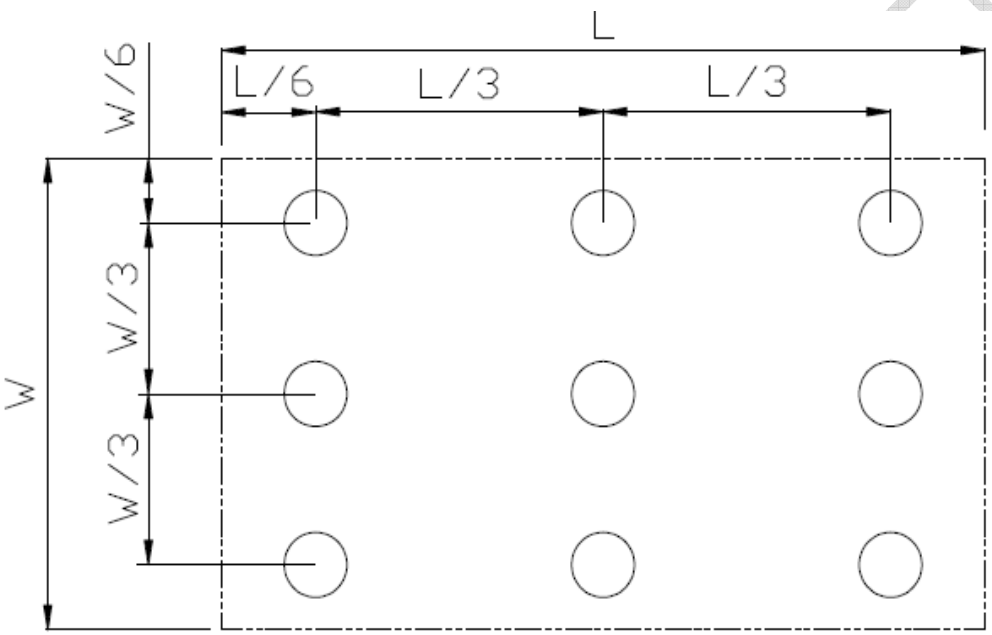


Fig. 2 Definition of uniformity

Lmax: The measured maximum luminance of all measurement position.

Lmin: The measured minimum luminance of all measurement position.

## Note 7: Definition of Luminance:

Measure the luminance of white state at center point.

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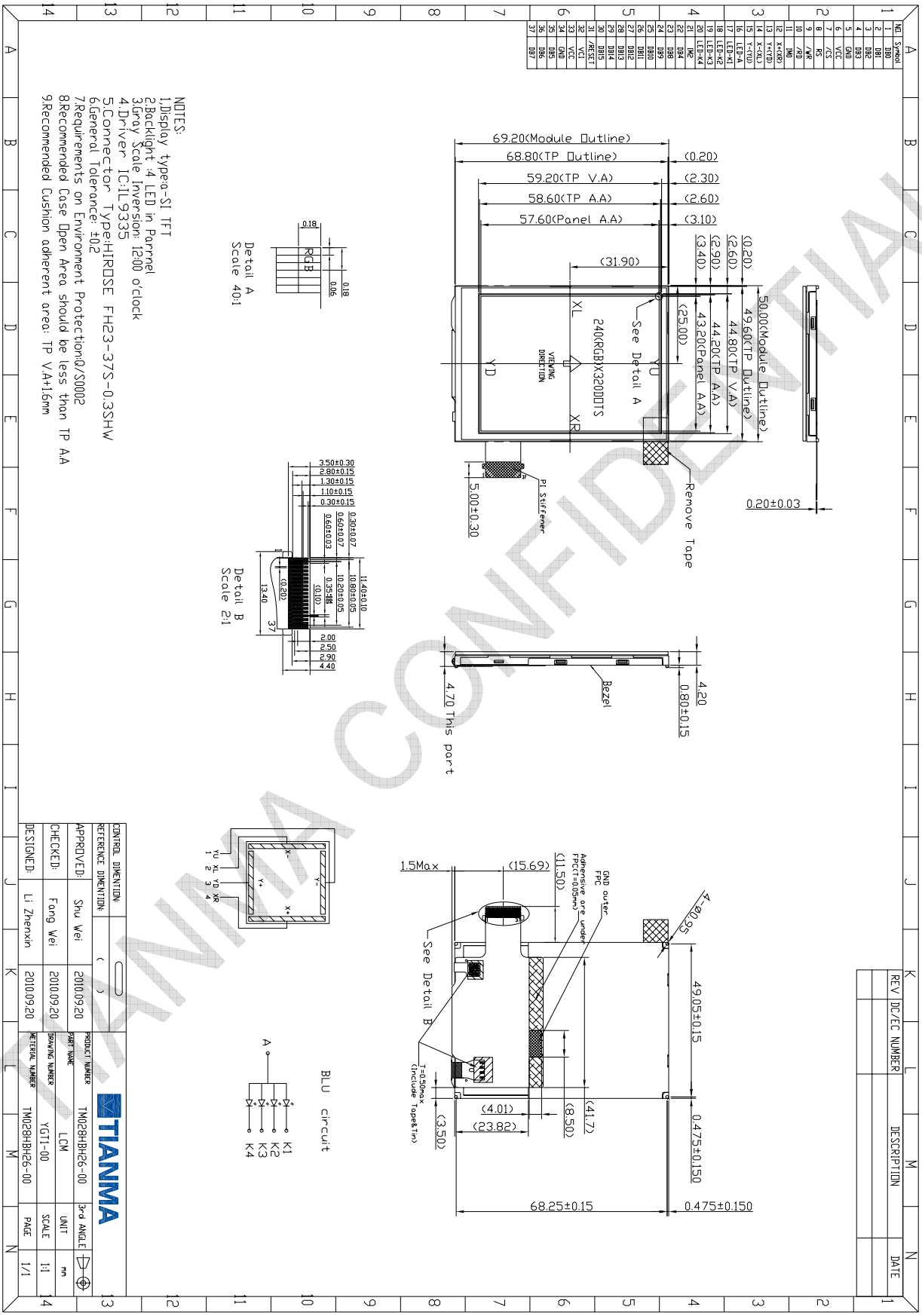
# 7. Mechanical Drawing

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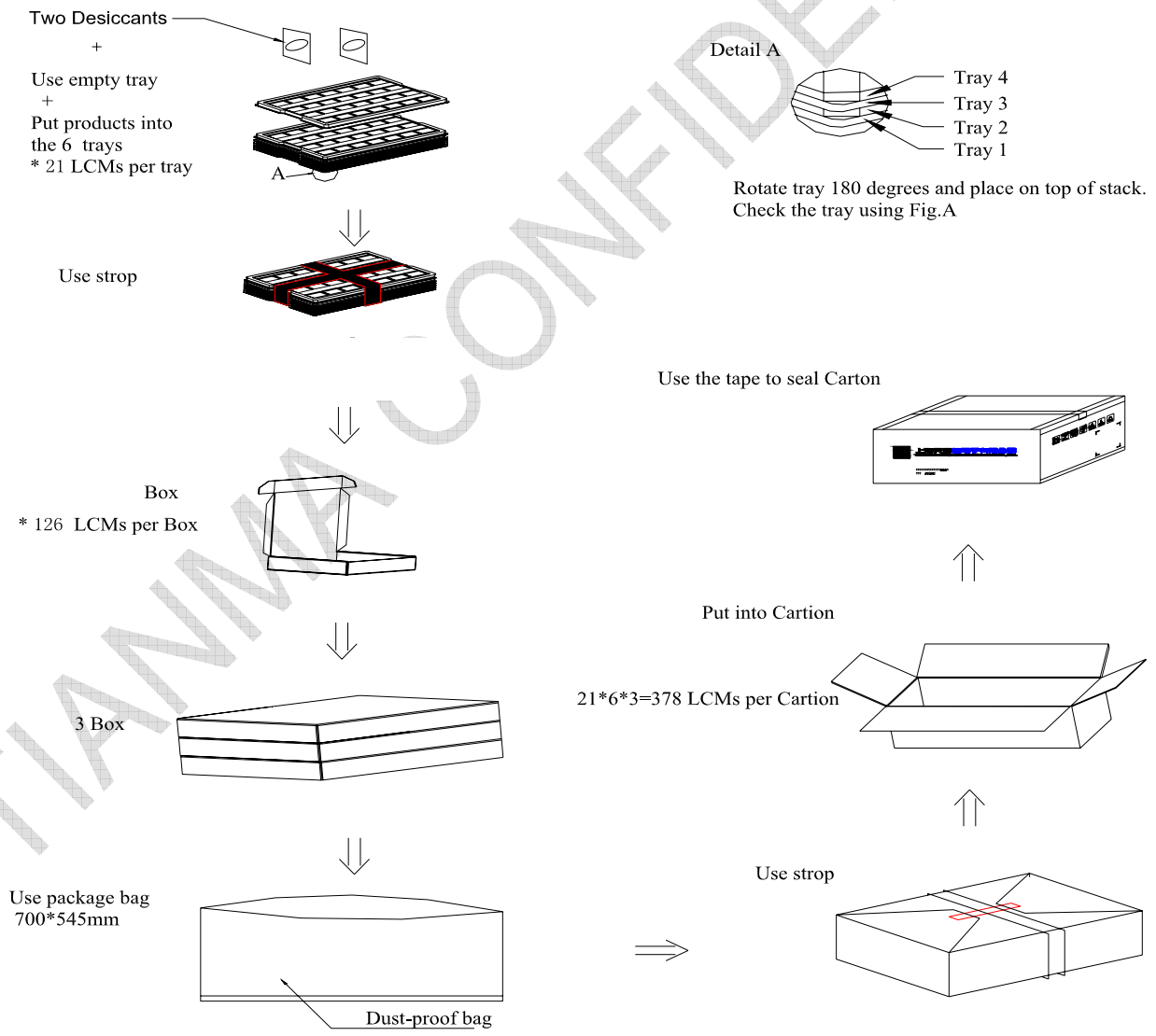
| No | Item | Model (Material) | Dimensions(mm) | Unit Weight(Kg) | Quantity | Remark |
|---|---|---|---|---|---|---|
| 1 | LCM module | TM028HBH26 | 50x69.2x4.2 | TBD | 378 | |
| 2 | Tray | PET（Transmit） | 485x330x14.3 | 0.172 | 21 | Anti-static |
| 3 | Anti-static bag | PE | 700x545 | 0.046 | 1 | |
| 4 | BOX | Corrugated paper | 520x345x74 | 0.3879 | 3 | |
| 5 | Desiccant | Desiccant | 45x50 | 0.002 | 6 | |
| 6 | Carton | Corrugated paper | 544x365x250 | 1.01 | 1 | |
| 7 | Total weight | TBD Kg | | | | |

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# 8 Environmental / Reliability Tests

| No | Test Item | Condition | Remarks |
|---|---|---|---|
| 1 | High Temperature Operation | Ts=+60℃, 240hrs | Note1<br>IEC60068-2-1,GB2423.2 |
| 2 | Low Temperature Operation | Ta=-20℃, 240hrs | IEC60068-2-1<br>GB2423.1 |
| 3 | High Temperature Storage | Ta=+70℃, 240hrs | IEC60068-2-1<br>GB2423.2 |
| 4 | Low Temperature Storage | Ta=-30℃, 240hrs | IEC60068-2-1<br>GB2423.1 |
| 5 | High Temperature & High Humidity Storage | Ta=+60℃, 90% RH<br>240 hours | Note2<br>IEC60068-2-78<br>GB/T2423.3 |
| 6 | Thermal Shock (Non-operation) | -30℃ 30 min~+70℃ 30 min,<br>Change time:5min, 20 Cycles | Start with cold temperature,<br>End with high temperature,<br>IEC60068-2-14,GB2423.22 |
| 7 | Electro Static Discharge (Operation) | C=150pF, R=330Ω，5points/panel<br>Air:±8KV, 5times;<br>Contact:±4KV, 5 times;<br>（Environment: 15℃～35℃,<br>30%～60%, 86Kpa～106Kpa） | IEC61000-4-2<br>GB/T17626.2 |
| 8 | Vibration (Non-operation) | Frequency range:10~55Hz,<br>Stroke:1.5mm<br>Sweep:10Hz~55Hz~10Hz 2 hours<br>for each direction of X.Y.Z.<br>(6 hours for total)(Package condition) | IEC60068-2-6<br>GB/T2423.10 |
| 9 | Shock (Non-operation) | 60G 6ms, ±X,±Y,±Z 3times,<br>for each direction | IEC60068-2-27<br>GB/T2423.5 |
| 10 | Package Drop Test | Height:80 cm,<br>1 corner, 3 edges, 6 surfaces | IEC60068-2-32<br>GB/T2423.8 |
| 11 | Package Vibration Test | Random Vibration:<br>0.015GxG/Hz for 5-200Hz,<br>-6dB/Octave from 200-500Hz<br>2 hours for each direction of X,Y,Z<br>(6 hours for total) | IEC60068-2-34<br>GB/T2423.11 |

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Note1: Ts is the temperature of panel's surface.

Note2: Ta is the ambient temperature of sample.

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# 9 Precautions for Use of LCD Modules

11.1 Handling Precautions

11.1.1. The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

11.1.2. If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes,promptly wash it off using soap and water.

11.1.3. Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

11.1.4. The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

11.1.5. If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:

— Isopropyl alcohol

— Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:— Water, Ketone, Aromatic solvents

11.1.6. Do not attempt to disassemble the LCD Module.

11.1.7. If the logic circuit power is off, do not apply the input signals.

11.1.8. To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

a. Be sure to ground the body when handling the LCD Modules.

b. Tools required for assembly, such as soldering irons, must be properly ground.

c. To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

d. The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

11.2 Storage precautions

11.2.1. When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

11.2.2. The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

Temperature : 0℃ ～ 40℃ Relatively humidity: ≤80%

11.2.3. The LCD modules should be stored in the room without acid, alkali and harmful gas.

10.3 Transportation Precautions

The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.

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