

**MODEL NO. : TM35KBH07****ISSUED DATE: 2011-04-11****VERSION : Ver 1.0**

- ☒ **Preliminary Product Specification**  
☐ **Final Product Specification**

**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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## 1 General Specifications

| Feature                    |                                 | Spec                   |
|----------------------------|---------------------------------|------------------------|
| Display Spec.              | Size                            | 3.5inch                |
|                            | Resolution                      | 320(RGB) X 240         |
|                            | Interface                       | RGB/CCIR656/601        |
|                            | Color Depth                     | 16.7M dithering        |
|                            | Technology type                 | a-si TFT               |
|                            | Dot pitch (mm)                  | 0.073 x 0.219          |
|                            | Pixel Configuration             | R.G.B. Vertical Stripe |
|                            | Display Mode                    | TM with Normally White |
|                            | Surface Treatment(Up Polarizer) | Clear type             |
|                            | Viewing Direction               | 12 o'clock             |
|                            | Gray Scale Inversion Direction  | 6 o'clock              |
| Mechanical Characteristics | DIM. LCM (W x H x D) (mm)       | 76.90 x 63.90 x 4.00   |
|                            | With /Without TSP               | With TSP               |
|                            | LED Numbers                     | 6 LEDs Serial          |
| Electronic                 | Driver IC                       | NT39016D               |

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%



## 2 Touch panel Specifications

| Feature                       |                  | Spec                              |
|-------------------------------|------------------|-----------------------------------|
| General Specifications        | TP Size          | 3.5inch                           |
|                               | Type             | Projective capacitive multi-touch |
|                               | View area        | 71.08mm x 53.56mm                 |
|                               | Active area      | 71.08mm x 53.56mm                 |
|                               | Interface        | IIC,UART                          |
|                               | Surface hardness | >5H                               |
|                               | Hitting life     | ≥ 100 000 000 times               |
| Optical Characteristics       | Transparency     | >85%                              |
|                               | Haze             | ≤5%                               |
| Environmental Characteristics | Operation        | -20℃ ~ +70℃                       |
|                               | Storage          | -30℃ ~ +80℃                       |
| Electrical Characteristics    | Working voltage  | 2.7V~5V                           |
|                               | Resolution       | 320*240                           |
| TP driver IC                  |                  | CY8CTMG110                        |



### 3 Input/Output Terminals

#### 3.1 TFT LCD Panel

Recommend connector: Kyocera elco: 6240 serials

| No  | Symbol      | I/O | Description                    | Remark   |
|-----|-------------|-----|--------------------------------|----------|
| 1,2 | LED_Cathode | I   | LED_Cathode                    |          |
| 3,4 | LED_Anode   | I   | LED_Anode                      |          |
| 5   | NC          | -   | No Connect                     |          |
| 6   | RESET       | I   | Reset                          |          |
| 7   | NC          | -   | No Connect                     |          |
| 8   | NC          | I   | No Connect                     |          |
| 9   | NC          | I   | No Connect                     |          |
| 10  | NC          | I   | No Connect                     |          |
| 11  | NC          | I   | No Connect                     |          |
| 12  | D00         | I   | Data 00                        | Note 3-1 |
| 13  | D01         | I   | Data 01                        | Note 3-1 |
| 14  | D02         | I   | Data 02                        | Note 3-1 |
| 15  | D03         | I   | Data 03                        | Note 3-1 |
| 16  | D04         | I   | Data 04                        | Note 3-1 |
| 17  | D05         | I   | Data 05                        | Note 3-1 |
| 18  | D06         | I   | Data 06                        | Note 3-1 |
| 19  | D07         | I   | Data 07                        | Note 3-1 |
| 20  | D08         | I   | Data 08                        | Note 3-1 |
| 21  | D09         | I   | Data 09                        | Note 3-1 |
| 22  | D10         | I   | Data 10                        | Note 3-1 |
| 23  | D11         | I   | Data 11                        | Note 3-1 |
| 24  | D12         | I   | Data 12                        | Note 3-1 |
| 25  | D13         | I   | Data 13                        | Note 3-1 |
| 26  | D14         | I   | Data 14                        | Note 3-1 |
| 27  | D15         | I   | Data 15                        | Note 3-1 |
| 28  | D16         | I   | Data 16                        | Note 3-1 |
| 29  | D17         | I   | Data 17                        | Note 3-1 |
| 30  | D18         | I   | Data 18                        | Note 3-1 |
| 31  | D19         | I   | Data 19                        | Note 3-1 |
| 32  | D20         | I   | Data 20                        | Note 3-1 |
| 33  | D21         | I   | Data 21                        | Note 3-1 |
| 34  | D22         | I   | Data 22                        | Note 3-1 |
| 35  | D23         | I   | Data 23                        | Note 3-1 |
| 36  | HSYNC       | I   | Horizontal Synchronous Signal  |          |
| 37  | VSYNC       | I   | Vertical Synchronous Signal    |          |
| 38  | CLK         | I   | Data Clock                     |          |
| 39  | NC          | -   | No Connect                     |          |
| 40  | NC          | -   | No Connect                     |          |
| 41  | VDD         | P   | power supply                   |          |
| 42  | VDD         | P   | power supply                   |          |
| 43  | SPENA       | I   | Serial port data enable signal |          |
| 44  | NC          | -   | No Connect                     |          |
| 45  | NC          | -   | No Connect                     |          |

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|    |      |     |                              |  |
|----|------|-----|------------------------------|--|
| 46 | NC   | -   | No Connect                   |  |
| 47 | NC   | -   | No Connect                   |  |
| 48 | NC   | -   | No Connect                   |  |
| 49 | SPCK | I   | SPI Serial Clock             |  |
| 50 | SPDA | I/O | SPI Serial Data Input/output |  |
| 51 | NC   | -   | No Connect                   |  |
| 52 | DEN  | I   | Data enabling signal         |  |
| 53 | GND  | P   | Ground                       |  |
| 54 | GND  | P   | Ground                       |  |

I: input      O: output      P: power

Note 3-1:

| Mode       | D(23:16) | D(15:8) | D(7:0) | HSYNC | VSYNC | DEN                                |
|------------|----------|---------|--------|-------|-------|------------------------------------|
| CCIR 656   | D(23:16) | GND     | GND    | NC    | NC    | NC                                 |
| CCIR 601   | D(23:16) | GND     | GND    | HSYNC | VSYNC | NC                                 |
| 8 Bit RGB  | D(23:16) | GND     | GND    | HSYNC | VSYNC | NC for HV mode<br>DEN for DEN mode |
| 24 Bit RGB | R(7:0)   | G(7:0)  | B(7:0) | HSYNC | VSYNC | NC for HV mode<br>DEN for DEN mode |

### 3.2 Touch panel pin description

| No | symbol | Description       |
|----|--------|-------------------|
| 1  | VCC    | VCC               |
| 2  | GND    | GND               |
| 3  | INT    | interrupt         |
| 4  | SCL    | IIC clock         |
| 5  | SDA    | IIC data          |
| 6  | TX     | UART transmission |

## 4. Absolute Maximum Ratings

GND=0V, Ta = 25°C

| Item                       | Symbol                                                                  | Min  | Max       | Unit | Remark       |
|----------------------------|-------------------------------------------------------------------------|------|-----------|------|--------------|
| Power Supply Voltage       | VDDIO, VCI                                                              | -0.3 | 5.0       | V    |              |
| Logic Input Signal Voltage | R0~R5, B0~B5, G0~G5, RESB,<br>SDI, CSB, SCK, HSYNC<br>VSYN, DOTCLK, DEN | -0.3 | VDDIO+0.3 | V    |              |
| Back Light Forward Current | I <sub>LED</sub>                                                        | --   | 25        | mA   | For each LED |
| Operating Temperature      | T <sub>OPR</sub>                                                        | -20  | 70        | °C   |              |
| Storage Temperature        | T <sub>STG</sub>                                                        | -30  | 80        | °C   |              |

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## 5 Electrical Characteristics

### 5.1) Driving TFT LCD Panel

GND=0V, Ta=25°C

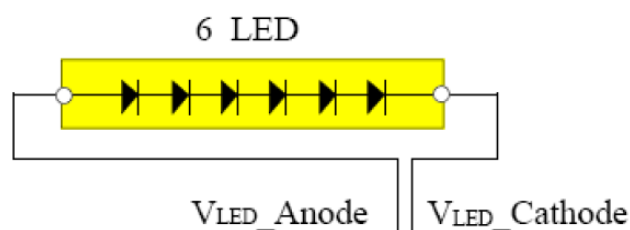
| Item                              |            | Symbol            | Min                | Typ | Max                | Unit | Remark                                                        |
|-----------------------------------|------------|-------------------|--------------------|-----|--------------------|------|---------------------------------------------------------------|
| Logic I/O power supply            |            | VDDIO             | 3.0                | 3.3 | 3.6                | V    |                                                               |
| Analog power supply               |            | VCI               | 3.0                | 3.3 | 3.6                | V    |                                                               |
| Input Signal Voltage              | Low Level  | $V_{IL}$          | 0                  | --  | $0.2 \times VDDIO$ | V    | D00~D23, RESET, DEN<br>SPENA, SPCK, SPDA<br>HSYNC, VSYNC, CLK |
|                                   | High Level | $V_{IH}$          | $0.8 \times VDDIO$ | --  | VDDIO              | V    |                                                               |
| (Panel+ LSI)<br>Power Consumption |            | Black Mode (60Hz) | --                 | 35  | 50                 | mW   |                                                               |
|                                   |            | Standby Mode      | --                 | 0.1 | 0.15               | mW   |                                                               |

### 5.2) Driving Backlight

Ta=25°C

| Item                | Symbol   | Min   | Typ     | Max  | Unit | Remark       |
|---------------------|----------|-------|---------|------|------|--------------|
| Forward Current     | $I_F$    | --    | 20      | 25   | mA   | For each LED |
| Forward Voltage     | $V_F$    | 16.8  | 19.2    | 21.6 | V    |              |
| Power Consumption   | $W_{BL}$ | --    | 384     | --   | mW   | Note1,2,3    |
| Operating Life Time | --       | 10000 | (20000) |      |      |              |

Note 1: The figure below shows the connection of backlight LED.



Note 2: One LED :  $I_F = 20\text{ mA}$ ,  $V_F = 3.2\text{V}$

Note 3: If is defined for one channel LED.

Optical performance should be evaluated at Ta=25°C only.

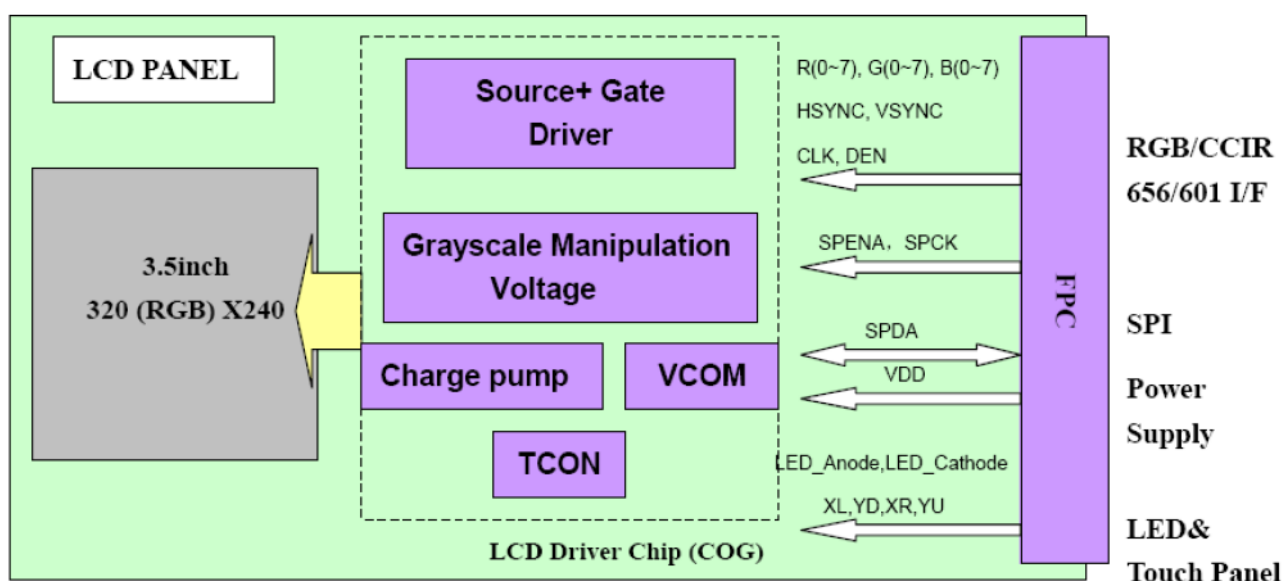
If LED is driven by high current, high ambient temperature & humidity condition, the life time of LED will be reduced.

Operating life means brightness goes down to 50% initial brightness. Typical operating life time is estimated data.





## 5.3) Block Diagram



## 6. Module Timing Chart

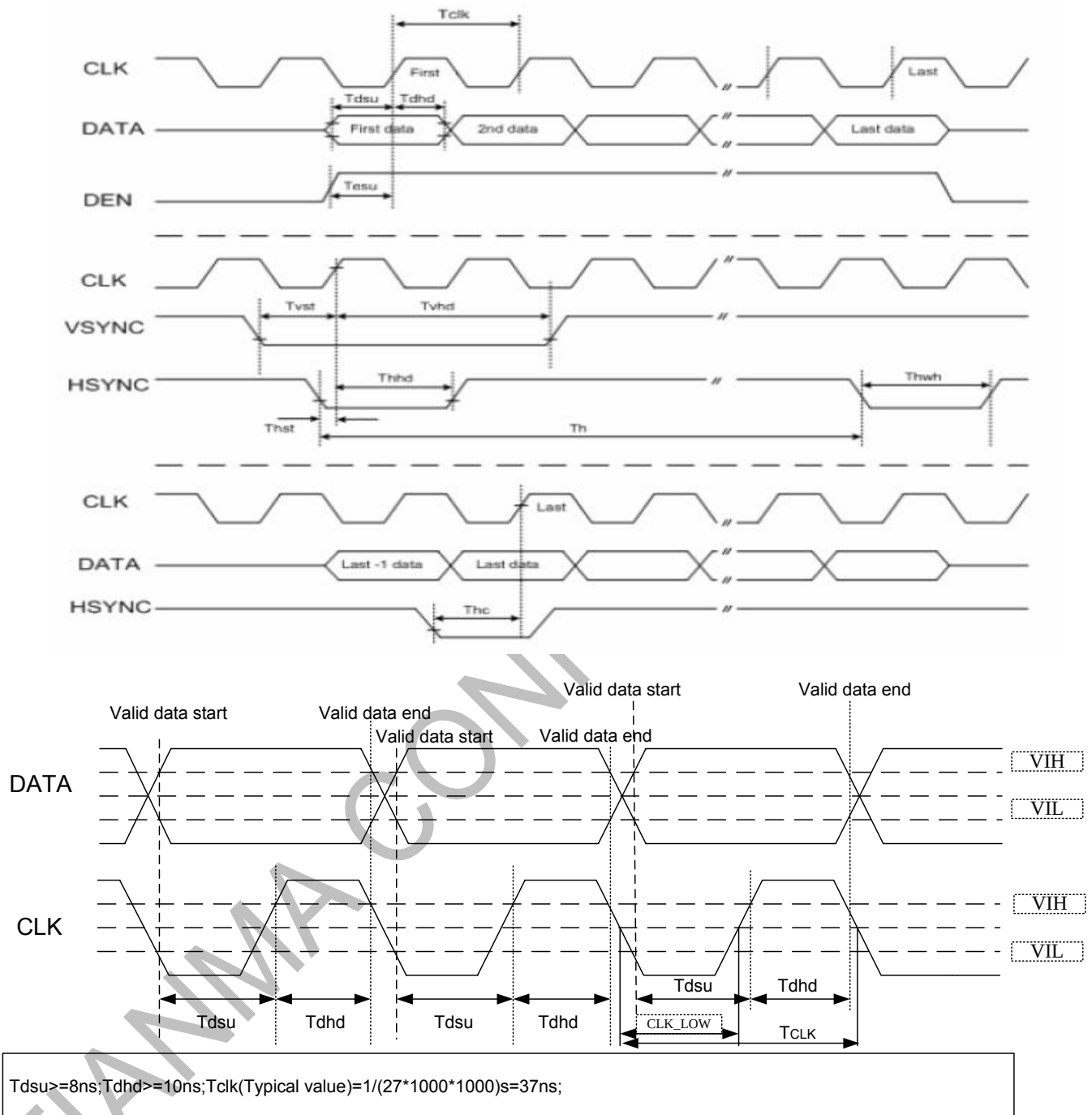
## 6.1) Timing Parameter

(VCC=3.3V GND =0V, Ta=25°C)

| Parameter         | Symbol    | Min  | Typ   | Max | Unit | Condition      |
|-------------------|-----------|------|-------|-----|------|----------------|
| CLK Clock Time    | $T_{clk}$ | 33.3 | --    | --  | ns   |                |
| CLK Pulse Duty    | $T_{chw}$ | 40   | 50    | 60  | %    | $T_{clk}$      |
| HSYNC to CLK      | $T_{hc}$  | --   | --    | 1   | CLK  | --             |
| HSYNC Width       | $T_{hwh}$ | 1    | --    | --  | CLK  | --             |
| VSYNC Width       | $T_{vwh}$ | 1    | --    | --  | ns   | --             |
| HSYNC Period Time | $T_h$     | 60   | 63.56 | 67  | ns   | --             |
| VSYNC Set-up Time | $T_{vst}$ | 8    | --    | --  | ns   | --             |
| VSYNC Hold Time   | $T_{vhd}$ | 10   | --    | --  | ns   | --             |
| HSYNC Setup Time  | $T_{hst}$ | 8    | --    | --  | ns   | --             |
| HSYNC Hold Time   | $T_{hhd}$ | 10   | --    | --  | ns   | --             |
| Data Set-up Time  | $T_{dsu}$ | 8    | --    | --  | ns   | D00~D23 to CLK |
| Data Hold Time    | $T_{dhd}$ | 10   | --    | --  | ns   | D00~D23 to CLK |
| DEN Set up Time   | $T_{esu}$ | 12   | --    | --  | ns   | DEN to CLK     |

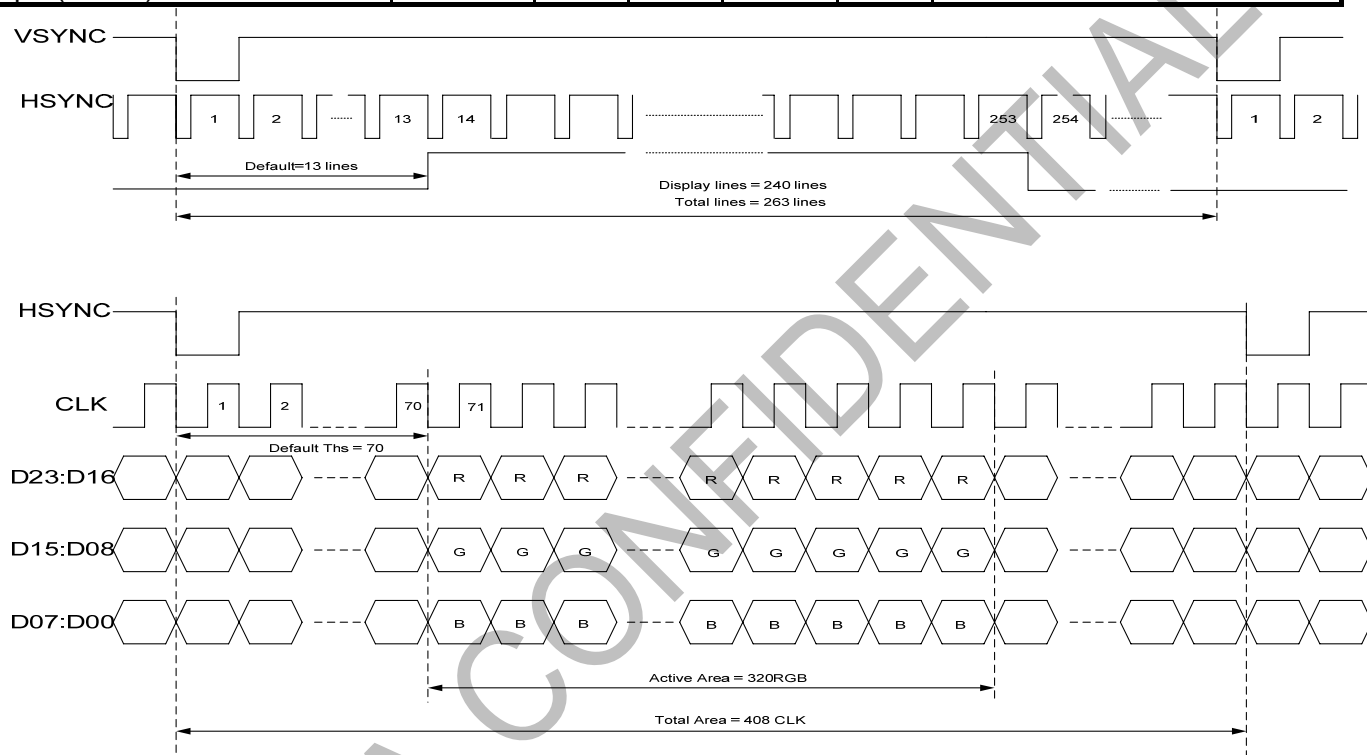
Note:

Each CLK Frequency of 24 Bit RGB Mode, 8 Bit RGB Mode, CCIR601 and CCIR656 are different.

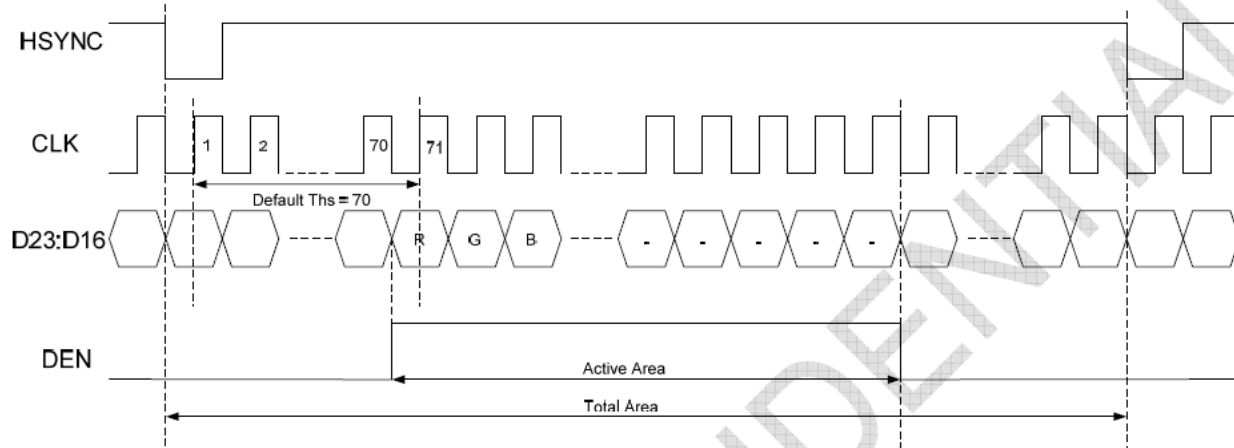


**6.2) 24 Bit RGB Mode for 320RGB x 240**

| Parameter                                | Symbol    | Min | Typ | Max | Unit | Condition                    |
|------------------------------------------|-----------|-----|-----|-----|------|------------------------------|
| CLK Frequency                            | $F_{clk}$ | 6.1 | 6.4 | 8.0 | MHz  | VCC=3.0V~3.6V                |
| CLK Cycle Time                           | $T_{clk}$ | 125 | 156 | 164 | ns   |                              |
| CLK Pulse Duty                           | $T_{cwh}$ | 40  | 50  | 60  | %    |                              |
| Time that HSYNC to 1 st data input(NTSC) | $T_{hs}$  | 40  | 70  | 255 | CLK  | DDLY =70, Offset = 0 (fixed) |

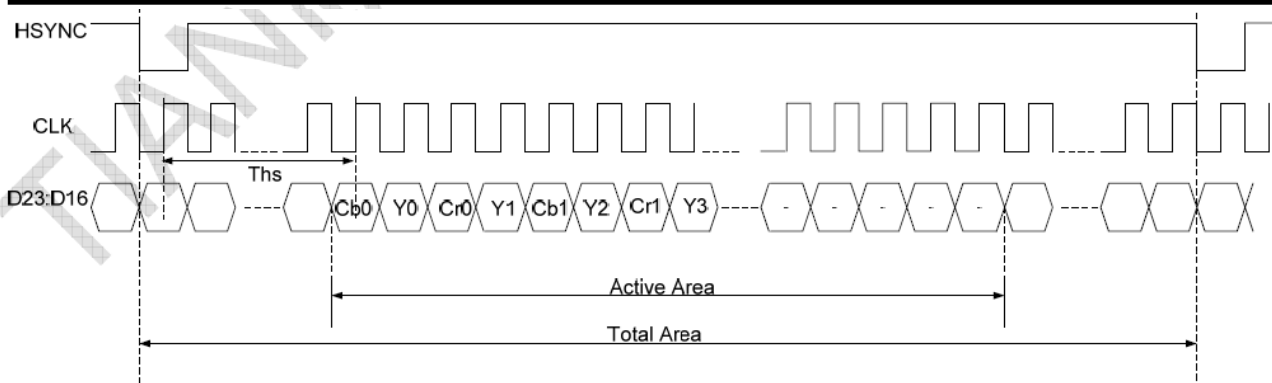
**6.3) 8 Bit RGB Mode for 320RGB x 240**

| Parameter                                | Symbol    | Min | Typ | Max | Unit | Condition                     |
|------------------------------------------|-----------|-----|-----|-----|------|-------------------------------|
| CLK Frequency                            | $F_{clk}$ | --  | 27  | 30  | MHz  | VCC=3.0~3.6V                  |
| CLK Cycle Time                           | $T_{clk}$ | --  | 37  | --  | ns   |                               |
| Time that HSYNC to 1'st data input(NTSC) | $T_{hs}$  | 35  | 70  | 255 | CLK  | DDLY = 70, Offset = 0 (fixed) |



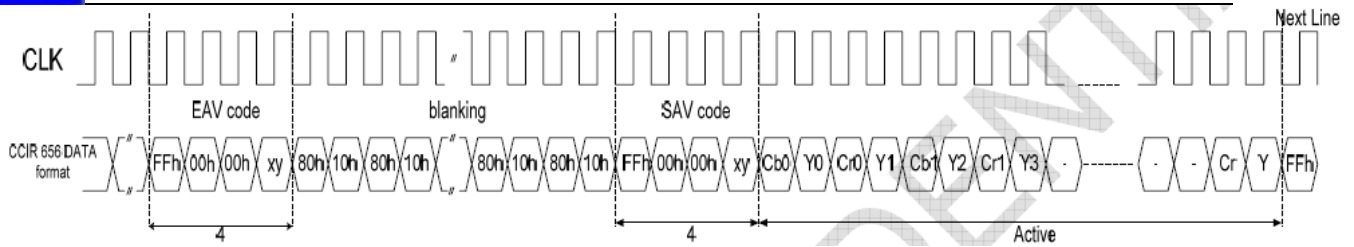
#### 6.4) CCIR601

| Parameter                                | Symbol    | Min | Typ          | Max | Unit | Condition                        |
|------------------------------------------|-----------|-----|--------------|-----|------|----------------------------------|
| CLK Frequency                            | $F_{clk}$ | --  | 24.54/<br>27 | 30  | MHz  | VCC=3.0V~3.6V                    |
| CLK Cycle Time                           | $T_{clk}$ | --  | 40/37        | --  | ns   |                                  |
| Time From HSYNC to 1 st data input(PAL)  | $T_{hs}$  | 128 | 264          | --  | CLK  | DDLY = 136, Offset = 128 (fixed) |
| Time From HSYNC to 1 st data input(NTSC) | $T_{hs}$  | 128 | 244          | --  | CLK  | DDLY = 116, Offset = 128 (fixed) |



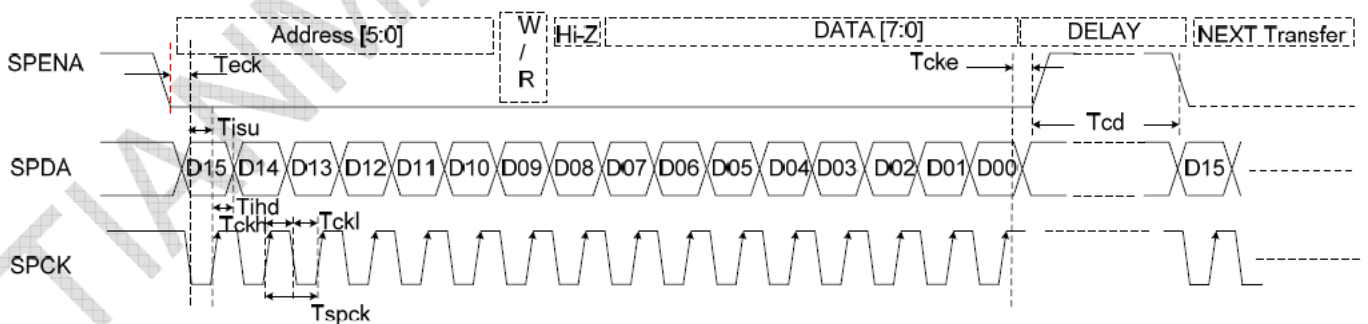
#### 6.5) CCIR656

| Parameter                              | Symbol    | Min | Typ | Max | Unit | Condition                        |
|----------------------------------------|-----------|-----|-----|-----|------|----------------------------------|
| CLK Frequency                          | $F_{clk}$ | --  | 27  | 30  | MHz  | VCC=3.0V~3.6V                    |
| CLK Cycle Time                         | $T_{clk}$ | --  | 37  | --  | ns   |                                  |
| Time that EVA to 1'st data input(PAL)  | $T_{hs}$  | 128 | 288 | --  | CLK  | DDLY = 152, Offset = 128 (fixed) |
| Time that EVA to 1'st data input(NTSC) | $T_{hs}$  | 128 | 276 | --  | CLK  | DDLY = 140, Offset = 128 (fixed) |



### 6.6) 3-Wire Serial Communication AC Timing

| Parameter               | Symbol            | Min | Typ | Max | Unit | Remark |
|-------------------------|-------------------|-----|-----|-----|------|--------|
| Serial Clock            | $T_{SPCK}$        | 320 | --  | --  | ns   |        |
| SPCK Pulse Duty         | $T_{scdut}$       | 40  | 50  | 60  | %    |        |
| Serial Data Setup Time  | $T_{isu}$         | 120 | --  | --  | ns   |        |
| Serial Data Hold Time   | $T_{ihd}$         | 120 | --  | --  | ns   |        |
| Serial Clock High/Low   | $T_{ckh}/T_{ckl}$ | 120 | --  | --  | ns   |        |
| Chip Select Distinguish | $T_{cd}$          | 1   | --  | --  | us   |        |
| SPENB input setup time  | $T_{eck}$         | 150 | --  | --  | ns   |        |
| SPENB input hold time   | $T_{cke}$         | 150 | --  | --  | ns   |        |



Note: DDLY Description

R04: Source Timing Delay Control Register

| Bit       | Name      | Initial | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-----------|-----------|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Bit [7:0] | DDLY[7:0] | 46h     | <p>Select the HSD signal to 1'st input data delay timing</p> <p>Under CCIR601 mode, <math>T_{hs} = DDLY[7:0] + 128</math>, (Unit = CLKIN)</p> <p>Under CCIR656 mode, <math>T_{hs} = DDLY[7:0] + 136</math>, (Unit = CLKIN)</p> <p>Under RGB 8/24 bit mode, <math>T_{hs} = DDLY[7:0]</math>, (Unit = CLKIN)</p> <p>The register value will be update to the different mode,such as 24RGB,8RGB,CCIR mode.</p> <p>Read the section of "24RGB,8RGB,CCIR mode" for the detail.</p> |



## 3-Wire Command Format:

| Bit     | Description                                                                           |
|---------|---------------------------------------------------------------------------------------|
| D15-D10 | Register Address [5:0].                                                               |
| D9      | W/R control bit. "1" for Write; "0" for Read                                          |
| D8      | Hi-Z bit during read mode. Any data within this bit will be ignored during write mode |
| D7-D0   | Data for the W/R operation to the address issued by Address phase                     |

## 3-Wire Writer Format:

| MSB                    |     |     |     |     |     |    |    |                                     |    |    |    |    |    |    |    | LSB |  |
|------------------------|-----|-----|-----|-----|-----|----|----|-------------------------------------|----|----|----|----|----|----|----|-----|--|
| D15                    | D14 | D13 | D12 | D11 | D10 | D9 | D8 | D7                                  | D6 | D5 | D4 | D3 | D2 | D1 | D0 |     |  |
| Register Address [5:0] |     |     |     |     |     | 1  | X  | DATA (Issue by external controller) |    |    |    |    |    |    |    |     |  |

## 3-Wire Read Format:

| MSB                    |     |     |     |     |     |    |      |                         |    |    |    |    |    |    |    | LSB |  |
|------------------------|-----|-----|-----|-----|-----|----|------|-------------------------|----|----|----|----|----|----|----|-----|--|
| D15                    | D14 | D13 | D12 | D11 | D10 | D9 | D8   | D7                      | D6 | D5 | D4 | D3 | D2 | D1 | D0 |     |  |
| Register Address [5:0] |     |     |     |     |     | 0  | Hi-Z | DATA (Issue by NT39016) |    |    |    |    |    |    |    |     |  |

## 6.7) 3-Wire Control Registers List

| 3-Wire Registers |      | Register Description |     |                                       |
|------------------|------|----------------------|-----|---------------------------------------|
| D[15:10]         | Name | Init                 | R/W | Function Description                  |
| 000000b          | R00  | 07h                  | R/W | System control register               |
| 000001b          | R01  | 00h                  | R/W | Timing controller function register   |
| 000010b          | R02  | 03h                  | R/W | Operation control register            |
| 000011b          | R03  | CCh                  | R/W | Input data Format control register    |
| 000100b          | R04  | 46h                  | R/W | Source timing delay control register  |
| 000101b          | R05  | 0Dh                  | R/W | Gate timing delay control register    |
| 000110b          | R06  | 00h                  | R/W | Reserved                              |
| 000111b          | R07  | 00h                  | R/W | Internal function control register    |
| 001000b          | R08  | 08h                  | R/W | RGB contrast control register         |
| 001001b          | R09  | 40h                  | R/W | RGB brightness control register       |
| 001010b          | R0A  | 88h                  | R/W | Hue/Saturation control register       |
| 001011b          | R0B  | 88h                  | R/W | R/B sub-contrast control register     |
| 001100b          | R0C  | 20h                  | R/W | R sub-brightness control register     |
| 001101b          | R0D  | 20h                  | R/W | B sub-brightness control register     |
| 001110b          | R0E  | 68h                  | R/W | VCOMDC level control register         |
| 001111b          | R0F  | 24h                  | R/W | VGL/VGH VOCMAC level control register |
| 010000b          | R10  | 04h                  | R/W | VGAM2 level control register          |
| 010001b          | R11  | 24h                  | R/W | VGAM3/4 level control register        |
| 010010b          | R12  | 24h                  | R/W | VGAM5/6 level control register        |



|         |     |     |     |                                               |
|---------|-----|-----|-----|-----------------------------------------------|
| 011110b | R1E | 00h | R/W | VCOMDC Trim function control register         |
| 100000b | R20 | 00h | R/W | Wide and narrow display mode control register |

Note :

R03: c4h:CCIR656 Mode

c2h:CCIR601 Mode

c8h:8 bit RGB Mode(HV Mode)

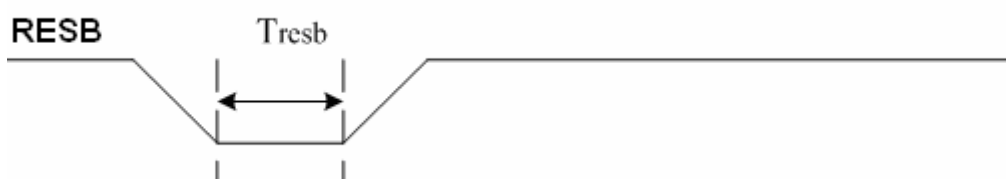
c9h:8 bit RGB Mode(DEN Mode)

cch(default):24 bit RGB Mode (HV mode)

cdh:24 bit RGB Mode (DEN mode)

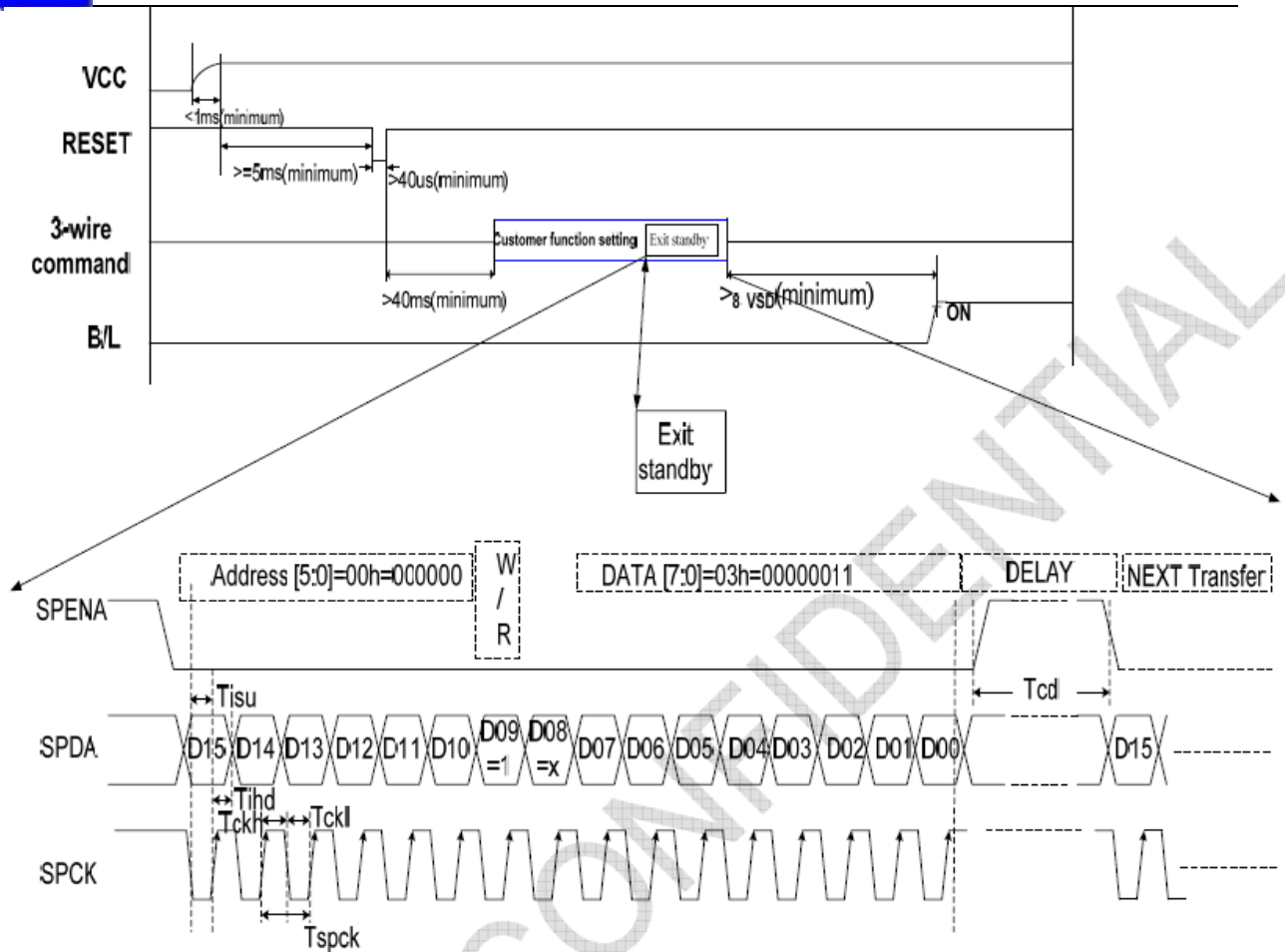
R0F: A4h(default):VGH=15V,VGL=-10V. 24h(recommend): VGH=15V,VGL=-7V.

## 6.8) Reset Timing



| Parameter | Min | Typ   | Max | Unit | Conditions |
|-----------|-----|-------|-----|------|------------|
| Tresb     | 40  | ----- | --- | us   | VCI = 3.3V |

## 6.9) Power On Sequence

**Note**

1. Please exit to Standby Mode through 3-wire command, detail sequence that exit to Standby Mode

under power on mode presentation as below.

2.Exit to standby mode, you can write data "0x03" to register "R00", D09=1 for writing data to register. D09=0 for reading data from register.

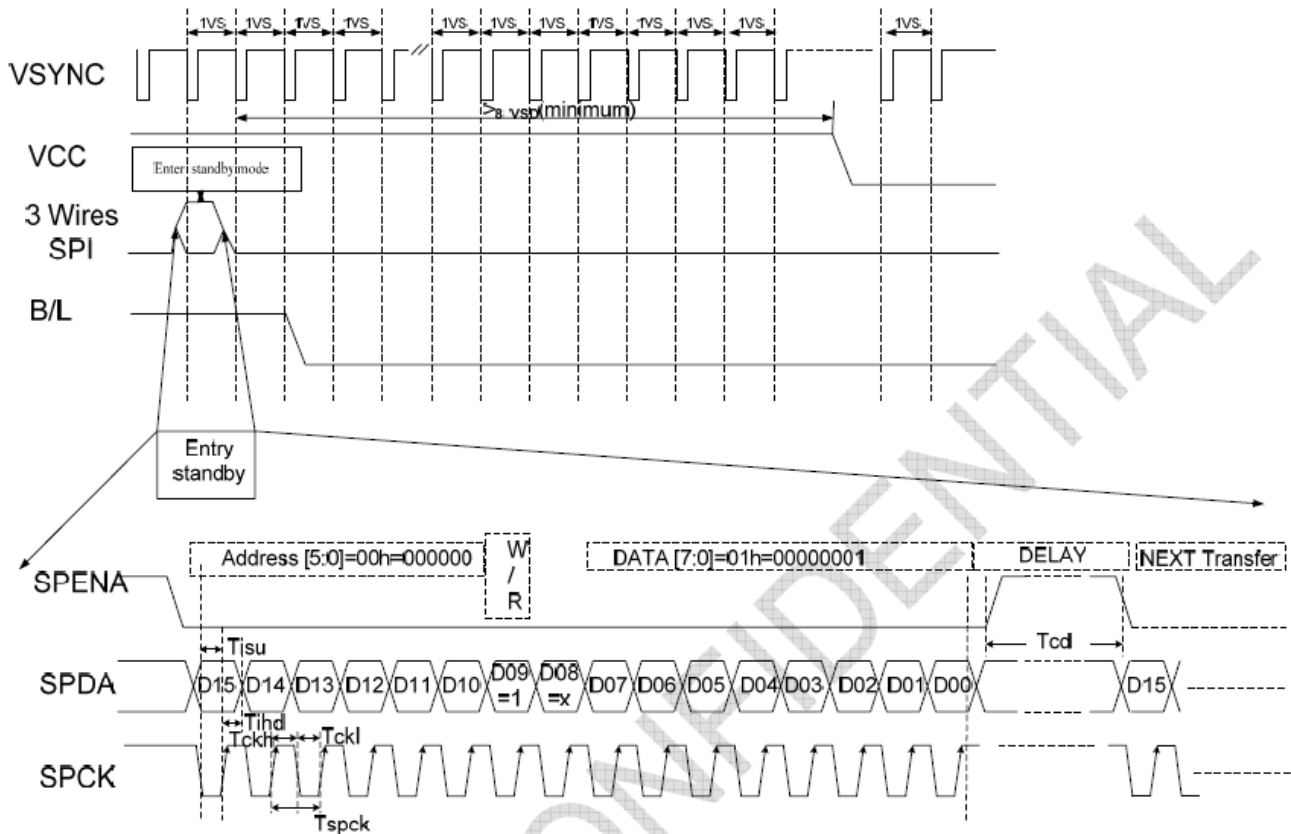
Under SPI write mode, D08=X, and 'X' means don't care D08='1' or '0'.

| Parameter               | Symbol | Min | Typ | Max | Unit | Remarks      |
|-------------------------|--------|-----|-----|-----|------|--------------|
| Serial Clock            | Tspck  | 320 | -   | -   | ns   |              |
| SPCK Pulse Duty         | Tscdut | 40  | 50  | 60  | %    |              |
| Serial Data Setup Time  | Tisu   | 120 | -   | -   | ns   |              |
| Serial Data Hold Time   | Tihd   | 120 | -   | -   | ns   |              |
| Serial Clock High/Low   | Tssw   | 120 | -   | -   | ns   | Tckh or Tckl |
| Chip Select Distinguish | Tcd    | 1   | -   | -   | us   |              |





## 6.10) Power off Sequence



## Note

1. 1VS=1VSYNC. Please entry Standby Mode through 3-wire command, detail sequence which enter

Standby Mode under power off mode presentation as below.

2. Enter to standby mode, you can write data "0x01" to register "R00", D09=1 for writing data to register. D09=0 for reading data from register.

Under SPI write mode, D08=X, and 'X' means don't care D08='1' or '0'.

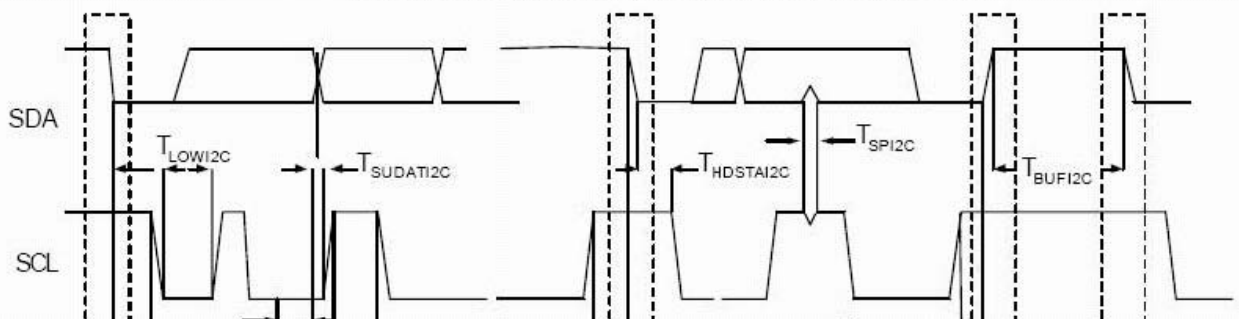
| Parameter               | Symbol | Min | Typ | Max | Unit | Remarks      |
|-------------------------|--------|-----|-----|-----|------|--------------|
| Serial clock            | Tspck  | 320 | -   | -   | ns   |              |
| SPCK pulse duty         | Tscdut | 40  | 50  | 60  | %    |              |
| Serial data setup time  | Tisu   | 120 | -   | -   | ns   |              |
| Serial data hold time   | Tihd   | 120 | -   | -   | ns   |              |
| Serial clock high/low   | Tssw   | 120 | -   | -   | ns   | Tckh or Tckl |
| Chip select distinguish | Tcd    | 1   | -   | -   | us   |              |



## 7 TP timing chart

| Symbol         | Description                                                                                  | Standard Mode |     | Fast Mode |     | Units   |
|----------------|----------------------------------------------------------------------------------------------|---------------|-----|-----------|-----|---------|
|                |                                                                                              | Min           | Max | Min       | Max |         |
| $F_{SCL2C}$    | SCL Clock Frequency                                                                          | 0             | 100 | –         | –   | KHz     |
| $T_{HDSTA12C}$ | Hold Time (repeated) START Condition. After this period, the first clock pulse is generated. | 4.0           | –   | –         | –   | $\mu$ s |
| $T_{LOW12C}$   | LOW Period of the SCL Clock                                                                  | 4.7           | –   | –         | –   | $\mu$ s |
| $T_{HIGH12C}$  | HIGH Period of the SCL Clock                                                                 | 4.0           | –   | –         | –   | $\mu$ s |
| $T_{SUSTA12C}$ | Setup Time for a Repeated START Condition                                                    | 4.7           | –   | –         | –   | $\mu$ s |
| $T_{HDDAT12C}$ | Data Hold Time                                                                               | 0             | –   | –         | –   | $\mu$ s |
| $T_{SUDAT12C}$ | Data Setup Time                                                                              | 250           | –   | –         | –   | ns      |
| $T_{SUSTOI2C}$ | Setup Time for STOP Condition                                                                | 4.0           | –   | –         | –   | $\mu$ s |
| $T_{BUFI2C}$   | Bus Free Time Between a STOP and START Condition                                             | 4.7           | –   | –         | –   | $\mu$ s |
| $T_{SPI2C}$    | Pulse Width of Spikes are Suppressed by the Input Filter.                                    | –             | –   | –         | –   | ns      |

Definition for Timing for Fast/Standard Mode on the I<sup>2</sup>C Bus





## 8 Optical Characteristics

### 8.1 Optical Specification

Ta=25℃

| Item           |       | Symbol           | Condition       | Min   | Typ   | Max   | Unit              | Remark         |
|----------------|-------|------------------|-----------------|-------|-------|-------|-------------------|----------------|
| View Angles    |       | θT               | CR≧10           | 50    | 60    | -     | Degree            | Note 2         |
|                |       | θB               |                 | 60    | 70    | -     |                   |                |
|                |       | θL               |                 | 60    | 70    | -     |                   |                |
|                |       | θR               |                 | 60    | 70    | -     |                   |                |
| Contrast Ratio |       | CR               | θ=0°            | 400   | 500   | -     | -                 | Note1<br>Note3 |
| Response Time  |       | T <sub>ON</sub>  | 25℃             | -     | 10    | 15    | ms                | Note1          |
|                |       | T <sub>OFF</sub> |                 | -     | 15    | 25    |                   | Note4          |
| Chromaticity   | White | x                | Backlight is on | 0.230 | 0.280 | 0.330 | -                 | Note5<br>Note1 |
|                |       | y                |                 | 0.260 | 0.310 | 0.360 |                   |                |
|                | Red   | x                |                 | 0.530 | 0.580 | 0.630 |                   |                |
|                |       | y                |                 | 0.270 | 0.320 | 0.370 |                   |                |
|                | Green | x                |                 | 0.280 | 0.330 | 0.380 |                   |                |
|                |       | y                |                 | 0.535 | 0.585 | 0.635 |                   |                |
|                | Blue  | x                |                 | 0.100 | 0.150 | 0.200 |                   |                |
|                |       | y                |                 | 0.050 | 0.100 | 0.150 |                   |                |
| Uniformity     |       | U                | -               | -     | 80    | -     | %                 | Note1<br>Note6 |
| NTSC           |       | -                | -               | -     | 50    | -     | %                 | Note 5         |
| Luminance      |       | L                |                 | 250   | 300   | -     | cd/m <sup>2</sup> | Note1<br>Note7 |

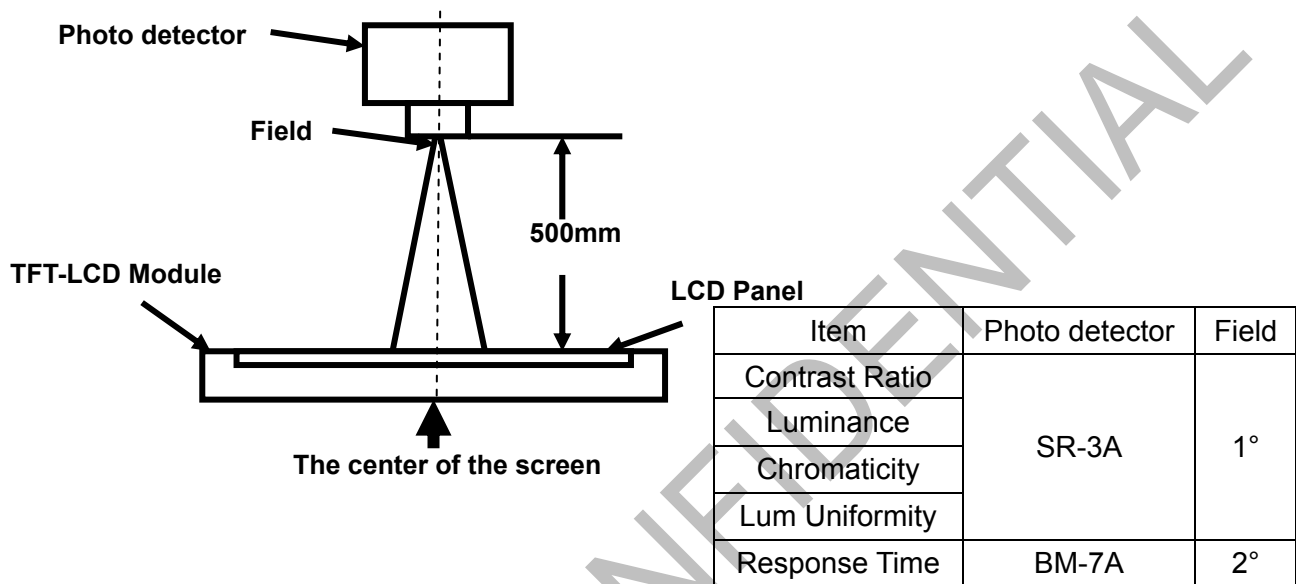
Test Conditions:

1. The ambient temperature is 25±2℃.humidity is 65±7%
2. The test systems refer to Note 1 and Note 2.



## 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.



## 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).

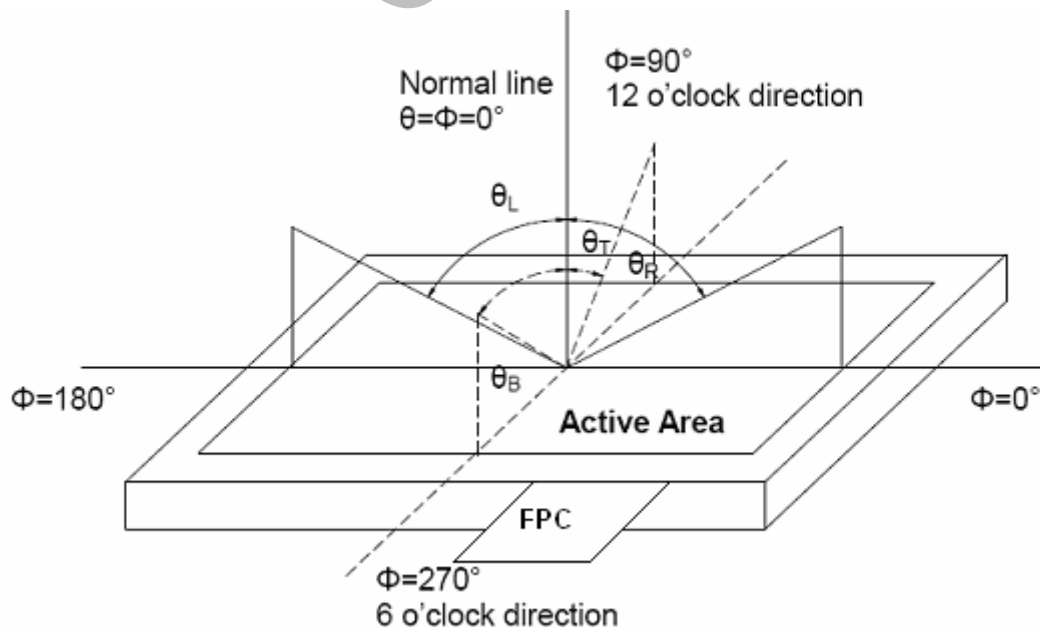


Fig. 1 Definition of viewing angle

**Note 3: Definition of contrast ratio**

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

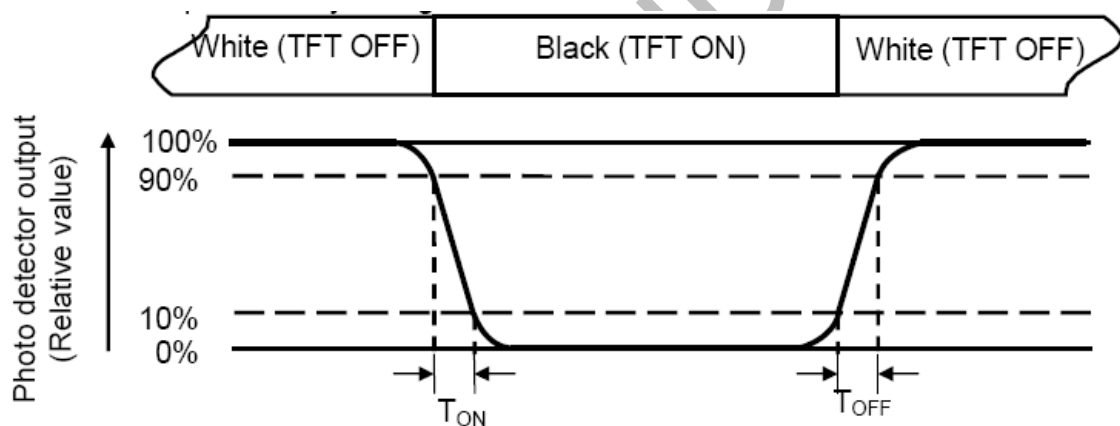
"White state": The state is that the LCD should driven by V<sub>white</sub>.

"Black state": The state is that the LCD should driven by V<sub>black</sub>.

V<sub>white</sub>: To be determined      V<sub>black</sub>: 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 (T<sub>ON</sub>) is the time between photo detector output intensity changed from 90% to 10%. And fall time (T<sub>OFF</sub>) is the time between photo detector output intensity changed from 10% to 90%.

**Note 5: Definition of color chromaticity (CIE1931)**

Color coordinates measured at center point of LCD.

**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.

$$\text{Luminance Uniformity}(U) = L_{\min} / L_{\max}$$

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

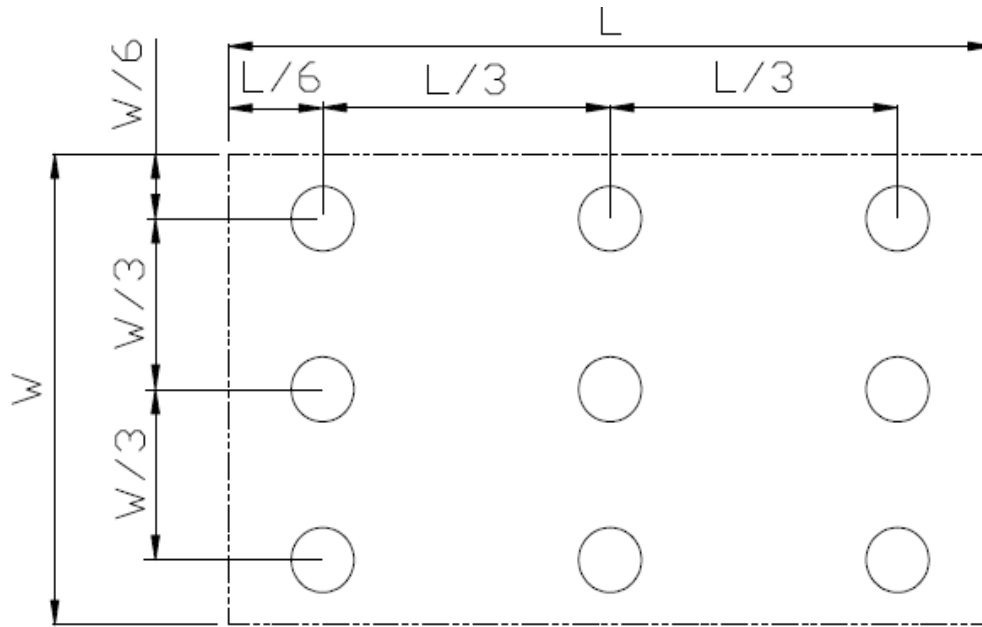


Fig. 2 Definition of uniformity

$L_{\max}$ : The measured maximum luminance of all measurement position.

$L_{\min}$ : The measured minimum luminance of all measurement position.

**Note 7: Definition of Luminance :**

Measure the luminance of white state at center point.

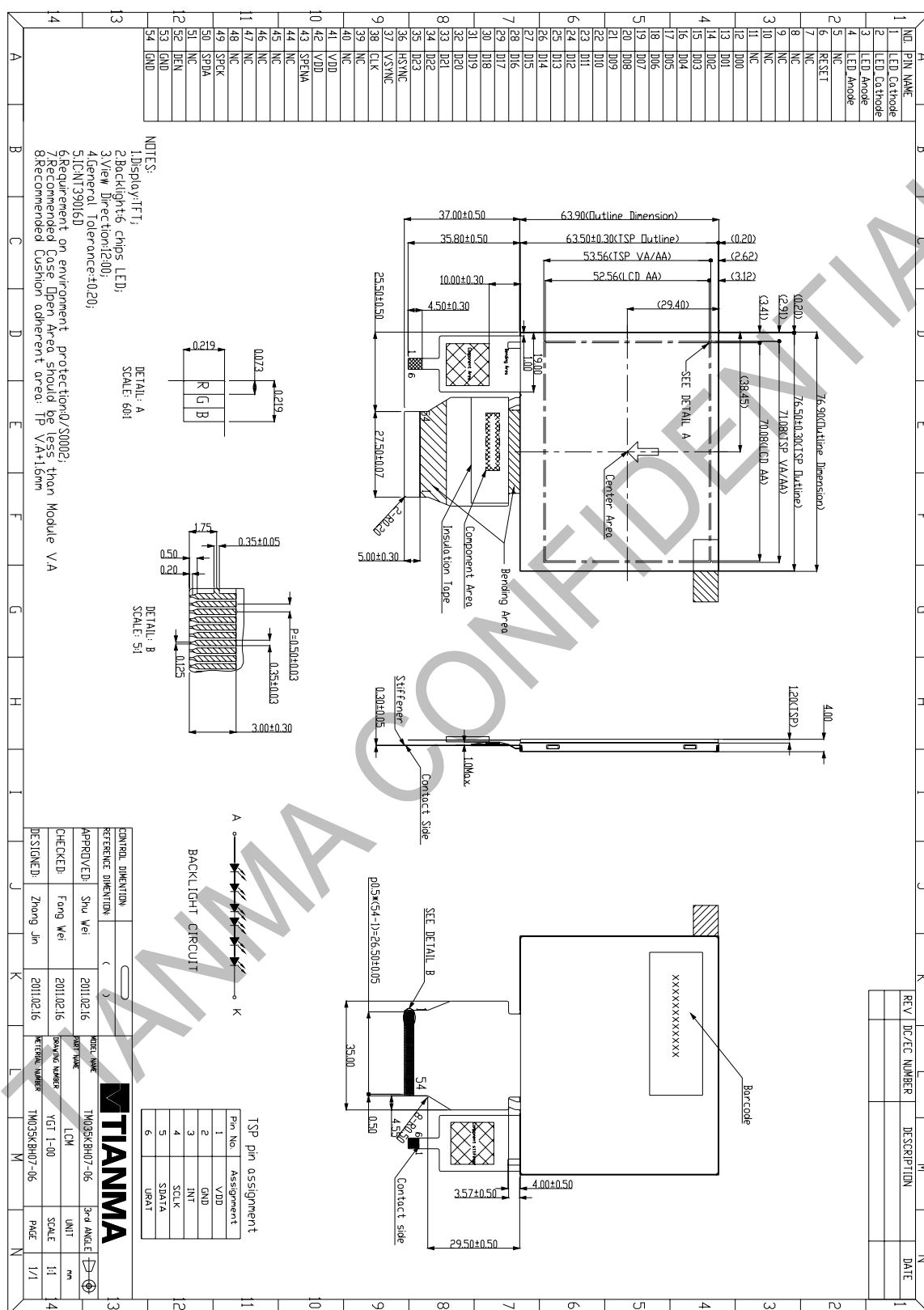
**9 Environmental / Reliability Tests**

| No | Test Item                                | Condition                                                                                                                                        | Remarks                                                                                 |
|----|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| 1  | High Temperature Operation               | Ts=+70℃,240hrs                                                                                                                                   | Note1<br>IEC60068-2-2,GB2423.2—89                                                       |
| 2  | Low Temperature Operation                | Ta=-20℃, 240hrs                                                                                                                                  | IEC60068-2-1<br>GB2423.1—89                                                             |
| 3  | High Temperature Storage                 | Ta=+80℃, 240hrs                                                                                                                                  | IEC60068-2-2,<br>GB2423.2—89                                                            |
| 4  | Low Temperature Storage                  | Ta=-30℃, 240hrs                                                                                                                                  | IEC60068-2-1<br>GB2423.1—89                                                             |
| 5  | High Temperature & High Humidity Storage | +60℃,90% RH max, 240 hours                                                                                                                       | Note2<br>IEC60068-2-3,<br>GB/T2423.3—2006                                               |
| 6  | Thermal Shock (Non-operation)            | -30℃ 30 min~+80℃ 30 min,<br>Change time:5min,30 Cycle.                                                                                           | Start with cold temperature, end<br>with high temperature<br>IEC60068-2-14,GB2423.22—87 |
| 7  | Electro Static Discharge (Operation)     | C=150pF, R=330Ω, 5points/panel<br>Air:±15KV,5times;Contact:±4KV,5times;<br>(Environment:15℃ ~ 35℃,30% ~ 60%,86Kpa ~ 106Kpa)                      | IEC61000-4-2<br>GB/T17626.2—1998                                                        |
| 8  | Vibration (Non-operation)                | Frequency<br>range:10~55Hz,Stroke:1.5mm<br>Sweep:10Hz~55Hz~10Hz 2 hours for each<br>direction of X.Y.Z.(6 hours for total)(package<br>condition) | IEC60068-2-6<br>GB/T2423.10—1995                                                        |
| 9  | Shock (Non-operation)                    | 60G 6ms,± X,± Y,± Z 3times for each direction                                                                                                    | IEC60068-2-27<br>GB/T2423.5—1995                                                        |
| 10 | Package Drop Test                        | Height:90 cm<br>1 corner, 3 edges, 1surfaces (bottom surface<br>toward to the ground)<br>Height:75 cm<br>1 corner, 5(other)surfaces              | IEC60068-2-32<br>GB/T2423.8—1995                                                        |

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

Note2: Ta is the ambient temperature of sample.

## 10 Mechanical Drawing









## 12 Precautions For Use of LCD Modules

### 12.1) Handling Precautions

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

12.1.2 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.

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

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

12.1.5 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

12.1.6 Do not attempt to disassemble the LCD Module.

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

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

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

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

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

12.1.8.4 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.

### 12.2) Storage Precautions

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

12.2.2 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°C ~ 40°C      Relatively humidity: ≤80%

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

### 12.3) Transportation Precautions

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