



# Chunghwa Picture Tubes, Ltd.

## Technical Specification

To : **SANTAIKE**

Date : 2009/06/18

*CPT TFT-LCD*  
**CLAA 260WU11A**

**ACCEPTED BY :**

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|---------------------|----------------|---|
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|          |                           |             |                   |
|----------|---------------------------|-------------|-------------------|
| Doc. No: | <b>CLAA260WU11A -SPEC</b> | Issue Date: | <b>2009/06/18</b> |
|----------|---------------------------|-------------|-------------------|

## 1. OVERVIEW

CLAA260WU11A is 25.5" color TFT-LCD (Thin Film Transistor Liquid Crystal Display) module composed of LCD panel, driver ICs, control circuit and backlight. By applying 8 bit digital data (6 bit +Hi-FRC), 1920x1200, 16.7M-color images are displayed on the 25.5" diagonal screen. Input power voltage is 5.0V for LCD driving.. General specifications are summarized in the following table:

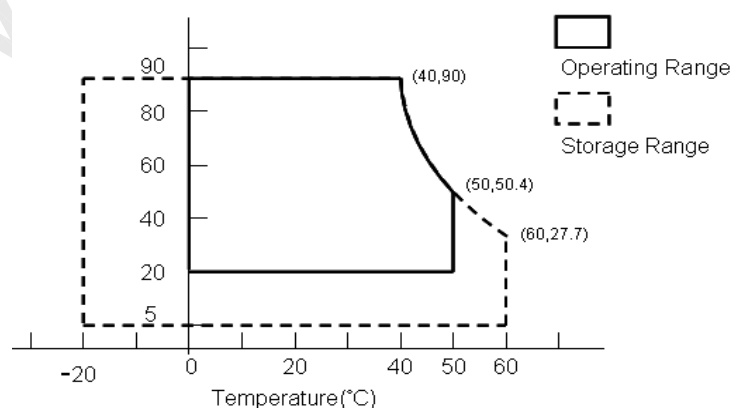
| ITEM                           | SPECIFICATION   |
|--------------------------------|---|
| Display Area(mm)               | 550.08(H)x343.8(V)  |
| Number of Pixels               | 1920(H)x1200(V)   |
| Pixel Pitch(mm)                | 0.2865(H)x0.2865(V)   |
| Color Pixel Arrangement        | RGB vertical stripe   |
| Display Mode                   | normally white, TN  |
| Number of Colors               | 16.7M (6 Bit +Hi-FRC)   |
| Brightness(cd/m <sup>2</sup> ) | 400 cd/m <sup>2</sup> (Typ.)(Center point, Lamp current=6 mA) |
| Viewing Angle                  | 160 / 160 (Typ.)  |
| Surface Treatment              | Glare type  |
| Module Size(mm)                | 582(W)x375.6(H)x37.2(D)(max)                                  |
| Module Weight(g)               | 3400(typ)   |
| Backlight Unit                 | CCFL, 6 tubes   |

## 2. ABSOLUTE MAXIMUM RATINGS

| ITEM                         | SYMBOL | MIN.  | MAX. | UNIT  | REMARK          |
|------------------------------|--------|-------|------|-------|-----------------|
| Power Supply Voltage for LCD | VCC    | 0     | 6    | V     |                 |
| Lamp Voltage                 | VL     | 1760  | 1900 | Vrms  |                 |
| Lamp Current                 | ILO    | 3     | 8    | mArms | *4). 7)         |
| Lamp Frequency               | FL     | 40    | 70   | kHz   |                 |
| static electricity           | VESDt  | -200  | 200  | V     | *5)             |
|                              | VESDc  | -8000 | 8000 | V     |                 |
| Operation Temperature        | Top    | 0     | 50   | °C    | *1). 2). 3). 6) |
| Storage Temperature          | Tstg   | -20   | 60   | °C    | *1). 2). 3)     |
| Delayed Discharge Time       | TD     | --    | 1    | Sec   | *8)             |

[Note]

- The relative temperature and humidity range are as below sketch, 90%RHMax. ( $T_a \leq 40^\circ\text{C}$ ).
- The maximum wet bulb temperature  $\leq 39^\circ\text{C}$  ( $T_a > 40^\circ\text{C}$ ) and without dewing.
- If you use the product in a environment which over the definition of temperature and humidity too long to effect the result of eye-aching.
- The life time of the lamp is related to the current of the lamp, so please according to the description of the “(b) backlight” on page 7.
- Test Condition: IEC 1000-4-2  
VESDt: Contact discharge to input connector; VESD<sub>C</sub>: Contact discharge to module
- If you operate the product in normal temperature range, the center surface of panel should be under  $60^\circ\text{C}$ .
- When lamp current is out of the absolute maximum range, the life will fall rapidly or shown unusual sign.  
IL min 2mA only for test only, but we can't guarantee the lifetime and performance.
- Delay lighting testing needs the volt above start voltage Vrms. Before the procedure tube needs typical lighting for 1 minute and stay in the temperature  $25 \pm 2^\circ\text{C}$  for 24 hours and then testing in the same condition in dark room.



### 3. ELECTRICAL CHARACTERISTICS

#### (1).TFT-LCD

Ta=25°C

| ITEM                                  | SYMBOL                     | MIN | TYP   | MAX  | UNIT  | Remark   |     |
|---------------------------------------|----------------------------|-----|-------|------|-------|----------|-----|
| Power Supply Voltage for LCD          | Vcc                        | 4.5 | 5.0   | 5.5  | V     | *1)      |     |
| Power Supply Current for LCD          | Icc                        | -   | 1500  | 2600 | mA    | *2)      |     |
| Permissive Input Ripple Voltage       | VRP                        | -   | -     | 100  | mVp-p | Vcc=5.0V |     |
| Differential impedance                | Zm                         | 90  | 100   | 110  | Ω     |          |     |
| Logic input voltage<br>LVDS:IN+ , IN- | Common Mode Voltag         | VCM | 1.125 | 1.25 | 1.375 | V        |     |
|                                       | Differential Input Voltage | VID | 250   | 350  | 450   | mV       |     |
|                                       | Threshold Voltage(High)    | VTH | -     | -    | 100   | mV       | *3) |
|                                       | Threshold Voltage(Low)     | VTL | -100  | -    | -     | mV       |     |
| LCD Inrush Current                    | Inrush                     |     |       | 3    | A     | *4)      |     |
| Power consumption                     | P                          |     | 7.5   | 13   | W     | *2)      |     |

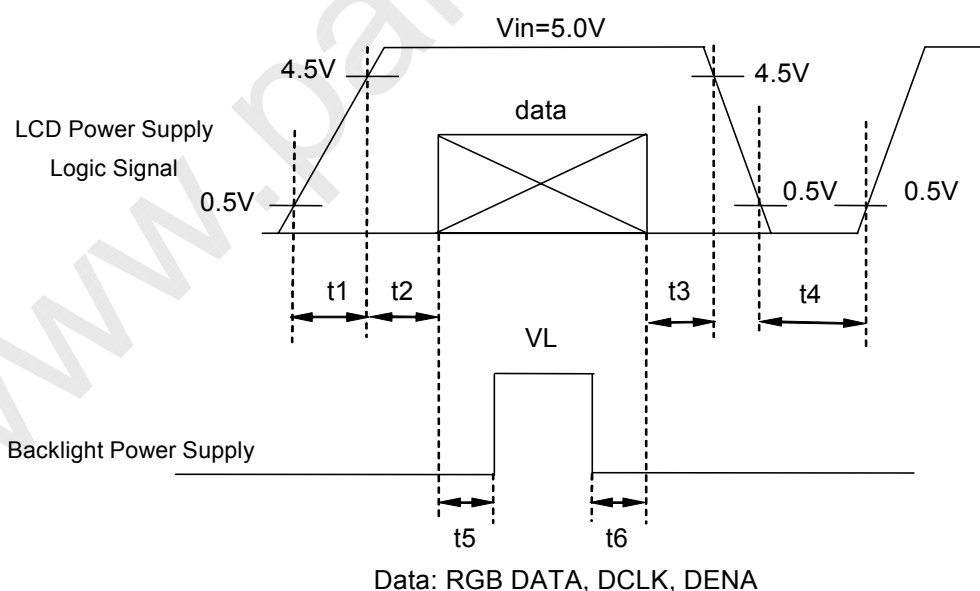
[Note]

1).VCC-turn-on conditions:

$$0.5\text{ms} \leq t1 \leq 10\text{ms} \quad 1 \text{ sec} \leq t4$$

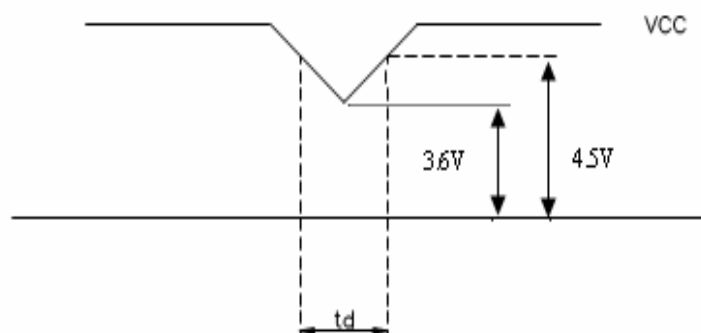
$$0 < t2 \leq 20\text{ms} \quad 200\text{ms} \leq t5$$

$$0 < t3 \leq 50\text{ms} \quad 200\text{ms} \leq t6$$



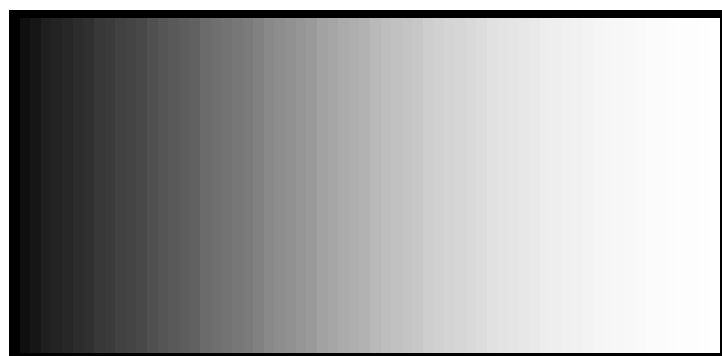
VCC-dip conditions:

(1) When  $3.6\text{V} \leq V_{cc} (\text{min}) < 4.5\text{V}$ :  $t_d \leq 10 \text{ ms}$



2). Circuit condition (Typ.)

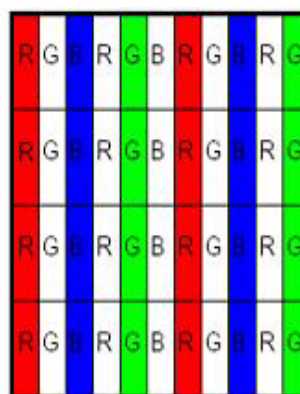
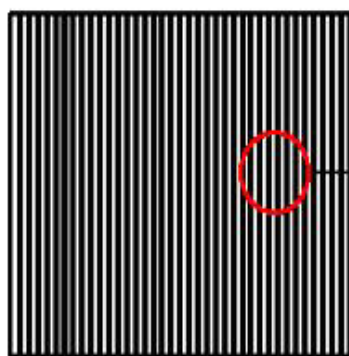
$V_{CC}=5.0 \text{ V}$  ,  $f_V=60 \text{ Hz}$   $f_H=74.1 \text{ kHz}$  ,  $f_{CLK}=77 \text{ MHz}$



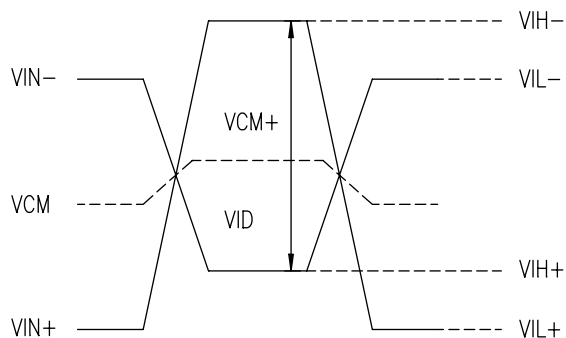
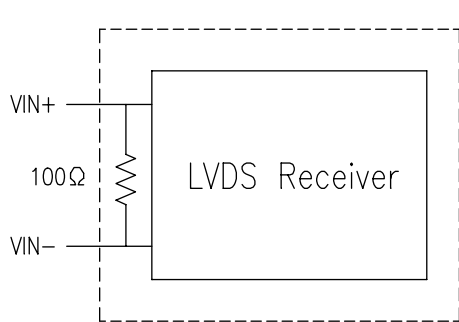
256-Gray :

Circuit condition (MAX.)

$V_{CC}=5.0 \text{ V}$  ,  $f_V=60 \text{ Hz}$   $f_H=74.1 \text{ kHz}$  ,  $f_{CLK}=77 \text{ MHz}$



3).LVDS Signal definition:



$$VID = VIN_+ - VIN_- ,$$

$$\Delta VCM = | VCM_+ - VCM_- | ,$$

$$\Delta VID = | VID_+ - VID_- | ,$$

$$VID_+ = | VIH_+ - VIH_- | ,$$

$$VID_- = | VIL_+ - VIL_- | ,$$

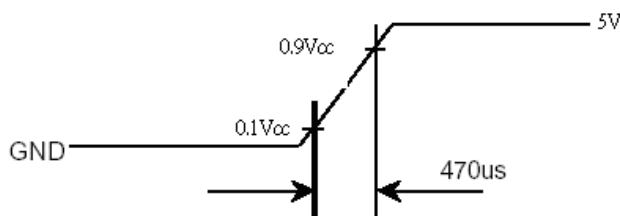
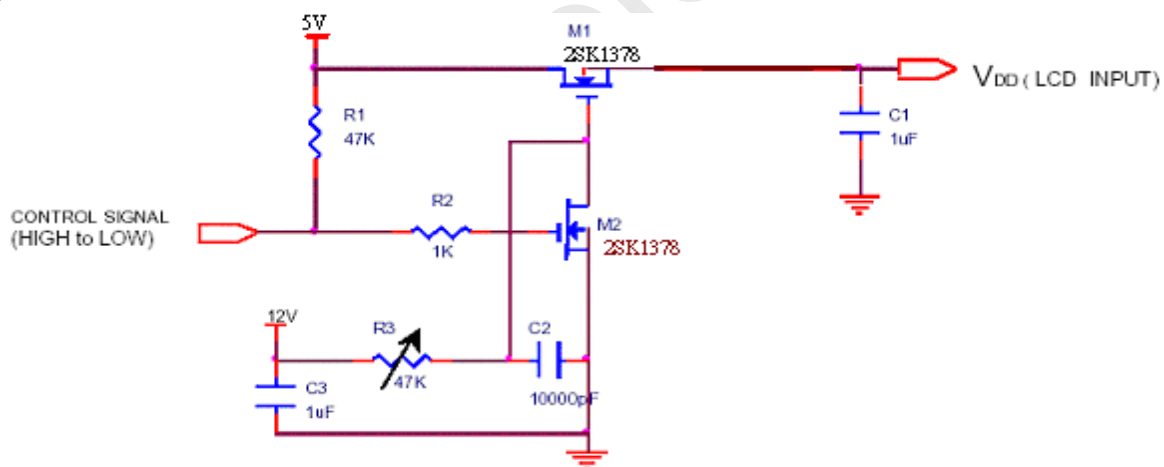
$$VCM = (VIN_+ + VIN_-)/2 ,$$

$$VCM_+ = (VIH_+ + VIH_-)/2 ,$$

$$VCM_- = (VIL_+ + VIL_-)/2 ,$$

VIN<sub>+</sub> = Positive differential DATA & CLK Input  
 VIN<sub>-</sub> = Negative differential DATA & CLK Input

4).Irush Measurement Condition



**(2).Backlight**

## 1. Electrical specification

| ITEM                  | SYMBOL | MIN  | TYP  | MAX  | UNIT  | REMARK              |
|-----------------------|--------|------|------|------|-------|---------------------|
| B/L Voltage           | VL     | 1701 | 1800 | 2079 | Vrms  | IL=6.0mA<br>Ta=25°C |
| B/L Current           | IL     | 5.5  | 6.0  | 6.5  | mArms | *1) Ta=25°C         |
| B/L operating current | ILO    | 3    | 6.0  | 8    | mArms | *1) Ta=25°C         |
| Starting Lamp Voltage | VS     | —    | —    | 3000 | Vrms  | Ta=0°C              |
|                       |        | —    | —    | 3500 | Vrms  | Ta=25°C             |

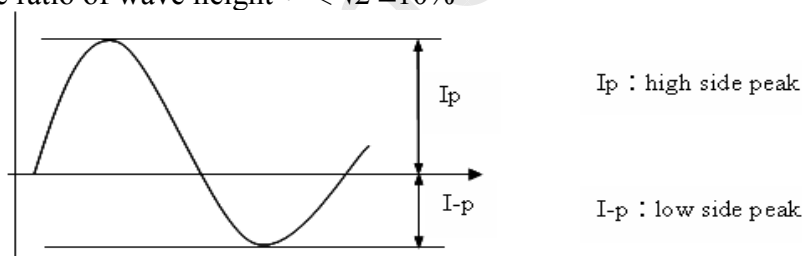
## 2. Lamp life time

| ITEM                     | ILO at 3.0 mA | ILO at 6.0 mA | ILO at 8.0 mA | UNIT | REMARK                   |
|--------------------------|---------------|---------------|---------------|------|--------------------------|
| Lamp life Time           | Min. 50,000   | Min. 50,000   | Min. 30,000   | hr   | Continuous Operation *3) |
| Rated time (turn on/off) | —             | Min.100,000   | —             | time | *4)                      |

[Note 1] Measuring inverter Type : Logah (力銘) MIT68013.50

If the waveform of light up-driving is asymmetric, the distribution of mercury inside the lamp tube will become unequally or will deplete the Argon gas in it. Then it may cause the abnormal phenomenon of lighting-up. Therefore, designers have to try their best to for fill the conditions under the inverter designing-stage as below:

- The degrees of unbalance :  $< 10\%$
- The ratio of wave height :  $< \sqrt{2} \pm 10\%$

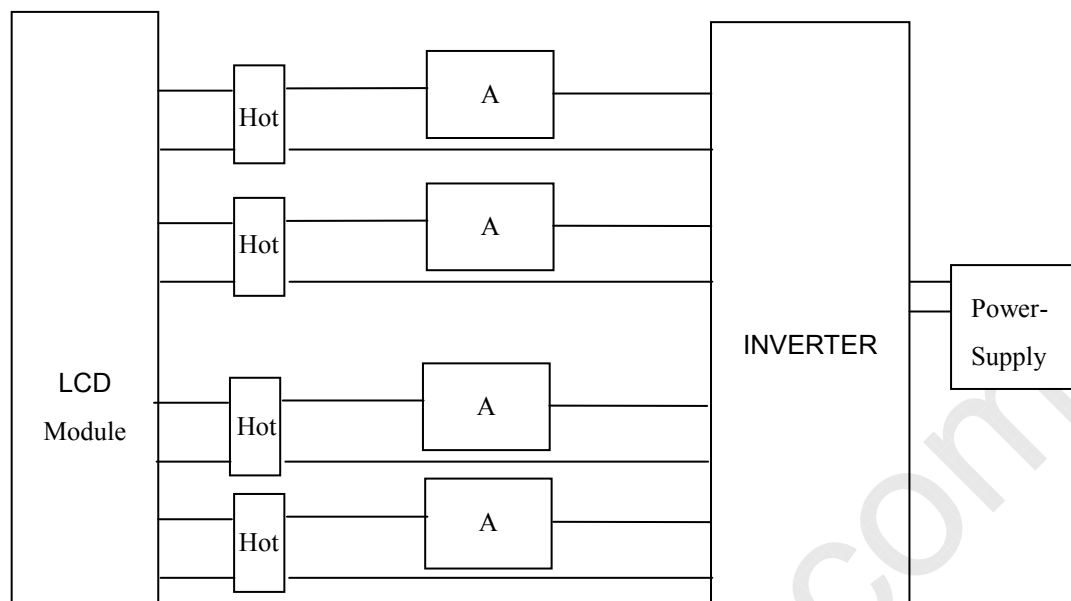


A : The degrees of unbalance =  $|Ip - I-p| / Irms \times 100 (\%)$

B : The ratio of wave height =  $Ip \text{ (or } I-p) / Irms$

[Note 2] The lamp working current ( $I_{cyc}$ ) of any waveform of light up-driving can not over the maximum of lamp typical current. ( $I_{cyc}$ : Cycle RMS of oscilloscope) °

## 1) Lamp Current measurement method (The current meter is inserted in cold line)



- a. Frequency in this range can mala the characterisitcs of electric and optics maintain in +/- 10% except hue.
  - b. If the lamp frequency can be maintain in 62~68KHz, the better charactristics of the electrical and the optical can be presented.
  - c. If the operating frequency is 40~70 KHz, the life time and the reliability of the lamp will not be affect.
  - d. Lamp frequency of inverter may produce interference with horizontal synchronous frequency, and this may cause horizontal beat on the display. Therefore, please adjust lamp frequency, and keep inverter as far from module as possible or use electronic shielding between inverter and module to avoid the interference.
- 3) Definition of the lamp life time : Luminance (L) under 50% of specification starting lamp voltage or starting lamp voltage is more than 130% of the initial value
- 4) The condition of Turn-on and Turn-off operation is as below:
- a. Lamp current is 6.0mA
  - b. Frequency is 10 sec.(on)/10 sec.(off)
  - c. Repeat it for 10 thousand times
  - d. The result of eye-etching of the lamp hue is normal, and can switch the lamp.
- It should not have motion fail when starting lamp voltage is lower than 130% of the initial value.
- 5) It is necessary to consider the maximal value when design inverter , in order to assure lighting.
- 6) The equation of power consumption  $WL=IL \times VL \times 6.$  ( $IL=6.0mA$  ,  $Ta=25^{\circ}C$ )



## 4. INTERFACE PIN CONNECTION

### (1) CN1 (Data Signal and Power Supply)

Used connector: MDF76GW-30S-1H(58) (Vendor : Hirose) or compatible.

| PIN NO. | SYMOBL | FUNCTION                                  |
|---------|--------|---|
| 1       | RXO0-  | minus signal of odd channel 0(LVDS)       |
| 2       | RXO0+  | plus signal of odd channel 0(LVDS)        |
| 3       | RXO1-  | minus signal of odd channel 1(LVDS)       |
| 4       | RXO1+  | plus signal of odd channel 1(LVDS)        |
| 5       | RXO2-  | minus signal of odd channel 2(LVDS)       |
| 6       | RXO2+  | plus signal of odd channel 2(LVDS)        |
| 7       | GND    | ground                                    |
| 8       | RXOC-  | minus signal of odd clock channel (LVDS)  |
| 9       | RXOC+  | plus signal of odd clock channel (LVDS)   |
| 10      | RXO3-  | minus signal of odd channel 3(LVDS)       |
| 11      | RXO3+  | plus signal of odd channel 3(LVDS)        |
| 12      | RXE0-  | minus signal of even channel 0(LVDS)      |
| 13      | RXE0+  | plus signal of even channel 0(LVDS)       |
| 14      | GND    | ground                                    |
| 15      | RXE1-  | minus signal of even channel 1(LVDS)      |
| 16      | RXE1+  | plus signal of even channel 1(LVDS)       |
| 17      | GND    | ground                                    |
| 18      | RXE2-  | minus signal of even channel 2(LVDS)      |
| 19      | RXE2+  | plus signal of even channel 2(LVDS)       |
| 20      | RXEC-  | minus signal of even clock channel (LVDS) |
| 21      | RXEC+  | plus signal of even clock channel (LVDS)  |
| 22      | RXE3-  | minus signal of even channel 3(LVDS)      |
| 23      | RXE3+  | plus signal of even channel 3(LVDS)       |
| 24      | GND    | ground                                    |
| 25      | NC     | NC  |
| 26      | NC     | NC  |
| 27      | NC     | NC  |
| 28      | VCC    | Power supply input voltage(5.0 V)         |
| 29      | VCC    | Power supply input voltage(5.0 V)         |
| 30      | VCC    | Power supply input voltage(5.0 V)         |

### (2) CN2, 3, 4, 5, 6, 7 (BACKLIGHT)

Backlight-side lamp connector (CN2~CN7) : CP0404SL000 (Cvilux)

## 5. INTERFACE TIMING

### (1) Timing Specifications

|            |      | ITEM                   | SYMBOL    | MIN   | TYP   | MAX   | UNIT      |
|------------|------|------------------------|-----------|-------|-------|-------|-----------|
| LCD Timing | DCLK | Frequency              | $f_{CLK}$ | 72    | 77    | 83    | MHz       |
|            |      | Period                 | $t_{CLK}$ | 12.05 | 12.98 | 13.88 | ns        |
|            | DENA | Horizontal Active Time | $t_{HA}$  | 960   | 960   | 960   | $t_{CLK}$ |

|  |                       |          |      |      |      |           |
|--|-----------------------|----------|------|------|------|-----------|
|  | Horizontal Blank Time | $t_{HB}$ | 70   | 80   | 115  | $t_{CLK}$ |
|  | Horizontal Total Time | $t_H$    | 1030 | 1040 | 1075 | $t_{CLK}$ |
|  | Vertical Active Time  | $t_{VA}$ | 1200 | 1200 | 1200 | $t_H$     |
|  | Vertical Blank Time   | $t_{VB}$ | 25   | 35   | 45   | $t_H$     |
|  | Vertical Total Time   | $t_V$    | 1225 | 1235 | 1245 | $t_H$     |
|  | Vertical Frame Rate   | Fr       | 57   | 60   | 63   | Hz        |

[Note]

- 1) DENA should always be positive polarity as shown in the timing specification.
- 2) CLK IN should appear during all blanking period,
- 3) Using LVDS IC

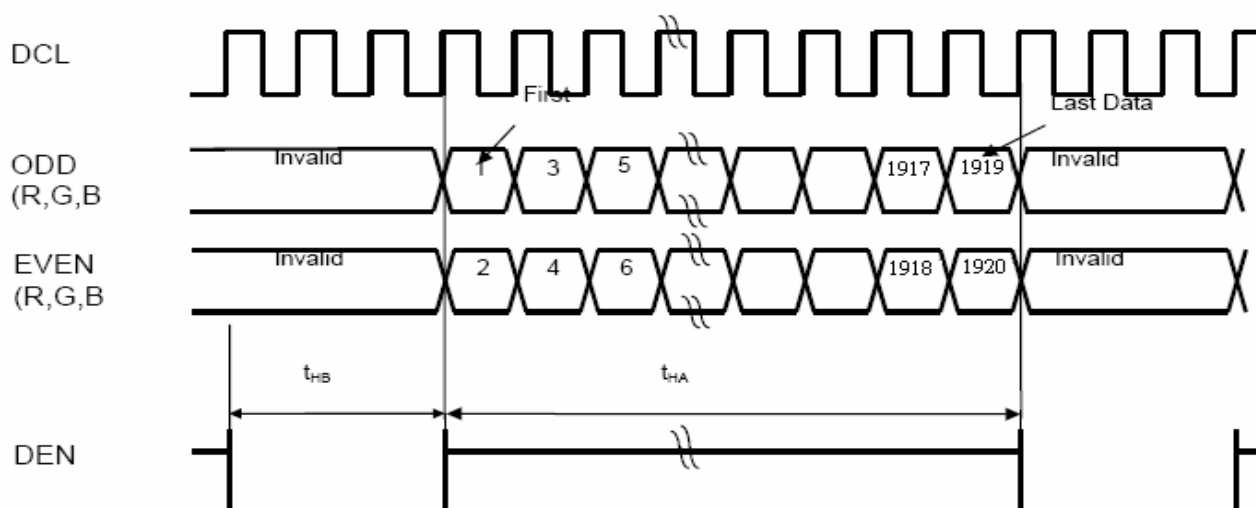
| Receiver        | Transmitter     |
|-----------------|-----------------|
| DS90C384MTD(NS) | DS90C383MTD(NS) |
| SN75LVDS82(TI)  | SN75LVDS83(TI)  |

- 4) Required signal assignment for flat link transmitter

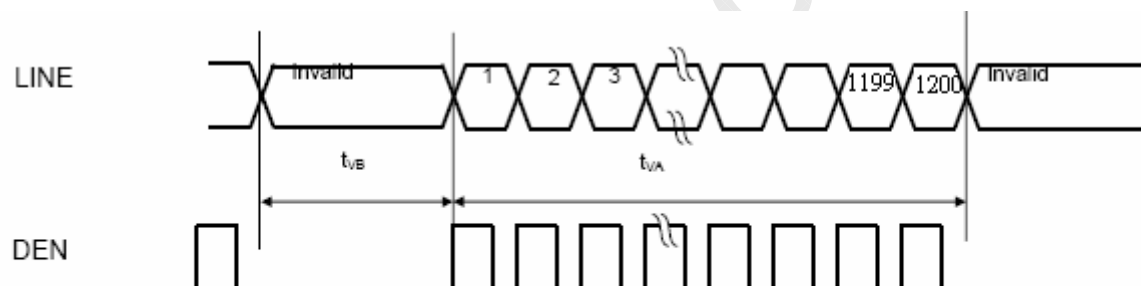
| Pin No. | Pin Name | Require Signal             | Pin No. | Pin Name  | Require Signal                           |
|---------|----------|----------------------------|---------|-----------|--|
| 1       | VCC      | Power Supply for TTL Input | 29      | GND       | Ground pin for TTL                       |
| 2       | D5       | TTL Input (R7)             | 30      | D26       | TTL Input(DE)                            |
| 3       | D6       | TTL Input (R5)             | 31      | TxCLKIN   | TTL Level clock Input                    |
| 4       | D7       | TTL Input (G0)             | 32      | PWR DWN   | Power Down Input                         |
| 5       | GND      | Ground pin for TTL         | 33      | PLL GND   | Ground pin for PLL                       |
| 6       | D8       | TTL Input (G1)             | 34      | PLL VCC   | Power Supply for PLL                     |
| 7       | D9       | TTL Input (G2)             | 35      | PLL GND   | Ground pin for PLL                       |
| 8       | D10      | TTL Input (G6)             | 36      | LVDS GND  | Ground pin for LVDS                      |
| 9       | VCC      | Power Supply for TTL Input | 37      | TxOUT3+   | Positive LVDS differential data output 3 |
| 10      | D11      | TTL Input (G7)             | 38      | TxOUT3-   | Negative LVDS differential data output 3 |
| 11      | D12      | TTL Input (G3)             | 39      | TxCLKOUT+ | Positive LVDS differential clock output  |
| 12      | D13      | TTL Input (G4)             | 40      | TxCLKOUT- | Negative LVDS differential clock output  |
| 13      | GND      | Ground pin for TTL         | 41      | TxOUT2+   | Positive LVDS differential data output 2 |
| 14      | D14      | TTL Input (G5)             | 42      | TxOUT2-   | Negative LVDS differential data output 2 |
| 15      | D15      | TTL Input (B0)             | 43      | LVDS GND  | Ground pin for LVDS                      |
| 16      | D16      | TTL Input (B6)             | 44      | LVDS VCC  | Power Supply for LVDS                    |
| 17      | VCC      | Power Supply for TTL Input | 45      | TxOUT1+   | Positive LVDS differential data output 1 |
| 18      | D17      | TTL Input (B7)             | 46      | TxOUT1-   | Negative LVDS differential data output 1 |
| 19      | D18      | TTL Input (B1)             | 47      | TxOUT0+   | Positive LVDS differential data output 0 |
| 20      | D19      | TTL Input (B2)             | 48      | TxOUT0-   | Negative LVDS differential data output 0 |
| 21      | GND      | Ground pin for TTL         | 49      | LVDS GND  | Ground pin for TTL                       |
| 22      | D20      | TTL Input (B3)             | 50      | D27       | TTL Input (R6)                           |
| 23      | D21      | TTL Input (B4)             | 51      | D0        | TTL Input (R0)                           |
| 24      | D22      | TTL Input (B5)             | 52      | D1        | TTL Input (R1)                           |
| 25      | D23      | TTL Input (LVDS)           | 53      | GND       | Ground pin for TTL                       |
| 26      | VCC      | Power Supply for TTL Input | 54      | D2        | TTL Input (R2)                           |
| 27      | D24      | TTL Input (HSYNC)          | 55      | D3        | TTL Input (R3)                           |
| 28      | D25      | TTL Input (VSYNC)          | 56      | D4        | TTL Input (R4)                           |

## (2) Timing Chart

## a. Horizontal Timing

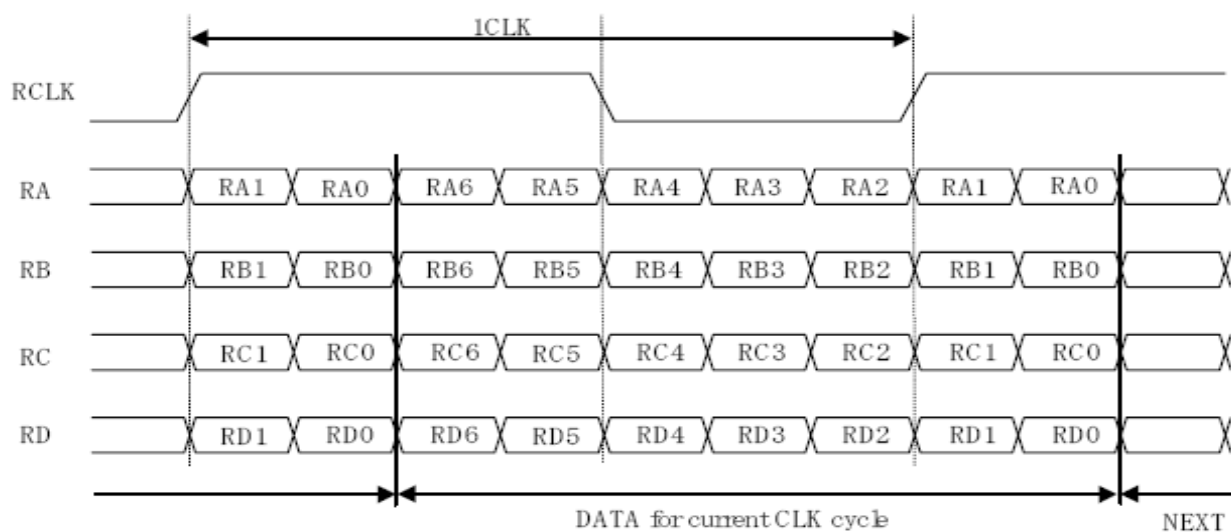


## b. Vertical Timing



(3) LVDS DATA

(a) Timing Chart



(b) Data mapping

| Cell     | Input Pin *) | Data(6bit + FRC) |
|----------|--------------|------------------|
| RA0      | TxIN0        | RI0              |
| RA1      | TxIN1        | RI1              |
| RA2      | TxIN2        | RI2              |
| RA3      | TxIN3        | RI3              |
| RA4      | TxIN4        | RI4              |
| RA5      | TxIN6        | RI5              |
| RA6      | TxIN7        | GI0              |
| RB0      | TxIN8        | GI1              |
| RB1      | TxIN9        | GI2              |
| RB2      | TxIN12       | GI3              |
| RB3      | TxIN13       | GI4              |
| RB4      | TxIN14       | GI5              |
| RB5      | TxIN15       | BI0              |
| RB6      | TxIN18       | BI1              |
| RC0      | TxIN19       | BI2              |
| RC1      | TxIN20       | BI3              |
| RC2      | TxIN21       | BI4              |
| RC3      | TxIN22       | BI5              |
| RC4      | TxIN24       | RSVD             |
| RC5      | TxIN25       | RSVD             |
| RC6      | TxIN26       | DENA             |
| RD0      | TxIN27       | RI6              |
| RD1      | TxIN5        | RI7              |
| RD2      | TxIN10       | GI6              |
| RD3      | TxIN11       | GI7              |
| RD4      | TxIN16       | BI6              |
| RD5      | TxIN17       | BI7              |
| RD6      | TxIN23       | (RSVD)           |
| Ref-RCLK | TxCLKIN      | DCLKI            |

\*) : DS90C383MTD

(4) Color Data Assignment

| COLOR | INPUT DATA | R DATA |    |    |    |    |    |    |    | G DATA |    |    |    |    |    |    |    | B DATA |    |    |    |    |    |    |    |
|-------|------------|--------|----|----|----|----|----|----|----|--------|----|----|----|----|----|----|----|--------|----|----|----|----|----|----|----|
|       |            | R7     | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G7     | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B7     | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| BASIC | BLACK      | 0      | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0      | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0      | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|       | RED(255)   | 1      | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0      | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0      | 0  | 0  | 0  | 0  | 0  | 0  | 0  |

|       |            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|-------|------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| COLOR | GREEN(255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
|       | BLUE(255)  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
|       | CYAN       | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
|       | MAGENTA    | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
|       | YELLOW     | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 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 | 1 | 1 | 1 | 1 | 1 |
| RED   | RED(0)     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
|       | RED(1)     | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
|       | RED(2)     | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
|       |            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|       | RED(254)   | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
|       | RED(255)   | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| GREEN | GREEN(0)   | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
|       | GREEN(1)   | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
|       | GREEN(2)   | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
|       |            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|       | GREEN(254) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
|       | GREEN(255) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
| BLUE  | BLUE(0)    | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |   |
|       | BLUE(1)    | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |   |
|       | BLUE(2)    | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |   |
|       |            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|       | BLUE(254)  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |   |
|       | BLUE(255)  | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |   |

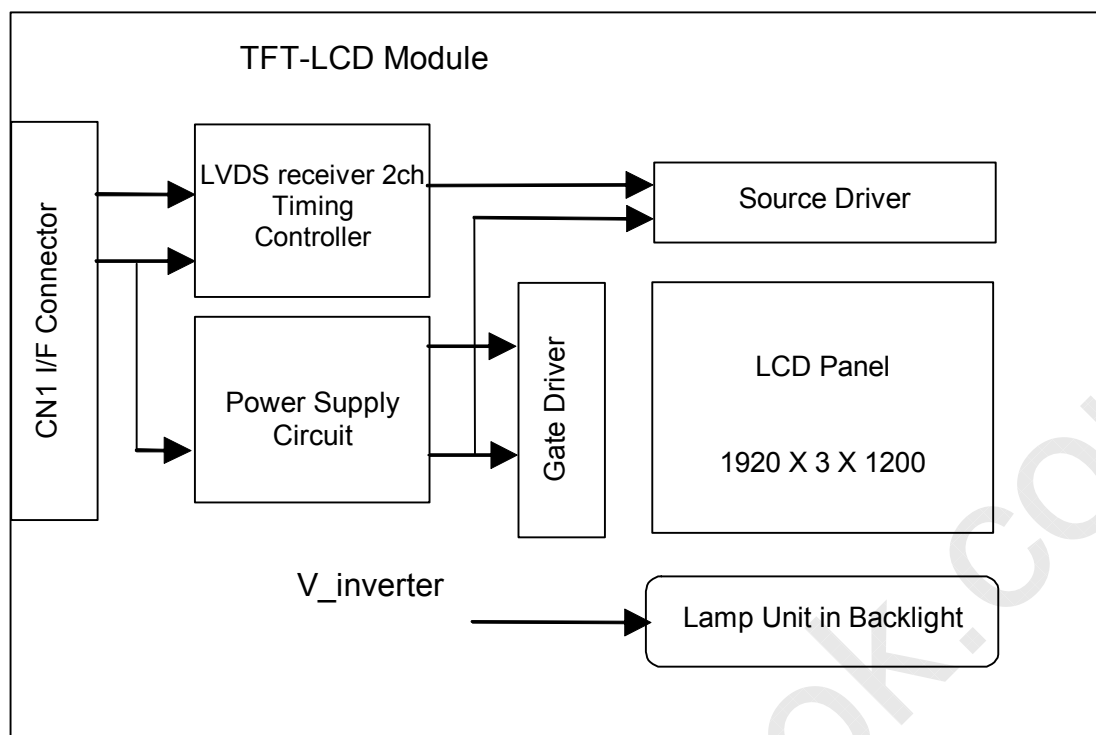
[Note]

- 1) Definition of gray scale: Color (n): n indicates gray scale level.  
Higher n means brighter level.
- 2) Data: 1-High, 0-Low.
- 3) This assignment is applied to both odd and even data.

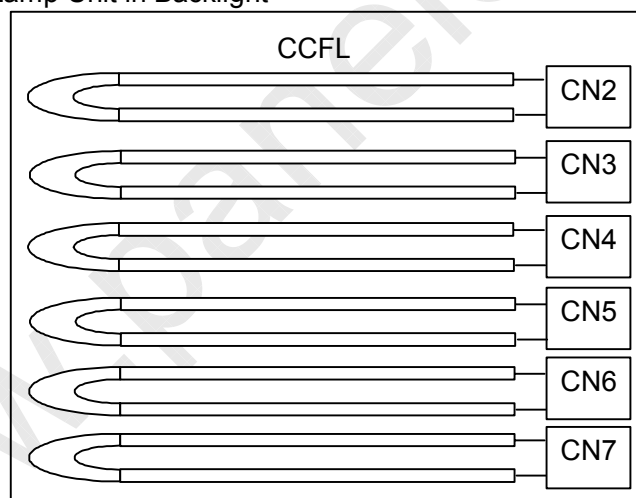
(5) Color Data Assignment

|           |            |    |            |    |              |              |
|-----------|------------|----|------------|----|--------------|--------------|
| D(1,1)    | D(2,1)     | -- | D(X,1)     | -- | D(1919,1)    | D(1920,1)    |
| D(1,2)    | D(2,2)     | -- | D(X,2)     | -- | D(1919,2)    | D(1920,2)    |
|           |            | +  | ..         | +  |              |              |
| D(1,Y)    | D(2,Y)     | -- | D(X,Y)     | -- | D(1919,Y)    | D(1920,Y)    |
|           |            | +  | ..         | +  |              |              |
| D(1,1199) | D(2, 1199) | -- | D(X, 1199) | -- | D(1919,1199) | D(1920,1199) |
| D(1,1200) | D(2, 1200) | -- | D(X, 1200) | -- | D(1919,1200) | D(1920,1200) |

## 6. BLOCK DIAGRAM



Lamp Unit in Backlight

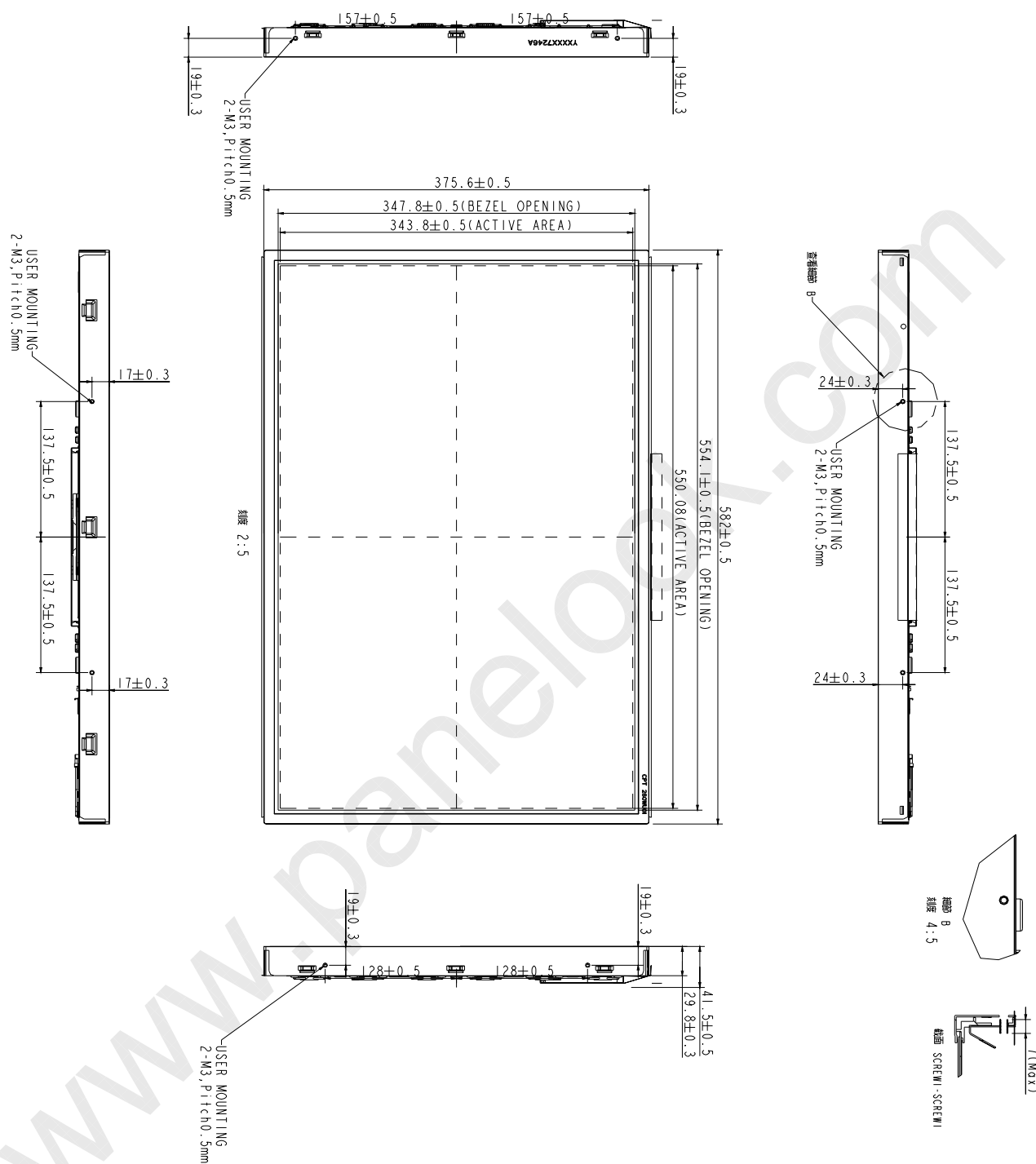


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## 7. MECHANICAL SPECIFICATION

(1) Front side (Tolerance is  $\pm 0.5\text{mm}$  unless noted)

Unit: mm

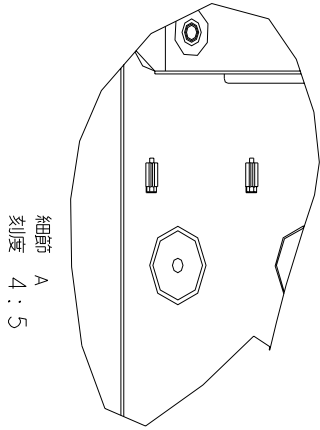
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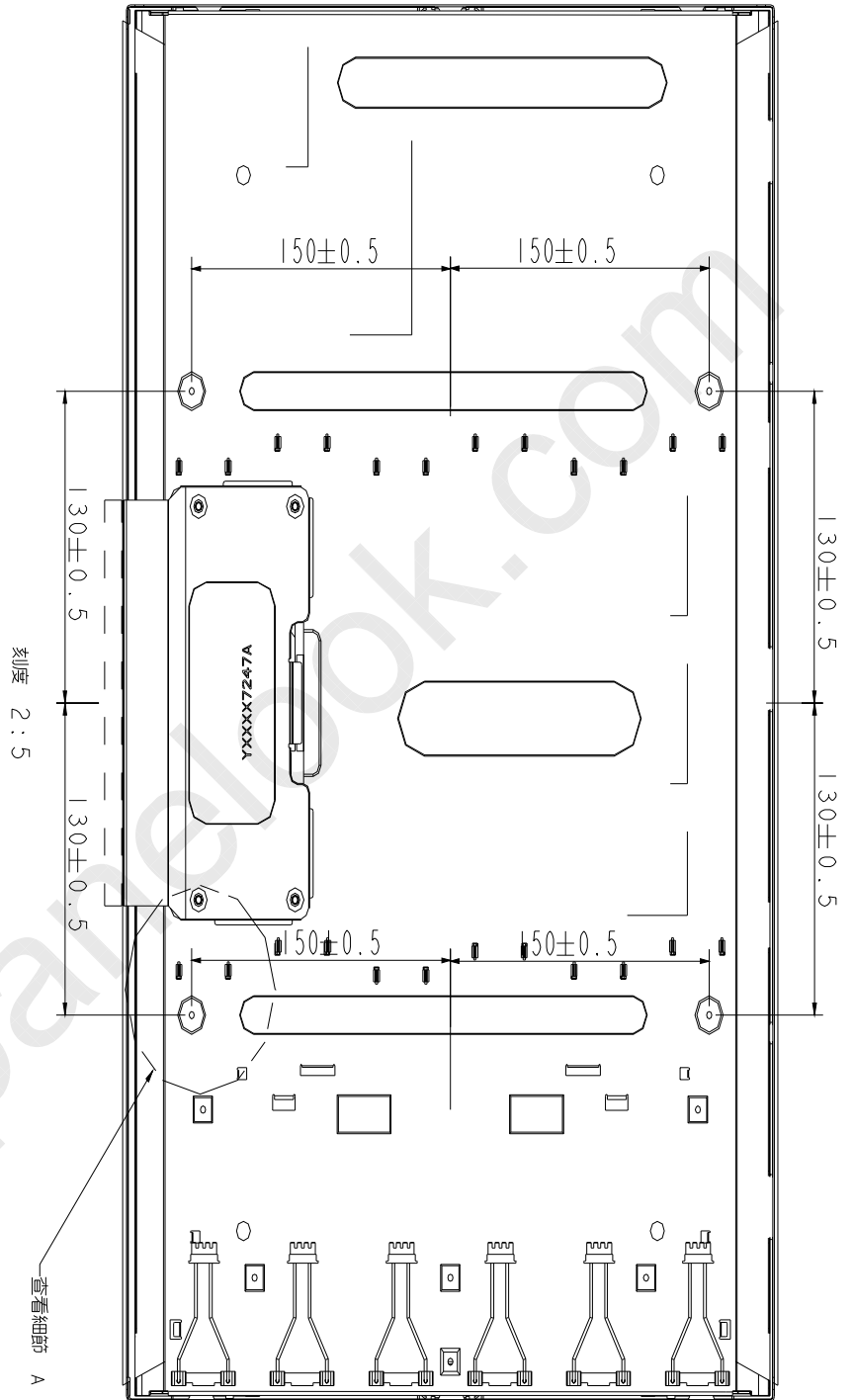
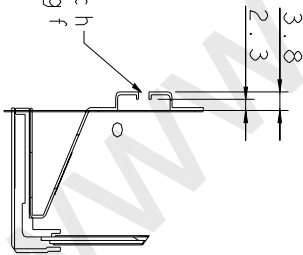
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(2) Rear side (Tolerance is ±0.5mm unless noted)

Unit: mm



M3 Machine Screw 0.5pitch  
Torque 3.0kgf~3.5kgf





## 8. OPTICAL CHARACTERISTICS

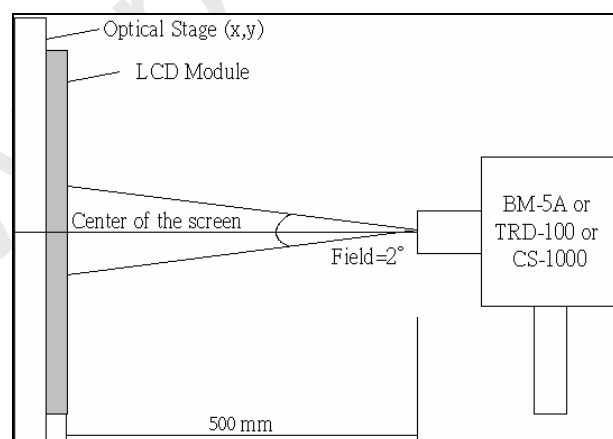
Ta=25°C , VCC=5.0V

| ITEM              | SYMBOL     | CONDITION                 | min                       | typ   | max   | UNIT              | REMARK            |     |
|-------------------|------------|---------------------------|---------------------------|-------|-------|-------------------|-------------------|-----|
| Contrast Ratio    | CR         | $\theta = \psi = 0^\circ$ | 700                       | 1000  | --    | --                | *1)               |     |
| Luminance(CEN)    | L          | $\theta = \psi = 0^\circ$ | 300                       | 400   | 450   | cd/m <sup>2</sup> | *2)               |     |
| 9P Uniformity     | $\Delta L$ | $\theta = \psi = 0^\circ$ | 75                        |       | --    | %                 | *2)               |     |
| Response Time     | Tr         | $\theta = \psi = 0^\circ$ | --                        | 5     | 10    | ms                | *4)               |     |
|                   | Tf         | $\theta = \psi = 0^\circ$ |                           |       |       |                   |                   |     |
| Crosstalk         | CT         | $\theta = \psi = 0^\circ$ | 0                         | --    | 1     | %                 | *5)               |     |
| Viewing Angle     | Horizontal | $\psi$                    | CR $\geq$ 10              | 140   | 160   | --                | °                 | *3) |
|                   | Vertical   | $\theta$                  |                           | 140   | 160   | --                | °                 |     |
| Color Coordinates | White      | X                         | $\theta = \psi = 0^\circ$ | 0.283 | 0.313 | 0.343             | Color Coordinates | *2) |
|                   |            | Y                         |                           | 0.299 | 0.329 | 0.359             |                   |     |
|                   | Red        | X                         |                           | 0.628 | 0.658 | 0.688             |                   |     |
|                   |            | Y                         |                           | 0.301 | 0.331 | 0.361             |                   |     |
| Green             | X          | 0.152                     | 0.182                     | 0.212 |       |                   |                   |     |
|                   | Y          | 0.678                     | 0.708                     | 0.738 |       |                   |                   |     |
| Blue              | X          | 0.118                     | 0.148                     | 0.178 |       |                   |                   |     |
|                   | Y          | 0.042                     | 0.072                     | 0.102 |       |                   |                   |     |
| Gamut             | CG         | $\theta = \psi = 0^\circ$ | 90                        | 100   | --    | %                 |                   |     |
| Gamma             | $\gamma$   | VESA                      | 2.0                       | 2.2   | 2.4   | --                | *6)               |     |

[Notes]

## Setup of Measurement Equipment

The LCD module should be turn-on to a stable luminance level to be reached. The measurement should be executed after lighting Backlight for 20 minutes and in a dark room.



All optical specification condition:

- (1) Equipment: BM-5A (TOPCON) under the dark room condition ( $2^\circ$  view angle) after more than 30 minutes turning on the lamp.

\*1).Definition of Contrast Ratio:

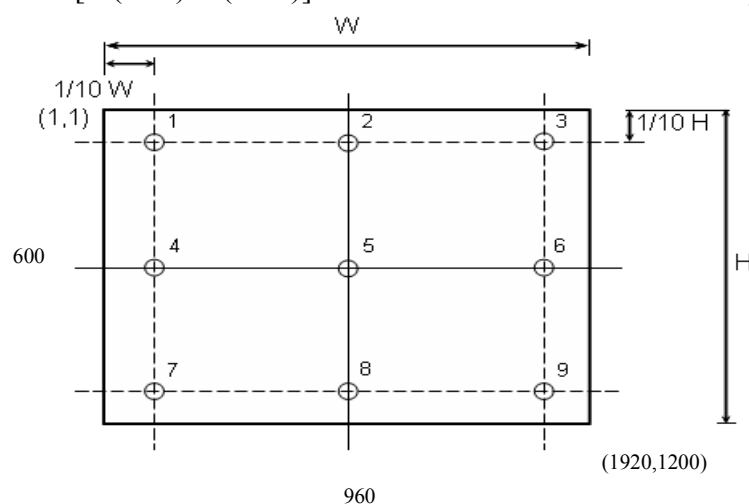
$$CR = \text{ON (White) Luminance} / \text{OFF (Black) Luminance}$$

\*2).Definition of Luminance and Luminance uniformity:

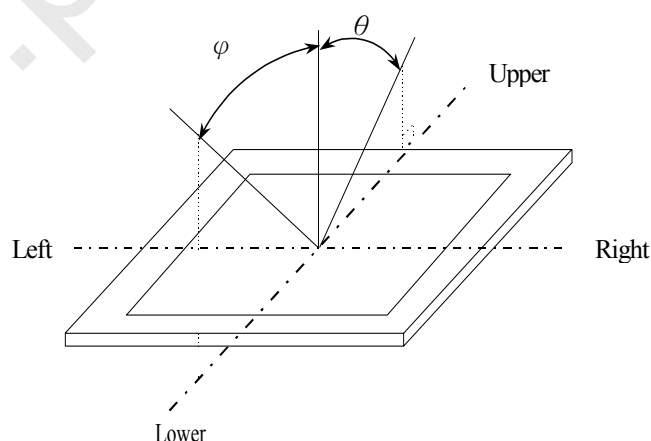
Center Luminance: measuring the luminance of the point no. 5

Average Luminance: measuring average luminance of points no.1-no.9

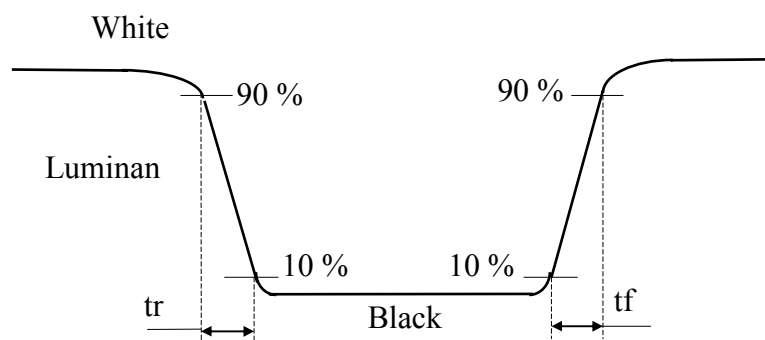
$$\text{Uniformity: } \Delta L = [L(\text{Min}) / L(\text{Max})] \times 100 \%$$



\*3).Definition of Viewing Angle ( $\theta, \psi$ ):



## \*4) Definition of Response Time (Tr, Tf):

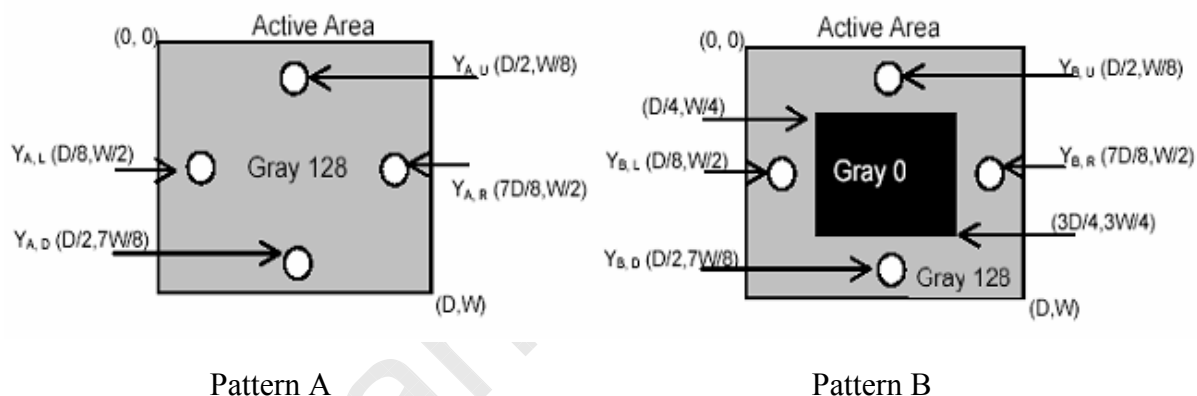
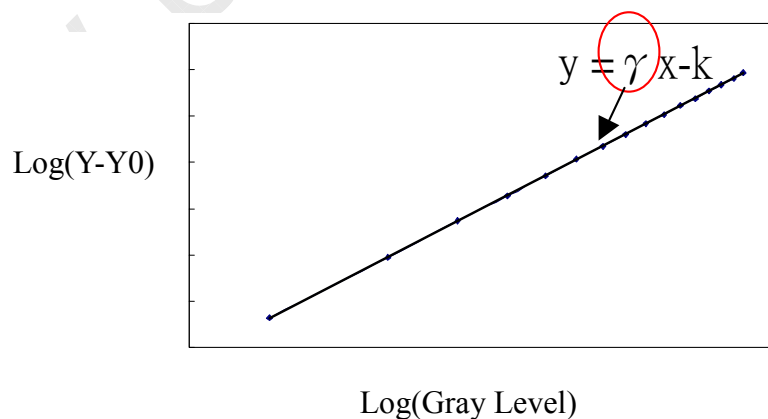


## \*5) Definition of crosstalk:

$$CT = |Y_B - Y_A| / Y_A \times 100 (\%)$$

$Y_A$ : The luminance of measured position at pattern A

$Y_B$ : The luminance of measured position at pattern B with Gray level

\*6) Definition of Gamma ( $\gamma$ ), follow VESA standard sampling every 16 gray level(0,16,32,...224,240,255)\*7) Definition of Response Time ( $T_{GtG\_AVE}$ ):

$T_{GtG\_AVE}$  is defined as the total average response time for “Gray to Gray”.

The Gray to Gray response time is defined as following chart.

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| Gray to Gray | Rising Time |    |    |    |     |     |     |     |     |  |
|--------------|-------------|----|----|----|-----|-----|-----|-----|-----|--|
|              | 0           | 32 | 64 | 96 | 128 | 159 | 191 | 223 | 255 |  |
| Falling Time | 0           |    |    |    |     |     |     |     |     |  |
|              | 32          |    |    |    |     |     |     |     |     |  |
|              | 64          |    |    |    |     |     |     |     |     |  |
|              | 96          |    |    |    |     |     |     |     |     |  |
|              | 128         |    |    |    |     |     |     |     |     |  |
|              | 159         |    |    |    |     |     |     |     |     |  |
|              | 191         |    |    |    |     |     |     |     |     |  |
|              | 223         |    |    |    |     |     |     |     |     |  |
|              | 255         |    |    |    |     |     |     |     |     |  |

## 9. RELIABILITY TEST CONDITIONS

### (1) Temperature and Humidity

| TEST ITEMS                                  | CONDITIONS                                    |
|---|---|
| HIGH TEMPERATURE<br>HIGH HUMIDITY OPERATION | 50°C ; 90%RH; 240h<br>(No condensation)       |
| HIGH TEMPERATURE<br>HIGH HUMIDITY STORAGE   | 60°C ; 90%RH;48h<br>(No condensation)         |
| HIGH TEMPERATURE OPERATION                  | 50°C ; 240h                                   |
| HIGH TEMPERATURE STORAGE                    | 60°C ; 240h                                   |
| LOW TEMPERATURE OPERATION                   | 0°C ; 240h                                    |
| LOW TEMPERATURE STORAGE                     | -20°C ; 240h                                  |
| THERMAL SHOCK                               | BETWEEN -20°C (1hr)AND 60°C (1hr); 100 CYCLES |

### (2) Shock & Vibration

| ITEMS                        | CONDITIONS   |
|------------------------------|--|
| SHOCK<br>(NON-OPERATION)     | Shock level:1470m/s <sup>2</sup> (150G)<br>Waveform: half sinusoidal wave, 2ms<br>Number of shocks: one shock input in each direction of three mutually perpendicular axes for a total of six shock inputs   |
| VIBRATION<br>(NON-OPERATION) | Vibration level: 9.8m/s <sup>2</sup> (1.0G) zero to peak<br>Waveform: sinusoidal<br>Frequency range: 5 to 500 Hz<br>Frequency sweep rate: 0.5 octave/min<br>Duration: one sweep from 5 to 500Hz in each of three mutually perpendicular axis(each x,y,z axis: 1 hour, total 3 hours) |

### (3) ESD

| POSITION  | CONDITION( MDL turn off)  |
|-----------|---|
| Connector | 1. 200 pF , 0 Ω , ±250 V<br>2. contact mode for each pin  |
| Module    | 1. 150 pF , 330 Ω , ±15K V<br>2. Air mode, test 25 times for each test point<br>3. Contact mode, 25 times for each test point |

## (4) Low Pressure test

| TEST ITEM                  | CONDITION                  |
|----------------------------|----------------------------|
| Low Pressure test(storage) | 260HPa (30000 ft.) ; 24 Hr |

## (5) Judgment standard

The judgment of the above test should be made as follow:

Pass: Normal display image with no obvious non-uniformity and no line defect. Partial transformation of the module parts should be ignored.

Fail: No display image, obvious non-uniformity, or line defects.

## 10. HANDLING PRECAUTIONS FOR TFT-LCD MODULE

Please pay attention to the followings in handling- TFT-LCD products;

### (1) ASSEMBLY PRECAUTION

- 1) Please use the mounting hole on the module side in installing and do not beading or wrenching LCD in assembling. And please do not drop, bend or twist LCD module in handling.
- 2) Please design display housing in accordance with the following guide lines.
  - a) Housing case must be destined carefully so as not to put stresses on LCD all sides and not to wrench module. The stresses may cause non-uniformity even if there is no non-uniformity statically.
  - b) Keep sufficient clearance between LCD module back surface and housing when the LCD module is mounted. Approximately 1.0 mm of the clearance in the design is recommended taking into account the tolerance of LCD module thickness and mounting structure height on the housing.
  - c) When some parts, such as, FPC cable and ferrite plate, are installed underneath the LCD module, still sufficient clearance is required, such as 0.5mm. This clearance is, especially, to be reconsidered when the additional parts are implemented for EMI countermeasure.
  - d) Design the inverter location and connector position carefully so as not to give stress to lamp cable, or not to interface the LCD module by the lamp cable.
  - e) Keep sufficient clearance between LCD module and the others parts, such as inverter and speaker so as not to interface the LCD module. Approximately 1.0mm of the clearance in the design is recommended.
- 3) Please do not push or scratch LCD panel surface with any-thing hard. And do not soil LCD panel surface by touching with bare hands. (Polarizer film, surface of LCD panel is easy to be flawed.)
- 4) Please do not press any parts on the rear side such as source TCP, gate TCP, control circuit board and FPCs during handling LCD module. If pressing rear part is unavoidable, handle the LCD module with care not to damage them.
- 5) Please wipe out LCD panel surface with absorbent cotton or soft cloth in case of it being soiled.
- 6) Please wipe out drops of adhesives like saliva and water on LCD panel surface immediately. They might damage to cause panel surface variation and color change.
- 7) Please do not take a LCD module to pieces and reconstruct it. Resolving and reconstructing modules may cause them not to work well.
- 8) Please do not touch metal frames with bare hands and soiled gloves. A color change of the metal frames can happen during a long preservation of soiled LCD modules.
- 9) Please pay attention to handling lead wire of backlight so that it is not tugged in connecting with inverter.

### (2) OPERATING PRECAUTIONS

- 1) Please be sure to turn off the power supply before connecting and disconnecting signal input cable.

- 2) Please do not change variable resistance settings in LCD module. They are adjusted to the most suitable value. If they are changed, it might happen LCD does not satisfy the characteristics specification.
- 3) Please consider that LCD backlight takes longer time to become stable of radiation characteristics in low temperature than in room temperature.
- 4) A condensation might happen on the surface and inside of LCD module in case of sudden change of ambient temperature.
- 5) Please pay attention to displaying the same pattern for very long time. Image might stick on LCD. If then, time going on can make LCD work well.
- 6) Please obey the same caution descriptions as ones that need to pay attention to ordinary electronic parts.

### (3) PRECAUTIONS WITH ELECTROSTATICS

- 1) This LCD module use CMOS-IC on circuit board and TFT-LCD panel, and so it is easy to be affected by electrostatics. Please be careful with electrostatics by the way of your body connecting to the ground and so on.
- 2) Please remove protection film very slowly on the surface of LCD module to prevent from electrostatics occurrence.

### (4) STORAGE PRECAUTIONS

- 1) When you store LCDs for a long time, it is recommended to keep the temperature between 0°C ~40°C without the exposure of sunlight and to keep the humidity less than 90%RH.
- 2) Please do not leave the LCDs in the environment of high humidity and high temperature such as 60°C 90%RH.
- 3) Please do not leave the LCDs in the environment of low temperature; below -20°C.

### (5) SAFETY PRECAUTIONS

- 1) When you waste LCDs, it is recommended to crush damaged or unnecessary LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.
- 2) If any liquid leaks out of a damaged-glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

### (6) OTHERS

- 1) A strong incident light into LCD panel might cause display characteristics' changing inferior because of polarizer film, color filter, and other materials becoming inferior. Please do not expose LCD module direct sunlight and strong UV rays.
- 2) Please pay attention to a panel side of LCD module not to contact with other materials in preserving it alone.
- 3) For the packaging box, please pay attention to the followings:
  - a) Packaging box and inner case for LCD are designed to protect the LCDs from the damage or scratching during transportation. Please do not open except picking LCDs up from the box.
  - b) Please do not pile them up more than 5 boxes. (They are not designed so.) And please do not turn over.

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- c) Please handle packaging box with care not to give them sudden shock and vibrations. And also please do not throw them up.
- d) Packing box and inner case for LCDs are made of cardboard. So please pay attention not to get them wet. (Such like keeping them in high humidity or wet place can occur getting them wet.)

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