

# HITACHI

KAOHSIUNG HITACHI ELECTRONICS CO., LTD.

FOR MESSRS: \_\_\_\_\_

DATE: Oct. 31<sup>th</sup> 2008

## CUSTOMER'S ACCEPTANCE SPECIFICATIONS

### TX16D11VM2CAC

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ACCEPTED BY: \_\_\_\_\_

PROPOSED BY: \_\_\_\_\_

*Dan Chung*

## 2. RECORD OF REVISION

| DATE | SHEET No. | SUMMARY |
|------|-----------|---------|
|      |           |         |

### 3. GENERAL DATA

#### 3.1 DISPLAY FEATURES

This module is a 6.2" HVGA of 8:3 format amorphous silicon TFT. The pixel format is vertical stripe and sub pixels are arranged as R(red), G(green), B(blue) sequentially. This display is RoHS compliant, and COG (chip on glass) technology and LED backlight are applied on this display.

|                         |   |
|-------------------------|---|
| Part Name               | TX16D11VM2CAC   |
| Module Dimensions       | 173.0(W) mm x 70.0(H) mm x (7.0)max (D) mm  |
| LCD Active Area         | 148.8(W) mm x 53.76(H) mm   |
| Dot Pitch               | 0.0775(W) mm x 3(R, G, B)(W) x 0.224(H) mm  |
| Resolution              | 640 x 3(RGB)(W) x 240(H) dots   |
| Color Pixel Arrangement | R, G, B Vertical stripe   |
| LCD Type                | Transmissive Color TFT; Normally White  |
| Display Type            | Active Matrix   |
| Number of Colors        | 262k Colors   |
| Backlight               | 7 LEDs parallel x 3 serial (21 LEDs in total)                                     |
| Weight                  | (110) g (typ.)  |
| Interface               | C-MOS; 18-bit RGB; 40 pins  |
| Power Supply Voltage    | 3.3V for LCD; 12V for Backlight   |
| Power Consumption       | 310.2 mW for LCD (HVGA) / 363 mW for LCD (VGA) ;<br>1.008W for backlight          |
| Viewing Direction       | 12 O'clock<br>(The direction without image inversion and least brightness change) |

## 4. ABSOLUTE MAXIMUM RATINGS

| Item                   |                 | Symbol | Min. | Max.    | Unit | Remarks |
|------------------------|-----------------|--------|------|---------|------|---------|
| Supply Voltage         |                 | VDD    | -0.3 | 4.0     | V    | -       |
| Input Voltage of Logic |                 | VI     | -0.2 | VDD+0.3 | V    | Note 1  |
| Operating Temperature  |                 | Top    | -20  | 70      | °C   | Note 2  |
| Storage Temperature    |                 | Tst    | -20  | 70      | °C   | Note 2  |
| LED Unit               | Forward Current | IF     | -    | 35      | mA   | Note 3  |
|                        | Reverse Voltage | VR     | -    | 5       | V    |         |

Note 1: The rating is defined for the signal voltages of the interface such as DTMG, DCLK and RGB data bus.

Note 2: The maximum rating is defined as above based on the temperature on the panel surface, which might be different from ambient temperature after assembling the panel into the application. Moreover, some temperature-related phenomenon as below needed to be noticed:

- Background color, contrast and response time would be different in temperatures other than 25°C.
- Operating under high temperature will shorten LED lifetime.

Note 3: Fig. 4.1 shows the maximum rating of LED forward current against temperature. The backlight unit in this display has been set to 12 mA per LED. This is within the range when operating the display between -20~70°C.

For the dimming function, reducing the LED backlight voltage 12V to the expected brightness is recommended. Alternatively, using PWM signal with 10KHz and 12V amplitude to dim by adjusting the duty ratio.

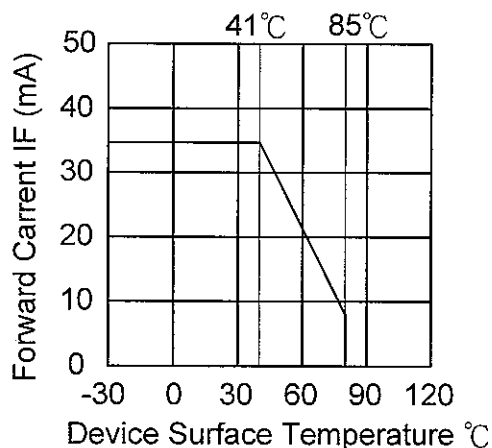


Fig. 4.1

## 5. ELECTRICAL CHARACTERISTICS

### 5.1 LCD CHARACTERISTICS

$T_a = 25^\circ\text{C}$ ,  $V_{SS} = 0\text{V}$

| Item                   | Symbol             | Condition        | Min. | Typ. | Max. | Unit | Remarks |
|------------------------|--------------------|------------------|------|------|------|------|---------|
| Power Supply Voltage   | VDD                | -                | 3.0  | 3.3  | 3.6  | V    | -       |
| Input Voltage of Logic | VI                 | "H" level        | 2.0  | -    | VDD  | V    | Note 1  |
|                        |                    | "L" level        | VSS  | -    | 0.8  |      |         |
| Power Supply Current   | IDD for HVGA       | VDD-VSS<br>=3.3V | -    | 94   | -    | mA   | Note 2  |
|                        | IDD for VGA        |                  | -    | 110  | -    |      |         |
| Vsync Frequency        | $f_v$              | -                | 52   | 60   | 68   | Hz   | -       |
| Hsync Frequency        | $f_H$ for HVGA     | -                | 12.8 | 15.1 | 36.1 | KHz  | -       |
|                        | $f_H$ for VGA      | -                | 25.3 | 29.5 | 36.1 |      |         |
| DCLK Frequency         | $f_{CLK}$ for HVGA | -                | 8.7  | 10.7 | 26.7 | MHz  | -       |
|                        | $f_{CLK}$ for VGA  | -                | 17.2 | 20.9 | 26.7 |      |         |

Note 1: The rating is defined for the signal voltages of the interface such as DTMG, DCLK and RGB data bus.

Note 2: An all black check pattern is used when measuring IDD,  $f_v$  is set to 60 Hz.

### 5.2 BACKLIGHT CHARACTERISTICS

$T_a = 25^\circ\text{C}$

| Item                | Symbol | Condition      | Min.   | Typ.   | Max.   | Unit | Remarks |
|---------------------|--------|----------------|--------|--------|--------|------|---------|
| LED Input Voltage   | VLED   | Backlight Unit | (11.5) | (12.0) | (12.5) | V    | Note1   |
| LED Forward Current | ILED   | Backlight Unit | -      | 84     | 95     | mA   | -       |
| LED Lifetime        | -      | 84 mA          | -      | 40K    | -      | hrs  | Note 2  |

Note 1: Fig. 5.1 shows the LED backlight circuit. The circuit has 21 LEDs in total and R is  $280\Omega$ .

Note 2: The estimated lifetime is specified as the time to reduce 50% brightness by applying 84 mA at  $25^\circ\text{C}$ .

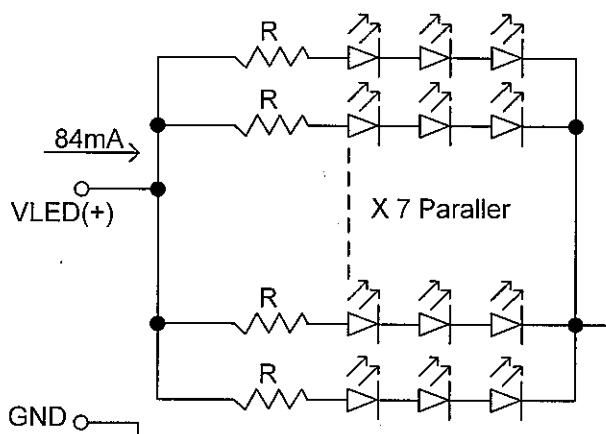


Fig. 5.1

## 6. OPTICAL CHARACTERISTICS

The optical characteristics are measured based on the conditions as below:

- Supplying the signals and voltages defined in the section of electrical characteristics.
- The backlight unit needs to be turned on for 30 minutes.
- The ambient temperature is 25°C.
- In the dark room around 500~1000 lx, the equipment has been set for the measurements as shown in Fig 6.1.

$T_a = 25^\circ\text{C}$ ,  $f_v = 60\text{ Hz}$ ,  $V_{DD} = 3.3\text{V}$

| Item                  | Symbol        | Condition   | Min. | Typ.   | Max. | Unit              | Remarks |
|-----------------------|---------------|---|------|--------|------|-------------------|---------|
| Brightness of White   | -             | $\phi = 0^\circ, \theta = 0^\circ$ ,<br>ILED= 84 mA | -    | 350    | -    | cd/m <sup>2</sup> | Note 1  |
| Brightness Uniformity | -             |   | 75   | -      | -    | %                 | Note 2  |
| Contrast Ratio        | CR            |   | 100  | 200    | -    | -                 | Note 3  |
| Response Time         | Rise + Fall   | $\phi = 0^\circ, \theta = 0^\circ$                  | -    | (45)   | -    | ms                | Note 4  |
| NTSC Ratio            | -             | $\phi = 0^\circ, \theta = 0^\circ$                  | -    | (60)   | -    | %                 | -       |
| Viewing Angle         | $\theta_x$    | $\phi = 0^\circ, \text{CR} \geq 5$                  | -    | 70     | -    | Degree            | Note 5  |
|                       | $\theta_{x'}$ | $\phi = 180^\circ, \text{CR} \geq 5$                | -    | 70     | -    |                   |         |
|                       | $\theta_y$    | $\phi = 90^\circ, \text{CR} \geq 5$                 | -    | 60     | -    |                   |         |
|                       | $\theta_{y'}$ | $\phi = 270^\circ, \text{CR} \geq 5$                | -    | 70     | -    |                   |         |
| Color Chromaticity    | Red           | X   | -    | (0.61) | -    | -                 | Note 6  |
|                       |               | Y   | -    | (0.37) | -    |                   |         |
|                       | Green         | X   | -    | (0.32) | -    |                   |         |
|                       |               | Y   | -    | (0.59) | -    |                   |         |
|                       | Blue          | X   | -    | (0.15) | -    |                   |         |
|                       |               | Y   | -    | (0.08) | -    |                   |         |
|                       | White         | X   | -    | (0.34) | -    |                   |         |
|                       |               | Y   | -    | (0.35) | -    |                   |         |

Note 1: The brightness is measured from 9 point average value of the panel, P5 in Fig. 6.2, for the typical value.

Note 2: The brightness uniformity is calculated by the equation as below:

$$\text{Brightness uniformity} = \frac{\text{Min. Brightness}}{\text{Max. Brightness}} \times 100\%$$

, which is based on the brightness values of the 9 points measured by BM-5 as shown in Fig. 6.2.

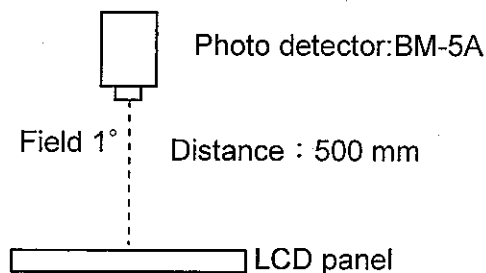


Fig. 6.1

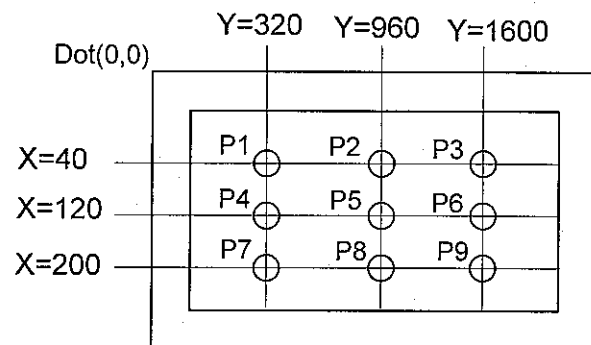


Fig. 6.2

Note 3: The Contrast ratio is measured from the center point of the panel, P5, and defined as the following equation:

$$CR = \frac{\text{Brightness of White}}{\text{Brightness of Black}} \times 100\%$$

Note 4: The definition of response time is shown in Fig. 6.3. The rising time is the period from 90% brightness to 10% brightness when the data is from white to black. Oppositely, Falling time is the period from 10% brightness rising to 90% brightness.

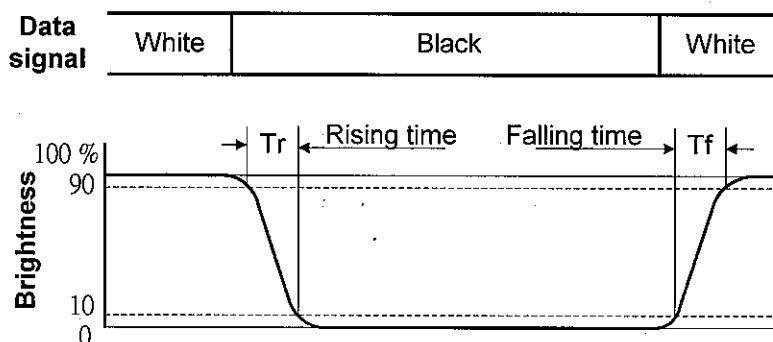


Fig. 6.3

Note 5: The definition of viewing angle is shown in Fig. 6.4. Angle  $\phi$  is used to represent viewing directions, for instance,  $\phi = 270^\circ$  means 6 o'clock, and  $\phi = 0^\circ$  means 3 o'clock. Moreover, angle  $\theta$  is used to represent viewing angles from axis Z toward plane XY.

The viewing direction of this display is 12 o'clock, which means that a photograph with gray scale would not be reversed in color and the brightness change would be less from this direction. However, the best contrast peak would be located at 6 o'clock.

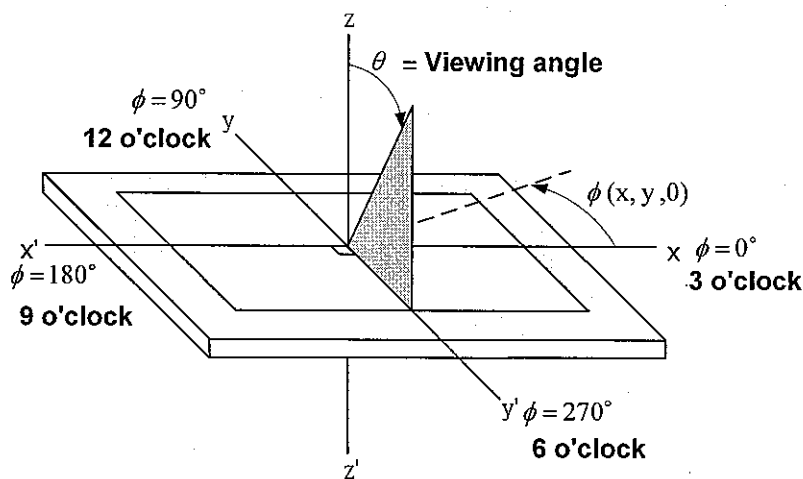
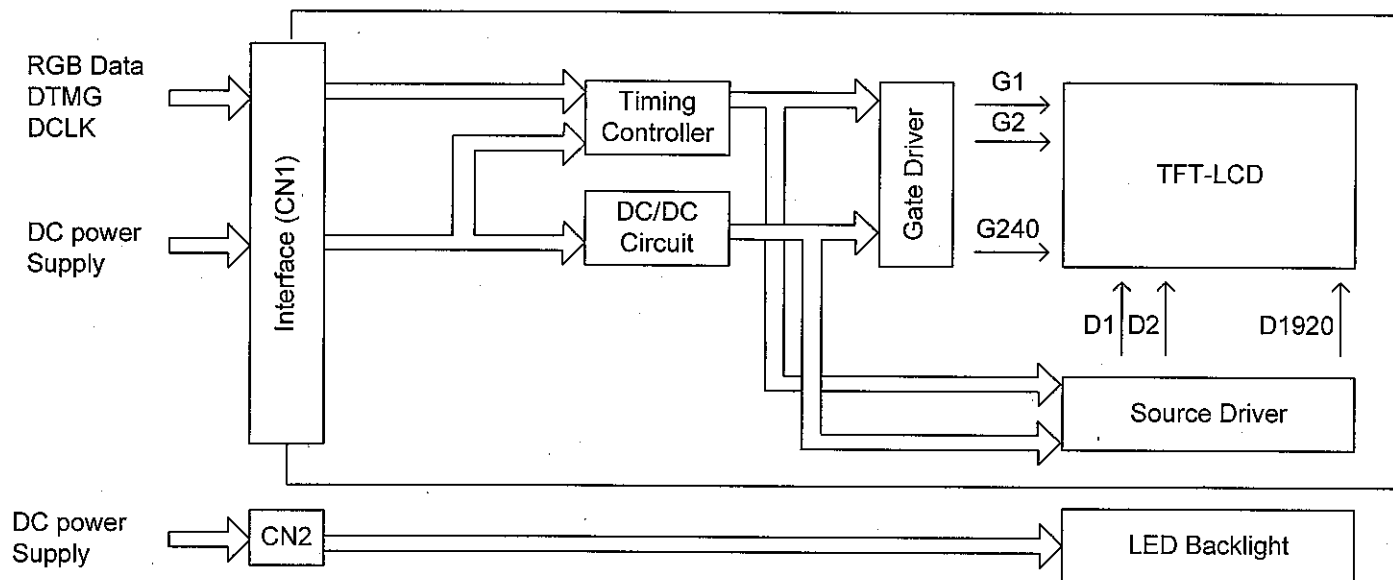


Fig. 6.4

Note 6: The color chromaticity is measured from the center point of the panel, P5, as shown in Fig. 6.2.

# 7 BLOCK DIAGRAM



## 8. RELIABILITY TESTS

| Test Item                   | Condition   |  |
|-----------------------------|---|--|
| High Temperature            | 1) Operating<br>2) 70°C   | 240 hrs  |
| Low Temperature             | 1) Operating<br>2) -20°C  | 240 hrs  |
| High Temperature            | 1) Storage<br>2) 70°C   | 240 hrs  |
| Low Temperature             | 1) Storage<br>2) -20°C  | 240 hrs  |
| Heat Cycle                  | 1) Operating<br>2) -20°C ~ 70°C<br>3) 3hrs~1hr~3hrs   | 240 hrs  |
| Thermal Shock               | 1) Non-Operating<br>2) -35°C ↔ 85°C<br>3) 0.5 hr ↔ 0.5 hr   | 240 hrs  |
| High Temperature & Humidity | 1) Operating<br>2) 40°C & 85%RH<br>3) Without condensation<br>4) Note 3   | 240 hrs  |
| Vibration                   | 1) Non-Operating<br>2) 20~200 Hz<br>3) 2G<br>4) X, Y, and Z directions  | 1 hr for each direction  |
| Mechanical Shock            | 1) Non-Operating<br>2) 10 ms<br>3) 50G<br>4) ±X, ±Y and ±Z directions   | Once for each direction  |
| ESD                         | 1) Operating<br>2) Tip: 200 pF, 250 Ω<br>3) Air discharge for glass: ± 8KV<br>4) Contact discharge for metal frame: ± 8KV<br>5) Contact discharge for LCD interface: ± 100V | 1) Glass: 9 points<br>2) Metal frame: 8 points<br>3) Connector: all pins |

Note 1: Display functionalities are inspected under the conditions defined in the specification after the reliability tests.

Note 2: The display is not guaranteed for use in corrosive gas environments.

Note 3: Under the condition of high temperature & humidity, if the temperature is higher than 40°C, the humidity needs to be reduced as Fig. 7.1 shown.

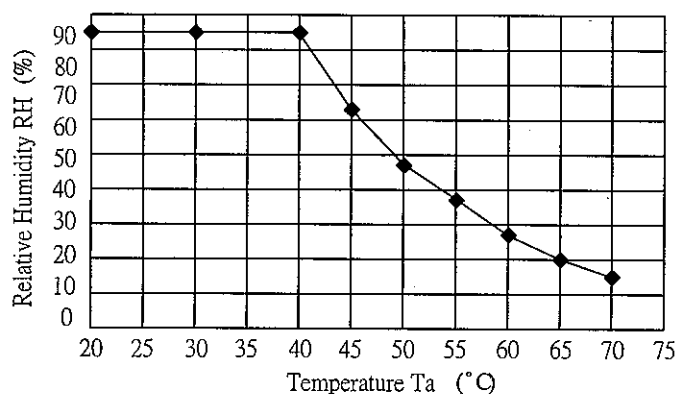


Fig. 7.1

## 9. LCD INTERFACE

### 9.1 INTERFACE PIN CONNECTIONS

The display interface connector is FA5B040HP1R3000 made by JAE (Thickness:  $0.3 \pm 0.05\text{mm}$ ; Pitch:  $0.5 \pm 0.05\text{mm}$ ) and more details of the connector are shown in the section of outline dimension.

Pin assignment of LCD interface is as below:

| Pin No. | Signal | Function               | Pin No. | Signal | Function                          |
|---------|--------|------------------------|---------|--------|-----------------------------------|
| 1       | VDD    | Power Supply for Logic | 21      | G4     | Green Data                        |
| 2       | VDD    |                        | 22      | G3     |                                   |
| 3       | VDD    |                        | 23      | VSS    | GND                               |
| 4       | VDD    |                        | 24      | G2     | Green Data                        |
| 5       | NC     | No Connection          | 25      | G1     |                                   |
| 6       | DTMG   | Timing Signal for Data | 26      | G0     |                                   |
| 7       | VSS    | GND                    | 27      | VSS    | GND                               |
| 8       | DCLK   | Dot Clock              | 28      | R5     | Red Data                          |
| 9       | VSS    | GND                    | 29      | R4     |                                   |
| 10      | NC     | No Connection          | 30      | R3     |                                   |
| 11      | VSS    | GND                    | 31      | VSS    | GND                               |
| 12      | B5     | Blue Data              | 32      | R2     | Red Data                          |
| 13      | B4     |                        | 33      | R1     |                                   |
| 14      | B3     |                        | 34      | R0     |                                   |
| 15      | VSS    | GND                    | 35      | Vcom   | Common Voltage (Generated by LCM) |
| 16      | B2     | Blue Data              | 36      | VSS    | GND                               |
| 17      | B1     |                        | 37      | NC     | No Connection                     |
| 18      | B0     |                        | 38      | NC     | No Connection                     |
| 19      | VSS    | GND                    | 39      | NC     | No Connection                     |
| 20      | G5     | Green Data             | 40      | NC     | No Connection                     |

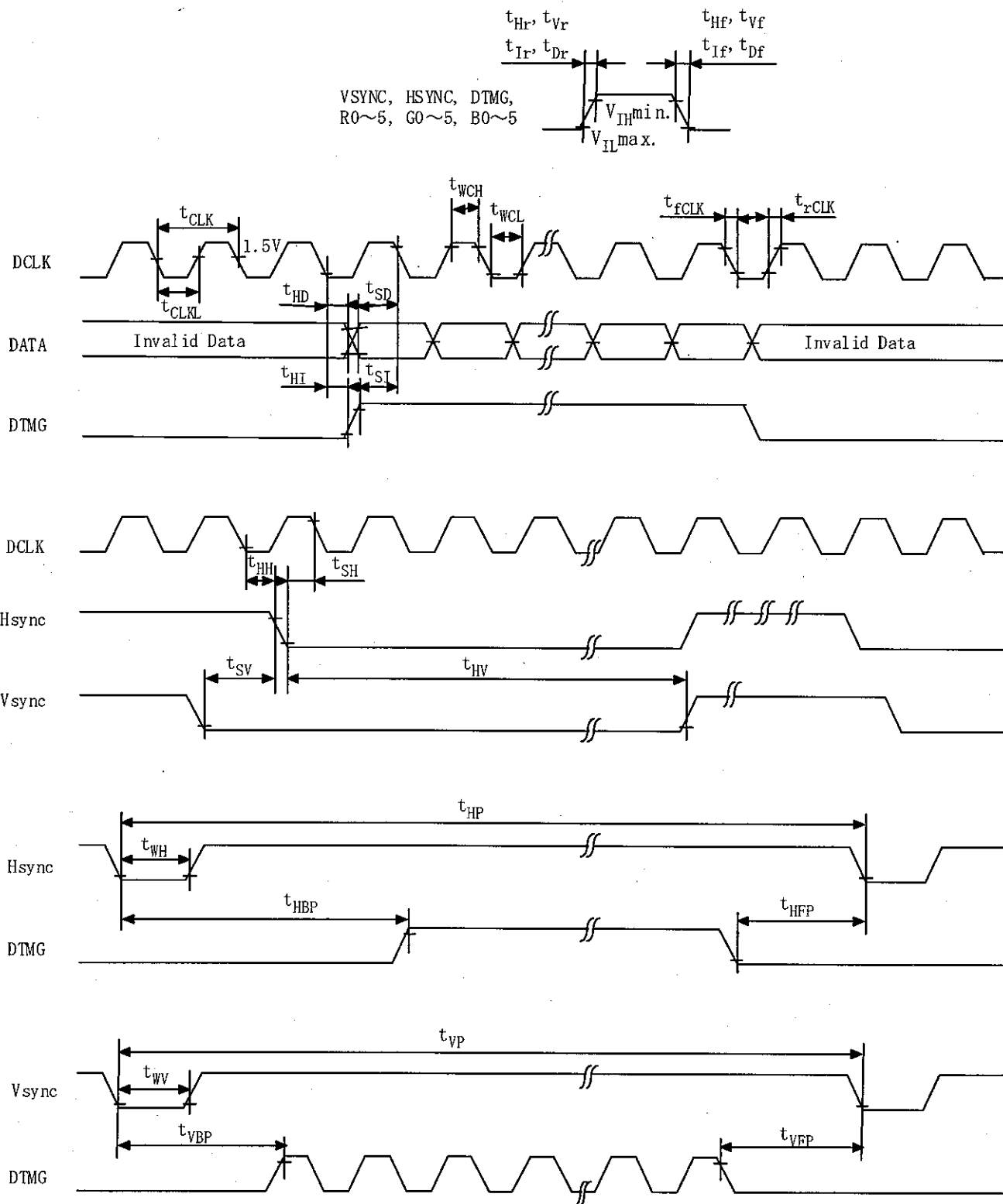
Note 1: Keep open electrically , Hitachi test use only.

The backlight interface connector is BHR-03VS-1 made by JST, and pin assignment of backlight is as below:

| Pin No. | Signal                        | Level | Function             |
|---------|-------------------------------|-------|----------------------|
| 1       | V <sub>LED</sub> <sup>+</sup> | -     | Power Supply for LED |
| 2       | NC                            | -     | No connection        |
| 3       | V <sub>LED</sub> <sup>-</sup> | -     | GND                  |

## 9.2 TIMING CHART

DTMG (Data Enable) is the signal to determine valid data, and the timing of DTMG can be determined from Hsync and Vsync as below. For this display, only DTMG and DCLK are the essential signals. Hsync and Vsync are not necessary to connect to display interface after DTMG has been generated and input.



Data is latched by falling edge triggered DCLK

## 9.3 INTERFACE TIMING SPECIFICATIONS

### 9.3.1 INTERFACE TIMING FOR HVGA DISPLAY MODE

|       | Item                   | Symbol           | Min. | Typ.  | Max.  | Unit |
|-------|------------------------|------------------|------|-------|-------|------|
| DCLK  | Cycle time             | $t_{CLK}$        | 37.5 | (94)  | 114.9 | ns   |
|       | Low level Width        | $t_{WCL}$        | 15   | -     | -     |      |
|       | High level Width       | $t_{WCH}$        | 15   | -     | -     |      |
|       | Rise time              | $t_{rCLK}$       | -    | -     | 25    |      |
|       | Fall time              | $t_{fCLK}$       | -    | -     | 25    |      |
|       | Duty                   | D                | 0.45 | 0.5   | 0.55  | -    |
| Hsync | Set up time            | $t_{SH}$         | 5    | -     | -     | ns   |
|       | Hold time              | $t_{HH}$         | 10   | -     | -     |      |
|       | Cycle                  | $t_{HP}$         | 679  | (709) | 739   | tCLK |
|       | Valid width            | $t_{WH}$         | 4    | 5     | 5     |      |
|       | Rise/Fall time         | $t_{Hr}, t_{Hf}$ | -    | -     | 30    | ns   |
| Vsync | Set up                 | $t_{SV}$         | 0    | -     | -     | tCLK |
|       | Hold                   | $t_{HV}$         | 2    | -     | -     |      |
|       | Cycle                  | $t_{VP}$         | 245  | (251) | 533   | tHP  |
|       | Valid width            | $t_{WV}$         | 2    | 2     | 2     |      |
|       | Rise/Fall time         | $t_{Vr}, t_{Vf}$ | -    | -     | 50    | ns   |
| DTMG  | Set up time            | $t_{SI}$         | 5    | -     | -     | ns   |
|       | Hold time              | $t_{HI}$         | 10   | -     | -     |      |
|       | Rise/Fall time         | $t_{Ir}, t_{If}$ | -    | -     | 30    | ns   |
|       | Horizontal back porch  | $t_{HBP}$        | 24   | (37)  | 50    | tCLK |
|       | Horizontal front porch | $t_{HFP}$        | 15   | (32)  | 49    |      |
|       | Vertical back porch    | $t_{VBP}$        | 4    | (7)   | 28    | tHP  |
|       | Vertical front porch   | $t_{VFP}$        | 1    | (4)   | 25    |      |
| Data  | Set up time            | $t_{SD}$         | 5    | -     | -     | ns   |
|       | Hold time              | $t_{HD}$         | 10   | -     | -     |      |
|       | Rise/Fall time         | $t_{Dr}, t_{Df}$ | -    | -     | 25    | ns   |

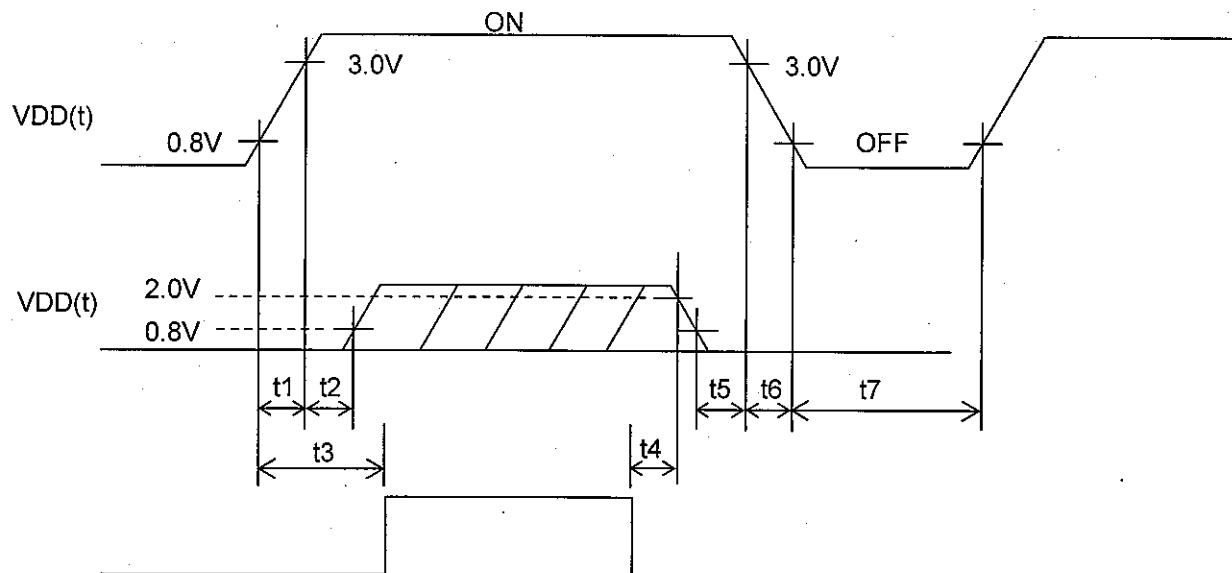
Note 1: Vsync needs to be set as odd numbers.

### 9.3.2 INTERFACE TIMING FOR VGA DISPLAY MODE

| Item  |                        | Symbol           | Min. | Typ.   | Max. | Unit |
|-------|------------------------|------------------|------|--------|------|------|
| DCLK  | Cycle time             | $t_{CLK}$        | 37.4 | (47:8) | 58.1 | ns   |
|       | Low level Width        | $t_{WCL}$        | 15   | -      | -    |      |
|       | High level Width       | $t_{WCH}$        | 15   | -      | -    |      |
|       | Rise time              | $t_{rCLK}$       | -    | -      | 25   |      |
|       | Fall time              | $t_{fCLK}$       | -    | -      | 25   |      |
|       | Duty                   | D                | 0.45 | 0.5    | 0.55 | -    |
| Hsync | Set up time            | $t_{SH}$         | 5    | -      | -    | ns   |
|       | Hold time              | $t_{HH}$         | 10   | -      | -    |      |
|       | Cycle                  | $t_{HP}$         | 679  | (709)  | 739  | tCLK |
|       | Valid width            | $t_{WH}$         | 4    | 5      | 5    |      |
|       | Rise/Fall time         | $t_{Hr}, t_{Hf}$ | -    | -      | 30   | ns   |
| Vsync | Set up                 | $t_{SV}$         | 0    | -      | -    | tCLK |
|       | Hold                   | $t_{HV}$         | 2    | -      | -    |      |
|       | Cycle                  | $t_{VP}$         | 485  | (491)  | 533  | tHP  |
|       | Valid width            | $t_{VV}$         | 2    | 2      | 2    |      |
|       | Rise/Fall time         | $t_{Vr}, t_{Vf}$ | -    | -      | 50   | ns   |
| DTMG  | Set up time            | $t_{SI}$         | 5    | -      | -    | ns   |
|       | Hold time              | $t_{HI}$         | 10   | -      | -    |      |
|       | Rise/Fall time         | $t_{Ir}, t_{If}$ | -    | -      | 30   | ns   |
|       | Horizontal back porch  | $t_{HBP}$        | 24   | (37)   | 50   | tCLK |
|       | Horizontal front porch | $t_{HFP}$        | 15   | (32)   | 49   |      |
|       | Vertical back porch    | $t_{VBP}$        | 4    | (7)    | 28   | tHP  |
|       | Vertical front porch   | $t_{VFP}$        | 1    | (4)    | 25   |      |
| Data  | Set up time            | $t_{SD}$         | 5    | -      | -    | ns   |
|       | Hold time              | $t_{HD}$         | 10   | -      | -    |      |
|       | Rise/Fall time         | $t_{Dr}, t_{Df}$ | -    | -      | 25   | ns   |

Note 1: Vsync needs to be set as odd numbers.

## 9.4 POWER SEQUENCE



### POWER ON

$$\begin{aligned} t1 &\leq 15\text{ms} \\ 0\text{ms} < t2 &\leq 45\text{ms} \\ 0.1\text{s} &\leq t3 \end{aligned}$$

### POWER OFF

$$\begin{aligned} 5\text{ms} &\leq t4 \\ 0\text{ms} < t5 &\leq 45\text{ms} \\ 0\text{ms} < t6 &\leq 20\text{ms} \\ 0.4\text{s} &\leq t7 \end{aligned}$$

Note 1 :  $0\text{V} \leq V_I(t) \leq V_{DD}(t)$

$V_I(t)$  and  $V_{DD}(t)$  is a surfeit of condition for power on/off.

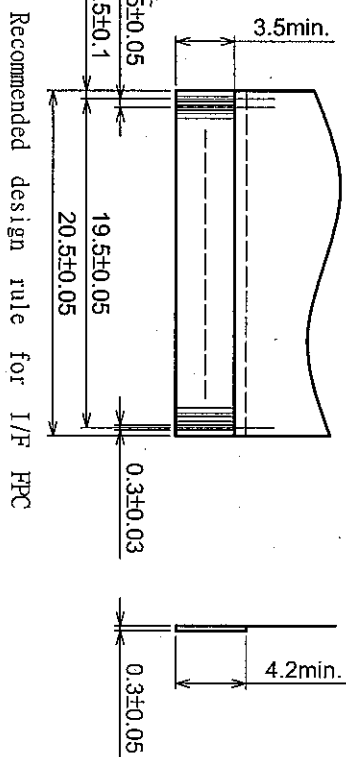
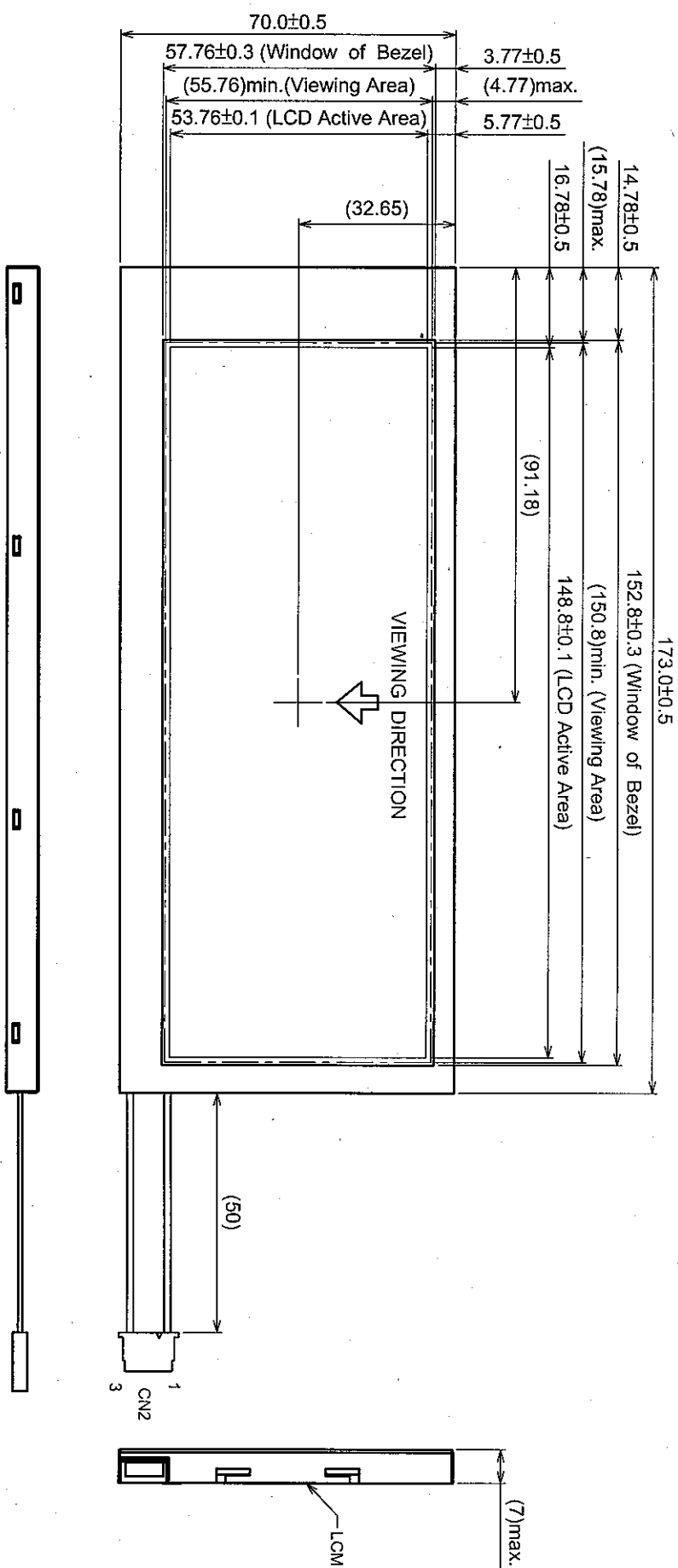
Note 2 : Input Voltage(Signal) should not be set high impedance when power on.

## 9.5 DATA INPUT for DISPLAY COLOR

|                | COLOR &<br>Gray Scale | Data Signal |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|----------------|-----------------------|-------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                |                       | R5          | R4 | R3 | R2 | R1 | R0 | G5 | G4 | G3 | G2 | G1 | G0 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic<br>Color | Black                 | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                | Red (0)               | 1           | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                | Green (0)             | 0           | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  |
|                | Blue (0)              | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  |
|                | Cyan                  | 0           | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
|                | Magenta               | 1           | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  |
|                | Yellow                | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  |
|                | White                 | 1           | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
| Red            | Black                 | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                | Red (62)              | 0           | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                | Red (61)              | 0           | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                | :                     | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  |
|                | :                     | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  |
|                | Red (1)               | 1           | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                | Red (0)               | 1           | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                | Black                 | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| Green          | Green (62)            | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  |
|                | Green (61)            | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                | :                     | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  |
|                | :                     | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  |
|                | Green (1)             | 0           | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                | Green (0)             | 0           | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  |
|                | Black                 | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                | Blue (62)             | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  |
| Blue           | Blue (61)             | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  |
|                | :                     | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  |
|                | :                     | :           | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  | :  |
|                | Blue (1)              | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 0  |
|                | Blue (0)              | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  |
|                | Black                 | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                | Red (62)              | 0           | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                | Red (61)              | 0           | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |

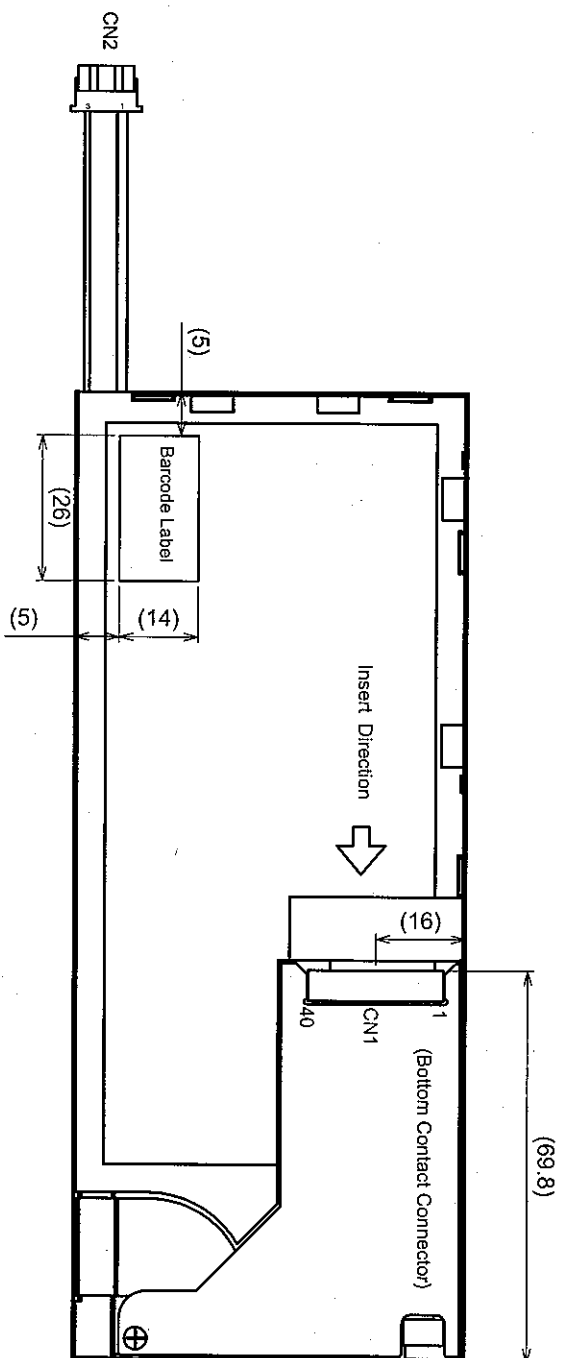
# 10. OUTLINE DIMENSIONS

## 10.1 SURFACE SIDE



Recommended design rule for I/F FPC

Scale : NTS  
Unit : mm



Scale : NTS  
Unit : mm

## 11. APPEARANCE STANDARD

The appearance inspection is performed in a dark room around 2000 lx based on the conditions as below:

- The distance between inspector's eyes and display is 30 cm.
- The viewing zone is defined with angle  $\theta$  shown in Fig. 11-1. The inspection should be performed within  $45^\circ$  when display is shut down. The inspection should be performed within  $5^\circ$  when display is power on.

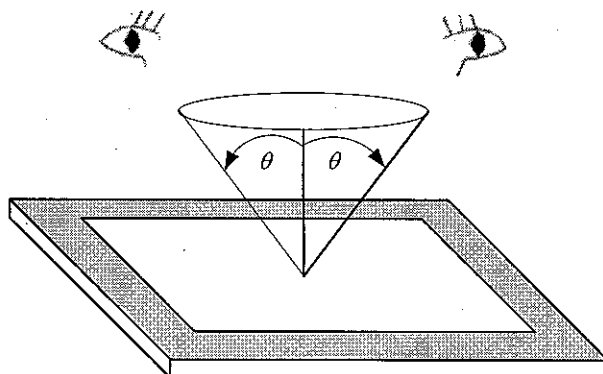


Fig. 11.1

### 11.1 THE DEFINITION OF LCD ZONE

LCD panel is divided into 3 areas as shown in Fig.11.2 for appearance specification in next section. A zone is the LCD active area (dot area); B zone is the area, which extended 1 mm out from LCD active area; C zone is the area between B zone and metal frame.

In terms of housing design, B zone is the recommended window area customers' housing should be located in.

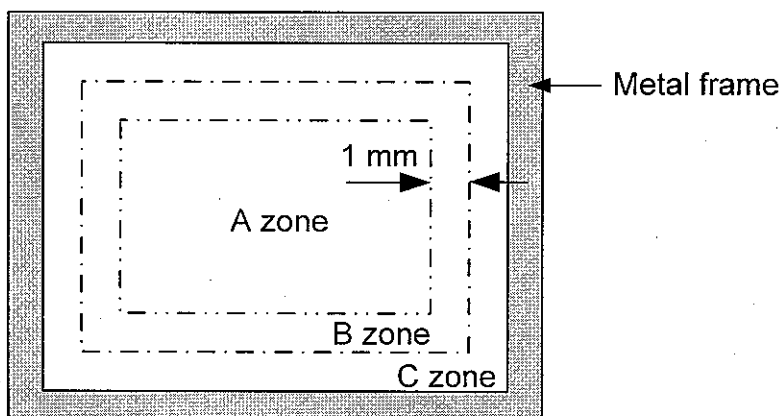


Fig. 11.2

## 11.2 LCD APPEARANCE SPECIFICATION

The specification as below is defined as the amount of unexpected phenomenon or material in different zones of LCD panel. The definitions of length, width and average diameter using in the table are shown in Fig. 11.3 and Fig. 11.4.

| Item  | Criteria  |                        |                |               | Applied zone |
|---|---|------------------------|----------------|---------------|--------------|
| Scratches   | Length (mm)   | Width (mm)             | Maximum number | Minimum space | A,B          |
|   | Ignored   | $W \leq 0.02$          | Ignored        | -             |              |
|   | $L \leq 40$   | $0.02 < W \leq 0.04$   | 10             | -             |              |
|   | $L \leq 20$   | $W \leq 0.04$          | 10             | -             |              |
| Dent  | Distinguished one is acceptable<br>(To be judged by HITACHI standard) |                        |                |               | A            |
| Wrinkles in polarizer                             | Same as above   |                        |                |               | A            |
| Bubbles on polarizer                              | Average diameter (mm)   |                        | Maximum number |               | A            |
|   | $D \leq 0.2$  |                        | Ignored        |               |              |
|   | $0.2 < D \leq 0.3$  |                        | 12             |               |              |
|   | $0.3 < D \leq 0.5$  |                        | 3              |               |              |
|   | $0.5 < D$   |                        | none           |               |              |
| 1) Stains<br>2) Foreign Materials<br>3) Dark Spot | Filamentous (Line shape)  |                        |                |               | A,B          |
|   | Length (mm)   | Width (mm)             | Maximum number |               |              |
|   | $L \leq 2.0$  | $W \leq 0.03$          | Ignored        |               |              |
|   | $L \leq 3.0$  | $0.03 < W \leq 0.05$   | 6              |               |              |
|   | $L \leq 2.5$  | $0.05 < W \leq 0.1$    | 1              |               |              |
|   | Round (Dot shape)   |                        |                |               | A,B          |
|   | Average diameter (mm)   | Maximum number         | Minimum Space  |               |              |
|   | $D \leq 0.2$  | Ignored                | -              |               |              |
|   | $0.2 \leq D < 0.3$  | 10                     | 10 mm          |               |              |
|   | $0.3 \leq D < 0.4$  | 5                      | 30 mm          |               |              |
|   | $0.4 \leq D$  | none                   | -              |               |              |
|   | In total  | Filamentous + Round=10 |                |               |              |
|   | Those wiped out easily are acceptable                                 |                        |                |               |              |
| Color Tone  | To be judged by HITACHI STANDARD                                      |                        |                |               | A            |
| Color Uniformity                                  | Sane as above   |                        |                |               | A            |
| Dot-Defect<br>(Note 1)                            |   | Type                   | Maximum number |               | A            |
|   | Bright dot-defect   | 1 dot                  | 4              |               |              |
|   |   | 2 dot                  | 1              |               |              |
|   |   | In total               | 5              |               |              |
|   | Dark dot-defect   | 1 dot                  | 5              |               |              |
|   |   | 2 dot                  | 2              |               |              |
|   |   | In total               | 5              |               |              |
| In total  |   |                        | 10             |               |              |

## (2) CFL BACKLIGHT APPEARANCE

| Item   | Criteria              |               |                | Applied zone |
|--|-----------------------|---------------|----------------|--------------|
| Dark Spots<br>White Spots<br>Foreign Materials(Spot) | Average diameter (mm) |               | Maximum number | A            |
|  | $D \leq 0.4$          |               | ignored        |              |
|  | $0.4 < D$             |               | none           |              |
| Foreign Materials<br>(Line)                          | Width (mm)            | Length (mm)   | Maximum number | A            |
|  | $W \leq 0.2$          | $L \leq 2.5$  | 1              |              |
|  |                       | $2.5 < L$     | None           |              |
|  | $0.2 < W$             | -             | none           |              |
| Scratches  | Width (mm)            | Length (mm)   | Maximum number | A            |
|  | $W \leq 0.1$          | -             | ignored        |              |
|  | $0.1 < W \leq 0.2$    | $L \leq 11.0$ | 1              |              |
|  |                       | $11.0 < L$    | None           |              |
|  | $0.2 < W$             | -             | none           |              |

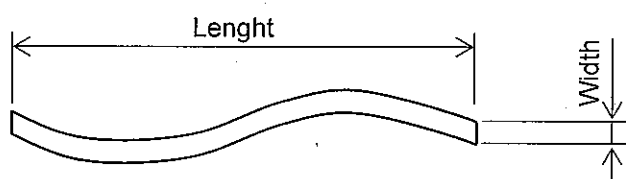


Fig 11.3

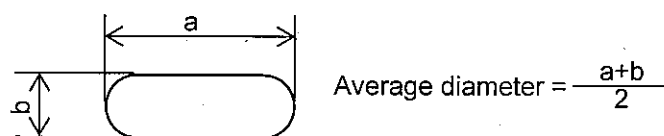
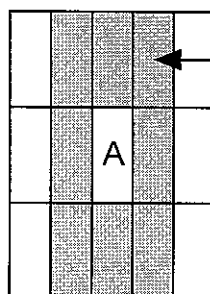


Fig 11.4

Note 1: The definitions of dot defect are as below:

- The defect area of the dot must be bigger than half of a dot.
- For bright dot-defect, showing black pattern, the dot's brightness must be over 30% brighter than others.
- For dark dot-defect, showing white pattern, the dot's brightness must be under 70% darker than others.
- The definition of 1-dot-defect is the defect-dot, which is isolated and no adjacent defect-dot.
- The definition of adjacent dot is shown as Fig. 11.5.
- The Density of dot defect is defined in the area within diameter  $\phi = 20\text{mm}$ .



The dots colored gray are adjacent to defect-dot A.

Fig. 11.5

## 12. PRECAUTIONS

### 12.1 PRECAUTIONS of ESD

- 1) Before handling the display, please ensure your body has been connected to ground to avoid any damages by ESD. Also, do not touch display's interface directly when assembling.
- 1) Please remove the protection film very slowly before turning on the display to avoid generating ESD.

### 12.2 PRECAUTIONS of HANDLING

- 1) In order to keep the appearance of display in good condition, please do not rub any surfaces of the displays by sharp tools harder than 3H, especially , metal frame and polarizer.
- 2) Please do not pile the displays in order to avoid any scars leaving on the display. In order to avoid any injuries, please pay more attention for the edges of glasses and metal frame, and wear finger cots to protect yourself and the display before working on it.
- 2) Touching the display area or the terminal pins with bare hand is prohibited. This is because it will stain the display area and cause poor insulation between terminal pins, and might affect display's electrical characteristics furthermore.
- 3) Do not use any harmful chemicals such as acetone, toluene, and isopropyl alcohol to clean display's surfaces.
- 4) Please use soft cloth or absorbent cotton with ethanol to clean the display by gently wiping. Moreover, when wiping the display, please wipe it by horizontal or vertical direction instead of circling to prevent leaving scars on the display's surface, especially polarizer.
- 5) Please wipe any unknown liquids immediately such as saliva, water or dew on the display to avoid color fading or any permanently damages.
- 6) Maximum pressure to the surface of the display must be less than  $1.96 \times 10^4$  Pa. If the area of adding pressure is less than  $1 \text{ cm}^2$ , the maximum pressure must be less than 1.96N.

### 12.3 PRECAUTIONS OF OPERATING

- 1) Please input signals and voltages to the displays according to the values defined in the section of electrical characteristics to obtain the best performance. Any voltages over than absolute maximum rating will cause permanent damages to this display. Also, any timing of the signals out of this specification would cause unexpected performance.
- 2) When the display is operating at significant low temperature, the response time will be slower than it at  $25^\circ\text{C}$ . In high temperature, the color will be slightly dark and blue compared to original pattern. However, these are temperature-related phenomenon of LCD and it will not cause permanent damages to the display when used within the operating temperature.
- 3) The use of screen saver or sleep mode is recommended when static images are likely for long periods of time. This is to avoid the possibility of image sticking.
- 4) Spike noise can cause malfunction of the circuit. The recommended limitation of spike noise is no bigger than  $\pm 100 \text{ mV}$ .

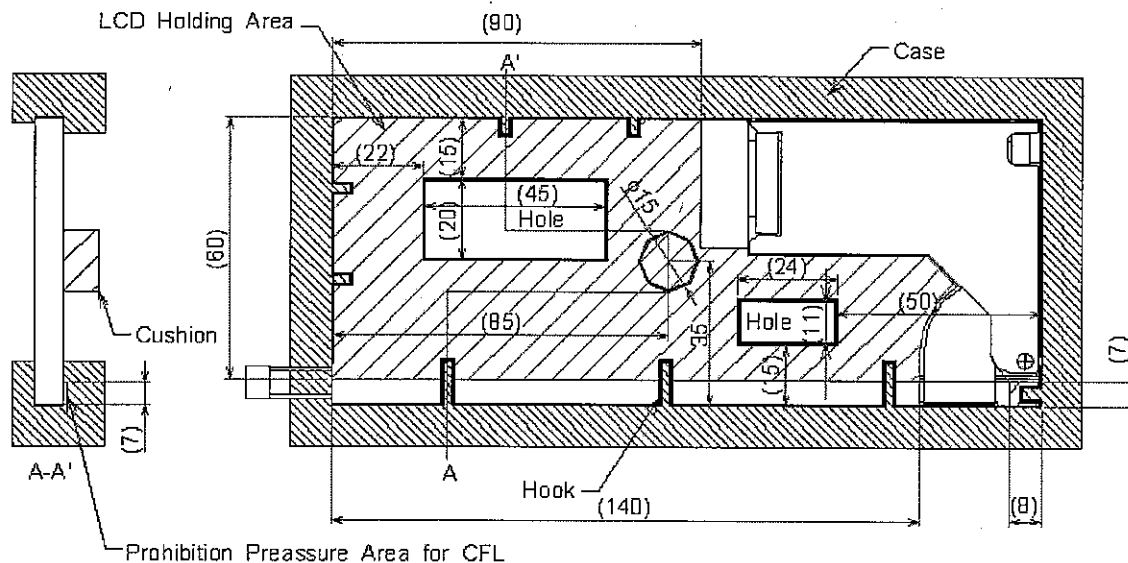
## 12.4 PRECAUTIONS of STORAGE

If the displays are going to be stored for years, please be aware the following notices.

- 1) Please store the displays in a dark room to avoid any damages from sunlight and other sources of UV light.
- 2) The recommended long term storage temperature is between 10°C~35°C and 55%~75% humidity to avoid causing bubbles between polarizer and LCD glasses, and polarizer peeling from LCD glasses.
- 3) It would be better to keep the displays in the container, which is shipped from Hitachi, and do not unpack it.
- 4) Please do not stick any labels on the display surface for a long time, especially on the polarizer.

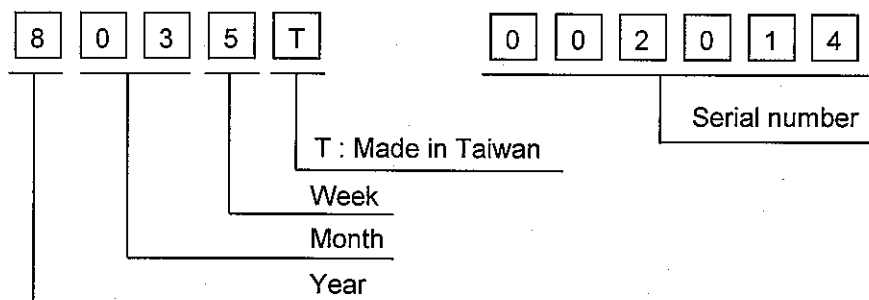
## 12.5 MOUNTING PRECAUTION

- 1) When assembling the LCM Module, please refer to the below.
- 2) The use of cushion is recommended in order to protect the module from shock.



### 13. DESIGNATION of LOT MARK

- 1) The lot mark is showing in Fig.14.3. First 4 digits are used to represent production lot, T represented made in Taiwan, and the last 6 digits are the serial number.



- 2) The tables as below are showing what the first 4 digits of lot mark are shorted for.

| Year | Mark |
|------|------|
| 2008 | 8    |
| 2009 | 9    |
| 2010 | 0    |
| 2011 | 1    |
| 2012 | 2    |

| Month | Mark | Month | Mark |
|-------|------|-------|------|
| 1     | 01   | 7     | 07   |
| 2     | 02   | 8     | 08   |
| 3     | 03   | 9     | 09   |
| 4     | 04   | 10    | 10   |
| 5     | 05   | 11    | 11   |
| 6     | 06   | 12    | 12   |

| Week (Days) | Mark |
|-------------|------|
| 1~7         | 1    |
| 8~14        | 2    |
| 15~21       | 3    |
| 22~28       | 4    |
| 29~31       | 5    |

- 3) Except letters I and O, revision number will be shown on lot mark and following letters A to Z.
- 4) The location of the lot mark is on the back of the display shown in Fig. 14.3.

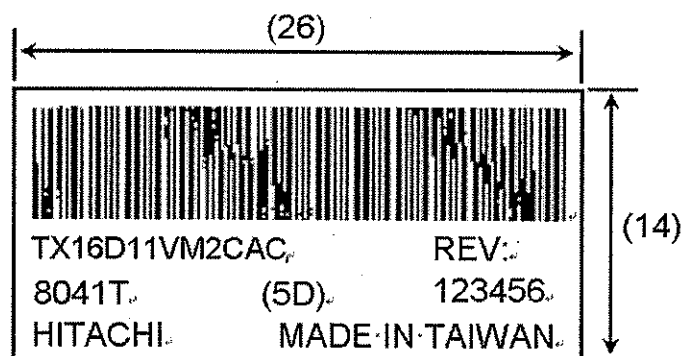


Fig 14.3