

# HITACHI

KAOHSIUNG HITACHI ELECTRONICS CO., LTD.

FOR MESSRS:

DATE: Jan. 09<sup>th</sup> 2009

## CUSTOMER'S ACCEPTANCE SPECIFICATIONS

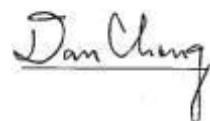
### TX14D17VM1BPB

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

PROPOSED BY:



2. RECORD OF REVISION

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

### 3. GENERAL DATA

#### 3.1 DISPLAY FEATURES

This module is a 5.7" VGA of 4:3 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               | TX14D17VM1BPB                                                                    |
| Module Dimensions       | 131.0(W) mm x 102.2(H) mm x (13.1)(D) mm typ.                                    |
| LCD Active Area         | 115.2(W) mm x 86.4(H) mm                                                         |
| Dot Pitch               | 0.06(W) mm x 3(R, G, B)(W) x 0.18(H) mm                                          |
| Resolution              | 640 x 3(RGB)(W) x 480(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                  | (200) g (typ.)                                                                   |
| Interface               | C-MOS; 18-bit RGB; 40 pins                                                       |
| Power Supply Voltage    | 3.3V for LCD; 12V for Backlight                                                  |
| Power Consumption       | 429 mW for LCD; 1.0 W for backlight                                              |
| Viewing Direction       | 6 O'clock<br>(The direction without image inversion and least brightness change) |
| Touch Panel             | Resistive type; Film on Glass; 4 wire type; Antiglare Surface.                   |

## 4. ABSOLUTE MAXIMUM RATINGS

| Item                   | Symbol | Min. | Max.    | Unit | Remarks |
|------------------------|--------|------|---------|------|---------|
| Supply Voltage         | VDD    | -0.3 | 4.0     | V    | -       |
| Input Voltage of Logic | VI     | -0.3 | VDD+0.3 | V    | Note 1  |
| Operating Temperature  | Top    | -20  | 70      | °C   | Note 2  |
| Storage Temperature    | Tst    | -30  | 80      | °C   | Note 2  |
| LED Forward Current    | IF     | -    | 35      | mA   | Note 3  |

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.

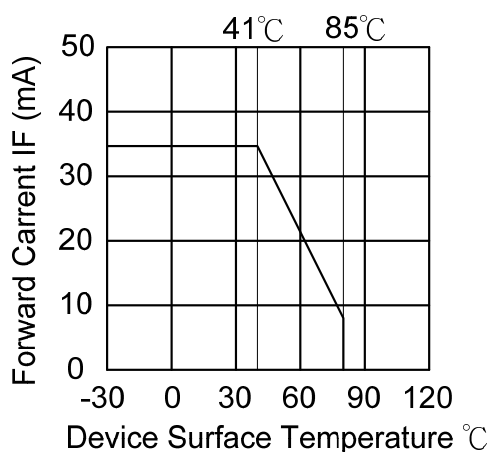


Fig. 4.1

## 5. ELECTRICAL CHARACTERISTICS

### 5.1 LCD CHARACTERISTICS

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

| 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    | 0.7VDD  | -    | VDD     | V    | Note 1  |
|                         |           | "L" level    | VSS     | -    | 0.3VDD  |      |         |
| Output Voltage of Logic | VO        | "H" level    | VDD-0.4 | -    | -       | V    | Note 1  |
|                         |           | "L" level    | VSS     | -    | VSS+0.4 |      |         |
| Power Supply Current    | IDD       | VDD-VSS=3.3V | -       | 130  | -       | mA   | Note 2  |
| Vsync Frequency         | $f_v$     | -            | -       | 60   | 73.3    | Hz   | -       |
| Hsync Frequency         | $f_H$     | -            | -       | 31.5 | 36.5    | KHz  | -       |
| DCLK Frequency          | $f_{CLK}$ | -            | -       | 25.2 | 29.0    | MHz  | -       |

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

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

### 5.2 BACKLIGHT CHARACTERISTICS

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

| 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     | 91     | 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  $255\Omega$ .

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

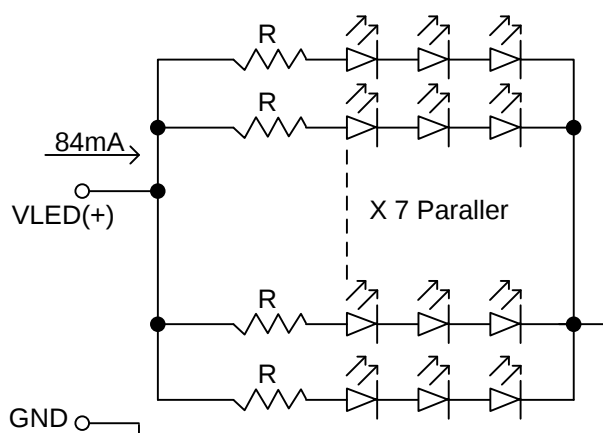


Fig. 5.1

## 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 | 150  | 280  | -    | cd/m <sup>2</sup> | Note 1  |
| Brightness Uniformity |       | -           |                                                     | -    | -    | ±25  | %                 | Note 2  |
| Contrast Ratio        |       | CR          |                                                     | 120  | 350  | -    | -                 | Note 3  |
| Response Time         |       |             | $\phi = 0^\circ, \theta = 0^\circ$                  | -    | (45) | -    | ms                | -       |
| NTSC Ratio            |       | -           | $\phi = 0^\circ, \theta = 0^\circ$                  | -    | (50) | -    | %                 | -       |
| Viewing Angle         |       | $\theta$ x  | $\phi = 0^\circ$ , CR ≥ 5                           | -    | (70) | -    | Degree            | Note 5  |
|                       |       | $\theta$ x' | $\phi = 180^\circ$ , CR ≥ 5                         | -    | (70) | -    |                   |         |
|                       |       | $\theta$ y  | $\phi = 90^\circ$ , CR ≥ 5                          | -    | (70) | -    |                   |         |
|                       |       | $\theta$ y' | $\phi = 270^\circ$ , CR ≥ 5                         | -    | (70) | -    |                   |         |
| Color Chromaticity    | Red   | X           | $\phi = 0^\circ, \theta = 0^\circ$                  | 0.57 | 0.62 | 0.67 | -                 | Note 6  |
|                       |       | Y           |                                                     | 0.30 | 0.35 | 0.40 |                   |         |
|                       | Green | X           |                                                     | 0.29 | 0.34 | 0.39 |                   |         |
|                       |       | Y           |                                                     | 0.55 | 0.60 | 0.65 |                   |         |
|                       | Blue  | X           |                                                     | 0.10 | 0.15 | 0.20 |                   |         |
|                       |       | Y           |                                                     | 0.08 | 0.13 | 0.18 |                   |         |
|                       | White | X           |                                                     | 0.28 | 0.33 | 0.38 |                   |         |
|                       |       | Y           |                                                     | 0.30 | 0.35 | 0.40 |                   |         |

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

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

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

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

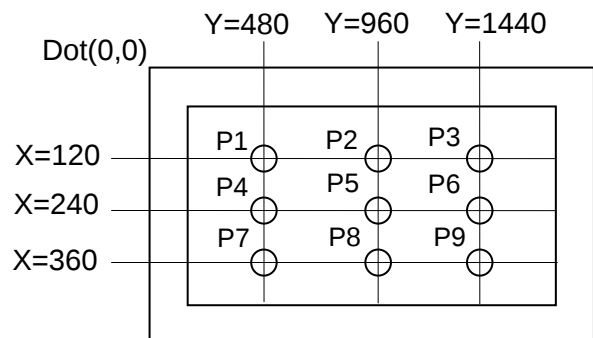
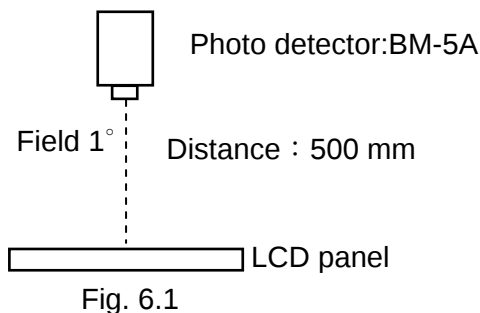


Fig. 6.2

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.

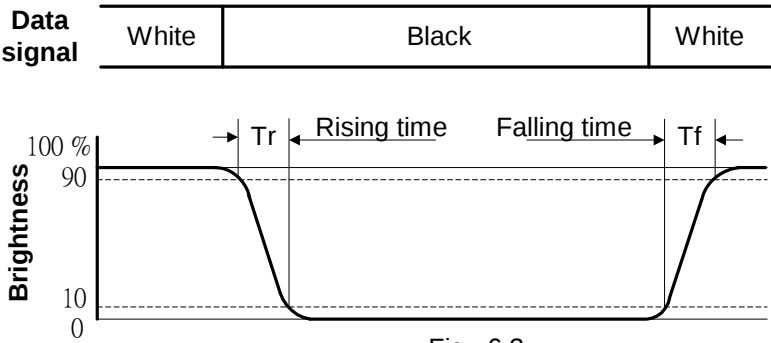


Fig . 6.3

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 6 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 12 o'clock.

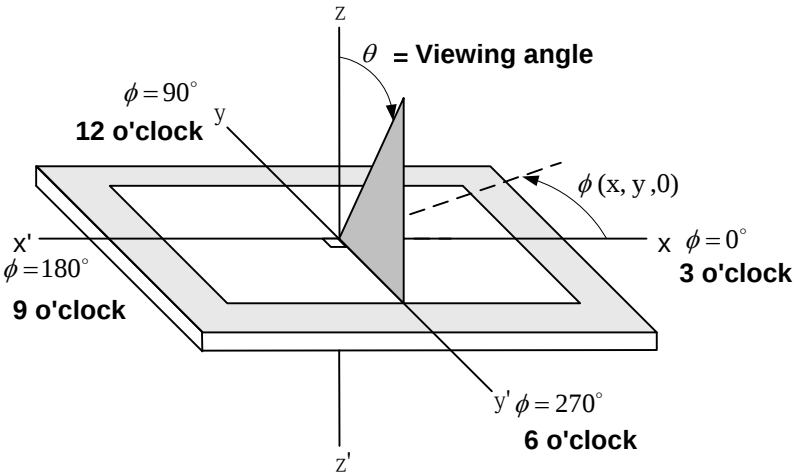
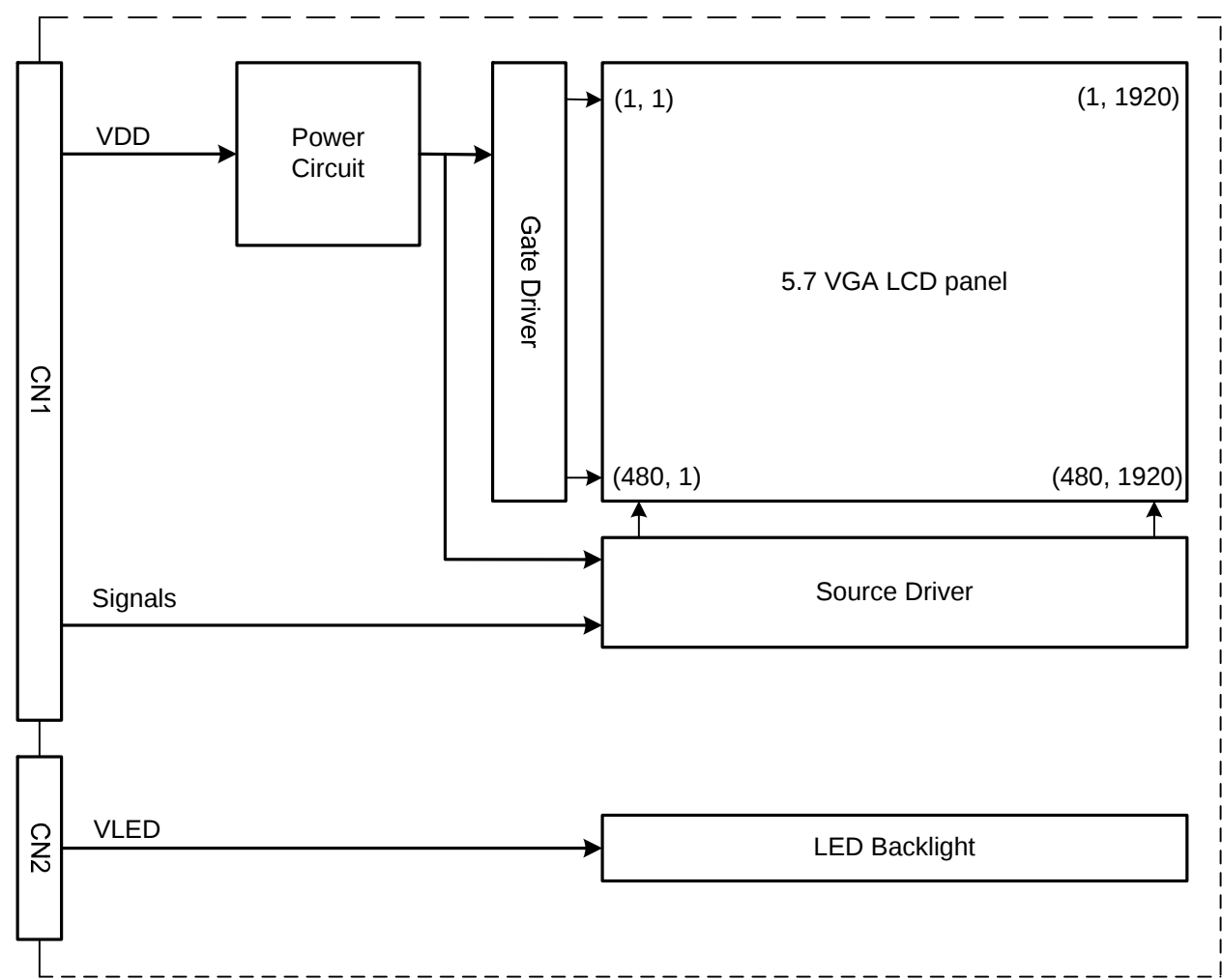


Fig. 6.4

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

7 BLOCK DIAGRAM



Note 1: Signals are DCLK, Hsync, Vsync ,DTMG and RGB data bus.

## 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) 80 °C                                                                                                                                                      | 240 hrs                                                                  |
| Low Temperature             | 1) Storage<br>2) -30 °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.

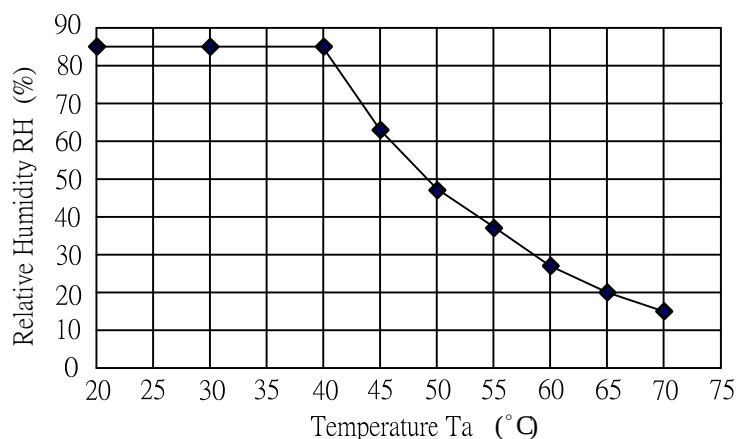


Fig. 7.1

## 9. LCD INTERFACE

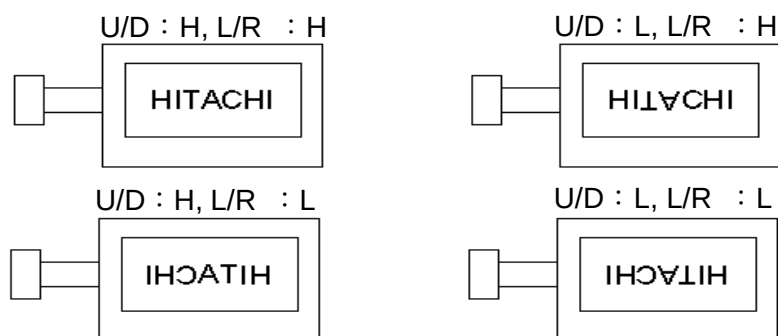
### 9.1 INTERFACE PIN CONNECTIONS

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       | U/D    | Vertical Display mode Control (Note 1)   | 23      | VSS    | GND                                  |
| 4       | L/R    | Horizontal Display mode Control (Note 1) | 24      | G2     | Green Data                           |
| 5       | Vsync  | Vertical Sync Pulse                      | 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      | Hsync  | Horizontal Sync Pulse                    | 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      | MODE   | Mode selection (Note 2)              |
| 16      | B2     | Blue Data                                | 36      | VSS    | GND                                  |
| 17      | B1     |                                          | 37      | XT     | Analog Signal Form Digitizer Top.    |
| 18      | B0     |                                          | 38      | YL     | Analog Signal Form Digitizer Left.   |
| 19      | VSS    | GND                                      | 39      | XB     | Analog Signal Form Digitizer Bottom. |
| 20      | G5     | Green Data                               | 40      | YR     | Analog Signal Form Digitizer Right.  |

Note 1: Scan direction is available to be switched as below by setting U/D and L/R pins.



Note 2 : Mode selection

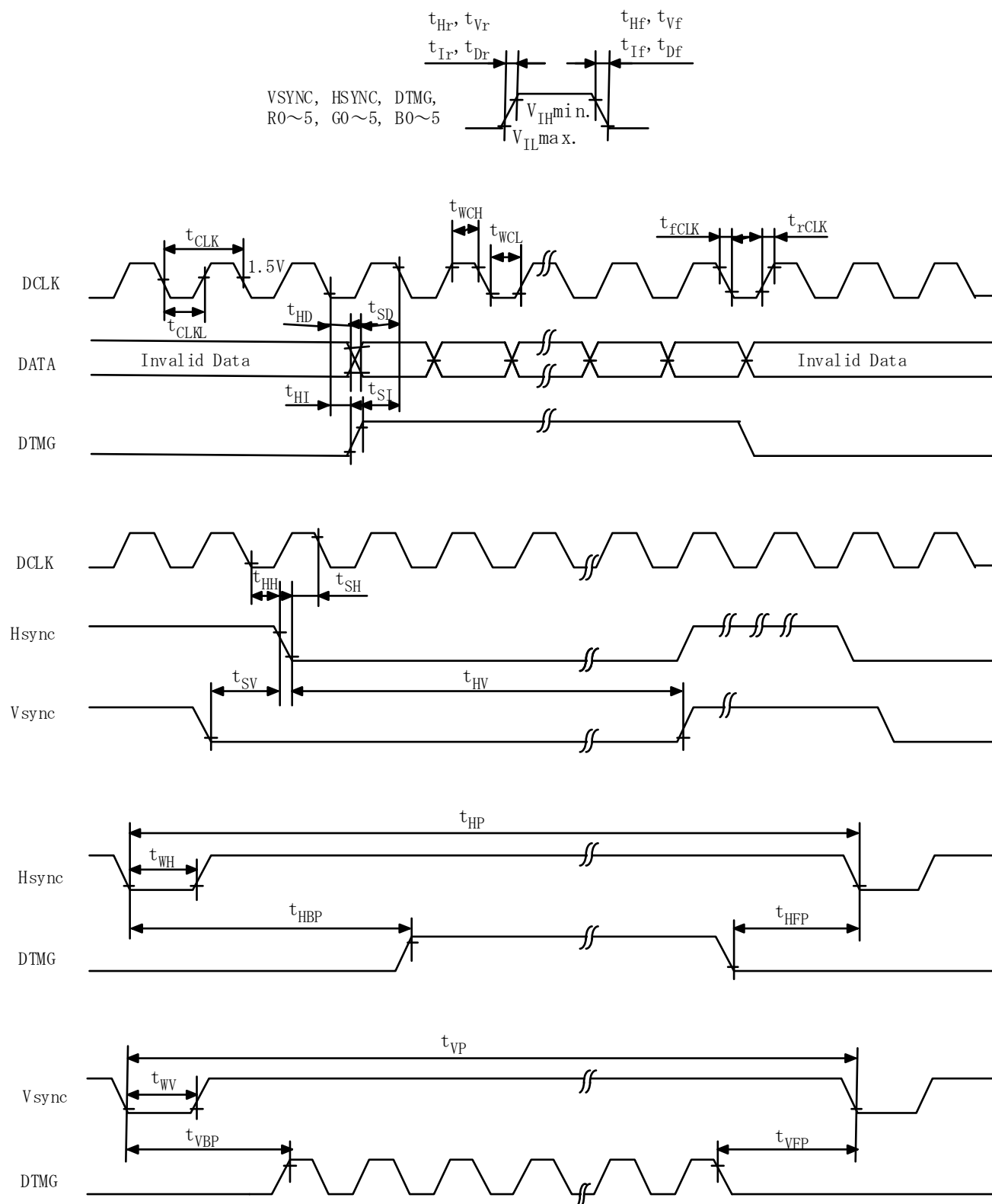
H : DTMG only, no need Hsync and Vsync.

L : Hsync and Vsync only, no need DTMG.

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       | $V_{LED+}$ | -     | Power Supply for LED |
| 2       | NC         | -     | No connection        |
| 3       | $V_{LED-}$ | -     | GND                  |

## 9.2 TIMING CHART



### 9.3 INTERFACE TIMING SPECIFICATIONS

| Item  |                        | Symbol    | Min.  | Typ.  | Max. | Unit |
|-------|------------------------|-----------|-------|-------|------|------|
| DCLK  | Cycle time             | $t_{CLK}$ | 34.48 | 39.71 | -    | ns   |
|       | Low level Width        | $t_{WCL}$ | 17.24 | -     | -    |      |
|       | High level Width       | $t_{WCH}$ | 17.24 | -     | -    |      |
|       | Duty                   | D         | 0.45  | 0.5   | 0.55 | -    |
| Hsync | Set up time            | $t_{SH}$  | 12    | -     | -    | ns   |
|       | Hold time              | $t_{HH}$  | 12    | -     | -    |      |
|       | Cycle                  | $t_{HP}$  | 792   | 800   | 1039 | tCLK |
|       | Valid width            | $t_{WH}$  | 6     | 96    | 138  |      |
|       | Horizontal back porch  | $t_{HBP}$ | 144   | 144   | 144  |      |
| Vsync | Set up                 | $t_{SV}$  | 12    | -     | -    | tCLK |
|       | Hold                   | $t_{HV}$  | 12    | -     | -    |      |
|       | Cycle                  | $t_{VP}$  | 496   | 525   | 747  | tHP  |
|       | Valid width            | $t_{WV}$  | 2     | 2     | 10   |      |
|       | Vertical back porch    | $t_{VBP}$ | 12    | 12    | 12   |      |
| DTMG  | Set up time            | $t_{SI}$  | 12    | -     | -    | ns   |
|       | Hold time              | $t_{HD}$  | 12    | -     | -    |      |
|       | Horizontal back porch  | $t_{HBP}$ | 115   | 160   | 255  | tCLK |
|       | Horizontal front porch | $t_{HFP}$ | 0     | 0     | 0    |      |
|       | Cycle time             | $t_{HP}$  | 755   | 800   | 895  | tHP  |
|       | Vertical back porch    | $t_{VBP}$ | 6     | (7)   | -    |      |
|       | Vertical front porch   | $t_{VFP}$ | 0     | 0     | 0    |      |
|       | Cycle time             | $t_{VP}$  | 486   | 525   | 735  |      |
| Data  | Set up time            | $t_{SD}$  | 12    | -     | -    | ns   |
|       | Hold time              | $t_{HD}$  | 12    | -     | -    |      |
|       | Cycle time             | $t_{CLK}$ | 34.48 | 39.71 | -    | ns   |

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

## 9.4 POWER SEQUENCE

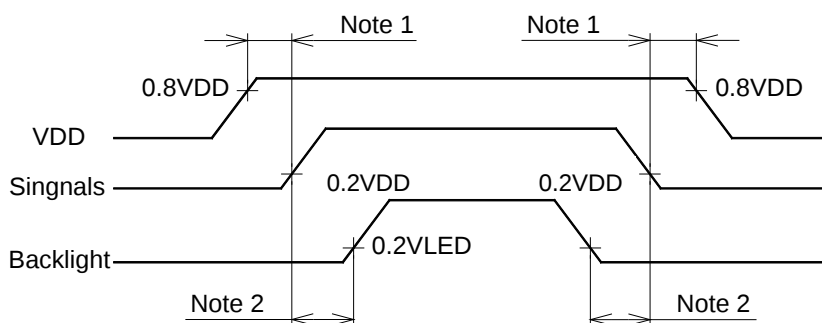


Fig. 9.1

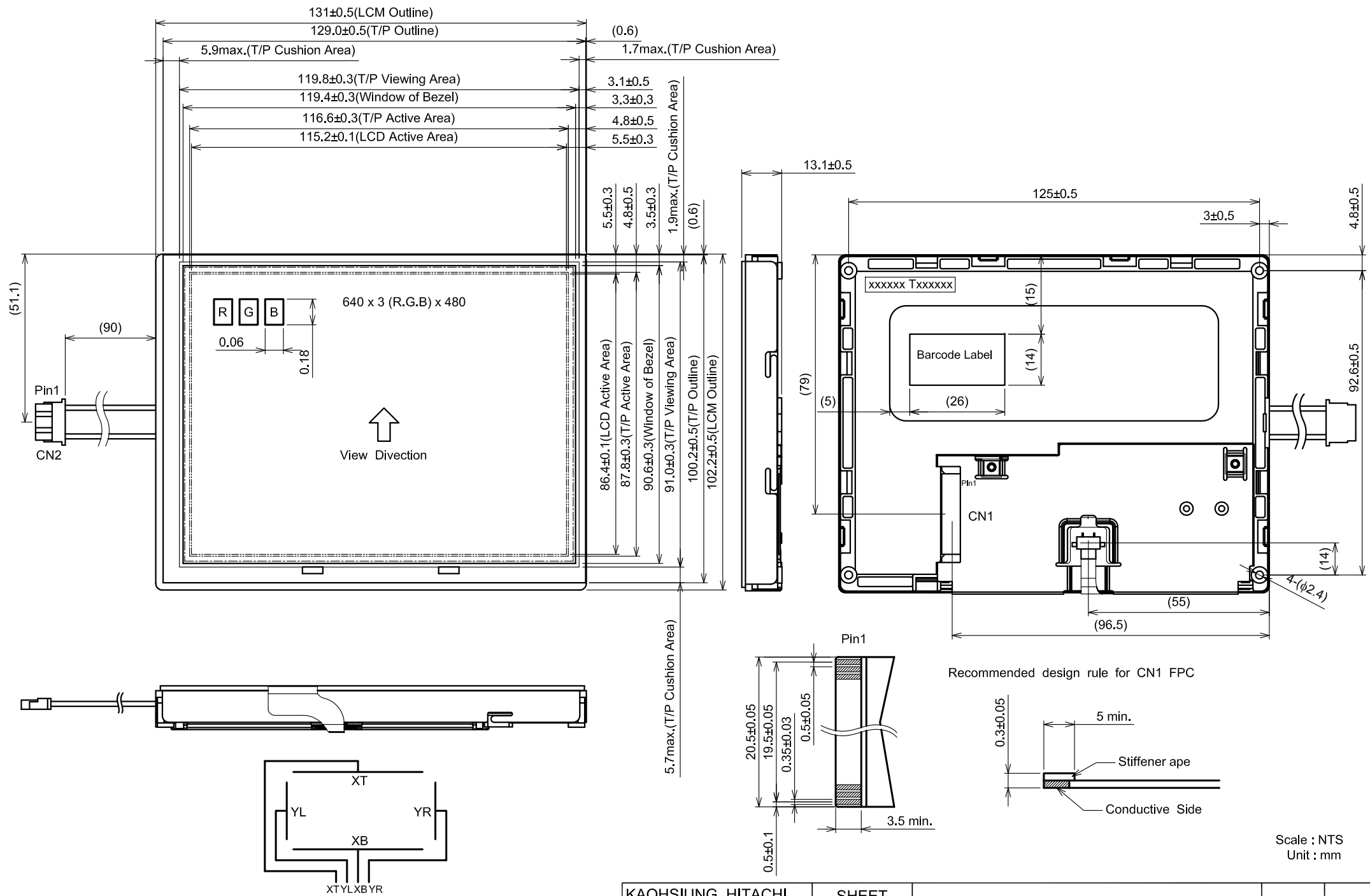
Note 1: In order to avoid any damages, the correct power On sequence must be followed and VDD have to be applied before all other signals (DTMG, DCLK, RGB data). The opposite is true for power Off where VDD have to be remained on until all other signals have been switch off. The recommended time period is 1 second.

Note 2: In order to avoid showing uncompleted patterns in transient state. It is recommended that switching the backlight on is delayed for 1 second after the signals have been applied. The opposite is true for power Off where the backlight have to be switched off 1 second before the signals are removed.

## 9.5 DATA INPUT for DISPLAY COLOR

|             | COLOR & Gray Scale | Data Signal |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|-------------|--------------------|-------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|             |                    | R5          | R4 | R3 | R2 | R1 | R0 | G5 | G4 | G3 | G2 | G1 | G0 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic 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  |
|             | Blue (62)          | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  |
|             | Blue (61)          | 0           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  |

10. OUTLINE DIMENSIONS



Scale : NTS  
Unit : mm

## 11. TOUCH PANEL

The type of touch panel used on this display is resistive, analog, 4-wire and film on glass, and more characteristics are shown as below:

### 11.1 OPERATING CONDITIONS

| Item              | Specification | Remarks |
|-------------------|---------------|---------|
| Operating Voltage | 5VDC max.     | -       |

### 11.2 ELECTRICAL CHARACTERISTICS

| Item                        |       | Specification     | Remarks   |
|-----------------------------|-------|-------------------|-----------|
| Resistance Between Terminal | XT-XB | 230~650 $\Omega$  | -         |
|                             | YR-YL | 210~880 $\Omega$  |           |
| Insulation Resistance       | X-Y   | 20M $\Omega$ min. | At 25V DC |
| Linearity                   | X     | $\pm 1.5\%$ max.  | Note 1    |
|                             | Y     | $\pm 1.5\%$ max.  |           |
| Chattering                  |       | 10ms max.         | -         |

Note 1: The test conditions and equipments of linearity are as below:

- Material of pen: poly-acetal resin
- End shape: R 0.8 mm
- Test force: 150 gf
- Pitch: 10 mm
- Test area is shown in Fig. 11.1

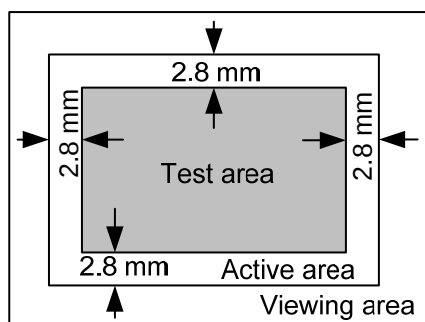


Fig. 11.1

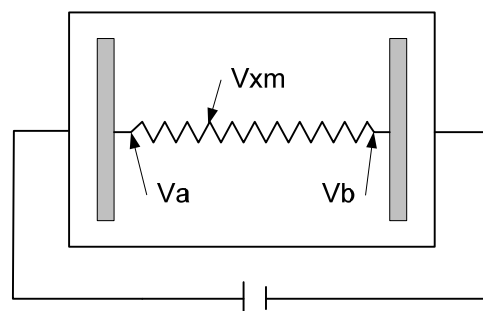


Fig. 11.2

As shown in Fig. 11.2, applying voltage meter to measure  $V_a$ ,  $V_b$  and  $V_{xm}$ , where  $V_a$  is the maximum voltage in the active area;  $V_b$  is the minimum voltage in the active area;  $V_{xm}$  is the measured voltage of point x selected by random. Afterwards, the linearity can be calculated by following equation:

$$Linearity = \frac{|V_{xi} - V_{xm}|}{V_a - V_b} \times 100\%$$

where  $V_{xi}$  is the idea voltage of point x.

The method to measure the linearity of Y-axis is the same as above.

### 11.3 MECHANICAL CHARACTERISTICS

| Item               | Specification | Remarks              |
|--------------------|---------------|----------------------|
| Pen Input Pressure | 1.2N max.     | R0.8, Polyacetal Pen |
| Finger             | 1.2N max.     | R8.0, Silicon Rubber |
| Surface Hardness   | 2H min.       | JIS K 5400           |

### 11.4 OPTICAL CHARACTERISTICS

| Item          | Specification | Remarks |
|---------------|---------------|---------|
| Transmittance | 80% min.      | -       |

### 11.5 SAFETY AND ATTENTIONS

- 1) Do not put heavy shock or stress on the touch panel.
- 2) Please use soft cloth or absorbent cotton with ethanol to clean the touch panel by gently wiping. Moreover, please wipe it by horizontal or vertical direction instead of circling to prevent leaving scars on the touch panel's surface.
- 3) Do not use any harmful chemicals such as acetone, toluene, and isopropyl alcohol to clean the display's surface.

## 12. 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. 12.1 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.

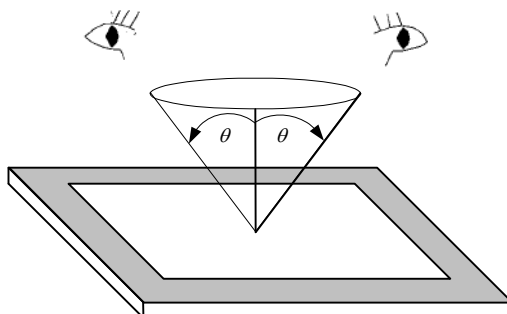


Fig 12.1

### 12.1 THE DEFINITION OF LCD ZONE

LCD panel is divided into 3 areas as shown in Fig.12.2 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.

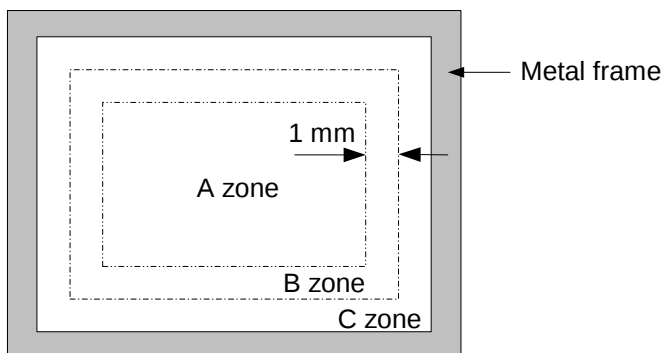


Fig 12.2

## 12.2 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. 12.3 and Fig. 12.4.

| 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                                              | Serious one is not allowed            |                         |                |                | A            |
| Wrinkles in polarizer                             | Serious one is not allowed            |                         |                |                | 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  |                |              |
|                                                   | $D < 0.2$                             | Ignored                 | -              |                |              |
|                                                   | $0.2 \leq D < 0.3$                    | 10                      | 10mm           |                |              |
|                                                   | $0.3 \leq D < 0.4$                    | 5                       | 30mm           |                |              |
|                                                   | $0.4 \leq D$                          | none                    | -              |                |              |
|                                                   | In total                              | Filamentous + Round=10  |                |                |              |
|                                                   | Those wiped out easily are acceptable |                         |                |                |              |
|                                                   | Dot-Defect<br>(Note 1)                |                         | Type           | Maximum number |              |
| Bright dot-defect                                 |                                       | 1 dot                   | 4              |                |              |
|                                                   |                                       | 2 adjacent dot          | 1              |                |              |
|                                                   |                                       | 3 adjacent dot or above | Not allowed    |                |              |
|                                                   |                                       | In total                | 5              |                |              |
| Dark dot-defect                                   |                                       | 1 dot                   | 5              |                |              |
|                                                   |                                       | 2 adjacent dot          | 2              |                |              |
|                                                   |                                       | 3 adjacent dot or above | Not allowed    |                |              |
|                                                   |                                       | In total                | 5              |                |              |
| In total                                          |                                       |                         | 10             |                |              |

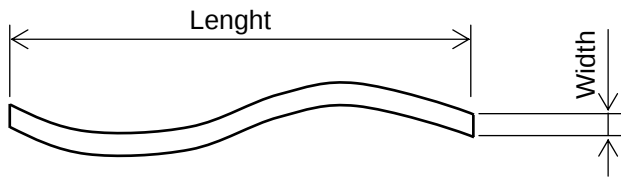


Fig 12.3

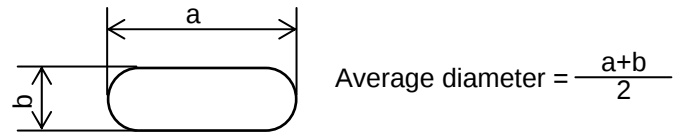


Fig 12.4

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. 12.5.
- The Density of dot defect is defined in the area within diameter  $\phi = 20\text{mm}$ .

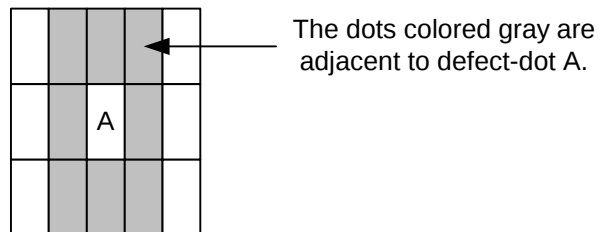


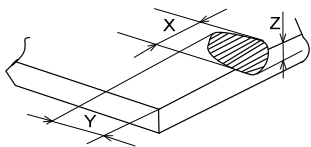
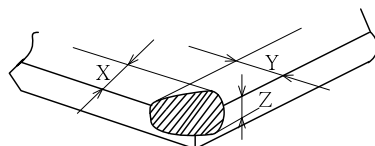
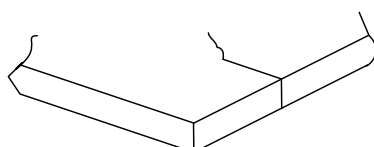
Fig 12.5

### 12.3 TOUCH PANEL APPEARANCE SPECIFICATION

The specification as below is defined by the amount of unexpected material in different zones of touch panel.

| Item              | Criteria                 |             |                | Applied zone |
|-------------------|--------------------------|-------------|----------------|--------------|
| Scratches         | Width (mm)               | Length (mm) | Maximum number | A,B          |
|                   | $W > 0.1$                | $L \geq 10$ | Not allowed    |              |
|                   | $0.10 \geq W > 0.05$     | $L < 10$    | 4 pcs max.     |              |
|                   | $0.05 \geq W$            | $L < 10$    | Ignored        |              |
| Foreign Materials | Filamentous (Line shape) |             |                | A,B          |
|                   | Width (mm)               | Length (mm) | Maximum number |              |
|                   | $0.10 \geq W > 0.05$     | $3 < L$     | Not allowed    |              |
|                   | $0.05 \geq W$            | $L \leq 3$  | Ignored        |              |
|                   | Round (Dot shape)        |             |                | A,B          |
|                   | Average diameter (mm)    |             | Maximum number |              |
|                   | $D > 0.35$               |             | Not allowed    |              |
|                   | $0.35 \geq D > 0.25$     |             | 6 pcs max.     |              |
|                   | $D \leq 0.25$            |             | Ignored        |              |

The limitation of glass flaw occurred on touch panel is defined in the table as below.

| Item             | Specifications                                                                      |                                                                                 |
|------------------|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| Edge flaw        |   | $X \leq 5.0 \text{ mm}$<br>$Y \leq 3.0 \text{ mm}$<br>$Z \leq \text{Thickness}$ |
| Corner flaw      |  | $X \leq 3.0 \text{ mm}$<br>$Y \leq 3.0 \text{ mm}$<br>$Z \leq \text{Thickness}$ |
| Progressive flaw |  | Not allowed                                                                     |

## 13. PRECAUTIONS

### 13.1 PRECAUTIONS of MOUNTING

- 1) Please refer to Fig. 13.1 for housing the display with touch panel into applications. The Fig. 13.1 shows some points as below:
  - The cushion needs to be designed between housing and touch panel in order to avoid unexpected pressure to cause any wrong reactions, and the cushion should be located in the insulated area.
  - The housing should not cover the active area of touch panel as the figure shown.

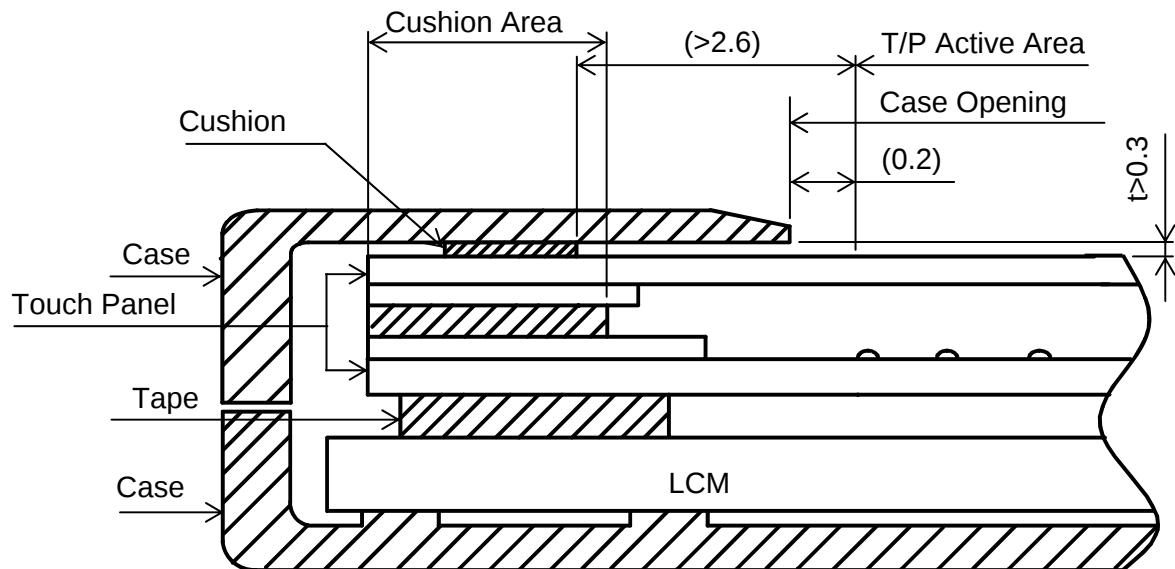


Fig 13.1

### 13.2 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.
- 2) Please remove the protection film very slowly before turning on the display to avoid generating ESD.

### 13.3 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 touch panel, metal frame and polarizer.
- 2) Please do not stack the displays as this may damage the surface. In order to avoid any injuries, please avoid touching the edge of the glass or metal frame and wore gloves during handling.
- 3) Touching the polarizer or terminal pins with bare hand should be avoided to prevent staining and poor electrical contact.
- 4) Do not use any harmful chemicals such as acetone, toluene, and isopropyl alcohol to clean display's surfaces.
- 5) 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.
- 6) Please wipe any unknown liquids immediately such as saliva, water or dew on the display to avoid color fading or any permanently damages.

- 7) 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.

#### 13.4 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  $\pm 100 \text{ mV}$ .

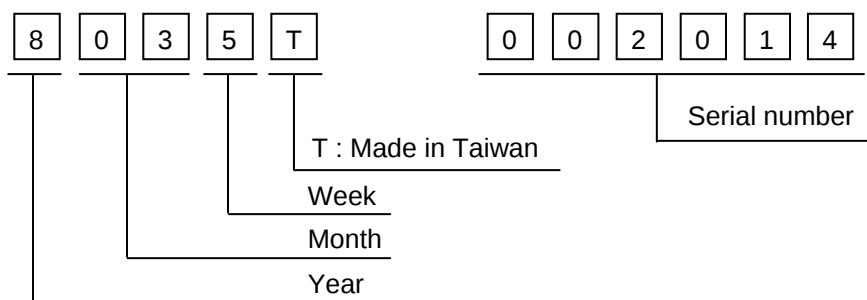
#### 13.5 PRECAUTIONS of STORAGE

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  $10^\circ\text{C} \sim 35^\circ\text{C}$  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.

## 14. DESIGNATION of LOT MARK

- 1) The lot mark is showing in Fig.13.3. First 4 digits are used to represent production lot, T represented made in Taiwan, and the last 5 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 |
|------|------|
| 2009 | 9    |
| 2010 | 0    |
| 2011 | 1    |
| 2012 | 2    |
| 2013 | 3    |

| 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. 14.1.

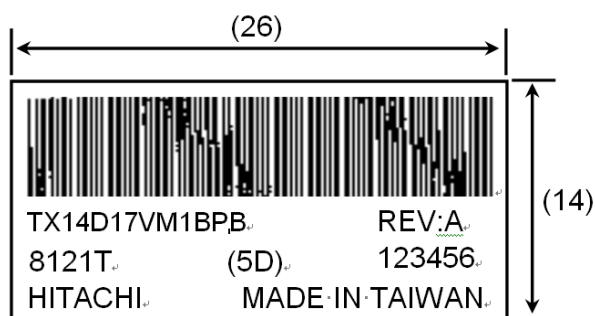


Fig 14.1