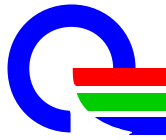




**Specification**



**Quanta Display Inc.  
SPECIFICATION**

**Doc No. QD15XL0604**

**Doc. REV. : 01**

**Issue Date : 6/27/2005**

**RoHS compliant**

**Specification for TFT LCD Module**

Model No.  
QD15XL06      Rev.:04

□ **Approved By**

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**Quanta Display Inc.**

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**In case of using the device for applications such as control and safety equipment for transportation (aircraft, trains, automobiles, etc. ), rescue and security equipment and various safety related equipment which require higher reliability and safety, take into consideration that appropriate measures such as fail-safe functions and redundant system design should be taken.**

**Do not use the device for equipment that requires an extreme level of reliability, such as aerospace applications, telecommunication equipment (trunk lines), nuclear power control equipment and medical or other equipment for life support.**

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## 1. Application

This specification applies to a color TFT-LCD module, QD15XL0604.

## 2. Overview

This module is a color active matrix LCD module incorporating amorphous silicon TFT (Thin Film Transistor). It is composed of a color TFT-LCD panel, driver ICs, control circuit and power supply circuit and a backlight unit. Graphics and texts can be displayed on a 1024×3×768 dots panel with 262,144 colors by using LVDS (Low Voltage Differential Signaling) to interface and supplying +3.3V DC supply voltage for TFT-LCD panel driving and supply voltage for backlight.

The TFT-LCD panel used for this module has very high aperture ratio. A low-reflection and higher-color-saturation type color filter is also used for this panel. Therefore, high-brightness and high-contrast image, which is suitable for the multimedia use, can be obtained by using this module.

Optimum viewing direction is 6 o'clock.

### [Features]

- 1) High aperture panel; high-brightness or low power consumption.
- 2) Brilliant and high contrast image.
- 3) Small footprint and thin shape.
- 4) Light weight.
- 5) 100% SPWG, style B
- 6) RoHS complaint (Pb contain is less than 1000ppm )

## 3. Mechanical Specifications

| Parameter                        | Specifications   | Unit  |
|----------------------------------|--|-------|
| Display size                     | 15" Diagonal   | inch  |
| Active area                      | 304.13 × 228.1   | mm    |
| Pixel format                     | 1024 (H) × 768 (V)                                     | Pixel |
|                                  | (1 pixel = R+G+B dots)                                 |       |
| Pixel pitch                      | 0.297(H) × 0.297 (V)                                   | mm    |
| Pixel configuration              | R, G, B vertical stripe                                |       |
| Display mode                     | Normally white   |       |
| Unit outline dimensions (typ.)*1 | 317.3(W) × 242.0 (H) × 5.9(D)<br>6.0 Max               | mm    |
| Mass                             | Max.: 570  | g     |
| Surface treatment                | Anti-glare and hard-coating 3H<br>Low reflection (~5%) |       |

\*1.Note : excluding backlight cables. Outline dimensions is shown in this specification

#### 4. Input Terminals

##### 4-1. TFT-LCD panel driving

CN1 (1 channel, LVDS signals – NSC/Ti standard and +3.3V DC power supply)

Using connector: FI-XB30S-HF10 (JAE) / equivalent

##### Interface Cable Pin Assignments

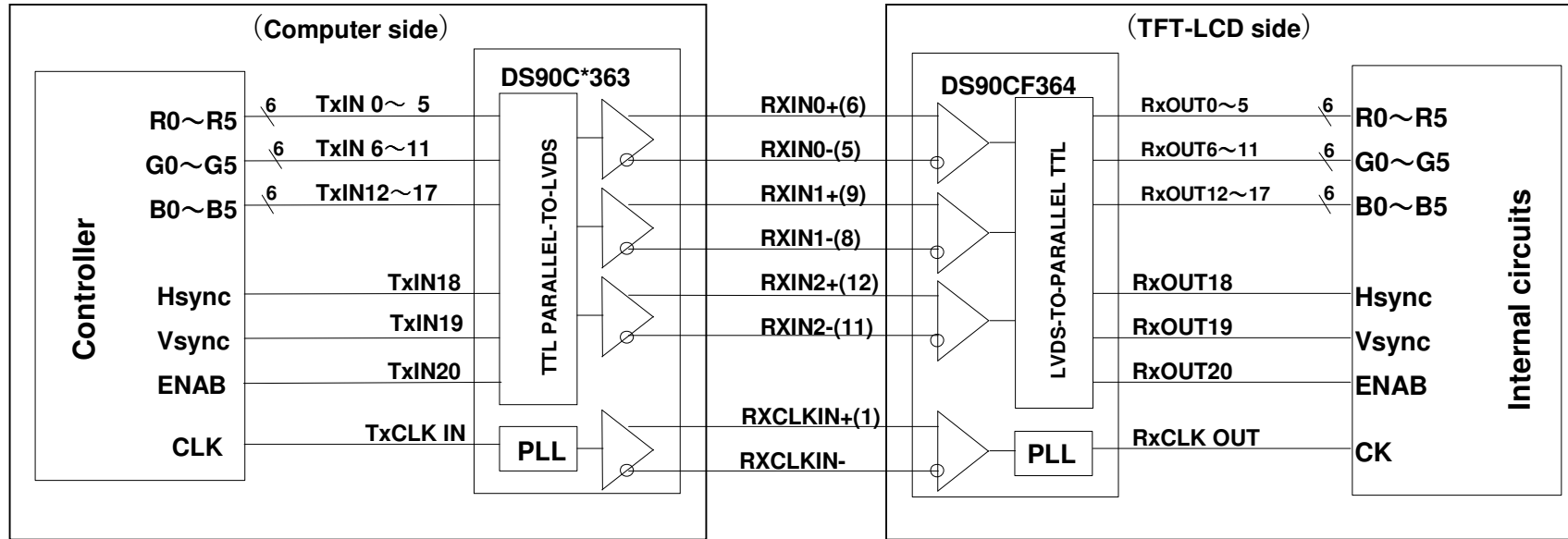
| PIN NO | . SYMBOL   | FUNCTION  |
|--------|------------|---|
| 1      | VSS        | Ground  |
| 2      | VDD        | Power Supply, 3.3 V (typical)                                   |
| 3      | VDD        | Power Supply, 3.3 V (typical)                                   |
| 4      | V EEDID    | DDC 3.3V power  |
| 5      | NC         | Reserved for supplier test point                                |
| 6      | Clk EEDID  | DDC Clock   |
| 7      | DATA EEDID | DDC Data  |
| 8      | Rin0-      | - LVDS differential data input (R0-R5, G0) (odd pixels)         |
| 9      | Rin0+      | + LVDS differential data input (R0-R5, G0) (odd pixels)         |
| 10     | VSS        | Ground  |
| 11     | Rin1-      | - LVDS differential data input (G1-G5, B0-B1) (odd pixels)      |
| 12     | Rin1+      | + LVDS differential data input (G1-G5, B0-B1) (odd pixels)      |
| 13     | VSS        | Ground  |
| 14     | Rin2-      | - LVDS differential data input (B2-B5, HS, VS, DE) (odd pixels) |
| 15     | Rin2+      | + LVDS differential data input (B2-B5, HS, VS, DE) (odd pixels) |
| 16     | VSS        | Ground  |
| 17     | ClkIN-     | - LVDS differential clock input (odd pixels)                    |
| 18     | ClkIN+     | + LVDS differential clock input (odd pixels)                    |
| 19     | VSS        | Ground  |
| 20     | NC         | No connect  |
| 21     | NC         | No connect  |
| 22     | NC         | No connect  |
| 23     | NC         | No connect  |
| 24     | NC         | No connect  |
| 25     | NC         | No connect  |
| 26     | NC         | No connect  |
| 27     | NC         | No connect  |
| 28     | NC         | No connect  |
| 29     | NC         | No connect  |
| 30     | NC         | No connect  |

**[Note 1]** Relation between LVDS signals and actual data shows below section (4-2).

**[Note 2]** The shielding case is connected with signal GND.

### 4-2 Interface block diagram

Using receiver : DS90CF364(National semiconductor)    Corresponding Transmitter : DS90C363,DS90C383(National semiconductor)



### 4-3. Backlight driving

CN2: BHSR-02VS-1(JST)

Mating connector: SM02B-BHSS-1-TB (JST) or 87210-0200

| Pin No. | Symbol            | Function                                  |
|---------|-------------------|---|
| 1       | V <sub>HIGH</sub> | Power supply for lamp (High voltage side) |
| 2       | V <sub>LOW</sub>  | Power supply for lamp (Low voltage side)  |

## 5. Absolute Maximum Ratings

### 5-1 LCD module

| Parameter                          | Symbol         | Condition | Ratings        | Unit | Remark         |
|------------------------------------|----------------|-----------|----------------|------|----------------|
| Input voltage                      | V <sub>I</sub> | Ta=25°C   | -0.3 ~ VDD+0.3 | V    | <b>【Note1】</b> |
| +3.3V supply voltage               | VDD            | Ta=25°C   | 0 ~ +4         | V    |                |
| Storage temperature                | Tstg           | —         | -25 ~ +60      | °C   | <b>【Note2】</b> |
| Operating temperature<br>(Ambient) | Topa           | —         | 0 ~ +50        | °C   |                |

**【Note1】** LVDS signals

**【Note2】** Humidity : 95%RH Max. at Ta ≤ 40°C.

Maximum wet-bulb temperature at 39°C or less at Ta > 40°C.

No condensation.

**【Note3】** When you apply the LCD module for OA system. Please make sure to keep the temperature of LCD module is less than 60°C.

**6. Electrical Characteristics**
**6-1. TFT-LCD panel driving**
**Ta=25°C**

| Parameter                            |                     | Symbol            | Min. | Typ. | Max. | Unit   | Remark                                   |
|--------------------------------------|---------------------|-------------------|------|------|------|--------|--|
| VDD                                  | Supply voltage      | VDD               | +3.0 | +3.3 | +3.6 | V      | <b>【Note2】</b>                           |
|                                      | Current dissipation | IDD               | —    | 420  | 700  | mA     | <b>【Note3】</b>                           |
| Permissible input ripple voltage     |                     | V <sub>RP</sub>   | —    | —    | 100  | mV p-p | V <sub>CC</sub> =+3.3V                   |
| Differential input Threshold voltage | High                | V <sub>TH</sub>   | —    | —    | +100 | mV     | V <sub>CM</sub> =+1.2V<br><b>【Note1】</b> |
|                                      | Low                 | V <sub>TL</sub>   | -100 | —    | —    | mV     |  |
| Terminal resistor                    |                     | R <sub>T</sub>    | —    | 100  | —    | Ω      | Differential input                       |
| Rush current                         |                     | I <sub>RUSH</sub> |      |      | 1.5  | A      | Rise time<br>470uS                       |

**【Note1】** V<sub>CM</sub> : Common mode voltage of LVDS driver.

**【Note2】**

On-off conditions for supply voltage

$0.5 < t_1 \leq 10 \text{ ms}$

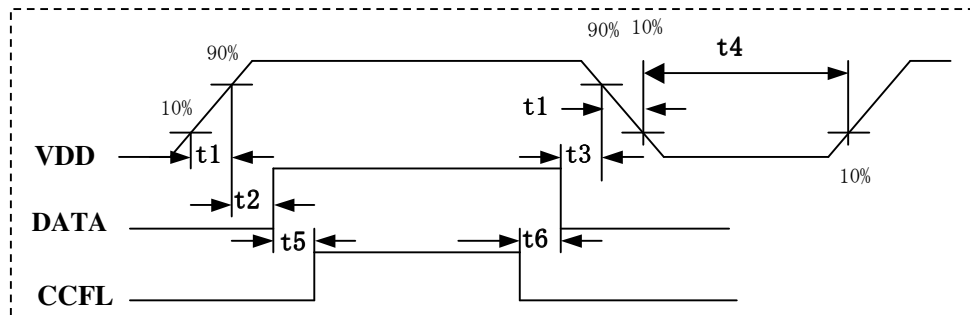
$0 < t_2 \leq 50 \text{ ms}$

$0 < t_3 \leq 50 \text{ ms}$

$400 \text{ ms} \leq t_4$

$200 \text{ ms} \leq t_5$

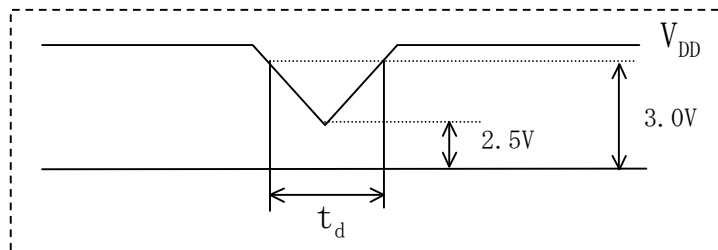
$200 \text{ ms} \leq t_6$


**V<sub>DD</sub>-dip conditions**

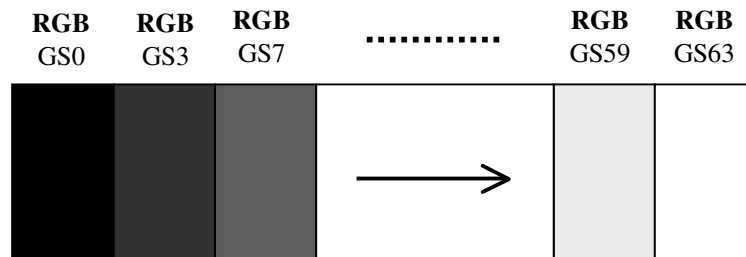
1)  $2.5 \text{ V} \leq V_{DD} < 3.0 \text{ V}$

$t_d \leq 10 \text{ ms}$

2)  $V_{DD} < 2.5 \text{ V}$


 V<sub>DD</sub>-dip conditions should also follow the On-off conditions for supply voltage

**【Note3】** Typical current situation : 16-gray-bar pattern.

**VDD=+3.3V**


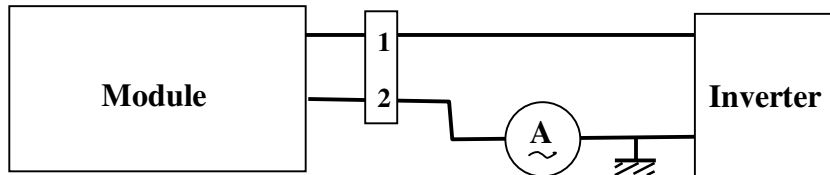
## 6-2. Backlight driving

The backlight system is an edge-lighting type with single CCFT (Cold Cathode Fluorescent Tube).

The characteristics of the lamp are shown in the following table.

| Parameter              | Symbol | Min.  | Typ. | Max. | Unit  | Remark                               |
|------------------------|--------|-------|------|------|-------|--------------------------------------|
| Lamp current range     | $I_L$  | 3.0   | 6.0  | 6.5  | mArms | <b>【Note1】</b>                       |
| Lamp voltage           | $V_L$  | 594   | 660  | 726  | Vrms  |                                      |
| Lamp power consumption | $P_L$  | —     | 3.96 | —    | W     | $I_L=6.0\text{mA}$ <b>【Note2】</b>    |
| Lamp frequency         | $F_L$  | 50    | 55   | 60   | kHz   | <b>【Note3】</b>                       |
| Kick-off voltage       | $V_s$  | —     | —    | 1350 | Vrms  | $T_a=25^\circ\text{C}$               |
|                        |        | —     | —    | 1500 | Vrms  | $T_a=0^\circ\text{C}$ <b>【Note4】</b> |
| Lamp life time         | $L_L$  | 10000 | —    | —    | hour  | <b>【Note5】</b>                       |

**【Note1】** Lamp current is measured with current meter for high frequency as shown below.



**【Note2】** Calculated Value for reference ( $I_L \times V_L$ )

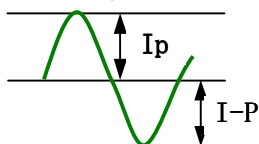
**【Note3】** Lamp frequency may produce interference with horizontal synchronous frequency, and this may cause beat on the display. Therefore lamp frequency shall be detached as much as possible from the horizontal synchronous frequency and from the harmonics of horizontal synchronous to avoid interference.

**【Note4】** The voltage above this value should be applied to the lamp for more than 1 second to start-up. Otherwise the lamp may not be turned on.

**【Note5】** Lamp life time is defined as the time when either ① or ② occurs in the continuous operation under the condition of  $T_a = 25^\circ\text{C}$  and  $I_L = 6.0 \text{ mArms}$ .

- ① Brightness becomes 50 % of the original value under standard condition.
- ② Kick-off voltage at  $T_a = 0^\circ\text{C}$  exceeds maximum value.

**【Note6】** The output of the inverter must have symmetrical waveform of voltage and current. The unsymmetrical rate should be less than 10%. You don't use the inverter which has unsymmetrical voltage, unsymmetrical current and spike wave.



\* Unsymmetrical ratio:  $(|I_p| - |I_{-P}|) / |I_{rms}| \times 100\% \leq 5\%$

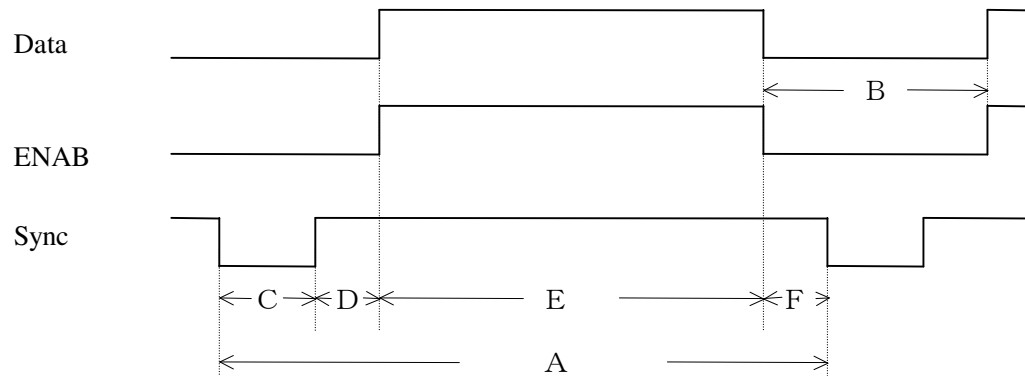
\* Distortion ratio:  $I_p \text{ (or } |I_{-P}|) / |I_{rms}| \leq \sqrt{2} \pm 10\%$

**Note)** The performance of the backlight, for example life time or brightness, is much influenced by the characteristics of the DC-AC inverter for the lamp. When you design or order the inverter, please make sure that a poor lighting caused by the mismatch of the backlight and the inverter (miss-lighting, flicker, etc.) never occur. When you confirm it, the module should be operated in the same condition as it is installed in your instrument.

## 7. Timing characteristics of LCD module input signals

### 7-1. Timing characteristics

(This is specified at digital outputs of LVDS driver.)



(Vertical)

| Item (symbol)                                     | Min. | Typ.   | Max. | Unit | Remark   |
|---|------|--------|------|------|----------|
| Vsync cycle ( $T_{VA}$ )                          | —    | 16.667 | —    | ms   | Negative |
|   | 803  | 806    |      | line |          |
| Blanking period( $T_{VB}$ )                       | 35   | 38     | —    | line |          |
| Sync pulse width ( $T_{VC}$ )                     | 4    | 6      | —    | line |          |
| Back porch ( $T_{VD}$ )                           | 0    | 29     |      | line |          |
| Sync pulse width + Back porch ( $T_{VC}+T_{VD}$ ) | 35   | 35     | 35   | line |          |
| Active display area ( $T_{VE}$ )                  | 768  | 768    | 768  | line |          |
| Front porch ( $T_{VF}$ )                          | 0    | 3      | —    | line |          |

(Horizontal)

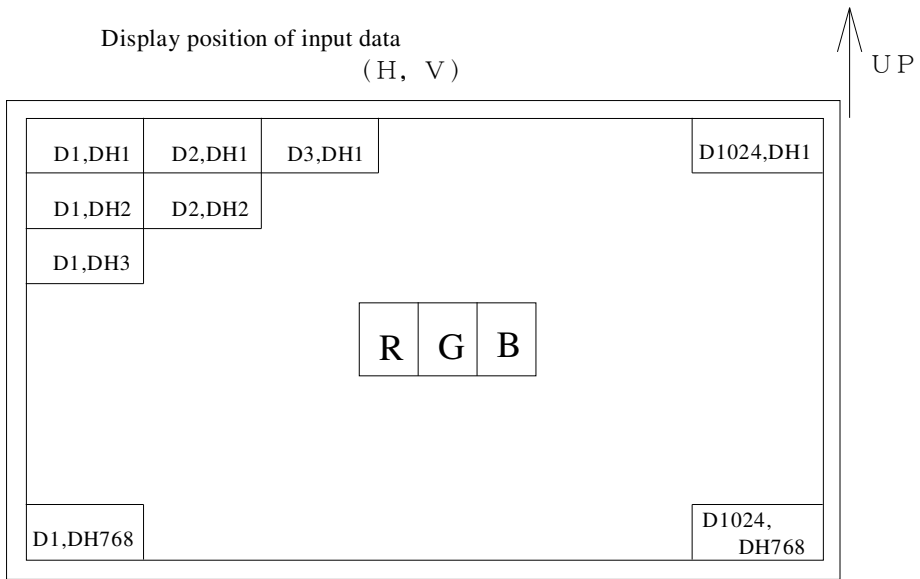
| Item (symbol)                                       | Min.            | Typ.   | Max.            | Unit    | Remark   |
|---|-----------------|--------|-----------------|---------|----------|
| Hsync cycle ( $T_{HA}$ )                            | 19.2            | 20.677 | —               | $\mu$ s | Negative |
|   | 1260            | 1344   | 1408            | clock   |          |
| Blanking period ( $T_{HB}$ )                        | 236             | 320    | —               | clock   |          |
| Sync pulse width ( $T_{HC}$ )                       | 8               | 136    | —               | clock   |          |
| Back porch ( $T_{HD}$ )                             | 0               | 160    | 312             | clock   |          |
| Sync pulse width + Back porch ( $T_{HC} + T_{HD}$ ) | $1500 - T_{HA}$ | 296    | $T_{HA} - 1024$ | clock   |          |
| Active display area ( $T_{HE}$ )                    | 1024            | 1024   | 1024            | clock   |          |
| Front porch ( $T_{HF}$ )                            | 8               | 24     | —               | clock   |          |

(Clock)

| Item      | Min. | Typ. | Max. | Unit | Remark         |
|-----------|------|------|------|------|----------------|
| Frequency | —    | 65.0 | 65.0 | MHz  | <b>[Note1]</b> |

Note) In case of lower frequency, the deterioration of display quality, flicker etc., may be occurred.

## 7-2. Input Data Signals and Display Position on the screen



**8. Input Signals, Basic Display Colors and Gray Scale of Each Color & EDID Data Structure**

|                     | Colors &<br>Gray scale | Data signal |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|---------------------|------------------------|-------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|                     |                        | Gray Scale  | R0 | R1 | R2 | R3 | R4 | R5 | G0 | G1 | G2 | G3 | G4 | G5 | B0 | B1 | B2 | B3 | B4 | B5 |
| Basic Color         | Black                  | —           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | Blue                   | —           | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  |
|                     | Green                  | —           | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | Cyan                   | —           | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
|                     | Red                    | —           | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | 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  |
| Gray Scale of Red   | Black                  | GS0         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | ↑                      | GS1         | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | Darker                 | GS2         | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | ↑                      | ↓           | ↓  |    |    |    |    | ↓  |    |    |    |    | ↓  |    |    |    |    |    |    |    |
|                     | ↓                      | ↓           | ↓  |    |    |    |    | ↓  |    |    |    |    | ↓  |    |    |    |    |    |    |    |
|                     | Brighter               | GS61        | 1  | 0  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | ↓                      | GS62        | 0  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | Red                    | GS63        | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| Gray Scale of Green | Black                  | GS0         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | ↑                      | GS1         | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | Darker                 | GS2         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | ↑                      | ↓           | ↓  |    |    |    |    | ↓  |    |    |    |    | ↓  |    |    |    |    |    |    |    |
|                     | ↓                      | ↓           | ↓  |    |    |    |    | ↓  |    |    |    |    | ↓  |    |    |    |    |    |    |    |
|                     | Brighter               | GS61        | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | ↓                      | GS62        | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | Green                  | GS63        | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0  | 0  | 0  | 0  |
| Gray Scale of Blue  | Black                  | GS0         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | ↑                      | GS1         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  | 0  |
|                     | Darker                 | GS2         | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0  | 0  | 0  |
|                     | ↑                      | ↓           | ↓  |    |    |    |    | ↓  |    |    |    |    | ↓  |    |    |    |    |    |    |    |
|                     | ↓                      | ↓           | ↓  |    |    |    |    | ↓  |    |    |    |    | ↓  |    |    |    |    |    |    |    |
|                     | Brighter               | GS61        | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 1  | 1  | 1  | 1  |
|                     | ↓                      | GS62        | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  |
|                     | Blue                   | GS63        | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 1  | 1  | 1  | 1  | 1  |

0 : Low level voltage, 1 : High level voltage

Each basic color can be displayed in 64 gray scales from 6 bit data signals. According to the combination of total 18 bit data signals, the 262,144-color display can be achieved on the screen.

**9.EDID data structure**

This is the EDID (Extended Display Identification Data) data format to support displays as defined in the VESA Plug & Display.

| Byte (decimal) | Byte (hex) | Field Name and Comments                          | Value (hex) | Value (binary) |
|----------------|------------|--|-------------|----------------|
| 0              | 00         | Header   | 00          | 00000000       |
| 1              | 01         | Header   | FF          | 11111111       |
| 2              | 02         | Header   | FF          | 11111111       |
| 3              | 03         | Header   | FF          | 11111111       |
| 4              | 04         | Header   | FF          | 11111111       |
| 5              | 05         | Header   | FF          | 11111111       |
| 6              | 06         | Header   | FF          | 11111111       |
| 7              | 07         | Header   | 00          | 00000000       |
| 8              | 08         | EISA manufacture code=QDS                        | 44          | 01000100       |
| 9              | 09         | EISA manufacture code (Compressed ASCII)         | 93          | 10010011       |
| 10             | 0A         | Product code (52) LSB                            | 34          | 00110100       |
| 11             | 0B         | Product code MSB                                 | 00          | 00000000       |
| 12             | 0C         | ID (32bit) Serial No (zero if not used)          | 00          | 00000000       |
| 13             | 0D         | ID (32bit) Serial No (zero if not used)          | 00          | 00000000       |
| 14             | 0E         | ID (32bit) Serial No (zero if not used)          | 00          | 00000000       |
| 15             | 0F         | ID (32bit) Serial No (zero if not used)          | 00          | 00000000       |
| 16             | 10         | Week of manufacture                              | xx          | xxxxxxxxxx     |
| 17             | 11         | Year of manufacture-1990 (ex. 2005 -1990=15)     | xx          | xxxxxxxxxx     |
| 18             | 12         | EDID structure version # = 1                     | 01          | 00000001       |
| 19             | 13         | EDID revision # = 3                              | 03          | 00000011       |
| 20             | 14         | Video I/P definition = Digital I/P               | 80          | 10000000       |
| 21             | 15         | Max H image size (cm) = 30cm                     | 1E          | 00011110       |
| 22             | 16         | Max V image size (cm) = 23cm                     | 17          | 00010111       |
| 23             | 17         | Display gamma=2.2 ( 2.2 × 100 ) -100= 120        | 78          | 01111000       |
| 24             | 18         | Features (no DMPS, Active off, RGB, timing BLK1) | 0A          | 00001010       |
| 25             | 19         | Red/Green Low bits (RxRy/GxGy)                   | 0B          | 00001011       |
| 26             | 1A         | Blue/White Low bits (BxBY/WxWy)                  | C0          | 11000000       |
| 27             | 1B         | Red X Rx=0.555                                   | 8E          | 10001110       |
| 28             | 1C         | Red Y Ry=0.317                                   | 51          | 01010001       |
| 29             | 1D         | Green X Gx=0.299                                 | 4C          | 01001100       |
| 30             | 1E         | Green Y Gy=0.566                                 | 90          | 10010000       |
| 31             | 1F         | Blue X Bx=0.152                                  | 26          | 00100110       |
| 32             | 20         | Blue Y By=0.137                                  | 23          | 00100011       |
| 33             | 21         | White X Wx=0.313                                 | 50          | 01010000       |
| 34             | 22         | White Y Wy=0.329                                 | 54          | 01010100       |
| 35             | 23         | Established timing 1                             | 00          | 00000000       |
| 36             | 24         | Established timing 2                             | 00          | 00000000       |
| 37             | 25         | Manufacture's timing                             | 00          | 00000000       |
| 38             | 26         | Standard timing ID1                              | 01          | 00000001       |
| 39             | 27         | Standard timing ID1                              | 01          | 00000001       |
| 40             | 28         | Standard timing ID2                              | 01          | 00000001       |
| 41             | 29         | Standard timing ID2                              | 01          | 00000001       |



|    |    |   |    |          |
|----|----|---|----|----------|
| 42 | 2A | Standard timing ID3   | 01 | 00000001 |
| 43 | 2B | Standard timing ID3   | 01 | 00000001 |
| 44 | 2C | Standard timing ID4   | 01 | 00000001 |
| 45 | 2D | Standard timing ID4   | 01 | 00000001 |
| 46 | 2E | Standard timing ID5   | 01 | 00000001 |
| 47 | 2F | Standard timing ID5   | 01 | 00000001 |
| 48 | 30 | Standard timing ID6   | 01 | 00000001 |
| 49 | 31 | Standard timing ID6   | 01 | 00000001 |
| 50 | 32 | Standard timing ID7   | 01 | 00000001 |
| 51 | 33 | Standard timing ID7   | 01 | 00000001 |
| 52 | 34 | Standard timing ID8   | 01 | 00000001 |
| 53 | 35 | Standard timing ID8   | 01 | 00000001 |
| 54 | 36 | Pixel Clock/10,000 (LSB)  | 64 | 01100100 |
| 55 | 37 | Pixel Clock/10,000 (MSB)  | 19 | 00011001 |
| 56 | 38 | Horizontal active 1024=400h "00"  | 00 | 00000000 |
| 57 | 39 | Horizontal blanking 320=140h "40"   | 40 | 01000000 |
| 58 | 3A | Horizontal active/Horizontal blanking "41h"   | 41 | 01000001 |
| 59 | 3B | Vertical active 768=300h "00"   | 00 | 00000000 |
| 60 | 3C | Vertical blanking 38=026h "26"  | 26 | 00100110 |
| 61 | 3D | Vertical active/Vertical blanking "30h"   | 30 | 00110000 |
| 62 | 3E | Horizontal sync, offset 24=018h "18"  | 18 | 00011000 |
| 63 | 3F | Horizontal sync, width 136=088h "88"  | 88 | 10001000 |
| 64 | 40 | Vertical sync, offset/Vertical sync, width  | 36 | 00110110 |
| 65 | 41 | Horizontal sync offset/width/Vertical sync offset/width   | 00 | 00000000 |
| 66 | 42 | Horizontal image size 304mm=130h "30"   | 30 | 00110000 |
| 67 | 43 | Vertical image size 228mm=E4h "E4"  | E4 | 11100100 |
| 68 | 44 | Horizontal image size / Vertical image size   | 10 | 00010000 |
| 69 | 45 | Horizontal border   | 00 | 00000000 |
| 70 | 46 | Vertical border   | 00 | 00000000 |
| 71 | 47 | Non-interlaced, Normal, no stereo, Separate sync, H/V pol<br>Negatives, DE only note LSB is set to "1" if panel is DE-<br>only timing (H/V can be ignored). | 19 | 00011001 |
| 72 | 48 | Flag  | 00 | 00000000 |
| 73 | 49 | Flag  | 00 | 00000000 |
| 74 | 4A | Flag  | 00 | 00000000 |
| 75 | 4B | Dada Type Tag: Descriptor Defined by Manufacturer   | 0F | 00001111 |
| 76 | 4C | Flag  | 00 | 00000000 |
| 77 | 4D | Value = $HSPW_{min} / 2$ (pixel clks) = $8/2 = 4$   | 04 | 00000100 |
| 78 | 4E | Value = $HSPW_{max} / 2$ (pixel clks) = $384/2 = 192$   | C0 | 11000000 |
| 79 | 4F | Value = $Thbp_{min} / 2$ (pixel clks) = $92/2 = 46$   | 2E | 00101110 |
| 80 | 50 | Value = $Thbp_{max} / 2$ (pixel clks) = $384/2 = 192$   | C0 | 11000000 |
| 81 | 51 | Value = $VSPW_{min} / 2$ (line pulses) = $4/2 = 2$  | 02 | 00000010 |
| 82 | 52 | Value = $VSPW_{max} / 2$ (line pulses) = $35/2 = 17$  | 11 | 00010001 |
| 83 | 53 | Value = $Tvbp_{min} / 2$ (line pulses) = $35/2 = 17$  | 11 | 00010001 |
| 84 | 54 | Value = $Tvbp_{max} / 2$ (line pulses) = $35/2 = 17$  | 11 | 00010001 |
| 85 | 55 | $Thp_{min} = value * 2 + HA_{pixel\ clks}$ (pixel clks), value = 118  | 76 | 01110110 |
| 86 | 56 | $Thp_{max} = value * 2 + HA_{pixel\ clk}$ (pixelclks), value = 192  | C0 | 11000000 |
| 87 | 57 | $Tvp_{min} = value * 2 + VA_{lines}$ (line pulses), value = 18  | 12 | 00010010 |
| 88 | 58 | $Tvp_{max} = value * 2 + VA_{lines}$ (line pulses), value = 99  | 63 | 01100011 |
| 89 | 59 | Module Revision = 00  | 00 | 00000000 |
| 90 | 5A | Flag  | 00 | 00000000 |
| 91 | 5B | Flag  | 00 | 00000000 |

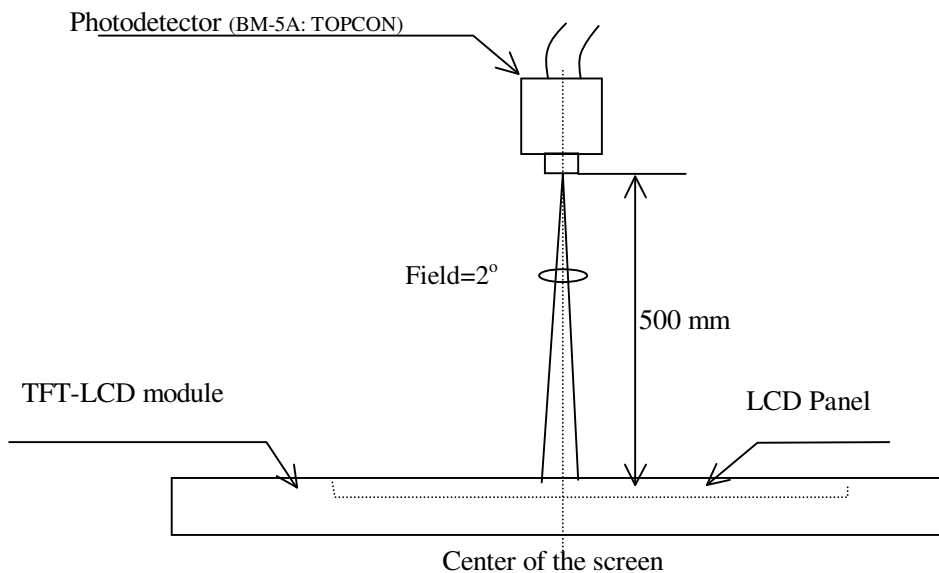


|     |    |  |    |            |
|-----|----|--|----|------------|
| 92  | 5C | Flag   | 00 | 00000000   |
| 93  | 5D | Data Type Tag: (Monitor) ASCII String                                    | FE | 11111110   |
| 94  | 5E | Flag   | 00 | 00000000   |
| 95  | 5F | Module serial no.  | XX | XXXXXXXXXX |
| 96  | 60 | Module serial no.  | XX | XXXXXXXXXX |
| 97  | 61 | Module serial no.  | XX | XXXXXXXXXX |
| 98  | 62 | Module serial no.  | XX | XXXXXXXXXX |
| 99  | 63 | Module serial no.  | XX | XXXXXXXXXX |
| 100 | 64 | Module serial no.  | XX | XXXXXXXXXX |
| 101 | 65 | Module serial no.  | XX | XXXXXXXXXX |
| 102 | 66 | Module serial no.  | XX | XXXXXXXXXX |
| 103 | 67 | Module serial no.  | XX | XXXXXXXXXX |
| 104 | 68 | Module serial no.  | XX | XXXXXXXXXX |
| 105 | 69 | Module serial no.  | XX | XXXXXXXXXX |
| 106 | 6A | Module serial no.  | XX | XXXXXXXXXX |
| 107 | 6B | Module serial no.  | XX | XXXXXXXXXX |
| 108 | 6C | Flag   | 00 | 00000000   |
| 109 | 6D | Flag   | 00 | 00000000   |
| 110 | 6E | Flag   | 00 | 00000000   |
| 111 | 6F | Data Type Tag: (Monitor) ASCII String                                    | FE | 11111110   |
| 112 | 70 | Flag   | 00 | 00000000   |
| 113 | 71 | Q  | 51 | 01010001   |
| 114 | 72 | D  | 44 | 01000100   |
| 115 | 73 | 1  | 31 | 00110001   |
| 116 | 74 | 5  | 35 | 00110101   |
| 117 | 75 | X  | 58 | 01011000   |
| 118 | 76 | L  | 4C | 01001100   |
| 119 | 77 | 0  | 30 | 00110000   |
| 120 | 78 | 6  | 36 | 00110110   |
| 121 | 79 | Rev. 04  | 34 | 00110100   |
| 122 | 7A | Terminate with 0Ah   | 0A | 00001010   |
| 123 | 7B | Pad field with ASCII code 20h  | 20 | 00100000   |
| 124 | 7C | Pad field with ASCII code 20h  | 20 | 00100000   |
| 125 | 7D | (If<13 char, then terminate with ASCII code 0Ah, set remaining char=20h) | 20 | 00100000   |
| 126 | 7E | Extension flag   | 00 | 00000000   |
| 127 | 7F | Checksum   | XX | XXXXXXXXXX |

**10. Optical Characteristics**
**Ta=25°C, V<sub>DD</sub>=+3.3V**

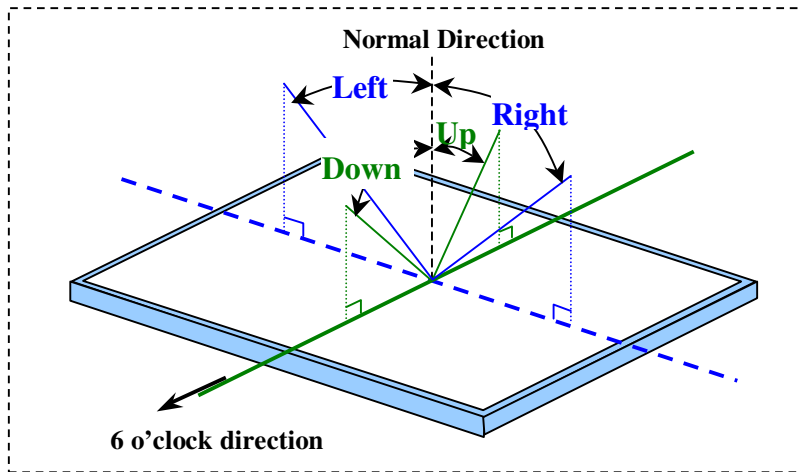
| Parameter                     | Symbol          | Condition          | Min.               | Typ.  | Max.  | Unit              | Remark  |           |
|-------------------------------|-----------------|--------------------|--------------------|-------|-------|-------------------|---|-----------|
| Viewing Angle Range           | Horizontal      | Left,Right         | CR>10              | 45    | —     | —                 | Deg.  | 【Note1,4】 |
|                               | Vertical        | Up                 |                    | 15    | —     | —                 | Deg.  |           |
|                               |                 | Down               |                    | 35    | —     | —                 | Deg.  |           |
| Contrast ratio                | C R n           | $\theta = 0^\circ$ | 200                | 300   | —     |                   | 【Note2,4】   |           |
| Response Time                 | Rise            | $\tau r$           | $\theta = 0^\circ$ | —     | 5     | —                 | ms  | 【Note3,4】 |
|                               | Decay           | $\tau d$           |                    | —     | 20    | —                 | ms  |           |
| Chromaticity of White         | W <sub>x</sub>  |                    | 0.283              | 0.313 | 0.343 |                   | 【Note4】   |           |
|                               | W <sub>y</sub>  |                    | 0.299              | 0.329 | 0.359 |                   |   |           |
| Chromaticity of Red           | R <sub>x</sub>  |                    | 0.525              | 0.555 | 0.585 |                   |   |           |
|                               | R <sub>y</sub>  |                    | 0.287              | 0.317 | 0.347 |                   |   |           |
| Chromaticity of Green         | G <sub>x</sub>  |                    | 0.269              | 0.299 | 0.329 |                   |   |           |
|                               | G <sub>y</sub>  |                    | 0.536              | 0.566 | 0.596 |                   |   |           |
| Chromaticity of Blue          | B <sub>x</sub>  |                    | 0.122              | 0.152 | 0.182 |                   |   |           |
|                               | B <sub>y</sub>  |                    | 0.107              | 0.137 | 0.167 |                   |   |           |
| Luminance of white<br>【Note4】 | Y <sub>L2</sub> | Center             | 130                | 160   | —     | Cd/m <sup>2</sup> | I <sub>L</sub> = 6.0mA <sub>rms</sub><br>F <sub>L</sub> = 55kHz |           |
| White Uniformity              | $\delta_w$      | 5 Points           | —                  | —     | 1.45  |                   | 【Note5】   |           |

The optical characteristics shall be measured in a dark room or equivalent state with the method shown in Fig.3.



**Fig 3. Optical characteristics measurement method**

**[Note1] Definitions of viewing angle range:**



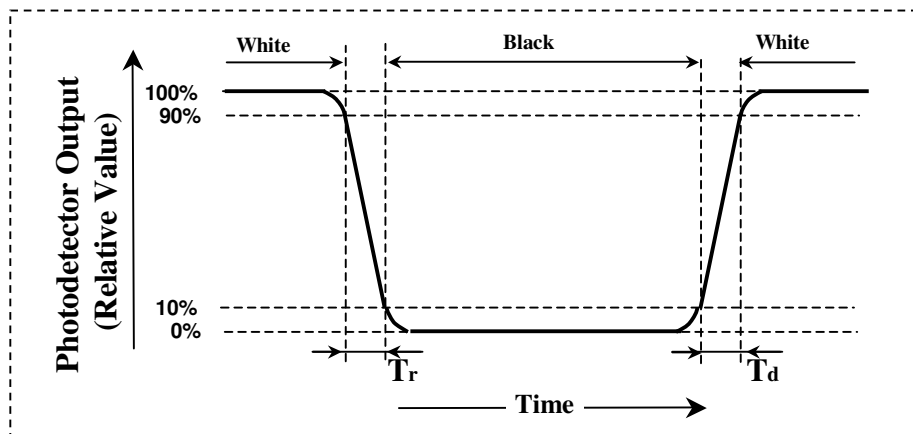
**[Note2] Definition of contrast ratio:**

The contrast ratio is defined as the following.

$$\text{Contrast Ratio (CR)} = \frac{\text{Luminance (brightness) with all pixels white}}{\text{Luminance (brightness) with all pixels black}}$$

**[Note3] Definition of response time:**

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white" .



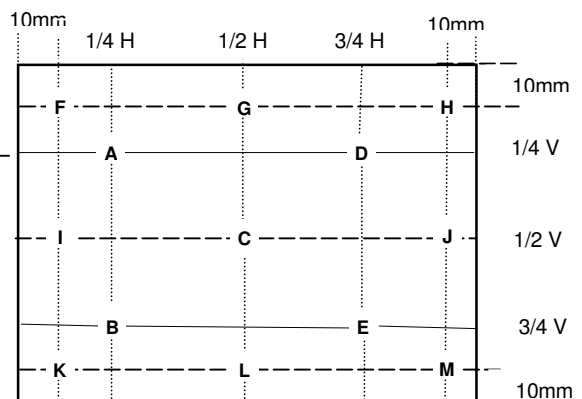
**[Note4] This shall be measured at center of the screen.**

**[Note5] Definition of white uniformity:**

$$\delta w = \frac{\text{Maximum Luminance of 5 points}}{\text{Minimum Luminance of 5 points}}$$

\*1) 5 Points are A,B,C,D,E

\*2) 13 Points are A~M



**11. Display Quality**

The display quality of the color TFT-LCD module shall be in compliance with the Incoming Inspection Standard.

**12. Handling Precautions**

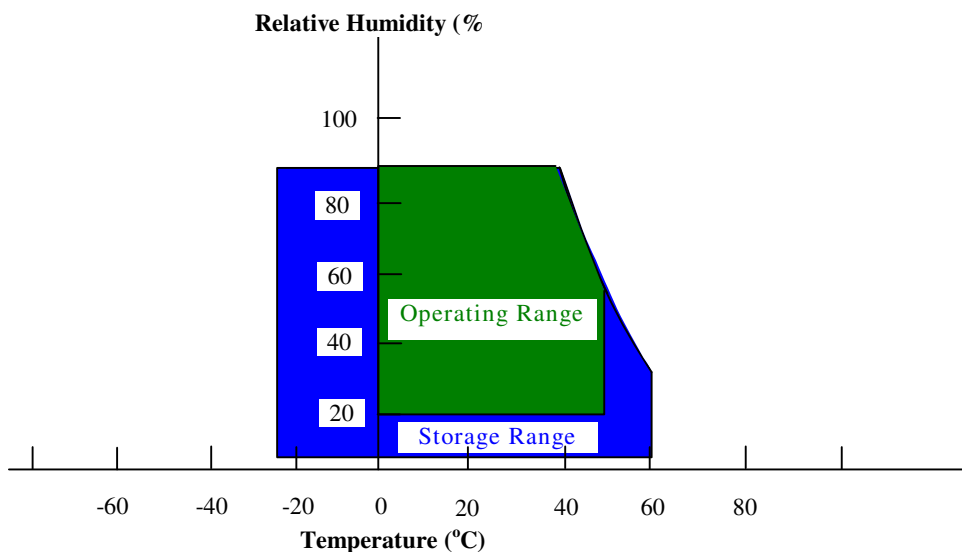
- a) Be sure to turn off the power supply when inserting or disconnecting the cable.
- b) Be sure to design the cabinet so that the module can be installed without any extra stress such as warp or twist.
- c) Since the front polarizer is easily damaged, pay attention not to scratch it.
- d) Wipe off water drop immediately. Long contact with water may cause discoloration or spots.
- e) When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.
- f) Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface. Handle with care.
- g) Since CMOS LSI is used in this module, take care of static electricity and injure the human earth when handling.
- h) Observe all other precautionary requirements in handling components.
- i) This module has its circuitry PCBs on the rear side and should be handled carefully in order not to be stressed.
- j) Laminated film is attached to the module surface to prevent it from being scratched. Peel the film off slowly just before the use with strict attention to electrostatic charges. Ionized air shall be blown over during the action. Blow off the 'dust' on the polarizer by using an ionized nitrogen gun, etc..
- k) Cold cathode fluorescent lamp in LCD panel contains a small amount of mercury, please follow local ordinance or regulation for disposal.

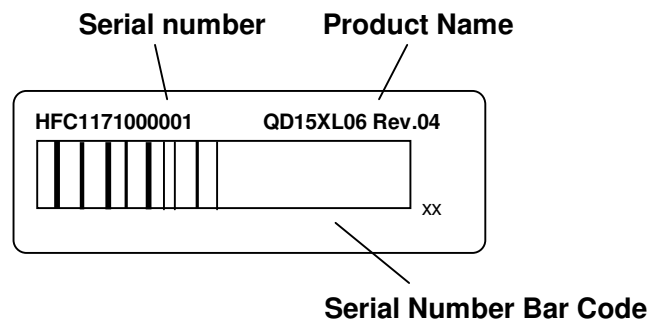
**13. Reliability test items**

| No. | Test item                                       | Conditions  |
|-----|---|---|
| 1   | High temperature storage test                   | Ta = 60°C    240h   |
| 2   | Low temperature storage test                    | Ta = -25°C    240h  |
| 3   | High temperature & high humidity operation test | Ta = 40°C ; 90 %RH    240h ; (As remark 3)<br>(No condensation)   |
| 4   | High temperature operation test                 | Ta = 50°C    240h<br>(The panel temp. must be less than 60°C)   |
| 5   | Low temperature operation test                  | Ta = 0°C    240h  |
| 6   | Vibration test<br>(non- operating)              | Frequency: 10~500Hz, 1.5G, Test period : 3 hours<br>(1 hour for each direction of X,Y,Z)                      |
| 7   | Shock test<br>(non- operating)                  | Max. gravity : 50G<br>Pulse width : 11 ms, Half sine wave<br>Direction : ±X,±Y,±Z<br>once for each direction. |
| 8   | Altitude test (Operating)                       | 700 mbar / 48hrs  |
| 9   | Altitude test (non-Operating)                   | 260 mbar / 48hrs  |

**Remark:**

- (1) A failure is defined as the appearance of pixel failed on any color layer or the appearance of horizontal or vertical lines, bars etc.
- (2) Low temperature storage “ Panel must return to operating temperature range prior to activation.”
- (3) Hi temperature / Humidity test  
Max. wet-bulb temperature is less than 39°C ; At glass temperature high than 40°C.  
Temperature and relative humidity range is shown in the figure below.



**14. Others****1) Lot No. Label:**

- 2) Disassembling the module can cause permanent damage and should be strictly avoided.**
- 3) Please be careful since image retention may occur when a fixed pattern is displayed for a long time.**
- 4) If any problem occurs in relation to the description of this specification, it shall be resolved through discussion with spirit of cooperation.**





