

Doc. Number:

- Tentative Specification
- Preliminary Specification
- Approval Specification

MODEL NO.: N156BGE

SUFFIX: P41

| | |
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| Customer: | |
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REVISION HISTORY

| Version | Date | Page | Description |
|---------|---------------|------|--------------------------------|
| 2.0 | Mar, 23, 2012 | All | Spec Ver.1.0 was first issued. |
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1. GENERAL DESCRIPTION

1.1 OVERVIEW

N156BGE-P41 is a 15.6 TFT Liquid Crystal Display with LED Driver ICs and a 40-pins-and-1ch-LVDS circuit board. This product supports 1366 x 768 HD mode and can display 262,144 colors. The backlight unit is not built in.

1.2 GENERAL SPECIFICATIONS

| Item | Specification | Unit | Note |
|-------------------|--------------------------|-------|------|
| Screen Size | 15.6" diagonal | | |
| Driver Element | a-si TFT active matrix | - | - |
| Pixel Number | 1366 x R.G.B. x 768 | pixel | - |
| Pixel Pitch | 0.252 (H) x 0.252 (V) | mm | - |
| Pixel Arrangement | RGB vertical stripe | - | - |
| Display Colors | 262,144 | color | - |
| Transmissive Mode | Normally white | - | - |
| Surface Treatment | Hard coating (3H), Glare | - | - |

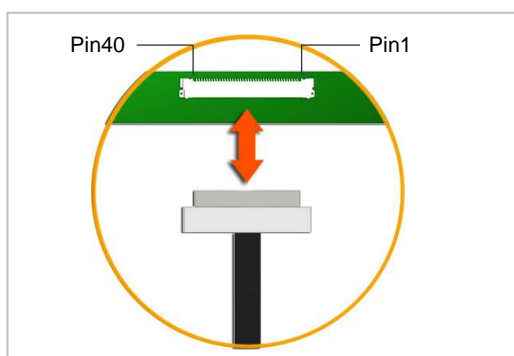
2. MECHANICAL SPECIFICATIONS

| item | | Min. | Typ. | Max. | Unit | Note |
|---------------------------------|-------------------------|--|---------|---------|------|---------|
| Size | Horizontal (H) with PCB | 353.532 | 353.632 | 353.732 | mm | (1) (2) |
| | Horizontal (H) w/o PCB | 353.532 | 353.632 | 353.732 | mm | |
| | Vertical (V) with PCB | 216.436 | 216.536 | 216.636 | mm | |
| | Vertical (V) w/o PCB | 202.736 | 202.836 | 202.936 | mm | |
| | Thickness (T) with PCB | - | 1.565 | - | mm | |
| | Thickness (T) w/o PCB | - | 1.27 | - | mm | |
| Weight | | - | 203.6 | | g | |
| I/F connector mounting position | | The mounting inclination of the connector makes the screen center within ± 0.5 mm as the horizontal. | | | | |

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.

(2) Connector mounting position

2.1 CONNECTOR TYPE



Please refer Appendix Outline Drawing for detail design.

Connector Part No.: IPEX-20455-040E-12

User's connector Part No: IPEX-20453-040T-01 or equivalent

2.1.2 LED Light-Bar Connector

MSK24022P10A

3. ABSOLUTE MAXIMUM RATINGS

3.1 ABSOLUTE RATINGS OF ENVIRONMENT

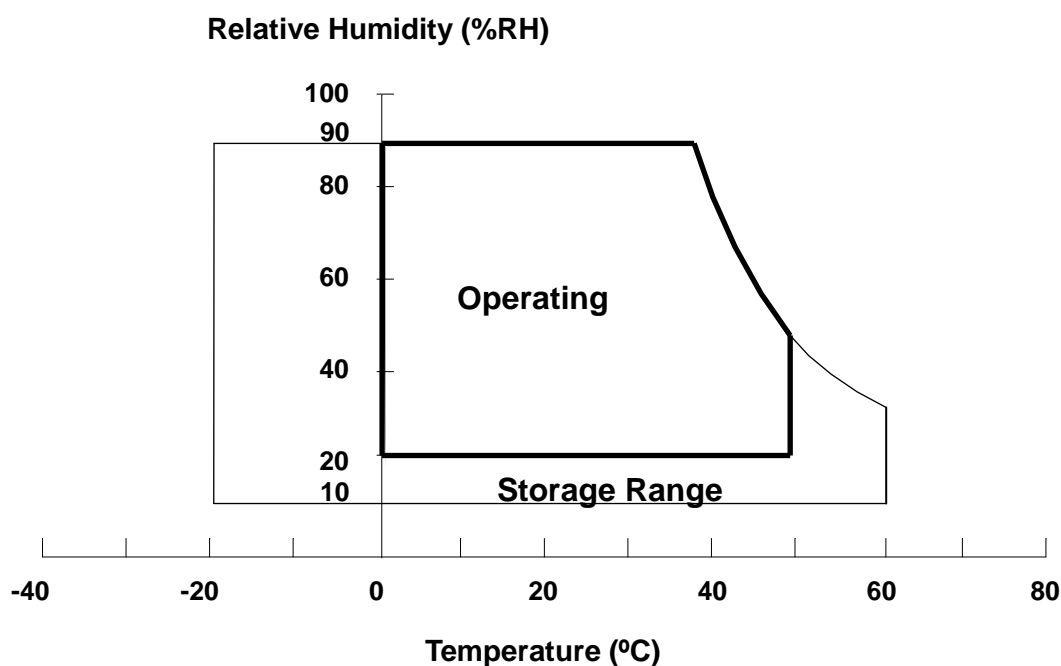
| Item | Symbol | Value | | Unit | Note |
|-------------------------------|-----------------|-------|------|------|----------|
| | | Min. | Max. | | |
| Storage Temperature | T _{ST} | -20 | +60 | °C | (1) |
| Operating Ambient Temperature | T _{OP} | 0 | +50 | °C | (1), (2) |

Note (1) (a) 90 %RH Max. (Ta <= 40 °C).

(b) Wet-bulb temperature should be 39 °C Max. (Ta > 40 °C).

(c) No condensation.

Note (2) The temperature of panel surface should be 0 °C min. and 60 °C max.



3.2 ABSOLUTE RATINGS OF ENVIRONMENT (OPEN CELL)

High temperature or humidity may reduce the performance of panel. Please store LCD panel within the specified storage conditions.

Storage Condition: With packing.

Storage temperature range: 25±5 °C.

Storage humidity range: 50±10%RH.

Shelf life: 30days

3.3 ELECTRICAL ABSOLUTE RATINGS (OPEN CELL)

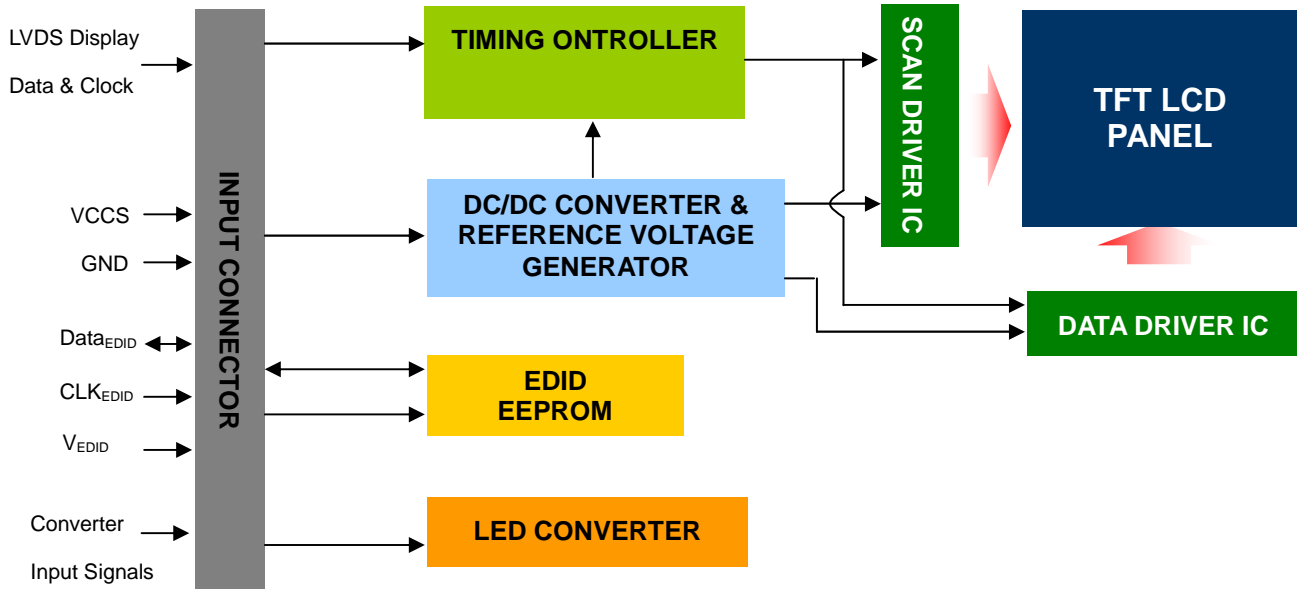
3.3.1 TFT LCD MODULE

| Item | Symbol | Value | | Unit | Note |
|----------------------|-----------------|-------|----------|------|------|
| | | Min. | Max. | | |
| Power Supply Voltage | VCCS | -0.3 | +4.0 | V | (1) |
| Logic Input Voltage | V _{IN} | -0.3 | VCCS+0.3 | V | |

Note (1) Stresses beyond those listed in above “ELECTRICAL ABSOLUTE RATINGS” may cause permanent damage to the device. Normal operation should be restricted to the conditions described in “ELECTRICAL CHARACTERISTICS”.

4. ELECTRICAL SPECIFICATIONS

4.1 FUNCTION BLOCK DIAGRAM



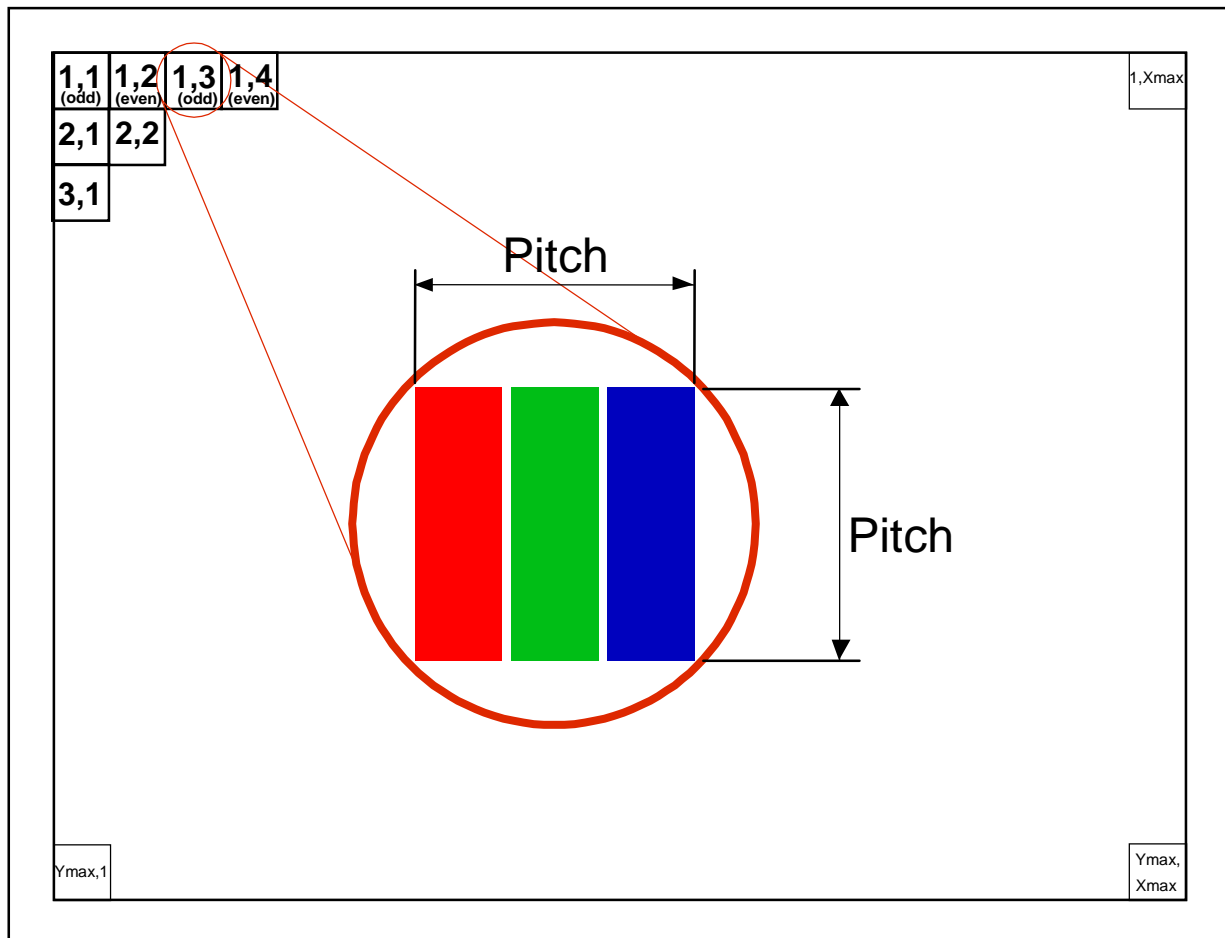
4.2. INTERFACE CONNECTIONS

PIN ASSIGNMENT

| Pin | Symbol | Description | Remark |
|-----|----------|---------------------------------------|-----------------|
| 1 | NC | No Connection (Reserve) | |
| 2 | VCCS | Power Supply (3.3V typ.) | |
| 3 | VCCS | Power Supply (3.3V typ.) | |
| 4 | VEDID | DDC 3.3V power | |
| 5 | NC | No Connection (Reserved for CMI test) | |
| 6 | CLKEDID | DDC clock | |
| 7 | DATAEDID | DDC data | |
| 8 | Rxin0- | LVDS differential data input | R0-R5, G0 |
| 9 | Rxin0+ | LVDS differential data input | |
| 10 | VSS | Ground | |
| 11 | Rxin1- | LVDS differential data input | G1-G5, B0, B1 |
| 12 | Rxin1+ | LVDS differential data input | |
| 13 | VSS | Ground | |
| 14 | Rxin2- | LVDS Differential Data Input | B2-B5,HS,VS, DE |
| 15 | Rxin2+ | LVDS Differential Data Input | |
| 16 | VSS | Ground | |
| 17 | RxCLK- | LVDS differential clock input | LVDS CLK |
| 18 | RxCLK+ | LVDS differential clock input | |
| 19 | VSS | Ground | |
| 20 | NC | No Connection (Reserve) | |

| | | | |
|----|----------|--|--|
| 21 | NC | No Connection (Reserve) | |
| 22 | VSS | Ground | |
| 23 | NC | No Connection (Reserve) | |
| 24 | NC | No Connection (Reserve) | |
| 25 | VSS | Ground | |
| 26 | NC | No Connection (Reserve) | |
| 27 | NC | No Connection (Reserve) | |
| 28 | VSS | Ground | |
| 29 | NC | No Connection (Reserve) | |
| 30 | NC | No Connection (Reserve) | |
| 31 | LED_GND | LED Ground | |
| 32 | LED_GND | LED Ground | |
| 33 | LED_GND | LED Ground | |
| 34 | NC | No Connection (Reserve) | |
| 35 | LED_PWM | PWM Control Signal of LED Converter | |
| 36 | LED_EN | Enable Control Signal of LED Converter | |
| 37 | NC | No Connection (Reserve) | |
| 38 | LED_VCCS | LED Power Supply | |
| 39 | LED_VCCS | LED Power Supply | |
| 40 | LED_VCCS | LED Power Supply | |

Note (1) The first pixel is odd as shown in the following figure.



4.2.2 LED CONVERTER OUTPUT PIN ASSIGNMENT

| Pin | Symbol | Description | Remark |
|-----|--------|----------------------------------|--------|
| 1 | NC | No Connection (Reserve) | |
| 2 | NC | No Connection (Reserve) | |
| 3 | LED1- | LED Light Bar Feedback Channel | |
| 4 | LED2- | LED Light Bar Feedback Channel | |
| 5 | LED3- | LED Light Bar Feedback Channel | |
| 6 | LED4- | LED Light Bar Feedback Channel | |
| 7 | LED5- | LED Light Bar Feedback Channel | |
| 8 | NC | No Connection (Reserve) | |
| 9 | LED+ | LED Light Bar Input Power Supply | |
| 10 | LED+ | LED Light Bar Input Power Supply | |

4.3 ELECTRICAL CHARACTERISTICS

4.3.1 LCD ELETRONICS SPECIFICATION

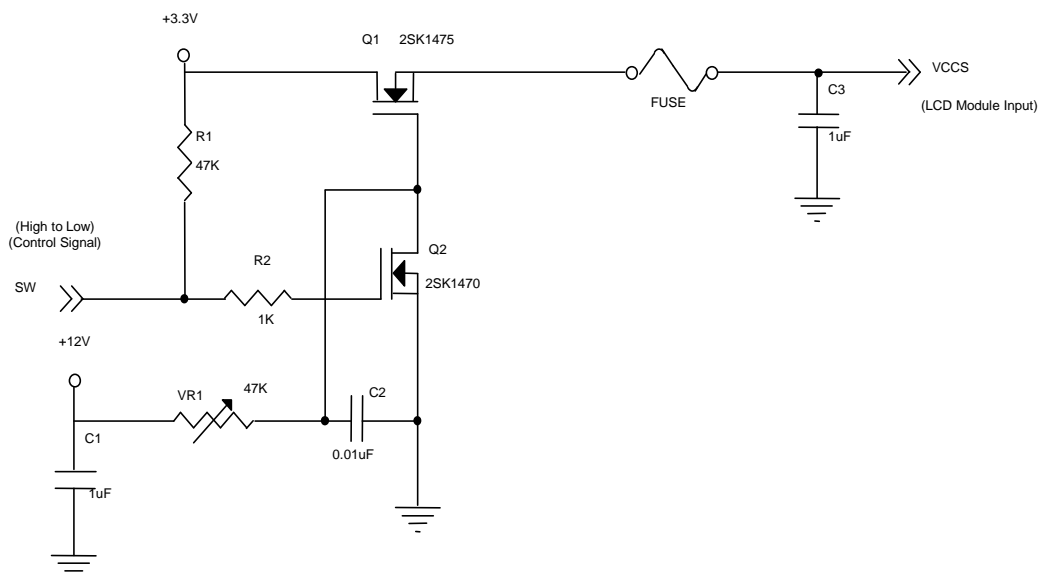
| Parameter | Symbol | Value | | | Unit | Note |
|----------------------|-------------------|-------|------|------|------|---------|
| | | Min. | Typ. | Max. | | |
| Power Supply Voltage | VCCS | 3.0 | 3.3 | 3.6 | V | (1) |
| Ripple Voltage | V _{RP} | - | 50 | - | mV | (1) |
| Inrush Current | I _{RUSH} | - | - | 1.5 | A | (1),(2) |
| Power Supply Current | Mosaic | - | 270 | 320 | mA | (3)a |
| | Black | - | 340 | 380 | mA | (3)b |

Note (1) The ambient temperature is $T_a = 25 \pm 2 \text{ }^\circ\text{C}$.

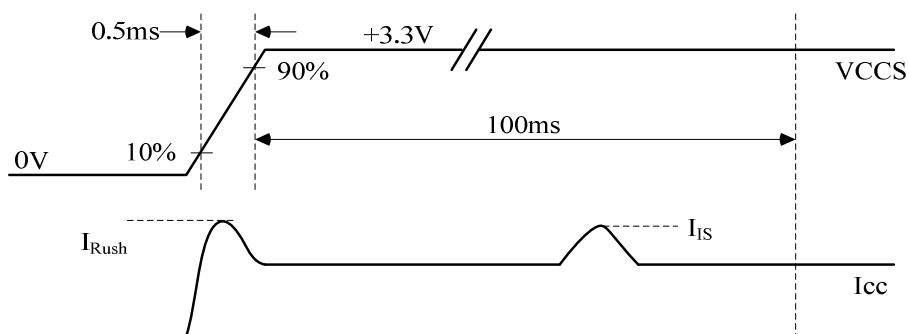
Note (2) I_{RUSH}: the maximum current when VCCS is rising

I_{IS}: the maximum current of the first 100ms after power-on

Measurement Conditions: Shown as the following figure. Test pattern: black.

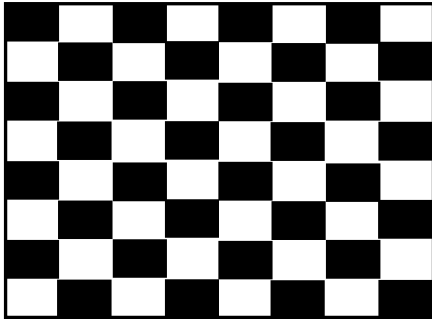


VCCS rising time is 0.5ms



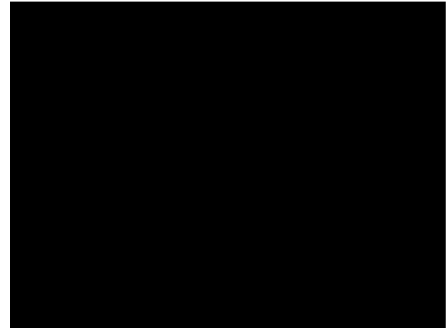
Note (3) The specified power supply current is under the conditions at $V_{CCS} = 3.3 \text{ V}$, $T_a = 25 \pm 2 \text{ }^\circ\text{C}$, DC Current and $f_v = 60 \text{ Hz}$, whereas a power dissipation check pattern below is displayed.

a. Mosaic Pattern



Active Area

b. Black Pattern



Active Area

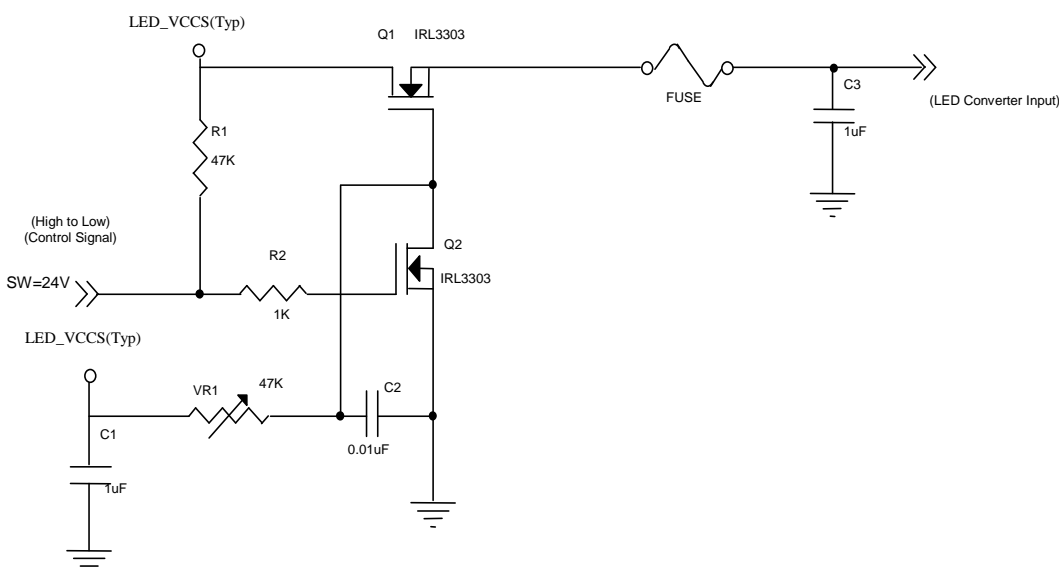
4.3.2 LED CONVERTER SPECIFICATION

| Parameter | | Symbol | Value | | | Unit | Note |
|--|----------------|----------------------|-------|------|------|------|------|
| | | | Min. | Typ. | Max. | | |
| Converter Input power supply voltage | | LED_Vccs | 6.0 | 12.0 | 21.0 | V | |
| Converter Inrush Current | | ILED _{RUSH} | - | - | 1.5 | A | (1) |
| EN Control Level | Backlight On | | 3.0 | - | 3.6 | V | |
| | Backlight Off | | 0 | - | 0.5 | V | |
| PWM Control Level | PWM High Level | | 3.0 | - | 3.6 | V | |
| | PWM Low Level | | 0 | - | 0.5 | V | |
| PWM Control Duty Ratio | | | 10 | - | 100 | % | |
| | | | 5 | - | 100 | % | (2) |
| PWM Control Permissible Ripple Voltage | | VPWM _{pp} | - | - | 100 | mV | |
| PWM Control Frequency | | f _{PWM} | 190 | - | 2K | Hz | (3) |
| LED Power Current | LED_VCCS =Typ. | ILED | 171 | 197 | 214 | mA | (4) |

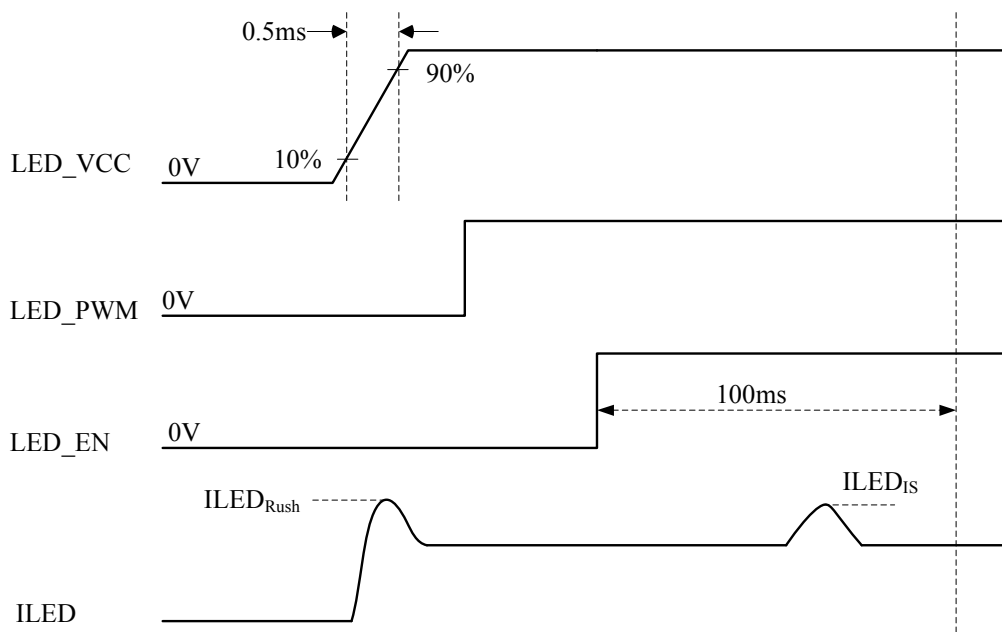
Note (1) ILED_{RUSH}: the maximum current when LED_VCCS is rising,

ILED_{IS}: the maximum current of the first 100ms after power-on,

Measurement Conditions: Shown as the following figure. LED_VCCS = Typ, Ta = 25 ± 2 °C, f_{PWM} = 200 Hz, Duty=100%.



VLED rising time is 0.5ms



Note (2) If the PWM control duty ratio is less than 10%, there is some possibility that acoustic noise or backlight flash can be found. And it is also difficult to control the brightness linearity.

Note (3) If PWM control frequency is applied in the range less than 1KHz, the “waterfall” phenomenon on the screen may be found. To avoid the issue, it’s a suggestion that PWM control frequency should follow the criterion as below.

PWM control frequency f_{PWM} should be in the range

$$(N + 0.33) * f \leq f_{PWM} \leq (N + 0.66) * f$$

N : Integer ($N \geq 3$)

f : Frame rate

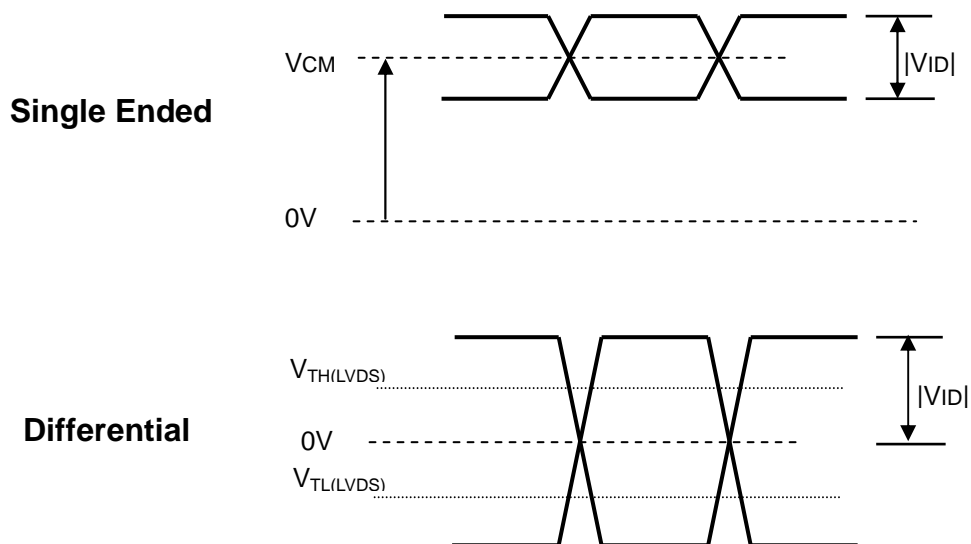
Note (4) The specified LED power supply current is under the conditions at “LED_VCCS = Typ.”, $T_a = 25 \pm 2 \text{ }^\circ\text{C}$, $f_{PWM} = 200 \text{ Hz}$, Duty=100%.

4.4 LVDS INPUT SIGNAL TIMING SPECIFICATIONS

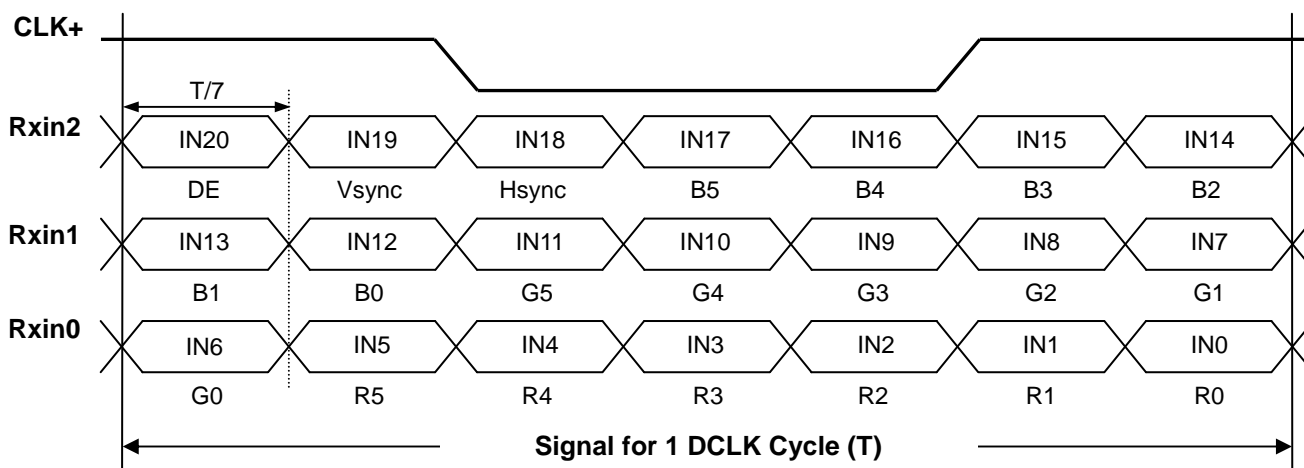
4.4.1 LVDS DC SPECIFICATIONS

| Parameter | Symbol | Value | | | Unit | Note |
|--|----------------|-------|------|-------|------|-----------------------|
| | | Min. | Typ. | Max. | | |
| LVDS Differential Input High Threshold | $V_{TH(LVDS)}$ | - | - | +100 | mV | (1), $V_{CM}=1.2V$ |
| LVDS Differential Input Low Threshold | $V_{TL(LVDS)}$ | -100 | - | - | mV | (1), $V_{CM}=1.2V$ |
| LVDS Common Mode Voltage | V_{CM} | 1.125 | - | 1.375 | V | (1) |
| LVDS Differential Input Voltage | $ V_{ID} $ | 100 | - | 600 | mV | (1) |
| LVDS Terminating Resistor | R_T | | 100 | | Ohm | - |

Note (1) The parameters of LVDS signals are defined as the following figures.



4.4.2 LVDS DATA FORMAT



4.4.3 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 6-bit gray scale data input for the color. The higher the binary input the brighter the color. The table below provides the assignment of color versus data input.

| Color | | Data Signal | | | | | | | | | | | | | | | | | |
|---------------------|---------------|-------------|----|----|----|----|----|-------|----|----|----|----|----|------|----|----|----|----|----|
| | | Red | | | | | | Green | | | | | | Blue | | | | | |
| | | R5 | R4 | R3 | R2 | R1 | R0 | G5 | G4 | G3 | G2 | G1 | G0 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Colors | Black | 0 | 0 | 0 | 0 | 0 | 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 |
| | Green | 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 | 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 |
| Gray Scale Of Red | Red(0)/Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Red(1) | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Red(2) | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | |
| | Red(61) | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Red(62) | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Red(63) | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Gray Scale Of Green | Green(0)/Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Green(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | |
| | Green(2) | 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 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | |
| | Green(62) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Green(63) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | |
| Gray Scale Of Blue | Blue(0)/Dark | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| | Blue(1) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | |
| | Blue(2) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | |
| | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | : | |
| | Blue(61) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | |
| | Blue(62) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | |
| | Blue(63) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | |

Note (1) 0: Low Level Voltage, 1: High Level Voltage

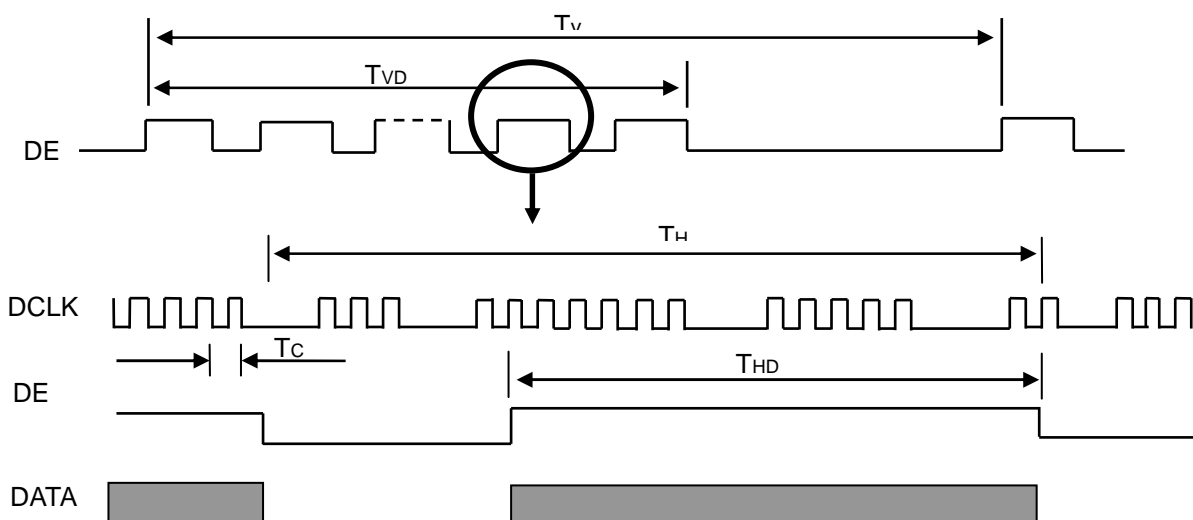
4.5 DISPLAY TIMING SPECIFICATIONS

The input signal timing specifications are shown as the following table and timing diagram.

| Signal | Item | Symbol | Min. | Typ. | Max. | Unit | Note |
|--------|-----------------------------------|--------|--------|------|--------|------|------|
| DCLK | Frequency | 1/Tc | 67.86 | 75.4 | 79.17 | MHz | - |
| DE | Vertical Total Time | TV | 773 | 806 | 815 | TH | - |
| | Vertical Active Display Period | TVD | 768 | 768 | 768 | TH | - |
| | Vertical Active Blanking Period | TVB | TV-TVD | 38 | TV-TVD | TH | - |
| | Horizontal Total Time | TH | 1452 | 1560 | 1608 | Tc | - |
| | Horizontal Active Display Period | THD | 1366 | 1366 | 1366 | Tc | - |
| | Horizontal Active Blanking Period | THB | TH-THD | 194 | TH-THD | Tc | - |

Note (1) Because this module is operated by DE only mode, Hsync and Vsync are ignored.

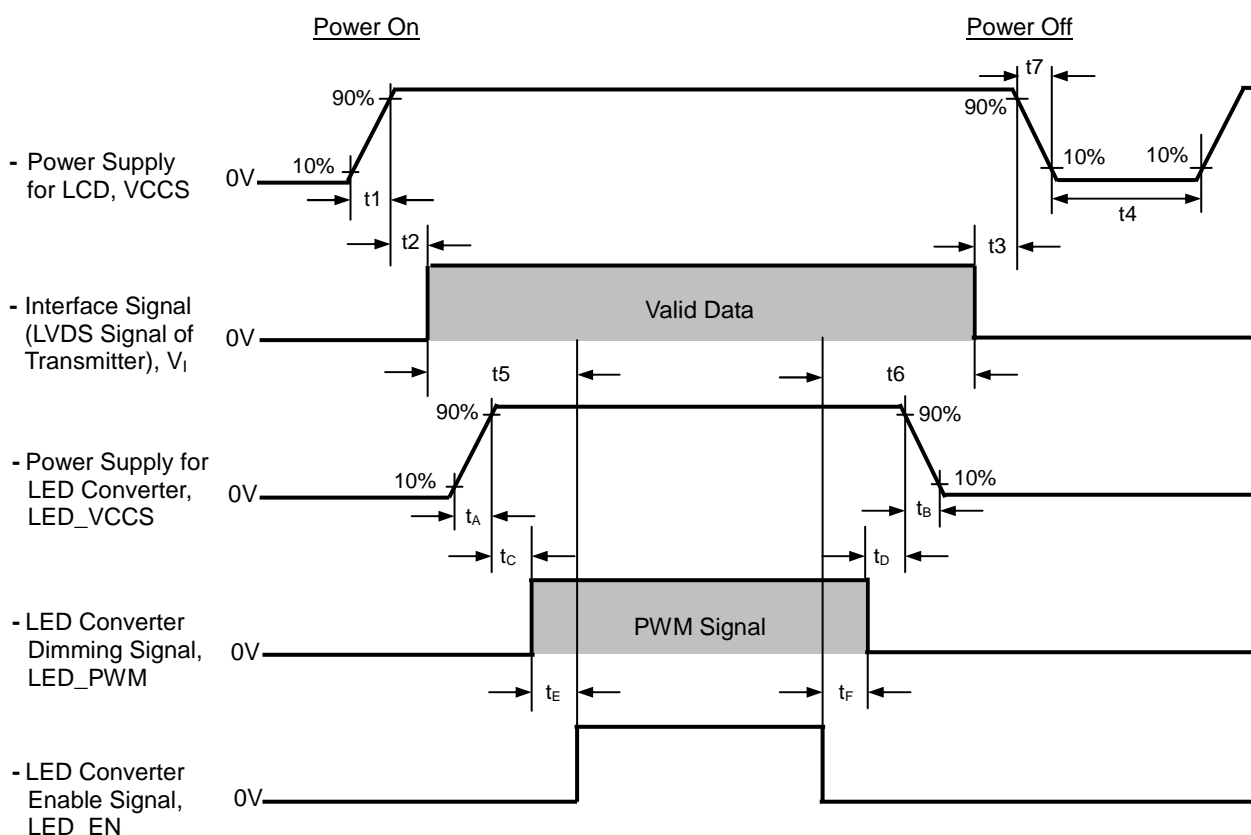
INPUT SIGNAL TIMING DIAGRAM



4.6 POWER ON/OFF SEQUENCE

The power sequence specifications are shown as the following table and diagram.

| Symbol | Value | | | Unit | Note |
|----------------|-------|------|------|------|------|
| | Min. | Typ. | Max. | | |
| t1 | 0.5 | - | 10 | ms | |
| t2 | 0 | - | 50 | ms | |
| t3 | 0 | - | 50 | ms | |
| t4 | 500 | - | - | ms | |
| t5 | 200 | - | - | ms | |
| t6 | 200 | - | - | ms | |
| t7 | 0.5 | - | 10 | ms | |
| t _A | 0.5 | - | 10 | ms | |
| t _B | 0 | - | 10 | ms | |
| t _C | 10 | - | - | ms | |
| t _D | 10 | - | - | ms | |
| t _E | 10 | - | - | ms | |
| t _F | 10 | - | - | ms | |



Note (1) Please don't plug or unplug the interface cable when system is turned on.

Note (2) Please avoid floating state of the interface signal during signal invalid period.

Note (3) It is recommended that the backlight power must be turned on after the power supply for LCD and the interface signal is valid.

5. OPTICAL CHARACTERISTICS

5.1 TEST CONDITIONS

| Item | Symbol | Value | Unit |
|-----------------------------|-----------------|-------|------|
| Ambient Temperature | Ta | 25±2 | °C |
| Ambient Humidity | Ha | 50±10 | %RH |
| Supply Voltage | V _{CC} | 3.3 | V |
| LED Light Bar Input Current | I _L | 63 | mA |

The measurement methods of optical characteristics are shown in Section 5.2. The following items should be measured under the test conditions described in Section 5.1 and stable environment shown in Note (5).

5.2 OPTICAL SPECIFICATIONS

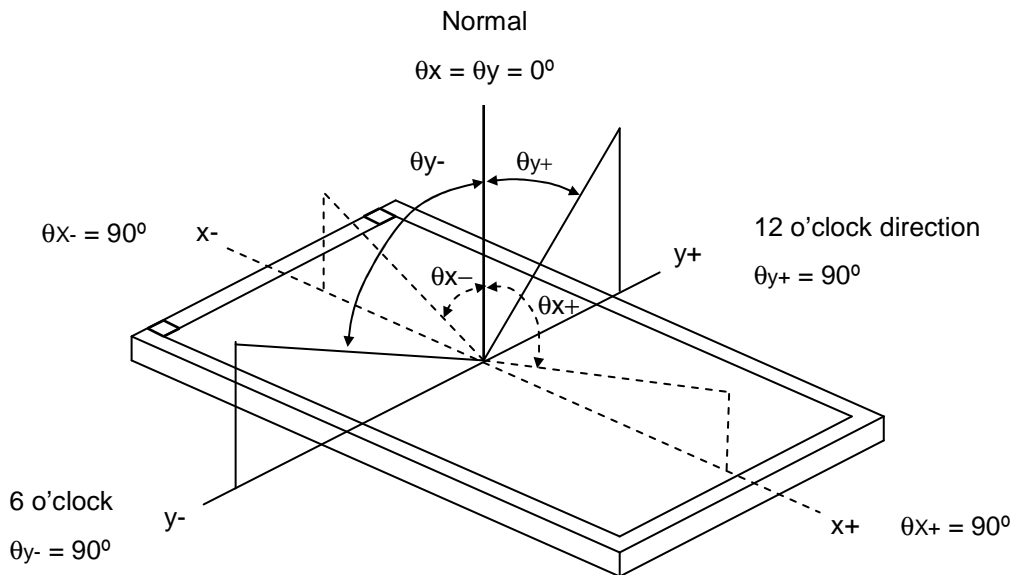
| Item | Symbol | Condition | Min. | Typ. | Max. | Unit | Note | |
|--------------------------|----------------|---|--|---------------|---------------|-------|---------------|---|
| Center Transmittance | T% | $\theta_x=0^\circ, \theta_y=0^\circ$ | 7.47 | 7.86 | | | (1), (5), (8) | |
| Contrast Ratio | CR | CS-1000T, CMO BLU | 500 | 650 | | | (1), (3), (5) | |
| Transmittance uniformity | δ T% | $\theta_x=0^\circ, \theta_y=0^\circ$ BM-5A | | | 1.25 | | (1), (5), (7) | |
| Response Time | T _R | $\theta_x=0^\circ, \theta_y=0^\circ$ | - | 3 | 8 | ms | (4) | |
| | T _F | | - | 7 | 13 | ms | | |
| Color Chromaticity | Red | Rcx | $\theta_x=0^\circ, \theta_y=0^\circ$ CS-1000T Standard light source "C" | Typ.- 0.03 | Typ.+ 0.03 | - | (0), (5) | |
| | | Rcy | | | | 0.597 | | - |
| | Green | Gcx | | | | 0.342 | | - |
| | | Gcy | | | | 0.301 | | - |
| | Blue | Bcx | | | | 0.557 | | - |
| | | Bcy | | | | 0.140 | | - |
| | White | Wcx | | | | 0.173 | | - |
| | | Wcy | | | | 0.313 | | - |
| Viewing Angle | Horizontal | θ_{x+} | 40 | 45 | - | Deg. | (1),(3),(5) | |
| | | θ_{x-} | 40 | 45 | - | | | |
| | Vertical | θ_{y+} | 15 | 20 | - | | | |
| | | θ_{y-} | 40 | 45 | - | | | |

Note (0) Light source is the standard light source "C" which is defined by CIE and driving voltages are based on suitable gamma voltages. The calculating method is as following :

1. Measure Module's and BLU's spectrums. White is without signal input and R, G, B are with signal input. BLU is supplied by CMI.
2. Calculate cell's spectrum.
3. Calculate cell's chromaticity by using the spectrum of standard light source "C"

Note (1) Light source is the BLU which is supplied by CMO and driving voltages are based on suitable gamma voltages. White is without signal input and R, G, B are with signal input. SPEC is judged by CMO's golden sample.

Note (2) Definition of Viewing Angle (θ_x, θ_y):



Note (3) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

$$\text{Contrast Ratio (CR)} = L_{63} / L_0$$

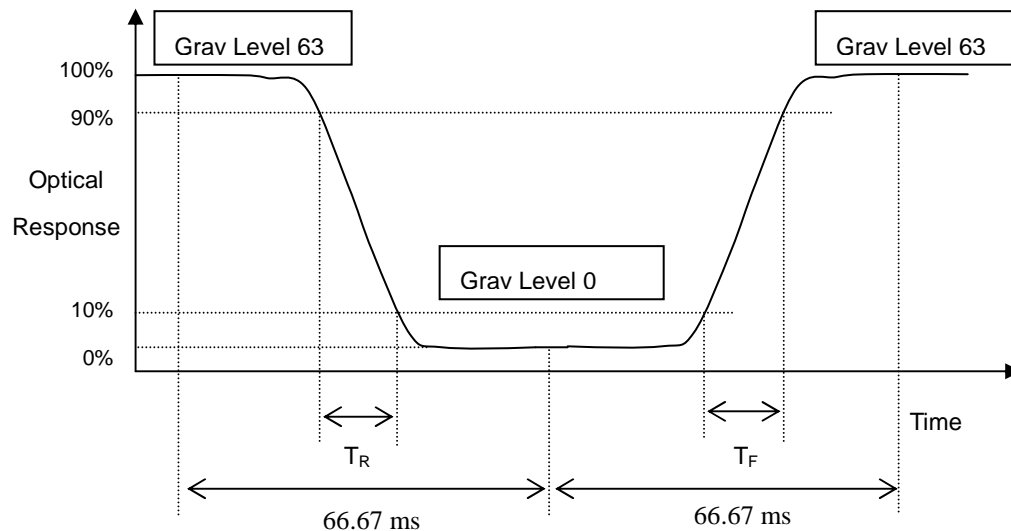
L63: Luminance of gray level 63

L 0: Luminance of gray level 0

$$\text{CR} = \text{CR} (1)$$

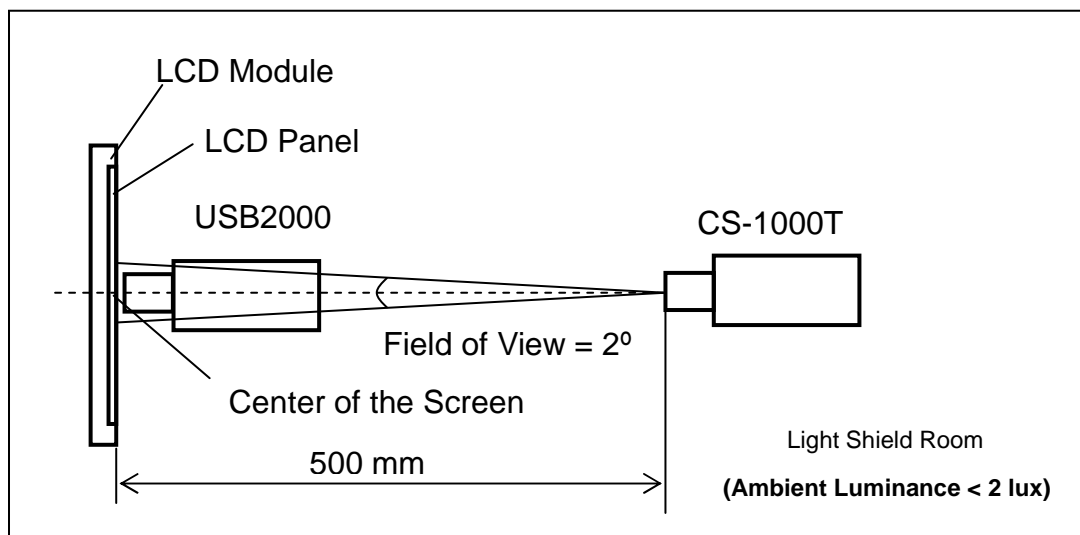
CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (6).

Note (4) Definition of Response Time (T_R, T_F):



Note (5) Measurement Setup:

The LCD module should be stabilized at given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.



Note (6) Definition of Transmittance Variation ($\delta T\%$):

Measure the transmittance at 5 points

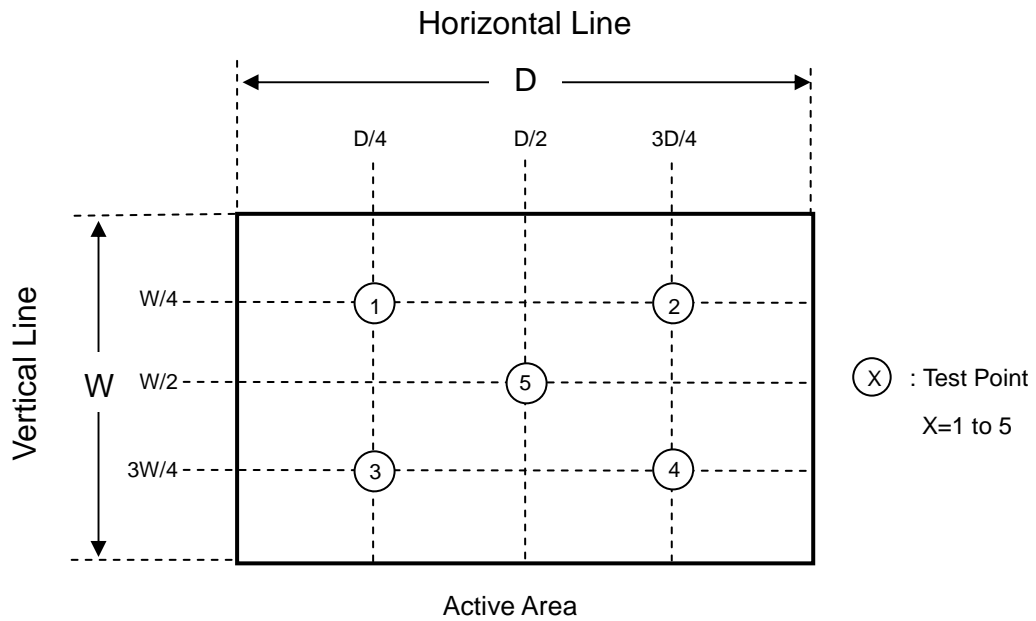
$$\delta T\% = \frac{\text{Maximum } [T\%(1), T\%(2), \dots T\%(5)]}{\text{Minimum } [T\%(1), T\%(2), \dots T\%(5)]}$$

Note (7) Definition of Transmittance (T%):

Module is without signal input.

BLU is supplied by CMO.

$$\text{Transmittance} = \frac{\text{Luminance of LCD module}}{\text{Luminance of backlight}} * 100\%$$



Note (8) The listed optical specifications refer to the initial value of manufacture, but the condition of the specifications after long-term operation will not be warranted.

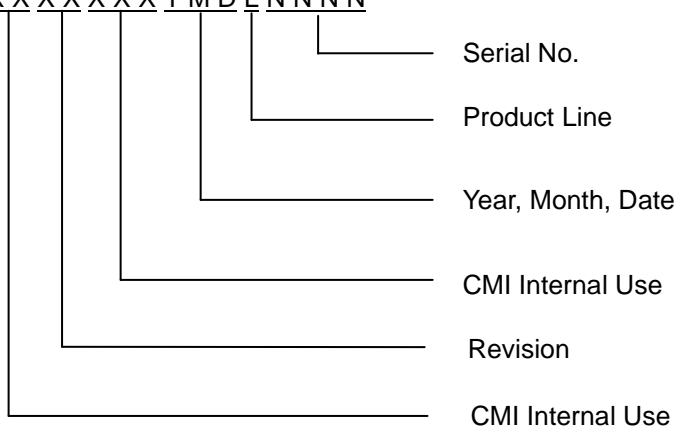
6. PACKING

6.1 CMI OPEN CELL LABEL

The barcode nameplate is pasted on each OPEN CELL as illustration for CMI internal control.



- (a) Model Name: N156BGE - P41
- (b) Revision: Rev. XX, for example: C1, C2 ...etc.
- (c) Serial ID: XXXXXXYMDLNNNN



Serial ID includes the information as below:

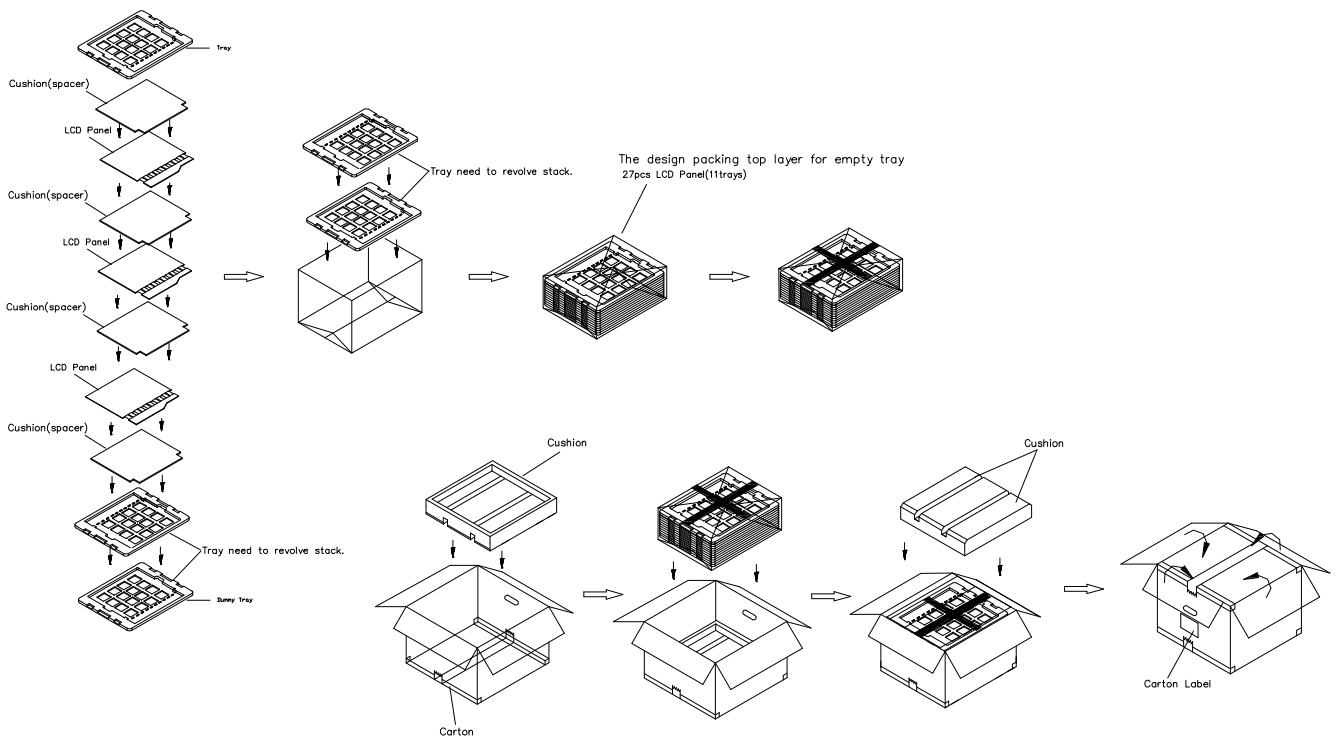
- (a) Manufactured Date: Year: 0~9, for 2010~2019
 Month: 1~9, A~C, for Jan. ~ Dec.
 Day: 1~9, A~Y, for 1st to 31st, exclude I, O and U
- (b) Revision Code: cover all the change
- (c) Serial No.: Manufacturing sequence of product
- (d) Product Line: 1 -> Line1, 2 -> Line 2, ...etc.

6.2 Package Reliability

(1) Carton Packing should have no failure in the following reliability test items

| Test Item | Test Conditions | Note |
|-------------------|--|---------------|
| Packing Vibration | ISTA STANDARD Random, Frequency Range: 1 – 200 Hz Top & Bottom: 30 minutes (+Z), 10 min (-Z), Right & Left: 10 minutes (X) Back & Forth 10 minutes (Y) | Non Operation |

6.3 CARTON

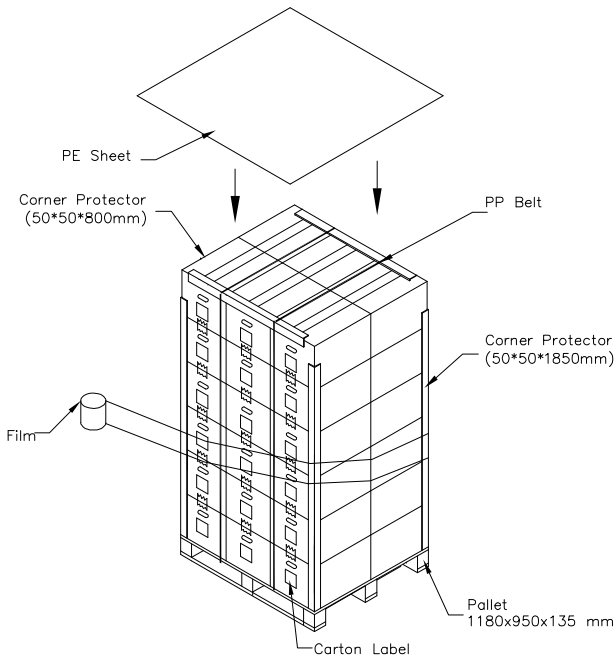


- (1) Carton Dimensions: 475(L)x390(W)x320(H)mm
- (2) 27 LCD Cells+PCB/Carton

Figure. 6-3 Packing method

6.4 PALLET

Sea and Land Transportation



Air Transportation

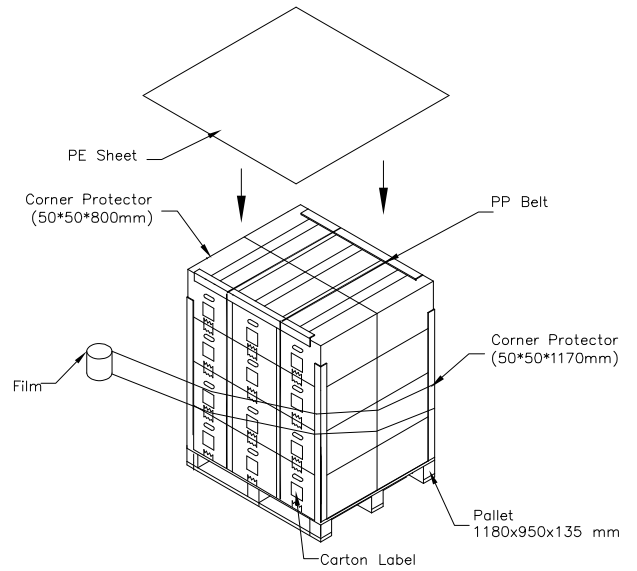


Figure. 6-4 Packing method

7. PRECAUTIONS

7.1 HANDLING PRECAUTIONS

- (1) The module should be assembled into the system firmly by using every mounting hole. Be careful not to twist or bend the module.
- (2) While assembling or installing modules, it can only be in the clean area. The dust and oil may cause electrical short or damage the polarizer.
- (3) Use fingerstalls or soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (4) Do not press or scratch the surface harder than a HB pencil lead on the panel because the polarizer is very soft and easily scratched.
- (5) If the surface of the polarizer is dirty, please clean it by some absorbent cotton or soft cloth. Do not use Ketone type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanently damage the polarizer due to chemical reaction.
- (6) Wipe off water droplets or oil immediately. Staining and discoloration may occur if they left on panel for a long time.
- (7) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contacting with hands, legs or clothes, it must be washed away thoroughly with soap.
- (8) Protect the module from static electricity, it may cause damage to the C-MOS Gate Array IC.
- (9) Do not disassemble the module.
- (10) Do not pull or fold the LED wire.
- (11) Pins of I/F connector should not be touched directly with bare hands.

7.2 STORAGE PRECAUTIONS

- (1) High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storage conditions.
- (2) It is dangerous that moisture come into or contacted the LCD module, because the moisture may damage LCD module when it is operating.
- (3) It may reduce the display quality if the ambient temperature is lower than 10 °C. For example, the response time will become slowly, and the starting voltage of LED will be higher than the room temperature.

7.3 OPERATION PRECAUTIONS

- (1) Do not pull the I/F connector in or out while the module is operating.
- (2) Always follow the correct power on/off sequence when LCD module is connecting and operating. This can prevent the CMOS LSI chips from damage during latch-up.
- (3) The startup voltage of Backlight is approximately 1000 Volts. It may cause electrical shock while assembling with converter. Do not disassemble the module or insert anything into the Backlight unit.

