# LCD MODULE

# SPECIFICATION

| | |
|---|---|
| **Model:** | UE020WV-UB40-L011A |
| **Version:** | V1.0 |
| **Date:** | 20191127 |

■ **Preliminary Specification** 样品规格书

□ **Final Specification** 量产规格书

**Customer Confirmation** 客户确认

| Approved by | Notes |
|---|---|
| | |

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**VIEWE Confirmation** 优奕确认

| Prepared by | Reviewed by | Approved by |
|---|---|---|
| | | |

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# REVISION HISTORY

| Revision<br>版本号 | Date<br>日期 | Contents of Revision Change<br>修改内容 | Remark<br>备注 |
|---|---|---|---|
| V1.0 | 2019.11.27 | Preliminary release | |
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# 1. GENERAL INFORMATION

## 1.1 Features

1) Pixel Arrangement：RGB Vertical Stripe
2) Interface Mode：40PIN　3SPI-RGB _16bits
3) Driver IC：　ST7701S
4) Operation Temperature：-20~70℃
5) Storage Temperature：-30~80℃
6) Backlight Type：White LED
7) Display mode：　Normally Black
8) Pixel Density：300PPI

## 1.2 Mechanical Specification

| Item<br>项目 | Specification<br>规格 | Unit<br>单位 | Remark<br>备注 |
|---|---|---|---|
| **Pixel Driving element** | IPS TFT | - | - |
| **Screen Size** | 2.0 | Inch | Diagonal |
| **Resolution** | 480(W)*3(RGB)*360(H) | Dots | - |
| **Interface** | 3SPI-RGB 16bits | - | 40PIN |
| **Module Power Consumption** | 0.4 | Watt | Typ. |
| **Active Area** | 40.82(W)*30.62(H) | mm | - |
| **Pixel pitch (W*H)** | 28.35W)*85.05(H) | μm | - |
| **Module Size (W*H*D)** | 46.16(W)*41.02(H)*2.6(D) | mm | - |
| **Luminance** | 1100 | $cd/m^2$ | Typ. |
| **Viewing Direction** | ALL | O'clock | - |
| **Display Color** | 16.7M | Colors | 16bits |

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# 2. ABSOLUTE MAXIMUM RATINGS

| Item<br>项目 | Symbol<br>符号 | Min.<br>最小值 | Max.<br>最大值 | Unit<br>单位 | Remark<br>备注 |
|---|---|---|---|---|---|
| Power supply voltage | VCI | -0.5 | 3.6 | V | Note1 |
| LED forward current | $I_F$ | -0.001 | 30 | mA | For each led,Note1 |
| LED Reverse Voltage | $V_R$ | - | 5 | V | For each led,Note1 |
| Operating temperature | $T_{op}$ | -20 | 70 | ℃ | Note1,2 |
| Storage temperature | $T_{st}$ | -30 | 80 | ℃ | Note1,2 |
| Humidity | $H_{st}$ | 10 | 90 | %RH | Note1,3 |

(Ta=+25°C,GND=0V)

Note1:If the module exceeds the absolute maximum ratings, it may be damaged permanently. Also if the module operates with the absolute maximum ratings for a long time, the reliability may drop.

Note2: In case of temperature below 0℃,the response time of liquid crystal (LC) becomes slower and the color of panel darker than normal one.

Note3: Temp. ≤ 60℃ , 90% RH MAX.
Temp. ＞60℃ , Absolute humidity shall be less than 90% RH at 60℃.

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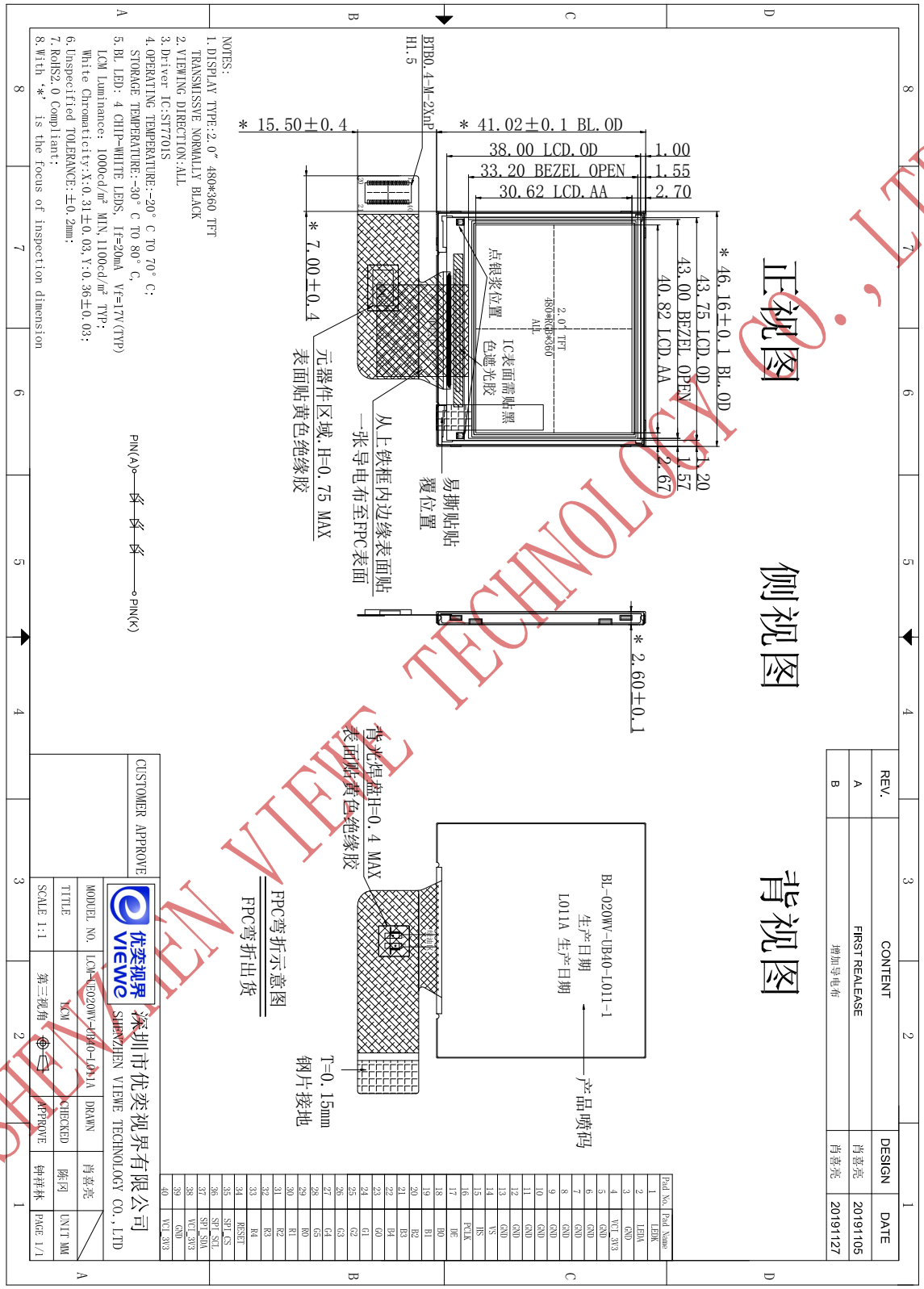
# 3. MECHANICAL DRAWING

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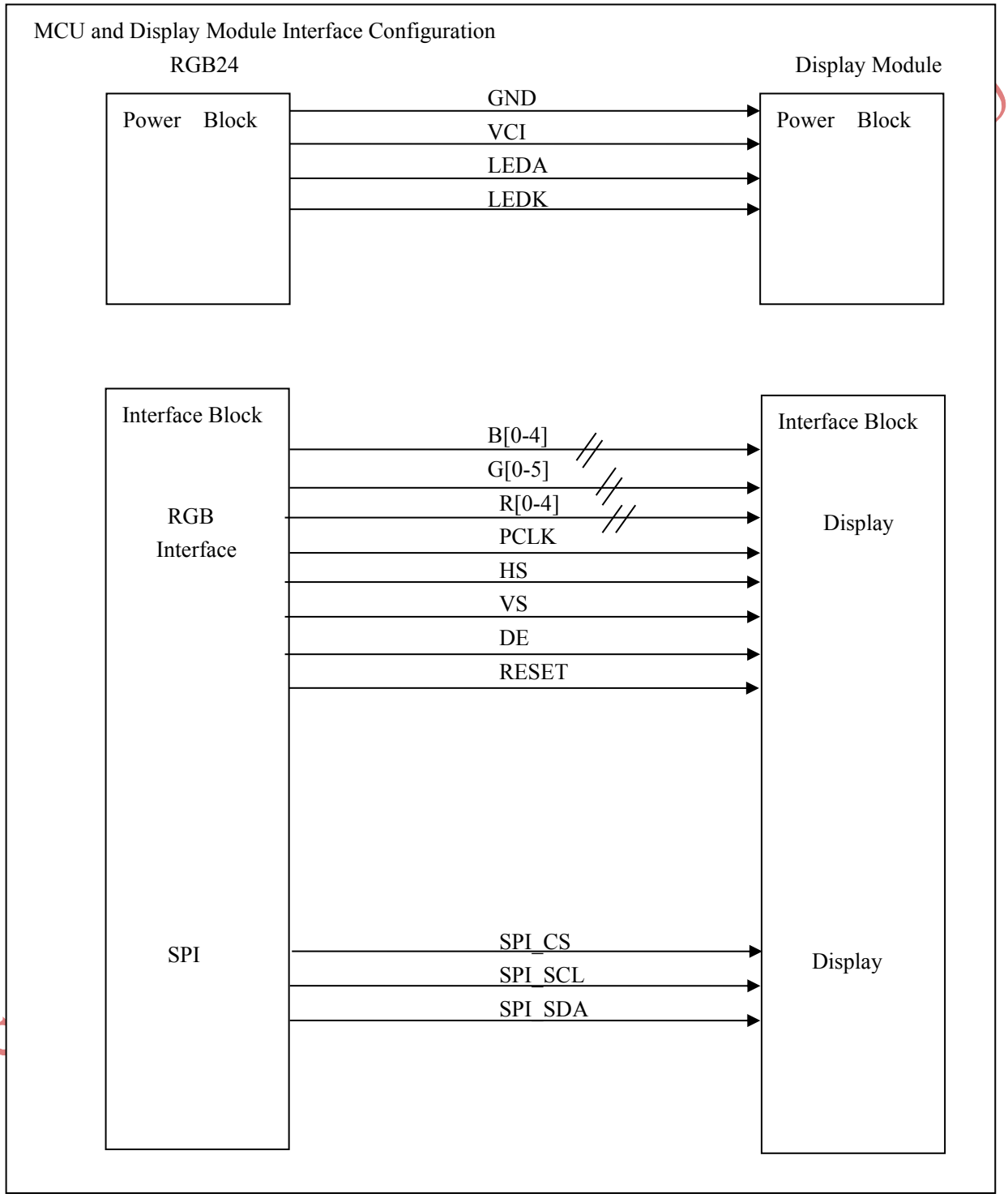
# 4. I/O CONNECTION & BLOCK DIAGRAM

## 4.1 I/O Connection

| Pin No.<br>序号 | Symbol<br>符号 | I/O | Description<br>描述 |
|---|---|---|---|
| 1 | LEDK | P | Power supply for backlight cathode |
| 2 | LEDA | P | Power supply for backlight anode |
| 3 | GND | P | Power Ground |
| 4 | VCC | P | Power supply to the internal logic power regulator( 3.3V) |
| 5-13 | GND | P | Power Ground |
| 14 | VS | I | Vertical sync signal, Negative polarity |
| 15 | HS | I | Horizontal sync signal, Negative polarity |
| 16 | PCLK | I | Pixel clock input pin, Negative polarity |
| 17 | DE | I | Data input enable. Display access is enabled when DE is “H” |
| 18-22 | B0-B4 | I | Blue data input. |
| 23-28 | G0-G5 | I | Green data input. |
| 29-33 | R0-R4 | I | Red data input. |
| 34 | RESET | I | Global reset pin. |
| 35 | SPI_CS | I | Chip select pin for SPI interface. |
| 36 | SPI_SCL | I | Serial clock input in SPI interface |
| 37 | SPI_SDI | I/O | Serial data input pin in serial interface operation. |
| 38 | VCC | P | Power supply to the internal logic power regulator( 3.3V) |
| 39 | GND | P | Power Ground |
| 40 | VCC | P | Power supply to the internal logic power regulator( 3.3V) |

I：Input；O：Output；P：Power

## 4.2 Block Diagram



# 5. ELECTRICAL CHARACTERISTICS

## 5.1 TFT-LCD Panel Driving Section

| Item 项目 | Symbol 符号 | Min. 最小值 | Typ. 典型值 | Max. 最大值 | Unit 单位 | Remark 备注 |
|---|---|---|---|---|---|---|
| Power Supply Voltage | VCC | 2.6 | 3.3 | 3.6 | V | - |
| Power Supply Current | $I_{VDD}$ | - | 30 | - | mA | Note1 |
| Logic Input High Voltage | $V_{IH}$ | 0.7VCC | - | VCC | V | - |
| Logic Input Low Voltage | $V_{IL}$ | 0 | - | 0.3VCC | V | - |
| Panel Power Consumption | $P_{VDD}$ | - | 0.099 | - | Watt | Note1 |
| Module Power Consumption | $P_{LCM}$ | - | 0.4 | - | Watt | Note1,2 |

(Ta=+25°C,GND=0V)

Note1:Measurement Conditions (Video Mode): Full Screen Red Pattern,VDD=3.3V,60Hz Refresh.

Note2: $P_{LCM}$= $P_{VDD}$+ $P_{BL}$， About $P_{BL}$ information, inference to 5.2 Back Light Driving Section.

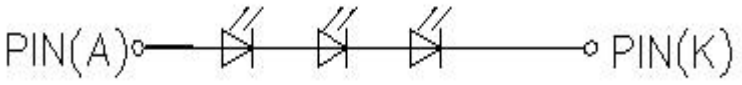
## 5.2 Back Light Driving Section

| Item 项目 | Symbol 符号 | Min. 最小值 | Typ. 典型值 | Max. 最大值 | Unit 单位 | Remark 备注 |
|---|---|---|---|---|---|---|
| Forward Voltage | $V_F$ | 15 | 17 | 18 | V | Note1 |
| Forward Current | $I_F$ | - | 20 | - | mA | Note1 |
| Backlight Power consumption | $P_{BL}$ | - | 0.34 | - | Watt | Note1 |
| LED Quantity | | | 3 | | PCS | |

(Ta=+25°C,GND=0V)

Note1: The LED driving condition is defined for each LED module (3 LED Serial, 1LED Parallel)。
For each LED ： IF=20mA,VF=3.2V(Typ.)/3.4V(Max.),Ta=25℃。

Note2:The “LED life time” is defined as the module brightness decrease to 50% of original brightness at $I_{LED}$=20mA(Per Led). The LED life time could be decreased if operating $I_{LED}$ is larger than 20mA.

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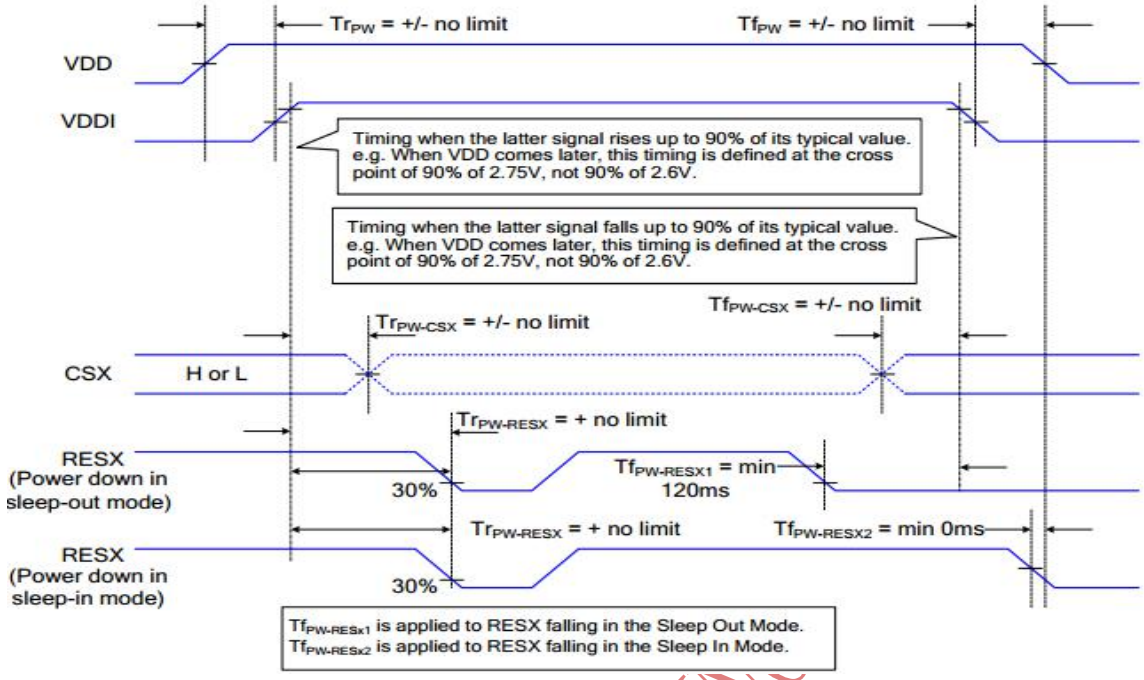
## 5.3 Power On/Off Sequence



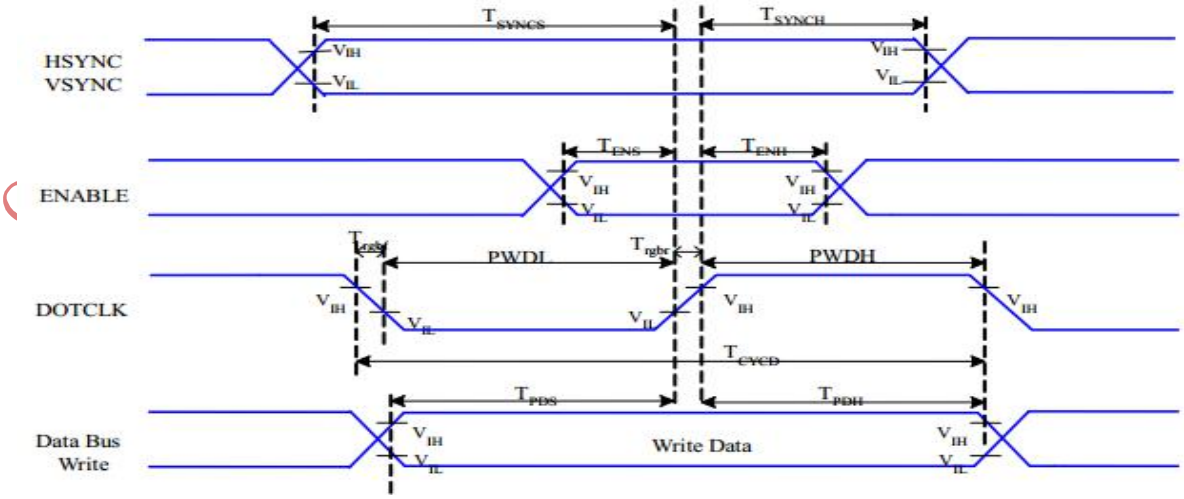

### 9.1 Uncontrolled Power Off

The uncontrolled power-off means a situation which removed a battery without the controlled power off sequence. It will neither damage the module or the host interface.

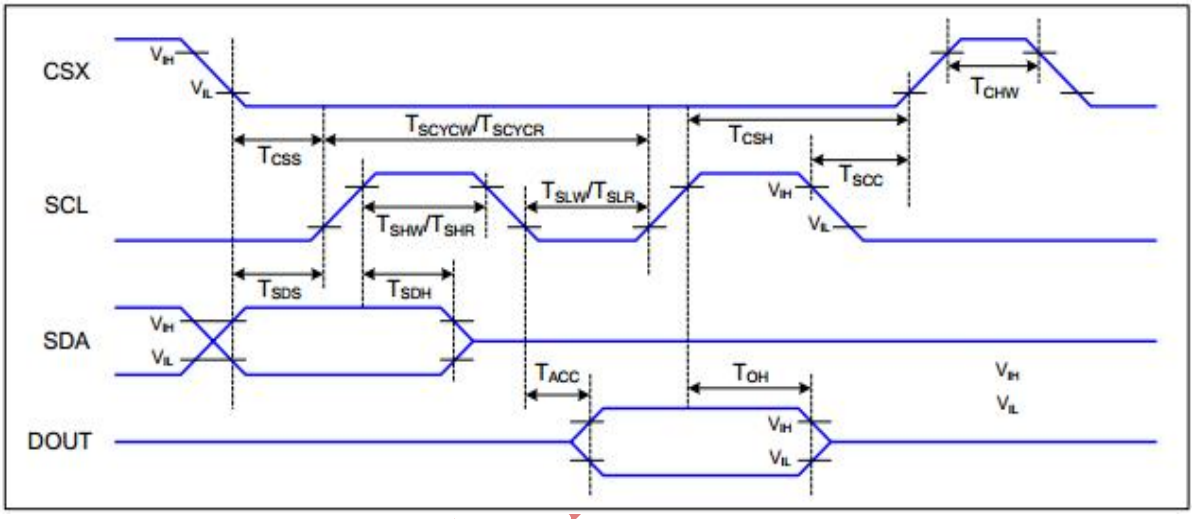
If uncontrolled power-off happened, the display will go blank and there will not any visible effect on the display (blank display) and remains blank until "Power On Sequence" powers it up.

## 5.4 Timing Characteristics

### 5.4.1 Timing Parameters

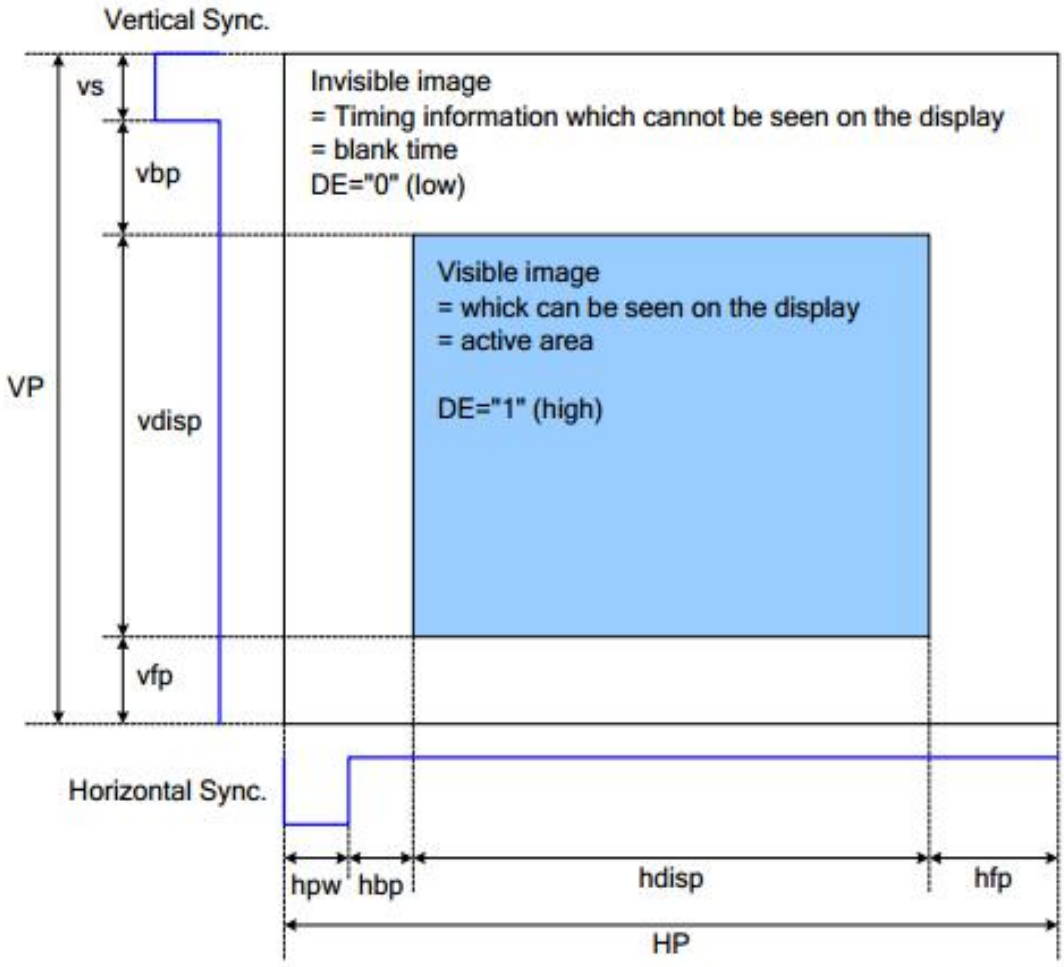


| Signal | Symbol | Parameter | MIN | MAX | Unit | Description |
|---|---|---|---|---|---|---|
| HSYNC, VSYNC | $T_{SYNCS}$ | VSYNC, HSYNC Setup Time | 5 | - | ns | |
| ENABLE | $T_{ENS}$ | Enable Setup Time | 5 | - | ns | |
| | $T_{ENH}$ | Enable Hold Time | 5 | - | ns | |
| DOTCLK | PWDH | DOTCLK High-level Pulse Width | 15 | - | ns | |
| | PWDL | DOTCLK Low-level Pulse Width | 15 | - | ns | |
| | $T_{CYCD}$ | DOTCLK Cycle Time | 33 | - | ns | |
| | Trghr, Trghf | DOTCLK Rise/Fall time | - | 15 | ns | |
| DB | $T_{PDS}$ | PD Data Setup Time | 5 | - | ns | |
| | $T_{PDH}$ | PD Data Hold Time | 5 | - | ns | |




| Signal | Symbol | Parameter | Min | Max | Unit | Description |
|---|---|---|---|---|---|---|
| CSX | $T_{CSS}$ | Chip select setup time (write) | 15 | | ns | |
| | $T_{CSH}$ | Chip select hold time (write) | 15 | | ns | |
| | $T_{CSS}$ | Chip select setup time (read) | 60 | | ns | |
| | $T_{SCC}$ | Chip select hold time (read) | 60 | | ns | |
| | $T_{CHW}$ | Chip select "H" pulse width | 40 | | ns | |
| SCL | $T_{SCYCW}$ | Serial clock cycle (Write) | 66 | | ns | |
| | $T_{SHW}$ | SCL "H" pulse width (Write) | 15 | | ns | |
| | $T_{SLW}$ | SCL "L" pulse width (Write) | 15 | | ns | |
| | $T_{SCYCR}$ | Serial clock cycle (Read) | 150 | | ns | |
| | $T_{SHR}$ | SCL "H" pulse width (Read) | 60 | | ns | |
| | $T_{SLR}$ | SCL "L" pulse width (Read) | 60 | | ns | |
| SDA (DIN) | $T_{SDS}$ | Data setup time | 10 | | ns | |
| | $T_{SDH}$ | Data hold time | 10 | | ns | |

### 5.4.2 Horizontal& Vertical Timing

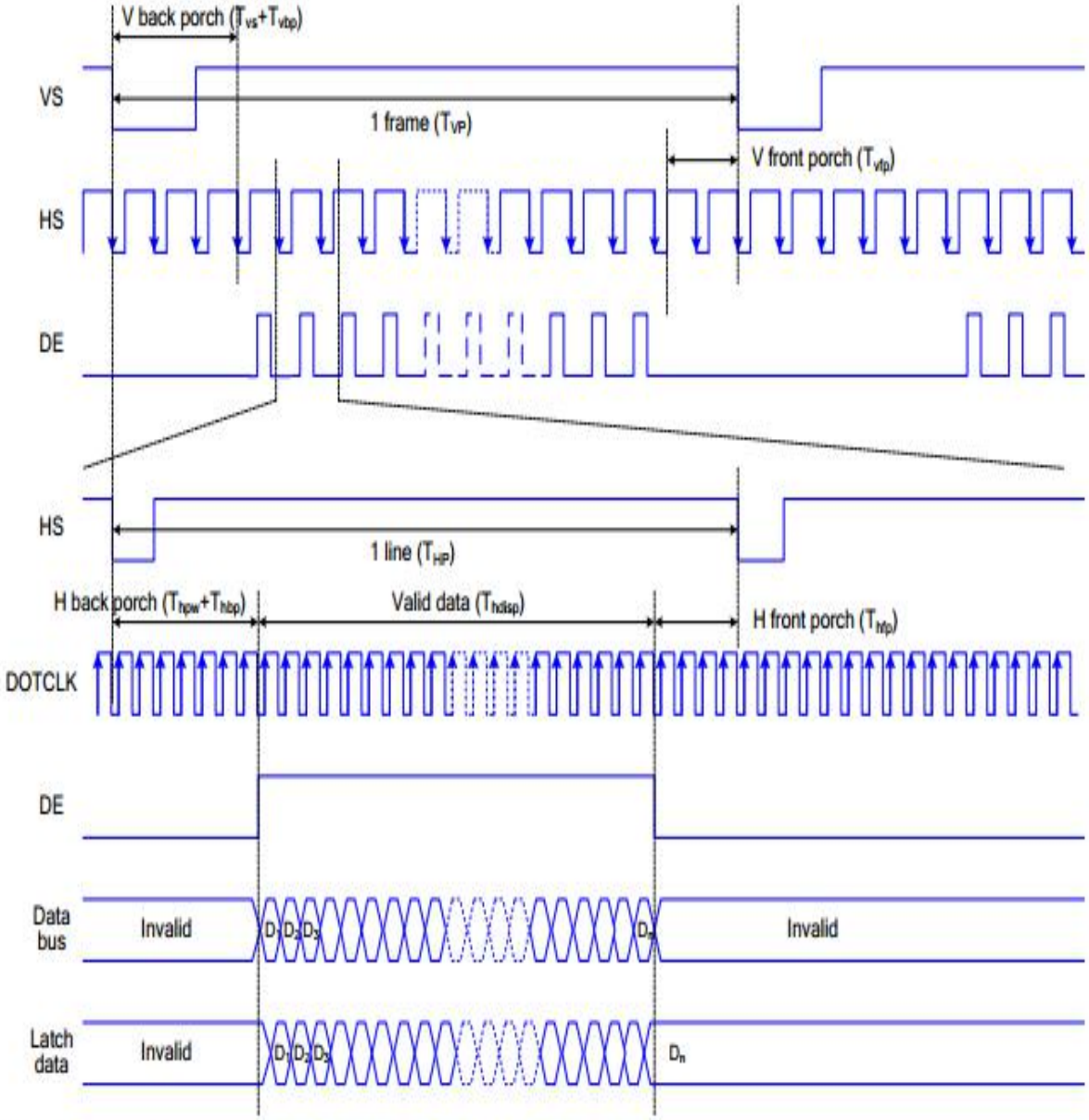



| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Horizontal Sync. Width | hpw | 1 | - | 255 | Clock |
| Horizontal Sync. Back Porch | hbp | 1 | -- | 255 | Clock |
| Horizontal Sync. Front Porch | hfp | 1 | -- | - | Clock |
| Vertical Sync. Width | vs | 1 | -- | 254 | Line |
| Vertical Sync. Back Porch | vbp | 1 | -- | 254 | Line |
| Vertical Sync. Front Porch | vfp | 2 | -- | -- | Line |

## 5.5 Timing Diagram

### 5.5.1 Horizontal&Vertical Timing

The timing chart of RGB interface DE mode is shown as follows.




*Note: The setting of front porch and back porch in host must match that in IC as this mode.*

# 6. OPTICAL CHARACTERISTICS

| Parameter 参数 | Symbol 符号 | Condition 条件 | Min. 最小值 | Typ. 典型值 | Max. 最大值 | Unit 单位 | Remark 备注 |
|---|---|---|---|---|---|---|---|
| Contrast Ratio | C/R | θ = 0° | 800 | 1000 | - | - | Note(4) |
| NTSC Ratio | S | θ =0° | 50 | 55 | - | % | Note(7) |
| Luminance | L | θ =0° | - | 1100 | - | cd/m2 | Note(5) |
| Luminance uniformity | $U_W$ | θ =0° | 70 | 80 | - | % | Note(3) |
| Response Time | $T_R$+ $T_F$ | 25 °C | - | 35 | 45 | ms | Note(2) |
| Color Coordination | $W_X$ | θ = 0° (Center) Normal viewing angle B/L On | -0.03 | 0.310 | +0.03 | NTSC (x,y) | Note(6) |
| | $W_Y$ | | | 0.360 | | | |
| | $R_X$ | | | TBD | | | |
| | $R_Y$ | | | TBD | | | |
| | $G_X$ | | | TBD | | | |
| | $G_y$ | | | TBD | | | |
| | $B_X$ | | | TBD | | | |
| | $B_Y$ | | | TBD | | | |
| Viewing Angle | $\theta_L$ | C/R>10 | 70 | 80 | - | Degree | Note(1) |
| | $\theta_R$ | | 70 | 80 | - | | |
| | $\theta_U$ | | 70 | 80 | - | | |
| | $\theta_D$ | | 70 | 80 | - | | |

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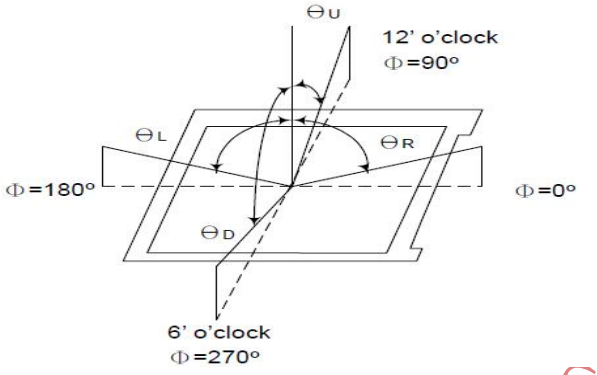
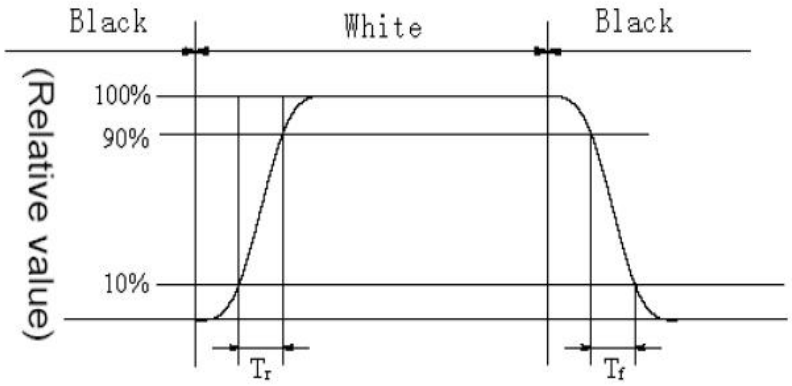
Test Conditions:

1. VDD=3.3V, $I_F$=40mA (Backlight current), the ambient temperature is+25℃.
2. The test systems refer to Note 8.

**Note1:** Definition of Viewing Angle: The viewing angle range that the CR>10

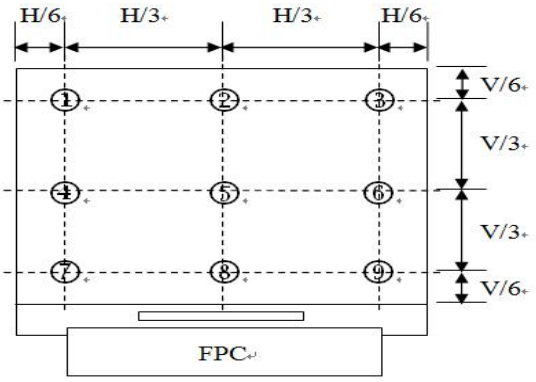



**Note2:** Definition of Response time: Sum of $T_R$ and $T_F$




**Note 3:** Definition of Luminance Uniformity: Active area is divided into 9 measuring areas, every measuring point is placed at the center of each measuring area.

$$\text{Luminance Uniformity} = \frac{\text{Min Luminance of white among 9-points}}{\text{Max Luminance of white among 9-points}} \times 100\%$$



**Note4:** Definition of Contrast Ratio (CR): measured at the center point of panel

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD on the "White" state}}{\text{Luminance measured when LCD on the "Black" state}}$$

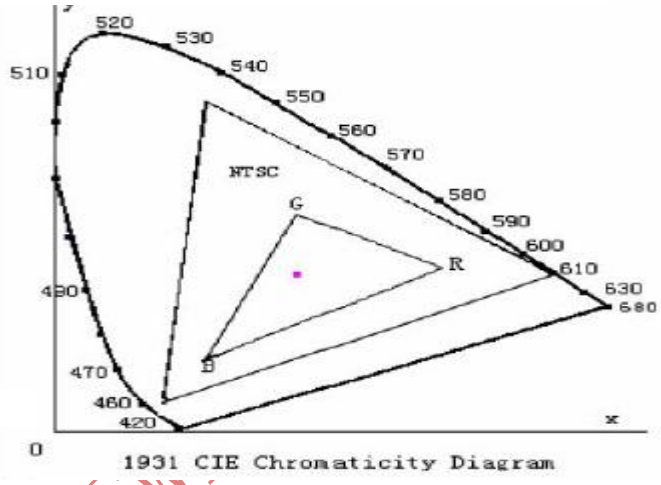
**Note 5:** Definition of Luminance: Center Luminance of white is defined as luminance values of 1point average across the LCD surface.

**Note 6:** Definition of Color Chromaticity (CIE 1931)

Color coordinates of white & red, green, blue measured at center point of LCD.

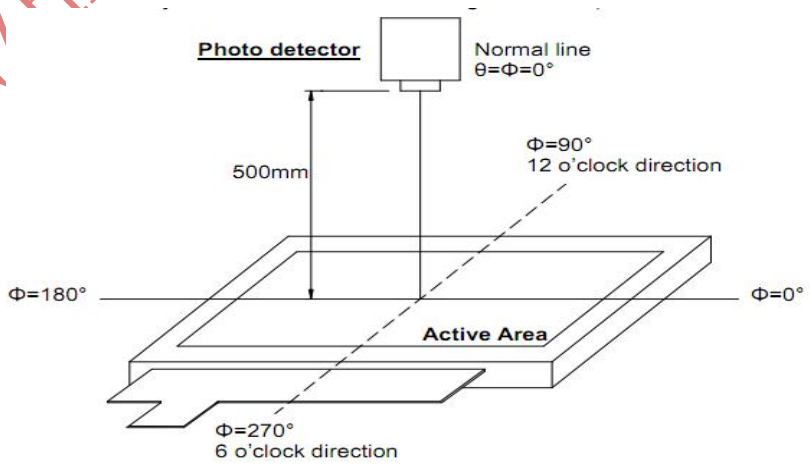
**Note 7:** Definition of NTSC ratio:

$$\text{NTSC ratio} = \frac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}}$$




**Note 8:** Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 5 minutes operation, the optical properties are measured at the center point of the LCD screen.(Response time is measured by Photo detector TOPCON BM-7, Field of view: 1°/Height: 500mm.)

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# 7. RELIABILITY

| Item<br>项目 | Test Condition<br>测试条件 | Remark<br>备注 |
|---|---|---|
| High Temperature Storage | Ta =+80°C / 96Hours | Note1,2,3 |
| Low Temperature Storage | Ta =-30°C / 96Hours | Note1,2,3 |
| High Temperature Operating | Ta =+70°C / 96Hours | Note1,2,3 |
| Low Temperature Operating | Ta =-20°C / 96Hours | Note1,2,3 |
| Temperature Cycle storage Test | -30°C/30min Δ+80°C /30min for 30cycles,Transfer time less than 5min | Note2,3 |
| Thermal humidity storage Test | 80°C x 90%RH / 96Hours | Note2,3 |
| Package Vibration Test | Frequency: 10Hz~55Hz,Amplitude:1.5mm, 1 hrs for each direction of X, Y, Z | Note2 |

**Inspection after Test:**

Note1:Ta is the ambient temperature of samples.

Note 2: In the standard condition, there shall be no practical problem that may affect the display function. After the reliability test, the product only guarantees operation, but doesn't guarantee all the cosmetic specification.

Note 3: Before cosmetic and function tests , the product must have enough recovery time, at least 2 hours at room temperature.

Note 4: In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judged as a good part.

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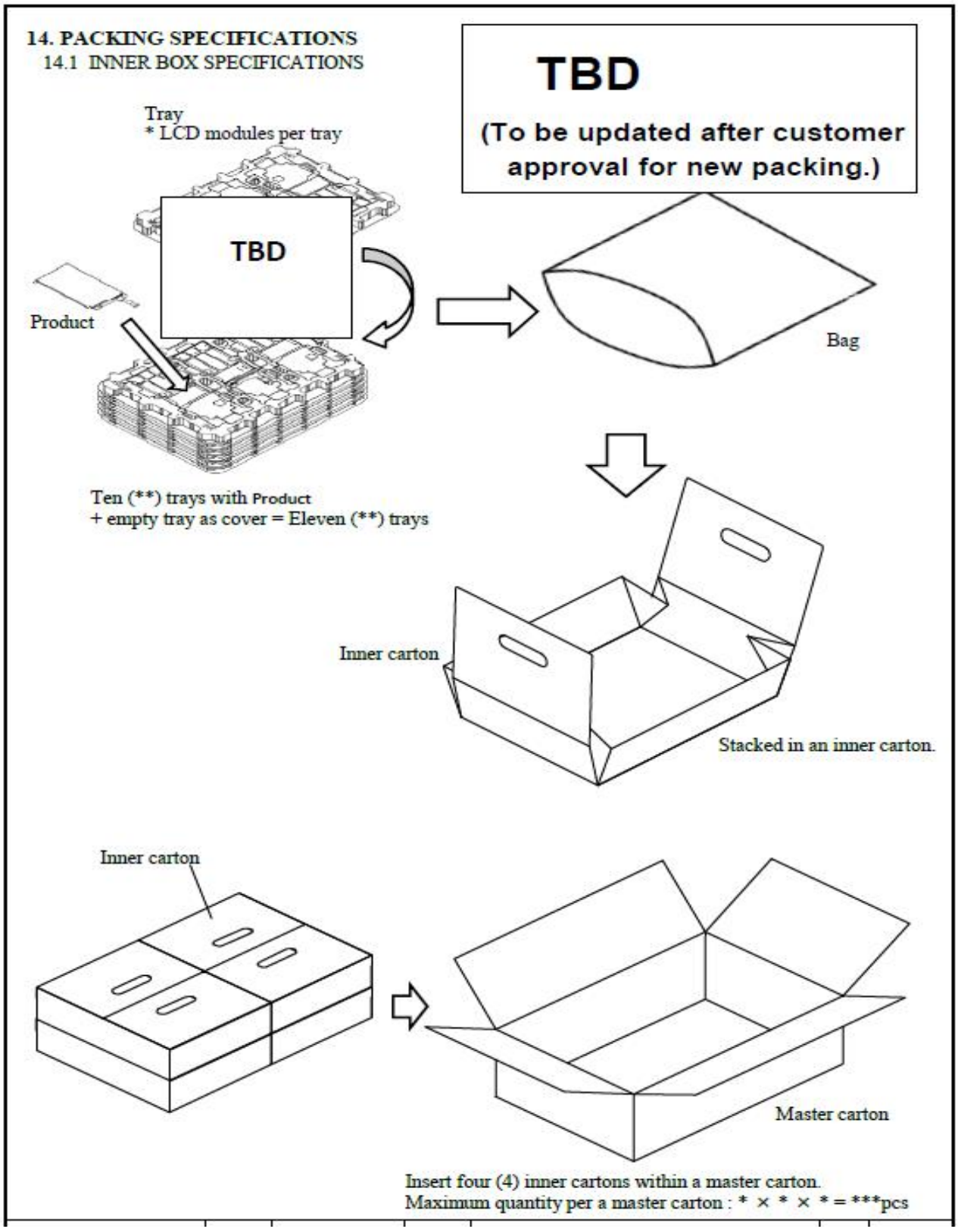
# 8. PACKAGE DRAWING