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**TITLE : HV236WHB-F10 Rev4.0**

**Product Specification**

**Rev.O**

**Fuzhou BOE Optoelectronics Technology Co., Ltd.**

SPEC. NUMBER

PRODUCT GROUP  
TFT-LCD

Rev. O

ISSUE DATE  
2024.03.14

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|                               | TFT- LCD PRODUCT                          |                                             | Rev. O     | 2024.03.14 |
| REVISION HISTORY              |                                           |                                             |            |            |
| ( ) Preliminary specification |                                           |                                             |            |            |
| (√) Final specification       |                                           |                                             |            |            |
| Revision No.                  | Page                                      | Description of changes                      | Date       | Prepared   |
| P0                            | All                                       | Initial Release                             | 2023.12.11 | Lin Zhun   |
| P1                            | 5/7<br>11                                 | Power Consumption<br>Pinmap                 | 2024.01.16 | Lin Zhun   |
| P2                            | 24                                        | Optical                                     | 2024.01.22 | Lin Zhun   |
| P3                            | 34                                        | Open Cell Outline Dimensions                | 2024.02.04 | Lin Zhun   |
| P4                            | 5/24<br>5<br>5/7                          | Transmittance<br>Weigh<br>Power Consumption | 2024.02.29 | Lin Zhun   |
| O                             |                                           | Final Release                               | 2024.03.14 | Lin Zhun   |
|                               |                                           |                                             |            |            |
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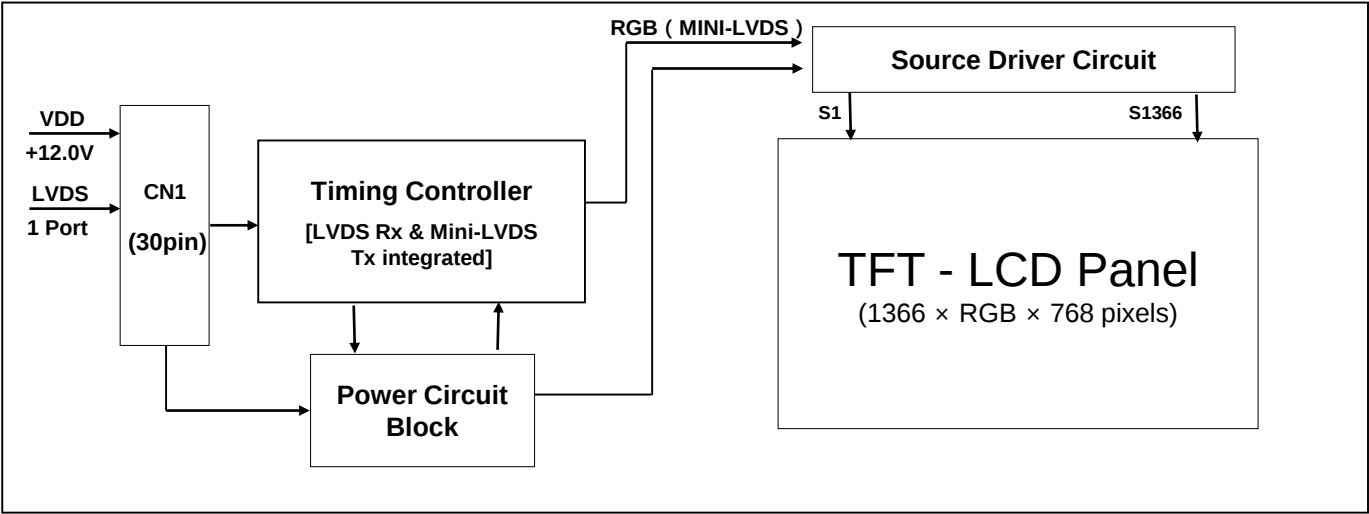
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## 1.0 GENERAL DESCRIPTION

### 1.1 Introduction

HV236WHB-F10 Rev4.0 is a color active matrix TFT LCD open cell using amorphous silicon TFT’s (Thin Film Transistors) as an active switching devices. This module has a 23.6 inch diagonally measured active area with HD resolutions (1366 horizontal by 768 vertical pixel array). Each pixel is divided into RED, GREEN, BLUE dots which are arranged in Z-inversion stripe and this module can display 1.07G colors. The TFT-LCD panel used for this module is adapted for a low reflection and higher color type.



### 1.2 Features

- LVDS interface with 1 pixel / clock
- High-speed response
- Low color shift image quality
- 8-bit+FRC color depth, display 1.07G colors
- High luminance and contrast ratio, low reflection and wide viewing angle
- Gate driver use GOA mode
- DE (Data Enable) only mode
- ADS technology is applied for high display quality
- RoHS compliant

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1.3 Application

- Home Alone Multimedia TFT-LCD TV only
- High Definition TV
- Display Terminals for Control System, Public Monitor and etc... are not allowed

1.4 General Specification

< Table 1. General Specifications >

| Parameter               | Specification                     | Unit   | Remark                       |
|-------------------------|-----------------------------------|--------|------------------------------|
| Active area             | 521.47(H) x 293.18(V)             | mm     |                              |
| Number of pixels        | 1366*(RGB)*768                    | pixels |                              |
| Pixel pitch             | 127.25(H) ×381.75(V)              | μm     |                              |
| Pixel arrangement       | Pixels RGB Vertical stripe        | -      |                              |
| Display colors          | 1.07G ( 8bit+FRC )                | colors | 8bit driver IC               |
| Display mode            | Transmission mode, Normally Black |        |                              |
| Open Cell Transmittance | 6.0 ( Typ. )                      | %      | At center point with BOE BLU |
| Weight                  | 470                               | gram   |                              |
| Power Consumption       | 3.6 ( Typ. ) 4.8 ( Max. )         | Watt   | With TCON board              |
| Surface Treatment       | AG1/Clear                         | -      |                              |

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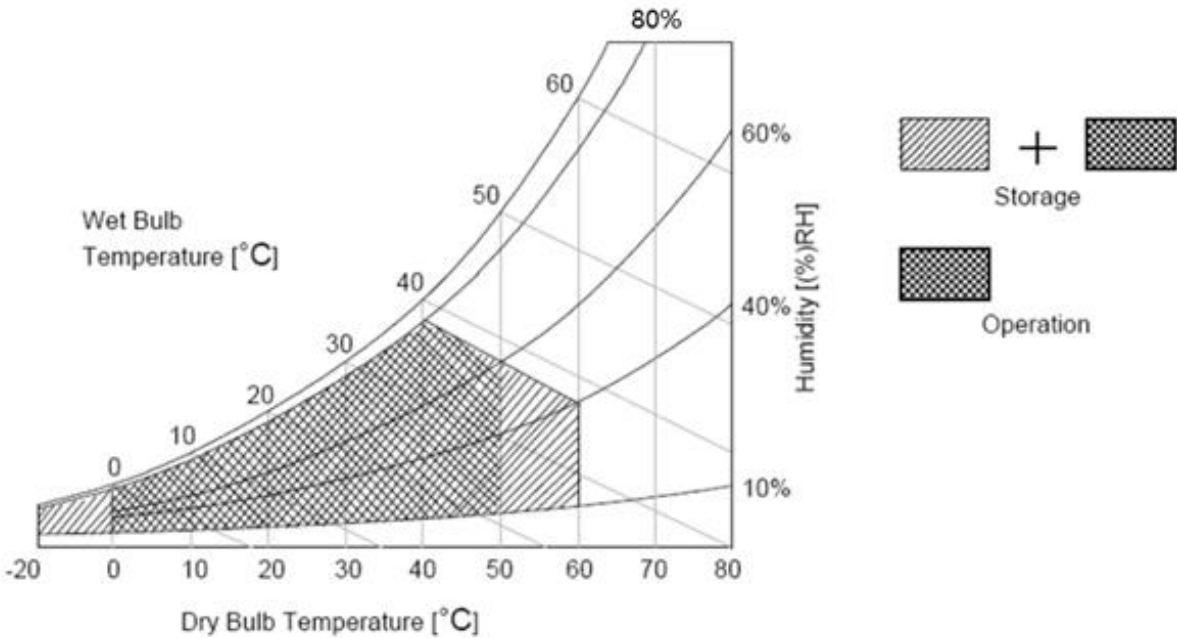
### 2.0 ABSOLUTE MAXIMUM RATINGS

The followings are maximum values which, if exceed, may cause faulty operation or damage to the unit. The operational and non-operational maximum values are listed in the below table.

< Table 2. Open Cell Absolute Maximum Ratings > [VSS=GND=0V]

| Parameter                  | Symbol           | Min.    | Max.  | Unit | Remark |
|----------------------------|------------------|---------|-------|------|--------|
| Power Supply Voltage       | VDD              | VSS-0.3 | +13.5 | V    | Ta=25℃ |
| CMOS/TTL Input Voltage     | DVDD             | VSS-0.3 | +3.6  | V    |        |
| Operating Temperature      | T <sub>OP</sub>  | 0       | +50   | ℃    | Note 1 |
|                            | T <sub>SUR</sub> | 0       | +60   | ℃    |        |
| Storage Temperature        | T <sub>ST</sub>  | -20     | +60   | ℃    |        |
| Operating Ambient Humidity | Hop              | 10      | 80    | %RH  |        |
| Storage Humidity           | Hst              | 10      | 80    | %RH  |        |

Note 1: Temperature and relative humidity range are shown in the figure below.  
Wet bulb temperature should be 39 °C max. and no condensation of water.



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3.0 ELECTRICAL SPECIFICATIONS

3.1 TFT LCD Open Cell

< Table 3. Open Cell Electrical Specifications > [Ta =25±2 °C]

| Parameter                   |                                           | Symbol | Values |     |      | Unit | Remark |
|-----------------------------|-------------------------------------------|--------|--------|-----|------|------|--------|
|                             |                                           |        | Min    | Typ | Max  |      |        |
| Power Supply Input Voltage  |                                           | VDD    | 10.8   | 12  | 13.2 | V    |        |
| Power Supply Ripple Voltage |                                           | VRP    | -      | -   | 600  | mV   |        |
| Power Supply Current        |                                           | IDD    | -      | 0.3 | 0.4  | A    | Note 1 |
| Power Consumption           |                                           | PDD    | -      | 3.6 | 4.8  | Watt |        |
| Rush current                |                                           | IRUSH  | -      | -   | TBD  | A    | Note 2 |
| LVDS Interface              | Differential Input High Threshold Voltage | VLVTH  | +100   | -   | +300 | mV   |        |
|                             | Differential Input Low Threshold Voltage  | VLVTL  | -300   | -   | -100 | mV   |        |
|                             | Common Input Voltage                      | VLVC   | 1.0    | 1.2 | 1.4  | V    |        |
| CMOS Interface              | Input High Threshold Voltage              | VIH    | 2.7    | -   | 3.3  | V    |        |
|                             | Input Low Threshold Voltage               | VIL    | 0      | -   | 0.6  | V    |        |

Note 1: The supply voltage is measured and specified at the interface connector of LCM.

The current draw and power consumption specified is for VDD=12.0V.

Frame rate f<sub>v</sub>= 60Hz and Clock frequency = 75.4MHz.

Test Pattern of power supply current.

a) Typ : Mosaic 7X5 (L0/L255)    b) Max : Vertical Sub Line ( L0/L255)    c) Flicker Test Pattern



2: The duration of rush current is less than 100ms .

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3.2 Temperature Characteristics

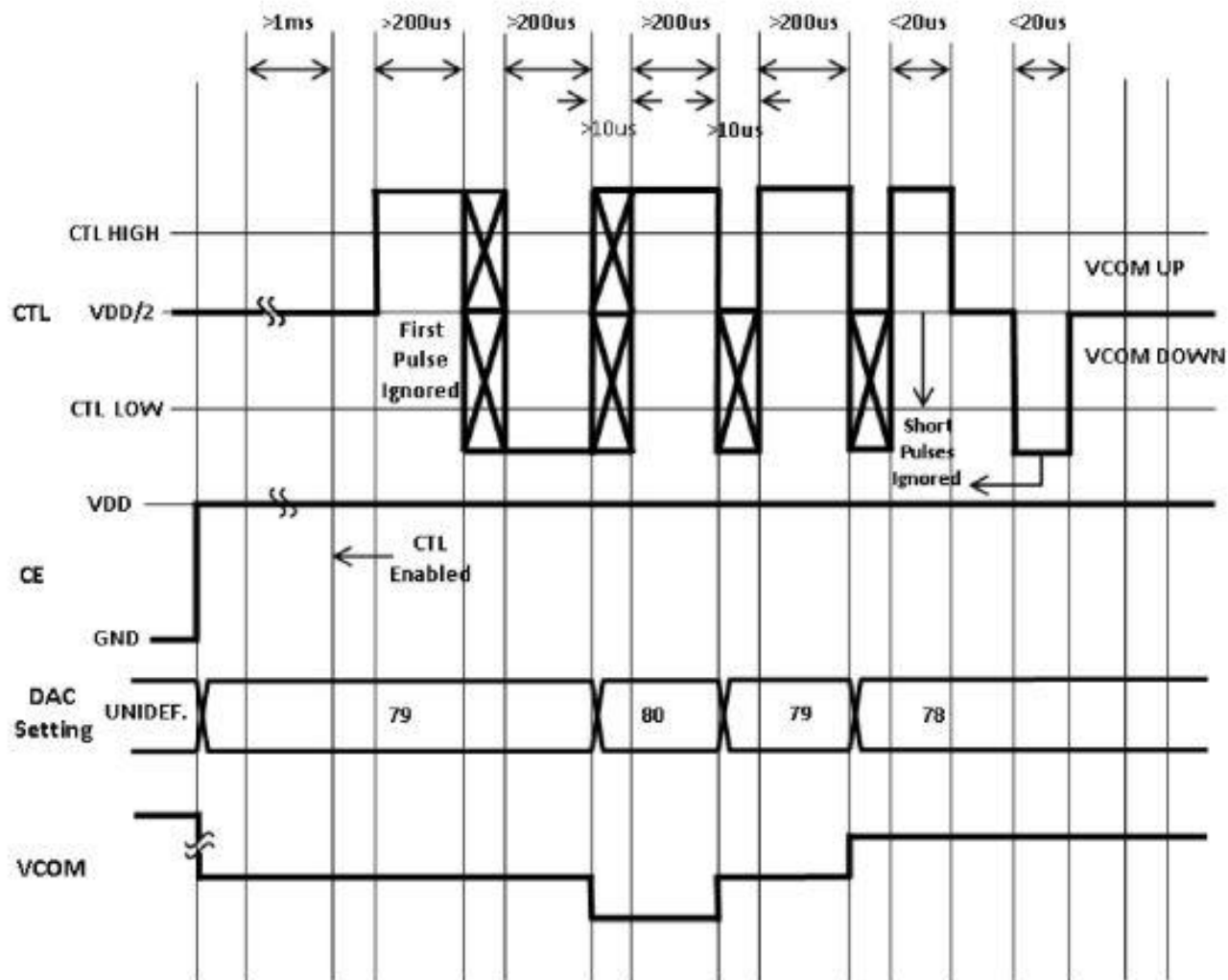
< Table 4. Temperature Characteristics >

| Parameter                  | Symbol          | Values |     |     | Unit | Remark |
|----------------------------|-----------------|--------|-----|-----|------|--------|
|                            |                 | Min    | Typ | Max |      |        |
| Driver Surface Temperature | T <sub>DS</sub> | -      | -   | 125 | °C   | Note1  |
| TCON Surface Temperature   | T <sub>TS</sub> | -      | -   | 100 | °C   | Note2  |
| PMIC Surface Temperature   | T <sub>PS</sub> | -      | -   | 100 | °C   | Note3  |

- Note 1. Any point on the driver surface must be less than 125 °C under any conditions.
2. Any point on the TCON surface must be less than 100 °C under any conditions.
3. Any point on the PMIC surface must be less than 100 °C under any conditions.
4. This test condition is based on BOE module.

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### 3.3 VCOM I2C Bus Format and interval setting requirement



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### 3.3 VCOM I2C Bus Format and interval setting requirement

CTL Voltage

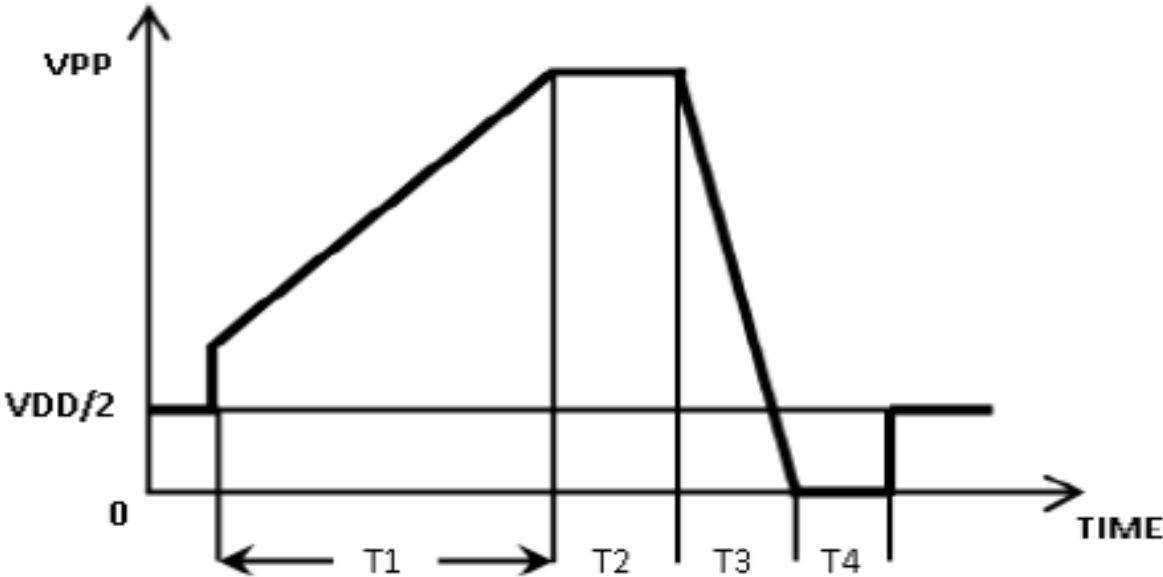


Table7.EEPROM programming Toming Specification

| SYMBOL | PARAMETER               | MIN  | TYP | MAX   | UNIT |
|--------|-------------------------|------|-----|-------|------|
| VPP    | CTL Programming Voltage | 9.75 | 10  | 15.75 | V    |
| T1     | CTL Programming Ramp    | 3.5  | 4   | 4.5   | ms   |
| T2     | EEPROM Program Time     | 0.9  | 1.0 | 1.1   | ms   |
| T3     | VPP Fall Time           | 0.01 |     | 1     | us   |
| T4     | Done Hold Time          | 200  |     |       | us   |

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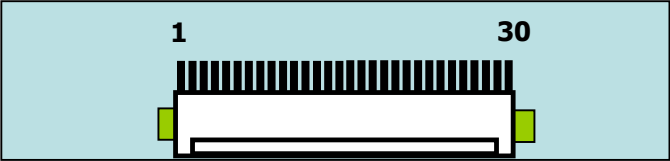
4.0 INTERFACE CONNECTION

4.1 Open Cell Input Signal & Power

< Table 5. Open Cell Input Connector Pin Configuration >

| Pin No | Symbol | Description             | Pin No | Symbol | Description                                  |
|--------|--------|-------------------------|--------|--------|----------------------------------------------|
| 1      | VDD    | Power Supply +12.0V     | 16     | RX1+   | LVDS Receiver Signal(+)                      |
| 2      | VDD    | Power Supply +12.0V     | 17     | GND    | Ground                                       |
| 3      | VDD    | Power Supply +12.0V     | 18     | RX2-   | LVDS Receiver Signal(-)                      |
| 4      | VDD    | Power Supply +12.0V     | 19     | RX2+   | LVDS Receiver Signal(+)                      |
| 5      | GND    | Ground                  | 20     | GND    | Ground                                       |
| 6      | GND    | Ground                  | 21     | RCLK-  | LVDS Receiver Clock Signal(-)                |
| 7      | GND    | Ground                  | 22     | RCLK+  | LVDS Receiver Clock Signal(+)                |
| 8      | GND    | Ground                  | 23     | GND    | Ground                                       |
| 9      | NC     | No Connection           | 24     | RX3-   | LVDS Receiver Signal(-)                      |
| 10     | WP     | Write-Protect           | 25     | RX3+   | LVDS Receiver Signal(+)                      |
| 11     | GND    | Ground                  | 26     | GND    | Ground                                       |
| 12     | RX0-   | LVDS Receiver Signal(-) | 27     | BIST   | 'L' =Free run mode ,<br>'H' or NC= BIST mode |
| 13     | RX0+   | LVDS Receiver Signal(+) | 28     | CE     | 1-wire                                       |
| 14     | GND    | Ground                  | 29     | CTL    | 1-wire                                       |
| 15     | RX1-   | LVDS Receiver Signal(-) | 30     | GND    | Ground                                       |

Rear view of LCM



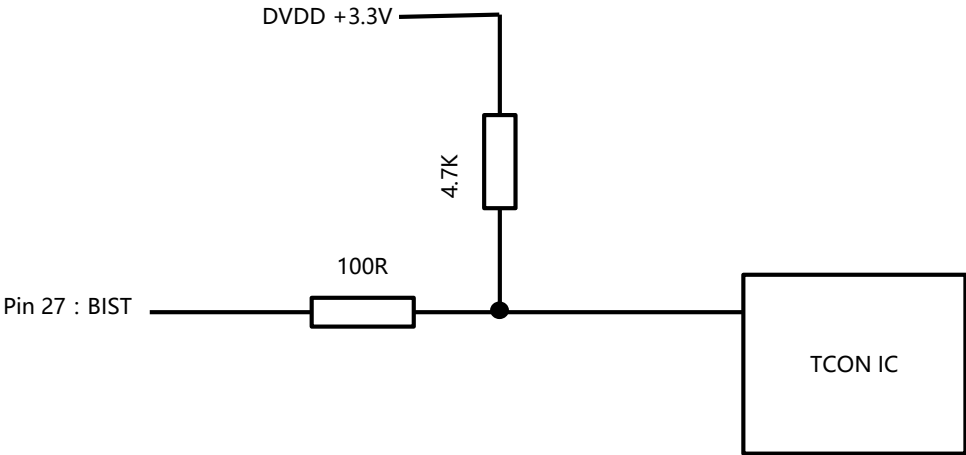
BIST Pattern

|                     |                      |                   |                     |                    |
|---------------------|----------------------|-------------------|---------------------|--------------------|
| PT1:White<br>(2sec) | PT2:Black<br>( 2sec) | PT3:Red<br>(2sec) | PT4:Green<br>(2sec) | PT5:Blue<br>(2sec) |
|                     |                      |                   |                     |                    |

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- Notes : 1. NC(Not Connected) : This pins are only used for BOE internal operations.
2. Input Level of LVDS signal is based on the IEA 664 Standard.
3. LVDS signal data format : Only support VESA.
4. BIST : This pin is used for selecting display pattern mode when input DE or input CLOCK quits toggling.
- If this Pin : Low (GND) → Free run mode(Black Pattern)
- Otherwise : High( 3.3V) or Open (NC) → BIST mode(BIST Pattern)
- Sequence : On = VDD ≥ LVDS Option , BIST Option ≥ Interface signal
- Off = Interface signal ≥ LVDS Option , BIST Option ≥ VDD



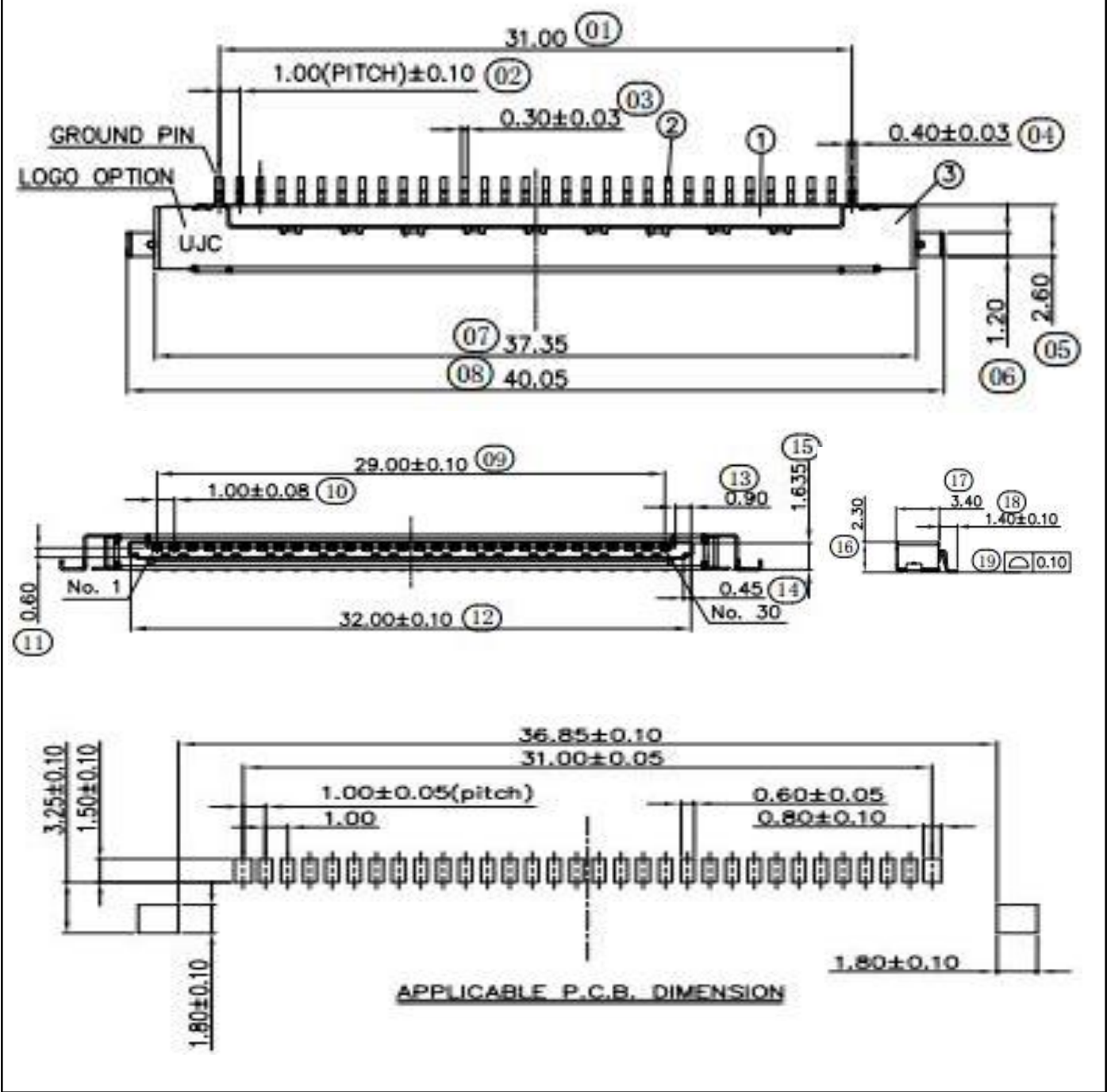
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4.0 INTERFACE CONNECTION

4.2 TCON Board Input Connector & FFC Drawing

-30pin Connector Drawing- IS100-L30B-C23

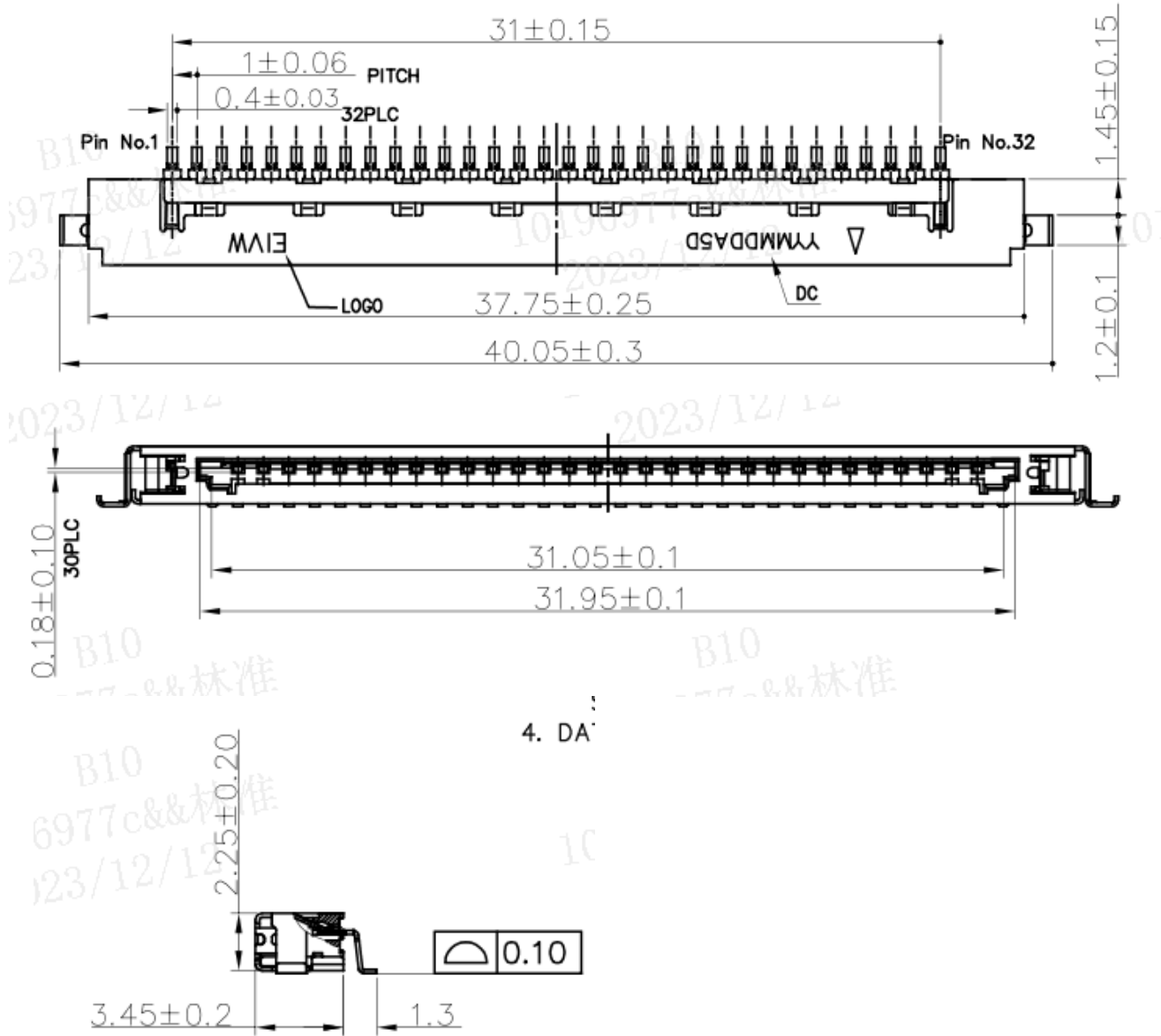


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4.2 TCON Board Input Connector & FFC Drawing

-30pin Connector Drawing- LS1030-L4005W475H225-E01



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5.0 INTERFACE SIGNAL TIMING SPECIFICATION

5.1 LVDS Interface

- LVDS Receiver : Timing Controller (LVDS Rx merged) / LVDS Data : Pixel Data

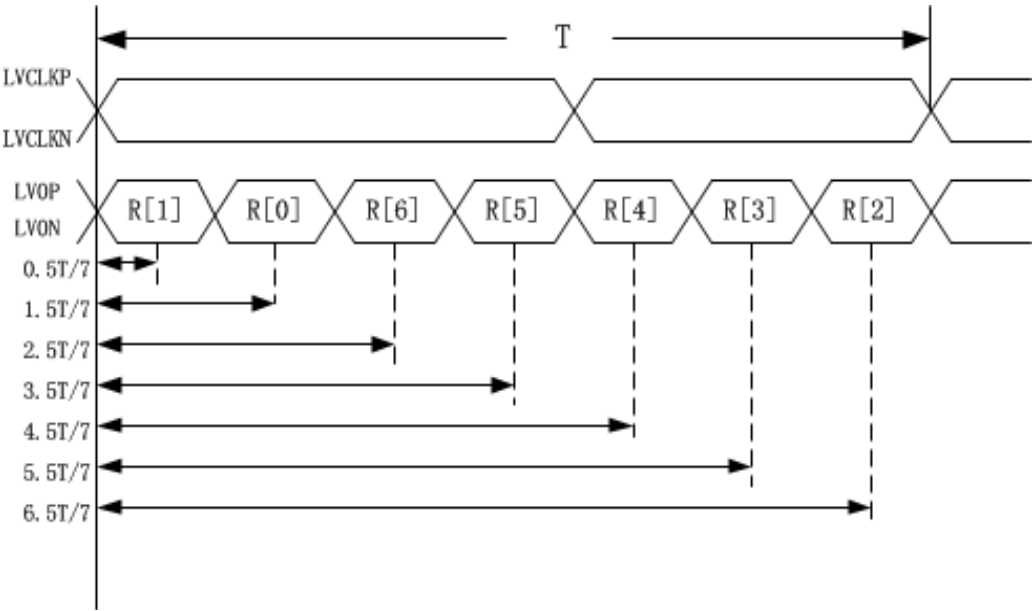
| Channel No. | Data No. | 8-bit LVDS Type |       |
|-------------|----------|-----------------|-------|
|             |          | NS              | JEIDA |
| 0           | Bit-0    | R0              | R2    |
|             | Bit-1    | R1              | R3    |
|             | Bit-2    | R2              | R4    |
|             | Bit-3    | R3              | R5    |
|             | Bit-4    | R4              | R6    |
|             | Bit-5    | R5              | R7    |
|             | Bit-6    | G0              | G2    |
| 1           | Bit-0    | G1              | G3    |
|             | Bit-1    | G2              | G4    |
|             | Bit-2    | G3              | G5    |
|             | Bit-3    | G4              | G6    |
|             | Bit-4    | G5              | G7    |
|             | Bit-5    | B0              | B2    |
|             | Bit-6    | B1              | B3    |
| 2           | Bit-0    | B2              | B4    |
|             | Bit-1    | B3              | B5    |
|             | Bit-2    | B4              | B6    |
|             | Bit-3    | B5              | B7    |
|             | Bit-4    | HS              | HS    |
|             | Bit-5    | VS              | VS    |
|             | Bit-6    | DE              | DE    |
| 3           | Bit-0    | R6              | R0    |
|             | Bit-1    | R7              | R1    |
|             | Bit-2    | G6              | G0    |
|             | Bit-3    | G7              | G1    |
|             | Bit-4    | B6              | B0    |
|             | Bit-5    | B7              | B1    |
|             | Bit-6    | -               | -     |

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5.2 LVDS Rx Interface Timing Parameter

< Table 6. LVDS Rx Interface Timing Specification >

| Item         | Symbol | Min        | Typ    | Max        | Unit | Note |
|--------------|--------|------------|--------|------------|------|------|
| CLKIN Period | T      | 11.8       | 13.5   | 17.9       | nsec |      |
| Input Data0  | tRCIP1 | 0.5T/7-0.4 | 0.5T/7 | 0.5T/7+0.4 | nsec |      |
| Input Data1  | tRCIP0 | 1.5T/7-0.4 | 1.5T/7 | 1.5T/7+0.4 | nsec |      |
| Input Data2  | tRCIP6 | 2.5T/7-0.4 | 2.5T/7 | 2.5T/7+0.4 | nsec |      |
| Input Data3  | tRCIP5 | 3.5T/7-0.4 | 3.5T/7 | 3.5T/7+0.4 | nsec |      |
| Input Data4  | tRCIP4 | 4.5T/7-0.4 | 4.5T/7 | 4.5T/7+0.4 | nsec |      |
| Input Data5  | tRCIP3 | 5.5T/7-0.4 | 5.5T/7 | 5.5T/7+0.4 | nsec |      |
| Input Data6  | tRCIP2 | 6.5T/7-0.4 | 6.5T/7 | 6.5T/7+0.4 | nsec |      |



Note: Input frequency ranges from 35MHz to 100MHz

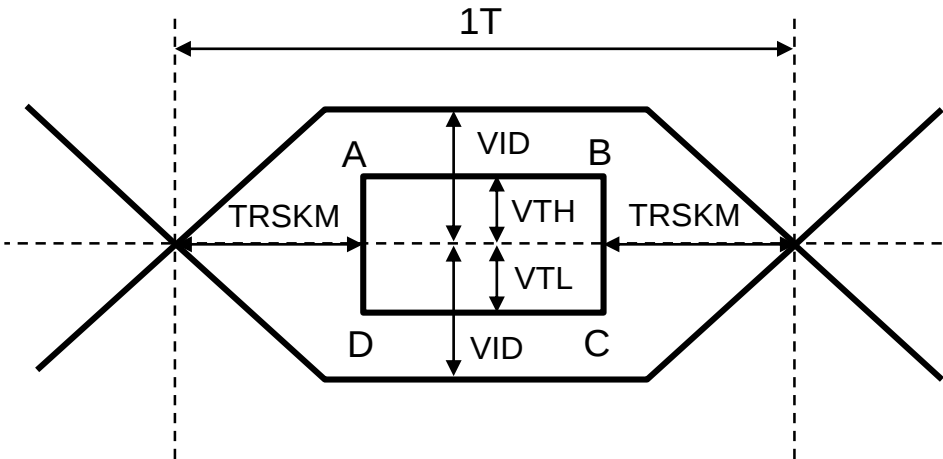
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### 5.3 LVDS Rx Interface Eye Diagram & DC SPEC

< Table 7. LVDS Rx Specification>

| Symbol | Min  | Typ | Max  | Unit | Remark |
|--------|------|-----|------|------|--------|
| A      | 100  | -   | -    | mV   |        |
| B      | 100  | -   | -    | mV   |        |
| C      | -    | -   | -100 | mV   |        |
| D      | -    | -   | -100 | mV   |        |
| VTH    | -    | -   | +100 | mV   |        |
| VTL    | -100 | -   | -    | mV   |        |
| VID    | ±100 | -   | ±600 | mV   |        |
| Rmodul | -3   | -   | +3   | %    |        |
| Fmodul | 10   | -   | 300  | KHz  |        |

- Notes:
1. TRSKM: 600ps@65MHz, 530ps@74.25MHz, 510ps@75.0MHz , 450ps@85MHz.
  2. VID /VTH/VTL measure point is below timing. VID measurement can be judge at the center of Eye.



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5.3 LVDS Rx Interface Eye Diagram & DC SPEC

< Table 8. LVDS Input SSCG>

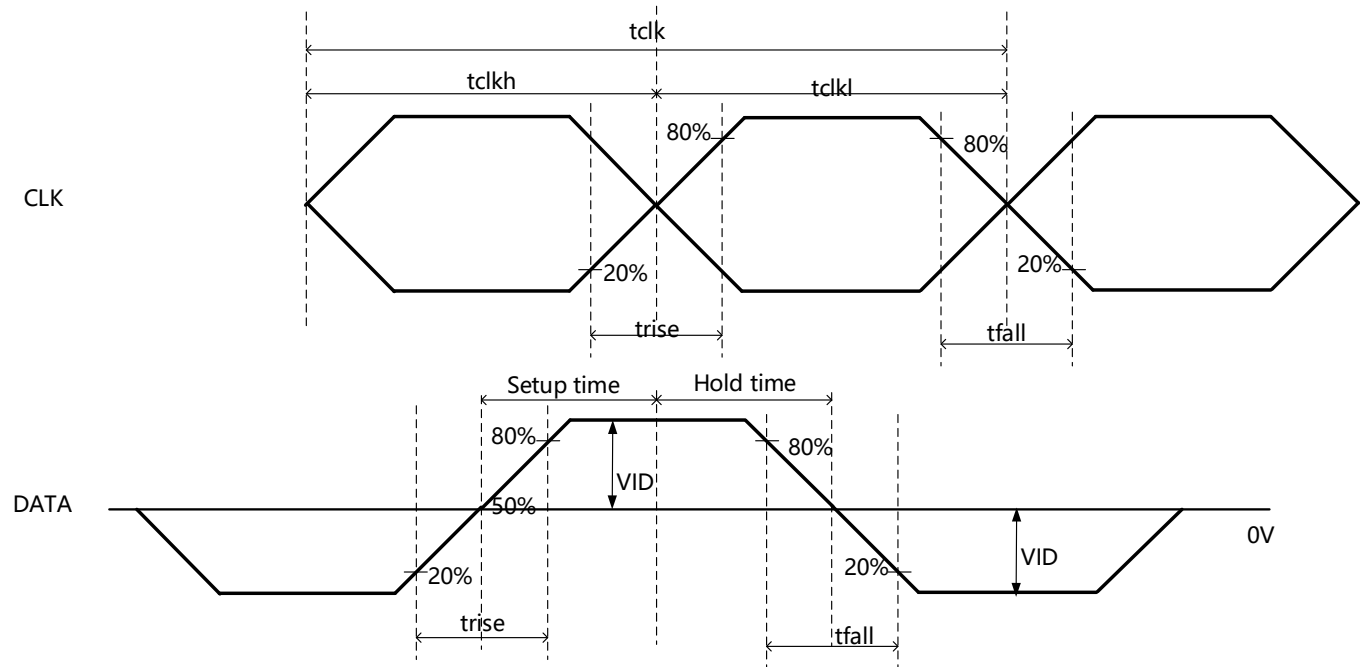
| Symbol             | Parameter                                             | Condition                                                   | Min  | Typ  | Max      | Unit |
|--------------------|-------------------------------------------------------|-------------------------------------------------------------|------|------|----------|------|
| F                  | LVDS Input frequency                                  | Frame Rate<br>=60Hz                                         | 56   | 75.4 | 85       | MHz  |
| T <sub>LVSK</sub>  | LVDS channel to channel skew                          | F=65MHz<br>V <sub>IC</sub> =1.2V<br>V <sub>ID</sub> =±200mV | -600 | -    | +60<br>0 | ps   |
| F <sub>LVMOD</sub> | Modulating frequency of input clock during SSC        | F=85MHz<br>V <sub>IC</sub> =1.2V<br>V <sub>ID</sub> =±200mV | 10   | -    | 300      | KHz  |
| F <sub>LVDEV</sub> | Maximum deviation of input clock frequency during SSC |                                                             | -3   | -    | +3       | %    |
| T <sub>CY-CY</sub> | Cycle to Cycle jitter                                 |                                                             | -200 | -    | 200      | ps   |

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5.4 Intra interface Signal Eye Diagram

< Table 9. Mini-LVDS Eye Diagram >



< Table 10. Eye Diagram information >

| Parameter                           | Symbol | Spec    |     |          | Unit |
|-------------------------------------|--------|---------|-----|----------|------|
|                                     |        | Min     | Typ | Max      |      |
| Clock Period                        | tclk   | 3.03    | -   | -        | ns   |
| Clock low pulse width               | tclkh  | 0.4tclk | -   | 0.6tclk  | ns   |
| Clock high pulse width              | tclkl  | 0.4tclk | -   | 0.6tclk  | ns   |
| Data setup time                     | tsetup | 0.6     | -   | -        | ns   |
| Data hold time                      | thold  | 0.6     | -   | -        | ns   |
| CLK,Data rising time                | trise  | -       | -   | 0.5      | ns   |
| CLK,Data falling time               | tfall  | -       | -   | 0.5      | ns   |
| mini-LVDS different voltage         | VID    | 120     | -   | -        | mv   |
| mini-LVDS common Mode input voltage | VIB    | 0.5     | 1.2 | VDDD-1.2 | V    |

- Notes :
- 1. Eye diagram test point is located on source board, close to source driver.
  - 2. Condition: Mini-LVDS CLK MAX Frequency≤330Mhz.

|              |                                           |          |
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5.0 INTERFACE SIGNAL TIMING SPECIFICATION

5.5 Signal Timing Parameters

< Table 11. Timing Table >

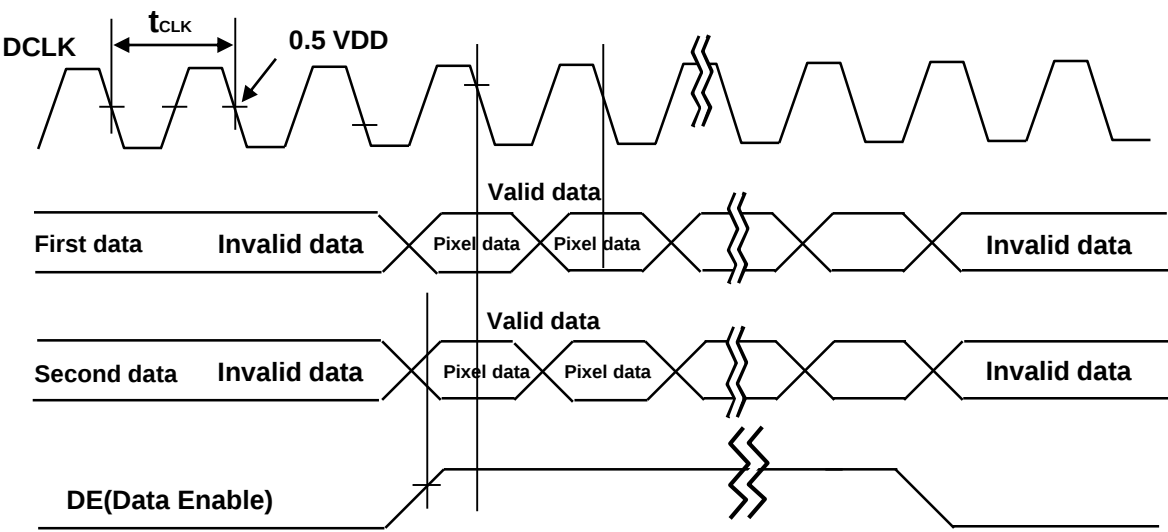
| Item       |            | Symbols         | Min  | Typ  | Max  | Unit             |
|------------|------------|-----------------|------|------|------|------------------|
| Frequency  |            | 1/Tc            | 56   | 75.4 | 85   | MHz              |
| Vertical   | Frame Rate | F               | 57   | 60   | 63   | Hz               |
|            | Total      | T <sub>V</sub>  | 790  | 806  | 1200 | T <sub>H</sub>   |
|            | Display    | T <sub>VD</sub> | 768  |      |      | T <sub>H</sub>   |
|            | Blank      | T <sub>VB</sub> | 22   | 38   | 432  | T <sub>H</sub>   |
| Horizontal | Total      | T <sub>H</sub>  | 1462 | 1560 | 2000 | T <sub>CLK</sub> |
|            | Display    | T <sub>HD</sub> | -    | 1366 | -    | T <sub>CLK</sub> |
|            | Blank      | T <sub>HB</sub> | 96   | 194  | 634  | T <sub>CLK</sub> |

| Item       |            | Symbols         | Min  | Typ  | Max  | Unit             |
|------------|------------|-----------------|------|------|------|------------------|
| Frequency  |            | 1/Tc            | 56   | 75.4 | 85   | MHz              |
| Vertical   | Frame Rate | F               | 47   | 50   | 53   | Hz               |
|            | Total      | T <sub>V</sub>  | 790  | 966  | 1200 | T <sub>H</sub>   |
|            | Display    | T <sub>VD</sub> | 768  |      |      | T <sub>H</sub>   |
|            | Blank      | T <sub>VB</sub> | 22   | 198  | 432  | T <sub>H</sub>   |
| Horizontal | Total      | T <sub>H</sub>  | 1462 | 1560 | 2000 | T <sub>CLK</sub> |
|            | Display    | T <sub>HD</sub> | -    | 1366 | -    | T <sub>CLK</sub> |
|            | Blank      | T <sub>HB</sub> | 96   | 194  | 634  | T <sub>CLK</sub> |

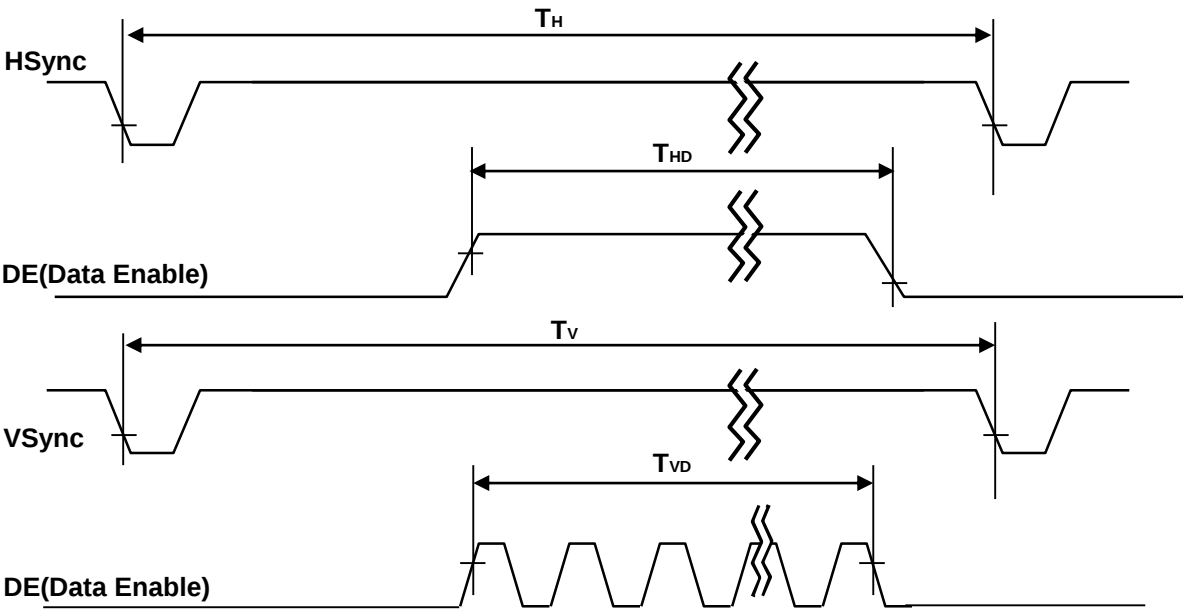
- Notes:
- 1.This product is DE only mode. The input of Hsync & Vsync signal does not have an effect on normal operation.
  - 2. This product should keep clock frequency and Horizontal value fixed when adjusting frame rate.
  - 3. It is recommended that the PWM frequency should be an integer multiple of the frame rate , If BLU use PWM mode.

|                |                  |        |            |
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5.6 Signal Timing Waveform



Notes: This product is DE only mode. The input of Hsync & Vsync signal does not have an effect on normal operation.



|              |                                           |          |
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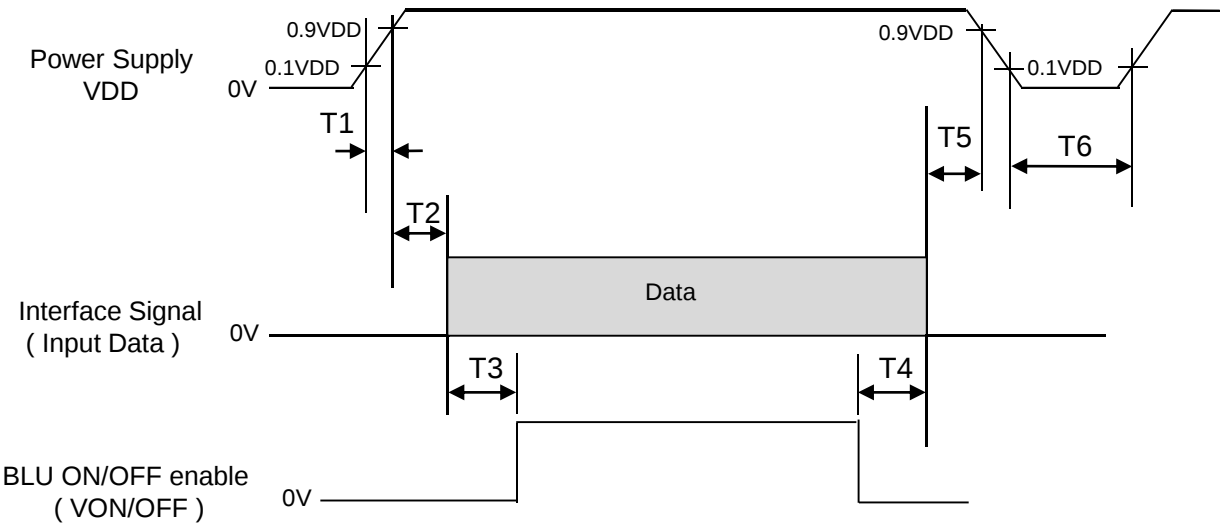
5.7 Input Signals, Basic Display Colors and Gray Scale of Colors

< Table 12. Input Signal and Display Color Table >

| Color & Gray Scale  |          | Input Data Signal |    |    |    |    |    |    |    |            |    |    |    |    |    |    |    |           |    |    |    |    |    |    |    |
|---------------------|----------|-------------------|----|----|----|----|----|----|----|------------|----|----|----|----|----|----|----|-----------|----|----|----|----|----|----|----|
|                     |          | Red Data          |    |    |    |    |    |    |    | Green Data |    |    |    |    |    |    |    | Blue Data |    |    |    |    |    |    |    |
|                     |          | R7                | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G7         | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B7        | B6 | 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  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | Blue     | 0                 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0          | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1         | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
|                     | Green    | 0                 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1          | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | Cyan     | 0                 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1          | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1         | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
|                     | Red      | 1                 | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0          | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | Magenta  | 1                 | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0          | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1         | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
|                     | Yellow   | 1                 | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1          | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0         | 0  | 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  | 1  | 1  | 1  | 1  | 1  | 1  |
| Gray Scale of Red   | Black    | 0                 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0          | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | △        | 0                 | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0          | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | Darker   | 0                 | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0          | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | △        | ↑                 |    |    |    |    |    |    |    | ↑          |    |    |    |    |    |    |    | ↑         |    |    |    |    |    |    |    |
|                     | ▽        | ↓                 |    |    |    |    |    |    |    | ↓          |    |    |    |    |    |    |    | ↓         |    |    |    |    |    |    |    |
|                     | Brighter | 1                 | 1  | 1  | 1  | 1  | 1  | 0  | 1  | 0          | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | ▽        | 1                 | 1  | 1  | 1  | 1  | 1  | 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  | 1  | 1  | 0          | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| Gray Scale of Green | Black    | 0                 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0          | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | △        | 0                 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0          | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | Darker   | 0                 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0          | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | △        | ↑                 |    |    |    |    |    |    |    | ↑          |    |    |    |    |    |    |    | ↑         |    |    |    |    |    |    |    |
|                     | ▽        | ↓                 |    |    |    |    |    |    |    | ↓          |    |    |    |    |    |    |    | ↓         |    |    |    |    |    |    |    |
|                     | Brighter | 0                 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1          | 1  | 1  | 1  | 1  | 1  | 0  | 1  | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | ▽        | 0                 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1          | 1  | 1  | 1  | 1  | 1  | 0  | 0  | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | Green    | 0                 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1          | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| Gray Scale of Blue  | Black    | 0                 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0          | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | △        | 0                 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0          | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 1  |
|                     | Darker   | 0                 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0          | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0  | 0  | 0  | 0  | 0  | 1  | 0  |
|                     | △        | ↑                 |    |    |    |    |    |    |    | ↑          |    |    |    |    |    |    |    | ↑         |    |    |    |    |    |    |    |
|                     | ▽        | ↓                 |    |    |    |    |    |    |    | ↓          |    |    |    |    |    |    |    | ↓         |    |    |    |    |    |    |    |
|                     | Brighter | 0                 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0          | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1         | 1  | 1  | 1  | 1  | 1  | 0  | 1  |
|                     | ▽        | 0                 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0          | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1         | 1  | 1  | 1  | 1  | 1  | 1  | 0  |
|                     | Blue     | 0                 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0          | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 1         | 1  | 1  | 1  | 1  | 1  | 1  | 1  |
| Gray Scale of White | Black    | 0                 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0          | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
|                     | △        | 0                 | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0          | 0  | 0  | 0  | 0  | 0  | 0  | 1  | 0         | 0  | 0  | 0  | 0  | 0  | 0  | 1  |
|                     | Darker   | 0                 | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0          | 0  | 0  | 0  | 0  | 0  | 1  | 0  | 0         | 0  | 0  | 0  | 0  | 0  | 1  | 0  |
|                     | △        | ↑                 |    |    |    |    |    |    |    | ↑          |    |    |    |    |    |    |    | ↑         |    |    |    |    |    |    |    |
|                     | ▽        | ↓                 |    |    |    |    |    |    |    | ↓          |    |    |    |    |    |    |    | ↓         |    |    |    |    |    |    |    |
|                     | Brighter | 1                 | 1  | 1  | 1  | 1  | 1  | 0  | 1  | 1          | 1  | 1  | 1  | 1  | 0  | 1  | 1  | 1         | 1  | 1  | 1  | 1  | 0  | 1  | 1  |
|                     | ▽        | 1                 | 1  | 1  | 1  | 1  | 1  | 0  | 1  | 1          | 1  | 1  | 1  | 1  | 1  | 0  | 1  | 1         | 1  | 1  | 1  | 1  | 1  | 1  | 0  |
|                     | White    | 1                 | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1          | 1  | 1  | 1  | 1  | 1  | 1  | 1  | 1         | 1  | 1  | 1  | 1  | 1  | 1  | 1  |

5.8 Power Sequence

To prevent a latch-up or DC operation of the Open Cell, the power on/off sequence shall be as shown in below.



< Table 13. Sequence Table >

| Parameter | Values |     |      | Units |
|-----------|--------|-----|------|-------|
|           | Min    | Typ | Max  |       |
| T1        | 0.5    | -   | 20   | ms    |
| T2        | 10     | -   | 1000 | ms    |
| T3        | 200    | -   | -    | ms    |
| T4        | 100    | -   | -    | ms    |
| T5        | 0      | -   | 1000 | ms    |
| T6        | 1      | -   | -    | s     |

- Notes: 1. Even though T1 is out of Min SPEC, it is still ok if the inrush current of VDD is below the limit.
2. Back Light must be turn on after power for logic and interface signal are valid.
3. When  $VDD < 0.9VDD(Typ.)$ , Power off.
4. VDD should rise and fall smoothly. If there is rebounding voltage when falling stage, it must smaller than 6 volts.
5. If interface signal exceed T2(max), enter to BIST mode.
6. When the power supply for LCD is off , be sure to pull down the valid and invalid data to 0V.
7. For any switch ( power on/off ) operation , the sequence must be satisfied with specification.

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6.0 OPTICAL SPECIFICATION

The test of optical specifications shall be measured in a dark room (ambient luminance≤1 lux and temperature=25±2°C) with the equipment of Luminance meter system (Goniometer system and PR730) and test unit shall be located at an approximate distance 180cm from the LCD surface at a viewing angle of  $\theta$  and  $\Phi$  equal to 0°. We refer to  $\theta_{\varnothing=0}$  ( $=\theta_3$ ) as the 3 o'clock direction (the “right”),  $\theta_{\varnothing=90}$  ( $=\theta_{12}$ ) as the 12 o'clock direction (“upward”),  $\theta_{\varnothing=180}$  ( $=\theta_9$ ) as the 9 o'clock direction (“left”) and  $\theta_{\varnothing=270}$ ( $=\theta_6$ ) as the 6 o'clock direction (“bottom”). While scanning  $\theta$  and/or  $\varnothing$ , the center of the measuring spot on the Display surface shall stay fixed. The measurement shall be executed after 30 minutes warm-up period. VDD shall be 12.0V +/-10% at 25°C. Optimum viewing angle direction is 6 ’clock.

< Table 14. Optical Table >

[VDD = 12.0V, Frame rate = 60Hz, Ta =25±2 °C]

| Parameter             |            | Symbol        | Condition                                                    | Min            | Typ    | Max            | Unit | Remark |       |
|-----------------------|------------|---------------|--------------------------------------------------------------|----------------|--------|----------------|------|--------|-------|
| Viewing Angle         | Horizontal | $\Theta_3$    | CR > 10                                                      | -              | 89     | -              | Deg. | Note1  |       |
|                       |            | $\Theta_9$    |                                                              | -              | 89     | -              | Deg. |        |       |
|                       | Vertical   | $\Theta_{12}$ |                                                              | -              | 89     | -              | Deg. |        |       |
|                       |            | $\Theta_6$    |                                                              | -              | 89     | -              | Deg. |        |       |
| Contrast ratio        |            | CR            | $\Theta = 0^\circ$<br>(Center)<br>Normal<br>Viewing<br>Angle | 900:1          | 1200:1 | -              |      | Note2  |       |
| Reproduction of color | White      | $W_x$         |                                                              | TYP.<br>- 0.03 | 0.307  | TYP.<br>+ 0.03 |      | Note3  |       |
|                       |            | $W_y$         |                                                              |                | 0.317  |                |      |        |       |
|                       | Red        | $R_x$         |                                                              |                | 0.648  |                |      |        |       |
|                       |            | $R_y$         |                                                              |                | 0.341  |                |      |        |       |
|                       | Green      | $G_x$         |                                                              |                | 0.323  |                |      |        |       |
|                       |            | $G_y$         |                                                              |                | 0.609  |                |      |        |       |
|                       | Blue       | $B_x$         |                                                              |                | 0.152  |                |      |        |       |
|                       |            | $B_y$         |                                                              |                | 0.061  |                |      |        |       |
| Response Time         | G to G     | $T_g$         |                                                              | -              | 14     |                | ms   | Note4  |       |
| Cell Transmittance    |            |               |                                                              |                | 5.4    | 6.0            |      | %      | Note5 |
| Gamma Scale           |            |               |                                                              |                | 2.0    | 2.2            | 2.4  |        |       |

|              |                                           |          |
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Notes :

1. Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing are determined for the horizontal or 3, 9 o'clock direction and the vertical or 6, 12 o'clock direction with respect to the optical axis which is normal to the LCD surface.
2. Contrast measurements shall be made at viewing angle of  $\theta=0^{\circ}$  and at the center of the LCD surface. Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black) state. (See Figure 1 shown in Appendix) Luminance Contrast Ratio (CR) is defined mathematically.

$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$

3. The color chromaticity coordinates specified in this table shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the panel. The chromaticity coordinates are based on BOE backlight.
4. Response time Tg is the average time required for display transition by switching the input signal as below table and is based on Frame rate fV = 60Hz with BOE Tcon Board to optimize. Each time in below table shall be measured by switching the input signal for “any level of gray(bright)”and “any level of gray(dark)”

| Measured Response Time |     | Target |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |
|------------------------|-----|--------|----|----|----|----|----|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|                        |     | 0      | 15 | 31 | 47 | 63 | 79 | 95 | 111 | 127 | 143 | 159 | 175 | 191 | 207 | 223 | 239 | 255 |
| Start                  | 0   |        |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |
|                        | 15  |        |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |
|                        | 31  |        |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |
|                        | 47  |        |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |
|                        | 63  |        |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |
|                        | 79  |        |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |
|                        | 95  |        |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |
|                        | 111 |        |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |
|                        | 127 |        |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |
|                        | 143 |        |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |
|                        | 159 |        |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |
|                        | 175 |        |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |
|                        | 191 |        |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |
|                        | 207 |        |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |
|                        | 223 |        |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |
| 239                    |     |        |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |
| 255                    |     |        |    |    |    |    |    |    |     |     |     |     |     |     |     |     |     |     |

5. Definition of Transmittance (T%) :

Module is with white(L255) signal input

$$\text{Transmittance} = \frac{\text{Luminance of LCD Module}}{\text{Luminance of BLU}} \times 100 \%$$

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7.0 RELIABILITY TEST

The Reliability test items and its conditions are shown in below.

< Table 15. Reliability Test Parameters >

| No | Test Items                                      | Conditions                              |
|----|-------------------------------------------------|-----------------------------------------|
| 1  | High temperature storage test                   | Ta = 60 °C, 240 hrs                     |
| 2  | Low temperature storage test                    | Ta = -20 °C, 240 hrs                    |
| 3  | High temperature & high humidity operation test | Ta = 50 °C, 80%RH, 240hrs               |
| 4  | High temperature operation test                 | Ta = 50 °C, 240hrs                      |
| 5  | Low temperature operation test                  | Ta = -5 °C, 240hrs                      |
| 6  | Thermal shock                                   | Ta = -20 °C ↔ 60 °C (0.5 hr), 100 cycle |

Note : Test condition is based on BOE module.

|              |                                           |          |
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8.0 PRECAUTIONS

Please pay attention to the followings when you use this TFT LCD Open Cell.

8.1 Precautions when taking out the Panel

- Pick the pouch only, when taking out panel from a shipping package.
- Recommend to use suitable sucker to pick up and put down panel.

8.2 Precautions for handling the panel

- As the electrostatic discharges may break the LCD panel, handle the LCD panel with care. Peel a protection sheet off from the LCD panel surface as slowly as possible. Refer to the appendix 3.
- As the LCD panel and backlight element are made from fragile glass material, impulse and pressure to the LCD panel should be avoided.
- As the surface of the polarizer is very soft and easily scratched, use a soft dry cloth without chemicals for cleaning.
- Put the panel display side down on a flat horizontal plane.
- Handle connectors and cables with care.

8.3 Precautions for the operation

- The LCD product shall be operated under normal conditions as below:
  - VDD: 12±0.12V
  - Temperature: 20±15℃
  - Humidity: 55±20%
  - Display pattern: continually changing pattern(Not stationary)
- Product reliability and functions are only guaranteed when the product is used under right operation usages. If product will be used in extreme conditions such as high temperature, high humidity, high altitude, special display patterns, long time operation, outdoor operation, etc., it is strongly recommended to contact BOE for the advice about the application of engineering. Otherwise its reliability and function may not be guaranteed. Extreme conditions are commonly found at airports, transit stations, banks, stock markets, and controlling systems.
- Do not exceed the absolute maximum rating value.
- Periodical power-off or screen save is needed after long-term display. Product reliability and functions may not be guaranteed when it under 24 hours operation continuously per day.

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8.0 PRECAUTIONS

- Do not insert or pull out the interface connector while the LCD panel is operating.
- LCD Response time depends on the temperature.(In lower temperature, it becomes longer)
- Ensure all input signals and power supplies are complete and valid when the panel is operating. Otherwise the LCD panel would be damaged.
- Obey the supply voltage sequence. If wrong sequence is applied, the panel would be damaged. Specially, pay attention to the turn on and off sequence.

8.4 Precautions for the atmosphere

- Recommend storage atmosphere

| ITEM                | UNIT                                                                                                                                                                                                                                                                                                                                                                                                                                               | MIN | MAX |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----|
| Storage Temperature | (°C)                                                                                                                                                                                                                                                                                                                                                                                                                                               | 5   | 40  |
| Storage Humidity    | (%RH)                                                                                                                                                                                                                                                                                                                                                                                                                                              | 35  | 75  |
| Storage Life        | 6 months                                                                                                                                                                                                                                                                                                                                                                                                                                           |     |     |
| Storage Condition   | <ul style="list-style-type: none"><li>• The storage room should be equipped with a dark and good ventilation facility.</li><li>• Prevent products from being exposed to the direct sunlight, moisture and water.</li><li>• The product need to keep away from organic solvent and corrosive gas.</li><li>• Be careful for condensation at sudden temperature change.</li><li>• Storage condition is guaranteed under packing conditions.</li></ul> |     |     |

- Dew drop atmosphere should be avoided. When expose to drastic fluctuation of temperature (hot to cold or cold to hot ) , the LCD module may be affected. Specifically, drastic temperature fluctuation from cold to hot, produces dew on the LCD module’s surface which may affect the operation of the polarizer and LCD module.
- Do not store and/or operate the LCD panel in a high temperature and/or humidity atmosphere. Storage in an electro-conductive polymer packing pouch and under relatively low temperature atmosphere is recommended.

8.5 Precautions for the panel characteristics

- Do not apply fixed pattern data signal to the LCD panel at product aging.
- Applying fixed or weak signal pattern ( low resolution or interlaced scanning video ) for a long time may cause image sticking.

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8.0 PRECAUTIONS

8.6 Other precautions

- In particular in winter, Before putting Panel boxes on the line, aging process is required to make the temperature of products similar to the temperature of workplace.
- Do not disassemble and/or re-assemble LCD panel.
- Do not re-adjust variable resistor or switch etc.
- When returning the panel for repair or etc., Please pack the panel not to be broken. We recommend to use the original shipping packages.
- Product assembled into module should be stored in the bag(cover case).
- Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- Be careful not to give any extra mechanical stress to the panel when designing the set, and backlight.
- Do not pull, fold or bend the source COF and the gate COF in any processes.
- If the liquid crystal material leaks from the panel, this should be kept away from the eyes or mouth. If this contacts to hands, legs, or clothes, you must washed it away with soap thoroughly and see a doctor for the medical examination.

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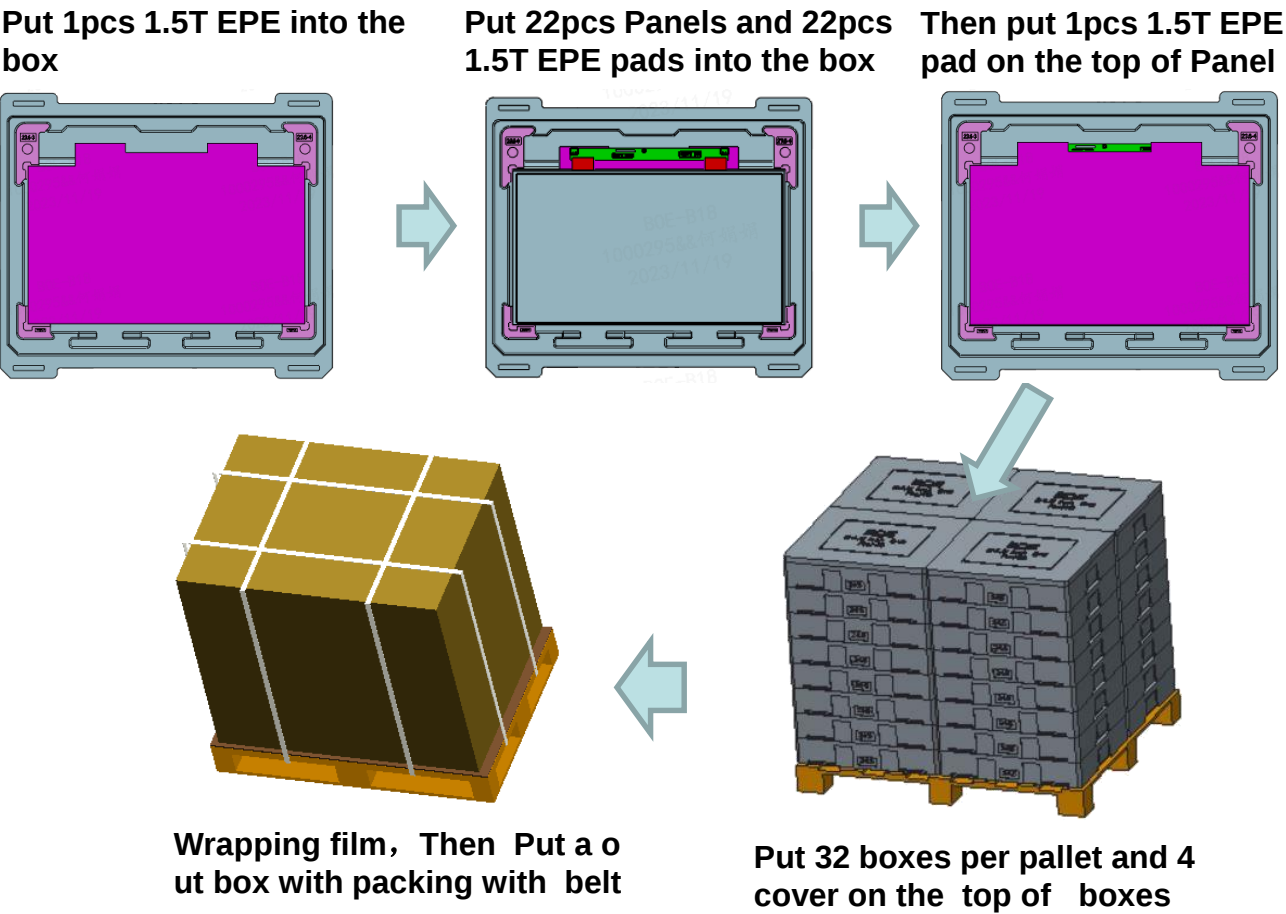


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## 10.0 PACKING INFORMATION

BOE provides the standard shipping container for customers, unless customer specifies their packing information. The standard packing method and Barcode information are shown in the below.

### 10.1 Packing Order



**Cautions :**  
 When transferring in warehouse or factory, the arm length of electric forklift or hand pallet truck must be longer than the pallet along the insertion direction.

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10.2 Packing Note

- Box Dimension : 640\*550\*125mm
- Package Quantity in one Box : 22pcs
- Wood Pallet Dimension : 1300\*1140\*138mm

10.3 Box Label

- Label Size : 70 mm (L) × 30 mm (W)
- Contents
  - Model : HV236WHB-F10 Rev4.0
  - Q`ty : 22 Open Cell in one box.
  - Serial No. : Box Serial No. See next detail description.
  - Date : Packing Date
  - FG Code : FG Code of Product

BOE

CHONGQING BOE OPTOELECTRONICS  
TECHNOLOGY Co., LTD

MODEL:   XXXXXXXX-XXX Rev X①

Q'TY: XX②

SERIAL NO:   XXXXXXXXXXXXXXX③

DATE: XXXXXXXXX④

BOX ID 条形码



XXXXXXXXXX⑤

XXXX⑥

XXXX⑦

1.

FG-CODE(前12位)
2.

包装数量
3.

Box ID
4.

包装日期
5.

客户端段物料号
6.

FG-Code后四位
7.

供应商代码

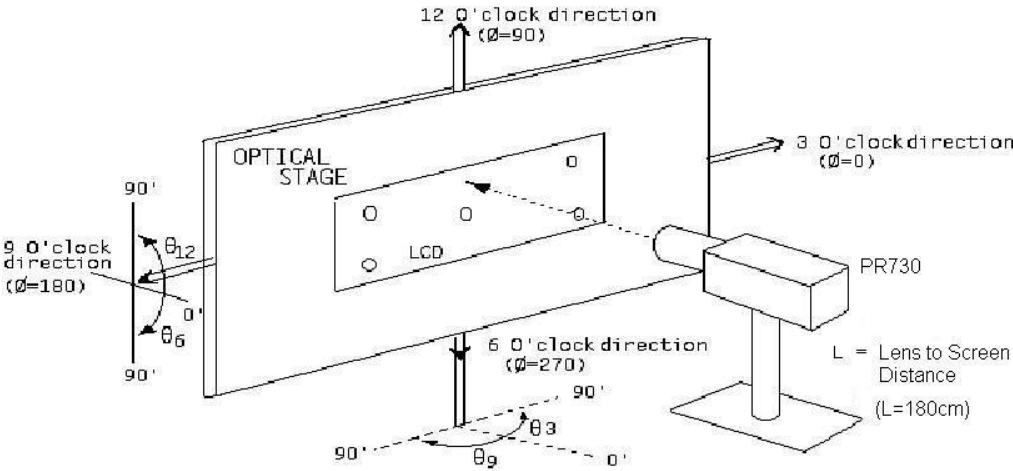
Box ID Naming Rule:

| Digit<br>Code | 1            | 2 | 3     | 4    | 5    | 6 | 7     | 8             | 9                     | 10 | 11 | 12 | 13 |
|---------------|--------------|---|-------|------|------|---|-------|---------------|-----------------------|----|----|----|----|
| Code          | S            | L | S     | 9    | 1    | 6 | 3     | 5             | 9                     | 4  | 2  | 0  | 0  |
| Description   | Products GBN |   | Grade | Line | Year |   | Month | Revision Code | Serial No (无、O、Q、U、Z) |    |    |    |    |

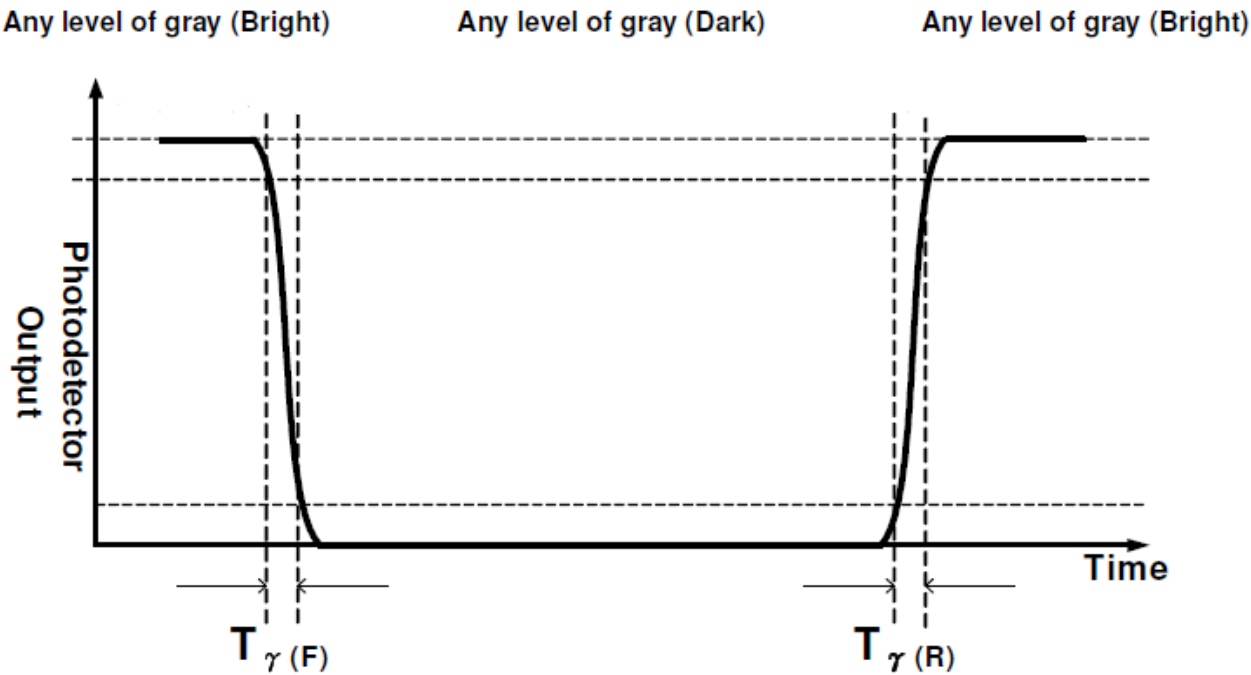
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11.0 APPENDIX 1



< Figure 1. Measurement Set Up >



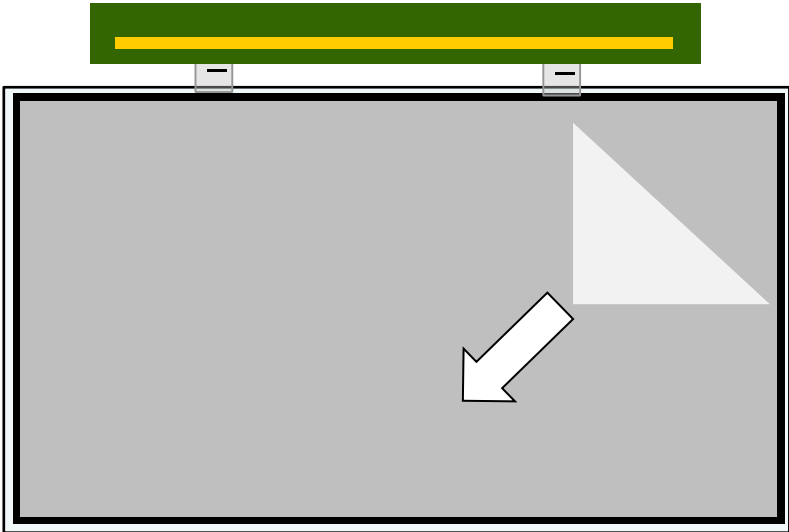
< Figure 2. Response Time Testing >

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11.0 APPENDIX 3



< Figure 4. TFT POL Protect Film Peeling Method >

Peeling Steps:

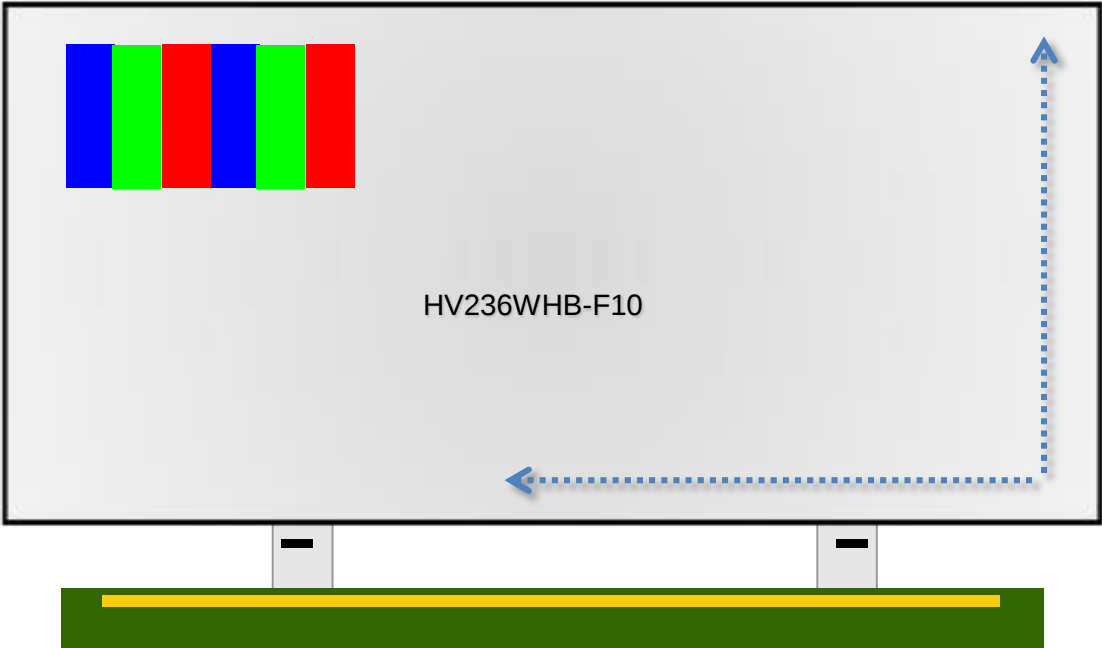
1. Be sure to peel off slowly(recommended more than 7sec) and constant speed.
2. Peeling direction shows in Figure 4.
3. Be sure to ground person with adequate methods such as the anti-static wrist band.
4. Be sure to ground each source PCB while peeling off the protection film.
5. Ionized air should be blown over during peeling action.
6. The protection film must not touch drivers and source PCBs.
7. If adhesive may remain on the polarizer after the protection film peeling off, please remove with isopropyl-alcohol.

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11.0 APPENDIX 4

This product is reverse type display. RGB data mapping scan direction : from right-down to left-up.



< Figure 5. Display Mode>

|              |                                           |          |
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