# DV860FBM-N10 Product Specification Rev.O

Fuzhou BOE Optoelectronics CO., LTD

# REVISION HISTORY

( ) Preliminary specification
(√) Final specification

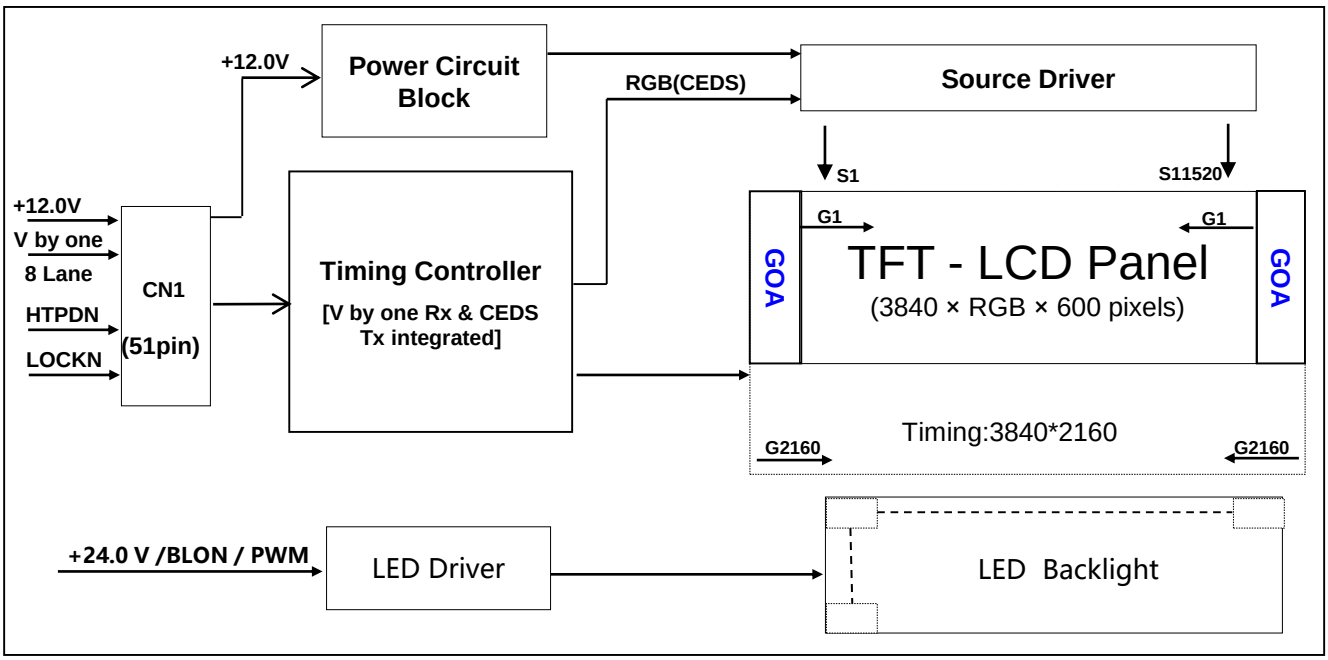
| Revision No. | Page | Description of changes | Date | Prepared |
|---|---|---|---|---|
| P0 | - | Initial Release | 2021/07/29 | Qiming.Li |
| P1 | P20/ P26 | 包材更新，RGB色坐标更新 | 2022/02/17 | Qiming.Li |
| P2 | P31 | 更新竖向使用旋转方向并增加旋转示意图 | 2022/03/23 | Qiming,Li |
| P3 | P2 | Modify Panel Power | 2022/04/04 | Zhangchunbing |
| O | | Final Spec | 2022/07/01 | Qiming.li |

# Contents

# 1.0 GENERAL DESCRIPTION

## 1.1 Introduction

DV860FBM-N10 a color active matrix TFT LCD open cell using amorphous silicon TFT‘s (Thin Film Transistors) as an active switching devices. This OC has a 86 inch diagonally measured active area with resolutions (3840 horizontal by 600 vertical pixel array). Each pixel is divided into RED, GREEN, BLUE dots which are arranged in vertical stripe and this OC can display 1.07G colors. The TFT-LCD panel used for this OC is adapted for a low reflection and higher color type.




## 1.2 Features

- V by one interface with 8 lanes
- 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
- GOA mode
- ADS technology is applied for high display quality
- RoHS compliant

## 1.3 Application

- Display Terminals for Control System
- Ultra High Definition Public Monitor

## 1.4 General Specification

< Table 1. General Specifications >

| Parameter | Specification | Unit | Remark |
|---|---|---|---|
| MDL Outline | 2171.08(H)X 359.5(V) | mm | |
| Active area | 2148.48(H)X 335.7(V) | mm | |
| Number of pixels | 3840(H) ×600(V) | pixels | |
| Pixel pitch | 562.2(H) ×562.2(V) | μm | |
| Pixel arrangement | 1G1D，Z Inversion，21T1C GOA | | |
| Display colors | 1.07G (8bits+FRC) | colors | |
| Display mode | Normally Black | | |
| Brightness | 1000(Typ.) | nit | Center point |
| MDL Thickness | 15.69 | mm | Body |
| Weight | 13500(Max.) | gram | |
| Power Consumption | 240W(Max.) | Watt | Note 1 |
| Surface Treatment | AG25/Clear(CF /TFT POL) | | |
| Life time | 50000 | Hrs | Note 2 |
| Remark | 7*24Hrs Continuous Operation<br>Horizontal and Perpendicular Compatibility | | |

Note 1: Total power consumption = $P_{DD}$.
BLU power efficiency is calculated as 85%， $P_{BLU}$= $P_{DD}$*85%

Note 2: The life time is determined as the time which luminance of LED is 50% compare to the initial value at the typical LED current on condition of continuous operating in LCM state at 25±2 ℃

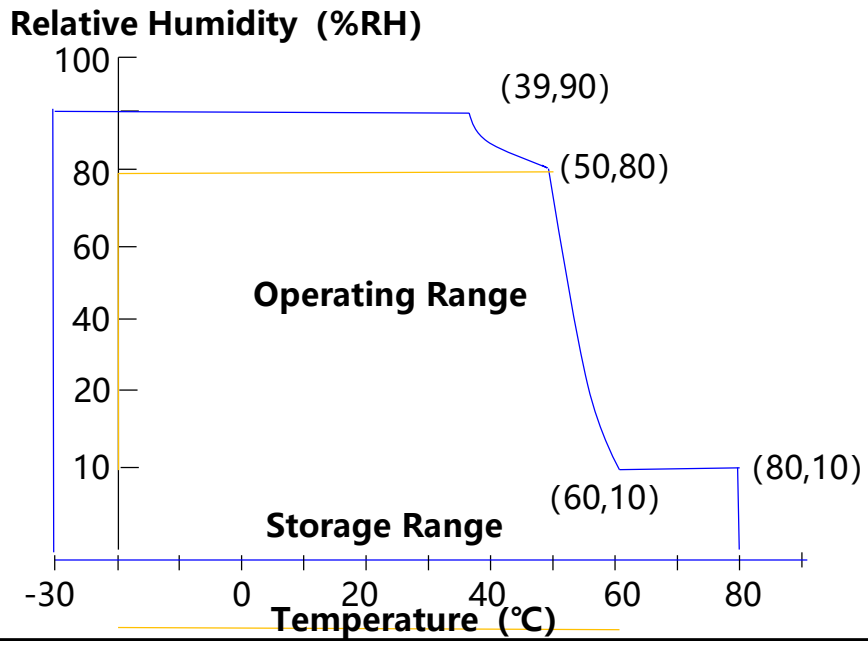
## 2.0 ABSOLUTE MAXIMUM RATINGS

The followings are maximum values which, if exceed, may cause faulty operation or damage to the unit. The operational and non-operational maximum voltage and current values are listed in Table 2.

< Table 2. Open Cell Electrical Specifications > [VSS=GND=0V]

| Parameter | Symbol | Min. | Max. | Unit | Remark |
|---|---|---|---|---|---|
| Power Supply Voltage | VDD | VSS-0.3 | 13.5 | V | Ta = 25 ℃ |
| Operating Temperature | $T_{OP}$ | -20 | 60 | ℃ | Note 1 |
| Storage Temperature | $T_{ST}$ | -30 | +70 | ℃ | |
| Operating Ambient Humidity | Hop | 10 | 90 | %RH | |
| Storage Humidity | Hst | 10 | 90 | %RH | |
| Panel Surface Temperature | PST | - | 80 | ℃ | Note 2 |

Note 1 : Temperature and relative humidity range are shown in the figure below.
Wet bulb temperature should be 39 ℃ max. and no condensation of water.
Note 2: Surface temperature is measure at 50℃ Dry condition



# 3.0 ELECTRICAL SPECIFICATIONS

## 3.1 TFT LCD Open Cell

< Table 3. Open Cell Electrical Specifications >

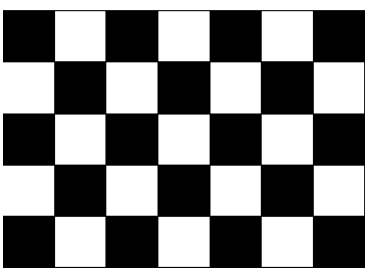
[Ta =25±2 ℃]

| Parameter | | Symbol | Values | | | Unit | Remark |
|---|---|---|---|---|---|---|---|
| | | | Min | Typ | Max | | |
| Power Supply Input Voltage | | VDD | 10.8 | 12 | 13.2 | Vdc | |
| Power Supply Ripple Voltage | | VRP | - | - | 600 | mV | |
| Power Supply Current | | IDD | - | 650 | 1200 | mA | Note 1 |
| Power Consumption | | PDD | - | 7.8 | 14.4 | Watt | |
| Rush current | | IRUSH | - | - | 4 | A | Note 2 |
| V by One Interface | Differential Input High Threshold Voltage | VLVTH | - | - | +50 | mV | - |
| | Differential Input Low Threshold Voltage | VLVTL | -50 | - | - | mV | - |
| | Common Input Voltage | VLVC | - | 0 | - | V | - |
| | Terminating Resistor | Rt | 80 | 100 | 120 | ohm | - |
| CMOS Interface | Input High Threshold Voltage | VIH | 2.7 | - | 3.3 | V | |
| | Input Low Threshold Voltage | VIL | 0 | - | 0.6 | V | |

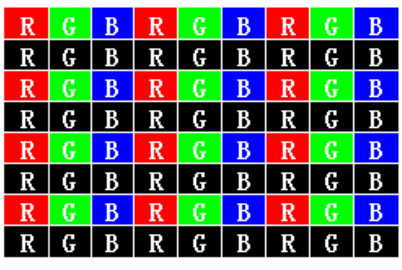
Note 1 : The supply voltage is measured and specified at the interface connector of LCM.
The current draw and power consumption specified is for VDD=12.0V,
Frame rate $f_V$=60Hz and Clock frequency = 74.25MHz.
Test Pattern of power supply current

Note 2 : The duration of rush current is about 2ms and rising time of Power Input is 0.5ms(min)

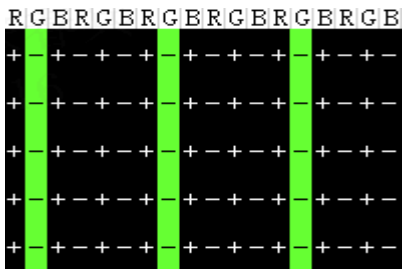
a) Typ : Mosaic 7X5 (L0/L255)



b) Max : Horizontal 1 Line (L0/L255)




c) Flicker Test Pattern



## 3.2 Converter Electrical Specifications

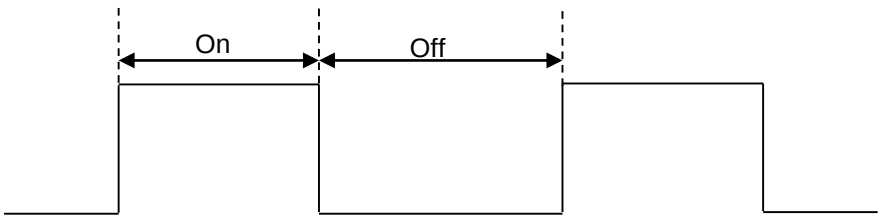
< Table 4. Converter Electrical Specifications >

[Ta =25±2 ℃]

| Parameter | Symbol | Values | | | Unit | Remark |
|---|---|---|---|---|---|---|
| | | Min | Typ | Max | | |
| Power Supply Input Voltage | $V_{BL}$ | 21.6 | 24 | 26.4 | Vdc | |
| Power Supply Ripple Voltage | $V_{RP}$ | - | - | 300 | mV | |
| Power Supply Current | $I_{DD}$ | - | 8.5 | 9 | A | |
| Power Consumption | $P_{DD}$ | - | 204 | 216 | Watt | Note 1 |
| Backlight On/Off Control Voltage | $V_{BLON}$ (off) | 0 | - | 0.3 | V | |
| | $V_{BLON}$ (on) | 2.4 | 3.3 | 3.6 | V | |
| Backlight PWM | High Level | 2.4 | 3.3 | 3.6 | V | On duty |
| | Low Level | 0 | - | 0.3 | V | Off duty |
| | Dimming Ratio | 1 | - | 100 | % | Note 2 |
| | PWM Frequency | 100 | - | 9K | Hz | |

Note 1:The specified current and power consumption are under the typical supply Input voltage, 24V.
It is power consumption for each board .Total power consumption = $P_{DD}$*2.
BLU power efficiency is calculated as 85%, $P_{BLU}$= $P_{DD}$*2*85%

Note 2 : High-duty = On/(On+Off) * 100



# 3.0 ELECTRICAL SPECIFICATIONS

## 3.2 TCON Characteristics

< Table 4. TCON Characteristics >

| Parameter | Symbol | Values | | | Unit | Remark |
|---|---|---|---|---|---|---|
| | | Min | Typ | Max | | |
| TCON Surface Temperature | $T_{TS}$ | - | - | 95 | ℃ | Note |

Note 1 : Any point on the TCON surface must be less than 104 ℃ under any conditions.

Note 2 : This test condition is based on BOE module.

## 3.3 Driver Characteristics

< Table 5. Driver Characteristics >

| Parameter | Symbol | Values | | | Unit | Remark |
|---|---|---|---|---|---|---|
| | | Min | Typ | Max | | |
| Driver Surface Temperature | $T_{DS}$ | - | - | 110 | ℃ | Note |

Note 3 : Any point on the driver surface must be less than 110 ℃ under any conditions.

Note 4: This test condition is based on BOE module.

## 3.4 PMIC Characteristics

< Table 6. PMIC Characteristics >

| Parameter | Symbol | Values | | | Unit | Remark |
|---|---|---|---|---|---|---|
| | | Min | Typ | Max | | |
| PMIC Surface Temperature | $T_{PS}$ | - | - | 110 | ℃ | Note |

Note 5 : Any point on the PMIC surface must be less than 110 ℃ under any conditions.

Note 6: This test condition is based on BOE module.

# 3.0 ELECTRICAL SPECIFICATIONS

## 3.5 VCOM I2C Bus Format

**Slave Address**

| Bit7 | Bit6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 = LSB |
|---|---|---|---|---|---|---|---|
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | R/$\overline{W}$ |

**Write Command**

**(a) Write single byte of data to Register**

| | Slave Address | | | | | | | | | Register Address | | | | | | | | Data From Master | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | Slave ACK | 0 | 0 | 0 | R4 | R3 | R2 | R1 | R0 | Slave ACK | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Slave ACK | Stop |

**(b) Write multiple bytes of data to Registers**

| | Slave Address | | | | | | | | | Register Address $n_{th}$ | | | | | | | | $n_{th}$ Data From Master | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | Slave ACK | 0 | 0 | 0 | R4 | R3 | R2 | R1 | R0 | Slave ACK | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Slave ACK |

| | $(n+1)_{th}$ Data From Master | | | | | | | | | | Last Data From Master | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Slave ACK | ----- | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Slave ACK | Stop |

**(c) Write All Registers into EEPROM**

| | Slave Address | | | | | | | | | Register Address | | | | | | | | Data From Master | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | Slave ACK | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | Slave ACK | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Slave ACK | Stop |

**(d) Write VCOM data Registers into EEPROM**

| | Slave Address | | | | | | | | | Register Address | | | | | | | | Data From Master | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | Slave ACK | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | Slave ACK | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | Slave ACK | Stop |

**Read Command**

**(a) Read single byte of data from Register**

| | Slave Address | | | | | | | | | Control Register Address | | | | | | | | Data From Master | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | Slave ACK | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | Slave ACK | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | Slave ACK | Stop |

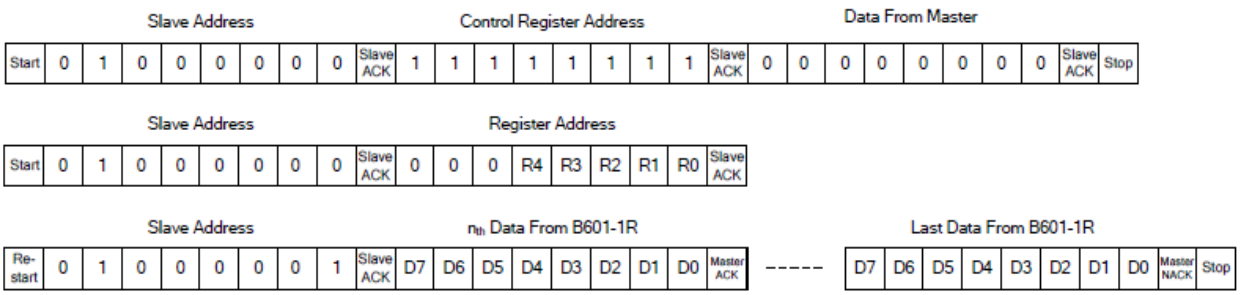
| | Slave Address | | | | | | | | | Register Address | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Start | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | Slave ACK | 0 | 0 | 0 | R4 | R3 | R2 | R1 | R0 | Slave ACK |

| | Slave Address | | | | | | | | | Data From B601-1R | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Re-start | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | Slave ACK | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Master NACK | Stop |

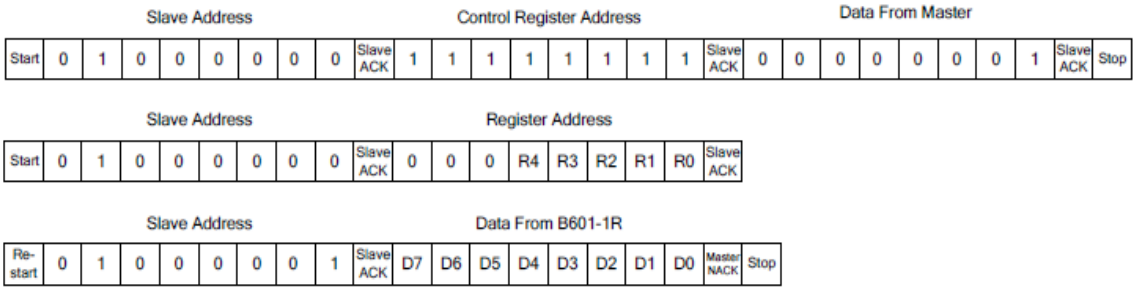
# 3.0 ELECTRICAL SPECIFICATIONS

## 3.5 VCOM I2C Bus Format

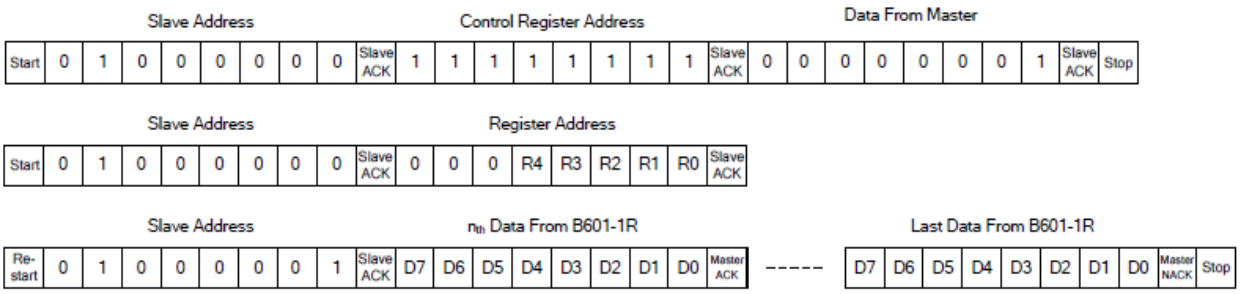
**(b) Read multiple bytes of data from Registers**




**(c) Read data from EEPROM**




**(d) Read multiple bytes of data from EEPROM**



# 4.0 INTERFACE CONNECTION

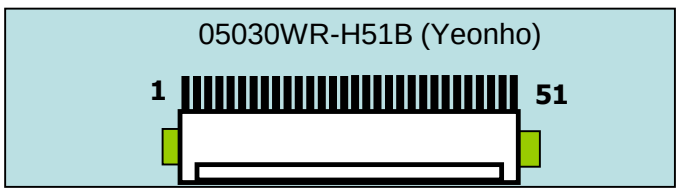
## 4.1 Open Cell Input Signal & Power

- V by one Connector : 05030WR-H51B (Yeonho)
-. < Table 5. Open Cell Input Connector Pin Configuration >

| Pin No | Symbol | Description | Pin No | Symbol | Description |
|---|---|---|---|---|---|
| 1 | VDD | Power Supply +12.0V | 27 | GND | Ground |
| 2 | VDD | Power Supply +12.0V | 28 | Rx0n | V-by-One HS Data Lane 0 |
| 3 | VDD | Power Supply +12.0V | 29 | Rx0p | V-by-One HS Data Lane 0 |
| 4 | VDD | Power Supply +12.0V | 30 | GND | Ground |
| 5 | VDD | Power Supply +12.0V | 31 | Rx1n | V-by-One HS Data Lane 1 |
| 6 | VDD | Power Supply +12.0V | 32 | Rx1p | V-by-One HS Data Lane 1 |
| 7 | VDD | Power Supply +12.0V | 33 | GND | Ground |
| 8 | VDD | Power Supply +12.0V | 34 | Rx2n | V-by-One HS Data Lane 2 |
| 9 | NC | No Connection | 35 | Rx2p | V-by-One HS Data Lane 2 |
| 10 | GND | Ground | 36 | GND | Ground |
| 11 | GND | Ground | 37 | Rx3n | V-by-One HS Data Lane 3 |
| 12 | GND | Ground | 38 | Rx3p | V-by-One HS Data Lane 3 |
| 13 | GND | Ground | 39 | GND | Ground |
| 14 | NC | No Connection | 40 | Rx4n | V-by-One HS Data Lane 4 |
| 15 | NC | No Connection | 41 | Rx4p | V-by-One HS Data Lane 4 |
| 16 | NC | No Connection | 42 | GND | Ground |
| 17 | Input_Mode | H:1 Section L: 2 Section | 43 | Rx5n | V-by-One HS Data Lane 5 |
| 18 | NC | No Connection | 44 | Rx5p | V-by-One HS Data Lane 5 |
| 19 | SDA | Panel self test pin floating | 47 | GND | Ground |
| 20 | SCL | Panel self test pin floating | 48 | Rx6n | V-by-One HS Data Lane 6 |
| 21 | NC | No Connection | 47 | Rx6p | V-by-One HS Data Lane 6 |
| 22 | NC | Panel self test pin floating | 48 | GND | Ground |
| 23 | Aging Test | Panel self test pin floating | 49 | Rx7n | V-by-One HS Data Lane 7 |
| 24 | GND | Ground | 50 | Rx7p | V-by-One HS Data Lane 7 |
| 25 | HTPDN | Hot Plug Detect | 51 | GND | Ground |
| 26 | LOCKN | Lock Detect | | | |

Notes : 1. NC (Not Connected) : This pins are only used for BOE internal operations.

**Rear view of LCM**



## 4.2 BLU Input Signal & Power

### 4.2.1 Master Converter Interface

- BLU Connector(CN1 & CN2 ) : CI0114M1HR0-NH (Cvilux)or Equivalent.

< Table 6. Input Connector Pin Configuration CN1&CN2>

| Pin No | Symbol | Description | Pin No | Symbol | Description |
|---|---|---|---|---|---|
| 1 | $V_{BL}$ | Operating Voltage Supply, +24V DC regulated | 8 | GND | Ground and Current Return |
| 2 | $V_{BL}$ | Operating Voltage Supply, +24V DC regulated | 9 | GND | Ground and Current Return |
| 3 | $V_{BL}$ | Operating Voltage Supply, +24V DC regulated | 10 | GND | Ground and Current Return |
| 4 | $V_{BL}$ | Operating Voltage Supply, +24V DC regulated | 11 | NC | No Connection |
| 5 | $V_{BL}$ | Operating Voltage Supply, +24V DC regulated | 12 | BLON | BLU On-Off control: DC 0 to 0.8V off，DC 2.4 to 5.25V On |
| 6 | GND | Ground and Current Return | 13 | PWM | 0V:Min，3.3V:Max |
| 7 | GND | Ground and Current Return | 14 | NC | No Connection |

### 4.2.2 Slave Converter Interface

- BLU Connector(CN1 & CN2 ) : CI0114M1HR0-NH (Cvilux)or Equivalent.

< Table 7. Input Connector Pin Configuration CN1&CN2>

| Pin No | Symbol | Description | Pin No | Symbol | Description |
|---|---|---|---|---|---|
| 1 | $V_{BL}$ | Operating Voltage Supply, +24V DC regulated | 8 | GND | Ground and Current Return |
| 2 | $V_{BL}$ | Operating Voltage Supply, +24V DC regulated | 9 | GND | Ground and Current Return |
| 3 | $V_{BL}$ | Operating Voltage Supply, +24V DC regulated | 10 | GND | Ground and Current Return |
| 4 | $V_{BL}$ | Operating Voltage Supply, +24V DC regulated | 11 | NC | No Connection |
| 5 | $V_{BL}$ | Operating Voltage Supply, +24V DC regulated | 12 | BLON | BLU On-Off control: DC 0 to 0.8V off，DC 2.4 to 5.25V On |
| 6 | GND | Ground and Current Return | 13 | PWM | 0V:Min，3.3V:Max |
| 7 | GND | Ground and Current Return | 14 | NC | No Connection |

## 4.3 VBO Interface

- VBO Receiver : Timing Controller (VBO Rx merged)

< Table 8. Input Connector Pin Configuration >

| Byte | Packer input | Color data mapping |
|---|---|---|
| | | 30 bpp RGB |
| 0 | Bit-0 | R2 |
| | Bit-1 | R3 |
| | Bit-2 | R4 |
| | Bit-3 | R5 |
| | Bit-4 | R6 |
| | Bit-5 | R7 |
| | Bit-6 | R8 |
| | Bit-7 | R9 |
| 1 | Bit-8 | G2 |
| | Bit-9 | G3 |
| | Bit-10 | G4 |
| | Bit-11 | G5 |
| | Bit-12 | G6 |
| | Bit-13 | G7 |
| | Bit-14 | G8 |
| | Bit-15 | G9 |
| 2 | Bit-16 | B2 |
| | Bit-17 | B3 |
| | Bit-18 | B4 |
| | Bit-19 | B5 |
| | Bit-20 | B6 |
| | Bit-21 | B7 |
| | Bit-22 | B8 |
| | Bit-23 | B9 |
| 3 | Bit-24 | - |
| | Bit-25 | - |
| | Bit-26 | B0 |
| | Bit-27 | B1 |
| | Bit-28 | G0 |
| | Bit-29 | G1 |
| | Bit-30 | R0 |
| | Bit-31 | R1 |

# 5.0 SIGNAL TIMING SPECIFICATION

## 5.1 Timing Parameters (DE only mode)

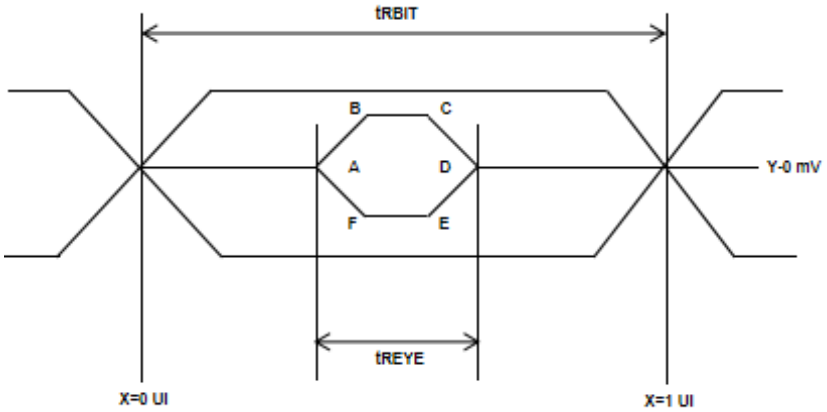
< Table 9. Timing Table >

| Item | | Symbols | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Frequency | | 1/Tc | 68.24 | 74.25 | 79.97 | MHz |
| Vertical | Frame Rate | F | 58 | 60 | 61 | Hz |
| | Total | $T_V$ | 2220 | 2250 | 2300 | $T_H$ |
| | Display | $T_{VD}$ | | 2160 | | $T_H$ |
| | Blank | $T_{VB}$ | 60 | 90 | 140 | $T_H$ |
| Horizontal | Total | $T_H$ | 530 | 550 | 570 | $T_{CLK}$ |
| | Display | $T_{HD}$ | - | 480 | - | $T_{CLK}$ |
| | Blank | $T_{HB}$ | 50 | 70 | 90 | $T_{CLK}$ |

## 5.2 Vx1 Input Signal Timing

< Table 10. Signal Timing Waveforms Table >

| Parameter | Symbol | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Unit Interval(VBO Operation Bit Rate) | tRBIT | 3-byte | 380 | tTCIP/30 | 1667 | PS |
| | | 4-byte | 285 | tTCIP/40 | 1250 | PS |
| | | 5-byte | 266 | tTCIP/50 | 1000 | PS |
| Eye Width at Package Pin | tREYE | - | - | 0.5 | - | UI |
| Eye Width Position A at Package Pin | tA | - | - | 0.25 | - | UI |
| Eye Width Position B at Package Pin | tB | - | - | 0.3 | - | UI |
| Eye Width Position Cat Package Pin | tC | - | - | 0.7 | - | UI |
| Eye Width Position D at Package Pin | tD | - | - | 0.75 | - | UI |
| Eye Width Position E at Package Pin | tE | - | - | 0.7 | - | UI |
| Eye Width Position F at Package Pin | tF | - | - | 0.3 | - | UI |
| Intra – pair Skew | TTOSK_intra | - | - | - | 0.3 | UI |
| Inter – pair Skew | TTOSK_inter | - | - | - | 40 | UI |
| SSCG | | | | | | % |



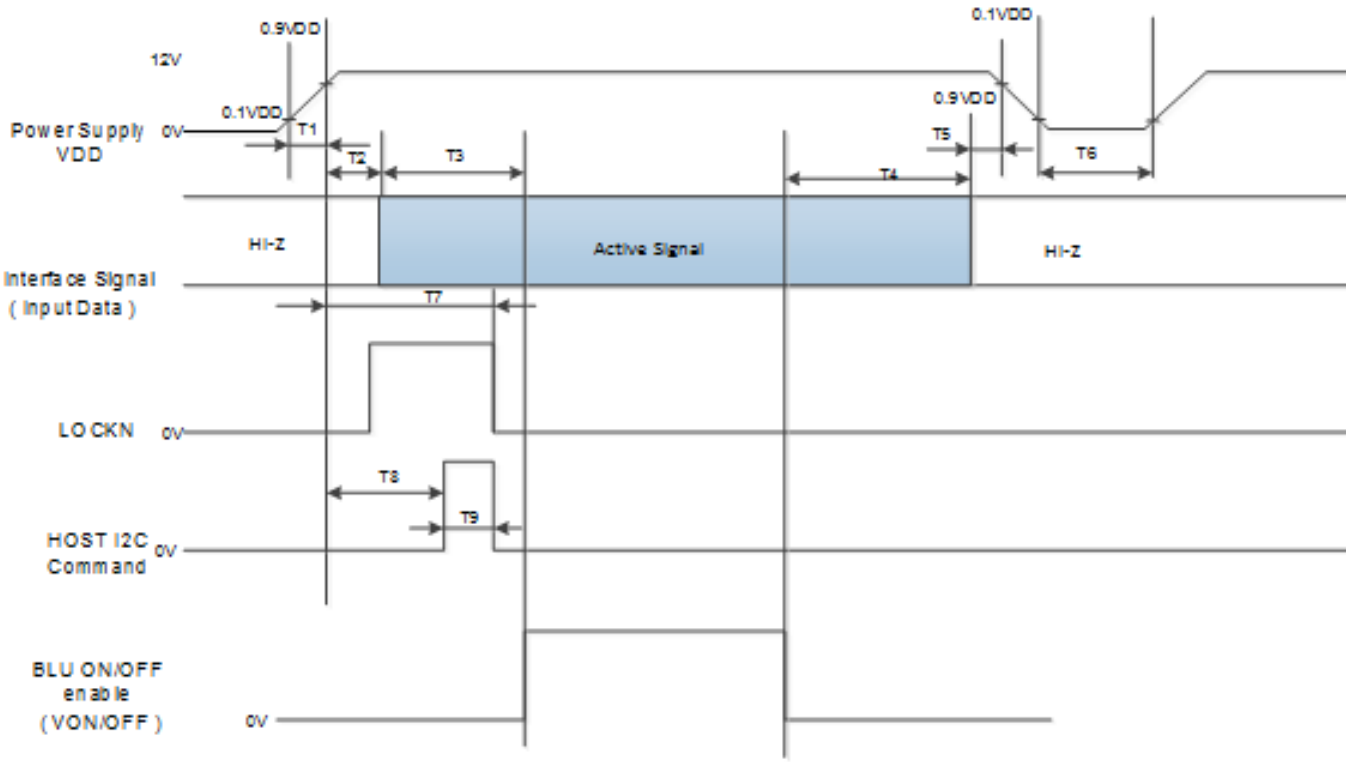

| | Y[mV] |
|---|---|
| A | 0 |
| B | 50 |
| C | 50 |
| D | 0 |
| E | -50 |
| F | -50 |

## 5.3 Input Signals, Basic Display Colors and Gray Scale of Colors

< Table 11. Input Signal and Display Color Table >

| Color | | Input Color Data | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | MSB | | | | | RED | | | | LSB | MSB | | | | | GREEN | | | | LSB | MSB | | | | | BLUE | | | | LSB |
| | | R9 | R8 | R7 | R6 | R5 | R4 | R3 | R2 | R1 | R0 | G9 | G8 | G7 | G6 | G5 | G4 | G3 | G2 | G1 | G0 | B9 | B8 | B7 | B6 | B5 | B4 | B3 | B2 | B1 | B0 |
| Basic Color | Black | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Red(1023) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green(1023) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Blue(1023) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Cyan | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| | Magenta | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 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 | 1 | 1 | 1 | 1 | 0 | 0 | 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 | 1 | 1 | 1 | 1 | 1 | 1 |
| R | RED(000) | 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 |
| | RED(001) | 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 | 0 | 0 | 0 | 0 |
| | ---- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | RED(1022) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | RED(1023) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| G | Green (000) | 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 |
| | Green (000) | 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 |
| | ---- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Green (1022) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Green (1023) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| B | Blue(000) | 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 |
| | Blue(000) | 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 |
| | ---- | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Blue(1022) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| | Blue(1023) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

## 5.4 Power Sequence




< Table 12. Sequence Table >

| Parameter | Values | | | Units |
|---|---|---|---|---|
| | Min | Typ | Max | |
| T1 | 0.5 | - | 10 | ms |
| T2 | 0 | - | - | ms |
| T3 | 200 | - | - | ms |
| T4 | 100 | - | - | ms |
| T5 | 0 | - | 50 | ms |
| T6 | 1 | - | - | s |
| T7 | 200 | - | - | ms |
| T8 | 0 | - | 1200 | ms |
| T9 | Depends on I2C command | | | ms |

Note 1: Even though T1 is over the specified value, there is no problem if the rush current is within Spec.
Note 2: The T3 / T4 is recommended value, the case when failed to meet a minimum specification, abnormal display would be shown. There is no reliability problem.
Note 3: It is recommendation specification that T5 has to be 0ms as a minimum value.
※ Please avoid floating state of interface signal at invalid period.
※ When the power supply for LCD (VDD) is off, be sure to pull down the valid and invalid data to 0V.
Note 4: Even though T7&T10 is over the specified value, please extend the time of Back Light open to ens ure invalid data will not be seen.
Note 5: T11: Voltage of VDD must decay smoothly after power-off. (customer system decide this value)

## 6.0 OPTICAL SPECIFICATIONS

The test of optical specifications shall be measured in a dark room (ambient luminance≤1 lux and temperature=25±2℃) with the equipment of Luminance meter system (Goniometer system and PR730) and test unit shall be located at an approximate distance 50cm from the LCD surface at a viewing angle of θ and Φ equal to 0°. We refer to $\theta_{Ø=0}$ (=$\theta_3$ ) as the 3 o'clock direction (the "right"), $\theta_{Ø=90}$ (= $\theta_{12}$ ) as the 12 o'clock direction ("upward"), $\theta_{Ø=180}$ (= $\theta_9$ ) as the 9 o'clock direction ("left") and $\theta_{Ø=270}$(= $\theta_6$ ) as the 6 o'clock direction ("bottom"). While scanning θ and/or Ø, 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 13. Optical Table >

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

| Parameter | | Symbol | Condition | Min | Typ | Max | Unit | Remark |
|---|---|---|---|---|---|---|---|---|
| Viewing Angle | Horizontal | $\Theta_3$ | CR > 10 | | 89 | | Deg. | Note 1 |
| | | $\Theta_9$ | | | 89 | | Deg. | |
| | Vertical | $\Theta_{12}$ | | | 89 | | Deg. | |
| | | $\Theta_6$ | | | 89 | | Deg. | |
| Contrast ratio | | CR | Θ = 0° (Center) Normal Viewing Angle | 900:1 | 1200:1 | - | | Note 2 |
| Chromaticity coordinate | White | $W_x$ | | TYP. - 0.03 | 0.28 | TYP. + 0.03 | | Note 3 |
| | | $W_y$ | | | 0.29 | | | |
| | Red | $R_x$ | | | 0.648 | | | |
| | | $R_y$ | | | 0.341 | | | |
| | Green | $G_x$ | | | 0.310 | | | |
| | | $G_y$ | | | 0.621 | | | |
| | Blue | $B_x$ | | | 0.152 | | | |
| | | $B_y$ | | | 0.052 | | | |
| Response Time | G to G | $T_g$ | | - | 13 | 20 | ms | Note 4 |
| Color Gamut | | | | - | 72 | - | % | NTSC |
| Gamma Scale | | | | 2.0 | 2.2 | 2.4 | | |
| Color Temp | | | | 8000 | 10000 | 12000 | K | |
| Brightness | | | | 800 | 1000 | | nit | |
| Uniformity | | | | 75 | | | % | Note 5 |

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 $\theta = 0°$ 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 Table 14 .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.
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 to optimize. Each ti me in below table is defined as Figure2 and shall be measured by switching the input signal;

| 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. Brightness Uniformity measurement shall be taken at the locations shown in Figure 3.

# 7.0 MECHANICAL CHARACTERISTICS

## 7.1 Dimensional Requirements

Table 15 provides general mechanical characteristics.
Other parameters are shown in Figure 4、Figure 5.

< Table 14. Dimensional Parameters >

| Parameter | Specification | Unit |
|---|---|---|
| MDL Outline | 2171.08(H)X 359.5(V) | mm |
| Active area | 2148.48（H）x335.7（V） | mm |
| MDL Thickness | 15.69（Body） | mm |
| Weight | 13500(Max.) | gram |

## 7.2 Surface treatment

The surface of the LCD has an Anti-glare coating to minimize reflection and a coating to Reduce scratching.

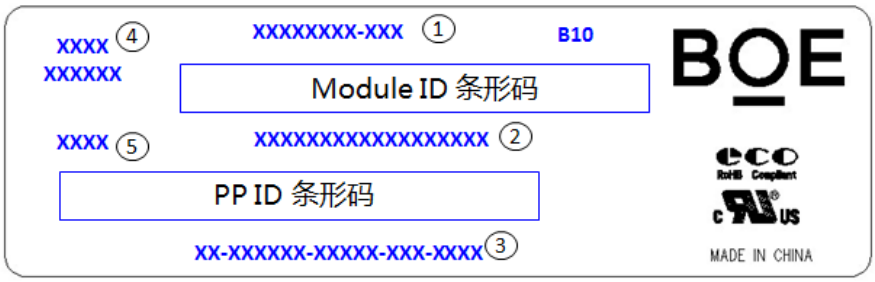
## 8.0 RELIABILITY TEST

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 = 70 ℃, 240 hrs |
| 2 | Low temperature storage test | Ta = -30 ℃, 240 hrs |
| 3 | High temperature & high humidity operation test | Ta = 50 ℃, 80%RH, 240hrs |
| 4 | Low temperature operation test | Ta = -20 ℃, 240hrs |
| 5 | High temperature operation test | Ta = 60 ℃, 240hrs |
| 6 | Electro-static discharge test | Air ：±15kV ,150pF/330Ω ,100Point ,1time/Point<br>MDL Contact :±8kV ,150pF/330Ω ,100Point , 1time/Point<br>Pin Contact:±5KV，150pF/330Ω，Input connector Pin, 3 times/pin with no function loss |

# 9.0 PRODCUT SERIAL NUMBER




① FG-CODE
② Module ID，最后一位为Revision Code（扫描不显示），前17位编码规则如下
③ PPID（客户端ID）
④ D/PN码，规格待确定
⑤ 生产年份+生产周别（中间无空格）

MDL ID Naming Rule:

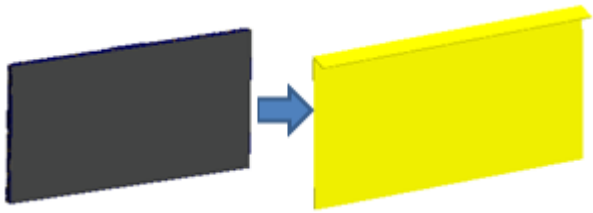
| Digit | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Code | S | L | S | A | 1 | 0 | 8 | 5 | 9 | 4 | 2 | 0 | 0 | 0 | 1 | D | B |
| Description | Product Code/GBN→FG-CODE一一对应 | | Grade | line | Year | Month | Model Extension Code (Last 4 Digits of FG-CODE) | | | | | Serial No. Hex-Decimal 000000-FFFFFF | | | | | |

# 10.0 PACKING INFORMATION

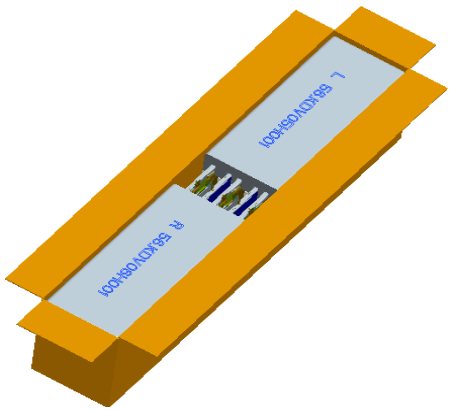
BOE provides the standard shipping container for customers, unless customer specifies their packing information. The standard packing method and Barcode information are shown in below.

## 10.1 Packing Order

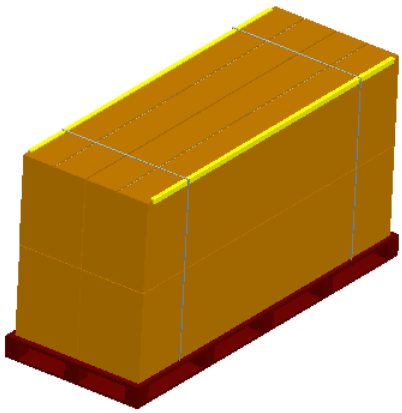
Put one Pcs into the PE Bag



Put Five LCD MDL in the EPS With Carton BOX.



Put 4 Carton BOX on the pallet.

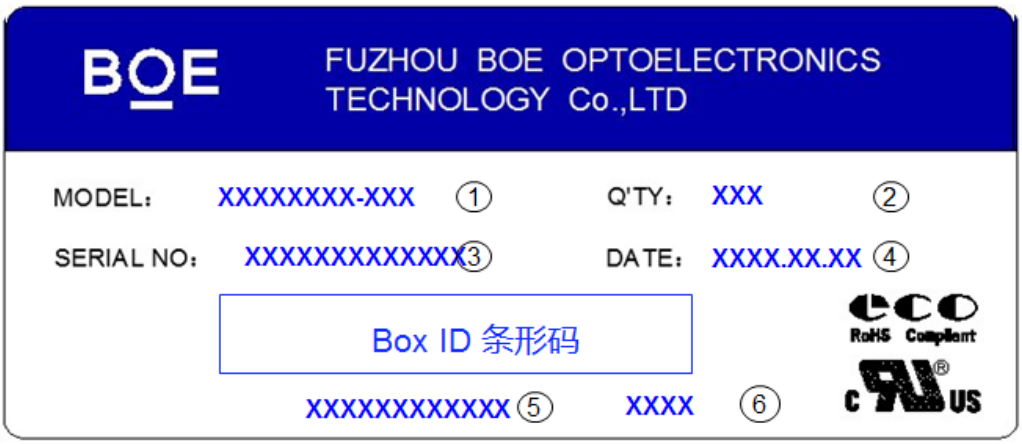


## 10.2 Packing Note

- Box Dimension : 2270mm (L) × 430mm (W) × 560mm (H)
- Package Quantity in one Box : 5pcs

## 10.3 Box Label

- Label Size : 100 mm (L) × 50 mm (W)
- Contents
  - Model : DV860FBM-N10
  - Q`ty : Module 5 Q`ty in one box
  - Serial No. : Box Serial No. See next page for detail description.
  - Date : Packing Date
  - FG Code : FG Code of Product




**打印内容，说明如下:**

① FG-CODE
② 产品数量
③ Box ID, 编码规则如下
④ Box Packing 日期
⑤ 产品物料号(客户端)
⑥ FG-CODE 后四位

| Digit / Code | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Code | X | X | X | X | 1 | 6 | 3 | D | 0 | 0 | 1 | A | 1 |
| Description | Products GBN | | Grade | Line | Year | | Month | Revision Code | Serial No. | | | | |

# 11.0 PRECAUTIONS

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

## 11.1 Mounting Precautions

- Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- You must mount a module using specified mounting holes (Details refer to the drawings).
- You should consider the mounting structure so that uneven force (ex. Twisted stress, Concentrated stress)is not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- Do not apply mechanical stress or static pressure on module; Abnormal display cause by pressing some parts of module during assembly process , do not belong to product failure, the press should be agreed by two sides.
- Determine the optimum mounting angle, refer to the viewing angle range in the specification for each model.
- You should adopt radiation structure to satisfy the temperature specification.
- 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.
- Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment.
- Do not touch the surface of polarizer for bare hand or greasy cloth.(Some cosmetics are detrimental to the polarizer.)
- When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzine. Normal-hexane & alcohol is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene , because they cause chemical damage to the polarizer.
- Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
- Do not apply static pressure on module , and avoid impact, vibration and falling.
- This module has its circuitry PCB’ s on the rear side and Driver IC, should be handled carefully in order not to be stressed.
- Avoid impose stress on PCB and Driver IC during assembly process ,Do not drawing, bending, COF package & wire
- Do not disassemble the module.

## 11.2 Operating Precautions

- Do not connector or disconnect the cable to/from the Module at the "Power On" Condition.
- When the module is operating, do not lose CLK, ENAB signals. If any one of these signals is lost, the module would be damaged.
- Obey the supply voltage sequence. If wrong sequence is applied, the module would be damaged.
- The electrochemical reaction caused by DC voltage will lead to LCD module degradation, so DC drive should be avoided.
- The LCD modules use C-MOS LSI drivers, so customers are recommended that any unused input terminal would be connected to Vdd or Vss, do not input any signals before power is turn on, and ground you body, work/assembly area, assembly equipment to protect against static electricity.
- Do not exceed the absolute maximum rating value. (supply voltage variation, input voltage variation, variation in part contents and environmental temperature, and so on) Otherwise the Module may be damaged.
- Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimized the interference.
- Design the length of cable to connect between the connector for back-light and the converter as shorter as possible and the shorter cable shall be connected directly , The long cable between back-light and Converter may cause the Luminance of LED to lower and need a higher startup voltage
- The cables should be as short as possible between System Board and PCB interface.
- Connectors are precision devices to transmit electrical signals, and operators should plug in parallel
- Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.

## 11.3 Electrostatic Discharge Precautions

- Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc.
- Do not touch interface pin directly.

## 11.4 Precautions for Strong Light Exposure

- Do not leave the module operation or storage in Strong light . Strong light exposure causes degradation of polarizer and color filter.

## 11.5 Precautions for Storage

A. Atmosphere Requirement

| ITEM | UNIT | MIN | MAX |
|---|---|---|---|
| Storage Temperature | (℃) | 5 | 40 |
| Storage Humidity | (%rH) | 35 | 75 |
| Storage Life | 6 months | | |
| Storage Condition | • The storage room should be equipped with a dark and good ventilation facility.<br>• Prevent products from being exposed to the direct sunlight, moisture and water.<br>• The product need to keep away from organic solvent and corrosive gas.<br>• Be careful for condensation at sudden temperature change.<br>• Storage condition is guaranteed under packing conditions. | | |

B. Package Requirement

- The product should be placed in a sealed polythene bag.
- Product Should be placed on the pallet, Which is away from the floor, Be cautions not to pile the product up.
- As the original protective film, do not use the adhesive protective film to avoid change of Pol color and characteristic.

## 11.6 Precautions for protection film

- Remove the protective film slowly, keeping the removing direction approximate 30-degree not vertical from panel surface, If possible, under ESD control device like ion blower, and the humidity of working room should be kept over 50%RH to reduce the risk of static charge.
- People who peeled off the protection film should wear anti-static strap and grounded well.

## 11.7 Appropriate Condition for Commercial Display

-. Generally large-sized LCD modules are designed for consumer applications . Accordingly, long-term display like in Commercial Display application, can cause uneven display including image sticking. To optimize module's lifetime and function, several operating usages are required.

1. Normal operating condition
   - -. Temperature: 20±15℃
   - -. Operating Ambient Humidity : 55±20%
   - -. Display pattern: dynamic pattern (Real display)
2. Special operating condition

a. Ambient condition

-. Well-ventilated place is recommended to set up Commercial Display system.

b. Power and screen save

-. Periodical power-off or screen save is needed after long-term display.

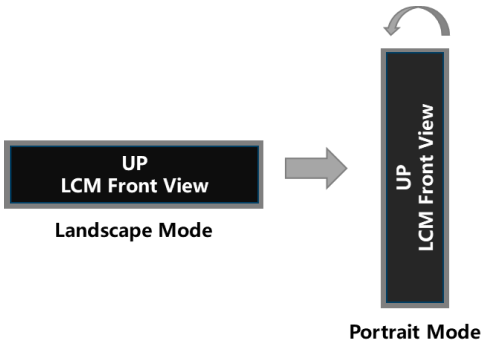
c. As the low temperature, the response time is greatly delayed. As the high temperatures (higher than the operating temperature) the LCD module may turn black screen. The above phenomenon cannot explain the failure of the display. When the temperature returns to the normal operating temperature, the LCD module will return to normal display.

d. 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

e. Do not exceed the absolute maximum rating value. (supply voltage variation, input voltage variation, variation in part contents and environmental temperature, and so on) Otherwise the Module may be damaged.

f. 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 images, running time, long time operation, outdoor operation, etc. It is strongly recommended to contact BOE for filed application engineering advice. Otherwise, its reliability and function may not be guaranteed. Extreme conditions are commonly found at airports, transit stations, banks, stock market and controlling systems.

3. Operating usages to protect against image sticking due to long-term static display.
   a. Suitable operating time: under 24 hours a day.
      (The moving picture can be allowed for 24 hours a day)
   b. Static information display recommended to use with moving image.
   -. Cycling display between 5 minutes' information(static) display and 10 seconds' moving image.
   c. Background and character (image) color change
   -. Use different colors for background and character, respectively.
   -. Change colors themselves periodically.
d. Avoid combination of background and character with large different luminance.
   -. Abnormal condition just means conditions except normal condition.
   -. Black image or moving image is strongly recommended as a screen save
4. Lifetime in this spec. is guaranteed only when Commercial Display is used according to operating usages.
5. Module should be turned counterclockwise based on front view when used in portrait mode.



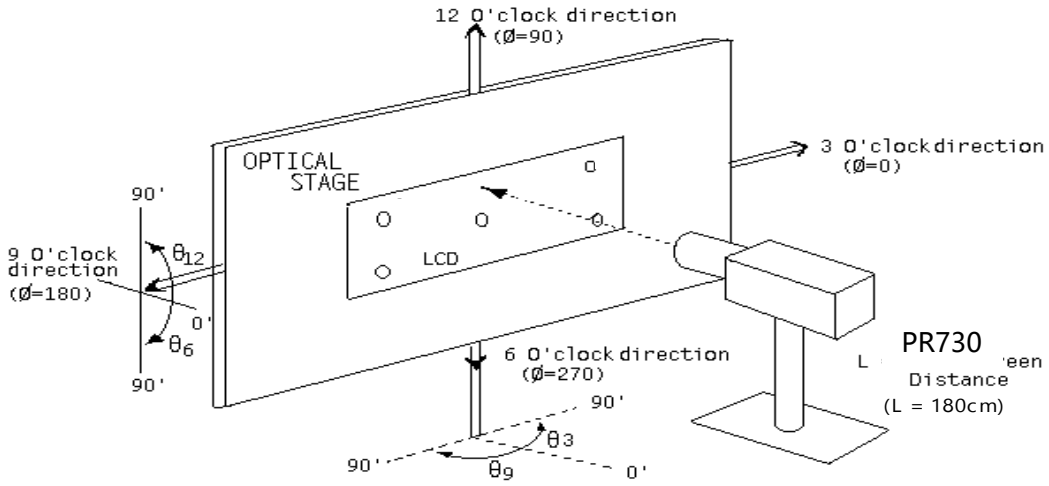

## 11.8 Other Precautions

A. LC Leak
- If the liquid crystal material leaks from the panel, it is recommended to wash the LC with acetone or ethanol and then burn it.
- In case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.
- If LC in mouth, mouth need to be washed, drink plenty of water to induce vomiting and follow medical advice.
- If LC touch eyes, eyes need to be washed with running water at least 15 minutes.

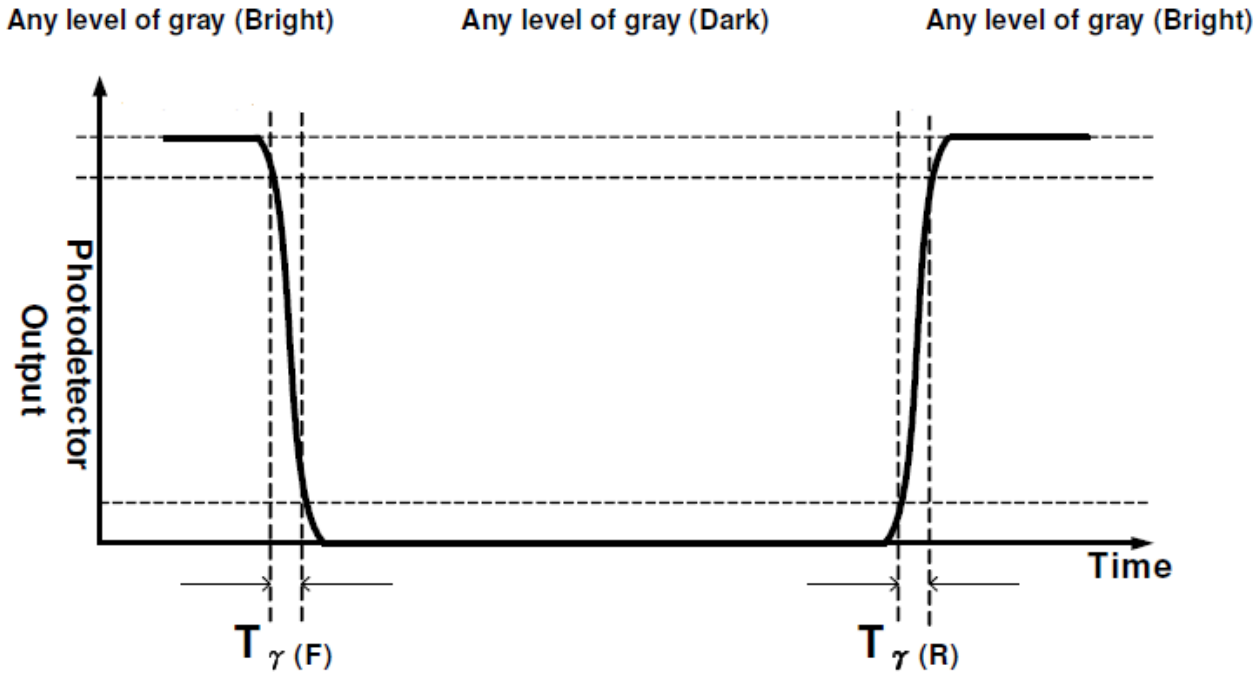
B. Rework
- When returning the module for repair or etc., Please pack the module not to be broken. We recommend to use the original shipping packages.

# 12.0 APPENDIX

< Figure 1. Measurement Set Up >




< Figure 2. Response Time Testing >



# 12.0 APPENDIX

< Figure 3. Uniformity Measurement Locations >

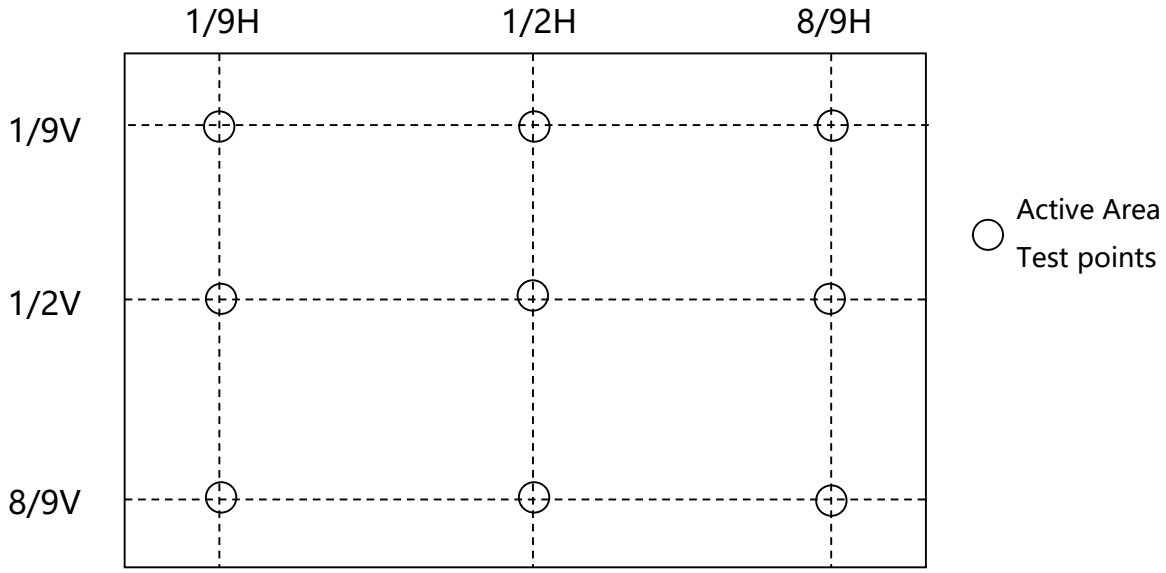


Figure 4. TFT-LCD Module Outline Dimensions (Front view)

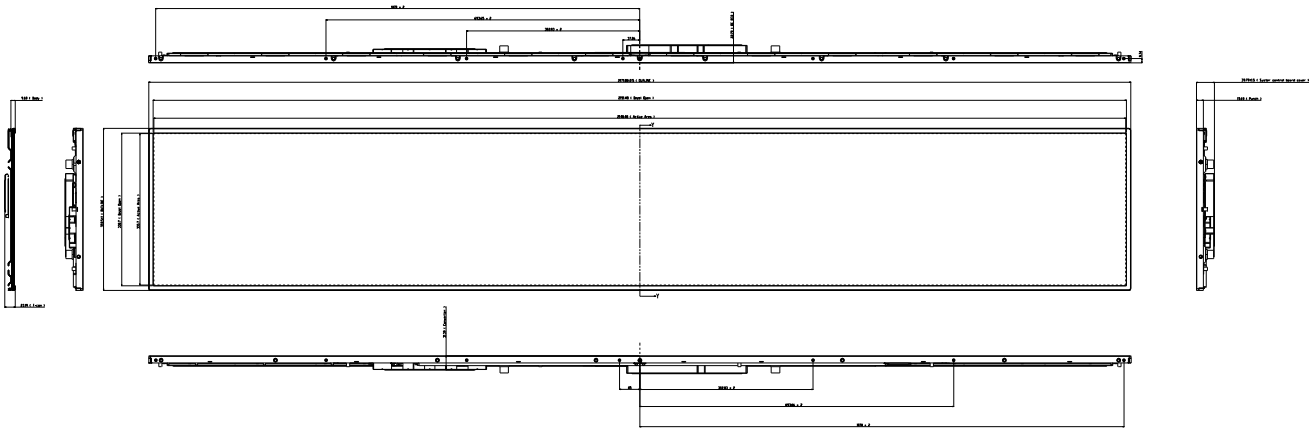


Figure 5. TFT-LCD Module Outline Dimensions (Back view)