DV190E0M-N11

Product Specification

Rev. O

FUZHOU BOE OPTOELECTRONICS TECHNOLOGY Co.,LTD

REVISION HISTORY

( )Preliminary specification

(√)Final specification

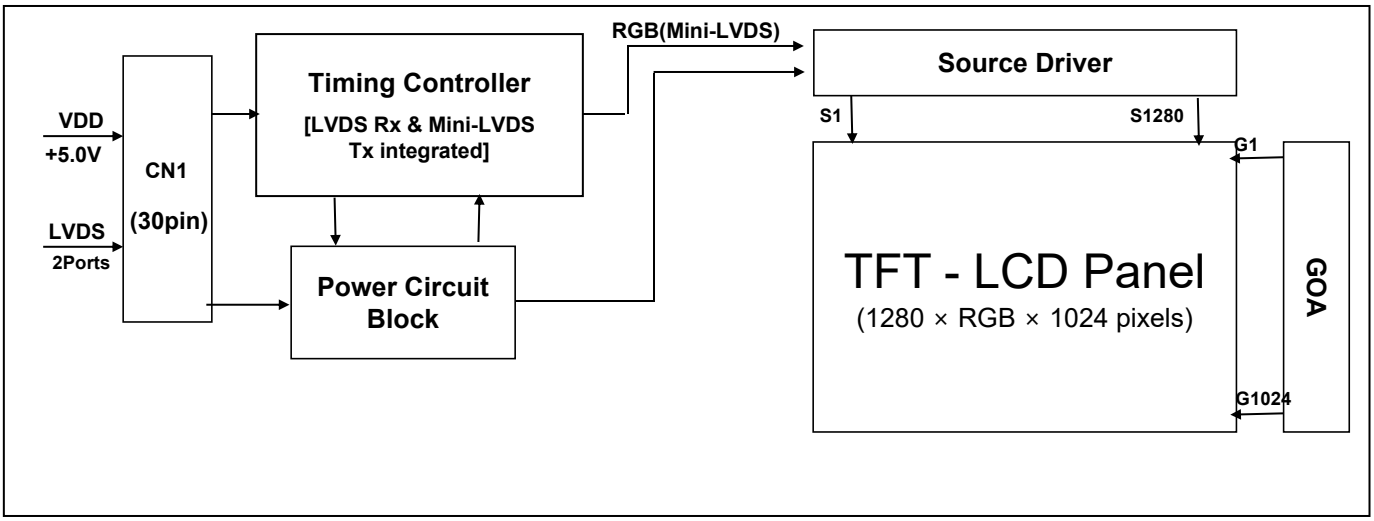
Revision No.	Page	Description of changes	Date	Prepared
P0		Initial Release	2020.05.11	Canrong Li
P1		DV产出后更新	2020.08.19	Canrong Li
O		量产更新	2020.10.14	Canrong Li

Contents

1.0 GENERAL DESCRIPTION

1.1 Introduction

DV190E0M-N11 is a color active matrix TFT LCD MDL using amorphous silicon TFT's (Thi n Film Transistors) as an active switching devices. This MDL has a 19inch diagonally mea sured active area with FHD resolutions (1280 horizontal by 1024 vertical pixel array). Each pixel is divided into RED, GREEN, BLUE dots which are arranged in vertical stripe and this module can display 16.7M colors. The TFT-LCD MDL panel is adapted for a low reflection and higher color type.



1.2 Features

- LVDS interface with 2 pixel / clock
- High-speed response
- Low color shift image quality
- 6-bit (Hi-FRC) color depth, display 16.7M colors
- Wide viewing angle
- DE (Data Enable) only mode
- HADS technology is applied for high display quality
- RoHS compliant

1.3 Application

- Commercial Digital Display
- Display Terminals for Control System
- Landscape and Portrait Display

1.4 General Specification

< Table 1. General Specifications >

Parameter	Specification	Unit	Remarks
Active area	374.784(H) × 299.8272 (V)	mm	
Number of pixels	1280(H) ×1024(V)	pixels	
Pixel pitch	97.6(H) ×292.8(V)	um	
Pixel arrangement	Pixels RGB Vertical stripe		
Display colors	16.7M	colors	6bits+FRC
Display mode	Normally Black		
Dimensional outline	396.0(H) ×324.0(V)×9.9(D)	mm	Detail refer to drawing
Weight	1520	g	19.82kg/box
Power Consumption	10.64 Typ. 14.216 Max.	Watt	BLU Consumption 8.64 Typ. 9.216 Max.
Bezel width (L/R/U/D)	8.6/8.6/10.5/10.5	mm	
Surface Treatment	Haze 25%, 3H		
Back-light	Down edge side, 1- LED Light bar		
Possible display type	Landscape and Portrait Enabled		

2.0 ABSOLUTE MAXIMUM RATINGS

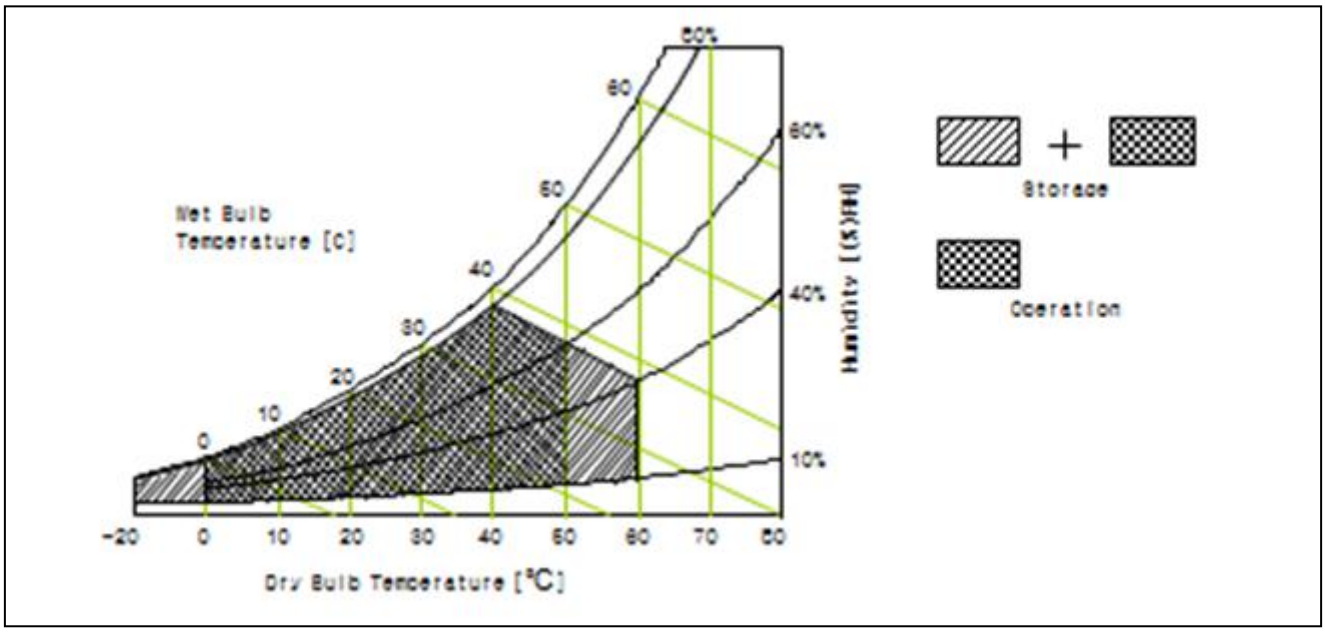
The followings are maximum values which, if exceed, may cause faulty operation or damage to the unit. The operational and non-operational maximum voltage and current values are listed in Table 2.

< Table 2. Open Cell Electrical Specifications >

[VSS=GND=0V]

Parameter	Symbol	Min.	Max.	Unit	Remark
Power Supply Voltage	VDD	-0.3	6.0	V	Ta = 25 ℃
Logic Supply Voltage	VIN	VSS-0.3	VDD+0.3	V	
Operating Temperature	T_{OP}	0	+50	℃	Note 1
Storage Temperature	T_{SUR}	-20	+60	℃	
	T_{ST}	-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 ℃ max. and no condensation of water.



3.0 ELECTRICAL SPECIFICATIONS

3.1 TFT LCD Open Cell

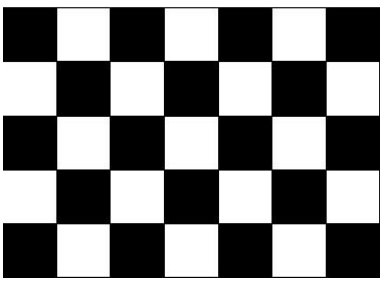
< Table 3. Open Cell Electrical Specifications >

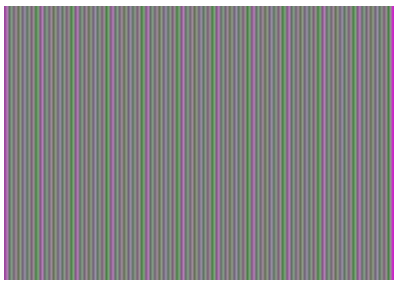
[Ta =25±2 ℃]

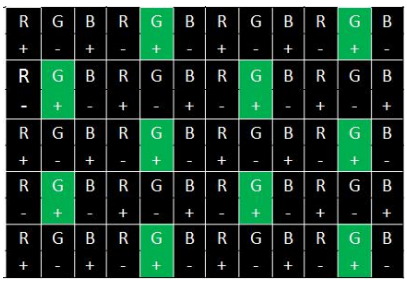
Parameter		Symbol	Values			Unit	Remark
			Min	Typ	Max		
Power Supply Input Voltage		VDD	4.5	5.0	5.5	Vdc	
Power Supply Ripple Voltage		VRP	-	-	200	mV	
Power Supply Current		IDD	-	400	1000	mA	Note 1
Power Consumption		PDD	-	2	5	Watt	
Rush current		IRUSH	-		3.0	A	Note 2
LVDS Interface	Differential Input High Threshold Voltage	VLVTH	+100	-	+300	mV	
	Differential Input Low Threshold Voltage	VLVTL	-300	-	-100	mV	
	Input Differential Voltage	| VID |	200	-	600	mV	
	Differential input common mode voltage	VCM	1.0	1.2	1.5	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=5.0V,
Frame rate f_V=60Hz and Clock frequency = 54MHz.
Test Pattern of power supply current

a) Typ : Mosaic 7X5 (L0/L255) b) Max : Vline Subline (L255)) c) Flicker Pattern







Note 2 : The duration of rush current is about 2ms and rising time of Power Input is 1ms(min)

3.0 ELECTRICAL SPECIFICATIONS

3.2 Backlight Unit

< Table 3. Backlight Unit Electrical Specifications > [Ta =25±2 ℃]

Parameter			Min.	Typ.	Max.	Unit	Remarks
LED Light Bar Input Voltage Per Input Pin		VPIN	32.4	36	38.4	V	Duty 100%
LED Light Bar Input Current Per Input Pin		IPIN	-	120	-	mA	-
Total Current				240		mA	
Total Voltage			32.4	36	38.4	V	
LED Power Consumption		PBL		8.64	9.22	W	Note 1
LED Life-Time		N/A	30000	-	-	Hour	IF = 120mA
PWM Control Level	PWM High Level		-	-	-	V	
	PWM Low Level		-	-	-	V	
PWM Control Frequency		F_{PWM}	-	-	-	Hz	
Duty Ratio		-	-	-	-	%	

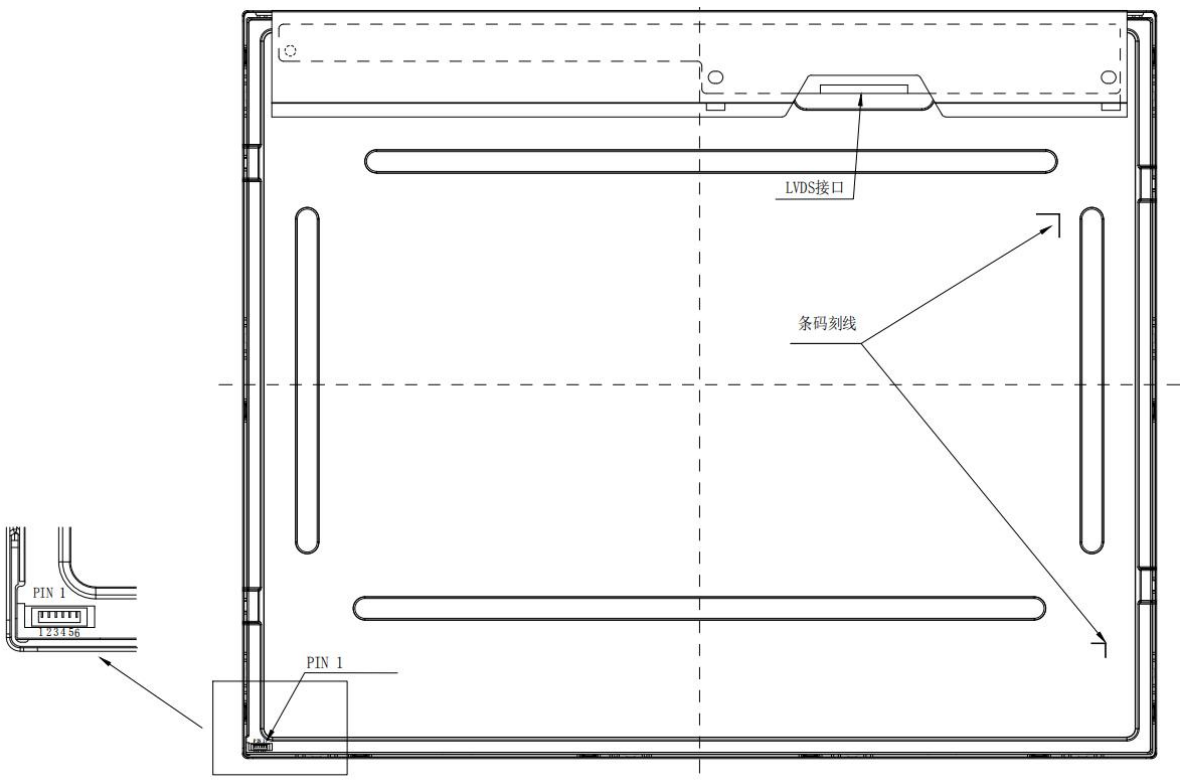
Notes :1.The sense current of each input pin is 120mA
2. PBL=2 Input pins*VPIN × IPIN
3. The LED Life-time define as the estimated time to 50% degradation of initial luminous.

3.3 Backlight Input Pin Assignments

Connector type : SM06B-SHJH(HF) or equivalent

Pin No.	Symbol	Feature
1	CH1-	-
2	NC	No Connection
3	CH1+	-
4	CH2+	-
5	NC	No Connection
6	CH2-	-

Remark: The mating type connector: SHJP-06V-S(HF) or SHJP-06-A-K(HF) and equivalent



4.0 INTERFACE CONNECTION

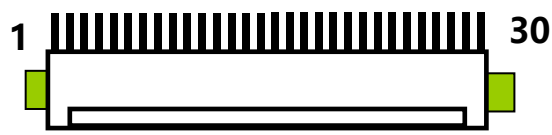
4.1 Open Cell Input Signal & Power

- LVDS Connector : IS100-L30O-C23(UJU), MSBKT2407P30HC(STM) or Equivalent.

< Table 4. Open Cell Input Connector Pin Configuration >

Pin No	Symbol	Description	Pin No	Symbol	Description
1	RXO0-	Negative Transmission data of Pixel 0 (ODD)	16	RXE1+	Positive Transmission data o f Pixel 1 (EVEN)
2	RXO0+	Positive Transmission data o f Pixel 0 (ODD)	17	GNG	Power Ground
3	RXO1-	Negative Transmission data of Pixel 1 (ODD)	18	RXE2-	Negative Transmission data of Pixel 2 (EVEN)
4	RXO1+	Positive Transmission data o f Pixel 1 (ODD)	19	RXE2+	Positive Transmission data o f Pixel 2 (EVEN)
5	RXO2-	Negative Transmission data of Pixel 2 (ODD)	20	RXEC-	Negative Transmission Cloc k (EVEN)
6	RXO2+	Positive Transmission data o f Pixel 2 (ODD)	21	RXEC+	Positive Transmission Clock (EVEN)
7	GND	Power Ground	22	RXE3-	Negative Transmission data of Pixel 3 (EVEN)
8	RXOC-	Negative Transmission Cloc k (ODD)	23	RXE3+	Positive Transmission data o f Pixel 3 (EVEN)
9	RXOC+	Positive Transmission Clock (ODD)	24	GND	Power Ground
10	RXO3-	Negative Transmission data of Pixel 3 (ODD)	25	NC	No. Connection
11	RXO3+	Positive Transmission data o f Pixel 3 (ODD)	26	NC	No. Connection
12	RXE0-	Negative Transmission data of Pixel 0 (EVEN)	27	NC	No. Connection
13	RXE0+	Positive Transmission data o f Pixel 0 (EVEN)	28	VDD	Power Supply: +5V
14	GND	Power Ground	29	VDD	
15	RXE1-	Negative Transmission data of Pixel 1 (EVEN)	30	VDD	

Note : Pin 24 should be connected with GND.

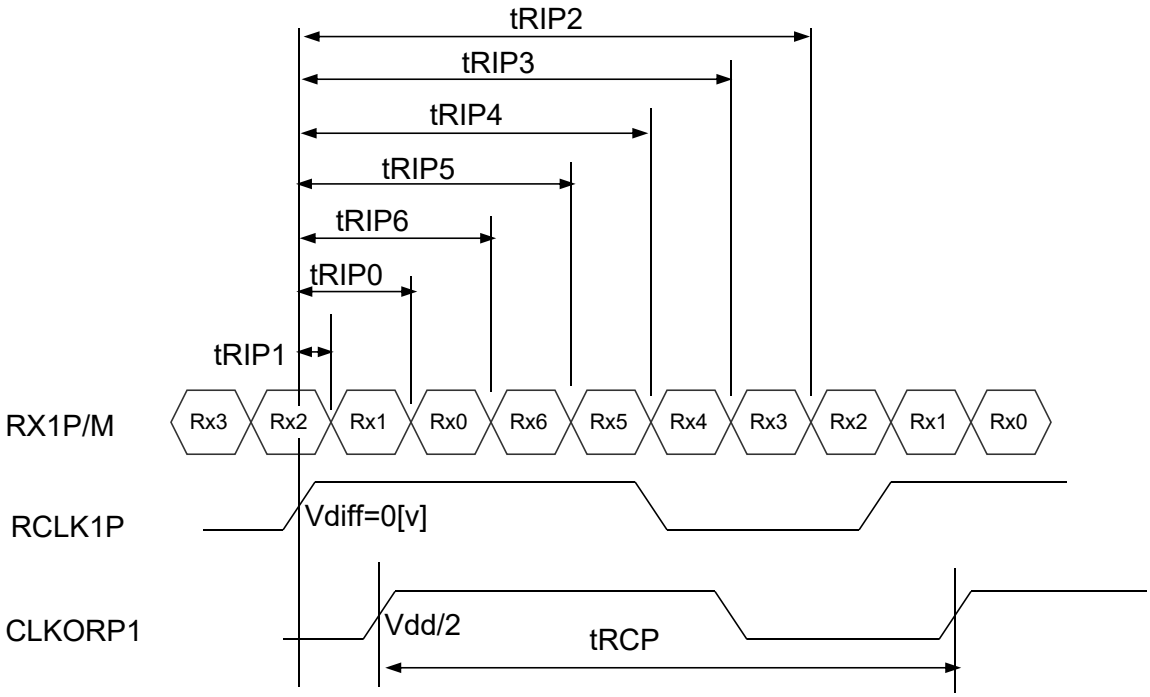


4.2 LVDS Rx Interface Timing Parameter

The specification of the LVDS Rx interface timing parameter is shown in Table 6.

<Table 6. LVDS Rx Interface Timing Specification>

Item	Symbol	Min	Typ	Max	Unit	Remark
CLKIN Period	tRCP	14.8	18.5	22.2	nsec	
Receiver Data Input Margin	tRMG	-0.35	-	0.35	nsec	fCLKIN=110MHz
		-0.40	-	0.40	nsec	fCLKIN=95MHz
		-0.45	-	0.45	nsec	fCLKIN=85MHz
		-0.60	-	0.60	nsec	fCLKIN=65MHz
Input Data 0	tRIP1	- | tRMG |	0.0	| tRMG |	Clock	
Input Data 1	tRIP0	T/7- | tRMG |	T/7	T/7+ | tRMG |	Clock	
Input Data 2	tRIP6	2 T/7- | tRMG |	2T/7	2T/7+ | tRMG |	Clock	
Input Data 3	tRIP5	3T/7- | tRMG |	3T/7	3T/7+ | tRMG |	Clock	
Input Data 4	tRIP4	4T/7- | tRMG |	4T/7	4T/7+ | tRMG |	Clock	
Input Data 5	tRIP3	5T/7- | tRMG |	5T/7	5T/7+ | tRMG |	Clock	
Input Data 6	tRIP2	6T/7- | tRMG |	6T/7	6T/7+ | tRMG |	Clock	



* Vdiff = (RXz+)-(RXz-),…. ,(RXCLK+)-(RXCLK-)

5.0 SIGNAL TIMING SPECIFICATION

5.1 Timing Parameters (DE only mode)

< Table 7. Timing Table >

Item		Symbols		Min	Typ	Max	Unit
Clock	Frequency	1/Tc		45	54	67.5	MHz
	High Time	Tch		-	4/7Tc	-	
	Low Time	Tcl		-	3/7Tc	-	
Frame Period		Tv		1036	1066	1150	lines
				50	60	75	Hz
Horizontal Active Display Term		Valid	t_{HV}	-	640	-	t_{CLK}
		Total	t_{HP}	704	844	960	t_{CLK}
Vertical Active Display Term		Valid	t_{VV}	-	1024	-	t_{HP}
		Total	t_{VP}	1036	1066	1150	t_{HP}

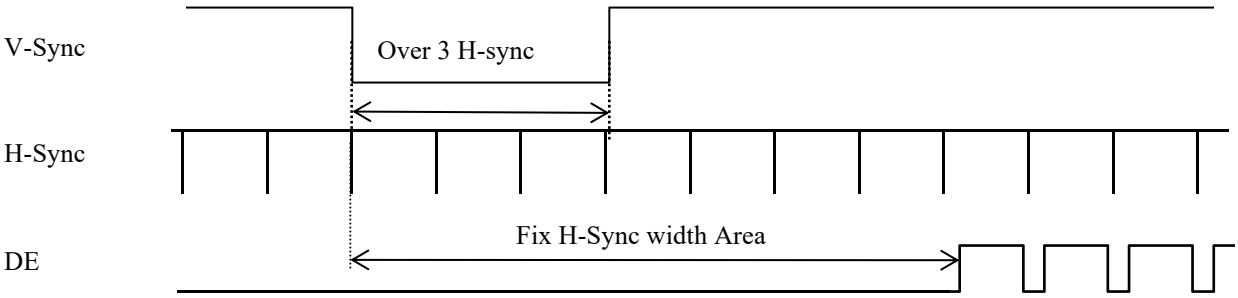
Notes: This product is DE only mode. The input of Hsync & Vsync signal does not have an effect on normal o peration.

< Table 8. LVDS Input SSCG>

Symbol	Parameter	Condition	Min	Typ	Max	Unit
F	LVDS Input frequency	-	45	54	67.5	MHz
T_{RSKM}	Input data skew margin	F=100MHz V_{IC}=1.2V V_{ID}=±400mV	-300	-	+300	ps
F_M	Input modulation frequency		-	-	300	KHz
SS_R	Input spread spectrum ratio		-3	-	+3	%

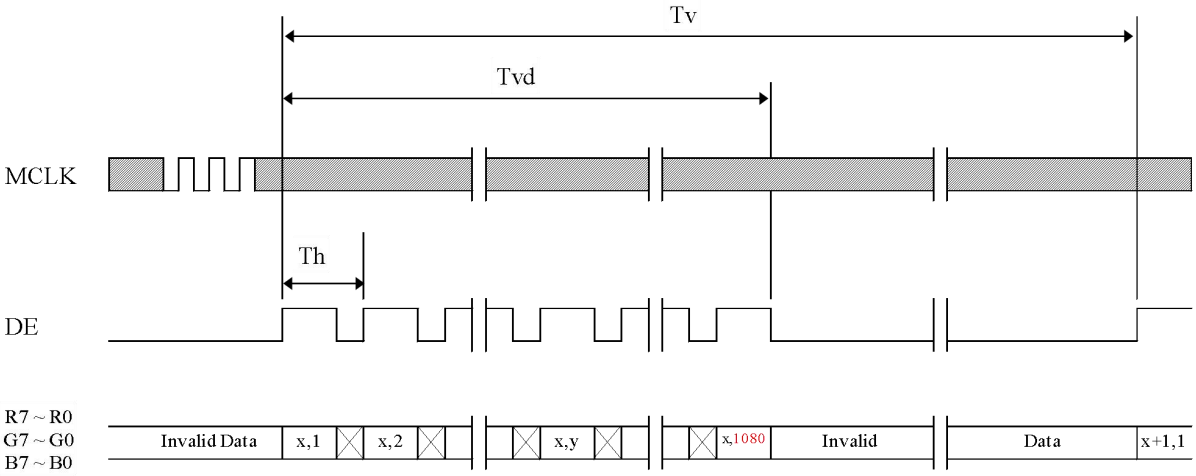
5.2 Signal Timing Waveform

5.2.1 Sync Timing Waveforms

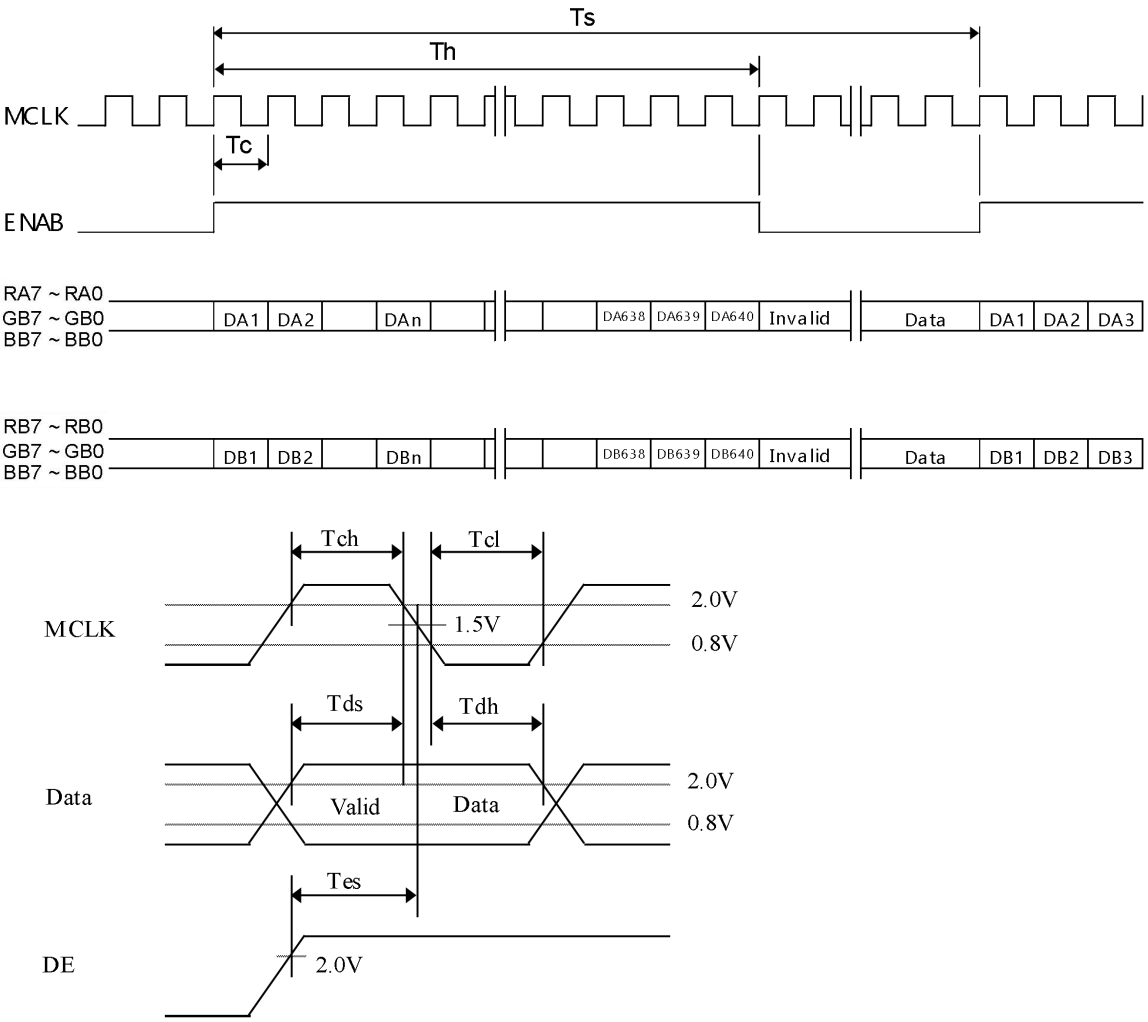


1) Need over 3 H-sync during V-Sync Low
2) Fix H-Sync width from V-Sync falling edge to first rising edge

5.2.2 Vertical Timing Waveforms



5.2.3 Horizontal Timing Waveforms



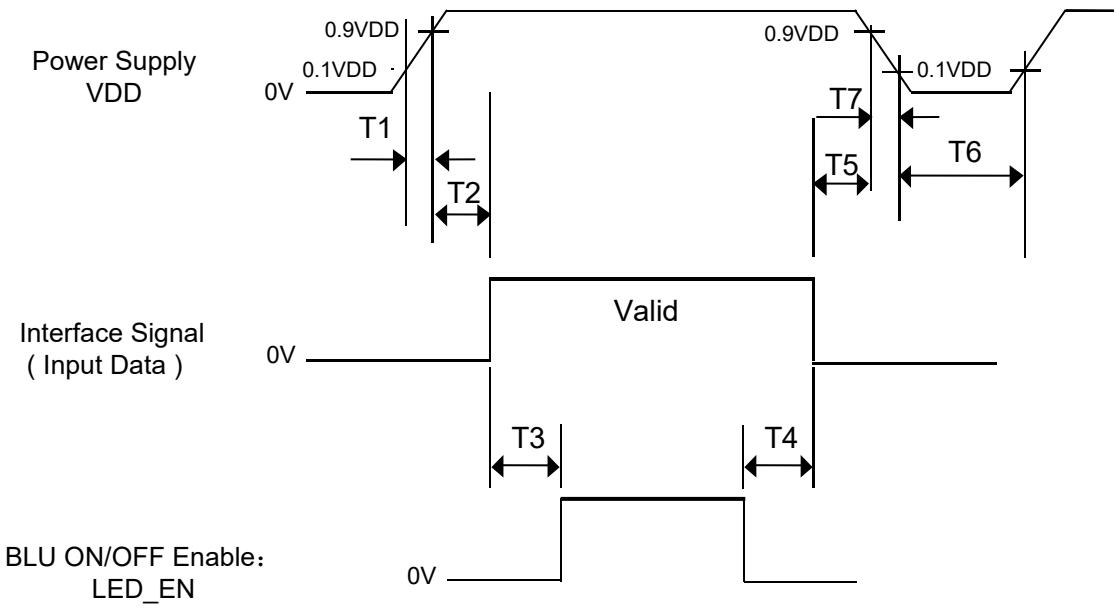
5.3 Input Signals, Basic Display Colors and Gray Scale of Colors

< Table 9. 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	1	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	1	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	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	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

5.4 Power Sequence

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



< Table 10. Sequence Table >

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

Notes: 1. Back Light must be turn on after power for logic and interface signal are valid.

2. Even though T1 is out of SPEC, it is still ok if the inrush current of VDD is below the limit.
3. When VDD<0.9VDD(Typ.),Power off.
4. T7 decreases smoothly, if there were rebounding voltage, it must smaller than 5 volts.

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 180cm from the LCD surface at a viewing angle of θ and Φ equal to 0°. We refer to $\theta_{Ø=0}$ (=θ_3) as the 3 o'clock direction (the "right"), $\theta_{Ø=90}$ (= θ_{12}) as the 12 o'clock direction ("upward"), $\theta_{Ø=180}$ (= θ_9) as the 9 o'clock direction ("left") and $\theta_{Ø=270}$(= θ_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 at 25°C. Optimum viewing angle direction is 6 'clock.

< Table 11. Optical Table >

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

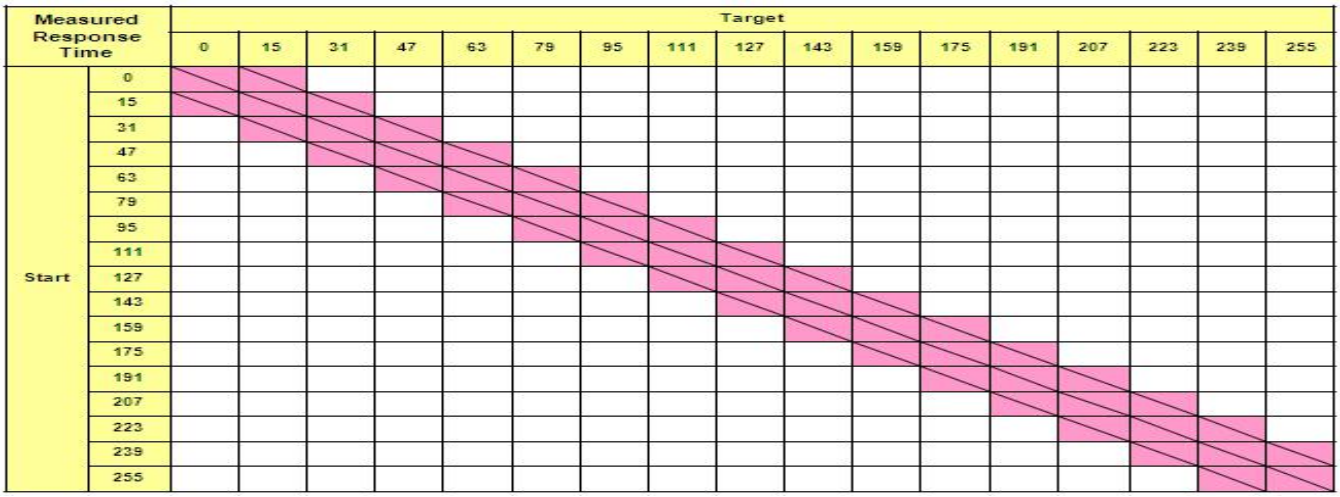
Parameter		Symbol	Condition	Min	Typ	Max	Unit	Remark
Viewing Angle	Horizontal	Θ_3	CR > 10	80	89	-	Deg.	Note 1
		Θ_9		80	89	-	Deg.	
	Vertical	Θ_{12}		80	89	-	Deg.	
		Θ_6		80	89	-	Deg.	
Brightness		Lv	Θ = 0° (Center) Normal Viewing Angle	200	250	-	nit	
Contrast ratio		CR		700:1	1000:1	-		Note 2
White luminance uniformity		ΔY		75	80	-	%	Note 3
Reproduction of color	White	W_x		TYP. - 0.03	0.313	TYP. + 0.03		Note 4
		W_y			0.329			
	Red	R_x			0.6520			
		R_y			0.3341			
	Green	G_x			0.3167			
		G_y			0.6262			
	Blue	B_x			0.1531			
		B_y			0.0586			
Color Gamut				68	72	-	%	
Cell Transmittance				4.9	5.5			
Response Time	G to G	T_g		-	14	20	ms	Note 5

Note :

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 White luminance uniformity on LCD surface is then expressed as :
   ΔY = (Minimum Luminance of 9 points / Maximum Luminance of 9 points) * 100
   (See Figure 5 shown in Appendix).
4. The color chromaticity coordinates specified in Table 9.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 BLU is used by BOE.
5. 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 time in below table shall be measured by switching the signal for "any level of gray(bright)"and "any level of gray(dark)".



6. Definition of Transmittance (T%) :
   Module is with white(L255) signal input

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

7.0 MECHANICAL CHARACTERISTICS

7.1 Dimensional Requirements

Figure 3(located in Appendix) shows mechanical outlines for the model DV190E0M-N11 . Other parameters are shown in Table 12.

< Table 12. Dimensional Parameters >

Parameter	Specification	Unit
Dimensional outline	396.0(H) ×324.0(V)×9.9(D)	mm
Weight	1520 g /(19.82kg/box)	
Active area	374.784(H)*299.8272(V)	mm
Pixel pitch	97.6(H) ×292.8(V)	um
Number of pixels	1280(H) ×1024(V)(1 pixel = R + G + B dots)	pixels
Back-light	Down edge side 1-LED Light bar Type	

7.2 Mounting

See FIGURE 5. (shown in Appendix)

7.3 Anti-Glare and Polarizer Hardness.

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

8.0 RELIABILITY TEST

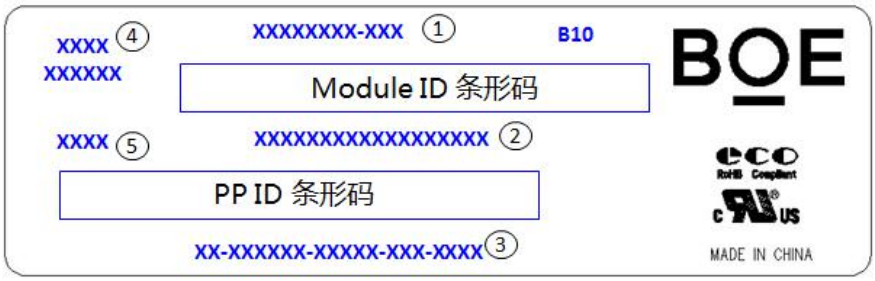
The Reliability test items and its conditions are shown in below.

< Table 13. Reliability Test Parameters >

No	Test Items	Conditions
1	High temperature storage test	Ta = 60 ℃, 240 hrs
2	Low temperature storage test	Ta = -20 ℃, 240 hrs
3	High temperature & high humidity operation test	Ta = 50 ℃, 80%RH, 240hrs
4	High temperature operation test	Ta = 50 ℃, 240hrs
5	Low temperature operation test	Ta = 0 ℃, 240hrs
6	Thermal shock	Ta = -20 ℃ ↔ 60 ℃ (0.5 hr), 100 cycle

This test condition is based on BOE module.

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:

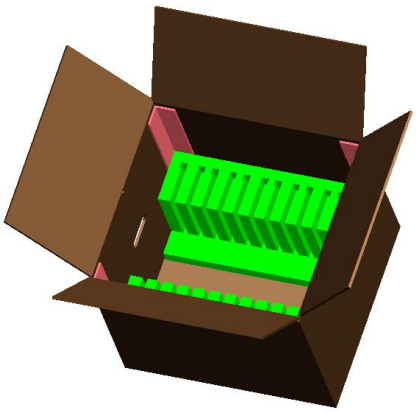
Digit	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Code	S	L	S	A	1	0	8	5	9	4	2	0	0	0	1	D	B
Description	Product Code/GBN→FG-CODE一一对应		Grade	line	Year	Month	Model Extension Code (Last 4 Digits of FG-CODE)					Serial No. Hex-Decimal 000000-FFFFFF					

10.0 PACKING INFORMATION

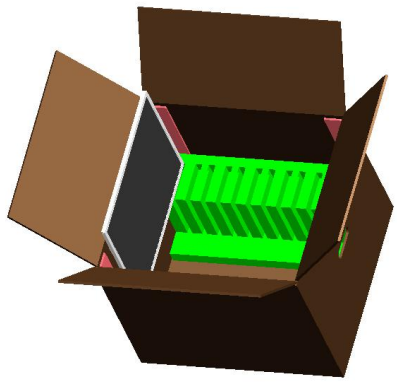
BOE provides the standard shipping container for customers, unless customer specifies th eir packing information. The standard packing method and Barcode information are shown in below.

10.1 Packing Order

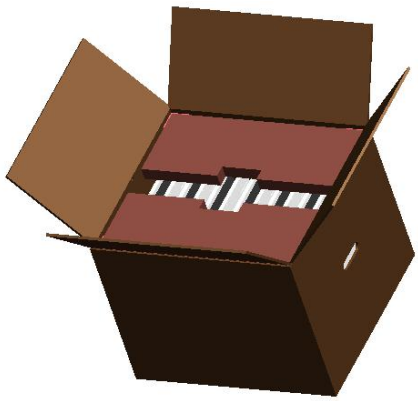
Put 1 EPE bottom into the inner box.

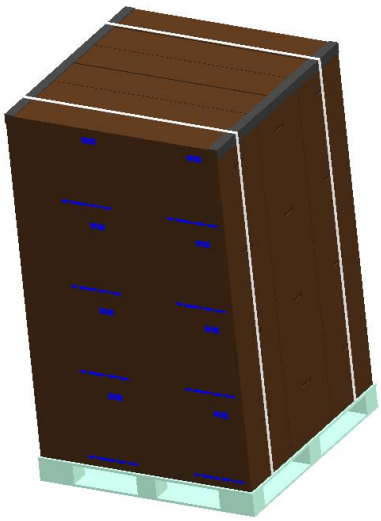


Put each module into a PE bag.
Insert 12 Pcs MDL into each box



Put 1 EPE cover in and seal the box.





-Put the boxes on the Pallet
16boxes/Pallet:16boxes per layer, total 1 layers
-Place paper corners and wrap film around the boxes
-Pack with 4 packing belts

10.2 Packing Note

- Box Dimension : 511mm(L)×472 mm(W)× 405mm(H)
- Package Quantity in one Box : 12 pcs

10.3 Box Label

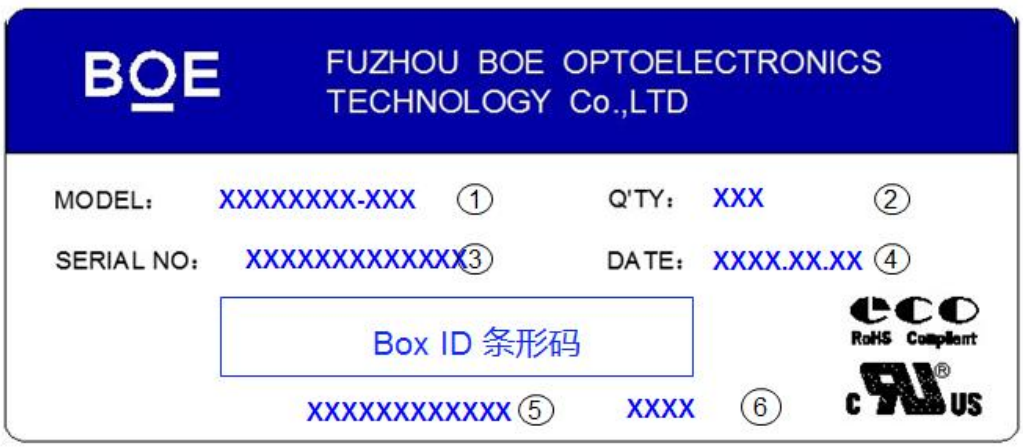
- Label Size : 100mm (L) × 50mm (W)
  - Contents

    Model : DV190E0M-N11

    Q`ty : Module **12** Q`ty in one box

    Serial No. : Box Serial No.

    Date : Packing Date



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.
- Do not apply mechanical stress or static pressure on module , and avoid impact, vibration and falling.
- 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.
- Protection film for polarizer on the module should be slowly peeled off before display.
- Be careful to prevent water & chemicals contact the module surface.
- You should adopt radiation structure to satisfy the temperature specification.
- 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..

- 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.
- Do not allow to adjust the adjustable resistance or switch
- 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

- Avoid the use work clothing made of synthetic fibers. We recommend cotton clothing or other conductivity-treated fibers.
- 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 close to static electricity to avoid product damage.
- 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)	40	75
Storage Life	6 months		
Storage Condition	• The storage room should be equipped with a dark and good ventilation facility. • Prevent products from being exposed to the direct sunlight, moisture and water. • The product need to keep away from organic solvent and corrosive gas. • Be careful for condensation at sudden temperature change. • 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.
- The polarizer surface should not come in contact with any other object. It is recommended that they be stored in the container in which they were shipped.
- 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 vertic al from panel surface, If possible, under ESD control device like ion blower, and the humidity of wor king 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)
   - Well-ventilated place is recommended to set up Commercial Display system
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 t he operating temperature) the LCD module may turn black screen. The above phenomenon cannot expl ain the failure of the display. When the temperature returns to the normal operating temperature, the LC D 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 20 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.
   1) Abnormal condition just means conditions except normal condition.
   2) 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.

11.8 Other Precautions

A. LC Leak

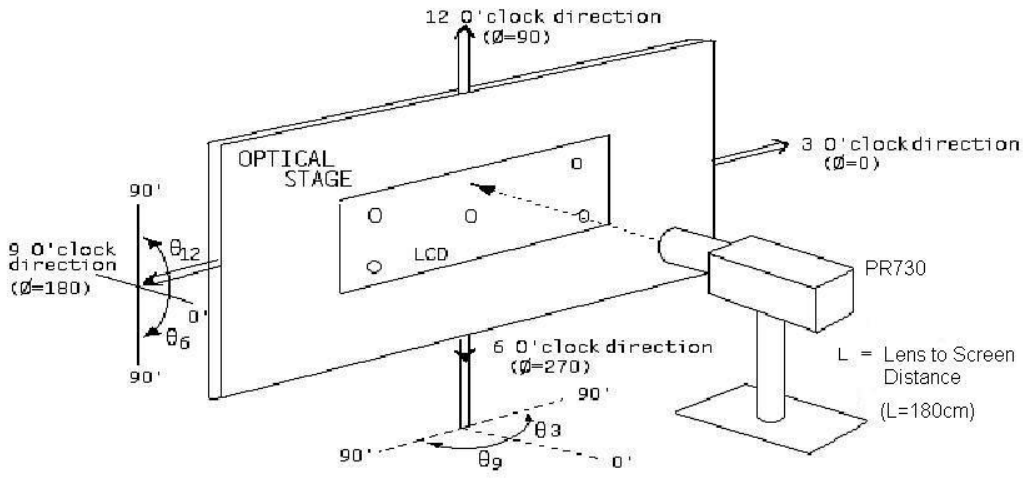
- If the liquid crystal material leaks from the panel, it is recommended to wash the LC with aceton e or ethanol and then burn it.
- If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, skin or clothes, it has to be washed 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

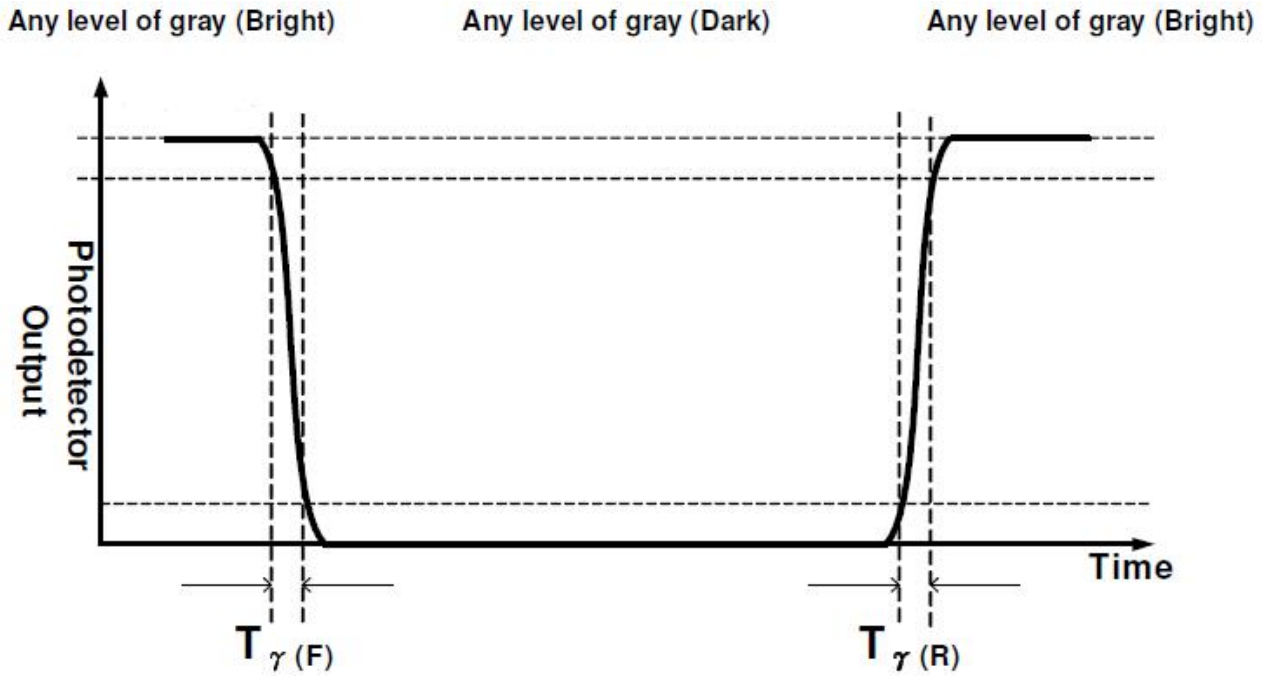
- When returning the module for repair or etc., Please pack the module not to be broken. We reco mmend to use the original shipping packages.

12.0 APPENDIX

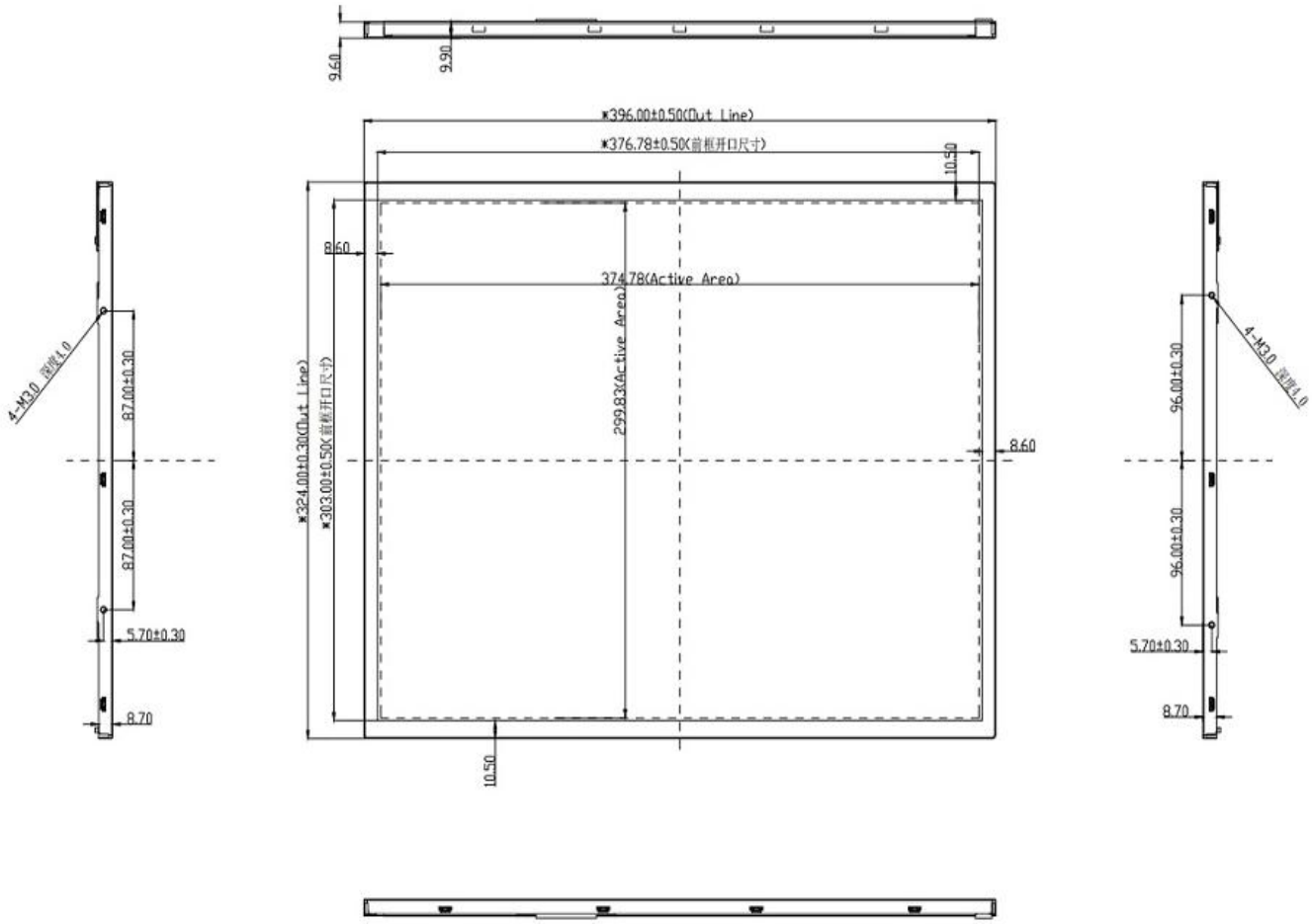
< Figure 1. Measurement Set Up >

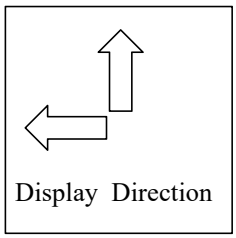


< Figure 2. Response Time Testing >

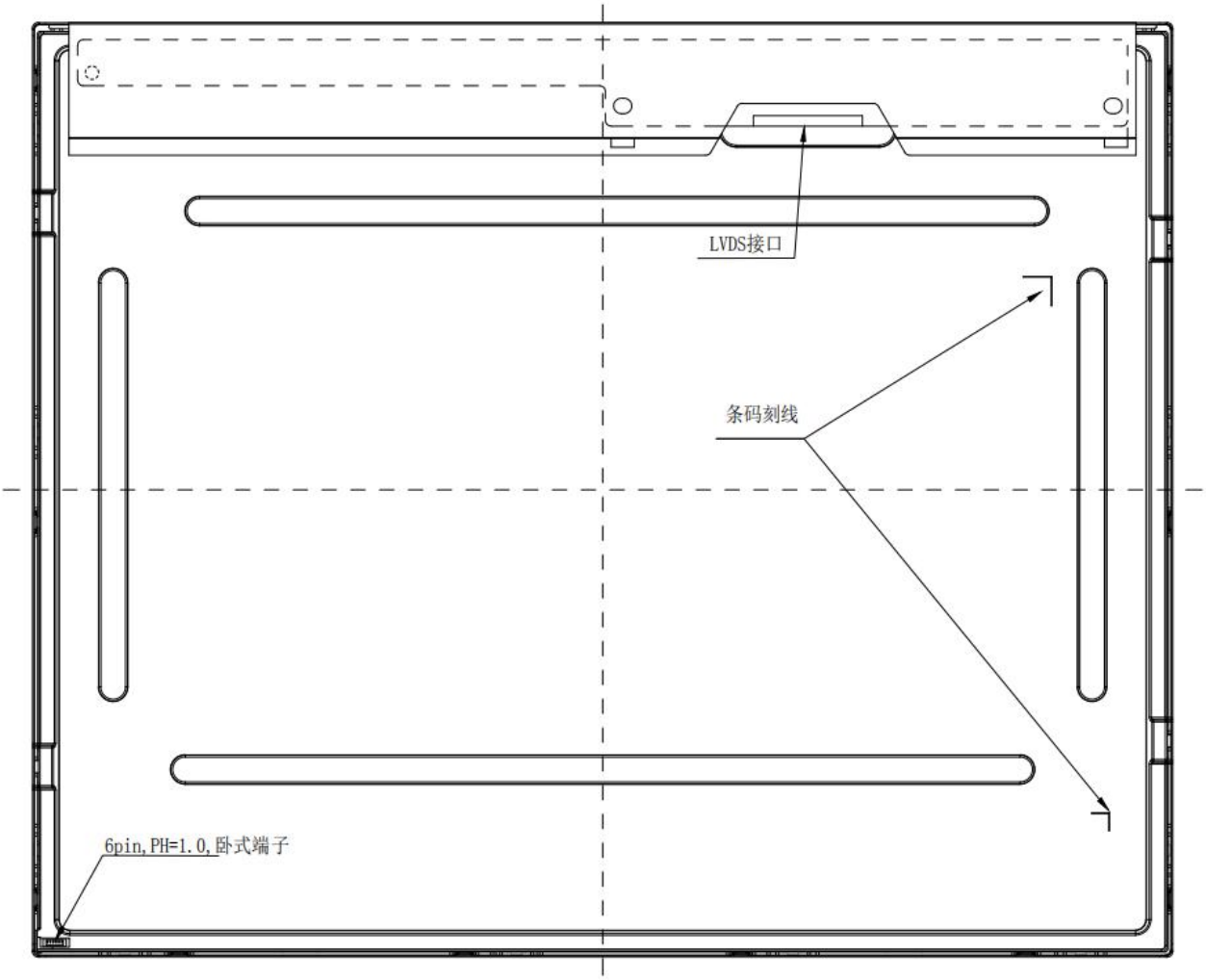


< Figure 3.TFT-LCD Module Outline Dimensions (Front View) >





< Figure 4.TFT-LCD Module Outline Dimensions (Rear View) >



< Figure 5. White Luminance and Uniformity Measurement Locations >