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# DV460FHM-NV1 Product Specification Rev.0

BEIJING BOE Display TECHNOLOGY CO., LTD

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**REVISION HISTORY**

( ) preliminary specification

(  ) Final specification

Revision No.	Page	Description of changes	Date	Prepared
0	-	Specification	2020.04.29	赵龙

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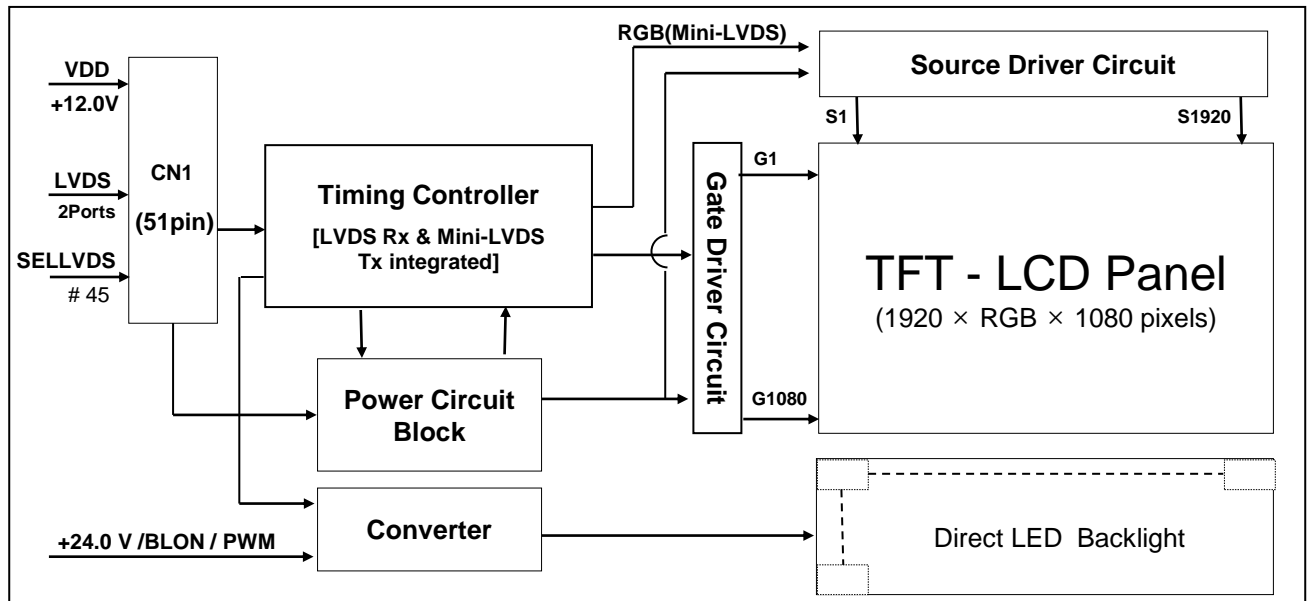
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## 1.0 GENERAL DESCRIPTION

### 1.1 Introduction

DV460FHM-NV1 is a color active matrix TFT LCD Module using amorphous silicon TFT's (Thin Film Transistors) as an active switching devices. This module has a 46.00 inch diagonally measured active area with FHD resolutions (1920 horizontal by 1080 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 panel used for this module is adapted for a low reflection and higher color type.



### 1.2 Features

- LVDS interface with 2 pixel / clock
- High-speed response
- 8-bit color depth, display 16.7M colors
- Direct LED Backlight
- DE (Data Enable) only mode
- ADS technology is applied for high display quality
- RoHS compliant

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### 1.3 Application

- High Definition Public Monitor
- Landscape and Portrait Display

### 1.4 General Specification

&lt; Table 1. General Specifications &gt;

Parameter	Specification	Unit	Remark
MDL Outline	1021.98 (H) ×576.57(V)	mm	
Active area	1018.08 (H) ×572.67(V)	mm	
Number of pixels	1920(H) ×1080(V)	pixels	
Pixel pitch	176.75(H) ×530.25(V)	μm	
Pixel arrangement	Pixels RGB Vertical stripe		
Display colors	16.7M(8bits-true)	colors	
Display mode	Transmission mode, Normally Black		
Brightness	500(Typ.)	nit	Center point
MDL Thickness	40.46	mm	Body
Weight	11,600(Typ.)	gram	
Power Consumption	136.8(Typ.) [Logic= 6.8W, LED Driver =130W(ExtVbr_B=100% )]	Watt	
Surface Treatment	Haze25%,3H,(Front Polarizer)		
Life time	50,000	Hrs	Note 1 2

Note 1: 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 °C

Note 2: Under 24 hours a day is available for black fog mura ( In ordinary temperature ) .

Life time 45,000 hours is available for black fog mura ( In ordinary temperature )

This test condition is based on BOE module.

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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 voltage and current values are listed in Table 2.

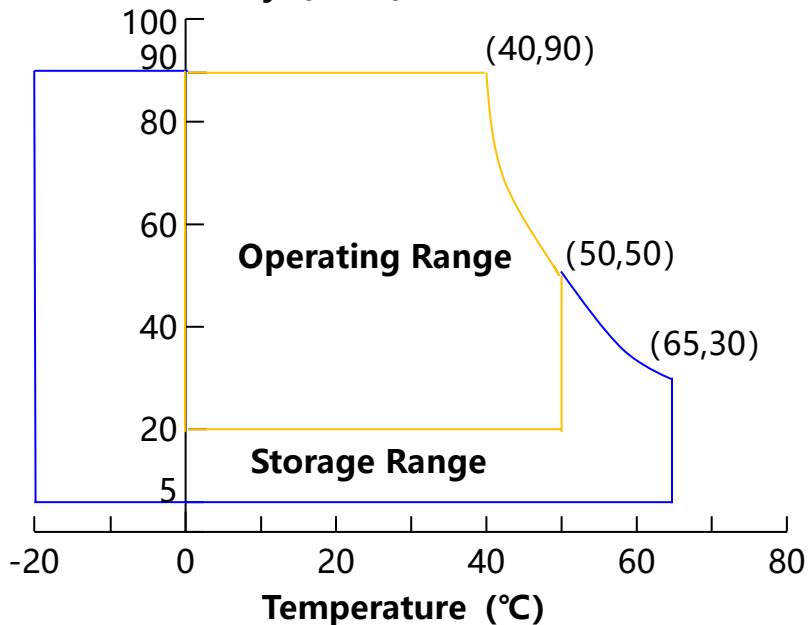
< Table 2. Open Cell Electrical Specifications >

[VSS=GND=0V]

Parameter		Symbol	Min.	Max.	Unit	Remark
Power Supply Voltage	LCD Module	$V_{DD}$	$V_{SS}-0.3$	13.2	V	Ta = 25 °C
	Converter	VBL	VSS-0.3	26.4	V	
Operating Temperature		$T_{OP}$	0	+50	°C	Note 1
		$T_{SUR}$	0	+60	°C	
Storage Temperature		$T_{ST}$	-20	+65	°C	
Operating Ambient Humidity		Hop	5	90	%RH	
Storage Humidity		Hst	20	90	%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.

**Relative Humidity (%RH)**

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### 3.0 ELECTRICAL SPECIFICATIONS

#### 3.1 Open Cell Electrical Specifications

< 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	Vdc	
Power Supply Ripple Voltage		VRP	-	-	300	mV	
Power Supply Current		IDD	-	560	950	mA	Note 1
Power Consumption		PDD	-	6.8	11.4	Watt	
Rush current		IRUSH	-	-	3	A	Note 2
LVDS Interface	Differential Input High Threshold Voltage	VLVTH	+100		+600	mV	
	Differential Input Low Threshold Voltage	VLVTL	-600		-100	mV	
	Common Input Voltage	VLVC	1.0	1.2	1.4	V	
TCON Option Selection Voltage	Input High Threshold Voltage	VIH	2.7	-	3.3	V	
	Input Low Threshold Voltage	VIL	0	-	0.6	V	

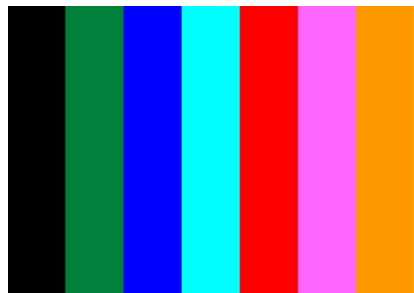
Note 1 : The supply voltage is measured and specified at the interface connector of LCM.

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

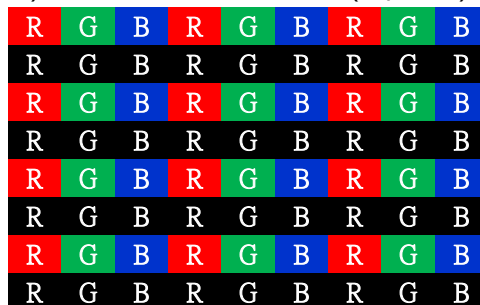
Frame rate  $f_v=60\text{Hz}$  and Clock frequency = 75.4MHz.

Test Pattern of power supply current

a) Typ : Color Test (L0/L255)



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



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

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## 3.2 Converter Electrical Specifications

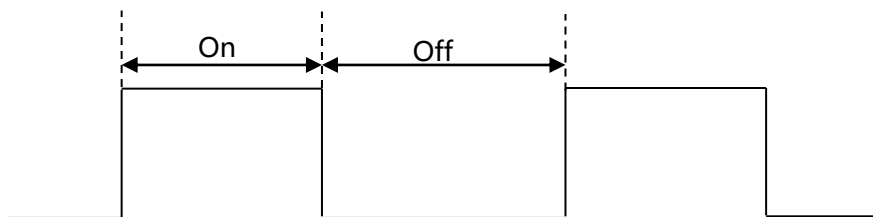
&lt; Table 4. Converter Electrical Specifications &gt;

[Ta =25±2 °C]

Parameter	Symbol	Values			Unit	Remark
		Min	Typ	Max		
Power Supply Input Voltage	VBL	21.6	24	26.4	Vdc	
Power Supply Ripple Voltage	VRP	-	-	300	mV	
Power Supply Current	IDD	-	5.2	6	A	
Power Consumption	PDD	-	120	135	Watt	Note 1
Backlight On/Off Control Voltage	V <sub>BLOn</sub> (off)	0	-	0.3	V	
	V <sub>BLOn</sub> (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	-	300	Hz	

Note 1: The specified current and power consumption are under the typical supply Input voltage, 24V.  
It is total power consumption.

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



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**4.0 INTERFACE CONNECTION****4.1 Open Cell Input Signal & Power**

-. Connector (CN1)PF050-O51B-C20-C (UJU)/05002HR-H51G5(G) (YEONHO) or Equivalent.

< Table 5. Input Connector Pin Configuration >

Pin No	Symbol	Description	Pin No	Symbol	Description
1	Rev_scan	Reverse_scan	20	CH1CLK+	First pixel positive LVDS clock
2	NC	Not Connected	21	GND	Ground
3	NC	Not Connected	22	CH1[3]-	First pixel negative LVDS differential data input. Pair3
4	NC	Not Connected	23	CH1[3]+	First pixel positive LVDS differential data input. Pair3
5	NC	Not Connected	24	GND	Ground
6	NC	Not Connected	25	GND	Ground
7	SELLVDS	High: VESA Low or Open: JEIDA	26	NC	Not Connected
8	SCL	IIC SCL	27	NC	Not Connected
9	SDA	IIC SDA	28	CH2[0]-	Second pixel negative LVDS differential data input. Pair0
10	LOCAL_ON	Local_Dimming 'H' =Enable , 'L' = Disable	29	CH2[0]+	Second pixel positive LVDS differential data input. Pair0
11			30	CH2[1]-	Second pixel negative LVDS differential data input. Pair1
12	CH1[0]-	First pixel negative LVDS differential data input. Pair0	31	CH2[1]+	Second pixel positive LVDS differential data input. Pair1
13	CH1[0]+	First pixel positive LVDS differential data input. Pair0	32	CH2[2]-	Second pixel negative LVDS differential data input. Pair2
14	CH1[1]-	First pixel negative LVDS differential data input. Pair1	33	CH2[2]+	Second pixel positive LVDS differential data input. Pair2
15	CH1[1]+	First pixel positive LVDS differential data input. Pair1	34	GND	Ground
16	CH1[2]-	First pixel negative LVDS differential data input. Pair2	35	CH2CLK-	First pixel negative LVDS clock
17	CH1[2]+	First pixel positive LVDS differential data input. Pair2	36	CH2CLK+	First pixel positive LVDS clock
18	GND	Ground	37	GND	Ground
19	CH1CLK-	First pixel negative LVDS clock	38	CH2[3]-	Second pixel negative LVDS differential data input. Pair3

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Pin No	Symbol	Description	Pin No	Symbol	Description
39	CH2[3]+	Second pixel positive LVDS differential data input. Pair3	46	GND	Ground
40	GND	Ground	47	GND	Ground
41	GND	Ground	48	VDD	Input Voltage
42	NC	Not Connected	49	VDD	Input Voltage
43	NC	Not Connected	50	VDD	Input Voltage
44	NC	Not Connected	51	VDD	Input Voltage
45	GND	Ground			

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. Pin 10 Local\_ON: This pin is used for selecting local dimming ON/OFF

4. Pin 7 SELLVDS : This pin is used for selecting LVDS signal data format.

If this Pin : High (3.3V) →VESA LVDS format

Otherwise : Low (GND) or Open(NC) → JEIDA LVDS format

**Rear view of LCM**

PF050-O51B-C20-C (UJU)  
/05002HR-H51G5(G) (YEONHO)



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## 4.2 BLU Input Signal & Power

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

< Table 6. Input Connector Pin Configuration CN1 >

Pin No	Symbol	Description	Pin No	Symbol	Description
1	VBL	Operating Voltage Supply, +24V DC regulated	8	GND	Ground and Current Return
2	VBL	Operating Voltage Supply, +24V DC regulated	9	GND	Ground and Current Return
3	VBL	Operating Voltage Supply, +24V DC regulated	10	GND	Ground and Current Return
4	VBL	Operating Voltage Supply, +24V DC regulated	11	NC	No Connection
5	VBL	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 调光	0V:Min, 3.3V:Max
7	GND	Ground and Current Return	14	NC	No Connection

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&lt; Table 7. Input Connector Pin Configuration CN2 &gt;

Pin No	Symbol	Description	Pin No	Symbol	Description
1	VBL	Operating Voltage Supply, +24V DC regulated	8	GND	Ground and Current Return
2	VBL	Operating Voltage Supply, +24V DC regulated	9	GND	Ground and Current Return
3	VBL	Operating Voltage Supply, +24V DC regulated	10	GND	Ground and Current Return
4	VBL	Operating Voltage Supply, +24V DC regulated	11	NC	No Connection
5	VBL	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 调光	0V:Min, 3.3V:Max
7	GND	Ground and Current Return	14	NC	No Connection

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### 4.3 LVDS Receiver Type

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

< Table 8. 8-bit LVDS Type >

Channel No.	Data No.	8-bit LVDS Type	
		VESA	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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## 5.0 SIGNAL TIMING SPECIFICATION

### 5.1 Timing Parameters (DE only mode)

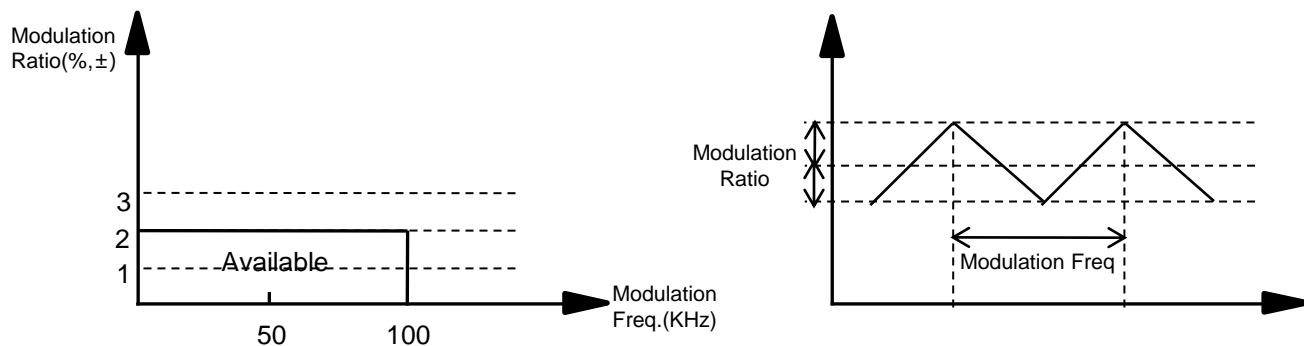
< Table 9. Timing Table >

Item		Symbols	Min	Typ	Max	Unit	Notes
Horizontal	Display Period	tHV	960	960	960	tCLK	2 ports
	Blank	tHB	90	140	190	tCLK	1
	Total	tHP	1050	1100	1150	tCLK	
Vertical	Display Period	tVV	-	1080	-	Lines	1
	Blank	tVB	20	45	69	Lines	
	Total	tVP	1100	1125	1149	Lines	

Item		Symbols	Min	Typ	Max	Unit	Notes
Frequency	DCLK	fCLK	66.00	74.25	82	MHz	2 ports
	Horizontal	fH	62.7	67.5	72.3	KHz	2
	Total	fV	57	60	63	Hz	2

**Notes:**

1. The input of HSYNC & VSYNC signal does not have an effect on normal operation (DE Only Mode). If you use spread spectrum of EMI, add some additional clock to minimum value for clock margin.
2. The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rate and the horizontal frequency.
3. LVDS Receiver Spread spectrum Clock is defined as below figure.



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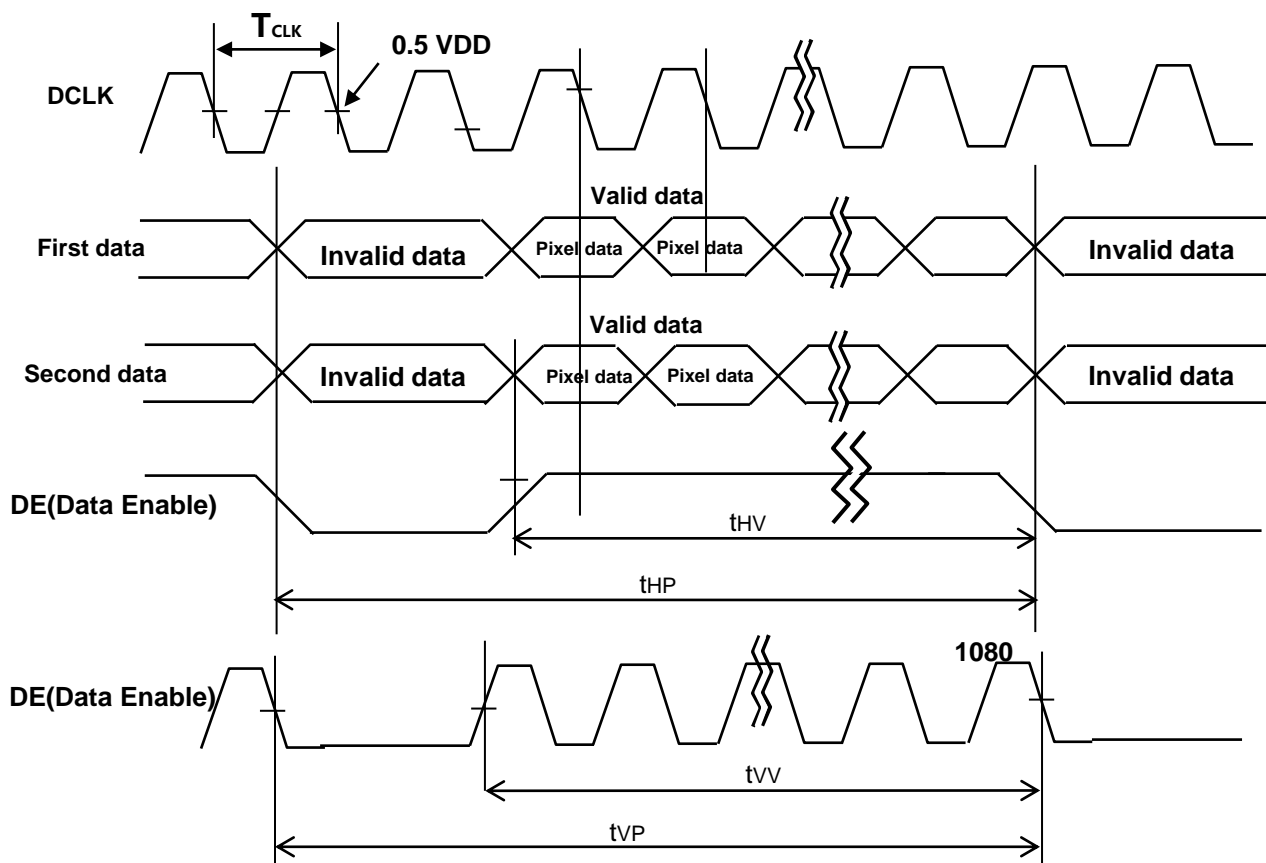
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Please pay attention to the followings when you set Spread Spectrum Rate(SSR) and Modulation Frequency(FMOD)

1. Please set proper Spread Spectrum Rate(SSR) and Modulation Frequency (FMOD) of TV system LVDS output.
2. Please check FOS after you set Spread Spectrum Rate(SSR) and Modulation Frequency(FMOD) to avoid abnormal display. Especially, harmonic noise can appear when you use Spread Spectrum under FMOD 30 KHz.

## 5.2 Signal Timing Waveform

### 5.2.1 LVDS Input Signal Timing Diagram



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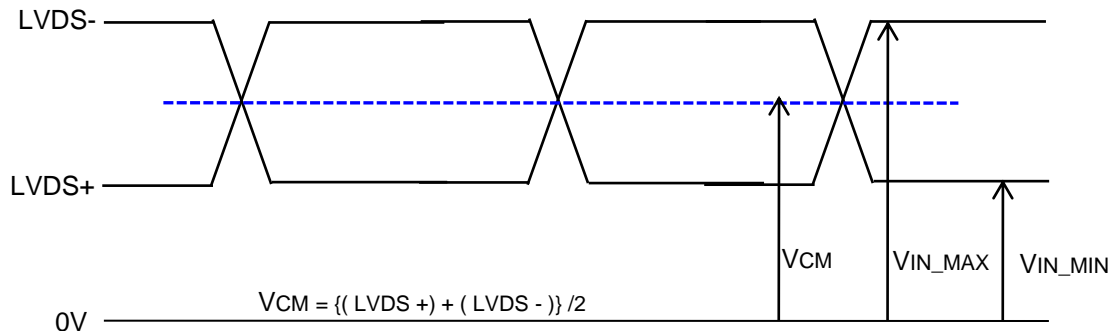
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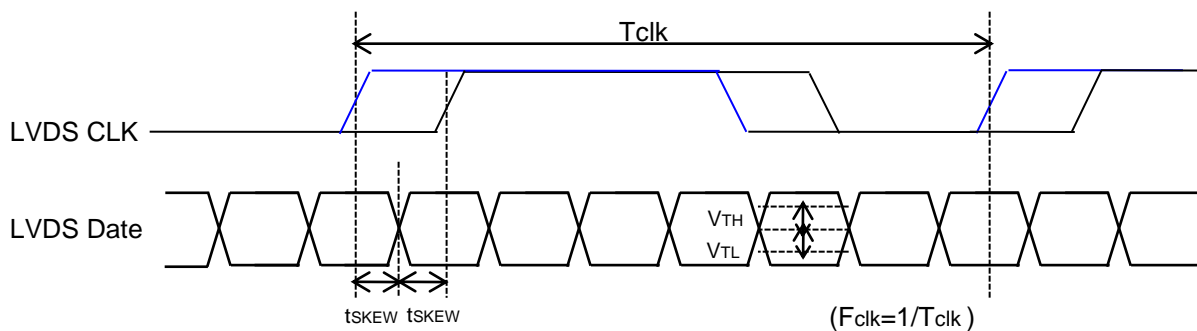
5.2.2 LVDS Input Signal Characteristics

1) DC Specification



Description	Symbols	Min	Max	Unit
LVDS Common mode Voltage	VCM	1.0	1.4	V
LVDS Input Voltage Range	VIN	0.7	1.7	V
Change in common mode Voltage	$\Delta V_{CM}$	-	200	mV

2) AC Specification



Description	Symbols	Min	Max	Unit	Notes
LVDS Differential Voltage	VTH	100	600	mV	Tested with Differential Probe
	VTL	-600	-100	mV	
LVDS Clock to Data Skew	tSKEW	-	400	ps	
LVDS Clock to Clock Skew (Even to Odd)	tSKEW <sub>E</sub> <sub>O</sub>	-	400	ps	

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

< Table 10. 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	1	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	
	△																								
	▽																								
	Brighter	1	1	1	1	1	1	0	1	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	
	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	1	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	
	△																								
	▽																								
	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	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	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	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	
	△																								
	▽																								
	Brighter	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	1	1	1	1	1	1	1	0	
	Blue	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	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	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	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	

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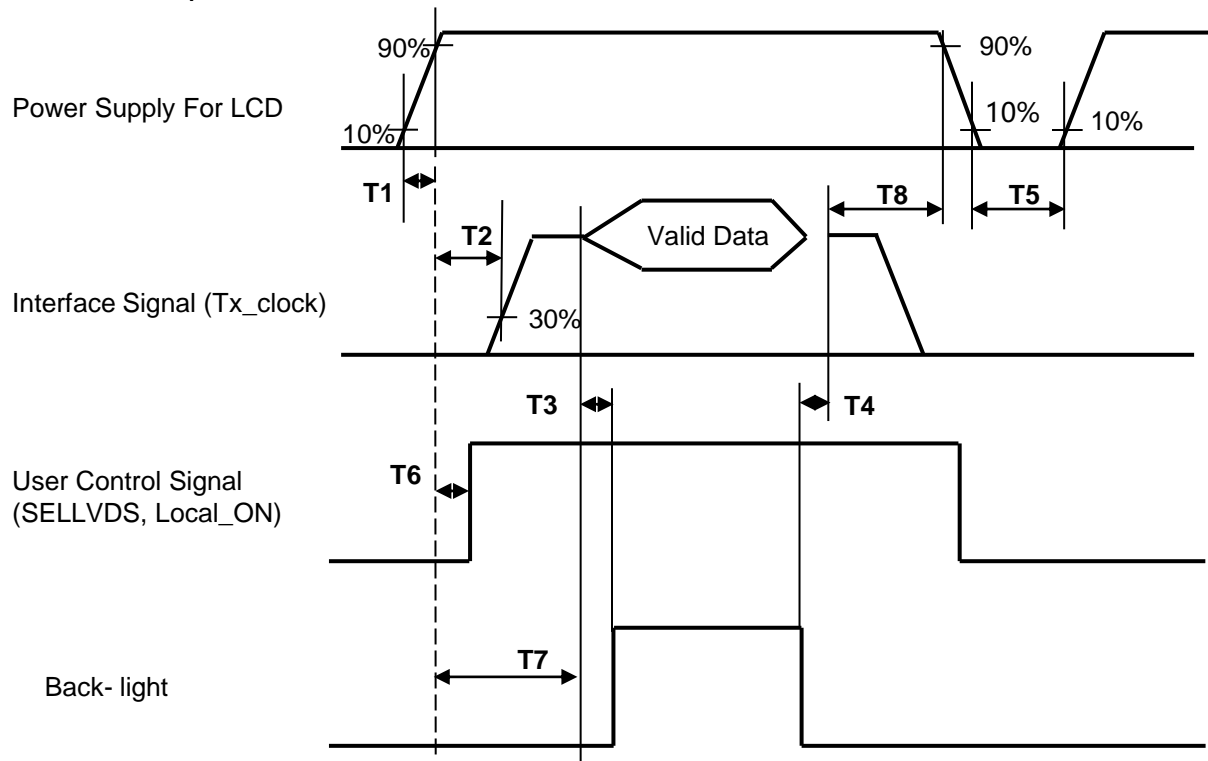
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## 5.4 Power Sequence

### 5.4.1 LCD driver circuit

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



Parameter	Values			Units
	Min	Typ	Max	
T1	0.5	-	10	ms
T2	0.1	-	T7	ms
T3	400	-	-	ms
T4	200	-	-	ms
T5	5	-	-	sec
T6	0.1	-	T2	ms
T7	1	-	10	sec
T8	100	-	-	ms

**Notes:**

1. When the power supply VDD is 0V, keep the level of input signals on the low or keep high impedance.
2. Do not keep the interface signal high impedance when power is on.
3. Back-light must be turn on after power for logic and interface signal are valid.

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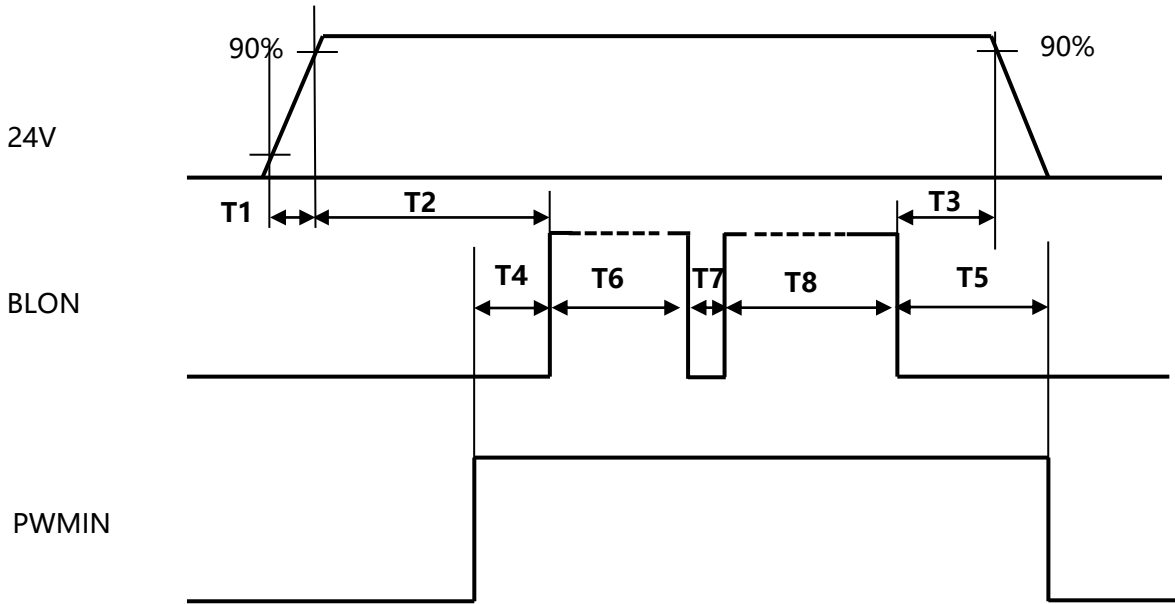
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### 5.4.2 Sequence for converter Power supply for converter



Parameter	Values			Units
	Min	Typ	Max	
T1/T3	10	-	-	ms
T2	200	-	-	ms
T4/T5	0.1	-	-	ms
T6/T8	2	-	-	sec
T7	500	-	-	ms

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**6.0 OPTICAL SPECIFICATIONS**

The test of optical specifications shall be measured in a dark room (ambient luminance  $\leq 1$  lux and temperature  $= 25 \pm 2^\circ\text{C}$ ) 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  $\theta$  and  $\Phi$  equal to  $0^\circ$ . We refer to  $\theta_{\phi=0}$  ( $=\theta_3$ ) as the 3 o'clock direction (the "right"),  $\theta_{\phi=90}$  ( $=\theta_{12}$ ) as the 12 o'clock direction ("upward"),  $\theta_{\phi=180}$  ( $=\theta_9$ ) as the 9 o'clock direction ("left") and  $\theta_{\phi=270}$  ( $=\theta_6$ ) as the 6 o'clock direction ("bottom"). While scanning  $\theta$  and/or  $\phi$ , 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  $25^\circ\text{C}$ . Optimum viewing angle direction is 6 'clock.

< Table 11. Optical Table >

[VDD = 12.0V, Frame rate = 60Hz, Ta =  $25 \pm 2^\circ\text{C}$ ]

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	LD_ON	CR1		-	45000:1	-		Note 2
	LD_OFF	CR2		900:1	1200:1	-		Note 3
Reproduction of color	White	$W_x$	$\theta = 0^\circ$ (Center) Normal Viewing Angle	TYP. - 0.02	0.280	TYP. + 0.02		Note 4
		$W_y$			0.290			
	Red	$R_x$			0.625			
		$R_y$			0.349			
	Green	$G_x$			0.287			
		$G_y$			0.615			
	Blue	$B_x$			0.150			
		$B_y$			0.041			
Response Time	G to G	$T_g$		-	8	10	ms	Note 5
Color Temperature				9000	10000	11000	K	
Color Gamut					72		%	
Gamma Scale				1.9	2.2	2.5		
Brightness				450	500		nit	
Uniformity		9P		85	90		%	Note 6
		25P		80	85		5	

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Notes :

- 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.
- 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.

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

- LD\_ON=Local Diming enable.  
LD\_OFF=Local Diming disable.
- The color chromaticity coordinates specified in Table 11 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.
- 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
0																	
15																	
31																	
47																	
63																	
79																	
95																	
111																	
127																	
143																	
159																	
175																	
191																	
207																	
223																	
239																	
255																	

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

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## 7.0 MECHANICAL CHARACTERISTICS

### 7.1 Dimensional Requirements

Table 12 provides general mechanical characteristics.  
Other parameters are shown in Figure 4、 Figure 5.

< Table 12. Dimensional Parameters >

Parameter	Specification	Unit
MDL Outline	1021.98 (H) ×576.57(V)	mm
Active area	1018.08 (H) ×572.67(V)	mm
MDL Thickness	40.46	mm
Weight	11,500(Typ.)	gram

### 7.2 Surface treatment

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

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**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 = 65 °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	Low temperature operation test	Ta = -5 °C, 240hrs
5	High temperature operation test	Ta = 50 °C, 240hrs
6	Vibration test (non-operating)	Frequency : 5~ 200 Hz, Random Gravity / AMP : 1.05Grms Period : +Z
7	Electro-static discharge test	Air : ±15kV , 150pF/330Ω , 100Point , 1time/Point MDL Contact : ±8kV , 150pF/330Ω , 100Point , 1time/Point Pin Contact: ±5KV, 150pF/330Ω, Input connector Pin, 3 times/pin with no function loss

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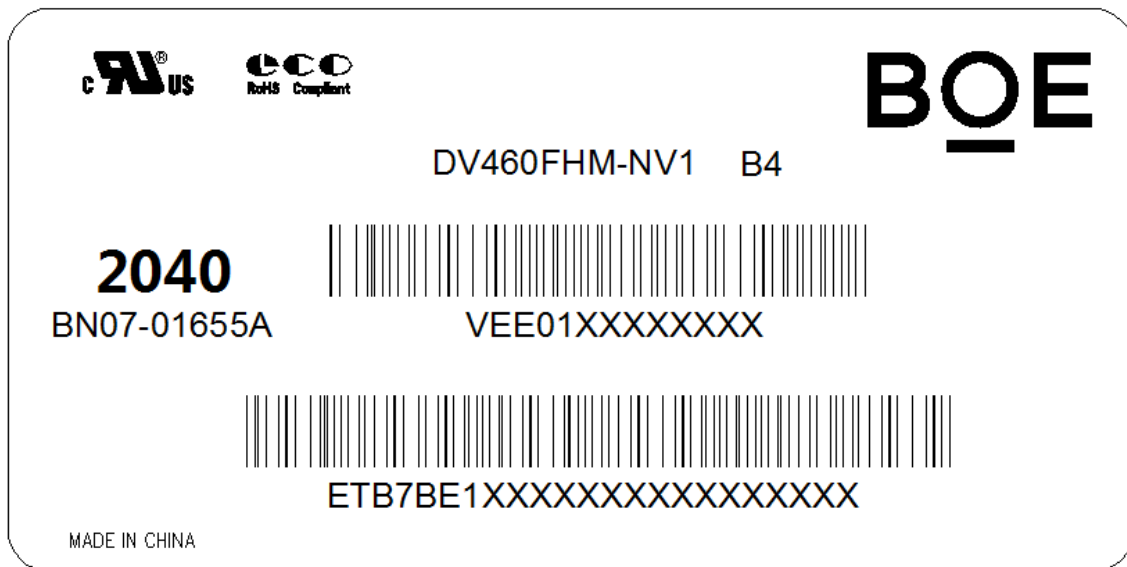
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**9.0 PRODCUT SERIAL NUMBER**



**1**

**2**

**3**

**4**

**5**

**6**

**7**

X X

X

X

X X

X

X X X X

X X X X X X

- 1. Control Number
- 2. Rank / Grade
- 3. Line Classification
- 4. Year (2011 : 11, 2012 : 12, ...)

- 5. Month (1,2,3, ... , 9, X, Y, Z)
- 6. Internal Use
- 7. Serial Number

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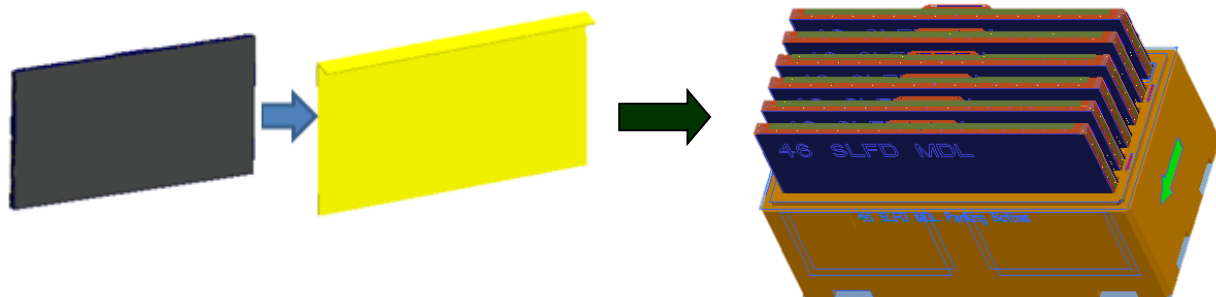


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**10.0 PACKING INFORMATION**

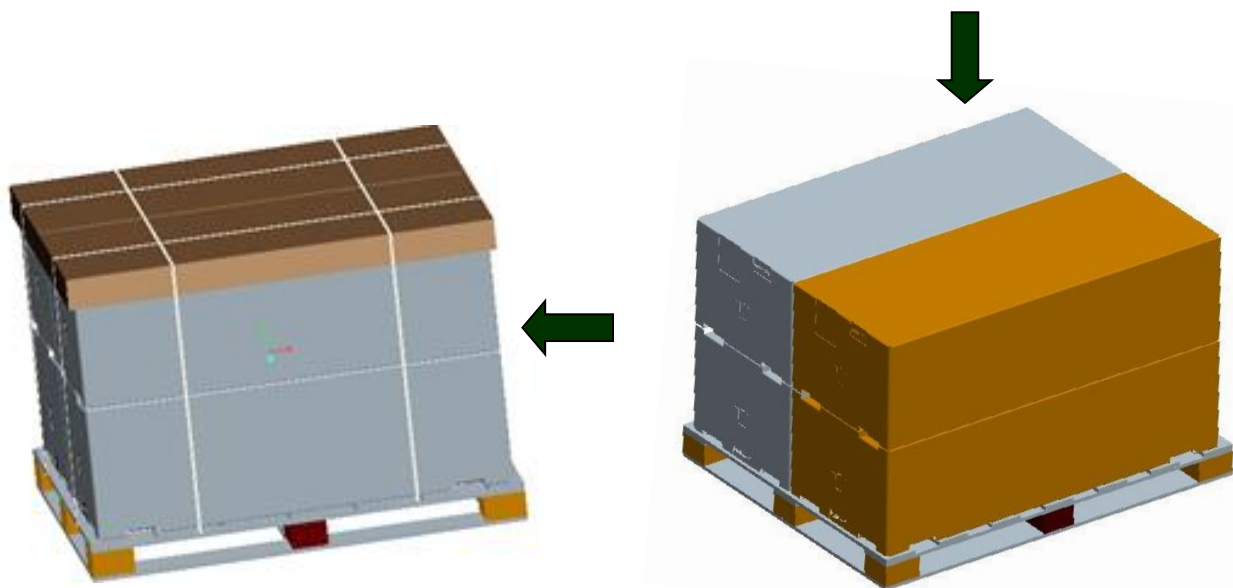
BOE provides the standard shipping container for customers, unless customer specifies their packing information. The standard packing method and Barcode information are shown in below.

**10.1 Packing Order**



Put one Pcs into the PE Bag

Put 6 Pcs LCD MDL in the EPS BOX.



Put the Top-cover on the Box (12ea MDLs per pallet) and Pack with 4 packing belts.

Put 2 EPS BOX on the pallet.

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### 10.2 Packing Note

- Box Dimension : 1138 mm (L) × 558 mm (W) × 777mm (H)
- Package Quantity in one Box : 6pcs

### 10.3 Box Label

- Label Size : 110 mm (L) × 55 mm (W)
- Contents

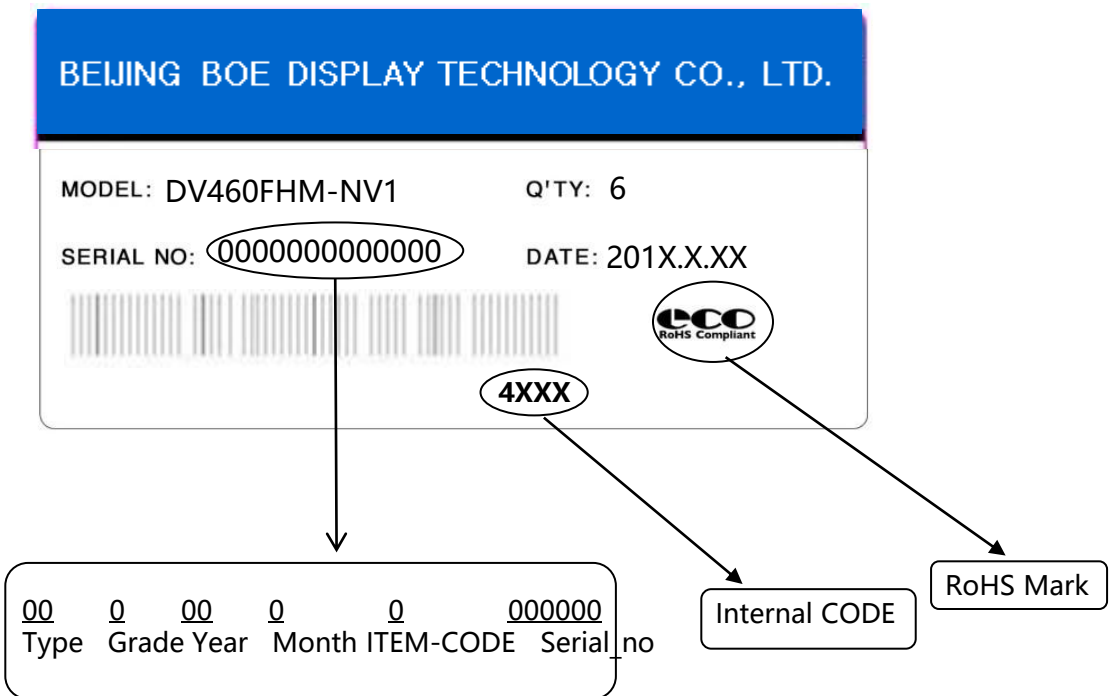
Model : DV460FHM-NV1

Q`ty : Module 6 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



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## 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.

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### 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.

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### 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	(°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>		

#### 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.

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### 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:  $20 \pm 15^{\circ}\text{C}$
- Operating Ambient Humidity :  $55 \pm 20\%$
- 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.

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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 clockwise 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.

**PROPRIETARY NOTE**

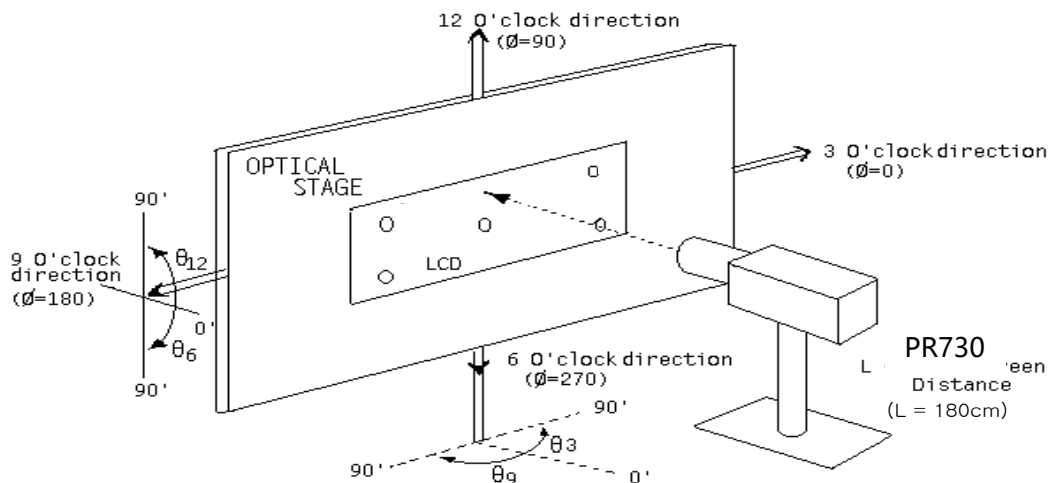
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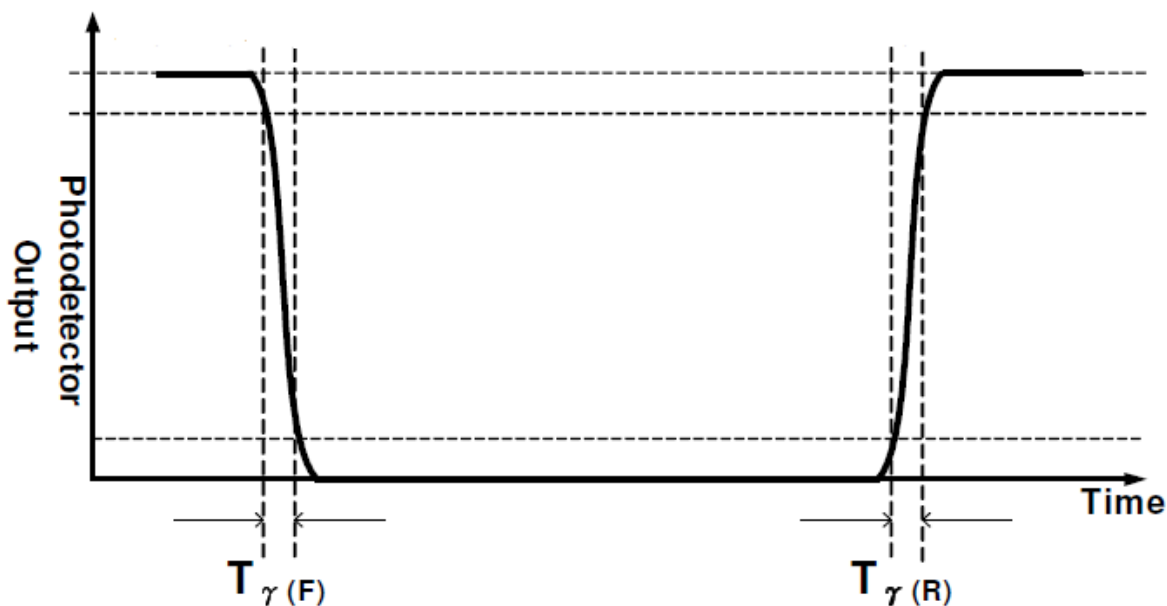
**12.0 APPENDIX**

< Figure 1. Measurement Set Up >



< Figure 2. Response Time Testing >

Any level of gray (Bright)      Any level of gray (Dark)      Any level of gray (Bright)



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< Figure 3. Uniformity Measurement Locations >



Active Area

Test points ○

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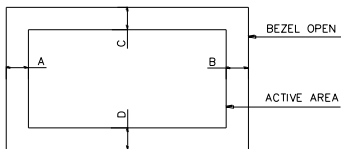
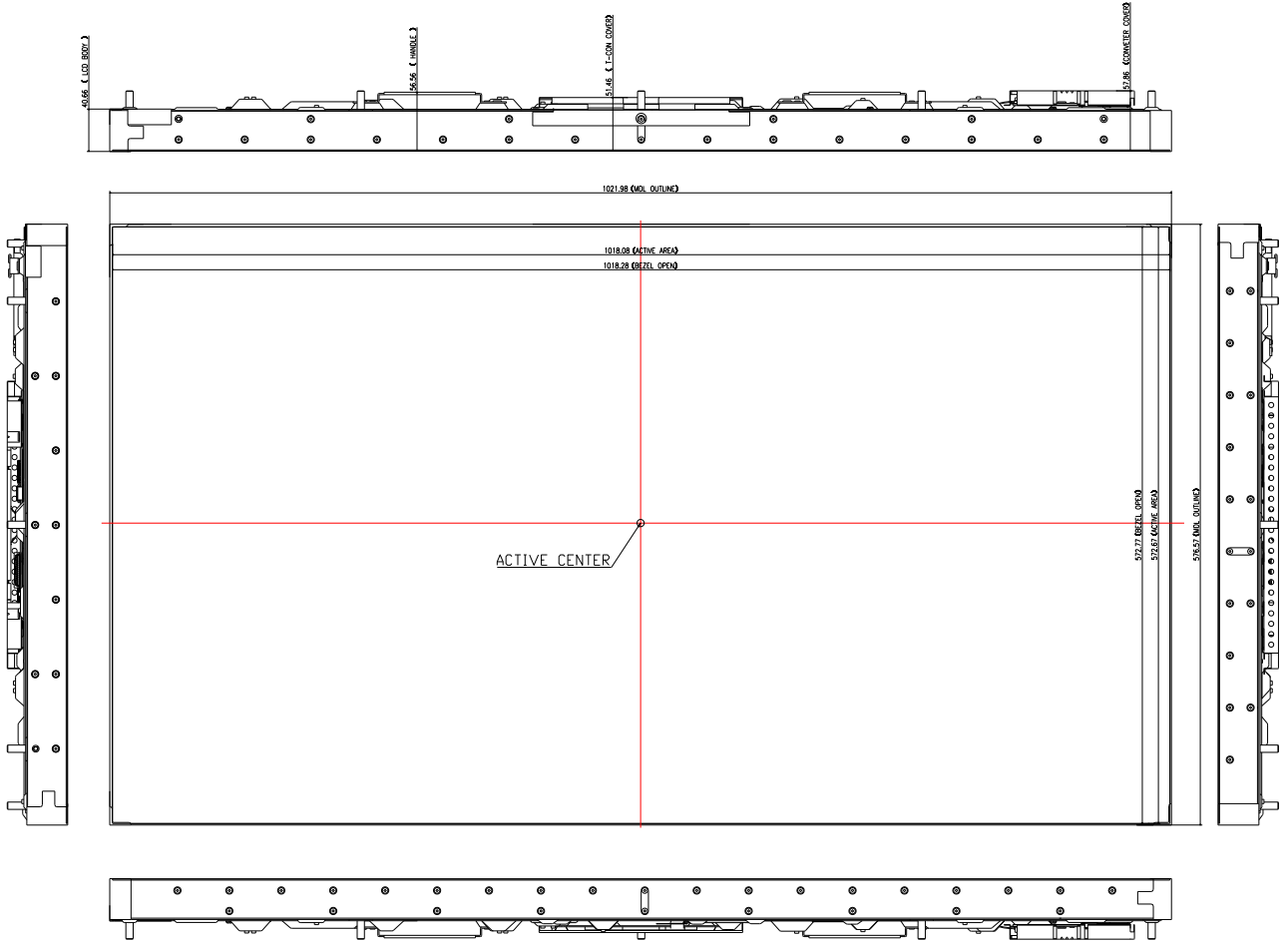
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Figure 4. TFT-LCD Module Outline Dimensions (Front view)



- NOTES:  
 1. UNSPECIFIED DIMENSIONAL TOLERANCES TO BE GRADE3.  
 2. TILT AND A PARTIAL DISPOSITION TOLERANCE OF DISPLAY AREA ARE AS FOLLOW.  
 1) X-DIRECTION: |A-B| < 2.0MM  
 2) Y-DIRECTION: |C-D| < 2.0MM

TOLERANCE TABLE(±)				
DIMENSION	GRADE 1	GRADE 2	GRADE 3	GRADE 4
L ≤ 20	0.05	0.1	0.1	0.2
20 < L ≤ 50	0.1	0.15	0.2	0.25
50 < L ≤ 100	0.15	0.2	0.25	0.3
100 < L ≤ 200	0.2	0.25	0.3	0.5
200 < L	0.25	0.3	0.5	0.8

UNLESS OTHERWISE SPECIFIED

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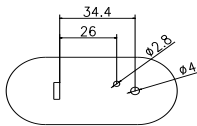
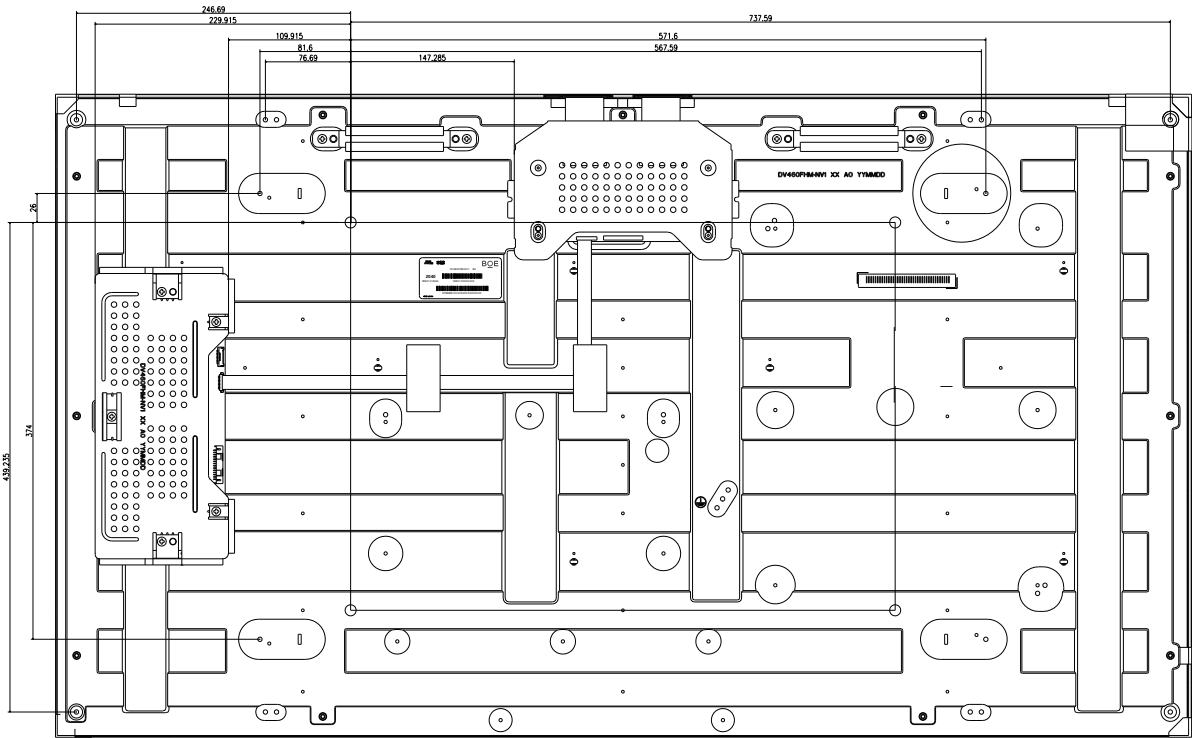
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Figure 5. TFT-LCD Module Outline Dimensions (Back view)



NOTES:  
1. UNSPECIFIED DIMENSIONAL TOLERANCES TO BE GRADE 3.  
2. CN1: IS050-C51B-C39-S CN2~CN3: C10114M1HR0-NH

TOLERANCE TABLE(±)				
DIMENSION	1 GRADE	2 GRADE	3 GRADE	4 GRADE
L ≤ 20	0.05	0.1	0.1	0.2
20 < L ≤ 50	0.1	0.15	0.2	0.25
50 < L ≤ 100	0.15	0.2	0.25	0.3
100 < L ≤ 200	0.2	0.25	0.3	0.5
200 < L	0.25	0.3	0.5	0.8

UNLESS OTHERWISE SPECIFIED