

	PRODUCT GROUP	REV	ISSUE DATE
	TFT-LCD	01	2026.06.26
DV320FHM-NN0 Product Specification Rev. 01 Beijing BOE Display Technology CO.,LTD			
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DBG-RD-2025003-B		A4(210 X 297)	

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REVISION HISTORY

() preliminary specification
(√) Final specification

REV	PAGE	DESCRIPTION OF CHANGES	DATE	PREPARED
00	-	Initial Release	2026.05.07	Zhang Di
01	-	Final Release	2026.06.26	Zhang Di

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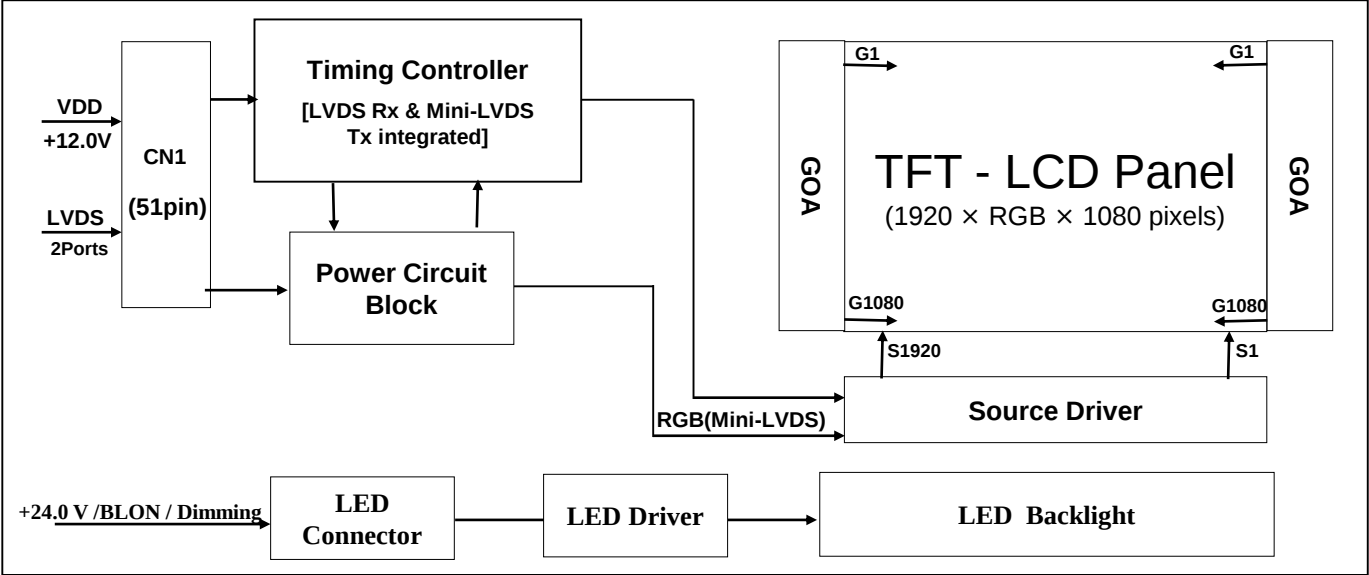
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1.0 GENERAL DESCRIPTION

1.1 Introduction

DV320FHM-NN0 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 32 inch diagonally measured ac tive 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 module 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
- 8-bit color depth, display 16.7M colors
- Wide viewing angle
- DE (Data Enable) only mode
- ADS technology is applied for high display quality
- RoHS compliant
- Reverse Type
- Support 7×24hrs, See chapter 12.7 for details

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1.3 Application

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

1.4 General Specification

< Table 1. General Specifications >

Parameter	Specification	Unit	Remarks
Active area	698.4(H) × 392.85 (V)	mm	
Number of pixels	1920(H) ×1080(V)	pixels	
Pixel pitch	121.25(H)×RGB×363.75(V)	um	
Pixel arrangement	Pixels RGB Vertical stripe		
Display mode	Normally Black		
Display colors	16.7M	colors	Real 8bit
Brightness	500(Typ.)	%	At center point
Power Consumption	41.7(Typ.)	Watt	
Frame Rate	60 (Typ.)	Hz	
Dimensional Outline	716.2(H) × 415.05(V)	mm	Dimensional outline
MDL Thickness	8.95(Body)/25.35(Mount)	mm	
Weight	4000(Typ.)	g	
Surface Treatment	Front Polarizer: AG1, 3H		
Possible Display Type	Landscape and Portrait Enabled		

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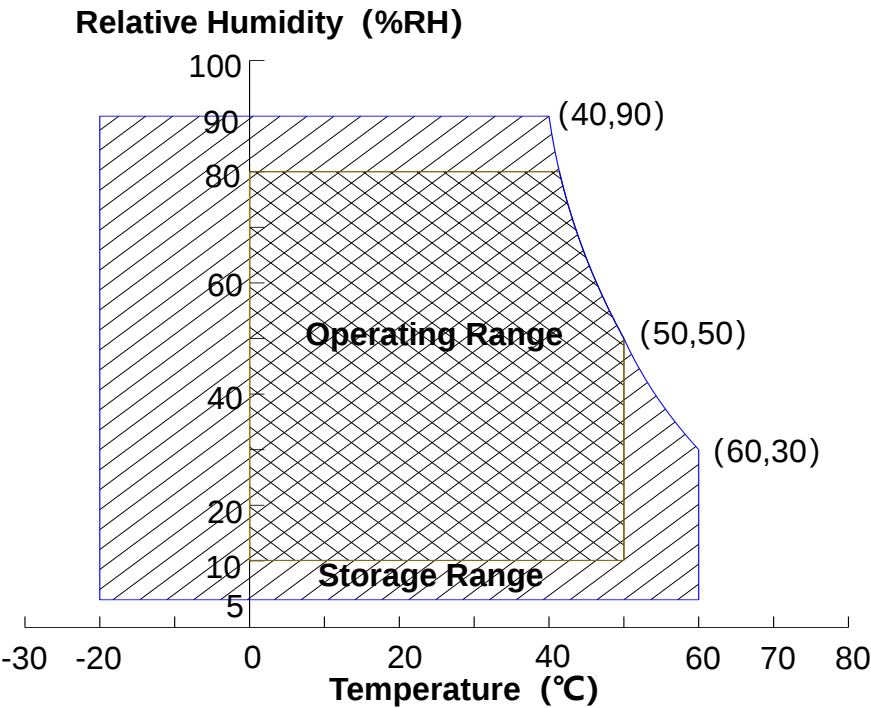
2.0 ABSOLUTE MAXIMUM RATINGS

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	VDD	VSS-0.3	13.5	V	Ta = 25 °C
	VBLU	VSS-0.3	26.7	V	
CMOS/TTL Input Voltage	DVDD	VSS-0.3	+3.6	V	
Operating Temperature	T _{OP}	0	+50	°C	Note 1、 2
	T _{SUR}	-	+60	°C	
Storage Temperature	T _{ST}	-20	+60	°C	
Operating Ambient Humidity	Hop	10	80	%RH	
Storage Humidity	Hst	5	90	%RH	

Note 1 : Temperature and relative humidity range are shown in the figure below.



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3.0 ELECTRICAL SPECIFICATIONS

3.1 TFT LCD Open Cell

< Table 3-1. 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	Note 1
Power Supply Current		IDD	-	330	630	mA	Note 2
Power Consumption		PDD	-	4	7.6	Watt	
Rush current		IRUSH	-		3.0	A	Note 3
LVDS Interface	Differential Input High Threshold Voltage	VLVTH		-	+100	mV	
	Differential Input Low Threshold Voltage	VLVTL	-100	-	-	mV	
	Input Differential Voltage	VID	100	-	600	mV	
	Common Input Voltage	VLVC	1.0	1.2	1.4	V	
CMOS Interface	Input High Threshold Voltage	VIH	2.7	-	3.3		
	Input Low Threshold Voltage	VIL	0	-	0.6	V	

Note 1：The supply voltage ripple should not exhibit over damped ringing.

Note 2：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,

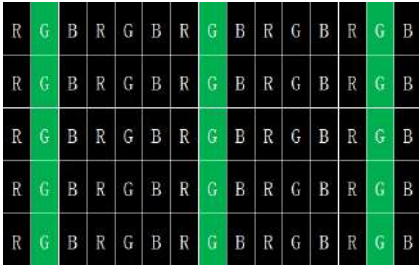
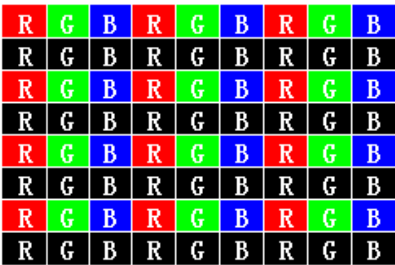
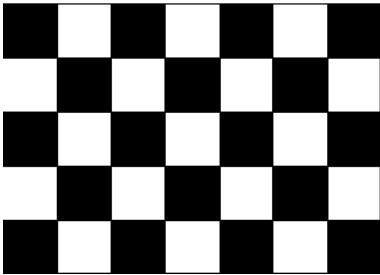
Frame rate f_v=60Hz and Clock frequency = 74.25MHz.

Test Pattern of power supply current

a) Typ：Mosaic 7X5 (L0/L255)

b) Max：Horizontal 1 Line (L0/L255)

c) Flicker Pattern



Note 3：The duration of rush current is about 2ms and rising time of Power Input is 0.5 ms(min)

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3.0 ELECTRICAL SPECIFICATIONS

3.2 IC Characteristics

< Table 3-2. TCON Characteristics >

Parameter	Symbol	Values			Unit	Remark
		Min	Typ	Max		
TCON Surface Temperature	T _{TS}	-	-	100	°C	Note

Note : Any point on the TCON surface must be less than 100°C under 25 °C ambient.

Note : This test condition is based on BOE module.

< Table 3-3. Driver Characteristics >

Parameter	Symbol	Values			Unit	Remark
		Min	Typ	Max		
Driver Surface Temperature	T _{DS}	-	-	125	°C	Note

Note : Any point on the driver surface must be less than 125 °C under 25 °C ambient.

Note : This test condition is based on BOE module.

< Table 3-4. PMIC Characteristics >

Parameter	Symbol	Values			Unit	Remark
		Min	Typ	Max		
PMIC Surface Temperature	T _{PS}	-	-	100	°C	Note

Note : Any point on the PMIC surface must be less than 100 °C under 25 °C ambient.

Note : This test condition is based on BOE module.

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3.0 ELECTRICAL SPECIFICATIONS

3.3 Backlight Unit

< Table 3-5. Backlight Unit Electrical Specifications > [Ta =25±2 °C]

Parameter	Symbol	Values			Unit	Remark
		Min	Typ	Max		
Power Supply Input Voltage	VIN	21.6	24	26.4	Vdc	
Power Supply Ripple Voltage	VRP	-	-	600	mV	
Power Supply Current	IDD	-	1.57	1.92	A	Brightness Max
Power Consumption	PDD	-	37.7	46	Watt	
Backlight On/Off Control Voltage	V _{BLON} (off)	0	-	0.8	V	
	V _{BLON} (on)	2.5	-	5	V	
DC Dimming Control	High Level	-	-	5	V	Brightness Min
	Low Level	0	-	-	V	Brightness Max
LED luminous degradation Time	-	50000	-	-	Hrs	Note 1

Note 1 : The LED luminous degradation 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

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4.0 INTERFACE CONNECTION

4.1 Open Cell Input Signal & Power

- LVDS Connector : IS050-C51B-C39-S (UJU).

< Table 4-1. Open Cell Input Connector Pin Configuration >

Pin No	Symbol	Description	Pin No	Symbol	Description
1	GND	Ground	16	RO2N	Odd LVDS Negative data differential input.
2	SDA	I2C Data for BOE Use Only	17	RO2P	Odd LVDS Positive data differential input.
3	SCL	I2C Clock fo BOE Use Only	18	GND	Ground
4	NC	No Connection	19	ROCLKN	Odd LVDS Negative CLK differential input.
5	NC	No Connection	20	ROCLKP	Odd LVDS Positive CLK differential input.
6	NC	No Connection	21	GND	Ground
7	LVDS_S ELECT	Low (Default) or NC: VESA; High: JEIDA	22	RO3N	Odd LVDS Negative data differential input.
8	NC	No Connection	23	RO3P	Odd LVDS Positive data differential input.
9	NC	No Connection	24	NC	No Connection
10	NC	No Connection	25	NC	No Connection
11	GND	Ground	26	NC	No Connection
12	RO0N	Odd LVDS Negative data differential input.	27	NC	No Connection
13	RO0P	Odd LVDS Positive data differential input.	28	RE0N	Even LVDS Negative data differential input.
14	RO1N	Odd LVDS Negative data differential input.	29	RE0P	Even LVDS Positive data differential input.
15	RO1P	Odd LVDS Positive data differential input.	30	RE1N	Even LVDS Negative data differential input.

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Pin No	Symbol	Description	Pin No	Symbol	Description
31	RE1P	Even LVDS Positive data differential input.	42	NC	No Connection
32	RE2N	Even LVDS Negative data differential input.	43	NC	No Connection
33	RE2P	Even LVDS Positive data differential input.	44	GND	Ground
34	GND	Ground	45	GND	Ground
35	RECLKN	Even LVDS Negative CLK differential input.	46	GND	Ground
36	RECLKP	Even LVDS Positive CLK differential input.	47	NC	No Connection
37	GND	Ground	48	VCC	+12V
38	RE3N	Even LVDS Negative data differential input.	49	VCC	+12V
39	RE3P	Even LVDS Positive data differential input.	50	VCC	+12V
40	NC	No Connection	51	VCC	+12V
41	NC	No Connection			

Notes : 1. NC(Not Connected) : This pins are only used for BOE internal operations.
2. Input Level of LVDS signal is based on the EIA-644 Standard.

Rear view of LCM



BIST Pattern

PT1:Black (2sec)	PT2:White (2sec)	PT3:Red (2sec)	PT4:Green (2sec)	PT5:Blue (2sec)

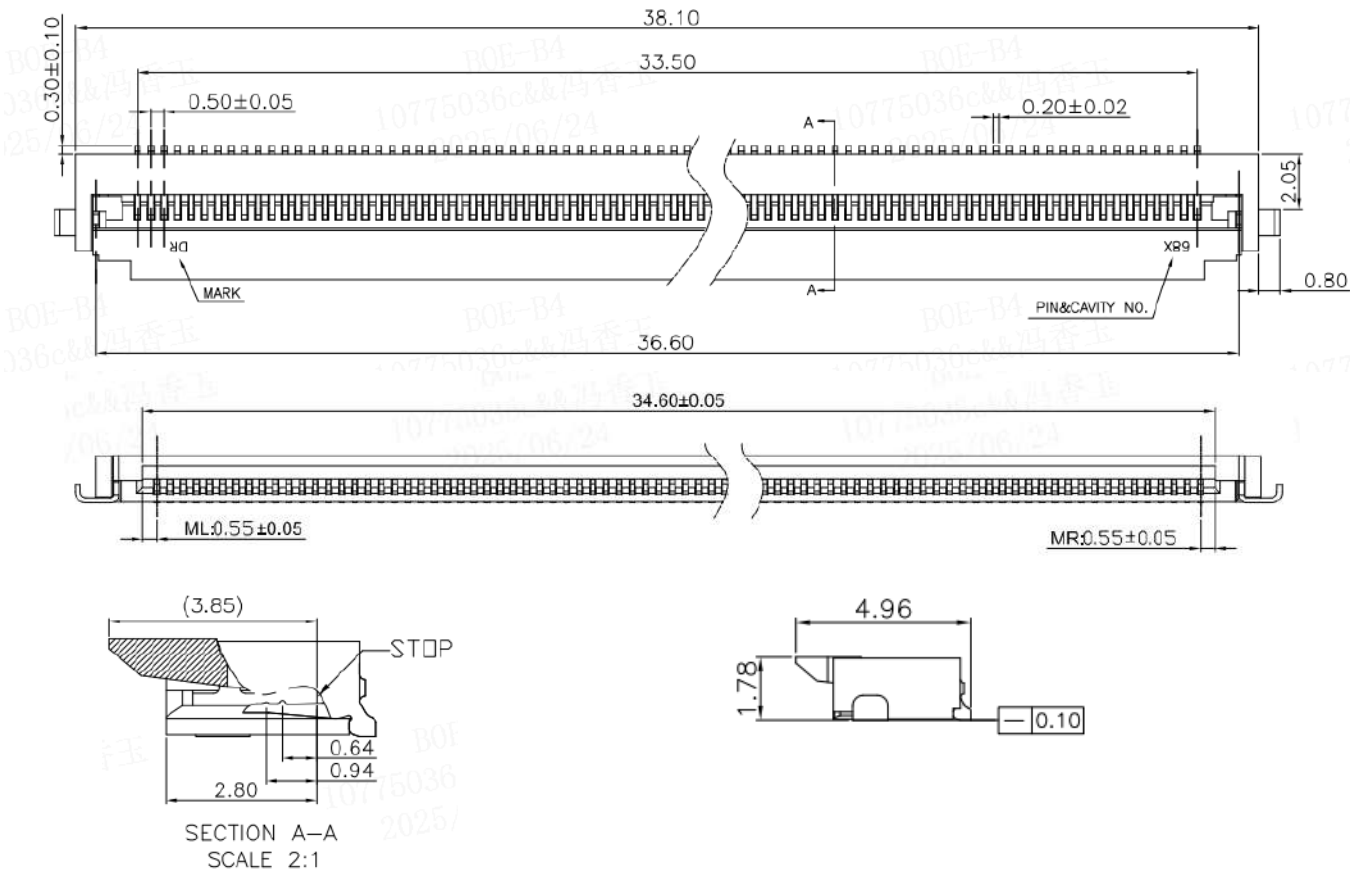
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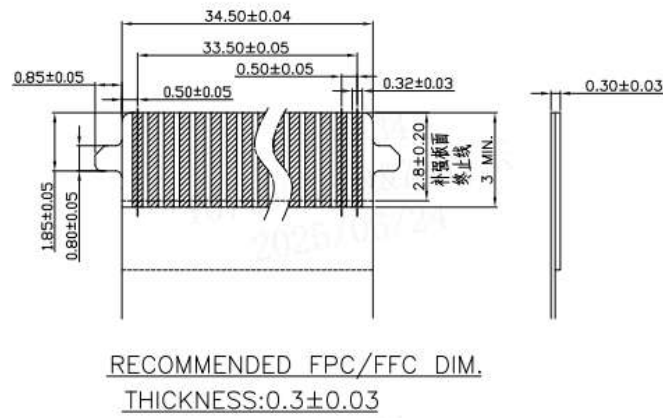
4.2 Dimension

TCON Board Input Connector & FFC Drawing

-68pin Connector Drawing-FC0568-L3970W496H180-N01



-68pin FFC Drawing

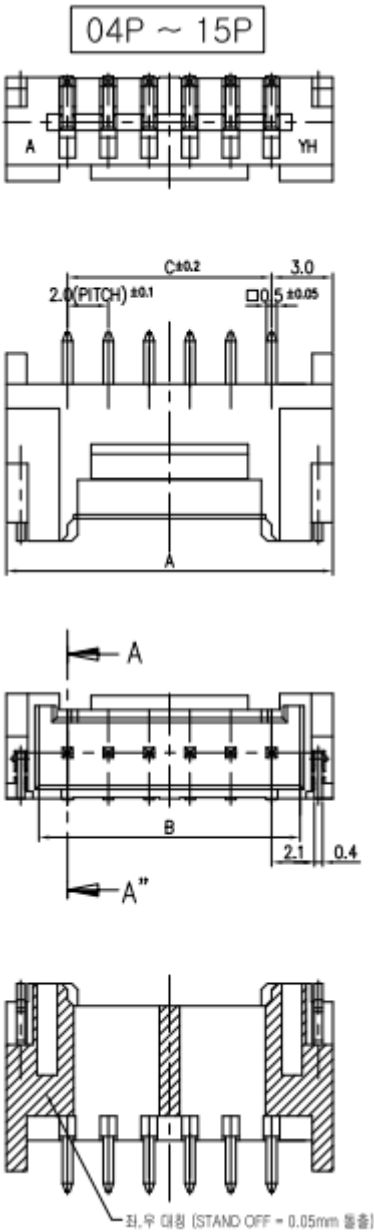


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4.2 Dimension

-5pin Connector



Circuits	Part NO	A	B	C
2	20037WR-H02	8.00	4.75	2.00
3	20037WR-H03	10.0	6.75	4.00
4	20037WR-H04	12.0	8.75	6.00
5	20037WR-H05	14.0	10.75	8.00
6	20037WR-H06	16.0	12.75	10.0
7	20037WR-H07	18.0	14.75	12.0
8	20037WR-H08	20.0	16.75	14.0
9	20037WR-H09	22.0	18.75	16.0
10	20037WR-H10	24.0	20.75	18.0
11	20037WR-H11	26.0	22.75	20.0
12	20037WR-H12	28.0	24.75	22.0
13	20037WR-H13	30.0	26.75	24.0
14	20037WR-H14	32.0	28.75	26.0
15	20037WR-H15	34.0	30.75	28.0

- NOTES.
- 1.GENERAL TOLERANCE : ± 0.3
 - 2.MATING PARTS :
 - HOOK=12505LR.
 - HOUSING = SMH200
 - TERMINAL = YST200
 3. 형 명 : 20037WR-HNN (*)

COLOR	
표시없음	--- NATURAL
(WT)	----- WHITE
(BK)	----- BLACK
(BL)	----- BLUE
(RE)	----- RED
(YE)	----- YELLOW
(BR)	----- BROWN

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4.3 BLU Input Signal & Power

-Connector : A2001WR-S-XP-LCP (Manufactured by Changjiang Connectors Co.,LTD.)

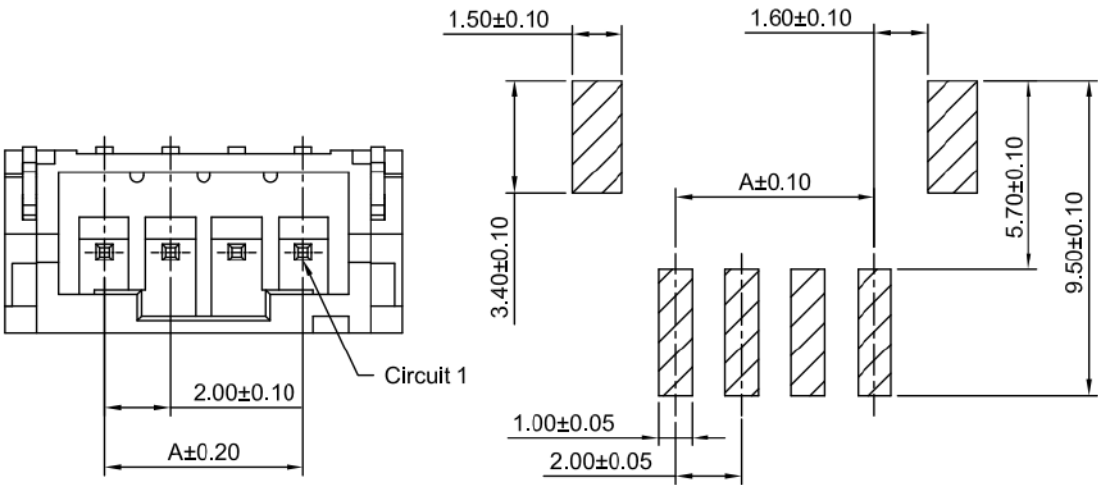
< Table 4-2. Input Connector Pin Configuration for CN2>

Pin No	Symbol	Description	Pin No	Symbol	Description
1	VIN	Operating Voltage Supply, +24V DC regulated	8	GND	Ground and Current Return
2	VIN	Operating Voltage Supply, +24V DC regulated	9	GND	Ground and Current Return
3	VIN	Operating Voltage Supply, +24V DC regulated	10	GND	Ground and Current Return
4	VIN	Operating Voltage Supply, +24V DC regulated	11	NC	No Connection
5	VIN	Operating Voltage Supply, +24V DC regulated	12	BLON	BLU On-Off control: DC 0 to 0.8V off, DC 2.5 to 3.3V On
6	GND	Ground and Current Return	13	Dimming	Dimming Control DC 0 to 5V 0V: Brightness Max 5V: Brightness Min
7	GND	Ground and Current Return	14	NC	No Connection

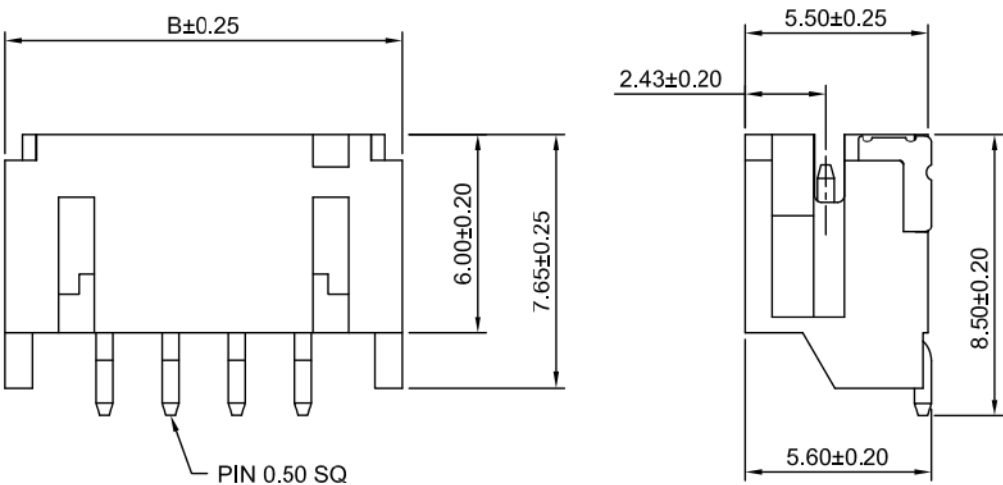
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-Connector : A2001WR-S-14P-LCP (Manufactured by Changjiang Connectors Co.,LTD.) .



P.C.B LAYOUT



Circuits	Dimensions(mm)		Circuits	Dimensions(mm)	
	A	B		A	B
2P	2.00	8.00	10P	18.00	24.00
3P	4.00	10.00	11P	20.00	26.00
4P	6.00	12.00	12P	22.00	28.00
5P	8.00	14.00	13P	24.00	30.00
6P	10.00	16.00	14P	26.00	32.00
7P	12.00	18.00	15P	28.00	34.00
8P	14.00	20.00	16P	30.00	36.00
9P	16.00	22.00			

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5.0 SIGNAL TIMING SPECIFICATION

5.1 LVDS Interface

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

< Table 5-1. LVDS Input Data Mapping >

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

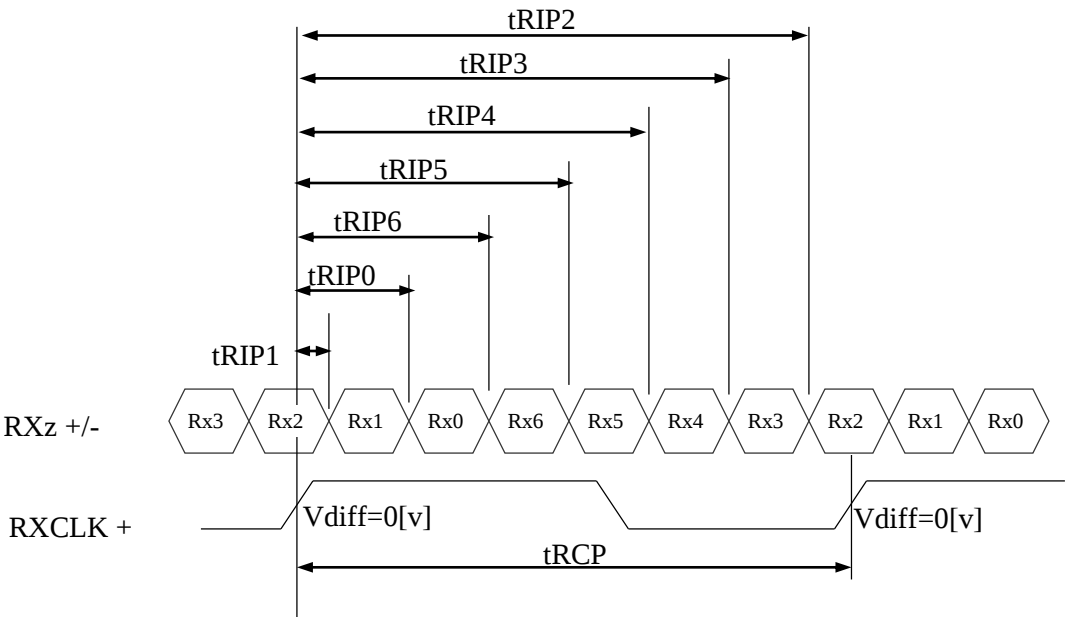
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5.2 LVDS Rx Interface Timing Parameter

The specification of the LVDS Rx interface timing parameter is shown in Table 5-2.

<Table 5-2. LVDS Rx Interface Timing Specification>

Item	Symbol	Min	Typ	Max	Unit	Remark
CLKIN Period	tRCP	10	T	25	nsec	
Receiver Data Input Margin	tRMG	-0.40	-	+0.40	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-)

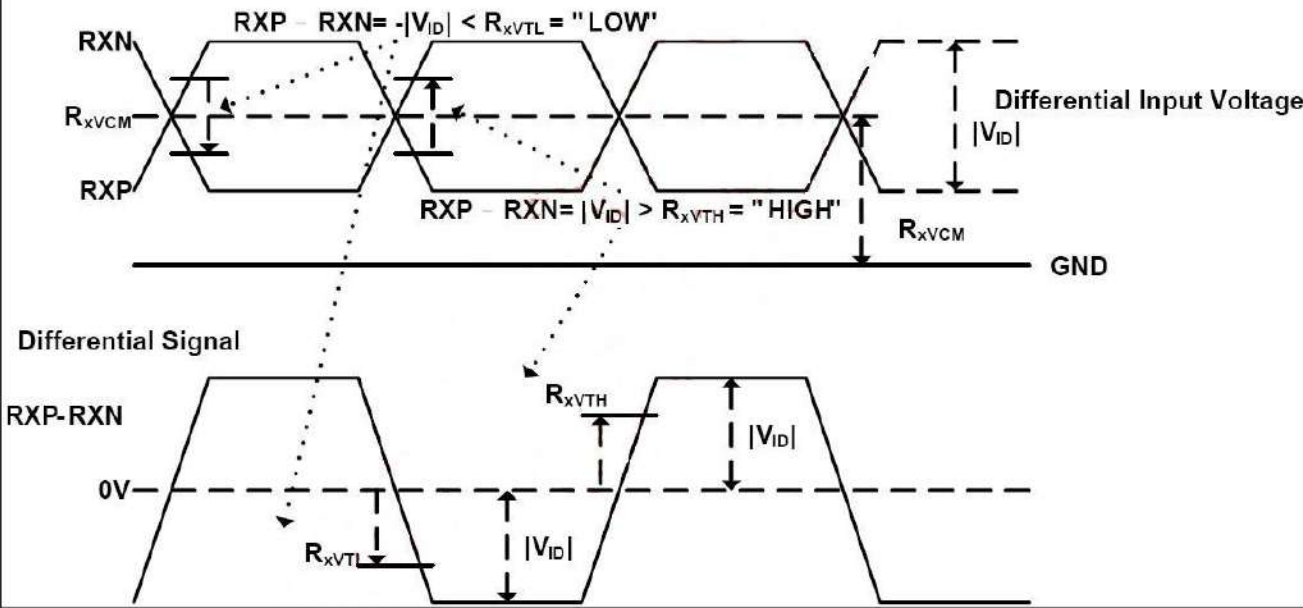
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5.3 LVDS Receiver Differential Input (DC Characteristics)

< Table 5-3. LVDS Rx DC Characteristics >

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Differential Input High Threshold Voltage	VTH	-	-	+100	mV	VCM=1.2V
Differential Input Low Threshold Voltage	VTL	-100	-	-	mV	
Differential Input Common Mode Voltage	VCM	1.0	1.2	1.4	V	
Differential Input Voltage	VID	100	-	600	mV	

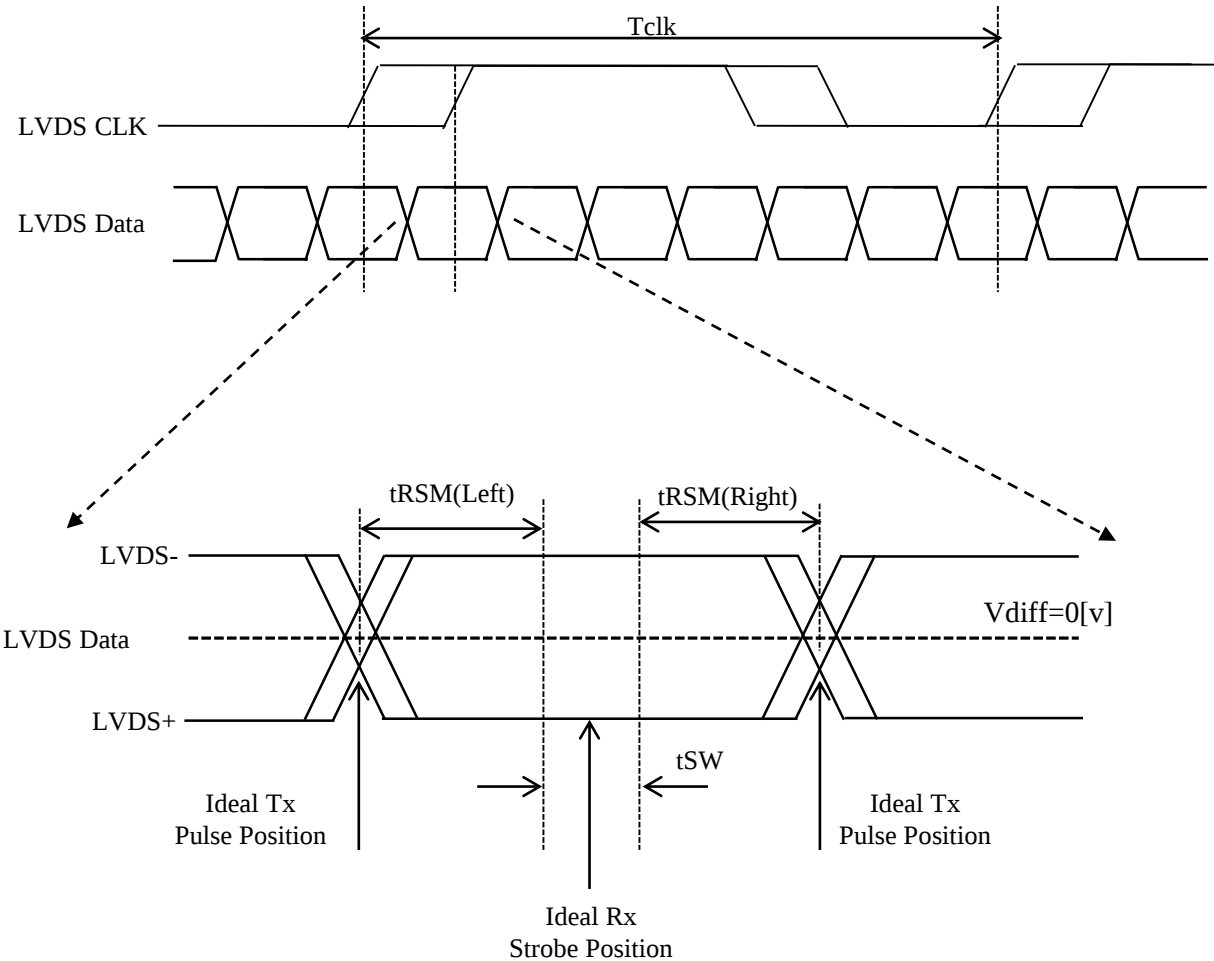
Single end Signals



5.4 LVDS Receiver Differential Input (AC Characteristics)

< Table 5-4. LVDS Rx AC Characteristics >

Parameter	Symbol	Min	Typ	Max	Unit	Notes
LVDS Strobe Width	tSW	200	-	-	ps	Vcm=1.2V VID = 400mV @65MHz
LVDS Receiver Skew Margin	trSM	-	-	400	ps	



Note:
RSM: Receiver Skew Margin
SW: Strobe Width (Setup and Hold time; TCON Internal data sampling window)

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5.5 Timing Parameters

< Table 5-5. Timing Table >

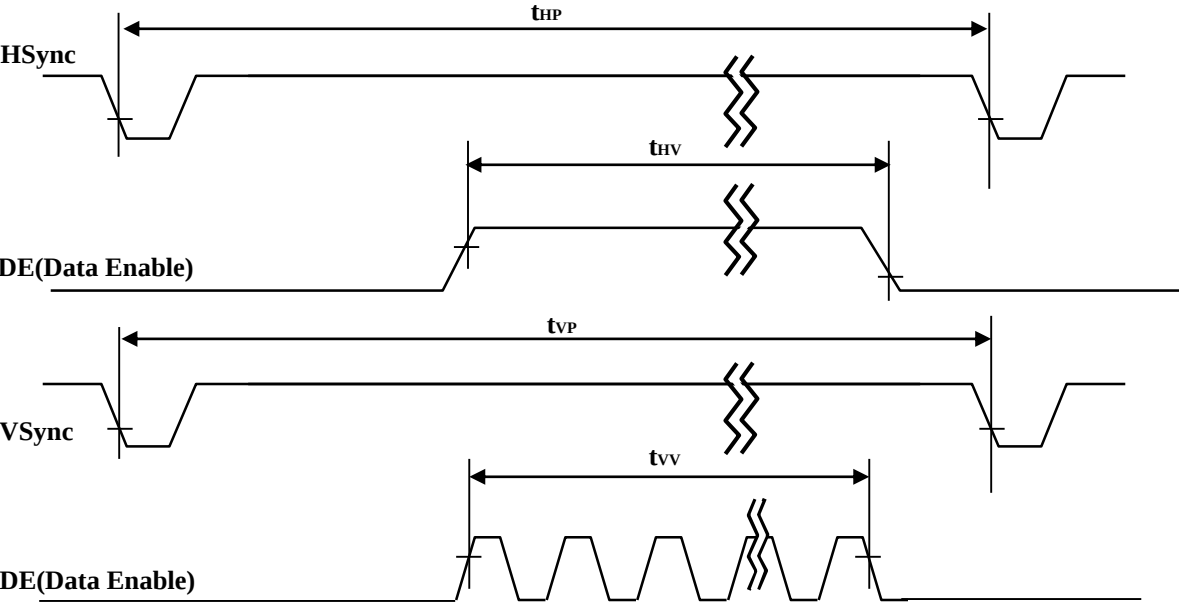
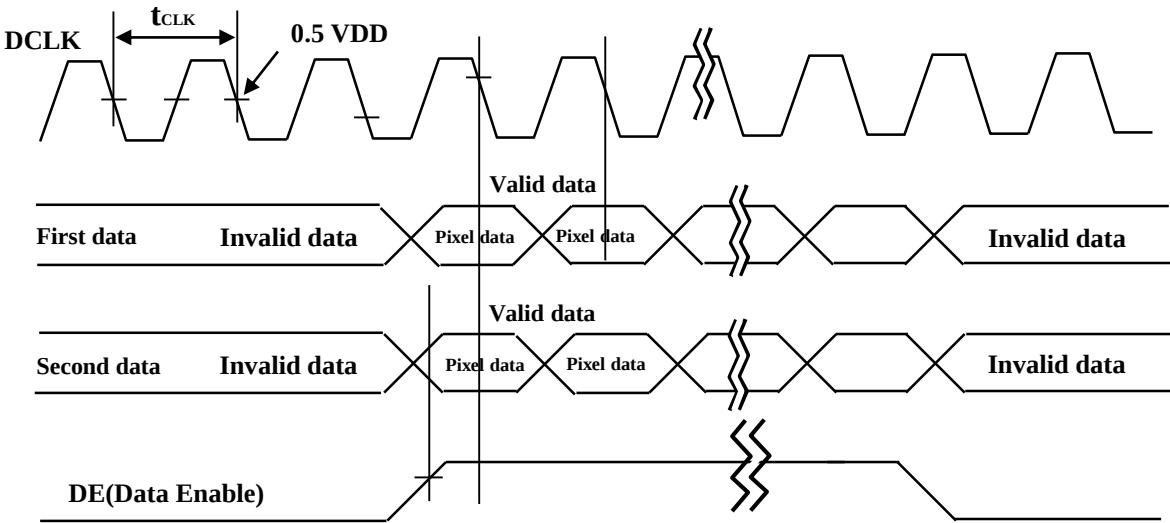
Item	Symbols		Min	Typ	Max	Unit	Note
DCLK	Period	tCLK	10.36	13.47 (10.77)	17.24	ns	
	Frequency	-	58	74.25 (92.8)	96.5	MHz	
Horizontal	Horizontal Period	tHP	1060	1100	1200	tCLK	
	Horizontal Valid	tHV	960			tCLK	
	Horizontal Blank	tHB	100	140	240	tCLK	
	Frequency	fH	56	67.5 (84.5)	87.8	KHz	
Vertical	Vertical Period	tVP	1100	1125	1149	tHP	
	Vertical Valid	tVV	1080			tHP	
	Vertical Blank	tVB	20	45	69	tHP	
	Frequency	fV	47	60 (75)	78	Hz	

- Note：
- While operation, DE signal should be have the same cycle. The input of HSYNC & VSYNC signal does not have an effect on normal operation (DE Only Mode, but the signals of Hsync and Vsync must be inputted even though this TCON is operated at DE Only Mode.
 - Best operation clock frequency is 74.25 Mhz.
 - Frequency = [H Total] * [V Total] * [vertical Frame rate]
H Total, V Total and Frame rate should operate within the range between Frequency_Min and Max
 - Except Best operation clock frequency, FOS(Flicker & Brightness & Crosstalk, Etc.) are not guaranteed.
 - Main frequency Max is 96.5Mhz without spread spectrum
 - When operating in non-VRR mode, signals from the mainboard shoud remain consistently stable with no abnormalities such as signal interruptions, frame rate jumps, Active/Blank transitions, and or noise.

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5.6 Signal Timing Waveform



Note: While operation, DE signal should be have the same cycle and continuous;

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

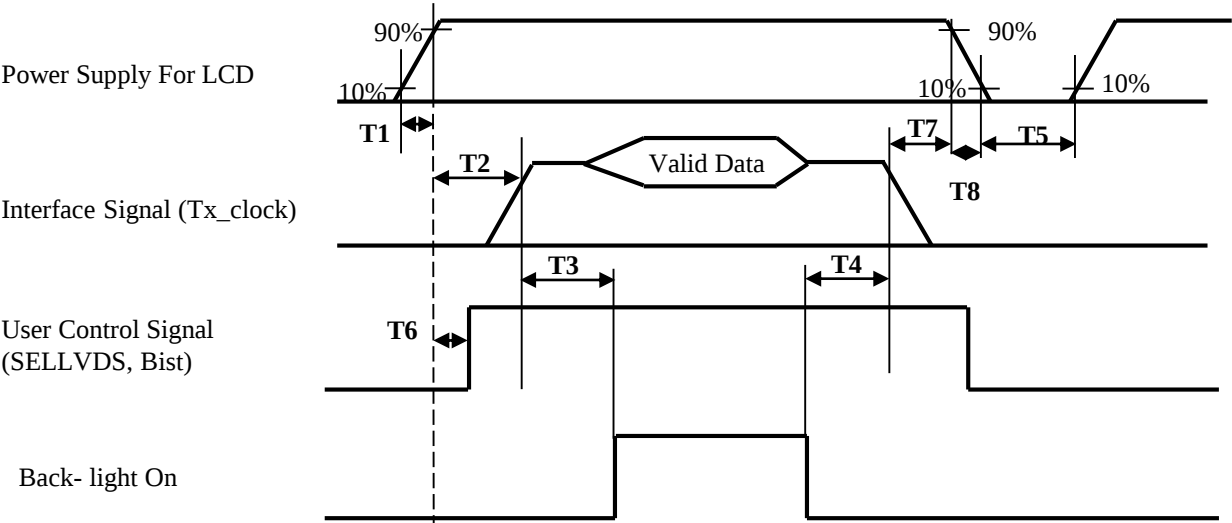
< Table 5-6. Input Signal and Display Color Table >

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
	Δ	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
	Δ	↑								↑								↑							
	▽	↓								↓								↓							
	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
	Δ	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
	Δ	↑								↑								↑							
	▽	↓								↓								↓							
	Brighter	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
	▽	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Gray Scale of Blue	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Δ	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
	Δ	↑								↑								↑							
	▽	↓								↓								↓							
	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
	Δ	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
	Δ	↑								↑								↑							
	▽	↓								↓								↓							
	Brighter	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	1	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

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6.0 Power Sequence

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



< Table 6. Sequence Table >

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

- Note 1: Even though T1 is over the specified value, there is no problem if the rush current is within Spec.
- Note 2: When the power supply VDD is 0V, keep the level of input signals on the low or high impedance;
 ※ 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 3: 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 4: T5 should be measured after the Module has been fully discharged between power off and on period
- Note 5: If the on time of signals (Interface signal and user control signals) precedes the on time of Power (VLCD),it will be happened abnormal display. When T6 is NC status, T6 doesn’t need to be measured
- Note 6: T8: Voltage of VDD must decay smoothly after power-off , there should be none re-bounding voltage. (customer system decide this value)
- Note 7.The supply voltage should not exhibit steps or drops.
- Note 8.If IIC lines on the mainboard are pulled up, they should be powered after VDD and all power supplies shoud decrease to 0V during shutdown.

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7.0 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 $\theta_{\varnothing=0}$ ($=\theta_3$) as the 3 o’clock direction (the “right”), $\theta_{\varnothing=90}$ ($=\theta_{12}$) as the 12 o’clock direction (“upward”), $\theta_{\varnothing=180}$ ($=\theta_9$) as the 9 o’clock direction (“left”) and $\theta_{\varnothing=270}$ ($=\theta_6$) as the 6 o’clock direction (“bottom”). While scanning θ and/or $\varnothing$, the center of the measuring spot on the Display surface shall stay fixed. The measurement shall be executed after 30 minutes warm-up period. VDD shall be 12.0V at 25℃. Optimum viewing angle direction is 6 ’clock.

< Table 7. Optical Table >

[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.	
Contrast ratio	CR			900:1	1200:1	-		Note 2
Reproduction of color	White	W_x	$\Theta = 0^\circ$ (Center) Normal Viewing Angle,	TYP. - 0.03	0.28	TYP. + 0.03		Note 3
		W_y			0.29			
	Red	R_x			0.646			
		R_y			0.338			
	Green	G_x			0.318			
		G_y			0.611			
	Blue	B_x			0.152			
		B_y			0.058			
Brightness		Lv		400	500	-	nit	
Color Gamut		NTSC		68	72		%	@CIE1931
White luminance uniformity		δ_{white}	9Point	75	80		%	Note 5
Response Time	G to G	T _g		-	10	12	ms	Note 4
Gamma Scale				2.0	2.2	2.4		

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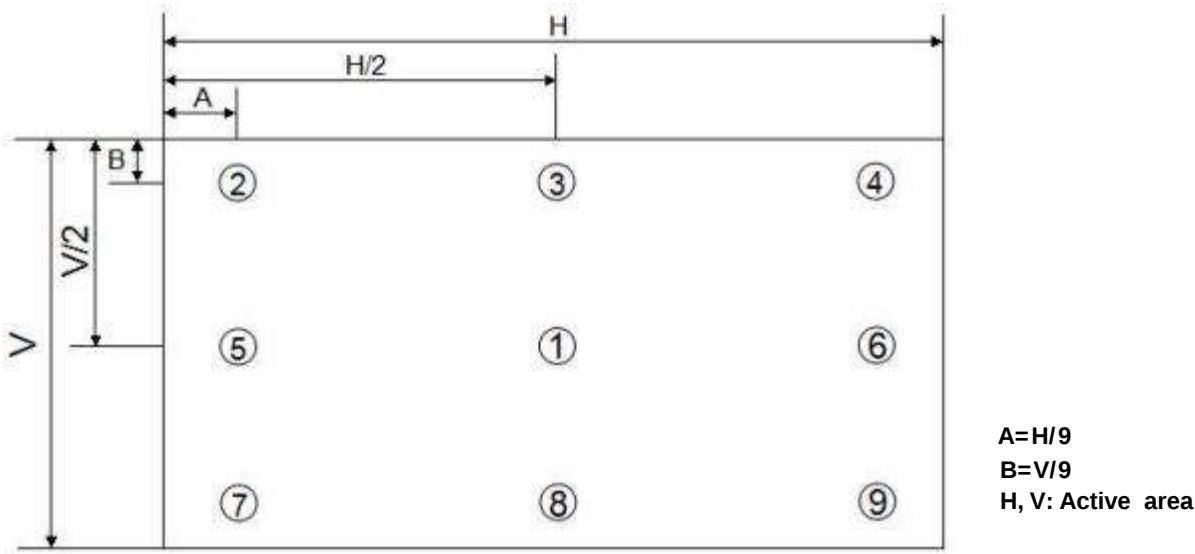
- Note :
- Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing are determined for the horizontal or 3, 9 o'clock direction and the vertical or 6, 12 o'clock direction with respect to the optical axis which is normal to the LCD surface.
 - Contrast measurements shall 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.

$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$
 - The color chromaticity coordinates specified in Table 7.shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the panel. The chromaticity coordinates are based on BOE backlight.
 - 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 $f_v = 60\text{Hz}$ to optimize. Each time in below table shall be measured by switching the input signal for “any level of gray(bright)”and “any level of gray(dark)”

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

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Note 5. δ_{white} = Minimum (Lon1,Lon2,..., Lon N) / Maximum (Lon1,Lon2,...,Lon N)*100(%), Where Lon1 to Lon N are the luminance with all pixels displaying white .



9 points for Brightness measure @ H,V: Active Area

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8.0 MECHANICAL CHARACTERISTICS

8.1 Dimensional Requirements

Figure 3(located in Appendix) shows mechanical outlines for the Module DV320FHM-NN0. Other parameters are shown in Table 8.

< Table 8-1. Dimensional Parameters >

Parameter	Specification	Unit
Dimensional Outline	716.2(H)*415.05(V)*8.95(B)	mm
MDL Thickness	8.95(Body)/25.35(Mount)	mm
Weight	4000(Typ.)	g
Active area	698.4(H)*392.85(V)	mm
Pixel pitch	121.25(H)×RGB×363.75(V)	um
Number of pixels	1920(H) ×1080(V)(1 pixel = R + G + B dots)	pixels

8.2 Mounting

See FIGURE 3. (shown in Appendix)

8.3 Anti-Glare and Polarizer Hardness.

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

< Table 8-2. Anti-Glare and Polarizer Hardness>

Items	Min	Typ	Max	Unit.	Remark
Haze	-	1	2	%	
Hardness	3H	-	-	-	Note 1

Note 1: Hardness is tested at 500G weight pressure.

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9.0 RELIABILITY TEST

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

< Table 9. Reliability Test Parameters >

No	Test Items	Conditions	
1	High temperature storage test	Ta = 60 °C, 240 hrs	
2	Low temperature storage test	Ta = -20 °C, 240 hrs	
3	High temperature & high humidity operation test	Ta = 50 °C, 80%RH, 240hrs	
4	High temperature operation test	Ta = 50 °C, 240hrs	
5	Low temperature operation test	Ta = -0 °C, 240hrs	
6	Thermal shock	Ta = -20 °C ↔ 60 °C (0.5 hr), 100 cycle	
7	Vibration test (non-operating)	Frequency	10 ~ 300 Hz, Sweep rate 30 min
		Gravity /AMP	1.05 G
		Period	X, Y, Z 30 min
8	Electro-static discharge test (non-operating)	Air : 150 pF, 330Ω, 15 KV Contact : 150 pF, 330Ω, 8 KV	

Note 1: The test result shall be evaluated after the sample has been left at room temperature and humidity for 1 hours. These defects can’t be accepted:1.Air bubble 2.Seal leak 3.Non-display 4.Missing segments 5.Glass crack

Note 2: In the ESD test process, LCD may appear abnormal phenomenon, can be restored after restart.

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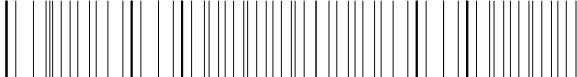
10.0 PRODCUT SERIAL NUMBER

DP/N

DV320FHM-NN0

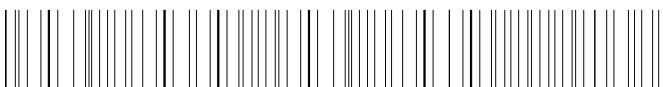
B4

XXXXXX

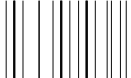


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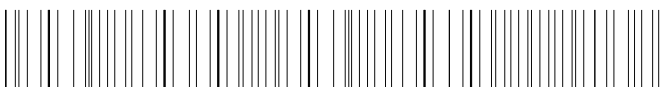
XXXXXXXXXXXXXXXXXXXX



REV A00



XX-XXXXXX-XXXXX-XXX-XXXX



MADE IN CHINA

BOE

CCO

RoHS Compliant

US

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)

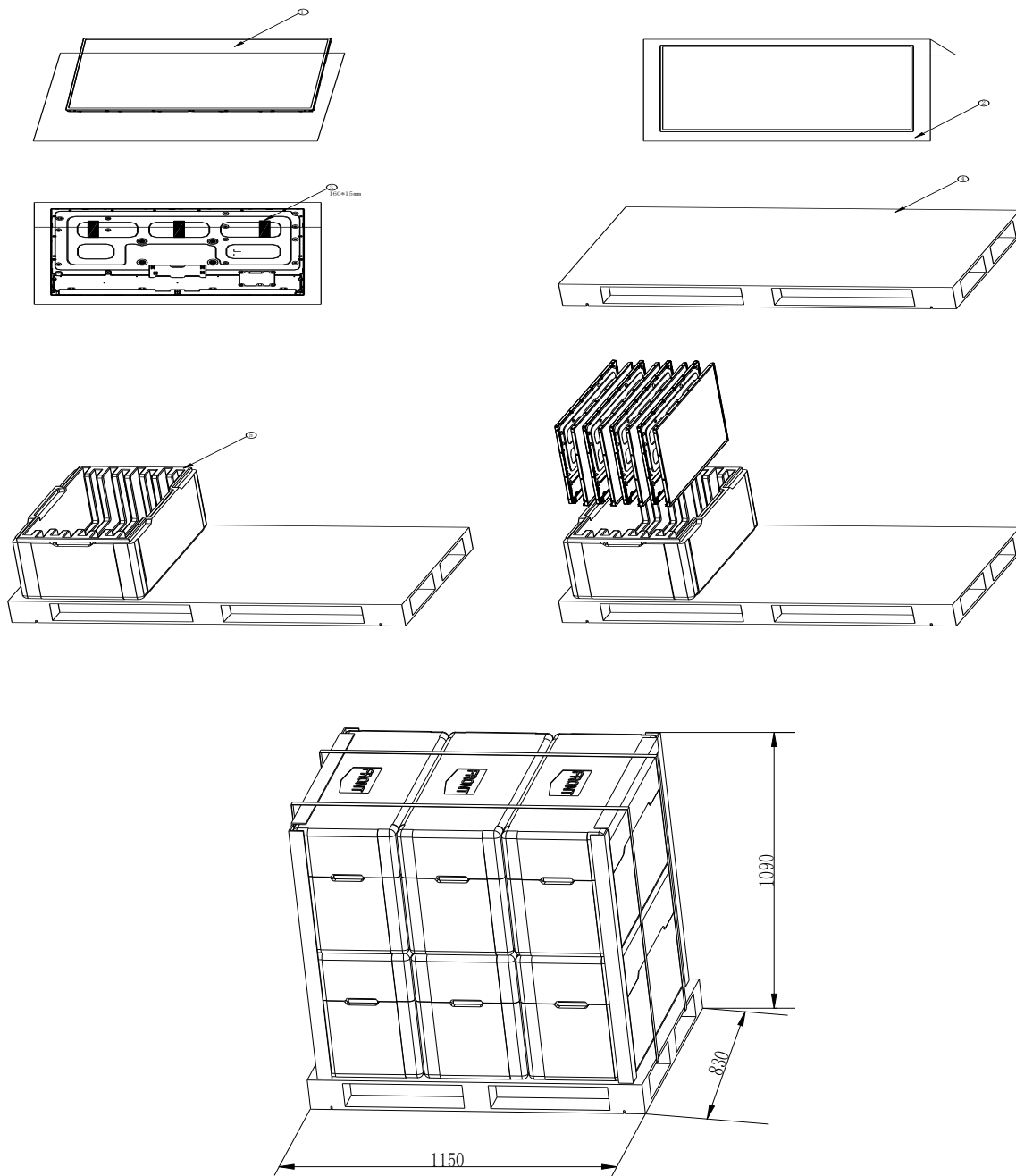
6. Internal Use

7. Serial Number

11.0 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.

11.1 Packing Method



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11.2 Packing Note

- (1) 8LCD modules / 1 Box
- (2) Box dimensions: 805(W) x 360 (D) x 485 (H)mm
- (3) Weight: approximately 36Kg (8 modules per box)

11.3 Box Label

- Label Size : 100mm (L) × 50mm (W)
- Contents
 - Model : DV320FHM-NN0
 - Q`ty : 8 Q`ty in one box
 - Serial No. : Box Serial No.
 - Date : Packing Date

BEIJING BOE DISPLAY TECHNOLOGY CO., LTD.

MODEL: XXXXXXXX-XXX

Q'TY: XXX

SERIAL NO: XXXXXXXXXXXXX

DATE: XXXX.XX.XX






XXXX

Internal CODE

Digit Code	1	2	3	4	5	6	7	8	9	10	11	12	13
Code	S	L	S	A	1	6	3	D	0	0	1	A	1
Description	Products GB N		Grad e	Line	Year		Mont h	Revision Code	Serial No.				

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12.0 PRECAUTIONS

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

12.1 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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12.2 Operating Precautions

- Do not connect or disconnect the cable to/from the LCD 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 Moudle degradation, so DC drive should be avoided.
- The LCD Module 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 your 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 LCD 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.
- 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.
- Long side LED Bar design is recommended when using E-LED type Back Light.
- For long-term lighting products, it is recommended to shut down periodically.
- If the product is used for a long time under the condition of 7*24 hrs, it is strongly recommended to contact BOE for filed application engineering advice.
- Long time and large angle forward use or unconventional use, It is strongly recommended to contact BOE for filed application engineering advice.
- Products exposed to low temperature environment for a long time, need to carry out necessary protection, low temperature environment is usually refrigerators, vending machine Etc...

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12.3 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.

12.4 Precautions for Strong Light Exposure

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

12.5 Precautions for Storage

A. Atmosphere Requirement

ITEM	UNIT	MIN	TYP	MAX
Storage Temperature	(°C)	5	25	40
Storage Humidity	(%rH)	40	50	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.

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12.6 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.

12.7 Appropriate Condition for Commercial Display

-Generally large-sized LCD module 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 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 panel’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 LCD 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, highlight, 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. Static information display recommended to use with moving image.

- Cycling display between 5 minutes' information(static) display and 10 seconds' moving image.

b. Background and character (image) color change

- Use different colors for background and character, respectively.

- Change colors themselves periodically.

c. 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.
5. LCD suggest be turned clockwise based on front view when used in portrait mode.

12.8 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.

• 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.

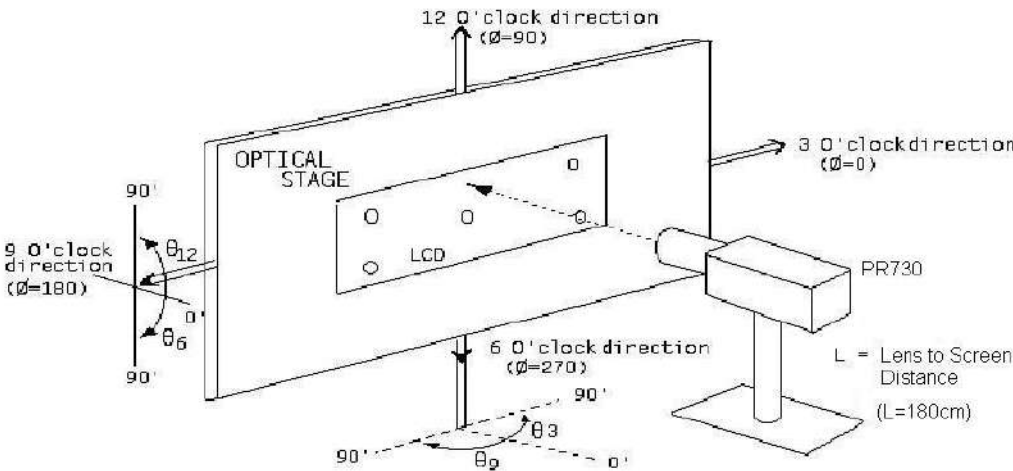
• If LC touch eyes, eyes need to be washed with running water at least 15 minutes.
- B. Rework
- When returning the Module for repair or etc., Please pack the Module not to be broken. We recommend to use the original shipping packages.
- C. In order to prevent potential problems, flicker should be adjusted by optimizing the Vcom value in customer Module Line through the I2C Interface.
- D. This Specification is the property of BOE and Shall not be reproduced or copied without the written permission of BOE and must be returned to BOE upon its Request

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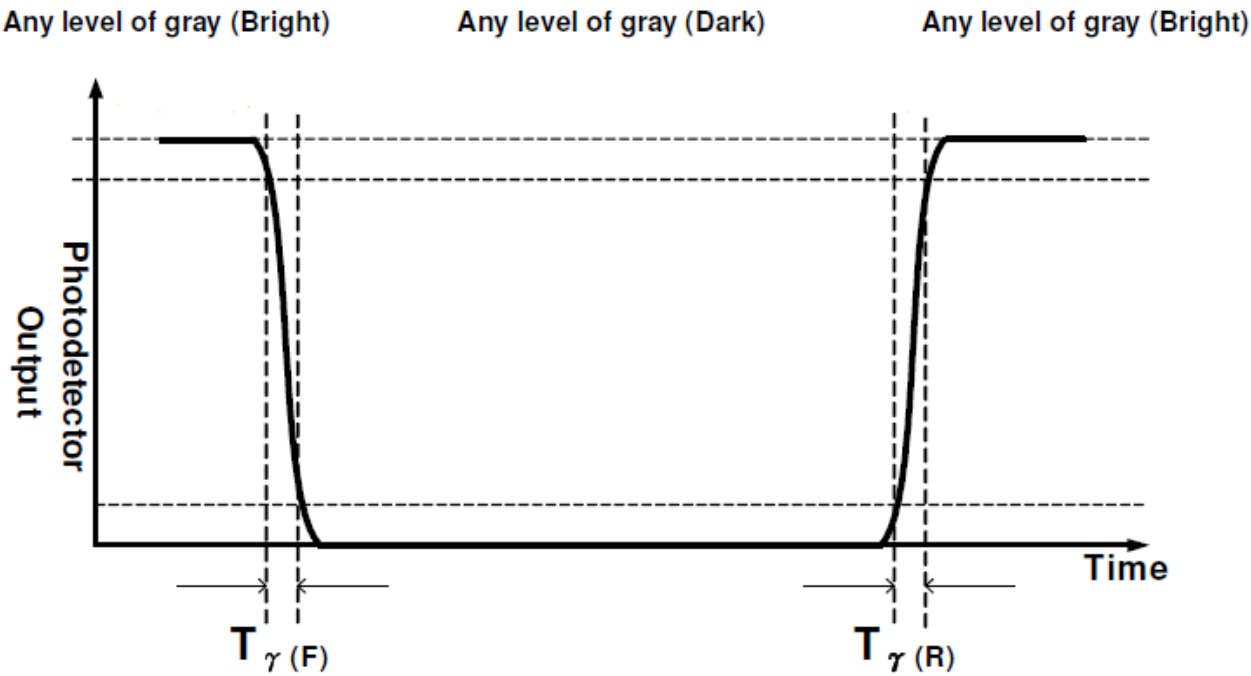
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13.0 APPENDIX

< Figure 1. Measurement Set Up >



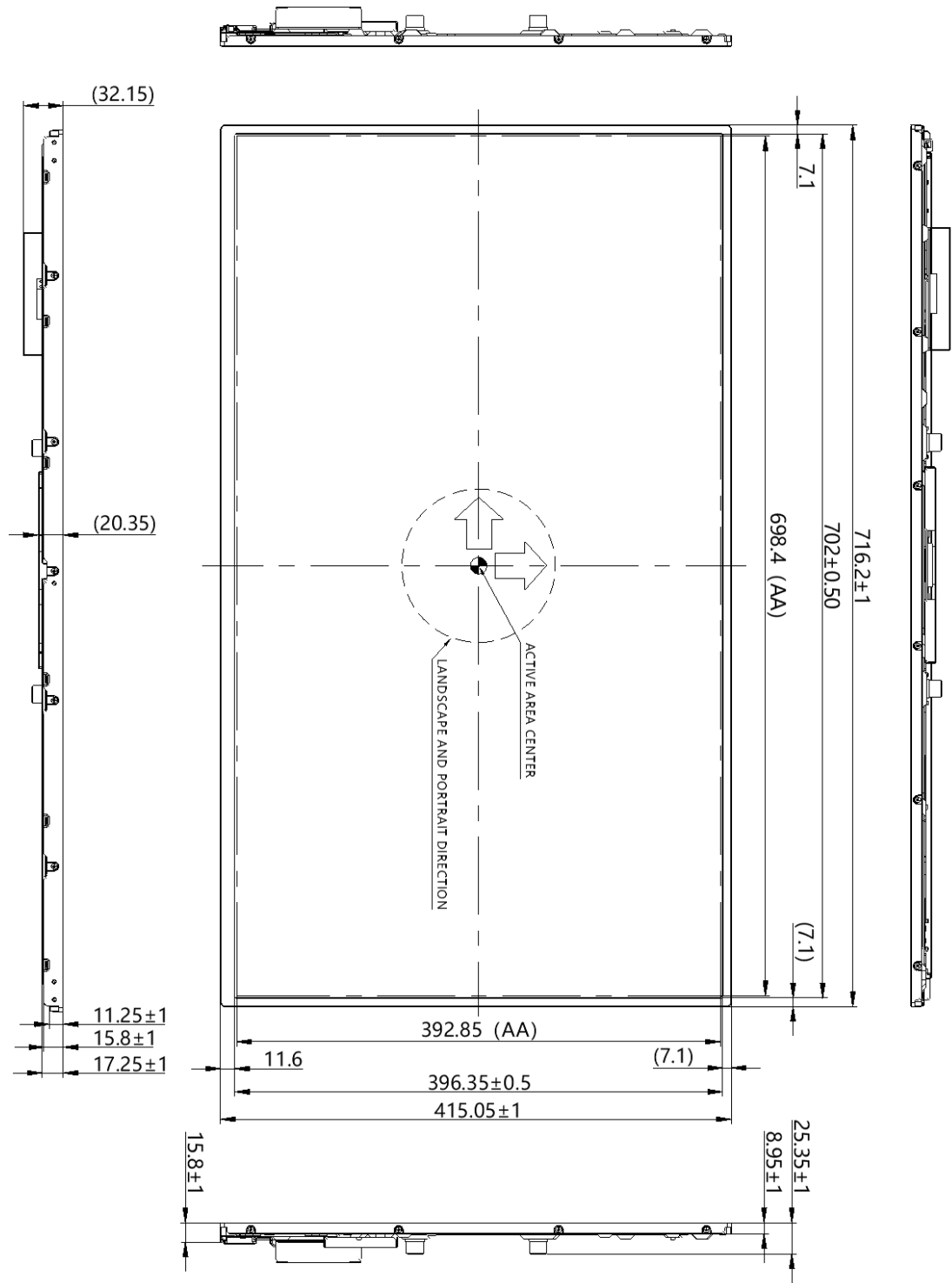
< Figure 2. Response Time Testing >



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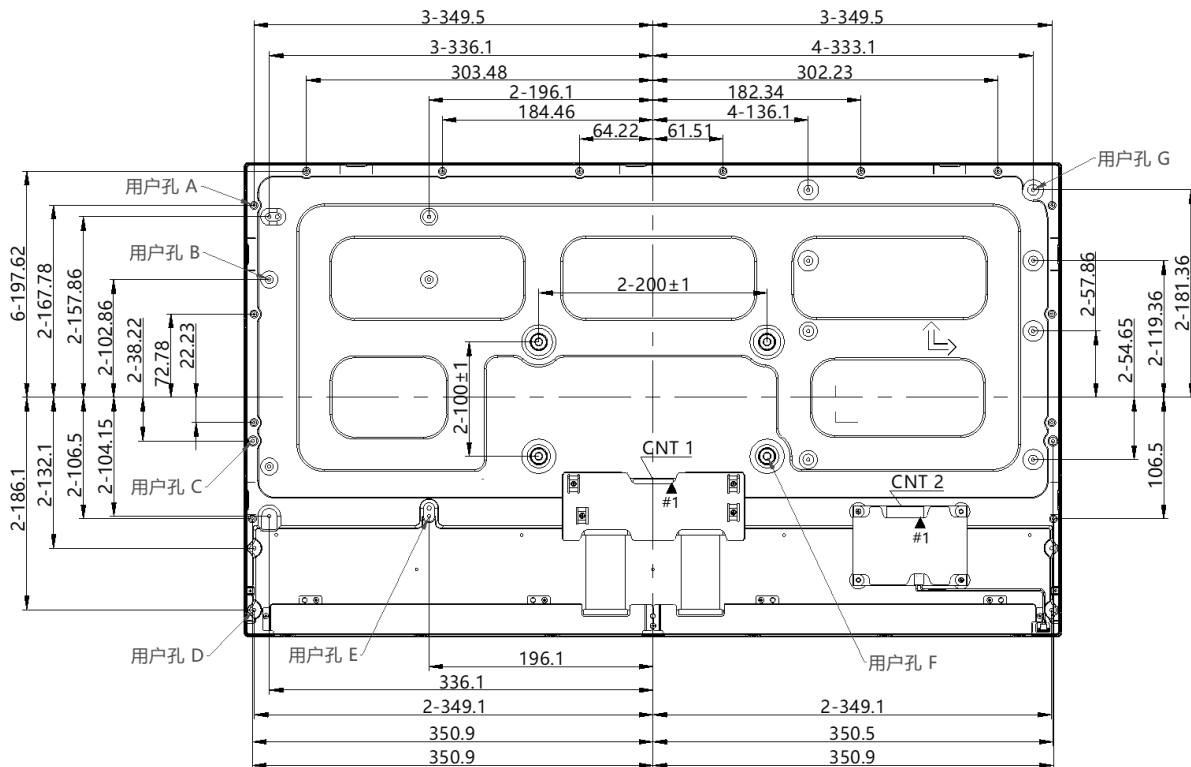
BOE	PRODUCT GROUP	REV	ISSUE DATE
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< Figure 3.TFT-LCD Module Outline Dimensions (Front View) >



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



NOTE:

1. CONNECTOR SPECIFICATION:

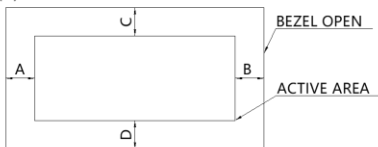
CN1: IS050-C51B-C39-S, 1EA/MDL

CN2: A2001WR-S-XP-LCP, 1EA/MDL

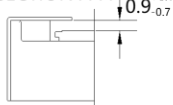
2. COMPARISON TABLE OF USER HOLE TORQUE:

ITEM NO	Description	Max Depth(mm)	Torque	Type	QTY (pcs)
A	M2.0	2	Max. 2kgf-cm	TAP	14
B	M3.0	2.5	Max. 5kgf-cm	TAP	5
C	M3.0	2	Max. 5kgf-cm	TAP	2
D	M3.0	2.0	Max. 5kgf-cm	TAP	4
E	M3.0	3.5	Max. 5kgf-cm	TAP	2
F	M6.0	10	Max. 10kgf-cm	PEMNUT	4
G	M3.0	5	Max. 5kgf-cm	TAP	8

3. TILT AND PARTIAL DISPOSITION TOLERANCE OF DISPLAY AREA

(1) X- DIRECTION : $|A - B| \leq 1.5$ (2) Y- DIRECTION : $|C - D| \leq 1.5$ 

4. SECTION A-A



5. ANGLE OF VIEW : 3rd



6. UNSPECIFIED TOLERANCES: GRADE 2

TOLERANCE TABLE(±)

DIMENSION	1 GRADE	2 GRADE	3 GRADE	4 GRADE
$L \leq 20$	0.05	0.1	0.1	0.2
$20 < L \leq 50$	0.1	0.15	0.2	0.25
$50 < L \leq 100$	0.15	0.2	0.25	0.3
$100 < L \leq 200$	0.2	0.25	0.3	0.5
$200 \leq L$	0.25	0.3	0.5	0.8

UNLESS OTHERWISE SPECIFIED

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