



- ☐ Tentative Specification
- ☐ Preliminary Specification
- ☒ Approval Specification

MODEL NO.: V320BK1
SUFFIX: LS5

Customer:

APPROVED BY SIGNATURE

Name / Title

Note

Please return 1 copy for your confirmation with your signature and comments.

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**CONTENTS**

1. GENERAL DESCRIPTION	5
1.1 OVERVIEW	5
1.2 FEATURES	5
1.3 APPLICATION	5
1.4 GENERAL SPECIFICATIONS	5
1.5 MECHANICAL SPECIFICATIONS	6
2. ABSOLUTE MAXIMUM RATINGS	7
2.1 ABSOLUTE RATINGS OF ENVIRONMENT	7
2.2 PACKAGE STORAGE	8
2.3 ELECTRICAL ABSOLUTE RATINGS	8
3. ELECTRICAL CHARACTERISTICS	9
3.1 TFT LCD MODULE (Ta = 25 ± 2 °C)	9
3.2 BACKLIGHT CONVERTER UNIT	12
3.2.1 LED LIGHT BAR CHARACTERISTICS (Ta = 25 ± 2 °C)	12
Note (6) Below diagram is only for power supply design reference.	13
4. BLOCK DIAGRAM OF INTERFACE	17
4.1 TFT LCD MODULE	17
5. INTERFACE PIN CONNECTION	18
5.1 TFT LCD MODULE	18
5.3 BLOCK DIAGRAM OF INTERFACE	22
5.4 LVDS INTERFACE	24
5.5 COLOR DATA INPUT ASSIGNMENT	25
6. INTERFACE TIMING	26
6. INTERFACE TIMING	26
6.1 INPUT SIGNAL TIMING SPECIFICATIONS	26
6.2 POWER ON/OFF SEQUENCE	30
7. OPTICAL CHARACTERISTICS	32
7.1 TEST CONDITIONS	32
7.2 OPTICAL SPECIFICATIONS	33



8. PRECAUTIONS	38
8.1 ASSEMBLY AND HANDLING PRECAUTIONS	38
8.2 SAFETY PRECAUTIONS	38
9. DEFINITION OF LABELS	39
9.1 CMI MODULE LABEL	39
10. PACKAGING	40
10.1 PACKAGING SPECIFICATIONS	40
10.2 PACKAGING METHOD	40
11. MECHANICAL CHARACTERISTIC	42

1. GENERAL DESCRIPTION

1.1 OVERVIEW

V320BK1-LS5 is a 32" TFT Liquid Crystal Display module with LED Backlight unit and 2ch-LVDS interface. This module supports 1366 x 768 HDTV format and can display 16.7M colors (8-bit).

1.2 FEATURES

- High brightness (350 nits)
- High contrast ratio (3000:1)
- Fast response time (Gray to gray average 8.5 ms)
- High color saturation (NTSC 72%)
- HDTV (1366 x 768 pixels) resolution, true HDTV format
- LVDS (Low Voltage Differential Signaling) interface
- Optimized response time for 120 Hz frame rate
- Ultra wide viewing angle : Super MVA technology
- Viewing Angle : 178(H)/178(V) (CR ≥ 20) VA Technology
- RoHs compliance

1.3 APPLICATION

- Standard Living Room TVs
- Public Display Application
- Home Theater Application
- MFM Application

1.4 GENERAL SPECIFICATIONS

Item	Specification	Unit	Note
Active Area	697.6845 (H) x 392.256 (V)	mm	(1)
Bezel Opening Area	703.8 (H) x 398.4 (V)	mm	
Driver Element	a-si TFT active matrix	-	-
Pixel Number	1366 x R.G.B. x 768	pixel	-
Pixel Pitch(Sub Pixel)	0.17025(H) x 0.51075 (V)	mm	-
Pixel Arrangement	RGB vertical stripe	-	-
Power consumption	(LVDS input Power 10W + LED Backlight Power 30.63W)	Watt	(2)
Display Colors	16.7M	color	-
Display Operation Mode	Transmissive mode / Normally Black	-	-
Surface Treatment	Anti-Glare coating (Haze 3.5%) Hardness 3H	-	(3)

Note (1) Please refer to the attached drawings in chapter 9 for more information about the front and back outlines.

Note (2) Please refer sec 3.1 and 3.2 for more information of Power consumption

Note (3) The spec. of the surface treatment is temporarily for this phase. CMI reserves the rights to change this feature.

**1.5 MECHANICAL SPECIFICATIONS**

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	724.2	725.2	726.2	mm	(1)
	Vertical (V)	420.9	421.9	422.9	mm	(1)
	Depth (D)				mm	(2)
	Depth (D)	24.6	25.6	26.6	mm	(3)
Weight			4480			-

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.

Note (2) Module Depth is between bezel to T-CON cover.

Note (3) Module Depth is between bezel to Converter cover.

**2. ABSOLUTE MAXIMUM RATINGS****2.1 ABSOLUTE RATINGS OF ENVIRONMENT**

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	T _{ST}	-20	+60	°C	(1)
Operating Ambient Temperature	T _{OP}	0	+50	°C	(1), (2)
Shock (Non-Operating)	S _{NOP}	-	50	G	(3), (5)
Vibration (Non-Operating)	V _{NOP}	-	1.0	G	(4), (5)

Note (1) Temperature and relative humidity range is shown in the figure below.

(a) 90 %RH Max. ($T_a \leq 40\text{ }^{\circ}\text{C}$).

(b) Wet-bulb temperature should be 39 °C Max. ($T_a > 40\text{ }^{\circ}\text{C}$).

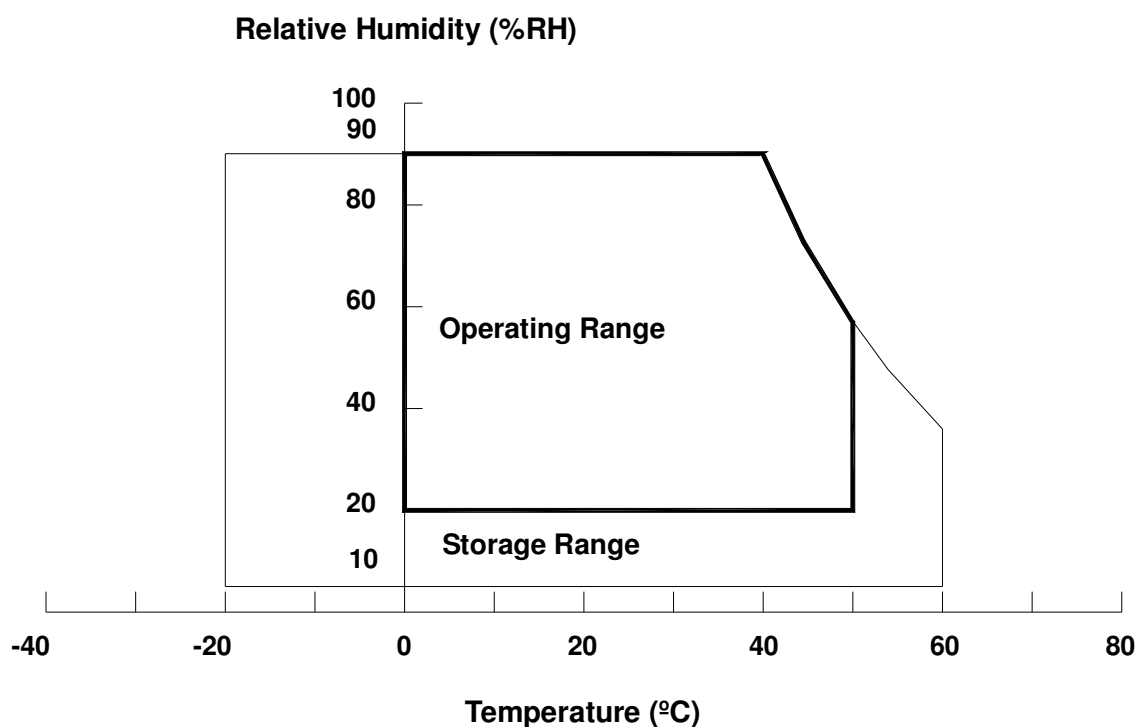
(c) No condensation.

Note (2) The maximum operating temperature is based on the test condition that the surface temperature of display area is less than or equal to 65 °C with LCD module alone in a temperature controlled chamber. Thermal management should be considered in final product design to prevent the surface temperature of display area from being over 65 °C. The range of operating temperature may degrade in case of improper thermal management in final product design.

Note (3) 11 ms, half sine wave, 1 time for $\pm X$, $\pm Y$, $\pm Z$.

Note (4) 10 ~ 200 Hz, 10 min, 1 time each X, Y, Z.

Note (5) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.



2.2 PACKAGE STORAGE

When storing modules as spares for a long time, the following precaution is necessary.

- (a) Do not leave the module in high temperature, and high humidity for a long time, It is highly recommended to store the module with temperature from 0 to 35 °C at normal humidity without condensation.
- (b) The module shall be stored in dark place. Do not store the TFT-LCD module in direct sunlight or fluorescent light.

2.3 ELECTRICAL ABSOLUTE RATINGS

2.3.1 TFT LCD MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	V _{CC}	-0.3	13.5	V	(1)
Input Signal Voltage	V _{IN}	-0.3	3.6	V	

2.3.2 BACKLIGHT UNIT

Item	Symbol	Test Condition	Min.	Type	Max.	Unit	Note
Light Bar Voltage	V _W	Ta = 25 °C	-	-	60	V _{RMS}	3D Mode
Converter Input Voltage	V _{BL}	-	0	-	30	V	
Control Signal Level	-	-	-0.3	-	7	V	

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Functional operation should be restricted to the conditions described under normal operating conditions.

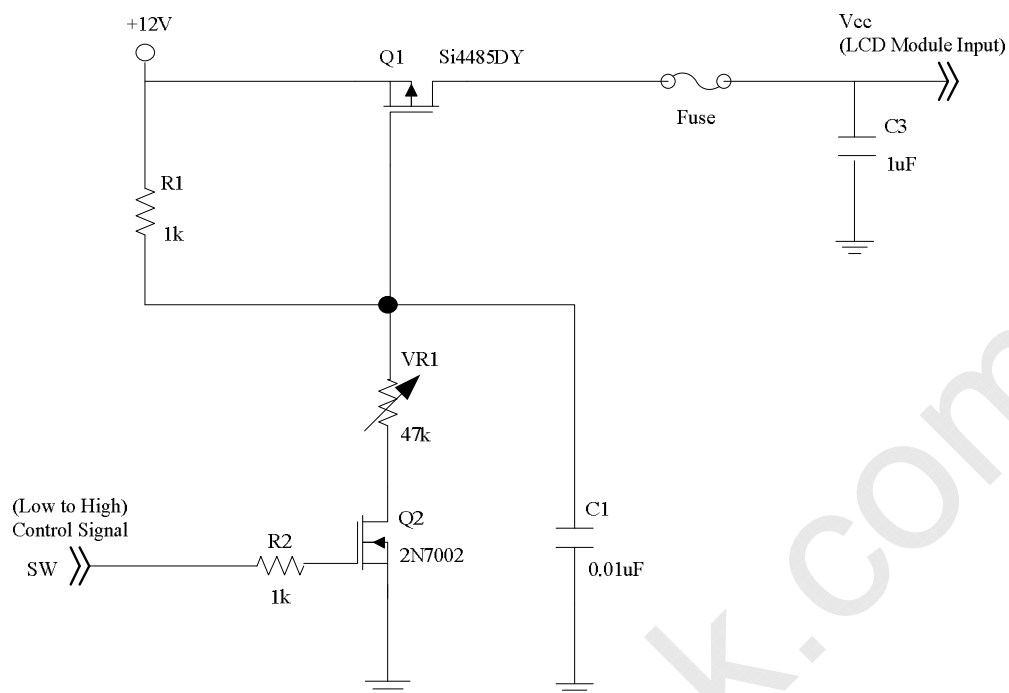
3. ELECTRICAL CHARACTERISTICS

3.1 TFT LCD MODULE (Ta = 25 ± 2 °C)

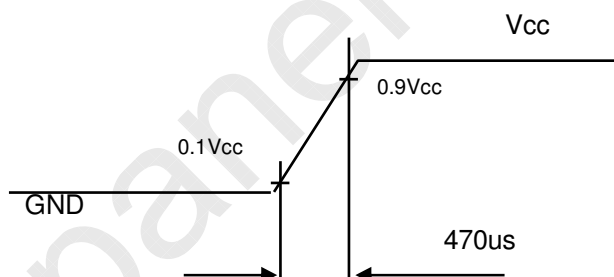
Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		V _{CC}	10.8	12	13.2	V	(1)
Rush Current		I _{RUSH}	—	—	3.87	A	(2)
Power Consumption	White Pattern	—	—	3.48	4.2	W	(3)
	Horizontal Stripe	—	—	5.52	6.72	W	
	Black Pattern	—	—	3.12	3.72	W	
Power Supply Current	White Pattern	—	—	0.29	0.35	A	
	Horizontal Stripe	—	—	0.46	0.56	A	
	Black Pattern	—	—	0.26	0.31	A	
LVDS interface	Differential Input High Threshold Voltage	V _{LVTH}	+100	—	—	mV	(4)
	Differential Input Low Threshold Voltage	V _{LVTL}	—	—	-100	mV	
	Common Input Voltage	V _{CM}	1.0	1.2	1.4	V	
	Differential input voltage (single-end)	V _{ID}	200	—	600	mV	
	Terminating Resistor	R _T	—	100	—	ohm	
CMIS interface	Input High Threshold Voltage	V _{IH}	2.7	—	3.3	V	
	Input Low Threshold Voltage	V _{IL}	0	—	0.7	V	

Note (1) The module should be always operated within above ranges.

Note (2) Measurement Conditions:

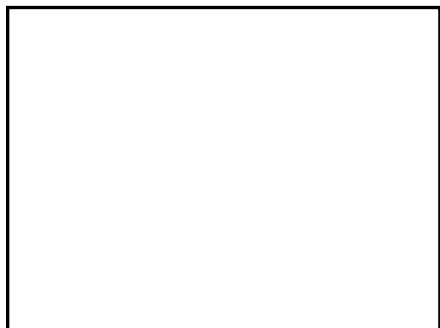


Vcc rising time is 470us



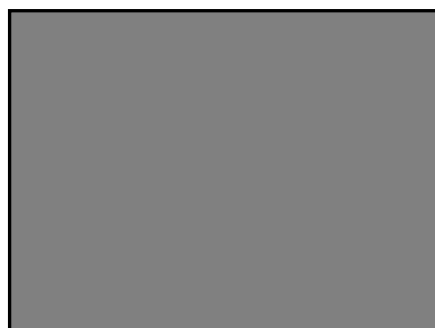
Note (3) The specified power consumption and power supply current is under the conditions at $V_{CC} = 12\text{ V}$, $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$, $f_v = 120\text{ Hz}$, whereas a power dissipation check pattern below is displayed.

a. White Pattern



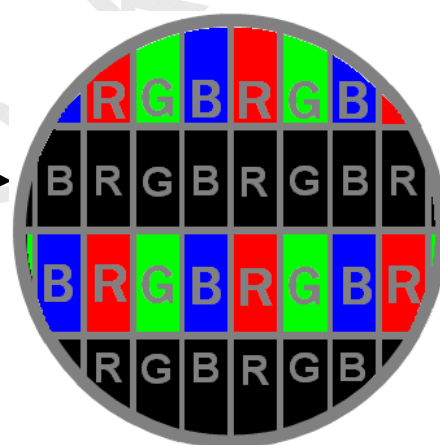
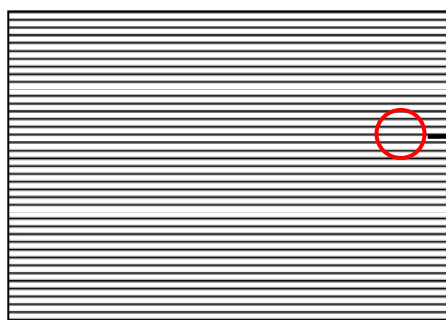
Active Area

b. Black Pattern

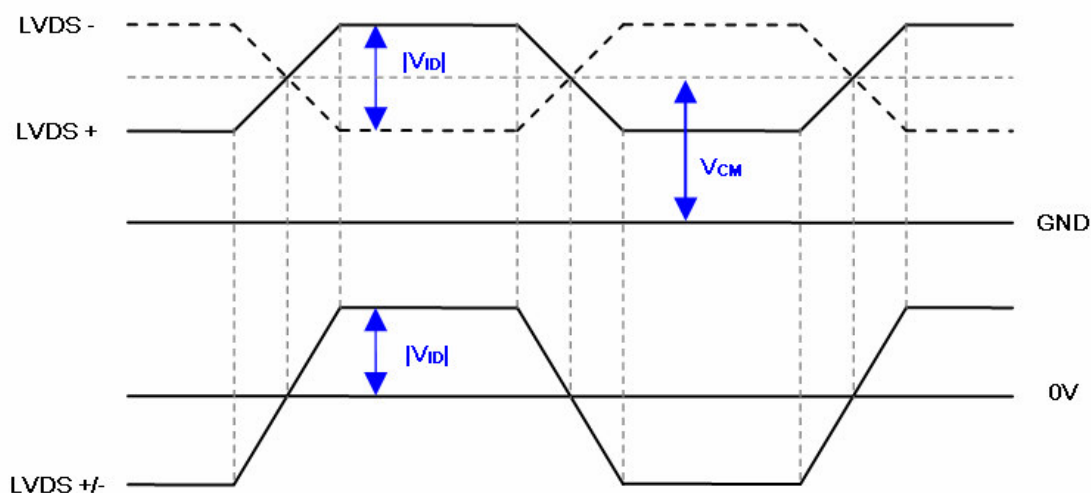


Active Area

c. Horizontal Stripe Pattern



Note (4) The LVDS input characteristics are as follows:



3.2 BACKLIGHT CONVERTER UNIT

3.2.1 LED LIGHT BAR CHARACTERISTICS (Ta = 25 ± 2 °C)

The backlight unit contains 1pcs light bar.

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Total Current (6 String)	If	-	780	826.8	mA	
One String Current	IL(2D)	-	130	137.8	mA	
	IL(3D)	-	450	477	mApeak	3D ENA=ON
LED Forward Voltage	Vf	5.64	6.17	6.51	VDC	IL = 130mA
One String Voltage	VW	33.84	-	39.2	VDC	IL = 130mA
One String Voltage Variation	△VW	-	-	2	V	
Life time	-	30,000	-	-	Hrs	(1)

3.2.2 CONVERTER CHARACTERISTICS (Ta = 25 ± 2 °C)

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Power Consumption	PBL(2D)	-	32.1	40	W	(1), (2) IL = 130 mA
	PBL(3D)	-	27.3	31.9	W	(1), (2) IL= 450mA
Converter Input Voltage	VBL	22.8	24.0	25.2	VDC	
Converter Input Current	IBL(2D)	-	1.34	1.67	A	Non Dimming
	IBL(3D)	-	1.14	1.33	A	
Input Inrush Current	IR(2D)	-	-	2.1	Apeak	VBL=22.8V,(IL=typ.) (3), (6)
	IR(3D)	-	-	3.63	Apeak	VBL=22.8V,(IL=450mA) (3), (6)
Dimming Frequency	FB	170	180	190	Hz	(5)
Minimum Duty Ratio	DMIN	5	10	-	%	(4), (5)

Note (1) The power supply capacity should be higher than the total converter power consumption P_{BL}. Since the pulse width modulation (PWM) mode was applied for backlight dimming, the driving current changed as PWM duty on and off. The transient response of power supply should be considered for the changing loading when converter dimming.

Note (2) The measurement condition of Max. value is based on 32" backlight unit under input voltage 24V, average LED current 137.8 mA at 2D Mode (LED current 477 mA_{peak} at 3D Mode) and lighting 1 hour

later.

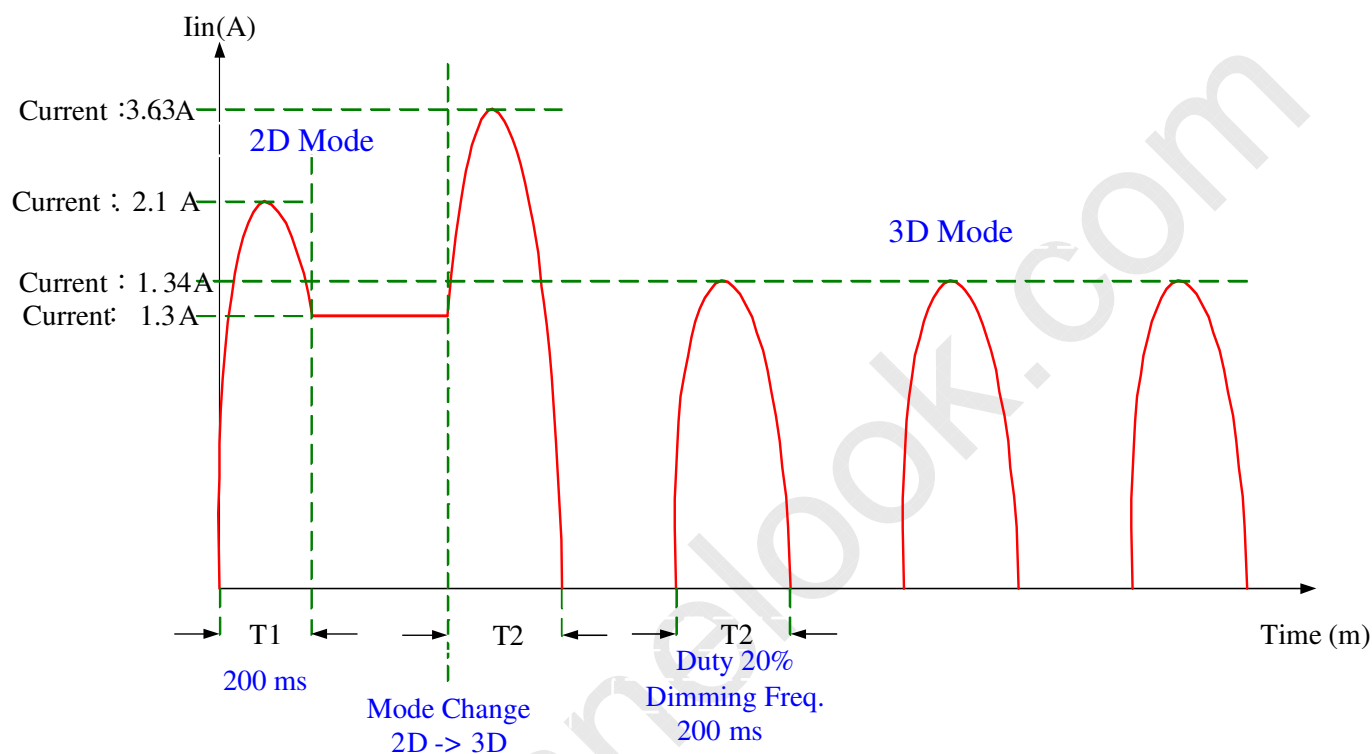
Note (3) For input inrush current measure, the VBL rising time from 10% to 90% is about 30ms.

Note (4) 5% minimum duty ratio is only valid for electrical operation.

Note (5) FB and DMIN are available only at 2D Mode.

Note (6) Below diagram is only for power supply design reference.

Test Condition: $V_{BL}=22.8V$, $I_L=130mA$ at 2D Mode/ $I_L=(450)mA_{peak}$ at 3D Mode



3.2.3 CONVERTER INTERFACE CHARACTERISTICS

Parameter		Symbol	Test Condition	Value			Unit	Note	
				Min.	Typ.	Max.			
On/Off Control Voltage	ON	VBLON	—	2.0	—	5.0	V		
	OFF		—	0	—	0.8	V		
External PWM Control Voltage	HI	VEPWM	—	2.0	—	5.25	V	Duty on	(5), (6)
	LO		—	0	—	0.8	V	Duty off	
External PWM Frequency		F _{EPWM}	—	150	160	170	Hz	Normal mode	
Error Signal		ERR	—	—	—	—	—	Abnormal: Open collector Normal: GND (4)	
VBL Rising Time		Tr1	—	30	—	—	ms	10%-90%V _{BL}	
Control Signal Rising Time		Tr	—	—	—	100	ms		
Control Signal Falling Time		Tf	—	—	—	100	ms		
PWM Signal Rising Time		TPWMR	—	—	—	50	us	(6)	
PWM Signal Falling Time		TPWMF	—	—	—	50	us		
Input Impedance		Rin	—	1	—	—	MΩ	EPWM, BLON	
PWM Delay Time		TPWM	—	100	—	—	ms	(6)	
BLON Delay Time		T _{on}	—	300	—	—	ms		
		T _{on1}	—	300	—	—	ms		
BLON Off Time		Toff	—	300	—	—	ms		

Note (1) The Dimming signal should be valid before backlight turns on by BLON signal. It is inhibited to change the external PWM signal during backlight turn on period.

Note (2) The power sequence and control signal timing are shown in the Fig.1. For a certain reason, the converter has a possibility to be damaged with wrong power sequence and control signal timing.

Note (3) While system is turned ON or OFF, the power sequences must follow as below descriptions:

Turn ON sequence: VBL → PWM signal → BLON

Turn OFF sequence: BLOFF → PWM signal → VBL

Note (4) When converter protective function is triggered, ERR will output open collector status.

Note (5) The EPWM interface that inserts a pull up resistor to 5V in Max Duty (100%), please refers to Fig.2.

Note (6) EPWM is available only at 2D Mode.

Note(7): [Recommend] EPWM duty ratio is set at 100%(Max. Brightness) in 3D Mode.

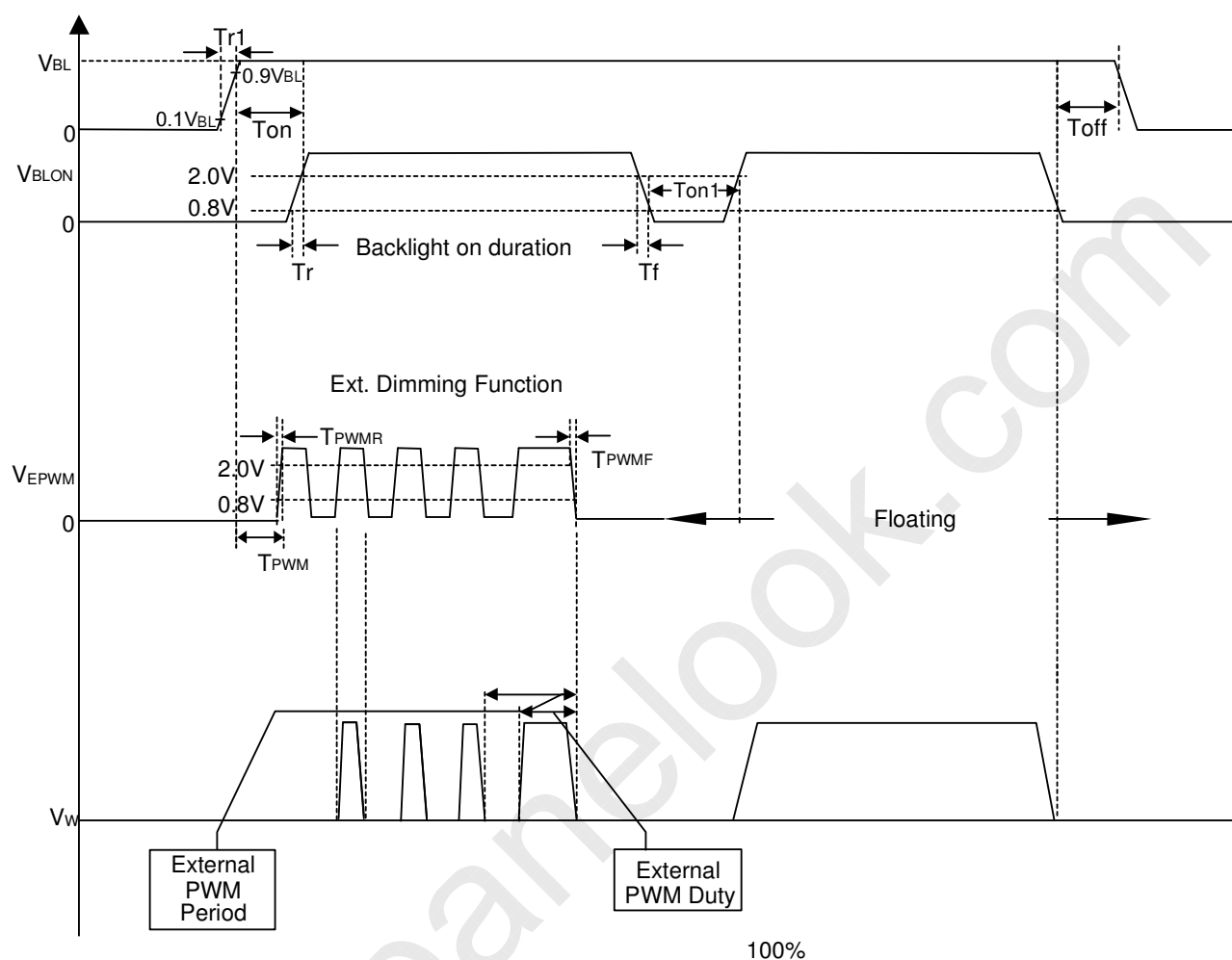


Fig. 1

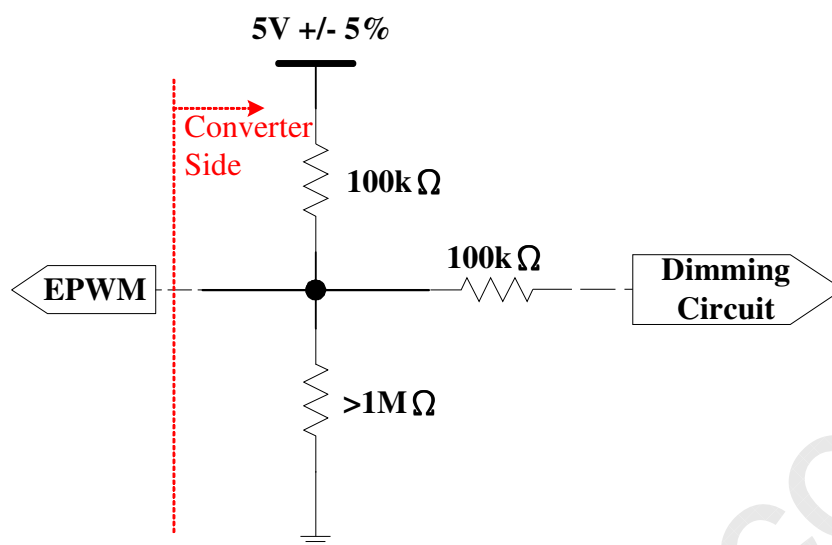
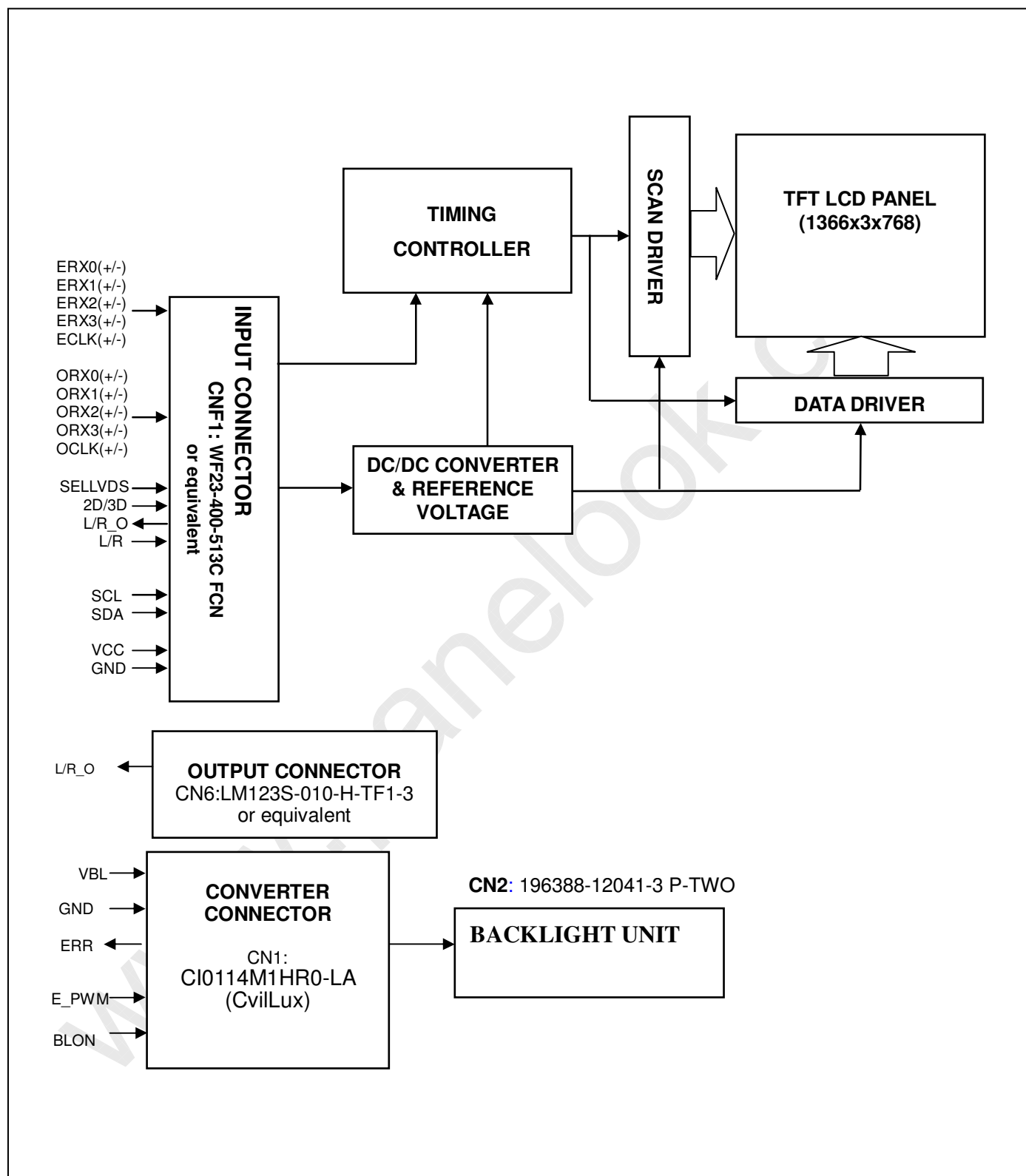


Fig. 2

4. BLOCK DIAGRAM OF INTERFACE

4.1 TFT LCD MODULE



5. INTERFACE PIN CONNECTION

5.1 TFT LCD MODULE

CNF1 Connector Pin Assignment: (WF23-400-513C (FCN) or equivalent)

Pin	Name	Description	Note
1	N.C.	No Connection	(1)
2	N.C.	No Connection	
3	N.C.	No Connection	
4	N.C.	No Connection	
5	L/R_O	Output signal for Left Right Glasses control	(8)
6	N.C.	No Connection	(1)
7	SELLVDS	Input signal for LVDS Data Format Selection	(2)(5)
8	N.C.	No Connection	(1)
9	N.C.	No Connection	
10	N.C.	No Connection	
11	GND	Ground	
12	ORX0-	Odd pixel Negative LVDS differential data input. Channel 0	(7)
13	ORX0+	Odd pixel Positive LVDS differential data input. Channel 0	
14	ORX1-	Odd pixel Negative LVDS differential data input. Channel 1	
15	ORX1+	Odd pixel Positive LVDS differential data input. Channel 1	
16	ORX2-	Odd pixel Negative LVDS differential data input. Channel 2	
17	ORX2+	Odd pixel Positive LVDS differential data input. Channel 2	
18	GND	Ground	
19	OCLK-	Odd pixel Negative LVDS differential clock input	(7)
20	OCLK+	Odd pixel Positive LVDS differential clock input	
21	GND	Ground	
22	ORX3-	Odd pixel Negative LVDS differential data input. Channel 3	(7)
23	ORX3+	Odd pixel Positive LVDS differential data input. Channel 3	
24	N.C.	No Connection	(1)
25	N.C.	No Connection	
26	2D/3D	Input signal for 2D/3D Mode Selection	(3)(6)
27	L/R	Input signal for Left Right eye frame synchronous	(4)(6)
28	ERX0-	Even pixel Negative LVDS differential data input. Channel 0	(7)

29	ERX0+	Even pixel Positive LVDS differential data input. Channel 0	
30	ERX1-	Even pixel Negative LVDS differential data input. Channel 1	
31	ERX1+	Even pixel Positive LVDS differential data input. Channel 1	
32	ERX2-	Even pixel Negative LVDS differential data input. Channel 2	
33	ERX2+	Even pixel Positive LVDS differential data input. Channel 2	
34	GND	Ground	
35	ECLK-	Even pixel Negative LVDS differential clock input.	(7)
36	ECLK+	Even pixel Positive LVDS differential clock input.	
37	GND	Ground	
38	ERX3-	Even pixel Negative LVDS differential data input. Channel 3	(7)
39	ERX3+	Even pixel Positive LVDS differential data input. Channel 3	
40	N.C.	No Connection	(1)
41	N.C.	No Connection	
42	N.C.	No Connection	
43	N.C.	No Connection	
44	GND	Ground	
45	GND	Ground	
46	GND	Ground	
47	N.C.	No Connection	(1)
48	VCC	+12V power supply	
49	VCC	+12V power supply	
50	VCC	+12V power supply	
51	VCC	+12V power supply	

CN6 Connector Pin Assignment (LM123S-010-H-TF1-3 (UNE) or equivalent)

1	N.C.	No Connection	(1)
2	N.C.	No Connection	
3	N.C.	No Connection	
4	GND	Ground	
5	N.C.	No Connection	(1)
6	L/R_O	Output signal for Left Right Glasses control	(8)

7	N.C.	No Connection	(1)
8	N.C.	No Connection	
9	N.C.	No Connection	
10	N.C.	No Connection	

Note (1) Reserved for internal use. Please leave it open.

Note (2) LVDS format selection.

L= Connect to GND, H=Connect to +3.3V or Open

SELLVDS	Note
L	JEIDA Format
H or Open	VESA Format

Note (3) 2D/3D mode selection.

L= Connect to GND or Open, H=Connect to +3.3V

2D/3D	Note
L or Open	2D Mode
H	3D Mode

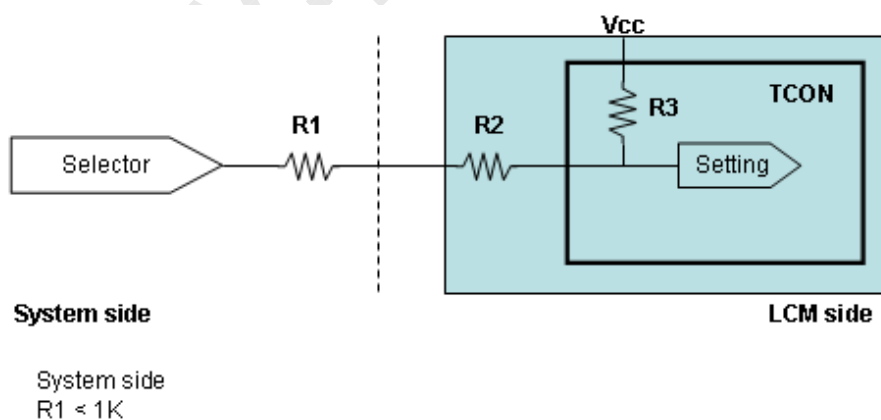
Note (4) Input signal for Left Right eye frame synchronous

$$V_{IL}=0\sim 0.7V, V_{IH}=2.7\sim 3.3V$$

L/R	Note
L	Right synchronous signal
H	Left synchronous signal

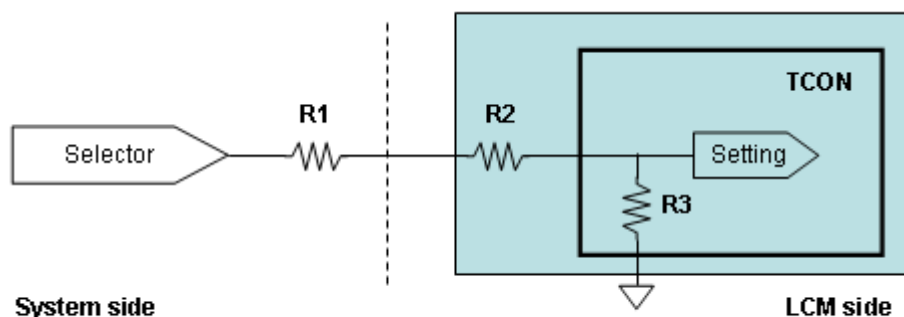
Note (5) SELLVDS signal pin connected to the LCM side has the following diagram.

R1 in the system side should be less than 1K Ohm. ($R1 < 1K \text{ Ohm}$)



Note (6) 2D/3D, L/R signal pin connected to the LCM side has the following diagram.

R1 in the system side should be less than 1K Ohm. ($R1 < 1K \text{ Ohm}$)



System side: $R1 < 1K$

Note (7) Two pixel data send into the module for every clock cycle. The first pixel of the frame is odd pixel and the second pixel is even pixel.

Note (8) The definition of L/R_O signal as follows

L= 0V , H= +3.3V

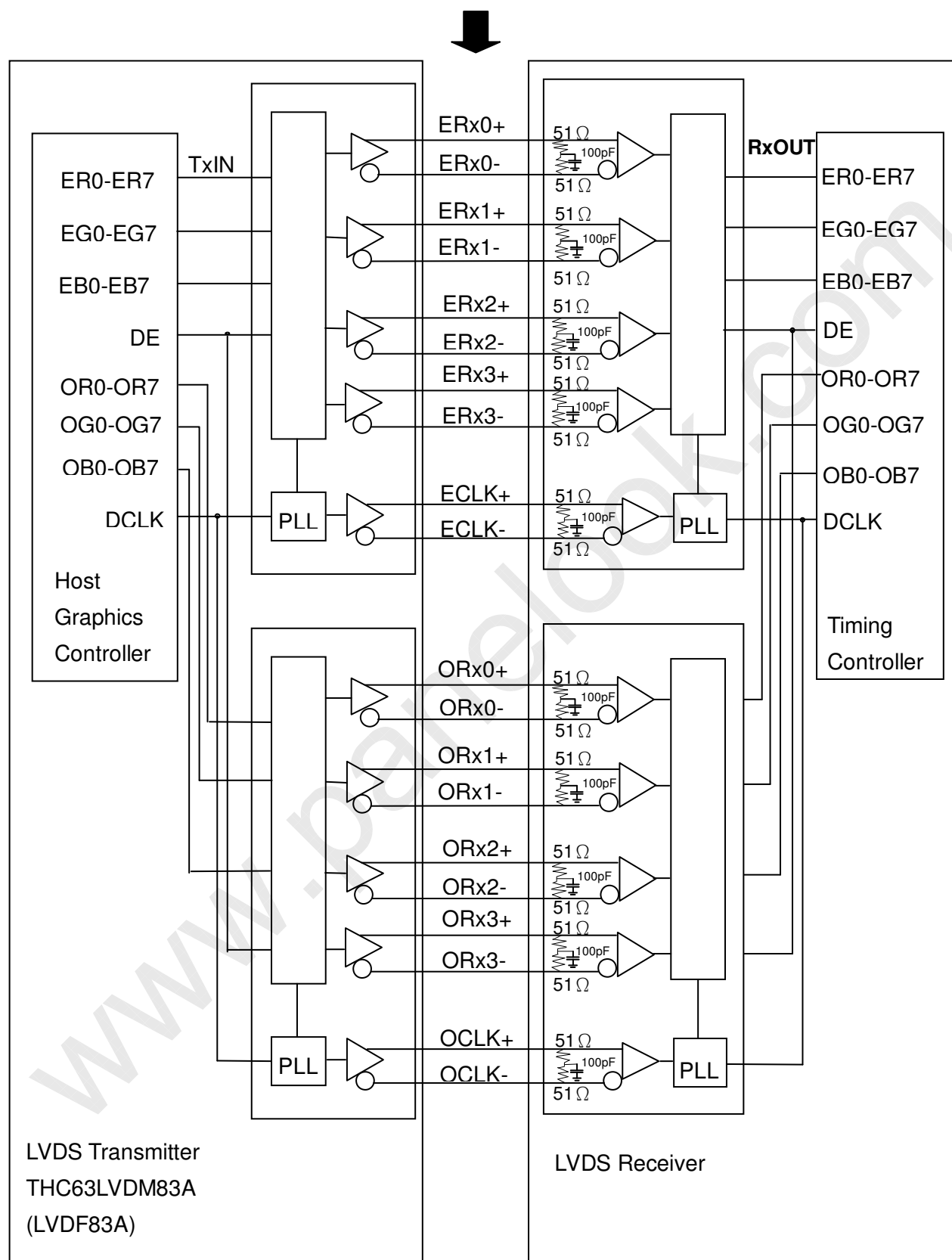
L/R_O	Note
L	Right glass turn on
H	Left glass turn on

5.2 BACKLIGHT UNIT

CN 2: 196388-12041-3 (P-TWO)

Pin №	Symbol	Feature
1	N1	Negative of Light Bar
2	N2	
3	N3	
4	N4	
5	N5	
6	N6	
7	NC	No Connection
8	NC	
9	NC	
10	VLED+	Positive of Light Bar
11	VLED+	
12	VLED+	

5.3 BLOCK DIAGRAM OF INTERFACE



ER0~ER7: Even pixel R data

EG0~EG7: Even pixel G data

EB0~EB7: Even pixel B data

OR0~OR7: Odd pixel R data

OG0~OG7: Odd pixel G data

OB0~OB7: Odd pixel B data

DE: Data enable signal

DCLK: Data clock signal

Note (1) The system must have the transmitter to drive the module.

Note (2) LVDS cable impedance shall be 50 ohms per signal line or about 100 ohms per twist-pair line when it is used differentially.

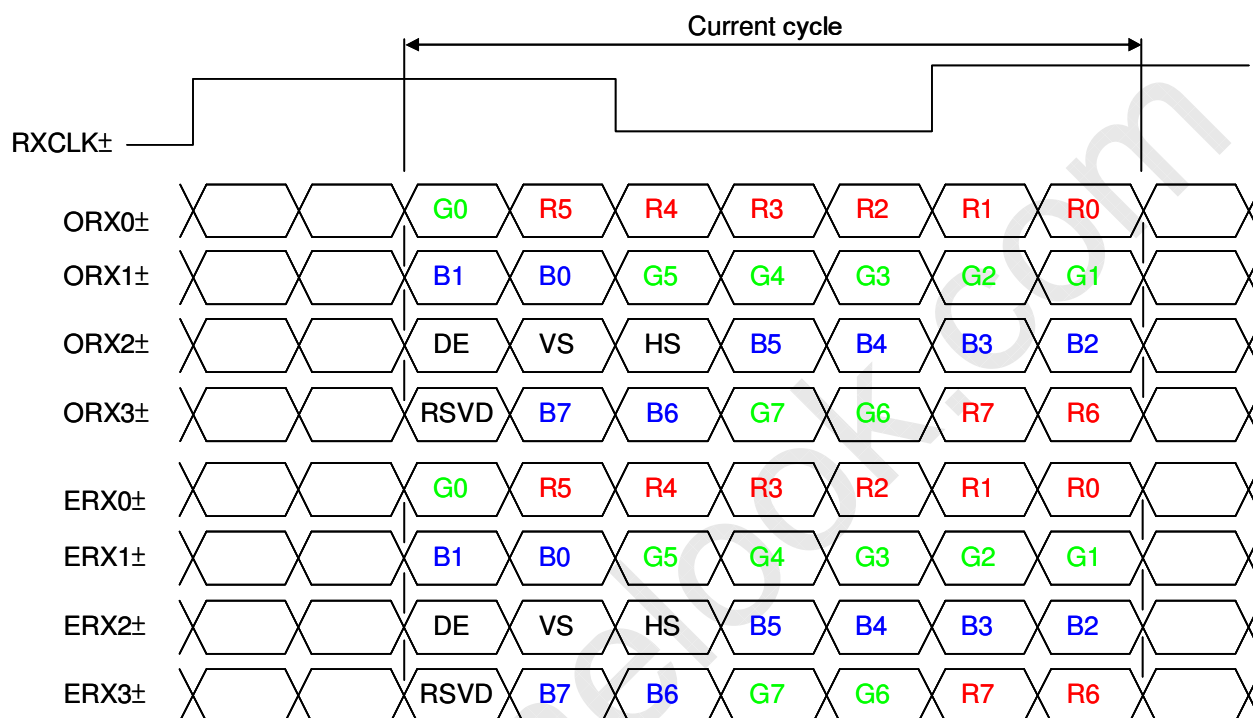
Note (3) Two pixel data send into the module for every clock cycle. The first pixel of the frame is odd pixel and the second pixel is even pixel.

5.4 LVDS INTERFACE

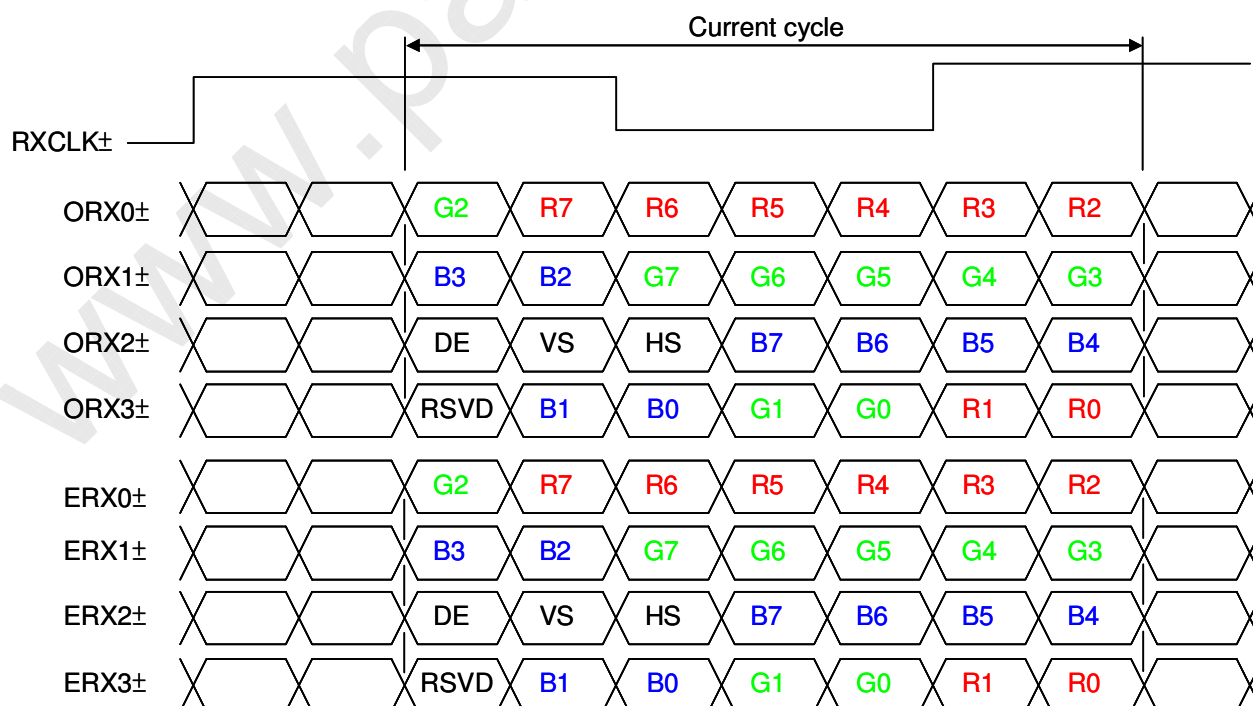
JEIDA Format : SELLVDS = L

VESA Format : SELLVDS = H or Open

VESA LVDS format



JEDIA LVDS format



R0~R7: Pixel R Data (7; MSB, 0; LSB)

G0~G7: Pixel G Data (7; MSB, 0; LSB)

B0~B7: Pixel B Data (7; MSB, 0; LSB)

DE: Data enable signal

DCLK : Data clock signal

Notes: (1) RSVD (reserved) pins on the transmitter shall be “H” or “L”.

5.5 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 8-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of the color versus data input.

Color		Data Signal																							
		Red								Green								Blue							
		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
	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
	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
	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
	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
	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	Red (0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red (253)	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (254)	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 (255)	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	Green(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Green (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green (253)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
	Green (254)	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 (255)	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	Blue(0) / Dark	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 (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue (253)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
	Blue (254)	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 (255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

Note (1) 0: Low Level Voltage, 1: High Level Voltage

6. INTERFACE TIMING

6. INTERFACE TIMING

6.1 INPUT SIGNAL TIMING SPECIFICATIONS

(Ta = 25 ± 2 °C)

The input signal timing specifications are shown as the following table and timing diagram.

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Receiver Clock	2D mode Frequency	$F_{\text{clkin}} (=1/TC)$	30	38	40	MHz	
	3D mode Frequency	$F_{\text{clkin}} (=1/TC)$	60	76	80	MHz	
	Input cycle to cycle jitter	T_{rcl}	-	-	200	ps	(3)
	Spread spectrum modulation range	$F_{\text{clkin_mod}}$	$F_{\text{clkin}}-2\%$	-	$F_{\text{clkin}}+2\%$	MHz	(4)
	Spread spectrum modulation frequency	F_{SSM}	-	-	200	KHz	
LVDS Receiver Data	Receiver Skew Margin	T_{RSKM}	-400	-	400	ps	(5)

6.1.1 Timing spec for Frame Rate = 50Hz@2D mode, 100Hz@3D mode

Signal	Item		Symbol	Min.	Typ.	Max.	Unit	Note
Frame rate	2D mode		F_{r5}	47	50	53	Hz	
	3D mode		F_{r5}	100	100	100	Hz	(7)
Vertical Active Display Term	2D Mode	Total	T_{v}	776	806	1018	Th	$T_{\text{v}}=T_{\text{vd}}+T_{\text{vb}}$
		Display	T_{vd}	768	768	768	Th	—
		Blank	T_{vb}	8	38	250	Th	—
	3D Mdoe	Total	T_{v}	968			Th	(6), (8)
		Display	T_{vd}	768			Th	
		Blank	T_{vb}	200			Th	
Horizontal Active Display Term	2D Mode	Total	T_{h}	721	780	1003	T_{c}	$T_{\text{h}}=T_{\text{hd}}+T_{\text{hb}}$
		Display	T_{hd}	683	683	683	T_{c}	—
		Blank	T_{hb}	38	97	320	T_{c}	—
	3D Mdoe	Total	T_{h}	721	780	1003	T_{c}	$T_{\text{h}}=T_{\text{hd}}+T_{\text{hb}}$
		Display	T_{hd}	683	683	683	T_{c}	—
		Blank	T_{hb}	38	97	320	T_{c}	—



6.1.2 Timing spec for Frame Rate = 60Hz@2D mode, 120Hz@3D mode

Signal	Item		Symbol	Min.	Typ.	Max.	Unit	Note
Frame rate	2D mode		F _{r6}	57	60	63	Hz	
	3D mode		F _{r6}	120	120	120	Hz	(7)
Vertical Active Display Term	2D Mode	Total	T _v	776	806	1018	Th	T _v =T _{vd} +T _{vb}
		Display	T _{vd}	768	768	768	Th	—
		Blank	T _{vb}	8	38	250	Th	—
	3D Mdoe	Total	T _v	806			Th	(6), (8)
		Display	T _{vd}	768			Th	
		Blank	T _{vb}	38			Th	
	2D Mode	Total	T _h	721	780	1003	T _c	T _h =T _{hd} +T _{hb}
		Display	T _{hd}	683	683	683	T _c	—
		Blank	T _{hb}	38	97	320	T _c	—
Horizontal Active Display Term	3D Mdoe	Total	T _h	721	780	1003	T _c	T _h =T _{hd} +T _{hb}
		Display	T _{hd}	683	683	683	T _c	—
		Blank	T _{hb}	38	97	320	T _c	—

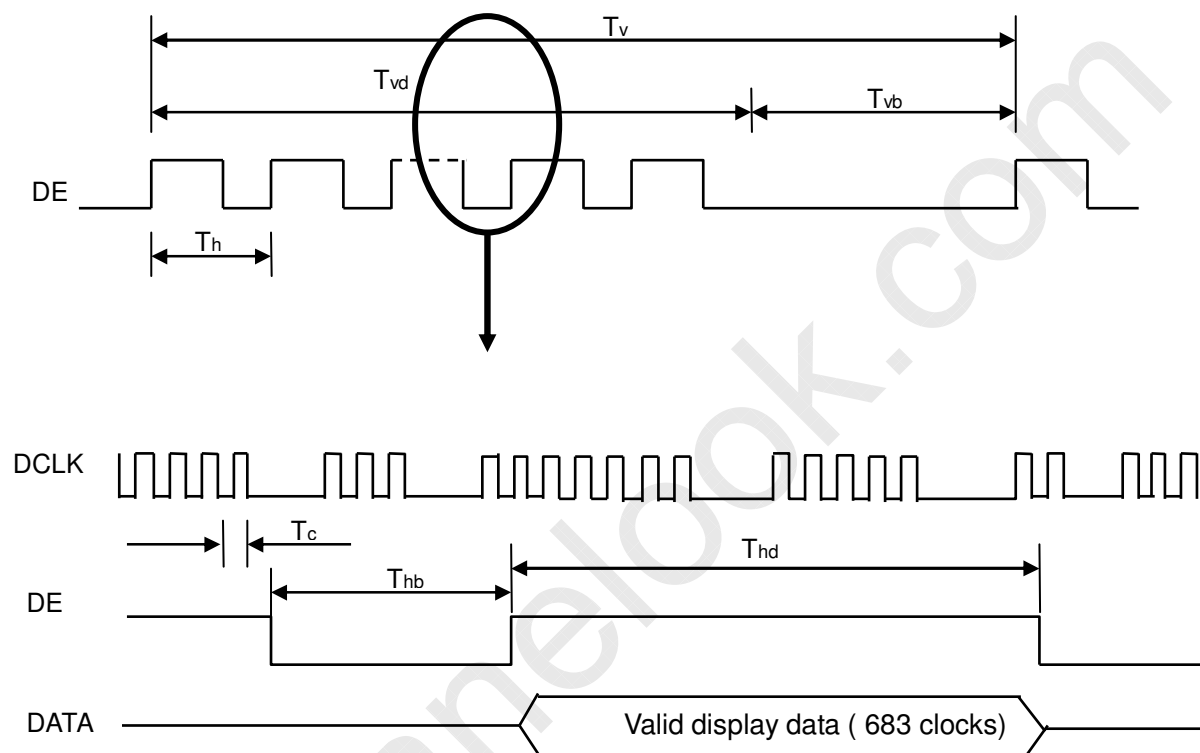
Note (1) Since the module is operated in DE only mode, Hsync and Vsync input signals should be set to low logic level. Otherwise, this module would operate abnormally.

Note (2) Please make sure the range of pixel clock has follow the below equation:

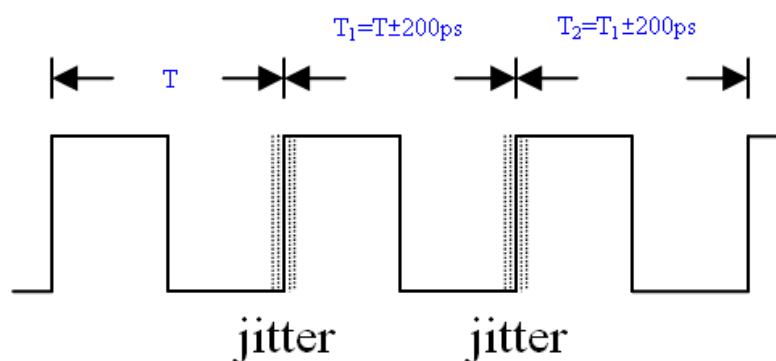
$$F_{clk}(max) \geq F_{r6} \times T_v \times T_h$$

$$F_{r5} \times T_v \times T_h \geq F_{clk}(min)$$

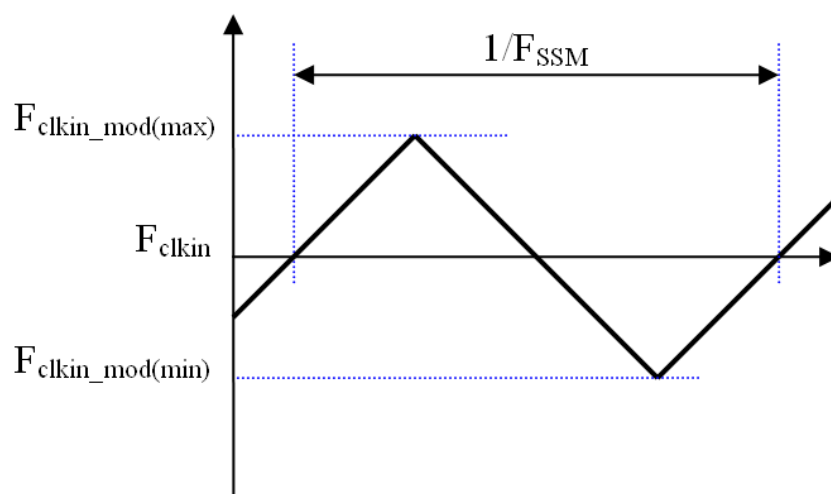
INPUT SIGNAL TIMING DIAGRAM



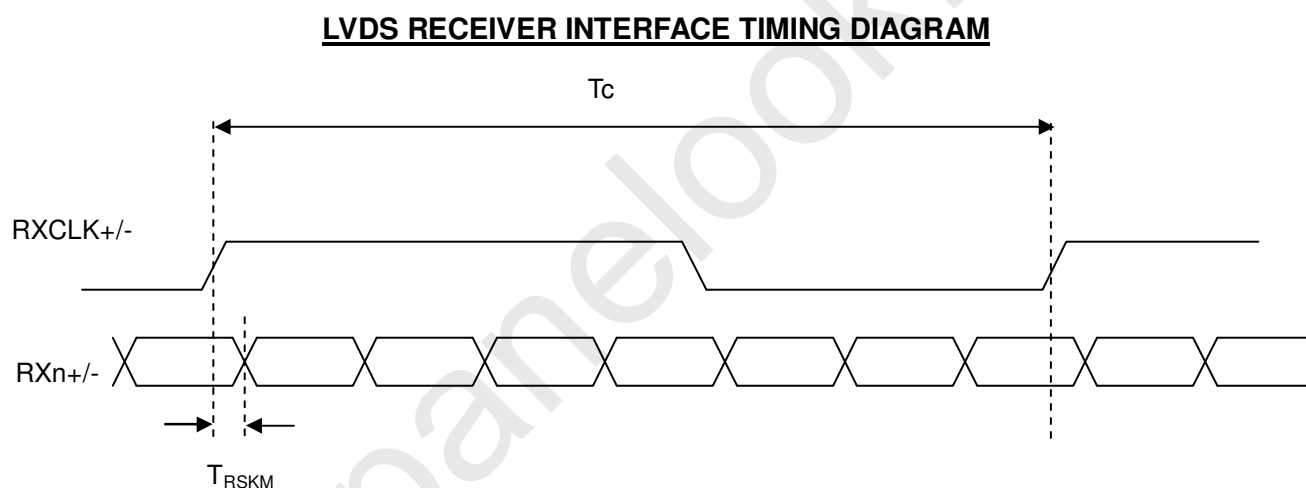
Note (3) The input clock cycle-to-cycle jitter is defined as below figures. $Trcl = |T_1 - T_1|$



Note (4) The SSCG (Spread spectrum clock generator) is defined as below figures.



Note (5) The LVDS timing diagram and setup/hold time is defined and showing as the following figures.



Note (6) Please fix the Vertical timing (Vertical Total = 968 / Display = 768 / Blank = 200) in 100Hz 3D mode
and Vertical timing (Vertical Total = 806 / Display = 768 / Blank = 38) in 120Hz 3D mode

Note (7) In 3D mode, the set up Fr5 and Fr6 in Typ. ± 3 HZ. In order to ensure that the electric function performance to avoid no display symptom. (Except picture quality symptom.)

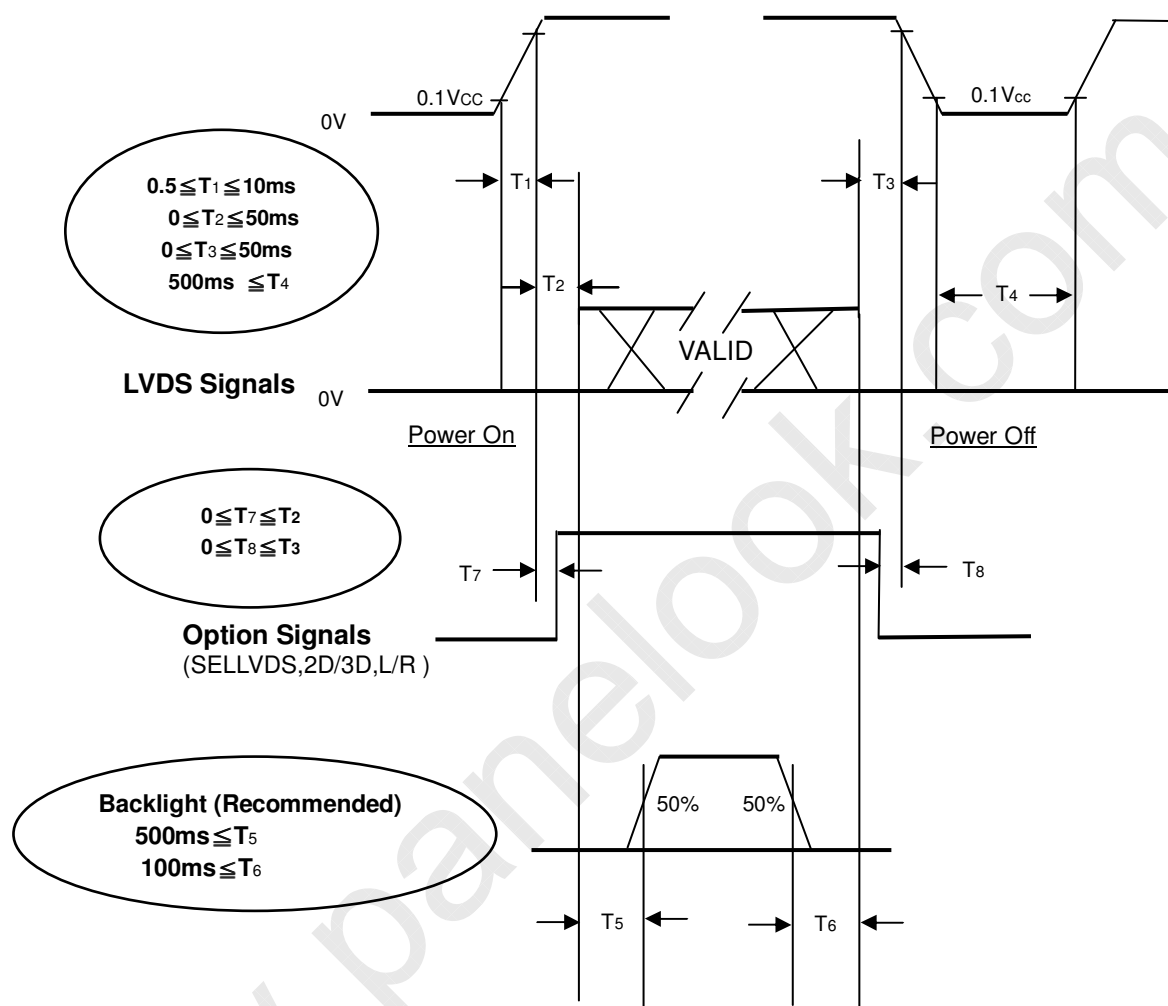
Note (8) In 3D mode, the set up Tv and Tvb in Typ. ± 30 . In order to ensure that the electric function performance to avoid no display symptom. (Except picture quality symptom.)

6.2 POWER ON/OFF SEQUENCE

($T_a = 25 \pm 2^\circ\text{C}$)

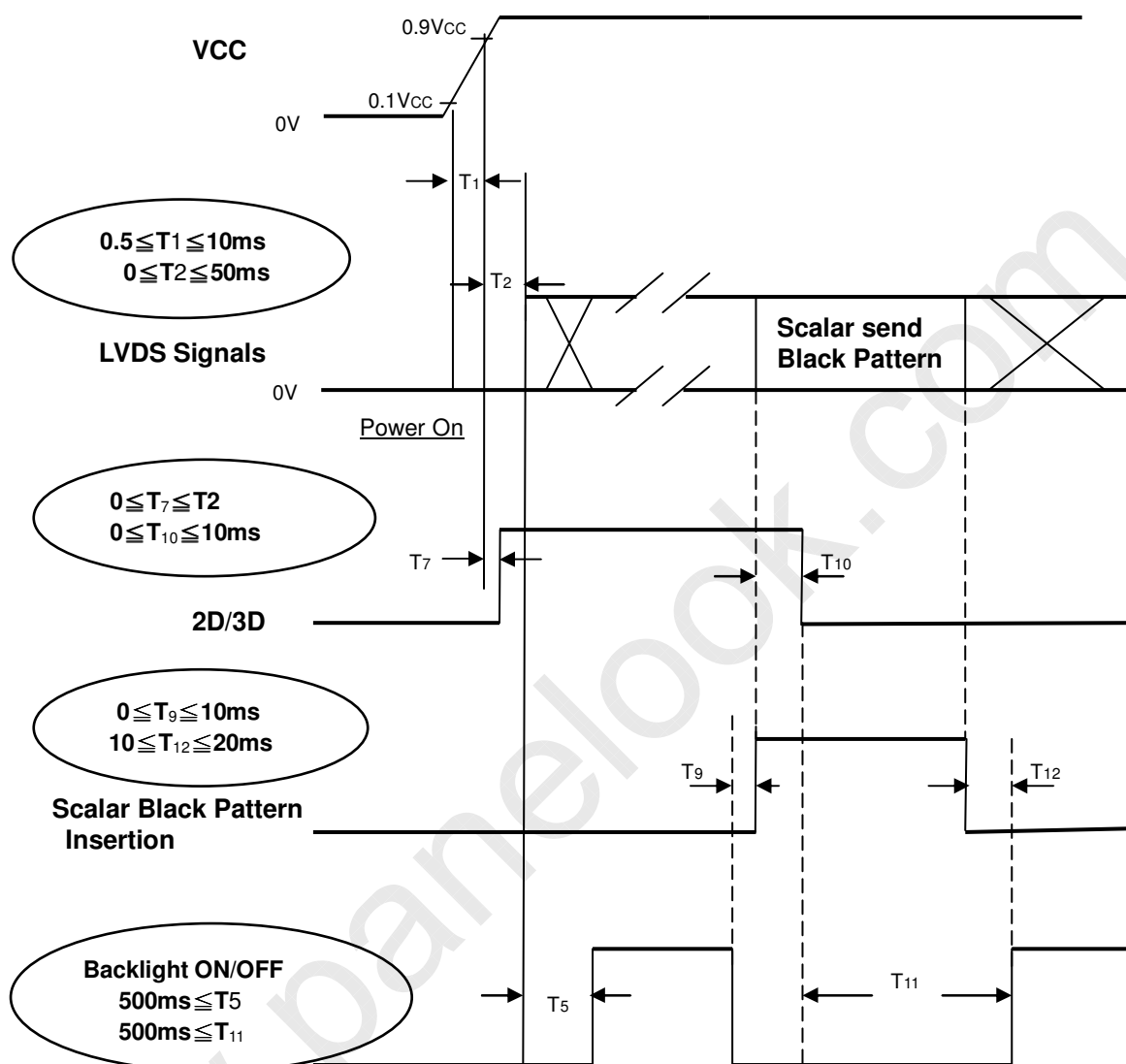
6.2.1 POWER ON/OFF SEQUENCE

To prevent a latch-up or DC operation of LCD module, the power on/off sequence should be as the diagram below.



Power ON/OFF Sequence

6.2.2 2D/3D MODE CHANGE SIGNAL SEQUENCE WITHOUT VCC TURN OFF AND TURN ON



Note (1) The supply voltage of the external system for the module input should follow the definition of V_{CC}.

Note (2) Apply the LED voltage within the LCD operation range. When the backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become abnormal screen.

Note (3) In case of V_{CC} is in off level, please keep the level of input signals on the low or high impedance. If T₂<0, that maybe cause electrical overstress failure.

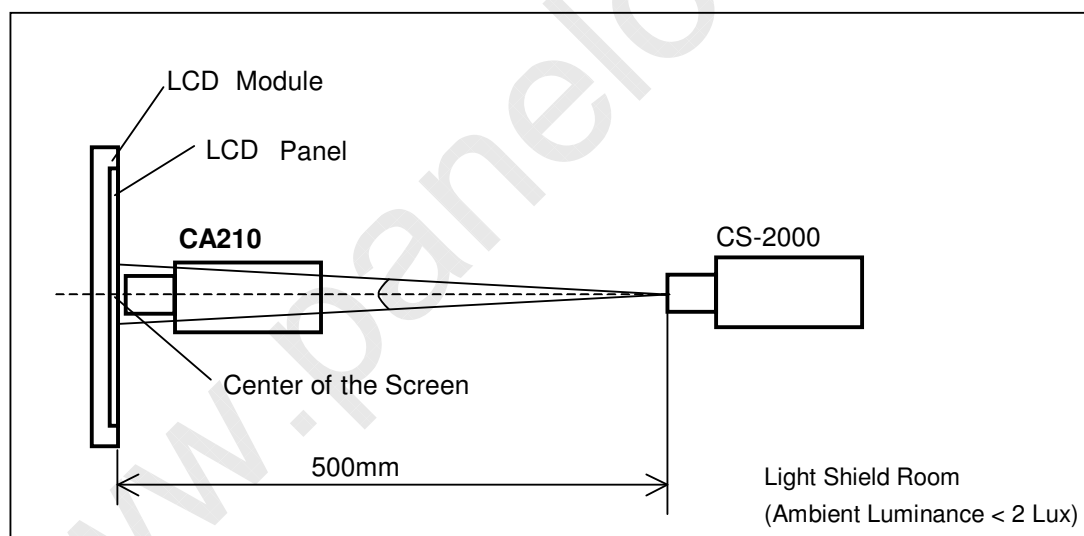
Note (4) T₄ should be measured after the module has been fully discharged between power off and on period.

Note (5) Interface signal shall not be kept at high impedance when the power is on.

7. OPTICAL CHARACTERISTICS**7.1 TEST CONDITIONS**

Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	oC
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	VCC	12	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
LED Current	IL	170±9	mA
Vertical Frame Rate	Fr	120	Hz

The LCD module should be stabilized at given temperature for 1 hour to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting backlight for 1 hour in a windless room.



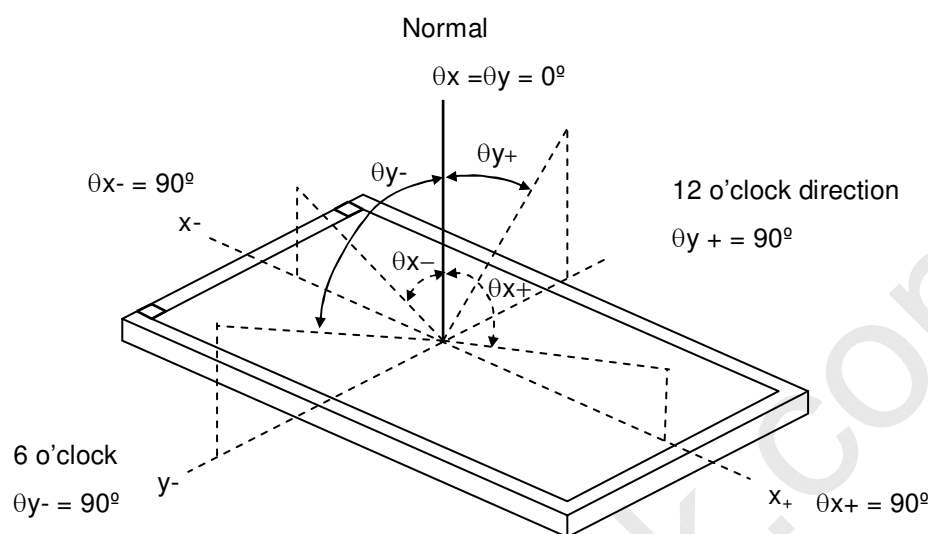
7.2 OPTICAL SPECIFICATIONS

The relative measurement methods of optical characteristics are shown in 7.2. The following items should be measured under the test conditions described in 7.1 and stable environment shown in 7.1.

Item		Symbol		Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio		CR		$\theta x=0^{\circ}, \theta y =0^{\circ}$ Viewing angle at normal direction	2100	3000		-	(2)
Response Time (VA)		Gray to gray				8.5	17	ms	(3)
Center Luminance of White		L_c	2D		280	350		cd/m^2	(4)
			3D			60		cd/m^2	(8)
White Variation		δW					1.3	-	(6)
Cross Talk		CT	2D				4	%	(5)
			3D-W		-	4	-	%	(8)
			3D-D		-	11	-	%	(8)
Color Chromaticity	Red	Rx			Typ. -0.03	0.639	Typ. +0.03	-	-
		Ry				0.337		-	
	Green	Gx				0.301		-	
		Gy				0.618		-	
	Blue	Bx				0.146		-	
		By				0.062		-	
	White	Wx				0.280		-	
		Wy				0.290		-	
	Correlated color temperature		-			10500		-	
	Color Gamut	C.G.			-	72	-	%	NTSC
Viewing Angle	Horizontal	$\theta x+$		CR $\geq$ 20	80	88	-	Deg.	(1)
		$\theta x-$			80	88	-		
	Vertical	$\theta y+$			80	88	-		
		$\theta y-$			80	88	-		
Transmission direction of the up polarizer		Φ_{up}		-	-	90	-	Deg.	(7)

Note (1) Definition of Viewing Angle (θ_x , θ_y) :

Viewing angles are measured by Autronic Conoscope Cono-80



Note (2) Definition of Contrast Ratio (CR) :

The contrast ratio can be calculated by the following expression.

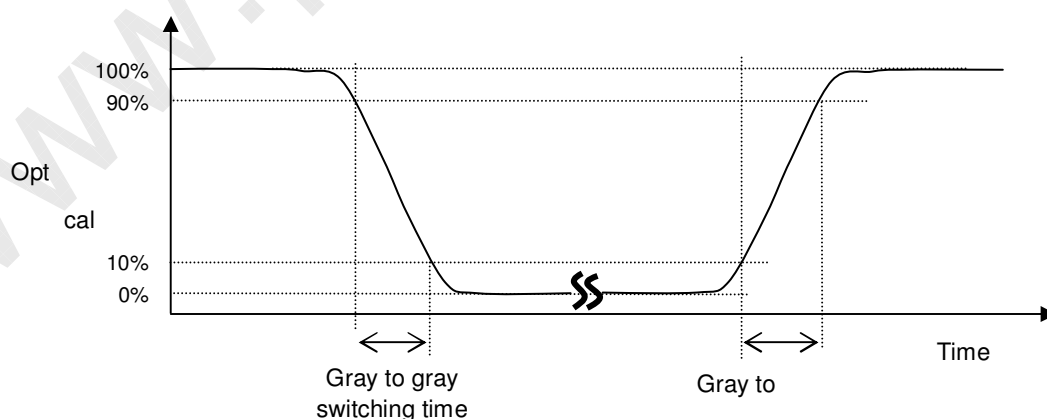
$$\text{Contrast Ratio (CR)} = \frac{\text{Surface Luminance of L255}}{\text{Surface Luminance of L0}}$$

L255: Luminance of gray level 255

L 0: Luminance of gray level 0

CR = CR (5), where CR (X) is corresponding to the Contrast Ratio of the point X at the figure in Note (6).

Note (3) Definition of Gray-to-Gray Switching Time:



The driving signal means the signal of gray level gray level (0,1,15, 63, 191, 223, 255)..Gray to gray average.

Gray to gray average time means the average switching time of gray level (0,1,15, 63, 191, 223, 255)..Gray to gray average

Note (4) Definition of Luminance of White (LC):

Measure the luminance of gray level 255 at center point and 5 points

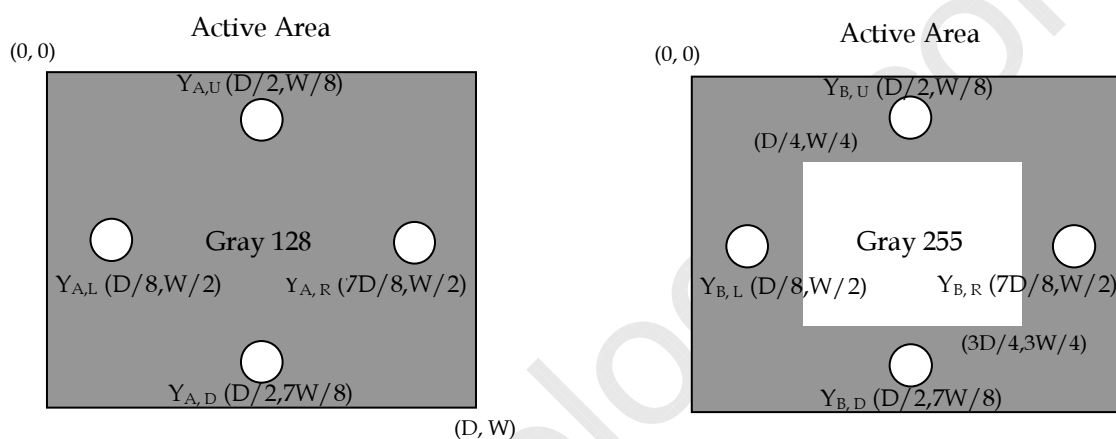
$L_C = L(5)$, where $L(X)$ is corresponding to the luminance of the point X at the figure in Note (6).

Note (5) Definition of Cross Talk (CT):

$$CT = |Y_B - Y_A| / Y_A \times 100 (\%)$$

Y_A = Luminance of measured location without gray level 255 pattern (cd/m^2)

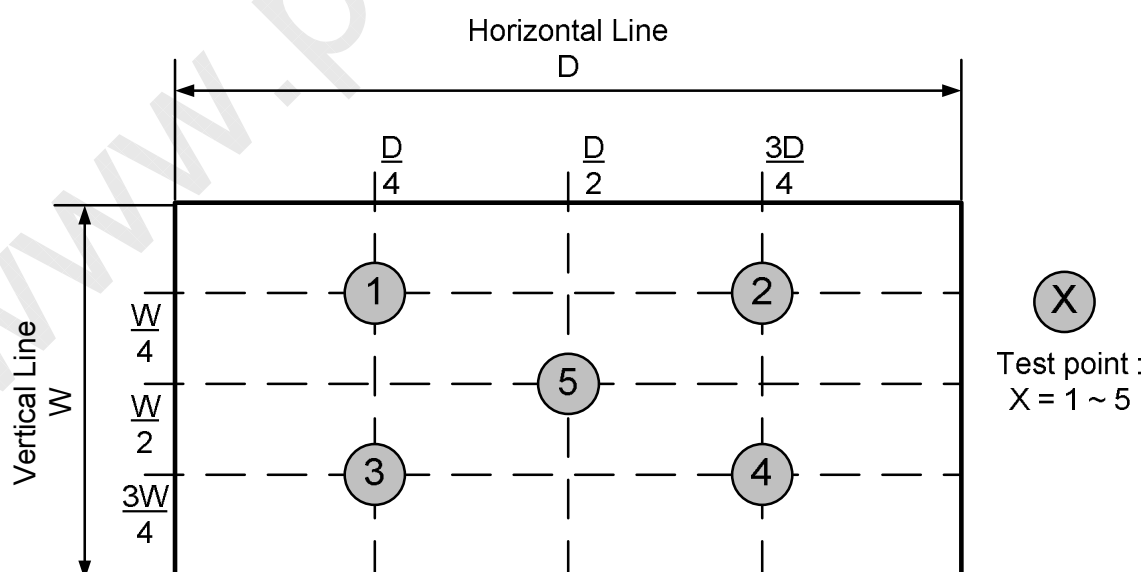
Y_B = Luminance of measured location with gray level 255 pattern (cd/m^2)



Note (6) Definition of White Variation (δW):

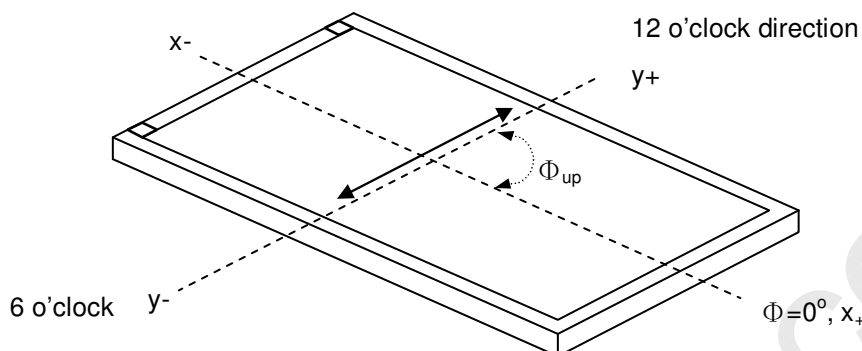
Measure the luminance of gray level 255 at 5 points

$$\delta W = \text{Maximum} [L(1), L(2), L(3), L(4), L(5)] / \text{Minimum} [L(1), L(2), L(3), L(4), L(5)]$$

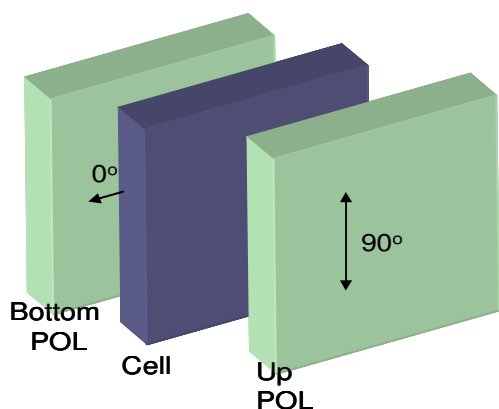


Note (7) This is a reference for designing the shutter glasses of 3D application. (VA)

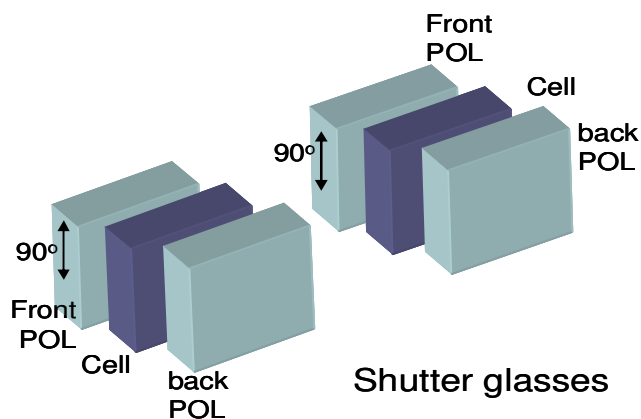
Definition of the transmission direction of the up polarizer:



The transmission axis of the front polarizer of the shutter glasses should be parallel to this panel transmission direction to get a maximum 3D mode luminance.



LCD module

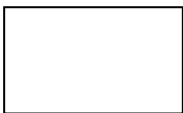


Shutter glasses

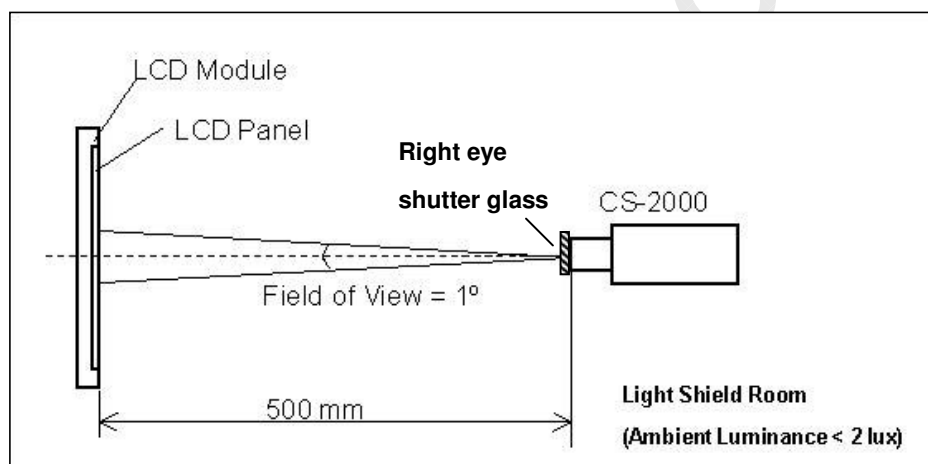
Note (8) Definition of the 3D mode performance (measured under 3D mode, use CMI's shutter glass):

a. Test pattern

Left eye image and right eye image are displayed alternated

		WW Left eye image: W255; Right eye image: W255
		WB Left eye image: W255; Right eye image: W0
		BW Left eye image: W0; Right eye image: W255
		BB Left eye image: W0; Right eye image: W0

b. Measurement setup



Shutter glasses are well controlled under suitable timing, and measure the luminance of the center point of the panel through the right eye glass. The transmittance of the glass should be larger than 40.0% under 3D mode operation.

The luminance of the test pattern "WW", denoted $L(WW)$; the luminance of the test pattern "WB", denoted $L(WB)$; the luminance of the test pattern "BW", denoted $L(BW)$; the luminance of the test pattern "BB", denoted $L(BB)$

c. Definition of the Center Luminance of White, $L_c(3D) : L(WW)$

d. Definition of the 3D mode white crosstalk, $CT(3D-W) : CT(3D-W) \equiv \frac{L(WB) - L(BB)}{L(WW) - L(BB)}$

e. Definition of the 3D mode dark crosstalk, $CT(3D-D) : CT(3D-D) \equiv \frac{L(WW) - L(BW)}{L(WW) - L(BB)}$

8. PRECAUTIONS

8.1 ASSEMBLY AND HANDLING PRECAUTIONS

- [1] Do not apply rough force such as bending or twisting to the module during assembly.
- [2] It is recommended to assemble or to install a module into the user's system in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
- [3] Do not apply pressure or impulse to the module to prevent the damage of LCD panel and Backlight.
- [4] Always follow the correct power-on sequence when the LCD module is turned on. This can prevent the damage and latch-up of the CMIS LSI chips.
- [5] Bezel of Set can not press or touch the panel surface. It will make light leakage or scrape.
- [6] Do not plug in or pull out the I/F connector while the module is in operation.
- [7] Do not disassemble the module.
- [8] Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.
- [9] Moisture can easily penetrate into LCD module and may cause the damage during operation.
- [10] When storing modules as spares for a long time, the following precaution is necessary.
 - [10.1] Do not leave the module in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35°C at normal humidity without condensation.
 - [10.2] The module shall be stored in dark place. Do not store the TFT-LCD module in direct sunlight or fluorescent light.
- [11] When ambient temperature is lower than 10°C, the display quality might be reduced. For example, the response time will become slow, and the starting voltage of CCFL will be higher than that of room temperature.

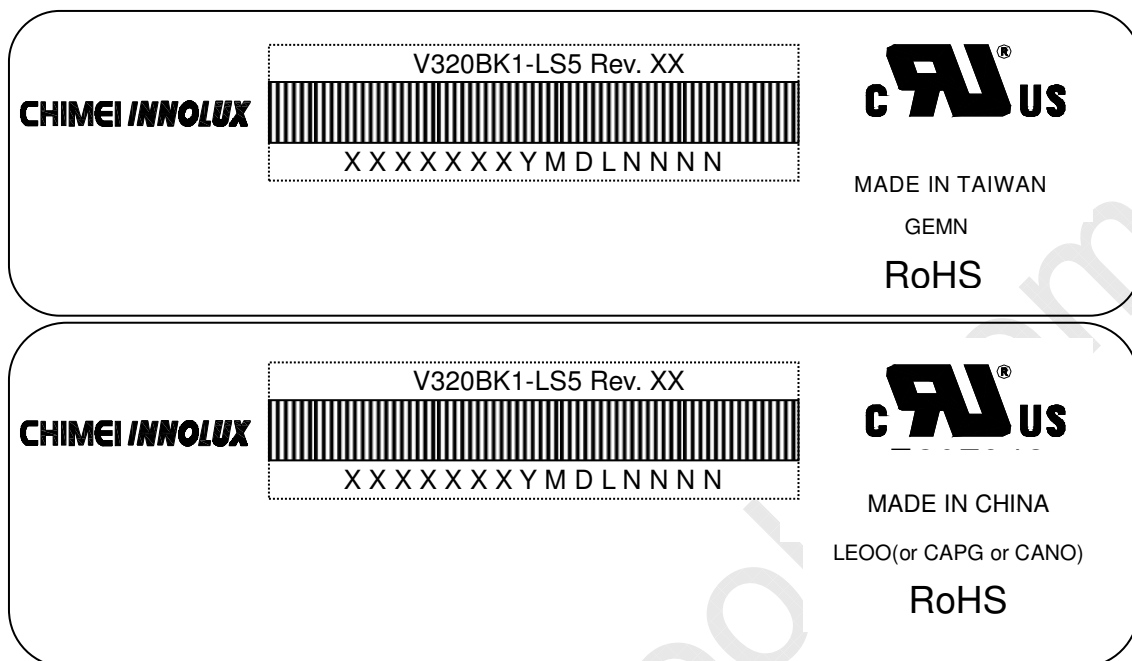
8.2 SAFETY PRECAUTIONS

- [1] The startup voltage of a Backlight is approximately 1000 Volts. It may cause an electrical shock while assembling with the converter. Do not disassemble the module or insert anything into the Backlight unit.
- [2] 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.
- [3] After the module's end of life, it is not harmful in case of normal operation and storage.

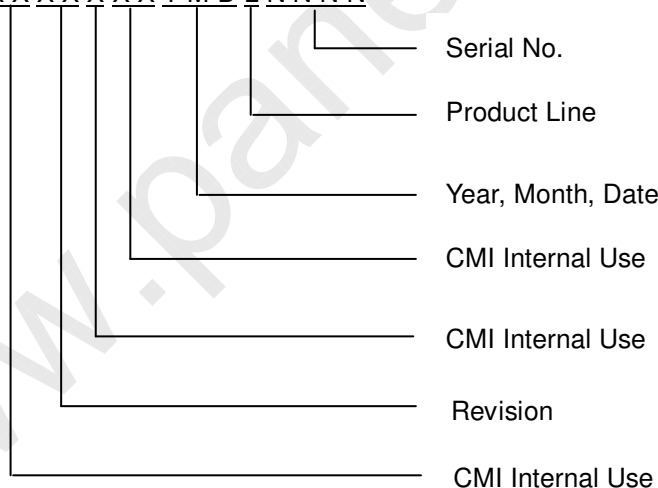
9. DEFINITION OF LABELS

9.1 CMI MODULE LABEL

The barcode nameplate is pasted on each module as illustration, and its definitions are as following explanation.



- (a) Model Name: V320BK1-LS5
 (b) Revision: Rev. XX, for example: A0, A1... B1, B2... or C1, C2...etc.
 (c) Serial ID: XXXXXXYMDLNNNN



Serial ID includes the information as below:

- (a) Manufactured Date: Year: 0~9, for 2010~2019
 Month: 1~9, A~C, for Jan. ~ Dec.
 Day: 1~9, A~Y, for 1st to 31st, exclude I, O, and U.
 (b) Revision Code: Cover all the change
 (c) Serial No.: Manufacturing sequence of product
 (d) Product Line: 1 -> Line1, 2 -> Line 2, ...etc.

10. PACKAGING

10.1 PACKAGING SPECIFICATIONS

- (1) 6 LCD TV modules / 1 Box
- (2) Box dimensions : 826(L)x376(W)x540(H)mm
- (3) Weight : approximately 32Kg (6 modules per box)

10.2 PACKAGING METHOD

Figures 10-1 and 10-2 are the packing method

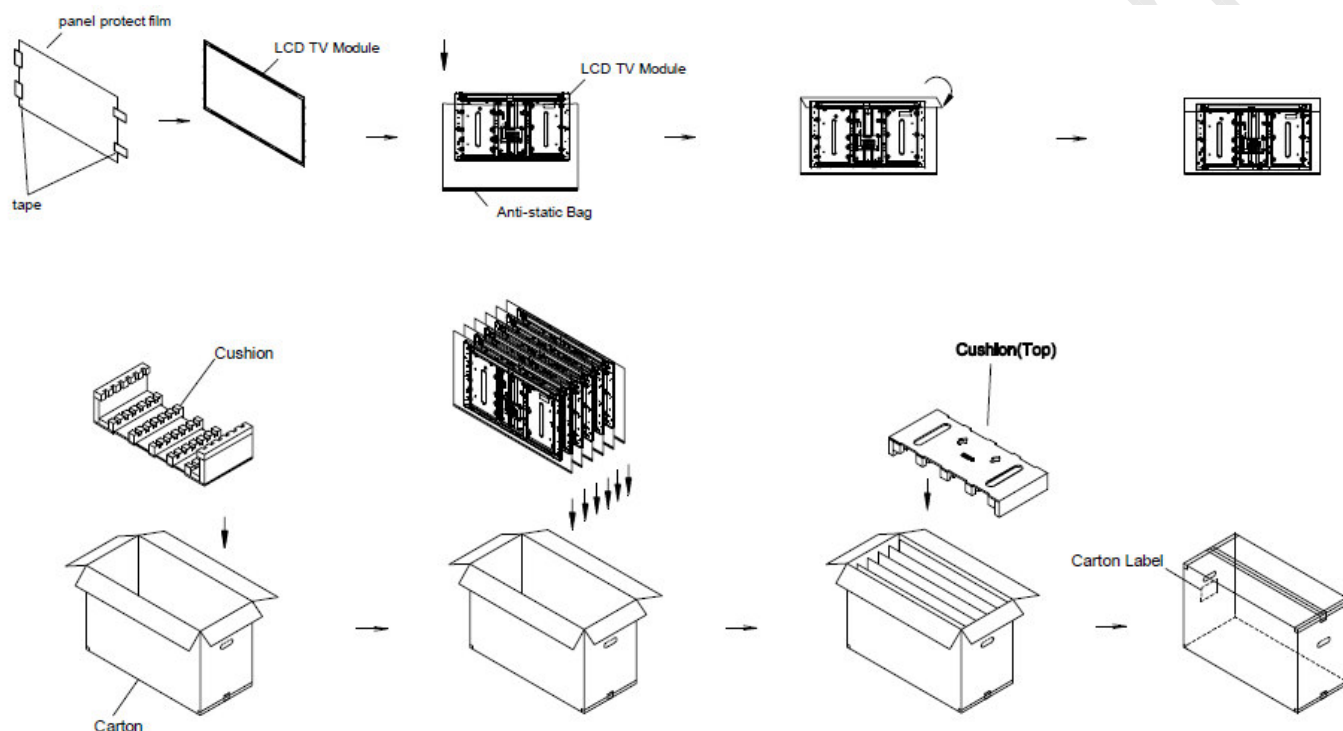
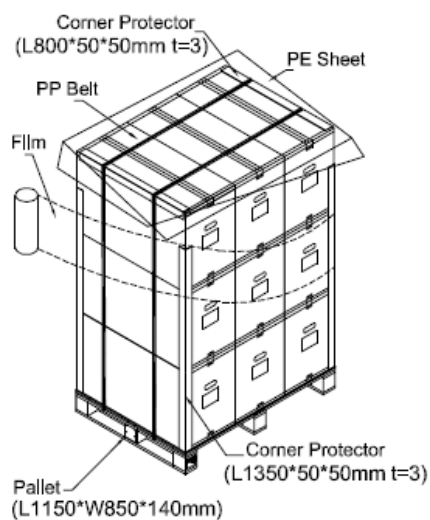
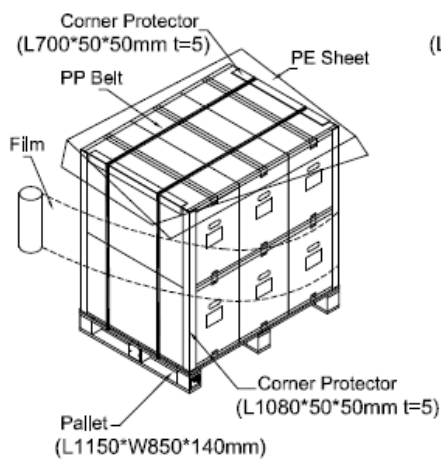


Figure 10-1 packing method

Sea / Land Transportation
(40ft Contalner)



Air Transportation



Sea / Land Transportation
(40ft HQ Contalner)

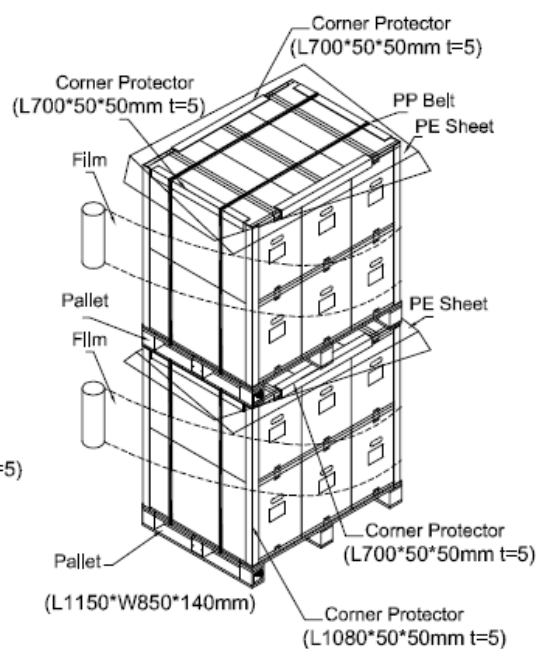
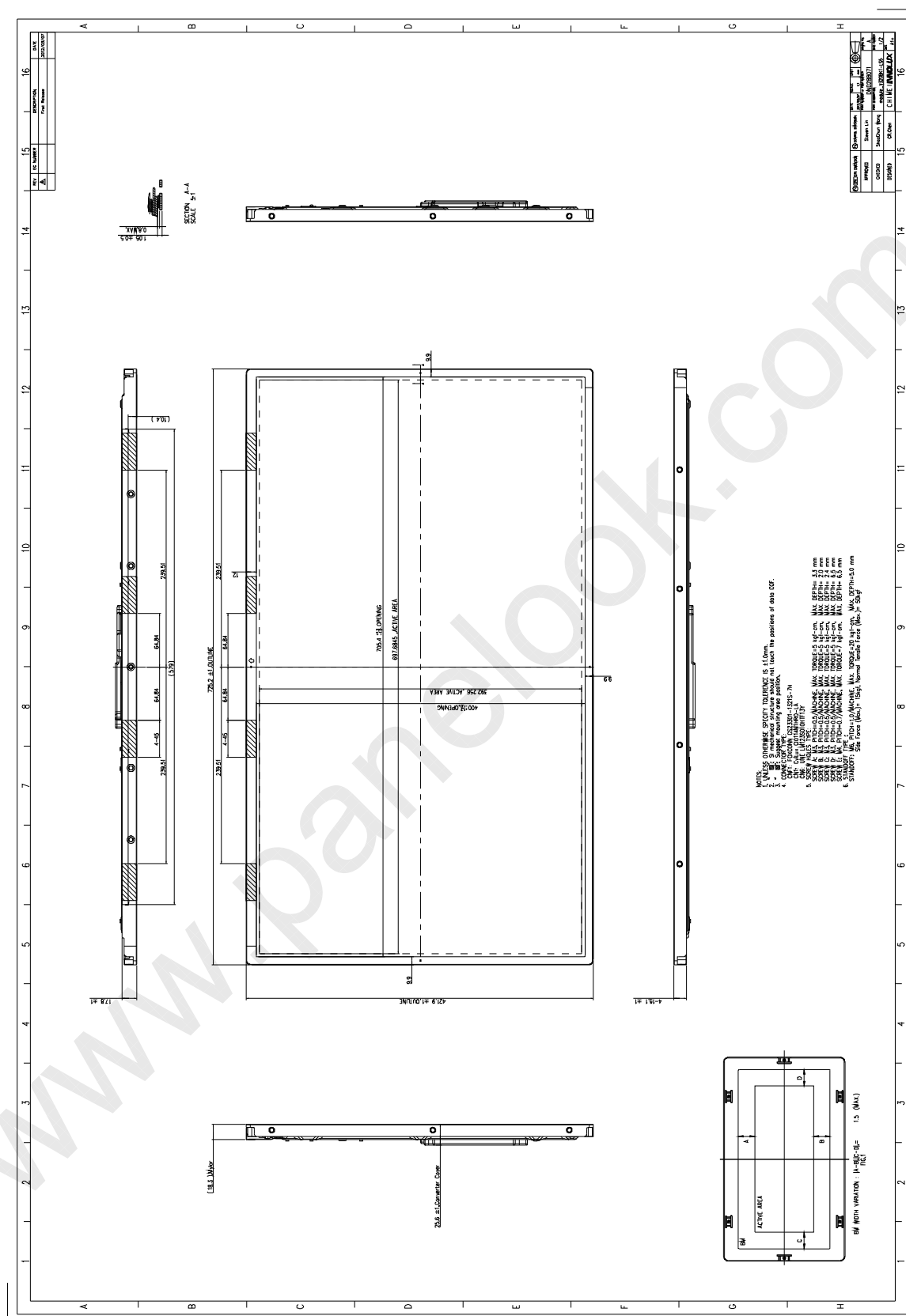


Figure 10-2 packing method

11. MECHANICAL CHARACTERISTIC



PRODUCT SPECIFICATION

