

Doc. Number :

- ☐ Tentative Specification
☐ Preliminary Specification
☒ Approval Specification

MODEL NO.: M315DJJ
 SUFFIX: K31

Customer:

APPROVED BY

SIGNATURE

Name / Title

Note

Product Version C1

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 GENERAL SPECIFICATIONS	5
2. MECHANICAL SPECIFICATIONS	6
3. ABSOLUTE MAXIMUM RATINGS	6
3.1 ABSOLUTE RATINGS OF ENVIRONMENT	6
3.2 ELECTRICAL ABSOLUTE RATINGS	7
3.2.1 TFT LCD MODULE	7
3.2.2 BACKLIGHT UNIT	7
4. ELECTRICAL SPECIFICATIONS	8
4.1 FUNCTION BLOCK DIAGRAM	8
4.2. INTERFACE CONNECTIONS	8
4.3 ELECTRICAL CHARACTERISTICS	11
4.3.1 LCD ELETRONICS SPECIFICATION	11
4.3.2 VCC POWER DIP CONDITION	12
4.3.3 BACKLIGHT UNIT	13
4.3.4 LIGHTBAR CONNECTOR PIN ASSIGNMENT	14
4.4 LVDS INPUT SIGNAL SPECIFICATIONS	16
4.4.1 V BY One ONE DATA MAPPING TABLE	16
4.4.2 COLOR DATA INPUT ASSIGNMENT	16
4.5 DISPLAY TIMING SPECIFICATIONS	17
4.6 V BY ONE INPUT SIGNAL TIMING DIAGRAM	19
4.7 BYTE LENGTH AND COLOR MAPPING OF V-BY-ONE HS	19
4.8 POWER ON/OFF SEQUENCE (Ta = 25 ± 2 °C)	20
5. OPTICAL CHARACTERISTICS	22
5.1 TEST CONDITIONS	22
5.2 OPTICAL SPECIFICATIONS	22
6. RELIABILITY TEST ITEM	26
7. MECHANICAL STRENGTH CHARACTERISTICS	27
7.1 MECHANICAL STRENGTH SPECIFICATIONS	27
7.2 TEST CONDITIONS	27
7.3 DEFINITION OF TEST POINTS	27
8. PACKING	28
8.1 PACKING SPECIFICATIONS	28
8.2 PACKING METHOD	28

8.3 PALLET	29
8.4 UN-PACKING METHOD	30
9. INX MODULE LABEL	31
10. PRECAUTIONS	32
10.1 ASSEMBLY AND HANDLING PRECAUTIONS	32
10.2 STORAGE PRECAUTIONS	32
10.3 OPERATION PRECAUTIONS	32
10.4 SAFETY PRECAUTIONS	33
10.5 SAFETY STANDARDS	33
10.6 OTHER	33
Appendix 1. SYSTEM COVER DESIGN NOTICE	34
Appendix 2. OUTLINE DRAWING	37

REVISION HISTORY

[illegible]

1. GENERAL DESCRIPTION

1.1 OVERVIEW

M315DJJ-K31 is a 31.5" TFT Liquid Crystal Display MNT module with WLED Backlight unit and 51 pins 8lane -V by1 interface. This module supports 3840 x 2160 UHD mode and can display up to 1.073G colors.

The converter module for Backlight is not built in.

1.2 GENERAL SPECIFICATIONS

Item	Specification	Unit	Note
Screen Size	31.5" real diagonal		
Driver Element	a-si TFT active matrix	-	-
Pixel Number	3840 x R.G.B. x 2160	pixel	-
Pixel Pitch	0.181 (H) x 0.181 (V)	mm	-
Pixel Arrangement	RGB vertical stripe	-	-
Display Colors	1.073G	color	-
Transmissive Mode	Normally Black	-	-
Surface Treatment	AG type, 3H hard coating, Haze 25	-	-
Luminance, White	400	Cd/m2	
Color Gamut	95% of NTSC(Typ.)	-	-
Display Orientation	Signal input with " INX"		(2)
Compliance	RoHS, Halogen Free TCO 7.0, VESA PCHDR-600 compliance		
Power Consumption	Total (91.92) W (Max.) @ cell 15.12 W (Max.), BL (76.8) W (Max.)		(1)

Note (1) The specified power consumption : Total= cell (reference 4.3.1)+BL (reference 4.3.3)

Note (2)



2. MECHANICAL SPECIFICATIONS

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	716.4	717.4	718.4	mm	(1)
	Vertical (V)	412.85	413.85	414.85	mm	
	Thickness (T)	16.9	17.9	18.9	mm	
Bezel Area	Horizontal	702.4	703.4	704.4	mm	
	Vertical	396.85	397.85	398.85	mm	
Active Area	Horizontal	-	698.4	-	mm	
	Vertical	-	392.85	-	mm	
Weight		-	3600	3650	g	

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

3. ABSOLUTE MAXIMUM RATINGS

3.1 ABSOLUTE RATINGS OF ENVIRONMENT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	TST	-20	60	°C	(1)
Operating Ambient Temperature	TOP	0	50	°C	(1), (2)

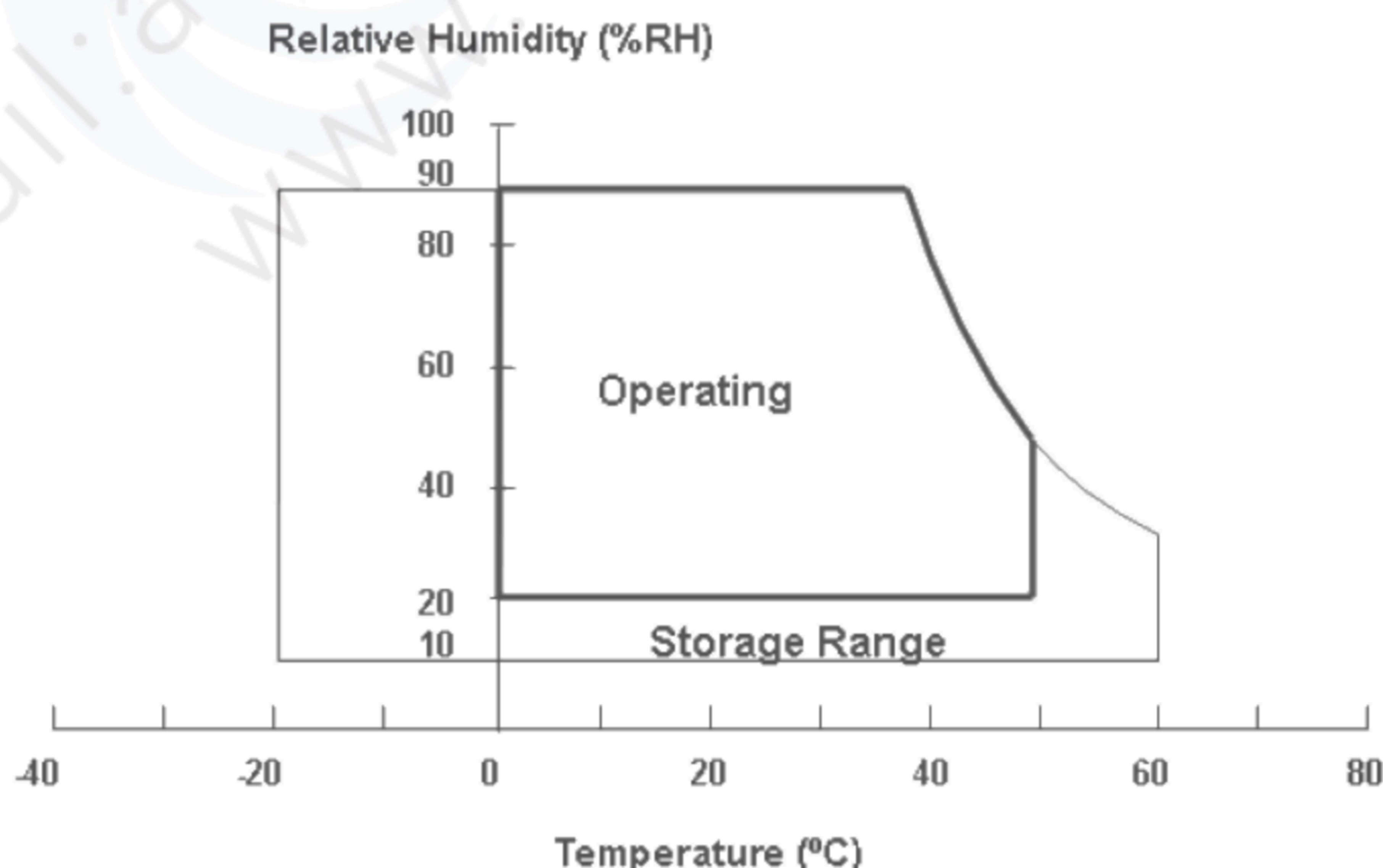
Note (1)

(a) 90 %RH Max.

(b) Wet-bulb temperature should be 39 °C Max.

(c) No condensation.

Note (2) Panel surface temperature should be 0°C min. and 65°C max under Vcc=5.0V, fr =60Hz, typical LED string current, 25°C ambient temperature, and no humidity control . Any condition of ambient operating temperature ,the surface of active area should be keeping not higher than 65°C .



3.2 ELECTRICAL ABSOLUTE RATINGS

3.2.1 TFT LCD MODULE

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

3.2.2 BACKLIGHT UNIT

Item	Symbol	Value			Unit	Note
		Min.	Typ	Max.		
LED Forward Current Per Input Pin	I _F	142.5	150	157.5	mA	(1), (2), (3),
LED Reverse Voltage Per Input Pin	V _R	24	30	32	V	
LED Pulse Forward Current Per Input Pin	I _P			500	mA	(1), (2) Pulse Width ≤ 10msec. and Duty ≤ 10%

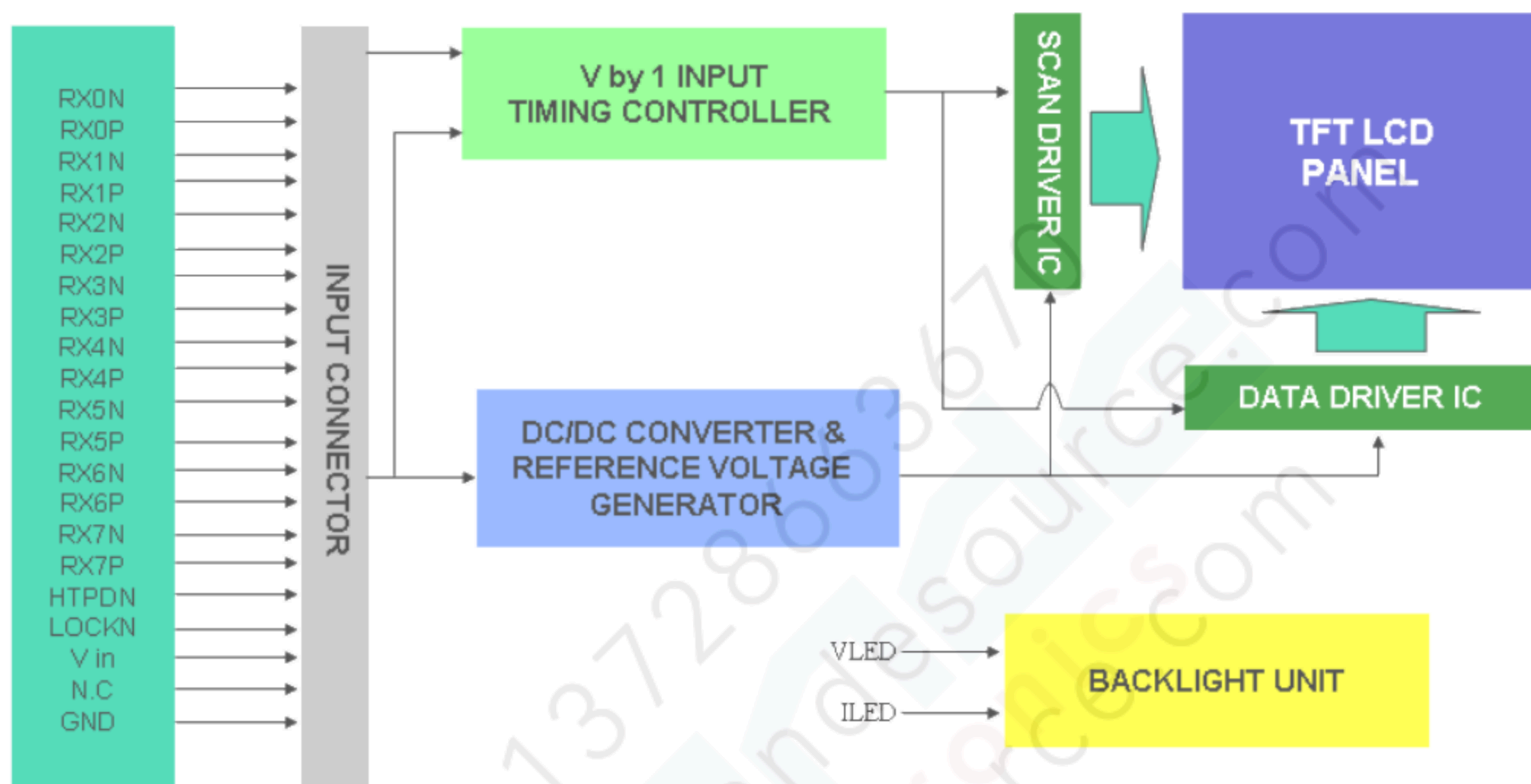
Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

Note (2) Specified values are for input pin of LED light bar at Ta=25±2 °C (Refer to 4.3.3 and 4.3.4 for further information).

Note (3) Duty=60% for normal mode/ Duty=5%~100% for HDR mode

4. ELECTRICAL SPECIFICATIONS

4.1 FUNCTION BLOCK DIAGRAM



4.2. INTERFACE CONNECTIONS

PIN ASSIGNMENT

Pin	Name	Description	Note
1	Vin	Power input (+12V)	
2	Vin	Power input (+12V)	
3	Vin	Power input (+12V)	
4	Vin	Power input (+12V)	
5	Vin	Power input (+12V)	
6	Vin	Power input (+12V)	
7	Vin	Power input (+12V)	
8	Vin	Power input (+12V)	
9	N.C.	No Connection	(2)
10	GND	Ground	
11	GND	Ground	
12	GND.	Ground	
13	GND.	Ground	
14	GND.	Ground	
15	N.C.	No Connection	(2)
16	N.C.	No Connection	(2)
17	N.C.	No Connection	(2)
18	N.C	For internal use, no connection	
19	N.C	For internal use, no connection	
20	N.C.	No Connection	(2)
21	N.C.	No Connection	(2)
22	N.C.	No Connection	(2)
23	N.C.	No Connection	(2)

24	N.C.	No Connection	(2)
25	HTPDN	Hot plug detect output, Open drain.	
26	LOCKN	Lock detect output, Open drain.	
27	GND	Ground	
28	RX0N	1 st Pixel Negative VbyOne differential data input in area A. Lan 0	(1)
29	RX0P	1 st Pixel Positive VbyOne differential data input in area A. Lan 0	
30	GND	Ground	
31	RX1N	2 nd Pixel Negative VbyOne differential data input in area A. Lan 1	(1)
32	RX1P	2 nd Pixel Positive VbyOne differential data input in area A. Lan 1	
33	GND	Ground	
34	RX2N	3 rd Pixel Negative VbyOne differential data input in area A. Lan 2	(1)
35	RX2P	3 rd Pixel Positive VbyOne differential data input in area A. Lan 2	
36	GND	Ground	
37	RX3N	4 th Pixel Negative VbyOne differential data input in area A. Lan 3	(1)
38	RX3P	4 th Pixel Positive VbyOne differential data input in area A. Lan 3	
39	GND	Ground	
40	RX4N	5 th Pixel Negative VbyOne differential data input in area A. Lan 4	(1)
41	RX4P	5 th Pixel Positive VbyOne differential data input in area A. Lan 4	
42	GND	Ground	
43	RX5N	6 th Pixel Negative VbyOne differential data input in area A. Lan 5	(1)
44	RX5P	6 th Pixel Positive VbyOne differential data input in area A. Lan 5	
45	GND	Ground	
46	RX6N	7 th Pixel Negative VbyOne differential data input in area A. Lan 6	(1)
47	RX6P	7 th Pixel Positive VbyOne differential data input in area A. Lan 6	
48	GND	Ground	
Pin	Name	Description	Note
49	RX7N	8 th Pixel Negative VbyOne differential data input in area A. Lan 7	(1)
50	RX7P	8 th Pixel Positive VbyOne differential data input in area A. Lan 7	
51	GND	Ground	

Connector Information

Item	Description
Manufacturer	FCN/ P-TWO
Type part number	FCN: WF23-402-5133 P-TWO: 187059-51221
User's Mating housing part number	JAE: FI-RE51HL

*Notice: There would be compatible issues if not using the indicated connectors in the matching list.

Note (1) V-by-One[®] HS Data Mapping

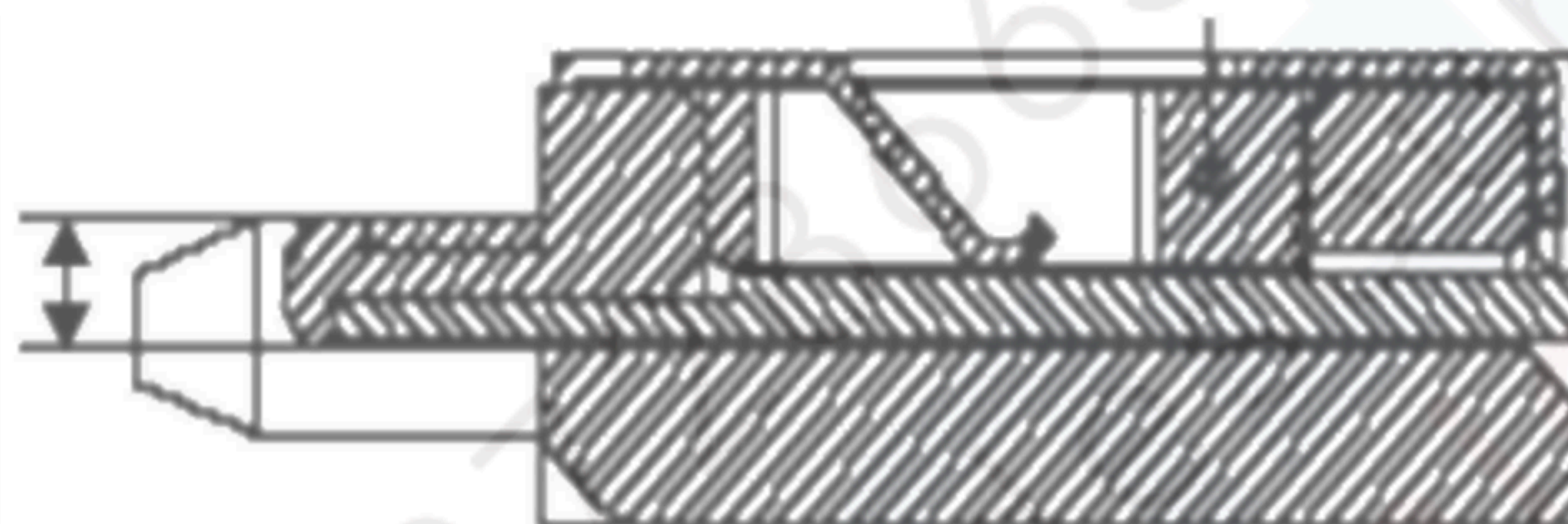
Lan	Data Stream
Lan 0	1, 9, 17,, 3825, 3833
Lan 1	2, 10, 18,, 3826, 3834
Lan 2	3, 11, 19,, 3827, 3835
Lan 3	4, 12, 20,, 3828, 3836
Lan 4	5, 13, 21,, 3829, 3837
Lan 5	6, 14, 22,, 3830, 3838
Lan 6	7, 15, 23,, 3831, 3839
Lan 7	8, 16, 24,, 3832, 3840

Note (2) Reserved for internal use. Please leave it open.

Note (3) VbyOne HS connector pin order defined as following:

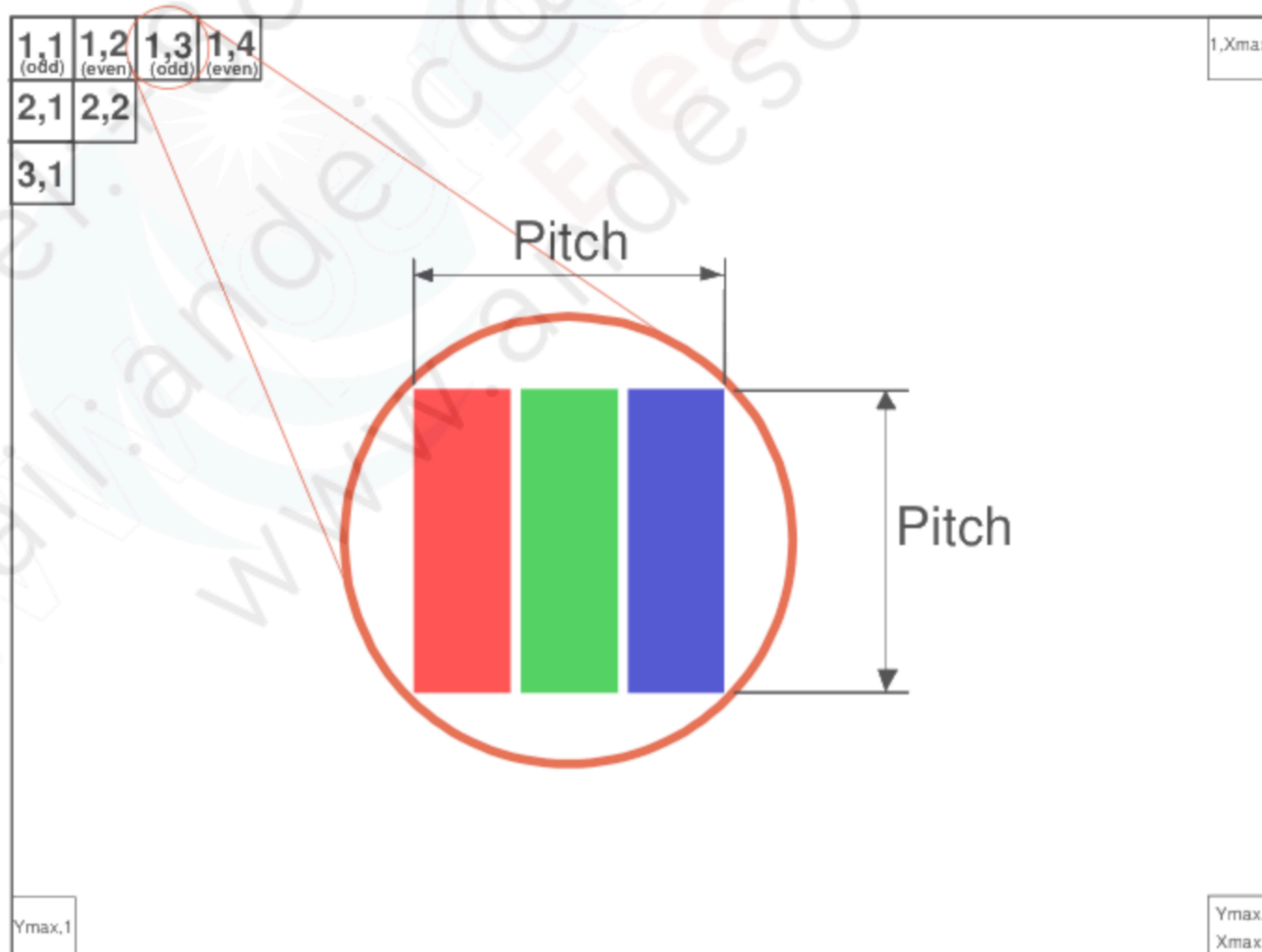


Note (4) V-by-One connector mating dimension range request is 0.93mm~1.0mm as below:



Note (5) The first pixel is odd.

Note (6) Input signal of even and odd clock should be the same timing



4.3 ELECTRICAL CHARACTERISTICS

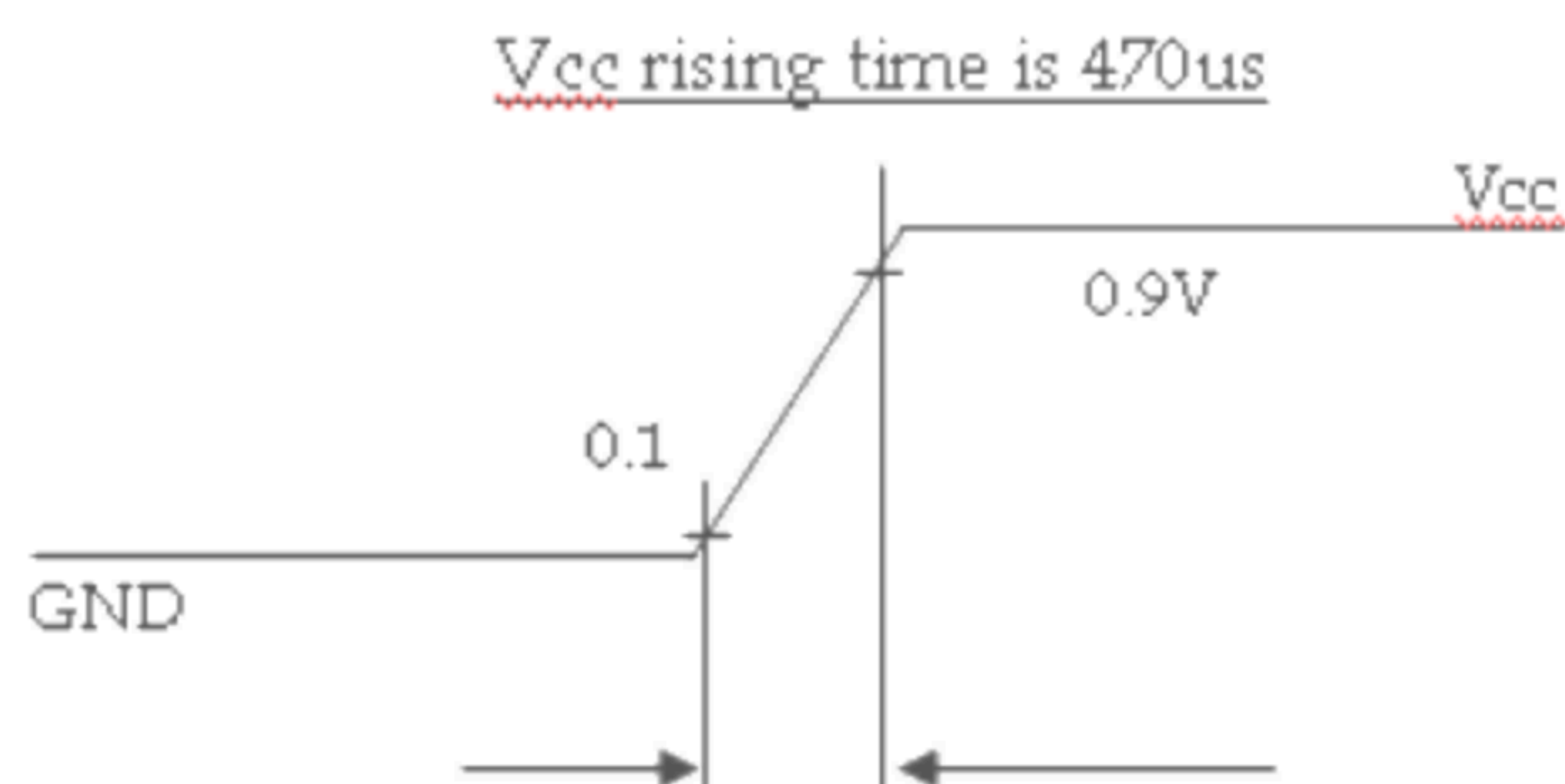
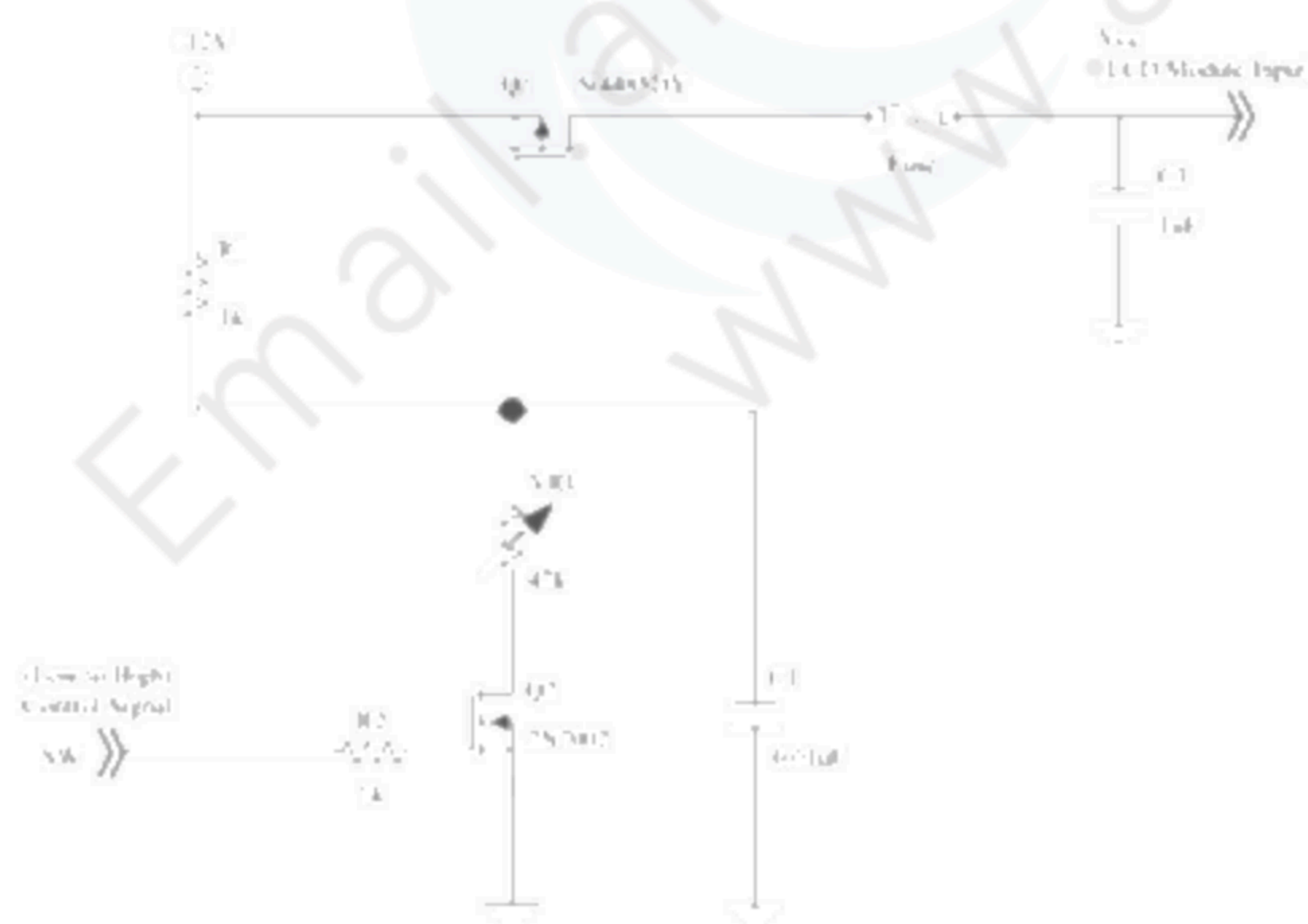
4.3.1 LCD ELETRONICS SPECIFICATION

(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}	—	—	2.6	A	(2)
Power Consumption	White Pattern	P _T	—	8.78	9.52	W	(3)
	Black Pattern	P _T	—	8.18	8.86	W	
	Horizontal Stripe	P _T	—	15.12	16.38	W	
Power Supply Current	White Pattern	—	—	0.73	0.88	A	(3)
	Black Pattern	—	—	0.68	0.82	A	
	Horizontal Stripe	—	—	1.26	1.53	A	
VbyOne HS	Differential Input High Threshold Voltage	VLVTH	—	—	+50	mV	
	Differential Input Low Threshold Voltage	VLVTL	-50	—	—	mV	
	Differential Input Resistor	RRIN	80	100	120	ohm	
CMOS interface	Input High Threshold Voltage	VIH	2.7	—	3.3	V	
	Input Low Threshold Voltage	VIL	0	—	0.7	V	

Note (1) The module should be always operated within the above ranges. The ripple voltage should be controlled under 10 % of V_{CC} (Typ.)

Note (2) Measurement Conditions



Note (3) The specified power supply current is under the conditions at $V_{CC} = 12\text{ V}$, $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$, $F_r = 60\text{ Hz}$, whereas a power dissipation check pattern below is displayed.

a. White Pattern



Active Area

b. Black Pattern

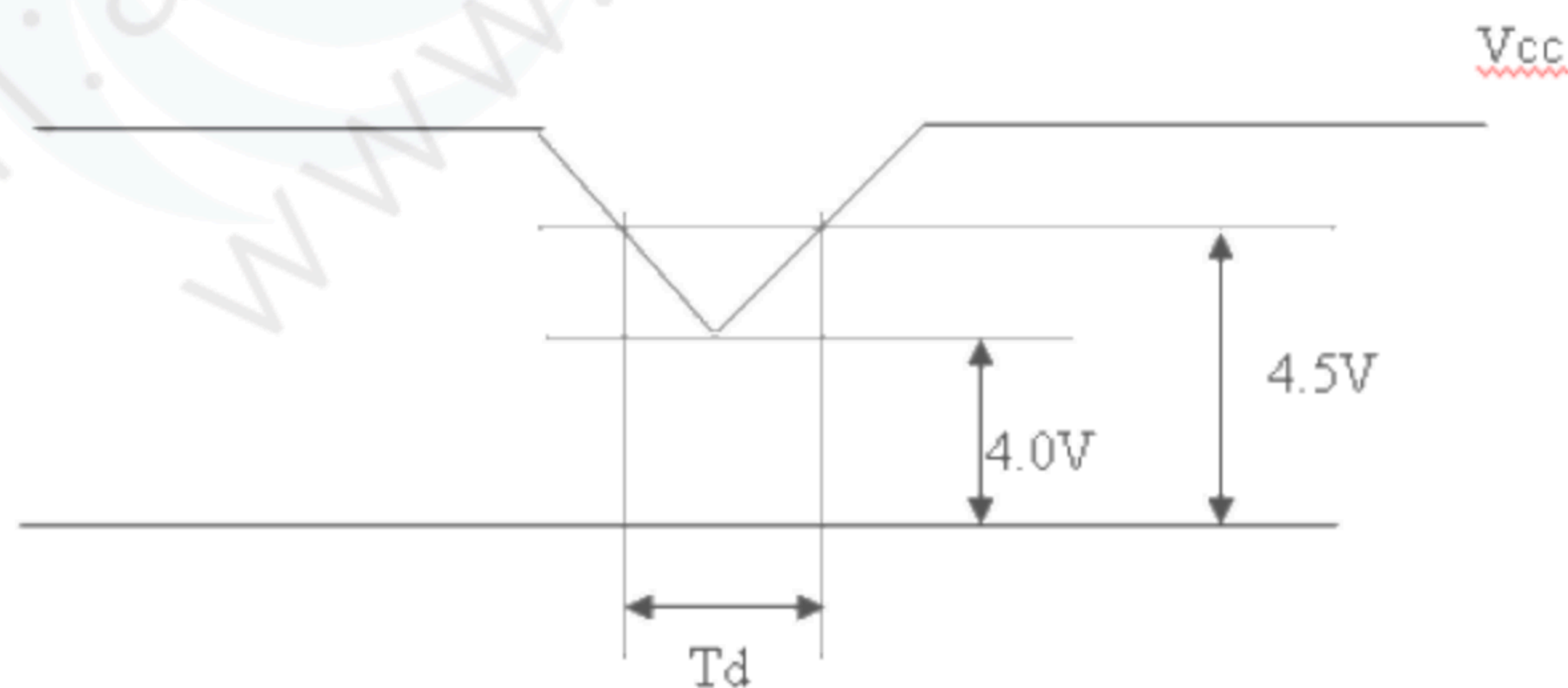


Active Area

c. Horizontal Pattern



4.3.2 VCC POWER DIP CONDITION



4.3.3 BACKLIGHT UNIT

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
LED Light Bar Input Voltage Per Input Pin	VPIN	24	30	32	V	(1), Duty=100%, IPIN=150mA
LED Light Bar Current Per Input Pin	IPIN	142.5	150	157.5	mA	(1), (2), (5)
LED Life Time	LLED	30000			Hrs	(3)
Power Consumption	PBL	---	72	76.8	W	(1) Duty=100%, IPIN=150mA

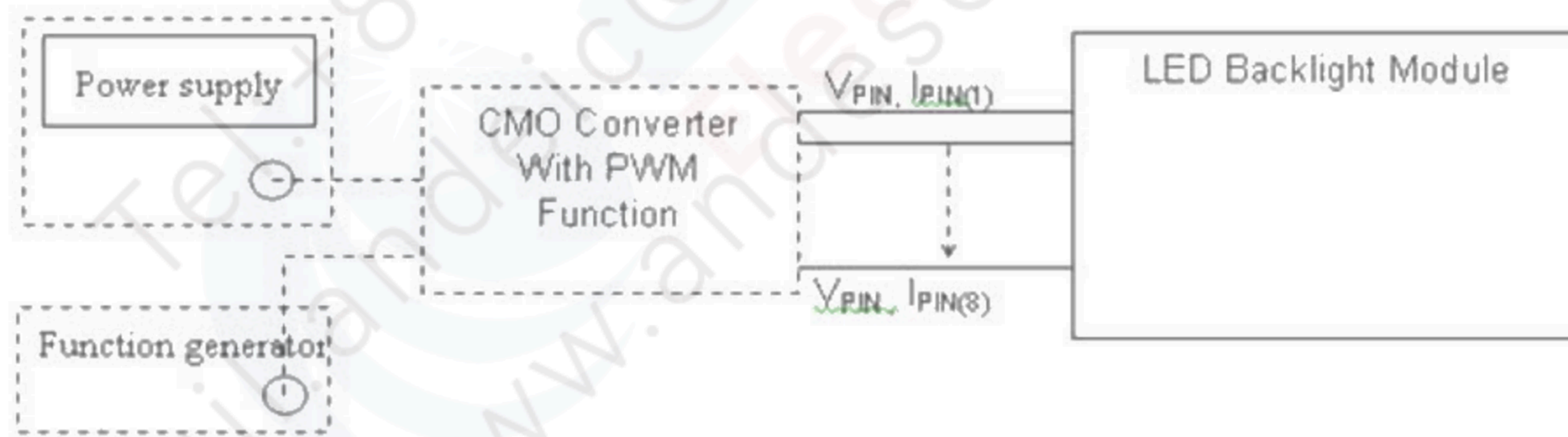
Note (1) LED light bar input voltage and current are measured by utilizing a true RMS multimeter as shown below:

Note (2) $PBL = IPIN \times VPIN \times (16)$ input pins ,

Note (3) The lifetime of LED is defined as the time when LED packages continue to operate under the conditions at $T_a = 25 \pm 2^\circ\text{C}$ and $I = (150)\text{mA}$ (per chip) until the brightness becomes $\leq 50\%$ of its original value.

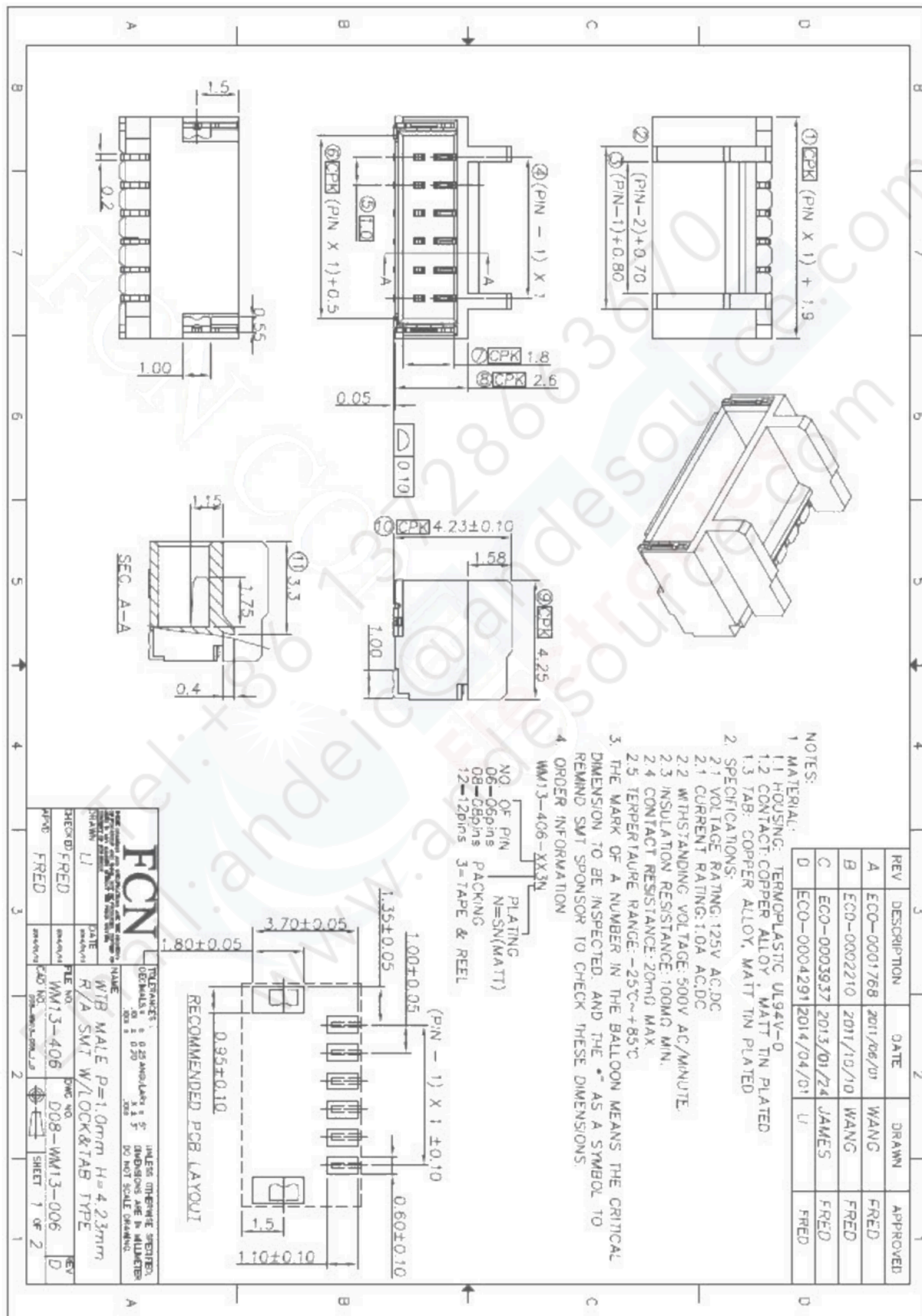
Note (4) The module must be operated with constant driving current.

Note (5) Duty=60% for normal mode/ Duty=5%~100% for HDR mode



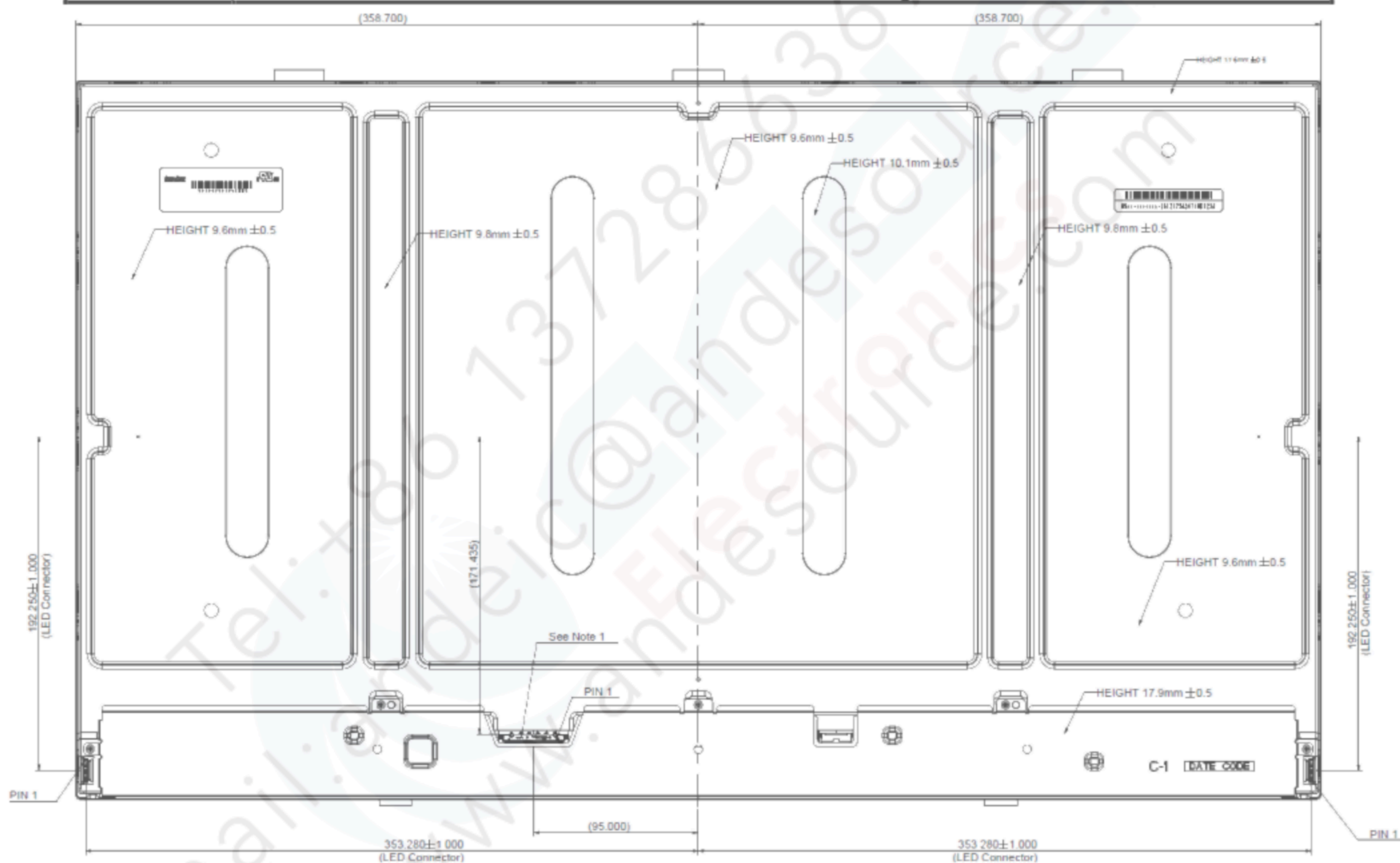
4.3.4 LIGHTBAR CONNECTOR PIN ASSIGNMENT

Connector: FCN WM13-406-123N or CviLux CI1412M1HRM-NH.



CN1

Pin number	Description
1	Cathode of LED string
2	Cathode of LED string
3	Cathode of LED string
4	Cathode of LED string
5	Not connection, this pin should be open
6	VLED
7	VLED
8	Not connection, this pin should be open
9	Cathode of LED string
10	Cathode of LED string
11	Cathode of LED string
12	Cathode of LED string



4.4 LVDS INPUT SIGNAL SPECIFICATIONS

4.4.1 V BY One ONE DATA MAPPING TABLE

Lan	Data Stream
Lan 0	1, 9, 17,, 3825, 3833
Lan 1	2, 10, 18,, 3826, 3834
Lan 2	3, 11, 19,, 3827, 3835
Lan 3	4, 12, 20,, 3828, 3836
Lan 4	5, 13, 21,, 3829, 3837
Lan 5	6, 14, 22,, 3830, 3838
Lan 6	7, 15, 23,, 3831, 3839
Lan 7	8, 16, 24,, 3832, 3840

4.4.2 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 10-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of color versus data input.

Color		Data Signal																															
		Red										Green										BLUE											
		R9	R8	G7	G6	R5	R4	R3	R2	R1	R0	G9	G8	G7	G6	G5	G4	G3	G2	G1	G0	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0		
Basic 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	0	0	0	0	0	0	0	
	Red	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Green	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	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	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	
	Cyan	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	Magenta	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	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	0	0	0	0	0	0	0	
	Red(1)	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Red(2)	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Red(1021)	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Red(1022)	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Red(1023)	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	0	0	0	0	0	0	0	
	Green(1)	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	
	Green(2)	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	
	Green(1021)	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	
	Green(1022)	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Green(1023)	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	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	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	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	0	0	0	0	0	0	0	0	1	0	
	Blue(1021)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	1	0	
	Blue(1022)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0		
	Blue(1023)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	

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

4.5 DISPLAY TIMING SPECIFICATIONS

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

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
V by One	Frequency	Fc	70	74.25	80	MHz	(1)
	Intra-Pair skew		-0.3	-	0.3	UI	(2)
	Inter-Pair skew		-5	-	5	UI	(3)
	Spread spectrum modulation range	Fclkin_mod	F _{clkin} -0.5%	-	F _{clkin} +0.5%	MHz	(4)
	Spread spectrum modulation frequency	F _{SSM}	-	-	30	KHz	
Vertical Display Term	Frame Rate	Fr	40	60	62.5	Hz	(5)(6)(7)
	Total	Tv	2200	2250	2790	Th	Tv=Tvd+Tvb
	Active Display	Tvd	2160	2160	2160	Th	-
	Blank	Tvb	40	90	630	Th	-
Horizontal Display Term	Total	Th	530	550	570	Tc	Th=Thd+Thb
	Active Display	Thd	480	480	480	Tc	-
	Blank	Thb	50	70	90	Tc	-

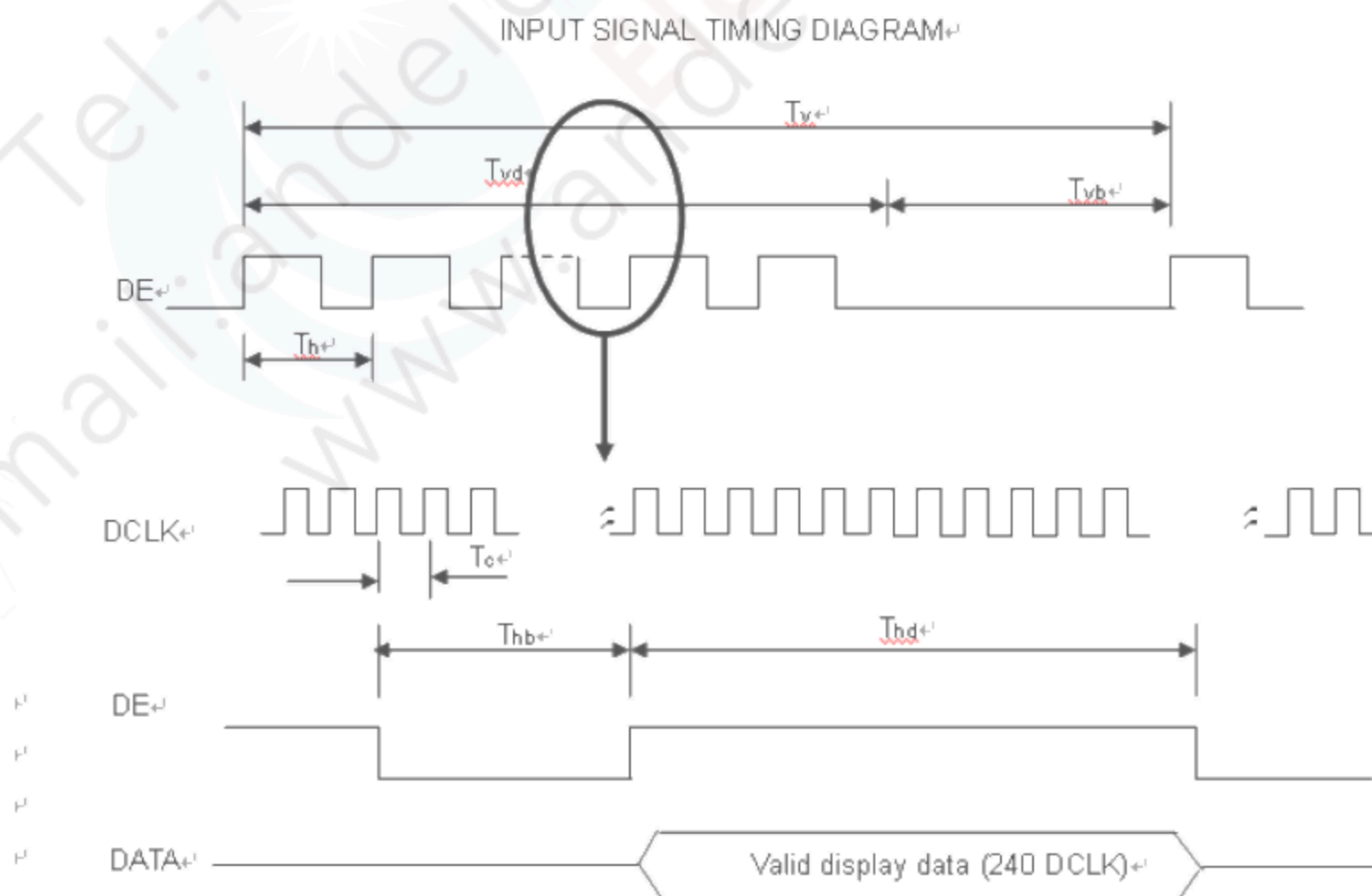
Note : In Free-sync mode, only guaranteed no functional failure, but don't guaranteed its quality of the optical and cosmetic performance.

Note (1) Please make sure the range of pixel clock has follow the below equation:

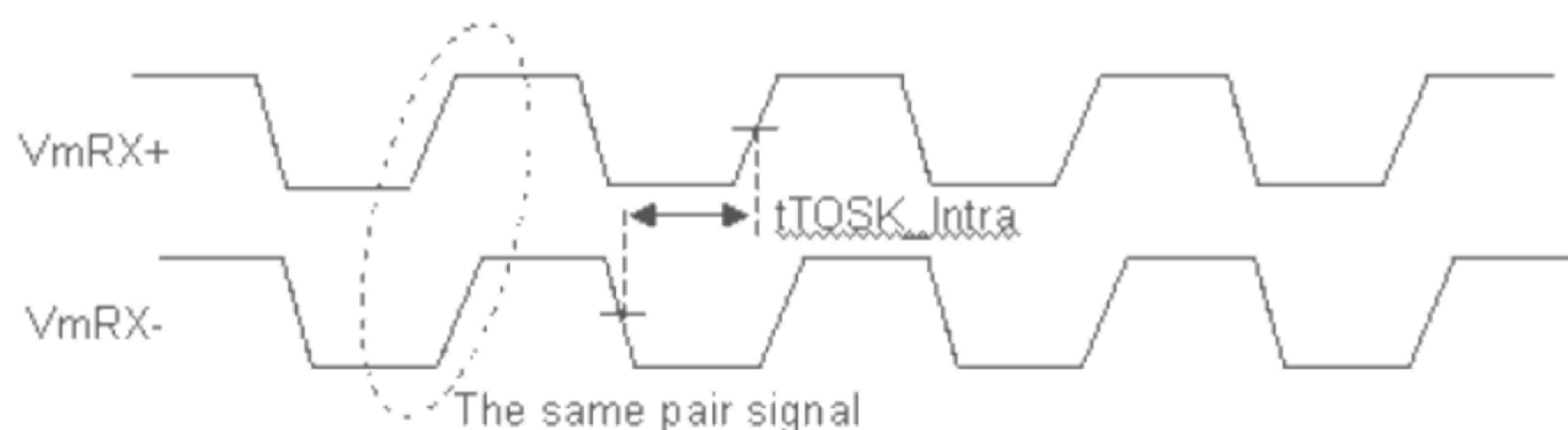
$$F_{clkin}(\max) \geq Fr \times Tv \times Th$$

$$Fr \times Tv \times Th \geq F_{clkin}(\min)$$

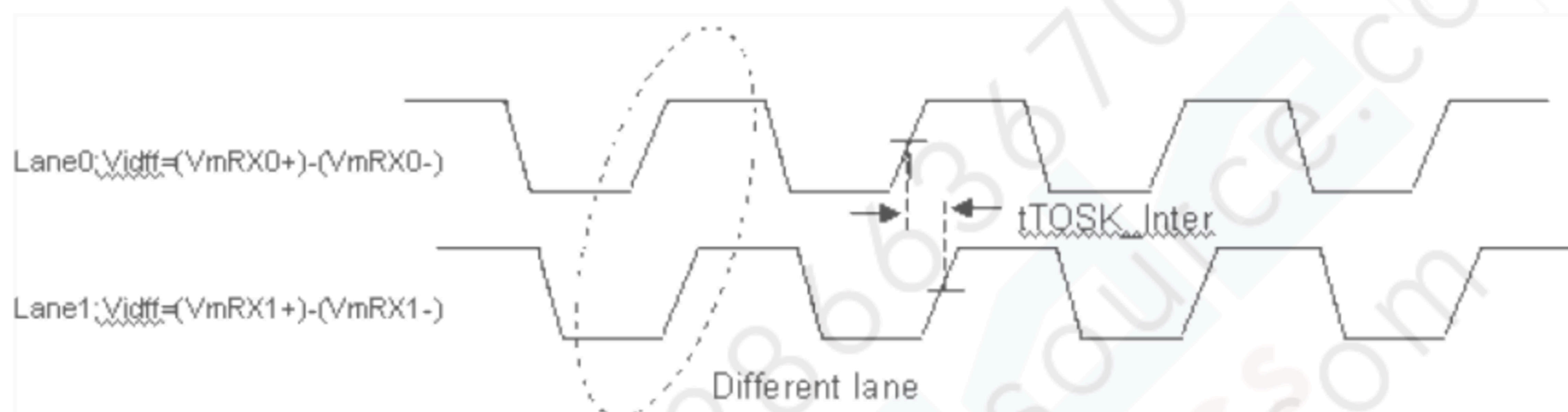
INPUT SIGNAL TIMING DIAGRAM



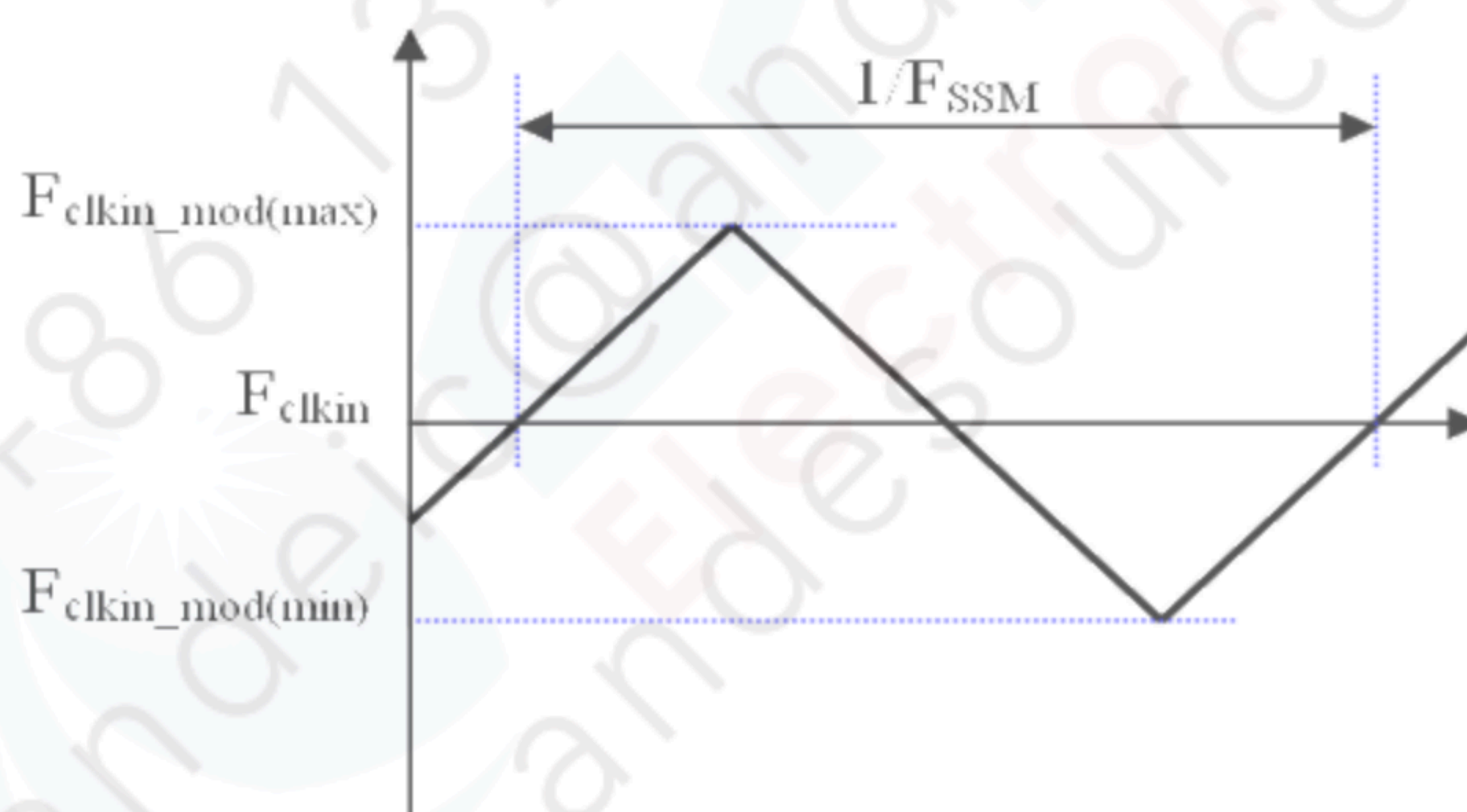
Note (2) V-by-One HS Intra-pair skew



Note (3) V-by-One HS Inter-pair skew

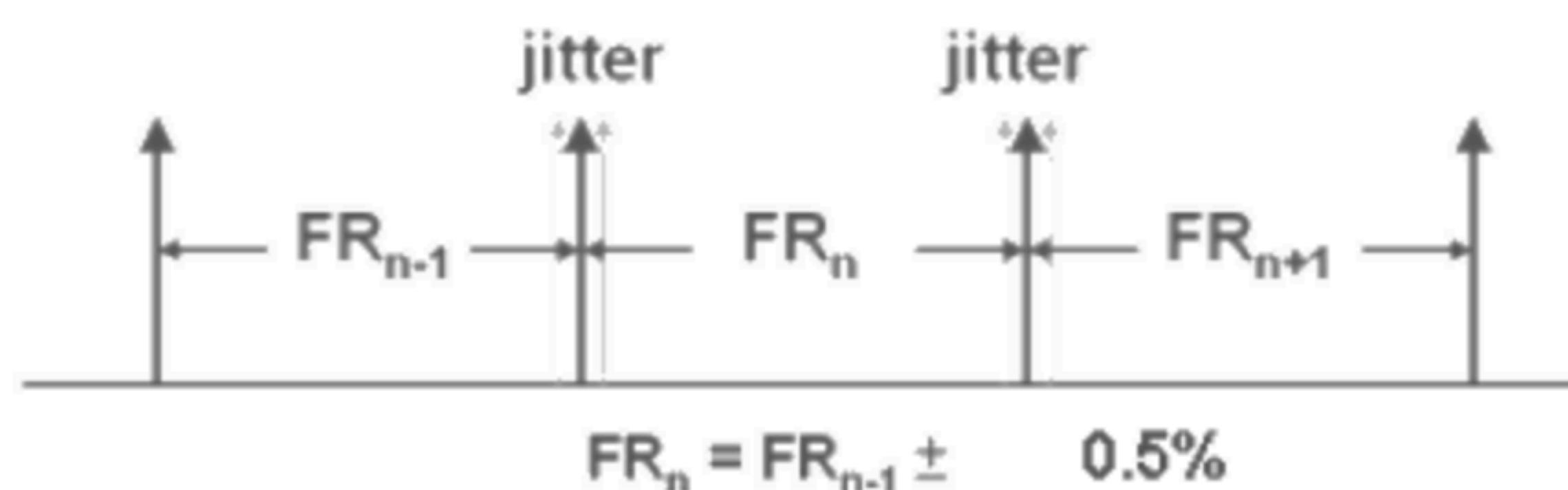


Note (4) The SSCG (Spread spectrum clock generator) is defined as below figures.



Note (5) The frame-to-frame jitter of the input frame rate is defined as the above figures. $FR_n = FR_{n-1} \pm 0.5\%$.

Note (6) The setup of the frame rate jitter $> 0.5\%$ may result in the cosmetic LED backlight symptom and the electric function is affected.



Note (7) In Free-sync mode, only guaranteed no functional failure, but don't guaranteed its quality of the optical and cosmetic performance.

4.6 V BY ONE INPUT SIGNAL TIMING DIAGRAM

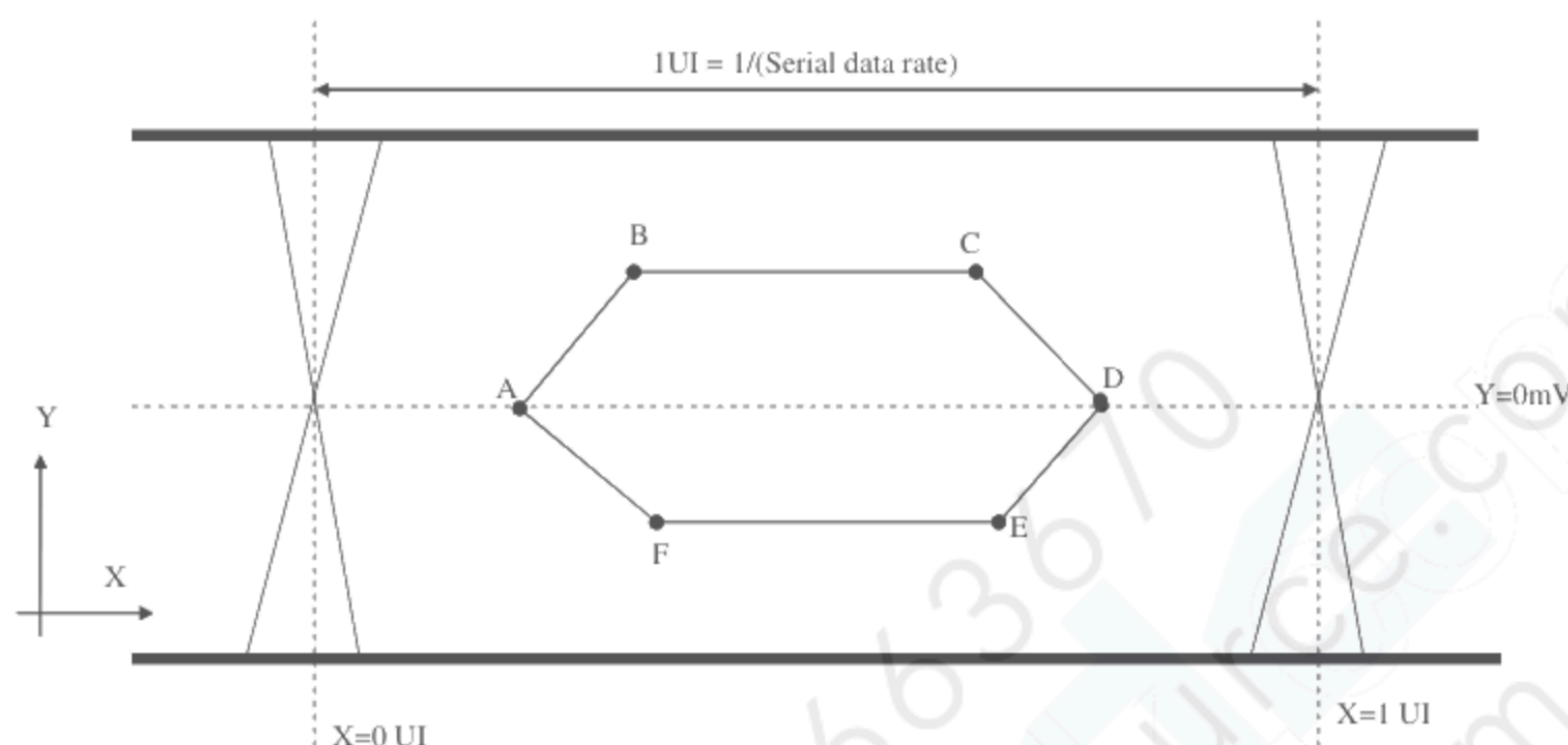


Table 1 Eye Mask Specification

	X [UI]	Y [mV]	Note
A	0.25	0	(1)
B	0.3	50	(1)
C	0.7	50	(1)
D	0.75	0	(1)
E	0.7	-50	(1)
F	0.3	-50	(1)

Note (1) Input levels of V-by-One HS signals are comes from "V-by-One HS Stander Ver.1.4"

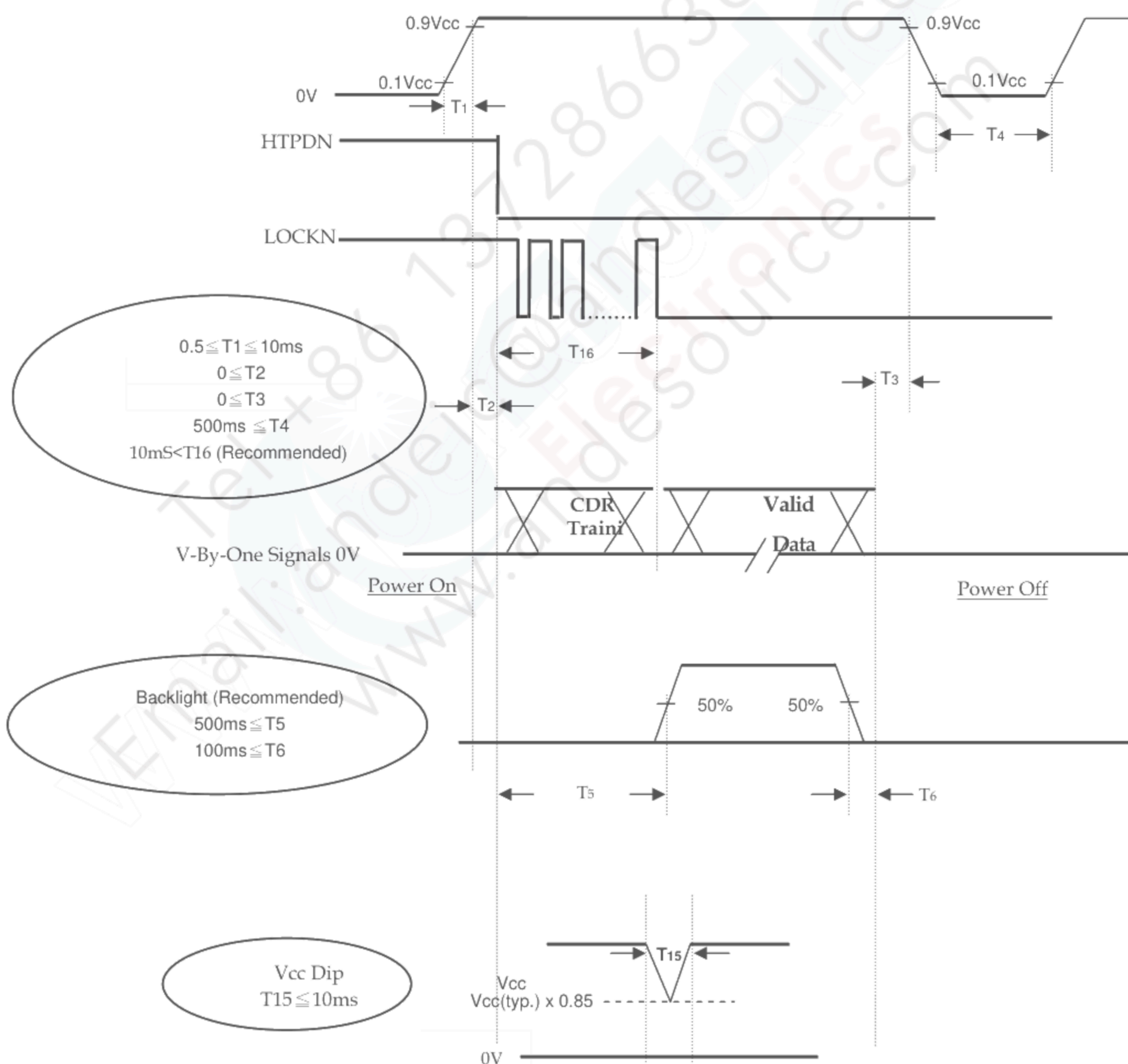
4.7 BYTE LENGTH AND COLOR MAPPING OF V-BY-ONE HS

Packer input & Unpacker output		30bpp RGB (10bit)
Byte 0	D[0]	R[2]
	D[1]	R[3]
	D[2]	R[4]
	D[3]	R[5]
	D[4]	R[6]
	D[5]	R[7]
	D[6]	R[8]
	D[7]	R[9]
Byte 1	D[8]	G[2]
	D[9]	G[3]
	D[10]	G[4]
	D[11]	G[5]
	D[12]	G[6]
	D[13]	G[7]
	D[14]	G[8]
	D[15]	G[9]
Byte 2	D[16]	B[2]
	D[17]	B[3]
	D[18]	B[4]
	D[19]	B[5]
	D[20]	B[6]

Byte 3	D[21]	B[7]
	D[22]	B[8]
	D[23]	B[9]
	D[24]	X
	D[25]	X
	D[26]	B[0]
	D[27]	B[1]
	D[28]	G[0]
	D[29]	G[1]
	D[30]	R[0]
	D[31]	R[1]

4.8 POWER ON/OFF SEQUENCE (Ta = 25 ± 2 °C)

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



Note (1) The supply voltage of the external system for the module input should follow the definition of Vcc.

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 Vcc is in off level, please keep the level of input signals on the low or high impedance. If $T_2 < 0$, 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

Note (6) Vcc must decay smoothly when power-off

5. OPTICAL CHARACTERISTICS

5.1 TEST CONDITIONS

Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	°C
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	V _{CC}	5	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
LED Light Bar Input Current Per Input Pin	I _{PIN}	150 ± 1.2	mA _{DC}
PWM Duty Ratio for normal mode	D	60	%
PWM Duty Ratio for PCHDR peak mode	D	100	%
LED Light Bar Test Converter	INX 27-D041745		

5.2 OPTICAL SPECIFICATIONS

The relative measurement methods of optical characteristics are shown in 5.2. The following items should be measured under the test conditions described in 5.1 and stable environment shown in Note (5).

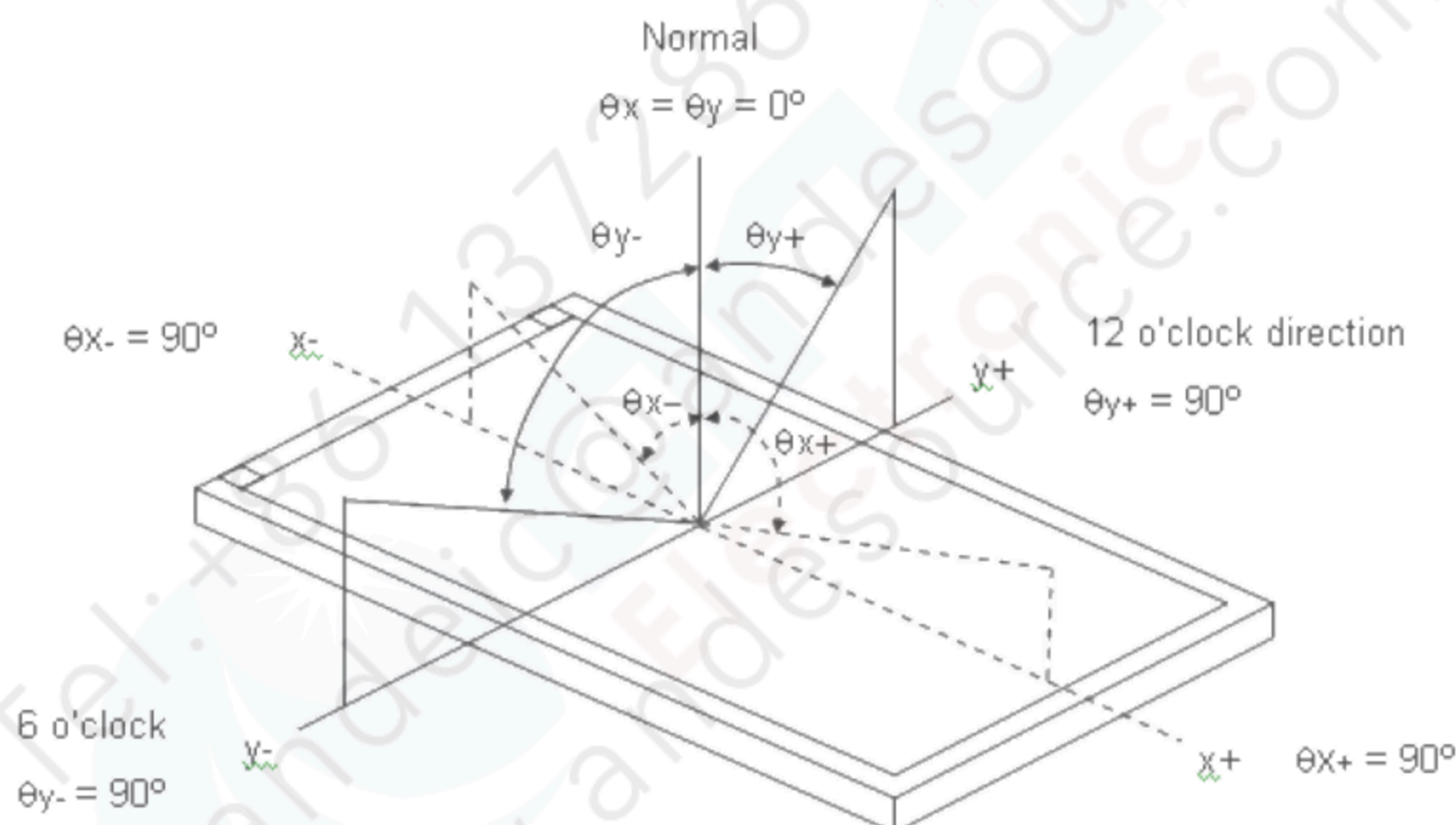
Normal mode

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Color Chromaticity (CIE 1931)	Red	$\theta_x=0^\circ, \theta_y=0^\circ$ CS-2000 R=G=B=255 Gray scale	Typ – 0.03	0.685	Typ + 0.03	-	(1), (5)
	Ry			0.310			
	Green			0.260			
	Gy			0.685			
	Blue			0.152			
	By			0.055			
	White			0.313			
	Wy			0.329			
Center Luminance of White (For normal mode)	L _c	$\theta_x=0^\circ, \theta_y=0^\circ$	350	400		cd/m ²	(4), (5)
Contrast Ratio (normal mode)	CR		2000	3000		-	(2), (5)
Response Time	T _R	$\theta_x=0^\circ, \theta_y=0^\circ$		15	20	ms	(3)
	T _F			5	10		
	GTG			9.5	20		
White Variation	W	$\theta_x=0^\circ, \theta_y=0^\circ$			1.42	%	(5), (6)
Viewing Angle	Horizontal	$\theta_{x-} + \theta_{x+}$	160	178		Deg.	(1), (5)
	Vertical	$\theta_{y-} + \theta_{y+}$	160	178			

PCHDR peak mode

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Color Chromaticity (CIE 1931)	Red	Rx	$\theta_x=0^\circ, \theta_Y=0^\circ$ CS-2000 R=G=B=255 Gray scale	Typ – 0.03	0.685	Typ + 0.03	-	(1), (5)
		Ry			0.310			
	Green	Gx			0.260			
		Gy			0.685			
	Blue	Bx			0.152			
		By			0.055			
	White	Wx			0.313			
		Wy			0.329			
	Center Luminance of White				Lc			
Contrast Ratio		CR	(6000)			-	(2), (5)	

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



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

The contrast ratio can be calculated by the following expression.

$$\text{Contrast Ratio (CR)} = L_{255} / L_0$$

L255: Luminance of gray level 255

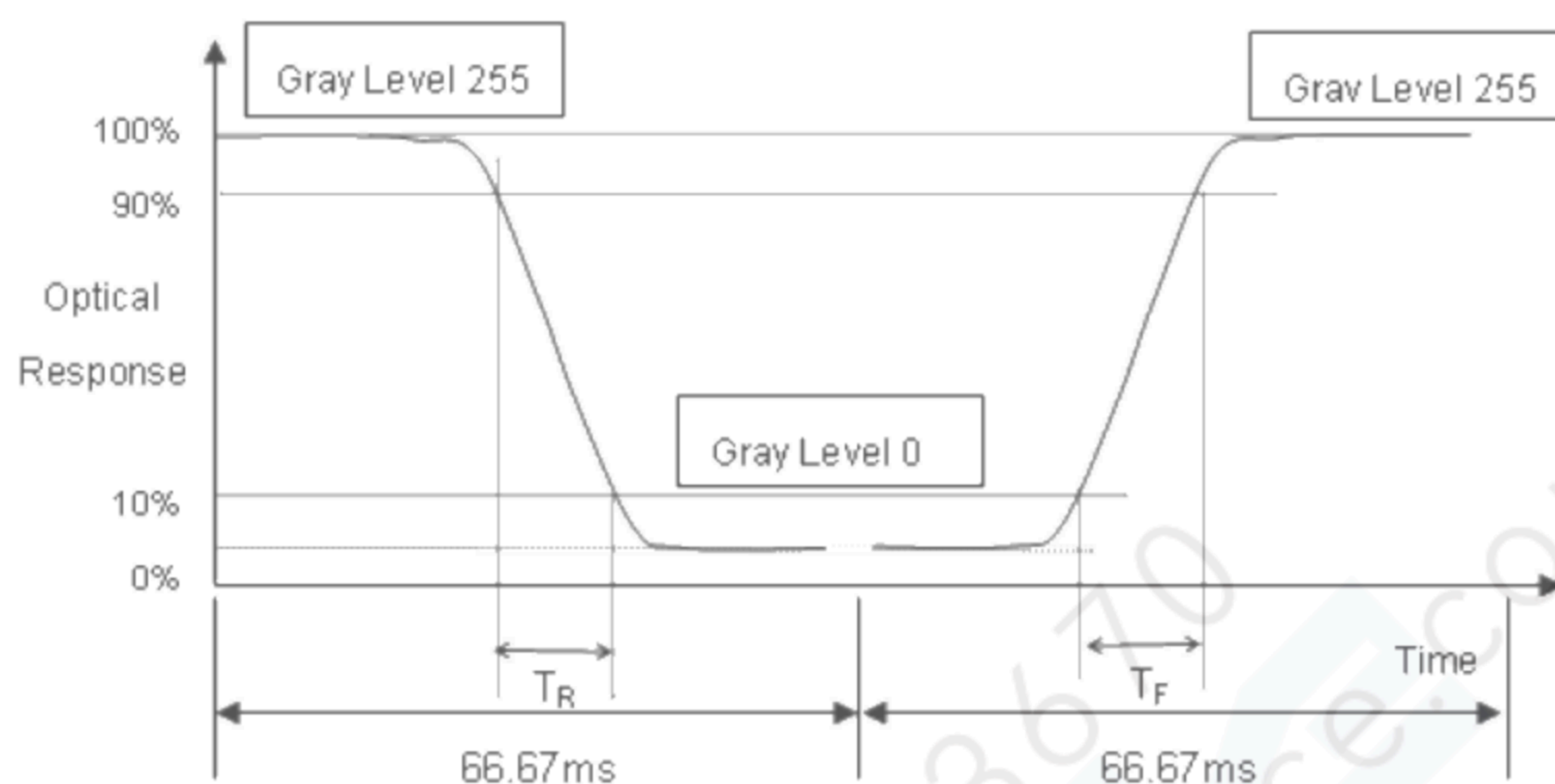
L 0: Luminance of gray level 0

$$\text{CR} = \text{CR} (5)$$

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (6).

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

-The TR is the rising-time means the transition time from "Full-Black (gray 0)" to "Full-White (gray 255)" and the TF is the falling-time means the transition time from "Full-White (gray 255)" to "Full-White (gray 0)" as the following figure.(Measured by TEKTRONIX TDS3054B):



- The TGtG is the response time means the transition time from "Gray N" to "Gray M" (N,M=0~255)
- T_{GTG_AVE} is the total average of the T_{GTG} data (Measured by INX GTG instrument)
- The gray (N,M) stands for the (0,32,64,...255) as the following 9*9 table

Gaty to Gary	0	31	63	95	127	159	191	223	255
0									
31									
63									
95									
127									
159									
191									
223									
255									

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

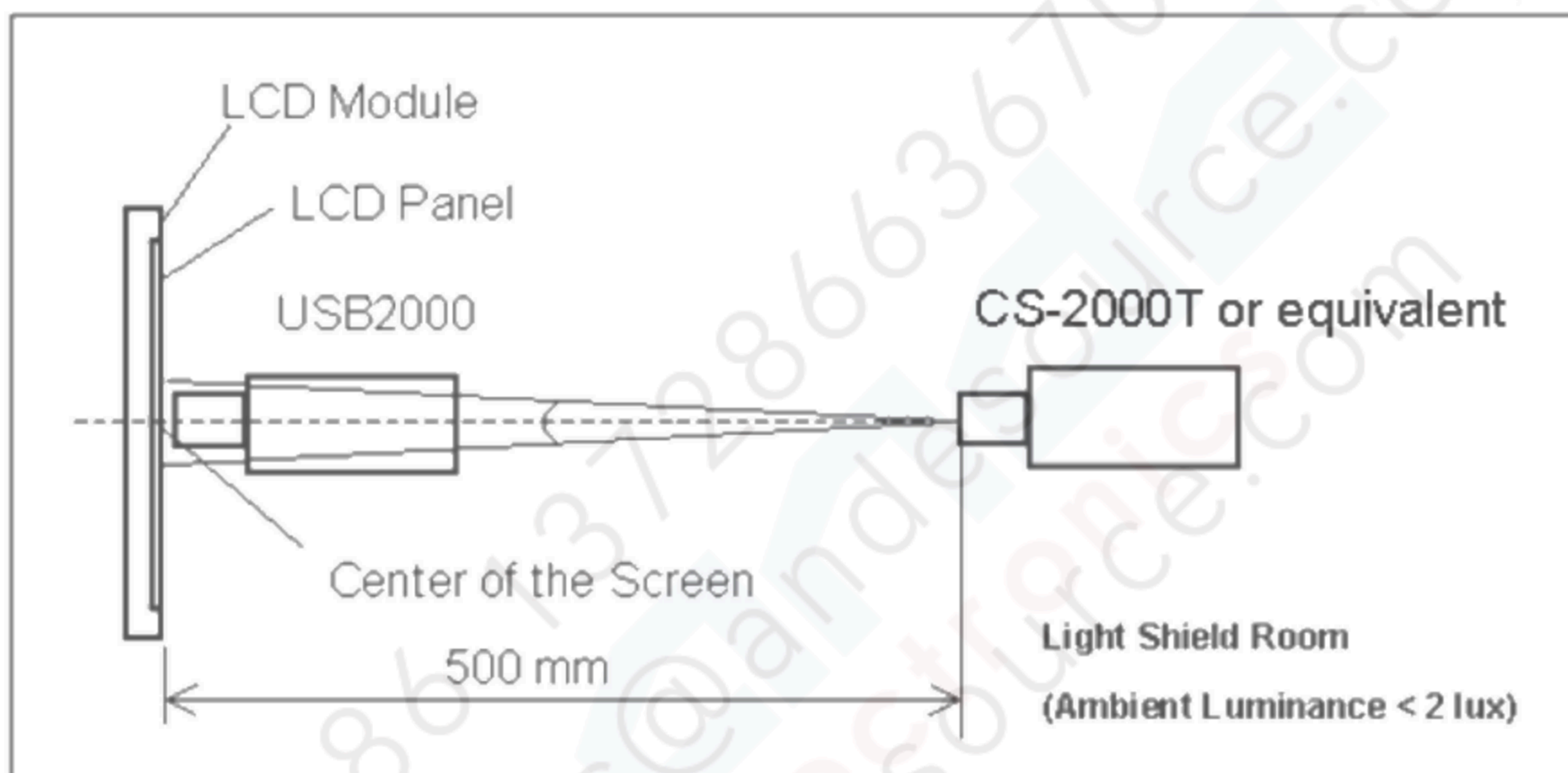
Measure the luminance of gray level 255 at center point

$$L_C = L(5)$$

$L(x)$ is corresponding to the luminance of the point X at Figure in Note (6).

Note (5) Measurement Setup:

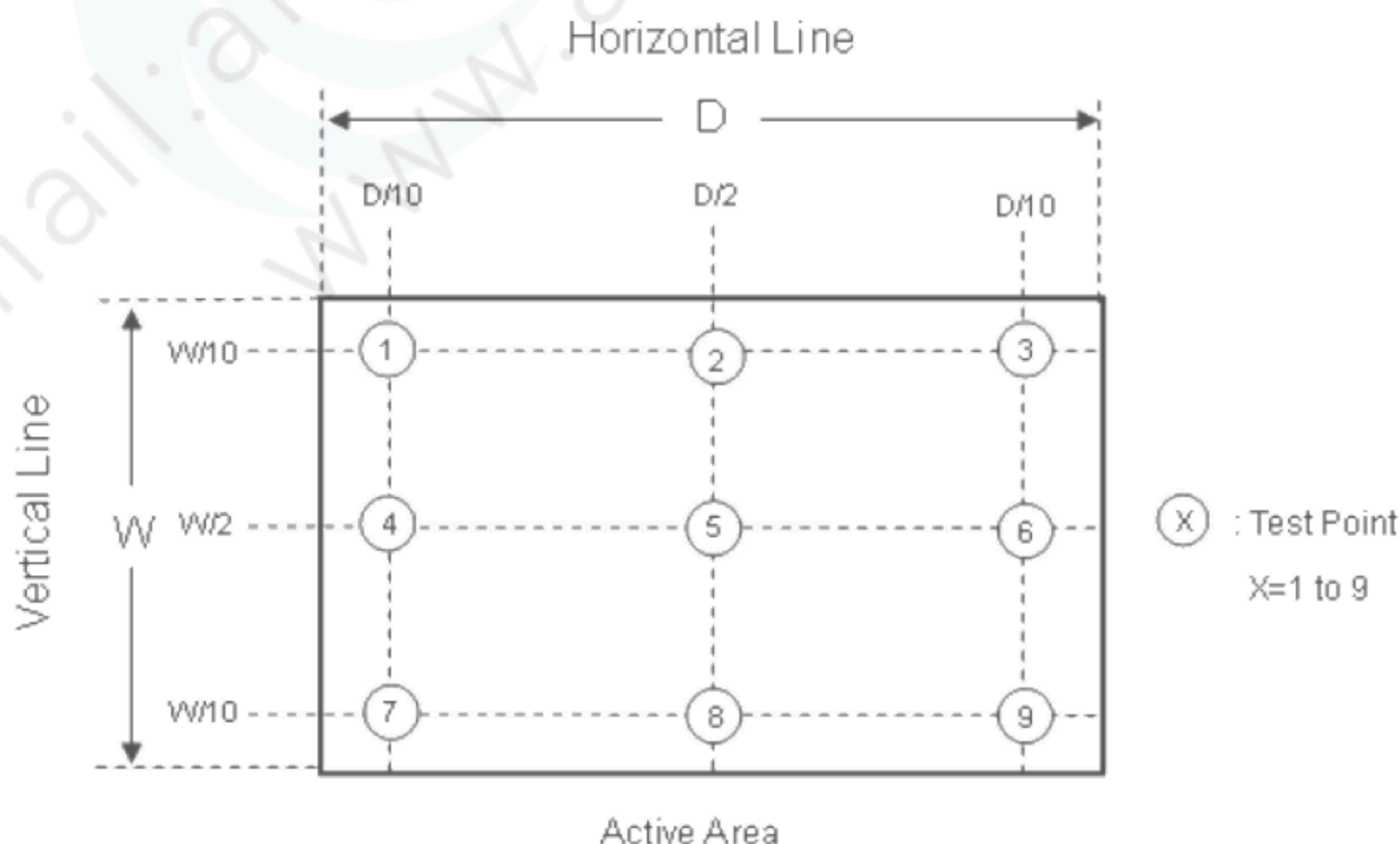
The LCD module should be stabilized at given temperature for 40 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 40 minutes in a windless room.



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

Measure the luminance of gray level 255 at 9 points

$$\delta W = (\text{Minimum } [L(1) \sim L(9)] / \text{Maximum } [L(1) \sim L(9)]) * 100\%$$



6. RELIABILITY TEST ITEM

Items	Required Condition	Note
Temperature Humidity Bias (THB)	Ta= 50℃ , 80%RH, 240hours	
High Temperature Operation (HTO)	Ta= 50℃ , 240hours	
Low Temperature Operation (LTO)	Ta= 0℃ , 240hours	
High Temperature Storage (HTS)	Ta= 60℃ , 240hours	
Low Temperature Storage (LTS)	Ta= -20℃ , 240hours	
Vibration Test (Non-operation)	Acceleration: 1.5 G Wave: sine Frequency: 10 - 300 Hz Sweep: 30 Minutes each Axis (X, Y, Z)	
Shock Test (Non-operation)	Acceleration: 50 G Wave: Half-sine Active Time: 11 ms Direction : ± X, ± Y, ± Z.(one time for each Axis)	
Thermal Shock Test (TST)	-20℃/30min , 60℃ / 30min , 100 cycles	
On/Off Test	25℃ , On/10sec , Off /10sec , 30,000 cycles	
ESD (Electro Static Discharge)	Contact Discharge: ± 8KV, 150pF(330Ω)	
	Air Discharge: ± 15KV, 150pF(330Ω)	
Altitude Test	Operation:10,000 ft / 24hours Non-Operation:30,000 ft / 24hours	

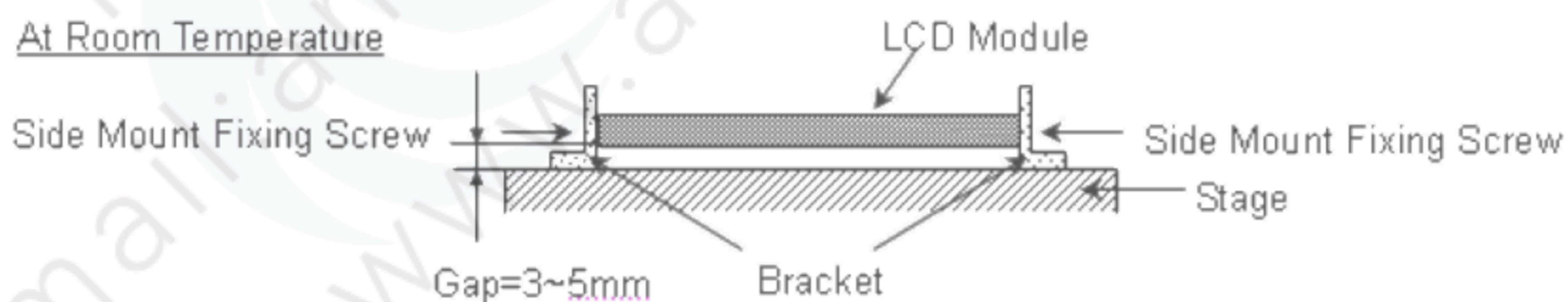
Note (1) criteria : Normal display image with no obvious non-uniformity and no line defect.

Note (2) Evaluation should be tested after storage at room temperature for more than two hour

Note (3) 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.

The fixing condition is shown as below:

At Room Temperature



7. MECHANICAL STRENGTH CHARACTERISTICS

7.1 MECHANICAL STRENGTH SPECIFICATIONS

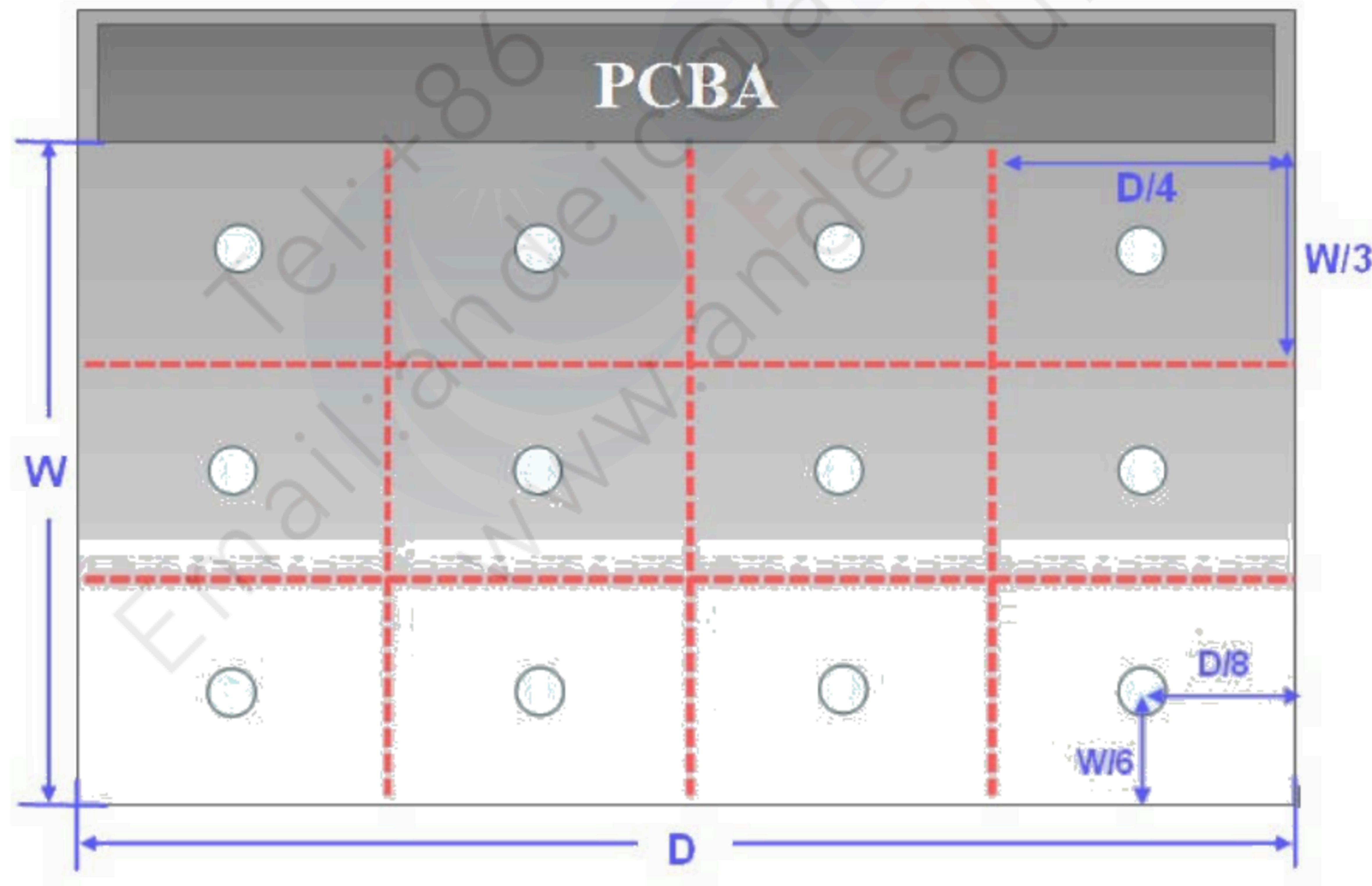
Item	Condition	Min	Unit	Note
Mechanical Strength	128 th Gray Pattern	0.6	Kgf	

7.2 TEST CONDITIONS

Items	Description
Test Condition	1. Ambient Illumination : 10~15 lux 2. Test Pattern : 128 Gray 3. Distance of the judgment : 30cm from the surface of module 4. Viewing angle of the judgment : Front
Gage Information	1. Push pull guage a. Model name : HF-50, maker : ALGOL b. Shape of gage tip - Diameter : 2mm - Thickness : 2mm
Definition of Minimum force	To measure minimum force when operator detects any white spot and light leakage that have occurred while operator presses on back side of module with push pull gage.

7.3 DEFINITION OF TEST POINTS

Measure the minimum force of test points at 128th Gray pattern. The test points at back side of module area is showing as below (except PCBA).



8. PACKING

8.1 PACKING SPECIFICATIONS

- (1) 8 LCD modules / 1 Box
- (2) Box dimensions: 826(L) X 376(W) X 540(H) mm
- (3) Weight: approximately: (32)kg (8 modules per box)

8.2 PACKING METHOD

- (1) Carton Packing should have no failure in the following reliability test items.

Test Item	Test Conditions	Note
Vibration	ISTA STANDARD Random, Frequency Range: 1 – 200 Hz Top & Bottom: 30 minutes (+Z), 10 min (-Z), Right & Left: 10 minutes (X) Back & Forth 10 minutes (Y)	Non Operation
Dropping Test	1 Corner , 3 Edge, 6 Face, 31cm	Non Operation

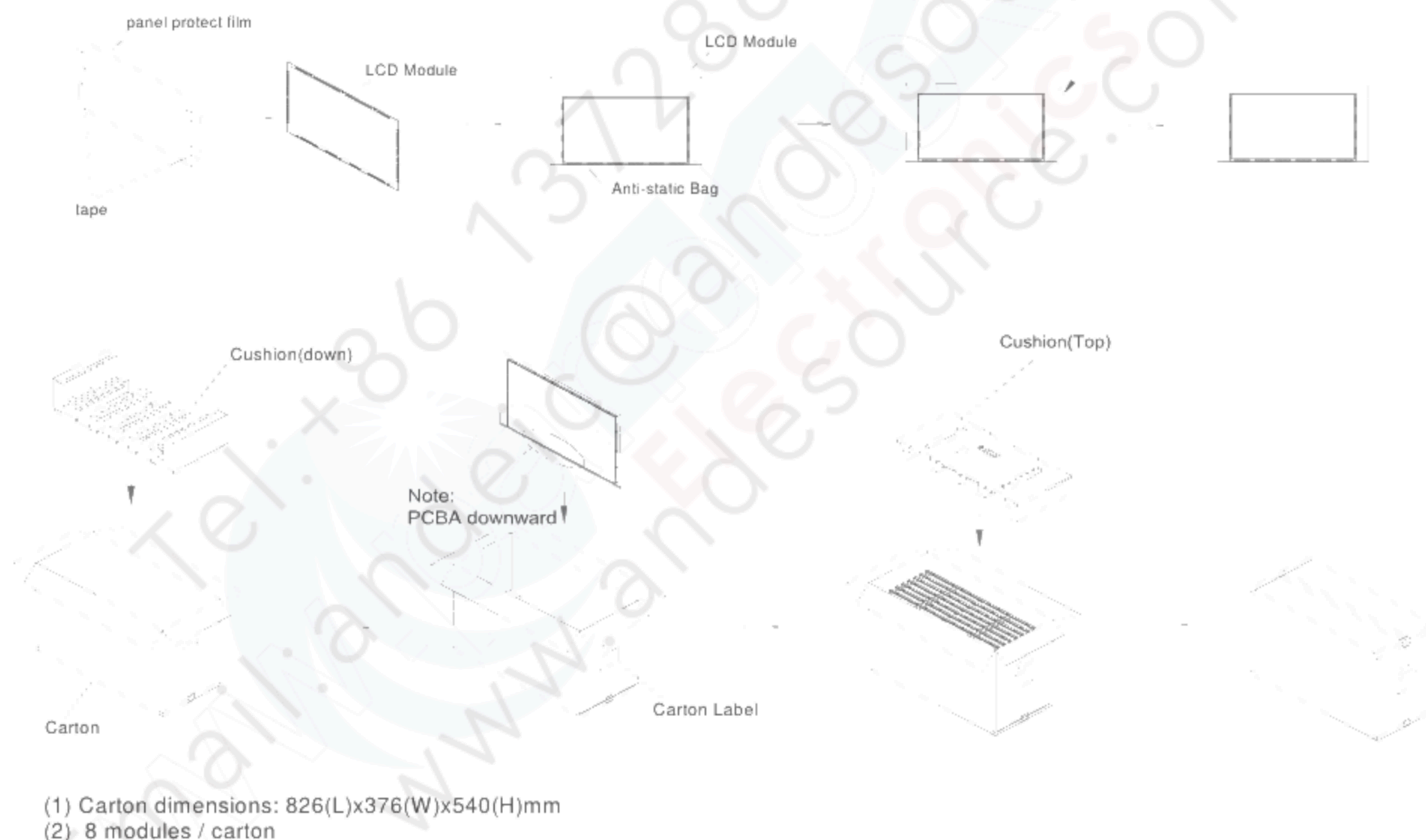


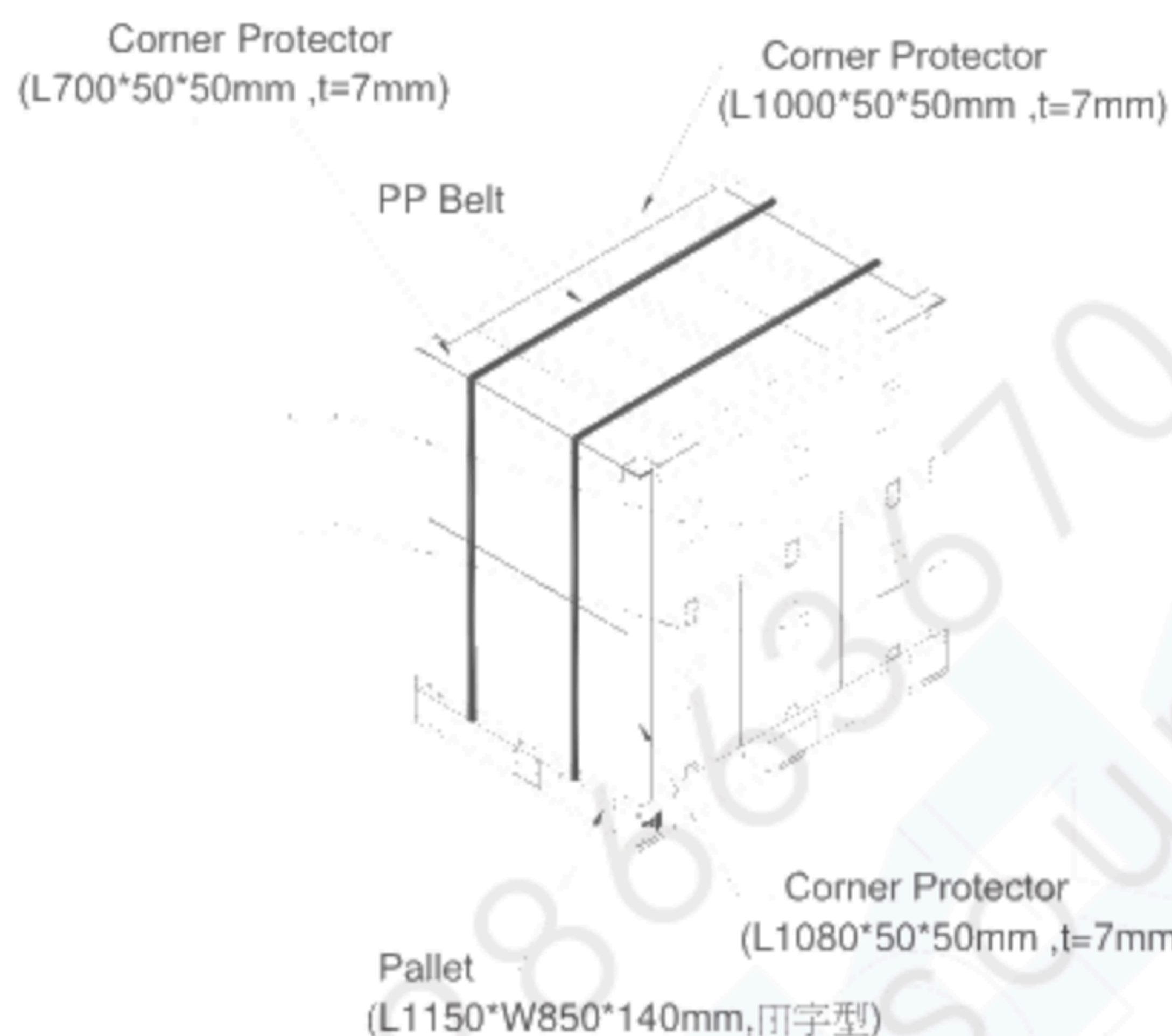
Figure. 8-1 Packing method

8.3 PALLET

For ocean shipping

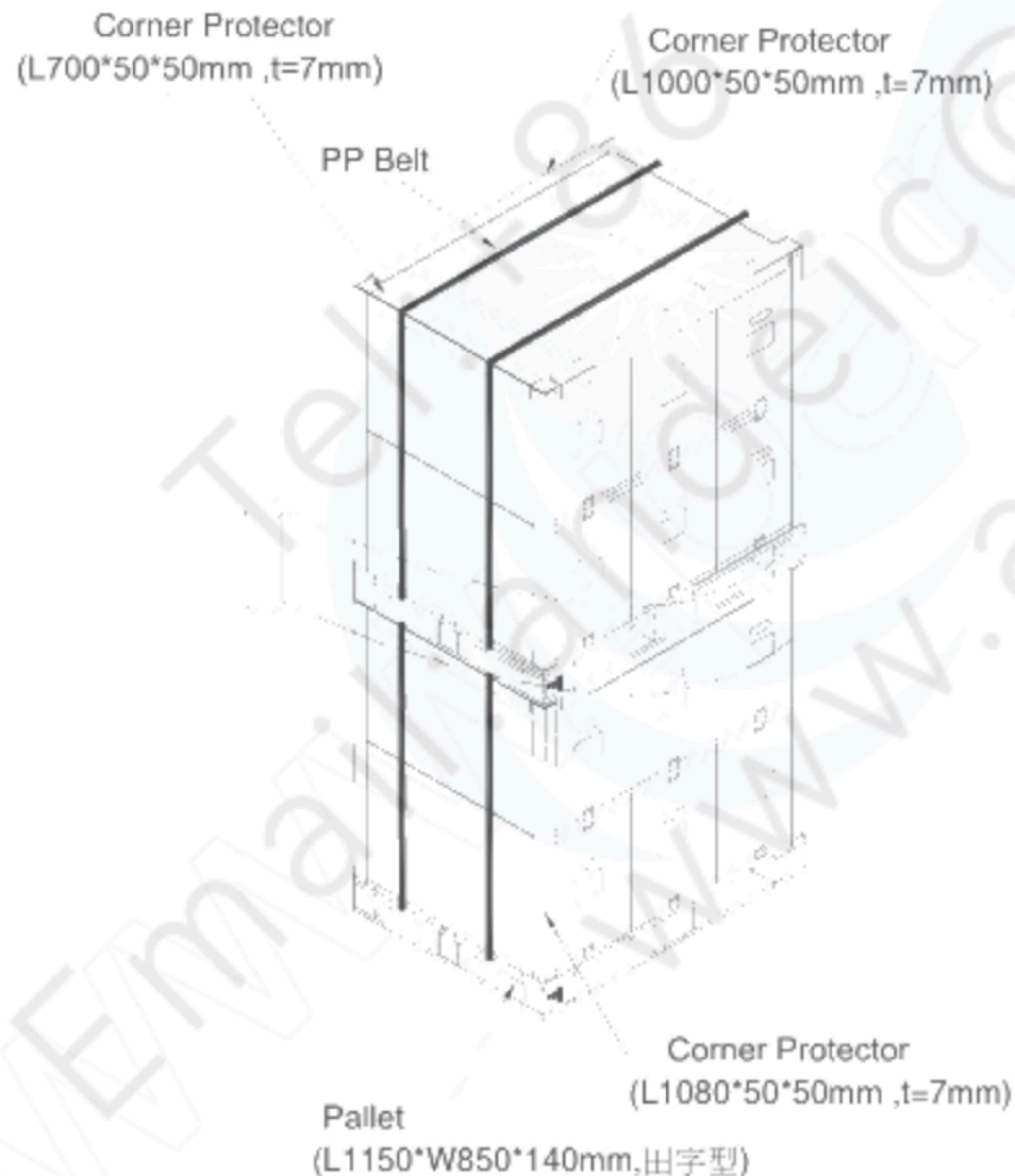
Air Transportation

2 Layer



Sea / Land Transportation (40ft HQ Container)

3+2 Layer



Sea / Land Transportation (40ft Container)

3 Layer

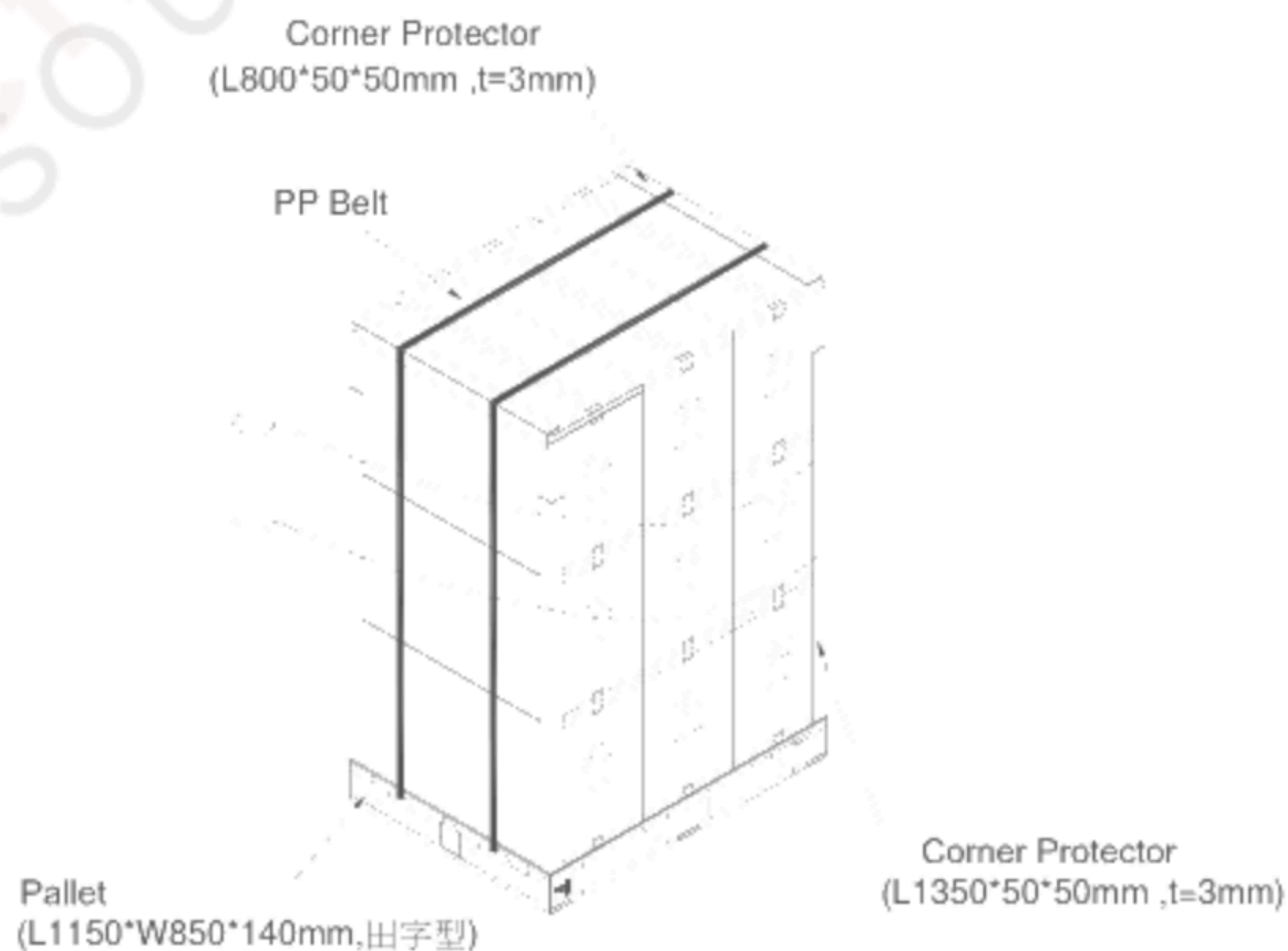


Figure. 8-2 Packing method

8.4 UN-PACKING METHOD

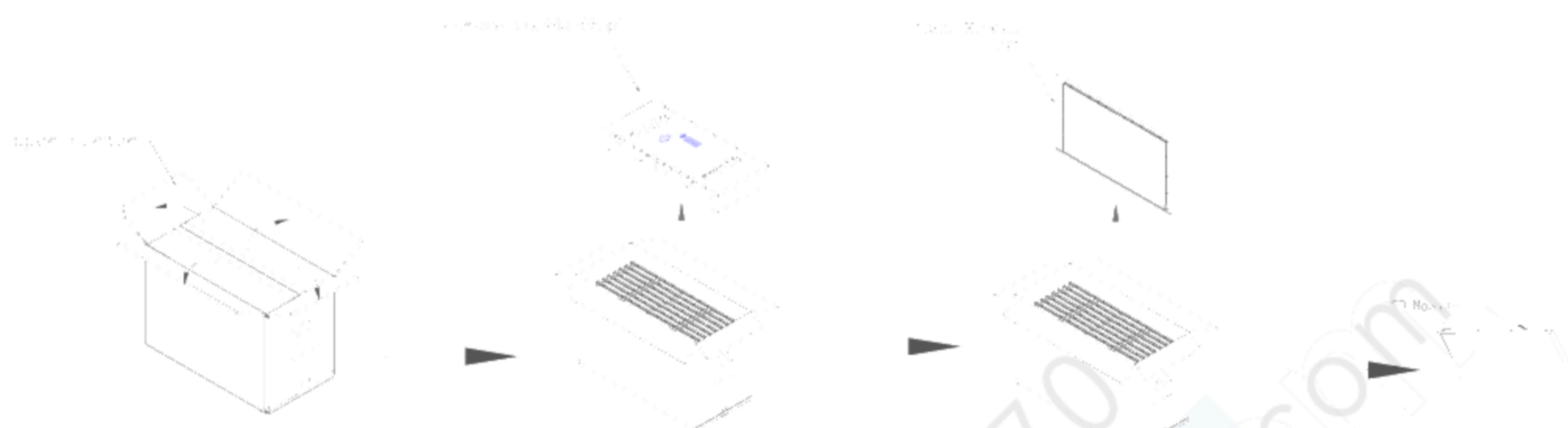


Figure. 8-3 UN-Packing method

9. INX MODULE LABEL

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



(a) Model Name: M315DJJ-K31

(b) Revision: Rev. XX, for example: A0, A1... B1, B2... or C1, C2...etc.

(c) INX barcode definition:

Serial ID: XX-XX-X-XX-YMD-L-NNNN

Code	Meaning	Description
XX	INX internal use	-
XX	Revision	Cover all the change
X	INX internal use	-
XX	INX internal use	-
YMD	Year, month, day	Year: 0~9, 2001=1, 2002=2, 2003=3...2010=0, 2011=1, 2012=2... Month: 1~12=1, 2, 3, ~, 9, A, B, C Day: 1~31=1, 2, 3, ~, 9, A, B, C, ~, W, X, Y, exclude I, O, and U.
L	Product line #	Line 1=1, Line 2=2, Line 3=3, ...
NNNN	Serial number	Manufacturing sequence of product

(d) Customer's barcode definition:

Serial ID: CM-V5J31-X-X-X-XX-L-XX-L-YMD-NNNN

Code	Meaning	Description
CM	Supplier code	INX=CM
N6E20	Model number	M315DJJ-K31= V5J31
X	Revision code	Non ZBD: 1,2,~,8,9 / ZBD: A~Z
X	Source driver IC code	Century=1, CLL=2, Demos=3, Epson=4, Fujitsu=5, Himax=6, Hitachi=7, Hynix=8, LDI=9, Matsushita=A, NEC=B, Novatek=C, OKI=D, Philips=E, Renesas=F, Samsung=G, Sanyo=H, Sharp=I, TI=J, Topro=K, Toshiba=L, Windbond=M, ILITEK=Q, Fiti=Y, None IC =Z
X	Gate driver IC code	
XX	Cell location	Tainan Taiwan=TN, Ningbo China=CN, Hsinchu Taiwan=SC
L	Cell line #	1,2,~,9,A,B,~,Y,Z
XX	Module location	Tainan, Taiwan=TN ; Ningbo China=NP ; Shenzhen China=SH ; Nanhai China=NH
L	Module line #	1,2,~,9,A,B,~,Y,Z
YMD	Year, month, day	Year: 0~9, 2001=1, 2002=2, 2003=3...2010=0, 2011=1, 2012=2... Month: 1~12=1, 2, 3, ~, 9, A, B, C Day: 1~31=1, 2, 3, ~, 9, A, B, C, ~, T, U, V
NNNN	Serial number	By LCD supplier

(e) FAB ID(UL Factory ID):

Region	Factory ID
TWINX	GEMN
NBINX	LEOO
NBINX	VIRO
NHINX	CAPG

10. PRECAUTIONS

10.1 ASSEMBLY AND HANDLING PRECAUTIONS

- (1) Do not apply rough force such as bending or twisting to the module during assembly.
- (2) To assemble or install module into user's system can be only in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
- (3) It's not permitted to have pressure or impulse on the module because the LCD panel and Backlight will be damaged.
- (4) Always follow the correct power sequence when LCD module is connecting and operating. This can prevent damage to the CMOS LSI chips during latch-up.
- (5) Do not pull the I/F connector in or out while the module is operating.
- (6) Do not disassemble the module.
- (7) Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.
- (8) It is dangerous that moisture come into or contacted the LCD module, because moisture may damage LCD module when it is operating.
- (9) High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storage conditions.
- (10) When ambient temperature is lower than 10°C may reduce the display quality. For example, the response time will become slowly.
- (11) While touching the panel surface under the patterns with higher grey levels, a shadow or mura phenomenon would be seen. This phenomenon is totally recoverable by switching the patterns to lower grey levels. It is a product feature.

10.2 STORAGE PRECAUTIONS

- (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°C to 35°C and relative humidity of less than 90%
- (2) Do not store the TFT – LCD module in direct sunlight
- (3) The module should be stored in dark place. It is prohibited to apply sunlight or fluorescent light in storing

10.3 OPERATION PRECAUTIONS

- (1) The LCD product should be operated under normal condition.

Normal condition is defined as below :

Temperature : $20\pm 15^{\circ}\text{C}$

Humidity: $65\pm 20\%$

Display pattern : continually changing pattern(Not stationary)

- (2) If the product will be used in extreme conditions such as high temperature, high humidity, high altitude, display pattern or operation time etc... It is strongly recommended to contact INX for application engineering advice. Otherwise, its reliability and function may not be guaranteed.

10.4 SAFETY PRECAUTIONS

- (1) 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.
- (2) After the module's end of life, it is not harmful in case of normal operation and storage.

10.5 SAFETY STANDARDS

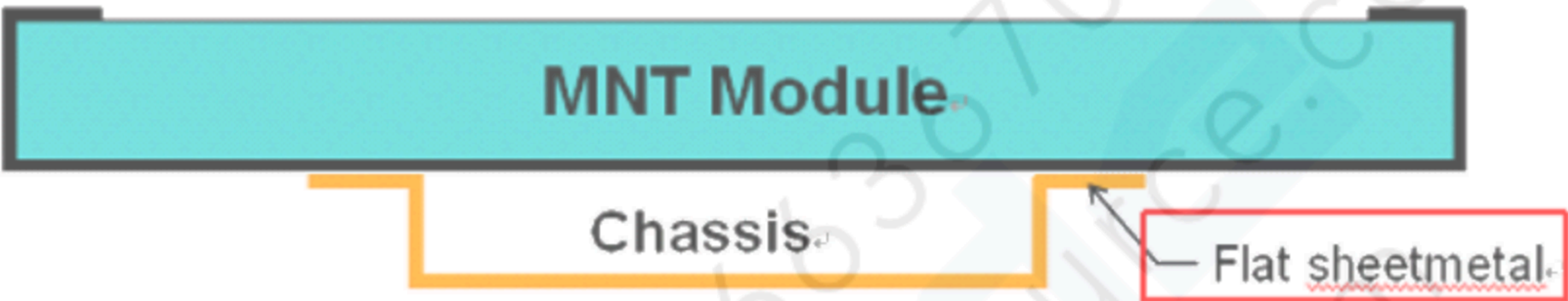
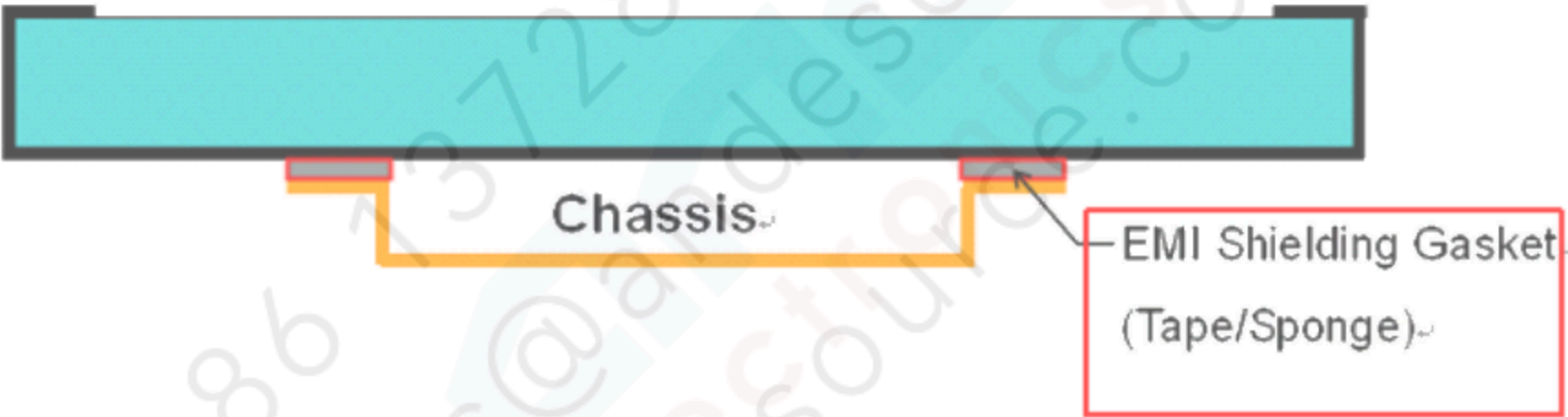
The LCD module should be certified with safety regulations as follows:

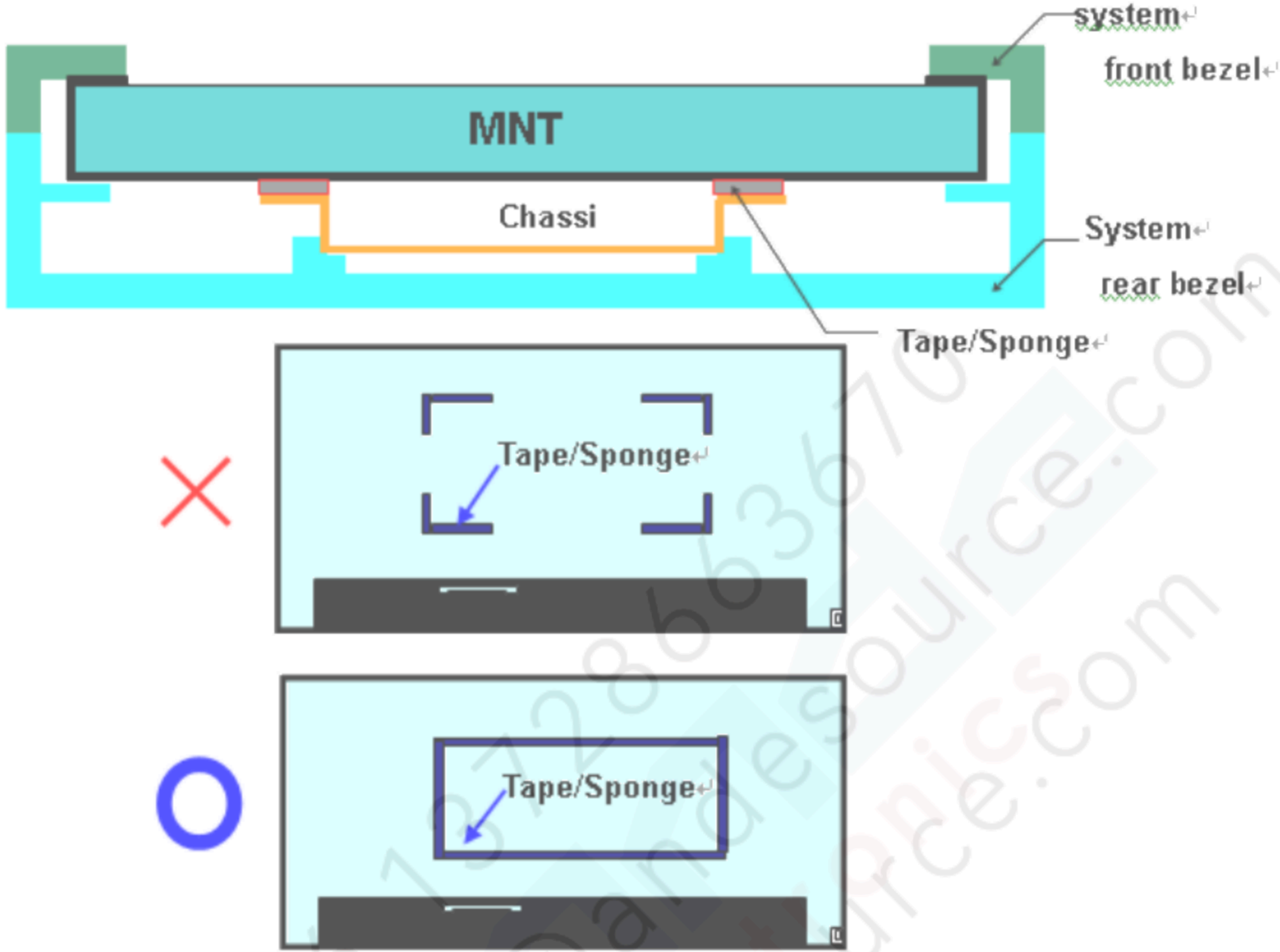
- (1) UL60950-1 or updated standard.
- (2) IEC60950-1 or updated standard.

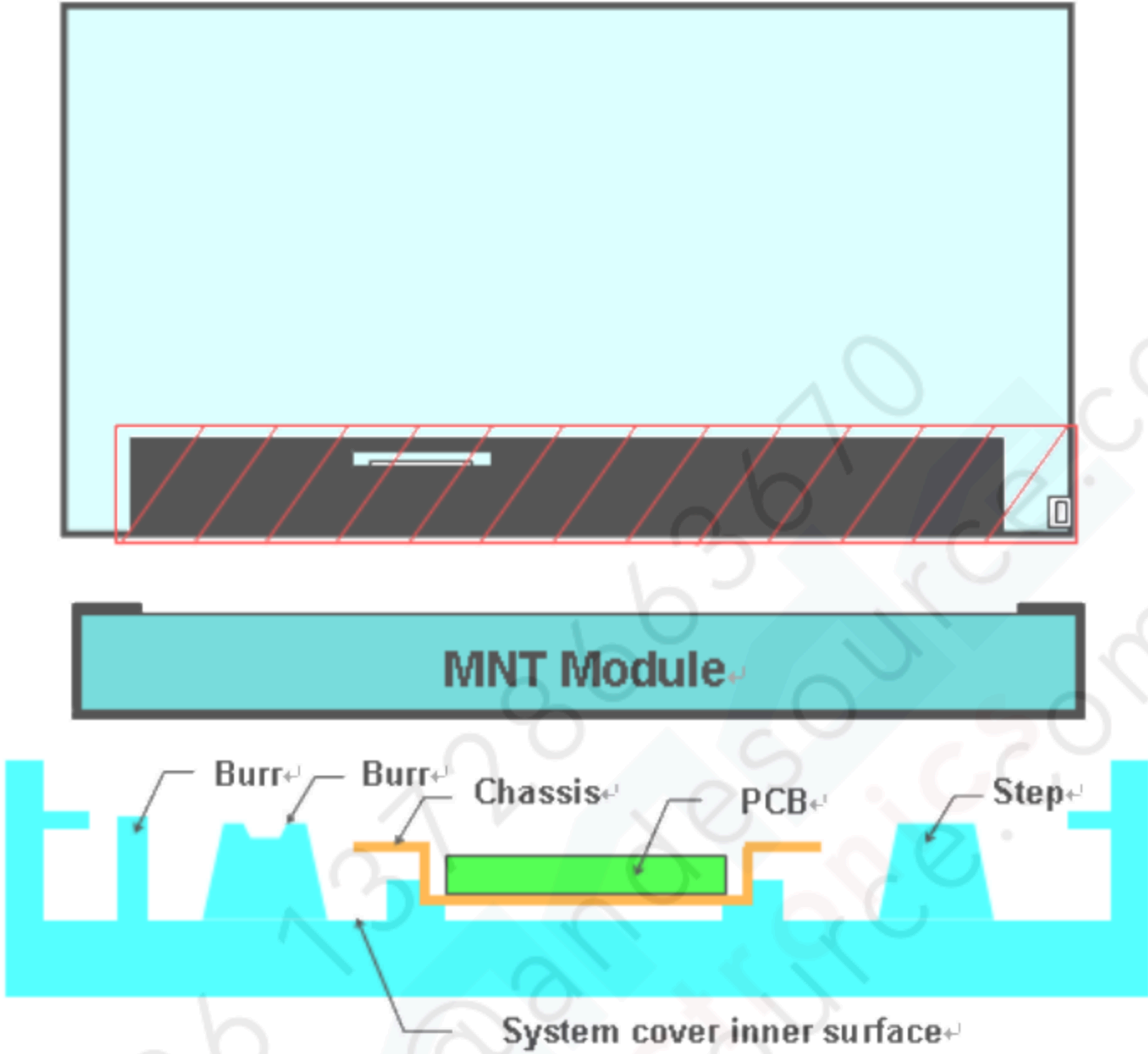
10.6 OTHER

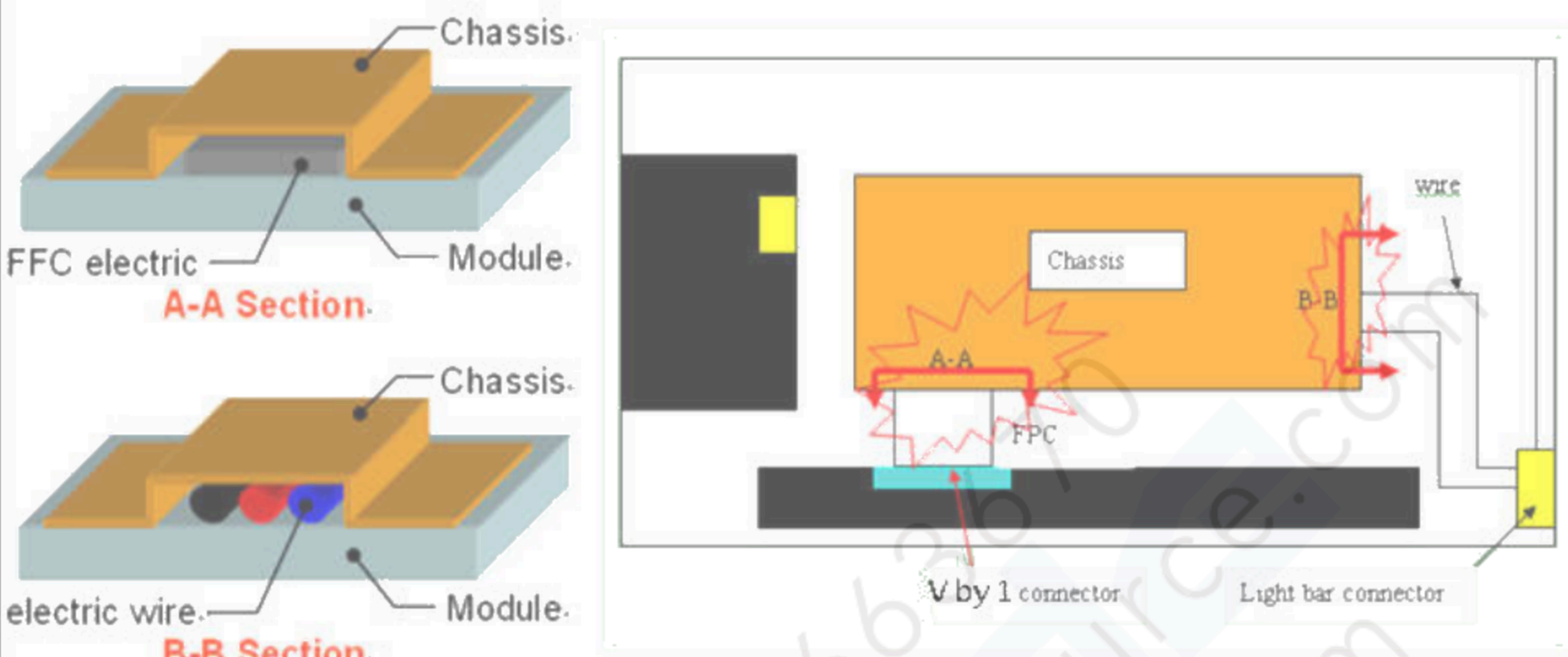
When fixed patterns are displayed for a long time, remnant image is likely to occur.

Appendix 1. SYSTEM COVER DESIGN NOTICE

1.	Set Chassis and MNT Module touching Mode
 	
 	
 	
Definition	a) To prevent from abnormal display & white spot after Mechanical test, it is not recommended to <u>used</u> spring type chassis. b) We suggest the contact mode between Chassis and Module rear cover is Tape/Sponge, second is <u>Flat sheetmetal</u> type chassis (Don't interference from flat sheetmetal of chassis to rear cover of <u>Module</u>).

2	Tape/sponge design on system inner surface
	
Definition	a) To prevent from abnormal display & white spot after Mechanical test, We suggest using Tape/Sponge as medium between chassis and Module rear cover could reduce the occurrence of white spot. b) When using the Tape/Sponge, suggest it be lay over between set chassis and module rear cover. it is not recommended to add tape/sponge in separate location. Since each tape/sponge may act as pressure concentration location.

3	System inner surface examination
	 The diagram illustrates the system inner surface examination. The top part shows a top-down view of a light blue rectangular area with a red hatched rectangle at the bottom. Below this is a cross-section view of the 'MNT Module' (teal) sitting on a 'System cover inner surface' (cyan). The cross-section shows a green 'PCB' and an orange 'Chassis' with labels for 'Burr' at the edges and a 'Step' on the right. A red hatched area on the PCB is highlighted.
Definition	a). Burr at logo edge, step, protrusion or PCB board will easily cause white spot. b). Keeping flat surface underneath module is recommended. c). The area () on Module PCBA and Light bar connector should keep at least 1mm gap to any structure with System cover inner surface.

4	The overlapping part on System's Chassis and electric wire needs gap structure.
	
Definition	The overlapping part on System's Chassis and electric wire (FPC、FFC and wire) needs gap structure to avoid display of white spot by pressing overlapping part cause interference.

Appendix 2. OUTLINE DRAWING