

Doc. Number :

- ☒ Tentative Specification
☐ Preliminary Specification
☐ Approval Specification

MODEL NO.: M280DCA
SUFFIX: E7B

Customer: common

APPROVED BY SIGNATURE

Name / Title _____

Note

Product Version B1

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

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REVISION HISTORY

[illegible]

1. GENERAL DESCRIPTION

1.1 OVERVIEW

M280DCA-E7B is a 28.0" TFT Liquid Crystal Display module with WLED Backlight unit and 8 lane – edp interface. This module supports 3840 x 2160 UHD(Ultra High Definition) mode and can display up to 16.7M colors. The converter module for Backlight is not built in.

1.2 GENERAL SPECIFICATIONS

Item	Specification	Unit	Note
Screen Size	631.928*359.78	mm	
Driver Element	a-si TFT active matrix	-	-
Pixel Number	3840 x R.G.B. x 2160	pixel	-
Pixel Pitch	0.16 (H) x 0.16 (V)	mm	-
Pixel Arrangement	RGB vertical stripe	-	-
Display Colors	16.7M	color	-
Transmissive Mode	AAS mode (Azimuthal Anchoring Switching), Normal Black	-	-
Surface Treatment	AG type, 3H hard coating, Haze 25	-	-
Color Gamut	DCI-P3 90% (min)	-	(1)(2)
Display Orientation	Signal input with "INX"		(3)
Luminance, White (SDR)	300 (Typ)	Cd/m2	(4)
Luminance, White (HDR_Normal)	370 (Typ.)	Cd/m2	(4)(7)
Luminance, White (HDR_Peaking)	460 (Typ.)	Cd/m2	(4)(7)
Power Consumption	Total (45.28) W(Typ) @ cell (27.36)W(Typ.), BL (17.92)W(Typ.)		(5)
RoHS, Halogen Free & TCO 8.0	RoHS, Halogen Free TCO 8.0 compliance		
Low Blue Light Compliance	blue-violet segment of the blue light spectrum ratio 50% (Max)		(5)
VESA HDR400	VESA HDR400_CTS1.1 compliance		

Note (1) Coverage of DCI-P3 color-space base on CIE-1976 system

Note (2) Area ratio of NTSC color space on CIE-1931 system:

(85%) of NTSC (Typ.)

Coverage of sRGB / Adobe color space on CIE-1976 system:

(100%) of sRGB (Typ.)

(90%) of Adobe (Typ.)

Note (3)



Note(4) ref. 4.3.2

Note(5) The specified power consumption : Total= cell (reference 4.3.1) + BL (reference 4.3.2) Typical BL
Power be measured while SDR mode on

Note(6) The ratio of display emission light in the range from 415-455nm to the display emission of 400-500nm
shall be less than 50%

Note (7)

- (a) 10% center patch test for HDR_Paking measurement item
- (b) full-screen flash test for HDR_Normal measurement item
- (c) LED Light on condition: 8(H) x 1(V) = 8 zones

10% Center Patch Test Pattern



Full Screen Flash Test pattern



2. MECHANICAL SPECIFICATIONS

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	631.43	631.93	632.93	mm	(1)
	Vertical (V)	359.28	359.78	360.78	mm	
	Thickness (T)	15.02	15.52	16.02	mm	
Bezel Area	Horizontal		NA		mm	
	Vertical		NA		mm	
Active Area	Horizontal		620.93		mm	
	Vertical		341.28		mm	
Weight			3150			

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.

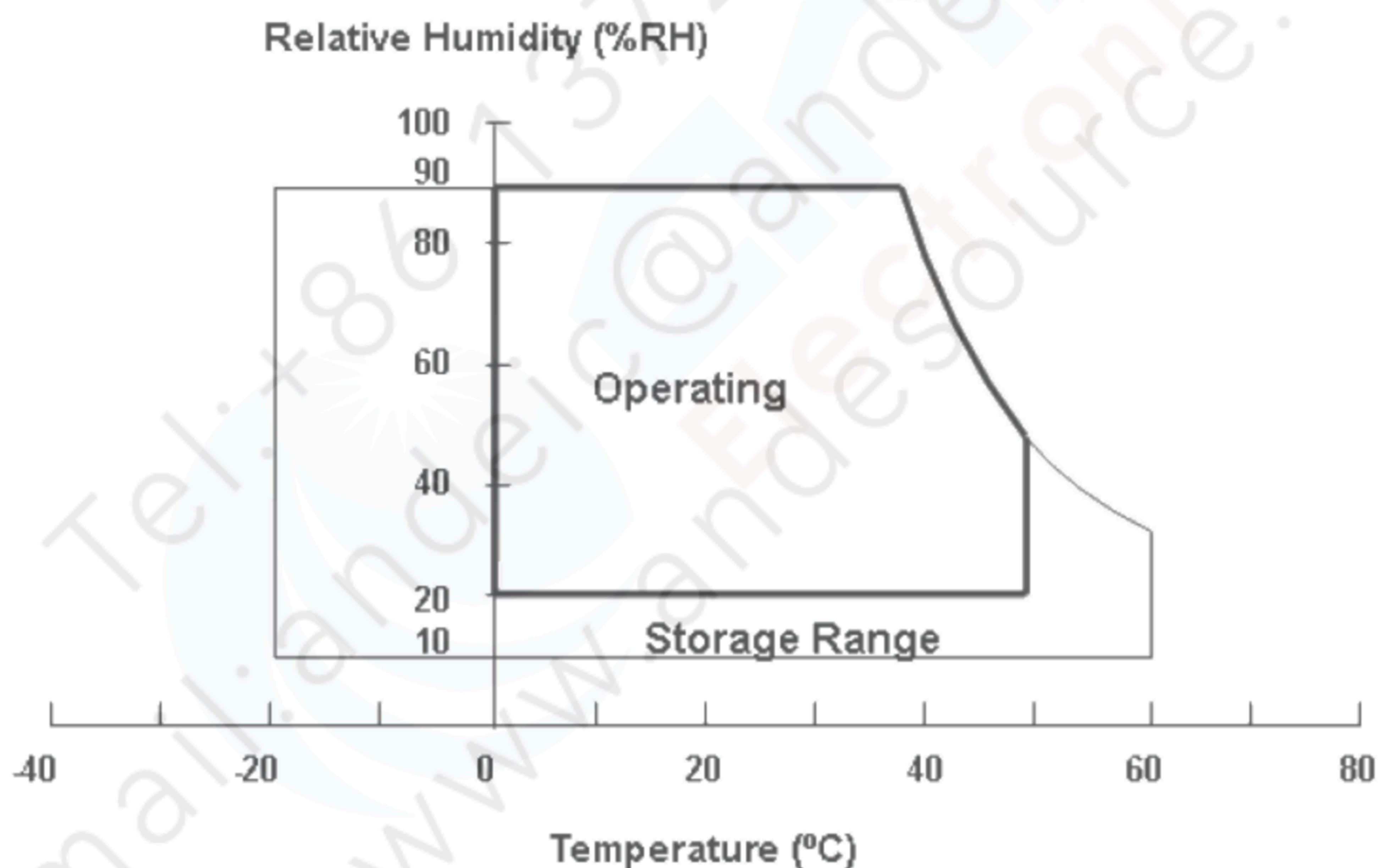
(b) Wet-bulb temperature should be 39°C Max.

(c) No condensation.

Note (2)

(a) Panel surface temperature should be 0°C min. and 65°C max under $V_{CC}=12.0V$, $f_r=120Hz$, 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.

(b) When enabling the HDR mode, the required supported ambient temperature range is 15 through 30°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	VIN	-0.3	3.6	V	

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

3.2.2 BACKLIGHT UNIT

Item	Symbol	Value			Unit	Note
		Min.	Typ	Max.		
LED Forward Current Per Input Pin	IF		95	100	mA	(1), (2) Duty=100%
LED Pulse Forward Current Per Input Pin	IP			300	mA	(1), (2) Pulse Width ≤ 10msec. and Duty ≤ 10%
LED Life Time	LLED	30000			Hrs	(3)

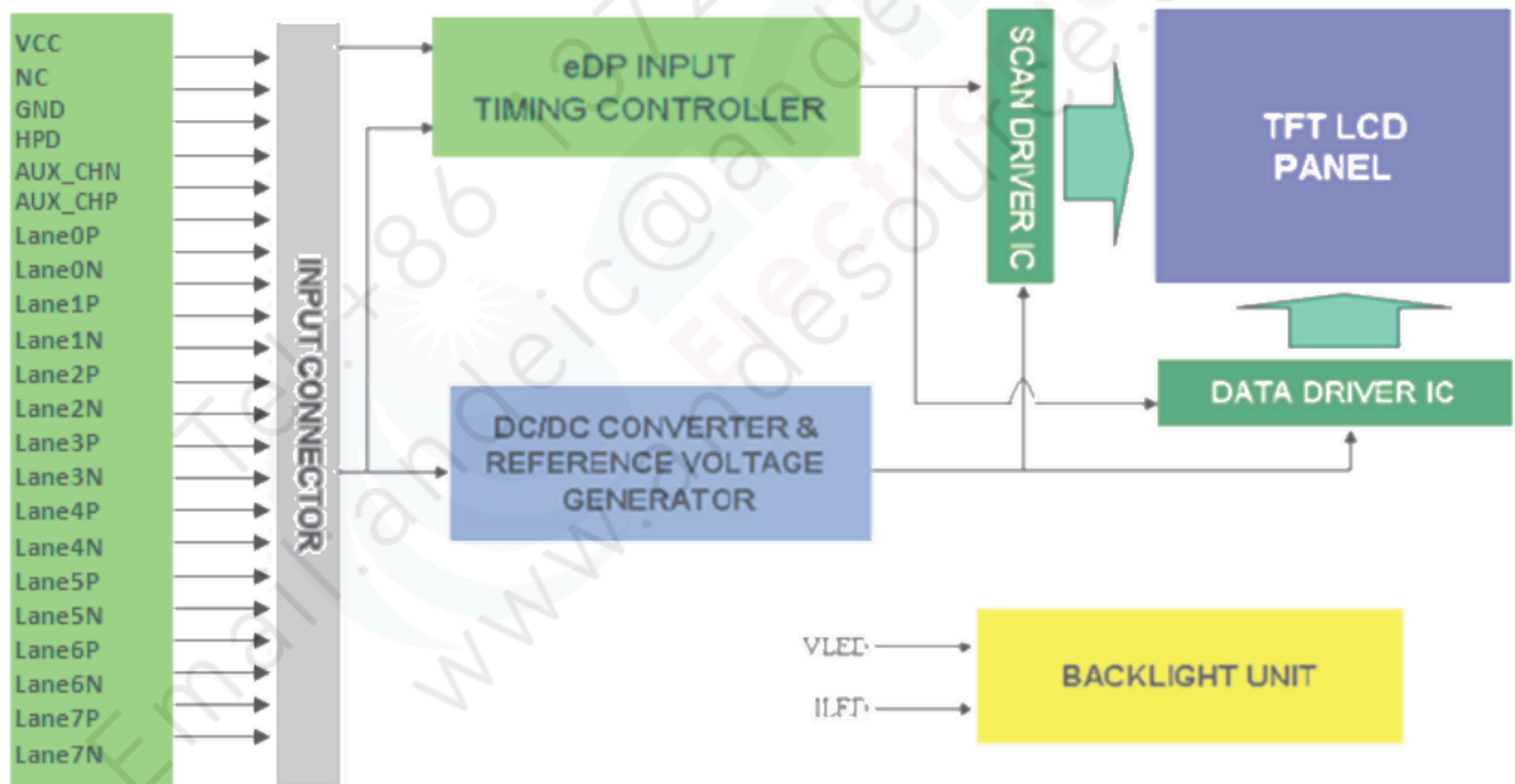
Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

Note (2) Specified values are for input pin of LED light bar at Ta=25±2 °C (Refer to 4.3.2 and 4.3.3 for further information).

Note (3) The lifetime of LED is defined as the time when LED packages continue to operate under the conditions at Ta = 25 ±2 °C and I= (60)mA (per chip) until the brightness becomes ≤ 50% of its original value.

4. ELECTRICAL SPECIFICATIONS

4.1 FUNCTION BLOCK DIAGRAM



4.2. INTERFACE CONNECTIONS

(1) 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	N.C.	No Connection	(1)
8	N.C.	No Connection	(1)
9	N.C.	No Connection	(1)
10	N.C.	No Connection	(1)
11	N.C.	No Connection	(1)
12	GND.	Ground	
13	N.C.	No Connection	(1)
14	N.C.	No Connection	(1)
15	N.C.	No Connection	(1)
16	GND.	Ground	
17	GND.	Ground	
18	RX0P	True Signal for Main Link 0	(4)
19	RX0N	Component Signal for Main Link 0	(4)
20	GND.	Ground	
21	RX1P	True Signal for Main Link 1	(4)
22	RX1N	Component Signal for Main Link 1	(4)
23	GND.	Ground	
24	RX2P	True Signal for Main Link 2	(4)
25	RX2N	Component Signal for Main Link 2	(4)
26	GND.	Ground	
27	RX3P	True Signal for Main Link 3	(4)
28	RX3N	Component Signal for Main Link 3	(4)
29	GND.	Ground	
30	AUXN0	Component Signal for Auxiliary Channel	
31	AUXP0	True Signal for Auxiliary Channel	
32	GND.	Ground	
33	HPD	Hot Plug Detect Signal	
34	GND.	Ground	
35	N.C.	No Connection	(1)
36	GND.	Ground	
37	RX4P	True Signal for Main Link 4	(4)
38	RX4N	Component Signal for Main Link 4	(4)
39	GND.	Ground	
40	RX5P	True Signal for Main Link 5	(4)
41	RX5N	Component Signal for Main Link 5	(4)
42	GND.	Ground	
43	RX6P	True Signal for Main Link 6	(4)
44	RX6N	Component Signal for Main Link 6	(4)
45	GND.	Ground	
46	RX7P	True Signal for Main Link 7	(4)
47	RX7N	Component Signal for Main Link 7	(4)
48	GND.	Ground	
49	AUXN1	Component Signal for Auxiliary Channel	
50	AUXP1	True Signal for Auxiliary Channel	
51	GND.	Ground	

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

(2) Connector Information

Item	Description
Manufacturer	JAE
Type part number	FI-RXE51S-HF

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

Note (2) Connector Part No.:

JAE FI-RXE51S-HF

Note (3) User's connector Part No:

Mating Wire Cable Connector Part No.: FI-RE51CL (JAE) or compatible

Note (4) eDP Four Lane Main Link.

4.3 ELECTRICAL CHARACTERISTICS

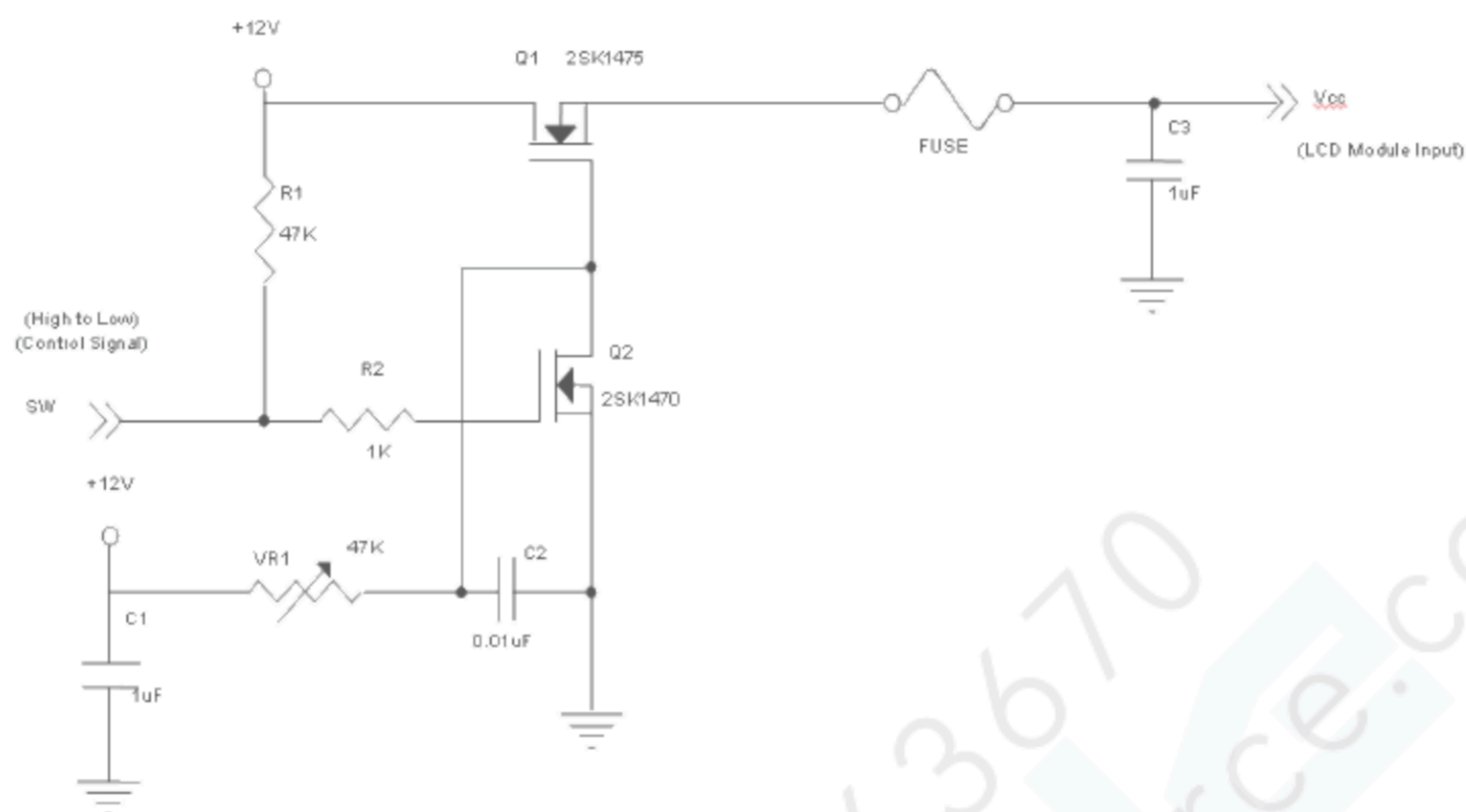
4.3.1 LCD ELETRONICS SPECIFICATION

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		V_{CC}	10.8	12	13.2	V	(2)
Rush Current		I_{RUSH}	-	-	3	A	(3)
Power Consumption	White Pattern	P_T	-	(11.88)	(14.28)	W	(4)
	Black Pattern	P_T	-	(11.64)	(14.04)	W	
	Horizontal Stripe	P_T	-	(27.36)	(33)	W	
Power Supply Current	White Pattern	-	-	(0.99)	(1.19)	A	(5)
	Black Pattern	-	-	(0.97)	(1.17)	A	
	Horizontal Stripe	-	-	(2.28)	(2.75)	A	
eDP interface	Differential peak to peak voltage	V_{dp-p}	100	-	1320	mV	
	DC common mode voltage		0	-	2	V	
	Differential Input Resistor	RRIN	80	100	120	ohm	
CMOS interface	Input High Threshold Voltage	V_{IH}	2.7	-	3.3	V	
	Input Low Threshold Voltage	V_{IL}	0	-	0.7	V	

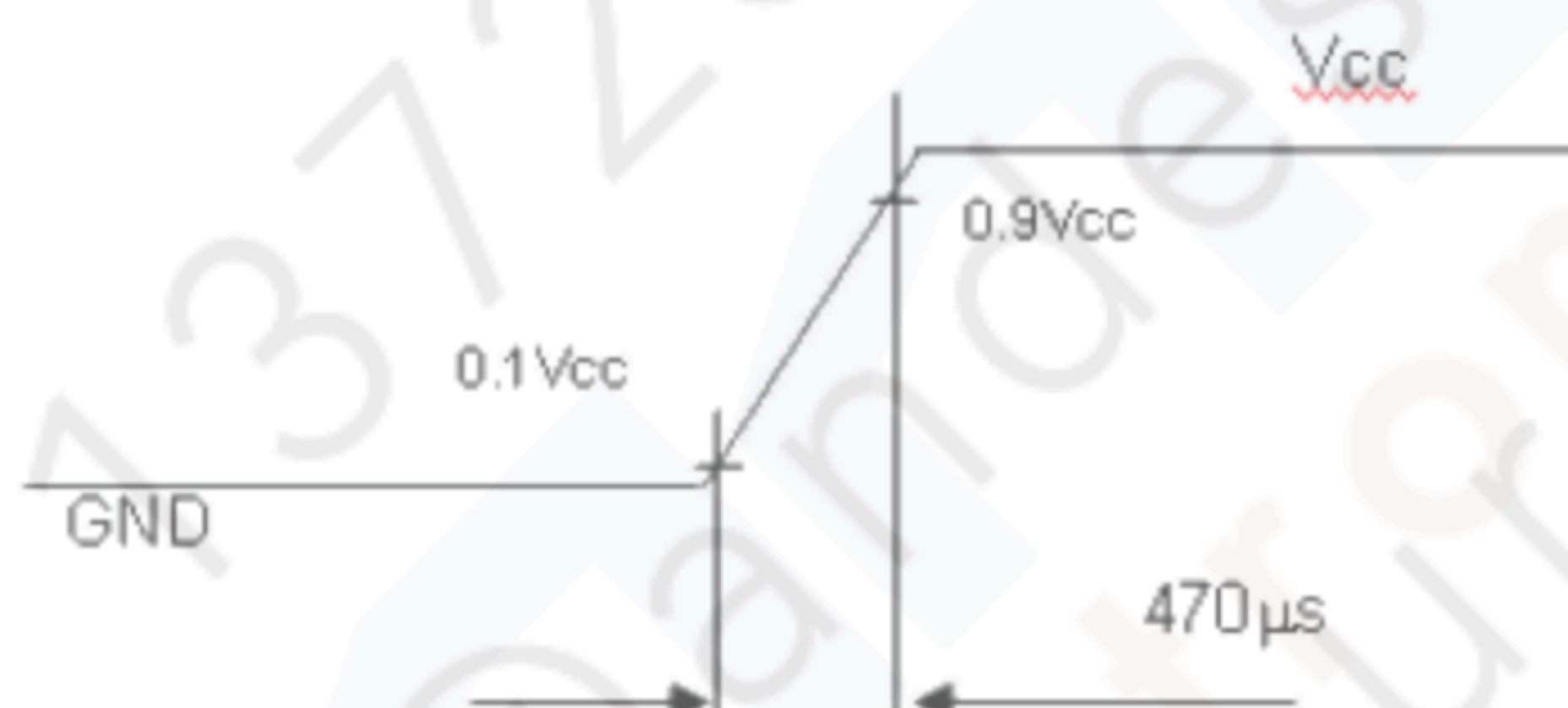
Note (1) The ambient temperature is $T_a = 25 \pm 2^\circ\text{C}$.

Note (2) The module should be always operated within the above ranges . The ripple voltage should be controlled under 10 % of V_{CC} (Typ.)

Note (3) Measurement Conditions:



V_{CC} rising time is 470μs



Note (4) The specified power supply current is under the conditions at $V_{CC} = 12\text{ V}$, $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$, $F_r = 144\text{ Hz}$, whereas a power dissipation check pattern below is displayed.

a. White Pattern



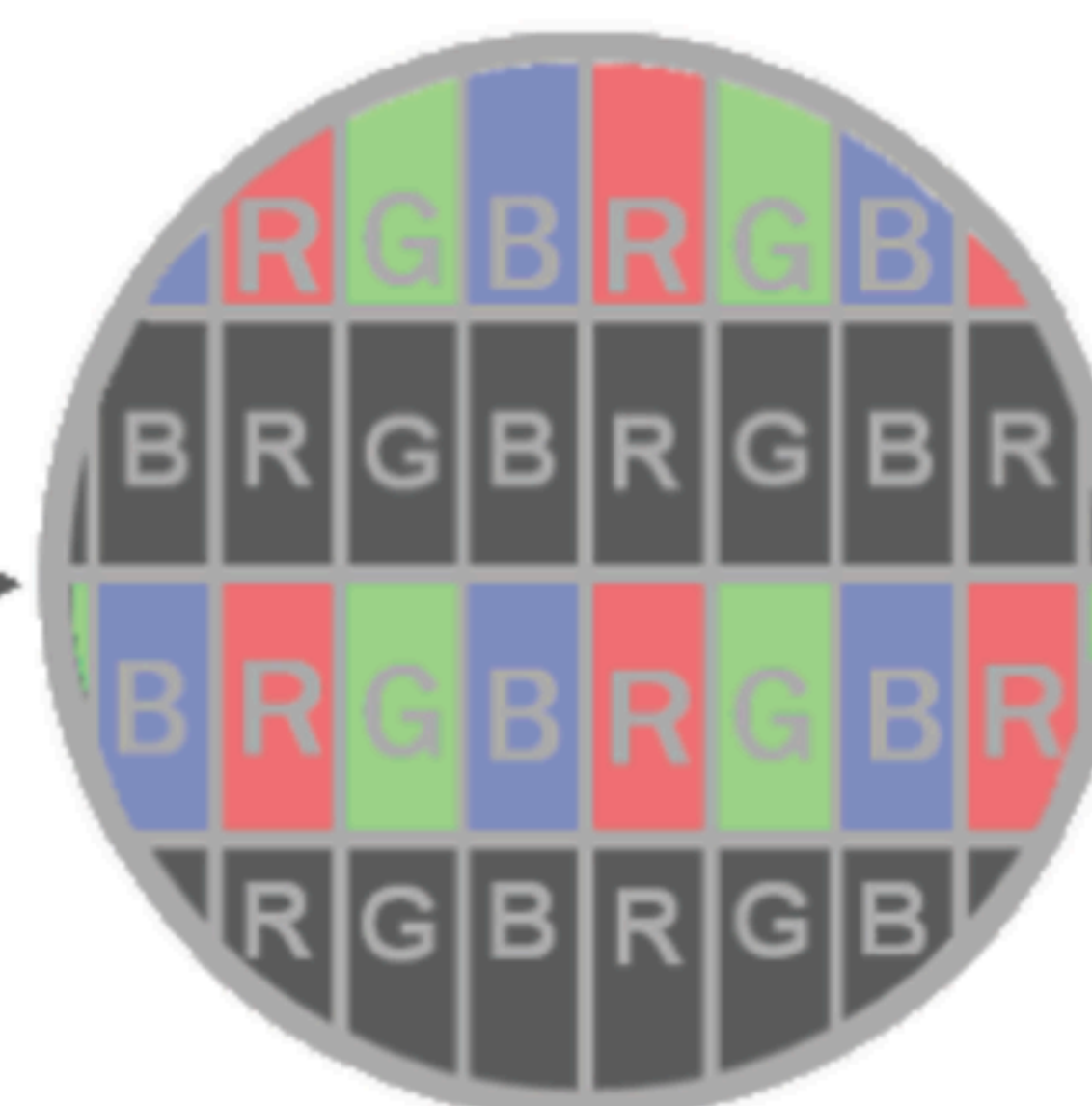
Active Area

b. Black Pattern



Active Area

c. Horizontal Pattern



Note (5) The power consumption is specified at the pattern with the maximum current.

4.3.2 BACKLIGHT UNIT

1. SDR Mode:

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
LED Light Bar Input Voltage Per Input Pin	VPIN	(32.4)	(37.33)	(41.60)	V	(1), Duty=100%, IPIN=(60mA)
LED Light Bar Current Per Input Pin	IPIN	(57)	(60)	(63)	mA	(1), (2), (4) Duty=100%
Power Consumption	PBL		(17.920)	(19.968)	W	(1), (2), (3) Duty=100%, IPIN=(60mA)
PWM Control Frequency	f _{PWM}	240	-	-	Hz	

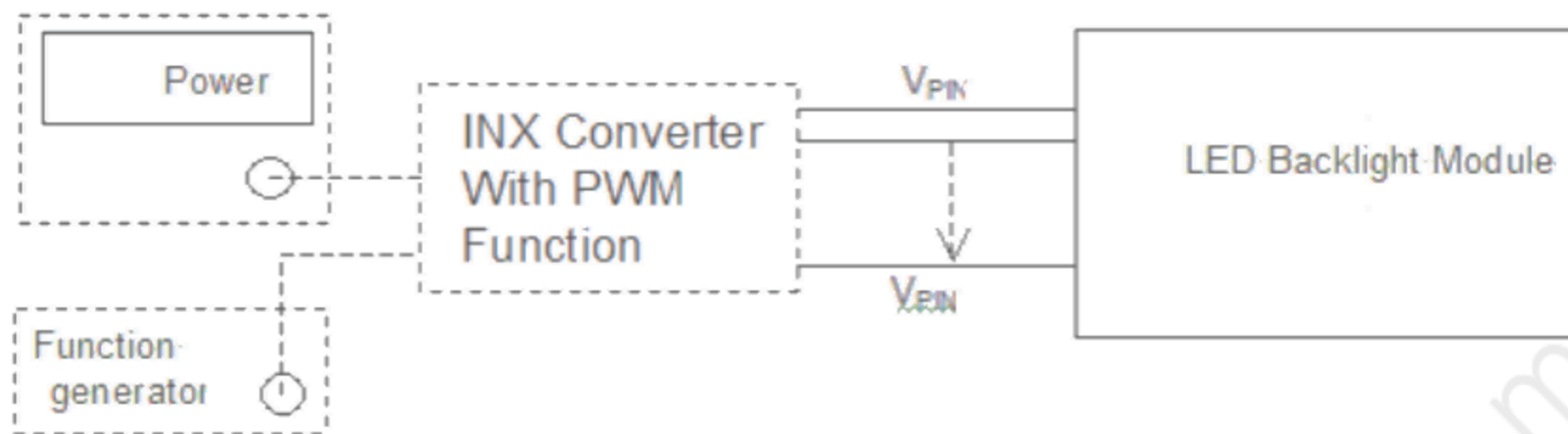
2. HDR_Normal Mode:

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
LED Light Bar Input Voltage Per Input Pin	VPIN	(32.4)	(37.98)	(41.6)	V	(1), Duty=100%, IPIN=(75mA)
LED Light Bar Current Per Input Pin	IPIN	(71)	(75)	(79)	mA	(1), (2), (4) Duty=100%
Power Consumption	PBL		(22.790)	(24.96)	W	(1), (2), (3) Duty=100%, IPIN=(75mA)
PWM Control Frequency	f _{PWM}	240	-	-	Hz	

3. HDR_Peaking Mode:

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
LED Light Bar Input Voltage Per Input Pin	VPIN	(32.4)	(38.80)	(41.6)	V	(1), Duty=100%, IPIN=(95mA)
LED Light Bar Current Per Input Pin	IPIN	(90)	(95)	(100)	mA	(1), (2), (4) Duty=100%
Power Consumption	PBL		(29.5)	(31.616)	W	(1), (2), (3) Duty=100%, IPIN=(95mA)
PWM Control Frequency	f _{PWM}	240	-	-	Hz	

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



Note (2) The module must be operated with constant driving current.

Note (3) $PBL = I_{PIN} \times V_{PIN} \times (4) \text{ input pins} \times (2) \text{ light bar}$

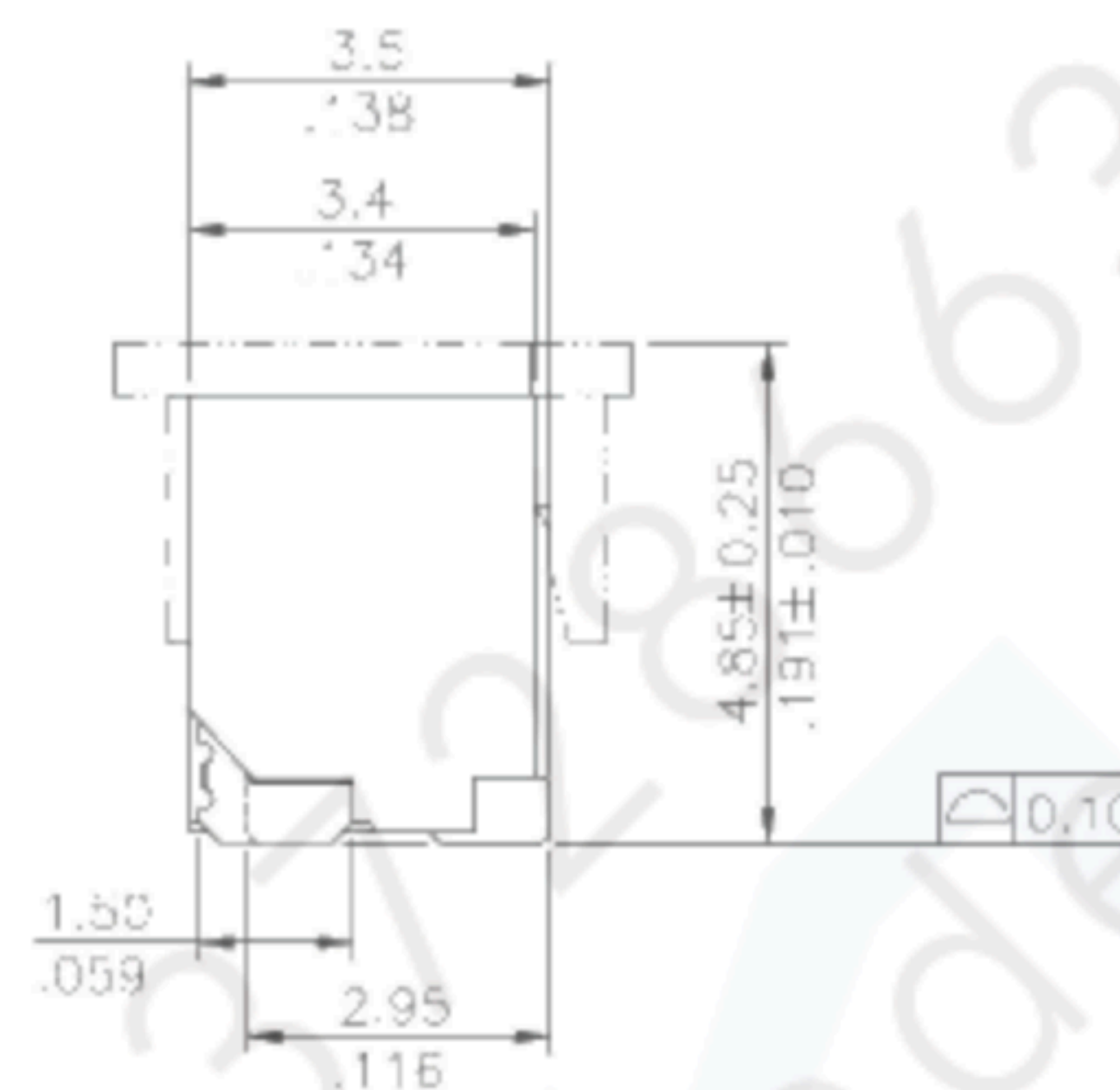
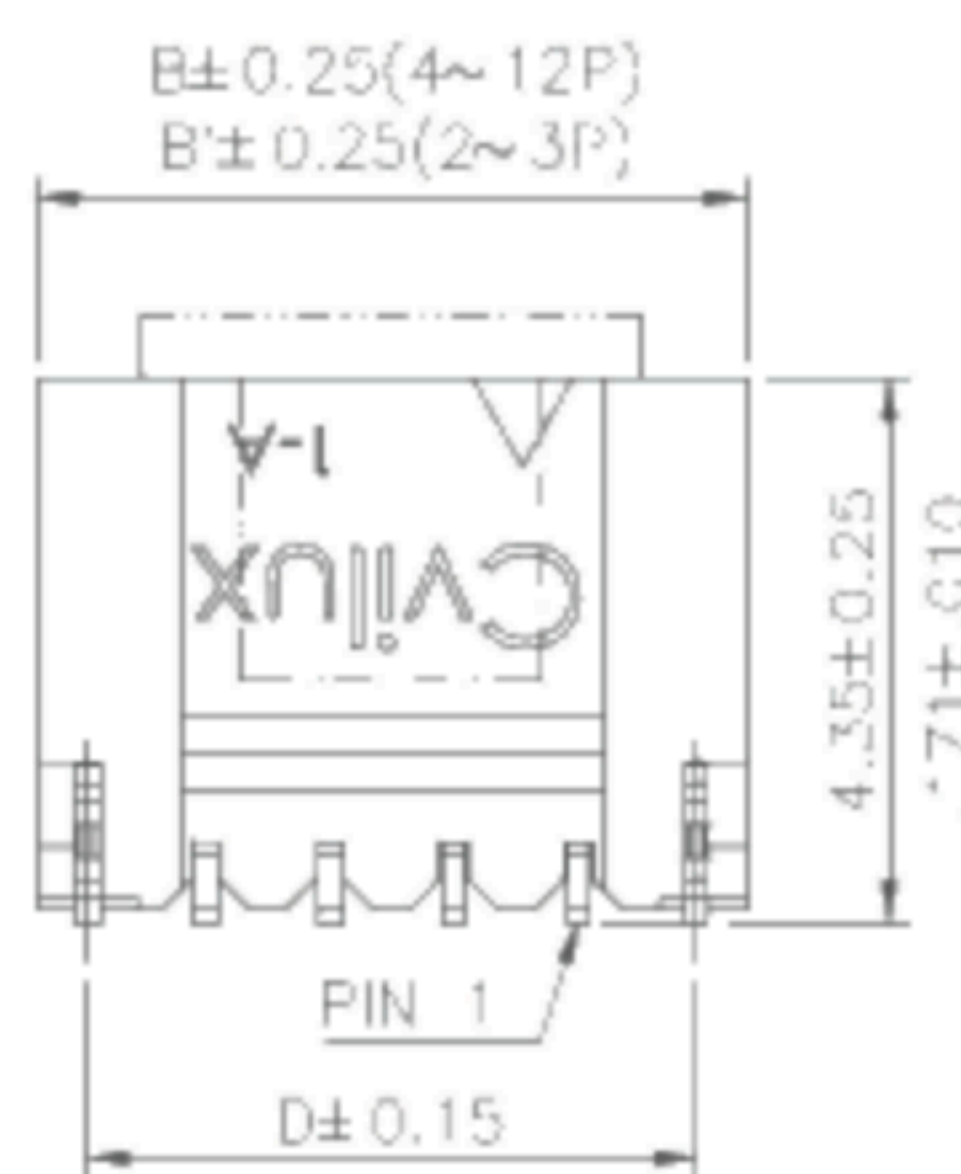
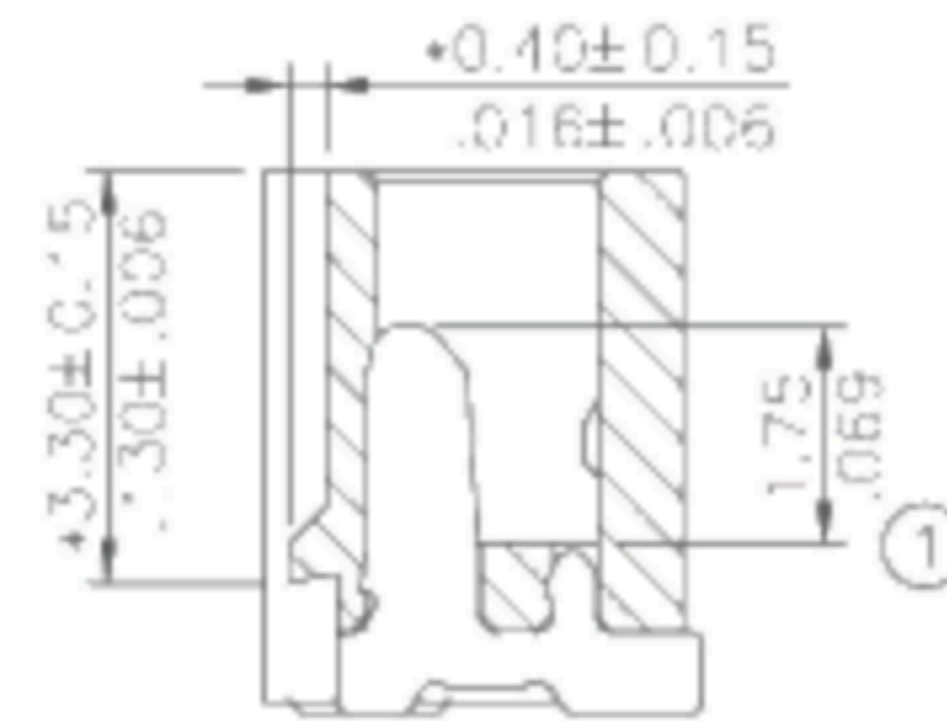
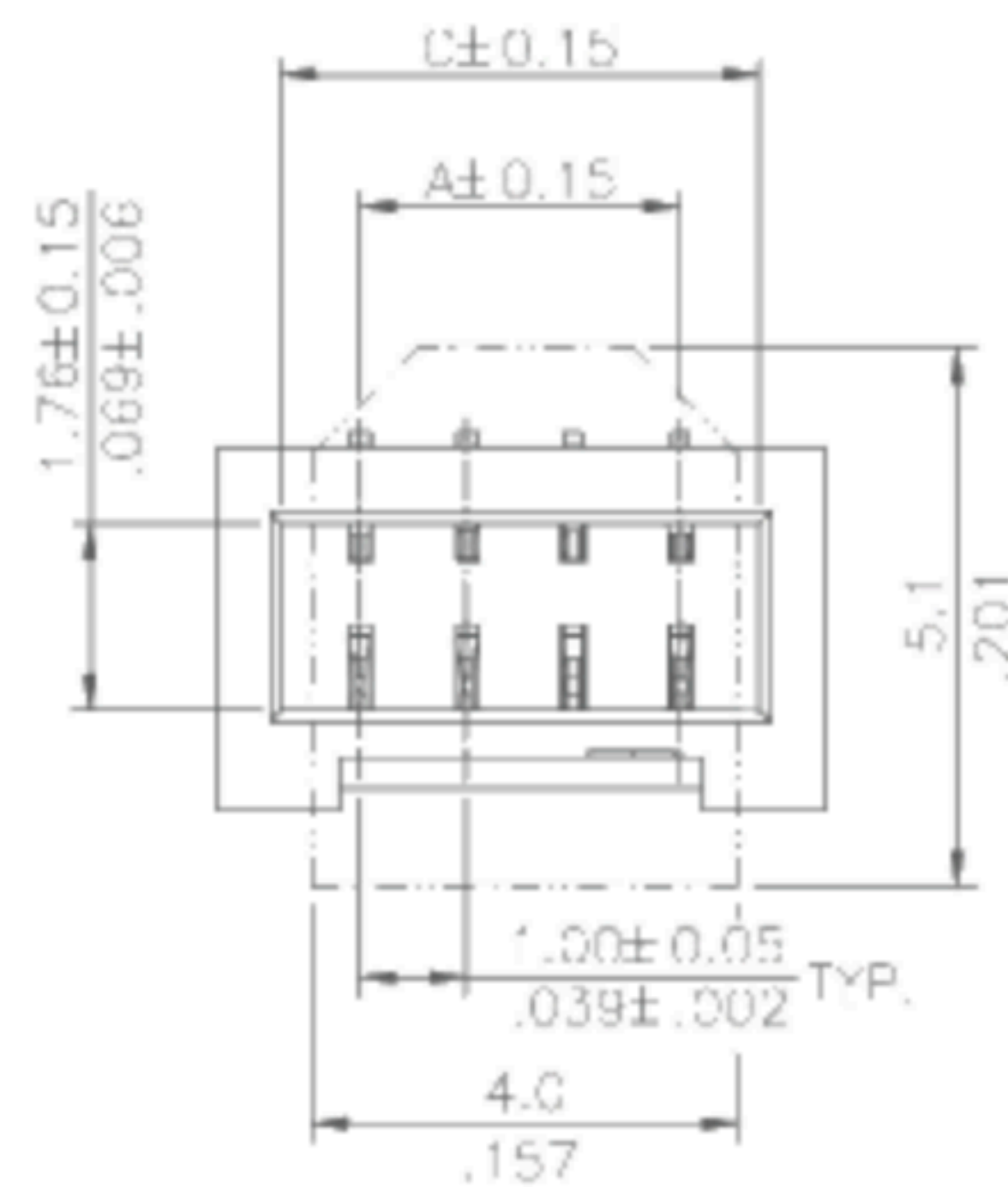
Note (4) When enabling the HDR mode, the required supported ambient temperature range is 15 through 30°C. Please make a note it should keep panel surface temperature under 65°C while operated.

4.3.3 LIGHTBAR CONNECTOR PIN ASSIGNMENT:

(1) Connector:

Item	Description
Manufacturer	CviLux
Type part number	CI1406M1VL0-NH (CviLux) or equivalent.
Mating housing part number	FCN(WF1300106-B) and hook width must be less than 4.5mm

(2) LB Connector drawing:



Notes:

- * Base: High temperature plastic UL 94V-0, Color Nature
- * Contact: Copper alloy
- * Tab: Copper alloy with Matte Tin plated
- * For Lead Free IR Processes

Ordering Code:

CI14 ** M 1 V L 0 - NH
① ② ③ ④ ⑤ ⑥ ⑦ ⑧

- ① Series No.
- ② No. of Circuits: 02~12 Pin
- ③ M= SMT type header
- ④ Plating: 1= 3.05um(120u") ~ 4.88um(192u")
Matte Tin over 1.27um(50u") Nickel
- ⑤ Type: V= Vertical Type
- ⑥ Packing Options: L= Latch Type
- ⑦ Option: 0= Standard
- ⑧ Other option:
-NH= For Lead Free IR Processes and Halogen-Free

DIM. A = 1.00 x NO. OF SPACES
DIM. B = DIM. A + 2.70
DIM. B' = DIM. A + 2.90
DIM. C = DIM. A + 1.50
DIM. D = DIM. A + 2.00
DIM. E = DIM. A + 2.70

* AVAILABLE IN 2 THROUGH 12

Halogen-Free Lead Free Process RoHS Compliant

Pin number	Description
1	Cathode of LED string
2	Cathode of LED string
3	VLED
4	VLED
5	Cathode of LED string
6	Cathode of LED string

4.4 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 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	0	1	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

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
eDP	Frequency	Fc	(420)	(1065.6)	(1244)	MHz	(1)
Vertical Display Term	Frame Rate	Fr	(48)	(120)	(144)	Hz	
	Total	Tv	(2175)	(2220)	(2350)	Th	Tv=Tvd+Tvb
	Active Display	Tvd	2160	2160	2160	Th	-
	Blank	Tvb	(15)	(60)	(190)	Th	-
Horizontal Display Term	Total	Th	(3920)	(4000)	(4020)	Tc	Th=Thd+Thb
	Active Display	Thd	3840	3840	3840	Tc	-
	Blank	Thb	(80)	(160)	(180)	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): Because this module is operated by DE only mode, Hsync and Vsync input signals are ignored.

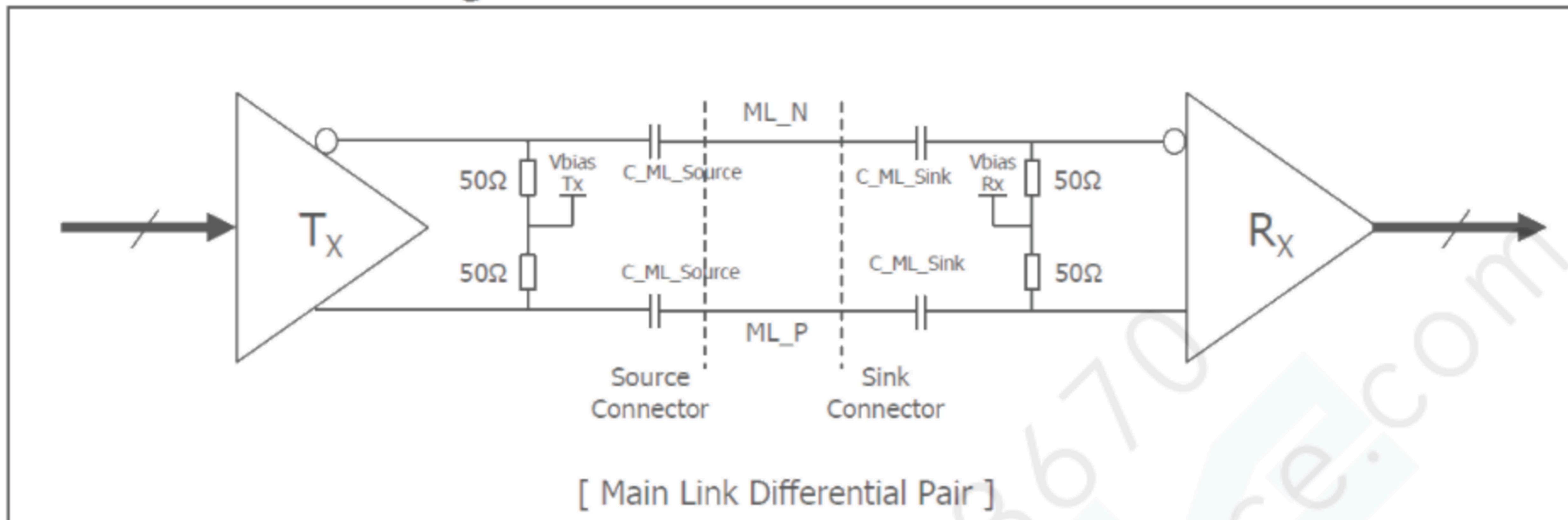
$$F_c = F_r \times T_v \times T_h$$

Please make sure the range of pixel clock has follow the below equation and Fc, Fr, Tv, Th not allowed to get beyond the min or max spec.

.

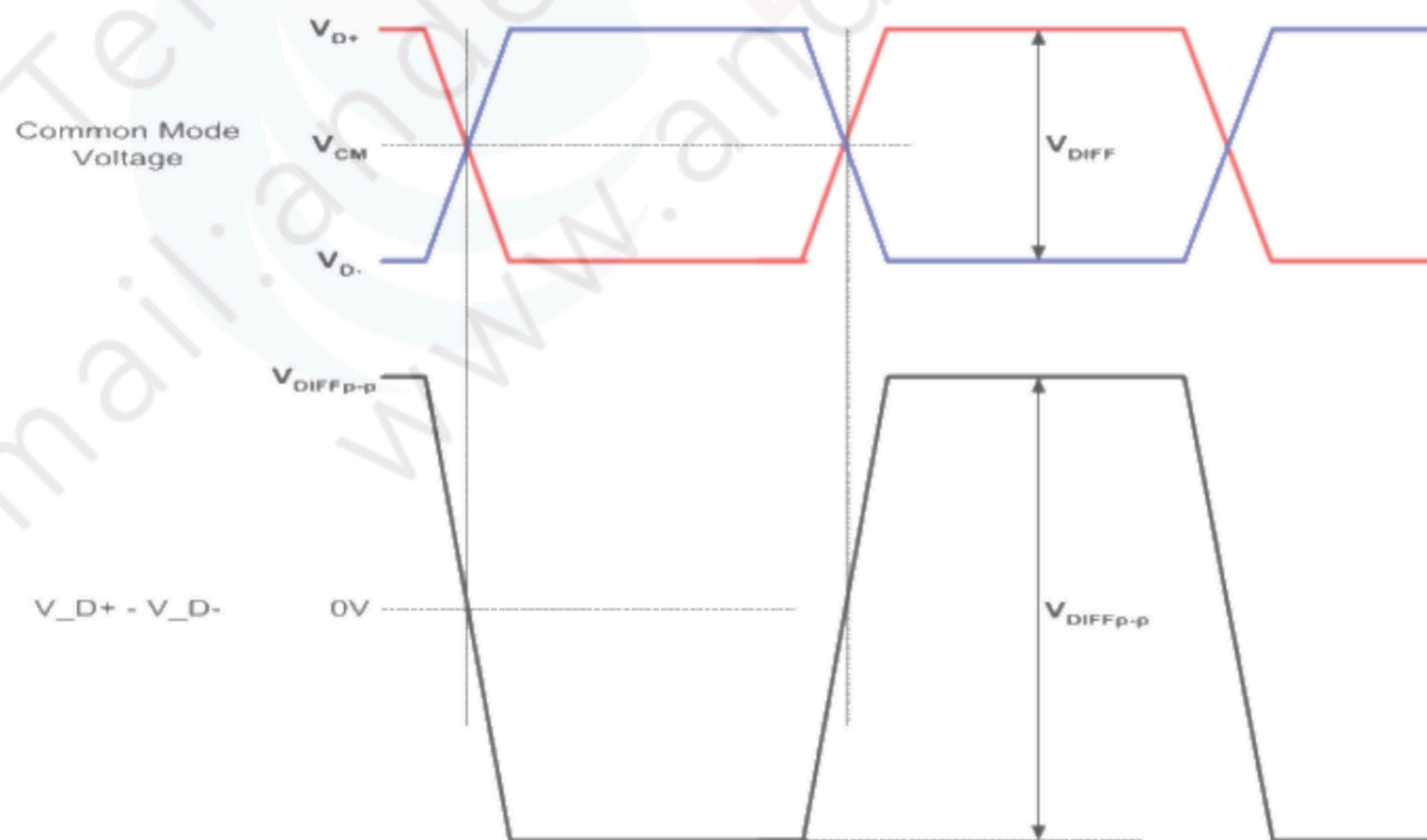
4.6 EDP SIGNAL SPECIFICATIONS

4.6.1 EDP MAIN LINK SIGNAL



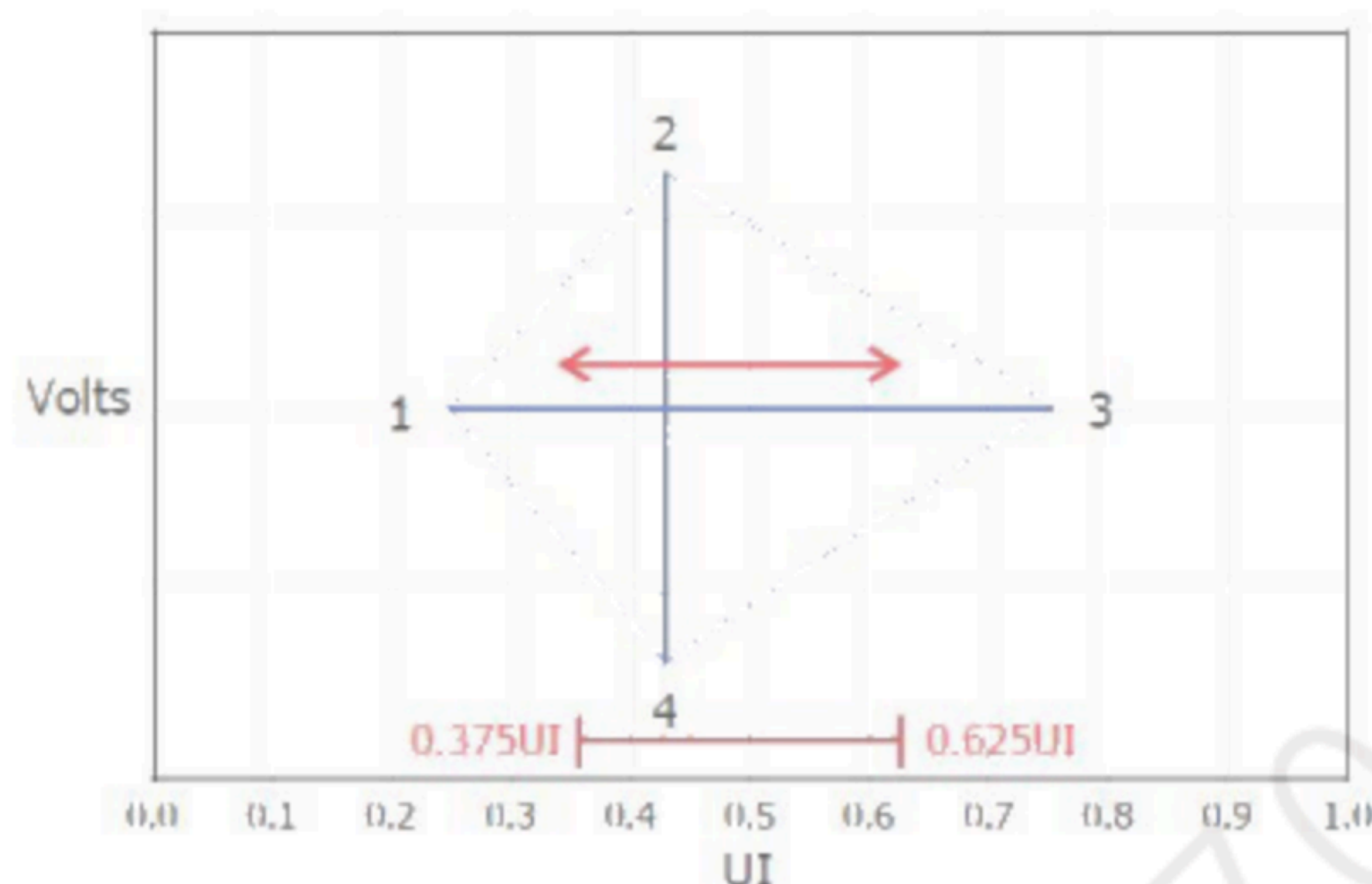
Parameter	Min	Typ	Max	Unit
Frequency for high bit rate (HBR2)	-	5.4	-	Gbps
pread spectrum clock (Down Spreading)	0	-	0.5	%
SSC modulation frequency	30	-	33	kHz
Differential peak to peak voltage at RX connector	100	-	1320	mV
Rx input DC common mode voltage	0	-	2	V
Differential termination resistance	80	100	120	ohm
Rx intra-pair skew at HBR	-	-	60	ps

Note(1) Definition of Differential Voltage



Definition of Differential Voltage and Differential Voltage Peak-to-Peak

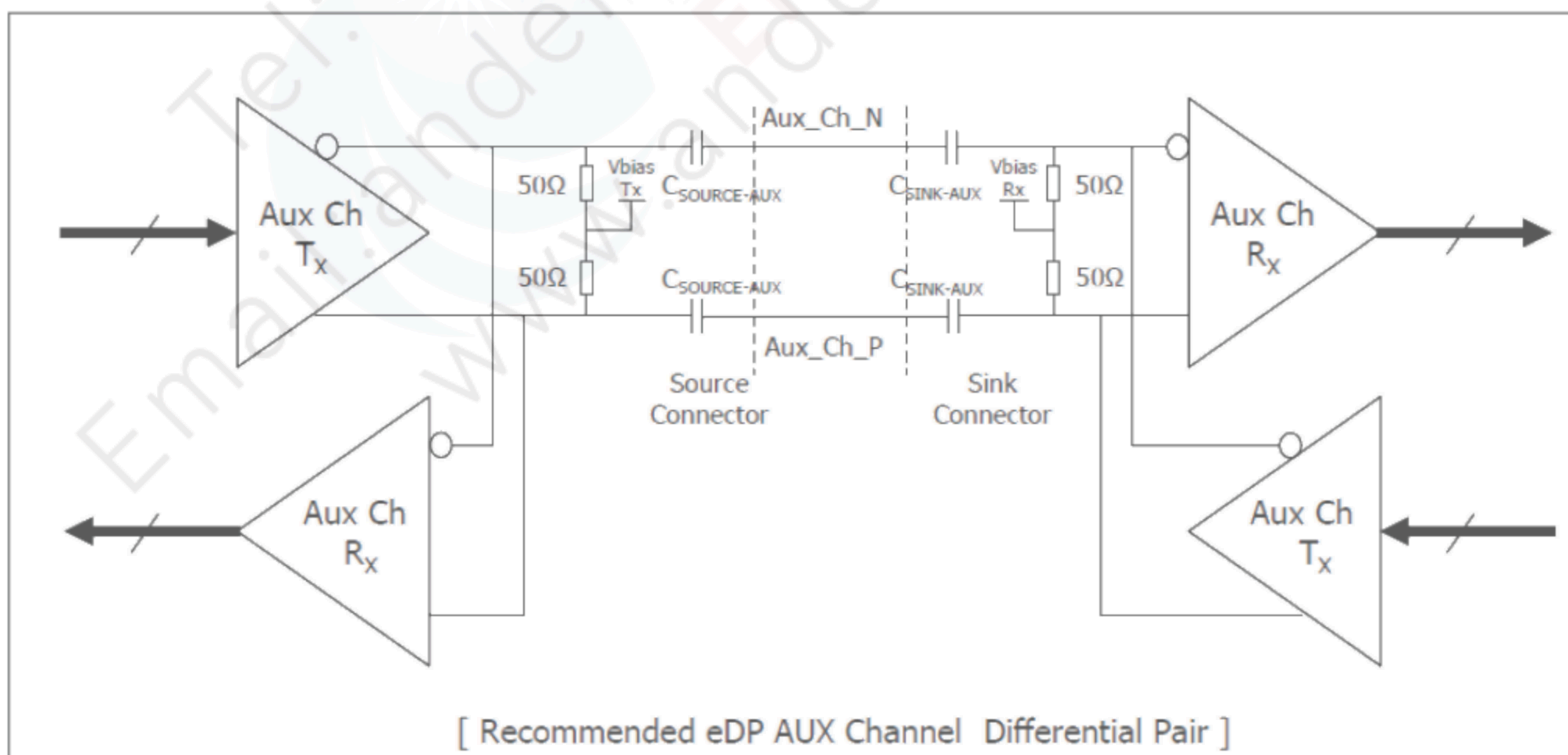
Note(2) Main Link EYE Diagram



Point	High Bit Rate 2 @ TP3 EQ	
	Time(UI)	Voltage(V)
1	Any UI location (x) where the eye width is open from x to x+0.38UI	0.000
2	Any passing UI location between 0.375UI-0.625UI	0.045
3	Point 1 + 0.38UI	0.000
4	Same as Point 2	-0.045

[EYE Mask Vertices at embedded DP Sink Connector Pins]

4.6.2 EDP AUX CHANNEL SIGNAL



[Recommended eDP AUX Channel Differential Pair]

Parameter	Symbol	Min	Typ	Max	Unit
AUX Unit Interval	UI	0.4	-	0.6	us
AUX Jitter at Tx IC Pins	T jitter	-	-	0.04	UI
AUX Jitter at Rx IC Pins	T jitter	-	-	0.05	UI
AUX Peak-to-peak voltage at Connector Rx Pins	VAUX-DIFFp-p	0.27	-	1.36	mV
AUX Peak-to-peak voltage at Connector Tx Pins	VAUX-DIFFp-p	0.29	-	1.38	V
AUX Differential termination resistance	AUX_dtr	-	100	-	ohm
AUX DC common mode voltage	VAUX_CM	0	-	2	V

4.6.3 EDP HPD SIGNAL

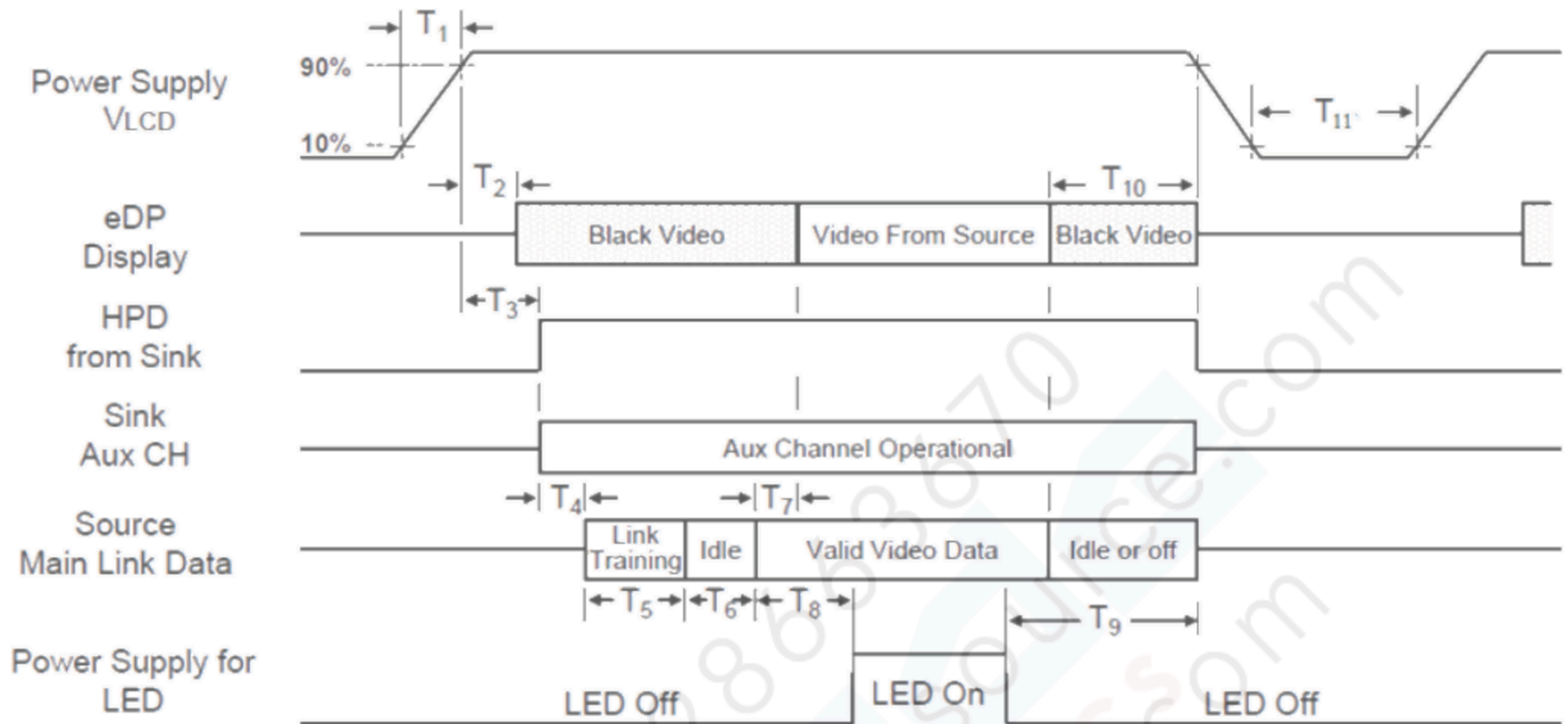


Parameter	Symbol	Min	Typ	Max	Unit
HPD Voltage	VOH_HPDP	3.135	-	3.465	V
HPD_IRQ Pulse Width	HPD_IRQ	0.5	-	1	ms

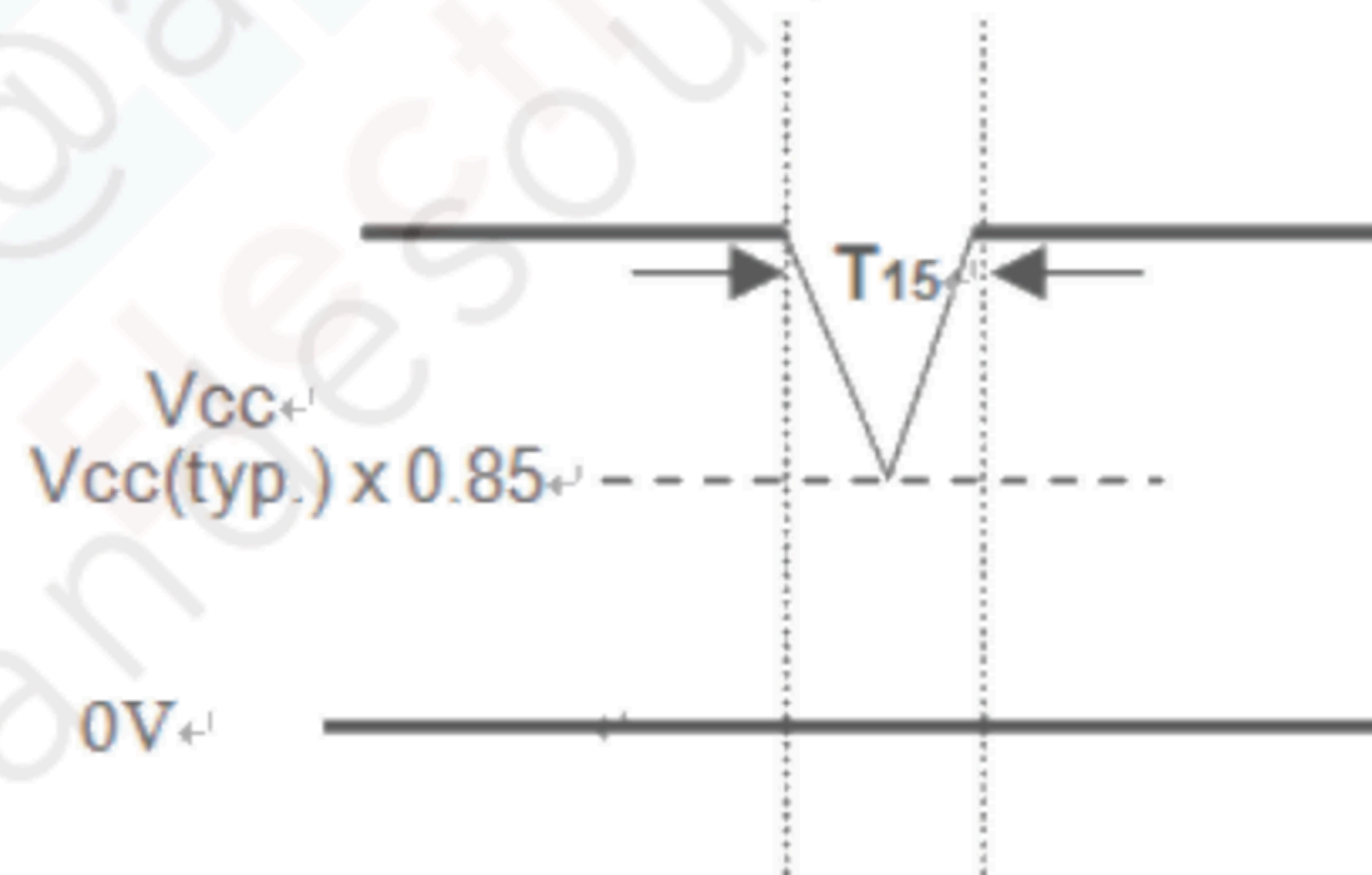
4.7 EDP RGB DATA MAPPING

[illegible]

4.8 POWER ON/OFF SEQUENCE



Vcc Dip
 $T_{15} \leq 10\text{ms}$



Timing	Required By	Min	Max	Units	Notes
T1	Source	0.5	10	ms	
T2	Sink	10	200	ms	
T3	Sink	15	200	ms	
T4	Source	-	-	ms	
T5	Source	-	-	ms	
T6	Source	-	100	ms	
T7	Sink	0	50	ms	
T8	Source	200	-	ms	
T9	Source	200	-	ms	
T10	Source	0	500	ms	
T11	Source	1000	-	ms	

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) T11 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	Condition	Symbol	Value	Unit
Ambient Temperature		Ta		oC
Ambient Humidity		Ha		%RH
Panel Surface Temperature	center	Tp	(31±2)	°C
Supply Voltage		VCC		V
Input Signal		According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
LED Light Bar Input Current Per Input Pin	SDR	I _{PIN_SDR}	(60)	mA _{DC}
PWM Duty Ratio	SDR	D _{_SDR}	100	%
LED Light Bar Test Converter		(INX 27 - D089583)		

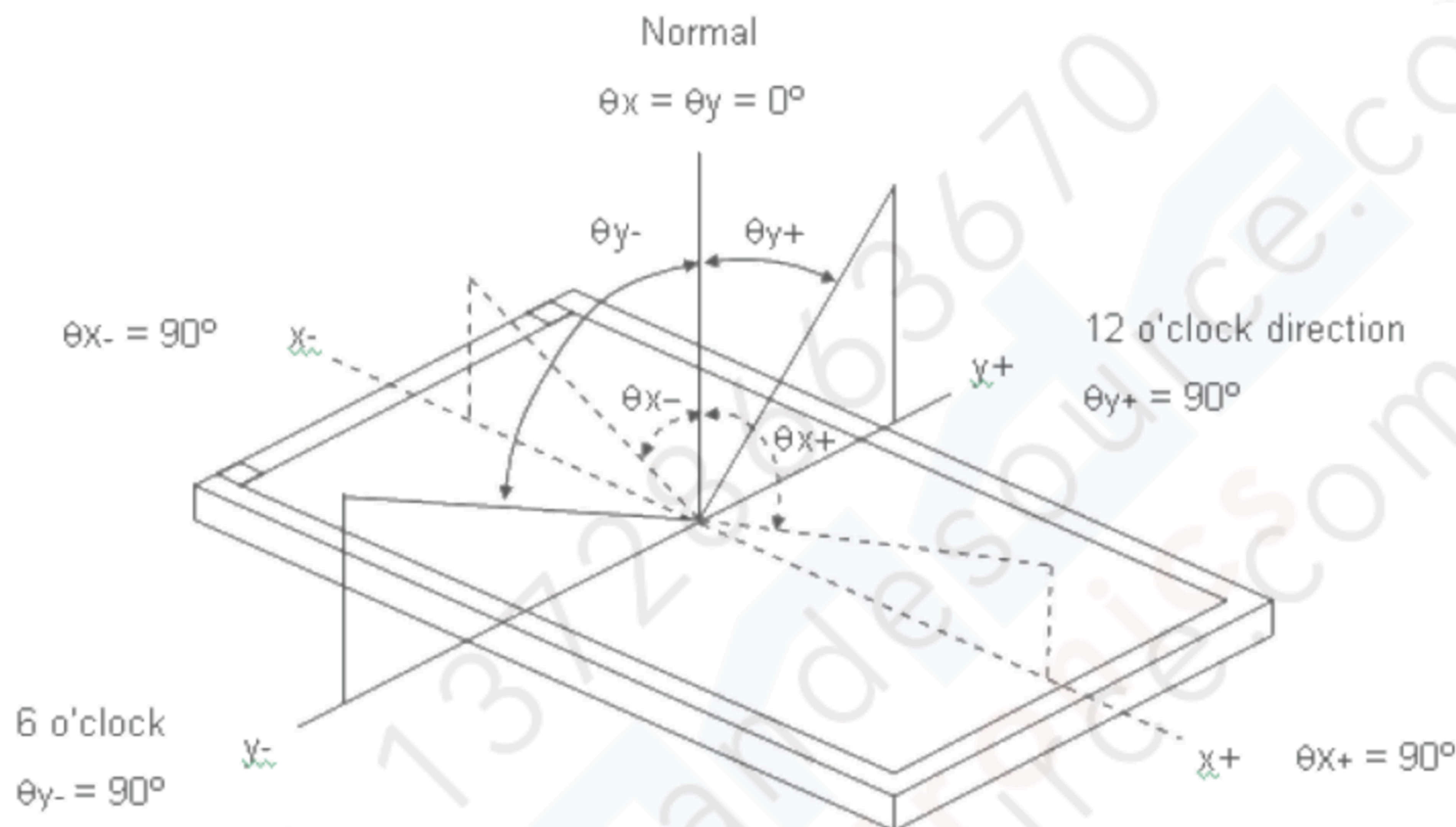
5.2 OPTICAL SPECIFICATIONS

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

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	-0.030	(0.675)	+0.030	-	(1), (5)
		Ry			(0.314)			
	Green	Gx			(0.271)			
		Gy			(0.623)			
	Blue	Bx			(0.148)			
		By			(0.056)			
	White	Wx			0.313			
		Wy			0.329			
Center Luminance of White (Center of Screen)		L _{C_SDR}		250	300	--	cd/m ²	(2), (5)

Contrast Ratio	CR		700	1000	--	-	(3), (5)
Response Time	T_{GTG_AVE}		--	(3.5)	(13)	ms	(4), (5)
White Variation	W	$\theta_x=0^\circ, \theta_y=0^\circ$	75	--	--	--	(5), (6)
Viewing Angle	Horizontal	$\theta_{x-} + \theta_{x+}$	$CR \geq 10$	170	178	--	Deg. (1), (5)
	Vertical	$\theta_{y-} + \theta_{y+}$		170	178	--	
Crosstalk	CT		--	--	2.0	%	(5), (7)

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



Note (2) 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 (3) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

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

L_{255} : Luminance of gray level 255

L_0 : Luminance of gray level 0

$$CR = CR(5)$$

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

Note (4) Definition of Gray-to-Gray Switching time :

-The TGtG is the response time means the transition time from "Gray N" to "Gray M" (N,M=0~255)

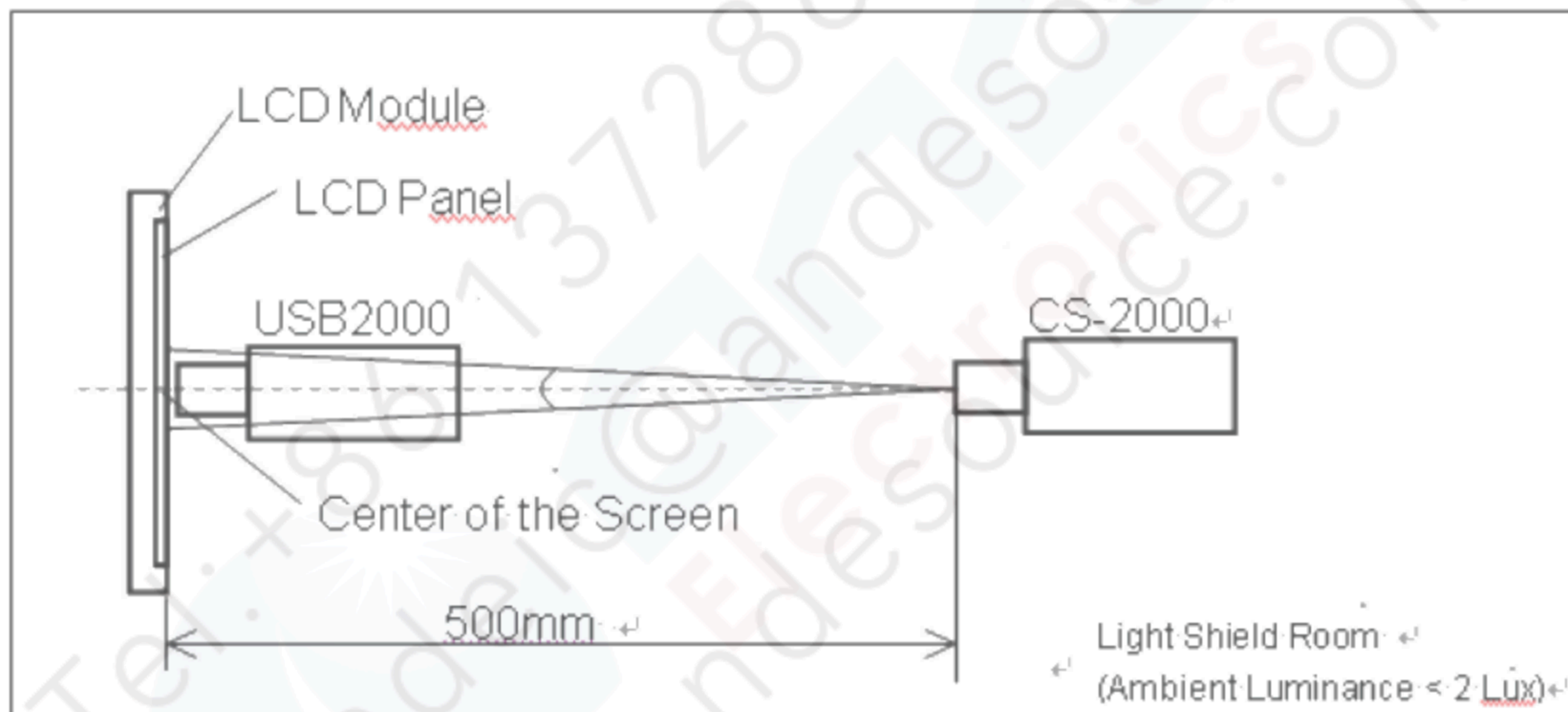
- T_{GTG_AVE} is the total average of the T_{GTG} data(Measured by INX GTG instrument & Enable Tcon ODC(Over Driving Circuit) function)

- The gray (N,M) stands for the (0,32,64,~255) as the following 9*9 table

Gray to Gray		Rising time								
		0	31	63	95	127	159	191	223	255
Falling time	0									
	31									
	63									
	95									
	127									
	159									
	191									
	223									
	255									

Note (5) Measurement Setup:

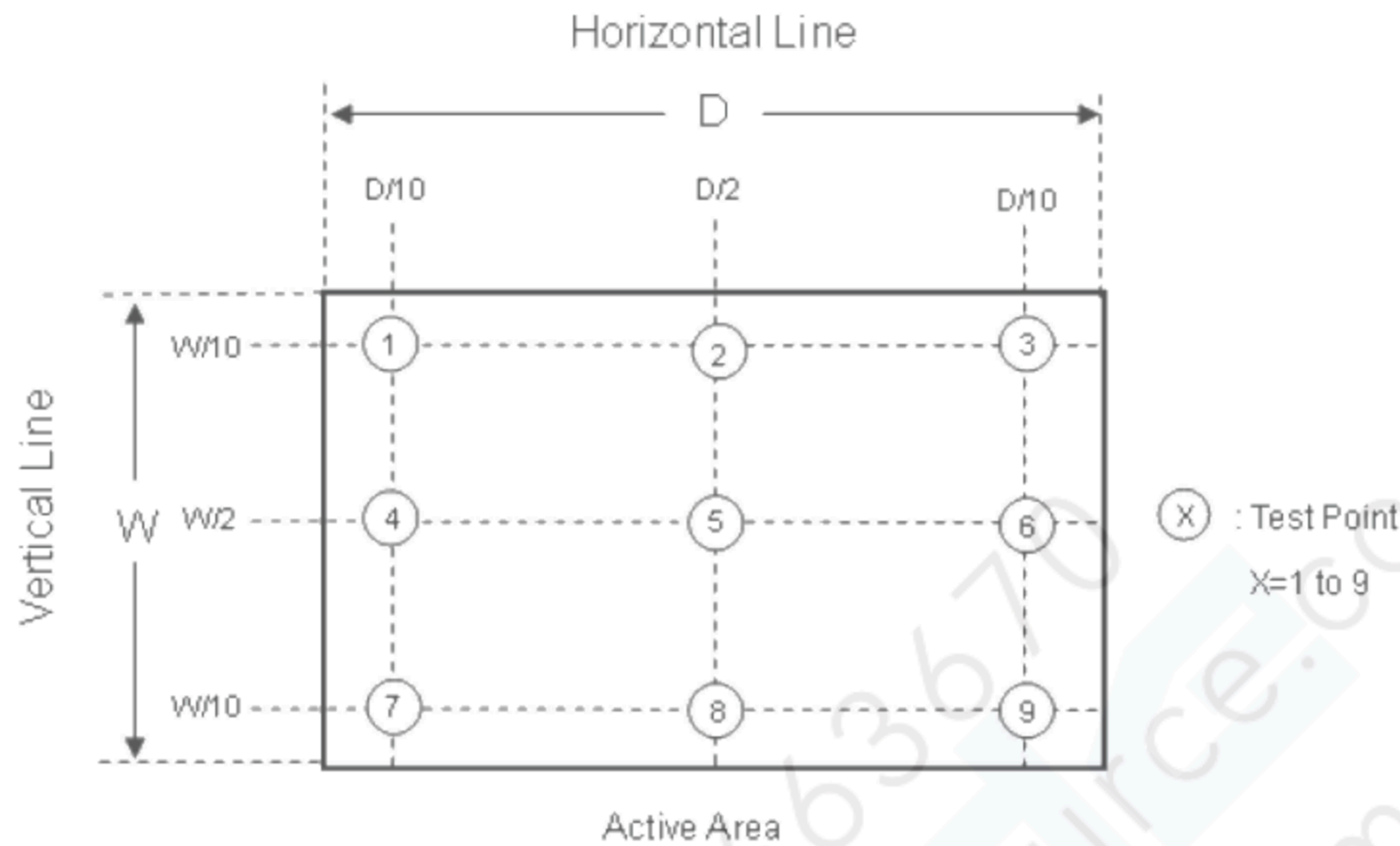
The LCD module should be stabilized at given temperature for 40 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 40 minutes in a windless room.



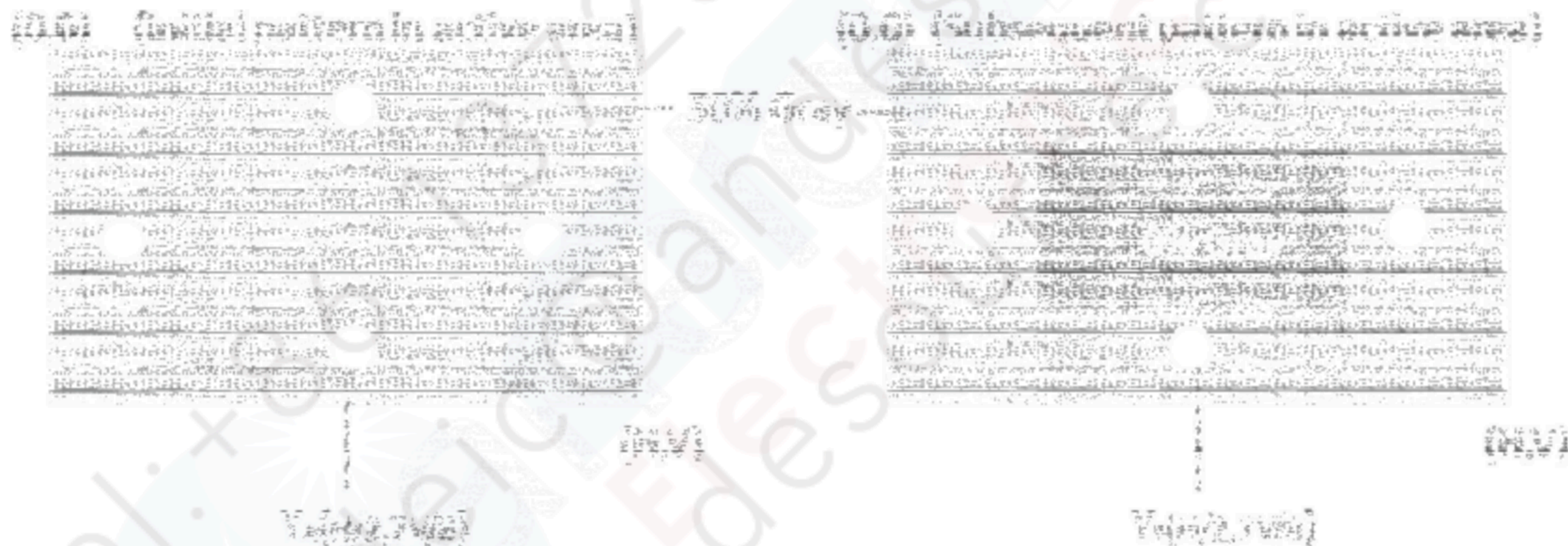
Note (6) Definition of White Variation (δW):

Measure the luminance of gray level 255 at 9 points

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



Note (7) Crosstalk measurement



$$CT\% = |(YB - YA) / YA| \times 100\%$$

Where

YA= Initial pattern's brightness at each specific position.

YB= Subsequent pattern's brightness at each specific position.

Each specific position (H/8,V/2),(H/2,7V/8),(7H/8,V/2) and (H/2,V/8) for measurement should be exactly the same in both patterns.

Note(8) Flicker measurement

6. RELIABILITY TEST ITEM

Items	Required Condition	Note
Temperature Humidity Bias (THB)	Ta= 50℃ , 80%RH, 240hours	(1)(2)
High Temperature Operation (HTO)	Ta= 50℃ , 240hours	
Low Temperature Operation (LTO)	Ta= 0℃ , 240hours	
High Temperature Storage (HTS)	Ta= 60℃ , 240hours	

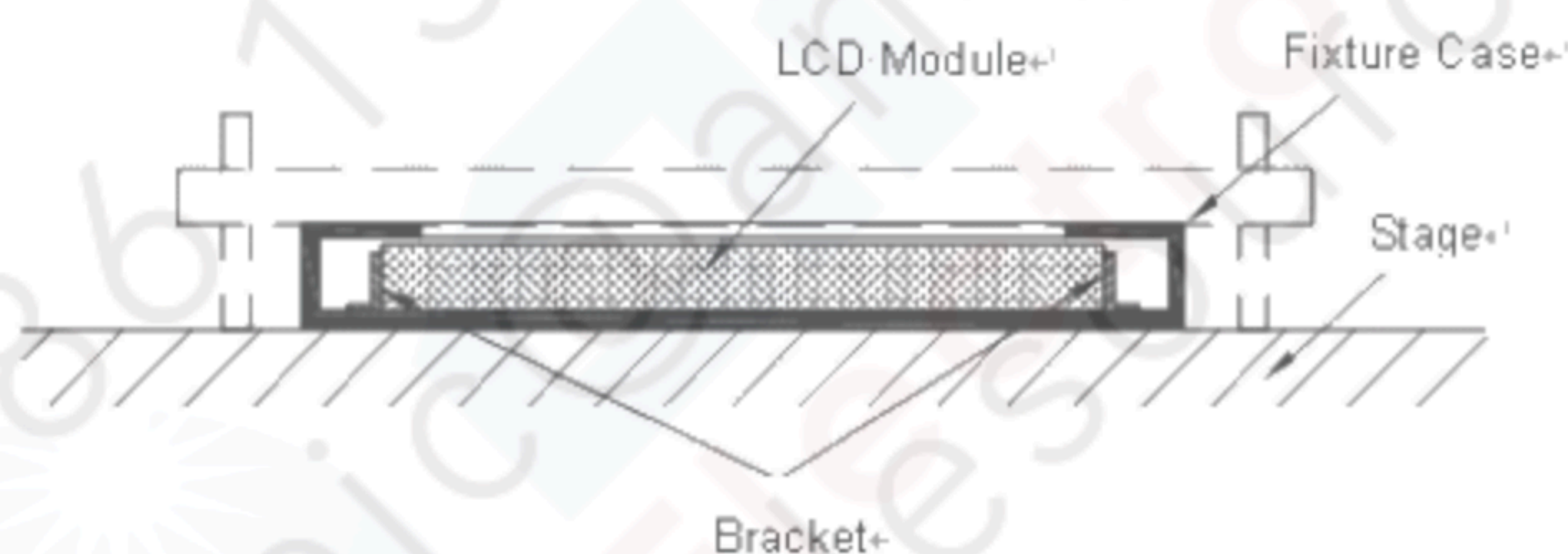
Low Temperature Storage (LTS)	Ta= -20°C , 240hours	
Vibration Test (Non-operation)	Acceleration: 1.5 G Wave: sine Frequency: 10 - 300 Hz Sweep: 30 Minutes each Axis (X, Y, Z)	(1)(3)
Shock Test (Non-operation)	Acceleration: 50 G Wave: Half-sine Active Time: 11 ms Direction : $\pm X, \pm Y, \pm Z$. (one time for each Axis)	
Thermal Shock Test (TST)	-20°C/30min , 60°C / 30min , 100 cycles	(1)(2)
On/Off Test	25°C , On/10sec , Off /10sec , 30,000 cycles	
ESD (Electro Static Discharge)	Contact Discharge: $\pm 8KV, 150pF(330\Omega)$	(1)
	Air Discharge: $\pm 15KV, 150pF(330\Omega)$	
Altitude Test	Operation: 10,000 ft / 24hours Non-Operation: 30,000 ft / 24hours	(1)(2)

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:



7. MECHANICAL STRENGTH CHARACTERISTICS

7.1 MECHANICAL STRENGTH SPECIFICATIONS

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

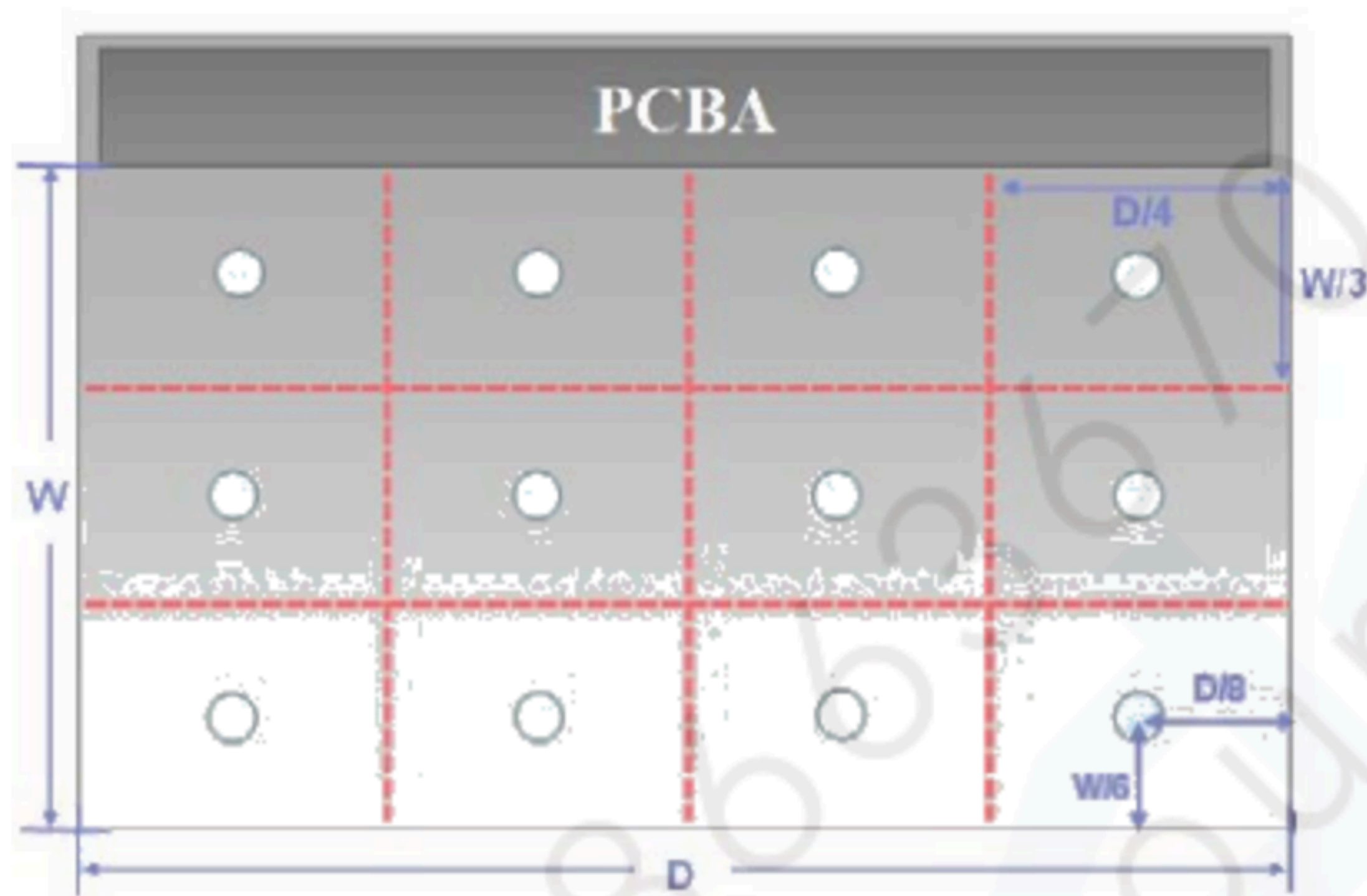
7.2 TEST CONDITIONS

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 gage 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) 11 LCD modules / 1 Box
- (2) Box dimensions: 713(L) X 429(W) X 453(H) mm
- (3) Weight: approximately: (35.4) Kg (11 modules per box)

8.2 PACKING METHOD

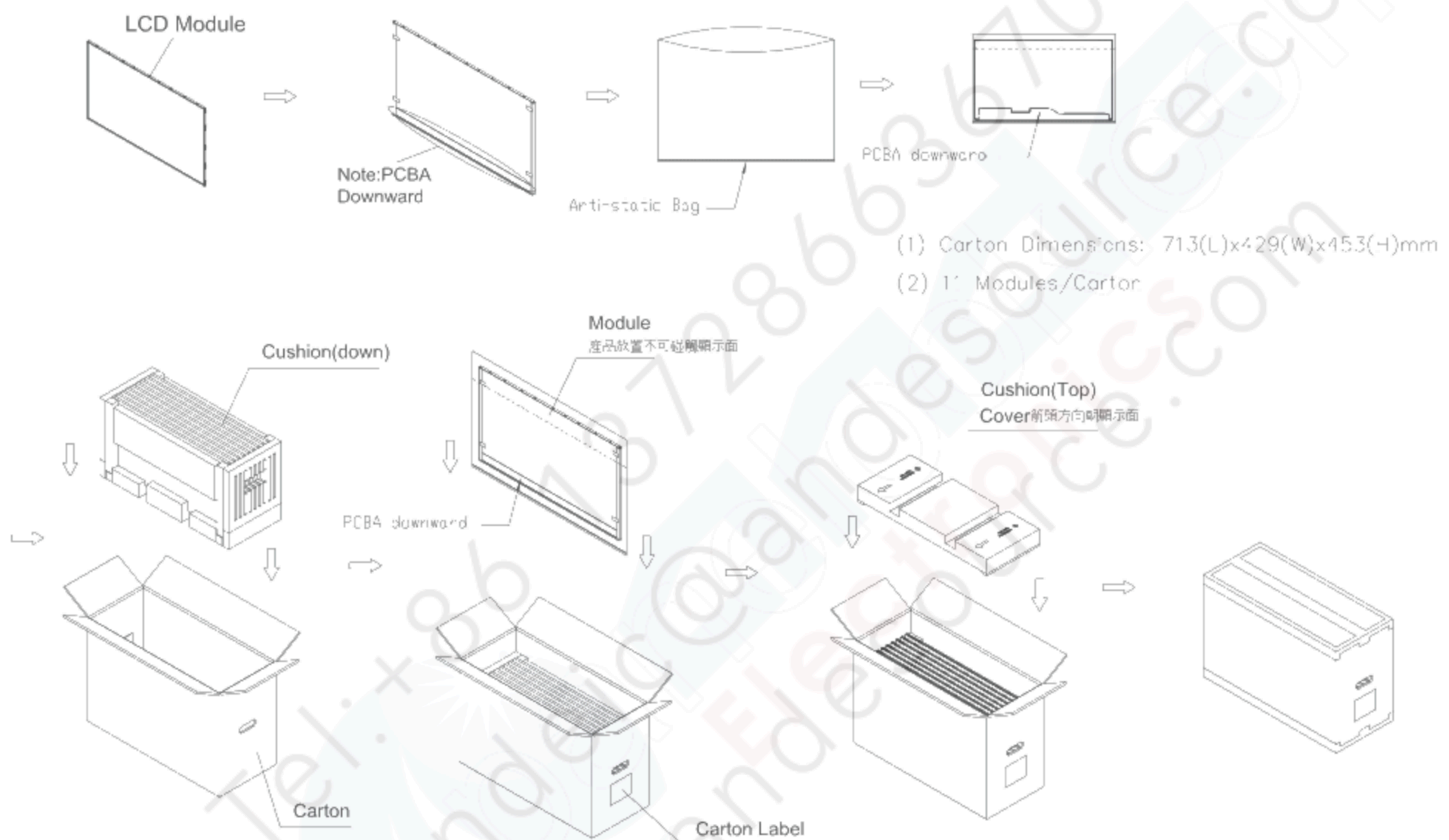


Figure. 8-1 Packing method

8.3 PALLET

For ocean shipping

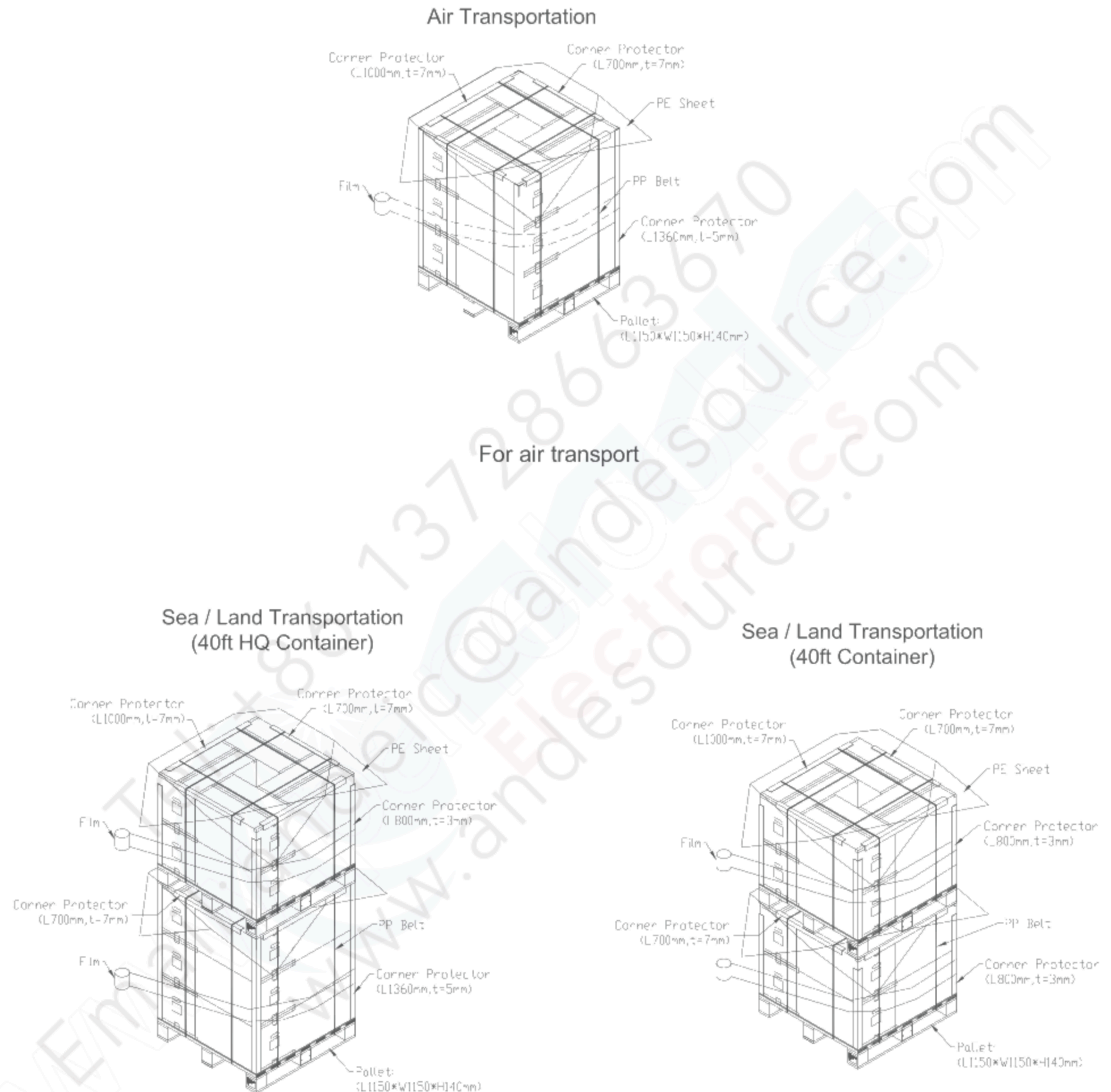


Figure. 8-2 Packing method

8.4 UN-PACKING METHOD

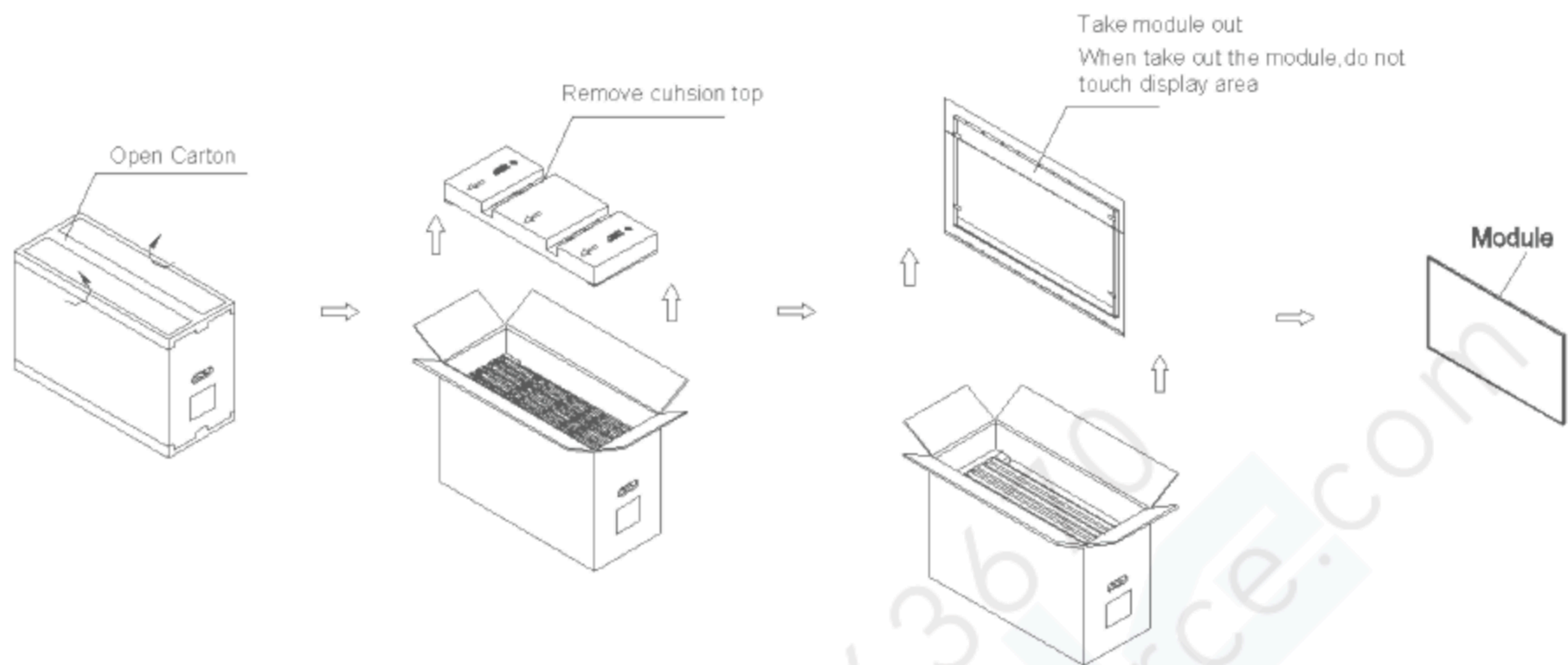
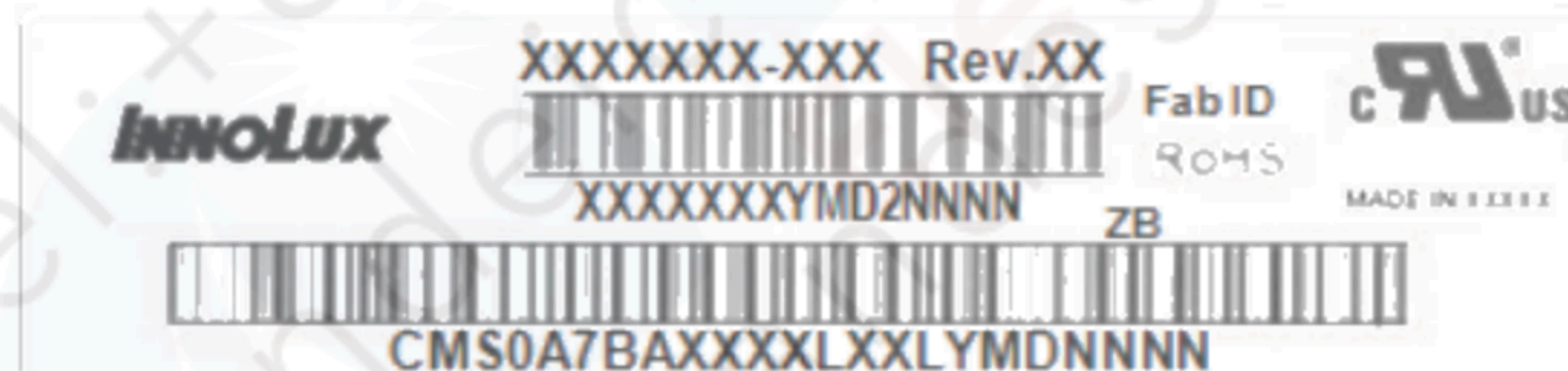


Figure. 8-3 UN-Packing method

9. INX MODULE LABEL

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

- (a) Model Name: M280DCA-E7B
- (b) Revision: Rev. XX, for example: A0, A1... B1, B2... or C1, C2...etc.
- (c) InnoLux barcode definition:



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

Code	Meaning	Description
XX	InnoLux internal use	-
XX	Revision	Cover all the change
X	InnoLux internal use	-
XX	InnoLux 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-S0A7BN-X-X-X-XX-L-XX-L-YMD-NNNN

Code	Meaning	Description
CM	Supplier code	INX=CM
S0A7B	Model number	M280DCA-E7B= S0A7B
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, Novatec=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
NBCMI	LEOO
NBCMI	VIRO
NBCME	CANO
NHCM	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 panel from damaging or becoming abnormal display.
- (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.

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±15°C

Humidity: 65±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

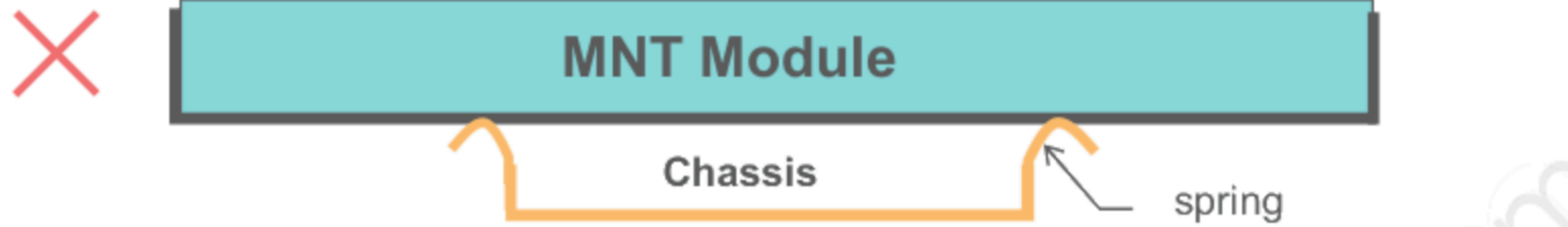
The LCD module should be certified with safety regulations as follows:

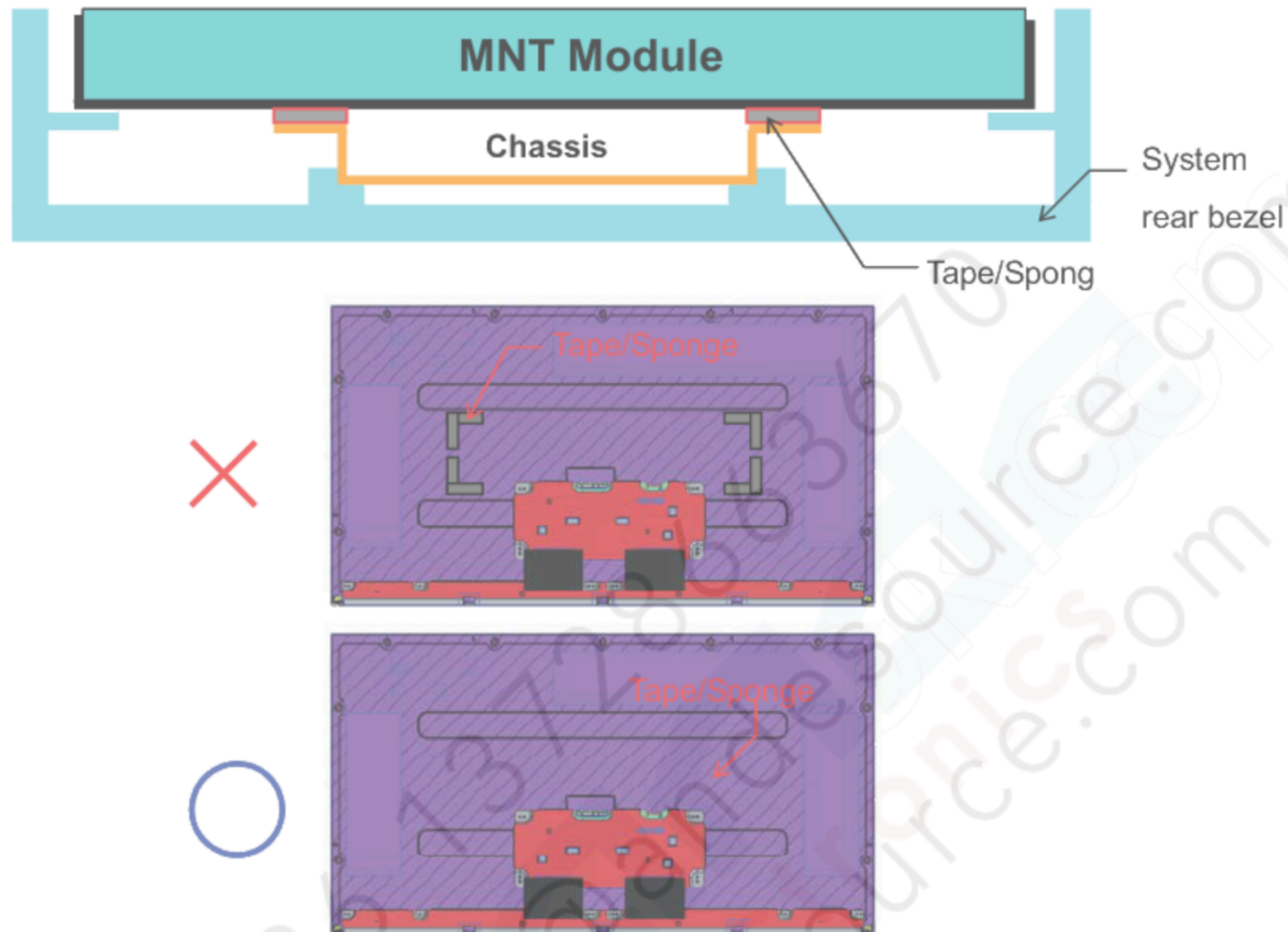
Requirement	Standard	remark
UL	UL60950-1:2006 or Ed.2:2007	
cUL/CSA	CAN/CSA C22.2 No.60950-1-03 or 60950-1-07	
CB	IEC60950-1:2005 / EN60950-1:2006+ A11:2009	

10.6 OTHER

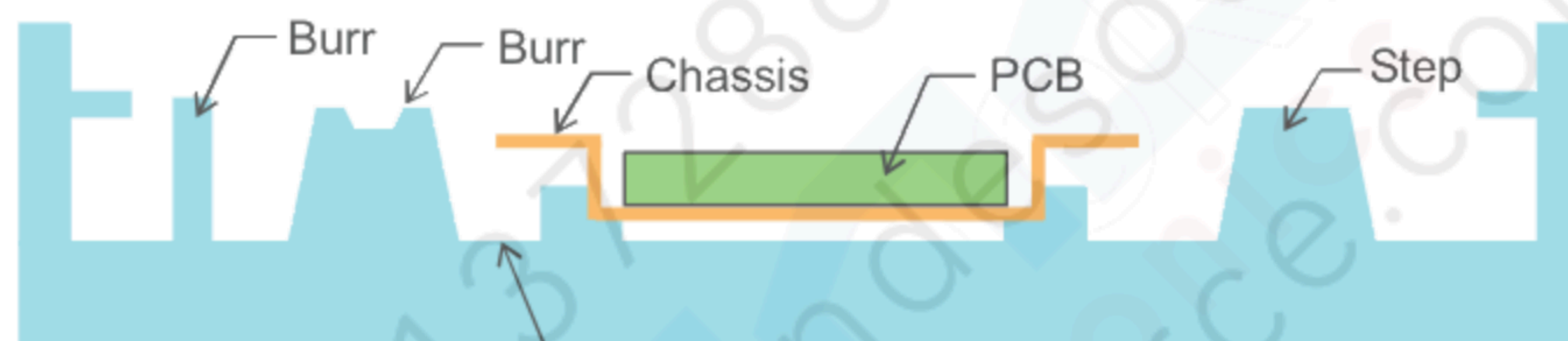
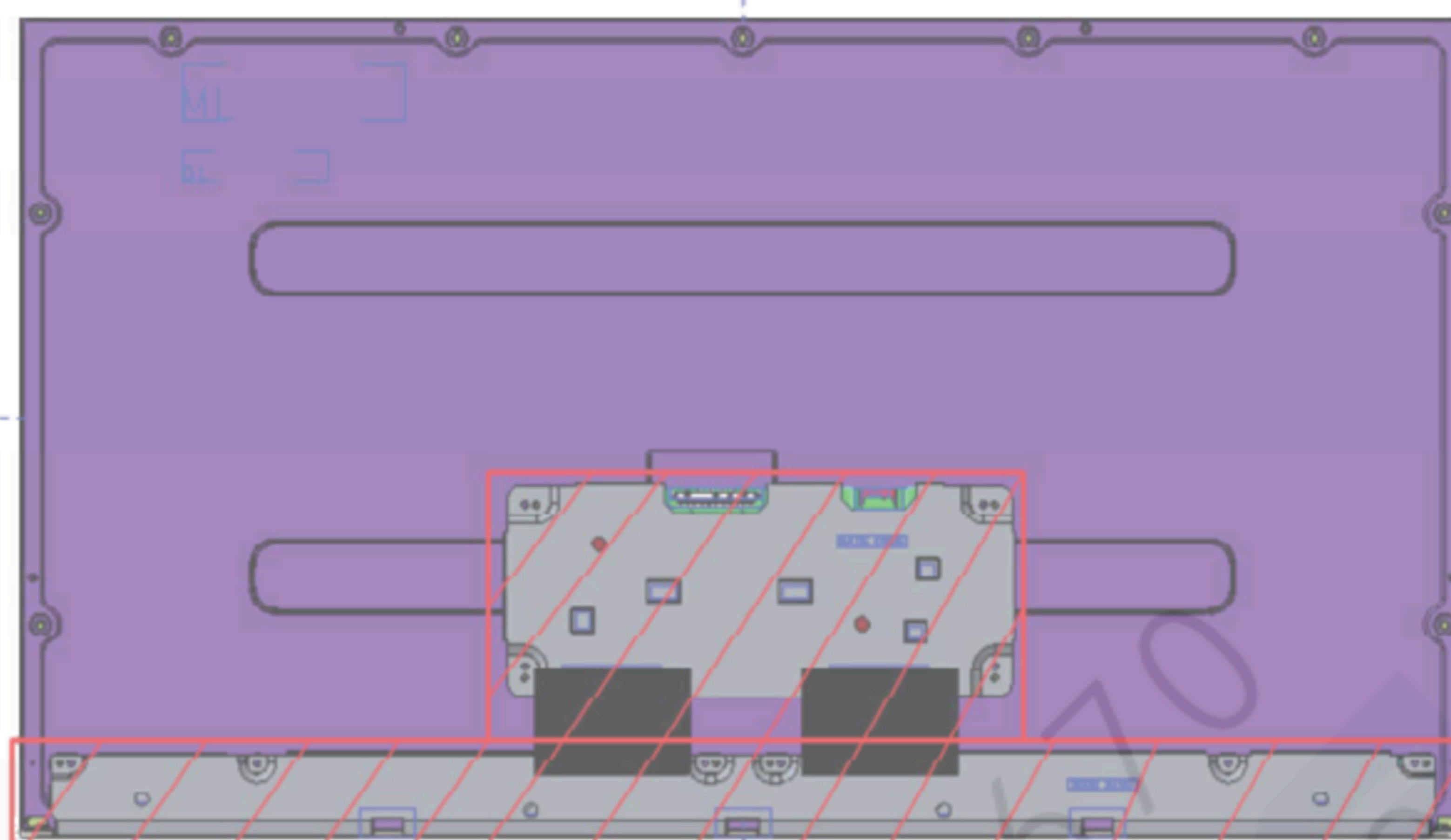
When fixed patterns are displayed for a long time, remnant image is likely to occur.

Appendix. 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 used spring type chassis. b) We suggest the contact mode between Chassis and Module rear cover is Tape/Sponge, sencond is Flat sheetmetal type chassis.
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



禁佈區

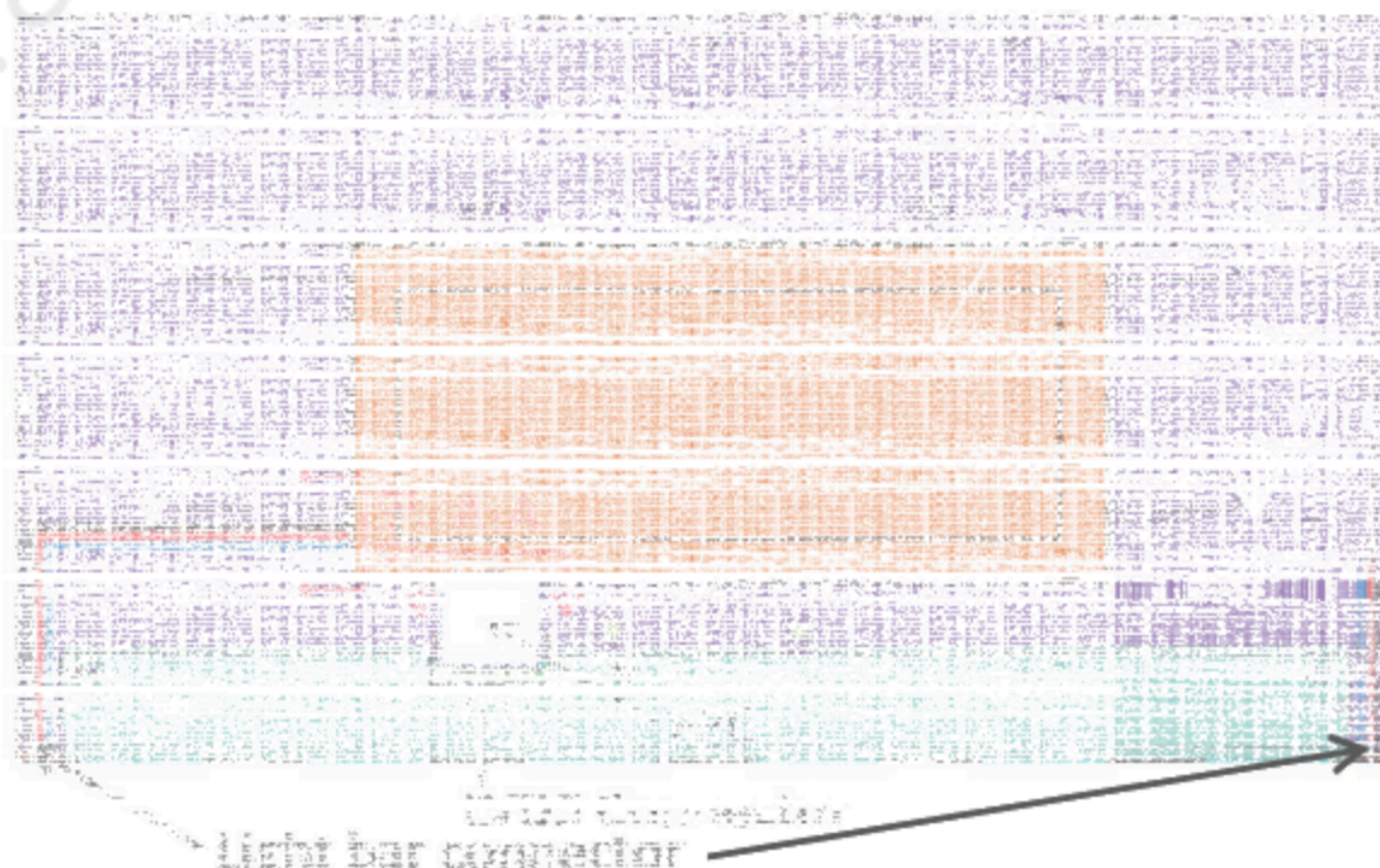
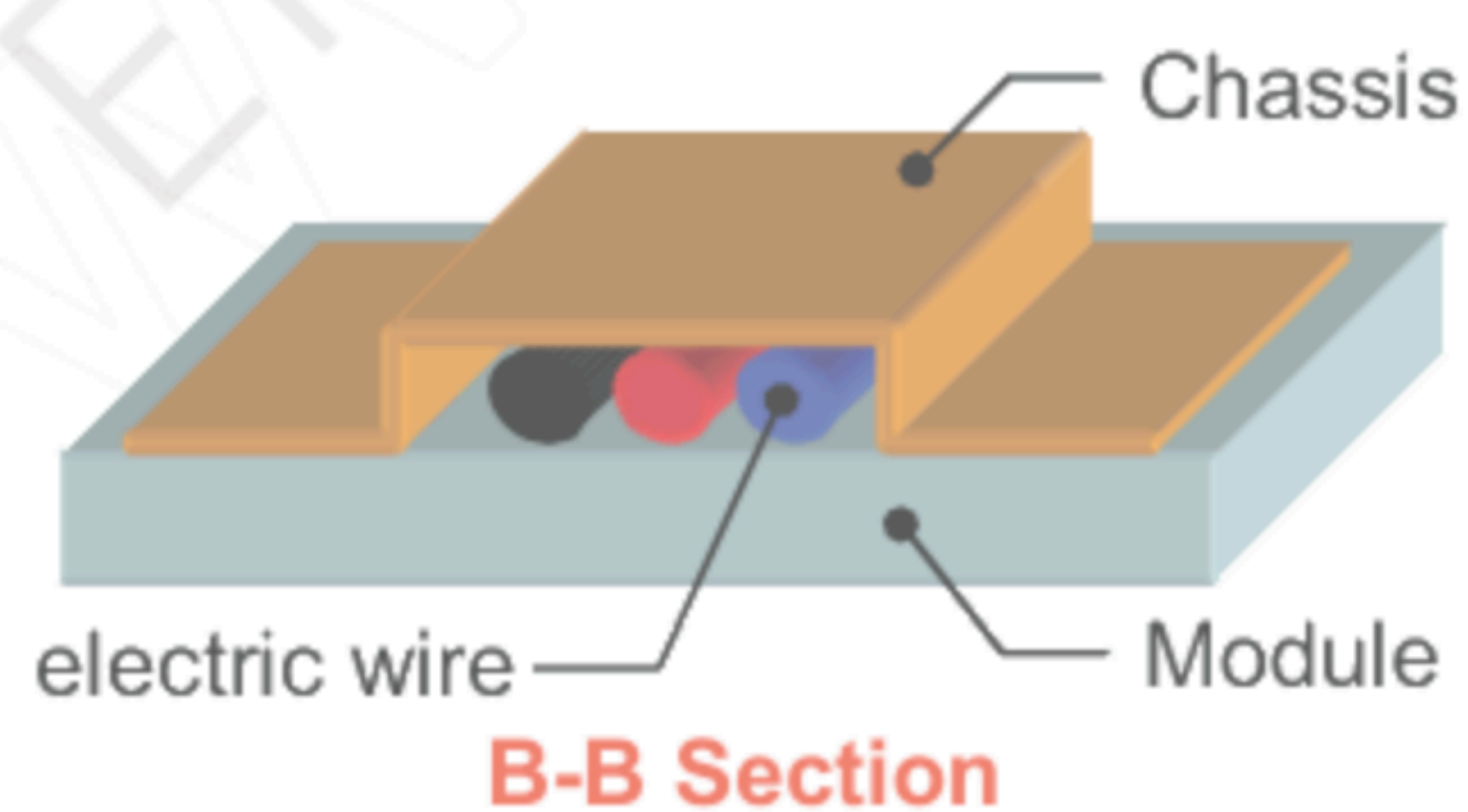
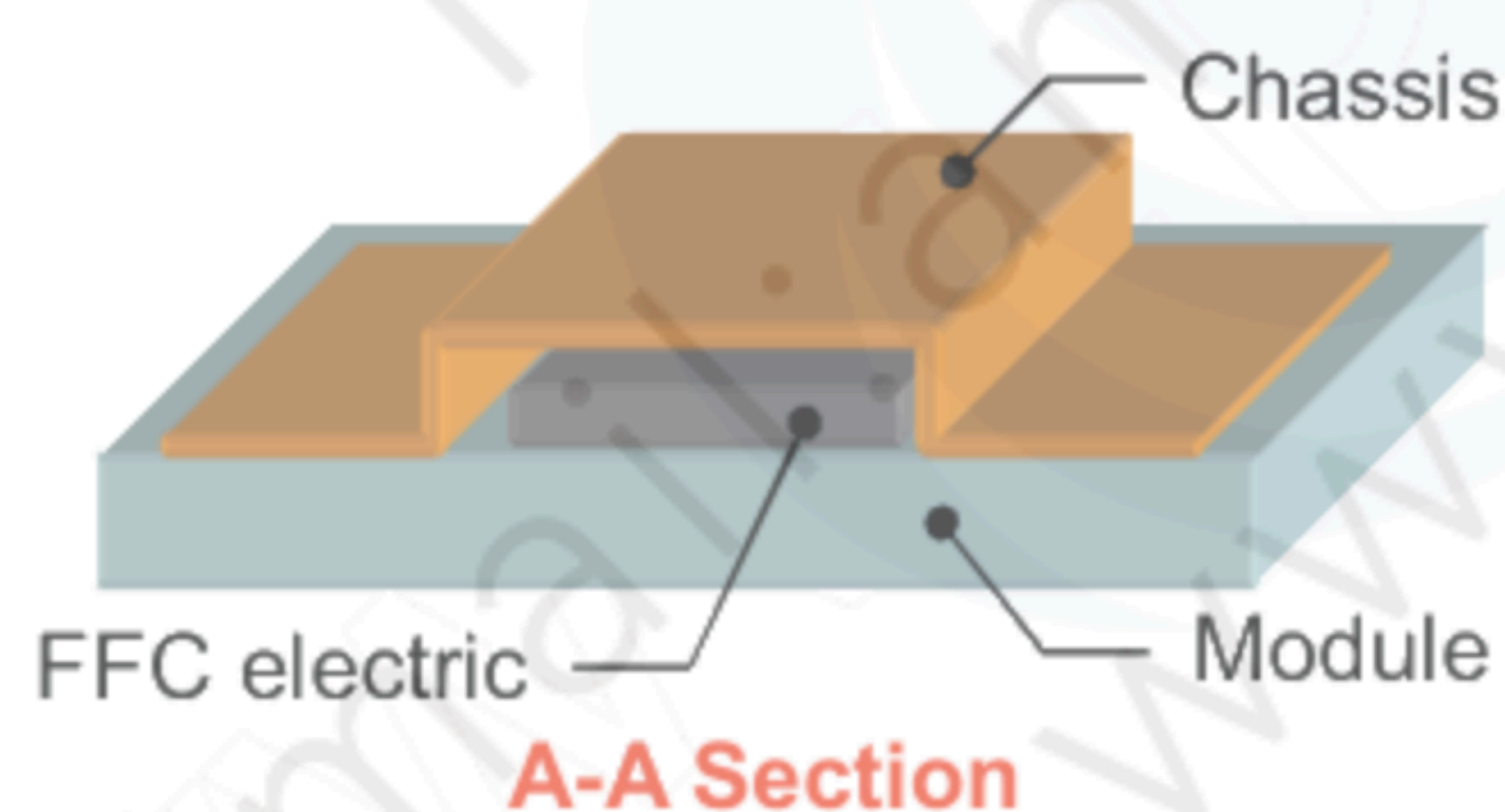
System cover inner surface

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.

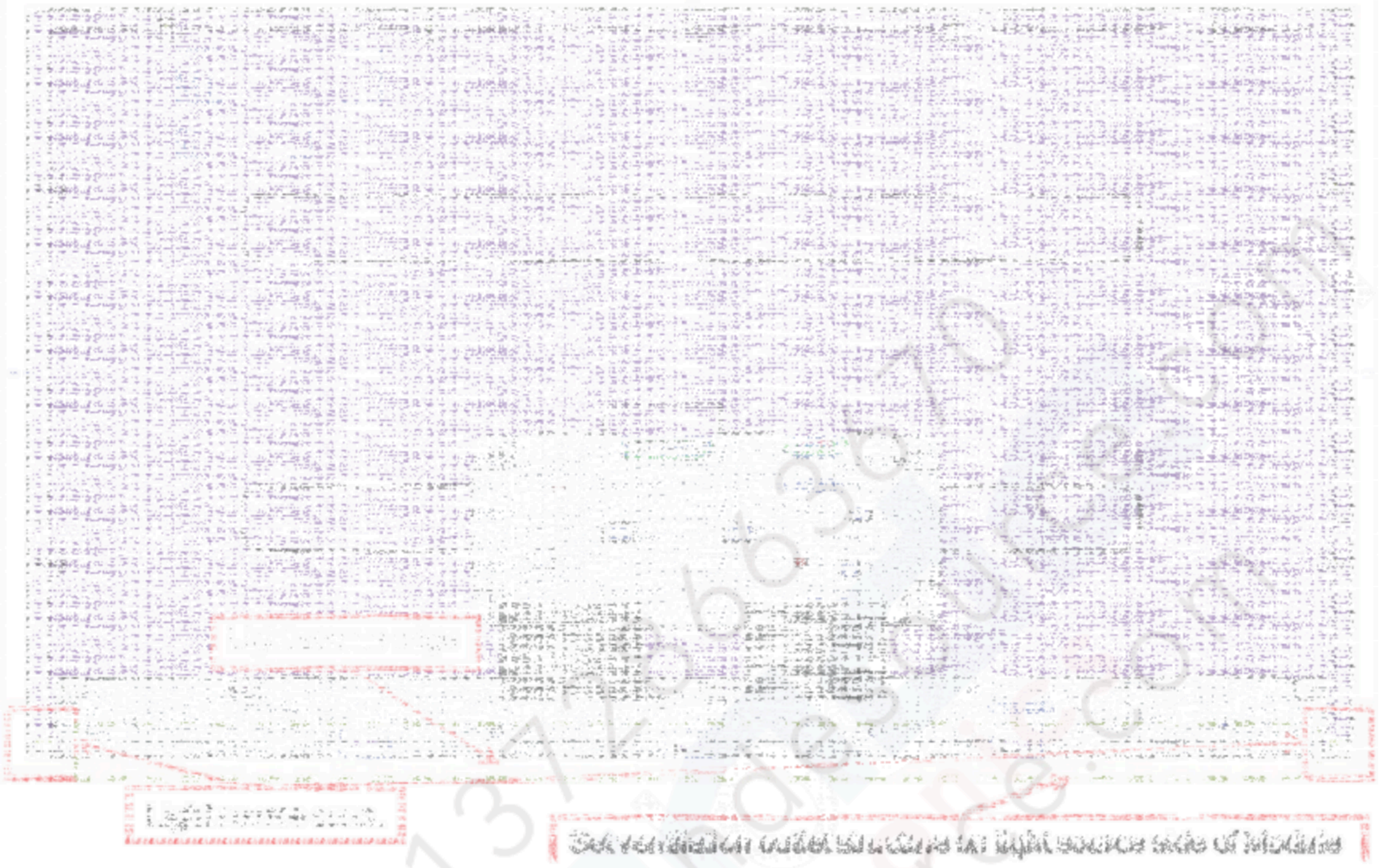
4

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.
5	System cover's ventilation outlet structure
	
Definition	To prevent from abnormal display of light leakage, We suggest to set ventilation outlet structure on side of Module Light bar in system cover inner surface.

Appendix 2. OUTLINE DRAWING



