

Doc. Number :

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

MODEL NO.: G238HCJ
SUFFIX: L02

Customer:

APPROVED BY

SIGNATURE

Name / Title

Note

Product Version

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

Approved By	Checked By	Prepared By
		Jack.pan

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REVISION HISTORY

Version	Date	Section	Description
0.0	2019.8.8	All	Tentative Specification was first issued.

1. GENERAL DESCRIPTION

1.1 OVERVIEW

G238HCJ-L02 is a 23.8" TFT Liquid Crystal Display MNT module with WLED Backlight unit and 30 pins 2ch-LVDS interface. This module supports 1920 x 1080 Full HD mode and can display up to 16.7M colors.

1.2 GENERAL SPECIFICATIONS

Item	Specification	Unit	Note
Screen Size	23.8" real diagonal		
Driver Element	a-si TFT active matrix	-	-
Pixel Number	1920 x R.G.B. x 1080	pixel	-
Pixel Pitch	0.2745 (H) x 0.2745 (V)	mm	-
Pixel Arrangement	RGB vertical stripe	-	-
Display Colors	16.7M	color	-
Transmissive Mode	Normally black	-	-
Surface Treatment	AG type, 3H hard coating, Haze 25	-	-
Luminance, White	450	Cd/m2	
Color Gamut	72% of NTSC(Typ.)	-	
ROHS, Halogen Free & TCO 7.0	ROHS, Halogen Free TCO 7.0 compliance	-	
Power Consumption	Total (22.10)W(Max.)@cell (4.18)W (Max.), BL (17.92)W (Max.)		(1)

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

2. MECHANICAL SPECIFICATIONS

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	539.74	540.24	540.74	mm	(1)
	Vertical (V)	315.16	315.66	316.16	mm	
	Thickness (T)	10.95	11.45	11.95	mm	
Bezel Area	Horizontal	529.74	530.24	530.74	mm	
	Vertical	299.16	299.66	300.16	mm	
Active Area	Horizontal		527.04		mm	
	Vertical		296.46		mm	
Weight		(2043)	(2270)	(2384)	g	

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

Thickness(T) of LB CNT is 12.8mm(Typ)

Note (2)



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	(60)	°C	(1), (2)

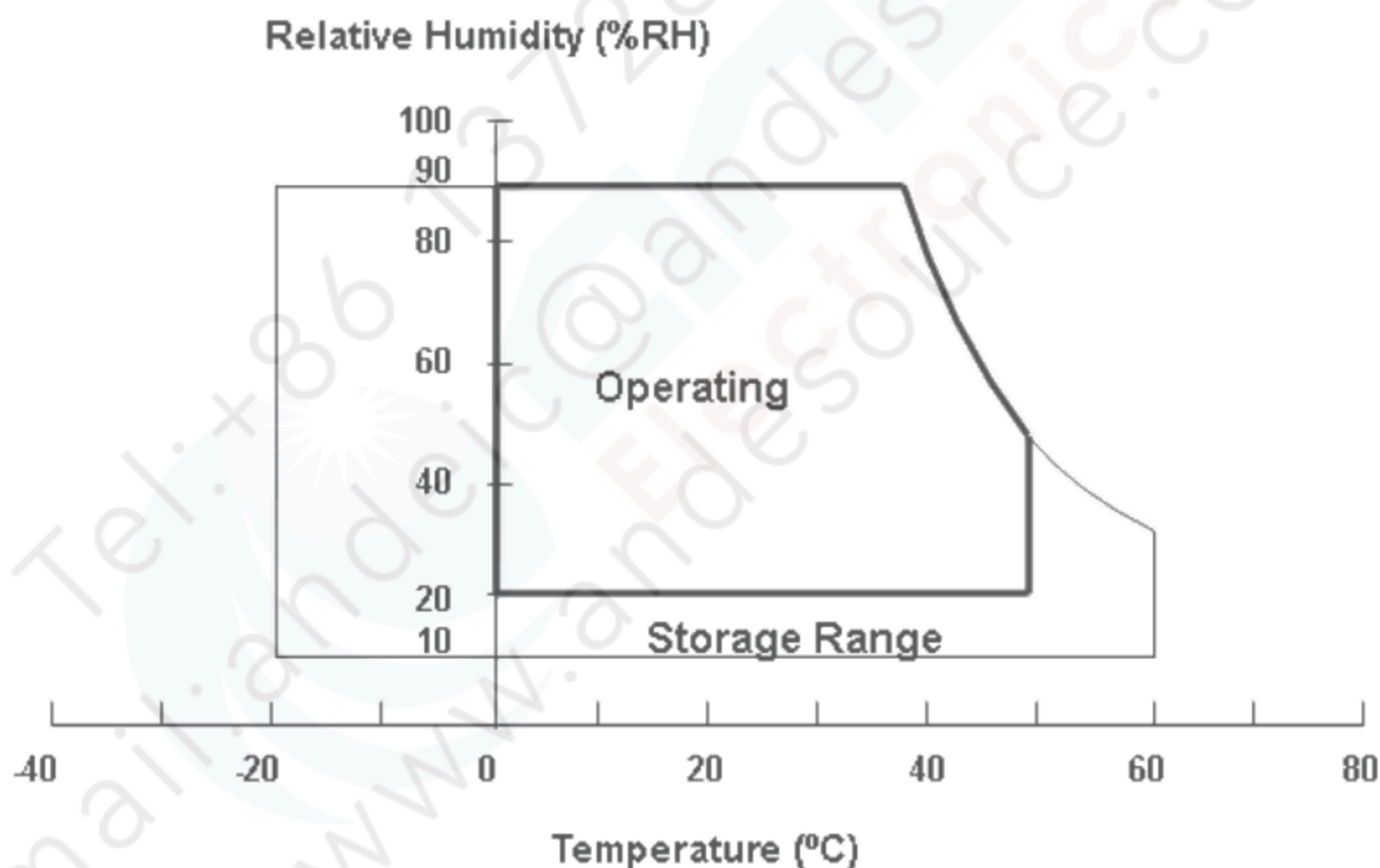
Note (1)

(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, Input 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	6.0	V	(1)
Logic Input Voltage	V _{IN}	-0.3	3.6	V	

3.2.2 BACKLIGHT UNIT

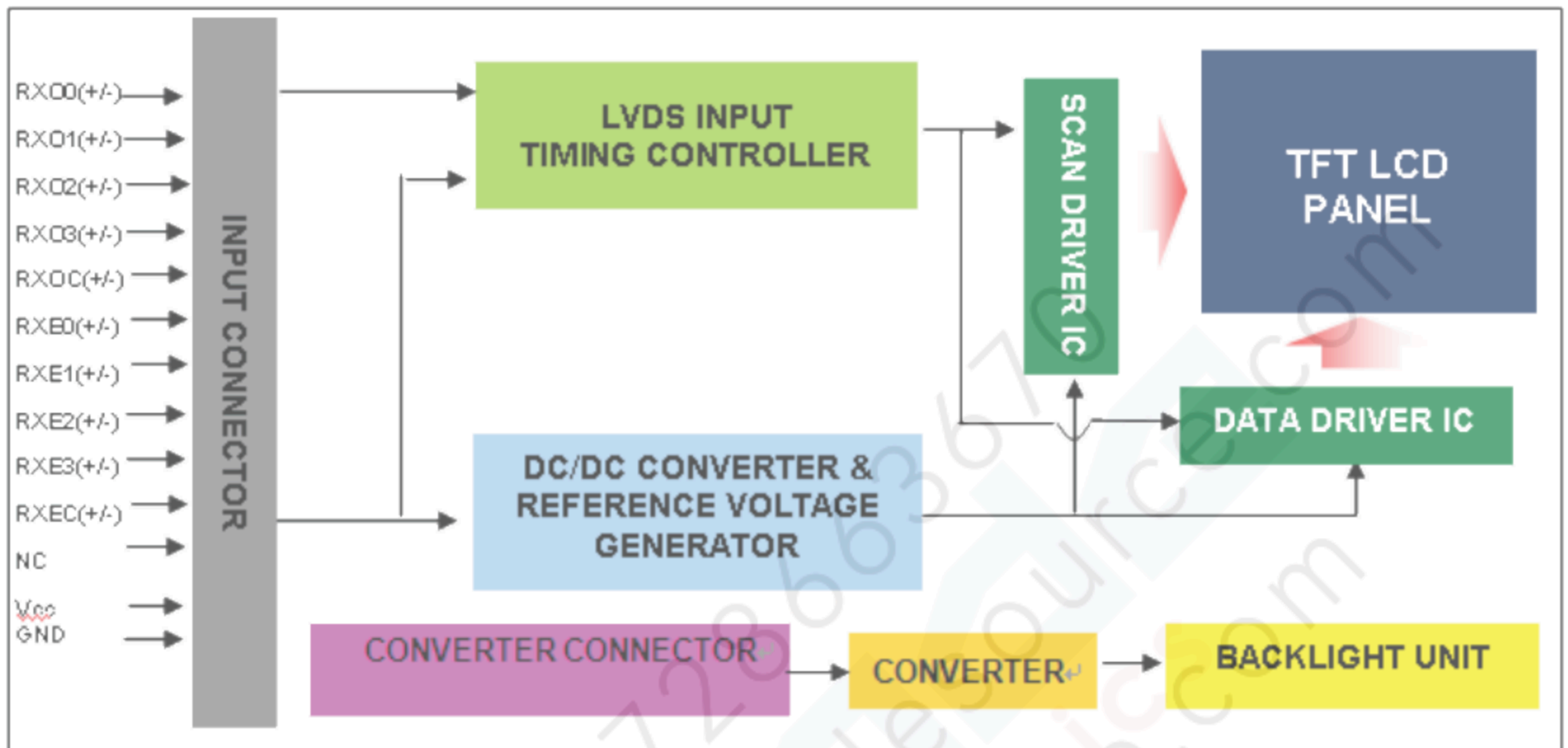
Item	Symbol	Value		Unit	Note
		Min.	Max.		
Converter Voltage	V_i	-0.3	18	V	(1) , (2)
Enable Voltage	EN	---	5.5	V	
Backlight Adjust	Dimming	---	5.5	V	

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.

Note (2) Specified values are for lamp (Refer to 4.3.3 for further information).

4. ELECTRICAL SPECIFICATIONS

4.1 FUNCTION BLOCK DIAGRAM



4.2. INTERFACE CONNECTIONS

PIN ASSIGNMENT

Pin	Name	Description
1	RX00-	Negative LVDS differential data input. Channel O0 (odd)
2	RX00+	Positive LVDS differential data input. Channel O0 (odd)
3	RX01-	Negative LVDS differential data input. Channel O1 (odd)
4	RX01+	Positive LVDS differential data input. Channel O1 (odd)
5	RX02-	Negative LVDS differential data input. Channel O2 (odd)
6	RX02+	Positive LVDS differential data input. Channel O2 (odd)
7	GND	Ground
8	RX0C-	Negative LVDS differential clock input. (odd)
9	RX0C+	Positive LVDS differential clock input. (odd)
10	RX03-	Negative LVDS differential data input. Channel O3(odd)
11	RX03+	Positive LVDS differential data input. Channel O3 (odd)
12	RXE0-	Negative LVDS differential data input. Channel E0 (even)
13	RXE0+	Positive LVDS differential data input. Channel E0 (even)
14	GND	Ground
15	RXE1-	Negative LVDS differential data input. Channel E1 (even)
16	RXE1+	Positive LVDS differential data input. Channel E1 (even)
17	GND	Ground
18	RXE2-	Negative LVDS differential data input. Channel E2 (even)
19	RXE2+	Positive LVDS differential data input. Channel E2 (even)
20	RXEC-	Negative LVDS differential clock input. (even)
21	RXEC+	Positive LVDS differential clock input. (even)
22	RXE3-	Negative LVDS differential data input. Channel E3 (even)
23	RXE3+	Positive LVDS differential data input. Channel E3 (even)
24	GND	Ground
25	NC	For LCD internal use only, Do not connect
Pin	Name	Description

26	NC	For LCD internal use only, Do not connect
27	NC	For LCD internal use only, Do not connect
28	Vcc	+5.0V power supply
29	Vcc	+5.0V power supply
30	Vcc	+5.0V power supply

Note (1) Connector Part No.:

Foxconn ; GS23301-0321R-7H

or FCN: WF13-422-3033 or P-TWO: 187098-30091 or equivalent.

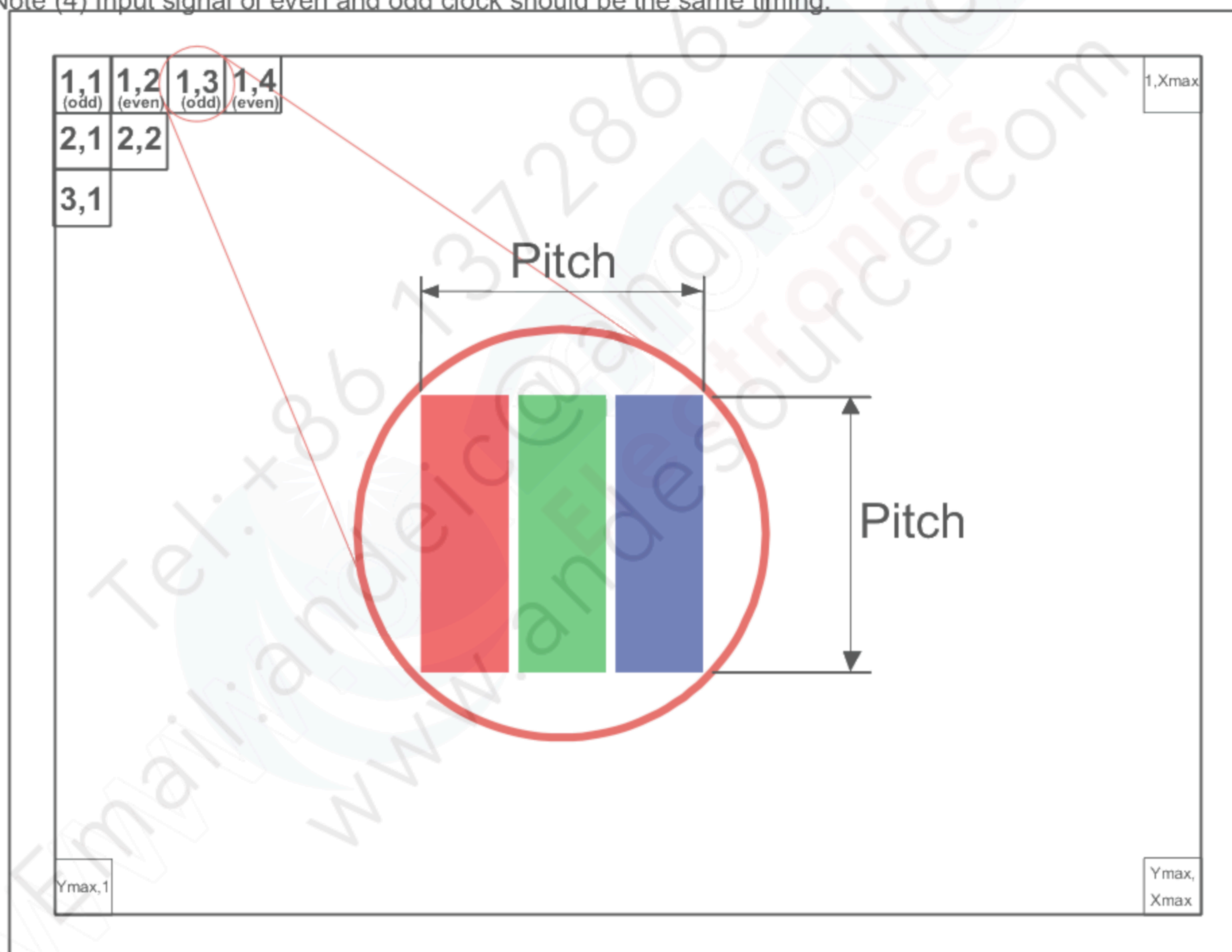
Note (2) User's connector Part No:

Mating Wire Cable Connector Part No.: FI-X30H(JAE) or FI-X30HL(JAE)

Mating FFC Cable Connector Part No.: 217007-013001 (P-TWO) or JF05X030-1 (JAE).

Note (3) The first pixel is odd.

Note (4) Input signal of even and odd clock should be the same timing.

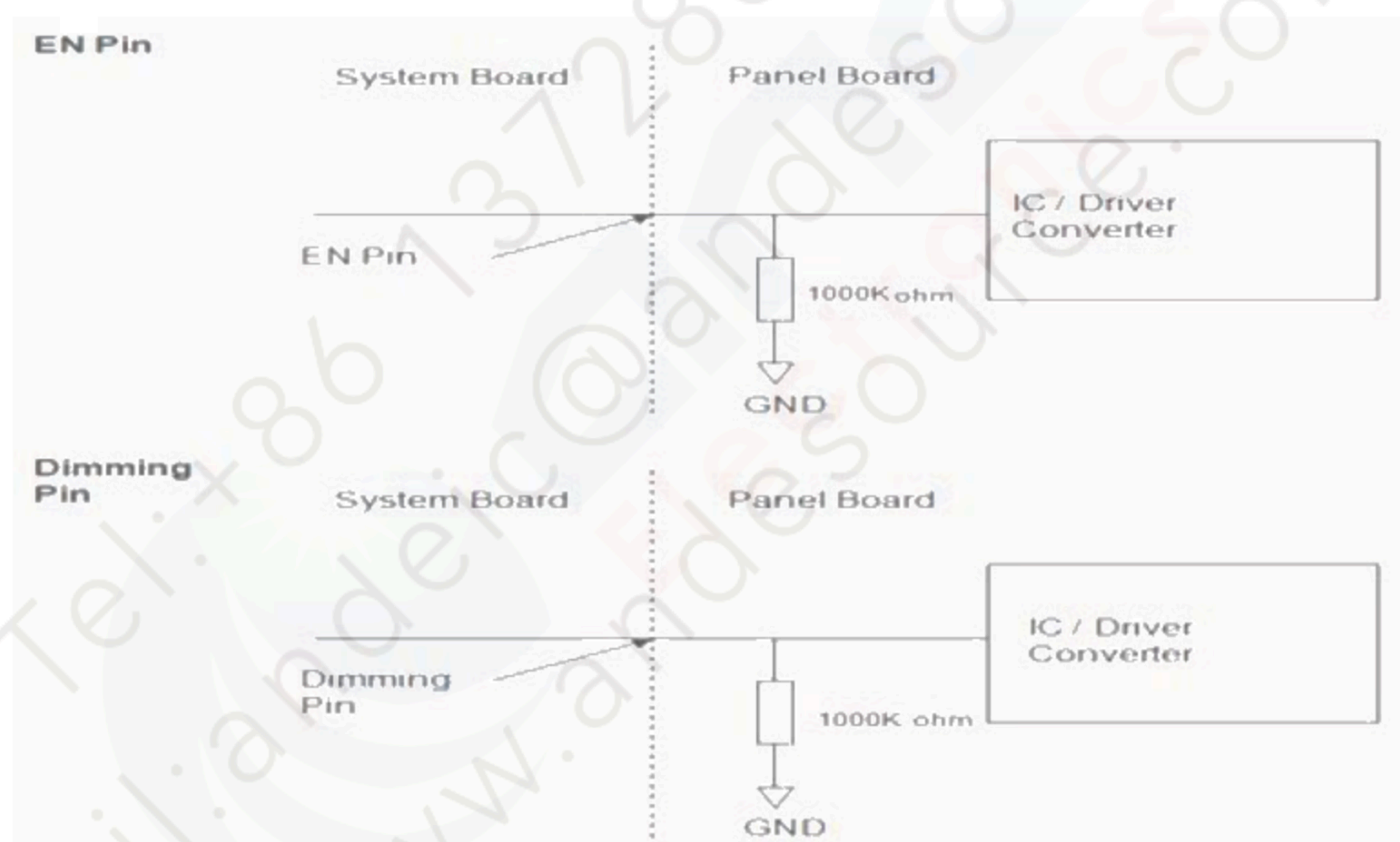


BACKLIGHT UNIT(Converter connector pin)

Pin	Symbol	Description	Remark
1	V_i	Converter input voltage	12V
2	V_i	Converter input voltage	12V
3	V_i	Converter input voltage	12V
4	V_i	Converter input voltage	12V
5	V_{GND}	Converter ground	Ground
6	V_{GND}	Converter ground	Ground
7	V_{GND}	Converter ground	Ground
8	V_{GND}	Converter ground	Ground
9	EN	Enable pin	3.3V
10	Dimming	Backlight Adjust	PWM Dimming (Hi: 3.3V _{DC} , Lo: 0V _{DC})

Note (1)Connector Part No.: CI4310M1HR0-NH (Cvilux) or equivalent.

Note (2)User's connector Part No.: CI4310S0000 (Cvilux) or equivalent.



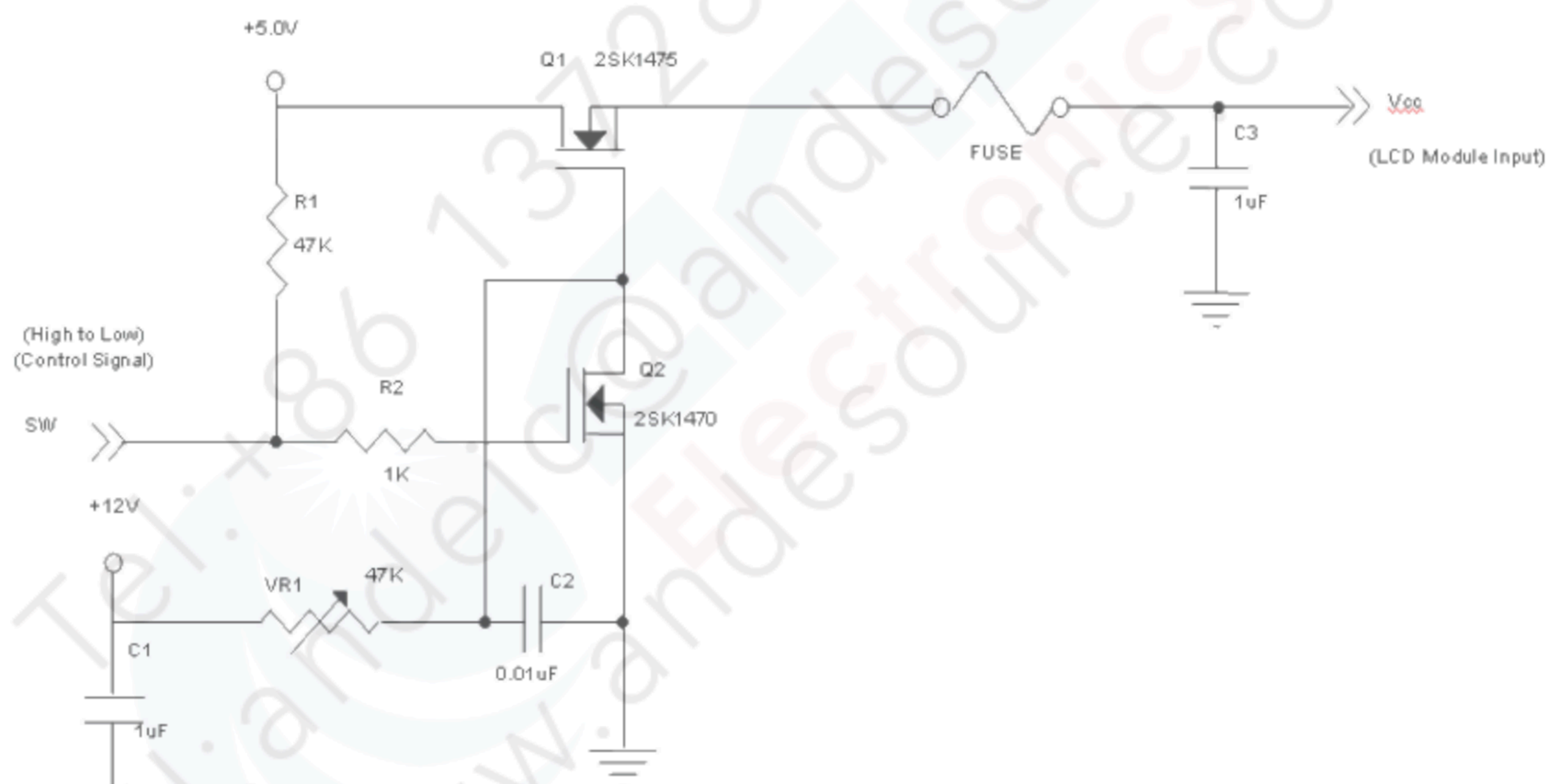
4.3 ELECTRICAL CHARACTERISTICS

4.3.1 LCD ELETRONICS SPECIFICATION

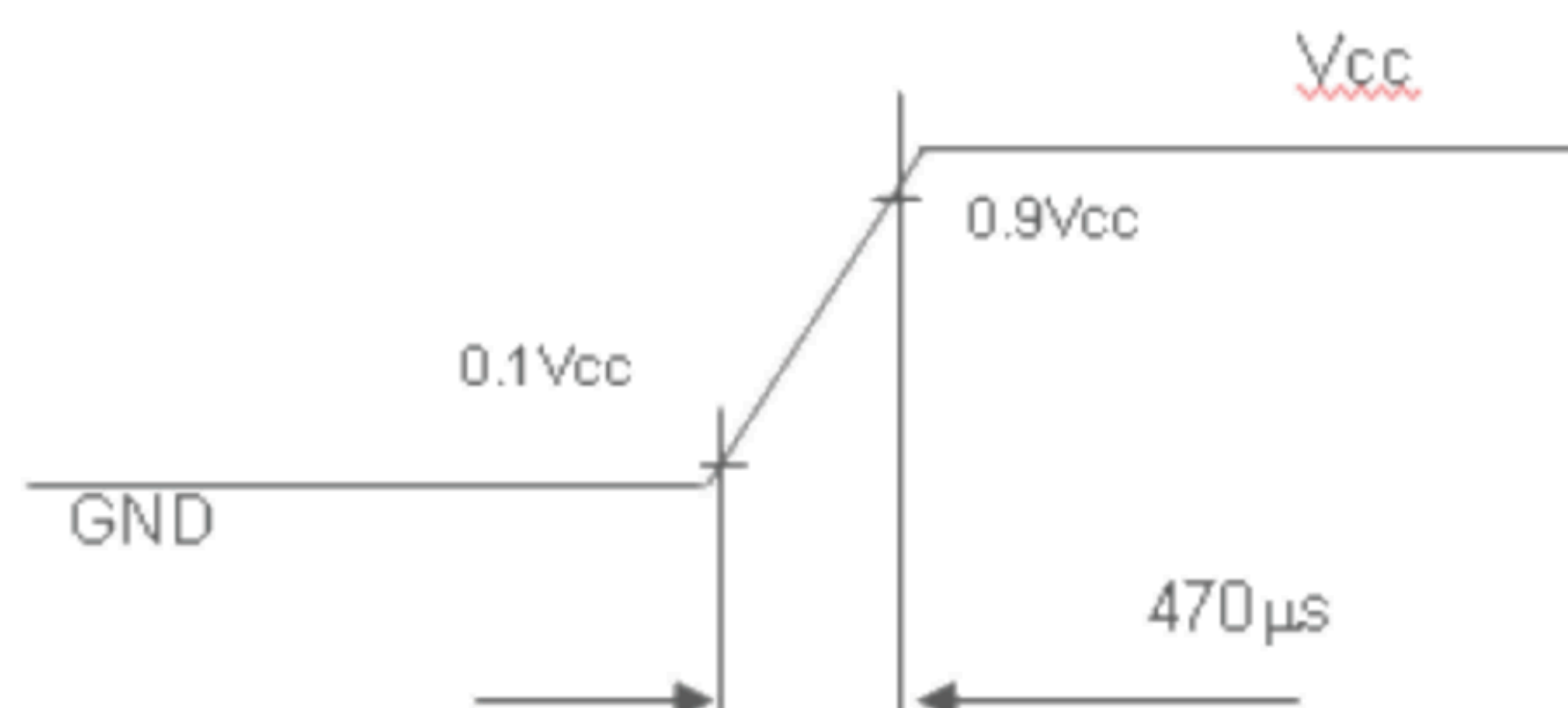
Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Power Supply Voltage	V _{CC}	4.5	5.0	5.5	V	-
Ripple Voltage	V _{RP}	-	-	300	mV	-
Rush Current	I _{RUSH}	-	-	3	A	(2)
Power Supply Current	White	-	(0.362)	(0.449)	A	(3)a
	Black	-	(0.361)	(0.434)	A	(3)b
	Vertical Stripe	-	(0.703)	(0.836)	A	(3)c
Power Consumption	PLCD	-	(3.516)	(4.18)	Watt	(4)
LVDS differential input voltage	V _{id}	100	-	600	mV	
LVDS common input voltage	V _{ic}	1.0	1.2	1.4	V	
LVDS Logic High Input Voltage	V _{IH}	-	-	0.1	V	
LVDS Logic Low Input Voltage	V _{IL}	-0.1	-	-	V	

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

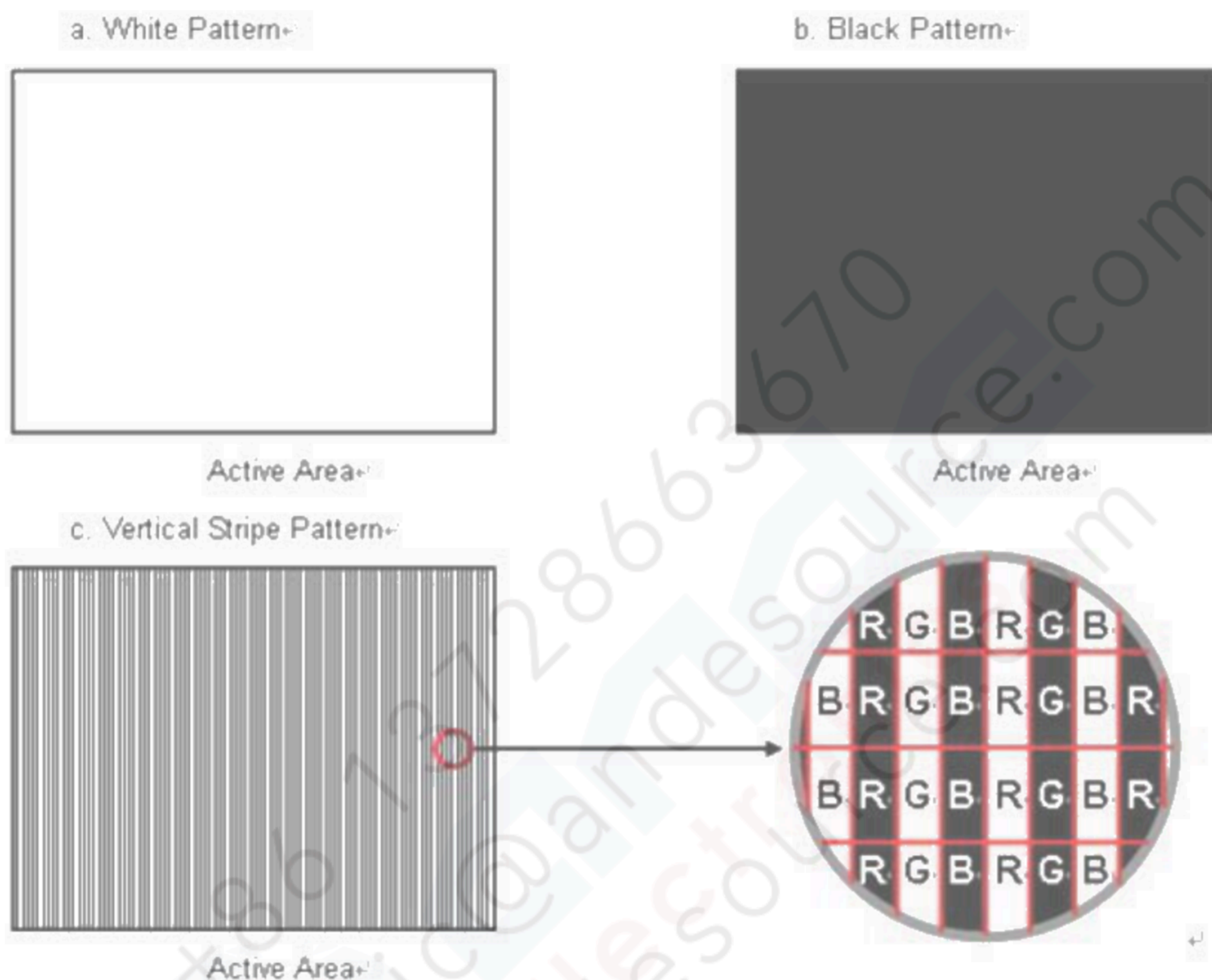
Note (2) Measurement Conditions:



V_{CC} rising time is 470μs



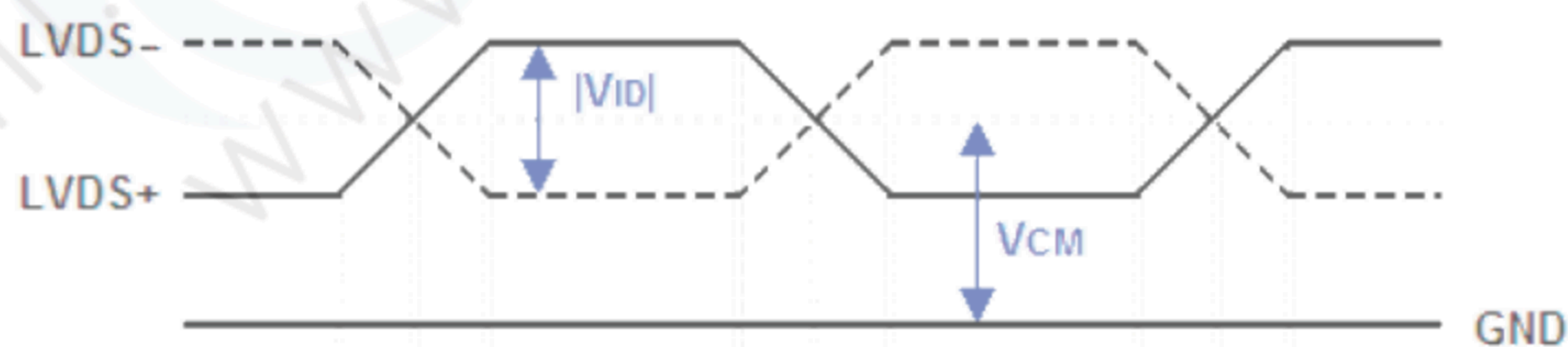
Note (3) The specified max power supply current is under the conditions at $V_{CC} = 5.0\text{ V}$, $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$, $F_r = 60\text{ Hz}$, whereas a power dissipation check pattern below is displayed.



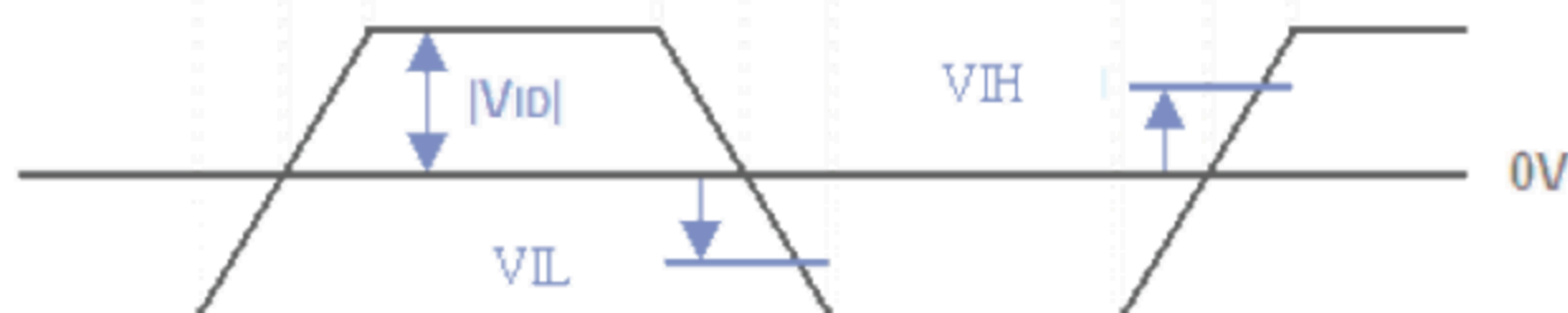
Note (4) The power consumption is specified at the pattern with the maximum current.

Note (5) VID waveform condition

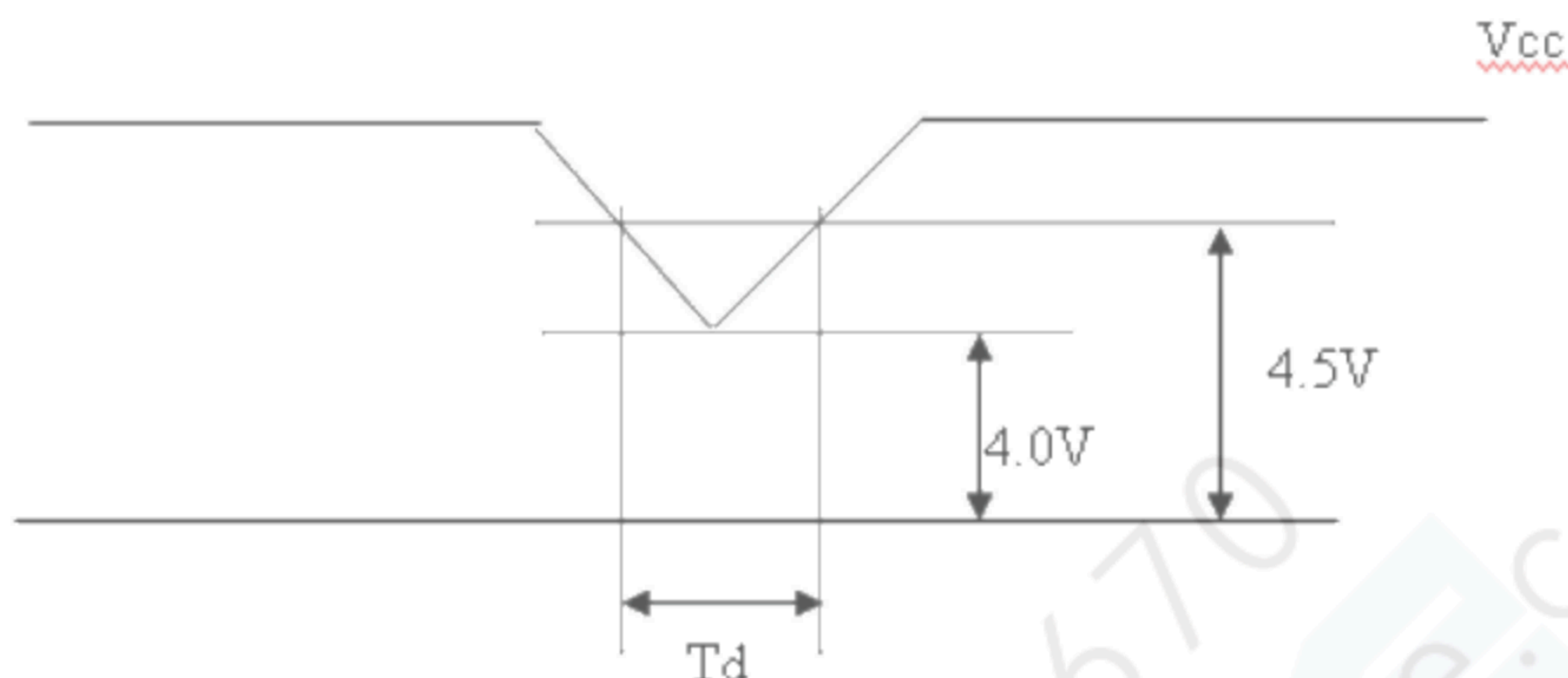
Single-end Signals



Differential Signal



4.3.2 V_{CC} POWER DIP CONDITION

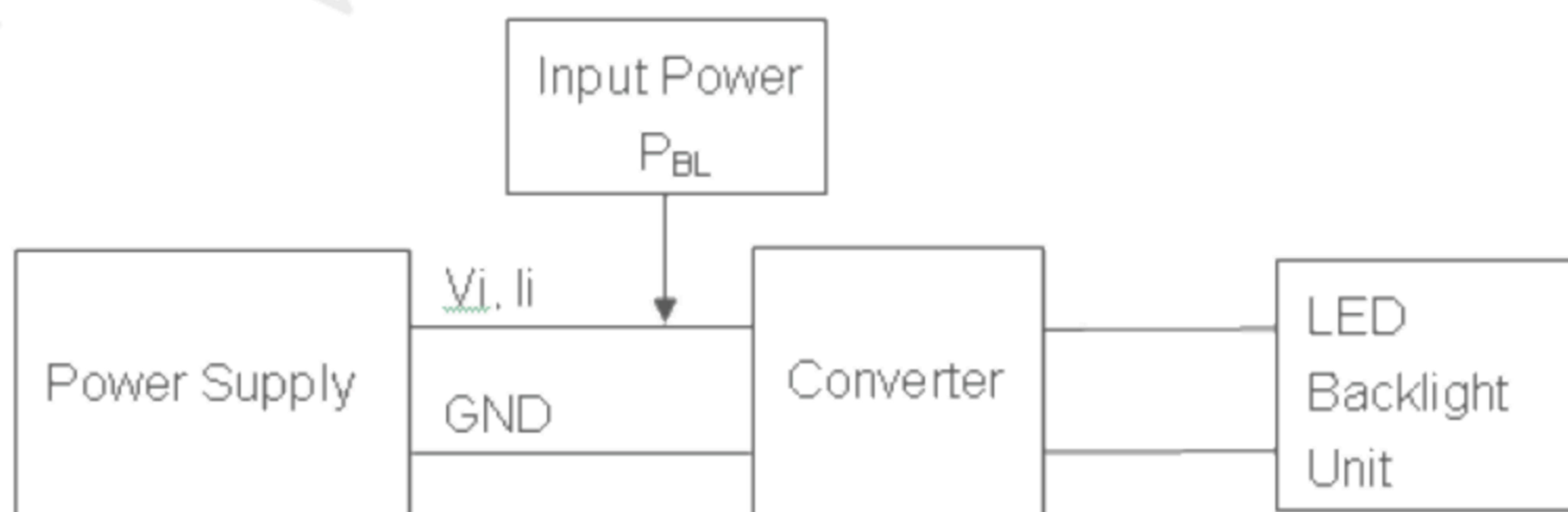


4.3.3 BACKLIGHT UNIT

T_a = 25 ± 2 °C

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Converter Power Supply Voltage	V _i	10.8	12.0	13.2	V	
Converter Power Supply Current	I _i	TBD	1.6	TBD	A	@ V _i = 12V (Duty 100% For V _f 3.05V _{max})
Backlight Power Consumption	P _{BL}	-	18.7	TBD	W	@ V _i = 12V (Duty 100%)
EN Control Level	Backlight on	2.0	3.3	5.0	V	
	Backlight off	0	-	0.15	V	
PWM Dimming Control Level	PWM High Level	2.0	3.3	5.0	V	
	PWM Low Level	0	-	0.15	V	
PWM Dimming Control Duty Ratio	-	1	-	100	%	@200Hz
PWM Dimming Control Frequency	f _{PWM}	190	200	20k	Hz	(2)
LED Life Time	L _L	30,000	-	-	Hrs	(3)

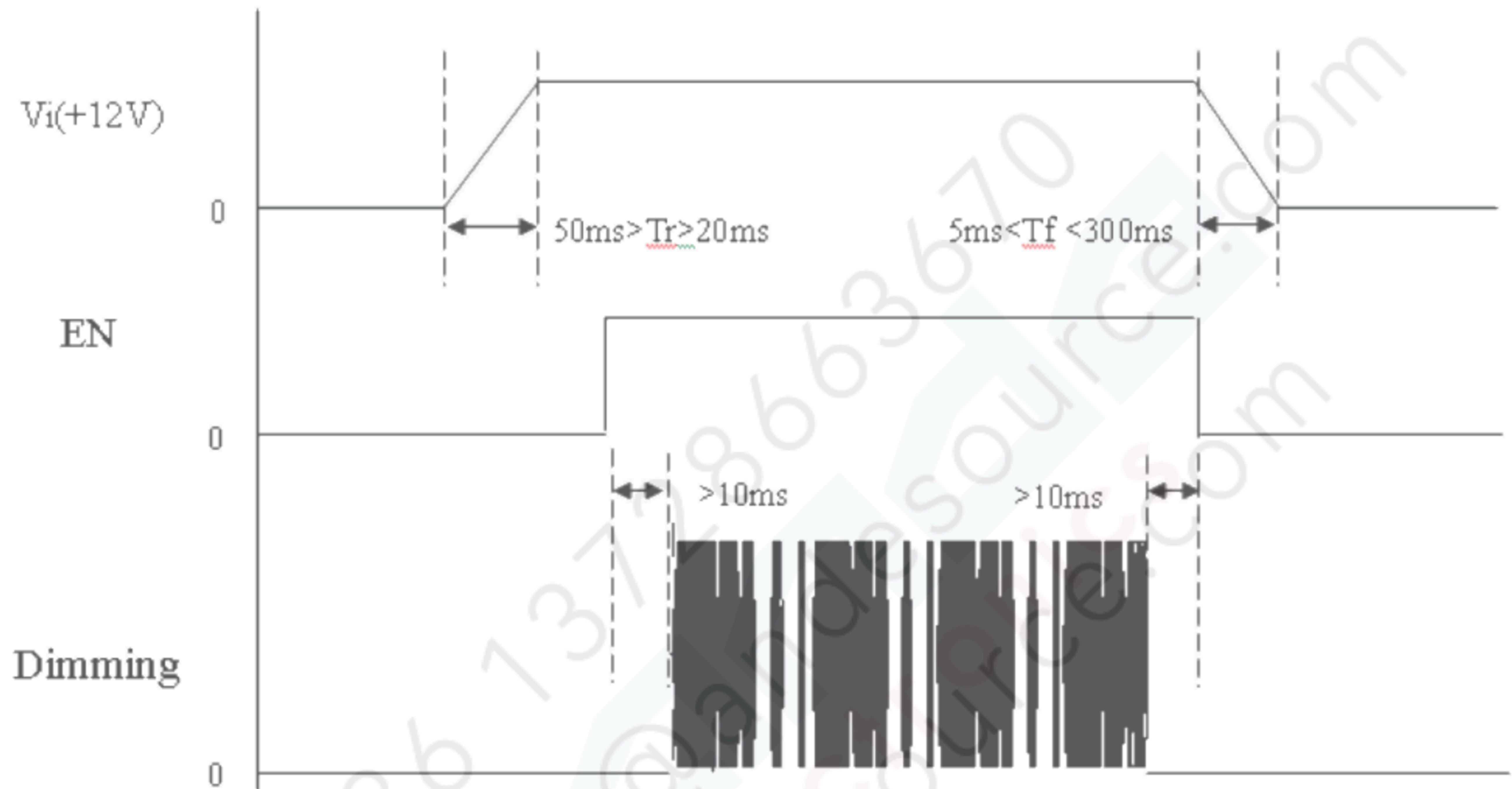
Note (1) LED current is measured by utilizing a high frequency current meter as shown below:



Note (2) At 20k Hz PWM control frequency, duty ratio range is restricted from 20% to 100%.

Note (3) The lifetime of LED is estimated data and defined as the time when it continues to operate under the conditions at $T_a = 25 \pm 2^\circ\text{C}$ and Duty 100% until the brightness becomes $\leq 50\%$ of its original value. Operating LED under high temperature environment will reduce life time and lead to color shift.

Power sequence and control signal timing are shown in the following figure

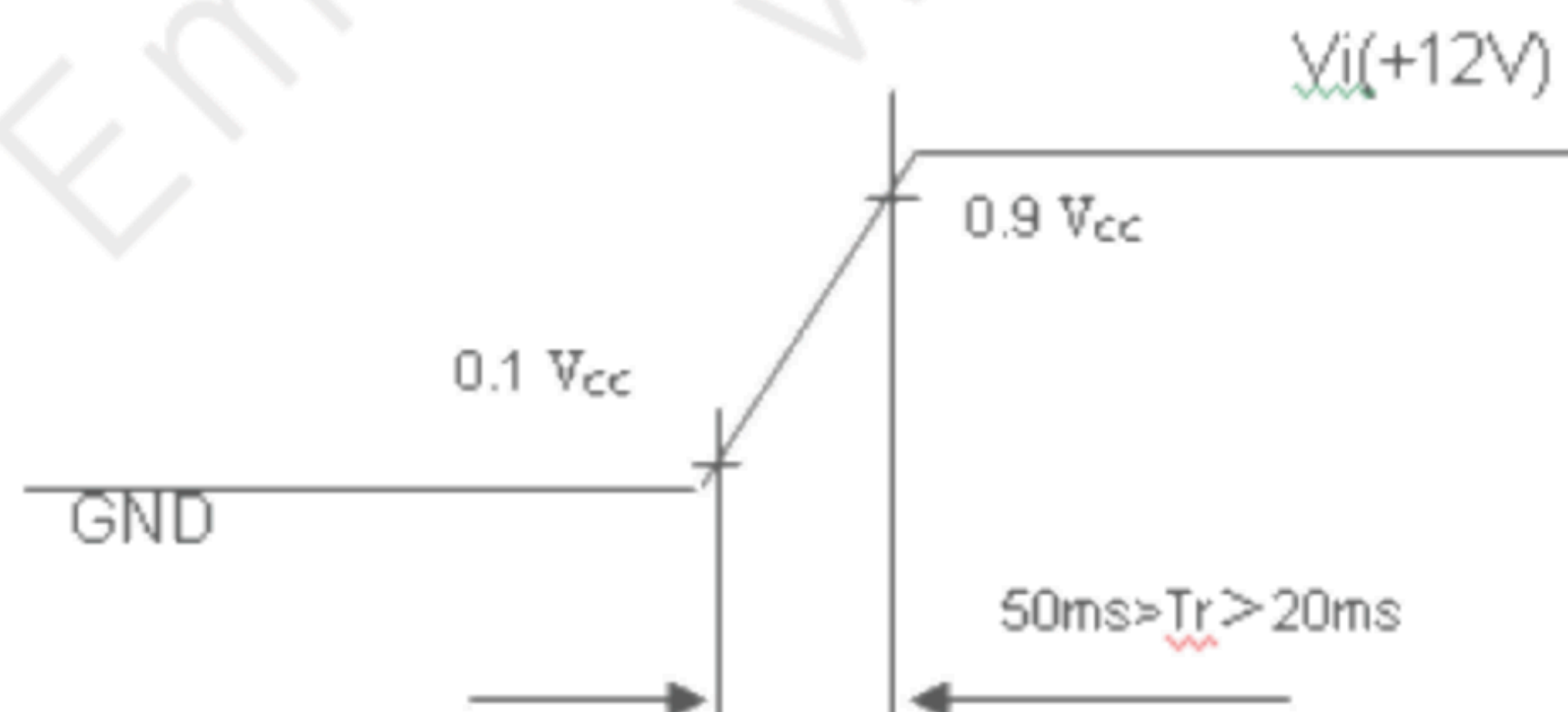


Note: While system is turned ON or OFF, the power sequences must follow as below descriptions

Turn ON sequence: $V_i(+12V) \rightarrow \text{EN} \rightarrow \text{Dimming}$

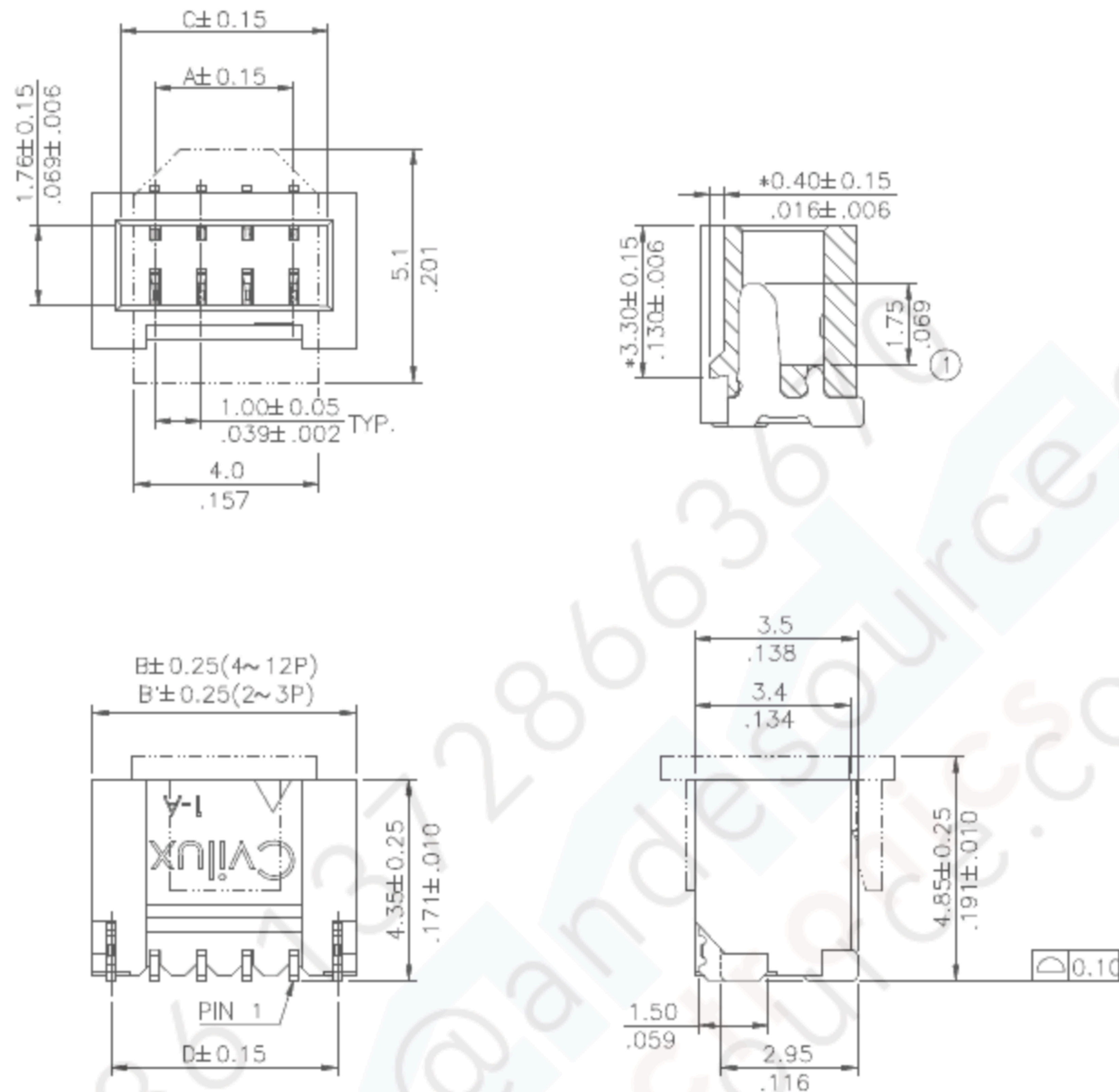
Turn OFF sequence: $\text{Dimming} \rightarrow \text{EN} \rightarrow V_i(+12V)$

Note (4)



4.3.4 POWER CONNECTOR PIN ASSIGNMENT

Connector: CI1406M1VL0-NH (CviLux) or Compatible

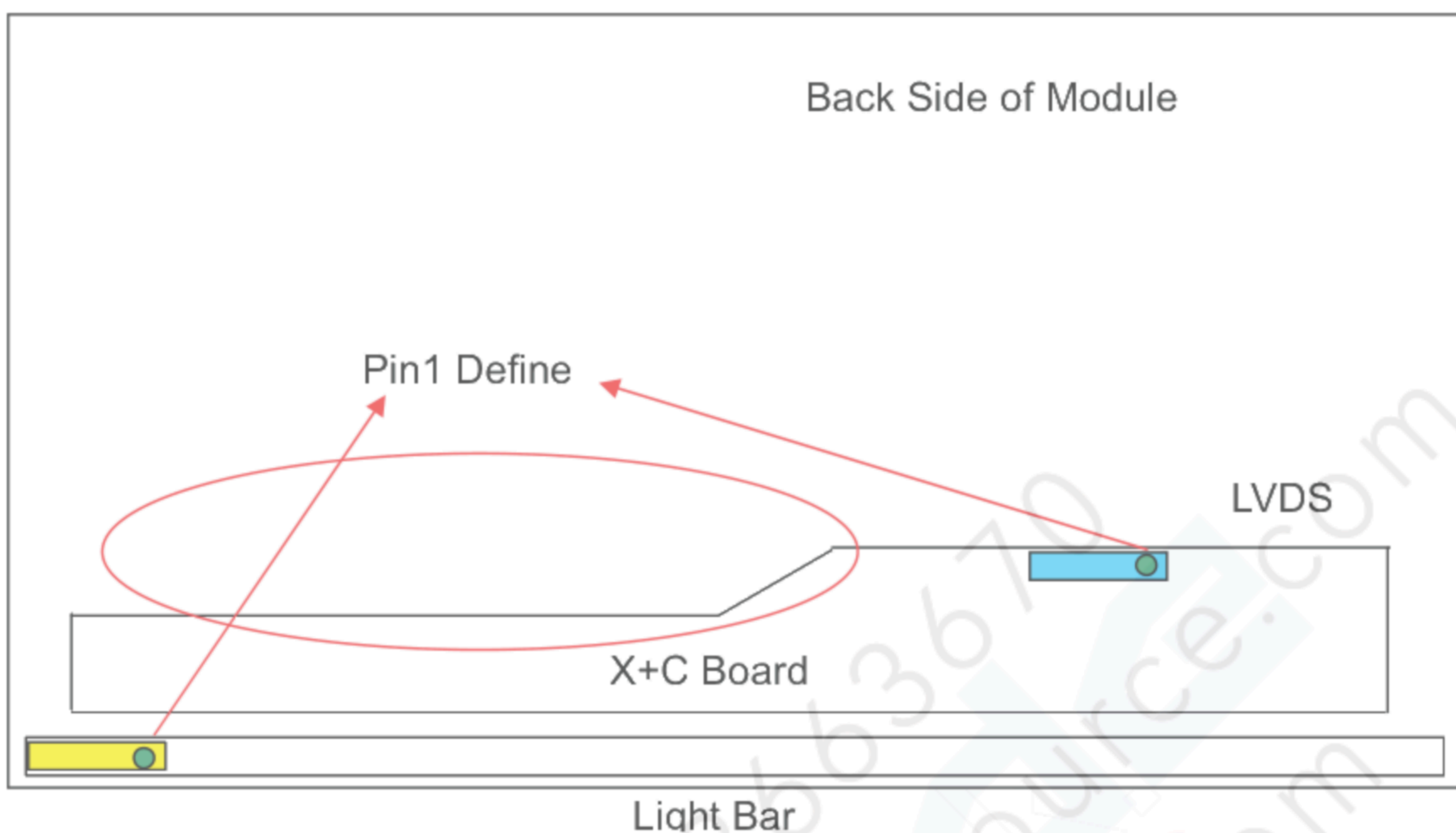


CN1

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

Note(1) Connector(wire type): CI1406M1VL0-NH (CviLux) or equivalent.

Note(2) User's mating connector part No.: FCN(WF1300106-B) and hook width must be less than 4.5mm.



4.4 LVDS INPUT SIGNAL SPECIFICATIONS

4.4.1 LVDS DATA MAPPING TABLE

LVDS Channel O0	LVDS output	D7	D6	D4	D3	D2	D1	D0
	Data order	OG0	OR5	OR4	OR3	OR2	OR1	OR0
LVDS Channel O1	LVDS output	D18	D15	D14	D13	D12	D9	D8
	Data order	OB1	OB0	OG5	OG4	OG3	OG2	OG1
LVDS Channel O2	LVDS output	D26	D25	D24	D22	D21	D20	D19
	Data order	DE	NA	NA	OB5	OB4	OB3	OB2
LVDS Channel O3	LVDS output	D23	D17	D16	D11	D10	D5	D27
	Data order	NA	OB7	OB6	OG7	OG6	OR7	OR6
LVDS Channel E0	LVDS output	D7	D6	D4	D3	D2	D1	D0
	Data order	EG0	ER5	ER4	ER3	ER2	ER1	ER0
LVDS Channel E1	LVDS output	D18	D15	D14	D13	D12	D9	D8
	Data order	EB1	EB0	EG5	EG4	EG3	EG2	EG1
LVDS Channel E2	LVDS output	D26	D25	D24	D22	D21	D20	D19
	Data order	DE	NA	NA	EB5	EB4	EB3	EB2
LVDS Channel E3	LVDS output	D23	D17	D16	D11	D10	D5	D27
	Data order	NA	EB7	EB6	EG7	EG6	ER7	ER6

4.4.2 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	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

4.5 DISPLAY TIMING SPECIFICATIONS

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

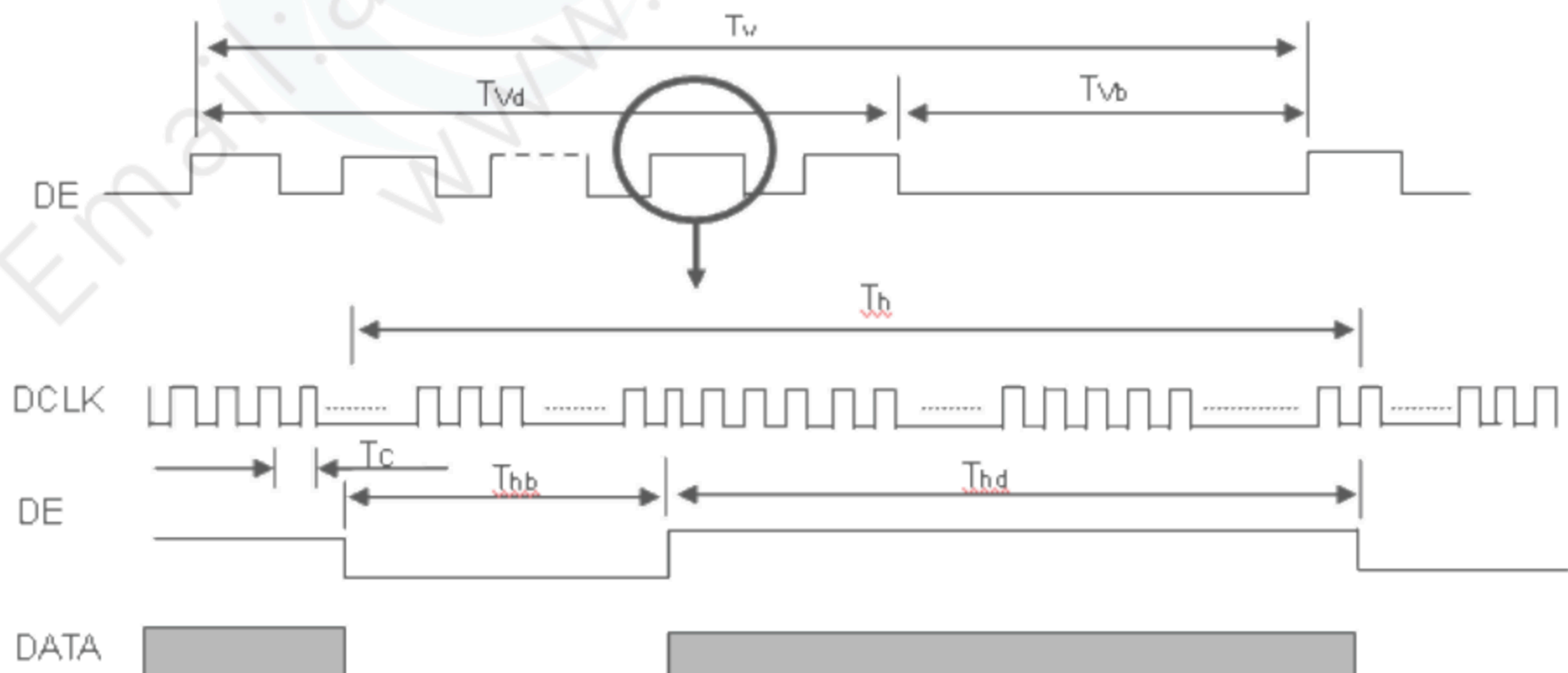
Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Clock	Frequency	F _c	56	74.25	(97.98)	MHz	-
	Period	T _c	-	13.47	-	ns	
	Input cycle to cycle jitter	T _{rcl}	-0.02*T _c	-	0.02*T _c	ns	(1)
	Input Clock to data skew	TLVCCS	-0.02*T _c	-	0.02*T _c	ps	(2)
	Spread spectrum modulation range	F _{clkin_mod}	0.97*F _c	-	1.03*F _c	MHz	(3)
	Spread spectrum modulation frequency	F _{SSM}	-	-	100	KHz	
Vertical Display Term	Frame Rate	Fr	49	60	77	Hz	T _v =T _{vd} +T _{vb}
	Total	T _v	1100	1125	1257	Th	-
	Active Display	T _{vd}	1080	1080	1080	Th	-
	Blank	T _{vb}	20	45	177	Th	-
Horizontal Display Term	Total	T _h	1050	1100	1150	Tc	T _h =T _{hd} +T _{hb}
	Active Display	T _{hd}	960	960	960	Tc	-
	Blank	T _{hb}	90	140	190	Tc	-

Note: Because this module is operated by DE only mode, Hsync and Vsync input signals are ignored.

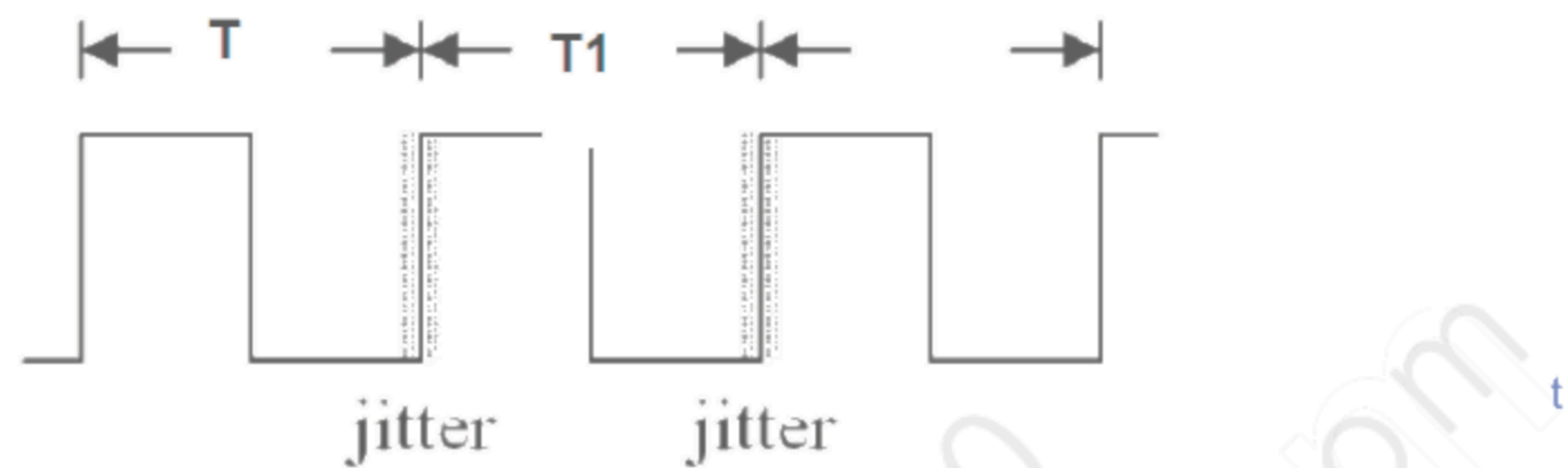
$$F_c = F_r \times T_v \times T_h$$

Please make sure the range of pixel clock has follow the below equation and F_c, F_r, T_v, T_h not allowed to get beyond the min or max spec.

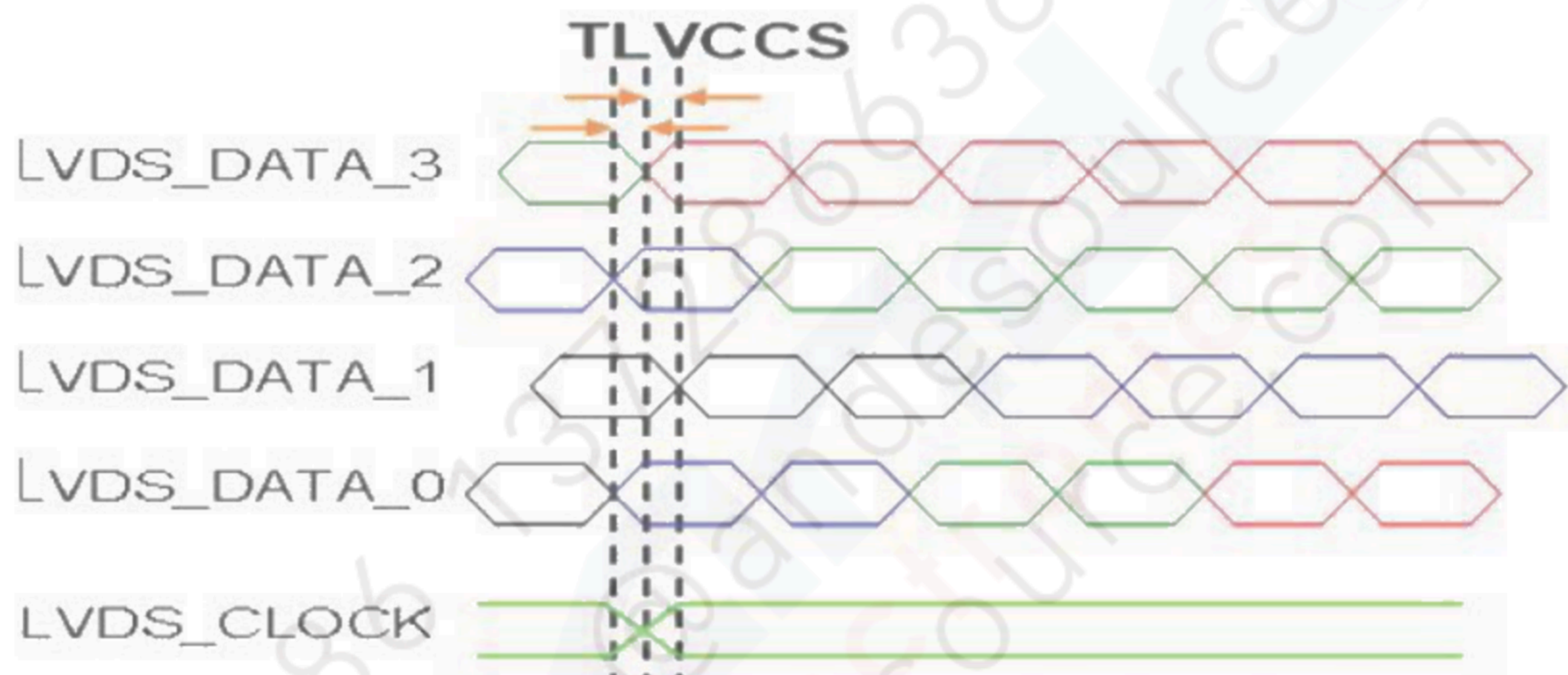
INPUT SIGNAL TIMING DIAGRAM



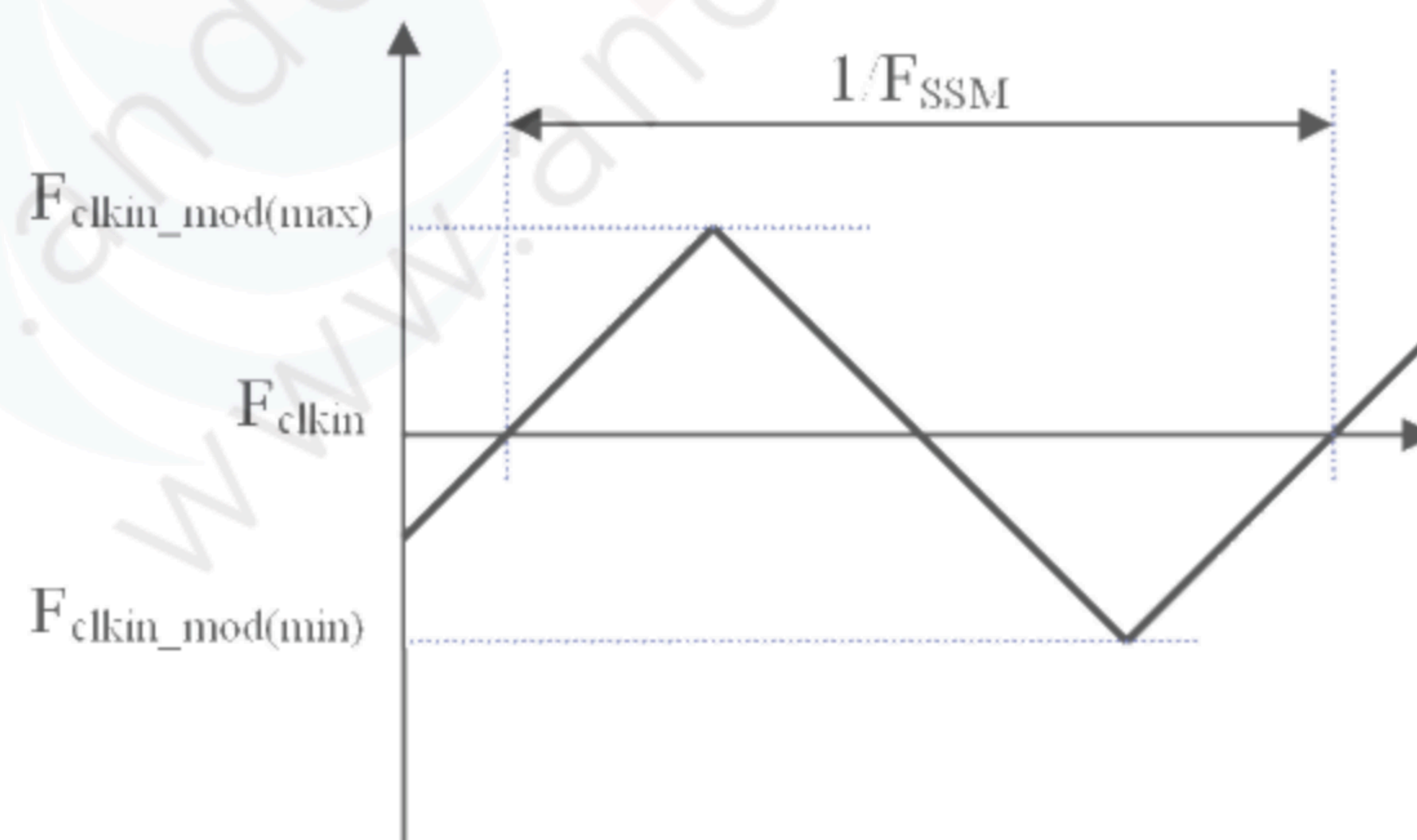
Note (1) The input clock cycle-to-cycle jitter is defined as below figures. $Trcl = |T_1 - T|$



Note (2) Input Clock to data skew is defined as below figures.



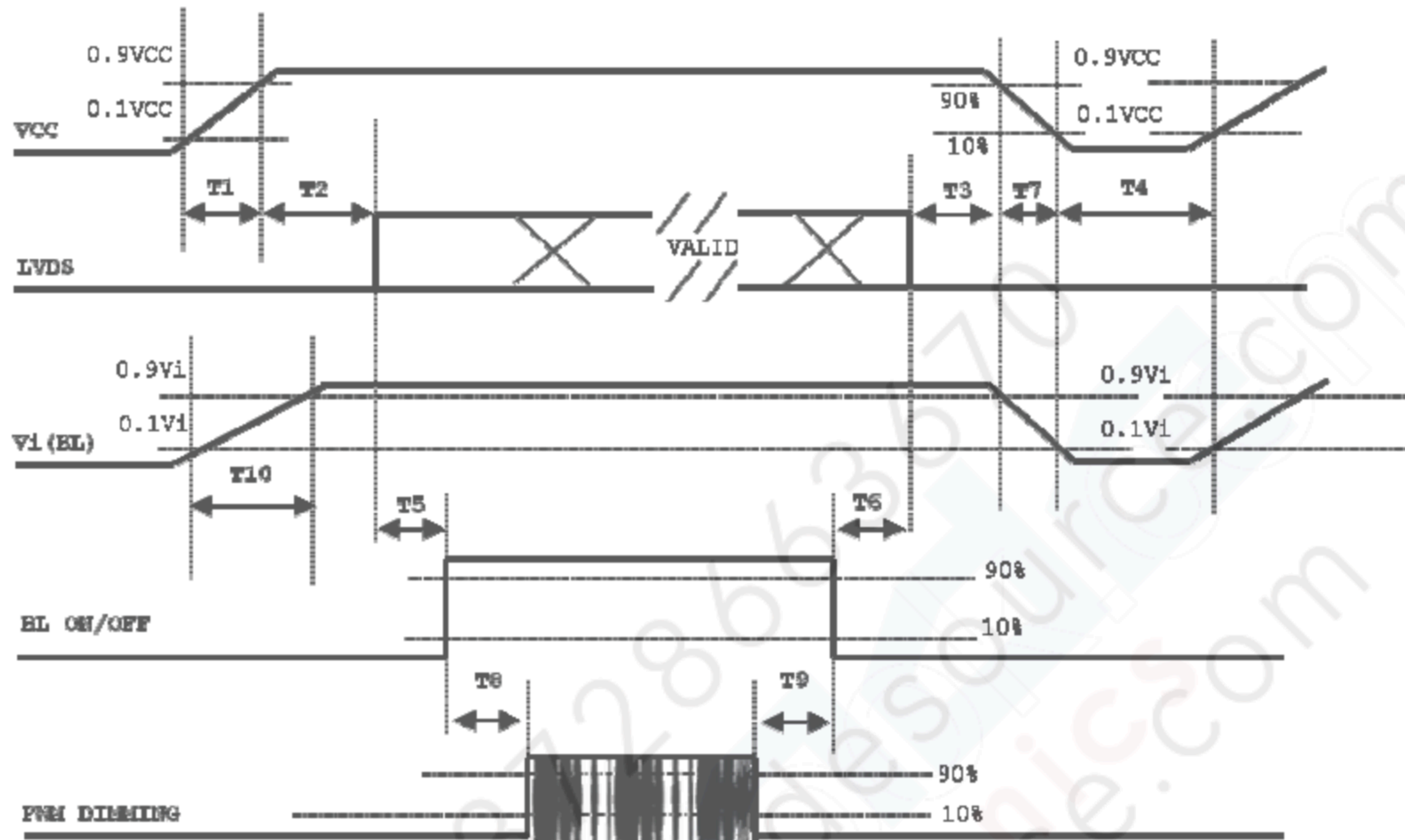
Note (3) The SSCG (Spread spectrum clock generator) is defined as below figures.



Note(4) Note(4) The DCLK range at last line of V-blank should be set in 0 to $H_{display}/2$

4.6 POWER ON/OFF SEQUENCE

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



Power ON/OFF sequence

Note (1) Please avoid floating state of interface signal at invalid period.

Note (2) When the interface signal is invalid, be sure to pull down the power supply of LCD VCC to 0 V.

Note (3) The Backlight converter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight converter power must be turned off before the power supply for the logic and the interface signal is invalid.

Parameter	Value			Units
	Min	Typ	Max	
T1	0.5	-	10	ms
T2	0	-	50	ms
T3	0	-	50	ms
T4	500	-	-	ms
T5	450	-	-	ms
T6	200	-	-	ms
T7	10	-	100	ms
T8	10	-	-	ms
T9	10	-	-	ms
T10	20		50	ms

Timing Specifications:

Parameters	Values			Units	Note
	Min	Typ.	Max		
T1	0.5	-	10	ms	
T2	0	30	50	ms	
T3	450	-	-	ms	
T4	100	250	-	ms	(2)
T5	0	20	50	ms	
T6	0.1	-	100	ms	(7)
T7	1000	-	-	ms	(4)

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

Note (2) When the backlight turns on before the LCD operation of the LCD turns off, the display may momentarily become abnormal screen and it will be no reliability concern(T4<100ms).

Note (3) In case of VCC = off level, please keep the level of input signals on the low or keep a high impedance.

Note (4) T7 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) INX won't take any responsibility for the products which are damaged by the customers not following the Power Sequence.

Note (7) There might be slight electronic noise when LCD is turned off (even backlight unit is also off). To avoid this symptom, we suggest "Vcc falling timing" to follow "t6 spec".

5. OPTICAL CHARACTERISTICS

5.1 TEST CONDITIONS

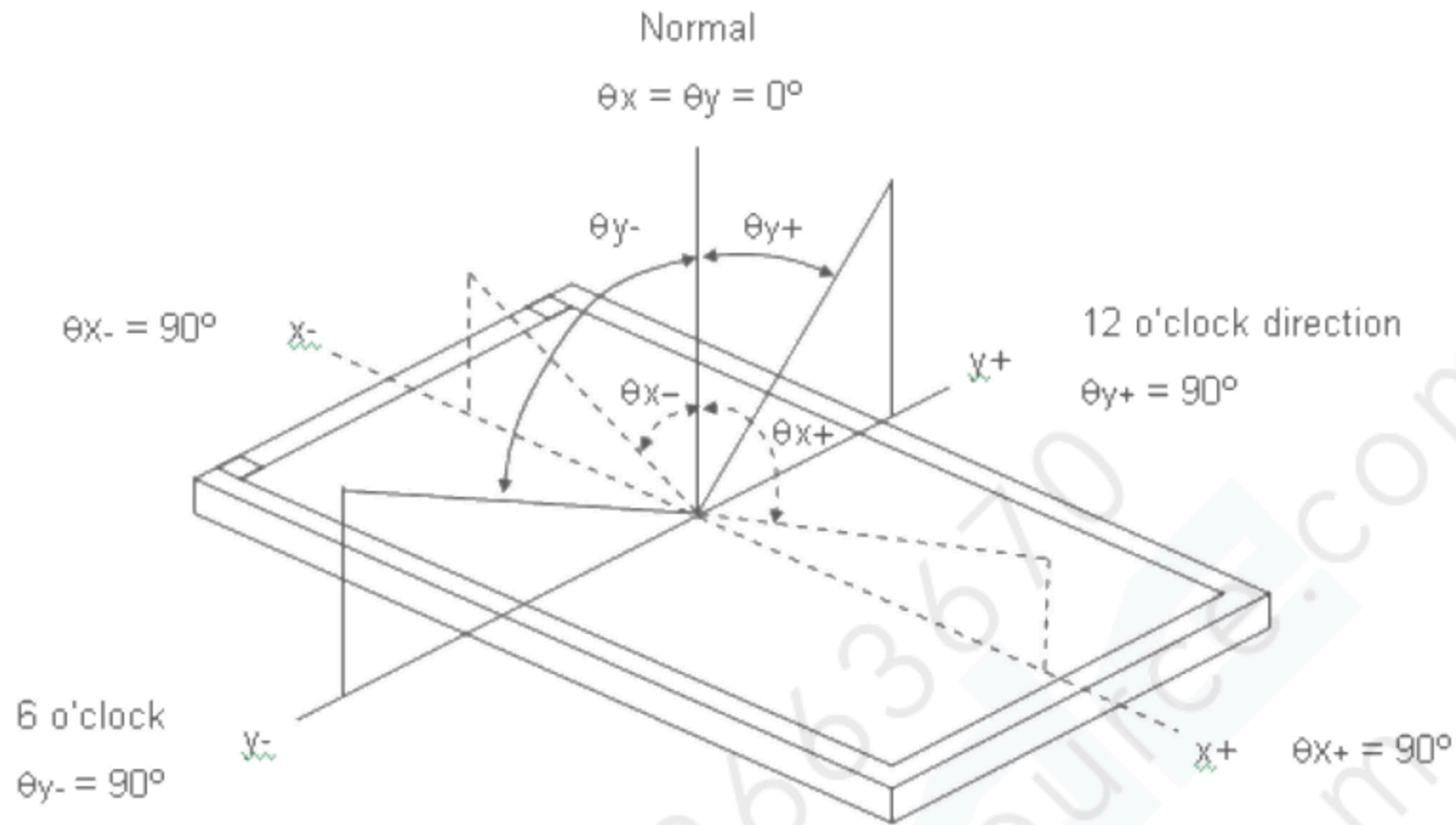
Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	°C
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	V _{CC}	5	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
LED Light Bar Input Current Per Input Pin	I _{PIN}	(140± 2.55)	mA _{DC}
PWM Duty Ratio	D	100	%
LED Light Bar Test Converter	INX 35-D080484		

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).

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Color Chromaticity (CIE 1931)	Red	R _x	$\theta_x=0^\circ, \theta_y=0^\circ$ CS-2000 R=G=B=255 Gray scale	Typ – 0.03	(0.652)	Typ + 0.03	-	(1), (5)
		R _y			(0.337)			
	Green	G _x			(0.313)			
		G _y			(0.626)			
	Blue	B _x			(0.151)			
		B _y			(0.066)			
	White	W _x			0.313			
		W _y			0.329			
Center Luminance of White (Center of Screen)		L _C			450	-	cd/m ²	(4), (5)
Contrast Ratio		CR		700	1000	-	-	(2), (5)
Response Time		T _R	$\theta_x=0^\circ, \theta_y=0^\circ$	-	(8)		ms	(3)
		T _F			(7)			
		T _{GtG_AVE}		-	(14)			
White Variation		δW	$\theta_x=0^\circ, \theta_y=0^\circ$	75			%	(5), (6)
Viewing Angle	Horizontal	θ _{x-} + θ _{x+}	CR ≧ 10	170	178	-	Deg.	(1), (5)
	Vertical	θ _{y-} + θ _{y+}		170	178	-		

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

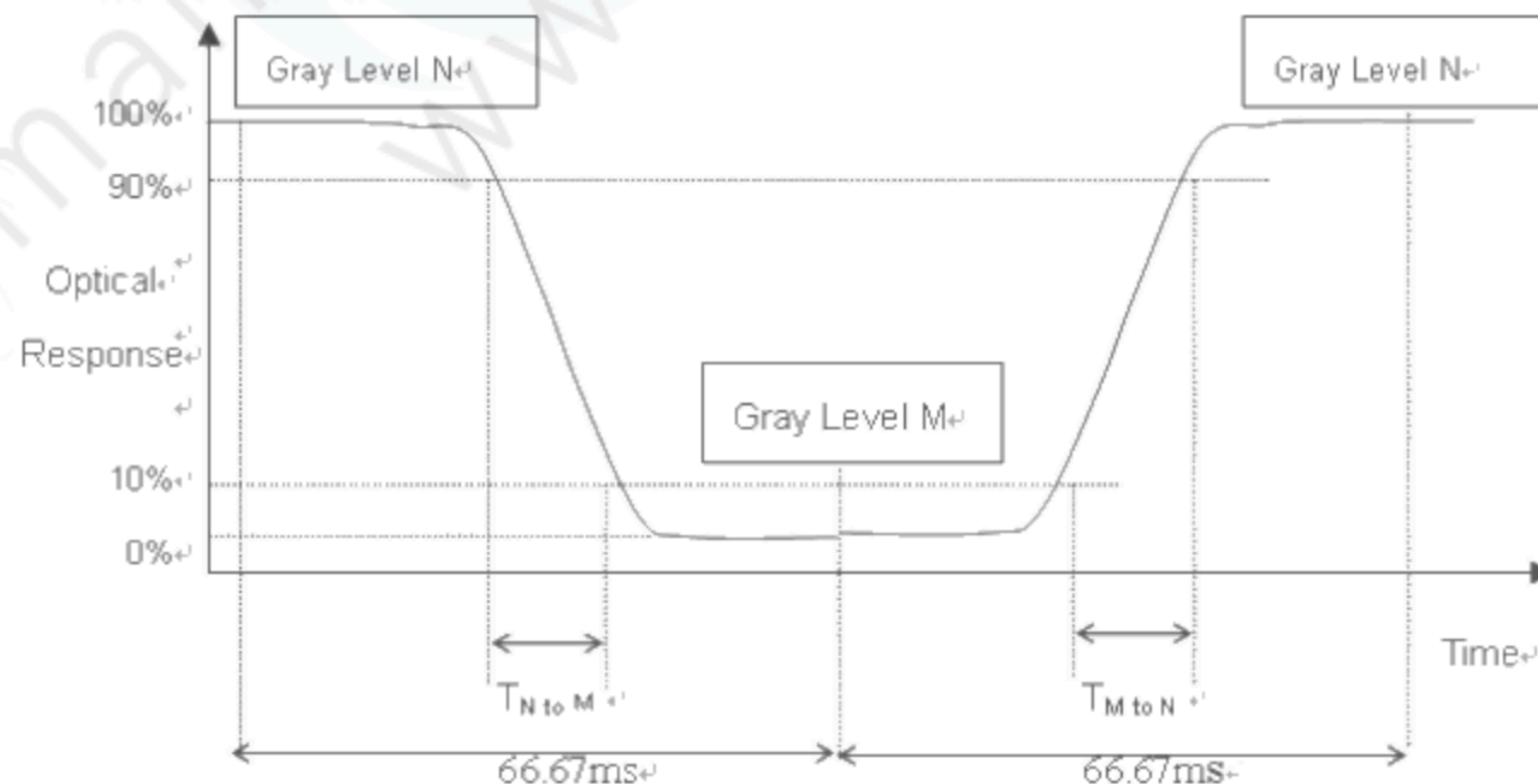
$$CR = CR(5)$$

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

Note (3) Definition of Response Time :

-The T_R is the rising-time means the transition time from "Full-Black (gray 0)" to "Full-White (gray 255)" and the T_F 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 T_{GTG} 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 (0,31,63,~255) as the following table.
- If system uses ODC (Over Driving Circuit) function, T_{GTG_AVE} may be 5ms~10ms.
- * It depends on Overshoot rate.

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

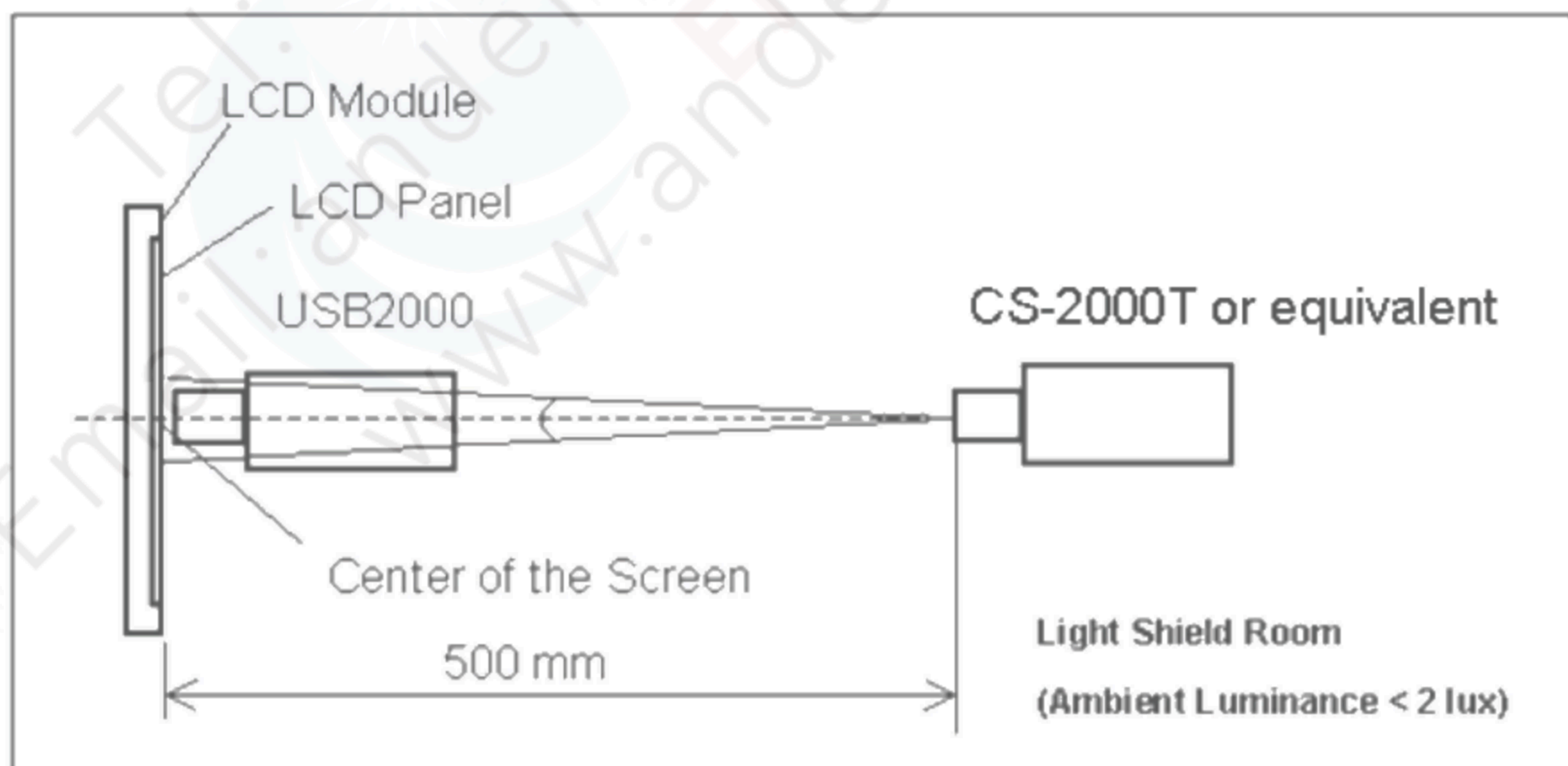
Measure the luminance of gray level 255 at center point

$$L_C = L(5)$$

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

Note (5) Measurement Setup:

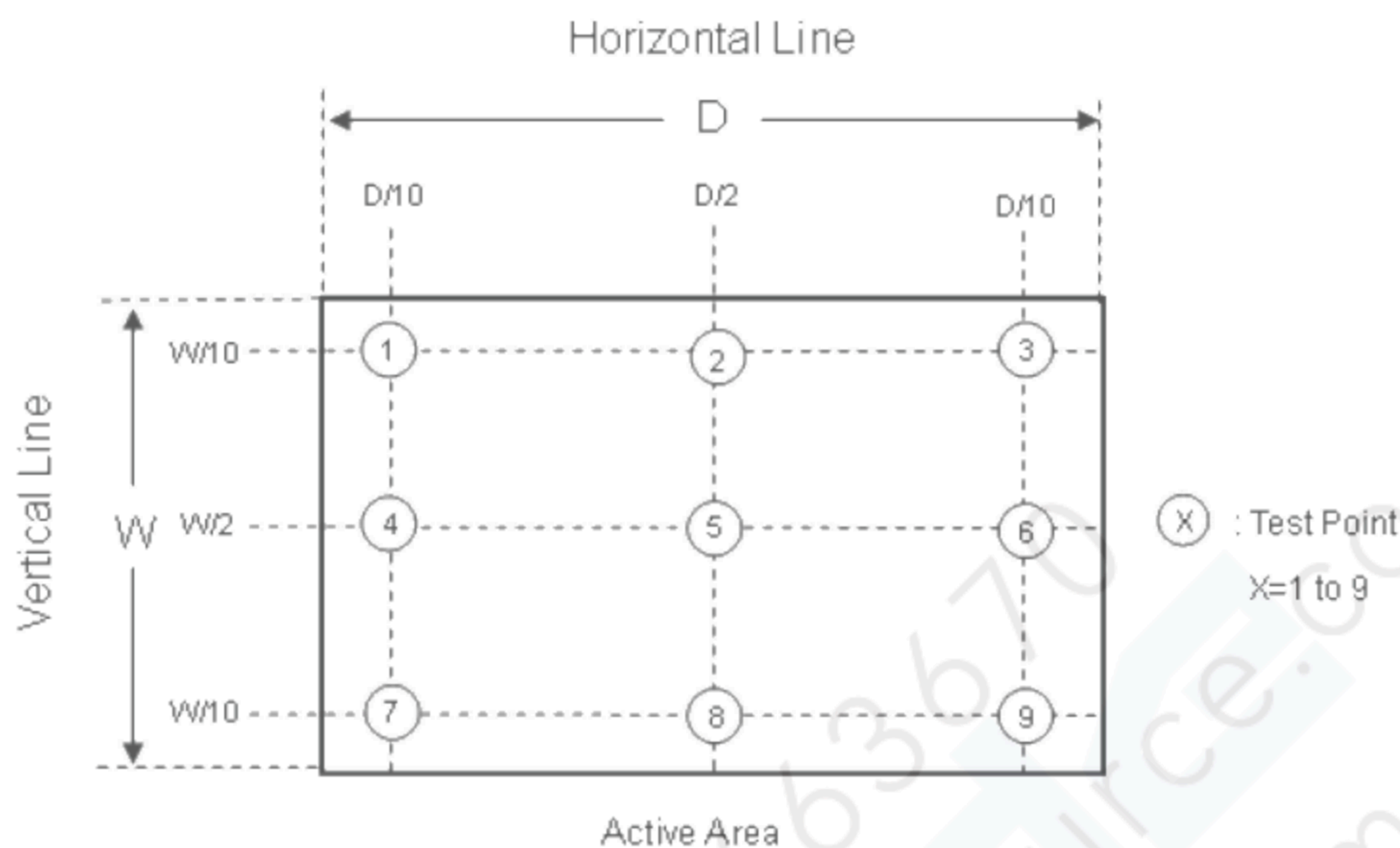
The LCD module should be stabilized at given temperature for 40 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 40 minutes in a windless room.



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

Measure the luminance of gray level 255 at 9 points

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



6. RELIABILITY TEST ITEM

Items	Required Condition	Note
Temperature Humidity Bias (THB)	Ta= 60°C , 80%RH, 240hours	
High Temperature Operation (HTO)	(Ta= 60°C , 240hours)	
Low Temperature Operation (LTO)	Ta= 0°C , 240hours	
High Temperature Storage (HTS)	Ta= 60°C , 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)	
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°C/30min , 60°C / 30min , 100 cycles)	
On/Off Test	25°C ,On/10sec , Off /10sec , 30,000 cycles	
Altitude Test	Operation:10,000 ft / 24hours Non-Operation:30,000 ft / 24hours	

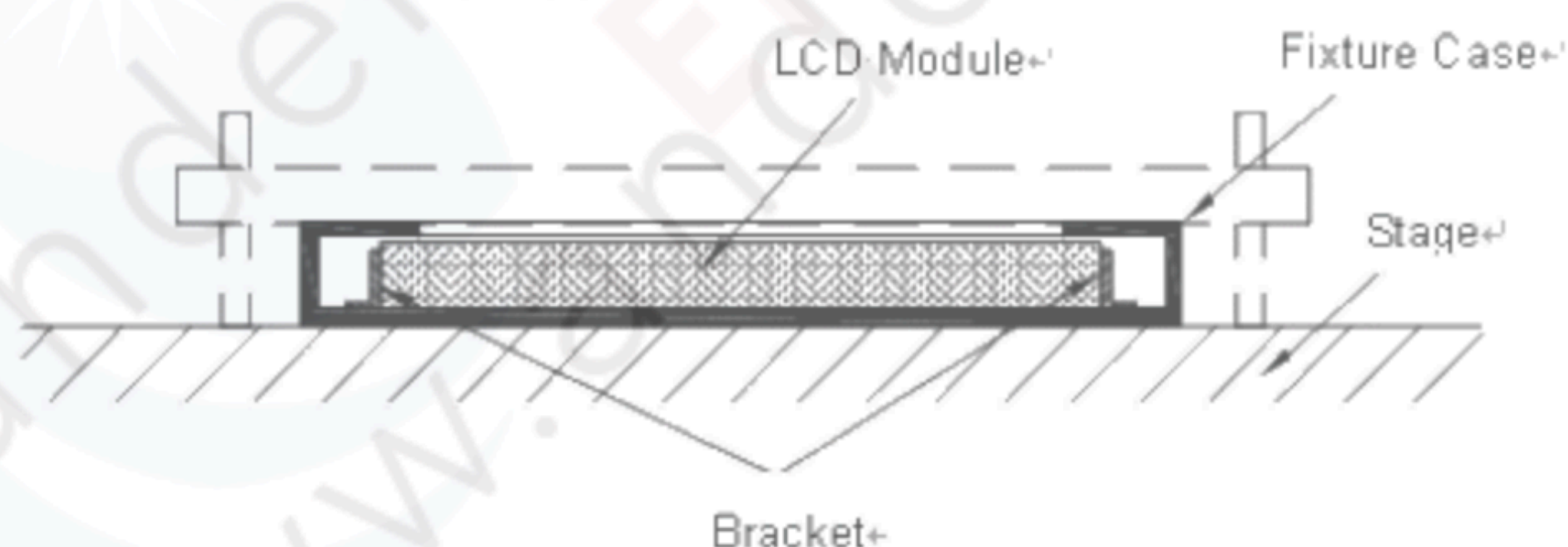
Note (1) criteria : Normal display image with no obvious non-uniformity and no line defect.

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

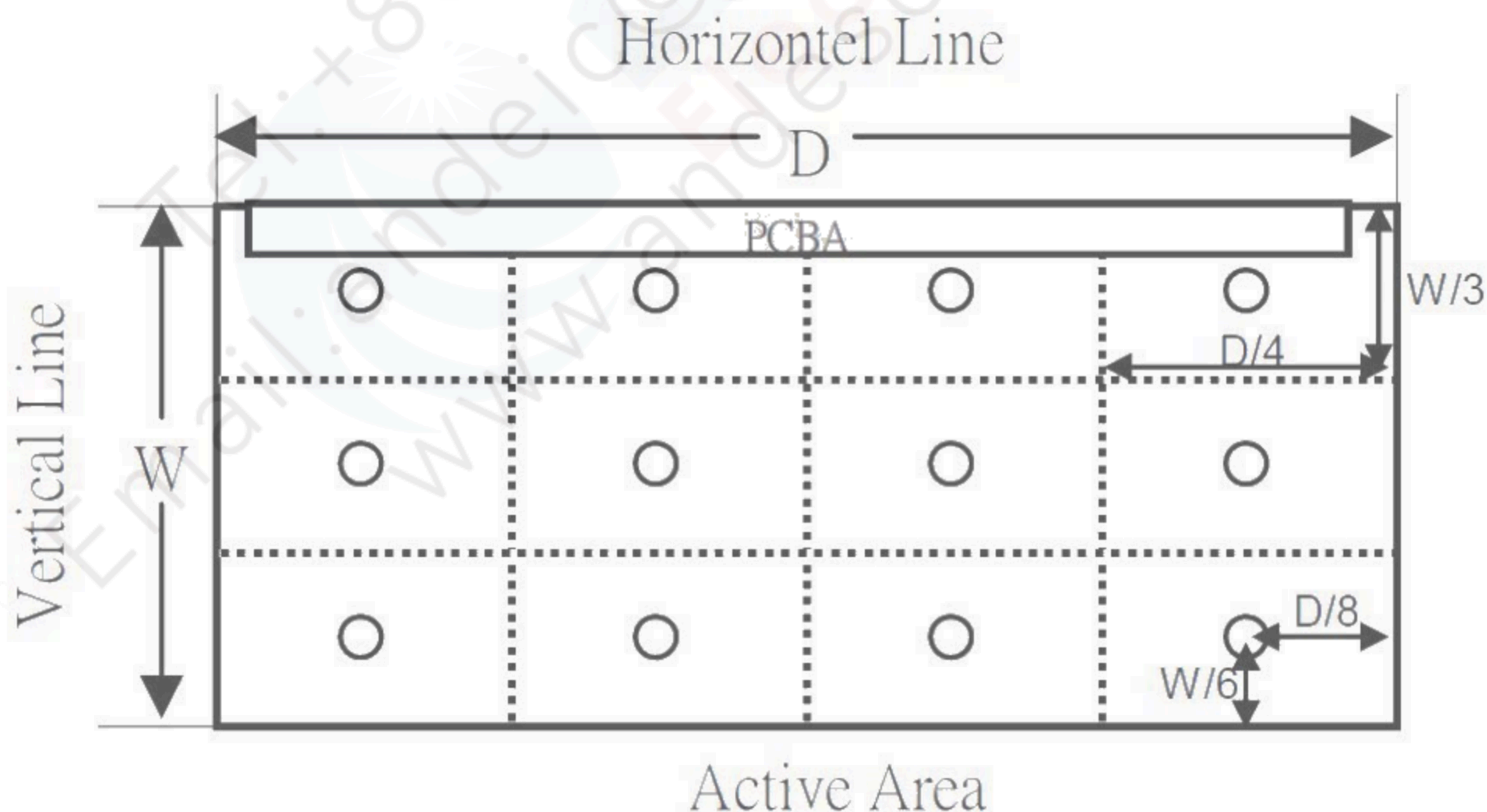
Item	Condition	Min	Unit	Note
Mechanical Strength	128 th Gray Pattern	0.6	Kgf	

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 (If the test points on the PCBA or TP board, these points are not included).



8. PACKING

8.1 PACKING SPECIFICATIONS

- (1) 12 LCD modules / 1 Box
- (2) Box dimensions: 620(L) X 348(W) X 390(H) mm
- (3) Weight: approximately: 28.8kg

8.2 PACKING METHOD

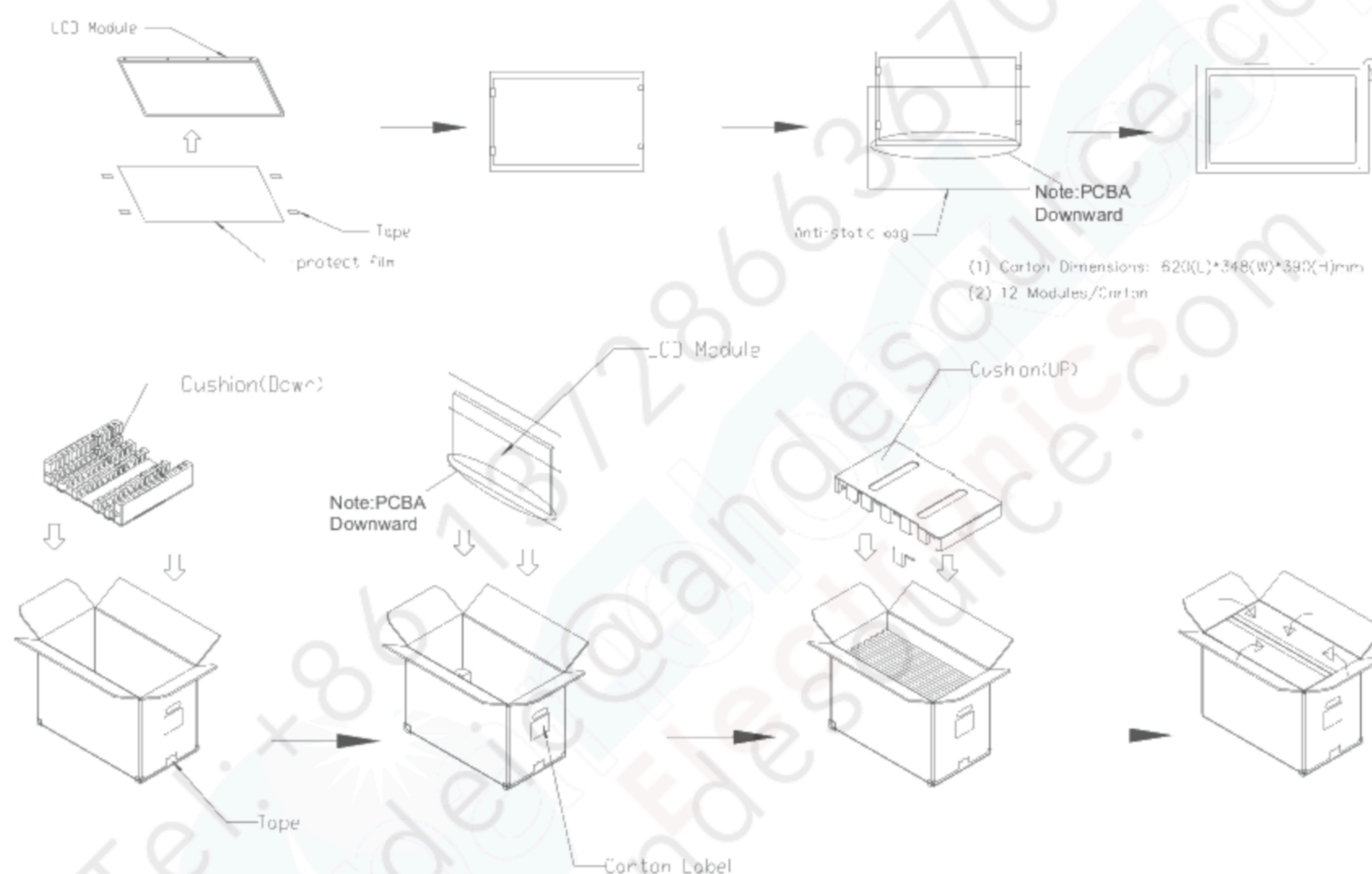


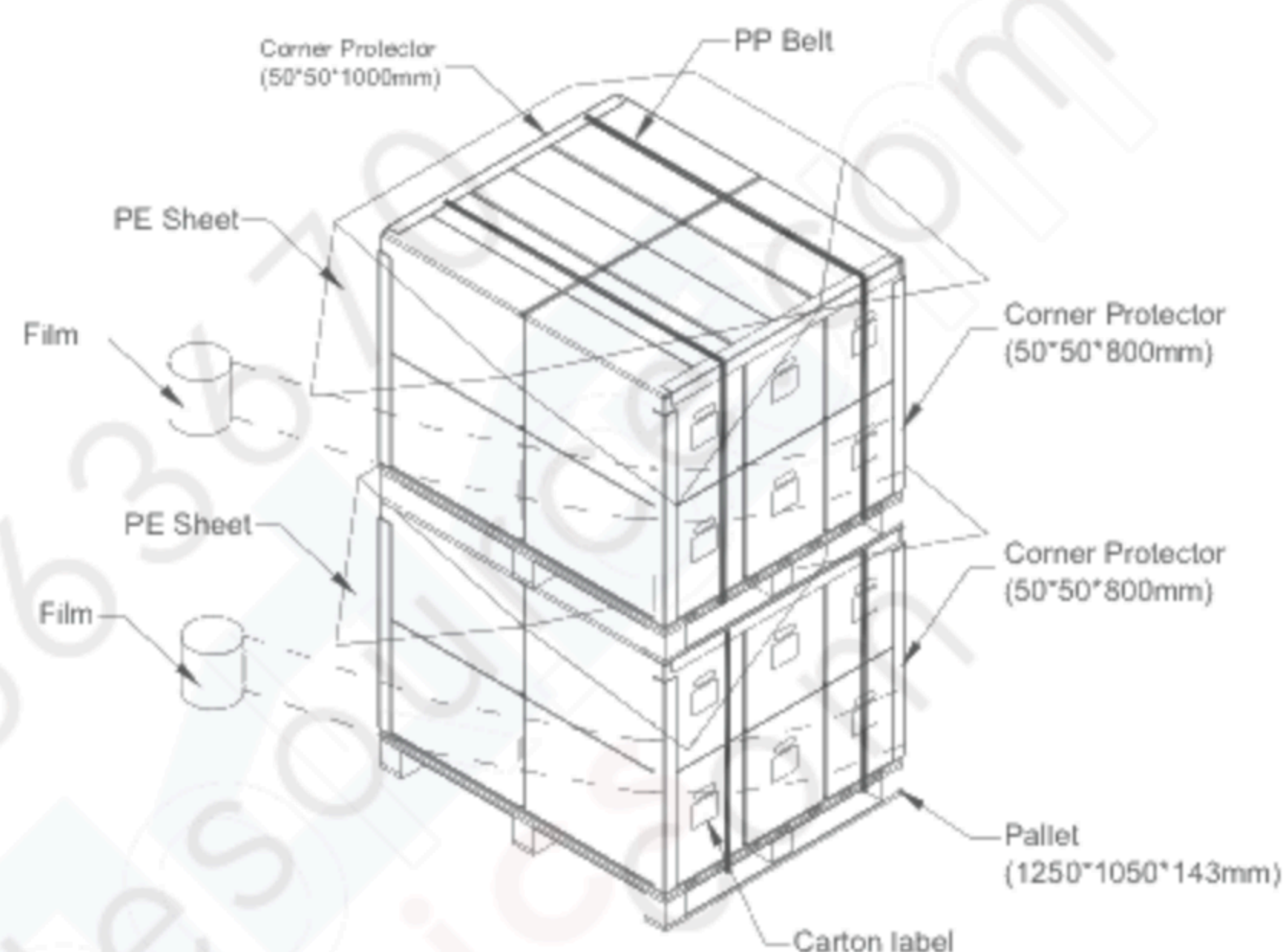
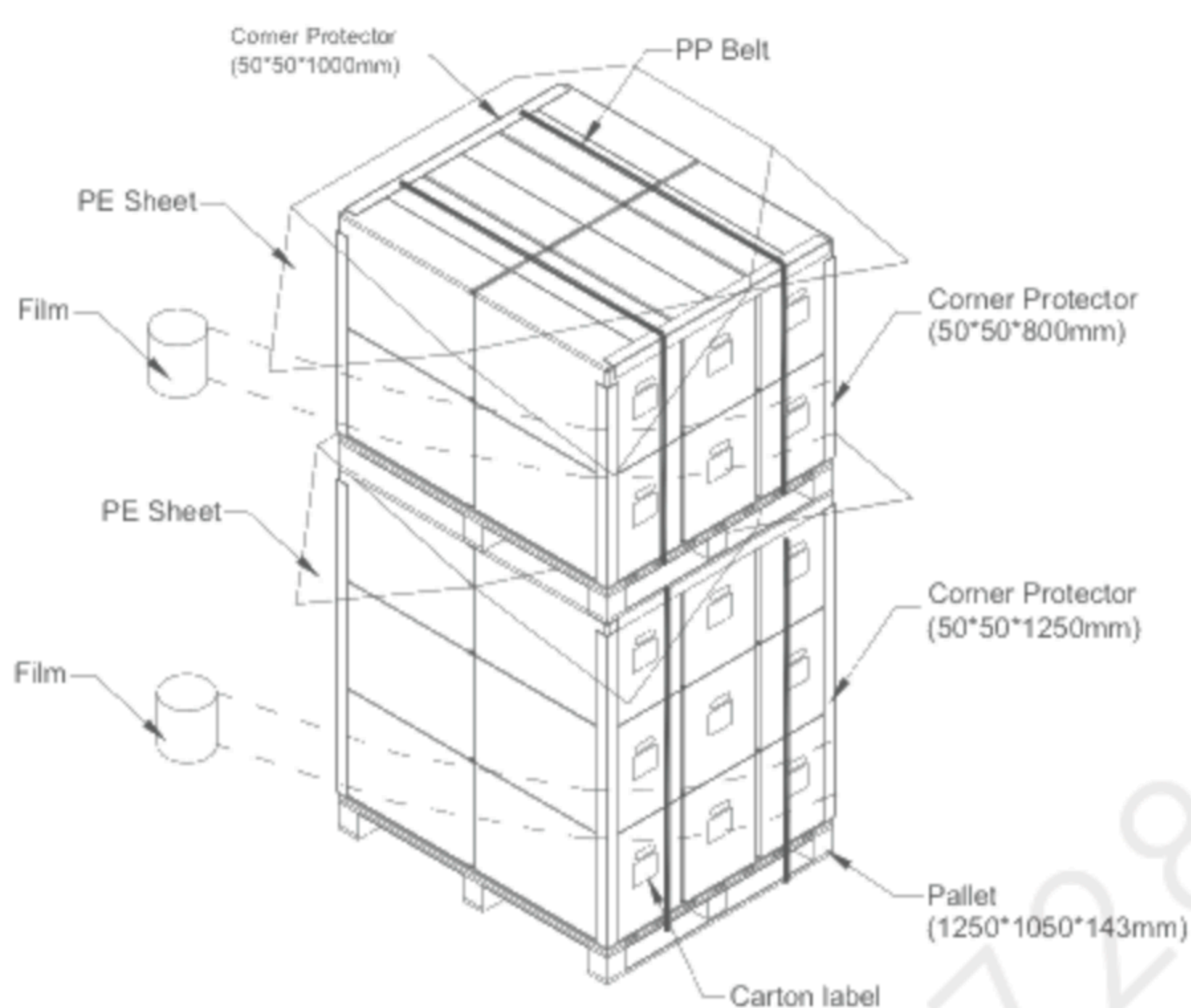
Figure. 8-1 Packing method

8.3 PALLET

For ocean shipping

Sea / Land Transportation (40ft HQ Container)

Sea / Land Transportation (40ft Container)



For air transport

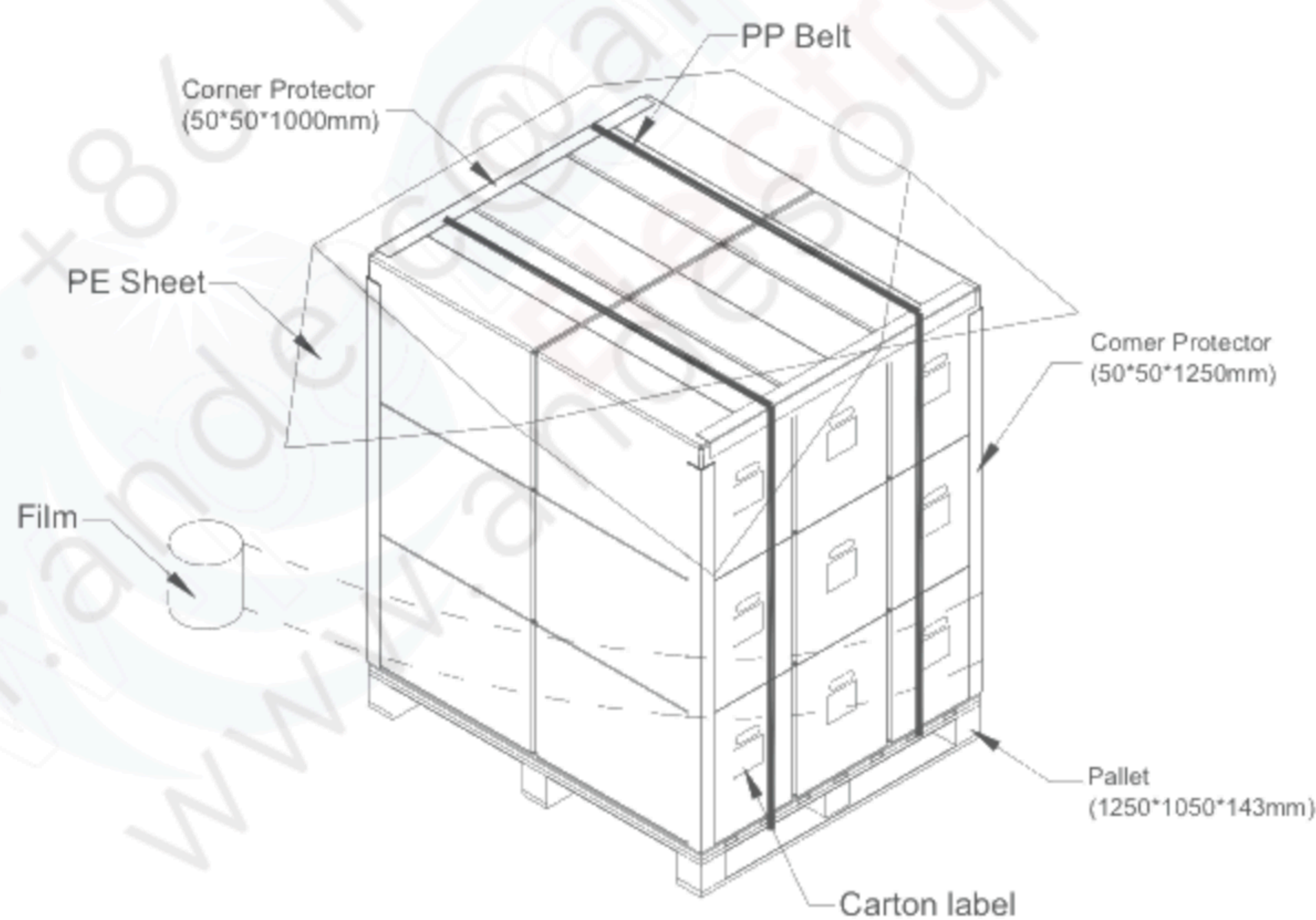


Figure. 8-2 Packing method

8.4 UN-PACKING METHOD

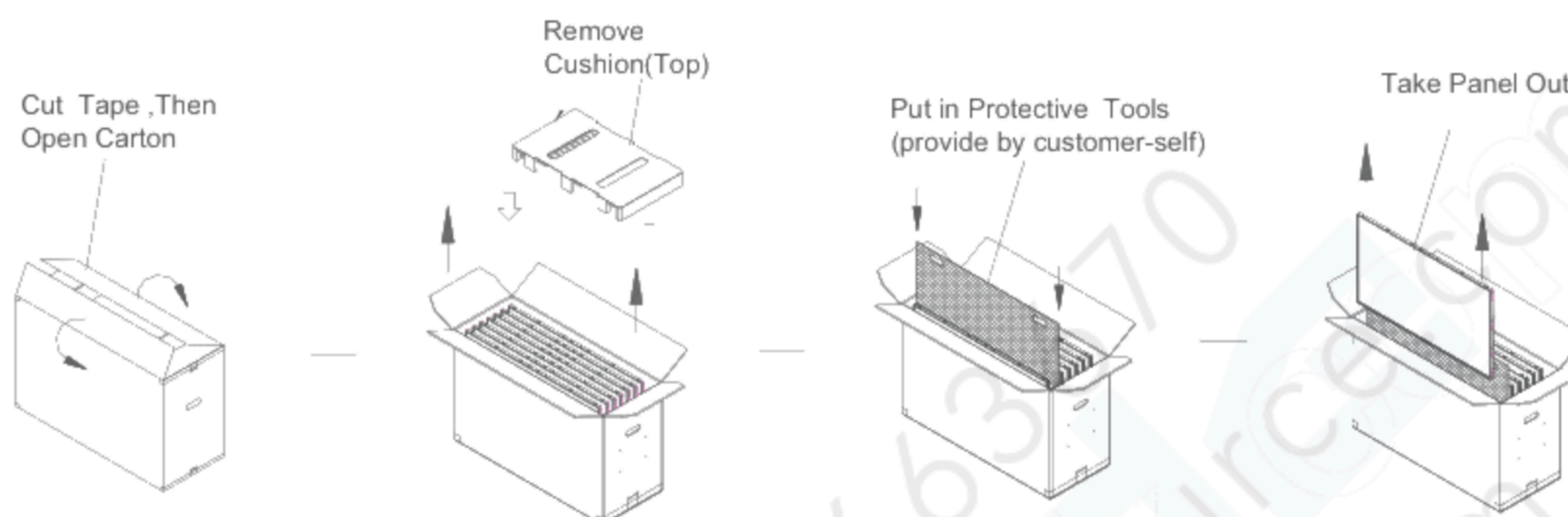


Figure. 8-3 UN-Packing method

9. Innolux MODULE LABEL

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



(a) Model Name: G238HCJ-L02

(b) * * * * : Factory ID

(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.
X	INX internal use	Grade Code
NNNN	Serial number	Manufacturing sequence of product

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.

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 70%
- (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 Innolux 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. OUTLINE DRAWING