

## Product Specification

# SPECIFICATION FOR APPROVAL

( ) Preliminary Specification  
 (●) Final Specification

Title	23.8" Full HD TFT LCD
-------	-----------------------

BUYER	
MODEL	

SUPPLIER	LG Display Co., Ltd.
*MODEL	LM238WF2-SSM2
SUFFIX	

\*When you obtain standard approval,  
 please use the above model name without suffix

SIGNATURE	DATE
/	
/	
/	

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

APPROVED BY	SIGNATURE	DATE
KwangHee Hwang / G.Manager		
<b>REVIEWED BY</b>		
JaeWon Hyun / Manager [C]		
YunHo Hwang / Manager [M]		
GyuSam Kim / Manager [O]		
JongChun Lim / Manager [P]		
<b>PREPARED BY</b>		
SangHoon Lee / Engineer		

**Product engineering dept.**  
**LG Display Co., Ltd**



## Product Specification

### Contents

No	ITEM	Page
	Cover	1
	Contents	2
	Record of revisions	3
1	General description	4
2	Absolute maximum ratings	5
3	Electrical specifications	6
3-1	Electrical characteristics	6
3-2	Interface connections	9
3-3	Signal timing specifications	14
3-4	Signal timing waveforms	15
3-5	Color input data reference	16
3-6	Power sequence	17
3-7	V <sub>LCD</sub> Power dip condition	18
4	Optical specifications	19
5	Mechanical characteristics	23
6	Reliability	26
7	International standards	27
7-1	Safety	27
7-2	Environment	27
8	Packing	28
8-1	Designation of lot mark	28
8-2	Packing form	29
9	Precautions	30



## Record of revisions

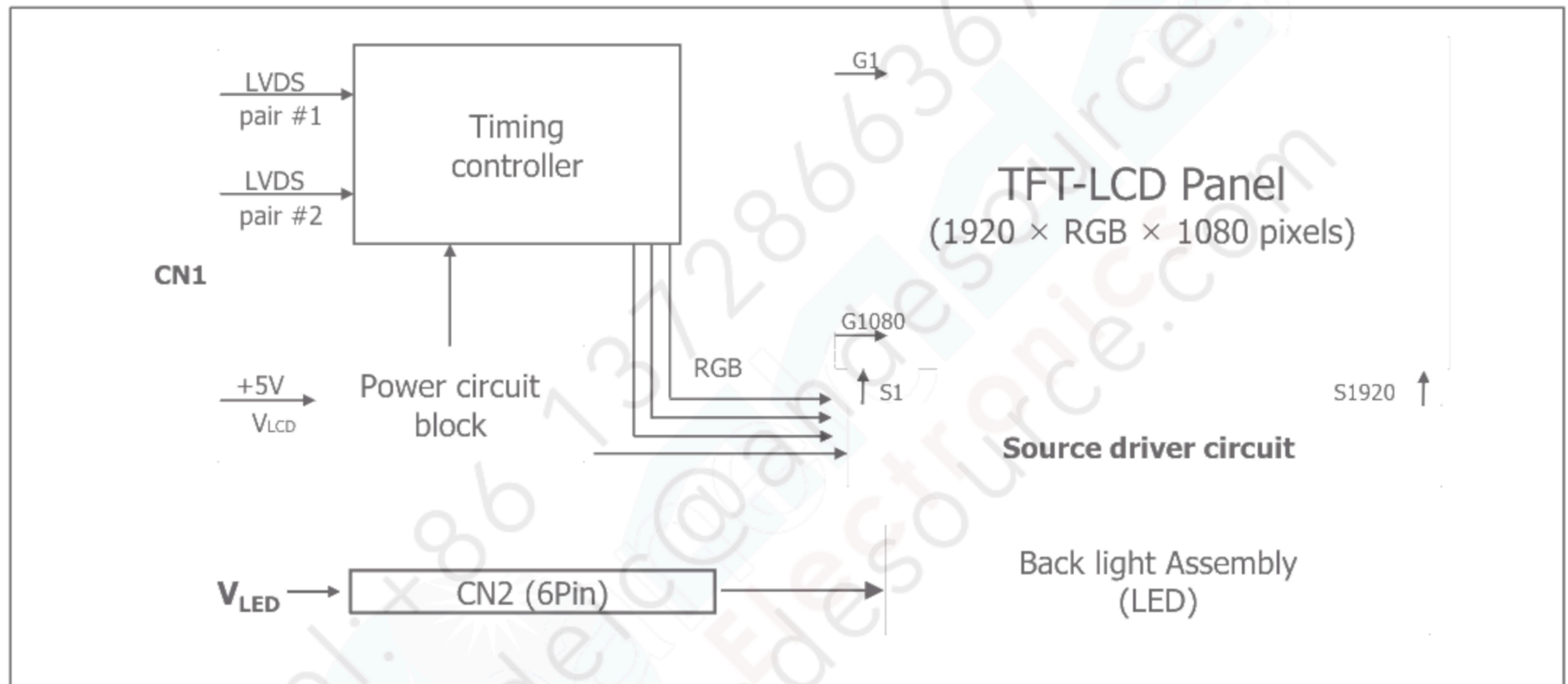
Sep. 10. 2019	19	Rx	0.652	Rx	0.655
		Ry	0.336	Ry	0.335
		Gx	0.321	Gx	0.330
		Gy	0.610	Gy	0.610
		Bx	0.153	Bx	0.150
		By	0.061	By	0.060



## Product Specification

### 1. General Description

LM238WF2-SSM2 is a color active matrix liquid crystal display with a light emitting diode (WLED) backlight system without LED driver. The matrix employs a-Si thin film transistor as the active element. It is a transmissive type display operating in the normally black mode. It has a 23.8 inch diagonally measured active display area with FHD resolution.(1920 horizontal by 1080 vertical pixels array)  
 Each pixel is divided into red, green and blue sub-pixels or dots which are arranged in vertical stripes. Gray scale or the brightness of the sub-pixel color is determined with a 8-bit gray scale signal for each dot, thus, presenting a palette of more than 16,78Million colors. It has been designed to apply the 8-Bit 2port LVDS interface. It is intended to support displays where high brightness, super wide viewing angle, high color saturation, and high color are important.



**[FIG. 1] Block diagram**

### General features

Active screen size	23.8 inches(60.47cm) (Aspect ratio 16:9)
Outline dimension	535.0(H) x 313.0(V) x 11.15(D) mm (Typ.)
Pixel pitch	0.2745(H)mm x 0.2745(V)mm
Pixel format	1920(H) x 1080(V) Pixels. RGB stripes arrangement
Color depth	16.78Million colors (6bit + A-FRC)
Luminance (@White)	250 cd/m <sup>2</sup> ( Center 1 Point, Typ.)
Viewing angle(CR>10)	View angle free (R/L 178(Typ.), U/D 178(Typ.))
Power consumption	Total 10.0 Watt ( 2.3Watt @V <sub>LCD</sub> , 7.7 Watt @I <sub>s</sub> =46mA )
Weight	2,170 g (Typ.)
Display operating mode	Transmissive mode, normally black
Panel type	Reverse type
Surface treatment	Hard coating(3H), Anti-glare treatment of the front polarizer



## Product Specification

### 2. Absolute Maximum Ratings

The following are maximum values which, if exceeded, may cause faulty operation or damage to the unit.

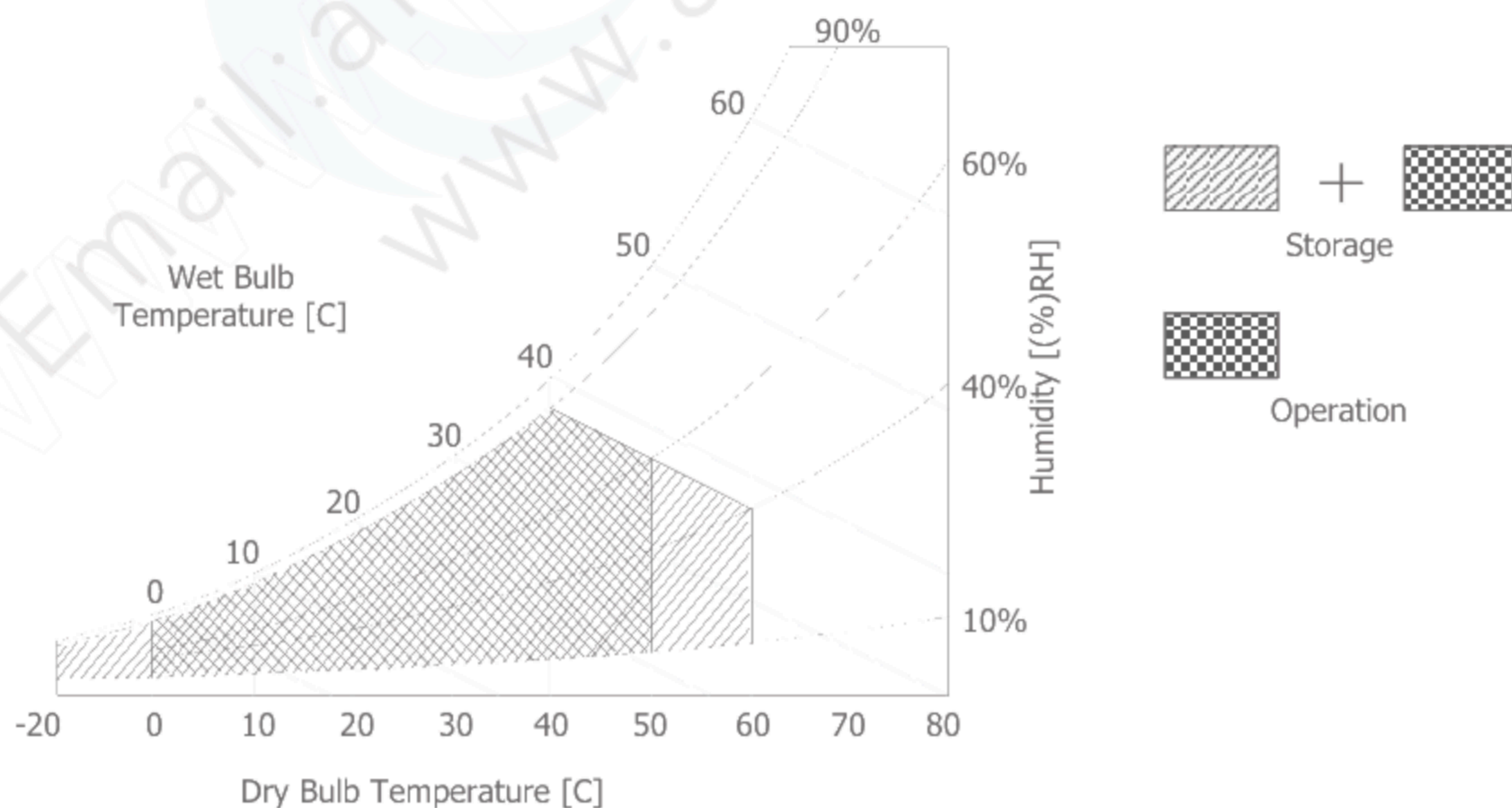
**Table 1. ABSOLUTE MAXIMUM RATINGS**

Parameter	Symbol	Values		Units	Notes
		Min	Max		
Power Input Voltage	VLCD	-0.3	6.0	Vdc	At 25 °C
Operating Temperature	TOP	0	50	°C	
Storage Temperature	TST	-20	60	°C	
Operating Ambient Humidity	HOP	10	90	%RH	1, 2, 3
Storage Humidity	HST	10	90	%RH	
LCM Surface Temperature (Operation)	T <sub>Surface</sub>	0	65	°C	1, 4

Notes :

- Temperature and relative humidity range are shown in the figure below.  
Wet bulb temperature should be 39 °C Max., and no condensation of water.
- Maximum storage humidity is up to 40 °C, 70% RH only for 4 corner light leakage mura.
- Storage condition is guaranteed under packing condition
- LCM surface temperature should be measured under the condition of  $V_{LCD}=5.0V$ ,  $f_v=60Hz$ ,  $T_a=25^{\circ}C$ , no humidity and typical LED string current.  
※.  $T_a$  = Ambient temperature

**[FIG. 2] Temperature and relative humidity**





## Product Specification

### 3. Electrical Specifications

#### 3-1. Electrical Characteristics

It requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The second input power for the LED/Backlight, is typically generated by a LED Driver. The LED Driver is an external unit to the LCDs.

**Table 2-1. ELECTRICAL CHARACTERISTICS**

Parameter	Symbol	Values			Unit	Notes
		Min	Typ	Max		
MODULE :						
Power Supply Input Voltage	V <sub>LCD</sub>	4.5	5	5.5	V <sub>dc</sub>	4
Permissive Power Input Ripple	V <sub>dRF</sub>	-	-	400	mV <sub>p-p</sub>	1
Power Supply Input Current	I <sub>LCD</sub>	-	460	575	mA	2
		-	610	762	mA	
Power Consumption	P <sub>c</sub> TYP	-	2.30	2.88	Watt	
	P <sub>c</sub> MAX	-	3.00	3.76	Watt	
Rush current	I <sub>RUSH</sub>	-	-	3	A	3

Notes :

1. Permissive power ripple should be measured under the condition of V<sub>LCD</sub>=5.0V, 25°C, \*f<sub>v</sub>=max.  
Refer to page 7 for the pattern and more information.
2. The specified current and power consumption can be measured under the V<sub>LCD</sub>=5.0V, 25°C, f<sub>v</sub>=60Hz and the pattern should be changed according to the typical or maximum power condition.  
The max. current can be measured only with the maximum power pattern.  
See the page 7 for details.
3. Maximum condition of inrush current :  
The duration of rush current is about 5ms and rising time of power input is 500us ± 20%. (min.).
4. V<sub>LCD</sub> level must be measured between two points on PCB of LCM [V<sub>LCD</sub> (test point) ~ LCM Ground)  
(Test condition : maximum power pattern, 25°C, f<sub>v</sub>=60Hz)

\* f<sub>v</sub>=frame frequency



## Product Specification

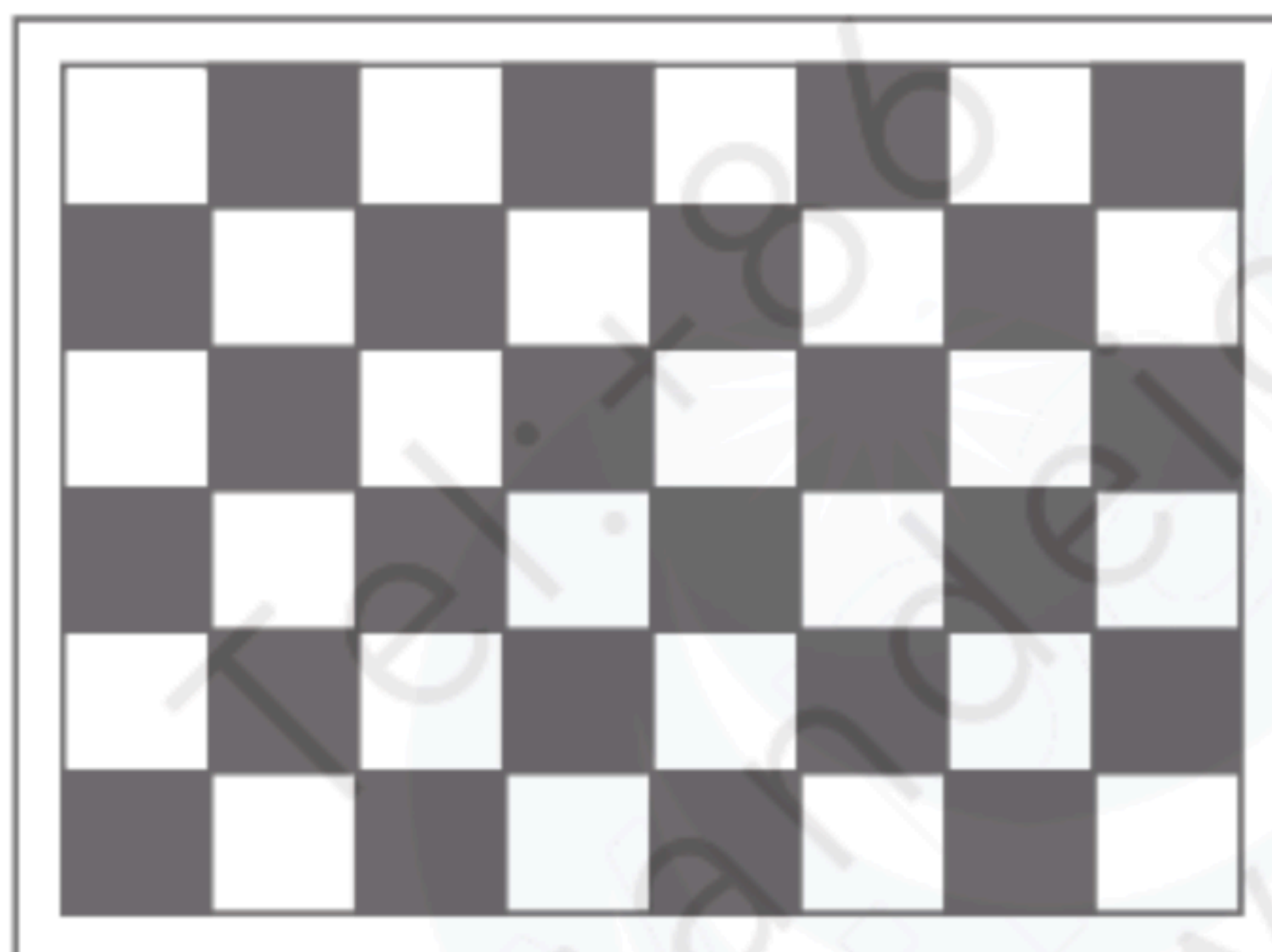
- **Permissive power input ripple** ( $V_{LCD} = 5.0V$ ,  $25^{\circ}C$ ,  $f_v$  (frame frequency)=Max. condition)



**Green 255 pattern**

For the exact ripple measurement, the condition of max. 20Mhz is recommended in the bandwidth configuration of oscilloscope.

- **Power consumption** ( $V_{LCD} = 5V$ ,  $25^{\circ}C$ ,  $f_v$  (frame frequency)=60Hz condition)



**Typical power pattern**



**Maximum power pattern**

**[FIG. 3] Mosaic pattern & Green 255 pattern for power consumption measurement**



## Product Specification

**Table 2-2. Electrical characteristics of LED bar in normal operating condition**

Parameter	Symbol	Values			Unit	Notes
		Min.	Typ.	Max.		
LED String Current	Is	-	46	51	mA	1, 2
LED String Voltage	Vs	38.7	41.7	44.7	V	1, 3
Power Consumption	PBar	-	7.7	8.2	Watt	1, 2, 5
LED Life Time	LED_LT	30,000	-	-	Hrs	4

Notes) The LED Bar consists of 60 LED packages, 4 strings (parallel) x 15packages (serial)

1. The specified values are for single LED bar.
2. The specified current is defined as the input current for single LED string with 100% duty cycle.
3. The specified voltage is the input LED string voltage at typical current 100% duty cycle.
4. The LED life time is defined as the time when the LED PKG brightness reach to the 50% of initial value under the conditions at  $T_a = 25 \pm 2^\circ\text{C}$  and typical LED string current.
5. The power consumption shown above does not include the loss of external LED driver.  
 The typical power consumption is calculated as  $P_{\text{Bar}} = V_s(\text{Typ.}) \times I_s(\text{Typ.}) \times \text{No. of strings}$ .  
 The maximum power consumption is calculated as  $P_{\text{Bar}} = V_s(\text{Max.}) \times I_s(\text{Typ.}) \times \text{No. of strings}$ .



## Product Specification

### 3-2. Interface connections

#### 3-2-1. LCD Module

- LCD connector(CN1) : IS100-L300-C23 (UJU) or equivalent
- Mating connector : FI-X30C2L (Manufactured by JAE) or equivalent

**Table 3. Module connector (CN1) pin configuration**

No	Symbol	Description	No	Symbol	Symbol
1	RX00-	Minus signal of odd channel 0 (LVDS)	16	RXE1+	Plus signal of even channel 1 (LVDS)
2	RX00+	Plus signal of odd channel 0 (LVDS)	17	GND	Ground
3	RX01-	Minus signal of odd channel 1 (LVDS)	18	RXE2-	Minus signal of even channel 2 (LVDS)
4	RX01+	Plus signal of odd channel 1 (LVDS)	19	RXE2+	Plus signal of even channel 2 (LVDS)
5	RX02-	Minus signal of odd channel 2 (LVDS)	20	RXEC-	Minus signal of even clock channel (LVDS)
6	RX02+	Plus signal of odd channel 2 (LVDS)	21	RXEC+	Plus signal of even clock channel (LVDS)
7	BIST	L(GND): Black, H(3.3V): Rotational Pattern	22	RXE3-	Minus signal of even channel 3 (LVDS)
8	RXOC-	Minus signal of odd clock channel (LVDS)	23	RXE3+	Plus signal of even channel 3 (LVDS)
9	RXOC+	Plus signal of odd clock channel (LVDS)	24	GND	Ground
10	RX03-	Minus signal of odd channel 3 (LVDS)	25	NC	No connection (I2C serial interface for LCM)
11	RX03+	Plus signal of odd channel 3 (LVDS)	26	NC	No connection.(I2C serial interface for LCM)
12	RXE0-	Minus signal of even channel 0 (LVDS)	27	ITLC	Interlace image sticking reduction mode selection
13	RXE0+	Plus signal of even channel 0 (LVDS)	28	V <sub>LCD</sub>	Power Supply +5.0V
14	GND	Ground	29	V <sub>LCD</sub>	Power Supply +5.0V
15	RXE1-	Minus signal of even channel 1 (LVDS)	30	V <sub>LCD</sub>	Power Supply +5.0V

Notes :

1. All GND(ground) pins should be connected together to the LCD module's metal frame.
2. All V<sub>LCD</sub> (input power) pins should be connected together.
3. All input level of LVDS signals are based on the EIA 644 standard.
4. ITLC is used for image sticking reduction in interlace mode.  
 (L: Normal mode, H: Interlace image sticking reduction mode)  
 This pin should be connected to GND in normal mode.  
 (Low level Input Voltage : GND ~ 0.4V, High level Input Voltage : 1.6 ~ 3.6V)
5. BIST (Build In Self Test) : If Pin No.7 is tied to "High(3.3V)", T-con generates Rotational Pattern.  
 Time to stay at every pattern is about 2sec.



**Rear view of LCM**

**[FIG. 4] Connector diagram**



## Product Specification

**Table 4. REQUIRED SIGNAL ASSIGNMENT FOR Flat Link (TI:SN75LVDS83) Transmitter**

Pin #	Pin Name	Require Signal	Pin #	Pin Name	Require Signal
1	Vcc	Power Supply for TTL Input	29	GND	Ground pin for TTL
2	D5	TTL Input (R7)	30	D26	TTL Input (DE)
3	D6	TTL Input (R5)	31	T <sub>X</sub> CLKIN	TTL Level clock Input
4	D7	TTL Input (G0)	32	PWR DWN	Power Down Input
5	GND	Ground pin for TTL	33	PLL GND	Ground pin for PLL
6	D8	TTL Input (G1)	34	PLL Vcc	Power Supply for PLL
7	D9	TTL Input (G2)	35	PLL GND	Ground pin for PLL
8	D10	TTL Input (G6)	36	LVDS GND	Ground pin for LVDS
9	Vcc	Power Supply for TTL Input	37	TxOUT3 +	Positive LVDS differential data output 3
10	D11	TTL Input (G7)	38	TxOUT3 –	Negative LVDS differential data output 3
11	D12	TTL Input (G3)	39	T <sub>X</sub> CLKOUT +	Positive LVDS differential clock output
12	D13	TTL Input (G4)	40	T <sub>X</sub> CLKOUT –	Negative LVDS differential clock output
13	GND	Ground pin for TTL	41	T <sub>X</sub> OUT2 +	Positive LVDS differential data output 2
14	D14	TTL Input (G5)	42	T <sub>X</sub> OUT2 –	Negative LVDS differential data output 2
15	D15	TTL Input (B0)	43	LVDS GND	Ground pin for LVDS
16	D16	TTL Input (B6)	44	LVDS Vcc	Power Supply for LVDS
17	Vcc	Power Supply for TTL Input	45	T <sub>X</sub> OUT1 +	Positive LVDS differential data output 1
18	D17	TTL Input (B7)	46	T <sub>X</sub> OUT1 –	Negative LVDS differential data output 1
19	D18	TTL Input (B1)	47	T <sub>X</sub> OUT0 +	Positive LVDS differential data output 0
20	D19	TTL Input (B2)	48	T <sub>X</sub> OUT0 –	Negative LVDS differential data output 0
21	GND	Ground pin for TTL Input	49	LVDS GND	Ground pin for LVDS
22	D20	TTL Input (B3)	50	D27	TTL Input (R6)
23	D21	TTL Input (B4)	51	D0	TTL Input (R0)
24	D22	TTL Input (B5)	52	D1	TTL Input (R1)
25	D23	TTL Input (RSVD)	53	GND	Ground pin for TTL
26	Vcc	Power Supply for TTL Input	54	D2	TTL Input (R2)
27	D24	TTL Input (HSYNC)	55	D3	TTL Input (R3)
28	D25	TTL Input (VSYNC)	56	D4	TTL Input (R4)

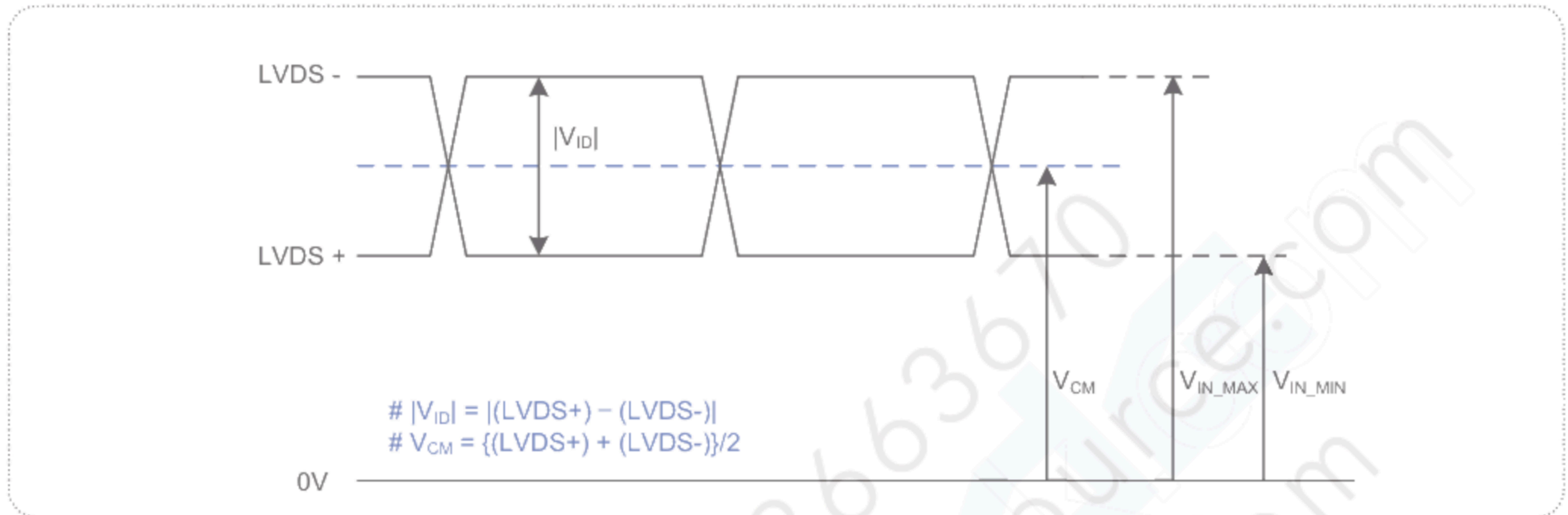
Notes : 1. Refer to LVDS Transmitter Data Sheet for detail descriptions.  
 2. 7 means MSB and 0 means LSB at R,G,B pixel data



## Product Specification

### 3-2-2. LVDS Input characteristics

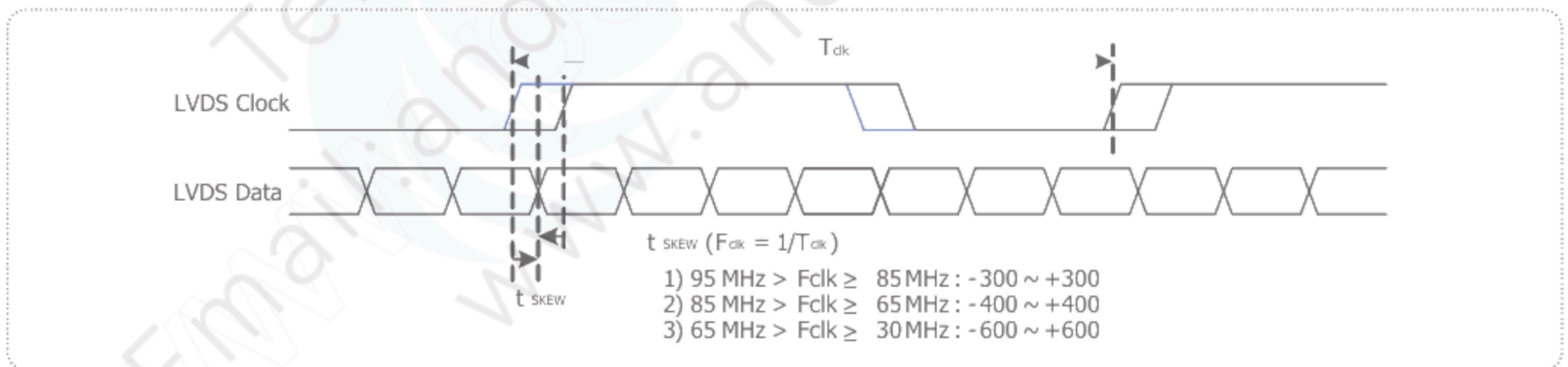
#### 1. DC Specification



Description	Symbol	Min	Max	Unit	Notes
LVDS Differential voltage	$ V_{ID} $	150	600	mV	-
LVDS Common mode voltage	$V_{CM}$	1.0	1.5	V	-
LVDS Input voltage range	$V_{IN}$	0.7	1.8	V	-
Change in common mode voltage	$\Delta V_{CM}$	-	250	mV	-

Notes : Dose not have any Noise & Peaking in LVDS Signal

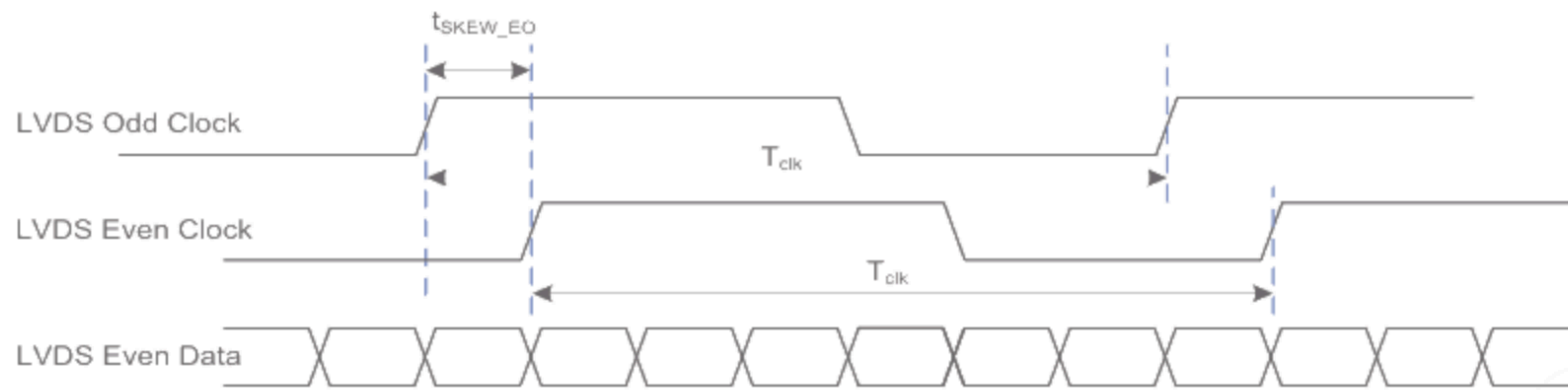
#### 2. AC Specification



Description	Symbol	Min	Max	Unit	Notes
LVDS Clock to data skew margin	t <sub>SKEW</sub>	- 300	+ 300	ps	95MHz > Fclk ≥ 85MHz
	t <sub>SKEW</sub>	- 400	+ 400	ps	85MHz > Fclk ≥ 65MHz
	t <sub>SKEW</sub>	- 600	+ 600	ps	65MHz > Fclk ≥ 30MHz
LVDS Clock to clock skew margin (Even to odd)	t <sub>SKEW_EO</sub>	- 1/7	+ 1/7	T <sub>clk</sub>	-



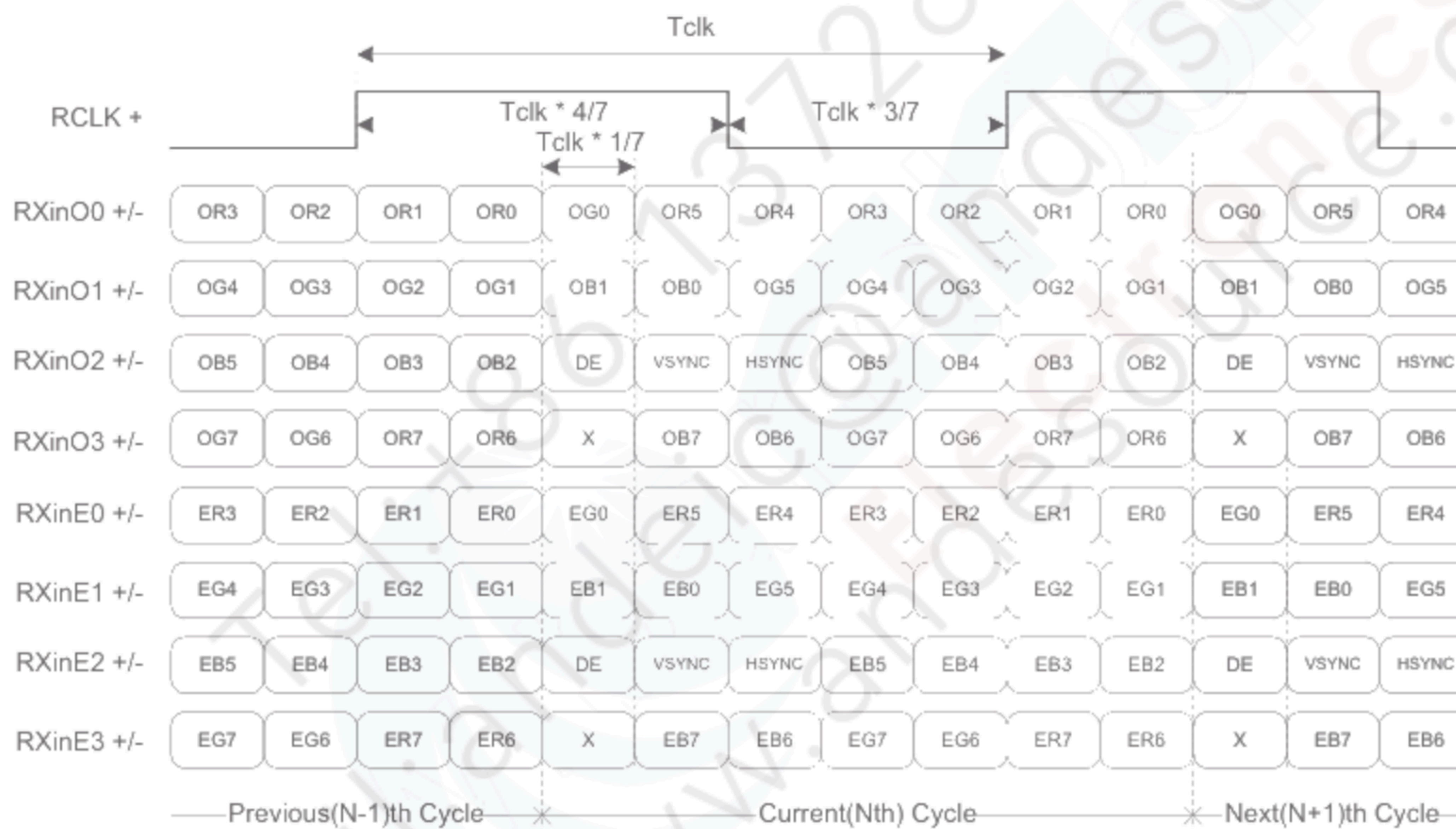
## Product Specification



< Clock skew margin between channel >

### 3. Data Format

#### 1) LVDS 2 Port



MSB	R7
	R6
	R5
	R4
	R3
	R2
	R1
LSB	R0

\* ODD = 1st Pixel  
 EVEN = 2nd Pixel



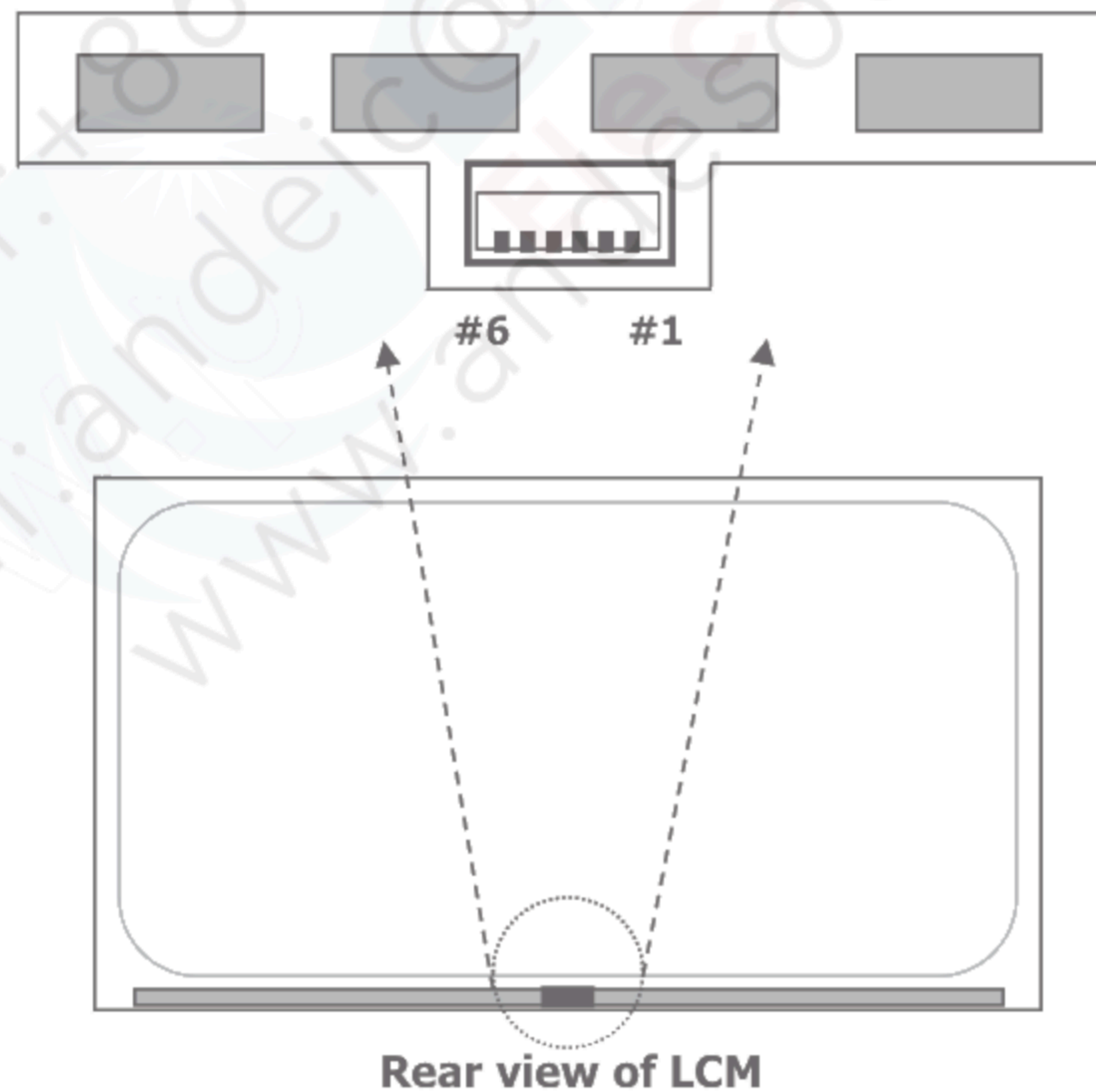
## Product Specification

### 3-2-3. Backlight connector pin configuration

**Table 5. Backlight connector pin configuration(CN2)**

The LED interface connector is 10035WS-H06D(HF)\_wire-locking type manufactured by Yeonho. The mating connector is a SHJP-06V-S(HF) or 10035HS-H06C(HF) or equivalent. The pin configuration for the connector is shown in the table below.

Pin	Symbol	Description	Notes
1	FB1	Channel1 current feedback	
2	FB2	Channel2 current feedback	
3	VLED	LED power supply (Common anode)	
4	VLED	LED power supply (Common anode)	
5	FB3	Channel3 current feedback	
6	FB4	Channel4 current feedback	



**[FIG. 5] Backlight connector view**



## Product Specification

### 3-3. Signal Timing Specifications

This is signal timing required at the input of the TMDS transmitter. All of the interface signal timing should be satisfied with the following specifications for it's proper operation.

**Table 6. TIMING TABLE**

ITEM	Symbol		Min	Typ	Max	Unit	Note
DCLK	Period	tCLK	10.81	13.93	18.10	ns	Pixel frequency (Typ. 144Mhz)
	Frequency	-	55.24	72	92.5	MHz	
Hsync	Period	tHP	1024	1088	1120	tCLK	1, 3, 4
	Horizontal Valid	tHV	960	960	960	tCLK	
	Horizontal Blank	tHB	64	128	160		
	Frequency	fH	53.94	66	89.14	KHz	
	Width	tWH	16	32	48	tCLK	
	Horizontal Back Porch	tHBP	32	48	64		
Vsync	Horizontal Front Porch	tHFP	16	48	48		2, 4, 5  ※ Free sync :47~77Hz
	Period	tVP	1090	1100	1300	tHP	
	Vertical Valid	tVV	1080	1080	1080	tHP	
	Vertical Blank	tVB	10	20	220	tHP	
	Frequency	fV	48	60	76.2	Hz	
	Width	tWV	2	4	10	tHP	
	Vertical Back Porch	tVBP	5	8	190		
	Vertical Front Porch	tVFP	3	8	20		

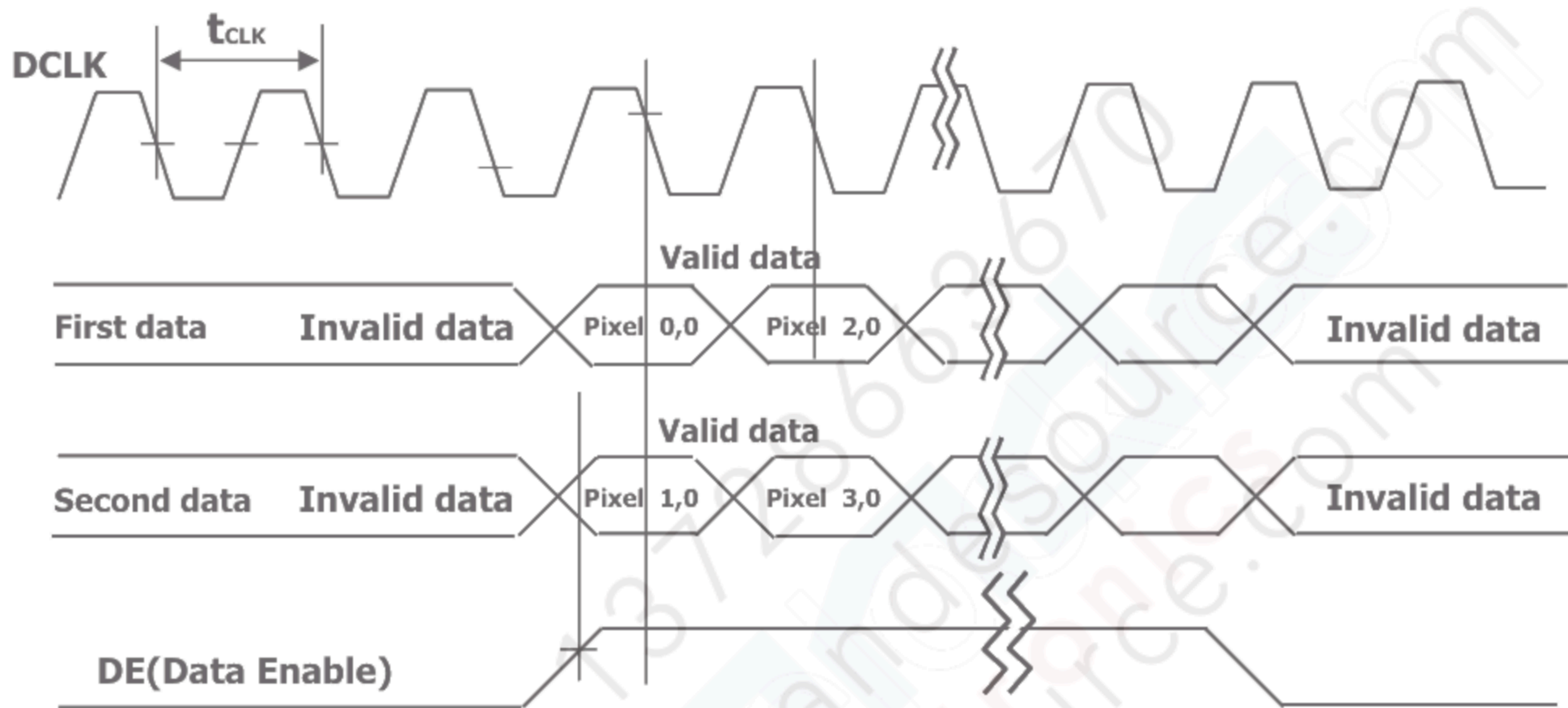
Notes :

- The value of Hsync period, Hsync width and Hsync valid should be even number times of tCLK.  
If the value is odd number times of tCLK, it can make asynchronous signal timing and cause abnormal display.
  - The performance of the electro-optical characteristics may be influenced by variance of the vertical refresh rates.
  - The value of Hsync Period, Hsync Width, and Horizontal Back Porch should be divided by 4 without a remainder.
  - The polarity of Hsync, Vsync is not restricted.
  - Vsync frequency allow 76.2Hz only at 1280 x 1024, 1152 x 900, 1152 x 870, 1024 x 768
- ※ This panel supports Free sync timing(47~77Hz) only under moving picture in room temperature(25±5℃).  
 - It would not work usually under still image & reliability test.  
 Under those condition, the phenomenon such as image sticking and flickering could be found on the screen.

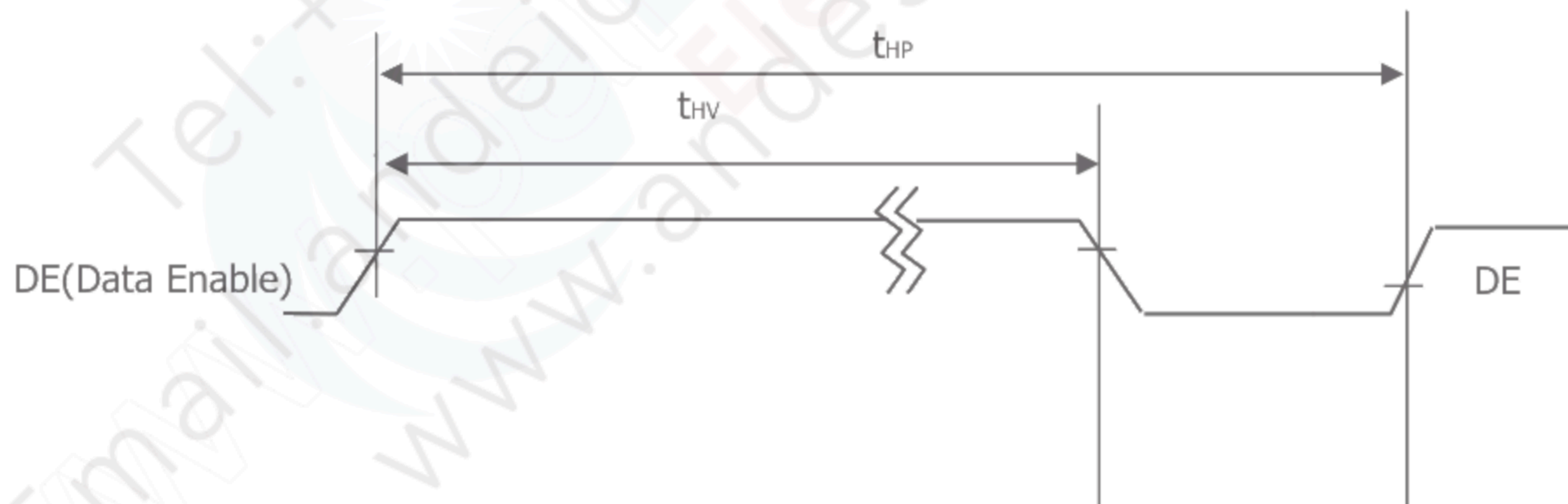


### 3-4. Signal Timing Waveforms

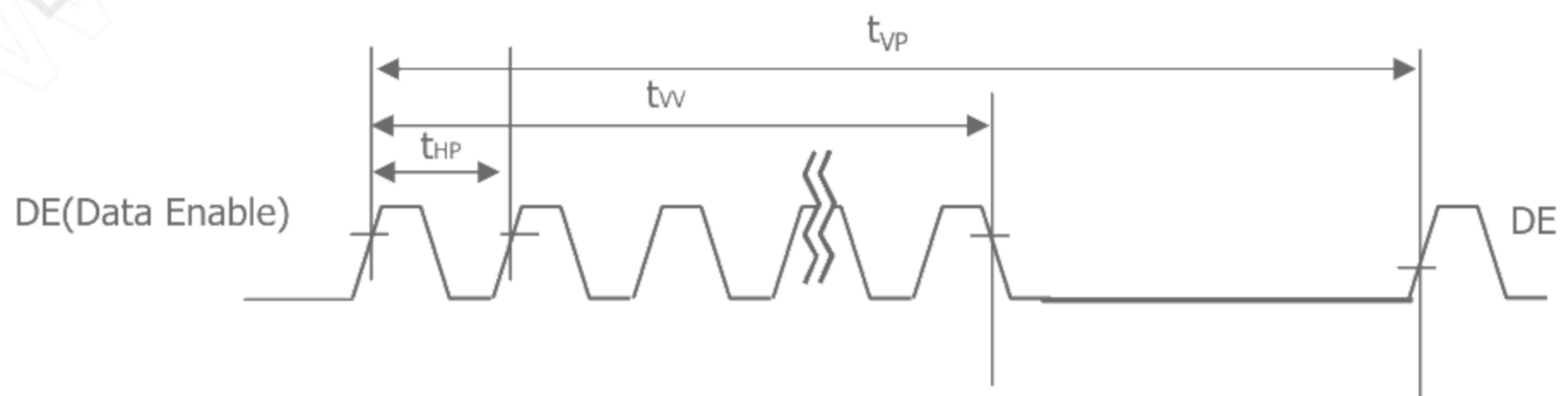
#### 1. DCLK, DE, DATA waveforms



#### 2. Horizontal waveform



#### 3. Vertical waveform





## Product Specification

### 3-5. Color Input Data Reference

The Brightness of each primary color(red,green,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 a reference for color versus data input.

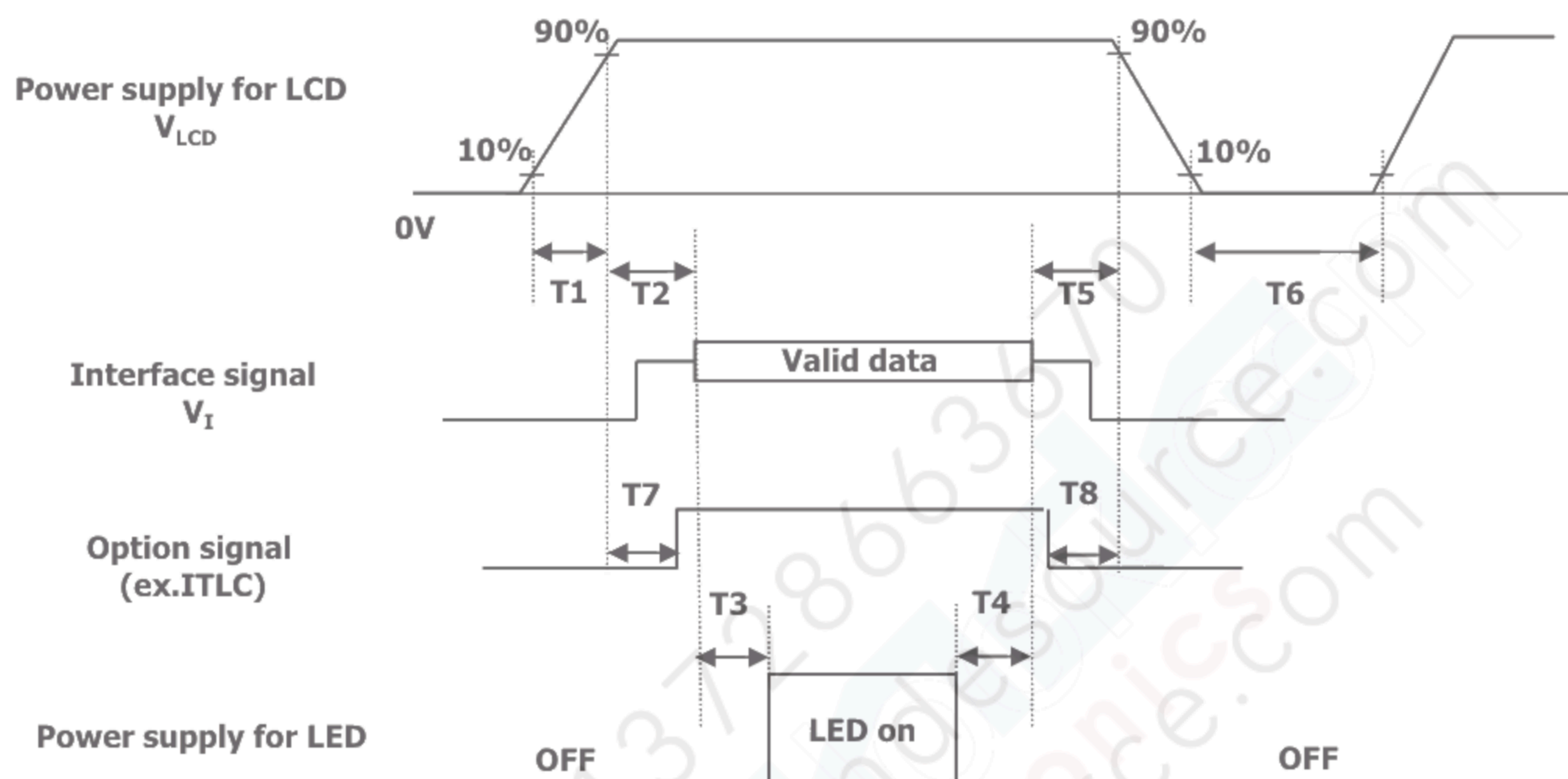
**Table 7. COLOR DATA REFERENCE**

Color		Input Color Data																							
		RED								GREEN								BLUE							
		MSB				LSB				MSB				LSB				MSB				LSB			
		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 Color	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 (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
	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
	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
	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
RED	RED (000) 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 (001)	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 (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
GREEN	GREEN (000) 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 (001)	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 (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
BLUE	BLUE (000) 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 (001)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	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



## Product Specification

### 3-6. Power sequence



**Table 8. Power sequence**

Parameter	Values			Units
	Min.	Typ.	Max.	
T1	0.5	-	10	ms
T2	0.01	-	50	ms
T3	500	-	-	ms
T4	200	-	-	ms
T5	0.01	-	50	ms
T6	1000	-	-	ms
T7	0.5	-	T2	ms
T8	0	-	-	ms

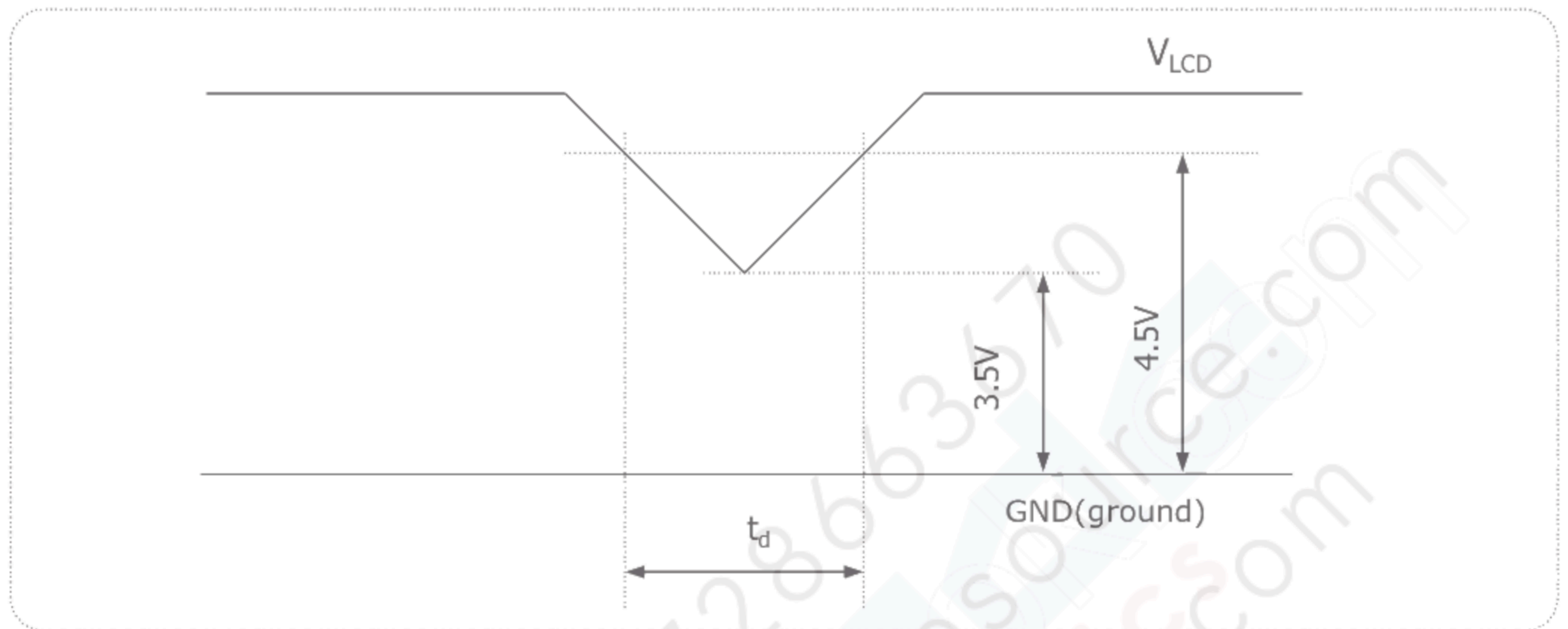
**Notes :**

- Power sequence should be kept all the time including below cases for normal operation.
  - .AC/DC Power On/Off
  - .Mode change (resolution, frequency, timing, sleep mode, color depth change, etc. )
 The violation of power sequence can cause a significant trouble in display and reliability.
- Please avoid floating state of interface signal during signal invalid period.
- When the interface signal is invalid, be sure to pull down the  $V_{LCD}$  (0V).
- Please turn off the power supply for LED when the level of  $V_{LCD}$  changes to prevent noise issue.
- When measuring valid data starting point, it can be measured that LVDS signal starts swing.



## Product Specification

### 3-7. $V_{LCD}$ Power dip condition



**[FIG. 6] Power dip condition**

For proper operation, stable power supply of  $V_{LCD}$  is necessary and power dip is allowed only in below condition. Except this condition, power on/off should follow power sequence specification in previous page exactly.

#### 1) Dip condition

$$3.5V \leq V_{LCD} < 4.5V, \quad t_d \leq 20ms$$

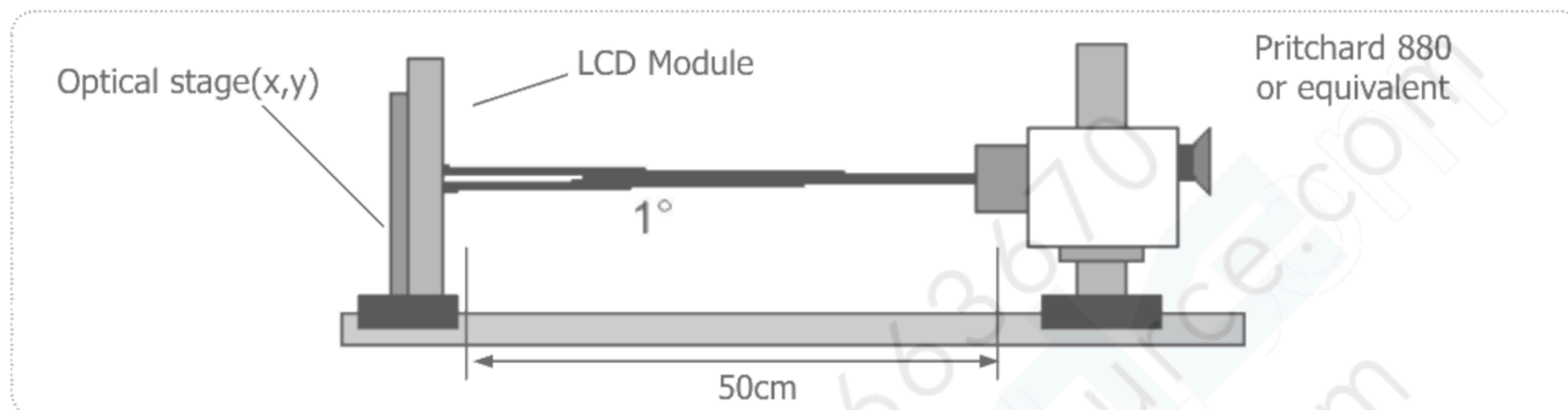


## Product Specification

### 4. Optical Specifications

Optical characteristics are determined after the unit has been 'ON' for approximately 30 minutes in a dark environment at  $25 \pm 2^\circ\text{C}$ . The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of  $\Phi$  and  $\theta$  equal to  $0^\circ$  and aperture 1 degree.

FIG. 7 presents additional information concerning the measurement equipment and method.



**[FIG. 7] Optical characteristic measurement equipment and method**

**Table 9. OPTICAL CHARACTERISTICS**

( $T_a = 25^\circ\text{C}$ ,  $V_{\text{LCD}} = 5\text{V}$ ,  $f_v = 60\text{Hz}$ ,  $D_{\text{clk}} = 144\text{MHz}$ ,  $I_s = 46\text{mA}$ )

Parameter	Symbol	Values			Units	Notes
		Min	Typ	Max		
Contrast Ratio	CR	700	1000	-		1
Surface Luminance, white	$L_{\text{WH}}$	200	250	-	$\text{cd/m}^2$	2
Luminance Variation	$\delta_{\text{WHITE}}$	75	-	-	%	3
Response Time	Gray To Gray					
	$T_{\text{GTG\_AVR}}$	-	14	25	ms	4
Color gamut (CIE 1931)	NTSC	-	72	-	%	
Color Coordinates [CIE1931] (By PR650)	RED					
	Rx		0.655			
	Ry		0.335			
	GREEN					
	Gx		0.330			
	Gy		0.610			
	BLUE					
	Bx	Typ -0.030	0.150	Typ +0.030		
	By		0.060			
	WHITE					
	Wx		0.313			
	Wy		0.329			
Color Temperature	-	-	6500	-	K	
Viewing Angle (CR>10, General)	Horizontal	$\theta_H$	170	178	-	Degree
	Vertical	$\theta_V$	170	178	-	
Gray Scale	-	-	2.2	-		6



Product Specification

Notes :

1. Contrast Ratio(CR) is defined mathematically as : **(By PR880)**

$$\text{Contrast Ratio} = \frac{\text{Surface luminance with all white pixels}}{\text{Surface luminance with all black pixels}}$$

It is measured at center point(Location P1)

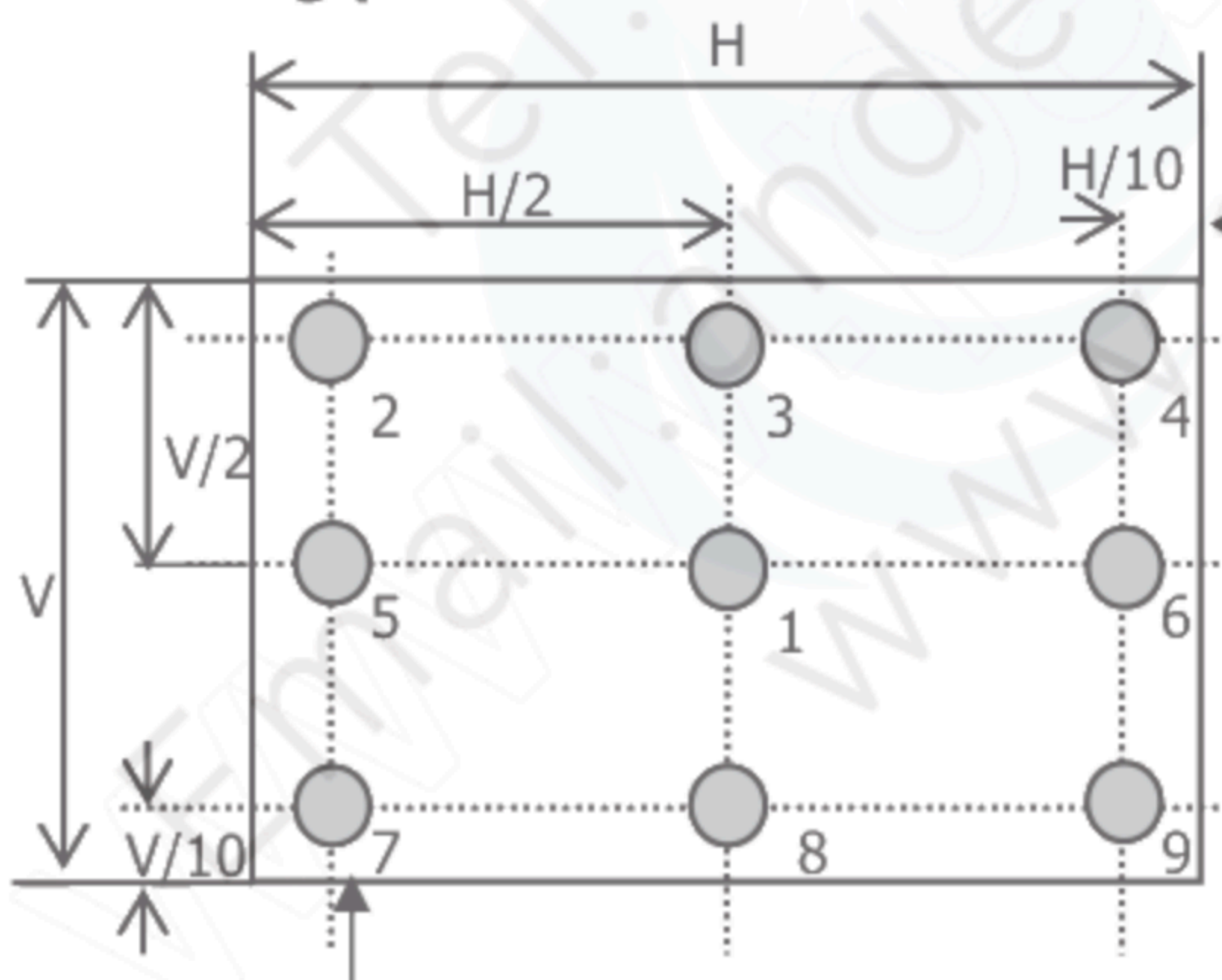
2. Surface luminance( $L_{WH}$ ) is luminance value at Center 1 point(P1) across the LCD surface 50cm from the surface with all pixels displaying white. For more information see FIG.7 **(By PR880)**

3. The variation in surface luminance ,  $\delta$  WHITE is defined as : **(By PR880)**

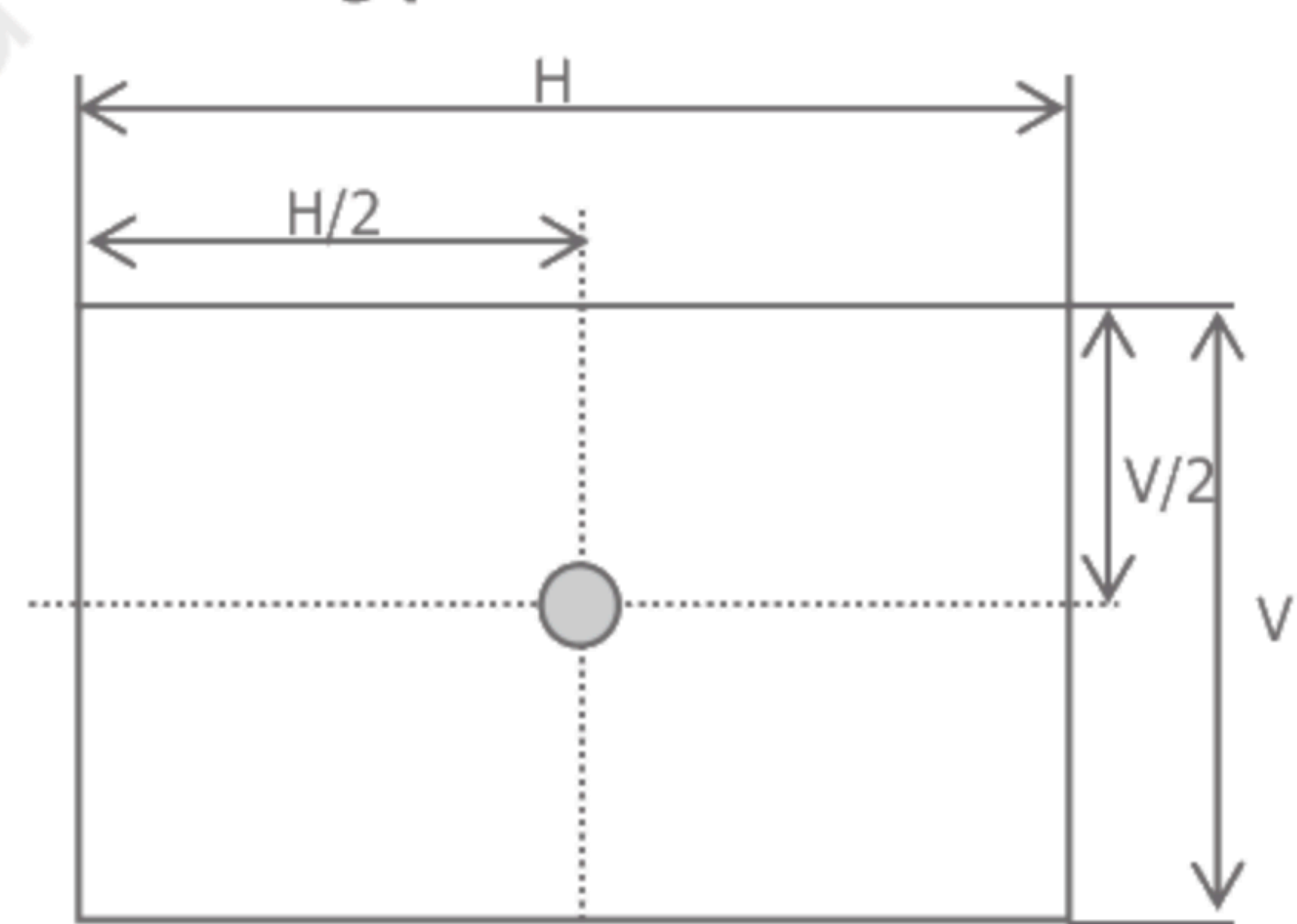
$$\delta_{WHITE} = \frac{\text{Minimum}(L_{P1}, L_{P2}, \dots, L_{P9})}{\text{Maximum}(L_{P1}, L_{P2}, \dots, L_{P9})} \times 100$$

Where L1 to L9 are the luminance with all pixels displaying white at 9 locations.  
For more information see FIG.8

<Measuring point for luminance variation>



<Measuring point for surface luminance>



Active Area

H : 596.74 mm  
V : 335.66 mm  
@ H,V : Active Area

**[FIG.8] Measure point for luminance**



## Product Specification

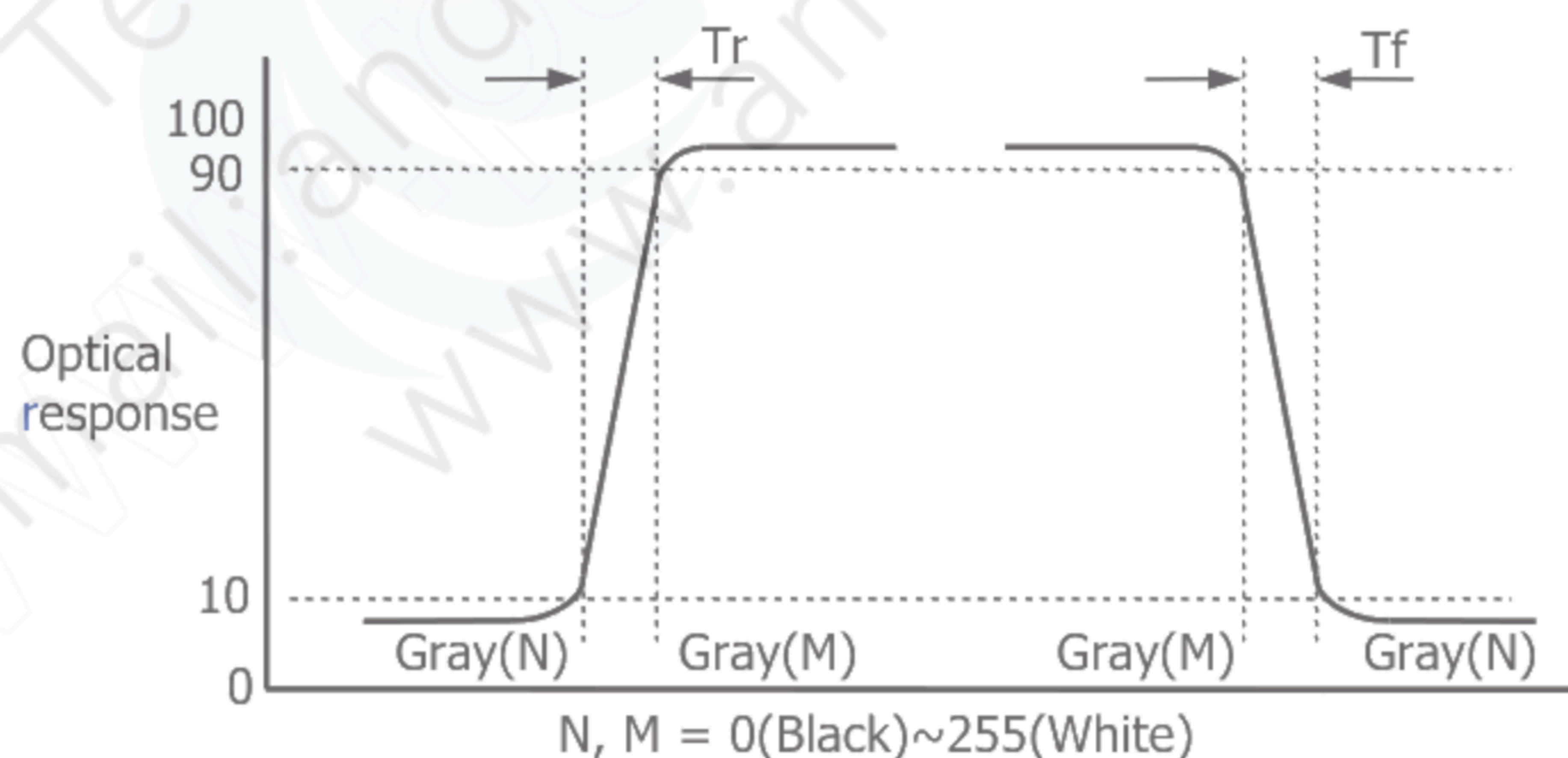
4. The Gray To Gray response time is defined as the following figure and shall be measured by switching the input signal for "Gray To Gray".

- Gray step : 5 Step
- TGTG\_AVR is the total average time at rising time and falling time for "Gray To Gray".
- By RD80S

**Table 10. GTG Gray table**

Gray To Gray		Rising time				
		G255	G191	G127	G63	G0
Falling time	G255					
	G191					
	G127					
	G63					
	G0					

Response time is defined as the following figure and shall be measured by switching the input signal for "Gray(N)" and "Gray(M)".

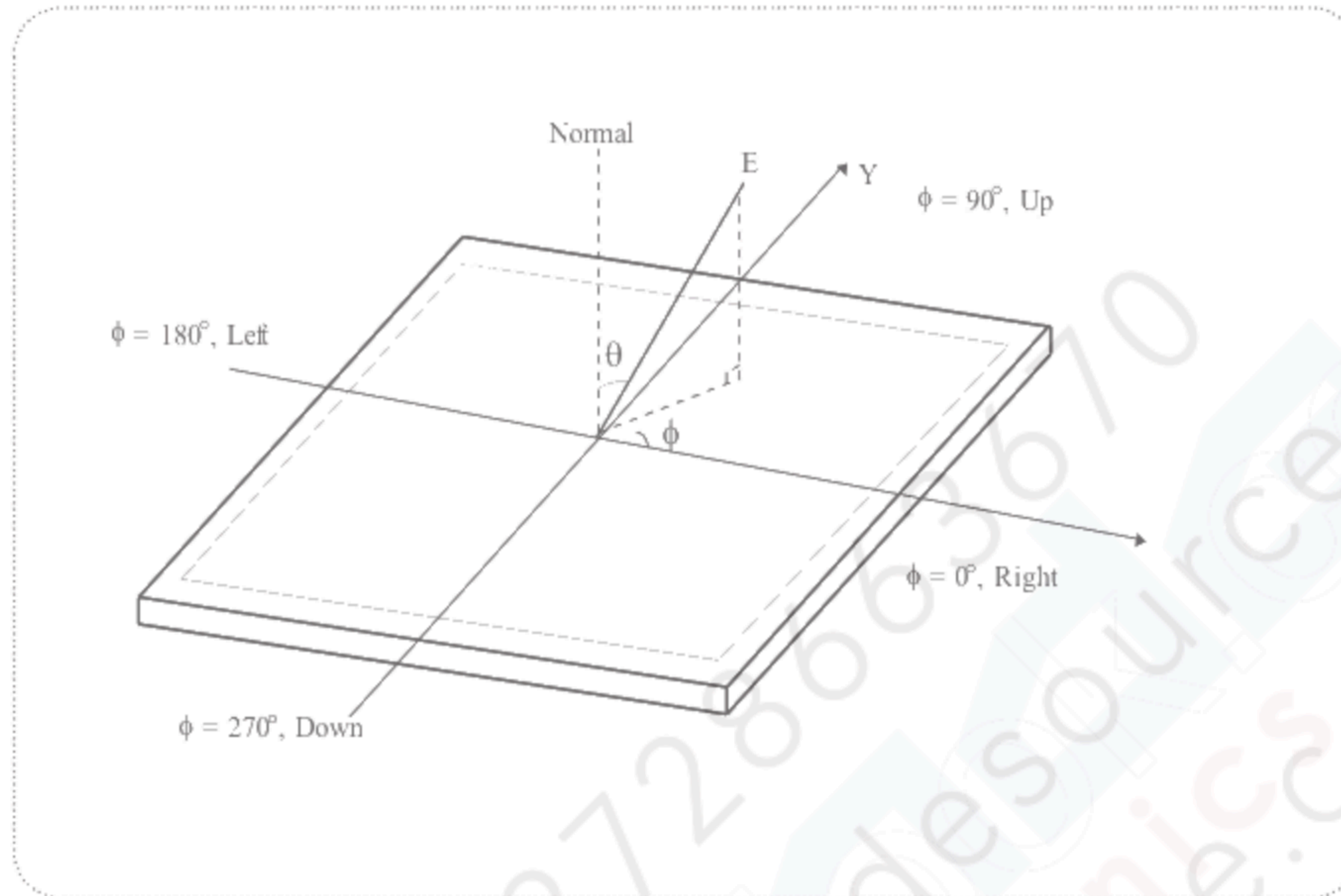


**[FIG. 9] Response Time**



## Product Specification

5. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG.10 **(By PR880)**



**[FIG. 10] Viewing angle**

6. Gamma Value is approximately 2.2. For more information see Table 11.

**Table 11. Gray Scale Specification**

Gray Level	Relative Luminance [%] (Typ)
0	0.10
15	0.30
31	1.08
47	2.50
63	4.72
79	7.70
95	11.49
111	16.20
127	21.66
143	28.20
159	35.45
175	43.8
191	53.00
207	63.30
223	74.48
239	86.80
255	100



## Product Specification

### 5. Mechanical Characteristics

The contents provide general mechanical characteristics. In addition the figures in the next page are detailed mechanical drawing of the LCD.

Outline Dimension	Horizontal	535.0mm
	Vertical	313.0mm
	Depth	11.15 mm
Bezel Area	Horizontal	-
	Vertical	-
Active Display Area	Horizontal	527.04mm
	Vertical	296.46mm
Weight	Typ : 2,170g , Max : 2280g	
Surface Treatment	Hard coating(3H) Anti-glare treatment of the front polarizer	

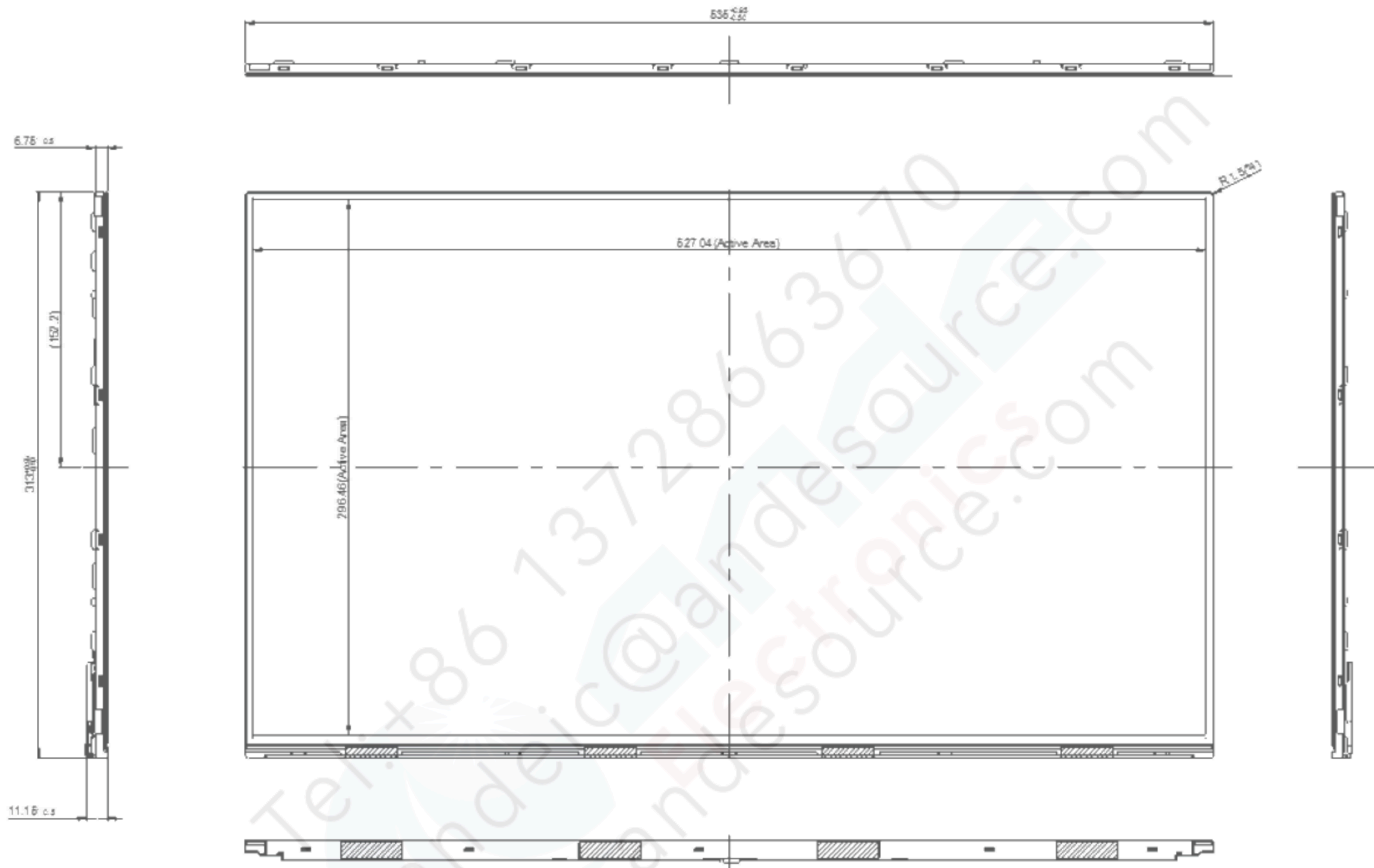
Notes : Please refer to a mechanic drawing in terms of tolerance at the next page.

Outline dimensions (horizontal, vertical and outside depth) are measured by using vernier calipers.  
The inside depth dimensions are measured by using height gauge, when LCM is put face down onto a flat surface.



Product Specification

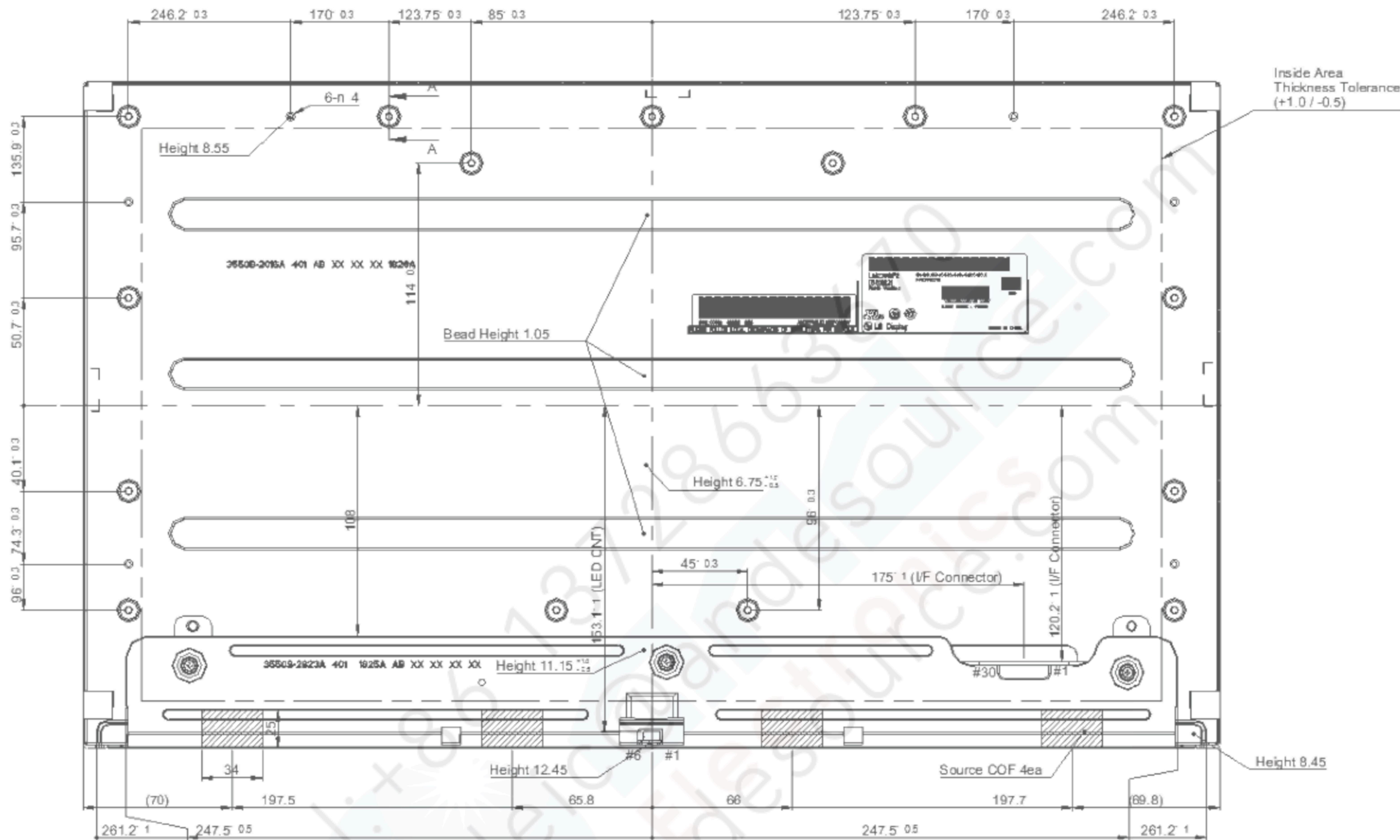
<FRONT VIEW>





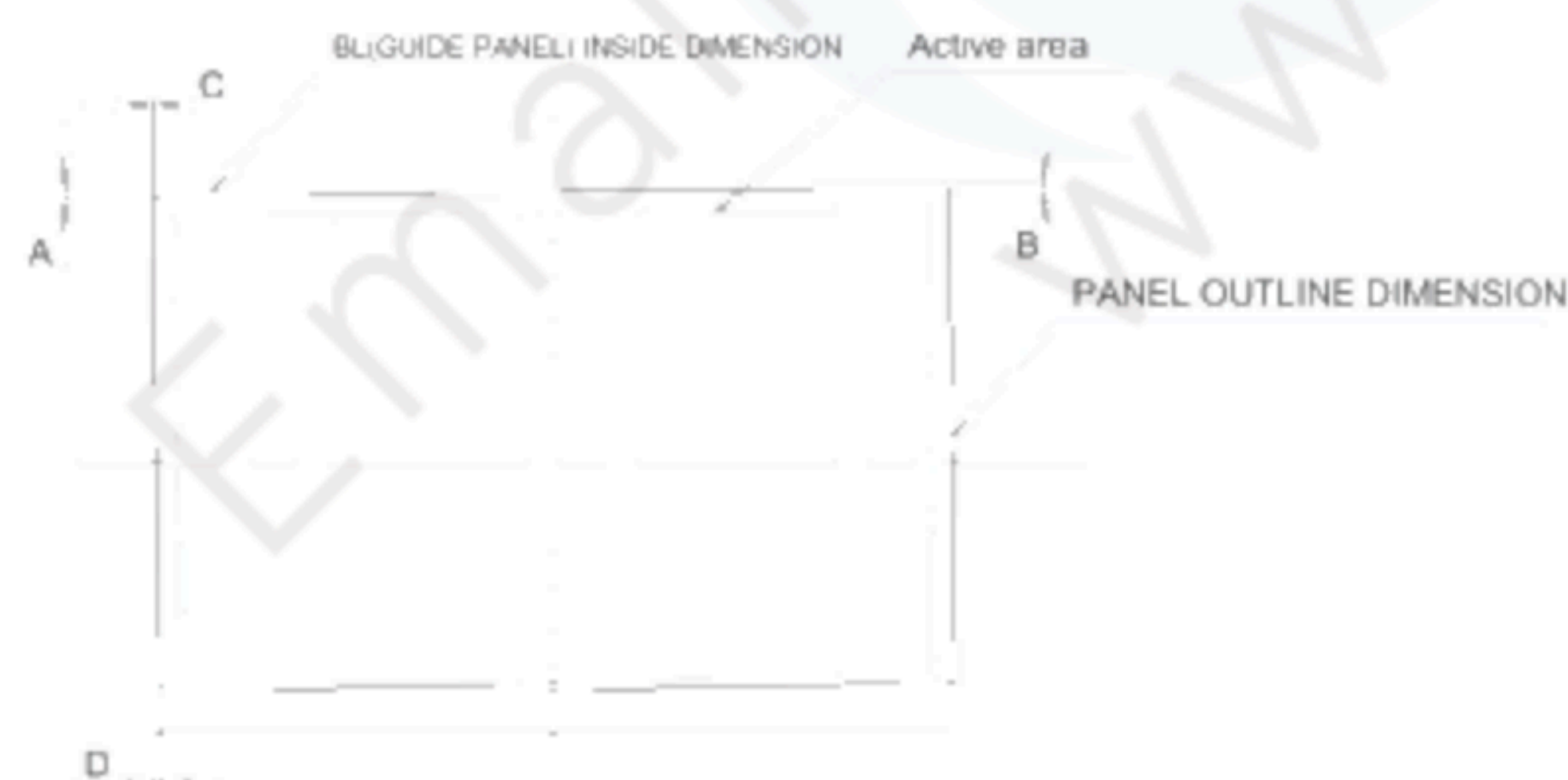
Product Specification

<REAR VIEW>



Notes

1. V/F connector specification : 15100-4.300-C23(LJU) or Equivalent
2. LED connector specification : Yeonho, 10035WS-H06D(HF) or Equivalent
3. Torque of user hole : 3.0~4.0kgf-cm
4. Tilt and partial disposition tolerance of display area as following  
(1) Y-direction :  $-0.45 \leq A \leq 0.45$ ,  $-0.45 \leq B \leq 0.45$   
(2) X-direction :  $-0.45 \leq C \leq 0.45$ ,  $-0.45 \leq D \leq 0.45$



5. Unspecified tolerances to be  $\pm 0.5$
6. The LCM warp(warpage) is less than 1.0 on the surface plate
7. The COF area is weak & sensitive, so please don't press the COF area
8. Undefined height should follow the 3D modeling data



SECTION A-A  
SCALE 2/1

LGD Highly recommendation :

System chassis or frame should be designed to keep the IPS Panel flat as it is vulnerable to panel light-leakage caused by deformation.



## Product Specification

### 6. Reliability

Environment test condition

No	Test Item	Condition
1	High temperature storage test	Ta= 60°C 240h
2	Low temperature storage test	Ta= -20°C 240h
3	High temperature operation test	Ta= 50°C 50%RH 240h
4	Low temperature operation test	Ta= 0°C 240h
5	Altitude operating storage / shipment	0 – 10,000 feet (3,048m) 0 - 40,000 feet (12,192m)

Note 1. Result evaluation criteria:

TFT-LCD panels test should take place after cooling enough at room temperature.

In the standard condition, there should be no particular problems that may affect the display function.

※. T<sub>a</sub>= Ambient Temperature



Product Specification
-----------------------

## **7. International Standards**

### **7-1. Safety**

- a) UL 60950-1, Underwriters Laboratories Inc.  
Information Technology Equipment - Safety - Part 1 : General Requirements.
- b) CAN/CSA-C22.2 No. 60950-1-07, Canadian Standards Association.  
Information Technology Equipment - Safety - Part 1 : General Requirements.
- c) EN 60950-1, European Committee for Electrotechnical Standardization (CENELEC).  
Information Technology Equipment - Safety - Part 1 : General Requirements.
- d) IEC 60950-1, The International Electrotechnical Commission (IEC).  
Information Technology Equipment - Safety - Part 1 : General Requirements

### **7-2. Environment**

- a) RoHS, Directive 2011/65/EU of the European Parliament and of the council of 8 June 2011



## Product Specification

### 8. Packing

#### 8-1. Designation of Lot Mark

##### a) Lot Mark

A	B	C	D	E	F	G	H	I	J	K	L	M
---	---	---	---	---	---	---	---	---	---	---	---	---

A,B,C : SIZE(INCH)  
 E : MONTH

D : YEAR  
 F ~ M : SERIAL NO.

##### Note

##### 1. YEAR

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Mark	A	B	C	D	E	F	G	H	J	K

##### 2. MONTH

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mark	1	2	3	4	5	6	7	8	9	A	B	C

##### b) Location of Lot Mark

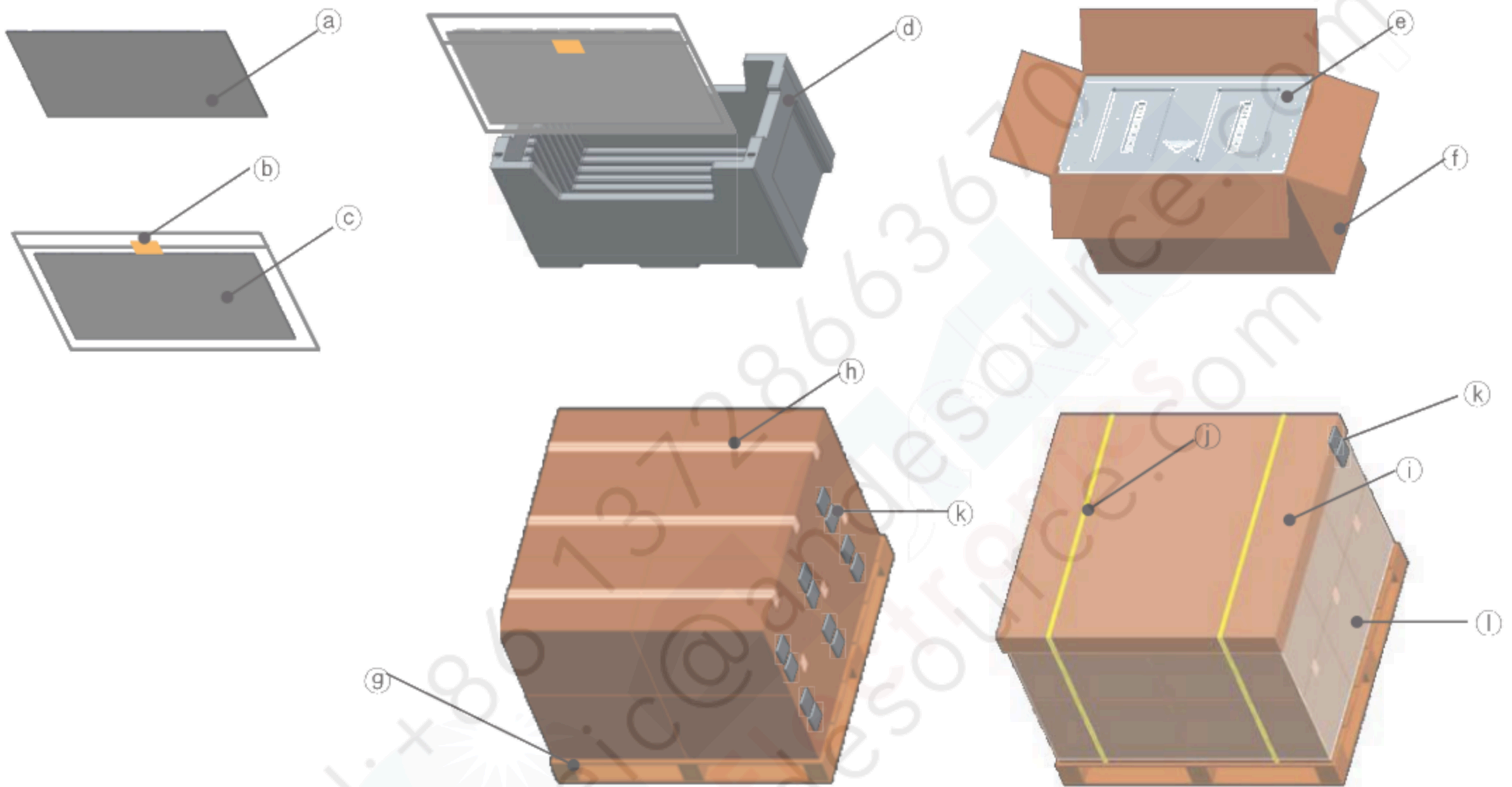
Serial No. is printed on the label. The label is attached to the backside of the LCD module.  
 This is subject to change without prior notice.



## Product Specification

### 8-2. Packing Form

- a) LCM quantity in one box : 10ea  
 LCM quantity in one Pallet : 120ea  
 b) Box Size : 635\*370\*400mm  
 C) Pallet Ass'y Size : 1140\*1300\*928mm



No.	Description	Material
(a)	LCM	-
(b)	Tape	OPP
(c)	AL-Bag	AL
(d)	Packing, Bottom	EPS
(e)	Packing, Top	EPS
(f)	Box	Paper(SW)
(g)	Pallet	Plywood
(h)	Tape	OPP
(i)	Angle Cover	Paper(SW)
(j)	BAND	PP
(k)	LABEL	YUPO PAPER
(l)	Wrap	-



## Product Specification

### 9. Precautions

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

#### 9-1. Mounting precautions

- (1) You must mount a module using holes arranged in rear side.
- (2) You should consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- (3) Please attach the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to resist external force.
- (4) You should adopt radiation structure to satisfy the temperature specification.
- (5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- (6) Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment. Do not touch the surface of polarizer for bare hand or greasy cloth. (Some cosmetics are detrimental to the polarizer.)
- (7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- (8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.
- (9) Do not open the case because inside circuits do not have sufficient strength.

#### 9-2. Operating precautions

- (1) Response time depends on the temperature. (In lower temperature, it becomes longer.)
- (2) Brightness depends on the temperature. (In higher temperature, it becomes lower.)  
And in lower temperature, response time (required time that brightness is stable after turned on) becomes longer.
- (3) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- (4) When fixed patterns are displayed for a long time, remnant image is likely to occur.
- (5) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.
- (6) Please do not give any mechanical and/or acoustical impact to LCM. Otherwise, LCM can't be operated its full characteristics perfectly.
- (7) A screw which is fastened up the steels should be a machine screw.  
(If not, it causes metallic foreign material and deal LCM a fatal blow)
- (8) Please do not set LCD on its edge.
- (9) When LCMs are used for public display, defects such as Yogore & image sticking can not be guaranteed.
- (10) LCM cannot support "Interlaced scan method"
- (11) When this reverse model is used as a forward-type model (PCB on top side), LGD can not guarantee any defects of LCM.
- (12) Please conduct image sticking test after 2-hour aging with Rolling pattern and normal temperature.  
(25~40°C)



Product Specification
-----------------------

### **9-3. ELECTROSTATIC DISCHARGE CONTROL**

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

### **9-4. PRECAUTIONS FOR STRONG LIGHT AND HAZARDOUS MATERIALS EXPOSURE**

Strong light exposure causes degradation of polarizer and color filter.

The LCM should be avoided direct contact with Hazardous materials such as sulfur, acetic acid, chlorine, etc. These materials may cause chemical reaction such as sulfurization, corrosion, discoloration, etc.

### **9-5. STORAGE**

When storing modules as spares for a long time, the following precautions are necessary.

- (1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
- (2) The polarizer surface should not come in contact with any other object.  
It is recommended that they be stored in the container in which they were shipped.

### **9-6. HANDLING PRECAUTIONS FOR PROTECTION FILM**

- (1) The protection film is attached to the bezel with a small masking tape.  
When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
- (2) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the bezel after the protection film is peeled off.
- (3) You can remove the glue easily. When the glue remains on the bezel surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.