

( ) Preliminary Specification  
(V) Final Specification

Module	23.8" Color TFT-LCD
Model Name	P238HVN01.0



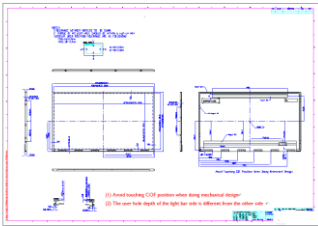
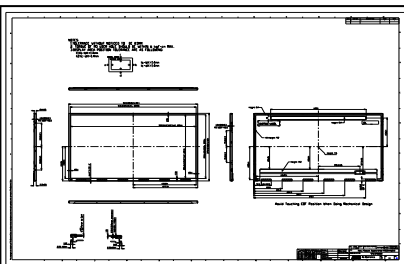
Customer	Date
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**Record of Revision**

Version	Date	Page	Old description	New Description	Remark
0.0	2021/01/08	-		Frist Draft (Preliminary)	
1.0	2021/01/31	P26	<p><b>6 Shipping Label</b></p>  <p>Note 6-1: For Pb Free products, we will add  for identification.          Note 6-2: For RoHS compatible products, we will add  for identification.          Note 6-3: For China RoHS compatible products, Qlads will add  for identification.          Note 6-4: The Green Mark will be presented only when the green documents have been ready by Qlads Internal Green Team.</p>	<p><b>6 Shipping Label</b></p>  <p>(1) For Pb Free Product, ADP will add  for identification.          (2) For RoHS compatible products, ADP will add  for identification.          (3) For "Cadmium Free product, ADP will add  for identification.          (4) Note: The green Mark will be present only when the green documents have been ready by ADP internal green team. (Validation of green design follows the ADP green design checklist.)</p>	
1.0	2021/01/31	P27	<p><b>7 Mechanical Characteristic</b></p> 	<p><b>7 Mechanical Characteristic</b></p> 	

## I Handling Precautions

- 1) Since polarizer is easily damaged, do not touch or press the surface of polarizer with hand.
- 2) Be sure to turn off power supply when inserting or disconnecting from input connector.
- 3) Wipe off water drop immediately. Long contact with water may cause discoloration or spots.
- 4) When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.
- 5) Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface.
- 6) Since CMOS LSI is used in this module, take care of static electricity and insure human earth when handling.
- 7) Do not open or modify the Module Assembly.
- 8) Do not press the reflector sheet at the back of the module to any directions.
- 9) In case a TFT-LCD Module has to be put back into the packing container slot after once it was taken out from the container, do not press the center of the LED lightbar edge. Otherwise the TFT-LCD Module may be damaged.
- 10) Insert or pull out the interface connector, be sure not to rotate nor tilt it of the TFT-LCD Module.
- 11) Do not twist nor bend the TFT -LCD Module even momentary. It should be taken into consideration that no bending/twisting forces are applied to the TFT-LCD Module from outside. Otherwise the TFT-LCD Module may be damaged.
- 12) Please avoid touching COF position while you are doing mechanical design.
- 13) When storing modules as spares for a long time, the following precaution is necessary: 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.
- 14) Do not apply the same pattern for a long time, it will enhance relevant defect.
- 15) When this reverse type model(PCBA on bottom side) is used as forward-type model(PCBA on top side) , ADP Display Plus can not guarantee any defects of LCM .

## 2 General Description

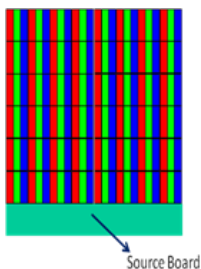
This specification applies to the 23.8 inch- wide Color a-Si TFT-LCD Module P238HVN01.0 The display supports the FHD - 1920(H) x 1080(V) screen format and 16.7M colors (8-bit RGB data input). The input interface is Dual channel LVDS and this module doesn't contain an driver board for backlight.

### 2.1 Display Characteristics

The following items are characteristics summary on the table under 25°C condition:

ITEMS	Unit	SPECIFICATIONS
Screen Diagonal	[mm]	23.8"
Active Area	[mm]	527.04(H) x 296.46(V)
Pixels H x V	-	1920 x 1080
Pixel Pitch	[um]	274.5(per one triad)×274.5
Pixel Arrangement	-	R.G.B. Vertical Stripe. Source board at bottom <i>Note 2-1</i>
Display Mode	-	VA Mode (Vertical Alignment), Normally Black
White Luminance ( Center )	[cd/m <sup>2</sup> ]	250 (Typ.)
Contrast Ratio	-	3000(Typ.)
Response Time	[msec]	16ms (Typ., on/off)
Power Consumption (LCD Module + Backligh unit)	[Watt]	12.17(Typ .) LCD module:PDD (Typ.)=3.2@White pattern, Fv=60Hz Backlight unit:P <sub>BLU</sub> (Typ.)=8.97 @Is=50mA
Weight	[Grams]	2280 (Typ.)
Outline Dimension	[mm]	543.0(H) x 317.4(V) x 11.2(D) (Typ.)
Electrical Interface	-	Dual channel LVDS,8-bits RGB data input
Support Color	-	16.7M colors
Surface Treatment	-	SAG 40%, 3H
Temperature Range Operating Storage (Shipping)	[°C] [°C]	0 to +50 -20 to +60
RoHS Compliance	-	RoHS Compliance
TCO Compliance	-	TCO 8.0 Compliance

**Note 2-1:** The following shows the figure of pixel arrangement



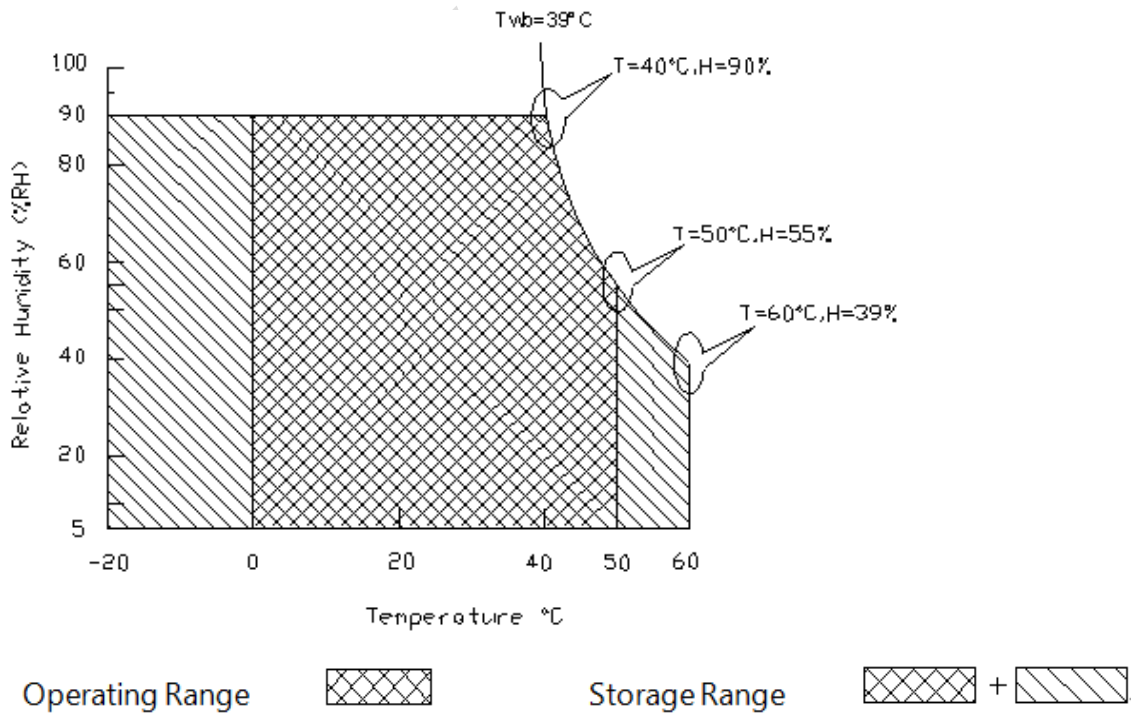
## 2.2 Absolute Maximum Rating of Environment

Permanent damage may occur if exceeding the following maximum rating.

Symbol	Description	Value		Unit	Note
		Min.	Max.		
TOP	Operating Temperature	0	+50	[ °C ]	<b>Note 2-2</b>
TGS	Glass surface temperature(operatin)	0	+65	[ °C ]	<b>Note 2-2</b> Function judged only
HOP	AOP	5	90	[ %RH ]	<b>Note 2-2</b>
TST	AST	-20	+60	[ °C ]	
HTS		5	90	[ %RH ]	

**Note 2-2:** Temperature and relative humidity range is shown in the figure .

1. 90% RH Max (  $T_a \leq 39^\circ\text{C}$  )
2. Wet-bulb temperature should be  $39^\circ\text{C}$  Max. (  $T_a \leq 39^\circ\text{C}$  )
3. No condensation



### 2.3 Optical Characteristics

The optical characteristics are measured on the following test condition.

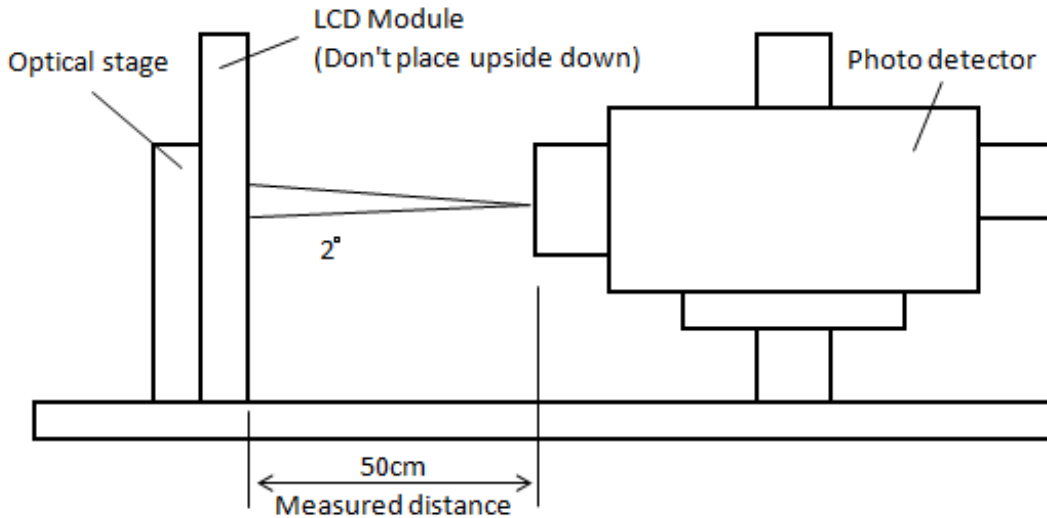
**Test Condition:**

1. Equipment setup: Please refer to *Note 2-3*.
2. Panel Lighting time: 30 minutes
3. VDD=5.0V, Fv=60Hz, Is=50mA, Ta=25°C
4. L/B must be in the bottom side at normal and MNT aging state

Symbol	Description		Min.	Typ.	Max.	Unit	Remark
L <sub>w</sub>	White Luminance (Center of screen)		200	250	-	[cd/m <sup>2</sup> ]	<i>Note 2-3</i> <i>By SR-3</i>
L <sub>uni</sub>	Luminance Uniformity (9 points)		75	80	-	[%]	<i>Note 2-4</i> <i>By SR-3</i>
CR	Contrast Ratio (Center of screen)		1800	3000	-	-	<i>Note 2-5</i> <i>By SR-3</i>
θ <sub>R</sub>	Horizontal Viewing Angle (CR=10)	Right	75	89	-	[degree]	<i>Note 2-6</i> <i>By SR-3</i>
θ <sub>L</sub>		Left	75	89	-		
Φ <sub>H</sub>	Vertical Viewing Angle (CR=10)	Up	75	89	-		
Φ <sub>L</sub>		Down	75	89	-		
θ <sub>R</sub>	Horizontal Viewing Angle (CR=5)	Right	75	89	-		
θ <sub>L</sub>		Left	75	89	-		
Φ <sub>H</sub>	Vertical Viewing Angle (CR=5)	Up	75	89	-		
Φ <sub>L</sub>		Down	75	89	-		
T <sub>R</sub>	Response Time	Rising Time	-	10	20	[msec]	<i>Note 2-7</i> <i>By TRD-100</i>
T <sub>F</sub>		Falling Time	-	6	12		
-		Rising + Falling	-	16	32		
R <sub>x</sub>	Color Coordinates (CIE 1931)	Red x	0.623	0.653	0.683	-	<i>By SR-3</i>
R <sub>y</sub>		Red y	0.305	0.335	0.365		
G <sub>x</sub>		Green x	0.292	0.322	0.352		
G <sub>y</sub>		Green y	0.587	0.617	0.647		
B <sub>x</sub>		Blue x	0.122	0.152	0.182		
B <sub>y</sub>		Blue y	0.050	0.080	0.110		
W <sub>x</sub>		White x	0.283	0.313	0.343		
W <sub>y</sub>		White y	0.299	0.329	0.359		
NTSC ratio				72		[%]	

**Note 2-3:** Equipment setup :

The LCD module should be stabilized at given temperature for 30 minutes to avoid abrupt temperature change during measuring (at surface 35°C). In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 30 minutes in a stable, windless and dark room.

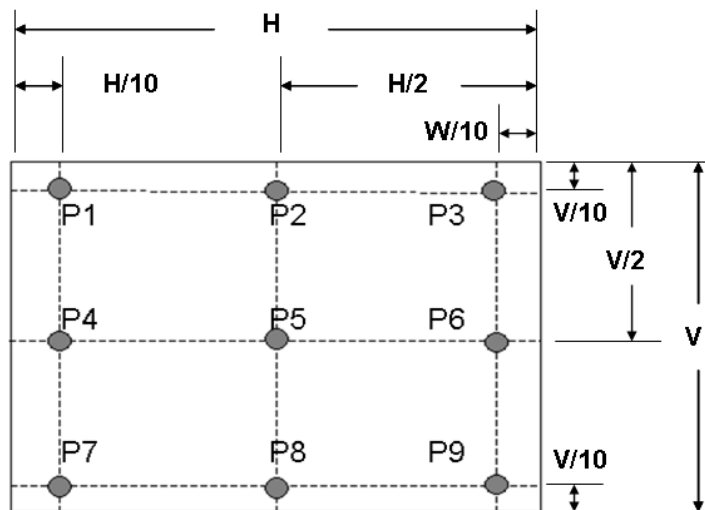


**Note 2-4:** Luminance Uniformity Measurement

**Definition:**

$$\text{Luminance Uniformity} = \frac{\text{Minimum Luminance of 9 Points (P1 ~ P9)}}{\text{Maximum Luminance of 9 Points (P1 ~ P9)}}$$

*a. Test pattern: White Pattern*





**Note 2-5: Contrast Ratio Measurement**

**Definition:**

$$\text{Contrast Ratio} = \frac{\text{Luminance of White pattern}}{\text{Luminance of Black pattern}}$$

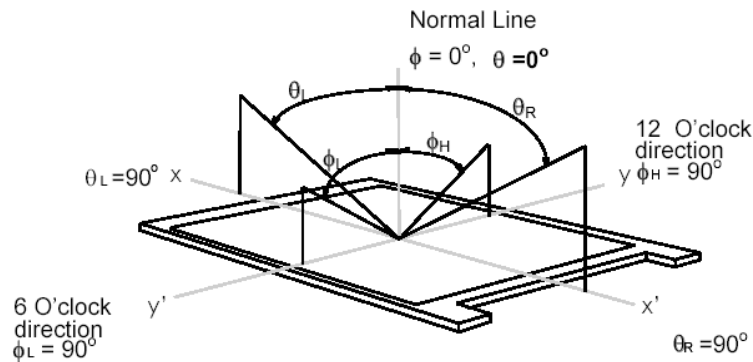
- a. Measured position: Center of screen (P5) & perpendicular to the screen ( $\theta = \Phi = 0^\circ$ )

**Note 2-6: Viewing angle measurement**

**Definition:** The angle at which the contrast ratio is greater than 10 & 5 .

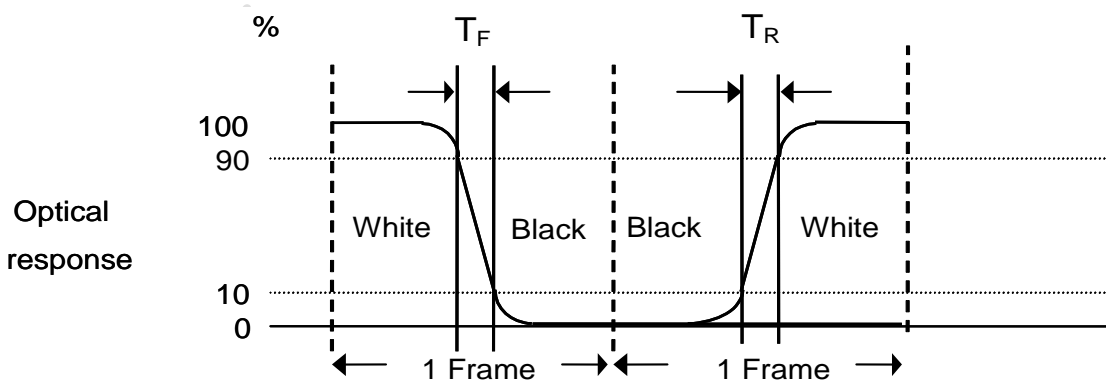
- a. Horizontal view angle: Divide to left & right ( $\theta_L$  &  $\theta_R$ )

Vertical view angle: Divide to up & down ( $\Phi_H$  &  $\Phi_L$ )



**Note 2-7: Response time measurement**

The output signals of photo detector are measured when the input signals are changed from “Gray level A” to “Gray level B” (falling time,  $T_F$ ), and from “Gray level B” to “Gray level A” (rising time,  $T_R$ ), respectively. The response time is interval between the 10% and 90% of optical



response.

**2.4 Mechanical Characteristics**

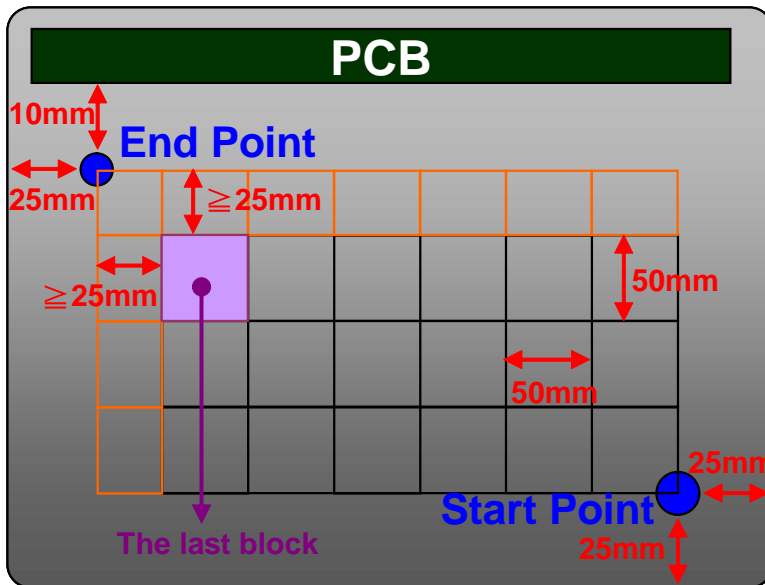
Symbol	Description	Min.	Max.	Unit	Remark
P <sub>bc</sub>	Backside Compression	2.5	-	[Kgf]	<b>Note 2-8</b>

**Note 2-8:** Test Method:

The point is at a distance from right-downside 25mm x 25mm defined as the Start Point of Measure Points, and the point is at a distance 25mm from left-side & around 10mm from PCB defined as the End Point.

Align 50mm x 50mm block from Start Point on the Bezel Back, and the corners of each block are Measure Points.

If the distance from the last block to each side of the End Point  $\geq 25\text{mm}$ , add other blocks to make sure that most area of Bezel Back can be measured.

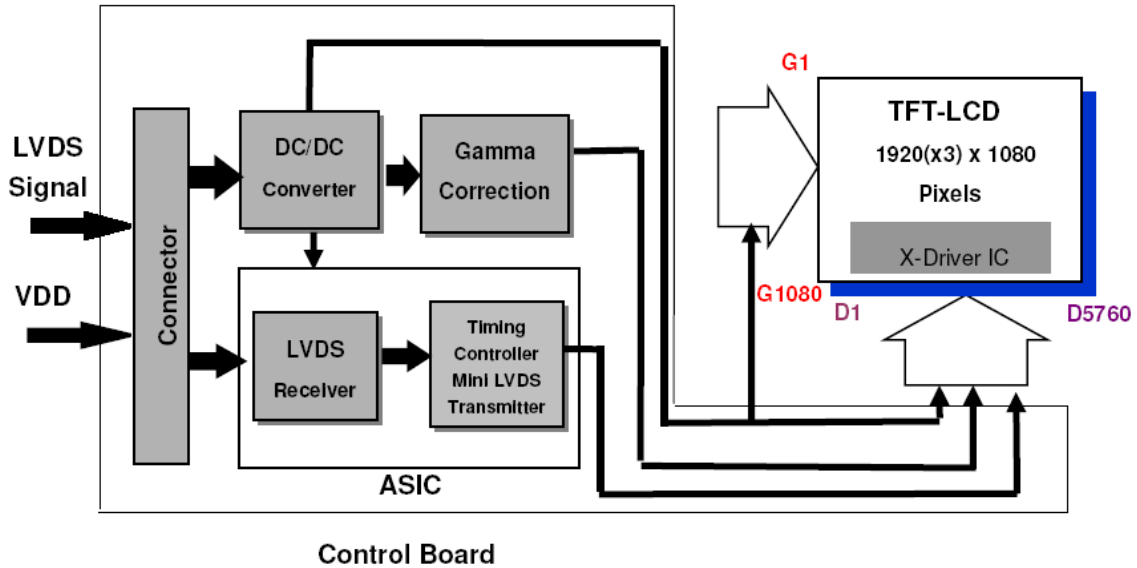


**Note 2-9:** Evaluation test and mass production inspection shall be applied with LED current I<sub>s</sub> @ HDR off condition if there is not specified condition.

### 3 TFT-LCD Module

#### 3.1 Block Diagram

The following shows the block diagram of the 23.8 inch Color TFT-LCD Module



#### 3.2 Interface Connection

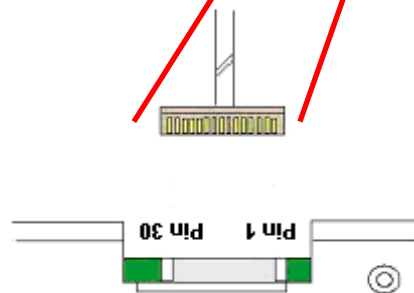
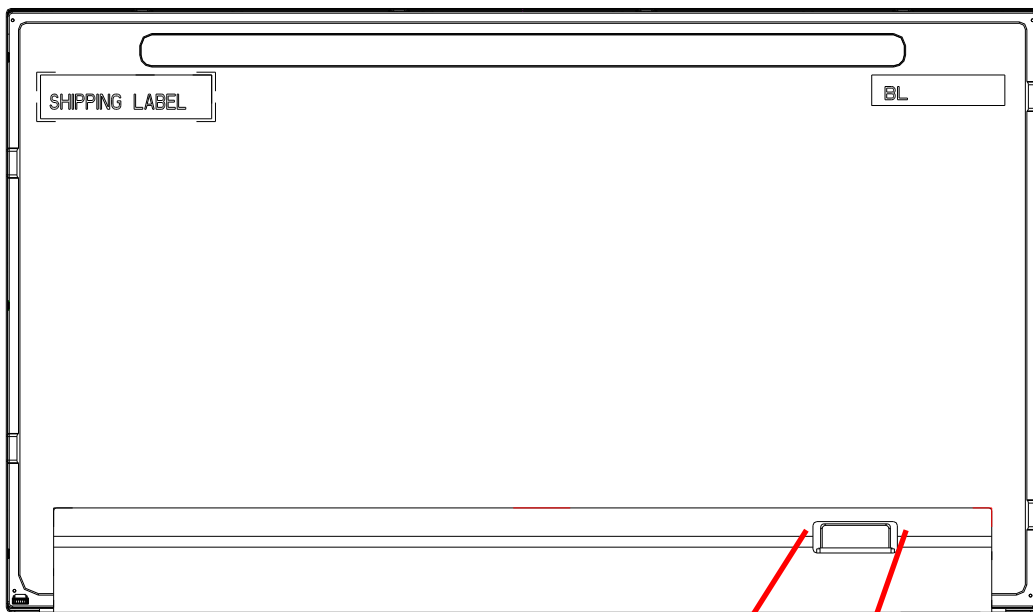
##### 3.2.1 Connector Type

TFT-LCD Connector	Manufacturer	P-TWO	STM
	Part Number	187034-3009	MSBKT240P30HB
Mating Connector	Manufacturer	JAE or Compatible	
	Part Number	FI-X30HL(Locked Type)	

##### 3.2.2 Connector Pin Assignment

PIN #	Symbol	Description	Remark
1	RxO0-	Negative LVDS differential data input (Odd data)	
2	RxO0+	Positive LVDS differential data input (Odd data)	
3	RxO1-	Negative LVDS differential data input (Odd data)	
4	RxO1+	Positive LVDS differential data input (Odd data)	
5	RxO2-	Negative LVDS differential data input (Odd data)	
6	RxO2+	Positive LVDS differential data input (Odd data)	
7	GND	Ground	
8	RxOCLK-	Negative LVDS differential clock input (Odd clock)	
9	RxOCLK+	Positive LVDS differential clock input (Odd clock)	
10	RxO3-	Negative LVDS differential data input (Odd data)	
11	RxO3+	Positive LVDS differential data input (Odd data)	
12	RxE0-	Negative LVDS differential data input (Even data)	

13	RxE0+	Positive LVDS differential data input (Even data)	
14	GND	Ground	
15	RxE1-	Negative LVDS differential data input (Even data)	
16	RxE1+	Positive LVDS differential data input (Even data)	
17	GND	Ground	
18	RxE2-	Negative LVDS differential data input (Even data)	
19	RxE2+	Positive LVDS differential data input (Even data)	
20	RxECLK-	Negative LVDS differential clock input (Even clock)	
21	RxECLK+	Positive LVDS differential clock input (Even clock)	
22	RxE3-	Negative LVDS differential data input (Even data)	
23	RxE3+	Positive LVDS differential data input (Even data)	
24	GND	Must Connect to GND	
25	NC	No connection (for internal test only. Do not connect)	
26	NC	No connection (for internal test only. Do not connect)	
27	NC	No connection (for internal test only. Do not connect)	
28	VDD	Power Supply Input Voltage	
29	VDD	Power Supply Input Voltage	
30	VDD	Power Supply Input Voltage	



### 3.3 Electrical Characteristics

#### 3.3.1 Absolute Maximum Rating

Permanent damage may occur if exceeding the following maximum rating.

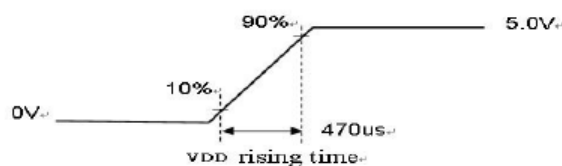
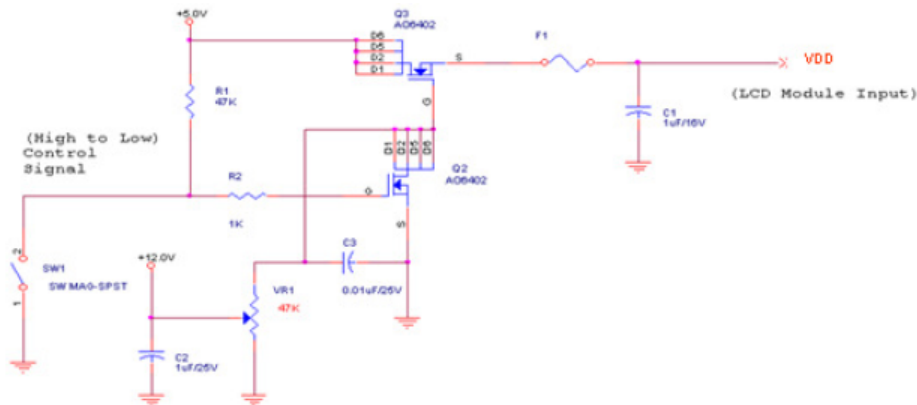
Symbol	Description	Min	Max	Unit	Remark
VDD	Power Supply Input Voltage	GND-0.3	6.0	[Volt]	Ta=25°C

#### 3.3.2 Recommended Operating Condition

Symbol	Description	Min	Typ	Max	Unit	Remark
VDD	Power supply Input voltage	4.5	5.0	5.5	[Volt]	
IDD	Power supply Input Current (RMS)	-	0.64	0.78	[A]	VDD= 5.0V, All white Pattern , Fv=60Hz
		-	0.74	0.9	[A]	VDD= 5.0V, All white Pattern , Fv=75Hz
PDD	VDD Power Consumption	-	3.2	3.9	[Watt]	VDD= 5.0V, All white Pattern , Fv=60Hz
		-	3.7	4.5	[Watt]	VDD= 5.0V, All white Pattern , Fv=75Hz
IRush	Inrush Current	-	-	3.0	[A]	Note 3-1
VDDrp	Allowable VDD Ripple Voltage	-	-	500	[mV]	VDD= 5.0V, All white Pattern , Fv=75Hz

**Note 3-1:** Inrush Current measurement:

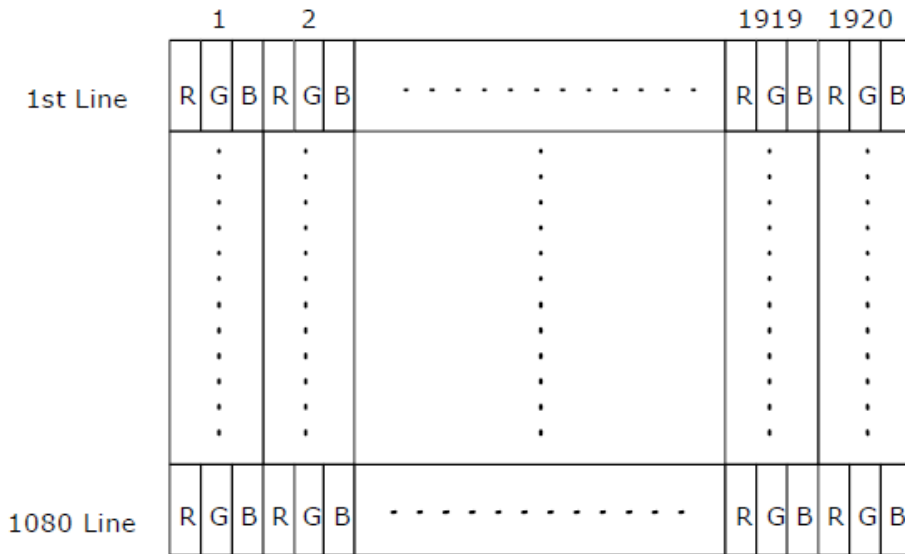
Test circuit:



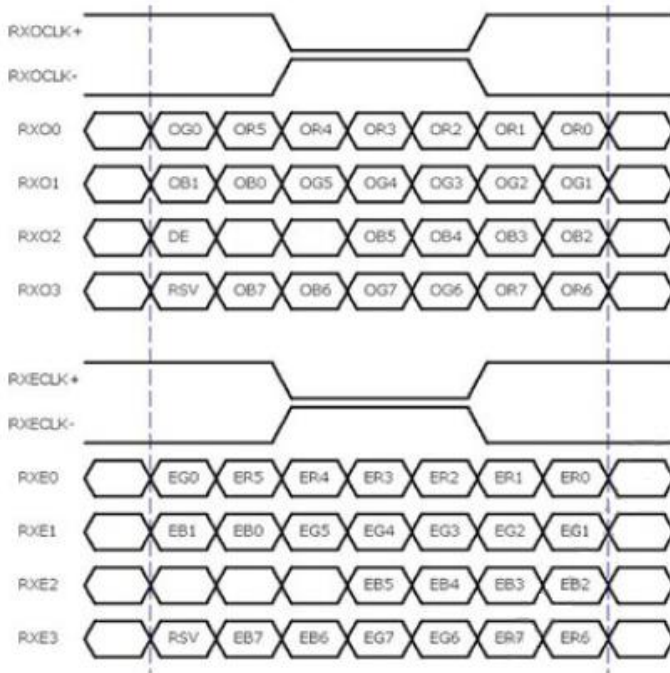
The duration of VDD rising time: 470us.

**3.4 Signal Characteristics**

**3.4.1 LCD Pixel Format**



**3.4.2 LVDS Data Format**



8 Bit Color Bit Order			
<b>MSB</b>	R7	G7	B7
	R6	G6	B6
	R5	G5	B5
	R4	G4	B4
	R3	G3	B3
	R2	G2	B2
	R1	G1	B1
<b>LSB</b>	R0	G0	B0

**Note 3-2:**

- a. O = "Odd Pixel Data" E = "Even Pixel Data"
- b. Refer to 3.4.1 LCD pixel format, the 1<sup>st</sup> data is 1 (Odd pixel Data), the 2<sup>nd</sup> data is 2 (Even Pixel Data) and the last data is 1920 (Even Pixel Data)

### 3.4.3 Color versus Input Data

The following table is for color versus input data (8bit). The higher the gray level, the brighter the color

Color	Gray Level	Color Input Data																				Remark				
		RED data (MSB:R7, LSB:R0)								GREEN data (MSB:G7, LSB:G0)								BLUE data (MSB:B7, LSB:B0)								
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4		B3	B2	B1	B0
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	
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 127	-	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1		
Red	L0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Black	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	L255	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
Green	L0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Black	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	L255	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0		
Blue	L0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Black	
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	L255	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1		

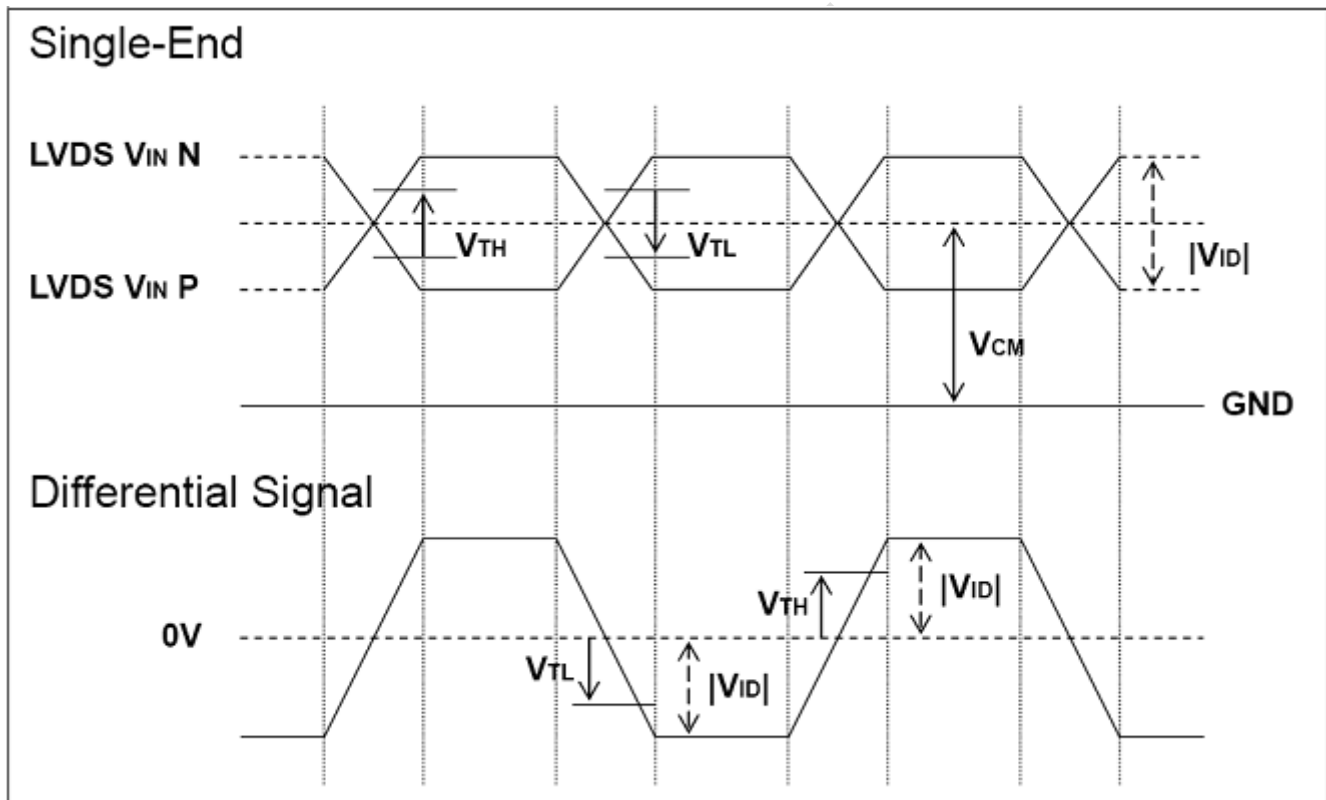
### 3.4.4 LVDS Specification

#### a. DC Characteristics

Symbol	Description	Min	Typ	Max	Units	Condition
$V_{TH}$	LVDS Differential Input High Threshold	-	-	+100	[mV]	$V_{CM} = 1.2V$
$V_{TL}$	LVDS Differential Input Low Threshold	-100	-	-	[mV]	$V_{CM} = 1.2V$
$ V_{ID} $	LVDS Differential Input Voltage	100	-	600	[mV]	
$V_{CM}$	LVDS Common Mode Voltage	+1.0	+1.2	+1.5	[V]	$V_{TH}-V_{TL} = 200mV$

LVDS Signal Waveform:

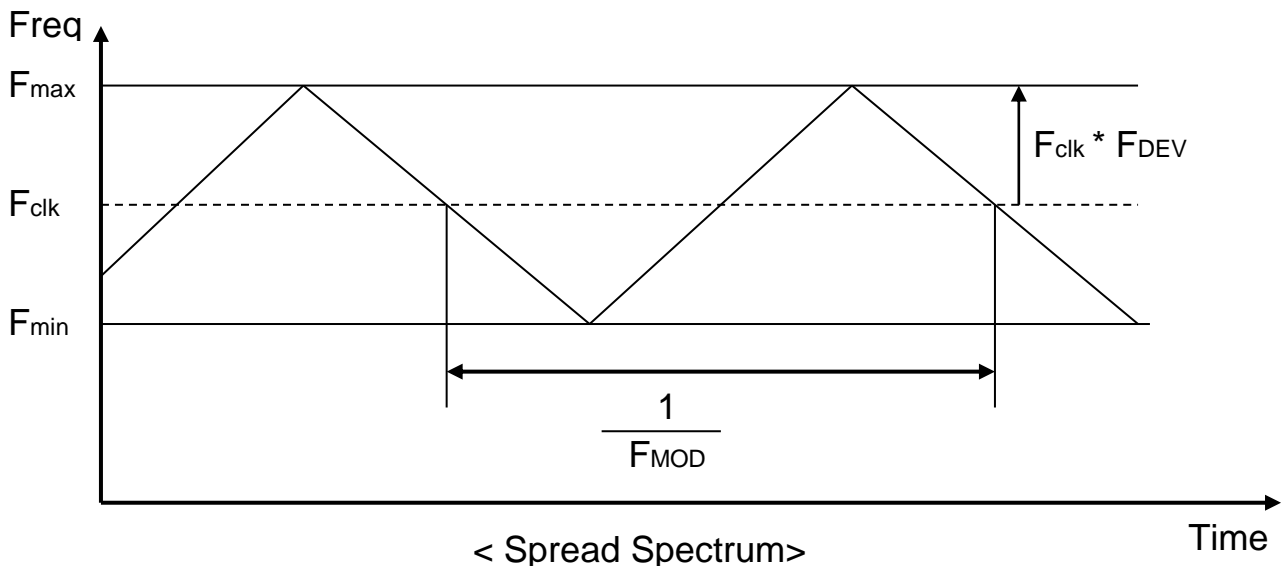
Use RxOCLK-& RxOCLK+ as example





**b. AC Characteristics:**

Symbol	Description	Min	Max	Unit	Remark
F <sub>DEV</sub>	Maximum deviation of input clock frequency during Spread Spectrum	-	± 3	%	
F <sub>MOD</sub>	Maximum modulation frequency of input clock during Spread Spectrum	-	200	KHz	



Fclk: LVDS Clock Frequency

**3.4.5 Input Timing Specification**

It only support DE mode, and the input timing are shown as the following table

Symbol	Description		Min.	Typ.	Max.	Unit	Remark
Tv	Vertical Section	Period	1094	1130	1836	Th	
Tdisp (v)		Active	1080	1080	1080	Th	
Tblk (v)		Blanking	14	50	756	Th	
Fv		Frequency	49	60	76	Hz	
Th	Horizontal Section	Period	1000	1050	1678	Tclk	

Tdisp (h)		Active	960	960	960	Tclk	
Tblk (h)		Blanking	40	90	718	Tclk	
Fh		Frequency	53.7	67.8	90	KHz	<b>Note 3-3</b>
Tclk	LVDS Clock	Period	11.2	14.0	18.6	ns	1/Fclk
Fclk		Frequency	53.7	71.2	90.0	MHz	<b>Note 3-4</b>

**Note 3-3:** The equation is listed as following. Please don't exceed the above recommended value.

$$Fh \text{ (Min.)} = Fclk \text{ (Min.)} / Th \text{ (Min.)};$$

$$Fh \text{ (Typ.)} = Fclk \text{ (Typ.)} / Th \text{ (Typ.)};$$

$$Fh \text{ (Max.)} = Fclk \text{ (Max.)} / Th \text{ (Min.)};$$

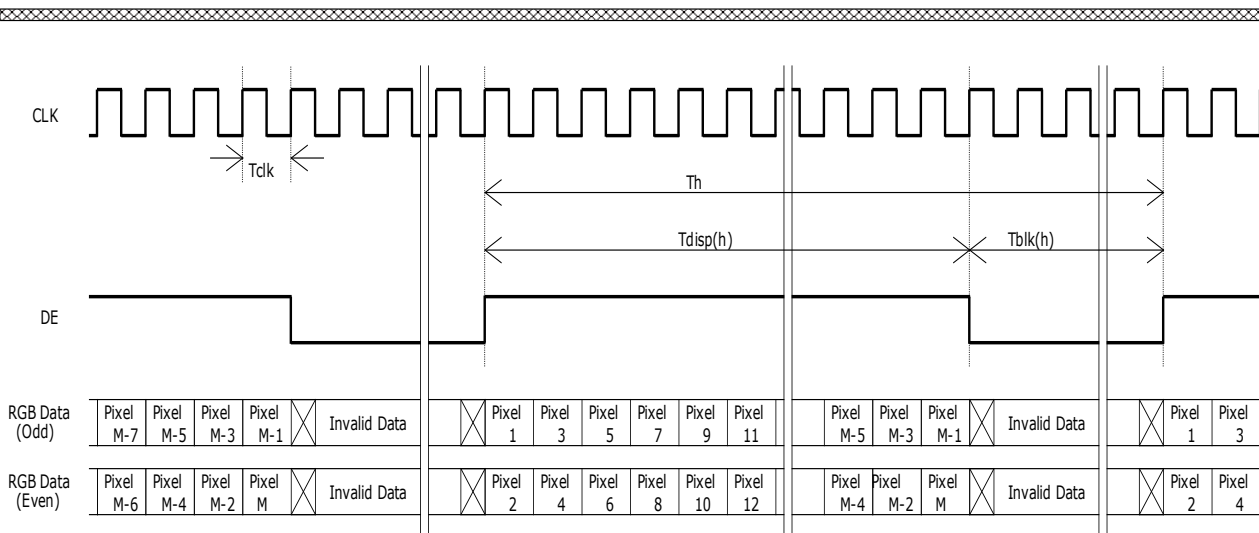
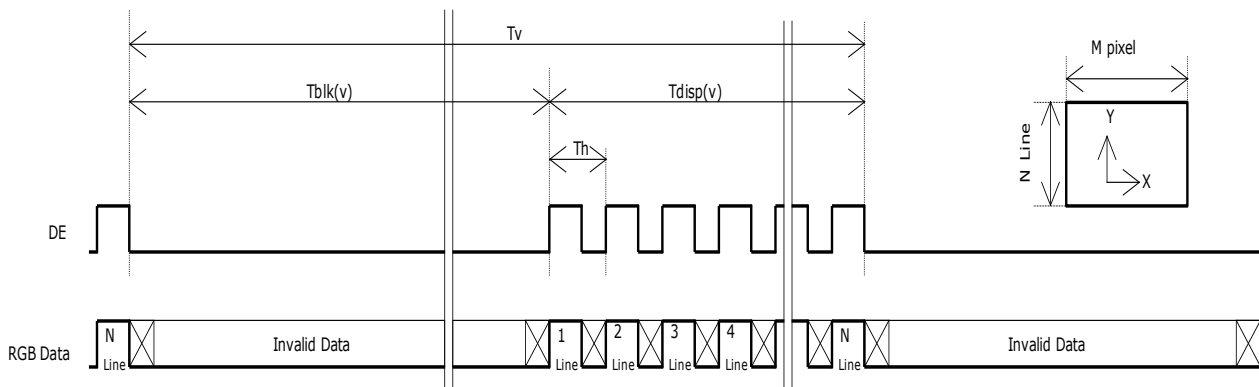
**Note 3-4:** The equation is listed as following. Please don't exceed the above recommended value.

$$Fclk \text{ (Min.)} = Fv \text{ (Min.)} \times Th \text{ (Min.)} \times Tv \text{ (Min.)};$$

$$Fclk \text{ (Typ.)} = Fv \text{ (Typ.)} \times Th \text{ (Typ.)} \times Tv \text{ (Typ.)};$$

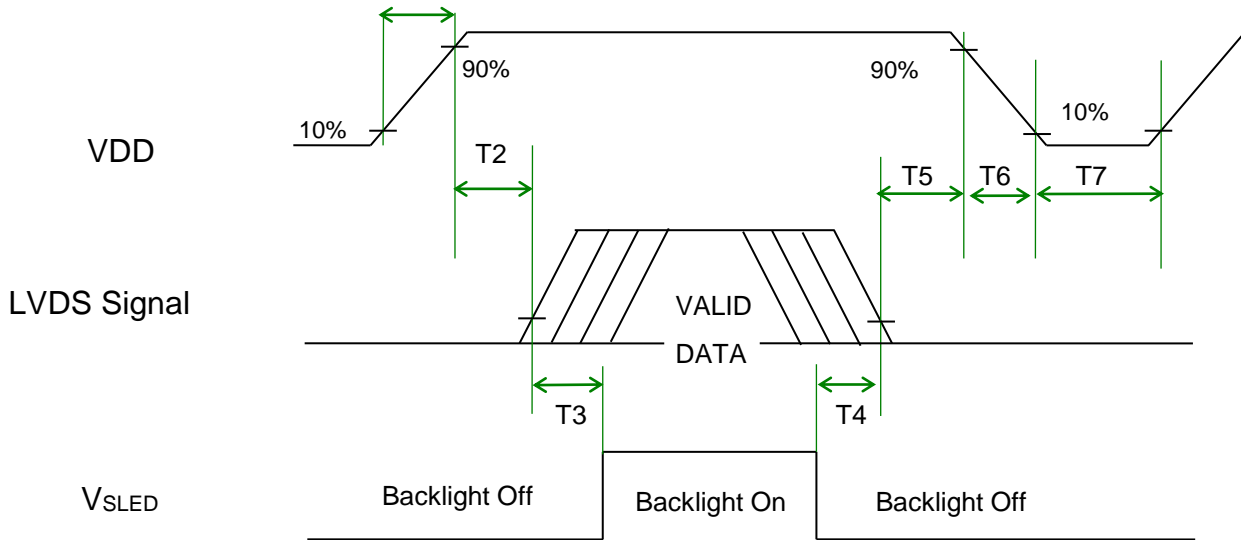
$$Fclk \text{ (Max.)} = Fv \text{ (Max.)} \times Th \text{ (Typ.)} \times Tv \text{ (Typ.)};$$

### 3.4.6 Input Timing Diagram



### 3.5 Power ON/OFF Sequence

VDD power ,LVDS signal and backlight on/off sequence are as following. LVDS signals from any system shall be Hi-Z state when VDD is off.



Power Sequence Timing

Symbol	Value			Unit	Remark
	Min.	Typ.	Max.		
T1	0.5	-	10	[ms]	
T2	0	-	50	[ms]	
T3	500	-	-	[ms]	
T4	100	-	-	[ms]	
T5	0		50	[ms]	<i>Note 3-6</i> <i>Note 3-7</i>
T6	0		200	[ms]	<i>Note 3-7</i> <i>Note 3-8</i>
T7	1000	-	-	[ms]	

**Note 3-6 :** Recommend setting T5 = 0ms to avoid electronic noise when VDD is off.

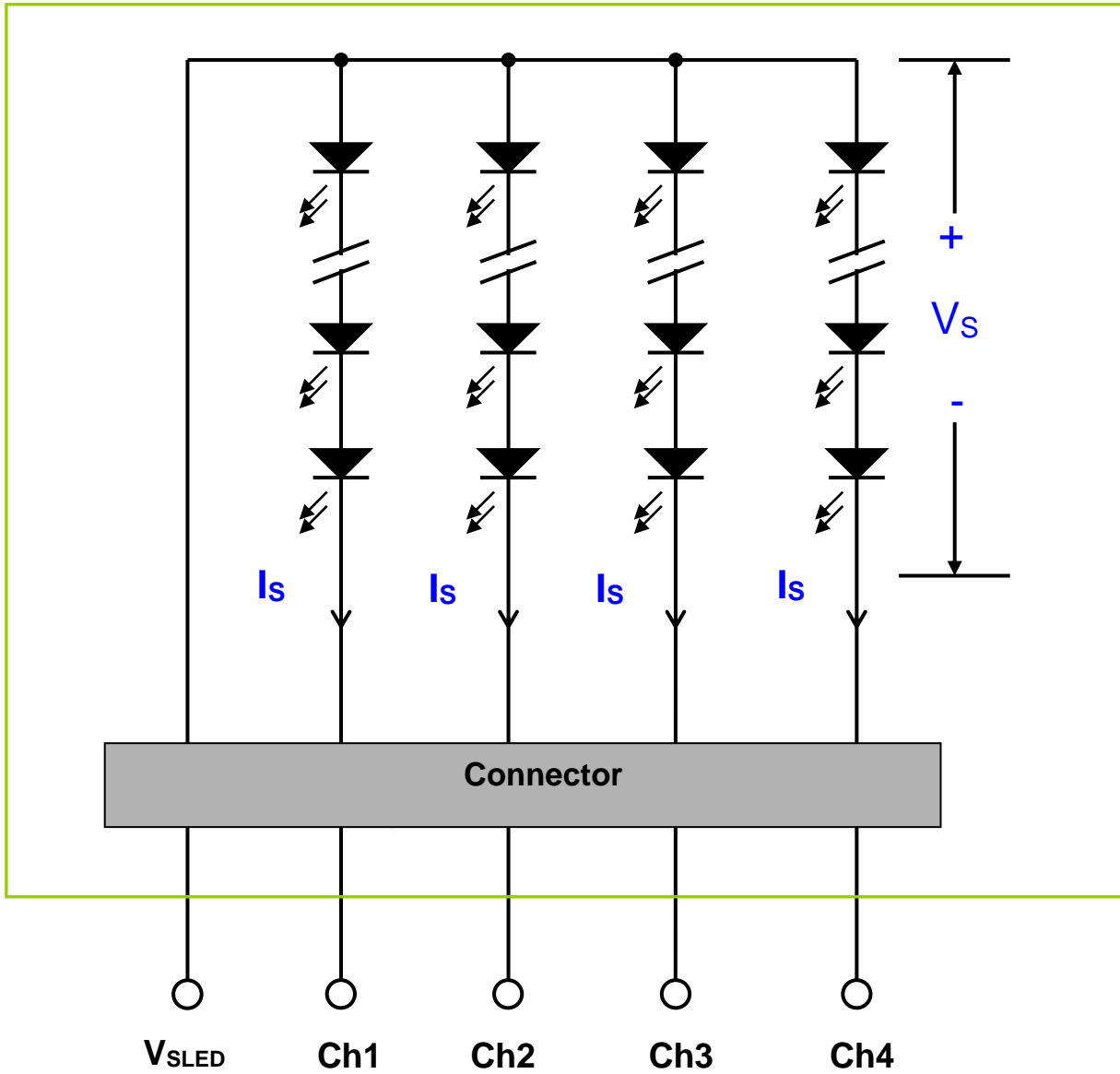
**Note 3-7 :** During T5 period , please keep the level of input LVDS signals with Hi-Z state.

**Note 3-8 :** Voltage of VDO must decay smoothly after power-off. (customer system decide this value)

**4 Backlight Unit**

**4.1 Block Diagram**

The following shows the block diagram of the 23.8 inch Backlight Unit. And it includes 64 pcs LED in the LED light bar. (4 strings and 16 pcs LED of one string).



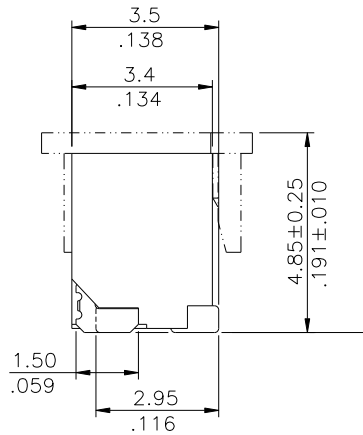
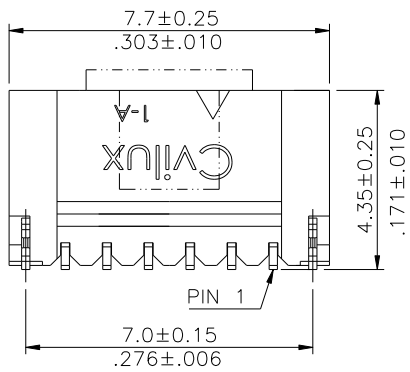
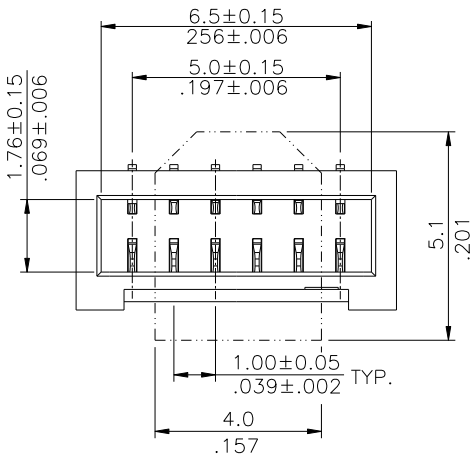
**4.2 Interface Connection**

**4.2.1 Connector Type**

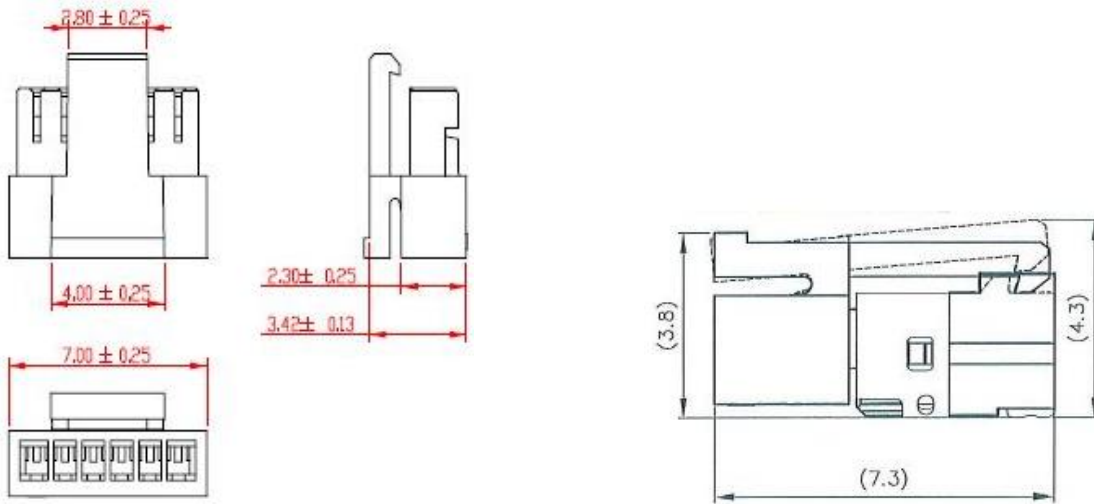
Backlight Connector	Manufacturer	ENTERY
	Part Number	3707K-S06N-21R (BLACK) (Locking Type, Wire Harness)
Mating Connector	Manufacturer	ENTERY
	Part Number	H112K-P06N-00B (Non-Locking type) H112K-P06N-11B(White) (Locking type) H112K-P06N-13B(Black) (Locking type)

**Backlight Connector dimension:**

$H \times V \times D = 7.7 \times 3.5 \times 4.35$ , Pitch = 1.0(unit = mm)

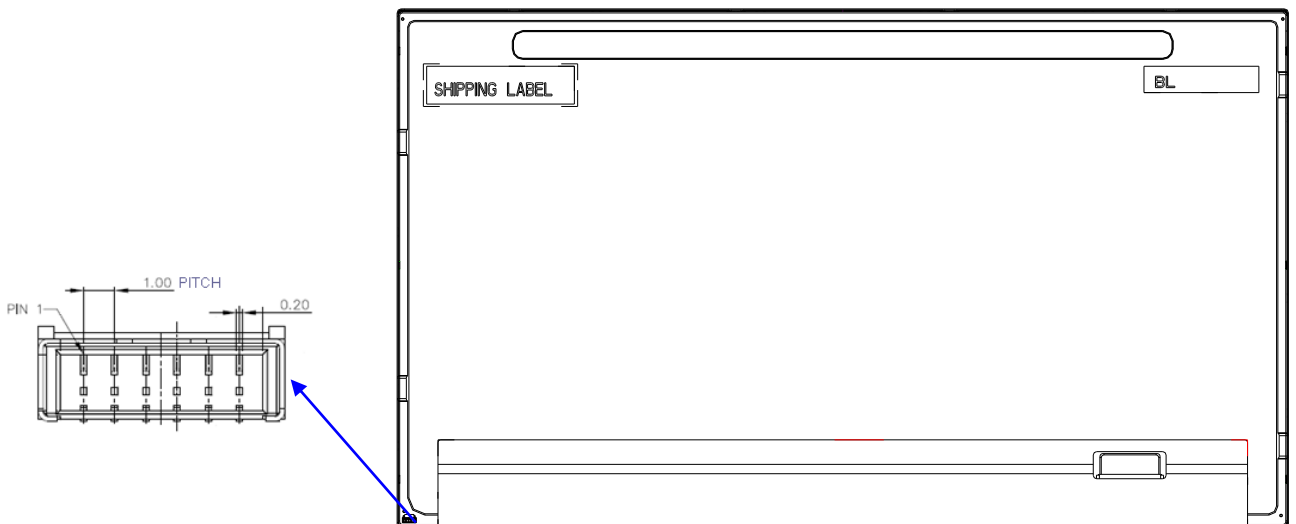


**Mating Connector dimension:**



**4.2.2 Connector Pin Assignment**

Pin#	Symbol	Description	Remark
1	Ch1	LED Current Feedback Terminal (Channel 1)	
2	Ch2	LED Current Feedback Terminal (Channel 2)	
3	V <sub>SLED</sub>	LED Power Supply Voltage Input Terminal	
4	V <sub>SLED</sub>	LED Power Supply Voltage Input Terminal	
5	Ch3	LED Current Feedback Terminal (Channel 3)	
6	Ch4	LED Current Feedback Terminal (Channel 4)	



### 4.3 Electrical Characteristics

#### 4.3.1 Absolute Maximum Rating

Permanent damage may occur if exceeding the following maximum rating.

(Ta=25°C)

Symbol	Description	Min	Max	Unit	Remark
Is	LED String Current	0	180	[mA]	100% duty ratio

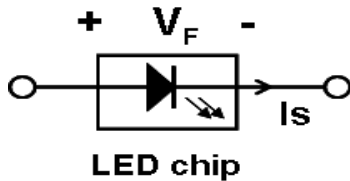
#### 4.3.2 Recommended Operating Condition

(Ta=25°C)

Symbol	Description	Min.	Typ.	Max.	Unit	Remark
Is	LED String Current	-	50	55	[mA]	100% duty ratio of LED chip, <i>Note 4-6</i>
Vs	LED String Voltage	38.87	44.86	47.85	[Volt]	Is=50mA @ 100% duty ratio; <i>Note 4-1, Note 4-5, Note 4-7</i>
$\Delta V_s$	Maximum Vs Voltage Deviation of light bar	-	-	3.2	[Volt]	Is=50mA @ 100% duty ratio; <i>Note 4-2</i>
P <sub>BLU</sub>	LED Light Bar Power Consumption	-	8.97	9.57	[Watt]	<i>Note 4-3</i>
LT <sub>LED</sub>	LED Life Time	30,000	-	-	[Hour]	<i>Note 4-4</i>
OVP	Over Voltage Protection in system board	110% Vsmax	-	-	[Volt]	<i>Note 4-5</i>

**Note 4-1:**  $V_s (\text{Typ.}) = V_F (\text{Typ.}) \times \text{LED No. (one string)}$ ;

- a.  $V_F$ : LED chip forward voltage,  $V_F (\text{Min.})=2.43\text{V}$ ,  $V_F(\text{Typ.})=2.8\text{V}$ ,  $V_F(\text{Max.})=2.99\text{V}$
- b. The same equation to calculate  $V_s(\text{Min.})$  &  $V_s (\text{Max.})$  for respective  $V_F (\text{Min.})$  &  $V_F(\text{Max.})$ ;



**Note 4-2:**  $\Delta V_s (\text{Max.}) = \Delta V_F \times \text{LED No. (one string)}$ ;

- a.  $\Delta V_F$ : LED chip forward voltage deviation; (0.2V , each Bin of LED  $V_F$ )

**Note 4-3:**  $P_{\text{BLU}} (\text{Typ.}) = V_s (\text{Typ.}) \times I_s (\text{Typ.}) \times 4$  ; ( 4 is total String No. of LED Light bar)

$$P_{\text{BLU}} (\text{Max.}) = V_s (\text{Max.}) \times I_s (\text{Typ.}) \times 4 ;$$

**Note 4-4:** Definition of life time:

- a. Brightness of LED becomes to 50% of its original value
- b. Test condition:  $I_s = 50\text{mA}$  and  $25^\circ\text{C}$  (Room Temperature)

**Note 4-5:** Recommendation for LED driver power design:

Due to there are electrical property deviation in LED & monitor set system component after long time operation. It's strongly recommend the design value of LED driver board OVP (over voltage protection) should be 10% higher than max. value of LED string voltage ( $V_s$ ) at least.

**Note 4-6:** Recommend "Analog Dimming" method for backlight brightness control for Wavy Noise Free. Otherwise, recommend that Dimming Control Signal (PWM Signal) should be synchronized with Frame Frequency.

**Note 4-7:** Ensure that the LED light bar is not subjected either forward or reverse voltage while monitor set is on standby mode or not in use.



## 5 Reliability Test

Reliability test items are listed as following table. (*Bare Panel only*)

Items	Condition	Remark
Temperature Humidity Bias (THB)	Ta= 50°C , 80%RH, 300hours	
High Temperature Operation (HTO)	Ta= 50°C , 50%RH, 300hours	
Low Temperature Operation (LTO)	Ta= 0°C , 300hours	
High Temperature Storage (HTS)	Ta= 60°C , 300hours	
Low Temperature Storage (LTS)	Ta= -20°C , 300hours	
Vibration Test (Non-operation)	Acceleration: 1.5 Grms Wave: Random Frequency: 10 - 200 Hz Sweep: 30 Minutes each Axis (X, Y, Z)	
Shock Test (Non-operation)	Acceleration: 50 G Wave: Half-sine Active Time: 20 ms Direction: ±X, ±Y, ±Z (one time for each Axis)	
Thermal Shock Test (TST)	-20°C/30min, 60°C/30min, 100 cycles	<b>Note 5-1</b>
ESD (Electro Static Discharge)	Contact Discharge: ± 15KV, 150pF(330Ω ) 1sec 8 points, 25 times/ point.	<b>Note 5-2</b>
	Air Discharge: ± 15KV, 150pF(330Ω ) 1sec 8 points, 25 times/ point.	

**Note 5-1:** a. A cycle of rapid temperature change consists of varying the temperature from -20°C to 60°C, and back again. Power is not applied during the test.

b. After finish temperature cycling, the unit is placed in normal room ambient for at least 4 hours before power on.

**Note 5-2:** EN61000-4-2, ESD class B: Certain performance degradation allowed

No data lost

Self-recoverable

No hardware failures.

ESD discharged points should avoid display area and periphery front bezel of display area.

Suggest points were 4 side parallel edge of display area surface.

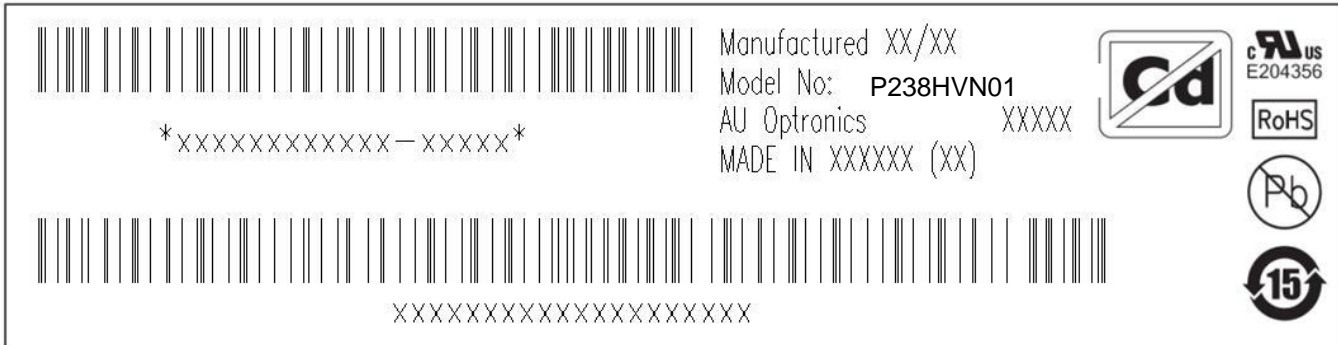
Metal front bezel must cover half area of BM (black matrix), and metal front bezel must connect with metal back bezel to protect source IC of panel by ESD damaged.




**Note 5-3:** Result Evaluation Criteria:

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

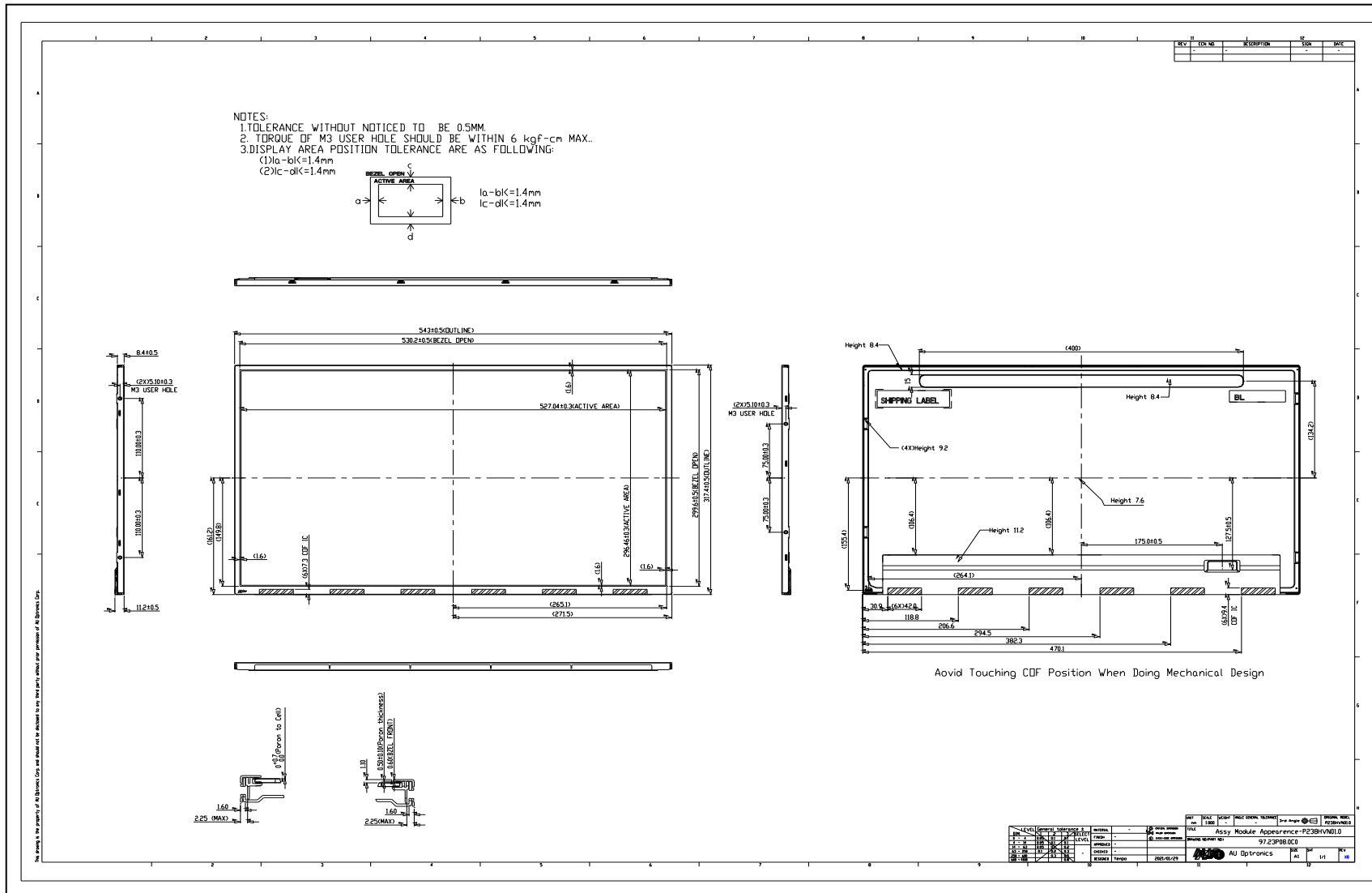
**6 Shipping Label**

The label is on the panel as shown below: (Example)



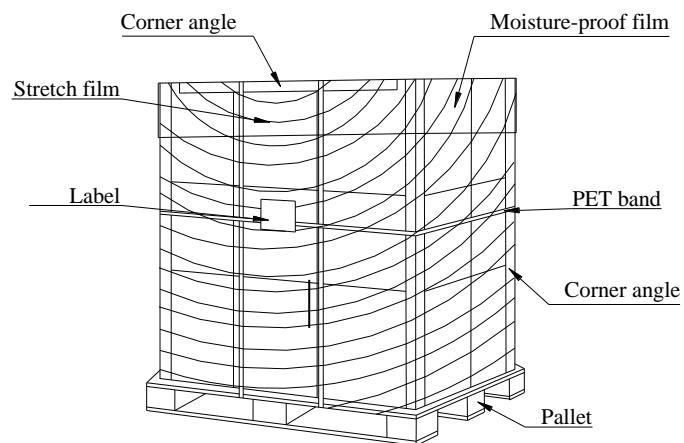
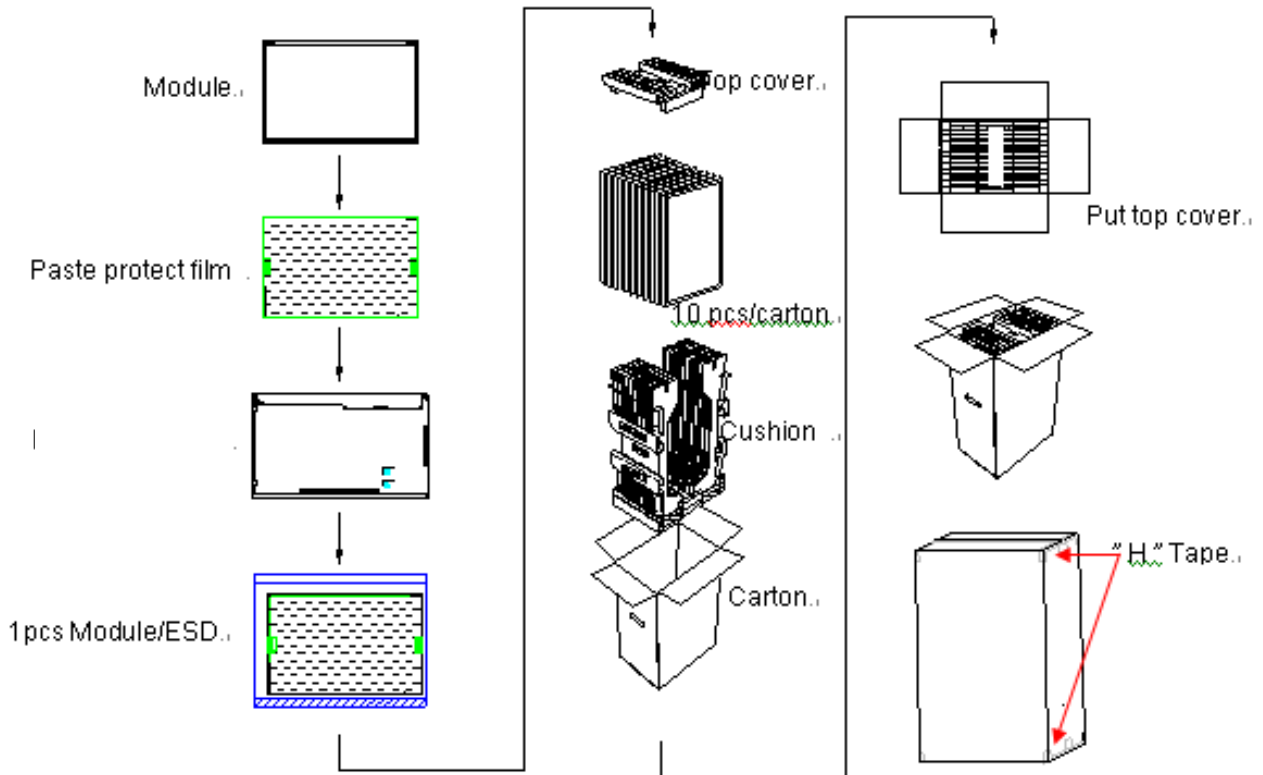
- (1) For Pb Free Product, ADP will add  for identification.
- (2) For RoHS compatible products, ADP will add  for identification.
- (3) For "Cadmium Free product, ADP will add  for identification.
- (4) Note: The green Mark will be present only when the green documents have been ready by ADP internal green team. (Definition of green design follows the ADP green design checklist.)

# 7 Mechanical Characteristics



## 8 Packing Specification

### 8.1 Packing Flow



## 8.2 Pallet and shipment information

Item	Specification			Remark
	Q'ty	Dimension	Weight(kg)	
Panel	1	543.0(H) x 317.4(V) x 11.2(D) (Typ.)	2.28	
Cushion	1	-	1.7	
Box	1	412(L)mm x 281(W)mm x 650(H)mm	1.2	without Panel & cushion
Packing Box	10 pcs/Box	412(L)mm x 281(W)mm x 650(H)mm	25.7	with panel & cushion
Pallet	1	1150(L)mm x 840(W)mm x 132(H)mm	13.6	
Pallet after Packing	16 boxes/pallet	1150(L)mm x 840(W)mm x 1432(H)mm	424.8	