

Model name: PT430GT01-2

Date: 28.Apr.2020

() Preliminary Specification

(✓) Final Specification

Any modification is not allowed without HKC's permission

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Revision History

Version	Date	Page (New)	Section	Description	Revision by
Rev. P1	2020/01/16	-	All	Preliminary Specification was first issued.	Fang.Yang
Rev. P2	2020/03/12	p8	3.1.1	Update power supply current.	Fang.Yang
Rev.F1	2020/04/28	-	All	Final Specification was first issued.	Fang.Yang

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1.GENERAL DESCRIPTION

The specification is applied to 43” model (PT430GT01-2) TFT Liquid Crystal Display open cell and it supports 3840 x 2160 UHD mode with 1.07G(8bit+FRC) colors. This product is with driver ICs and a 51-pins-8 lane-VBO circuit board and built in without backlight unit.

1.1 General Specifications

Item	Specification	Unit	Note
Screen Size	43 inch Diagonal		-
Cell Outline Dimension	953(H)x543(V) x1.433 (D)	mm	
Active Area	941.184(H) x 529.416(V)	mm	
Driver Element	a-Si TFT active matrix	-	-
GOA Type	Yes		
Cell Transmittance	4.6 %(Typ)	-	HKC B/L,center point
Pixel Number	3840 x 2160	pixel	-
Pixel Pitch	0.2451 (H) x 0.2451 (V)	mm	-
Pixel Arrangement	RGB vertical	-	-
Display Colors	1.07G	color	8 bit+FRC
Display Mode	Normally Black		
Display Orientation	Signal input with “ABC”		
Viewing Angle	89/89/89/89		CR≥10
Surface Treatment	Type=AG		
	Haze=3%		
	Top Surface Hardness: 3H		
Weight	1580	g	-

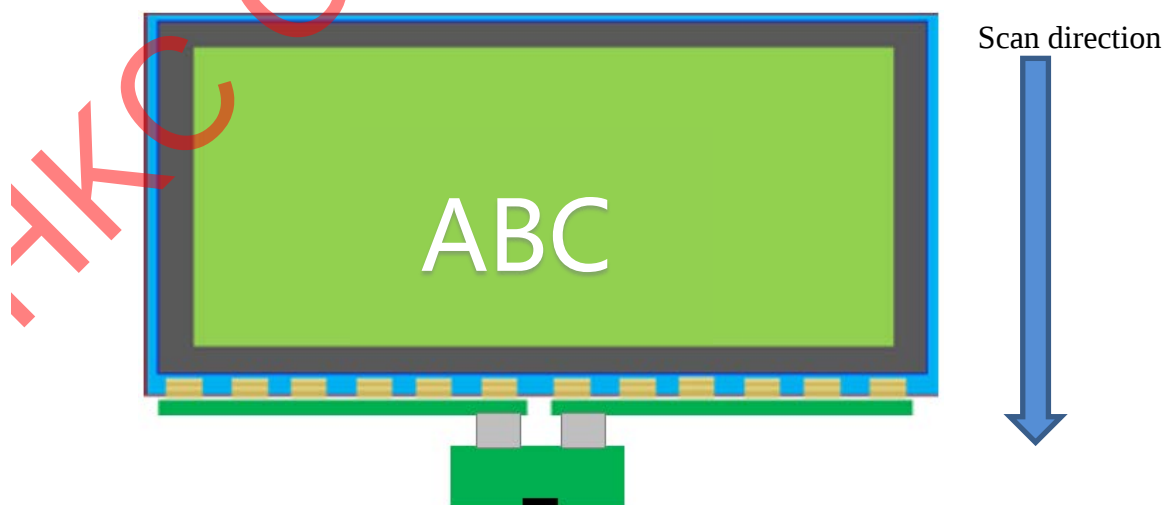


Fig 1.1 TFT LCD Panel

2.ABSOLUTE MAXIMUM RATINGS

2.1 Absolute Maximum Ratings

The followings are maximum values which, if exceeded, may cause damage to the unit.

Item	Symbol	Value		Unit
		Min.	Max.	
Power Supply Voltage	V_{CC}	-0.3	13.5	V
Input Signal Voltage	V_{IN}	-0.3	3.6	V

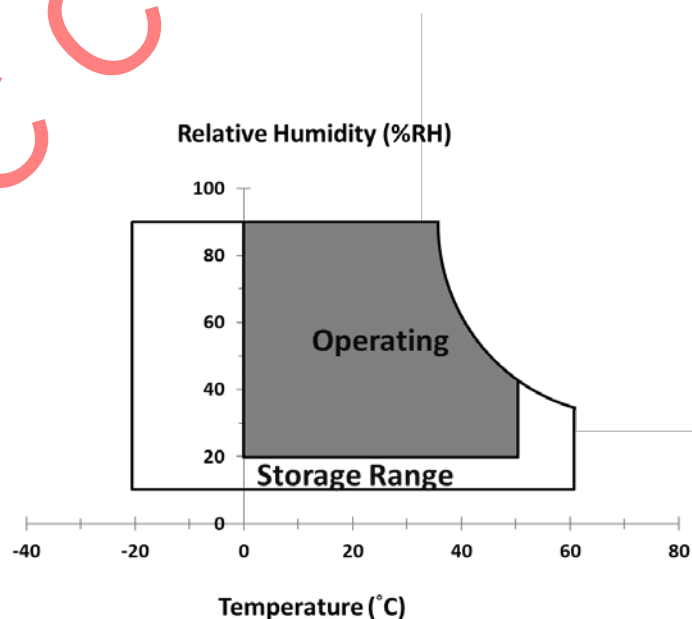
2.2 Absolute Ratings Of Environment

Temperature and relative humidity range is shown in the figure below.

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	TST	-20	60	°C	(1)
Operating Temperature	TOP	0	50	°C	(1), (2), (3)

Note:

- (1) a. 90 % RH Max. ($T_a \leq 40^\circ\text{C}$).
- b. Web-bulb temperature should be 39°C Max. ($T_a > 40^\circ\text{C}$)
- c. No condensation
- d. Operating condition with a assemble module
- (2) The temperature of panel surface should be 0°C min. and 50°C max.
- (3) Any point on the Driver surface must be less than 105°C under any condition ,If the surface temperature is out of the spec, thermal solutions should be applied to avoid be damaged.



2.3 Package Storage

When storing open cell as spares for a long time, please follow the precaution instructions:

- (1) Do not store the open cell in high temperature and high humidity for a long time. It is highly recommended to store the module with temperature from 20°C to 30°C in normal humidity ($50 \pm 10\%RH$) with shipping package.
- (2) The open cell should be keep within one month shelf life.

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3. ELECTRICAL SPECIFICATIONS

3.1 Electrical Characteristics

3.1.1 Power Consumption

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		V_{CC}	10.8	12	13.2	V	(1)
Rush Current		I_{RUSH}	-	-	3	A	(2)
Power Supply current	White Pattern	I_{CC}	-	0.632	0.83	A	(3)
	Horizontal Stripe	I_{CC}	-	1.415	1.846	A	
	Black Pattern	I_{CC}	-	0.61	0.8	A	

Note:

(1) The ripple voltage should be controlled less than 10% of V_{CC} .

(2) Measurement condition: V_{CC} rising time = 470 μ s.

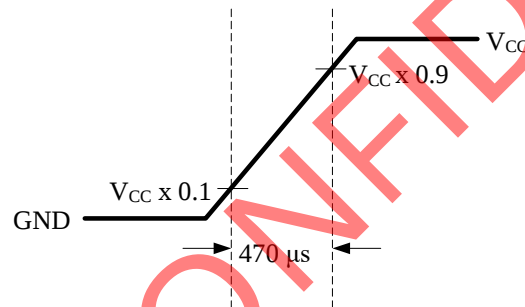
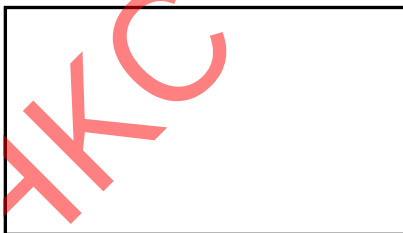


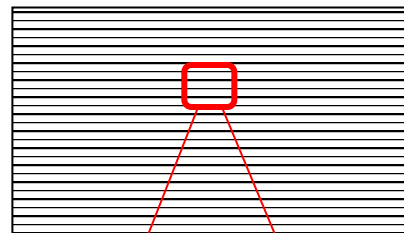
Fig.3.1 V_{CC} rising time condition

(3) Measurement condition: V_{CC} = 12V, T_a = 25 $\pm$ 2 $^{\circ}$ C, F = 60 Hz. The test patterns are shown as below.

A. White Pattern



B. Horizontal Pattern



C. Black Pattern

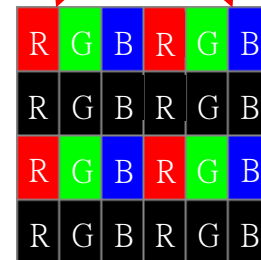
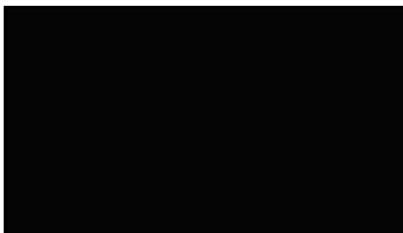


Fig.3.2 Test patterns

3.1.2 V By One Characteristics

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
V by one Interface	Differential Input High Threshold Voltage	V_{TH}	-	-	+50	mV	
	Differential Input Low Threshold Voltage	V_{TL}	- 50	-	-	mV	
	Intra-pair Skew	TTOSK_intra	-0.3	-	0.3	UI	(1)
	Inter-pair Skew	TTOSK_inter	-5	-	5	UI	(2)
	Spread Spectrum Modulation range	30KHz modulation	-0.5		+0.5	%	(3)(4)
	Spread Spectrum Modulation frequency	F_{SSM}	-		30K	Hz	
	Differential Input Swing Voltage	V	200		400	mV	
CMOS Interface	Input High Threshold Voltage	V_{IH}	2.4	-	3.3	V	
	Input Low Threshold Voltage	V_{IL}	0	-	0.6	V	

Note:

(1) Intra-pair skew

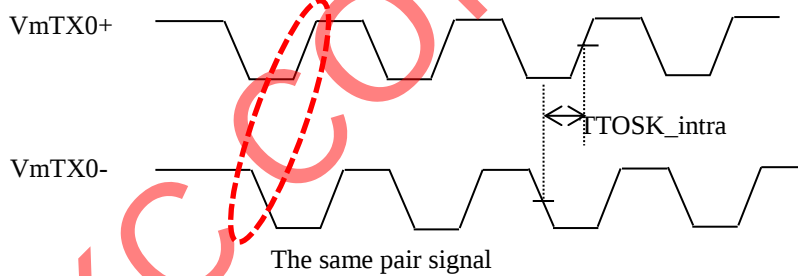


Fig. 3.3 V by one Intra-pair skew

(2) Inter-pair skew

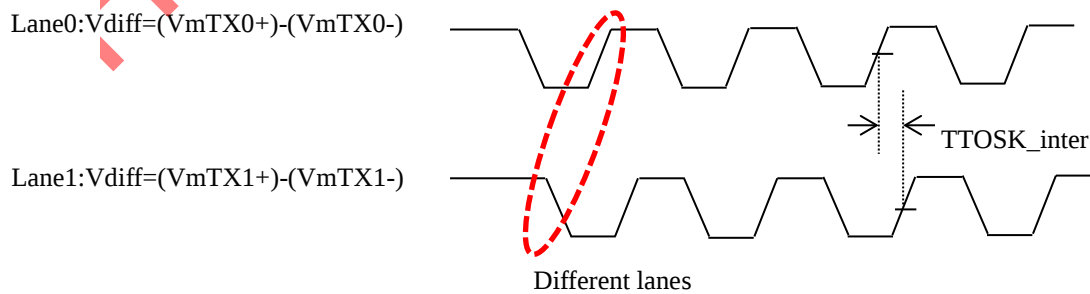


Fig.3.4 V by one Inter-pair skew

(3) The SSCG (Spread Spectrum Clock Generator) is defined as the following figure.

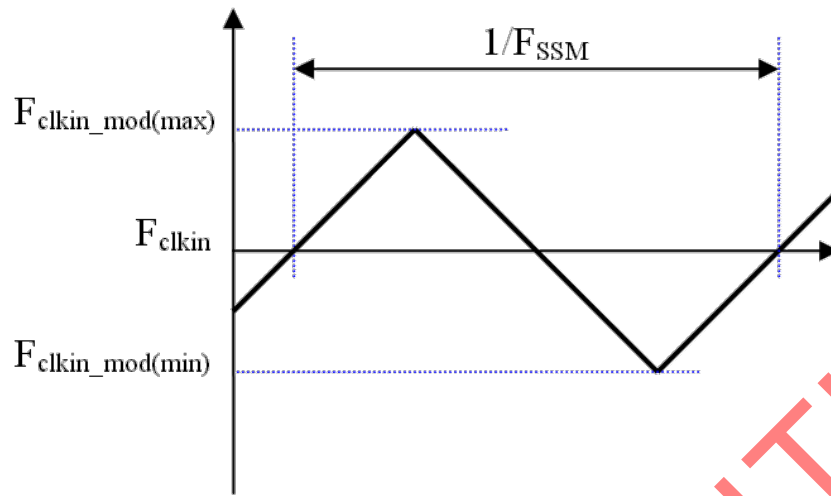


Fig.3.5 Spread Spectrum Clock Generator

(4)The V by one SSM's suggestion is off by default, SOC board must test all validation if SOC board open the V by one SSM.

3.1.3 V By One Input Signal Timing

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

Note:
(1)

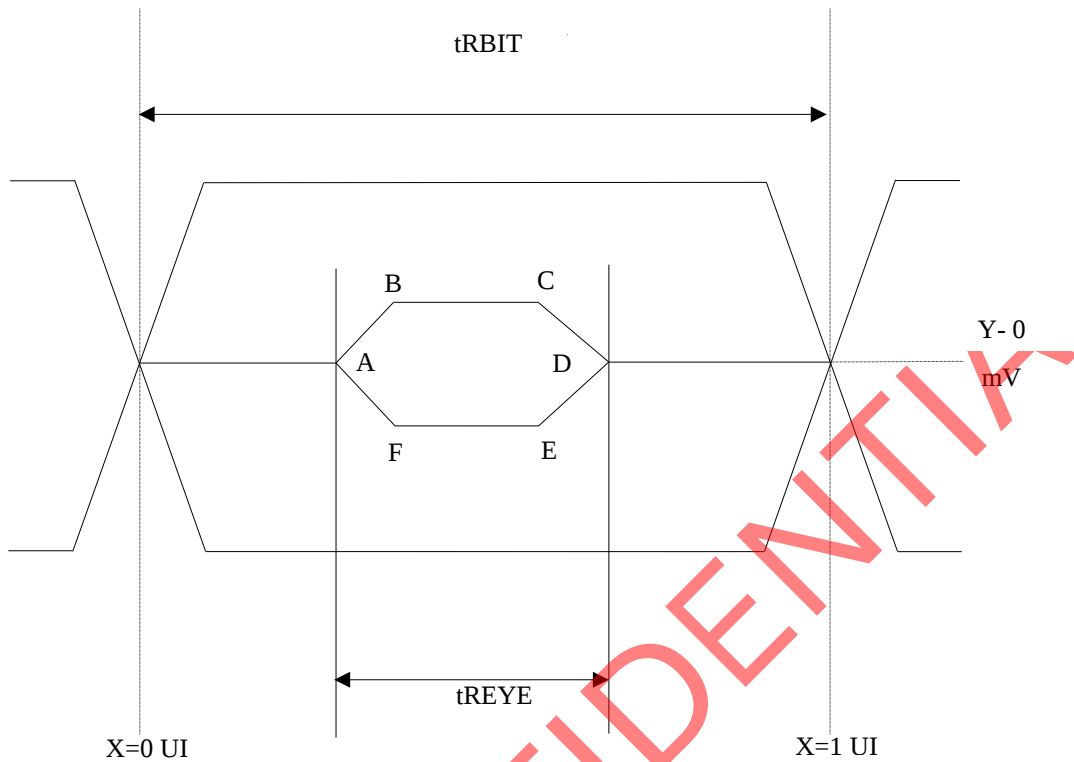


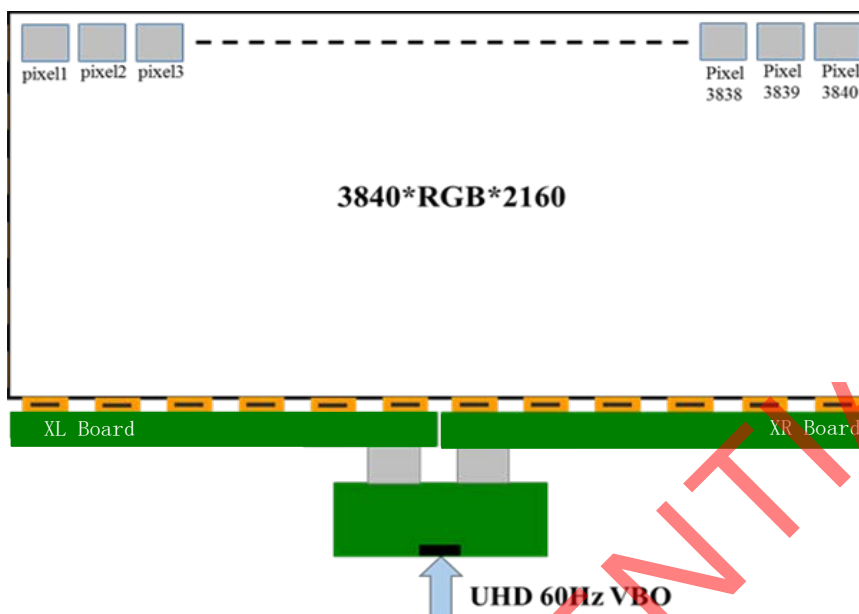
Fig.3.6 V by one input signal timing

3.1.4 V By One Data Mapping

V by One Data Mapping

Lane	Data Stream
Lane 0	Pixel 1, 5, 9,,1913, 1917
Lane 1	Pixel 2, 6, 10,,1914, 1918
Lane 2	Pixel 3, 7, 11,,1915, 1919
Lane 3	Pixel 4, 8, 12,,1916, 1920
Lane 4	Pixel 1921, 1925, 1929,,3833, 3837
Lane 5	Pixel 1922, 1926, 1930,,3834, 3838
Lane 6	Pixel 1923, 1927, 1931,,3835, 3839
Lane 7	Pixel 1924, 1928, 1932,,3836, 3840

TFT LCD Panel



3.1.5 Color Data Input Assignment

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

Data Input Color		Data Signal																																									
		Red										Green										Blue																					
		MSB										LSB										MSB										LSB											
		R9	R8	R7	R6	R5	R4	R3	R2	R1	R0	G9	G8	G7	G6	G5	G4	G3	G2	G1	G0	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0												
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0										
	Red (1023)	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0										
	Green (1023)	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0										
	Blue (1023)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1										
	Cyan	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1										
	Magenta	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1										
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0										
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1										
Gray Scale of Red	Red (000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0										
	Red (001)	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0										
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	Red (1022)	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0										
	Red (1023)	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0										
	Green (000)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0										

[illegible]

Attention:

0: Low level voltage; 1: High level voltage.

3.2 Interface Connections

3.2.1 Input Connector:

CN1: 21EJ0-110-0001_04(Jonhon)

Pin No.	Symbol	Description	Note
1	Vcc	Power input (+12V)	
2	Vcc	Power input (+12V)	
3	Vcc	Power input (+12V)	
4	Vcc	Power input (+12V)	
5	Vcc	Power input (+12V)	
6	Vcc	Power input (+12V)	
7	Vcc	Power input (+12V)	
8	Vcc	Power input (+12V)	
9	NC	No Connection	(2)
10	GND	Ground	
11	GND	Ground	
12	GND	Ground	
13	GND	Ground	
14	GND	Ground	
15	NC	No Connection	(2)
16	NC	No Connection	(2)
17	NC	No Connection	(2)
18	SDA	SDA	(3)
19	SCL	SCL	

20	WP	Write Protection High(3.3V) for Writable, Open/Low(GND) for Protection	
21	NC	No Connection	(2)
22	NC	No Connection	(2)
23	NC	No Connection	(2)
24	NC	No Connection	(2)
25	HTPND	Hot Plug Detect	
26	LOCKN	Lock Detect	
27	GND	Ground	
28	Rx0N	V-By One HS Negative Data Lane 0	
29	Rx0P	V-By One HS Positive Data Lane 0	
30	GND	Ground	
31	Rx1N	V-By One HS Negative Data Lane 1	
32	Rx1P	V-By One HS Positive Data Lane 1	
33	GND	Ground	
34	Rx2N	V-By One HS Negative Data Lane 2	
35	Rx2P	V-By One HS Positive Data Lane 2	
36	GND	Ground	
37	Rx3N	V-By One HS Negative Data Lane 3	
38	Rx3P	V-By One HS Positive Data Lane 3	
39	GND	Ground	
40	Rx4N	V-By One HS Negative Data Lane 4	
41	Rx4P	V-By One HS Positive Data Lane 4	
42	GND	Ground	
43	Rx5N	V-By One HS Negative Data Lane 5	
44	Rx5P	V-By One HS Positive Data Lane 5	
45	GND	Ground	
46	Rx6N	V-By One HS Negative Data Lane 6	
47	Rx6P	V-By One HS Positive Data Lane 6	
48	GND	Ground	
49	Rx7N	V-By One HS Negative Data Lane 7	
50	Rx7P	V-By One HS Positive Data Lane 7	
51	GND	Ground	

Notes:

(1)The direction of pin assignment is shown as below:

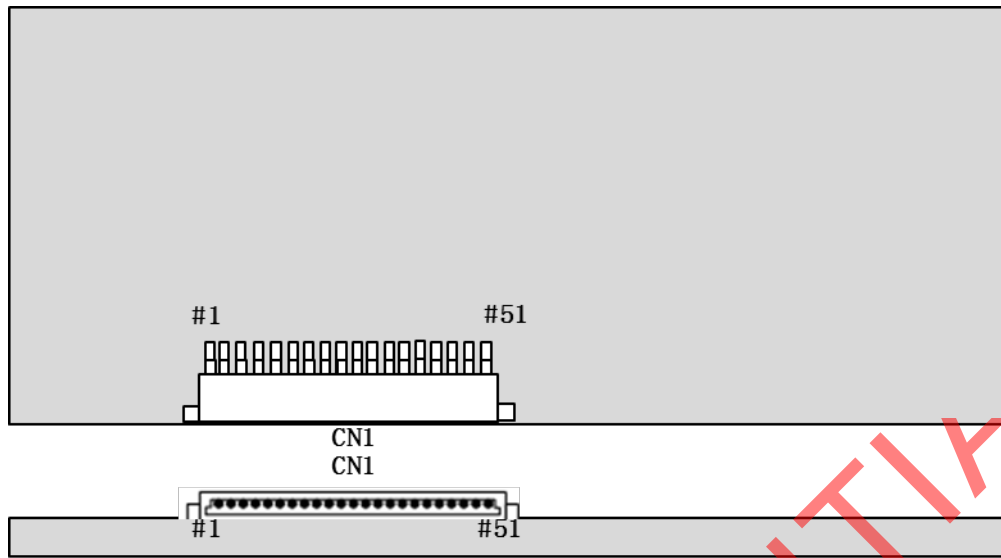


Fig.3.7 Connector direction sketch map

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

(3)a. Please leave it open (Do not line out from PCBA connector) if it is not used.(for example : TV set)

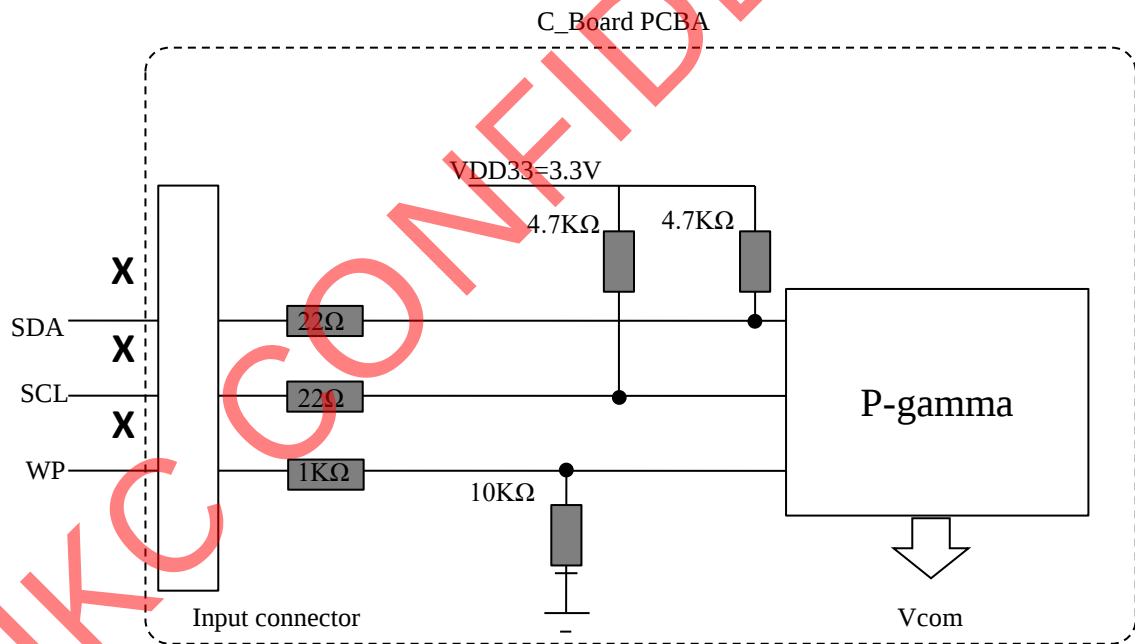


Fig.3.8 WP/SDA/SCL PCBA set

b. For the Vcom (Flicker) regulation and control, SDA and SCL must pull high in the flicker set, and the flicker set's VDD must ready before the input power (Vcc=12V)

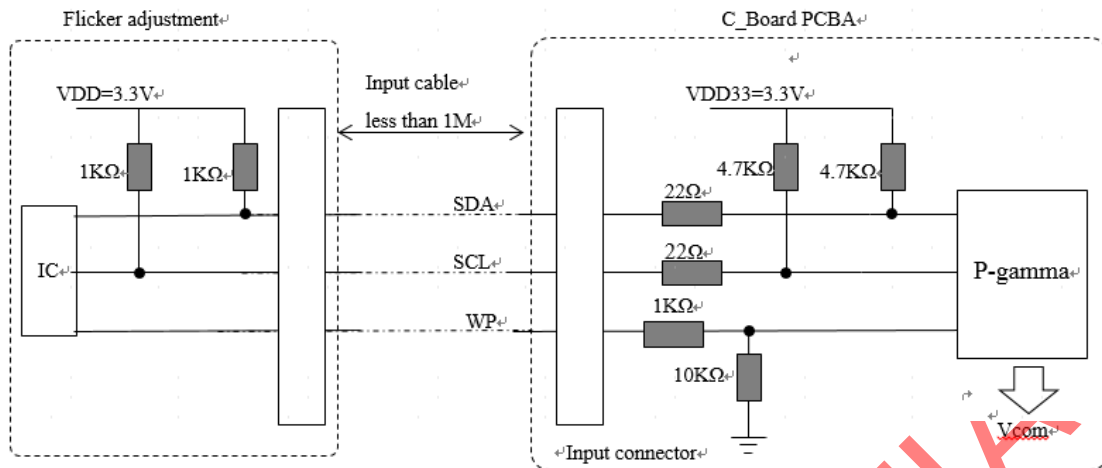
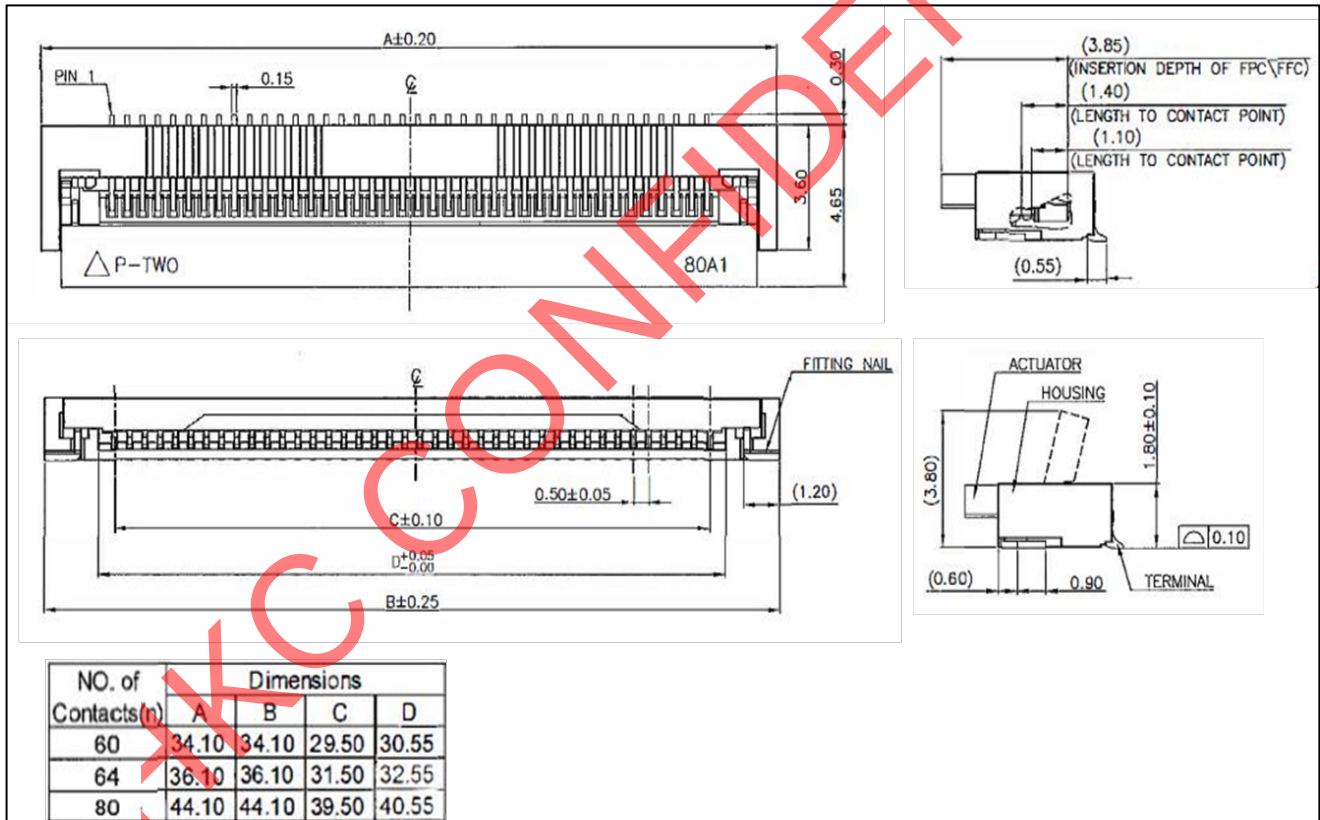


Fig.3.9 WP/SDA/SCL flicker set

3.2.2 Output Connector

80 pin connector drawing- 196590-80041-3 (P-two)



3.3 Timing Spec

Timing Table (DE Only Mode)

Frame Rate=60Hz

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
Frequency		F_{CLK} (= 1 / T_{CLK})	60	74.25	78.5	MHz	(1)
Frame Rate		F	57	60	63	Hz	
Vertical Term	Total	T_V	2208	2250	2450	T_H	$T_V = T_{VD} + T_{VB}$
	Display	T_{VD}	2160			T_H	
	Blank	T_{VB}	48	90	290	T_H	
Horizontal Term	Total	T_H	530	550	600	T_{CLK}	$T_H = T_{HD} + T_{HB}$
	Display	T_{HD}	480			T_{CLK}	
	Blank	T_{HB}	50	70	120	T_{CLK}	

Frame Rate=50Hz

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
Frequency		F_{CLK} (= 1 / T_{CLK})	60	74.25	78.5	MHz	(1)
Frame Rate		F	47	50	53	Hz	
Vertical Term	Total	T_V	2208	2700	2800	T_H	$T_V = T_{VD} + T_{VB}$
	Display	T_{VD}	2160			T_H	
	Blank	T_{VB}	48	540	640	T_H	
Horizontal Term	Total	T_H	530	550	600	T_{CLK}	$T_H = T_{HD} + T_{HB}$
	Display	T_{HD}	480			T_{CLK}	
	Blank	T_{HB}	50	70	120	T_{CLK}	

Attention:

The module is operated in DE only mode, H sync and V sync input signal have no effect on normal operation.

Note:

- Please make sure the range of pixel clock follows the following equations:

$$F_{clk}(max) \geq F_{max} \times T_v \times T_H$$

$$F_{min} \times T_v \times T_H \geq F_{clk}(min)$$

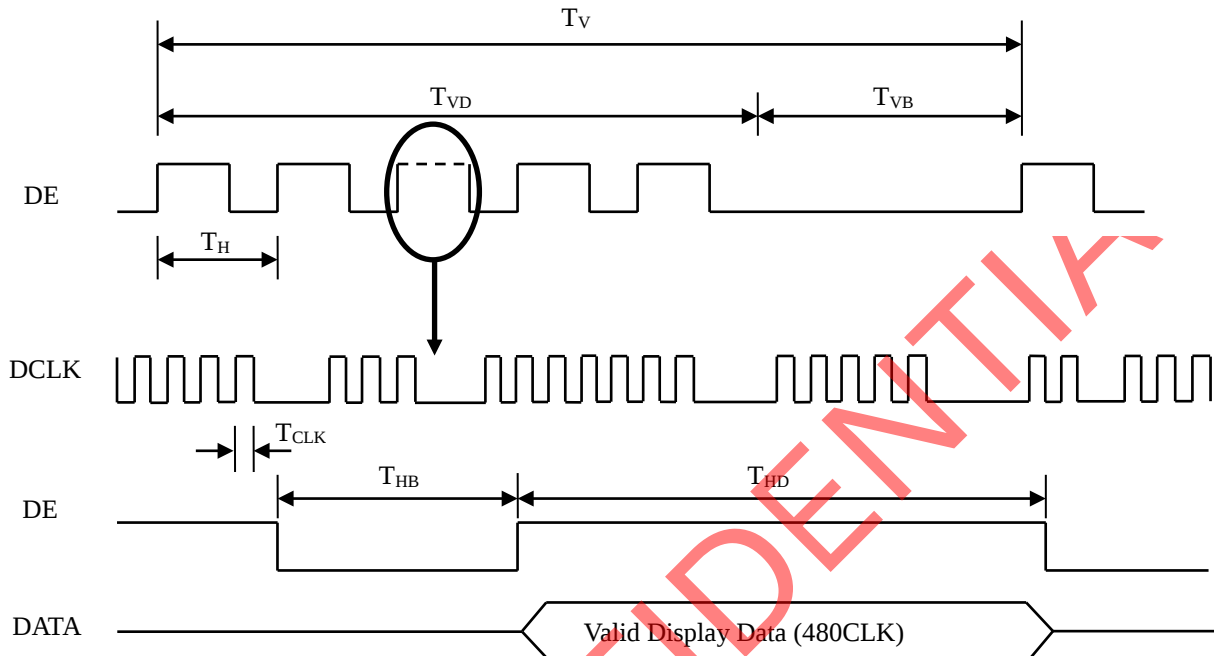


Fig.3.10 Interface signal timing diagram

3.4 Power On/Off Sequence

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

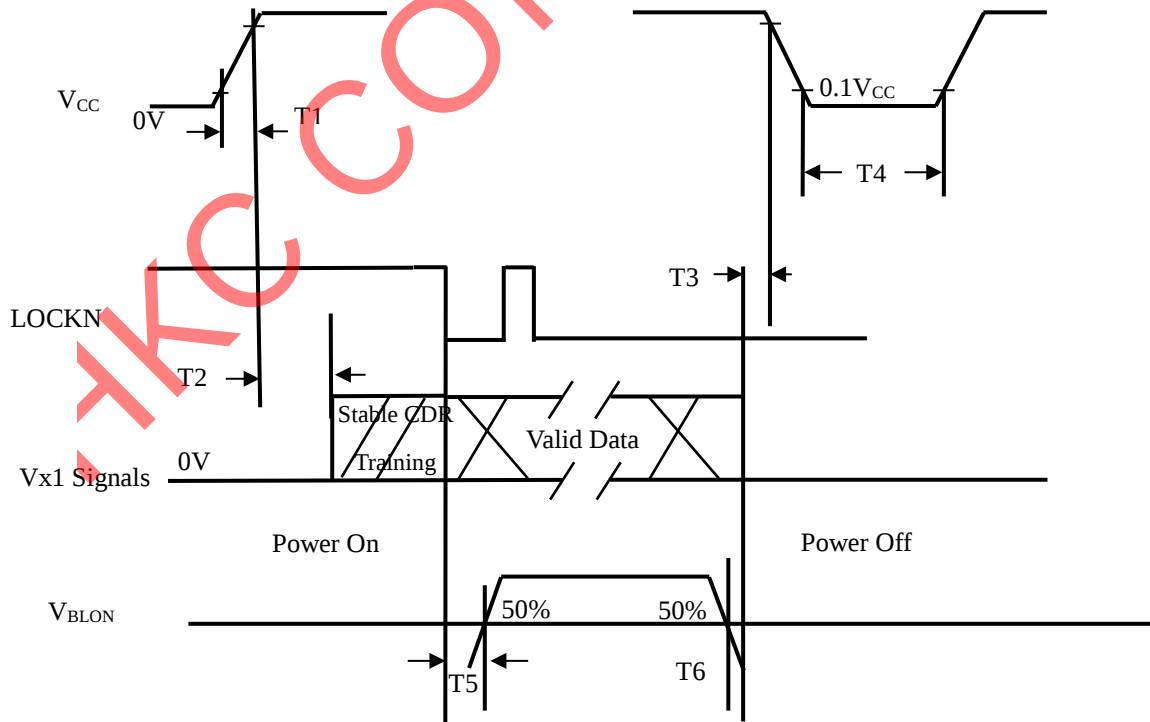


Fig.3.11 Power on/off sequence LOCKN

Parameter	Values			Unit
	Min.	Typ.	Max.	
T1	0.5	-	10.0	ms
T2	0	-	-	ms
T3	0	-	-	ms
T4	1000	-	-	ms
T5	500	-	-	ms
T6	100	-	-	ms

Attention:

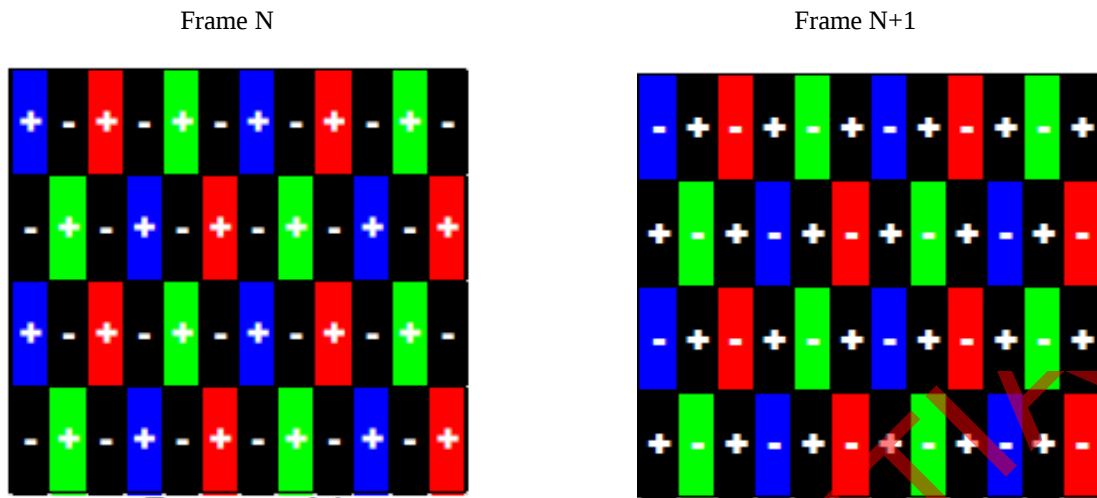
- (1) Apply the light bar voltage within the LCD operation range. When the backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become abnormal screen.
- (2) In case that V_{CC} is in off level, please keep the level of input signals on the low or high impedance.
- (3) T4 should be measured after the module has been fully discharged between power off and on period.
- (4) Interface signal shall not be kept at high impedance when the power is on.
- (5) The product should be always operated within above ranges.

3.5 Flicker Adjustment

- (a) Flicker should be adjusted by optimizing the Vcom value in customer LCM line through the I2C interface.(Master & Slave = I2C communication)

Pin. NO.	Symbol	Function	Remark
18	SDA	I2C Interface	I2C Interface
19	SCL	I2C Interface	
20	WP	EN	Default:0V Vcom tuning:3.3V (Shouldn't be communicated with I2C device as output level "5V")

(b) The Flicker adjustment pattern suggested as below.



Bright sub-pixel=G127(50% grayscale); dark sub-pixel=G0 (0%grayscale)

3.6 Driver IC ESD Spec

If the LCD module is designed with the Plastic Bezel, we suggest ESD protection solutions should be applied to avoid IC damaged, as shown in Fig.3.12 and Fig.3.13.

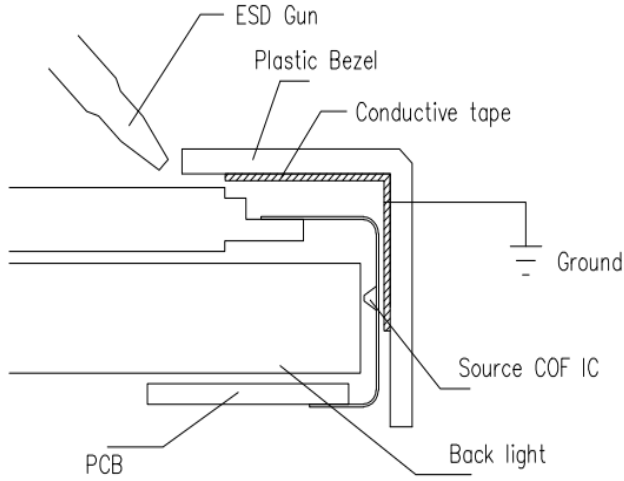


Fig.3.12 Source COF IC ESD protection

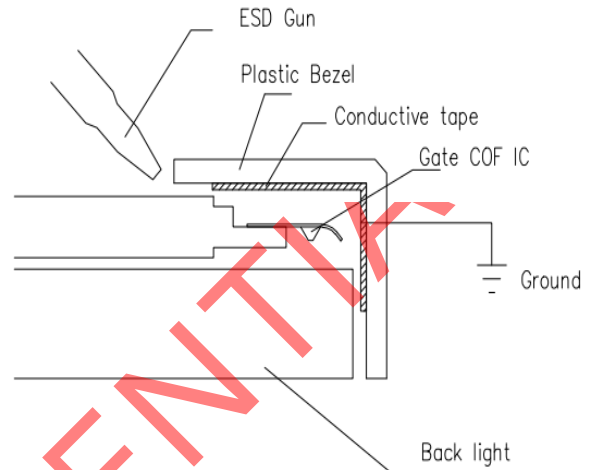


Fig.3.13 Gate COF IC ESD protection

4. OPTICAL CHARACTERISTICS

4.1 Measurement Conditions

The table below is the test condition of optical measurement.

Item	Symbol	Value	Unit
Ambient Temperature	T_A	25 ± 2	$^{\circ}\text{C}$
Ambient Humidity	H_A	50 ± 10	% RH
Supply Voltage	V_{CC}	12	V
Driving Signal	Refer to the typical value in Chapter 3: Electrical Specification		
Vertical Refresh Rate	F_v	60	Hz
Light source	HKC 31.5" WXGA module White LED Backlight Module/ Film structure		
Warm up time	T_{warm}	$>30 \text{ min}$	min
Dark room	ED	$1\text{lux}>$	lux

To avoid abrupt temperature change during optical measurement, the measurement should be executed in a stable, windless, in dark room after lighting the light source.

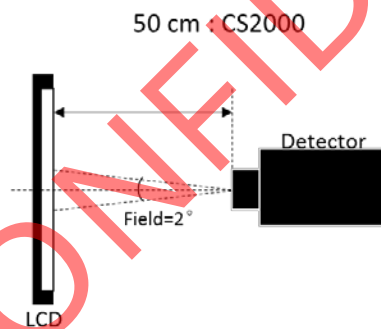


Fig 4.1 Measurement equipment.

4. 2 Optical Specifications

The relative measurement methods of optical characteristics are shown in 4.2. The following items should be measured under the test conditions described in 4.1 and stable environment shown in 4.1.

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Color Chromaticity (CIE1931)	Red	Rx	$\theta_x=0^\circ, \theta_y=0^\circ$ Viewing Angle at Normal Direction at center point of panel, Light source is C light	Typ - 0.03	0.661	Typ + 0.03	--	(1)
		Ry			0.326			
	Green	Gx			0.272			
		Gy			0.590			
	Blue	Bx			0.136			
		By			0.093			
	White	Wx			0.307			
		Wy			0.354			
Color Gamut		CG	-	72	-	%	(2)	
Transmittance		T%	-	4.6	-	%	(3)	
Contrast Ratio		CR	$\theta_x=0^\circ, \theta_y=0^\circ$	-	5000	-	-	(4)
Response Time		T _g	With HKC module	-	9.5	19	ms	(5)
Viewing angle	Horizontal	θ_{x+}	CR ≥ 10	-	89	-	Deg.	(6)
		θ_{x-}		-	89	-		
	Vertical	θ_{y+}		-	89	-		
		θ_{y-}		-	89	-		
Gamma		γ	-	-	2.2	-	-	(7)

- (1) Each chromaticity coordinates (x, y) are measured in CIE1931 color space when full-screen displaying (Red, Green, Blue, White) and light source is defined by C-light, Measurements shall be made at the center of the panel, and setup of measurement is shown in Fig 4.1.
- (2) The color gamut is defined as the fraction in percent of the area of the triangle bounded by R, G, B coordinates and the area is defined by NTSC 1931 color standard in the CIE color space. Chromaticity coordinates are measured by CS2000 and the standard setup of measurement is shown in Fig 4.1.

- (3) Definition of Transmittance (T%):

The transmittance is measured with full white pattern (L_{max}) at the center of the LCD panel, and backlight is defined by C-light..

$$\text{Transmittance (T\%)} = \frac{\text{Luminance of LCD module}}{\text{Luminance of backlight}}$$

(4) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression,

$$\text{Contrast Ratio (CR): } CR = \frac{CR_W}{CR_D}$$

CR_W : Luminance of LCD module with full screen white pattern (255,255, 255) at center point.

CR_D : Luminance of LCD module with full screen Dark pattern (0, 0, 0) at center point.

Where the measure point of to the Contrast Ratio is the center of the panel

(5) Definition of Response time (T_g):

Average of gray to gray response time (T_g) means the average switching time of luminance ratios among 0%,25%,50%,75%,and 100% to each other and is optimized on frame rate =60Hz.

Measured Response time		To				
		0%	25%	50%	75%	100%
From	0%		$T_{0\%to25\%}$	$T_{0\%to50\%}$	$T_{0\%to75\%}$	$T_{0\%to100\%}$
	25%	$T_{25\%to0\%}$		$T_{25\%to50\%}$	$T_{25\%to75\%}$	$T_{25\%to100\%}$
	50%	$T_{50\%to0\%}$	$T_{50\%to25\%}$		$T_{50\%to75\%}$	$T_{50\%to100\%}$
	75%	$T_{75\%to0\%}$	$T_{75\%to25\%}$	$T_{75\%to50\%}$		$T_{75\%to100\%}$
	100%	$T_{100\%to0\%}$	$T_{100\%to25\%}$	$T_{100\%to50\%}$	$T_{100\%to75\%}$	

Table 4.2 Switching time of luminance ratios matrix

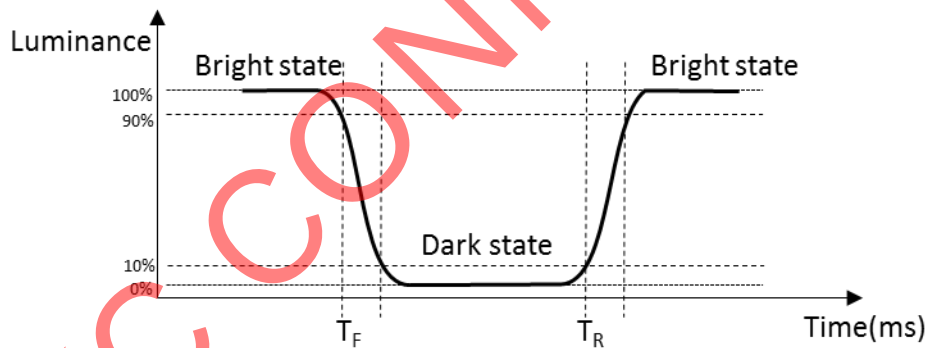


Fig 4.3 The definition of TR and TF

Measured response time is determined by 10% to 90% brightness difference of rising (T_R) or falling (T_F) time,

(6) Definition of Viewing angle:

As Note (4) the static contrast ratio definition, the viewing angles are defined at the angle that the contrast ratio is larger than 10 at four directions relative to the perpendicular direction of the HKC's module (two vertical angles: up θ_{y+} and down θ_{y-} ; and two horizontal angles: right θ_{x+} and left θ_{x-}). The standard setup of measurement is shown in Fig 4.1 & 4.4

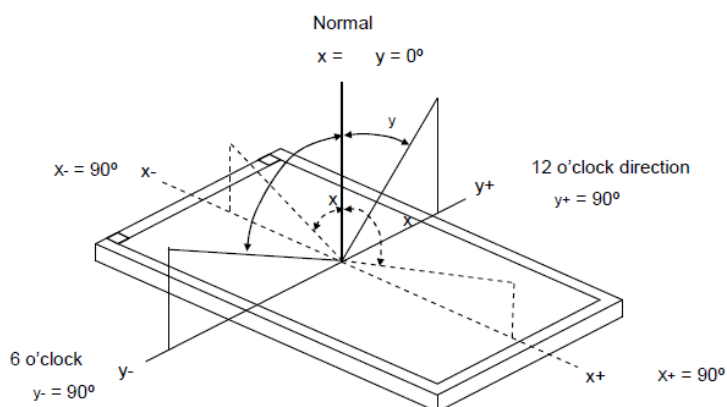


Fig.4.4 View angle coordination system

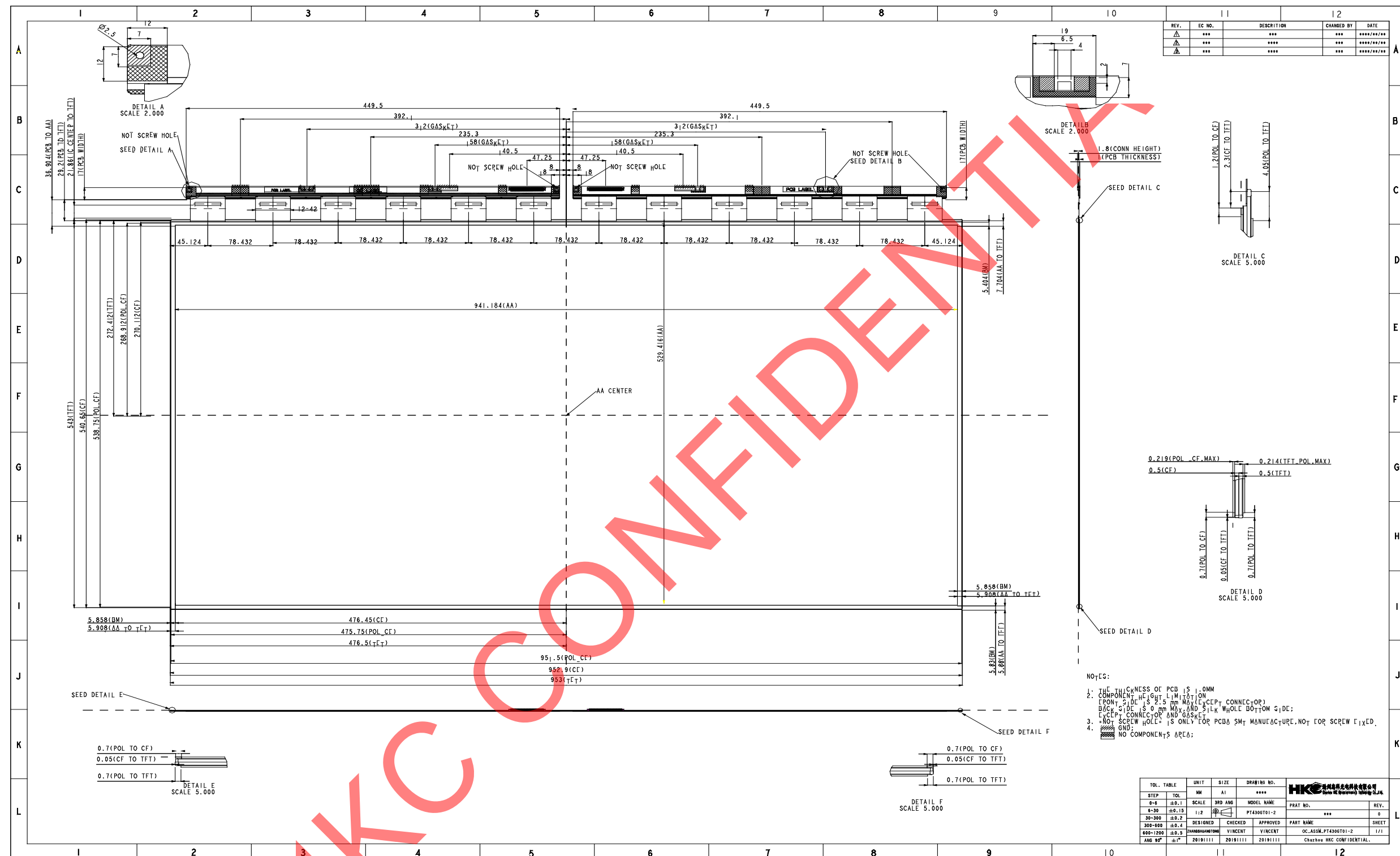
- (7) The gamma value is approximately 2.2 . For more information of luminance of gray level , see the Table 4.5.

Gray Level	Luminance [%] (Typ.)
L0	0.02
L15	0.20
L31	0.97
L47	2.42
L63	4.61
L79	7.59
L95	11.39
L111	16.04
L127	21.58
L143	28.01
L159	35.37
L175	43.68
L191	52.95
L207	63.20
L223	74.45
L239	86.71
L255	100

Table 4.5. GRAY SCALE SPECIFICATION

5. Mechanical Characteristics

5.1 Mechanical Specification

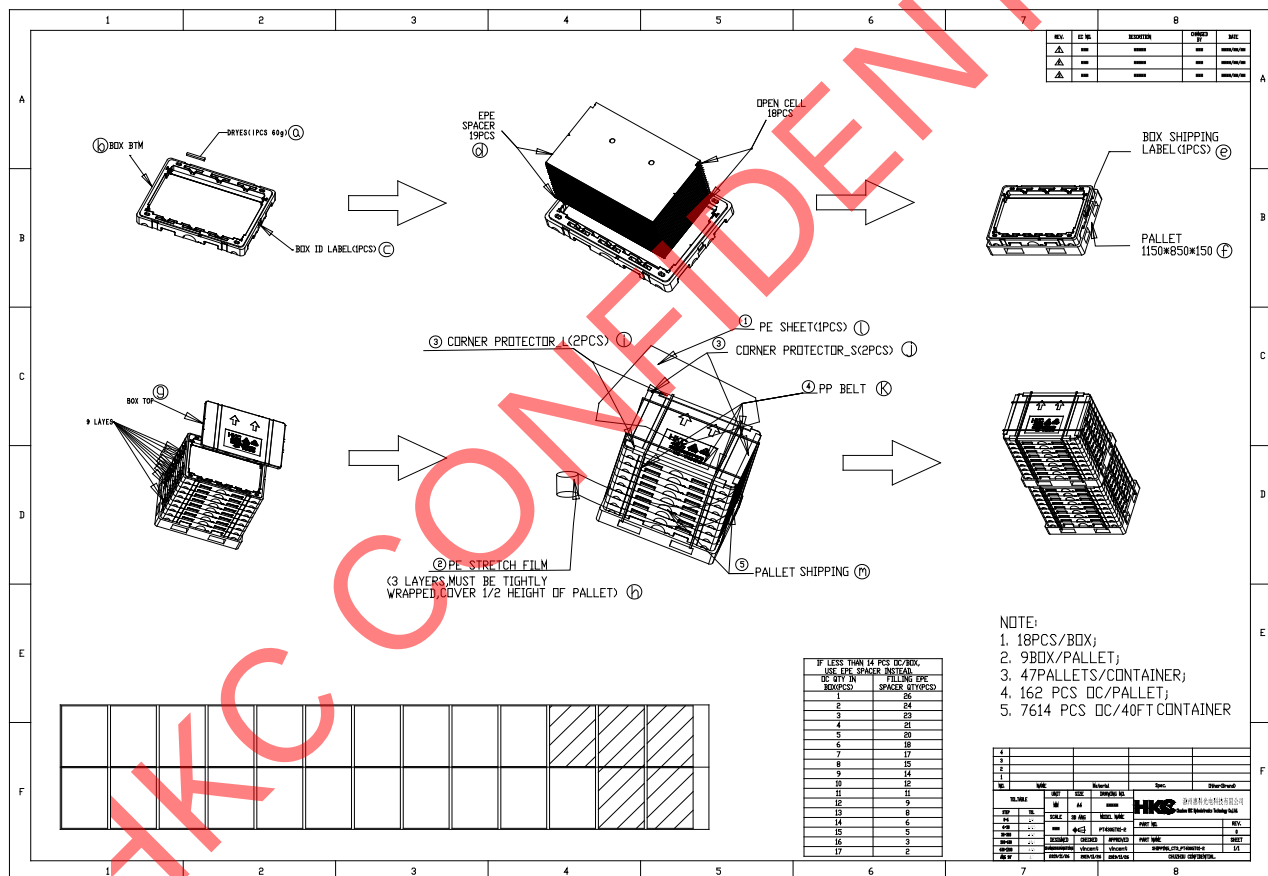


5.2 Packing

5.2.1 Packing Specifications

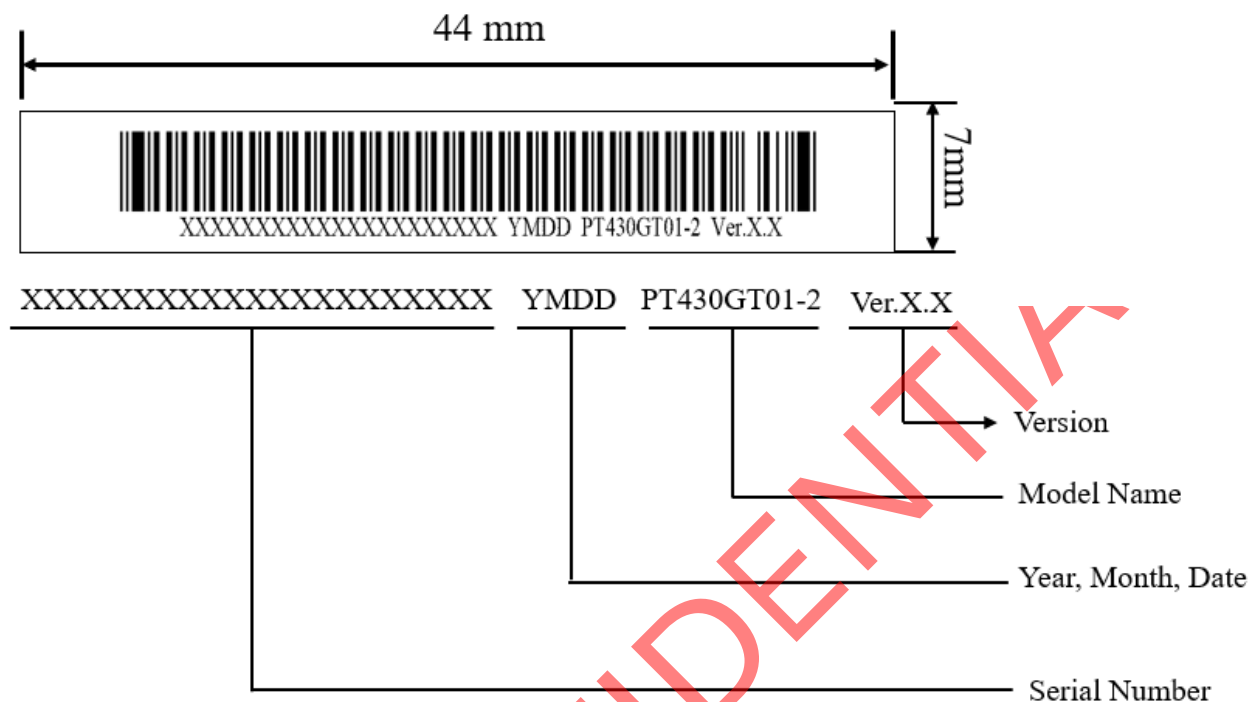
Item	Specification			
	Quantity	Dimension(mm)	Item	Weight(Kg)
Packing Box	18pcs/box	1100*800*108.5	Net Weight	28.44
			Gross Weight	31.375
Pallet	1	1150*850*150	Net Weight	14.8
Stack Layer	9			
Boxes per Pallet	9			
Pallet after Packing	162pcs/pallet	1150*850*1060.5	Gross Weight	290.935

Packaging materials and composition

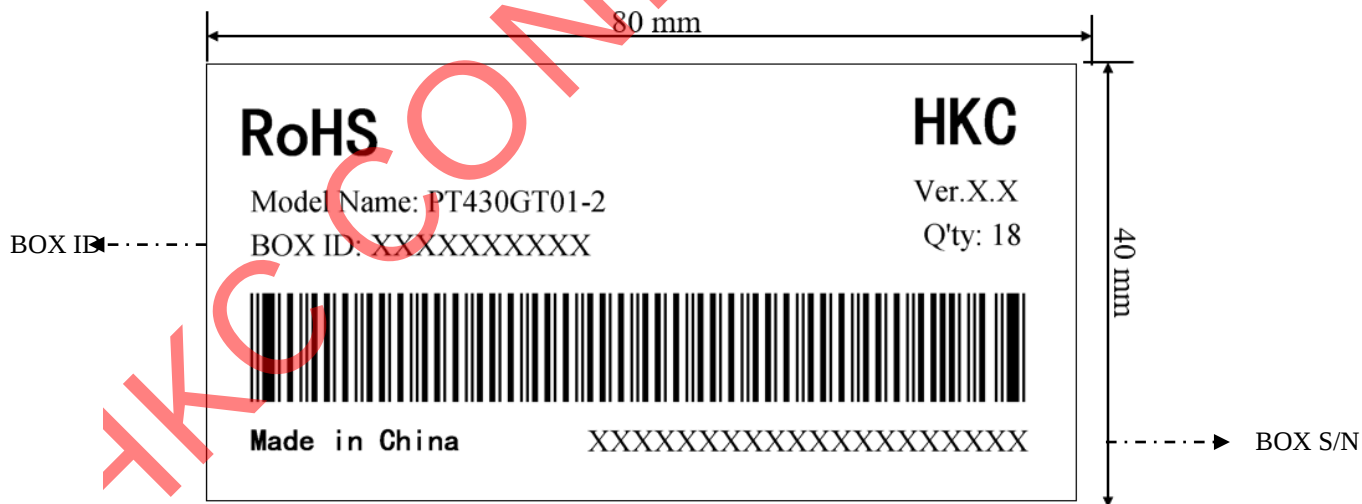


6. DEFINITION OF LABELS

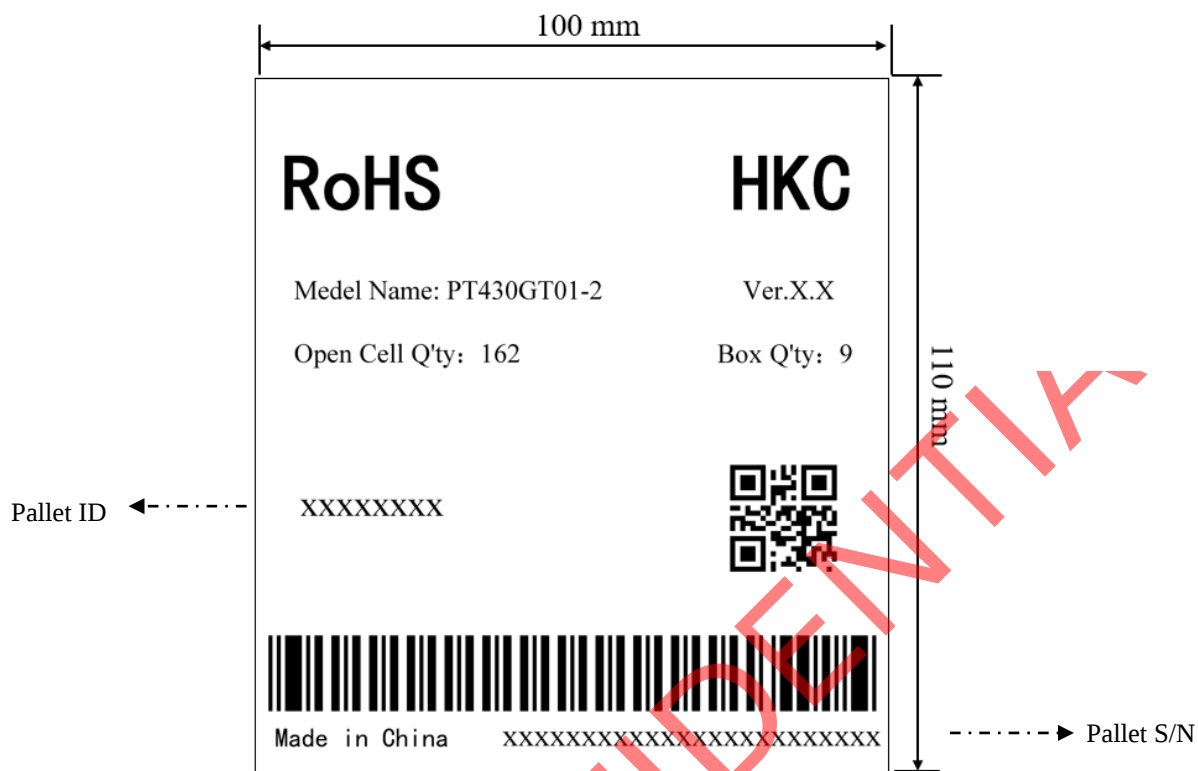
6.1 Open Cell Label



6.2 Carton Label



6.3 Pallet Label



7. PRECAUTION

Please pay attention to the followings when a TFT-LCD cell is used, handled and mounted.

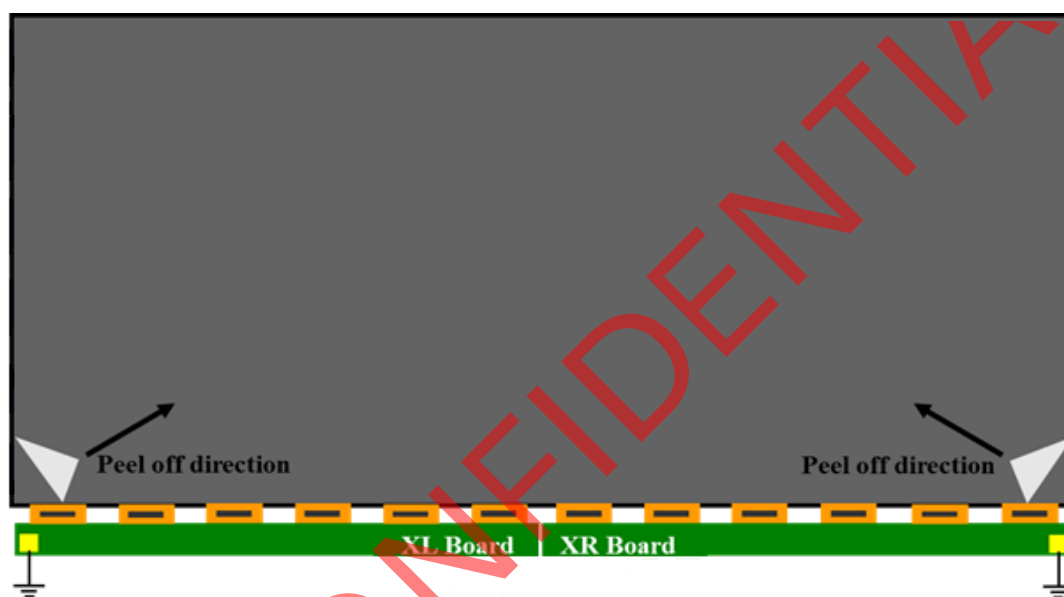
7.1 Unpacking

Should use immediately after unpacking TFT -LCD cell to prevent the terminal corrosion.

Protection film for a polarizer on a TFT open cell should be slowly peeled off so that the electrostatic charge can be minimized.

Source PCB should be connected to the ground when peel off the protection film.

The protection film should not be contacted to the driver during peeling off.



7.2 Storage test

Any attachment on polarizer of open-cell, such as tape, is forbidden and not recommended, especially under the high temperature and high humidity environment.

8. GP REQUIREMENT

- a) RoHS, Directive 2011/65/EU of the European Parliament and council of 1 July 2011
- b) RoHS, Directive (EU) 2015/863 of the European Parliament and council of 31 March 2015
- c) PPW

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