

# **INNOLUX DISPLAY CORPORATION**

## **LCD MODULE SPECIFICATION**

**Customer:** \_\_\_\_\_  
**Model Name:** AT050TN22 V.1  
**SPEC NO.:** A050-22-TT-11  
**Date:** 2008/12/09  
**Version:** 01

- Preliminary Specification  
 Final Specification

**For Customer's Acceptance**

Approved by	Comment

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### Record of Revision

Version	Revise Date	Page	Content
Pre-Spec.01	2008/09/29		Initial Release
Final-Spec.01	2008/12/09		The first version final specification.

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# 1. General Specifications

No.	Item	Specification	Remark
1	LCD size	5.0 inch(Diagonal)	
2	Driver element	a-Si TFT active matrix	
3	Resolution	640 × 3(RGB) × 480	
4	Display mode	Normally White, Transmissive	
5	Dot pitch	0.0529(W) × 0.1587(H) mm	
6	Active area	101.568(W) × 76.176(H) mm	
7	Module size	117.65(W) × 88.43(H) × 5.7(D) mm	Note 1
8	Surface treatment	Anti-Glare	
9	Color arrangement	RGB-stripe	
10	Interface	Digital	
11	Backlight Power consumption	1.200W (Typ.)	
12	Panel Power consumption	0.193W (Typ.)	
13	Weight	108g (Typ.)	

Note 1: Refer to Mechanical Drawing.

## 2. Pin Assignment

TTL connector is used for the module electronics interface. The recommended model is FH12S-50S-0.5SH manufactured by HiRose.

Pin No.	Symbol	I/O	Function	Remark
1	V <sub>LED+</sub>	P	Power for LED Circuit	
2	V <sub>LED+</sub>	P	Power for LED Circuit	
3	V <sub>LED-</sub>	P	Power for LED Circuit	
4	V <sub>LED-</sub>	P	Power for LED Circuit	
5	GND	P	Power ground	
6	V <sub>COM</sub>	I	V <sub>COM</sub> input	
7	DV <sub>DD</sub>	P	Power for Digital Circuit	
8	MODE	I	DE or HV mode control	Note1
9	DE	I	Data Enable	
10	VS	I	Vsync signal input	
11	HS	I	Hsync signal input	
12	B7	I	Blue data input (MSB)	
13	B6	I	Blue data input	
14	B5	I	Blue data input	
15	B4	I	Blue data input	
16	B3	I	Blue data input	
17	B2	I	Blue data input	
18	B1	I	Blue data input	
19	B0	I	Blue data input(LSB)	
20	G7	I	Green data input(MSB)	
21	G6	I	Green data input	
22	G5	I	Green data input	
23	G4	I	Green data input	
24	G3	I	Green data input	
25	G2	I	Green data input	
26	G1	I	Green data input	
27	G0	I	Green data input(LSB)	
28	R7	I	Red data input(MSB)	
29	R6	I	Red data input	
30	R5	I	Red data input	

31	R4	I	Red data input	
32	R3	I	Red data input	
33	R2	I	Red data input	
34	R1	I	Red data input	
35	R0	I	Red data input(LSB)	
36	GND	P	Power ground	
37	DCLK	I	Sample clock	
38	GND	P	Power ground	
39	L/R	I	Select left to right scanning direction	Note2
40	U/D	I	Select up or down scanning direction	Note2
41	VGH	I	Positive power for scan driver	
42	VGL	I	Negative power for scan driver	
43	AV <sub>DD</sub>	P	Power for Analog Circuit	
44	RESET	I	Reset	
45	POL	O	Polarity select for the line inversion control signal	
46	V <sub>COM</sub>	I	V <sub>COM</sub> input	
47	NC	-	No Connection	
48	NC	-	No Connection	
49	NC	-	No Connection	
50	NC	-	No Connection	

Note: I: input, O: output, P: Power

Note 1: DE Mode, Mode="H",HS floating and VS floating

HV Mode, Mode="L" and DE floating

Note2: Selection of scanning mode

Setting of scan control input		Scanning direction
U/D	L/R	
GND	DV <sub>DD</sub>	Up to down, left to right
DV <sub>DD</sub>	GND	Down to up, right to left
GND	GND	Up to down, right to left
DV <sub>DD</sub>	DV <sub>DD</sub>	Down to up, left to right

### 3. Operation Specifications

#### 3.1. Electrical Absolute Maximum Ratings

(Note 1)

Item	Symbol	Values		Unit	Remark
		Min.	Max.		
Power voltage	$DV_{DD}$	-0.3	7	V	
	$AV_{DD}$	-0.3	7	V	
	$V_{GH}$	-0.3	18	V	
	$V_{GL}$	-15	0.3	V	
	$V_{GH}-V_{GL}$	-	33	V	
Operation Temperature	$T_{OP}$	-20	70	°C	
Storage Temperature	$T_{ST}$	-30	80	°C	
LED Reverse Voltage	$V_r$	-	1.2	V	Each LED
LED Forward Current	$I_f$	-	25	mA	Each LED

Note 1: Device is subject to be damaged permanently if stresses beyond those absolute maximum ratings listed above.

Note 2:  $V_r$  conditions: Zener Diode 20mA.



## 3.2. Typical Operation Conditions

### 3.2.1. Typical Operation Conditions

(Note 2)

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Power voltage	$DV_{DD}$	3.0	3.3	3.6	V	
	$AV_{DD}$	4.8	5.0	5.2	V	
	$V_{GH}$	14.3	15.0	15.7	V	
	$V_{GL}$	-10.5	-10.0	-9.5	V	
$V_{COM}$	$V_{CAC}$	-	5.65	-	V	Note 1
	$V_{CDC}$	0.94	1.14	1.34	V	
Input logic high voltage	$V_{IH}$	$0.7DV_{DD}$	-	$DV_{DD}$	V	
Input logic low voltage	$V_{IL}$	0	-	$0.3DV_{DD}$	V	

Note 1: The brightness of LCD panel could be changed by adjusting the AC component of  $V_{COM}$ .

Note 2: Be sure to apply GND,  $DV_{DD}$ , and  $V_{GL}$ , to the LCD first, and then apply  $V_{GH}$ .

### 3.2.2. Current Consumption

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Current for Driver	$I_{GH}$	-	170	230	uA	$V_{GH} = +15V$
	$I_{GL}$	-	180	240	uA	$V_{GL} = -10V$
	$I_{CC}$	-	30	40	mA	$DV_{DD} = 3.3V$
	$I_{DD}$	-	18	24	mA	$AV_{DD} = 5V$



**3.2.3 Backlight Driving Conditions**

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Voltage for LED Backlight	$V_L$	8.7	9.3	9.9	V	Note 1,2
Current for LED Backlight	$I_L$	108	120	132	mA	
LED life time	-	20,000	-	-	Hr	Note 3

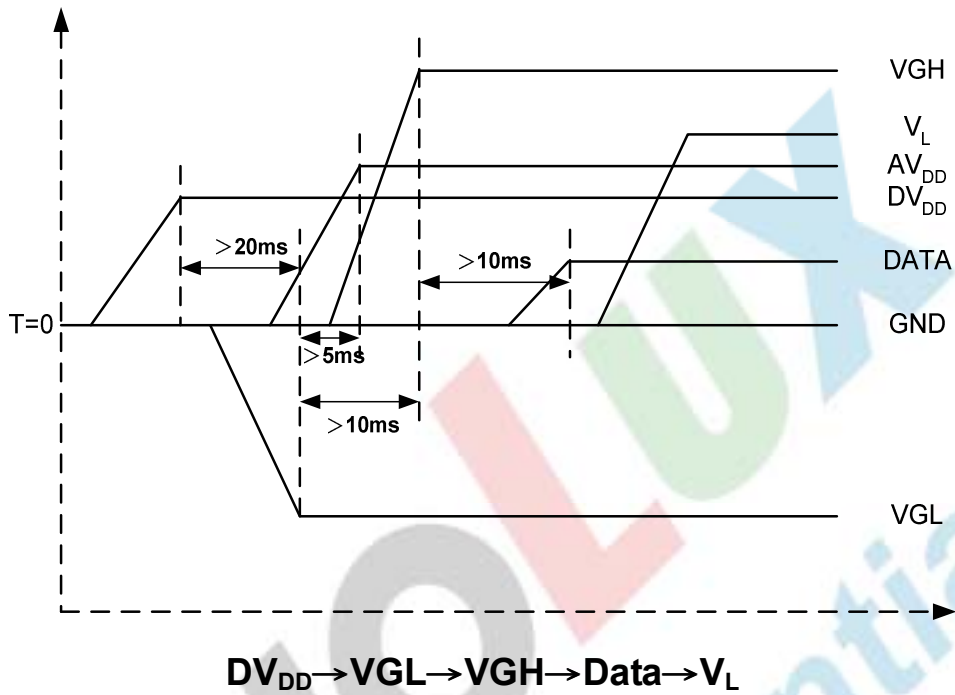
Note 1: The LED is supplied by Nichia.

Note 2: The Voltage for LED Backlight is defined at  $T_a=25^{\circ}\text{C}$  and  $I_L=120\text{mA}$ .

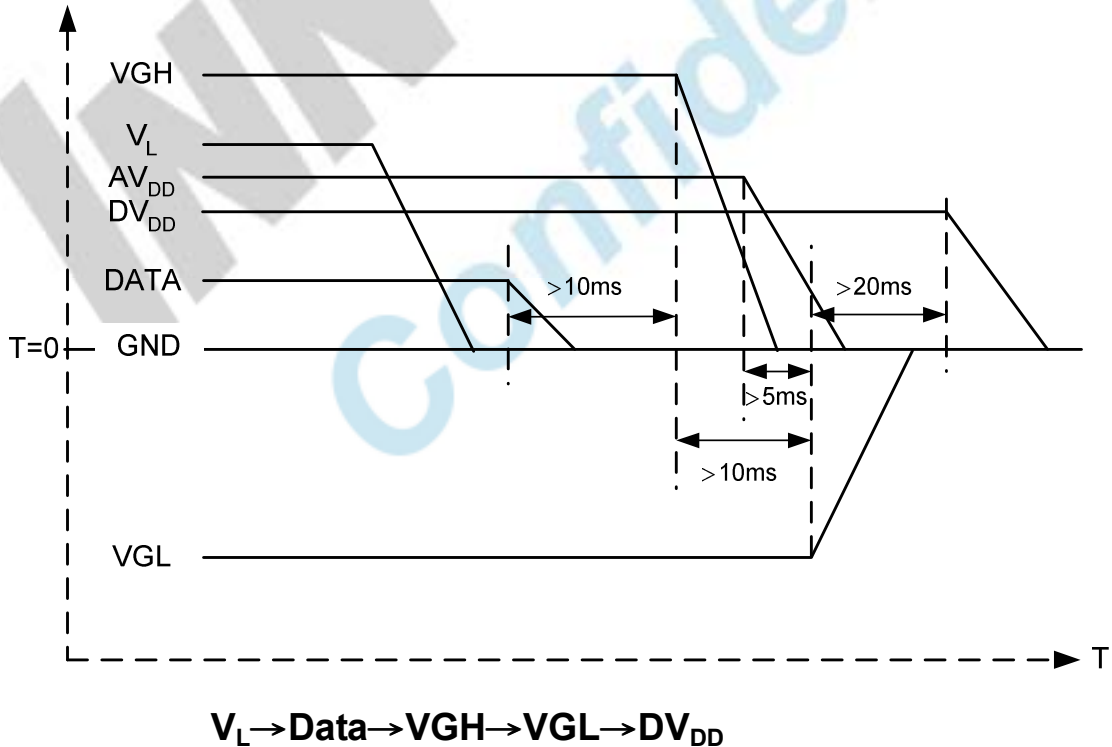
Note 3: The "LED life time" is defined as the module brightness decrease to 50% original brightness that the ambient temperature is  $25^{\circ}\text{C}$  and  $I_L=120\text{mA}$ . The LED lifetime could be decreased if operating  $I_L$  is larger than 120 mA.

### 3.3. Power Sequence

#### 1. Power on:



#### 2. Power off:



Note: Data includes DE, VS, HS, B0~B7, G0~G7, R0~R7, DCLK.

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### 3.4. Timing Characteristics

#### 3.4.1. Timing Conditions

##### Input/Output Timing

Item	Symbol	Values			Unit.	Remark
		Min.	Typ.	Max.		
PXLCLK clock time	Tclk	33.3	39.7	-	ns	1 Tclk
PXLCLK pulse duty	Tcwh	40	50	60	%	Tclk
DATA set-up time	Tdsu	12	-	-	ns	DATA to PXLCLK
DATA hold time	Tdhd	12	-	-	ns	DATA to PXLCLK
DE setup time	Tesu	12	-	-	ns	DE to PXLCLK
VSYNC setup time	Tvst	12	-	-	ns	
VSYNC hold time	Tvhd	12	-	-	ns	
HSYNC setup time	Thst	12	-	-	ns	
HSYNC hold time	Thhd	12	-	-	ns	
HSYNC period time	Th	22.91	31.76	-	us	
HSYNC width	Thwh	1	-	-	Tclk	
VSYNC width	Tvwh	1	-	-	Th	
HSYNC to CLKIN	Thc	-	-	1	Tclk	

##### Input Timing Limitation of DE Mode

DE Mode	Values			Unit	Remark
	Min.	Typ.	Max.		
THC	48	160	765	tclk	
THD	640	640	640	tclk	
TH	688	800	1405	tclk	1TH=1line
TVC	6	45	255	Line	
TVD	480	480	480	line	
TV	486	525	735	line	1TV=1field

## Input Timing Limitation of HV Mode

HV Mode	Values			Unit	Remark
	Min.	Typ.	Max.		
Thwh	-	10	-	tclk	
Thbp	-	134	-	tclk	
Thfp	-	16	-	tclk	
THD	-	640	-	tclk	
TH	-	800	-	tclk	
Tvwh	-	2	-	line	
Tvbp	-	11	-	line	
Tvfp	-	32	-	line	
TVD	-	480	-	line	
TV	-	525	-	line	1TV=1field

### 3.4.2. Timing Diagram

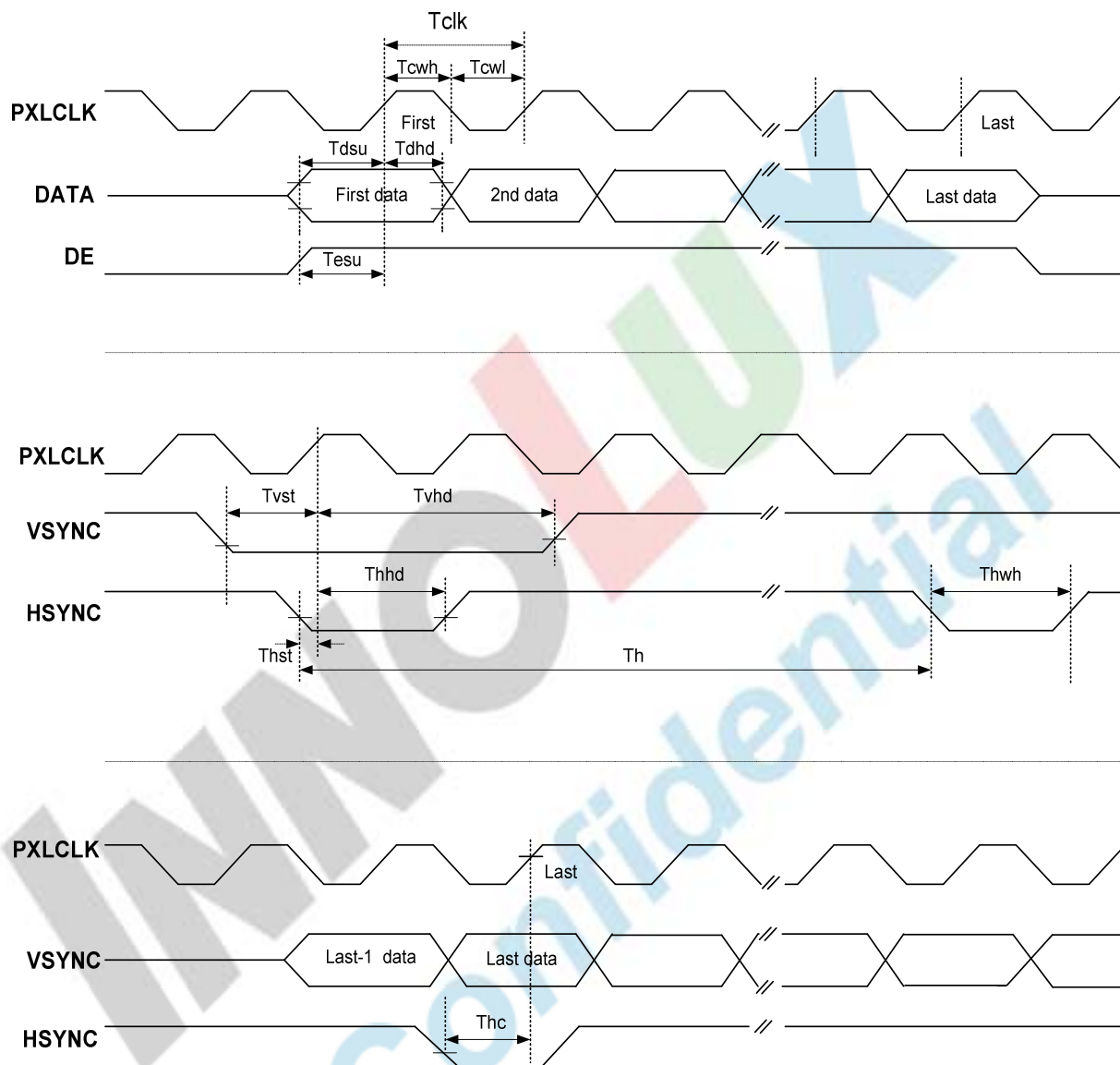


Fig.3-1 Clock and Data Input Timing Diagram

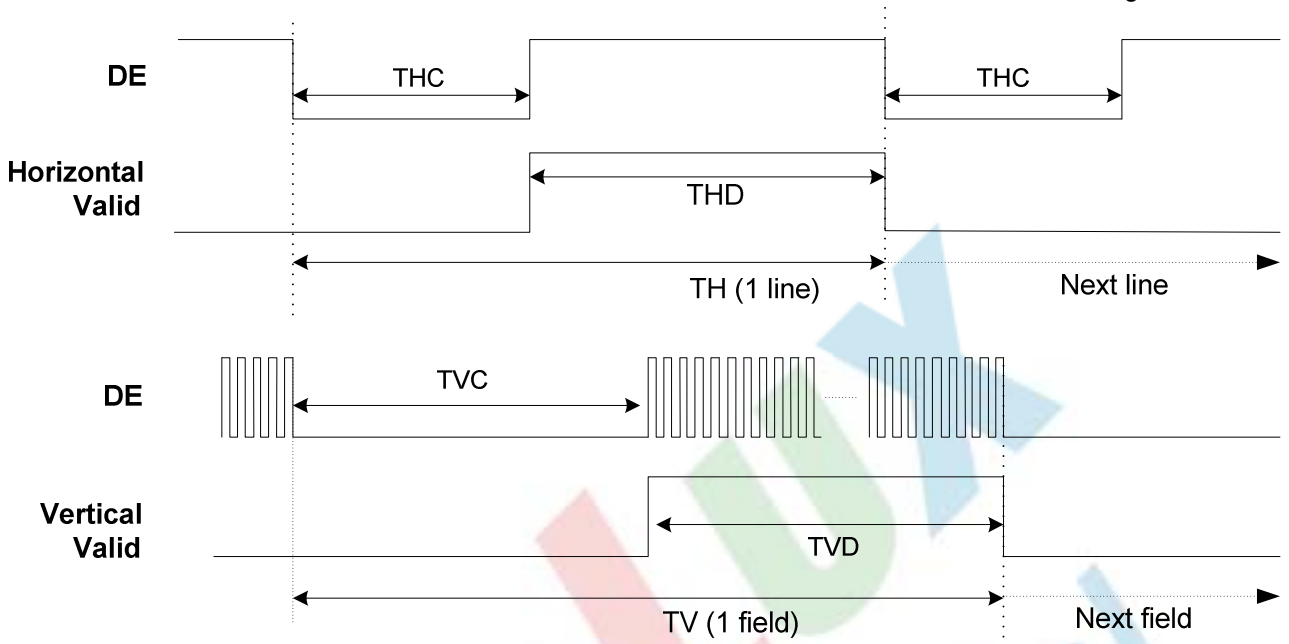


Fig.3-2 DE Mode Input Timing

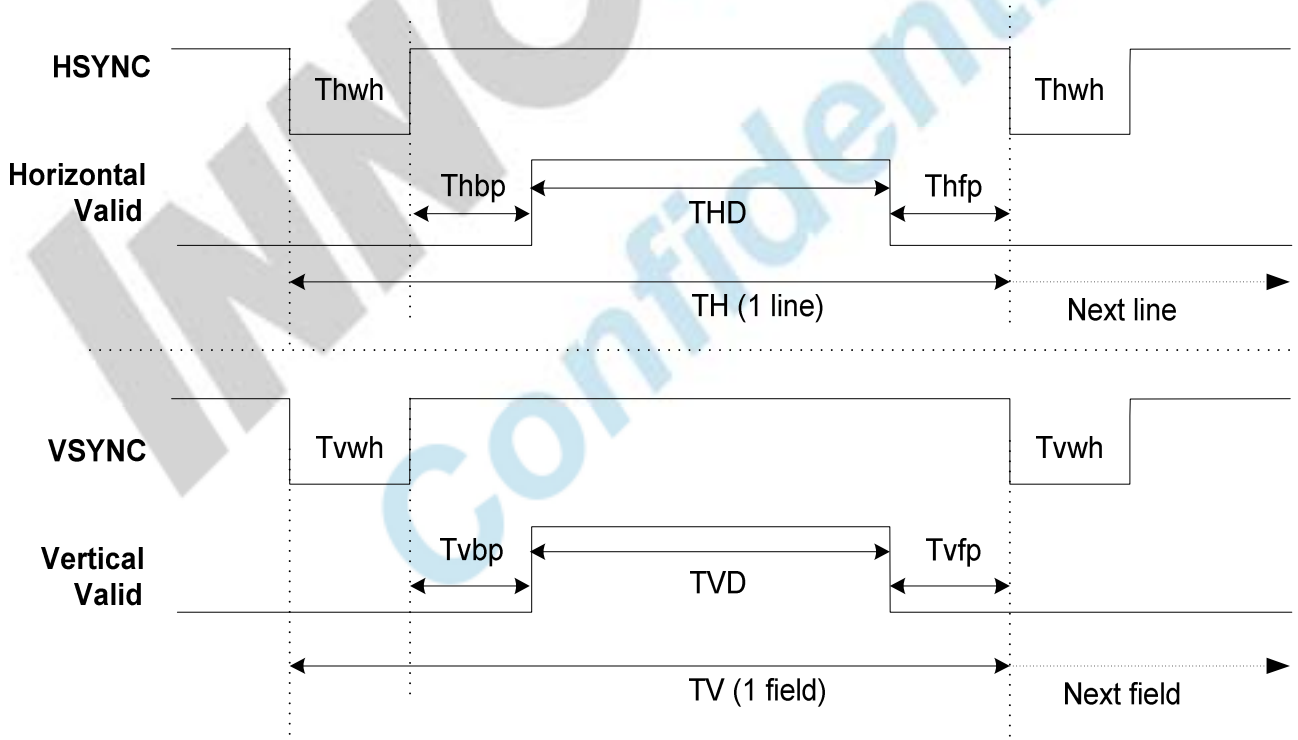


Fig.3-3 HV Mode Input Timing

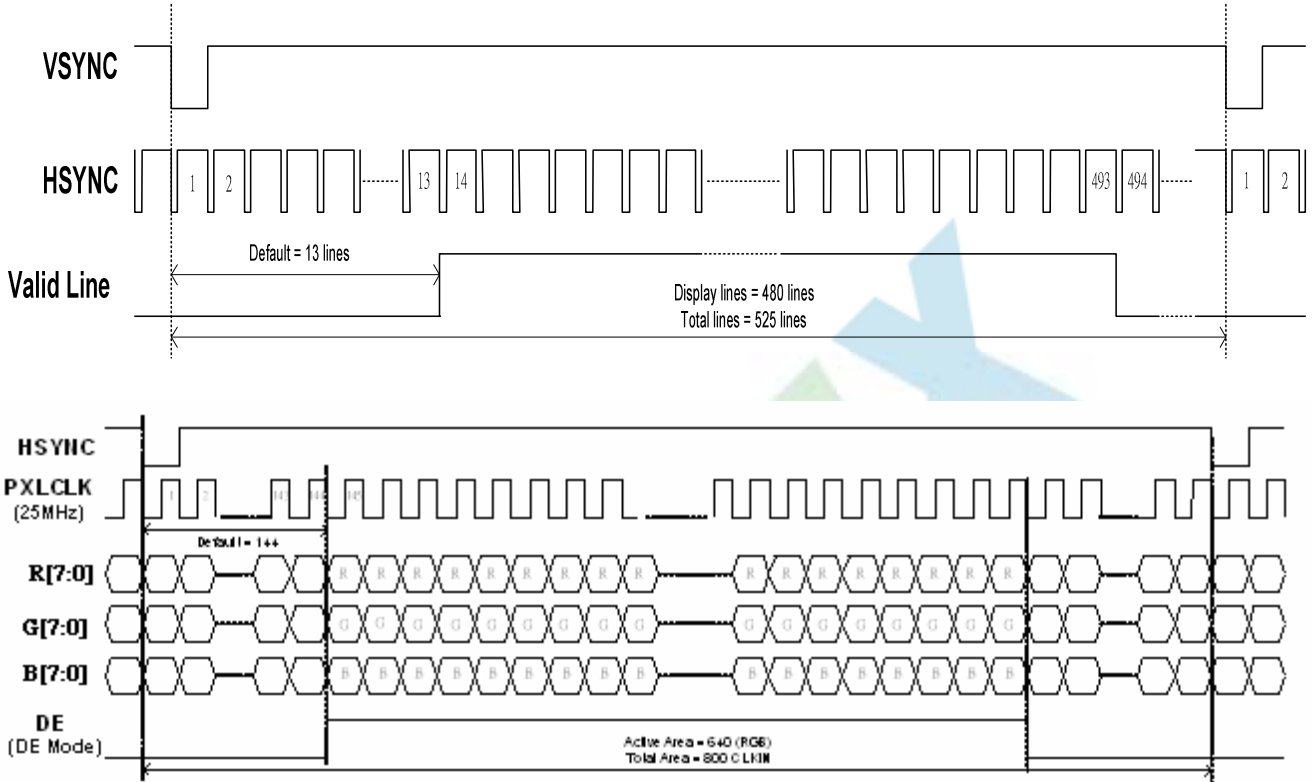


Fig. 3-4 24 bit RGB mode for 640 x(RGB)x 480



## 4. Optical Specification

Item	Symbol	Condition	Values			Unit	Remark
			Min.	Typ.	Max.		
Viewing angle (CR≥10)	$\theta_L$	$\Phi=180^\circ$ (9 o'clock)	60	70	-	degree	Note 1
	$\theta_R$	$\Phi=0^\circ$ (3 o'clock)	60	70	-		
	$\theta_T$	$\Phi=90^\circ$ (12 o'clock)	40	50	-		
	$\theta_B$	$\Phi=270^\circ$ (6 o'clock)	60	70	-		
Response time	$T_{ON}$	Normal $\theta=\Phi=0^\circ$	-	10	20	msec	Note 3
	$T_{OFF}$		-	15	30	msec	Note 3
Contrast ratio	CR		400	500	-	-	Note 4
Color chromaticity	$W_X$		0.26	0.31	0.36	-	Note 2 Note 5
	$W_Y$		0.28	0.33	0.38	-	Note 6
Luminance	L		200	250	-	cd/m <sup>2</sup>	Note 6
Luminance uniformity	$Y_U$		70	75	-	%	Note 6,7

### Test Conditions:

1.  $DV_{DD}=3.3V$ ,  $I_L=120mA$ , the ambient temperature is  $25^\circ C$ .
2. The test systems refer to Note 2.

Note 1: Definition of viewing angle range

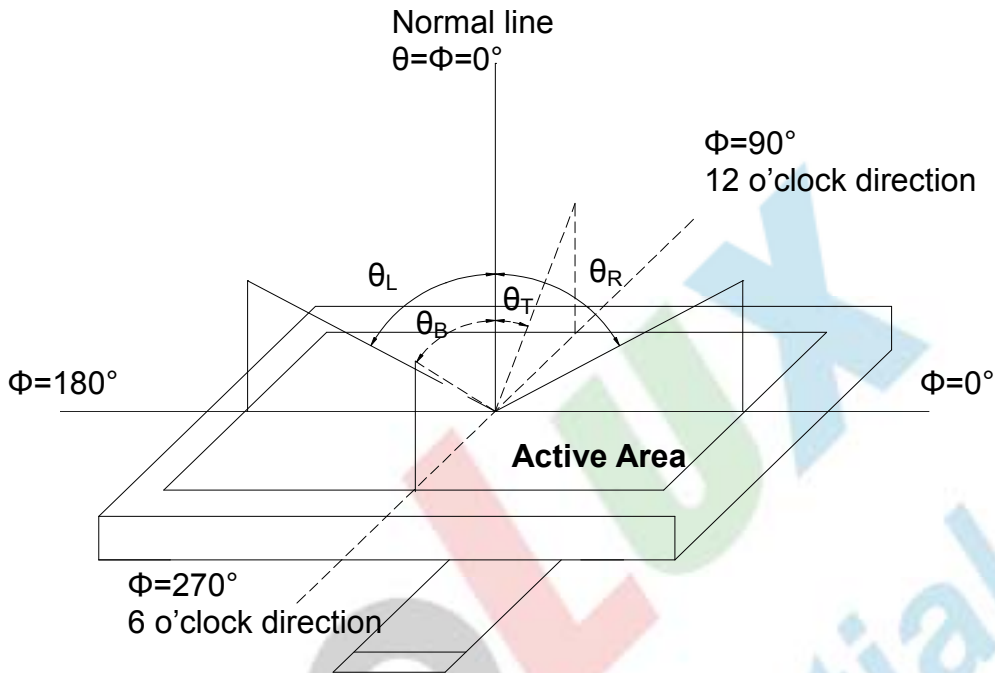


Fig. 4-1 Definition of viewing angle

Note 2: Definition of optical measurement system.

The optical characteristics should be measured in dark room. The optical properties are measured at the center point of the LCD screen. (Response time is measured by Photo detector TOPCON BM-7, other items are measured by BM-5A/Field of view: 1° /Height: 500mm.)

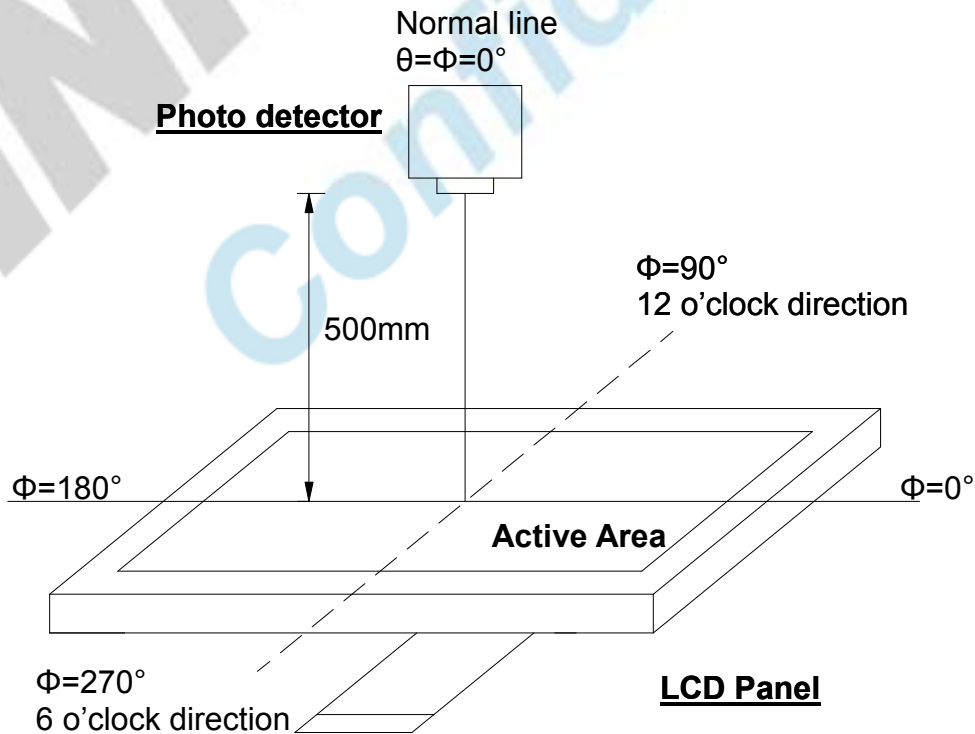


Fig. 4-2 Optical measurement system setup

### Note 3: Definition of Response time

The response time is defined as the LCD optical switching time interval between "White" state and "Black" state. Rise time ( $T_{ON}$ ) is the time between photo detector output intensity changed from 90% to 10%. And fall time ( $T_{OFF}$ ) is the time between photo detector output intensity changed from 10% to 90%.

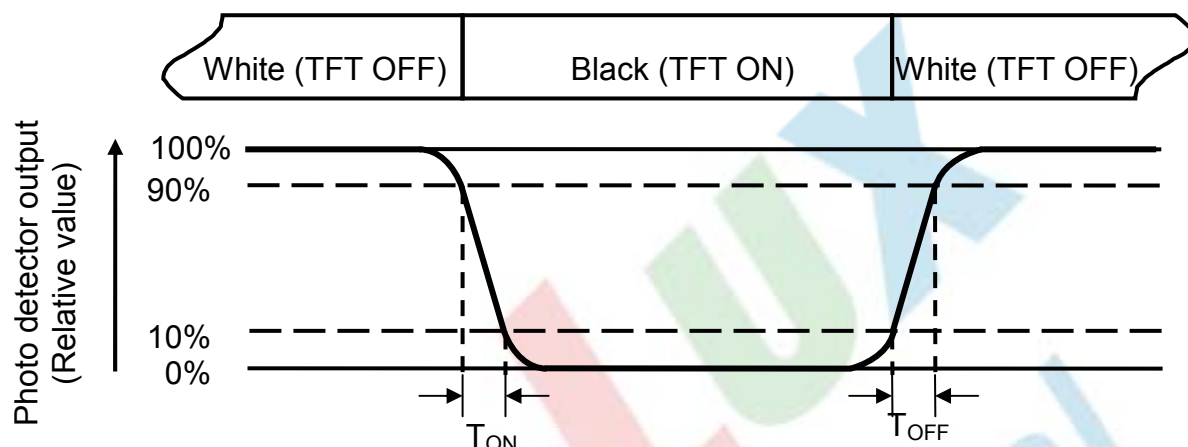


Fig. 4-3 Definition of response time

### Note 4: Definition of contrast ratio

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD on the "White" state}}{\text{Luminance measured when LCD on the "Black" state}}$$

### Note 5: Definition of color chromaticity (CIE1931)

Color coordinates measured at center point of LCD.

Note 6: All input terminals LCD panel must be ground while measuring the center area of the panel. The LED driving condition is  $I_L=120\text{mA}$ ,

**Note 7: Definition of Luminance Uniformity**

Active area is divided into 9 measuring areas (Refer to Fig. 4-4 ).Every measuring point is placed at the center of each measuring area.

$$\text{Luminance Uniformity (Yu)} = \frac{B_{min}}{B_{max}}$$

L-----Active area length      W----- Active area width

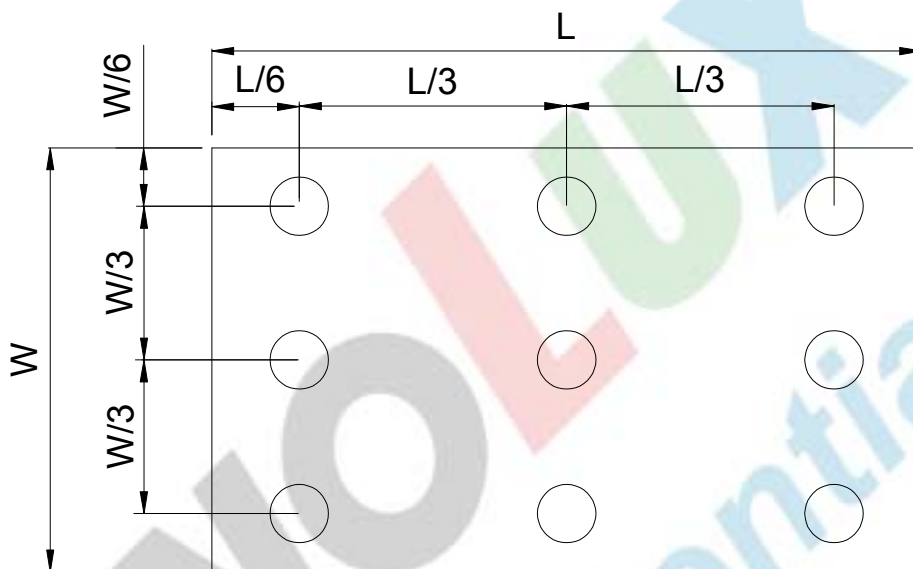


Fig. 4-4 Definition of measuring points

$B_{max}$ : The measured maximum luminance of all measurement position.

$B_{min}$ : The measured minimum luminance of all measurement position.



## 6. General Precautions

### 6.1. Safety

Liquid crystal is poisonous. Do not put it in your mouth. If liquid crystal touches your skin or clothes, wash it off immediately by using soap and water.

### 6.2. Handling

1. The LCD panel is plate glass. Do not subject the panel to mechanical shock or to excessive force on its surface.
2. The polarizer attached to the display is easily damaged. Please handle it carefully to avoid scratch or other damages.
3. To avoid contamination on the display surface, do not touch the module surface with bare hands.
4. Keep a space so that the LCD panels do not touch other components.
5. Put cover board such as acrylic board on the surface of LCD panel to protect panel from damages.
6. Transparent electrodes may be disconnected if you use the LCD panel under environmental conditions where the condensation of dew occurs.
7. Do not leave module in direct sunlight to avoid malfunction of the ICs.

### 6.3. Static Electricity

1. Be sure to ground module before turning on power or operating module.
2. Do not apply voltage which exceeds the absolute maximum rating value.

### 6.4. Storage

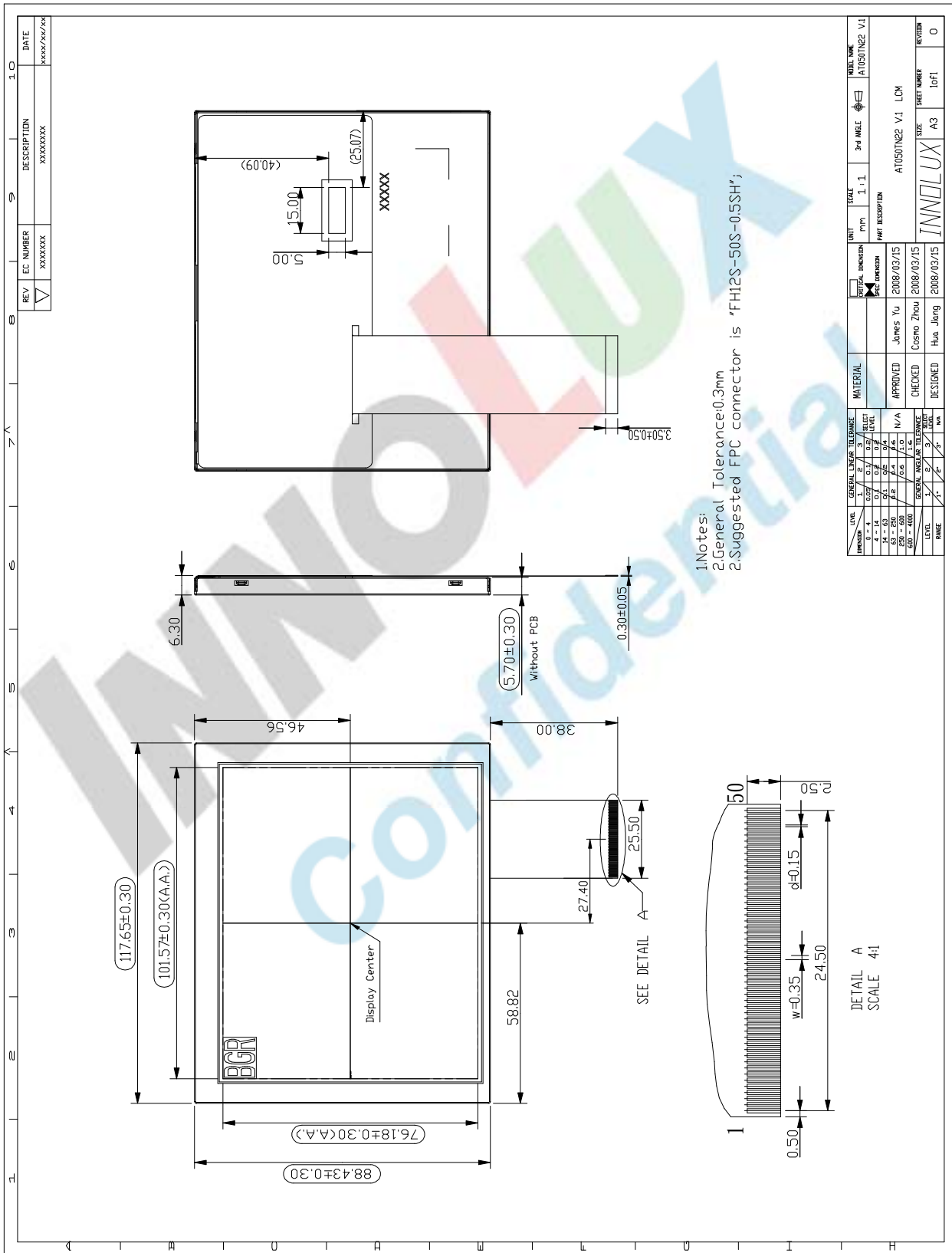
1. Store the module in a dark room where must keep at  $25\pm 10^{\circ}\text{C}$  and 65%RH or less.
2. Do not store the module in surroundings containing organic solvent or corrosive gas.
3. Store the module in an anti-electrostatic container or bag.

### 6.5. Cleaning

1. Do not wipe the polarizer with dry cloth. It might cause scratch.
2. Only use a soft sloth with IPA to wipe the polarizer, other chemicals might permanent damage to the polarizer.



# 7. Mechanical Drawing



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## 8. Package Drawing

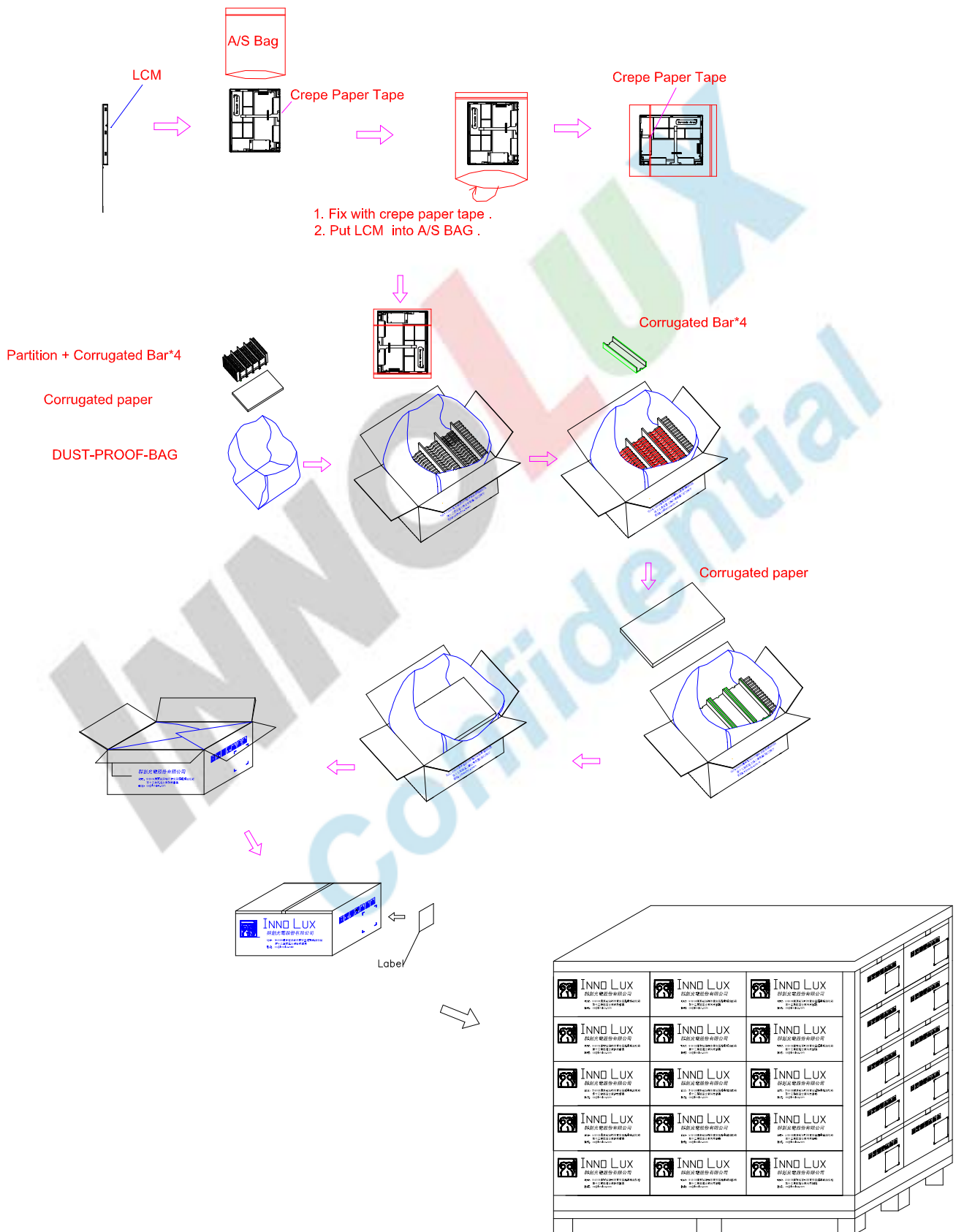
### 8.1. Packaging Material Table

No.	Item	Model (Material)	Dimensions(mm)	Unit Weight (kg)	Quantity	Remark
1	LCM Module	AT050TN22 V.1	117.65 × 88.43 × 5.7	0.108	60pcs	
2	Partition	B Corrugated paper	512 × 349 × 226	1.050	1set	
3	Corrugated Bar	B Corrugated paper	349 × 198 × 49	0.098	2set	
4	Corrugated Board	B Corrugated paper	512 × 349	0.040	8pcs	
5	Dust-Proof Bag	PE	700 × 530	0.060	1pcs	
6	A/S Bag	PE	180 × 133 × 0.2	0.001	60pcs	
7	Carton	Corrugated paper	530 × 355 × 255	1.100	1pcs	
8	Total Weight	9.292kg ± 5%				

### 8.2. Packaging Quantity

Total LCM quantity in Carton: no. of Partition	4 Rows x quantity per Row 15= 60
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### 8. 3.Package Drawing



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