

# **INNOLUX DISPLAY CORPORATION**

## **LCD MODULE SPECIFICATION**

Customer: \_\_\_\_\_

Model Name: AT043TN13 V.11

SPEC NO.: A043-13-TT-112

Date: 2006/07/21

Version: 02

☒ Preliminary Specification

☐ Final Specification

For Customer's Acceptance

Approved by	Comment

Approved by	Reviewed by	Prepared by
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## Record of Revision

Version	Revise Date	Page	Content
1	2006/06/29		Initial Release.
2	2006/7/21	4	Delete $V_{GH}$ , $V_{GL}$ of Power Voltage.
		5	Delete $V_{COM}$ of Input Signal Voltage Modify $V_{DD}$ of Input Signal Voltage
		6	Delete $I_{GH}$ , $I_{GL}$ of Current for Driver
		14	Modify the Viewing Angle.
		12	Modify the Active Force of Mechanical & Reliability Characteristics about Touch Screen Panel specification.
		2	Modify the definition of Pin.4.
			Modify Model Name from AT043TN01 V.2 to AT043TN13 V.11
		20	Modify the Mechanical Drawing.

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# 1. General Specifications

No.	Item	Specification	Remark
1	LCD size	4.3 inch(Diagonal)	
2	Driver element	a-Si TFT active matrix	
3	Resolution	480X3(RGB)X272	
4	Display mode	Normally White, Transmissive	
5	Dot pitch	0.066(W)X0.198(H) mm	
6	Active area	95.04(W)X53.856(H) mm	
7	Module size	105.5(W)X67.2(H)X4.95(D) mm	Note 1
8	Surface treatment	Anti-Glare	
9	Color arrangement	RGB-stripe	
10	Interface	Digital	
11	Backlight Power consumption	TBD	
12	Panel Power consumption	TBD	
13	Weight	TBD	

Note 1: Refer to Mechanical Drawing.

## 2. Pin Assignment

### 2.1. TFT LCD Panel Driving Section

Pin No.	Symbol	I/O	Function	Remark
1	VLED-	P	Power for LED	
2	VLED+	P	Power for LED	
3	GND	P	Power ground	
4	V <sub>DD</sub>	P	Power supply	
5	R0	I	Red data (LSB)	
6	R1	I	Red data	
7	R2	I	Red data	
8	R3	I	Red data	
9	R4	I	Red data	
10	R5	I	Red data	
11	R6	I	Red data	
12	R7	I	Red data (MSB)	
13	G0	I	Green data (LSB)	
14	G1	I	Green data	
15	G2	I	Green data	
16	G3	I	Green data	
17	G4	I	Green data	
18	G5	I	Green data	
19	G6	I	Green data	
20	G7	I	Green data (MSB)	

21	B0	I	Blue data (LSB)	
22	B1	I	Blue data	
23	B2	I	Blue data	
24	B3	I	Blue data	
25	B4	I	Blue data	
26	B5	I	Blue data	
27	B6	I	Blue data	
28	B7	I	Blue data (MSB)	
29	GND	P	Power ground	
30	PCLK	P	Pixel clock	
31	DISP	I	Display on/off	
32	HSYNC	I	Horizontal Sync Signal	
33	VSYNC	I	Vertical Sync Signal	
34	DE	I	Data Enable	
35	AV <sub>DD</sub>	P	Power supply (+5V)	
36	GND	P	Power ground	
37	X1	I/O	Right side of touch panel	
38	Y1	I/O	Bottom side of touch panel	
39	X2	I/O	Left side of touch panel	
40	Y2	I/O	Up side of touch panel	

I: input, O: output, P: Power

### 3. Operation Specifications

#### 3.1. Absolute Maximum Rating

 (GND=AV<sub>SS</sub>=0V, Note 1)

Item	Symbol	Values		Unit	Remark
		Min.	Max.		
Power voltage	V <sub>DD</sub>	-0.3	6.0	V	
	AV <sub>DD</sub>	-0.3	6.0	V	
Input signal voltage	Logic input	-0.3	V <sub>DD</sub> +0.3	V	
Operation Temperature	T <sub>OP</sub>	(-20)	(70)	°C	
Storage Temperature	T <sub>ST</sub>	(-30)	(80)	°C	

Note 1: The absolute maximum rating values of this product are not allowed to be exceeded at any times. Should a module be used with any of the absolute maximum ratings exceeded, the characteristics of the module may not be recovered, or in an extreme case, the module may be permanently destroyed.

### 3.1.1. Typical Operation Conditions

 (GND=AV<sub>SS</sub>=0V, Note 1)

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Power voltage	V <sub>DD</sub>	2.3	2.5	2.7	V	Note 2
		3.0	3.3	3.6	V	
	AV <sub>DD</sub>	4.8	5.0	5.2	V	
Input logic high voltage	V <sub>IH</sub>	0.7V <sub>DD</sub>	-	V <sub>DD</sub>	V	
Input logic low voltage	V <sub>IL</sub>	0	-	0.3V <sub>DD</sub>	V	

 Note 1: Be sure to apply V<sub>DD</sub> and V<sub>GL</sub> to the LCD first, and then apply V<sub>GH</sub>.

 Note 2: You should choose only one from the typical values of V<sub>DD</sub>.



### 3.1.2. Current Consumption

 (GND=AV<sub>SS</sub>=0V)

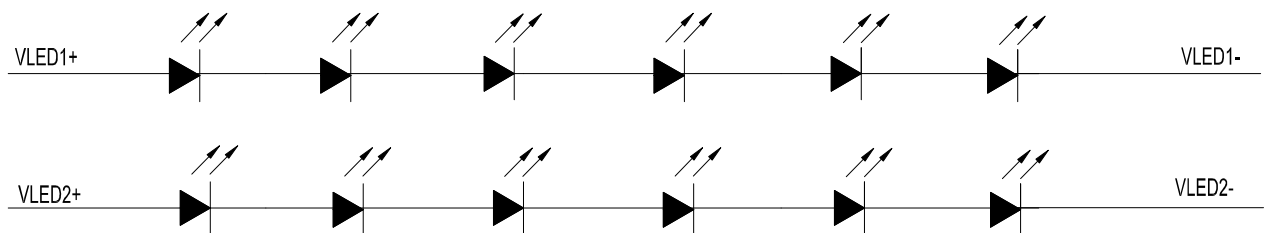
Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Current for Driver	I <sub>DD</sub>	-	TBD	TBD	mA	V <sub>DD</sub> =2.5V
	I <sub>AVDD</sub>	-	TBD	TBD	mA	AV <sub>DD</sub> =5.0V

### 3.1.3. Backlight Driving Conditions

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
LED voltage	V <sub>L</sub>	-	19.8	21.0	V	Note 2
LED current	I <sub>L</sub>	-	(16)	-	mA	Note 2
LED life time	-	20,000	-	-	Hr	Note 1

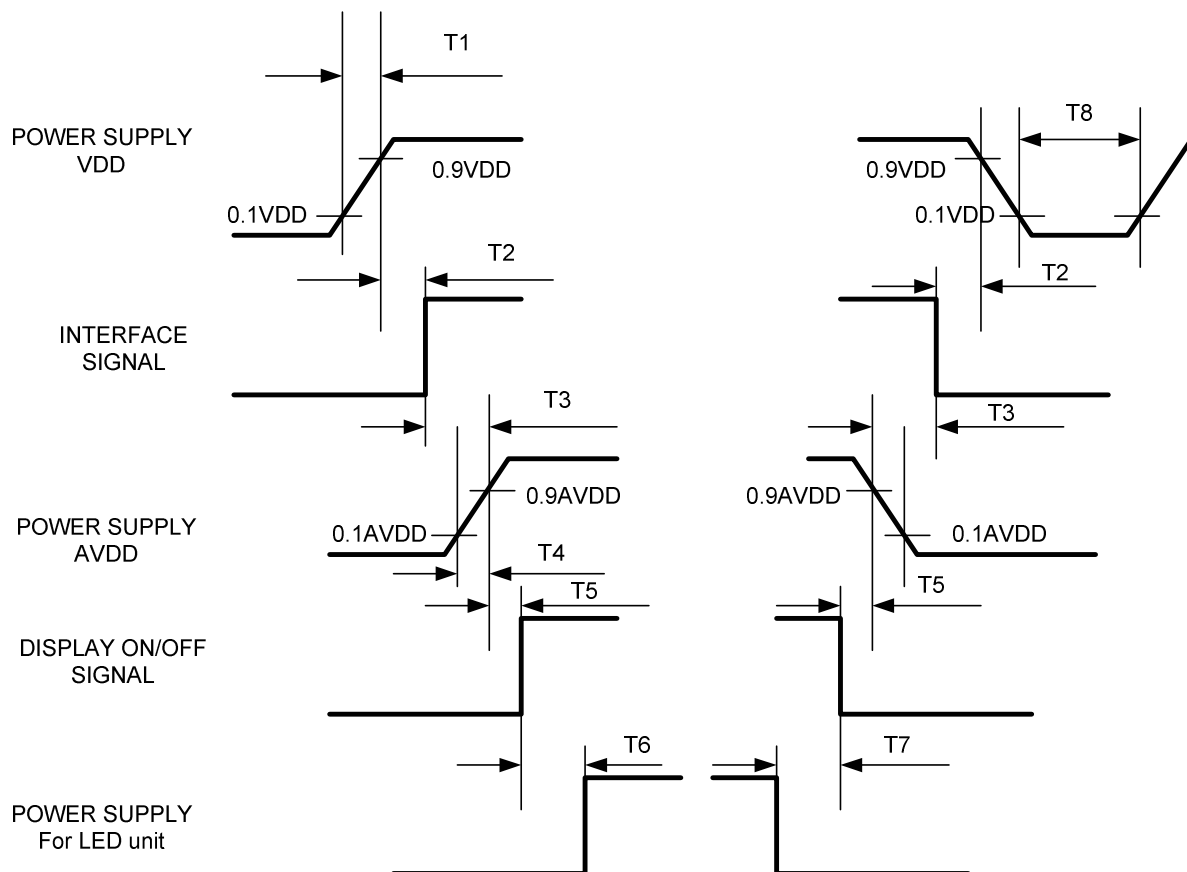
Note 1: The “LED life time” is defined as the module brightness decrease to 50% original brightness that the ambient temperature is 25°C and I<sub>L</sub> =16mA.

Note 2: The LED driving condition is defined for each LED module (6 LED Serial).



### 3.2. Power Sequence

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



Symbol	Specification	Symbol	Specification
T1	$0 \leq T1 \leq 10 \text{ msec}$	T5	$0 \leq T5 \leq 160 \text{ msec}$
T2	$0 \leq T2 \leq 100 \text{ msec}$	T6	$160 \text{ msec} \leq T6$
T3	$0 \leq T3 \leq 50 \text{ msec}$	T7	$160 \text{ msec} \leq T7$
T4	$0 \leq T4 \leq 10 \text{ msec}$	T8	$1 \text{ msec} \leq T8$

### 3.3. Timing Characteristics

#### 3.3.1. Timing Conditions

(TA = 25°C, VDD = 2.3V~3.5V, GND = 0V)

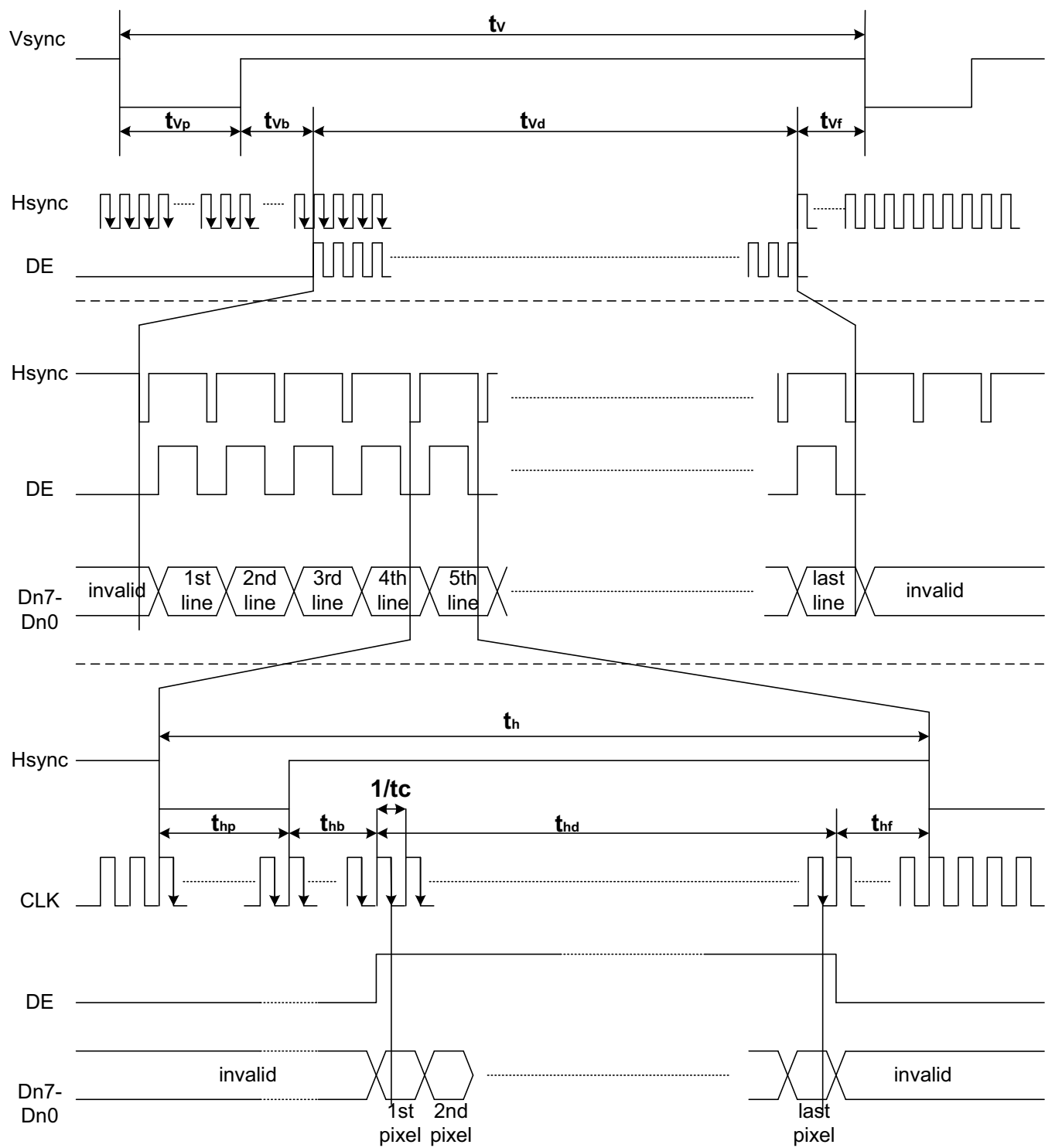
Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Clock cycle	1/tc	-	9.00	15	MHz	
Hsync cycle	1/fH	-	17.14	-	KHz	
Vsync cycle	1/fv	59.94	-	-	Hz	
Horizontal signal	t <sub>h</sub>	-	525	-	CLK	Note 1
Horizontal display period	t <sub>hd</sub>	-	480	-	CLK	
Horizontal Front porch	t <sub>hf</sub>	2	-	-	CLK	Note 2
Horizontal Pulse width	t <sub>hp</sub>	2	41	-	CLK	Note 2
Horizontal Back porch	t <sub>hb</sub>	2	-	-	CLK	Note 2
Vertical cycle	t <sub>v</sub>	-	286	-	H	
Vertical display period	t <sub>vd</sub>	-	272	-	H	
Vertical Front porch	t <sub>vf</sub>	2	2	-	H	
Vertical Pulse width	t <sub>vp</sub>	2	10	-	H	
Vertical Back porch	t <sub>vb</sub>	2	2	-	H	
DISP Setup Time	t <sub>diss</sub>	10	-	-	ns	
DISP Hold Time	t <sub>dish</sub>	10	-	-	ns	
Clock Period	PW CLK	66.7	-	-	ns	
Clock Pulse High Period	PWH	26.7	-	-	ns	
Clock Pulse Low Period	PWL	26.7	-	-	ns	
Hsync Setup Time	t <sub>hs</sub>	10	-	-	ns	
Hsync Hold Time	t <sub>hh</sub>	10	-	-	ns	

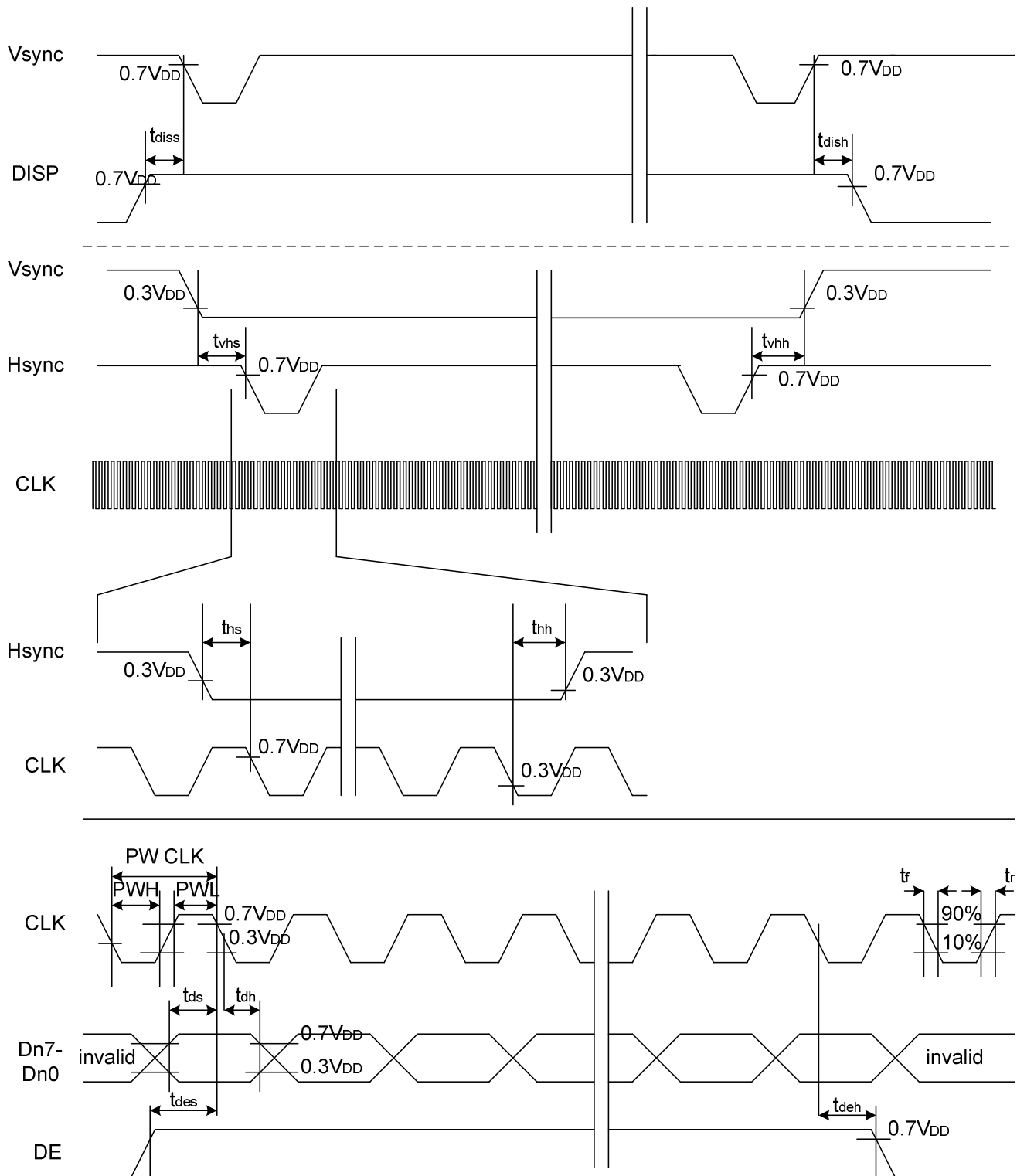
Data Setup Time	$t_{ds}$	10	-	-	ns	
Data Hold Time	$t_{dh}$	10	-	-	ns	
DE Setup Time	$t_{des}$	10	-	-	ns	
DE Hold Time	$t_{deh}$	10	-	-	ns	
Vsync Setup Time	$t_{vhs}$	10	-	-	ns	
Vsync Hold Time	$t_{vhh}$	10	-	-	ns	

Note 1:  $t_{hd}=480\text{CLK}$ ,  $t_{hf}=2\text{CLK}$ ,  $t_{hp}=41\text{CLK}$ ,  $t_{hb}=2\text{CLK}$   
 $525\text{CLK}=480\text{CLK} + 2\text{CLK} + 41\text{CLK} + 2\text{CLK}$

Note 2:  $t_{hf}+t_{hp}+t_{hb}>44\text{ CLK}$

3.3.2. Timing Diagram





## 4. Touch Screen Panel Specifications

### 4.1. Electrical Characteristics

Item	Value			Unit	Remark
	Min.	Typ.	Max.		
Linearity	-1.5	-	1.5	%	Analog X and Y directions
Terminal Resistance	100	-	900	$\Omega$	X(Film side)
	100	-	900	$\Omega$	Y(Glass side)
Insulation resistance	25	-	-	M $\Omega$	DC 25V
Voltage	-	5	7	V	DC
Chattering	-	-	10	ms	100k $\Omega$ pull-up
Transparency	79	-	-	%	JIS K7105

Note: Do not operate it with a thing except a polyacetal pen (tip R0.8mm or less) or a finger, especially those with hard or sharp tips such as a ball point pen or a mechanical pencil.

### 4.2. Mechanical & Reliability Characteristics

Item	Value			Unit	Remark
	Min.	Typ.	Max.		
Activation force	80	-	-	gf	Note 1
Durability-surface scratching	Write 100,000	-	-	characters	Note 2
Durability-surface pitting	1,000,000	-	-	touches	Note 3
Surface hardness	3	-	-	H	JIS K5400

Note 1: Stylus pen input: R0.8mm polyacetal pen or finger.

Note 2: Measurement for surface area.

-Scratch 100,000 times straight line on the film with a stylus change every 20,000

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times.

-Force: 250gf.

-Speed: 60mm/sec.

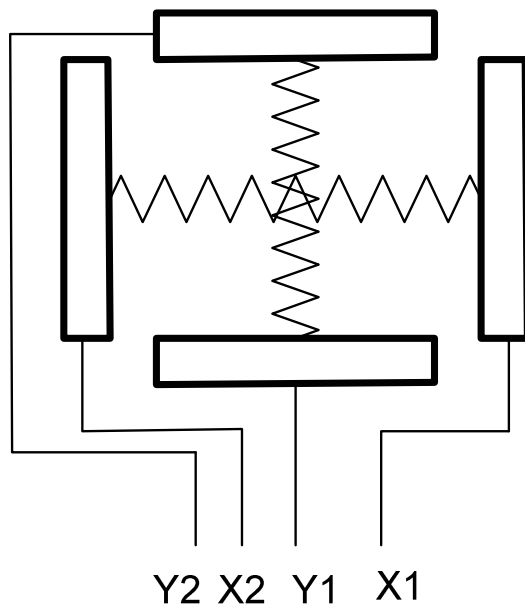
-Stylus: R0.8 polyacetal tip.

Note 3: Pit 1,000,000 times on the film with a R0.8 silicon rubber.

-Force: 250gf.

-Speed: 2times/sec.

### 4.3. Touch Screen Panel Block



Top View



## 5. Optical Specifications

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	$L_1$		(230)	(280)	-	cd/m <sup>2</sup>	Note 6 (With touch screen)
	$L_2$		(300)	(350)	-	cd/m <sup>2</sup>	Note 6 (Without touch screen)
Luminance uniformity	$Y_U$		70	75	-	%	Note 7

Test Conditions:

1.  $V_{DD}=3.3V$ ,  $I_L=16mA$  (Backlight current), the ambient temperature is 25°C.
2. The test systems refer to Note 2.

Note 1: Definition of viewing angle range

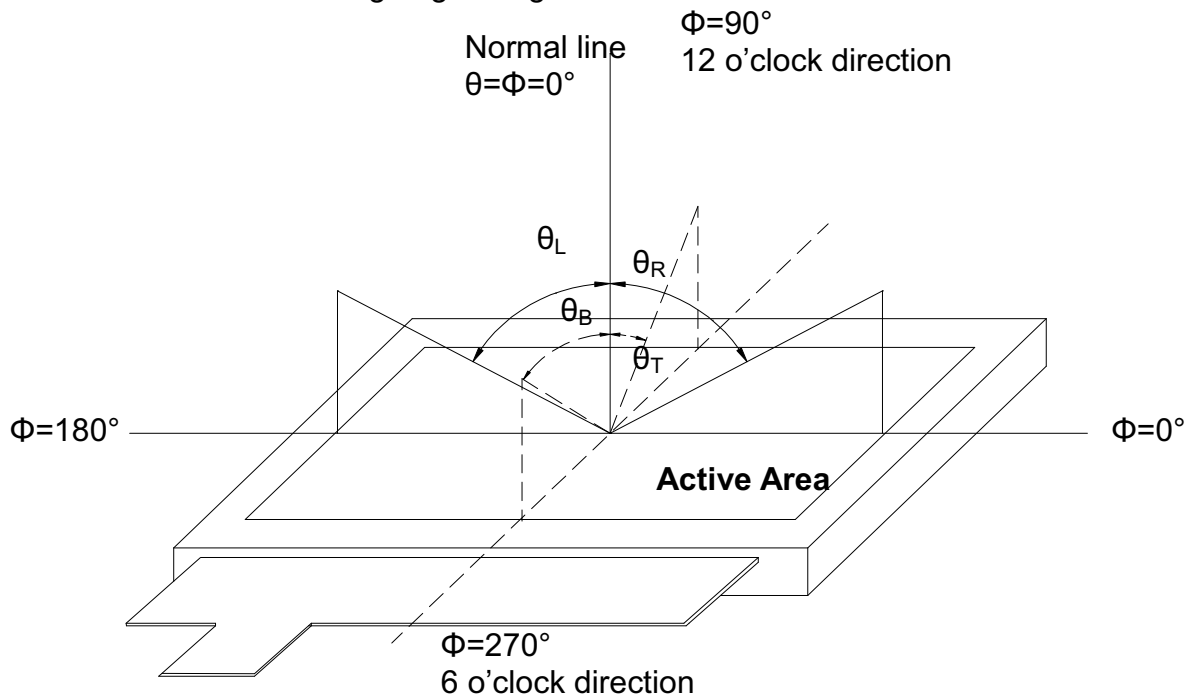


Fig. 4-1 Definition of viewing angle

Note 2: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 30 minutes operation, 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.)

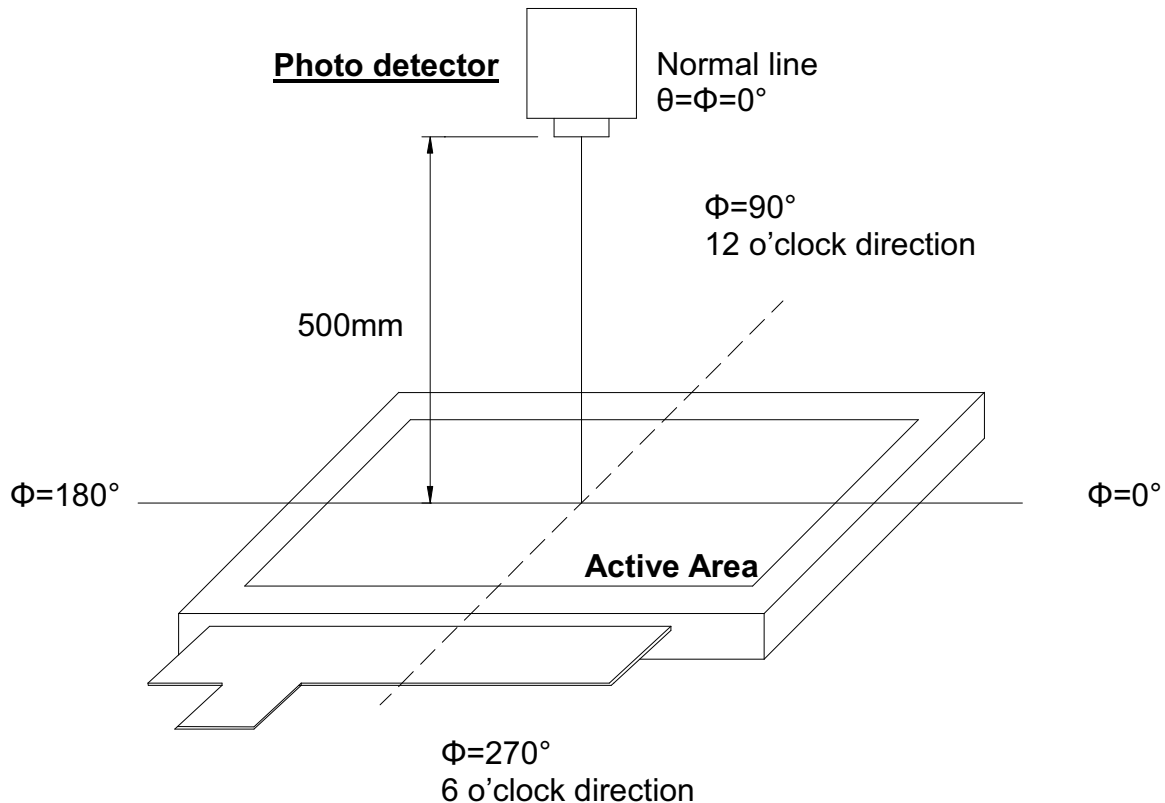


Fig. 4-2 Optical measurement system setup

**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%.

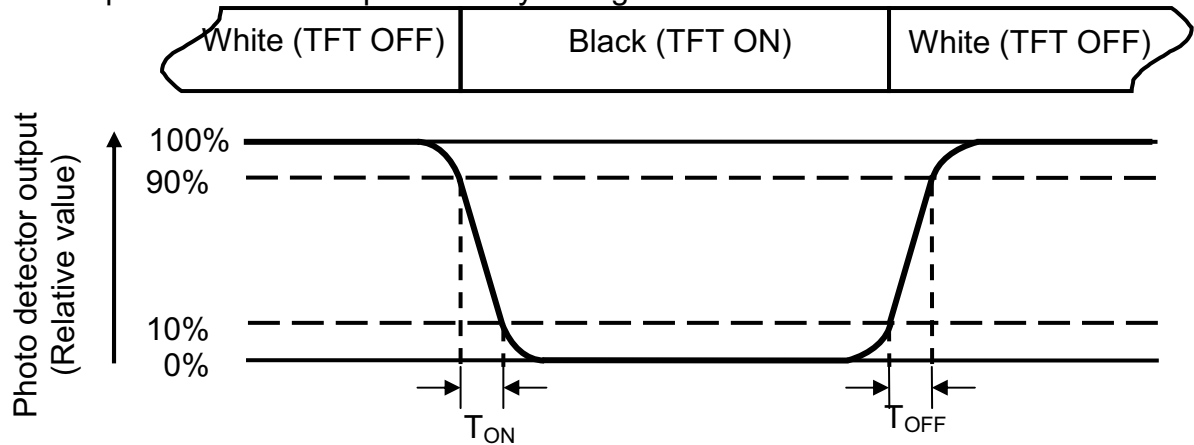


Fig. 4-3 Definition of response time

**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.

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

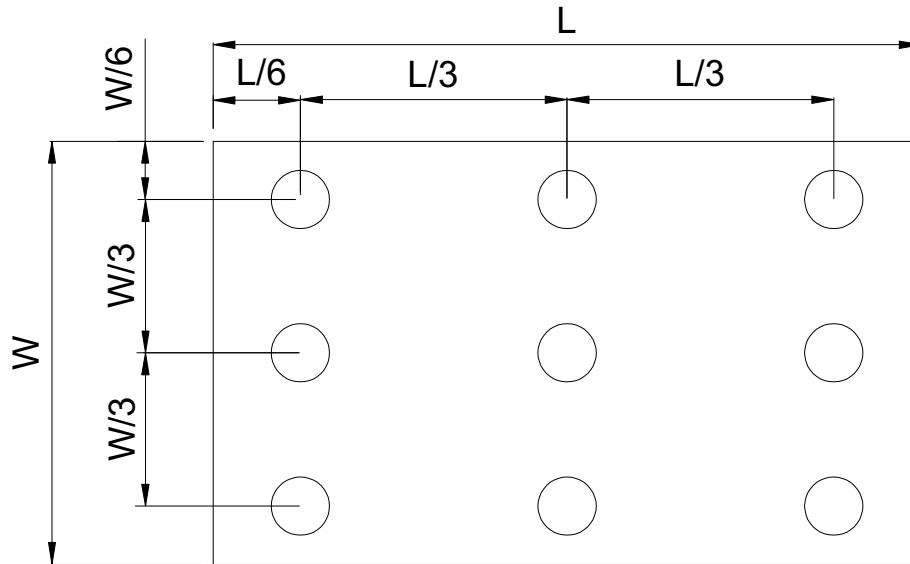


Fig. 4-4 Definition of measuring points

**B<sub>max</sub>**: The measured maximum luminance of all measurement position.

**B<sub>min</sub>**: The measured minimum luminance of all measurement position.

## 6. Reliability Test Items

(Note3)

Item	Test Conditions	Remark
High Temperature Storage	Ta = (80℃) 240 hrs	Note 1
Low Temperature Storage	Ta = (-30℃) 240hrs	Note 1
High Temperature Operation	Ts = (70℃) 240hrs	Note 2
Low Temperature Operation	Ta = (-20℃) 240hrs	Note 1
Operate at High Temperature and Humidity	+40℃, 90%RH 240 hrs	
Thermal Shock	-30℃/30 min ~ +80℃/30 min for a total 100 cycles, Start with cold temperature and end with high temperature	
Vibration Test	Frequency range:10~55Hz Stroke:1.5mm Sweep:10Hz~55Hz~10Hz 2 hours for each direction of X. Y. Z. (6 hours for total)	
Mechanical Shock	100G 6ms,±X, ±Y, ±Z 3 times for each direction	
Package Vibration Test	Random Vibration : 0.015G*G/Hz from 5-200HZ, -6dB/Octave from 200-500HZ 2 hours for each direction of X. Y. Z. (6 hours for total)	
Package Drop Test	Height:60 cm 1 corner, 3 edges, 6 surfaces	
Electro Static Discharge	± 2KV, Human Body Mode, 100pF/1500Ω	

Note 1: Ta is the ambient temperature of samples.

Note 2: Ts is the temperature of panel's surface.

Note 3: In the standard condition, there shall be no practical problem that may affect the display function. After the reliability test, the product only guarantees operation, but doesn't guarantee all the cosmetic specification.

## **7. General Precautions**

### **7.1. 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.

### **7.2. 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.

### **7.3. 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.

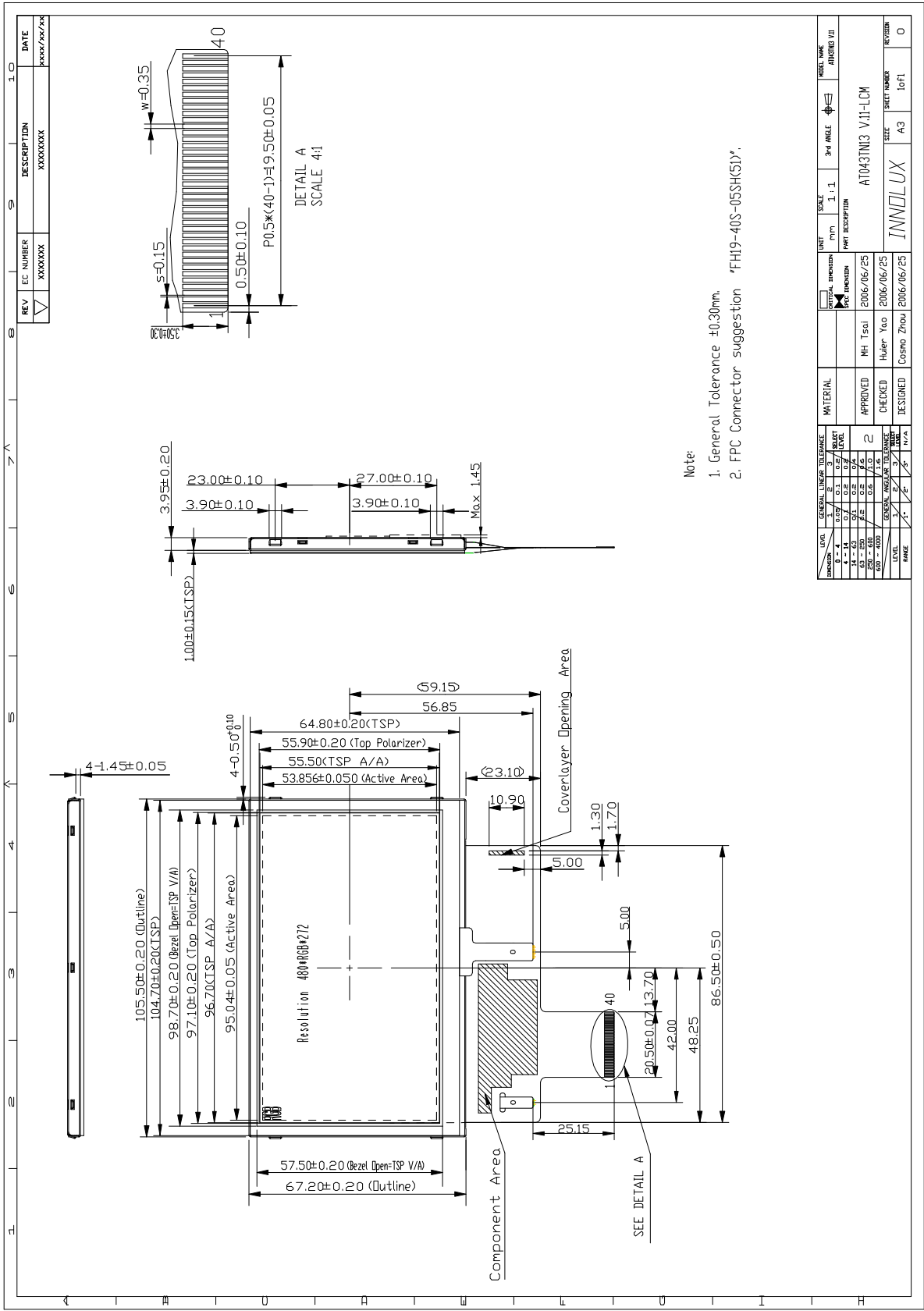
### **7.4. Storage**

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.

### **7.5. 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.

8. Mechanical Drawing



## **9. Package Drawing**

**TBD**