INNOLUX DISPLAY CORPORATION
LCD MODULE
SPECIFICATION

Customer: _____

Model Name: AT043TN13 (3 in 1)

SPEC NO.: A043-13-TT-02

Date: 2006/12/22

Version: 02

☐ Preliminary Specification

■ Final Specification

Option
■ Touch Screen Panel (3-in-1FPC)

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
Pre SPEC			
01	2006/06/29		Initial Release.
02	2006/07/21	2	Modify the definition of Pin.4.
			Modify Model Name from AT043TN01 V.2 to AT043TN13
		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
		12	Modify the Active Force of Mechanical & Reliability Characteristics about Touch Screen Panel specification.
		14	Modify the Viewing Angle.
		20	Modify the Mechanical Drawing.
03	2006/10/12	21	Modify the Mechanical Drawing.
		12	Modify Note 1 of touch screen panel mechanical & reliability characteristics
		18	Add reliability test environmental characteristics
		2	Add FPC connector type.
Final SPEC			
01	2006/11/13		Final specification
		1	Add Backlight power consumption, Panel power consumption, Weight
			Add values of current for driver
		6	Add the Min. & Max. values of LED forward voltage and LED forward current.
			Add note2
			Modify "LED voltage" to "LED forward voltage", and " LED current" to " LED forward current"
		22	Add Package drawing
		4	Add the LED reverse voltage and LED forward current. Add note 2
		16	Modify note 6
02	2006/12/22	4	Add Absolute ratings of environment
		5	Modify Absolute maximum ratings to Electrical absolute maximum ratings
		19	Delete Environmental characteristics Add Note 4 & Note 5
		21	Modify mechanical drawing.

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Contents

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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	633.6mW(Typ.)	
12	Panel Power consumption	103.2mW(Typ.)	
13	Weight	64g(Typ.)	

Note 1: Refer to Mechanical Drawing.

2. Pin Assignment

2.1. TFT LCD Panel Driving Section

FPC Connector is used for the module electronics interface. The recommended model is FH19S-40S-0.5SH(51) manufactured by HIROSE.

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_{DD}	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_{DD}	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 Ratings of Environment

Item	Symbol	Values		Unit	Remark
		Min.	Max.		
Operation temperature	T_{OP}	-10	60	℃	Note 1, 2
Storage temperature	T_{ST}	-20	70	℃	Note 1, 2

Note 1 : 90% RH Max.(Max wet temp. is 40℃)
Maximum wet-bulb temperature is at 38℃ or less. And No condensation (no drops of dew)
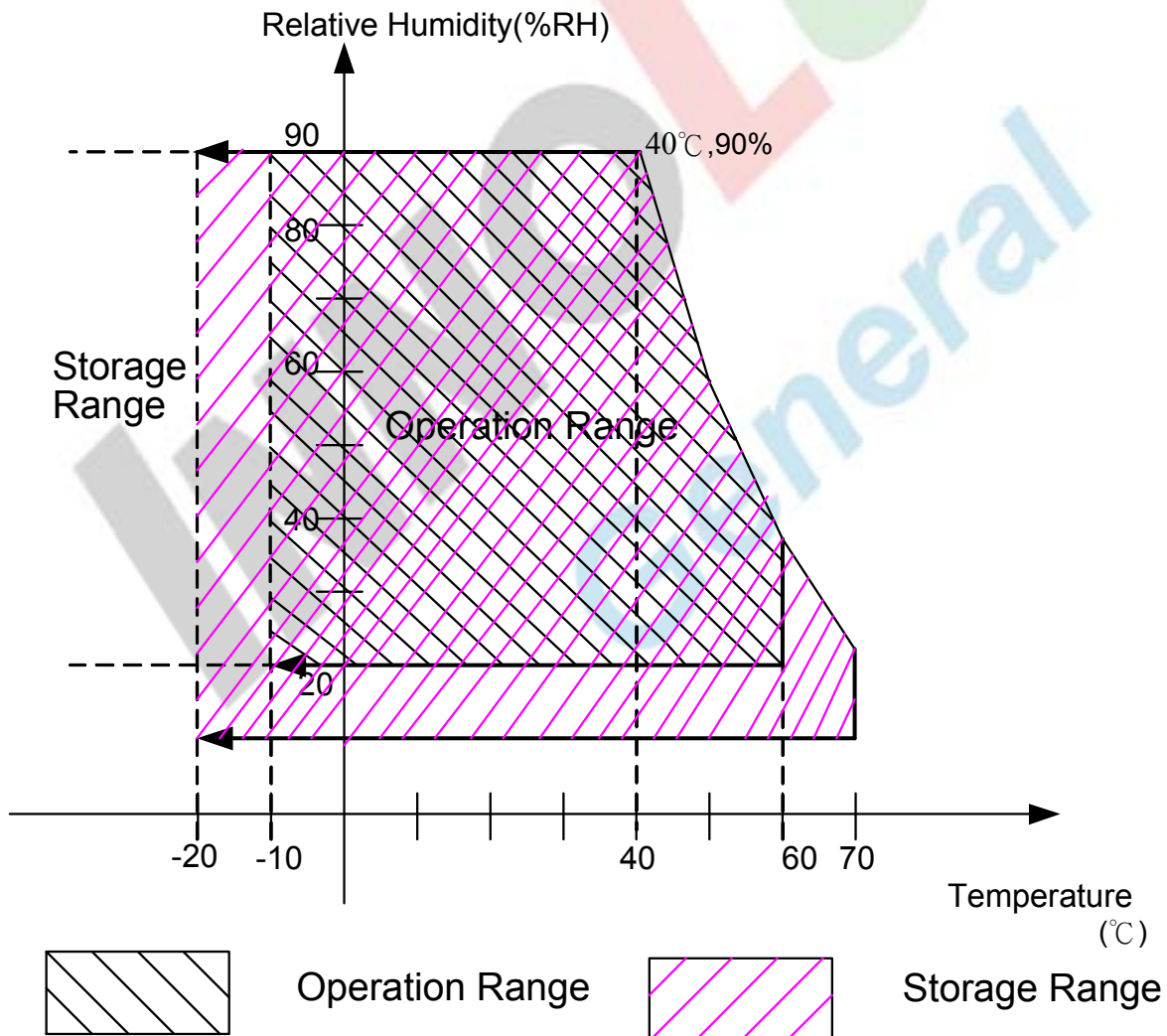
Note 2: In case of below 0 the response time of liquid crystal (LC) becomes slower and the color of panel darker than normal one.Level of retardation depends on temperature, because of LC's characteristics.

3.2. Electrical Absolute Maximum Ratings

(GND=AV$_{SS}$=0V, Note 1)

Item	Symbol	Values		Unit	Remark
		Min.	Max.		
Power voltage	V$_{DD}$	-0.3	6.0	V	
	AV$_{DD}$	-0.3	6.0	V	
Input signal voltage	Logic input	-0.3	V$_{DD}$+0.3	V	
LED Reverse Voltage	V$_R$	-	1.2	V	each LED Note 2
LED Forward Current	I$_F$	-	25	mA	each LED

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.

Note 2: V$_R$ Conditions: Zener Diode 20mA

3.2.1.   Typical Operation Conditions

(GND=AV$_{SS}$=0V)

Item	Symbol	Values			Unit	Remark
		Min.	**Typ.**	**Max.**		
Power voltage	V$_{DD}$	2.3	2.5	2.7	V	Note 1
		3.0	3.3	3.6	V	
	AV$_{DD}$	4.8	5.0	5.2	V	
Input logic high voltage	V$_{IH}$	0.7V$_{DD}$	-	V$_{DD}$	V	
Input logic low voltage	V$_{IL}$	0	-	0.3V$_{DD}$	V	

Note 1: You should choose only one from the typical values of V$_{DD}$.

3.2.2. Current Consumption

(GND=AV$_{SS}$=0V)

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Current for Driver	I$_{DD}$	-	4.0	8.0	mA	V$_{DD}$ =2.5V or 3.3V
	IAV$_{DD}$	-	16.0	32.0	mA	AV$_{DD}$ =5.0V

3.2.3. Backlight Driving Conditions

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
LED forward voltage	V$_L$	18.6	19.8	21.0	V	Note 2, 3
LED forward current	I$_L$	14	16	22	mA	Note 3
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℃ and I$_L$ =16mA. The LED lifetime could be decreased if operating I$_L$ is lager than 16 mA.
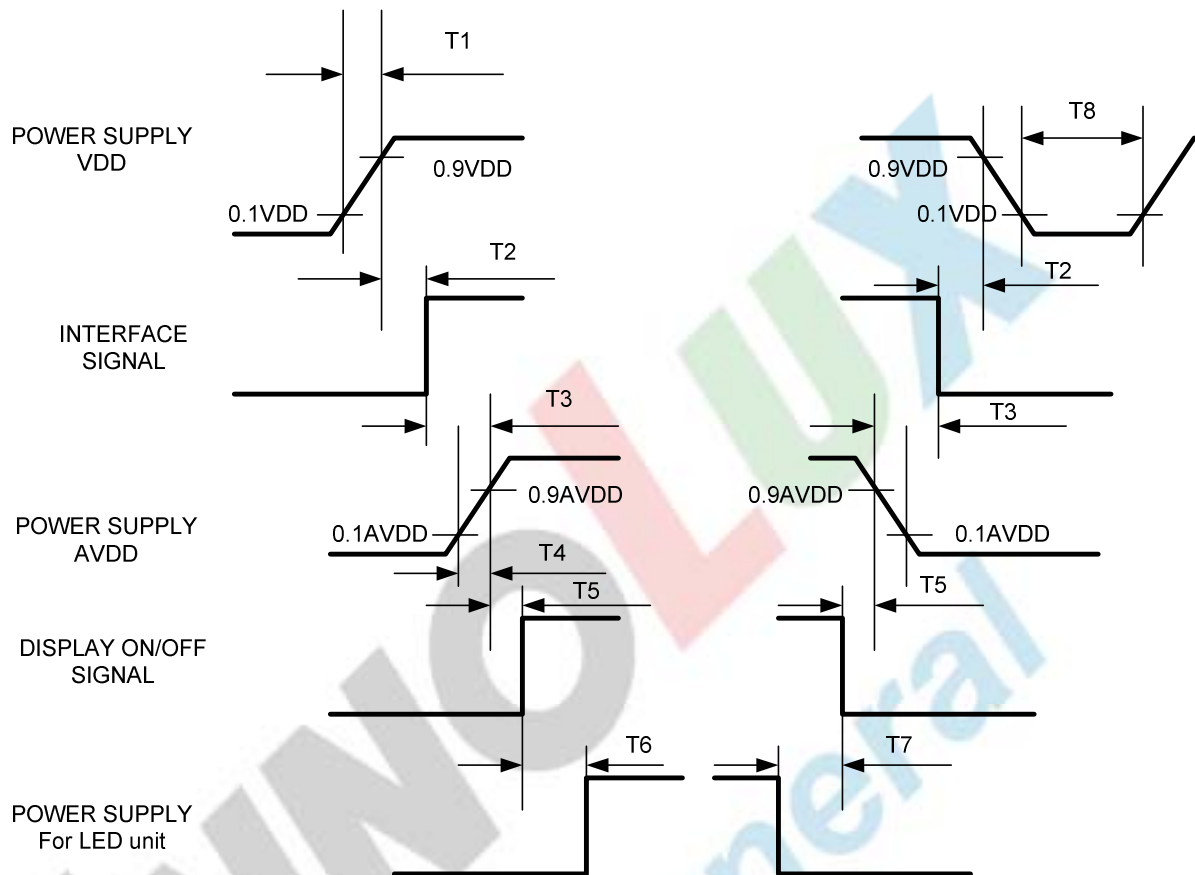
Note 2: The LED Supply Voltage is defined by the number of LED at Ta=25℃ and I$_L$ =16mA. In the case of 6pcs LED , V$_L$=3.3*6=19.8V

Note 3: The LED driving condition is defined for each LED module (6 LED Serial).
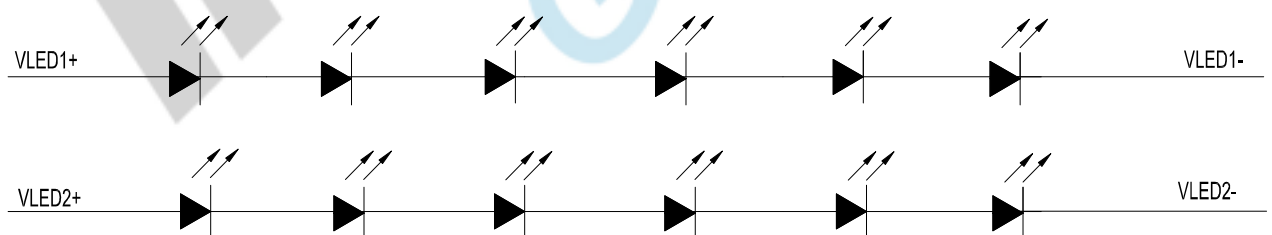
3.3.   Power Sequence

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	$0 \leqq T1 \leqq 10$ msec	T5	$0 \leqq T5 \leqq 160$ msec
T2	$0 \leqq T2 \leqq 100$ msec	T6	160 msec $\leqq T6$
T3	$0 \leqq T3 \leqq 50$ msec	T7	160 msec $\leqq T7$
T4	$0 \leqq T4 \leqq 10$ msec	T8	1 msec $\leqq T8$

3.4.   Timing Characteristics

3.4.1.   Timing Conditions

(TA = 25℃, VDD = 2.3V~3.5V, GND = 0V)

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Clock cycle	1/tc	-	9.00	15	MHz	
Hsync cycle	1/fH	-	17.14	-	KHz	
Vsync cycle	1/fV	59.94	-	-	Hz	
Horizontal signal	th	-	525	-	CLK	Note 1
Horizontal display period	thd	-	480	-	CLK	
Horizontal Front porch	thf	2	-	-	CLK	Note 2
Horizontal Pulse width	thp	2	41	-	CLK	Note 2
Horizontal Back porch	thb	2	-	-	CLK	Note 2
Vertical cycle	tv	-	286	-	H	
Vertical display period	tvd	-	272	-	H	
Vertical Front porch	tvf	2	2	-	H	
Vertical Pulse width	tvp	2	10	-	H	
Vertical Back porch	tvb	2	2	-	H	
DISP Setup Time	tdiss	10	-	-	ns	
DISP Hold Time	tdish	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	ths	10	-	-	ns	
Hsync Hold Time	thh	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}=480CLK, t_{hf}= 2CLK, t_{hp}= 41CLK, t_{hb}= 2CLK
525CLK=480CLK + 2CLK + 41CLK + 2CLK
Note 2: t_{hf}+ t_{hp}+ t_{hb}＞ 44 CLK

3.4.2. Timing Diagram
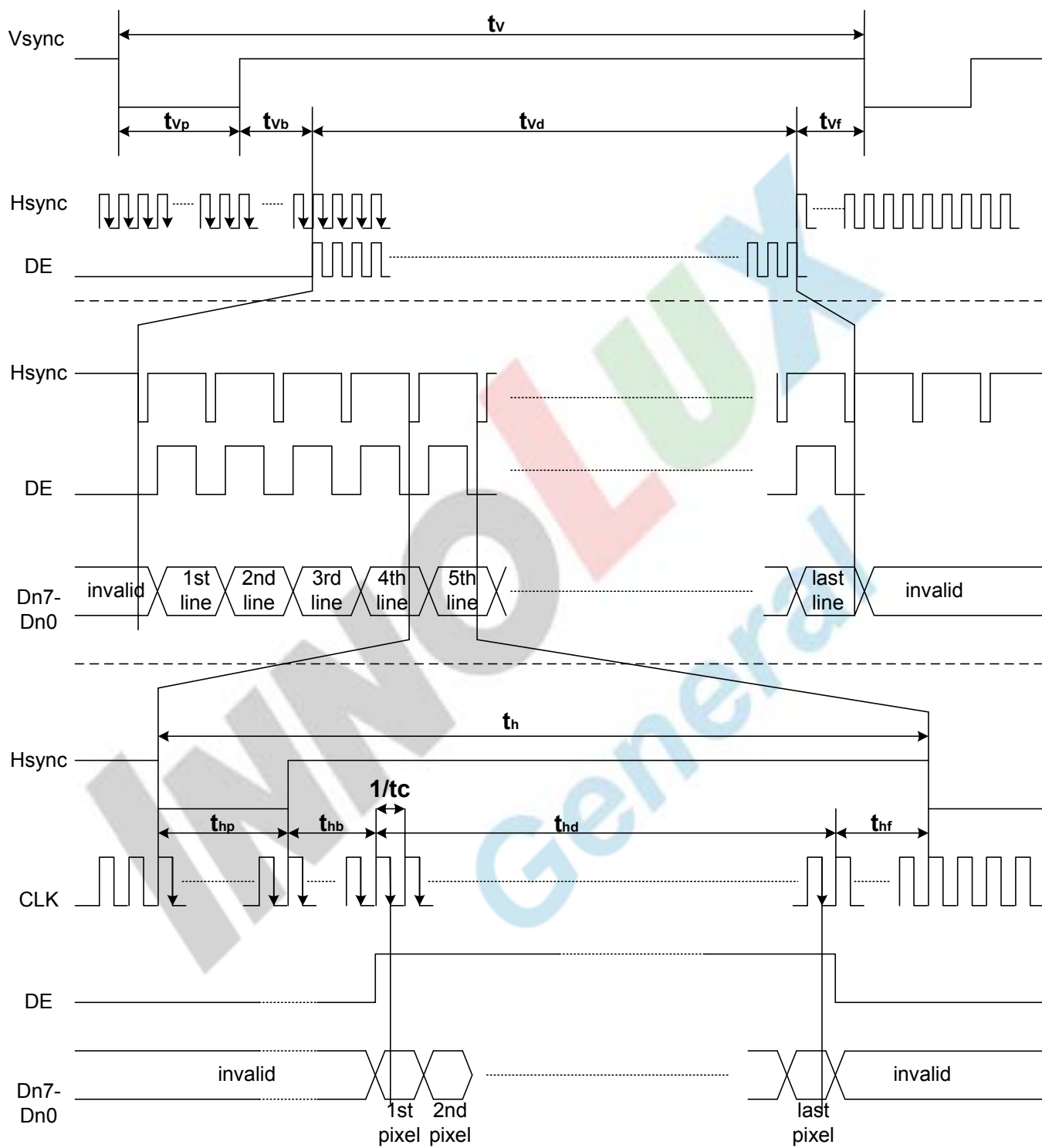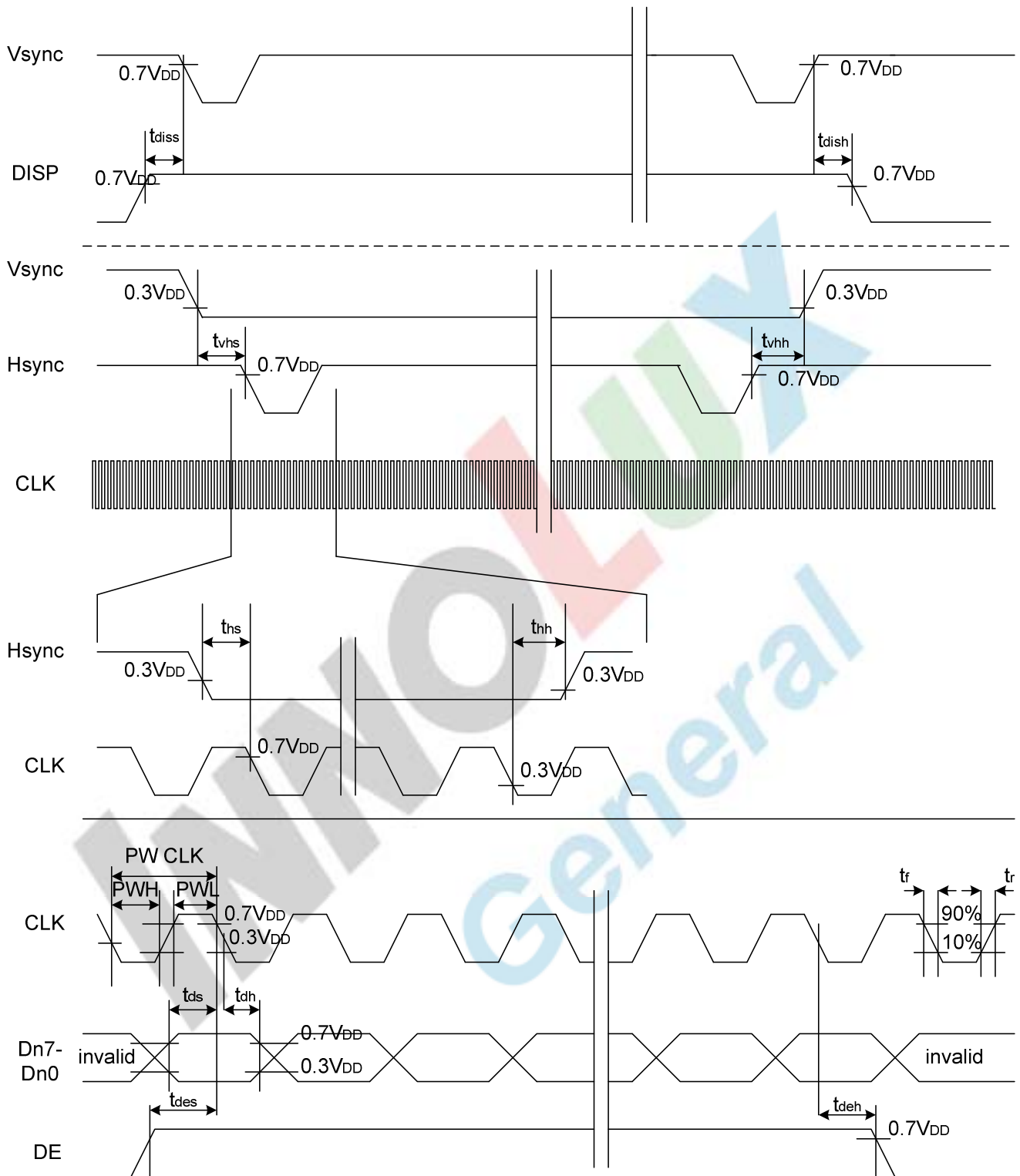
4. Touch Screen Panel Specifications

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	Ω	X(Film side)
	100	-	900	Ω	Y(Glass side)
Insulation resistance	25	-	-	MΩ	DC 25V
Voltage	-	5	7	V	DC
Chattering	-	-	10	ms	100kΩ pull-up
Transparency	80	-	-	%	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	-	-	g	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: Activation force test condition
    (1) Input DC 5V on X direction, Drop off Polyacetal Stylus (R0.8), until
       output voltage stabilize ,then get the activation force。

(2) R8.0mm Silicon rubber for finger Activation force test
(3) Test point: 9 points

<Measurement of Pen Input>   <Measurement of Finger Input>
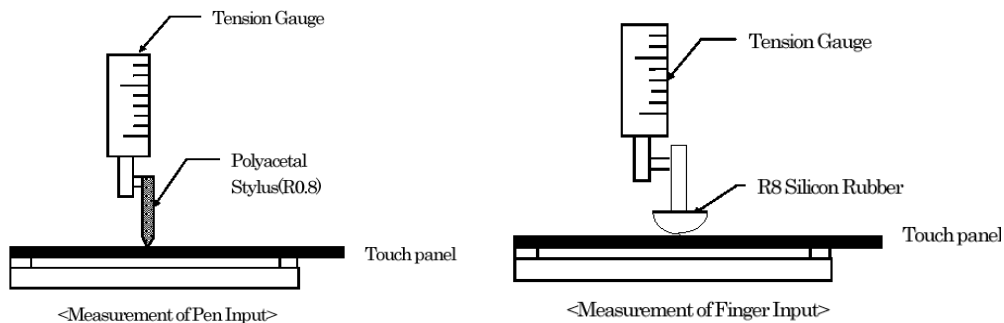
Note 2: Measurement for surface area.
    -Scratch 100,000 times straight line on the film with a stylus change every 20,000
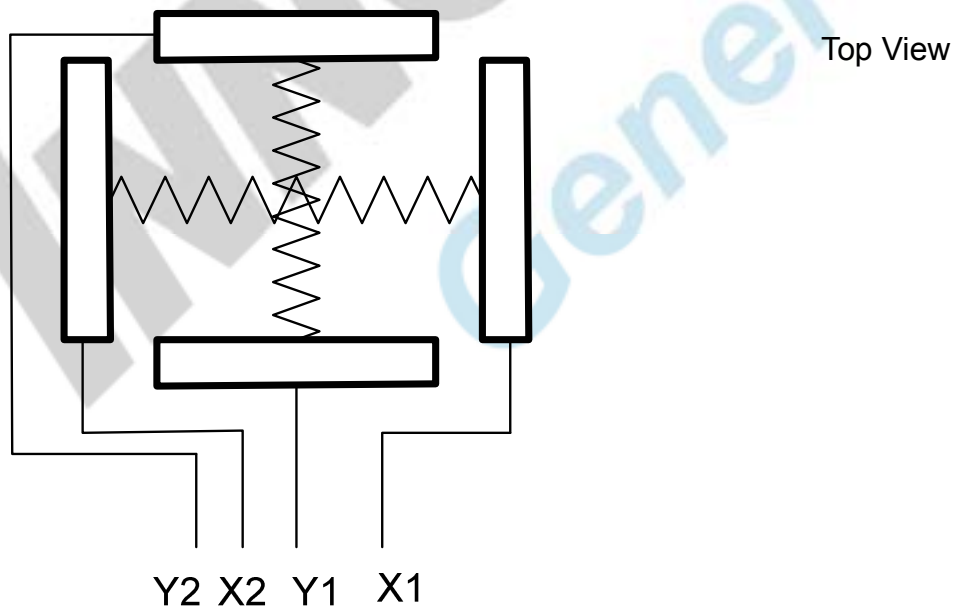   times.
    -Force: 250gf.
    -Speed: 60mm/sec.
    -Stylus: R0.8 polyacetal tip.
Note 3: Pit 1,000,000 times on the film with a R0.8 silicon rubber.
    -Force: 250gf.
    -Speed: 2times/sec.

4.3.   Touch Screen Panel Block

Top View

Y2 X2 Y1 X1

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5. Optical Specifications

Item	Symbol	Condition	Values			Unit	Remark
			Min.	Typ.	Max.		
Viewing angle (CR≥ 10)	θ_L	Φ=180°(9 o'clock)	60	70	-	degree	Note 1
	θ_R	Φ=0°(3 o'clock)	60	70	-		
	θ_T	Φ=90°(12 o'clock)	40	50	-		
	θ_B	Φ=270°(6 o'clock)	60	70	-		
Response time	T_ON		-	10	20	msec	Note 3
	T_OFF		-	15	30	msec	Note 3
Contrast ratio	CR		400	500	-	-	Note 4
Color chromaticity	W_X	Normal θ=Φ=0°	0.26	0.31	0.36	-	Note 2 Note 5 Note 6
	W_Y		0.28	0.33	0.38	-	
Luminance	L_1		230	280	-	cd/m²	Note 6 (With touch screen)
	L_2		300	350	-	cd/m²	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℃.
2. The test systems refer to Note 2.
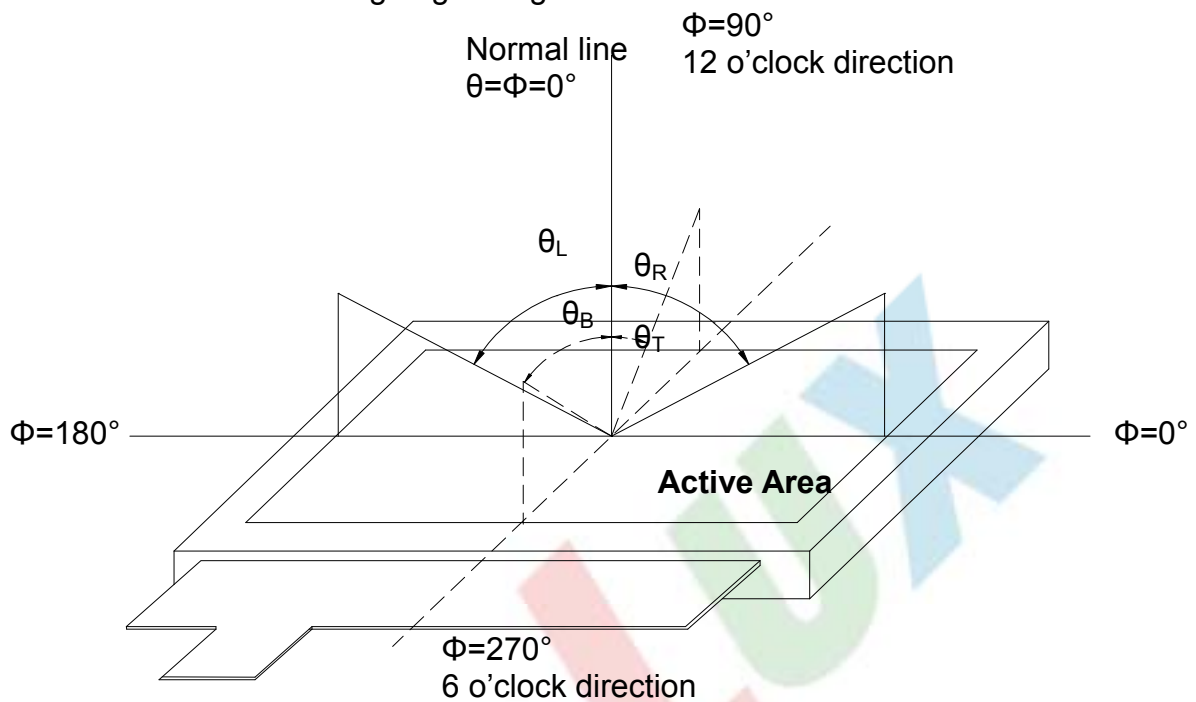
Note 1: Definition of viewing angle range

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.)
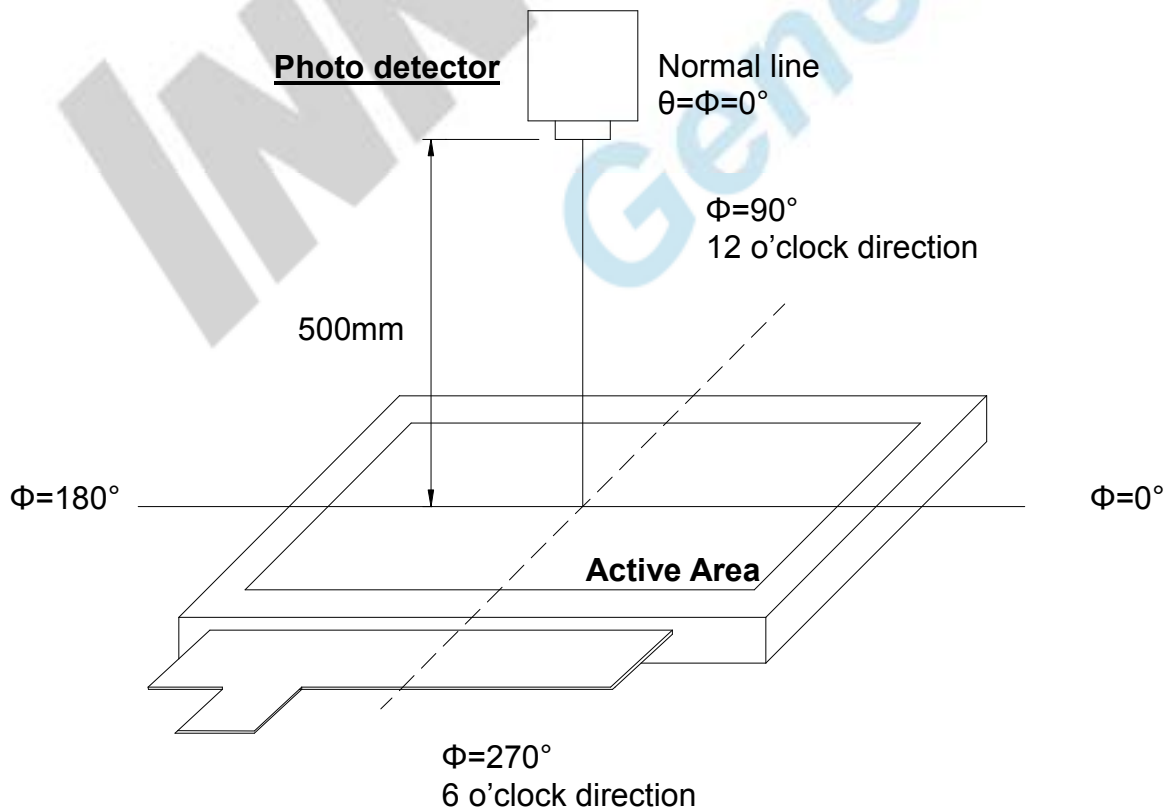

Fig. 4-2 Optical measurement system setup

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%.
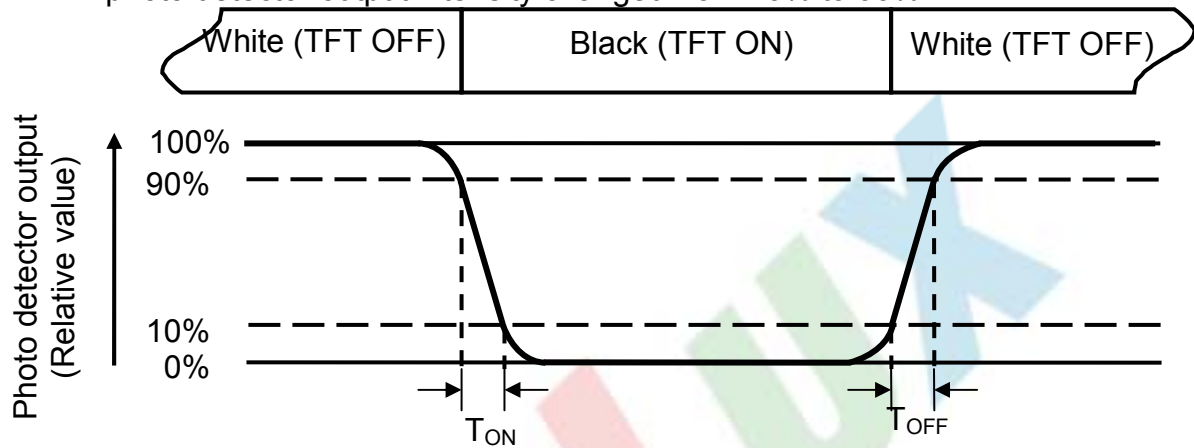
| White (TFT OFF) | Black (TFT ON) | White (TFT OFF) |

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=16mA of which each LED module is 6 LED serial.

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.

$$Luminance\ \ Uniformity\ (Yu) = \frac{B_{min}}{B_{max}}$$
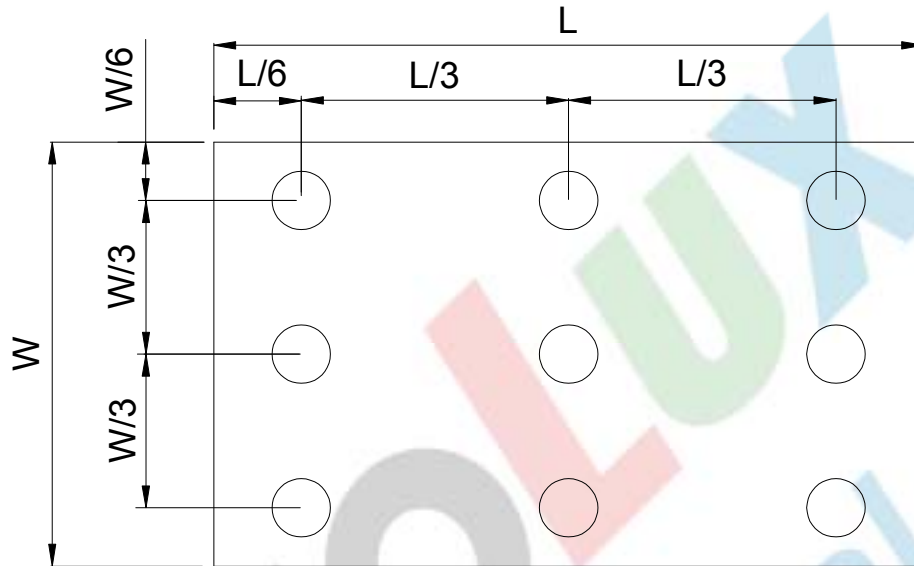
L-------Active area length   W----- Active area width

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. Reliability Test Items

(Note3)

Item	Test Conditions	Remark
High Temperature Storage	Ta = 80℃　　　　　　240 hrs	Note 1,Note 4
Low Temperature Storage	Ta = -30℃　　　　　　240hrs	Note 1,Note 4
High Temperature Operation	Ts = 70℃　　　　　　240hrs	Note 2,Note 4
Low Temperature Operation	Ta = -20℃　　　　　　240hrs	Note 1,Note 4
Operate at High Temperature and Humidity	+40℃, 90%RH　　　　　240 hrs	Note 5
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.
Note 4: Before cosmetic and function tests , the product must have enough recovery time, at least 2 hours at room temperature.
Note 5: Before cosmetic and function tests , the product must have enough recovery time, at least 24 hours at room temperature.

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±10℃ 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.
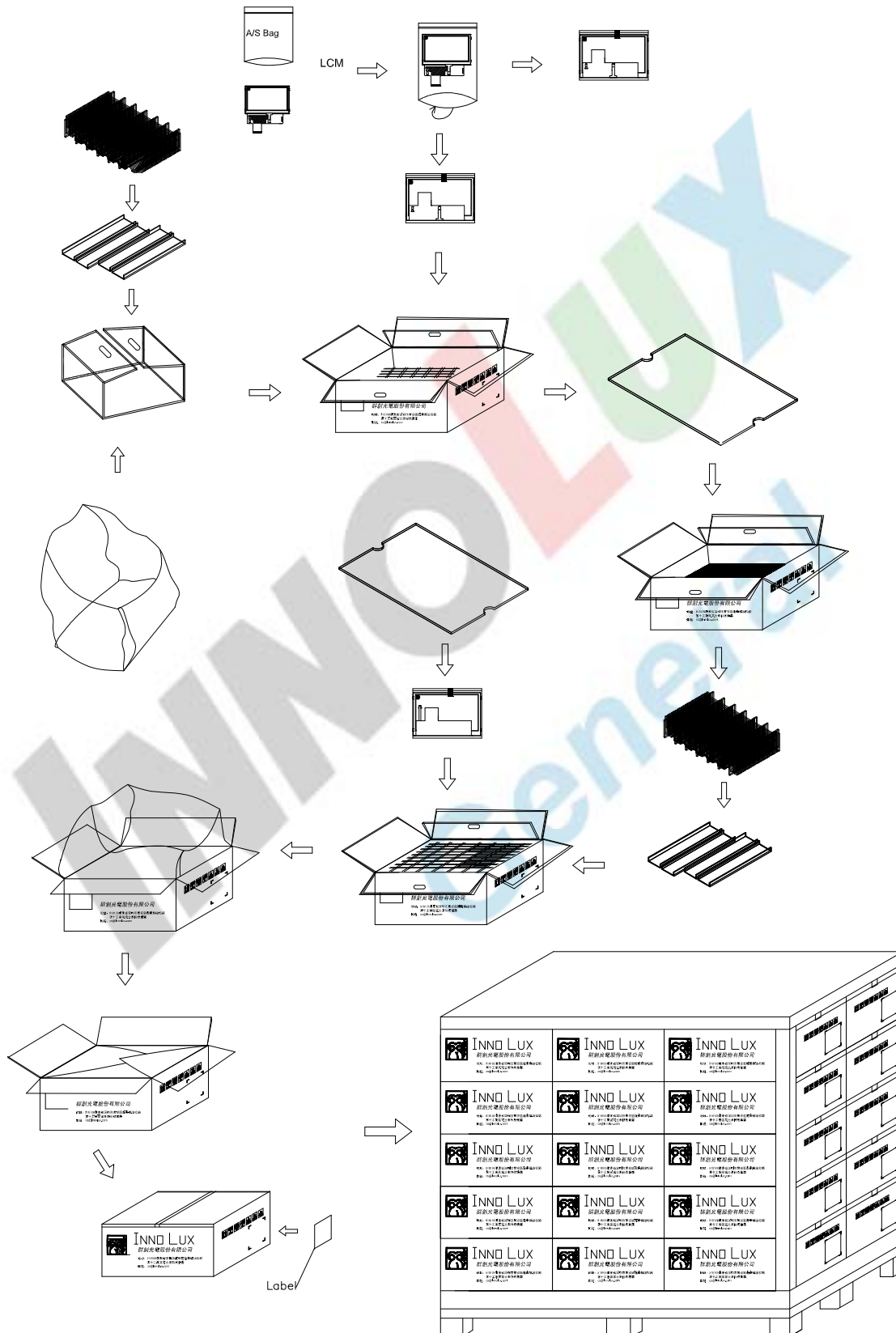
8. Mechanical Drawing
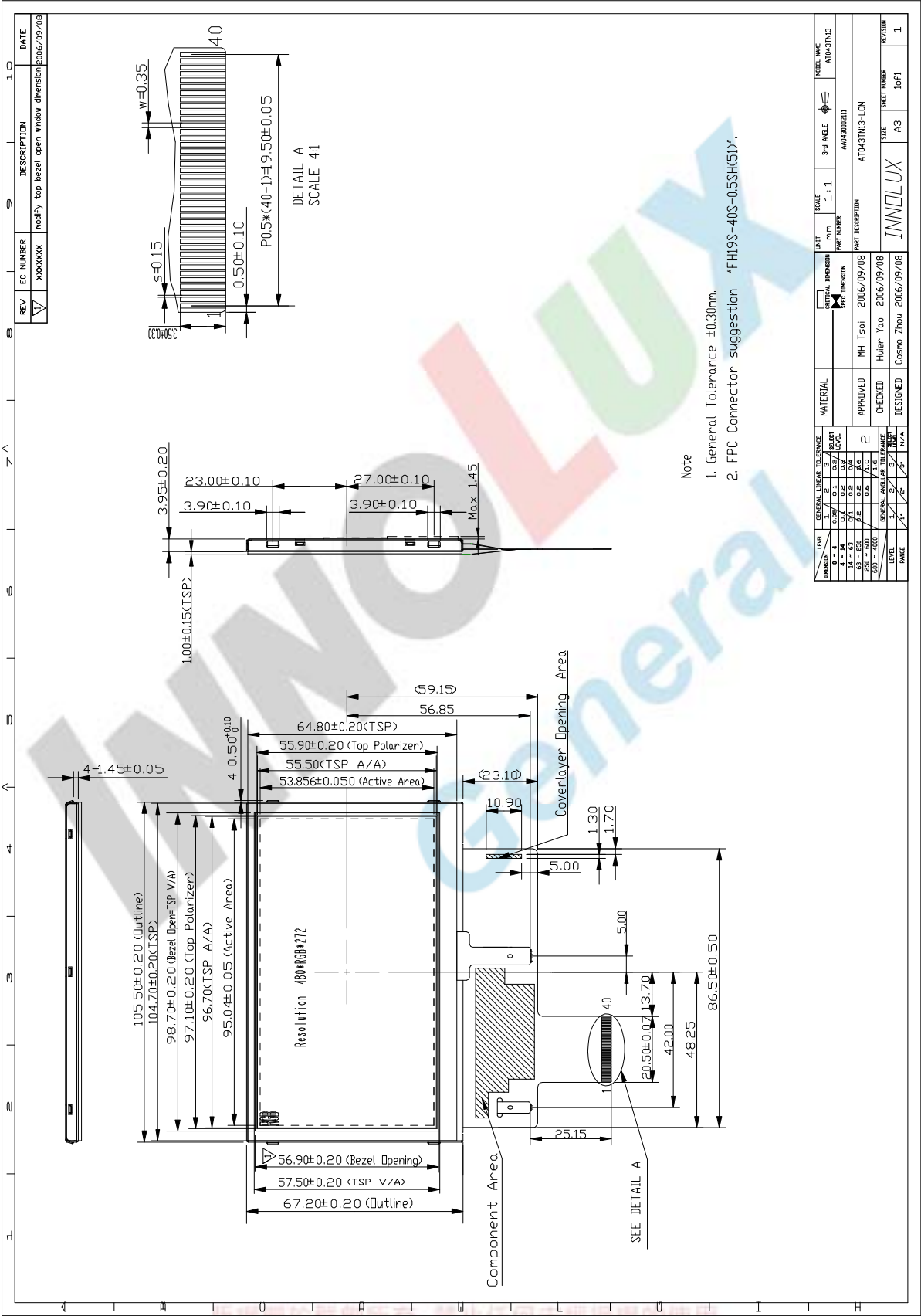
9. Package Drawing

9.1. Packaging Material Table

No.	Item	Model (Material)	Dimensions(mm)	Unit Weight (kg)	Quantity	Remark
1	LCM Module	AT043TN13	105.5X67.2X4.95	0.064	160pcs	
2	Partition	BC Corrugated paper	512X349X106	1.102	2set	
3	Corrugated Bar	B Corrugated paper	349X173	0.03	8pcs	
4	Dust-Proof Bag	PE	700×530	0.060	1pcs	
5	Corrugated Board-1	BC Corrugated Paper	510×343	0.130	2pcs	
6	Corrugated Board-2	B Corrugated Paper	1152×512	0.26	1pcs	
7	A/S Bag	PE	132X117	0.002	160pcs	
8	Carton	Corrugated paper	530×355×255	1.1	1pcs	
9	Total weight	14.444± 5％Kg				

9.2. Packaging Quantity

(1) LCM quantity per Partition: 2Rows x 40quantity per Row = 80 pcs

(2) Total LCM quantity in Carton: 2 layer x 80 pcs per Partition = 160 pcs

9.3. Packaging Drawing