

# INNOLUX DISPLAY CORPORATION

## LCD MODULE

# SPECIFICATION

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

Model Name: AT035TN01 V.2

SPEC NO.: A035-01-TT-04

Data: 2005/02/28

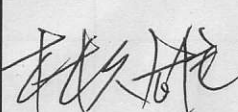
Version: 1

Preliminary Specification

Final Specification

For Customer's Acceptance

Approved by	Comment

Approved by	Reviewed by	Prepared by
 150316 1064	蔡明 3/15/05	[Signature] 05/03/15

### Record of Revision

Version	Revise Date	Page	Content
V.1	2005/02/28		Initial Release
V.2	2005/03/11	13	Change Luminance from 250nits to 200nits Approved

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# 1. General Specifications

No.	Item	Specification	Remark
1	LCD size	3.5 inch	
2	Driver element	a-Si TFT active matrix	
3	Resolution	160X3(RGB)X234	
4	Display mode	Normally White, Transmissive	
5	Dot pitch	0.15(W)X0.216(H) mm	
6	Active area	72.0(W)X50.544(H) mm	
7	Module size	83.0(W)X60.5(H)X4.5(D) mm	Note 1
8	Surface treatment	Anti-Glare	
9	Color arrangement	RGB-delta	
10	Interface	Analog	
11	Weight	34.5 g	

Note 1: Refer to Mechanical Drawing.

## 2. Pin Assignment

### 2.1. TFT LCD Panel Driving Section

Pin No.	Symbol	I/O	Function	Remark
1	GND	-	Ground	
2	V <sub>CC</sub>	I	Supply voltage for logic control circuit scan driver	
3	V <sub>GL</sub>	I	Negative power for scan driver	
4	V <sub>GH</sub>	I	Positive power for scan driver	
5	STVR	I/O	Vertical start pulse	Note 1
6	STVL	I/O	Vertical start pulse	Note 1
7	CKV	I	Shift clock input for scan driver	
8	U/D	I	UP/DOWN scan control input	Note 1, 2
9	OEV	I	Output enable control for scan driver	
10	V <sub>COM</sub>	I	Common electrode driving signal	
11	V <sub>COM</sub>	I	Common electrode driving signal	
12	GLED1	P	LED module 1 Cathode	
13	VLED1	P	LED module 1 Anode	
14	VLED2	P	LED module 2 Anode	
15	GLED2	P	LED module 2 Cathode	
16	L/R	I	LEFT/RIGHT scan control input	Note 1, 2
17	MOD	I	Sequential sampling and simultaneous sampling setting	
18	OEH	I	Output enable control for data driver	
19	STHL	I/O	Start pulse for horizontal scan line	Note 1
20	STHR	I/O	Start pulse for horizontal scan line	Note 1
21	CPH3	I	Sampling and shifting clock pulse for data driver	
22	CPH2	I	Sampling and shifting clock pulse for data driver	

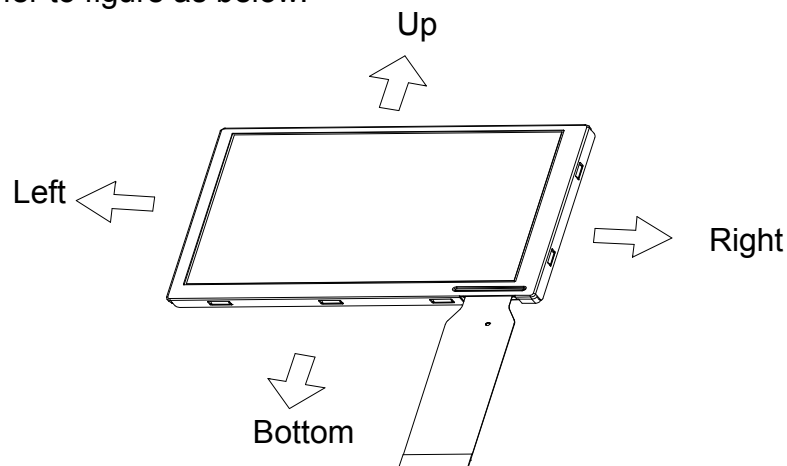
23	CPH1	I	Sampling and shifting clock pulse for data driver	
24	V <sub>CC</sub>	I	Supply voltage for logic control circuit scan driver	
25	GND	-	Ground	
26	V <sub>R</sub>	I	Alternated video signal (Red)	
27	V <sub>G</sub>	I	Alternated video signal (Green)	
28	V <sub>B</sub>	I	Alternated video signal (Blue)	
29	AV <sub>DD</sub>	I	Supply voltage for analog circuit	
30	AV <sub>SS</sub>	I	Ground for analog circuit	

Note 1: Selection of scanning mode

Setting of scan control input		IN/OUT state for start pulse				Scanning direction
U/D	L/R	STVR	STVL	STHR	STHL	
GND	V <sub>CC</sub>	O	I	O	I	Up to down, left to right
V <sub>CC</sub>	GND	I	O	I	O	Down to up, right to left
GND	GND	O	I	I	O	Up to down, right to left
V <sub>CC</sub>	V <sub>CC</sub>	I	O	I	I	Down to up, left to right

I: input, O: output

Note 2: Definition of Scanning Direction.  
Refer to figure as below:



Note 3: MOD=H: Simultaneous sampling.  
MOD=L: Sequential sampling.  
Please set CPH2 and CPH3 to GND when MOD=H.

## 3. Operation Specifications

### 3.1. Absolute Maximum Rating

(GND=AV<sub>SS</sub>=0V, Note 3)

Item	Symbol	Values		Unit	Remark
		Min.	Max.		
Power voltage	V <sub>CC</sub>	-0.3	7	V	
	AV <sub>DD</sub>	-0.3	7	V	
	V <sub>GH</sub>	-0.3	18	V	
	V <sub>GL</sub>	-15	0.3	V	
	V <sub>GH</sub> -V <sub>GL</sub>	-	33	V	
Input signal voltage	V <sub>i</sub>	-0.2	AV <sub>DD</sub> +0.2	V	Note 1
	V <sub>l</sub>	-0.3	V <sub>CC</sub> +0.3	V	Note 2
Operation Temperature	T <sub>OP</sub>	0	60	°C	
Storage Temperature	T <sub>ST</sub>	-30	80	°C	

Note 1: V<sub>R</sub>, V<sub>G</sub>, V<sub>B</sub>.

Note 2: STHL, STHR, OEH, L/R, CPH1~CPH3, STVR, STVL, OEV, CKV, U/D.

Note 3: 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.

## 3.2. Electrical Characteristics

### 3.2.1. Typical Operation Conditions

(GND=AV<sub>SS</sub>=0V, Note 4)

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Power voltage	V <sub>CC</sub>	3	5	5.2	V	
	AV <sub>DD</sub>	4.8	5	5.2	V	
	V <sub>GH</sub>	14.3	15	15.7	V	
	V <sub>GL</sub>	-10.5	-10	-9.5	V	
Video signal amplitude (VR, VG, VB)	V <sub>iA</sub>	0.4	-	AV <sub>DD</sub> - 0.4	V	Note 1
	V <sub>iAC</sub>	-	3	-	V	AC component
	V <sub>iDC</sub>	-	AV <sub>DD</sub> /2	-	V	DC component
V <sub>COM</sub>	V <sub>CAC</sub>	3.5	5	6.5	V	Note 2
	V <sub>CDC</sub>	1.0	1.25	1.5	V	DC component
Input logic high voltage	V <sub>IH</sub>	0.8V <sub>CC</sub>	-	V <sub>CC</sub>	V	Note 3
Input logic low voltage	V <sub>IL</sub>	0	-	0.2V <sub>CC</sub>	V	

Note 1: Refer to Fig.3-3-(a).

Note 2: The brightness of LCD panel could be changed by adjusting the AC component of V<sub>COM</sub>.

Note 3: STHL, STHR, OEH, L/R, CPH1~CPH3, STVR, STVL, OEV, CKV, U/D.

Note 4: Be sure to apply GND, V<sub>CC</sub>, and V<sub>GL</sub>, to the LCD first, and then apply V<sub>GH</sub>.



**3.2.2. Current Consumption**

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

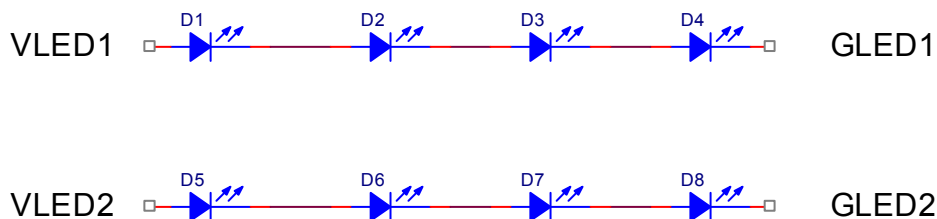
Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Current for Driver	I <sub>GH</sub>	-	100	300	uA	V <sub>GH</sub> =15V
	I <sub>GL</sub>	-	-100	-300	uA	V <sub>GL</sub> = -10V
	I <sub>CC</sub>	-	1.5	4	mA	V <sub>CC</sub> =5V
	I <sub>DD</sub>	-	5	10	mA	AV <sub>DD</sub> =5V

**3.2.3. Backlight Driving Condition**

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
LED voltage	V <sub>L</sub>	-	15	-	V	Note 2
LED current	I <sub>L</sub>	-	20	-	mA	Note 2
Lamp life time	-	10,000	-	-	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> =6mA.

Note 2: The LED driving condition is defined for each LED module (4 LED Serial).



### 3.3. Timing Characteristics

#### 3.3.1. Timing Conditions

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Rising time	$t_r$	-	-	10	ns	Note 1
Falling time	$t_f$	-	-	10	ns	Note 1
High and low level pulse width	$t_{CPH}$	299	312	342	ns	CPH1~CPH3
CPH pulse duty	$t_{CWH}$	40	50	60	%	CPH1~CPH3
CPH pulse delay	$t_{C12}$	70	$t_{CPH}/3$	$t_{CPH}/2$	ns	CPH1~CPH3
	$t_{C23}$					
	$t_{C31}$					
STH setup time	$t_{SUH}$	35	-	-	ns	STHR, STHL
STH hold time	$t_{HDH}$	35	-	-	ns	STHR, STHL
STH pulse width	$t_{STH}$	-	1	-	$t_{CPH}$	STHR, STHL
STH period	$t_H$	61.5	63.5	65.5	$\mu s$	STHR, STHL
OEH pulse width	$t_{OEH}$	-	3	-	$\mu s$	
Sample and hold disable time	$t_{DIS1}$	-	8.42	-	$\mu s$	
OEV pulse width	$t_{OEV}$	-	13	-	$\mu s$	
CKV pulse width	$t_{CKV}$	16	20	40	$\mu s$	
Clean enable time	$t_{DIS2}$	-	10	-	$\mu s$	
Horizontal display start	$t_{SH}$	-	0	-	$t_{CPH}/3$	
Horizontal display timing range	$t_{DH}$	-	480	-	$t_{CPH}/3$	
STV setup time	$t_{SUV}$	400	-	-	ns	STVL, STVR
STV hold time	$t_{HDV}$	400	-	-	ns	STVL, STVR
STV pulse width	$t_{STV}$	-	-	1	$t_H$	STVL, STVR
Horizontal lines per field	$t_V$	256	262	268	$t_H$	Note 2

Vertical display start	$t_{SV}$	-	3	-	$t_H$	
Vertical display timing range	$t_{DV}$	-	234	-	$t_H$	
$V_{COM}$ rising time	$t_{rCOM}$	-	-	5	$\mu s$	
$V_{COM}$ falling time	$t_{fCOM}$	-	-	5	$\mu s$	
$V_{COM}$ delay time	$t_{DCOM}$	-	-	3	$\mu s$	
RGB delay time	$t_{DRGB}$	-	-	1	$\mu s$	

Note 1: For all of the logic signals

Note 2: Please don't use odd horizontal lines to drive LCD panel for both odd and even field simultaneously.

3.3.2. Timing Diagram

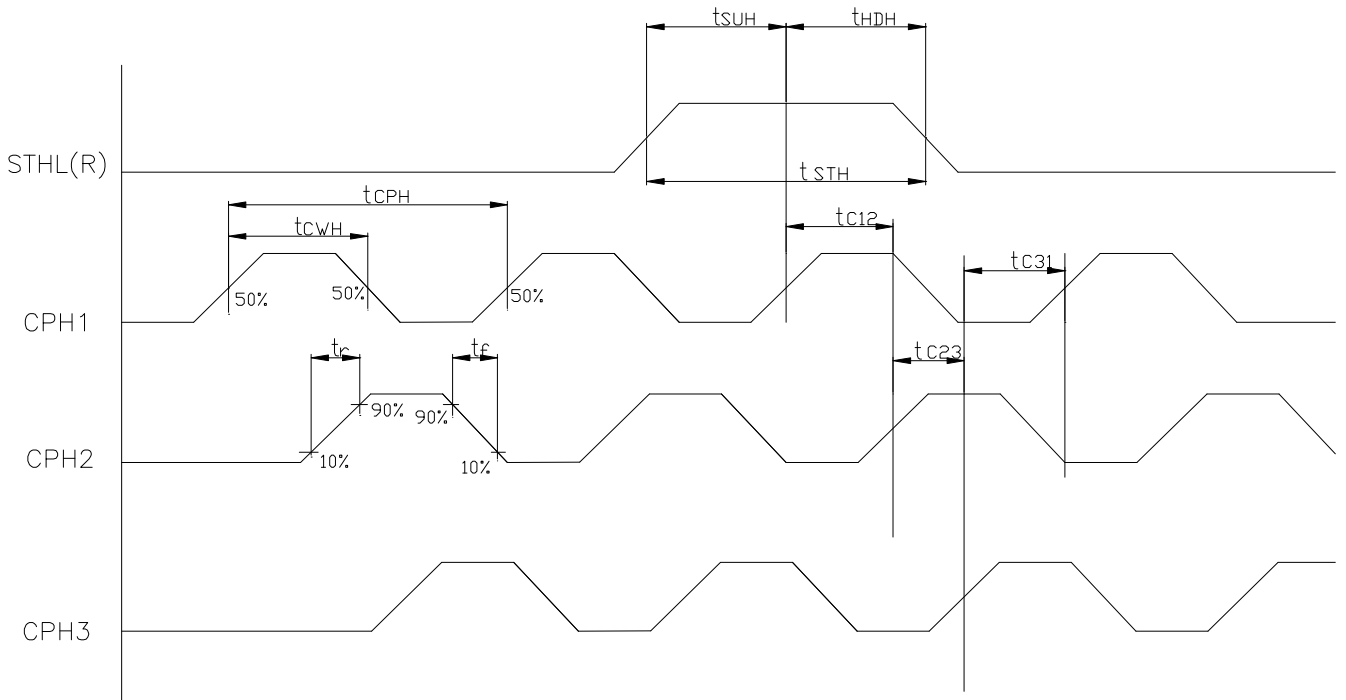


Fig.3-1 Sampling clock timing

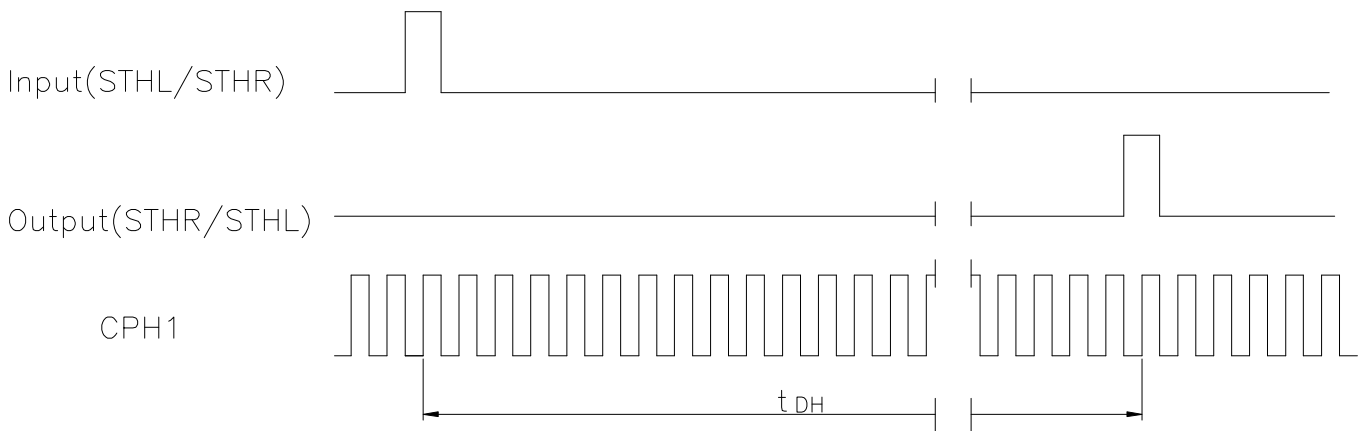


Fig.3-2 Horizontal display timing range

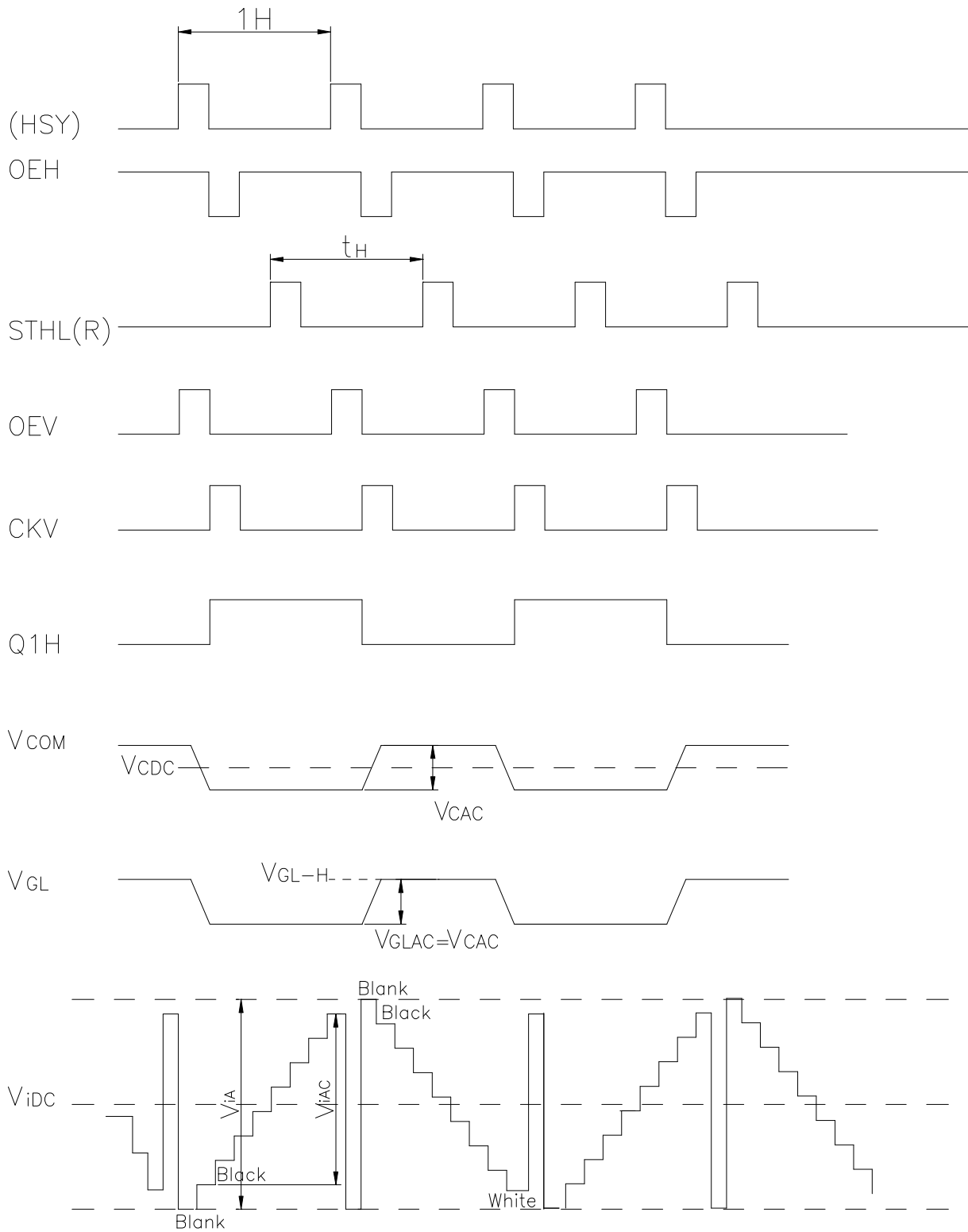
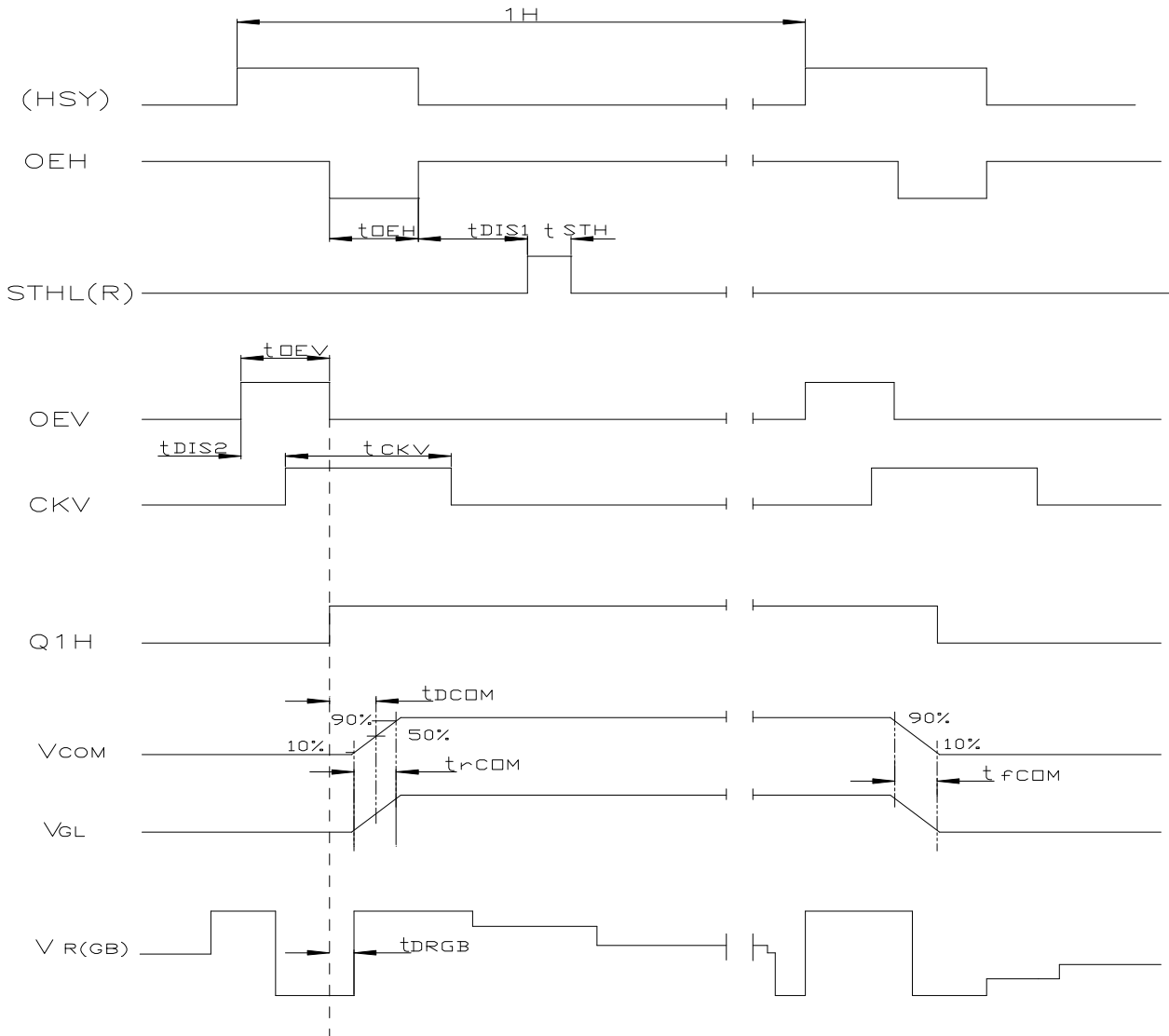


Fig.3-3-(a) Horizontal timing



Note: The falling edge of OEV should be synchronized with the falling edge of OEH  
 Fig.3-3-(b) Detail horizontal timing

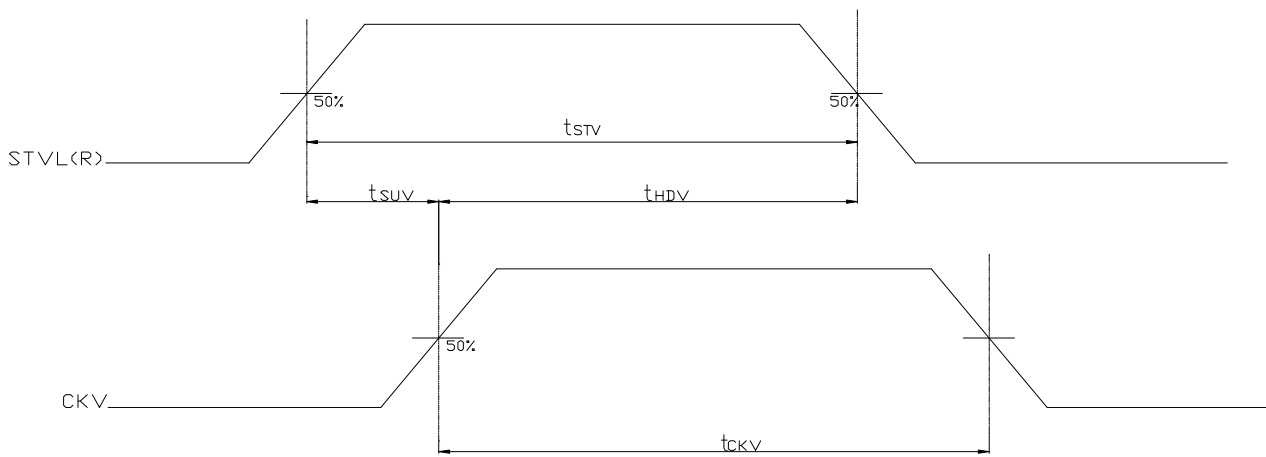


Fig.3-4 Vertical shift clock timing horizontal timing

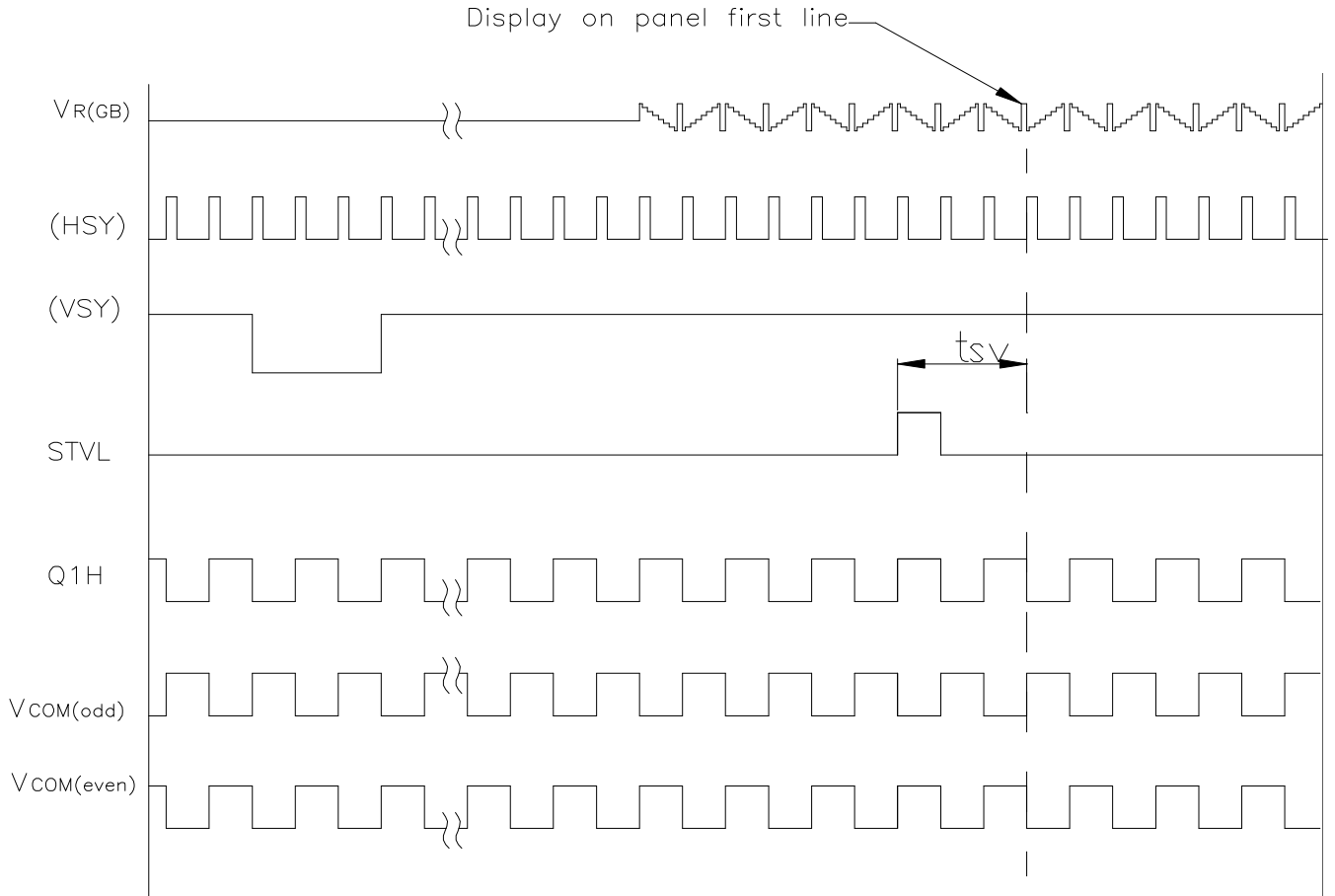


Fig.3-5(a) Vertical timing (from up to down)

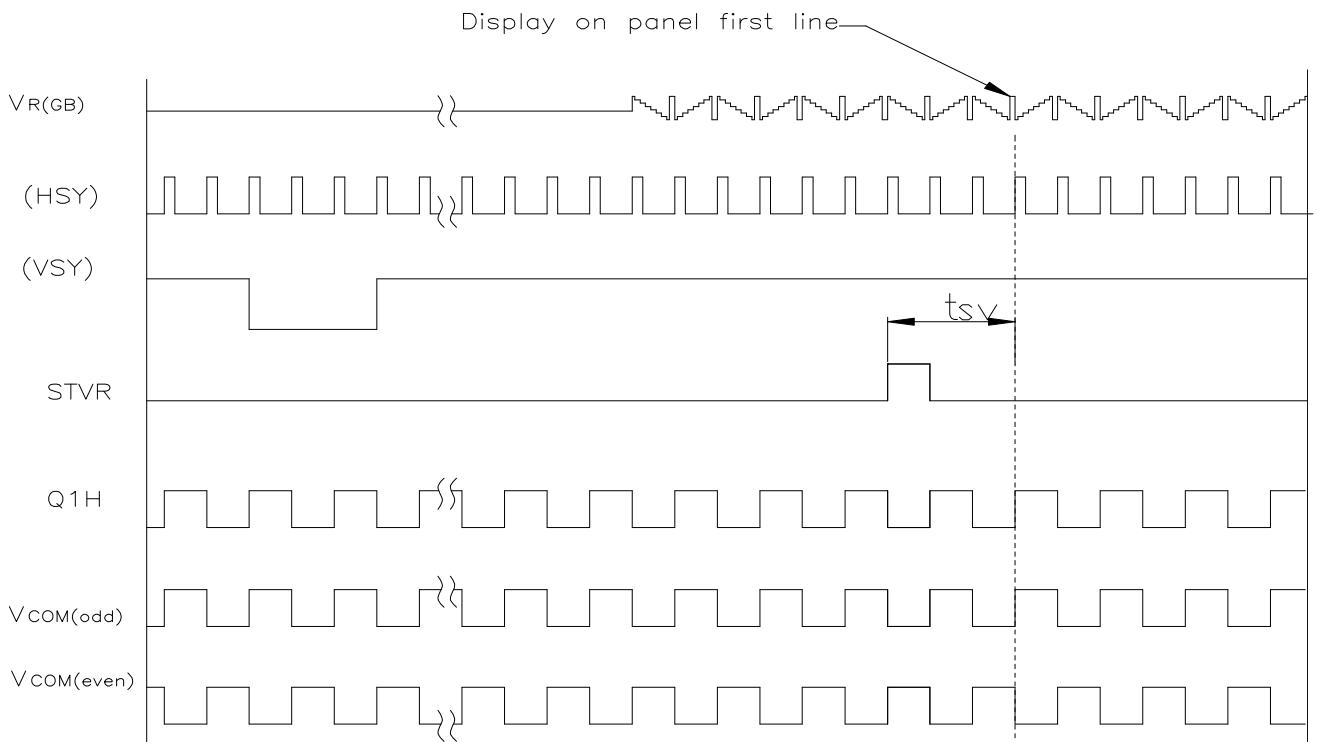


Fig.3-5(b) Vertical timing (from down to up)

## 4. Optical Specifications

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing angle (CR≥10)	$\theta_L$	$\Phi=180^\circ$ (9 o'clock)	40	45	-	degree	Note 1
	$\theta_R$	$\Phi=0^\circ$ (3 o'clock)	40	45	-		
	$\theta_T$	$\Phi=90^\circ$ (12 o'clock)	10	15	-		
	$\theta_B$	$\Phi=270^\circ$ (6 o'clock)	30	35	-		
Response Time	$T_{ON}$	Normal $\theta=\Phi=0^\circ$	-	20	30	msec	Note 3
	$T_{OFF}$		-	30	40	msec	Note 3
Contrast ratio	CR		150	200	-	-	Note 4
Color chromaticity	$W_X$		0.26	0.31	0.36	-	Note 5 Note 6
	$W_Y$		0.28	0.33	0.38	-	
	$R_X$		0.54	0.59	0.64	-	
	$R_Y$		0.30	0.35	0.40	-	
	$G_X$		0.30	0.35	0.40	-	
	$G_Y$		0.52	0.57	0.62	-	
	$B_X$		0.10	0.15	0.20	-	
	$B_Y$	0.06	0.11	0.16	-		
Luminance	L	150	200	-	cd/m <sup>2</sup>	Note 6	
Luminance uniformity	$Y_U$	70		-	-	Note 7	

### Test Conditions:

- $V_{CC}=5V$ ,  $AV_{DD}=5V$ ,  $I_L=20mA$  (Backlight current), the ambient temperature is  $25^\circ C$ .
- The test systems refer to Note 2.



Note 1: Definition of viewing angle range

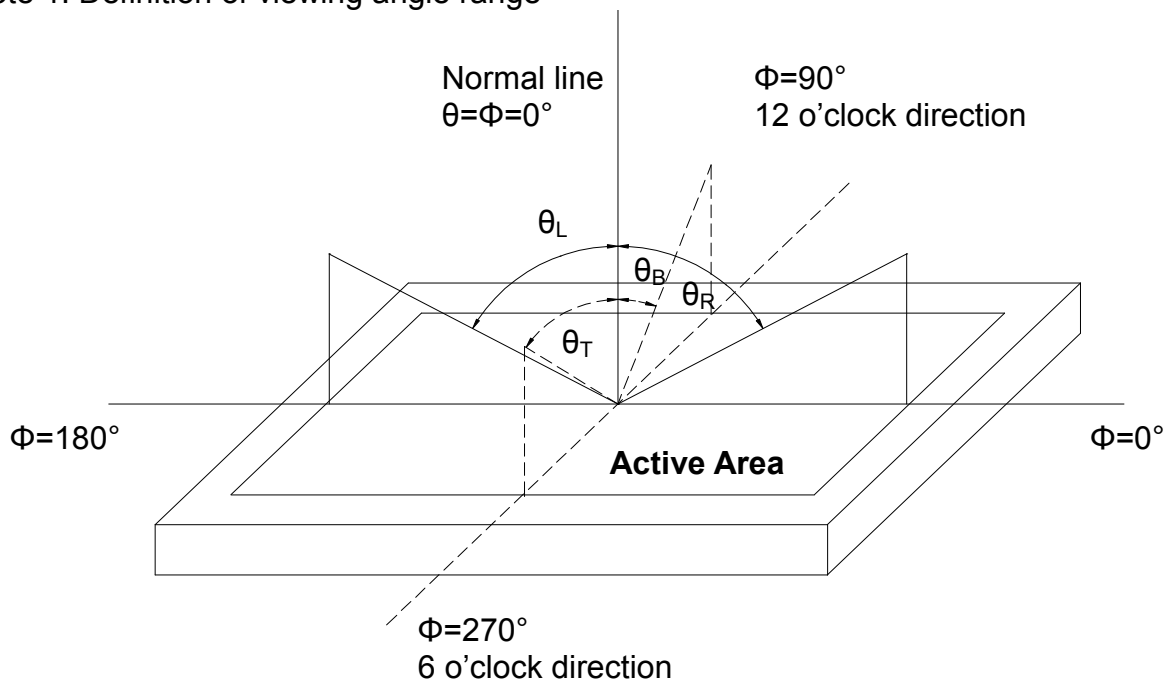


Fig. 4-1 Definition of viewing angle

Note 2: Definition of optical measurement system. (TFT)

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.)

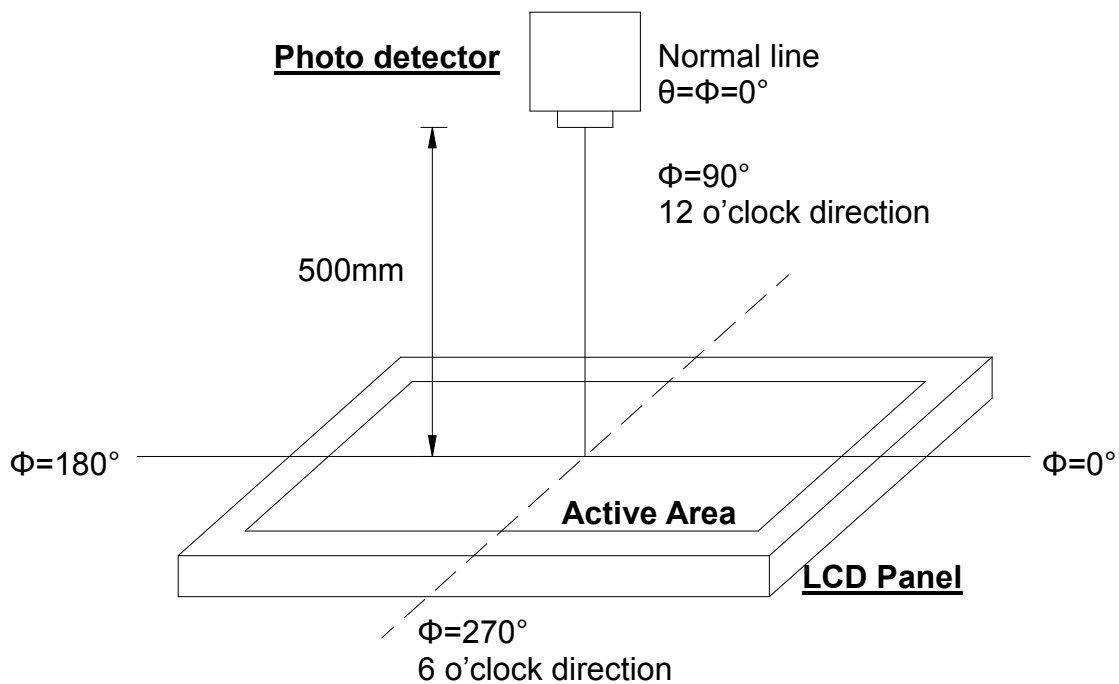


Fig. 4-2 Optical measurement system setup

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%.

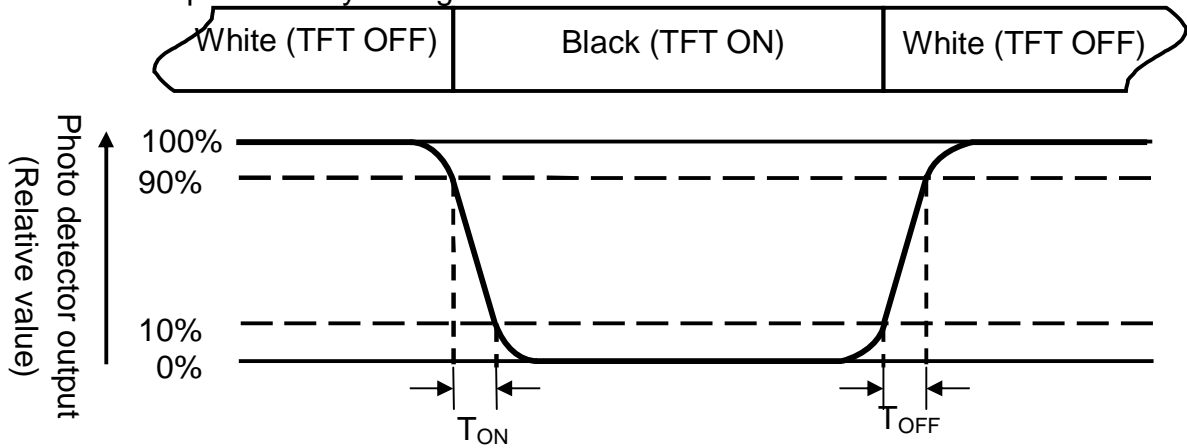


Fig. 4-3 Definition of response time

Note 4: Definition of contrast ratio

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

White  $V_i = V_{i50\%} \pm 1.5 \text{ V}$

Black  $V_i = V_{i50\%} \mp 2.0 \text{ V}$

“ $\pm$ ” means that the analog input signal swings in phase with VCOM signal.

“ $\mp$ ” means that the analog input signal swings out of phase with VCOM signal.

$V_{i50\%}$ : The analog input voltage when transmission is 50%

The 100% transmission is defined as the transmission of LCD panel when all the input terminals of module are electrically opened.

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 when measuring the center area of the panel.

Note 7: Definition of Luminance Uniformity

To test for uniformity, the tested area, which is inside the active area, is divided into 3 rows and 3 columns. The measurement spot is placed at the center of each box.

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

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

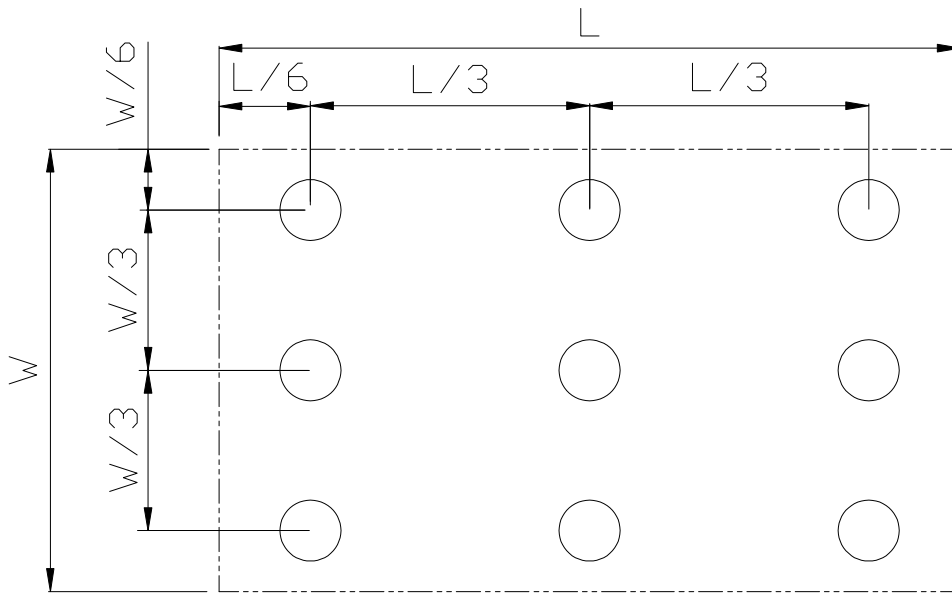


Fig. 4-4 Definition of uniformity

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

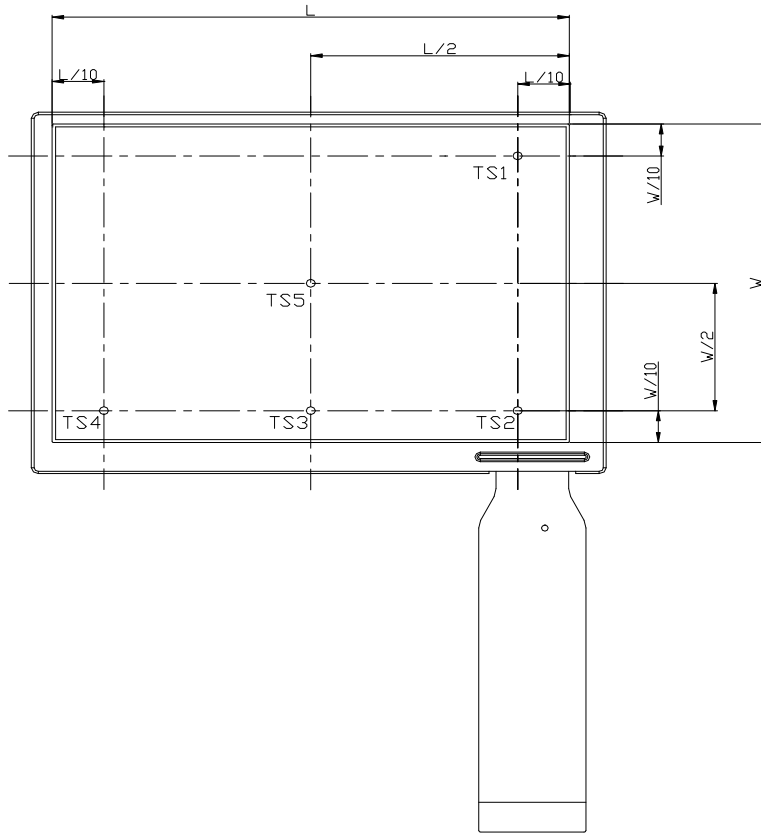
$B_{min}$  : The measured minimum luminance of all measurement position.

## 5. Reliability Test Items

Item	Test Conditions	Remark
High Temperature Storage	Ta = 80°C 240 hrs	Note 1
Low Temperature Storage	Ta = -30°C 240hrs	Note 1
High Temperature Operation	Ts = 60°C 240hrs	Note 2
Low Temperature Operation	Ta = 0°C 240hrs	Note 1
Operate at High Temperature and Humidity	+40°C, 90%RH max. 240 hrs	
Thermal Shock	-30°C/30 min ~ +80°C/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)	JIS C7021 A-10 Condition A
Mechanical Shock	100G 6ms,±X, ±Y, ±Z 3 times for each direction	JIS C7021 A-7 Condition C
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)	IEC 68-34
Package Drop Test	Height:60 cm 1 corner, 3 edges, 6 surfaces	JIS Z0202
Electro Static Discharge	± 2KV, Human Body Mode, 100pF/1500Ω	EIA/JESD22-A114

Note 1: Ta is the ambient temperature of samples.

Note 2:  $T_s$  is the temperature of panel's surface.  
 $T_s = (T_{s1} + T_{s2} + T_{s3} + T_{s4} + T_{s5}) / 5$ .



$L$  is the length of Top Bezel open window,  
 $W$  is the width of Top Bezel open window.

Note 3: In the standard condition, there shall be no practical problem that may affect the display function.

## 6. Handling Precautions

### 6.1. Safety

The liquid crystal in the LCD is poisonous. **DO NOT** put it in your mouth. If the liquid crystal touches your skin or clothes, wash it off immediately 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 very easy to damage, handle it with careful attention.
3. To avoid contamination on the display surface, **DO NOT** touch the display surface with bare hands.
4. Provide a space so that the LCD panel does not come into contact with other components.
5. To protect the LCD panel from external pressure, put covering glass (acrylic board or similar board) keeping appropriate gap between them.
6. Transparent electrodes may be disconnected if you use the LCD panel under environmental conditions where dew condensation occurs.
7. Property of semiconductor devices may be affected when they are exposed to light, possibly resulting in malfunctioning of the ICs.
8. To prevent such malfunctioning of the ICs, your design and mounting layout done are so that the IC is not exposed to light in actual use.

### 6.3. Static Electricity

1. Ground soldering iron tips, tools and testers when you operate.
2. Ground your body when handling the products.
3. **DO NOT** apply voltage to the input terminal without applying power supply.
4. **DO NOT** apply voltage which exceeds the absolute maximum rating.
5. Store the products in an anti-electrostatic container.

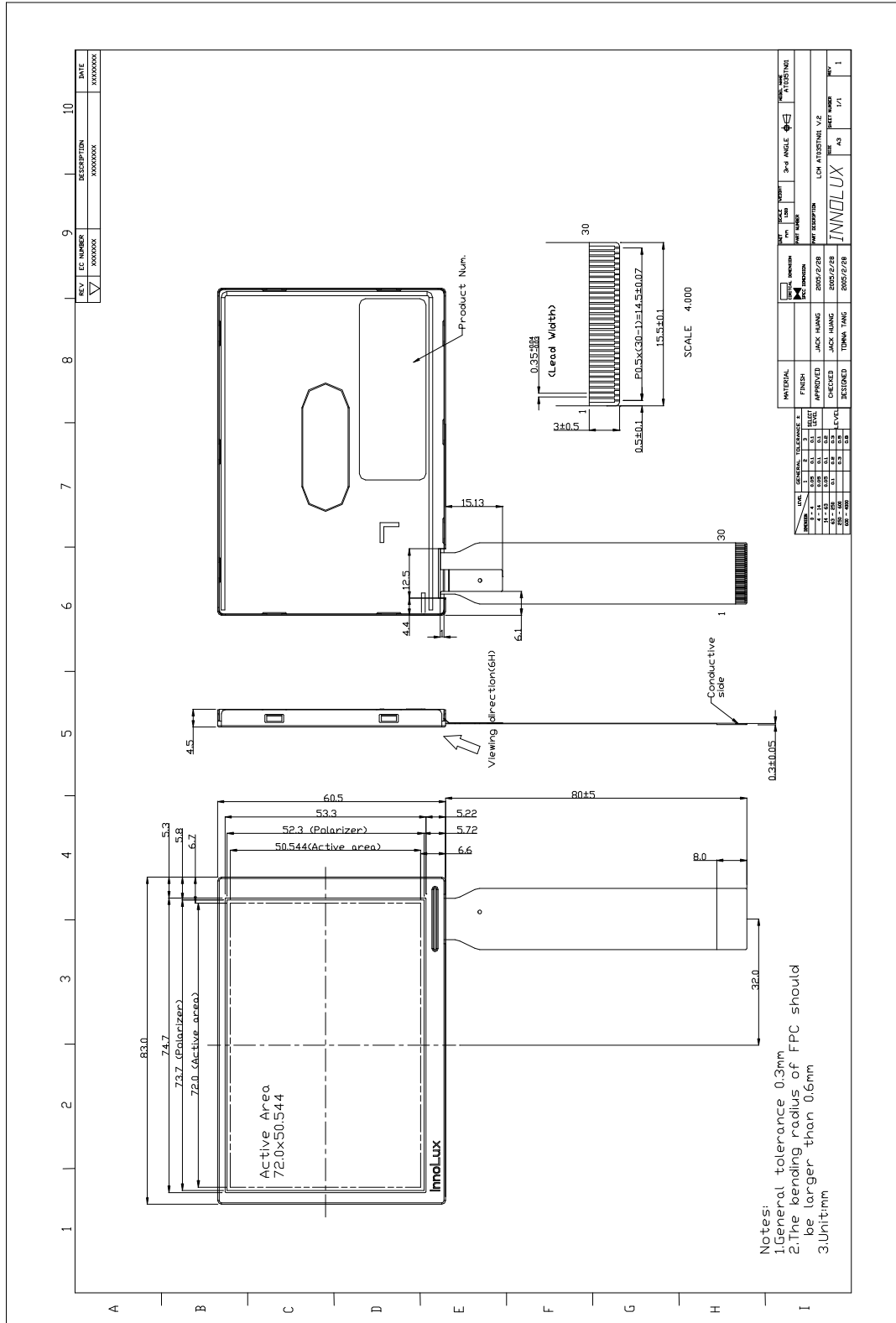
### 6.4. Storage

1. Store the products in a dark place at  $+25^{\circ}\text{C} \pm 10^{\circ}\text{C}$ , low humidity (65%RH or less).
2. **DO NOT** store the products in an atmosphere containing organic solvents or corrosive gases.

### 6.5. Cleaning

1. **DO NOT** wipe the polarizer with dry cloth, as it might cause scratch.
2. Wipe the polarizer with a soft cloth soaked with petroleum IPA, other chemical might damage.

# 7. Mechanical Drawing



## 8. Package Drawing

### 8.1. Packaging Material Table

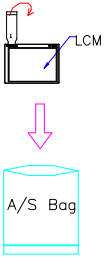


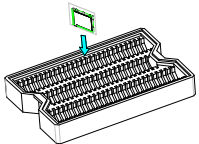
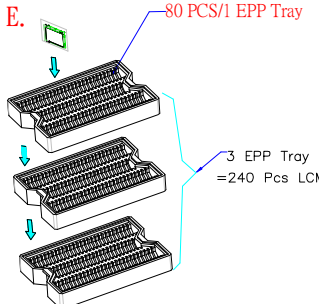
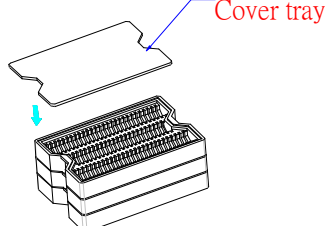
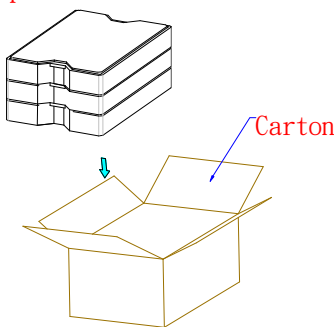

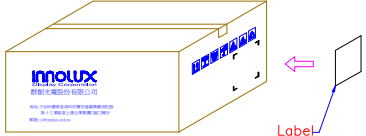

No.	Item	Model (Material)	Dimensions(mm)	Unit Weight (kg)	Quantity	Remark
1	LCM module	AT035TN01	83×60.5×4.5	0.0345	240	
2	Cover tray	EPP	516x384x6.5	0.142	3	Anti-static
3	EPP tray	EPE	493×326×10	0.024	1	Anti-static
4	A/S bag	PE	100×80×0.05	0.001	240	Anti-static
5	Carton	Carton	530x355x255	1.1	1	
6	Total weight	10.07 ± 0.5% kg				

### 8.2. Packaging Quantity

LCM quantity per tray: 2 row X 28 column + 1 row X 24 column =80
Total LCM quantity in Carton: 3 X quantity per tray 80 = 240



### 8.3. Packaging Drawing

<p>Step A.</p>  <p>Put LCM in the A/S bag</p>	<p>Step B.</p>  <p>Turn the upwards A/S bag back</p>	<p>Step C.</p>  <p>Seal the A/S bag</p>
<p>Step D.</p>  <p>Put LCM in the EPP tray 80pcs per EPP tray</p>	<p>Step E.</p>  <p>Stack 3 EPP trays Total numbers :240pcs</p>	<p>Step F.</p>  <p>Put 1 cover tray on the top of of every 3 stacked trays</p>
<p>Step G.</p>  <p>Put stacked trays in outer carton</p>	<p>Step H.</p>  <p>Seal outer carton</p>	<p>Step I.</p>  <p>Paste the label on outer carton</p>
<p style="text-align: center;">Label</p> <div style="border: 1px solid black; padding: 10px; margin: 0 auto; width: 80%;"> <p style="text-align: center;"><b>INNOLUX DISPLAY</b></p> <p>Customer Name :</p> <p>Customer P/N :</p> <p>Box ID :</p> <p>Model No :</p> <p>Quantity :</p> <p>MFG Date :</p> <p>QC :</p> <div style="text-align: right; margin-top: 10px;">  </div> </div>		