

INNOLUX DISPLAY CORPORATION

LCD MODULE

SPECIFICATION

Customer: _____

Model Name: AT056TN02

SPEC NO: A05602TT01

Date: July. 2004

Version: 1.0

Preliminary Specification

Final Specification

For Customer's Acceptance

Approved by	Comment

Approved by	Reviewed by	Prepare by

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1.0	2004/07/28		Initial Release

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1. General specification

NO.	Item	Specification	Remark
1	LCD size	5.6 inch	
2	Driver element	α -Si TFT active matrix	
3	Resolution	320 X RGB X 234	
4	Display mode	Normally white, Transmissive	
5	Display number of colors	Full color	
6	Optimal viewing direction	6 o'clock	
7	Dot pitch	0.118 X 0.362 mm	
8	Active Area	113.28 X84.708 mm	
9	Module size	126.5 X 100 X 5.7 mm	
10	Color arrangement	RGB-stripe	
11	Weight	142g	
12	Driver IC	Himax HX8204+HX8604	

2. Electrical specifications

2.1 Absolute maximum ratings

Parameter	Symbol	Values		Unit	Remark
		Min.	Max.		
Power voltage	V_{CC}	-0.3	7	V	
	V_{DD}	-0.3	7	V	
	V_{GH}	-0.3	18	V	
	V_{GL}	-15	0.3	V	
	$V_{GH}-V_{GL}$	-	31	V	
Input signal voltage	V_i	-0.3	$V_{DD}+0.3$		Note 1
	V_I	-0.3	$V_{CC}+0.3$		Note 2
	VCOM	-2.9	5.2		
Operating temperature	Top	-10	70	°C	Ambient temperature
Storage temperature	T_{ST}	-30	80	°C	Ambient temperature

Note:

1. VR, VG, VB
2. STHL, STHR, Q1H, OEH, L/R, CPH1~CPH3, STVR, STVL, OEV, CKV, U/D.
3. The absolute maximum ratings are the values that must not be exceeded at any time for this product. It is not allowed for any of these ratings to be exceeded. 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.

2.2. Pin assignment

2.2.1 TFT-LCD panel driving section

Pin no	Symbol	IO	Function	Remark
1	GND	-	Ground	
2	V _{CC}	I	Supply voltage for logic control circuit scan driver	
3	V _{GL}	I	Negative power for scan driver	
4	V _{GH}	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	VCOM	I	Common electrode driving signal	
11	VCOM	I	Common electrode driving signal	
12	L/R	I	LEFT/RIGHT scan control input	Note 1, 2
13	Q1H	I	Analog signal rotate input	
14	OEH	I	Output enable control for data driver	
15	STHL	I/O	Start pulse for horizontal scan line	Note 1
16	STHR	I/O	Start pulse for horizontal scan line	Note 1
17	CPH3	I	Sampling and shifting clock pulse for data driver	
18	CPH2	I	Sampling and shifting clock pulse for data driver	
19	CPH1	I	Sampling and shifting clock pulse for data driver	
20	V _{CC}	I	Supply voltage for logic control circuit scan driver	
21	GND	-	Ground	Note 1, 2
22	VR	I	Alternated video signal (Red)	Note 1
23	VG	I	Alternated video signal (Green)	
24	VB	I	Alternated video signal (Blue)	
25	AV _{DD}	I	Supply voltage for analog circuit	
26	AV _{SS}	I	Ground for analog circuit	

Note:

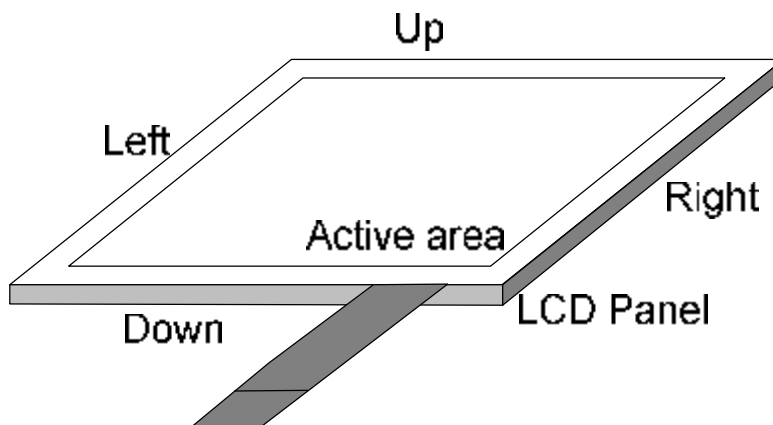
1. Selection of scanning mode (please refer to the following table)

Setting of scan control input		IN/OUT state for start pulse				Scanning direction
U/D	L/R	STVR	STVL	STHR	STHL	
GND	DV _{DD}	O	I	O	I	Up to Down, Left to Right
DV _{DD}	GND	I	O	I	O	Down to Up, Right to Left
GND	GND	O	I	I	O	Up to Down, Right to Left
DV _{DD}	DV _{DD}	I	O	O	I	Down to Up, Left to Right

I: input, O: output

2. Definition of Scanning Direction.

Refer to figure as below:



2.2.2 Backlight driving section

JST BHR-03VS-1

NO.	Symbol	I/O	Description	Remark
1	HI	I	Power supply for backlight unit (High voltage)	
2	NC	-		
3	GND	-	Ground for backlight unit	

2.3 Electrical characteristics

2.3.1 Typical operating conditions (GND=AV_{SS}=V, Note 4)

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Power supply	V _{CC}	4.8	5	5.2	V	
	AV _{DD}	4.8	5	5.2	V	
	V _{GH}	14.3	15	15.7	V	
	V _{GLAC}	-	5	-	V _{p-p}	Note 1
	V _{GL-H}	-10.5	-10	-9.5	V	High level of V _{GL}
Video signal Amplitude(VR, VG, VB)	V _{iA}	AV _{SS} +0.4	-	AV _{DD} -0.4	V	
	V _{iAC}	-	3	-	V	AC component
	V _{iDC}	-	AV _{DD} /2	-	V	DC component
VCOM	V _{CAC}	-	5	-	V _{p-p}	Note2
	V _{CDC}	1.56	1.76	1.96	V	DC component
Input Signal voltage	H Level	V _{IH}	0.8V _{CC}	-	V _{CC}	Note 3
	L Level	V _{IL}	0	-	0.2V _{CC}	

Note:

- 1: The same phase and amplitude with common electrode driving signal (VCOM).
- 2: The brightness of LCD panel could be adjusted by the adjustment of the AC component of VCOM.
- 3: STHL, STHR, Q1H, OEH, L/R, CPH1~CPH3, STVR, STVL, OEV, CKV, U/D.
- 4: Be sure to apply GND, V_{CC} and V_{GL} to the LCD first, and then apply V_{GH}.

2.3.2 Current consumption (GND=AV_{SS}=V)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Current for driver	I _{GH}	V _{GH} =15V	-	0.2	0.8	mA	
	I _{GL}	V _{GL} =-10V	-	-0.5	-1	mA	
	I _{CC}	V _{CC} =5V	-	4	8	mA	
	I _{DD}	V _{DD} =5V	-	12	20	mA	
	I _{VCOM}	V _{GH} =15V	-	10	18	mA	
	I _{LI1}	-	-10	-	10	uA	Note 1

Note 1: Input Leakage Current

2.3.3 Backlight driving condition

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Lamp voltage	V _L	-	470	528	Vrms	Note 3
Lamp current	I _L	5.9	6	6.1	mArms	
Frequency	F _L	-	60	80	kHz	Note 3,4
Lamp starting voltage	V _S	-	-	650	Vrms	Note 1,3,5
		-	-	910	Vrms	Note 2,3,5
Lamp Lifetime	-	20,000	-	-	hr	Note 6

Note:

- 1: Ta = 25°C.
- 2: Ta = 0°C.
- 3: Reference value, correct value is subject to final backlight specification which will be decided in the future.
- 4: The lamp frequency should be selected as different as possible from display horizontal synchronous signal to avoid interference
- 5: For starting the backlight unit, the output voltage of DC/AC's transformer should be larger than the maximum lamp starting voltage.
- 6: The "Lamp life time " is defined as the module brightness decrease to 50% original brightness at Ta= 25°C, I_L=6mA.

2.4 AC Timing

2.4.1 Timing conditions

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Rising time	t_r	-	-	60	ns	Note 1
Falling time	t_f	-	-	60	ns	Note 1
High and low level pulse width	t_{CPH}	150	154	158	ns	CPH1~CPH3
CPH pulse duty	t_{CWH}	40	50	60	%	CPH1~CPH3
CPH pulse delay	t_{C12} t_{C23} t_{C31}	30	$t_{CPH}/3$	$t_{CPH}/2$	ns	CPH1~CPH3
STH setup time	t_{SUH}	20	-	-	ns	STHR, STHL
STH hold time	t_{HDH}	20	-	-	ns	STHR, STHL
STH pulse width	t_{STH}	-	1	-	t_{CPH}	STHR, STHL
STH period	t_H	61.5	63.5	65.5	μs	STHR, STHL
OEH pulse width	t_{OEH}	-	7	-	t_{CPH}	
Sample and hold disable time	t_{DIS1}	-	55	--	μs	
OEV pulse width	t_{OEV}	-	27		t_{CPH}	
CKV pulse width	t_{CKV}	16	41	40	t_{CPH}	
Clean enable time	t_{DIS2}	-	16	--	t_{CPH}	
Horizontal display start	t_{SH}	-	0	-	$t_{CPH}/3$	
Horizontal display timing range	t_{DH}	-	960	-	$t_{CPH}/3$	
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	Note 3
VCOM rising time	t_{RCOM}		-	5	μs	
VCOM falling time	t_{FCOM}		-	5	μs	
VCOM delay time	t_{DCOM}		-	3	μs	
RGB delay time	t_{DRGB}		-	1	μs	

Note:

1. For all of the logic signals
2. Please don't use odd horizontal lines to drive LCD panel for both odd and even field simultaneously.
3. Vertical total display lines.

2.4.2 Timing diagram

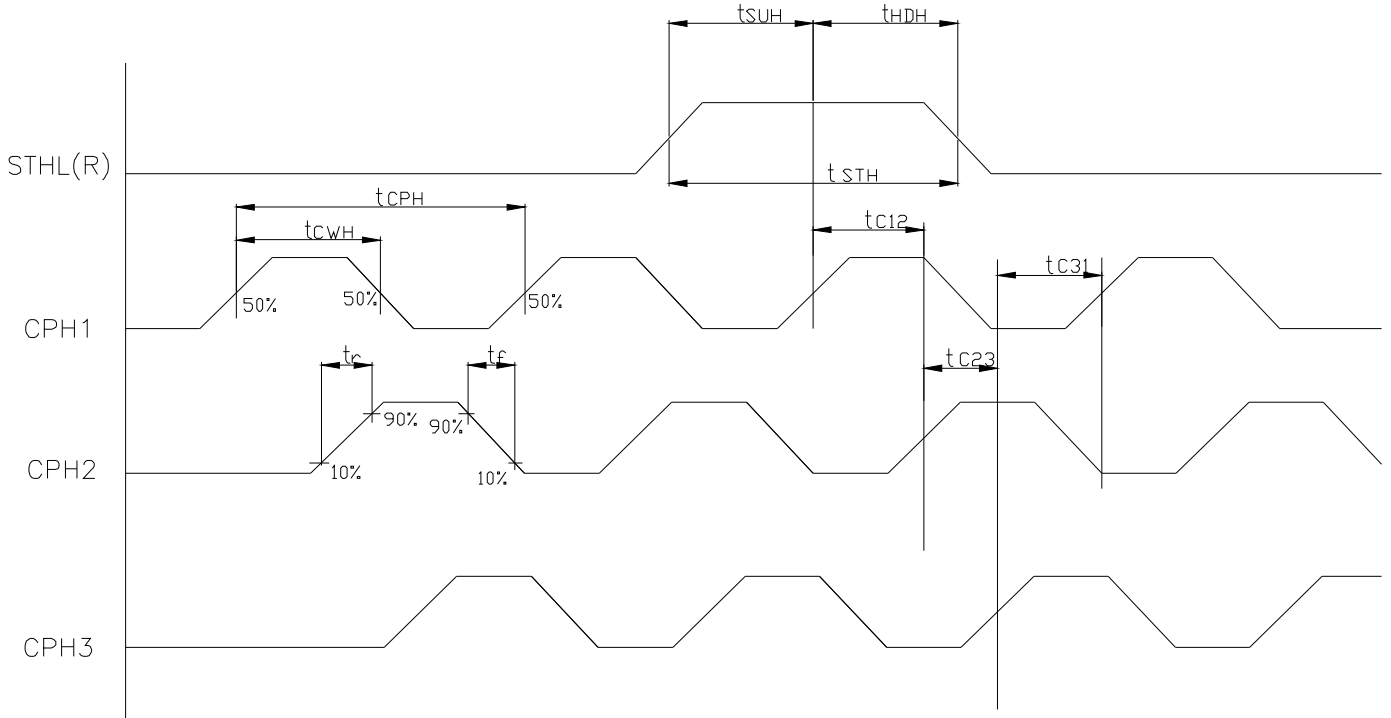


Fig.1 Sampling clock timing

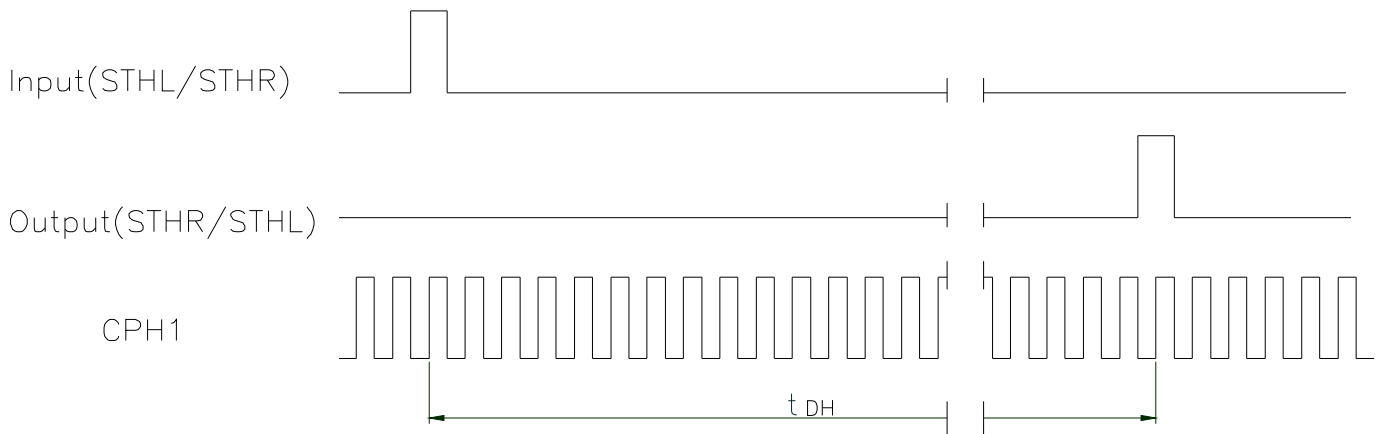


Fig.2 Horizontal display timing range

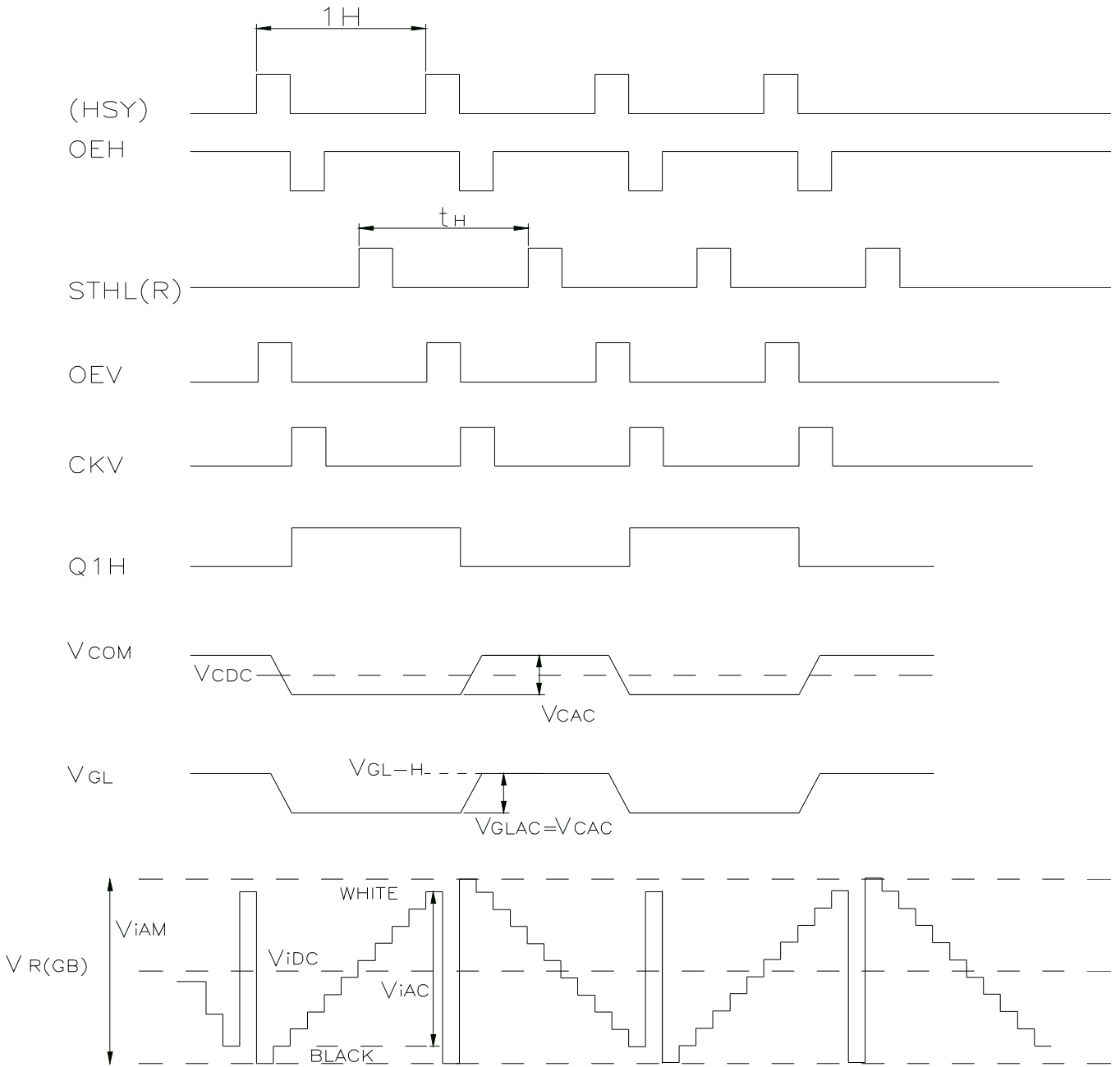
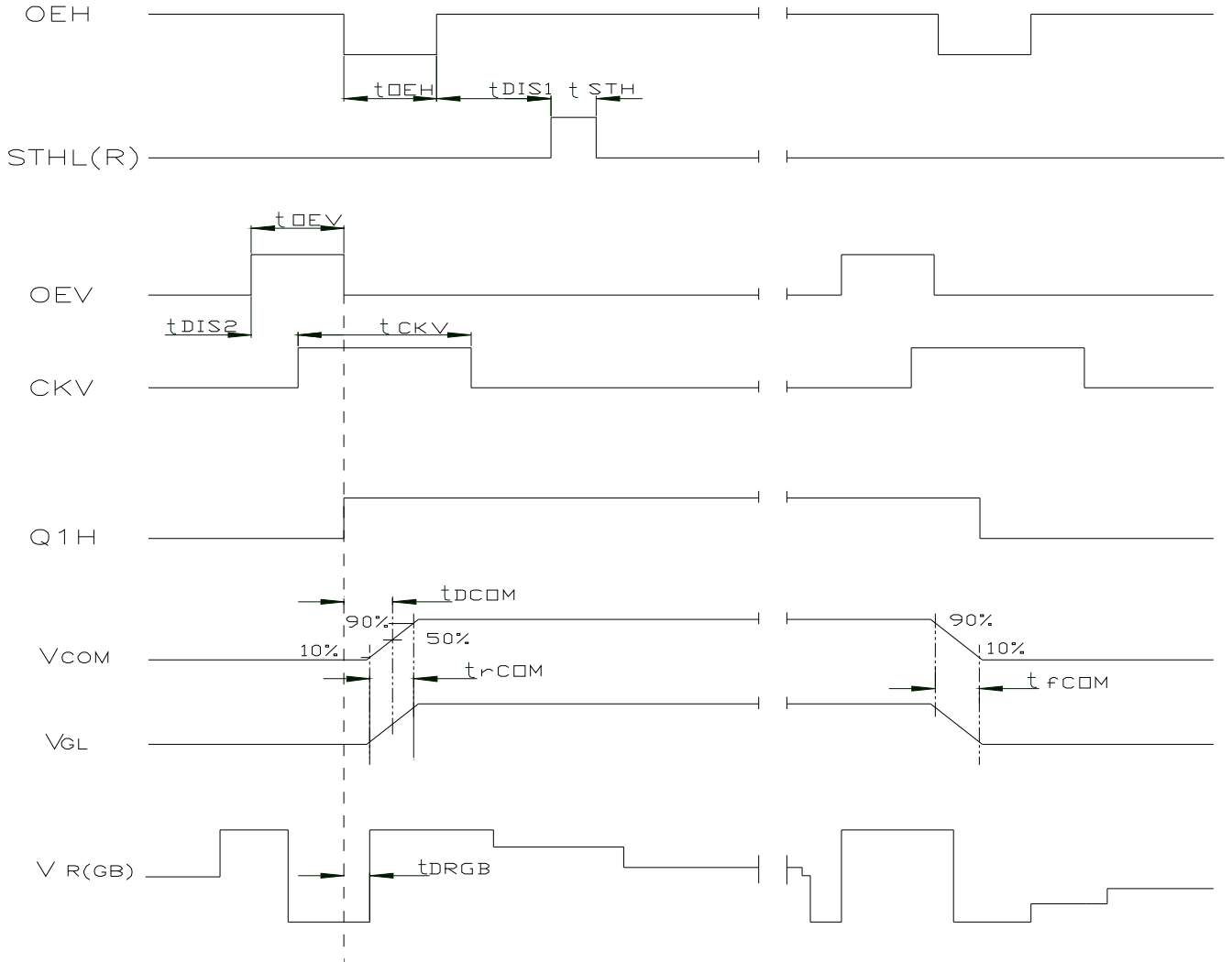


Fig.3-(a) Horizontal timing



Note: The falling edge of OEV should be synchronized with the falling edge of OEH

Fig.3-(b) Detail horizontal timing

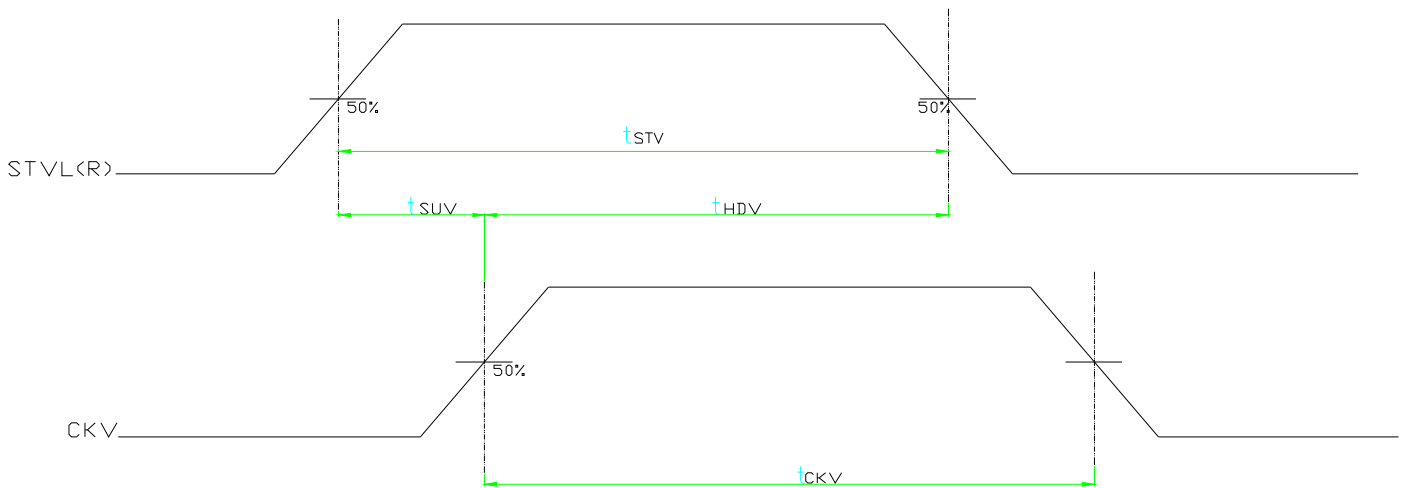


Fig.4 Vertical shift clock timing

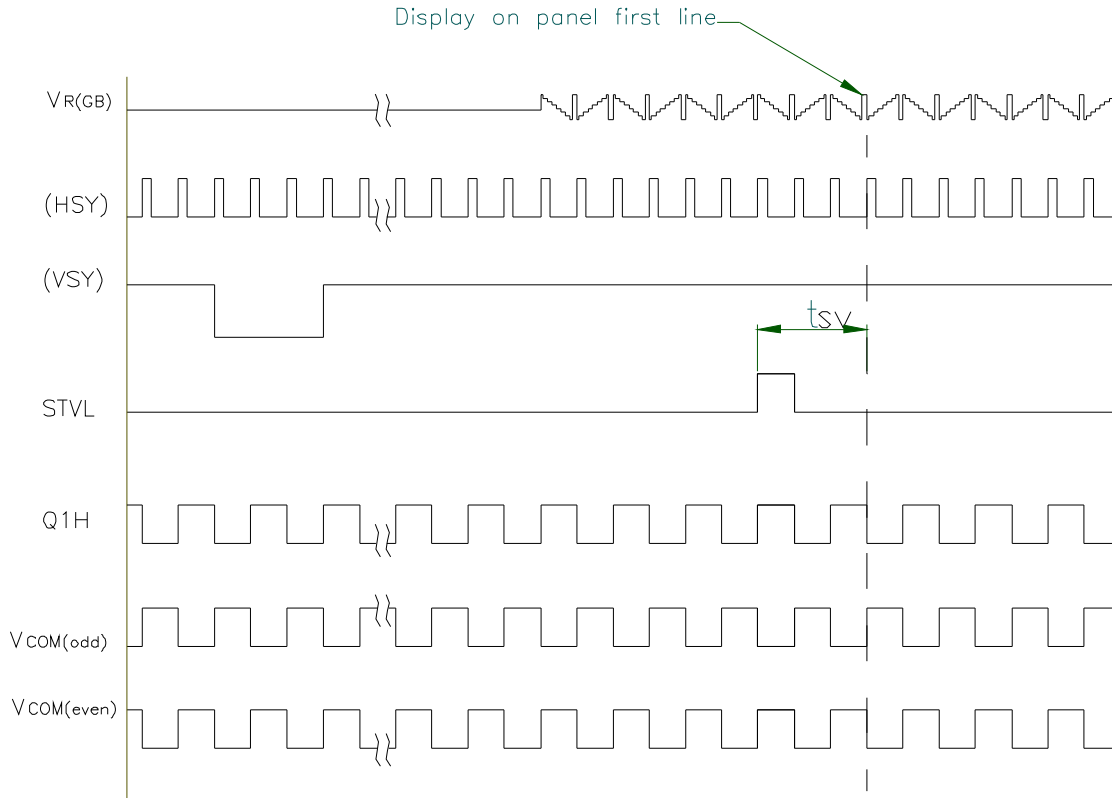


Fig.5 (a) Vertical timing (from up to down)

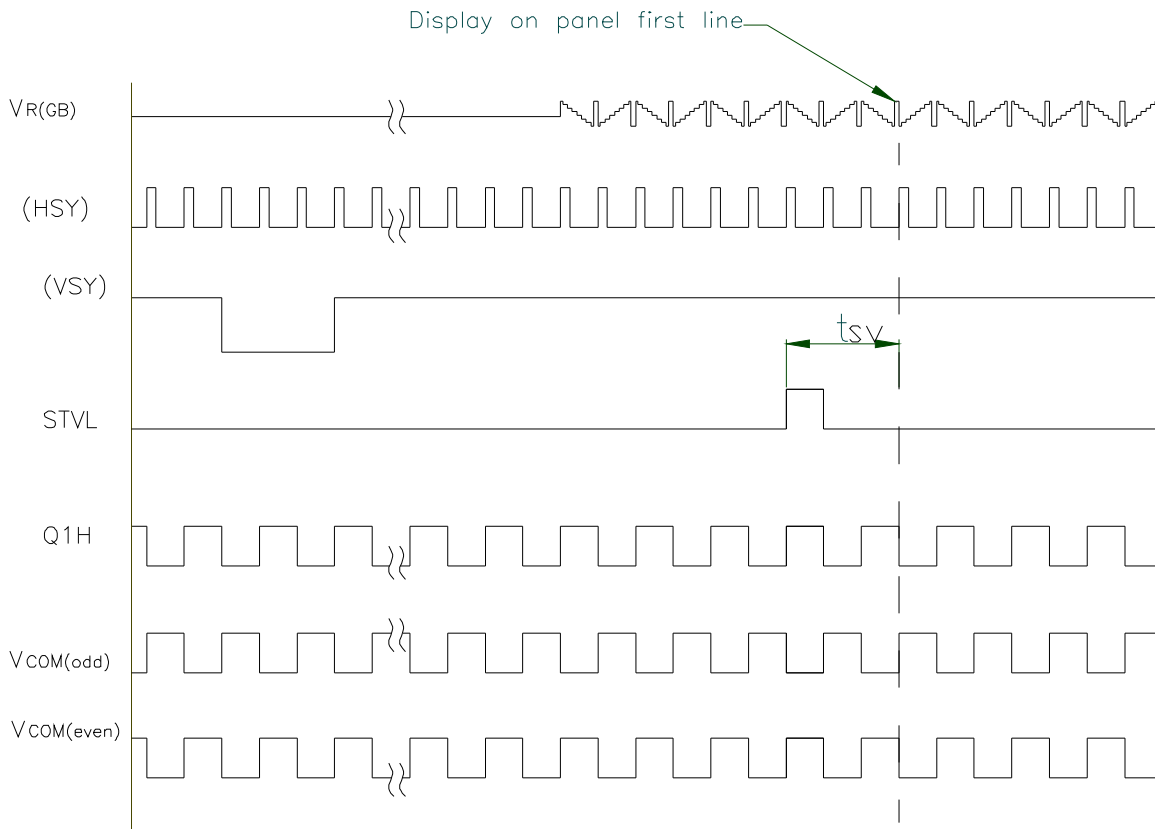


Fig.5 (b) Vertical timing (from up to down)

3. Optical specifications

The following items are measured under stable conditions. The optical characteristics should be measured in dark room or equivalent state with the methods shown in Note 1.

$T_a=25\pm 2^\circ\text{C}, I_L=6\text{mA}$

Item	Symbol	Condition	Min	Typ	Max	Unit	Remark	
Contrast ratio	CR	Note 1 $\Theta=\Phi=0$ Normal Viewing Angle B/L ON	100	150	-		Note2	
Luminance of white	Y_L		270	330	-	Cd/m^2	Note3	
Response Time	$(T_r)+(T_f)$		-	35	70	msec	Note4	
Color Chromaticity	White		W_x	0.25	0.30	0.35		
			W_y	0.30	0.35	0.40		
	Red		R_x	0.50	0.55	0.60		
			R_y	0.28	0.33	0.38		
	Green		G_x	0.26	0.31	0.36		
			G_y	0.55	0.60	0.65		
	Blue		B_x	0.10	0.15	0.20		
		B_y	0.08	0.13	0.18			
Viewing Angle	Hor.	θ_L	40	45	-	Degree	Note5	
		θ_R	40	45	-			
	Ver.	Φ_L	25	30	-			
		Φ_H	10	10	-			

Note:

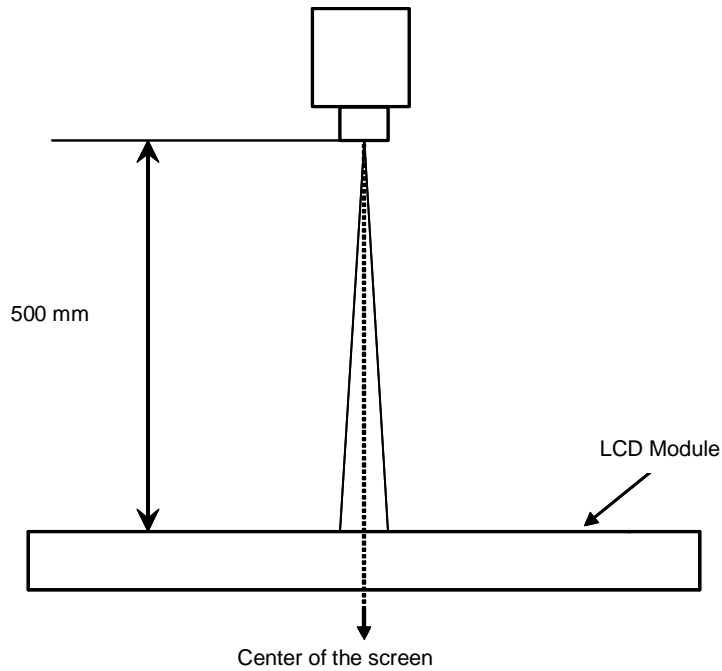
1. Test Equipment Setup

After stabilizing and leaving the panel alone at a given temperature for 20 minutes, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 20 minutes after lighting the back-light. This should be measured in the center of screen.

-Back-Light ON Condition

Measuring Instrument : TOPCON BM-5A

Field : 1°



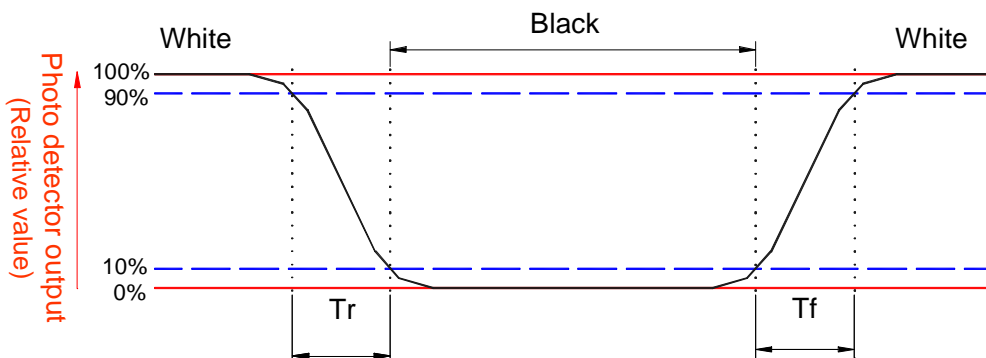
2. Definition of Contrast Ratio (CR): Ratio of gray max (Gmax) & gray min (Gmin) at the center Point

$$CR = \frac{G_{max}}{G_{min}}$$

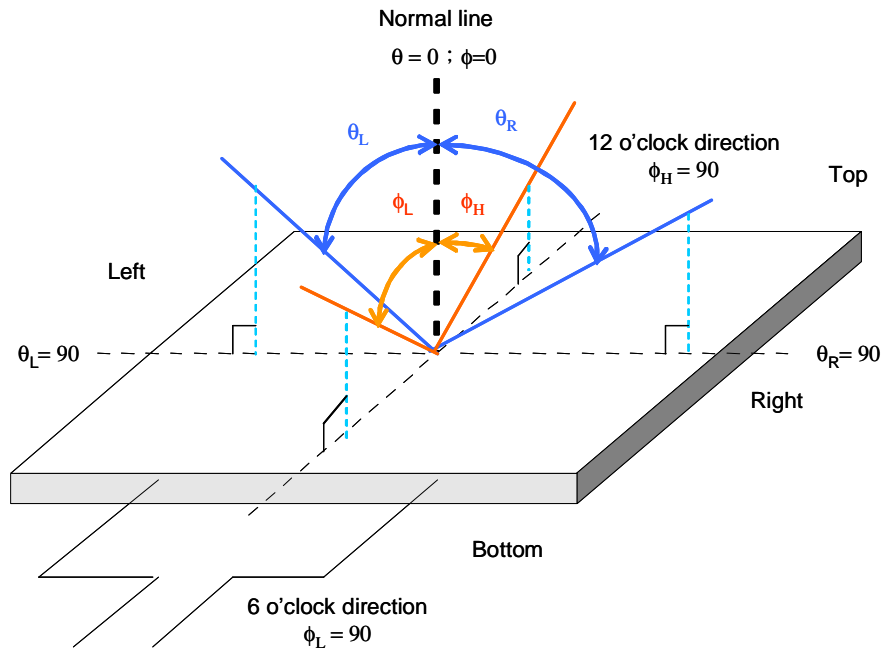
Gmax: Luminance with all pixels white

Gmin: Luminance with all pixels black

3. Definition of Luminance of white: Luminance of white at the center point
4. Definition of Response time: sum of Tr, Tf



5. Definition of Viewing Angle: Viewing angle range ($CR \geq 10$)



4. Reliability test items

Reliability levels in Mass production

Test Items	Test Conditions	Remark
High temperature storage	+80°C± 3°C for 240 hours	
Low temperature storage	-30°C± 3°C for 240 hours	
High temperature operation	+70°C± 3°C for 240 hours	
Low temperature operation	-10°C± 3°C for 240 hours	
High temperature and humidity Operation	+60°C± 3°C, 90%± 3%RH max. for 240 hours	Operation
Thermal shock	-30°C /1h ~ +80°C/1h for a total 50 cycles, Start with cold temp and end with high temp	Non-operation
Vibration	Frequency range :10~55Hz Stoke :1.5mm Sweep:10~55Hz~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 drop Test (with carton)	60 cm high /3 times/ each 6 plane /total 18 drops	
Package vibration test (with carton)	Random Vibration 0.015G*G/HZ from 5-200HZ,-6dB/octave from 200-500HZ	IEC 68-34
Electro-static discharge	±2kV Human Body Mode, 100pF/1500Ω	Non-operation
	±200V Machine Model 200pF/no series resistance	

Note:

- 1 High temp storage & High temp/High humidity Op the polarizer is out of subject.
- 2 The test samples have recovery time 2 hours at room temp before function check.
- 3 No changes (affecting reliability or performance) shall be allowed on production material, process, or manufacturing locations, regardless of whether such changes affect characteristics specified.

5. Handling Precautions

5.1 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.

5.2 Handling

- 5.2.1 The LCD panel is plate glass. **DO NOT** subject the panel to mechanical shock or to excessive force on its surface.
- 5.2.2 The polarizer attached to the display is very easy to damage, handle it with careful attention.
- 5.2.3 To avoid contamination on the display surface, **DO NOT** touch the display surface with bare hands.
- 5.2.4 Provide a space so that the LCD panel does not come into contact with other components.
- 5.2.5 To protect the LCD panel from external pressure, put covering glass (acrylic board or similar board) keeping appropriate gap between them.
- 5.2.6 Transparent electrodes may be disconnected if you use the LCD panel under environmental conditions where dew condensation occurs.
- 5.2.7 Property of semiconductor devices may be affected when they are exposed to light, possibly resulting in malfunctioning of the ICs.
- 5.2.8 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.

5.3 Static electricity

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

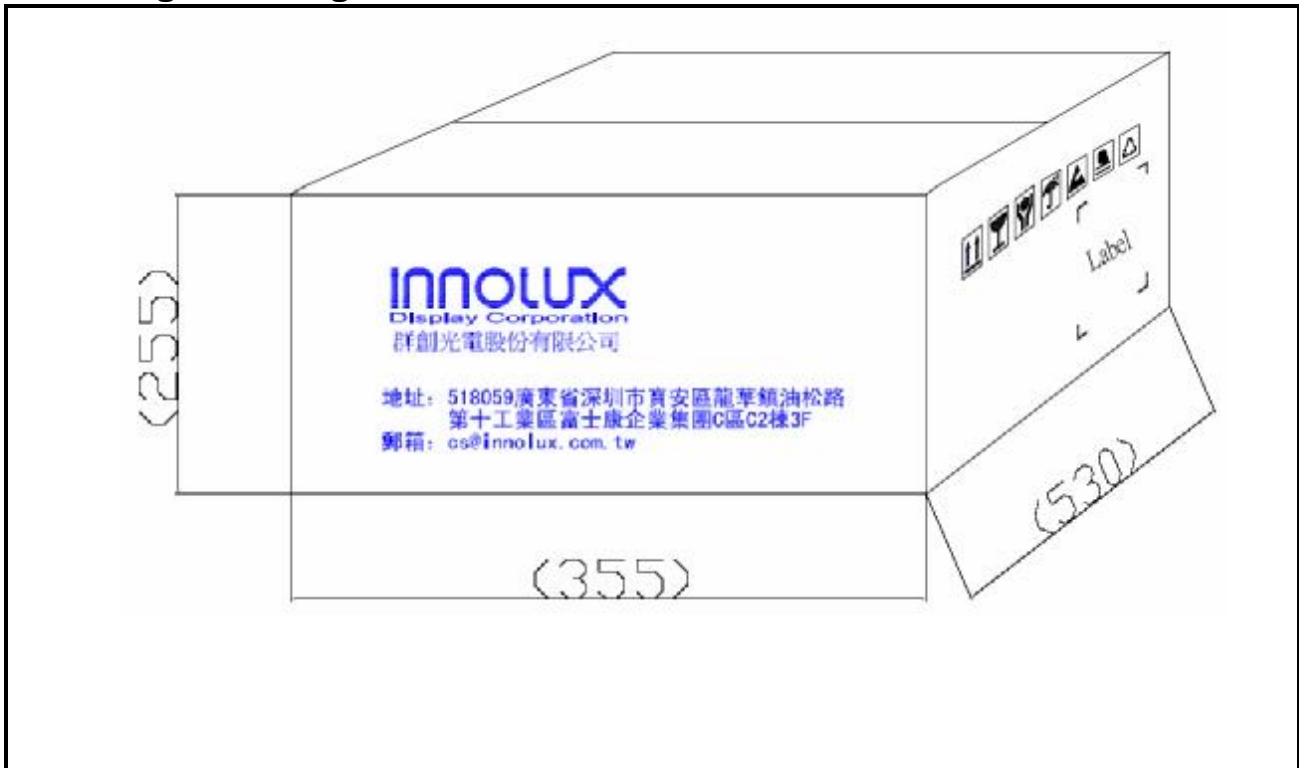
5.4 Storage

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

5.5 Cleaning

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

7. Package drawing



Label

INNOLUX DISPLAY	
Customer Name :	
Customer P/N :	
Box ID:	
Model No:	
Quantity:	
MFG Date:	
QC:	

