

INNOLUX DISPLAY CORPORATION

LCD MODULE

SPECIFICATION

Customer: _____

Model Name: AT035TN02

SPEC NO: AT035-01-TT-02

Date: March.31, 2004

Version: 1.0

Preliminary Specification

Final Specification

For Customer's Acceptance

Approved by	Comment

Presented by	Reviewed by	Prepare by
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Revisions Section

Revision	Description	Date
1	Initial Release	03/31 04

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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	Display contents(dot)	480(W)X 234 (H)	
4	Display Mode	Normally white, Transmissive with Backlight	
5	Dot pitch	0.15(W) X 0.216(H) mm	
6	Active area	72(W) X 50.544(H) mm	
7	Module Size	82.8±0.3(W)x60±0.3(H)x6.0±0.3 (D)mm	
8	Color configuration	R.G.B delta	
9	Weight	37g±3g	

2. Electrical specifications**(1). Absolute maximum ratings**

Item	Symbol	Condition	Values		Unit	Remark
			Min.	Max.		
Power voltage	DV _{DD}	GND=0	-0.3	7	V	
	AV _{DD}	AV _{SS} =0	-0.3	7	V	
	V _{GH}	GND=0	-0.3	18	V	
	V _{GL}		-15	0.3	V	
	V _{GH} -V _{GL}	-	-	33	V	
Input signal voltage	V _i	-	-0.3	AV _{DD} +0.3	V	Note 1
	V _I	-	-0.3	DV _{DD} +0.3	V	Note 2
	V _{COM}	-	-2.9	5.2	V	
Operation Temperature	Top	-	0	60	°C	Ambient
Storage Temperature	T _{st}	-	-25	80	°C	Ambient

Note :

1. VR, VG, VB.

2. STHL, STHR, OEH, L/R, CPH1~CPH3, STVR, STVL, OEV, CKV, U/D, Q1H

(2). Pin assignment

Pin no	Symbol	IO	Function	Remark
1	STHL	I/O	Start pulse for horizontal scan line	Note 1
2	OEH	I	Output enable control for data driver	
3	Q1H	I	Analog signal rotate input	
4	CPH1	I	Sampling and shifting clock pulse for data driver	
5	CPH2	I	Sampling and shifting clock pulse for data driver	
6	CPH3	I	Sampling and shifting clock pulse for data driver	
7	GND	P	Ground	
8	VB	I	Alternated video signal (Blue)	
9	VG	I	Alternated video signal (Green)	
10	VR	I	Alternated video signal (Red)	
11	NC	-	This pin should be electrical opened during operation	
12	L/R	I	LEFT/RIGHT scan control input	Note 1,2
13	STHR	I/O	Start pulse for horizontal scan line	Note 1
14	AV _{DD}	P	Supply voltage for analog circuit	
15	VCOM	I	Common electrode driving signal	
16	V _{GH}	P	Positive power for scan driver	
17	DV _{DD}	P	Supply voltage of logic control circuit for driver	
18	STVL	I/O	Start pulse for vertical scan frame	Note 1
19	OEV	I	Output enable control for scan driver	
20	CKV	I	Shift clock input for scan driver	
21	U/D	I	UP/DOWN scan control input	Note 1,2
22	STVR	I/O	Start pulse for vertical scan frame	Note 1
23	NC	-	This pin should be electrical opened during operation	
24	V _{GL}	P	Negative power for scan driver	

Note:

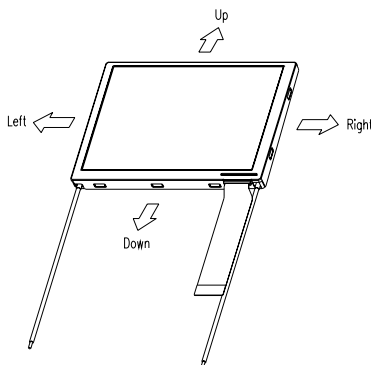
1. Selection of scanning mode (please refer to the following table)

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:



(3). Electrical characteristics

(a). Typical operating conditions (GND =0V, Note 4)

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Power supply	DV _{DD}	3	5	5.2	V	
	AV _{DD}	4.8	5	5.2	V	
	V _{GH}	14.3	15	15.7	V	
	V _{GLAC}	3.5	5	6.5	V	AC component of V _{GL}
	V _{GL-H}	-10.5	-10	-9.5	V	High level of V _{GL}
Video signal amplitude (VR, VG, VB)	V _{iAM}	0.4	-	AV _{DD} -0.4	V	Note2
	V _{iAC}	-	3	-	V	AC component
	V _{iDC}	-	AV _{DD} /2	-	V	DC component
VCOM	V _{CAC}	3.5	5	6.5	V	Note3
	V _{CDC}	1.0	(1.25)	1.5	V	DC component
Input signal Voltage	H level	V _{IH}	0.8 DV _{DD}	-	DV _{DD}	Note4
	L level	V _{IL}	0	-	0.2 DV _{DD}	

Note:

1. The same phase and amplitude with common electrode driving signal (VCOM)
2. Refer to Fig.3-(a).
3. The brightness of LCD panel could be changed by adjusting the AC component of VCOM.
4. SRHL, STHR, OEH, L/R, CPH1~CPH3, STVR, STVL, OEV, CKV, U/D, Q1H
5. Be sure to apply GND, DV_{DD} , and V_{GL} , to the LCD first, and then apply V_{GH}
6. V_{CDC} should be provided an optimized voltage, so as to minimized flicker or maximum contrast every each module.

(b). Current consumption (GND =0V)

Parameter	Symbol	Condition	Values			Unit	Remark
			Min.	Typ.	Max.		
Current for Driver	I_{GH}	$V_{GH}=15V$	-	100	300	μA	V_{GH}
	I_{GL}	$V_{GL-H}=-10V$	-	-100	-300	μA	V_{GL}
	I_{DD}	$DV_{DD}=5V$	-	1.5	4	mA	DV_{DD}
	I_{AVDD}	$AV_{DD}=5V$	-	5	10	mA	AV_{DD}

(c). Backlight driving conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Lamp voltage	V_L	-	260	290	Vrms	Note 3
Lamp current	I_L	2.5	2.9	3.3	mArms	
Frequency	F_L	55	60	65	KHz	Note 3,4
Lamp starting voltage	V_S	-	-	550	Vrms	Note 1,3,5
		-	-	850	Vrms	Note 2,3,5

Note 1: $T_a = 25^\circ C$

Note 2: $T_a = 0^\circ C$

Note 3: Reference value , correct value is subject to final backlight specification which will be decided in the future.

Note 4: The lamp frequency should be selected as different as possible from display horizontal Synchronous signal to avoid interference.

Note 5: For starting the backlight unit , the output voltage of DC/AC's transformer should be larger than the maximum lamp starting voltage.

(4). AC timing

(a). Timing conditions (sequential mode)

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} t_{C23} t_{C31}	70	$t_{CPH/3}$	$t_{CPH/2}$	ns	CPH1~CPH3
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	μs	STHR, STHL
OEH pulse width	t_{OEH}	-	3	-	t_{CPH}	
Sample and hold disable time	t_{DIS1}	-	8.42	--	μs	
OEV pulse width	t_{OEV}	-	13		t_{CPH}	
CKV pulse width	t_{CKV}	16	20	40	t_{CPH}	
Clean enable time	t_{DIS2}	-	10	--	t_{CPH}	
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	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.

(b). Timing diagram

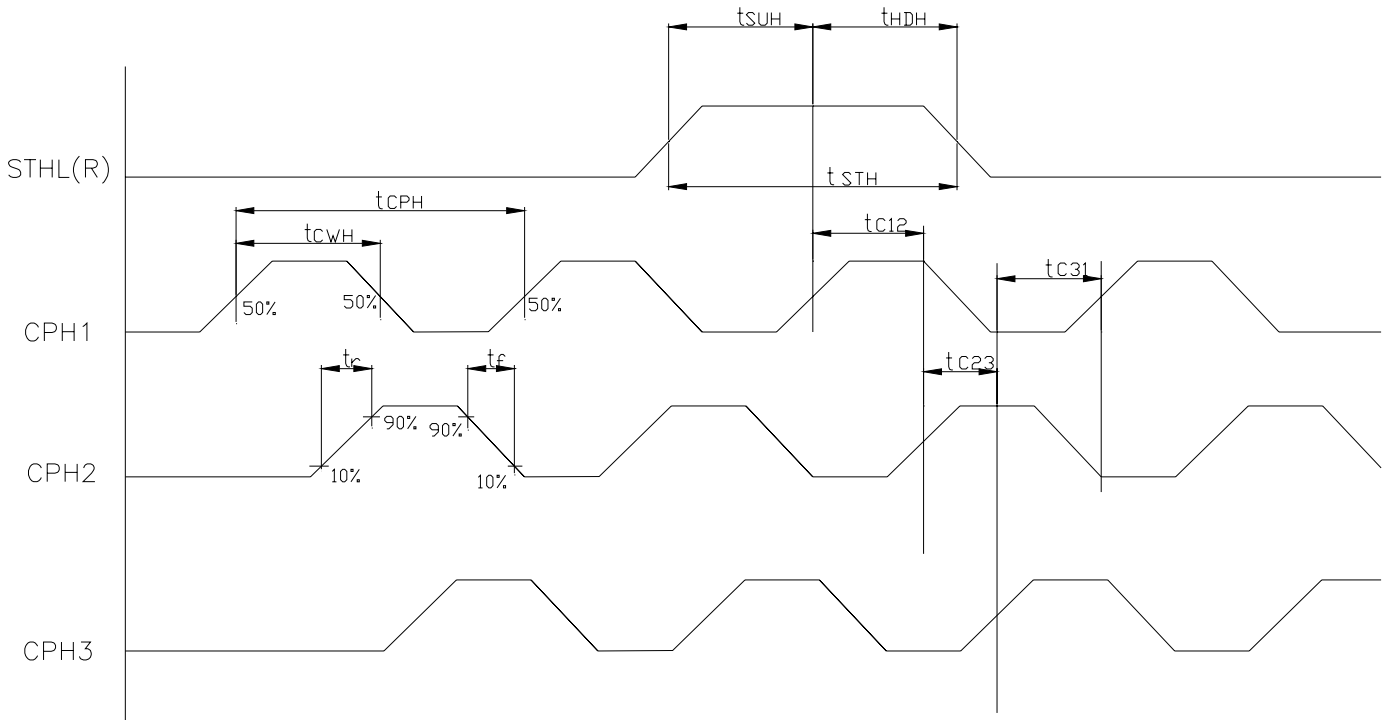


Fig.1 Sampling clock timing

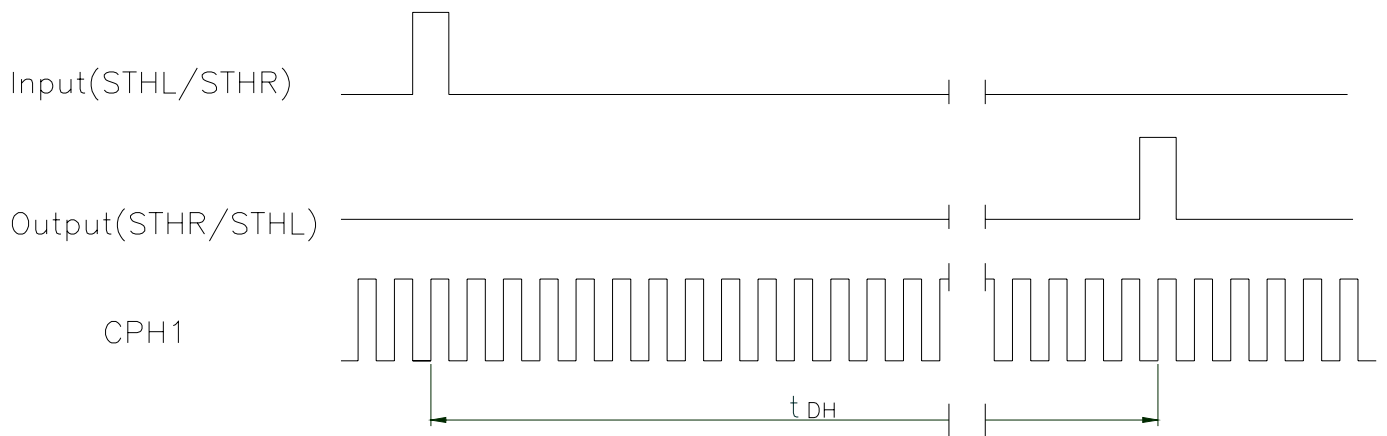


Fig.2 Horizontal display timing range

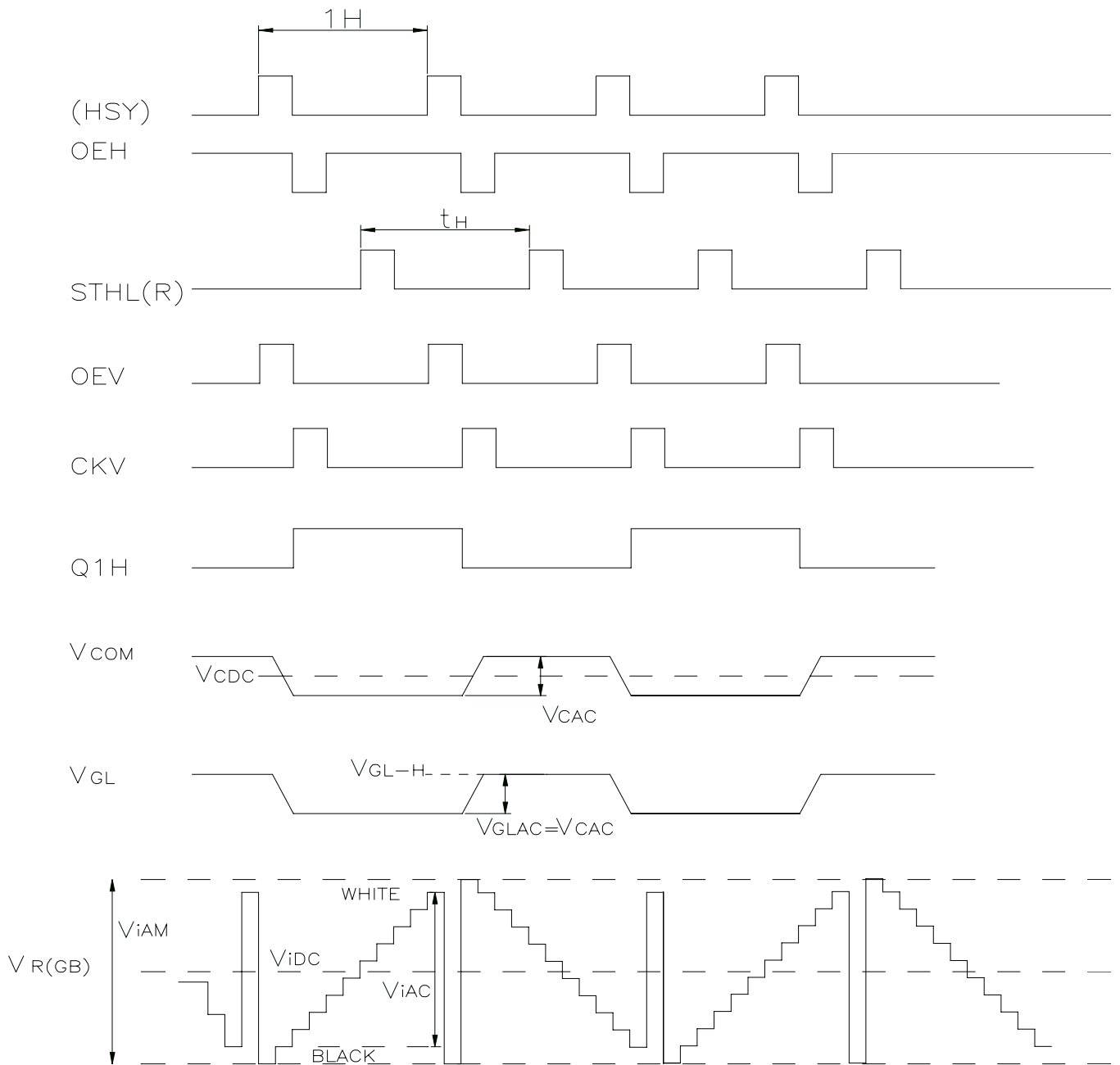
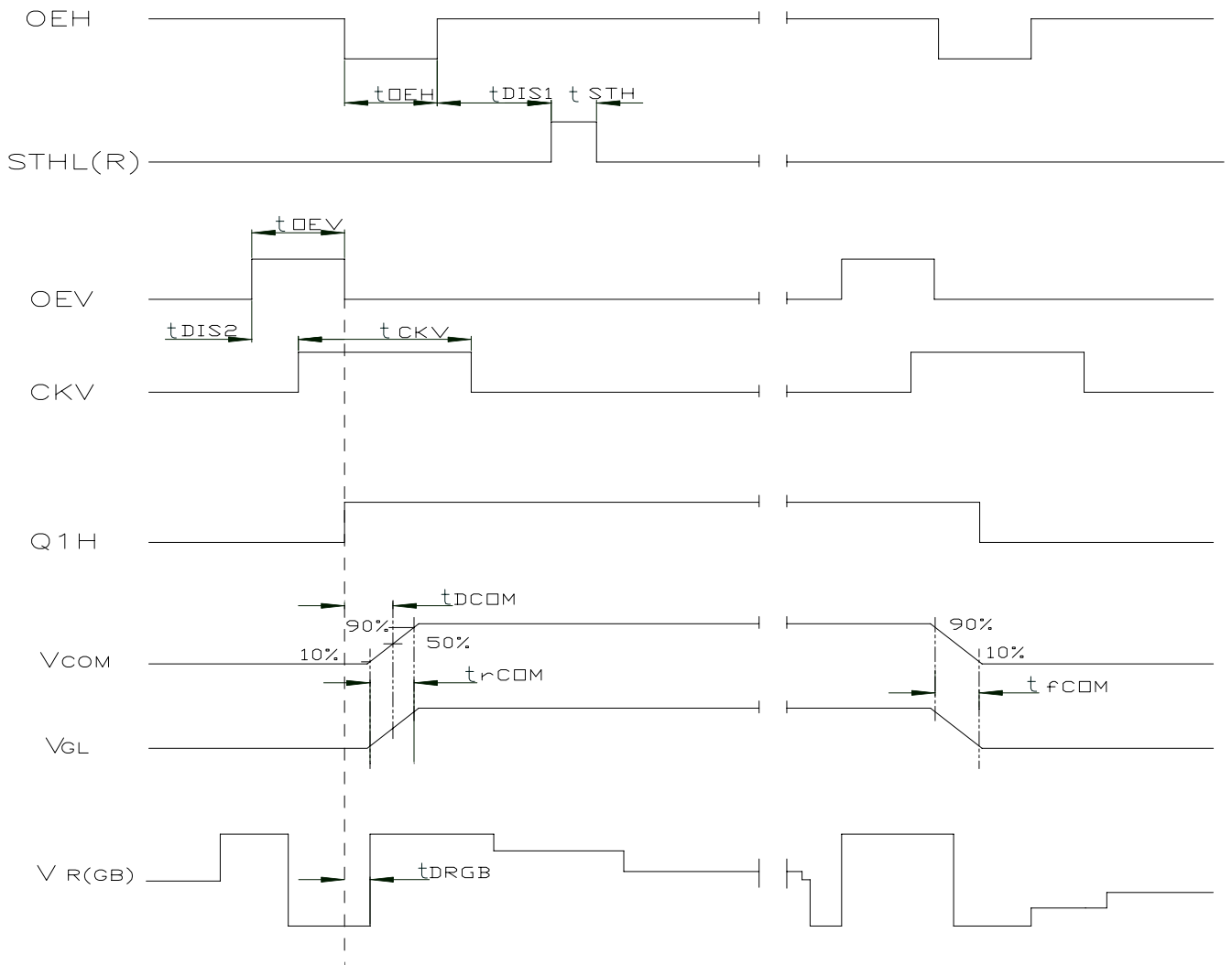


Fig.3-(a) Horizontal timing



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

Fig.3-(b) Detail horizontal timing

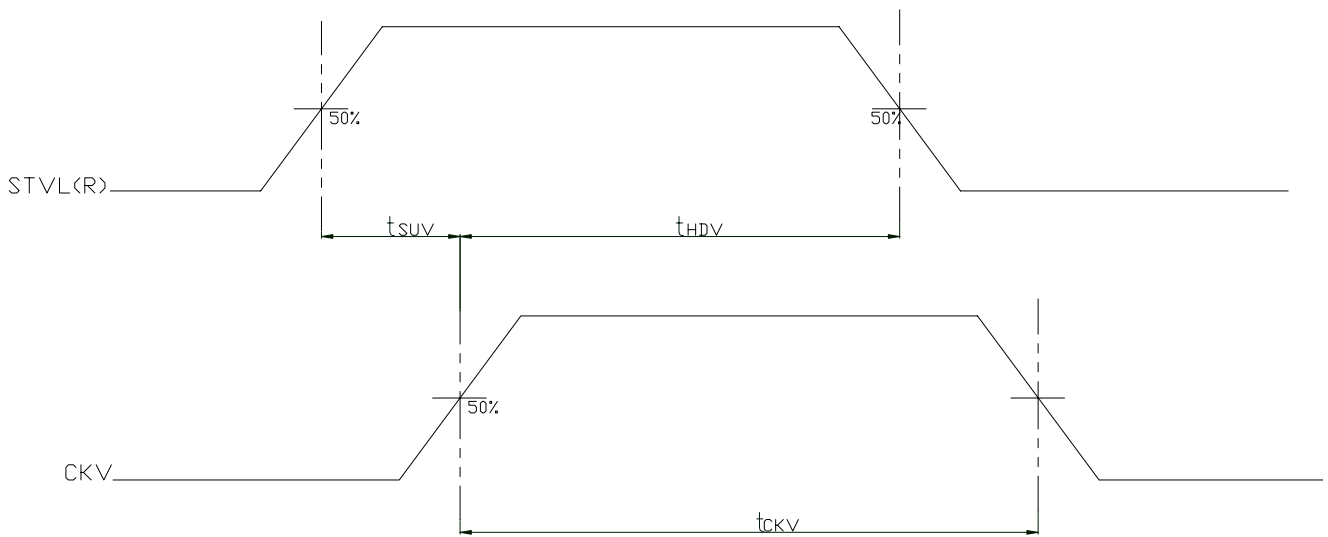


Fig.4 Vertical shift clock timing

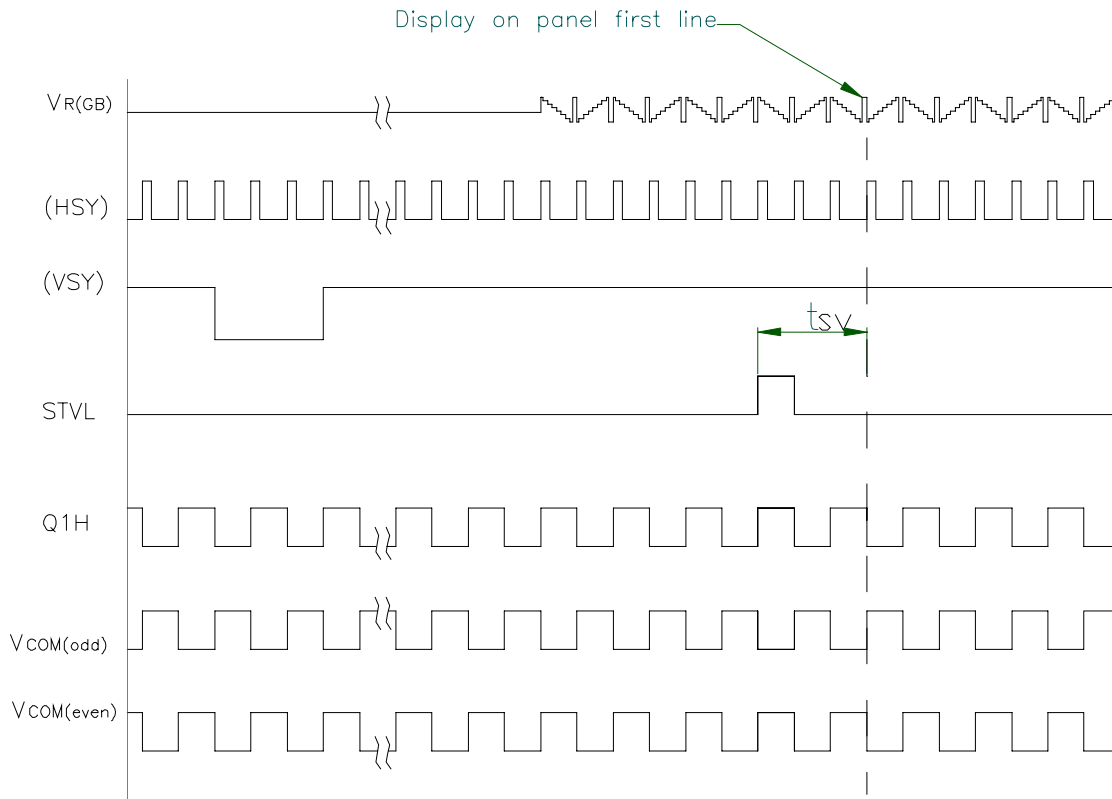


Fig.5(a) Vertical timing(from up to down)

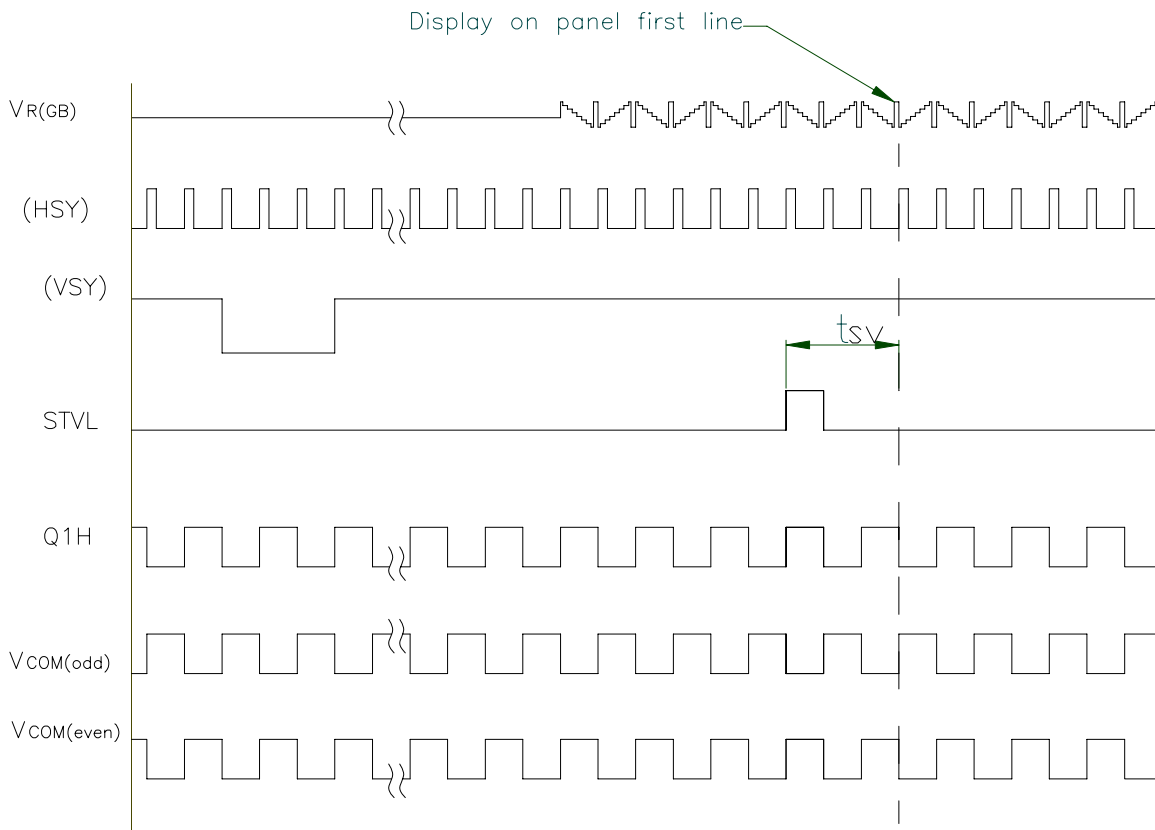
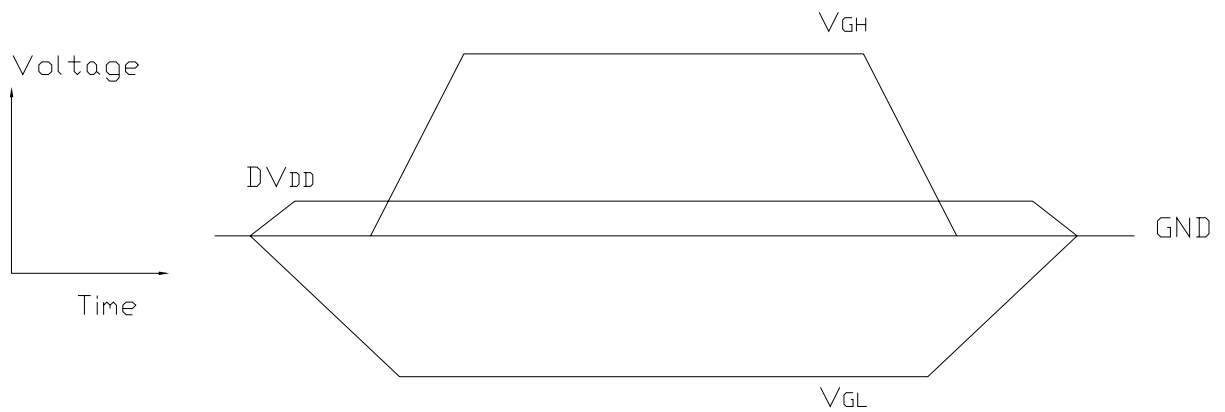


Fig.5(b) Vertical timing(from up to down)

(5)Power sequence

This module adopts high voltage driver IC, so it may be damaged by a large current flow if a wrong power on/off sequence is used! The recommend power sequence is to connect DV_{DD} first, then connect power to driver gate power, V_{GL} and V_{GH} . When shutting off the power, shut off the driver gate power, V_{GL} and V_{GH} , then shut off the logic power, DV_{DD} , or shut off the power simultaneously!



3. Optical specifications

Note 1, Note 2

Ta=25°C, I_L=2.9mA/m²

Parameter		Symbol	Condition	Min	Typ	Max	Unit	Remarks
Response time	rise time	Tr	Normal θ=φ=0°	-	20	30	ms	Note 3, 5
	fall time	Tf		-	30	40		
Contrast ratio		CR	At optimized viewing angle	150	200	-		Note 4, 5
Luminance		L	Normal θ=φ=0°	200	250	-	cd/m ²	Note 6, 8
Color chromaticity (CIE1931)	White	W _x	Normal θ=φ=0°	(0.26)	(0.31)	(0.36)		Note 7, 8
		W _y		(0.28)	(0.33)	(0.38)		
Viewing angle range	Left	θ _R	CR ≥ 10	40	45	-	degree	Note 5
	Right	θ _L		40	45	-		
	Top	φ _T		10	15	-		
	Bottom	φ _B		30	35	-		

Note 1: Definition of viewing angle range

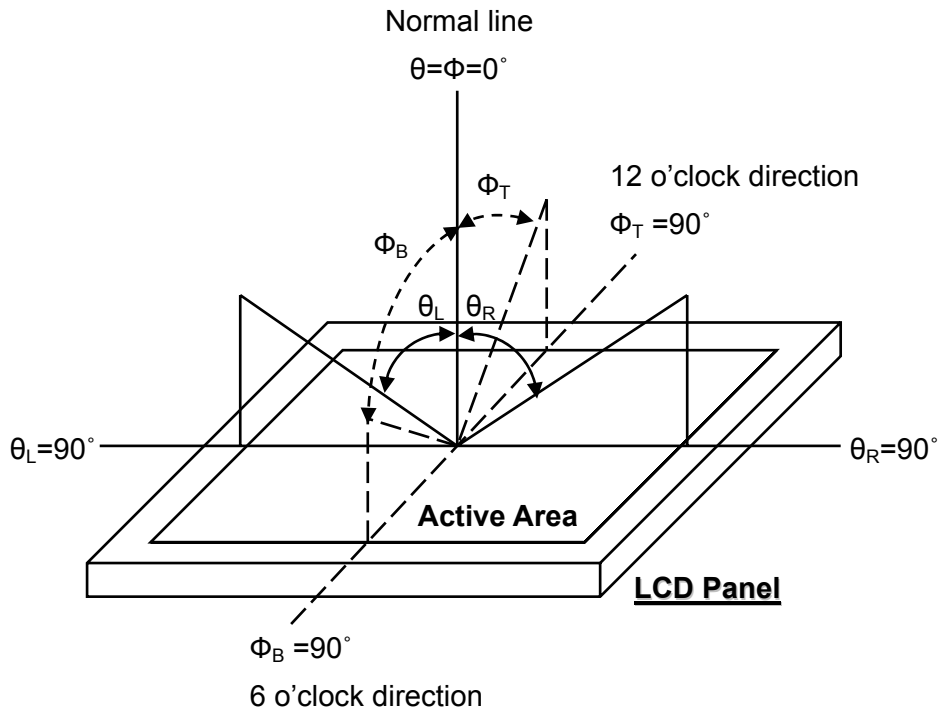


Fig. 3-1 Definition of viewing angle

Note 2: Definition of optical measurement system

The optical characteristics should be measured in dark room and with ambient temperature $T_a=25^\circ\text{C}$. After 30 minutes operation, the optical properties are measured at the center point of the LCD screen.

Equipment: Photo detector TOPCON BM-5A or BM-7 /Field of view: 1° /Height: 500mm.

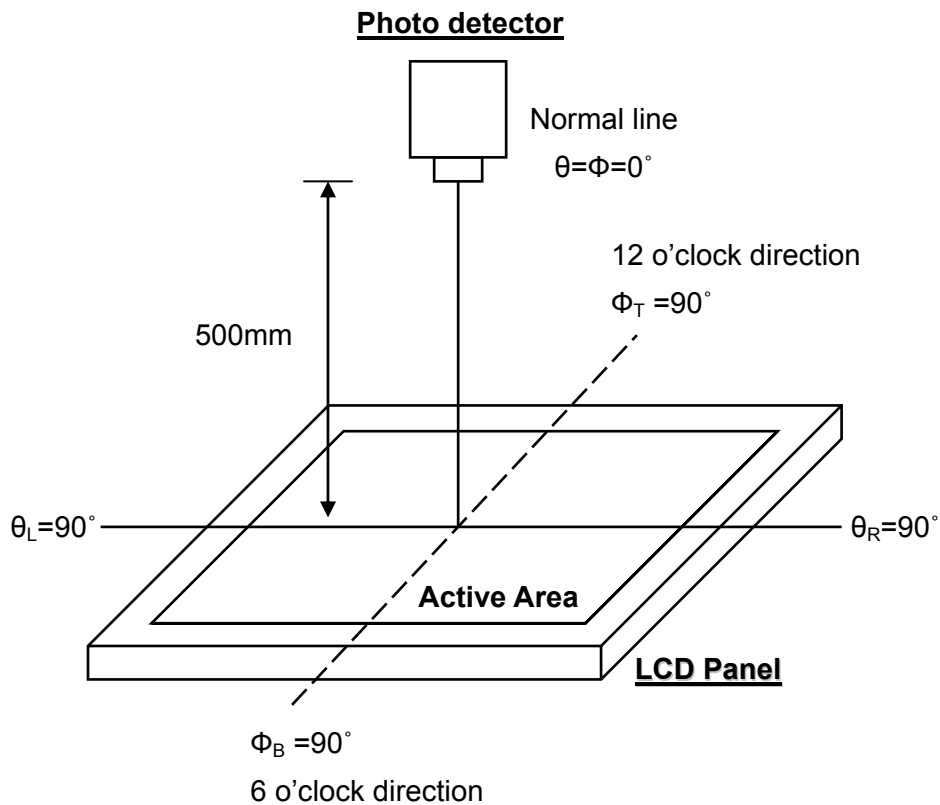


Fig. 3-2 Optical measurement system setup

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_r , is the time between photo detector output intensity changed from 90% to 10%. And fall time, T_f , is the time between photo detector output intensity changed from 10% to 90%.

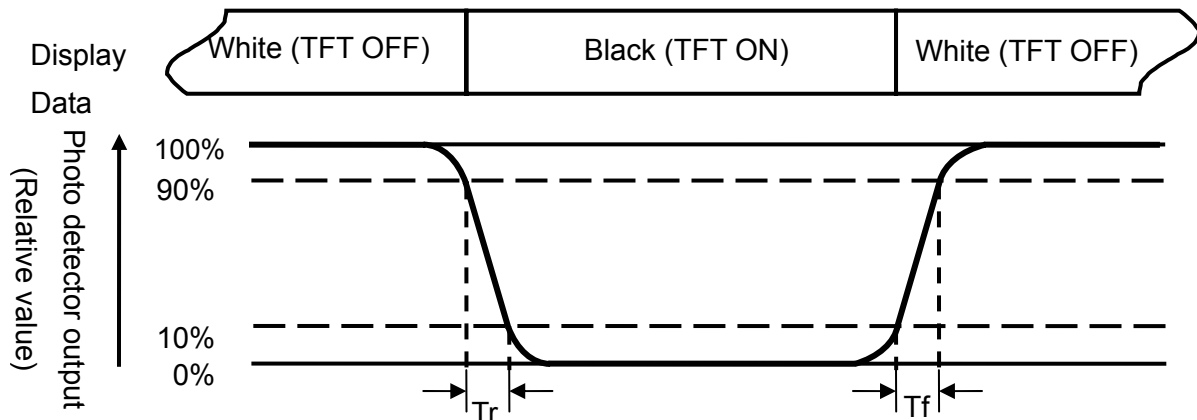


Fig. 3-3 Definition of response time

Note 4: Definition of contrast ratio

The contrast ratio is defined as the following expression.

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

Note 5: White $V_i = V_{i50} \pm 1.5V$

Black $V_i = V_{i50} \pm 2.0V$

" \pm " means that the analog input signal swings in phase with VCOM signal.

" \pm " means that the analog input signal swings out of phase with VCOM signal.

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

Note 6: Definition of luminance

Luminance of "White" state measured at the center point of LCD.

Note 7: Definition of color chromaticity (CIE1931)

Color coordinates measured at the center point of LCD.

Note 8: Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.

4. Reliability test items

(1). Reliability levels in mass production are as below:

Test Items	Test Conditions	Remark
High temperature storage	+80°C±3°C, Dry(30%RH max.) for 240 hours	
Low temperature storage	-25°C±3°C for 240 hours	
High temperature operation	+60°C±3°C, Dry(30%RH max.) for 240 hours	
Low temperature operation	0°C±3°C for 240 hours	
Operation at high temperature and humidity	+50°C±3°C, 80%±3%RH max. for 240 hours	Note 3
Thermal shock	-25°C/1h ~ +80°C/1h for a total 50 cycles, Start with cold temp and end with high temp	Not Operation
Vibration test	Frequency range:10~55Hz Stoke:1.5m Sweep:10Hz~55Hz~10Hz 2 hours for each direction of X. Y. Z. (6 hours for total)	JIS C7021 A-10 Condition A
Vibration Test (with carton)	Random Vibration : 0.015G*G/Hz from 5-200HZ, -6Db/Octave from 200-500HZ	IEC 68-36
Drop Test (with carton)	Height:60 cm 1 corner, 3 edges, 6 surfaces	JIS Z0202
Pressure Test of panel surface	8KGf, 1mm, Φ5mm in center and four corners of panel	
Mechanical Shock	100G 6ms,±X, ±Y, ±Z 3 times for each direction	JIS C7021 A-7 Condition C

Note 1: High temp storage & High temp/High humidity Op the polarizer is out of subject

Note 2: the test sample has recovery time 2 hours at room temp before function check

Note 3: The display is in the Op test Item should be in the autorun mode

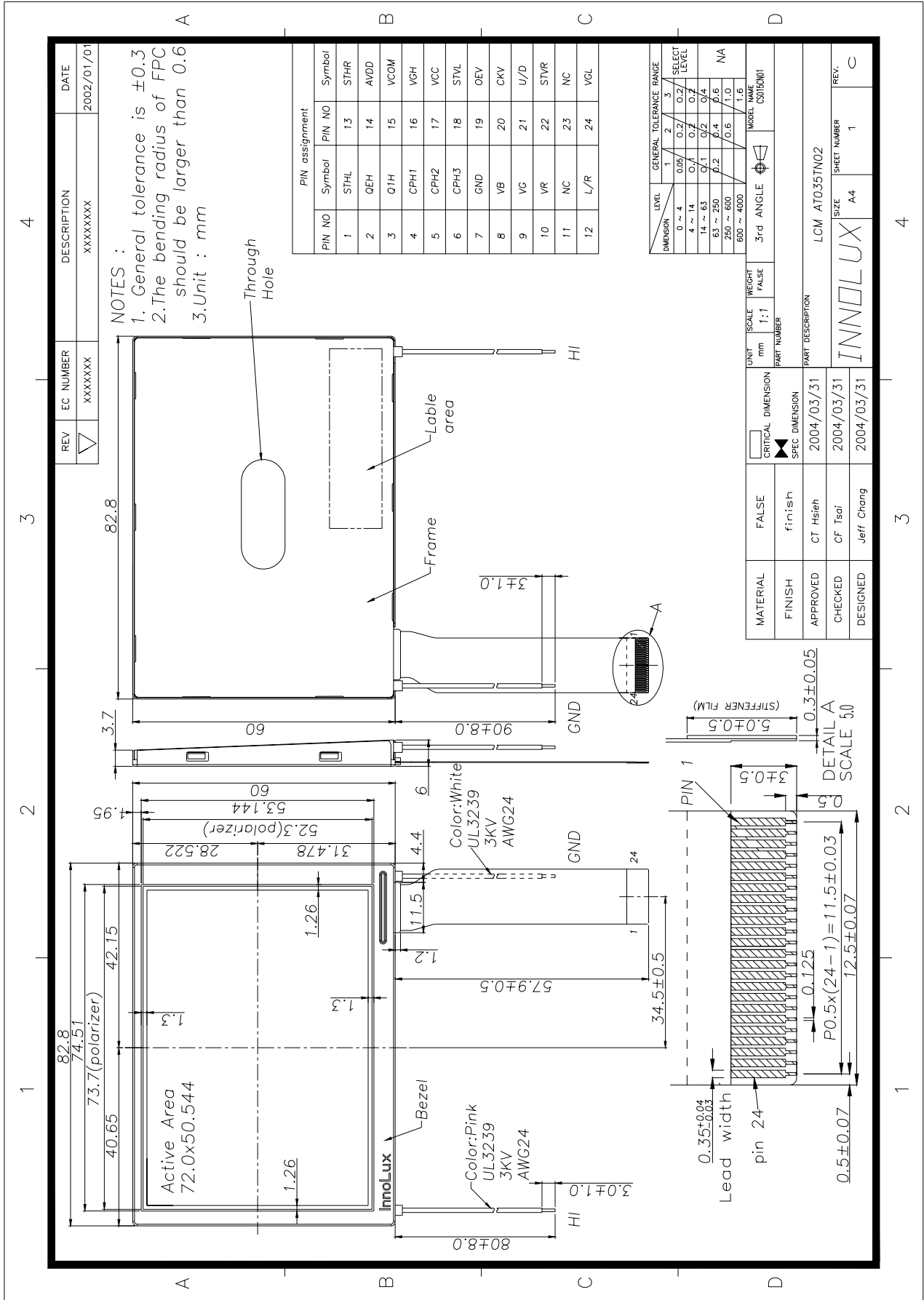
(2). Criteria:

There should be no change which might affect the practical display function when the display quality test is conducted under normal operating condition.

(3). Electro Static Discharge

Parameter	Symbol	Values	unit	Remark
Electro-static discharge	V _{ESD}	±2K	V	Human Body Mode, 100pF/1500Ω
		±200	V	Machine Mode 200pF/0Ω

5. Mechanical dimensions



NOTES :
 1. General tolerance is ± 0.3
 2. The bending radius of FPC should be larger than 0.6
 3. Unit : mm

PIN assignment			
PIN NO	Symbol	PIN NO	Symbol
1	STHL	13	STHR
2	QEH	14	AVDD
3	QIH	15	VCOM
4	CPH1	16	VGH
5	CPH2	17	VCC
6	CPH3	18	STVL
7	GND	19	OEV
8	VB	20	CKV
9	VG	21	U/D
10	VR	22	STVR
11	NC	23	NC
12	L/R	24	VGL

LEVEL	1	2	3	SELECT LEVEL
0 ~ 4	0.05	0.2	0.2	0.2
4 ~ 14	0.1	0.2	0.2	0.2
14 ~ 63	0.1	0.2	0.4	0.4
63 ~ 250	0.2	0.4	0.6	0.6
250 ~ 600	0.2	0.6	1.0	NA
600 ~ 4000	0.6	1.0	1.6	NA

UNIT	mm	SCALE	1:1	WEIGHT	FALSE	3rd ANGLE	MODEL NAME	CS16C01
MATERIAL	FALSE	CRITICAL DIMENSION	finish	SPEC DIMENSION	2004/03/31	APPROVED	CT Hsieh	2004/03/31
FINISH	CT Hsieh	CHECKED	CF Tsai	DESIGNED	Jeff Chang	LCM AT035TN02		
PART NUMBER			PART DESCRIPTION			SIZE		
INNOLUX			A4			SHEET NUMBER		
1			REV.			C		

6. Packing specifications

(1). Packaging material table

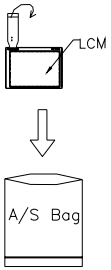


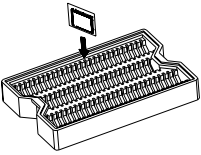
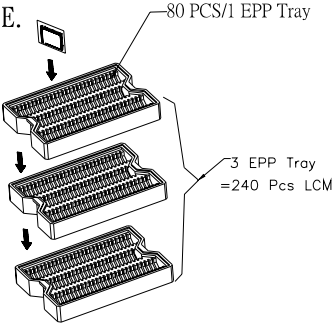
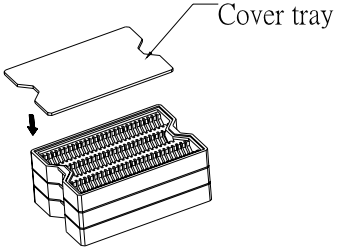
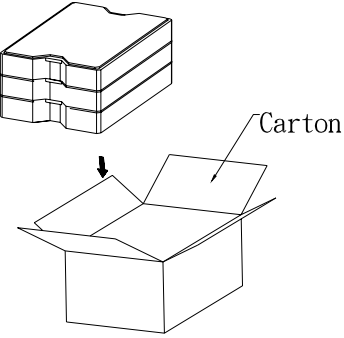

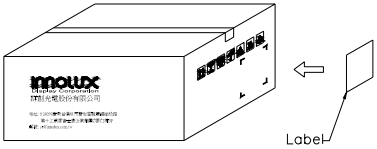
Per carton

No	Item	Model (Material)	Dimensions(mm)	Unit Weight(Kg)	Quantity	Remark
1	LCM module	AT035TN02	82.8x60x6.0	0.037	240	
2	EPP tray	EPP	516x384x6.5	0.142	3	Anti-static
3	Cover tray	EPE	493x326x10	0.024	1	Anti-static
4	Anti-Static Bag	PE	100x80x0.05	0.001	240	Anti-static
5	Carton	Carton	530x355x255	1.1	1	
5	Total weight	11 Kg ± 0.6Kg				

(2). Packaging quantity

(1) LCM quantity per tray: no. of the row	$2 \text{ row} \times 28 \text{ column} + 1 \text{ row} \times 24 \text{ column} = 80$
(2) Total LCM quantity in Carton: no. of EPP trays	$3 \times \text{quantity per tray } 80 = 240$

(3).Packing 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>80 PCS/1 EPP Tray 3 EPP Tray =240 Pcs LCM</p> <p>Stack 3 EPP trays Total numbers :240pcs</p>	<p>Step F.</p>  <p>Cover tray</p> <p>Put 1 cover tray on the top of of every 3 stacked trays</p>
<p>Step G.</p>  <p>Carton</p> <p>Put stacked trays in outer carton</p>	<p>Step H.</p>  <p>Seal outer carton</p>	<p>Step I.</p>  <p>Label</p> <p>Paste the label on outer carton</p>