INNOLUX DISPLAY CORPORATION

LCD MODULE

SPECIFICATION

Customer: ______________________________

Model Name: AT070TN04
SPEC NO: A07-04-TT-01
Date: June., 2004
Version: 1.0

☐ **Preliminary Specification**

■ **Final Specification**

For Customer's Acceptance

Approved by	Comment

Presented by	Reviewed by	Prepare by

Innolux Display Corporation,

2F, No.16, Ke-Tung Road 3, Science-Based Industrial Park, Chu-Nan 350, Mao-Li County, Taiwan

Tel: 886-37-586000 Fax: 886-37-586060

Revisions Section

Revision	Description	Date
1	Initial Release	2004/06/25

Contents:

1. General specification…… 2

2. Electrical specifications…….. 2

(1). Absolute maximum ratings

(2). Pin assignment

(a). TFT LCD panel driving section

(b). Backlight Unit

(3). Electrical characteristics

(a). Typical operating conditions

(b). Current consumption

(c). Backlight driving conditions

(4). AC timing

(a). Timing conditions

(b). Timing diagram

3. Optical specifications…….. 11

4. Reliability test Items…….. 13

5. Handling precautions……. 13

(1). Safety

(2). Handling

(3). Static electricity

(4). Storage

(5). Cleaning

6. Mechanical dimensions…… 14

7. Packing form…… 16

1. General specifications

NO.	Item	Specification	Remark
1	LCD size	7.0 inch	
2	Driver Element	a-Si TFT active matrix	
3	Display contents	480 pixels X 234 pixels	
4	Display Mode	Normally white, Transmissive with Backlight	
5	Dot pitch	0.107(W) X 0.370(H) mm	
6	Active area	154.08(W) X 86.58(H) mm	
7	Module Size	164.9 X 100 X 5.7 mm	
8	Surface Treatment	AG	
9	Weight	160 g Typical	

2. Electrical characteristics

(1). Absolute maximum ratings

Item	Symbol	Condition	Values		Unit	Remark
			Min.	Max.		
Power voltage	V_{CC}	GND=0	(-0.3)	(7)	V	
	AV_{DD}	AVSS=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	Vi		(-0.3)	AV_{DD}+0.3	V	Note 1
	VI		(-0.3)	V_{CC}+0.3	V	Note 2
	VCOM		(-2.9)	(5.2)	V	
Operation Temperature (Ambient)	Top		-30	85	℃	
Storage Temperature (Ambient)	Tst		-40	95	℃	

Note:

1. VR, VG, VB.
2. STHL, STHR, OEH, L/R, CPH1~CPH3, STVR, STVL, OEV, CKV, U/D.

(2). Pin assignment

(a). TFT LCD panel driving section

Pin no	Symbol	IO	Function	Remark
1	GND	-	Ground for logic circuit	
2	V_{CC}	I	Supply voltage of logic control circuit for 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	Note 1,2
13	MOD	I	Sequential sampling and simultaneous sampling setting	Note 3
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 of logic control circuit for data driver	
21	GND	-	Ground for logic circuit	
22	VR	I	Alternated video signal (Red)	
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}	-	Ground for analog circuit	

Note:

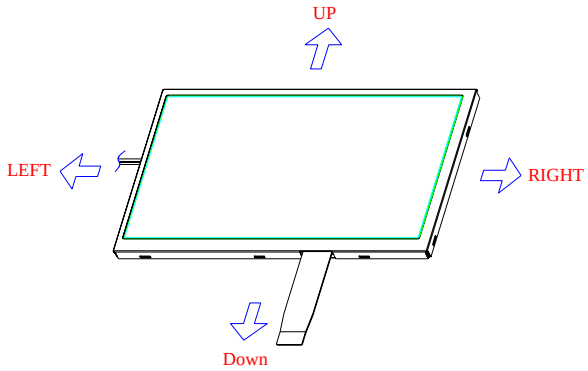
1. Selection of scanning mode (please refer to the following table)

Setting of scan control input		IN/OUT state for start pulse				Scanning direction
U/D	L/R	STVR	STVL	STHR	STHL	
GND	V_{CC}	O	I	O	I	Up to down, left to right
V_{CC}	GND	I	O	I	O	Down to up, right to left
GND	GND	O	I	I	O	Up to down, right to left
V_{CC}	V_{CC}	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. MOD=H: Simultaneous sampling.

   MOD=L: Sequential sampling.

   Please set CPH2 and CPH3 to GND when MOD=H,

(b).Backlight unit

Pin no	Symbol	Function	Remark
1	HI	Power supply for backlight unit (high voltage)	Pink
2	GND	Ground for backlight unit	White

(3). Electrical characteristics

(a). Typical operating conditions (GND=AV_{SS}=0V, Note 4)

Item		Symbol	Values			Unit	Remark
			Min.	Typ.	Max.		
Power supply		V_{CC}	3	5	5.2	V	Note 1
		AV_{DD}	4.8	5	5.2	V	
		V_{GH}	14.3	15	15.7	V	
		V_{GH}	-10.5	-10	-9.5	V	
Video signal amplitude (VR, VG, VB)		V_{iA}	0.4	-	AV_{DD}-0.4	V	Note 2
		V_{iAC}	-	3	-	V	AC component
		V_{iDC}	-	AV_{DD}/2	-	V	DC component
VCOM		V_{CAC}	3.5	5.6	6.5	V	Note 3
		V_{CDC}	1.7	2.0	2.3	V	Note 4
Input signal Voltage	H level	V_{IH}	0.8V_{CC}	-	V_{CC}	V	Note 5
	L level	V_{IL}	0	-	0.2V_{CC}	V	

Note:

1. Be sure to apply GND, V_{CC}, and V_{GL}, to the LCD first, and then apply V_{GH}
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
5. V_{CDC} Should be adjusted by each module to avoid image retention

(b). Current consumption (GND=AV_{SS}=0V)

Parameter	Symbol	Condition	Values			Unit	Remark
			Min.	Typ.	Max.		
Current for Driver	I_{GH}	V_{GH}=15V		0.2	0.5	mA	
	I_{GL}	V_{GL}=-10V		0.8	1.5	mA	
	I_{CC}	V_{CC}=5V		3.0	6.0	mA	
	I_{DD}	AV_{DD}=5V		17	30	mA	

(c). Backlight driving conditions

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Lamp voltage	V_L	-	560	620	Vrms	
Lamp Current	I_L	-	6	7	mArms	
Frequency	F_L	-	60	80	kHz	Note 4
Lamp starting voltage	V_S	-	-	900	Vrms	Note 1,5
		-	-	-	Vrms	Note 2,5
		-	-	1,100	Vrms	Note 3,5
Lamp life time		10,000	-	-	Hr	Note 6

Note:
1. Ta=25℃
2. Ta=0℃
3. Ta=-20℃
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℃, I_L=6mA

(4). AC timing

(a). Timing conditions (sequential mode)

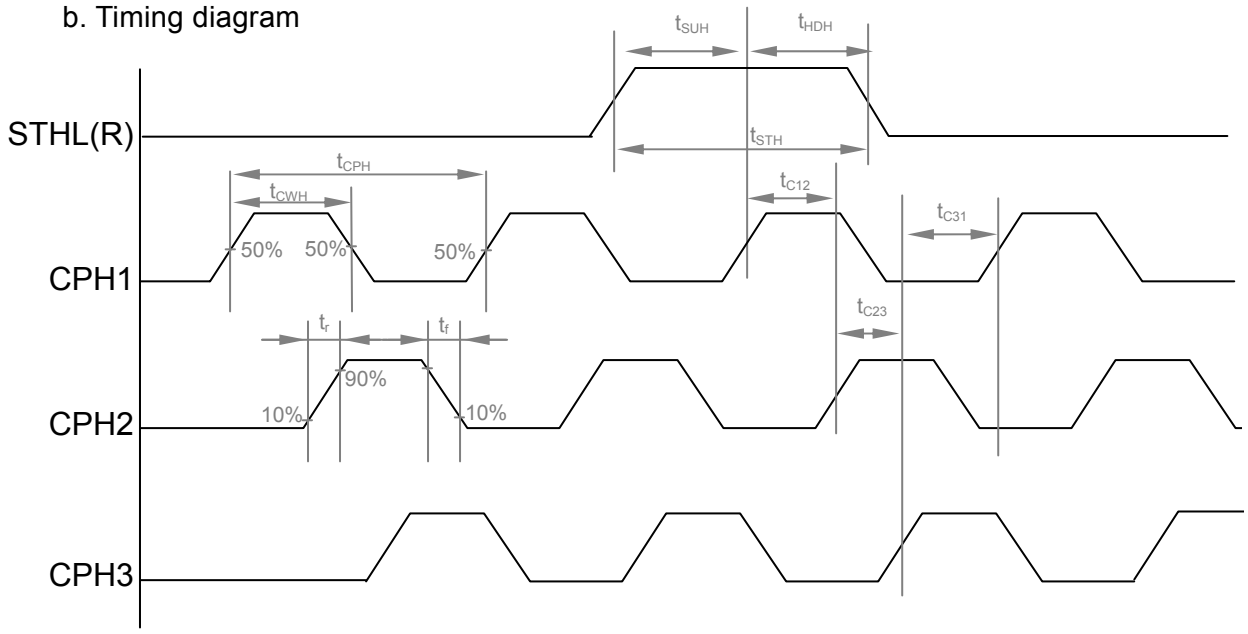
Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Rising time	t_r	-	-	10	ns	Note 1
Falling time	t_f	-	-	10	ns	Note 1
High and low level pulse width	t_{CPH}	99	103	107	ns	CPH1~CPH3
CPH pulse duty	t_{CWH}	40	50	60	%	CPH1~CPH3
CPH pulse delay	t_{C12} t_{C23} t_{C31}	30	t_{CPH}/3	t_{CPH}/2	ns	CPH1~CPH3

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}	-	1.22	-	μs	
Sample and hold disable time	t_{DIS1}	-	8.28	--	μs	
OEV pulse width	t_{OEV}	-	5.40		μs	
CKV pulse width	t_{CKV}	-	4.18	-	μs	
Clean enable time	t_{DIS2}	-	3.74	--	μs	
Horizontal display start	t_{SH}	-	0	-	$t_{CPH}/3$	
Horizontal display timing range	t_{DH}	-	1440	-	$t_{CPH}/3$	
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	
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.

b. Timing diagram



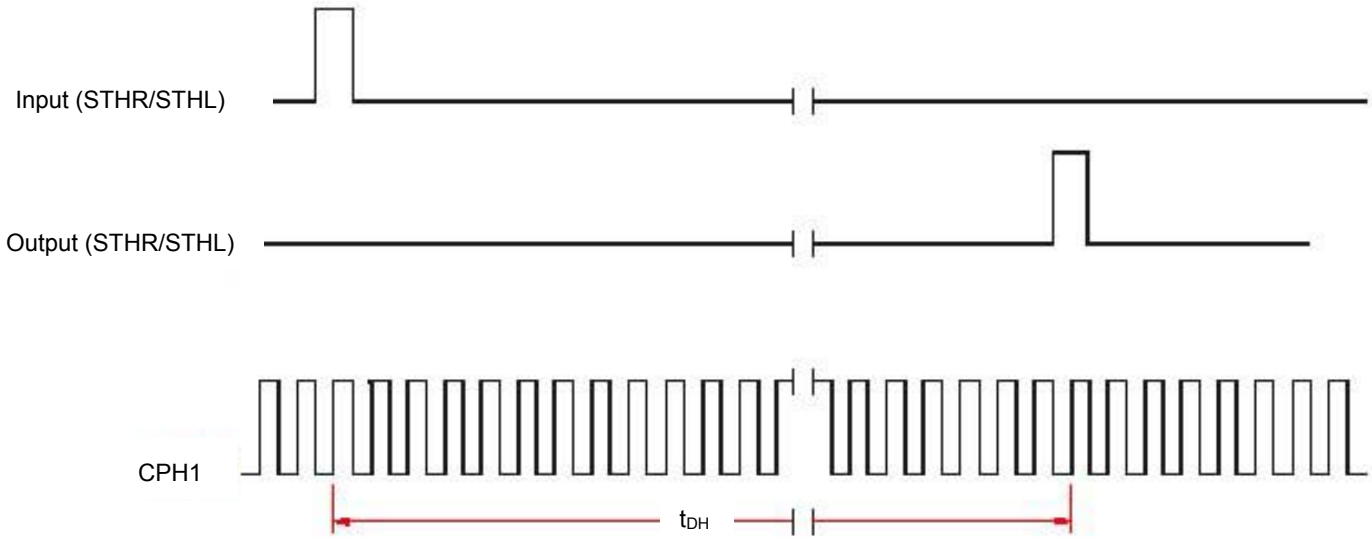


Fig.2 Sampling clock timing

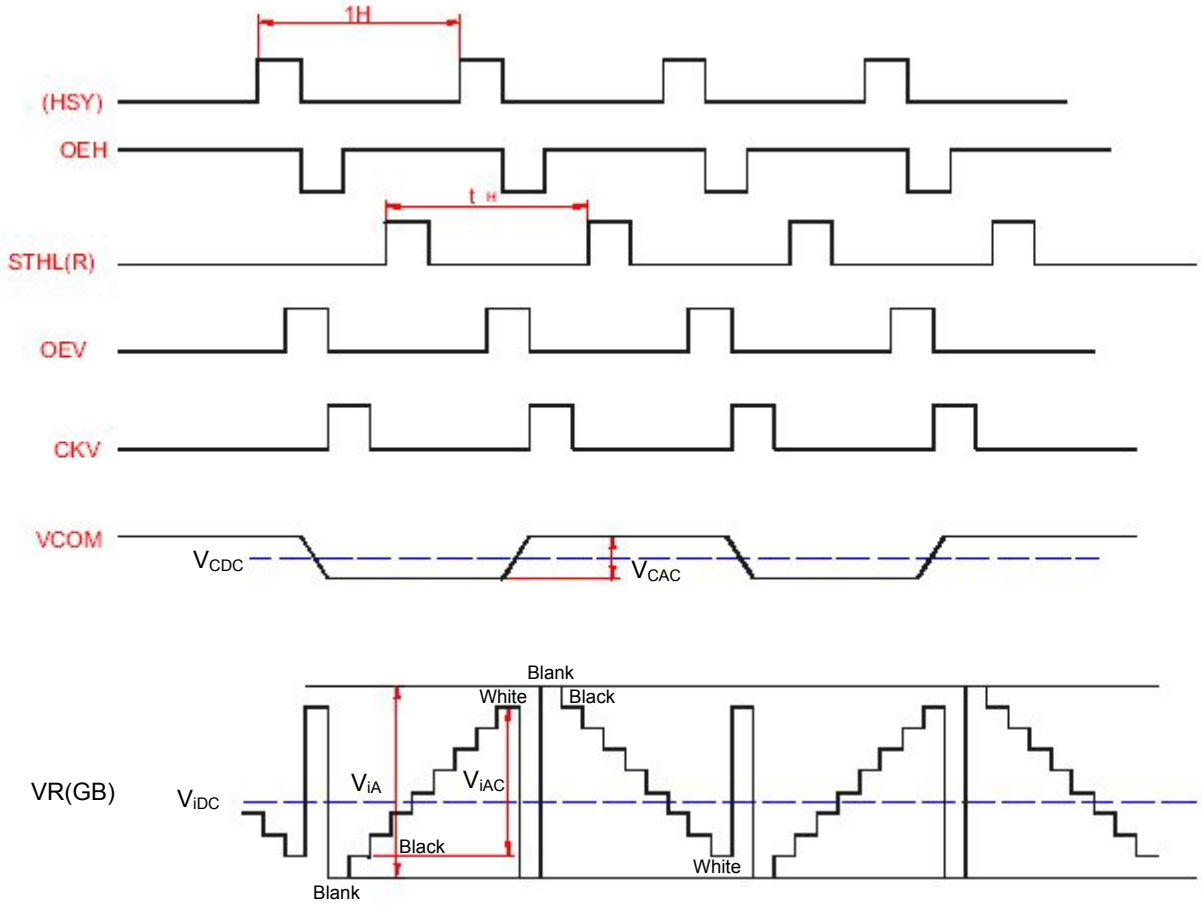
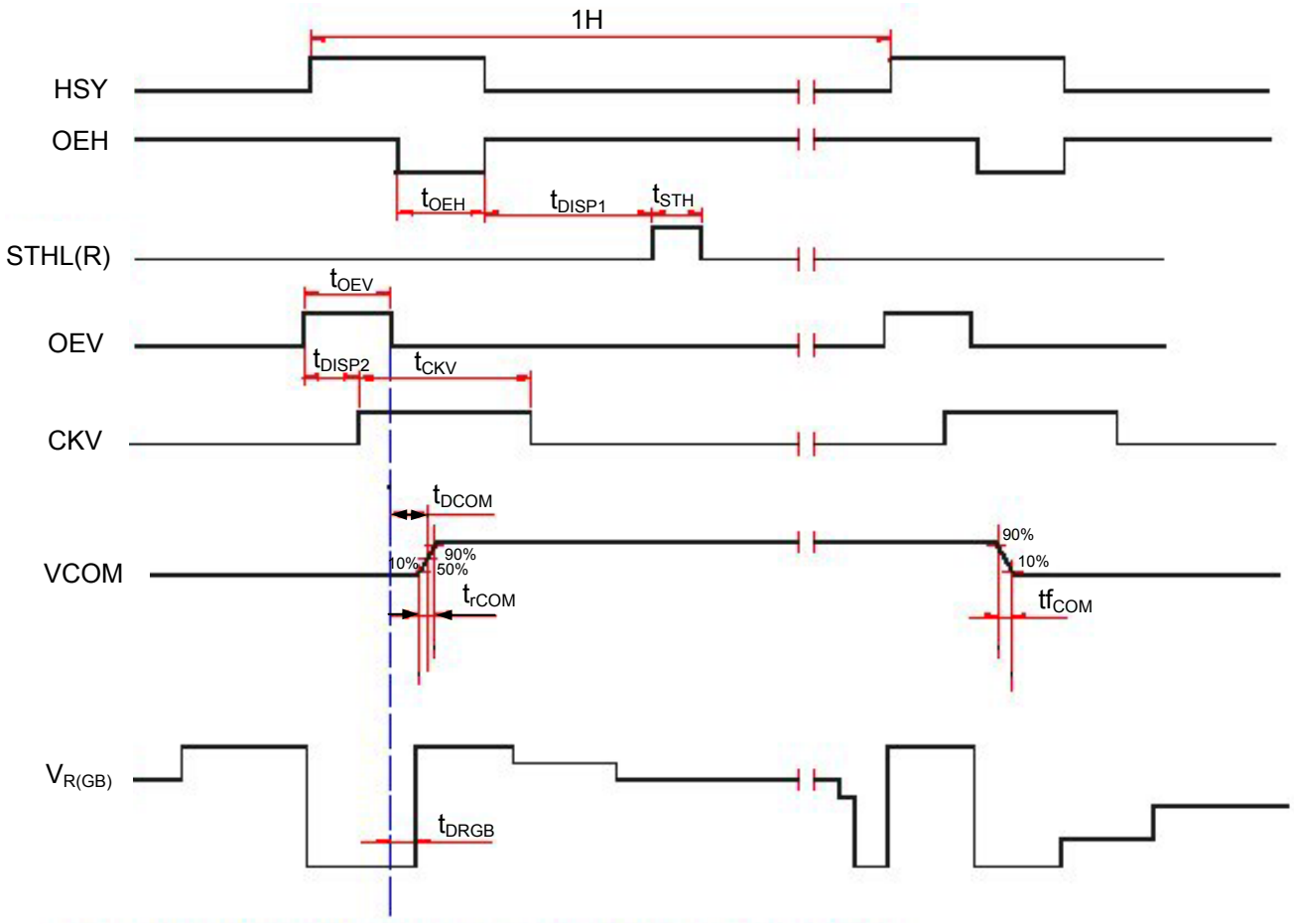


Fig.3-(a) Horizontal timing



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

Fig.3-(b) Detail horizontal timing

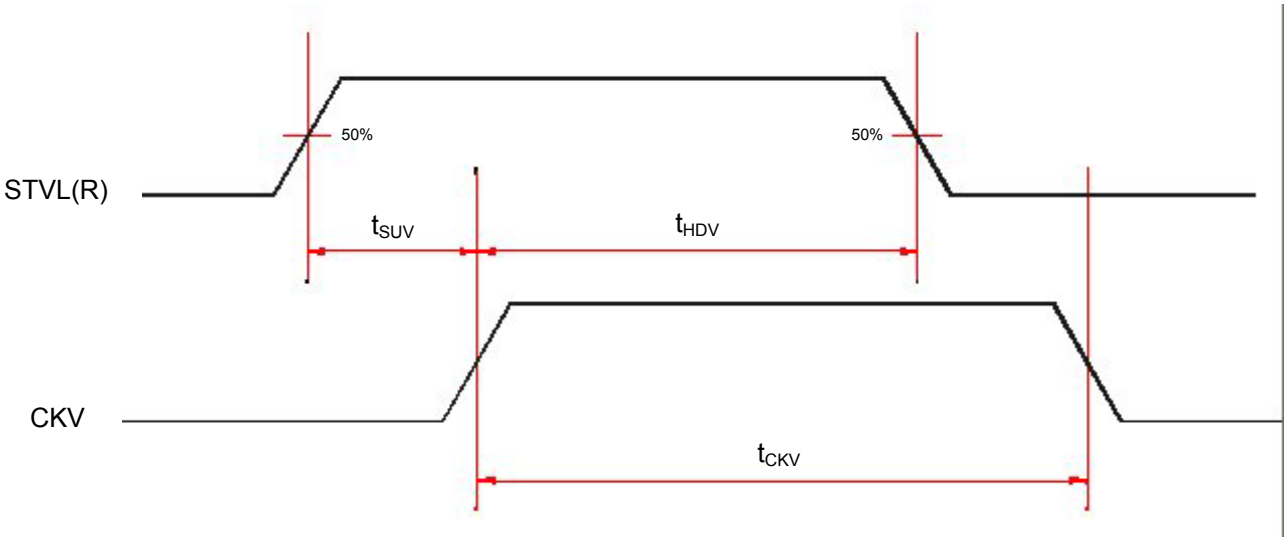


Fig.4 Vertical shift clock timing

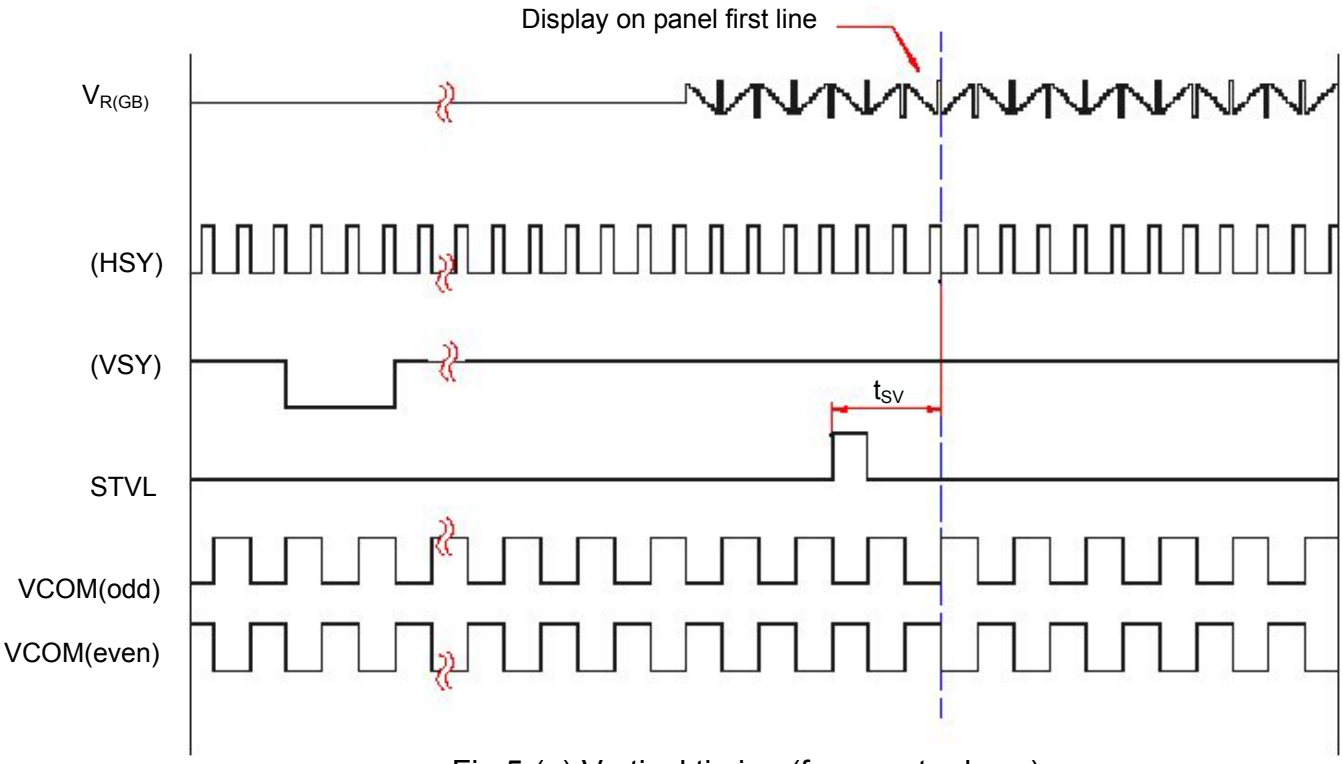


Fig.5-(a) Vertical timing (from up to down)

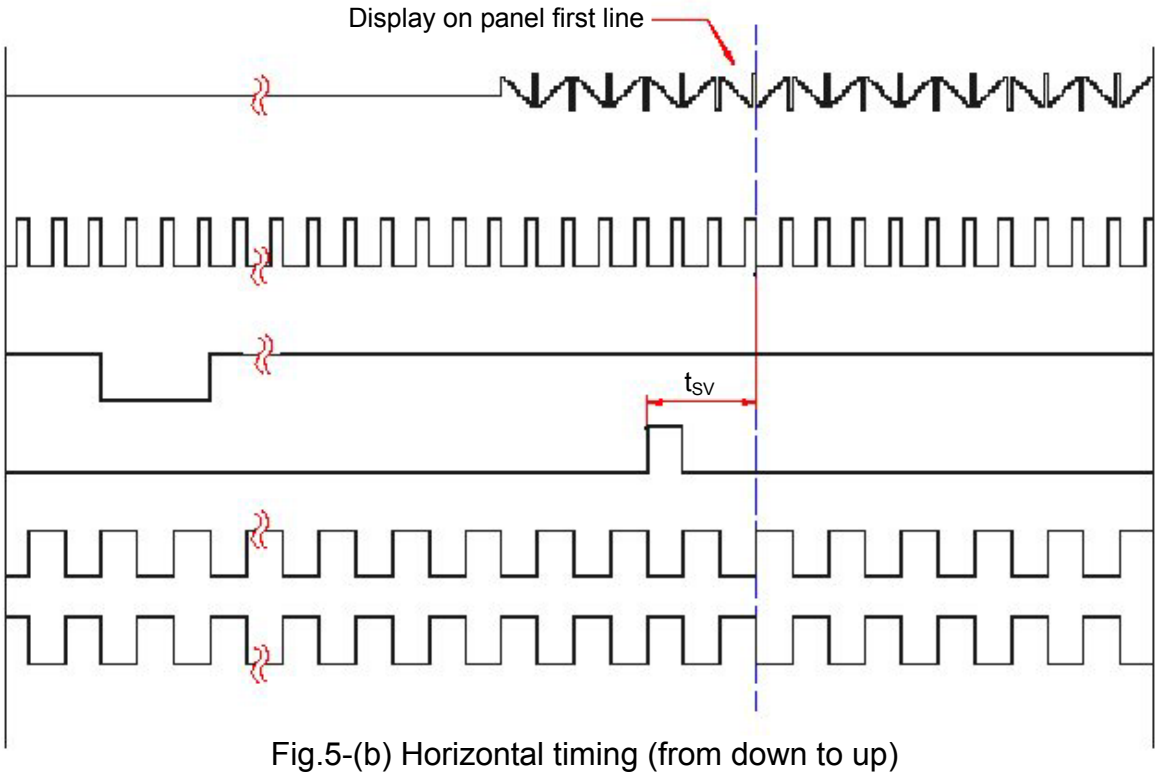
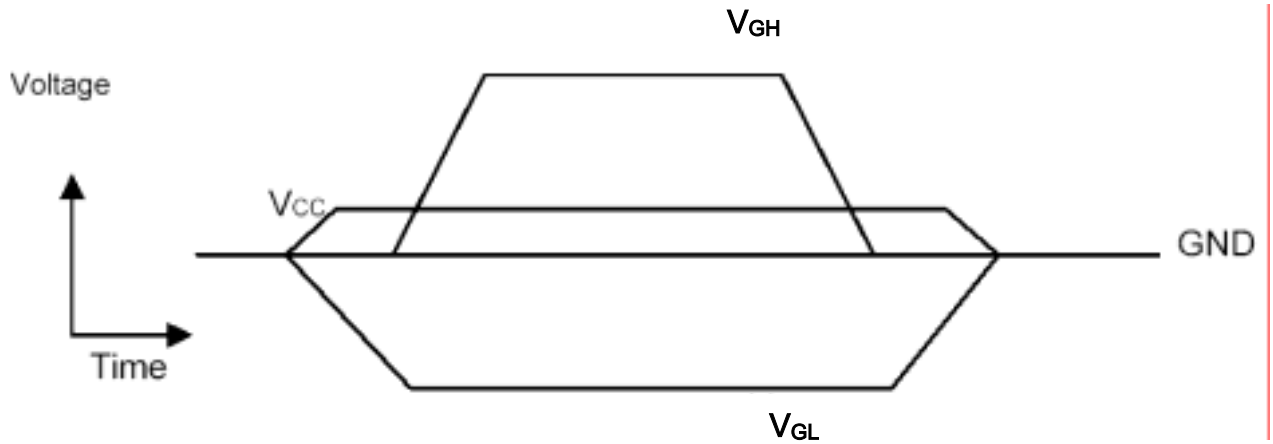


Fig.5-(b) Horizontal timing (from down to up)

(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 V_{CC} 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, V_{CC}, or shut off the power simultaneously!



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.

Ta=25±2℃, I_L=6mA

Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
Response time		T_R	Θ=0	-	10	50	ms	Note2
		T_F		-	20	60	ms	
Contrast ratio		CR	At optimized viewing angle	200	300			Note3
Brightness		Y_L	Θ=0	400	500		Cd/m^2	Note4
Color Chromaticity	White	W_x	Θ=0	0.26	0.31	0.36		Note4
		W_y		0.28	0.33	0.38		
Viewing Angle	Hor.	$Θ_R$	CR≥10	50	60		Degree	Note5
		$Θ_L$		50	60			
	Ver.	$Φ_H$		30	40			
		$Φ_L$		50	60			

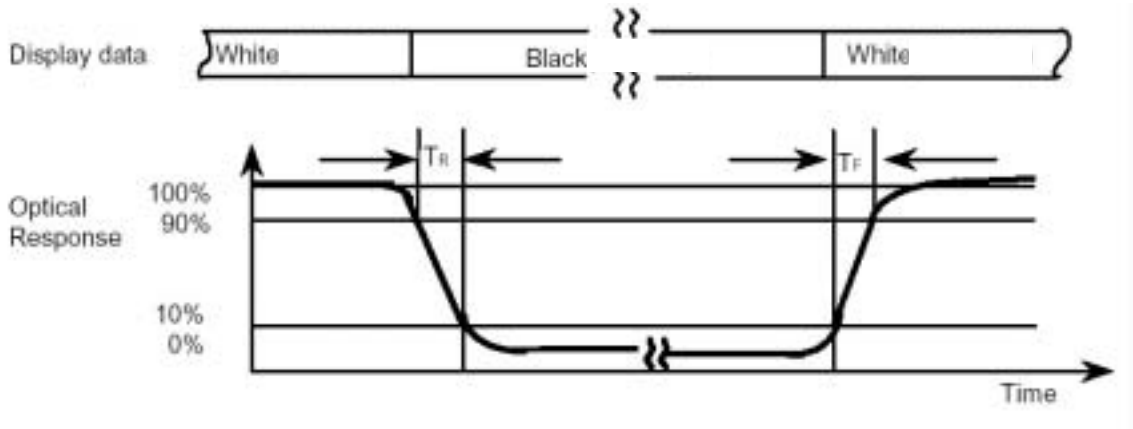
Note:

1. Test equipment setup

After stabilizing and leaving the panel alone at a given temperature for 30 minutes, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. Optical specifications are measured by Topcon BM-5A with a viewing angle of 1° at a distance 0f 50cm and normal direction.

2. Definition of response time: T_R and T_F

The figure below is the output signal of the photo detector.



3. Definition of contrast ratio:

$$\text{Contrast ratio (CR)} = \frac{\text{Brightness measured when LCD is at “white” state}}{\text{Brightness measured when LCD is at “black” state}}$$

White Vi = $Vi_{50\%}$ ± 1.5 V

Black Vi = $Vi_{50\%}$ ∓ 2.0 V

“±”means that the analog input signal swings in phase with V_{COM} signal.

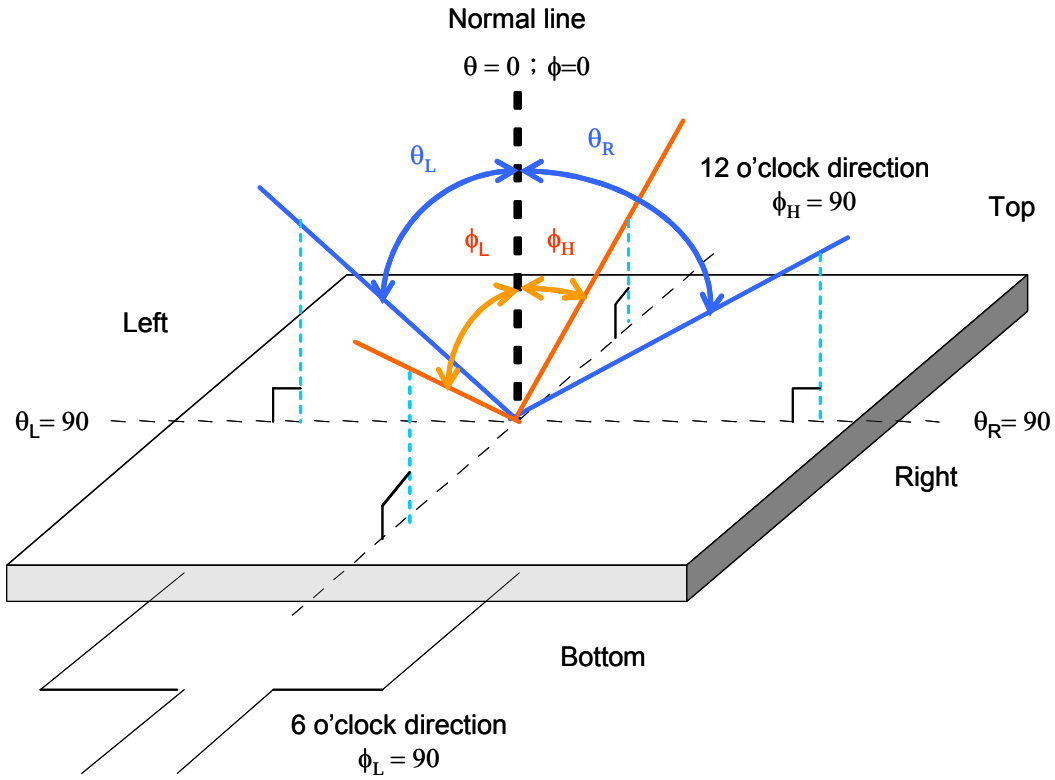
“∓” means that the analog input signal swings out of phase with V_{COM} signal.

$V_{i50\%}$: 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.

4. Measured at the center area of the panel when all the input terminal of LCD panel are electrically opened.

5. Definition of viewing angle:



4. Reliability test items

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

NO.	Test Items	Test Conditions
1	High Temperature Storage	Tamb = 95℃ 240 hrs
2	Low Temperature Storage	Tamb = - 40℃ 240hrs
3	High Temperature Operation	Ts = 85℃ 240hrs
4	Low Temperature Operation	Ts = - 30℃ 240hrs
5	High Temperature & High Humidity Operation	Ts = 60℃/90%RH 240hrs
6	Thermal Shock	-30℃/30min~ 85℃/30min, total 200 cycles
7	Vibration(LCM)	Frequency range : 8~33.3Hz Stoke : 1.3mm Sweep : 2.9G,33.3~400Hz Cycle : 15minutes 2 hours for X, Z direction 4 hours for Y direction
8	Mechanical Shock(LCM)	100G . 6ms, ±X,±Y,±Z 3 times for each direction Non-operation JIS C7021,A-7condition C
9	Random Vibration(with carton)	0.015G*G/Hz from 5-200HZ, -6dB/Octave From 200-500HZ
10	Drop(with carton)	Height : 60cm 1 corner, 3 edges, 6 sides
11	ESD	+/- 200V, 200pf (0 Ohm), once for each terminal

Note: 1. Tamb is the ambient temperature of samples.

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

3. Judgment criteria: The cosmetic judgment is before reliability test and no function fail issue occurred after reliability test.

5. Handling precautions

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.

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.

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.

4 Storage

1) Store the products in a dark place at +25℃±10℃, low humidity (65%RH or less).

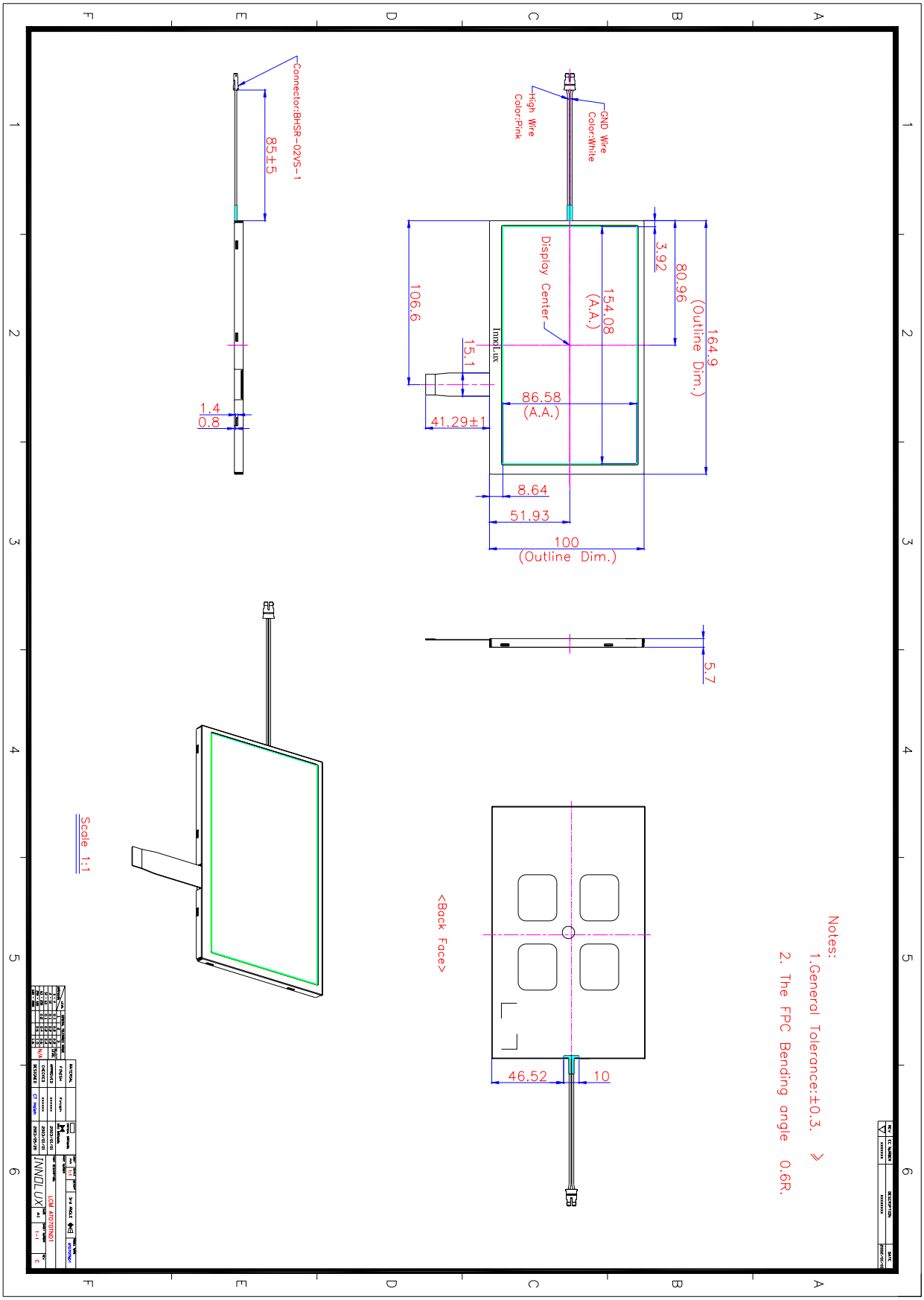
2) **DO NOT** store the products in an atmosphere containing organic solvents or corrosive gases.

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.

6. Mechanical dimensions



7. Packing specifications

(1). Packaging material table

Per carton

No	Item	Model (Material)	Dimensions (mm)	Unit Weight (Kg)	Quantity	Remark
1	LCM module	AT070TN01	164.9*100*5.7	0.160	30	
2	EPP tray	EPP	516*384*6.5	0.07	7	Anti-static
3	Carton	Carton	530*355*255	1.06	1	
4	Total weight	6.5 Kg ± 5%				

(2). Packaging quantity

(1) LCM quantity per tray: no. of the row 5 x no. the column 6 = 30
(2) Total LCM quantity in Carton: no. of EPP trays 30 x quantity per tray 7= 30