Version :6.0

TECHNICAL   SPECIFICATION

MODEL   NO. : PD050OX5

The content of this information is subject to be changed without notice.

Please contact E Ink or its agent for further information.

☐Customer's Confirmation

Customer _____

Date _____

By _____

☐E Ink's Confirmation

Confirmed By _____

Prepared By _____

Revision History

Rev.	Issued Date	Revised Contents
1.0	Mar 17 ,2008	New

2.0	Apr.02 ,2008	Page 23 14.Handling Cautions
		  Add e) Please following the tear off direction as figure 14-1 to remove the
		      protective film as slowly as possible, so that electrostatic charge can
		      be minimized.

3.0	May.11, 2011	**Modify**
		Page 4 2. Features
		  Delete RTV Seal (Black color)
		Page 5 4. Mechanical Drawing of TFT-LCD module
		  Remove internal sealing & Protect sheet
		Page 26 16. Packing Diagram

4.0	July.28.2011	Update to E Ink logo

5.0	Nov.19,2012	**Modify**
		Page 5 4. Mechanical Drawing of TFT-LCD module
		    Modify EIH to E Ink
		Page 10 7-2) Recommended Driving Condition for Back Light
		    Modify Lamp Voltage
		    Min./Typ./Max.=553/615/677→576/640/704
		Page 11 7-3) Power Consumption
		    Back Light Lamp Power Consumption = -/3.69/4.06 → -/3.84/4.23
		    Total Power Consumption = -/3.8/4.29 → -/3.95/4.46
		Page 20 13. Optical Characteristics
		    Modify Brightness Min=800,Typ=900
		Page 26 16. Packing Diagram
		    Modify EIH to E Ink

6.0	Oct.15,2013	**Modify** Page 5 4. Mechanical Drawing of TFT-LCD module Remove grounding wire & screw

TECHNICAL   SPECIFICATION

CONTENTS

1.Application

This data sheet applies to a color TFT LCD module, PD050OX5. PD050OX5 module applies to OA product, GPS, which require high quality flat panel display. If you must use in high reliability environment can't over reliability test condition. If you use PD050OX5, E Ink advises your system sides must use PVI-2003A which one generates signal to control PD050OX5.

2. Features

- . Amorphous silicon TFT LCD panel with back-light unit
- . Pixel in stripe configuration
- . Thin and light weight
- . Display Colors：262,144 colors
- . Optimum Viewing Direction：6 o'clock
- . TTL transmission interface

3.Mechanical Specifications

Parameter	Specifications	Unit
Screen Size	5.0(diagonal)	inch
Display Format	480×(R, G, B)×480	dot
Display Colors	262,144	
Active Area	90(H)×90(V)	mm
Pixel Pitch	0.0625(H)×0.1875(V)	mm
Pixel Configuration	Stripe	
Outline Dimension	111.5(W)×110.0 (H)×7.2 (typ.) (D)	mm
Weight	144±10	g
Back-light	CCFL, 1 tube	
Surface treatment	Anti-glare and Wide View Film	
Display mode	Normally white	
Gray scale inversion direction	6 o'clock [ref Note 13-1]	

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4.Mechanical Drawing of TFT-LCD Module

5.Input / Output Terminals

5-1) TFT-LCD Panel Driving

CN 1

Pin No.	Symbol	I/O	Function	Remark
1	VEE	I	Gate Off Voltage	Note5-1
2	GND	I	Ground	
3	VCC	I	Voltage for logic circuit	
4	GND	I	Ground	
5	VGG	I	Gate On Voltage	Note5-2
6	STVD	I/O	Vertical Shift Pulse Signal Input or Output	Note5-3
7	STVU	I/O	Vertical Shift Pulse Signal Input or Output	Note5-3
8	CKV	I	Vertical Shift Clock	Note5-4
9	U/D	I	Up/Down Selection	Note 5-3
10	OE	I	Output Enable	Note5-5
11	XON	I	NC	Note 5-11
12	VCOM	I	Common Voltage	
13	VDD2	I	Voltage for analog circuit	Note5-10
14	VSS1	I	Ground	
15	V14	I	Gamma Voltage 14	Note5-10
16	V13	I	Gamma Voltage 13	Note5-10
17	V12	I	Gamma Voltage 12	Note5-10
18	V11	I	Gamma Voltage 11	Note5-10
19	V10	I	Gamma Voltage 10	Note5-10
20	V9	I	Gamma Voltage 9	Note5-10
21	V8	I	Gamma Voltage 8	Note5-10
22	VSS1	I	Ground	
23	V7	I	Gamma Voltage 7	Note5-10
24	V6	I	Gamma Voltage 6	Note5-10
25	V5	I	Gamma Voltage 5	Note5-10
26	V4	I	Gamma Voltage 4	Note5-10
27	V3	I	Gamma Voltage 3	Note5-10
28	V2	I	Gamma Voltage 2	Note5-10
29	V1	I	Gamma Voltage 1	Note5-10
30	VSS1	I	Ground	

CN 2

Pin No.	Symbol	I/O	Function	Remark
1	DIO1	I/O	Horizontal Start Pulse Signal Input or Output 1	Note5-6
2	VSS2	I	Ground	
3	VDD1	I	Power Supply	
4	CLK	I	Horizontal Shift Clock	
5	VSS2	I	Ground	
6	R/L	I	Left/Right Selection	Note 5-6
7	R0	I	Red Data (LSB)	
8	R1	I	Red Data	
9	R2	I	Red Data	
10	R3	I	Red Data	
11	R4	I	Red Data	
12	R5	I	Red Data (MSB)	
13	VSS2	I	Ground	
14	G0	I	Green Data (LSB)	
15	G1	I	Green Data	
16	G2	I	Green Data	
17	G3	I	Green Data	
18	G4	I	Green Data	
19	G5	I	Green Data (MSB)	
20	VSS2	I	Ground	
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 (MSB)	
27	POL	I	Polarity selection	Note5-9
28	REV	I	Data invert control	Note5-8
29	LD	I	Load output signal	Note5-7
30	DIO2	I/O	Horizontal Start Pulse Signal Input or Output	Note5-6

Note 5-1: Gate off voltage, V_{EE}=-10V.

Note 5-2: Gate on voltage, V_{GG}=+17V.

Note 5-3: Select up or down shift

U/D	STVU	STVD	Shift
1	Hi-Z	Input	Up to Down
0	Input	Hi-Z	Down to Up

Note 5-4: Gate driver shift clock

Note 5-5: When OE is connected to high "1", the driver outputs are disabled (Gate output = V_{EE}). Under this condition, the operation of registers will not be affected.

Note 5-6: Select left or right shift

R/L	DIO1	DIO2	Shift
1	Input	Hi-Z	Left to right
0	Hi-Z	Input	Right to left

Note 5-7: Latch the polarity of outputs and switch the new data to outputs
At the rising edge (LD), latch the "POL" signal to control the polarity of the outputs.
Note 5-8: Control whether the Data R0~G5 are inverted or not. (E Ink suggests connecting to GND)   When "REV=1", these data will be inverted.
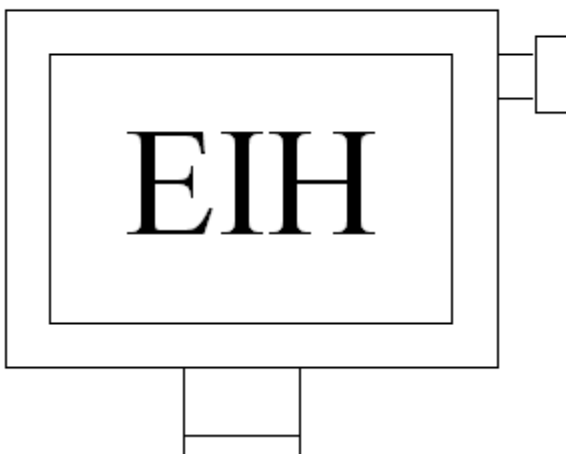EX: "00"→"3F", "07"→"38", "15"→"2A"

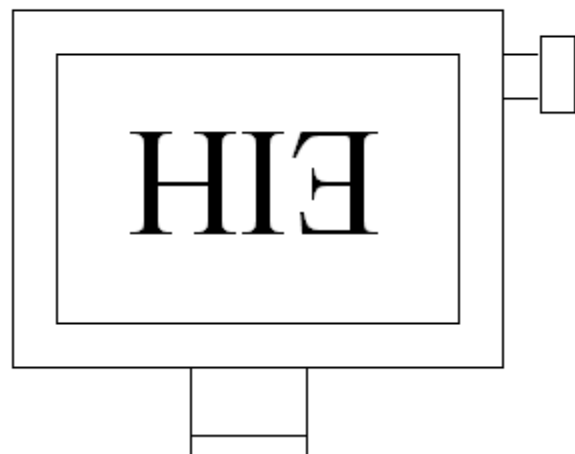Note 5-9: Polarity selector for dot-inversion control. Available at the rising edge of LD.
When POL=1: Even outputs range from V1~V7, and Odd outputs range from V8~V14;
When POL=0: Even outputs range from V8~V14, and Odd outputs range from V1~V7.
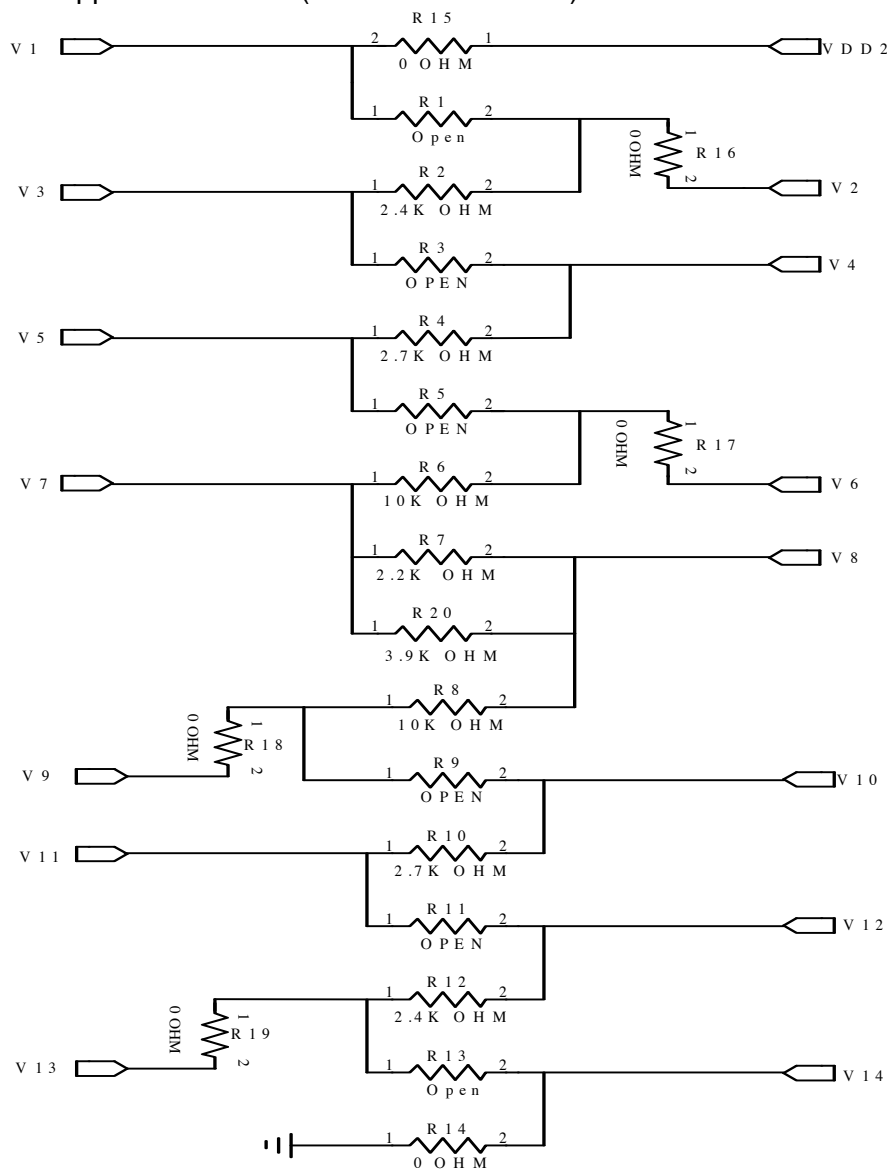
U/D(PIN9)=1 , R/L(PIN6)=1

U/D(PIN9)=0 , R/L(PIN6)=0

![E Ink 元太科技 E Ink Holdings logo]

Note 5-10: Typical Application Circuit (When V_{DD2} = +9.7V)

Note 5-11 :This pin is NC or must connect VDD1

5-2) Backlight driving

Connector type: JST BHSR-02VS-1, PIN No 2 pin, pitch=3.5mm

Pin No	Symbol	Description	Remark
1	VL1	Input terminal (Hi voltage side)	Wire color : Pink
2	VL2	Input terminal (Low voltage side)	Wire Color : White Note 5-12

Note 5-12 : Low voltage side of backlight inverter connects with ground of inverter circuits.

![E Ink 元太科技 E Ink Holdings logo]

6. Absolute Maximum Ratings: Vss1=Vss2=GND=0V, Ta=25℃

Parameters	Symbol	MIN.	MAX.	Unit	Remark
Supply Voltage	V_{DD1}	-0.3	5	V	
	V_{CC}	-0.3	5	V	
	V_{DD2}	-0.5	10.0	V	
	V_{GG}	-0.3	40.0	V	
	$V_{GG}-V_{EE}$	-	40.0	V	
	V_{EE}	-20	0.3	V	
Storage Temperature	T_{ST}	-30	80	℃	
Operating Temperature	T_{OP}	-20	70	℃	

7. Electrical Characteristics

7-1) Recommended Operating Conditions: Vss1=Vss2=GND = 0V，Ta = 25℃

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Supply Voltage for Source Driver	V_{DD1}	3.0	3.3	3.6	V	
	V_{DD2}	9	9.7	10	V	
Supply Voltage for Gate Driver	V_{GG}	-	17	-	V	
	V_{EE}	-	-10	-	V	
	V_{CC}	3.0	3.3	3.6	V	
Digital Input Voltage	V_{IH}	$0.8V_{DD1}$	-	V_{DD1}	V	
	V_{IL}	0	-	$0.2V_{DD1}$	V	
V_{com} Voltage	V_{com}	-	3.3	-	V	

7-2) Recommended Driving Condition for Back Light Ta=25℃

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Lamp Voltage	V_L	576	640	704	V	I_L=6mA
Lamp Current	I_L	3	6	8	mA	Note 7-1
Lamp Frequency	P_L	35	45	55	KHz	Note 7-2
Starting Voltage (25℃) (Reference Value)	Vs			1210	Vrms	Note 7-3
Starting Voltage (0℃) (Reference Value)	Vs			1580	Vrms	Note 7-3

Note 7-1: In order to satisfy the quality of B/L, no matter use what kind of inverter, the output lamp current must between Min. and Max. to avoid the abnormal display image caused by B/L.

Note 7-2: The waveform of lamp driving voltage should be as closed to a perfect sine wave as possible.

Note 7-3: This value is not output voltage of inverter.

The voltage of inverter must larger than the starting voltage.

The Kick-off times≧1sec

7-3) Power Consumption

Parameter	Symbol	Condition	Typ.	Max.	Unit	Remark
Supply Current for Gate Driver (Hi level)	I_{GG}	V_{GG}=+17V	0.14	0.42	mA	
Supply Current for Gate Driver (Low level)	I_{EE}	V_{EE}=-10V	0.18	0.54	mA	
Supply Current for Source Driver (Digital)	I_{DD1}	V_{DD1}=+3.3V	0.18	0.36	mA	
Supply Current for Source Driver (Analog)	I_{DD2}	V_{DD2}=+9.7V	11	22	mA	
Supply Current for Gate Driver (Digital)	I_{CC}	V_{CC}=+3.3V	0.13	0.39	mA	
LCD Panel Power Consumption	-	-	111.9	228.42	mW	Note 7-4
Back Light Lamp Power Consumption	-	-	3.84	4.23	W	Note 7-5
Total Power Consumption	-	-	3.95	4.46	W	

Note 7-4: The power consumption for back light is not included.

Note 7-5: Back light lamp power consumption is calculated by $I_L \times V_L$.

8. Pixel Arrangement

The LCD module pixel arrangement is the stripe.
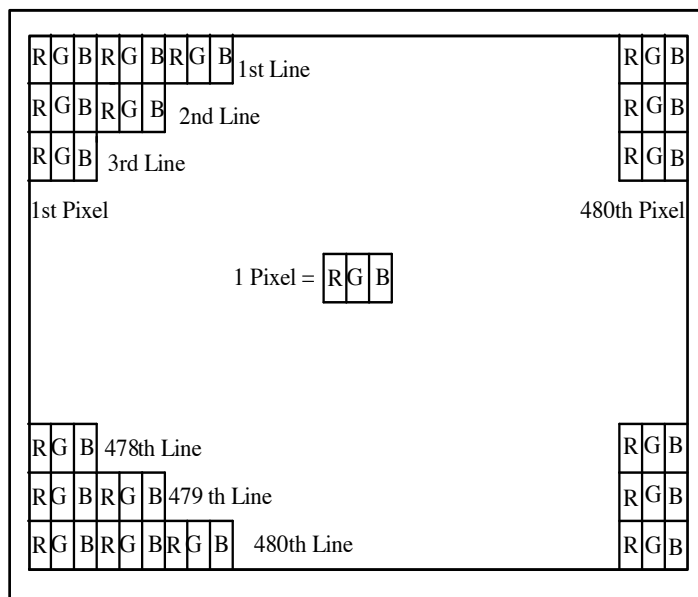
9. Display Color and Gray Scale Reference

Color		Input Color Data																	
		Red						Green						Blue					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green (63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue (63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Red	Red (00)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (01)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red (02)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker ↓ Brighter	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	Red (61)	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red (62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red (63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Green	Green (00)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green (01)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Green (02)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	Darker ↓ Brighter	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	Green (61)	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
	Green (62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	Green (63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Blue	Blue (00)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue (01)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue (02)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	Darker ↓ Brighter	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
	Blue (61)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
	Blue (62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue (63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

10. Block Diagram

10-1) TFT-module Block Diagram

SYSTEM
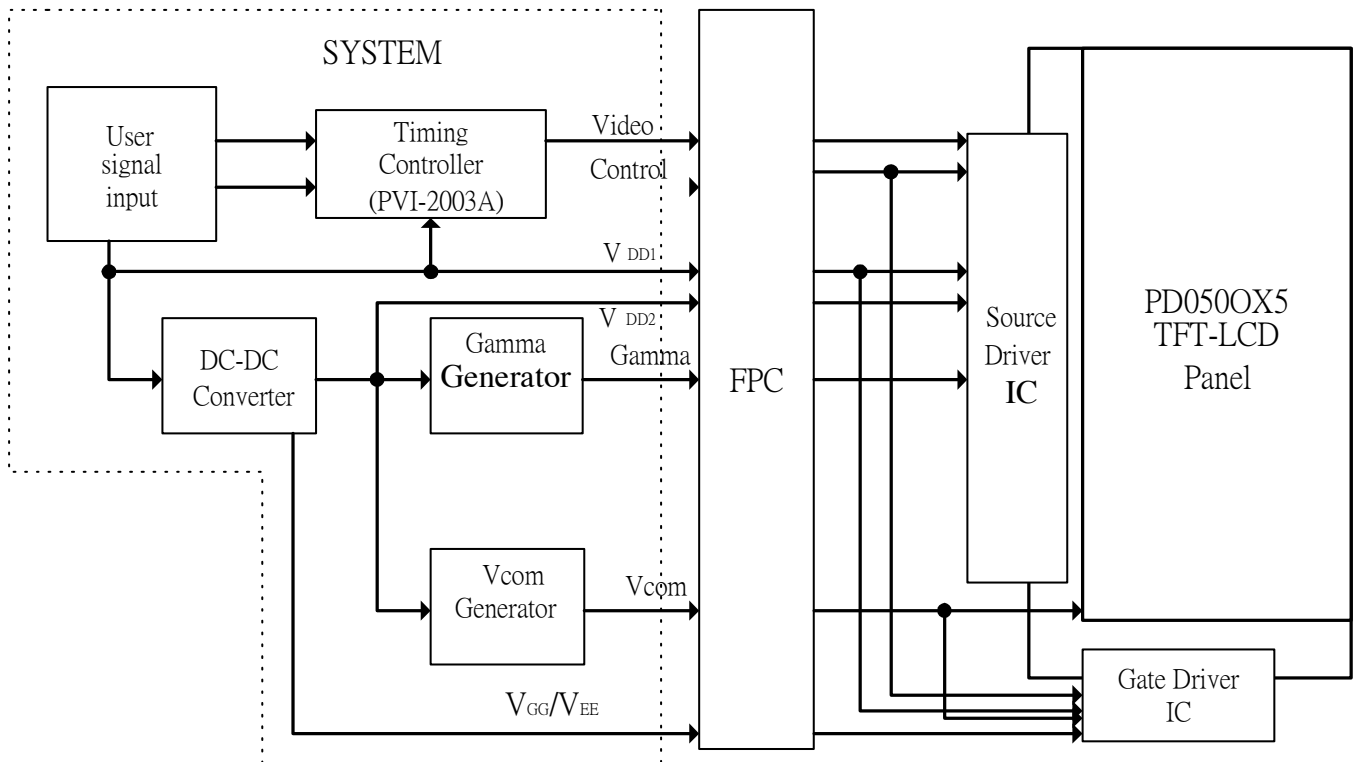
If you use PD050OX5, you must apply PVI-2003A(Timing controller) which Will gernerate signal to support PD050OX5.

11. Interface Timing
11.1) Timing Parameters

AC Electrical Characteristics (V$_{CC}$=V$_{DD1}$=3.3V, V$_{DD2}$=9.7V, GND=V$_{SS1}$=V$_{SS2}$=0V, Ta=25℃)

| Parameter	Symbol	Min.	Typ.	Max.	Unit
CLK Frequency	Fclk	-	20	40	MHz
CLK Pulse Width	T$_{CPH}$	25	-	-	ns
Data Set-up Time	Tsu	4	-	-	ns
Data Hold Time	Thd	2	-	-	ns
Propagation Delay of DIO2/1	Tphl	6	10	15	ns
Time That The Last Data to LD	Tld	1	-	-	T$_{CPH}$
Pulse width of LD	Twld	2	-	-	T$_{CPH}$
Time That LD to DIO1/2	Tlds	5	-	-	T$_{CPH}$
POL Set-up Time	Tpsu	6	-	-	ns
POL Hold Time	Tphd	6	-	-	ns
OE Pulse Width	T$_{OEV}$	1	-	-	μs
CKV Pulse Width	T$_{CKV}$	500	-	-	ns
STV Set-up Time	T$_{SUV}$	400	-	-	ns
STV Hold Time	T$_{HDV}$	400	-	-	ns
Horizontal Display Period	T$_{HDP}$	-	480	-	T$_{CPH}$
Horizontal Period Timing Range	T$_{HP}$	-	640	-	T$_{CPH}$
Horizontal Lines Per Field	T$_V$	520	525	640	T$_{HP}$
Vertical Display Timing Range	T$_{DV}$	-	480	-	T$_{HP}$

11.2) Timing Diagram
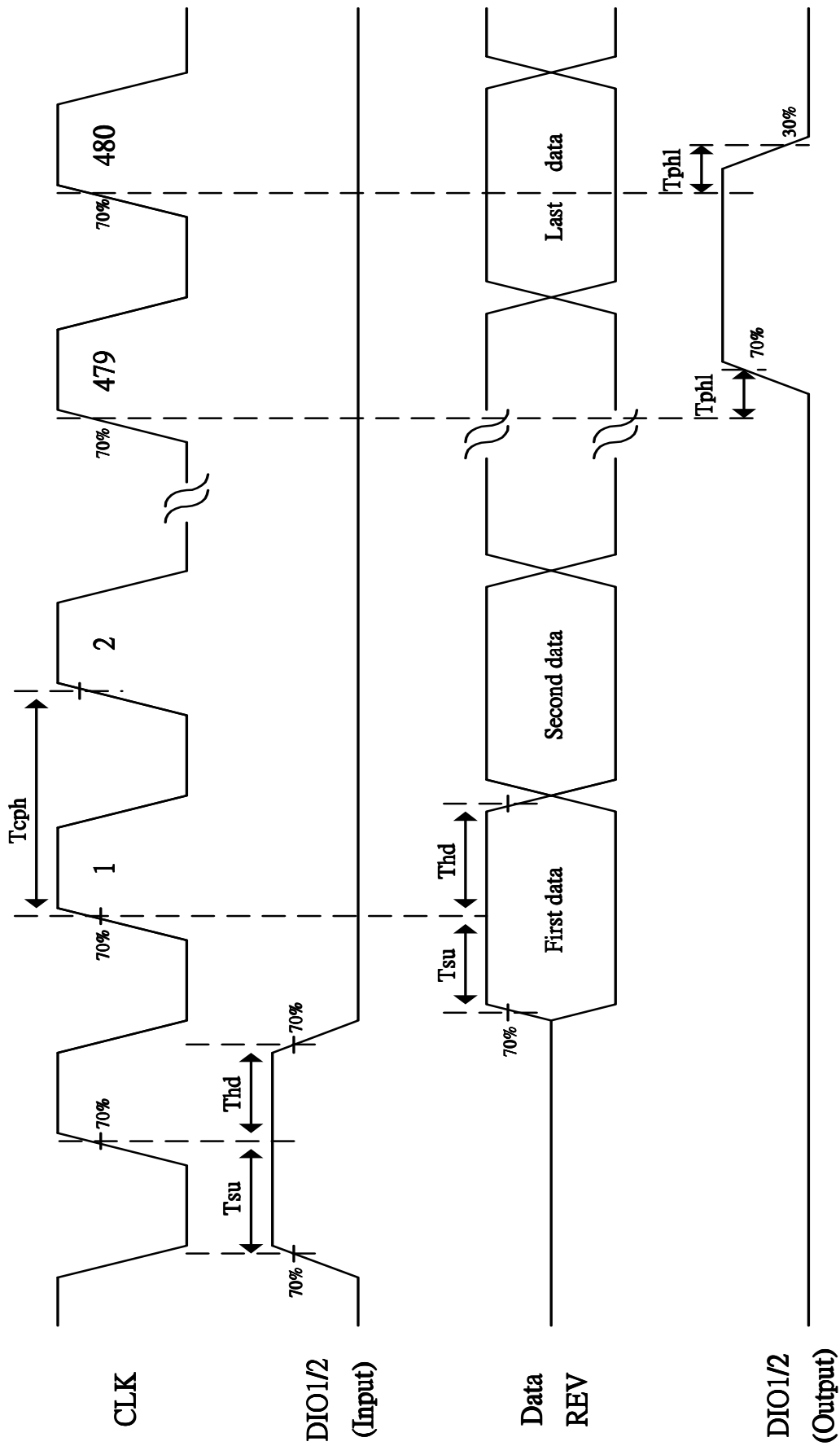
Fig. 11-1 Horizontal timing(1)
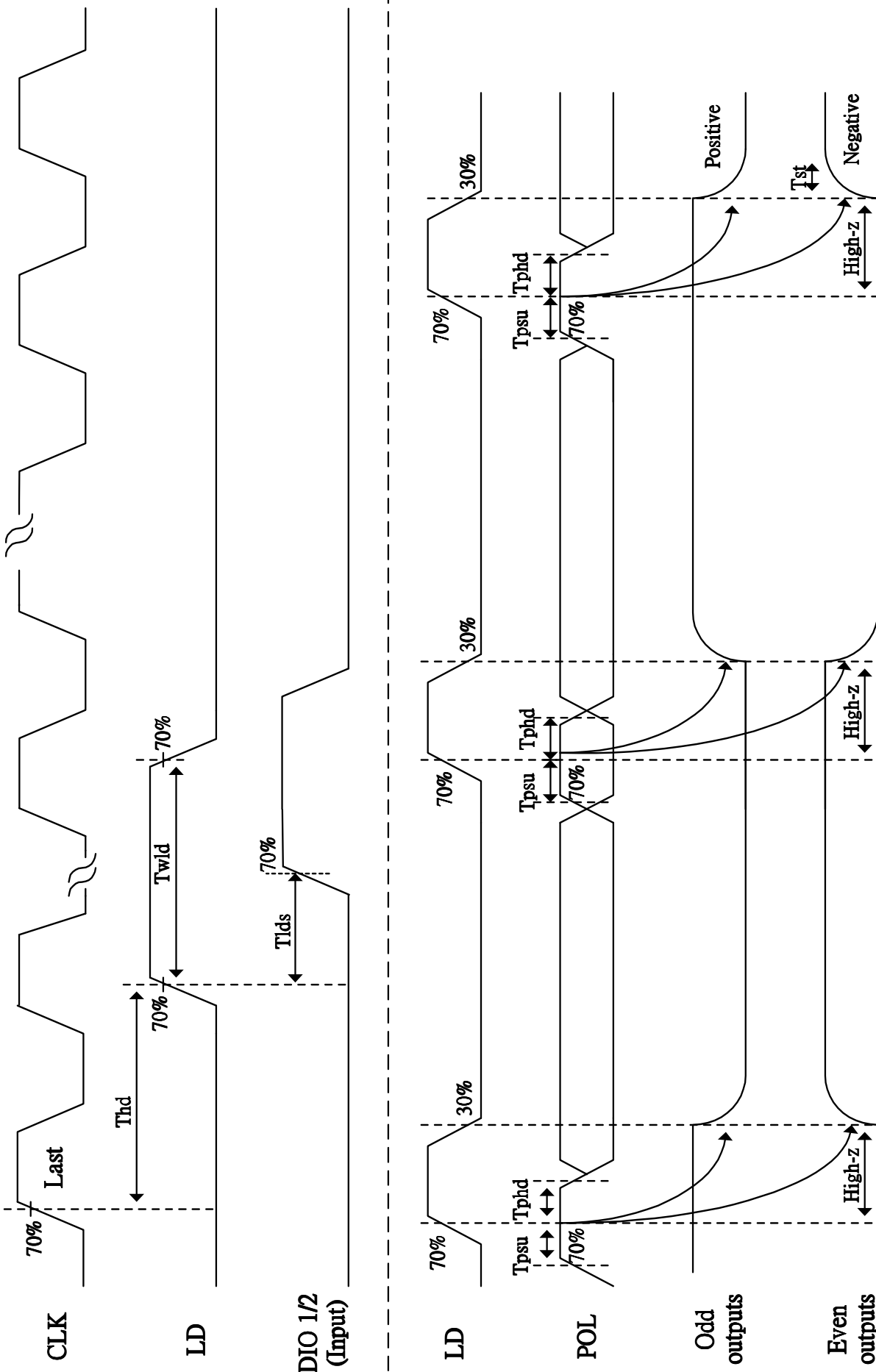
Fig. 11-2 Horizontal timing(2)
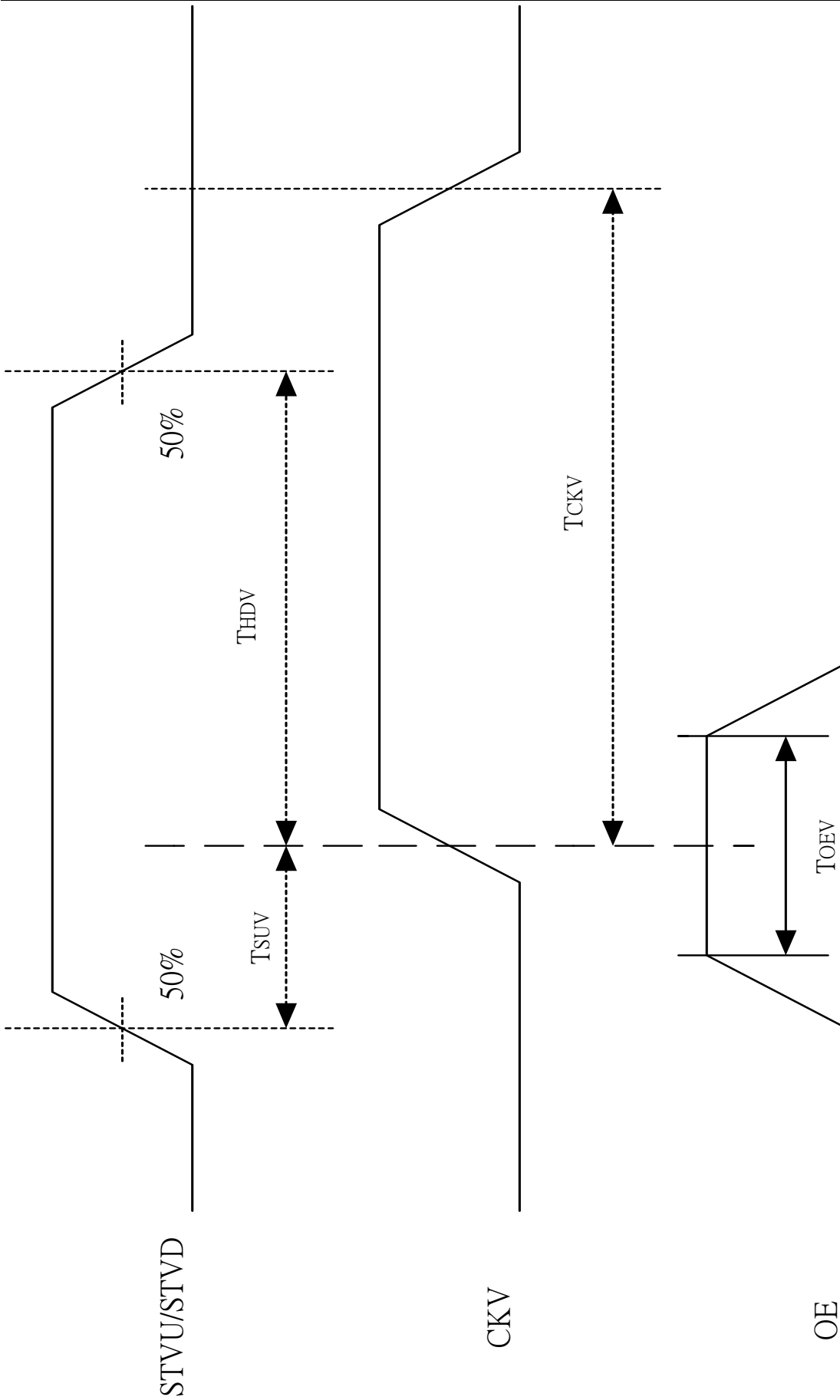
Fig. 11-3 Vertical shift clock timing

T_{HDP}

T_{HP}

(HSY)

(VSY)

STVU/STVD

POL(Odd Field)
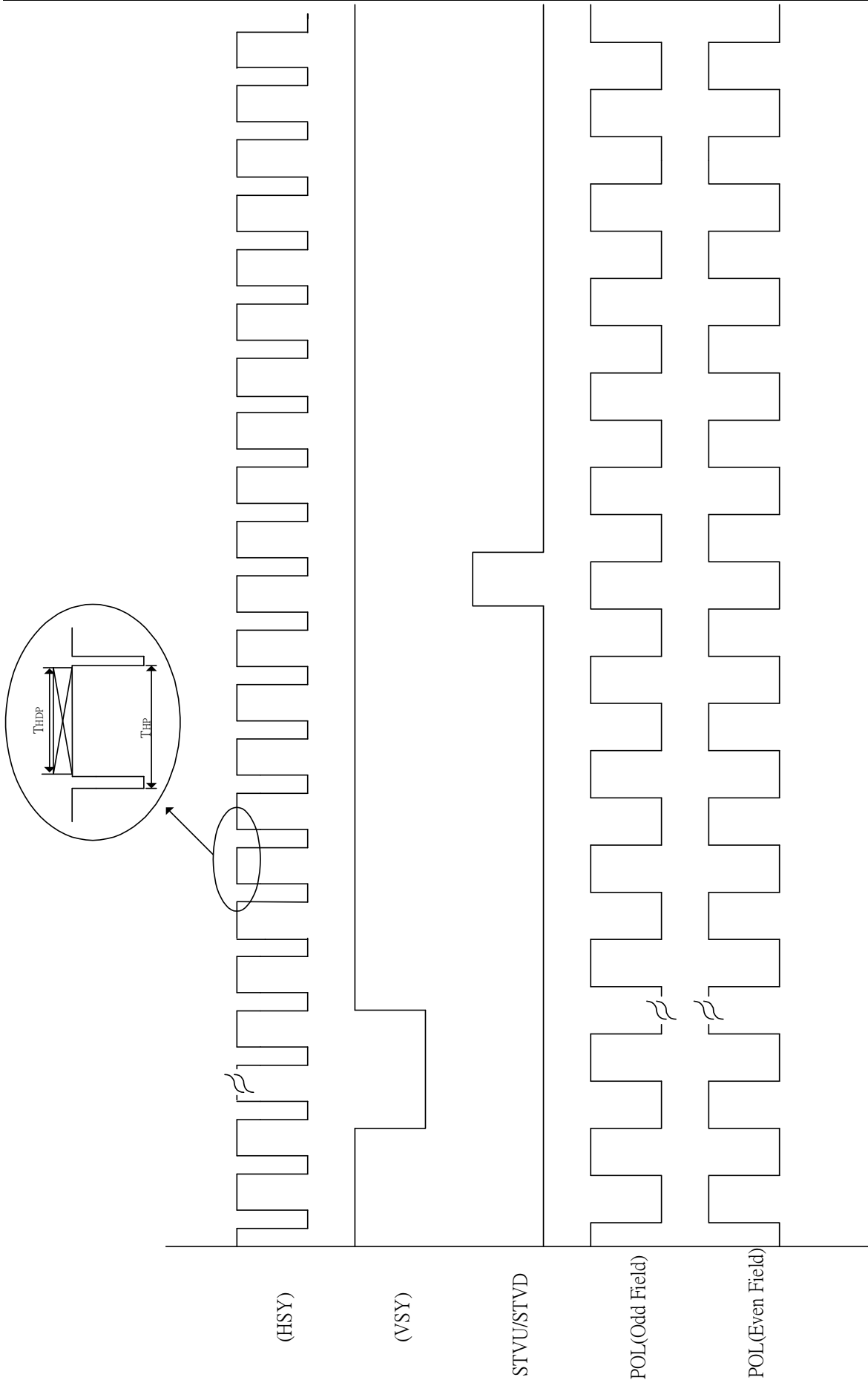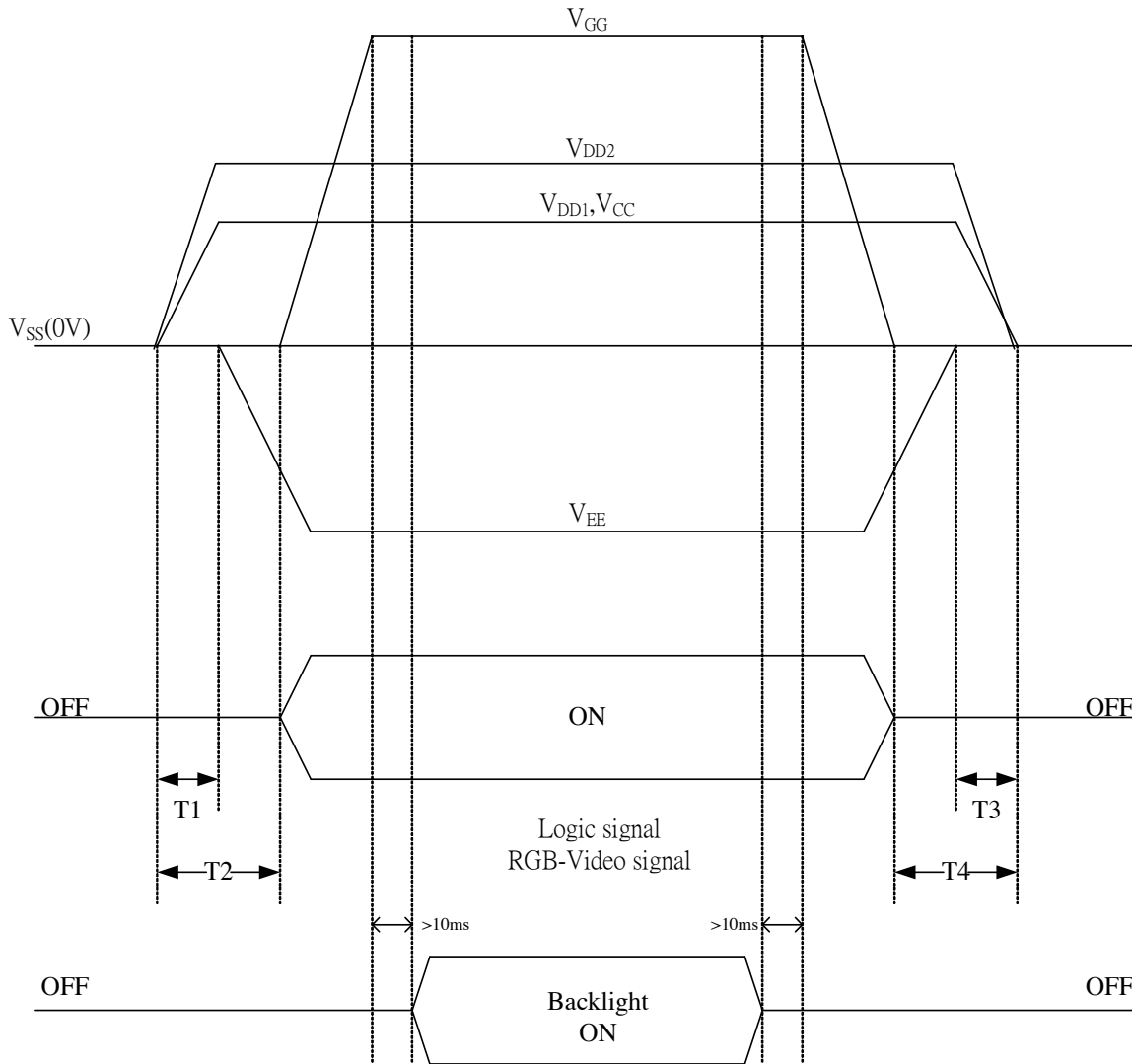
POL(Even Field)

Fig. 11-4 Vertical timing

12. Power On Sequence

0 10ms≦T1＜T2
2. 0ms＜T3≦T4≦10ms

13. Optical Characteristics

13-1) Specification:

Ta=25℃

Parameter		Symbol	Condition	MIN.	TYP.	MAX.	Unit	Remarks
Viewing Angle	Horizontal	θ	CR＞10	±55	±60		deg	Note 13-1
	Vertical	θ 12(to 12 o'clock)		35	40	-	deg	
		θ 11(to 6 o'clock)		45	50	-	deg	
Contrast Ratio		CR		200	400	-	-	Note 13-2
Response time	Rise	Tr	θ =0°	-	15	30	ms	Note 13-3
	Fall	Tf		-	25	50	ms	
Brightness			θ =0°/ φ =0	800	900		cd/㎡	Note 13-4
Luminance Uniformity		U		75	80	-	%	Note 13-5
Lamp Life Time				40000	-	-	hr	At 6mA
White Chromaticity		x		0.28	0.31	0.34	-	
		y		0.30	0.33	0.36	-	
Cross Talk			θ =0°	-	-	3.5	%	Note 13-6

All the optical measurement shall be executed 30 minutes after backlight being turn-on. The optical characteristics shall be measured in dark room (ambient illumination on panel surface less than 1 Lux). The measuring configuration shows as following figure.

Photometer (TOPCON BM-5A or BM-7 fast)

500 mm +/- 50 mm

Field = 1°

TFT-LCD module

DC/AC Inverter
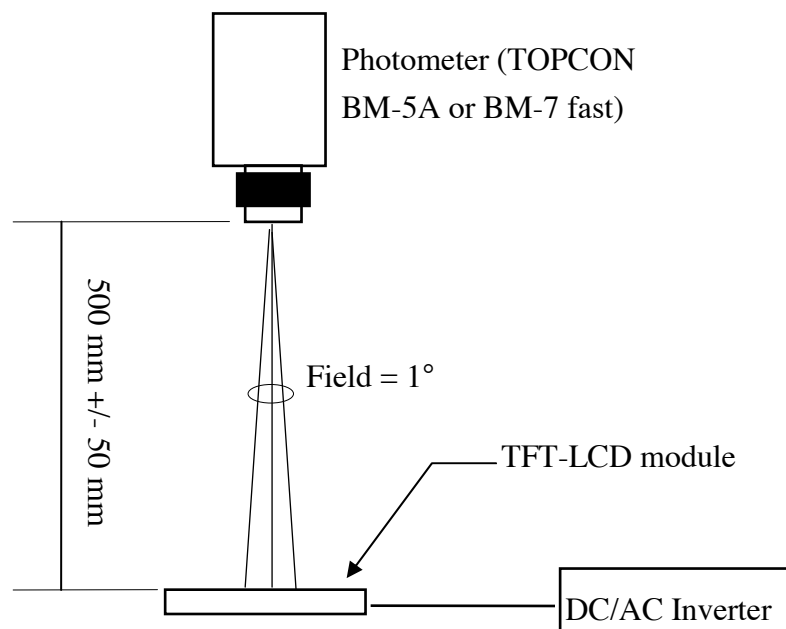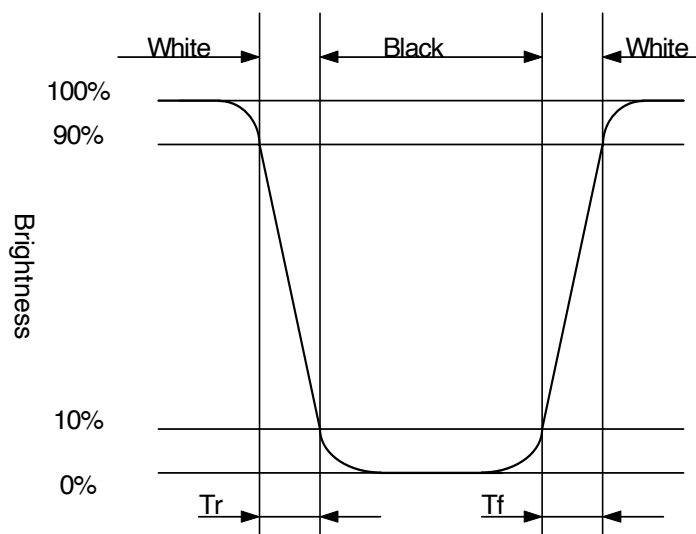
Optical characteristics measuring configuration

Note 13-1: The definitions of viewing angles are as follow
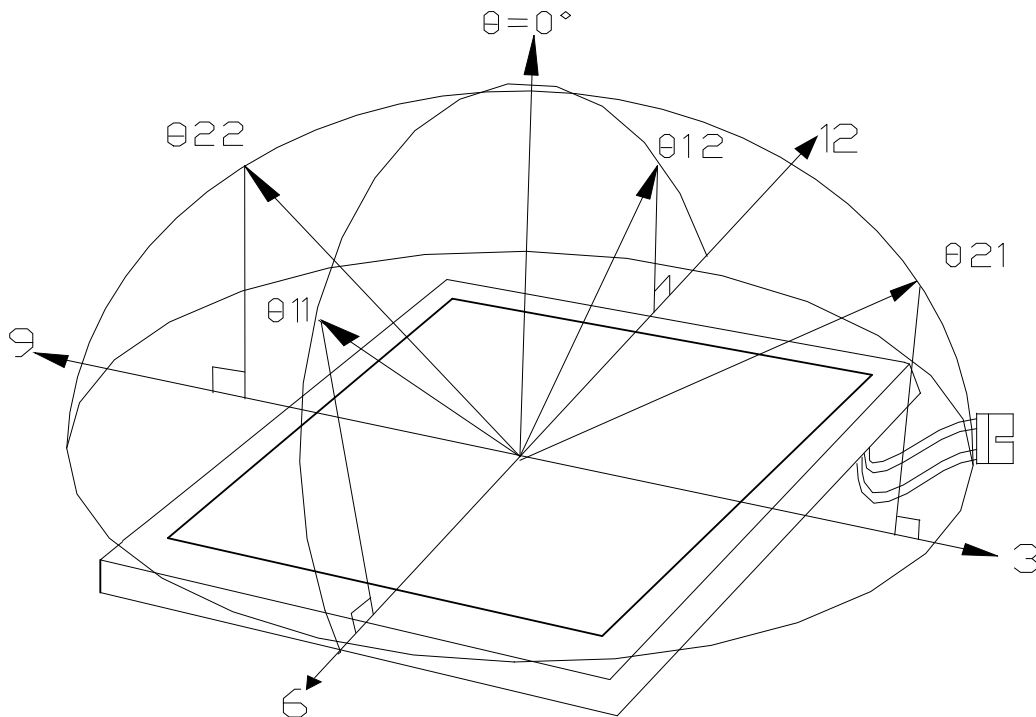
*θ11(to 6 o'clock) Gray scale inversion direction

Note 13-2: The definition of contrast ratio $\quad CR = \dfrac{\text{Luminance when Testing point is White}}{\text{Luminance when Testing point is Black}}$

Note 13-3: Definition of Response Time T_r and T_f:

Note 13-4 : 1.Topcon BM-7(fast) luminance meter 1°field of view is used in the testing (after 30 minutes operation).

2.Lamp current : 6 mA

Note 13-5: The uniformity of LCD is defined as

$$U = \frac{\text{The Minimum Brightness of the 9 testing Points}}{\text{The Maximum Brightness of the 9 testing Points}}$$
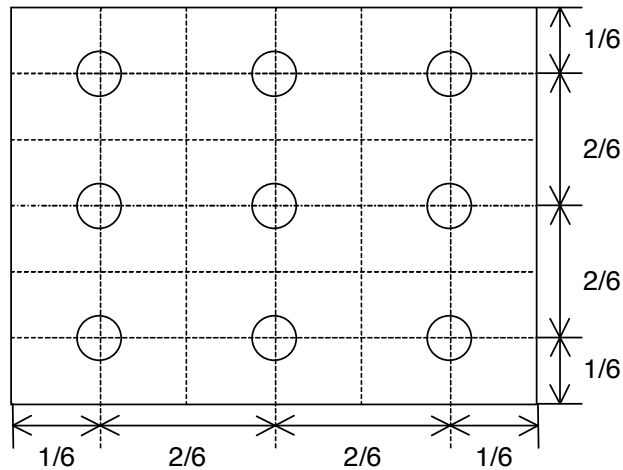
Luminance meter : BM-5A or BM-7 fast(TOPCON)

Measurement distance : 500 mm +/- 50 mm

Ambient illumination : < 1 Lux

Measuring direction : Perpendicular to the surface of module

The test pattern is white.

Note 13-6: Cross Talk (CTK) = $\frac{|YA-YB|}{YA} \times 100\%$

YA: Brightness of Pattern A

YB: Brightness of Pattern B

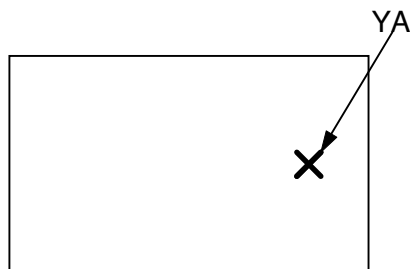Luminance meter : BM 5A or BM-7 fast (TOPCON)

Measurement distance : 500 mm +/- 50 mm

Ambient illumination : < 1 Lux

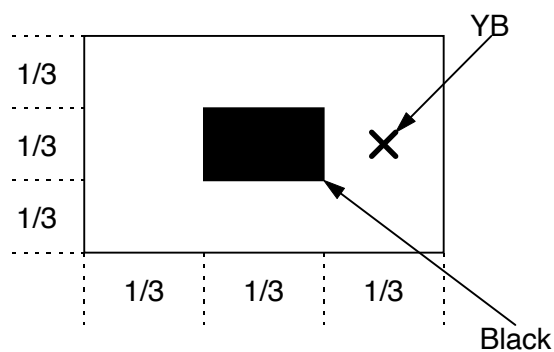Measuring direction : Perpendicular to the surface of module

Pattern A

(Gray Level 31)

Pattern B

(Gray Level 31, central

black box exclusive)

✕: Measuring Point (A and B are at the same point.)

Black

(Gray Level 0)

14. Handling Cautions

14-1) Mounting of module

a) Please power off the module when you connect the input/output connector.

b) Please connect the ground pattern of the inverter circuit surely. If the connection is not perfect, some following problems may happen possibly.

   1.The noise from the backlight unit will increase.

   2.The output from inverter circuit will be unstable.

   3.In some cases a part of module will heat.

c) Polarizer which is made of soft material and susceptible to flaw must be handled carefully.

d) Protective film (Laminator) is applied on surface to protect it against scratches and dirt.

e) Please following the tear off direction as figure 14-1 to remove the protective film as slowly as possible, so that electrostatic charge can be minimized.

14-2) Precautions in mounting

a) When metal part of the TFT-LCD module (shielding lid and rear case) is soiled, wipe it with soft dry cloth.

b) Wipe off water drops or finger grease immediately. Long contact with water may cause discoloration or spots.

c) TFT-LCD module uses glass which breaks or cracks easily if dropped or bumped on hard surface. Please handle with care.

d) Since CMOS LSI is used in the module. So take care of static electricity and earth yourself when handling.

14-3) Adjusting module

a) Adjusting volumes on the rear face of the module have been set optimally before shipment.

b) Therefore, do not change any adjusted values. If adjusted values are changed, the specifications described may not be satisfied.

14-4) Others

a) Do not expose the module to direct sunlight or intensive ultraviolet rays for many hours.

b) Store the module at a room temperature place.

c) The voltage of beginning electric discharge may over the normal voltage because of leakage current from approach conductor by to draw lump read lead line around.

d) If LCD panel breaks, it is possibly that the liquid crystal escapes from the panel. Avoid putting it into eyes or mouth. When liquid crystal sticks on hands, clothes or feet. Wash it out immediately with soap.

e) Observe all other precautionary requirements in handling general electronic components.

f) Please adjust the voltage of common electrode as material of attachment by 1 module.

14-5) Polarizer mark

The polarizer mark is to describe the direction of wide view angle film how to mach
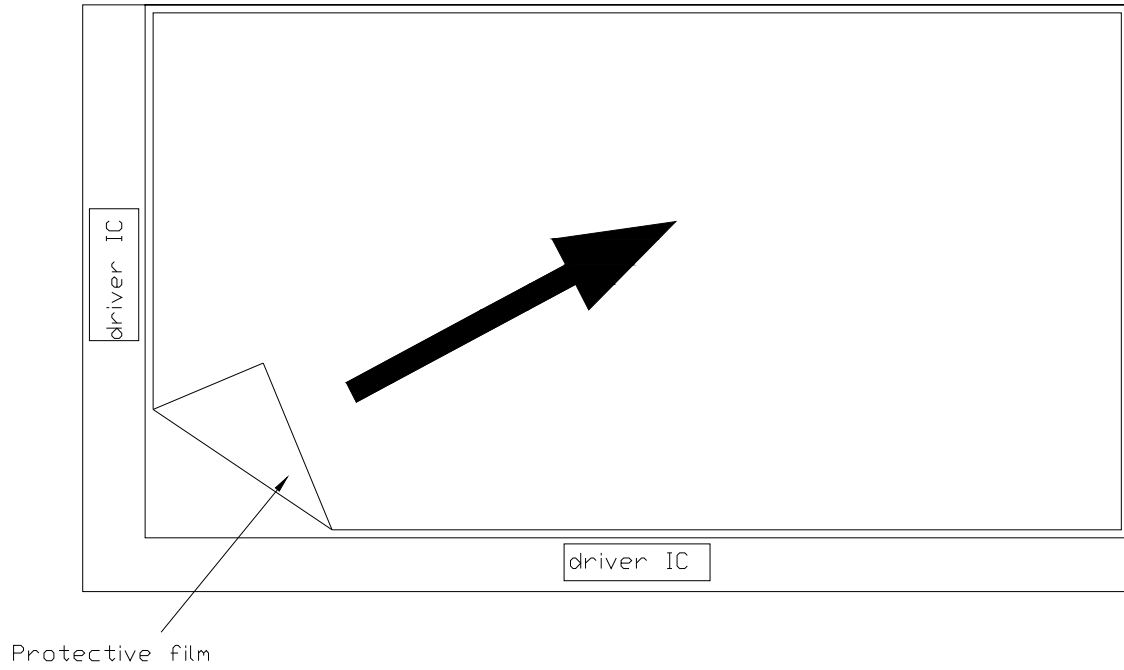
up with the rubbing direction.

Figure 14-1 the way to peel off protective film

15. Reliability Test

No	Test Item	Test Condition	Remark
1	High Temperature Storage Test	Ta = +80℃, 240 hrs	
2	Low Temperature Storage Test	Ta = -30℃, 240 hrs	
3	High Temperature Operation Test	Ta = +70℃, 240 hrs	
4	Low Temperature Operation Test	Ta = -20℃, 240 hrs	
5	High Temperature & High Humidity Operation Test	Ta = +60℃, 90%RH, 240 hrs (No Condensation)	
6	Thermal Cycling Test (non-operating)	-20℃→+70℃, 200 Cycles 30min 30min	
7	Vibration Test (non-operating)	Frequency：10～55 H_Z, Amplitude：1 mm Sweep time: 11 min Test Period : 6 Cycles for each direction of X, Y, Z	
8	Shock Test (non-operating)	100G, 6ms Direction: ±X, ±Y, ±Z Cycle: 3 times	
9	Electrostatic Discharge Test (non-operating)	200pF, 0Ω ±200V 1 time / each terminal	

Ta: ambient temperature
Note : The protective film must be removed before temperature test.

[Criteria]
In the standard conditions, there is not display function NG issue occurred.
(including : line defect ,no image), All the cosmetic specification is judged before the reliability stress.

16. Packing Diagram

ZONE	REV.	DOCUUMENT NO.	DESCRIPTION	DATE	REV.BY

NOTE:
1.Q'TY: 30 pcs panel/carton.
2.Dimension: 530*295*230mm
3.Weight: 7.6 Kg

4	CARTON		1	
3	PINK Bag 125*170mm		30	抗靜電
2	5" Square Panel		30	
1	瓦楞隔板緩衝材		1	上蓋＋底座
ITEM	DESCRIPTION		QTY	REMARK

MTL.SPEC.		UNSPECIFIED TOL'S		REMARK	
		ANGLE			
		ROUGHNESS			

Tape

Eink 元太科技工業股份有限公司
E Ink Holdings

APPROVE	Franks	'04.11.24	SCALE	UNIT	SHEET 1 OF 1	DWG.TITLE 5"Square Model Packing Draw
CHECK	Franks	'04.11.24				
DRAWN	Jimmyc	'04.11.24	MTL.NO.			DWG FILE: / REV. 01 / A4 SIZE