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## Contact us

Tel: +86-755-8981 8866 Fax: +86-755-8427 6832

Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



# Product Specifications

<b>Customer</b>	<b>Standard</b>
<b>Description</b>	<b>2.0" TFT EPD Panel</b>
<b>Model Name</b>	<b>EG020AS012</b>
<b>Date</b>	<b>2013/ 07/ 15</b>
<b>Doc. No.</b>	<b>1P001-00</b>
<b>Revision</b>	<b>04</b>

<b>Customer Approval</b>	
<b>Date</b>	
The above signature represents that the product specifications, testing regulation, and warranty in the specifications are accepted	

	<b>Design Engineering</b>		
	<b>Approval</b>	<b>Check</b>	<b>Design</b>
			

No.71, Delun Rd., Rende Dist., Tainan City 71743, Taiwan (R.O.C.)

Tel: +886-6-279-5399

Fax: +886-6-279-5300

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龍亭新技股份有限公司 Pervasive Displays Inc.

No.71, Delun Rd., Rende Dist., Tainan City 71743, Taiwan (R.O.C.)

Tel: +886-6-279-5399

<http://www.pervasivedisplays.com>

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## Revision History

Version	Date	Page (New)	Section	Description
Ver.01	2011/05/23	All	All	Approval specification first issued.
Ver.02	2012/02/24	15	9	Add module Label.
Ver.03	2012/06/20	All	All	Revise document format.
Ver.04	2013/07/15	12	1	Modify EPD drawing
		13	2.2	Add Note 3 at Reliability Test Items
		15	3.2	Add current value(MAX) Add Note description
		17	5.1	Modify description in Terminal Pin Assignment
		19	5.2	Modify Reference circuit
		23	6.2.2	About refreshing of Test1 & Test2 had modified "1h storage" to "Refresh immediately", and to delete the PCS test.
		28 29	9	Modify definition of labels

## Glossary of Acronyms

EPD	Electrophoretic Display (e-Paper Display)
EPD Panel	EPD
EPD Module	EPD with TCon board
TCon	Timing Controller
TFT	Thin Film Transistor
MCU	Microcontroller Unit
FPC	Flexible Printed Circuit
FPL	Front Plane Laminate
SPI	Serial Peripheral Interface
COG	Chip on Glass
PCS	Print Contrast Signal
PDI	Pervasive Displays Incorporated



## 1 General Description

### 1.1 Overview

This is a 2.0" a-Si, active matrix TFT, Electronic Paper Display (EPD) panel. The panel has such high resolution (111 dpi) that it is able to easily display fine patterns. Due to its bi-stable nature, the EPD panel requires very little power to update and needs no power to maintain an image.

### 1.2 Features

- a-Si TFT active matrix Electronic Paper Display(EPD)
- Resolution: 200 x 96
- Ultra low power consumption
- Super Wide Viewing Angle - near 180°
- Extra thin & light
- SPI interface
- RoHS compliant

### 1.3 Applications

- Electronic shelf label (ESL)
- Reusable container
- Badge

## 1.4 General Specifications

**Table 1-1 General Specification**

Item	Specification	Unit	Note
Outline Dimension	57.0(H) x 28.8(V) x 1.0(T)	mm	(1)
Active Area	45.800(H) x 21.984(V)	mm	
Driver Element	a-Si TFT active matrix	-	
FPL	V110	-	
Pixel Number	200 x 96	pixel	
Pixel Pitch	0.229 x 0.229 (111dpi)	mm	
Pixel Arrangement	Vertical stripe	-	
Display Colors	Black/White	-	
Surface Treatment	Anti-Glare	-	

Note (1): Not including the FPC.

## 1.5 Mechanical Specifications

**Table 1-2 Mechanical Specification**

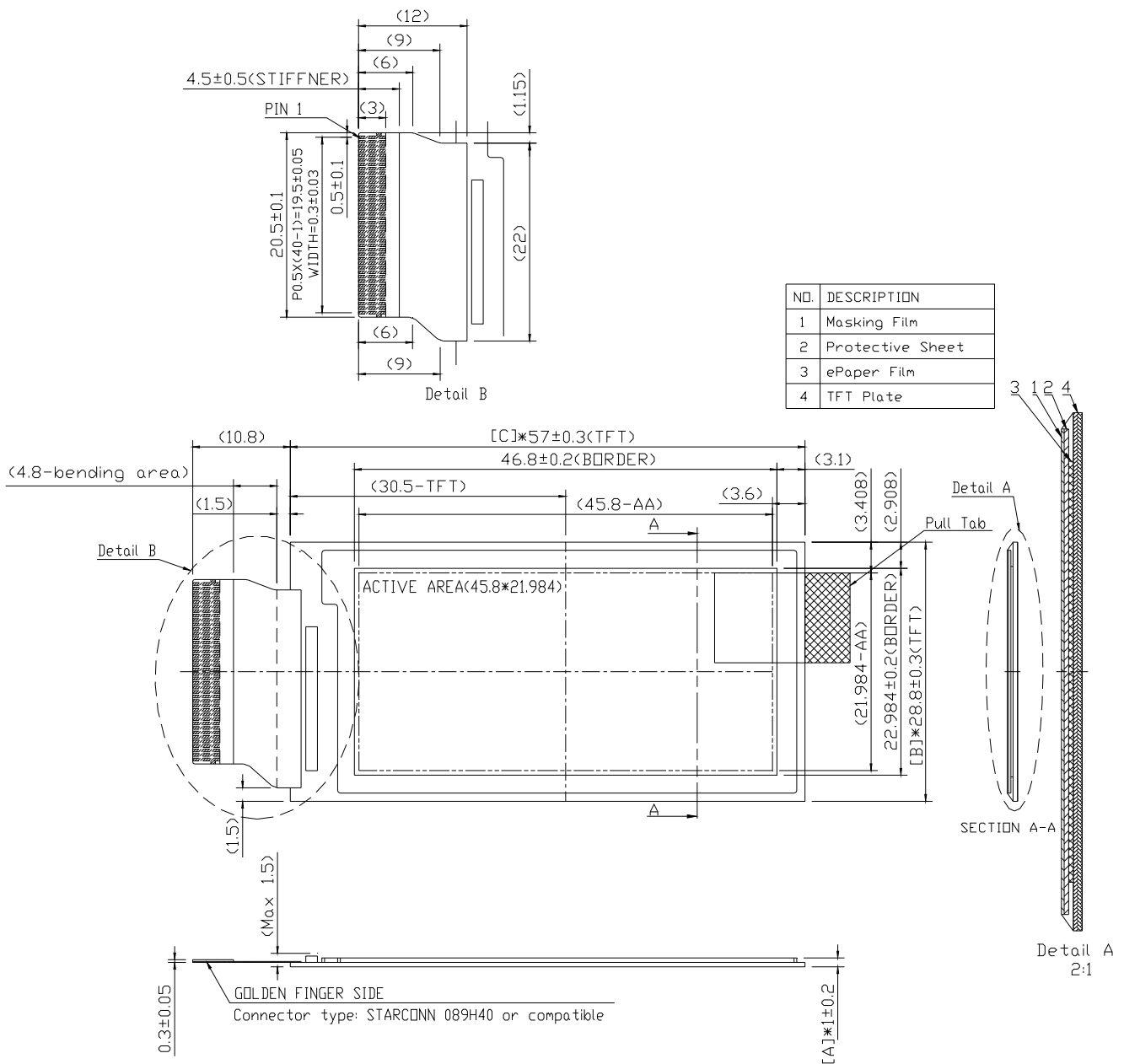
Item		Min.	Typ.	Max.	Unit	Note
Glass Size	Horizontal(H)	56.7	57.0	57.3	mm	
	Vertical(V)	28.5	28.8	29.1	mm	
	Thickness(T)	0.8	1.0	1.2	mm	(1)
Weight			3.7	4.5	g	

Note (1): Not including the Masking Film.

**Table 1-3 FPC Specification**

Item	Pin numbers	Pitch (mm)	Connector	Note
Golden Finger	40	0.5	STARCONN 089H40 or Compatible	

**Figure 1-1 EPD Drawing**



**General tolerance: ±0.3mm**

## 2 Absolute Maximum Ratings

### 2.1 Absolute Ratings of Environment

**Table 2-1 Absolute Ratings of Environment**

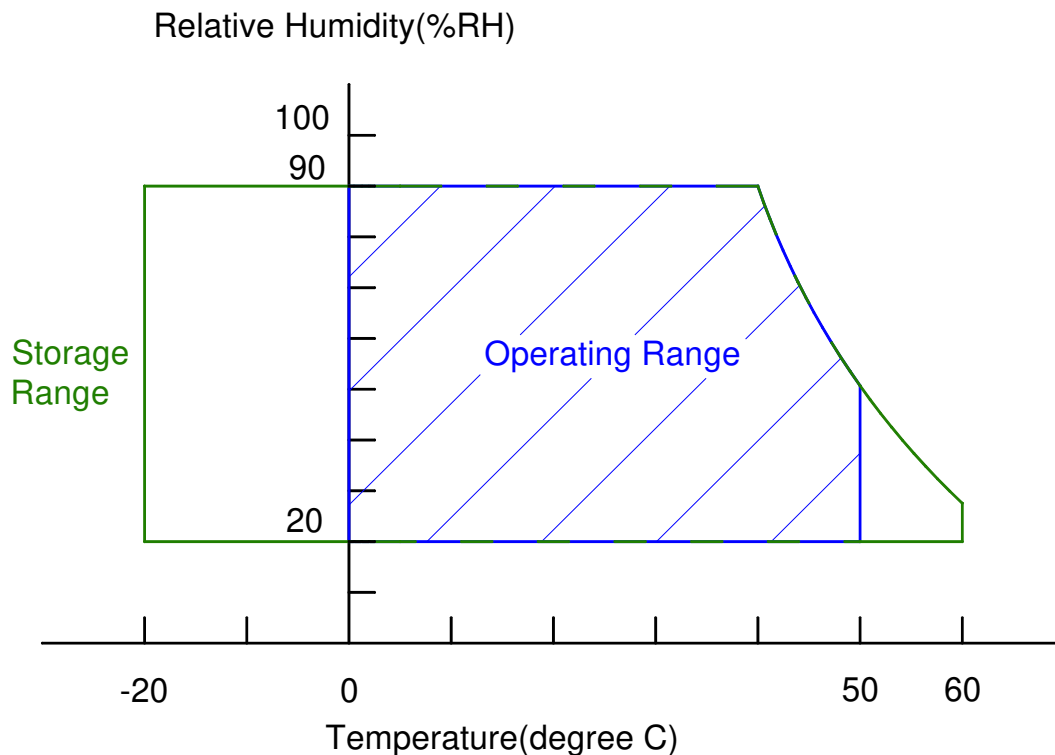
Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	T <sub>ST</sub>	-20	+60	°C	(1)
Operating Ambient Temperature	T <sub>OP</sub>	0	+50	°C	(1), (2)

Note (1):

- (a) 90 %RH Max. ( $T_a \leq 40 \text{ }^\circ\text{C}$ ), where  $T_a$  is ambient temperature.
- (b) Wet-bulb temperature should be 39 °C Max. ( $T_a > 40 \text{ }^\circ\text{C}$ ).
- (c) No condensation.

Note (2): The temperature of panel display surface area should be 0 °C Min. and 50 °C Max. Refresh time depends on operation temperature.

**Figure 2-1 Operating Range of Relative Humidity and Temperature**



## 2.2 Reliability Test Item

**Table 2-2 Reliability Test Items**

Item	Test Condition	Remark
High Temperature Operation	50 °C for 240h	(1) (2)
Low Temperature Operation	0 °C for 240h	(1) (2)
High Temperature/Humidity Operation	40 °C / 90 %RH for 168h	(1) (2)
High Temperature Storage	60 °C for 240h	(1) (2)(3)
Low Temperature Storage	-20 °C for 240h	(1) (2) (3)
High Temperature/Humidity Storage	50 °C / 80 %RH for 168h	(1) (2) (3)
Thermal Cycles ( Non-operation )	1 Cycle:-20°C/30min → 60°C/30min, for 100 Cycles	(1) (2) (3)
Package Drop Test	Drop from 97cm. ( ISTA ) 1 corner, 3 edges, 6 sides. One drop for each.	(1) (2) (3)
Package Random Vibration Test	1.15Grms, 1Hz ~ 200Hz. ( ISTA )	(1) (2) (3)

Note (1): End of test, function, mechanical, and optical shall be satisfied.

Note (2): The test result and judgment are based on PDI's 1bit driving waveform, driving fixture and driving system.

Note (3): Test with white pattern



### 3 Electrical Characteristics

#### 3.1 Absolute Maximum Ratings of Panel

**Table 3-1 Absolute Maximum Ratings of Panel**

Parameter	Symbol	Value		Unit	Note
		Min	Max		
Digital Power	$V_{DD}$	-0.3	5.0	V	
Analog Power	$V_{CC}$	-0.3	5.0	V	
Ground	$V_{SS}$	-		-	Connect $V_{SS}$ to Ground

$T_a = 25 \pm 2 \text{ } ^\circ\text{C}$

#### 3.2 Recommended Operation Conditions of Panel

**Table 3-2 Recommended Operation Conditions of Panel**

Parameter	Symbol	Value			Unit	Note
		Min	Typ	Max		
Digital Power	$V_{DD}$	2.7	3.0	3.3	V	
Analog Power	$V_{CC}$	2.7	3.0	3.3	V	
Input Voltage	High	$V_{IH}$	$0.8V_{DD}$	-	$V_{DD}$	/CS, ID, SCLK, SI, /RESET
	Low	$V_{IL}$	$V_{SS}$	-	$0.2V_{DD}$	
Output Voltage	High	$V_{OH}$	$0.8V_{DD}$	-	$V_{DD}$	$I_{OH}=0.5\text{mA}$ , SO, BUSY
	Low	$V_{OL}$	$V_{SS}$	-	$0.2V_{DD}$	$I_{OL}=-0.5\text{mA}$ , SO, BUSY
Input Leakage Current	High	$I_{IH}$	-	-	1.0	$\mu\text{A}$
	Low	$I_{IL}$	-	-	-1.0	$\mu\text{A}$

Input Current	$I_{DD} + I_{CC}$	-	4	8	mA	(1),(2),(3)
DC/DC Inrush Current	$I_{PEAK}$	-	40	100	mA	(1),(2),(3)

$T_a = 25 \pm 2 \text{ }^\circ\text{C}$

Note (1):

**Figure 3-1 Test Pattern of Panel**

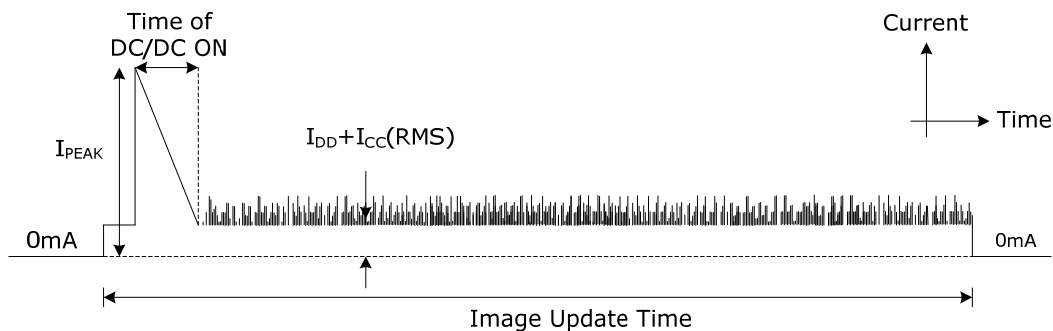


These currents are tested with PDI test jig.

Note (2):

$$V_{DD} = V_{CC} = 3.0V$$

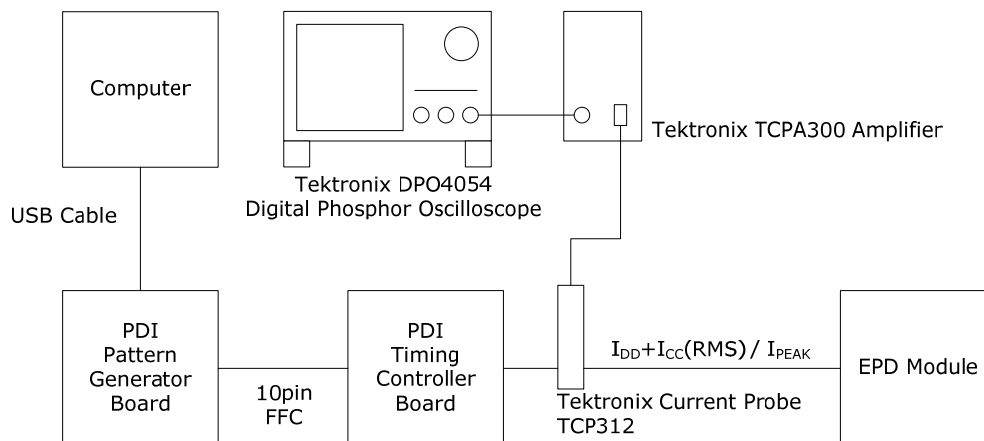
**Figure 3-2 Image Update Current Profile**



The "Time of DC/DC ON" which contains the some current peak of  $V_{GH}/V_{DH}/V_{GL}/V_{DL}/V_{COM}$ .

Note (3):

**Figure 3-3 Current Measurement**





## 5 Terminal Pin Assignment & Reference Circuit

### 5.1 Terminal Pin Assignment

**Table 5-1 Terminal Pin Assignment**

No.	Signal	Type	Connected to	Function
1	/CS	I	Tcon	Chip Select. Low enable
2	BUSY	O	Tcon	When BUSY = HIGH, EPD stays in busy state that EPD ignores any input data from SPI
3	ID	I	Ground	Connect ID to ground
4	SCLK	I	Tcon	Clock for SPI
5	SI	I	Tcon	Serial input from Timing Controller to EPD
6	SO	O	Tcon	Serial output from EPD to Timing Controller
7	/RESET	I	Tcon	Reset signal. Low enable
8	ADC_IN	-	-	Not connected
9	V <sub>CL</sub>	C	Capacitor	
10	C42P	C	Charge-Pump Capacitor	
11	C42M	C		
12	C41P	C	Charge-Pump Capacitor	
13	C41M	C		
14	C31M	C	Charge-Pump Capacitor	
15	C31P	C		
16	C21M	C	Charge-Pump Capacitor	
17	C21P	C		
18	C16M	C	Charge-Pump Capacitor	
19	C16P	C		
20	C15M	C	Charge-Pump Capacitor	
21	C15P	C		

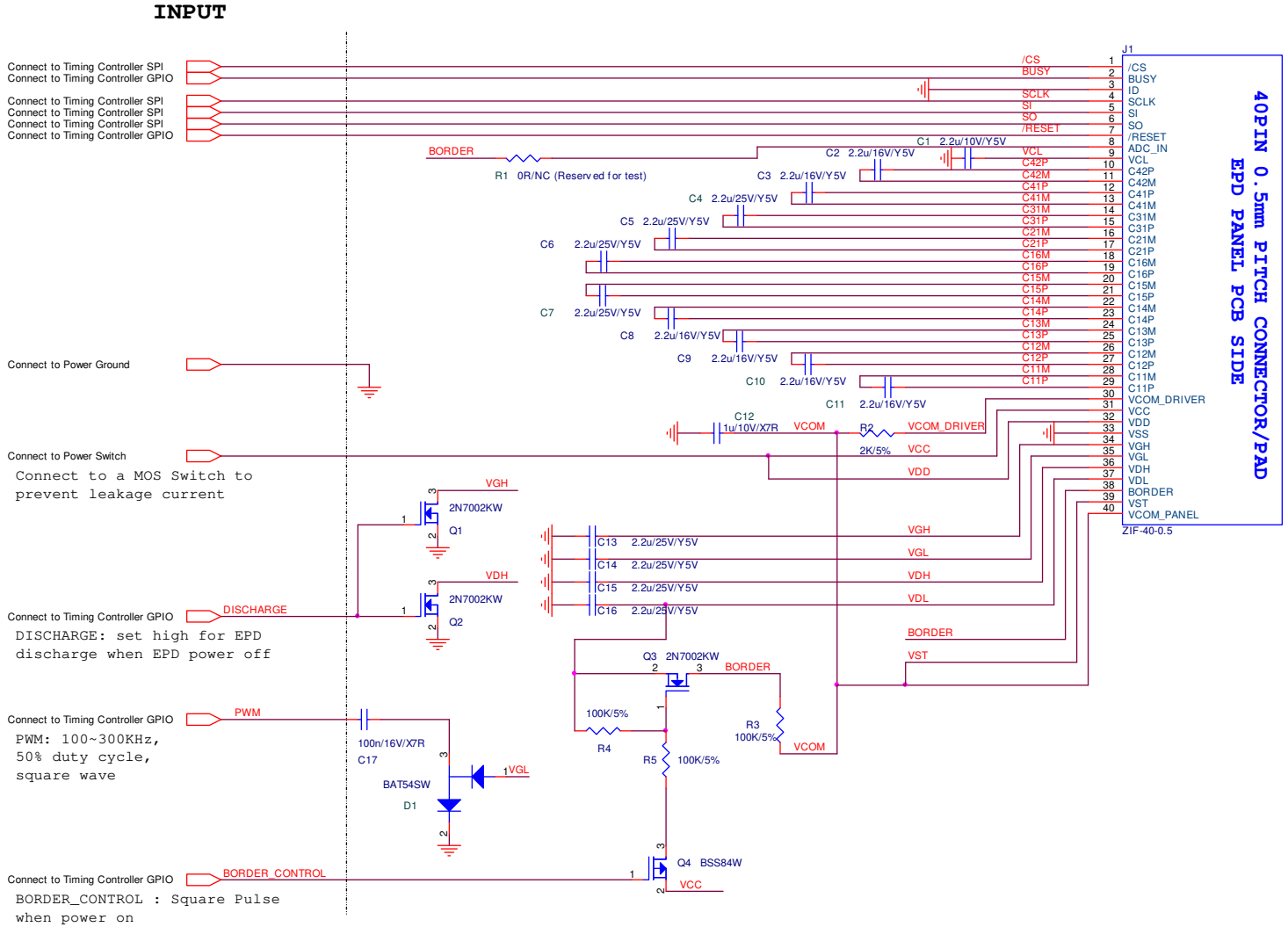
22	C14M	C	Charge-Pump Capacitor	
23	C14P	C		
24	C13M	C	Charge-Pump Capacitor	
25	C13P	C		
26	C12M	C	Charge-Pump Capacitor	
27	C12P	C		
28	C11M	C	Charge-Pump Capacitor	
29	C11P	C		
30	V <sub>COM_DRIVER</sub>	RC	Resistor & Capacitor	The signal duty cycle can drive V <sub>COM</sub> voltage from source driver IC
31	V <sub>CC</sub>	P	V <sub>CC</sub>	Power supply for analog part of source driver
32	V <sub>DD</sub>	P	V <sub>DD</sub>	Power supply for digital part of source driver
33	V <sub>SS</sub>	P	Ground	
34	V <sub>GH</sub>	C	Capacitor	
35	V <sub>GL</sub>	C	Capacitor	
36	V <sub>DH</sub>	C	Capacitor	
37	V <sub>DL</sub>	C	Capacitor	
38	BORDER	I	-	Connect to V <sub>DL</sub> via control circuit for white frame border
39	V <sub>ST</sub>	P	V <sub>COM_PANEL</sub>	
40	V <sub>COM_PANEL</sub>	C	Capacitor	V <sub>COM</sub> to panel

**Note:**

- Type: I: Input
- O: Output
- C: Capacitor
- RC: Resistor and Capacitor
- P: Power

## 5.2 Reference Circuit

Figure 5-1 EPD Reference Circuit



Note: (1)  $V_{DD}$  and  $V_{CC}$  must be discharged promptly after power off.



## 6 Optical Characteristics

### 6.1 Test Conditions

**Table 6-1 Optical Test Conditions**

Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	°C
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	V <sub>CC</sub> & V <sub>DD</sub>	3.0	V

### 6.2 Optical Specifications

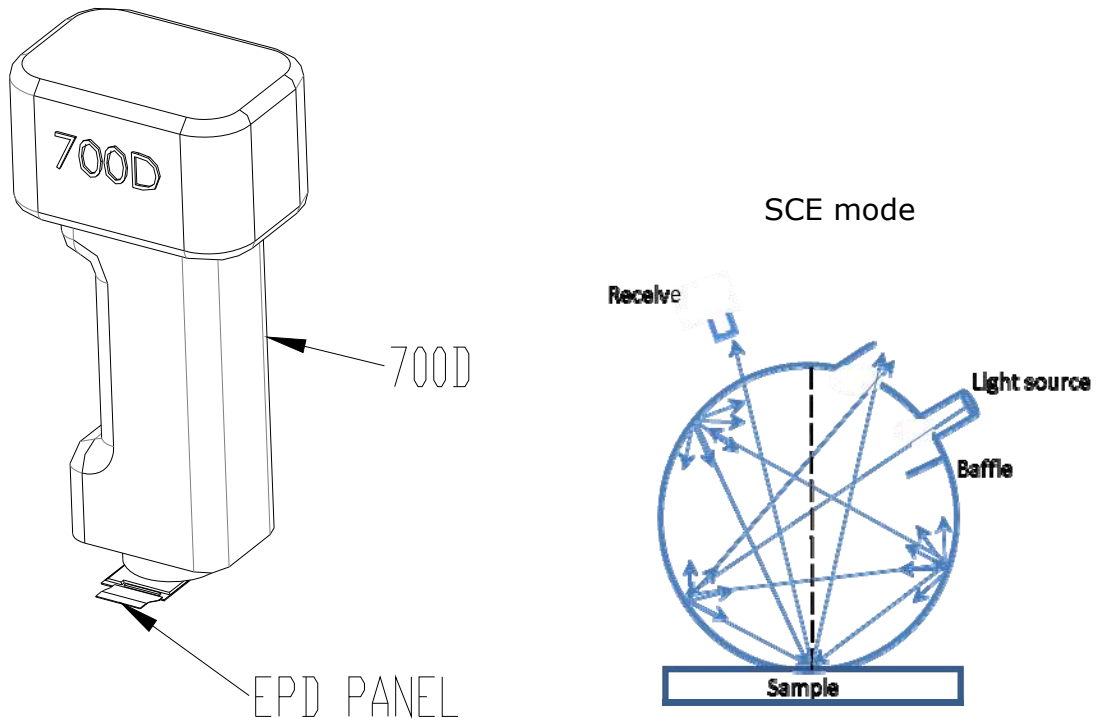
#### 6.2.1 Optical

**Table 6-2 Optical Measurement with D65 light source**

Item	Symbol	Rating			Unit	Note
		Min.	Typ.	Max.		
Contrast ratio	CR	5:1	7:1	-	-	$\theta_x=\theta_y=0$ (1),(2),(3),(4)
Refresh time	Tr	-	2	-	sec	(3)
White Chromaticity	Wx	-	0.313	-	-	$\theta_x=\theta_y=0$ (1),(4)
	Wy	-	0.338	-		
Reflectance	R%	25	32	-	%	(1),(4)

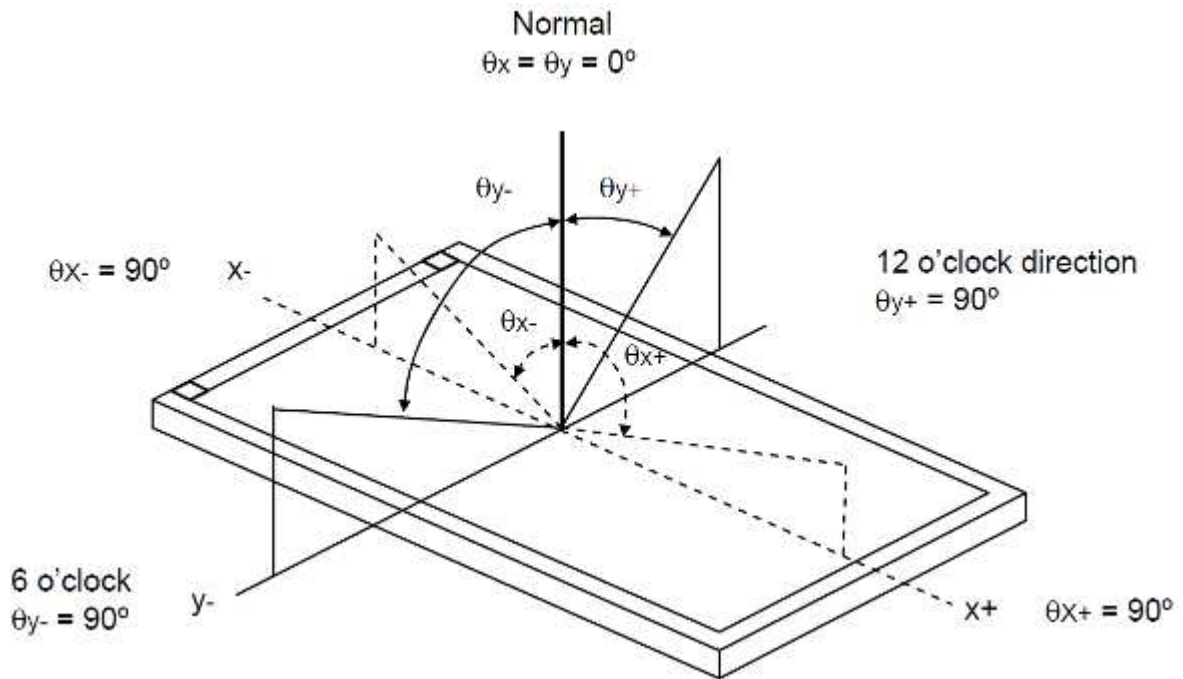
Note (1): Panel is driven by PDI waveform without masking film and optical measurement by CM-700D with D65 light source and SCE mode.

Figure 6-1 Optical measurement



Note (2): Definition of Viewing Angle ( $\theta_x$ ,  $\theta_y$ ):

**Figure 6-2 Definition of Viewing Angle to Measure Contrast Ratio**



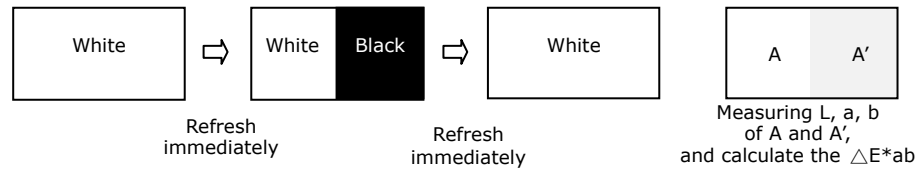
Note (3): Refresh time is the time that e-paper particles move not including the power on and off time. The refresh time is measured at 25°C. The refresh time and contrast ratio varies due to different films, display performance requirements, and ambient temperatures.

Note (4): Contrast ratio (C.R.): The Contrast ratio is calculated by the following expression.  $C.R. = (R\% \text{ White}) / (R\% \text{ Black})$ . Reflectance is measured at 120 seconds after refresh.

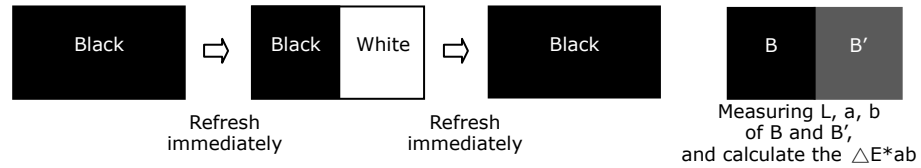
### 6.2.2 Ghosting

Below are two test methods to verify that ghosting within an acceptable range. Test 1 and Test 2 use measured data to calculate Delta E which is a single number representing the distance between two colors in a 3 dimensional color space. Test 1 and test 2 are performed at 25°C.

- Test 1: White to Black Ghosting



- Test 2: Black to White Ghosting



The formula is used to calculate Test1 and Test2. For example of Test 2:

$$\Delta E^*ab = [ (L_B - L_{B'})^2 + (a_B - a_{B'})^2 + (b_B - b_{B'})^2 ]^{1/2}$$

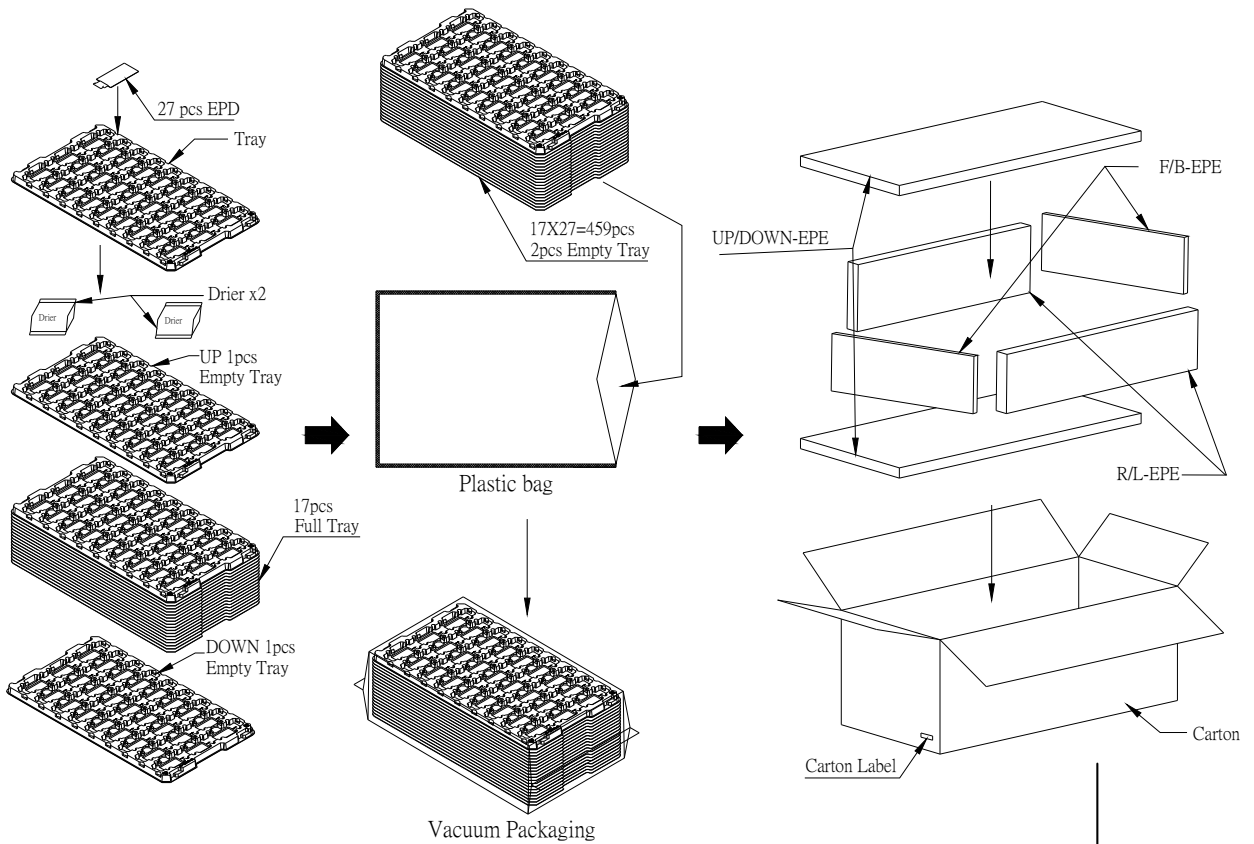
**Table 6-3 Measurement of Ghosting**

Item	Rating		
	Min.	Typ.	Max.
Test 1 ΔE*ab	-	-	2
Test 2 ΔE*ab	-	-	2

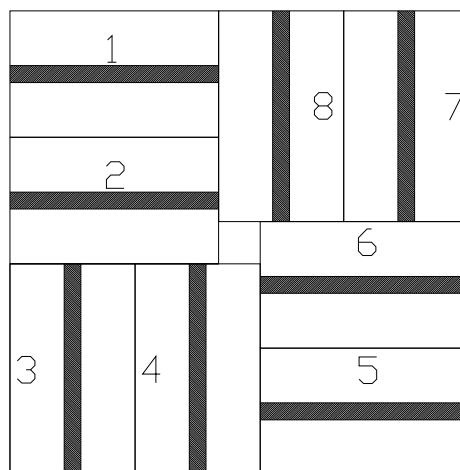
Note: Panel is driven by PDI waveform without masking film and optical measurement by CM-700D with D65 light source and SCE mode.

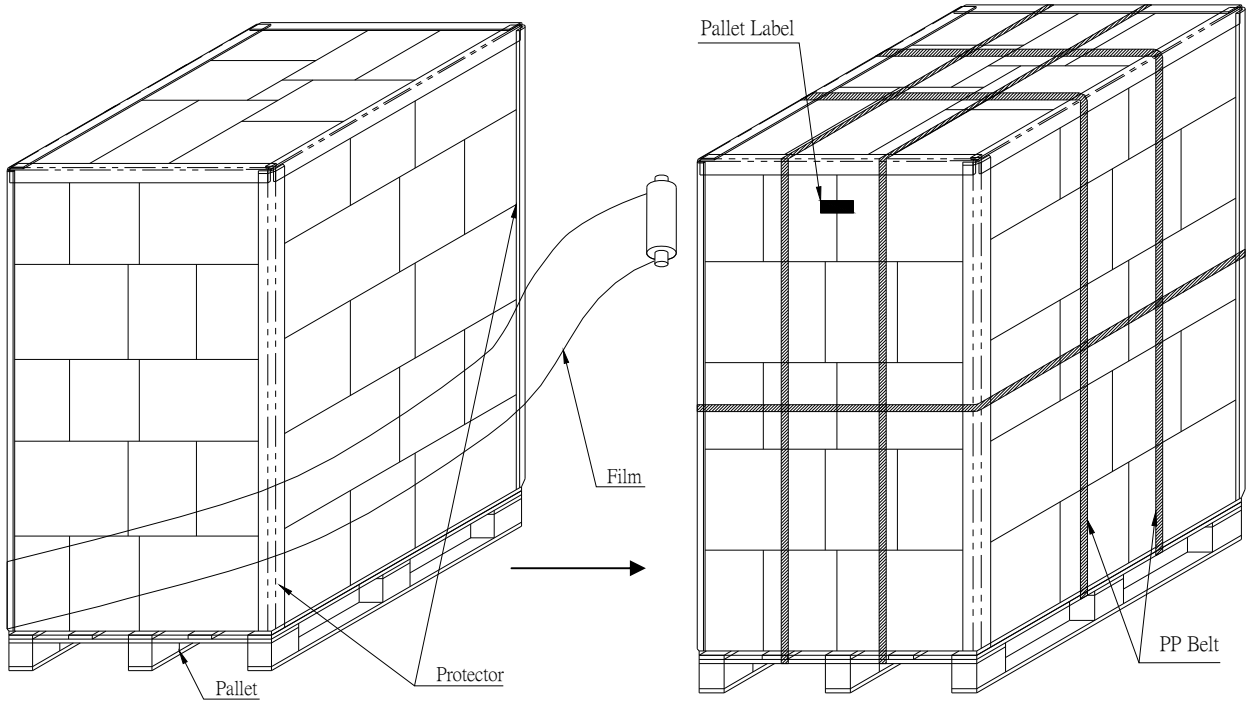
# 7 Packing

Figure 7-1 Packing Diagram



- Note: 1. Carton outline size: 500L X 300W X 200H mm  
 2. Material of tray: A-PET  
 3. Material of plastic bag: PE-LD





459(pcs) x 40(BOX)=18,360pcs

	2" EPD BOX
N.W. :	1.47Kg
G.W. :	4.83Kg

### Sea / Land / Air Transportation

