


# Product Specifications

<b>Customer</b>	<b>Standard</b>
<b>Description</b>	<b>10.2" TFT EPD Panel(V220)</b>
<b>Model Name</b>	<b>EZ102AT011</b>
<b>Date</b>	<b>2012/12/25</b>
<b>Doc. No.</b>	<b>1P021-00</b>
<b>Revision</b>	<b>01</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>
			

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**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

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## 1 General Description

### 1.1 Overview

This is a 10.2" a-Si TFT active matrix Electronic Paper Display (EPD) module. Since this module has high resolution, 160dpi, it can display fine pattern easily. Additionally, this module needs not only no power while hold pattern due to the bistable character of EPD but also ultra low power to update pattern.

### 1.2 Features

- a-Si TFT active matrix Electronic Paper Display(EPD)
- Resolution: 1024 x 1280
- Ultra low power consumption
- Super Wide Viewing Angle - near 180°
- Extra thin & light
- SPI interface
- RoHS compliant

### 1.3 Applications

- e-POP/Signage
- Electronic bulletins
- Office Automation
- Navigator



## 1.4 General Specifications

**Table 1-1 General Specification**

Item	Specification	Unit	Note
Outline Dimension	171.76(H) x 218.30(V) x 1.20(T)	mm	(1)
Active Area	162.56(H) x 203.20(V)	mm	
Driver Element	a-Si TFT active matrix	-	
FPL	V220	-	
Pixel Number	1024 x 1280	pixel	
Pixel Pitch	0.15875 x 0.15875 (160dpi)	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 EPD Mechanical Specification**

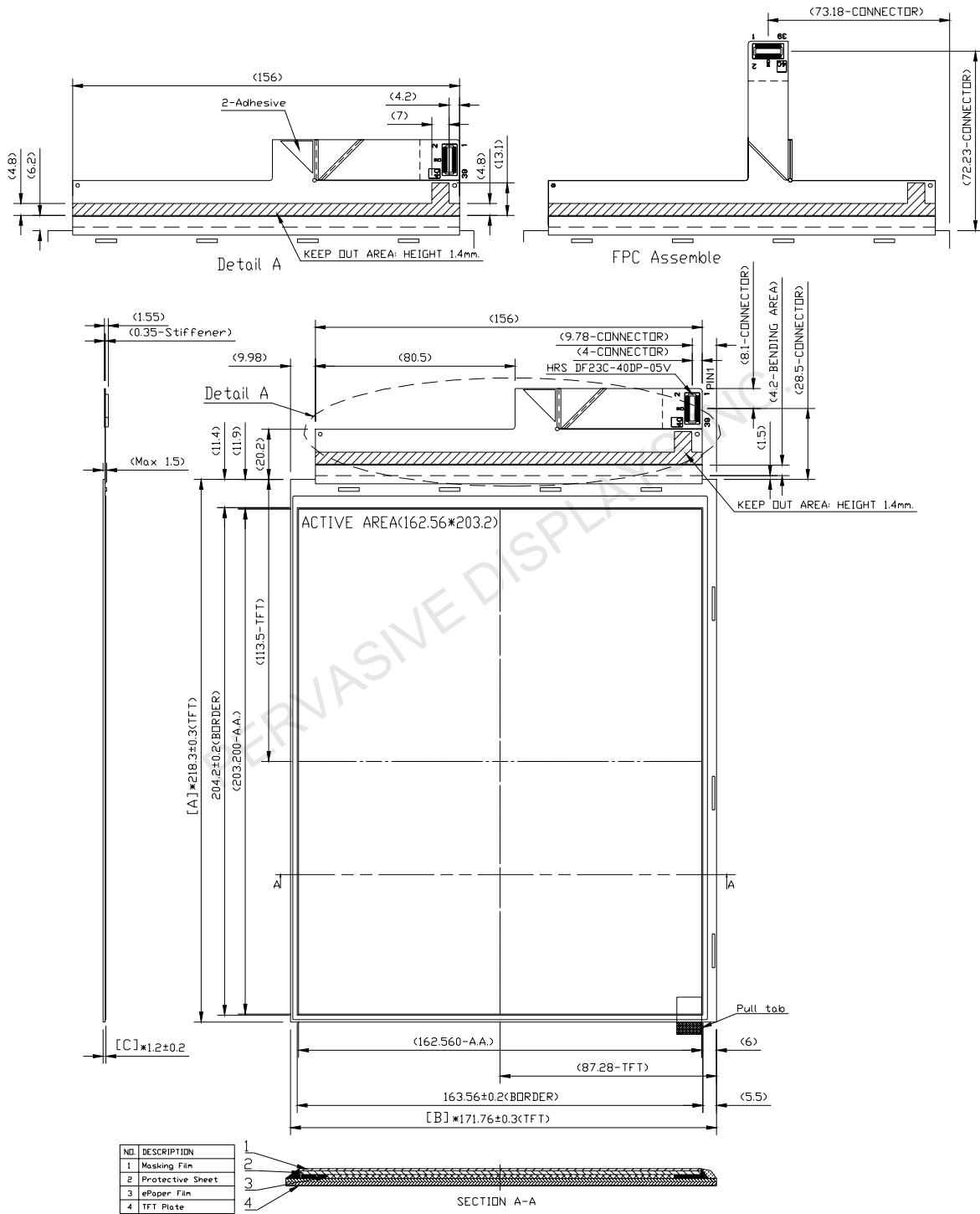
Item		Min.	Typ.	Max.	Unit	Note
Glass Size	Horizontal(H)	171.46	171.76	172.06	mm	
	Vertical(V)	218.00	218.30	218.60	mm	
	Thickness(T)	1.0	1.2	1.4	mm	(1)
Weight			91.7	110	g	

Note (1): Not including the Masking Film.

**Table 1-3 FPC Specification**

Item	Pin numbers	Pitch (mm)	Connector	Note
Board to Board Connector	40		HRS DF23C-40DP-0.5V	

Figure 1-1 EPD Drawing



## 2 Absolute Maximum Ratings

### 2.1 Absolute Ratings of Environment

Table 2-1 Absolute Ratings of Environment

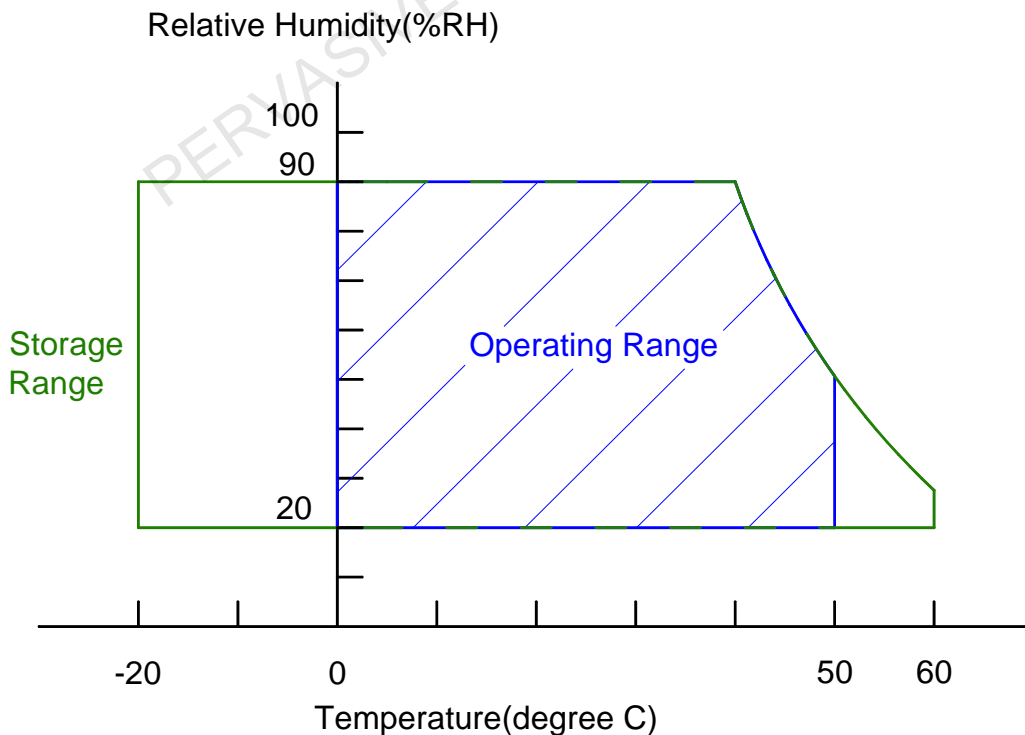
Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	T <sub>ST</sub>	-20	+60	°C	(1)
Operating Ambient Temperature	T <sub>OP</sub>	0	+50	°C	(1), (2)

Note (1):

- (a) 90 %RH Max. (Ta ≤ 40 °C).
- (b) Wet-bulb temperature should be 39 °C Max. (Ta > 40 °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 Item**

Item	Test Condition	Note
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)
Temperature Shock ( Storage )	-20 °C/30 min ~ 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	Rating	Unit
Logic supply voltage	$V_{DD}$	-0.3 to +7	V
Source positive supply voltage	$V_{POS}$	-0.3 to +20	V
Source negative supply voltage	$V_{NEG}$	+0.3 to -20	V
Max. drive voltage range	$V_{POS}-V_{NEG}$	40	V
Gate supply range	$V_{GG}-V_{EE}$	40	V
Operating temp. range		0 to +50	°C

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

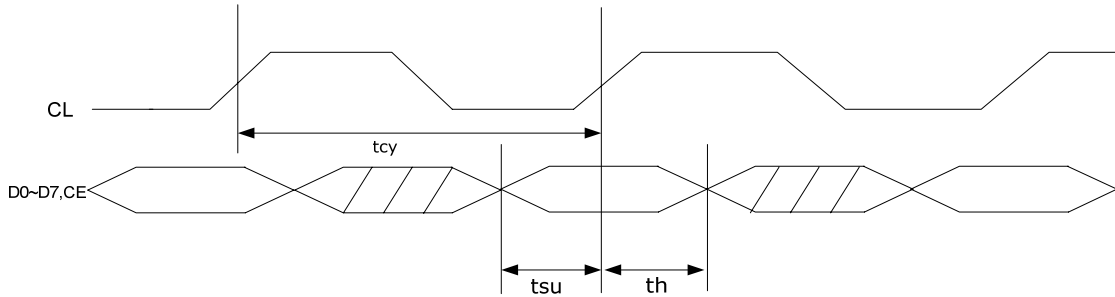
#### 3.2 Recommended Operation Conditions of Panel

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

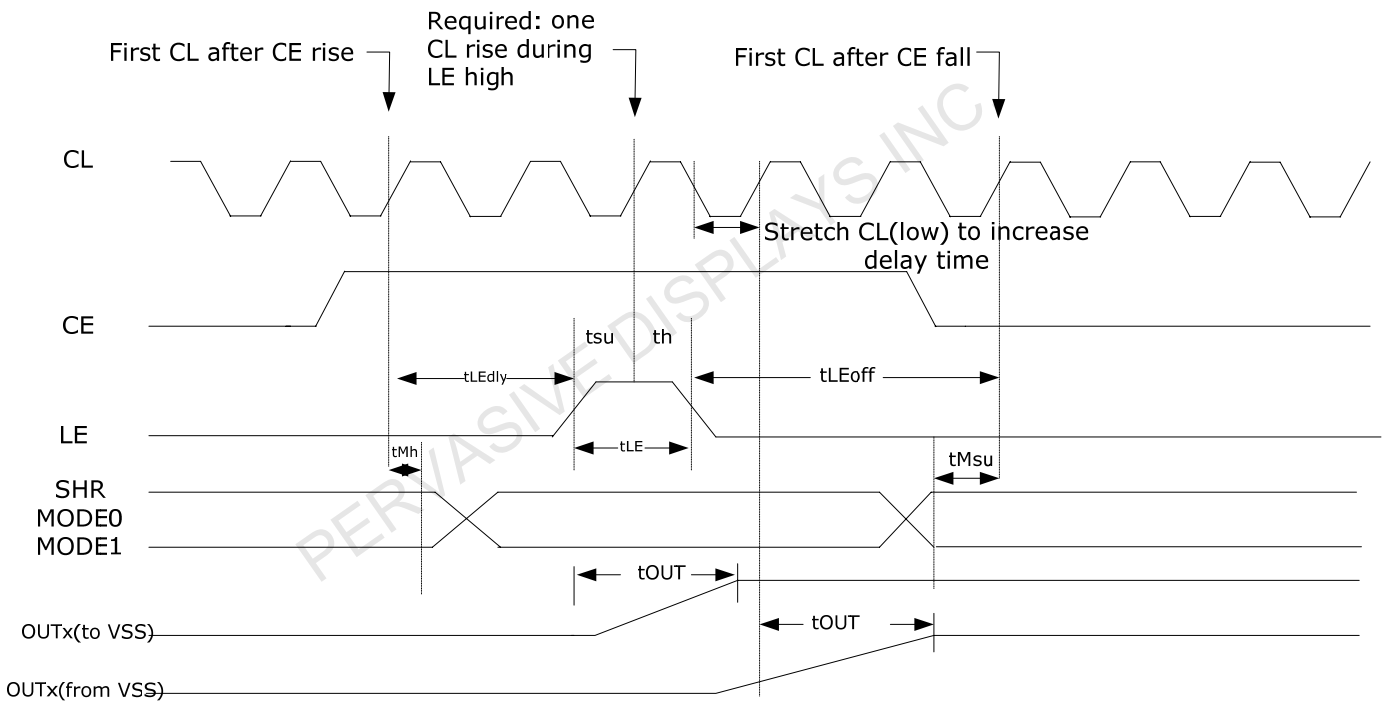
Parameter	Symbol	Value			Unit
		Min	Typ	Max	
Signal Ground	$V_{SS}$	-	0	-	V
Logic Power	$V_{DD}$	3.0	3.3	3.6	V
Source positive Voltage	$V_{POS}$	14	15	16	V
Source negative Voltage	$V_{NEG}$	-16	-15	-14	V
Gate positive Voltage	$V_{GG}$	$V_{POS}+5$	22	$V_{EE}+40$	V
Gate negative Voltage	$V_{EE}$	-21	-20	$V_{NEG}-5$	V
Common voltage	$V_{COM}$	-	-1.8	-	V

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

#### 3.3 Source driver Ac characteristics

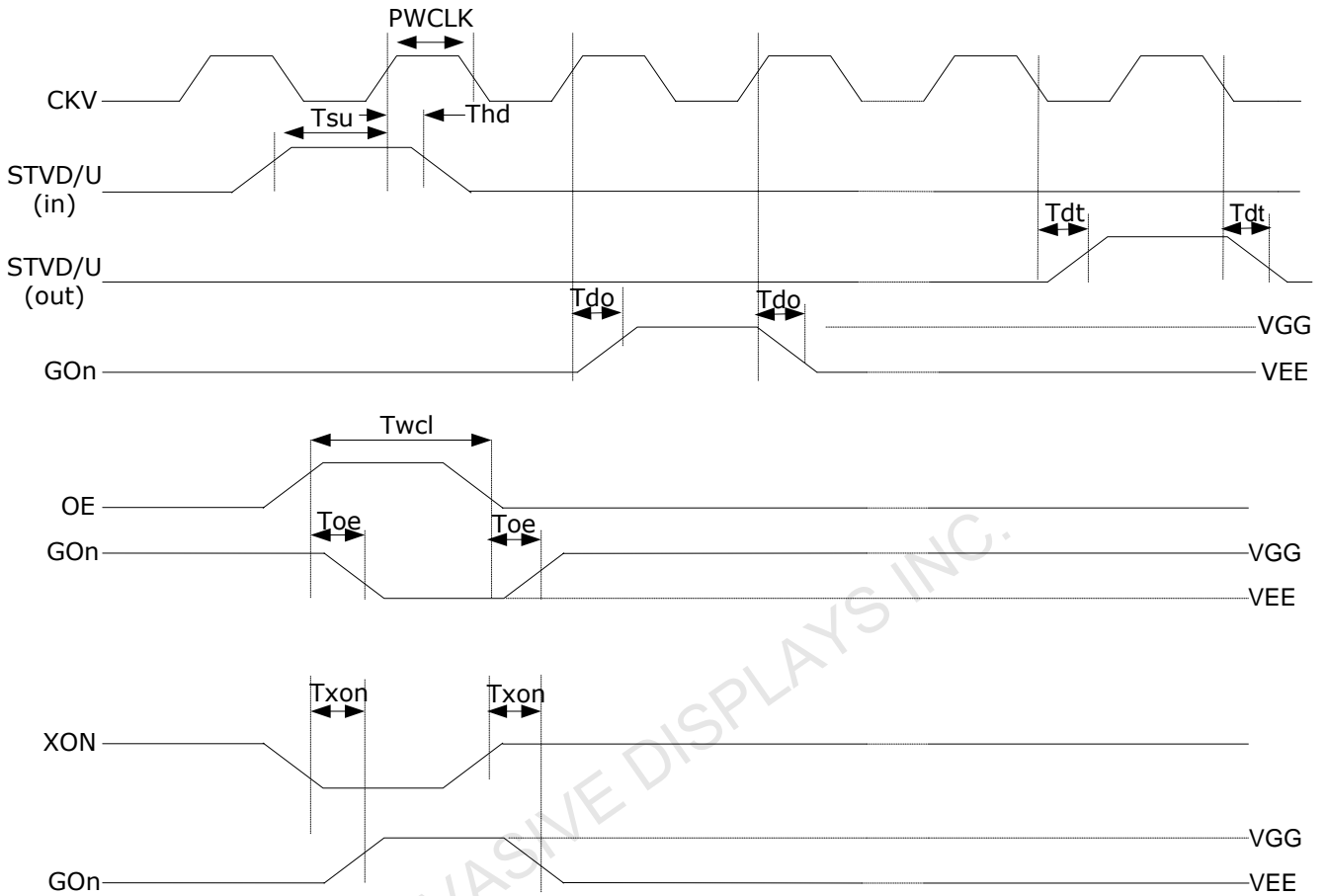


Parameter	Symbol	Min.	Typ.	Max.	Unit
Clock CL cycle time	$t_{cy}$	40	-	-	ns
D0...D7, CE setup time	$t_{su}$	8	-	-	ns
D0...D7, CE hold time	$t_h$	1	-	-	ns



Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
LE on delay time	$t_{LEdly}$		40	-	-	ns
LE high-level pulse width	$t_{LEw}$		40	-	-	ns
LE off delay time	$t_{LEoff}$		40	-	-	ns
SHR,MODE0,MODE1 setup time	$t_{Msu}$		100	-	-	ns
SHR,MODE0,MODE1 hold time	$t_{Mh}$		10	-	-	ns
Output settling time to +/-30mV	$t_{OUT}$	Clad=50pf	100	-	12	us

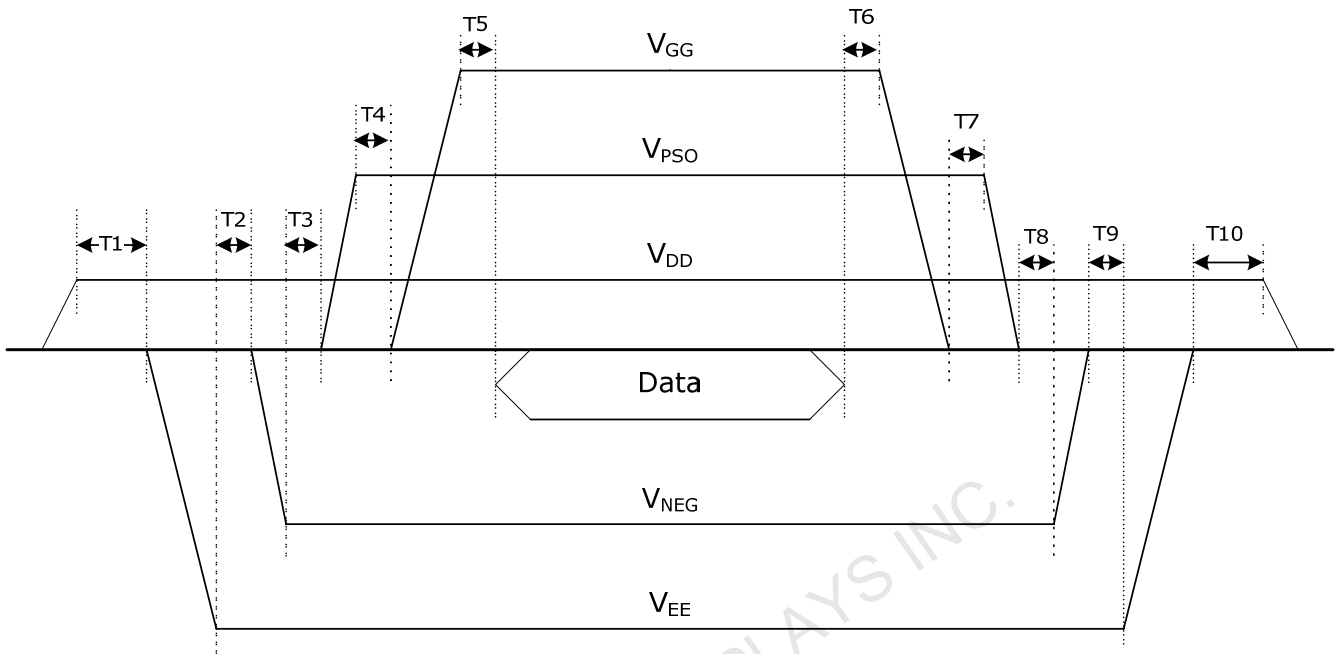
3.4 Gate driver AC characteristics



Parameter	Symbol	Condition.	Min.	Typ.	Max.	Unit
Clock pulse width(High to low period)	PWCLK		500			ns
STVD/STVU setup time	Tsu		200			ns
STVD/STVU hold time	Thd		300			ns
Driver output delay time	Tdo	CL=220pF			900	ns
STVD/STVU delay time	Tdt	CL=220pF			500	ns
Output enable pulse width	Twcl		1			us
OE to driver output delay time	Toe	CL=220pF			900	ns
XON to driver output delay time	Txon	CL=220pF			10	us



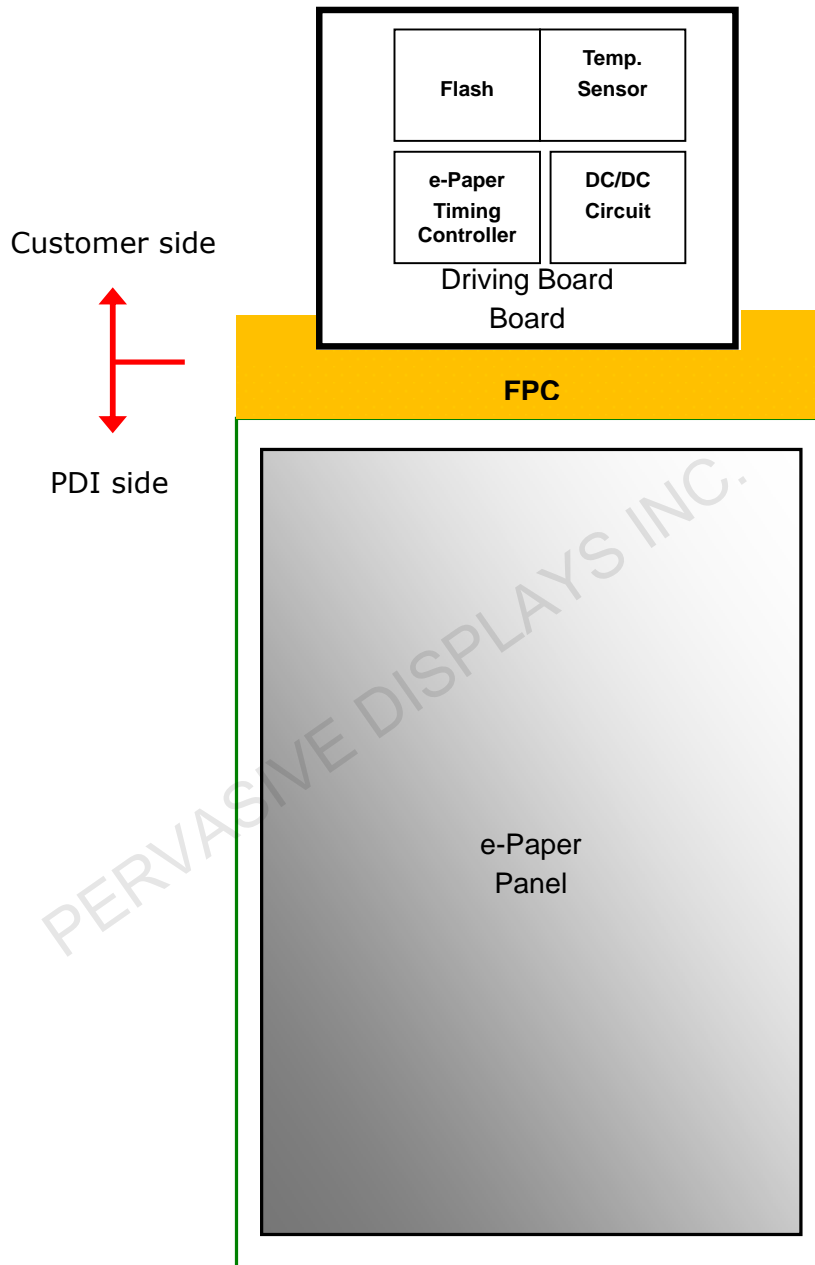
### 3.5 Power ON/OFF sequence



Symbol	Min.	Max.
T1	20 ms	-
T2	4 ms	-
T3	4 ms	-
T4	4 ms	-
T5	100 us	-
T6	100 us	-
T7	4ms	-
T8	4ms	-
T9	4ms	-
T10	20ms	-

## 4 Application Circuit Block Diagram

Figure 4-1 Application Circuit Block Diagram



## 5 Panel Pin Assignment

### 5.1 Terminal Pin Assignment

**Table 5-1 Terminal Pin Assignment**

No.	Signal	Type	Connected to	Function
1	V <sub>NEG</sub>	P	V <sub>NEG</sub>	Source driver negative power supply
2	V <sub>POS</sub>	P	V <sub>POS</sub>	Source driver positive power supply
3	V <sub>NEG</sub>	P	V <sub>NEG</sub>	Source driver negative power supply
4	V <sub>POS</sub>	P	V <sub>POS</sub>	Source driver positive power supply
5	V <sub>NEG</sub>	P	V <sub>NEG</sub>	Source driver negative power supply
6	V <sub>POS</sub>	P	V <sub>POS</sub>	Source driver positive power supply
7	GND	P	Ground	Grounding
8	NC	-	Floating	
9	GND	P	Ground	Grounding
10	GND	P	Ground	Grounding
11	D0	I	MCU	Bit0 of the data bus
12	D1	I	MCU	Bit1 of the data bus
13	D2	I	MCU	Bit2 of the data bus
14	D3	I	MCU	Bit3 of the data bus
15	D4	I	MCU	Bit4 of the data bus
16	D5	I	MCU	Bit5 of the data bus
17	D6	I	MCU	Bit6 of the data bus
18	D7	I	MCU	Bit7 of the data bus
19	GND	P	Ground	Grounding
20	GND	P	Ground	Grounding
21	CE1	I	MCU	Chip Enable 1

No.	Signal	Type	Connected to	Function
22	CE2	I	MCU	Chip Enable 2
23	CE3	I	MCU	Chip Enable 3
24	CE4	I	MCU	Chip Enable 4
25	OE	I	MCU	Output enable
26	OE123L	I	MCU	Output enable 1, 2 and 3 (connected)
27	CL	I	MCU	Pixel Clock
28	LE	I	MCU	Latch enable
29	U/D	I	MCU	Gate scan direction
30	V <sub>COM</sub>	P	V <sub>COM</sub>	Common voltage (backplane)
31	CKV	I	MCU	Line clock
32	STVD	I/O	MCU / -	Gate start pulse. When U/D=1, the pin is input.
33	SHR	I	MCU	Source scan direction
34	STVU	I/O	MCU/ -	Gate start pulse. When U/D=0, the pin is input.
35	VST	P	V <sub>COM</sub>	Common voltage (capacitor line)
36	V <sub>DD</sub>	P	V <sub>DD</sub>	Logic supply voltage
37	V <sub>EE</sub>	P	V <sub>EE</sub>	Gate driver negative power supply
38	V <sub>DD</sub>	P	V <sub>DD</sub>	Logic power supply
39	V <sub>GG</sub>	P	V <sub>GG</sub>	Gate driver positive power supply
40	NC	-	Floating	

Note (1): Type:

I: Input  
 O: Output  
 P: Power

## 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>	3.3	V

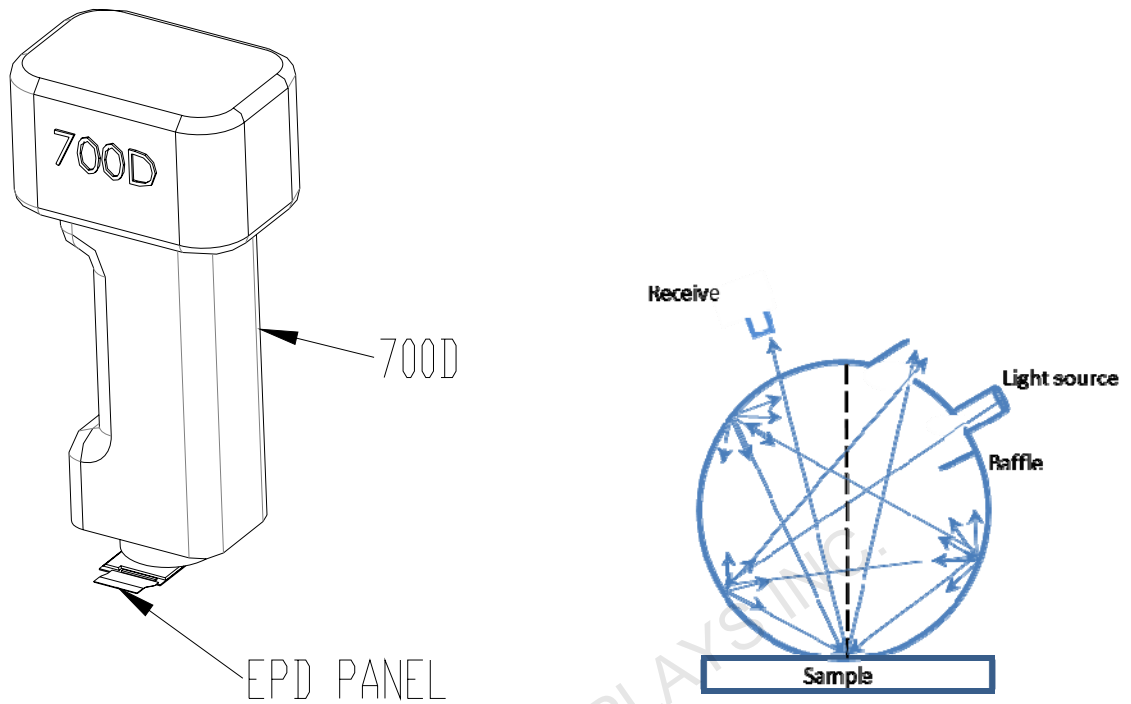
### 6.2 Optical Specifications

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

Item	Symbol	Rating			Unit	Note
		Min.	Typ.	Max.		
Contrast ratio	CR	-	10:1	-	-	$\theta_x=\theta_y=0$ (1),(2),(3),(4)
Refresh time	Tr	-	2.2	-	sec	(3)
White Chromaticity	Wx	-	0.31	-	-	$\theta_x=\theta_y=0$ (1),(4)
	Wy	-	0.33	-		
Reflectance	R%		38	-	%	(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.

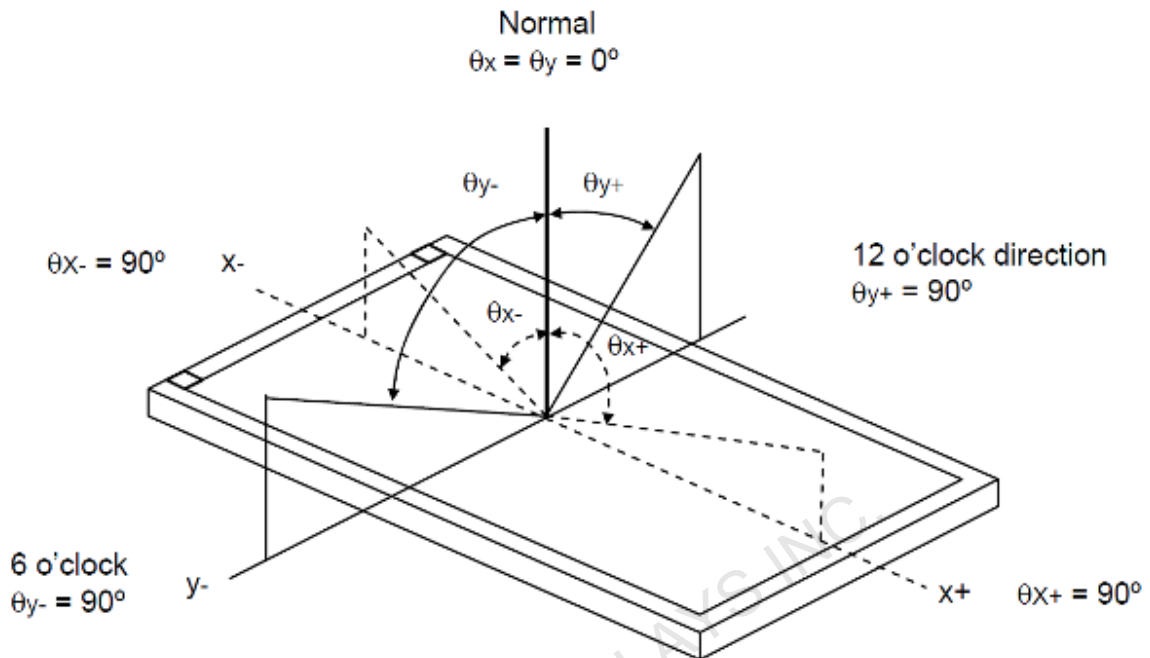
**Figure 6-1 Optical measurement**



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

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



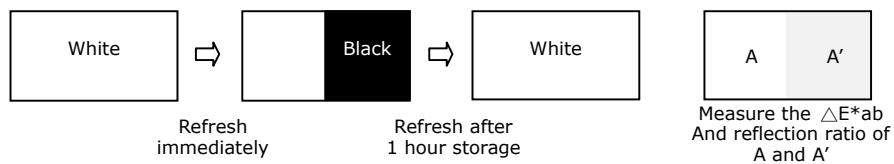
Note (3): Refresh time is the time that e-paper particles move not including the power on and off time. The refresh time is measured at 25°C. The refresh time and contrast ratio varies due to different films, display performance requirements, and ambient temperatures.

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.

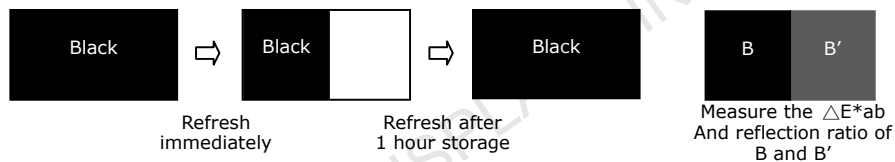
### 6.3 Ghosting

Below are three 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, 2, and 3 are performed at 25°C.

- Test 1: White to Black Ghosting

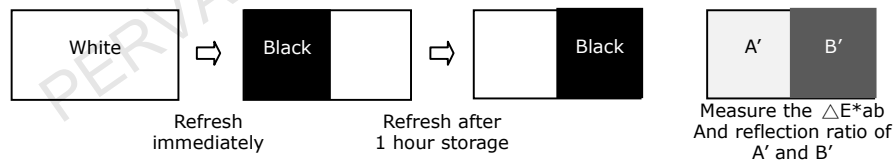


- Test 2: Black to White Ghosting



This formula is used to calculate:  $\Delta E^{*ab} = [ (\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2 ]^{1/2}$

- Test 3: PCS



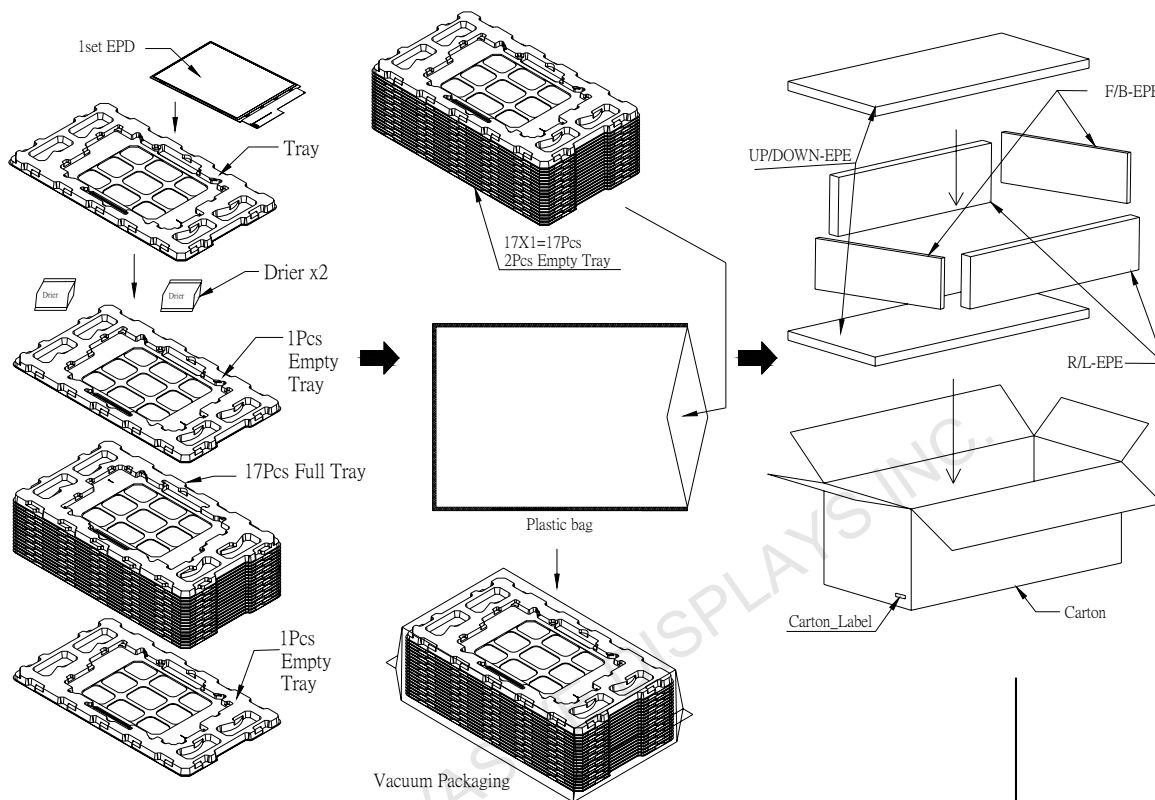
PCS = (White Reflection Ratio – Black Reflection Ratio) / White Reflection Ratio @ 630nm (wavelength of bar-code reader)

Item	Rating		
	Min.	Typ.	Max.
Test 1 $\Delta E^{*ab}$	-	-	2
Test 2 $\Delta E^{*ab}$	-	-	2
Test 3 PCS	0.75	-	

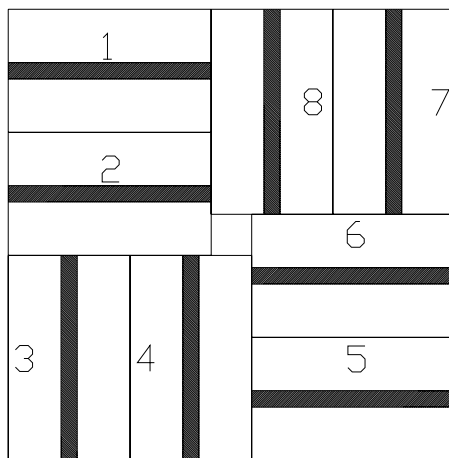


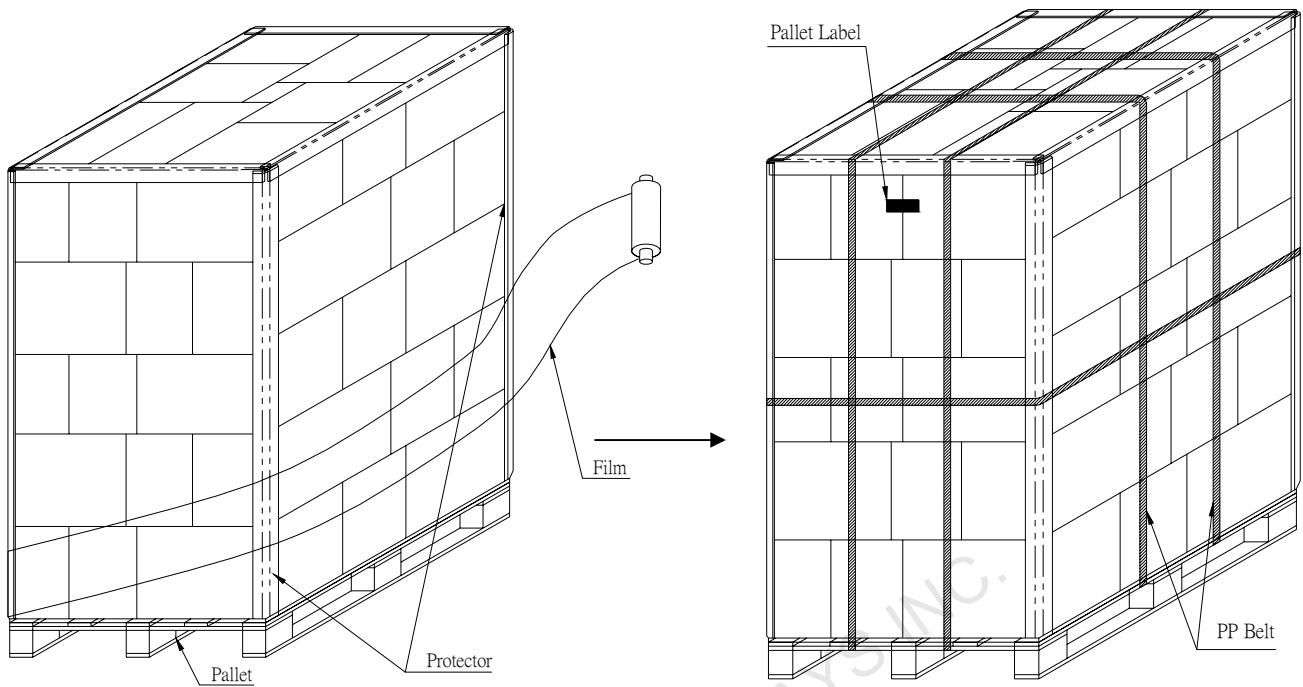
## 7 Packing

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

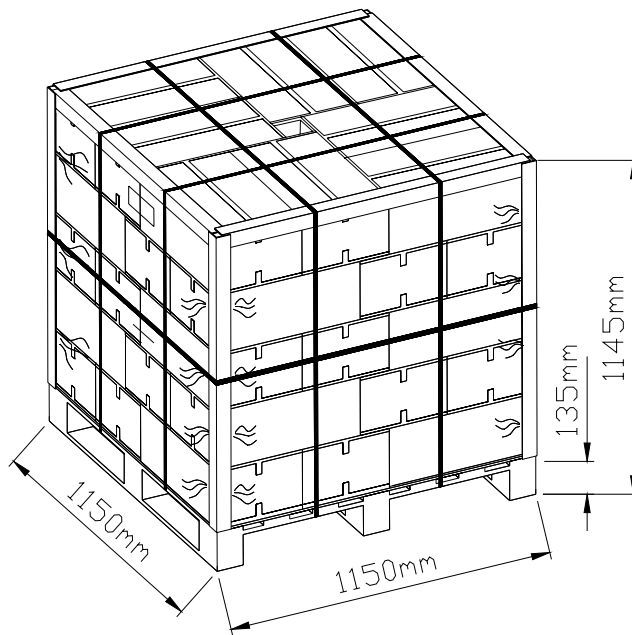




17(pcs)x40(BOX)=680pcs

	10.2" EPD BOX
N.W. :	1.56Kg
G.W. :	4.77Kg

Sea / Land / Air Transportation



## 8 Precautions

- (1) The EPD Panel / Module is manufactured from fragile materials such as glass and plastic, and may be broken or cracked if dropped. Please handle with care. Do not apply force such as bending or twisting to the EPD panel during assembly.
- (2) It is recommended to assemble or install EPD panels in a clean working area. Dust and oil may cause electrical shorts or degrade the protection sheet film.
- (3) Do not apply pressure to the EPD panel in order to prevent damaging it.
- (4) Do not connect or disconnect the interface connector while the EPD panel is in operation.
- (5) Please support the bezel with your finger while connecting the interface cable such as the FPC.
- (6) Do not stack the EPD panels / Modules.
- (7) Do not press the FPC on the glass edge or Pull FPC up / down to 90°.
- (8) Do not touch the FPC lead connector.
- (9) Wear a Wrist Strap (Grounding connect) when handling and during assembly. Semiconductor devices are included in the EPD Panel / Module and they should be handled with care to prevent any electrostatic discharge (ESD). (An Ion Fan may be needed in assembly operation to reduce ESD risk.)
- (10) Keep the EPD Panel / Module in the specified environment and original packing boxes when storage in order to avoid scratching.
- (11) Do not disassemble or reassemble the EPD panel.
- (12) Use a soft dry cloth without chemicals for cleaning. The surface of the protection sheet film is very soft and easily scratched.
- (13) Be mindful of moisture to avoid its penetration into the EPD panel, which may cause damage during operation.
- (14) High temperature, high humidity, sunlight or fluorescent light may degrade the EPD panel's performance. Please do not expose the unprotected EPD panel to high temperature, high humidity, sunlight, or fluorescent for long periods of time. It is highly recommended to store the EPD panel in a dark place without condensation, a temperature range of 15°C to 35°C, and humidity from 30%RH to 60%RH.
- (15) The ink used for marking the Panel ID number is erased easily by solvent. Please avoid using solvent to clean the EPD panel.
- (16) The EPD is vacuum packed.
- (17) Before approved by PDI and customer, products and product specifications may be subject to change without notice. Confirm that you have received the latest product standards or specifications before final design, purchase or use.
- (18) PDI makes every attempt to ensure that its products are of high quality and reliability. However, contact PDI sales office before using the product in an application that demands especially high quality and reliability or where its failure or malfunction may directly threaten human life or cause risk of bodily injury, such as aerospace, aeronautics, nuclear power, combustion control, transportation, traffic, safety equipment or medical equipment for life support.
- (19) Design your application so that the product is used within the ranges guaranteed by PDI particularly for maximum rating, operating supply voltage range, heat radiation characteristics, installation conditions and other characteristics. PDI bears no

responsibility for failure or damage when used beyond the guaranteed ranges. Even within the guaranteed ranges, consider normally foreseeable failure rates or failure modes in semiconductor devices and employ systemic measures such as fail safes, so that the equipment incorporating PDI product does not cause bodily injury, fire or other consequential damage due to operation of the PDI product.

(20) This product is not designed to be radiation resistant.

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## 9 Definition of Labels

Figure 9-1 Model Labels

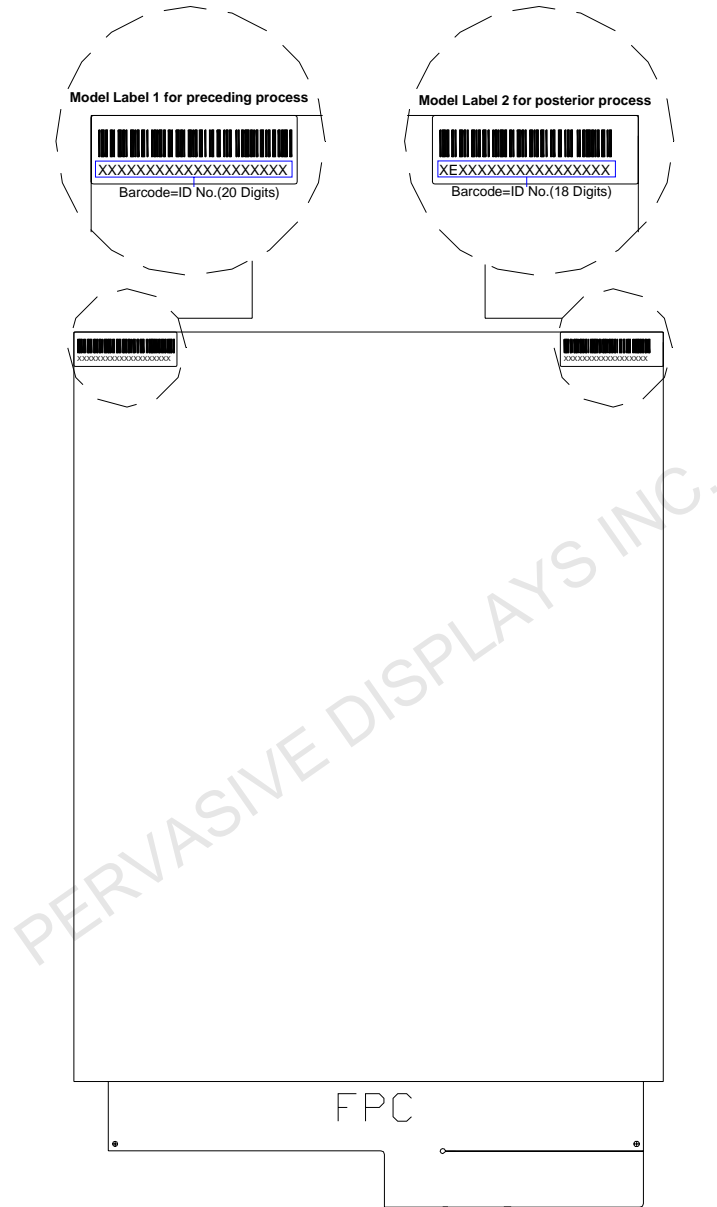
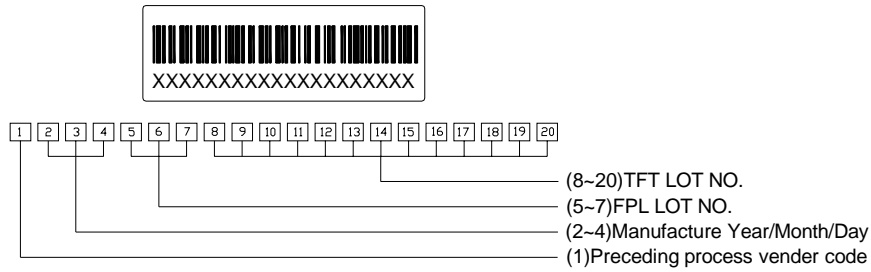
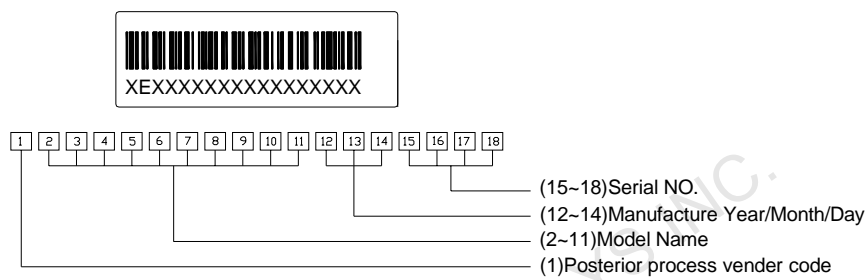


Figure 9-2 Definition of Model Labels

ID NO. definition of Model Label 1

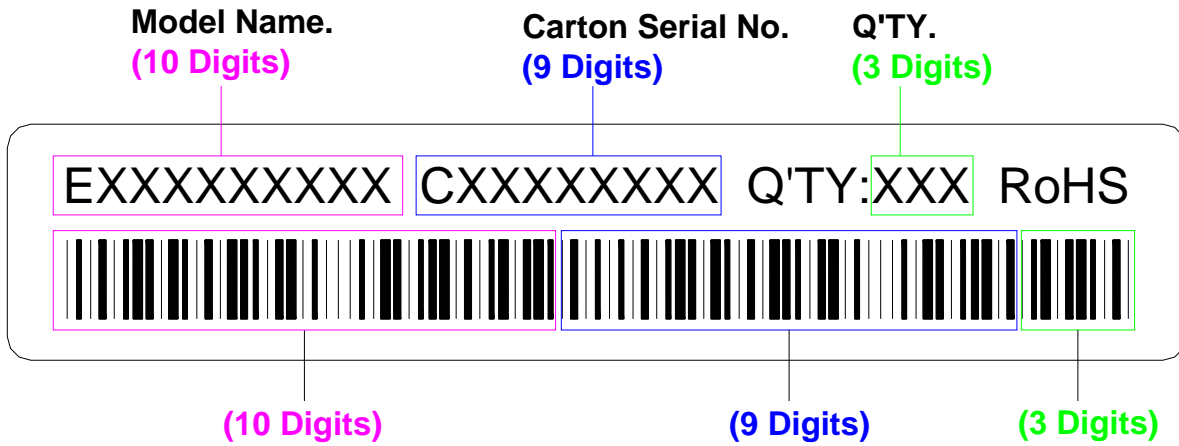


ID NO. definition of Model Label 2



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Figure 9-3 Carton Label



Bar Code=Model Name.+Carton Serial No.+Q'TY.(22 Digits)

# Carton Label

Figure 9-4 Pallet Label



Bar Code=Model Name.+Pallet Serial No.+Q'TY.(22 Digits)

# Pallet Label