

Product Specifications

Customer	Standard
Description	10.2" TFT EPD with TCon board
Model Name	EZ102AS181
Date	2013/06/27
Doc. No.	1P022-00
Revision	06

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

	Design Engineering		
	Approval	Check	Design
			

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	2011/05/27	All	All	Specification first issued.
Ver.02	2012/02/09	11	6.2	Modify SPI Timing
		13	7.2	Modify optical specification
		17	10	Modify :Definition of labels
Ver.03	2012/03/14	12	6.2	Modify SPI Timing
Ver.04	2012/06/20	All	All	Revise document format.
Ver.05	2012/08/09	20	6	Modify interface timing document NO.
Ver.06	2013/06/27	10	1	Modify TCon board Mechanical Specification Add FPCA Specification
		11	1	Modify EPD Drawing
		12	1	Modify TCon Board Drawing
		14	2.2	Add Note 3 at Reliability Test Items
		16	3.2	Modify input current & inrush current
		21	7.2	Modify refresh time
		24	7.3	About refreshing of Test1 & Test2 had modified "1h storage" to "Refresh immediately", and to delete the PCS test.
		25 26	8	Modify Packing
		29 30 31 32	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 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
- Include 10.2" Timing control board

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 TCon board Mechanical Specification

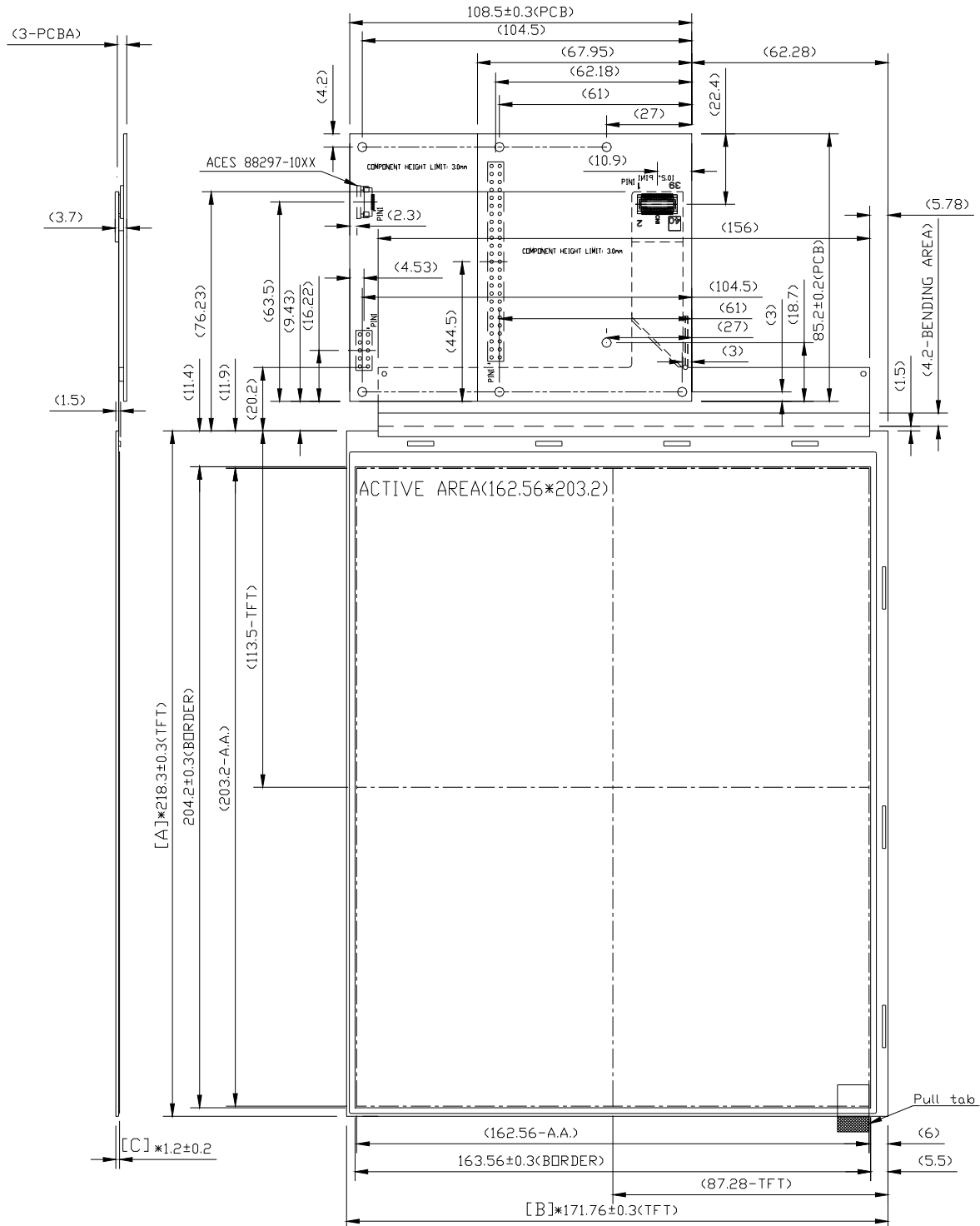
Item		Min.	Typ.	Max.	Unit	Note
PCBA Size	Horizontal(H)	85.0	85.2	85.4	mm	
	Vertical(V)	108.2	108.5	108.8	mm	
	Thickness(T)	0.9	1.0	1.1	mm	(1)
Weight			25.0	27.5	g	

Note (1): Not including components. Maximum components height is 3.0 mm.

Table 1-4 FPCA Specification

Item	Pin numbers	Pitch (mm)	Connector	Note
Board to Board	40	-	On FPCA: HRS DF23C-40DP-0.5V On PCBA: HRS DF23C-40DS-0.5V	

Figure 1-1 EPD Drawing



2 Absolute Maximum Ratings

2.1 Absolute Ratings of Environment

Table 2-1 Absolute Ratings of Environment

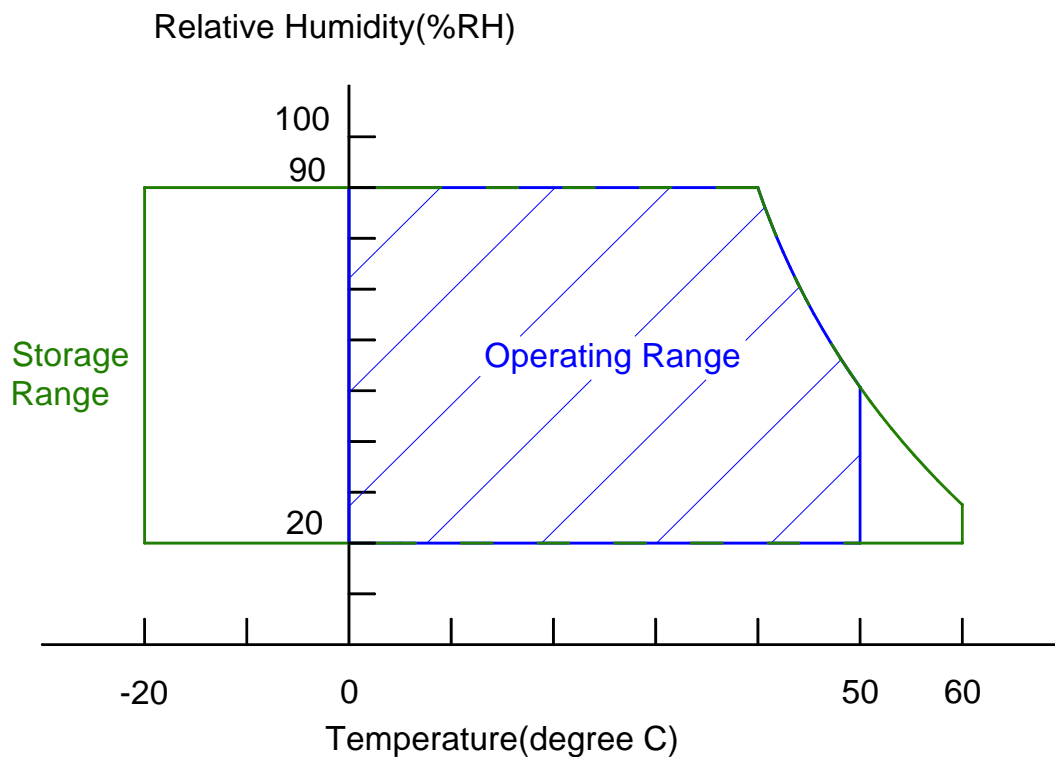
Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	T _{ST}	-20	+60	°C	(1)
Operating Ambient Temperature	T _{OP}	0	+50	°C	(1), (2)

Note (1):

- (a) 90 %RH Max. ($T_a \leq 40$ °C).
- (b) Wet-bulb temperature should be 39 °C Max. ($T_a > 40$ °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	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}	3.0	3.3	3.6	V	
Analog Power	V_{CC}	3.0	3.3	3.6	V	
Input Voltage	V_{IH}	$0.8 V_{DD}$	-	V_{DD}	V	/CS,SCLK, SI, ON
	V_{IL}	V_{SS}	-	$0.2 V_{DD}$	V	
Output Voltage	V_{OH}	$0.8V_{DD}$	-	V_{DD}	V	$I_{OH}=0.5\text{mA}$, SO, BUSY
	V_{OL}	V_{SS}	-	$0.2 V_{DD}$	V	$I_{OL}=-0.5\text{mA}$, SO, BUSY
Input Leakage Current	I_{IH}	-	-	1.0	μA	
	I_{IL}	-	-	-1.0	μA	

Input Current	$I_{DD} + I_{CC}$	-	85	-	mA	(1),(2) not include inrush current
Power on inrush current	I_{PEAK}	-	350	-	mA	(1),(2)

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

Note (1):

Figure 3-1 Test Pattern of Panel

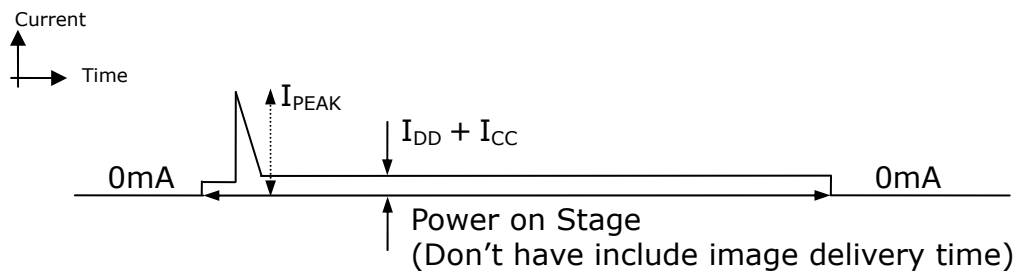


These currents are tested with PDI test jig.

Note (2):

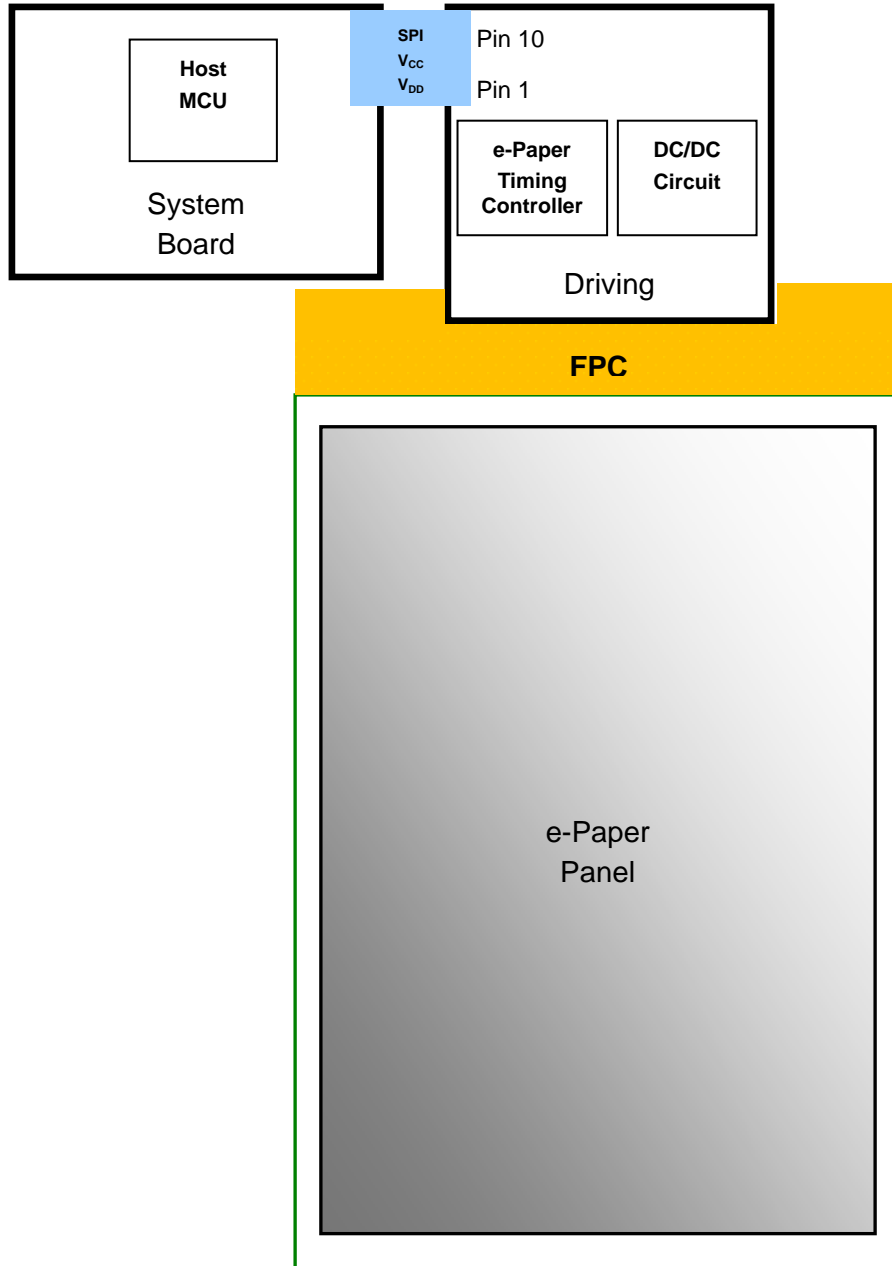
$V_{DD} = V_{CC} = 3.3V$

Figure 3-2 Power On Inrush Current Profile



4 Application Circuit Block Diagram

Figure 4-1 Application Circuit Block Diagram



5 TCon Board Terminal Pin Assignment

5.1 Terminal Pin Assignment

Table 5-1 Terminal Pin Assignment

No.	Signal	Type	Connected to	Function
1	BUSY	O	MCU	When BUSY = 1, EPD stays in busy state that EPD ignores any input data from SPI.
2	ON	I	MCU	ON must be "H" when host MCU uses EPD.
3	SO	O	MCU	Serial output from EPD to host MCU
4	SI	I	MCU	Serial input from host MCU to EPD
5	SCLK	I	MCU	Clock for SPI
6	/CS	I	MCU	Chip select. Low enable
7	V _{SS}	P	Ground	
8	V _{SS}	P	Ground	
9	V _{CC}	P	V _{CC}	Power for analog circuit
10	V _{DD}	P	V _{DD}	Power for digital circuit

Note (1): Connector type: ACES 88297 10 pins pitch 0.5mm or compatible

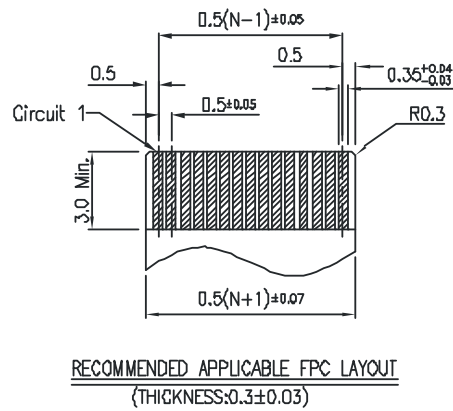
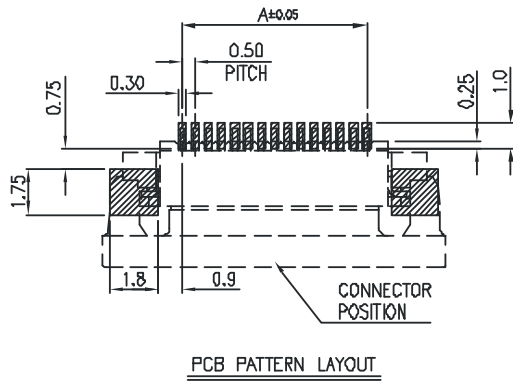
Note (2): Type:

I: Input

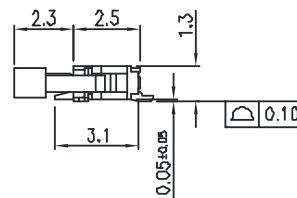
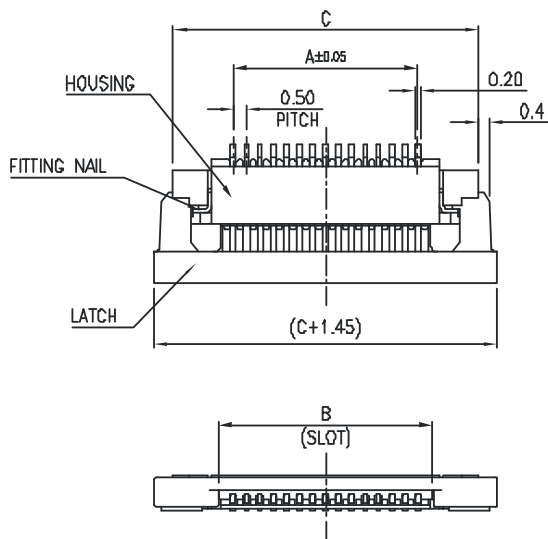
O: Output

P: Power

5.2 SPI Connector Drawing



CKT	Dim A	Dim B	Dim C
4	1.50	2.60	6.05
5	2.00	3.10	6.55
6	2.50	3.60	7.05
7	3.00	4.10	7.55
8	3.50	4.60	8.05
9	4.00	5.10	8.55
10	4.50	5.60	9.05
11	5.00	6.10	9.55
12	5.50	6.60	10.05
13	6.00	7.10	10.55
14	6.50	7.60	11.05
15	7.00	8.10	11.55
16	7.50	8.60	12.05
17	8.00	9.10	12.55
18	8.50	9.60	13.05
19	9.00	10.10	13.55
20	9.50	10.60	14.05
21	10.00	11.10	14.55
22	10.50	11.60	15.05
23	11.00	12.10	15.55
24	11.50	12.60	16.05
25	12.00	13.10	16.55
26	12.50	13.60	17.05
27	13.00	14.10	17.55
28	13.50	14.60	18.05
29	14.00	15.10	18.55
30	14.50	15.60	19.05



6 TCon Board SPI Interface Timing

6.1 SPI Timing Sequence

Please reference the document: "4P009-00_E-paper Display Interface Timing".

6.2 Display Pattern Transmission Sequence

Please reference the document: "4P009-00_E-paper Display Interface Timing".

6.3 Bitmap Data Format

Please reference the document: "4P009-00_E-paper Display Interface Timing".

7 Optical Characteristics

7.1 Test Conditions

Table 7-1 Optical Test Conditions

Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	°C
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	V _{CC} & V _{DD}	3.3	V

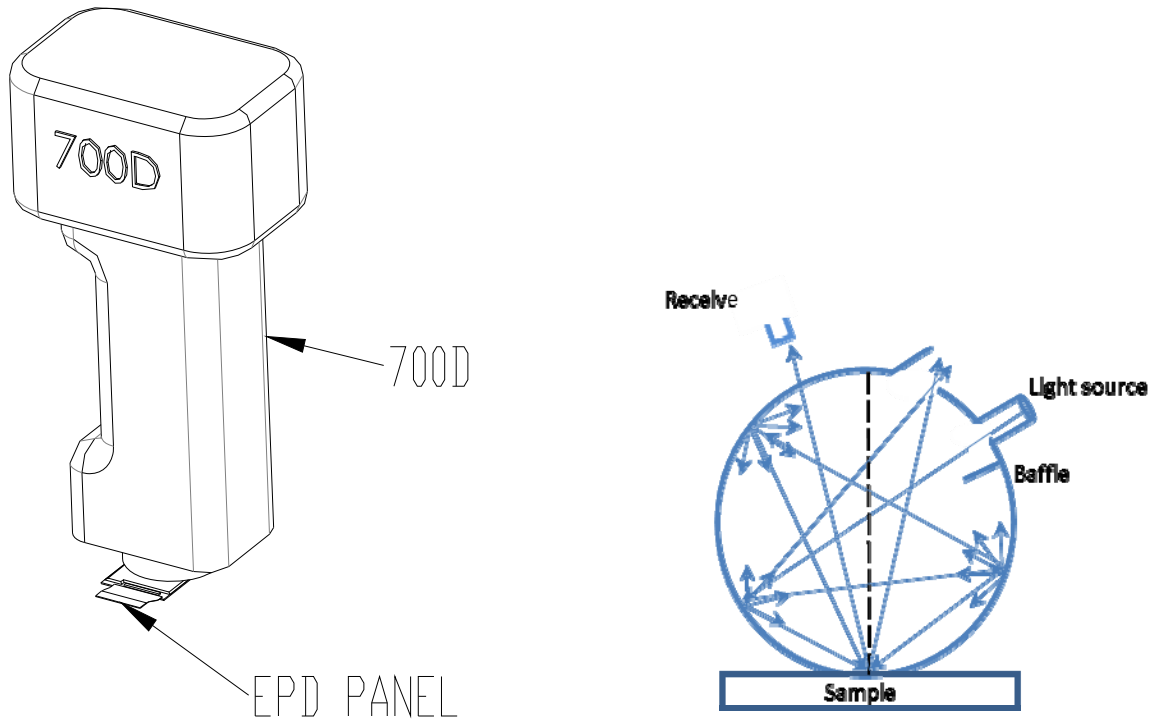
7.2 Optical Specifications

Table 7-2 Optical Measurement with D65 light source

Item	Symbol	Rating			Unit	Note
		Min.	Typ.	Max.		
Contrast ratio	CR	5:1	10:1	-	-	$\theta_x = \theta_y = 0$ (1),(2),(3),(4)
Refresh time	Tr	-	3.7	-	sec	(3)
White Chromaticity	Wx	-	0.31	-	-	$\theta_x = \theta_y = 0$ (1),(4)
	Wy	-	0.33	-		
Reflectance	R%		38	-	%	(1),(4)

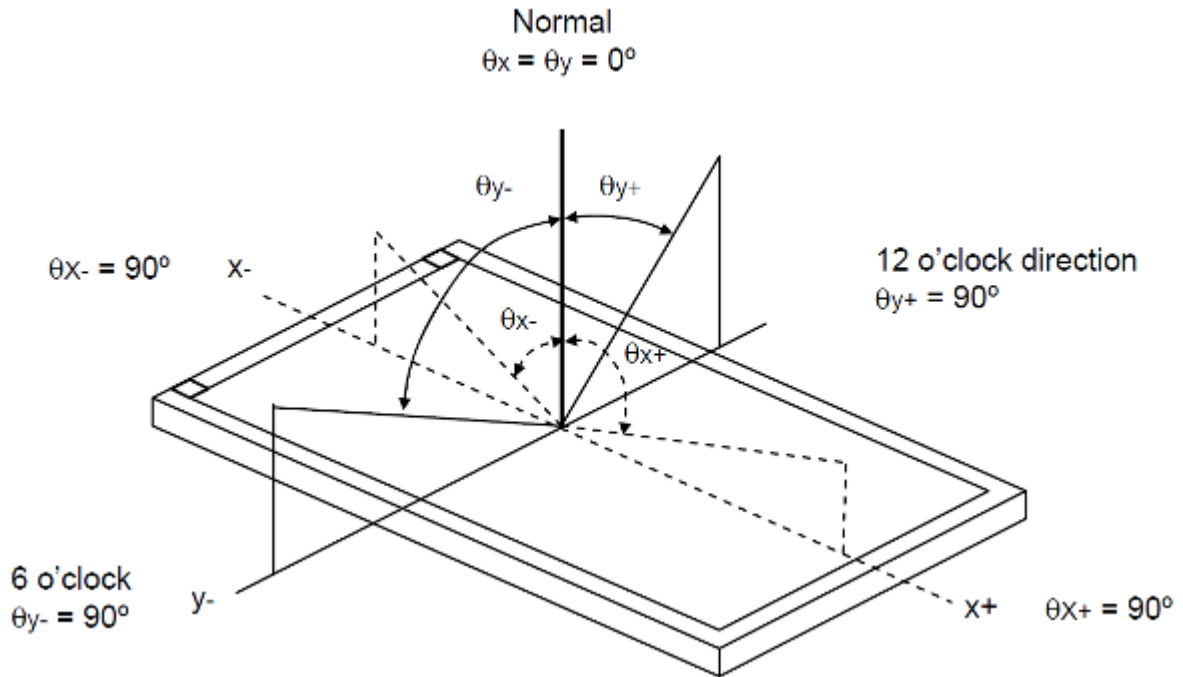
Note (1): Panel is driven by PDI waveform without masking film and optical measurement by CM-700D with D65 light source and SCE mode.

Figure 7-1 Optical measurement



Note (2): Definition of Viewing Angle (θ_x , θ_y):

Figure 7-2 Definition of Viewing Angle to Measure Contrast Ratio



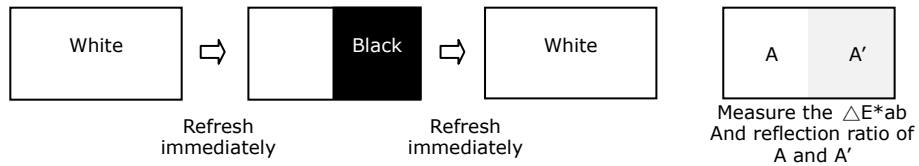
Note (3): Refresh time is the time that e-paper particles move not including the power on and off time. The refresh time is measured at 25°C. The refresh time and contrast ratio varies due to different films, display performance requirements, and ambient temperatures.

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.

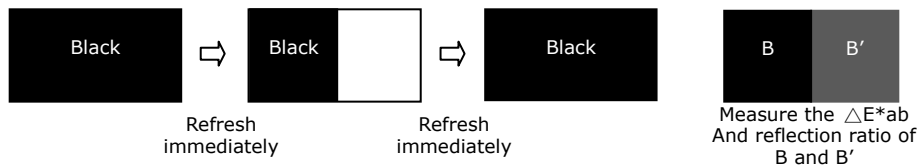
7.3 Ghosting

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 2 are performed at 25°C.

- Test 1: White to Black Ghosting



- Test 2: Black to White Ghosting

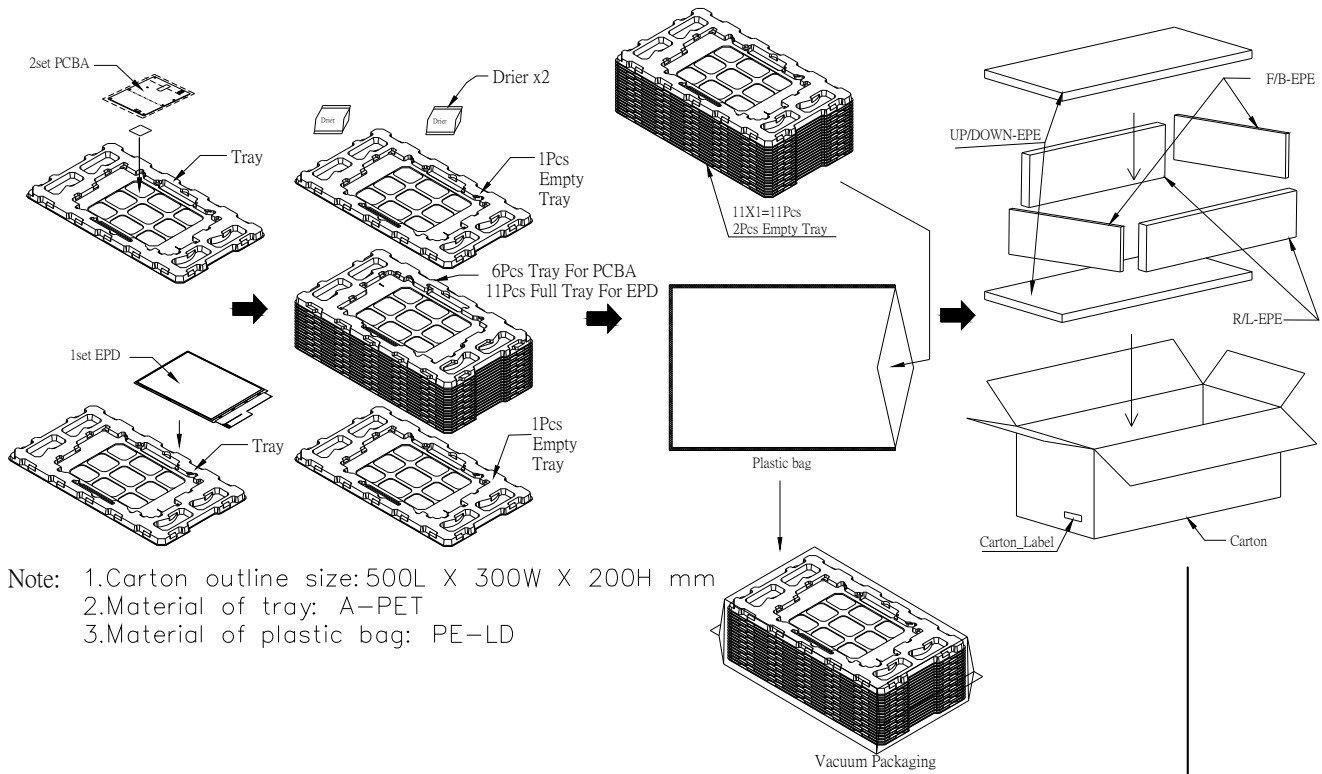


This formula is used to calculate: $\Delta E^{*ab} = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2}$

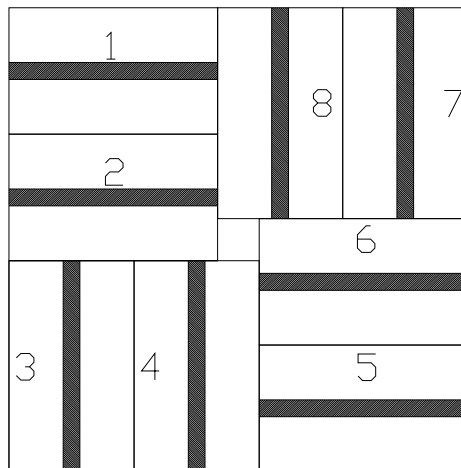
Item	Rating		
	Min.	Typ.	Max.
Test 1 ΔE^{*ab}	-	-	2
Test 2 ΔE^{*ab}	-	-	2

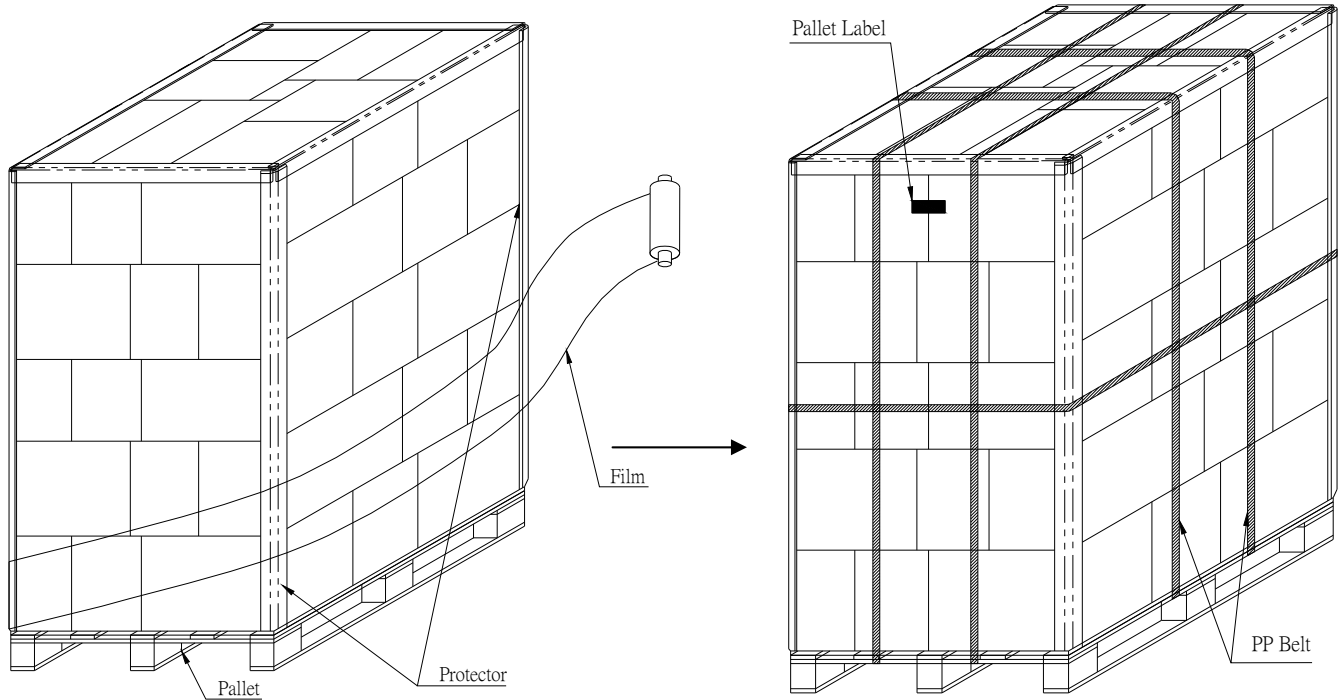
8 Packing

Figure 8-1 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

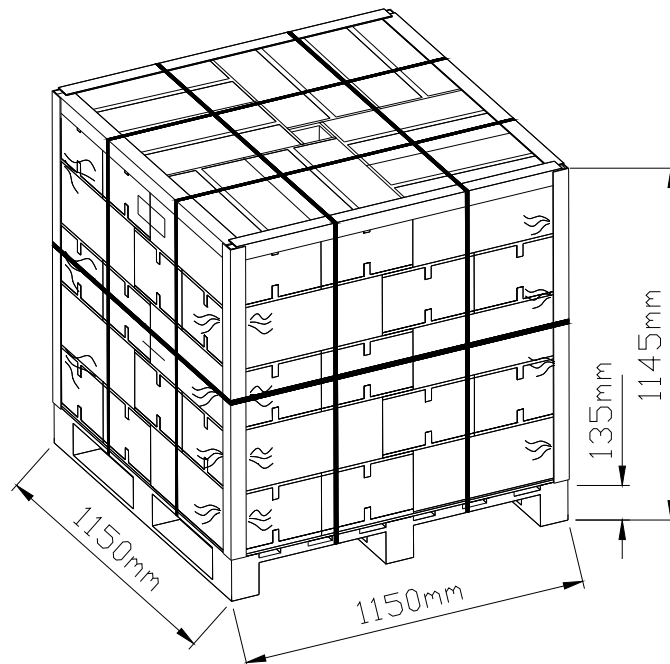




11(pcs)x40(BOX)=440pcs

	10.2" EPD BOX
N.W. :	1.28 Kg
G.W. :	4.55 Kg

Sea / Land / Air Transportation



9 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.

10 Definition of Labels

Figure 10-1 Model Labels

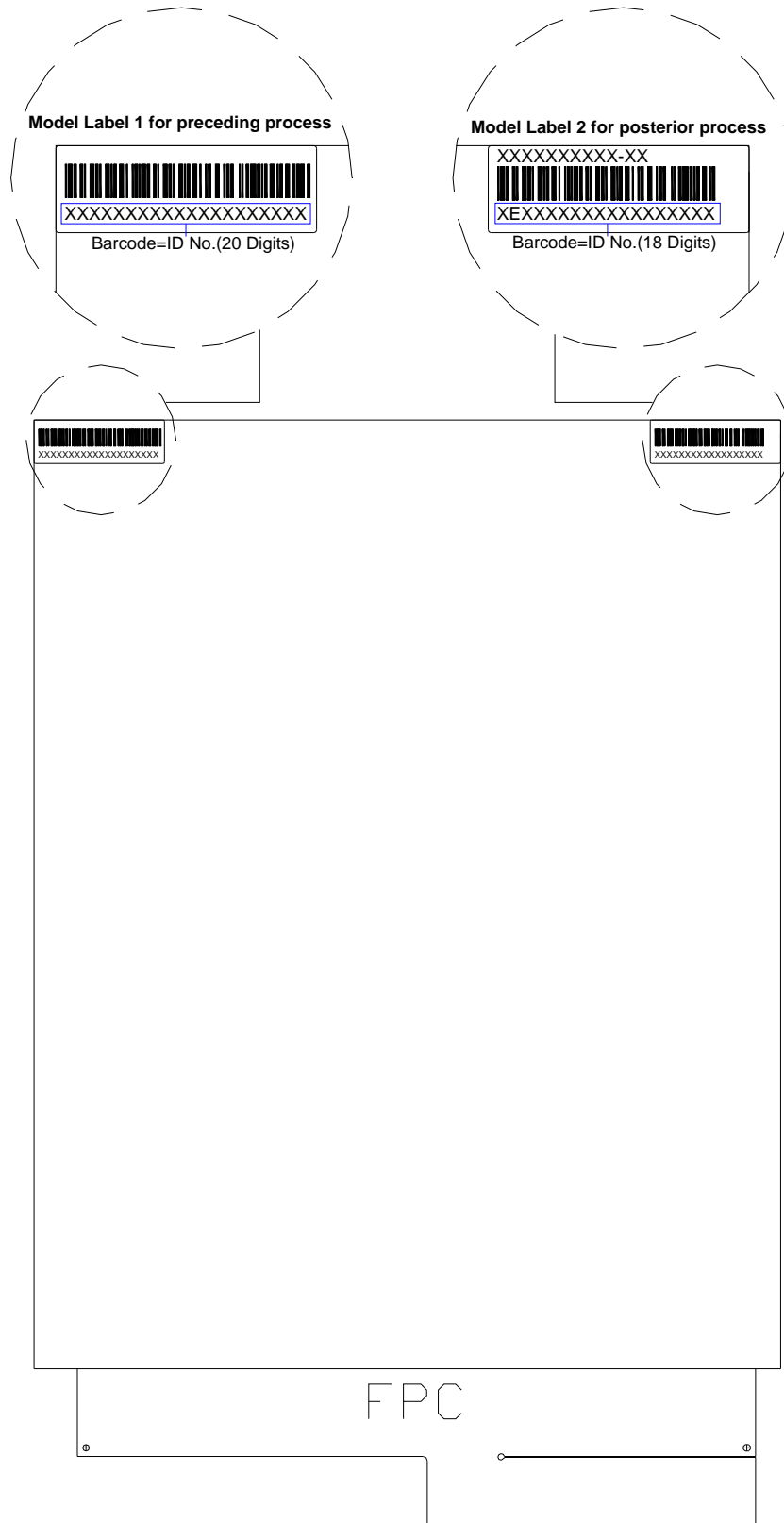
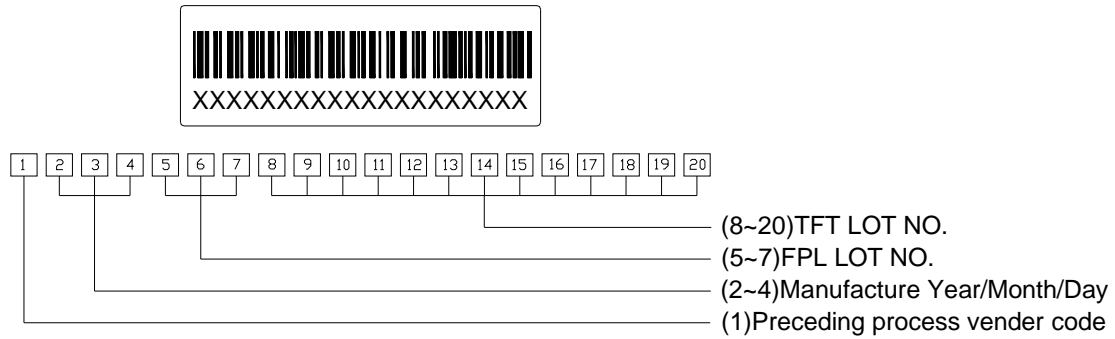


Figure 10-2 Definition of Model Labels

ID NO. definition of Model Label 1



ID NO. definition of Model Label 2

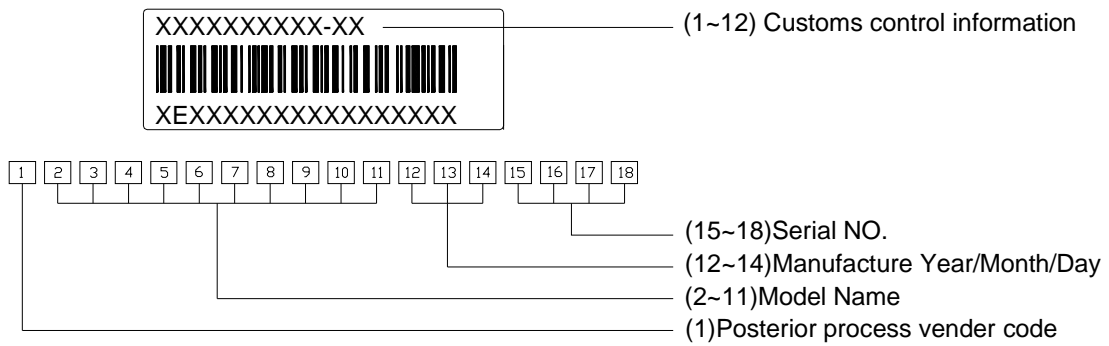


Figure 10-3 PCBA Label

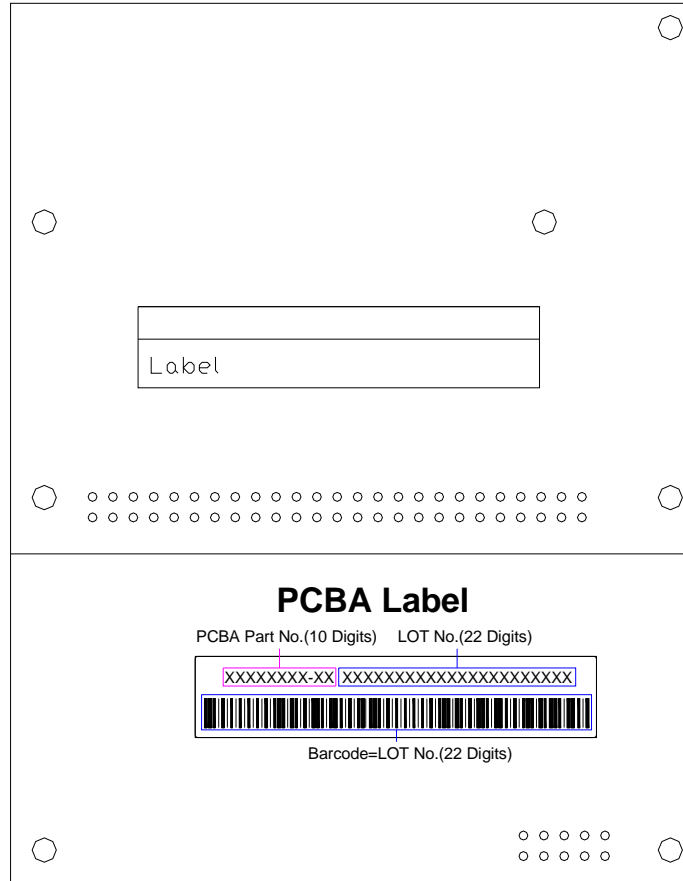


Figure 10-4 Definition of PCBA Label

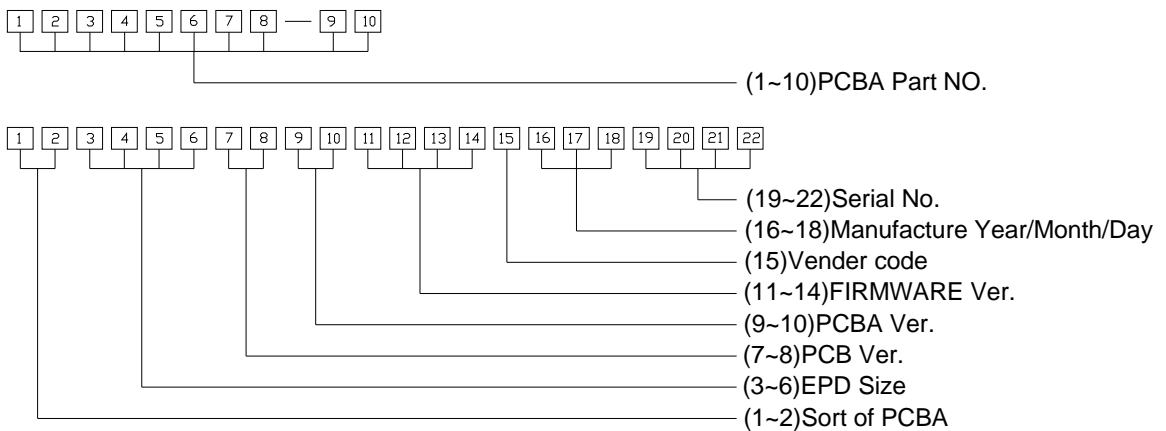
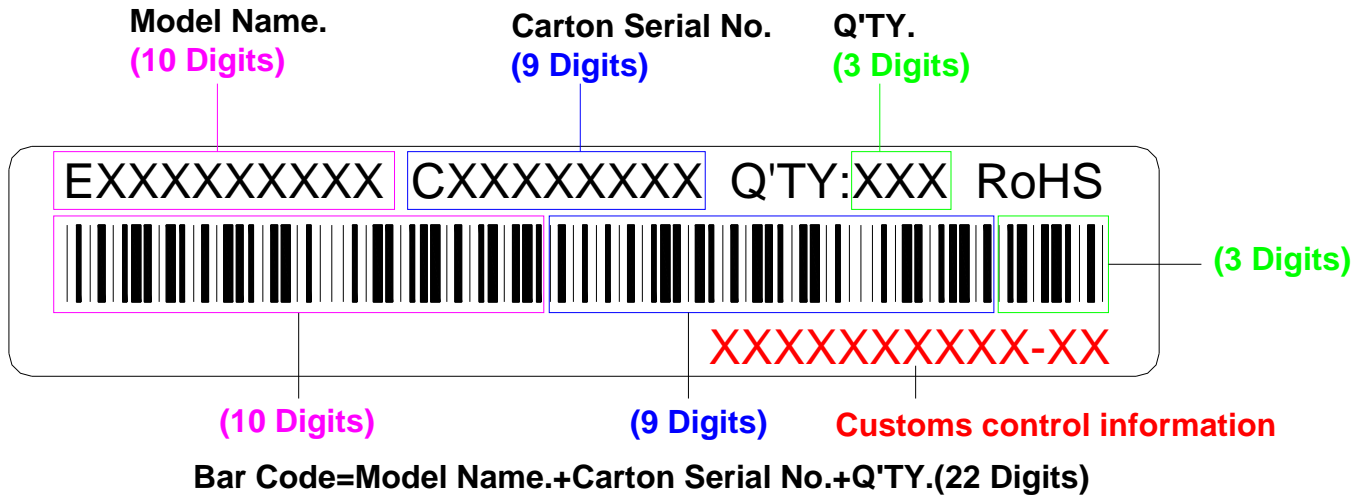


Figure 10-5 Carton Label



Carton Label

Figure 10-6 Pallet Label



Pallet Label