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Product Specifications

Customer	Standard
Description	2.71" TFT EPD Panel
Model Name	E2271CS091
Date	2018/ 05/ 11
Doc. No.	1P186-00
Revision	01

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

	Design Engineering		
	Approval	Check	Design
			

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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
FPC	Flexible Printed Circuit
FPL	Front Plane Laminate
SPI	Serial Peripheral Interface
COG	Chip on Glass
IIS	Incoming Inspection Standard
ISTA	International Safe Transit Association
PDI	Pervasive Displays Incorporated

1 General Description

1.1 Overview

This is a 2.71" a-Si, active matrix TFT, Electronic Paper Display (EPD) panel. The panel has high resolution (117dpi) 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: 264 x 176
- 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	70.42(H) x 45.80(V) x 1.0(T)	mm	(1)
Active Area	57.288(H) x 38.192(V)	mm	
Driver Element	a-Si TFT active matrix	-	
FPL	Aurora Mb	-	
Pixel Number	264 x 176	pixel	
Pixel Pitch	0.217 x 0.217 (117dpi)	mm	
Pixel Arrangement	Vertical stripe	-	
Display Colors	Black/White	-	
Surface Treatment	Anti-Glare	-	
Driving IC	UC8451	-	

Note (1): Not including FPC and Masking Film.

1.5 Mechanical Specifications

Table 1-2 Mechanical Specification

Item		Min.	Typ.	Max.	Unit	Note
Glass Size	Horizontal(H)	70.22	70.42	70.62	mm	
	Vertical(V)	45.6	45.8	46.0	mm	
	Thickness(T)	0.9	1.0	1.1	mm	(1)
Weight		-	6.0	7.2	g	

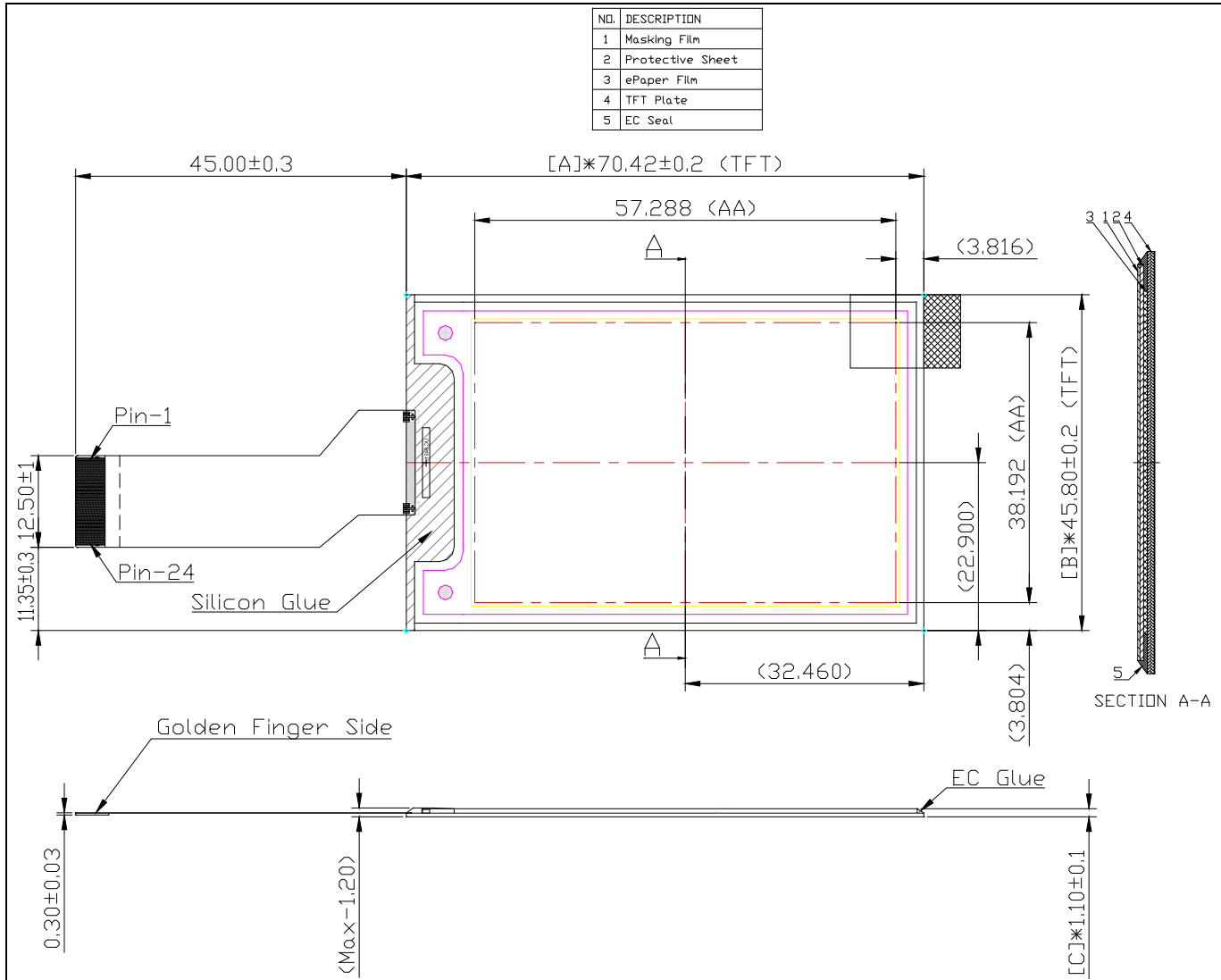
Note (1): Not including the Masking Film.

Table 1-3 Input Connector Specification

Item	Pin numbers	Pitch (mm)	Connector	Note
Golden Finger	24	0.5	HRS FH34SRJ 24S or STARCONN 6700S24 or Compatible	(1)

Note (1): HRS FH34SRJ 24S is 24-pins connectors. The 24 pins are used to connect FPC pads of EPD. Please refer PDI demo kit for detailed connection.

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 _{ST}	-20	+ 60	°C	(1),(3)
Storage Humidity	H _{ST}	30	90	% RH	(1),(3)
Operating Ambient Temperature	T _{OP}	0	+ 50	°C	(1),(2),(4)
Operating Ambient Humidity	H _{OP}	30	90	% RH	(1),(2),(4)
Optimal Storage Temperature	T _{OST}	-10	35	°C	(1),(3)
Optimal Storage Humidity	H _{OST}	40	60	% RH	(1),(3)

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 and no frost in absolute ratings of Environment.

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

Note (3): E Ink Material is Moisture and UV sensitive. The absolute rating operating environments describes the boundary conditions for updating the display while the absolute rating storage environment describe the boundary conditions for a display not updating. While displays are rated to perform according to specification for the warranty period at the absolute specified operating environment, the better the storage condition, the better the E Ink displays will perform. Similar to other moisture and UV sensitive components, we recommend that our displays be stored in temperature and humidity control environments, and whenever possible, under above defined Optimal Storage Condition, away from sunlight, to optimize their performance.

Note (4): The performance of EPD may be degraded under sunlight. Please customer consults PDI if customer wants to use EPD under sunlight.

2.2 Reliability Test Item

Table 2-2 Reliability Test Items

Item	Test Condition	Note
High Temperature Operation	50 °C/30%RH for 240h	(1) (2)
Low Temperature Operation	0 °C for 240h	(1) (2)
High Temperature/Humidity Operation	40 °C / 90 %RH for 240h	(1) (2)
High Temperature Storage	60 °C / 30%RH for 240h	(1) (2)(3)
Low Temperature Storage	-20 °C for 240h	(1) (2) (3)
High Temperature/Humidity Storage	60 °C / 80 %RH for 240h	(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): No condensation and no frost during test. End of test, function, mechanical, and optical shall be satisfied with product specification and IIS.

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

Note (3): Stay white pattern for storage and non-operation test.

2.3 Product Lifetime

The EPD Module is designed for a 5-year life-time with 25 °C/50%RH operation assumption. Reliability estimation testing with accelerated life-time theory would be demonstrated to provide confidence of EPD lifetime.

2.4 Product Warranty

Warranty conditions have to be negotiated between PDI and individual customers. PDI provides 13months warranty for all products which are purchased from PDI.

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		
Logic supply voltage	V_{DD}, V_{DDIO}	-0.3	4.0	V	
Ground	GND	-		-	Connect to Ground

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

3.2 Recommended Operation Conditions of Panel

Table 3-2 DC Characteristics of Panel

Parameter	Symbol	Value			Unit	Note	
		Min	Typ	Max			
Operation Voltage	V_{DD}, V_{DDIO}	2.3	3.0	3.6	V	V_{DDIO}, V_{DD} must be stable. (1)	
Input Voltage	High	V_{IH}	$0.8V_{DDIO}$	-	-	V	(1),(2),(3)
	Low	V_{IL}	-	-	$0.2V_{DDIO}$	V	
Output Voltage	High	V_{OH}	$V_{DDIO}-0.4$	-	-	V	$V_{DDIO}=V_{DD}$ $I_{OH}=400\mu\text{A}$ (1),(2),(3)
	Low	V_{OL}	-	-	$0.2V_{DDIO}$	V	$V_{DDIO}=V_{DD}$ $I_{OL}=-400\mu\text{A}$, (1),(2),(3)
Input Current	$I_{DD}+I_{CC}$	-	7.90	-	-	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



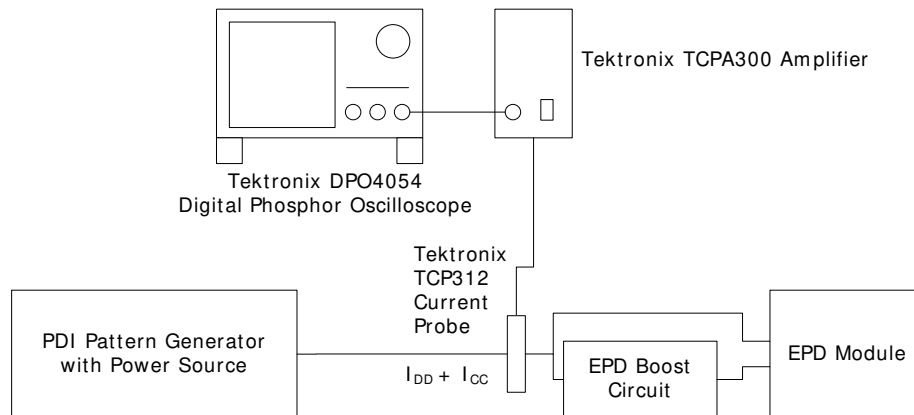
* T_r : Refresh time of the image update.

Note (3): I_{DD} : The current of $V_{DD} + V_{DDIO}$.

I_{CC} : The current of V_{CC} (EPD Boost Circuit).

Note (4): The width of the Peak current was around 3us.

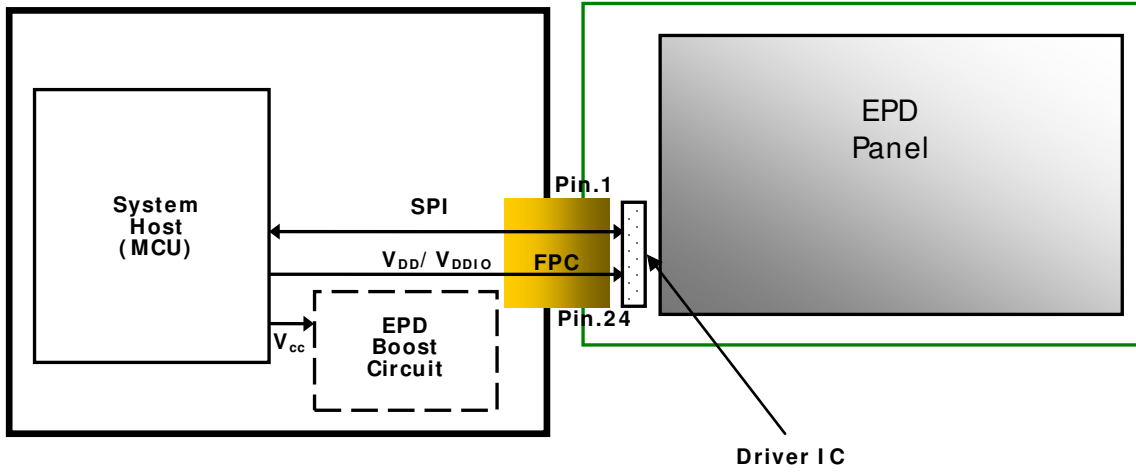
Figure 3-3 Current Measurement



* Set oscilloscope filter to 250MHz and record length to 1M points.

4 Application Circuit Block Diagram

4.1 Application Circuit Block Diagram



5 Terminal Pin Assignment

5.1 Input Terminal Pin Assignment

Table 5-1 Terminal Pin Assignment

No.	Signal	Type	Connected to	Function
1	NC	-	-	Not connected
2	GDR	O	Power MOSFET Driver control	This pin is the N-Channel MOSFET Gate Drive Control.
3	RESE	I	Booster Control Input	This pin is the Current Sense Input for the Control Loop.
4	NC	-	-	Not connected
5	NC	-	-	Not connected
6	NC	-	-	Not connected
7	NC	-	-	Not connected
8	BS	I	Ground	This pin is setting panel interface.
9	BUSY_N	O	Device Busy Signal	This pin is Busy state output pin. When Busy is High, the operation of the chip should not be interrupted, and Command should not be sent.
10	RST_N	I	System Reset	This pin is reset signal input. Active Low.
11	DC	I	VDDIO or VSS	This pin is Data/Command control.
12	CSB	I	VDDIO or VSS	This pin is the chip select.
13	SCL	I	Data Bus	Serial communication clock input.
14	SDA	I	Data Bus	Serial communication data input/output.
15	VDDIO	P	Power Supply	Power for interface logic pins & I/O. It should be connected with VDDIO.
16	VDD	P	Power Supply	Power Supply for the chip.
17	GND	P	Ground	Ground

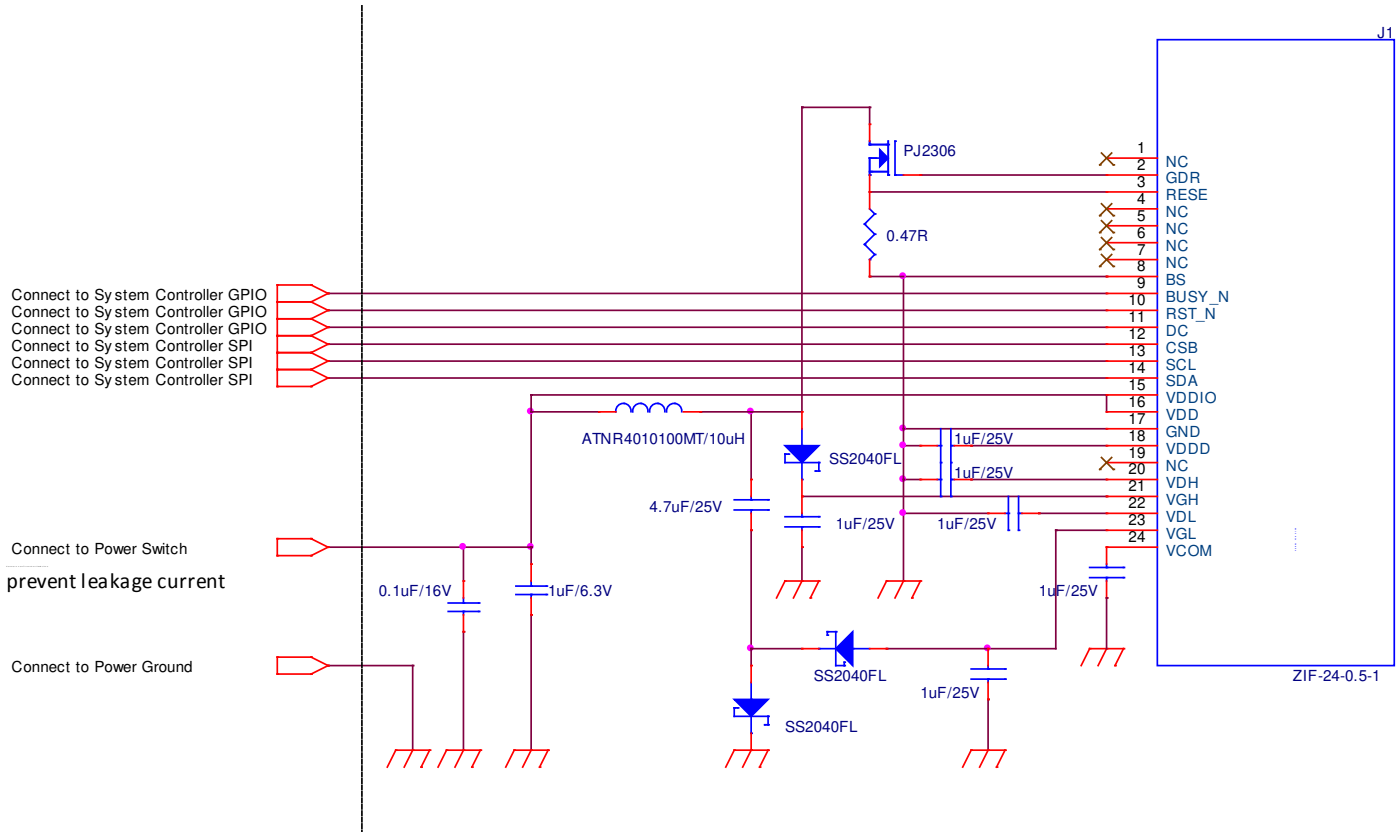
No.	Signal	Type	Connected to	Function
18	VDDD	C	Capacitor	Internal regulator output A capacitor should be connected between VDDD and VSS.
19	NC	-	-	-
20	VDH	C	Capacitor	This pin is the Positive Source driving voltage. A stabilizing capacitor should be connected between VDH and GND.
21	VGH	C	Capacitor	This pin is the Positive Gate driving voltage. A stabilizing capacitor should be connected between VGH and GND.
22	VDL	C	Capacitor	This pin is the Negative Source driving voltage. A stabilizing capacitor should be connected between VDL and GND.
23	VGL	C	Capacitor	This pin is the Negative Gate driving voltage. A stabilizing capacitor should be connected between VGL and GND.
24	VCOM	C	Capacitor	This pin is the VCOM driving voltage. A stabilizing capacitor should be connected between VCOM and GND.

Note:

Type: I : Input
O : Output
C : Capacitor
P : Power

5.2 Reference Circuit

Figure 5-1 EPD Reference Circuit



Type	Part	Vendor
Inductor	10uH ATNR4010100MT + -20% 0.8A	ARLITECH
Transistor	PJ2306 SOT-23 N-Channel 30V/3.2A	PANJIT
Diode	SS2040FL SOD-123FL	PANJIT

Note:

- (1) PJ2306 is a N-Channel Power MOSFET. The specification of selection criteria are $R_{DS} < 100 \text{ mohm}$ (the lower the better), $V_{DSS} = 30V$, $V_{GS-th} < 2.5V@250\mu A$.
- (2) SS2040FL is a Schottky diode needs the V_f as lower as possible, 0.2 to 0.4V and the repetitive peak reverse voltage $> 25V$.

6 Optical Characteristics

6.1 Measurement Conditions

Table 6-1 Optical Measurement Conditions

Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	°C
Ambient Humidity	Ha	50±10	% RH
Supply Voltage	V _{CC} , V _{DD} , V _{DDIO} , V _{DDA}	3.0	V

Note (1): Image is updated with above condition.

6.2 Optical Specification

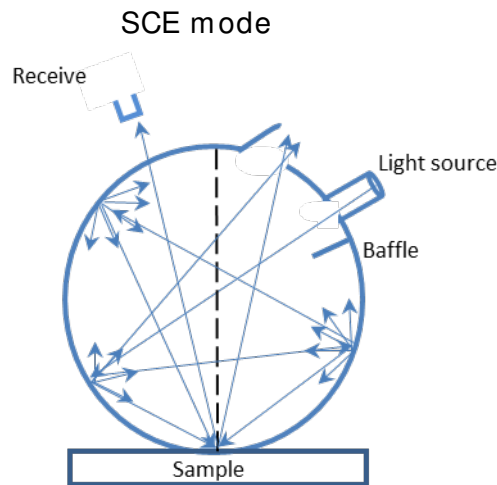
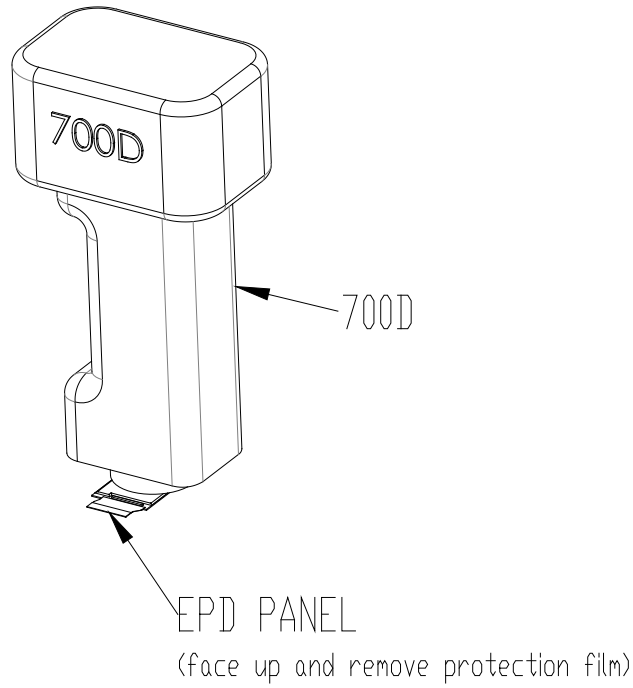
6.2.1 Optical

Table 6-2 Optical Measurement with D65 Light Source

Item	Color	Symbol	Rating			Unit	Note
			Min.	Typ.	Max.		
Contrast ratio	Black/ White	CR	-	16:1	-	-	$\theta_x=\theta_y=0$ (1),(2),(5),(6)
Refresh time	Black/ White	Tr	-	5	-	sec	(3),(4),(6)
White state	White	L*	-	72.6	-	-	$\theta_x=\theta_y=0$ (1),(2),(6)
	White	a*		-2.8			
	White	b*	-	0.1	-		
Reflectance	White	R%	-	44	-	%	(1),(2),(6)

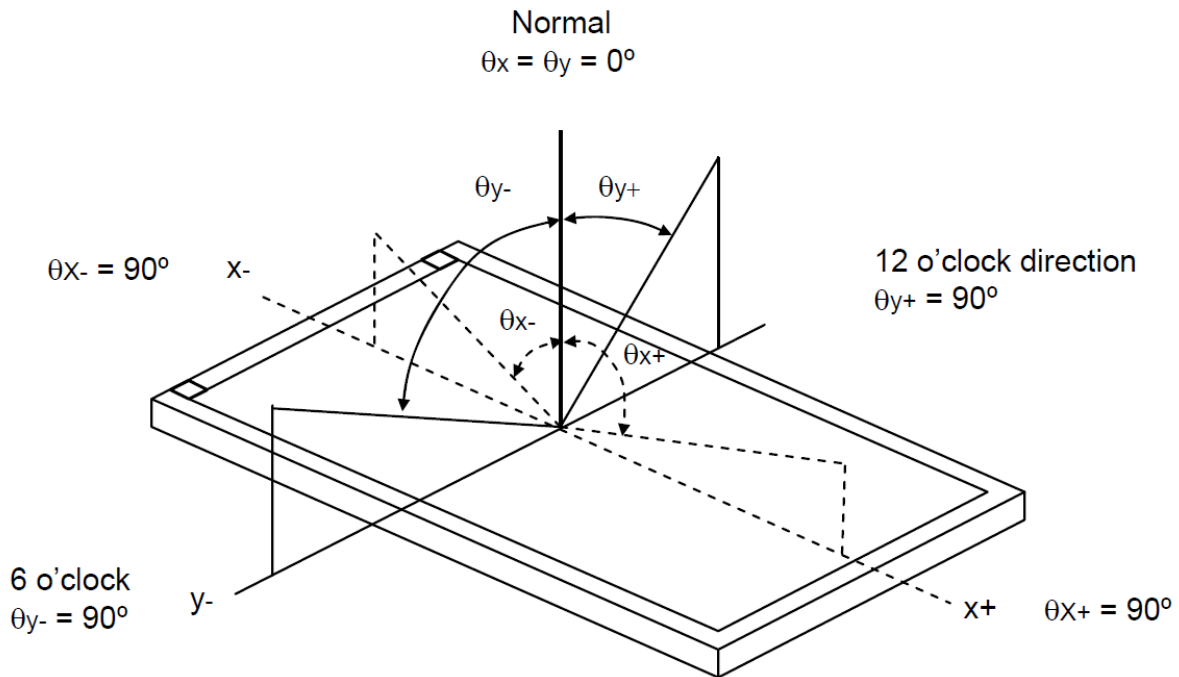
Note (1): Panel is driven by PDI waveform without masking film and optical measurement by CM-700D with D65 light source and SCE mode.

Figure 6-1 Optical Measurement



Note (2): Definition of Viewing Angle (θ_x, θ_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 vary due to different lot of film, display performance requirements, and ambient temperatures.

Note (4): T_r is the refresh time. For an image with Red, Red/White, Red/Black, or Red/Black/White, the total update time is (T_r).

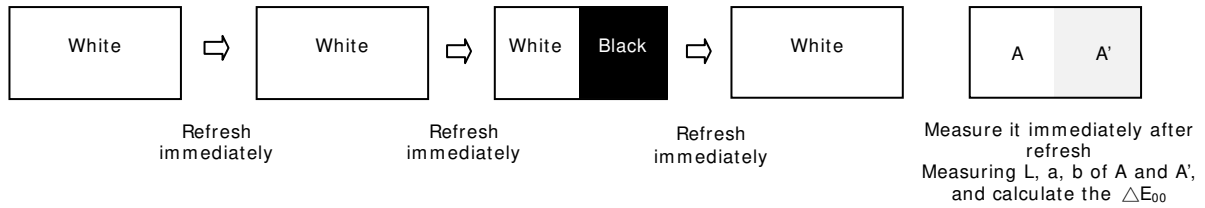
Note (5): Contrast ratio (C.R.): The Contrast ratio is calculated by the following expression. $C.R. = (R\% \text{ White}) / (R\% \text{ Black})$.

Note (6): Optical data is measured at 60 seconds after refresh with PDI's global update procedure.

6.2.2 Ghosting

Below are two test methods to verify if ghosting is within an acceptable range. Test 1 and Test 2 use measured data to calculate color different, ΔE_{00} (CIEDE 2000). The condition of measurement is to follow “ Table 6-1 Optical Measurement Conditions”.

- Test 1: White to Black Ghosting



- Test 2: Black to White Ghosting

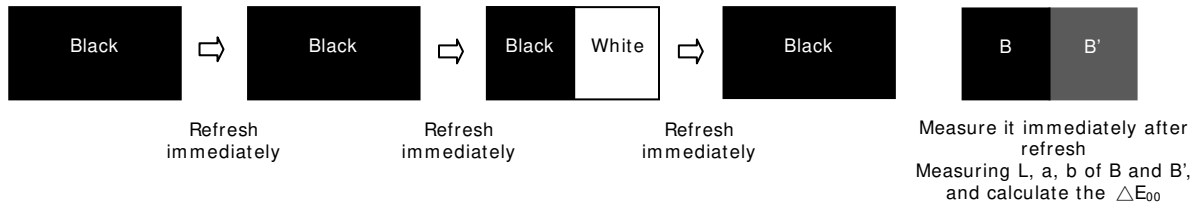


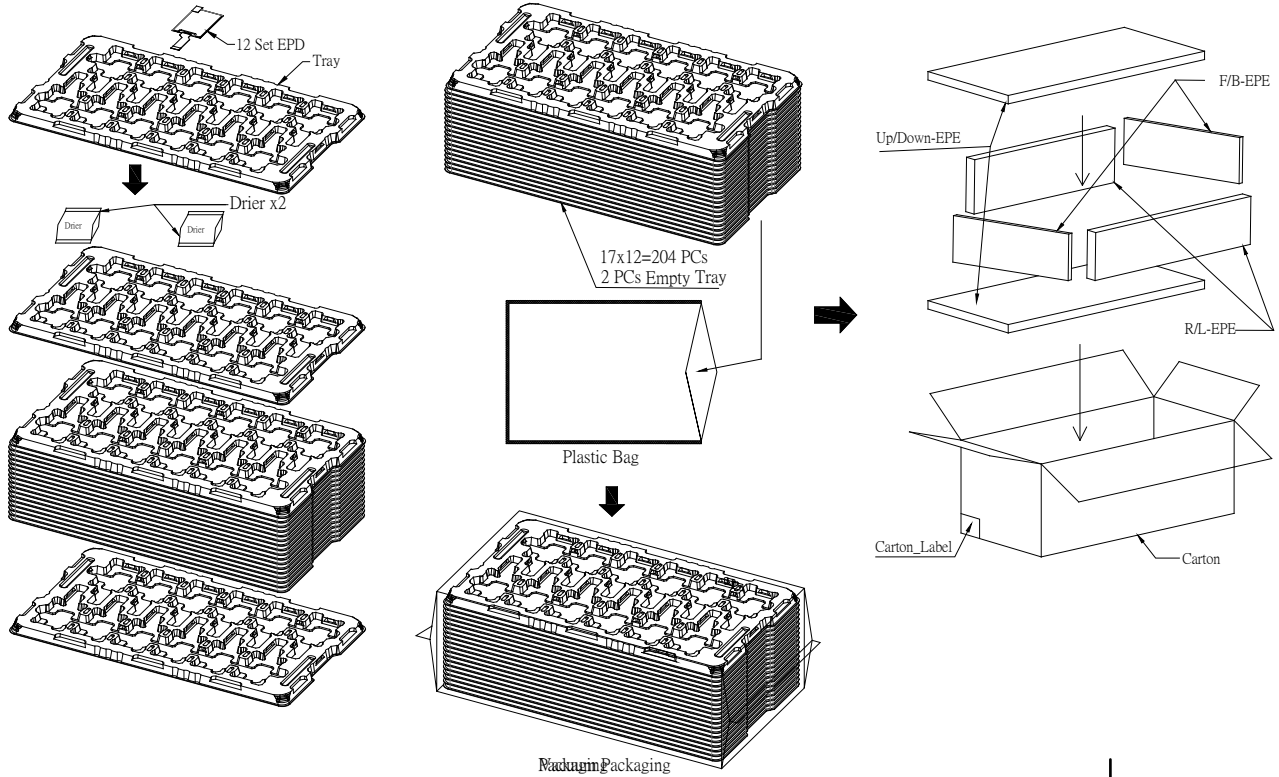
Table 6-3 Measurement of Ghosting

Item	Rating		
	Min.	Typ.	Max.
Test 1 ΔE_{00}	-	-	2
Test 2 ΔE_{00}	-	-	2

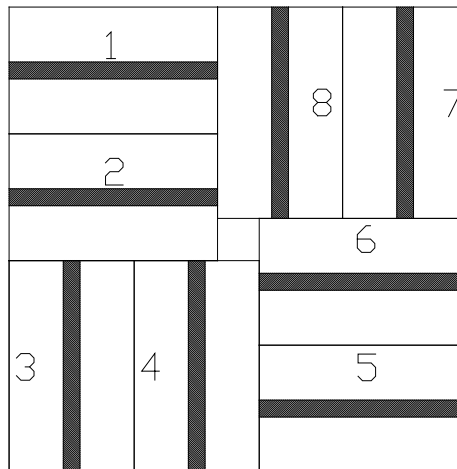
Note: Panel is driven by PDI’s tooling system and PDI’s waveform without masking film and optical measurement by CM-700D with D65 light source and SCE mode.

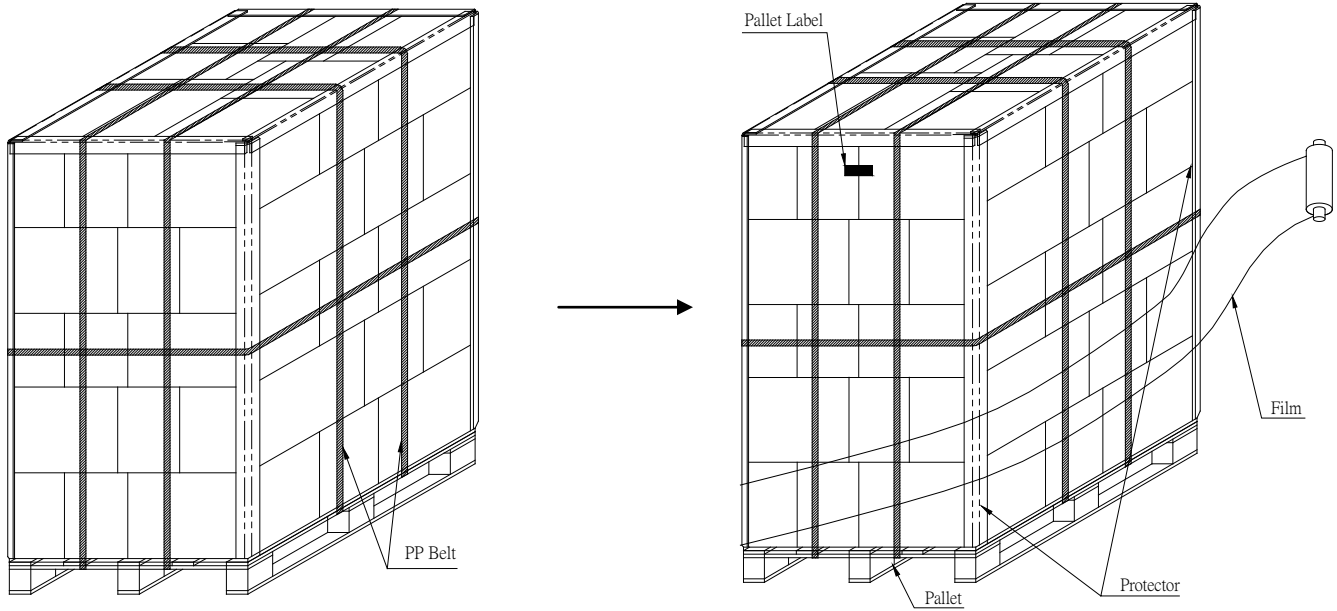
7 Packing

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





204(pcs)x40(BOX)=8,160pcs

	2.7" EPD BOX
N.W. :	1.22 Kg
G.W. :	4.58 Kg

Sea / Land / Air Transportation

