

Product Specifications

Customer	STANDARD
Description	3.70" Touch EPD Module
Model Name	TP370PGH01
Date	2022/09/28
Doc. No.	TP002-00
Revision	03

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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Revision History

Version	Date	Page (New)	Section	Description
01	2022/04/08	All	All	Product specification first issued.
02	2022/04/21	10	1.4	Modify Figure 1-1 Module Drawing
03	2022/09/28	13	3.2	Update Table 3-2 Recommended Operation Conditions of EPD
		14	3.2	Update Figure 3-3 Current Measurement of EPD
		20	6.2	Update Table 6-2 Optical Measurement with D65 light source

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Glossary of Acronyms

COG	Chip on Glass
EPD	Electrophoretic Display (e-Paper Display)
EPD Module	EPD with TCon board
EPD Panel	EPD
FPC	Flexible Printed Circuit
FPL	Front Plane Laminate
IIS	Incoming Inspection Standard
ISTA	International Safe Transit Association
PDI	Pervasive Displays Incorporated
SPI	Serial Peripheral Interface
TCon	Timing Controller
TFT	Thin Film Transistor

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1 General Description

1.1 Overview

EPD is bi-stable where power is only consumed when content is changing. The faster EPD can be refreshed, the better the user experience. To achieve this purpose, a touch sensor fitted to the top of EPD becomes the trend with fast refresh. This 3.70" EPD with touch module integrated unit will give you the ability to realize more applications for interaction.

1.2 Features

- Electronic Paper Display (EPD) with Capacitive touch
- Ultra-low power consumption
- Super Wide Viewing Angle - near 180°
- Extra thin & light
- SPI and I²C interface
- RoHS compliant
- Wide temperature support

1.3 Applications

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

1.4 General Specifications

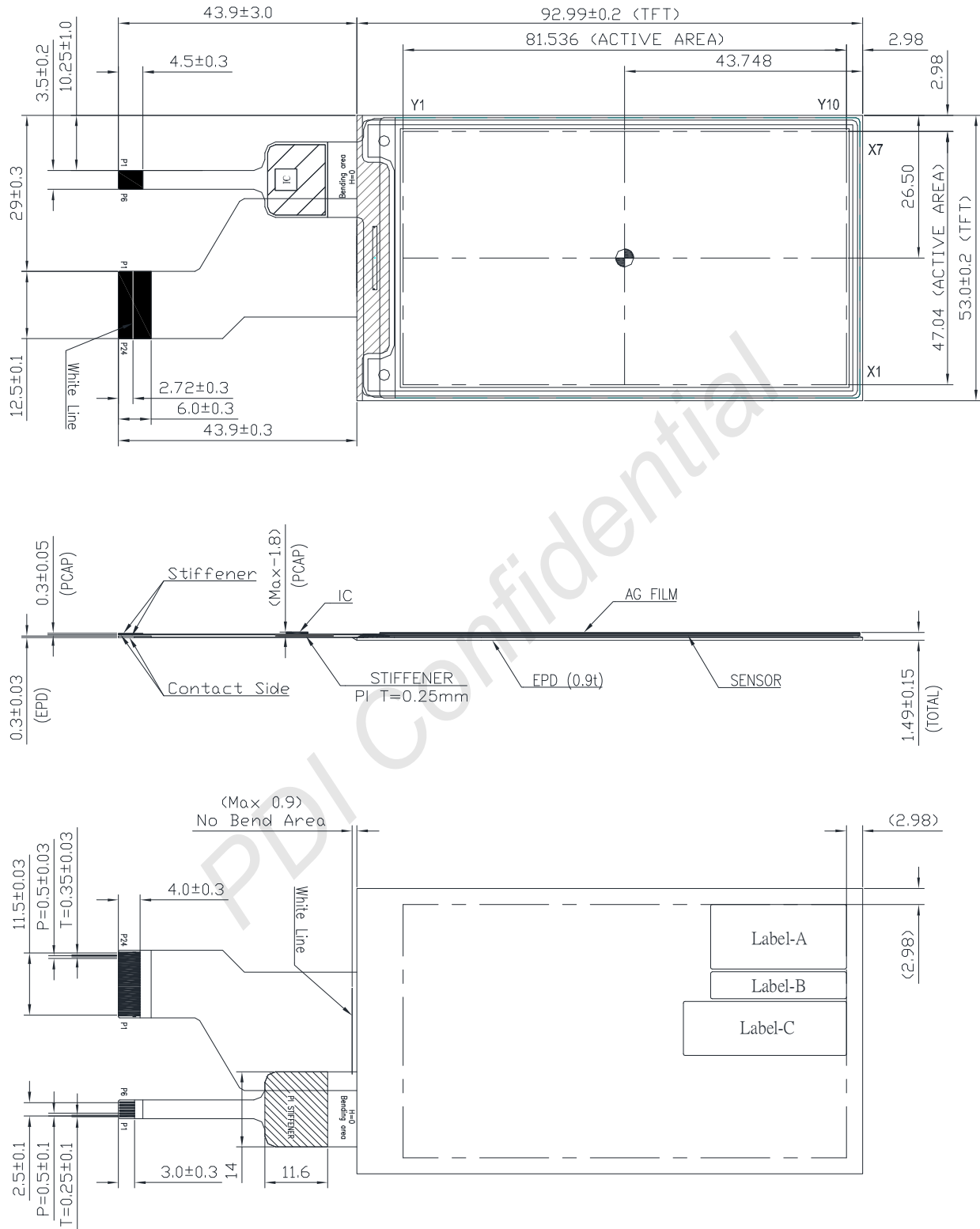
Table 1-1 General Specification

Item	Specification	Unit	Note
Outline Dimension	92.99(H) x 53.00(V) x 1.49(T)	mm	(1)
View Area	81.536(H) x 47.04(V)	mm	
Display Colors	Black/White	-	
Pixel Size	0.196 x 0.196 (130dpi)	mm	
Touch sensor type	Capacitive touch/GF1		
Input Mode	Single Finger touch		
Surface Hardness	2H	-	
Surface Treatment	Anti-Glare	-	
Weight	12.8	g	

Note (1): Not including the FPC.

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Figure 1-1 Module Drawing



General tolerance: $\pm 0.5\text{mm}$

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	85	%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 module surface area should be 0 °C Min. and 50 °C Max. Refresh time depends on operating 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 module 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	Remark
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	-25 °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:-25°C/30min → 60°C/30min, for 100 Cycles	(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 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 EPD

Table 3-1 Absolute Maximum Ratings of EPD

Parameter	Symbol	Value		Unit	Note
		Min	Max		
Logic supply voltage	V_{DD}, V_{DDIO}	-0.3	6.0	V	
Ground	GND	-		-	Connect to Ground

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

3.2 Recommended Operation Conditions of EPD

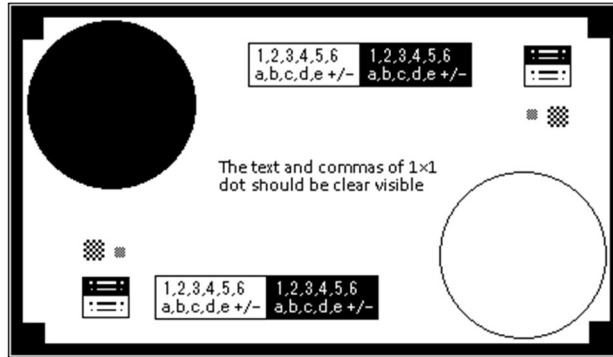
Table 3-2 Recommended Operation Conditions of EPD

Parameter	Symbol	Value			Unit	Note	
		Min	Typ	Max			
Operation voltage	V_{DDIO}, V_{DD}	2.5	3.0	3.6	V		
Input Voltage	High	V_{IH}	$0.7V_{DDIO}$	-	V_{DDIO}	V	$V_{DDIO}=V_{DD}$
	Low	V_{IL}	0	-	$0.3V_{DDIO}$		
Output Voltage	High	V_{OH}	$V_{DDIO}-0.4$	-	-	V	$V_{DDIO}=V_{DD}$ $I_{OH}=400\mu\text{A}$
	Low	V_{OL}	0	-	0.4	V	$V_{DDIO}=V_{DD}$ $I_{OL}=-400\mu\text{A}$,
Input Current	I_{DD}	-	2.49	-	mA	(1),(2),(3)	

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

Note (1):

Figure 3-1 Test Pattern of EPD



Normal pattern

These currents are tested with PDI test jig.

Note (2):

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

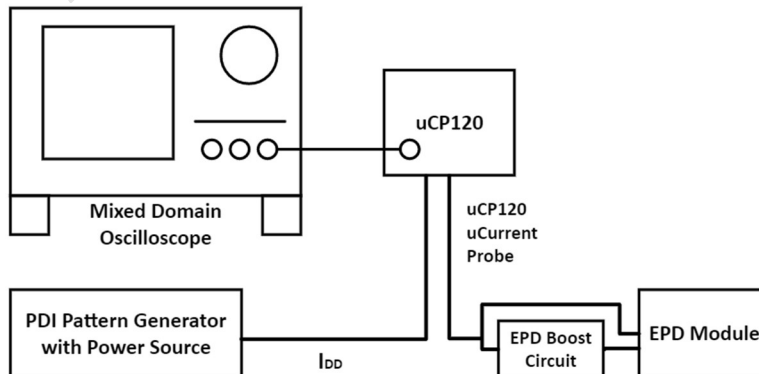
Figure 3-2 Image Update Current Profile



Normal pattern

Note (3):

Figure 3-3 Current Measurement of EPD



*Set oscilloscope filter to >200MHz and record length to 10M points.

3.3 Recommended Operation Conditions of Touch Sensor

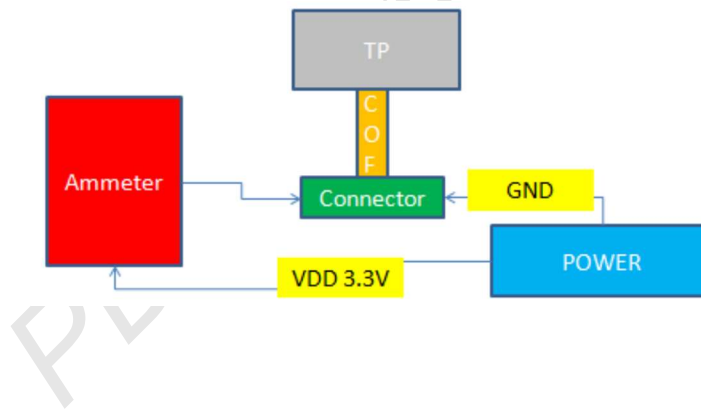
Table 3-3 Recommended Operation Conditions of Touch Sensor

Parameter	Symbol	Value			Unit	Note
		Min	Typ	Max		
VDDIO, VDD operation voltage	V_{DDIO}, V_{DD}	-	3.0	-	V	
Input Current	Active	1	-	10	mA	$V_{DD}=3.3V$ (1)
	Idle	0.1	-	2.5	mA	Sweep frequency 50ms (1)
I ² C Transmission speed	Standard		100		kHz	
	Fast		400		kHz	

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

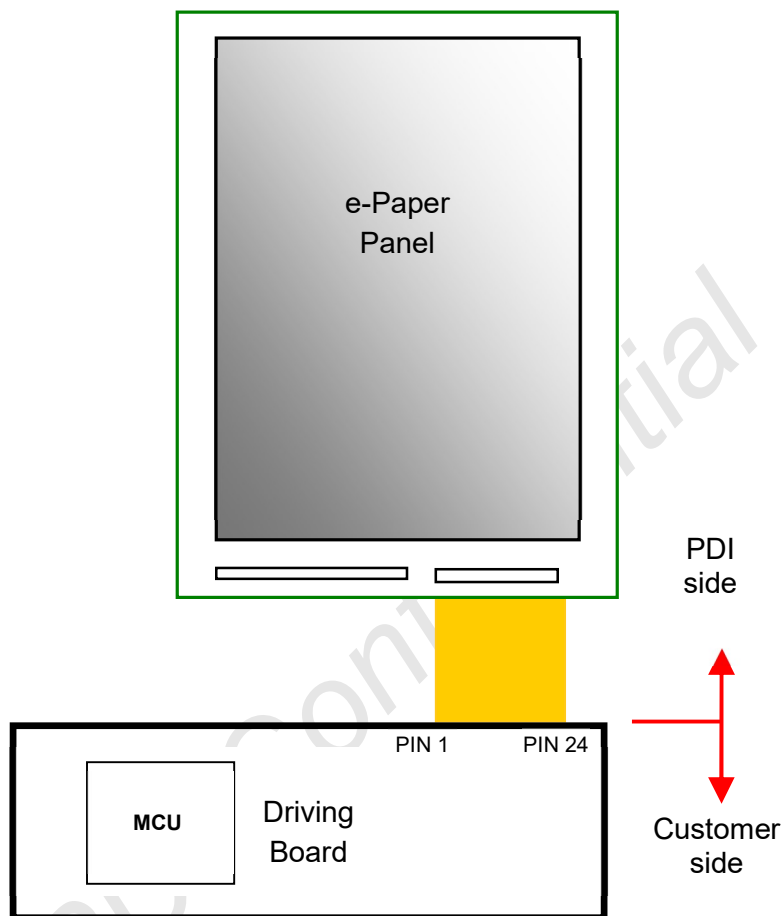
Note (1):

Figure 3-4 Current Measurement of Touch Sensor



4 Application Circuit Block Diagram

Figure 4-1 Application Circuit Block Diagram



5 Terminal Pin Assignment & Reference Circuit

5.1 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	VDHR	C	Capacitor	This pin is the Positive Source driving voltage. A stabilizing capacitor should be connected between VDHR and GND.
6	NC	-	-	Not connected
7	NC	-	-	Not connected
8	BS	I	GND	This pin is setting panel interface.
9	BUSY_N	O	Device Busy Signal	This pin is Busy state output pin. When Busy is Low, 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 GND	This pin is Data/Command control.
12	CSB	I	VDDIO or GND	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.

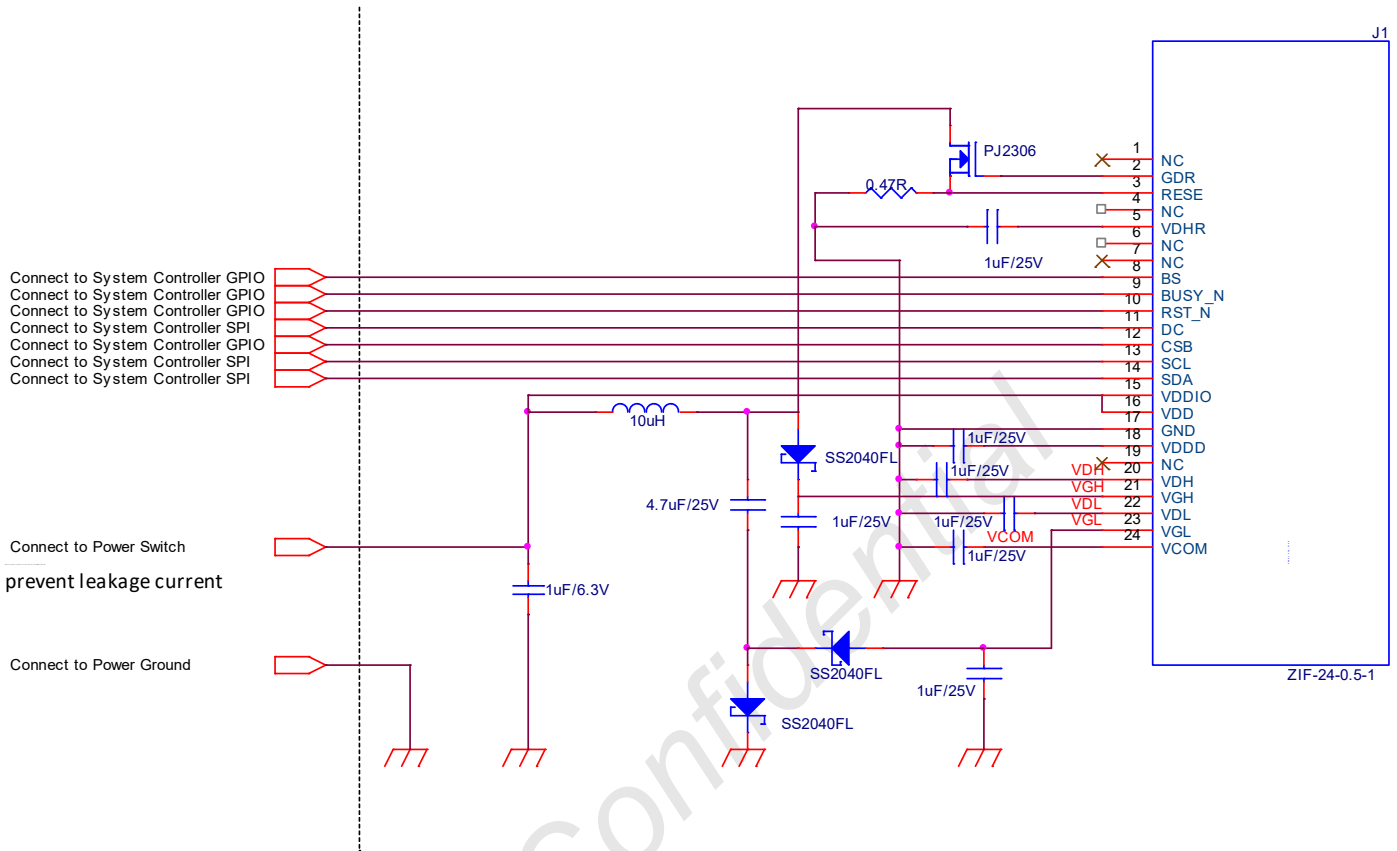
No.	Signal	Type	Connected to	Function
17	GND	P	Ground	Ground
18	VDDD	C	Capacitor	Internal regulator output A capacitor should be connected between VDDD and GND.
19	NC	-	-	-
20	VDH	C	Capacitor	This pin is the Positive Source driving voltage. A stabilizing capacitor should be connected between VDH and 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 H=0.9mm	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 $R_{DS} < 100$ 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 _{DDIO} & V _{DD}	3.0	V

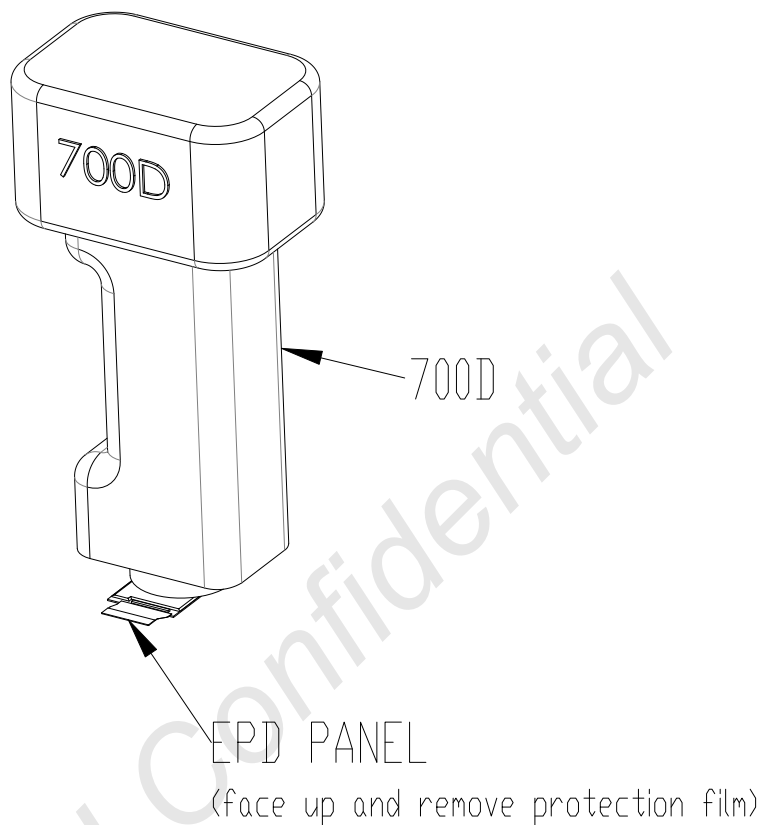
6.2 Optical Specifications

Table 6-2 Optical Measurement with D65 light source

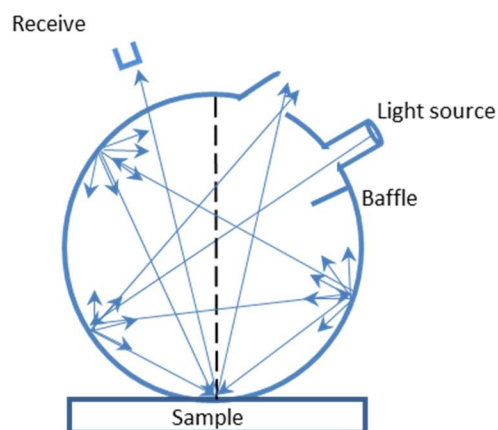
Item	Symbol	Rating			Unit	Note
		Min.	Typ.	Max.		
Contrast ratio	CR	-	12	-	-	$\theta_x=\theta_y=0$ (1),(2),(4),(5)
Refresh time	Tr	-	3.7	-	sec	(1),(3),(5)
White state	L*	-	66	-	-	$\theta_x=\theta_y=0$ (1),(2),(5)
	a*	-	-3.0	-		
	b*	-	3.8	-		
Reflectance	R%	-	35.0	-	%	(1),(2),(5)

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

Figure 6-1 Optical Measurement

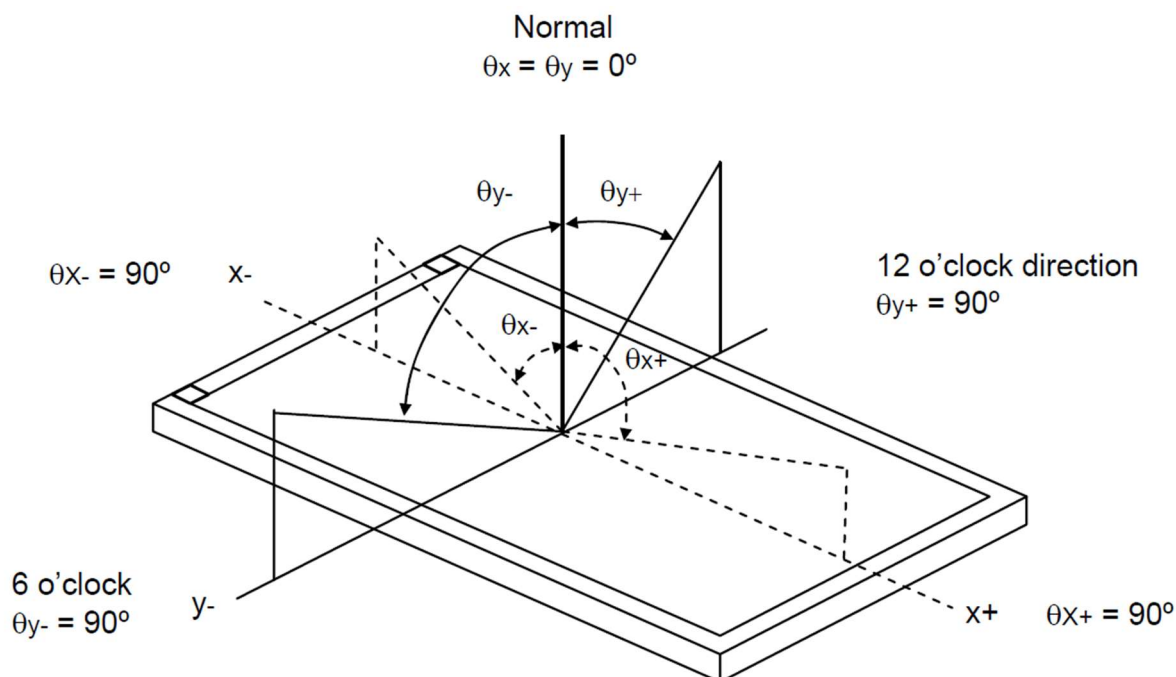


SCE mode



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 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. $C.R. = (R\% \text{ White}) / (R\% \text{ Black})$.

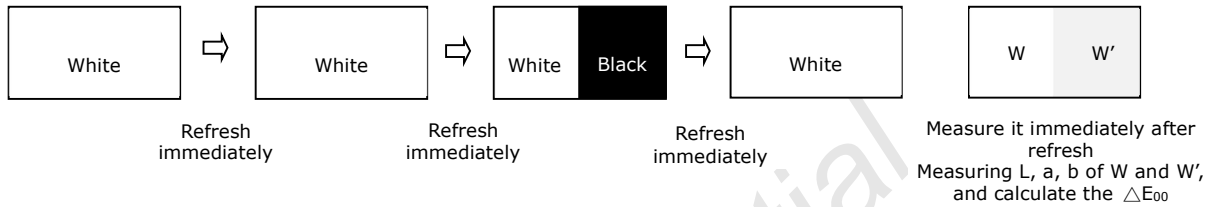
Note (5): Optical data is measured at 60 seconds after refresh with PDI's update procedure.

6.3 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

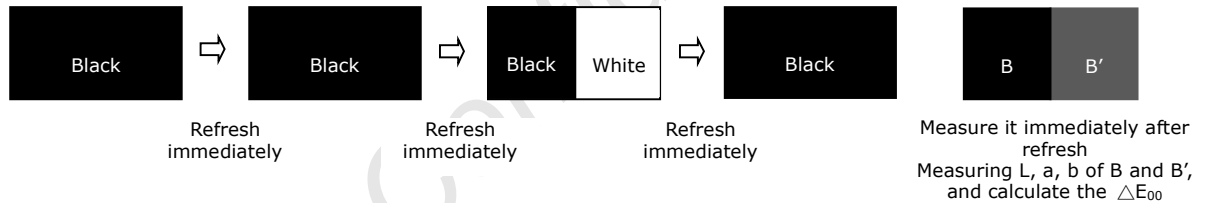


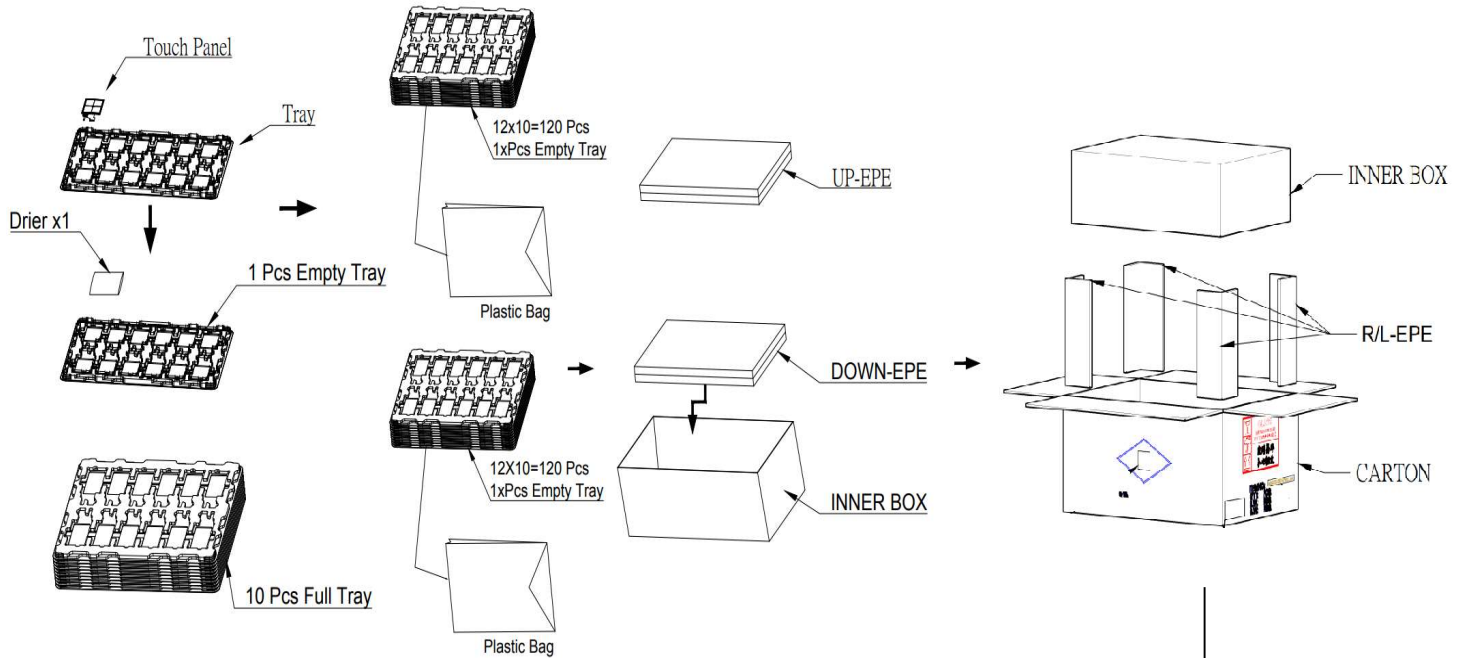
Table 6-3 Measurement of Ghosting

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

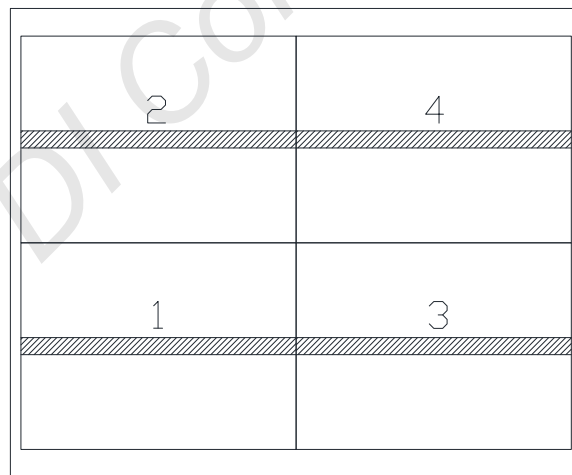
Note: Panel is driven by PDI waveform without masking film and optical is measured by CM-700D with D65 light source and SCE mode.

7 Packing

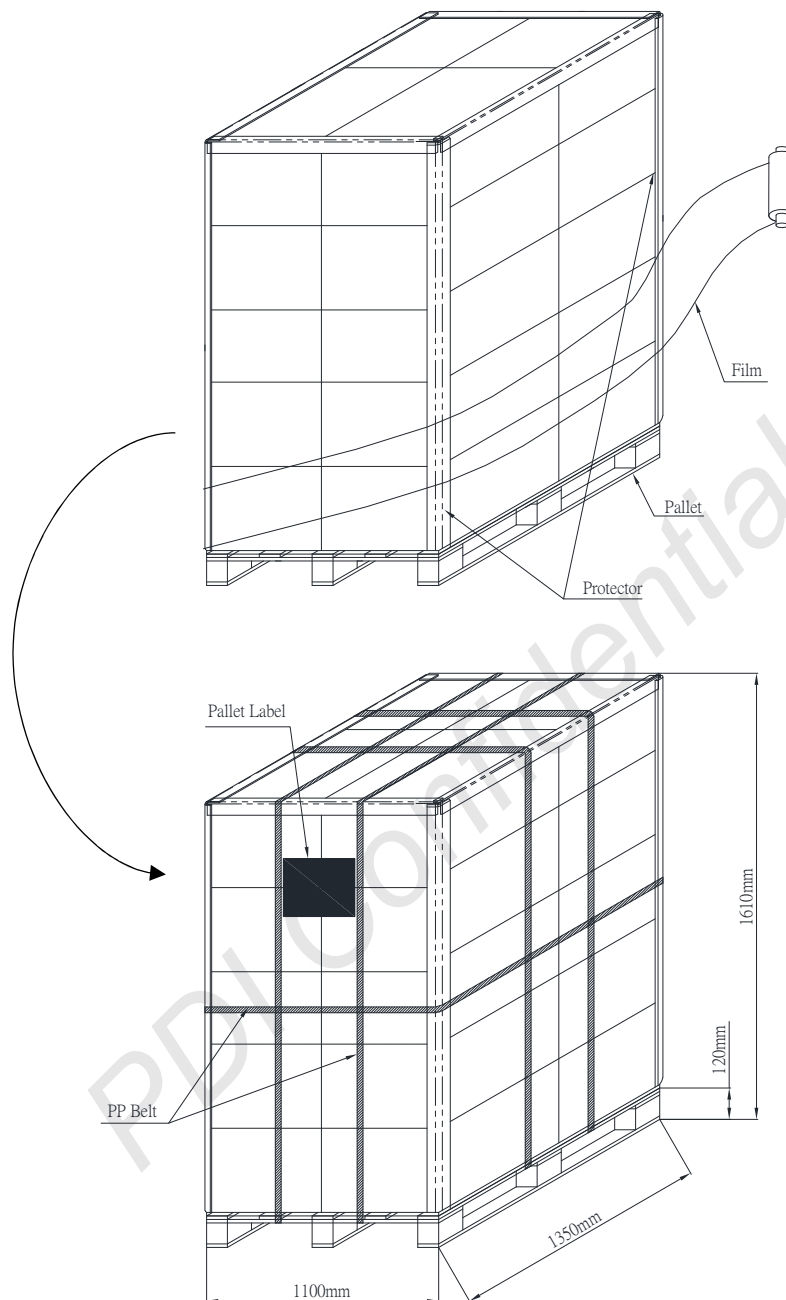
Figure 7-1 Packing Diagram



Note: Carton Dimension: 650(L) x 480(W) x 320(H) mm



Sea / Land / Air Transportation



240(pcs)x20(BOX)=4800pcs

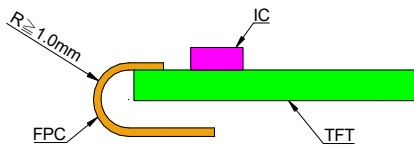
	3.7" Touch EPD BOX
N.W.:	3.07 Kg
G.W.:	9.99 Kg

8 Precautions

- (1) Touch EPD 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 module during assembly. Please put on gloves to handle EPD to avoid slash.
- (2) It is recommended to assemble or install modules in a clean working area. Dust and oil may cause electrical shorts or degrade / scratch / den the protection sheet film.
- (3) Do not apply pressure to the module to prevent damaging it.
- (4) Do not connect or disconnect the interface connector while the module 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 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) Do not touch IC bonding area. It may scratch TFT lead or damage IC function.
- (10) Wear a Wrist Strap (Grounding connect) when handling and during assembly. Semiconductor devices are included in the 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.)
- (11) Keep the Module in the specified environment and original packing boxes when storage in order to avoid scratching and keep original performance.
- (12) Do not disassemble or reassemble the Module.
- (13) Use a soft dry cloth without chemicals for cleaning. Please don't press hard for cleaning because the surface of the protection sheet film is very soft and without hard coating. This behavior would make dent or scratch on protection sheet.
- (14) Please be mindful of moisture to avoid its penetration into the Module, which may cause damage during operation.
- (15) It's low temperature operation product. Please be mindful the temperature different to make frost or dew on the surface of Module. Moisture may penetrate into the Module because of frost or dew on surface of Module and makes Module damage.
- (16) If the Module is not refreshed every 24 hours, phenomena known as "Ghosting" or "Image Sticking" may occur. It is recommended that customer refreshed the Module every 24 hours in use case. It is recommended that customer ships or stores the Module with a completely white image to avoid this issue.
- (17) High temperature, high humidity, sunlight, or fluorescent light may degrade the Module's performance. Please do not expose the unprotected Module to high temperature, high humidity, sunlight, or fluorescent for long periods of time.
- (18) The label ink used for marking the Panel ID number is erased easily by solvent. Please avoid using solvent to clean the EPD panel. It would be concerned for RMA.
- (19) The Module is vacuum packed with white image for shipment and storage.
- (20) 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.
- (21) 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.

- (22) 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.
- (23) This product is not designed to be radiation resistant.
- (24) If the update method was not followed by our waveform, the quality will not be guaranteed.
- (25) Please keep $R \geq 1.0\text{mm}$ when bend for assembly.



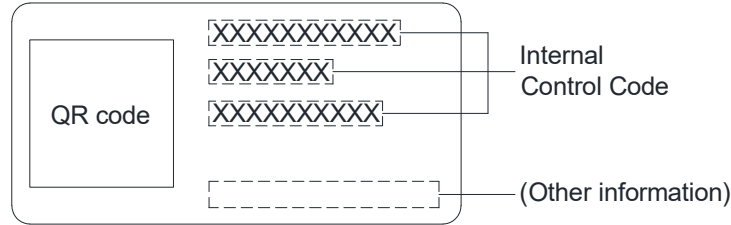
- (26) If you found ghosting issue after you refreshed the image by fast update you designed , please visit [this link](#) to get application guide.

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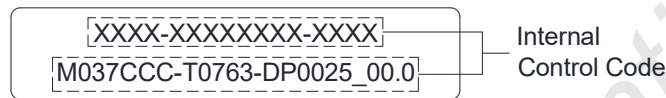
9 Definition of Labels

Figure 9-1 Module Labels

(1) Label-A



(2) Label-B



(3) Label-C: Definition of Module Label

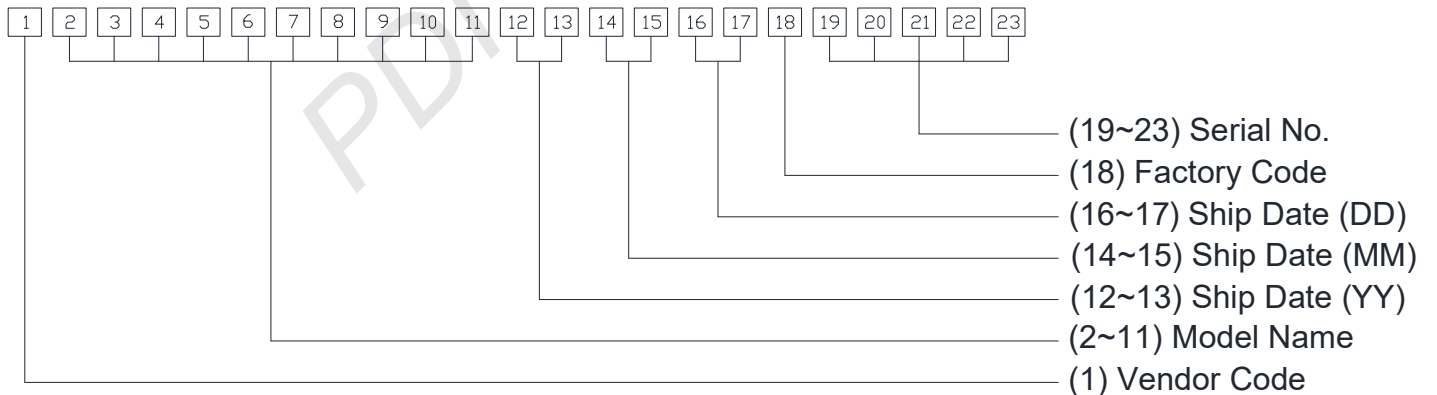
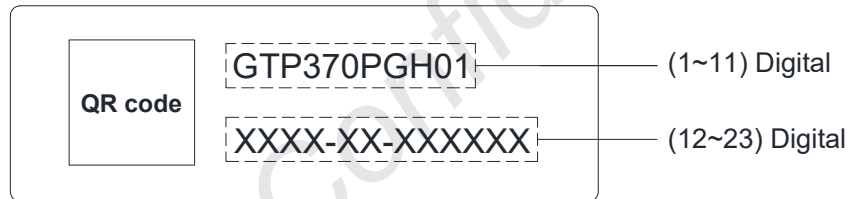
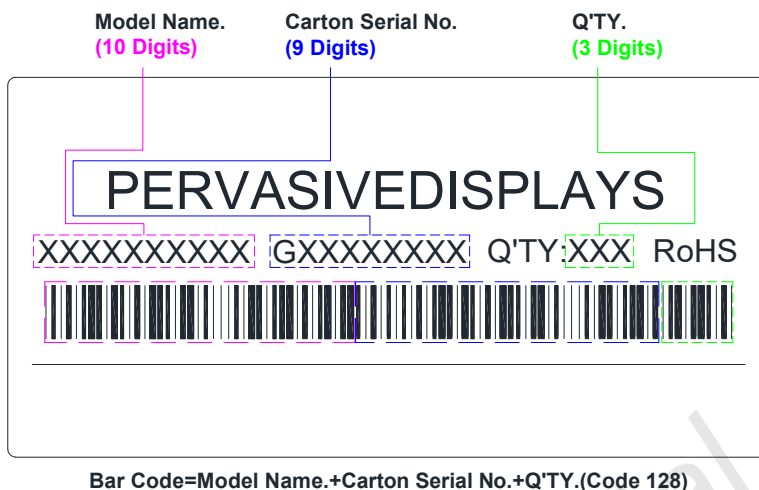


Figure 9-2 Carton Label



Carton Label

Figure 9-3 Pallet Label



Pallet Label