DATA MODUL

SPECIFICATION

Eink

AC057TC1

5.65", 600x448, SPI

Version: 1.0
Date: 19.01.2021

Note: This specification is subject to change without prior notice

Version: 1.0

Technical Specification

MODEL NO: AB1024-EGA (AC057TC1)

The content of this information is subject to be changed without notice.

Please contact E Ink or its agent for further information.

☐Customer's Confirmation

Customer _____

Date _____

By _____

☐E Ink's Confirmation

Approved By _Sean Chen_____

Confirmed By _林育生 1/15'21_____

Prepared By _Emi Tsui_____

Revision History

Rev.	Issued Date	Revised Contents
0.1	2019.10.16	Tentative
0.1	2019.10.30	Preliminary
0.2	2019.11.19	Update Page 17: Remove R65H (DAM) SPI Flash control
1.0	2021.01.19	Final

TECHNICAL SPECIFICATION

CONTENTS

1. Application

AB1024-EGA is a reflective electrophoretic E Ink® technology display module on an active matrix TFT substrate. The diagonal length of the active area is 5.65" and contains 600 x 448 pixels. The panel is capable of displaying 7-colors of black, white, red, yellow, blue, green, and orange images depending on the associated lookup table used. The circuitry on the panel includes an integrated gate and source driver, timing controller, oscillator, DC-DC boost circuit, and memory to store the frame buffer and lookup tables, and additional circuitry to control VCOM and BORDER settings.
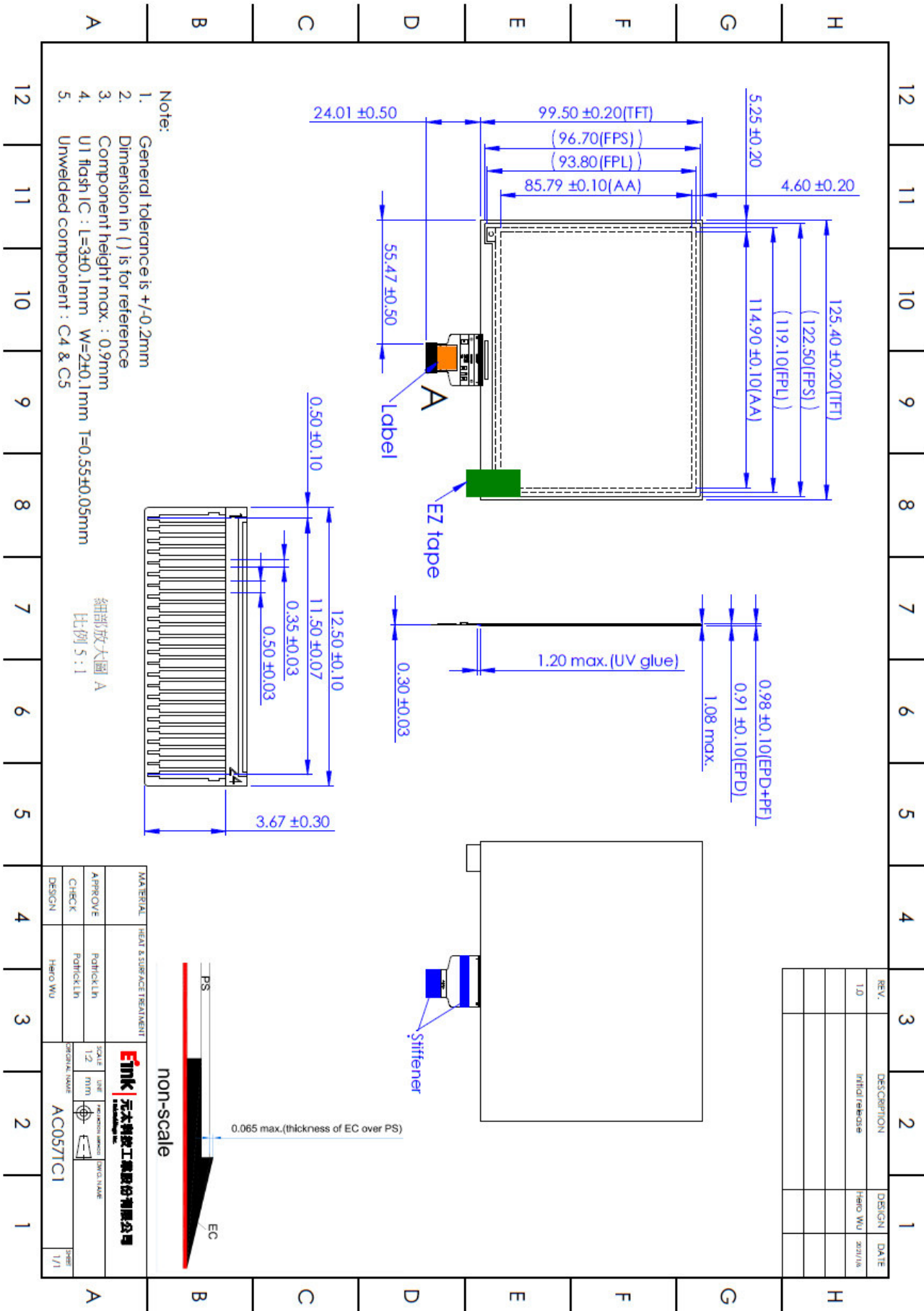
2. Features

➢ E Ink Gallery Palette™ display

➢ High contrast TFT electrophoretic

➢ 600 x 448 display

➢ High reflectance

➢ Ultra wide viewing angle

➢ Ultra low power consumption

➢ Pure reflective mode

➢ Bi-stable

➢ Low current sleep mode

➢ On chip display RAM

➢ Serial Peripheral Interface

➢ External SPI flash/eeprom for waveform

➢ On-chip oscillator

➢ On-chip booster and regulator control for generating Vcom, Gate and Source driving voltage

➢ I2C Signal Master Interface to read external temperature sensor

➢ Operational temperature range $(15 \sim 35\,^{\circ}\text{C})$

3. Mechanical Specifications

| Parameter	Specifications	Unit	Remark
Screen Size	5.65	Inch	
Display Resolution	600 (H) × 448 (V)	Pixel	132dpi
Active Area	114.9 (H) × 85.8 (V)	mm	
Pixel Pitch	191.5 (H) × 191.5 (V)	um	
Outline Dimension	125.4 (H) × 99.5 (V) × 0.91 (D)	mm	Without protective film
Module Weight	22 ± 2.2	g	

4. Mechanical Drawing of EPD Module

Note:
1. General tolerance is +/-0.2mm
2. Dimension in ( ) is for reference
3. Component height max. : 0.9mm
4. U1 flash IC : L=3±0.1mm W=2±0.1mm T=0.55±0.05mm
5. Unwelded component : C4 & C5

24.01 ±0.50
99.50 ±0.20(TFT)
(96.70(FPS))
(93.80(FPL))
85.79 ±0.10(AA)
5.25 ±0.20
4.60 ±0.20
55.47 ±0.50
125.40 ±0.20(TFT)
(122.50(FPS))
(119.10(FPL))
114.90 ±0.10(AA)

Label
EZ tape

0.50 ±0.10
12.50 ±0.10
11.50 ±0.07
0.35 ±0.03
0.50 ±0.03
0.30 ±0.03
3.67 ±0.30

細部放大圖 A
比例 5:1

1.20 max.(UV glue)
0.98 ±0.10(EPD+PF)
0.91 ±0.10(EPD)
1.08 max.

Stiffener
PS
non-scale
0.065 max.(thickness of EC over PS)
EC

MATERIAL HEAT & SURFACE TREATMENT
APPROVE Patrick Lin
CHECK Patrick Lin
DESIGN Hero Wu

SCALE 1:2
UNIT mm
ORIGINAL NAME AC057TC1

REV. 1.0
DESCRIPTION Initial release
DESIGN Hero Wu
DATE 2020/18
SHEET 1/1

5. **Input/Output Interface**

5-1) Recommended Connector Type of Panel

AYF532435

5-2) Pin Assignment of Panel

Pin #	Type	Single	Description	Remark
1	I	MFCSB	MCU to flash/EEprom chip select	
2	O	GDR	N-Channel MOSFET Gate Drive Control	
3	O	RESE	Current Sense Input for the Control Loop	
4	P	VSL_LV	Negative source driver voltage (low voltage**)**	
5	P	VSH_LV	Positive source driver voltage (low voltage)	
6	O	TSCL	I2C Interface to digital temperature sensor Clock pin	
7	I/O	TSDA	I2C Interface to digital temperature sensor Data pin	
8	I	BS1	Bus selection pin; L: 4-wire IF. H: 3-wire IF. (Default)	
9	O	BUSY_N	Busy state output pin	
10	I	RST_N	Reset	
11	I	D/C	Data /Command control pin	
12	I	CSB	Chip Select input pin	
13	O	SCL	Serial clock pin (SPI)	
14	I/O	SDA	Serial data pin (SPI)	
15	P	VDDIO	Power for interface logic pins	
16	P	VDD	Power Supply pin for the chip	
17	P	VSS	Ground	
18	P	VDD_1.8	Core logic power pin	
19	O	FMSDO	Flash/EEprom to MCU data output	Cannot share pin with SDA of SPI.
20	P	VSH	Positive Source driving voltage	
21	P	VGH	Power Supply pin for VGH , VSH and VSH_LV	
22	P	VSL	Negative Source driving voltage	
23	P	VGL	Power Supply pin for VCOM, VGL, VSL and VSL_LV	
24	P	VCOM	VCOM driving voltage	

5-2) Panel Scan Directions
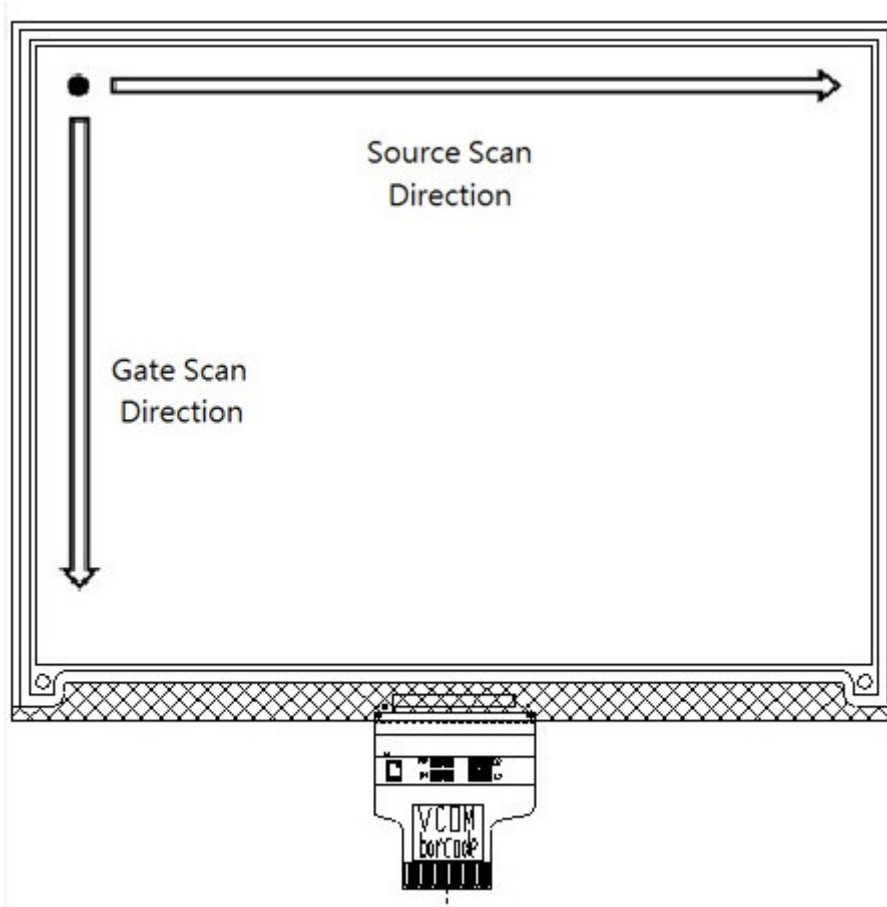
6. Command Table

6-1) Register Definition

6-1-1) R02H (POF): Power OFF Command

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Turning OFF the power	0	0	0	0	0	0	0	0	1	0

6-1-2) R04H (PON): Power ON Command

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Turning ON the power	0	0	0	0	0	0	0	1	0	0

6-1-3) R06h (BTST): Booster Soft Start

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Starting data transmission	0	0	0	0	0	0	0	1	1	0
	0	1	1	1	0	0	0	1	1	1
	0	1	1	1	0	0	0	1	1	1
	0	1	0	0	0	1	1	1	0	1

6-1-4) R07H (DSLP): Deep sleep

Action	W/R	C/D	D7	D6	D5	D4	D3	D2	D1	D0
Deep sleep	0	0	0	0	0	1	0	0	0	0
	0	1	1	0	1	0	0	1	0	1

NOTE: "-" Don't care, can be set to VDD or VSS level

This command makes the chip enter the deep-sleep mode. The deep sleep mode could return to stand-by mode by hardware reset assertion.

The only one parameter is a check code, the command would be executed if check code is A5h.

7. Electrical Characteristics

7-1) Absolute Maximum Ratings:

Item	Symbol	Min	Max	Unit
Logic Supply Voltage	VDD	-0.3	+4.0	V
Operating Temperature	T_{OPR}	15	35	℃
Storage Temperature	T_{STG}	-25	60	℃

Note: Maximum ratings are those values beyond which damages to the device may occur.

Functional operation should be restricted to the limits in the Electrical Characteristics chapter.

Suggested operation temperature range between 17~31℃ for better optical performance.

7-2) Panel DC Characteristics

The following specifications apply for: VDD = 3.3V, VDD_1.8 = 1.8V, TA = 25°C

DIGITAL DC CHARACTERISTICS						
Symbol	Parameter	Conditions	MIN.	TYP.	MAX.	Unit
VDD	Logic supply voltage		2.3	3.3	3.6	V
VGH	Positive Gate driving voltage		--	20.0	--	V
VGL	Negative Gate driving voltage		--	-20.0	--	V
VSH	Positive source driving voltage		--	15.0	--	V
VSL	Negative source driving voltage		--	-15.0	--	V
VCOM_DC	VCOM_DC output voltage		-2.0	Adjusted	-0.5	V
VCOM_AC	VCOM_AC output voltage		VSL+ VCOM_DC	--	VSH+ VCOM_DC	V
V_{IL}	Low level input voltage	Digital input pins	0	--	0.2xVDD	V
V_{IH}	High level input voltage	Digital input pins	0.8xVDD	--	VDD	V
V_{OH}	High level output voltage	Digital input pins, I_{OH}= 400 uA	0.8xVDD	--	--	V
V_{OL}	Low level output voltage	Digital input pins, I_{OL}= -400 uA	0	--	0.2xVDD	V
I_{MSTB}	Module stand-by current	Stand-by mode	--	0.2	--	mA
I_{MDS}	Module deep sleep & Flash power down current	Deep sleep mode & Flash power down mode		3.0	--	uA
Inc	Inrush Current		--	0.12	0.15	A
I_{MOPR}	Module operating current		--	10.0	68.0	mA
P	Operation Power Dissipation	VDD=3.3V with DC-DC	--	33.0	225.0	mW
P_{STBY}	Standby Power Dissipation	VDD=3.3V	--	0.66	--	mW

Note: The Module operating current data is measured by using Oscilloscope, and extract the Mean value.

- The Typical power consumption is measured using associated 25C waveform with following pattern transition: from full white pattern to black, white, red, yellow, blue, green and orange stripe pattern. (Note 7-1)

- The Max power consumption is measured using associated 25C waveform with following pattern transition: from full white pattern to pattern of repeated 1 consecutive red scan lines followed by 1 consecutive yellow scan line. (Note 7-2)

- The standby power is the consumed power when panel controller is in standby mode.

- The listed electrical/optical characteristics are only guaranteed under the controller & waveform provided by E INK.

Note 7-1

The Typical power consumption

600

448
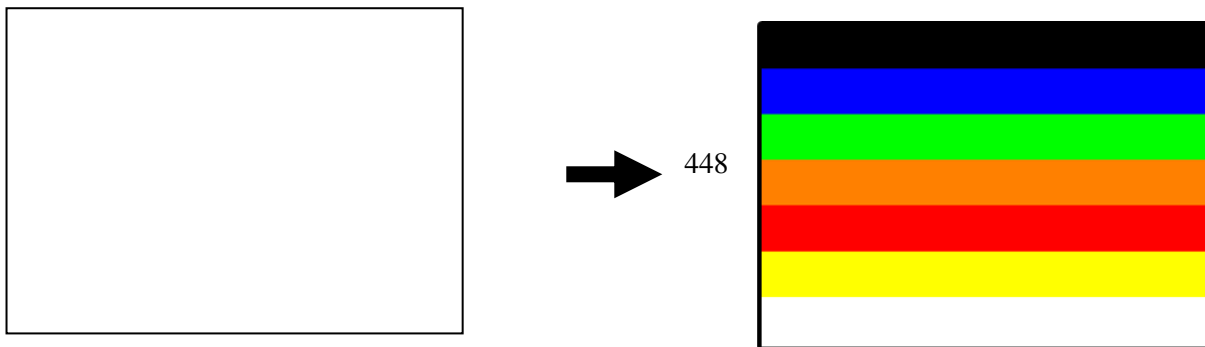
Note 7-2

The High loading power consumption

600

448
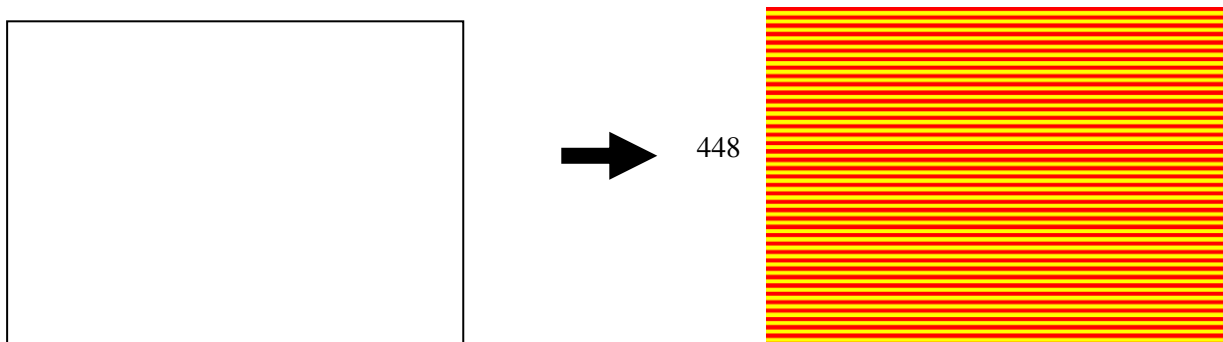
7-3) Panel AC Characteristics

VDD=2.5V to 3.6V, unless otherwise specified.

SYMBOL	SIGNAL			MIN.	TYP.	MAX.	UNIT
		SERIAL COMMUNICATION					
tCSS	CSB	Chip select setup time		60			ns
tCSH		Chip select hold time		65			ns
tSCC		Chip select setup time		20			ns
tCHW		Chip select setup time		40			ns
tSCYCW	SCL	Serial clock cycle (Write)		100			ns
tSHW		SCL "H" pulse width (Write)		35			ns
tSLW		SCL "L" pulse width (Write)		35			ns
tSCYCR		Serial clock cycle (Read)		150			ns
tSHR		SCL "H" pulse width (Read)		60			ns
tSLR		SCL "L" pulse width (Read)		60			ns
tSDS	SDA (DIN) (DOUT)	Data setup time		30			ns
tSDH		Data hold time		30			ns
tACC		Access time				10	ns
tOH		Output disable time		15			ns
		DRIVER					
trS		Source driver rise time	99% final value		5		us
tFS		Source driver fall time			5		us
trG		Gate driver rise time	99% final value		5		us
tFG		Gate driver fall time			5		us
trCOM		VCOM rise time	99% final value		1		ms
tFCOM		VCOM fall time			1		ms
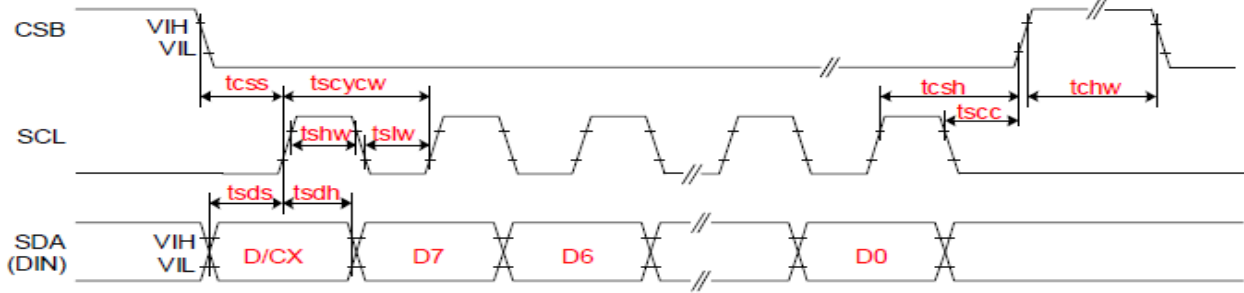
3-wire Serial Interface – Write
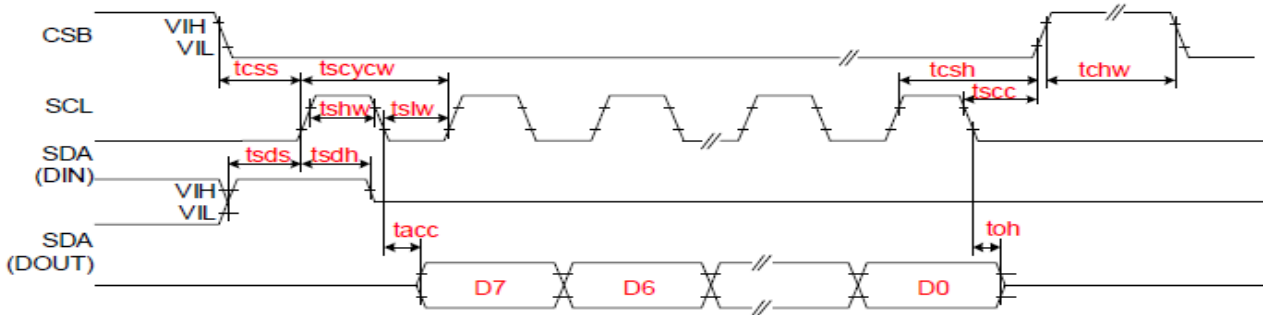
7-3-1) MCU Serial Interface

3-WIRE SPI

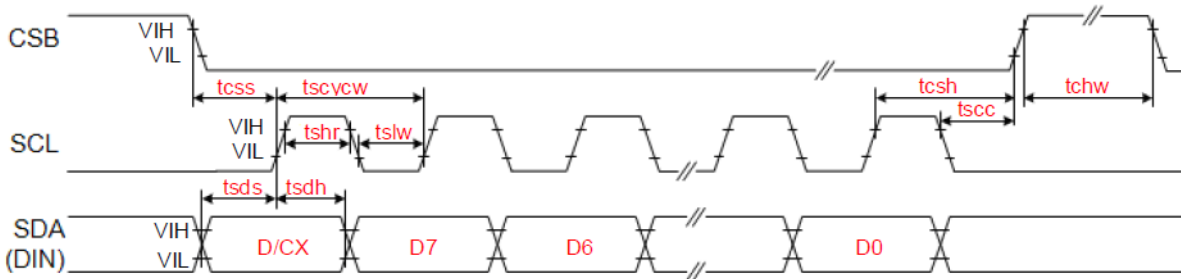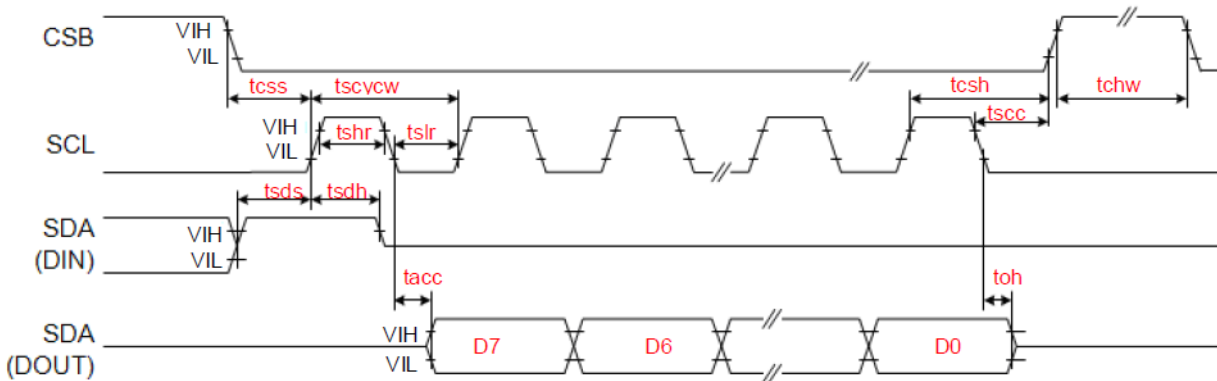**Figure :** 3-wire Serial Interface – Write

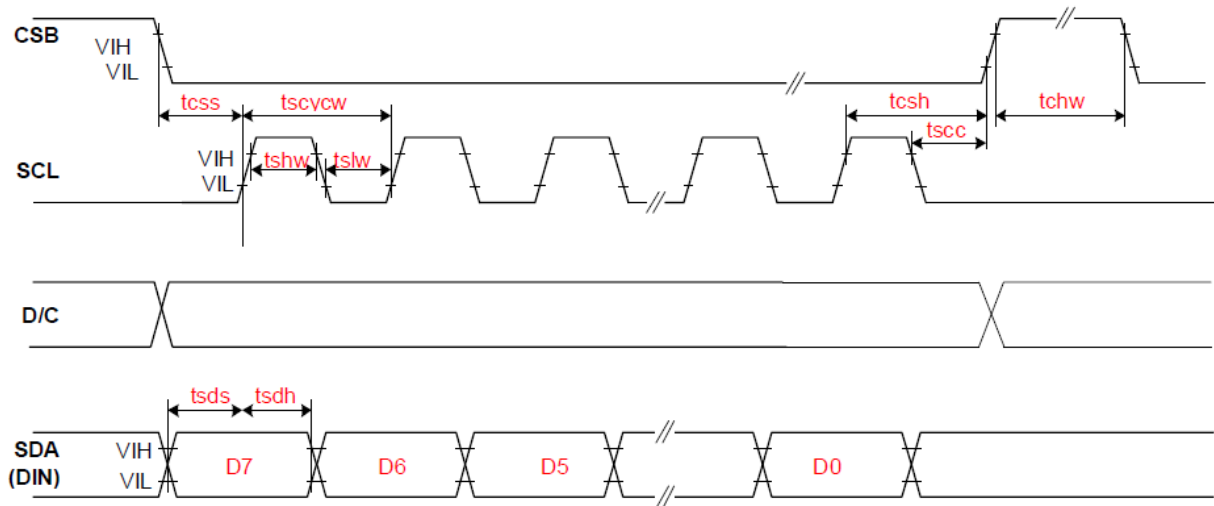**Figure :** 3-wire Serial Interface – Read
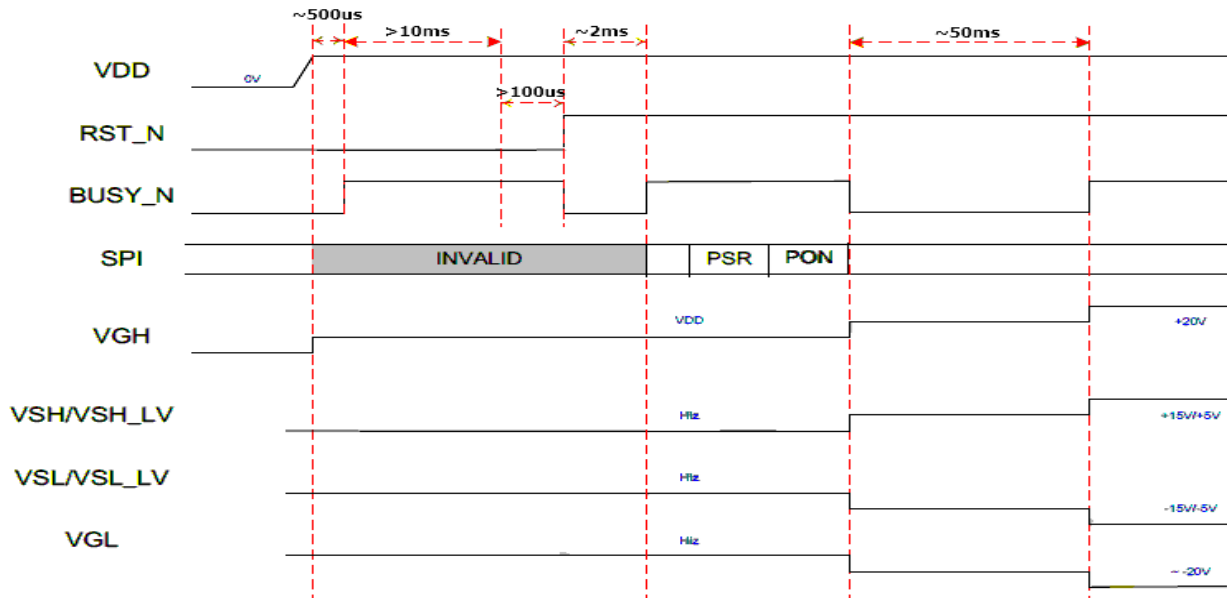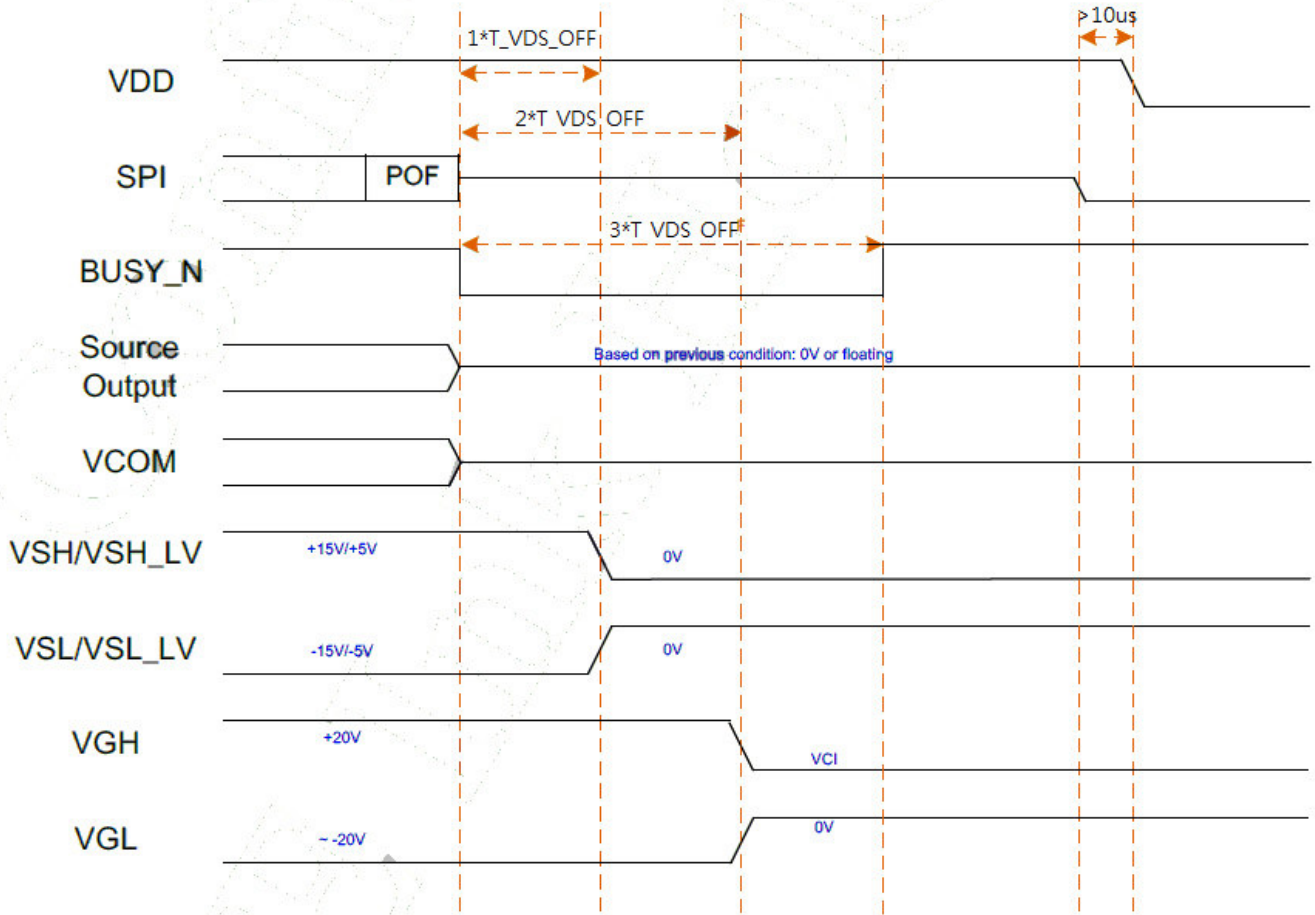
4-WIRE SPI

Figure : 4-wire Serial Interface – Read

7-3-2) Power On/Off Characteristics

Power ON Sequence

Power OFF Sequence

E Ink 元太科技
E Ink Holdings

7-4) Reference Circuit

panel terminal
EPD Circuit

CN2

MFCSB	1
GDR	2
RESE	3
VSL_LV	4
VSH_LV	5
TSCL	6
TSDA	7
BS1	8
BUSY	9
RES#	10
D/C#	11
CS#	12
SCL	13
SDA	14
VCI	15
VCI	16
VSS	17
VDD	18
FMSDO	19
VSH	20
VGH	21
VSL	22
VGL	23
VCOM	24

AYF532435

MFCSB

Q3
RUF015N02

C7 4.7uF/25V
C5 4.7uF/25V

TSCL
TSDA

R2 0R
R1 0R

GND_MCU

R3 0.47

GND_MCU

BS1
BUSY
RES#
D/C#
CS#
SCL
SDA

VDD_EPD

VDD_EPD

L1 10uH
C3 4.7uF/25V

C0 1uF/25V
C10 10uF/25V

D1 MBR0530
D2 MBR0530
D3 MBR0530

C1 1uF/25V

FMSDO

C6 4.7uF/25V

GND_MCU

C8 4.7uF/25V

C2 1uF/25V

C9 0.47uF/25V

R5 56K

GND_MCU

C12 4.7uF/25V
C11 4.7uF/25V
C4 1uF/25V

GND_MCU   GND_MCU   GND_MCU   GND_MCU

Note: The pin of FMSDO can't connect with the I/O pin of other ICs(Ex. Flash) for preventing to affect the signal of other ICs.

Option：Temperature Sensor

VDD_EPD

R8 10K   R7 4.7K   R6 4.7K

C13 0.1uF

GND_MCU

U3

TSCL

TSDA

SDA	Vcc
SCL	A0
OS	A1
GND	A2

TCN75A

R29 NC

GND_MCU   GND_MCU   GND_MCU
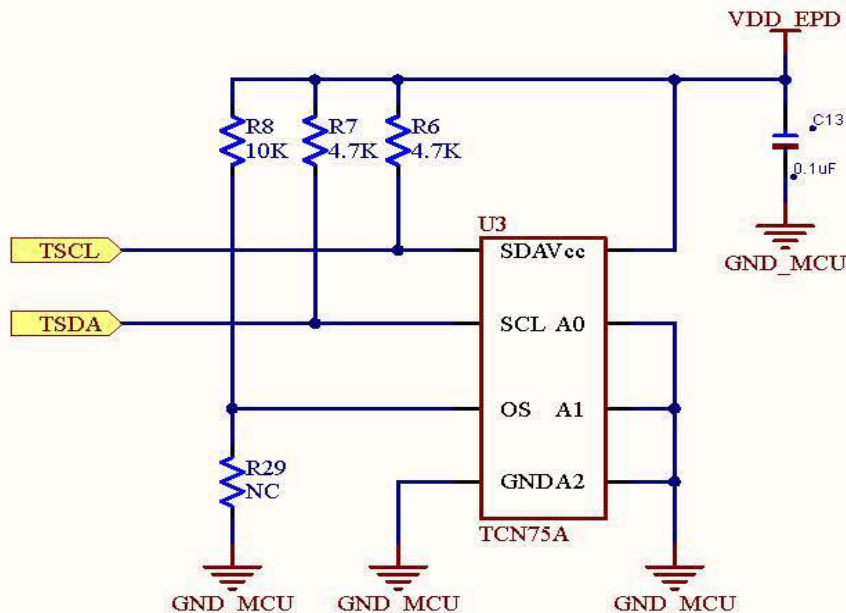
8. Optical Characteristics

8-1)Specifications

Measurements are made with that the illumination is under an angle of 45 degrees, the detector is perpendicular unless otherwise specified.

T = 24°C

| SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	Unit
R	Reflectance	White		41		%
CR	Contrast Ratio		9	12		
T_{update}	Update time			30		sec
SYMBOL	**Color coordinates**		**L*_TYP**	**a*_TYP**	**b*_TYP**	**dE2000_Max**
DS	Dark state		21.7	5.2	-10.1	7
WS	White state		70.3	-0.3	0.6	4
BS	Blue state		29.1	6.9	-20.6	5
GS	Green state		39.6	-25.4	11.2	7
RS	Red state		37.3	32.4	11.8	5
YS	Yellow state		64.1	-4.5	48.5	4
OS	Orange state		46.1	24.3	23.3	5

*Color performance measured with Konica Minolta CM-25cG
*Image Transition: White → Black →White →Picture

8-2) Definition of contrast ratio

The contrast ratio (CR) is the ratio between the reflectance in a full white area (Rl) and the reflectance in x

$$CR = Rl/Rd$$
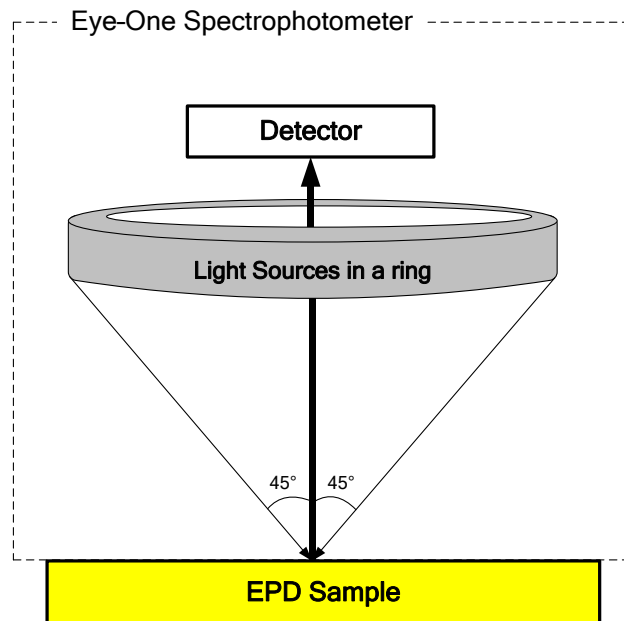
8-3) Reflection Ratio

The reflection ratio is expressed as：

$R = $ Reflectance Factor$_{white\ board}$ x   (L_{center} / $L_{white\ board}$)

L_{center} is the luminance measured at center in a white area (R=G=B=1). $L_{white\ board}$ is the luminance of a standard white board. Both are measured with equivalent illumination source. The viewing angle shall be no more than 2 degrees.

9. Handling, Safety and Environmental Requirements and Remark

WARNING
The display glass may break when it is dropped or bumped on a hard surface. Handle with care. Should the display break, do not touch the electrophoretic material. In case of contact with electrophoretic material, wash with water and soap.

CAUTION
The display module should not be exposed to harmful gases, such as acid and alkali gases, which corrode electronic components.
Disassembling the display module can cause permanent damage and invalidate the warranty agreements.
IPA solvent can only be applied on active area and the back of a glass. For the rest part, it is not allowed.

Mounting Precautions
(1) It`s recommended that you consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to the module.
(2) It`s recommended that you attach a transparent protective plate to the surface in order to protect the EPD. Transparent protective plate should have sufficient strength in order to resist external force.
(3) You should adopt radiation structure to satisfy the temperature specification.
(4) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the PS at high temperature and the latter causes circuit break by electro-chemical reaction.
(5) Do not touch, push or rub the exposed PS with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment. Do not touch the surface of PS for bare hand or greasy cloth. (Some cosmetics deteriorate the PS)
(6) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach the PS. Do not use acetone, toluene and alcohol because they cause chemical damage to the PS.
(7) Wipe off saliva or water drops as soon as possible. Their long time contact with PS causes deformations and color fading.

Data sheet status	
Product specification	This data sheet contains final product specifications.

Limiting values

Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

Application information

Where application information is given, it is advisory and does not form part of the specification.

Long Term Storage

When storing modules as spares for a long time, the following precautions are necessary.

(1) Store them in dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5℃ and 35℃ at normal humidity.

REMARK
All The specifications listed in this document are guaranteed for module only. Post-assembled operation or component(s) may impact module performance or cause unexpected effect or damage and therefore listed specifications is not warranted after any Post-assembled operation.

10. Reliability Test

	TEST	CONDITION	REMARK
1	High Temperature Storage	Ta= 60°C 40% RH, 240hrs	(Test in White Pattern)
2	Low Temperature Storage	Ta= -25°C, 240hrs	(Test in White Pattern)
3	High Temperature Operation	Ta= 35°C 35% RH, 240hrs	
4	Low Temperature Operation	Ta= 15°C 35% RH, , 240hrs	
5	High Temperature, High Humidity Operation test	Ta= 35°C 80% RH, 240hrs	
6	High Temperature, High Humidity Storage test	Ta= 50°C 80% RH, 240hrs	(Test in White Pattern)
7	Thermal cycles	-25°C(30min) ~60°C (30min), 50 cycle, 1hr/cycle	(Test in White Pattern)
8	Electrostatic Discharge	(Machine model) +/- 200V 0Ω , 200pF	Non-operation

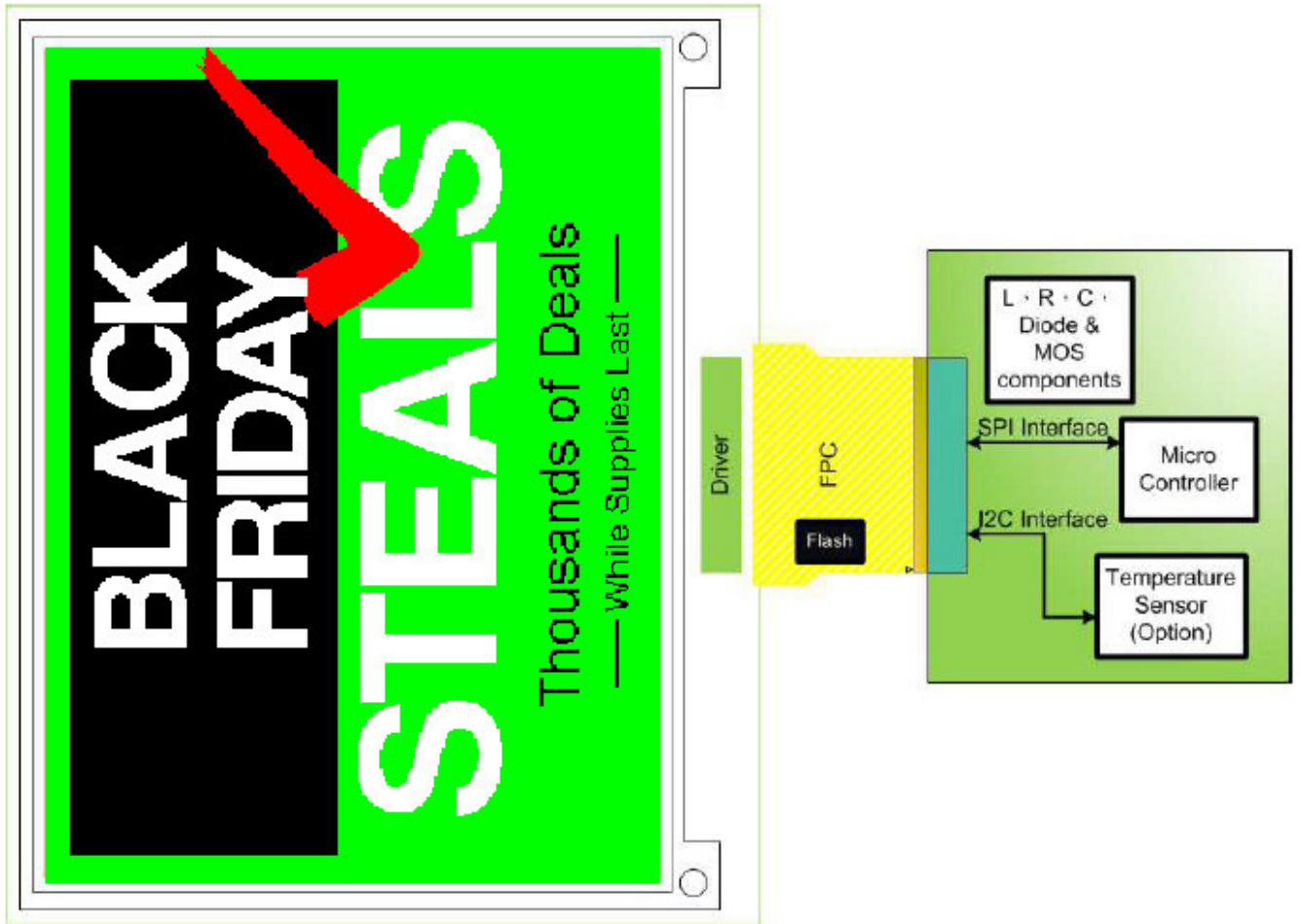Actual EMC level to be measured on customer application.

Note：The protective film must be removed before temperature test.

< Criteria >

In the standard conditions, there is not display function NG issue occurred.

All the cosmetic specification is judged before the reliability stress.

11. Block Diagram

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12. Packing

REV	DESCRIPTION	DESIGN	DATE
1.0	Preliminary drawing	Hero.Wu	2019.10.29

1st Layer

2nd Layer

Total 12 Layers

NOTE:
1. One layer include: 8 pcs panel,
   1 pc epe cusion sheet & 1 pc tray
2. Q'TY: 96 pcs panel/carton.
3. Dimension: 558*370*170mm
4. Weight: 5.9kg
5. Make sure tray stacked with 0° rotation,
   we can check this by tray's half circles from lateral side view

ITEM	DESCRIPTION	QTY	REMARK
7	30g 防潮劑	2	
6	CARTON INTERNAL	1	
5	摺口袋	1	抗靜電
4	EPD	96	
3	EPE CUSION SHEET	12	
2	TRAY	13	抗靜電
1	EPE FOAM	2	

MTL.SPEC.	UNSPECIFIED TOL'S	REMARK
	ANGLE	
	ROUGHNESS	

E Ink | 元太科技工業股份有限公司
E Ink Holdings Inc.

APPROVE	Patrick.Lin	2019.10.29	UNIT	SHEET	DWG.TITLE
CHECK	Hero.Wu	2019.10.29	mm	1 OF 1	AC057TC1 Packing
DESIGN	Hero.Wu	2019.10.29			A4 SIZE

DATA MODUL

ALL TECHNOLOGIES. ALL COMPETENCIES. ONE SPECIALIST.

DATA MODUL AG

Landsberger Straße 322
DE-80687 Munich
Phone: +49-89-56017-0

DATA MODUL WEIKERSHEIM GMBH

Lindenstraße 8
DE-97990 Weikersheim
Phone: +49-7934-101-0

More information and worldwide locations can be found at

www.data-modul.com