Ｅink 元太科技
E Ink Holdings

Version: 1.0

<div style="border: 1px solid black">

TECHNICAL SPECIFICATION

MODEL NO: ED060KG1

</div>

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 _____

Confirmed By _____

Prepared By _____

Revision History

Rev.	Issued Date	Revised Contents
1.0	January 30,2015	New

TECHNICAL SPECIFICATION

<u>*CONTENTS*</u>

1. General Description

ED060KG1 is a reflective electrophoretic E Ink® technology display module based on active matrix TFT substrate. It has 6" active area with 1072 x 1448 pixels, the display is capable to display images at 2-16 gray levels (1-4 bits) depending on the display controller and the associated waveform file it used.

2. Features

➢ Carta High contrast reflective/electrophoretic technology

➢ 1072 x 1448 display

➢ Ultra wide viewing angle

➢ Ultra low power consumption

➢ Pure reflective mode

➢ Bi-stable

➢ Commercial temperature range

➢ Landscape, portrait mode

➢ Front light module

3. Mechanical Specifications

Parameter	Specifications	Unit	Remark
Screen Size	6.0 (3:4 diagonal)	Inch	
Display Resolution	1072 (H)×1448(V)	Pixel	
Active Area	90.584 (H)×122.356 (V)	mm	
Pixel Pitch	0.0845 (H)×0.0845 (V)	mm	
Pixel Configuration	Square		
Outline Dimension	101.8(W)*138.4(H)*1.875(D)	mm	
Module Weight	42±4	g	
Number of Gray	16 Gray Level (monochrome)		
Display operating mode	Reflective mode		

4. Mechanical Drawing of EPD Module
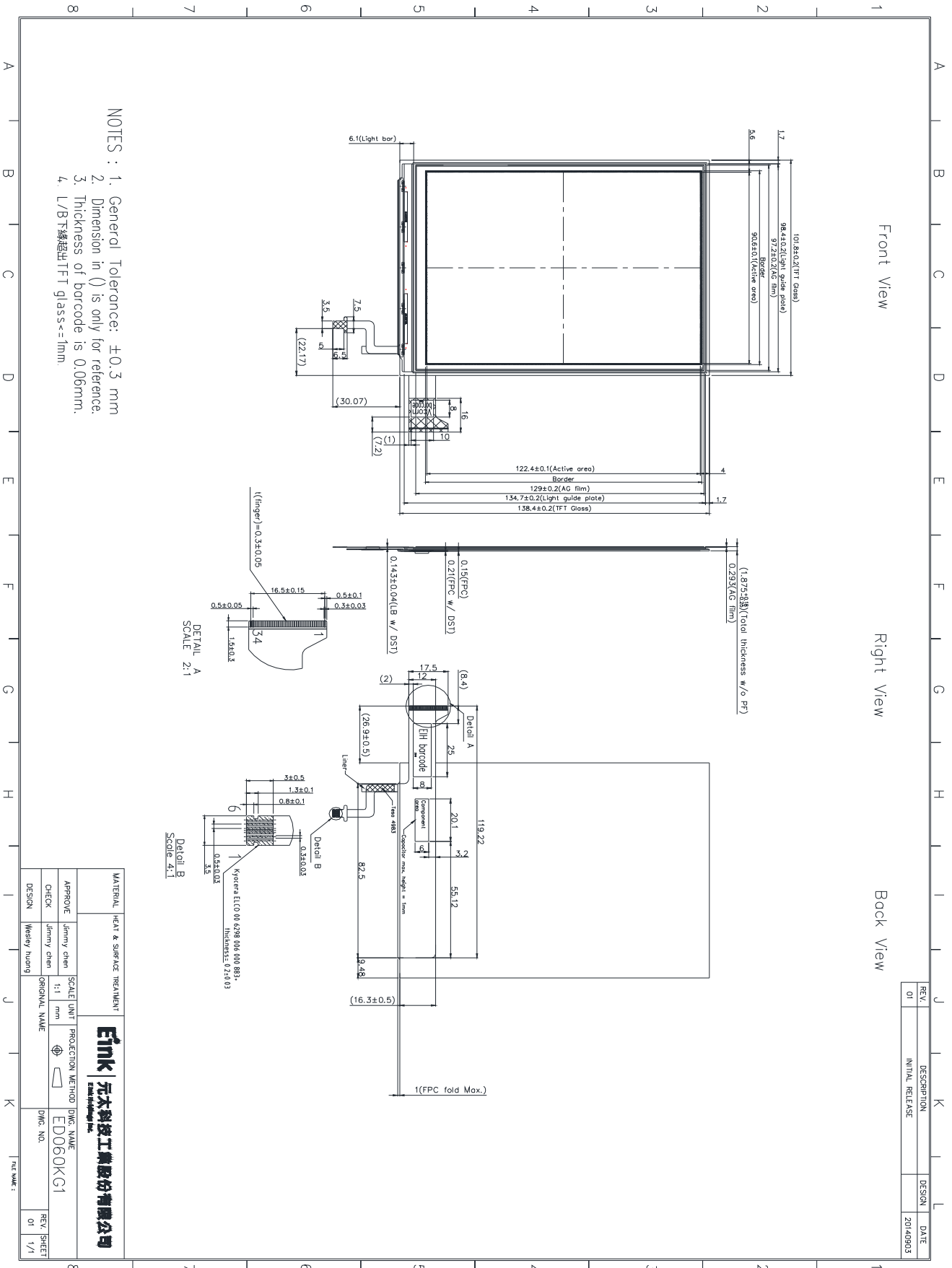
5. Input/Output Interface
## 5-1) Connector type: FH34S-34S-0.5SH(50)-Hirose
Pin Assignment

Pin #	Signal	Description	Remark
1	VNEG	Negative power supply source driver	
2	VGL	Negative power supply gate driver	
3	VSS	Ground	
4	NC	NC	
5	NC	NC	
6	VDD	Digital power supply drivers	
7	VSS	Ground	
8	XCL	Clock source driver	
9	VSS	Ground	
10	XLE	Latch enable source driver	
11	XOE	Output enable source driver	
12	XSTL	Start pulse source driver	
13	D0	Data signal source driver	
14	D1	Data signal source driver	
15	D2	Data signal source driver	
16	D3	Data signal source driver	
17	D4	Data signal source driver	
18	D5	Data signal source driver	
19	D6	Data signal source driver	
20	D7	Data signal source driver	
21	VCOM	Common connection	
22	NC	NC	
23	NC	NC	
24	NC	NC	
25	NC	NC	
26	VSS	Ground	
27	MODE 1	Output mode selection gate driver	
28	CKV	Clock gate driver	
29	SPV	Start pulse gate driver	
30	NC	NC	
31	Border	Border connection	
32	VSS	Ground	
33	VPOS	Positive power supply source driver	
34	VGH	Positive power supply gate driver	

5-2) Pin assignment of LED circuit

No.	Pin assignment
1	Anode
2	Anode
3	Dummy
4	Dummy
5	Cathode
6	Cathode

5-3) Panel Scan direction

ED060KG1
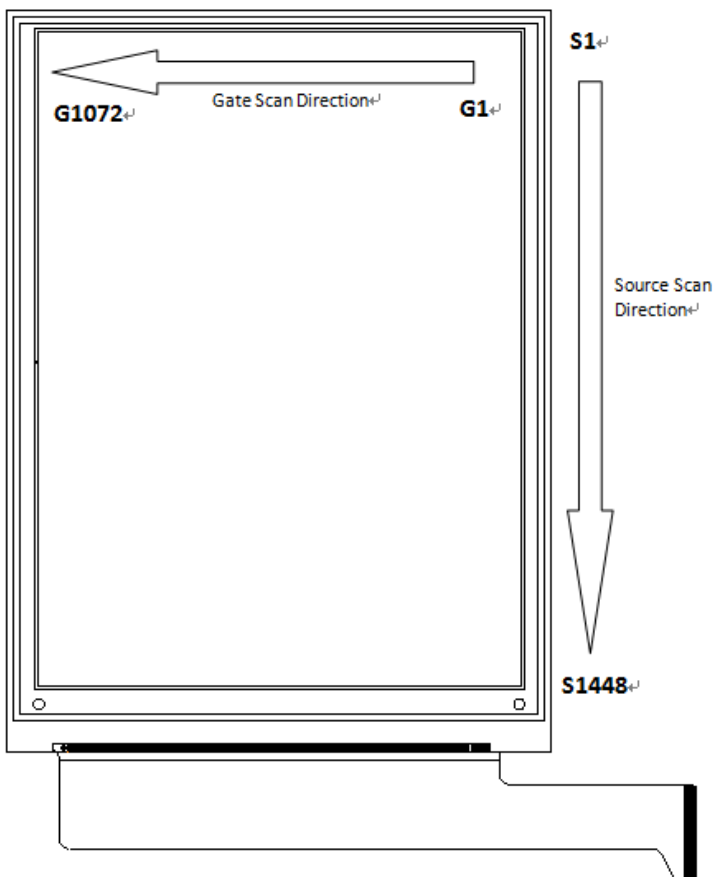
6. Electrical Characteristics

6-1)Absolute Maximum Ratings:

Parameter	Symbol	Rating	Unit	Remark
Logic Supply Voltage	VDD	-0.3 to +7	V	--
Positive Supply Voltage	V_{POS}	-0.3 to +18	V	--
Negative Supply Voltage	V_{NEG}	+0.3 to -18	V	--
Max .Drive Voltage Range	V_{POS} - V_{NEG}	36	V	--
Supply Voltage	VGH	-0.3 to +45	V	--
Supply Voltage	VGL	-25.0 to +0.3	V	--
Supply Range	VGH-VGL	-0.3 to +45	V	--
Operating Temp. Range	TOTR	0 to +50	℃	--
Storage Temperature	TSTG	-25 to +60	℃	--

6-2) Panel DC characteristics

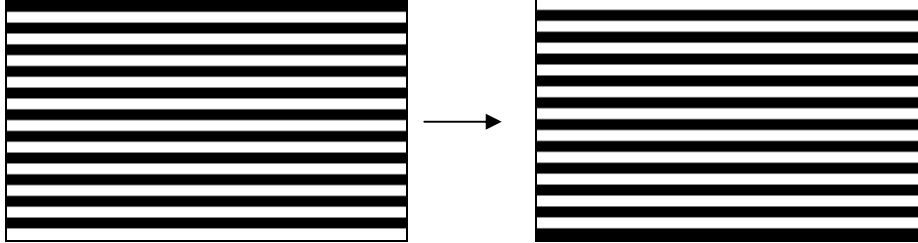| Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Signal ground	V_{SS}		-	0	-	V
Logic Voltage supply	V_{DD}		1.7	1.8	2.1	V
	I_{VDD}	V_{DD}=1.8V	-	3.5	8.3	mA
Gate Negative supply	VGL		-21	-20	-19	V
	I_{GL}	VGL =-20V	-	1.2	12	mA
Gate Positive supply	VGH		24	25	26	V
	I_{GH}	VGH = 25V	-	1.2	2.5	mA
Source Negative supply	V_{NEG}		-15.4	-15	-14.6	V
	I_{NEG}	V_{NEG} = -15V	-	8.5	160	mA
Source Positive supply	V_{POS}		14.6	15	15.4	V
	I_{POS}	V_{POS} = 15V	-	8.2	166	mA
Border supply	V_{COM}		-4	Adjusted	-0.3	V
Asymmetry source	V_{Asym}	V_{POS}+V_{NEG}	-800	0	800	mV
Common voltage	V_{COM}		-4	Adjusted	-0.3	V
	I_{COM}		-	0.2	-	mA
Panel Power	P		-	315	5200	mW
Standby power panel	P_{STBY}		-	-	0.01	mW

- The maximum power consumption is measured using 85Hz waveform with following pattern transition: from pattern of repeated 1 consecutive black scan lines followed by 1 consecutive white scan line to that of repeated 1 consecutive white scan lines followed by 1 consecutive black scan lines. (Note 6-1)

- The Typical power consumption is measured using 85Hz waveform with following pattern transition: from horizontal 4 gray scale pattern to vertical 4 gray scale pattern. (Note 6-2)

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

- The listed electrical/optical characteristics are only guaranteed under the controller & waveform

provided by E Ink.

- Vcom is recommended to be set in the range of assigned value $\pm 0.1V$

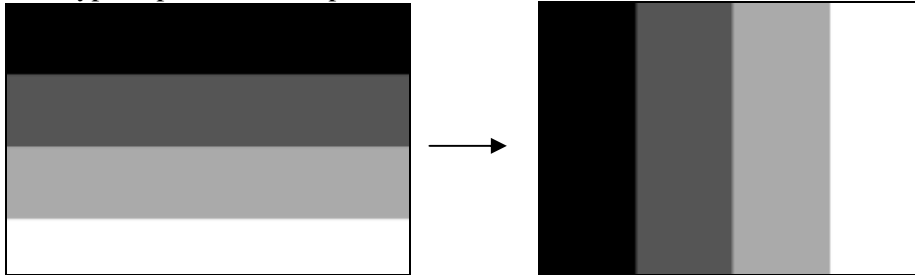- The maximum I_{COM} inrush current is about 1000 mA

Note 6-1

The maximum power consumption

Note6-2
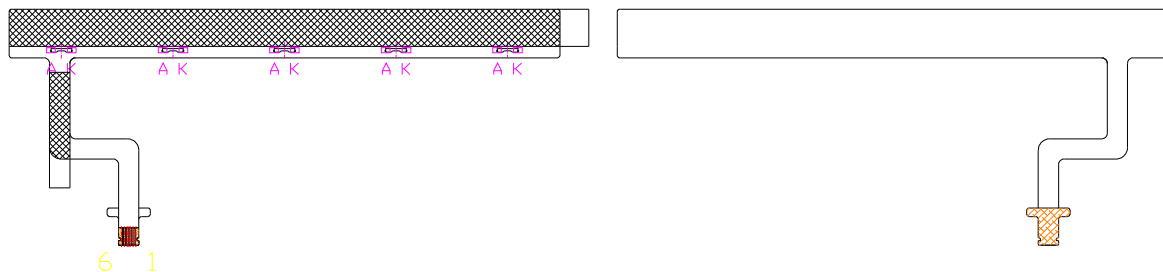
The Typical power consumption

6-3) Recommended driving condition for Front light

GND = 0 V， Ta = 25°C

Parameter	Symbol	Min	TYP	MAX	Unit	Remark
Supply voltage of LED Front light	V_{LED}	14	15.5	17	V	Serial 5 pcs
Supply current of LED Front light	I_{LED}	--	20	--	mA	
Front light Power Consumption	P_{LED}	280	310	340	mW	Note 6-3

Note 6-3 : I_{LED}=20 mA with 1-serial LED circuit(5 LEDs)

6-4)Panel AC characteristics

VDD=1.7V to 2.1V, unless otherwise specified.

| Parameter	Symbol	Min.	Typ.	Max.	Unit
Clock frequency	fckv	-	-	200	kHz
Minimum "L" clock pulse width	twL	1	-	-	us
Minimum "H" clock pulse width	twH	1	-	-	us
Clock rise time	trckv	-	-	100	ns
Clock fall time	tfckv	-	-	100	ns
SPV setup time	tSU	100	-	twH-100	ns
SPV hold time	tH	100	-	twH-100	ns
Pulse rise time	trspv	-	-	100	ns
Pulse fall time	tfspv	-	-	100	ns
Clock XCL cycle time	tcy	22.22	-	-	ns
D0 .. D7 setup time	tsu	11	-	-	ns
D0 .. D7 hold time	th	11	-	-	ns
XSTL setup time	tstls	0.5* tcy	-	0.8* tcy	ns
XSTL hold time	tstlh	0.5* tcy	-	180*tcy-tstls	ns
XLE on delay time	tLEdly	4.5* tcy	-	-	ns
XLE high-level pulse width (When VDD=1.7V to 2.1V)	tLEw	400	-	-	ns
XLE off delay time	tLEoff	250	-	-	ns
Output setting time to +/- 30mV(C_{load}=200pF)	tout	-	-	20	us

OUTPUT LATCH CONTROL SIGNALS
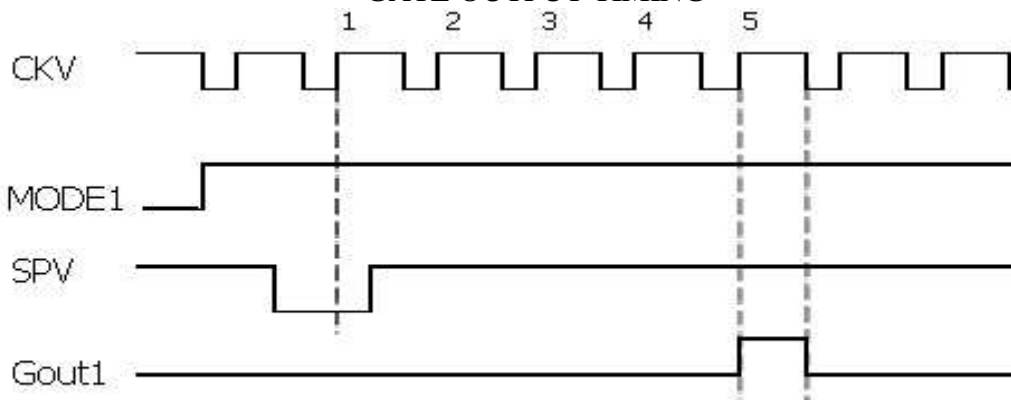

PAGE:10
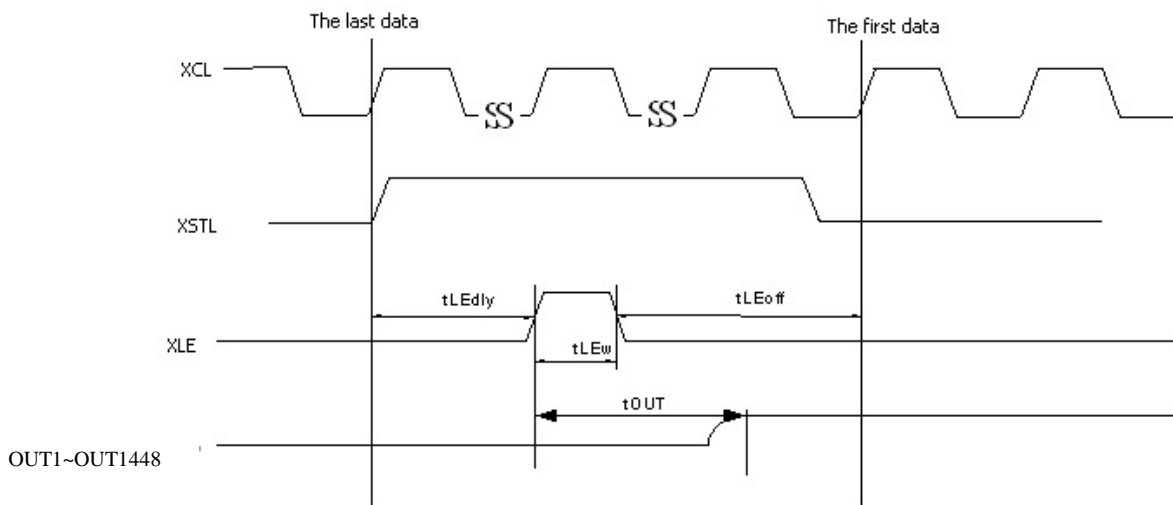
CLOCK & DATA TIMING
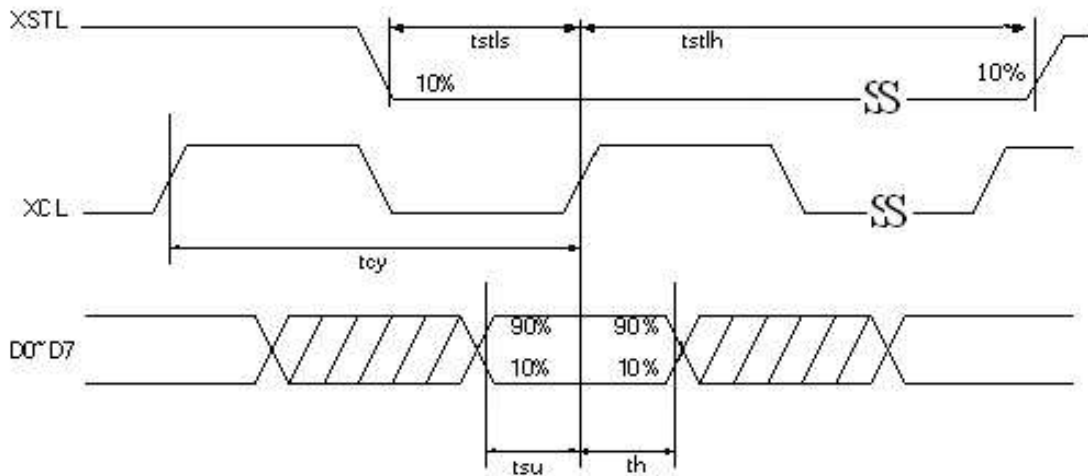
CKV & SPV TIMING
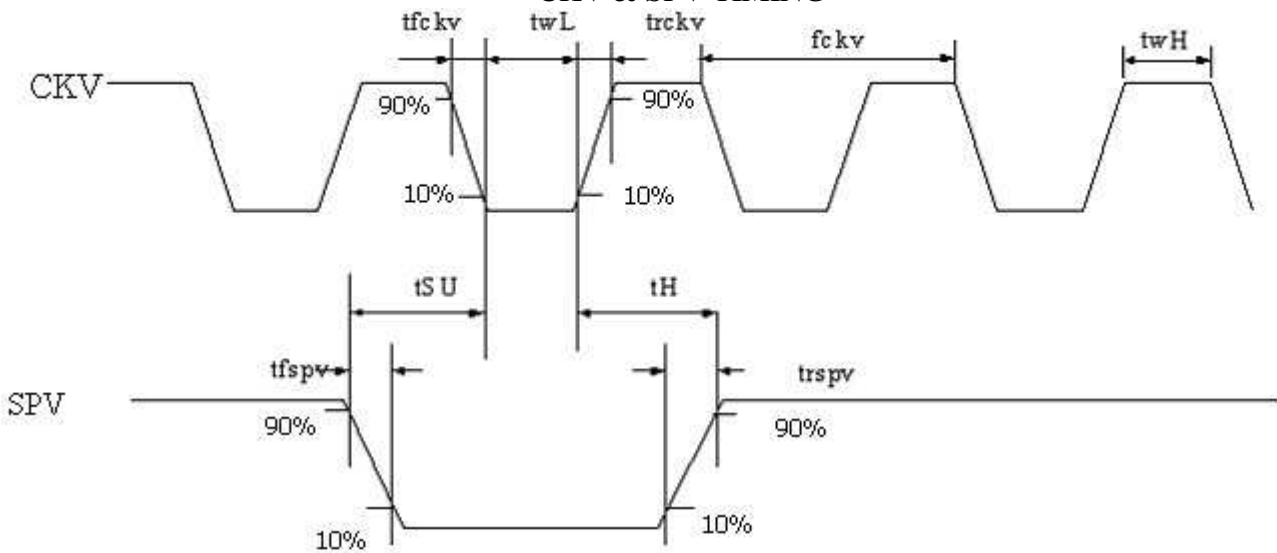
GATE OUTPUT TIMING

Note：First gate line on timing

After 5CKV，gate line is on .

6-5) Controller Timing

This timing mode is depicted on Figure 1 and Figure 2 and it refers to timing of Source Driver Output Enable (SDOE) and Gate Driver Clock (GDCK). Note, that in this mode LGON follows GDCK timing.
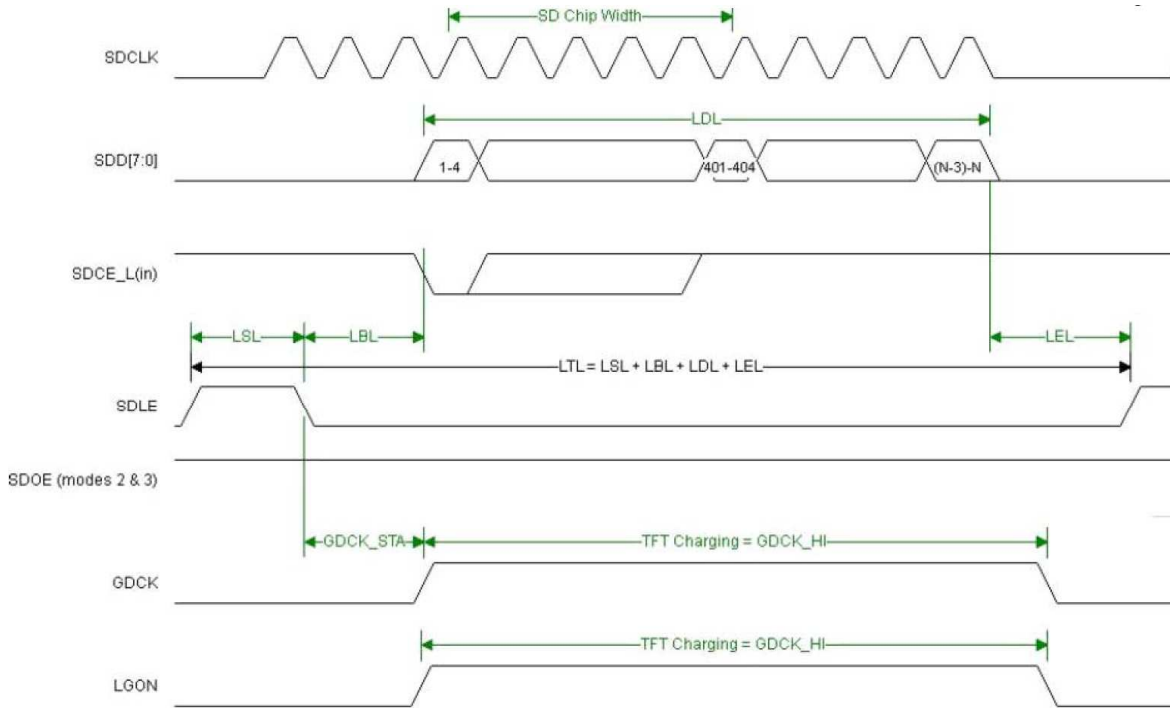
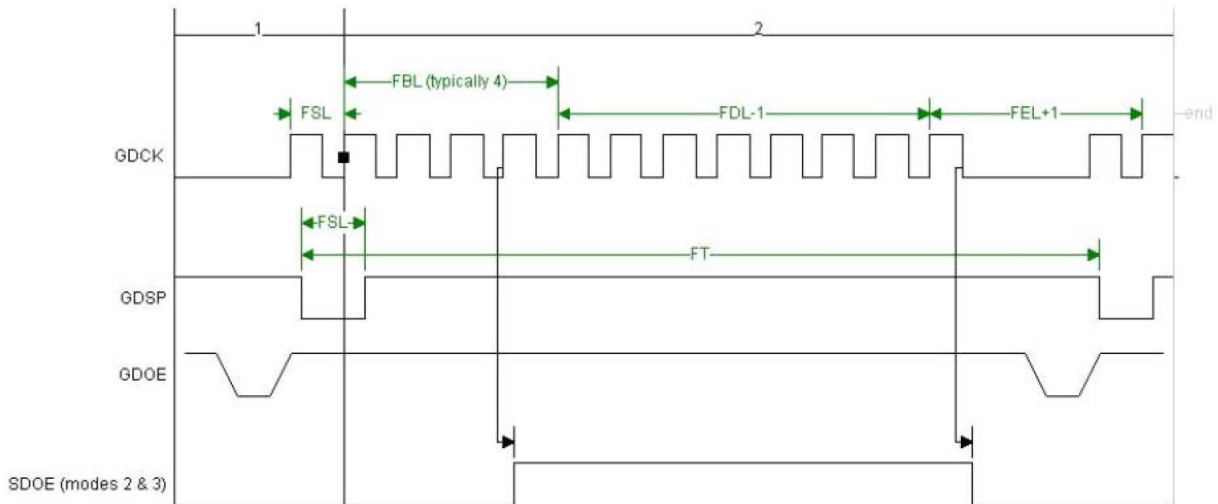

Figure 1 Line Timing in Mode 3

Figure 2 Frame Timing in Mode 3

Table Timing Parameters Table

Mode	3	Resolution 1072*1448					
SDCK【MHz】	40						
Pixels Per SDCK	4						
Line Parameters【SDCK】		LSL	LBL	LDL	LEL	GDCK _STA	LGONL
		14	8	362	51	100	281
Line Parameters【us】		-	-	-	-	-	-
		0.35	0.20	9.05	1.28	2.5	7.03
Frame Parameters【lines】		FSL	FBL	FDL	FEL	-	FR【Hz】
		2	4	1072	4	-	84.99
Frame Parameters【us】						-	-
		21.75	43.5	11658	43.5	-	-

Note 1 : For parameters definition , see Section 6. Active Matrix Electronic Paper Display Timings

Note 2 : For Isis Controller GDCK_STA and LGONL are not settable parameters ; GDCK_STA=LBL, LGONL=LDL+0.5

Note 3 : For Freescale SoC GDOE Low pulse represent FSL and GDSP pulses with the first period of FBL

Note 4:
    SDCLK = XCL
    SDD[7:0] = D0~D7
    SDCE_L(in) = XSTL
    GDCK = CKV
    GDSP = SPV
    GDOE = Mode 1
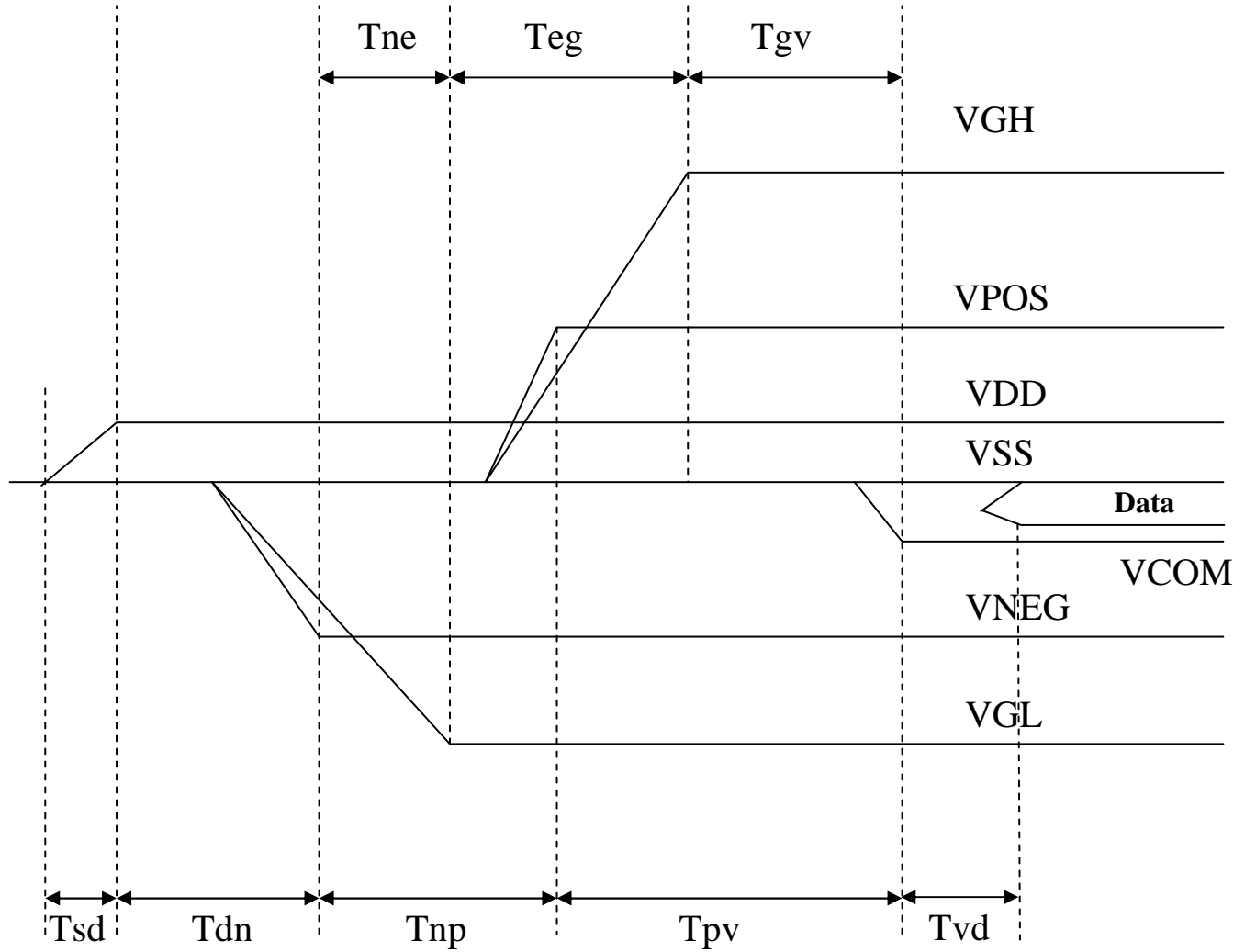   SDOE = XOE

7. Power on Sequence

Power Rails must be sequenced in the following order：

1. VSS → VDD → VNEG → VPOS (Source driver) → VCOM
2. VSS → VDD → VGL → VGH (Gate driver)

POWER ON

	Min	Max
Tsd	30us	-
Tdn	100us	-
Tnp	1000us	-
Tpv	100us	-
Tvd	100us	-
Tne	0us	-
Teg	1000us	-
Tgv	100us	-

POWER DOWN
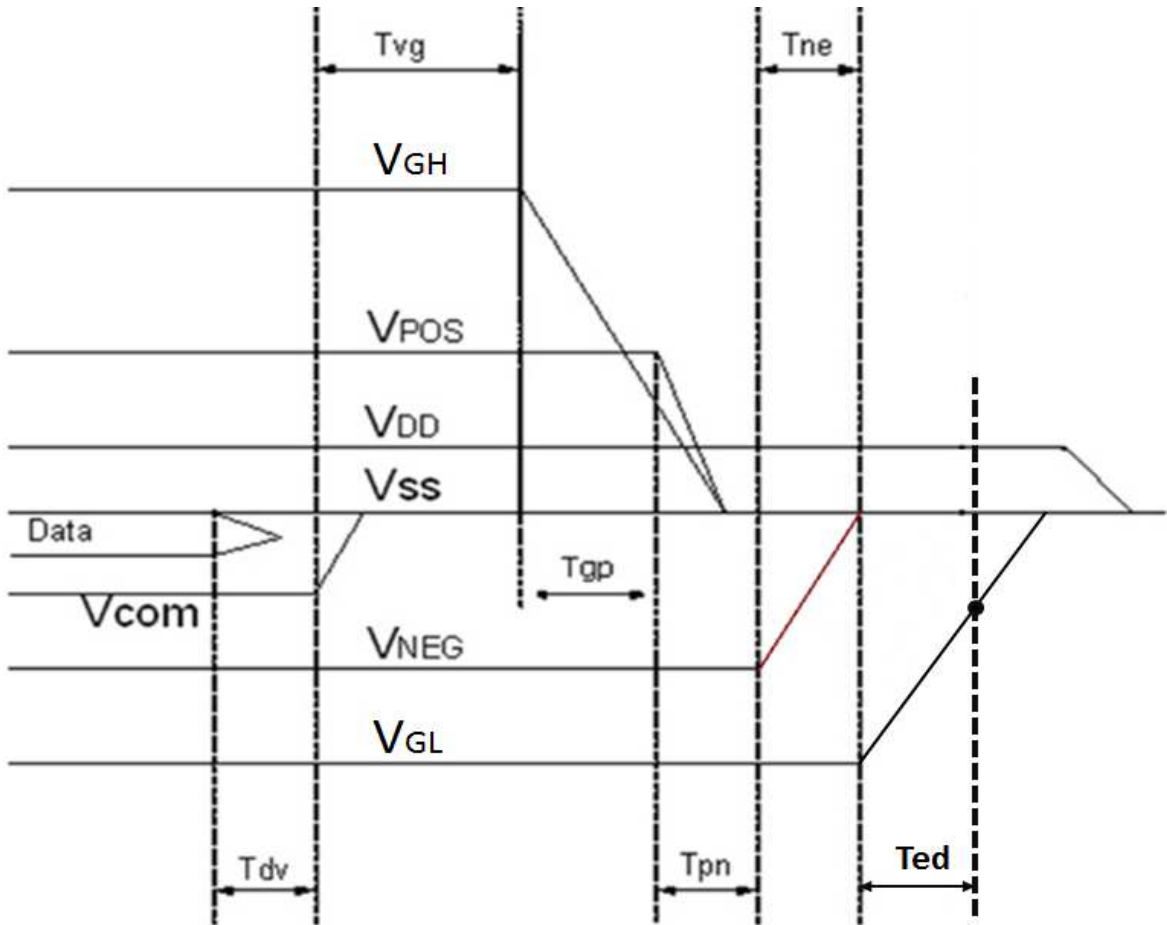
	Min	Max	Remark
Tdv	100μs	-	
Tvg	0μs	-	
Tgp	0μs	-	
Tpn	0μs	-	
Tne	0μs	-	
Ted	0.5s	-	Discharged point @ -7.4 Volt

Note1：Supply voltages decay through pull-down resistors.
Note2：Begin to turn off　VGL　power after VNEG and VPOS are completely or almost discharged to GND state.
Note3：VGL must remain negative of Vcom during decay period

8. Refresh Rate

The module ED060KG1 is applied at a maximum screen refresh rate of 85Hz.

	Min	Max
Refresh Rate	-	85Hz

9. Optical characteristics

9-1) Specifications

Measurements are made by PR655 with MS-75 or equivalent SepctaScan Colorimeter with that the illumination is at an angle 45° from the perpendicular at the center of sample surface, and the detector is perpendicular unless otherwise specified

$T = 25{}^{o}C$

Symbol	Parameter		Conditions		Min	Typ.	Max	Unit	Note
R	Reflectance		White	Front Light off	40	47	-	%	Note 9-1
Gn	N_{th} Grey	-			-	$DS+(WS-DS)\times n /(m-1)$	-	L*	-
	Level								
CR	Contrast Ratio	-			12	17	-	-	Note 9-2
Brightness		$\theta=0°$	Front Light On		-	180	-	cd/㎡	Note 9-4
White Chromaticity	x	$\theta=0°$			0.28	0.32	0.36	-	-
	y				0.30	0.34	0.38	-	
Luminance Uniformity		$\theta=0°$			60	75	-	%	Note 9-5
CR	Contrast Ratio	$\theta=0°$			10	14	-	-	Note 9-6

WS: White state , DS: Dark state, Gray state from Dark to White :DS、G1、G2…、Gn…、Gm-2、WS

m:4、8、16　when 2、3、4 bits mode

9-2) Definition of contrast ratio for Front light off mode

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

CR = Rl/Rd
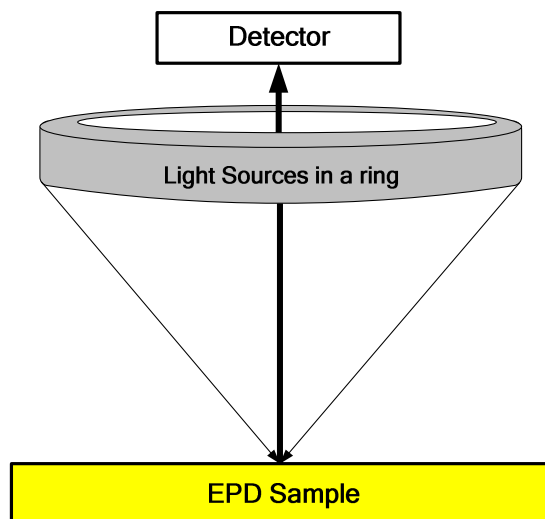
9-3) Reflection Ratio

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.

9-4)Optical characteristics are determined after the front light has been 'ON' and stable for approximately 60 minutes in a dark environment at 25℃. The values specified are at an approximate distance 50cm

from the EPD display surface at a viewing angle of Φ and θ equal to 0°.
The typical luminance value is measured at LED current 20 mA.

9-5) The uniformity is defined as

$$U = \frac{\text{The Minimum Brightness of the 9 testing Points}}{\text{The Maximum Brightness of the 9 testing Points}}$$

Ambient illumination : < 1 Lux

Measuring direction : Perpendicular to the surface of module

The test pattern is white
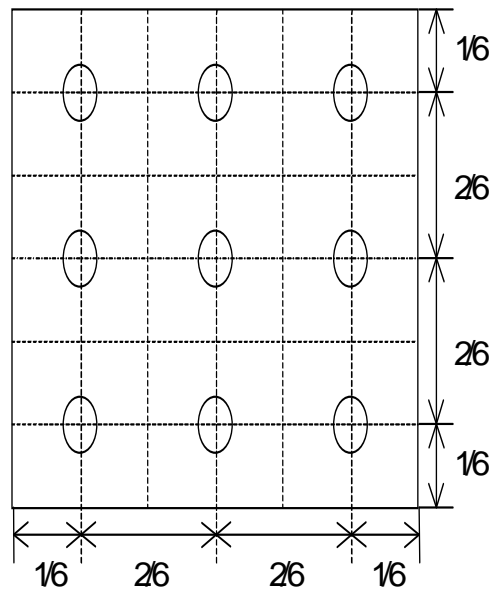
9-6) Definition of contrast ratio for Front light on mode

$$CR = \frac{\text{Luminance when Testing point is White}}{\text{Luminance when Testing point is Black}}$$

10. HANDLING, SAFETY AND ENVIROMENTAL 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 formal specifications.
Limiting values	

Data sheet status

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.

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.

11. Reliability test

	TEST	CONDITION	METHOD	REMARK
1	High-Temperature Operation	T = +50°C, RH = 30% for 240 hrs	IEC 60 068-2-2Bp	--
2	Low-Temperature Operation	T = 0°C for 240 hrs	IEC 60 068-2-2Ab	--
3	High-Temperature Storage	T = +60°C, RH = 26% for 240 hrs	IEC 60 068-2-2Bp	
4	Low-Temperature Storage	T = -25°C for 240 hrs Test in white pattern	IEC 60 068-2-1Ab	
5	High-Temperature, High-Humidity Operation	T = +40°C, RH = 90% for 168 hrs	IEC 60 068-2-3CA	
6	Temperature Cycle	-25℃→+70℃ , 100 Cycles 30min 30min Test in white pattern	IEC 60 068-2-14	--
7	Solar radiation test	765 W/m^2 for 168hrs,40℃ Test in white pattern	IEC60 068-2-5Sa	--
8	Package Vibration	1.04G, Frequency: 10~500Hz Direction: X,Y,Z Duration: 1 hours in each direction	Full packed for shipment	--
9	Package Drop Impact	Drop from height of 122 cm on concrete surface. Drop sequence: 1 corner,3 edges,6 faces One drop for each.	Full packed for shipment	--
10	Stylus Tapping	POLYACETAL Pen: Top R:0.8mm Load: 300gf Speed: 2 times/sec Total 13,500times,	--	Test with bezel and device to simulate full product test.
11	Electrostatic Effect (non-operating)	(Machine model)+/- 250V 0Ω, 200pF	IEC 62179, IEC 62180	--

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. (including : line defect ,no image). All the cosmetic specification is judged before the reliability stress.

12. Bar Code definition

12-1) Panel Barcode Label

EDJ	00	9	01	1	P	7	4	00361	A	T
1	2	3	4	2	5	6	2	7	2	8

1 ：EPD model code:

　　ED060KG1 : EDJ,EDR

2 ：Internal control codes:Do not care

3 ：FPL reversion code

　　Carta：9,R

4 ：FPL batch code:

01~99	001~099	G0~G9	160~169	Q0~Q9	230~239	X0~X9	300~309
A0~A9	100~109	H0~H9	170~179	R0~R9	240~249	Y0~Y9	310~319
B0~B9	110~119	J0~J9	180~189	S0~S9	250~259	Z0~Z9	320~329
C0~C9	120~129	K0~K9	190~199	T0~T9	260~269		
D0~D9	130~139	L0~L9	200~209	U0~U9	270~279		
E0~E9	140~149	M0~M9	210~219	V0~V9	280~289		
F0~F9	150~159	N0~N9	220~229	W0~W9	290~299		

5 ：Year:

　　N: 2013 / P: 2014 / Q: 2015 / R: 2016 /... / Z: 2024

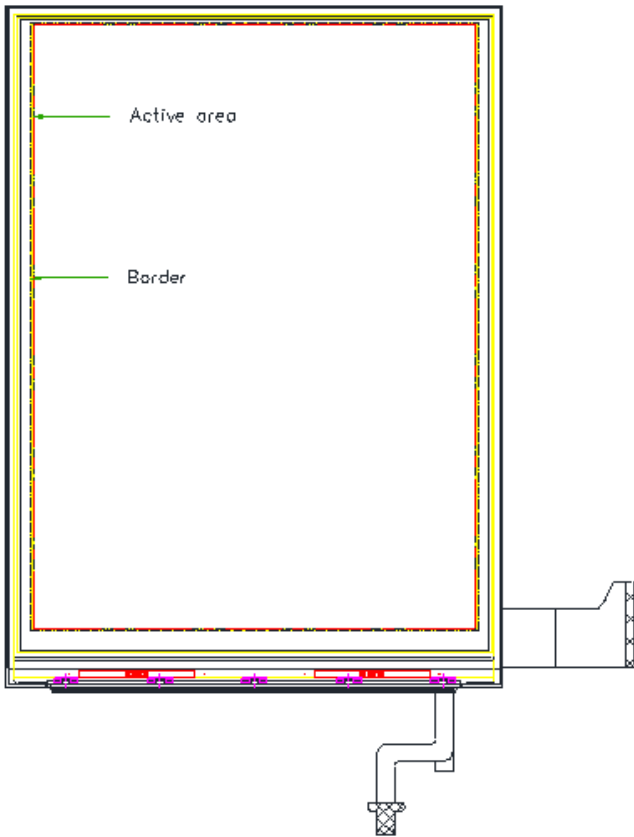6 ：Month:

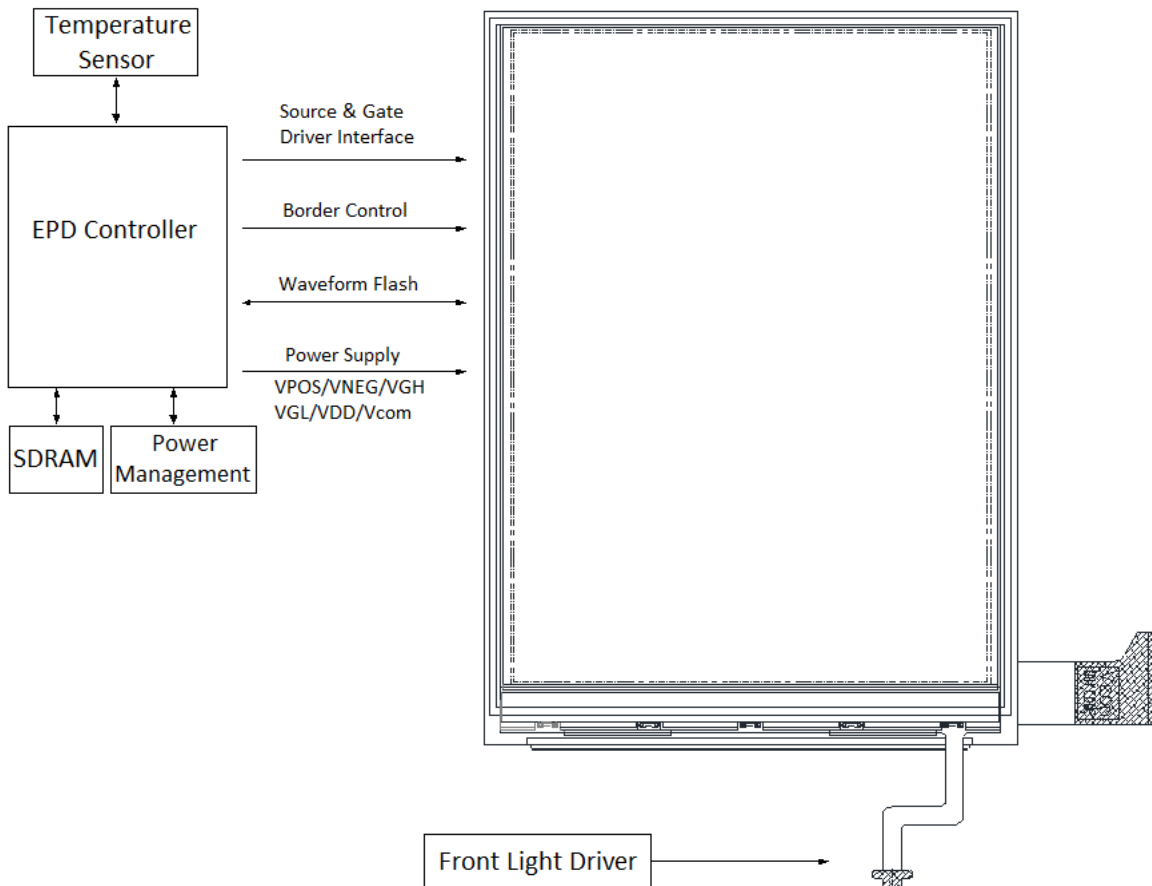　　1:Jan.　2:Feb. ... 9:Sep. A:Oct. B:Nov. C:Dec.

7 ：Serial number

　　00000-99999

8 ：MFG code:
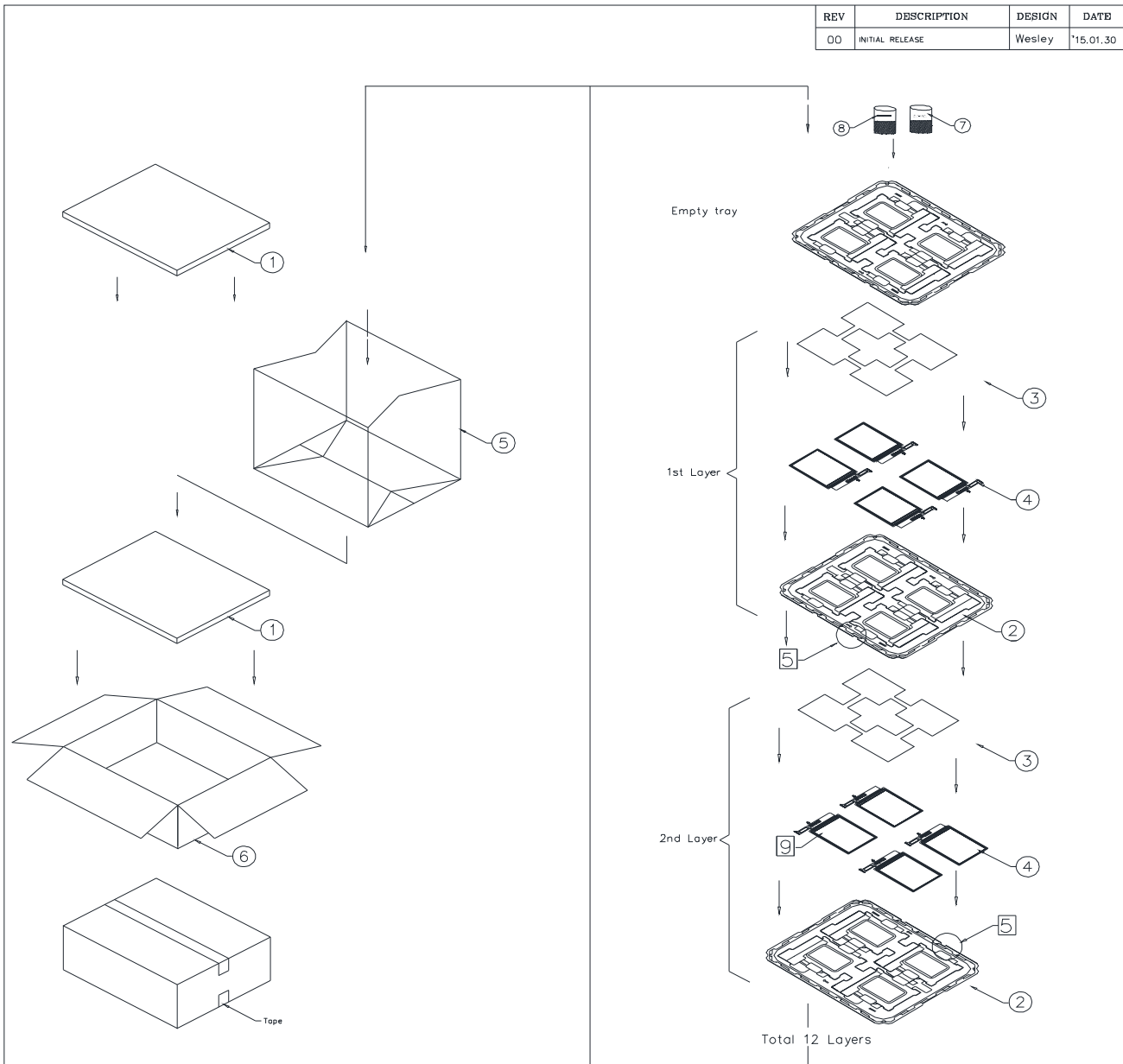　　 E Ink Yanzhou :　FAB1: K ,　FAB2 : Y,　FAB3 : T,　FAB4 : L,　FAB5 : G,
　　 E Ink Hsinchu : P

![E Ink 元太科技 E Ink Holdings]

13. Border definition

14.Block Diagram

15.Packing

REV	DESCRIPTION	DESIGN	DATE
00	INITIAL RELEASE	Wesley	'15.01.30

Empty tray

1st Layer

2nd Layer

Total 12 Layers

9	EASY TAPE	48	For Remove Protect Sheet
8	30g 加厚複合紙活礦乾燥劑73*95mm	2	
7	防鏽劑(保護容積25L)	3	
6	CARTON INTERNAL	1	
5	摺口袋450*380*700mm	1	抗靜電
4	ED060KG1	48	
3	EPE CUSHION SHEET	12	抗靜電
2	TRAY	13	抗靜電
1	EPE FOAM	2	
ITEM	DESCRIPTION	QTY	REMARK

NOTE:
1. One layer include: 1 piece of cushion sheet, 4 pcs module & 1 piece of tray.
2. Q'TY: 48 pcs panel/carton.
3. Dimension: 455*375*190mm
4. Make sure tray stacked with 180° rotation. We can check this by lateral side view.

MTL.SPEC.	UNSPECIFIED TOL'S ±5.0mm	REMARK		
	ANGLE			
	ROUGHNESS			

APPROVE	Jimmy Chen	'15.01.30	SCALE 1:1	UNIT mm	SHEET 1 OF 1	DWG.TITLE
CHECK	Jimmy Chen	'15.01.30				ED060KG1 PACKING Dim
DESIGN	Wesley Huang	'15.01.30	MTL.NO.		DWG.NO.	REV. 01 / A4 SIZE

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