6.0 inch
E-paper Display Series

GooDisplay®

GDEW060C01

Dalian Good Display Co., Ltd.

Revision History

Rev.	Issued Date	Revised Contents
1.0	May.26.2020	Preliminary
1.1	Jun.08.2020	1. In part 10: Modify Reliability test. 2. In part 4: Modify module.

TECHNICAL SPECIFICATION

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1. Over View

The display is a TFT active matrix electrophoretic display, with interface and a reference system design. The 6” active area contains 1072×1448 pixels, and has 2-16 gray levels (1-4 bits) white/black full display capabilities.

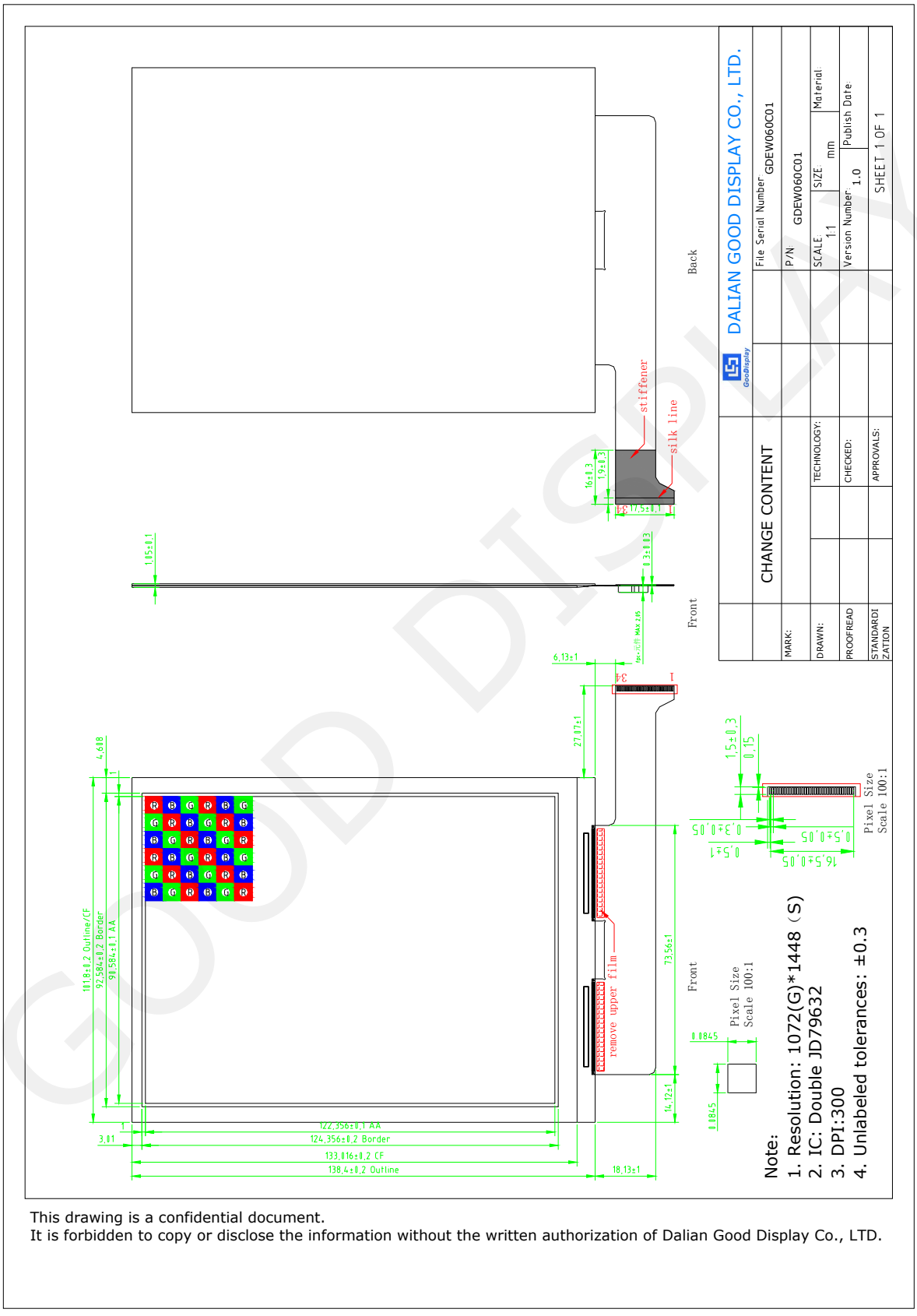
2. Features

- Carta high contrast reflective/electrophoretic technology
- 1072 x 1448 resolution
- Ultra wide viewing angle
- Low power consumption
- Pure reflective mode
- Bi-stable
- Commercial temperature range
- Landscape, portrait mode

3. Mechanical Specifications

Parameter	Specifications	Unit	Remark
Screen Size	6	Inch	
Display Resolution	1072(H)×1448(V)	Pixel	Dpi: 300
Active Area	90.584(H)×122.356(V)	mm	
Pixel Pitch	0.0845×0.0845	mm	
Pixel Configuration	Square		
Outline Dimension	101.8(H)×138.4(V) ×1.05(D)	mm	
Weight	34.4±1	g	

4. Mechanical Drawing of DES module



5. Input/Output Terminals

5-1) Pin out List

Pin #	Single	Description
1	VNEG	Negative power supply source driver
2	VGL	Negative power supply gate driver
3	VSS	Ground
4	NC	No connection
5	NC	No connection
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 gate 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	NO Connection
23	NC	NO Connection
24	NC	NO Connection
25	NC	NO Connection
26	VSS	Ground
27	MODE1	Output mode selection gate driver
28	CKV	Clock gate driver
29	SPV	Start pulse gate driver
30	NC	NO Connection
31	BORDER	Border connection
32	VSS	Ground
33	VPOS	Positive power supply source driver
34	VGH	Positive power supply gate driver

6. Electrical Characteristics

6-1) Absolute maximum rating

Parameter	Symbol	Rating	Unit
Logic Supply Voltage	VDD	-0.3 to +5	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	VGG	-0.3 to +45	V
Supply Voltage	VEE	-25.0 to +0.3	V
Supply Range	VGG-VEE	-0.3 to +45	V
Operating Temp. range	T_{OPR}	-10 to +60	℃
Storage Temp. range	T_{STG}	-25 to +75	℃

6-2) Panel DC Characteristics

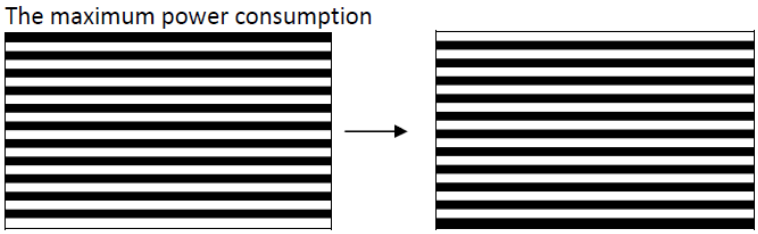
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Single ground	V_{SS}		-	0	-	V
Logic Supply Voltage	V_{DD}		1.7	3.0	3.6	V
	I_{VDD}	V_{DD}=3.0V	-	3.1	7.8	mA
Gate Negative Supply	VGL		-20	-	VNEG-4	V
	I_{GL}	VGL=-20V	-	1.2	12	mA
Gate Positive Supply	VGH		7	VGL+42	VGL+45	V
	I_{GH}	VGH=22V	-	1.2	2.5	mA
Source Negative Supply	V_{NEG}		-15.4	-	-10	V
	I_{NEG}	V_{NEG} = -15V	-	8.5	160	mA
Source Positive Supply	V_{POS}		10	-	15	V
	I_{POS}	V_{POS} = 15V	-	8.2	166	mA
Border Supply	V_{com}		-4	Adjusted	-0.2	V
Asymmetry Source	V_{ASYM}	V_{POS} + V_{NEG}	-800	0	800	mV
Common voltage	V_{COM}		-4	Adjusted	-0.2	V
	I_{COM}		-	0.2	-	mA
Panel Power	P		-	285	4680	mW
Standby power panel	P_{STBY}		-	-	1.3	mW

- The maximum power consumption is measured using 85 Hz 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 1)
- The Typical power consumption is measured using 85 Hz waveform with following pattern transition: from horizontal 4 gray scale pattern to vertical 4 gray scale pattern. (Note 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 Good Display.

- Vcom is recommended to be set in the range of assigned value ± 0.1 V
- The maximum I_{COM} inrush current is about 1000 mA
- Customer need to use decoupling capacitors on each power rail at system board as below table to keep EPD driving power stable. (Note 3)

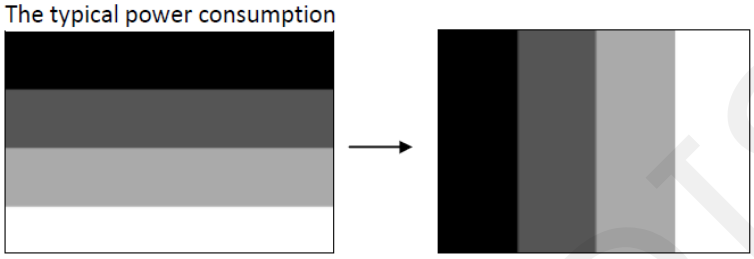
Note 1

The maximum power consumption



Note 2

The typical power consumption



Note 3

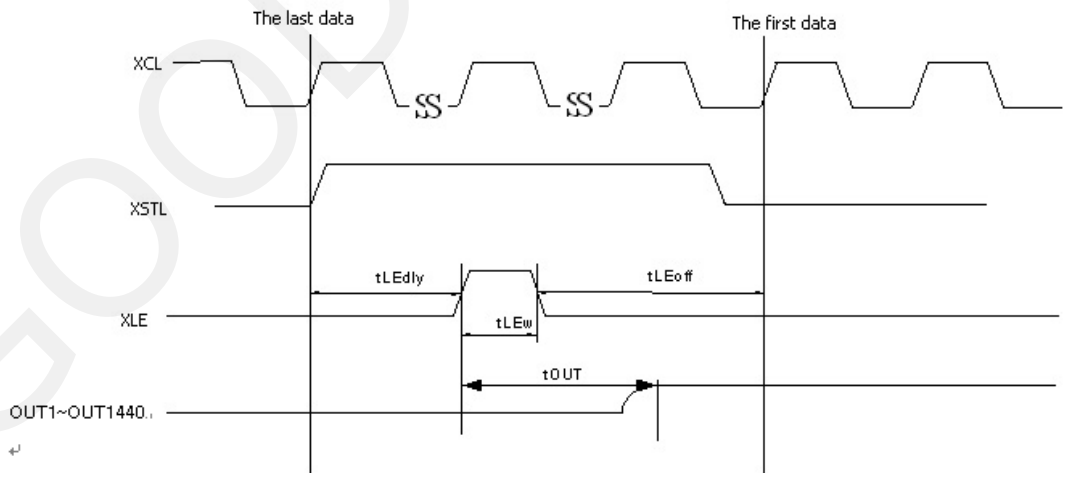
The decoupling capacitors on each power rail at customer system side

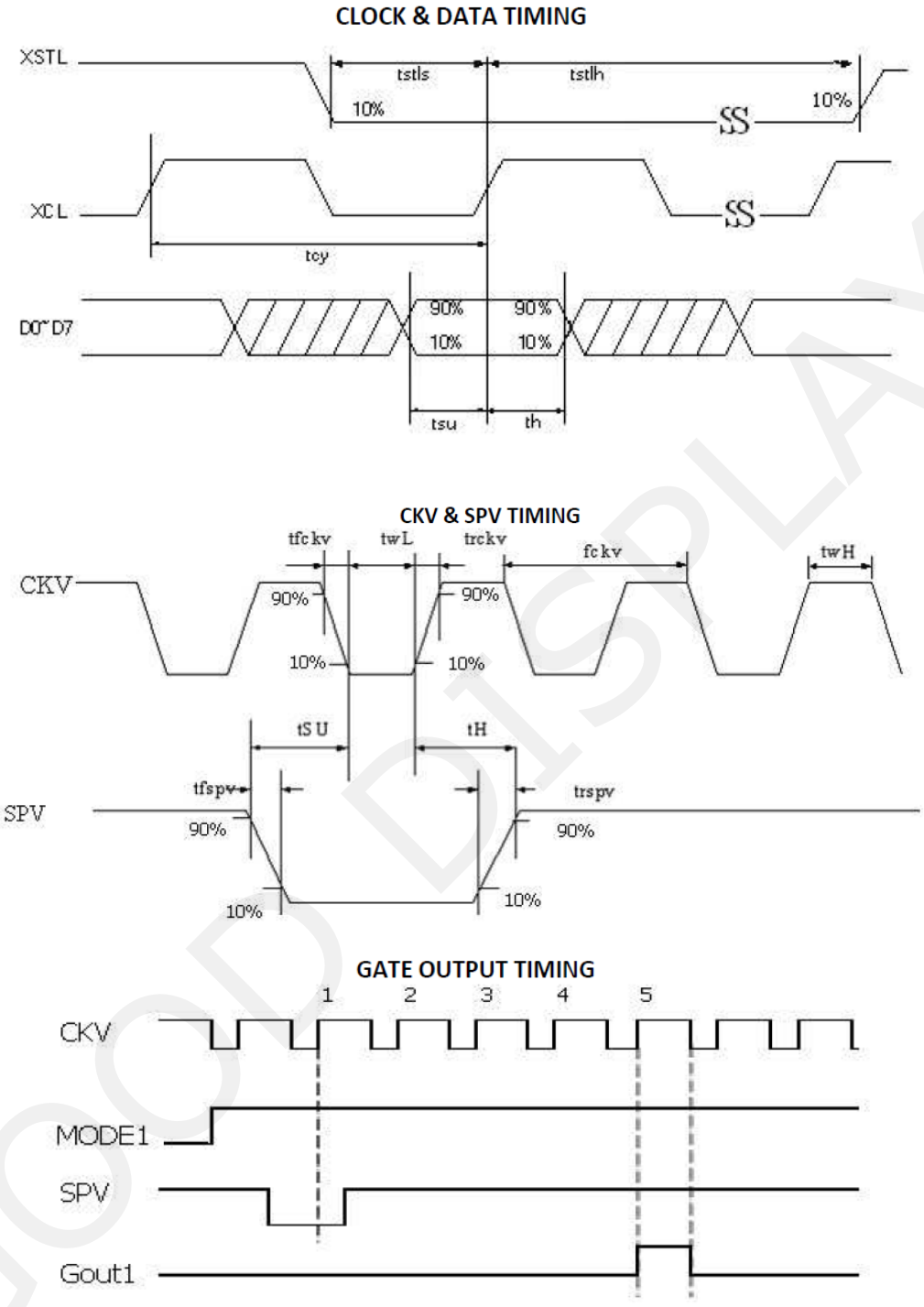
Power rail	Capacitors suggested (uF / Tolerance)
IPOS	4.7uF x 2pcs / ±10%
INEG	4.7uF x 2pcs / ±10%
IGH	4.7uF x 1pcs / ±10%
IGL	4.7uF x 1pcs / ±10%
IDD	4.7uF x 1pcs / ±10%

6-3) Panel AC Characteristics

VDD=3.0V, 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..D7setup 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	-	-	ns
XLE on delay time	tLEdly	4.5*tcy	-	-	ns
LEH 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





Note 1: First gate line on timing . After 5 CKV, gate line be on.

6-4) Refresh rate

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

	Min	Max
Refresh rate	-	85Hz

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.

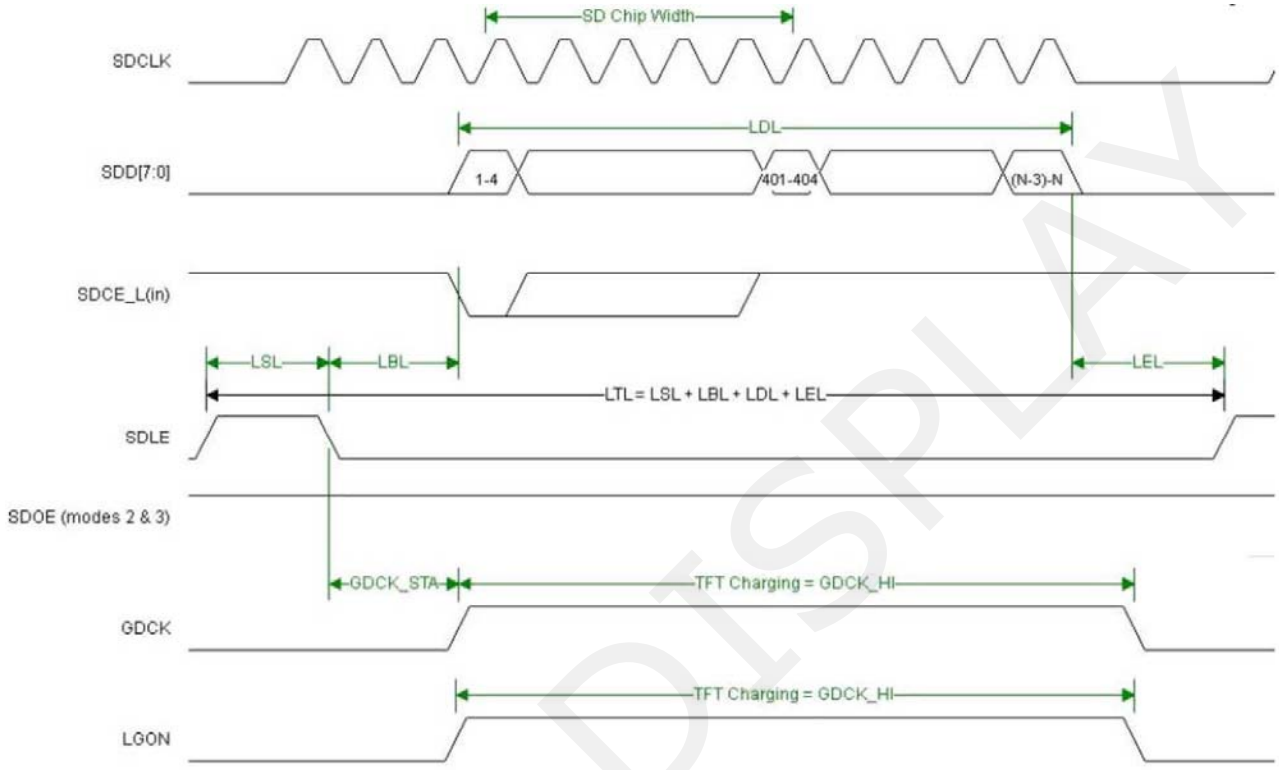


Figure 1 Line Timing in Mode 3

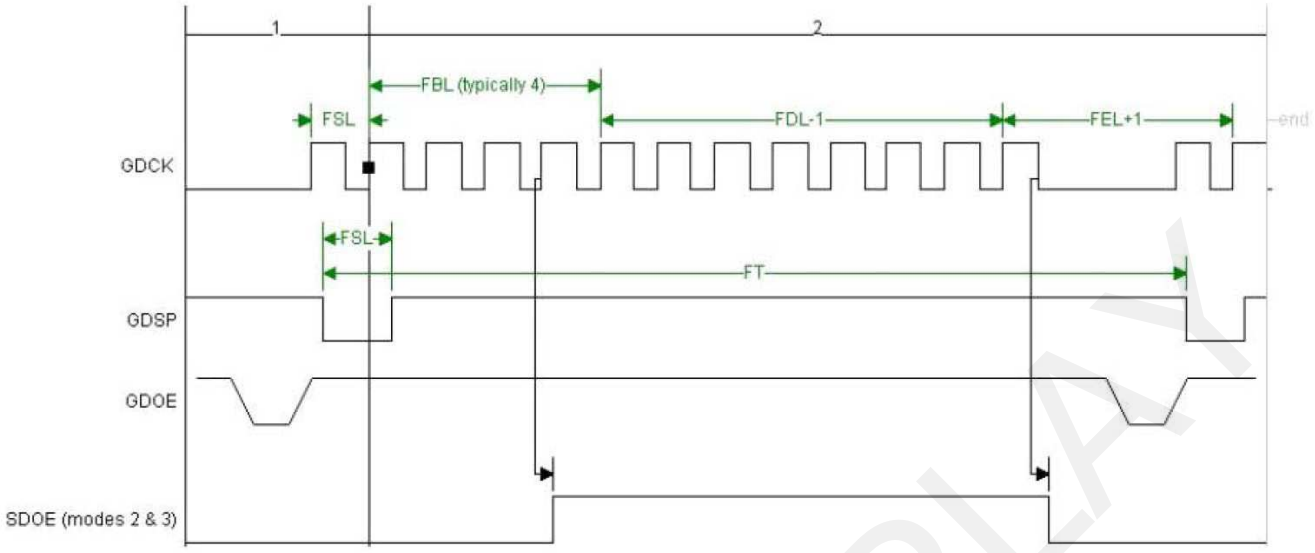


Figure2 Frame Timing in Mode 3

Mode	3					
SDCK(MHz)	40					
Pixel per SDCK	4					
Line Parameters	LSL	LBL	LDL	LEL	GDCK_STA	LGONL
(SDCK)	14	8	362	51	100	281
Line Parameters	-	-	-	-	-	-
(us)	0.35	0.20	9.05	1.28	2.5	7.03
Frame parameters	FSL	FBL	FDL	FEL	-	FR(Hz)
(lines)	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

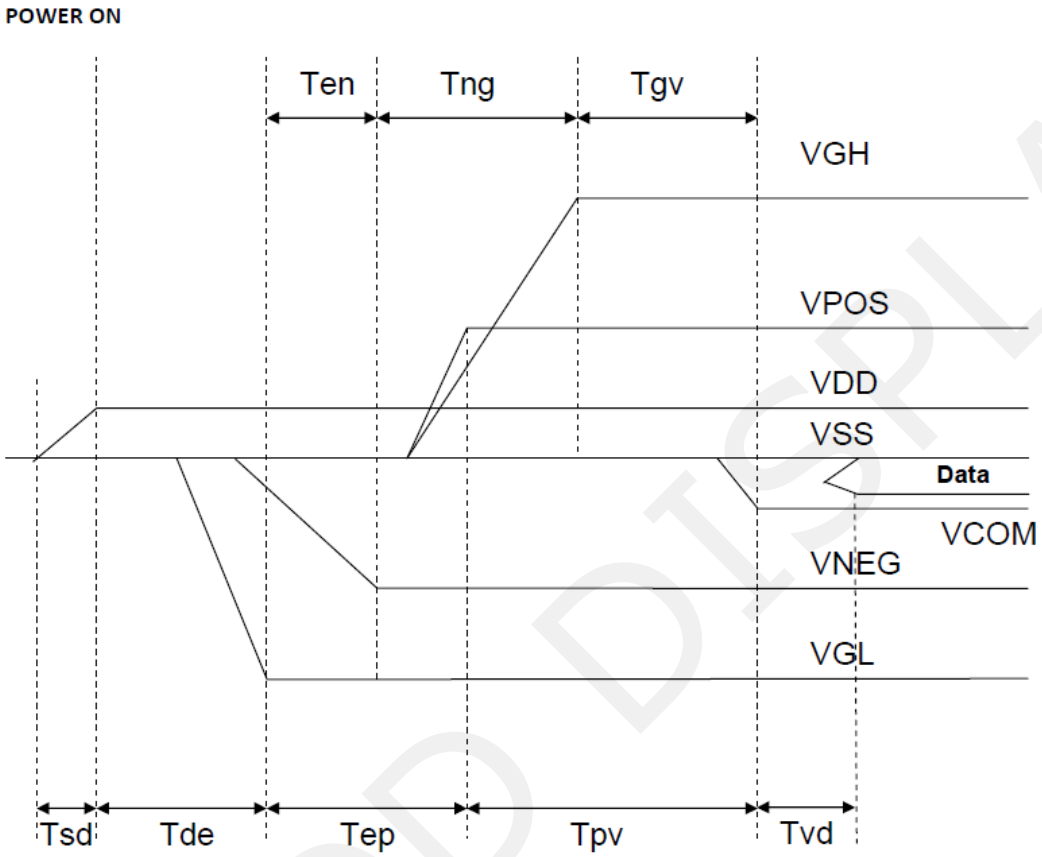
GDOE = Mode 1

SDOE = XOE

7. Power on sequence

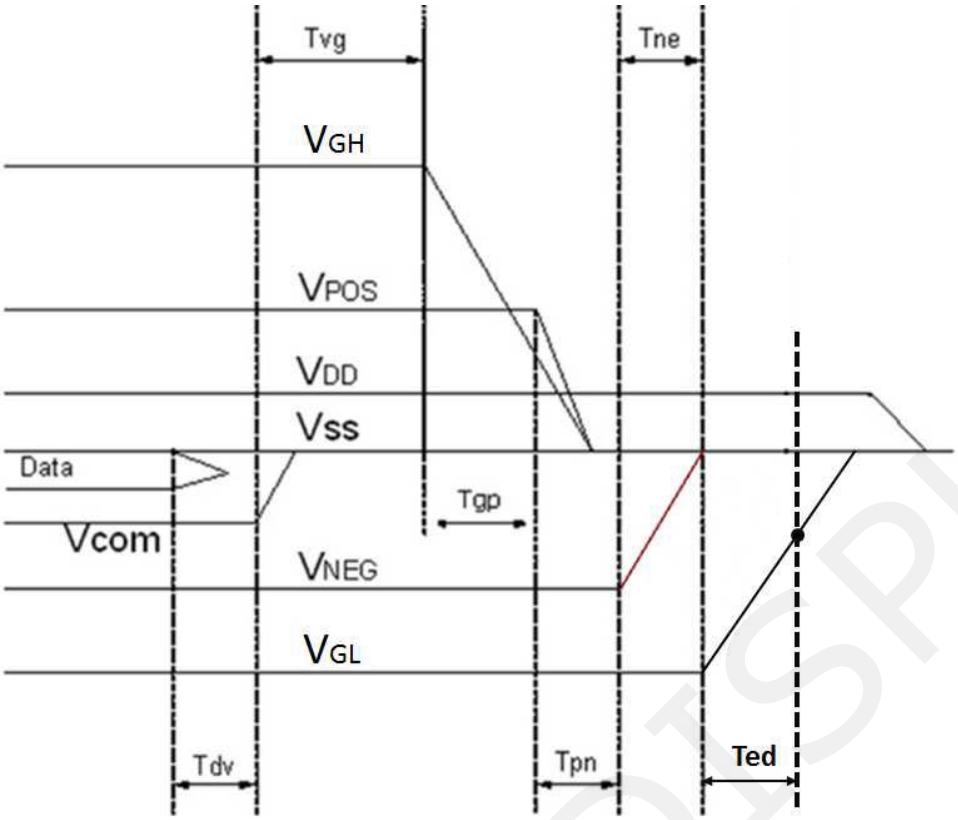
Power Rails must be sequenced in following order:

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



	Min	Max
Tsd	30us	-
Tde	100us	-
Tep	1000us	-
Tpv	100us	-
Tvd	100us	-
Ten	0us	-
Tng	1000us	-
Tgv	100us	-

Power OFF



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

Note 1: Supply voltages decay through pull-down resistors.

Note 2: Turn off VGL power after VNEG and VPOS power discharged to GND state.

Note 3: VGL must remain negative of Vcom during decay period.

8. Optical characteristics

8-1) Specifications

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

T=25℃

SYMBOL	PARAMETER	CONDITIONS	MIN	TYPE	MAX	UNIT	Note
R	Reflectance	White	30	35	-	%	Note 8-1
Gn	N_{th} Grey Level	-	-	DS+(WS-DS)×n/(m-1)	-	L*	-
CR	Contrast Ratio	indoor	8		-	-	-
T_{update}	Update time	25℃	-	1	-	Sec	-
Panel's life		-10℃~60℃		1000000 times or 5 years	-	-	Note 8-2

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 bit mode.

Note 8-1: Luminance meter: Eye – One Pro Spectrophotometer

Note 8-2: Each update interval time should be minimum at 180 seconds.

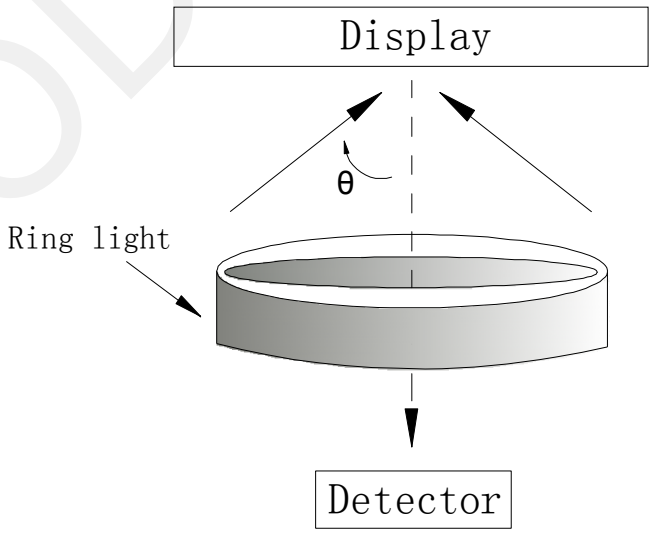
Note 8-3: When work in temperature 60 degree, suggest update once every 1hours.

9-2) Definition of contrast ratio

The contrast ratio (CR) is the ratio between the reflectance in a full white area (R1) and the reflectance in a dark area (Rd)() :

R1: white reflectance Rd: dark reflectance

CR = R1/Rd

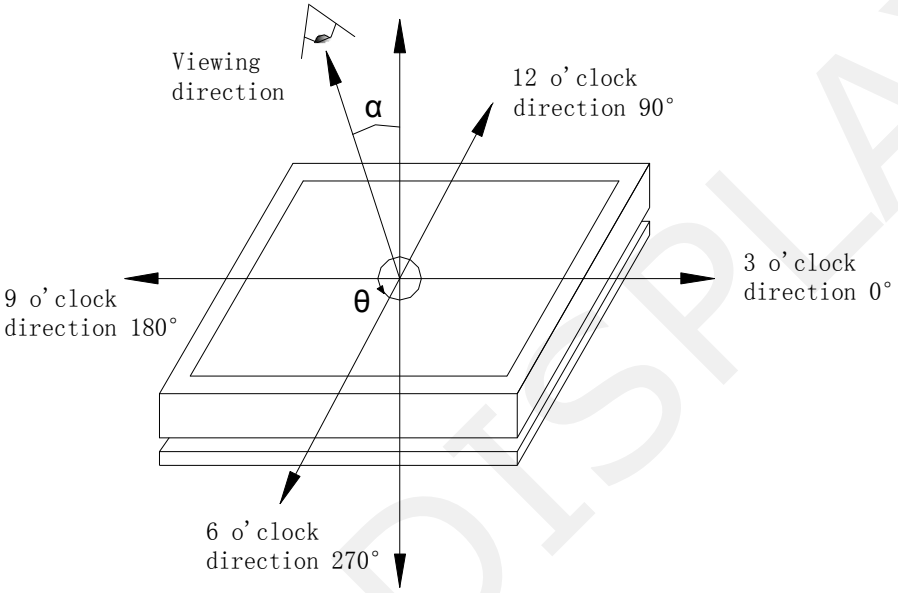


8-3) Reflection Ratio

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

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.

Observe general precautions that are common to handling delicate electronic components. The glass can break and front surfaces can easily be damaged. Moreover the display is sensitive to static electricity and other rough environmental conditions.

Data sheet status	
Product specification	The 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 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 dose not form part of the specification.	

Product environmental certification
RoHS

10. Reliability test

	TEST	CONDITION	METHOD	REMARK
1	High-Temperature Operation	T = 60℃, RH=20% for 240 hrs	When the experimental cycle finished, the DES samples will be taken out from the high temperature environmental chamber and set aside for a few minutes. As DESs return to room temperature, testers will observe the appearance, and test electrical and optical performance based on standard # IEC 60 068-2-2Bp.	When experiment finished, the DES must meet electrical and optical performance standards.
2	Low-Temperature Operation	T = -10℃ for 240 hrs	When the experimental cycle finished, the DES samples will be taken out from the low temperature environmental chamber and set aside for a few minutes. As DESs return room temperature, testers will observe the appearance, and test electrical and optical performance based on standard # IEC 60 068-2-2Ab.	When experiment finished, the DES must meet electrical and optical performance standards.
3	High-Temperature Storage	T = +70℃, RH=20% for 240 hrs Test in white pattern	When the experimental cycle finished, the DES samples will be taken out from the high temperature environmental chamber and set aside for a few minutes. As DESs return to room temperature, testers will observe the appearance, and test electrical and optical performance based on standard # IEC 60 068-2-2Bp.	When experiment finished, the DES must meet electrical and optical performance standards.
4	Low-Temperature Storage	T = -25℃ for 240 hrs Test in white pattern	When the experimental cycle finished, the DES samples will be taken out from the low temperature environmental chamber and set aside for a few minutes. As DESs return to room temperature, testers will observe the appearance, and test electrical and optical performance based on standard # IEC 60 068-2-2Ab	When experiment finished, the DES must meet electrical and optical performance standards.
5	High Temperature, High-Humidity Operation	T=+40℃, RH=90% for240hrs	When the experimental cycle finished, the DES samples will be taken out from the environmental chamber and set aside for a few minutes. As DESs return to room temperature, testers will observe the appearance, and test electrical and optical performance based on standard # IEC 60 068-2-3CA.	When experiment finished, the DES must meet electrical and optical performance standards.
6	High Temperature, High-Humidity Storage	T=+60℃, RH=80% for 240 hrs Test in white pattern	When the experimental cycle finished, the DES samples will be taken out from the environmental chamber and set aside for a few minutes. As DESs return to room temperature, testers will observe the appearance, and test electrical and optical performance based on standard # IEC 60 068-2-3CA.	When experiment finished, the DES must meet electrical performance standards.
7	Temperature Cycle	[-25℃ 30mins]→ [+70℃, RH=20% 30mins],	1. Samples are put in the Temp & Humid. Environmental Chamber. Temperature cycle starts with -25℃, storage period 30 minutes. After 30 minutes, it needs 30min to	When experiment finished, the DES must meet electrical

		70cycles, Test in white pattern	let temperature rise to 75℃. After 30min, temperature will be adjusted to 75℃, RH=20% and storage period is 30 minutes. After 30 minutes, it needs 30min to let temperature rise to -25℃. One temperature cycle (2hrs) is complete. 2. Temperature cycle repeats 70 times. 3. When 70 cycles finished, the samples will be taken out from experiment chamber and set aside a few minutes. As DESs return to room temperature, tests will observe the appearance, and test electrical and optical performance based on standard # IEC 60 068-2-14NB.	and optical performance standards.
8	UV exposure Resistance	765 W/m^2 for 168 hrs,40℃	Standard # IEC 60 068-2-5 Sa	
9	Electrostatic discharge	Machine model: +/-250V, 0Ω,200pF	Standard # IEC61000-4-2	
10	Package Vibration	1.04G,Frequency : 10~500Hz Direction : X,Y,Z Duration:1hours in each direction	Full packed for shipment	
11	Package Drop Impact	Drop from height of 122 cm on Concrete surface Drop sequence:1 corner, 3edges, 6face One drop for each.	Full packed for shipment	

Actual EMC level to be measured on customer application.

Note: (1) The protective film must be removed before temperature test.

(2) In order to make sure the display module can provide the best display quality, the update should be made after putting the display module in stable temperature environment for 4 hours at 25℃.

11. Point and line standard

Shipment Inseption Standard

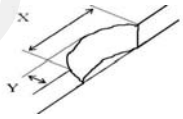
Part-A：Active area Part-B：Border area

Equipment：Electrical test fixture, Point gauge

Outline dimension：

101.8(H)×138.4(V) ×1.05(D) Unit：mm

Environment	Temperature	Humidity	Illuminance	Distance	Time	Angle
	23±2℃	55± 5%RH	1200～ 1500Lux	300 mm	35 Sec	

Name	Causes	Spot size		Part-A	Part-B
Spot	B/W spot in glass or protection sheet, foreign mat. Pin hole	D ≤ 0.25mm		Ignore	Ignore
		0.25mm ＜ D ≤ 0.4mm		4	
		0.4mm ＜ D ≤ 0.5mm		2	
		0.5mm ＜ D		0	
Scratch or line defect	Scratch on glass or Scratch on FPL or Particle is Protection sheet.	Length	Width	Part-A	Ignore
		L ≤3mm	W≤0.1 mm	Ignore	
		3 mm < L≤ 6mm	0.1 mm<W≤ 0.2mm	2	
		6 mm < L	0.2mm < W	0	
Air bubble	Air bubble	D1, D2 ≤ 0.3 mm		Ignore	Ignore
		0.3 mm < D1,D2 ≤ 0.5mm		4	
		0.5mm < D1, D2		0	
Side Fragment					
	X≤6mm，Y≤1mm & display is ok, Ignore				

Remarks: Spot define: That only can be seen under WS or DS defects.

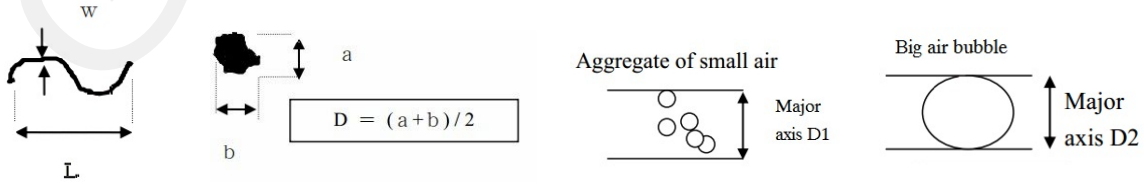
Any defect which is visible under gray pattern or transition process but invisible under black and white is disregarded.

Here is definition of the “Spot” and “Scratch or line defect”.

Spot: W > 1/4L Scratch or line defect: W ≤1/4L

Definition for L/W and D (major axis)

FPC bonding area pad doesn’t allowed visual inspection.



Note: AQL = 0.4

12. Packing

TBD