



SPECIFICATION



EC058TC1

5.84", 720x1440 B/W, 240x480 Color, TTL

Version: 1.0

Date: 23.06.2020

Note: This specification is subject to change without prior notice

www.data-modul.com

Version: 1.0

Technical Specification

MODEL NO: SA1452-EHA
(EC058TC1)

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

Approval by

Confirmed by

Prepared by

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Revision History

Rev.	Issued Date	Revised / Contents
1.0	Jun, 23 , 2020	First initial

TECHNICAL SPECIFICATION

CONTENTS

<i>NO.</i>	<i>ITEM</i>	<i>PAGE</i>
-	Cover	1
-	Revision History	2
-	Contents	3
1	General Description	3
2	Features	3
3	Mechanical Specifications	4
4	Mechanical Drawing of Display module	5
5	Input/Output Interface	6
6	Display Module Electrical Characteristics	8
7	Power Sequence	14
8	Optical Characteristics	16
9	Handling, Safety and Environment Requirements And Remark	18
10	Reliability test	20
11	Border definition	21
12	Block Diagram	22
13	Packing	23

1. General Description

SA1452-EHA (EC058TC1) as a reflective electrophoretic E Ink® technology display module with color based on active matrix TFT substrate. It has 5.84" active area with 720 x 1440 pixels, the display is capable to display images with Black/White at 2-16 gray levels (1-4 bits), color mode at 480 x 240 pixels with 4096 color depending on the display controller and the associated waveform file it used.

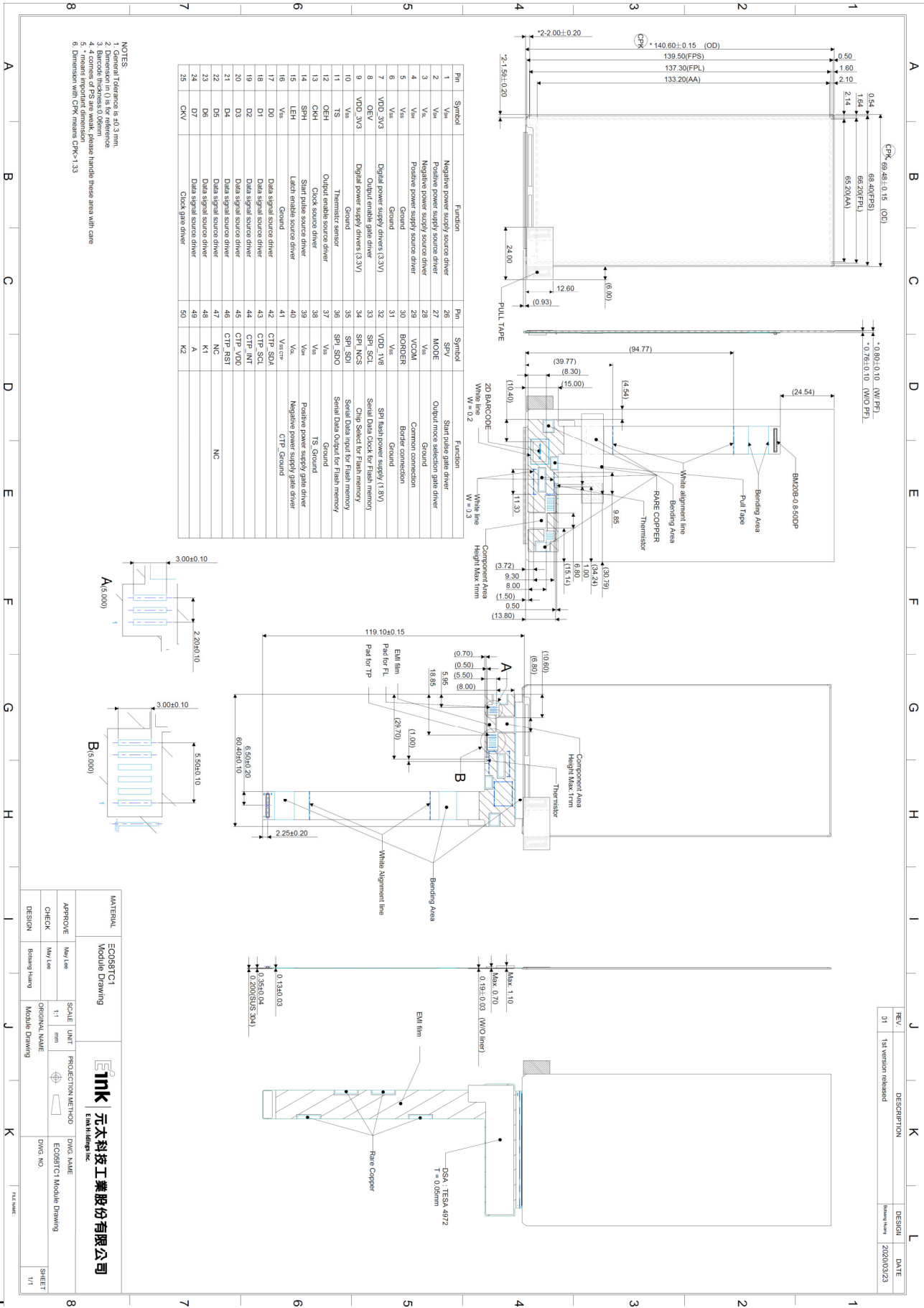
2. Features

- Carta High contrast reflective/electrophoretic technology
- 4096 colour
- 720 x 1440 B/W display, 240 x 480 colour display
- High reflectance
- Ultra wide viewing angle
- Ultra low power consumption
- Pure reflective mode
- Bi-stable
- Commercial temperature range
- Portrait mode

3. Mechanical Specifications

Parameter	Specifications	Unit	Remark
Screen Size	5.84	Inch	
Display Resolution	B/W 720 (H)×1440(V), Color 240(H)×480(V)	Pixel	4096 color
Active Area	65.16 (H)×133.2 (V)	mm	
Pixel Pitch	90.5 (H) × 92.5 (V)	μm	
Pixel Configuration	Rectangle		
Outline Dimension	69.48 (W) × 140.60 (H) × 0.76 (D)	mm	w/o PF
Module Weight	15.9+/-1.6	g	w/o PF
Number of Gray	16 Gray Level (monochrome)		
Display operating mode	Reflective mode		

4. Mechanical Drawing of Display Module



5. Input/output Interface

5-1) Connector type: BM20B(0.8)-50DP-0.4V(51)-ND

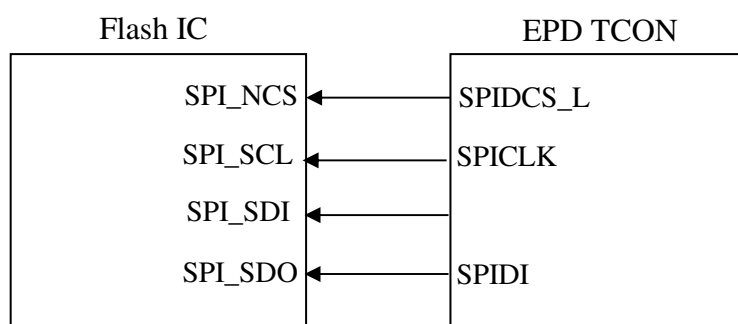
5-2) Pin Assignment

Pin #	Signal	I/O	Description	Remark
1	V _{SL}	P	Negative power supply source	
2	V _{SH}	P	Positive power supply source	
3	V _{SL}	P	Negative power supply source	
4	V _{SH}	P	Positive power supply source	
5	V _{SS}	P	Ground	
6	V _{SS}	P	Ground	
7	V _{DD}	P	Digital power supply drivers (3.3V)	
8	OE _V	I	Output enable of gate driver	
9	V _{DD}	P	Digital power supply drivers (3.3V)	
10	V _{SS}	P	Ground	
11	TS	-	Thermistor sensor	
12	OE _H	I	Output enable source driver	
13	CK _H	I	Clock of source driver	
14	SP _H	I	Start pulse of source driver	
15	LE _H	I	Latch enable of source driver	
16	V _{SS}	P	Ground	
17	D ₀	I	Data signal source driver	
18	D ₁	I	Data signal source driver	
19	D ₂	I	Data signal source driver	
20	D ₃	I	Data signal source driver	
21	D ₄	I	Data signal source driver	
22	D ₅	I	Data signal source driver	
23	D ₆	I	Data signal source driver	
24	D ₇	I	Data signal source driver	
25	CK _V	I	Clock of gate driver	
26	SP _V	I	Start pulse of gate driver	
27	MODE	I	Output mode selection gate driver	
28	V _{SS}	P	Ground	
29	V _{COM}	P	Common connection	
30	Border	P	Border connection	
31	V _{SS}	P	Ground	
32	V _{DD1.8}	P	SPI flash power supply (1.8V)	
33	SPI SCL	I	Serial Data Clock for Flash	
34	SPI NCS	I	Chip Select for Flash memory	
35	SPI SDI	I	Serial Data Input for Flash	

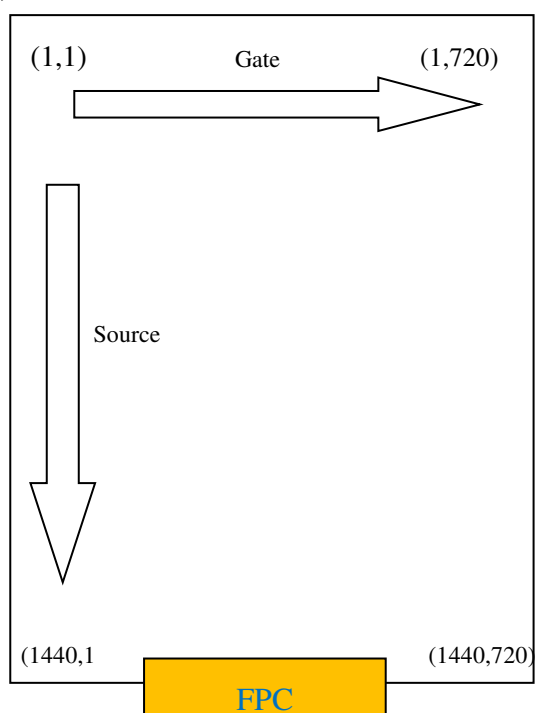
SA1452-EHA (EC058TC1)

36	SPI SDO	I	Serial Data Output for Flash	
37	V _{SS}	P	Ground	
38	V _{SS}	P	Ground	
39	V _{GH}	P	Positive power supply gate driver	
40	V _{GL}	P	Negative power supply gate driver	
41	V _{SS} CTP	P	CTP Ground	
42	CTP SDA	I	Touch signal	
43	CTP SCL	I	Touch signal	
44	CTP INT	I	Touch signal	
45	CTP VDD	I	Touch signal	
46	CTP RST	I	Touch signal	
47	NC	-	NO Connection	
48	K1	-	Front light signal	
49	A	-	Front light signal	
50	K2	-	Front light signal	

Note 5-1



5-3) Panel Scan Direction



6. Electrical Characteristics

6-1) Absolute Maximum Ratings:

Parameter	Symbol	Rating	Unit	Remark
Logic Supply Voltage	VDD_3V3	-0.3 to 5.0	V	--
Positive Supply Voltage	V _{SH}	-0.3 to +18	V	--
Negative Supply Voltage	V _{SL}	-18 to +0.3	V	--
Max .Drive Voltage Range	V _{SH} - V _{SL}	36	V	--
Supply Voltage	V _{GH}	-0.3 to 46	V	--
Supply Voltage	V _{GL}	-25 to +0.3	V	--
Supply Range	V _{GH} -V _{GL}	-0.3 to +46	V	--
Operating Temp. Range	TOTR	0 to +50	°C	--
Storage Temperature	TSTG	-25 to 70	°C	--

6-2) Panel DC Characteristics

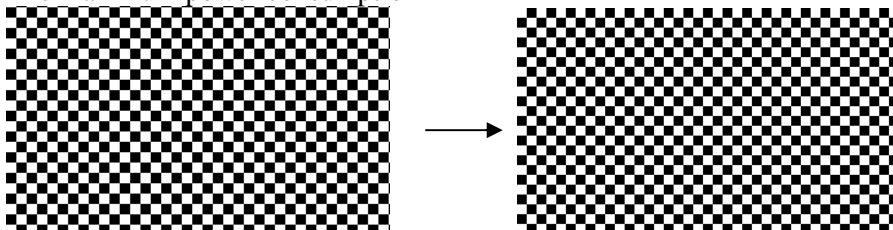
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Signal ground	V _{SS}		-	0	-	V
Logic Voltage supply	VDD_3V3		3.0	3.3	3.6	V
	I _{VDD_3V3}	V _{DD} =3.3V	-	9.42	10.01	mA
SPI Voltage supply	VDD_1V8		1.65	1.8	1.95	V
	I _{VDD_1V8}	V _{DD_1V8} =1.8V	-		1.5	mA
Gate Negative supply	V _{GL}		-22	-21	-20	V
	I _{GL}	V _{GL} = -20V	-	3.55	11.62	mA
Gate Positive supply	V _{GH}		21	22	23	V
	I _{GH}	V _{GH} = 22V	-	0.79	2.28	mA
Source Negative supply	V _{SL}		-15.4	-15	-14.6	V
	I _{SL}	V _{SL} = -15V	-	35	87.02	mA
Source Positive supply	V _{SH}		14.6	15	15.4	V
	I _{SH}	V _{SH} = 15V	-	39.54	100.37	mA
Border supply	V _{COM}		-	Adjusted	-	V
Asymmetry source	V _{Asym}	V _{SH} + V _{SL}	-800	0	800	mV
Common voltage	V _{COM}		-4	Adjusted	-0.5	V
	I _{COM}		-	1.33	4.18	mA
Total Power	P		-	1240.81	3163.24	mW
Standby power	P _{STBY}		-	-	0.4	mW

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Maximum Currents	I _{GL}	V _{GL} = -20V	-	-	158	mA
	I _{GH}	V _{GH} = +22V	-	-	22	mA
	I _{SL}	V _{SL} = -15V	-	-	493	mA
	I _{SH}	V _{SH} = +15V	-	-	549	mA
	I _{COM}	-	-	-	272	mA

- 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 6-1)
- 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 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.
- V_{com} is recommended to be set in the range of assigned value ± 0.1 V

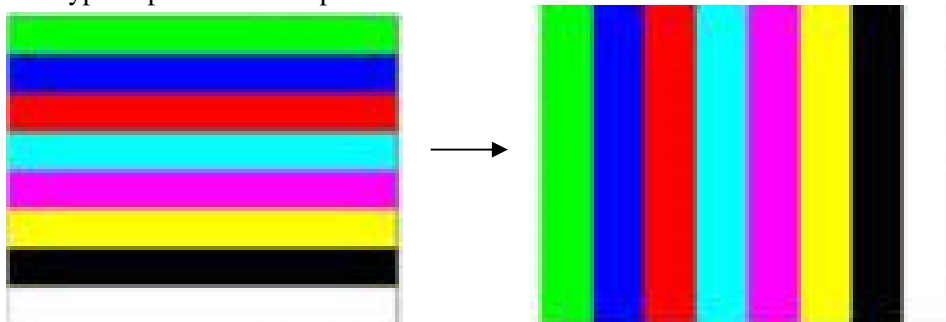
Note6-1

The maximum power consumption



Note 6-2

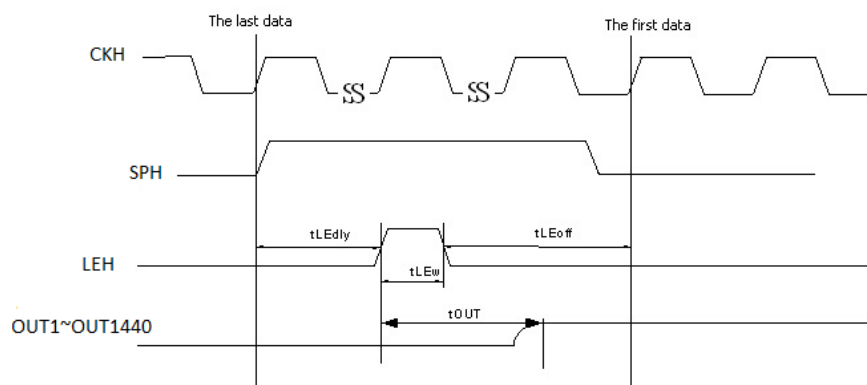
The typical power consumption



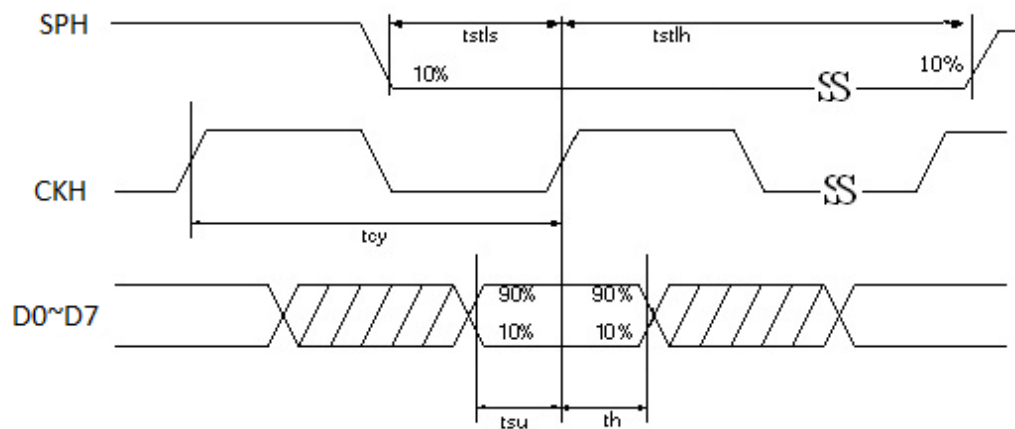
6-4) Panel AC characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit
Clock frequency	fckv			200	kHz
Minimum “L” clock pulse width	twL	0.5			us
Minimum “H” clock pulse width	twH	0.5			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 CKH cycle time	tcy	16.67	50		ns
D0 .. D7 setup time	tsu	8			ns
D0 .. D7 hold time	th	8			ns
SPH setup time	tstls	0.5*tcy		0.8*tcy	ns
SPH hold time	tstlh	0.5*tcy		240*tcy-tstls	ns
LEH on delay time	tLEdly	3.5*tcy			ns
LEH high-level pulse width (When VDD=1.7V to 2.1V)	tLEw	300			ns
LEH off delay time	tLEoff	200			ns
Output setting time to +/- 30mV(C _{load} =200pF)	tout			20	us

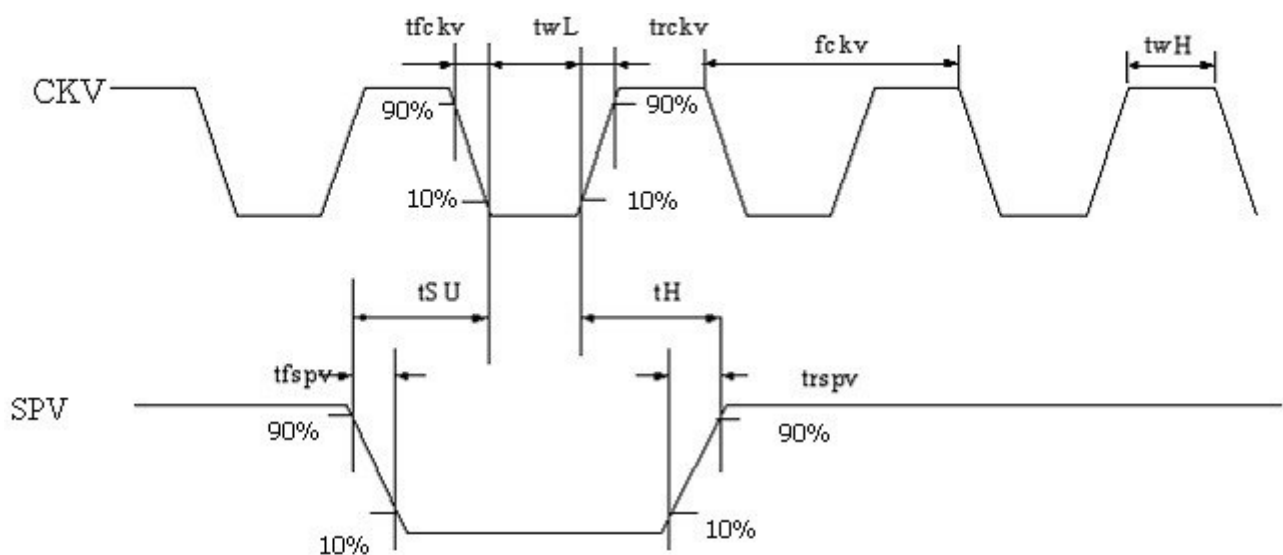
OUTPUT LATCH CONTROL SIGNALS



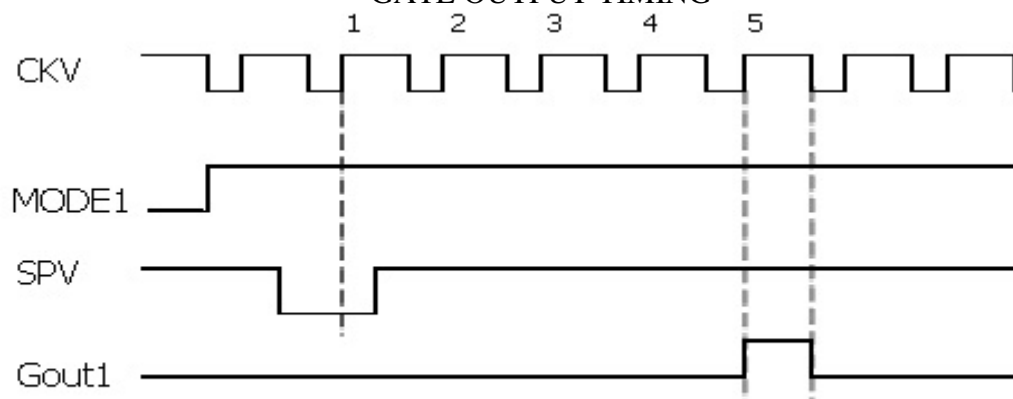
CLOCK & DATA TIMING



CKV & SPV TIMING



GATE OUTPUT TIMING



Note : First gate line on timing after 5CKV gate line is on

6-5) Refresh Rate

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

	Min	Max
Refresh Rate	-	85 Hz

6-6) Controller Timing

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

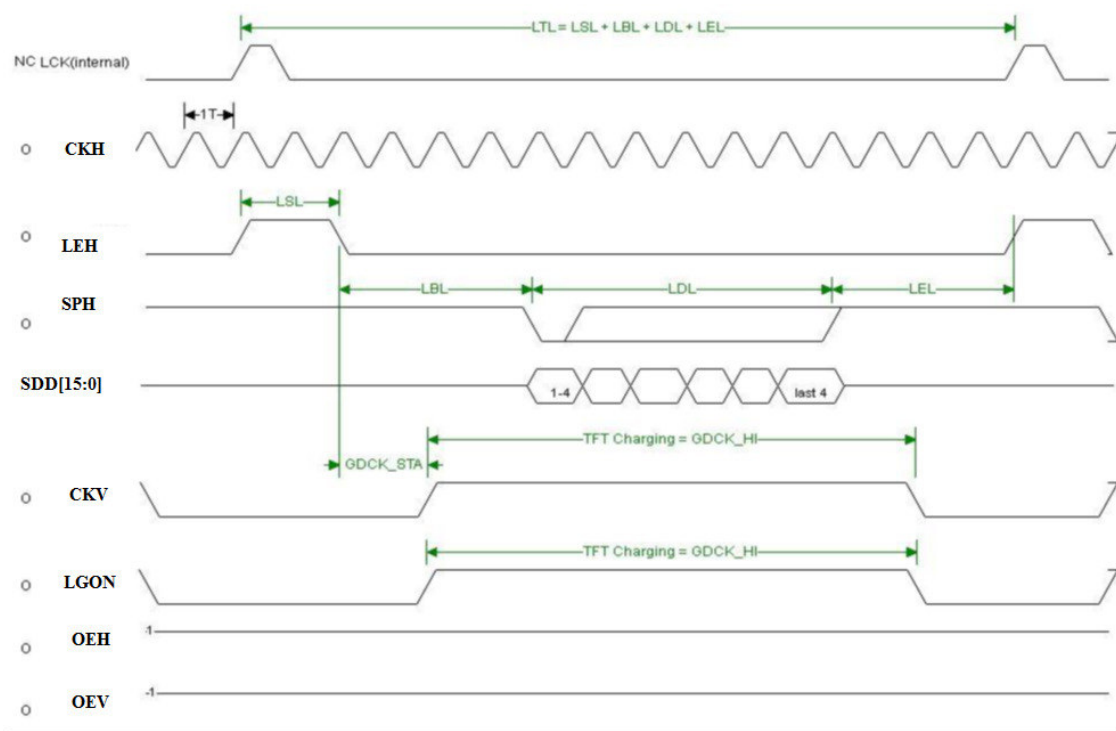


Figure 1. Line Timing in Mode 3

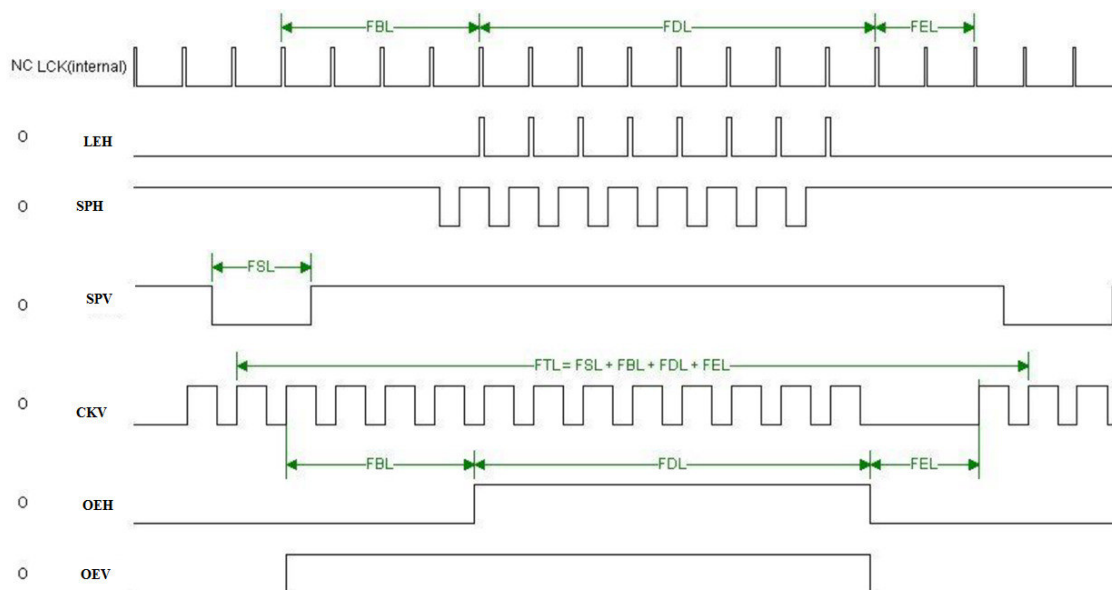


Figure 2 Frame Timing in Mode 3

Timing Parameters Table

Mode	3	Resolution 1440 x 720				
CKH [MHz]	24					
Pixels Per CKH	4					
Line	LSL	LBL	LDL	LEL	CKV_STA	LGONL
Parameters[CKH]	10	6	360	6	4	354
Line	-	-	-	-	-	-
Parameters[us]	0.42	0.25	15.00	0.25	0.17	14.75
Frame	FSL	FBL	FDL	FEL	-	FR [Hz]
Parameters [lines]	1	4	720	14	-	85.02
Frame	-	-	-	-	-	-
Parameters [us]	15.92	63.67	11460.00	222.83	-	-

Note 1: For parameters definition, see Section 7. Active Matrix Electronic Paper Display Timings

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

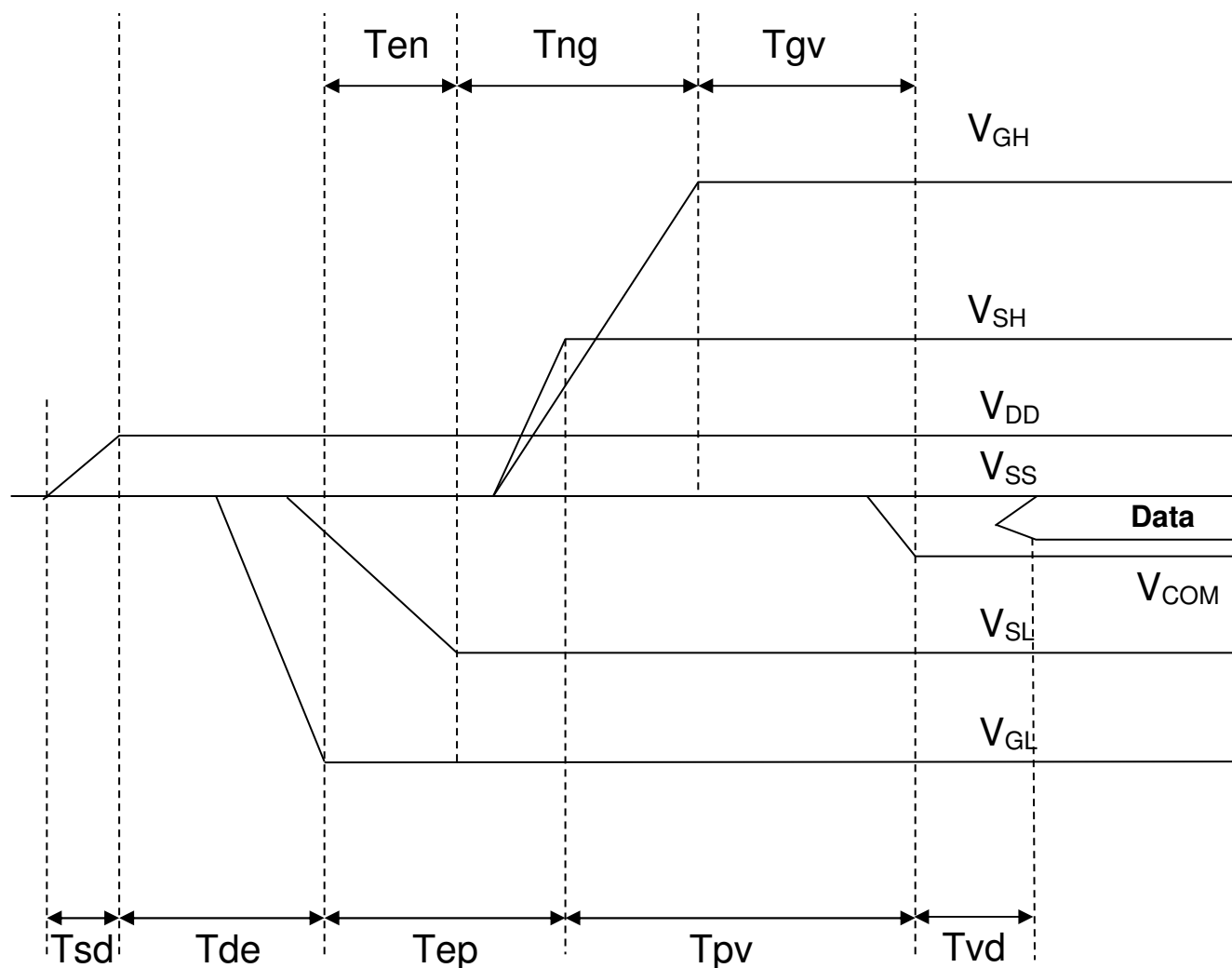
Note 3: For Freescale SoC OEV Low pulse represent FSL and SPV pulses with the first period of FBL

7. Power Sequence

Power Rails must be sequenced in the following order :

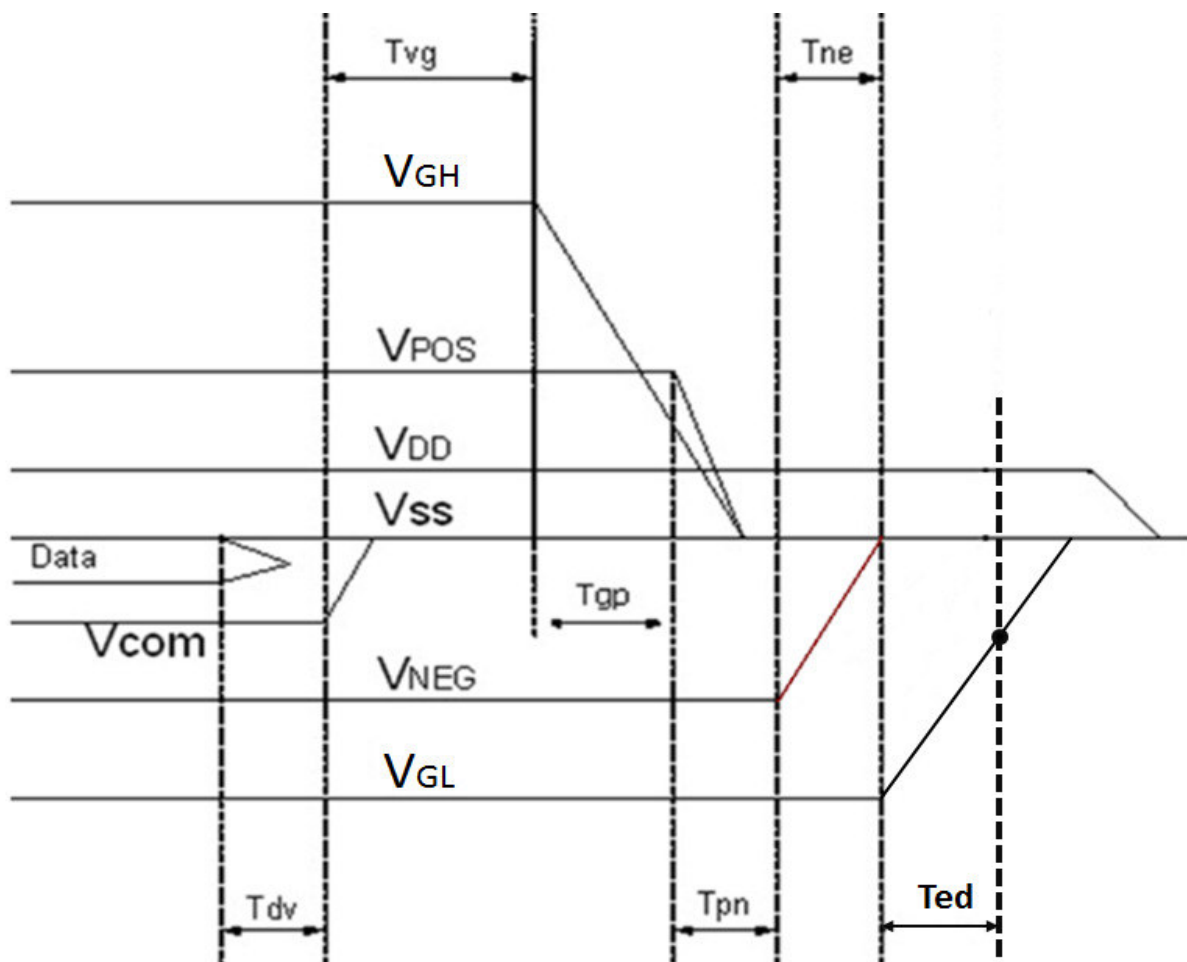
1. $V_{SS} \rightarrow V_{DD} \rightarrow V_{SL} \rightarrow V_{SH}$ (Source Driver) $\rightarrow V_{COM}$
2. $V_{SS} \rightarrow V_{DD} \rightarrow V_{GL} \rightarrow V_{GH}$ (Gate Driver)

POWER ON



	Min	Max
T_{sd}	30us	-
T_{de}	100us	-
T_{ep}	1000us	-
T_{pv}	100us	-
T_{vd}	100us	-
T_{en}	0us	-
T_{ng}	1000us	-
T_{gv}	100us	-

POWER OFF



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

Note 7-1 : Supply voltages decay through pull-down resistors.

Note 7-2 : Begin to turn off V_{GL} power after V_{SL} and V_{SH} are completely or almost discharged to GND state.

Note 7-3 : V_{GL} must remain negative of V_{com} during decay period

8. Optical characteristic

8-1) Specification

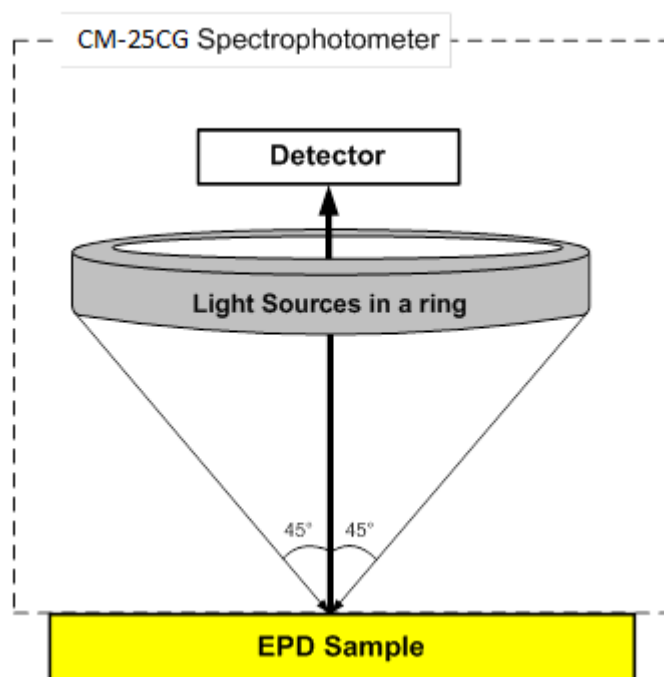
Measurements are made with that the illumination is under an angle of 45 degrees, the detector is perpendicular unless otherwise specified.

T = 25°C

Symbol	Parameter	Conditions	Min	Typ.	Max	Unit	Note
R	Reflectance	White	18	24	-	%	8-3
CR	Contrast Ratio	WK	10	15	-		8-4
Color Gamut		RGBCMYWK	1100	1570			8-5
Symbol	Parameter	Conditions	L*TYP	a*TYP	b*TYP	Unit	Note
R	Color coordinates ($\Delta E_{00} < 5$)	Red	32.81	5.29	0.12		8-6
G		Green	35.99	-8.52	2.97		
B		Blue	33.04	-4.19	-8.16		

Note 8-1) W: White , K: Dark , R: Red, G: Green , B: blue, C: Cyan , M: Magenta , Y: Yellow

Note 8-2) Luminance meter: Minolta CM-25cG Spectrophotometer



8-3) Reflection Ratio

The reflection ratio is expressed as:

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

L_{center} is the luminance measured at center in a white area ($R=G=B=1$). $L_{\text{white board}}$ 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.

8-4) Definition of contrast ratio

The contrast ratio (CR) is the ratio between the reflectance in a full white area (R_l) and the reflectance in a dark area (R_d): $CR = R_l / R_d$

8-5 Definition of Color Gamut

Gamut metric: color volume of Red, Green, Blue, Cyan, Magenta, Yellow white, and black in 3D CIE 1976 $L^* a^* b^*$ (CIELAB) color space.

8-6) Definition of Color difference (ΔE_{00})

The formula of CIEDE2000 color difference create an uniform color space, which means the ΔE_{00} value is equivalent to the perceptual difference in every color.

$$\Delta E_{00} = \left(\left(\frac{\Delta L^*}{k_L S_L} \right)^2 + \left(\frac{\Delta C'}{k_C S_C} \right)^2 + \left(\frac{\Delta H'}{k_H S_H} \right)^2 + R_T \left(\frac{\Delta C' \Delta H'}{S_C S_H} \right) \right)^{1/2}$$

9. Handling, Safety and Environment 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.

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.

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 product specifications.
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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.

10. Reliability test

	TEST	CONDITION	METHOD	REMARK
1	High-Temperature Operation	T = +50°C, RH = 30% for 240 hrs	IEC 60 068-2-2Be	
2	Low-Temperature Operation	T = 0°C for 240 hrs	IEC 60 068-2-1Ae	
3	Low-Temperature Storage	T = -25°C for 240 hrs Test in white pattern	IEC 60 068-2-1Ab	
4	High-Temperature, High-Humidity Operation	T = +40°C, RH = 90% for 168 hrs	IEC 60 068-2-78	
5	High Temperature Storage	T = +60°C, RH=26% for 240 hrs Test in white pattern	IEC 60 068-2-78	
6	Temperature Cycle	-25°C → +70°C, 100 Cycles 30min 30min Test in white pattern	IEC 68-2-14 Nb	
7	Solar radiation test	765 W/m ² for 168hrs, 40°C Test in white pattern	IEC60 068-2-5Sa	
8	Electrostatic Effect (non-operating)	(Machine model)+/- 250V 0Ω, 200pF	IEC 62180	

Actual EMC level to be measured on customer application

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

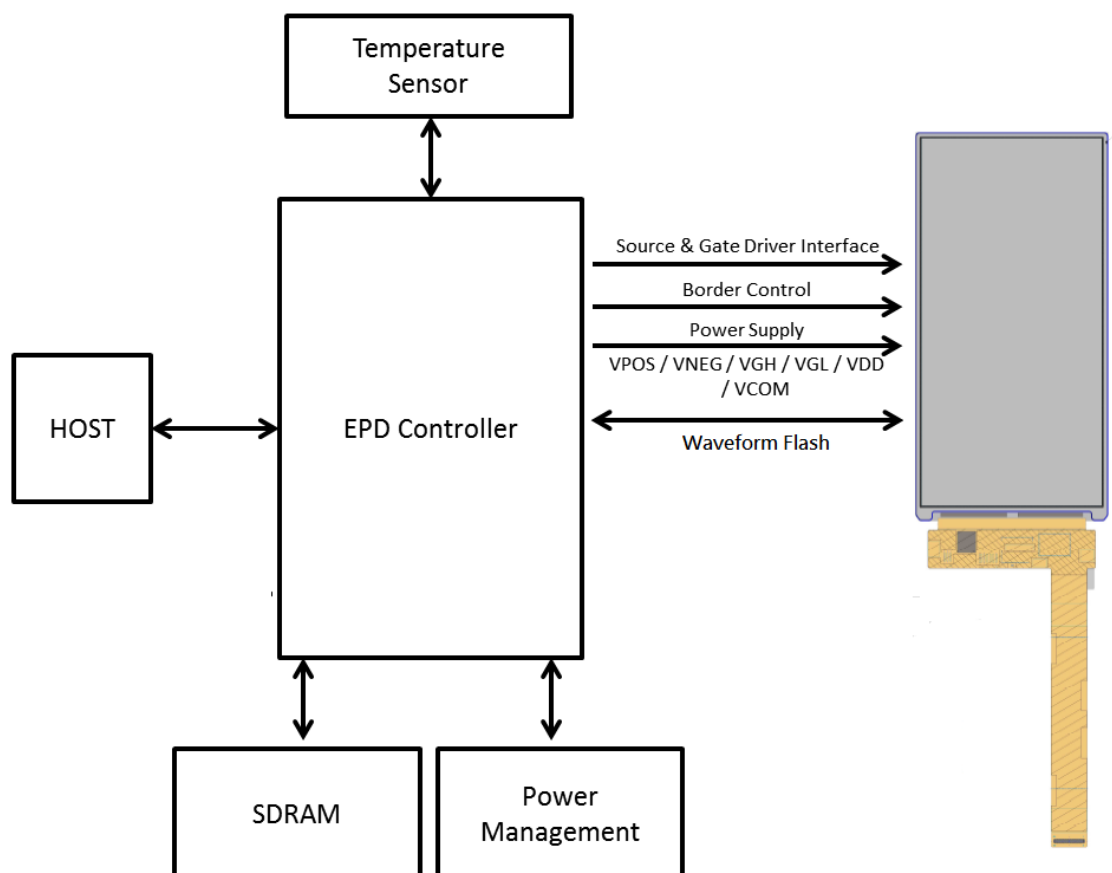
< Criteria >

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.

11. Border definition



12. Block Diagram



13. Packing

REV	DESCRIPTION	DESIGN	DATE
01	INITIAL RELEASE	Botsang Huang	2020/03/23
02			

Diagram illustrating the packing structure assembly. It shows the sequence of components: 1. One layer (module, tray, EPE sheet), 2. Q'TY: 72 pcs panel/carton, 3. Dimension: 445*365*170mm. The final assembly is shown as a box with tape.

Diagram illustrating the 12 layers of the packing structure. The layers are arranged in two groups: 1st Layer (modules, trays, EPE sheets) and 2nd Layer (modules, trays, EPE sheets). The total number of layers is 12.

NOTE:

1. One layer include:
6 pcs module & 1pcs tray & 1pcs EPE sheet

2. Q'TY: 72 pcs panel/carton.

3. Dimension: 445*365*170mm

7	30g加厚複合紙(含乾燥劑)	73*95mm	2	
6	EPE SHEET		12	
5	CARTON INTERNAL		1	
4	摺口袋	450*380*580mm	1	抗靜電
3	EC058TC1		72	
2	TRAY		13	抗靜電
1	EPE FOAM		2	

ITEM	DESCRIPTION	Q'TY	REMARK
7	30g加厚複合紙(含乾燥劑)	2	
6	EPE SHEET	12	
5	CARTON INTERNAL	1	
4	摺口袋	1	抗靜電
3	EC058TC1	72	
2	TRAY	13	抗靜電
1	EPE FOAM	2	

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

APPROVE	May Lee	2020/03/23	SCALE	UNIT	SHEET	DWG.TITLE
CHECK	May Lee	2020/03/23	1:1	mm	1 OF 1	EC058TC1 PACKING
DESIGN	Botsang Huang	2020/03/23	MTL.NO.			DWG.NO.

A₄ SIZE



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