SAMSUNG DISPLAY

Approval

LEAD-FREE

DATE : May. 11, 2012

SAMSUNG TFT-LCD

MODEL NO : LTL101AL06

NOTE : Surface type [Glare]

This Specification is subject to change without notice.

APPROVED BY :

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Application engineering part, LCD Division
Samsung Display Co., Ltd.

Samsung Secret

CONTENTS

REVISION HISTORY

Approval

Date	Revision No.	Page	Summary
May, 11. 2012	A00	All	LTL101AL06 model spec was issued first.

GENERAL DESCRIPTION

DESCRIPTION

LTL101AL06 is a color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as switching devices. This model is composed of a TFT LCD panel, a driver circuit and a backlight system. The resolution of a 10.1" contains 1280 x 800 pixels and can display up to 16.2 Mega colors(6bit+FRC).

FEATURES

- High contrast ratio, high aperture structure
- 1280 x 800 pixels resolution
- LED BLU Structure
- DE (Data enable) only mode
- 3.3V Operating Voltage
- RoHS Compliance
- PB, Halogen Free Product
- LVDS interface

APPLICATIONS

- Tablet

GENERAL INFORMATION

Item	Specification	Unit	Note
Display area	216.96 (H) x 135.60 (V) (10.1”diagonal)	mm	
Driver element	a-Si TFT active matrix		
Display colors	16.2M	colors	6bit + FRC
Number of pixel	1280 * 800	pixel	16 : 9
Pixel arrangement	RGB vertical stripe		
Pixel pitch	0.1695(H) x 0.1695 (V) (TYP.)	mm	
Display Mode	Normally Black		
Surface treatment	Hardness 3H		Glare

Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal (H)	227.91	228.21	228.51	mm	(2)
	Vertical (V)	148.56	148.86	149.16	mm	(2)
	Depth (D)	-	2.39	2.59	mm	(1), (2)
Weight		120	130	140	g	(2)

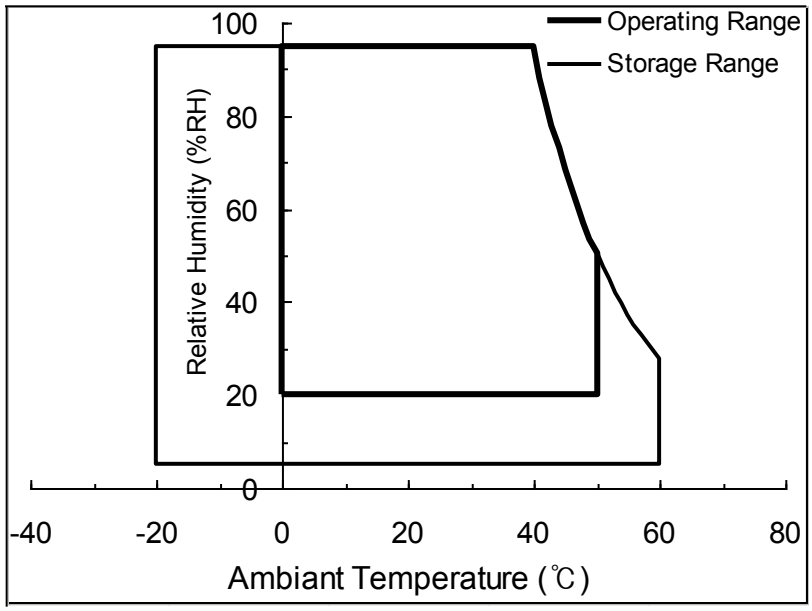
Note (1) Measurement condition of outline dimension .
X-Y Dimension(Equipment : Vernier Calipers) : Push Force 300g ·f (minimum)
Z Dimension (Equipment : Height Gage) : Push Force 150g ·f (minimum)
Note (2) W/O Tape Thickness

1. ABSOLUTE MAXIMUM RATINGS

1.1 ENVIRONMENTAL ABSOLUTE RATINGS

Item	Symbol	Min.	Max.	Unit	Note
Storage temperature	TSTG	-20	60	°C	(1)
Operating temperature (Temperature of glass surface)	TOPR	-20	50	°C	(1)

Note (1) Temperature and relative humidity range are shown in the figure below.
95 % RH Max. (40 °C ≥ Ta)
Maximum wet - bulb temperature at 39 °C or less. (Ta > 40 °C)



1.2 ELECTRICAL ABSOLUTE RATINGS

(1) TFT LCD MODULE

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	V_{CC}	- 0.3	5	V	(1)
Logic Input Voltage (LVDS)	V_{LOGIC}	- 0.3	2.0	V	(1)
LED Current	I_{LED}	-	35	mA	(2)

Note (1) Within Operating Temperature.
(2) LED Current for 1 CH, External type.

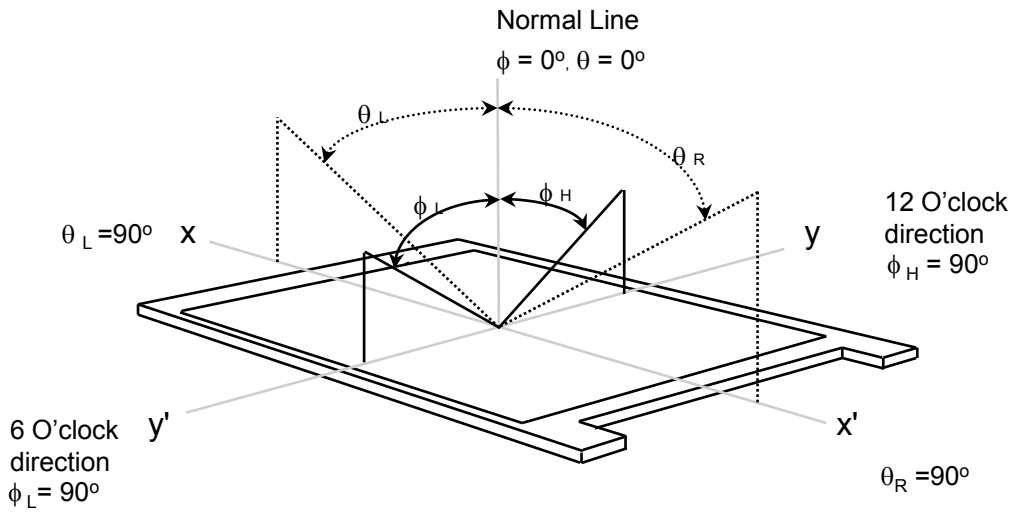
2. OPTICAL CHARACTERISTICS

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state.

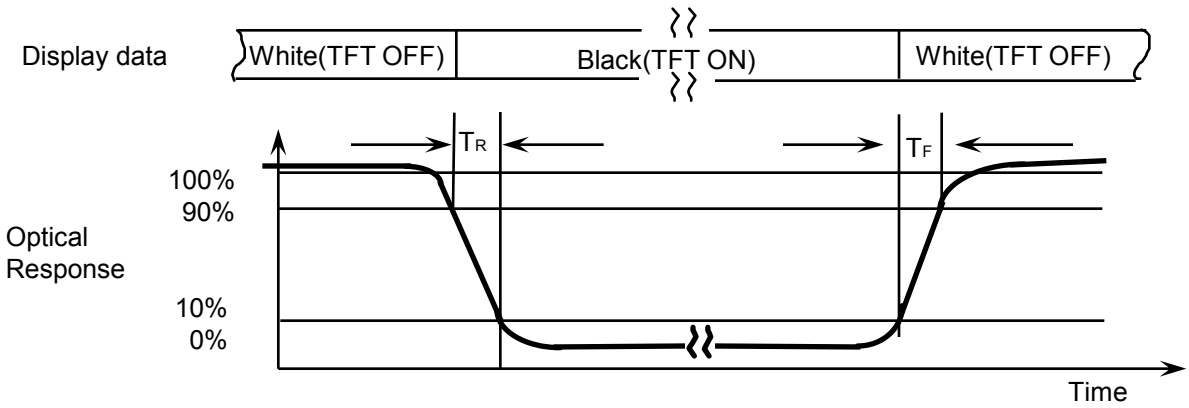
* Ta = 25 ± 2 °C, V_{DD}=3.3V, fv= 60Hz, f_{DCLK} = 68.94 MHz, I_L = 21 mA

Item		Symbol	Condition	Min.	Typ.	Max	Unit	Note
Contrast Ratio (5 Points)		CR	Normal Viewing Angle $\phi = 0$ $\theta = 0$	720	900	-	-	(① of Note(4))
Response Time at Ta (Rising + Falling)		T_{RT}		-	30	45	msec	Note (1), (2)
Average Luminance of White (Center)		$Y_{L,AVE}$		320	400	-	cd/m^2	② of Note(4)
Color Chromaticity (CIE)	Red	R_X		Typ -0.03	0.601	Typ +0.03	-	CA-210
		R_Y			0.347			
	Green	G_X			0.322			
		G_Y			0.580			
	Blue	B_X			0.147			
		B_Y			0.126			
	White	W_X			0.295			
		W_Y			0.327			
Viewing Angle	Hor.	θ_L	CR ≥ 10	-	80	-	Degrees	Note (1), (3)
		θ_R		-	80	-		
	Ver.	ϕ_H		-	80	-		
		ϕ_L		-	80	-		
Color Gamut				45	50	-	%	
Uniformity (9 points)		δW		80%	-		-	③ of Note(4)

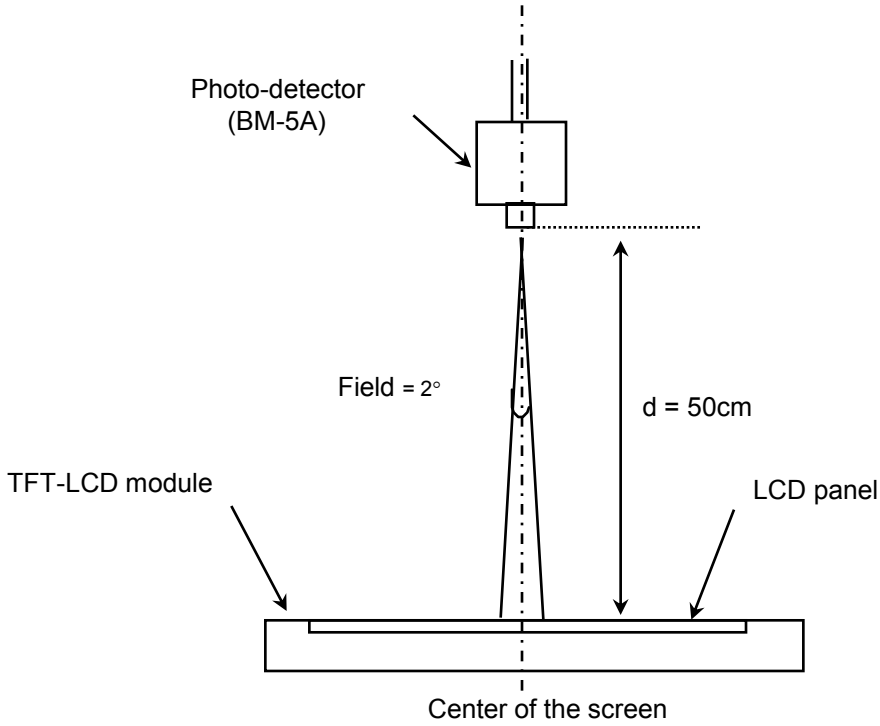
Note 1) Definition of Viewing Angle : Viewing angle range(10 ≤ C/R)



Note 2) Definition of Response time :

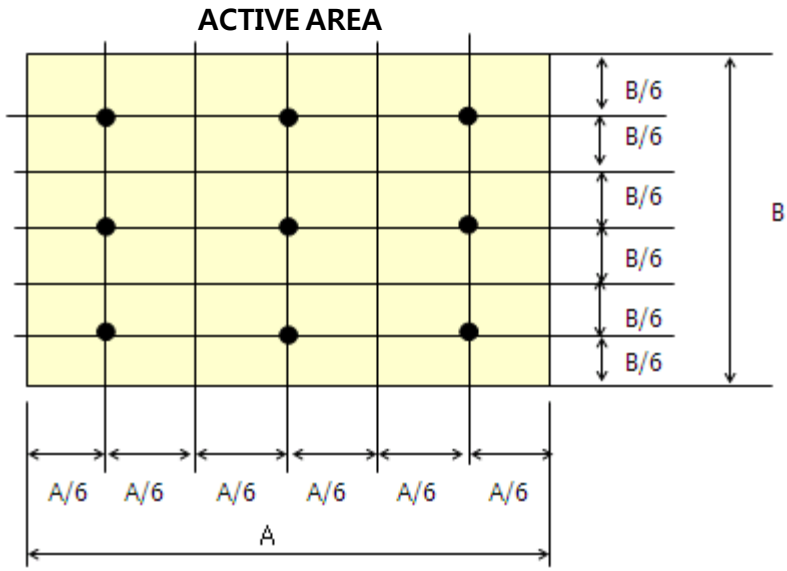


Note 3) After stabilizing and leaving the panel alone at a given temperature for 30 min , the measurement should be executed. Measurement should be executed in a stable, windless and dark room. 30 min after lighting the backlight. This should be measured in the center of screen.
Environment condition : Ta = 25 ± 2 °C



[Optical characteristics measurement setup]

Note 4) There are 9 measure points on the panel.



① **Contrast Ratio (C/R)**

: The ratio of Maximum luminance(Gmax) and Minimum luminance(Gmin) at the centre point on the panel.

$$C/R(n) = \frac{\text{Maximum luminance of Centre point}}{\text{Minimum luminance of Centre point}}$$

② **The definition of Average White Brightness**

: White brightness at the centre point on the panel.

③ **Uniformity of 9 points (9 points white variation , δW)**

$$\delta W = \frac{\text{Maximum luminance of 9 points}}{\text{Minimum luminance of 9 points}}$$

④ **Gray scale linearity**

: Measured at the following gray scale level
(64 gray scale level : 63, 56, 48, 41, 33, 26, 18, 12)

: Measurement Point : Active Area Center point
LED Current : 21mA

3. ELECTRICAL CHARACTERISTICS

3.1 TFT LCD MODULE

Ta= 25 ± 2°C

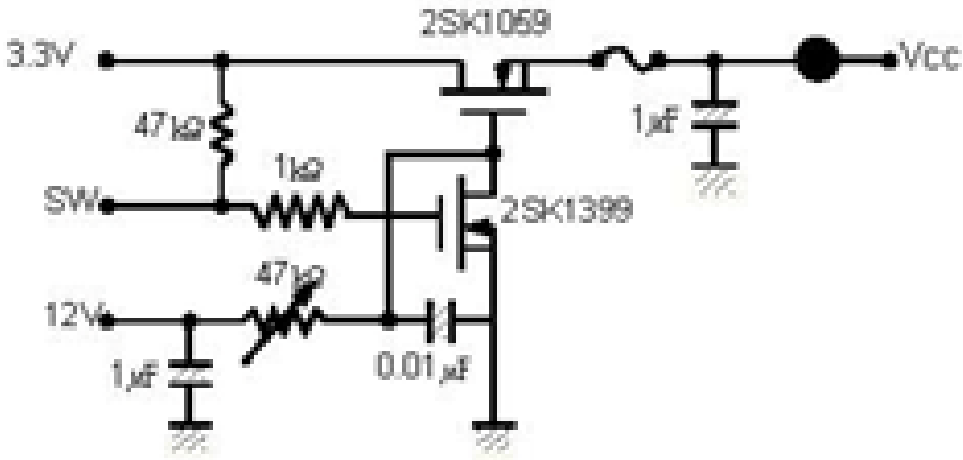
Item00	Symbol	Min.	Typ.	Max.	Unit	Note
Power Supply Voltage	V_{CC}	3.0	3.3	3.6	V	
Panel Power Consumption	-	-	0.74	0.81	W	Note (2),(3) Panel Only
Differential input high threshold voltage	V_{TH}	-	-	100	mV	V_{CM} = 1.2V
Differential input high threshold voltage	V_{TH}	-100	-	-		
Vsync Frequency	f_V	-	60	-	Hz	
Main Frequency	f_{DCLK}	-	68.94	-	MHz	
Rush Current	Irush	-	-	1.5	A	Note(4)

Note (1) Display data pins and timing signal pins should be connected.(GND = 0V)

(2) f_V = 60Hz, f_{DCLK} =68.94 MHZ, V_{CC} = 3.3V , DC Current.

(3) Power dissipation pattern (Full white)

(4) Rush current measurement condition : Vcc rising time=470us



3.2 BACK-LIGHT UNIT

Ta= 25 ± 2 °C

Item	Symbol	Min.	Typ.	Max.	Unit	Note
LED Forward Current	I_F	-	21	-	mA	-
LED Forward Voltage	V_F	2.8	2.9	3.0	V	(1)
BLU Power Consumption (Without LED Driver)	-	-	2.44	2.68	W	(3)
LED Number	-	-	40	-	EA	(2)
LED Luminance	-	2400	2500	2600	mcd	(1)

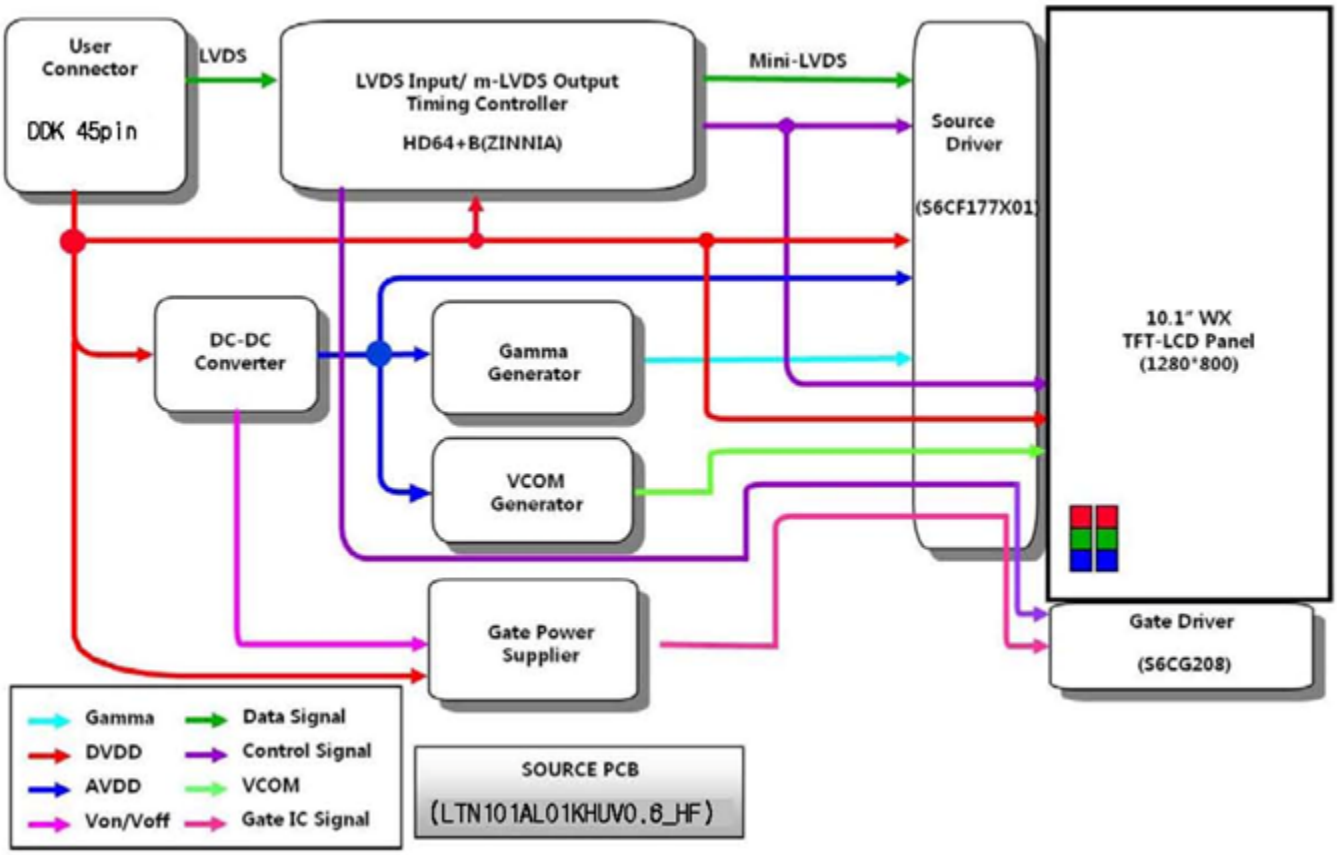
Note (1) Life time (Hr) of LEDs can be defined as the time in which it continues to operate under the condition Ta= 25 ± 2 °C and IF = 21mA until one of the following event occurs.
When the brightness becomes 50% or lower than the original.

Note (2) LED placement structure

Note (3) LED Forward Voltage * LED numbers * LED Current
→ 2.9V * 21mA * 40 ea = 2.44W (Without LED Driver's Efficiency)

4. BLOCK DIAGRAM

4.1 TFT LCD Module



4.2 LED connection and placement

TBD

5. INPUT TERMINAL PIN ASSIGNMENT

5.1. Input Signal & Power (LVDS, Connector : DDK 45pin)

No.	Symbol	Function	Polarity	Remarks
1	VSS	Ground		
2	VSS	Ground		
3	NC	NO CONNECT		
4	VDD	Power Supply +3.3V		Typ
5	VDD	Power Supply +3.3V		Typ
6	VDD	Power Supply +3.3V		Typ
7	VDD	Power Supply +3.3V		Typ
8	VDD	Power Supply +3.3V		Typ
9	WPN	WPN		
10	SCL	DVR_I2C CLK		
11	SDA	DVR_I2C Data		
12	VSS	Ground		
13	VSS	Ground		
14	VSS	Ground		
15	RxOIN3-	-LVDS Differential Data	Negative	
16	RxOIN3+	+LVDS Differential Data	Positive	
17	VSS	Ground		
18	RxOCKIN-	-LVDS Odd Differential CLK	Negative	CLOCK
19	RxOCKIN+	+LVDS Odd Differential CLK	Positive	
20	VSS	Ground		
21	RxOIN2-	-LVDS Differential Data	Negative	
22	RxOIN2+	+LVDS Differential Data	Positive	
23	VSS	Ground		
24	RxOIN1-	-LVDS Differential Data	Negative	
25	RxOIN1+	+LVDS Differential Data	Positive	
26	VSS	Ground		
27	RxOIN0-	-LVDS Differential Data	Negative	
28	RxOIN0+	+LVDS Differential Data	Positive	
29	VSS	Ground		
30	VSS	Ground		
31	NC	NO CONNECT		
32	FB1	Feedback1		
33	FB2	Feedback2		
34	FB3	Feedback3		
35	FB4	Feedback4		
36	NC	NO CONNECT		
37	NC	NO CONNECT		
38	NC	NO CONNECT		
39	VLED	BLU VCC		
40	VLED	BLU VCC		
41	VLED	BLU VCC		
42	VLED	BLU VCC		
43	VLED	BLU VCC		
44	NC	NO CONNECT		
45	VSS	Ground		

5.2 LVDS Interface

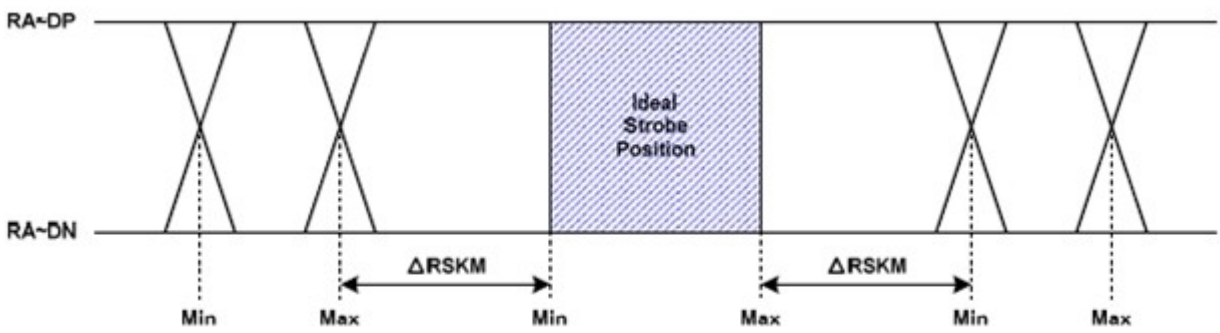
5.2.1 LVDS DC characteristic

ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
LVDS Differential Voltage	|VID|	100	-	400	mV	
Input Common Mode Voltage	V_{CM}	0.8	1.2	1.4	V	

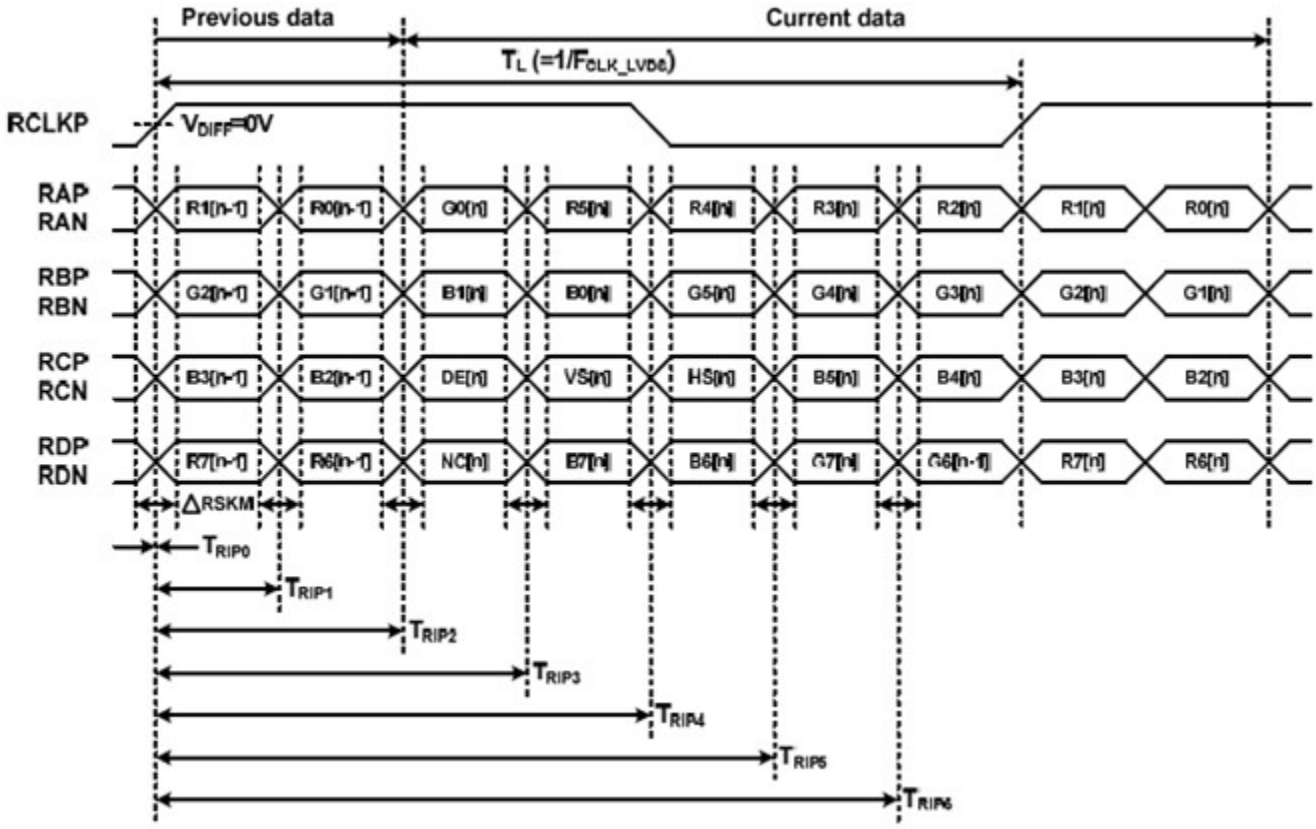
5.2.2 LVDS AC characteristic

ITEM		SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
LVDS input clock frequency		F_{CLK_LVDS}	20	-	90	MHz	
RIN skew margin	90MHz > F_{CLK_LVDS} ≥ 65MHz	ΔRSKM	-400	-	400	ps	(1),(2)
	65MHz > F_{CLK_LVDS} ≥ 20MHz		-600	-	600	ps	(1),(2)
Modulating frequency of LVDS input clock during SSCG		F_{CLK_MOD}	-	-	300	KHz	
Maximum deviation of LVDS input clock during SSCG		F_{CLK_DEV}	-	-	± 3	%	

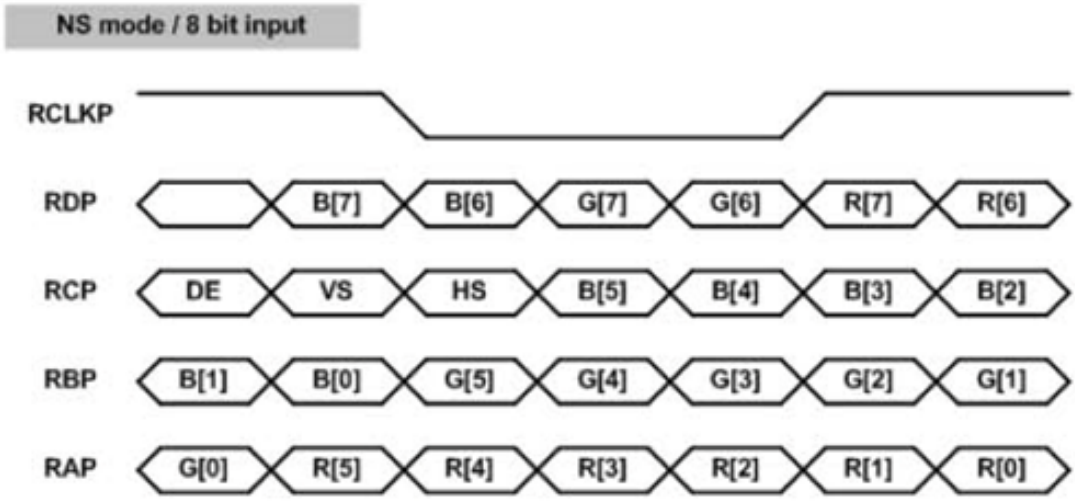
Note (1) : LVDS Input Skew (Strobe) Margin



Note (2) : LVDS Input Timing Diagram



5.2.3 LVDS Inputs

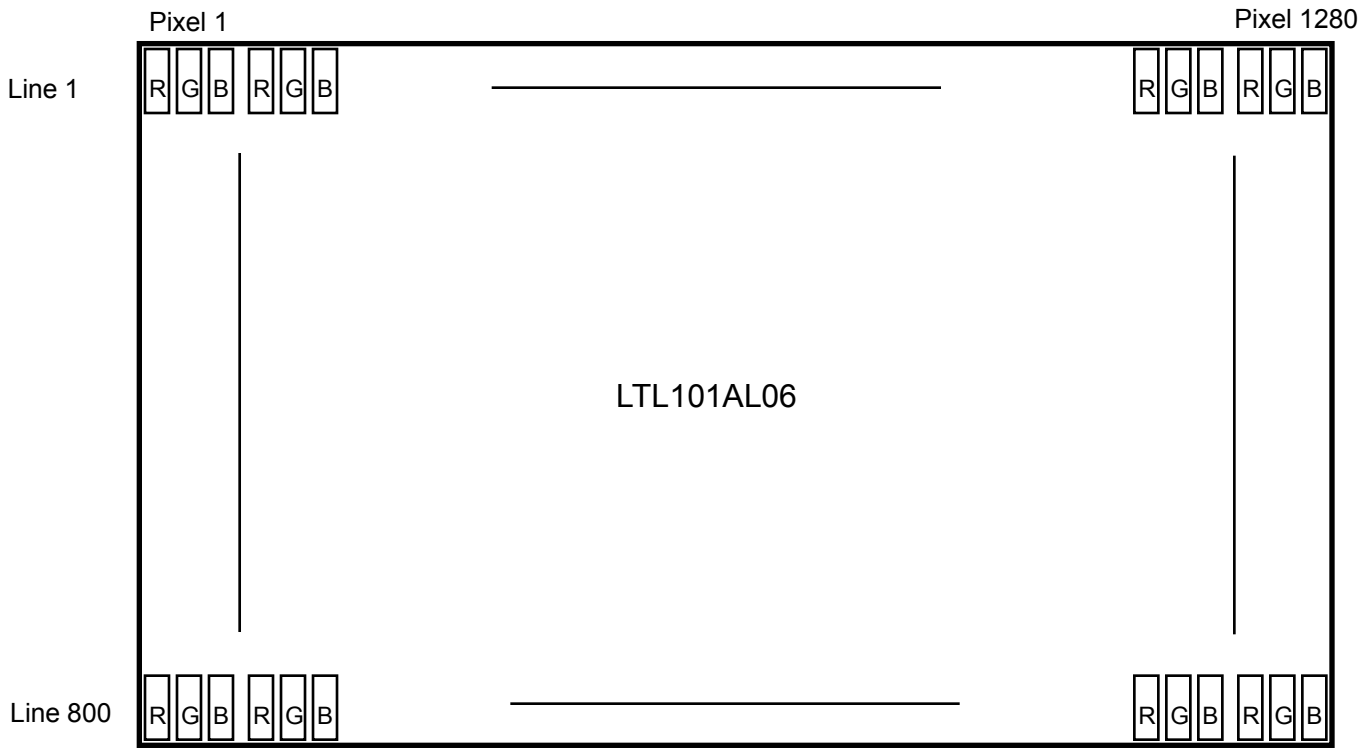


5.3 Input Signals, Basic Display Colors and Gray Scale of Each Color

COLOR	DISPLAY	DATA SIGNAL																								GRAY SCALE LEVEL
		RED								GREEN								BLUE								
		R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3	B4	B5	B6	B7	
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	-
	CYAN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	MAGENTA	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	-
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
GRAY SCALE OF RED	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R0
	DARK ↑	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1
		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R3~ R252
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	↓ LIGHT	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R253
		0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R254
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R255
GRAY SCALE OF GREEN	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G0
	DARK ↑	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G1
		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	G3~ G252
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	↓ LIGHT	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G253
		0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G254
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G255
GRAY SCALE OF BLUE	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B0
	DARK ↑	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	B1
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	B2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3~ B252
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	↓ LIGHT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	B253
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	B254
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	B255

Note 1) Definition of gray :
Rn: Red gray, Gn: Green gray, Bn: Blue gray (n=gray level)
Note 2)Input signal: 0 =Low level voltage, 1=High level voltage

5.4 Pixel Format in the display



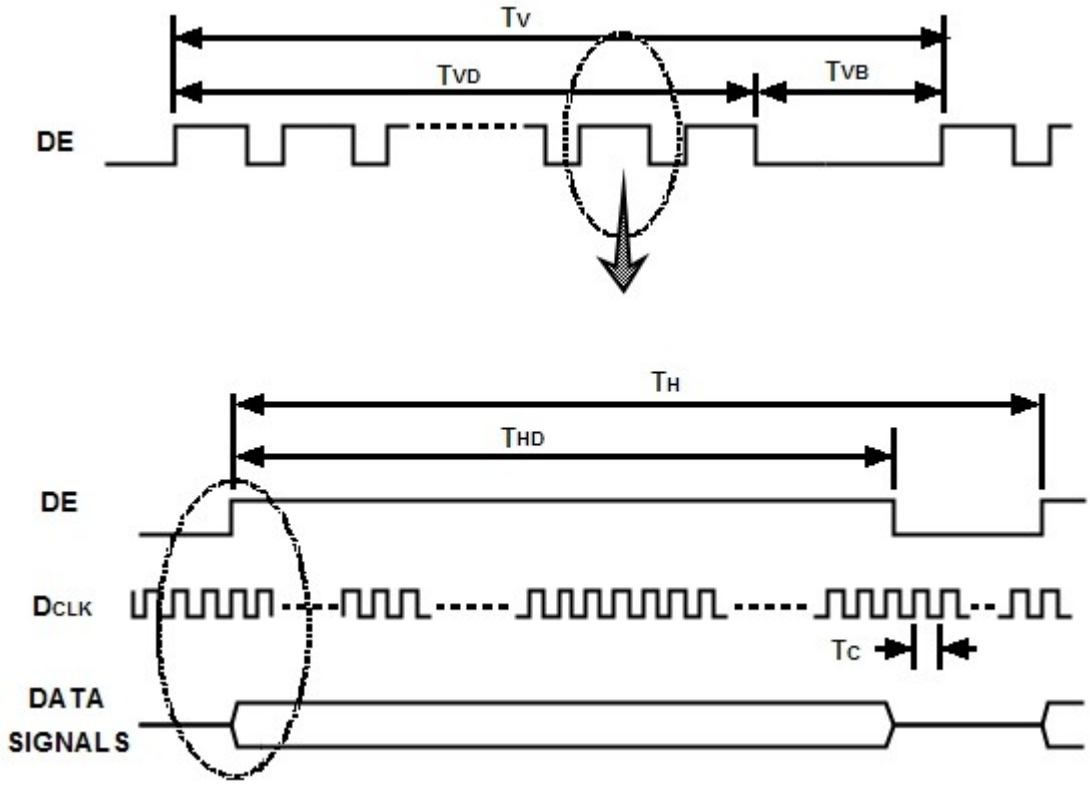
6. INTERFACE TIMING

6.1 Timing Parameters (DE Only Mode)

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
Frame Frequency	Cycle	f_V	-	60	-	Hz	
		T_V	-	816	-	Lines	(1)
Vertical Active Display Term	Display Period	T_{VD}	-	800	-	Lines	
	Vertical Blank Period	T_{VB}	-	16	-	Lines	(1)
One Line Scanning Time	Cycle	T_H	-	1408	-	Clocks	(1)
Horizontal Active Display Term	Display Period	T_{HD}	-	1280	-	Clocks	(1)
		T_{HB}	-	128	-	Pixels	
Main CLK Freq.	Cycle	1/Tc	-	68.94	-	MHz	

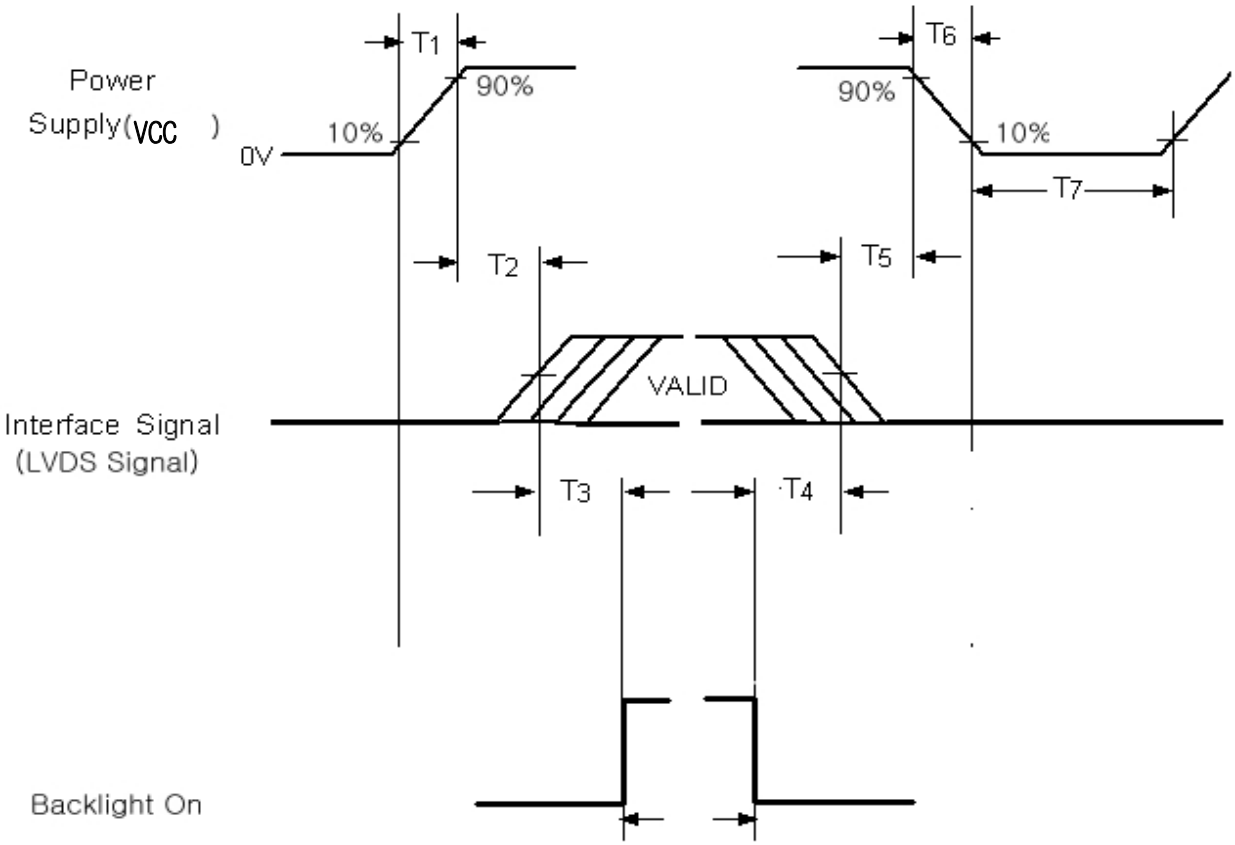
Note (1) The value of (T_V + T_H) * f_V cannot exceed MAX value of Main CLK Freq.

6.2 Timing diagrams of interface signal



6.3 Power ON/OFF Sequence

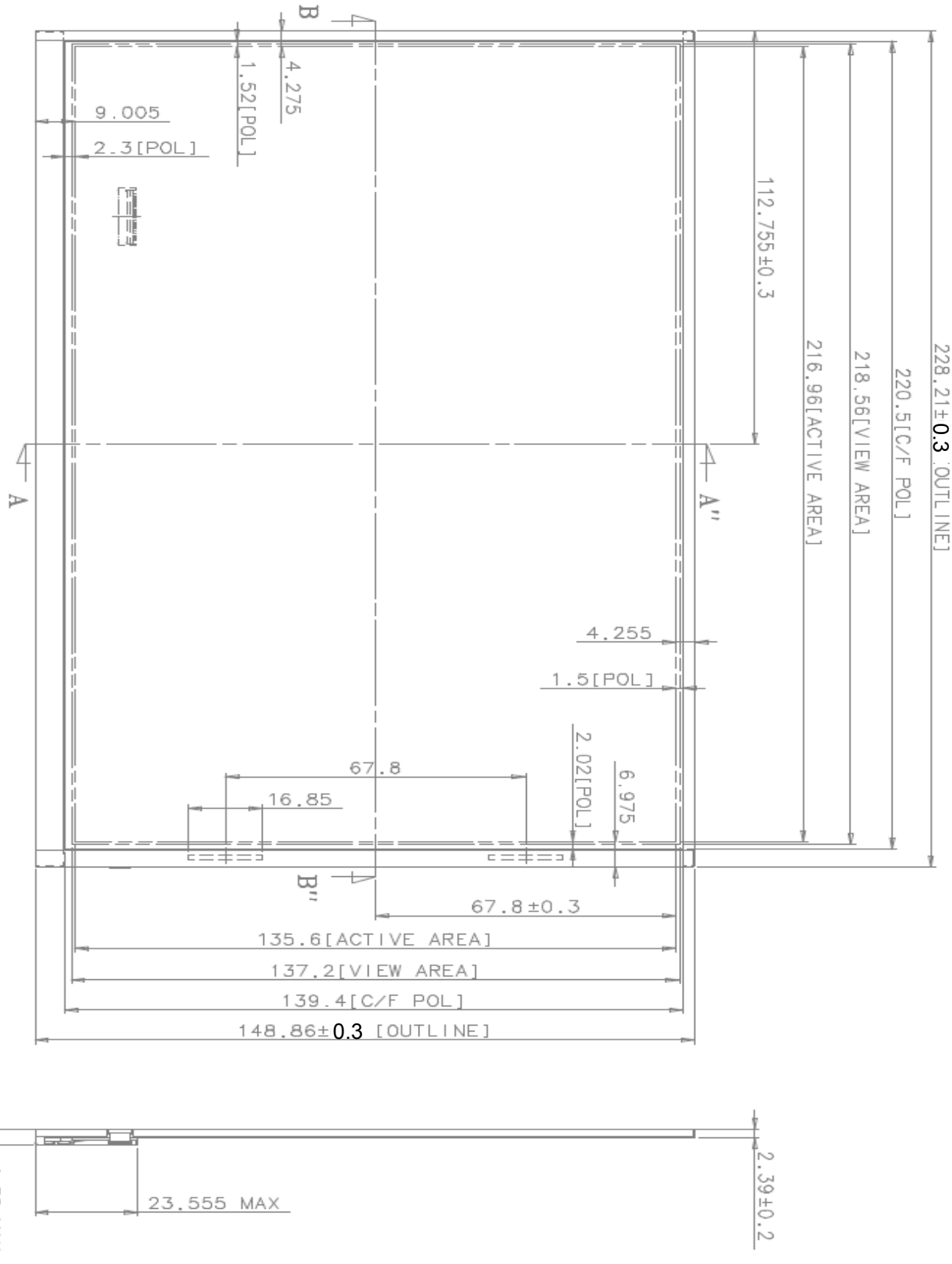
: To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should be as the diagram below.

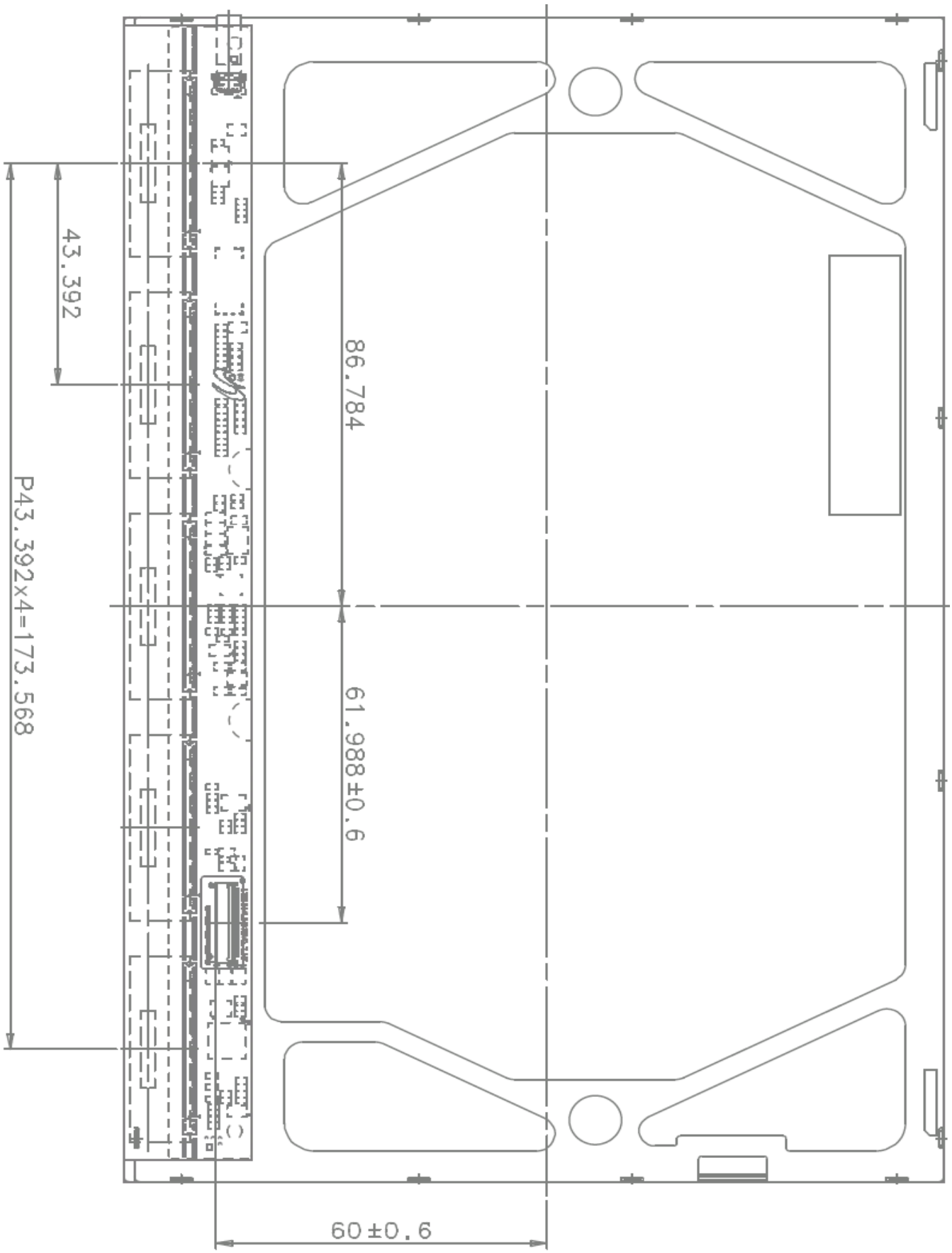


Item	Spec
T1	0.5≤ T1 ≤10msec
T2	0≤ T2 ≤50msec
T3	T3 ≥ 300msec
T4	T4 ≥ 200msec
T5	0≤ T3 ≤50msec
T6	0≤ T6 ≤10msec
T7	T7 ≥ 500msec

7. MECHANICAL OUTLINE DIMENSION

Approval





8. PACKING

(1) Packing Method (Small box)

TBD

9. MARKINGS & OTHERS

TBD

10. GENERAL PRECAUTIONS

1. Handling

(a) When the module is assembled, It should be attached to the system firmly using every mounting holes. Be careful not to twist and bend the modules.

(b) Refrain from strong mechanical shock and / or any force to the module. In addition to damage, this may cause improper operation or damage to the module.

(c) Note that polarizers are very fragile and could be easily damaged. Do not press or scratch the surface harder than a HB pencil lead.

(d) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, Staining and discoloration may occur.

(e) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.

(f) The desirable cleaners are water, IPA (Isoprophyl Alcohol) or Hexane.
Do not use Ketone type materials(ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.

(g) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth . In case of contact with hands, legs or clothes, it must be washed away thoroughly with soap.

(h) Protect the module from static , it may cause damage to the C-MOS Gate Array IC.

(i) Use fingerstalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.

(j) Do not disassemble the module.

(k) Do not pull or fold the lamp wire.

(l) Do not adjust the variable resistor which is located on the back side.

(m) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.

(n) Pins of I/F connector shall not be touched directly with bare hands.

2. STORAGE

We highly recommend to comply with the criteria in the table below.

ITEM	Unit	Min.	Max.
Storage Temperature	(℃)	5	40
Storage Humidity	(%rH)	35	75
Storage life	12 months		
Storage Condition	- The storage room should provide good ventilation and temperature control. - Products should not be placed on the floor, but on the Pallet away from a wall. - Prevent products from direct sunlight, moisture nor water; Be cautious of a build up of condensation. - Avoid other hazardous environment while storing goods. - If products delivered or kept in conditions of over the storage period of 3 months, the recommended temperature or humidity range, we recommend you leave them at a temperature of 20℃ and a humidity of 50% for 24 hours.		

3. OPERATION

(a) Do not connect, disconnect the module in the " Power On" condition.

(b) Power supply should always be turned on/off by following item 6.3 " Power on/off sequence ".

(c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.

(d) The standard limited warranty is only applicable when the module is used for general notebook applications. If used for purposes other than as specified, SEC is not to be held reliable for the defective operations. It is strongly recommended to contact SEC to find out fitness for a particular purpose.

4. OTHERS

(a) Ultra-violet ray filter is necessary for outdoor operation.

(b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.

(c) Do not exceed the absolute maximum rating value. (the supply voltage variation, input voltage variation, variation in part contents and environmental temperature, so on) Otherwise the module may be damaged.

(d) If the module displays the same pattern continuously for a long period of time,it can be the situation when the image "sticks" to the screen.

(e) This module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.