SAMSUNG MOBILE DISPLAY

Preliminary

Product Information

ISSUE DATE : Nov. 30. 2010
MODEL : LMS501KF03
Customer : Pantech

Note. The Product and Specification are subject to change without any notice. Please ask for the latest Product Standards to guarantee the satisfaction of your product requirements.

PREPARED BY : Samsung Mobile Display Development Team

Samsung Mobile Display

Preliminary

Contents

Revision History

Preliminary

Data	Rev. No.	Page	Summary
Nov.30.2010	000		First issued

General Description

* Description

LMS501KF03 is a TMR(Transmissive with Micro Reflective) type color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching devices. This model is composed of a TFT-LCD module, a driver circuit and a back-light unit.

The resolution of a 5.01" contains 480(xRGB) x 800 dots and can display 16.7M colors.

* Features

- Transmissive with Micro Reflective type and back-light with 12 LEDs are available.
- VA(Normally black) mode.
- RGB 24bit Parallel + SPI
- Portrait type

* Applications

- Display terminals for PMP(Portable Multimedia Player), PND(Portable Navigation Display) application products.
- Display terminals for AV application products

* General information

Items	Specification	Unit	Note
Display area	65.52(H) x 109.2(V) (5.01" diagonal)	mm	-
Driver element	a-Si TFT active matrix	-	-
Display colors	16.7M	colors	-
Number of pixels	480 x RGB x 800	dot	-
Pixel arrangement	RGB Vertical Stripe	-	-
Pixel pitch	0.1365(H) x 0.1365(V)	mm	186ppi
Display mode	Normally black	-	-

* Mechanical information

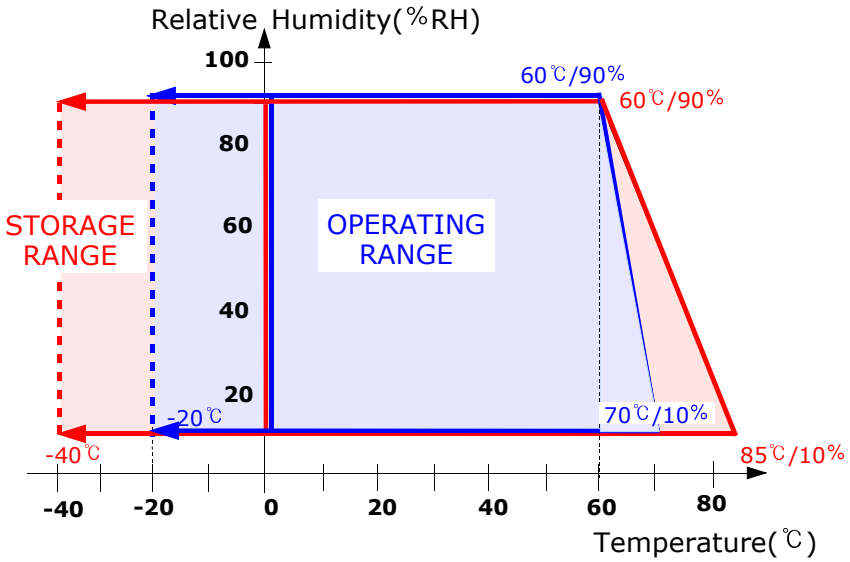
Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal(H)	(71.20)	(71.40)	(71.60)	mm	(1)
	Vertical(V)	(120.20)	(120.40)	(120.60)	mm	(1)
	Thickness(T)	(2.30)	(2.50)	(2.70)	mm	(1)
Weight		-	TBD	-	g	-

Note (1) Include Back-light without FPC.
Refer to the Outline Dimension in page 27.

1. Absolute Maximum Ratings

1.1 Absolute Ratings of Environment

Item	Symbol	Min.	Max.	Unit	Note
Storage temperature	TSTG	-40	85	℃	(1)
Operating temperature (Ambient temperature)	TOPR	-20	70	℃	(2),(3)



Note (1) 90 % RH Max. (40 °C ≥ Ta)
Maximum wet-bulb temperature at 39 °C or less. (Ta > 40 °C) No c ondensation.

Note (2) In case of below 0°, the response time of liquid cryst al (LC) becomes slower and the color of panel becomes darker than normal one.
Level of retardation depends on temperature, because of LC' s characteristics.

Note (3) If any fixed pattern is displayed on LCD for minutes, image-sticking phenomenon may occur.

1.2 Electrical Absolute Ratings

(1) TFT-LCD Module

(Ta = 25°C)

Item	Symbol	Min.	Max.	Unit	Note
Analog/Logic Voltage	VDD3	-0.3	5.5	V	(1)
I/O Interface Voltage	VDD1	-0.3	3.6	V	(1)

(2) Back-Light Unit

(Ta = 25 ± 2°C)

Item	Symbol	Min.	Max.	Unit	Note
Current	I_{LED}	-	25	mA	(2)

Note (1) When used out of the absolute maximum ratings, the LSI may be permanently damaged.

Note (2) Permanent damage to the device may occur if maximum values are exceeded or reverse voltage is loaded.

2. Optical Characteristics

The following items are measured under stable conditions. The optical characteristics should be measured in a dark room or equivalent state with the methods shown in Note (1).
(Measuring equipment: SR-3, BM-7, EZ-Contrast)

(Ta = 25 ± 2°C, VDD3 = 3.0V, f_{Frame} = 60Hz, I_{LED} = 18mA)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast ratio (Center point)		C/R	NOTE (1) θ = 0 Φ = 0 Normal Viewing Angle B/L On	(400)	(800)	-	-	(2) SR-3
Average Luminance of White at 9 points		YLAVE.		(450)	-	-	cd/m2	(3),(4) SR-3
Uniformity				(70)	(80)		%	
Flicker						(-25)	dB	
Crosstalk						(3)	%	
Response time	Rising:Tr	Tr+Tf		-	(32)	-	msec	(5) BM-7
	Falling:Tf							
Color chromaticity (CIE 1931)	White	Wx		(0.259)	(0.309)	(0.359)		(6) SR-3
		Wy		(0.285)	(0.335)	(0.385)		
	Red	Rx		(0.538)	(0.588)	(0.638)		
		Ry		(0.301)	(0.351)	(0.401)		
	Green	Gx		(0.294)	(0.344)	(0.394)		
		Gy		(0.533)	(0.583)	(0.633)		
	Blue	Bx		(0.106)	(0.156)	(0.206)		
		By		(0.064)	(0.114)	(0.164)		
Viewing angle	Hor.	θ_L	C/R≥10 B/L On	-	(80)	-	Degrees	(7) EZ-Contrast
		θ_R		-	(80)	-		
	Ver.	Φ_H		-	(80)	-		
		Φ_L		-	(80)	-		

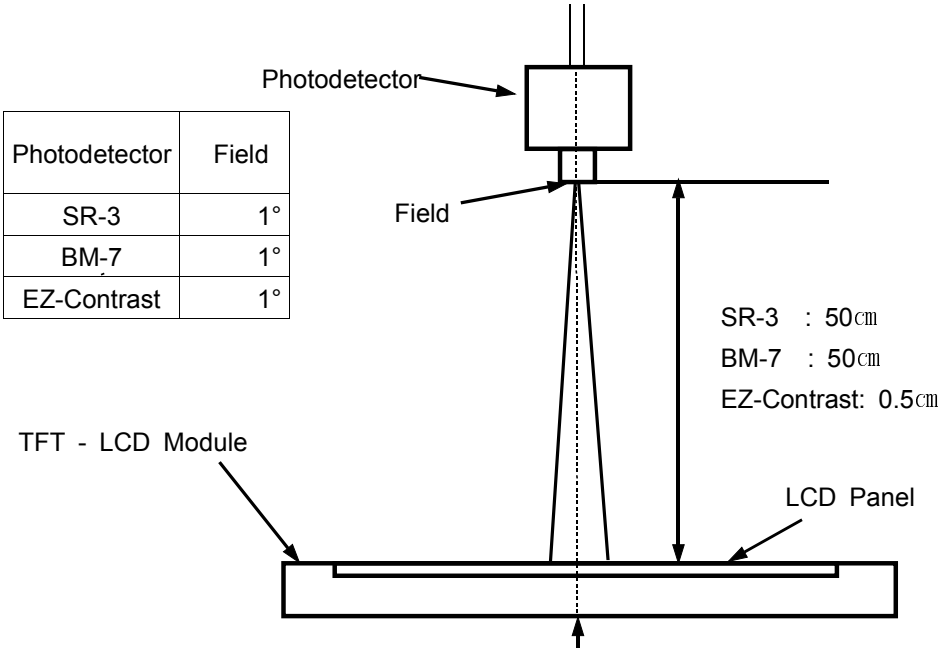
Note (1) Test Equipment Setup

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 back-light. This should be measured in the center of screen.

Environment condition : Ta = 25 ± 2 °C

Back-Light On condition

Photodetector	Field
SR-3	1°
BM-7	1°
EZ-Contrast	1°



Note (2) Definition of Contrast Ratio (C/R)

Ratio of gray max (Gmax) & gray min (Gmin) at the center point

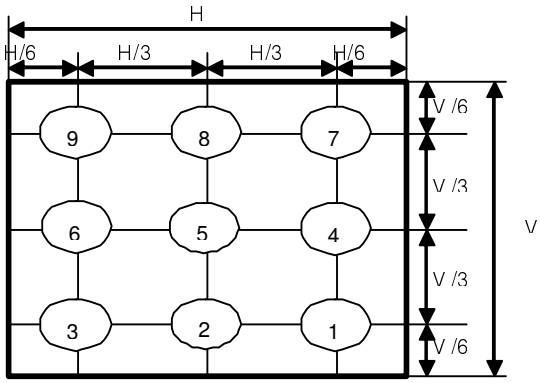
$$CR = \frac{G\max}{G\min}$$

* Gmax : Luminance with all pixels white
* Gmin : Luminance with all pixels black

Note (3) Definition of Luminance of White: Average Luminance of white at 9 points
Refer to Note(4)

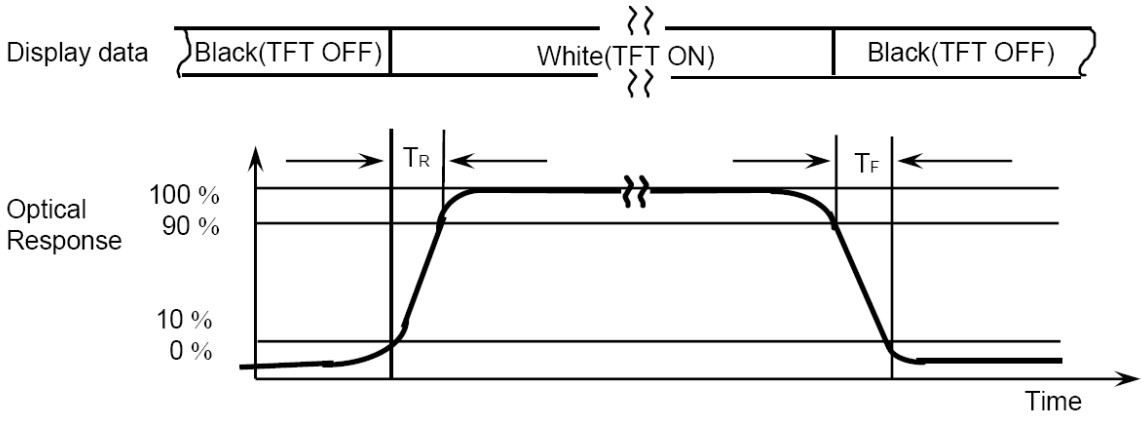
$$Y_{LAVE.} = \frac{Y_{L1}+Y_{L2}+Y_{L3}+\cdots\cdots+Y_{L9}}{9}$$

Note (4) Definition of White Uniformity :



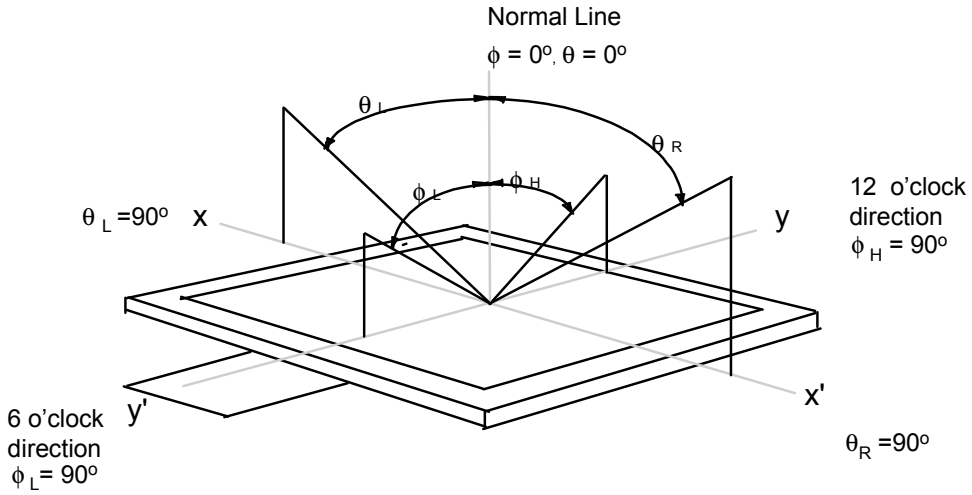
$$\text{Uniformity} = \frac{L_{Min}}{L_{Max}} \times 100$$

Note (5) Definition of Response time : Sum of Tr ,Tf



Note (6) Definition of Color Chromaticity (CIE 1931)
Color coordinate of white & red, green, blue at center point.

Note (7) Definition of Viewing Angle : Viewing angle range (CR≥10)



3. Electrical Characteristics

3.1 TFT-LCD Module

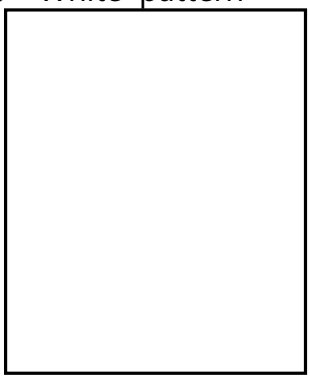
Ta = 25 ± 2°C

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Digital Supply voltage	VDD3	(2.3)	(3.0)	(4.8)	V	
I/O Logic Voltage	VDD1	(1.65)	(1.8)	(3.3)	V	
Power Dissipation	Ptotal	-	TBD	-	mW	w/o BLU
Frame frequency	f_{Frame}	-	60	-	Hz	-
Dot Clock	DOTCLK	24.576	24.576	-	MHz	-

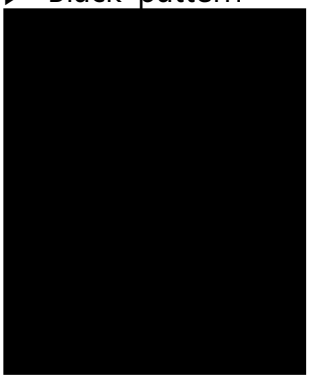
Note (1) VDD3 = 3.0V, f_{Frame} = 60Hz, DOTCLK = 24.576MHz

(2) Dissipation current check pattern

▶ White pattern



▶ Black pattern



3.2 Back-Light unit

The Back-Light system is an edge-lighting type with 12(6+6) white LEDs (Light Emitting Diode).

(Ta=25 ± 2°C)

Item	Symbol	MIN.	TYP.	MAX.	Unit	Note
LEDs Current	I_B	-	(18)	25	mA	(1),(2)
Power Consumption	P_{BL}	-	(0.72)	1.0	W	(2),(3)

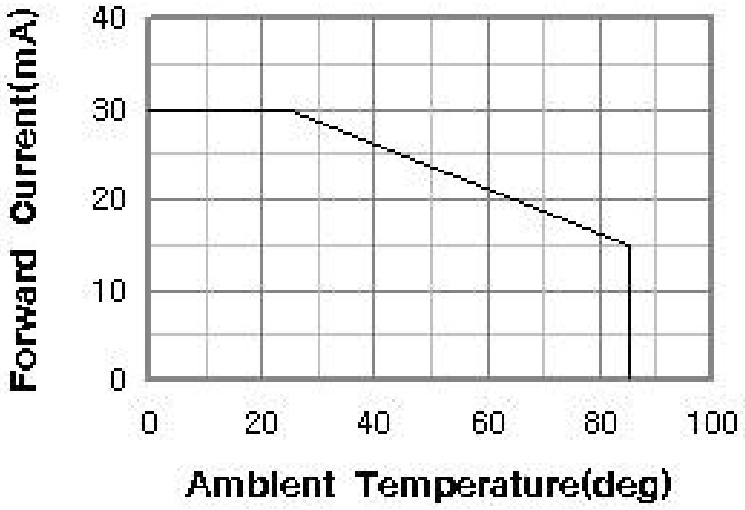
Note (1) The LEDs parallel type (6LEDs x 2)

(2) Where I_B = (18)mA, V_B = P_{BL} / I_B per 1 LEDs string

(3) DC current(voltage) use only.

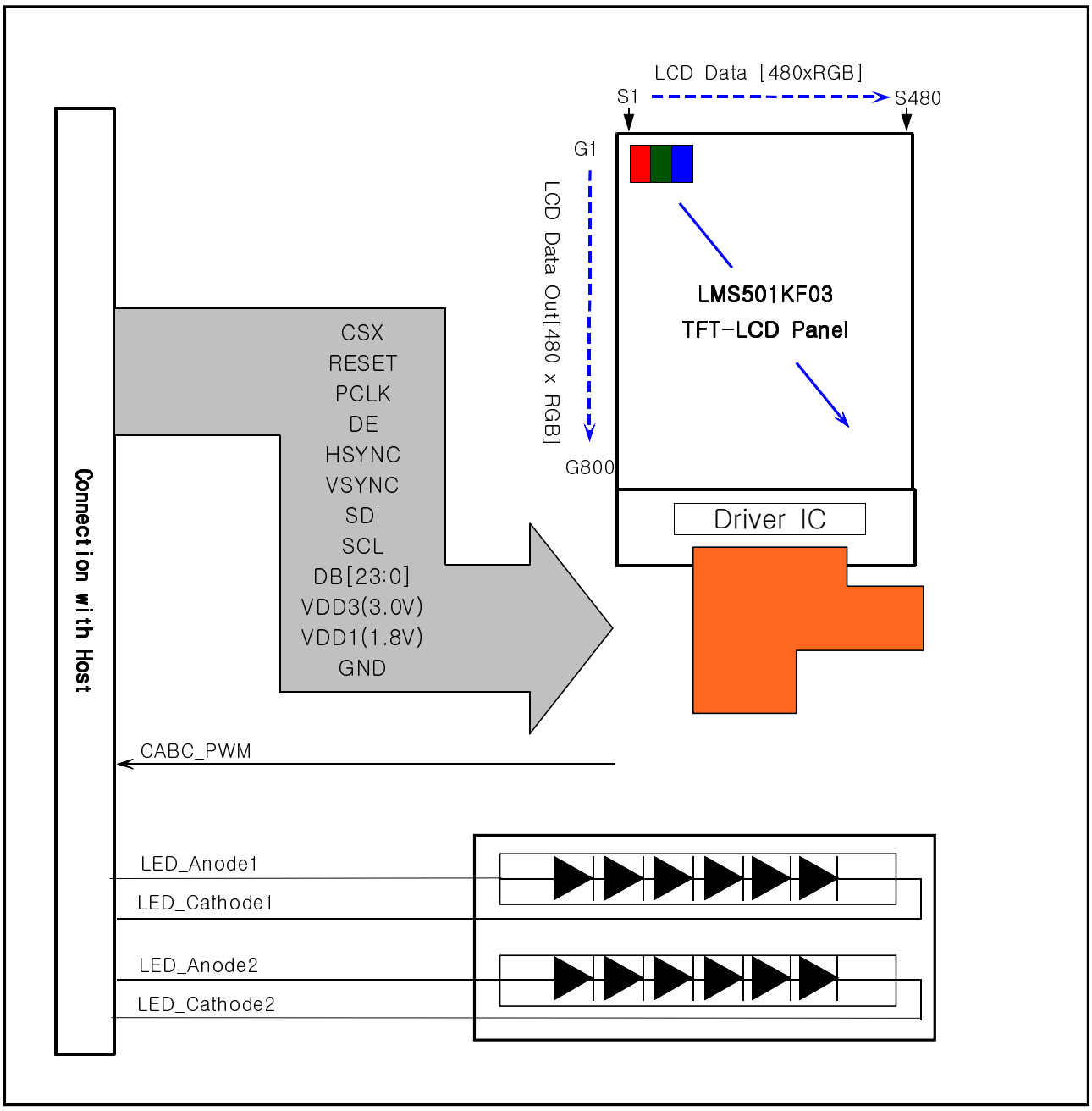
If PWM(pulse width modulation) used, some problems may be happened.

< Ambient Temp vs. Allowable Forward Current _ BLU LED >



4. Block Diagram

4-1. TFT-LCD Module (Interface System Structure) with Back Light Unit



5. Input Terminal Pin Assignment

5.1 Input Signal & Power (*.Connector : Hirose, FH26-51S-0.3SHW)

No.	Symbol	Description	No.	Symbol	Description
1	GND	Ground	27	DG2	RGB Data (G2)
2	VDD3	Analog/Logic Power (3.0V)	28	DG3	RGB Data (G3)
3			29	DG4	RGB Data (G4)
4	GND	Ground	30	DG5	RGB Data (G5)
5	VDD1	I/O I/F Power (1.8V)	31	DG6	RGB Data (G6)
6	N.C	No connection	32	DG7	RGB Data (G7)
7	PCLK	Dot Clock	33	GND	Ground
8	DE	Data Enable	34	DR0	RGB Data (R0)
9	HSYNC	Horizontal Sync	35	DR1	RGB Data (R1)
10	VSYNC	Vertical Sync	36	DR2	RGB Data (R2)
11	N.C	No connection	37	DR3	RGB Data (R3)
12	SDI	SPI Data Input	38	DR4	RGB Data (R4)
13	CSX	chip selection	39	DR5	RGB Data (R5)
14	SCL	SPI Clock	40	DR6	RGB Data (R6)
15	GND	Ground	41	DR7	RGB Data (R7)
16	DB0	RGB Data (B0)	42	GND	Ground
17	DB1	RGB Data (B1)	43	RESET	RESET
18	DB2	RGB Data (B2)	44	CABC_PWM	PWM Signal Out
19	DB3	RGB Data (B3)	45	N.C	No connection
20	DB4	RGB Data (B4)	46	LED2-	LED Cathode 2
21	DB5	RGB Data (B5)	47	LED1-	LED Cathode 1
22	DB6	RGB Data (B6)	48	N.C	No connection
23	DB7	RGB Data (B7)	49	LED2+	LED Anode 2
24	GND	Ground	50	LED1+	LED Anode 1
25	DG0	RGB Data (G0)	51	GND	Ground
26	DG1	RGB Data (G1)	-	-	-

5.2 Input Signal, Basic Display Colors and Gray Scale of Each Colors

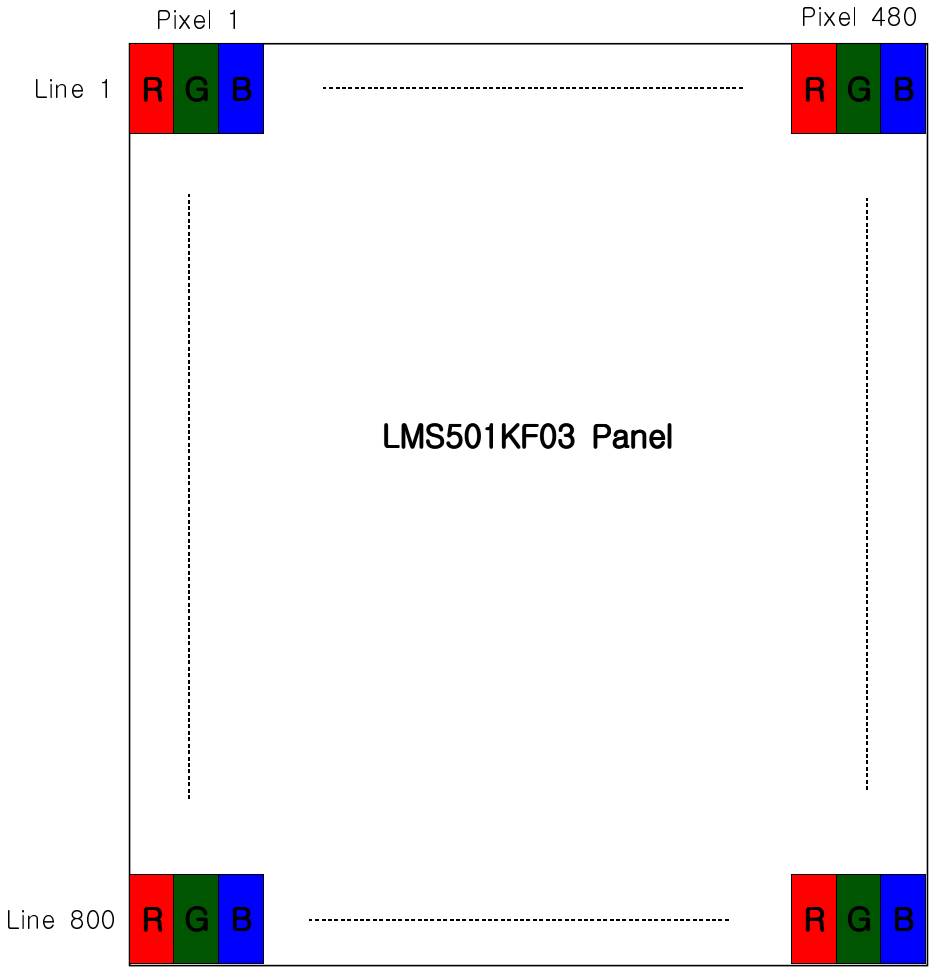
COLOR	DISPLAY	DATA SIGNAL																								GRAY SCALE LEVEL
		RED								GREEN								BLUE								
		R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3	B4	B5	B6	B7	
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-
	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) Definition of Gray :

Rn : Red Gray, Gn : Green Gray, Bn : Blue Gray (n = Gray level)

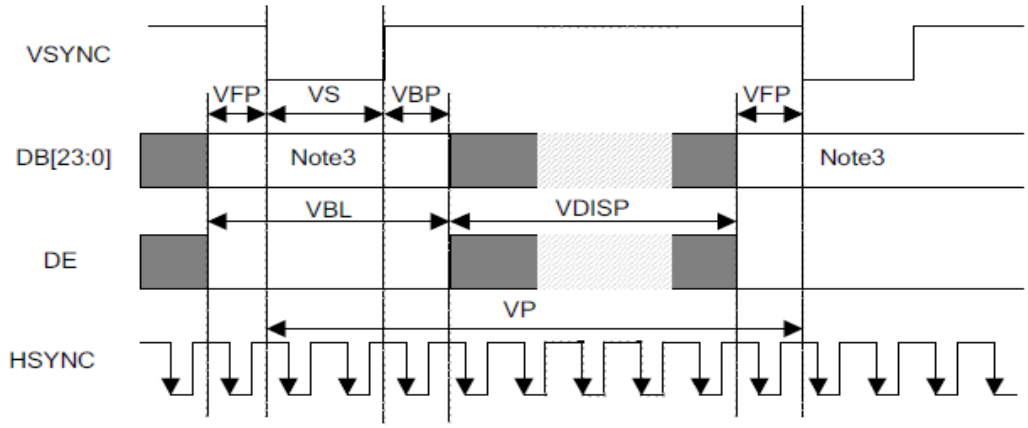
Input Signal : 0 = Low level voltage, 1 = High level voltage

5.3 Pixel Format



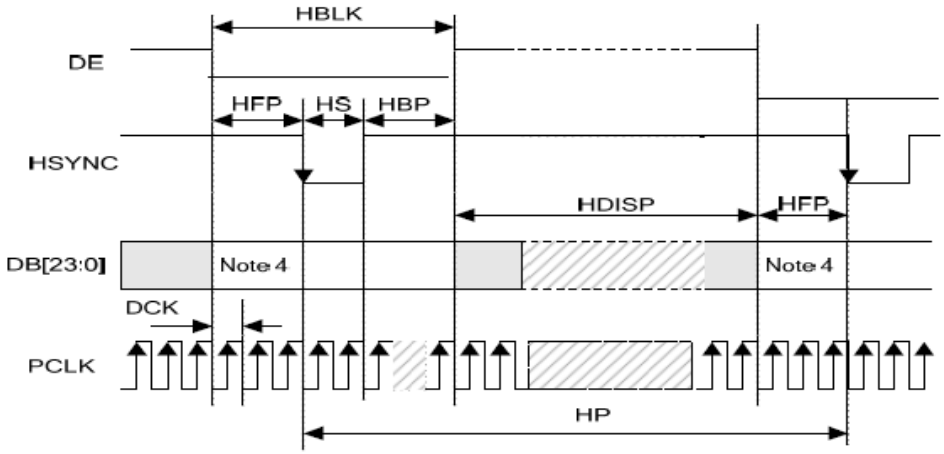
6. Interface Timing

6.1 Vertical Timing



Signal	Symbol	Min.	Typ.	Max.	Unit	Note
Frame Frequency	fFRM	60	60	-	Hz	
VSYNC(Frame) Period	VP	816	816	-	H	
VSYNC Low width	VS	4	4	-	H	
Vertical Display Period	VDISP	800	800	-	H	
Vertical Back porch	VBP	6	6	-	H	
Vertical Front porch	VFP	6	6	-	H	

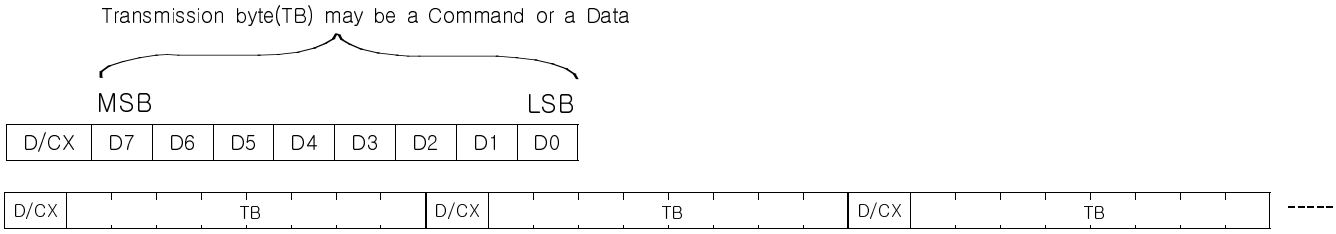
6.2 Horizontal Timing



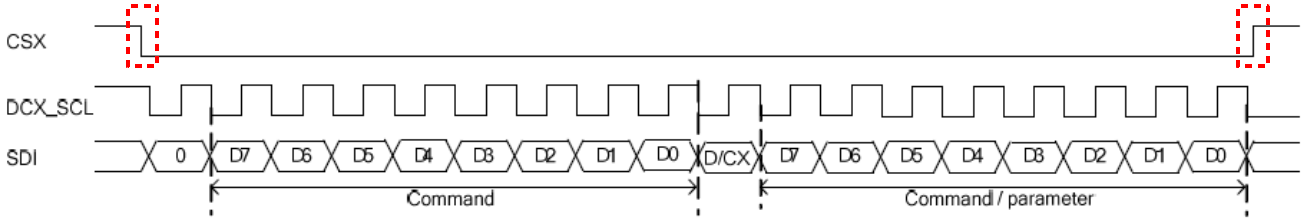
Signal	Symbol	Min.	Typ.	Max.	Unit	Note
HSYNC(1H) Period	HP	502	502	-	DCK	
HSYNC Low width	HS	6	6	-	DCK	
Horizontal Display Period	HDISP	480	480	-	DCK	
Horizontal Back porch	HBP	8	8	-	DCK	
Horizontal Front porch	HFP	8	8	-	DCK	
DOTCLK Frequence	DCK	24.576	24.576	-	MHz	

6.3 SPI Signal

6.3.1 Serial data stream format, write mode



6.3.2 Serial Interface protocol

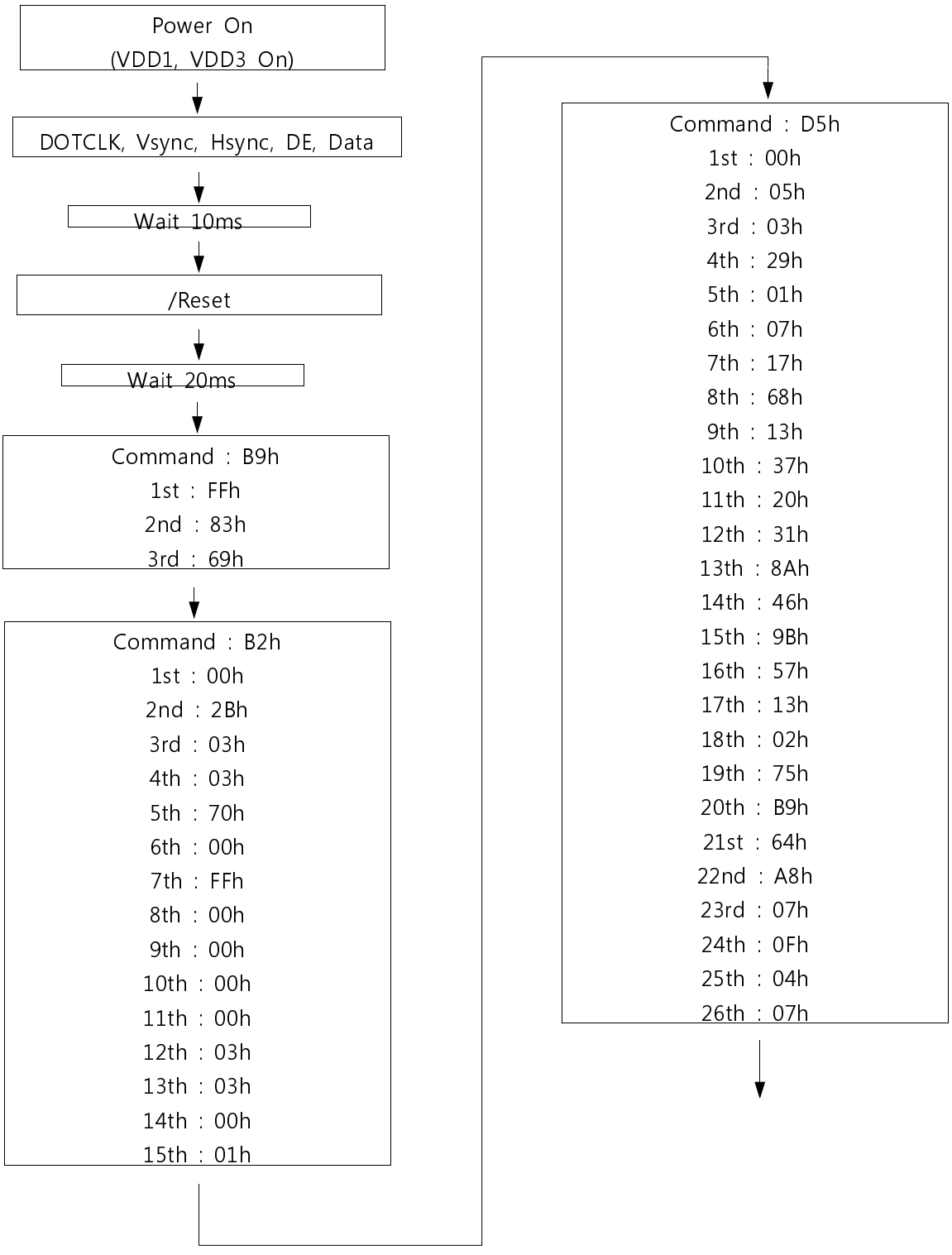


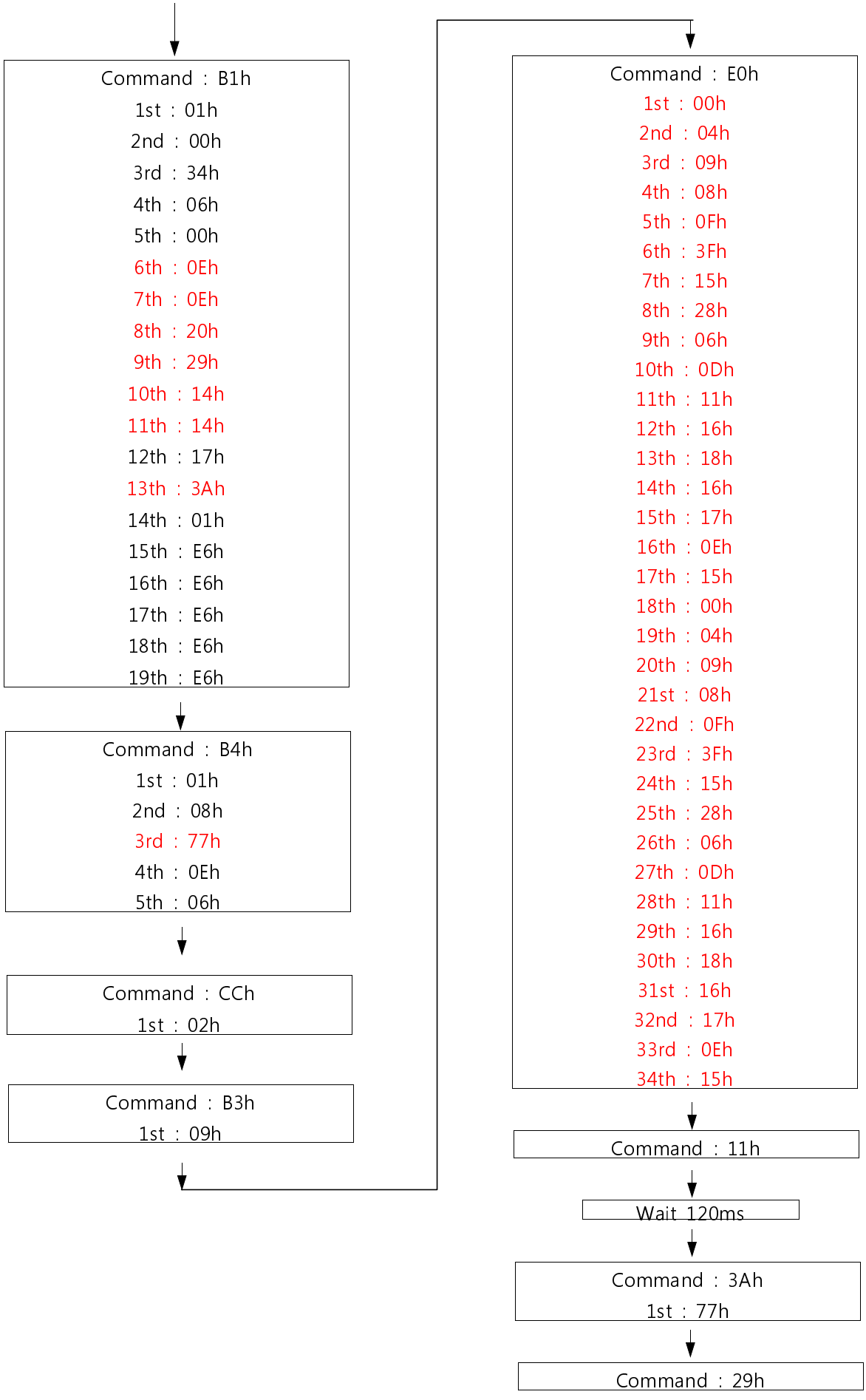
This serial data packet contains a control bit D/CX and a transmission byte. If D/CX is low, the transmission byte is command byte. If D/CX is high, transmission byte is stored in to command register or GRAM. The MSB is transmitted first. A falling edge on CSX enables the serial interface and indicates the start of data transmission.

6.4 Register Setting (Value)

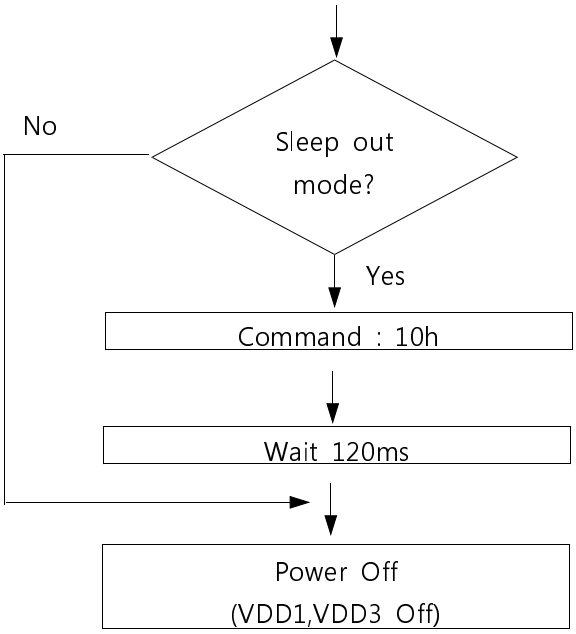
TBD

< Power On Sequence>



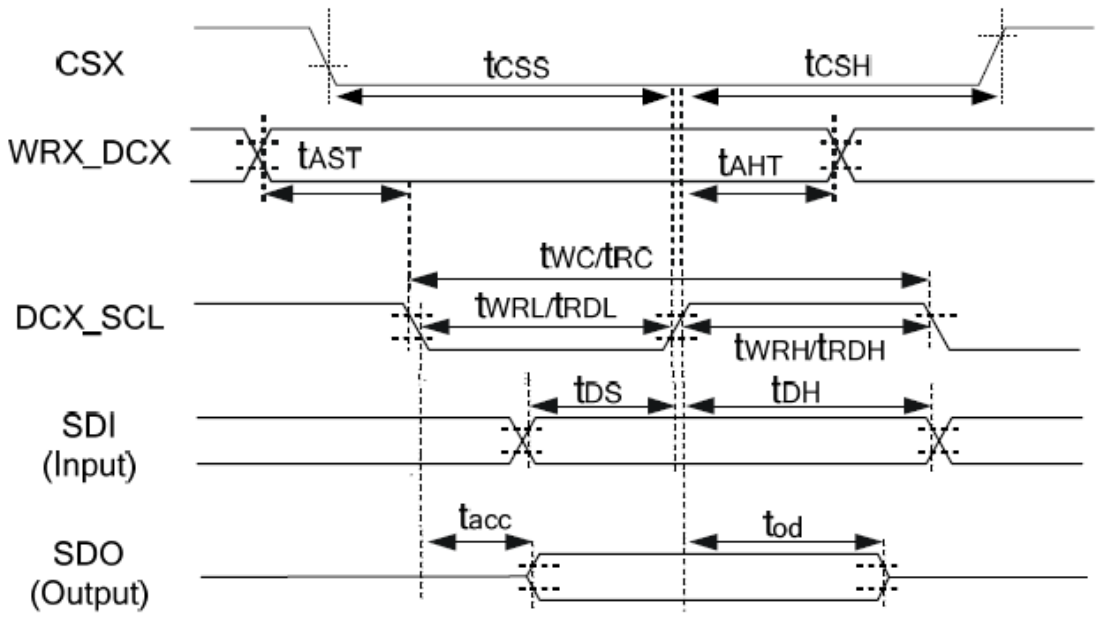


< Power Off Sequence>



6.5 AC Characteristic

6.5.1 Serial Interface Timing Characteristic

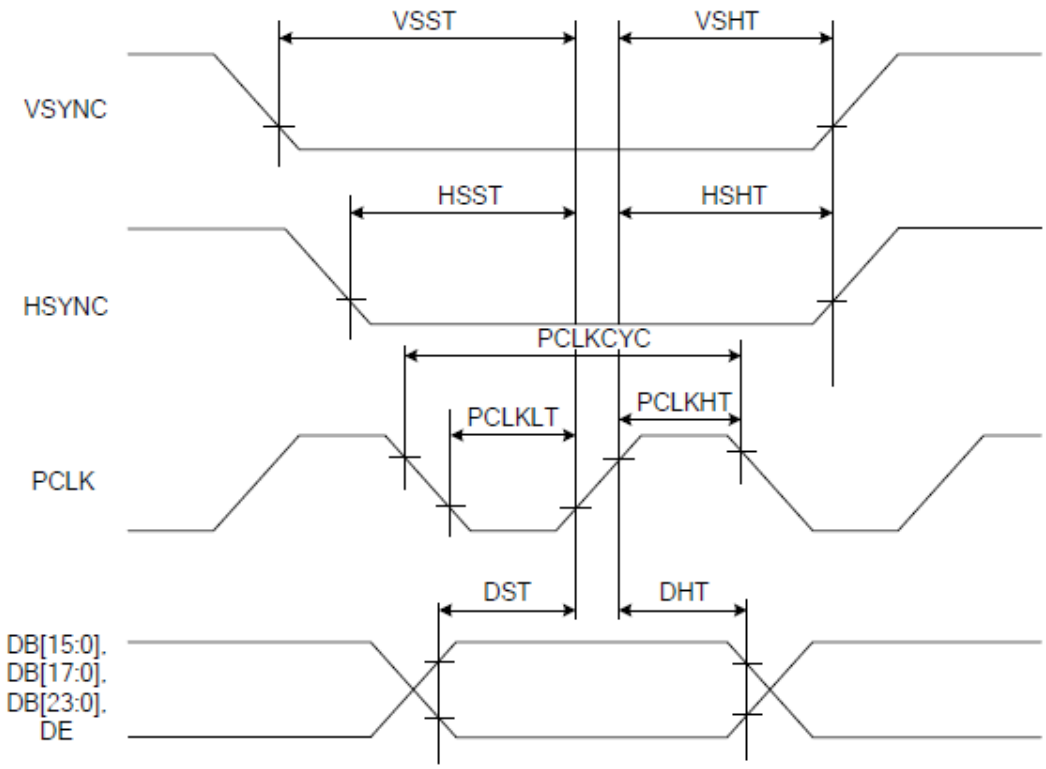


(VSSA=0V, VDD1=1.8V, VDD2=2.8V, VDD3=2.8V, T_A = 25°C)

Signal	Symbol	Parameter	Min.	Max.	Unit	Description
CSX	tCSS tCSH	Chip select setup time (Write) Chip select setup time (Read)	40 40	- -	ns	-
WRX_DCX	tAST tAHT	Address setup time Address hold time (Write/Read)	10 10	- -	ns	-
DCX_SCL (Write)	twc twRH twRL	Write cycle Control pulse "H" duration Control pulse "L" duration	100 40 40	- - -	ns	-
DCX_SCL (Read)	tRC tRDH tRDL	Read cycle Control pulse "H" duration Control pulse "L" duration	150 60 60	- - -	ns	-
SDI/SDO (Input)	tDS tDT	Data setup time Data hold time	30 30	- -	ns	For maximum CL=30pF For minimum CL=8pF
SDI/SDO (Output)	tRACC tOD	Read access time Output disable time	10 10	- 50	ns	

Note: The input signal rise time and fall time (tr, tf) is specified at 15 ns or less.
Logic high and low levels are specified as 30% and 70% of VDD1 for Input signals.

6.5.2 Image Data Interface Timing Characteristic



(VSSA=0V, VDD1=1.8V, VDD2=2.8V, VDD3=2.8V, T_A=25°C)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Vertical sync. setup time	VSST	-	5	-	-	ns
Vertical sync. hold time	VSHT	-	5	-	-	ns
Horizontal sync. setup time	HSST	-	5	-	-	ns
Horizontal sync. hold time	HSHT	-	5	-	-	ns
Pixel clock cycle when RGB I/F is running	PCLKCYC	VRR(4)= 60Hz	38.46	38.46(3)	-	ns
Pixel clock low time	PCLKLT	-	5	-	-	ns
Pixel clock high time	PCLKHT	-	5	-	-	ns
Data setup time DB[23:0]	DST	-	5	-	-	ns
Data hold time DB[23:0]	DHT	-	5	-	-	ns

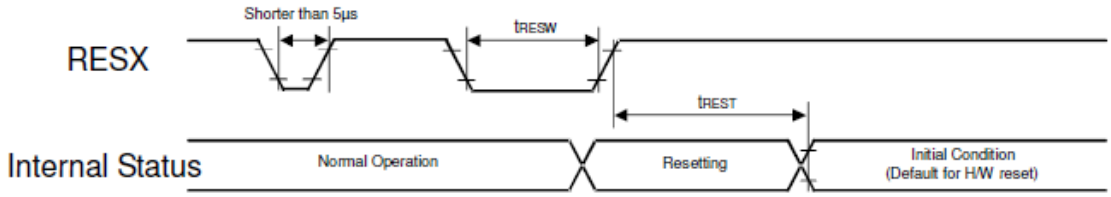
Note:(1) Signal rise and fall times are equal to or less than 20ns.

(2) Input signals are measured by 0.3xVDD1 for low state and 0.7xVDD1 for high state.

(3) 26MHz

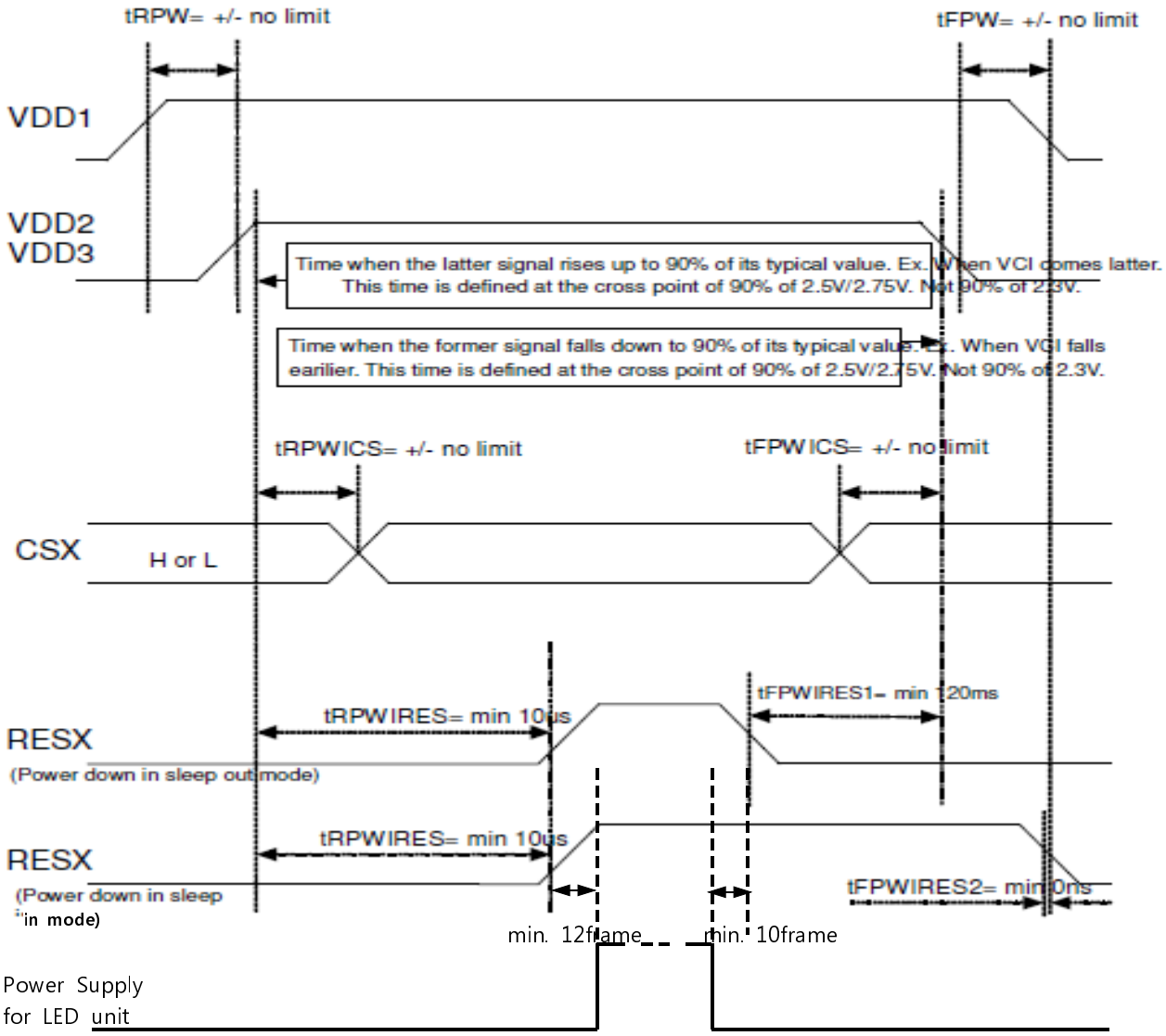
(4) VRR : Vertical Refresh Rate, equal to VSYNC frequency.

6.5.3 Reset Input Timing Characteristic

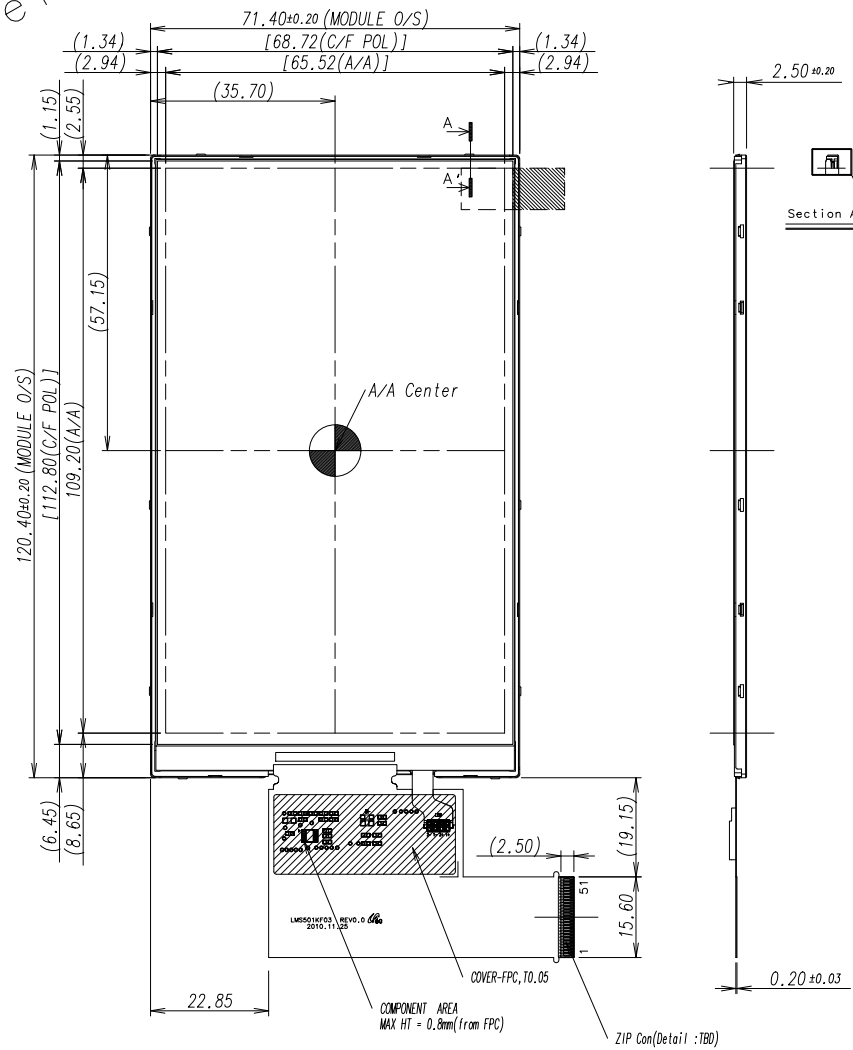


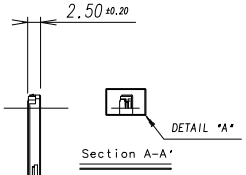
Symbol	Parameter	Related pins	Min.	Typ.	Max.	Note	Unit
t_{RESW}	Reset low pulse width[1]	RESX	10	-	-	-	µs
t_{REST}	Reset complete time[2]	-	-	-	5	When reset is applied during Sleep In mode	ms
		-	-	-	120	When reset is applied during Sleep Out mode	ms

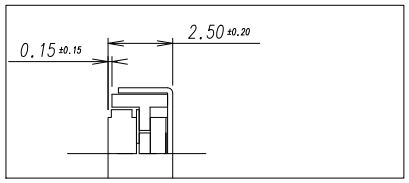
7. Power On/Off Sequence



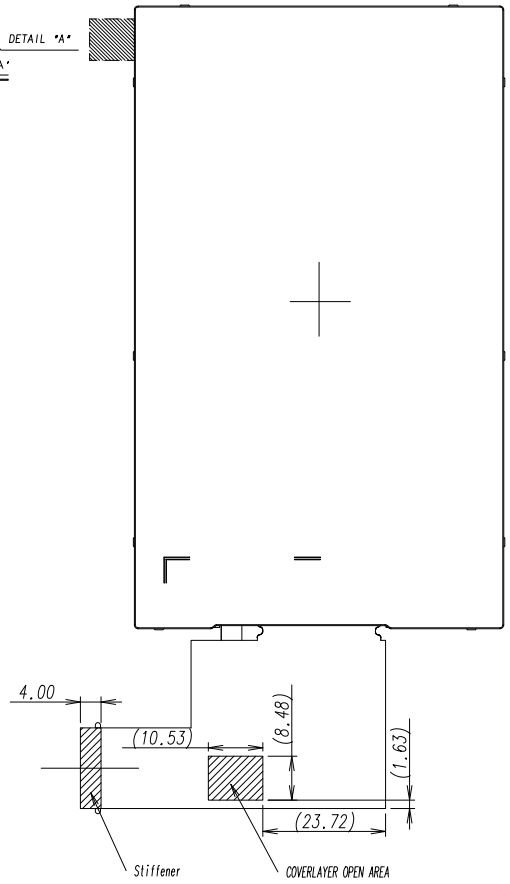
Preliminary

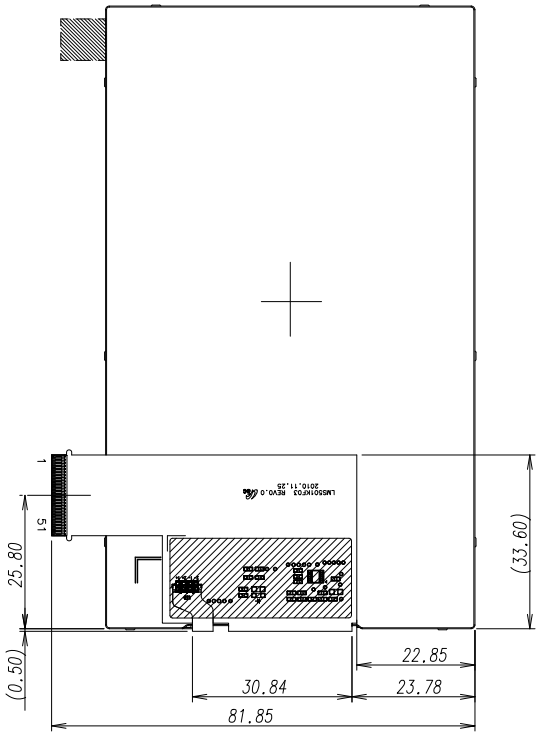






DETAIL A(S:5/1)





FPC INSTALLED POSITION
(REFERANCE)

REV	DATE	DISCRIPTION OF REVISION	REASON

GENERAL TOLERANCE

STEP	LEVEL 1	LEVEL 2	LEVEL 3
0 < X ≤ 4	±0.05	±0.1	±0.2
4 < X ≤ 16	±0.08	±0.15	±0.3
16 < X ≤ 64	±0.12	±0.25	±0.5
64 < X ≤ 256	±0.25	±0.4	±0.8

UNIT	mm	DES'D BY	CHK'D BY	APP'D BY
SCALE	1 / 1	Y.H.KIM	J.S.OH	S.H.LEE
TOLERANCE LEVEL	3	'10.11.26	'10.11.26	'10.11.26

SAMSUNG MOBILE DISPLAY

PROJECTION	STD.TOL	SIZE
		A3

MODEL NAME	LMS501KF0X
PART/SHEET NAME	Outline Dimension
CODE NO.	SHEET 1/1
SPEC. NO.	VER. 000

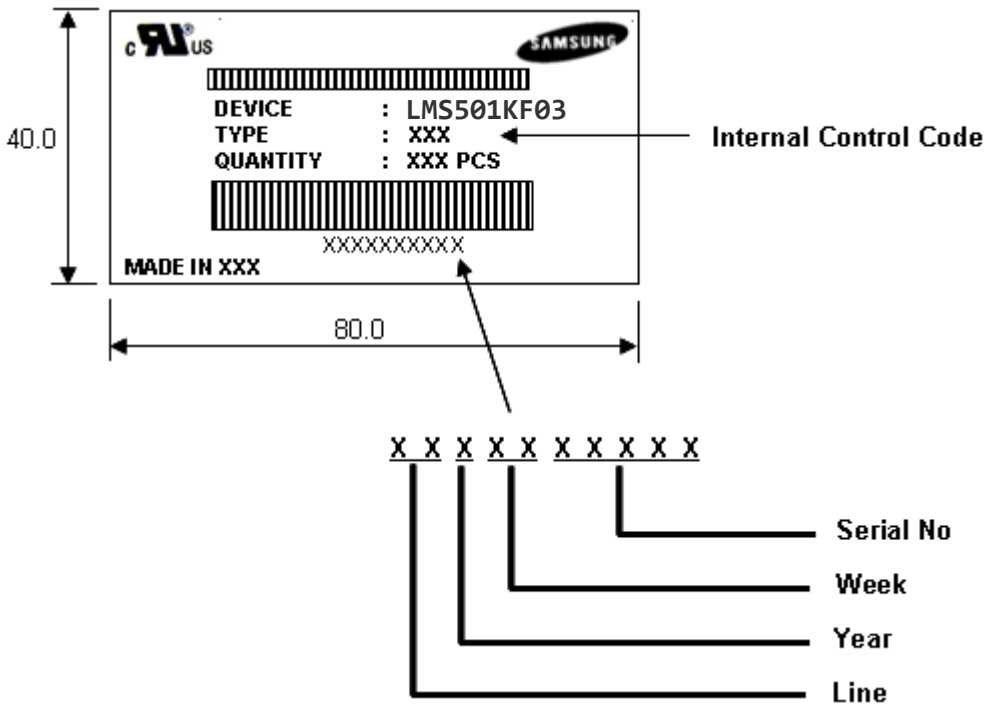
9. Packing

TBD

10. Marking & Others

A nameplate bearing followed by is affixed to a shipped product at the specified location on each product.

(1) Packing case attach



11. General Precautions

11.1 Handling

(a) When the module is assembled, it should be attached to the system firmly. Be careful not to twist and bend the module.

(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 and back-light unit.

(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(Isopropyl 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 Integrated Gate Circuit.

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

(j) Do not disassemble the module.

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

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

11.2 Storage

(a) Do not leave the panel in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35°C and relative humidity of less than 70%.

(b) Do not store the TFT-LCD module in direct sunlight.

(c) The module shall be stored in a dark place. It is prohibited to apply sunlight or fluorescent light during the store.

11.3 Operation

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

(b) Power supply should always be turned on/off by the "Power on/off sequence"

11.4 Others

(a) The Liquid crystal is deteriorated by ultraviolet, do not leave it in direct sunlight and strong ultraviolet ray for many hours.

(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, and so on) Otherwise the panel may be damaged.

(d) If the panel 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 panel has its circuitry FPC on the bottom side and should be handled carefully in order not to be stressed.