



TO :
DATE : June. 07. 2011

SAMSUNG TFT-LCD

MODEL NO. : LMS501KF03

NOTE :

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Production Development Team 2
SAMSUNG Mobile Display Co., Ltd.

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Scope

This Specification defines general provisions as well as inspection standards for LCD module supplied by SAMSUNG SMD Co., LTD., If the event of unforeseen problems or unspecified items occurs, we naturally shall negotiate and agree to solution with customer.

Warranty

Basically, warranty term is **15 months** of reliability characteristics of quality level after the outgoing date in SAMSUNG SMD Co., LTD., and SAMSUNG SMD Co., LTD., could compensate for defectives which happens within warranty term under condition that the products should be stored or be used as specified under normal condition within the contents of specification.

Otherwise, it is impossible to compensate for defectives when they happens by customer's mistake such as careless handling or circuit change, etc.

And after 15 months of warranty term, all replacements for defectives will be charged.

This Specification stipulates the final and comprehensive requirements for the respective products hereof. Beyond this Specification, it is responsibility of the customer to explicitly disclose any additional requirements, information or reservations regarding these requirements to Samsung SMD prior to implementation, where any and all disclosures of the customer shall be with an authorized representative of Samsung SMD in writing.

Samsung SMD shall not be responsible for safety, performance, functionality, compatibility of the system with which the Samsung SMD-supplied components are integrated unless such features have been expressly communicated and described in the Specification.

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Moreover, any party should do their own due diligence regarding these requirements prior to implementation.

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
- mPVA(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	-	-
Surface strength	Min. 3	H	-

* 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		-	45	54	g	-

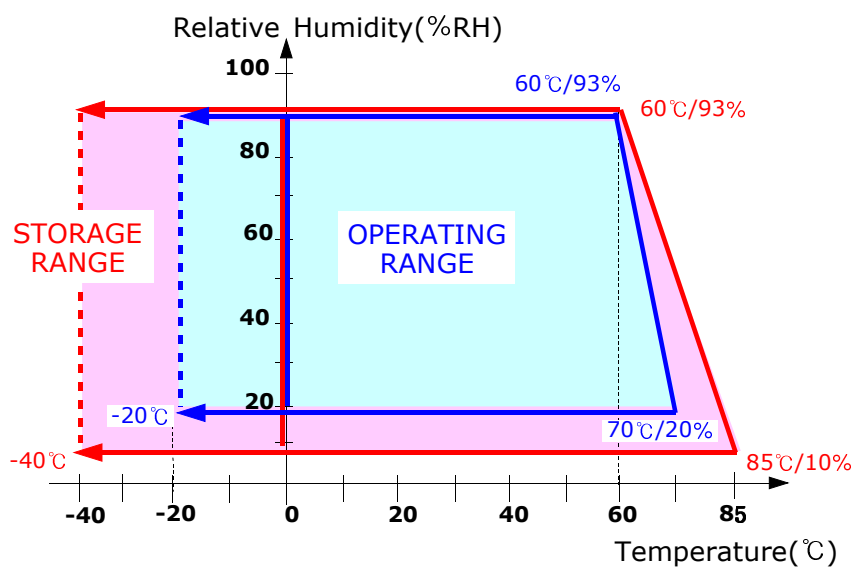
Note (1) Include Back-light without FPC.

Refer to the Outline Dimension in Appendix.

1. Absolute Maximum Ratings

1.1 Absolute Ratings of Environment

Item	Symbol	Min.	Max.	Unit	Note
Storage temperature	T _{STG}	-40	85	°C	(1)
Operating temperature (Ambient temperature)	T _{OPR}	-20	70	°C	(1),(2),(3)



- Note (1) 93 % RH Max. (40 °C ≥ Ta)
Maximum wet-bulb temperature at 39 °C or less. (Ta > 40 °C) No condensation.
- Note (2) In case of below 0°, the response time of liquid crystal (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	2.3	4.8	V	(1)
I/O Interface Voltage	VDD1	1.65	3.3	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-UL2, DMS-505, EZ CONTRAST)

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

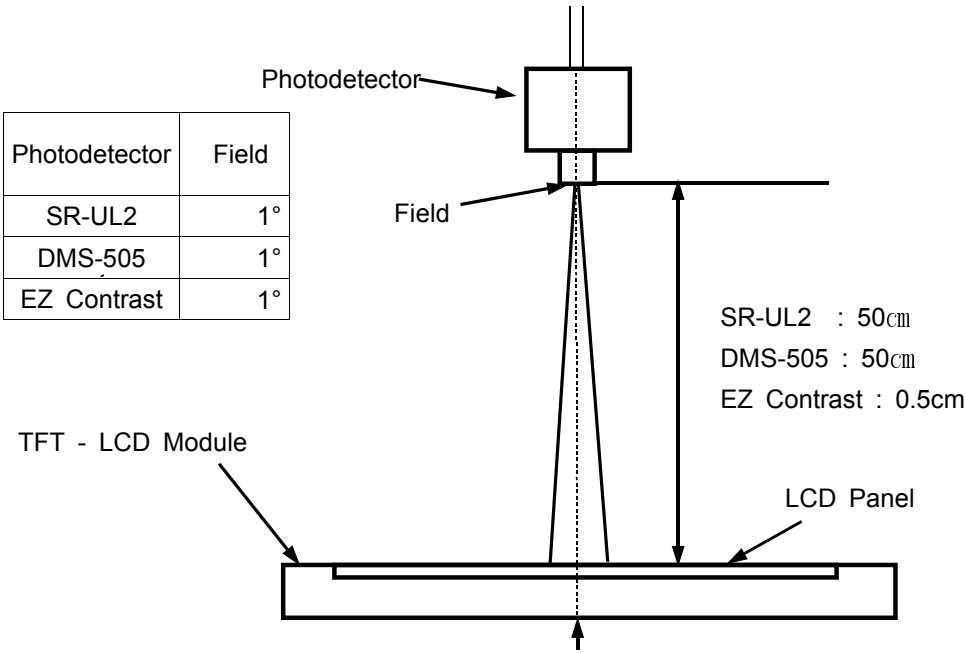
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast ratio (Center point)		C/R	NOTE (1) θ = 0 Φ = 0 Normal Viewing Angle B/L On	700	1000	-	-	(2)
Average Luminance of White at 9 points		YLAVE.		400	500	-	cd/m2	(3),(4)
Uniformity				70	80		%	
Flicker						-25	dB	(9)
						6.5	%	(11)
Crosstalk						3	%	(10)
NTSC Color Purity (CIE 1931)				45	50		%	(8)
Response time	Rising:Tr	Tr+Tf		-	25	-	msec	(5)
	Falling:Tf							
Color chromaticity (CIE 1931)	White	Wx		0.259	0.309	0.359		(6)
		Wy		0.285	0.335	0.385		
	Red	Rx		0.551	0.601	0.651		
		Ry		0.310	0.360	0.410		
	Green	Gx		0.276	0.326	0.376		
		Gy		0.515	0.565	0.615		
	Blue	Bx		0.099	0.149	0.199		
		By		0.073	0.123	0.173		
Viewing angle	Hor.	θ _L	C/R≥10 B/L On	75	80	-	Degrees	(7)
		θ _R		75	80	-		
	Ver.	Φ _H		75	80	-		
		Φ _L		75	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



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

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

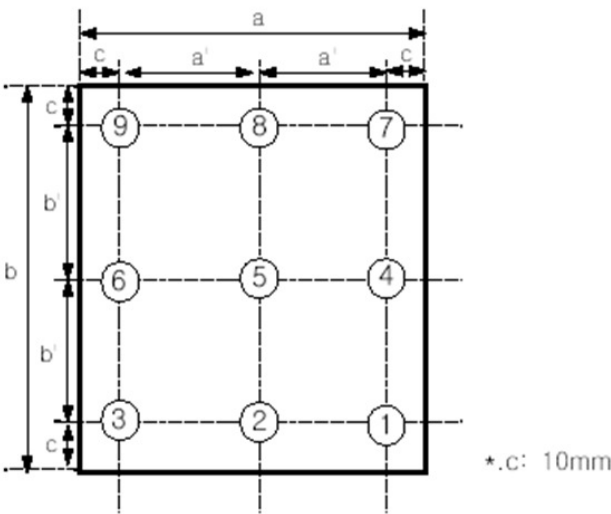
$$CR = \frac{G_{\max}}{G_{\min}}$$

- * 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)

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

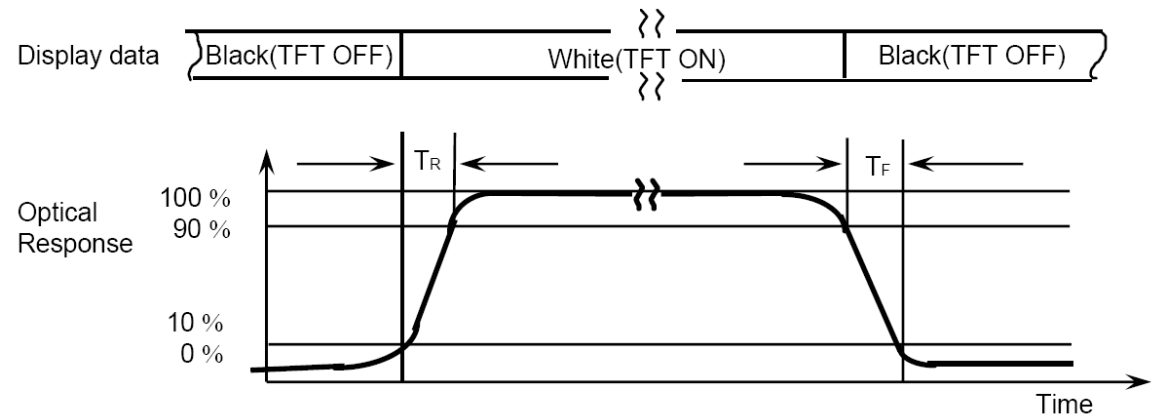
Note (4) Definition of White Uniformity :



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

Test Equipment (SR-UL2)

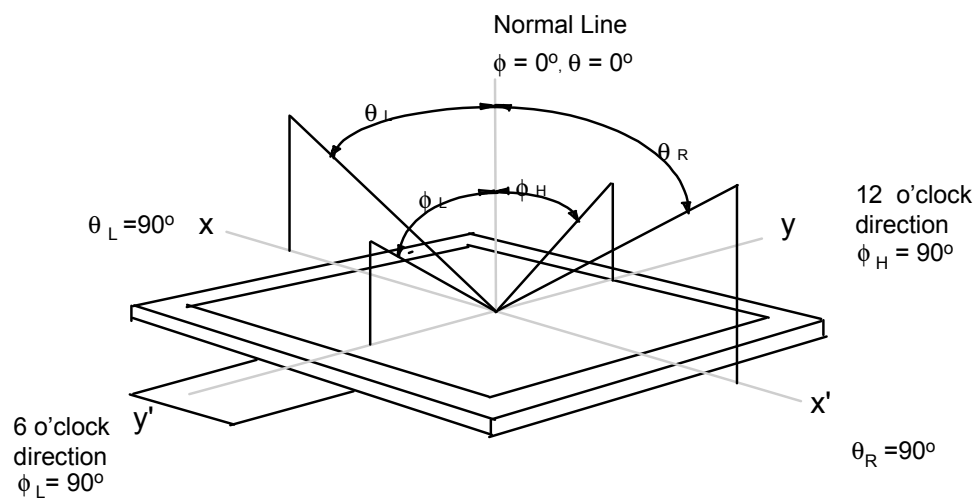
Note (5) Definition of Response time : Sum of Tr ,Tf



Test Equipment (DMS-505)
Environment condition : Ta = 25 ± 2 °C

Note (6) Definition of Color Chromaticity (CIE 1931)
Color coordinate of white & red, green, blue at center point.
Test Equipment (SR-UL2)

Note (7) Definition of Viewing Angle : Viewing angle range ($CR \geq 10$)



Test Equipment (EZ Contrast)

Note (8) NTSC Color Purity (CIE 1931)

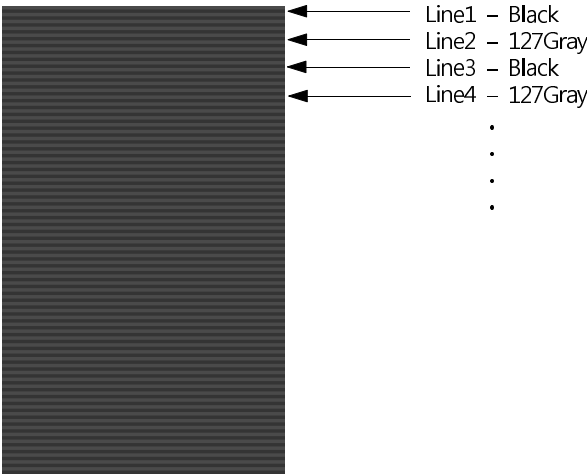
$$\frac{\text{Triangle Area based on measured red, green, blue color coordinate}}{\text{Triangle Area based on NTSC standard red, green, blue color coordinate}} \times 100\%$$

Note (9) Test Equipment (DMS-505)

▶ Pattern- 1 Dot Inversion (SMD 판정 패턴)

Note (10) Test Equipment (SR-UL2)

Note (11) ▶ Pattern- 1 Line Inversion (Pantech 판정 패턴)



▶ Pantech 판정기준: Note (9)가 아닌 Note (11) 조건을 만족시키지 못할 시 불량 처리함

3. Electrical Characteristics

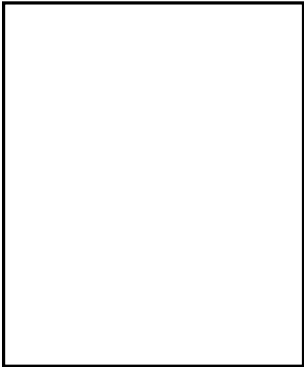
3.1 TFT-LCD Module

Ta = 25 ± 2°C

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Power Supply voltage (analog)	VDD3	2.95	3.0	3.05	V	
I/O Logic Voltage	VDD1	1.75	1.8	1.85	V	
Power Supply current (logic)	IDD1		250	500	uA	w/o BLU, @ White, (1)
Power Supply current(analog)	IDD3		50	60	mA	
Sleep current (logic)	IDD1			10	uA	w/o BLU,
Sleep current (analog)	IDD3			100	uA	
Frame frequency	f _{Frame}	-	60	-	Hz	-
Dot Clock	DOTCLK	-	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).

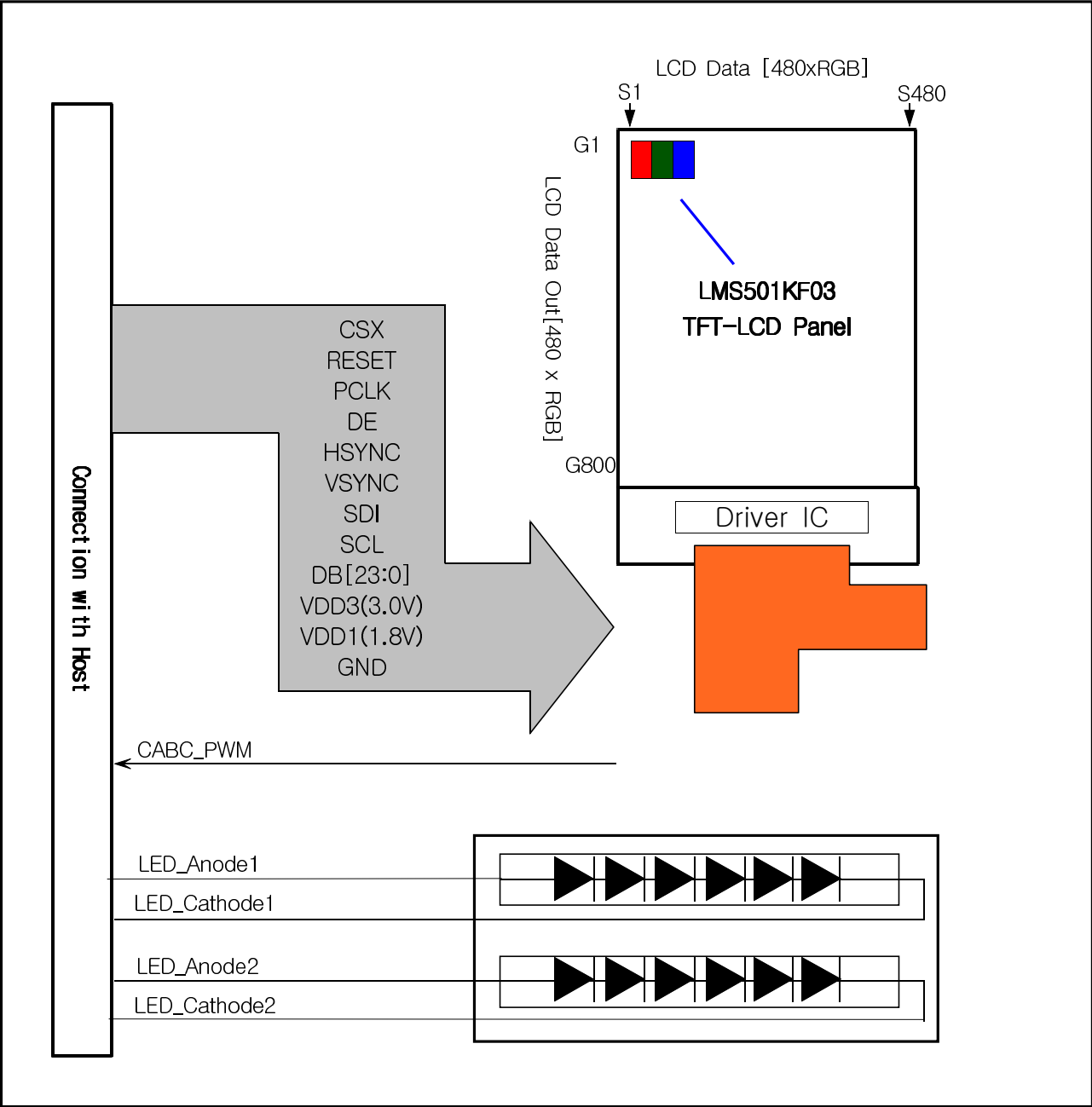
(Ta=25 ± 2°C)

Item	Symbol	MIN.	TYP.	MAX.	Unit	Note
LEDs Current	I _B	-	18	25	mA	(1),(2)
Power Consumption	P _{BL}	-	0.66	1.0	W	(2),(3)

Note (1) The LEDs parallel type (6LEDs x 2)
(2) Where $I_B = (18)\text{mA}$, $V_B = P_{BL} / I_B$ per 1 LEDs string
(3) DC current(voltage) use only.
If PWM(pulse width modulation) used, some problems may be happened.

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	N.C	No connection	27	DG2	RGB Data (G2)
2	VDD3	Analog/Logic Power (3.0V)	28	DG3	RGB Data (G3)
3			29	DG4	RGB Data (G4)
4	N.C	No connection	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

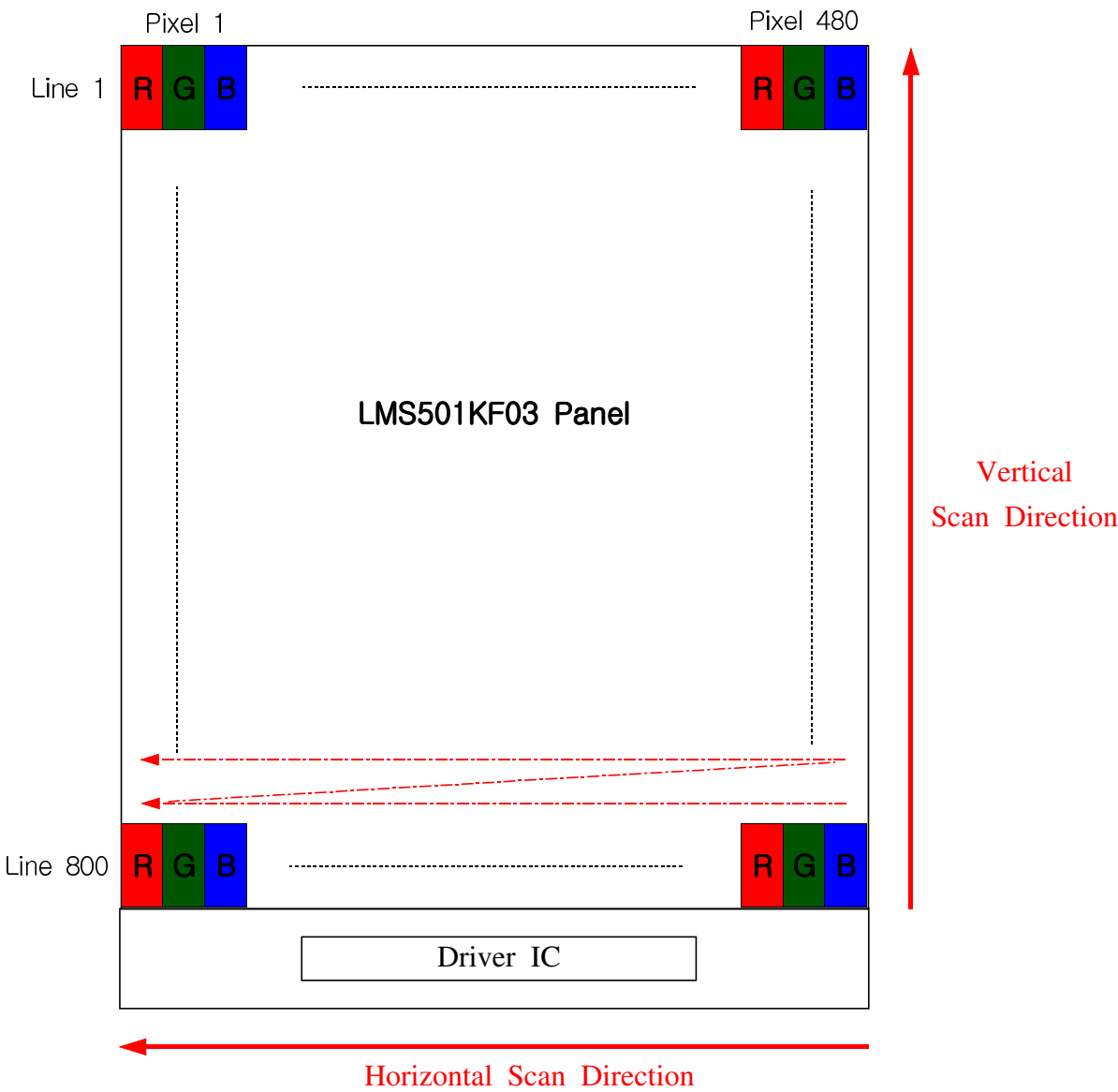
COLOR	DISPLAY	DATA SIGNAL																												GRAY SCALE LEVEL
		RED										GREEN								BLUE										
		R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3	B4	B5	B6	B7					
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-		
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	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	0	B1			
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	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	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	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	1	B255			

Note) Definition of Gray :

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

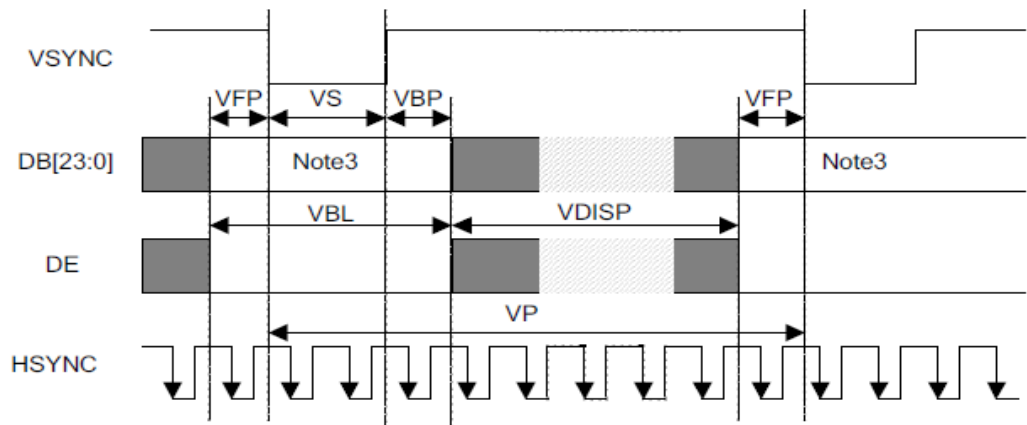
Input Signal : 0 = Low level voltage, 1 = High level voltage

5.3 Pixel Format



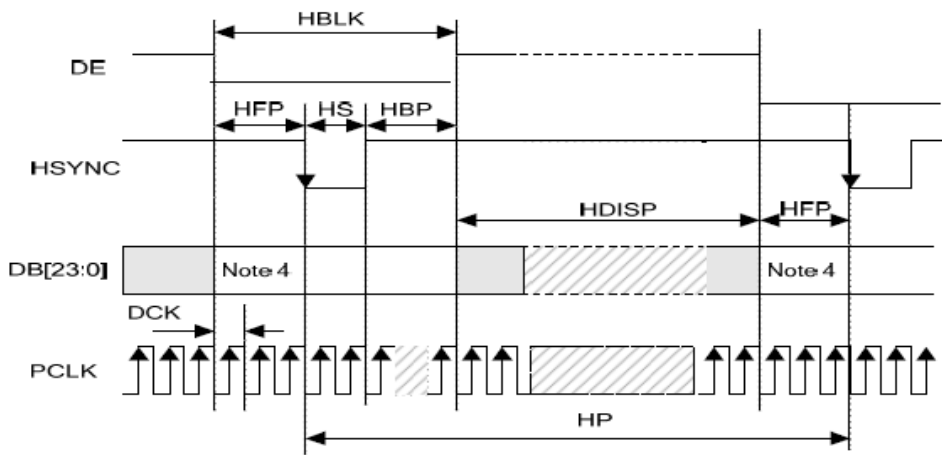
6. Interface Timing

6.1 Vertical Timing



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

6.2 Horizontal Timing

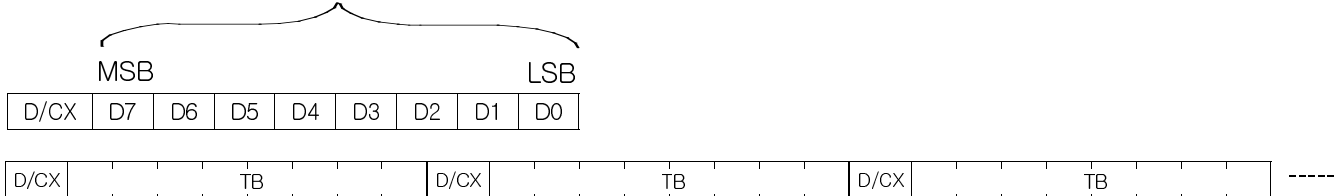


Signal	Symbol	Min.	Typ.	Max.	Unit	Note
HS _{SYNC} (1H) Period	HP	-	502	-	DotCLK	
HS _{SYNC} Low width	HS	-	6	-	DotCLK	
Horizontal Display Period	HDISP	-	480	-	DotCLK	
Horizontal Back porch	HBP	-	8	-	DotCLK	
Horizontal Front porch	HFP	-	8	-	DotCLK	
DOTCLK Frequency	DCK	-	24.576	-	MHz	

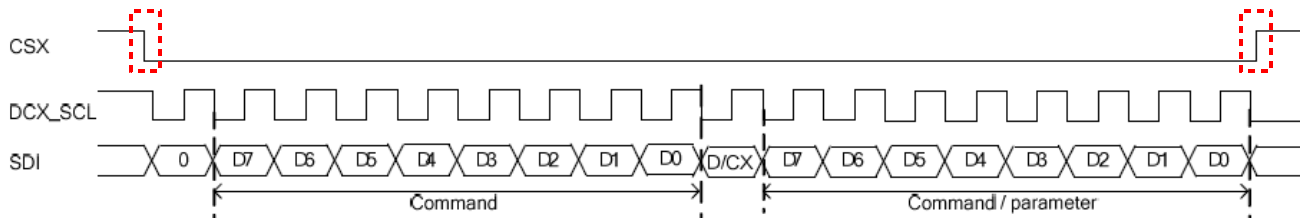
6.3 SPI Signal

6.3.1 Serial data stream format, write mode

Transmission byte(TB) may be a Command or a Data



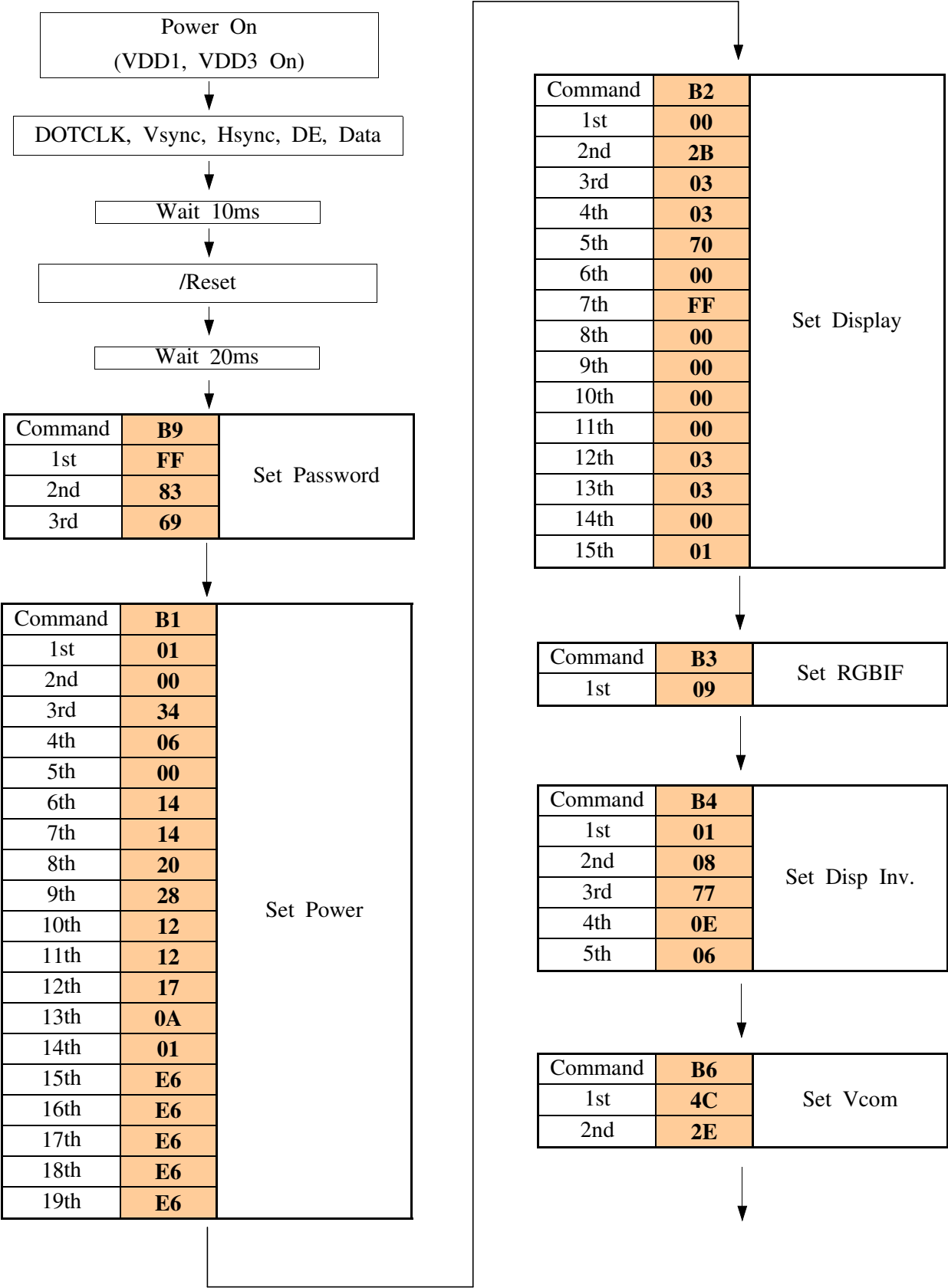
6.3.2 Serial Interface protocol



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)

< Power On Sequence >



Command	D5	Set Gate
1st	00	
2nd	05	
3rd	03	
4th	29	
5th	01	
6th	07	
7th	17	
8th	68	
9th	13	
10th	37	
11th	20	
12th	31	
13th	8A	
14th	46	
15th	9B	
16th	57	
17th	13	
18th	02	
19th	75	
20th	B9	
21st	64	
22nd	A8	
23rd	07	
24th	0F	
25th	04	
26th	07	

Command	CC	Set Panel
1st	0A	

Command	3A	Set COLMOD
1st	77	

Command	E0	Set W Gamma
1st	00	
2nd	04	
3rd	09	
4th	0F	
5th	1F	
6th	3F	
7th	1F	
8th	2F	
9th	0A	
10th	0F	
11th	10	
12th	16	
13th	18	
14th	16	
15th	17	
16th	0D	
17th	15	
18th	00	
19th	04	
20th	09	
21st	0F	
22nd	38	
23rd	3F	
24th	20	
25th	39	
26th	0A	
27th	0F	
28th	10	
29th	16	
30th	18	
31st	16	
32nd	17	
33rd	0D	
34th	15	

Command	C1
1st	01
2nd	03
3rd	07
4th	0F
5th	1A
6th	22
7th	2C
8th	33
9th	3C
10th	46
11th	4F
12th	58
13th	60
14th	69
15th	71
16th	79
17th	82
18th	89
19th	92
20th	9A
21st	A1
22nd	A9
23rd	B1
24th	B9
25th	C1
26th	C9
27th	CF
28th	D6
29th	DE
30th	E5
31st	EC
32nd	F3
33rd	F9
34th	FF
35th	DD
36th	39
37th	07
38th	1C
39th	CB
40th	AB
41st	5F
42nd	49
43rd	80

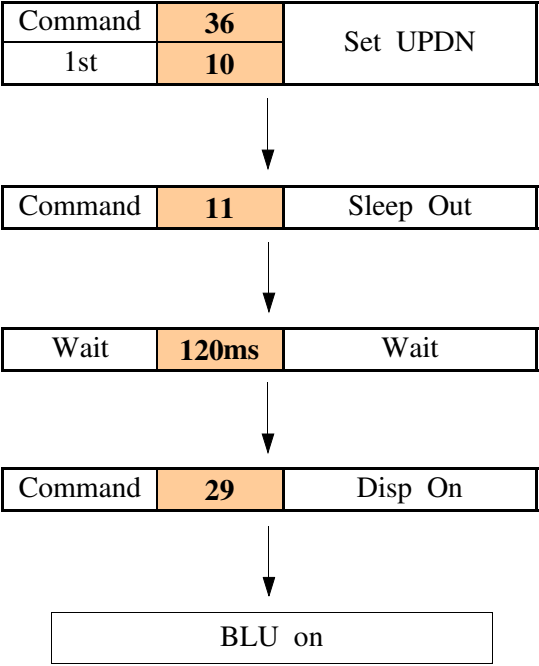
Set RGB Gamma

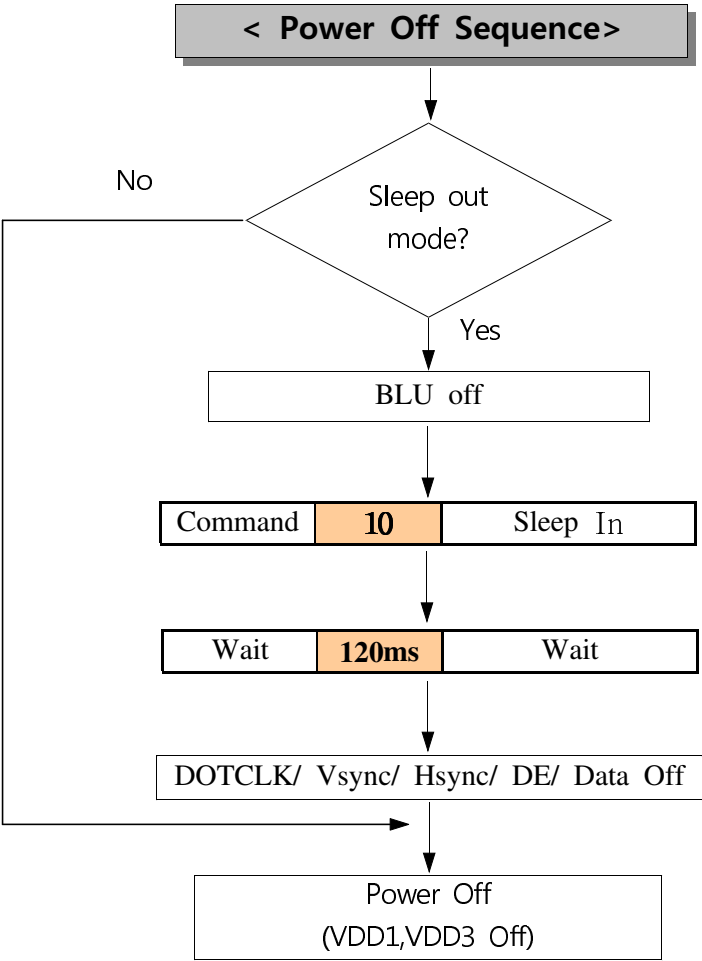
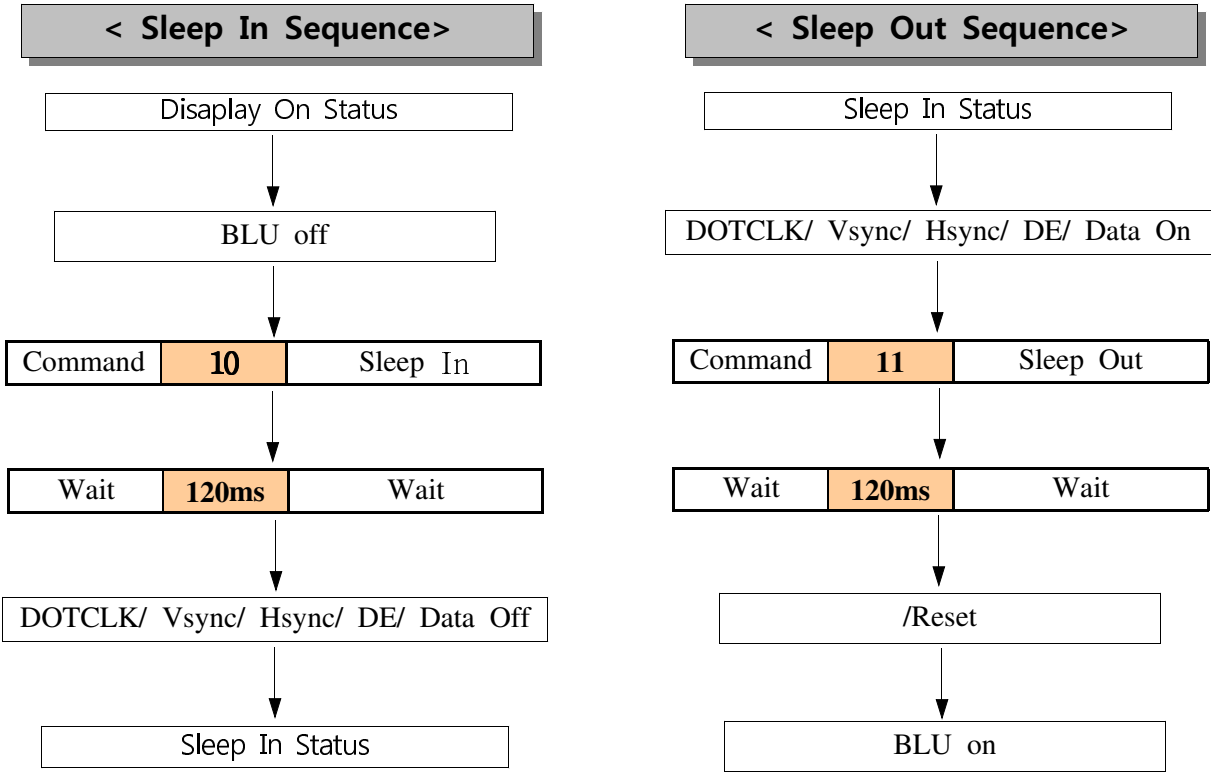
44th	03
45th	07
46th	0F
47th	19
48th	20
49th	2A
50th	31
51st	39
52nd	42
53rd	4B
54th	53
55th	5B
56th	63
57th	6B
58th	73
59th	7B
60th	83
61st	8A
62nd	92
63rd	9B
64th	A2
65th	AA
66th	B2
67th	BA
68th	C2
69th	CA
70th	D0
71st	D8
72nd	E1
73rd	E8
74th	F0
75th	F8
76th	FF
77th	F7
78th	D8
79th	BE
80th	A7
81st	39
82nd	40
83rd	85
84th	8C
85th	C0

Set RGB Gamma

86th	04
87th	07
88th	0C
89th	17
90th	1C
91st	23
92nd	2B
93rd	34
94th	3B
95th	43
96th	4C
97th	54
98th	5B
99th	63
100th	6A
101st	73
102nd	7A
103rd	82
104th	8A
105th	91
106th	98
107th	A1
108th	A8
109th	B0
110th	B7
111th	C1
112th	C9
113th	CF
114th	D9
115th	E3
116th	EA
117th	F4
118th	FF
119th	00
120th	00
121st	00
122nd	00
123rd	00
124th	00
125th	00
126th	00
127th	00

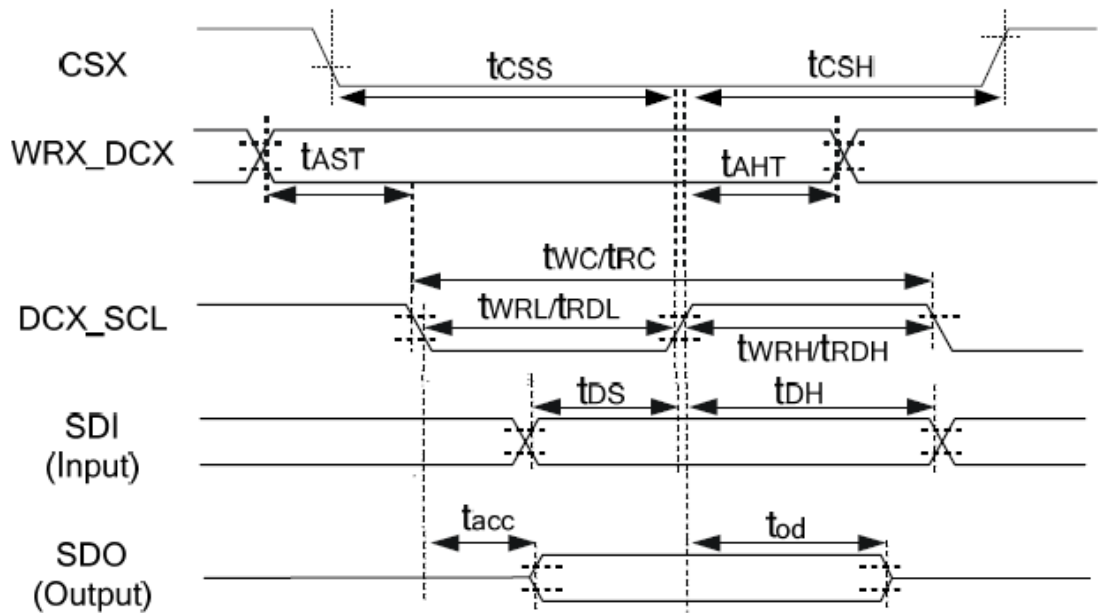
Set RGB Gamma





6.5 AC Characteristic

6.5.1 Serial Interface Timing Characteristic

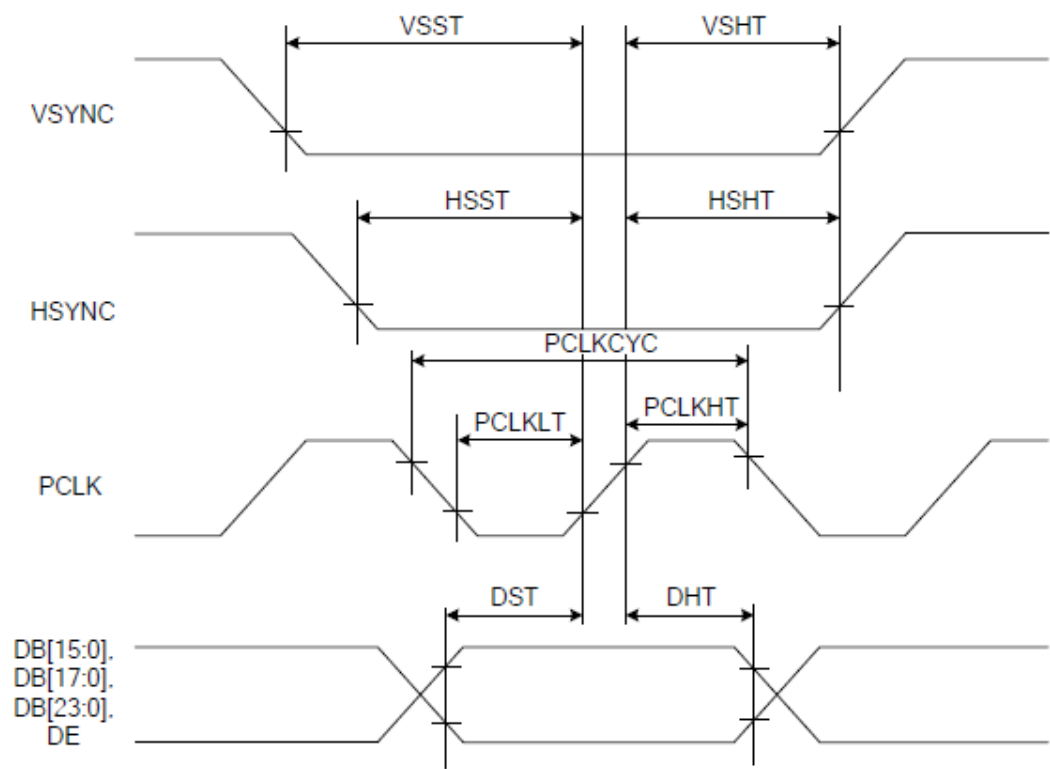


(VSSA=0V, VDD1=1.8V, VDD2=2.8V, VDD3=2.8V, T_A = 25 °C)

Signal	Symbol	Parameter	Min.	Max.	Unit	Description
CSX	t_{CSS}	Chip select setup time (Write)	40	-	ns	-
	t_{CSH}	Chip select setup time (Read)	40	-	ns	
WRX_DCX	t_{AST}	Address setup time	10	-	ns	-
	t_{AHT}	Address hold time (Write/Read)	10	-	ns	
DCX_SCL (Write)	t_{WC}	Write cycle	100	-	ns	-
	t_{WRH}	Control pulse "H" duration	40	-	ns	
	t_{WRL}	Control pulse "L" duration	40	-	ns	
DCX_SCL (Read)	t_{RC}	Read cycle	150	-	ns	-
	t_{RDH}	Control pulse "H" duration	60	-	ns	
	t_{RDL}	Control pulse "L" duration	60	-	ns	
SDI/SDO (Input)	t_{DS}	Data setup time	30	-	ns	For maximum C _L =30pF For minimum C _L =8pF
	t_{DH}	Data hold time	30	-	ns	
SDI/SDO (Output)	t_{ACC}	Read access time	10	-	ns	
	t_{OD}	Output disable time	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

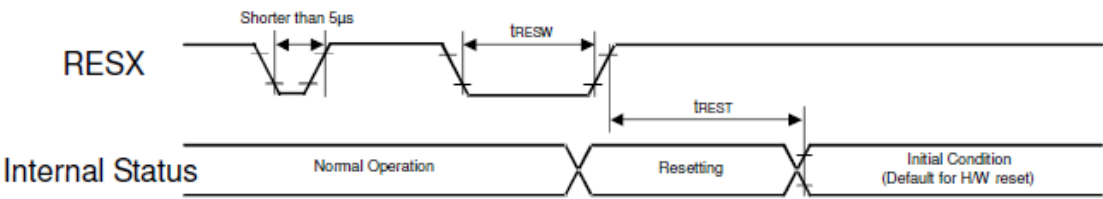


(VSSA=0V, VDD1=1.8V, VDD2=2.8V, VDD3=2.8V, T_A=25°C)

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	-	40.69 ⁽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

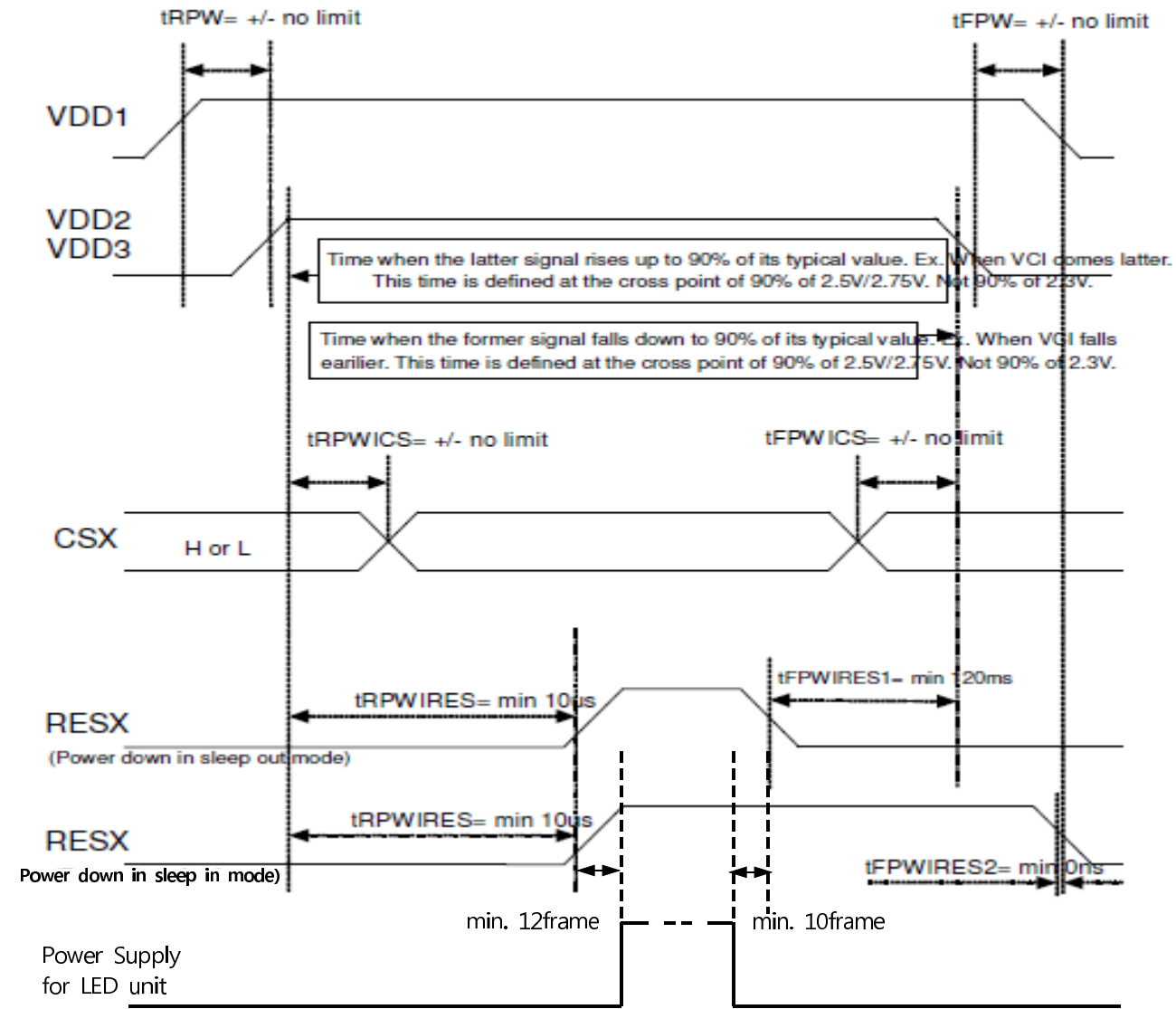
Note:(1) Signal rise and fall times are equal to or less than 20ns.
(2) Input signals are measured by 0.3xVDD1 for low state and 0.7xVDD1 for high state.
(3) 24.576MHz
(4) VRR : Vertical Refresh Rate, equal to VSYNC frequency.

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

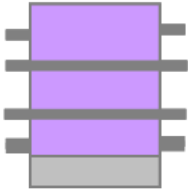
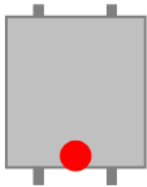


8. Reliability Test Result

8.1 Condition

Item	Condition	Test Result	Note
High Temperature Operating Life test	70°C, 128HR	PASS	-
Low Temperature Operating Life test	-20°C, 128HR	PASS	-
Thermal Humidity Bias test	60°C, 93%RH, 128HR	PASS	-
High Temperature and Humidity Storage	85°C, 85%RH 128HR	PASS	
Temperature Cycle ON/OFF test	-40°C ↔ 85°C [30min], ON/OFF, 30CYC	PASS	-
High Temperature Storage test	85°C, 128HR	PASS	-
Low Temperature Storage test	-40°C, 128HR	PASS	-
Electro-Static Discharge test	Contact : ±6kV, 10times	PASS	(1)
	Air : ±8kV, 10times	PASS	
Box Vibration Test	RANDOM 6-200hz 1.074Grms, x/y/z axis, 각1Hr (SMALL BOX)	PASS	(2)
Box Drop Test	(10kg ↓_76Cm, 11kg ↑_66Cm) 1edge 3corner 6sides, 10times	PASS	-
Surface pressure test	Module 4PB : More than 12.78kgf @ Weibull 10%	PASS	(3)
	Driver IC 4PB : More than 3.63kgf @ Weibull 10%	PASS	

Note (1) Main-LCD, 2 times to every 5 corners of active area
Note (2) Basic transportation by common carrier environmental, 514.4 MIL-STD-810E
Note (3) Surface pressure test

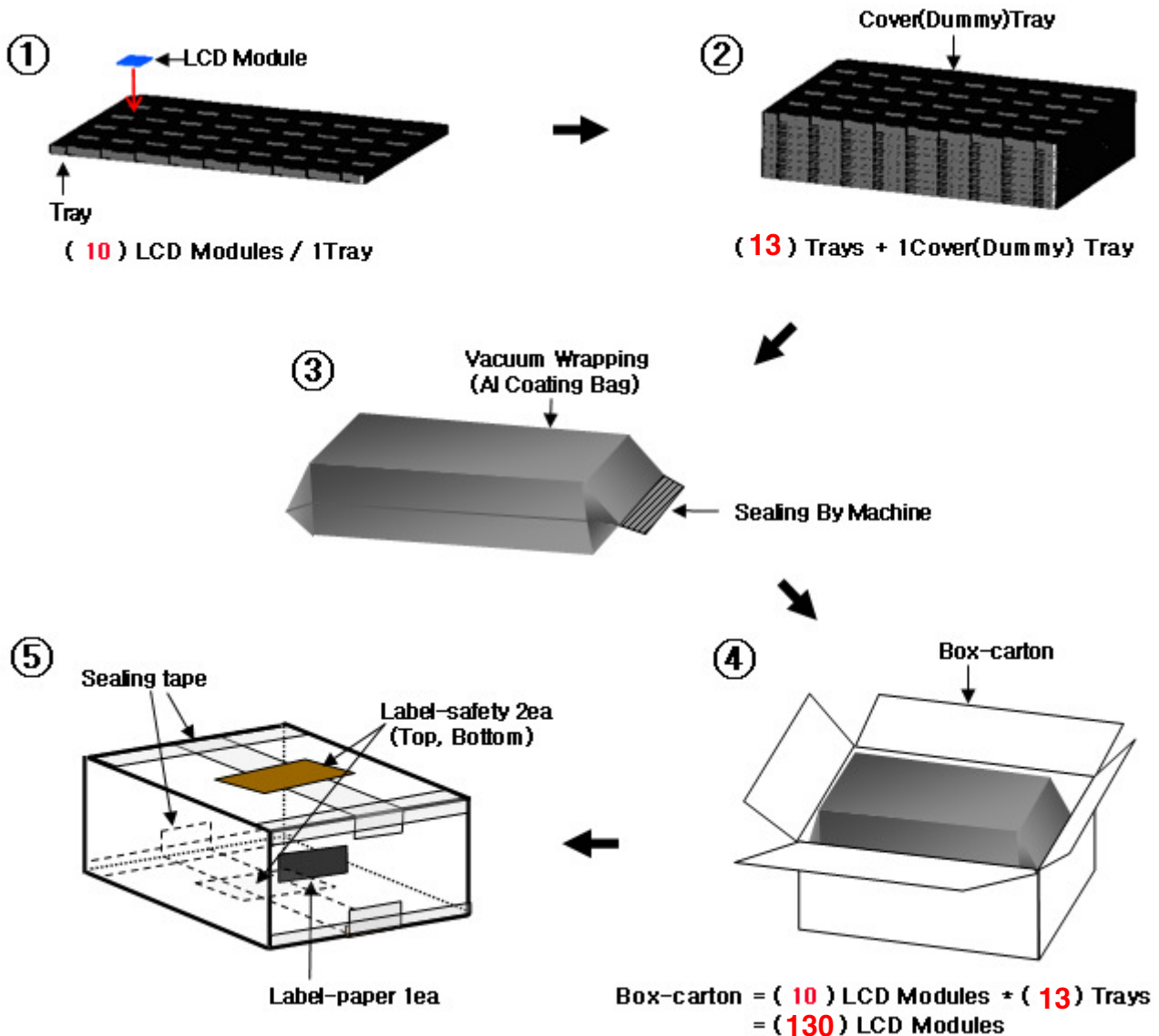
Module 4PB		Driver IC 4PB	
	평가단위: Module face up 지지 JIG간 거리 : 40mm 누름 JIG간 거리 : 20mm JIG 누름 속도 : 5mm/min JIG Center : CF center		평가단위:Module bottom up (Driver IC 배면) 지지 JIG간 거리 : 30mm 누름 속도 : 5mm/min

8.2 Judgement

- (1) Main LCD should work under the normal condition.
- (2) After the temperature and humidity test, the luminance and CR(Contrast Ratio) should not be changed over 50% compared with those before the test.

9. Packing

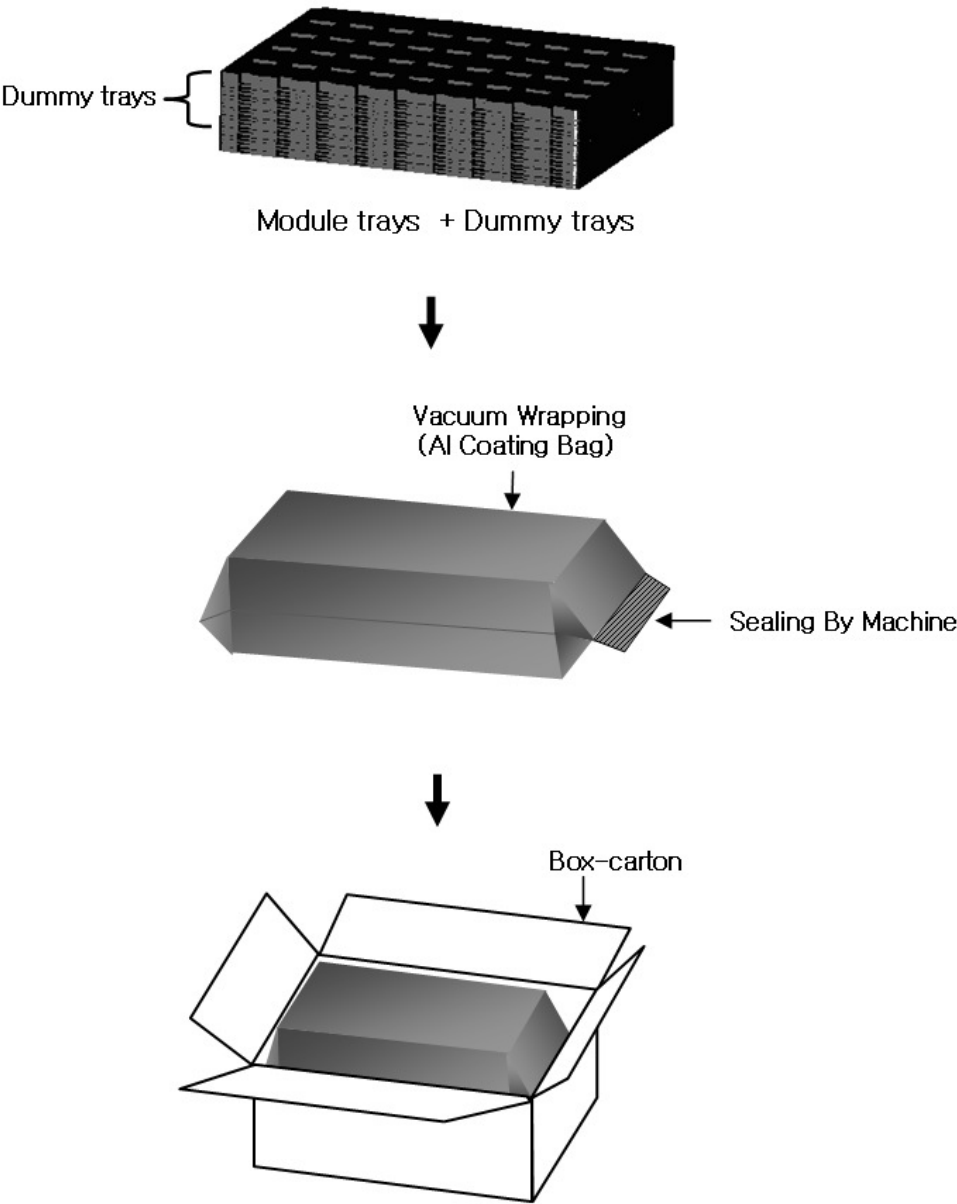
9.1 Case & Box



Note

- Total : Box-carton approx. : 9.1 kg
- Size : 579(W) x 384(D) x 157(H)
- (1) Place the LCD Module in the tray facing the active area direction.
- (2) Stack the trays and cover (dummy) tray.
- (3) Resistance of tray surface : $10^6 \sim 10^9 \Omega$.
- (4) Wrap the Al coating bag by vacuum sealing machine.
- (5) Put the bag in the Box-carton.
- (6) Seal the Box-carton and affix the Label-safety & Label-paper.

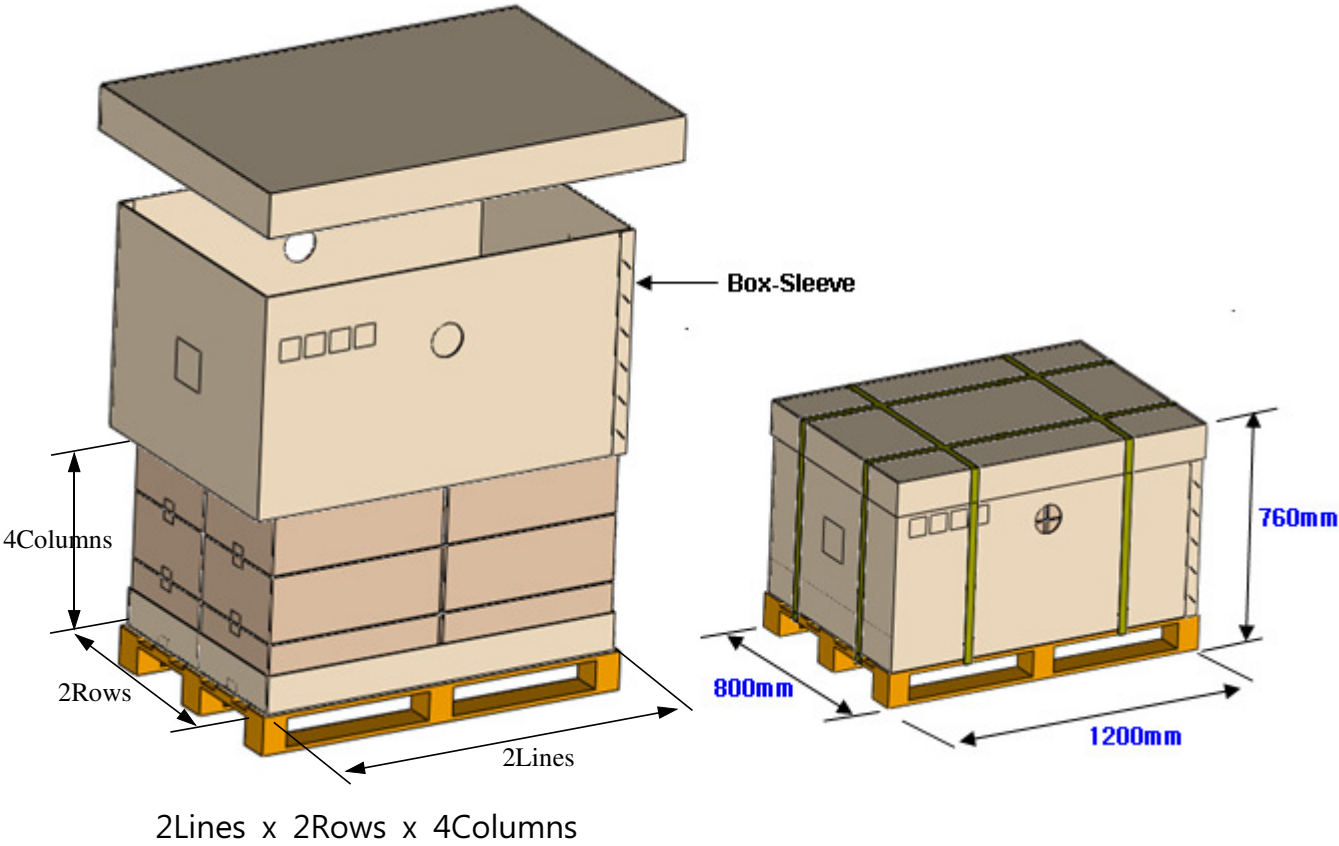
9.2 Packing for Small Quantities



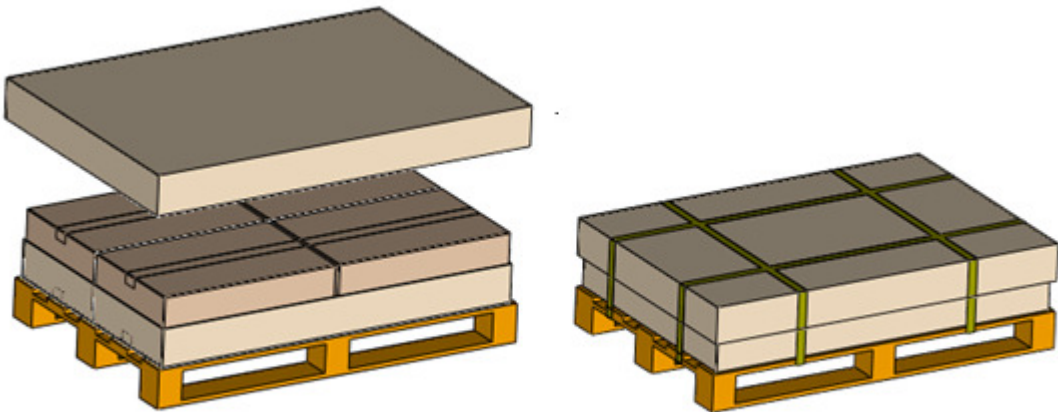
Note

When package quantity is small, LCD Modules containing trays are stacked the bottom, and dummy trays are stacked at the top of package, then wrap the Al coating bag by vacuum sealing machine

9.3 Over Pack



9.4 Packing for Small Quantities



10. Marking & Others

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

10.1 Laser Printing on the back side of TFT-LCD Module

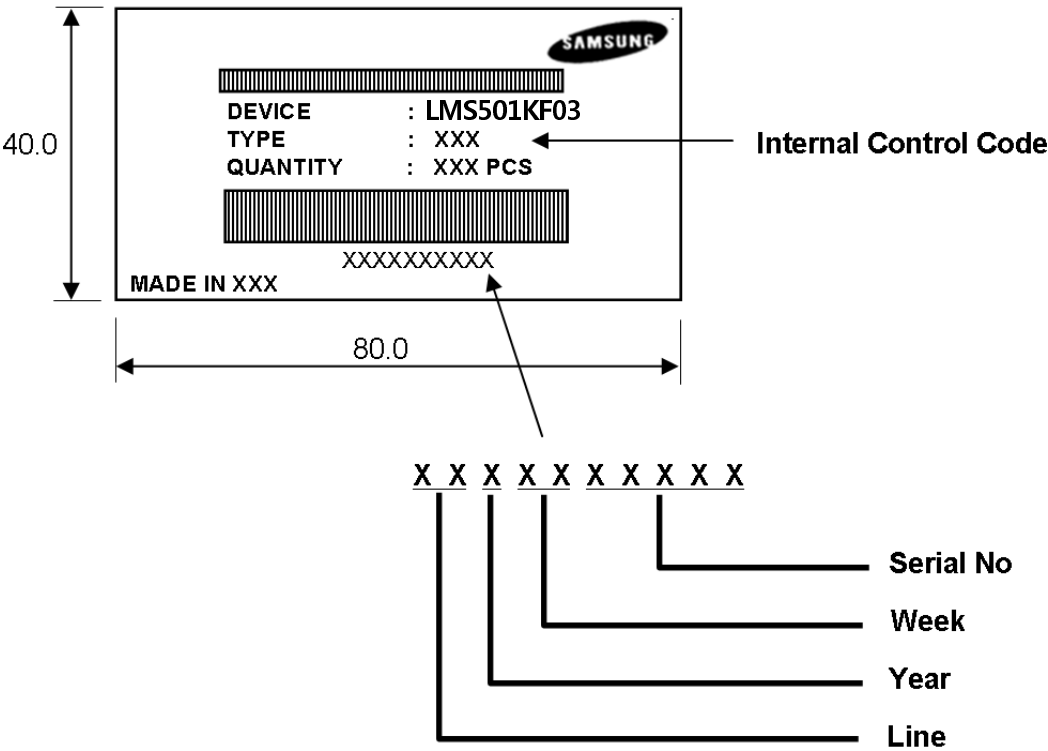
- 10 digits marking on the back side of TFT-LCD module

K	A	10	05	28	A	0
①	②	③	④	⑤	⑥	⑦

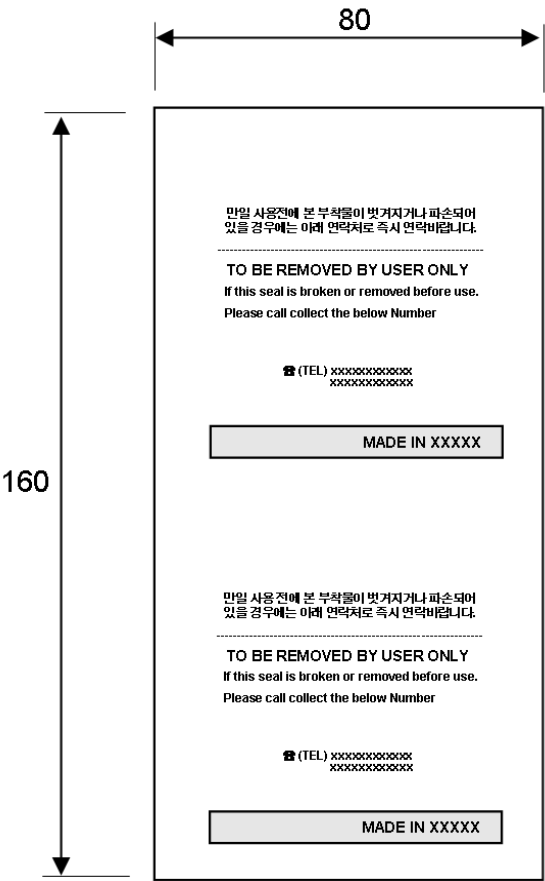
- ① Module Site
→ K (SEC), V (Voda), I (IDS Korea), Z(BK), C (DTC), T (Intelligent),
H (IDS, China), L (E-Litecom), D (DSMD), J (CSMD), M (SM HITECH)
- ② Production Shift
- ③ Year : 10(2010), 11(2011)
- ④ Month : 01(January), 02(February), 03(March)
- ⑤ Day
- ⑥ ASSY 조립 LINE
- ⑦ SAMPLE 구분

10.2 Box Attach

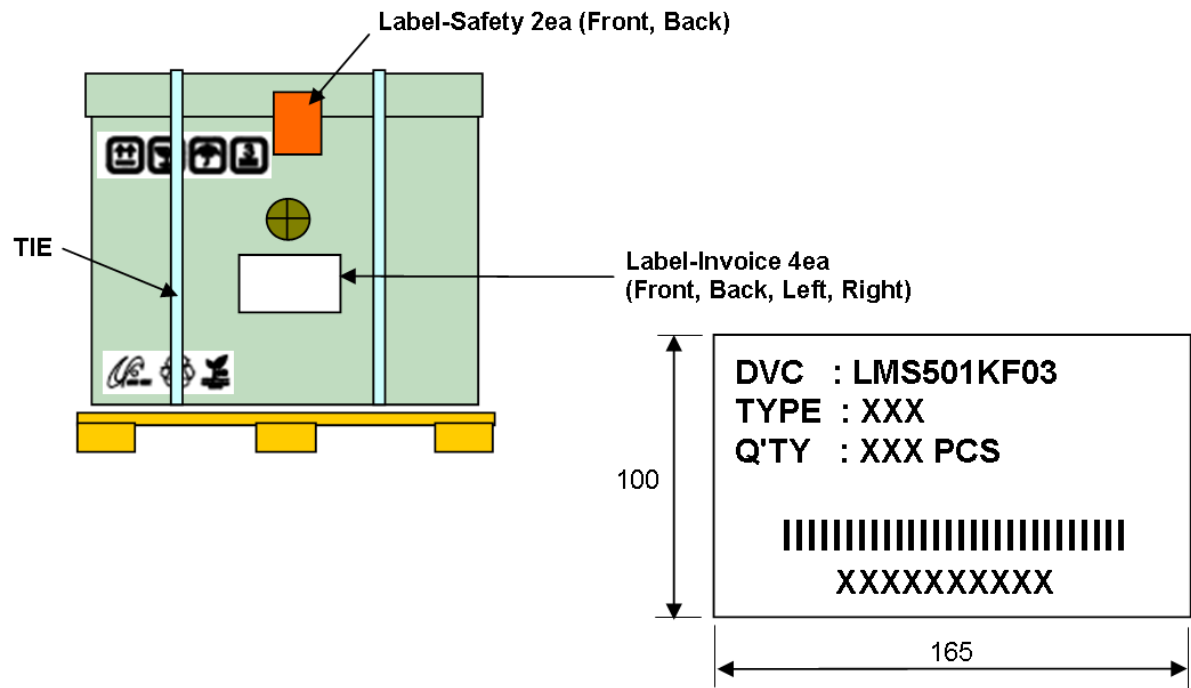
* Label-paper



* Label-safety



10.3 Over Pack 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

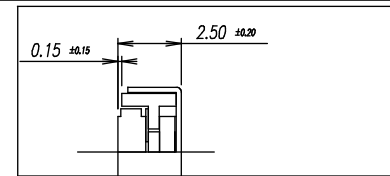
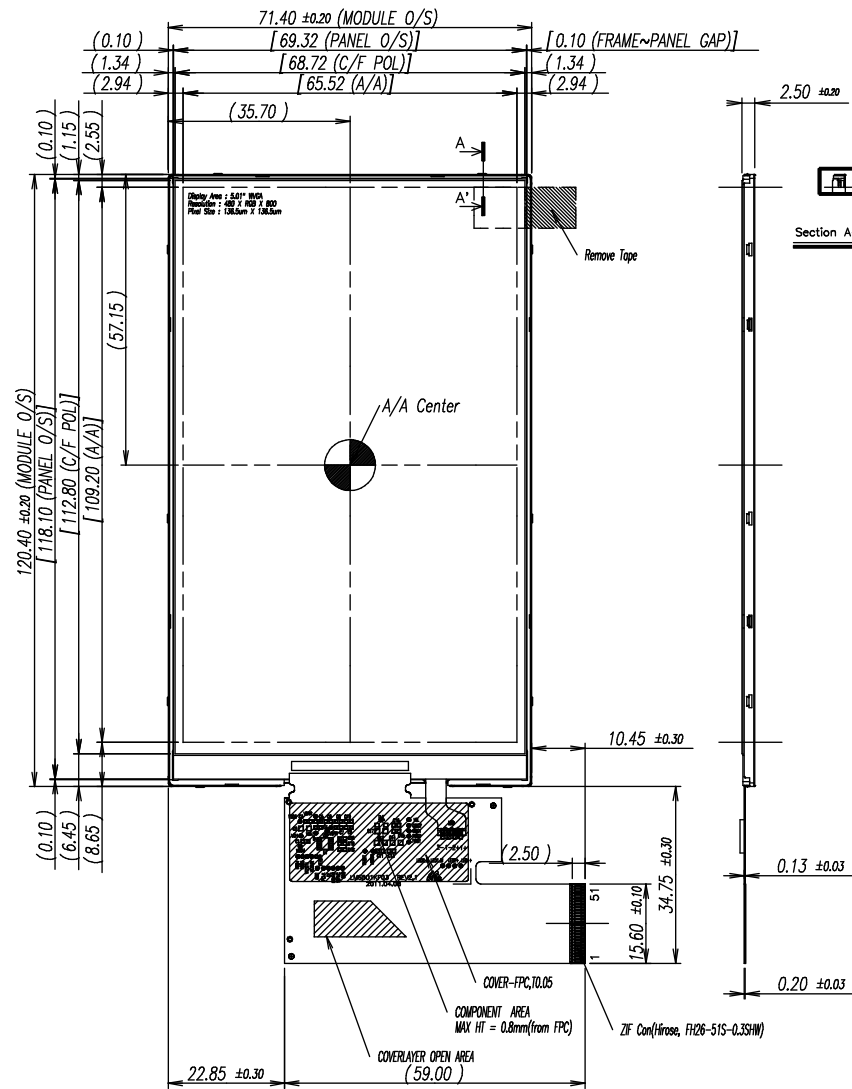
- (a) The Liquid crystal is deteriorated by ultraviolet, do not leave it in direct sunlight and strong ultraviolet ray for many hours.
- (b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.
- (c) Do not exceed the absolute maximum rating value. (the supply 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.

12. Appendix

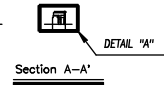
- 제품도면	-----	39
- 제품 Tray 도면	-----	40
- MAIN FPC 회로도	-----	41
- MAIN FPC PARTLIST	-----	42
- MAIN FPC 부품배치도	-----	43
- MAIN FPCB 도면	-----	44
- MAIN FPCB Structure	-----	45
- Material List	-----	46
- Module QCP	-----	47
- 환경유해물질 성적서	-----	50
- 검사표준	-----	66

제품도면

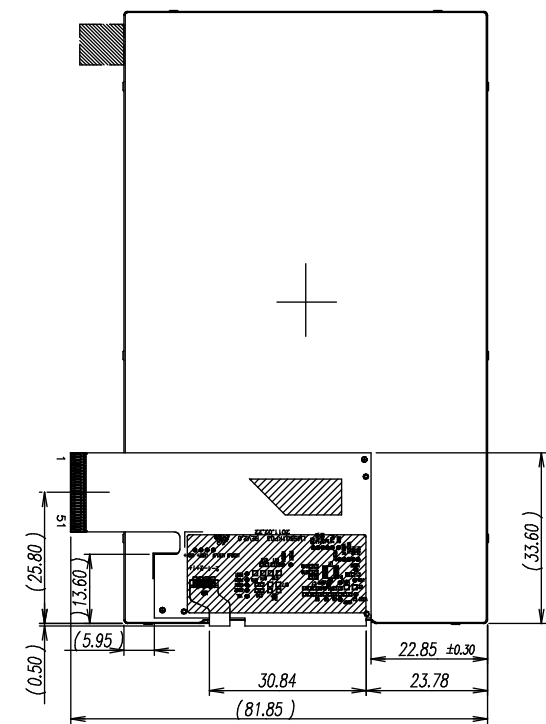
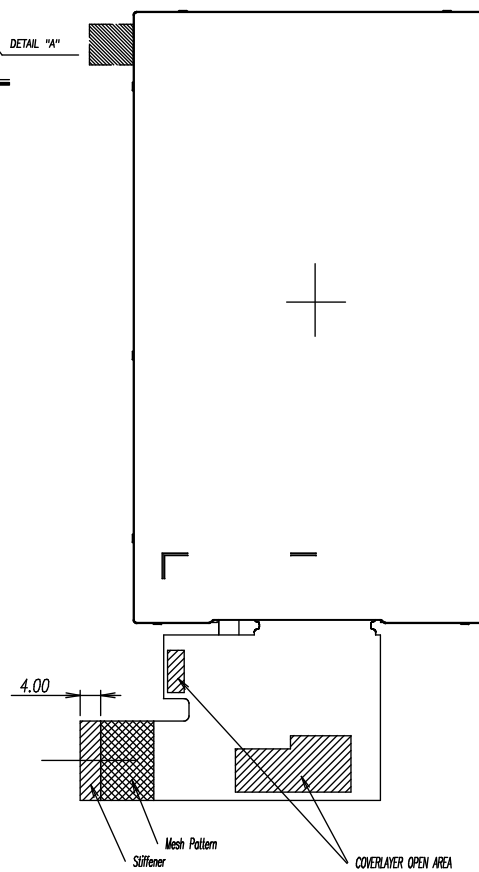
Approval



DETAIL A(S:5/1)



Section A-A'

FPC INSTALLED POSITION
(REFERENCE)

NOTE

- DESCRIPTION : 5.01" WGA(480X800) a-Si TFT DISPLAY
- UNIT : mm
- BURR CONTROL: Max 0.03
Max 0.02(FPC TOUCH PART)
BURR DIRECTION: INSIDE
ADDING HALF IMPACTING PROCESSING
ON PIERCING AREA
- EJECTOR PIN AND GATE REMNANTS TO BE SUB-FLUSH
- LCD MODULE FLATNESS SPEC : Max 0.25
- UNLESS OTHERWISE SPECIFIED TOLERANCE OF RADIUS : ± 0.3
- THIS MODULE IS ACCORDING TO ENVIRONMENTAL REQUIREMENTS(ROHS).

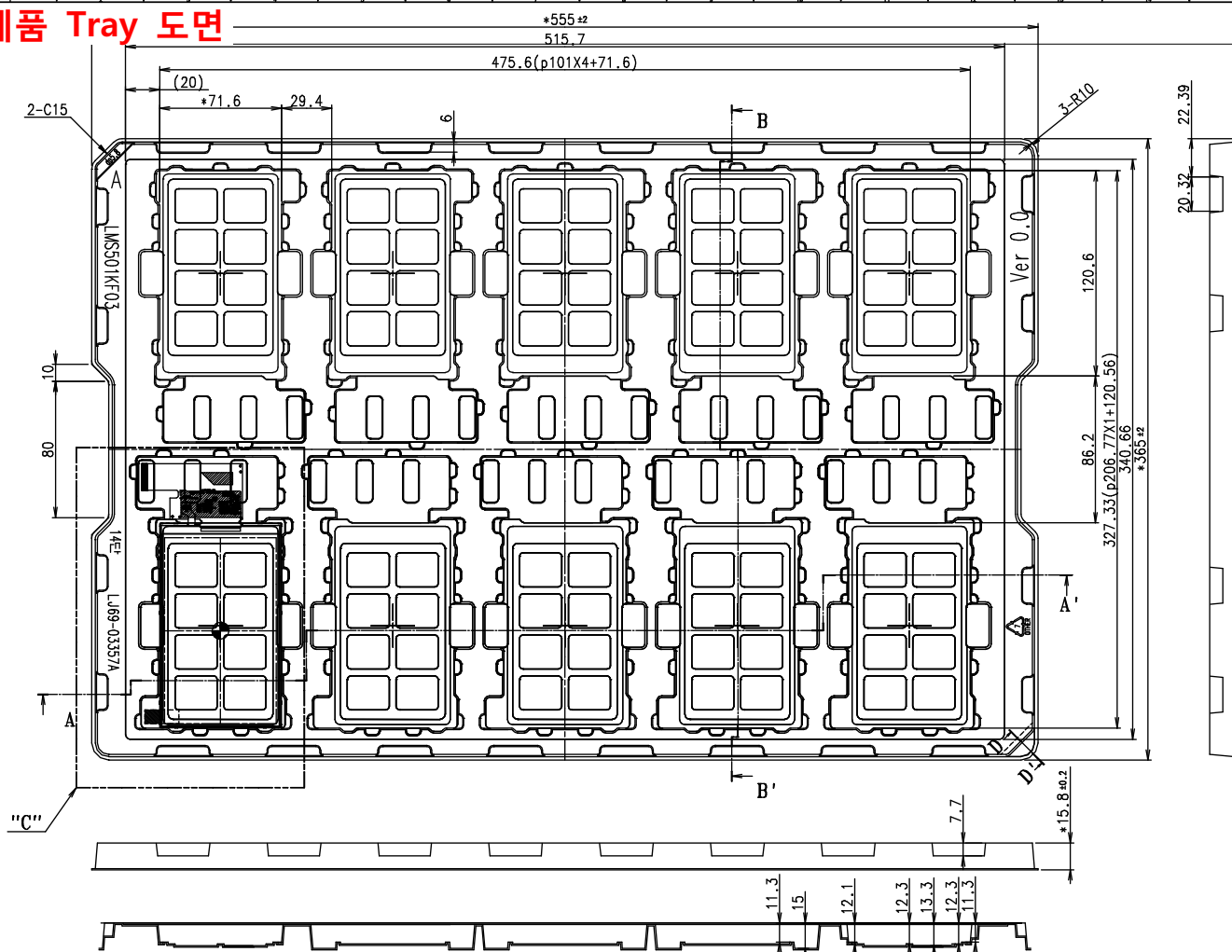
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3) NOT TO REUSE IT

제품 Tray 도면

SMD CONFIDENTIAL

NO	PART NAME	CODE NO	SPECIFICATION	QTY	SPEC NO	REMARK
1	TRAY	14E1	14E1-03357A	1	0001	

Approval



SEC' B-B'

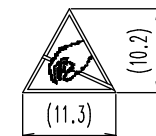
DETAIL "C"(S:1.5/1)

*NOTE

1. Dimension(mm) : 555(W) x 365(L) x 15.8(H) (Material thickness : 0.8 ± 0.05 mm)
2. The tray thickness must be within -40% of the Material thickness.
(Checking point : 1. 4 corners on the frame
2. Center of the pocket)
3. No unformed part.
4. No scratch and No wrinkle on the surface.
5. Round of corners : R0.5
6. All angles must be 5° unless otherwise specified.
7. Material : ABS (glossy - black)
Surface resistivity : $10^6 \sim 10^9$ ohms/sq
Abrasion resistance(ASTM D 4060) : Max 150mg
8. "*" is critical dimension.
The outside dimension must be measured from corner to corner
9. Weight : $170g \pm 10g$
10. Total stack-up height is 127 ± 3 (After vacuum packing work).



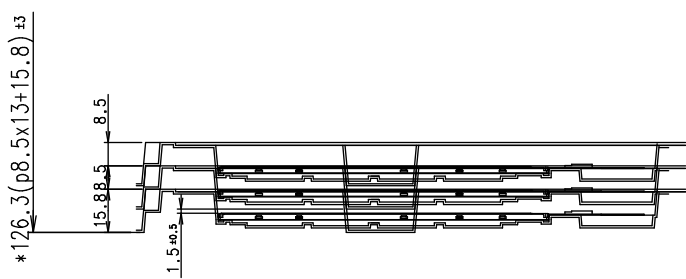
SEC' D-D'



(ESD SYMBOL)



Other
(RECYCLING MARK)



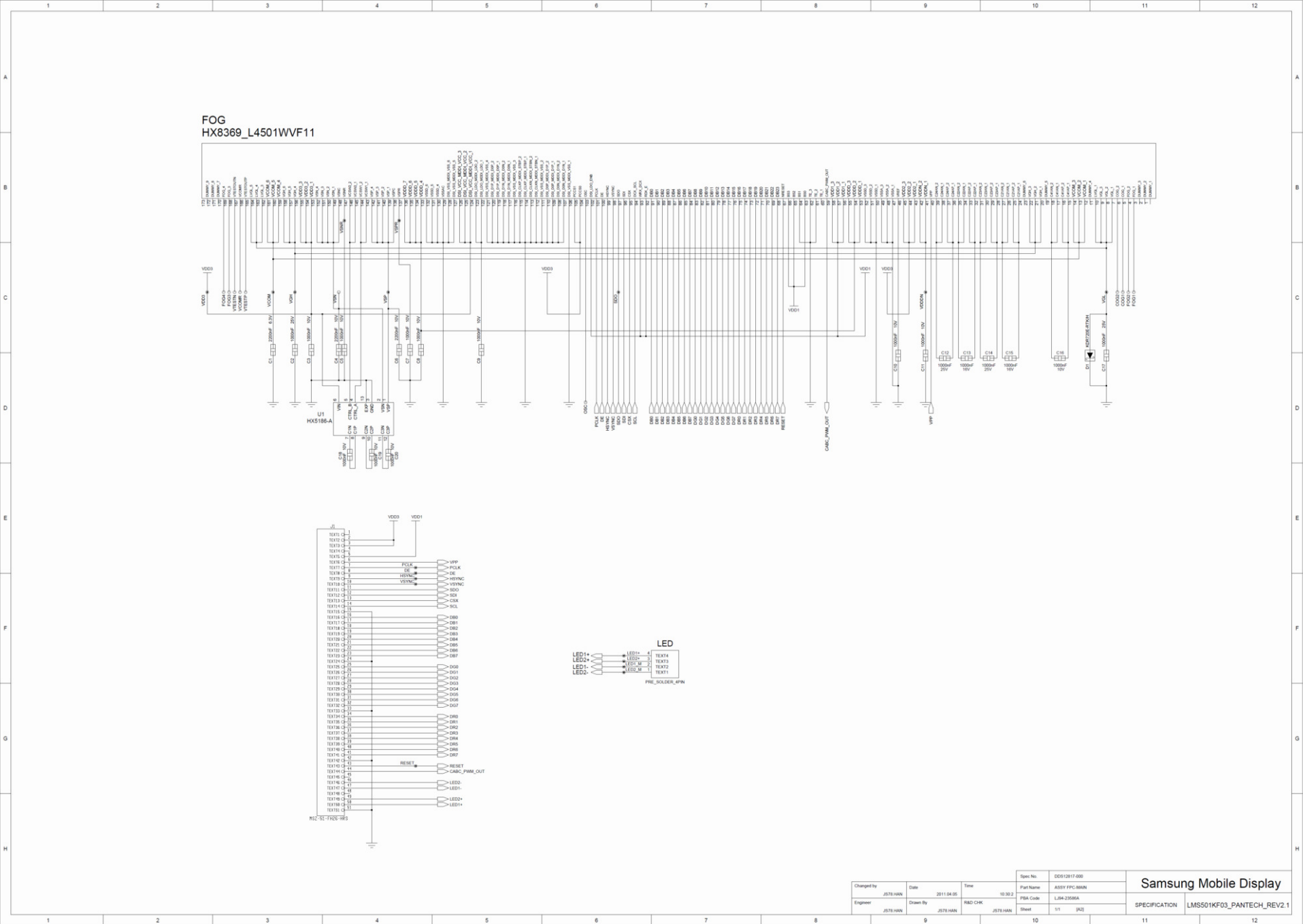
STACKING(S:1.5/1)

GENERAL TOLERANCE				UNIT	mm	DESIGNED BY	CHK'D BY	APP'D BY	MODEL NAME
STEP	LEVEL			mm	1 / 1	Y.H.KIM	J.S.OH	S.K.LEE	14E1-03357A
0 < X ≤ 30	10.2			TOLERANCE					P/TRAY M
				LEVEL 1		±0.20	±0.30		
30 < X ≤ 120	10.3								
120 < X ≤ 400	10.5								
400 < X ≤ 1000	10.8								
REVISION				DRAWING SYMBOL		APPROVAL		NO	
REV.	DATE	DESCRIPTION OF REVISION		REASON					

2011.04.04/김운호 선임/제품개발1팀

Main FPC 회로도

Approval



Main FPC Partlist

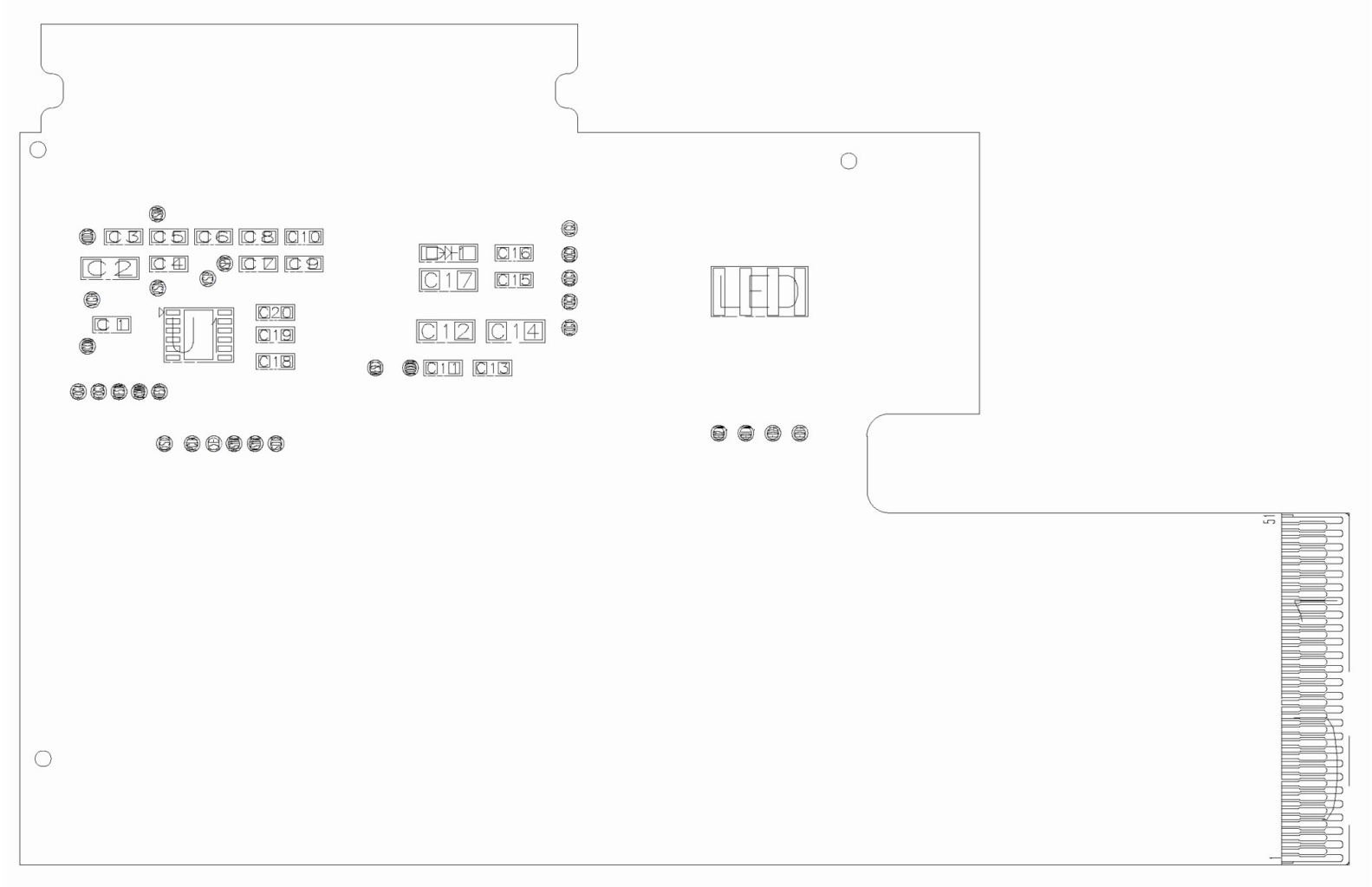
Approval

NO	CATEGORY	REFERENCE	Q'ty	SPECIFICATION
1	C- CER,CHIP	C3,C5,C7,C8,C9,C10 C11,C16,C18,C19,C20	11	1000nF,10%,10V,X5R,1005
2	C- CER,CHIP	C13,C15	2	1000nF,10%,16V,X5R,1005
3	C- CER,CHIP	C2,C12,C14,C17	4	1000nF,10%,25V,X5R,1608, 0.55Tmax
4	C- CER,CHIP	C1	1	2200nF,10%,6.3V,X5R,1005
5	C- CER,CHIP	C4,C6	3	2200nF,10%,10V,X5R,1005
6	DIODE- SCHOTTKY	D1	1	RB521S- 30G,30V,200mA,ESC(EMD2)
7	DC- DC IC	U1	1	HX- 5186- A

Note: Connector specification for LCD connection refers to Input Terminal Pin Assignment in page 15 and Outline Dimension in page 39

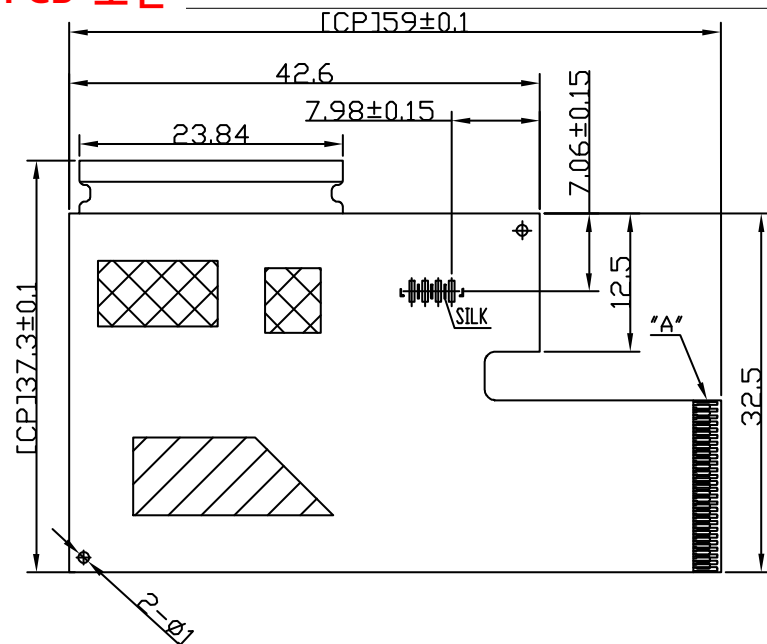
Main FPC 부품배치도

Approval



Main FPCB 도면

Approval



0.2±0.03
(FPCB+STIFFENER)

[CP]10.125±0.02
(FPCB)

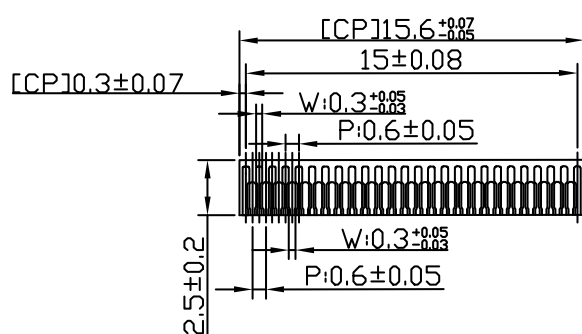
4±0.3

SILK

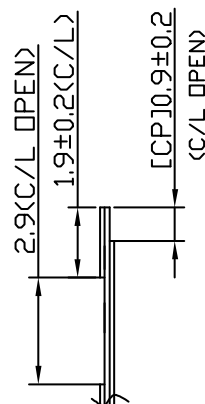
STIFFENER+ADHESIVE

1.32±0.15

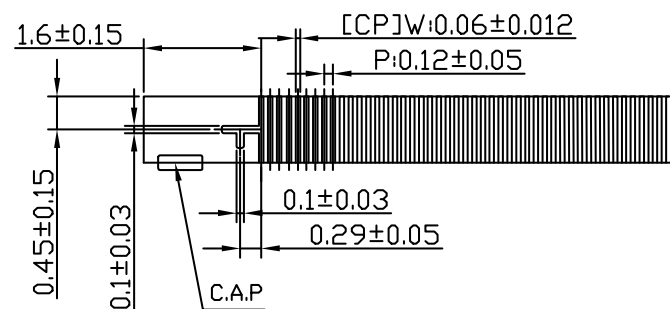
1.35±0.15



Detail A
[SCALE 3:1]



Detail B
[SCALE 5:1]



Detail C
[SCALE 10:1]

NOTE

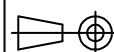
1. FPCB : 2 LAYER
2. PLATING : HD ENIG
3. Width Tolerance of Each Pad $\pm 20\%$
4. CRITICAL PARAMETERS ARE DENOTED BY THE SYMBOL [CP]
- 5: COMPONENTS AREA
- 6: GND AREA
7. Apply Shrink ratio(-0.16%) to FOG Pad(Except Dummy Pad)
8. Rev. NO : 2.1

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Confidential

				UNIT	mm	DES'D BY	CHK'D BY	APP'D BY	MODEL NAME	LMS501KF03		
				SCALE	15 / 1	J.M.LEE	J.I.KIM	J.S.HAN	PART/SHEET NAME	FPC-MAIN		
				TOLERANCE		'11.04.12	'11.04.12	'11.04.12	CODE NO.	LJ41-09867A	SHEET	1/1
									SPEC. NO.	DDS12818-000	REV.	000
000	'11.04.12	FIRST DRAWING										
REV	DATE	DISCRIPTION OF REVISION	REASON									

SAMSUNG
MOBILE DISPLAY



±0.1

A4

Main FPCB Structure

Approval

1. 본체

층수	재 료		두께	업체	품명	HALOGEN FREE 적용 여부
1,2	C/L	film	12.5 μm	HANWHA	HGCS-A405L	H/F
		접착제	20.0 μm			
		동도금	8.0 μm			
	FCCL	Copper	12.0 μm	LG화학	DL-2012-E	H/F
		Base film	20.0 μm			
		Copper	12.0 μm			
		동도금	8.0 μm			
	C/L	접착제	20.0 μm	HANWHA	HGCS-A405L	H/F
		film	12.5 μm			
		전체두께	125.0 μm			

층수	재료		두께	업체	품명	HALOGEN FREE 적용 여부
기타 부착재	Bending부 Ink	<input type="checkbox"/> TOP <input type="checkbox"/> BOTTOM	μm			
	Silk marking	<input checked="" type="checkbox"/> TOP <input checked="" type="checkbox"/> BOTTOM	20 μm	TAIYO	S-200WEF	H/F
	Black silk	<input type="checkbox"/> TOP <input type="checkbox"/> BOTTOM	μm			
	Silver Paste	<input type="checkbox"/> TOP <input type="checkbox"/> BOTTOM	μm			
	Over Coat	<input type="checkbox"/> TOP <input type="checkbox"/> BOTTOM	μm			
	PSR	<input type="checkbox"/> Yellow <input type="checkbox"/> TOP <input type="checkbox"/> BOTTOM	μm			
		<input type="checkbox"/> Blue <input type="checkbox"/> TOP <input type="checkbox"/> BOTTOM	μm			
	보강판	<input type="checkbox"/> TOP <input checked="" type="checkbox"/> BOTTOM	75 μm	이녹스	MSH-3X-00FX	H/F
	기타 접착제	<input type="checkbox"/> TOP <input checked="" type="checkbox"/> BOTTOM	35 μm	SONY	D3450	H/F






2. 단면도

원자재 구성	두께	압착부 Open 면	BENDING 영역	압착부 후면 Overlap	Body 영역	C/N 연결부	Connector
PI Film	12.5						
Adhesive	20.0						
Copper Plating	8.0						
Copper	12.0						
Adhesive							
Base Film	20.0						
Adhesive							
Copper	12.0						
Copper Plating	8.0						
Adhesive	20.0						
PI Film	12.5						
Adhesive	35.0						
Stiffener	75.0						
Total Thickness		72.5	72.5	72.5	125.0	125.0	202.5






Material List

Approval









CATEGORY	Maker	Material	Specification
Panel	SMD	Glass	5.01", 69.32(W)*118.1(H)*0.8(T)
		Liquid Crystal	
Polarizer-CF	KORENO	NZD-VEGQ1763CUHC	MS501KF03, NZDCVEQUHC-KS17, 68.72(H)x112.8(V), H/C
Polarizer-TFT	KORENO	APCFH2ZDVEQSU22	LMS501KF03, APCFH2ZDVEQSU22, 68.72(H)x112.8(V), APCF
IC Driver Source	SEC	Aluminum	HX8369-A,COG,312,1448,30um,22430x1701x250
		Gold	
		Silicon	
Cover FPC	Samjoo	Bow 538S	LMS501KF03, T0.05, W35.1, L15.4, GREEN
Flexible Printed Circuit	SI-FLEX	Silk (S-200WEF)	LMS501KF03, 37.3X59.0, 51P/173P ,2L ,V2.1
		CoverLay (HGCS-A405L)	
		FCCL (DL-2012-E)	
		CoverLay (HGCS-A405L)	
		Adhesive (D3450)	
		Stiffener (MSH-3X-00FX)	
Back Light Unit	E-Litecom	FRAME-MOLD (PC)	LMS501KF03, SWDA07, S18H/S19H, 12LED, 4PIN
		LGP (PC)	
		CHASSIS-BOTTOM (SUS201)	
		ASSY FPC-LED (PI)	
		SHEET- PROTECTOR (JS562HK)	
		SHEET-PRISM(U) (HLAS4.30B)	
		SHEET-PRISM(L) (HLAS4.30B)	
		SHEET-DIFFUSER (CH19NH)	
		SHEET-REFLECTOR (ESR)	
		SHEET-PANEL (3808BH)	

	LMS501KF03 Q C 공 정 도										
공정 FLOW	공정명	JIG/도 구	작 업 내 용	투입 자 재	공정 불 량	관리 항목	관리 방법	관리 도구	관리 표준	조치 계획	조치 책임자
	PANEL 세정 CTQ	세정기	세정기 혹은 MaunaI로 POL 투입 전 세정을 실시한다	PANEL HE05 ML0, IPA,DI	이물	PAD부식 /침식 표면 얼룩	검사기기 육안 검사	농도측정기 온도계 압력계 유량계 전기전도- 측정기	CELL 세정 표준	조정	공정 관리자
	POL 부착	POL부착 M/C	LCD 전.후면에 POL 부착 도면에 맞추어 POL을 부착한다.	POL IPA	오염 버블 S/C Align	설비성 불 량 Align	육안 검사	버니어 캘리 퍼스 루베 Scale자	POL 부착 표준	조정	공정 관리자
	V/I 2차	검사기	POL 부착 후 V/I 2차 화질검사를 실시한다.	-	특성불량	검사정밀도	육안검사	V/I Pin Board	검사표준 V/I작업 표준	조정	공정 관리자
	L/T CTQ	L/T설비	Laser를 이용하여 V/I Shorting Bar를 Cutting한다.	-	cutting 안됨 cutting 덜됨	L/T 위치 -정확성 Laser Power	육안검사	설비 indicator	L/T 표준	조정	공정 관리자
	O/G	Scale자	V/I 2차 양품에 한해 외관 검사 를 실시한다	-	외관불량	검사정밀도	육안검사	-	검사표준	조정	공정 관리자

LMS501KF03 Q C 공 정 도

공정 FLOW	공정명	JIG/도구	작 업 내 용	투입자재	공정불량	관리 항목	관리 방법	관리 도구	관리 표준	조치 계획	조치 책임자
	투입전 PAD 세정	-	무진천에 IPA를 묻혀서 COG PAD부를 세정한다	무진천 IPA	COG본딩부 이물	이물 오염	육안 검사	-	COG 작업표준	조정	공정 관리자
	COG 본딩 CTQ	ACF부착 M/C COG본딩 M/C	COG PAD면에 ACF 부착 및 D-IC 본딩을 실시하여 IC Bump와 PAD부 ITO간 전기적으로 도통 시킨다.	ACF D-IC 테프론시트	특성불량	Align 압흔 정도 압흔 수량 IC깨짐,S/C	육안 검사	현미경 감압지 압력계 온도계	COG 작업 표준	조정	공정 관리자
	FPC 본딩 CTQ	ACF부착 M/C FOG압착 M/C	FOG PAD에 ACF를 부착한다. ACF가 부착된 LCD PAD면위에 FPCB를 정확하게 위치 맞춘후 열과 압력을 가해 ACF를 열경화 시킴으로서 LSI입력단과 FPCB를 전기적으로 도통시킨다.	ACF FPCB 실리콘 시트	특성불량	Align 압흔 정도 압흔 거리 도전불통침	관리 도구 측정치	압력계 TIMER 온도계 육안 감압지	FOG 작업 표준	조정 수리	공정 관리자
	방습제 도포 CTQ	방습제 도포기	제품의 특성상 방습이 필요로 할때 방습제(실리콘, TUFFY)를 PAD 전면 및 후면에 도포한다. * 상 POL 보다 낮게 도포, * D-IC 올라타지 않을 것. (미세 올라탐기준:W0.3, L5.0, T0.01) * 균일 높이로 전면에 도포 될것 * 배선 및 TP 노출 없을것 * Max Glass Edge를 넘지 않을 것	방습제	외관불량	건조시간 도포범위 도포높이	육안 검사	육안	SI작업표준 제조사양서	수리	공정 관리자
	MTP	검사기 JIG	Flicker MTP를 실시한다.	-	MTP불량	PIN 접촉	특성검사	-	검사사양서	조정 수리	공정 관리자

LMS501KF03 Q C 공 정 도

공정 FLOW	공정명	JIG/도구	작 업 내 용	투입 자재	공정 불량	관리 항목	관리 방법	관리 도구	관리 표준	조치 계획	조치 책임자
	B/L+LCD 조립	-	LCD를 PAD쪽부터 B/L에 삽입하여 조립하고 Panel 테두리 4면을 가압해 준다.	B/L	외관불량	이물 & 오염 L/G 들뜸	육안 검사	육안	제조사양서	수리	공정 관리자
	LED 단자 납땜 CTQ	SOLDERING JIG	LED 단자 & FPCB단자를 전기적으로 신호를 연결하기 위해서 LED 단자를 납땀한다.	Solder Wire	특성불량	ALIGN MISS 솔더링 높이 인두기온도	검사 측정치	육안, 두께측정기	SOLDERING 작업 표준 제조사양서	조정 수리	공정 관리자
	REMOVE TAPE 부착	-	LCD 전면 보호막 탈피용 REMOVE TAPE를 부착한다.	REMOVE TAPE	외관불량	ALIGN MISS Tape 떨어짐	육안 검사	육안	제조사양서	수리	공정 관리자
	FPC 절연 Tape 부착	-	FPC 부품 위에 절연 Tape를 부착한다	절연 tape	외관불량	ALIGN MISS Tape 미부착	육안 검사	육안	제조사양서	수리	공정 관리자
	INK-JET PRINT	INKJET PRINTER	B/L후면 정해진 위치에 Lot Marking을 실시한다. (조립 이후에 해도 무방)	잉크	외관불량	ALIGN MISS 마킹 안됨	육안 검사	육안	Lot- Marking 표준 제조사양서	수리 조정	공정 관리자
	F/T	검사기 검사JIG	조립 완료된 MOD' 완제품에 대해 육안 화질 검사를 실시한다.	-	특성불량	검사정밀도	육안검사	육안 Scale자 루빠	출하표준 검사사양서	수리	공정 관리자
	P/K	-	조립 완료된 MOD' 완제품에 대해 육안 외관 검사를 실시한다.	-	특성불량	검사정밀도	육안 검사	육안 Scale자 루빠	출하표준 검사사양서	조정 수리	공정 관리자
	포장	-	최종검사에서 양품인 제품을 각종 포장 자재를 사용하여 포장한다.	LABEL BOX류 실딩백 파레트 봉인지 쿠션시트	LABEL 미부착 수량차이	LABEL 위치 포장수량 포장방법	육안 검사	포장도면	제품표준 포장표준	조정	공정 관리자



TEST SUMMARY

Applicant : Samsung Mobile Display Co., Ltd.
Address : #508, Seongseong-dong, Seobuk-gu,
Cheonan-city, Chungcheongnam-do, 330-300 Korea

Page: 1 of 2
Date: Mar. 17, 2011

Sample Description : The following submitted sample(s) said to be: -

Name/Type of Model : LMS501KF03
Manufacturer/Vender : Samsung Mobile Display Co., Ltd.

Test Method(s) : Please see the following page(s).
Test Result(s) : Please see the following page(s).

* Note 1 : This test summary shall not be reproduced except in full without the written approval of the testing laboratory.
* Note 2 : The part list is assigned by client and indicated according to their requirement and guarantee letter.

Authorized by,
Bo Park / Lab. General Manager

Intertek Testing Services Korea Ltd.

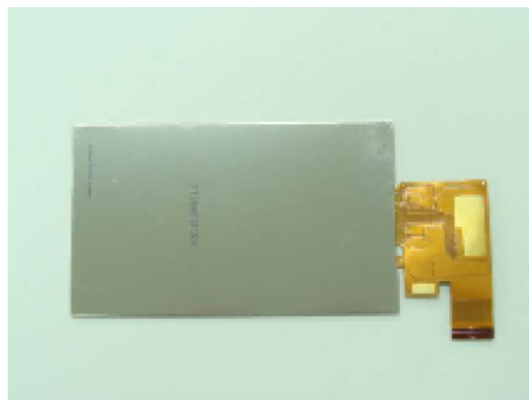
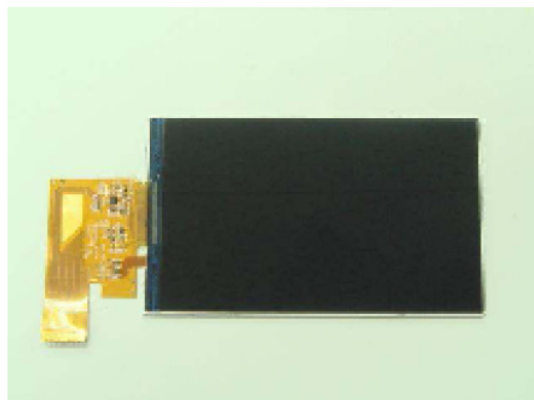


PART LIST

Page: 2 of 2
Date: Mar. 17, 2011

No.	Name/Type of Product	Report No.
1	Panel with FPCB Ass'y	RT11R-S1050-001-E
2	BLU	RT11R-S1050-002-E
3	Bezel	RT11R-S1050-003-E

* View of sample as received;-



***** End of Report *****

Intertek

TEST REPORT

Applicant : Samsung Mobile Display Co., Ltd.
 Address : #508, Seongseong-dong, Seobuk-gu,
 Cheonan-city, Chungcheongnam-do, 330-300 Korea

Page: 1 of 5

Report No. RT11R-S1050-001-E

Date: Mar. 17, 2011

Sample Description : The following submitted sample(s) said to be:-

Name/Type of Product : Panel with FPCB Ass'y

Sample ID No. : RT11R-S1050-001

Manufacturer/Vender : Samsung Mobile Display Co., Ltd.

Sample received : Mar. 15, 2011

Testing Date : Mar. 15, 2011 ~ Mar. 17, 2011

Testing Environment : Temperature : (24 ± 2) °C, Humidity : (60 ± 5) % R.H.

Test Type : RoHS wet chemical analysis

Test Method(s) : Please see the following page(s).

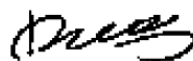
Test Result(s) : Please see the following page(s).

* Note 1 : The test results presented in this report relate only to the object tested.

* Note 2 : This report shall not be reproduced except in full without the written approval of the testing laboratory.

Approved by,

Authorized by,



Jade Jang / Lab. Technical Manager

Bo Park / Lab. General Manager

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Intertek Testing Services Korea Ltd.

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 Ulsan Lab. Address : #340-2, Yongam-Ri, Chongryang-Myun, Ulju-Gun, Ulsan 689-865 Korea



TEST REPORT

Report No. RT11R-S1050-001-E

Page: 2 of 5
Date: Mar. 17, 2011

Sample ID No. : RT11R-S1050-001
Sample Description : Panel with FPCB Ass'y

Test Item	Unit	Test Method	MDL	Result
Cadmium (Cd)	mg/kg	With reference to IEC 62321 Edition 1.0 : 2008, by acid digestion and determined by ICP-OES	0.5	N.D.
Lead (Pb)	mg/kg		5	N.D.
Mercury (Hg)	mg/kg		2	N.D.
Hexavalent Chromium (Cr ⁶⁺) (For non-metal)	mg/kg	With reference to IEC 62321 Edition 1.0 : 2008, by alkaline digestion and determined by UV-VIS Spectrophotometer	1	N.D.
Polybrominated Biphenyl (PBBs)				
Monobromobiphenyl	mg/kg	With reference to IEC 62321 Edition 1.0 : 2008, by solvent extraction and determined by GC/MS	5	N.D.
Dibromobiphenyl	mg/kg		5	N.D.
Tribromobiphenyl	mg/kg		5	N.D.
Tetrabromobiphenyl	mg/kg		5	N.D.
Pentabromobiphenyl	mg/kg		5	N.D.
Hexabromobiphenyl	mg/kg		5	N.D.
Heptabromobiphenyl	mg/kg		5	N.D.
Octabromobiphenyl	mg/kg		5	N.D.
Nonabromobiphenyl	mg/kg		5	N.D.
Decabromobiphenyl	mg/kg		5	N.D.
Polybrominated Diphenyl Ether (PBDEs)				
Monobromodiphenyl ether	mg/kg	With reference to IEC 62321 Edition 1.0 : 2008, by solvent extraction and determined by GC/MS	5	N.D.
Dibromodiphenyl ether	mg/kg		5	N.D.
Tribromodiphenyl ether	mg/kg		5	N.D.
Tetrabromodiphenyl ether	mg/kg		5	N.D.
Pentabromodiphenyl ether	mg/kg		5	N.D.
Hexabromodiphenyl ether	mg/kg		5	N.D.
Heptabromodiphenyl ether	mg/kg		5	N.D.
Octabromodiphenyl ether	mg/kg		5	N.D.
Nonabromodiphenyl ether	mg/kg		5	N.D.
Decabromodiphenyl ether	mg/kg		5	N.D.

Tested by : Nikkie Lee, Leo Kim, Ellen Jung, Jessica Kang

Notes : mg/kg = ppm = parts per million
< = Less than
N.D. = Not detected (<MDL)
MDL = Method detection limit

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Intertek Testing Services Korea Ltd.

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Seoul Lab. Address : 1/F, A-ju Digital Tower, #284-56, Seongsu 2-ga, Seongdong-Gu, Seoul, 133-833 Korea
Ulsan Lab. Address : #340-2, Yongam-Ri, Chongryang-Myun, Ulsan-Gun, Ulsan 689-865 Korea



TEST REPORT

Report No. RT11R-S1050-001-E

Page: 3 of 5
Date: Mar. 17, 2011

Sample ID No. : RT11R-S1050-001
Sample Description : Panel with FPCB Ass'y

Test Item	Unit	Test Method	MDL	Result
Bromine (Br)	mg/kg	With reference to EN 14582, by oxygen combustion with bomb and determined by IC	30	N.D.
Chlorine (Cl)	mg/kg	With reference to EN 14582, by oxygen combustion with bomb and determined by IC	30	70

Tested by : Nikkie Lee

Notes : mg/kg = ppm = parts per million
< = Less than
N.D. = Not detected (<MDL)
MDL = Method detection limit

* View of sample as received;-



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Ulsan Lab. Address : #340-2, Yongam-Ri, Chongryang-Myun, Ulju-Gun, Ulsan 689-865 Korea

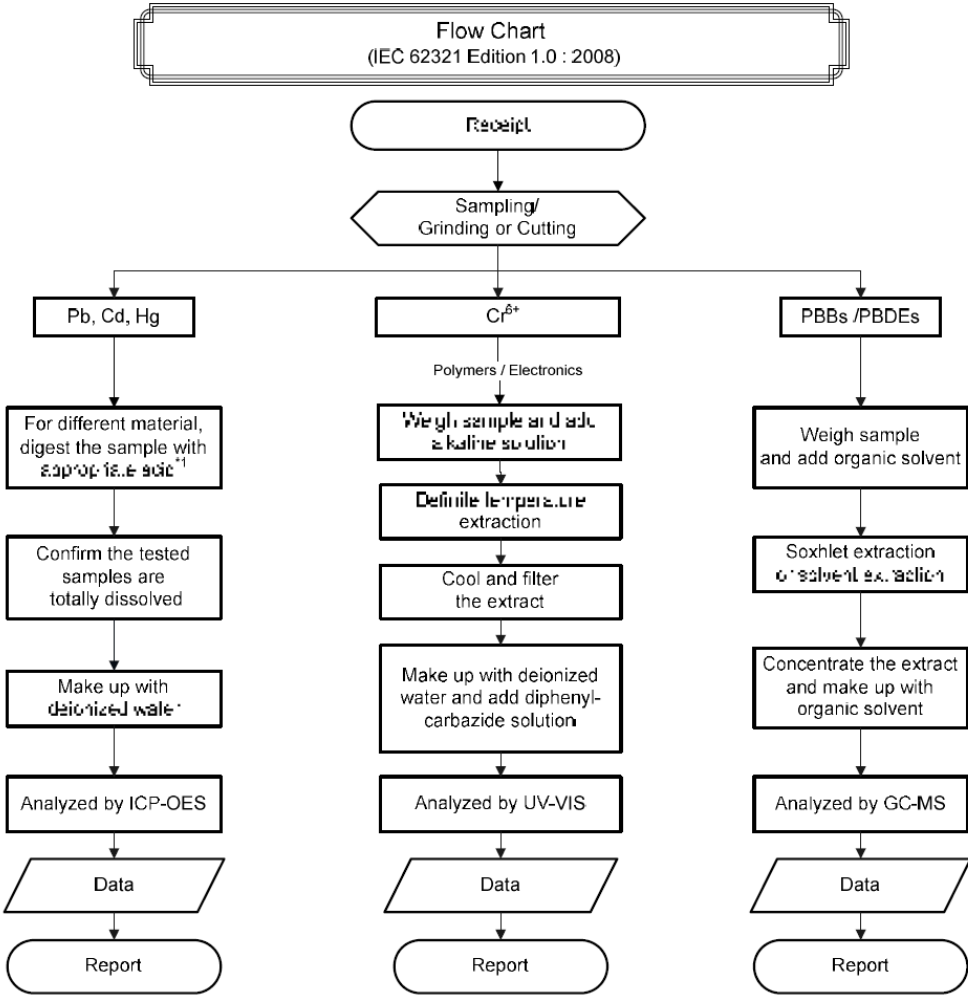


TEST REPORT

Report No. RT11R-S1050-001-E

Page: 4 of 5
Date: Mar. 17, 2011

Sample ID No. : RT11R-S1050-001
Sample Description : Panel with FPCB Ass'y



Remarks :

*1 : List of appropriate acid :

Material	Acid added for digestion
Polymers	HNO ₃ , HCl, HF, H ₂ O ₂ , H ₃ BO ₃
Metals	HNO ₃ , HCl, HF
Electronics	HNO ₃ , HCl, H ₂ O ₂ , HBF ₄

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TEST REPORT

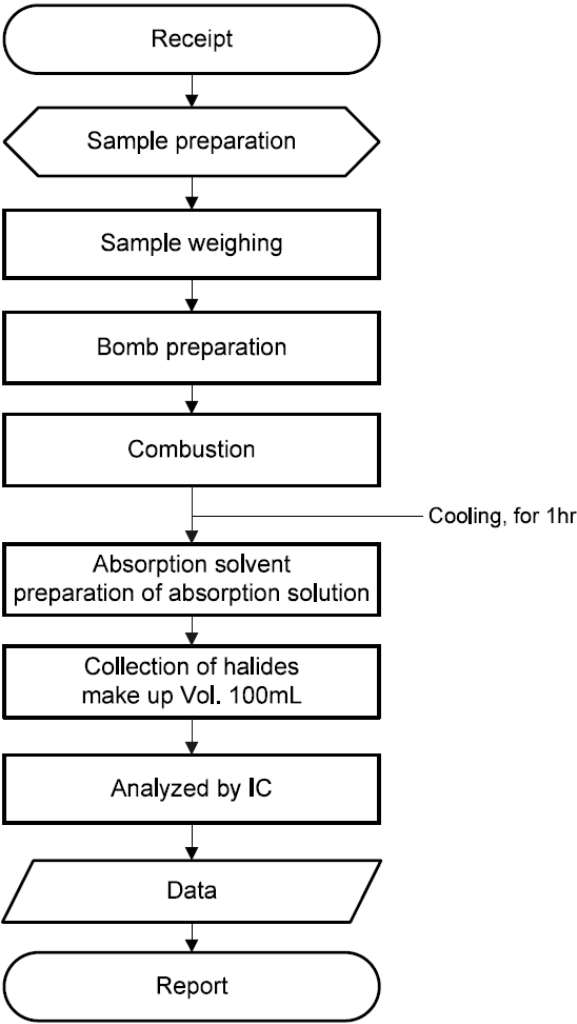
Report No. RT11R-S1050-001-E

Page: 5 of 5
Date: Mar. 17, 2011

Sample ID No. : RT11R-S1050-001

Sample Description : Panel with FPCB Ass'y

Flow Chart (Halogen)



***** End of Report *****

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TEST REPORT

Applicant : Samsung Mobile Display Co., Ltd.
 Address : #508, Seongseong-dong, Seobuk-gu,
 Cheonan-city, Chungcheongnam-do, 330-300 Korea

Page: 1 of 5

Report No. RT11R-S1050-002-E

Date: Mar. 17, 2011

Sample Description : The following submitted sample(s) said to be:-

Name/Type of Product : BLU
 Sample ID No. : RT11R-S1050-002
 Manufacturer/Vender : Samsung Mobile Display Co., Ltd.

Sample received : Mar. 15, 2011
 Testing Date : Mar. 15, 2011 ~ Mar. 17, 2011
 Testing Environment : Temperature : (24 ± 2) °C, Humidity : (60 ± 5) % R.H.

Test Type : RoHS wet chemical analysis
 Test Method(s) : Please see the following page(s).
 Test Result(s) : Please see the following page(s).

* Note 1 : The test results presented in this report relate only to the object tested.

* Note 2 : This report shall not be reproduced except in full without the written approval of the testing laboratory.

Approved by,

Authorized by,




Jade Jang / Lab. Technical Manager

Bo Park / Lab. General Manager

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TEST REPORT

Report No. RT11R-S1050-002-E

Page: 2 of 5
Date: Mar. 17, 2011

Sample ID No. : RT11R-S1050-002
Sample Description : BLU

Test Item	Unit	Test Method	MDL	Result
Cadmium (Cd)	mg/kg	With reference to IEC 62321 Edition 1.0 : 2008, by acid digestion and determined by ICP-OES	0.5	N.D.
Lead (Pb)	mg/kg		5	N.D.
Mercury (Hg)	mg/kg		2	N.D.
Hexavalent Chromium (Cr ⁶⁺) (For non-metal)	mg/kg	With reference to IEC 62321 Edition 1.0 : 2008, by alkaline digestion and determined by UV-VIS Spectrophotometer	1	N.D.
Polybrominated Biphenyl (PBBs)				
Monobromobiphenyl	mg/kg	With reference to IEC 62321 Edition 1.0 : 2008, by solvent extraction and determined by GC/MS	5	N.D.
Dibromobiphenyl	mg/kg		5	N.D.
Tribromobiphenyl	mg/kg		5	N.D.
Tetrabromobiphenyl	mg/kg		5	N.D.
Pentabromobiphenyl	mg/kg		5	N.D.
Hexabromobiphenyl	mg/kg		5	N.D.
Heptabromobiphenyl	mg/kg		5	N.D.
Octabromobiphenyl	mg/kg		5	N.D.
Nonabromobiphenyl	mg/kg		5	N.D.
Decabromobiphenyl	mg/kg		5	N.D.
Polybrominated Diphenyl Ether (PBDEs)				
Monobromodiphenyl ether	mg/kg	With reference to IEC 62321 Edition 1.0 : 2008, by solvent extraction and determined by GC/MS	5	N.D.
Dibromodiphenyl ether	mg/kg		5	N.D.
Tribromodiphenyl ether	mg/kg		5	N.D.
Tetrabromodiphenyl ether	mg/kg		5	N.D.
Pentabromodiphenyl ether	mg/kg		5	N.D.
Hexabromodiphenyl ether	mg/kg		5	N.D.
Heptabromodiphenyl ether	mg/kg		5	N.D.
Octabromodiphenyl ether	mg/kg		5	N.D.
Nonabromodiphenyl ether	mg/kg		5	N.D.
Decabromodiphenyl ether	mg/kg		5	N.D.

Tested by : Nikkie Lee, Leo Kim, Ellen Jung, Jessica Kang

Notes : mg/kg = ppm = parts per million
< = Less than
N.D. = Not detected (<MDL)
MDL = Method detection limit

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TEST REPORT

Report No. RT11R-S1050-002-E

Page: 3 of 5

Date: Mar. 17, 2011

Sample ID No. : RT11R-S1050-002

Sample Description : BLU

Test Item	Unit	Test Method	MDL	Result
Bromine (Br)	mg/kg	With reference to EN 14582, by oxygen combustion with bomb and determined by IC	30	N.D.
Chlorine (Cl)	mg/kg	With reference to EN 14582, by oxygen combustion with bomb and determined by IC	30	N.D.

Tested by : Nikkie Lee

Notes : mg/kg = ppm = parts per million

< = Less than

N.D. = Not detected (<MDL)

MDL = Method detection limit

* View of sample as received:-



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TEST REPORT

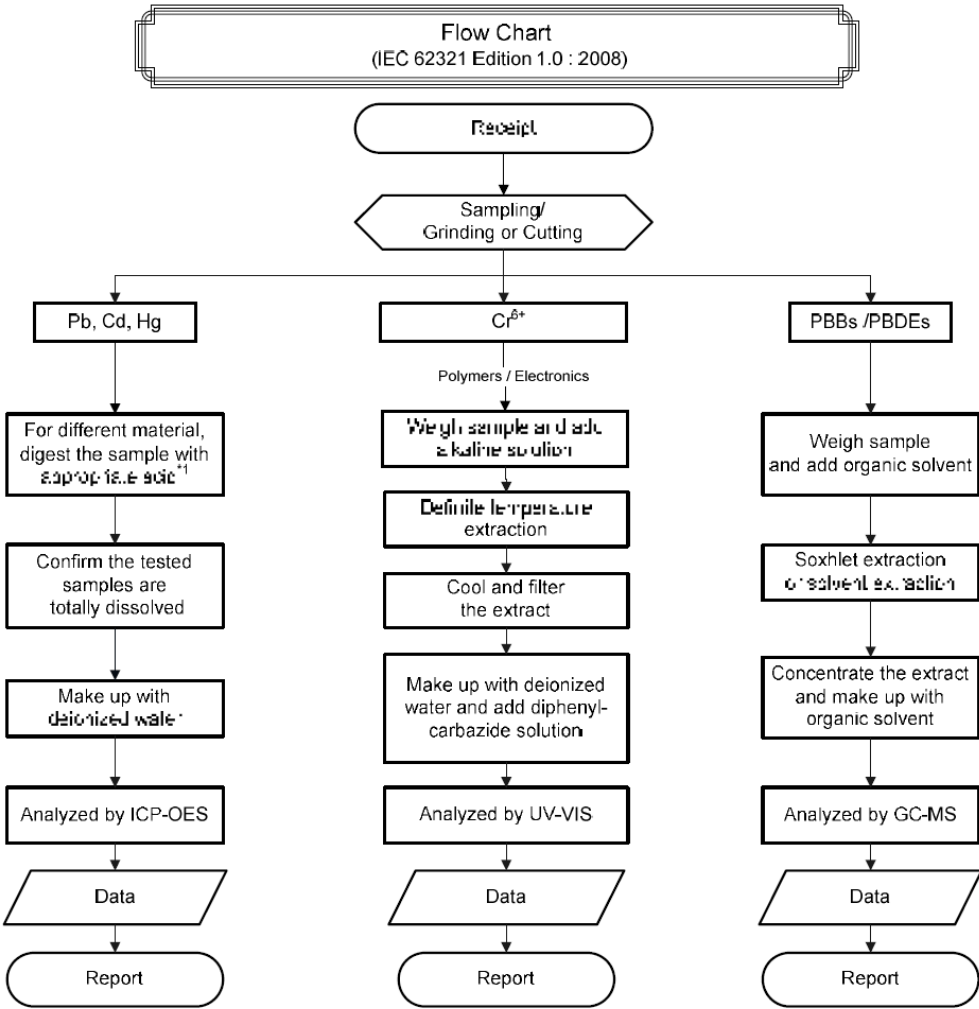
Report No. RT11R-S1050-002-E

Page: 4 of 5

Date: Mar. 17, 2011

Sample ID No. : RT11R-S1050-002

Sample Description : BLU



Remarks :

*1 : List of appropriate acid :

Material	Acid added for digestion
Polymers	HNO ₃ , HCl, HF, H ₂ O ₂ , H ₃ BO ₃
Metals	HNO ₃ , HCl, HF
Electronics	HNO ₃ , HCl, H ₂ O ₂ , HBF ₄

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TEST REPORT

Report No. RT11R-S1050-002-E

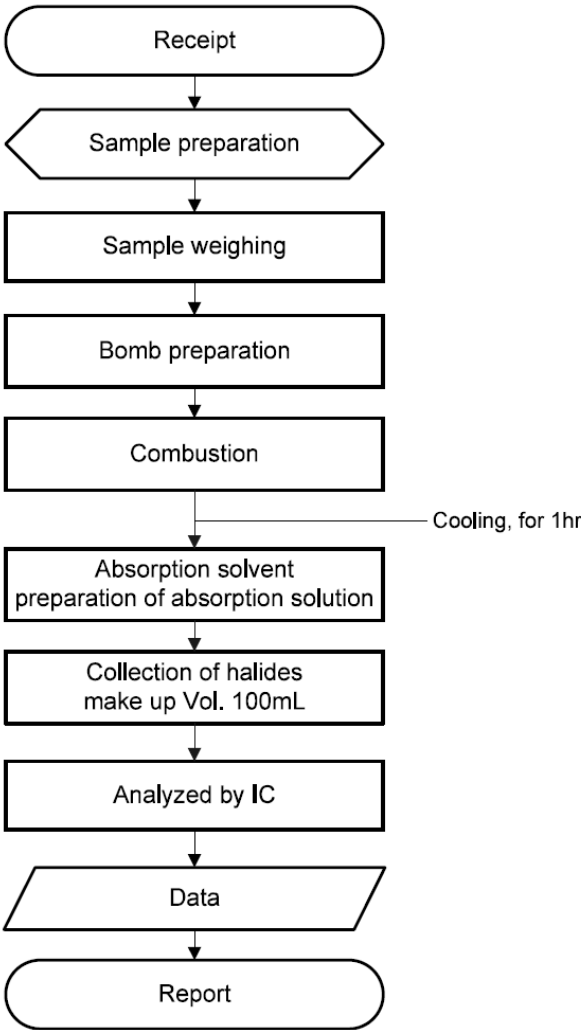
Sample ID No. : RT11R-S1050-002

Sample Description : BLU

Page: 5 of 5

Date: Mar. 17, 2011

Flow Chart (Halogen)



***** End of Report *****

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Ulsan Lab. Address : #340-2, Yongam-Ri, Chongryang-Myun, Ulju-Gun, Ulsan 689-865 Korea



TEST REPORT

Applicant : Samsung Mobile Display Co., Ltd.
 Address : #508, Seongseong-dong, Seobuk-gu,
 Cheonan-city, Chungcheongnam-do, 330-300 Korea

Page: 1 of 4

Report No. RT11R-S1050-003-E

Date: Mar. 17, 2011

Sample Description : The following submitted sample(s) said to be:-

Name/Type of Product : Bezel
 Sample ID No. : RT11R-S1050-003
 Manufacturer/Vender : Samsung Mobile Display Co., Ltd.

Sample received : Mar. 15, 2011
 Testing Date : Mar. 15, 2011 ~ Mar. 17, 2011
 Testing Environment : Temperature : (24 ± 2) °C , Humidity : (60 ± 5) % R.H.

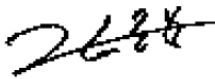
Test Type : RoHS wet chemical analysis
 Test Method(s) : Please see the following page(s).
 Test Result(s) : Please see the following page(s).

* Note 1 : The test results presented in this report relate only to the object tested.

* Note 2 : This report shall not be reproduced except in full without the written approval of the testing laboratory.

Approved by,

Authorized by,




Jade Jang / Lab. Technical Manager

Bo Park / Lab. General Manager

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TEST REPORT

Report No. RT11R-S1050-003-E

Page: 2 of 4
Date: Mar. 17, 2011

Sample ID No. : RT11R-S1050-003

Sample Description : Bezel

Test Item	Unit	Test Method	MDL	Result
Cadmium (Cd)	mg/kg	With reference to IEC 62321 Edition 1.0 : 2008, by acid digestion and determined by ICP-OES	0.5	N.D.
Lead (Pb)	mg/kg		5	N.D.
Mercury (Hg)	mg/kg		2	N.D.
Hexavalent Chromium (Cr ⁶⁺) (For metal)	-	With reference to IEC 62321 Edition 1.0 : 2008, by Spot test	(Threshold of 1 mg/kg)	Negative
Hexavalent Chromium (Cr ⁶⁺) (For metal)	-	With reference to IEC 62321 Edition 1.0 : 2008, by boiling water extraction and determined by UV-VIS Spectrophotometer	(Threshold of 0.02 mg/kg with 50 cm ²)	Negative

Tested by : Nikkie Lee, Leo Kim

Notes : mg/kg = ppm = parts per million
mg/kg with 50 cm² = milligram per kilogram with 50 square centimeter
< = Less than
N.D. = Not detected (<MDL)
MDL = Method detection limit
Positive = A positive test result indicated the presence of Cr(VI) at the time of testing, equal to or greater than threshold of 1 mg/kg for spot test procedures or 0.02 mg/kg for boiling water extraction procedures with a sample surface area of 50 cm² used. However, it shall not be interpreted as the Cr(VI) concentration in the coating layer of the sample and should not be used as a method detection limit for this qualitative test.
Negative = A negative test result indicates above positive observation was not found at the time of testing. When the spot test showed a negative result, the boiling water extraction procedure shall be used to verify the result.

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TEST REPORT

Report No. RT11R-S1050-003-E

Page: 3 of 4

Date: Mar. 17, 2011

Sample ID No. : RT11R-S1050-003

Sample Description : Bezel

* View of sample as received;-



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TEST REPORT

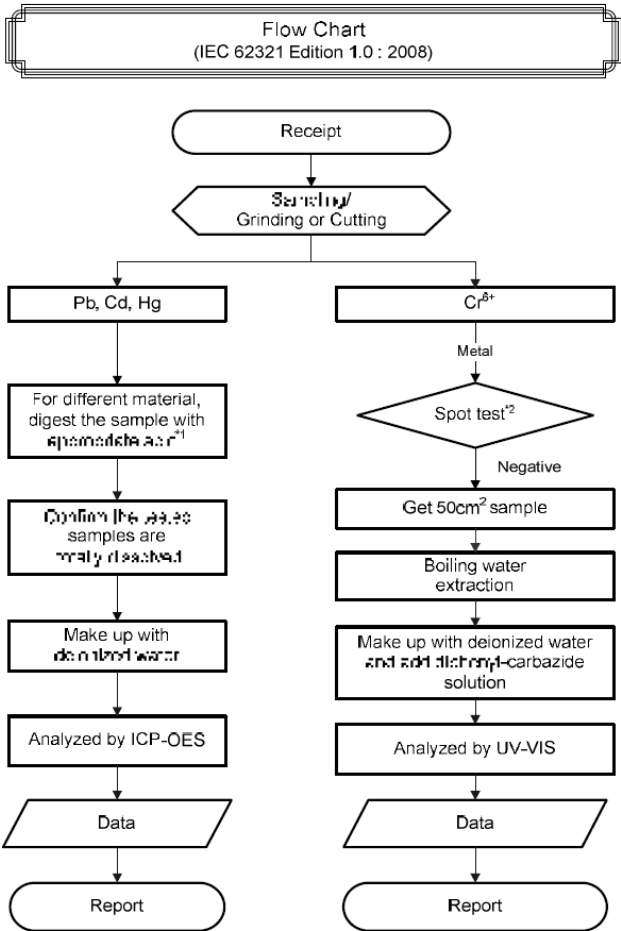
Report No. RT11R-S1050-003-E

Page: 4 of 4

Date: Mar. 17, 2011

Sample ID No. : RT11R-S1050-003

Sample Description : Bezel



Remarks :

*1 : List of appropriate acid :

Material	Acid added for digestion
Polymers	HNO ₃ , HCl, HF, H ₂ O ₂ , H ₃ BO ₃
Metals	HNO ₃ , HCl, HF
Electronics	HNO ₃ , HCl, H ₂ O ₂ , HBF ₄

*2 : If the result of spot test is positive, Chromium (VI) would be determined as detected.
No further analysis is required.

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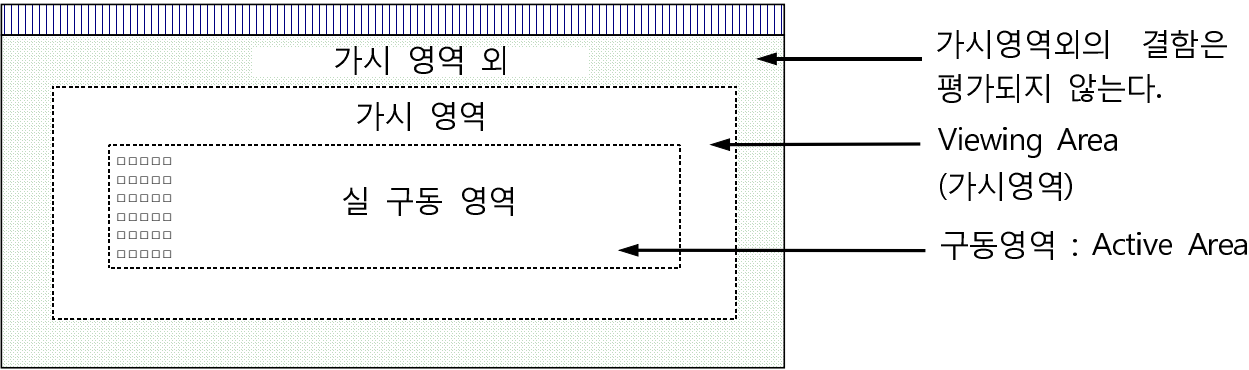
1. 검사 조건

- ① 검사환경
 - 가) 온 도 : 23 ± 2℃
- ② 검사거리와 각도
 - 가) 거 리 : 30 ± 5cm
 - 나) 각 도 : 상하좌우 30°
- ③ 검사 조도
 - 가) 외관 : 1,000 ~ 1,500 Lux
 - 나) 구동 : 50 ~ 150 Lux

2. 검사 방법(샘플링)

검사수준	시 료 발 취	AQL
일반검사 I	MIL-STD-105D 계수조정형 1회 샘플링 검사	중결점 : 0.1 경결점 : 0.65

- ① 중결점 : 제품을 못쓰게 되거나, 제품이 목적으로 하는 실질적인 특성을 저하시켜 소기의 목적을 달성하지 못하게 하는 결점
- ② 경결점 : 제품의 각 부품별 기능 및 동작 시 사용상 불안정 하거나 제품의 가치를 저하시키는 결점
- ③ 결함 적용 영역: 가시영역 (도면확인)



3. 검사 항목 및 판정 기준

1) 주요 구동 불량 Spec

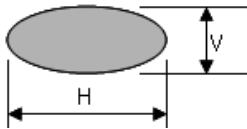
항 목	판정기준	결점구분
1)Display무	·없을 것	중결점
2)표시이상	·없을 것	중결점
3)Short	·없을 것	중결점
4)Open(BIT)	·없을 것	중결점

2) 외관 검사 Spec

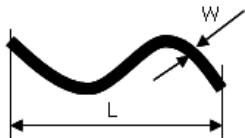
항목	판정기준		결점구분
원형 이물	크기 D (mm)	허용 개수 (ea)	경결점
	D≤0.1	무시	
	0.1 < D ≤ 0.15	2 (점간 거리 5mm 이상)	
	0.15<D≤0.2	1	
선형 이물	Width W (mm) , Length L (mm)	허용 개수 (ea)	경결점
	W≤0.03	3	
	W≤0.05, L≤2.0	2	
	W≤0.08, L≤1.0	1	
	W>0.08		
POL기포 / POL찍힘	크기 D (mm)	허용 개수 (ea)	경결점
	D≤0.1	무시	
	0.1<D≤0.3	3	
POL긁힘	Width W (mm), Length L (mm)	허용개수 (ea)	경결점
	W≤0.05	무시	
	0.05<W≤0.08, 1.0<L≤5.0	1	
최대 허용 개수		3	-

※ Remark

- 원형이물, 기포의 지름 : $D = [\text{세로}(V) + \text{가로}(H)] / 2$




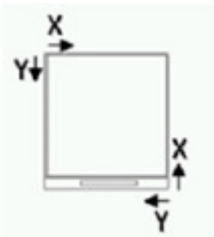
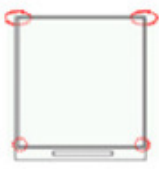

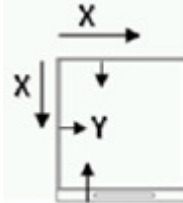
- 선형이물, 긁힘의 길이 및 두께



3) Dot 불량 Spec

항목	판정기준		
	Dot Type	허용개수 (ea)	결점구분
명점	Random (Red , Blue, Green)	0	경결점
	2개 또는 인접한 dot인 경우	0	
암점	Dark dot	2 (거리 ≥ 10mm)	경결점
	2개 인접한 dot인 경우	0	
	3개 또는 그 이상 인접한 dot인 경우	0	
최대 허용 개수		2	-

4) Crack, Chipping, Broken

불량구분	발생유형	SPEC		검사 Point	X, Y 정의
		공통기준	결점구분		
CRACK	CRACK	없을 것	중결점	TFT & CF Glass전체	-
PAD부 모서리 (TFT)	CHIPPING BROKEN	X≤2.5, Y≤1.5 X≤1.5, Y≤2.5 (단, Align mark 침범 없을 것)	경결점		장축/단축에 따라 X,Y 길이 개념으로 적용함. Depth는 X,Y 길이 방향 외 안쪽 영역의 깨짐. 
PAD부 이외 모서리 (CF, TFT)	CHIPPING	X≤1.5 Y≤1.0	경결점		
	BROKEN	X≤1.5 Y≤0.3	경결점		
옆면(edge) (CF, TFT)	CHIPPING	X≤5.0, Y≤0.5	경결점		X는 옆면 4변부이며, Y는 Active 및 PAD부 안쪽으로 침범한 영역임. 
옆면(edge) (CF)	BROKEN	X≤5.0, Y≤0.5	경결점		
옆면(edge) (TFT)	BROKEN	X≤5.0, Y≤0.3	경결점		
PAD부 FPC 본딩부 (edge)	CHIPPING BROKEN	X≤5mm Y≤0.4mm (단, FOG PAD 0.2mm이상 침범 시 불량. Vcom 배선 침범 안할 것)	경결점	