



Date : JAN.12th, 2018

Specification for Approval

Customer : _____

Product Name : AMOLED Module

Model Name : LX390ED01 V1.1

Description : 3.9" Visual 480*854 16M Color

Proposed by			Customer's Approval
Designed	Checked	Approved	
Seungwon Jegal	Minhyeng Lee	Jeongil Yoo	

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Revision History

Date	Rev. No.	Contents	Remark
OCT. 7th. '11	0.0	-.Initial issue	Preliminary
OCT. 18th. '11	0.1	-.Maximum Rating: Humidity (85%→90%) -.VCI, VDD Change(Typo)	Page 6 Page 7
NOV. 7th. '11	0.2	-.ACL 70% Setting add	Page 21
JAN. 12th. '12	1.0	-. 6.Electrical Characteristics > Max Current Consumption add > Frame Frequency tolerance add -. 7.Electro-Optical Charateristics > Brightness, Color Coordinate, Gamma tolerance add > Crosstalk(CIE62341-6-3), Gamma Condition Changed -. 11.Quality Level Updated (V1.5) -. 12.Reliability > Environmental, Mechanical, Other(ESD) Updated -. 13-7. Safety Precautions -. 14. Product Drawing > Module, Main FPC, TSP FPC Updated	Page 7 Page 8 Page 30-38 Page 39-40 Page 43 Page 44- 46

Contents

1. Scope 5

2. Warranty 5

3. Features 6

4. Mechanical specification 6

5. Maximum rating 6

6. Electrical characteristics 7

7. Electro-optical characteristics 8

8. Input/Output terminal 11

 8-1. I/O Connection 11

 8-2. Circuit Block Diagram (Module) 12

 8-3. Circuit Block Diagram (IC) 13

 8-4. MIPI Interface 14

9. Recommended Operating Sequence 15

 9-1. Power ON/Off sequence 15

 9-2. Stand by/ Wake up sequence 16

 9-3. ACL ON/OFF Sequence 17

 9-4. Initial Register Set 18

 9-5. Power Supply pattern Diagram 24

10. INTERFACE 25

 10-1. MIPI Interface 25

 10-2. Reset Timing 29

11. Quality Level 30

 11-1. AMOLED Module of Characteristic Inspection..... 30

 11-2. Sampling Procedures for each item's acceptance table 31

 11-3. Inspection Item 32

 11-3-1. Panel 32

 11-3-2. Window 33

 11-3-3. Other 37

12. Reliability 39

 12-1. Environmental test 39

 12-2. Mechanical test 39

 12-3. Other test 40

13. Handling Precautions	41
13-1. Mounting Method	41
13-2. Caution of AMOLED Handling and Cleaning	41
13-3. Caution against Static Charge	41
13-4. Packing	42
13-5. Caution for Operation	42
13-6. Storage	42
13-7. Safety Precautions	43
13-8. Precautions before Use	43
14. Drawing	44
14-1. Product Drawing	44
14-2. Main FPCB Drawing	45
14-2-1. Schematic Diagram	45
14-2-2. Electronic Part List	46
14-2-3. Placement (Front)	47
14-2-4. Placement (Rear)	48
15. Packing Specification.....	49
15.1 Box Pack	49
15.2 Label	50
15.3 Packing for Small Quantities.....	51
15.4 Over Pack	52
15.5 Pack for Small Quantities.....	53

1. Scope

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

2. Warranty

Basically, warranty term is 12 months of reliability characteristics of quality level after the outgoing date in SAMSUNG Mobile Display Co., LTD., and SAMSUNG Mobile Display 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 handing or circuit change, etc.
And after 12 months of warranty term, all replacements for defectives will be charged.

3. Features

- 1) Display Color : 16M_Color (RGB)
- 2) DisplayFormat: : 3.9" Visual 480*854 16M Color
- 3) Interface: : MIPI 2 Lane
- 4) DriverIC: : S6D63J0X03
- 5) Polarizer : Hard Coating Polarizer

4. Mechanical Specification

GENERAL	
Technology	AM OLED
Display format	480*854*RGB
Pixel Density	220 ppi
Weight [g]	23g
Image mode	Normally black
Functions	Automatic current limit, Low power mode, High brightness mode
DIMENSIONS	
Diagonal size [inch]	3.91
Display module size	51.26*94.78*1.10mm
Glass size (width x height x thickness)	
Active area size	48.26*87.08
Pixel height to width ratio	1:1
Sub pixel pitch	0.0265 mm • 0.1295 mm

5. Maximum Rating

Item		Symbol	Min.	Max.	Unit	Note
Supply voltage	Logic	VCI	-0.3	5.0	V	(1),(2)
		VDD3	-0.3	5.0	V	(1),(2)
	Power	ELVDD	-0.3	6.0	V	(1),(2)
		ELVSS	-10	AGND+0.3	V	(1),(2)
Input voltage		VI	-0.3	VDD3+0.5	V	(2)
Operating temperature		Top	-30	70	°C	-
Storage temperature		Tstg	-40	85	°C	-
Humidity		Hstg	10	90	%RH	

Note 1) VCI, VDD3, should satisfy the below condition of
 $VCI, VDD3 > VSS (GND)$.

Note 2) If the supplied voltage exceeds the maximum limitation, LSI can be damaged permanently. Therefore, while operating, it is recommend to use LSI within the maximum electrical limitation.

If not, LSI can cause decreased reliability or operational problems.

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6. Electrical Characteristics

-. Test Conditions: VDD3=1.8V, VCI=3.0V, VSS=0V,
Temp=25℃ unless otherwise specified.

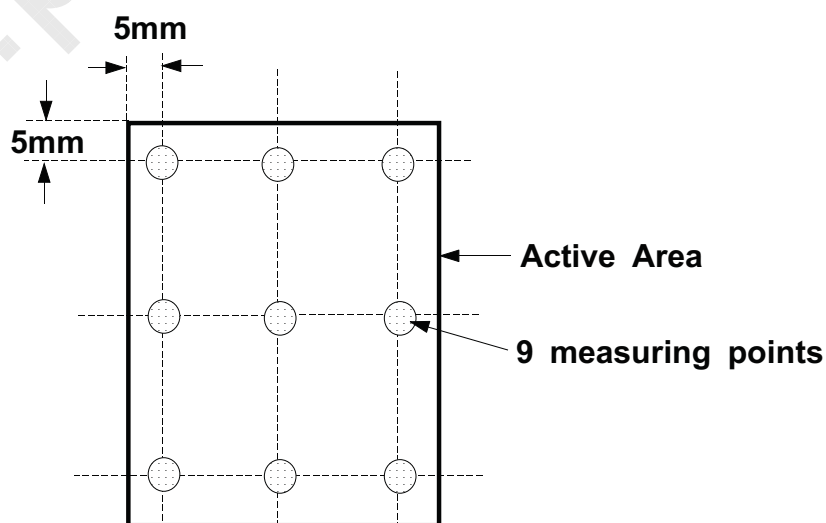
Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Supply voltage	I/O Voltage	VDD3	-	1.65	1.8	2.0	V
	Operating Voltage	VCI	-	2.85	3.0	3.3	
	Battery Supply Voltage	VBAT		3.2	3.8	4.2	
Logic Input Voltage	"H" level	VIH	-	0.7*VDD3	-	VDD3	V
	"L" level	VIL	-	0.0	-	0.3*VDD3	
Logic Output Voltage	"H" level	VOH	IOH = -0.1mA IOL = 0.1mA	0.8*VDD3	-	VDD3	V
	"L" level	VOL		0.0	-	0.2*VDD3	
Logic Current	"H" level	IIH	VI=VDD3 or VSS		-	10.0	uA
	"L" level	IIL		-10.0	-		uA
Current Consumption	Sleep out mode Display mode	IVDD3	Frame frequency=60Hz, white pattern		(1.6)	5 (Note1)	mA
		IVCI			(27.5)	40	mA
		IBAT			(460)	610	mA
	Sleep in mode Stand by mode	IVDD3	Signals (Dotclk,Hsync,V sync,Enable) not toggling	-	(35)	60	uA
		IVCI		-	(20)	30	uA
	Frame Frequency		VCI: 2.85~3.3V Ta=25℃	53	60	67	Hz

Note1. IVDD3 Current is measured with TSP Deep-Standby Mode

7. Electro-optical characteristics

Item		Symbol	Temp	Condition	Min.	Typ.	Max.	Unit	Note
Brightness			25℃	Normal (White Mode)	240	300	360	cd/m²	Center brightness
Uniformity			25℃	Normal (White Mode)	80	-	-	%	(1)
Contrast ratio		K	25℃	Φ=0°,θ=0°	7000	10,000	-	-	(1),(2)
Color of CIE coordinate	White	x	25℃	Φ=0° θ=0°	0.285	0.310	0.335	-	(1),(2),(3)
		y			0.305	0.330	0.355	-	
	Red	x			0.640	0.670	0.700	-	
		y			0.299	0.329	0.359	-	
	Green	x			0.170	0.210	0.270	-	
		y			0.666	0.726	0.766	-	
	Blue	x			0.103	0.143	0.183	-	
		y			0.015	0.055	0.095	-	
Color Gamut			25℃	vs. NTSC	80	105		%	
Viewing angle			25℃	Up/Down/Right/Left CR ratio ≥10					
Cross Talk			25℃	Window: 4% white/black background: gray117		-	3	%	(4)
Gamma			25℃	Log(Lv-Lb)=Ylog(V)+log(a) V(Gray)= 48,72,104,132,164,224,252,255 Lum(gray255)=300nit	1.9	2.2	2.5	-	
Life Time			25℃	50% Brightness drop @270cd/m², Full White	-	12,000			(5)
Response Time			25℃	(6)	-	-	1	ms	for reference

Note 1) Uniformity Measuring Point



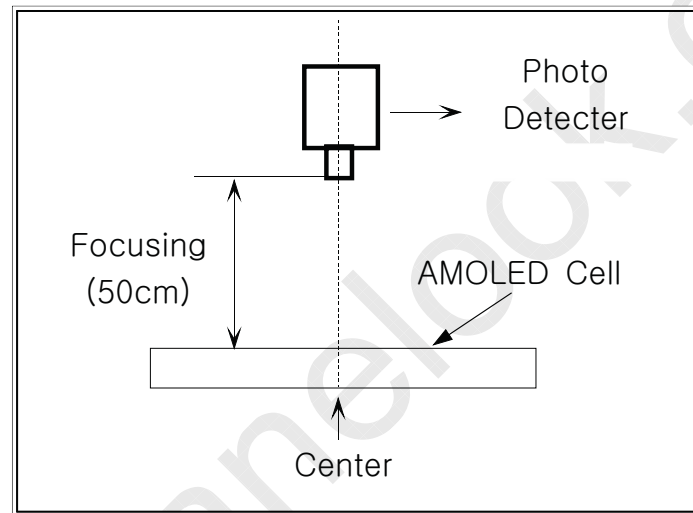
$$\text{Uniformity} = L_{\min} / L_{\max} * 100 [\%]$$

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Note 2) Definition of contrast ratio (K)

$$\text{Contrast Ratio(K)} = \frac{\text{Brightness of selected dot (White patterned area) at 300cd/m}^2}{\text{Brightness of non-selected dot (Black patterned area) at 300cd/m}^2}$$

Note 3) Optical measuring system
temperature regulated chamber



Note 4) Cross Talk

- measure luminance at the position, P_0 .
- calculate cross talk as below equation.

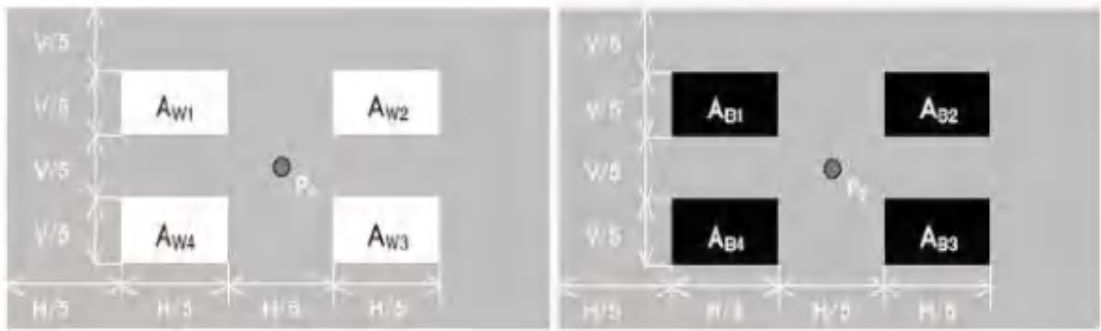
$$L_{W_OFF} = \frac{L_{W1} + L_{W2} + L_{W3} + L_{W4}}{4}$$

$$L_{B_OFF} = \frac{L_{B1} + L_{B2} + L_{B3} + L_{B4}}{4}$$

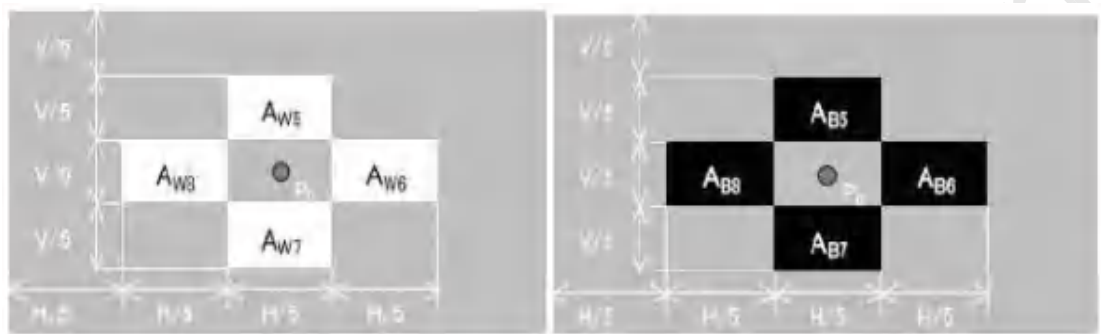
$$crosstalk = \frac{|L_{Wi_ON} - L_{W_OFF}|}{L_{W_OFF}} \times 100\% \quad (i=5 \text{ to } 8)$$

$$crosstalk = \frac{|L_{Bi_ON} - L_{B_OFF}|}{L_{B_OFF}} \times 100\% \quad (i=5 \text{ to } 8)$$

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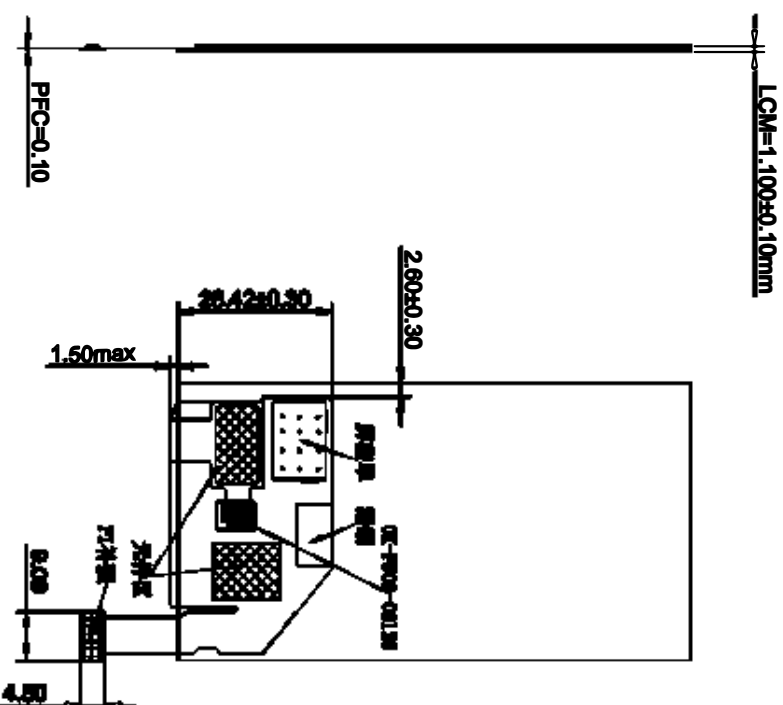
(a) L_{W_OFF} , L_{B_OFF} measuring pattern



(b) L_{W_ON} , L_{B_ON} measuring pattern

Note 5) Life Time : The elapsed time that the full white brightness decreases to the half of initial value.

Note 6) Response time=Pixel turn on and turn off time (White $\rightleftharpoons$ Black).
It is measuring transition time from 10% to 90% of luminance.



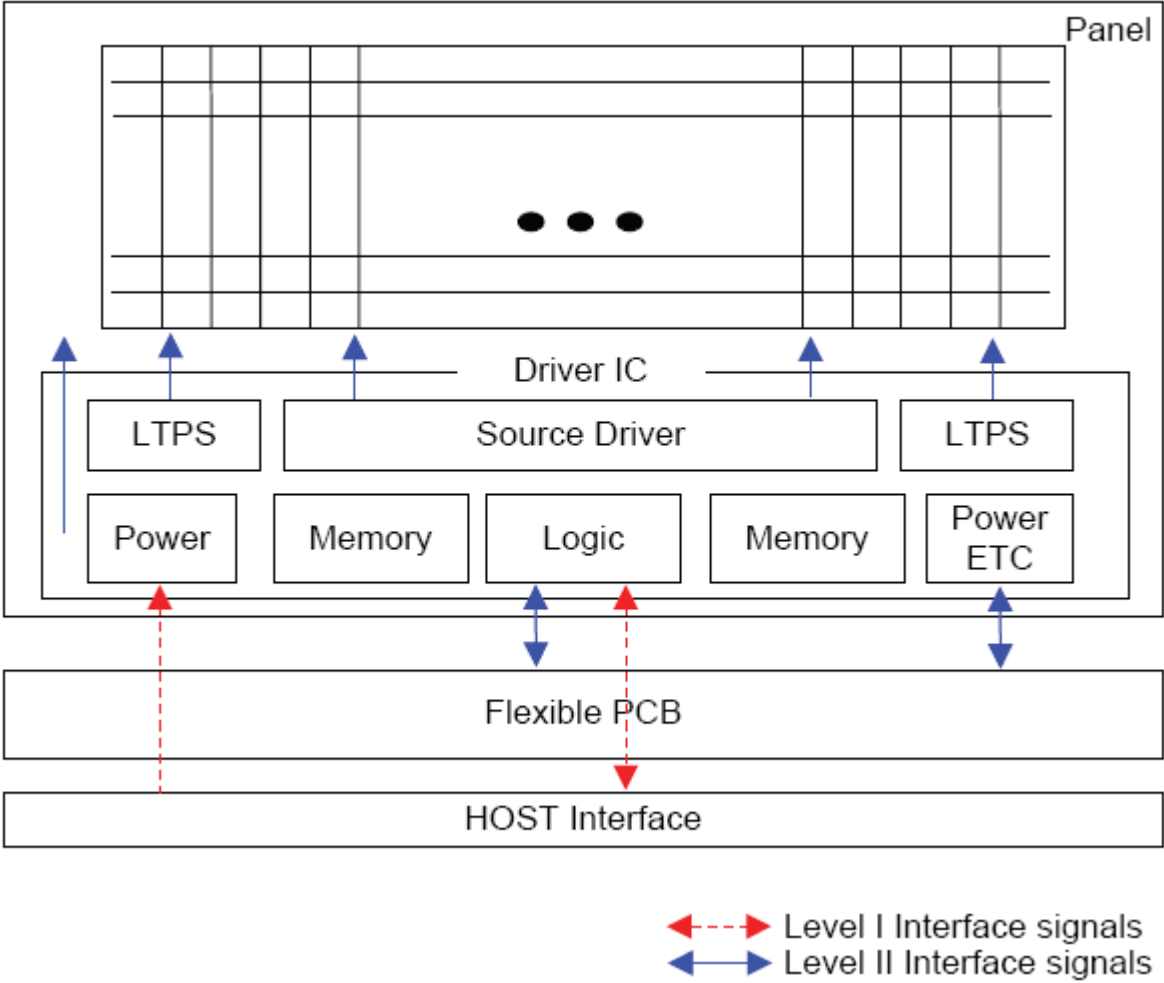
1. Display: 3.91"480*854, ALL' clock;
2. Driver IC;
3. General Tolerance: ± 0.2 ;
4. General angle radius: $r=0.2$;
5. Check ltrms;
6. Connector;
7. Non-marked dimension to CAD file and general tolerance;
8. Requirements on Environment Protection: RoHS Halogen free;
9. working temperature: 30C 80C;

				 THIRD ANGLE PROJECT		VIEW DIRECTION		DRAW DATE		2021-05-18	
								DESIGN BY		YGP	
MODULE BEARING				UNMARK TOL.		SCALE		UNIT		CHECK BY	
VERSION:				A		±0.2		1:1		mm	
LOA NO:						PAGE 1OF 1		APPROVAL			

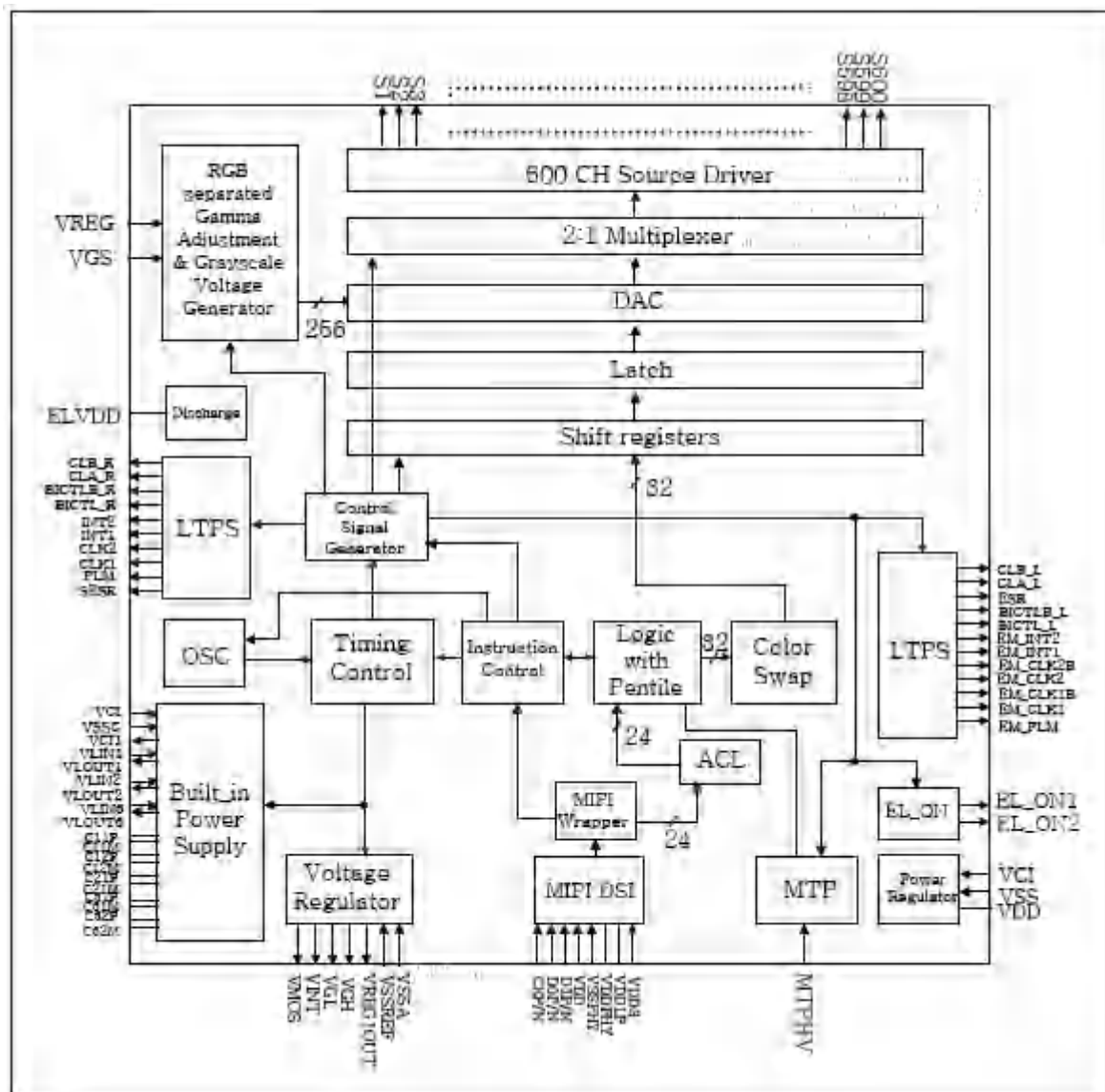
Sl. No.	Particulars	Amount
1	100	100
2	100	100
3	100	100
4	100	100
5	100	100
6	100	100
7	100	100
8	100	100
9	100	100
10	100	100
11	100	100
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14	100	100
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91	100	100
92	100	100
93	100	100
94	100	100
95	100	100
96	100	100
97	100	100
98	100	100
99	100	100
100	100	100

Pin No	Symbol	Function	Remark
1	GND	System power ground.	
2	NC	System power supply.(Typ.:2.8V)	
3	TP-SDA	CTP	
4	TP-SCL	CTP	
5	TP-INT	CTP	
6	TP-RST	CTP	
7	TP-VCC	CTP	
8	NC	NC	
9	GND	System power ground	
10	NC	NC	
11	VCI	System power supply.(Typ.:2.8V)	
12	VCI	System power supply.(Typ.:2.8V)	
13	VCI	System power supply.(Typ.:2.8V)	
14	VCI	System power supply.(Typ.:2.8V)	
15	NC	NC	
16	GND	System power ground	
17	D0N	MIPI_DSI data Lane0 negative-end input pin.	
18	D0P	MIPI_DSI data Lane0 positive-end input pin.	
19	GND	System power ground	
20	CLKN	Data Input	
21	CLKP	Data Input	
22	GND	System power ground	
23	D1N	MIPI_DSI data Lane1 negative-end input pin.	
24	D1P	MIPI_DSI data Lane1 positive-end input pin.	
25	GND	System power ground	
26	NC	NC	
27	NC	NC	
28	VDD	System power supply.(Typ.:3.3V)	
29	VDD	System power supply.(Typ.:3.3V)	
30	GND	System power ground	

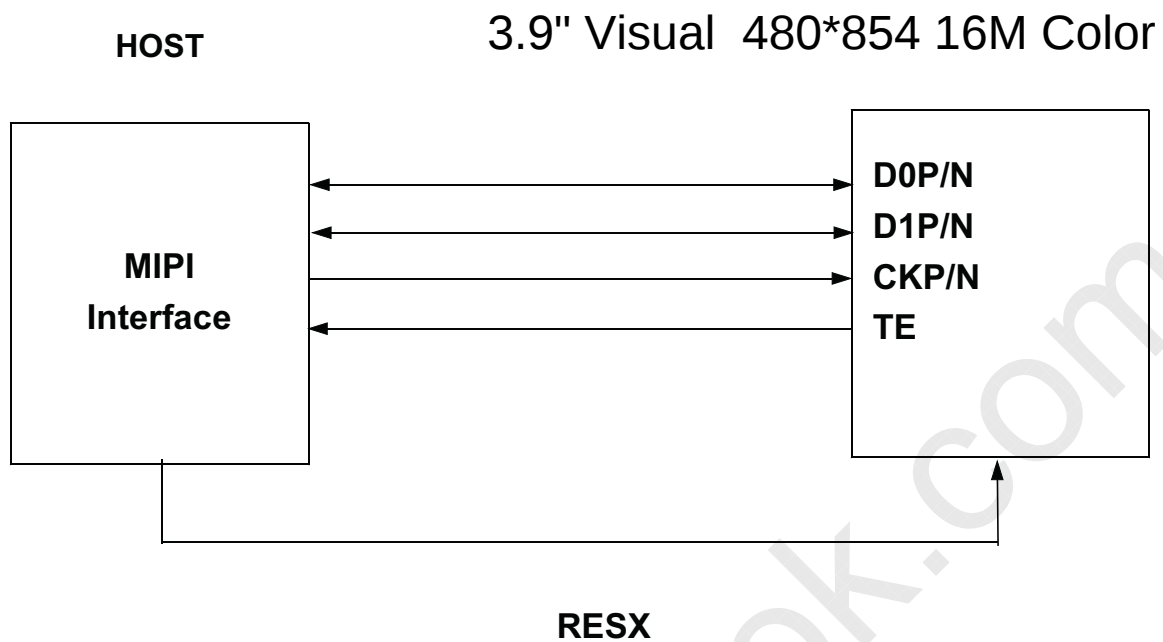
8-2. Circuit block diagram (Module)



8-3. Circuit block diagram (IC)



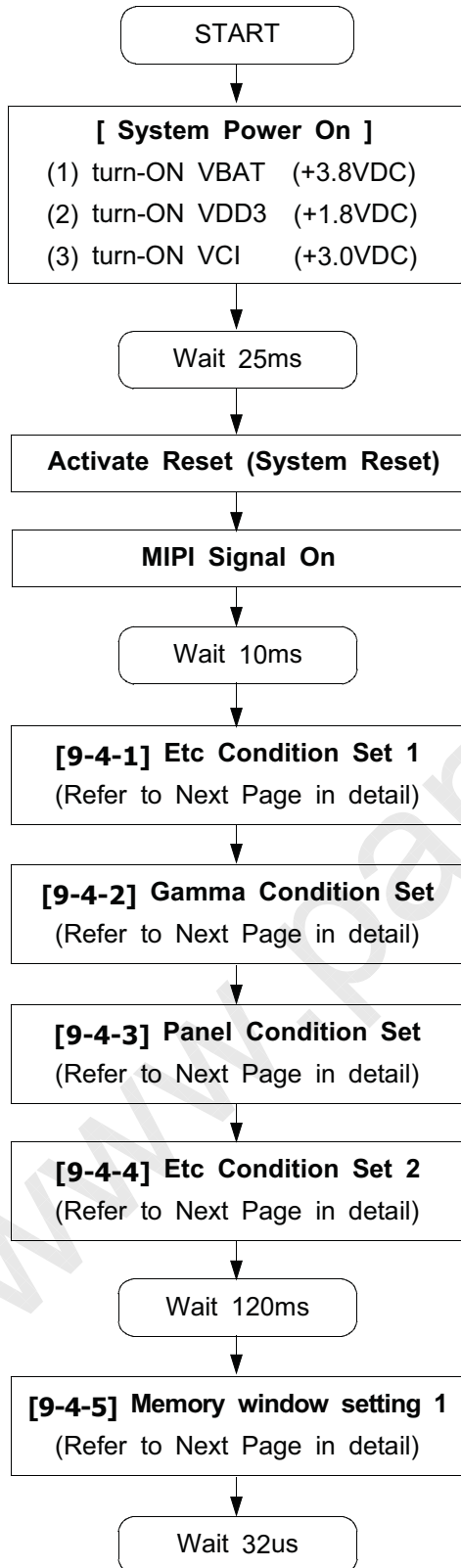
8-4. MIPI Interface



9. Recommended Operating Sequence

9-1. Power ON/OFF sequence

[Power On Sequence]



[9-4-6] Memory window setting 1
(Refer to Next Page in detail)

[9-4-7] ACL 70% Setting
(Refer to Next Page in detail)

Display On Command (29h)

[Power Off Sequence]

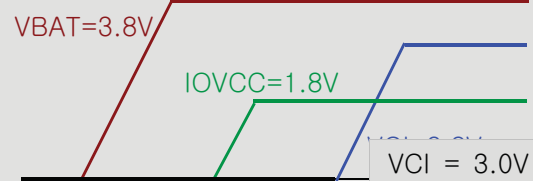
Stand-by Off Command (10h)

Wait 120ms

[System Power On]
(1) turn-OFF VCI (+2.8VDC)
(2) turn-OFF VDD3 (+1.8VDC)
(3) turn-OFF VBAT (+3.8VDC)

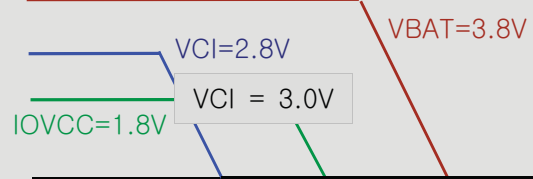
[System Power On Sequence]

VBAT→VDD3→VCI or Simultaneously

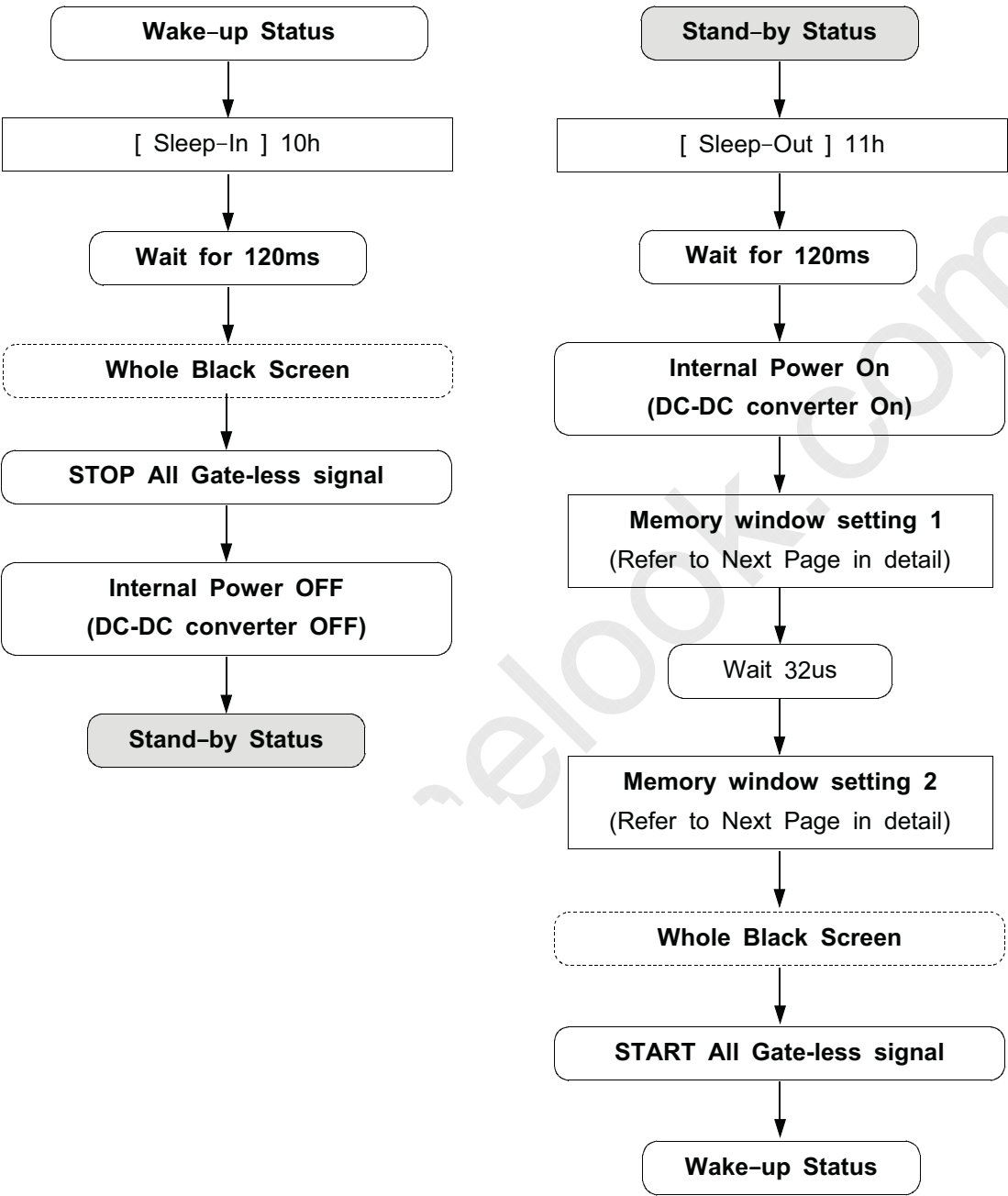


[System Power OFF Sequence]

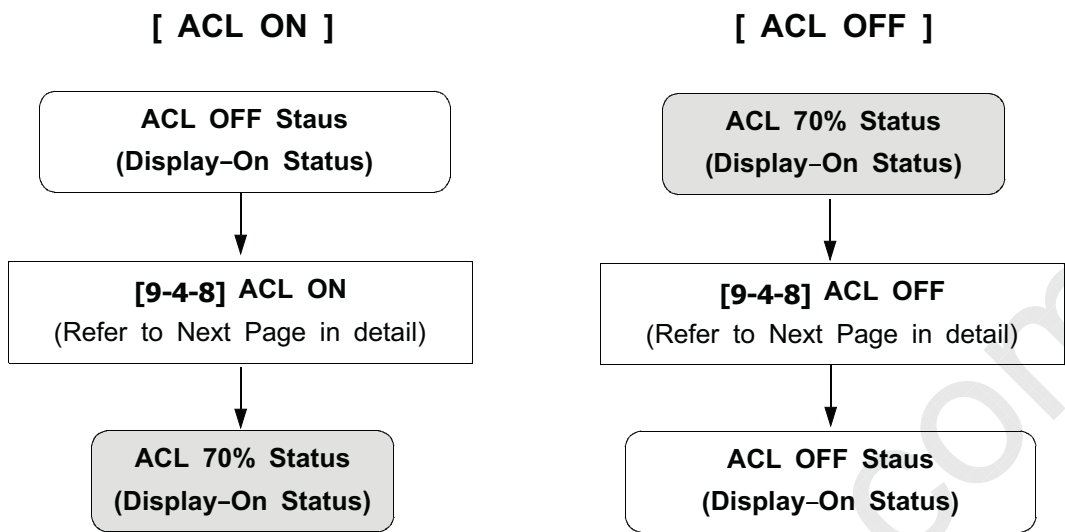
VCI→VDD3→VBAT or Simultaneously



9-2. Stand By/ Wake Up Sequence



9-3. ACL ON / ACL OFF Sequence



9-4.Initial Register Setting

9-4-1.Etc Condition Set 1

Command	Parameter	
F0h	1st	5Ah
	2nd	5Ah
F1h	1st	5Ah
	2nd	5Ah
FCh	1st	5Ah
	2nd	5Ah

9-4-2.Gamma condition set

- to set Gamma : 1) Gamma Setting 2) Gamma Set Update
- After step 2), Gamma is updated.
- Without step 2), Gamma is not updated even though step 1) Gamma setting.
- If want to change the Gamma during display, both step 1) & 2) are needed.

1) Gamma setting

- 2.2 Gamma

Command	Parameter	Brightness							
		300	290	280	270	260	250	240	230
FAh	1st	02	02	02	02	02	02	02	02
	2nd	51	53	55	53	52	53	52	51
	3rd	39	41	3E	3D	3C	3A	39	38
	4th	55	5A	58	58	58	57	58	58
	5th	B0	B0	AC	AE	B0	AE	AF	B0
	6th	C7	C4	C4	C4	C6	C7	C7	C8
	7th	A0	A4	A7	A6	A6	A7	A3	A3
	8th	B0	B0	AF	B1	B1	B1	B1	B1
	9th	C5	C2	C5	C5	C7	C8	C8	C9
	10th	B8	B6	B8	B9	B9	BA	BA	B9
	11th	C2	C2	C1	C2	C2	C2	C3	C3
	12th	CB	CA	CB	CB	CB	CD	CD	CE
	13th	C1	C1	C1	C1	C1	C2	C3	C3
	14th	94	94	94	95	96	95	97	98
	15th	A0	9C	9F	A0	A0	A1	A3	A4
	16th	8F	8C	8E	8E	8F	90	8F	90
	17th	AD	AE	AC	AE	B0	B0	B1	B1
	18th	B3	B2	B2	B4	B6	B7	B7	B8
	19th	A6	A5	A7	A8	A9	A9	AB	AB
	20th	00	00	00	00	00	00	00	00
	21th	E0	DF	DD	D9	D6	D3	CF	CD
	22th	00	00	00	00	00	00	00	00
	23th	D7	D6	D4	D0	CD	CA	C7	C4
	24th	01	01	01	01	00	00	00	00
	25th	08	0A	06	01	FD	FA	F4	F1

Command	Parameter	Brightness							
		220	210	200	190	180	170	160	150
FAh	1st	02	02	02	02	02	02	02	02
	2nd	4F	4F	4F	50	4F	4D	4C	4C
	3rd	38	34	31	2E	28	2A	26	1F
	4th	57	58	57	58	57	58	58	57
	5th	B3	B2	B2	B0	B1	B3	B5	B3
	6th	C6	C9	CB	CD	D0	CE	D0	D5
	7th	A3	9F	A0	9D	9D	9C	99	9C
	8th	B4	B3	B3	B2	B2	B4	B5	B4
	9th	CA	CC	CE	D0	D3	D2	D3	D6
	10th	BB	BA	BB	BB	BB	BB	BB	BB
	11th	C4	C4	C4	C4	C5	C6	C7	C7
	12th	CE	CF	D1	D2	D5	D4	D6	D8
	13th	C3	C3	C4	C3	C5	C4	C5	C6
	14th	99	9A	9B	9A	9B	9B	9C	9E
	15th	A4	A7	A9	A9	AD	AD	B0	B4
	16th	92	91	92	92	94	93	94	96
	17th	B3	B3	B3	B4	B5	B9	B9	B8
	18th	B9	BB	BC	C0	C1	C1	C3	C5
	19th	AB	AC	AD	AE	AD	B1	B0	AF
	20th	00	00	00	00	00	00	00	00
	21th	C9	C6	C3	BF	BB	B7	B4	B0
	22th	00	00	00	00	00	00	00	00
	23th	C0	BD	BA	B6	B2	AF	AB	A7
	24th	00	00	00	00	00	00	00	00
	25th	ED	E9	E5	E0	DC	D6	D2	CE

Command	Parameter	Brightness							
		140	130	120	110	100	90	80	70
FAh	1st	02	02	02	02	02	02	02	02
	2nd	4A	4A	48	47	43	43	3C	38
	3rd	1D	19	00	00	00	00	10	00
	4th	57	58	57	57	58	57	57	56
	5th	B5	B6	B7	B9	BD	BD	C6	C9
	6th	D4	D7	E5	E3	E2	E1	D3	DD
	7th	98	95	95	93	90	91	90	94
	8th	B6	B7	B9	BA	BC	BB	C0	C2
	9th	D7	D8	DE	DE	DE	DC	D7	D9
	10th	BB	BA	BA	B9	B6	B3	B1	AC
	11th	C8	C8	CA	C9	CC	CD	D0	D3
	12th	D9	DB	E2	E2	E2	E3	E2	E6
	13th	C6	C6	C8	C9	C8	CA	CA	CE
	14th	A0	9F	A2	A4	A6	A7	AB	AE
	15th	B5	B7	C0	C1	C2	C4	BF	C5
	16th	96	96	97	98	99	9B	9B	9D
	17th	B9	BA	BE	BC	C0	C0	C4	C6
	18th	C7	C9	CE	D0	D1	D1	CF	D4
	19th	B2	B4	B5	B3	B4	B5	B8	B9
	20th	00	00	00	00	00	00	00	00
	21th	AC	AA	A1	9F	9A	95	90	8A
	22th	00	00	00	00	00	00	00	00
	23th	A3	A0	9B	96	92	8D	88	82
	24th	00	00	00	00	00	00	00	00
	25th	C8	C3	BC	B9	B3	AD	A6	9F

Hong Kong Panox Electronics

2) Gamma setting Update

Command	Parameter		Description
FAh	1st	03h	Gamma set update enable

9-4-3. Panel Condition Set

Command	Parameter		Description
F8h	1st	27h	CLWEA
	2nd	27h	CLWEB
	3rd	08h	CLTE
	4th	08h	SHE
	5th	4Eh	FLTE
	6th	AAh	FLWE
	7th	5Eh	SCTE
	8th	8Ah	SCWE
	9th	10h	INTE
	10th	3Fh	INWE
	11th	10h	EMPS
	12th	10h	E_INTE
	13th	00h	E_INWE

9-4-4. Etc Condition Set 2

Command	Parameter	
F6h	1st	00h
	2nd	84h
	3rd	09h

Command	Parameter	
B0h	1st	09h

Command	Parameter	
D5h	1st	64h

Command	Parameter	
B0h	1st	0Bh

Command	Parameter	
D5h	1st	A4h
	2nd	7Eh
	3rd	20h

Command	Parameter	
F7h	1st	03h

(Panel direction setting)

Command	Parameter	
B0h	1st	02h

Command	Parameter	
B3h	1st	C3h

(GRAM direction setting)

Command	Parameter	
B0h	1st	08h

Command	Parameter	
FDh	1st	F8h

Command	Parameter	
B0h	1st	04h

Command	Parameter	
F2h	1st	4Dh

Command	Parameter	
B0h	1st	05h

Command	Parameter	
FDh	1st	1Fh

Command	Parameter	
B1h	1st	01h
	2nd	00h
	3rd	16h

Command	Parameter	
B2h	1st	08h
	2nd	08h
	3rd	08h
	4th	08h

Command	Parameter	
11h	-	-

(sleep out)

9-4-5. Memory window setting 1

Command	Parameter	
2Ah	1st	00h
	2nd	00h
	3rd	02h
	4th	57h

Command	Parameter	
2Bh	1st	00h
	2nd	00h
	3rd	03h
	4th	FFh

(Memory window size = 600*1024)

Command	Parameter		Description
2Ch or 3Ch	1st~Nth	00h	Black data write

9-4-6. Memory window setting 2

Command	Parameter	
35h	1st	-

(TE ON)

Command	Parameter	
2Ah	1st	00h
	2nd	1Eh
	3rd	02h
	4th	39h

Command	Parameter	
2Bh	1st	00h
	2nd	00h
	3rd	03h
	4th	BFh

(Memory window size = 540*960)

Command	Parameter	
D1h	1st	8Ah

(VINIT : 2.0V)

9-4-7. ACL Control Setting 70%

Command	Parameter	
C1h	1st	47h
	2nd	53h
	3rd	13h
	4th	53h
	5th	00h
	6th	00h
	7th	01h
	8th	DFh
	9th	00h
	10th	00h
	11th	03h
	12th	1Fh
	13th	00h
	14th	00h
	15th	00h
	16th	00h
	17th	00h
	18th	01h
	19th	02h
	20th	03h
	21th	07h
	22th	0Eh
	23th	14h
	24th	1Ch
	25th	24h
	26th	2Dh
	27th	2Dh
	28th	00h

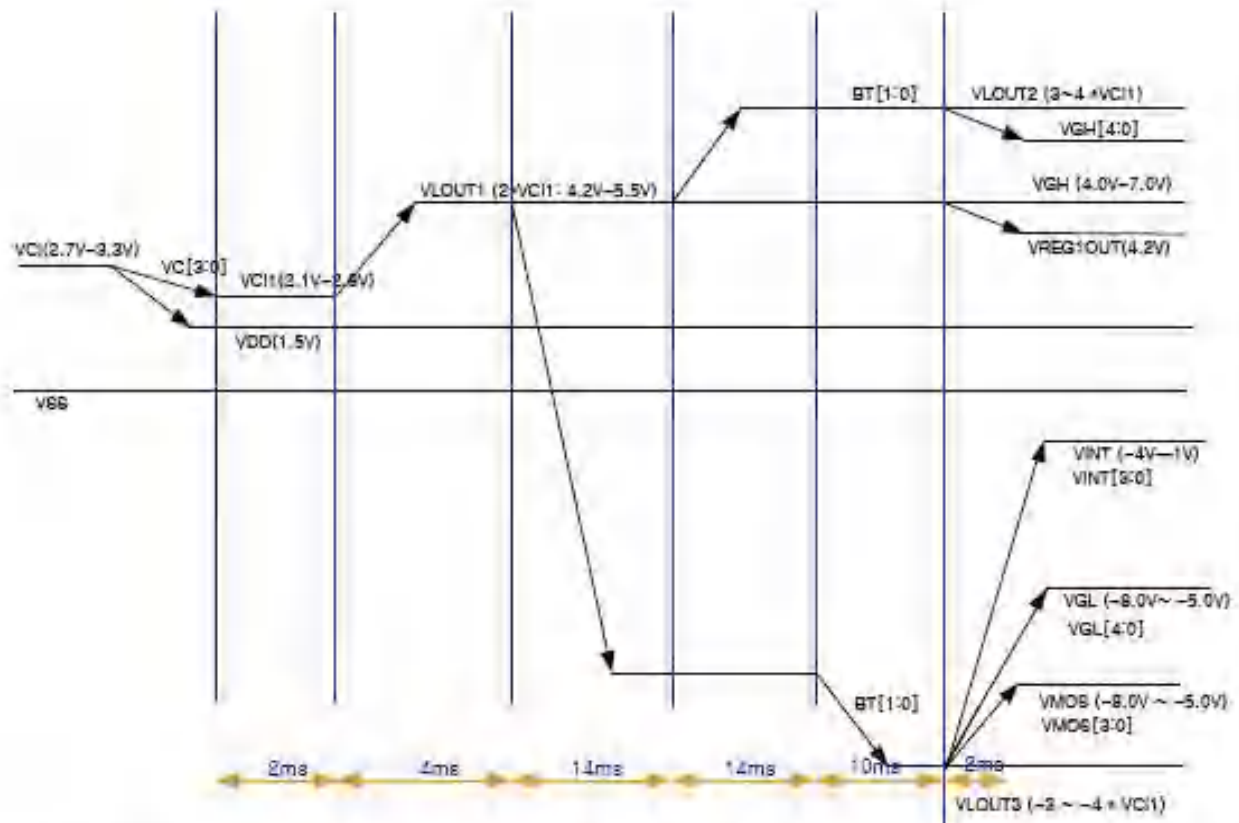
9-4-8. ACL ON/OFF**1) ACL ON**

Command	Parameter	
C0h	1st	01h

2) ACL OFF

Command	Parameter	
C0h	1st	00h

9-5. Power Supply pattern Diagram



Note:

Adjust the conditions of $(VOUT1 - VREG1OUT) > 0.5V$, $(VOUT2 - VGH) > 1.0V$, $(VINT - VOUT3) > 1.0V$, $(VGL - VOUT3) > 1.0V$, and $(VMOS - VOUT3) > 1.0V$, with loads because they differ depending on the display load to driven.
S6E3BA0 has to used in $(VOUT2 - VOUT3) < 20V$ range.

10-1. MIPI Interface

(W[3])	(W[2])	(W[1])	(W[0])	Interface
1	1	1	1	MIF operation for Z lane
Other cases				Setting disable

TX

Init Master

HS-Prpr LP-00

HS-Rqst LP-01

Stop LP-11

LP-Rqst LP-10

SoT

HST

EoT

Turnaround LP-00>10>00>10

Escape Mode

Trigger

ULP

LPDT

RX

Init Slave

HS-Prpr LP-00

HS-Rqst LP-01

Stop LP-11

LP-Rqst LP-10

SoT

HST

EoT

Turnaround LP-00>10>00>10

Escape Mode

Trigger

ULP

Wait

LPDT

The diagram illustrates the timing sequence for a 1-Wire bus. It shows the relationship between the bus voltage (V_{bus}), the data pin (Dp/Dn), and the internal capture circuitry. Key timing parameters include:

- T_{bus} : Bus delay time.
- $T_{transmit}$: Transmit time.
- T_{wait} : Wait time.
- $T_{capture}$: Capture time.
- T_{hold} : Hold time.
- $T_{disconnect}$: Disconnect time.
- T_{bus-1} : Bus time for the first data bit.
- T_{bus-2} : Bus time for the second data bit.
- T_{bus-3} : Bus time for the third data bit.
- T_{bus-4} : Bus time for the fourth data bit.
- T_{bus-5} : Bus time for the fifth data bit.
- T_{bus-6} : Bus time for the sixth data bit.
- T_{bus-7} : Bus time for the seventh data bit.
- T_{bus-8} : Bus time for the eighth data bit.
- T_{bus-9} : Bus time for the ninth data bit.
- T_{bus-10} : Bus time for the tenth data bit.
- T_{bus-11} : Bus time for the eleventh data bit.
- T_{bus-12} : Bus time for the twelfth data bit.
- T_{bus-13} : Bus time for the thirteenth data bit.
- T_{bus-14} : Bus time for the fourteenth data bit.
- T_{bus-15} : Bus time for the fifteenth data bit.
- T_{bus-16} : Bus time for the sixteenth data bit.
- T_{bus-17} : Bus time for the seventeenth data bit.
- T_{bus-18} : Bus time for the eighteenth data bit.
- T_{bus-19} : Bus time for the nineteenth data bit.
- T_{bus-20} : Bus time for the twentieth data bit.
- T_{bus-21} : Bus time for the twenty-first data bit.
- T_{bus-22} : Bus time for the twenty-second data bit.
- T_{bus-23} : Bus time for the twenty-third data bit.
- T_{bus-24} : Bus time for the twenty-fourth data bit.
- T_{bus-25} : Bus time for the twenty-fifth data bit.
- T_{bus-26} : Bus time for the twenty-sixth data bit.
- T_{bus-27} : Bus time for the twenty-seventh data bit.
- T_{bus-28} : Bus time for the twenty-eighth data bit.
- T_{bus-29} : Bus time for the twenty-ninth data bit.
- T_{bus-30} : Bus time for the thirtieth data bit.
- T_{bus-31} : Bus time for the thirty-first data bit.
- T_{bus-32} : Bus time for the thirty-second data bit.
- T_{bus-33} : Bus time for the thirty-third data bit.
- T_{bus-34} : Bus time for the thirty-fourth data bit.
- T_{bus-35} : Bus time for the thirty-fifth data bit.
- T_{bus-36} : Bus time for the thirty-sixth data bit.
- T_{bus-37} : Bus time for the thirty-seventh data bit.
- T_{bus-38} : Bus time for the thirty-eighth data bit.
- T_{bus-39} : Bus time for the thirty-ninth data bit.
- T_{bus-40} : Bus time for the fortieth data bit.
- T_{bus-41} : Bus time for the forty-first data bit.
- T_{bus-42} : Bus time for the forty-second data bit.
- T_{bus-43} : Bus time for the forty-third data bit.
- T_{bus-44} : Bus time for the forty-fourth data bit.
- T_{bus-45} : Bus time for the forty-fifth data bit.
- T_{bus-46} : Bus time for the forty-sixth data bit.
- T_{bus-47} : Bus time for the forty-seventh data bit.
- T_{bus-48} : Bus time for the forty-eighth data bit.
- T_{bus-49} : Bus time for the forty-ninth data bit.
- T_{bus-50} : Bus time for the fiftieth data bit.
- T_{bus-51} : Bus time for the fifty-first data bit.
- T_{bus-52} : Bus time for the fifty-second data bit.
- T_{bus-53} : Bus time for the fifty-third data bit.
- T_{bus-54} : Bus time for the fifty-fourth data bit.
- T_{bus-55} : Bus time for the fifty-fifth data bit.
- T_{bus-56} : Bus time for the fifty-sixth data bit.
- T_{bus-57} : Bus time for the fifty-seventh data bit.
- T_{bus-58} : Bus time for the fifty-eighth data bit.
- T_{bus-59} : Bus time for the fifty-ninth data bit.
- T_{bus-60} : Bus time for the sixtieth data bit.
- T_{bus-61} : Bus time for the sixty-first data bit.
- T_{bus-62} : Bus time for the sixty-second data bit.
- T_{bus-63} : Bus time for the sixty-third data bit.
- T_{bus-64} : Bus time for the sixty-fourth data bit.
- T_{bus-65} : Bus time for the sixty-fifth data bit.
- T_{bus-66} : Bus time for the sixty-sixth data bit.
- T_{bus-67} : Bus time for the sixty-seventh data bit.
- T_{bus-68} : Bus time for the sixty-eighth data bit.
- T_{bus-69} : Bus time for the sixty-ninth data bit.
- T_{bus-70} : Bus time for the seventieth data bit.
- T_{bus-71} : Bus time for the seventy-first data bit.
- T_{bus-72} : Bus time for the seventy-second data bit.
- T_{bus-73} : Bus time for the seventy-third data bit.
- T_{bus-74} : Bus time for the seventy-fourth data bit.
- T_{bus-75} : Bus time for the seventy-fifth data bit.
- T_{bus-76} : Bus time for the seventy-sixth data bit.
- T_{bus-77} : Bus time for the seventy-seventh data bit.
- T_{bus-78} : Bus time for the seventy-eighth data bit.
- T_{bus-79} : Bus time for the seventy-ninth data bit.
- T_{bus-80} : Bus time for the eightieth data bit.
- T_{bus-81} : Bus time for the eighty-first data bit.
- T_{bus-82} : Bus time for the eighty-second data bit.
- T_{bus-83} : Bus time for the eighty-third data bit.
- T_{bus-84} : Bus time for the eighty-fourth data bit.
- T_{bus-85} : Bus time for the eighty-fifth data bit.
- T_{bus-86} : Bus time for the eighty-sixth data bit.
- T_{bus-87} : Bus time for the eighty-seventh data bit.
- T_{bus-88} : Bus time for the eighty-eighth data bit.
- T_{bus-89} : Bus time for the eighty-ninth data bit.
- T_{bus-90} : Bus time for the ninetieth data bit.
- T_{bus-91} : Bus time for the ninety-first data bit.
- T_{bus-92} : Bus time for the ninety-second data bit.
- T_{bus-93} : Bus time for the ninety-third data bit.
- T_{bus-94} : Bus time for the ninety-fourth data bit.
- T_{bus-95} : Bus time for the ninety-fifth data bit.
- T_{bus-96} : Bus time for the ninety-sixth data bit.
- T_{bus-97} : Bus time for the ninety-seventh data bit.
- T_{bus-98} : Bus time for the ninety-eighth data bit.
- T_{bus-99} : Bus time for the ninety-ninth data bit.
- $T_{bus-100}$: Bus time for the hundredth data bit.

TCLK-TRAIL	Time to drive HS differential state after last payload clock bit of a HS transmission burst	60	-	-		
TCLK-TRAIL	Minimum lead HS-0 drive period before starting clock	300	-	-		
TEOT	Time from start of THS-TRAIL or TCLK-TRAIL period to start of LP-11 state	-	-	105ns+n x12xUI		
THS-EXIT	Time from start of THS-TRAIL or TCLK-TRAIL period to start of LP-11 state	100	-	-		
THS-PREPARE	Time to drive LP-00 to prepare for HS transmission	40ns + 4 x UI	-	85ns + 6 xUI		
THS-PREPARE +THS-ZERO	THS-PREPARE + Time to drive HS-0 before the Sync sequence	145ns +10 xUI	-	-		
THS-SETTLE	Time interval during which the HS receiver shall ignore any data lane HS transitions. starting from the beginning of THS-PREPARE	85ns + 6x UI	-	145ns + 10 x UI		
THS-SKIP	Time-out at RX to ignore transition period of EoT	40	-	55ns +4 x UI		
THS-TRAIL	Time to drive flipped differential state after last payload data bit of a HS tranmission burst	Max (n x 8x UI, 60ns + x4 xUI)				(3) (4)
TINIT	Initialization period	100	-	-	us	
TLPX	Length of any low-power state period	75	83.3	91.7	ns	(5)
Ratio TLPX	Ratio of TLPX (MASTER)/TLPX(SLAVE) between Master and Slave side	2/3	-	3/2		
TTA-GET	Time to drive LP-00 by new TX	5 x TLPX			ns	
TTA-GO	Time to drive LP-00 after turnaround request	4 x TLPX				
TTA-SURE	Time-out before new TX side starts driving	TLPX	-	2xTLPX		
TWAKEUP	Time that a transmitter drives a Mark-1 state prior to a Stop state in order to initiate an ex it from ULPS	1	-	-	ms	

Note (1) : the minimum value depends on the bit rate. Implementations should ensure proper operation for all the supported bit rates.

Note (2) : UI is the instantaneous unit interval.

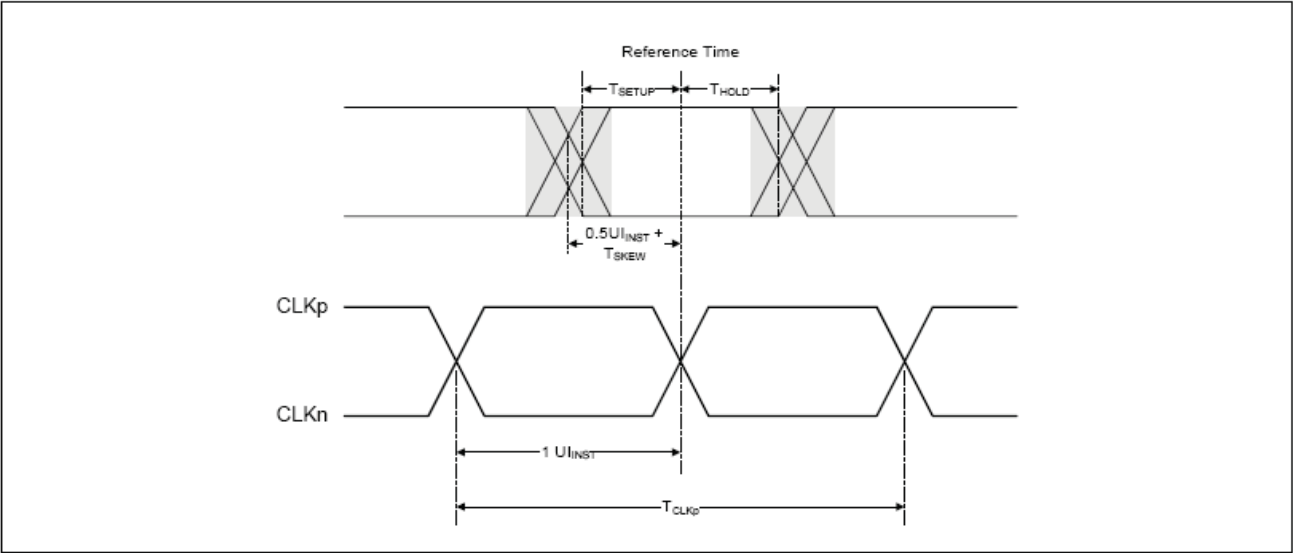
Note (3) : If $a > b$ then $\max(a,b) = a$. otherwise $\max(a,b) = b$

Note (4) : Where $n=1$ for Forward-direction HS mode and $n=4$ for reverse-direction HS mode

Note (5) : TLPX is an internal state machine timing reference. Externally measured values may differ slightly from the specified values due to asymmetrical rise and fall times.

10-1-6. AC characteristics (High Speed Data-clock Timing)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Data to clock skew (Measured at transmitter)	TSKEW (TX)	-0.15	-	0.15	UNINST	(1)
Data to clock setup time (Receiver)	TSETUP (RX)	0.15	-	-	UNINST	(2)
Clock to data hold time (Receiver)	THOLD (RX)	0.15	-	-	UNINST	(2)



Note (1) : This value corresponds to a minimum 80mbps data rate.

Note (2) : The minimum UI shall not be violated for any single bit period, i.e., any DDR half cycle within a data burst.

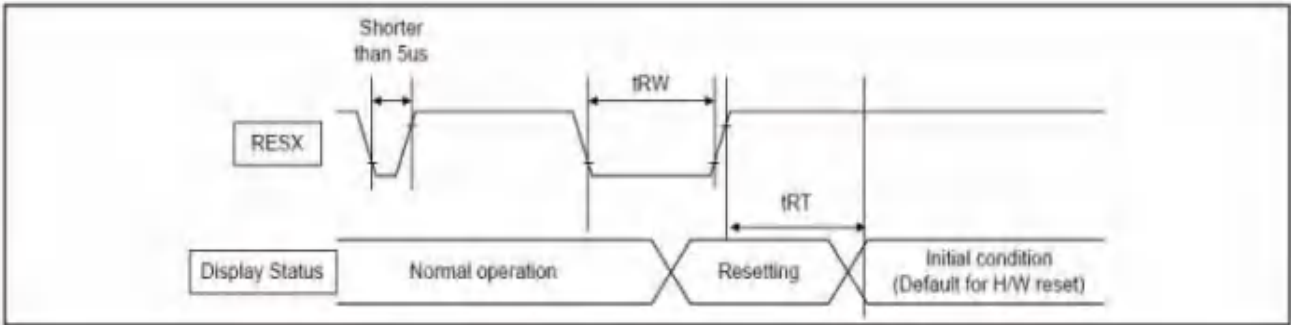
Clock Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
UI instantaneous	UNINST	-0.15	-	0.15	UNINST	(1), (2)

Note (1) : Total silicon and package delay budget of 0.3 x UIINST

Note (2) : Total setup and hold window for receiver of 0.3 x UIINST

10-2. Reset timing

10-2-1. Reset timing



10-2-2. AC characteristics

Signal	Symbol	Parameter	Min	Max	Unit
RESX	t_{RW}	Reset pulse duration	10	-	Us
	t_{RT}	Reset cancel	-	5 (note 1)	Ms
			-	120 (note 2, 3)	ms

Note :

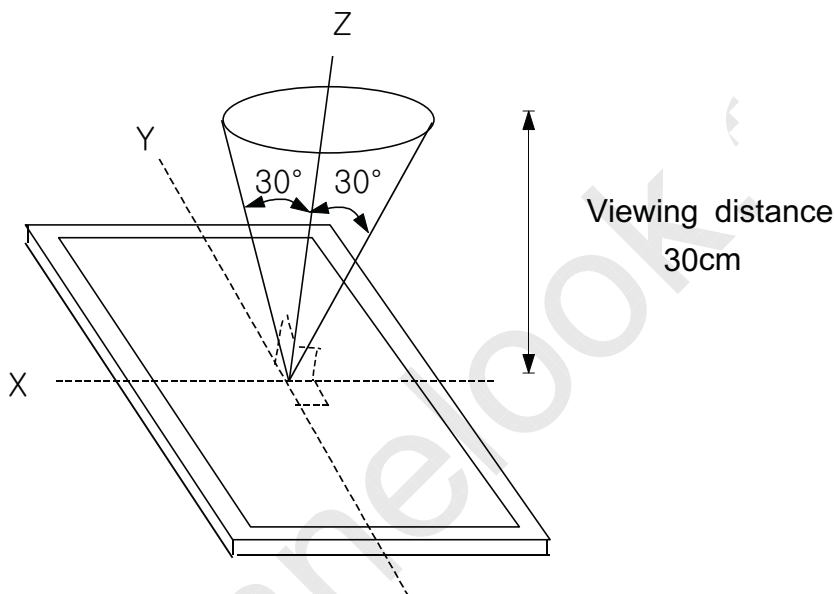
1. When Reset is applied during Sleep In Mode.
2. When Reset is applied during Sleep Out Mode.
3. It is necessary to wait 4 msec after releasing RESX before sending commands, Also Sleep Out command cannot be set out for 120msec.

11. Quality Level

11-1. AMOLED Module of Characteristic Inspection

11-1-1. Environment Condition

- ① Temperature & Humidity
Room temperature : $22 \pm 3^{\circ}\text{C}$
Humidity : $65 \pm 20\% \text{RH}$
- ② Viewing distance : $35\text{cm} \pm 5\text{cm}$
Viewing angle(tolerance) : $\pm 30^{\circ}$



- ③ Ambient light intensity : 800 ~ 1000 lux

11-1-1. Window

The environmental conditions for inspection shall be as follows.

- ① Light source : D65, Bar type 1 Lamp
- ② Ambient light intensity : 800 ~ 1000 lux
- ③ Viewing Distance : $35 \pm 5\text{cm}$
- ④ Viewing angle (tolerance) : the front side $90^{\circ}(\text{Z}) \pm 5^{\circ}$
- ⑤ Viewing Time : $10 \pm 2 \text{ sec}$
- ⑥ Inspection Background : Only Black
- ⑦ Inspection Mode : Only Reflection inspection

11-2. Sampling Procedures for each item's acceptance table

Defect type	Sampling Procedures	AQL
Major Defect	MIL-STD-105D Inspection level I normal inspection single sample inspection	0.65
Minor Defect	MIL-STD-105D Inspection level I normal inspection single sample inspection	1.5

① Major defect

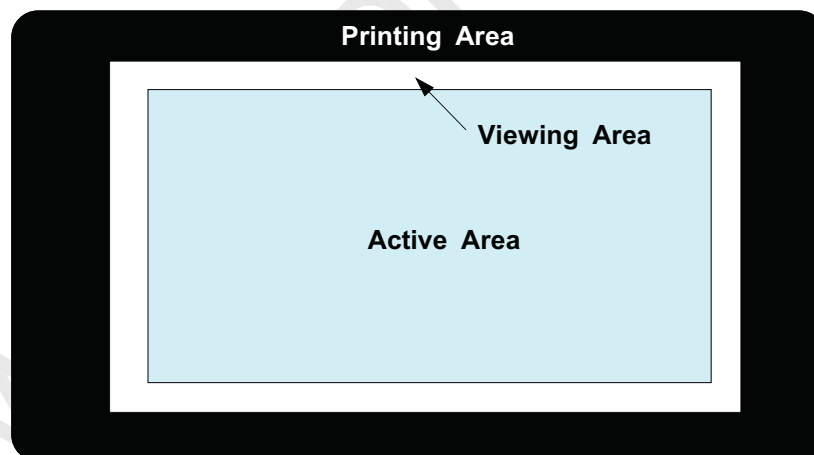
: A major defect refers to a defect which may substantially degrade usability for product applications.

② Minor defect

: A minor defects refers to a defect which is not considered to substantially degrade product application, or a defect which deviates from existing standards almost unrelated to the effective use of the product or its operation.

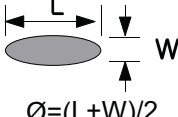
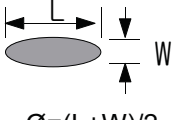
③ Determination of inspection area : Active Area + Viewing Area

Defect in "Out of Viewing Area" Zone should not be judged.



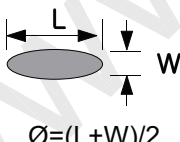
11-3. Inspection Item

11-3-1. Panel

No.	Item	Criterion of Defect		Type																		
1	No Display	Not allowance		Major																		
2	Irregular operating	Not allowance		Major																		
3	Dot Defect	<table><tr><th colspan="2">Defect</th><th>Acceptable number</th></tr><tr><td colspan="2">Bright Dot</td><td>0</td></tr><tr><td rowspan="3">Dark Dot</td><td>Red</td><td>2</td></tr><tr><td>Green</td><td>2</td></tr><tr><td>Blue</td><td>2</td></tr><tr><td colspan="2">Total Acceptance Number</td><td>2</td></tr></table> - Dark Dot Distance ≤ 20mm	Defect		Acceptable number	Bright Dot		0	Dark Dot	Red	2	Green	2	Blue	2	Total Acceptance Number		2	Minor			
Defect		Acceptable number																				
Bright Dot		0																				
Dark Dot	Red	2																				
	Green	2																				
	Blue	2																				
Total Acceptance Number		2																				
4	Polarizer Dent / Bubble  Ø=(L+W)/2	<table><tr><th>Size Ø (mm)</th><th>Acceptable number</th></tr><tr><td>Ø ≤ 0.20</td><td>Ignore</td></tr><tr><td>0.20 < Ø ≤ 0.50</td><td>3</td></tr><tr><td>0.50 < Ø ≤ 0.80</td><td>2</td></tr><tr><td>0.80 < Ø</td><td>0</td></tr></table>	Size Ø (mm)	Acceptable number	Ø ≤ 0.20	Ignore	0.20 < Ø ≤ 0.50	3	0.50 < Ø ≤ 0.80	2	0.80 < Ø	0	Minor									
Size Ø (mm)	Acceptable number																					
Ø ≤ 0.20	Ignore																					
0.20 < Ø ≤ 0.50	3																					
0.50 < Ø ≤ 0.80	2																					
0.80 < Ø	0																					
5	Dark / Bright Spots (Foreign Material)  Ø=(L+W)/2	<table><tr><th>Size Ø (mm)</th><th>Acceptable number</th></tr><tr><td>Ø ≤ 0.15</td><td>Ignore</td></tr><tr><td>0.15 < Ø ≤ 0.25</td><td>2</td></tr><tr><td>0.25 < Ø</td><td>0</td></tr></table>	Size Ø (mm)	Acceptable number	Ø ≤ 0.15	Ignore	0.15 < Ø ≤ 0.25	2	0.25 < Ø	0	Major											
Size Ø (mm)	Acceptable number																					
Ø ≤ 0.15	Ignore																					
0.15 < Ø ≤ 0.25	2																					
0.25 < Ø	0																					
6	Polarizer Scratch / Fiber(Linear) 	<table><tr><th>Width (mm)</th><th>Length (mm)</th><th>Acceptable number</th></tr><tr><td>W ≤ 0.03</td><td>Ignore</td><td>Ignore</td></tr><tr><td rowspan="2">0.03 < W ≤ 0.05</td><td>L ≤ 2.0</td><td>Ignore</td></tr><tr><td>2.0 < L ≤ 5.0</td><td>2</td></tr><tr><td rowspan="2">0.05 < W ≤ 0.08</td><td>L ≤ 1.0</td><td>Ignore</td></tr><tr><td>1.0 < L ≤ 5.0</td><td>2</td></tr><tr><td>0.08 < W</td><td>-</td><td>0</td></tr></table>	Width (mm)	Length (mm)	Acceptable number	W ≤ 0.03	Ignore	Ignore	0.03 < W ≤ 0.05	L ≤ 2.0	Ignore	2.0 < L ≤ 5.0	2	0.05 < W ≤ 0.08	L ≤ 1.0	Ignore	1.0 < L ≤ 5.0	2	0.08 < W	-	0	Major
Width (mm)	Length (mm)	Acceptable number																				
W ≤ 0.03	Ignore	Ignore																				
0.03 < W ≤ 0.05	L ≤ 2.0	Ignore																				
	2.0 < L ≤ 5.0	2																				
0.05 < W ≤ 0.08	L ≤ 1.0	Ignore																				
	1.0 < L ≤ 5.0	2																				
0.08 < W	-	0																				
7	Discoloration / Panel Stain	Ignore If its limit sample is needed, it can be fixed mutually with a customer.	Major																			
8	WAD (White angular dependency)	Ignore If its limit sample is needed, it can be fixed mutually with a customer.	Major																			

No.	Item	Criterion of Defect	Type																		
9	Glass Chipping   [Pad area]	These criteria are applied to all corners of panel glass (unit : mm) <table><tr><td></td><td>Z</td><td>X</td><td>Y</td></tr><tr><td>Non-pad area</td><td>≤ t</td><td>≤ 1.0</td><td>≤ 1.0</td></tr><tr><td>Pad area</td><td>≤ t</td><td>≤ 2.0</td><td>≤ 1.2</td></tr></table> * Pad means the contact edge, overhung single glass part		Z	X	Y	Non-pad area	≤ t	≤ 1.0	≤ 1.0	Pad area	≤ t	≤ 2.0	≤ 1.2	Major						
		Z	X	Y																	
	Non-pad area	≤ t	≤ 1.0	≤ 1.0																	
Pad area	≤ t	≤ 2.0	≤ 1.2																		
	These criteria are applied to all side edges of panel glass (unit : mm) <table><tr><td>Z</td><td>X</td><td>Y</td></tr><tr><td>≤ t</td><td>≤ 2.0</td><td>≤ 0.5</td></tr></table>	Z	X	Y	≤ t	≤ 2.0	≤ 0.5	Major													
Z	X	Y																			
≤ t	≤ 2.0	≤ 0.5																			
 [Front]  [Opposite]	These criteria are applied to only sides of pad area of panel glass (unit : mm) <table><tr><td colspan="2"></td><td>Z</td><td>X</td><td>Y</td></tr><tr><td rowspan="2">Pad front side</td><td>Near Pattern</td><td>≤ t</td><td>≤ 5.0</td><td>≤ 0.4</td></tr><tr><td>No Pattern</td><td>≤ t</td><td>≤ 5.0</td><td>≤ 0.5</td></tr><tr><td colspan="2">Pad opposite side</td><td>≤ t</td><td>≤ 5.0</td><td>≤ 0.6</td></tr></table>			Z	X	Y	Pad front side	Near Pattern	≤ t	≤ 5.0	≤ 0.4	No Pattern	≤ t	≤ 5.0	≤ 0.5	Pad opposite side		≤ t	≤ 5.0	≤ 0.6	Major
		Z	X	Y																	
Pad front side	Near Pattern	≤ t	≤ 5.0	≤ 0.4																	
	No Pattern	≤ t	≤ 5.0	≤ 0.5																	
Pad opposite side		≤ t	≤ 5.0	≤ 0.6																	

11-3-2. Window

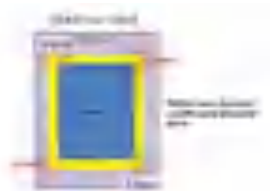
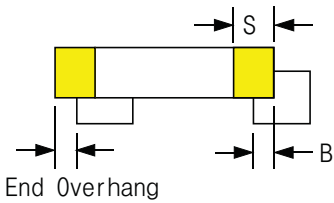
No.	Item	Criterion of Defect		Type
1	Window Black/White Spots (Circular Foreign Material)  Ø=(L+W)/2	Size Ø (mm)	Acceptable number	
			V/A	Ouf of V/A (BM area)
		Ø ≤ 0.15	Ignore	Ignore
		0.15 < Ø ≤ 0.25	2	2
		0.25 < Ø	0	0
		Note : In case a foreign material is removed with a soft cloth, it is ignored.		
2	Window Dent / Bubble	Size Ø (mm)	Acceptable number	
			V/A	Ouf of V/A (BM area)
		Ø ≤ 0.15	Ignore	Ignore
		0.15 < Ø ≤ 0.25	2	2
		0.25 < Ø	0	0

No.	Item	Criterion of Defect			Type		
3	Window Scratch 	Width (mm)	Length (mm)	Acceptable number	Major		
		$W \leq 0.03$	Ignore	Ignore			
		$0.03 < W \leq 0.05$	$L \leq 2.0$	Ignore			
			$2.0 < L \leq 5.0$	1			
		$0.05 < W \leq 0.08$	$L \leq 1.0$	Ignore			
			$1.0 < L \leq 4.0$	1			
		$0.08 < W$	Apply to Dent/Bubble	–			
4	Window (Line-shaped Foreign Material)	Width (mm)	Length (mm)	Acceptable number	Major		
		$W \leq 0.03$	Ignore	Ignore			
		$0.03 < W \leq 0.05$	$L \leq 2.0$	Ignore			
			$2.0 < L \leq 5.0$	1			
		$0.05 < W \leq 0.08$	$L \leq 1.0$	Ignore			
			$1.0 < L \leq 4.0$	1			
		$0.08 < W$	Apply to Spots (Circular Foreign Material)	–			
5	Window Chipping 				Major		
			X	Y		Z	Acceptable number
		Front	$X \leq 1.0$	$Y \leq 0.35$			Total 2
		Side/Corner/Back	$X \leq 1.0$	$Y \leq 0.16$		$Z \leq 1/2t$	
6	Window Printing Defect 	Location	Size	Acceptable Number	Major		
		Printing Inside	$D \leq 0.1$	Ignore			
			$0.1 \leq D \leq 0.2$	2			
			$D > 0.2$	0			
		Printing Outside	$Y \leq 0.1$	Ignore			
			$X \leq 1.5, 0.1 < Y \leq 0.15$	1			
			$X > 1.5, \text{ or } Y > 0.15$	0			
		[Inside]				[Outside]	
							
		$D = (X + Y) / 2$					
Note : These criteria are applied to each side							

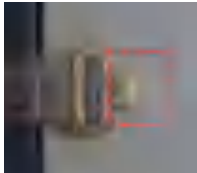
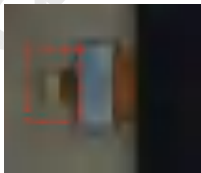
No.	Item	Criterion of Defect	Type																						
7	Window Logo Area Printing Defect	<table><tr><th>Size (mm)</th><th>Spec</th><th>Acceptable Number</th></tr><tr><td>Logo printing width > 1mm</td><td>within 1/10</td><td>Ignore</td></tr><tr><td>0.5mm < Logo Printing width ≤ 1mm</td><td>within 1/5</td><td>Ignore</td></tr><tr><td>Logo Printing width ≤ 0.5mm</td><td>Not disconnected</td><td>Ignore</td></tr></table>	Size (mm)	Spec	Acceptable Number	Logo printing width > 1mm	within 1/10	Ignore	0.5mm < Logo Printing width ≤ 1mm	within 1/5	Ignore	Logo Printing width ≤ 0.5mm	Not disconnected	Ignore	Major										
Size (mm)	Spec	Acceptable Number																							
Logo printing width > 1mm	within 1/10	Ignore																							
0.5mm < Logo Printing width ≤ 1mm	within 1/5	Ignore																							
Logo Printing width ≤ 0.5mm	Not disconnected	Ignore																							
8	Window Icon Foreign Material	<table><tr><th>Size (mm)</th><th>Acceptable Number</th></tr><tr><td>Φ≤0.2</td><td>1</td></tr><tr><td>0.2<Φ</td><td>0</td></tr></table> Note) Light intensity : 400Lux Apply to each icon at transmitted inspection mode	Size (mm)	Acceptable Number	Φ≤0.2	1	0.2<Φ	0	Major																
Size (mm)	Acceptable Number																								
Φ≤0.2	1																								
0.2<Φ	0																								
9	Window Camera Hole	Foreign material/Stain/Scratch/Printing defects 1) Not allowed at Camera Hole center area 2) Allowed at Edge Area Printing Face : within 0.15mm stain Print defect Print defect	Major																						
10	Window IR Sensor Area	<table><tr><th></th><th>Defect Mode</th><th>Size (mm)</th><th>Acceptable Number</th></tr><tr><td>1</td><td>Pinhole</td><td>Φ≤0.15</td><td>1</td></tr><tr><td rowspan="2">2</td><td rowspan="2">Black Foreign Material</td><td>Φ≤0.1</td><td>Ignore</td></tr><tr><td>0.1<Φ≤0.15</td><td>1</td></tr><tr><td>3</td><td>Abnormal Color Stain</td><td>Φ≤0.3</td><td>Ignore</td></tr><tr><td>4</td><td>Printing Inside</td><td>W≤0.5</td><td>Ignore</td></tr></table> Pinhole Black foreign material Abnormal color stain Inside		Defect Mode	Size (mm)	Acceptable Number	1	Pinhole	Φ≤0.15	1	2	Black Foreign Material	Φ≤0.1	Ignore	0.1<Φ≤0.15	1	3	Abnormal Color Stain	Φ≤0.3	Ignore	4	Printing Inside	W≤0.5	Ignore	Major
	Defect Mode	Size (mm)	Acceptable Number																						
1	Pinhole	Φ≤0.15	1																						
2	Black Foreign Material	Φ≤0.1	Ignore																						
		0.1<Φ≤0.15	1																						
3	Abnormal Color Stain	Φ≤0.3	Ignore																						
4	Printing Inside	W≤0.5	Ignore																						

No.	Item	Criterion of Defect	Type
11	Surface Contamination	There should be no surface contamination which cannot be removed when being cleaned with a soft cloth.	Major
12	Icon Color Variation (Transparency)	If its limit sample is needed, it can be fixed mutually with a customer.	Major
13	IR Color Variation (Transparency)	If its limit sample is needed, it can be fixed mutually with a customer.	Major

11-3-3. Other

No.	Item	Criterion of Defect		Type
1	Lamination	Resin cleaning marks (no height difference)	Allowed	Major
		Resin overflow /residues	0.5mm allowed from each edge of a panel 	
		Resin bubble	Not allowed. (If its limit sample is needed, it can be fixed mutually.) 	
		Resin non-application (under viewing/active area)	Not allowed	
		Resin Vertical Pit	Not allowed	
2	FPCA SMT(Soldering)	(1) No polarity opposition (2) No wrong insertion		Major
3	FPCA Solder Short	Short of proximity pattern and land is defect		Major
4	FPCA Solder Crack	There should be no crack which gives an effect to quality of the display		Major
5	FPCA End Overhang	The size above 1/2 of soldering electrode of the parts overhang to the LAND is prohibited (but, contacting near other components is prohibited.) 		Major
6	FPCA Solder Ball	Not allowed if ($\Phi > 150\mu\text{m}$) 		Major

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No.	Item	Criterion of Defect	Type											
7	FPCB (Dent/Scratch)	(1) Open Area : Not allowed if Cu layer exposed. (2) Solder mask Area : Not allowed if Cu layer exposed. (3) Pattern Area : Not allowed if Cu layer exposed. (4) Black shield Area : <table><tr><td>Defect Mode</td><td>Size</td><td>Acceptable Number</td></tr><tr><td>Line shaped</td><td>$L \leq 5\text{mm}$</td><td>Ignore</td></tr><tr><td rowspan="2">Spot / Face Shaped</td><td>$S(\text{Area}) \leq 0.6\text{mm}^2$</td><td>Ignore</td></tr><tr><td>$0.6\text{mm}^2 < S(\text{Area}) < 1.0\text{mm}^2$</td><td>2 Point</td></tr></table>	Defect Mode	Size	Acceptable Number	Line shaped	$L \leq 5\text{mm}$	Ignore	Spot / Face Shaped	$S(\text{Area}) \leq 0.6\text{mm}^2$	Ignore	$0.6\text{mm}^2 < S(\text{Area}) < 1.0\text{mm}^2$	2 Point	Major
Defect Mode	Size	Acceptable Number												
Line shaped	$L \leq 5\text{mm}$	Ignore												
Spot / Face Shaped	$S(\text{Area}) \leq 0.6\text{mm}^2$	Ignore												
	$0.6\text{mm}^2 < S(\text{Area}) < 1.0\text{mm}^2$	2 Point												
8	FPC Tilt Defect	Not allowed	Major											
9	TSP Function NG	Not allowed	Major											
10	Black Tape Bubble	If it's not seen at the front side : allowed.	Major											
11	Black Tape Dent	If it's not seen at the front side : allowed.	Major											
12	window cover film (protect film)	Cover film shall not be located out of the window area. Cover film shall not be torn, made a hole.	Major											
13	Risk point of Connector Section	<table><tr><td></td><td>Criteria</td></tr><tr><td>Tear</td><td>Disallowed</td></tr><tr><td>Wrinkle, S/C, Dent</td><td>If it doesn't give an effect to quality of the display, allowed.</td></tr></table>  <front> <Rear>		Criteria	Tear	Disallowed	Wrinkle, S/C, Dent	If it doesn't give an effect to quality of the display, allowed.	Major					
	Criteria													
Tear	Disallowed													
Wrinkle, S/C, Dent	If it doesn't give an effect to quality of the display, allowed.													

※ Other cosmetic items which are not defined above are allowed, if they are not seen at the front side after assembling phone set.

But, they follow the SMD's criteria, if SMD has one.

12. Reliability

12-1. Environmental test

No	Item	Condition	n	Result	Judgment Criterion
1	High Temperature Operation	70℃/ 240hours	10		1. No clearly visible defects or remarkable deterioration of display quality. However, any polarizer's deteriorations by the high temperature/ High humidity Storage test and the High temperature/ High humidity Operation test are permitted. 2. No function-related abnormalities.
2	Low Temperature Operation	-30℃/ 240hours	10		
3	High Temperature Storage	80℃/ 240hours	5		
4	Low Temperature Storage	-40℃/ 240hours	5		
5	High Temperature Humidity Operation	60℃/90%RH/ 240hours	5		
6	Thermal Shock	-40℃~85℃ / 100cycles	5		

Note) The results must be measured after 2 hours later under room temperature keeping.

12-2. Mechanical test

No	Item	Condition	n	Result	Judgment Criterion
1	3-PB (Glass)	X,Y Direction UP Loading speed:5mm/min	6		The intension of the glass should be More than 50Mpa for every sample

Note) Calculate the Intension of the glass formula : $\sigma_f = \frac{3PL}{2bh^2}$

12-3. Other test

No.	Item	Condition	n	Result	Judgment Criterion
1	ESD	Contact: $\pm 6\text{kV}$, $150\text{pF}/330\Omega$, 2times, 5Point, Power off Air: $\pm 8\text{kV}$, $150\text{pF}/330\Omega$, 2times, 5Point, Power off 	10		No functional defects

13. Handling Precautions

13-1. Mounting Method

The AMOLED panel of SAMSUNG Mobile Display CO.,LTD. module consists of two slim glasses with polarizer which can easily get damaged. Since the module is constructed as to be fixed by utilizing fitting holes in the printed circuit board. Extreme care should be used when handling the AMOLED modules.

13-2. Caution of AMOLED Handling and Cleaning

When cleaning the display surface, use soft cloth solvent as recommended below and wipe gently.

- ⊙ Isopropyl alcohol
- ⊙ Ethyl alcohol
- ⊙ Trichlorotrifluoroethane

Do not wipe the display surface with dry or hard materials that will damage the polarizer surface. Do not use the following solvent.

- ⊙ Water
- ⊙ Ketone
- ⊙ Aromatics

Do not wipe ITO pad area with the dry or hard materials that will damage the ITO patterns.

Do not use the following solvent on the pad and prevent it from being contaminated.

- ⊙ HCFC (Other area except ITO pad can use the HCFC for cleaning process)
- ⊙ Soldering flux
- ⊙ Chlorine(Cl), Sulfur(S)
- ⊙ Spit, Fingerprint

If the product is not wrapped with a desiccant added pad, ITO pattern can be damaged by corrosion. SAMSUNG Mobile Display CO.,LTD. suggests wrapping a product with a desiccant unless customers particularly indicate that they do not want it. In case ITO pattern corrodes due to the usage of chlorine, sulfur or customer's mishandling of the product, the responsibility lies with the customer.

13-3. Caution Against Static Charge

For AMOLED module, use C-MOS LSI drivers, therefore we recommend that you.

Connect any unused input terminal to VCI or VSS, do not input any signals before power is turned on, and ground your body, work/assembly areas, assembly equipment to protect against static electricity. It could occur static electricity when taping off the film which protects AMOLED.

Against static charge, you should make sure that the product is safe or not by experiment in advance.

13-4. Packing

- ⊙ The packing principle is that AMOLED module should keep its packing condition at the time of delivery.
- ⊙ For safety & avoiding the module damage, Carton box must stack the below 4 boxes. When storing the AMOLED after unpacking, note the followings.
- ⊙ AMOLED module is consisted of GLASS and assemblies. It should avoid pressure, strong impact, and being dropped from a height.
- ⊙ To prevent modules from degradation, do not operate or store them in a place where they are directly exposed to sunlight or high temperature/humidity.

13-5. Caution for Operation

- ⊙ If you do not follow normal POWER ON , OFF sequence or abnormal operating, then AMOLED module can be damaged electro-optically and does not recover.
- ⊙ Response time may extremely delay at a temperature lower than operating range, AMOLED does not normally operate at a high temperature. But this may recover at a proper temperature.
- ⊙ When you set optimal operating voltage to AMOLED module, you can see the optimal contrast of AMOLED. So, add voltage controllable function at SET Module.
- ⊙ AMOLED module may not display normally when twisting power or pressing power is added. Therefore you should secure AMOLED module maximum thickness at set assembly not to have any pressure affect AMOLED module.
- ⊙ Electro-chemical reaction may occur when there is humidity on pad, therefore, you should use AMOLED Module below maximum operating humidity.
- ⊙ AMOLED Module Power Vdd should be designed to protect surge current at SET Module.
- ⊙ You should not damage connector and cable for AMOLED module assembly by force folding or by applying extreme power.
- ⊙ AMOLED may not display normally when it is interfered by surrounding elements, therefore you should consider setting design not to damage AMOLED module by surrounding elements.
- ⊙ To satisfy EMI standards, you should plan your design after considering emitting energy.
- ⊙ We can not guarantee display characteristics outside viewing area, therefore your set window should be fixed into viewing area.
- ⊙ Image-sticking may occur if AMOLED displays same image for a long time, so you need to make a change for AMOLED.

13-6. Storage

- ⊙ Place in a dark place where neither exposure to direct sunlight or any fluorescent light is permitted and keep at room temperature & room humidity.
- ⊙ Store with no contact with polarizer surface.
[It is recommended to store them as they have been contained in the inner container when we delivered them.]

13-7. Safety Precautions

- ⦿ Disassembly or modification may cause electric shock, damages to sensitive part inside of the AMOLED module, dust adhesion, or scratches on the display part.
- ⦿ In the event that the contents of AMOLED module are on skin, wipe them with a paper towel or gauze and wash the part well, and receive medical attention if necessary.
- ⦿ Do not use the AMOLED module for the special purpose besides display units.
- ⦿ Be careful of the glass chips that may cause injury to fingers or skin, when the display part is broken. '
- ⦿ For keeping safe quality from outer exposure or contamination, modules should be consumed within 2 months after unpacking.

13-8. Precautions before Use

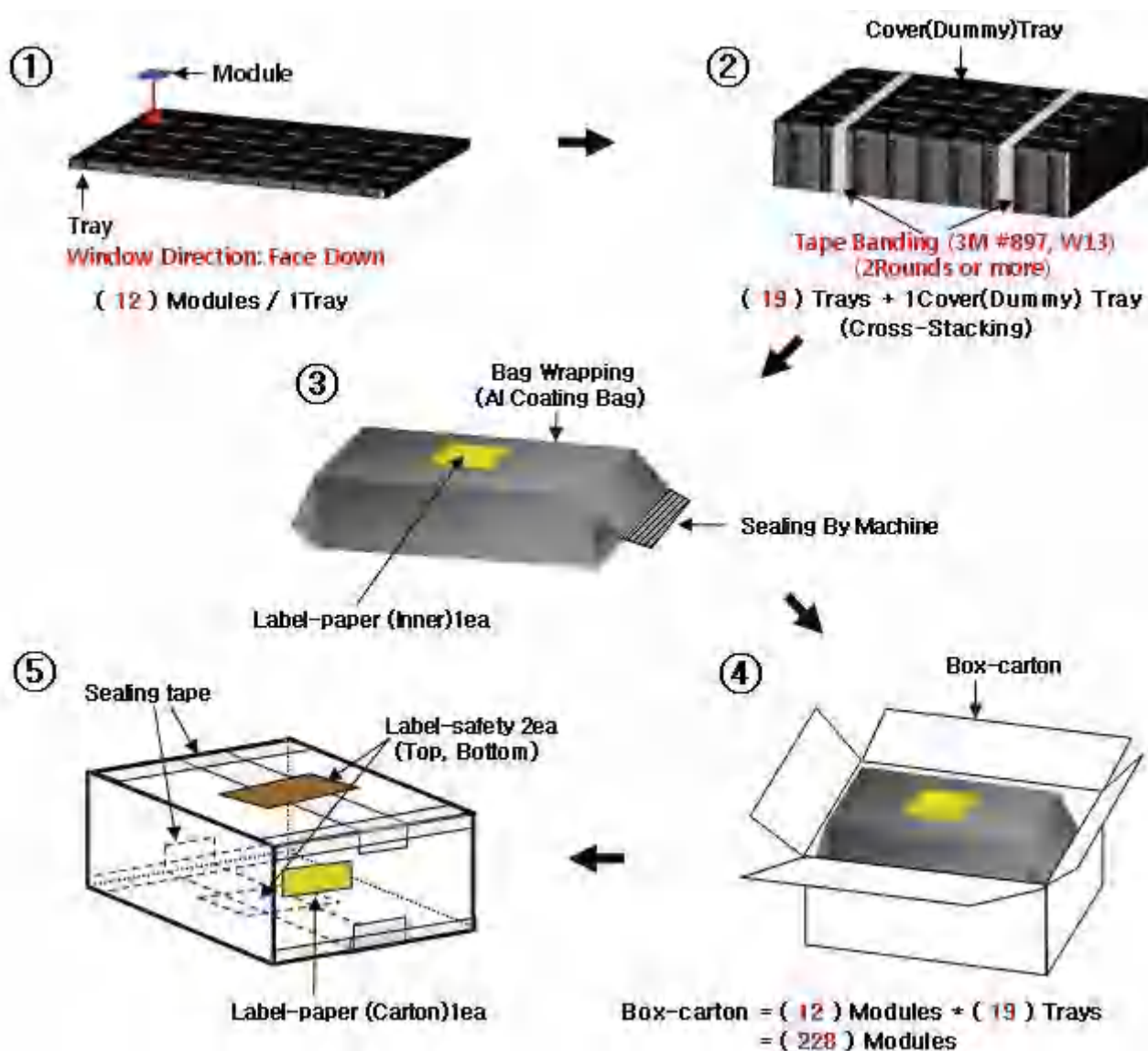
You should discuss the following case with SAMSUNG Mobile Display CO., LTD.

- ⦿ in case of any questions about contents of this "Specification For Approval".
- ⦿ in case of occurring new problems not mentioned at this "Specification For Approval".
- ⦿ in case of your request about inspection specification change.
- ⦿ in case of occurring new problem at your driving test.

※ If SAMSUNG Mobile Display CO., LTD has to change the conditions specified in the specification, previously the negotiation shall be held and decided.

15. Packing Specification

15.1 Box Pack

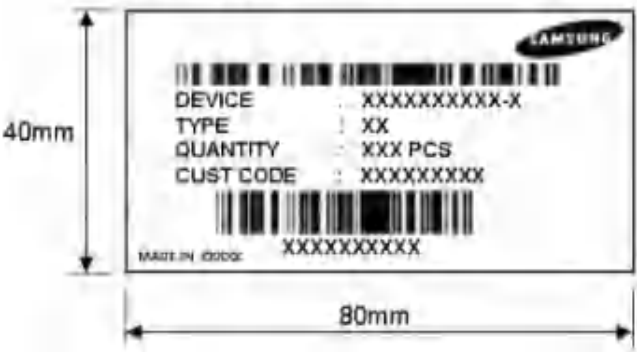


Note

- (1) Total :Box-carton approx. : (13)kg
- (2) Size : 583(L) x 388(W) x 210(H)
- (3) Place the Module in the tray facing the active area direction.
- (4) Stack the trays and cover (dummy) tray.
- (5) Resistance of tray surface : $10^6 \sim 10^9 \Omega$
- (6) Wrap the Al coating bag by vacuum sealing machine and affix the Label-Paper on Bag
- (7) Put the bag in the Box-carton .
- (8) Seal the Box-carton and affix the Label-safety & Label-paper.

15.2 Label

* Label-paper (Inner)

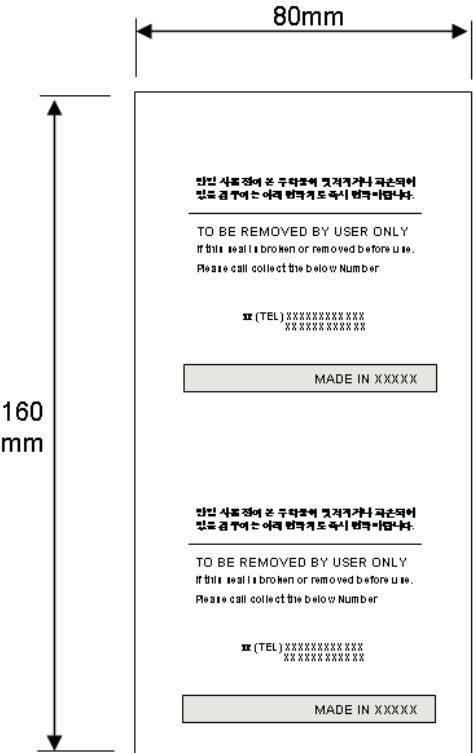


* Label-paper (Carton)



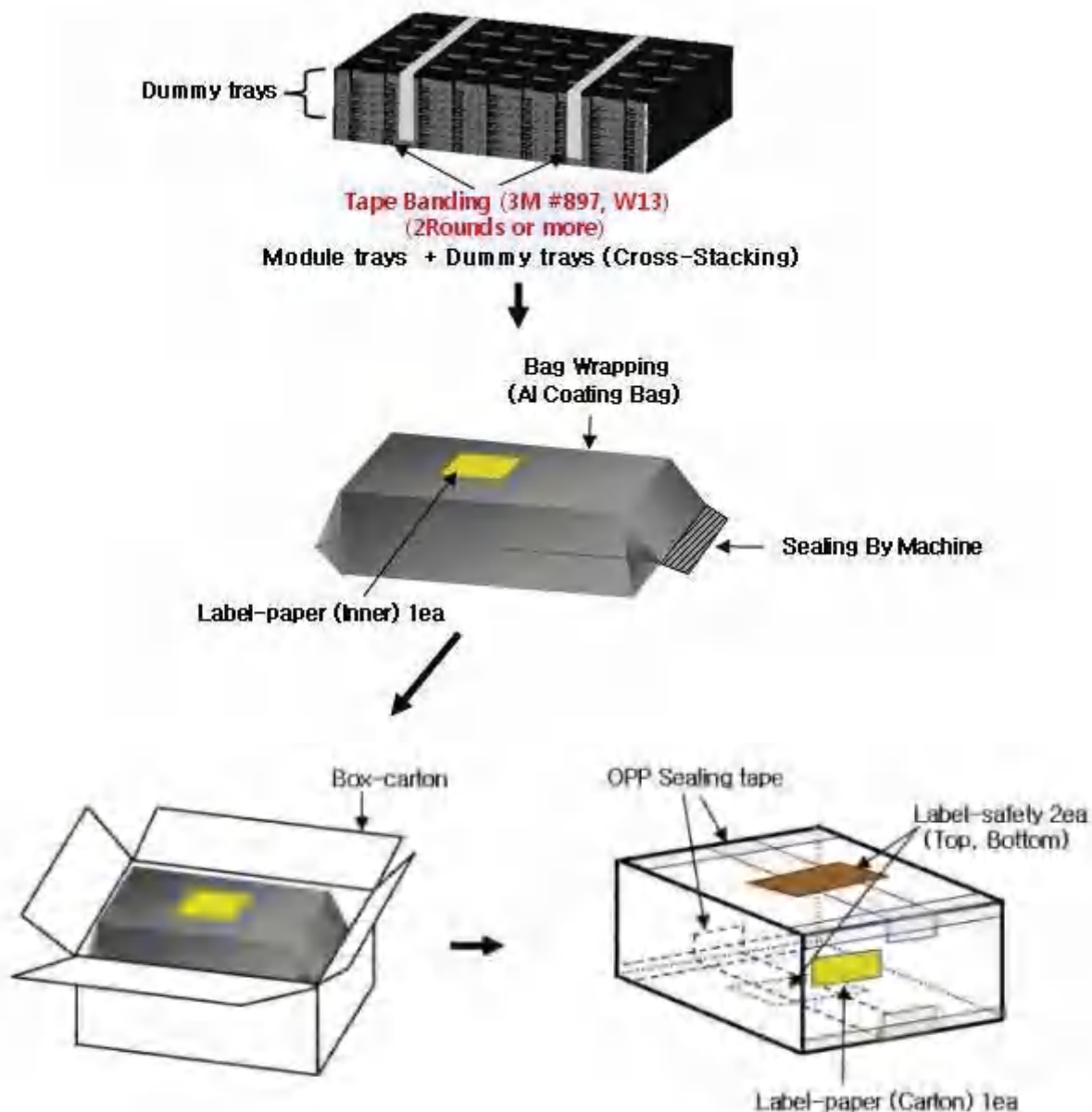
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* Label-safety



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15.3 Packing for Small Quantities



Note

When package quantity is small, 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 and affix the Label-Paper on Bag. Put the Bag in the Box-carton. Seal the Box-carton and affix the Label-safety & Label-Paper.