SAMSUNG ELECTRONICS

Preliminary

Product Information

ISSUE Date : 2005-01-17
MODEL : LTV350QV-F04

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

PREPARED BY : LCD Mobile Display Development

Samsung Electronics Co. , LTD.

Preliminary

Contents

15.3 Operation

15.4 Others

Preliminary

Revision History

Date	Rev. No.	Page	Summary
Jan. 17. 2004	000		Rev.000 was issued.

Preliminary

General Description

* Description

LTV350QV-F04 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 3.5" contains 320RGBx240 dots and can display up to 16.7M colors.

* Features

- Transmissive with Micro Reflective type and back-light with six LEDs are available.
- Visible in outdoor & back-light off condition with reflectivity.
- TN(Twisted Nematic) mode.
- Line inversion mode with stripe type.
- 24bit RGB Interface + Serial Peripheral Interface(SPI)
- DE(Data Enable, Dotclk) mode, SYNC(Vsync, Hsync, Dotclk) mode
- Gate Driver IC embeded on Panel(Double ASG)

* Applications

- Display terminals for DSC(Digital Still Camera), PMP(Portable Multimedia Player) application products.

* General information

Items	Specification	Unit	Note
Display area	70.08(H) x 52.56(V)	mm	-
Driver element	a-Si TFT active matrix	-	-
Display colors	16.7M	colors	-
Number of pixels	320RGB(H) x 240(V)	dot	-
Pixel arrangement	stripe type	-	-
Pixel pitch	0.219(H) x 0.219(V)	mm	-
Display mode	Normally White	-	-
Viewing direction	6	o'clock	-

* Mechanical information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal(H)	76.70	76.90	77.10	mm	-
	Vertical(V)	63.70	63.90	64.10	mm	(1)
	Depth(D)	2.85	3.20	3.25	mm	(1)
Weight		-	31.75		g	-

Note (1) Not include FPC

Refer to the Outline Dimension in the "12.Outline Dimension" for further information.

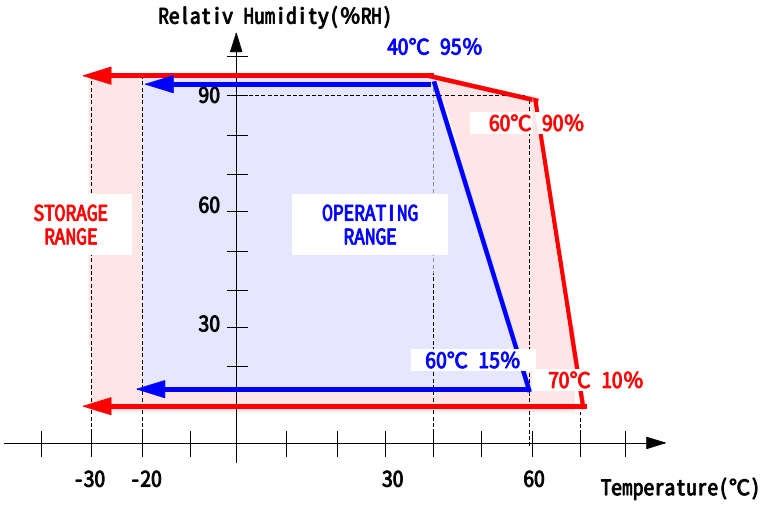
Preliminary

1. Absolute Maximum Ratings

1.1 Absolute Ratings of Environment

Item	Symbol	Min.	Max.	Unit	Note
Storage temperature	T_{STG}	-30	70	℃	(1)
Operating temperature (Ambient temperature)	T_{OPR}	-20	60	℃	(1),(2)

Note (1) 95 % RH Max. (40 °C ≥ Ta)
Maximum wet-bulb temperature at 39 °C or less. (Ta > 40 °C) No condensation.



(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.

1.2 Electrical Absolute Ratings

(1) TFT-LCD Module

(Ta = 25 ± 2°C, V_{SS}=GND=0)

Characteristics	Symbol	Min.	Max.	Unit	Note
Digital supply voltage	V_{CC}	-0.3	4.3	V	-
Analog supply voltage	DDVDH	-0.3	6.0	V	-
Gate On voltage	V_{GH}	-0.3	22.0	V	-
Gate Off voltage	V_{GL}	-18.5	0.3	V	-

(2) Back-Light Unit

(Ta = 25 ± 2°C)

Item	Symbol	Min.	Max.	Unit.	Note
Current	I_B		25	mA	(1)

Note (1) Permanent damage to the device may occur if maximum values are exceeded or reverse voltage is loaded.
Functional operation should be restricted to the conditions described under normal operating conditions.

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: LCD-5000, BM-5A, BM-7, PR-650, EZ-Contrast

(Ta = 25 ± 2°C, V_{CC} = V_{CI} = 3.3V, I_B = 20mA)

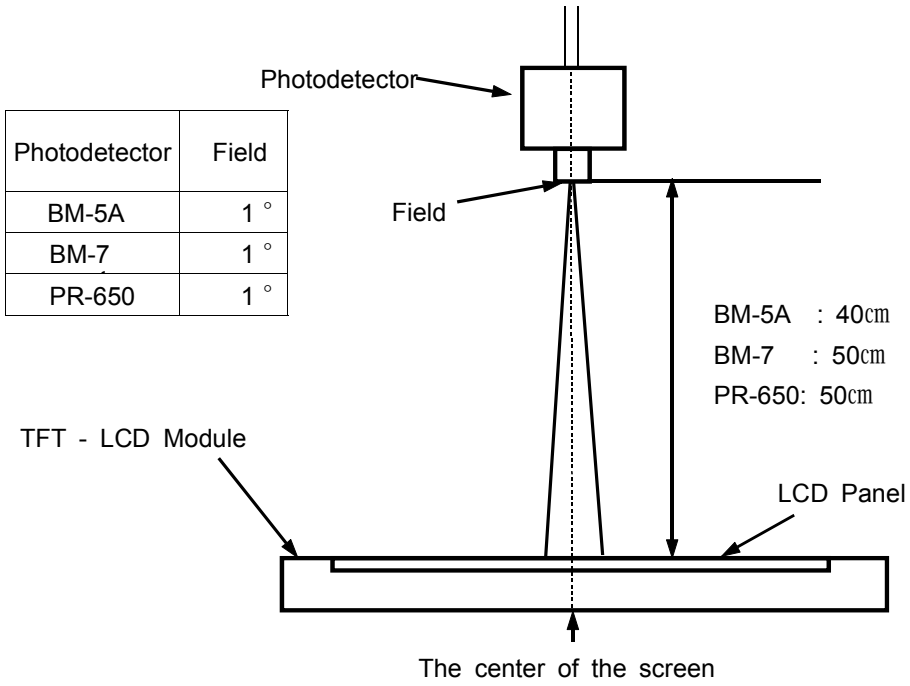
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast ratio (Center point)		C/R	NOTE (1)	150	300	-	-	(2) BM-5A
Luminance of white (Center point)		Y_L			250	-	cd/㎡	(3) BM-5A
Response time	Rising:Tr	Tr+Tf	ϕ = 0 θ = 0 Normal Viewing Angle B/L On	-	25	30	msec	(4) BM-7
	Falling:Tf							
Color chromaticity (CIE 1931)	White	Wx			0.31		-	(5) PR-650
		Wy			0.34			
	Red	Rx			0.61			
		Ry			0.35			
	Green	Gx			0.33			
		Gy			0.56			
	Blue	Bx			0.14			
		By			0.13			
Viewing angle	Hor.	θL	C/R≥10 B/L On		60		Degrees	(6) Ez-Contrast
		θR			60			
	Ver.	ϕH			50			
		ϕL			55			

Note (1) Test Equipment Setup

After stabilizing and leaving the panel alone at a given temperature for 30 min , the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 30 min after lighting the back-light. This should be measured in the center of screen.

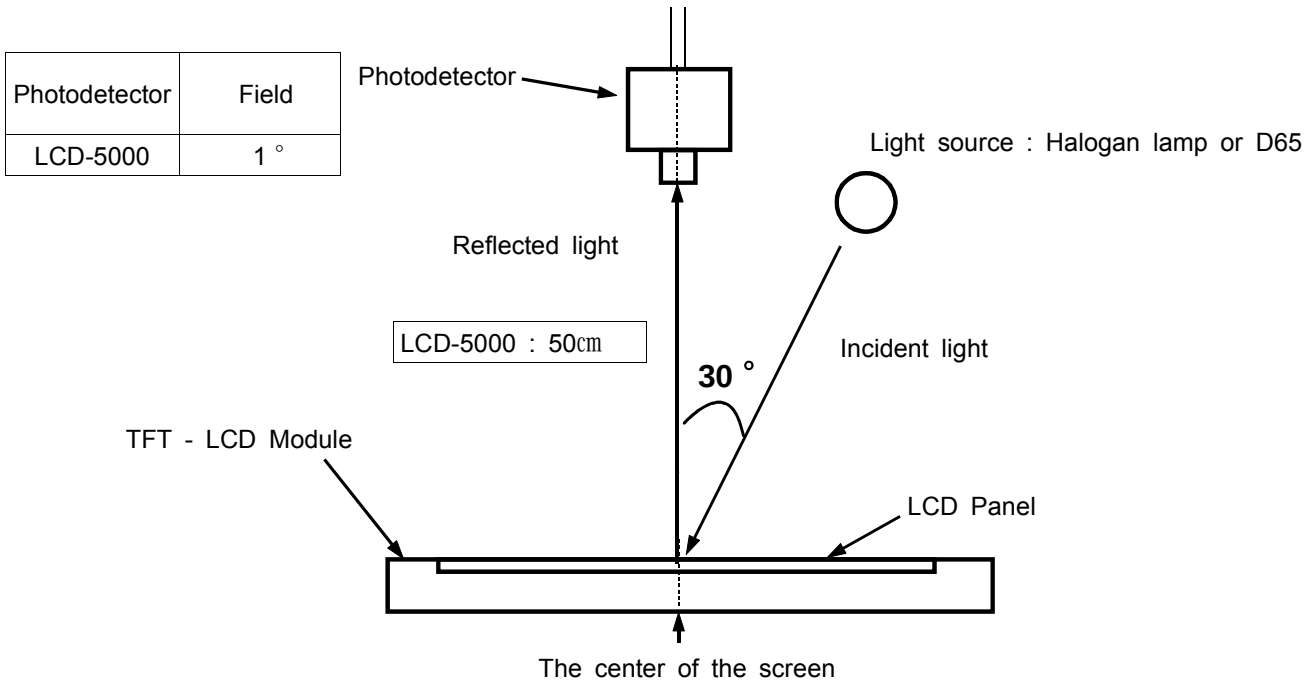
Environment condition : Ta = 25 ± 2 °C

Back-Light On condition



Photodetector	Field
BM-5A	1 °
BM-7	1 °
PR-650	1 °

Back-Light Off condition



Photodetector	Field
LCD-5000	1 °

Optical Measuring Equipment Setup

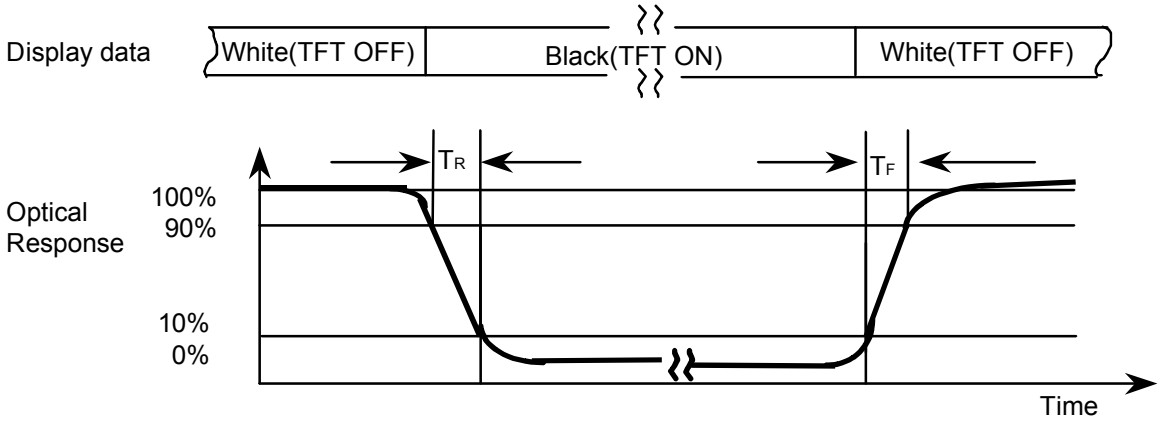
Note (2) Definition of Contrast Ratio (C/R) : Ratio of gray max (Gmax) & gray min (Gmin) at the center point

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

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

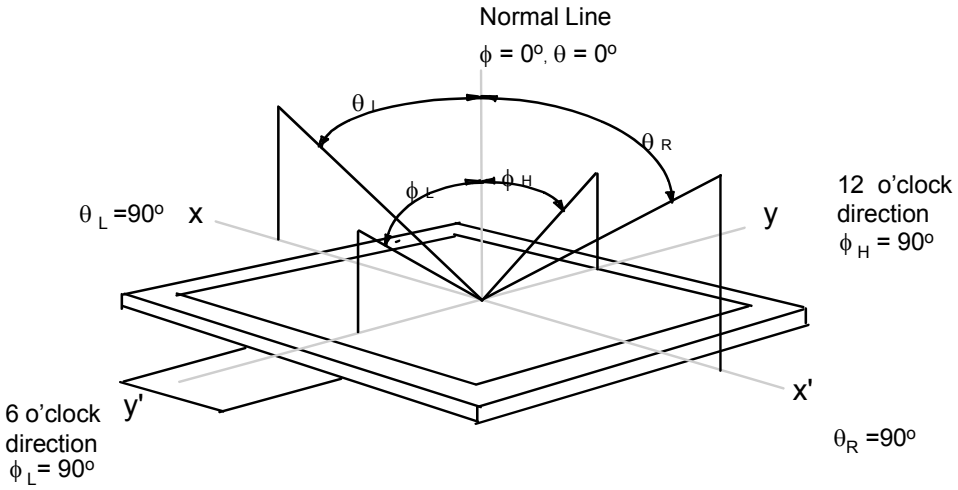
Note (3) Definition of Luminance of White : Luminance of white at the center point

Note (4) Definition of Response time : Sum of Tr ,Tf



Note (5) Definition of Color Chromaticity (CIE 1931)
Color coordinate of white & red, green, blue at center point.

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



3. Electrical Characteristics

3.1 TFT-LCD Module

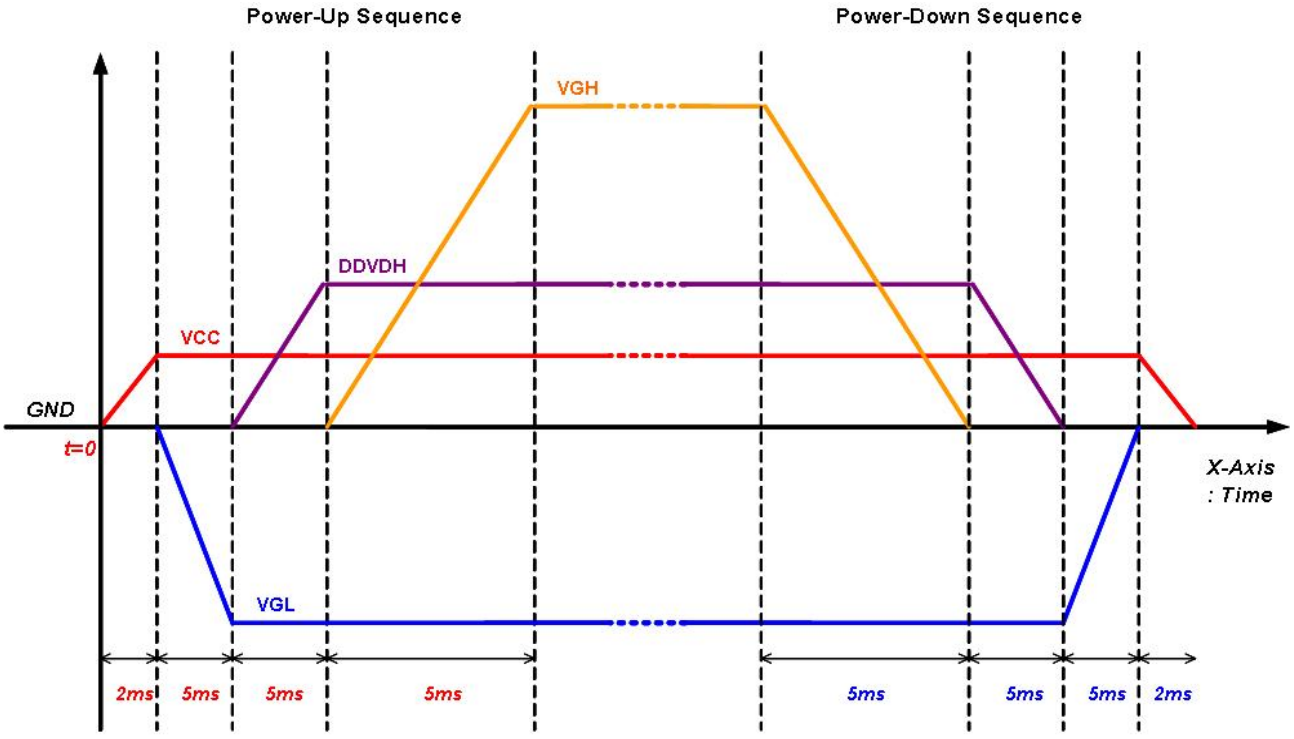
Ta = 25 ± 2°C

Characteristics		Symbol	Min.	Typ.	Max.	Unit	Note
Digital supply voltage		V_{CC}	2.5	3.3	3.3	V	-
Analog supply voltage		DDVDH	4.8	5.0	5.0	V	-
Gate On voltage		V_{GH}	17.0	18.0	19.0	V	-
Gate Off voltage		V_{GL}	-11	-10	-9.0	V	-
Vcom High voltage		VcomH		3.65			
Vcom Low voltage		VcomL		0.35			
Power Dissipation	Full	P_{FULL}		60		mW	#1,#2
Frame frequency		f_{Frame}	60	60	90	Hz	-
Dot Clock		DOTCLK	-	-	30.0	MHz	-
Serial Clock		SCL	-	-	16.0	MHz	-

* To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should be as the Chapter 9. Power On/Off Sequence.

Note #1. V_{CC} = 3.3V, f_{Frame} = 60Hz, DOTCLK = 14.4MHz

- Power On : VCC → VGL → DDVDH → VGH → Data
- Power Off : Data → VGH → DDVDH → VGL → VCC



#2. Dissipation current check pattern

▶ 0 Gray black pattern

3.2 Back-Light unit

The back-light system is an edge-lighting type with **six** white LED(Light Emitting Diode)s.

(Ta=25 ± 2°C)

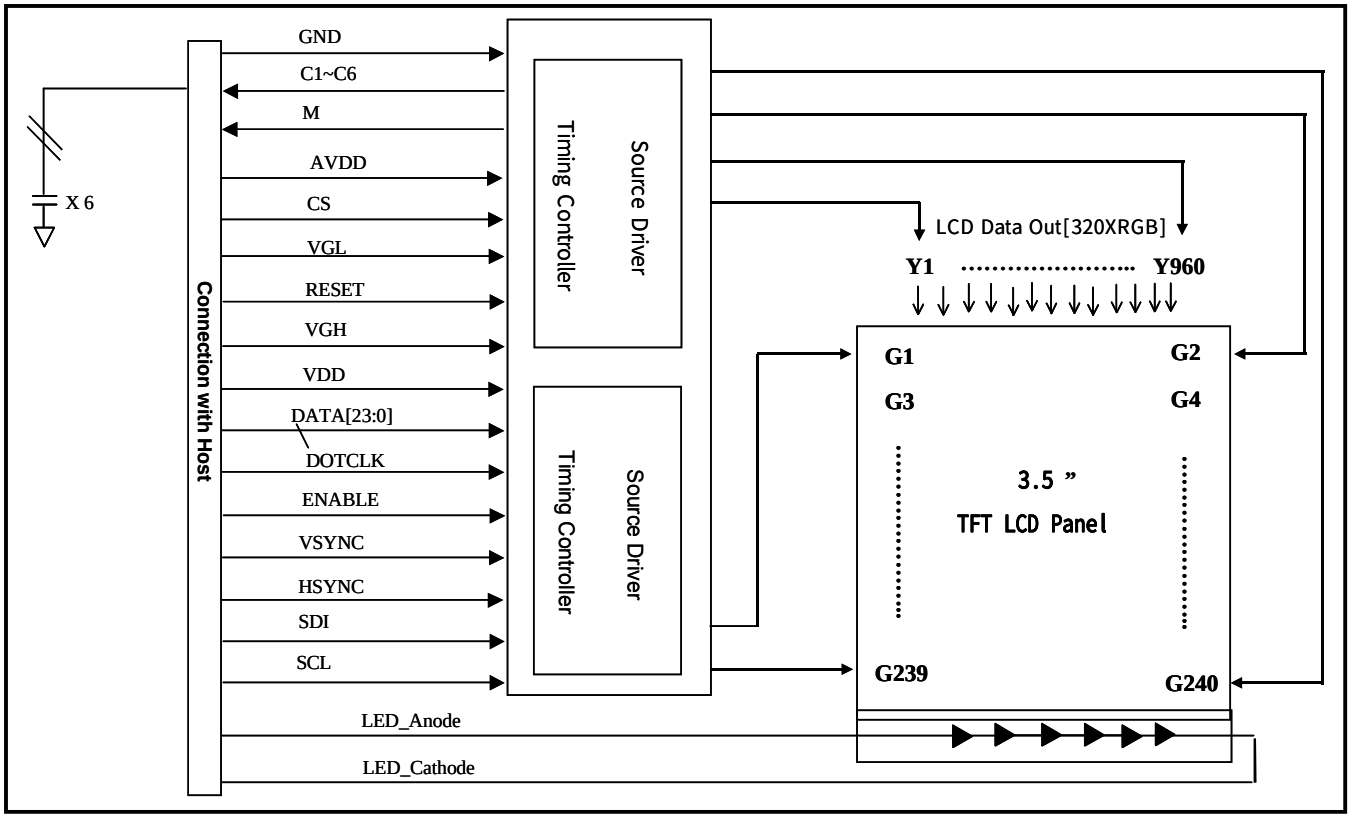
Item	Symbol	Min.	Typ.	Max.	Unit	Note
Current	I_B	-	20	-	mA	(1)
Power Consumption	P_{BL}	-	440	-	mW	(2)

Note (1) **Six** LEDs serial type.

(2) Where I_B = 20mA, V_B = P_{BL} / I_B

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 type : 54Pin / 0.5mm pitch / Bottom contact)

- kyocera elco : 6240 series

No	Symbol	Description	I/O	No	Symbol	Description	I/O
1,2	LED_Cathode	LED_Cathode	I	27	DATA15	Green Data(MSB)	I
3,4	LED_Anode	LED_Anode	I	28	DATA16	Red Data (LSB)	I
5	C6	Stable Capacitor connection	O	29	DATA17	Red Data	I
6	C5	Stable Capacitor connection	O	30	DATA18	Red Data	I
7	M	The signal to generate Vcom	O	31	DATA19	Red Data	I
8	RESET	Reset	I	32	DATA20	Red Data	I
9	CS	Chip Select	I	33	DATA21	Red Data	I
10	SCL	Serial Clock	I	34	DATA22	Red Data	I
11	SDI	Serial Data	I	35	DATA23	Red Data(MSB)	I
12	DATA0	Blue Data (LSB)	I	36	HSYNC	Horizontal Synchronous Signal	I
13	DATA1	Blue Data	I	37	VSYNC	Vertical Synchronous Signal	I
14	DATA2	Blue Data	I	38	DOTCLK	Data Colck	I
15	DATA3	Blue Data	I	39,40	AVDD	Vanalog	I
16	DATA4	Blue Data	I	41.42	VDD	Vdigital	I
17	DATA5	Blue Data	I	43	C4	Stable Capacitor connection	O
18	DATA6	Blue Data	I	44,45	VGL	Vgoff Voltage	I
19	DATA7	Blue Data(MSB)	I	46	C3	Stable Capacitor connection	O
20	DATA8	Green Data(LSB)	I	47	VGH	Vgon Voltage	I
21	DATA9	Green Data	I	48	C2	Stable Capacitor connection	O
22	DATA10	Green Data	I	49	C1	Stable Capacitor connection	O
23	DATA11	Green Data	I	50,51	VCOM	VCOM	I
24	DATA12	Green Data	I	52	ENABLE	Data enabling signal	I
25	DATA13	Green Data	I	53,54	GND	Ground	I
26	DATA14	Green Data	I				

Note (1) Connect Hsync, Vsync pin at Vcc or GND in DE mode.

(2) Connect ENABLE pin at Vcc or GND in SYNC mode.

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

COLOR	DISPLAY	DATA SIGNAL																								GRAY SCALE LEVEL
		RED								GREEN								BLUE								
		R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3	B4	B5	B6	B7	
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	-
	CYAN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	MAGENTA	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	-
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
GRAY SCALE OF RED	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R0
	DARK ↑	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1
		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R3~R252
	↓ LIGHT	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
		1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R253
		0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R254
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R255
GRAY SCALE OF GREEN	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G0
	DARK ↑	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G1
		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G2
		:			:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	G3~G252
	↓ LIGHT	:			:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	
		0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G253
		0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G254
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G255
GRAY SCALE OF BLUE	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B0
	DARK ↑	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	B1
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	B2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3~B60
	↓ 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	B61
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	B62
	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	B63

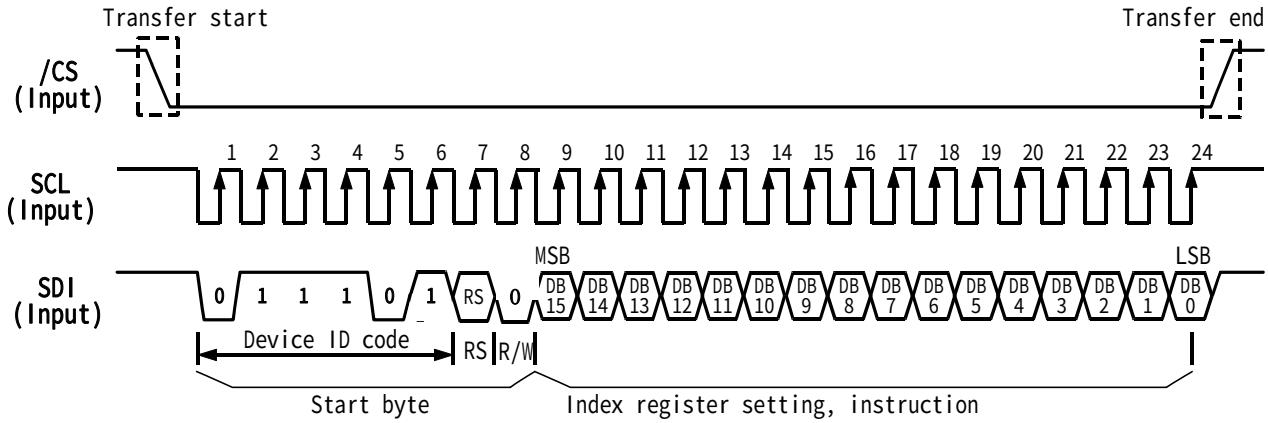
Note) Definition of Gray :

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

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

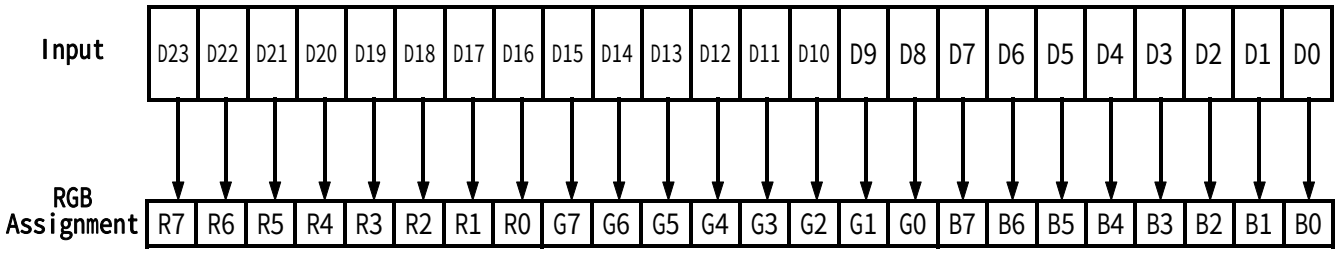
6. Operation Specifications

6.1 Serial Peripheral Interface



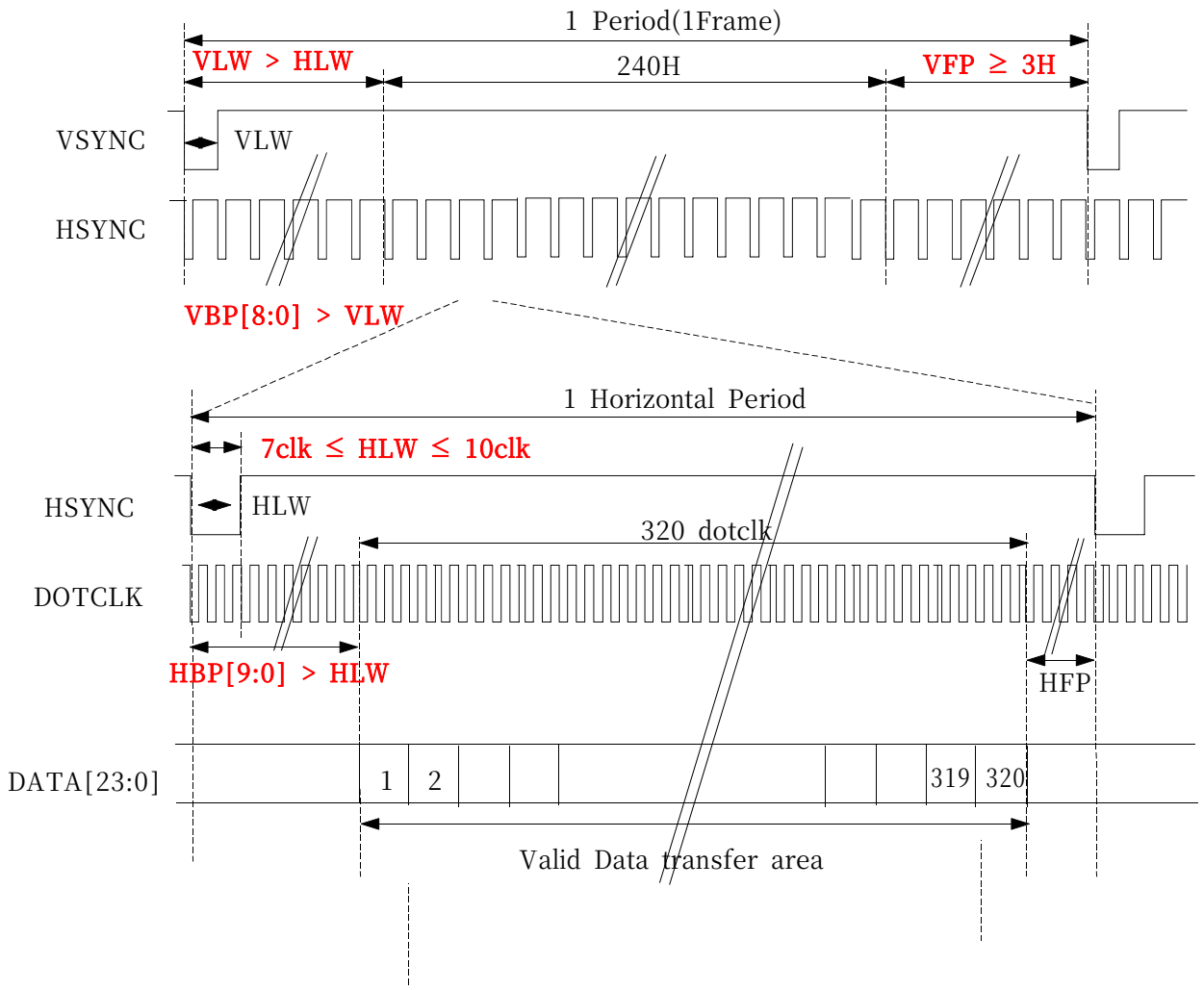
(Note) RS="0": Index data
RS="1": Instruction data

6.2 Data Format for 24bit RGB Interface



6.3 24bit RGB Interface Timing

a. SYNC mode

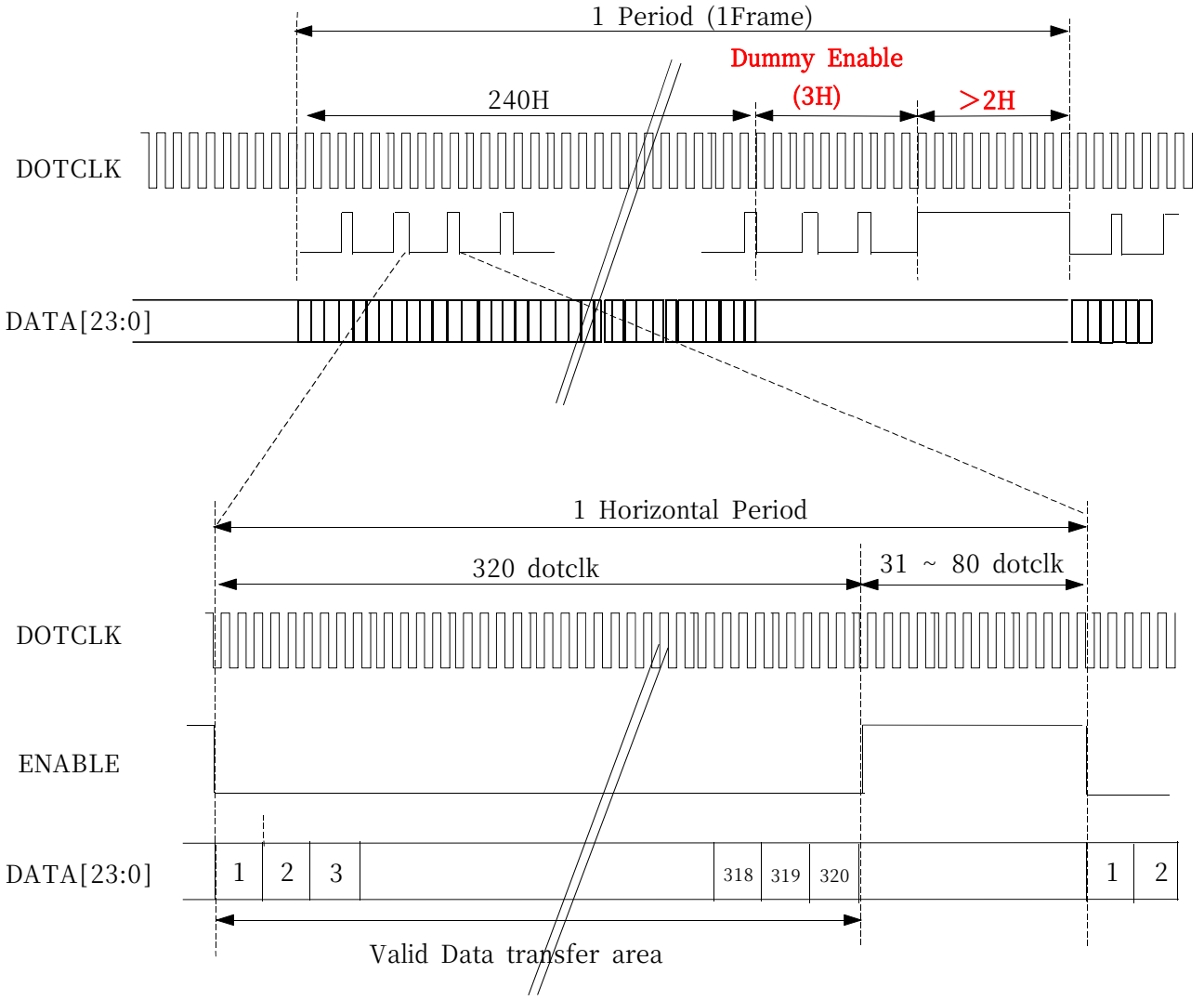


* DOTCLK = f_{frame} × (240 + VBP + VFP) × (320 + HBP + HFP)
  = 60Hz × (240 + VBP + VFP) × (320 + HBP + HFP)
* 3H ≤ VFP
* HBP > HLW
* VBP > VLW
* 7clk ≤ HLW ≤ 10clk
* VLW > HLW

Note 1. Polarity register setting : VPL = 0, HPL = 0, DPL=0

2. The rising edge of DOTCLK is used to fetch display data

b. DE mode

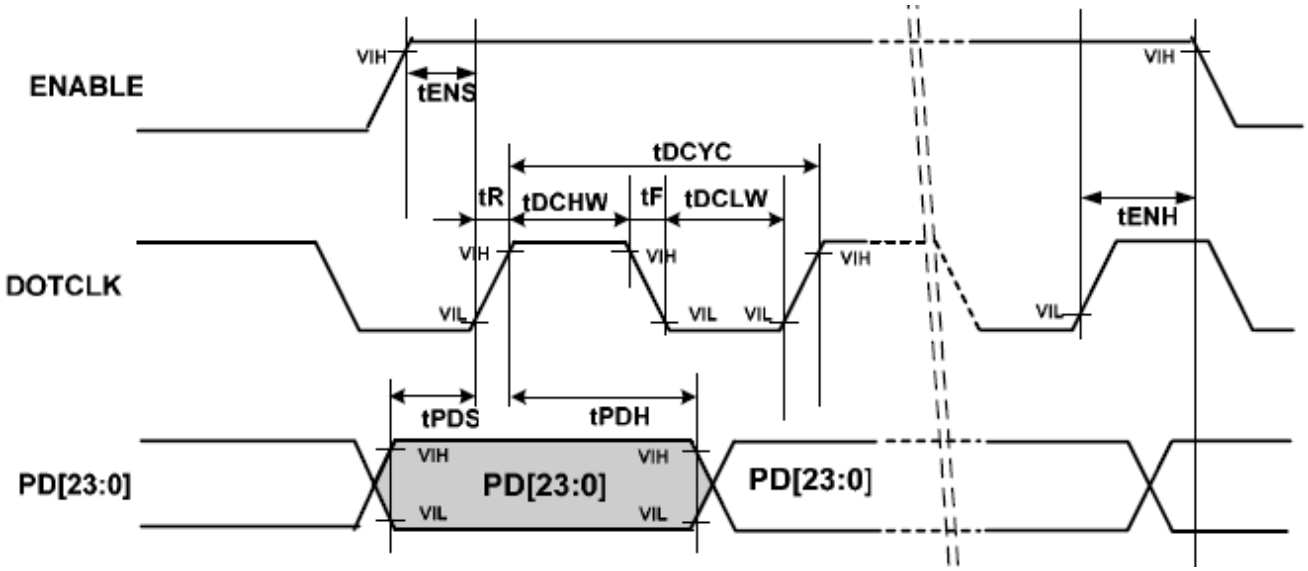


6.4 Electrical Specifications

a. RGB Data Interface Characteristics

(T_A = -40 to +85 ^oC)

Characteristic	Symbol	24bit RGB Interface		Unit
		Min	Max	
DOTCLK cycle time	tDCYC	100	-	ns
DOTCLK rise/fall time	tR,tF	-	2	
DOTCLK Pulse width high	tDCHW	50	-	
DOTCLK Pulse width low	tDCLW	50	-	
ENABLE setup time	tENS	30	-	
ENABLE hold time	tENH	30	-	
PD data setup time	tPDS	30	-	
PD data hold time	tPDH	30	-	



AC Characteristics(DE Mode)

b. Clock Synchronized Serial Mode Characteristics

(T_A = -40 to +85 ^oC)

Characteristic	Symbol	Min	Max	Unit
Serial clock cycle time	tscyc	100	-	ns
Serial clock rise/fall time	tR,tF	-	2	
Pulse width high for write	tSCHW	30	-	
Pulse width high for read	tSCHR	50	-	
Pulse width low for write	tSCLW	30	-	
Pulse width low for read	tSCLR	50	-	
Chip Select setup time	tCSS	20	-	
Chip Select hold time	tCSH	50	-	
Serial input data setup time	tSIDS	30	-	
Serial input data hold time	tSIDH	30	-	
Serial output data delay time	tSODD	-	100	
Serial output data hold time	tSODH	5	-	

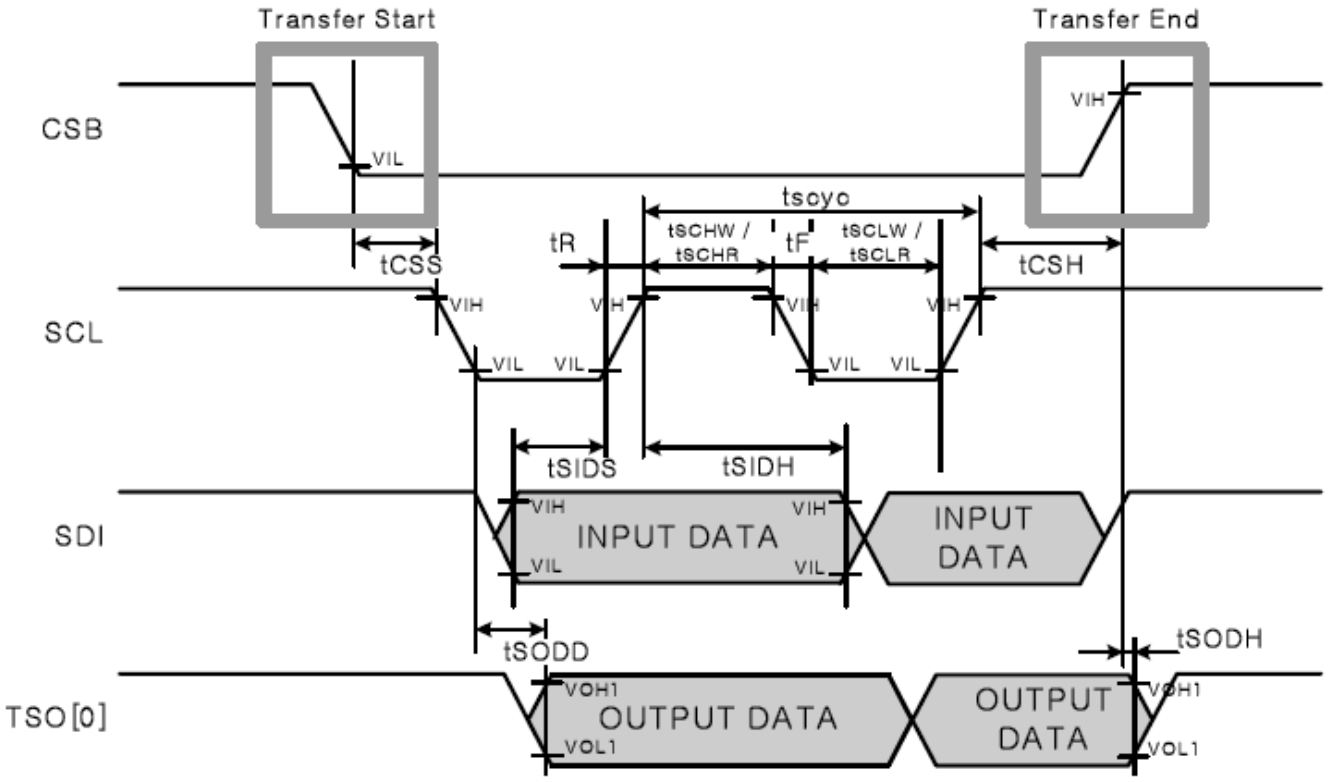
c. Reset Timing Characteristics

(T_A = -40 to +85 ^oC)

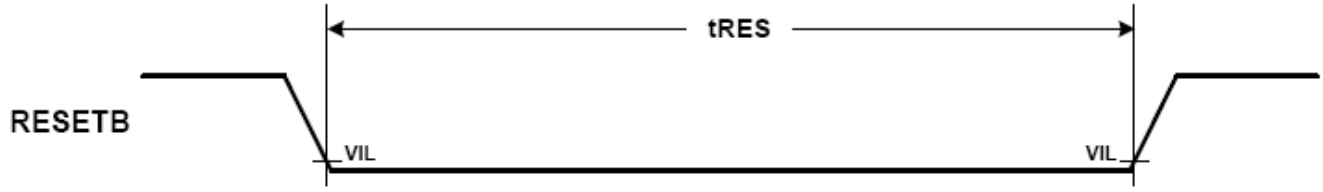
Characteristic	Symbol	Min	Max	Unit
Reset low pulse width	tRES	3*	-	us

***NOTE. Reset low pulse width shorter than 1us do not make reset. It means undesired short pulse such as glitch, bouncing noise or electorstatic discharge do not cause irregular system reset. Please refer to the table below.**

tRES Pulse	Action
Shorter than 1 us	No reset
Longer than 3 us	Reset
Between 1 us and 3 us	Not determined



AC Characteristics(SPI Mode)



AC Characteristics(RESET timing)

7. Command List & Instruction Descriptions

7.1 Command List

Refer to the Appendix 1: S6F2002 IC Specification

7.2 Instruction Descriptions

Refer to the Appendix 1: S6F2002 IC Specification

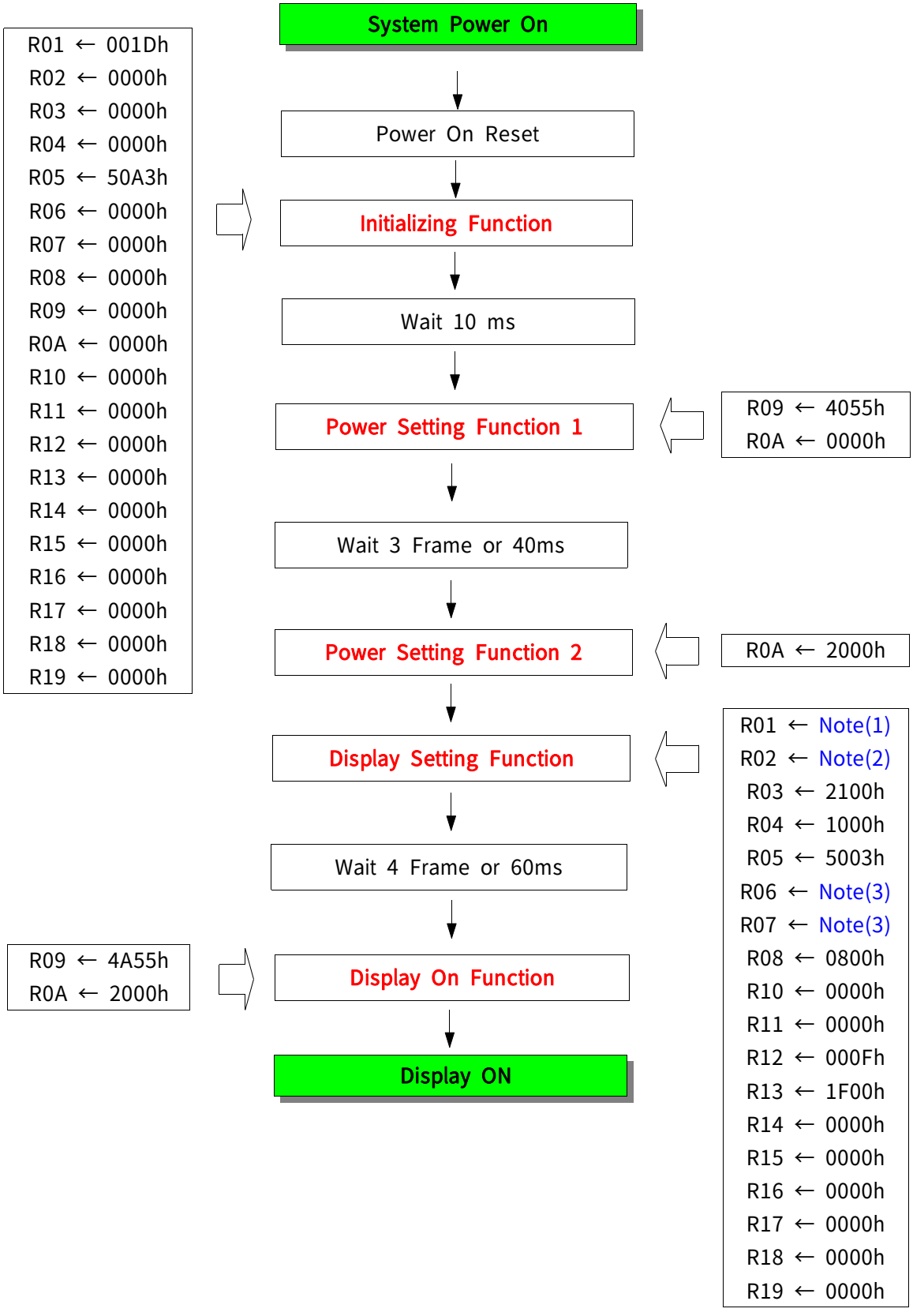
8. Reset

If the /RESET input becomes "L" or the reset command is input, the each register to its default value. These default values are listed in the table below.

Register		Default	Note
Display Interface Control	R01	001DH	-
Display Data Control	R02	0000H	-
Entry Mode	R03	0000H	-
Gate Control 1	R04	0000H	-
Gate Control 2	R05	0000H	-
Display Control 1	R06	50A3H	-
Display Control 1	R07	0000H	-
Source Output Timing Control	R08	0000H	-
Power Contorl 1	R09	0000H	-
Power Contorl 2	R0A	0000H	-
Gamma Control	R10 ~ R19	0000H	-

9. Power On/Off Sequence

9.1 Power On Sequence



< Note (1) >

- Register 'R01' determine specify the interface mode

(R01H)

IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
0	1	**SSMD**	0	0	0	0	0	1	0	0	1	1	1	0	1

- SSMD Bits Setting

SSMD	Inferface	**R01H**
0	SYNC mode	**409D**
1	DE mode	**609D**

< Note (2) >

- Register 'R02' determines Data format

(R02H)

IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
0	0	0	0	0	0	1	0	**DF1**	**DF0**	0	0	0	1	0	0

- DF Bits Setting

DF1	DF0	Data Format	**R02H**
0	0	RGB RGB	**0204**
0	1	RGBX RGBX	**0244**
1	0	XRGB XRGB	**0284**
1	1	Setting Inhibited	

- Register 'R06', 'R07' determine Vsync Backporch('R06') & Hsync Backporch period('R07')
- Backporch limit
  (1) 7clk < Hsync Backporch < 1024clk
  (2) 3line < Vsync Backporch < 512line

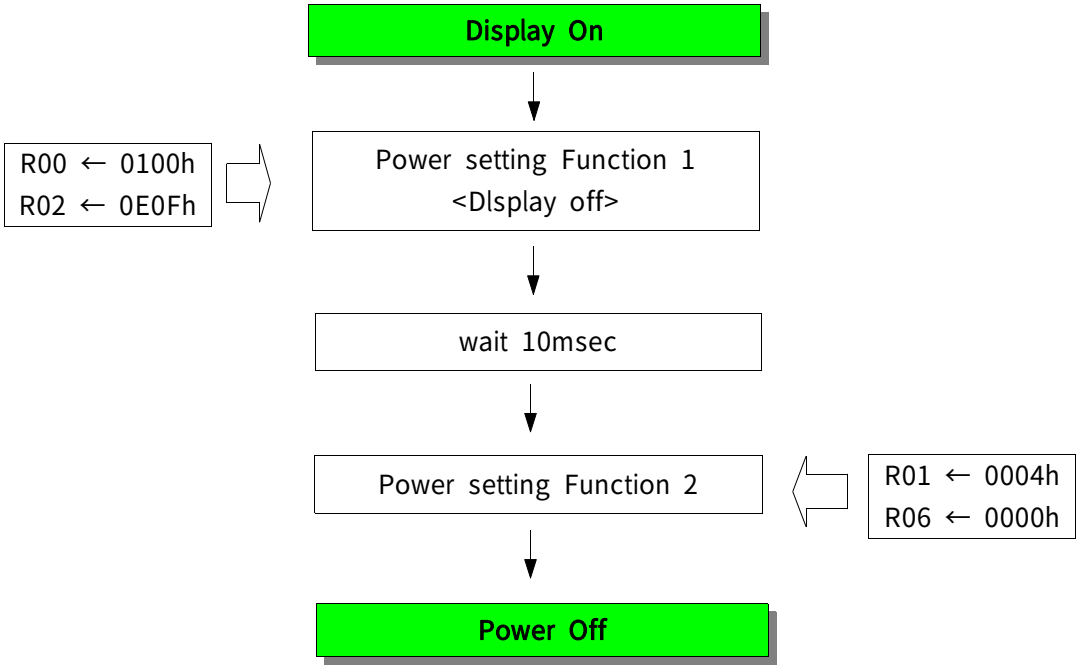
(R06H)

IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
0	0	0	0	0	0	0	**VBP8**	**VBP7**	**VBP6**	**VBP5**	**VBP4**	**VBP3**	**VBP2**	**VBP1**	**VBP0**

(R07H)

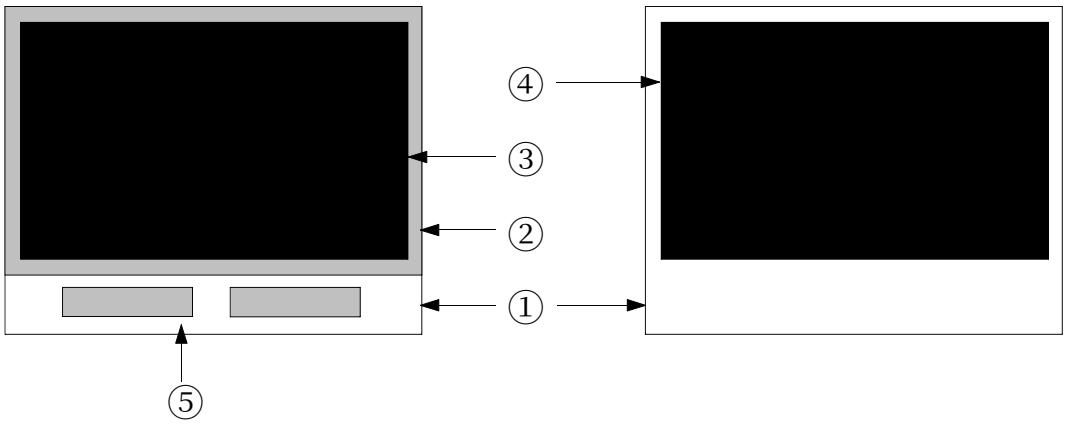
IB15	IB14	IB13	IB12	IB11	IB10	IB9	IB8	IB7	IB6	IB5	IB4	IB3	IB2	IB1	IB0
0	0	0	0	0	0	0	**HBP8**	**HBP7**	**HBP6**	**HBP5**	**HBP4**	**HBP3**	**HBP2**	**HBP1**	**HBP0**

9.2 Power Off Sequence



10. Part List of Components

10.1 Panel, Driver IC

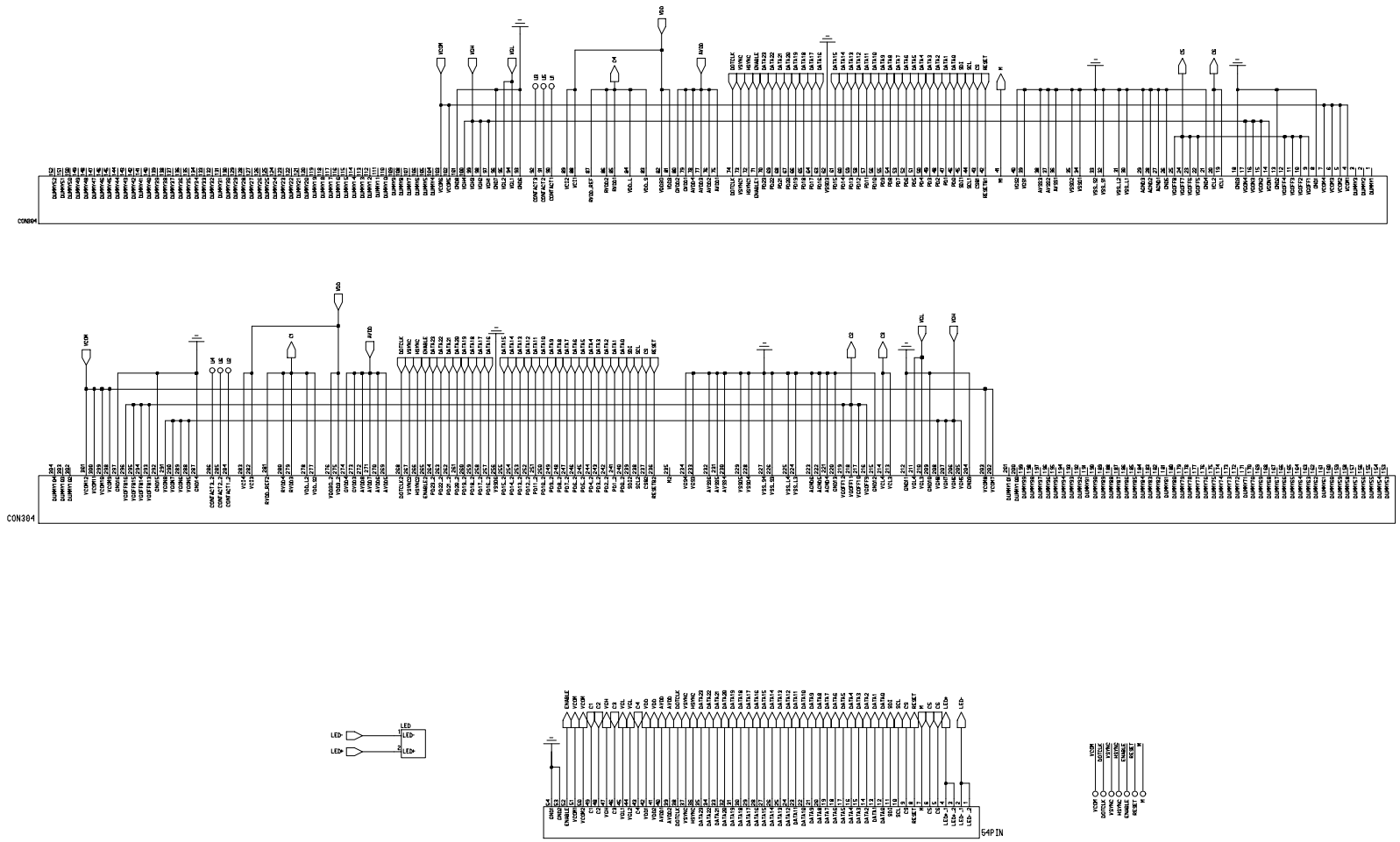


UPPER SIDE

BOTTOM SIDE

No.	Part Name	Specification	Maker	EA	Note
1	TFT GLASS	T0.5	SAMSUNG CORNING	1	ⓛ
2	COLOR FILTER GLASS	T0.5	SEC	1	②
3	UPPER POLARIZER	Thin-Pol	KORENO	1	③
4	LOWER POLARIZER	Thin-Pol	KORENO	1	④
5	DRIVER IC	S6F2002	LDI	2	⑤

10.2 FPC Circuit Drawing



Engineer eurol890	COMPANY NAME Address City	
Drawn by eurol890		
R&D CHK	TITLE	Size A2
DOC CTRL CHK		
MFG ENGR CHK	LTV350QV_F02_00R2_V0.2	
QA CHK	REV / Drawing Number	Sheet of

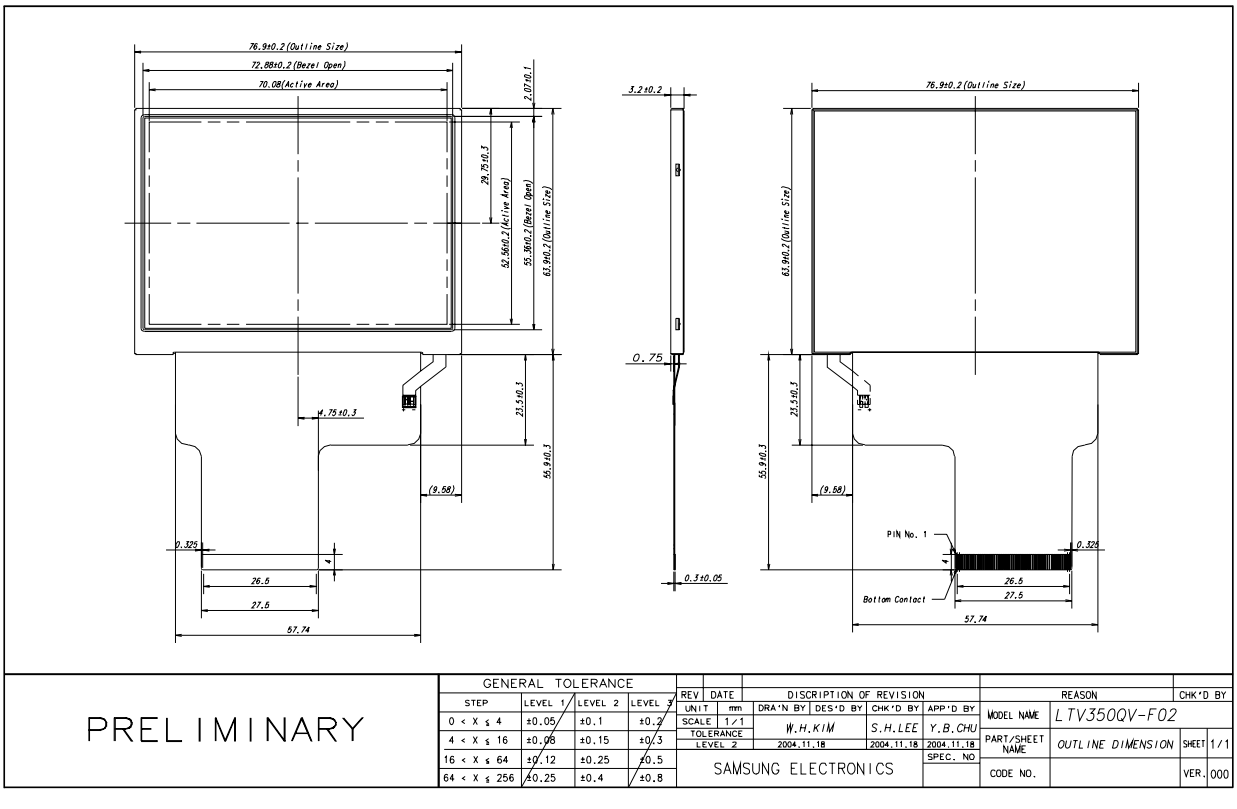
Changed by eurol890 | Date Changed Saturday, September 18, 2004 10:25:53 am | Time Changed

11. Reliability Test Result

T.B.D.

Preliminary

12. Outline Dimension



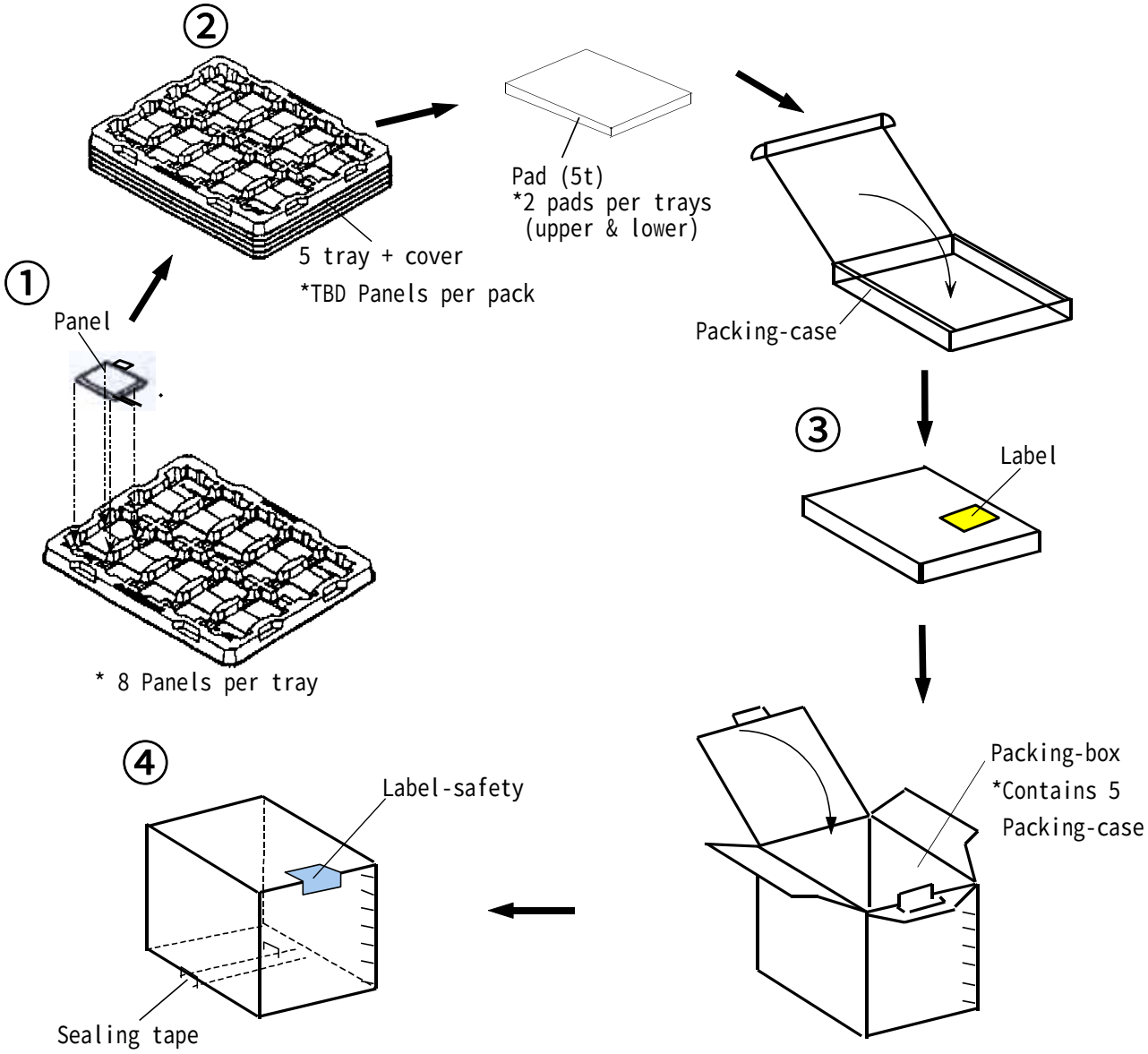
PRELIMINARY

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

REV	DATE	DISCRIPTION OF REVISION			
UNIT	mm	DRA'N BY	DES'D BY	CHK'D BY	APP'D BY
SCALE	1/1	W.H.KIM		S.H.LEE	Y.B.CHU
TOLERANCE LEVEL 2		2004.11.18		2004.11.18	2004.11.18
SAMSUNG ELECTRONICS					SPEC. NO

REASON	CHK'D BY
MODEL NAME	LTV350QV-F02
PART/SHEET NAME	OUTLINE DIMENSION
SHEET	1/1
CODE NO.	VER. 000

13. Packing



Note (1) Total : Case: Approx. TBD Kg
Box: Approx. TBD Kg

(2) Size : Case: 490(W) x 342(D) x 58(H)
Box: 505(W) x 355(D) x 312(H)

(3) Place the panels in the tray facing the direction shown in the figure.

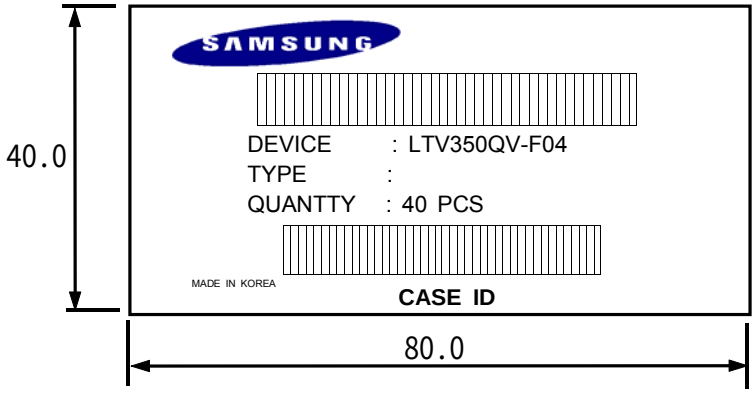
(4) Place 5 tray and cover(empty tray) and pads inside the packing-case.

(5) Place 5 packing-case inside the packing-box.(Affix the label)

(6) Seal the packing-box. Affix the label-safety.

14. Marking & Others

(1) Packing case attach



CASE ID : V 00 00 00001

- Serial No.(00001-99999)
- Week
- Year
- Device

15. General Precautions

15.1 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

15.2 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.

15.3 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"

15.4 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.