



ELECTRONICS

Product Information

ISSUE DATE : 03-02-12

MODEL : LTS350Q1-PE1

Note : This product information is subject to change without any notice.

PREPARED BY : AMLCD Application Engineering Group 1

Samsung Electronics Co . , LTD.



SAMSUNG TFF-LCD

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General Description

* Description

LTS350Q1-PE1 is a transfective 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(TFT-LCD panel, driver ICs and FPC), a Back-light unit and a touch screen panel. The resolution of a 3.5" contains 240 x 320 pixels and can display up to 260K colors.

* Features

- Transfective type.
- 6 LED Back-light
- Using the Clear type Touch Screen Panel
- Line Inversion mode.
- Low Power Consumption.

* Applications

- Display terminals for PDA application products.
- Smart phone / Game machine / Camcoder.

* General Information

Items	Specification	Unit	Note
Display area	53.64(H) x 71.52(V)	mm	-
Driver element	a-Si TFT active matrix	-	-
Display colors	262,144	colors	-
Number of pixels	240(H) x 320(V)	pixel	-
Pixel arrangement	RGB vertical stripe	-	-
Pixel pitch	0.2235(H) x 0.2235(V)	mm	-
Display mode	Normally White	-	-
Viewing Direction	8:00	o'clock	-

* Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Model size	Horizontal(H)	63.0	63.3	63.6	mm	(1)
	Vertical(V)	85.3	85.6	85.9	mm	(1),(2)
	Depth(D)	4.6	4.8	5.0	mm	(1)
Weight		-	52	57	g	(1)

Note (1) Touch screen panel and Back-light unit are included.

(2) FPC is not included. (Refer to the Outline Dimension in the page 24 for further information.)

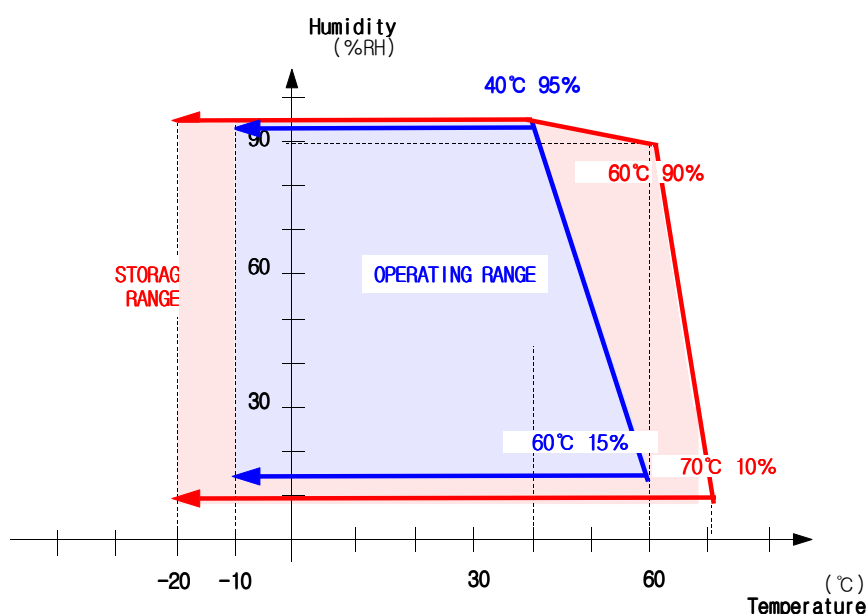
1. Absolute Maximum Ratings

1.1 Absolute Ratings of Environment

Item	Symbol	Min.	Max.	Unit	Note
Storage temperature	T _{STG}	-20	70	°C	(1),(5)
Operating temperature (Ambient temperature)	T _{OPR}	-10	60	°C	(1),(2),(5)
Vibration (Non - operating)	V _{nop}	10	500	Hz	(3),(4)

Note (1) 90 % 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.

- (3) $(10 \Leftrightarrow 500\text{Hz})^{6\text{CYC}}$ 10min/Cycle, 3G_{pk,,} for each X, Y, Z axis.
- (4) At testing vibration, the fixture in holding the module to be tested have to be hard and rigid enough so that the module would not be twisted or bent by the fixture.
- (5) If product is exposed to high temperatures for extended time, there is a possibility of the polarizer film damage which could degrade the optical characteristics.

1.2 Electrical Absolute Ratings

(1) TFT-LCD Module

(Ta = 25 ± 2°C, V_{SS}=GND=0V)

Characteristics	Symbol	Min.	Max.	Unit	Note
Power supply(analog, digital)	V _{DD}	-0.3	6.5	V	-
Power supply(gate on)	V _{ON}	-0.3	44	V	-
Power supply(gate off)	V _{OFF}	V _{ON} - 44	0.3	V	-
Common Voltage	V _{COM}	-0.3	6.5	V	DC
Input voltage	V _I	-0.3	V _{DD} + 0.3	V	-

(2) Back-Light Unit

(Ta = 25 ± 2°C)

Characteristics	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 (3), (4).

Measuring equipment: LCD-7200, BM-5A, BM-7, PR-650, EZ-Contrast

(Ta = 25 ± 2°C)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Reflectance	Rf	B/L Off	(5)	(8)	-	%	(5) LCD-7200
Contrast ratio (Center point)	C/R1	B/L On	40	60	-	-	(6) BM-5A
	C/R2	B/L Off	3	8	-	-	(6) LCD-7200
Luminance of white (Center point)	YL	B/L On	(30)	(50)	-	cd/m2	(7) BM-5A
Response time	Rising:Tr	Tr+Tf	-	40	55	msec	(8) BM-7
	Falling:Tf						
Color Chromaticity (CIE 1931)	White	Wx1	B/L On	(0.22)	(0.32)	(0.42)	(9) PR-650
		Wy1		(0.23)	(0.33)	(0.43)	
	Red	Rx		(0.41)	(0.51)	(0.61)	
		Ry		(0.23)	(0.33)	(0.43)	
	Green	Gx		(0.24)	(0.34)	(0.44)	
		Gy		(0.36)	(0.46)	(0.56)	
	Blue	Bx		(0.05)	(0.15)	(0.25)	
		By		(0.06)	(0.16)	(0.26)	
	White	Wx1	B/L Off	0.26	0.31	0.36	(10) LCD-7200
		Wy1		0.30	0.35	0.40	
Viewing angle	Hor.	θL1	C/R≥10 B/L On	(20)	-	-	(11) Ez-Contrast
		θR1		(20)	-	-	
	Ver.	φH1		(15)	-	-	
		φL1		(35)	-	-	
	Hor.	θL2	C/R≥2 B/L Off	(40)	-	-	(11) LCD-7200
		θR2		-	-	-	
	Ver.	φH2		(40)	-	-	
		φL2		-	-	-	

* Optical Characteristics can be changed without special notice

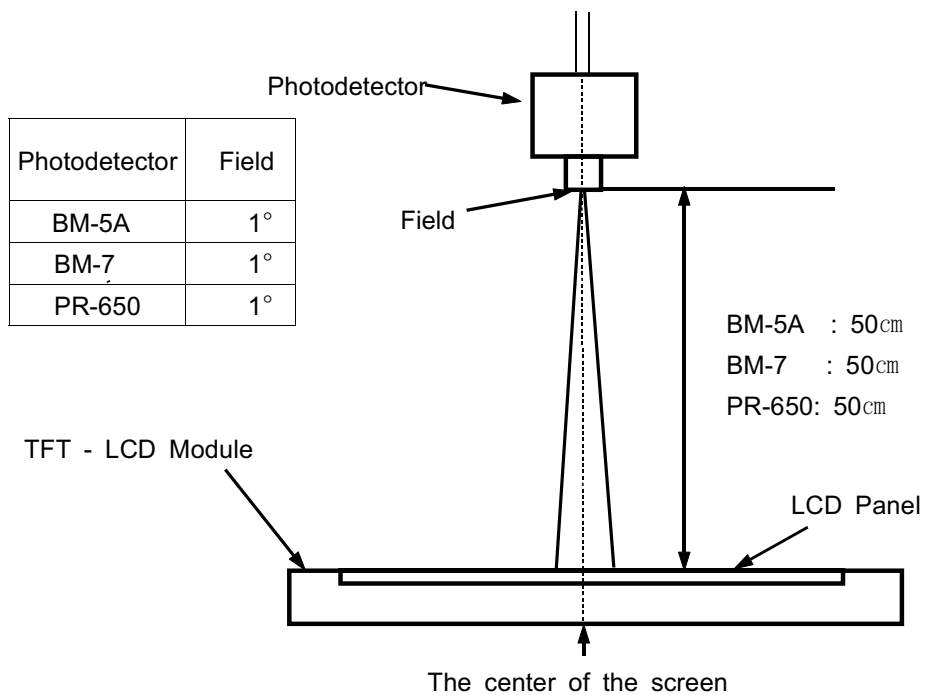
Note (1) The optical characteristics is measured with Back-light and Touch screen panel.

(2) If product is exposed to high temperatures for extended time, there is a possibility of the polarizer film damage which could degrade the optical characteristics.

Note (4) Test Equipment Setup for the Transmissive Mode (Back-light On)

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.

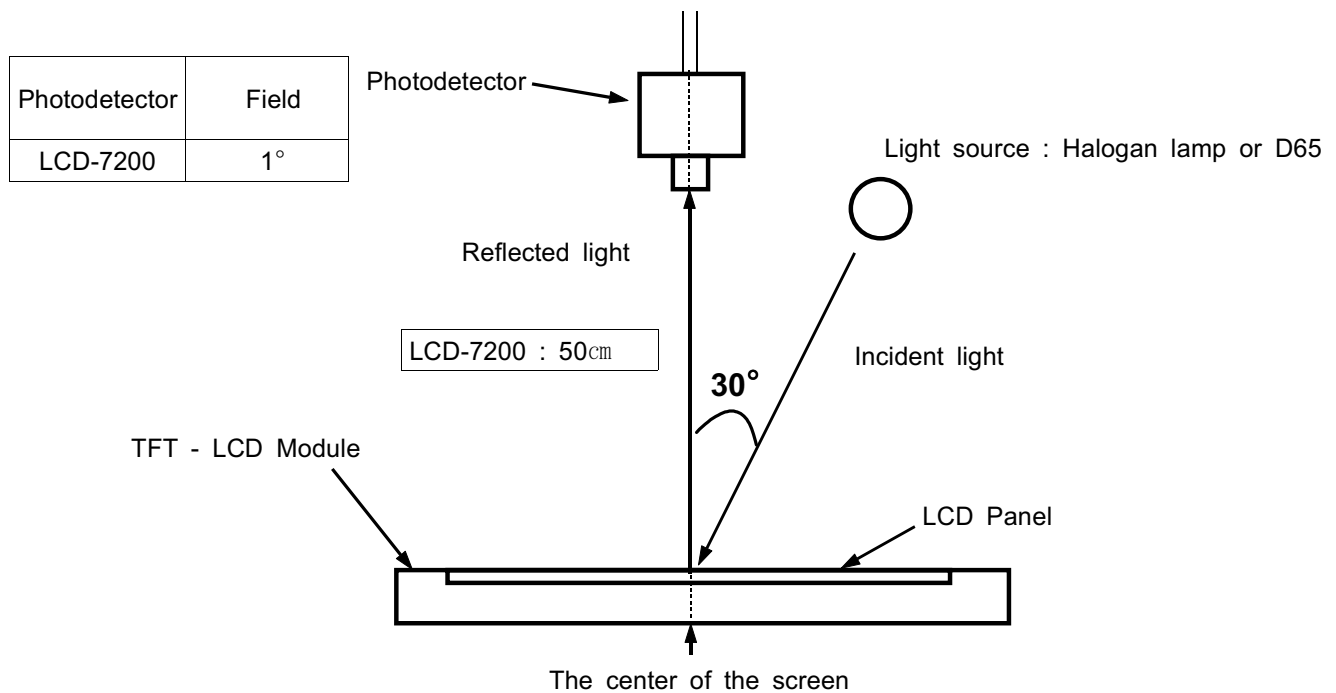
- Back-light Current : 15mA
- Back-Light On condition



Note (4) Test Equipment Setup for the Reflective Mode (Back-light Off)

After stabilizing and leaving the panel alone at a given temperature for 30min, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 30min after lighting of reference light source. The reflected light intensity should be measured in the center of screen. The incident angle of the light source is 30° to the normal direction where the photodetector is positioned.

- Back-Light Off Condition



Note (5) Definition of Reflectance : The reflectance is relative quantity to the standard white BaSO₄ or MgO plate that the reflectance of the standard white plate is the 100%.

$$\text{Reflectance} = \frac{\frac{\text{Intensity of the reflected light on LCD}}{\text{Intensity of the incident light on BaSO}_4 \text{ plate}}}{\frac{\text{Intensity of the reflected light on BaSO}_4 \text{ plate}}{\text{Intensity of the incident light on BaSO}_4 \text{ plate}}} \times 100\%$$

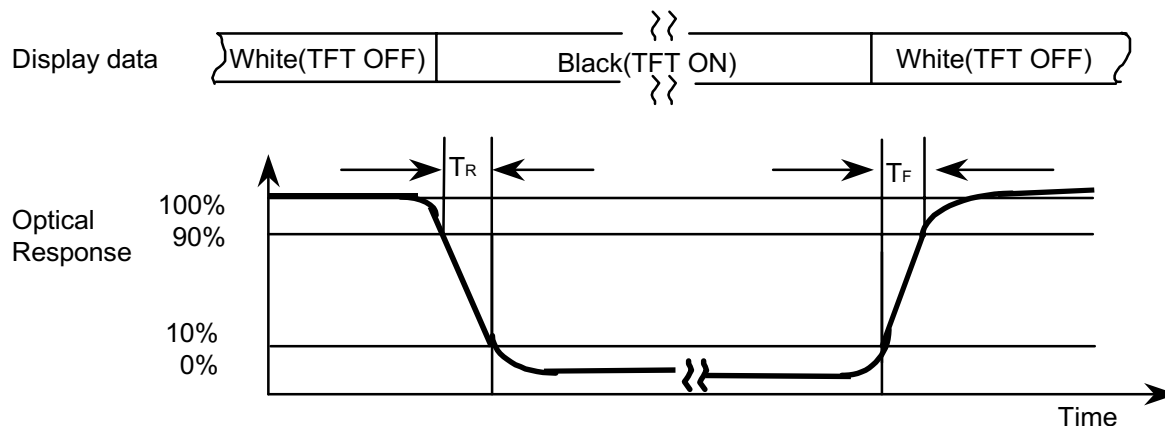
Note (6) Definition of Contrast Ratio (C/R) : Ratio of gray max (Gmax) & gray min (Gmin) at the center point of the panel. If Back-light is on state, it is the light source and the BM-5A will be used to measure.

$$C/R = \frac{G_{\max}}{G_{\min}}$$

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

Note (7) Definition of Luminance of White : Luminance of white at center point.
In this case, the incident light is not from the light source but from the Back-light that generates the reflected light source on LCD in the dark room.

Note (8) Definition of Response time : Sum of Tr ,Tf



Note (9) Definition of Color Chromaticity (CIE 1931), (Back-light: On)

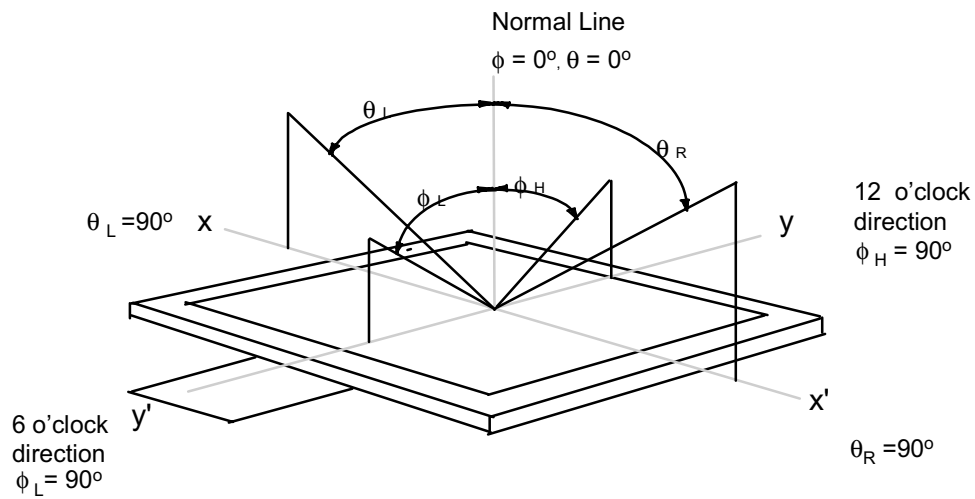
Note (10) Definition of Color Chromaticity (CIE 1931), (Back-light: Off)

Color coordinate of white at center point.

It should be measured at vertical direction on Back-light off state

* Light Source : D65.

Note (11) Definition of Viewing Angle : Viewing angle range ($CR \geq 2$)



3. Electrical Characteristics

3.1 TFT-LCD Module

(Ta = 25 ± 2°C)

Characteristics		Symbol	MIN.	TYP.	MAX.	Unit	Note
Digital supply voltage		DV _{DD}	3.0	3.3	3.6	V	
Analog supply voltage		AV _{DD}	4.7	5.0	5.3	V	
Gate On voltage		V _{ON}	15	18	20	V	
Gate Off voltage		V _{OFF}	-8	-10	-12	V	
Common voltage		V _{COMH(Vpp)}	3.6	4.0	4.4	V	
Digital supply current		I _{DVDD}	-	0.35	0.9	mA	
Analog supply current		I _{AVDD}	-	4	5	mA	
Gate supply current		I _{VON/VOFF}	-	0.3	0.5	mA	
Input voltage	Source driver (High)	V _{IHS}	0.8DV _{DD}	-	DV _{DD}	V	
	Source driver (Low)	V _{ILS}	GND	-	0.2DV _{DD}	V	
Power Dissipation	White	P _W	-	(30)	(40)	mW	(1),(2)
	Black	P _B	-	(35)	(45)	mW	
	Vertical	P _V	-	(35)	(45)	mW	

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

- Power On : DV_{DD} → AV_{DD} → V_{OFF} → V_{ON} → Data
- Power Off : Data → V_{ON} → V_{OFF} → AV_{DD} → DV_{DD}

Note (1) Condition : TFT-LCD module only with typ. electrical characteristics

- (2) Power dissipation check pattern
[240 x 320 Black patten]



3.2 Back-Light Unit

The Back-light system is an edge-lighting type with 6 white LED(Light Emitting Diode)s.
The characteristics of 6 white LEDs are shown in the following tables.

(Ta=25 ± 2°C)

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Note
Current	I _B	-	15	-	mA	(1)
Power Consumption	P _{BL}	240	300	360	mW	(2)

Note (1) 6 white LEDs serial type.

(2) Where $I_B = 15\text{mA}$, $V_B = P_{BL} / I_B$

4. Touch Screen Panel Specifications

4-1. Electrical Characteristics

Item	Min.	Typ.	Max.	Unit	Note
Linearity	-1.5	-	1.5	%	Analog X and Y directions
Terminal resistance	150	350	650	Ω	X(Glass side)
	180	370	730	Ω	Y(Film side)
Insulation resistance	20	-	-	M Ω	DC 25V
Voltage	-	5	7	V	DC
Chattering	-	12	15	ms	DC 5V, 100k Ω
Transparency	80	83	-	%	No anti-glare

Caution (1) : Do not operate it with a thing except a polyacetal pen(tip R0.8mm or less) or a finger, especially those with hard or sharp tips such as a ball point pen or a mechanical pencil.

4-2. Mechanical & Reliability Characteristics

Item	Min.	Typ.	Max.	Unit	Note
ITO glass	-	-	0.7	mm	Glass substrate material option
ITO plastic	-	-	0.4	mm	
ITO film	-	-	175	μ m	No anti-glare
Activation force	-	15	80	g	(1)
Durability-surface scratching	Write 120,000	-	-	Characters	(2)
Durability-surface hitting	1,000,000	-	-	touches	(3)
Durability-chemical	-	-	-	-	(4)
Operating pressure	-	-	-	-	(5)
Surface hardness	3	-	-	H	JIS K5400

Note (1) Stylus pen Input : R0.8mm polyacetal pen or Finger

(2) Measurement for Surface area

- Stylus Pen has a 20mm× 20mm area
- Force :250g
- Speed : 1000 characters/hour

(3) Each Touch by R0.8mm Stylus pen & 500gf load

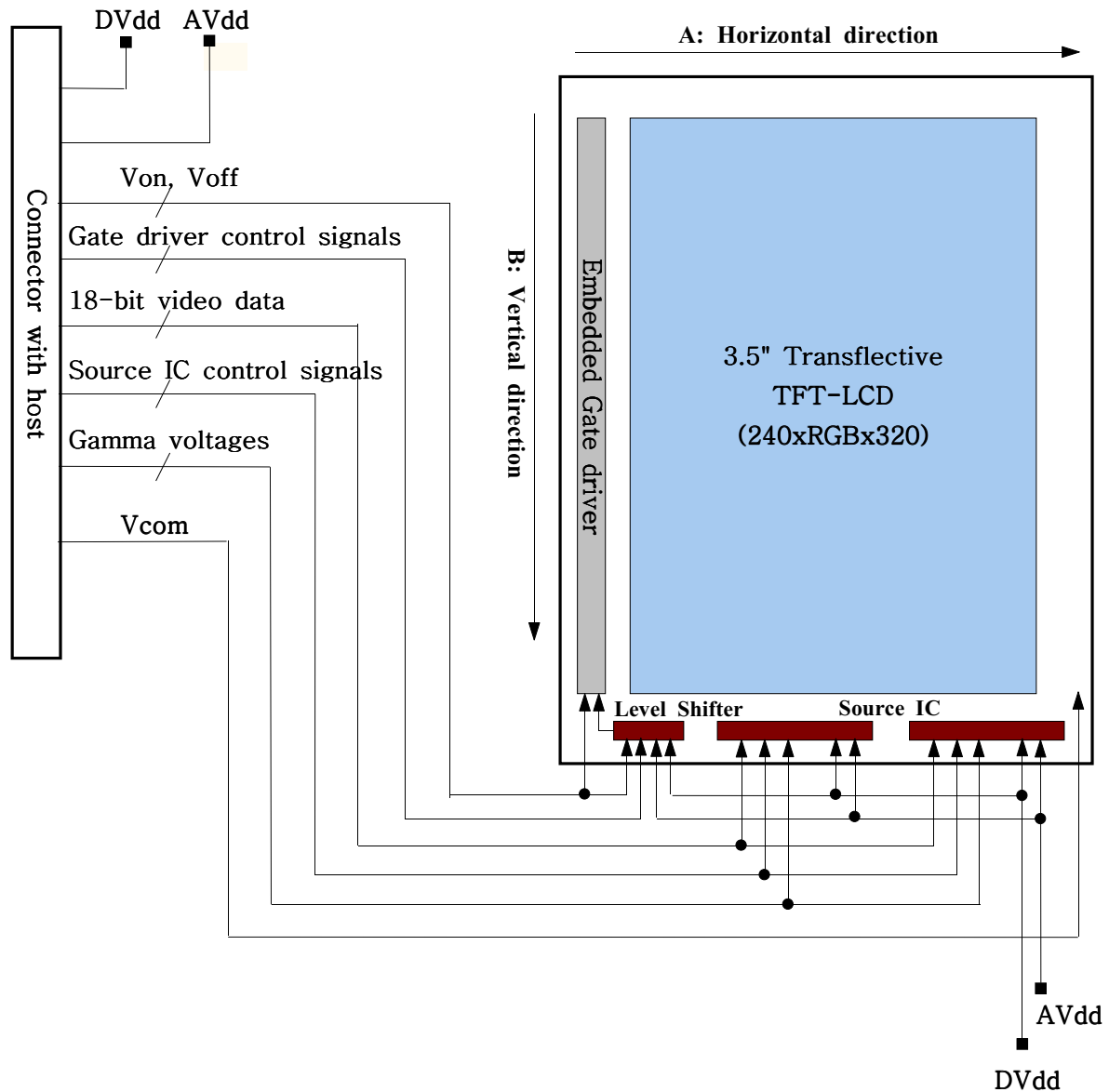
(4) After Dropping a drop of Toluene (or Acetone, Methanol, crude Ethanol), brushing with Fabrics for 3min. Don't be detected uneven point.

(5) Pen : 80g or less (R0.8mm)

Finger : 80g or less (R8.0mm)

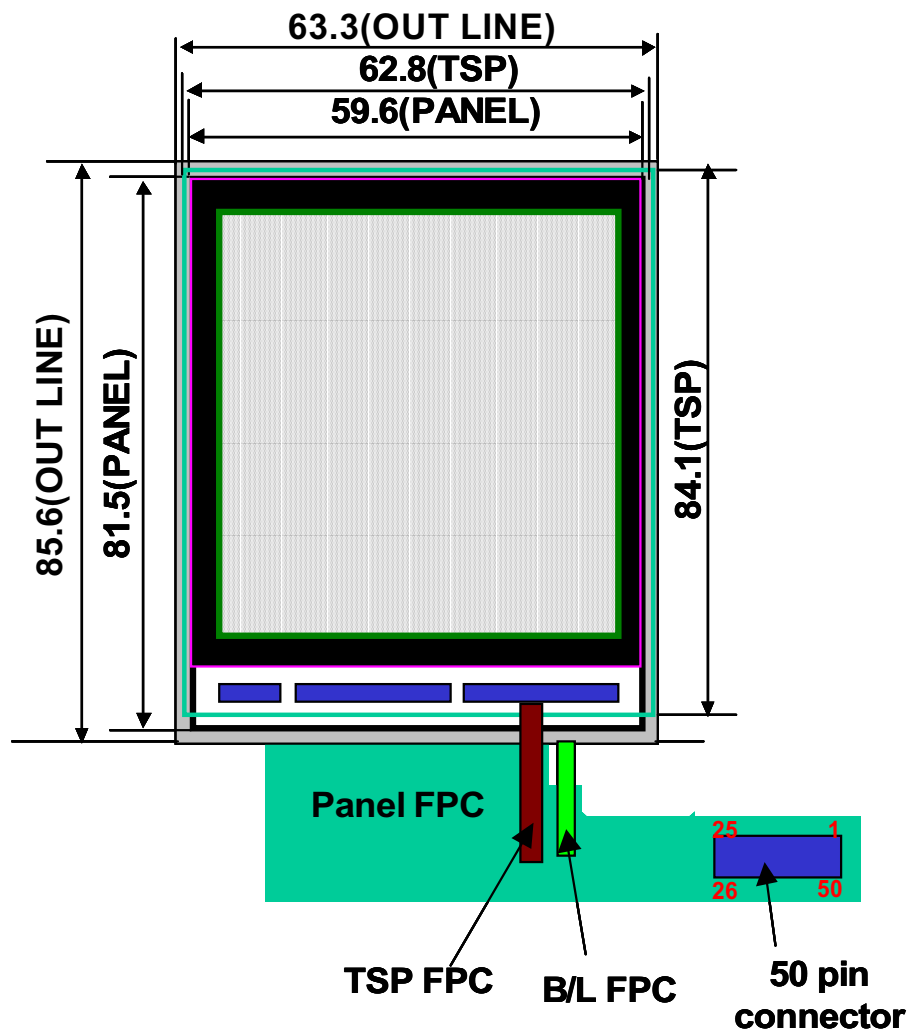
5. Block Diagram

5.1 TFT-LCD Block Diagram

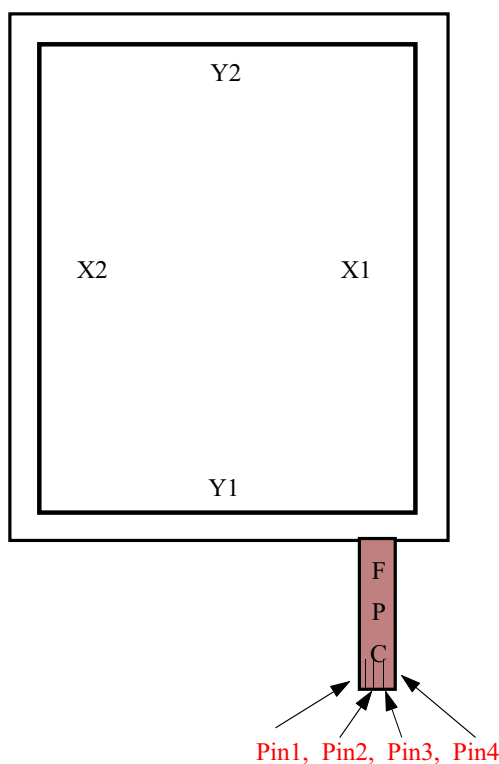


The scanning direction for the horizontal period and the vertical period are **A** and **B** respectively as shown upper diagram. The scanning directions are from a front view.

5.2 TFT-LCD Module Schematics

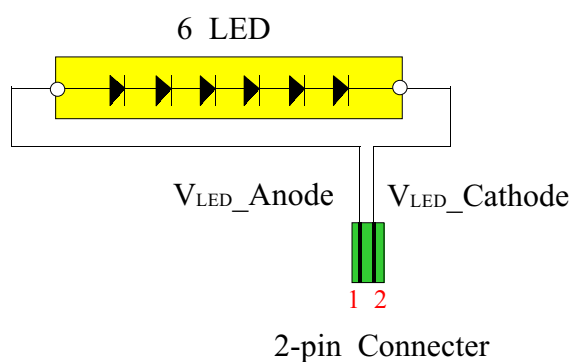


5.3 Touch Screen Panel (Front view)



Pin No.	Symbol	I/O
1	X2	X_Left
2	Y1	Y_Bottom
3	X1	X_Right
4	Y2	Y_Up

5.4 Back-light Unit (Front view)



Pin No.	Symbol	I/O
1	LED_ANODE	Anode
2	LED_CATHODE	Cathode

6. Input Terminal Pin Assignment

6.1 TFT-LCD Module (Connector : 50Pin ↔ KYOCERA 20 5602 050 001 829)

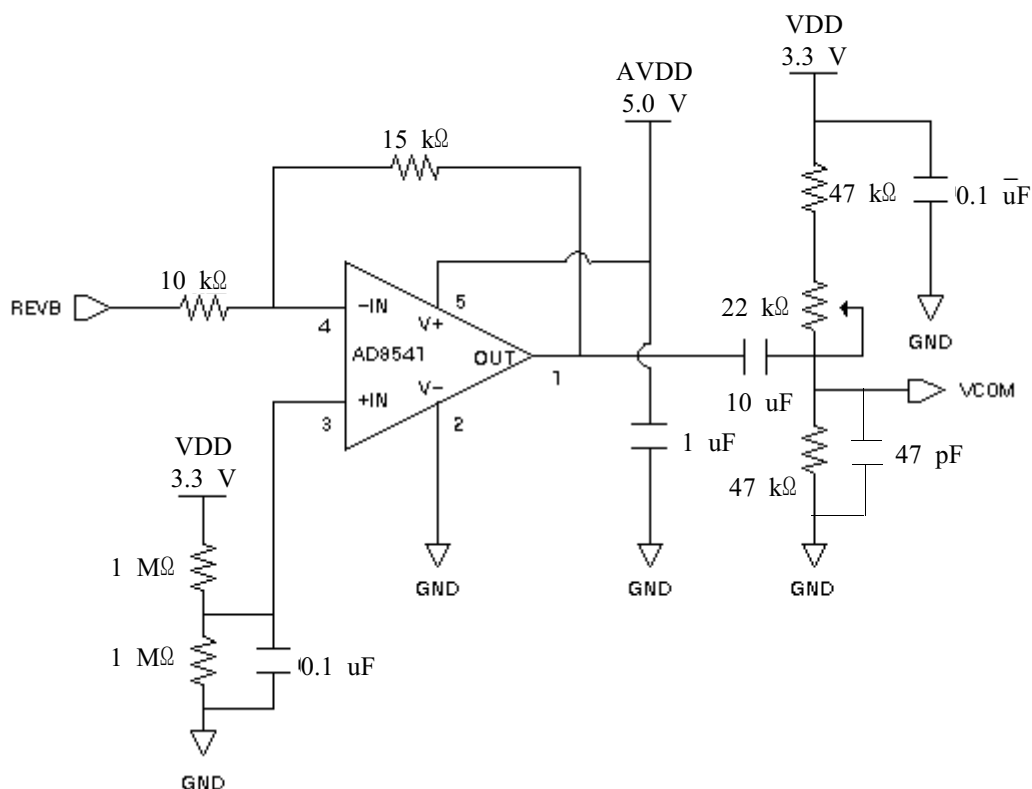
Pin No	Symbol	Description	Remark
1	V _{OFF}	Power Supply (Gate OFF)	-
2	V _{OFF}	Power Supply (Gate OFF)	-
3	NC	No Connection	-
4	NC	No Connection	-
5	V _{ON}	Power Supply (Gate ON)	-
6	V _{ON}	Power Supply (Gate ON)	-
7	AV _{SS}	Ground (Analog)	-
8	AV _{SS}	Ground (Analog)	-
9	AV _{DD}	Power Supply (Analog)	-
10	AV _{DD}	Power Supply (Analog)	-
11	DV _{DD}	Power Supply (Digital)	-
12	DV _{DD}	Power Supply (Digital)	-
13	DV _{SS}	Ground (Digital)	-
14	DV _{SS}	Ground (Digital)	-
15	V _{COM}	Common Voltage	(1)
16	V _{COM}	Common Voltage	
17	STV	Vertical Start Pulse	-
18	CKV	Vertical Shift Clock	-
19	DV _{SS}	Ground (Digital)	-
20	STH	Horizontal Start Pulse	-
21	R0	Red Pixel Data (LSB)	-
22	R1	Red Pixel Data	-
23	R2	Red Pixel Data	-
24	R3	Red Pixel Data	-
25	R4	Red Pixel Data	-
26	R5	Red Pixel Data (MSB)	-
27	G0	Green Pixel Data (LSB)	-
28	G1	Green Pixel Data	-
29	G2	Green Pixel Data	-
30	G3	Green Pixel Data	-
31	G4	Green Pixel Data	-
32	G5	Green Pixel Data (MSB)	-
33	HCLK	Horizontal Sampling Clock	-
34	INV	Digital Data Inversion	(2)

Pin No	Symbol	Description	Remark
35	VREF0	Gray Scale Voltage0	(2)
36	VREF1	Gray Scale Voltage1	
37	VREF2	Gray Scale Voltage2	
38	VREF3	Gray Scale Voltage3	
39	VREF4	Gray Scale Voltage4	
40	VREF5	Gray Scale Voltage5	
41	VREF6	Gray Scale Voltage6	
42	LD	Source Driver Data Load Pulse	-
43	B0	Blue Pixel Data (LSB)	-
44	B1	Blue Pixel Data	-
45	B2	Blue Pixel Data	-
46	B3	Blue Pixel Data	-
47	B4	Blue Pixel Data	-
48	B5	Blue Pixel Data (MSB)	-
49	NC	No Connection	-
50	NC	No Connection	-

Note (1) Recommended VCOM generator circuit

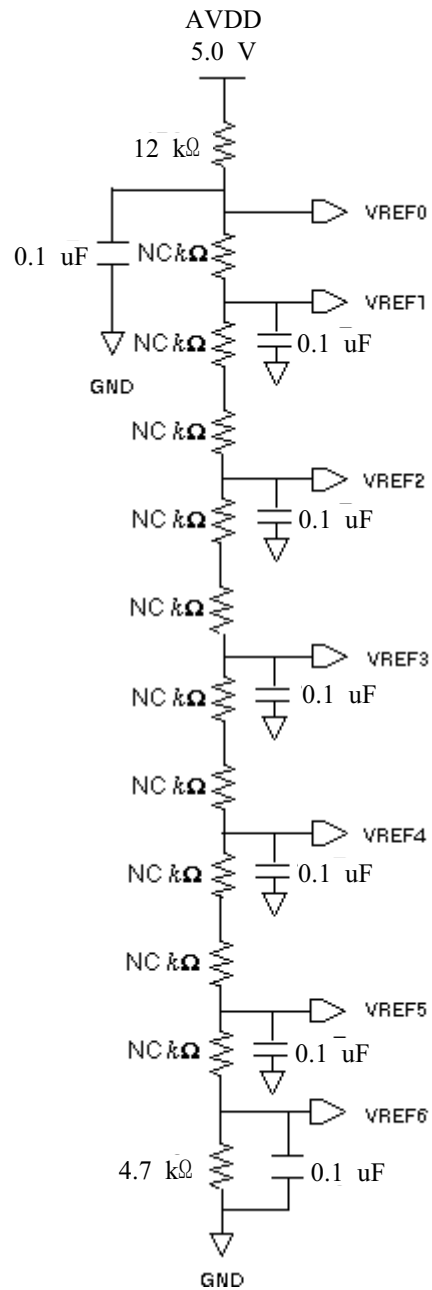
Recommended circuits could not be optimal circuits and could be modified by user.

REVB : Timing control IC output signal



Note (2) Recommended Gray scale voltage generator circuit

Recommended circuits could not be optimal circuits and could be modified by user.



※ The above Circuit can be changed for improving the product efficiency or performance

6.2 Back-Light Unit (Connector : 2 pin FPC type)

Pin No.	Symbol	Function
1	LED_ANODE	LED Anode
2	LED_CATHODE	LED Cathode

6.3 Touch Screen Panel (Connector : 4Pin FPC type)

Pin No.	Symbol	I/O	Function
1	X2	X_Left	X axis position - differential analog
2	Y1	Y_Bottom	Y axis position - differential analog
3	X1	X_Right	X axis position - differential analog
4	Y2	Y_Up	Y axis position - differential analog

6.4 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	G0	G1	G2	G3	G4	G5	B0	B1	B2	B3	B4		B5
BASIC COLOR	BLACK	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	1	1	1	1	1	1	-
	GREEN	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	-
	CYAN	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	-
	RED	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	-
	MAGENTA	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1	-
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	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	-
GRAY SCALE OF RED	BLACK	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	R1
		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R3~R60
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	R61	
	LIGHT ↓	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	R62
		RED	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	R63
GRAY SCALE OF GREEN	BLACK	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	1	0	0	0	0	0	0	0	0	0	0	0	G1
		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	G2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	G3~G60
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0	0	0	G61	
	LIGHT ↓	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	G62
		GREEN	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	G63
GRAY SCALE OF BLUE	BLACK	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	1	0	0	0	0	0	B1
		0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	B2
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3~B60
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	B61	
	LIGHT ↓	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	B62
		BLUE	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	B63

Note) Definition of Gray :

R_n : Red Gray, G_n : Green Gray, B_n : Blue Gray (n = Gray level)

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

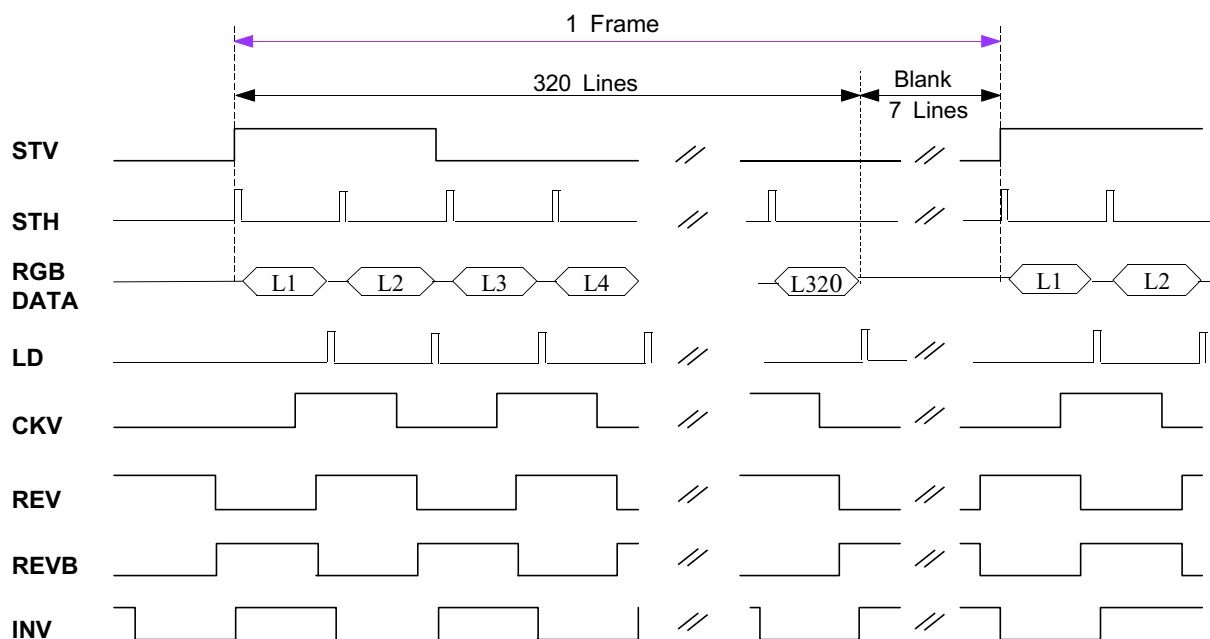
※R5,G5,B5 : MSB R0,G0,B0 : LSB

7. Interface Timing

7.1 Timing Parameters of TFT-LCD Module Input Signals

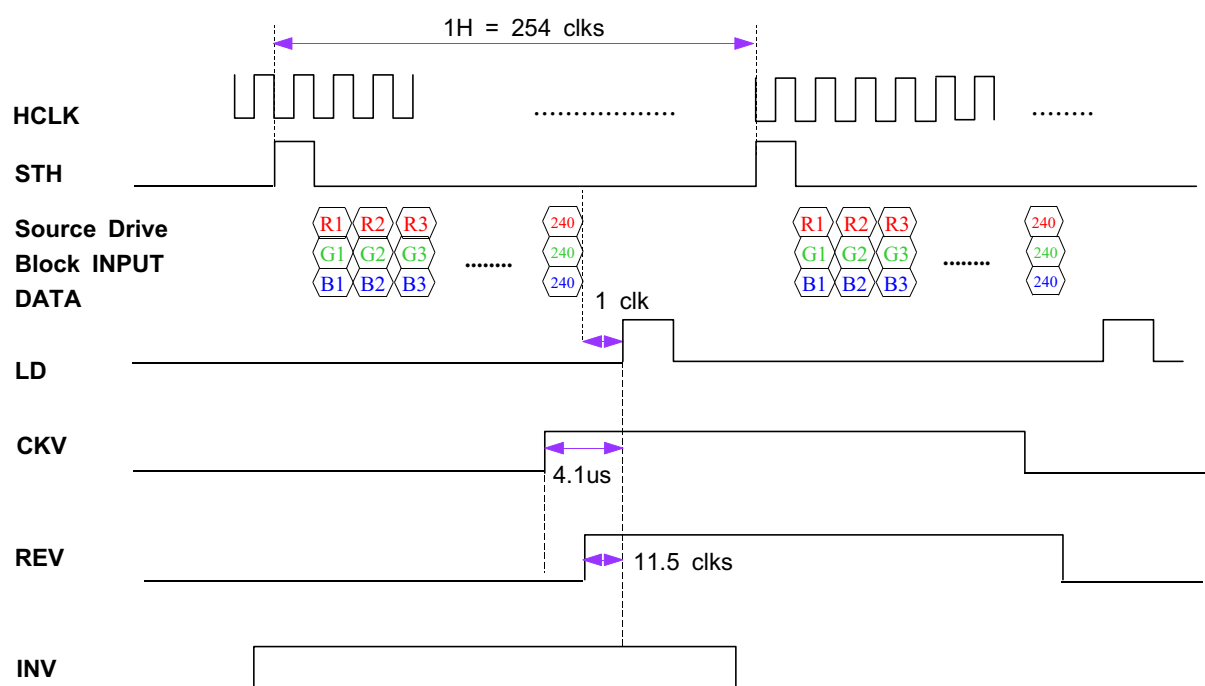
ITEM	Symbol	MIN.	TYP.	MAX.	Unit
HCLK frequency	$1/t_{HCLK}$	-	5.0	-	MHz
HCLK pulse low width	t_{WL1}	$0.5t_{HCLK}$	-	-	-
HCLK pulse high width	t_{WH1}	$0.5t_{HCLK}$	-	-	-
STH setup time	t_{ST1}	15	-	-	ns
STH hold time	t_{HD1}	15	-	-	ns
LD setup time	t_{ST2}	15	-	-	ns
LD hold time	t_{HD2}	15	-	-	ns
INV setup time	t_{ST3}	15	-	-	ns
INV hold time	t_{HD3}	15	-	-	ns
STV setup time	t_{ST4}	100	-	-	ns
STV hold time	t_{HD4}	300	-	-	ns
CKV cycle	t_{CPV}	2	-	-	μs
CKV pulse low width	t_{WL2}	500	-	-	ns
CKV pulse high width	t_{WL2}	500	-	-	ns

7.2 Timing Diagrams of Interface Signal



☆ The phase of REV & REVB inverse at the first Line of each frame

Vertical Timing Chart



Horizontal Timing Chart

Note (1) Vsync, Hsync, DE, Data Input : Timing control IC input signals

REV, REVB : Timing control IC output signals

INV : TFT-LCD module input signal

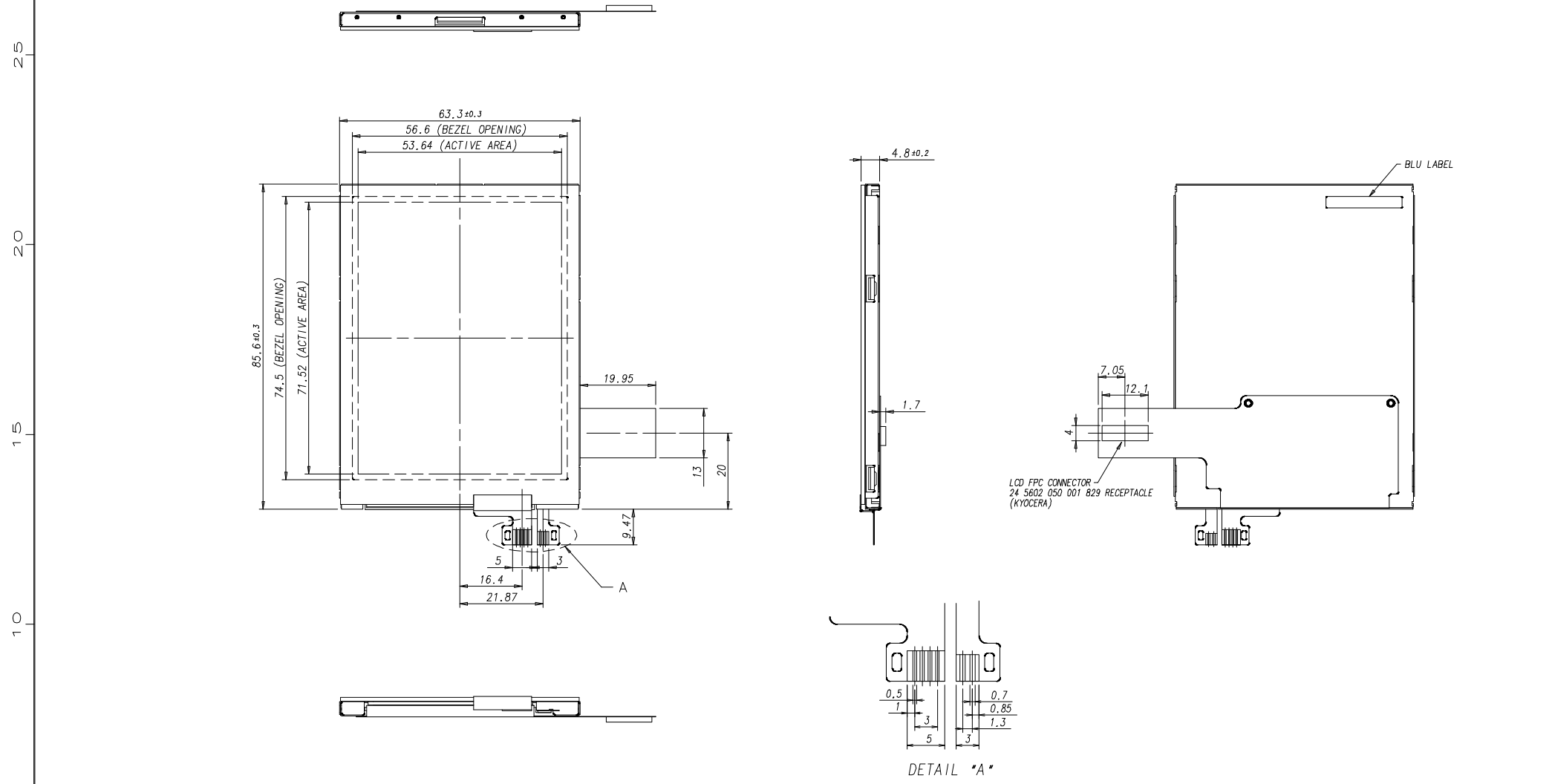
Others : Timing control IC output and TFT-LCD module input signals

8. Outline Dimensions

8.1 Module Outline Dimensions (Total Assa'y)

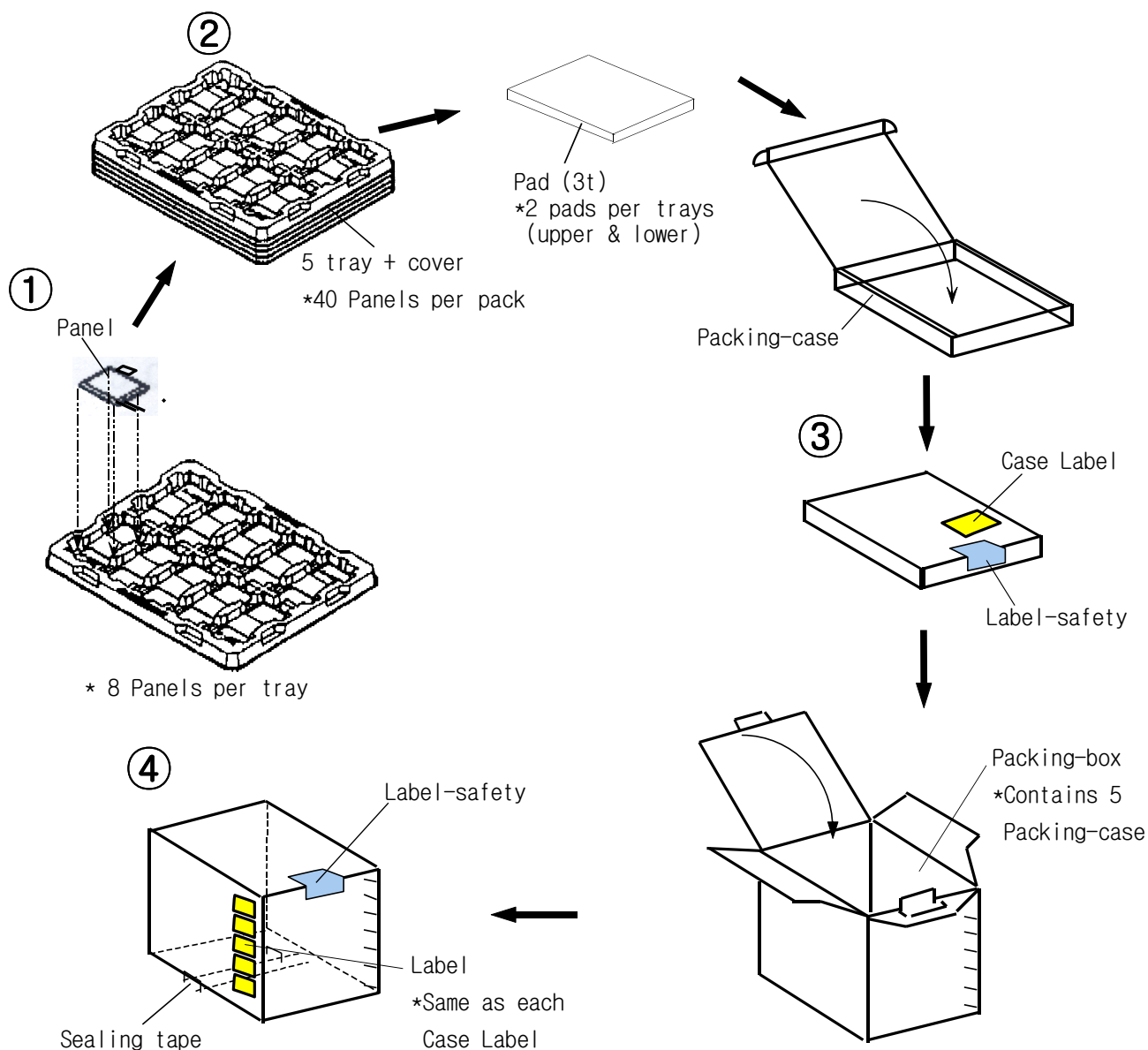
- Refer to the Next Page.

NO	PART NAME	CODE NO	SPECIFICATION	Q'TY	WEIGHT		UNFOLDED DIM. OF. MATERIAL	REMARK
					FINISH	MATERIAL		
1	Outline Dimension							



REVISION	Preliminary	GENERAL TOLERANCE				REV	DATE	DESCRIPTION OF REVISION				REASON		CHG'D BY	
		STEP	LEVEL 1	LEVEL 2	LEVEL 3	UNIT	mm	DRA'N BY	DES'D BY	CHK'D BY	APP'D BY	MODEL NAME	LTS350Q1-PE1		
		0 < X ≤ 4	±0.05	±0.1	±0.2	SCALE	/	J.K.KIM			I.S.LEE	PART/SHEET NAME	Outline Dimension	SHEET	1/1
		4 < X ≤ 16	±0.08	±0.15	±0.3	TOLERANCE		2002. 11. 22		.	2002. 11. 22				
		16 < X ≤ 64	±0.12	±0.25	±0.5	SAMSUNG ELECTRONICS				SPEC. NO	CODE NO.		VER.	000	
		64 < X ≤ 256	±0.25	±0.4	±0.8										
		www.DataSheet4U.com													

9. Packing



Note (1) Total : Case: Approx. 2.7 Kg

Box: Approx. 13.6 Kg

(2) Size : Case: 490(W) x 342(D) x 58(H)

Box: 505(W) x 355(D) x 319(H)

(3) Pad Material : Polyethylene Foam T=3.0

(4) Resistance of tray surface : $10^3 \sim 10^6 \Omega$

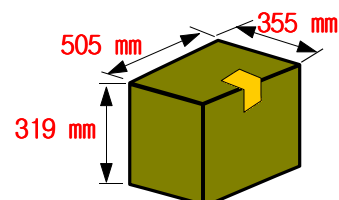
(5) ESD of tray surface : 20~100V

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

(7) Place 3 tray and cover(empty tray) and pads inside the packing-case.

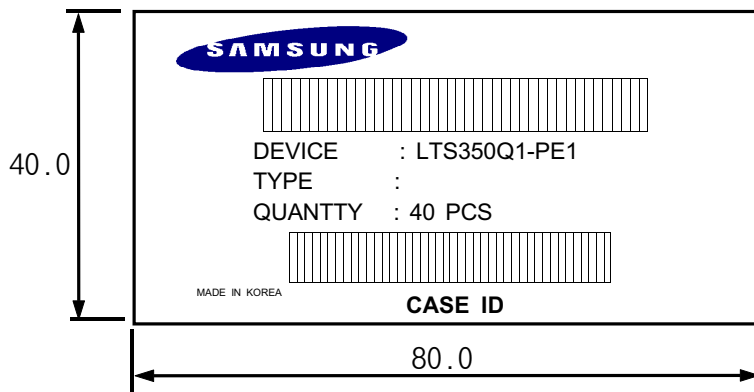
(8) Place 5 packing-case inside the packing-box.(Affix the label)

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

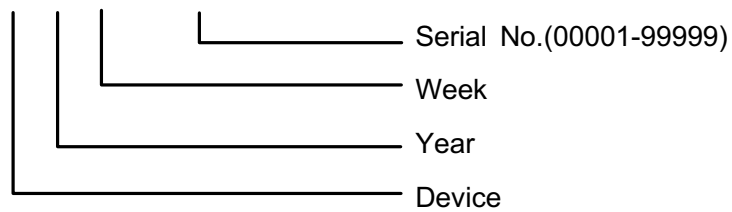


10. Marking & Others

(1) Packing case attach



CASE ID : NA 0 00 00001



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 item 3.1 "Power on/off sequence"

11.4 Others

- (a) The liquid-crystal is deteriorated by ultraviolet rays. Do not leave it in direct sunlight and strong ultraviolet rays 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.