



ELECTRONICS

Preliminary

TO :

DATE : December. 08. 2004

SAMSUNG TFT-LCD

MODEL NO.:LTP400WQ-F02

NOTE :

Any Modification of Spec is not allowed without SEC's permission.

APPROVED BY :

PREPARED BY : Mobile Display R&D Team, AMLCD Division

SAMSUNG ELECTRONICS CO., LTD.



Doc.No.	LTP400WQ-F02	Rev.No	000	Page	1 /24
---------	--------------	--------	-----	------	-------

CONTENTS

Revision History	----- (3)
General Description	----- (4)
1. Absolute Maximum Ratings	----- (5)
1.1 Absolute Ratings Of Environment	
1.2 Electrical Absolute Ratings	
2. Optical Characteristics	----- (7)
3. Electrical Characteristics	----- (10)
3.1 TFT LCD Module	
3.2 Back-light Unit	
4. Block Diagram	----- (12)
4.1 TFT LCD Module	
4.2 Back-light Unit	
5. Input Terminal Pin Assignment	----- (13)
5.1 Input Signal & Power	
5.2 Input Signals, Basic Display Colors and Gray Scale of Each Color.	
5.3 Pixel format	
6. Interface Timing	----- (16)
6.1 Timing Parameters	
6.2 Power ON/OFF Sequence	
7. Outline Dimension	----- (20)
8. Packing	----- (21)
9. Markings & others	----- (22)
9.1 Module attach	
10. General Precautions	----- (23)

Revision History

Preliminary

Date	Rev.No.	Page	Summary
Dec. 8. 2004	000		Rev.000 was first issues.

Doc.No.	LTP400WQ-F02	Rev.No	000	Page	3 /24
---------	--------------	--------	-----	------	-------

GENERAL DESCRIPTION

DESCRIPTION

LTP400WQ-F02 is a 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 panel, a driver circuit and a back-light system. The resolution of a 4.0 " Contains 480 x 272 pixels and can display up to 16,777,216colors. 6 o'clock direction is the optimum viewing angle.

FEATURES

- High Brightness
- High contrast ratio
- 8Bits color depth
- WQVGA (480 x 272 pixels) resolution
- Low power consumption
- DE(Data enable) mode, SYNC mode

APPLICATIONS

- PMP(Personal Multimedia Player), MP3 application product
- Display terminals for AV application products

GENERAL INFORMATION

ITEM	SPECIFICATION	UNIT	NOTE
Display area	87.84(H) x 49.776(V) (4.0" diagonal)	mm	
Driver element	a-Si TFT active matrix		
Display colors	16,777,212		
Number of pixel	480×RGB(H) x 272(V)	pixel	
Pixel arrangement	RGB vertical stripe		
Pixel pitch	0.183(H) x 0.183(V) (TYP.)	mm	138ppi
Display Mode	Normally white		
Surface treatment	Haze (25), Hard-Coating 3H		

MECHANICAL INFORMATION

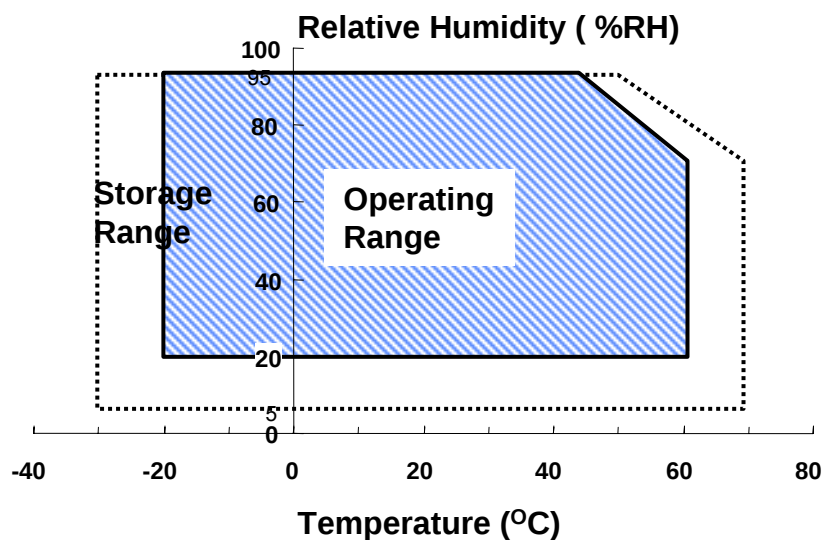
ITEM		MIN.	TYP.	MAX.	UNIT
Module size	Horizontal (H)	98.1	98.3	98.5	mm
	Vertical (V)	62.4	62.6	62.8	mm
	Depth (D)	5.05	5.25	5.45	mm
Weight		-	51.88		g

1. ABSOLUTE MAXIMUM RATINGS

1.1 ABSOLUTE RATINGS OF ENVIRONMENT

ITEM	SYMBOL	MIN.	MAX.	UNIT	NOTE
Storage temperature	T_{STG}	-30	70	°C	(1)
Operating temperature (Temperature of glass surface)	T_{OPR}	-20	60	°C	(1)

Note (1) Temperature and relative humidity range are shown in the figure below.
 95 % RH Max. ($50^{\circ}\text{C} \geq T_a$)
 Maximum wet - bulb temperature at 39°C or less. ($T_a > 50^{\circ}\text{C}$) No condensation.



1.2 ELECTRICAL ABSOLUTE RATINGS**(1) TFT LCD MODULE**(V_{ss} = GND = 0 V)

ITEM	SYMBOL	MIN.	MAX.	UNIT	NOTE
Logic Input Voltage	VDD	2.3	2.7	V	(1)
Analog Input Voltage	AVDD5	4.8	5.2	V	(1)

NOTE (1) Within Ta = 25 ± 2 °C

(2) BACK-LIGHT UNIT

Ta = 25 ± 2 °C

ITEM	SYMBOL	MIN.	MAX.	UNIT	NOTE
Lamp current	IB	-	25	mA	(1)

NOTE (1) Permanent damage to the device may occur if maximum values are exceeded or reverse voltage loaded.
Functional operation should be restricted to the conditions described under Normal Operating Conditions.

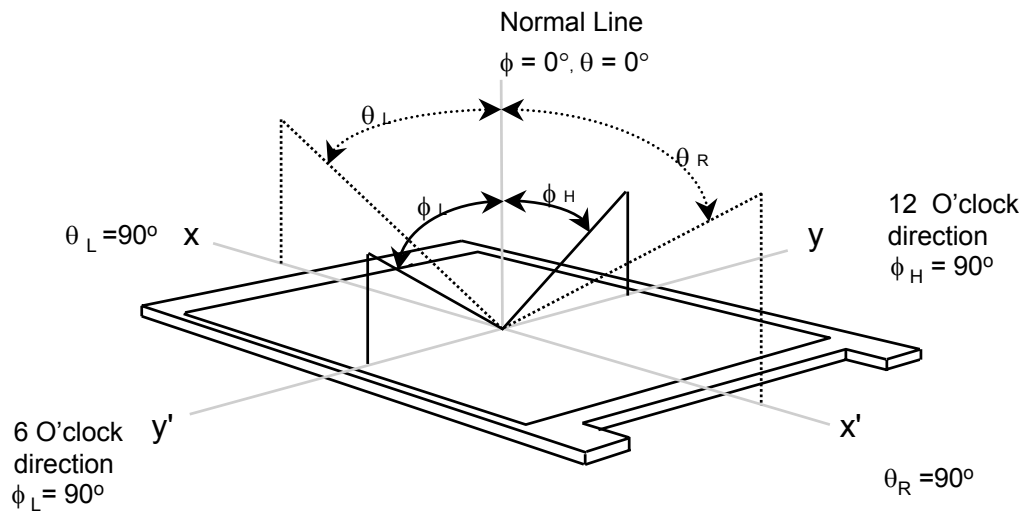
2. OPTICAL CHARACTERISTICS

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 (5).
Measuring equipment : TOPCON BM-5A,EZ-CONTRAST

* Ta = $25 \pm 2^{\circ}\text{C}$, VDD=2.5V, fv= 60Hz, fdCLK=9.0MHz, IL = 20mA

ITEM		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Contrast Ratio (1 Points)		CR	$\phi = 0,$ $\theta = 0$ Normal Viewing Angle	150	200			(1), (2), (5)
Response Time at Ta	Rising	T _R		-	10	15	msec	(1), (3)
	Falling	T _F		-	25	30		
Luminance of White (center)		Y _L		150	180		cd/m ²	(1), (4), (5)
Color Chromaticity (CIE)	Red	R _X			0.5815			(1), (5)
		R _Y			0.3295			
	Green	G _X			0.349			
		G _Y			0.565			
	Blue	B _X			0.1545			
		B _Y			0.1327			
	White	W _X			0.304			
		W _Y			0.332			
	Viewing Angle	Hor.	θ_L	CR ≥ 10		68	-	
θ_R					69	-		
Ver.		ϕ_H			53	-		
		ϕ_L			59	-		
5 Points White Variation		δ L		-	87.22		%	(6) Ez-contrast

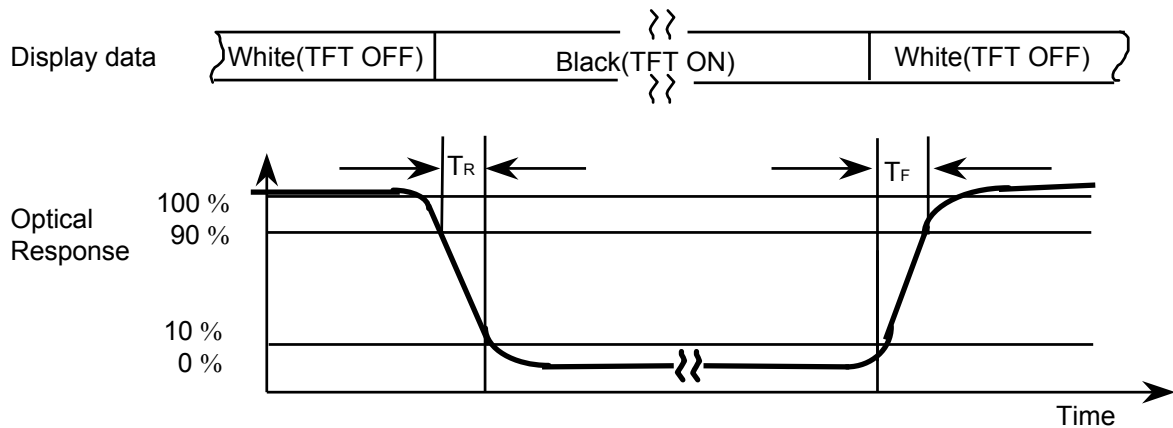
Note 1) Definition of Viewing Angle : Viewing angle range($10 \leq C/R$)



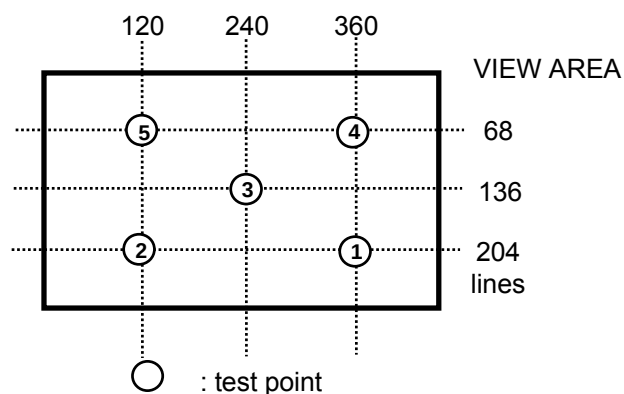
Note 2) Definition of Contrast Ratio (CR) : Ratio of gray max (Gmax) ,gray min (Gmin) at center point

$$CR = \frac{\text{gray max (Gmax)}}{\text{gray min (Gmin)}}$$

Note 3) Definition of Response time :



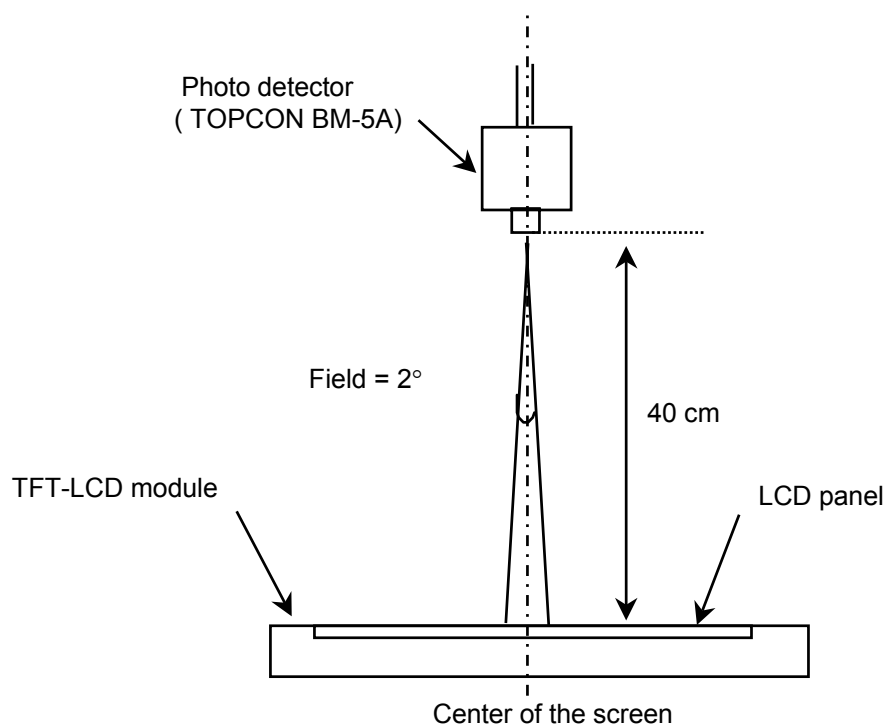
Note 4) Definition of Luminance of White : measure the luminance of white at center point(@)



Note 5) After stabilizing and leaving the panel alone at a given temperature for 30 minutes, the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. This should be measured in the center of screen.

LED current : 20 mA

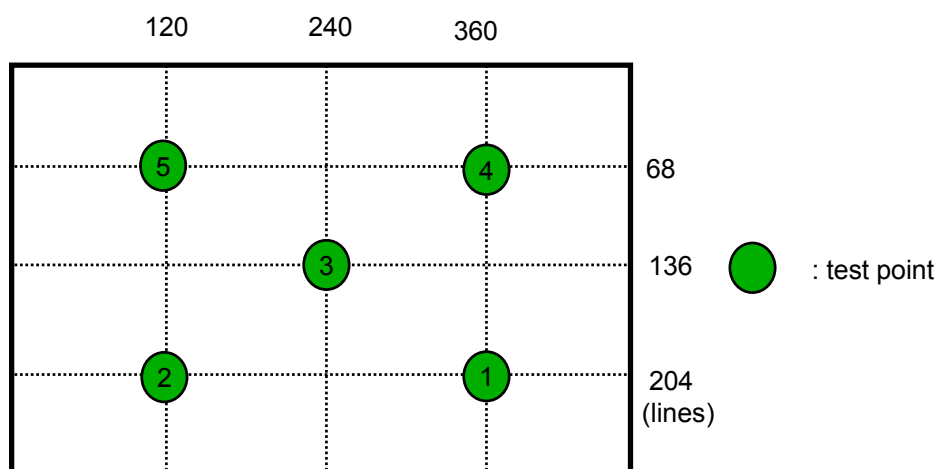
Environment condition : $T_a = 25 \pm 2 \text{ }^{\circ}\text{C}$



Optical characteristics measurement setup

Note 6) Definition of 5 points white variation (δL) [~]

$$\delta L = \frac{\text{Minimum luminance of 5 points}}{\text{Maximum luminance of 5 points}} \times 100 (\%)$$



3. ELECTRICAL CHARACTERISTICS

Preliminary

3.1 TFT LCD MODULE

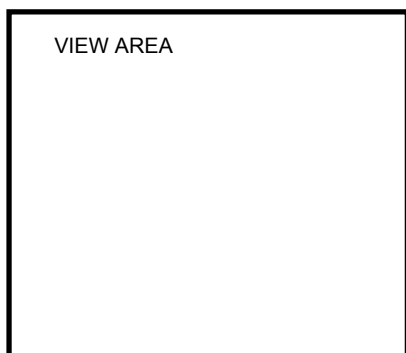
Ta = 25 ± 2°C

ITEM		SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Logic Supply Voltage		VDD	2.3	2.5	2.7	V	
Analog Supply Voltage		AVDD5	4.8	5.0	5.2	V	
Vsync Frequency		f _v		59.94		Hz	
Hsync Frequency		f _H		17.14		kHz	
Main Frequency		f _{DCLK}		9.0	15.0	MHz	
Power Consumption	White			47		mW	(1),(2)
	Black			78.75		mW	

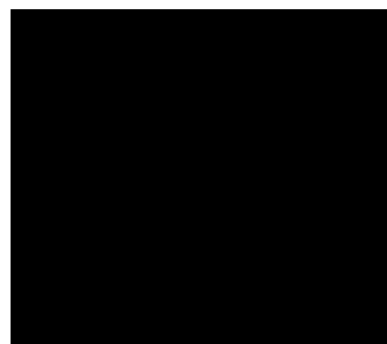
Note (1) f_v=60Hz, f_{DCLK} = 9.0MHZ, VDD = 2.5V , AVDD5 = 5.0V, DC Current.

(2) Power dissipation check pattern

*a) White Pattern



*b) Black Pattern



3.2 BACKLIGHT UNIT

Preliminary

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

$T_a=25 \pm 2^{\circ}\text{C}$

ITEM	SYMB	MIN	TYP	MAX	UNIT	NOTE
LEDs Current	IB	-	20	25	mA	(1)
Power Consumption	PBL	-	(372)	(500)	mW	(2)

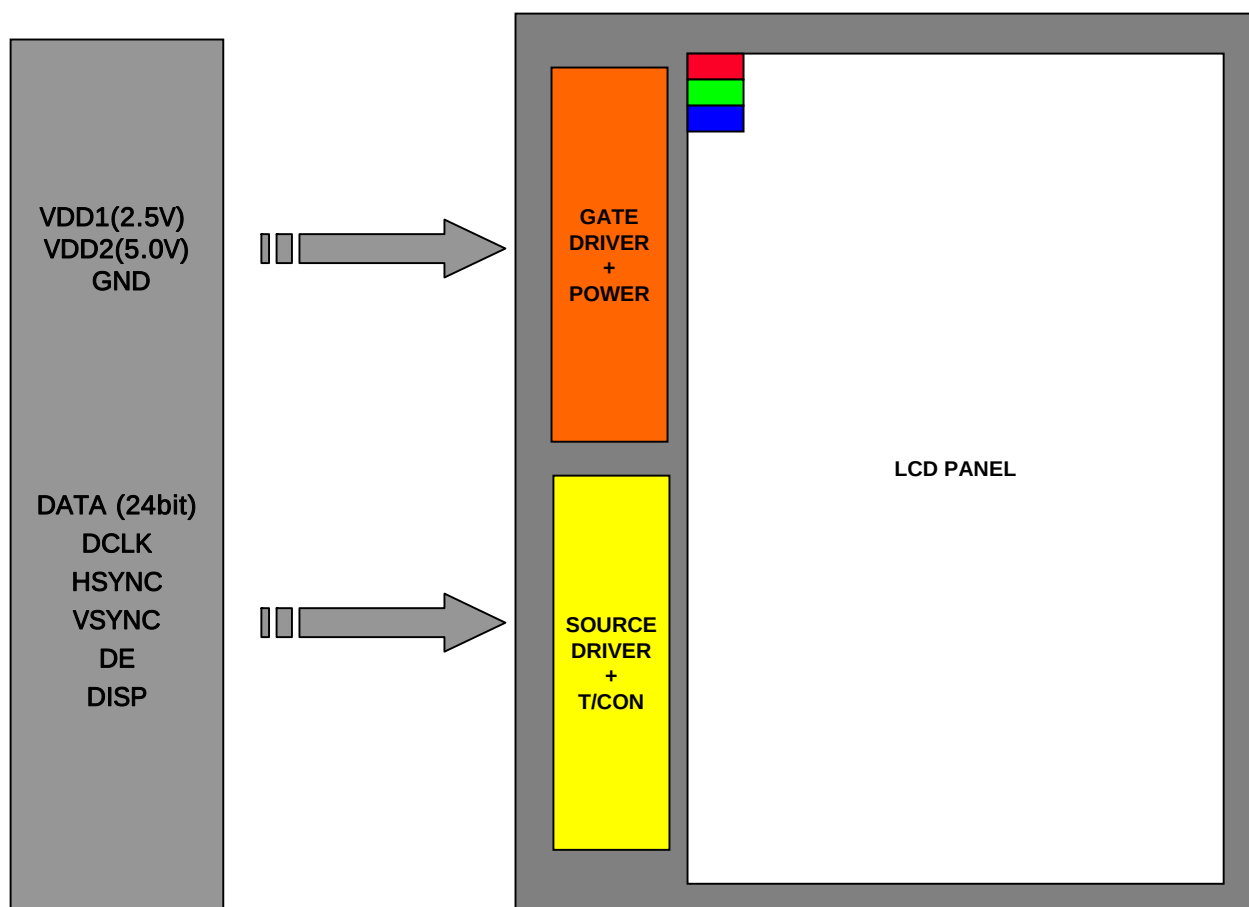
Note

(1) Six LEDs serial type

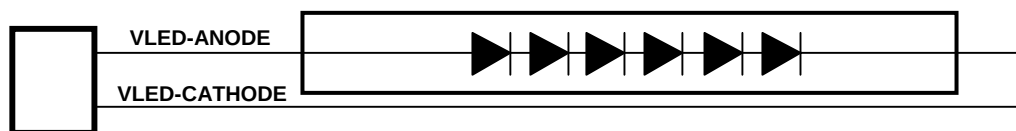
(2) Where $IB = 15\text{mA}$ & 20mA , $VB = PBL / IB$

4. BLOCK DIAGRAM

4.1 TFT LCD MODULE



4.2 BACKLIGHT UNIT



5. INPUT TERMINAL PIN ASSIGNMENT

5.1. Input Signal & Power (connector type ; 40pin / 0.5mm pitch / Top contact) - kyocera elco : 6212 series, Molex connector : 51296 series

Pin NO	Symbol	Description	Remark	Pin NO	Symbol	Description	Remark
1	VSS	Ground		21	B0	Blue data(LSB)	
2	VSS	Ground		22	B1	Blue data	
3	VDD	POWER SUPPLY(+2.5V)		23	B2	Blue data	
4	VDD	POWER SUPPLY(+2.5V)		24	B3	Blue data	
5	R0	Red data(LSB)		25	B4	Blue data	
6	R1	Red data		26	B5	Blue data	
7	R2	Red data		27	B6	Blue data	
8	R3	Red data		28	B7	Blue data(MSB)	
9	R4	Red data		29	VSS	Ground	
10	R5	Red data		30	PCLK	Pixel clock	
11	R6	Red data		31	DISP	Display on/off	
12	R7	Red data(MSB)		32	HSYNC	Horizontal Sync Signal	
13	G0	Green data(LSB)		33	VSNC	Vertical Sync Signal	
14	G1	Green data		34	DE	Data Enable	
15	G2	Green data		35	AVDD5	Power supply(+5V)	
16	G3	Green data		36	AVDD5	Power supply(+5V)	
17	G4	Green data		37	VSS	Ground	
18	G5	Green data		38	VSS	Ground	
19	G6	Green data		39	VLED-	LED Voltage(LED cathode)	
20	G7	Green data(MSB)		40	VLED+	LED Voltage(LED anode)	

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		
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:				
	↓ 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		
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:				
	↓ 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		
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:				
	↓ Light	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	B253		
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	B254		
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	B255		

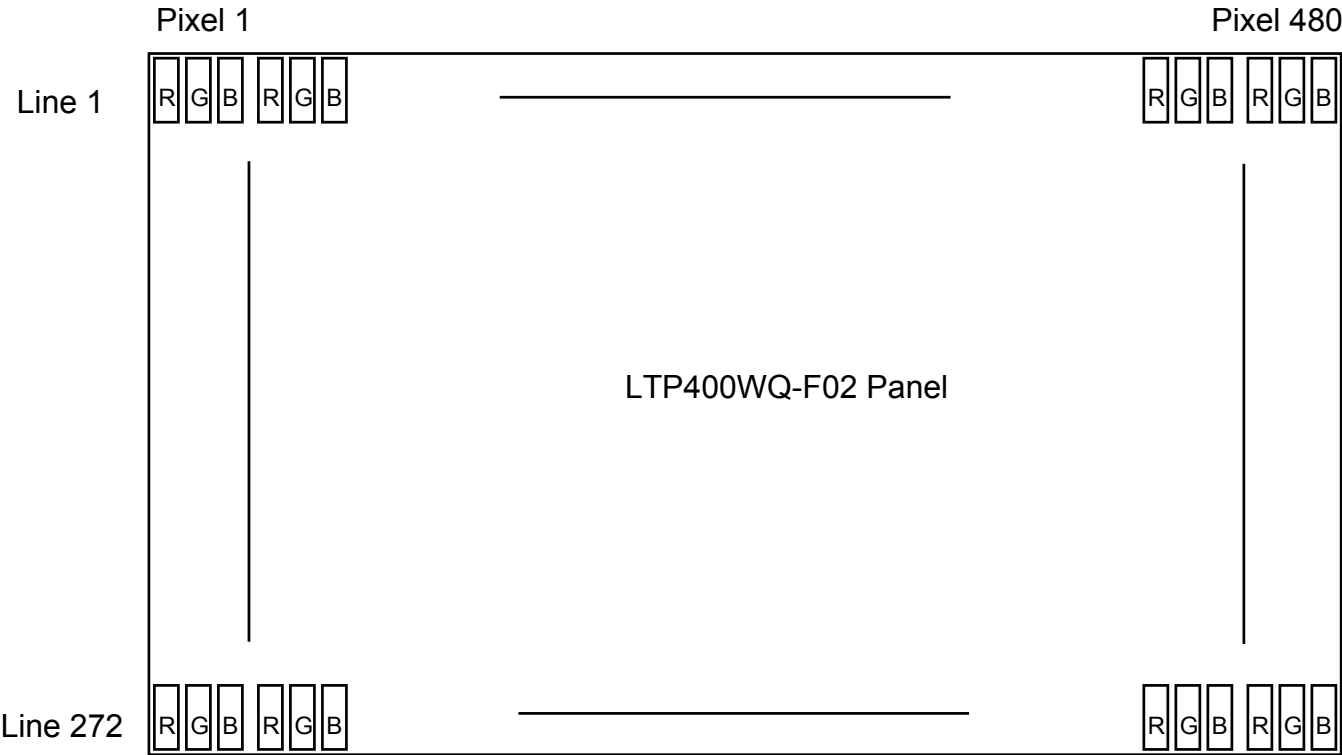
Note

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

(2) Input Signal : 0 = Low level voltage, 1 = High level voltage

5.3 PIXEL FORMAT

Preliminary



6. INTERFACE TIMING

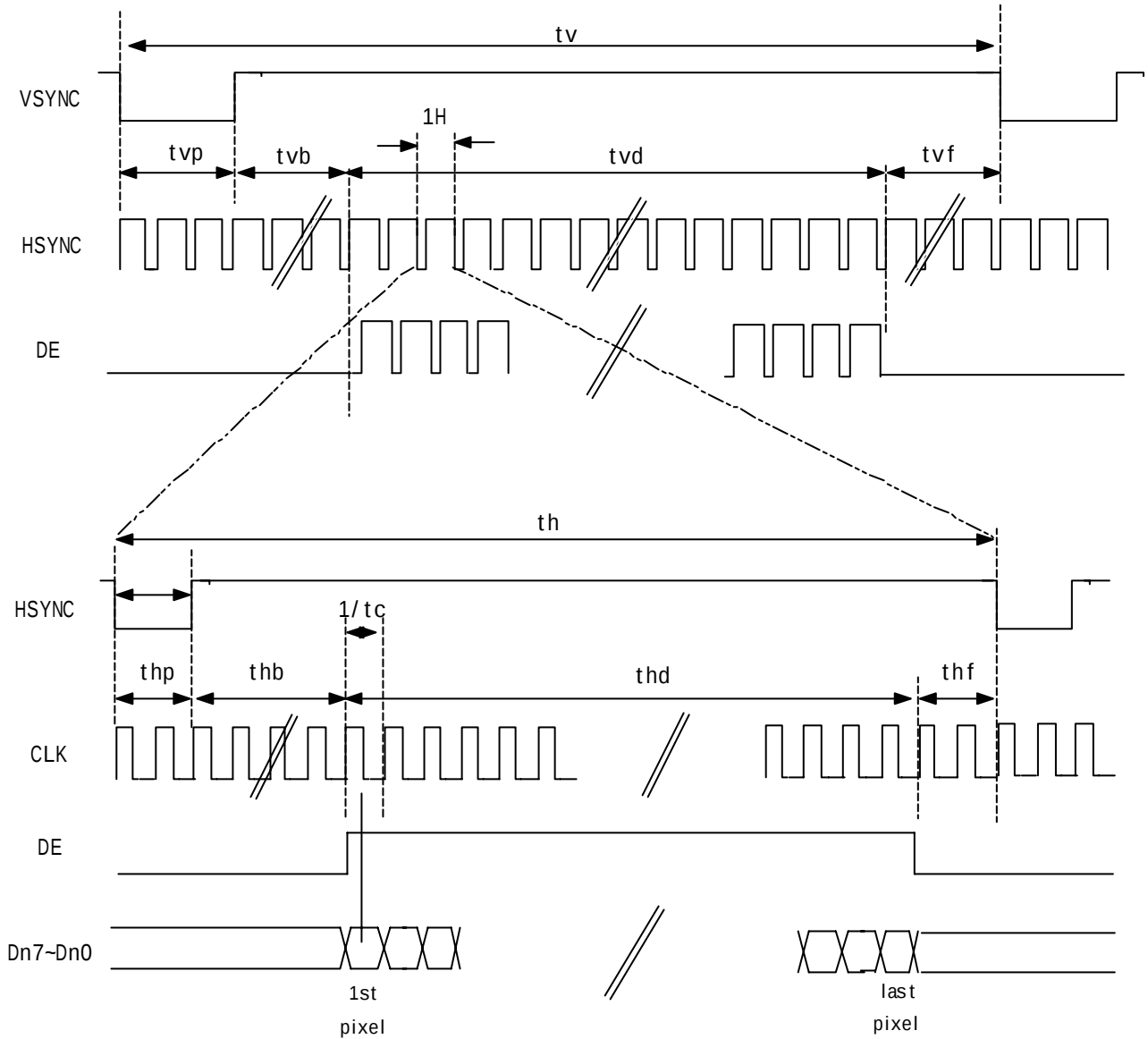
6.1 Timing Parameters

Signal	Item	Symb ol	Min.	Typ.	Max.	Unit	Note
Clock	Frequency	1/Tc		9.0	15	MHz	
	High Time	TCH	26.7			nsec	
	Low Time	TCL	26.7			nsec	
Data	Setup Time	TDS	10			nsec	
	Hold Time	TDH	10			nsec	
Frame Frequency	Cycle	tv		16.7		msec	
				59.94		Hz	
1 Frame Scanning Time	Cycle	tv		286		CLK	
	Display Period	tvd	272			CLK	
	Front porch	tvf	2	2		CLK	
	Pulse width	tv _p	2	10		CLK	
	Back porch	tv _b	2	2		CLK	
1 Line Scanning Time	Cycle	th		525		H	NOTE(1)
	Display Period	thd	480			H	
	Front porch	thf	2			H	NOTE(2)
	Pulse width	th _p	2	41		H	NOTE(2)
	Back porch	th _b	2			H	NOTE(2)

NOTE(1) $thd = 480CLK$, $thf = 2CLK$, $thp = 41CLK$, $thb = 2CLK$

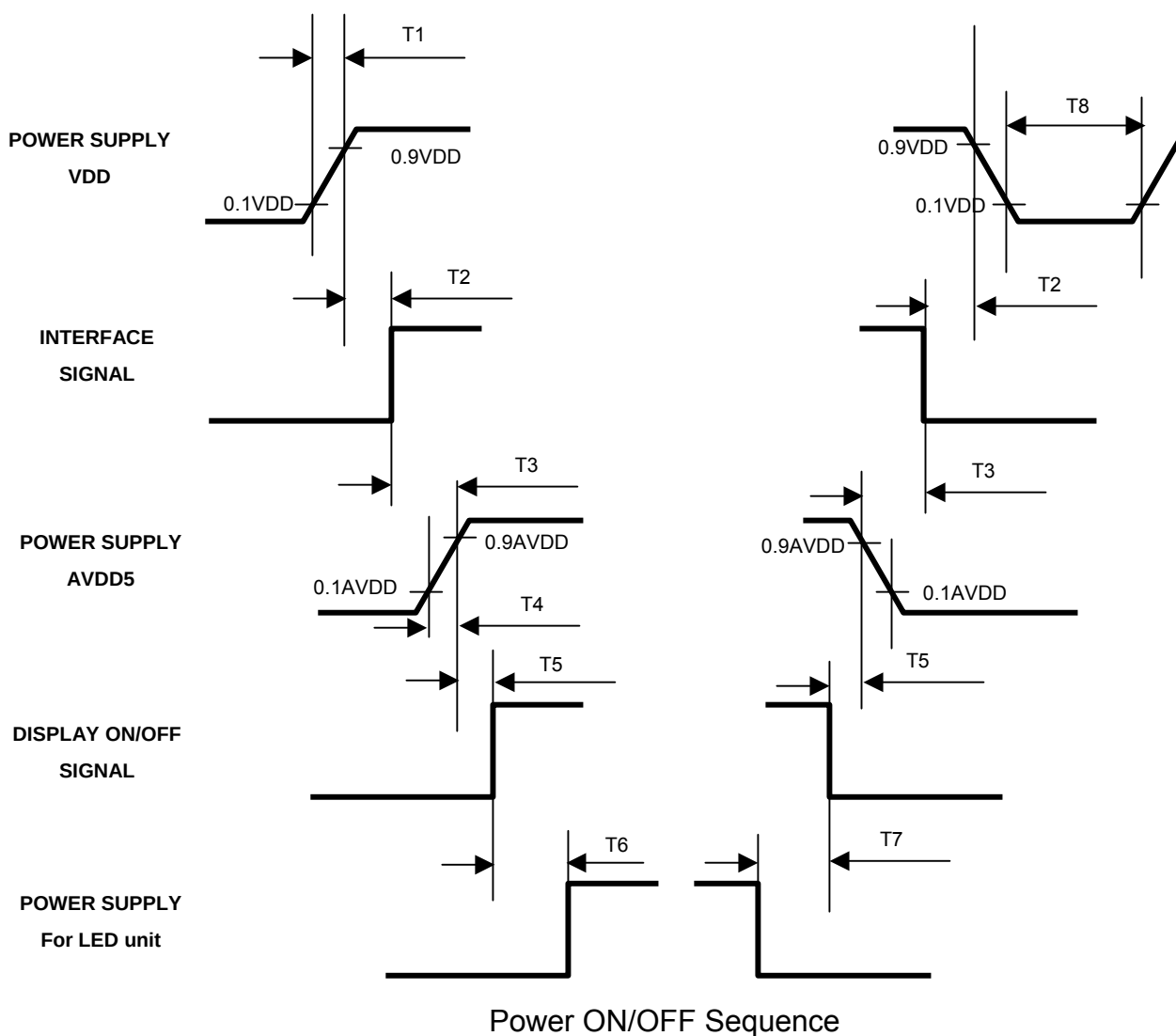
$525CLK = 480CLK + 2CLK + 41CLK + 2CLK$

NOTE(2) $thf + thp + thb > 44$



6.2 Power ON/OFF Sequence

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

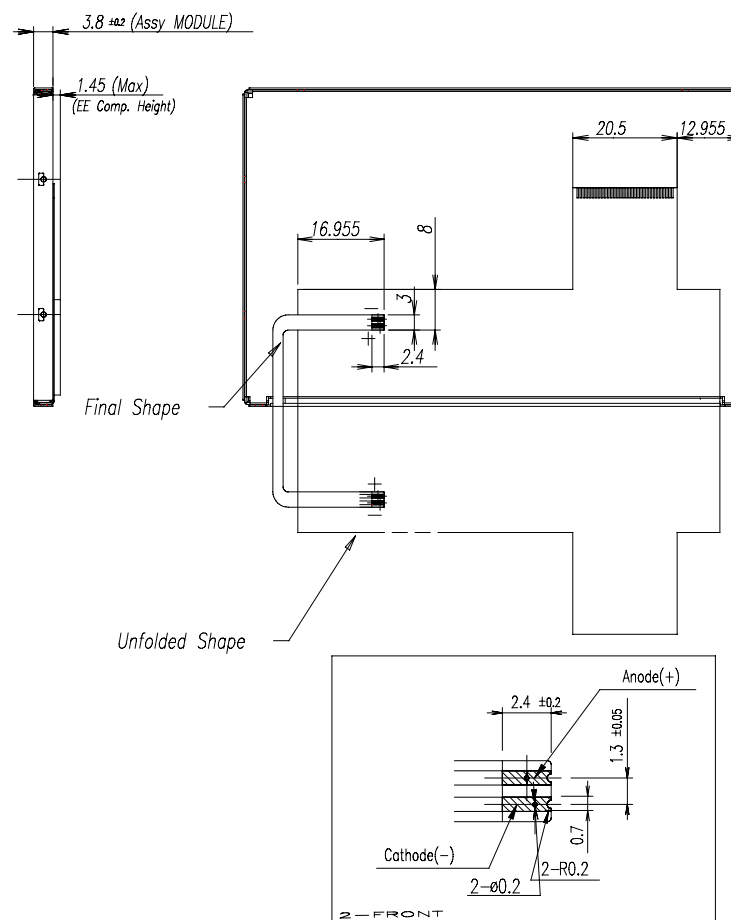
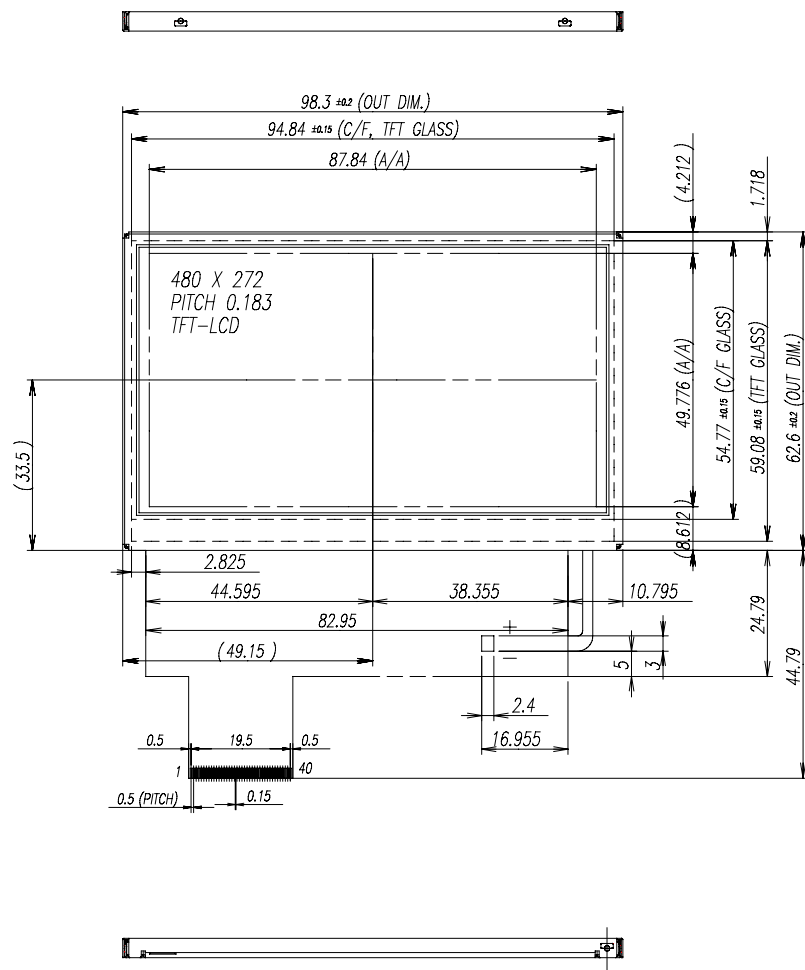


Symbol	Specification	Symbol	Specification
T1	$0 \leq T1 \leq 10 \text{ msec}$	T5	$0 \leq T5 \leq 50 \text{ msec}$
T2	$0 \leq T2 \leq 50 \text{ msec}$	T6	$160 \text{ msec} \leq T6$
T3	$0 \leq T3 \leq 50 \text{ msec}$	T7	$160 \text{ msec} \leq T7$
T4	$0 \leq T4 \leq 10 \text{ msec}$	T8	$1 \text{ sec} \leq T8$

NOTE.

- (1) The supply voltage of the external system for the module input should be the same as the definition of V_{DD} and V_{DD} .
- (2) Apply the LED voltage within the LCD operation range. When the back-light turns on before the LCD operation or the LCD turns off before the LEDs turns off, the display may momentarily become white.
- (3) In case of V_{DD} = off level, please keep the level of input signals on the low or keep a high impedance.
- (4) T8 should be measured after the module has been fully discharged between power off and on period.
- (5) Interface signal shall not be kept at high impedance when the power is on.

7. Outline Dimension



PRELIMINARY

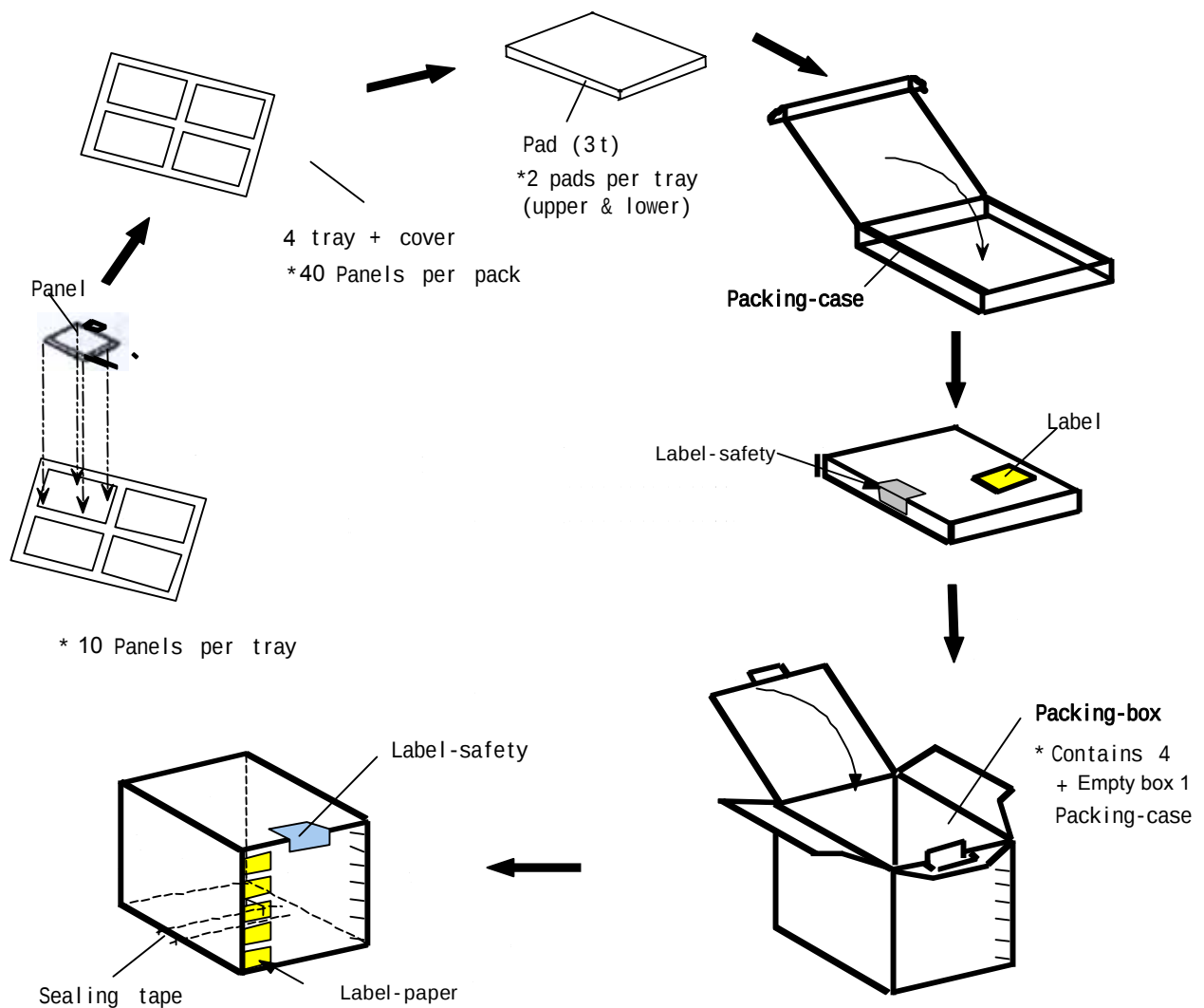
GENERAL TOLERANCE

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	DRA'N BY	DES'D BY	CHK'D BY	APP'D BY
UNIT	mm	S.M.Kim	Y.B.Chu		
SCALE	1/1	04.09.09	04.09.09		
TOLERANCE					
SAMSUNG ELECTRONICS					SPEC. NO.

MODEL NAME	4.0" 480x272 TFT-LCD		
PART/SHEET NAME	Outline Dimension	SHEET	1/1
CODE NO.		VER.	00

8. Packing



Note

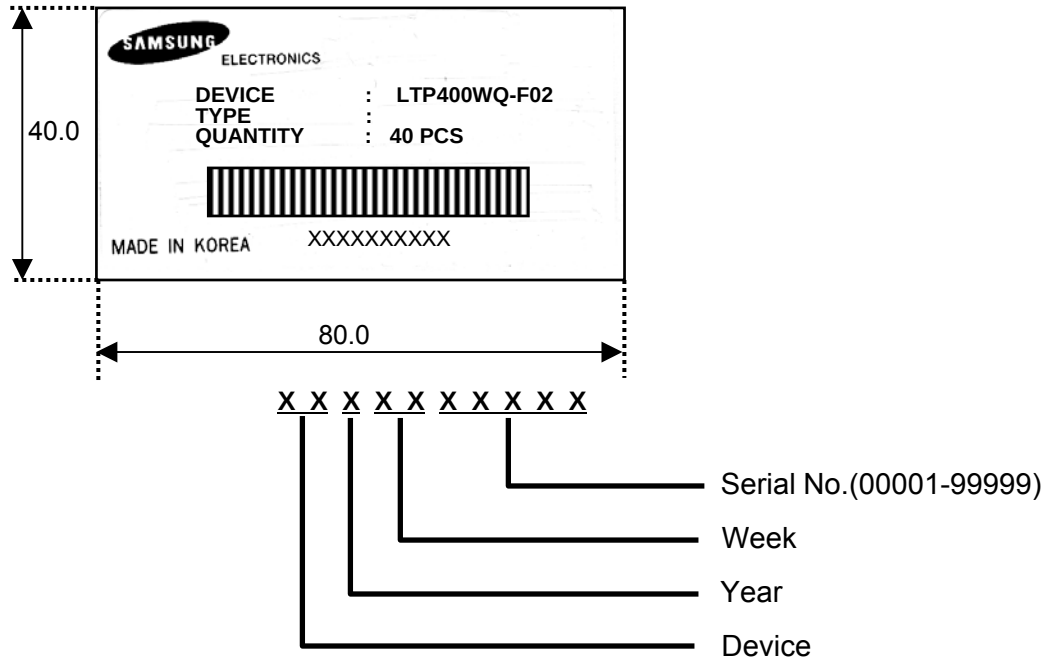
- (1) Total : Case: Approx. : TBD Kg
Box: Approx. : TBD Kg
- (2) Size : Case:TBD
Box: TBD
- (3) Place the panels in the tray facing the direction shown in the figure.
- (4) Place 2 tray and cover(empty tray) and pads inside the packing-case.
- (5) Place 4 packing-case and 1 Empty case inside the packing-box.(Affix the label)
- (6) Seal the packing-box. Affix the label-safety.

9. MARKINGS & OTHERS

Preliminary

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

9.1 Packing case attach



10. GENERAL PRECAUTIONS

Preliminary

1. Handling

- (a) When the module is assembled, It should be attached to the system firmly using every mounting holes. Be careful not to twist and bend the modules.
- (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 LED back-light.
- (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 CMOS IC.
- (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) Do not adjust the variable resistor which is located on the back side.
- (l) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (m) Pins of I/F connector shall not be touched directly with bare hands.

2. STORAGE

- (a) Do not leave the module 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.

3. OPERATION

- (a) Do not connect, disconnect the module in the “Power On” condition.
- (b) Power supply should always be turned on/off by following item 6.2
“Power on/off sequence”.
- (c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.

4. OTHERS

- (a) Ultra-violet ray filter is necessary for outdoor operation.
- (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, so on)
Otherwise the module may be damaged.
- (d) If the module 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 module has its circuitry FPC's on the rear side and should be handled carefully in order not to be stressed.