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SAMSUNG TFT-LCD
MODEL NO. : LTA320W2-L03

Note _____

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

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* Revision History

No	Date	Page	Before change	After change	Remark
0.0	2004.10.18	All	First issued		

General Description

* Description

LTA320W2-L03 is a color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses amorphous silicon TFTs 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 32.0" contains 1366 x 768 pixels and can display up to 16.7 million colors with wide viewing angle of 85° or higher in all directions.

* Features

- High contrast ratio, high aperture structure
- APVA(Advanced Patterned Vertical Align) mode
- Wide viewing angle($\pm 170^\circ$)
- High speed response(applied to DCC)
- WXGA(1366 x 768 pixels) resolution (16:9)
- Low Power consumption
- Dyrect Type 16 CCFL(Cold Cathode Fluorescent Lamp)
- DE only mode
- LVDS(Low-Voltage Differential Signal) interface.(1pixel/clock)

* Applications

Home-alone Multimedia TFT-LCD TV

Display terminals for AV application products

High Definition TV (HD TV)

* General information

Items	Specification	Unit	Note
Display area	697.6845(H) × 392.256(V)	mm	
Driver element	a-Si TFT active matrix		
Display colors	16.7M(true)	colors	16,777,216
Number of pixels	1366 x 768	pixel	16:9
Pixel arrangement	RGB Vertical Stripe		
Pixel pitch	0.51075(H) × 0.17025(V)	mm	
Display mode	Normally Black		
Surface treatment	Haze 44% , Hard-Coating (3H)		Conductive pol

*** Mechanical information**

Item		Min.	Typ.	Max.	Note
Module size	Horizontal(H)	759.0	760.0	761.0	mm
	Vertical(V)	449.0	450.0	451.0	mm
	Depth(D)	49.0	50.0	51.0	mm
Weight		-	6500	7000	g

1. Absolute Maximum Ratings
1.1 Absolute ratings of environment

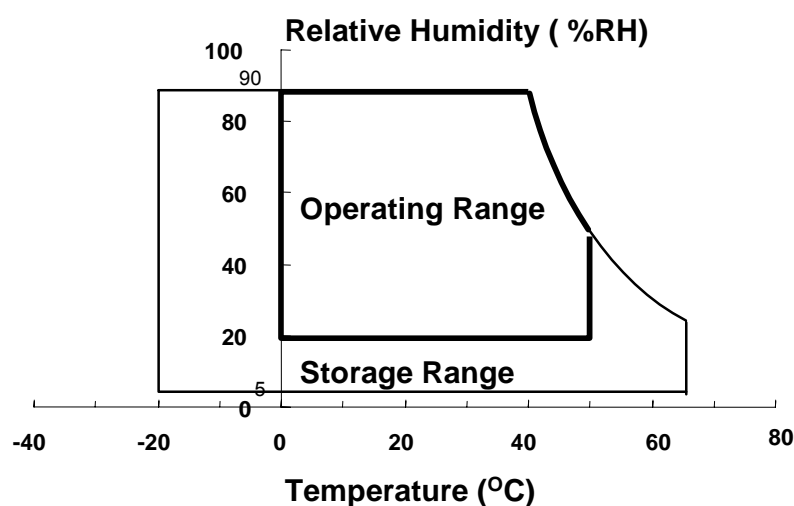
Item	Symbol	Min.	Max.	Unit	Note
Storage temperature	T _{STG}	-20	65	℃	(1)
Operating temperature (Ambient temperature)	T _{OPR}	0	50	℃	(1)
	T _{sur}	0	65	℃	(2)
Shock (non - operating)	Snop	-	50	G	(3),(5)
Vibration (Non - operating)	Vnop	-	1.5	G	(4),(5)

Note (1) Temperature and relative humidity range are shown in the figure below.

93.8 % RH Max. (40 °C ≥ Ta)

Maximum wet-bulb temperature at 39 °C or less. (Ta > 40 °C) No condensation.

- (2) Abnormal visual problems by panel surface temperature can be occurred in specific range. But materials(ex : polarizer) are not damaged permanently in this range, T_{sur}.
- (3) 20ms, sine wave, 1 time for ±X, ±Y, ±Z axis
- (4) 10~300Hz/1.5G
(11min/cycle, 30min for X,Y,Z axis)
- (5) At testing Vibration and Shock, 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.



1.2 ELECTRICAL ABSOLUTE RATINGS

(1) TFT LCD Module

(V_{ss} = GND = 0 V)

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	VDD	V _{ss} -0.5	6.5	V	(1)

NOTE (1) Within Ta (25 ± 2 °C)

(2) BACK-LIGHT UNIT

(Ta = 25 ± 2°C)

ITEM	SYMBOL	MIN.	MAX.	UNIT	NOTE
Power Supply Voltage/ Inverter	V _{CC}	V _{ss} -0.5	25.2	V	(1)
Lamp Current	I _L	4.0	7.0	mArms	(2),(3)
Lamp Frequency	F _L	40	65	kHz	(2)

NOTE (1) Inverter Input power

(2) Permanent damage to the device may occur if maximum values are exceeded.

Functional operation should be restricted to the conditions described under Normal Operating Conditions.

(3) Specified values are for a single lamp.

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 : TOPCON BM-5A , BM-7, PHOTO RESEARCH PR650

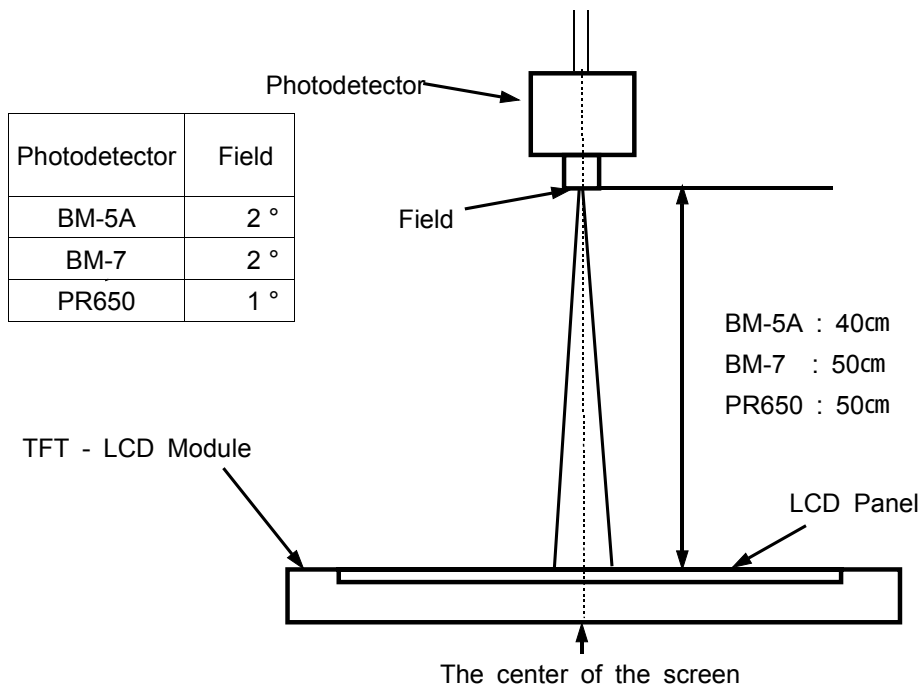
* $T_a = 25 \pm 2^\circ\text{C}$, $V_{DD}=5.0\text{V}$, $f_v= 60\text{Hz}$, $f_{CLK}=75 \text{ MHz}$, $I_L = 5.0\text{mA}_{rms}$

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio (Center of screen)		C/R	Normal $\phi = 0$ $\theta = 0$	600	800	-		(3) BM-5A
Response Time	Rising	Tr		-	8	16	msec	(4) BM-7
	Falling	Tf		-	6	9		
	G to G	-		-	8	-		
Luminance of White (Center of screen)		YL	Viewing Angle	450	500	-	cd/m2	(5) BM-5A
Color Chromaticity (CIE 1931)	Red	Rx		TYP. -0.03	0.642	TYP. +0.03		(6) PR650
		Ry			0.332			
	Green	Gx			0.276			
		Gy			0.600			
	Blue	Bx			0.144			
		By			0.061			
	White	Wx			0.278			
		Wy			0.290			
		Color Temperature			CCT		-	
Color Gamut		-		70	72	-	%	
Viewing Angle	Hor.	θ L	$C/R \geq 10$	75	85	-	Degrees	(7) BM-5A
		θ R		75	85	-		
	Ver.	ϕ H		75	85	-		
		ϕ L		75	85	-		
		Brightness Uniformity (9 points)		Buni		-		

Note 1) Test Equipment Setup

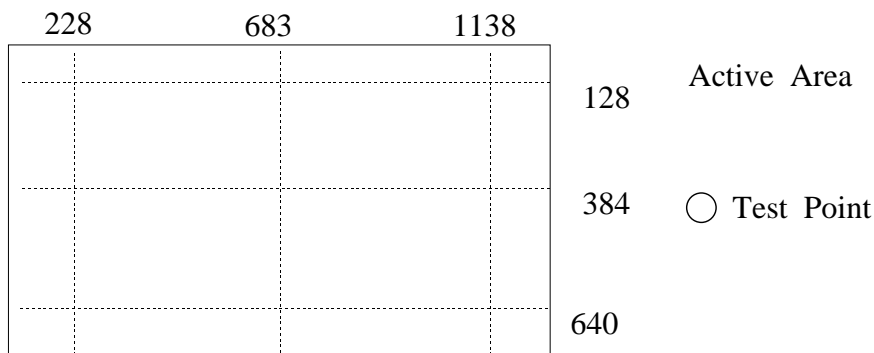
After stabilizing and leaving the panel alone at a given temperature for 30 min ,the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 30 min after lighting the back-light. This should be measured in the center of screen.

A single lamp current : 5.0mA
Environment condition : Ta = 25 ± 2 °C



Optical Measuring Equipment Setup

Note 2) Definition of test point



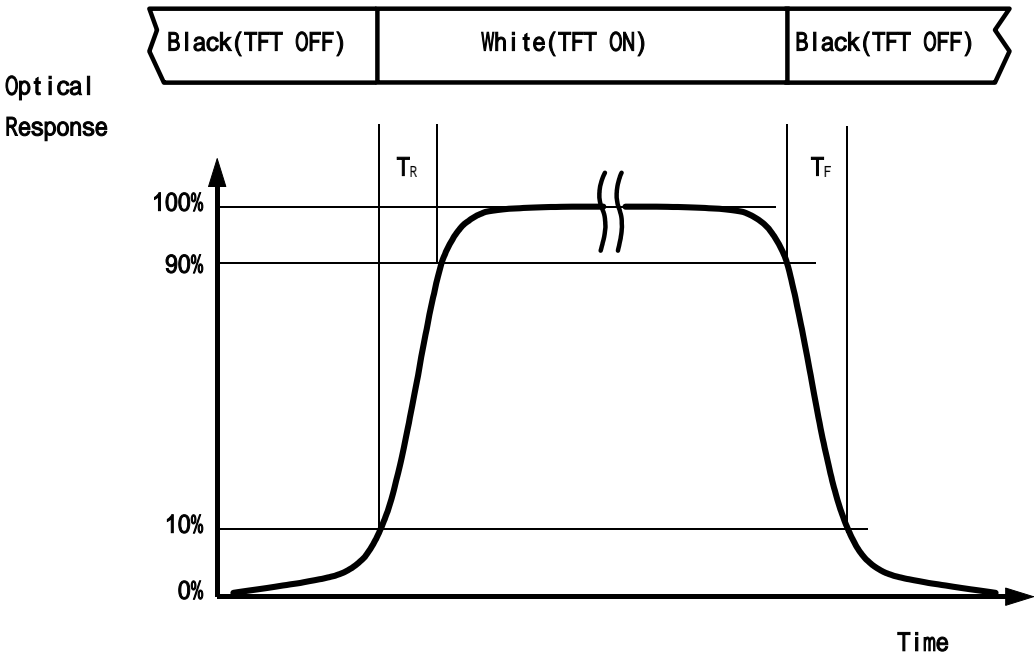
Note 3) Definition of Contrast Ratio (C/R) : Ratio of gray max (Gmax) & gray min (Gmin) at the center point(5) of the panel

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

Gmax : Luminance with all pixels white

Gmin : Luminance with all pixels black

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

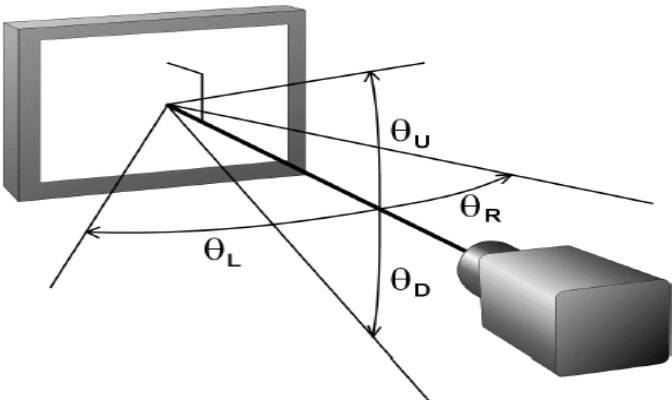


Note 5) Definition of Luminance of White : Luminance of white at center point(5).

Note 6) Definition of Color Chromaticity (CIE 1931)

Color coordinate of Red , Green , Blue & White at center point(5).

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



Note 8) Definition of 9 points brightness uniformity

$$B_{uni} = 100 * \frac{(B_{max} - B_{min})}{B_{max}}$$

Bmax : Maximum brightness

Bmin : Minimum brightness

3. Electrical Characteristics

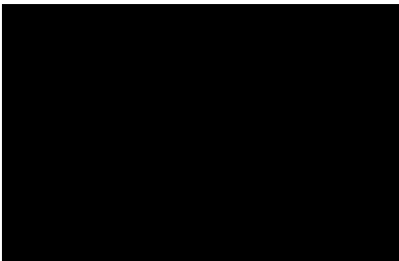
3.1 TFT LCD MODULE

Ta = 25°C

Item		Symbol	Min.	Typ.	Max.	Unit	Note
Voltage of Power Supply		V _{DD}	4.5	5.0	5.5	V	(1)
Interface Type		LVDS	Tcon merged				
Power Consumption	(a)Black	I _{DD}	-	1000	-	mA	(2),(3), (5)
	(b)White		-	1250	-	mA	
	(c)N-Pattern		-	1500	2000	mA	
Vsync Frequency		f _V	48	60	66	Hz	
Hsync Frequency		f _H	44	47.3	53	kHz	
Main Frequency		f _{DCLK}	65	75	82	MHz	
Rush Current		I _{RUSH}	-	-	4	A	(4)

- Note
- (1) Main pixel clock frequency is the value which is measured at the input of LVDS transmitter.
 - (2) f_V=60Hz, f_{DCLK} =75MHz, V_{DD} = 5.0V, DC Current.
 - (3) Power dissipation check pattern(LCD Module only)

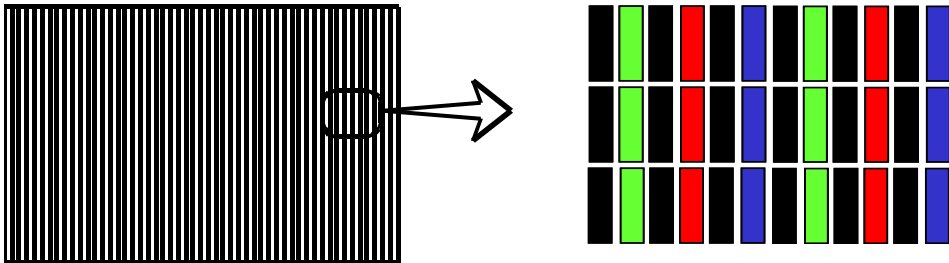
(a) Black Pattern



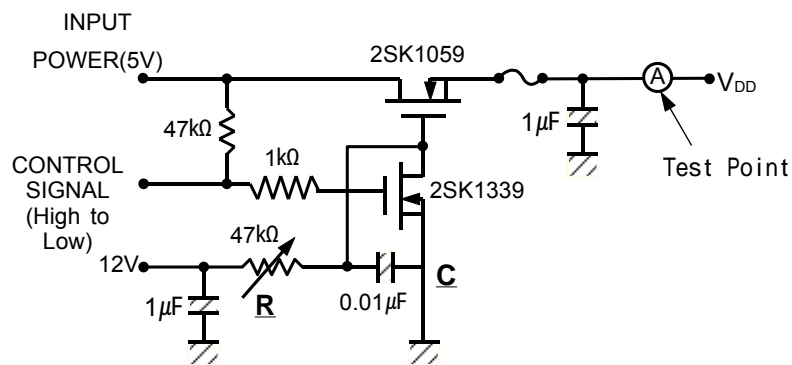
(b) White Pattern



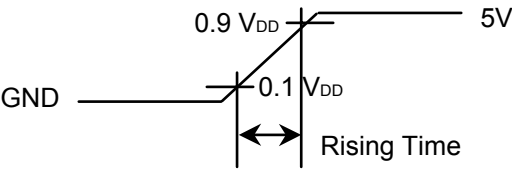
(C) N-pattern



(4) Measurement Conditions (Rising time =470μs)



Note : Control Signal : High(+5V) -->Low(Ground)
All Signal lines to panel except for power 5V : Ground
The rising time of supplied voltage is controlled to 470us by R and C value.



(5) Power Consumption Except for Inverter power consumption

3.2 BACK-LIGHT UNIT

The back-light system is an direct - lighting type with 16 CCFTs (Cold Cathode Fluorescent Tube) The characteristics of 16 direct lamps are shown in the following tables.

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

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Lamp Current	I_L	4.0	-	5.0 (7.0)*	mArms	(1)
Lamp Voltage	V_L	-	1100	1130	Vrms	(1)
Lamp Frequency	f_L	-	60	-	kHz	
Operating Life Time	Hr	50,000	-	-	Hour	(3) @5.0mA
Start up Voltage	V_s	-	-	1750@0 1260@25	Vrms	(4)

Note) The waveform of the inverter output voltage must be area symmetric and the design of the inverter must have specifications for the modularized lamp.

Specified values are for a single lamp.

The performance of the back-light, for example life time or brightness, is much influenced by the characteristics of the DC-AC inverter for the lamp. So all the parameters of an inverter should be carefully designed so as not to produce too much leakage current from high-voltage output of the inverter.

When you design or order the inverter, please make sure that a poor lighting caused by the mismatch of the back-light and the inverter(miss lighting, flicker, etc.) never occur. When you confirm it, the module should be operated in the same condition as it is installed in your instrument.

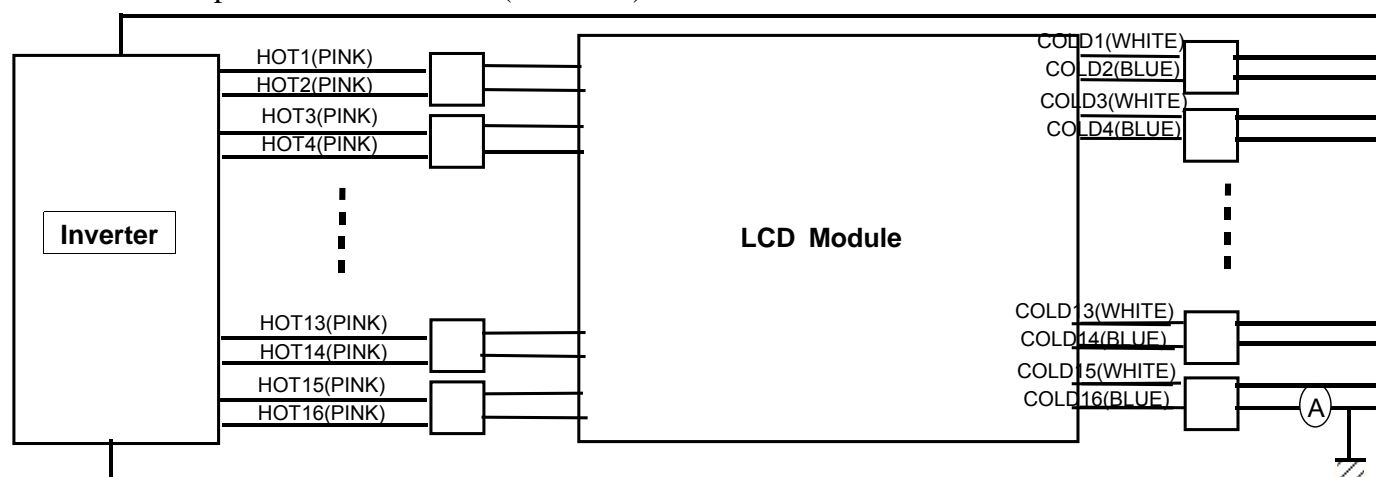
Note (1) lamp current is measured with current meter.

Refer to the following block diagram of the back-light unit for more information.

Lamp Voltage Min : Lamp Current 5.0 mArms

Lamp Voltage Min : Lamp Current 4.0 mArms

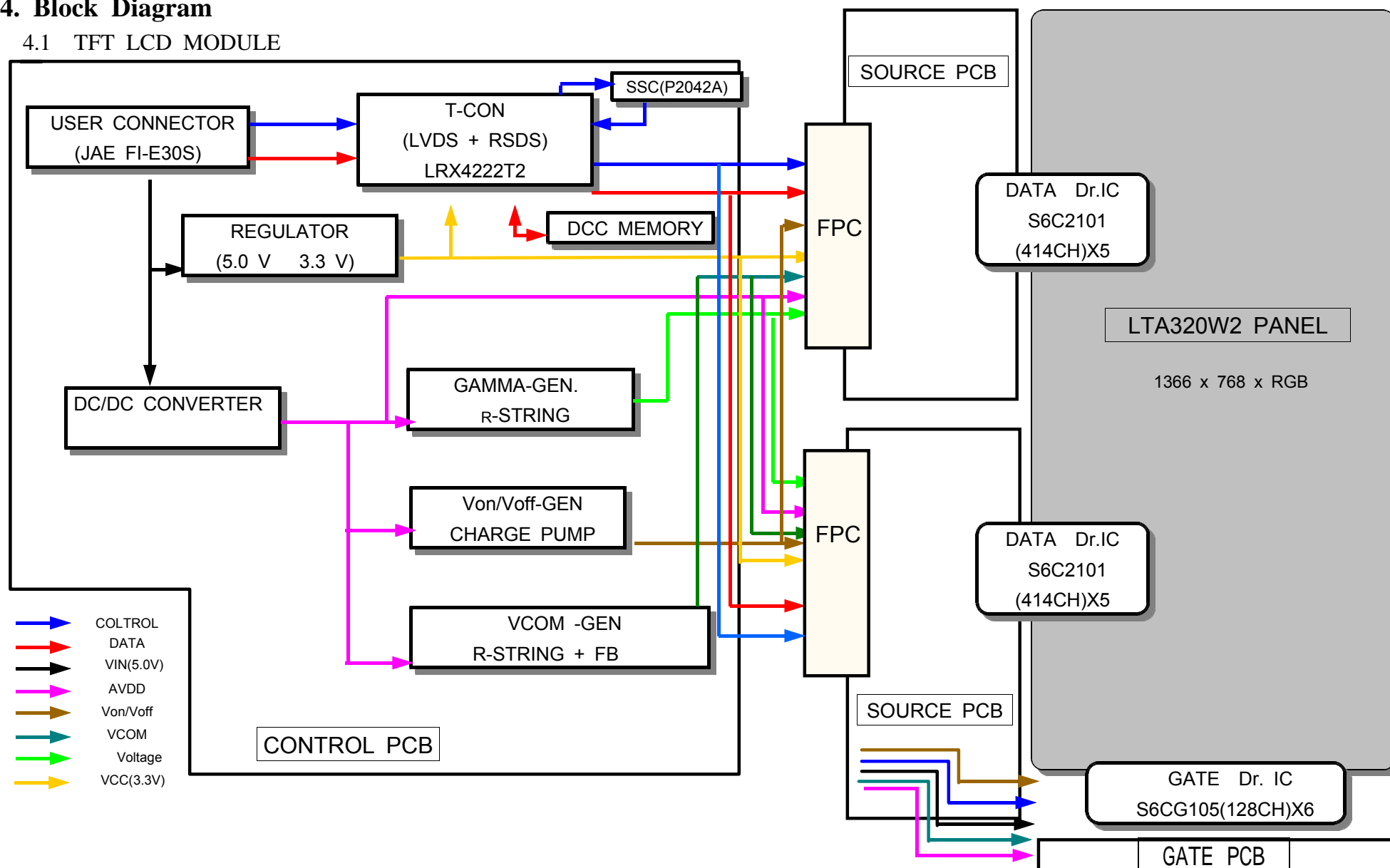
*The operation with max I_L (5.5~7mA) should not be lasted over 10 minutes.




- (2) Life time (Hr) of a lamp is defined as the time in which it continues to operate under the condition of $T_a = 25 \pm 2^\circ\text{C}$ for a lamp until the brightness becomes 50% or lower than its original value.
- (3) If an inverter has shutdown function it should keep its output for more than 1 second even if the lamp connector open. Otherwise the lamps may not to be turned on.

4. Block Diagram

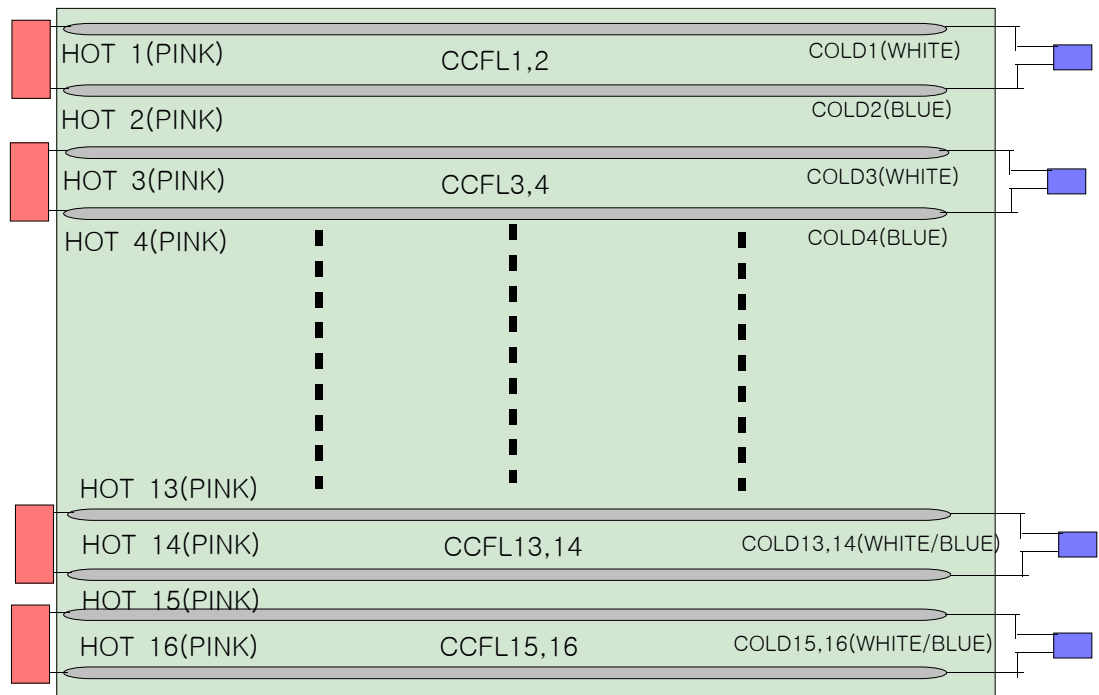
4.1 TFT LCD MODULE



4.2 BACL-LIGHT UNIT

 HOT : HIGH VOLTAGE (Part NO. : BHCR-02VS-3 (JST))

 COLD : GROUND (Part NO. : C-1612472 (AMP))



5. Input Terminal Pin Assignment

5.1. Input Signal & Power : Connector FI-E30S (JAE)

N o	S i g n a l	N o	S i g n a l
1	N . C	16	G N D
2	N . C	17	R x 3 -
3	N . C	18	R x 3 +
4	G N D	19	G N D
5	R x 0 -	20	N . C
6	R x 0 +	21	LVDS OPTION **
7	G N D	22	N . C
8	R x 1 -	23	G N D
9	R x 1 +	24	G N D
10	G N D	25	G N D
11	R x 2 -	26	V d d (+5 V d c)
12	R x 2 +	27	V d d (+5 V d c)
13	G N D	28	V d d (+5 V d c)
14	R x C L K -	29	V d d (+5 V d c)
15	R x C L K +	30	V d d (+5 V d c)

* **NOT CONNECTED : THIS PINS ARE ONLY USED FOR SEC INTERNAL OPERATIONS.**

** LVDS OPTION : IF THIS PIN : HIGH (3.3 V) NORMAL NS LVDS FORMAT

OTHERWISE : LOW (GND) OR OPEN(NC) JEIDA LVDS FORMAT

Sequence : On = Vdd(T1) LVDS Option Interface Signal(T2)

OFF = Interface Signal(T3) LVDS Option Vdd

5.2 LVDS Interface

-LVDS Receiver : Tcon (LVDS Rx merged)

-Pixel data (single data)

LVDS OPTION(Input 21pin) : IF THIS PIN : HIGH (3.3 V)	NORMAL NS LVDS FORMAT
OTHERWISE : LOW (GND) OR OPEN(NC)	JEIDA LVDS FORMAT

	LVDS pin	JEIDA -DATA	Normal -DATA
TxOUT/RxIN0	TxIN/RxOUT0	R2	R0
	TxIN/RxOUT1	R3	R1
	TxIN/RxOUT2	R4	R2
	TxIN/RxOUT3	R5	R3
	TxIN/RxOUT4	R6	R4
	TxIN/RxOUT6	R7	R5
	TxIN/RxOUT7	G2	G0
TxOUT/RxIN1	TxIN/RxOUT8	G3	G1
	TxIN/RxOUT9	G4	G2
	TxIN/RxOUT12	G5	G3
	TxIN/RxOUT13	G6	G4
	TxIN/RxOUT14	G7	G5
	TxIN/RxOUT15	B2	B0
	TxIN/RxOUT18	B3	B1
TxOUT/RxIN2	TxIN/RxOUT19	B4	B2
	TxIN/RxOUT20	B5	B3
	TxIN/RxOUT21	B6	B4
	TxIN/RxOUT22	B7	B5
	TxIN/RxOUT24	HSYNC	HSYNC
	TxIN/RxOUT25	VSYNC	VSYNC
	TxIN/RxOUT26	DEN	DEN
TxOUT/RxIN3	TxIN/RxOUT27	R0	R6
	TxIN/RxOUT5	R1	R7
	TxIN/RxOUT10	G0	G6
	TxIN/RxOUT11	G1	G7
	TxIN/RxOUT16	B0	B6
	TxIN/RxOUT17	B1	B7
	TxIN/RxOUT23	RESERVED	RESERVED

5.3 INVERTER UNIT

Connector :S14B-PH-SM3-TB(JST)

PIN NO.	PIN Configuration (FUNCTION)
1	AWG24 24 V
2	AWG24 24 V
3	AWG24 24 V
4	AWG24 24 V
5	AWG24 24 V
6	AWG24 GND
7	AWG24 GND
8	AWG24 GND
9	AWG24 GND
10	AWG24 GND
11	Status(Normal Operation : GND, Error(Shut-down) : Floating)
12	BACKLIGHT ON ~ OFF / ON:2.4 - 5.25 V, OFF: 0 - 0.8 V
13	Analog Dimmer / GND Min. Lum ~ 3.3V DC Max. Lum
14	PWM Dimmer / PWM Duty(ADIM=3.3V) : 30 ~100%

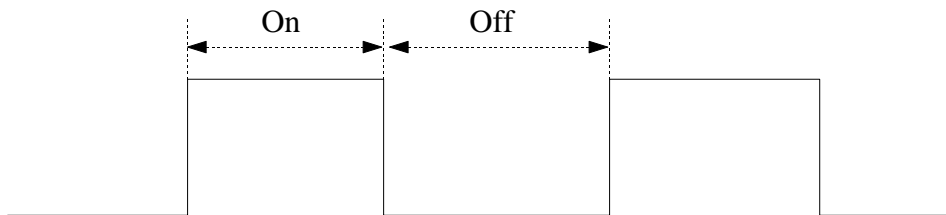
5.4 Inverter Specification

Items	Symbol	Conditions	Specifications			Unit	Note
			Min.	Typ.	Max.		
Input Voltage	Vin	-	21.6	24	26.4	V	Ta=25
Input Current	Pin		-	5.4	-	Adc	After 2hour Warm-up @ Vin=24V (1)
Output Current	Io,max	Vadim=1.5V Vadim=3.3V	4.5 6.5	5.0 7.0	5.5 7.5	mArms	
	Io,min	Vadim=0V	3.5	4.0	4.5		
Lamp Frequency	FL	Vin=24, Vbr=3.3V	60 ± 5			kHz	
Shutdown Time	Ts-d	No Load	1	-	2	sec	
Open Lamp Voltage	Vo	No Load	1750	-	-	V	
Backlight On/Off Control	On	ON/OFF=High	2.4	-	5.25	V	
	Off	ON/OFF=Low	0	-	0.8	V	
PWM Frequency	Fpwm	Vin=24, Vadim=3.3V	120	180	240	Hz	(3)
PWM Dimming Range	PMD	Vin=24, Vadim=3.3V	30	-	100	%	(2)

Note(1) Controlled by Analog or PWM dimming

When IL is 500mA, Luminance is 500nits. This condition is just for max luminance.

Note(2) High-duty = $\text{On}/(\text{On}+\text{Off}) * 100$



Note(3) - Controlled by Analog dimming only

- Analog dimming 0 V (Minimum Lamp current)
- Analog dimming 3.3 V (Maximum Lamp current)

5.5 Input Signal, Basic Display Colors and Gray Scale of Each Color

COLOR	DISPLAY	DATA SIGNAL																											GRAY SCALE
		RED									GREEN								BLUE										LEVEL
		R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3	B4	B5	B6	B7				
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-		
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	-		
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	-		
	CYAN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-		
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-		
	MAGENTA	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	-		
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	-		
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-		
GRAY SCALE OF RED	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R0		
	DARK	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1		
		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2		
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R3~R252		
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:				
		1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R253		
	LIGHT	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R254		
		RED	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R255		
GRAY SCALE OF GREEN	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G0		
	DARK	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G1		
		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G2		
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	G3~G252		
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:				
		0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	G253		
	LIGHT	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	G254		
		GREEN	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	G255		
GRAY SCALE OF BLUE	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B0		
	DARK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	B1		
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	B2		
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3~B252		
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:				
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	B253		
	LIGHT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	B254		
		BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	B255		

Note) Definition of Gray :

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

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

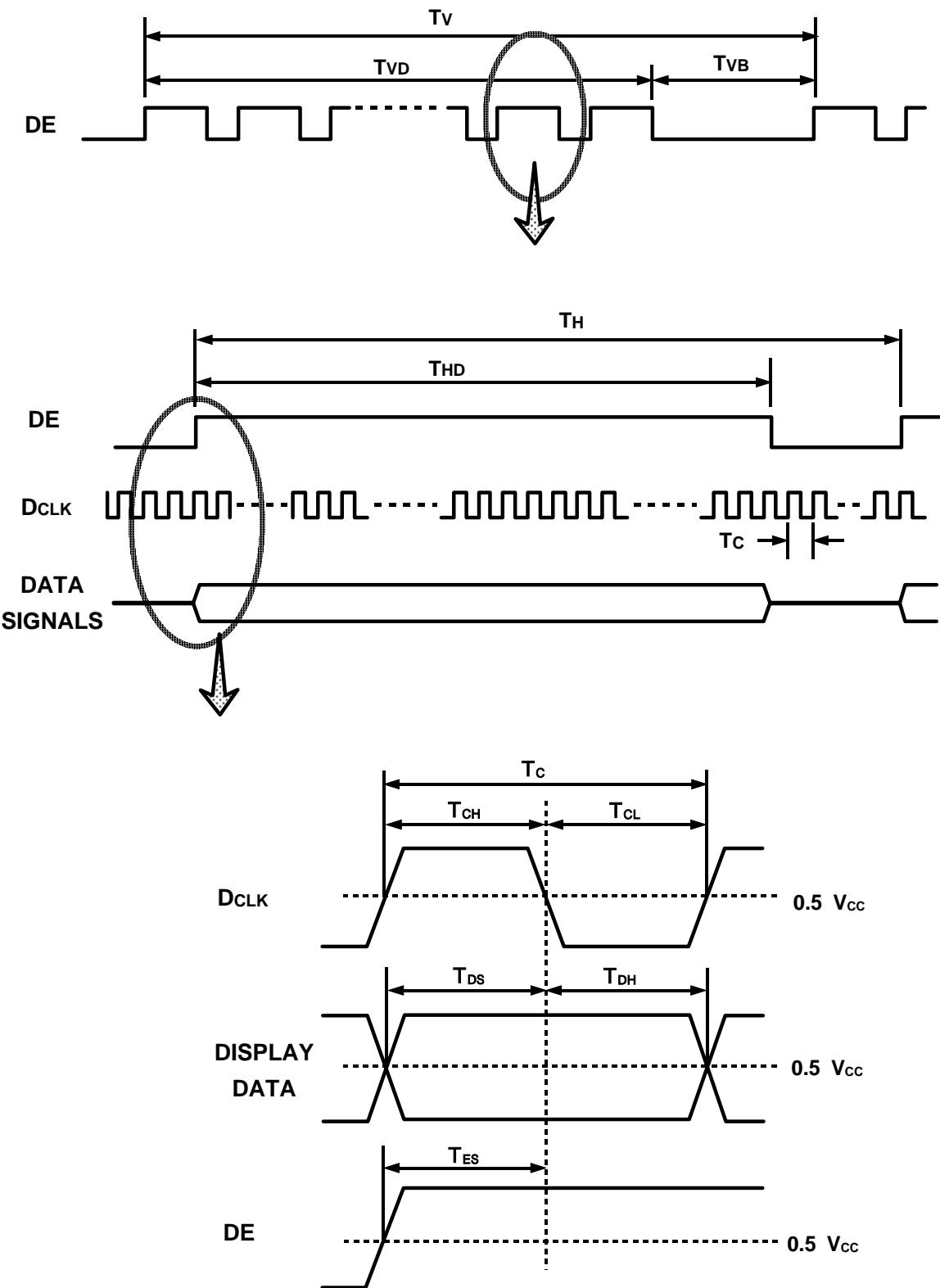
6. Interface Timing

6.1 Timing Parameters (DE only mode)

SIGNAL	ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Clock	Frequency	1/TC	65	75	82	MHz	
Hsync		Fh	44	48	53	KHz	
Vsync		Fv	48	60	66	Hz	
Vertical Active Display Term	Display Period	TVD	-	768	-	lines	
	Vertical Total	TV	773	838	1200	lines	
Horizontal Active Display Term	Display Period	THD	-	1366	-	clocks	
	Horizontal Total	TH	1570	1600	1700	clocks	

Note) This product is DE only mode. The input of Hsync & Vsync signal does not have an effect on normal operation.

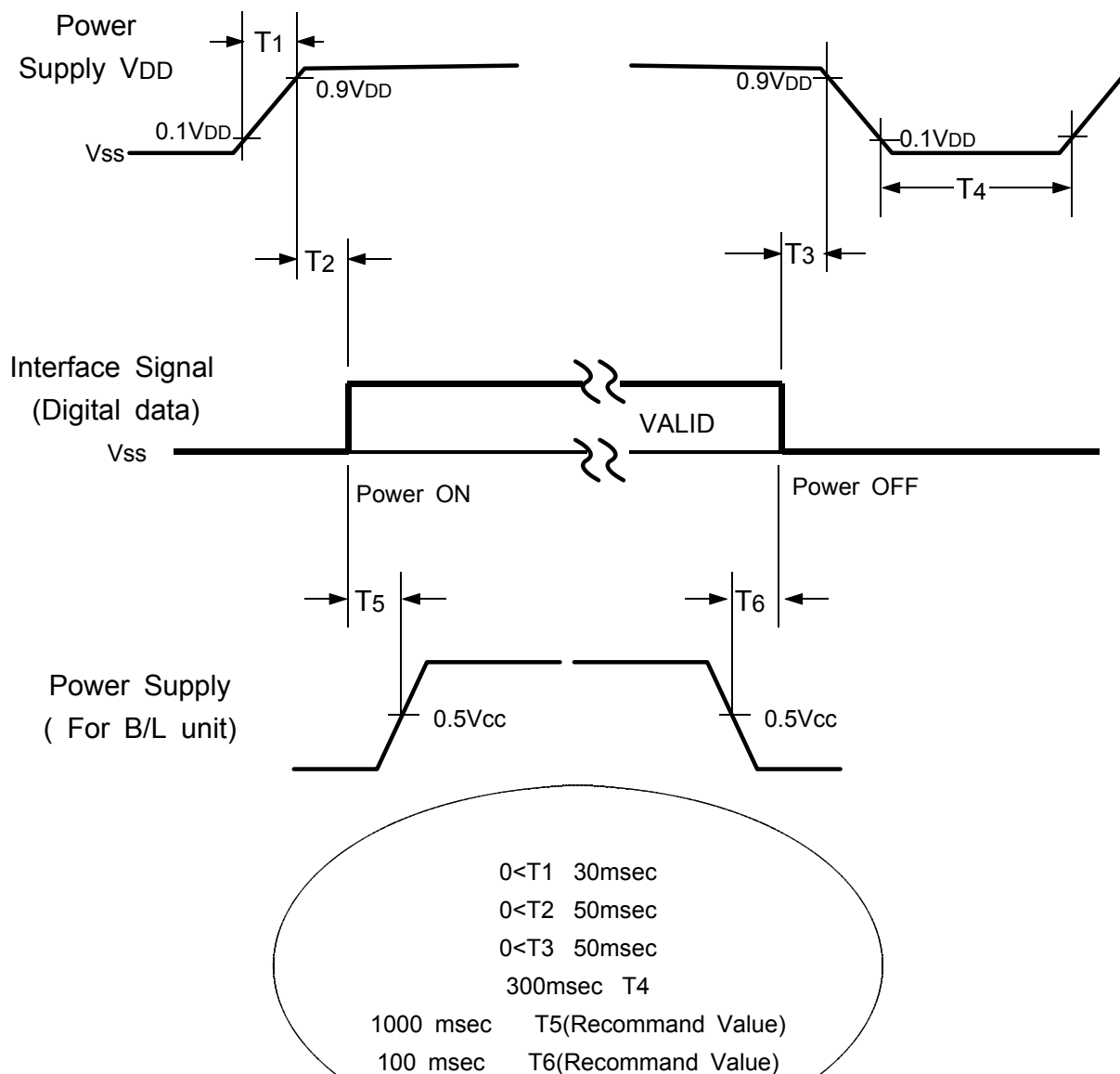
6.2 Timing diagrams of interface signal (DE only mode)



6.3 Power ON/OFF Sequence

6.3.1 Control B/D Sequence

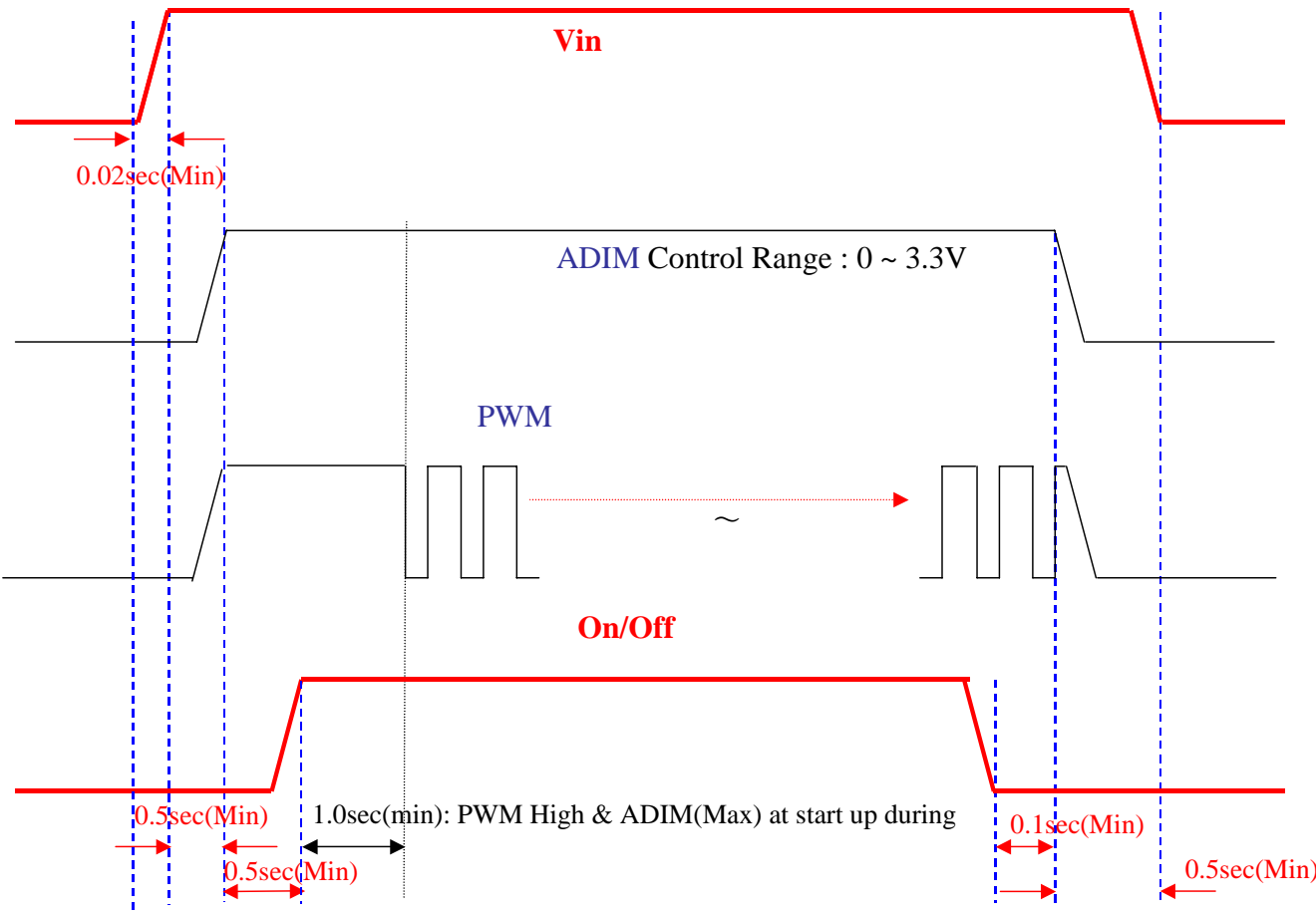
: To prevent a latch-up or DC operation of the LCD module, the power on/off sequence should be as the diagram below.



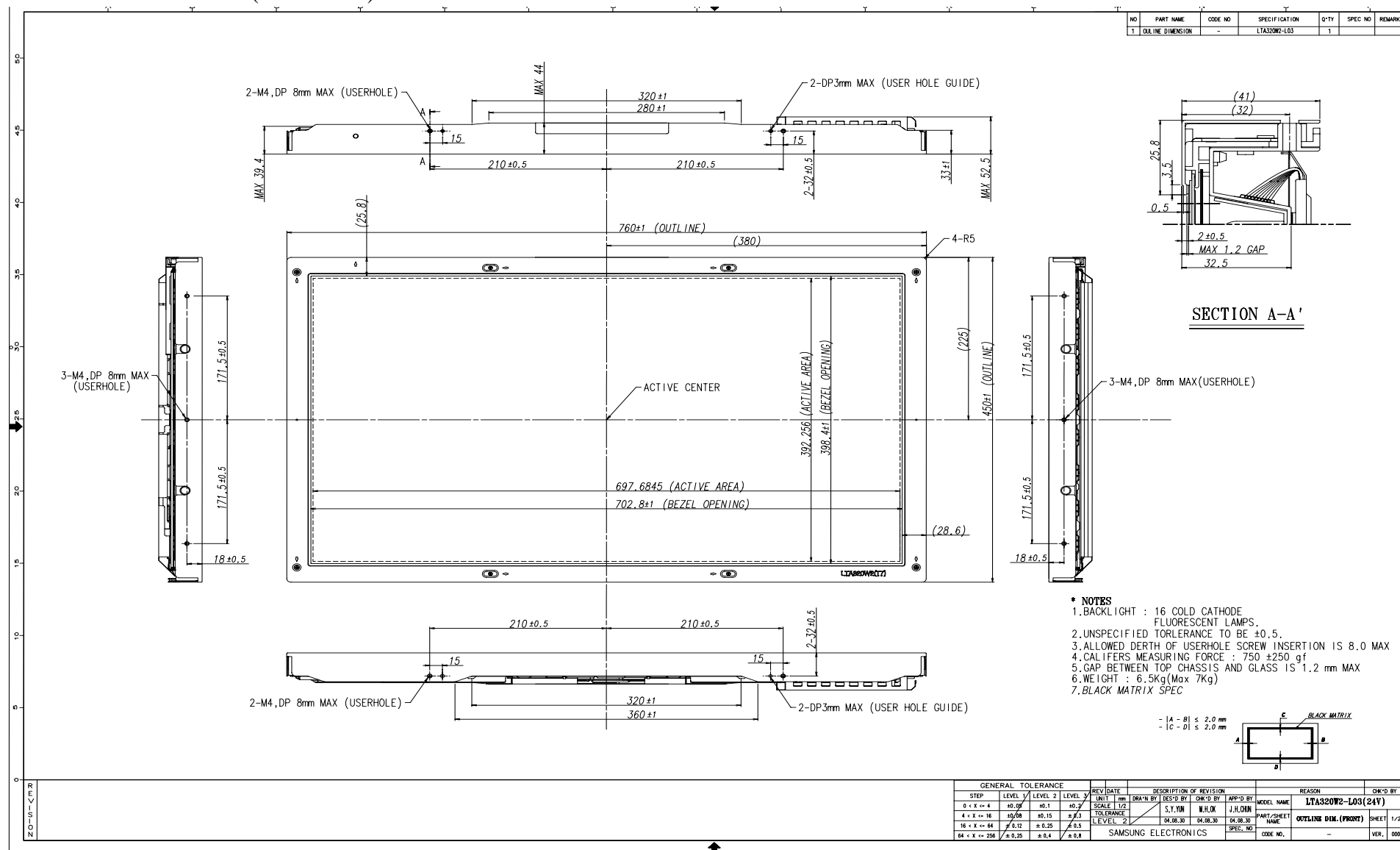
NOTE.

- (1) The supply voltage of the external system for the module input should be the same as the definition of V_{DD} .
- (2) Apply the lamp voltage within the LCD operation range. When the back-light turns on before the LCD operation or the LCD turns off before the back-light turns off, the display may momentarily become abnormal screen.
- (3) In case of $V_{DD} = \text{off level}$, please keep the level of input signals on the low or keep a high impedance.
- (4) T_4 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.

6.3.2 Inverter B/D Sequence



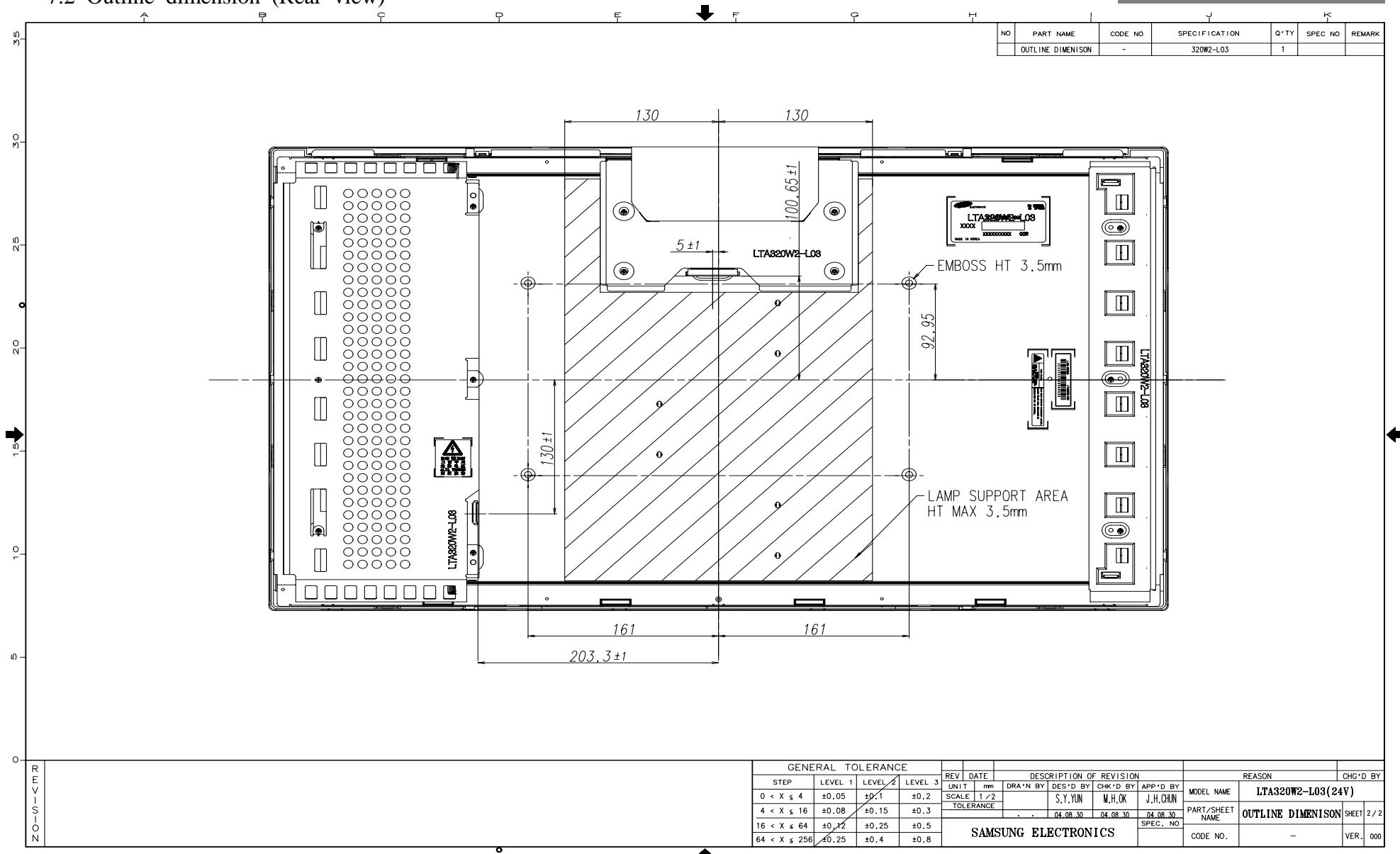
Product Information



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Product Information

NO	PART NAME	CODE NO	SPECIFICATION	Q'TY	SPEC NO	REMARK
	OUTLINE DIMENSION	-	320W2-L03	1		



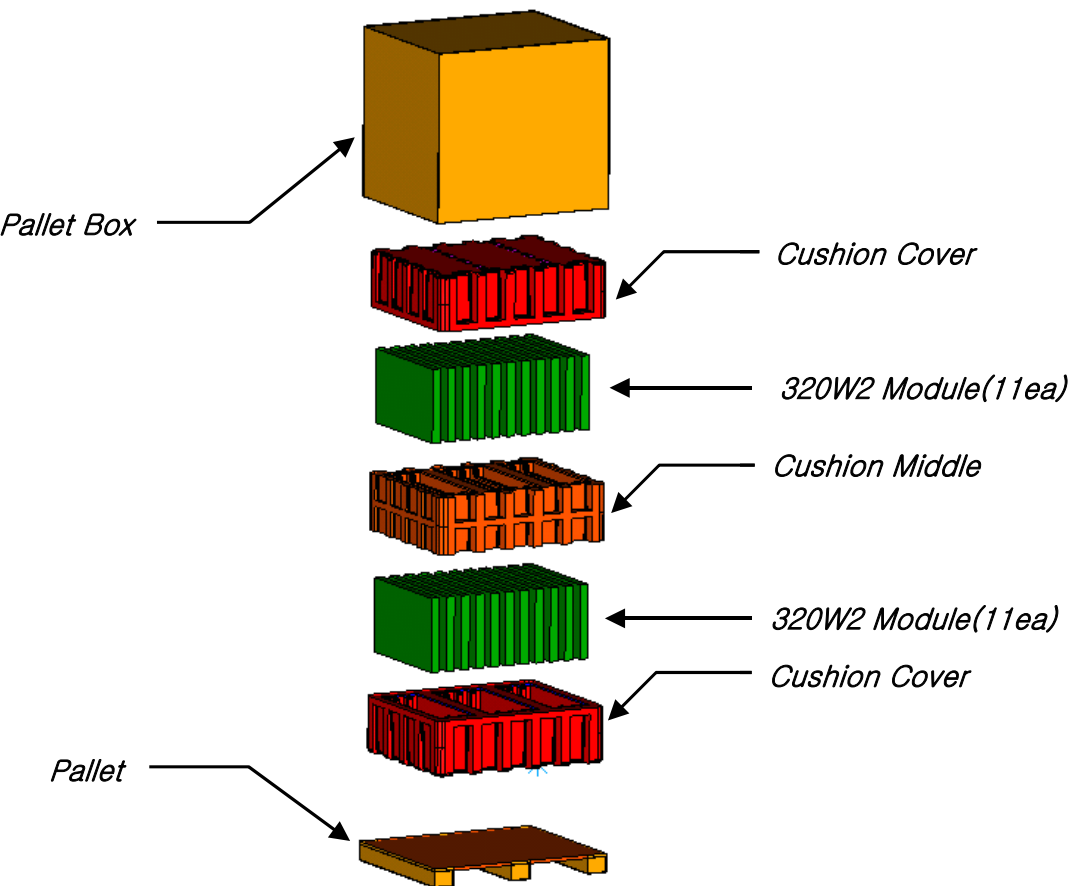
8. PACKING

8.1 CARTON(Internal Package)

(1) Packing Form

Corrugated fiberboard box and corrugated cardboard as shock absorber

(2) Packing Method



8.2 Packing Specification

Item	Specification	Note
Pallet	22ea / Pallet	1. Pallet weight = TBD kg 2. TBD Kg / Pallet → TBD Kg / Pallet

9. MARKING & OTHERS

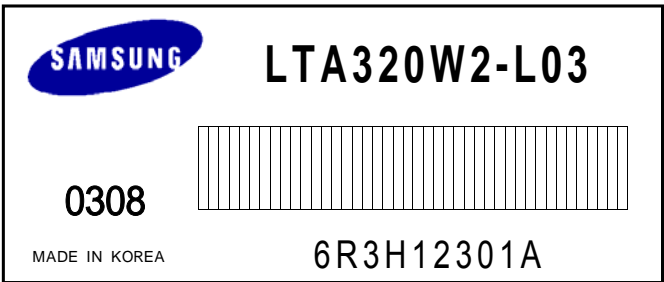
A nameplate bearing followed by is affixed to a shipped product at the specified location on each product.

- (1) Parts number : LTA320W2-L03-00R6
- (2) Revision : One letter
- (3) Control : One letter
- (4) Lot number :

6	Y	3	H	123	01	A
1	2	3	4	5	6	7

6 : Line
Y : Device
3 : Year
H : Month
123 : LOT NO
01 : GLASS NO
A : CELL NO

(5) Nameplate Indication



(6) Bar code marking for Customer

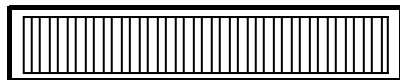
The bar code marking is attached to module backside.

- 1) MODEL NAME : LTA320W2-L03-00R6
- 2) SAMSUNG
- 3) MADE IN KOREA
- 4) PRODUCTION NUMBER
- 5) USER MODEL NAME

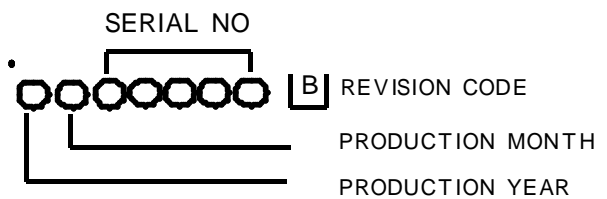
Bar codeshows

a) User model name

LTA320W2-L03-00R6



6430008B



(7) Packing box attach



10. General Precautions

10.1 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 CCFT 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 Gate Array 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 pull or fold the lamp wire.
- (l) Do not adjust the variable resistor which is located on the module.
- (m) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (n) Pins of I/F connector shall not be touched directly with bare hands.

10.2 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 35C 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.

10.3 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 6.3 "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.
- (d) The cable between the back-light connector and its inverter power supply shall be a minimized length and be connected directly . The longer cable between the back-light and the inverter may cause lower luminance of lamp(CCFT) and may require higher startup voltage(Vs).

10.4 Operation Condition Guide

- (a) LCD product supposed to be operated under circumstance of normal condition. **Normal condition** is defined as below;
 - Temperature : $20\pm15^{\circ}\text{C}$
 - Humidity : $65\pm20\%$
 - Display pattern : continually changing pattern (Not stationary)
- (b) When the product is used for special application where operates LCD products in a special condition - sever then normal temperature or humidity or operation time or display pattern -that may happen at Airport, Transit Station, Stock market, Bank, and Controlling system Etc, please contact SEC and take application AMLCD engineers advice. Otherwise, it may not be guaranteed its life time and function.

10.5 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, and 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.
We recommend that you should discuss SEC when you want the module to be operated in displaying the same pattern for a long time.
- (e) This module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.