



ELECTRONICS

Product Information

Customer :

DATE : 09. Jan. 2009

**SAMSUNG TFT-LCD**

**MODEL : LTA216AT01**

APPROVAED BY	DATE	PREPARED BY	DATE
<i>Kyunghwan Ko</i>	09. Jan. 2009	<i>Jinsu Jung</i>	09. Jan. 2009

LCD Business

Samsung Electronics Co . , LTD.

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**\* Revision History**

Date	Rev. No	Page	Summary
Jan. 09 2009	000	All	First issued.

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## General Description

### Description

LTA216AT01 is a color active matrix liquid crystal display (LCD) that uses amorphous silicon TFT(Thin Film Transistor) as switching components. This model is composed of a TFT LCD panel, a driver circuit and a back light unit. The resolution of a 21.6" is 1366 x 768 and this model can display up to 16.7 million colors with wide viewing angle of 80° or higher in all directions. This panel is intended to support applications to provide a excellent performance for Flat Panel Display such as Home-alone Multimedia TFT-LCD TV and High Definition TV.

### Features

- RoHS compliance (Pb-free)
- High contrast & aperture ratio with wide color gamut
- TN( Twisted Nematic ) mode
- Wide viewing angle
- High speed response
- HD resolution (16:9)
- Low Power consumption
- 4 CCFLs (Cold Cathode Fluorescent Lamp)
- DE(Data Enable) mode
- LVDS (Low Voltage Differential Signaling) interface (1pixel/clock)

## General Information

Items	Specification	Unit	Note
Module Size	501.0(H) x 297.0(V) x 17.3(D)	mm	±0.5mm
Weight	TBD (Max)	g	
Pixel Pitch	0.349(H) x 0.349(V)	mm	
Active Display Area	477.4(H) x 268.4(V)	mm	
Surface Treatment	Haze TBD %, Hard-Coating (3H)		
Display Colors	6 bit + FRC - 16.7M	colors	
Number of Pixels	1366 x 768	pixel	
Pixel Arrangement	RGB vertical stripe		
Display Mode	Normally White		
Luminance of White	TBD (Typ.)	cd/m <sup>2</sup>	

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## 1. Absolute Maximum Ratings

If the condition exceeds maximum ratings, it can cause malfunction or unrecoverable damage to the device.

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	$V_{DD}$	GND-0.5	5.5	V	(1)
Storage temperature	$T_{STG}$	-20	60	°C	(2)
Center of Glass Surface temperature (Operation)	$T_{SUR}$	0	50	°C	(2)
Operation temperature	$T_{OPR}$	0	50	°C	(2)
Shock ( non - operating )	$S_{nop}$	-	50	G	(3)
Vibration ( non - operating )	$V_{nop}$	-	1.5	G	(4)

Note (1)  $T_a = 25 \pm 2$  °C

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

a. 90 % RH Max. ( $T_a \leq 39$  °C)

b. Relative Humidity is 90% or less. ( $T_a > 39$  °C)

c. No condensation

(3) 11ms, sine wave, one time for  $\pm X$ ,  $\pm Y$ ,  $\pm Z$  axis

(4) 10-300 Hz, Sweep rate 10min, 30min for X,Y,Z axis

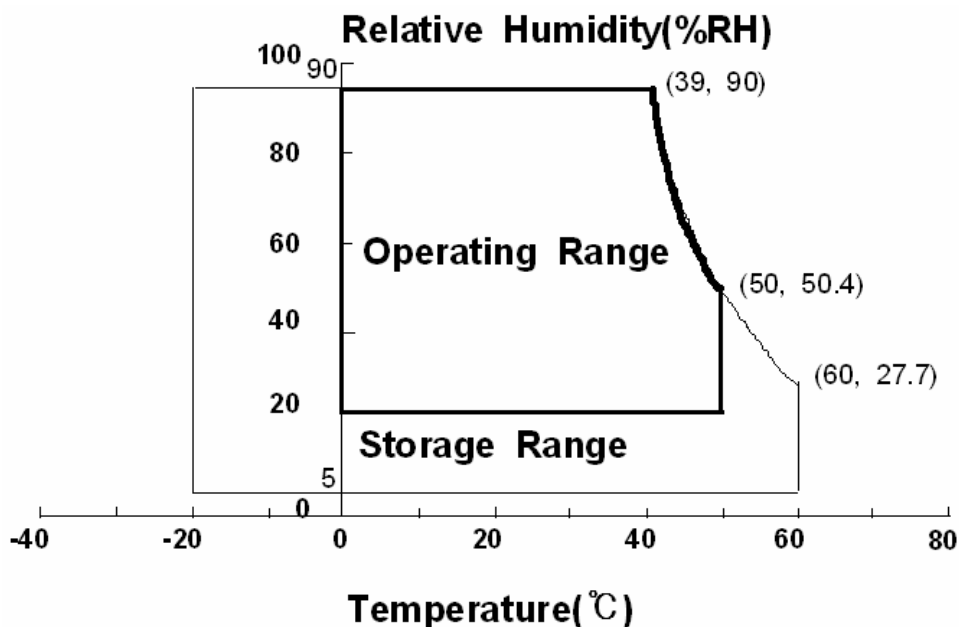


Fig. Temperature and Relative humidity range

## 2. Optical Characteristics

The optical characteristics should be measured in a dark room or equivalent.

Measuring equipment : TOPCON RD-80S, TOPCON SR-3, ELDIM EZ-CONTRAST

( $T_a = 25 \pm 2^\circ\text{C}$ ,  $V_{DD}=5.0\text{V}$ ,  $f_v= 60\text{Hz}$ ,  $f_{DCLK}=72.33\text{ MHz}$ ,  $I_L = \text{TBD mA}$ )

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note	
Contrast Ratio (Center of screen)	C/R	Normal $\theta_{L,R}=0$ $\theta_{U,D}=0$	TBD	1000	-		(1) SR-3	
Response Time	Rising		Tr	-	TBD	TBD	msec	(3) RD-80S
	Falling		Tf	-	TBD	TBD		
	G-to-G		Tg	-	TBD	-		
Luminance of White (Center of screen)	$Y_L$	Viewing Angle	TBD	TBD	-	cd/m <sup>2</sup>	(4) SR-3	
Color Chromaticity (CIE 1931)	Red		Rx	TYP. -0.03	TBD	TYP. +0.03		(5),(6) SR-3
			Ry		TBD			
	Green		Gx		TBD			
			Gy		TBD			
	Blue		Bx		TBD			
			By		TBD			
	White		Wx		TBD			
			Wy		TBD			
Color Gamut	-		-	TBD	-	%	(5) SR-3	
Color Temperature	-	-	TBD	-	K	(5) SR-3		
Viewing Angle	Hor.	$\theta_L$	C/R $\geq$ 10	70	80	-	Degree	(6) EZ-Contrast
		$\theta_R$		70	80	-		
	Ver.	$\theta_U$		70	80	-		
		$\theta_D$		70	80	-		
Brightness Uniformity (9 Points)	$B_{uni}$		-	-	25	%	(2) SR-3	

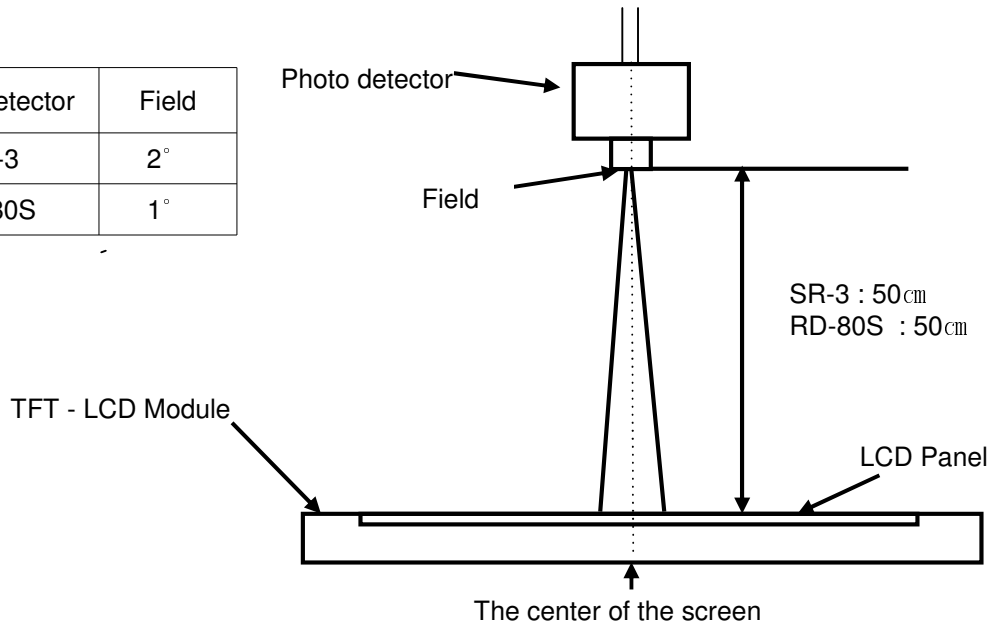
### - Test Equipment Setup

The measurement should be executed in a stable, windless and dark room between 40min and 60min after lighting the back light at the given temperature for stabilization of the back light. This should be measured in the center of screen.

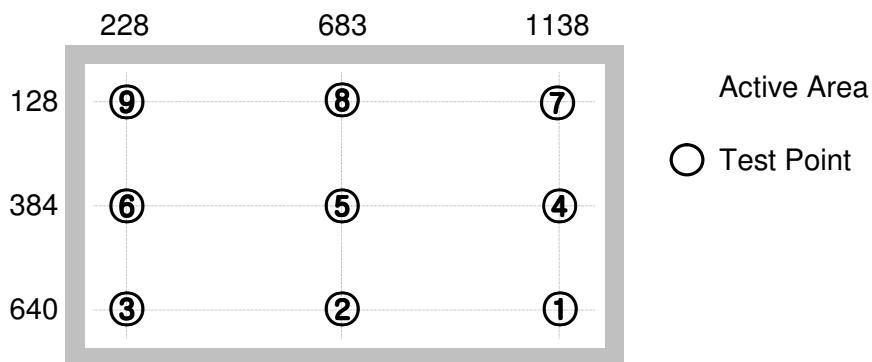
Environment condition :  $T_a = 25 \pm 2^\circ\text{C}$

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Photo detector	Field
SR-3	2°
RD-80S	1°



- Definition of test point



Note (1) Definition of Contrast Ratio (C/R)

: Ratio of gray max (Gmax) & gray min (Gmin) at the center point ⑤ of the panel

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

Gmax : Luminance with all pixels white

Gmin : Luminance with all pixels black

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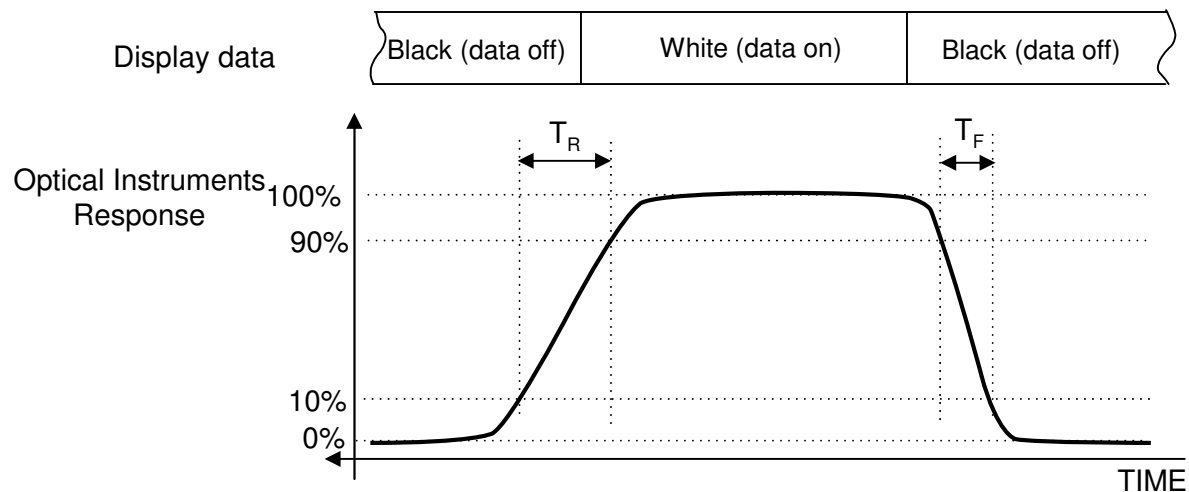
Note (2) Definition of 9 points brightness uniformity ( Test Pattern : Full White )

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

Bmax : Maximum brightness

Bmin : Minimum brightness

Note (3) Definition of Response time : Sum of Tr, Tf



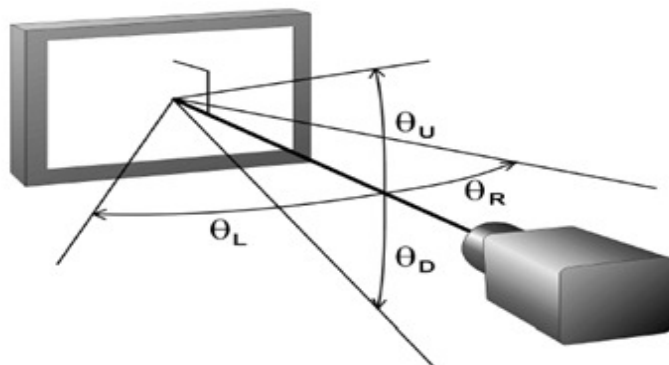
Note (4) Definition of Luminance of White : Luminance of white at center point ⑤

Note (5) Definition of Color Chromaticity (CIE 1931)

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

Note (6) Definition of Viewing Angle

: Viewing angle range (C/R  $\geq 10$ )





### 3. Electrical Characteristics

#### 3.1 TFT LCD Module

The connector for display data & timing signal should be connected.

Ta = 25°C

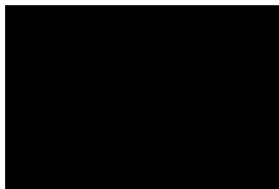
Item	Symbol	Min.	Typ.	Max.	Unit	Note
Voltage of Power Supply	$V_{DD}$	4.5	5.0	5.5	V	(1)
Current of Power Supply	(a) Black	-	TBD	-	mA	(2),(3)
	(b) White	-	TBD	-	mA	
	(c) Dot-Pattern	-	TBD	TBD	mA	
Vsync Frequency	$f_V$	TBD	60	TBD	Hz	
Hsync Frequency	$f_H$	TBD	47.4	TBD	kHz	
Main Frequency	$f_{DCLK}$	TBD	72.33	TBD	MHz	
Rush Current	$I_{RUSH}$	-	-	TBD	A	(4)

Note (1) The ripple voltage should be controlled under 10% of  $V_{DD}$ .

(2)  $f_V=60\text{Hz}$ ,  $f_{DCLK} = 72.33 \text{ MHz}$ ,  $V_{DD} = 5.0\text{V}$ , DC Current.

(3) Power dissipation check pattern (LCD Module only)

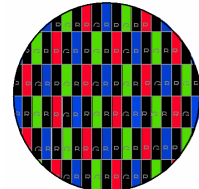
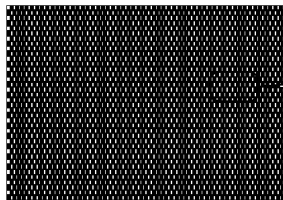
a) Black Pattern



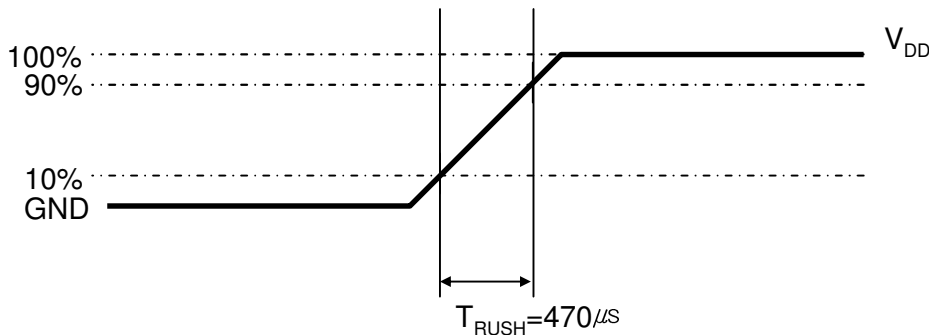
b) White Pattern



c) Dot-Pattern



#### (4) Measurement Conditions



Rush Current  $I_{RUSH}$  can be measured when  $T_{RUSH}$  is  $470 \mu\text{s}$ .

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### 3.2 Back Light Unit

The back light unit is an edge - lighting type with 4 CCFLs ( Cold Cathode Fluorescent Lamps ) The characteristics of two dual lamps are shown in the following tables.

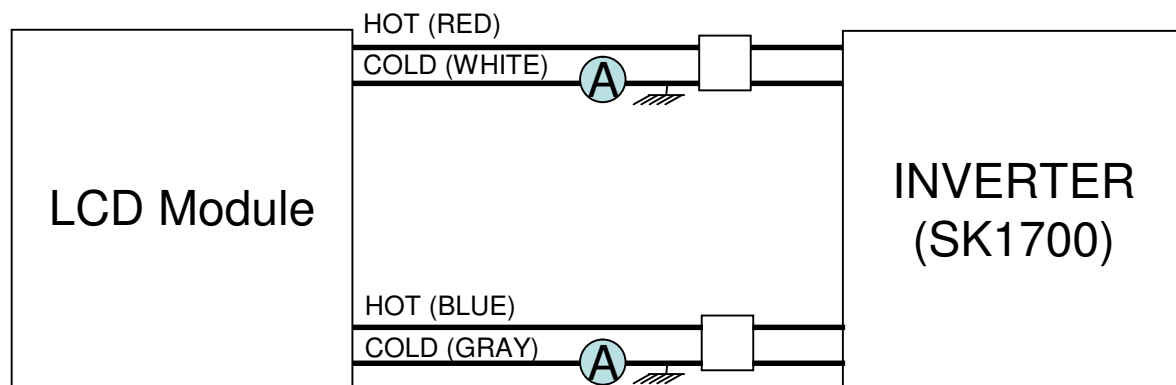
Ta=25 ± 2°C

Item	Symbol	Min.	Typ.	Max.	Unit	Note	
Lamp Current	$I_L$	TBD	TBD	TBD	mArms	(1)	
Lamp Voltage	$V_L$	-	TBD	-	Vrms		
Lamp Frequency	$f_L$	TBD	-	TBD	kHz	(2)	
Operating Life Time	Hr	TBD	-	-	Hour	(3)	
Inverter waveform	Asymmetry rate	Wasy	-	-	10	%	(4)
	Distortion rate	Wdis	1.2726	1.414	1.5554		
Startup Voltage	$V_s$	-	-	0°C : 1,480	Vrms	(5)	
				25°C : 1,170			

Note (1) Specified values are for a single lamp.

Lamp current is measured with current meter for high frequency as shown below.

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



**Fig. Measurement point of Lamp Current**

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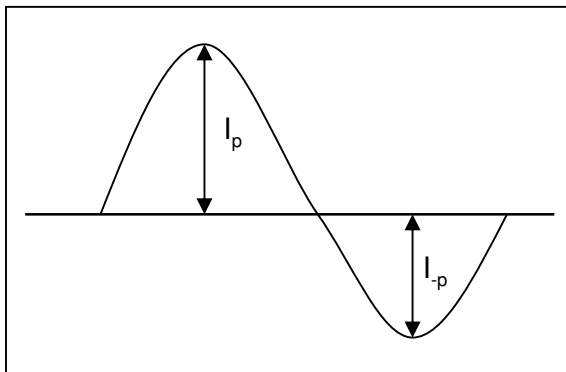
(2) Lamp frequency which may produce interference with horizontal synchronous frequency may cause line flow on the display. Therefore lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible in order to avoid interference.

(3) Life time (Hr) is defined as the time when brightness of a lamp unit itself becomes 50% or less than its original value at the condition of  $T_a = 25 \pm 2^\circ\text{C}$  and  $I_L = \text{TBD mA rms}$

(4) Designing a system inverter intended to have better display performance, power efficiency and lamp reliability.

They would help increase the lamp lifetime and reduce leakage current.

- a. The measurement should be done at typical lamp current.
- b. The asymmetry rate of the inverter waveform should be less than 10%.
- c. The distortion rate of the waveform should be  $\sqrt{2}$  with  $\pm 10\%$  tolerance.
  - Inverter output waveform had better be more similar to ideal sine wave.



**Fig. Wave form of the inverter**

- Asymmetry rate

$$\frac{|I_p - I_{-p}|}{I_{rms}} \times 100$$

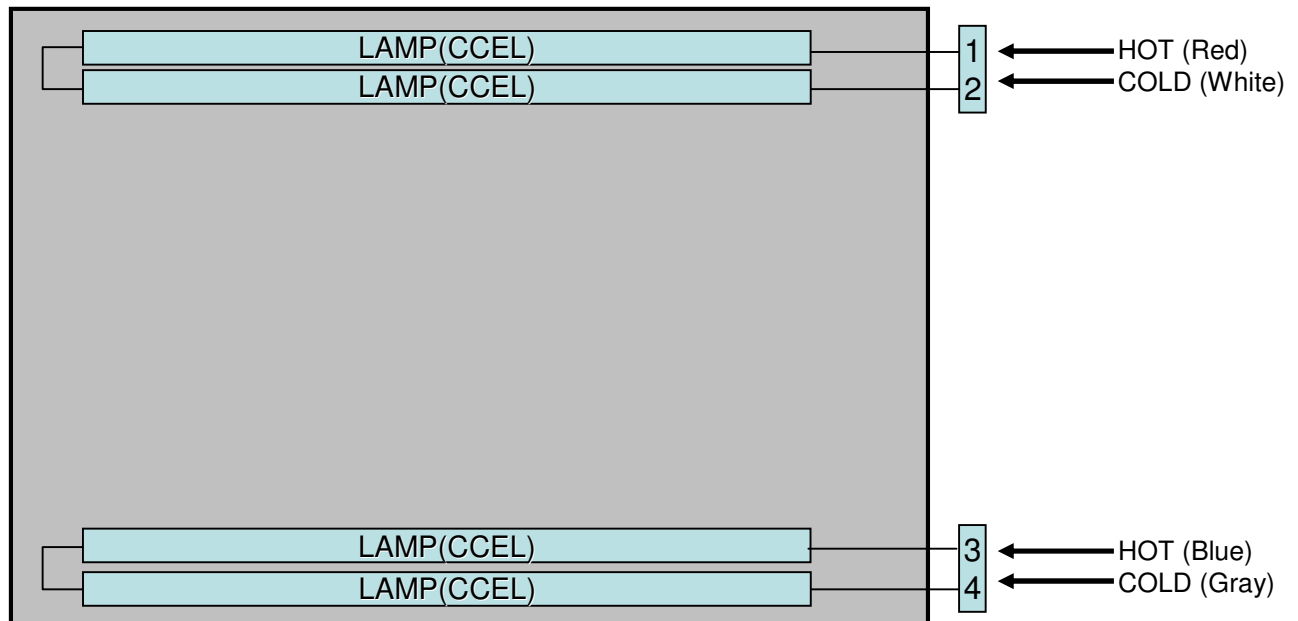
- Distortion rate

$$\left| \frac{I_p}{I_{rms}} \right| \text{ or } \left| \frac{I_{-p}}{I_{rms}} \right|$$

(5) If an inverter has shutdown function, it should keep its output for over 1 second even if the lamp connector is open. Otherwise the lamps may not be turned on.

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### 3.3 Back Light Unit Diagram



### 3.4 Back Light Unit Pin Assignment

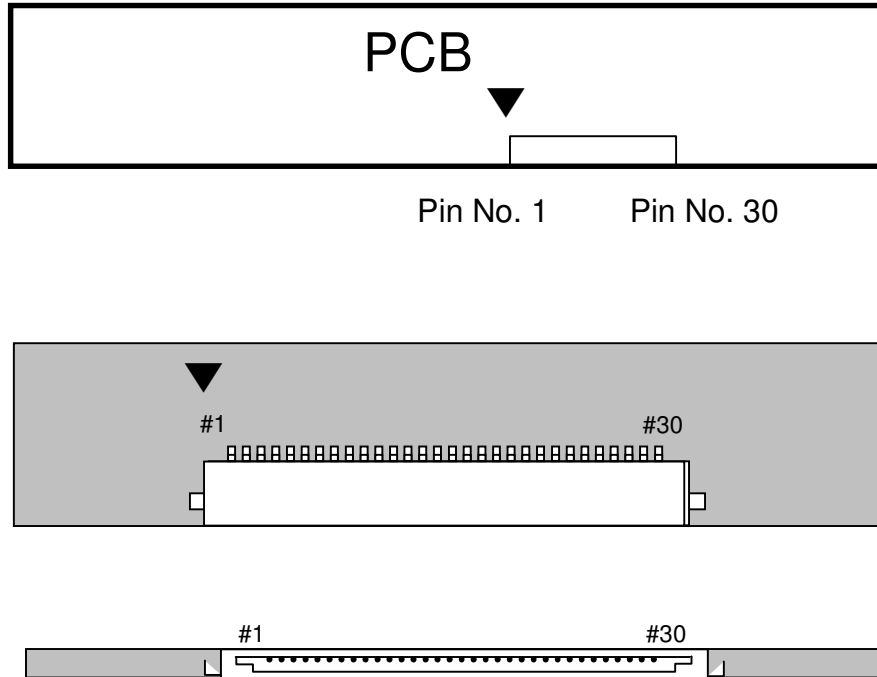
	Pin No.	Input	Color	Function
Upper	1	Hot – 1	Red	High Voltage
	2	Cold – 1	White	Ground
Lower	3	Hot – 2	Blue	High Voltage
	4	Cold – 2	Gray	Ground
Connector Part No.		JST SM02B-BHSS-1-TB or Compatible		

## 4. Input Terminal Pin Assignment

### 4.1. Input Signal & Power ( Connector : P-Two 187034-30091 or Compatible )

PIN NO	SYMBOL	FUNCTION
1	NC	No Connection
2	CE	No Connection
3	CTL	No Connection
4	GND	Power Ground
5	RXIN0-	Negative LVDS Differential Data Input (0)
6	RXIN0+	Positive LVDS Differential Data Input (0)
7	GND	Power Ground
8	RXIN1-	Negative LVDS Differential Data Input (1)
9	RXIN1+	Positive LVDS Differential Data Input (1)
10	GND	Power Ground
11	RXIN2-	Negative LVDS Differential Data Input (2)
12	RXIN2+	Positive LVDS Differential Data Input (2)
13	GND	Power Ground
14	RXCLKIN-	Negative LVDS Differential Clock Input (Clock)
15	RXCLKIN+	Positive LVDS Differential Clock Input (Clock)
16	GND	Power Ground
17	RXIN3-	Negative LVDS Differential Data Input (3)
18	RXIN3+	Positive LVDS Differential Data Input (3)
19	GND	Power Ground
20	NC	No Connection
21	NC	No Connection
22	NC	No Connection
23	GND	Power Ground
24	GND	Power Ground
25	GND	Power Ground
26	VCC	Power Supply : +5V
27	VCC	
28	VCC	
29	VCC	
30	VCC	

Note) Pin number starts from Left side



**Fig. Connector diagram**

- a. All GND pins should be connected together and also be connected to the LCD's metal chassis.
- b. All power input pins should be connected together.
- c. All NC pins should be separated from other signal or power.

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## 4.2 LVDS Interface

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

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### 4.3 Input Signals, Basic Display Colors and Gray Scale of Each Color

COLOR	DISPLAY (8bit)	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	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	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	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	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	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	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	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	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	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	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	0	R2		
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R3~R252		
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	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	0	0	R252		
		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	0	R252		
	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	0	R252		
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	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	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	0	G2		
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	G3~G252		
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	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	0	0	G252		
		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	0	G252		
	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	0	G252		
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	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	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	0	B2		
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3~B252		
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3~B252		
	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	1	1	B252		
		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	1	B252		
	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	1	B252		

Note (1) 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

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## 5. Interface Timing

### 5.1 Timing Parameters ( DE only mode )

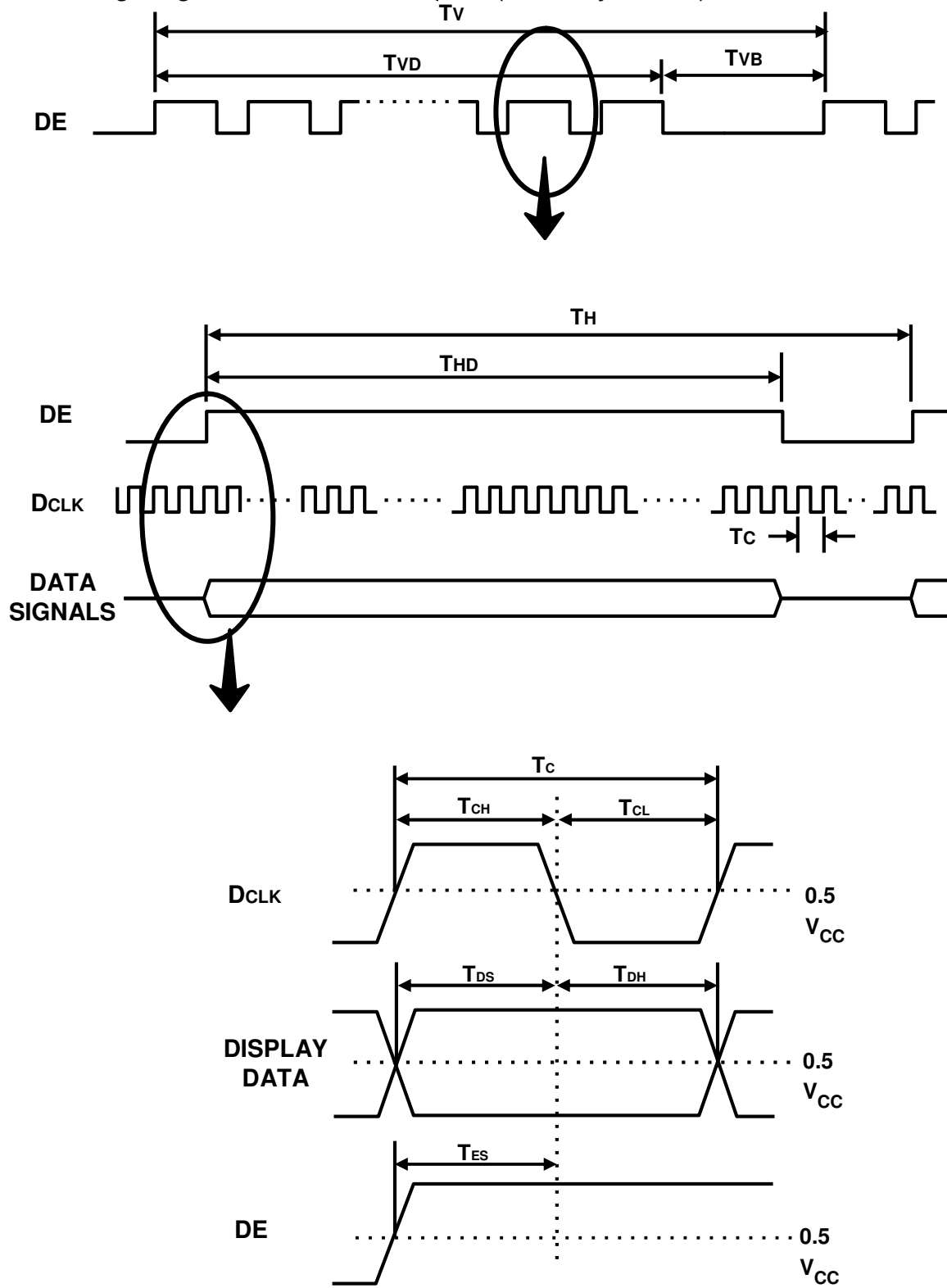
SIGNAL	ITEM	SYMBOL	MIN.	TYP.	MAX.	Unit	NOTE
Clock	Frequency	$1/T_C$	TBD	72.33	TBD	MHz	-
Hsync		$F_H$	TBD	47.4	TBD	KHz	-
Vsync		$F_V$	TBD	60	TBD	Hz	-
Vertical Display Term	Active Display Period	$T_{VD}$	-	768	-	lines	-
	Vertical Total	$T_{VB}$	TBD	790	TBD	lines	-
Horizontal Display Term	Active Display Period	$T_{HD}$	-	1366	-	clocks	-
	Horizontal Total	$T_H$	TBD	1526	TBD	clocks	-

Note (1) This product is DE only mode. The input of Hsync & Vsync signal does not have an effect on normal operation.

(2) Test Point : TTL control signal and CLK at LVDS Tx input terminal in system

(3) Internal Vcc = 3.3V

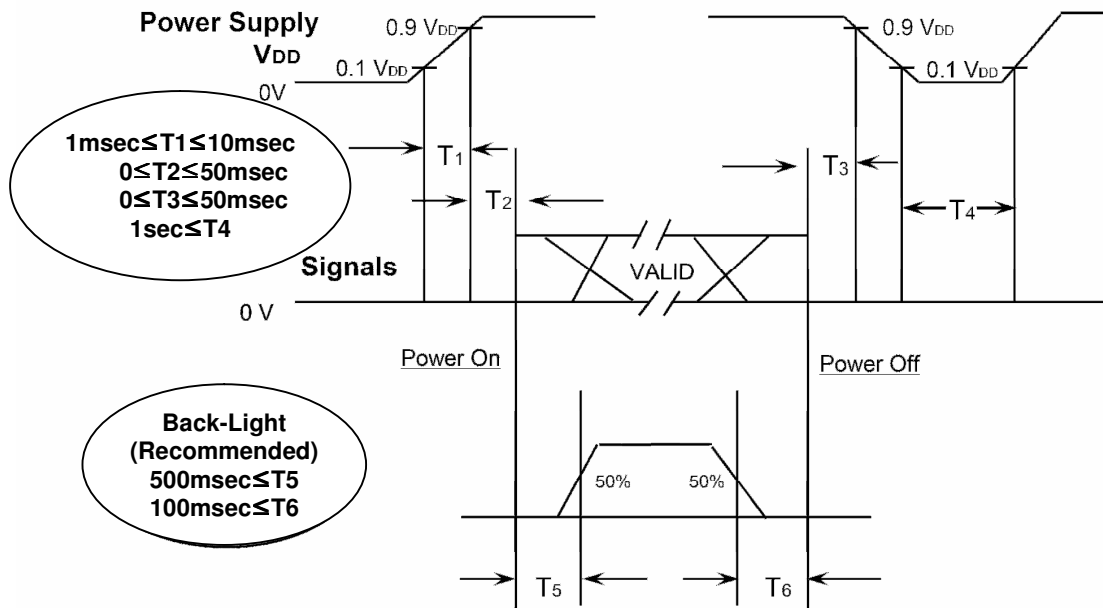
## 5.2 Timing diagrams of interface signal ( DE only mode )



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### 5.3 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.



- T1 : V<sub>DD</sub> rising time from 10% to 90%
- T2 : The time from V<sub>DD</sub> to valid data at power ON.
- T3 : The time from valid data off to V<sub>DD</sub> off at power Off.
- T4 : V<sub>DD</sub> off time for Windows restart
- T5 : The time from valid data to B/L enable at power ON.
- T6 : The time from valid data off to B/L disable at power Off.

- The supply voltage of the external system for the Module input should be the same as the definition of V<sub>DD</sub>.
- 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 show abnormal screen.
- In case of V<sub>DD</sub> = off level, please keep the level of input signals low or keep a high impedance.
- T4 should be measured after the Module has been fully discharged between power off and on period.
- Interface signal should not be kept at high impedance when the power is on.

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**TBD**

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**TBD**

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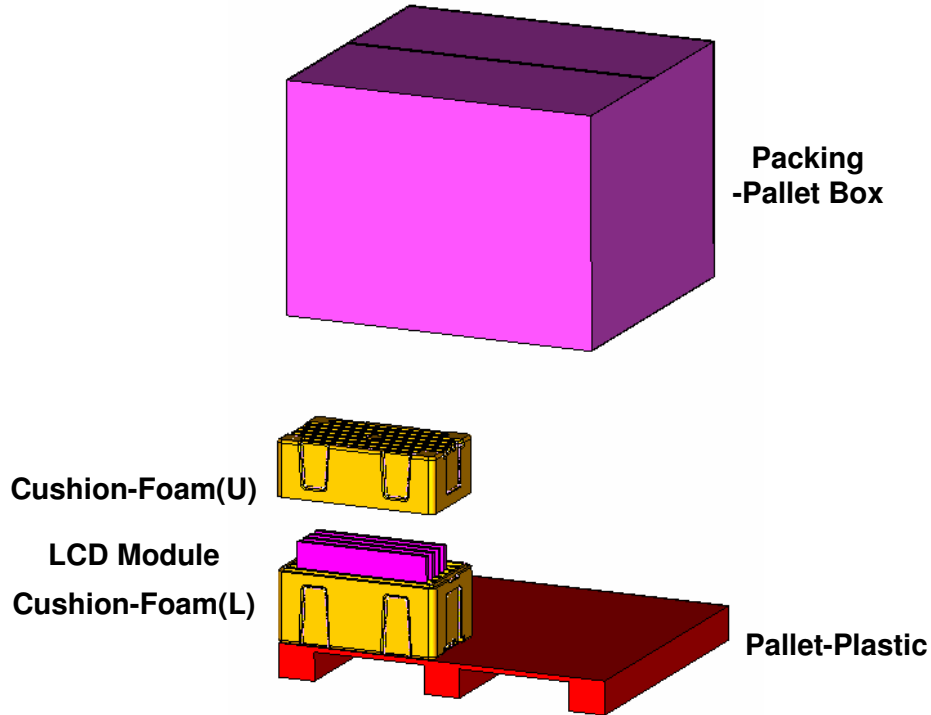
## 7. PACKING

### 7.1 CARTON (Internal Package)

(1) Packing Form

Corrugated fiberboard box and corrugated cardboard as shock absorber

(2) Packing Method



### 7.2 Packing Specification

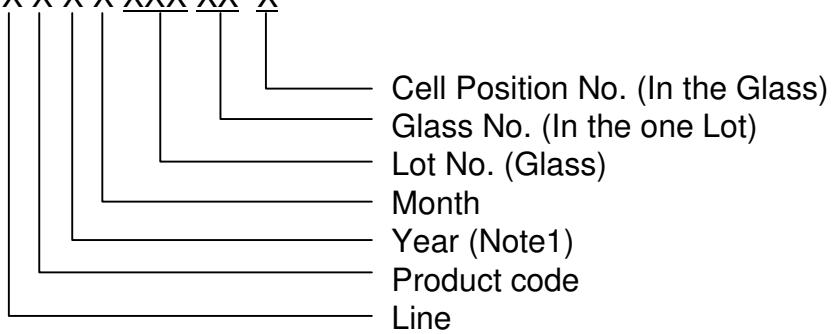
Item	Specification	Remark
LCD Packing	72ea / (Packing-Pallet Box)	1. TBD Kg / LCD (72ea) 2. TBD Kg / Cushion-Foam (U:12ea, L:12ea) 3. TBD Kg / Packing-Pallet Box (1ea) 4. Cushion-pallet Material : EPS 5. Packing-Pallet Box Material : DW4
Pallet	1Box / Pallet	1. Pallet weight = TBD kg
Packing Direction	Vertical	
Total Pallet Size	H x V x height	1130mm(H) x 965mm(V) x 696mm(height)
Total Pallet Weight	TBD kg	Pallet(TBDkg)+Module(TBD*72=TBD)+Cushion (up*12+botton*12=TBDkg)+Pallet-BOX (TBDkg)

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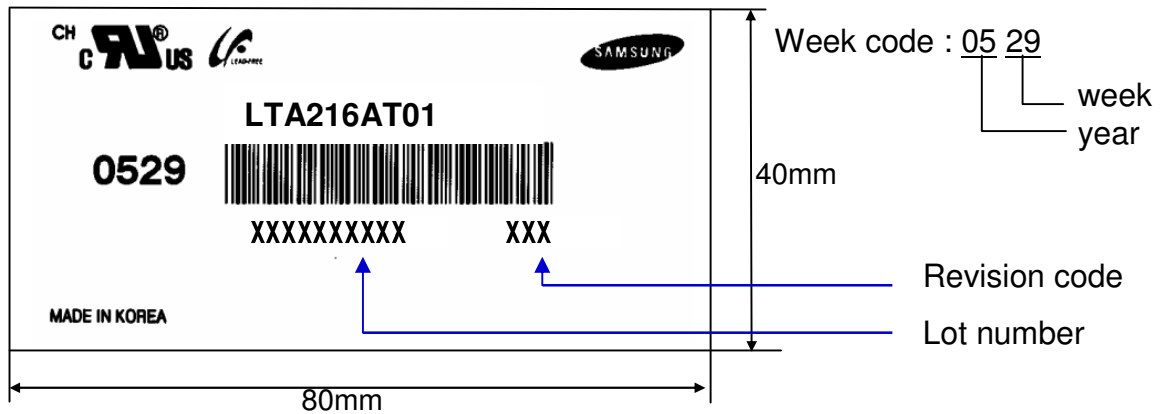
## 8. MARKING & OTHERS

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

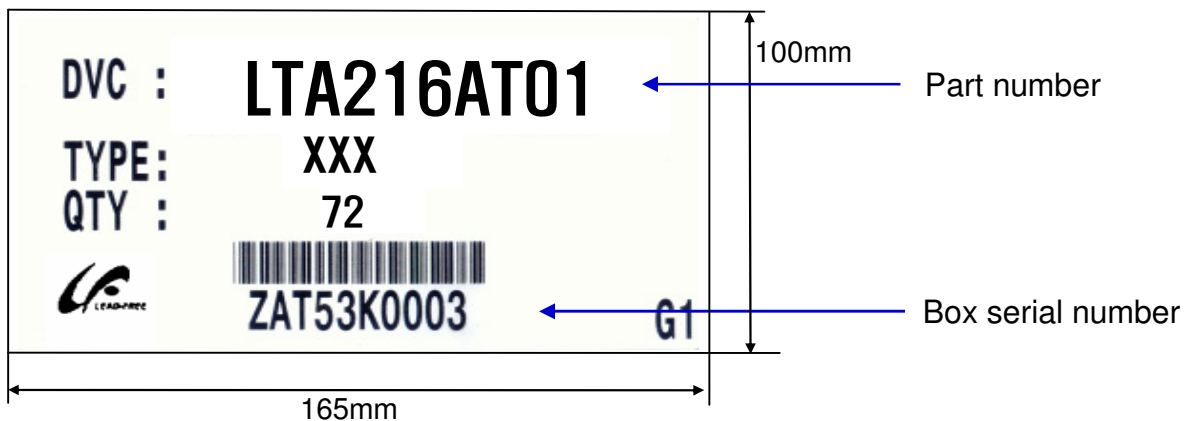
- (1) Part number : LTA216AT01
- (2) Revision: Three letters
- (3) Lot number : X X X X XXX XX X



### (4) Nameplate Indication



### (5) Packing box attach



### (6) Others

- 1. After service part  
 Lamps cannot be replaced because of the narrow bezel structure.

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## 9. General Precautions

### 9.1 Handling

- (a) When the Module is assembled, it should be attached to the system firmly using all mounting holes. Be careful not to twist and bend the Module.
- (b) Because the inverter use high voltage, it should be disconnected from power before it is assembled or disassembled.
- (c) 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.
- (d) Note that polarizers are very fragile and could be damage easily.  
Do not press or scratch the surface harder than a HB pencil lead.
- (e) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, staining or discoloration may occur.
- (f) If the surface of the polarizer is dirty, clean it using absorbent cotton or soft cloth.
- (g) 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.
- (h) 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 with soap thoroughly.
- (i) Protect the Module from static, or the CMOS Gate Array IC would be damaged.
- (j) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (k) Do not disassemble the Module.
- (l) Do not pull or fold the lamp wire.
- (m) Do not adjust the variable resistor located on the Module.
- (n) Protection film for polarizer on the Module should be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (o) Pins of I/F connector should not be touched directly with bare hands.

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## 9.2 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 should be stored in a dark place. It is prohibited to apply sunlight or fluorescent light in storing.

## 9.3 Operation

- (a) Do not connect or disconnect the Module in the "Power On" condition.
- (b) Power supply should always be turned on/off by the "Power on/off sequence"
- (c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference should 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 should be connected directly with a minimized length. A longer cable between the back light and the inverter may cause lower luminance of lamp(CCFT) and may require higher startup voltage(Vs).

## 9.4 Operation Condition Guide

- (a) The LCD product should be operated under normal conditions.  
Normal condition is defined as below;
  - Temperature :  $20 \pm 15$  °C
  - Humidity :  $55 \pm 20$  %
  - Display pattern : continually changing pattern (Not stationary)
- (b) If the product will be used in extreme conditions such as high temperature, humidity, display patterns or operation time etc., It is strongly recommended to contact SEC for Application engineering advice. Otherwise, its reliability and function may not be guaranteed. Extreme conditions are commonly found at Airports, Transit Stations, Banks, Stock market, and Controlling systems.

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## 9.5 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. ( 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 keeps displaying the same pattern for a long period of time, the image may be "sticked" to the screen.  
To avoid image sticking, it is recommended to use a screen saver.
- (e) This Module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.
- (f) Please contact SEC in advance when you display the same pattern for a long time.

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