

Product Information

Issued Date : July. 2, 2004

SAMSUNG TFT-LCD

MODEL NO. : LTA190W1-L01

Note:

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

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Samsung Electronics Co . , LTD.

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* Revision History

No	Date	Page	Before change	After change	Remark
0.0	2004.03.02	All	First issued		
0.1	2004.07.01	6	Lamp Current[Min, Max] = [3.5, 7.5][mA _{rms}]	Lamp Current[Min, Max] = [3.8, 7.0][mA _{rms}]	Changed
		17	PIN NO 13 Analog Dimmer / Open or GND Max. Lum ~ 3.3V DC Min. Lum	PIN NO 13 Analog Dimmer / Open or GND Min. Lum ~ 3.3V DC Max. Lum	Changed
			PWM Dimmer Fqwm[Min, Typ, Max] = [130, 180, 210][Hz]	PWM Dimmer Fqwm[Min, Typ, Max] = [120, 180, 240][Hz]	Changed
			Analog Dimmer [Max Lum, Min Lum] = [0, 3.3][V]	Analog Dimmer [Max Lum, Min Lum] = [3.3, 0][V]	Changed

General Description

* Description

LTA190W1-L01 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 19.0" contains 1280 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
- PVA (Patterned Vertical Align) mode
- Wide viewing angle($\pm 170^\circ$)
- High speed response
- WXGA(1280 x 768 pixels) resolution (15:9)
- Low Power consumption
- 6 U-Type CCFTs (Cold Cathode Fluorescent Tube)
- DE only mode
- LVDS(Low-Voltage Differential Signal) interface.(1pixel/clock)

* Applications

Home-alone Multimedia TFT-LCD TV

Display terminals for AV application products

Internet Surfing

High Definition TV (HD TV)

* General information

Items	Specification	Unit	Note
Display area	412.8(H) × 247.68(V)	mm	
Driver element	a-Si TFT active matrix		
Display colors	16.7M(true)	colors	
Number of pixels	1280 x 768	pixel	15:9
Pixel arrangement	RGB Vertical Stripe		
Pixel pitch	0.1075(H) × 0.3225(W)	mm	
Display mode	Normally Black		
Surface treatment	Haze 44% , Hard-Coating (3H)		

*** Mechanical information (Panel Module Only)**

Item		Min.	Typ.	Max.	Note
Module size	Horizontal(H)	447.0	448.0	449.0	mm
	Vertical(V)	275.0	276.0	277.0	mm
	Depth(D)	37.0	38.0	39.0	mm (with Inverter)
Weight		-	2.2	-	Kg

1. Absolute Maximum Ratings
1.1 Absolute ratings of environment

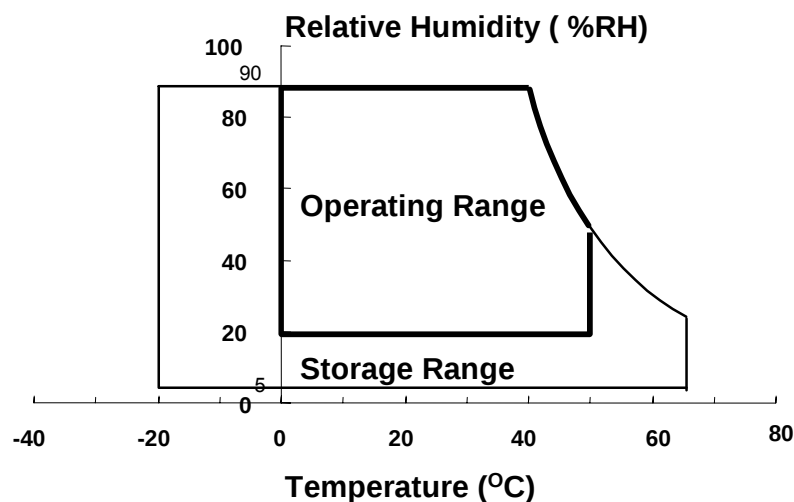
Item	Symbol	Min.	Max.	Unit	Note
Storage temperature	T _{STG}	-20	65	°C	(1)
Operating temperature (Ambient temperature)	T _{OPR}	0	50	°C	(1)
	T _{sur}	0	65	°C	(2)
Shock (non - operating)	Snop	-	50	G	(3)
Vibration (Non - operating)	Vnop	-	1.5	G	(4)

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

90 % 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) 11ms, sine wave, 1 time for ±X, ±Y, ±Z axis
- (4) 10~300Hz/1.5G/10minSR, XYZ, 30min/axis
(10min/cycle, 30min for X,Y,Z axis)



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	26.4	V	(1)
Lamp Current	I _L	3.8	7.0	mA _{rms}	(2),(3)
Lamp Frequency	F _L	40	60	kHz	(2)

NOTE (1) Inverter 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
EZ-Contrast (Eldim)

* Ta = 25 ± 2°C , VDD=5.0V, fv= 60Hz, fDCLK=75 MHz, IL = 5.0mA_{rms}

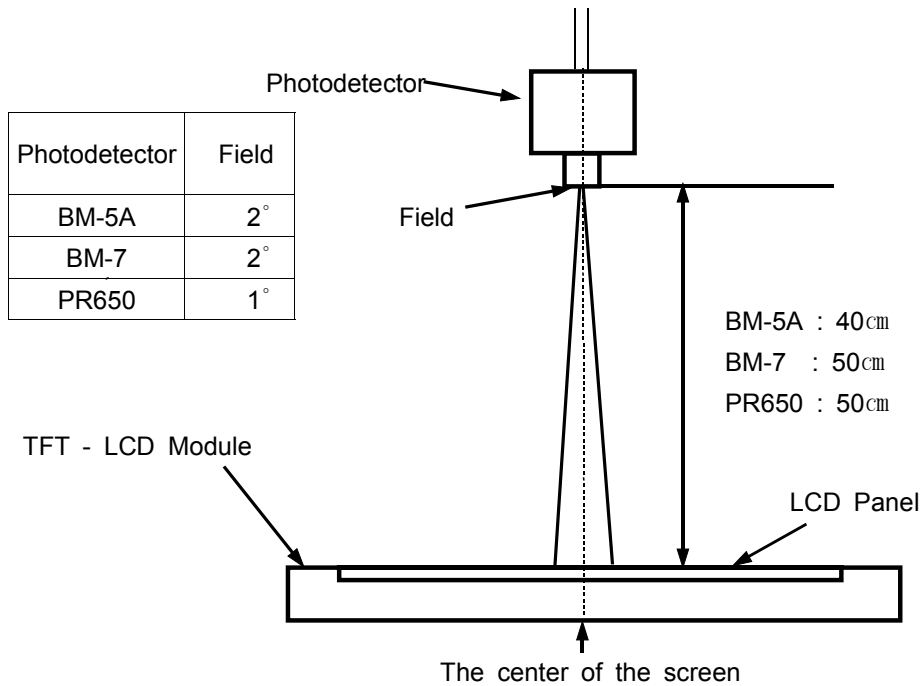
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio (Center of screen)		C/R	Normal $\phi = 0$ $\theta = 0$ Viewing Angle	600	800	-		(3) BM-5A
Response Time (DCC On)	Rising	Tr		-	16	21	msec	(4),(10) BM-7
	Falling	Tf		-	9	12		
Luminance of White (Center of screen)		YL		400	450	-	cd/m2	(5) BM-5A
Color Chromaticity (CIE 1931)	Red	Rx		TYP. -0.03	0.640	TYP. +0.03		(6) PR650
		Ry			0.333			
	Green	Gx			0.275			
		Gy			0.595			
	Blue	Bx			0.143			
		By			0.064			
	White	Wx			0.280			
		Wy			0.290			
Color Temperature		CCT	-	10000	-	K		
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		-	-	25	%	(8) BM-5A

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.

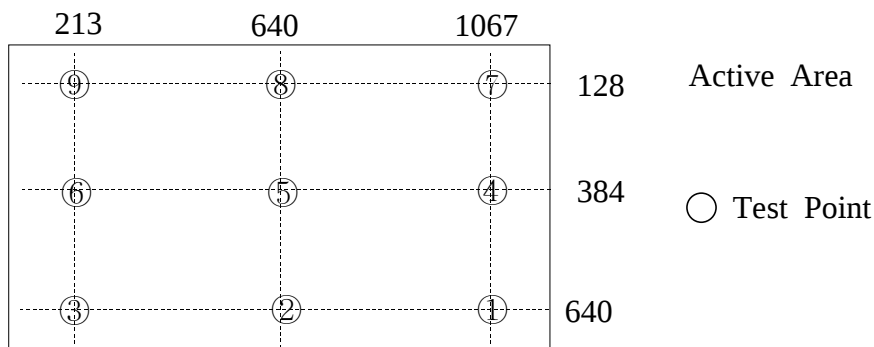
A single lamp current : 5.0mA

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



Optical Measuring Equipment Setup

Note 2) Definition of test point



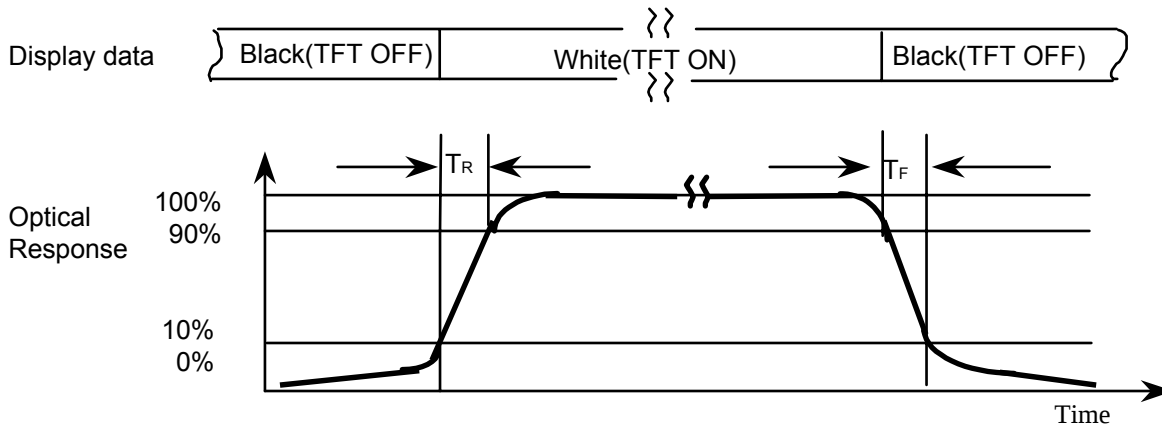
Note 3) Definition of Contrast Ratio (C/R) : Ratio of gray max (Gmax) & gray min (Gmin) at the center point(5) of the panel

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

Gmax : Luminance with all pixels white

Gmin : Luminance with all pixels black

Note 4) Definition of Response time : Sum of T_r , T_f

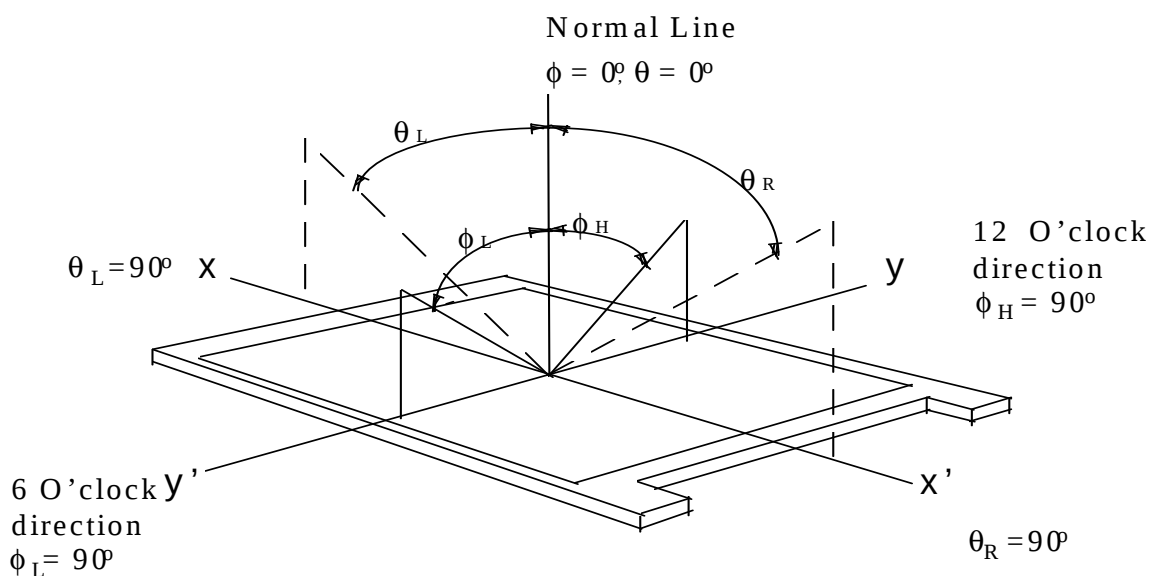


Note 5) Definition of Luminance of White : Luminance of white at center point(5).

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

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

B_{max} : Maximum brightness

B_{min} : Minimum brightness

3. Electrical Characteristics

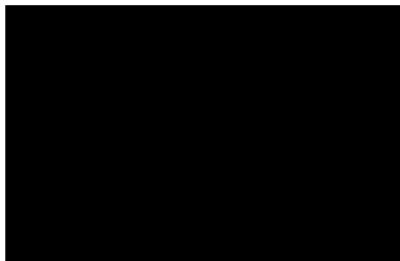
3.1 TFT LCD MODULE

Ta = 25°C

Item		Symbol	Min.	Typ.	Max.	Unit	Note
Voltage of Power Supply		V _{DD}	4.5	5.0	5.5	V	(1)
Current of Power Supply	(a)Black	I _{DD}	-	1200	-	mA	(2),(3), (5)
	(b)White		-	1300	-	mA	
	(c)N-Pattern		-	1500	1700	mA	
Vsync Frequency		f _V	48	60	66	Hz	
Hsync Frequency		f _H	43	48	53	kHz	
Main Frequency		f _{DCLK}	60	75	82	MHz	
Rush Current		I _{RUSH}	-	-	4.0	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)

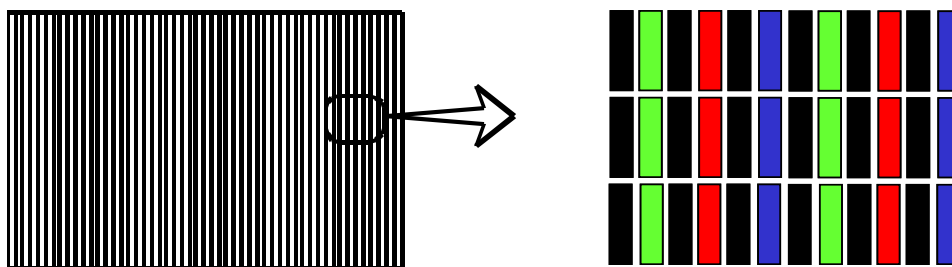
(a) Black Pattern



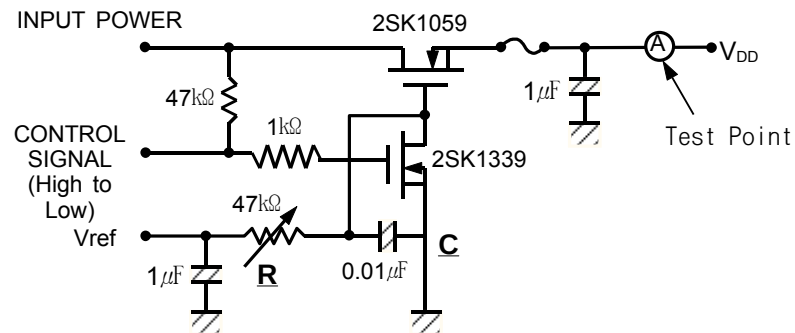
(b) White Pattern



(C) N-pattern



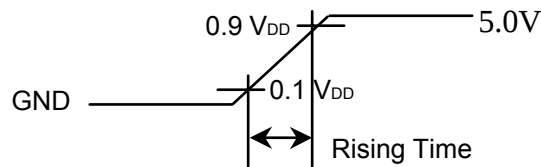
(4) Measurement Conditions (Rising time =470 μ s)



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 → Execpt for Inverter power consumption

3.2 BACK-LIGHT UNIT

The back-light system is an direct - lighting U-type with 6 CCFTs (Cold Cathode Fluorescent Tube) The characteristics of 6 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	6.5	mArms	(1)
Lamp Voltage	V_L	1420	1520	1570	Vrms	(1)
Lamp Frequency	f_L	-	60	-	kHz	(2)
Operating Life Time	Hr	50,000	-	-	Hour	(3) at 7.0mA
Start up Voltage	V_s	-	-	0°C:2560	Vrms	(4)
				25°C:2040		

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 block diagram of the back-light unit in the next page for more information.

Lamp Voltage tolerance (at 48.5kHz) : $1420 \pm 7\%$ Vrms at 4.0mArms

$1570 \pm 7\%$ Vrms at 6.5mArms

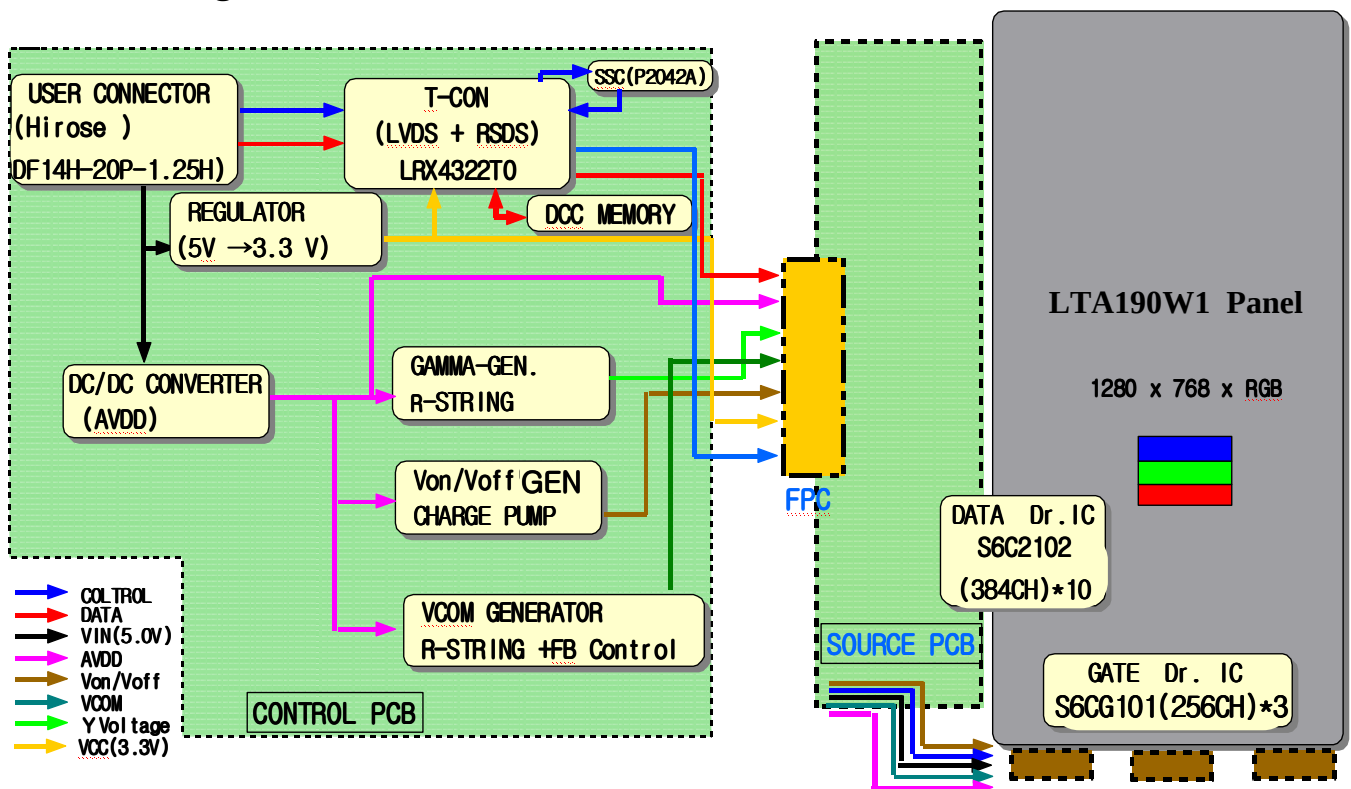
(2) Start-up frequency must be under 80kHz.

(3) Life time (Hr) of a lamp is defined as the time in which it continues to operate under the condition of $T_a = 25 \pm 2^\circ\text{C}$ and allowed current range for a lamp until the brightness becomes 50% or lower than it's original value.

(4) 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.

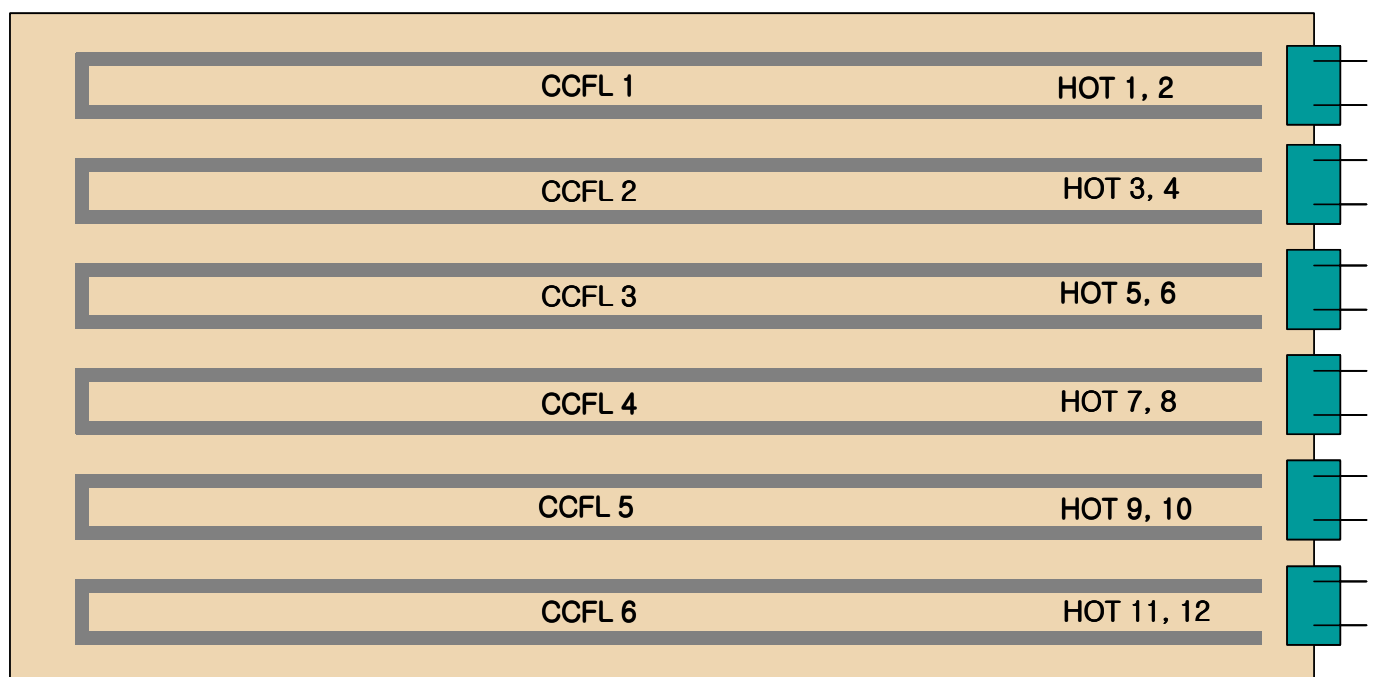
(5) Start up Voltage at 0°C is the value of BLU(Back-Light Unit) only. Thus lamp itself cannot guarantee the value written in the table above.

4. Block Diagram



4.2 BACK-LIGHT UNIT

HOT : HIGH VOLTAGE (Part NO. : BHCR-02VS-2 (JST))



5. Input Terminal Pin Assignment

5.1. Input Signal & Power : Connector DF14A-20P-1.25H (Hirose)

No	Signal	No	Signal
1	5.0V	11	Rx2-
2	5.0V	12	Rx2+
3	GND	13	GND
4	GND	14	RxCLK-
5	Rx0-	15	RxCLK+
6	Rx0+	16	GND
7	GND	17	Rx3-
8	Rx1-	18	Rx3+
9	Rx1+	19	LVDS Option (JEIDA/VESA)
10	GND	20	NC (Internal Use)

* 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 = $V_{dd}(T1) \geq \text{LVDS Option} \geq \text{Interface Signal}(T2)$

OFF = $\text{Interface Signal}(T3) \geq \text{LVDS Option} \geq V_{dd}$

5.2 LVDS Interface

-LVDS Receiver : Tcon (LVDS Rx merged)

-Pixel data (single data)

LVDS Signal	Input Data	JEIDA (Pin19=GND)	VESA (Pin19=3.3V)
RxIN0	RxOUT0	R2	R0
	RxOUT1	R3	R1
	RxOUT2	R4	R2
	RxOUT3	R5	R3
	RxOUT4	R6	R4
	RxOUT6	R7	R5
	RxOUT7	G2	G0
RxIN1	RxOUT8	G3	G1
	RxOUT9	G4	G2
	RxOUT12	G5	G3
	RxOUT13	G6	G4
	RxOUT14	G7	G5
	RxOUT15	B2	B0
	RxOUT18	B3	B1
RxIN2	RxOUT19	B4	B2
	RxOUT20	B5	B3
	RxOUT21	B6	B4
	RxOUT22	B7	B5
	RxOUT24	HSYNC	HSYNC
	RxOUT25	VSYNC	VSYNC
	RxOUT26	DE	DE
RxIN3	RxOUT27	R0	R6
	RxOUT5	R1	R7
	RxOUT10	G0	G6
	RxOUT11	G1	G7
	RxOUT16	B0	B6
	RxOUT17	B1	B7
	RxOUT23		

5.3 INVERTER UNIT : Inverter input pin configuration

Input 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	NC
12	BACKLIGHT ON/OFF / ON: 2.4~5.0V, OFF: 0~0.8V
13	Analog Dimmer / Open or GND Min. Lum~ 3.3V DC Max. Lum
14	PWM Dimmer / Input 3.3V Max. Lum

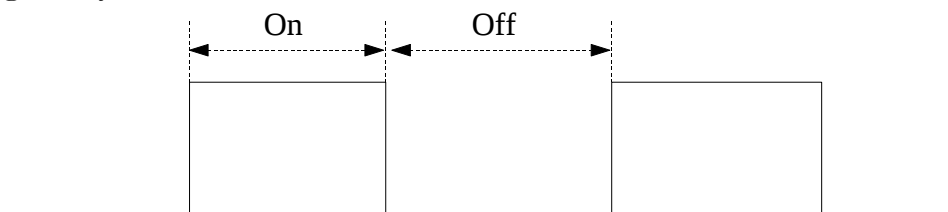
5.4 Inverter specification

Item	Symbol	MIN	TYP	MAX	Unit	Note
Inverter Power	Vcc	21.6	24	26.4	V	(1)
	Icc	-	-	3	A	
PWM Dimming	High-Duty	20	-	100	%	(2)
	High(on)	4.0	-	5.0	V	(3)
	Low(off)	0	-	0.5		
	Fpwm	120	180	240	Hz	
Analog Dimming	Max. Lum	3.3			V	
	Min. Lum	0				
Backlight on/off	High(on)	2.4 ~ 5.0			V	
	Low(off)	0 ~ 0.8				

Note(1) VCC is the Inverter Input Voltage .

Controlled by PWM dimming

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



Note(3) When Analog Dimming control, PWM pin should be NC or high or pulse input status.

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

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	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	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	↓ 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	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	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	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	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	↓ 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	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	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	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	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	↓ 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	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	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	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

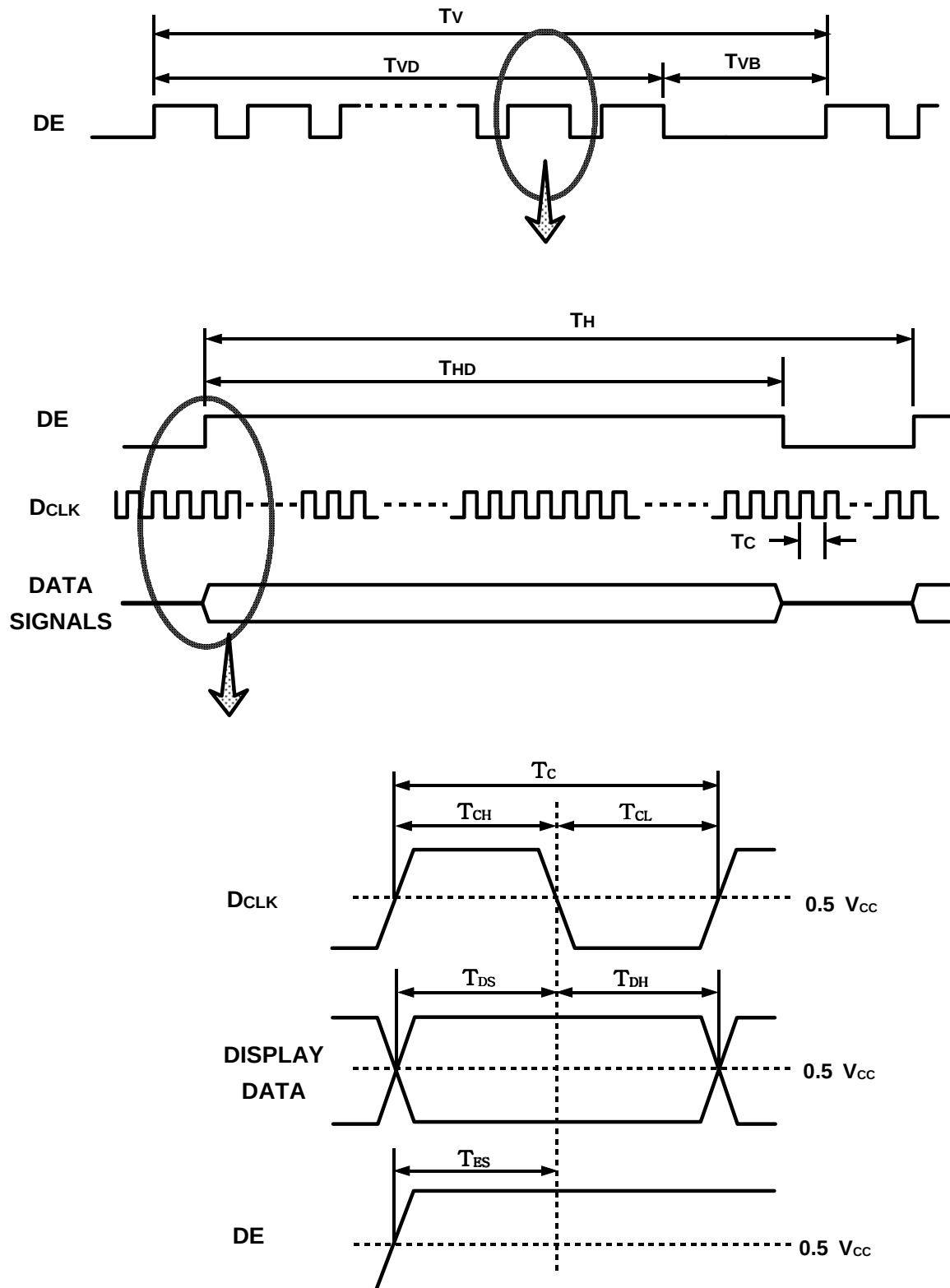
6. Interface Timing

6.1 Timing Parameters (DE only mode)

SIGNAL	ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Clock	Frequency	1/TC	60	75	82	MHz	
Hsync		Fh	43	48	53	KHz	
Vsync		Fv	48	60	66	Hz	
Vertical Active Display Term	Display Period	TVD	–	768	–	lines	
	Vertical Total	TVB	773	838	1200	lines	
Horizontal Active Display Term	Display Period	THD	–	1280	–	clocks	
	Horizontal Total	TH	1368	1600	2040	clocks	

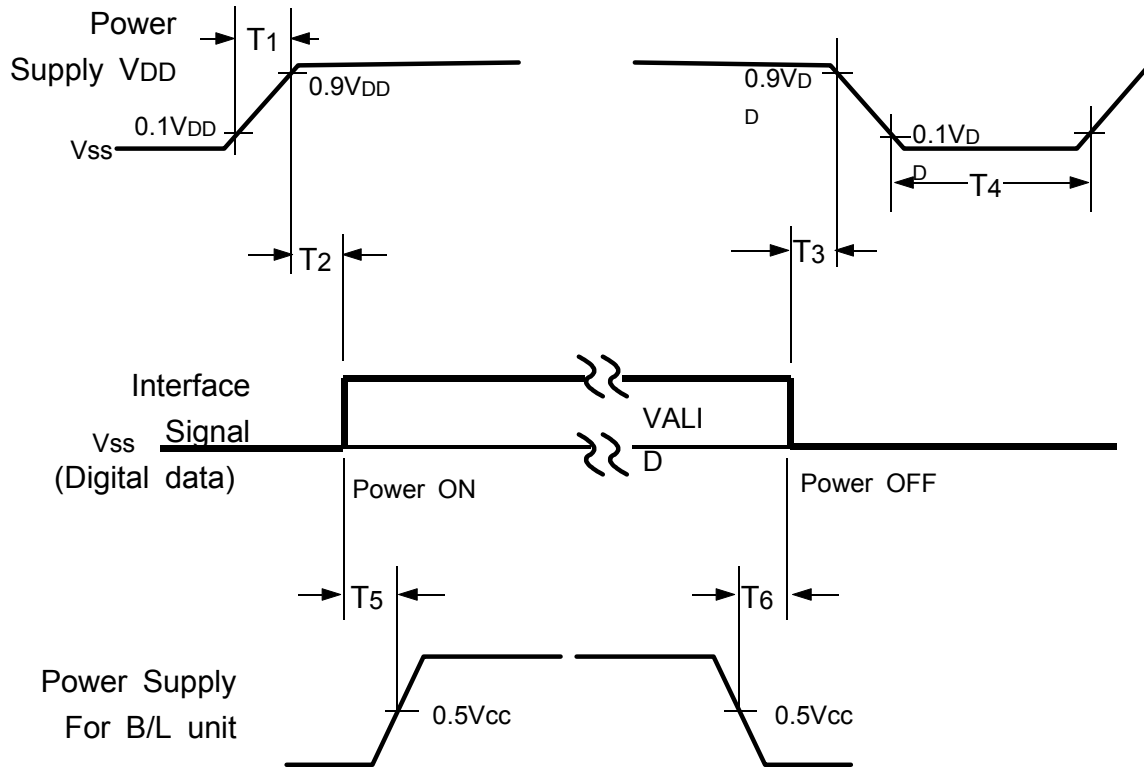
Note) This product is DE only mode. The input of Hsync & Vsync signal does not have an effect on normal operation.

6.2 Timing diagrams of interface signal (DE only mode)



6.3 Power ON/OFF Sequence

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



$$0 < T_1 \leq 30 \text{ msec}$$

$$0 < T_2 \leq 50 \text{ msec}$$

$$0 < T_3 \leq 50 \text{ msec}$$

$$300 \text{ msec} \leq T_4$$

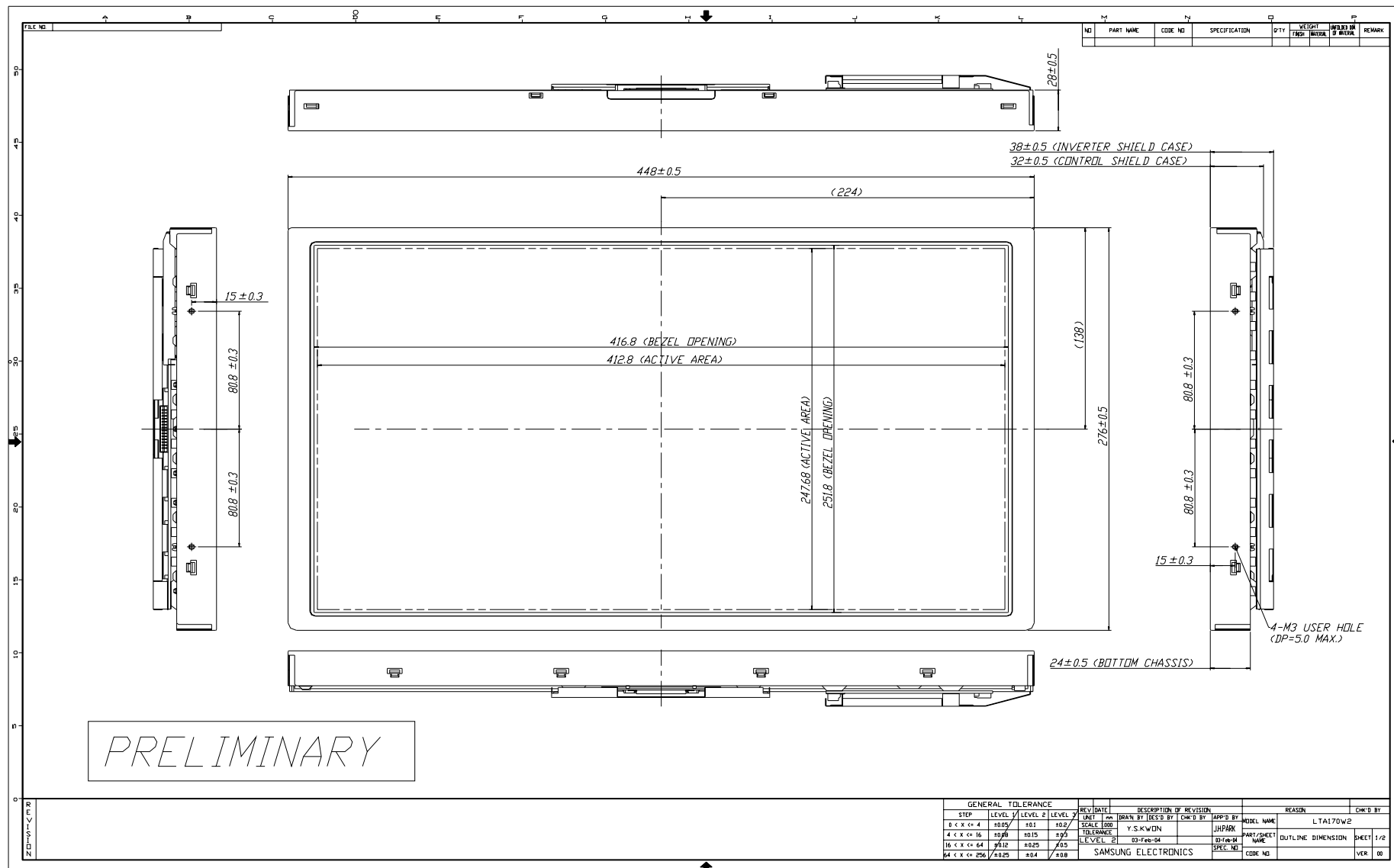
$$500 \text{ msec} \leq T_5 (\text{Recommend Value})$$

$$100 \text{ msec} \leq T_6 (\text{Recommend Value})$$

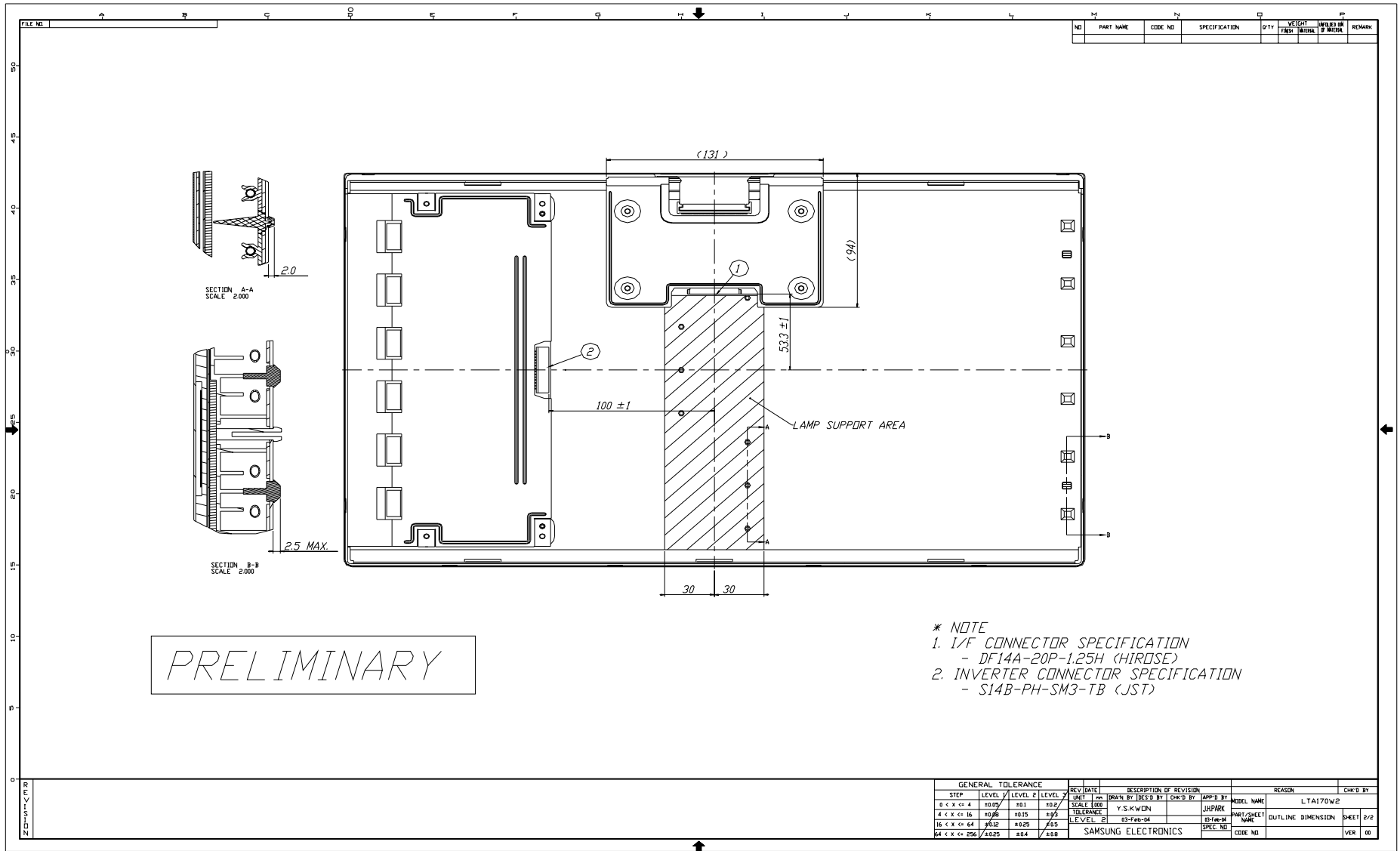
NOTE.

- (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.

7. Outline Dimension(Front View)



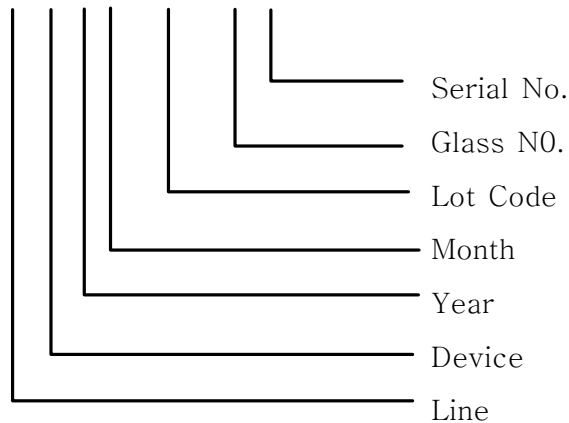
(Rear View)



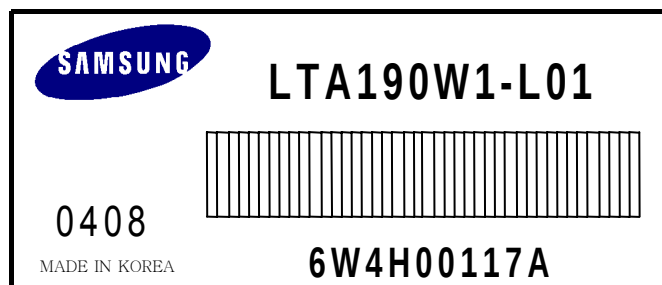
8. Marking & Others

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

- (1) Parts number : LTA190W1-L01-00R6
- (2) Revision : One letter
- (3) Control : One letter
- (4) Lot number : 6 W 4 H 0 0 1 1 7 A



(5) Nameplate Indication



(6) Bar code marking for Customer

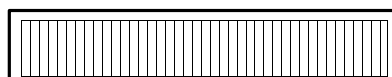
The bar code marking is attached to module backside.

- 1) MODEL NAME : LTA190W1-L01-00R6
- 2) SAMSUNG
- 3) MADE IN KOREA
- 4) PRODUCTION NUMBER
- 5) USER MODEL NAME

Bar code shows a) user model name, b) production number

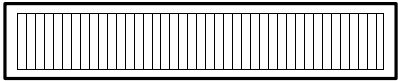
a) User model name

LTA190W1-L01-00R6

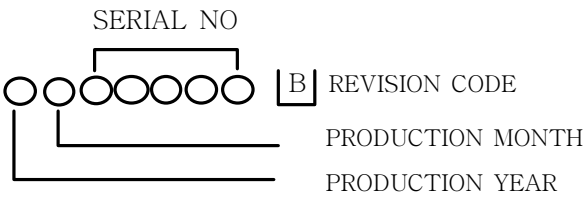


b) Production Number

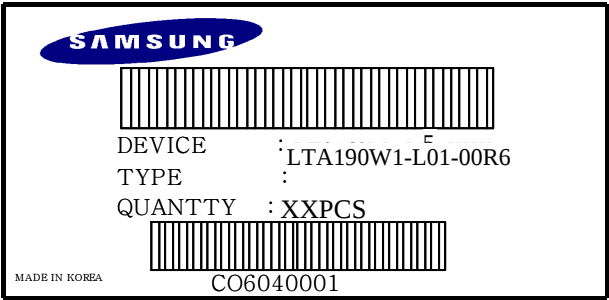
SAMSUNG
MADE IN KOREA



00000000



(7) Packing box attach



9. General Precautions

9.1 Handling

- (a) When the module is assembled into a system, it should be attached firmly using all 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 CCFL back-light.
- (c) Note that polarizers are very fragile and can 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 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 may cause permanent polarizer damage due to the chemical reaction.
- (g) If the liquid crystal material leaks from the panel, it should be kept away from the eyes and mouth. In case of contact with skin or clothes, thoroughly wash it away with soap and water.
- (h) Protect the module from static electricity. It may cause damage to the C-MOS Gate Array IC.
- (i) Use finger-stalls with soft gloves to keep display clean during the incoming inspection and the assembly process.
- (j) Do not disassemble the module.
- (k) Do not pull or fold the lamp wire.
- (l) Do not adjust the variable resistor located on the back side.
- (m) I/F connector pins should not be touched directly with bare hands.

9.2 Storage

- (a) Do not expose the module in high temperature, and/or high humidity for a long time. It is highly recommended to store the module within the temperature from 0 to 35°C and relative humidity of less than 70%.
- (b) Do not store the TFT-LCD module in direct sunlight. The module shall be stored in a dark place. Prolonged exposure to sunlight or fluorescent light during the storage will damage the module.

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 following item 6.3 “ Power on/off sequence “.
- (c) The 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 should be at the minimum length possible to 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).

Operation Condition Guide

- (a) The LCD product should to be operated under normal conditions.
Normal condition is defined as below;
 - Temperature : $20 \pm 15^{\circ}\text{C}$
 - Humidity : $65 \pm 20\%$
 - 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.

9.4 Others

- (a) Use Ultra-violet light filters if outdoor operation is necessary.
- (b) Avoid water condensation. Moisture may penetrate sensitive electrical connections resulting in improper operation.
- (c) Do not exceed the absolute maximum rating values. (supply voltage variation, input voltage variation, variation in part contents and environmental temperature, etc..) Otherwise, the module may be damaged.
- (d) If the module displays the same pattern continuously for a long period of time, it can result in the situation where the image “sticks” (remains) on 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) The module has sensitive PCB circuitry on the back side and should be handled carefully in order prevent stress and possible failure.