SAMSUNG ELECTRONICS

Preliminary

Customer : SONY

Date : Feb. 25, 2004

SAMSUNG TFT-LCD

MODEL NO. : LTA230W1-L01

Note:

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

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Samsung Electronics Co . , LTD.

wise view™ SAMSUNG TFT-LCD

Contents

* Revision History

No	Date	Page	Before change	After change	Remark
0.0	2004.2.25	All	First issued		

General Description

*** Description**

LTA230W1-L01 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 23.0" 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(± 170°)
- High speed response
- WXGA(1366 x 768 pixels) resolution (16:9)
- Low Power consumption
- 6 Direct U-Type CCFL(Cold Cathode Fluorescent Lamp)
- 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	508.125(H) × 285.696(V)	mm	
Driver element	a-Si TFT active matrix		
Display colors	16.7M(true)	colors	
Number of pixels	1366 x 768	pixel	16:9
Pixel arrangement	RGB Vertical Stripe		
Pixel pitch	0.372(H) × 0.372(W)	mm	
Display mode	Normally Black		
Surface treatment	TBD		conductive pol

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

Item		Min.	Typ.	Max.	Note
Module size	Horizontal(H)	545.0	546.0	547.0	mm
	Vertical(V)	319.0	320.0	321.0	mm
	Depth(D)	-	27.0	-	mm
Weight		-	3,000	-	g

1. Absolute Maximum Ratings

1.1 Absolute ratings of environment

Item	Symbol	Min.	Max.	Unit	Note
Storage temperature	TSTG	-20	65	℃	(1)
Operating temperature	TOPR	0	50	℃	(1)
(Ambient temperature)	Tsur	0	65	℃	(2)
Shock (non - operating)	Snop	-	50	G	(3),(5)
Vibration (Non - operating)	Vnop	-	1.5	G	(4),(5)

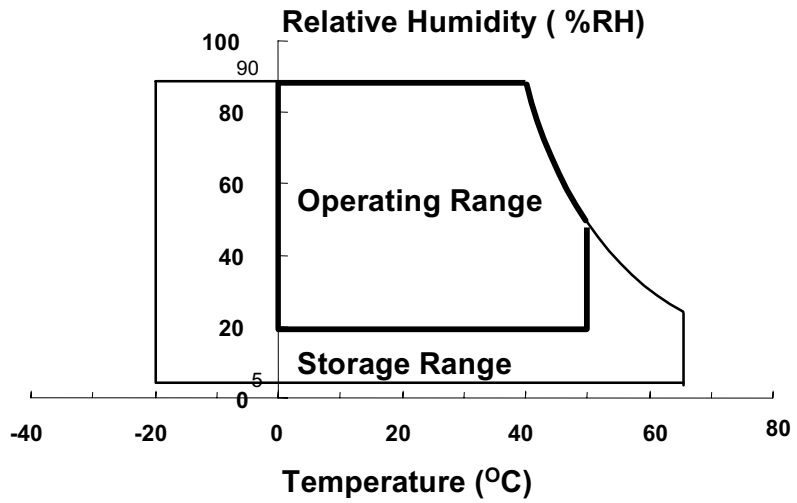
Note (1) Temperature and relative humidity range are shown in the figure below.
93.8 % RH Max. (40 °C ≥ Ta)
Maximum wet-bulb temperature at 39 °C or less. (Ta > 40 °C) No condensation.

(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, Tsur.

(3) 11ms, sine wave, 1 time for ±X, ±Y, ±Z axis

(4) 10～300Hz/1.5G
(10min/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 (Vss = GND = 0 V)

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	VDD	Vss-0.5	13.0	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	TBD	V	(1)
Lamp Current	I_L	4.0	7.0	㎃rms	(2),(3)
Lamp Frequency	F_L	40	60	㎑	(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

* Ta = 25 ± 2°C , V_{DD}=5.0V, fv= 60Hz, f_{DCLK}=80 MHz, I_L = TBDmA_{rms}

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio (Center of screen)		C/R	Normal $\phi = 0$ $\theta = 0$ Viewing Angle	500	800	-		(3) BM-5A
Response Time	Rising	Tr		-	16	18	msec	(4) BM-7
	Falling	Tf		-	5	7		
Luminance of White (Center of screen)		Y_L		400	500	-	cd/m2	(5) BM-5A Dimmer Voltage2.8V
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			0.281			
		Wy			0.288			
Color Temperature		k		-	10000	-		
Viewing Angle	Hor.	θ L	C/R≥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		-	-	23	%	(8) BM-5A

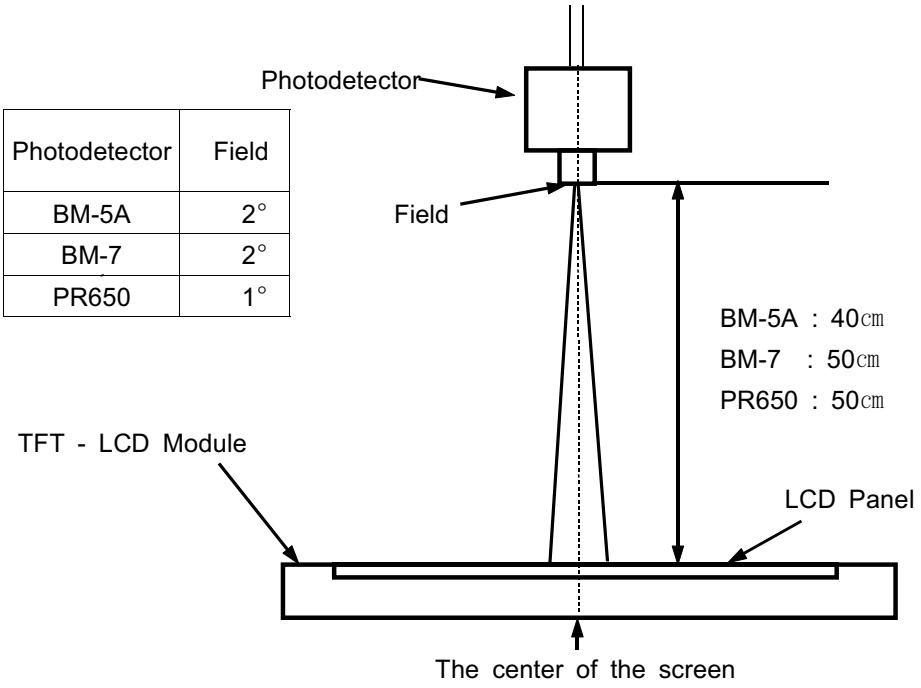
Note 1) Test Equipment Setup

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 : TBDmA

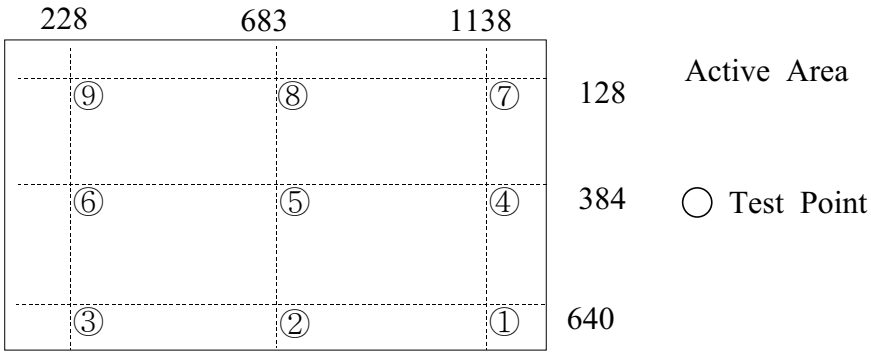
Environment condition : Ta = 25 ± 2 °C

Photodetector	Field
BM-5A	2°
BM-7	2°
PR650	1°



Optical Measuring Equipment Setup

Note 2) Definition of test point



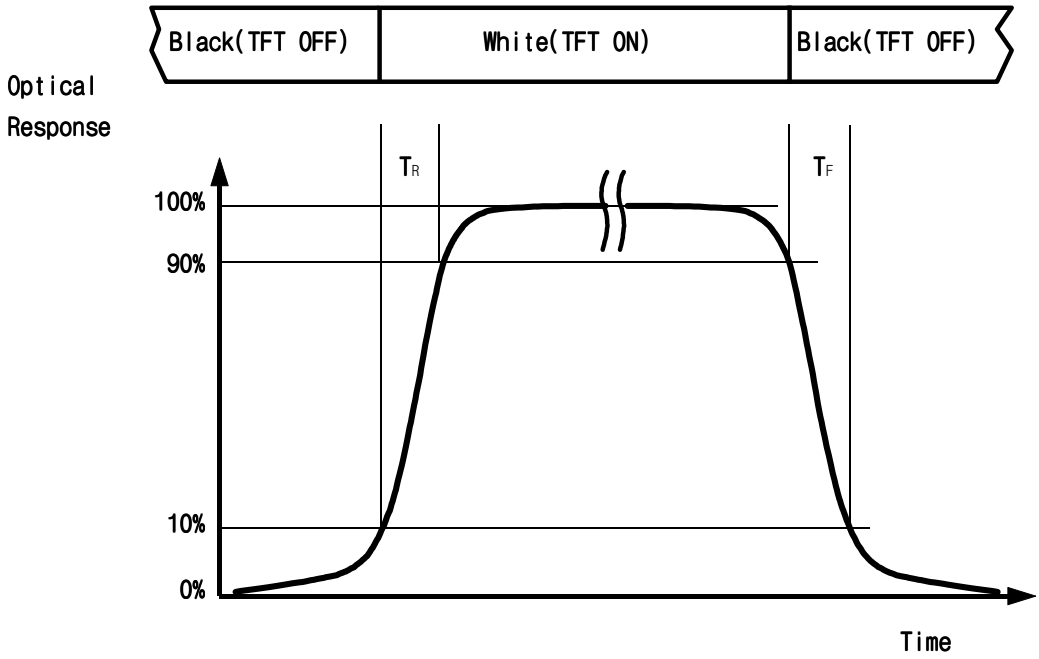
Note 3) Definition of Contrast Ratio (C/R) : Ratio of gray max (Gmax) & gray min (Gmin) at the center point(5) of the panel

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

Gmax : Luminance with all pixels white

Gmin : Luminance with all pixels black

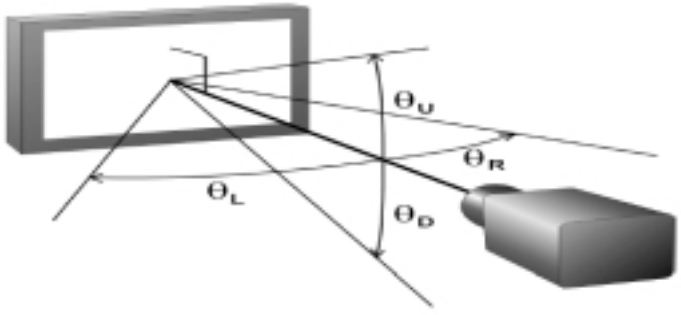
Note 4) Definition of Response time : Sum of Tr ,Tf



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≥ 10)



Note 8) Definition of 9 points brightness uniformity

$$Buni = 100 * \frac{(B\max - B\min)}{B\max}$$

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}	11.0	12.0	13.0	V	(1)
Power Consumption	(a)Black	I_{DD}		TBD	TBD	mA	(2),(3), (5)
	(b)White			TBD	TBD	mA	
	(c)N-Pattern			TBD	TBD	mA	
Vsync Frequency		f_V	48	60	66	Hz	
Hsync Frequency		f_H	43	48	53	kHz	
Main Frequency		f_{DCLK}	60	80	82	MHz	
Rush Current		I_{RUSH}	-	-	5	A	(4)

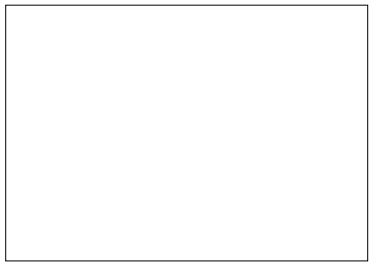
Note (1) Main pixel clock frequency is the value which is measured at the input of LVDS transmitter.

(2) f_V=60Hz, f_{DCLK} =80MHz, V_{DD} = 5.0V, DC Current.

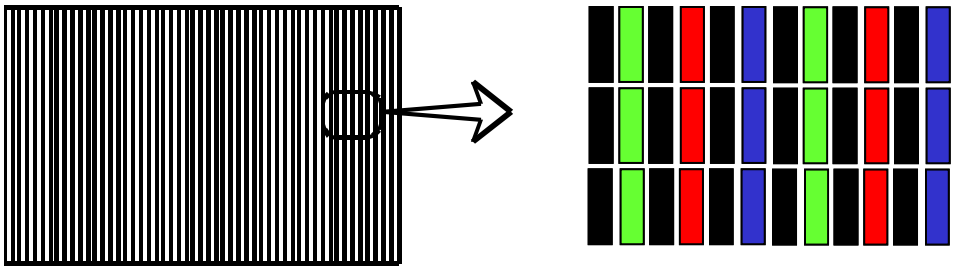
(3) Power dissipation check pattern(LCD Module only)

(a) Black Pattern

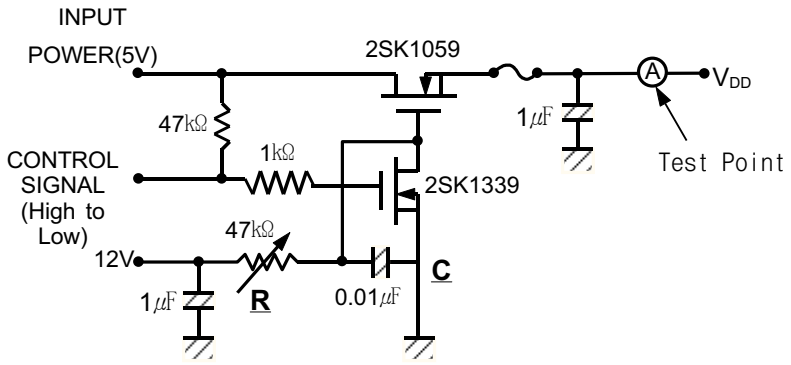
(b) White Pattern



(C) N-pattern



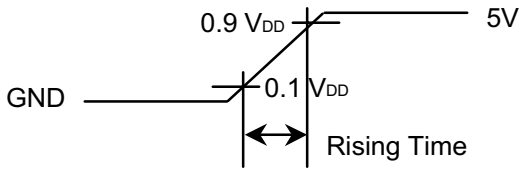
(4) Measurement Conditions (Rising time =470μs)



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 → 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.

Ta=25 ± 2°C

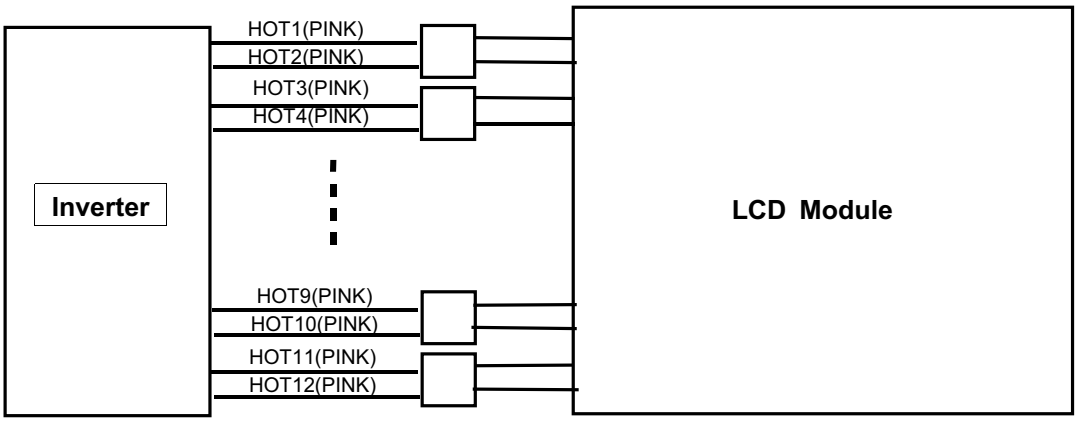
Item	Symbol	Min.	Typ.	Max.	Unit	Note
Lamp Current	I_L	4.0	-	7.0	mArms	(1)
Lamp Voltage	V_L	1730	-	1820	Vrms	(1)
Lamp Frequency	f_L	(55)	60	(65)	kHz	(2)
Operating Life Time	Hr	50,000 (25℃)	-	-	Hour	(3) at 6mA
Start up Voltage	Vs	-	-	0℃:2800 25℃:TBD	Vrms	(4)

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 7.0 mArms
Lamp Voltage Max : Lamp Current 4.0 mArms



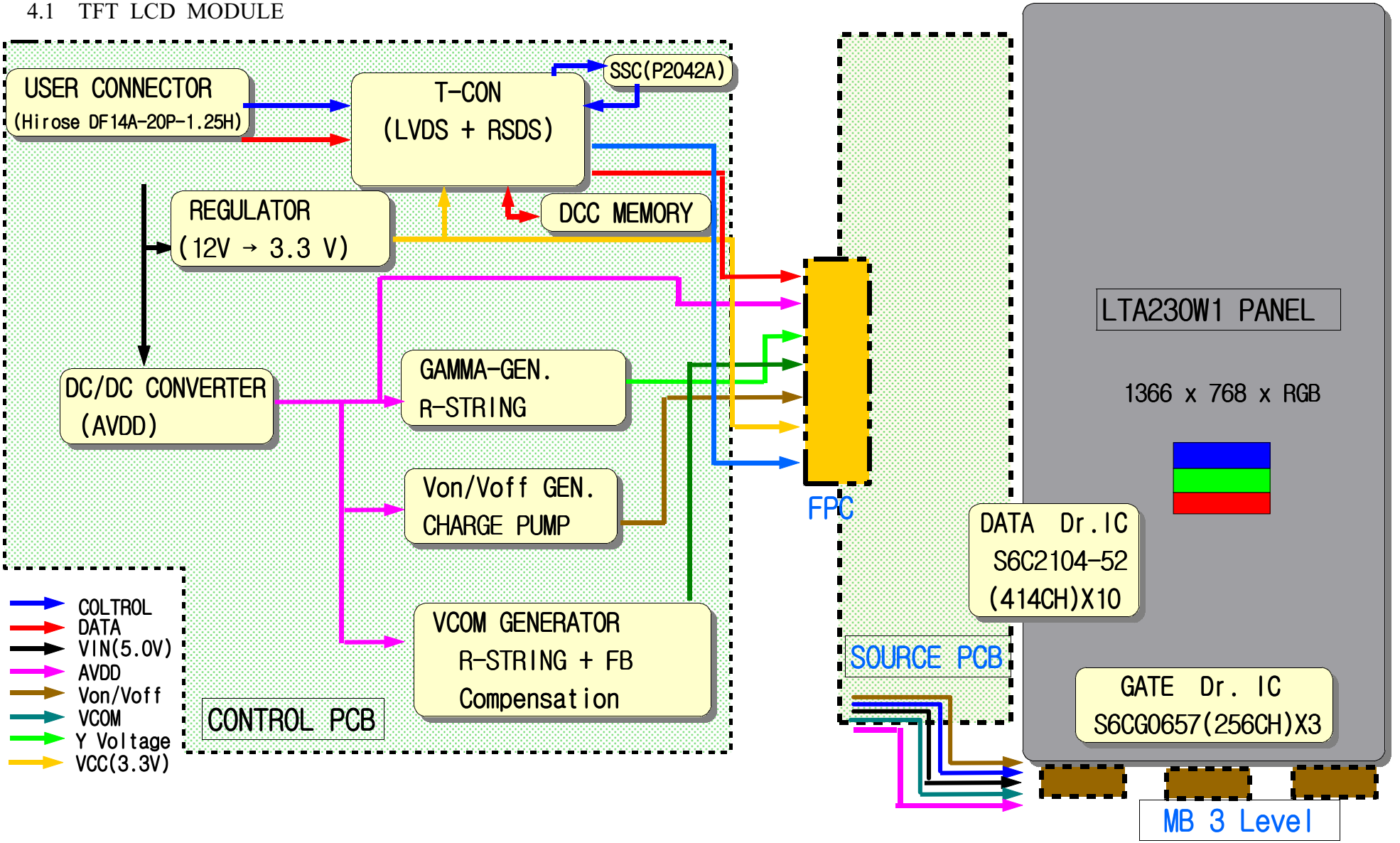
(2) Lamp frequency may produce interference with horizontal synchronous frequency and this may cause line flow on the display.

(3) Life time (Hr) of a lamp is defined as the time in which it continues to operate under the condition of Ta = 25±2°C and IL = TBDmArms(max) 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.

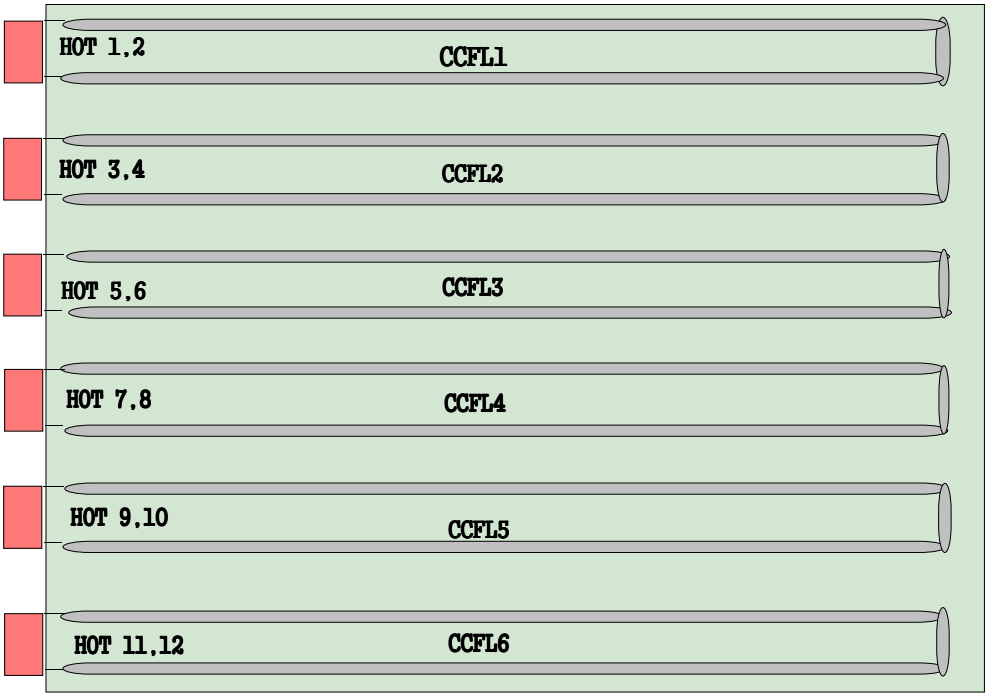
4. Block Diagram

4.1 TFT LCD MODULE



4.2 BACL-LIGHT UNIT

HOT : HIGH VOLTAGE (Part NO. : 20015WR-07L01 (Yeonho))



5. Input Terminal Pin Assignment

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

No.	Siganl	No.	Signal
1.	Vin(12.0V)	11.	Rx2-
2.	Vin(12.0V)	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.	GND
10.	GND	20	DCC*

* : DCC On/Off Selection
(High:Off, Low:On)

5.2 LVDS Interface

-LVDS Receiver : Tcon (LVDS Rx merged)

-Pixel data (single data)

LVDS Signal	Input Data	VESA
RxIN0	RxOUT0	R0
	RxOUT1	R1
	RxOUT2	R2
	RxOUT3	R3
	RxOUT4	R4
	RxOUT6	R5
	RxOUT7	G0
RxIN1	RxOUT8	G1
	RxOUT9	G2
	RxOUT12	G3
	RxOUT13	G4
	RxOUT14	G5
	RxOUT15	B0
	RxOUT18	B1
RxIN2	RxOUT19	B2
	RxOUT20	B3
	RxOUT21	B4
	RxOUT22	B5
	RxOUT24	HSYNC
	RxOUT25	VSYNC
	RxOUT26	DE
RxIN3	RxOUT27	R6
	RxOUT5	R7
	RxOUT10	G6
	RxOUT11	G7
	RxOUT16	B6
	RxOUT17	B7
	RxOUT23	
Model		LTA230W1-L01

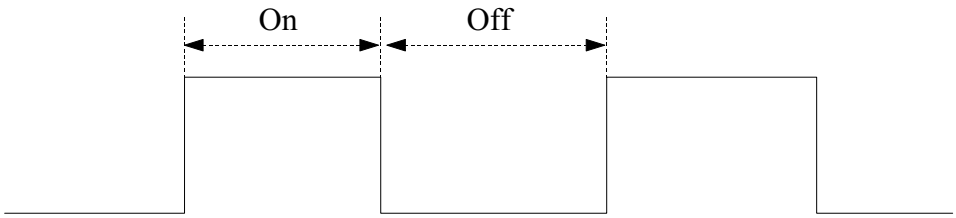
5.3 INVERTER UNIT : Inverter input pin configuration (Connector : PHR14 (JST))

PIN NO.	PIN Configuration (FUNCTION)
1	Vin
2	Vin
3	Vin
4	Vin
5	Vin
6	GND
7	GND
8	GND
9	GND
10	GND
11	PD
12	B/L On/Off
13	PWM DIM (MAX 3.3V, TYP 2.8)
14	GND

5.4 Inverter specification

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Input Voltage	Vin	-	16.0	17.0	18.0	V	
Input Current	Iin	Vin=17V, Vbr=3.3V after 2hr aging	TBD	TBD	TBD	A	
Back-Light On/Off Control	On/Off	Enable the inverter	4.5	5.0	5.5	V	
		Disable the inverter	0	-	0.8	V	
Lamp Current	Iout (max)	Vbr=3.3V(max)	TBD	TBD	TBD	mArms	
Operating Frequency	Freq1	VIN=17V Vbr=3.3V	55	60	65	kHz	
PWM Frequency	Freq2	VIN=17V Vbr=3.3V	TBD	TBD	TBD	Hz	
PWM start dimmer Voltage	PSDV	Vbr down from 3.3V	TBD	3.15	TBD	V	
PWM Minimum Duty	PMD	VIN=17V Vbr=0V	TBD	20	TBD	%	(1)
Open Lamp Voltage	Vopen	No load, 0℃ VIN=17.0V Vbr=3.3V	2800	TBD	TBD	Vrms	
Striking Time	Ts	No load, 0℃ VIN=17V Vbr=3.3V	TBD	-	TBD	sec	

Note(1) High-duty = On/(On+Off) * 100



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	-
	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
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	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	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	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
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	G3~G252
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	
	↓	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
	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	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
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	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	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	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) 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

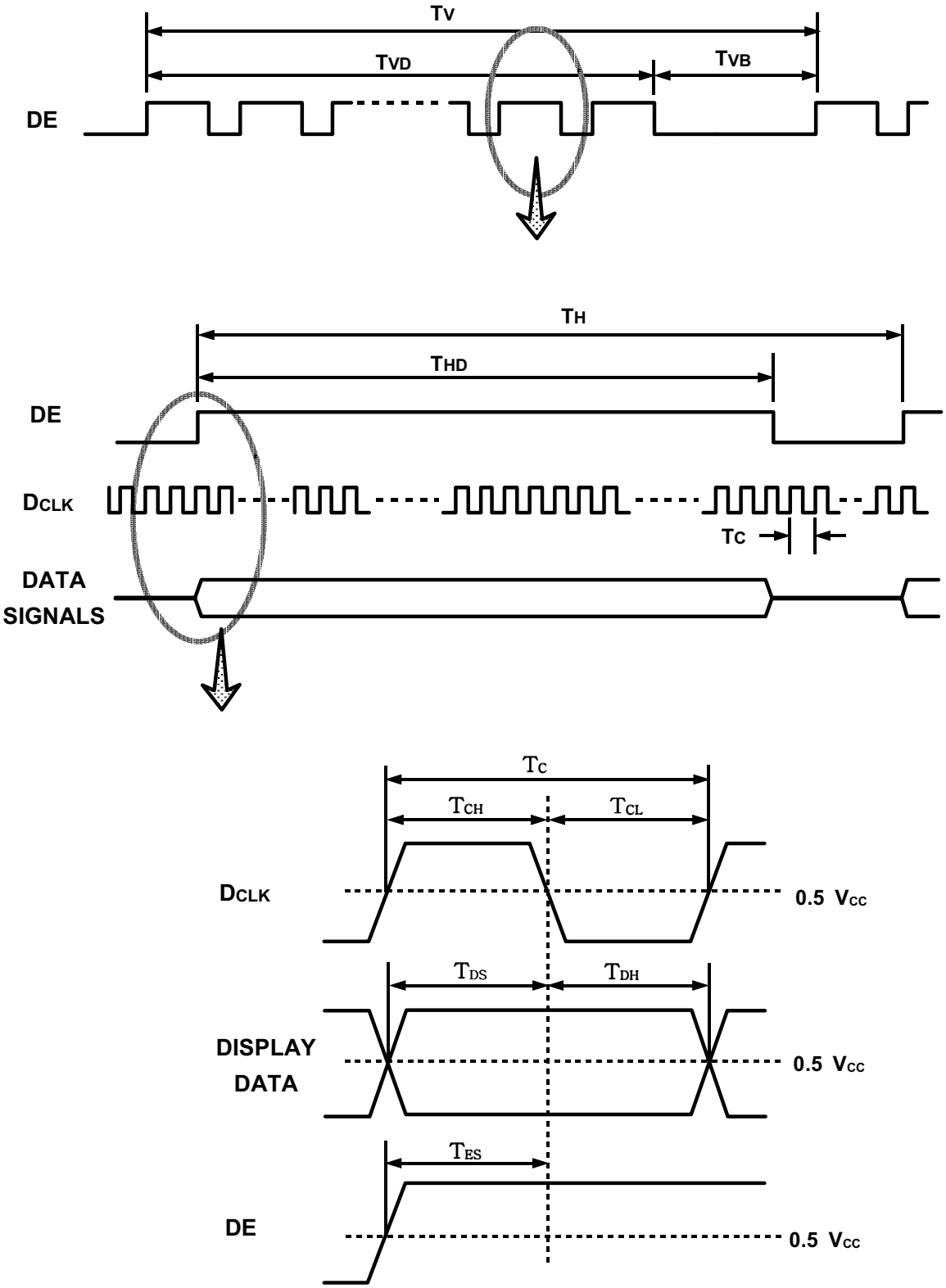
6. Interface Timing

6.1 Timing Parameters (DE only mode)

SIGNAL	ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Clock	Frequency	1/TC	60	80	82	MHz	-
Hsync		Fh	43	48	53	KHz	-
Vsync		Fv	47	60	66	Hz	-
Vertical Active Disply Term	Display Period	T_{VD}	-	768	-	lines	-
	Vertical Total	T_V	785	810	1200	lines	-
Horizontal Active Display Term	Display Period	T_{HD}	-	1366	-	clocks	-
	Horizontal Total	T_H	1420	1648	1900	clocks	-

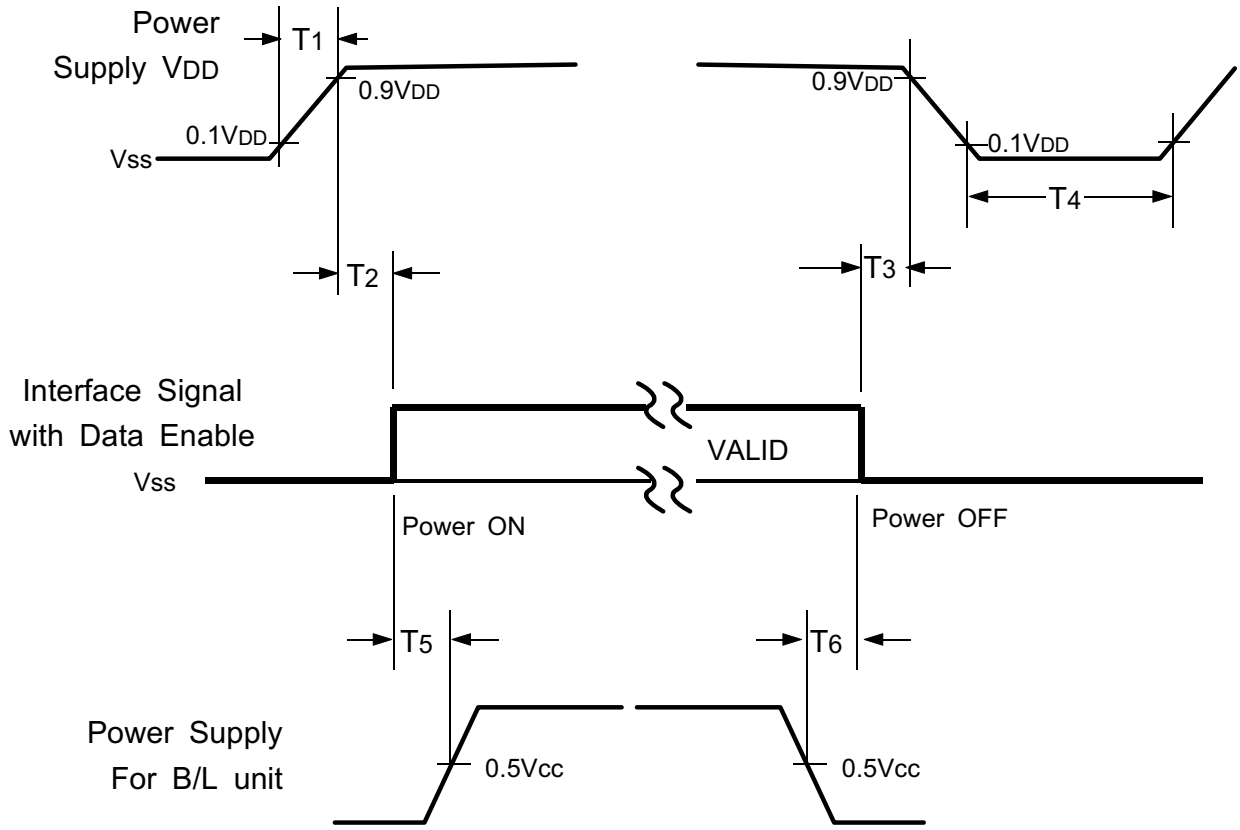
Note) This product is DE only mode. The input of Hsync & Vsync signal does not have an effect on normal operation.

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<T1≤30msec
0<T2≤50msec
0<T3≤50msec
300msec≤T4
500 msec ≤ T5(Recommand Value)
100 msec ≤ T6(Recommand Value)

NOTE.

(1)The supply voltage of the external system for the module input should be the same as the definition of VDD.

(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 VDD = off level, please keep the level of input signals on the low or keep a high impedance.

(4) T4 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 & Rear View)

- Refer to Another File

8. PACKING

- TBD

9. MARKING & OTHERS

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

(1) Parts number : LTA230W1-L01-XXXX

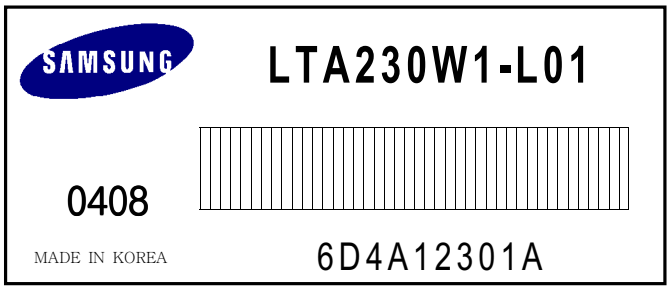
(2) Revision : One letter

(3) Control : One letter

(4) Lot number : 6 D 4 A 123 01 A
1 2 3 4 5 6 7

① 6 : Line
② D : Device
③ 4 : Year
④ A : Month
⑤ 123 : LOT NO
⑥ 01 : GLASS NO
⑦ A : CELL NO

(5) Nameplate Indication



(6) Bar code marking for Customer

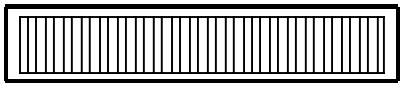
The bar code marking is attached to module backside.

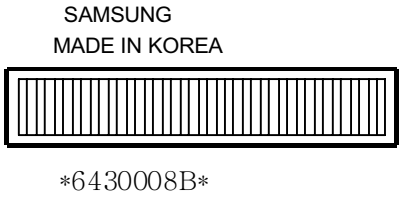
1) MODEL NAME : LTA230W1-L01-XXXX
2) SAMSUNG
3) MADE IN KOREA
4) PRODUCTION NUMBER
5) USER MODEL NAME

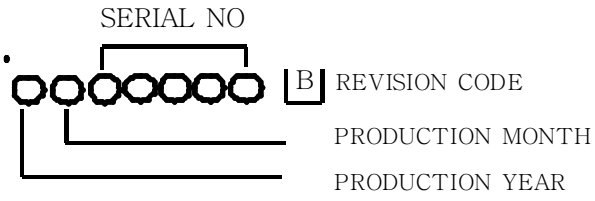
Bar codeshows

a) User model name

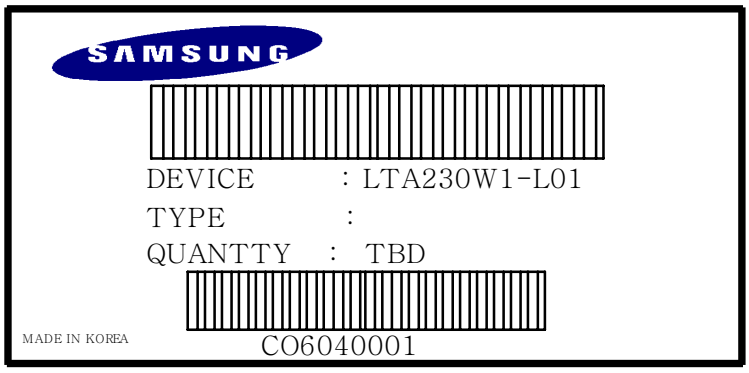
LTA230W1-L01-0006







(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).

Operation Condition Guide

(a) LCD product supposed to be operated under circumstance of normal condition.
Normal condition is defined as below;
- Temperature : 20±15℃
- Humidity : 65±20%
- 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.

10.4 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, 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.

(e) This module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.