

TO :
Date : 2002. 12. 04.

SAMSUNG TFT-LCD
MODEL NO. : LTA320W1-L02

Note: _____

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

Samsung Electronics Co . , LTD.



Contents

Revision History	-----	(3)
General Description	-----	(4)
1. Absolute Maximum Ratings	-----	(5)
1.1 Absolute Ratings Of Environment		
1.2 Electrical Absolute Ratings		
2. Optical Characteristics	-----	(7)
3. Electrical Characteristics	-----	(11)
3.1 TFT LCD Module		
3.2 Back-light Unit		
4. Block Diagram	-----	(14)
4.1 TFT LCD Module		
4.2 Back-light Unit		
5. Input Terminal Pin Assignment	-----	(15)
5.1 Input Signal & Power		
5.2 LVDS Interface		
5.3 Inverter Unit		
5.4 Input Signals, Basic Display Colors and Gray Scale of Each Color		
6. Interface Timing	-----	(19)
6.1 Timing Parameters (DE only mode)		
6.2 Timing Diagrams of interface Signal (DE only mode)		
6.3 Power ON/OFF Sequence		
7. Outline Dimension	-----	(22)
8. General Precautions	-----	(23)

*** Revision History**

No	Date	Page	Befor change	After change	Remark
0.0	2002.08.08	All	First issued		
0.1	2002.09.26	5	(Outline dimension) 746*463*55	745.6*462.6*55	changed
		7	Measurement Point : 1/10 distance	1/6 distance	changed
		11	Max.Power Consumption : 1300mA	1600mA	changed
		11,13,19	Horizontal Frequency 40 ~ 50KHz	48.5 ±1 KHz	changed
		11	(Rush current) TBD	3.0A	changed
		13	(Lamp frequency) 25 ~ 100KHz	48.5± 1KHz	changed
		13	Addition explain (note 2)	synchronized the lamp frequency to horizontal frequency.	changed
		14,17	(Hot connector) TBD	SM02B-BHCS-1 (JST)	changed
		15	Input connector : FH12F-30S-0.5SH	FH12-30S-0.5SH	changed
		19	(H-total Max) 2060	2048clk	changed
		22	Front outline dimension	Revised DWG	changed
0.2	2002.11.12	5	Thickness 55.0(D)±1.0	Max. 53.0(D)	changed
		12	-	add to Note(5)	addition
		15	Connector type : FH12-30S-0.5SH	DF14A-30P-1.25SH(Hirose)	changed
		22	-	Revised Outline dimension	changed

General Description

* Description

LTA320W1-L02 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 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
- Dyrect Type 16 CCFT(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

High Definition TV (HD TV)

* General information

Items	Specification	Unit	Note
Display area	687.36(H) × 412.42(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	0.537(H) × 0.537(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)	-	745.6	-	mm
	Vertical(V)	-	462.6	-	mm
	Depth(D)	-	-	53.0	mm
Weight		-	-	11,500	g

1. Absolute Maximum Ratings

1.1 Absolute ratings of environment

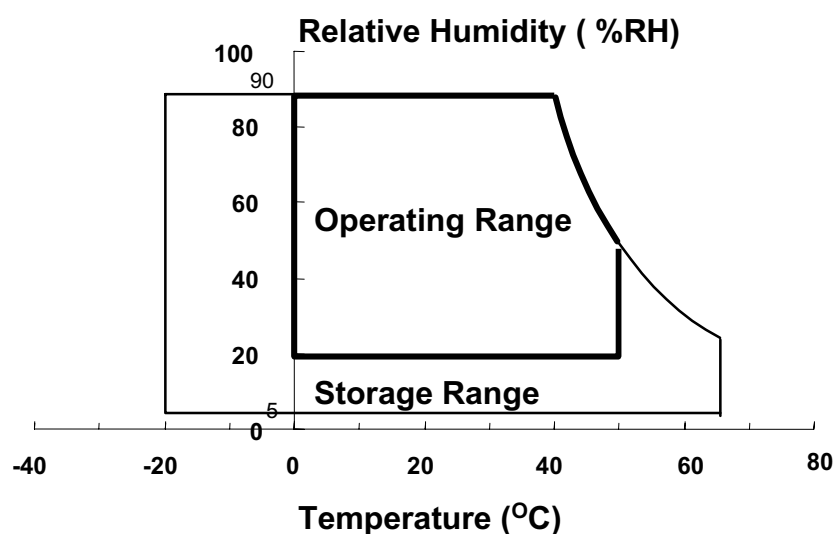
Item	Symbol	Min.	Max.	Unit	Note
Storage temperature	T _{STG}	-20	65	°C	(1)
Operating temperature (Ambient temperature)	T _{OPR}	0	50	°C	(1)
Shock (non - operating)	Snop	-	50	G	(2),(4)
Vibration (Non - operating)	Vnop	-	1.0	G	(3),(4)

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

90 % RH Max. ($40\text{ }^{\circ}\text{C} \geq T_a$)

Maximum wet-bulb temperature at $39\text{ }^{\circ}\text{C}$ or less. ($T_a > 40\text{ }^{\circ}\text{C}$) No condensation.

- (2) 11ms, sine wave, 1 time for $\pm X$, $\pm Y$, $\pm Z$ axis
- (3) 10-300 Hz, Sweep rate 10min, 30min for X,Y,Z axis
- (4) 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
Lamp Current	I _L	4.0	7.0	mArms	(1),(2)
Lamp Frequency	F _L	25	100	kHz	(1)

NOTE (1) 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.

(2) 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)

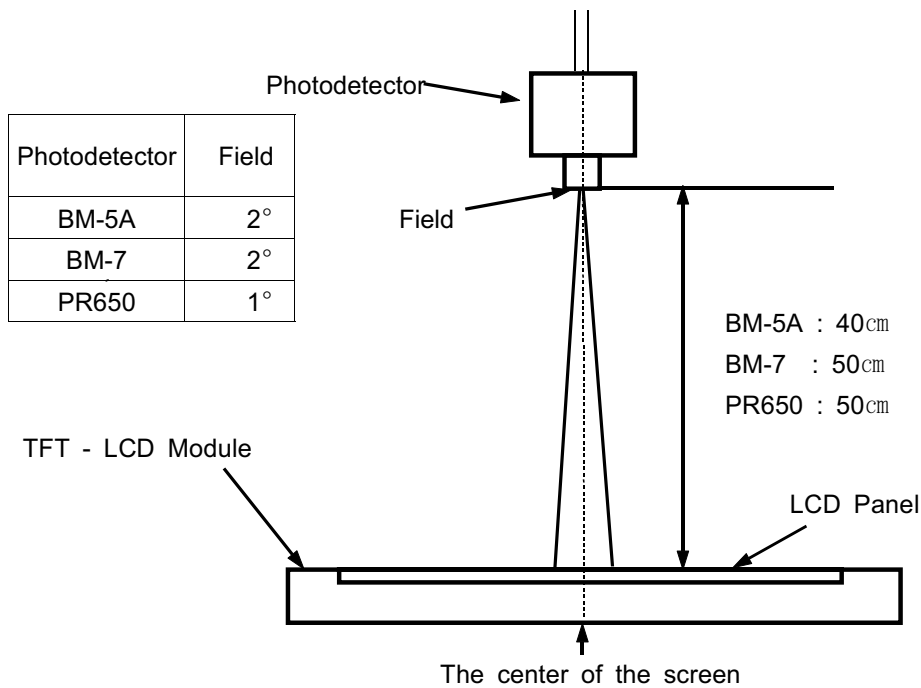
* $T_a = 25 \pm 2^\circ\text{C}$, $V_{DD}=5\text{V}$, $f_v=60\text{Hz}$, $f_{CLK}=65\text{ MHz}$, $I_L = 5.5\text{mA}_{rms}$

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio (Center of screen)		C/R	Normal $\phi = 0$ $\theta = 0$	400	500	-		(2),(3) BM-5A
Response Time	Rising	Tr		-	15	18	msec	(4) BM-7
	Falling	Tf		-	8	11		
Luminance of White (Center of screen)		YL			400	450	-	cd/m2
Color Chromaticity (CIE 1931)	Red	Rx	Viewing Angle	TYP. -0.03	TBD	TYP. +0.03		(6) PR650
		Ry			TBD			
	Green	Gx			TBD			
		Gy			TBD			
	Blue	Bx			TBD			
		By			TBD			
	White	Wx			0.280			
		Wy			0.290			
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

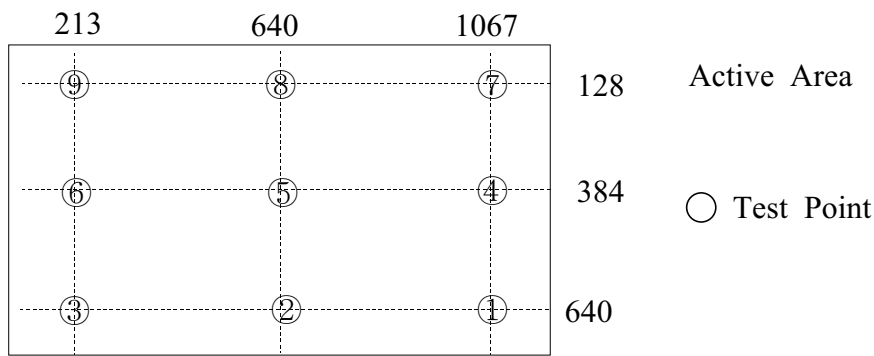
After stabilizing and leaving the panel alone at a given temperature for 30 min ,the measurement should be executed. Measurement should be executed in a stable, windless, and dark room. 30 min after lighting the back-light. This should be measured in the center of screen.

A single lamp current : 5.5mA
Environment condition : Ta = 25 ± 2 °C



Optical Measuring Equipment Setup

Note 2) Definition of test point



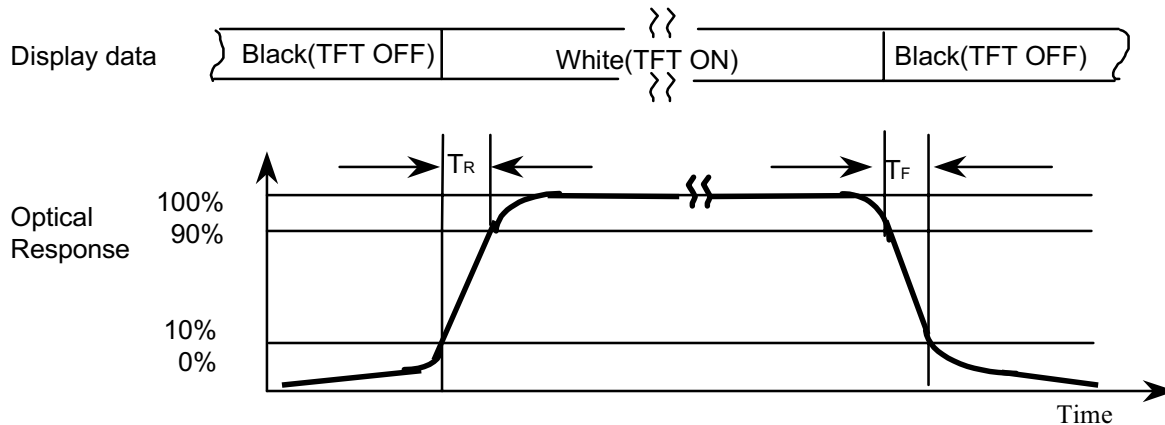
Note 3) Definition of Contrast Ratio (C/R) : Ratio of gray max (Gmax) & gray min (Gmin) at the center point(5) of the panel

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

Gmax : Luminance with all pixels white

Gmin : Luminance with all pixels black

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

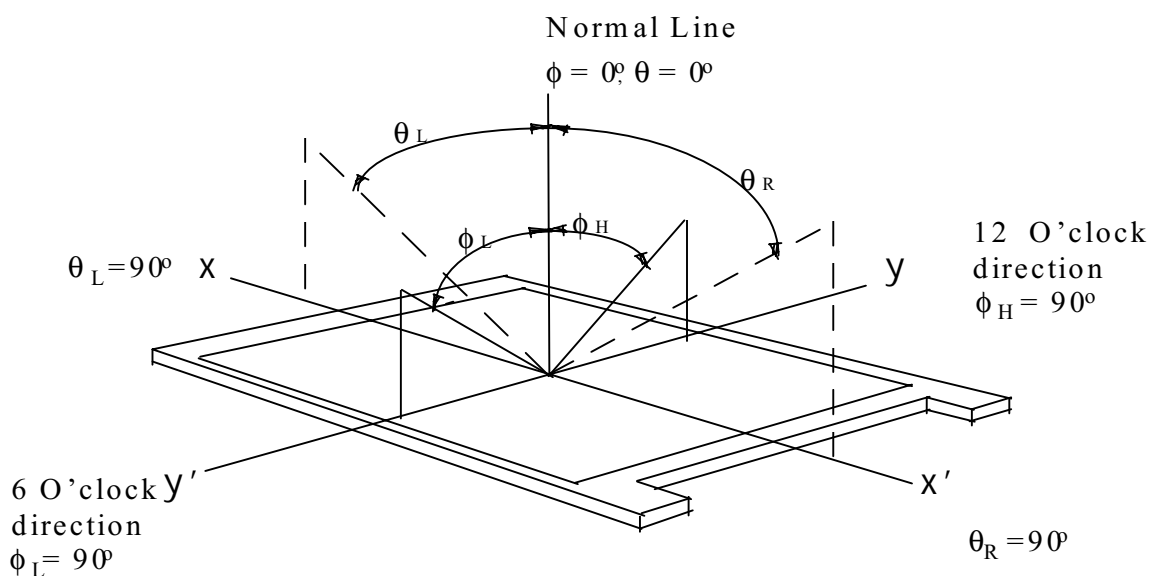


Note 5) Definition of Luminance of White : Luminance of white at center point(5).

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

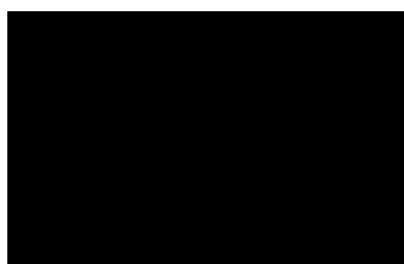
3.1 TFT LCD MODULE

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

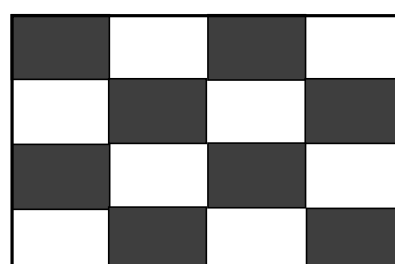
Item		Symbol	Min.	Typ.	Max.	Unit	Note
Voltage of Power Supply		V_{DD}	4.5	5.0	5.5	V	(1)
Current of Power Supply	(a)Black	I_{DD}	-	TBD	-	mA	(2),(3) (5)
	(b)Mosaic		-	TBD	-	mA	
	(c)2 Line Stripe		-	TBD	-	mA	
	(d)N-Pattern		-	TBD	1600	mA	
Vsync Frequency		f_V	-	60	-	Hz	
Hsync Frequency		f_H	47.5	48.5	49.5	kHz	
Main Frequency		f_{DCLK}	58	65	TBD	MHz	
Rush Current		I_{RUSH}	-	-	3.0	A	(4)

- Note
- (1) Main pixel clock frequency is the value which is measured at the input of LVDS transmitter.
 - (2) $f_V=60\text{Hz}$, $f_{DCLK}=65\text{MHz}$, $V_{DD}=5.0\text{V}$, DC Current.
 - (3) Power dissipation check pattern(LCD Module only)

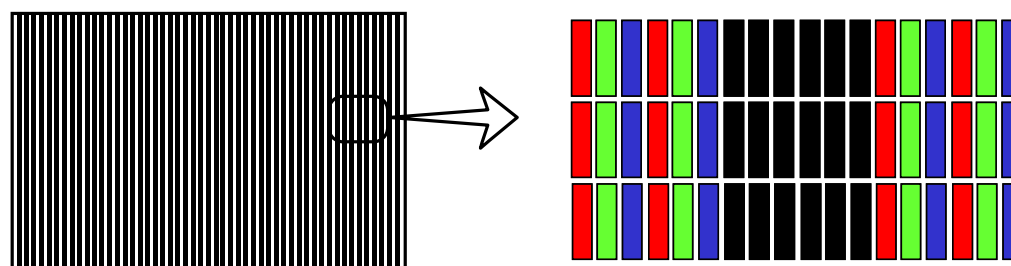
(a) Black Pattern



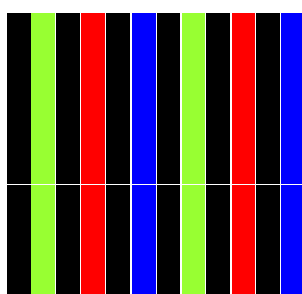
(b) Mosaic Pattern

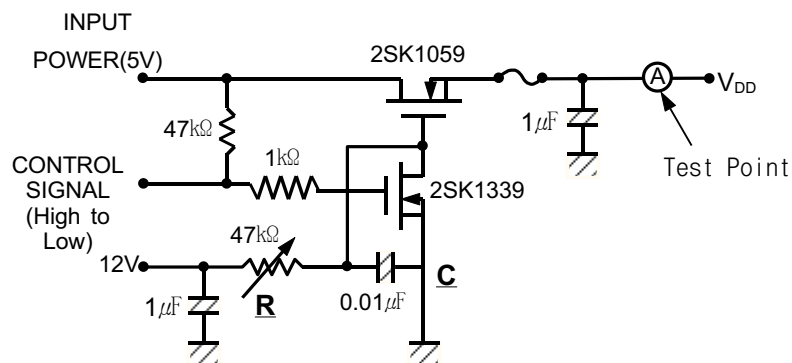


(c) 2 Line Stripe Pattern



(d) N-pattern

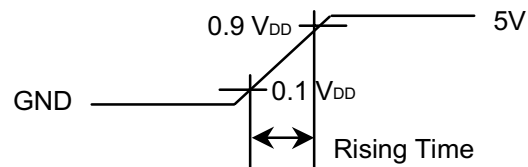


(4) Measurement Conditions (Rising time = $470\mu\text{s}$)

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 → 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	5.5	7.0	mArms	(1)
Lamp Voltage	V_L	1080	1150	1210	Vrms	(1)
Lamp Frequency	f_L	47.5	48.5	49.5	kHz	(2)
Operating Life Time	Hr	50,000	-	-	Hour	(3) at 7mA
Start up Voltage	V_s	-	-	0 $^\circ\text{C}$, 2600	Vrms	(4)
				25 $^\circ\text{C}$, 1730		

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.

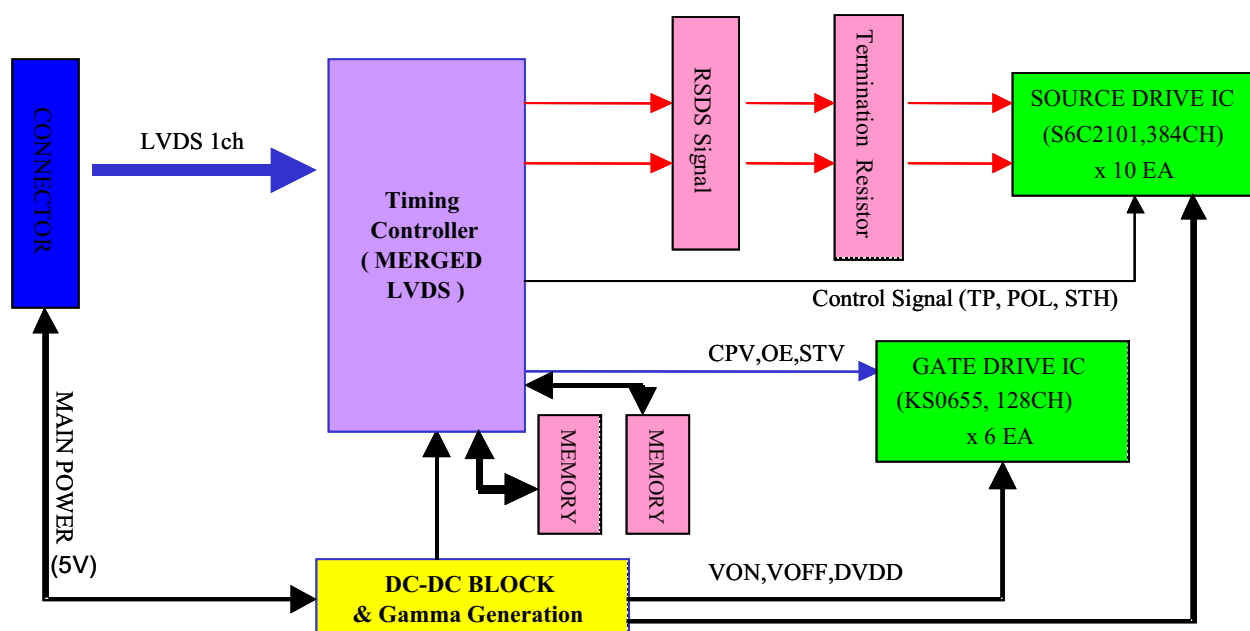
Lamp Voltage tolerance (at 48.5kHz) : 1200 ± 120 Vrms at 4mArms

1100 ± 110 Vrms at 7mArms

- (2) Lamp frequency may produce interference with horizontal synchronous frequency and this may cause line flow on the display. Therefore We synchronized the lamp frequency to horizontal frequency.
- (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 $I_L = 7.0\text{mArms}$ 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

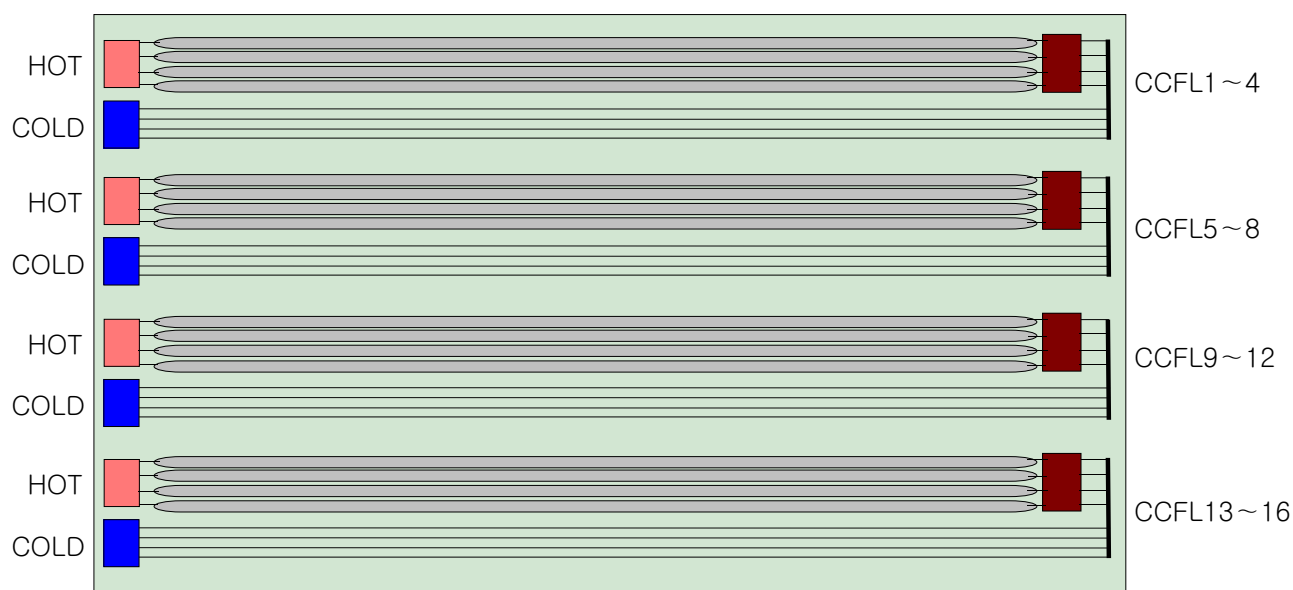
4.1 TFT LCD MODULE



4.2 BACL-LIGHT UNIT

HOT : HIGH VOLTAGE (Part NO. : SM02B-BHCS-1 (JST))

COLD : GROUND (Part NO. : BHSR-02VS-1 (JST))



5. Input Terminal Pin Assignment

5.1. Input Signal & Power : Connector DF14A-30P-1.25SH(Hirose)

No	Signal	No	Signal
1	P W M dimming	16	GND
2	Analog dimming	17	Rx3 -
3	B/L On/Off	18	Rx3 +
4	GND	19	GND
5	Rx0 -	20	Reserved (ACCE)
6	Rx0 +	21	Reserved (Y_inc)
7	GND	22	Reserved (Y_dec)
8	Rx1 -	23	GND
9	Rx1 +	24	GND
10	GND	25	GND
11	Rx2 -	26	Vin (+5V)
12	Rx2 +	27	Vin (+5V)
13	GND	28	Vin (+5V)
14	RxCCLK -	29	Vin (+5V)
15	RxCCLK +	30	Vin (+5V)

Note) Num.30 → Inverter Input Power (Min 5.0V, Typ.5.3V, Max. 5.5V)

Num 26~Num 29 → Module Input Power (Min 4.5V, Typ.5.0V, Max.5.5V)

5.2 LVDS Interface

-LVDS Receiver : Tcon (LVDS Rx merged)

-Pixel data (single data)

	DATA	T-CON
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	DE
TxOUT/RxIN3	TxIN/RxOUT27	R6
	TxIN/RxOUT5	R7
	TxIN/RxOUT10	G6
	TxIN/RxOUT11	G7
	TxIN/RxOUT16	B6
	TxIN/RxOUT17	B7
	TxIN/RxOUT23	

5.3 INVERTER UNIT : Inverter input pin configuration

INPUT CONNECTOR : S14B-PASK-2 (JST)

OUTPUT HOT Connector : **SM02B-BHCS-1 (JST)**

OUTPUT COLD Connector : 35001 (Yeonho Elec.) / SM02B-BHSS-1-TB (JST)

Pin No.	1	2	3	4	5	6	7
Function	VCC(+120V)	VCC(+120V)	NC	GND	GND	GND	GND

Pin No.	8	9	10	11	12	13	14
Function	NC	NC	NC	NC	NC	NC	NC

5.4 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	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	↓	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	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	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	↓	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	
		LIGHT	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	
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:		
	↓	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	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)

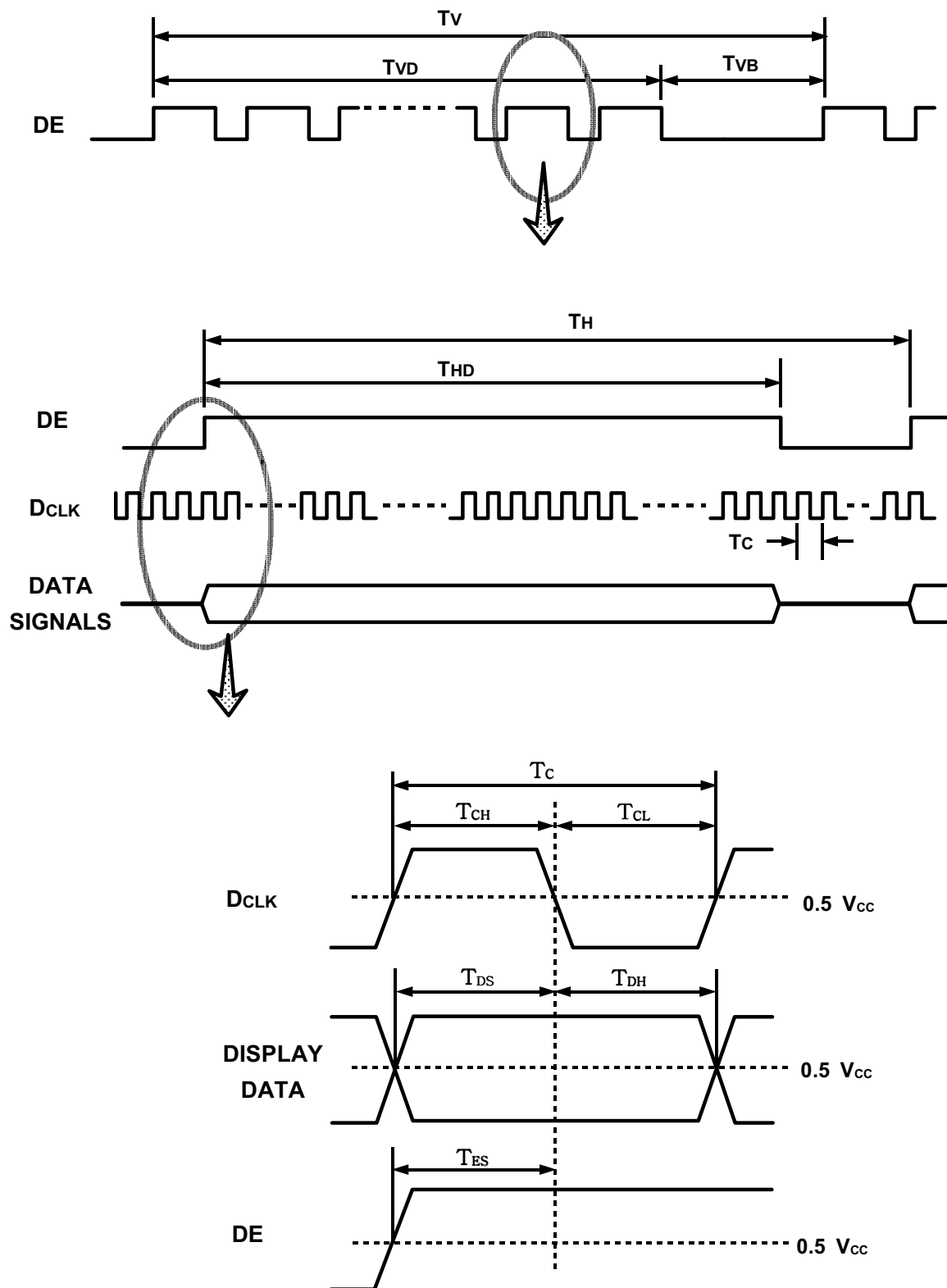
Input Signal : 0 = Low level voltage, 1 = High level voltage

6. Interface Timing

6.1 Timing Parameters (DE only mode)

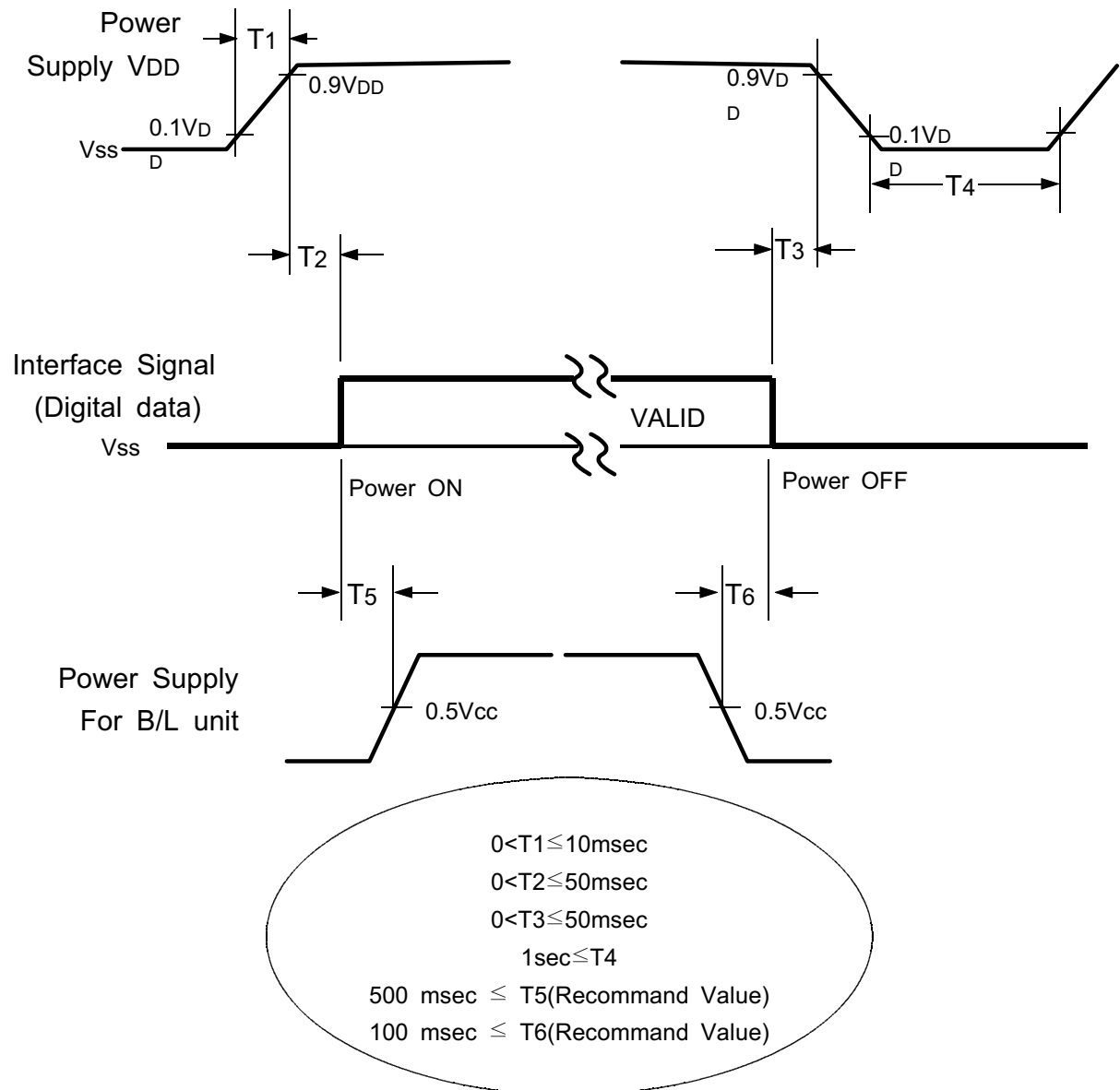
SIGNAL	ITEM	SYMBOL	MIN.	TYP.	MAX.	UNIT	NOTE
Clock	Frequency	1/TC	58	65	TBD	MHz	
Hsync		Fh	47.5	48.5	49.5	KHz	
Vsync		Fv	48	60	66	Hz	
Vertical Active Disply Term	Display Period	TVD	768	768	768	lines	
	Vertical Total	TVB	787	806	1170	lines	
Horizontal Active Display Term	Display Period	THD	1280	1280	1280	clocks	
	Horizontal Total	TH	1332	1344	TBD	clocks	

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.



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

-Refer to another file.

8. General Precautions

8.1 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.

8.2 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.

8.3 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).

8.4 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.