SAMSUNG
ELECTRONICS

ISSUED DATE : 2008-09-02

SAMSUNG TFT-LCD PRODUCT INFORMATION

MODEL : LTM185AT01

Note : This is Product Information is subject to change after 3 months of issuing date.

Application Engineering Part 1, HD LCD Division

Samsung Electronics Co . , LTD.

wise view™

SAMSUNG TFT-LCD

MODEL	LTM185AT01	Page	1/31

Contents

MODEL	LTM185AT01	Page	2/31

General Description

Description

LTM185AT01 product 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 18.5" is 1366 X 768 and this model can display up to 16.7 millions colors.

Features

- High contrast ratio, high aperture structure
- TN (Twisted Nematic) mode
- Wide Viewing Angle
- High speed response
- HD (1366 x 768 pixels) resolution
- Low power consumption
- 2 CCFLs (Cold Cathode Fluorescent Lamp)
- DE (Data Enable) only mode
- LVDS (Low Voltage Differential Signaling) interface (1pixel/clock)
- Compact Size Design
- RoHS compliance
- TCO'03 compliance

Applications

- Workstation & desktop monitors
- Display terminals for AV application products
- Monitors for industrial machine
  * If the module is used to other applications besides the above, please contact SEC in advance.

General Information

Items	Specification	Unit	Note
Pixel Pitch	0.300(H) x 0.300(W)	mm	
Active Display Area	409.8(H) x 230.4(V)	mm	
Surface Treatment	Haze 25%, Hard-coating(3H)		
Display Colors	16.7M (6bit Hi-FRC)	colors	
Number of Pixels	1366 x 768	pixel	
Pixel Arrangement	RGB vertical stripe		
Display Mode	Normally White		
Power Consumption	TBD		
Luminance of White	250(Typ.)	cd/㎡	

MODEL	LTM185AT01	Page	3/31

Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal (H)	-	430.37	-	mm	w/o inverter ass'y
	Vertical (V)	-	254.6	-	mm	
	Depth (D)	-	-	17.0	mm	
Weight		-	-	TBD	g	LCD module only

Note (1) Mechanical tolerance is $\pm$ 0.5mm unless there is a special comment.

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	6.5	V	(1)
Storage temperature	T_{STG}	-25	60	℃	(2)
Glass surface temperature (Operation)	T_{OPR}	0	50	℃	(2)
Shock (non - operating)	S_{nop}	-	50	G	(3)
Vibration (non - operating)	V_{nop}	-	1.5	G	(4)

Note (1) Ta= 25 $\pm$ 2 °C

MODEL	LTM185AT01	Page	4/31

(2) Temperature and relative humidity range are shown in the figure below.
    a. 90 % RH Max. (Ta ≤ 39 °C)
    b. Maximum wet-bulb temperature at 39 °C or less. (Ta ≤ 39 °C)
    c. No condensation
(3) 11ms, sine wave, one time for ±X, ±Y, ±Z axis
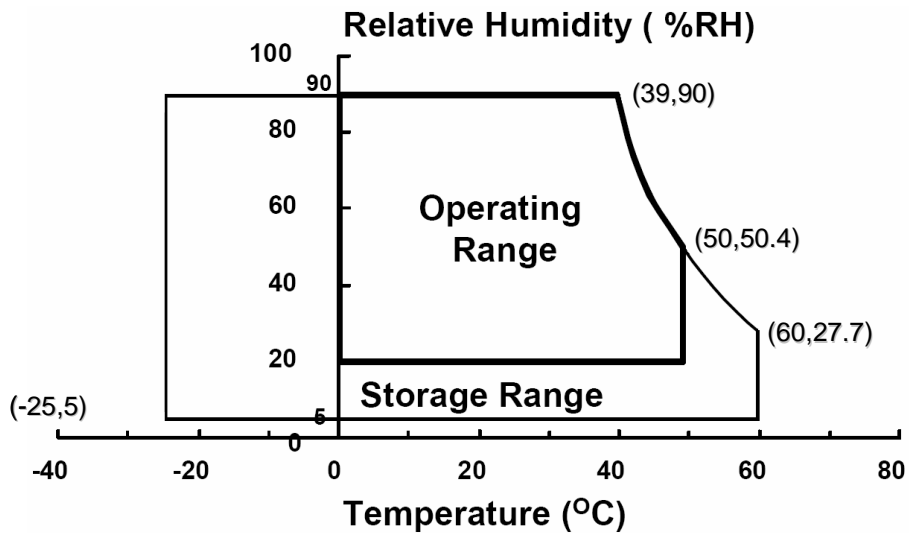(4) 10-300 Hz, Sweep rate 10min, 30min for X,Y,Z axis

Fig. Temperature and Relative humidity range

MODEL	LTM185AT01	Page	5/31

2. Optical Characteristics

The optical characteristics should be measured in a dark room or equivalent.
Measuring equipment : SR-3, RD-80S (TOPCON), EZ-Contrast (Eldim)

(Ta = 25 $\pm$ 2°C, VDD=5V, fv= 60Hz, fDCLK=85.8MHz, IL = 7.5mArms)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio (Center of screen)		C/R		-	1000	-		(3) SR-3
Response Time	On/Off	Tr+ Tf		-	5	10	msec	(5) RD-850S
Luminance of White (Center of screen)		Y_L		-	300	-	cd/m2	(6) SR-3
Color Chromaticity (CIE 1931)	Red	Rx	Normal $\theta_{L,R}=0$ $\theta_{U,D}=0$ Viewing Angle		(0.650)			
		Ry			(0.335)			
	Green	Gx			(0.295)			
		Gy			(0.605)			
	Blue	Bx			(0.145)			
		By			(0.075)			
	White	Wx			0.313			
		Wy			0.329			(7),(8)
Color Chromaticity (CIE 1976)	Red	Ru'		-	TBD	-		SR-3
		Rv'		-	TBD	-		
	Green	Gu'		-	TBD	-		
		Gv'		-	TBD	-		
	Blue	Bu'		-	TBD	-		
		Bv'		-	TBD	-		
	White	Wu'		-	0.198	-		
		Wv'		-	0.468	-		
C.G.L	White	$\triangle$u'v'		-	0.011	0.02		(9)

* C.G.L : Color Grayscale Linearity

MODEL	LTM185AT01	Page	6/31

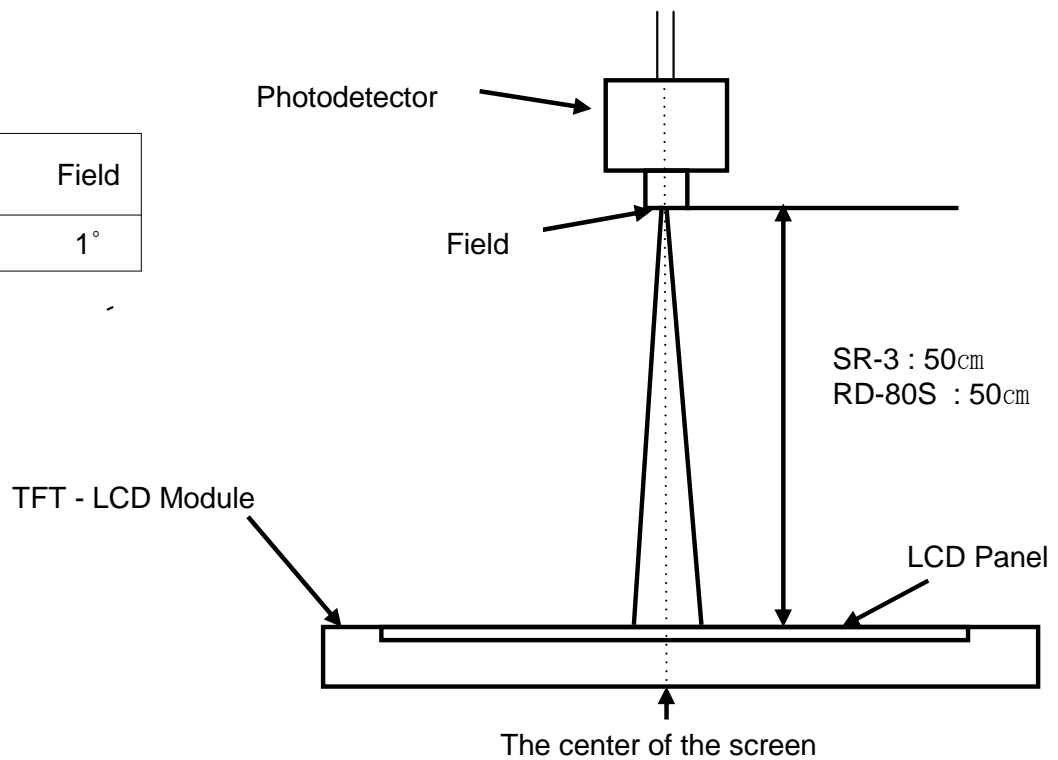| Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Color Gamut		-		-	72	-	%	
Color Temperature		-		-	6500	-	K	
Viewing Angle	Hor.	Θ_L	CR≥10	70	80	-	Degrees	(8) EZ-Contrast
		Θ_R		70	80	-		
	Ver.	Θ_U		70	80	-		
		Θ_D		70	80	-		
Brightness Uniformity (9 Points)		B_{uni}		-	-	25	%	(4) SR-3

Note (1) Test Equipment Setup

The measurement should be executed in a stable, windless and dark room between 30min after lighting the back light at the given temperature for stabilization of the back light. This should be measured in the center of screen.

Single lamp current : 7.5mA
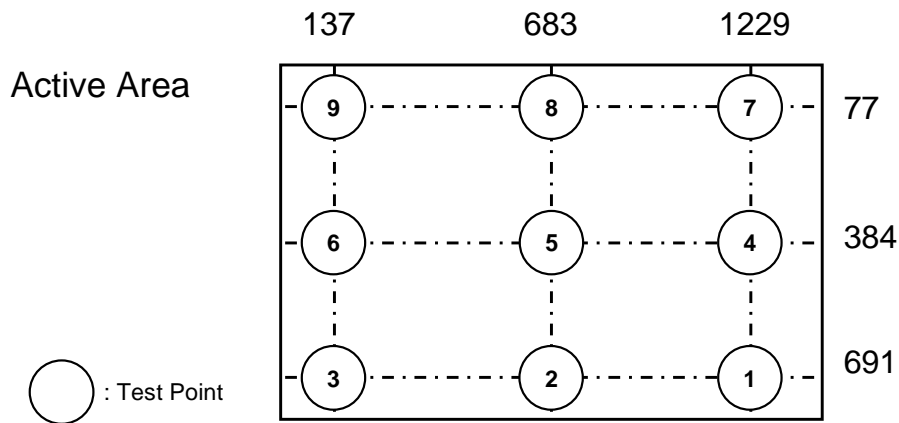Environment condition : Ta = 25 ± 2 ℃

Photodetector	Field
SR-3	1°

Photodetector

Field

SR-3 : 50㎝
RD-80S : 50㎝

TFT - LCD Module

LCD Panel

The center of the screen

MODEL	LTM185AT01	Page	7/31

Note (2) Definition of test point

Active Area

	137	683	1229

9   8   7   77

6   5   4   384

3   2   1   691

◯ : Test Point

Note (3) Definition of Contrast Ratio (C/R)

: Ratio of gray max (Gmax) & gray min (Gmin) at the center point⑤ 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 9 points brightness uniformity
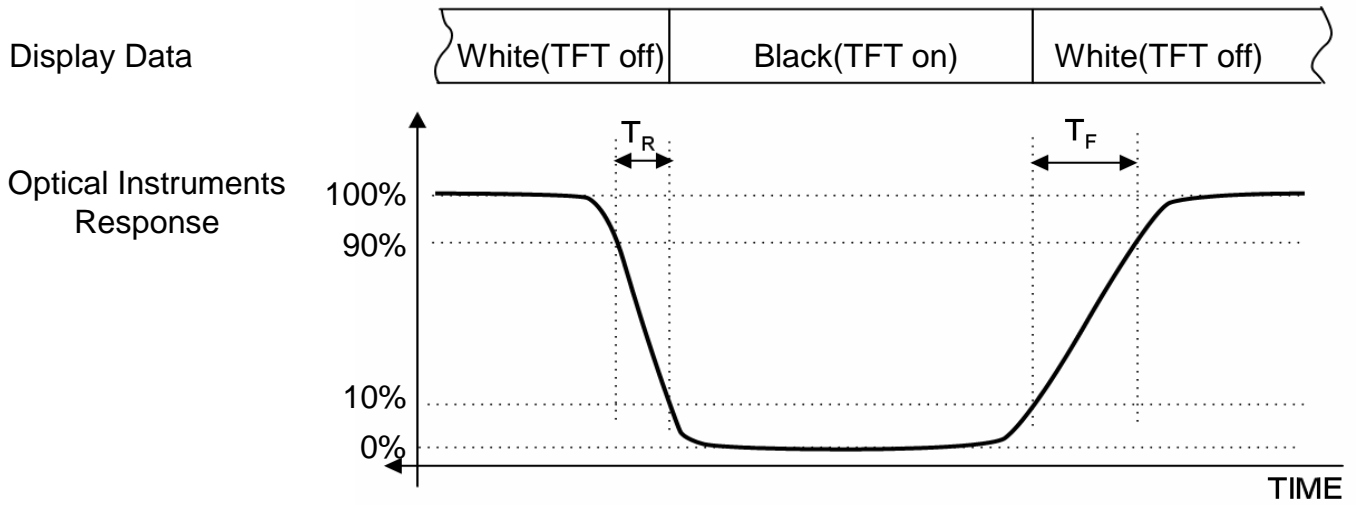
$$Buni = 100 \times \frac{(B\max - B\min)}{B\max}$$

Bmax : Maximum brightness

Bmin : Minimum brightness

MODEL	LTM185AT01	Page	8/31

Note (5) Definition of Response time

a. On/Off response time : Sum of Tr, Tf

Display Data | White(TFT off) | Black(TFT on) | White(TFT off)

Optical Instruments Response
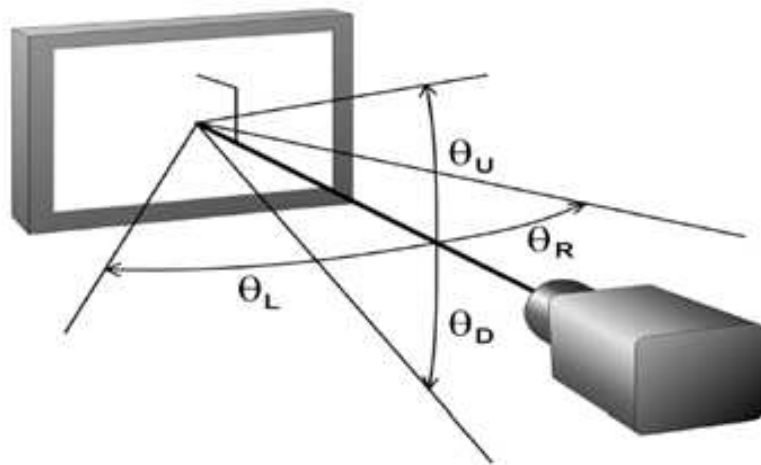
100%
90%
10%
0%

T_R

T_F

TIME

Note (6) Definition of Luminance of White : Luminance of white at center point⑤

Note (7) Definition of Color Chromaticity (CIE 1931, CIE1976)
Color coordinate of Red, Green, Blue & White at center point⑤

Note (8) Definition of Viewing Angle
: Viewing angle range (CR ≥10)

θ_U

θ_R

θ_L

θ_D

| MODEL | LTM185AT01 | Page | 9/31 |

Note (9) Color Grayscale Linearity

    a. Test image : 100% full white pattern with a test pattern as below

    b. Test pattern : Squares, 40mm by 40mm in size, filled with 255, 225, 195, 165, 135 and 105 grays steps should be arranged at the center⑤ of the screen.

    c. Test method

    -1st gray step : move a square of 255 gray level should be moved into the center of the screen and measure luminance and u' and v' coordinates.

    - Next gray step : Move a 225 gray square into the center and measure both luminance and coordinates, too.

    d. Test evaluation

$$\Delta u' v' = \sqrt{(u'_A - u'_B)^2 + (v'_A - v'_B)^2}$$

    Where A, B : 2 gray levels found to have the largest color differences between them

    i.e. get the largest △u' and △v' of each 6 pair of u' and v' and calculate the △u'v'.

MODEL	LTM185AT01	Page	10/31

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)
LVDS Input Characteristics	Differential Input Voltage for LVDS Receiver Threshold	High	-	-	+100	mV	(2)
		Low	-100	-	-	mV	
	LVDS skew	t_{SKEW}	-300		300		(3)
	Differential input voltage	$|V_{ID}|$	200		600	mV	(4)
	Input voltage range (single-ended)	V_{IN}	0		2.4	V	(4)
	Common mode voltage	V_{CM}	$0+$ $|V_{ID}|/2$	1.2	$2.4-$ $|V_{ID}|/2$	V	(4)
Current of Power Supply	(a) Black	I_{DD}	-	TBD	-	mA	(5),(6)
	(b) White		-	TBD	-	mA	
	(c) Dot		-	TBD	TDB	mA	
Vsync Frequency		f_V	50	60	76	Hz	
Hsync Frequency		f_H	39.9	47.9	60.6	kHz	
Main Frequency		f_{DCLK}	71.4	85.8	108.8	MHz	
Rush Current		I_{RUSH}	-	-	3	A	(7)

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

MODEL	LTM185AT01	Page	11/31

(2) Differential receiver voltage definitions and propagation delay and transition time test circuit
     a. All input pulses have frequency = 10MHz, t_R or t_F=1ns
     b. C_L includes all probe and fixture capacitance
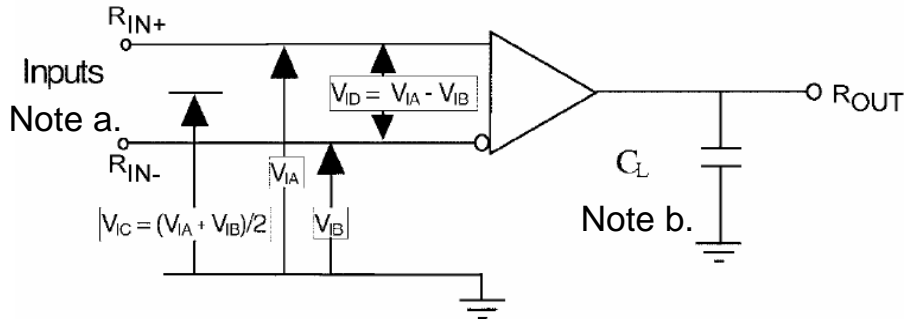
(3) LVDS Receiver DC parameters are measured under static and steady conditions
   which may not be reflective of its performance in the end application.
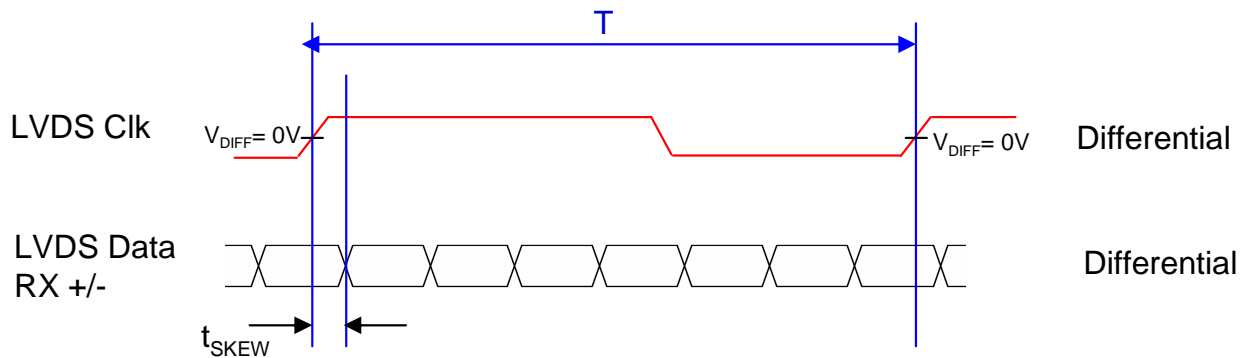
    where tskew : skew between LVDS clock & LVDS data,
        T   : 1 period time of LVDS clock
        cf) (-/+) of 300psec means LVDS data goes before or after LVDS clock.

(4) Definition of V_{ID} and V_{CM} using single-end signals

MODEL	LTM185AT01	Page	12/31
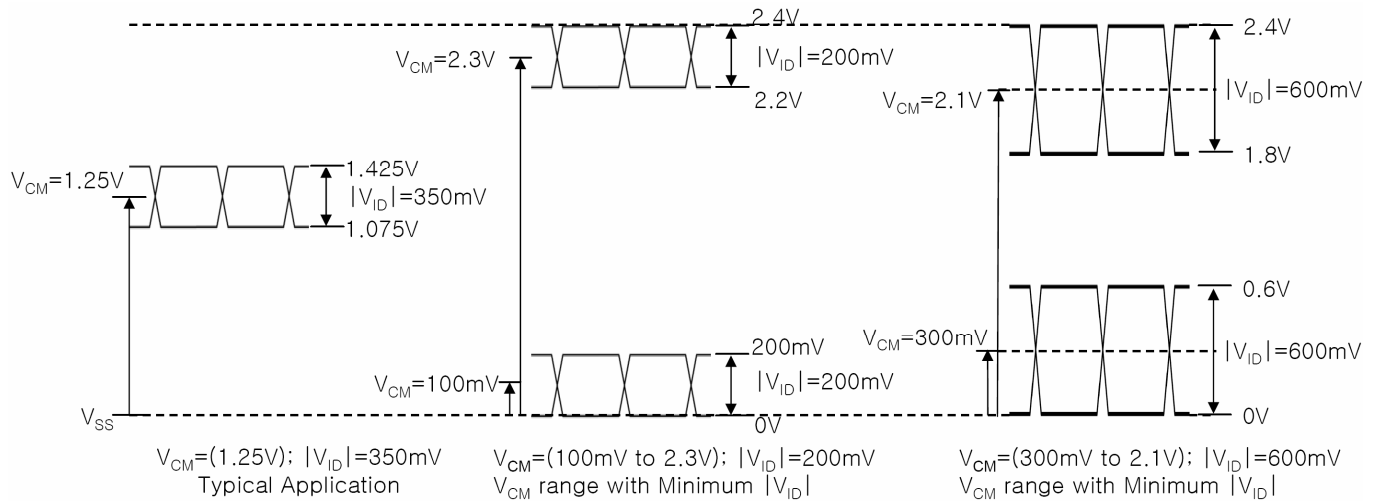
(5) fV=60Hz, fDCLK = 85.8MHz, VDD = 5.0V, DC Current.

(6) Power dissipation check pattern (LCD Module only)
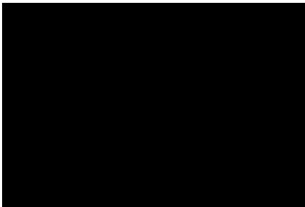
a) Black Pattern   b) White Pattern   c) Dot Pattern
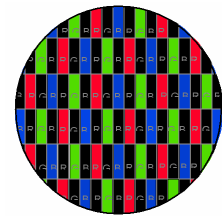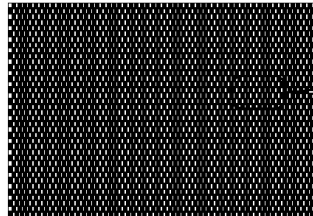
(7) Measurement Condition

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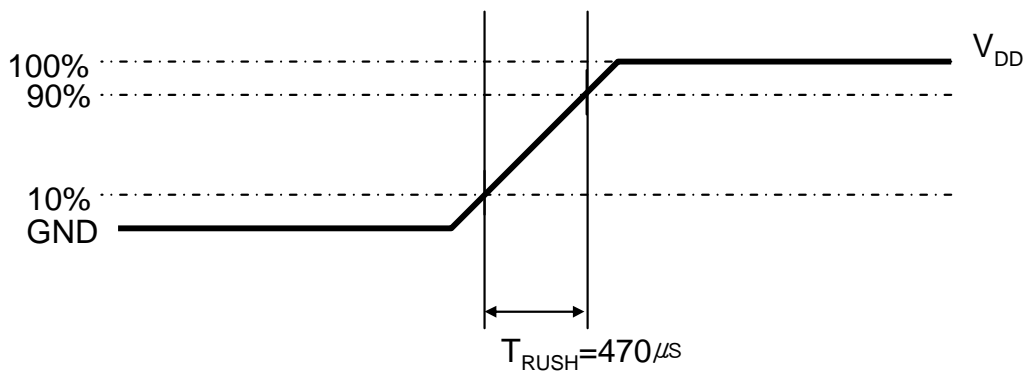
Rush Current I_{RUSH} can be measured when T_{RUSH}. is $470 \mu s$.

MODEL	LTM185AT01	Page	13/31

3.2 Back Light Unit

The back light unit is an edge type with 2 CCFLs(Cold Cathode Fluorescent Lamp).

The characteristics of those lamps are shown in the following table.

Ta=25 $\pm$ 2°C

Item		Symbol	Min.	Typ.	Max.	Unit	Note
Lamp Current		I_L	(3.0)	7.5	(8.0)	mArms	(1)
Lamp Voltage		V_L	-	700	-	Vrms	
Lamp Frequency		f_L	(45)	-	(60)	kHz	(2)
Operating Life Time		Hr	50,000	-	-	Hour	(3)
Inverter waveform	Asymmetry rate	Wasy	-	-	10	%	(4)
	Distortion rate	Wdis	1.2726	1.414	1.5554		
Startup Voltage		Vs	-	-	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

MODEL	LTM185AT01	Page	14/31

(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.
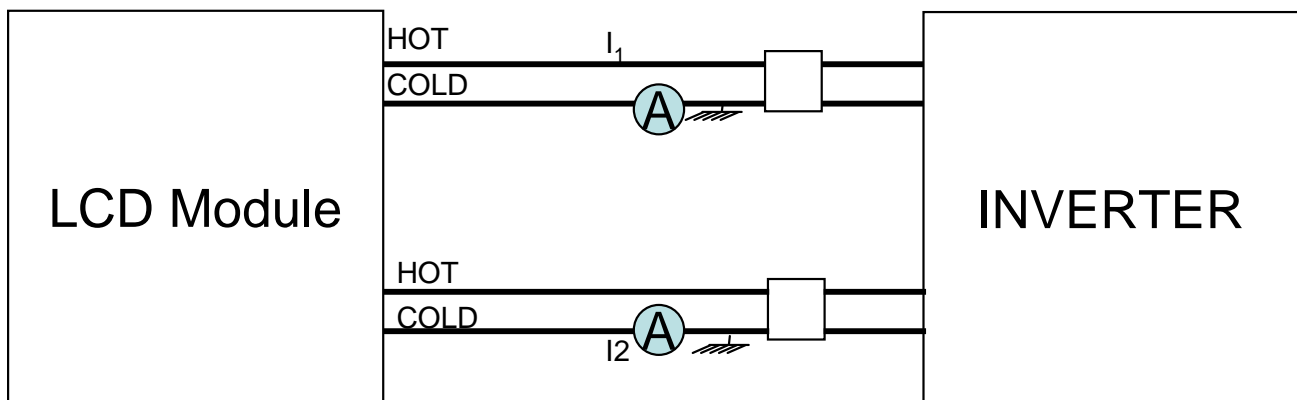
(3) Life time (Hr) is defined as the time when brightness of a lamp unit itself becomes 50% or less than its original value at the condition of Ta = 25±2°C and I_L = 7.5mArms

(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 √2 with ±10% tolerance.

          - Inverter output waveform had better be more similar to ideal sine wave.
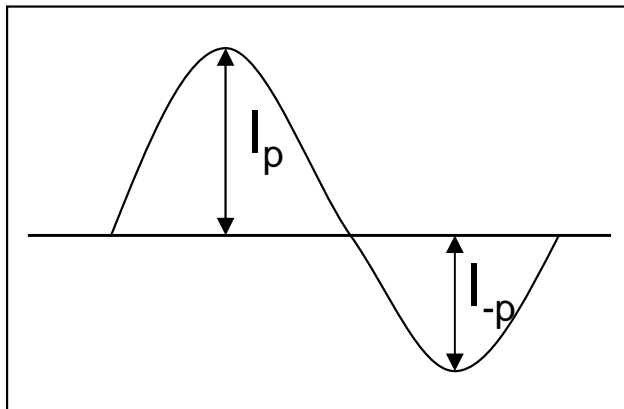
Fig. Wave form of the inverter

▪ 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.

MODEL	LTM185AT01	Page	15/31

4. BLOCK DIAGRAM

4.1 TFT LCD Module

RSDS

Control signal

Source Driver ICs

S1   S1366

LVDS pair #1

LVDS pair #2

CN1 (30pin)

LVDS (Rx)

RSDS(Tx)

Control signal

Timing Controller

TFT-LCD
(1366 x RGB x 768 pixels)

+5.0V V_DD

Power Circuit

4.2 Back Light Unit

LAMP(CCEL)

1
2

HOT
COLD

LAMP(CCEL)

1
2

HOT
COLD

| MODEL | LTM185AT01 | Page | 16/31 |
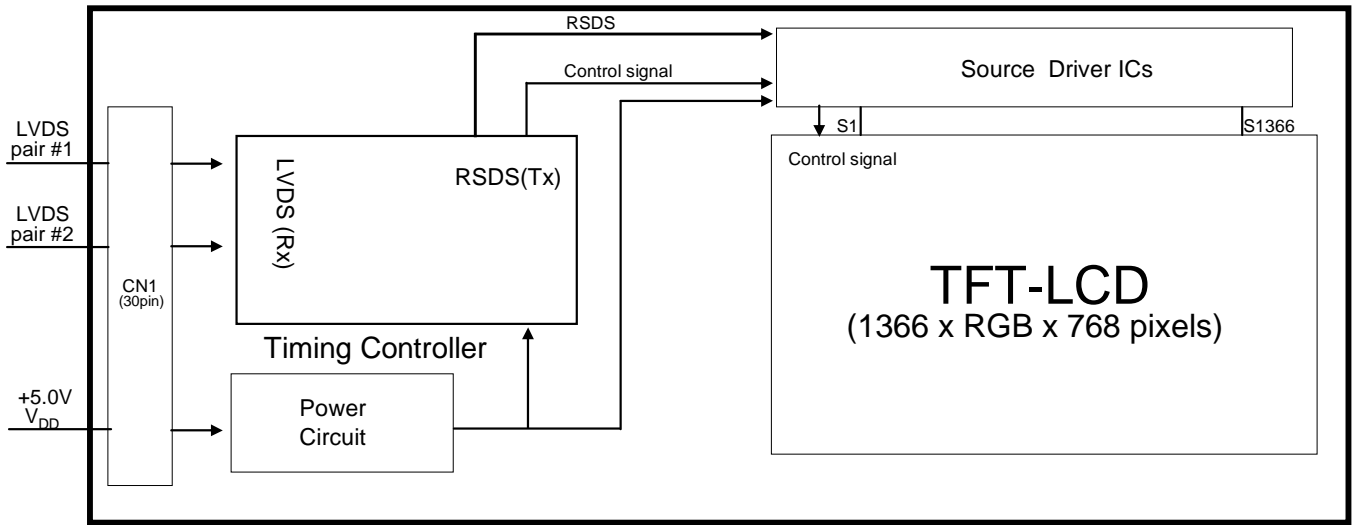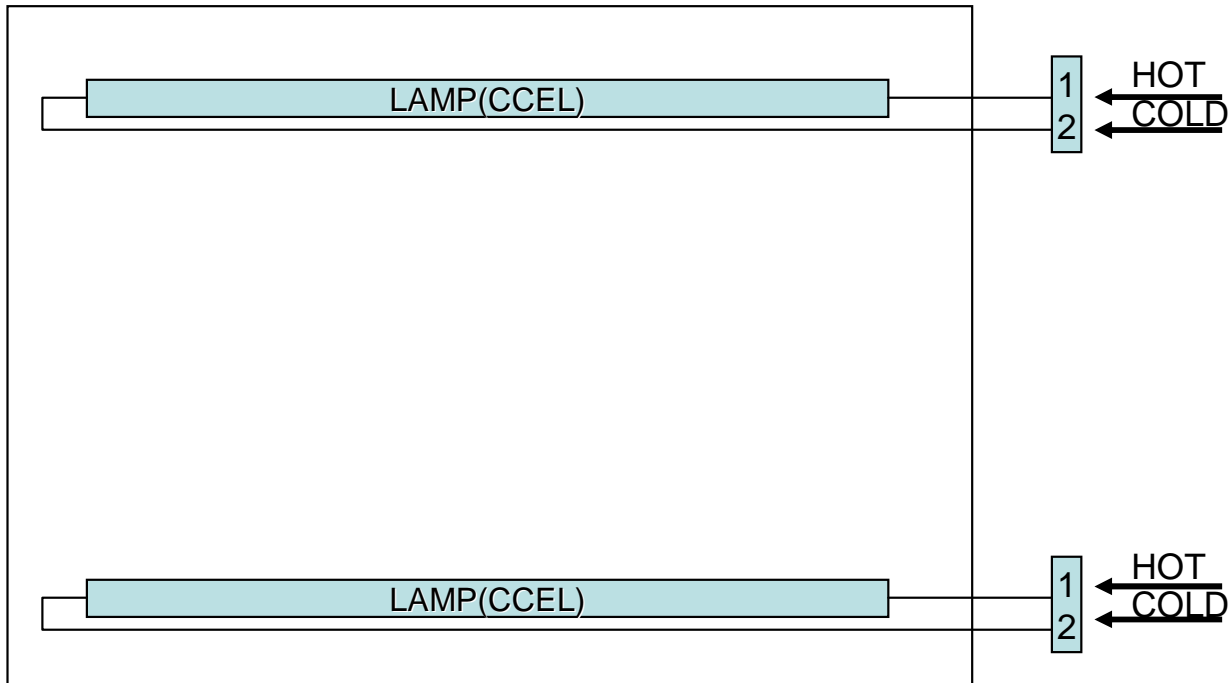
5. Input Terminal Pin Assignment

5.1. Input Signal & Power (Connector : P-TWO 187034-30091 or equivalent)

PIN NO	SYMBOL	FUNCTION
1	CTL	No Connection (for DVR : CTL)
2	CE	No Connection (for DVR : CE)
3	NC	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	

* If the system already uses the 1, 2pins, it should keep under GND level
The voltage applied to those pins should not exceed -200mV.

MODEL	LTM185AT01	Page	17/31

Note) Pin number starts from Left side

PCB

Pin No. 1   Pin No. 30

#1   #30

#1   #30
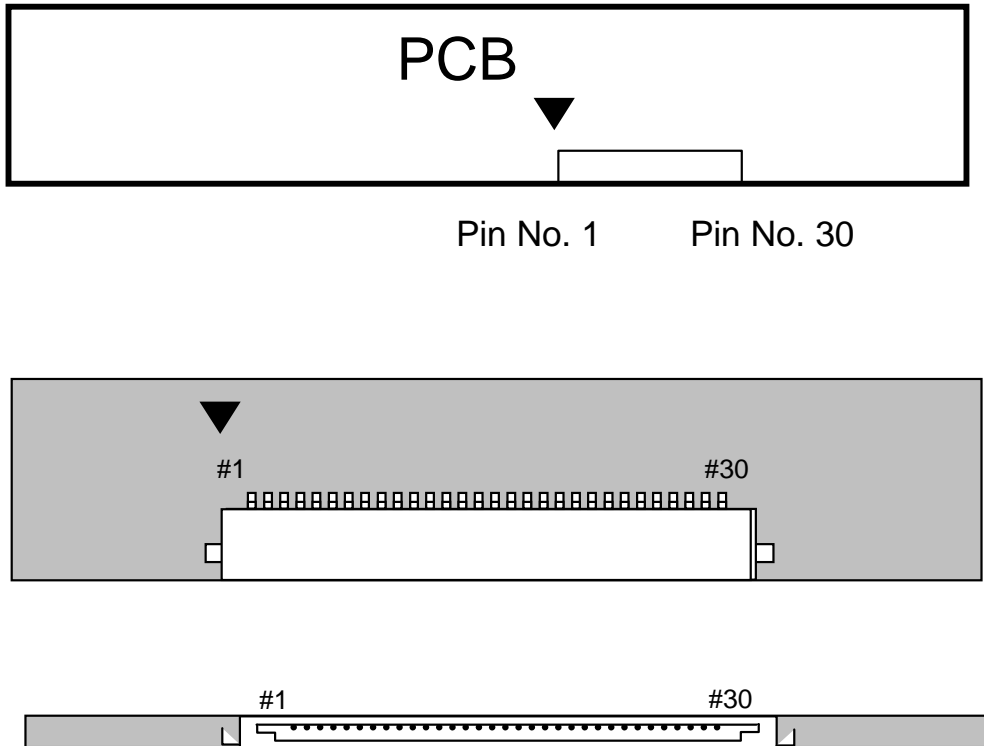
Fig. Connector diagram

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.

MODEL	LTM185AT01	Page	18/31

008951220402407

5.2 LVDS Interface

5.2.1 Pixel data

DS90C385
THC63LVDM83A

DF14H-20P-1.25H

Host System 24-bit		DS90C385 THC63LVDM83A		DF14H-20P-1.25H			
RED0	51						
RED1	52	TxOUT0-	48	5		5	RxIN0-
RED2	54				100Ω	6	
RED3	55	TxOUT0+	47	6			RxIN0+
RED4	56						
RED5	3					8	
RED6	50	TxOUT1-	46	8			RxIN1-
RED7	2				100Ω	9	
GREEN0	4	TxOUT1+	45	9			RxIN1+
GREEN1	6						
GREEN2	7					11	
GREEN3	11	TxOUT2-	42	11			RxIN2-
GREEN4	12				100Ω	12	
GREEN5	14	TxOUT2+	41	12			RxIN2+
GREEN6	8						
GREEN7	10					14	
BLUE0	15	TxCLKOUT-	40	14			RxCLKIN-
BLUE1	19				100Ω	15	
BLUE2	20	TxCLKOUT+	39	15			RxCLKIN+
BLUE3	22						
BLUE4	23					17	
BLUE5	24	TxOUT3-	38	17			RxIN3-
BLUE6	16				100Ω	18	
BLUE7	18	TxOUT3+	37	18			RxIN3+
Hsync	27						
Vsync	28						
Enable	30						
CLOCK	31						

Note :
The LCD Module uses a 100ohm resistor between positive and negative lines of each receiver input.

MODEL	LTM185AT01	Page	19/31

5.3.3 Timing Diagrams of LVDS For Transmitting
LVDS Receiver : Integrated T-CON

MODEL	LTM185AT01	Page	20/31
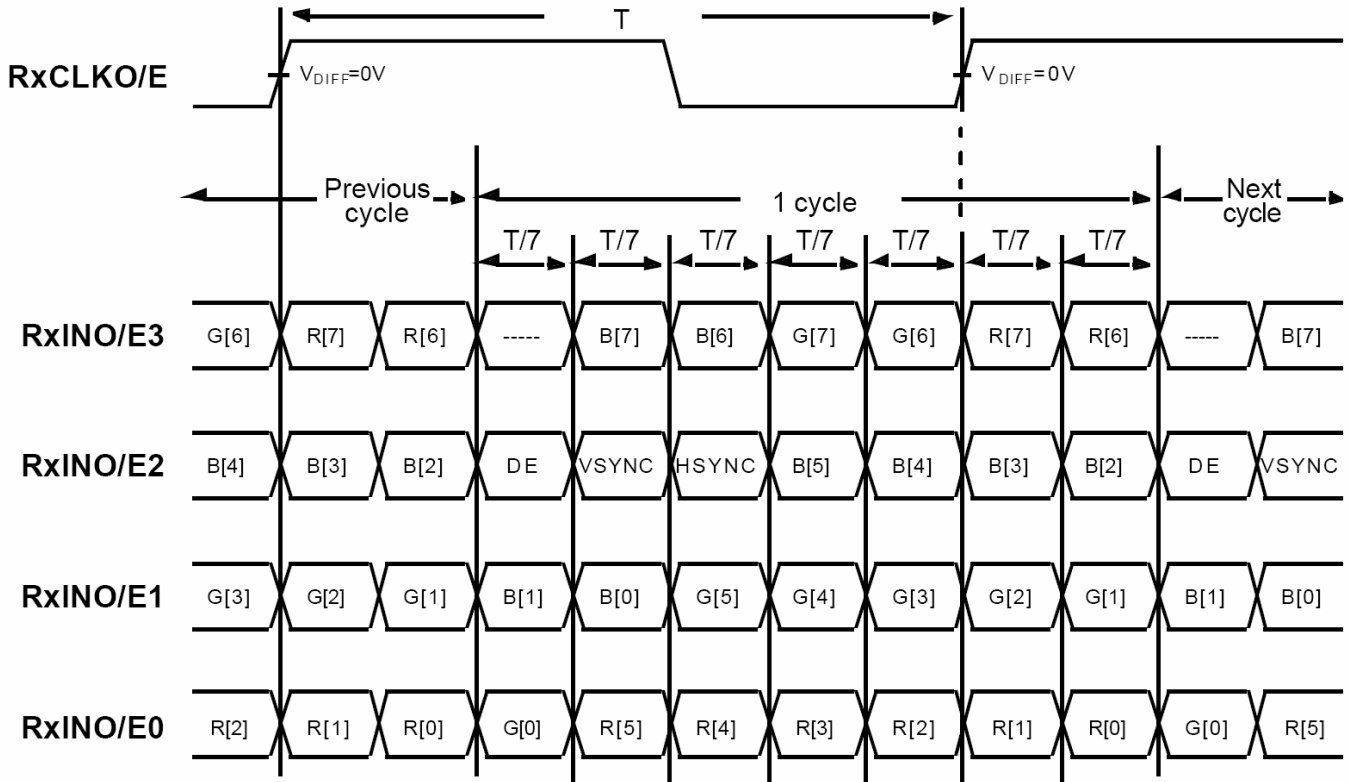
5.4 Back Light Unit

	Pin No.	Input	Color	Function
Upper	1	Hot – 1	Red	High Voltage
	2	Cold – 1	White	Ground
Lower	1	Hot – 1	Red	High Voltage
	2	Cold – 1	White	Ground
	Connect or Part No.	Yeonho 35001HS-02L or equivalent		

MODEL	LTM185AT01	Page	21/31

5.5 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	-
	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
	↓	:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	:			
	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	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	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
	↓	:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	:			
	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	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	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
	↓	:	:	:	:	:	:			:	:	:	:	:	:			:	:	:	:	:	:			
	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	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	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 (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

MODEL	LTM185AT01	Page	22/31

6. Interface Timing

6.1 Timing Parameters   (DE only mode)

SIGNAL	ITEM	SYMBOL	MIN.	TYP.	MAX.	Unit	NOTE
Clock	Frequency	$1/T_C$	71.4	85.8	108.8	MHz	-
Hsync		F_H	39.9	47.9	60.6	KHz	-
Vsync		F_V	50	60	76	Hz	-
Vertical Display Term	Active Display Period	T_{VD}	-	768	-	lines	-
	Vertical Total	T_{VB}	776	798	1108	lines	-
Horizontal Display Term	Active Display Period	T_{HD}	-	1366	-	clocks	-
	Horizontal Total	T_H	1446	1792	2046	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

MODEL	LTM185AT01	Page	23/31

6.2 Timing diagrams of interface signal (DE only mode)

MODEL	LTM185AT01	Page	24/31
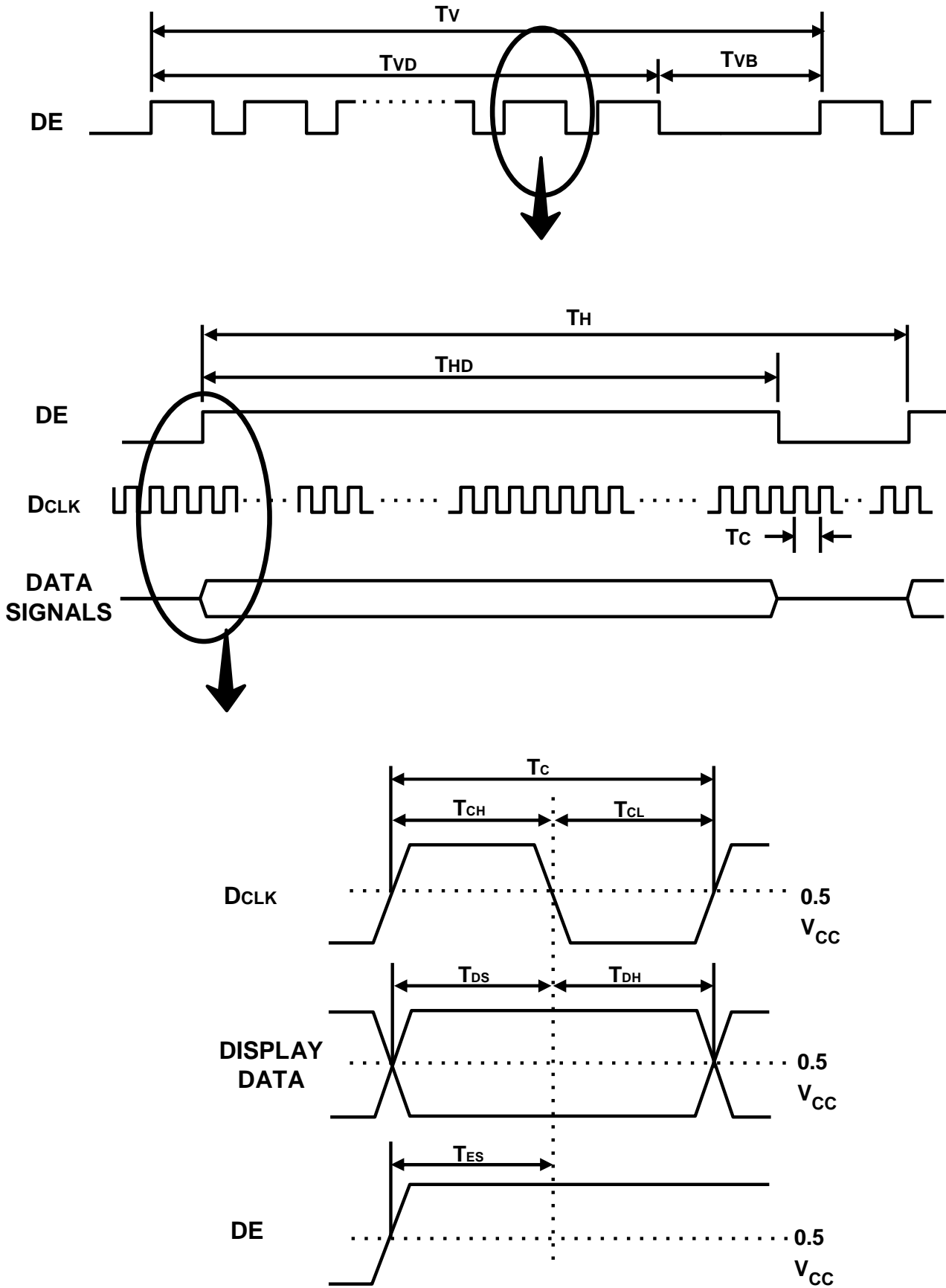
6.3 Power ON/OFF Sequence

To prevent a latch-up or DC operation of the LCD Module, the power on/off sequence should be as the diagram below.
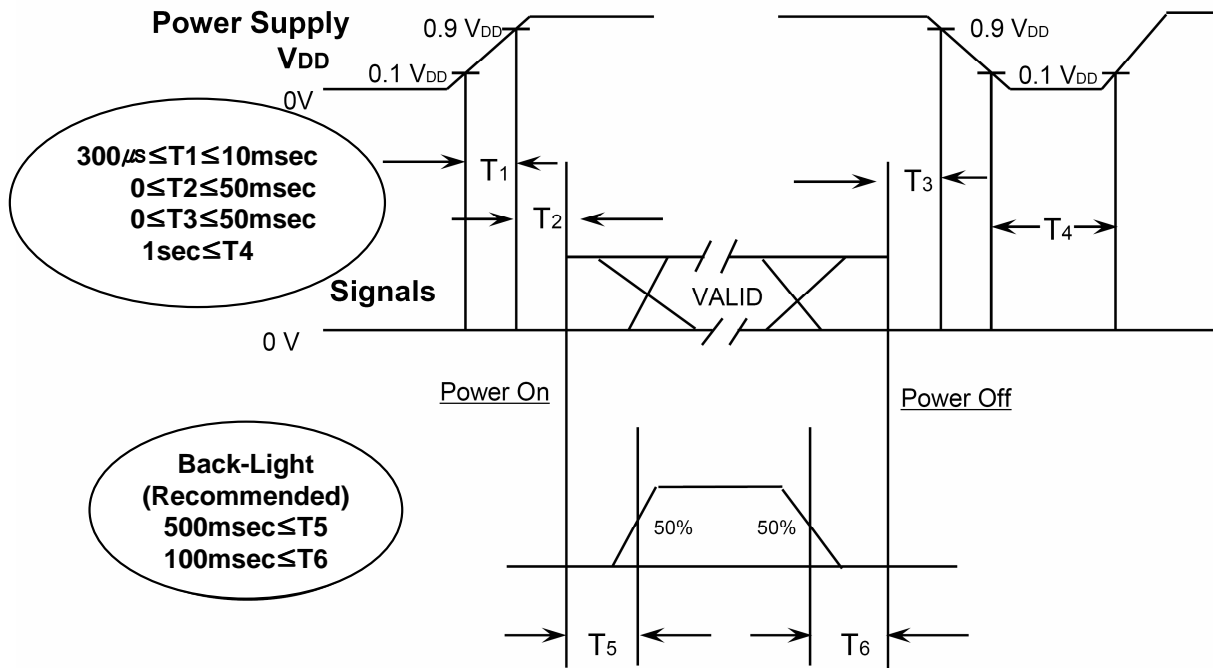
T1 : V_{DD} rising time from 10% to 90%
T2 : The time from V_{DD} to valid data at power ON.
T3 : The time from valid data off to V_{DD} off at power Off.
T4 : V_{DD} off time for Windows restart
T5 : The time from valid data to B/L enable at power ON.
T6 : The time from valid data off to B/L disable at power Off.

- The supply voltage of the external system for the Module input should be the same as the definition of V_{DD}.
- 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_{DD} = 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.
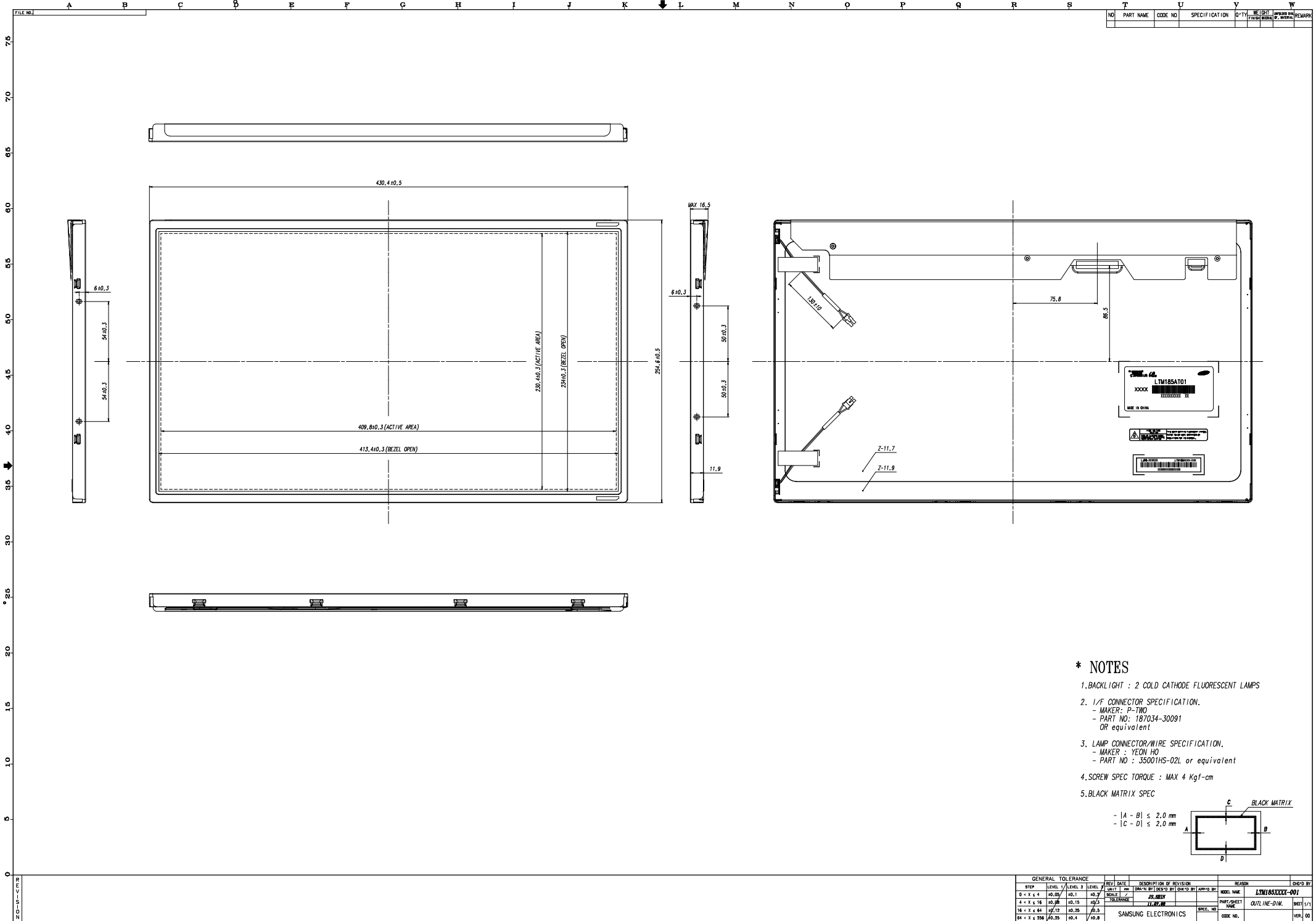- Interface signal should not be kept at high impedance when the power is on.

MODEL	LTM185AT01	Page	25/31

6.4 VDD Power Dip Condition
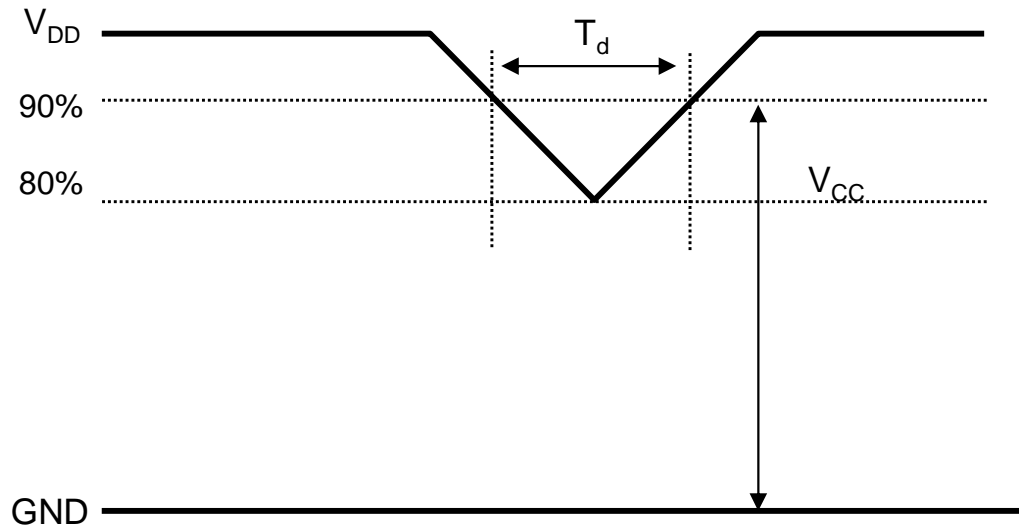
$$4.5V \leq V_{DD} \leq 5.5V$$
If V_{DD}(typ.) x 80% $\leq V_{CC} \leq V_{DD}$(typ) x 90%, then 0<Td $\leq$20msec

Note　(1) The above conditions are for the glitch of the input voltage.

　(2) For stable operation of an LCD Module power, please follow them.

　　i.e., if typ VDD x 80% $\leq$ Vcc $\leq$ typ VDD x 90%, then T_d should be less than 20ms.

MODEL	LTM185AT01	Page	26/31

7. Outline Dimension
[Refer to the next page]

MODEL	LTM185AT01	Page	27/31

* NOTES

1.BACKLIGHT : 2 COLD CATHODE FLUORESCENT LAMPS

2. I/F CONNECTOR SPECIFICATION.
  - MAKER: P-TWO
  - PART NO: 187034-30091
    OR equivalent

3. LAMP CONNECTOR/WIRE SPECIFICATION.
  - MAKER : YEON HO
  - PART NO : 35001HS-02L or equivalent

4.SCREW SPEC TORQUE : MAX 4 Kgf-cm

5.BLACK MATRIX SPEC

  - |A − B| ≤ 2.0 mm
  - |C − D| ≤ 2.0 mm

024061218529726

8. General Precautions

8.1 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 uses high voltages, it should be disconnected from power source before it is assembled or disassembled.

(c) Refrain from strong mechanical shock and / or any force to the module. In addition to damage, it may cause improper operation or damage to the module and CCFT back light.

(d) Note that polarizer films are very fragile and could be damaged 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 cause 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.

MODEL	LTM185AT01	Page	29/31

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 35℃
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.

8.3 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 item 6.3
"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).

8.4 Operation Condition Guide

(a) The LCD product should be operated under normal conditions.
Normal condition is defined as below;
- Temperature : 20±15℃
- Humidity : 65±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.

MODEL	LTM185AT01	Page	30/31

8.5 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 "stuck" 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.

MODEL	LTM185AT01	Page	31/31