Samsung Secret

Product Information

Customer : General DATE : Jan. 07. 2011

SAMSUNG TFT-LCD

MODEL : LTA460HN01-W

The Information Described in this Specification is Preliminary and can be changed without prior notice

NOTE :

Samsung Electronics Co . , LTD.

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* Revision History

Date	Rev. No	Page	Summary
Jan 07 2011	000	-	First Issued

General Description

Description

LTA460HN01 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 46.0“ is 1920 x 1080 and this model can display up to 1.07G colors with wide viewing angle of 89° or higher in all directions. This panel is intended to support applications to provide a excellent performance for Flat Panel Display such as Home-alone Multimedia TFT-LCD TV, Display terminals for AV application products, and High Definition TV (HDTV).

Features

- RoHS compliance (Pb-free)
- High contrast ratio, high aperture ratio, fast response time
- SVA mode
- Wide viewing angle (±89°)
- Full HD (1920 x 1080 pixels) resolution (16:9)
- Low Power consumption
- 12 CCFTs (Cold Cathode Fluorescent Tube)
- LVDS (Low Voltage Differential Signaling) interface

General Information

Items	Specification	Unit	Note
Module Size	1083(H_{TYP}) x 627(V_{TYP})	mm	±1.0mm
	61.7(D_{MAX})		
Weight	12000(Max)	g	
Pixel Pitch	0.17675(H) * 3 x 0.53025(V)	mm	
Active Display Area	1018.08(H) x 572.67(V)	mm	
Surface Treatment	Haze 5.5%, Hard-coating (2H)		
Display Colors	8 bit + 2bit FRC – 1.07G	colors	
Number of Pixels	1920 x 1080	pixel	
Pixel Arrangement	RGB vertical stripe		
Display Mode	Normally Black		
Luminance of White	400	cd/m^2	Typ.

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	*13*	V	(1)
Storage temperature	T_{STG}		-20	65	℃	(2)
Operating Temperature	T_{OPR}		0	50	℃	(2)
Panel surface temperature	T_{SUR}		0	65	℃	(3)
Shock (non - operating)	S_{NOP}	±XY axis	-	40	G	(4)
		±Z axis	-	30		
Vibration (non - operating)	V_{NOP}		-	1.5	G	(5)

Note (1) Ta= 25 ± 2 °C

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

a. 93.8 % RH Max. (Ta ≤ 40 °C)

b. Maximum wet-bulb temperature at 40 °C or less. (Ta ≤ 40 °C)

c. No condensation

(3) Polarizer will not be damaged in this range, even though abnormal visual problems occur in T_{SUR} range.

(4) 11ms, sine wave, one time for ±X, ±Y, ±Z axis

(5) 10-300 Hz, Sweep rate 10min, 30min for X,Y,Z axis

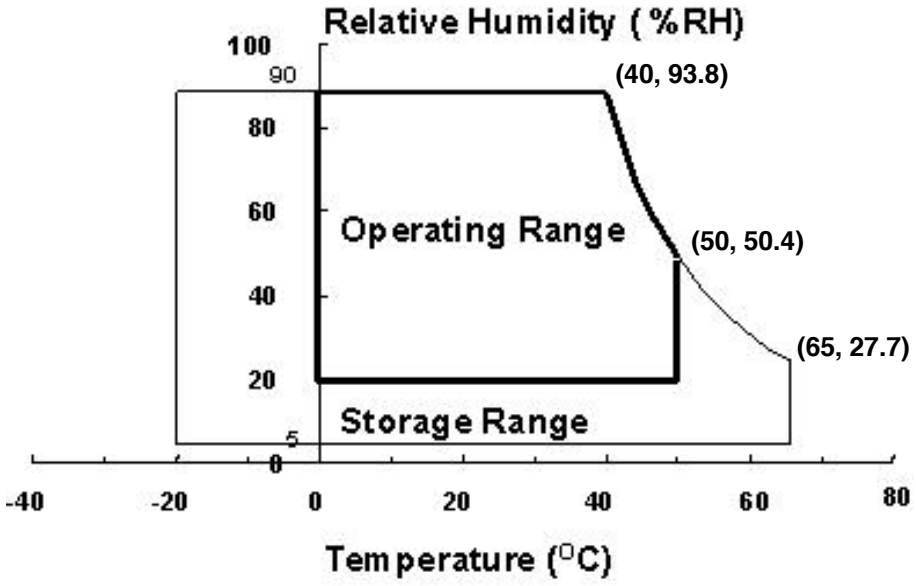


Fig. Temperature and Relative humidity range

2. Optical Characteristics

The optical characteristics should be measured in a dark room or equivalent.
Measuring equipment : TOPCON BM-7,SPECTRORADIOMETER SR-3
(Ta = 25 ± 2°C, VDD=12V, fv= 60Hz, f_{DCLK}=148.5MHz, Dim = 100%)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio (Center of screen)		C/R	Normal θL,R=0 θU,D=0 Viewing Angle	*2500	5000	-		(3) SR-3A
Response Time	Rising	Tr		-	12	70	msec	(5) RD-80S
	Falling	Tf		-	8	18		
	G-to-G [AVE]	Tg		-	8	-		
Luminance of White (Center of screen)		Y_L		330	400	-	cd/m²	(6) SR-3A
Color Chromaticity (CIE 1931)	Red	Rx		TYP. -0.03	0.637	TYP. +0.03		(7),(8) SR-3A
		Ry			0.326			
	Green	Gx			0.293			
		Gy			0.599			
	Blue	Bx			0.149			
		By			0.058			
	White	Wx			0.280			
		Wy			0.285			
Color Gamut		-		-	72	-	%	(7) SR-3A
Color Temperature		-		-	10000	-	K	(7) SR-3A
Gamma		γ		-	2.2	-		
Viewing Angle	Hor.	θ_L	C/R≥10	79	89	-	Degree	(8) EZ-Contrast
		θ_R		79	89	-		
	Ver.	θ_U		79	89	-		
		θ_D		79	89	-		
Brightness Uniformity (9 Points)		B_{uni}		-	-	30	%	(4) SR-3

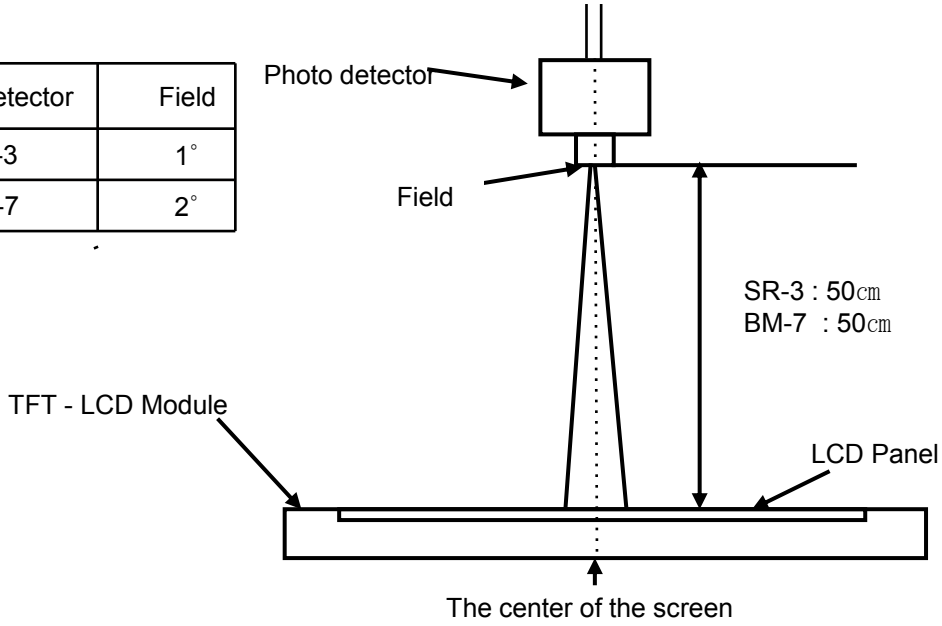
* marked Items Value does not Specification above when “White stain” occurs at Center Point [Point ⑤ of Note 2.]

Note (1) Test Equipment Setup

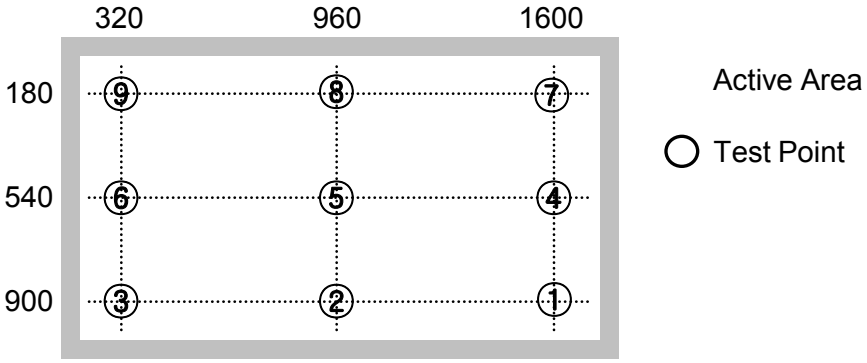
The measurement should be executed in a stable, windless and dark room between 40min and 60min after lighting the back light at the given temperature for stabilization of the back light. This should be measured in the center of screen.

Single lamp current @ Vdim = 100%
Environment condition : Ta = 25 ± 2 °C

Photo detector	Field
SR-3	1°
BM-7	2°



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

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

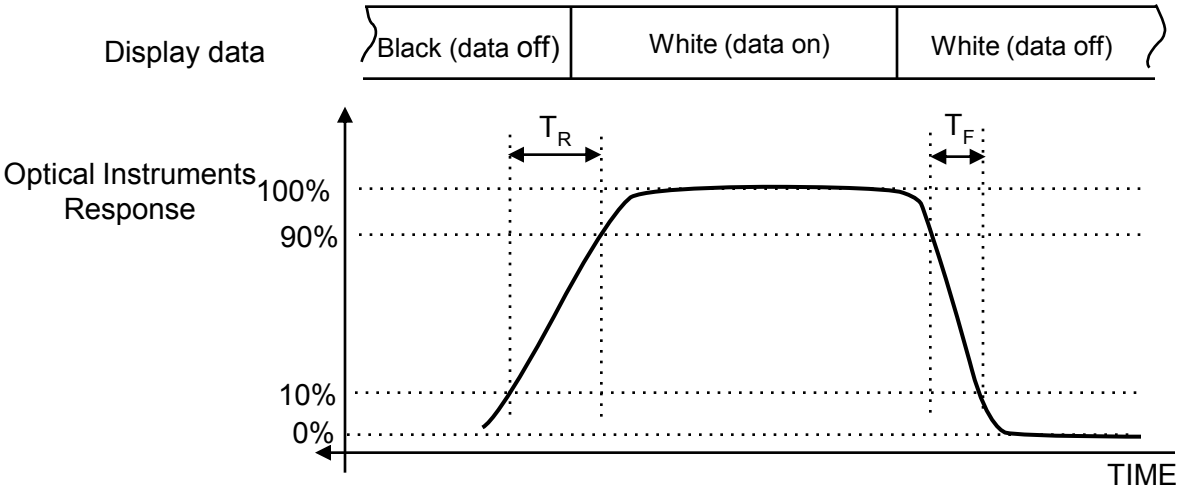
Gmax : Luminance with all pixels white
Gmin : Luminance with all pixels black

Note (4) Definition of 9 points brightness uniformity

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

Bmax : Maximum brightness
Bmin : Minimum brightness

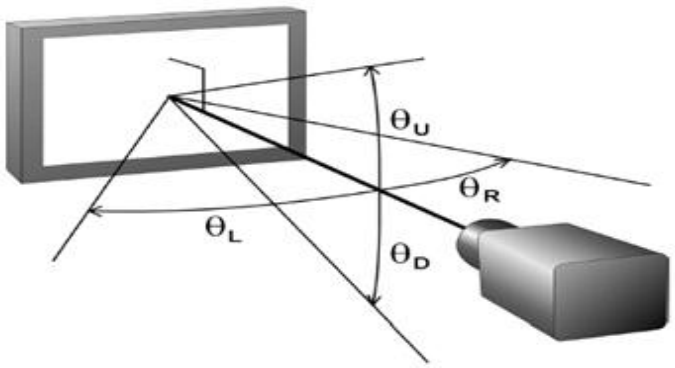
Note (5) Definition of Response time : Sum of Tr, Tf



Note (6) Definition of Luminance of White : Luminance of white at center point ⑤

Note (7) Definition of Color Chromaticity (CIE 1931)
Color coordinate of Red, Green, Blue & White at center point ⑤

Note (8) Definition of Viewing Angle
: Viewing angle range (C/R ≥10)



3. Electrical Characteristics

3.1 TFT LCD Module

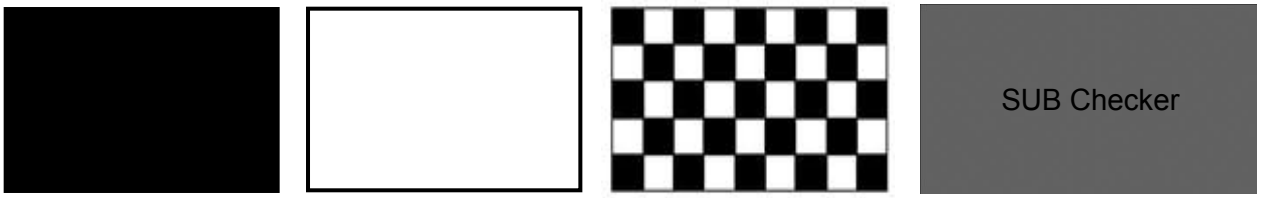
The connector for display data & timing signal should be connected.

Ta = 25°C ± 2 °C

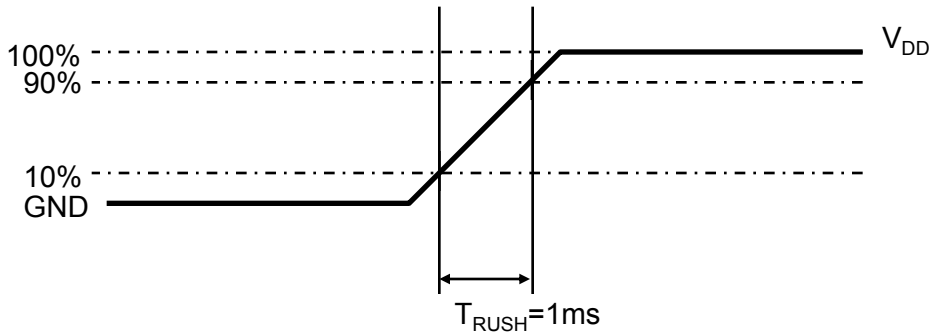
Item		Symbol	Min.	Typ.	Max.	Unit	Note
Voltage of Power Supply		V_{DD}	11	12	13	V	(1)
Current of Power Supply	(a) Black	I_{DD}	-	500	-	mA	(2),(3)
	(b) White		-	520	700		
	(c) Mosaic		-	520	-		
	(4) Max Pattern		-	830	1000		
Vsync Frequency		f_V	47	60	62	Hz	
Hsync Frequency		f_H	50	67.5	73	kHz	
Main Frequency		f_{DCLK}	130	148.5	155	MHz	
Rush Current		I_{RUSH}	-	-	5	A	(4)

Note (1) The ripple voltage should be controlled under 10% of V_{DD}.
(2) fv=60Hz, f_{DCLK} = 148.5MHz, V_{DD} = 12.0V, DC Current.
(3) Power dissipation check pattern (LCD Module only)

a) Black Pattern b) White Pattern c) Mosaic d)Max. Pattern



(4) Measurement Conditions



Rush Current I_{RUSH} can be measured when T_{RUSH}. is1ms

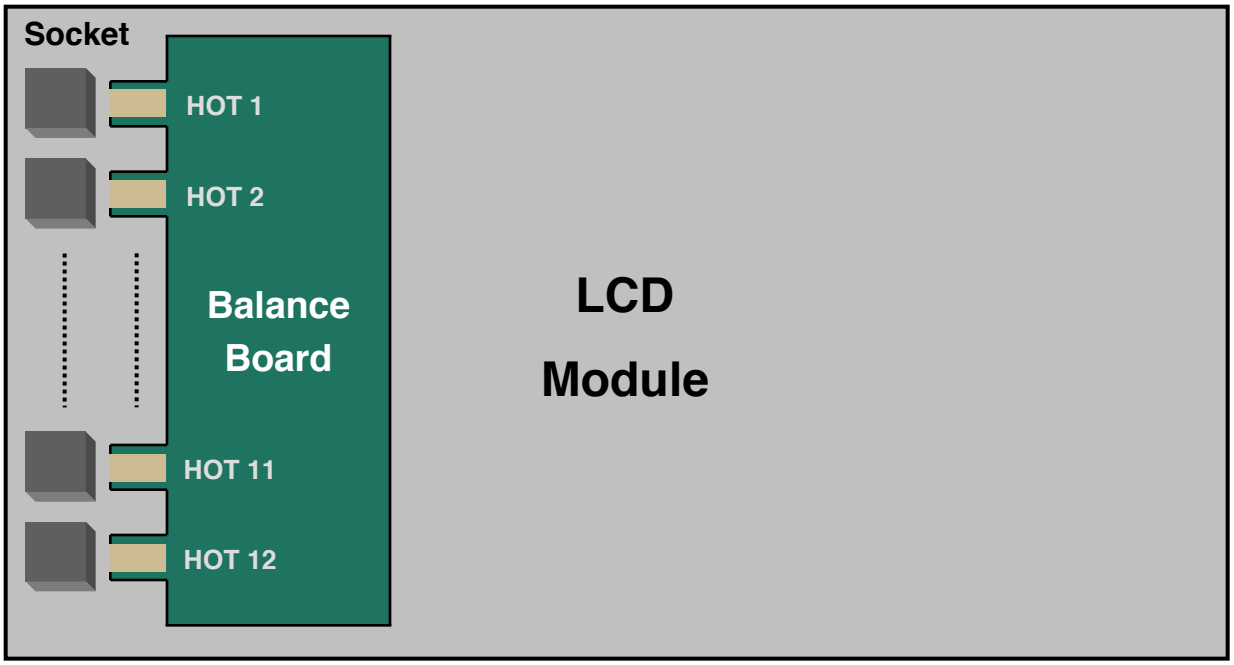
3.2 Back Light Unit

The back light unit contains 12 CCFTs (Cold Cathode Fluorescent Tube).
The characteristics of lamps are shown in the following tables.

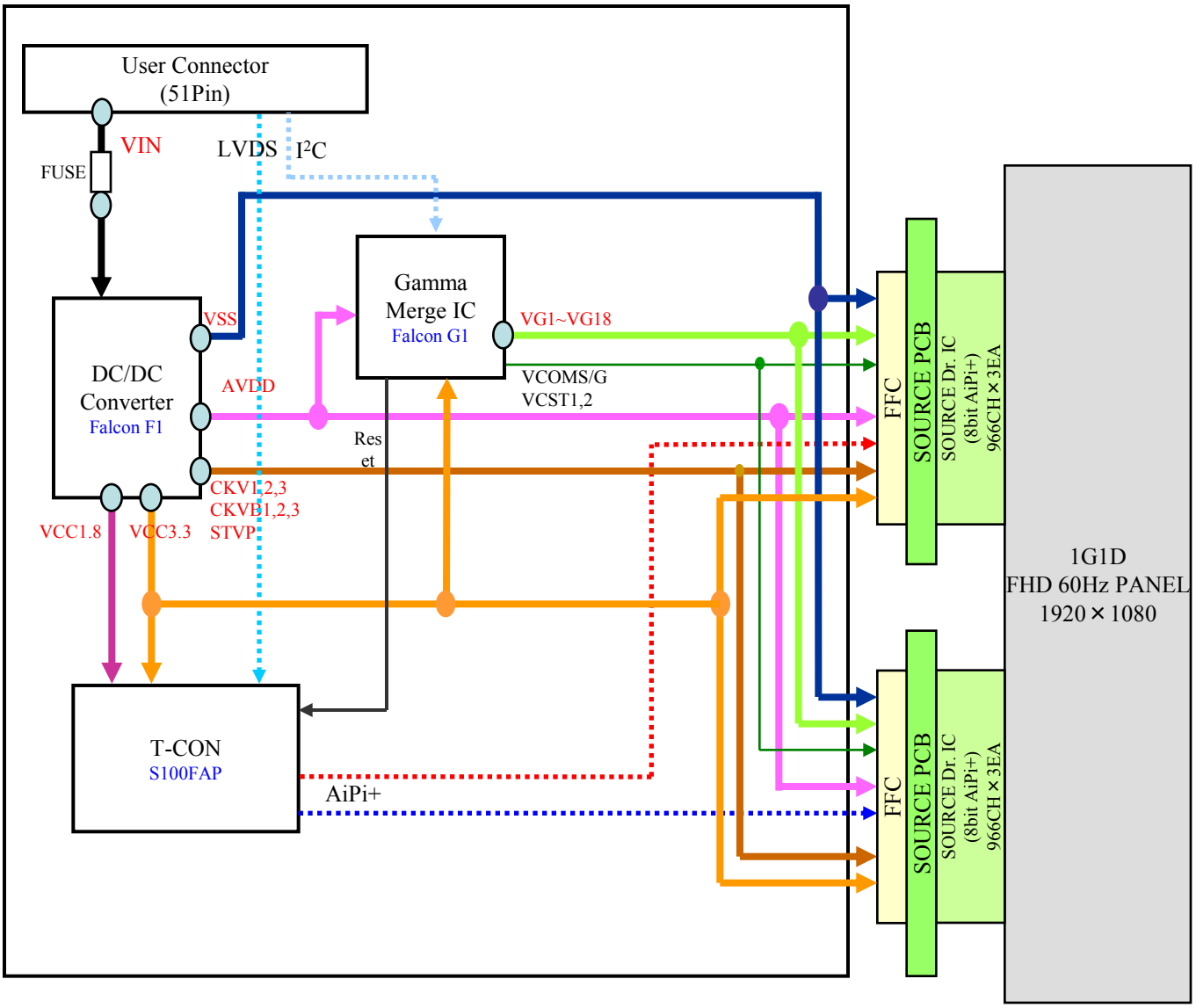
Ta=25 ± 2°C

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Operating Life Time	Hr	50,000	-	-	Hour	(1)
Lamp Current	Lc	12	-	16	mA	-

Note (1) It is defined as the time to take until the brightness reduces to 50% of its original value.
[Operating condition : Ta = 25±2℃, I_L = 14 mArms(typ.), For single lamp only.]



4. Block Diagram



5. Input Terminal Pin Assignment

5.1. Input Signal & Power

Connector : FI-RE51S-HF(JAE)

Compatible with IS050-C51B-C38(UJU)

PIN No.	Signal	Description	PIN No.	Signal	Description
1	Power	V_{DD}	26	LVE[0]P	Even LVDS Signal +
2	Power	V_{DD}	27	LVE[1]N	Even LVDS Signal -
3	Power	V_{DD}	28	LVE[1]P	Even LVDS Signal +
4	Power	V_{DD}	29	LVE[2]N	Even LVDS Signal -
5	Power	V_{DD}	30	LVE[2]P	Even LVDS Signal +
6	N.C.	No Connection	31	GND	GND
7	GND	GND	32	LVECLK-	Even LVDS Clock-
8	GND	GND	33	LVECLK+	Even LVDS Clock+
9	GND	GND	34	GND	GND
10	LVO[0]N	Odd LVDS Signal -	35	LVE[3]N	Even LVDS Signal -
11	LVO[0]P	Odd LVDS Signal +	36	LVE[3]P	Even LVDS Signal +
12	LVO[1]N	Odd LVDS Signal -	37	LVE[4]N	Even LVDS Signal -
13	LVO[1]P	Odd LVDS Signal +	38	LVE[4]P	Even LVDS Signal +
14	LVO[2]N	Odd LVDS Signal -	39	GND	GND
15	LVO[2]P	Odd LVDS Signal +	40	SCL	I2C SCL
16	GND	GND	41	SDA	I2C SDA
17	LVOCLK-	Odd LVDS CLK -	42	N.C	No Connection
18	LVOCLK+	Odd LVDS CLK +	43	B-INT	Bus Release
19	GND	GND	44	PANEL_SEL	PANEL_SEL
20	LVO[3]N	Odd LVDS Signal -	45	N.C.	No Connection
21	LVO[3]P	Odd LVDS Signal +	46	LUT SEL0	DCC LUT Select 0
22	LVO[4]N	Odd LVDS Signal -	47	LUT SEL1	DCC LUT Select1
23	LVO[4]P	Odd LVDS Signal +	48	LUT SEL2	DCC LUT Select2
24	GND	GND	49	N.C.	No Connection
25	LVE[0]N	Even LVDS Signal -	50	TCON_RDY	T-Con Ready
			51	SEL1	LVDS Option

■ Option Pin Description

These pins are CMOS interface.
Please use within the range of the following restriction.
VIH : 2.4V(min) / 3.5V(max)
VIL : 0.0V(min) / 0.4V(max)

■ BUS_SW : I2C BUS Switching (Damping100Ω / Pull Down10kΩ)

Operation	Description
LOW/OPEN	SDA/SCL LINE BECOME HI-Z
HIGH	USER CAN ACCESS EEPROM

■ DCC Look Up Table Selection (Damping 100Ω / Pull Down 4.7kΩ)

Pin N.O.	48	47	46	Description (Based on DCC On)	
				LUT	%(For Interpolate)
Select bit	0	0	0	For 60Hz	100%
	0	0	1	For 60Hz	100%X1.25
	0	1	0	For 60Hz @ Low Temp.	100%
	0	1	1	For 60Hz @ Low Temp.	100%X1.25
	1	0	0	For 50Hz	100%
	1	0	1	For 50Hz	100%X1.25
	1	1	0	DCC Off	0%
	1	1	1	DCC Off	0%

■ TCON Ready (Direct 100Ω)

Operation	Description
Low → High	Normal Operation
High → Low	Error Operation

■SCL : Pull up 22Ω/ 4.7kΩ
■SDA : Pull up 22Ω/ 4.7kΩ

Note(1) Pin number starts from Right side

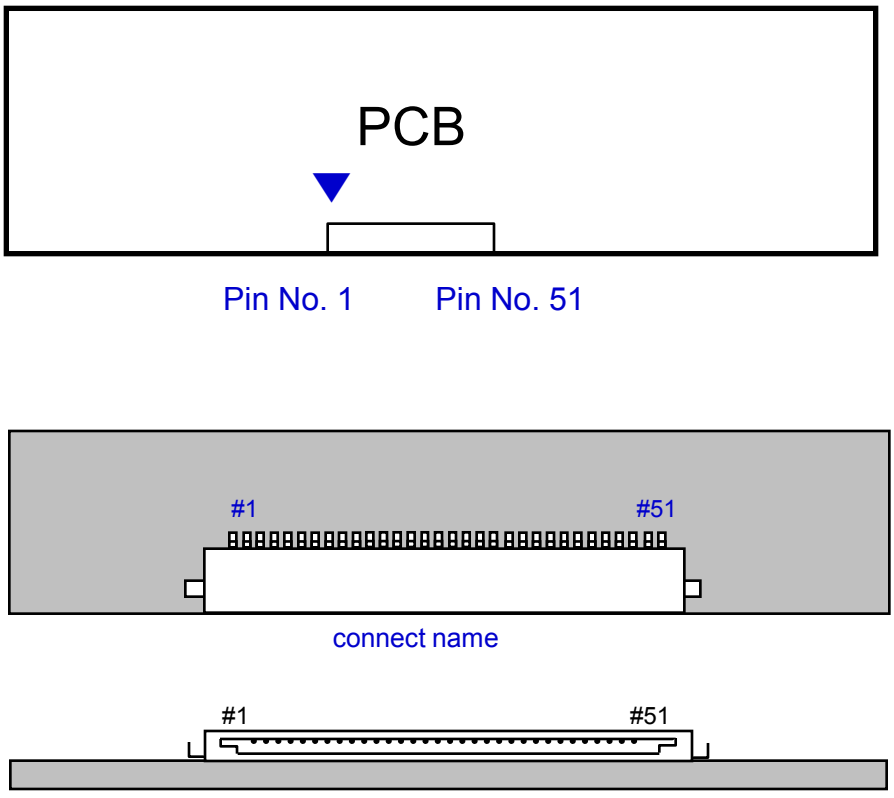


Fig. Connector diagram

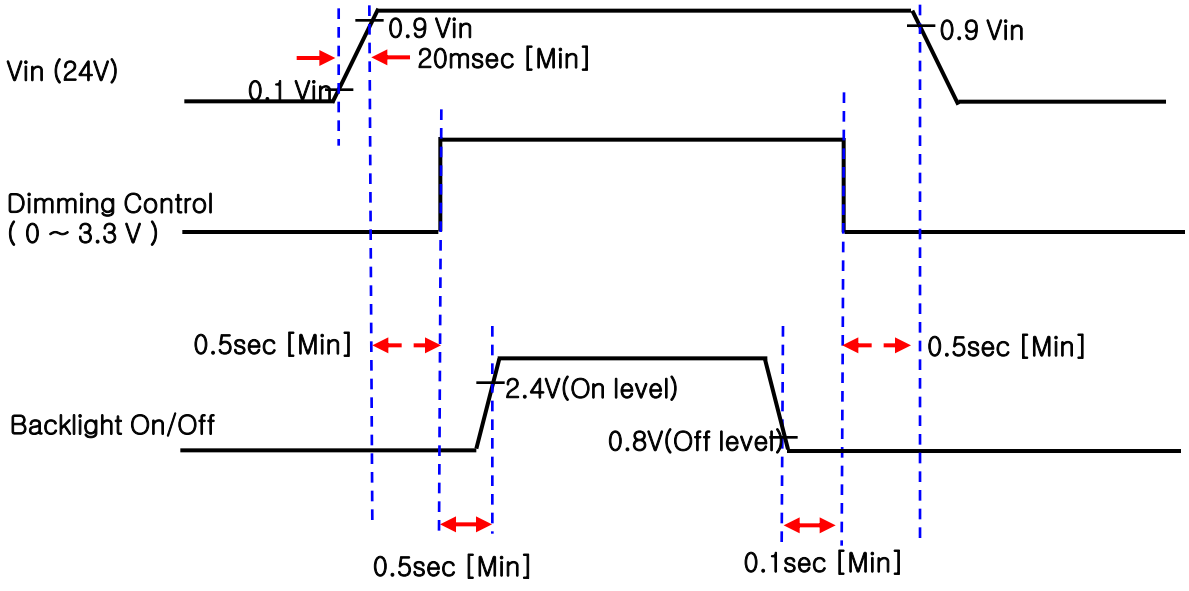
a. All GND pins should be connected together and also be connected to the LCD's metal chassis.
b. All power input pins should be connected together.
c. All NC pins should be separated from other signal or power.

5.2. Inverter Input Pin Configuration

Connector : 20022WR-14AML

Pin No.	Pin Configuration(FUNCTION)
1	24V
2	24V
3	24V
4	24V
5	24V
6	GND
7	GND
8	GND
9	GND
10	GND
11	Inverter Operation Status Output
12	Inverter On/Off Control Signal
13	No Connection
14	External Dimming Control Signal

5.3. Inverter Input Power Sequence

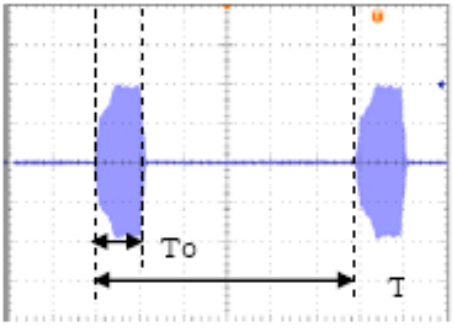


5.3. Inverter Input Power Sequence & Specification

Items	Symbol	Conditions	Specifications			Unit	Note
			Min.	Typ.	Max.		
Input Voltage	Vin	-	21.6	24.0	26.4	V	Ta=25±3°C
Input Current	I_{SAT}	Vin=24V EX_DIM=100%	-	-	8.30	A	-
Lamp Current	I_O	Vin=24V EX_DIM=100%	11.0	12.0	13.0	mArms	-
Operating Frequency	F_O	Vin=24V EX_DIM=100%	50	52	54	kHz	-
Backlight On/Off	ENA	ON	2.4	-	5.25	V	-
		OFF	0	-	0.8		
Dimming Duty Output	D_{max}	Vin=24V EX_DIM=100%	100	-	-	%	Note 1
	D_{min}		15	20	25		-
	D_{min}		10	-	-		Note 2
Open Lamp Voltage	Vopen	Vin=24V EX_DIM=100%	1880	-	-	Vrms	Note 3
Striking Time	Tst	Vin=24V EX_DIM=100%	1.0	1.5	2.0	sec	-
EX_DIM Frequency	F_{EX_DIM}	Vin=24.0V	120	150	180	Hz	-
PWM Signal Amplitude	V_{pwm}	High (On)	2.4	-	5.25	V	-
		Low (Off)	0	-	0.4		

※ All data was approved after running 120minutes with LCM.

Note1. Duty Measurement [Duty(%) = Ton / T x 100]



Note 2. There are not shut down and flicker at 10% @ 150Hz.

There is not shut down at 5% @ 75Hz.

Note 3. Measurement Method : Check Vs on BLU Remaining all Lamps.

5.4 LVDS Interface

	LVDS pin	Odd Data	Even Data
TxOUT/RxIN0	TxIN/RxOUT0	R0	R0
	TxIN/RxOUT1	R1	R1
	TxIN/RxOUT2	R2	R2
	TxIN/RxOUT3	R3	R3
	TxIN/RxOUT4	R4	R4
	TxIN/RxOUT6	R5	R5
	TxIN/RxOUT7	G0	G0
TxOUT/RxIN1	TxIN/RxOUT8	G1	G1
	TxIN/RxOUT9	G2	G2
	TxIN/RxOUT12	G3	G3
	TxIN/RxOUT13	G4	G4
	TxIN/RxOUT14	G5	G5
	TxIN/RxOUT15	B0	B0
	TxIN/RxOUT18	B1	B1
TxOUT/RxIN2	TxIN/RxOUT19	B2	B2
	TxIN/RxOUT20	B3	B3
	TxIN/RxOUT21	B4	B4
	TxIN/RxOUT22	B5	B5
	TxIN/RxOUT24	HSYNC	HSYNC
	TxIN/RxOUT25	VSYNC	VSYNC
	TxIN/RxOUT26	DEN	DEN
TxOUT/RxIN3	TxIN/RxOUT28	R6	R6
	TxIN/RxOUT29	R7	R7
	TxIN/RxOUT30	G6	G6
	TxIN/RxOUT31	G7	G7
	TxIN/RxOUT32	B6	B6
	TxIN/RxOUT33	B7	B7
	TxIN/RxOUT34	Reserved	Reserved
TxOUT/RxIN4	TxIN/RxOUT35	R8	R8
	TxIN/RxOUT36	R9	R9
	TxIN/RxOUT37	G8	G8
	TxIN/RxOUT38	G9	G9
	TxIN/RxOUT39	B8	B8
	TxIN/RxOUT40	B9	B9
	TxIN/RxOUT41	Reserved	Reserved

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

COLOR	DISPLAY (10bit)	DATA SIGNAL																														GRAY SCALE LEVEL
		RED										GREEN										BLUE										
		R0	R1	R2	R3	R4	R5	R6	R7	R8	R9	G0	G1	G2	G3	G4	G5	G6	G7	G8	G9	B0	B1	B2	B3	B4	B5	B6	B7	B8	B9	
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	-
	GREEN	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	-
	CYAN	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
	RED	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	MAGENTA	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	-
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	-
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
GRAY SCALE OF RED	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R0
	DARK ↑	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1
		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2
		:	:	:	:	:	:					:	:		:	:	:	:				:	:		:	:	:		:			R3~ R1020
		:	:	:	:	:	:					:	:		:	:	:	:				:	:		:	:	:		:			
	↓ LIGHT	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1021
		0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1022
	RED	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1023
GRAY SCALE OF GREEN	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G0
	DARK ↑	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G1
		0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G2
		:	:	:	:	:	:					:	:	:	:	:	:					:	:		:	:	:		:			G3~ G1020
		:	:	:	:	:	:					:	:	:	:	:	:					:	:		:	:	:		:			
	↓ LIGHT	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	G1021
		0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	G1022
	GREEN	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	G1023
GRAY SCALE OF BLUE	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B0
	DARK ↑	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	B1
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	B2
		:	:	:	:	:	:					:	:	:	:	:	:					:	:	:	:	:	:					B3~ B1020
		:	:	:	:	:	:					:	:	:	:	:	:					:	:	:	:	:	:					
	↓ LIGHT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	B1021
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	B1022
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	B1023

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)

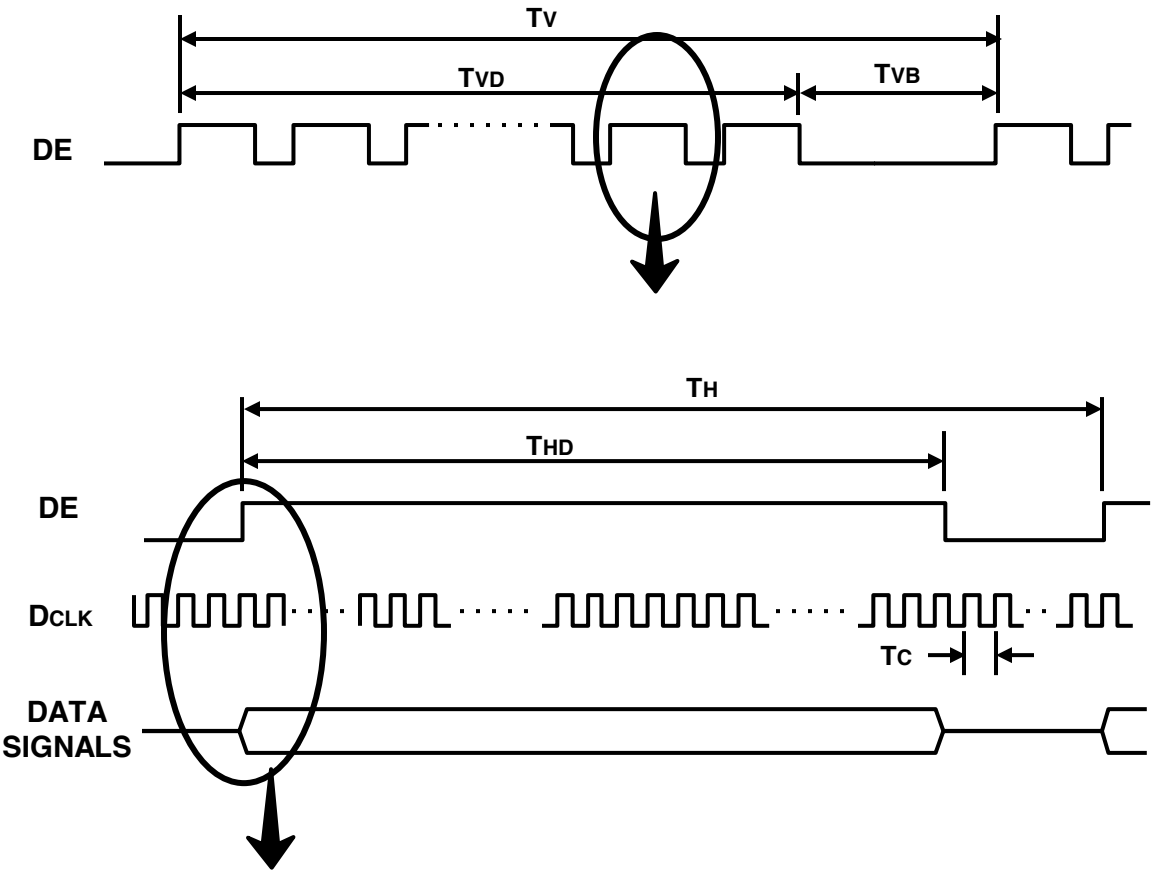
SIGNAL	ITEM	SYMBOL	MIN.	TYP.	MAX.	Unit	NOTE
Clock	Frequency	$1/T_C$	130	148.5	155	MHz	-
Hsync		F_H	50	67.5	73	KHz	-
Vsync		F_V	47	60	62	Hz	-
Vertical Display Term	Active Display Period	T_{VD}	1080	1080	1080	lines	-
	Vertical Total	T_{VB}	1100	1125	1480	Lines	-
Horizontal Display Term	Active Display Period	T_{HD}	1920	1920	1920	clocks	-
	Horizontal Total	T_H	2154	2200	2450	clocks	-

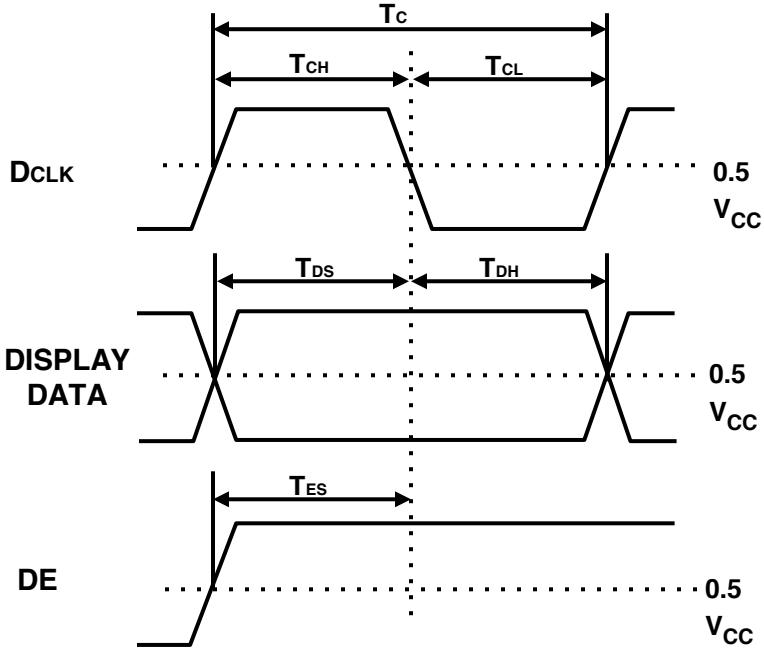
Note) This product is DE only mode. The input of Hsync & Vsync signal does not have an effect on normal operation.

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

(2) Internal V_{DD} = 3.3V

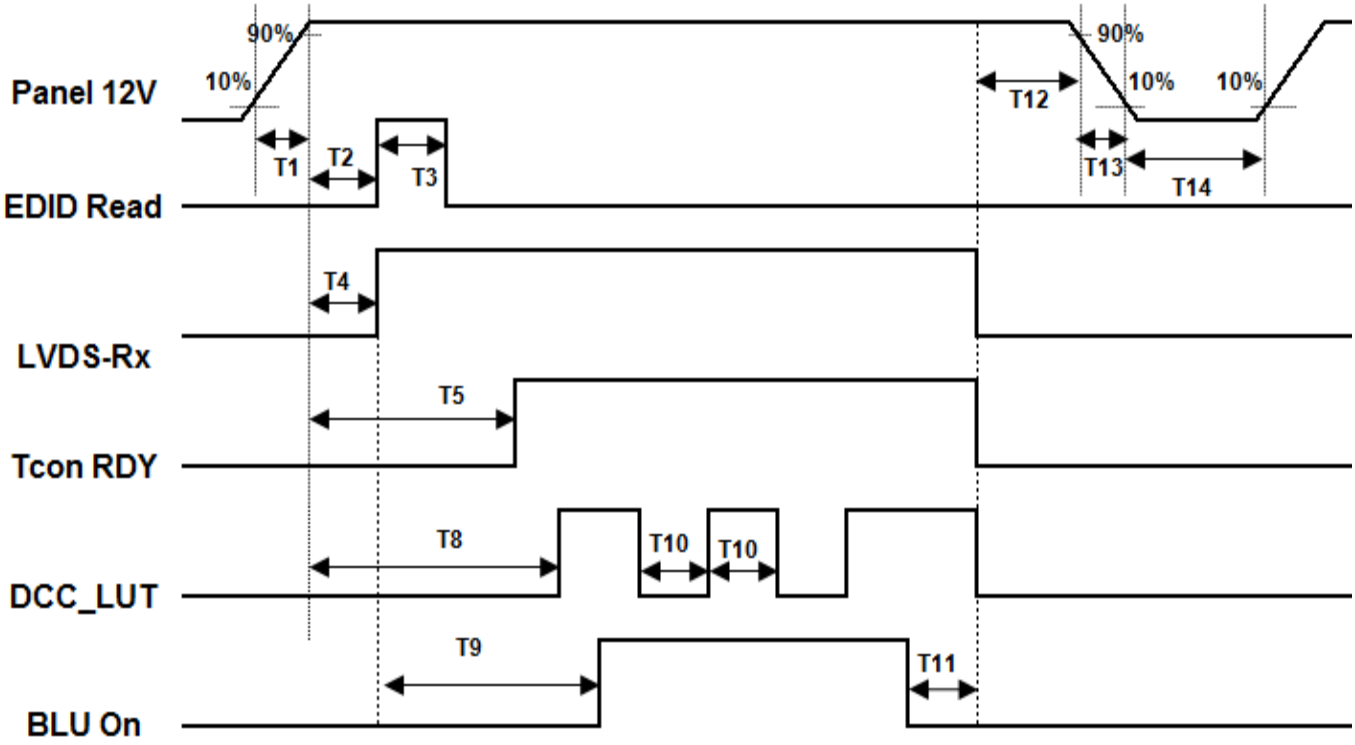
6.2 Timing diagrams of interface signal (DE only mode)





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.



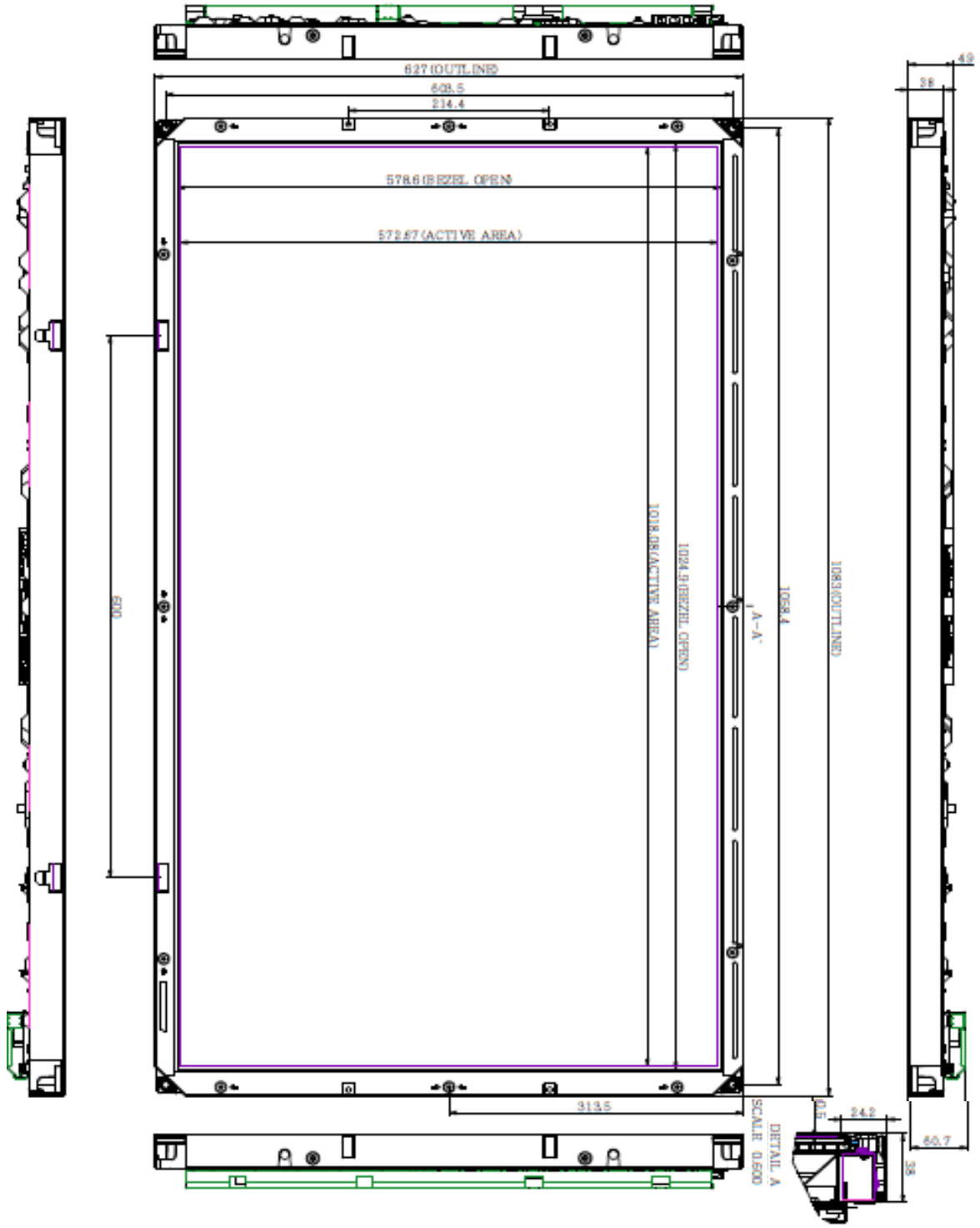
[UNIT : mS]

	Min	Max		Min	Max
T1	0.47	30	T9	570	-
T2	0	100	T10	50	-
T3	0	100	T11	100	-
T4	0.1	50	T12	0	50
T5	20	100	T13	0	300
T8	450	-	T14	1000	-

- **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.**
- **T14 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.**

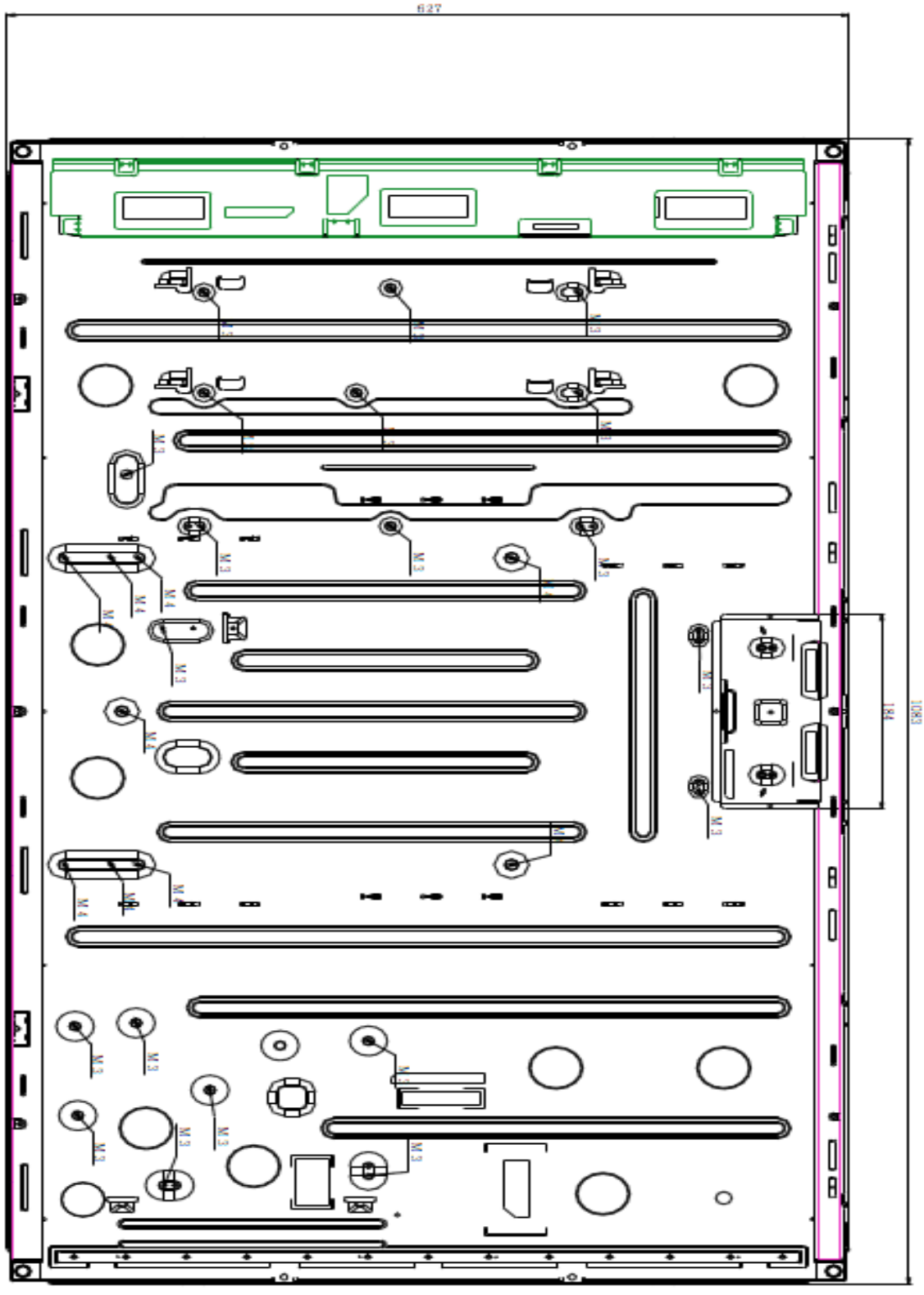
7. Outline Dimension

a. Front View



7. Outline Dimension

b. Rear View



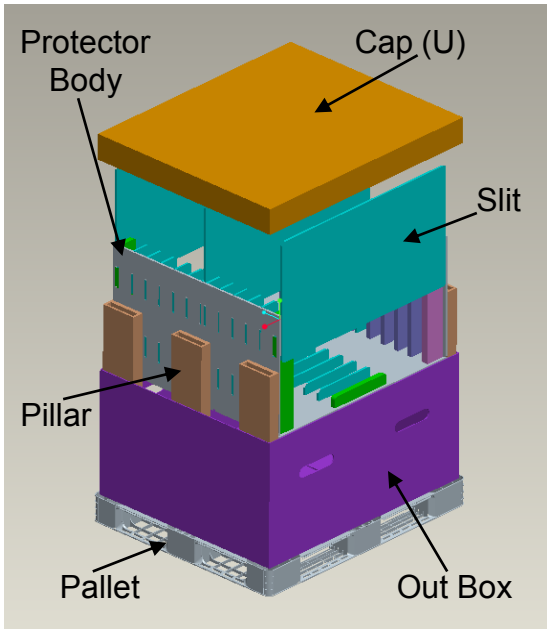
8. PACKING

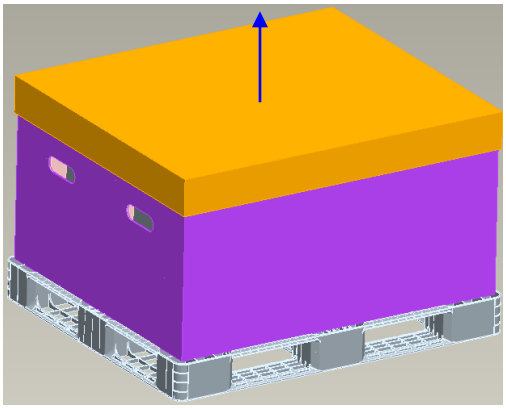
8.1 CARTON (Internal Package)

(1) Packing Form

Corrugated fiberboard box and corrugated cardboard as shock absorber

(2) Packing Method





Module (13EA)

→ Direction be able to Open

Pallet

8.2 Packing Specification

Item	Specification	Remark
LCD Packing	13 ea / (Packing-Pallet Box)	1. 156Kg/LCD(13ea) 2. 17kg/Packing SET 3. Packing Material : Paper
Desiccant (Drier)	3ea/LCD	10g/ea, Cobalt-dichloride-free
Pallet	1 Box / Pallet	Pallet weight : 8.8kg
Packing Direction	Vertical	-
Total Pallet Size	H x V x height	1275mm(H) x 1150mm(V) x 802mm(Height)
Total Pallet Weight	182.16kg	Pallet(8.8kg) + Module(12 x 13 = 156kg) + Packing SET(17kg) +Desiccant(0.03kg x 12 = 0.36kg)

9. MARKING & OTHERS

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

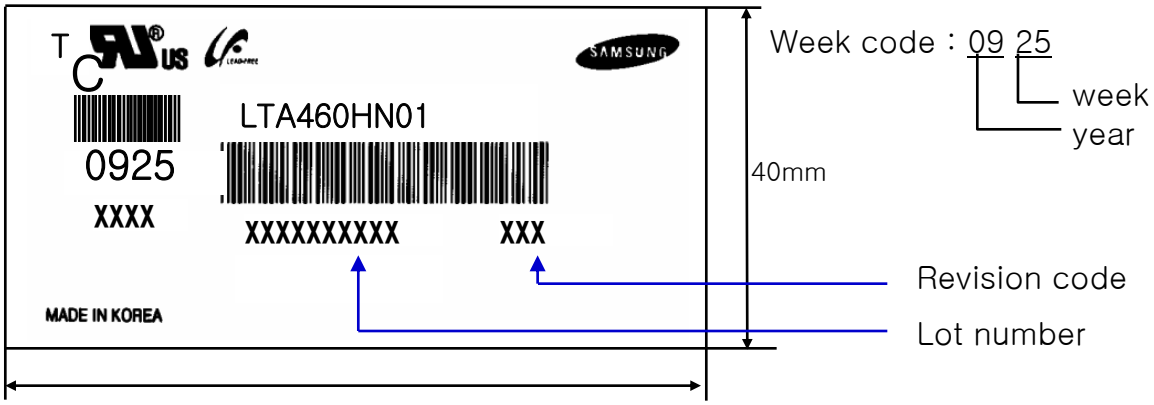
(1) Parts number :

(2) Revision: One letters

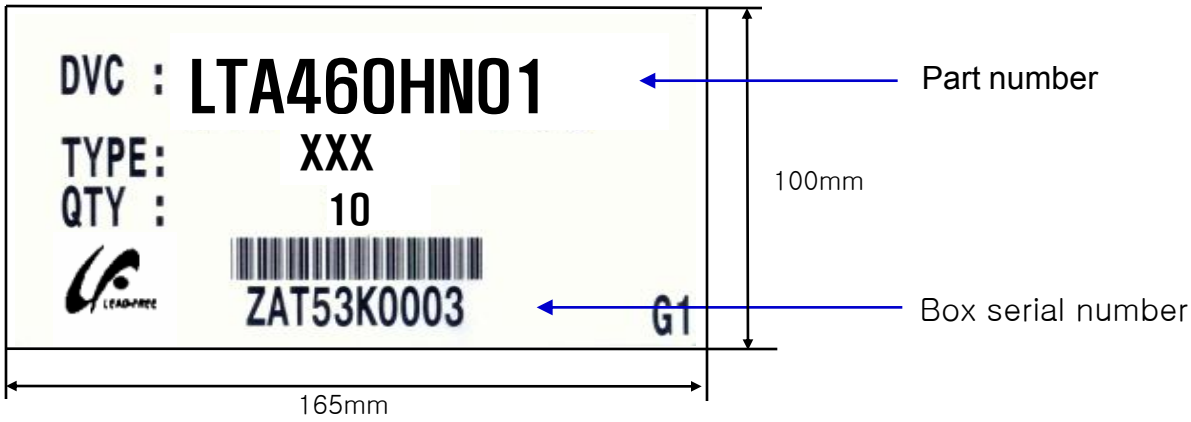
(3) Lot number : X X X X XXX XX X

- Cell Position No. (In the Glass)
- Glass No. (In the one Lot)
- Lot No. (Glass)
- Month
- Year (Note1)
- Product code
- Line

(4) Nameplate Indication



(5) Packing box attach



(6) Others

1. After service part

Lamps cannot be replaced because of the narrow bezel structure.

10. General Precautions

10.1 Handling

(a) When the Module is assembled, it should be attached to the system firmly using all mounting holes. Be careful not to twist and bend the Module.

(b) Because the inverter use high voltage, it should be disconnected from power before it is assembled or disassembled.

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

(d) Note that polarizers are very fragile and could be damage easily. Do not press or scratch the surface harder than a HB pencil lead.

(e) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, staining or discoloration may occur.

(f) If the surface of the polarizer is dirty, clean it using absorbent cotton or soft cloth.

(g) Desirable cleaners are water, IPA(Isopropyl Alcohol) or Hexane. Do not use Ketone type materials(ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.

(h) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth . In case of contact with hands, legs or clothes, it must be washed away with soap thoroughly.

(i) Protect the Module from static, or the CMOS Gate Array IC would be damaged.

(j) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.

(k) Do not disassemble the Module.

(l) Do not pull or fold the lamp wire.

(m) Do not adjust the variable resistor located on the Module.

(n) Protection film for polarizer on the Module should be slowly peeled off just before use so that the electrostatic charge can be minimized.

(o) Pins of I/F connector should not be touched directly with bare hands.

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 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.

10.3 Operation

(a) No Connection or disconnect the Module in the "Power On" condition.

(b) Power supply should always be turned on/off by the "Power on/off sequence"

(c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference should be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.

(d) The cable between the back light connector and its inverter power supply should be connected directly with a minimized length. A longer cable between the back light and the inverter may cause lower luminance of lamp(CCFT) and may require higher startup voltage(Vs).

10.4 Operation Condition Guide

(a) The LCD product should be operated under normal conditions.
Normal condition is defined as below;
- Temperature : 20±15℃
- Humidity : 55±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.

10.5 Others

(a) Ultra-violet ray filter is necessary for outdoor operation.

(b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.

(c) Do not exceed the absolute maximum rating value. (supply voltage variation, input voltage variation, variation in part contents and environmental temperature, and so on)
Otherwise the Module may be damaged.

(d) If the Module keeps displaying the same pattern for a long period of time, the image may be "sticked" to the screen.
To avoid image sticking, it is recommended to use a screen saver.

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

(f) Please contact SEC in advance when you display the same pattern for a long time.