



Approval

Customer : SONY

DATE : 07 Sep. 2007

SAMSUNG TFT-LCD

MODEL : LTY[Z]460HB01

Any Modification of Specification is not allowed without SEC's Permission.

NOTE :

Customer's Approval		APPROVAED BY <i>Gyusu Lee</i>	DATE 07 Sep,2007
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SAMSUNG TFT-LCD

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*** Revision History**

Date	Rev. No	Page	Summary
Sep. 07, 2007	000	-	First Issued

General Description

Description

LTY[Z]460HB01 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 1.07 billion colors with wide viewing angle of 89° or higher in all directions. This panel is intended to support applications to provide an 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)
- 1.07(True-10Bit) Color Support
- High contrast ratio, high aperture ratio, fast response time
- SPVA (Super Patterned Vertical Align) mode
- Wide viewing angle ($\pm 89^\circ$)
- High speed response
- Full HD(1920 x 1080 pixels) resolution (16:9)
- Low Power consumption
- 24 High color gamut CCFTs (Cold Cathode Fluorescent Tube)
- DE(Data Enable) mode
- Mini-LVDS (Mini Low Voltage Differential Signaling) interface

General Information

Items	Specification	Unit	Note
Module Size	1083.0(H _{TYP}) x 627.0(V _{TYP})	mm	±1.0mm
	57.1(D _{MAX})		
Weight	16000(Max)	g	
Pixel Pitch	0.53025(H) x 0.17675(W)*3	mm	
Active Display Area	1018.08(H) x 572.67(V)	mm	
Surface Treatment	DSL(R3H)		
Display Colors	1.07 billion(True-10Bit)	colors	
Number of Pixels	1920 x 1080	pixel	
Pixel Arrangement	RGB vertical stripe		
Display Mode	Normally Black		
Luminance of White	550	cd/m ²	Refer to Page 6

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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) $T_a = 25 \pm 2$ °C

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

a. 93.8 % RH Max. ($T_a \leq 40$ °C)

b. Maximum wet-bulb temperature at 40 °C or less. ($T_a \leq 40$ °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 $\pm X$, $\pm Y$, $\pm Z$ axis

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

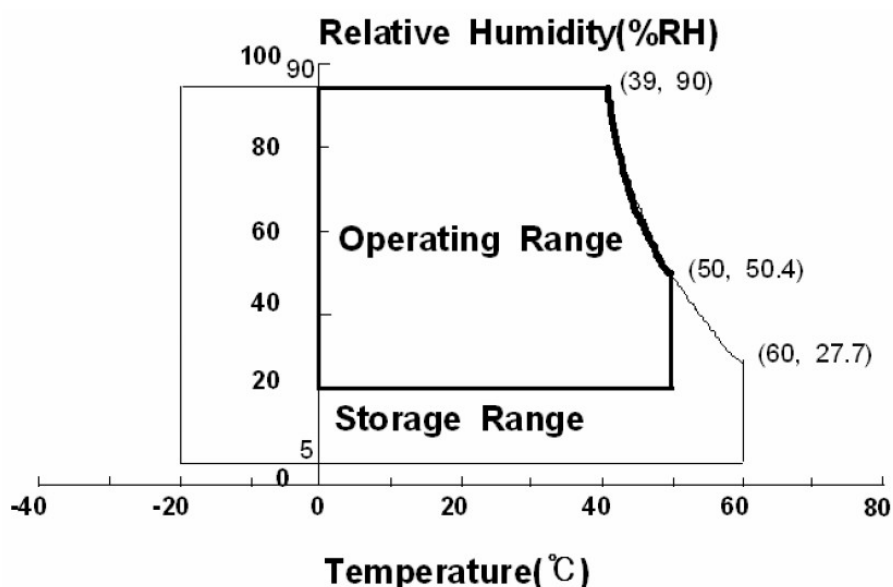


Fig. Temperature and Relative humidity range

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 = 90%)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio (Center of screen)		C/R	Normal θ _L , R = 0 θ _U , D = 0 Viewing Angle	(1000)*	1700	-		(3) SR-3
Response Time	Rising	Tr		-	10	16	msec	(5) BM-7
	Falling	Tf		-	6	10		
	G-to-G	Tg		-	8	-		
Luminance of White (Center of screen)		Y _L		450	550	-	cd/m ²	(6) SR-3
Color Chromaticity (CIE 1931)	Red	R _x		TYP. -0.03	(0.651)*	TYP. +0.03		(7),(8) SR-3
		R _y			(0.324)*			
	Green	G _x			(0.211)*			
		G _y			(0.662)*			
	Blue	B _x			(0.148)*			
		B _y			(0.059)*			
	White	W _x			(0.274)*			
		W _y			(0.274)*			
Color Gamut		-	-	90	-	%	(7) SR-3	
Color Temperature		-	-	(11800)*	-	K	(7) SR-3	
Gamma		γ	-	2.2	-			
Viewing Angle	Hor.	θ _L	C/R≥10	79	89	-	Degree	(8) SR-3
		θ _R		79	89	-		
	Ver.	θ _U		79	89	-		
		θ _D		79	89	-		
Brightness Uniformity (9 Points)		B _{uni}		-	-	23	%	(4) SR-3

* marked Items will be decided after taking data of early mass production.

Note (1) Test Equipment Setup

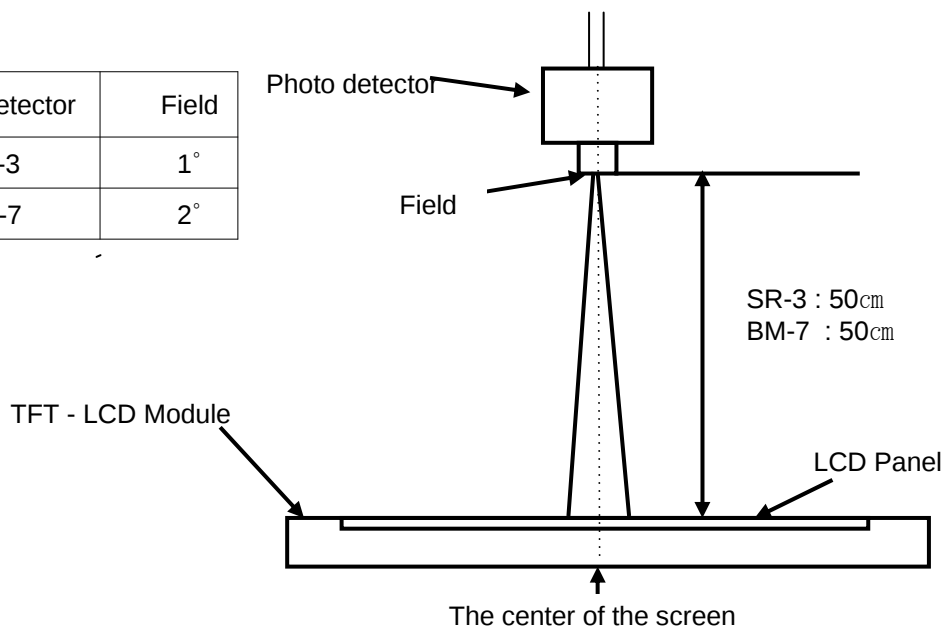
The measurement should be executed in a stable, windless and dark room between 40min and 60min after lighting the back light at the given temperature for stabilization of the back light. This should be measured in the center of screen.

Single lamp current @ I_L = 6.5mA_{rms}(typ.), Dim = 90%

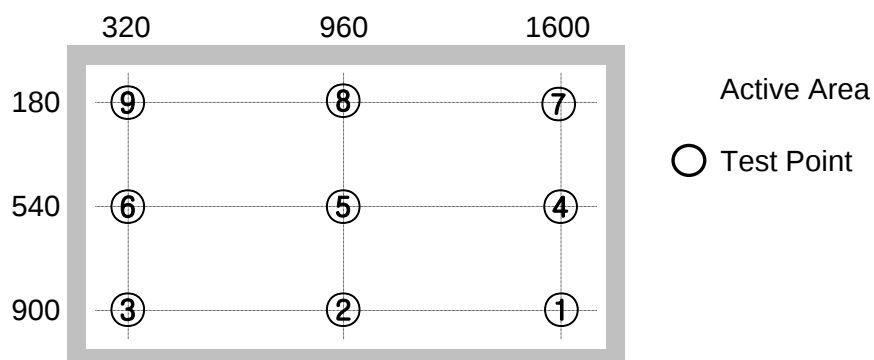
Environment condition : Ta = 25 ± 2 °C

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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

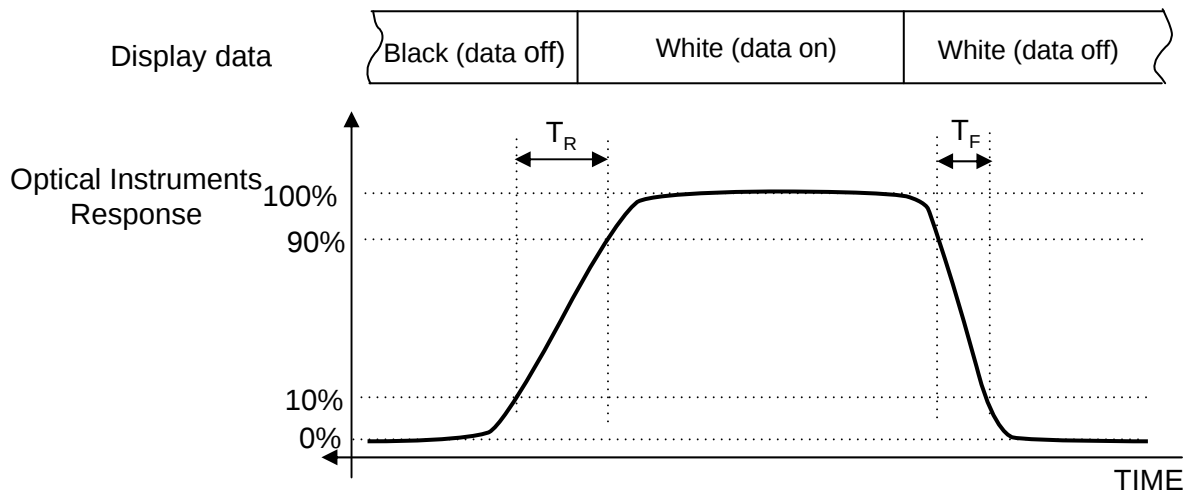
Note (4) Definition of 9 points brightness uniformity

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

Bmax : Maximum brightness

Bmin : Minimum brightness

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



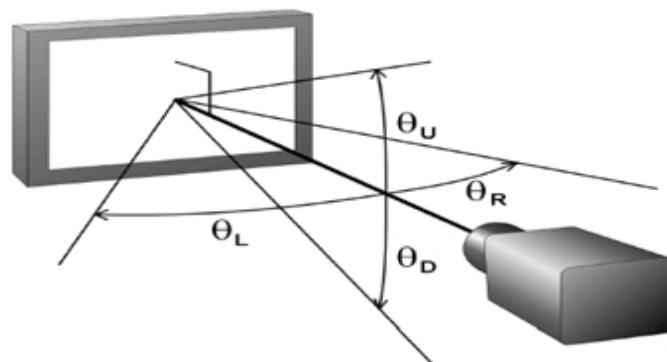
Note (6) Definition of Luminance of White : Luminance of white at center point ⑤

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 ($C/R \geq 10$)



3. Electrical Characteristics

3.1 TFT LCD Module

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

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

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}	-	800	-	mA	(2),(3)
	(b) White		-	1200	1300	mA	
	(c) Mosaic		-	1000	-	mA	
Vsync Frequency		f _V	47	60	63	Hz	
Hsync Frequency		f _H	50	67.5	75	kHz	
Main Frequency		f _{DCLK}	130	148.5	155	MHz	
Rush Current		I _{RUSH}	-	-	3	A	(4)

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

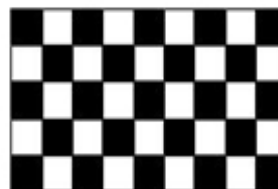
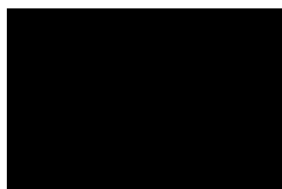
(2) $f_V=60\text{Hz}$, $f_{DCLK} = 148.5\text{MHz}$, $V_{DD} = 12.0\text{V}$, DC Current.

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

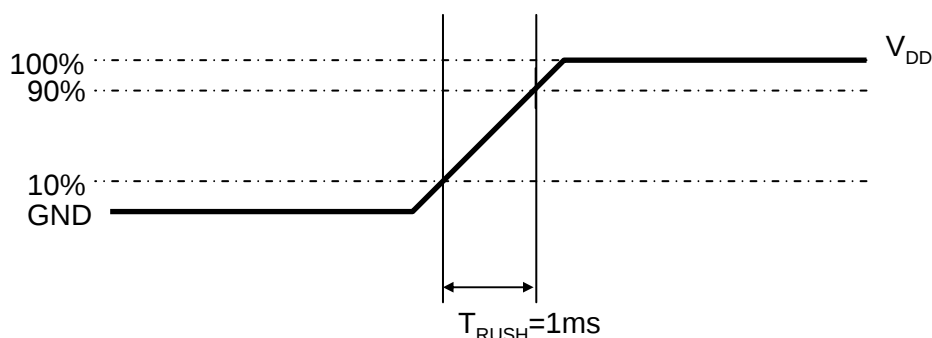
a) Black Pattern

b) White Pattern

c) Mosaic



(4) Measurement Conditions



Rush Current I_{RUSH} can be measured when T_{RUSH} is 1ms.

3.2 Back Light Unit

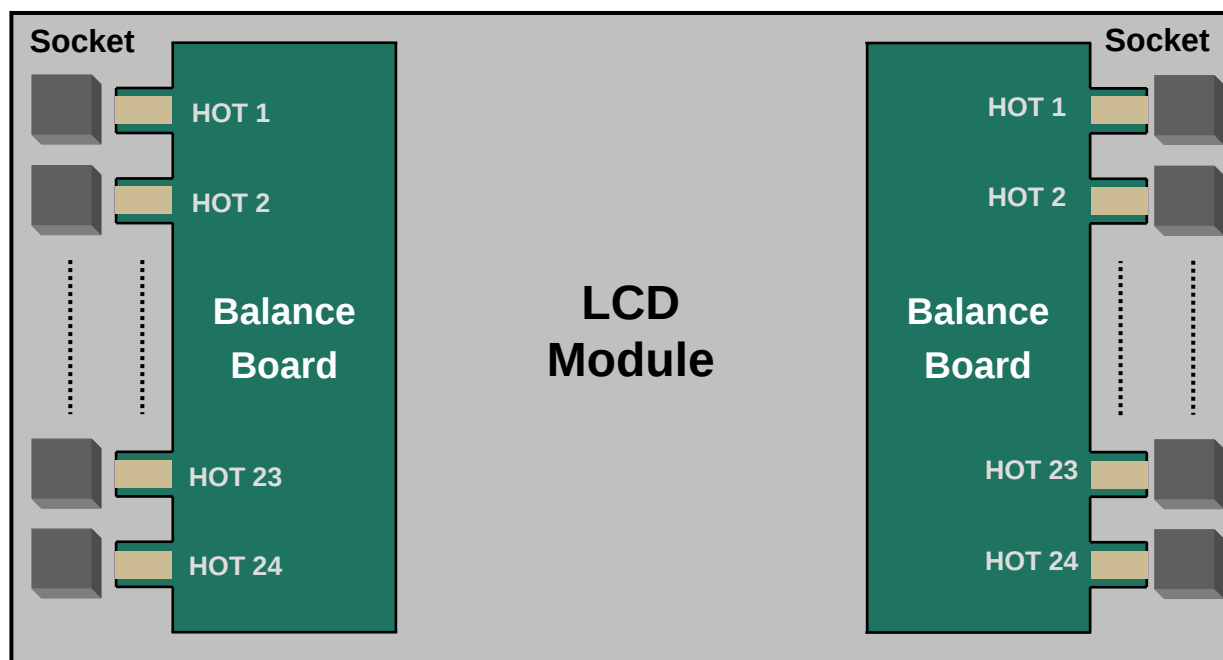
The back light unit contains 24 CCFTs (Cold Cathode Fluorescent Tube).
The characteristics of lamps are shown in the following tables.

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

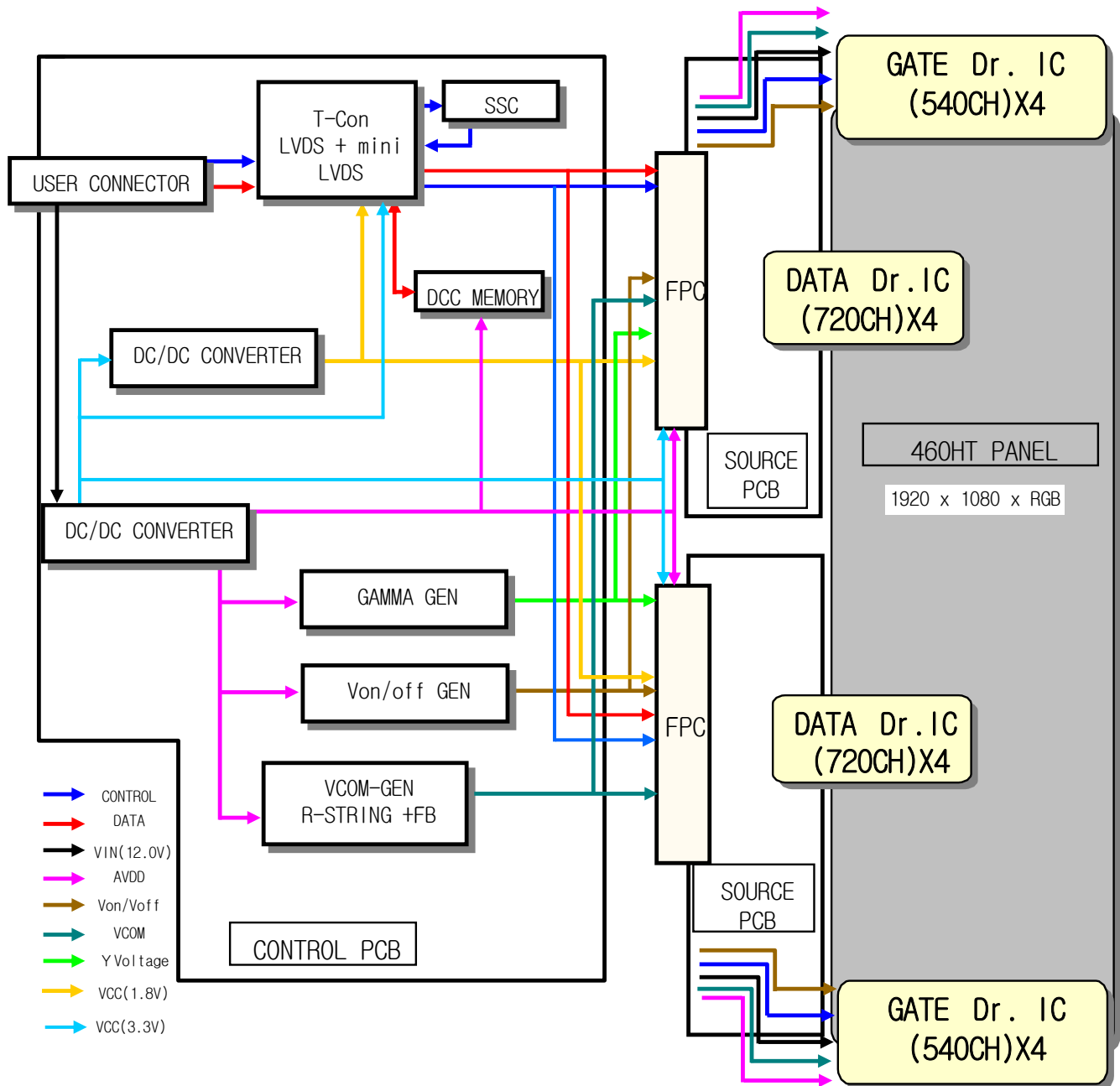
Item	Symbol	Min.	Typ.	Max.	Unit	Note
Operating Life Time	Hr	30,000	-	-	Hour	(1)

Note (1) It is defined as the time to take until the brightness reduces to 50% of its original value.

[Operating condition : $T_a = 25 \pm 2^\circ\text{C}$, $I_L = 6.5\text{mA rms (typ.)}$, For single lamp only.]



4. Block Diagram



5. Input Terminal Pin Assignment

5.1. Input Signal & Power

Connector : FI_R51S_HF (JAE)

PIN No.	Signal	Description	PIN No.	Signal	Description
1	Power	V_{DD}	26	RE[0]P	Even LVDS Signal +
2	Power	V_{DD}	27	RE[1]N	Even LVDS Signal -
3	Power	V_{DD}	28	RE[1]P	Even LVDS Signal +
4	Power	V_{DD}	29	RE[2]N	Even LVDS Signal -
5	Power	V_{DD}	30	RE[2]P	Even LVDS Signal +
6	N.C.	N.C.	31	GND	GND
7	GND	GND	32	RECLK-	Even LVDS Clock-
8	GND	GND	33	RECLK+	Even LVDS Clock+
9	GND	GND	34	GND	GND
10	RO[0]N	Odd LVDS Signal -	35	RE[3]N	Even LVDS Signal -
11	RO[0]P	Odd LVDS Signal +	36	RE[3]P	Even LVDS Signal +
12	RO[1]N	Odd LVDS Signal -	37	RE[4]N	Even LVDS Signal -
13	RO[1]P	Odd LVDS Signal +	38	RE[4]P	Even LVDS Signal +
14	RO[2]N	Odd LVDS Signal -	39	GND	GND
15	RO[2]P	Odd LVDS Signal +	40	SCL	I2C SCL
16	GND	GND	41	SDA	I2C SDA
17	ROCLK-	Odd LVDS CLK -	42	N.C	N.C.
18	ROCLK+	Odd LVDS CLK +	43	B-INT	Bus Release
19	GND	GND	44	ACC SEL	ACC On/Off
20	RO[3]N	Odd LVDS Signal -	45	N.C	N.C.
21	RO[3]P	Odd LVDS Signal +	46	DCC SEL	DCC Select Bit
22	RO[4]N	Odd LVDS Signal -	47	LUT SEL0	DCC Look-up Table Select
23	RO[4]P	Odd LVDS Signal +	48	LUT SEL1	
24	GND	GND	49	LUT SEL2	
25	RE[0]N	Even LVDS Signal -	50	T-Con Ready	T-Con Ready Check
			51	SEL1	SEC Internal Use Only

■ ACC SEL - HIGH : ACC OFF LOW/OPEN : ACC ON

■ B-INT : I2C BUS RELEASE

L/OPEN	SDA/SCL LINE BECOME HI-Z
H	USER CAN ACCESS EEPROM

■ DCC SELECTION

Select Bit	L/OPEN	DCC 1.5 On
	H	DCC 1.5 Off

■ DCC Look Up Table Selection

Pin N.O.	49	48	47	Description
Select bit	0	0	0	-
	0	0	1	60Hz*175%
	0	1	0	-
	0	1	1	60Hz*50%
	1	0	0	-
	1	0	1	50Hz*175%
	1	1	0	-
	1	1	1	50Hz*50%

■ TCON Ready

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

Note(1) Pin number starts from Right side

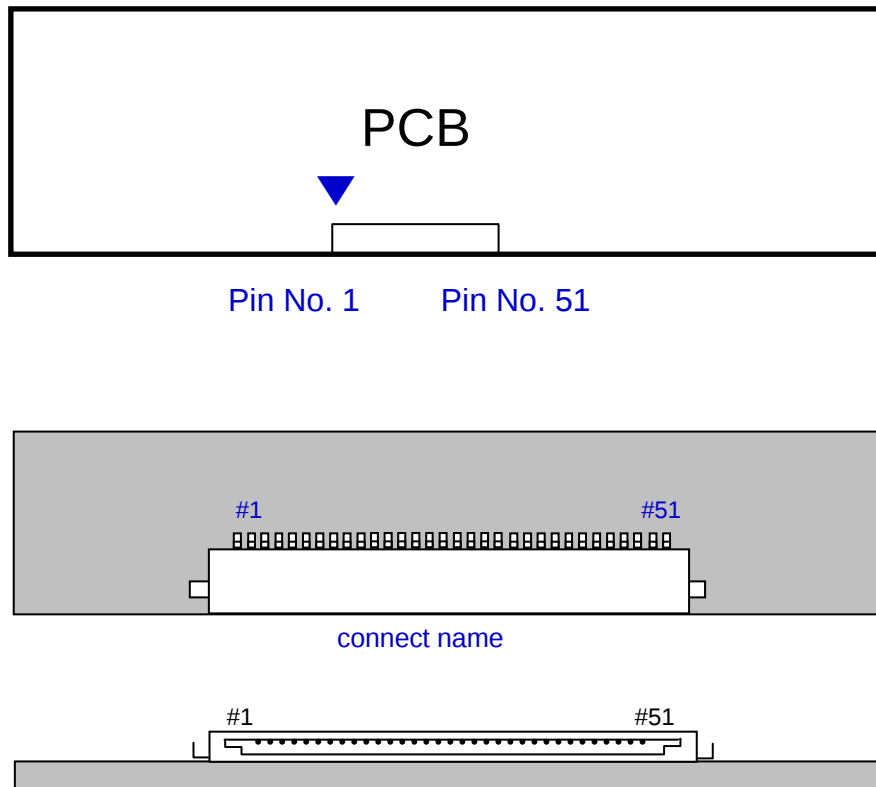


Fig. Connector diagram

- 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. Balance Board

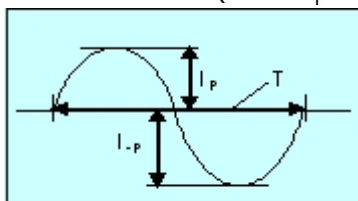
5.2.1 Recommended Operation Condition

Item	Symbol	Recommendation			Unit	Note	Remark
		Min.	Typ.	Max.			
Inverter Frequency	F_{OP}	53	55	62	kHz		Switching Frequency
Dimming Frequency	F_{DIM}	150	160	170	Hz		
Dim Duty Ratio	D_{PWM}	20	-	100	%		Bright Control
Striking Voltage	HV_{STRIKE}	4200	-	-	Vrms	(1)	

Note

Asymmetric ratio of Total Input Current must be less than 10 % ($|I_P - I_{-P}| / (I_{rms@T} < 0.1)$)

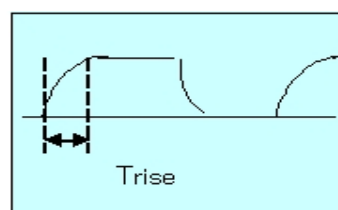
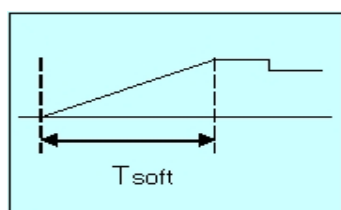
Crest factor must be from 90 % to 110 % ($0.9 < I_P / I_{rms@T/2 \times \sqrt{2}} < 1.1$)



(1) Striking Voltage (HV_{STRIKE}) based on CCFL spec. for ambient temperature.

Soft rising time must be

- at starting time $T_{soft} > 300\text{msec}$
- at PWM dimming condition $T_{rise} < 100\text{usec}$



5.2.2 Balance Board Input Pin Configuration

1. HV Input Connector : MD51SU-2P-13V(Hirose)

PIN NO.	SYMBOL	REMARK
1	HV1	Power Supply for CCFL
2	HV2	Power Supply for CCFL

2. Feed Back Interface : KN30-7P-1.25H(Hirose)

PIN NO.	SYMBOL	REMARK
1	Vcc	12V
2	FB	Feed Back
3	GND	GND
4,5,6,7	LD	Lamp Detection

3. HV Input Connector : BM03-XASS-TF(LF)(SN)(JST)

PIN NO.	SYMBOL	REMARK
1	HV1	Power Supply for CCFL
2	NC	NC
3	HV1	Power Supply for CCFL

4. HV Input Connector : BM04B-XASS-TF(LF)(SN)(JST)

PIN NO.	SYMBOL	REMARK
1	HV2	Power Supply for CCFL
2	NC	NC
3	HV2	Power Supply for CCFL
4	NC	NC

5. Left Right Interface Connector : KN30-10P-1.25H (Hirose)

PIN NO.		SYMBOL	REMARK
Left	Right		
10,9	1,2	GND	Ground
8,7	3,4	VCC	12V
6,5,	5,6	PROT	Protect Interface
4,3,2,1	7,8,9,10	LOOP	JIN Coil Loop

5.2.3 Feedback I/O Specification

ITEM		SYMBOL	Recommendation			UNIT	REMARKS
			Min.	Typ.	Max.		
Supply Voltage		V_{CC}	11	12	15	V	Lamp
Input current Of Vcc		I_{OC}	-	-	20	mA	at Recommended Load Condition
Lamp Detection	High (Normal)	V_{LD}	$V_{CC}-1$	-	-	V	@Vcc = 12 [V]
	Low (LD)		-	-	1		

5.3 LVDS Interface

	LVDS pin	Odd Data	Even Data
TxOUT/RxIN0	TxIN/RxOUT0	R4	R4
	TxIN/RxOUT1	R5	R5
	TxIN/RxOUT2	R6	R6
	TxIN/RxOUT3	R7	R7
	TxIN/RxOUT4	R8	R8
	TxIN/RxOUT6	R9	R9
	TxIN/RxOUT7	G4	G4
TxOUT/RxIN1	TxIN/RxOUT8	G5	G5
	TxIN/RxOUT9	G6	G6
	TxIN/RxOUT12	G7	G7
	TxIN/RxOUT13	G8	G8
	TxIN/RxOUT14	G9	G9
	TxIN/RxOUT15	B4	B4
	TxIN/RxOUT18	B5	B5
TxOUT/RxIN2	TxIN/RxOUT19	B6	B6
	TxIN/RxOUT20	B7	B7
	TxIN/RxOUT21	B8	B8
	TxIN/RxOUT22	B9	B9
	TxIN/RxOUT24	HSYNC	HSYNC
	TxIN/RxOUT25	VSYNC	VSYNC
	TxIN/RxOUT26	DEN	DEN
TxOUT/RxIN3	TxIN/RxOUT27	R2	R2
	TxIN/RxOUT5	R3	R3
	TxIN/RxOUT10	G2	G2
	TxIN/RxOUT11	G3	G3
	TxIN/RxOUT16	B2	B2
	TxIN/RxOUT17	B3	B3
	TxIN/RxOUT23	RESERVED	RESERVED
TxOUT/RxIN4	TxIN/RxOUT28	R0	R0
	TxIN/RxOUT29	R1	R1
	TxIN/RxOUT30	G0	G0
	TxIN/RxOUT31	G1	G1
	TxIN/RxOUT32	B0	B0
	TxIN/RxOUT33	B1	B1
	TxIN/RxOUT34	RESERVED	RESERVED

5.4 Input Signals, 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	R8	R9	G0	G1	G2	G3	G4	G5	G6	G7	G8	G9	B0	B1	B2	B3	B4	B5	B6		B7	B8
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	-
	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	-
	GREEN	0	0	0	0	0	0	0	0	0	1	1	1	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	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	1	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	-
	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	-
	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	-
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	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	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	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	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	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	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	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	G1
		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	G1021
		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	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	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	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	B1	
		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	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	B1021
		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	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	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

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6. Interface Timing

6.1 Timing Parameters (DE only mode)

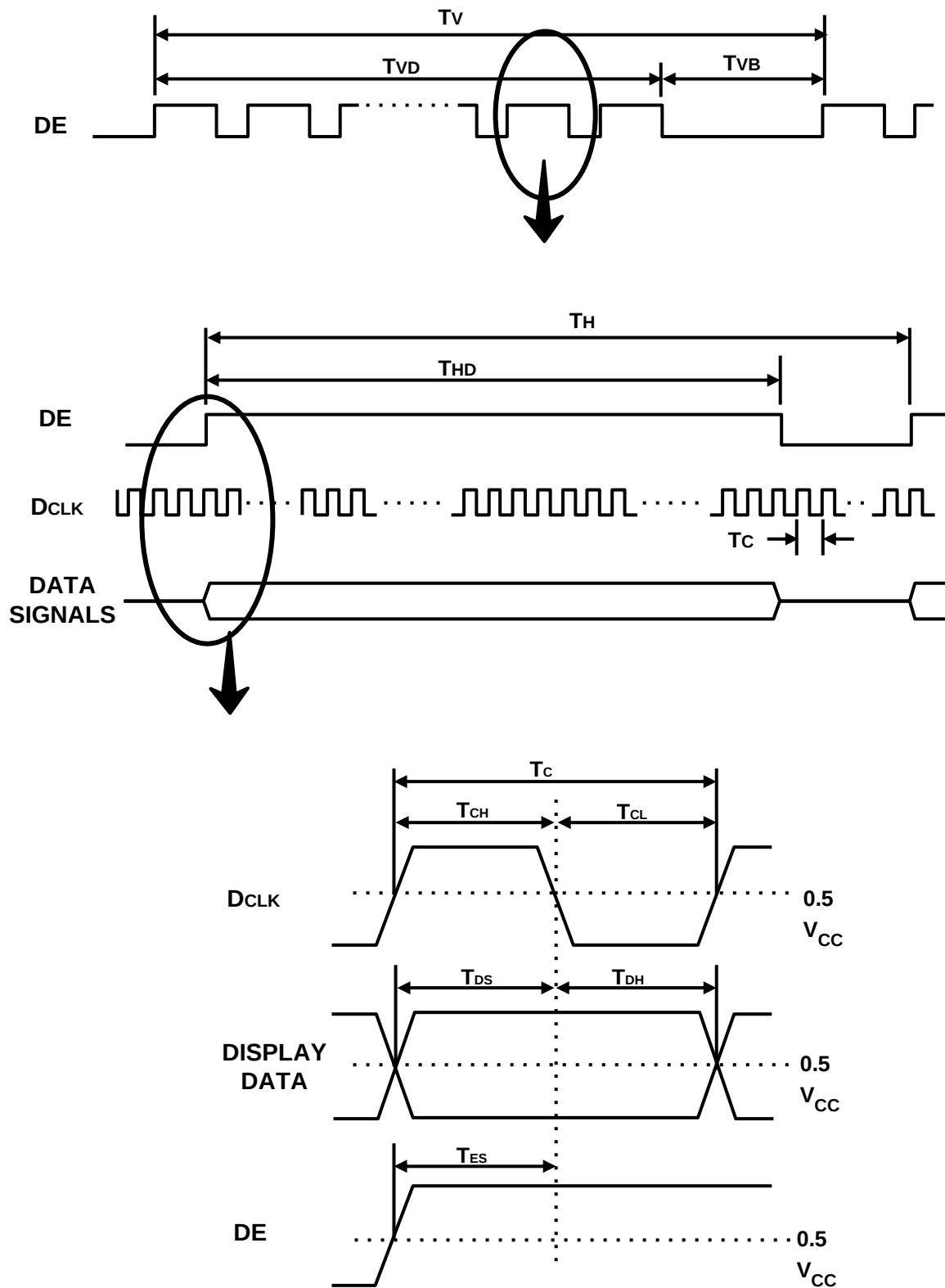
SIGNAL	ITEM	SYMBOL	MIN.	TYP.	MAX.	Unit	NOTE
Clock	Frequency	$1/T_C$	130	148.5	155	MHz	-
Hsync		F_H	50	67.5	75	KHz	-
Vsync		F_V	47	60	63	Hz	-
Vertical Display Term	Active Display Period	T_{VD}	-	1080	-	lines	-
	Vertical Total	T_{VB}	1100	1125	1480	Lines	-
Horizontal Display Term	Active Display Period	T_{HD}	-	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

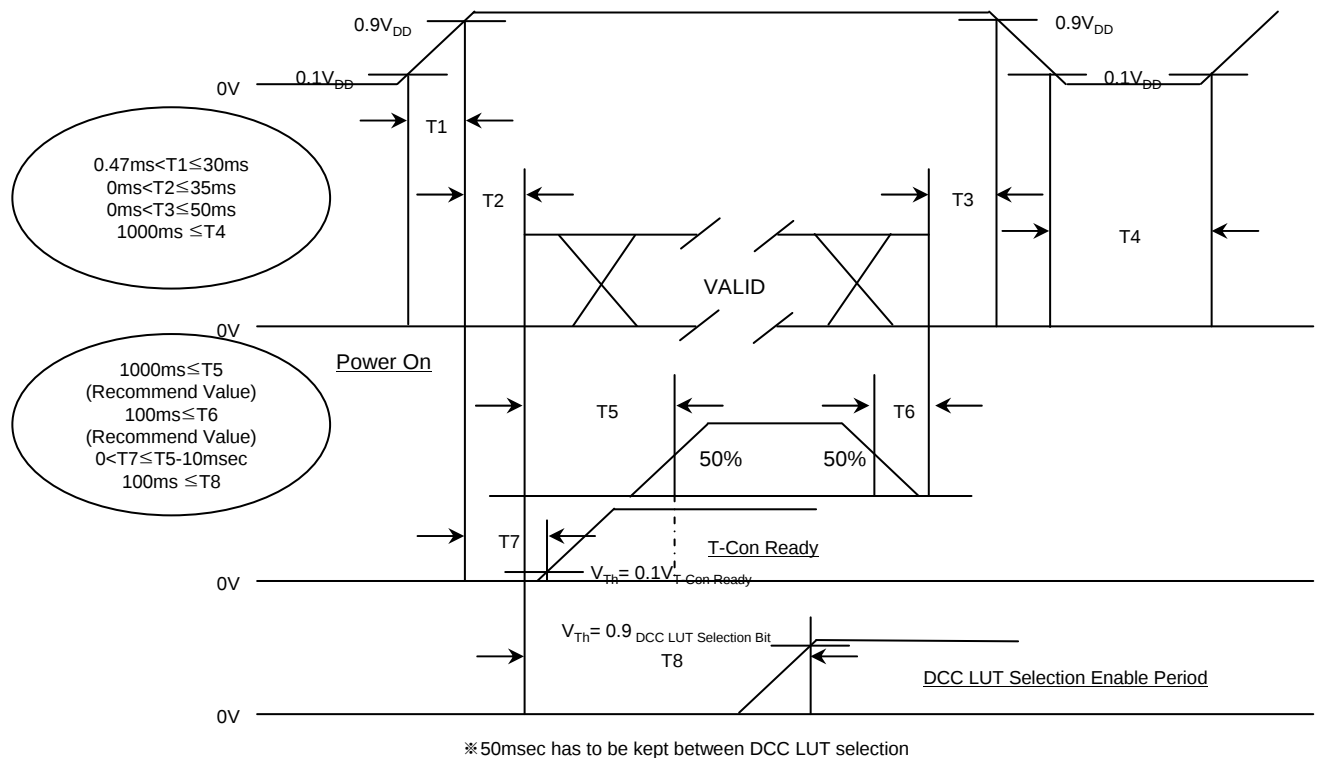
(2) Internal $V_{DD} = 3.3V$

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.



T1: V_{DD} rising time from 10% to 90%

T2: The Time from V_{DD} to data at power On.

T3: The time from valid data off to V_{DD} off at power off.

T4: V_{DD} off time for TV SET restart

T5: The time from valid data to B/L enable at power ON.

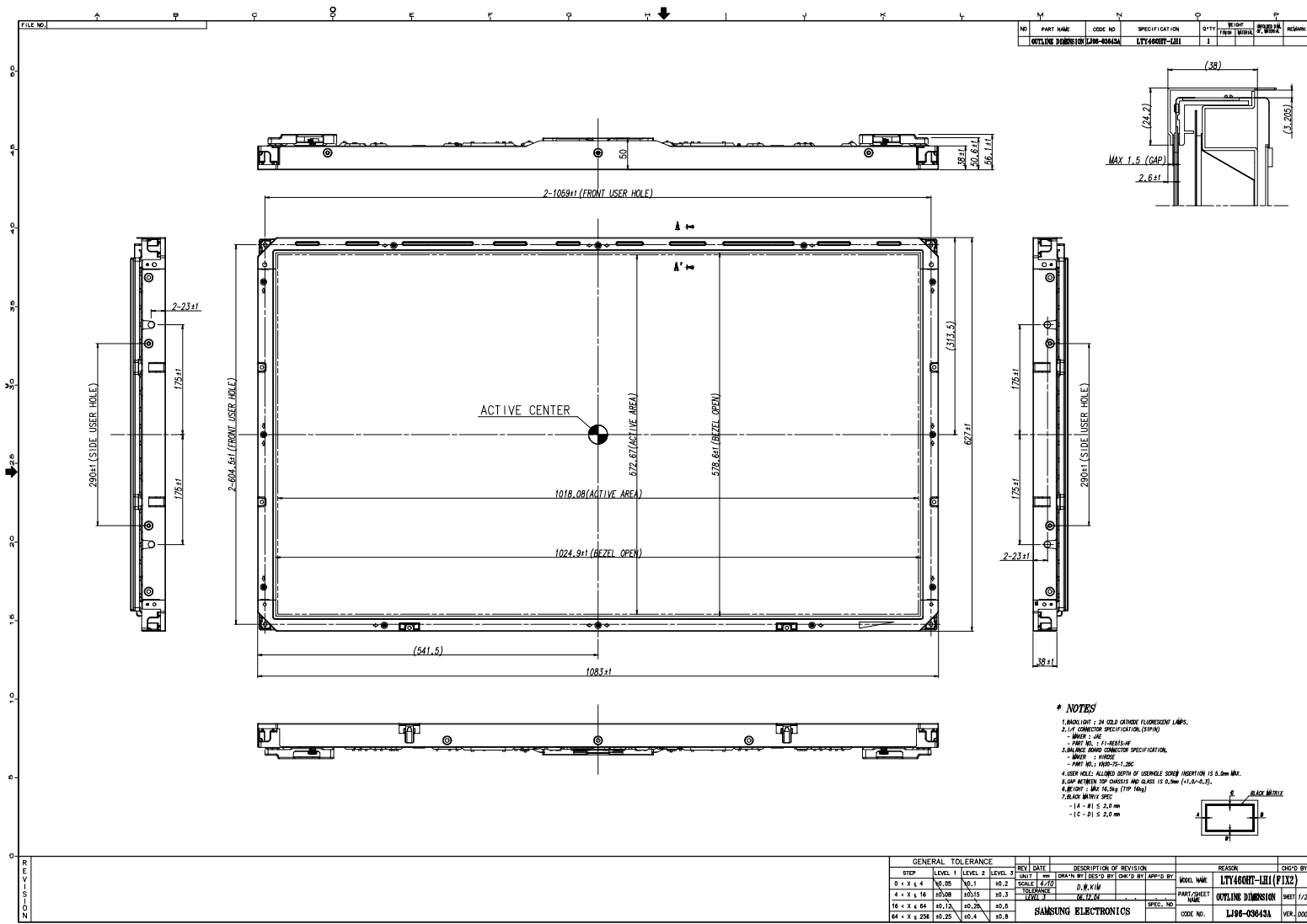
T6: The time from valid data off to B/L disable at power off.

T7: The time from Vin to T-Con Ready

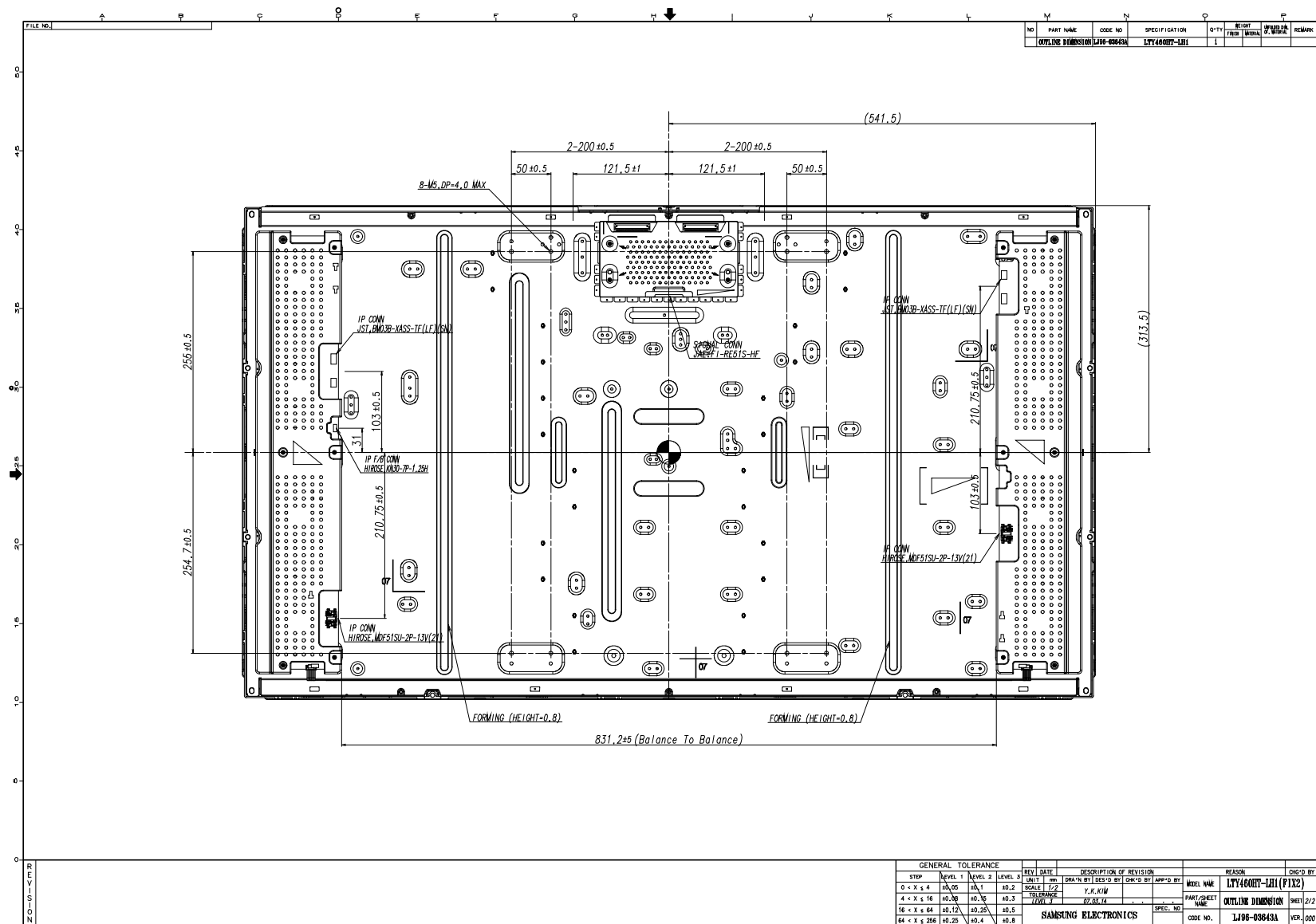
T8 : The Time from Valid Data to DCC LUT Selection Enable Period.

- 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 $V_{DD} = \text{off level}$, 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.

7. Outline dimension (Front view)



Outline dimension (Rear View)



8. EMI Recommendation

: -3dB at CISPR22 Class B

This EMI Recommendation is recommended to be measured at SET Condition.

9. Input Spread Spectrum Specification

	Modulation Rate (Max.)	Modulation Frequency (Min.)	Modulation Frequency (Max.)
Input Signal	$\pm 1.2\%$	50KHz	200Khz

10. UL Approval

11. Reliability Test

Item	Test condition	Quantity
Temperature Step Stress	0 ~ 50℃, 10Cycle determination	4EA
HTOL	50℃, 1000hr (500hr determination)	8EA
LTOL	0℃, 1000hr (500hr determination)	4EA
RTOL	20℃, continue ~	4EA
HTS	60℃, 1000hr (500hr determination)	4EA
LTS	-30℃, 1000hr (500hr determination)	4EA
THB	40℃ / 95%RH, 1000hr (500hr determination)	4EA
WHTS	60℃ / 75%RH, 1000hr (500hr determination)	4EA
T/C	-20℃ ~ 60℃, 200cycle (100cycle determination)	4EA
ESD(operation)	contact : ± 8 kV, 150pF/330Ω, 210Point, 1 time/Point non-contact : ± 15 kV, 150pF/330Ω, 100Point, 1 time/Point	3EA
POWER ON/OFF	30sec (on) / 30sec(off) : 12,000 times	4EA
Vibration	10~300Hz/1.5G/10minSR, XYZ, 30min/axis	3EA
Shock	SEC condition : 11msec, ±XY 1time/axis 40G 11msec, ±Z 1time/axis 30G	3EA
PALLET Vibration	1.146 Grms, 2~200Hz, Random, Z axis 1Hr	1PALLET(10EA)
PALLET Drop	20cm, Bottom, Front, Rear 1times	1PALLET(10EA)

[Result Evaluation Criteria]

Under the display quality test conditions with normal operation state, these shall be no change which may affect practical display function.

HTOL/ LTOL : High/Low Temperature Operating Life,
 THB : Temperature Humidity Bias
 HTS/LTS : High/Low Temperature Storage
 WHTS : Wet High Temperature Storage

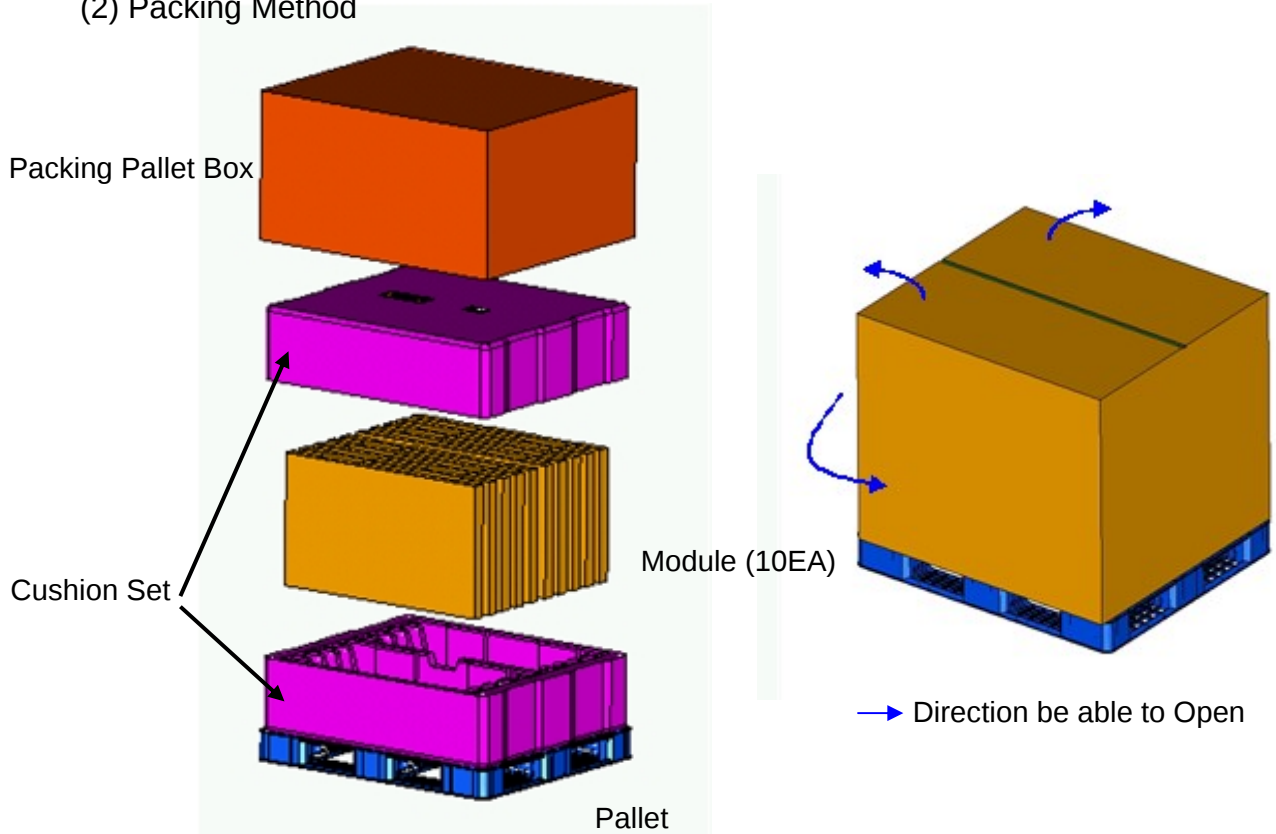
12. PACKING

12.1 CARTON (Internal Package)

(1) Packing Form

Corrugated fiberboard box and corrugated cardboard as shock absorber

(2) Packing Method



12.2 Packing Specification

Item	Specification	Remark
LCD Packing	10 ea / (Packing-Pallet Box)	1. 160Kg/LCD(10ea) 2. 10kg/Cushion Set(2ea) 3. 8kg/Packing-Pallet Box(1ea) 4. Cushion Material : EPS 5. Packing Pallet Box Material : DW4
Pallet	1 Box / Pallet	Pallet weight : 8.8kg
Packing Direction	Vertical	-
Total Pallet Size	H x V x height	1270mm(H) x 1150mm(V) x 884mm(Height)
Total Pallet Weight	186.8 kg	Pallet(8.8kg) + Module(16 x 10 = 160kg) + Cushion(10kg) + Pallet-BOX(8kg)

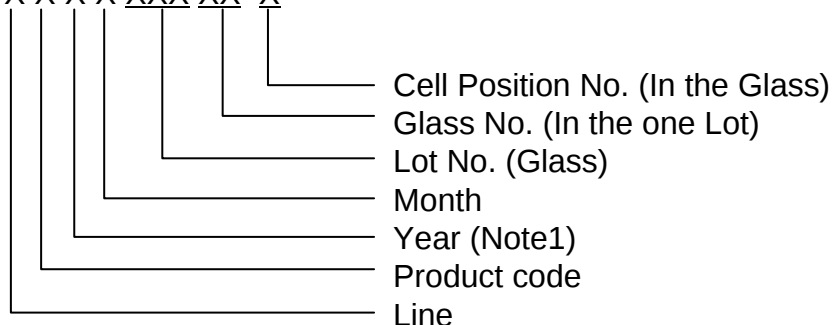
13. MARKING & OTHERS

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

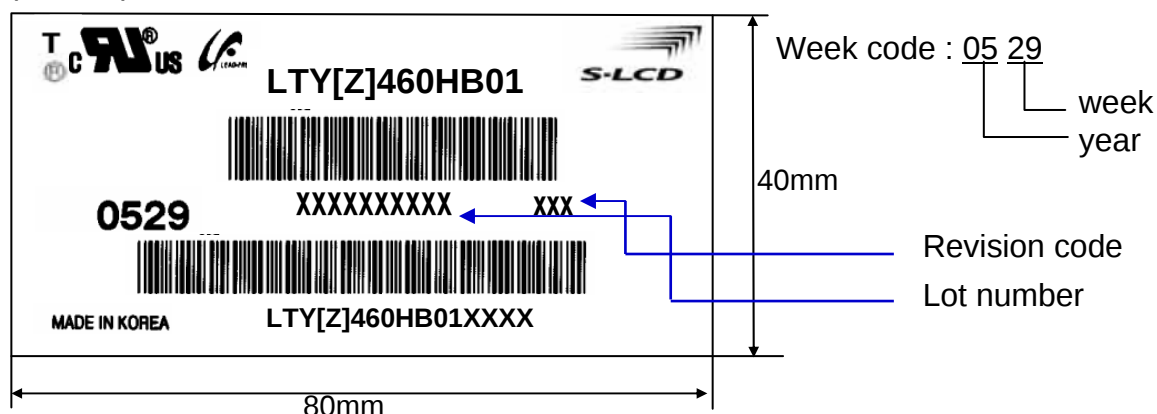
(1) Parts number : LTY[Z]460HB01-XXXX

(2) Revision: One letters

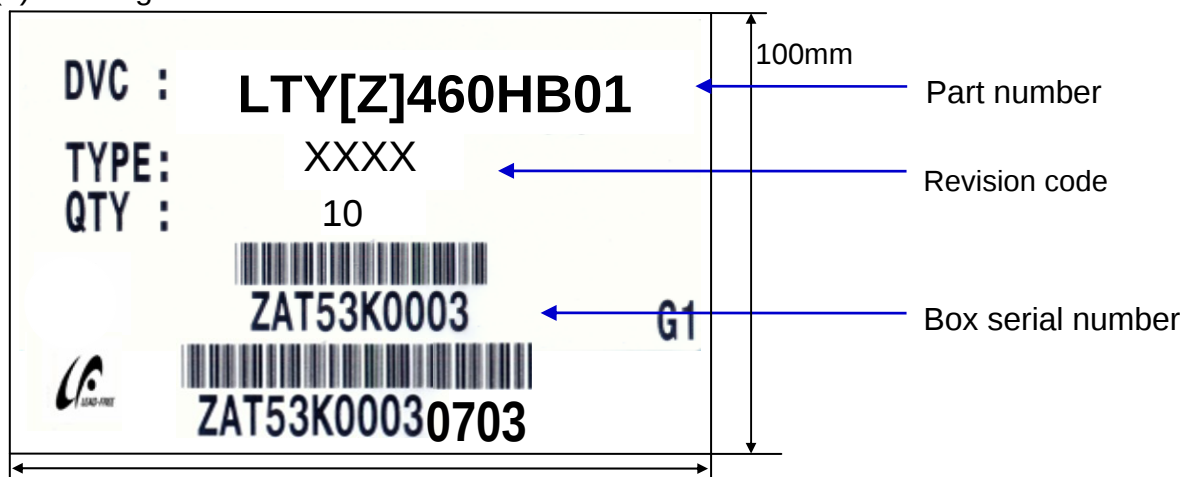
(3) Lot number : X X X X XXX XX X



(4) Nameplate Indication



(5) Packing box attach



(6) Others

1. After service part

Lamps cannot be replaced because of the narrow bezel structure.

14. General Precautions

14.1 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 adjust the variable resistor located on the Module.
- (m) Protection film for polarizer on the Module should be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (n) Pins of I/F connector should not be touched directly with bare hands.

14.2 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.

14.3 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).

14.4 Operation Condition Guide

- (a) The LCD product should be operated under normal conditions.
Normal condition is defined as below;
 - Temperature : $20 \pm 15^{\circ}\text{C}$
 - Humidity : $55 \pm 20\%$
 - Display pattern : continually changing pattern (Not stationary)
- (b) If the product will be used in extreme conditions such as high temperature, humidity, display patterns or operation time etc., It is strongly recommended to contact SEC for Application engineering advice. Otherwise, its reliability and function may not be guaranteed. Extreme conditions are commonly found at Airports, Transit Stations, Banks, Stock market, and Controlling systems.

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14.5 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.