SAMSUNG TFT-LCD

MODEL: LTA550HJ15-X

The Information described in this specification is for the first draft and can be changed without prior notice.

Samsung Display Co., LTD

Contents

General Description

Description

LTA550HJ15-0 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. This 55.0” model has a resolution of 1920 x1080 pixels (16:9) can display up to 1.07Billion colors with the wide viewing angle of 89° or higher in all directions. This panel is intended to support applications by providing an excellent performance for the display products with a flat panel such as Home-alone Multimedia TFT-LCD TV and a High Definition TV.

General Information

- High contrast ratio & aperture ratio with the wide color gamut
- SPVA(Patterned Vertical Align) mode
- Wide viewing angle (±178°)
- High speed response (with DCC circuit)
- Wide UXGA (1,920 x 1,080 pixels, 16:9)
- Edge LED (Light Emitted Diode) BLU
- 2D : 2ch LVDS 10bit Input interface
  3D : 2ch LVDS 10bit Input interface
- The interface (2pixel/clock) of LVDS serial interface

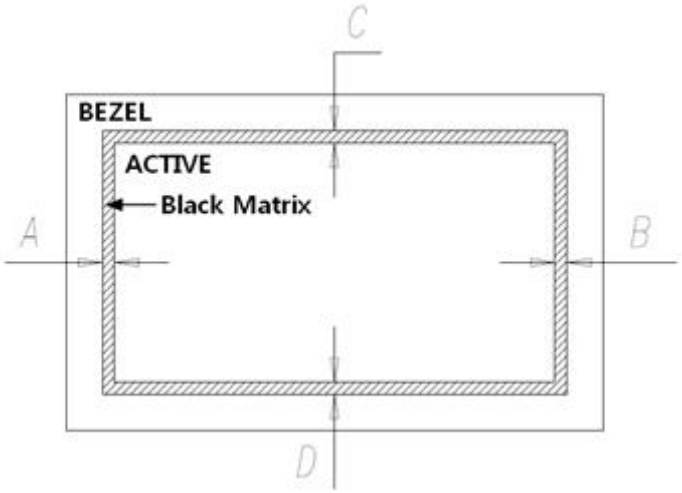
Items	Specification	Unit	Note
Module Size	1238.4(H) x 712.3(V)	mm	Max
	17.1(D)	mm	Max
Weight	17000	g	Typ
Pixel Pitch	0.210 x 630	㎜	
Active Display Area	1209.6 x 680.4	㎜	
Surface Treatment	Anti-glare		
Haze	2.0	%	
Hardness	Hard coating 2H		
Display Colors	1.07B (8 bits+FRC)	colors	
Number of Pixels	1920 x 1080	pixel	16 : 9
Pixel Arrangement	RGB horizontal stripe		
Display Mode	Normally Black		
Luminance of White	350	cd/m^2	2D
	40		3D

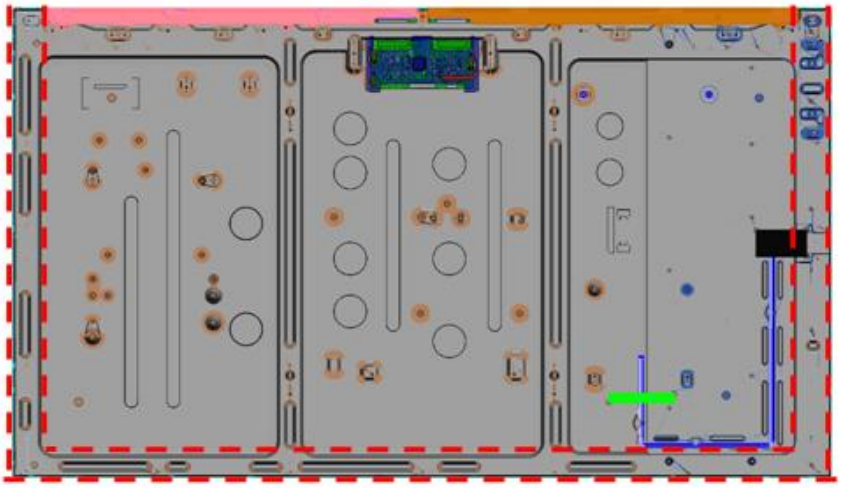
MECHANICAL INFORMATION

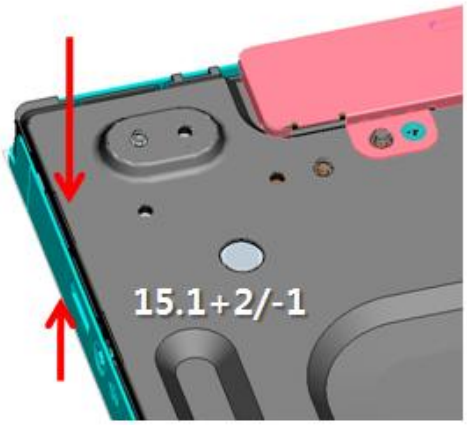
Item		Min.	Typ.	Max.	Note
Module size	Horizontal(H)	1236.4	1237.4	1238.4	mm
	Vertical(V)	710.3	711.3	712.3	mm
	Depth(D)	14.1	15.1	17.1	mm
Bezel Open	Horizontal(H)	1216.6	1217.6	1218.6	mm
	Vertical(V)	687.4	688.4	689.4	mm
Black Matrix Shift	Horizontal(H)			2.0	mm (1)
	Vertical(V)			2.0	
Weight			17000	17500	g

NOTE (1) Measure the figure for **Black Matrix shift** to be recorded on the spec. with referring to the drawings.

- | A − B | ≤ Horizontal Spec
- | C − D | ≤ Vertical Spec







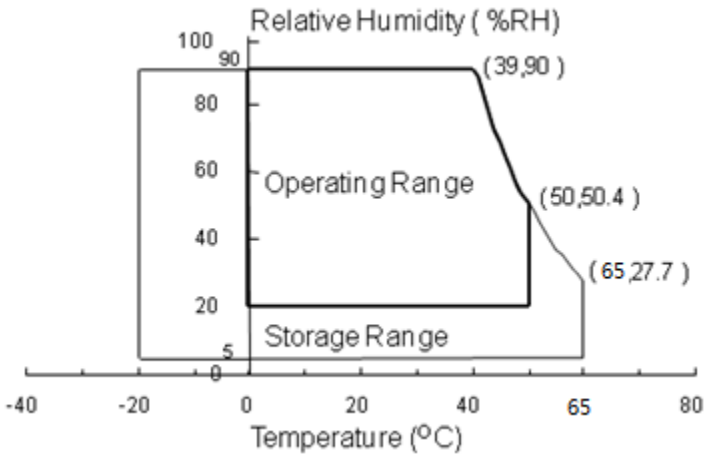
<Module Depth Measure Point>

1. ABSOLUTE MAXIMUM RATINGS

1.1 Environmental Absolute Ratings

Item	Symbol	Min.	Max.	Unit	Note
Storage temperate (Temperature of glass surface)	TSTG	-20	65	°C	(1)
Operating temperate	TOPR	0	50	°C	(1)
Humidity for storage	HSTG	5	90	%RH	
Operating humidity	HOPR	20	90	%RG	
Endurance on static electricity			150	V	(5)
Shock (non-operating)	Snop(X,Y)		50	G	(2),(4)
	Snop(Z)	-	50		
Vibration (non-operating)	Vnop	-	1.5	G	(3),(4)

Note (1) The ranges of temperature and relative humidity are shown in the graph below. 90% RH Max.
(The temperature of Ta shall be over 39℃.)
The maximum temperature of wet–bulb shall be less than 39℃.
No condensation



Note (2) 11ms, half sine wave, one time for ±X, ±Y, ± Z axis
Note (3) 10 ~ 300 Hz, Swap rate for X, Y, Z axis one time*
Note (4) The fixture for the test of the vibration and shock, which holds the module to be tested shall be hard and rigid in order for the module not to be twisted or bent by the fixture.
Note (5) Keep the static electricity under 50V in Polarizer attaching process.(Open Cell)

1.2 Electrical Absolute Ratings

(1) TFT LCD MODULE

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Power Supply Voltage	V_{DD}	10.8	12	13.2	V	(1)
Dimming Control	Vdim	-	-	5.25	V	(1)

Note (1) Within Ta (25 ± 2 °C)
The permanent damage or defect to the device may occur if the panel is operated at the figure set, which exceeds a limit of maximum value stated in the former spec.
The functional operation should be limited to the conditions described above under normal operating conditions.

(2) BACK-LIGHT UNIT

Ta (25 ± 2 °C)

Item	Symbol	Min.	Typ.	Max.	Unit	Note
Input Supply Voltage / Converter	Vcc	22	24	26	V	Without converter
LED Current (2D)	ILED,2D	-	-	208	mA	per string duty 100%
LED Current (3D)	ILED,3D		-	427	mA	per string duty 25%

1.3 The Others Absolute Ratings

STATIC ELECTRICITY PRESSURE RESISTANCE

Item	Test Conditions	Remark
CONTACT DISCHARGE	150pF, 330Ω, ± 10kV, 210points, 1 time/point	Operating
AIR DISCHARGE	150pF, 330Ω, ± 20kV, 210points, 1 time/point	Operating

2. Optical characteristics

The optical characteristics shall be measured in the dark room or the space surrounded by the similar ambient setting.

Measuring equipment : TOPCON RD-80S, TOPCON SR-3, ELDIM EZ-Contrast

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast ratio (At the center of screen)		C/R		3000	5000	-		(1) SR-3
Response time	G-to-G	Tg	@2D	-	8	16	msec	(3) RD-80S
Luminance of white (At the center of screen)		Y_L	@2D	300	350	-	cd/m^2	(4) SR-3
			@3D		40			
Chromaticity (CIE 1931)	Red	Rx	Normal qL,R=0 qU,D=0 Viewing Angle	TYP. -0.03	0.640	TYP. +0.03		(5),(6) SR-3
		Ry			0.330			
	Green	Gx			0.300			
		Gy			0.600			
	Blue	Bx			0.150			
		By			0.060			
	White	Wx			0.280			
		Wy			0.290			
Color gamut		-			70	-	%	(5) SR-3
Color Temperature		-		-	10,000	-	K	
Viewing Angle	Hor.	q_L	C/R > 10		89	-	Degree	(6) SR-3 EZ-Contrast
		q_R			89	-		
	Ver.	q_U			89	-		
		q_D			89	-		
Crosstalk		D_{SHA}	Center (W-B)	-	3	5	☐	(7)
			Top/Bottom (W-B @ 1/8 from edge)			8		
Flicker		F		-	15	20		(8) RD-80S
					30	40		(8), CA-210
Gamma		-		1.9	2.2	2.5		SR-3
Brightness uniformity (9 Points)		B_{uni}		-	-	25	%	(2) SR-3

* Ta = 25 ± 2 °C, V_{DD}=3.3V, fv= 60Hz, fDCLK = 148.5MHz, 2D Mode, IF = 145mA, IF = 100% duty

- Test equipment for setup

The measurement shall be executed under the condition including a stable, windless and dark room for 40min or 60min with lighting the back-light at the given temperature, which is suitable to stabilize the back-light.
The module shall be measured at the center of screen.
The ideal temperature for setup is a value derived from the formula, Ta = 25 ± 2 °C.

Note (1) Definition of Viewing angle : The range of Viewing angle (10 ≤ C/R)
: Ratio of gray max (Gmax) & gray min (Gmin) at the center point of the panel

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

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

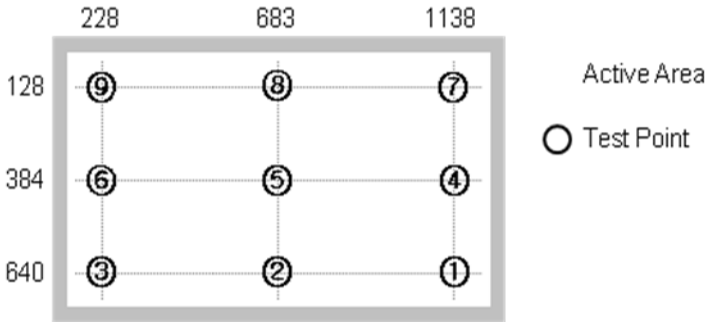
Note (2) Definition of brightness uniformity at 9 points (Test pattern : Full white)

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

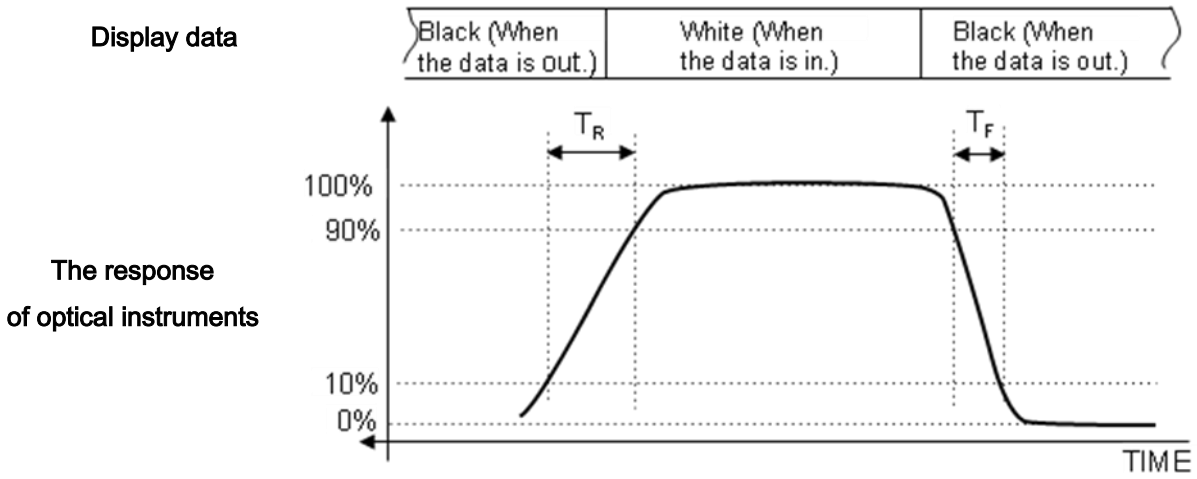
Bmax : Maximum brightness

Bmin : Minimum brightness

- Definition of test point



Note (3) Definition of response time : Sum of Tr, Tf



※ G-to-G : Average response time between the whole gray scale to the whole gray scale.

Gray to Gray Response Time											
	Gray	End									
		0	31	63	95	127	159	191	223	255	
Start	0		Tr(0-31)	Tr(0-63)	Tr(0-95)	Tr(0-127)	Tr(0-159)	Tr(0-191)	Tr(0-223)	Tr(0-255)	Ton
	31	Tf(31-0)		Tr(31-63)	Tr(31-95)	Tr(31-127)	Tr(31-159)	Tr(31-191)	Tr(31-223)	Tr(31-255)	
	63	Tf(63-0)	Tf(63-31)		Tr(63-95)	Tr(63-127)	Tr(63-159)	Tr(63-191)	Tr(63-223)	Tr(63-255)	
	95	Tf(95-0)	Tf(95-31)	Tf(95-63)		Tr(95-127)	Tr(95-159)	Tr(95-191)	Tr(95-223)	Tr(95-255)	
	127	Tf(127-0)	Tf(127-31)	Tf(127-63)	Tf(127-95)		Tr(127-159)	Tr(127-191)	Tr(127-223)	Tr(127-255)	
	159	Tf(159-0)	Tf(159-31)	Tf(159-63)	Tf(159-95)	Tf(159-127)		Tr(159-191)	Tr(159-223)	Tr(159-255)	
	191	Tf(191-0)	Tf(191-31)	Tf(191-63)	Tf(191-95)	Tf(191-127)	Tf(191-159)		Tr(191-223)	Tr(191-255)	
	223	Tf(223-0)	Tf(223-31)	Tf(223-63)	Tf(223-95)	Tf(223-127)	Tf(223-159)	Tf(223-191)		Tr(223-255)	
	255	Tf(255-0)	Tf(255-31)	Tf(255-63)	Tf(255-95)	Tf(255-127)	Tf(255-159)	Tf(255-191)	Tf(255-223)		
		Toff									

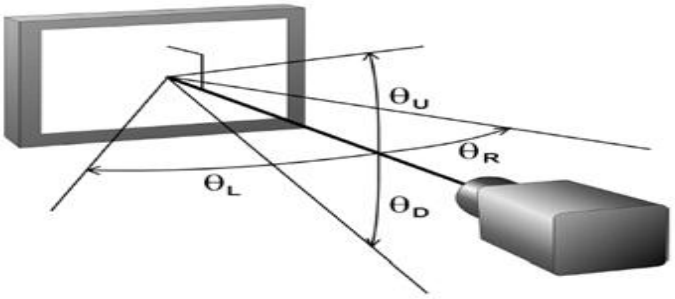
T*(X-Y) : Response time from level of gray at X to level of gray at Y

The definition of response time = Σ [T*(X-Y)] / 72

Note (4) The definition of luminance of white: The luminance of white at the center point ⑤

Note (5) The definition of chromaticity (CIE 1931)

The color coordinate of red, green, blue and white at the center point ⑤



Note (6) Definition of viewing angle : The range of viewing angle (C/R ≥10)

NOTE (7)

▸ The definition of crosstalk; (Cross modulation) (DSHA): The phenomenon, which the level of contrast ratio is declined by the interference of signals in pixels.

$$Crosstalk\ Modulation\ \ Ratio(D_{SHA}) = \frac{|Y_{normal} - Y_{abnormal}|}{Y_{normal}} \times 100(\%)$$

* Measure the size of background pattern at the interval of 4 grays with excluding the size of white rectangle within the range from gray 1 to gray 64.

* Measure the horizontal crosstalk and vertical crosstalk both.

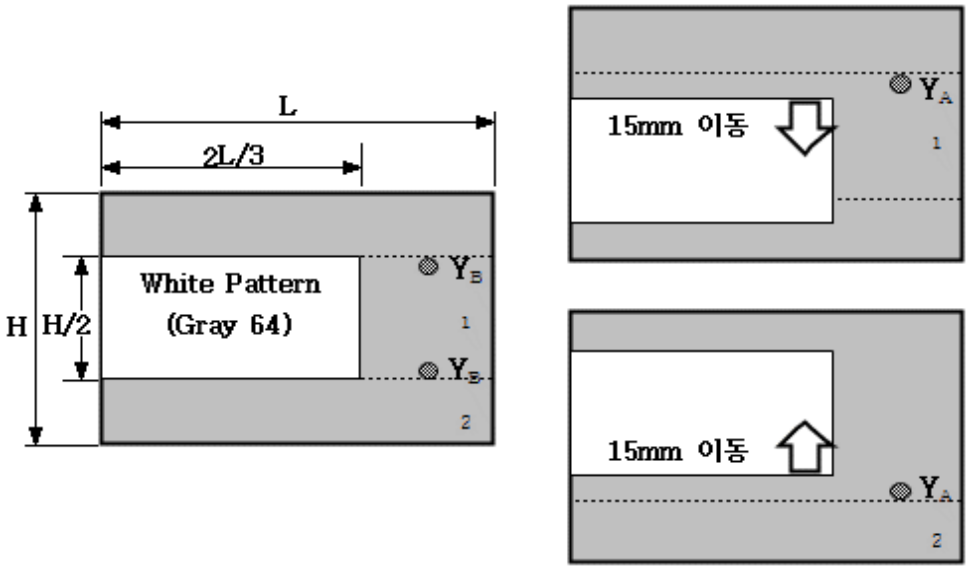
* The maximum value among measured values can be defined as a crosstalk.

Reference : The color of rectangle for Gmin is black when the color of screen is white.

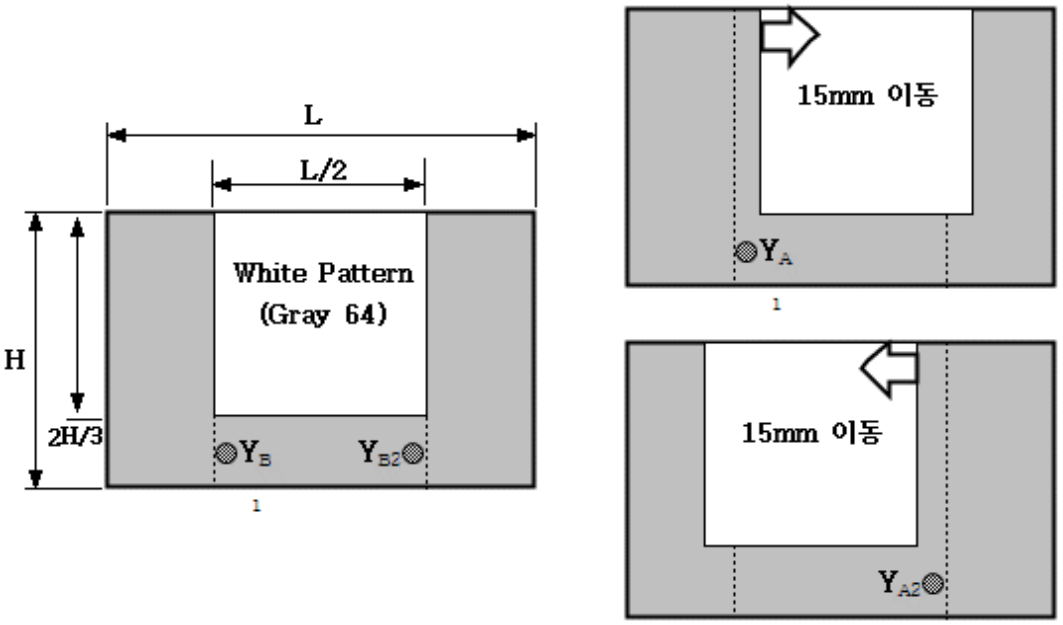
The color of rectangle for Gmax is white when the color of screen is black.

* Pattern to measure the crosstalk and points to be measured

< Horizontal Crosstalk >



< Vertical Crosstalk >



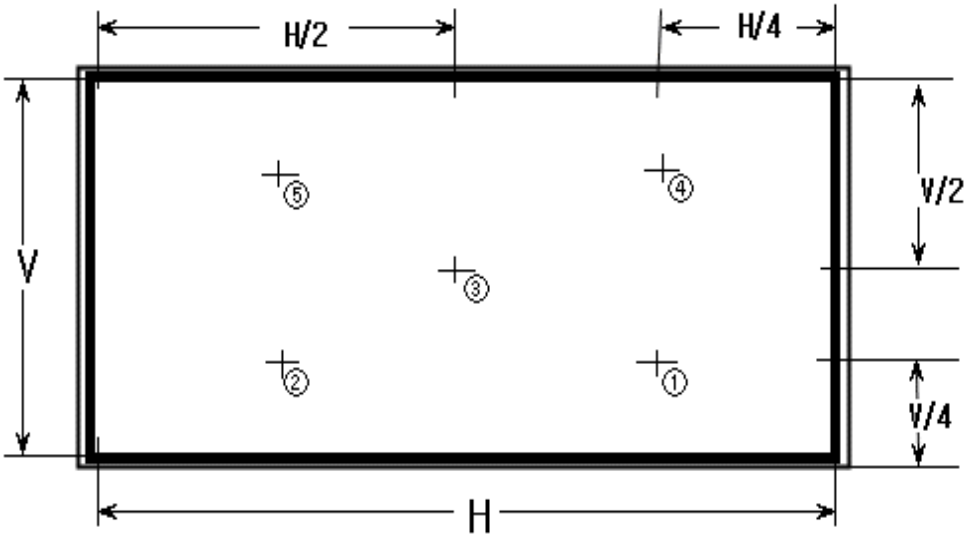
NOTE (8)

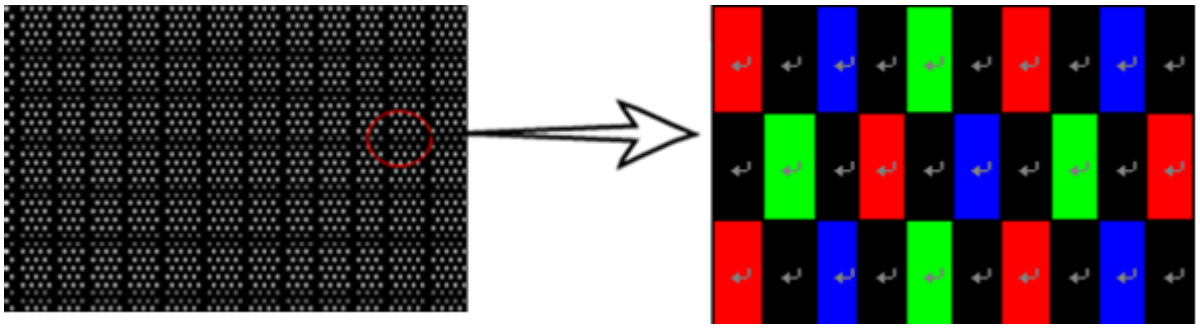
▸ The definition of terminology, flicker: The phenomenon, which the pixels on the screen of LCD panel blink.

1) Calculate the value of crosstalk with observing the standard for measuring the flicker.

2) The points to be measured

- The pattern to measure the flicker



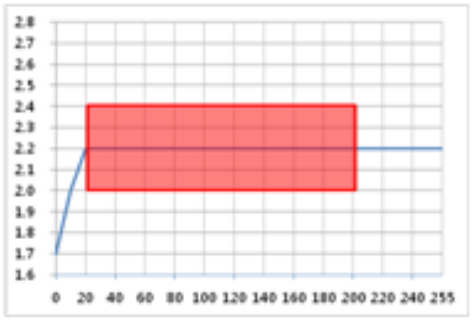


< Dot Inversion >

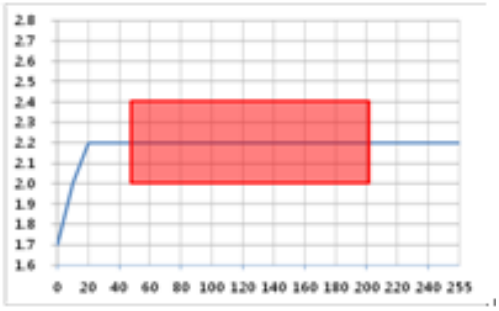
NOTE(9)

The local gamma

<TV> (20Gray ~ 200Gray)



<DID> (50Gray ~ 200Gray)



Note(10)

A C C

-.Allowed the difference of 15/1000 between any point's value in Wx color coordinate and in Wy color within the range between over 30 gray and under 255 gray. The crossing within the specific range of gray shall not be allowed.

-. The one time crossing is allowed under the 30 G if the value of Wx's coordinate starts at a higher value than that of Wy 's coordinate at 0 gray.(If the crossing is over two time, it is N.G.)

3. Electrical characteristics

3.1 TFT_LCD Module

The connector to transmit a display data and a timing signal shall be connected.

Ta = 25°C ± 2 °C

Item		Symbol	Min.	Typ.	Max.	Unit		Note
Voltage of power supply		V_{DD}	10.8	12.0	13.2	V		(1)
Current of power supply	(a) Black	I_{DD}	-	500	550	2D	mA	(2),(3)
			-	500	550	3D		
	(b) White		-	470	520	2D		
			-	470	520	3D		
	(c) N-pattern		-	790	870	2D		
			-	1100	1220	3D		
Vsync frequency		fV	48	60	62.5	Hz		
Hsync frequency		f_H	53	67.5	70	kHz		
Main frequency		f_{dclk}	130.0	148.5	160.0	MHz		
Rush current		IRUSH	-	-	3	A		(4)

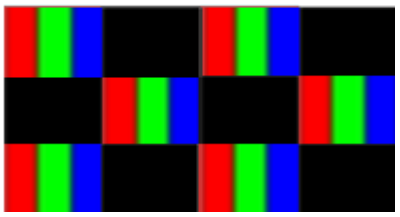
Note (1) The voltage for ripple shall be controlled under the range of fewer than 10% of V_{DD} voltage.

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

(3) The pattern for checking the power dissipation (LCD module only)

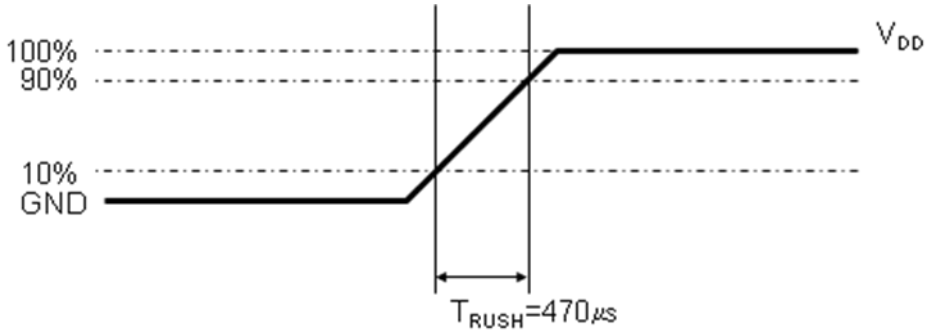
a) Black pattern

b) White pattern



c) N-pattern

(4) Conditions for measurement



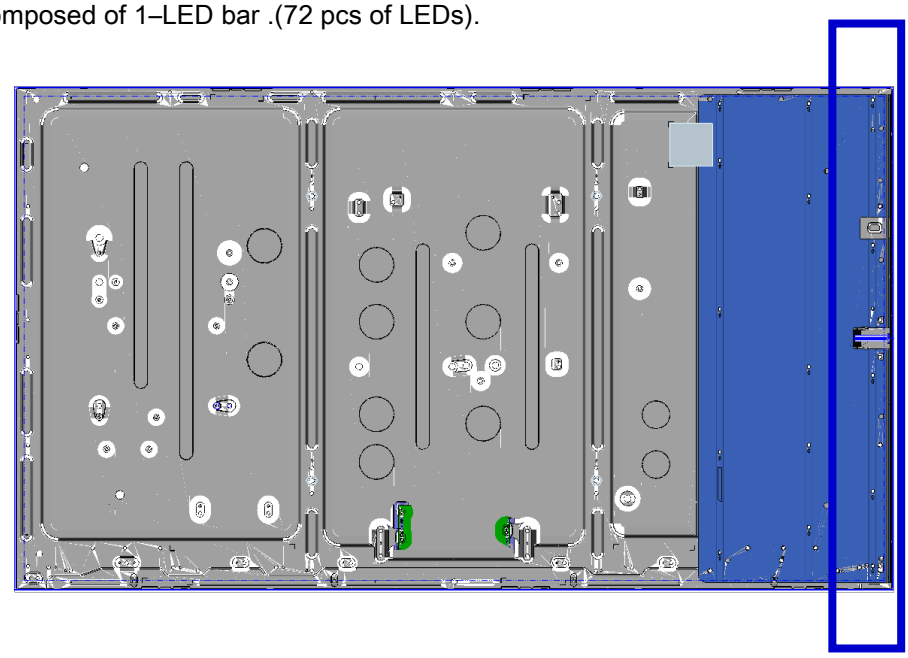
The rush current, I_{RUSH} can be measured when T_{RUSH} is 470㎲.

* The temperature range for component of the some major part of operating module

Part	Spec	Ambient Operating Temperature	Junction Operating Temperature
Timing Controller	SQ60PB	-20℃ ~ 70℃	0℃ ~ 125℃

3.2 BACK-LIGHT UNIT

* Back light unit is composed of 1–LED bar .(72 pcs of LEDs).

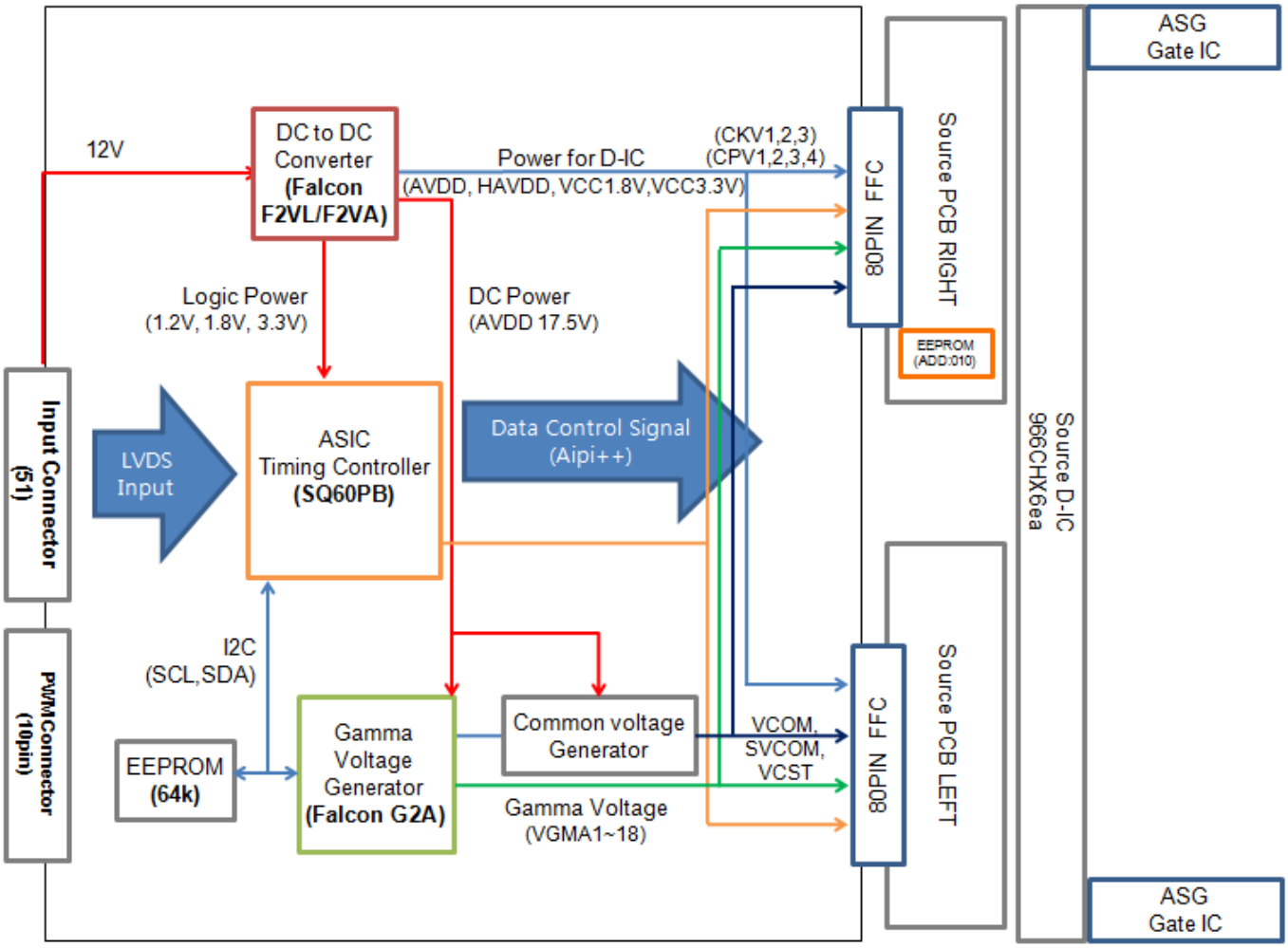


Ta=25℃

Item	Symbol	Min.	Typ.	Max.	Unit	Note
LED Operating Temperature range	Top	-20	-	70	℃	LED unit
LED Storage Temperature range	Tstg	-30	-	85	℃	
LED Junction Temperature	Tj	-	-	130	℃	
LED Forward Current	IF	137.75	145	152.25	mA	Continuous Operation@String (6String/PCB) Operating Current 145mA
	IFP	-	-	427	mA	120Hz/duty25%
LED Forward Voltage	VF	70.3	75.1	79.9	V	Continuous Operation @string (12LEDs @145mA/String)
	VFP	-	-	90.3	V	120Hz/Duty25%
Thermal Resistance Junction to PCB	Rth, JS	-	-	20	K/W	
Power Consumption	P	61.1	65.3	69.5	W	
Operating Life Time	Hr		〉35,000		Hour	MTTF, 2D Only
LED Counts	Q	-	72	-	EA	

4. Block diagram

4.1 TFT LCD MODULE



4.2 Back Light

LED: W/O converter

5. The Pin assignment in the input terminal

5.1 Input Signal & Power

Connector : IS050-C51B-C38 (UJU)

INPUT CONNECTOR PIN MAP					
PIN	SYMBOL	Description	PIN	SYMBOL	Description
1	B_INT	Bus release (3)	27	N.C	Not Connect
2	SCL_I	I2C SCL	28	Rx2[A]N	2ND Pixel, A ch LVDS Signal -
3	SDA_I	I2C SDA	29	Rx2[A]P	2ND Pixel, A ch LVDS Signal +
4	3D_Format0	3D Format '0' signal (4)	30	Rx2[B]N	2ND Pixel, B ch LVDS Signal -
5	3D_SYNC_O	Shutter Glass sync output signal (4)	31	Rx2[B]P	2ND Pixel, B ch LVDS Signal +
6	3D_Format1	3D Format '1' signal (2)	32	Rx2[C]N	2ND Pixel, C ch LVDS Signal -
7	LVDS_SEL	LVDS Selection signal, Sequence	33	Rx2[C]P	2ND Pixel, C ch LVDS Signal +
8	TEMP_SEL0	Not Used	34	GND	Ground
9	TEMP_SEL1	Not Used	35	Rx2CLK-	2ND Pixel, LVDS Clock -
10	N.C	Not Connect	36	Rx2CLK+	2ND Pixel, LVDS Clock +
11	GND	Ground	37	GND	Ground
12	Rx1[A]N	1ST Pixel, A ch LVDS Signal -	38	Rx2[D]N	2ND Pixel, D ch LVDS Signal -
13	Rx1[A]P	1ST Pixel, A ch LVDS Signal +	39	Rx2[D]P	2ND Pixel, D ch LVDS Signal +
14	Rx1[B]N	1ST Pixel, B ch LVDS Signal -	40	Rx2[E]N	2ND Pixel, E ch LVDS Signal - (1)
15	Rx1[B]P	1ST Pixel, B ch LVDS Signal +	41	Rx2[E]P	2ND Pixel, E ch LVDS Signal + (1)
16	Rx1[C]N	1ST Pixel, C ch LVDS Signal -	42	N.C	Not Connect
17	Rx1[C]P	1ST Pixel, C ch LVDS Signal +	43	N.C	Not Connect
18	GND	Ground	44	GND	Ground
19	Rx1CLK-	1ST Pixel, LVDS Clock -	45	GND	Ground
20	Rx1CLK+	1ST Pixel, LVDS Clock +	46	GND	Ground
21	GND	Ground	47	N.C	Not Connect
22	Rx1[D]N	1ST Pixel, D ch LVDS Signal -	48	12V	DC power supply
23	Rx1[D]P	1ST Pixel, D ch LVDS Signal +	49	12V	DC power supply
24	Rx1[E]N	1ST Pixel, E ch LVDS Signal - (1)	50	12V	DC power supply
25	Rx1[E]P	1ST Pixel, E ch LVDS Signal + (1)	51	12V	DC power supply
26	3D_EN	3D_EN signal (4)			

Note(1) :
- Input Mode 8Bit Setting & 8bit input 시, ==> E_Chanel : Floating
- Input Mode 10bit Setting & 8bit input 시, ==> E_Chanel : Keep Level '0'
  (51 PIN) No.24 / No.40 : Pull Up(3.3V) with 10Kohm resist
  (51 PIN) No.25 / No.41 : Pull Down(GND) with 10Kohm resist
  * Level of LVDS signals are base on LVDS CHARACTERISTICS(7-12)

NOTE(2) : 3D input format selection
- FORMATI[1:0] : 2'b0x = Line interleave , 2'b10 = side/side , 2'b11 = top/bottom

NOTE(3) : WP, SCL_I and SDA_I shouldn`t be communicated with I2C device whose output level is 5V

Note(4) : FORMAT / 3D_EN / 3D sync_O

Symbol	Description	Min	Typ.	Max.	Unit.	Note
FORMAT[0]	Input High Voltage	2.0	-	3.6	V	
	Input Low Voltage	-0.3	-	0.8	V	
FORMAT[1]	Input High Voltage	2.0	-	3.6	V	
	Input Low Voltage	-0.3	-	0.8	V	
3D_EN	Input High Voltage	2.0	-	3.6	V	
	Input Low Voltage	-0.3	-	0.8	V	
3D Sync O	Input High Voltage	2.4	-	-	V	
	Input Low Voltage	-	-	0.4	V	

5.2 Input Signal & Power _ 3D Mode Only BLU signal connector

Part No.: 104091-1020 (MOLEX)

Pin No.	Pin Name	Note
1	EXT_DIM	(1)
2	INT_DIM	
3	3D_EN	
4	PWM-1	
5	PWM-2	
6	PWM-3	
7	PWM-4	
8	PWM-5	
9	PWM-6	
10	GND	

NOTE(1) : SDC applied serial 100ohm resister for prevent damage of T-con

5.2.1Scanning frequency : 120Hz

5.2.2 High/Low voltage Specification

Characteristics	Min	Typ	Max	Unit
VDD	3.0	3.3	3.6	V
Output Low Voltage (V_Sync/3D_EN)	-	-	0.4	V
Output High Voltage (V_Sync/3D_EN)	2.4	-	-	V
Output Low Voltage @PWM	0	-	0.4	V
Output Low Voltage @PWM	VDD-0.2V	-	VDD+0.2V	V

5.2.3 EXT-DIM Signal

(1) 2D Mode

	Min	Typ	Max	Remarks
EXT-DIM Frequency	95Hz	100Hz	1kHz	
EXT-DIM Duty	1%	-	100%	When EXT-DIM Duty is 1%, T-Con Output Duty is 0.78%.

(2) 3D Mode

	Min	Typ	Max	Remarks
EXT-DIM Frequency	95Hz	100Hz	1kHz	EXT-DIM: High (Recommendation) for 3D Mode
EXT-DI Duty	1%	-	100%	

Caution: EXT-DIM should be high or EXT-DIM Frequency is higher than 50Hz for 3D mode.
Otherwise, there would be abnormal display for 3D mode.

5.3 LVDS Interface

- LVDS Receiver : T-CON
- Data Format(JEIDA, NORMAL)

LVDS OPTION(input : pin9) : IF THIS PIN : LOW (GND) → JEIDA LVDS FORMAT
OTHERWISE : HIGH (3.3V) OR OPEN(NC) → NORMAL NS LVDS FORMAT

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

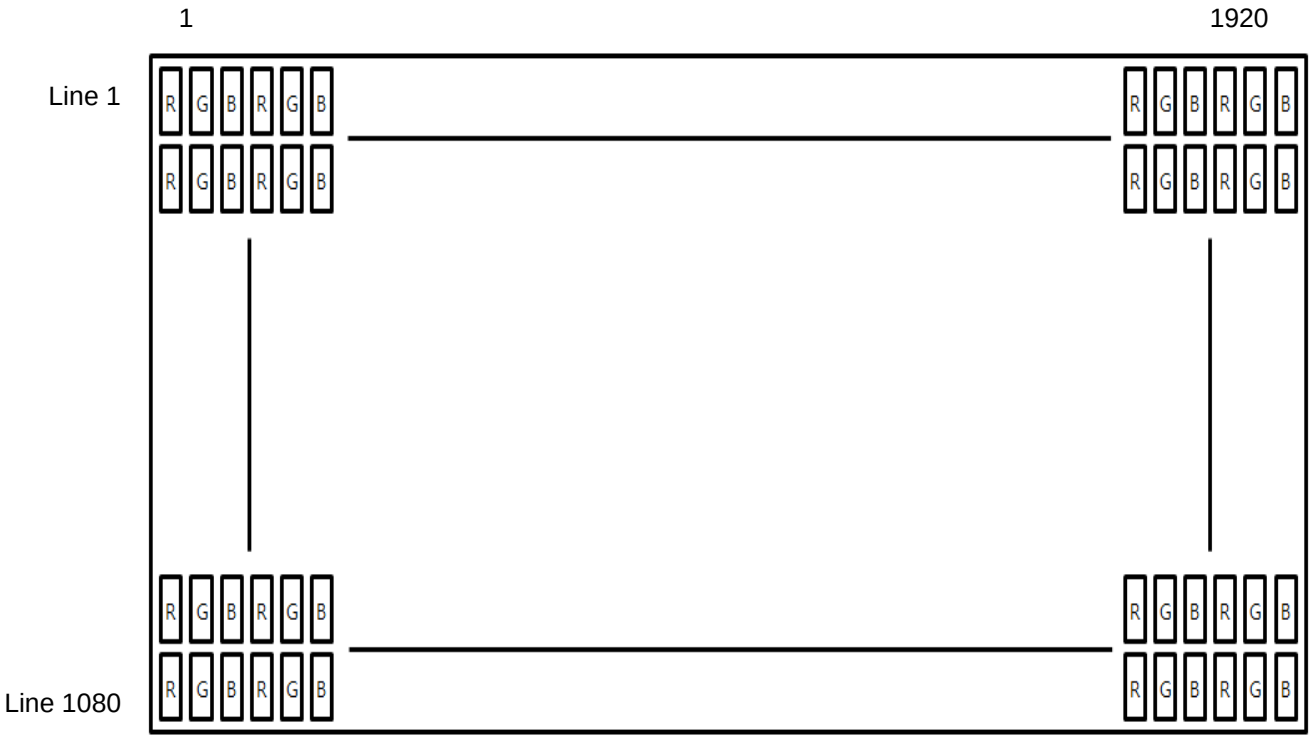
5.4 Input Signals, Basic display colors and Gray Scale of Each Color

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	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	1	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 1) Definition of gray : Rn: Red gray, Gn: Green gray, Bn: Blue gray (n=gray level)

Note 2) Input signal: 0 =Low level voltage, 1=High level voltage

5.5 Pixel Format in the display



6. Interface timing

6.1 The parameters of timing (DE mode)

SIGNAL	ITEM	SMBOL	MIN.	TYP.	MAX.	Unit	NOTE
Clock	Frequency	$1/T_C$	130	148.5	160.0	MHz	-
Hsync		F_H	53	67.5	70	KHz	-
Vsync		F_V	48	60	62	Hz	-
Term for the vertical display	Active display period	T_{VD}	-	1080	-	Lines	-
	Total vertical	T_V	1095	1125	1160	Lines	-
Term for the horizontal display	Active display period	T_{HD}	-	1920	-	Clocks	-
	Total Horizontal	T_H	2100	2200	2350	clocks	-

Note) The signals of Hsync and Vsync must be inputted even though this T-con is operated at DE mode.

(1) Test Point: TTL controls signal and CLK at LVDS Tx at the input terminal of system.

(2) Internal VDD = 3.3V

(3) The spread spectrum

- The limit of spread spectrum's range of SET in which the LCD module is assembled should be within ± 3 %
- Frequency for modulation : 30KHz ~ 150KHz

Parameter		Symbol	Value			Unit	Note
			Min	Typ	Max		
CMOS Interface	Input High Threshold Voltage	V_{IH} (High)	2.5	-	3.3	V	
	Input Low Threshold Voltage	V_{IL} (Low)	0	-	0.5	V	

6.2 Timing diagrams of interface signal (Only DE mode)

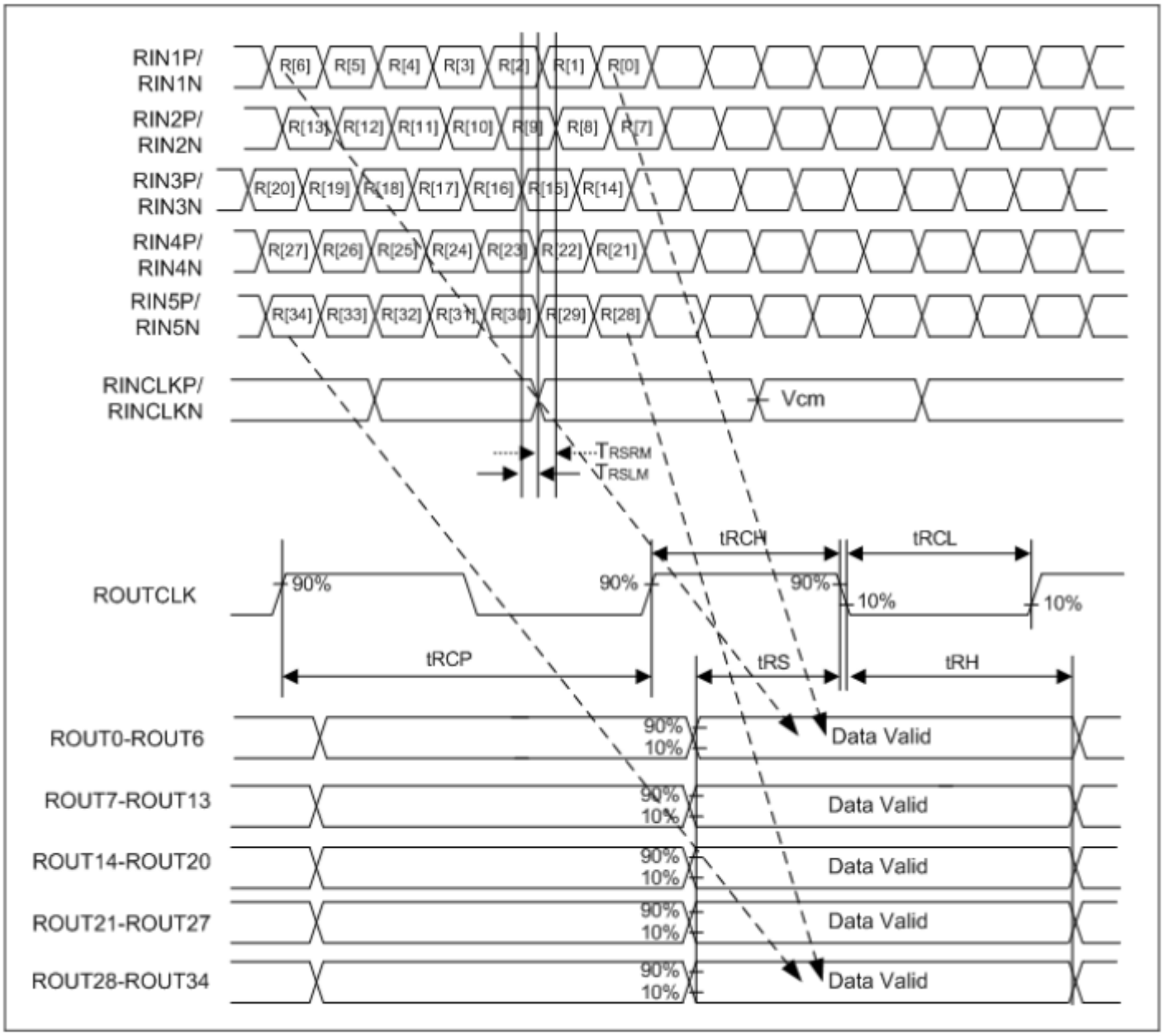


Figure 6. Timing diagram of LVDS input/output operation

6.3 Characteristics of Input data of LVDS

(1) DC Specification

Table 8. LVDS receiver DC characteristics

Characteristics	Symbol	Condition	Min.	Typ.	Max.	Unit
IO Supply Voltage	VDD33_LVDS		3.0	3.3	3.6	V
Core Supply Voltage	VDD12_LVDS		1.1	1.2	1.3	V
Color Depth				8/10		bit
Input Common Mode Voltage	V_{CM}		0.3		1.8	V
Differential Input Voltage	$\|V_{ID}\|$		100	350	600	mV

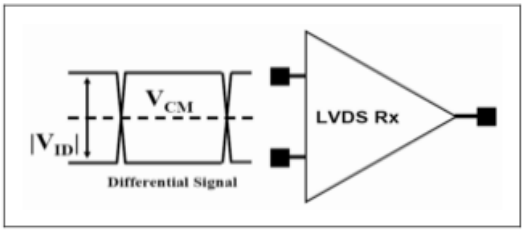


Figure 3. Definition of LVDS receiver DC characteristics

(2) AC Specification

Table 9. LVDS receiver AC characteristics

Symbol	Characteristics	Min.	Typ.	Max.	Unit
F_{IN}	Input Clock Frequency (= 1/T)	25		90	MHz
t_{RCP}	Output Clock period	11.11		40	ns
t_{RSRM}	Input Data position			+400	ps
t_{RSLM}	Input Data position	-400			ps
t_{RPLL}	Lock Time			100	μsec
t_{duty}	Rx Output Clock Duty Ratio	45	50	55	%

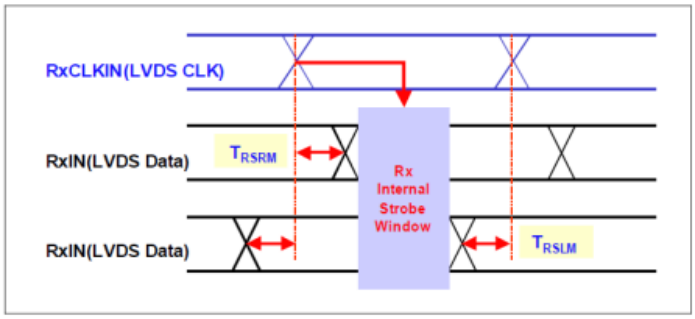


Figure 4. Timing diagram of LVDS receiver skew margin

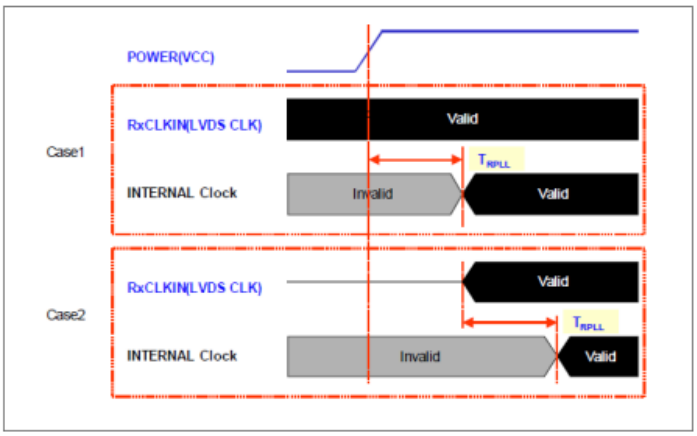
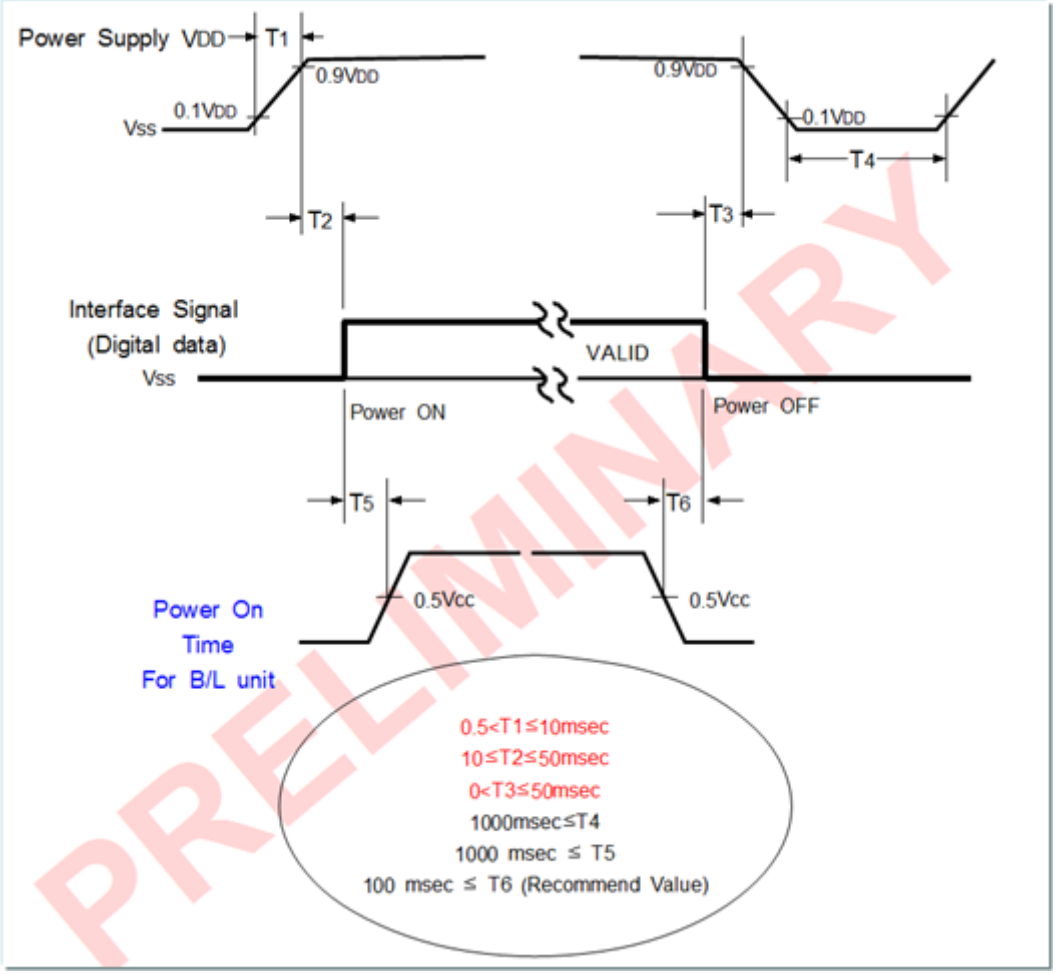


Figure 5. Timing diagram of LVDS receiver operation

6.4 The sequence of power on and off

To prevent the LCD module from being latched up or being operated at the DC.

The order to turn the power on and off should be same as shown in the diagram below.



T1 : The time, during which the level of VDD is rising from 10% to 90%.

T2 : The change for the time, during which the VDD starts rising the level above 90% until the valid data of signal started coming in.

T3 : The change for the time, during which the valid data of signal starts coming out until the 0.9VDD falling Level

T4 : The time, during which level VDD falls below 10% until the next VDD starts rising exceed 10%.

T5 : The time, during which the valid data starts coming in until the power of B/L on time exceed 50%.

T6 : The time, during which the level of B/L's power falls below 50% until the valid data of signal starts coming out.

- The inputted V_{DD} 's value for supply voltage, BLU, and signal to the external system of the module shall be computed in observance of the former mentioned value.
- The method to apply the voltage to the lamp within the range, which the LCD operates. When the back-light is turned on before the LCD is operated or the power of LCD is turned off before the back-light is turned off, the abnormal display on the screen may be shown momentarily.
- Please keep the level of input signal low or keep the level of impedance high when the V_{DD} is off.
- The value shall be measured after the module has been fully discharged between the periods when the power is on and off during the T4.

7 3D MODE GUIDE

7.1 3D INPUT SOURCE DEFINITION

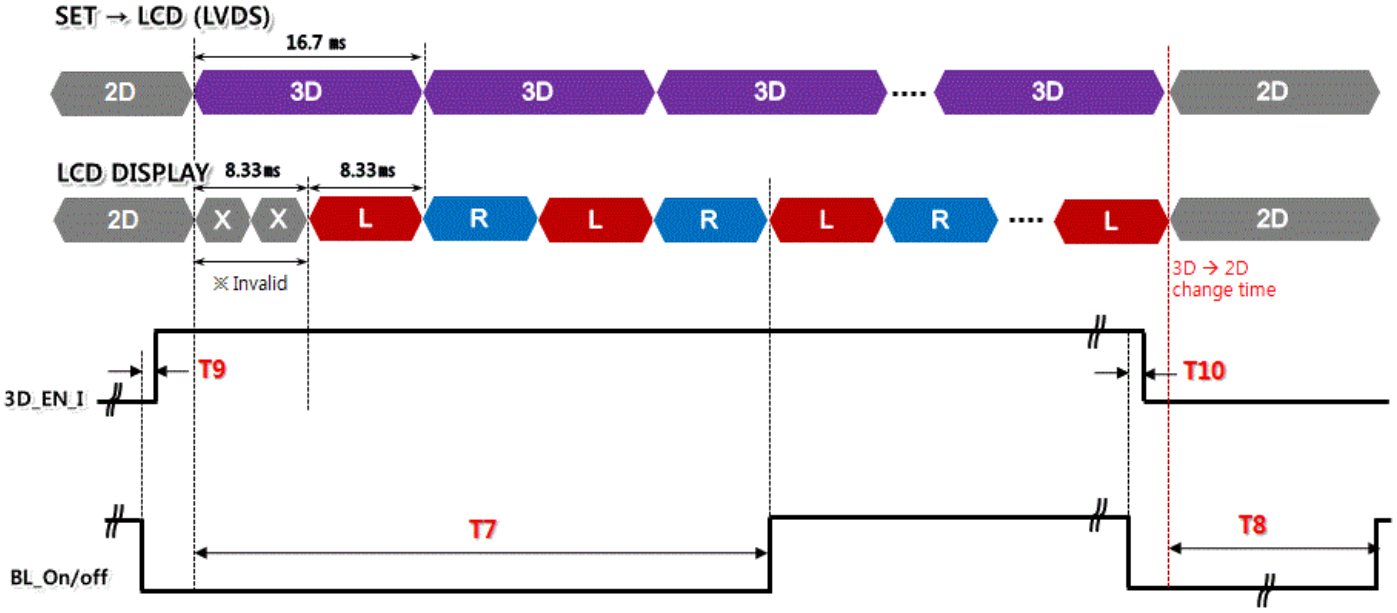
For the 3D operating of the Model,
3D drive Source of the 60Hz line interleave or side/side or top/bottom method must be input.
3D operating cannot support 3D drive Source of another Format.

7.2 INPUT PIN DEFINITION

PIN Number	PIN	Definition
26	3D_EN	If Voltage Level of 3D_EN signal is high(3.3V), 3D MODE operate
5	3D_SYNC_O	This Pin is L/R Sync output signal of Shutter Glass
4, 6	3D_Format 0 3D_Format 1	3D input format selection FORMATI[1:0]: 2'b0x = Line interleave, 2'b10 = side/side 2'b11 = top/bottom

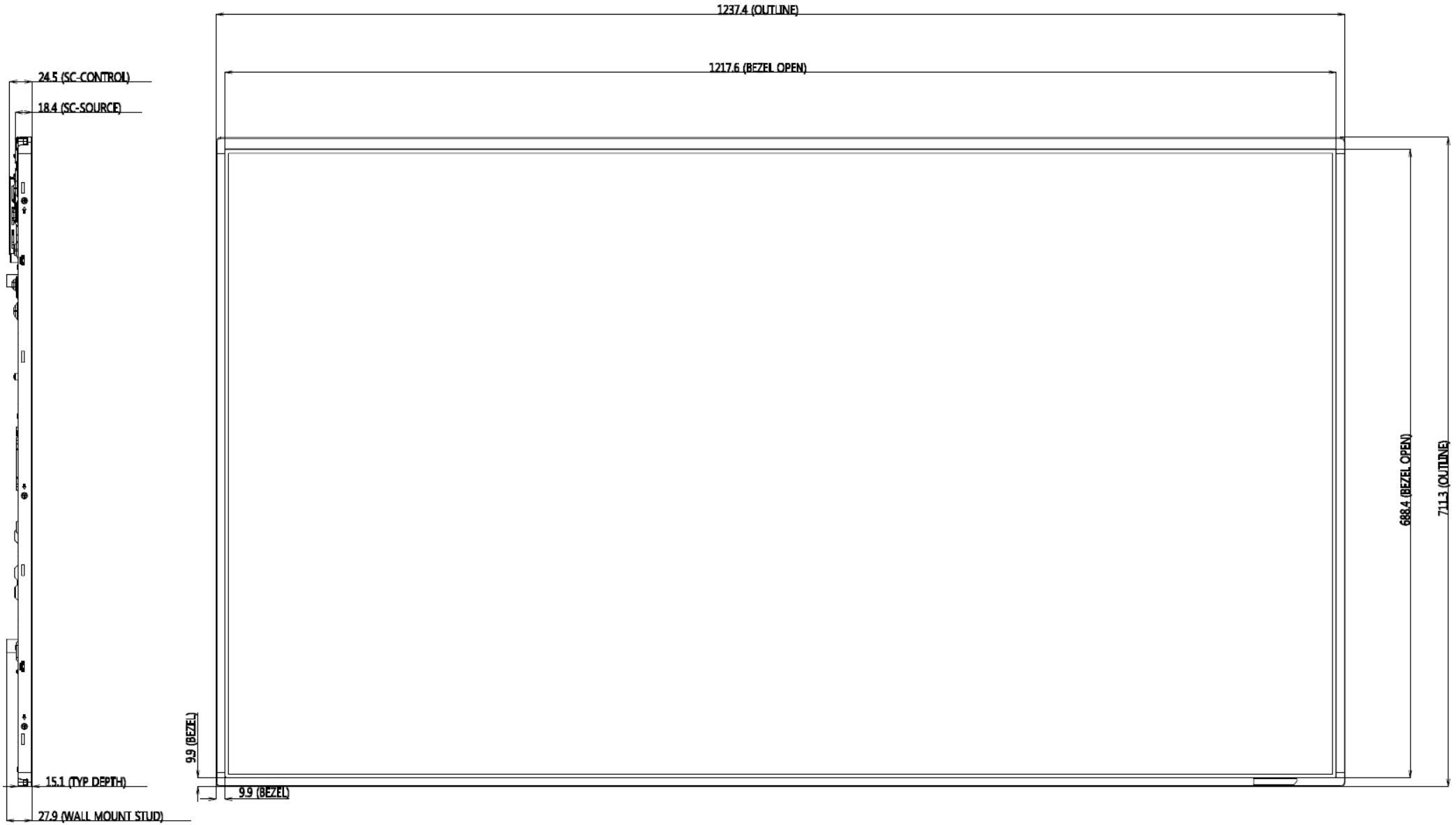
7.3 3D TIMING (Recommendation)

<3D signal Timing (Recommendation)>



Timing	Spec (ms)			Description
	Min.	Typ	Max	※ 1 frame (=8.33ms / 120Hz)
T7	≥ 42			Backlight should be on after 5 frame when 3D signal input from SET
T8	≥ 34			Backlight should be off after 4 frame when 3D signal change to 2D signal from SET
T9	≥ 0			
T10	≥ 0			
FORMAT				if you need to change format data, Backlight should be off.

8. Outline dimension



9. Reliability test

Items to be evaluated	Condition for the evaluation	Quantity	**Standard for evaluation**
HTOL	50 ℃	4	
	60 ℃	8	
LTOL	-5℃	4	
THB	Evaluate the whole cell in the panel when examining the panel, which is over 32" at 50℃ and 90 %RH.*	10	
Margin on the operation of ASG at a low temperature. (Optional)	Check the temperature when the noise occurs under the conditions, the max. frequency and between the -40℃ and 25℃.	Each cell	Applied to products with ASG only.
Margin on the operation of ASG at a high temperature. (Optional)	Examine the panel operated under the conditions, the min. frequency and the 60℃ for 96hrs.	Each cell	Applied to products with ASG only.
Residual image at a normal temp.	Repeat the exam. to examine the mosaic pattern(9"*10") of panel at 25 ℃ for 12hrs followed by the exam for the rolling pattern at 25 ℃ for 12hrs three times.	8	
New decompression	Examine the panel, which is in the temp. range of -40℃ to 50℃ between the 0m(0ft) and 13,700m(45,000ft) for 72 and half hrs.	4	
HTS	Store at the 70 ℃.	4	
LTS	Store at the -25 ℃.	4	
Evaluation for the panel on the **pallet**	Dropping(20cm)->Set the temp. and humidity(-30℃~60℃ / 40℃~90%RH)->Pressurizing-> Vibrating(Vibrate the panel within the frequency range between 5hz and 200hz for 2hrs at the sine wave of 1.05 g.)->Dropping(20cm)	1 Pallet	
Vibration	Vibrate the panel within the frequency range between 10hz and 300hz for 10min at the sine wave at 1.5G Vibrate the panel in the direction of X, Y, and Z axis for 30min.	3	
Shock	If the screen size of panel is below 40", drop the panel with applying the 50G one time toward the direction of ±X, Y, and Z axis from the spot where the panel is placed respectively for 11msec. (±XYZ), If the screen size is 46", apply the 40G for ±X and Y axis or the 30G for ±Z. If the screen size is over 52", apply the 30G.	3	
TSS	Test the TV between the -20℃ and 65℃ 440 times. Test the DID between the -20℃ and 65℃ 220 times.	4	
WHTS	Store the module at 60 ℃ and 75 %RH.	4	
TS	Execute the exam for TV at -20℃ for 30 min. and at 60℃ for 30min 100 times. / Execute the exam for the DID at -20℃ for 30 min. and at 60℃ for 30min 200 times.	4	
Dust	Execute the test to observe the status of falling dust for 5 min. after spraying the dust in the air for 5 sec. at a normal temperature and normal humidity for 5 hrs.	2	

	Turn the panel on and off at the interval of 10 min. Execute the test for the DID for 10hrs.		
Twist	Examine the 52″-sized module by pushing the one point of panel by 10 degrees forward and backward with fixing other three points for 0.9s 500 times respectively., Examine the 46″-sized module by pushing the one point of panel by 10 degrees forward and backward with fixing other three points for 0.7s 500 times respectively. Examine the 40"-sized module by pushing the one point of panel by 20 degrees forward and backward with fixing other three points for 0.85s 250 times respectively., Examine the 32″-sized module by pushing the one point of panel by 20 degrees forward and backward with fixing other three points for 0.7s 250 times respectively. Examine the 26″-sized module by pushing the one point of panel by 20 degrees forward and backward with fixing other three points for 0.6s 250 times respectively.	4	
Noise	Noise occurred when the frame of instrument is expanded as the operating module emits the heat.: Max 50dB (Below the 10 times when the level of sound is over 36dB.)	2	
Noise	Noise from machine : Under the 23dB on average.	2	
The new compound stress	Repeat the exam, which stresses the panel under the temp. range of -20℃ to 60℃ and the humidity range of 0%RH to 90%RH two times.	4	
ESD	Shoot the ESD with the measuring gun, which is operated at ±10 kV to the 210 points with contacting the panel.	3	
	Shoot the ESD with the measuring gun, which is operated at ±20 kV to the 210 points without contacting the panel.	3	
	Input pin for inverter and converter (optional): Apply ± 15kV three times.	3	Only for the attached part of inverter and converter.

[Criteria on evaluation]

The components of product, which may affect to the function of display shall not be changed when the display quality test is executed under the normal operating condition.

* HTOL/ LTOL : The operating at the high and low temperature*

* THB : The slant of temperature and humidity

* HTS/LTS : The storage at the high and low temperature

* WHTS : The storage condition at the high temperature with the high humidity

10. Special precautions

No.	Component	Expected cause
1	Upholding part for panel	Prevent the panel from breaking by assigning gaps between the panel and the upholding part for panel on the drawing for the upholding part for panel. Refer to the (a), (b), (c) of 3-1 for the design of BLU.
2	The shape of the upholding part for panel	Design the upholding part for panel to fit to the panel appropriately when designing the BLU since the shape of the upholding part for panel may damage the panel. Refer to the (a), (b), (c) of 3-1 for the design of BLU.
3	The edge of upholding part for panel	Design the edge of panel to have a sufficient space with the upholding part for panel when designing the BLU since the edge of the upholding part for panel may damage the panel when assembling the panel and BLU. Refer to the (a), (b), (c) of 3-1 for the design of BLU.
4	Upholding part for panel	Place the upholding part for the panel in order for the shape of mold, which contacts with the panel not to interfere with the area of panel. Refer to the (a), (b), (c) of 3-1 for the design of BLU.
5	Drive IC	Design the BLU in order for the COF not to contain the lead crack resulted from the tensioned COF created when the product is twisted if the space between the D-IC COF and the middle mold isn't sufficient. Refer to the (a), (b), (c),(d),(e),(f), and (g)of 3-2 for the design of BLU.
6	Drive IC	Design the BLU in order for the product not to contain the lead crack resulted from the tensioned COF caused under the condition, which the product is twisted by fixing the source PCB. Refer to the (a), (b), (c),(d),(e),(f), and (g)of 3-2 for the design of BLU.
7	IC component	1) The temperature of each part of product suggested by our company and the second vendor shall meet the standard of temperature, which is recommended not to be exceeded by our company when the product is affected under the various temperature ranges. Apply over 1mm long separation distance stated in the safety standard between the electric part and each conductor. (Apply the rated separation distance when insulating.)
8	Thermal pad	Apply the thermal pad in a designated size to the product as a measure to lower the temperature of heat in order for each part to use the rated temperature.
9	POL	The surrounding area of the POL shall be treated with an electrification treatment since the external ESD may cause a phenomenon, which the POL is coming off. In addition, the GND portion of source PBA shall be grounded.
10	PBA	The GND portion of each PBA shall be contacted with the GND portion of BLU. Refer to the (a) and (b) of 3-3 for the design of BLU.
11	Circuit	The standardized approval from the client is required since the EMI is executed by a client. Our company can only measure the reference since the client measures the BLU.
12	The height of component	Design the BLU with considering the maximum height of parts, which our company suggests.
13	Between the FFC and the C-PBA	Design the instrument with considering the length between the FFC and the control PBA. (The marginal minimum length of 5mm or 8mm is required.)
14	Panel	The surface temperature of panel shall be maintained within 0℃ and 45℃ when the external ambient temperature is at 25℃. (Design the BLU with considering the increase of the temperature in the panel by the LED, CCFL, and etc.)
15	Aging	Recommend to age for over 1 hour at least in the state, which the product is driving initially to stabilize the characteristic of the initial TFT.
16	The attachment of gasket	The additional confirmation by our company is required If the attachment of gasket to the S-PBA of our company is required.(To fix the S-PBA or the EMI)
17	Drive IC	Design the top chassis and the driver IC to be contacted by placing the shape of emboss inside the top chassis as a measure to prevent the driver IC from heating. The size of emboss shall be designed in larger size than the size of IC inside the film of the driver IC. Refer to the (a), (b), (c),(d),(e),(f), and (g)of 3-2 for the design of BLU.
18	The prohibited bandwidth	Design the BLU in order for the BLU not to interfere with the area, where the control PBA and the source PBA are located densely according to the drawing for the BLU from our company.
19	S-PBA	The material, which contacts with the bottom side of S-PBA which has a pattern shall be non-conducting material or shall be insulated.

11. APPENDIX

<3D Mode Scanning Timing (Recommendation)>