SHARP

No.	LD-K22575
DATE	Aug. 27. 2010

TECHNICAL LITERATURE

TFT - LCD MODULE

MODEL No. LK315T3LA94

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DEVELOPMENT DEPARTMENT. 1
LIQUID CRYSTAL DISPLAY DIVISION.1
LIQUID CRYSTAL DISPLAY GROUP
SHARP CORPORATION

RECORDS OF REVISION

LK315T3LA94

SPEC No.	DATE	REVISED No.	PAGE	SUMMARY	NOTE
LD-K22575	Aug. 27. 2010	-	-	-	1st. Issue

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1. Application

This technical literature applies to the color 31.5” TFT-LCD Module (LK315T3LA94).

* In case of using the device for applications such as control and safety equipment for transportation (aircraft, trains, automobiles, etc.), rescue and security equipment and various safety related equipment which require higher reliability and safety, take into consideration that appropriate measures such as fail-safe functions and redundant system design should be taken.

* Do not use the device for equipment that requires an extreme level of reliability, such as aerospace applications, telecommunication equipment (trunk lines), nuclear power control equipment and medical or other equipment for life support.

* SHARP assumes no responsibility for any damage resulting from the use of the device that does not comply with the instructions and the precautions specified in this technical literature.

* Contact and consult with a SHARP sales representative for any questions about this device.

2. Overview

This module is a color active matrix LCD panel incorporating amorphous silicon TFT (Thin Film Transistor). It is composed of a color TFT-LCD panel, driver ICs, Source-PWB, Control-PWB, optical sheets, LED-PWBs and mechanical chassis.
Graphics and texts can be displayed on a 1366×RGB×768 dots panel with 16,777,216 colors by using LVDS (Low Voltage Differential Signaling), I2C interface and +12V DC supply voltage, which are put into Control-PWB.
This module applies the Over Shoot driving (O/S driving) technology, signals are being applied to the Liquid Crystal according to a pre-fixed process as image signals of the present frame when a difference is found between image signals of the previous and current frame by comparing each other. The O/S driving technology makes the Liquid Crystal response within 1 frame completely, motion blur reduce, so that clearer display performance can be realized.
This module also can switch 2D and 3D mode to each other. In 2D mode, this can display images by converting Single Frame Rate signals to Double Frame rate, while in 3D mode, by converting 3D input signals of Single Frame Rate to pseudo-quarter Frame Rate. In both modes, FRC (Frame Rate Control) function operates.

3. Mechanical specifications

Parameter	Specifications	Unit
Display size	80.039 （Diagonal）	cm
	31.5 （Diagonal）	inch
Active area	697.69 (H) × 392.26 (V)	mm
Pixel Format	1366 (H) × 768 (V) （1pixel = R + G + B dot）	pixel
Pixel pitch	0.51075(H) × 0.51075 (V)	mm
Pixel configuration	R,G, B vertical stripe	
Display mode	Normally black	
Outline Dimensions [Note1]	735.4(W) × 433.0(H) × (26.5)(D)	mm
Mass	TBD	kg
Surface treatment [Note2] (Polarizer)	Low-Haze Anti Glare, Hard coating Surface Hardness; 2H	

[Note1] Outline dimensions are shown in Fig.16 & 17.
[Note2] Without the protection film.

4. Interface specifications

4.1. TFT panel driving

CN1 (Interface signals and +12V DC power supply; shown in Fig.1)

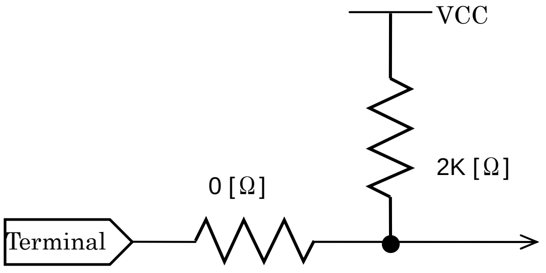
Used connector: GT103-30S-H23-D-E2500 (LSMtron) or IS100-L30B-C23 (UJU)

Mated connector: FI-X30H/FI-X30HL, FI-X30C/FI-X30C2L
or FI-X30M (Japan Aviation Electronics Ind. , Ltd.)

Mated LVDS transmitter: THC63LVDM83R (THine) or equivalent device

Pin No.	Symbol	Function	Type	Remark
1	VCC	+12V Power Supply	I	
2	VCC	+12V Power Supply	I	
3	VCC	+12V Power Supply	I	
4	VCC	+12V Power Supply	I	
5	GND	Ground	I	
6	GND	Ground	I	
7	SDA	I2C data	I/O	[Note1]
8	SCL	I2C clock	I/O	[Note1]
9	Reserved	Not available	-	
10	Reserved	Not available	-	
11	GND	Ground	I	
12	RIN0-	Negative (-) LVDS differential data input	I	[Note 6]
13	RIN0+	Positive (+) LVDS differential data input	I	[Note 6]
14	GND	Ground	I	
15	RIN1-	Negative (-) LVDS differential data input	I	[Note 6]
16	RIN1+	Positive (+) LVDS differential data input	I	[Note 6]
17	GND	Ground	I	
18	RIN2-	Negative (-) LVDS differential data input	I	[Note 6]
19	RIN2+	Positive (+) LVDS differential data input	I	[Note 6]
20	GND	Ground	I	
21	CLKIN-	Clock Signal(-)	I	[Note 6]
22	CLKIN+	Clock Signal(+)	I	[Note 6]
23	GND	Ground	I	
24	RIN3-	Negative (-) LVDS differential data input	I	[Note 6]
25	RIN3+	Positive (+) LVDS differential data input	I	[Note 6]
26	GND	Ground	I	
27	FST	Frame start signal	O	[Note 2, 5]
28	LST	Line start signal	O	[Note 2, 5]
29	LRI	Discriminating signal either left or right eye data (for 3D frame alternative mode only)	I	[Note 3, 5]
30	GLS	Glass shutter control signal	O	[Note 4, 5]

[Note 1] These signals are I2C interface, used to control 2D/3D data. The equivalent circuit figure of these terminals as below:



[Note 2]

These signals are used for LED-ON/OFF scanning. Timing characteristic of them is explained in section 8.2.

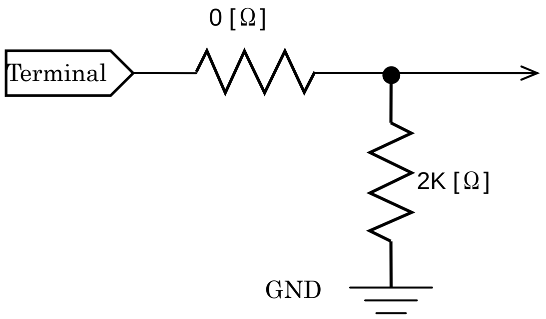
[Note 3]

This signal is used to distinguish Left eye data from Right eye data for 3D frame alternative mode only. Timing characteristic of this signal is explained in section 8.3.

[Note 4]

If you connect this signal to your emitter device and glass, you can synchronize glass shutter timing with 3D data and see 3D contents. Timing characteristic of this signal is explained in section 8.3.

[Note 5] The equivalent circuit figure of these terminals is as below:

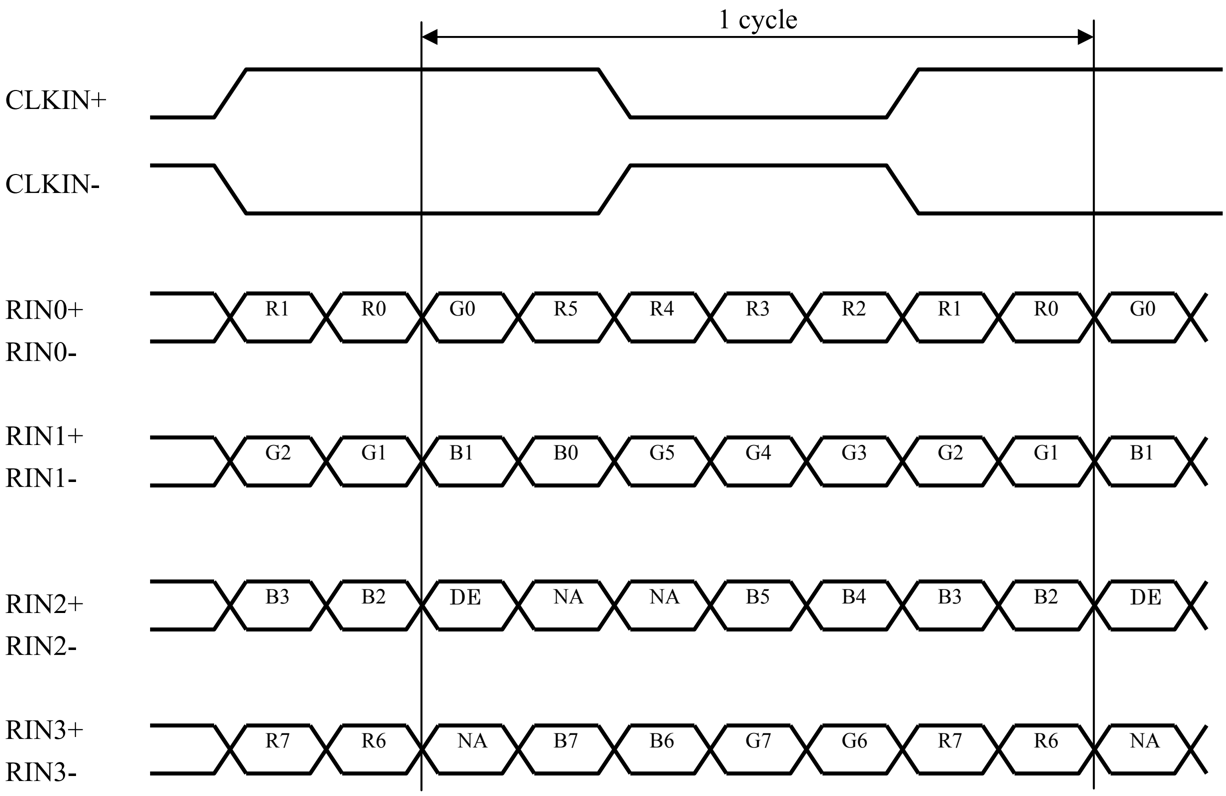


[Note 6] The LVDS data order corresponds to VESA format only in this module. Please input LVDS data as follows:

Transmitter	Data
TA0	R0(LSB)
TA1	R1
TA2	R2
TA3	R3
TA4	R4
TA5	R5
TA6	G0(LSB)
TB0	G1
TB1	G2
TB2	G3
TB3	G4
TB4	G5
TB5	B0(LSB)
TB6	B1
TC0	B2
TC1	B3
TC2	B4
TC3	B5
TC4	NA
TC5	NA
TC6	DE(*)
TD0	R6
TD1	R7(MSB)
TD2	G6
TD3	G7(MSB)
TD4	B6
TD5	B7(MSB)
TD6	NA

NA: Not Available (Fixed Low)

(*) Since the display position is prescribed by the rise of DE (Display Enable) signal, please do not fix DE signal during operation at "High."



NA: Not Available (Fixed Low)

DE: Display Enable

Fig. 1 LVDS input data format

4.2. LED driving

You should adjust LED current to 0.525A. (I_{LED}=0.525A , V_{LED}=about 92V).

CN101 (+525mA DC power supply)

TBD

4.3. Interface block diagram

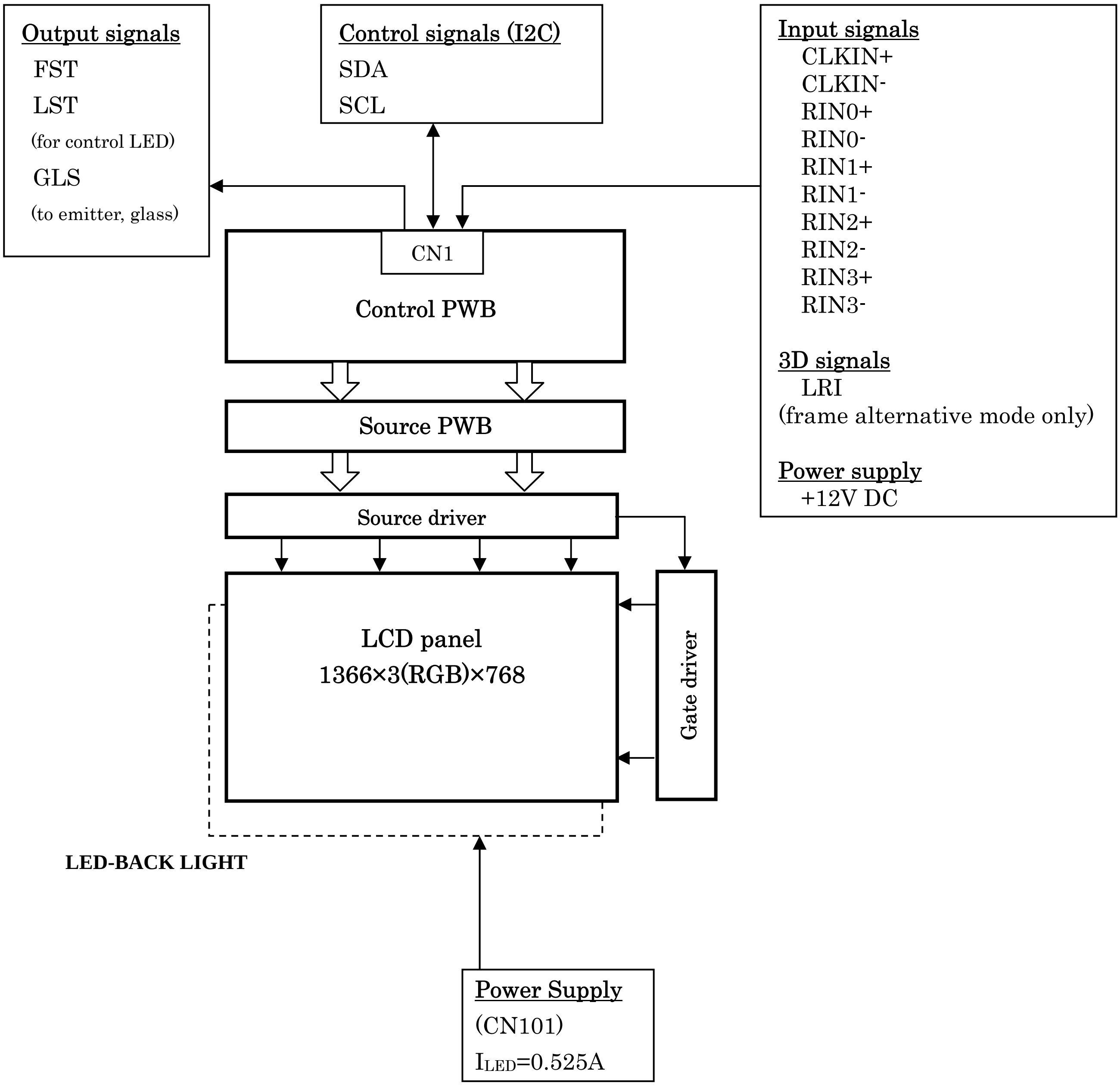


Fig. 2 Interface block diagram

4.4. Display position of data

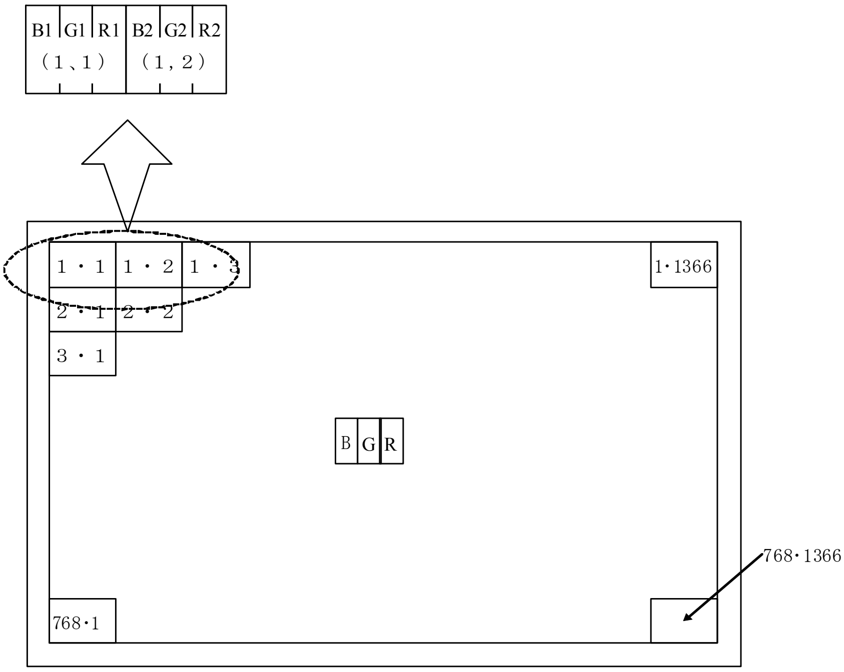


Fig. 3 Display position of data (V, H)

5. Back light lifetime

The back light system is direct type with LED packages. The characteristics of the back light are shown as below:

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
Life time	T_{LED}	TBD	TBD	-	Hour	[Note]

[Note] The value of life time is per one LED.

LED life time is defined as the time when brightness becomes 50% of the original value in the continuous operation under the condition of TC(Temperature of LED terminal)=85℃.

6. Absolute maximum ratings

Parameter	Symbol	Condition	Ratings	Unit	Remark
Input voltage (for Control PWB)	V_I	Ta=25°C	-0.3 ~+ 3.6	V	[Note 1]
+12V supply voltage (for Control PWB)	V_{CC}	Ta=25°C	-0.3 ~+18	V	
Input voltage (for LED)	V_{LED}	Ta=25°C	TBD	V	
Input current (for LED)	I_{LED}	Ta=25°C	TBD	A	
Storage temperature	Tstg	-	-25 ~ +60	°C	[Note 2]
Operation temperature (Ambient)	Topa	-	0 ~ +50	°C	

[Note 1] SDA, SCL, GSP, GCK, LRI, LRO

[Note 2] Humidity 95%RH Max.(Ta ≤ 40°C)

Maximum wet-bulb temperature is 39°C or less (Ta > 40°C). No condensation.

7. Electrical characteristics

7.1. Control circuit

Ta=25°C

Parameter		Symbol	Min.	Typ.	Max.	Uniit	Remark
+12V DC power	Supply voltage	V_{CC}	(+11.4)	+12.0	(+12.6)	V	[Note 1]
	Current consumption	I_{CC}	-	TBD		mA	[Note 2]
		I_{RUSH}	-	TBD		mA	[Note 6]
		T_{RUSH}	-	TBD	-	ms	[Note 6]
	Permissible input ripple voltage	V_{RP}	-	-	TBD	mV_{P-P}	Vcc = +12.0V
Differential signal	Threshold high	V_{TH}	-	-	TBD	mV	*V_{CM} = +1.2V [Note 4]
	Threshold low	V_{TL}	TBD	-	-	mV	
	Terminal resistor	R_T	-	100	-	Ω	LVDS input
Input voltage	Low voltage	V_{IL}	0	-	0.7	V	[Note 3]
	High voltage	V_{IH}	2.6	-	3.3	V	
	Leak current (Low)	I_{IL}	-	-	TBD	μA	V_I = 0V [Note 3]
	Leak current (High)	I_{IH}	-	-	TBD	μA	V_I =3.3V [Note 3]
Output voltage	Low voltage	V_{OL}	0	-	0.7	V	[Note 5]
	High voltage	V_{OH}	2.6		3.3	V	

[Note] *V_{CM}: Common mode voltage of LVDS driver.

[Note 1]

Input voltage sequences

TBD < t1 ≤ TBD

TBD < t2-1

TBD < t2-2

0 < t3 ≤ TBD

t4 ≥ TBD

t5 ≥ TBD

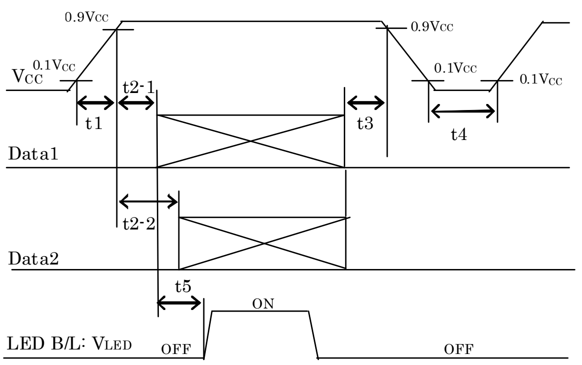
Dip conditions for supply voltage

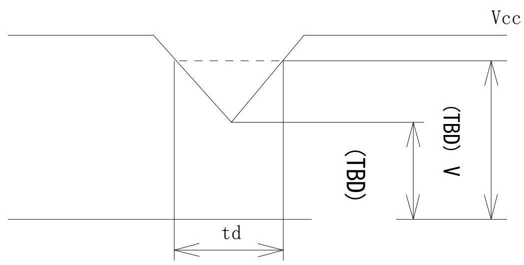
a) TBD ≤ V_{CC} < TBD V

td ≤ TBD

b) V_{CC} < TBD

Dip conditions for supply voltage is based on input voltage sequence.





※ Data1: CLKIN±,RIN0±,RIN1±, RIN2±, RIN3±

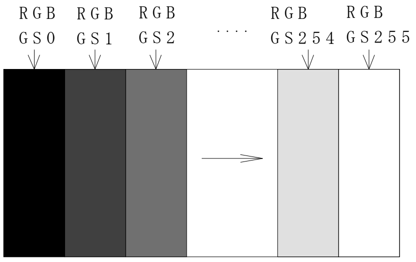
※ Data2: SDA, SCL, LRI

※ About the relation between data input and back light lighting, we recommend the above-mentioned input sequence.

If the back light is switched on before a panel operation begins or after a panel operation stops, the screen may not be displayed properly. But this phenomenon is not caused by change of an incoming signal, and does not give damage to a liquid crystal display.

[Note 2]Typical current situation: 256 gray-bar pattern (V_{CC} = +12.0V)

The explanation of RGB gray scale is seen in section 8.



V_{CC} = +12.0V
CK = 82.0MHz
Th = 20.68μs

[Note 3] SDA, SCL, LRI

[Note 4] CLKIN+/CLKIN-, RIN0+/RIN0-, RIN1+/RIN1-, RIN2+/RIN2-, RIN3+/RIN3-

[Note 5] FST, LST, GLS

[Note 6] The rush current corrugation at the time of power on: TBD

7.2. LED back light

Ta=25℃

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
LED Current	I_{LED}		(0.525)		A	Tc≦85℃ [Note1]
LED Voltage	V_{LED}		(92)		V	[Note2]

[Note1] LED current (I_{LED}) is the value of total packages. It must be controlled to keep Tc lower than 85℃.

[Note2] Ta = 25℃, Measurement after 1hour has passed since power supply was turned on.

8. Timing characteristic of input and output signals

8.1. Input data format

You need to send I2C command in order to start up. At first you send target device command, next input data format command to each register. Slave address of target device should be set to “0x5A”. Register command table is as follows:

*Slave address (7bit) : 0x5A

Register address	Description	Definition
0x 0000	I2C status	0 : Busy 1 : OK
0x 0010	Target device	00 (fixed)
0x 0030	Input data format	00: 2D mode 81: Side by Side 82: Top and Bottom 83: Frame Alternative 84: Frame Packing

[Note] We recommend SOC device of input signals are MSD3819JX, MSD3819SV (for digital TV) and MST6300RS, MST6100VS (for analog TV).

Input data format diagrams are shown as follows. Please refer to section 8.2 about the range of TH, TV, THd and TVd.

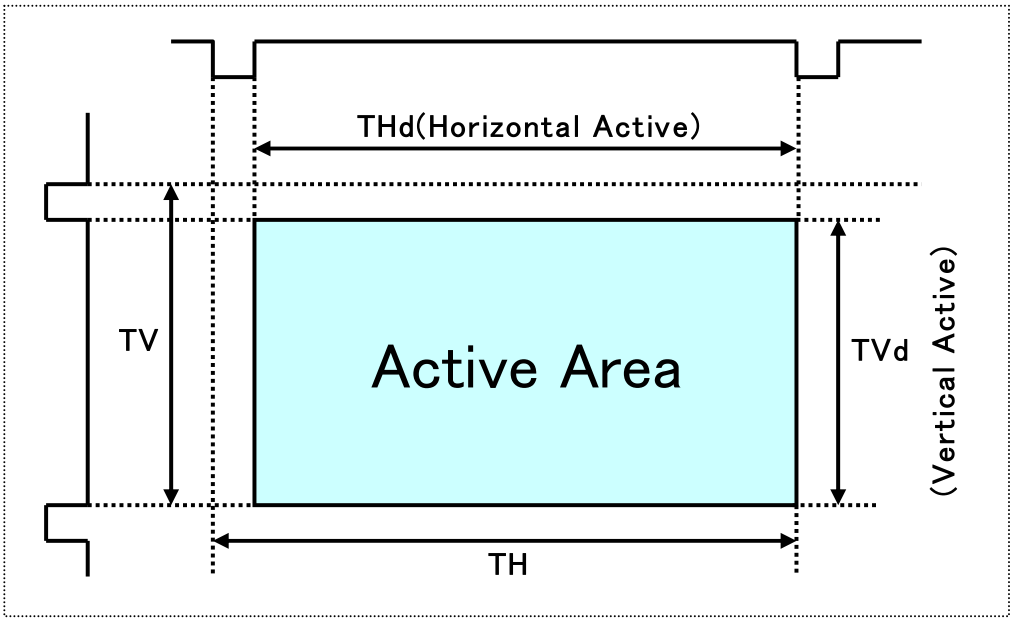


Fig. 4 2D mode

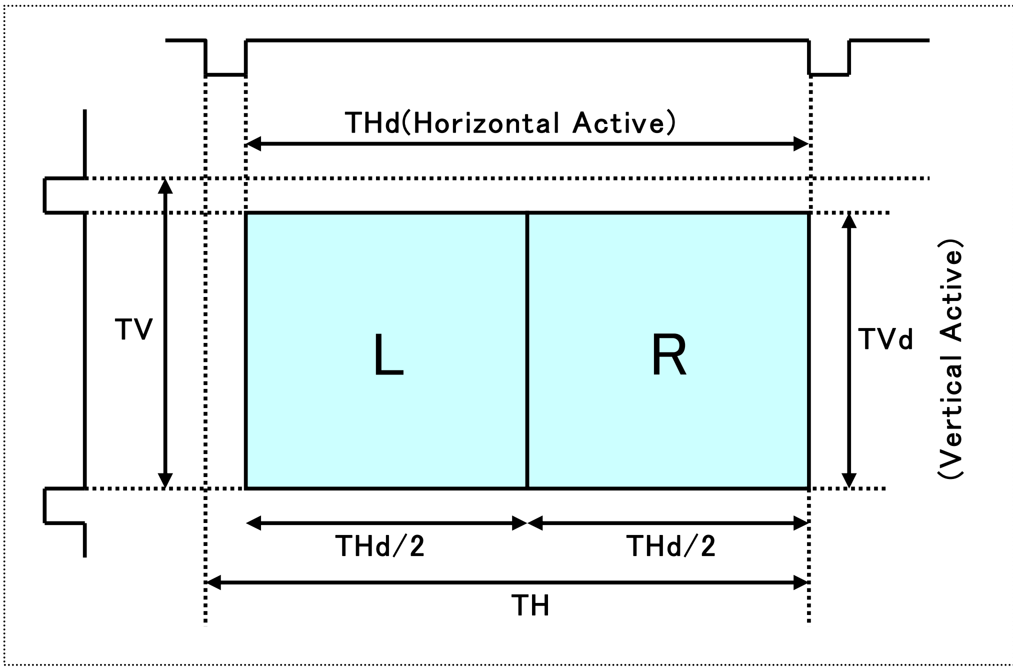


Fig. 5　3D-Side by Side mode

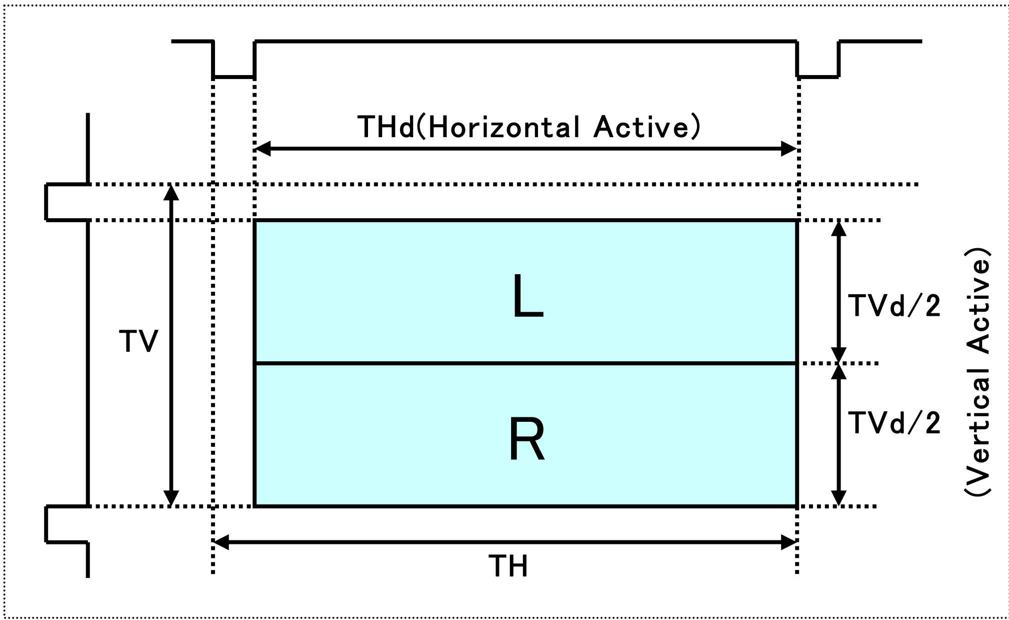


Fig. 6　3D-Top and Bottom mode

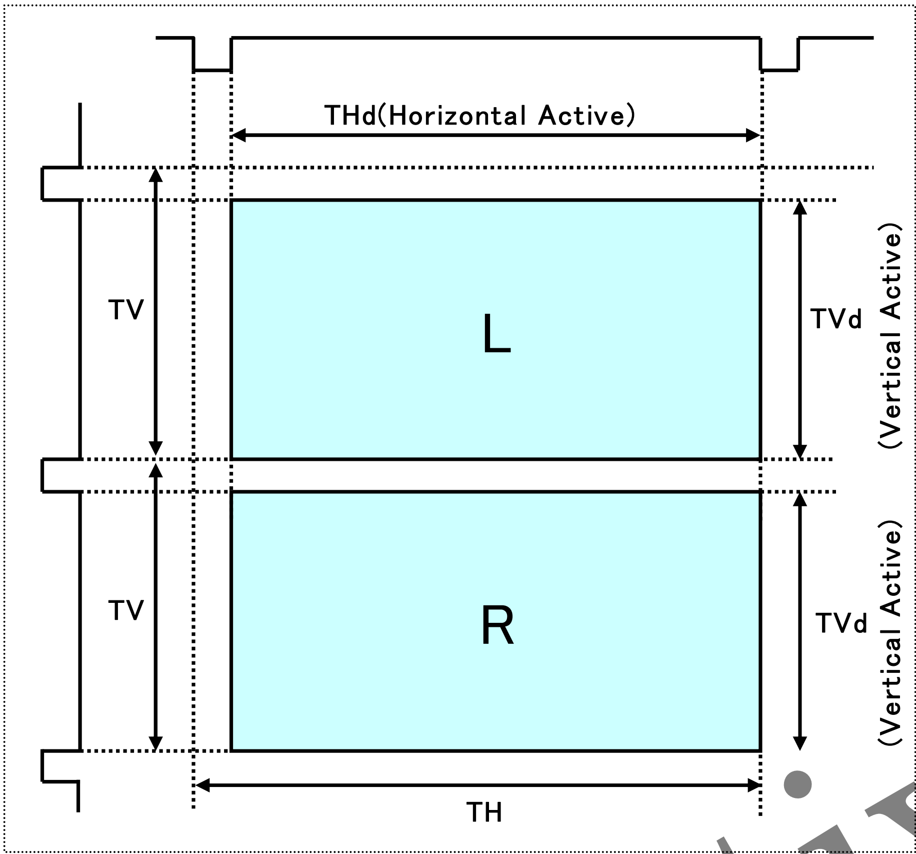


Fig. 7 3D-Frame Alternative mode (TBD)

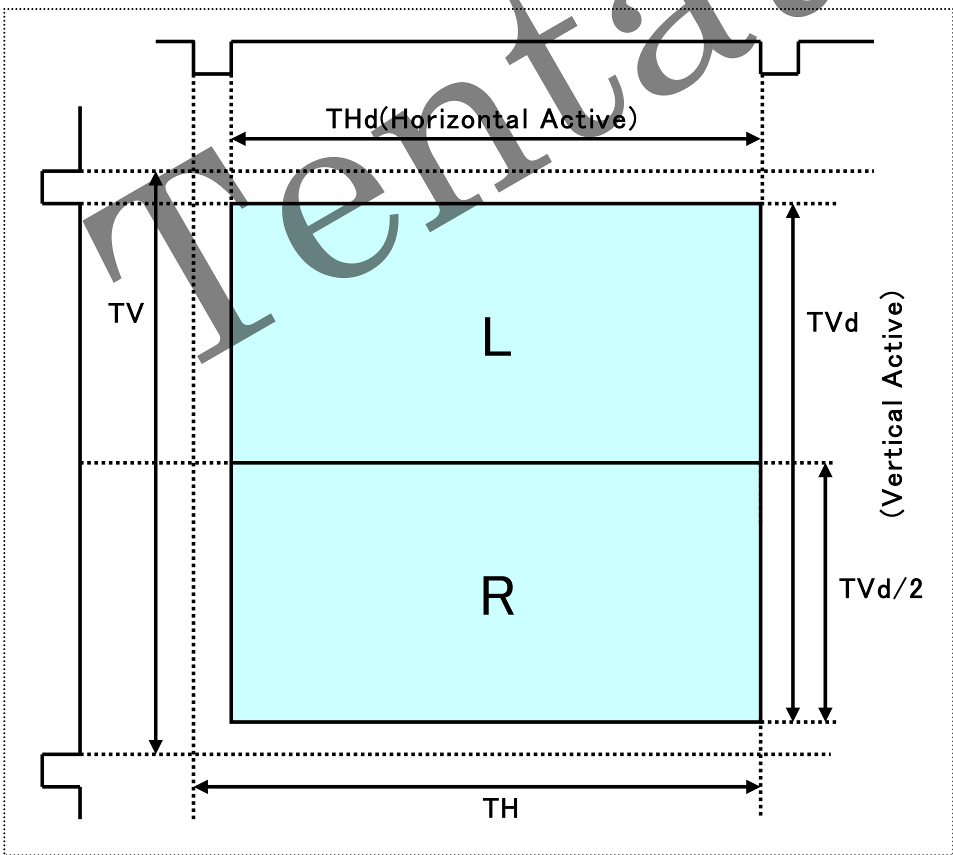


Fig. 8 3D-Frame Packing mode (TBD)

8.2. Timing characteristics of input signals

Timing diagrams of input signal are shown in Fig.9.

[2D mode / 3D mode Side by Side, Top and Bottom]

Parameter		Symbol	Min.	Typ.	Max.	Unit
Clock	Frequency	1/Tc	TBD	82	TBD	MHz
Data enable signal	Horizontal period	TH	TBD	1696	TBD	clock
			TBD	20.68	-	μs
	Horizontal period (High)	THd	-	1366	-	clock
	Vertical period	TV	TBD	806	TBD	line
	Vertical period (High)	TVd	-	768	-	line

[3D mode / Frame Alternative]

Parameter		Symbol	Min.	Typ.	Max.	Unit
Clock	Frequency	1/Tc	TBD	TBD	TBD	MHz
Data enable signal	Horizontal period	TH	TBD	TBD	TBD	clock
			TBD	TBD	-	μs
	Horizontal period (High)	THd	-	TBD	-	clock
	Vertical period	TV	TBD	TBD	TBD	line
	Vertical period (High)	TVd	-	TBD	-	line

[3D mode / Frame Packing]

Parameter		Symbol	Min.	Typ.	Max.	Unit
Clock	Frequency	1/Tc	TBD	TBD	TBD	MHz
Data enable signal	Horizontal period	TH	TBD	TBD	TBD	clock
			TBD	TBD	-	μs
	Horizontal period (High)	THd	-	TBD	-	clock
	Vertical period	TV	TBD	TBD	TBD	line
	Vertical period (High)	TVd	-	TBD	-	line

[Note] *When a vertical period is very long, a flicker may occur.
*Please turn off the module after it shows the black screen.
*Please make sure that a length of vertical period should be an integral multiple of horizontal period, otherwise the screen may not display properly.
*Please be careful not to fall below the minimum horizontal period, otherwise the display may be dark.

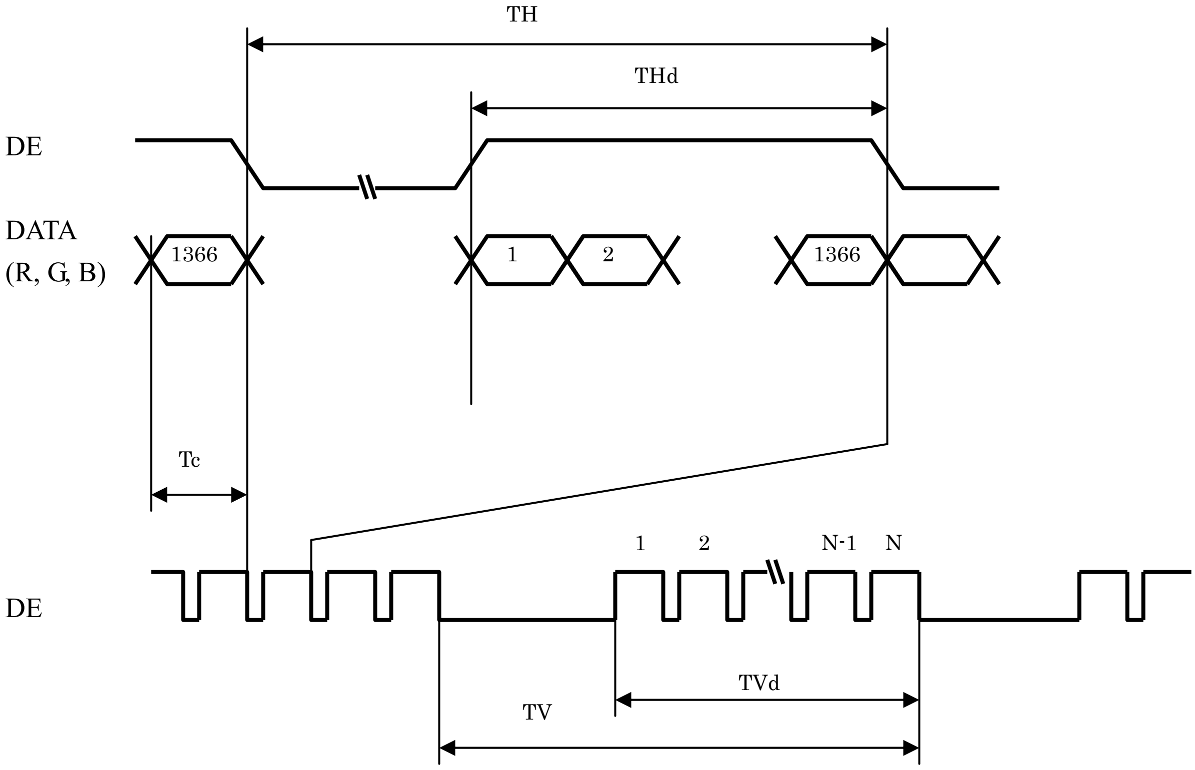


Fig. 9 Timing diagram of input signals

8.3. Control signals for 3D mode

[Input signal] LRI

LRI indicates the status of either left or right eye data for 3D frame alternative mode only. When LRI is 'High', input data is recognized as Right eye data. When LRI is 'Low', input data is recognized as Left eye data.

If you use 3D frame alternative mode, you should input LRI synchronized with data as below. In other modes, LRI is not used. (Don't care)

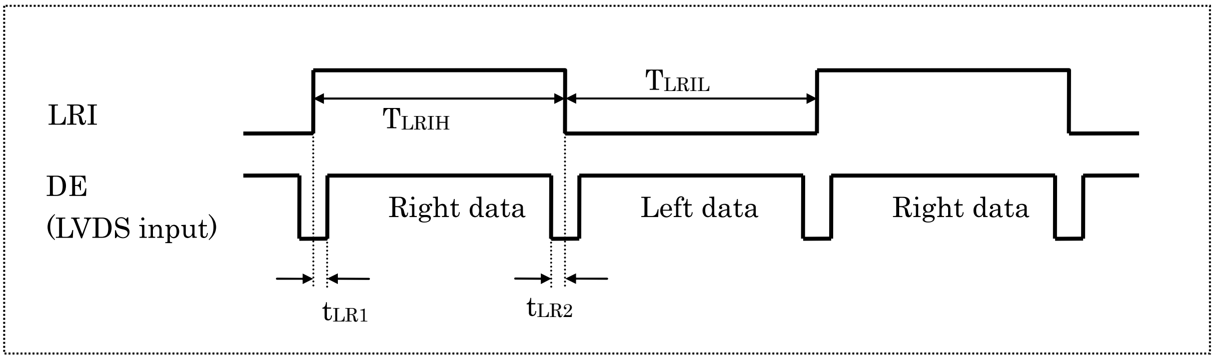


Fig. 10 LRI timing diagram

Parameter	Symbol	Min.	Typ.	Max.	unit
High time of LRI	T_{LRIH}	-	T_V	-	
Low time of LRI	T_{LRIL}	-	T_V	-	
LRI High to DE rise edge	t_{LR1}	TBD	TBD	TBD	us
DE High to LRI fall edge	t_{LR2}	TBD	TBD	TBD	us

[Output signal]   FST, LST, GLS

FST is a frame start pulse and output by the period of $T_V/2$. LST is a line start pulse and output by the period of T_H. Since they can be used for control LED-ON/OFF duty, you may design any device able to control LED. These signals are fixed at ‘Low’ in 2D mode.

GLS is a rectangular signal to control glass shutter timing, reversed by period of $T_V/2$ and synchronized with FST. You connect this signal to your emitter device in order to control opening and closing glass shutter. This signal is fixed at ‘Low’ in 2D mode.

The timing diagram between these signals and data is shown in Fig. 12.

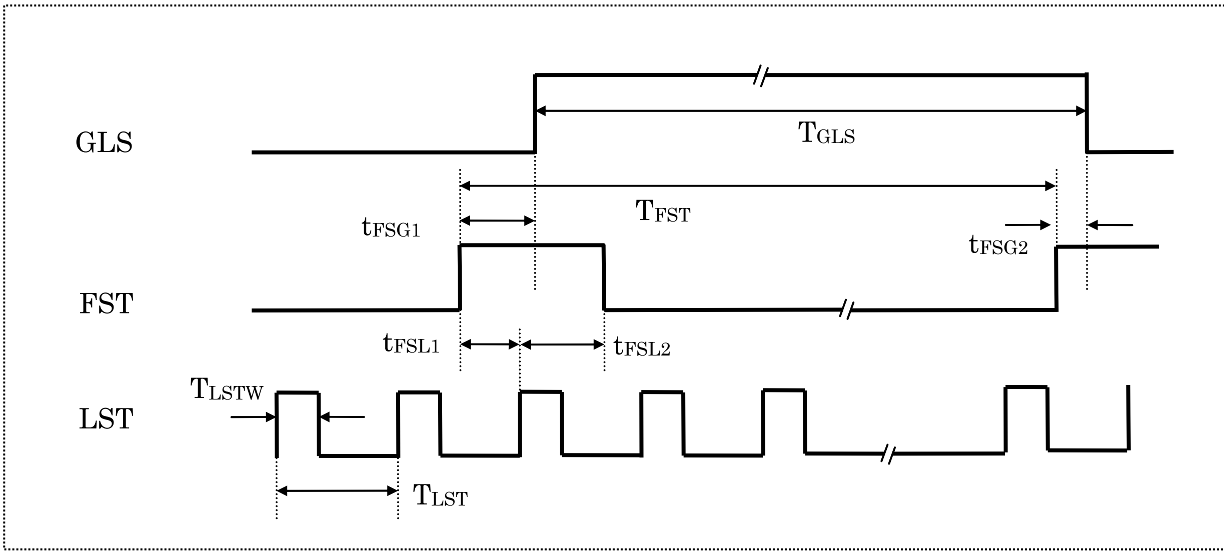


Fig. 11 Timing diagram of GLS, FST, and LST

Parameter	Symbol	Min.	Typ.	Max.	unit
Reverse period of GLS	T_{GLS}	-	$T_V/2$	-	
Period of FST	T_{FST}	-	$T_V/2$	-	
Width of LST	T_{LSTW}	TBD	TBD	TBD	us
Period of LST	T_{LST}	-	T_H	-	
Time from FST rise to GLS rise edge	t_{FSG1}	TBD	TBD	TBD	us
Time from FST rise to GLS fall edge	t_{FSG2}	TBD	TBD	TBD	us
Time from FST rise to GLS rise edge	tFSL1	TBD	TBD	TBD	us
Time from LST rise to GLS fall edge	tFSL2	TBD	TBD	TBD	us

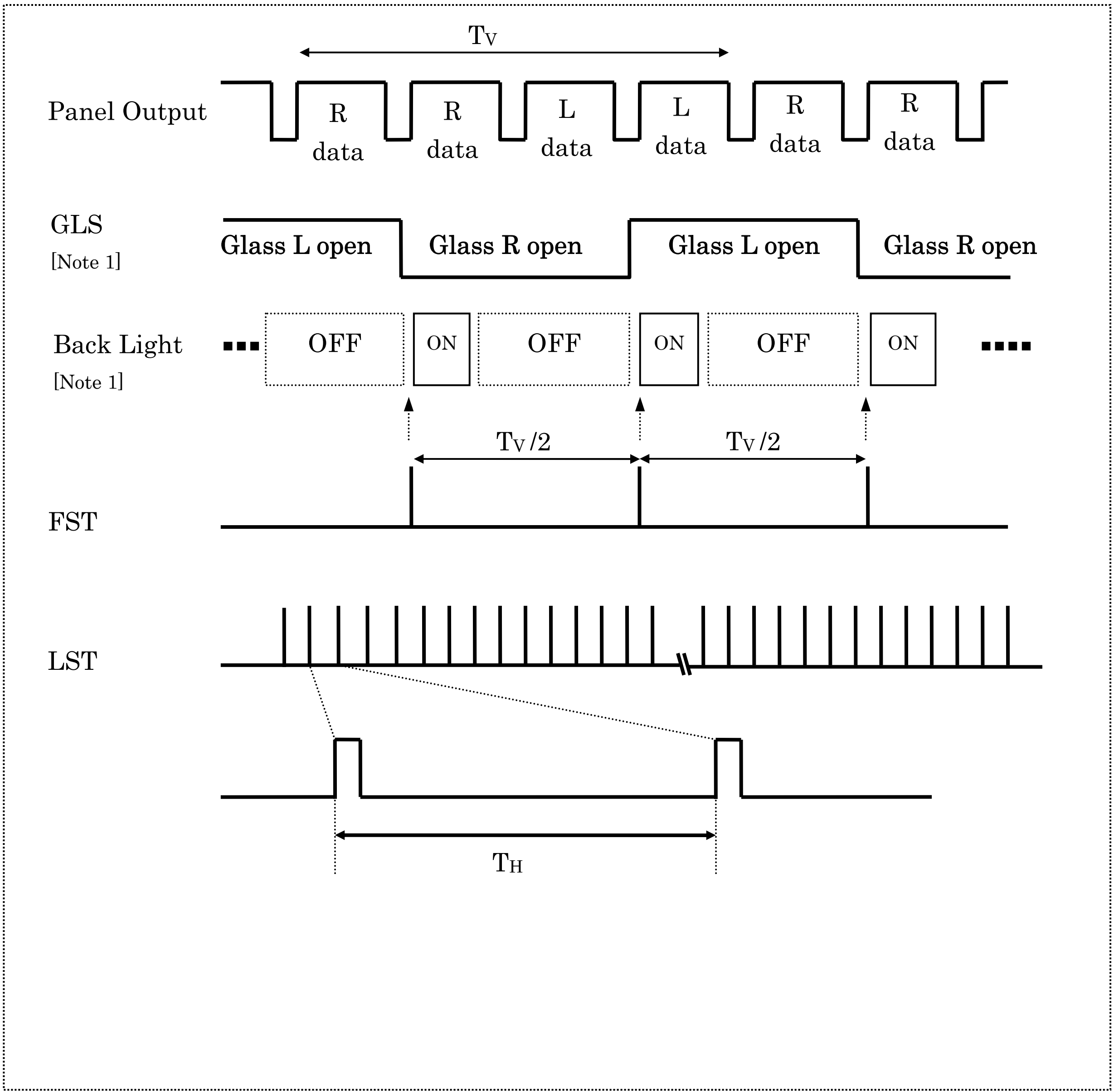


Fig. 12 The timing diagram between LED control signals and data (3D mode)

[Note 1]

The way of glass shutter opening is depended on each 3D glass. Above diagram is an example of the condition;

・Left glass open and right glass close when GLS is 'H'

・Left glass close and right glass open when GLS is 'L'.

When you use 3D glass different from above mentioned type, you should reverse the order of LED-ON/OFF.

9. Input signal, basic display colors and gray scale of each color

	Colors & Gray scale	Gray Scale	R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3	B4	B5	B6	B7
			Data signal																							
Basic Color	Black	–	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	–	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Green	–	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Cyan	–	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Red	–	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	–	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	–	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	White	–	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gray Scale of Red	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	GS1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	GS2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	↓				↓								↓								↓				
	⇩	↓				↓								↓								↓				
	Brighter	GS253	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇩	GS254	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	GS255	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray Scale of Green	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	GS1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Darker	GS2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	↓				↓								↓								↓				
	⇩	↓				↓								↓								↓				
	Brighter	GS253	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	⇩	GS254	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Green	GS255	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Gray Scale of Blue	Black	GS0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	⇧	GS1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	Darker	GS2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	⇧	↓				↓								↓								↓				
	⇩	↓				↓								↓								↓				
	Brighter	GS253	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1
	⇩	GS254	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
	Blue	GS255	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

0: Low level voltage　　　　1: High level voltage

Each basic color can be displayed in 256 gray scales from 8 bit data signals. According to the combination of total 24 bit data signals, the 16,777,216 colors can be displayed on the screen.

10. Optical characteristics

10.1. 2D mode

Ta = 25°C, Vcc = +12V, V_{LED} = (92V), I_{LED} = 0.525A

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing angle range	Horizontal	θ 21 θ 22	CR ≥ 10	70	88	-	Deg.	[Note1,4]
	Vertical	θ 11 θ 12		70	88	-	Deg.	
Contrast ratio		CRn	θ=0 deg.	(TBD)	(5000)	-	-	[Note2,4]
Response time		τ_{DRV}		-	(4)	-	ms	[Note3,4,5]
Chromaticity of white		x		Typ.-0.03	TBD	Typ.+0.03	-	[Note 4]
		y		Typ.-0.03	TBD	Typ.+0.03	-	
Chromaticity of red		x		Typ.-0.03	TBD	Typ.+0.03	-	
		y		Typ.-0.03	TBD	Typ.+0.03	-	
Chromaticity of green		x		Typ.-0.03	TBD	Typ.+0.03	-	
		y		Typ.-0.03	TBD	Typ.+0.03	-	
Chromaticity of blue		x		Typ.-0.03	TBD	Typ.+0.03	-	
		y		Typ.-0.03	TBD	Typ.+0.03	-	
Luminance of white		Y_L		(TBD)	(450)		cd/m^2	[Note 4]
Luminance uniformity		δ_W		-	-	TBD	-	[Note 6]

*The measurement shall be executed 60 minutes after turning on.

*These characteristics are for 2D mode only.

[Note] The optical characteristics are measured using the following equipment.

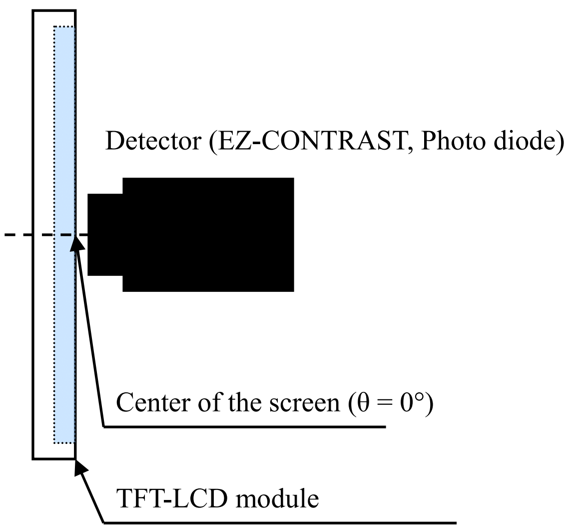


Fig. 13 Measurement of viewing angle range and response time. (Viewing angle range: EZ-CONTRAST Response time: Photo diode)

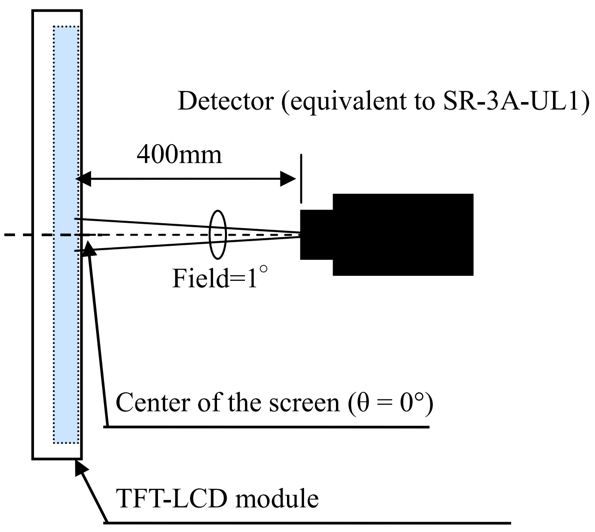
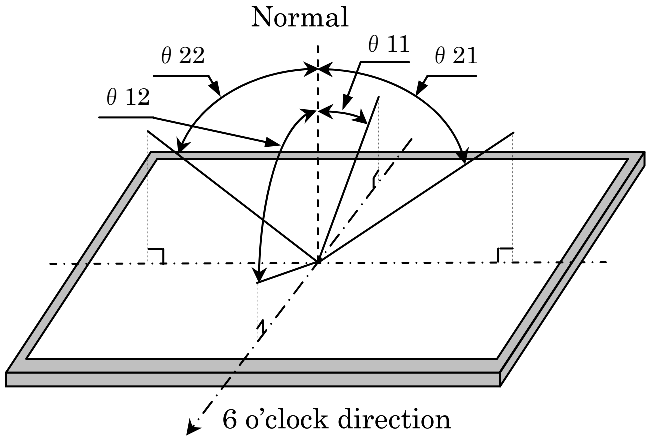


Fig. 14 Measurement of Contrast, Luminance, and Chromaticity.

[Note 1] Definitions of viewing angle range:



[Note 2] Definition of contrast ratio:

The contrast ratio is defined as the following.

$$\text{Contrast ratio} = \frac{\text{Luminance (brightness) with all pixels white}}{\text{Luminance (brightness) with all pixels black}}$$

[Note 3] Definition of response time

The response time (τ_{DRV}) is defined as the following equation and shall be measured by switching the input signal from "any level of gray (0%, 25%, 50%, 75% and 100%)" to "any level of gray (0%, 25%, 50%, 75% and 100%)".

	0%	25%	50%	75%	100%
0%		tr: 0%-25%	tr: 0%-50%	tr: 0%-75%	tr: 0%-100%
25%	td: 25%-0%		tr: 25%-50%	tr: 25%-75%	tr: 25%-100%
50%	td: 50%-0%	td: 50%-25%		tr: 50%-75%	tr: 50%-100%
75%	td: 75%-0%	td: 75%-25%	td: 75%-50%		tr: 75%-100%
100%	td: 100%-0%	td: 100%-25%	td: 100%-50%	td: 100%-75%	

$\tau_{DRV} = \Sigma(t^*:x\text{-}y)/20$

t*:x-y...response time from level of gray(x) to gray(y)

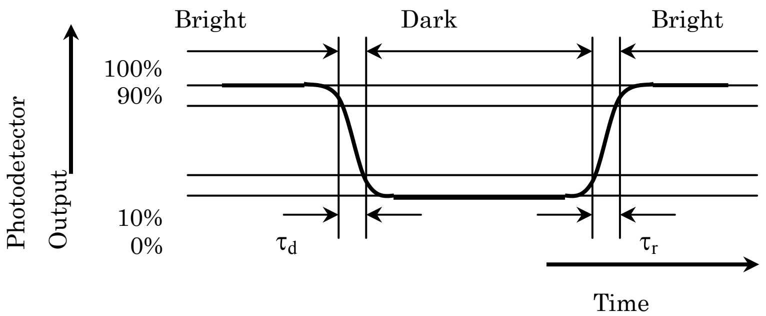


Fig. 15 Response time of fall (τ_d) and rise (τ_r)

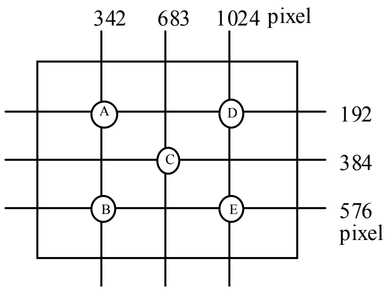
[Note 4] This shall be measured at center of the screen.

[Note 5] This value is valid when O/S driving is used at typical input timing.

[Note 6] Definition of white uniformity;

White uniformity is defined as the following with five measurements. (A～E)

$$\delta w = \frac{\text{Maximum luminance of five points (brightness)}}{\text{Minimum luminance of five points (brightness)}}$$



10.2. 3D mode

TBD

11. Reliability

Reliability test item:

No.	Test item	Condition
1	High temperature storage test	Ta=60°C 240h
2	Low temperature storage test	Ta=-25°C 240h
3	High temperature and high humidity operation test	Ta=40°C ; 95%RH 240h (No condensation)
4	High temperature operation test	Ta=50°C 240h
5	Low temperature operation test	Ta=0°C 240h

12. Packing form

a) Piling number of cartons: TBD / 1pallette.

b) Packing quantity in one carton: TBD pcs

c) Carton size: TBD(W) × TBD(D) × TBD(H)

d) Total mass of one carton filled with full modules: TBD(Max)

13. Carton storage condition

a) Temperature: 0°C to 40°C

b) Humidity: 95%RH or less

Reference condition: 20°C to 35°C, 85%RH or less (summer)

: 5°C to 15°C, 85%RH or less (winter)

The total storage time (40°C, 95%RH): 240H or less

c) Sunlight:

Be sure to shelter a product from the direct sunlight.

d) Atmosphere:

Do not store in a place where exists the risk of corrosive gas (such as acid and alkali) or volatile solvents.

e) Prevent condensation:

Be sure to put cartons on a palette or base, don’t put it on the floor, and store them keeping off the wall.

Please take care of ventilation in storehouse and around cartons, and control temperature not to change abruptly beyond the natural environment.

f) Storage life: 1 year

14. Precautions

a) Be sure to turn off the power supply when inserting or disconnecting the cable.

b) Be sure to design the cabinet so that the module can be installed without any extra stress such as warp or twist.

c) Since the front polarizer is easily damaged, pay attention not to scratch it.

d) Since long contact with water may cause discoloration or spots, wipe off water drop immediately.

e) When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.

f) Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface. Handle with care.

g) Since CMOS LSI is used in this module, take care of static electricity and take the human earth into consideration when handling.

h) The module has some printed circuit boards (PCBs) on the back side, take care to keep them form any stress or pressure when handling or installing the module; otherwise some of electronic parts on the PCBs may be damaged.

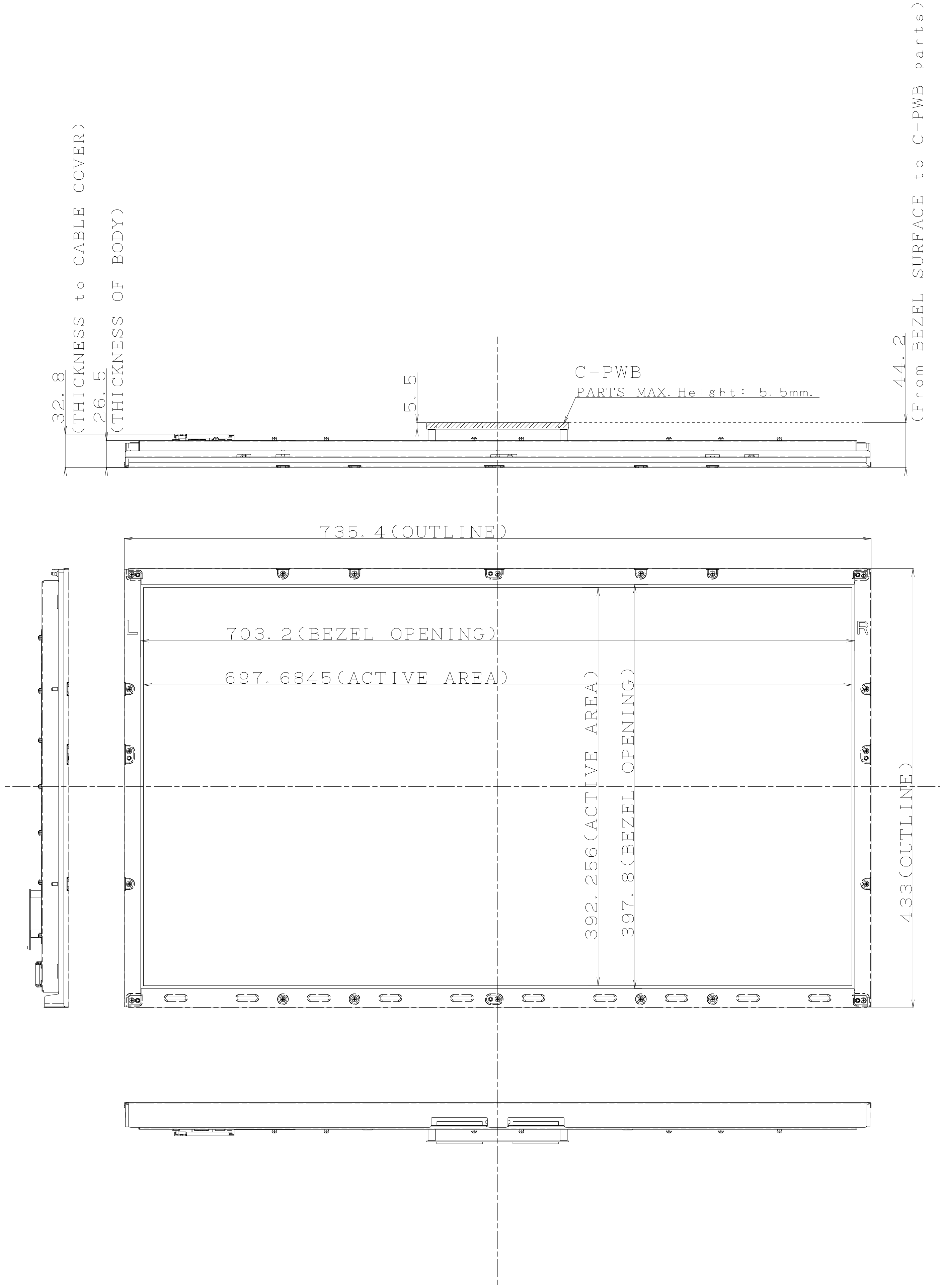
i) Observe all other precautionary requirements in handling components.

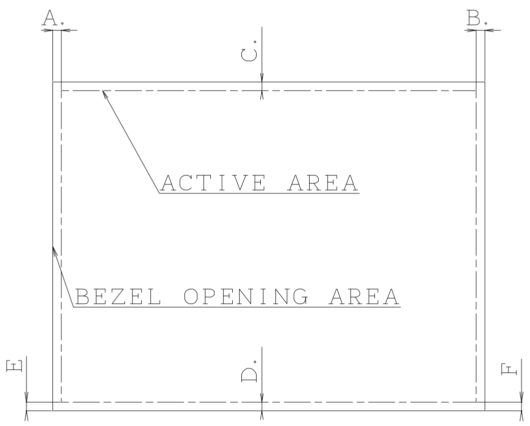
j) When some pressure is added onto the module from rear side constantly, it causes display non-uniformity issue, functional defect, etc. So, please avoid such design.

k) When giving a touch to the panel at power on supply, it may cause some kinds of degradation. In that case, once turn off the power supply, and turn on after several seconds again, and that is disappear.

l) When handling LCD modules and assembling them into cabinets, please be noted that long-term storage in the environment of oxidization or deoxidization gas and the use of such materials as reagent, solvent, adhesive, resin, etc. which generate these gasses, may cause corrosion and discoloration of the LCD modules.

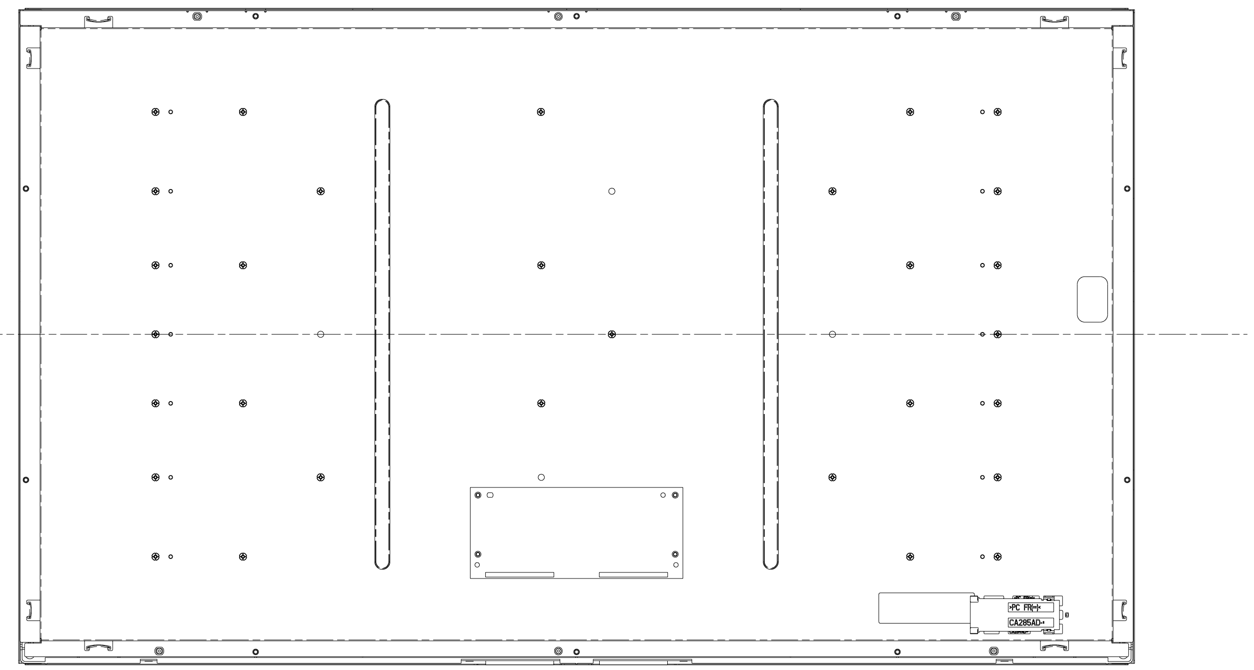
m) This LCD module is designed to prevent dust from entering into it. However, there would be a possibility to have a bad effect on display performance in case of having dust inside of LCD module. Therefore, please ensure to design your TV set to keep dust away around LCD module.





BEZEL/DISPLAY POSITION

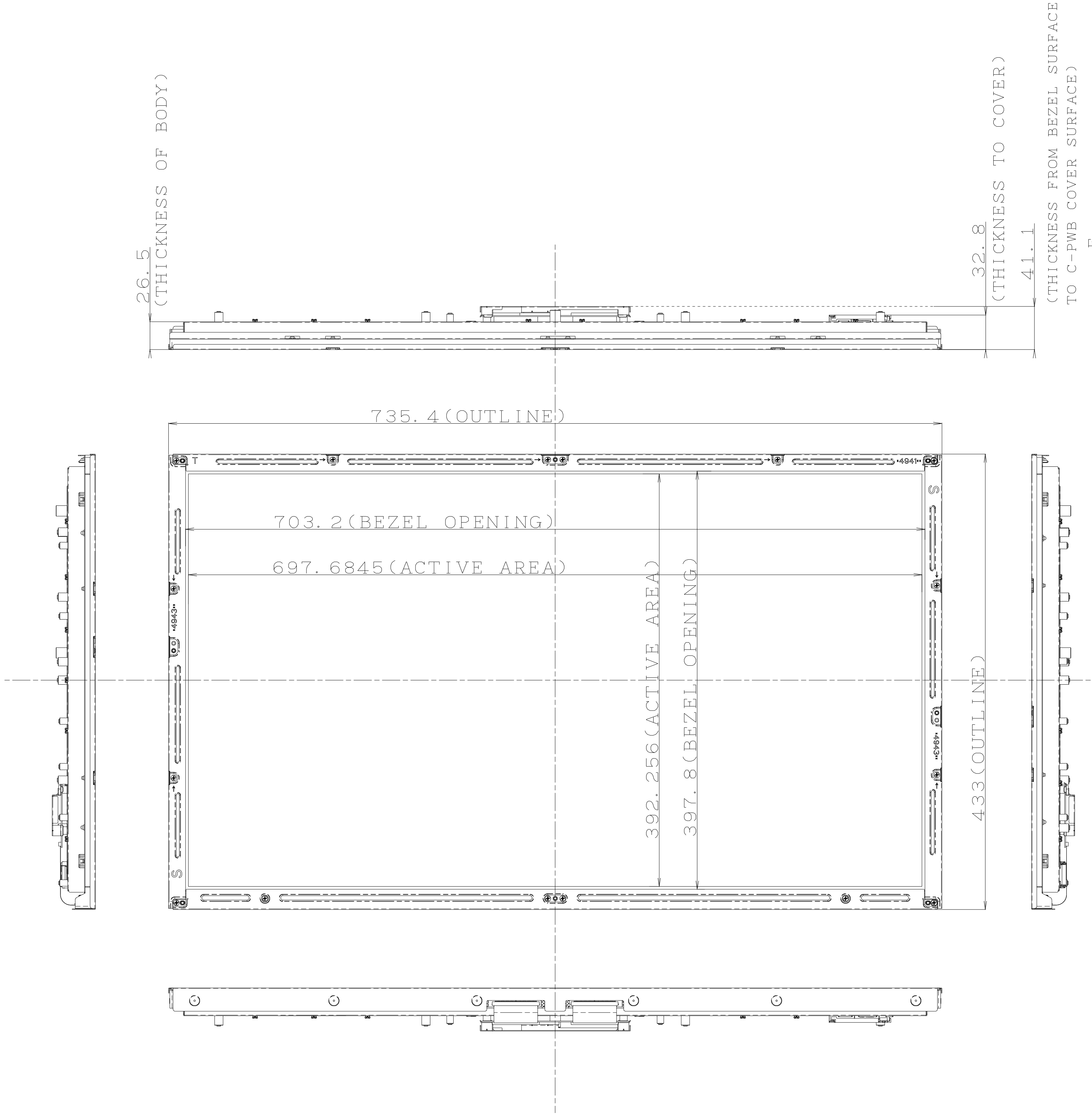
1) TOLERANCE X-DIRECTION A: 2.7578 ±0.8
2) TOLERANCE X-DIRECTION B: 2.7578 ±0.8
3) TOLERANCE Y-DIRECTION C: 2.772 ±0.8
4) TOLERANCE Y-DIRECTION D: 2.772 ±0.8
5) OBLIQUITY OF DISPLAY AREA |E-F|<0.8

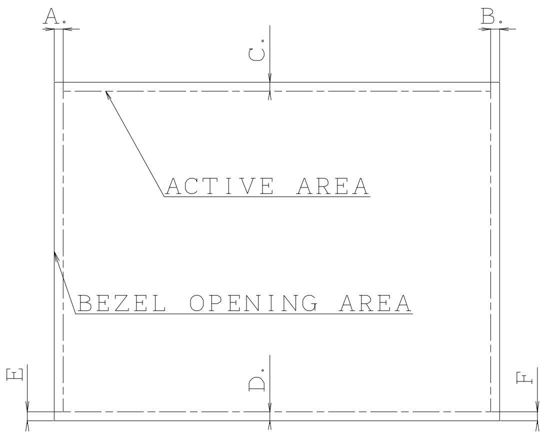


NOTE)
TOLERANCE OF DIMENSIONS MUST BE ±1.0 UNLESS OTHERWISE SPECIFIED.

FIG. 16 OUTLINE DIMENSION of LK315T3LA94
(FOR WS SAMPLE ONLY)

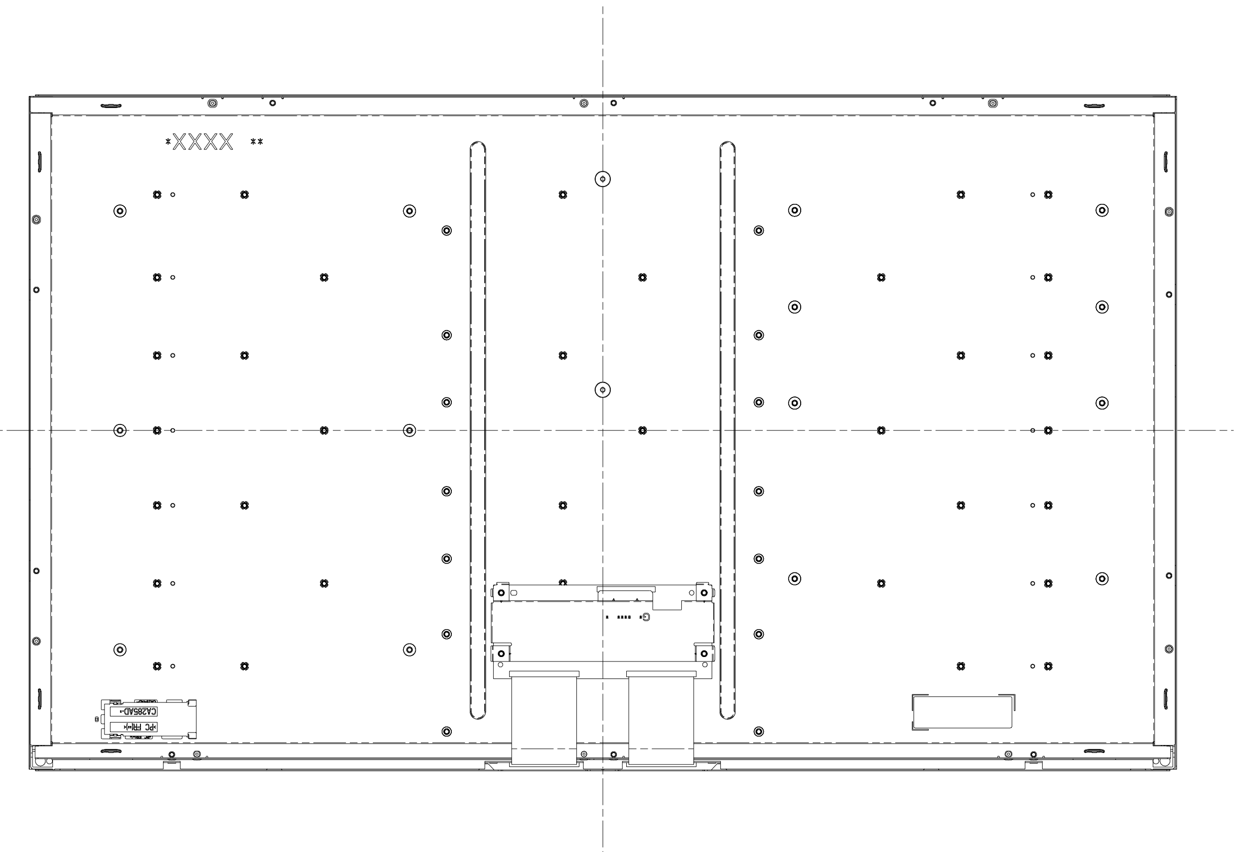
LD-K22575-23





BEZEL/DISPLAY POSITION

1) TOLERANCE X-DIRECTION A: 2.7578 ±0.8
2) TOLERANCE X-DIRECTION B: 2.7578 ±0.8
3) TOLERANCE Y-DIRECTION C: 2.772 ±0.8
4) TOLERANCE Y-DIRECTION D: 2.772 ±0.8
5) OBLIQUITY OF DISPLAY AREA |E-F|<0.8



NOTE)
TOLERANCE OF DIMENSIONS MUST BE ±1.0 UNLESS OTHERWISE SPECIFIED.

LD-K22575-24

FIG.17 OUTLINE DIMENSION of LK315T3LA94