



# SmarterGlass

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# Chunghwa Picture Tubes, Ltd.

## Technical Specification

To : **Samrterglass**

Date : 160629

*CPT TFT-LCD*  
**CLAA101FP0A XG**

ACCEPTED BY : (V0.3)

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**Modification Record List**

NO.	Issue Date	Modification Index
1	2016/02/17	First Edition
2	2016/03/04	(1) Modify Viewing Angle(85→89) P4,P16 (2) Modify Luminance (560nits→650nits) P16 (3) Modify LED Driver Input Voltage(19V→17V) P5, P7
3	2016/04/12	(1)Modify PIN assignment→P9

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## 1. OVERVIEW

**CLAA101FP0A** is 10.1" color (16 : 10) TFT-LCD (Thin Film Transistor Liquid Crystal Display) module composed of LCD panel, driver ICs, control circuit and backlight. By applying 8 bit digital data, 1920×RGB (3) ×1200, 16.7M-color images are displayed on the 10.1" diagonal screen. General specifications are summarized in the following table :

ITEM	SPECIFICATION
Display Area	216.576 (H) x 135.36 (V) (mm) (10.1-inch diagonal)
Number of Pixels	1920×RGB (3) ×1200
Pixel Pitch	0.1128 (H) × 0.1128 (V) (mm)
Color Pixel Arrangement	RGB vertical stripe
Display Mode	HFFS
Number of Colors	16,777,216
Interface Signal	LVDS
Gamut	50% (Typ)
Response Time	30ms (Typ) / 40ms (Max)
Surface Treatment	HC-LR
Viewing Angle	80°、80°/ 80°、80° (Min) 89°、89°/89°、89° (Typ.)
Brightness	700 cd/m <sup>2</sup> (Center) (Typ)
Uniformity	9point : 75%(min)
Consumption of Power	6.5 (Max)
Module Size	229(W)×153 (H)×2.5 (D) (mm) (Typical) (w/o pcb))
Module Weight	150g (Typ.)

The LCD Products listed on this document are not suitable for use of aerospace equipment, submarine cable, and nuclear reactor control system and life support systems. If customers intend to use these LCD products for applications listed above or those not included in the "Standard" list as follows, please contact our sales in advance.

Standard : Computer, Office equipment, Communication equipment, Test and Measurement equipment, Machine tool, Industrial robot, Audio and Visual equipment, Other consumer products.

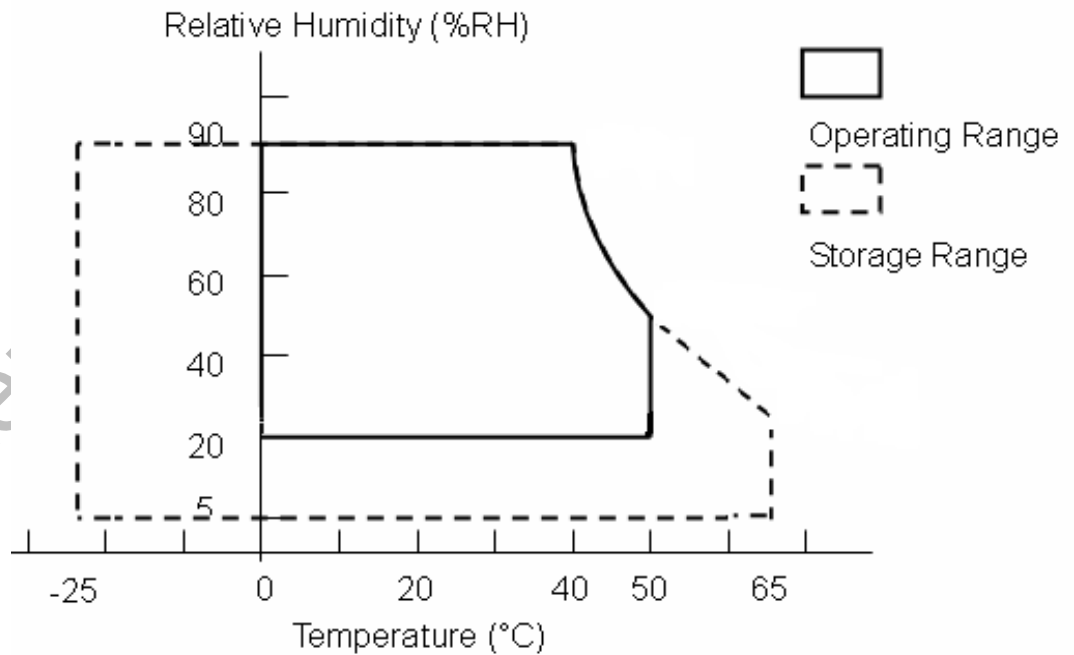
## 2. ABSOLUTE MAXIMUM RATINGS

The following are maximum value, which if exceeded, may cause faulty operation or damage to the unit.

ITEM	SYMBOL	MIN	MAX	UNIT	NOTE
LCD Power Voltage	Vin	0	4.0	V	
LED Driver Input Voltage	VBL+	0	17	V	
Operation Temperature	Top	0	50	°C	*1).*2).*3).*4)
Storage Temperature	Tstg	-25	65	°C	*1).*2).*3)

**【Note】**

- \*1) The relative temperature and humidity range are as below sketch, 90%RH Max. ( $T_a \leq 40^\circ\text{C}$ )
- \*2) The maximum wet bulb temperature  $\leq 39^\circ\text{C}$  ( $T_a > 40^\circ\text{C}$ ) and without dewing.
- \*3) If product in environment which over the definition of the relative temperature and humidity out of range too long, it will affect visual of LCD.
- \*4) If you operate LCD in normal temperature range, the center surface of panel should be under  $50^\circ\text{C}$ .



### 3. ELECTRICAL CHARACTERISTICS

#### (A) TFT LCD

ITEM	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
LCD Power Voltage	Vin	3.0	3.3	3.6	V	*1)
LCD Power Current	Iin	-	400	600	mA	*2)
Rush Current	Irush	-	-	3	A	*4)

**【Note】**

\*1) Power Sequence :

$$0.01 \text{ ms} < t1 \leq 50 \text{ ms}$$

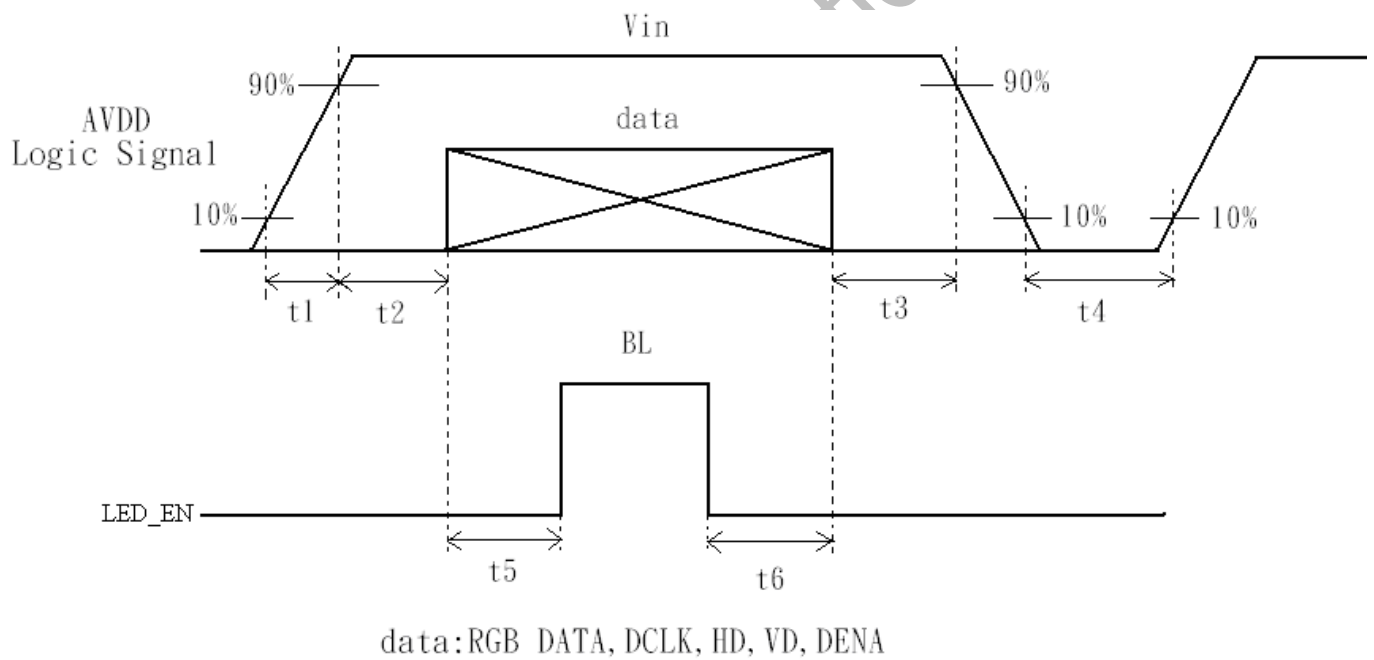
$$100 \text{ ms} \leq t2 \leq 150 \text{ ms}$$

$$0.01 \text{ ms} < t3 \leq 50 \text{ ms}$$

$$500 \text{ ms} \leq t4$$

$$200 \text{ ms} \leq t5$$

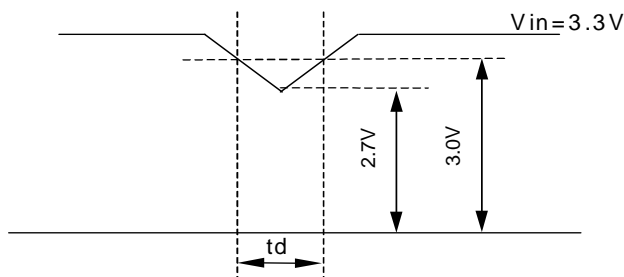
$$200 \text{ ms} \leq t6$$



Vin-dip state

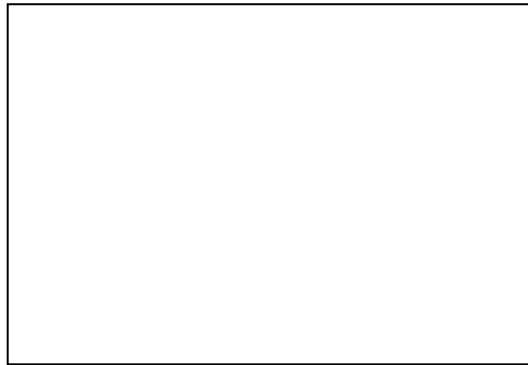
(1) when  $3.0V > Vin \geq 2.7V$  ,  $t_d \leq 10 \text{ ms}$ .

(2) when  $Vin < 2.7V$  , Vin-dip condition should as the Vin-turn-off condition.

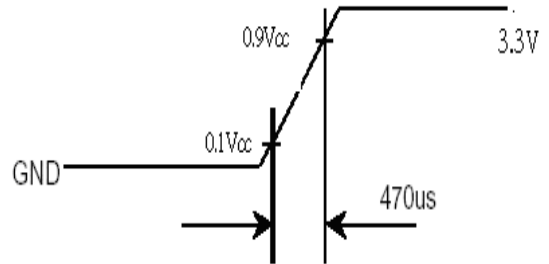
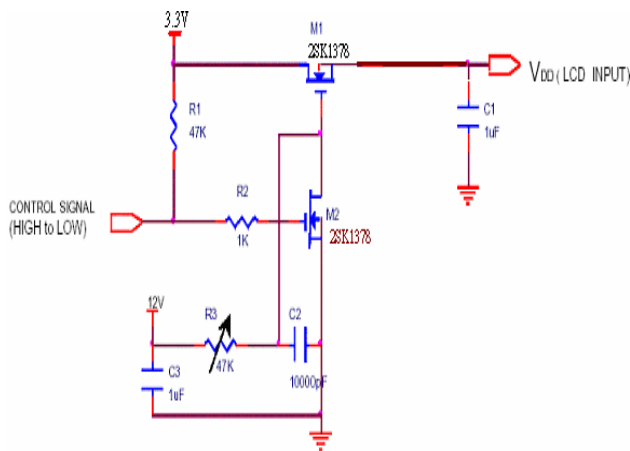


\*2) Max value is White Pattern : 1200 line mode.

Circuit condition (Max) :  $V_{CC}=3.3\text{ V}$  ,  $f_V=60\text{ Hz}$  ,  $f_H=74.1\text{ kHz}$  ,  $f_{CLK}=154\text{ MHz}$ .



\*4) Irush measure condition



**(B) BACK LIGHT**

(a.) ELECTRICAL CHARACTERISTICS

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

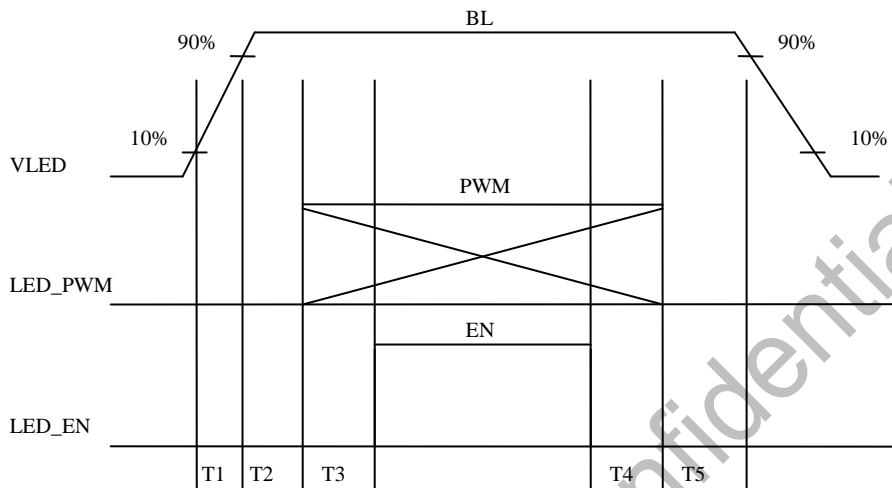
ITEM	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
LED Driver Input Voltage	VLED	7.0	12	17	V	
LED Driver Input Current	I <sub>LED+</sub>	-		900	mA	*1)
Forward Voltage	V <sub>F</sub>	2.6	2.8	3.0	V	*2) I <sub>F</sub> =20mA
Forward Current	I <sub>F</sub>	-	20	-	mA	*2) I <sub>F</sub> =20mA
Power Consumption	P <sub>LED</sub>		4.09		W	*2)*3) I <sub>F</sub> =20mA
PWM Frequency	PWM <sub>BL</sub>	100	-	1000	Hz	
Duty ratio	Dim	10	-	100	%	

(b.) LED LIFE – TIME

ITEM	CONDITION	MIN	TYP	MAX	UNIT	NOTE
Life Time	I <sub>F</sub> =20mA , $T_a=25^\circ\text{C}$	15000			hrs	*4)



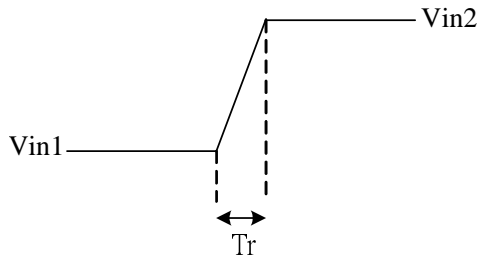
(c.) LED ON/OFF Sequence :



- 0.5ms ≤ T1 ≤ 10ms
- 10ms ≤ T2
- 10ms ≤ T3
- 0ms ≤ T4
- 10ms ≤ T5

Note:

The LED power variation spec. is defined as the following figure.



When LED input voltage is from Vin1 up to Vin2, the slew rate should be less than 20 V/ms.

Slew rate = (Vin2-Vin1) / Tr , Vin2 > Vin1

- \*1) Maximum LED Driver Input Current at 12V Input Voltage/PWM Duty 100%.
- \*2) Life time means that estimated time to 50% degradation of initial luminous intensity.

## 4. Connector Interface PIN & Function

### CN (Interface signal)

Outlet connector: AYF334535 (PANASONIC)

- Pin No. is 45 pin define of Plug connector

Pin No.	SYMBOL	FUNCTION
1	VDD	Power Supply, 3.3V(Typical)
2	VDD	Power Supply, 3.3V(Typical)
3	VDD	Power Supply, 3.3V(Typical)
4	VDD	Power Supply, 3.3V(Typical)
5	NC(BIST)	BIST testing
6	2-L3P	LVDS 2 data 3 (positive)
7	GND	Ground
8	2-L3N	LVDS 2 data 3 (negative)
9	GND	Ground
10	GND	Ground
11	1-L3P	LVDS 1 data 3 (positive)
12	2-LCNKP	LVDS 2 Clock (positive)
13	1-L3N	LVDS 1 data 3 (negative)
14	2-LCNKN	LVDS 2 Clock (negative)
15	GND	Ground
16	GND	Ground
17	1-LCNKP	LVDS 1 Clock (positive)
18	2-L2P	LVDS 2 data 2 (positive)
19	1-LCNKN	LVDS 1 Clock (negative)
20	2-L2N	LVDS 2 data 2 (negative)
21	GND	Ground
22	GND	Ground
23	1-L2P	LVDS 1 data 2 (positive)
24	2-L1P	LVDS 2 data 1 (positive)
25	1-L2N	LVDS 1 data 2 (negative)
26	2-L1N	LVDS 2 data 1 (negative)
27	GND	Ground
28	GND	Ground
29	1-L1P	LVDS 1 data 1 (positive)
30	2-L0P	LVDS 2 data 0 (positive)
31	1-L1N	LVDS 1 data 1 (negative)
32	2-L0N	LVDS 2 data 0 (negative)
33	GND	Ground
34	GND	Ground
35	1-L0P	LVDS 1 data 0 (positive)
36	NC	NC
37	1-L0N	LVDS 1 data 0 (negative)
38	LED_EN	LED Enable Pin. (ON : 3.3V / OFF: 0V)
39	NC	NC
40	CABC_EN	CABC Function Enable Pin.
41	LED_PWM	PWM Signal for LED Dimming Control. (+3.3V Swing)
42	VLED	LED Power Supply, 12V(Typical)
43	VLED	LED Power Supply, 12V(Typical)
44	VLED	LED Power Supply, 12V(Typical)
45	VLED	LED Power Supply, 12V(Typical)

### 5. INTERFACE TIMING CHART

(1) Timing Characteristic

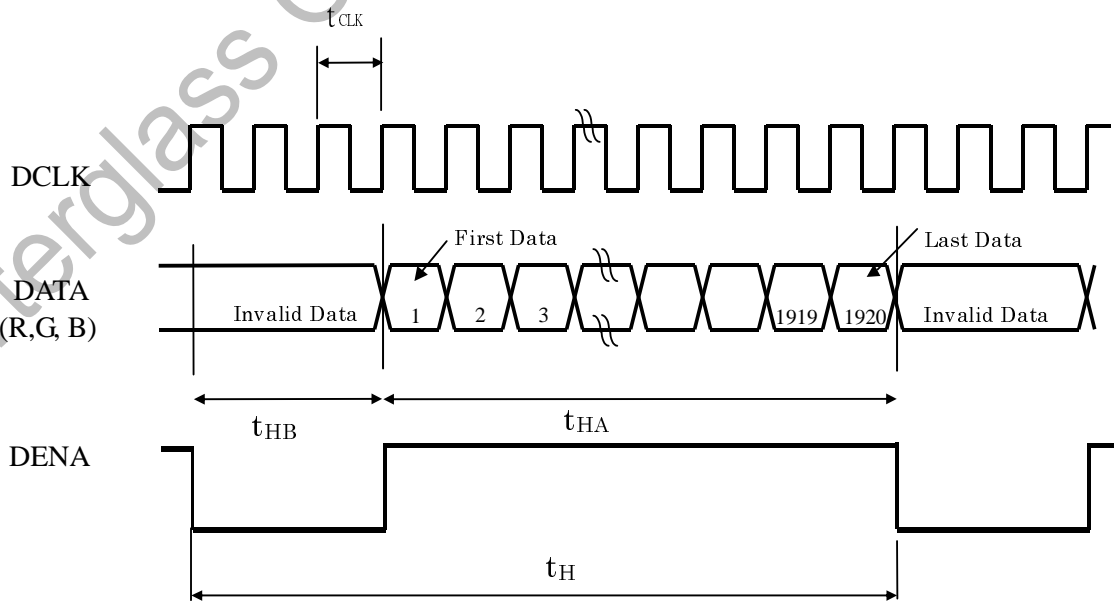
ITEM		SYMBOL	MIN	TYP	MAX	UNIT		
LCD Timing	Frame Rate		-	60	60	Hz		
	DCLK	Frequency	$f_{CLK}$	-	154	-	MHz	
		Period	$t_{CLK}$	-	6.5	-	ns	
	DENA	Horizontal	Horizontal total time	$t_H$	-	2080	-	$t_{CLK}$
			Horizontal Active time	$t_{HA}$	1920	1920	1920	$t_{CLK}$
			Horizontal Blank time	$t_{HB}$	-	160	-	$t_{CLK}$
		Vertical	Vertical total time	$t_V$	-	1235	-	$t_H$
			Vertical Active time	$t_{VA}$	1200	1200	1200	$t_H$
			Vertical Blank time	$t_{VB}$	-	35	-	$t_H$

【Note】

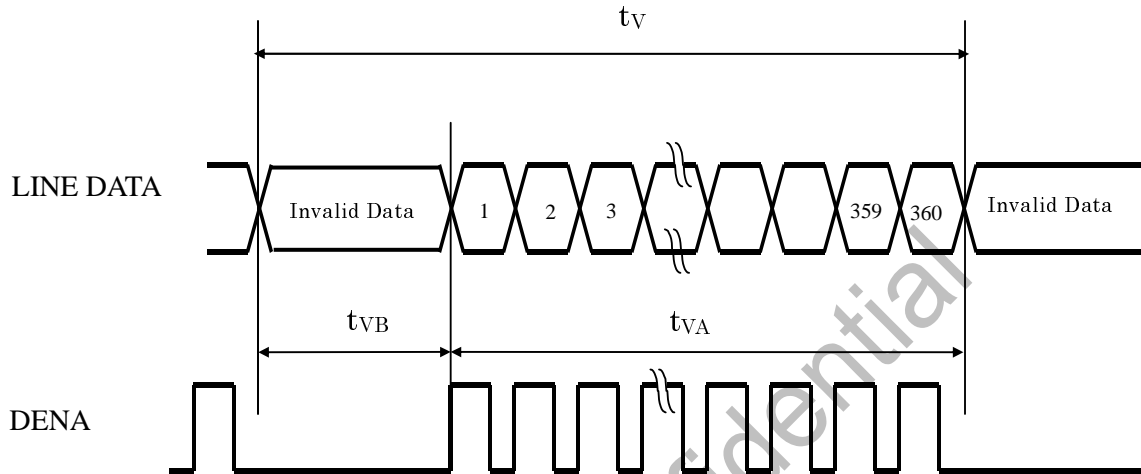
- \*1) DENA (DATA ENABLE) usually is positive.
- \*2) During the whole blank period, DCLK should keep input.

(2).Timing Chart

a. Horizontal Timing

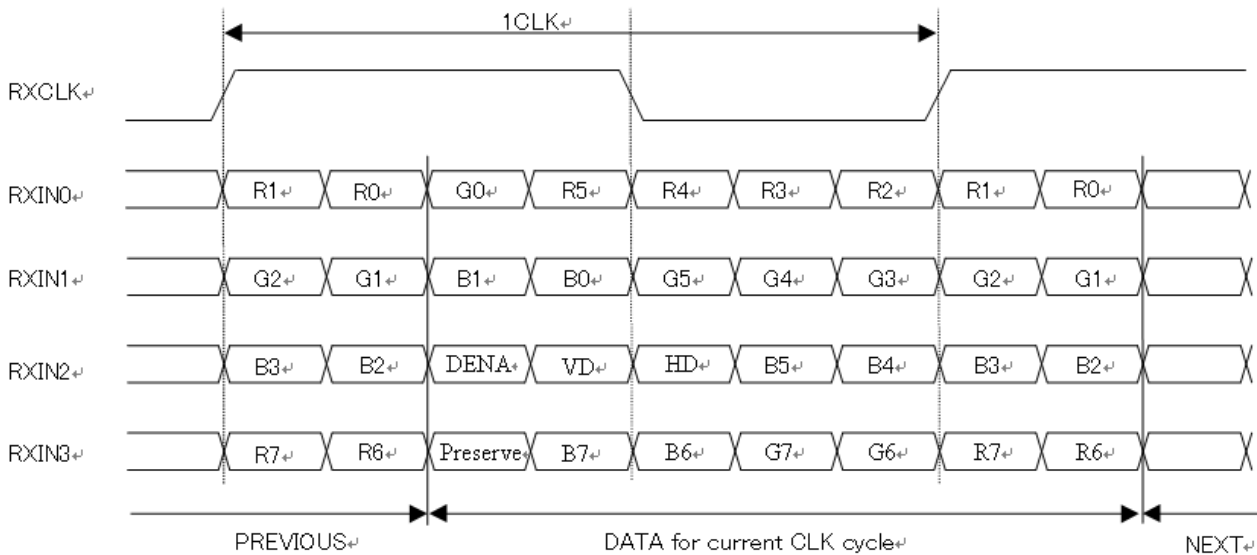


b. Vertical Timing



(3). LVDS DATA (VESA) : Timing Chart

For 6Bit+Hi-FRC



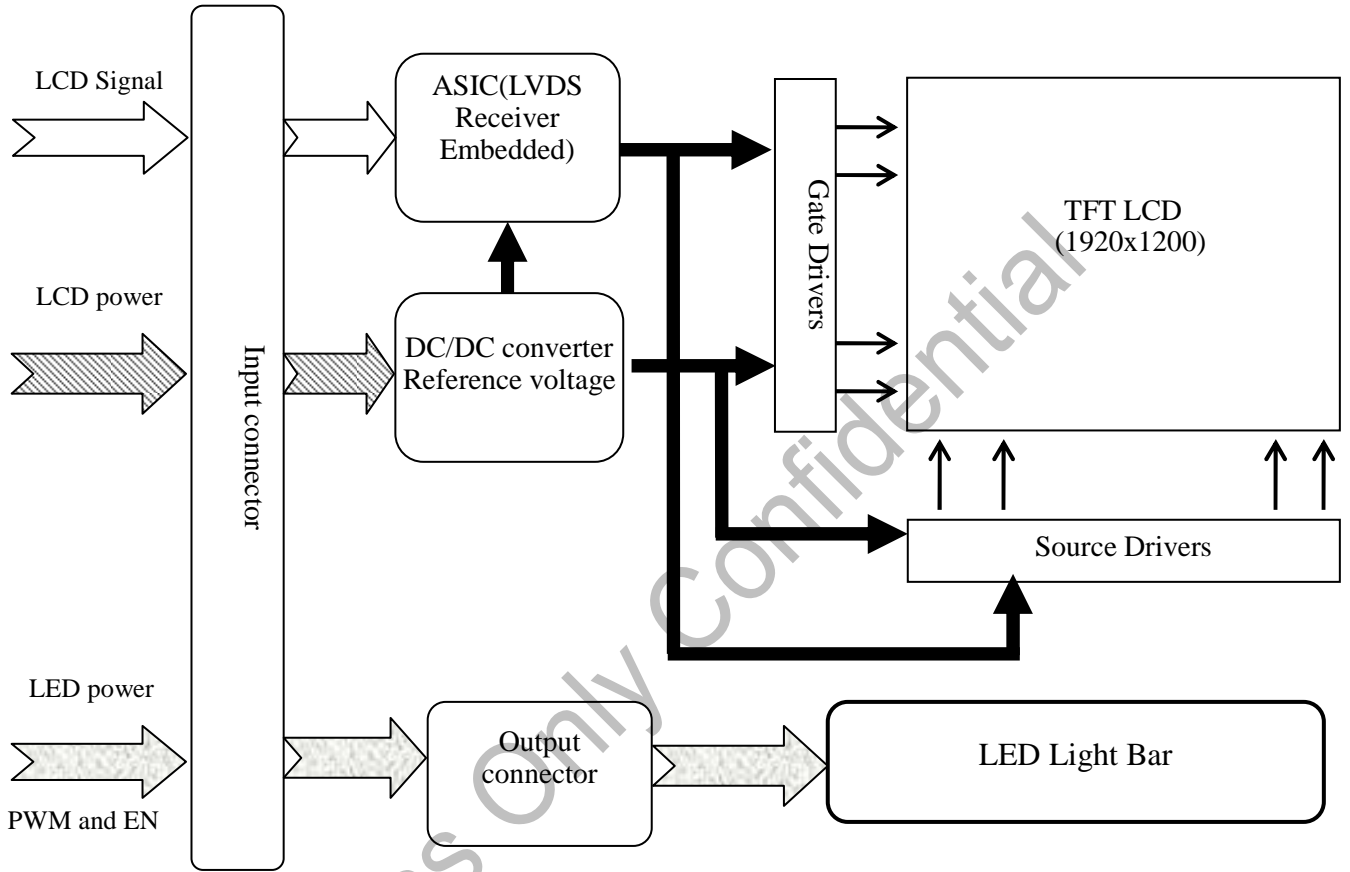
(4) Data mapping

COLOR	INPUT DATA	R DATA								G DATA								B DATA							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
		MSB							LSB	MSB							LSB	MSB							LSB
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
	RED(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	GREEN(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	
	BLUE(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	
	CYAN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
	MAGENTA	1	1	1	1	1	1	1	1	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	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	
RED	RED(0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	RED(1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	RED(2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	RED(254)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	RED(255)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
GREEN	GREEN(0)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	GREEN(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
	GREEN(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	
	GREEN(254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	
	GREEN(255)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	
BLUE	BLUE(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(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	
	BLUE(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
	BLUE(254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	
	BLUE(255)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	

[Note] 1) Definition of gray scale: Color (n): n indicates gray scale level; higher n means brighter level.

2) Data: 1-High, 0-Low.

### 6. BLOCK DIAGRAM

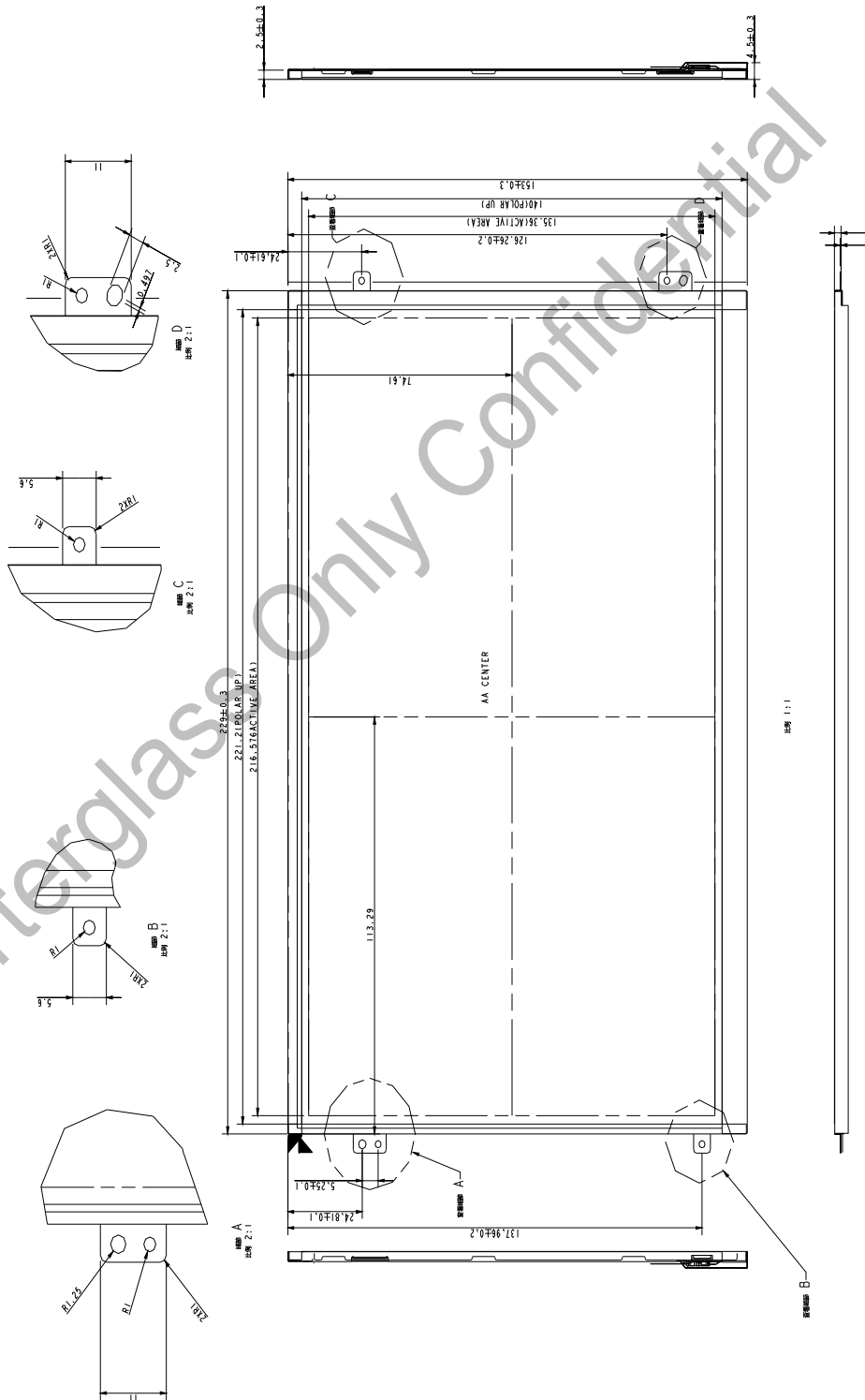


### 7. MECHANICAL SPECIFICATION

#### (1) Front side

The tolerance, not show in the figure, is  $\pm 0.5$  mm.

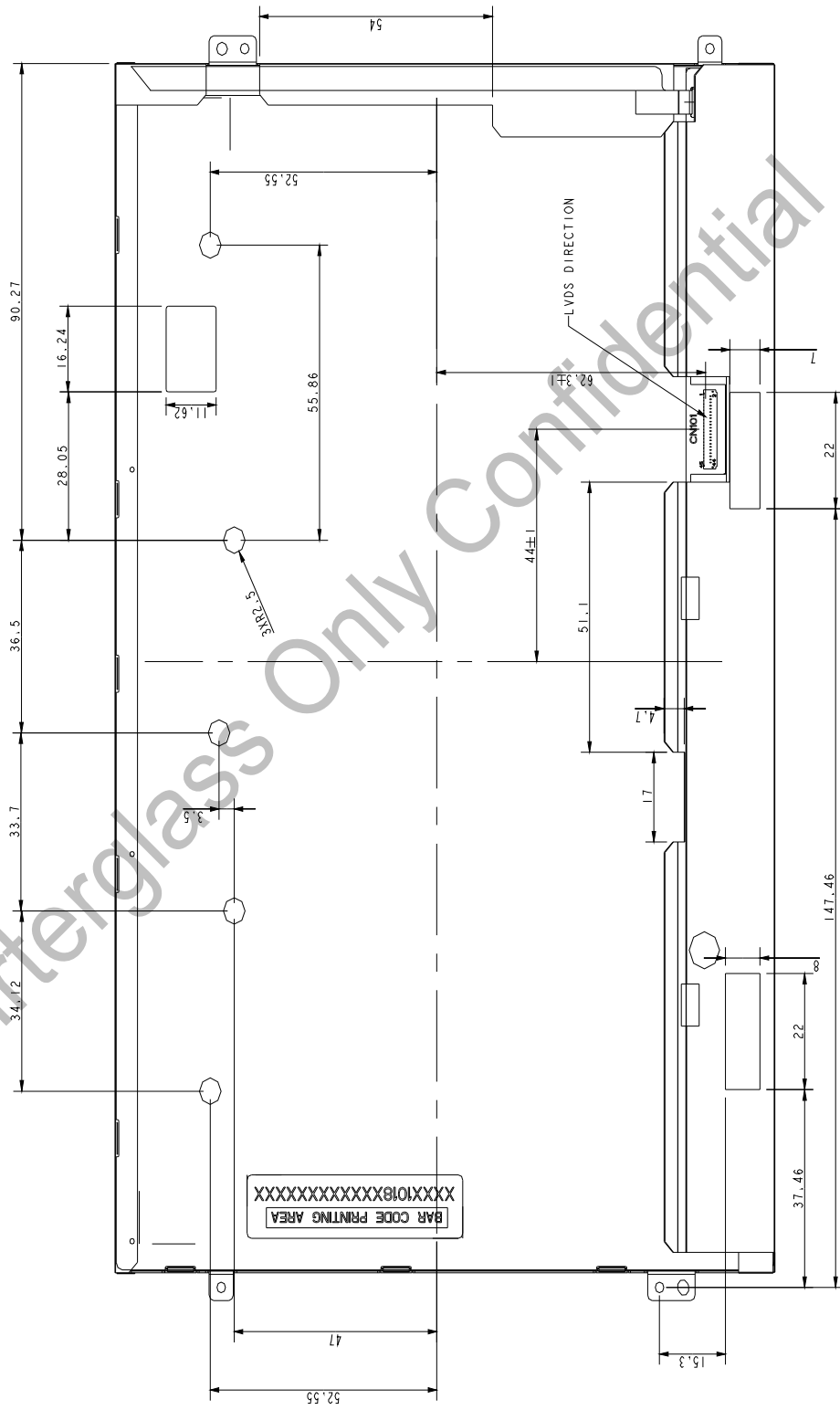
[Unit : mm]



(2) Rear side

The tolerance, not show in the figure, is  $\pm 0.5$  mm.

[Unit : mm]





## 8. OPTICAL CHARACTERISTICS

Ta=25°C , VDD=3.3V

ITEM	SYMBOL	CONDITION	MIN	TYP	MAX	UNIT	NOTE	
Contrast Ratio	CR	$\theta = \psi = 0^\circ$	600	800	--	--	*1) 2)	
Luminance (center)	L	$\theta = \psi = 0^\circ$	650	700	--	cd/m <sup>2</sup>	*1) 3)	
Uniformity(9P)	$\Delta L$	$\theta = \psi = 0^\circ$	75	--	--	%	*1) 3)	
Response Time	Tr	$\theta = \psi = 0^\circ$	--	30	40	ms	*5)	
	Tf							
Cross Talk	CT	$\theta = \psi = 0^\circ$	--	--	1.0	%	*6)	
View Angle	Horizontal	$\psi$	$CR \geq 10$	80/-80	89/-89	--	°	*4)
	Vertical	$\theta$		80/-80	89/-89	--	°	*4)
Color Coordinate	W	x	$\theta = \psi = 0^\circ$	0.281	0.311	0.341	*3)	
		y		0.327	0.357	0.387		
	R	x		(0.540)	(0.570)	(0.600)		
		y		(0.294)	(0.324)	(0.354)		
	G	x		(0.301)	(0.331)	(0.361)		
		y		(0.548)	(0.578)	(0.608)		
B	x	(0.129)	(0.159)	(0.189)				
	y	(0.075)	(0.105)	(0.135)				
Gamut		$\theta = \psi = 0^\circ$	45	50	--	%		
Gamma	$\gamma$	GL	2.0	2.2	2.4		*7)	

Color coordinate and color gamut are measured by SRUL1R, response time is measured by TRD-100, and all the other items are measured by BM-5A (TOPCON). All these items are measured under the dark room condition (no ambient light).

Measurement Condition: IL= 20mA (each LED)

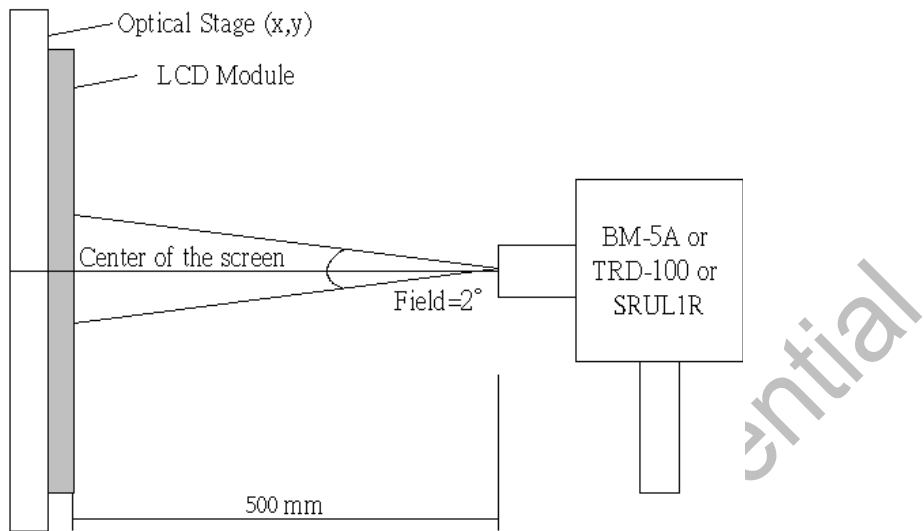
**Definition of these measurement items is as follows:**

### \*1) Setup of Measurement Equipment

The LCD module should be turn-on to a stable luminance level to be reached. The measurement should be executed after lighting Backlight for 20 minutes and in a dark room.

### \*2) Definition of Contrast Ratio

CR=ON (White) Luminance/OFF (Black) Luminance



**\*3) Definition of Luminance and Luminance uniformity**

Central luminance: The white luminance is measured at the center position "5" on the screen, see Fig.1 below.

9P Uniformity:  $\Delta L = (L_{min} / L_{max}) \times 100\%$

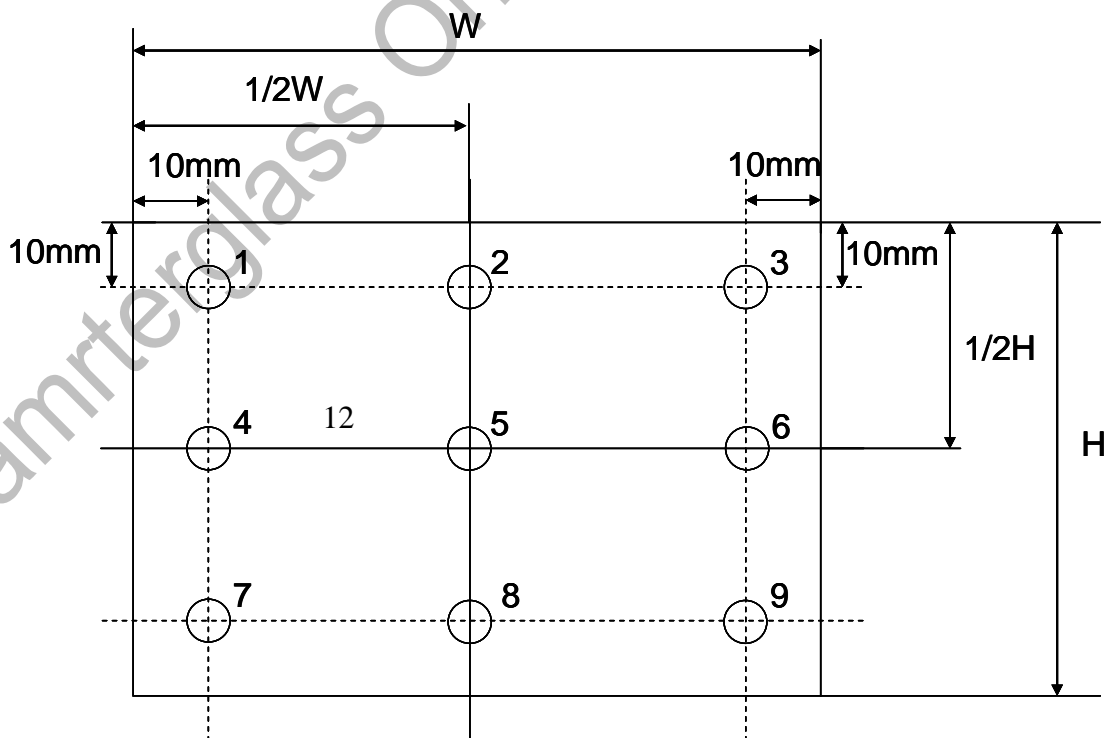
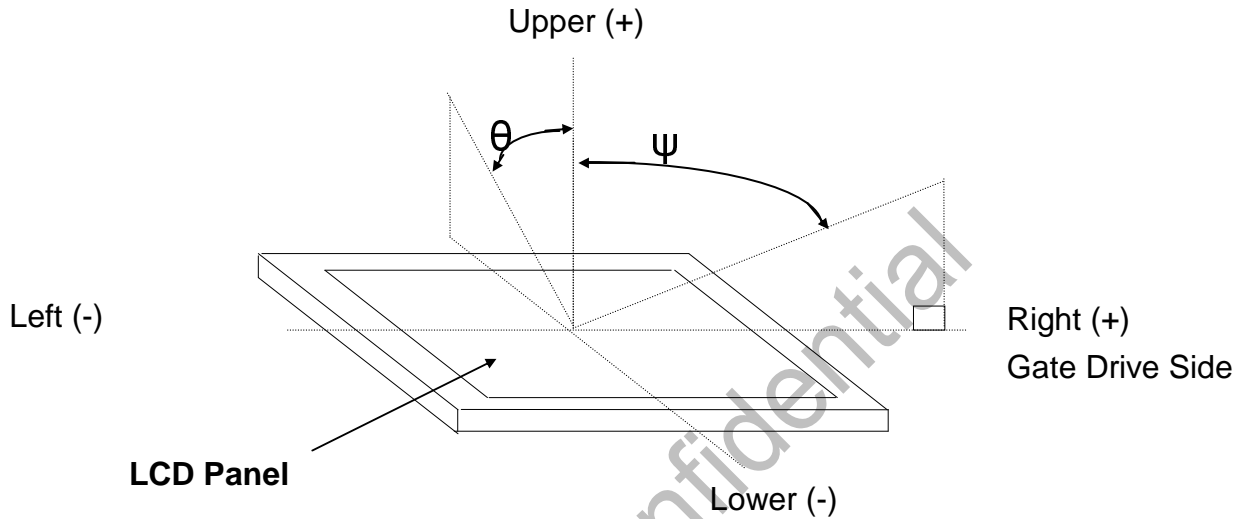
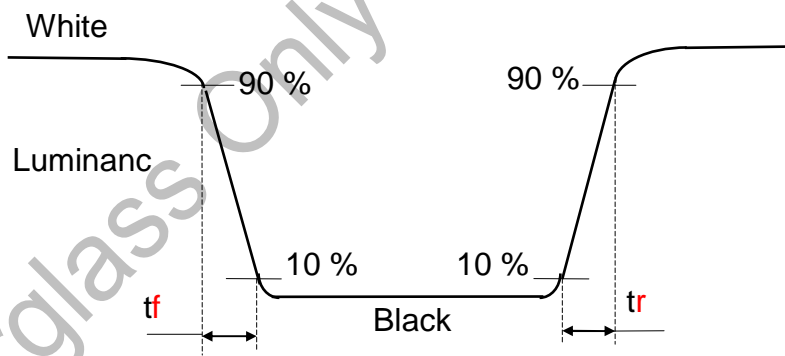


Fig.1 Measure point (Active Area)

**\*4) Definition of view angle( $\theta$  ,  $\psi$ )**



**\*5) Definition of response time**



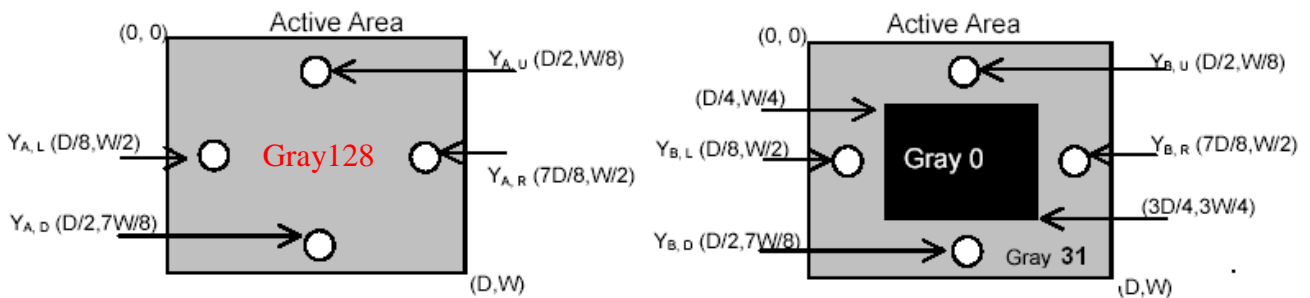
**\*6) Crosstalk Modulation Ratio**

$$CT = |Y_B - Y_A| / Y_{Ax} \times 100\%$$

$Y_A$  ,  $Y_B$  measure position and definition

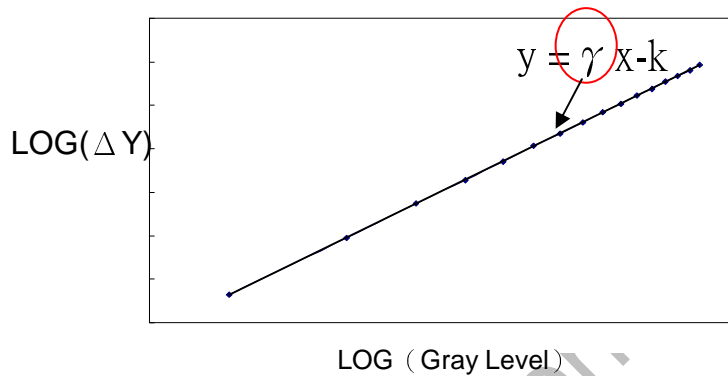
$Y_A$  means luminance at gray level 128(exclude gray level 0 pattern)

$Y_B$  means luminance at gray level 128(include gray level 0 pattern)



**\*7) Definition of Gamma (VESA)**

Based on Customer Sample, take the average value as a standard center value and the variation range of gamma value caused by loop voltage error should be between +/- 0.2. the bellow figure shows how to obtain the gamma curve and  $\gamma$  (from gray level: 0、15、31-----239、255).



## 9. RELIABILITY TEST CONDITIONS

### (1) Temperature and Humidity

TEST ITEMS	CONDITIONS
High Temperature Operation	50° C ; 240Hrs
High Temperature Storage	60° C ; 240Hrs
High Temperature High Humidity Operation	40° C ; 90% RH ; 240Hrs
High Temperature High Humidity Storage	50° C ; 90% RH ; 240 Hrs
Low Temperature Operation	-20° C ; 240 Hrs
Low Temperature Storage	-30° C ; 240 Hrs
Thermal Shock	-30° C (0.5 Hr) ~ 60° C (0.5 Hr), Ramp<20° C ,27 CYCLES
Low Air Pressure Test	533mbar(100mbar/min ramp) -40°C~55°C(1°C/min ramp) and 2hrs per each temperature , 24 Hrs

### (2) Shock & Vibration

TEST ITEMS	CONDITIONS
Shock (Non-Operation)	100G, 6ms, half sine wave, ± X,± Y,± Z 1time each
Vibration (Non-Operation)	Frequency : 8~33.3Hz, Stoke : 1.3 mm , 33.3 Hz -400 Hz,2.9G Vibration : sin wave, both X,Z axis: 2hrs ,Y axis: 4hrs Cycle time: 15 min.

### (3) ESD

	Surface discharge(Panel display area · Frame · PWB · Panel back side)		Electrics capacity of Connector
	Contact	Air	Contact
Capacity	150 pF	150 pF	200 pF
Resistance	330 Ω	330 Ω	0 Ω
Voltage	±8kV/±15kV	±8kV/±15kV	±200 V
Interval	1 sec	1 sec	1 sec
Times(single point)	25	25	1

### (4) Judgment standard

The judgment of the above test should be made as follow:

Pass : Normal display image with no obvious non-uniformity and no line defect.

Partial transformation of the module parts should be ignored.

Fail : No display image, function NG, or line defects.

**10. WARRANTY**

- (1). The period is within 12 months since the date of shipping out under normal using and storage conditions.
- (2). The warranty will be avoided in case of defect induced by customer

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