



SmarterGlass

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Chunghwa Picture Tubes, Ltd.

Technical Specification

To : **Smarterglass**

Date : 160629

CPT TFT-LCD
CLAA121XA01CW

APPROVED BY	CHECKED BY	PREPARED BY
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<small>SPEC_CLAA121XA01CW_V0.3_Sm arterglass_160629</small>		

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Doc. No:	SPEC_CLAA121XA01CW_V0.3_CPT_20160502	Issue Date:	2016/05/02
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Modification Record List

Revision Notice	Description	Page	Rev. Date
0.0	First revision (Tentative)	---	2015.12.24
0.1	Revise note(3) definition of luminance and luminance uniformity	21	2016.01.27
0.2	Modify reliability test (image sticking)	23	2016.03.23
0.3	Modify power consumption, module weight	4	2016.05.02
	Modify absolute maximum rating	5	2016.05.02
	Modify electrical characteristic (1)TFT LCD	6	2016.05.02
	Modify electrical characteristic (2)Converter Specification for Backlight	8	2016.05.02
	Interface timing	13	2016.05.02
	Modify color coordinate	20	2016.05.02

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1. OVERVIEW

CLAA121XA01CW is 12.1" color 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 (6Bit+HFRC), 1024x768, 16.7M-color images are displayed on the 12.1" diagonal screen.

General specifications are summarized in the following table:

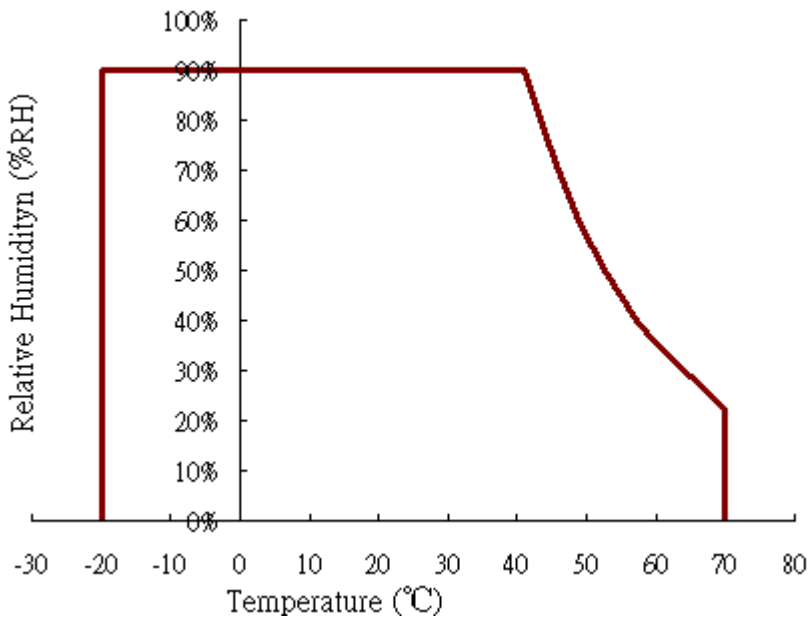
ITEM	SPECIFICATION
Display Area(mm)	245.76 (W) x184.32 (H) (12.1-inch diagonal)
Number of Pixels	1024(H) x 768(V)
Pixel Pitch(mm)	0.24(W) x 0.24(H)
Color Pixel Arrangement	RGB vertical strip
Display Mode	Normally white, TN
Number of Colors	16.7M(6bit+Hi-FRC)
Brightness(cd/m ²)	600 (typ.) (Center point)
Viewing Angle	160 /140(Typ.)
Surface Treatment	Anti-Glare, 3H
Optimum Viewing Direction	6 O'clock(Max. contrast ratio, Gray level inversion)
Power consumption(W)	8.67W (typ.)
Interface Connection	LVDS
Module Size(mm)	260.5 x204 x8.4 (typ.)
Module Weight(g)	497(typ.)
Backlight Unit	LED:(white-LED)

2. ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	MIN.	MAX.	UNIT	REMARK
Power Supply Voltage for LCD	VCC	0	5	V	
Logic Input Voltage	VI	0	5	V	
Backlight Power Supply Voltage	VLED	0	20	V	
Backlight ON-OFF Voltage	LED_EN	0	20	V	
Backlight Dimming Control Input Voltage	LED_PWM	0	20	V	4)
Operation Temperature	Top	-20	70	°C	1). 2). 3).
Storage Temperature	Tstg	-20	70	°C	1). 2). 3).

[Note]

- 1).The relative humidity and temperature range are as below sketch,90%RH Max.
- 2).The maximum wet bulb temperature $\leq 39^{\circ}\text{C}$ and without dewing.
- 3).If you use the product in an environment which over the definition of temperature and humidity too long to effect the result of eye-etching.
- 4). LED_EN, LED_PWM voltage must be smaller than VLED or equal to VLED.



3. ELECTRICAL CHARACTERISTICS

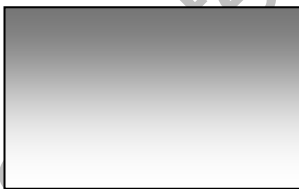
(1).TFT-LCD

ITEM		SYMBOL	MIN	TYP	MAX	UNIT	NOTE
LCD Power Voltage		VCC	3.0	3.3	3.6	V	
LCD Power Current		ICC	-	263	306	mA	*1)
LCD Rush Current		VCC_Irush			2	A	*3)
Logic Input Voltage (LVDS: IN+,IN-)	Common Voltage	VCM	$\frac{ VID }{2}$	-	$2.4 - \frac{ VID }{2}$	V	Logic Input Voltage (LVDS: IN+,IN-)
	Differential Input Voltage	VID	200	-	600	mV	
	Threshold Voltage (HIGH)	VTH	-	-	100	mV	
	Threshold Voltage (LOW)	VTL	-100	-	-	mV	
Logic Input Voltage	VIH	0.7*DVDD	-	DVDD	V		Logic Input Voltage
	VIL	GND	-	0.3*DVDD	V		
Power consumption		P		0.87	1.01	W	

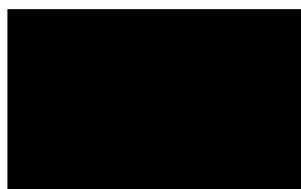
【 Note 】

*1)TYP. specification : Gray-level test Pattern (TYP Freq. @3.3V)

MAX. specification : Black test Pattern (TYP Freq. @3.3V)

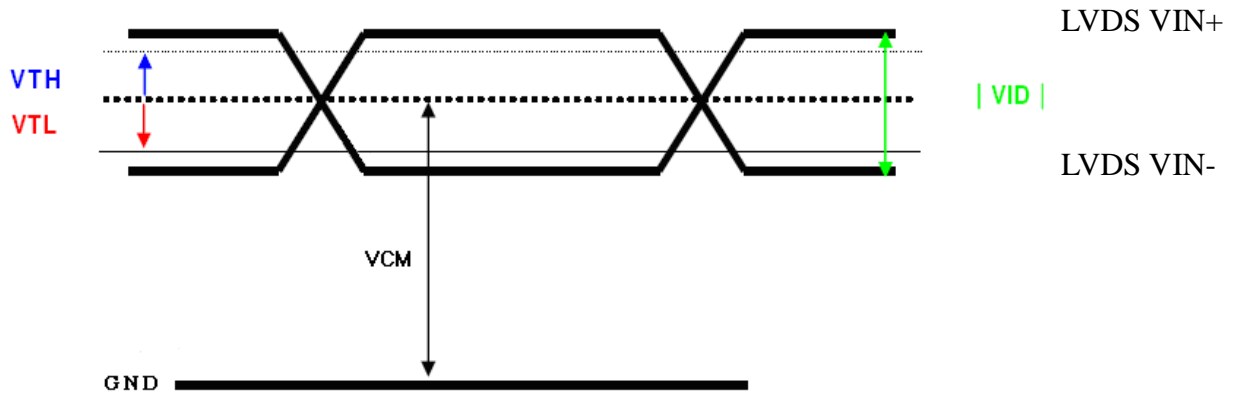


Gray-level Pattern



Black Pattern

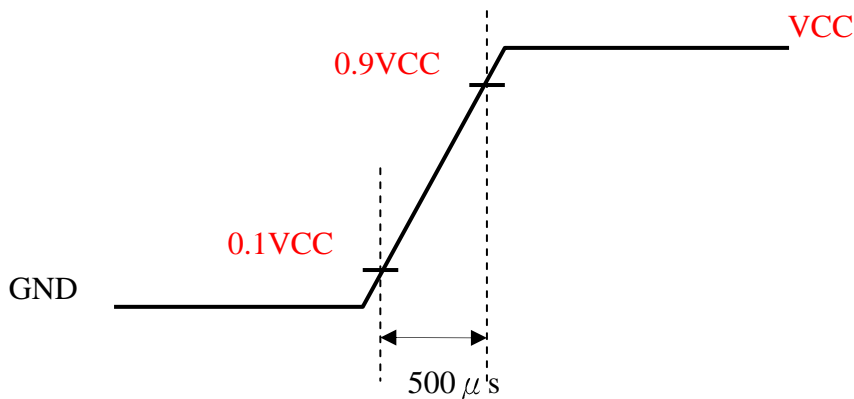
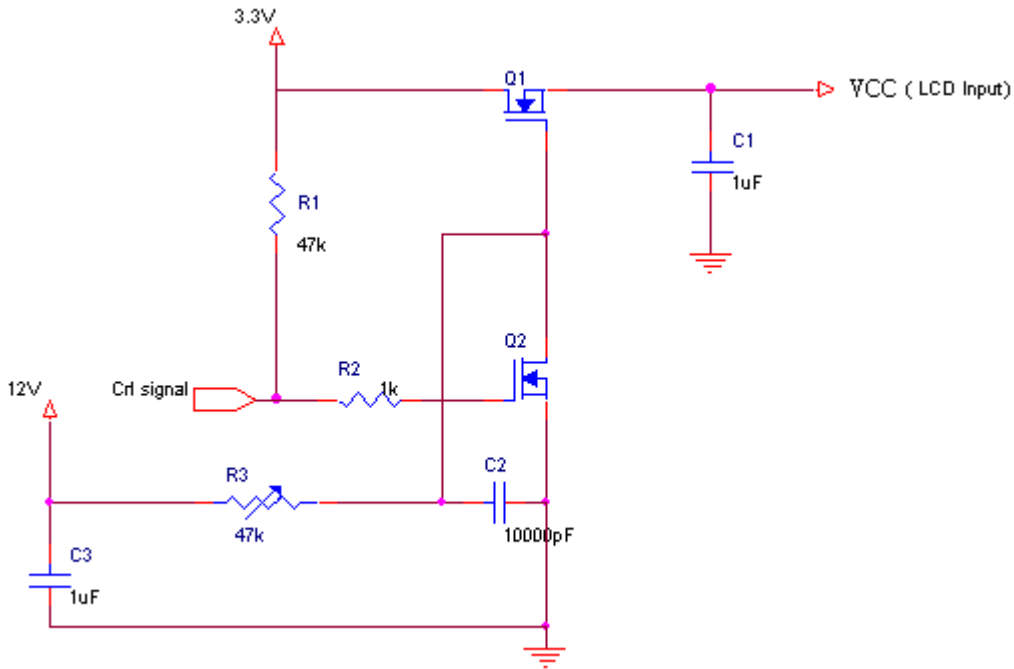
*2) LVDS Signal Definite :



VIN+ : Positive differential DATA & CLK Input

VIN- : Negative differential DATA & CLK Input

*3) Irush measure condition



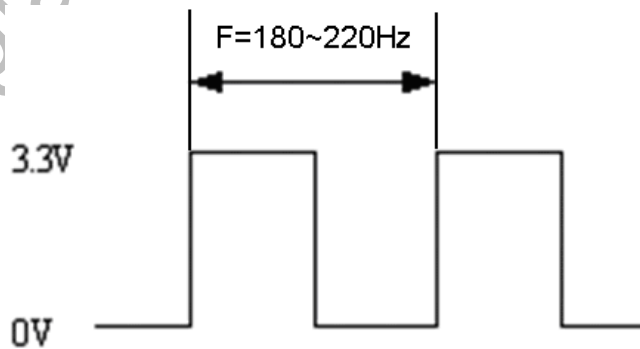
(2).Converter Specification for Backlight

Ta=25°C

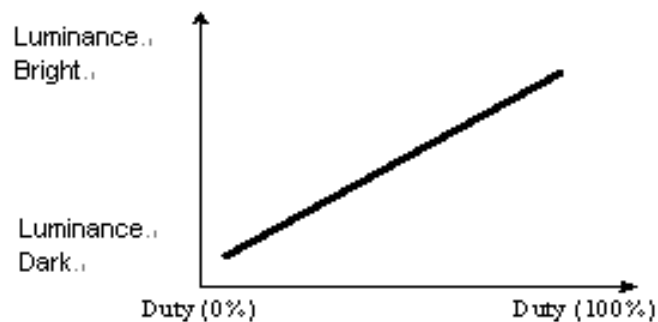
ITEM	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
LED Driver Input Voltage	VLED	7	12	13.2	V	
LED Driver Input Current	IVLED	-	660	1200	mA	*1)
LED Rush Current	VLED_Irush			2	A	*3)
Dimming Control	High	2.4	--	5	V	Dimming Control
	Low	0		0.8		
PWM Frequency	LED_PWM	180	200	220	Hz	*2)
Duty Ratio		2	-	100	%	
ON/OFF Control	High	1.8		5	V	ON/OFF Control
	Low	0		0.8		
Power Consumption (Backlight)	BLW	--	7.8	8.3	W	
LED Forward voltage (single LED)	VF	2.8	--	3.4	V	IF=75mA Ta=25°C
LED Forward current (single LED)	IF	--	75	--	mA	Ta=25°C
LIFE TIME(Backlight)		50000	70000		hr	*4)

*1) Maximum LED Driver Input Current at 10.8V Input Voltage/PWM Duty 100%.

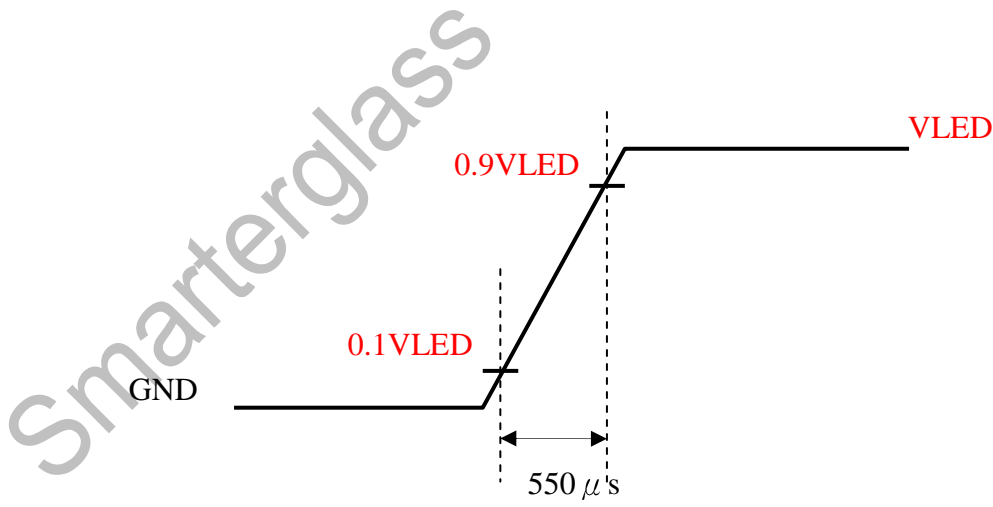
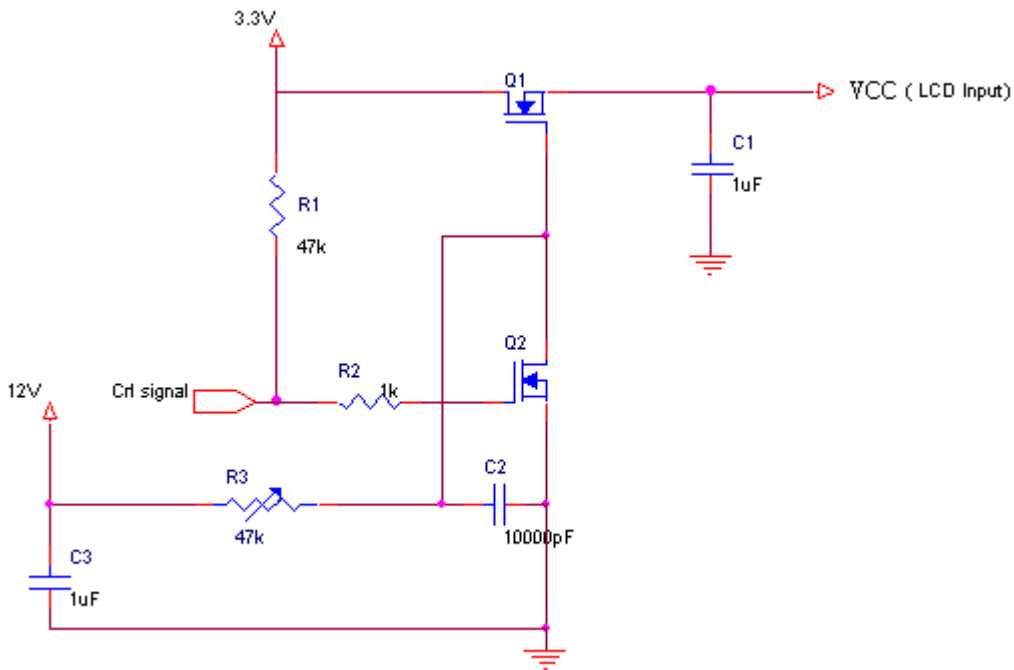
*2) The ADJ adjust signal level is 0~3.3V , operation frequency:180Hz~220Hz ◦



The ADJ can adjust LED BL brightness , where Duty and Luminance are in direct ratio.



*3) Irush measure condition

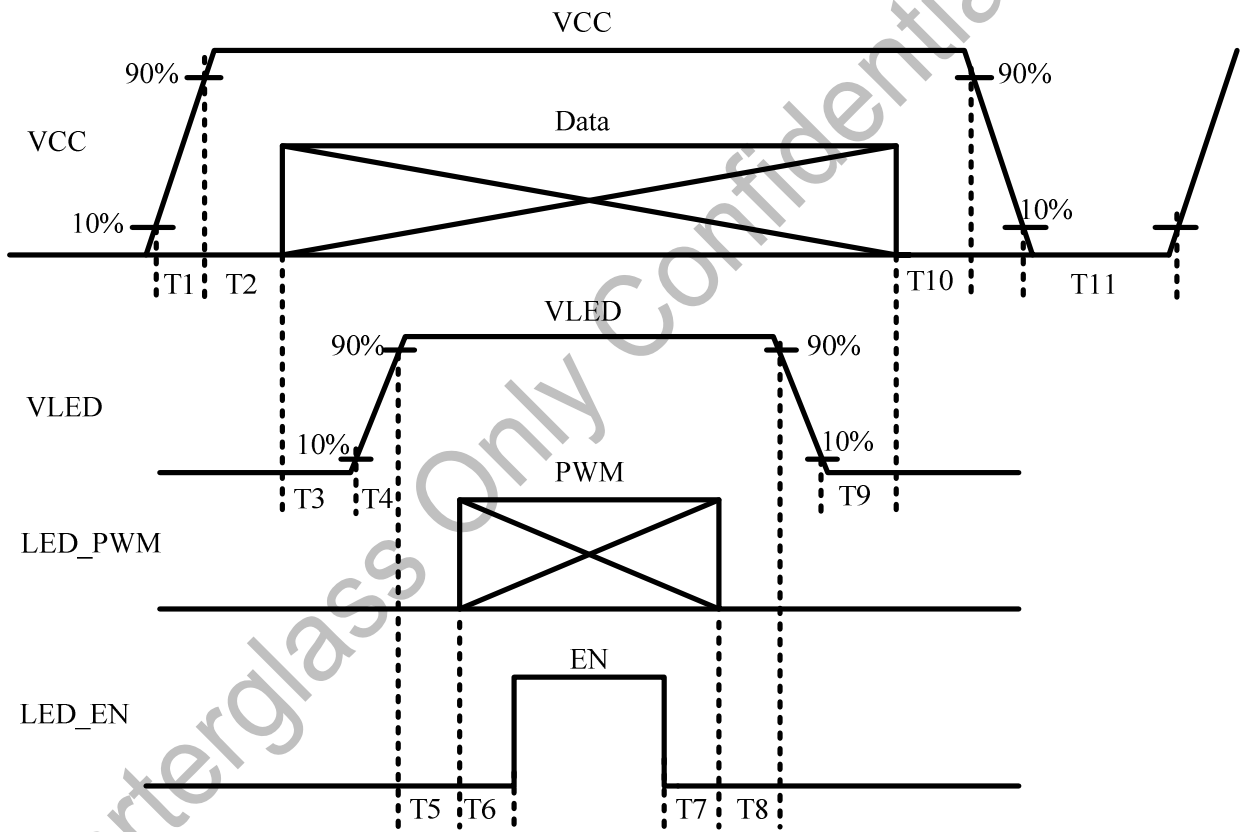


*4). Definition of the LED life time: Luminance (L) under 50% of the initial value. LED life time is restricted under normal condition, ambient temperature=25°C and LED operation forward current=75mA.

(3). Power and Signal sequence

Power Sequence :

- | | | |
|--|---------------------------------------|------------------------|
| $0.50\text{ ms} \leq T1 \leq 20\text{ ms}$ | $50\text{ ms} \leq T3 < 100\text{ms}$ | $1\text{ ms} \leq T8$ |
| $16\text{ ms} < T2 \leq 50\text{ ms}$ | $1\text{ ms} \leq T5$ | $20\text{ ms} \leq T9$ |
| $0.50\text{ ms} \leq T4 \leq 10\text{ ms}$ | $1\text{ ms} \leq T6$ | $1\text{ s} \leq T11$ |
| $0.01\text{ ms} < T10 \leq 100\text{ ms}$ | $1\text{ ms} \leq T7$ | |



4. INTERFACE PIN CONNECTION

(1) CN1 (Data Signal and Power Supply)

Outlet connector: 076B20-0048RA-G4 (STARCONN) or FI-SEB20P-HFE(JAE)

User's connector: JAE FI-SE20ME or equivalent

PIN #	SYMBOL	FUNCTION	Note
1	RXIN3+	Differential Data Input , CH3 (Positive)	
2	RXIN3-	Differential Data Input , CH3 (Negative)	
3	NC	Don't connect	1
4	SEL68	LVDS 6/8 bit select function control, Low or NC=> 6 bit Input Mode High=> 8bit Input Mode	1
5	GND	Gound	2
6	RXC+	Differential Clock Input (Positive)	
7	RXC-	Differential Clock Input (Negative)	
8	GND	Gound	2
9	RX2+	Differential Data Input , CH2 (Positive)	
10	RX2-	Differential Data Input , CH2 (Negative)	
11	GND	Gound	2
12	RX1+	Differential Data Input , CH1 (Positive)	
13	RX1-	Differential Data Input , CH1 (Negative)	
14	GND	Gound	2
15	RX0+	Differential Data Input, CH0 (Positive)	
16	RX0-	Differential Data Input, CH0 (Negative)	
17	reLR	Horizontal Reverse Scan Control, Low or NC Normal Mode. High Horizontal Reverse Scan	1
18	reUD	Vertical Reverse Scan Control, Low or NC Normal Mode, High Vertical Reverse Scan	1
19	VCC	Power supply	3.0~3.6V
20	VCC	Power supply	3.0~3.6V

1) NC: Please don't connect it to GND or other signals.

High: Please connect it to 3.3V

Low: Please connect it to GND

2) GND Pin must connect to the ground, don't let it be a vacant pin.

(2) CN2 (Backlight)

Outlet connector: 91208-01001-H01 (ACES) or equivalent

User's connector: 91209-01011 (ACES) or equivalent

Pin	Symbol	Description	Remark
1	VLED	Converter input voltage	12V
2	VLED	Converter input voltage	12V
3	VLED	Converter input voltage	12V
4	NC	Don't connect	
5	GND	Gound	
6	GND	Gound	
7	GND	Gound	
8	GND	Gound	
9	EN	Enable pin	3.3V
10	ADJ	Backlight Adjust	Diming(180-220Hz, Hi: 3.3V ,Lo: 0V)

*1) Enable High=2.4 to 5V, Low=0 to 0.8V or Open.

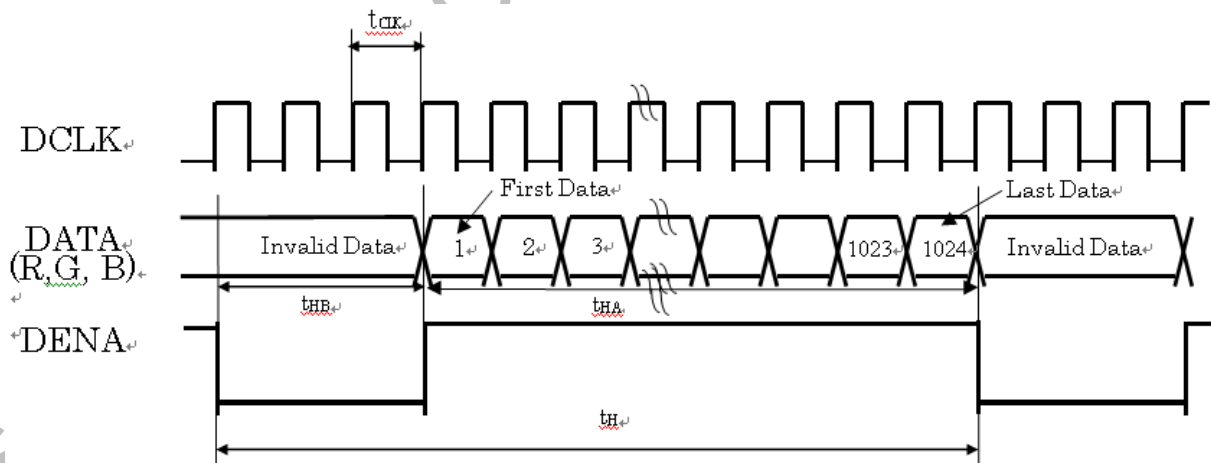
5. INTERFACE TIMING

(1) Timing Specifications

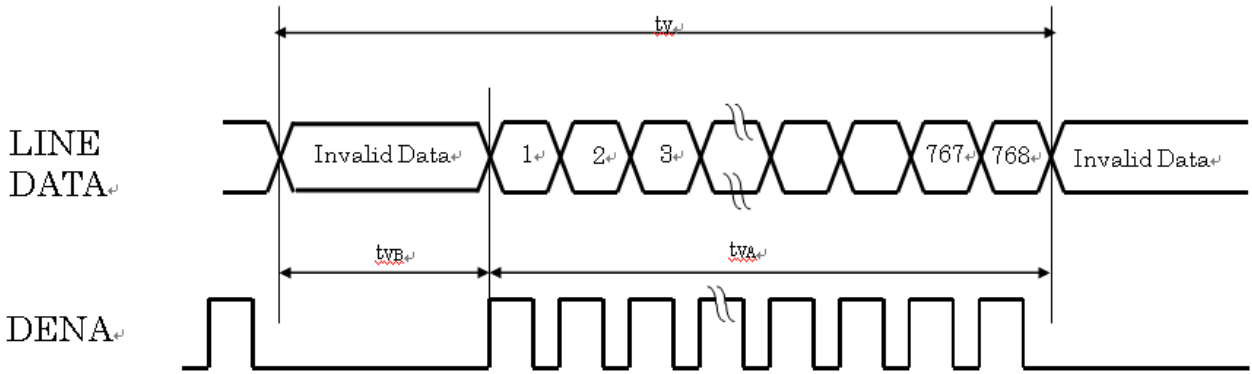
ITEM			SYMBOL	MIN.	TYP.	MAX.	UNIT	
LCD Timing	DCLK		Frequency	f_{CLK}	57.5	64.9	74.4	MHz
				T_{CLK}	13.44	15.41	17.4	ns
	DENA	Horizontal	Horizontal total time	t_H	1240	1344	1464	t_{CLK}
			Horizontal effective time	t_{HA}	1024			t_{CLK}
			Horizontal blank time	t_{HB}	216	320	440	t_{CLK}
		Vertical	Vertical total time	t_V	778	806	848	t_H
			Vertical effective time	t_{VA}	768			t_H
			Vertical blank time	t_{VB}	10	38	80	t_H
	Frame rate			F_V	50	60	65	Hz

(2) Timing Chart

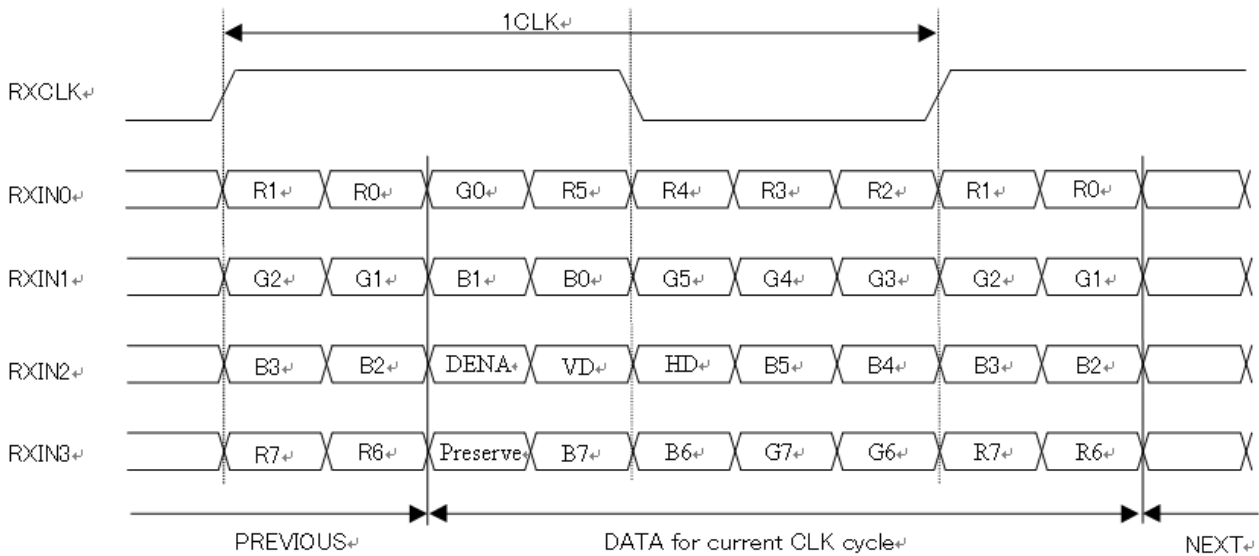
a. Horizontal Timing



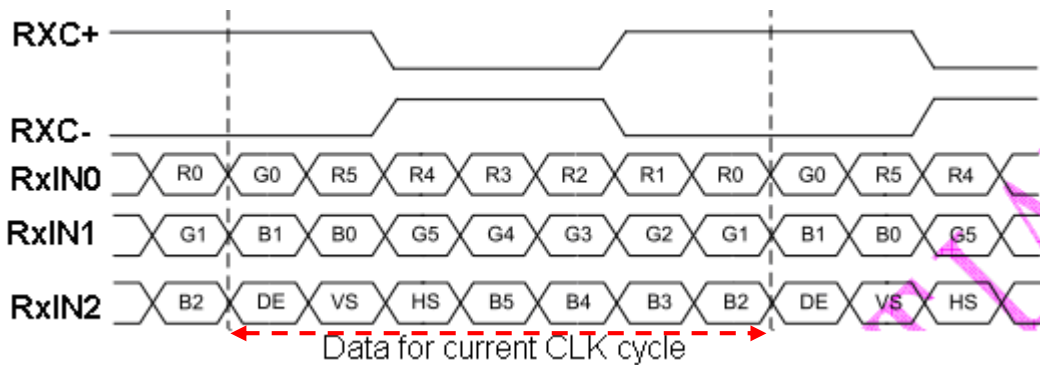
b. Vertical Timing



(3) 8-bits LVDS DATA Timing Chart (VESA) :



(4) 6-bits LVDS DATA Timing Chart (VESA) :



(5) 8-bits in Color Data Assignment

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

3) This assignment is applied to both odd and even data.

(6) 6-bits in Color Data Assignment

COLOR	INPUT DATA	R DATA						G DATA						B DATA					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	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
	RED(255)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	GREEN(255)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	BLUE(255)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	CYAN	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	MAGENTA	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	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
RED	RED(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	1	0	0	0	0	0	0	0	0	0	0	0	0
	RED(2)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(254)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(255)	1	1	1	1	1	1	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
	GREEN(1)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	GREEN(2)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	GREEN(254)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	GREEN(255)	0	0	0	0	0	0	1	1	1	1	1	1	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
	BLUE(1)	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	1	0
	BLUE(254)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	BLUE(255)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

[Note]

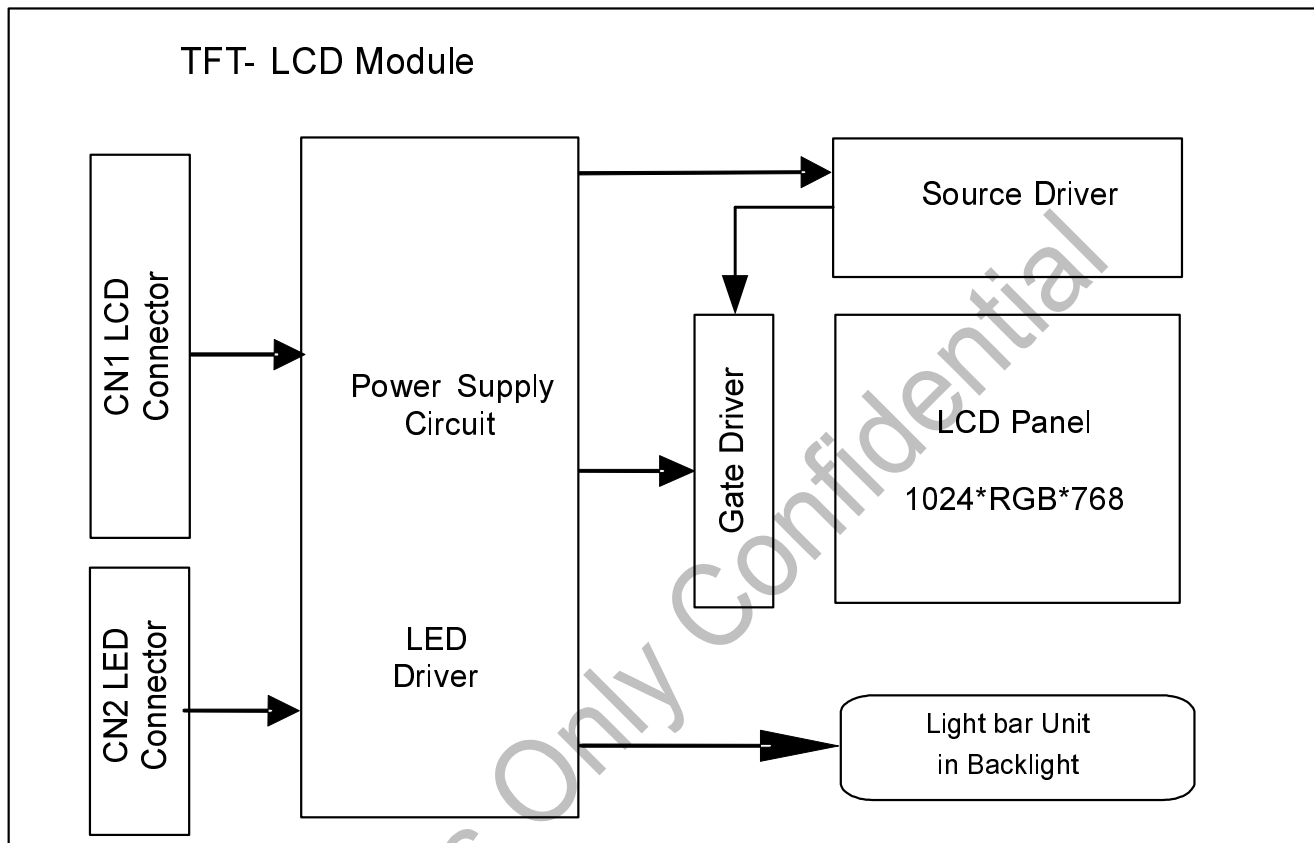
4) Definition of gray scale:

Color (n): n indicates gray scale level; higher n means brighter level.

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

6) This assignment is applied to both odd and even data.

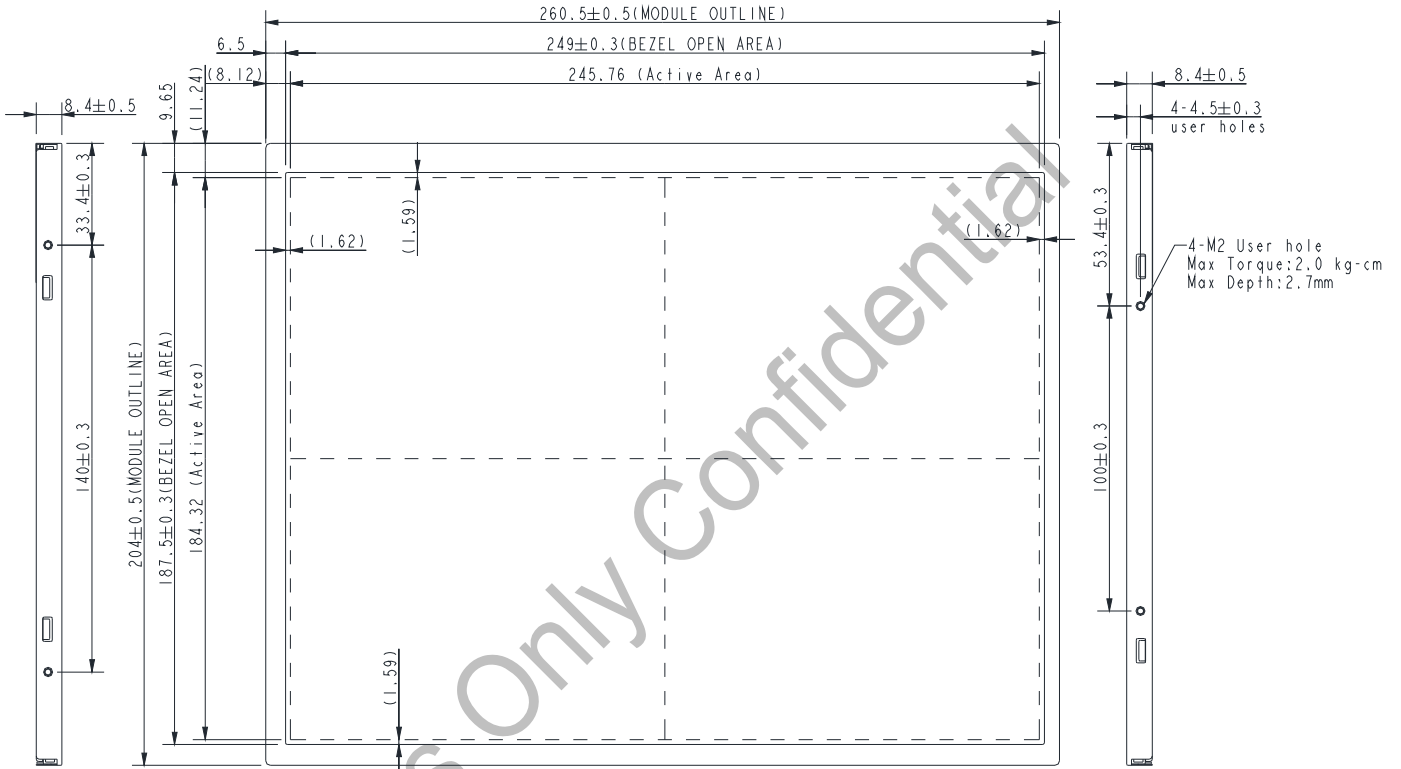
6. BLOCK DIAGRAM



7. MECHANICAL SPECIFICATION

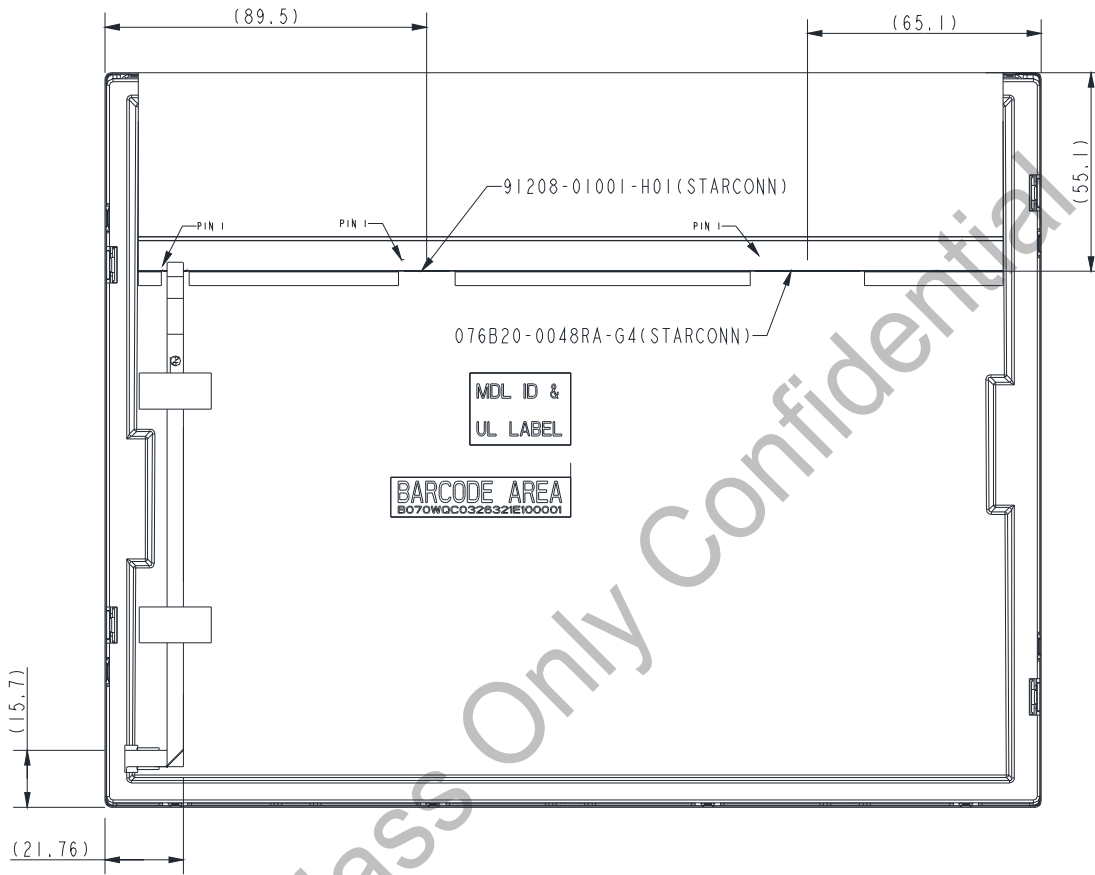
(1) Front side (Tolerance is ±0.5mm unless noted)

Unit: mm



(2) Rear side (Tolerance is $\pm 0.5\text{mm}$ unless noted)

Unit: mm:



8. OPTICAL CHARACTERISTICS

Ta=25°C , VCC=3.3

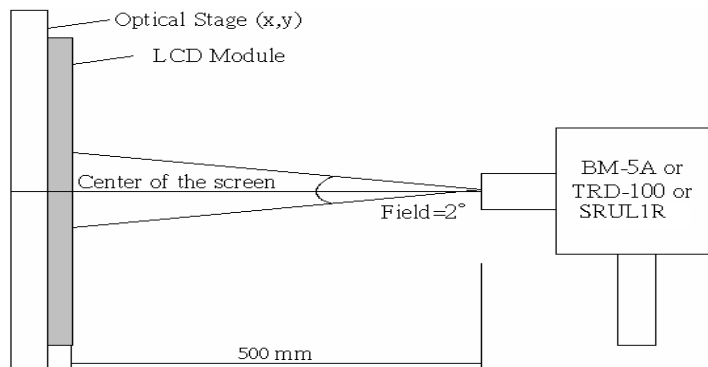
ITEM	SYMBOL	CONDITION	min	typ	max	UNIT	REMARK	
Contrast Ratio	CR	$\theta = \psi = 0^\circ$	500	700	--	--	*1) 2)	
Luminance(CEN)	L	$\theta = \psi = 0^\circ$	500	600	--	cd/m ²	*1) 3)	
9P Uniformity	ΔL	$\theta = \psi = 0^\circ$	75	80	--	%	*1) 3)	
Response Time	Tr+Tf	$\theta = \psi = 0^\circ$		16	--	ms	*5)	
Crosstalk	CT	$\theta = \psi = 0^\circ$	--	--	1	%	*6)	
Viewing Angle	Horizontal	Left(ψ)	CR \geq 10	70	(80)	--	Deg.	*4)
		Right(ψ)		70	(80)	--		
	Vertical	Upper(θ)		60	(70)	--		
		Down(θ)		60	(70)	--		
Color Coordinates	White	X	$\theta = \psi = 0^\circ$	(0.263)	(0.313)	(0.363)	*3)	
		Y		(0.279)	(0.329)	(0.379)		
	Red	X		(0.587)	(0.637)	(0.687)		
		Y		(0.294)	(0.344)	(0.394)		
Green	X	(0.249)	(0.299)	(0.349)				
	Y	(0.576)	(0.626)	(0.676)				
Blue	X	(0.096)	(0.146)	(0.196)				
	Y	(0.024)	(0.074)	(0.124)				
Gamut	CG	$\theta = \psi = 0^\circ$	65	70	--	--	--	
Gamma	γ	VESA	2	2.2	2.4	--	*7)	
Image Sticking	Tis	4hrs			5	min	*8)	

[Note]

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:

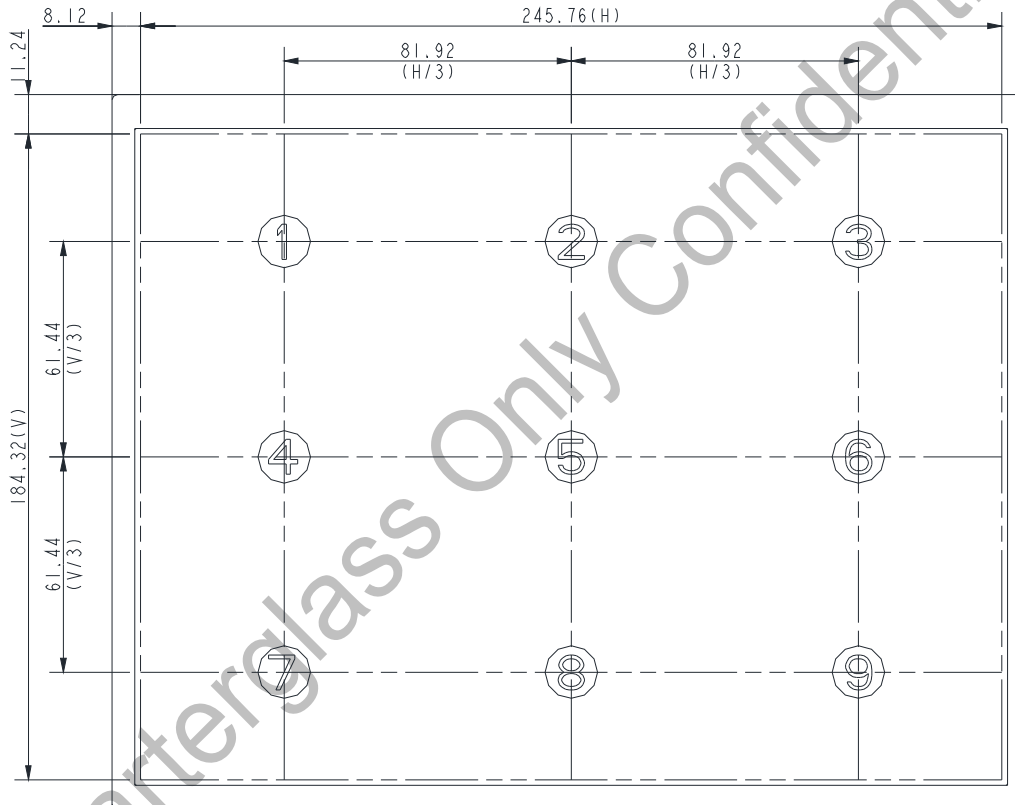
$$CR = \text{ON (White) Luminance} / \text{OFF (Black) Luminance}$$

3).Definition of Luminance and Luminance uniformity:

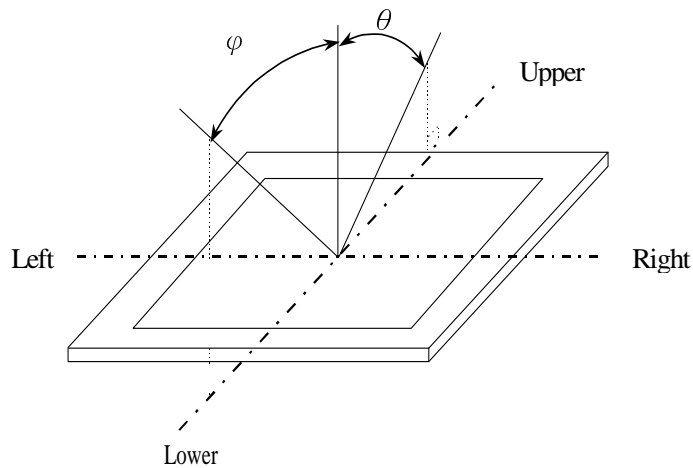
Center Luminance, &Color coordinate: measuring the luminance of the point no. 5

Average Luminance: measuring average luminance of points no.1-no.9

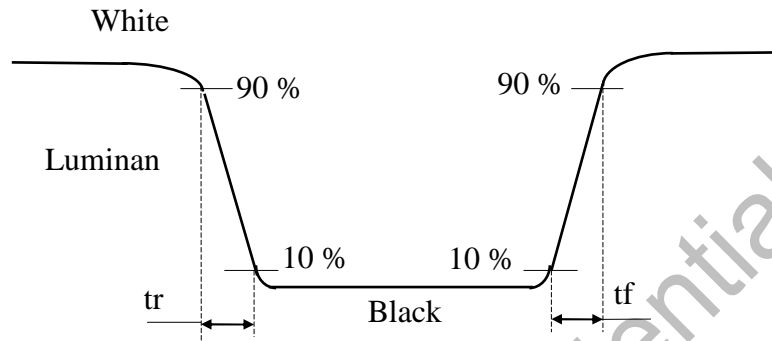
$$\text{Uniformity: } \Delta L = [L (\text{Min}) / L (\text{Max})] \times 100 \%$$



4).Definition of Viewing Angle (θ, ψ):



5) Definition of Response Time:

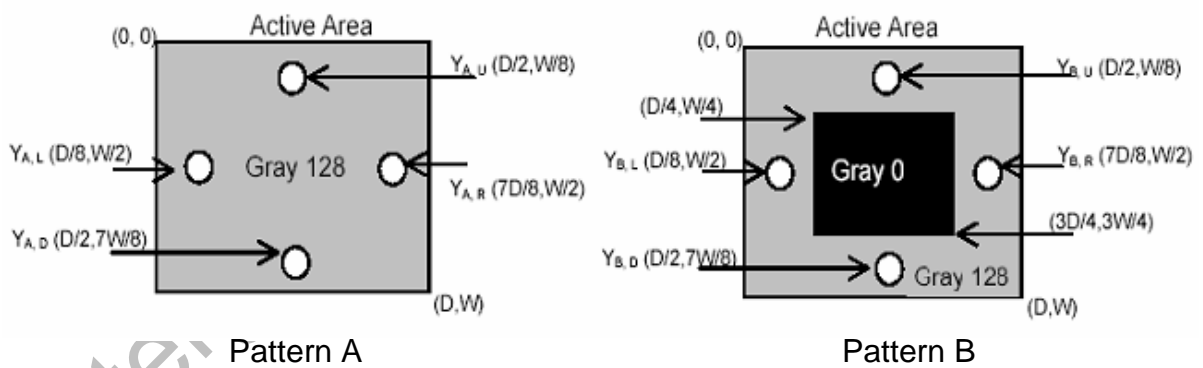


6) Definition of crosstalk:

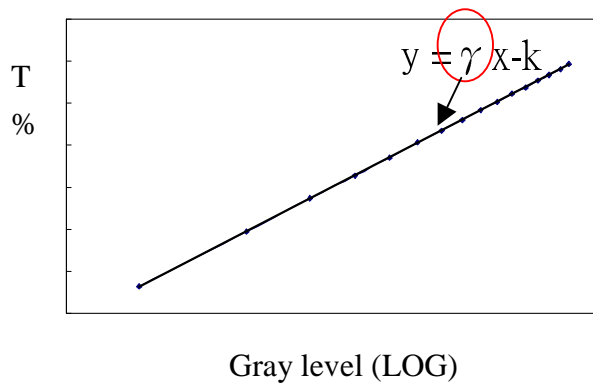
$$CT = |Y_B - Y_A| / Y_A \times 100 (\%)$$

Y_A : The luminance of measured position at pattern A

Y_B : The luminance of measured position at pattern B with Gray level 0



7) Definition of Gamma (γ), follow VESA standard sampling every 16 gray level (0,16,32,.....224,240,255)



9. RELIABILITY TEST CONDITIONS

(1) Temperature and Humidity

TEST ITEMS	CONDITIONS	NOTE
High Temperature High Humidity Operation	60°C; 90%RH; 240hrs	No condensation
High Temperature Operation	70°C; 240hrs	
High Temperature Storage	70°C; 240hrs	
Low Temperature Operation	-20°C; 240hrs	
Low Temperature Storage	-20°C; 240hrs	
Thermal Shock	-20°C (0.5hr) ~ 70°C (0.5hr); 200 Cycles	
Image Sticking	25°C, 4hrs	*1)

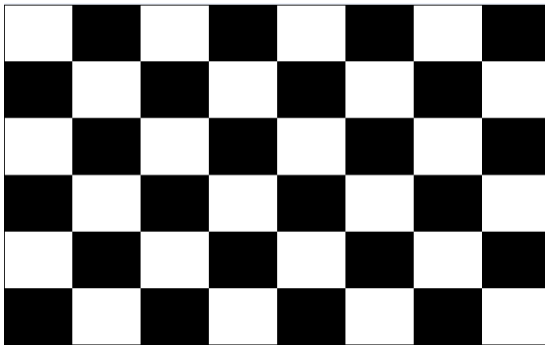
[Note]

1) Image Sticking :

Condition of image sticking test: 25°C

Operation with test pattern sustained for 4hrs, then change to gray pattern immediately.

After 5 min, the Mura must be disappeared completely.



(a) Test Pattern(Chess Board Pattern)



(b) judgment Pattern(128 Gray Pattern)

(2) Shock & Vibration

ITEMS	CONDITIONS
SHOCK (NON-OPERATION)	Shock level: 1470 m/s ² (150 G) Waveform: half sinusoidal wave, 2 ms Number of shocks: one shock of each direction
VIBRATION (NON-OPERATION)	Vibration level: (1.0G) zero to peak Waveform: sinusoidal Frequency range: 10 to 300 Hz Frequency sweep rate: 0.5 octave/min Duration: one sweep from 10 to 300Hz in each of three mutually, each x,y,z axis: 30 min.

(3) ESD

POSITION	CONDITION(MDL turn off)
ESD (power off)	<p>【MM Connector】 200pF, 0 , ±250V , contact mode for each pin</p> <ol style="list-style-type: none"> 150 pF , 330 Ω , ±8K V/±15K V (Air mode) , ±8K V (Contact mode) Air mode, test 25 times for each test point Contact mode, 25 times for each test point

(4) Judgment standard

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

Pass: Normal display image with no line defect.

Fail: No display image or line defects

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