Chunghwa Picture Tubes, Ltd.
Technical Specification

CPT TFT-LCD

CLAA 215FA03

APPROVED BY	CHECKED BY	PREPARED BY

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Title：CLAA215FA03 Technical Specification

Modification Record List

NO.	Issue Date	Modification Index
1	2009/1/08	First edition for project.
2	2009/2/26	Version A release. To fine tuning the mechanistic statistics.

Title : CLAA215FA03 Technical Specification

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Title：CLAA215FA03 Technical Specification

1. OVERVIEW

CLAA215FA03 is 21.5” color TFT-LCD (Thin Film Transistor Liquid Crystal Display) module composed of LCD panel, driver ICs, control circuit and backlight. By applying 6 bit digital data, 1920×1080, 16.7M-color images are displayed on the 21.5” diagonal screen. Input power voltage is 5.0V for LCD driving. Inverter for backlight is not included in this module. General specification is summarized in the following table:

ITEM	SPECIFICATION
Display Area(mm)	476.64 (H) × 268.11 (V) (21.53-inch diagonal)
Number of Pixels	1920 (H) × 1080(V)
Pixel Pitch(mm)	0.24825 (H) × 0.24825 (V)
Color Pixel Arrangement	RGB vertical stripe
Display Mode	Normally white, TN
Number of Colors	16.7M(6bits+Hi-FRC)
Brightness(cd/m^2)	250cd/m^2 (Typ.)(center, 7.5mA)
Viewing Angle(H/V)	170/160 (Typ.)
Surface Treatment	Anti-glare, 3H
Power consumption(W)	(20.0 (Typ.)) (w/o Inverter)
Module Size(mm)	495.6 (W) × 292.2 (H) ×12.5 (D) (Typ.)
Module Weight(g)	2000g(Typ.)
Backlight Unit	CCFL, 2 tubes(top × 1/bottom × 1) , Edge light

2. ABSOLUTE MAXIMUM RATINGS

ITEM		SYMBOL	MIN.	MAX.	UNIT	REMARK
Power Supply Voltage for LCD		VCC	0	6	V	
Lamp Voltage	Delta	VL	780	930	Vrms	
	STI	VL	760	950		
Lamp Current	Delta	ILO	3	8	mArms	
	STI	ILO	3	8		
Lamp Frequency		FL	40	80	kHz	
static electricity		VESDt	-200	200	V	*5)
		VESDc	-8000	8000	V	
Operation Temperature		Top	0	50	℃	*1). 2). 3). 6)
Storage Temperature		Tstg	-20	60	℃	*1). 2). 3)
Delayed Discharge Time		TD	--	1	sec	*8)

[Note]

1).The relative temperature and humidity range are as below sketch, 90%RHMax.(Ta≦40℃).

2).The maximum wet bulb temperature ≦39℃(Ta＞40℃) 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.

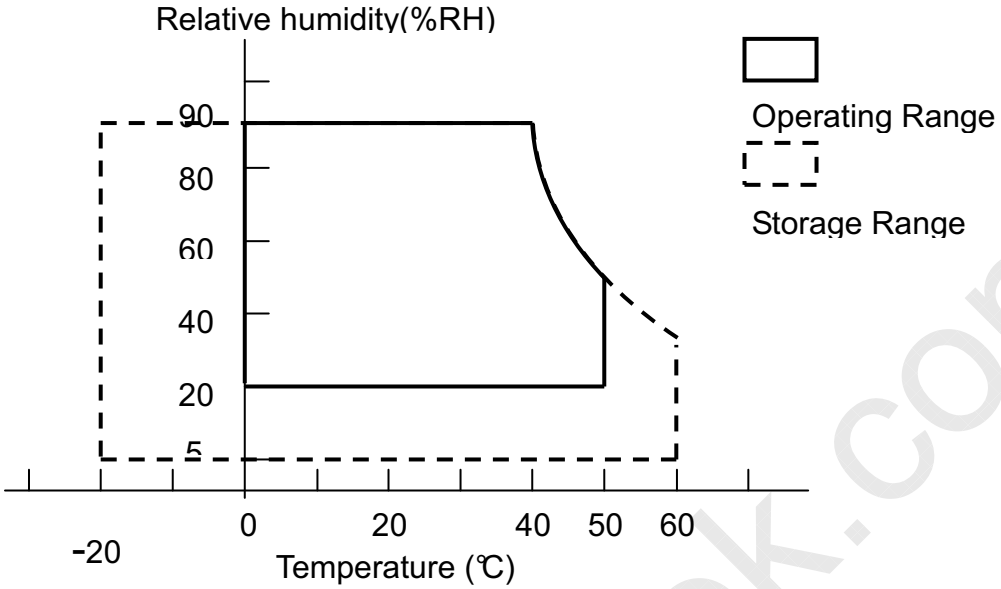
4).The life time of the lamp is related to the current of the lamp, so please according to the description of the “(b) backlight” on page 7.

5).Test Condition: IEC 1000-4-2 VESDt: Contact discharge to input connector; $VESD_C$: Contact discharge to module

6).If you operate the product in normal temperature range, the center surface of panel should be under 50℃.

7).When lamp current is out of the absolute maximum range, the life will fall rapidly or shown unusual sign.
IL min 2mA only for test only, but we can’t guarantee the lifetime and performance.

8).Delay lighting testing needs the volt above start voltage Vrms**.** Before the procedure tube needs typical lighting for 1 minute and stay in the temperature 25±2℃ for 24 hours and then testing in the same condition in dark room**.**



3. ELECTRICAL CHARACTERISTICS

(1).TFT-LCD

Ta=25℃

ITEM		SYMBOL	MIN	TYP	MAX	UNIT	REMARK
Power Supply Voltage for LCD		VCC	4.5	5.0	5.5	V	*1)
Power Supply Current for LCD		ICC	--	1000	1500	mA	*2)
Permissive Ripple Voltage for Logic		VRP	--	--	100	mVp-p	VCC=5.0V
Differential Resistance		Zm	90	100	110	Ω	
LVDS: IN+，IN-	The same motion input Voltage	VCM	1.125	1.25	1.375	V	*3)
	Differential input Voltage	| VID |	250	350	450	mV	
	High electric potential threshold voltage	VTH	-	-	100	mV	
	Low electric potential threshold voltage	VTL	-100	-	-	mV	
LCD Irush Current		Irush	-	-	4	A	*4)
Power consumption		P	-	5	7.5	W	*2)

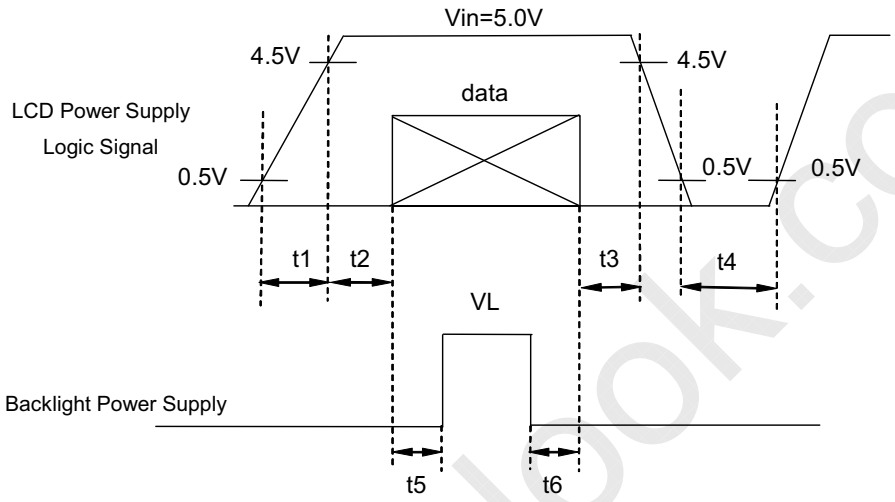
[Note]

*1)Power、data sequence

0.50ms≦t1≦10ms t4≧1 sec

0.01ms＜t2≦50ms t5≧200ms

0.01ms＜t3≦50ms t6≧200ms

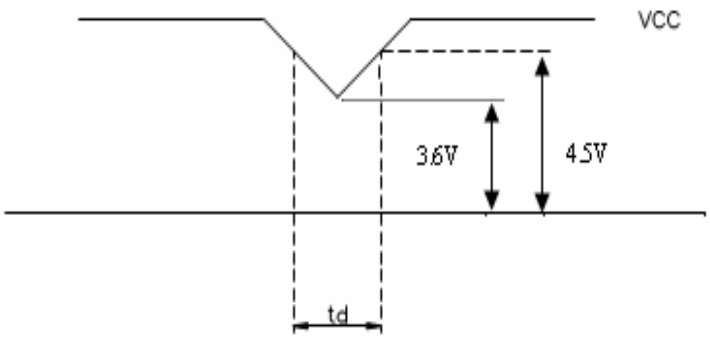


Data: RGB DATA, DCLK, DENA

VCC-dip conditions:

(1) When 3.6V≦Vcc(min)<4.5V: td≦10 ms

(2) When Vcc <3.6 V, VCC-dip conditions should also follow the VCC-turn-on conditions.

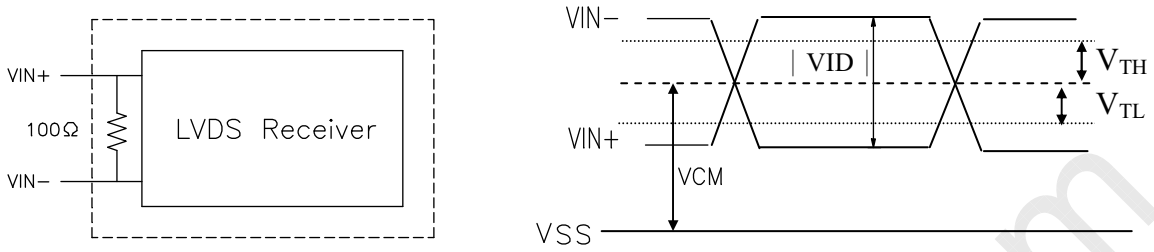


2). Typical value is measured when displaying horizontal gray scale line pattern:

64 gray level, 1920 line mode

VCC=5.0 V，fH= 67.8 kHz，fV=60 Hz，fCLK=72 MHz

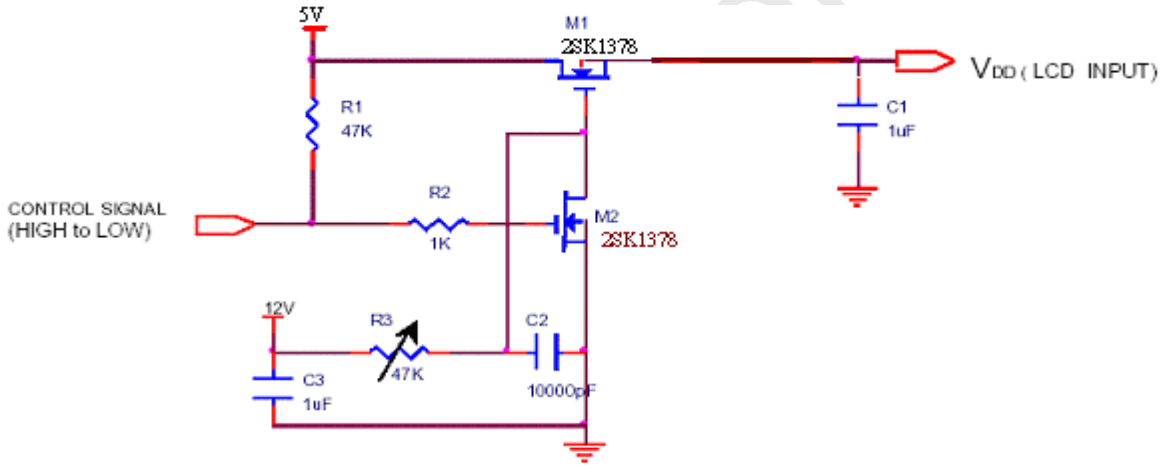
*3) LVDS Signal definition

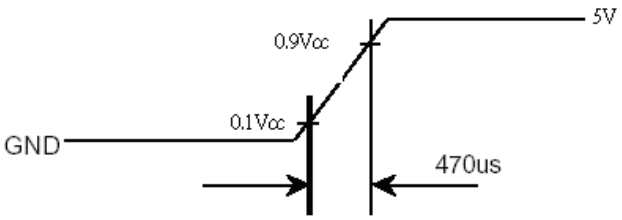


VIN+：Positive differential DATA & CLK Input

VIN-： Negative differential DATA & CLK Input

*4).Irush Measurement Condition





(2).Backlight

1. Electrical specification

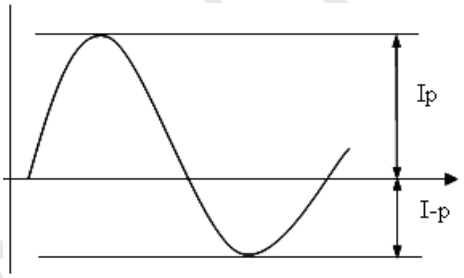
ITEM		SYMBOL	MIN	TYP	MAX	UNIT	REMARK
B/L Voltage	Delta	VL	738	820	902	Vrms	IL=7.5mA Ta=25℃
	STI	VL	702	780	858	Vrms	
B/L Current		IL	7.0	7.5	8.0	mArms	*1) Ta=25℃
B/L operating current		ILO	3	7.5	8.0	mArms	*1) Ta=25℃
B/L power consumption		WL	—	12.3	13.6	W	IL=7.5mA Ta=25℃
Inverter Frequency		FI	40	50	60	kHz	*2) Ta=25℃
Starting Lamp Voltage	Delta	VS	—	—	1770	Vrms	Ta=0℃
			—	—	1530	Vrms	Ta=25℃
	STI	VS	—	—	1600	Vrms	Ta=0℃
			—	—	1400	Vrms	Ta=25℃

2. Lamp life time

ITEM		ILO at 3.0 mA	ILO at 7.5 mA	ILO at 8.0 mA	UNIT	REMARK
	Delta	Min. 50,000	Min. 50,000	Min. 35,000	Hr	
	STI	Min. 50,000	Min. 50,000	Min. 35,000		
Rated time (turn on/off)		—	Min.100,000	—	time	*4)

[Note] Inverter vendor: CVT, model: 215FA03

1) If the waveform of light up-driving is asymmetric, the distribution of mercury inside the lamp tube will become unequally or will deplete the Ar gas in it. Then it may cause the abnormal phenomenon of lighting-up. Therefore, designers have to try their best to fulfill the conditions under the inverter designing-stage as below:



Ip : high side peak

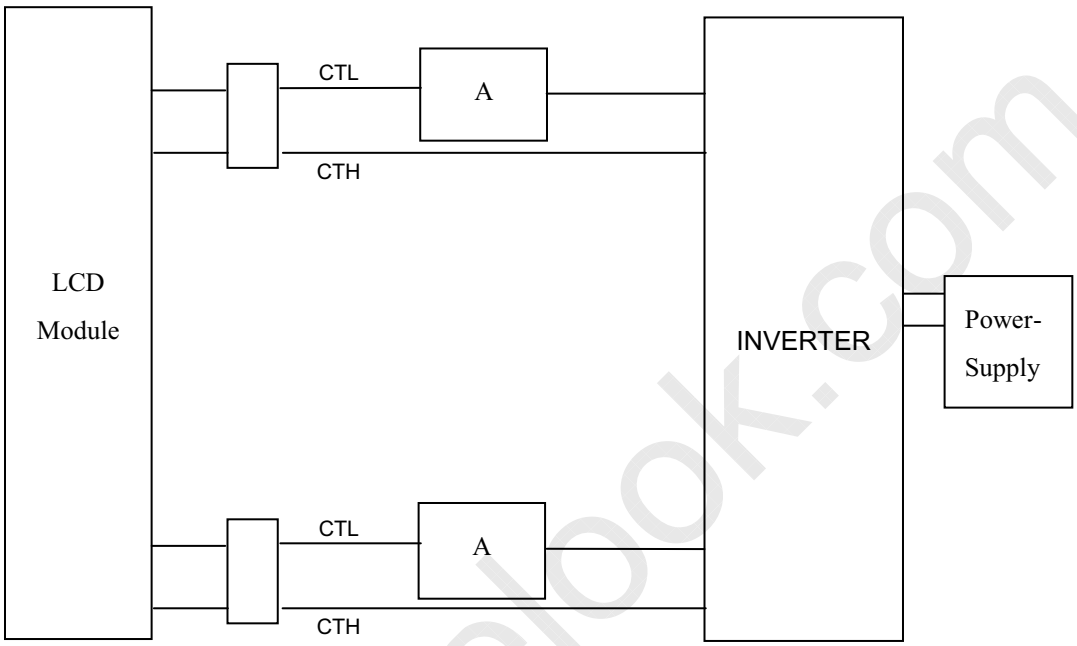
I-p : low side peak

A : The degrees of unbalance = $| I_p - I_{-p} | / I_{rms} \times 100(\%)$, & $| I_p - I_{-p} | / I_{cycle\ rms} \times 100(\%)$,
B : The ratio of wave height = I_p(or I_{-p})/ I_{rms} ,& I_p(or I_{-p})/ $I_{cycle\ rms}$,
A : The degrees of unbalance : <10%
B : The ratio of wave height : $<\sqrt{2} \pm 10\%$

2) The lamp working current (I_{cyc}) of any waveform of light up-driving can not over the maximum of lamp typical current.(I_{cyc} : Cycle RMS of oscilloscope)
*The property of single lamp

*Measure system: connector current meter with low voltage end

3) Lamp Current measurement method (The current meter is inserted in cold line)



4) a. Frequency in this range can make the characteristics of electric and optics maintain in +/- 10% except color coordinates.

b. Frequency in 50~60kHz can make characteristics of electric and optics better.

c. Frequency in 45~80kHz won't damage the lifetime and reliability of lamp.

d. Lamp frequency of inverter may produce interference with horizontal(or vertical) synchronous frequency,and this may cause horizontal beat on the display.Therefore, please adjust lamp frequency, and keep inverter as far from module as possible or use electronic shielding between inverter and module to avoid the interference.

5) Definition of the lamp life time：

a. Luminance (L) under 50% of specification.

b. Starting Lamp Voltage: over130% of the initial value. Ta=25℃

6) The condition of Turn-on and Turn-off operation is as below:

a. Lamp current is 7.5mA

b. Frequency is 10 sec.(on)/10 sec.(off)

c. Repeat it for 100 thousand times

d. The lamp hue variation must smaller than 0.03

e. It should not have motion fail when starting lamp voltage is lower than 130%of the initial value.

7) For keeping good lighting situation, when design the inverter, it must be considered that the voltage large than starting lamp voltage.

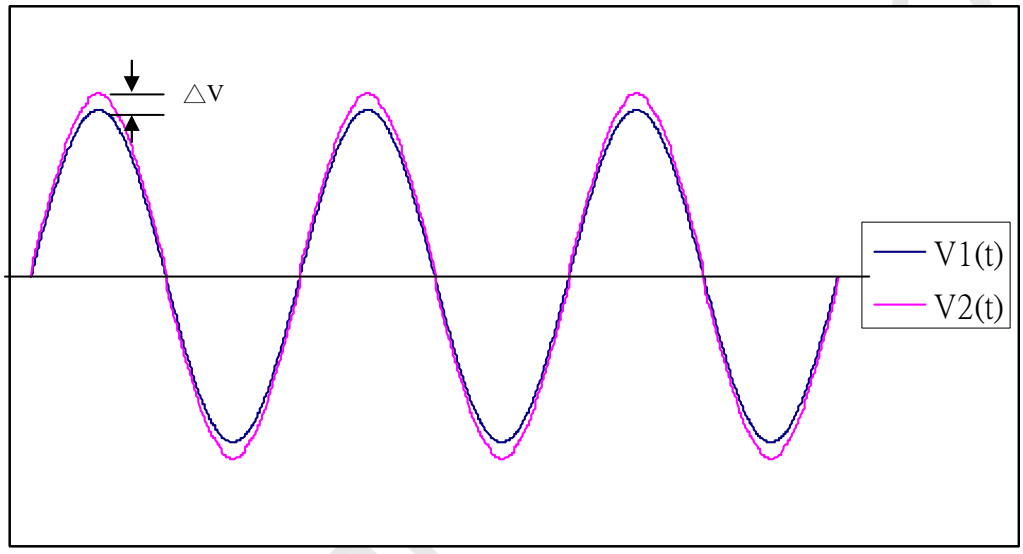
8) WL=IL x VL x 2。(IL=7.5mA，Ta=25℃)

9) The Starting Lamp Voltage (VS) of inverter must be driven large than one second.

10) The output voltage of inverter (Vn) must be the same phase of between any lamps.

11) The difference in voltage between any lamps (△V) must be smaller than 300V at the same time.
Example：｜△V｜＜300V，△V： ＝V1(t)-V2(t)

12) $\frac{|Vnrms - VL|}{VL} \leq 15\%$ ，n=1，2… 4，n：the number of lamp



13) The lamp working current (Icyc) of any cycle of lighting driving wave can't exceed maximum of lamp standard working current (IL).Therefore, the inverter design should be avoided the state.

Note：

1. VL：The lamp voltage(typical) of the standard working current.
2. The lamp working current (Icyc) is defined the RMS of current cycle from the oscilloscope.

4. INTERFACE PIN CONNECTION

(1) CN1

Outlet connector: GS2330-0312R-7F (FOXCONN) (or equivalent)

PIN NO.	REMARK	FUNCTION
1	RXO0-	minus signal of odd channel 0(LVDS)
2	RXO0+	plus signal of odd channel 0(LVDS)
3	RXO1-	minus signal of odd channel 1(LVDS)
4	RXO1+	plus signal of odd channel 1(LVDS)
5	RXO2-	minus signal of odd channel 2(LVDS)
6	RXO2+	plus signal of odd channel 2(LVDS)
7	GND	GND
8	RXOC-	minus signal of odd clock channel (LVDS)
9	RXOC+	plus signal of odd clock channel (LVDS)
10	RXO3-	minus signal of odd channel 3(LVDS)
11	RXO3+	plus signal of odd channel 3(LVDS)
12	RXE0-	minus signal of even channel 0(LVDS)
13	RXE0+	plus signal of even channel 0(LVDS)
14	GND	GND
15	RXE1-	minus signal of even channel 1(LVDS)
16	RXE1+	plus signal of even channel 1(LVDS)
17	GND	GND
18	RXE2-	minus signal of even channel 2(LVDS)
19	RXE2+	plus signal of even channel 2(LVDS)
20	RXEC-	minus signal of even clock channel (LVDS)
21	RXEC+	plus signal of even clock channel (LVDS)
22	RXE3-	minus signal of even channel 3(LVDS)
23	RXE3+	plus signal of even channel 3(LVDS)
24	GND	GND
25	NC	NC
26	NC	Test pin (Can't connect to GND)
27	NC	NC
28	VCC	Power supply input voltage(5.0 V)
29	VCC	Power supply input voltage(5.0 V)
30	VCC	Power supply input voltage(5.0 V)

1) Keep the NC Pin and don't connect it to GND or other signals.

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

(2) CN2, 3, (BACKLIGHT)

CN2、CN3：35001HS-02L (YEONHO)

<Mating connector: 35002WR-02L (YEONHO)>

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No.	Pin	Symbol	Description
CN2	1	HV	High Voltage Output for CCFL Lamp 1
	2	LV	Low Voltage Output for CCFL Lamp 1
CN3	1	HV	High Voltage Output for CCFL Lamp 2
	2	LV	Low Voltage Output for CCFL Lamp 2

5. INTERFACE TIMING

(1) Timing Characteristic

ITEM				SYMBOL	MIN.	TYP.	MAX.	UNIT
LCD Timing	DCLK		Freq.	f_{CLK}	55	72	90	MHz
			Cycle	t_{CLK}	18.18	13.89	11.11	ns
	DENA	Horizontal	Horizontal effective time	t_{HA}	960	960	960	t_{CLK}
			Horizontal blank time	t_{HB}	32	100	115	t_{CLK}
			Horizontal total time	t_H	992	1060	1075	t_{CLK}
		Vertical	Vertical frame Rate	Fr	50	60	75	Hz
			Vertical total time	t_V	1084	1130	1170	t_H
			Vertical effective time	t_{VA}	1080	1080	1080	t_H
			Vertical blank time	t_{VB}	4	50	90	t_H

[Note]

*1) DENA (data enable) usually is positive

*2) DCLK still inputs during blanking

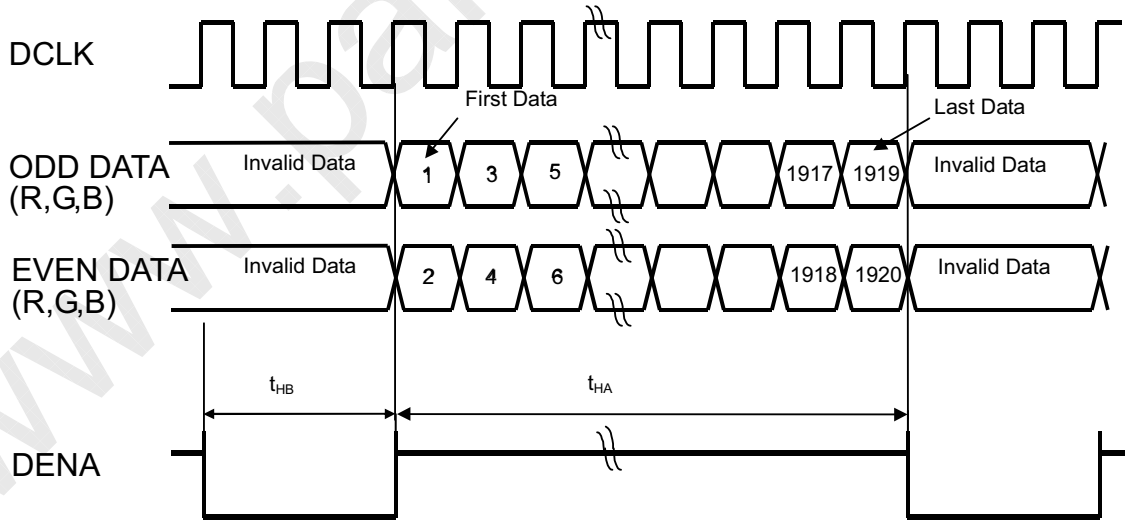
*3) LVDS transmitter IC: NT71679-00024(NVT)

*4) DE mode only

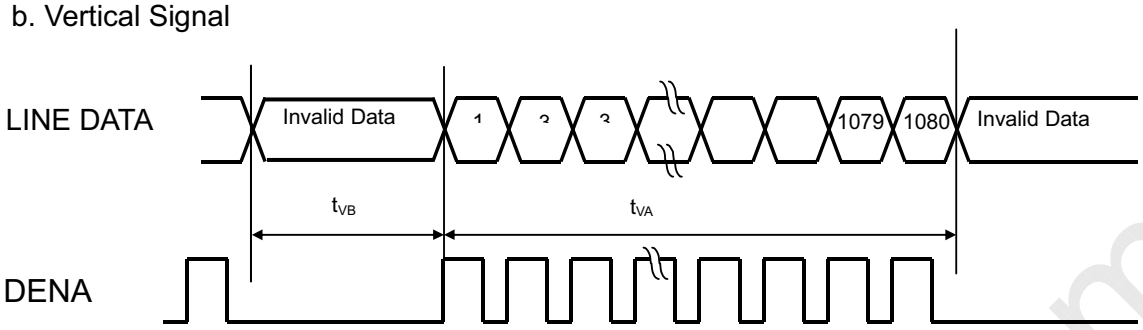
*5) It maybe cause flicker at 50Hz.

(2).Timing Chart

a. Horizontal Signal

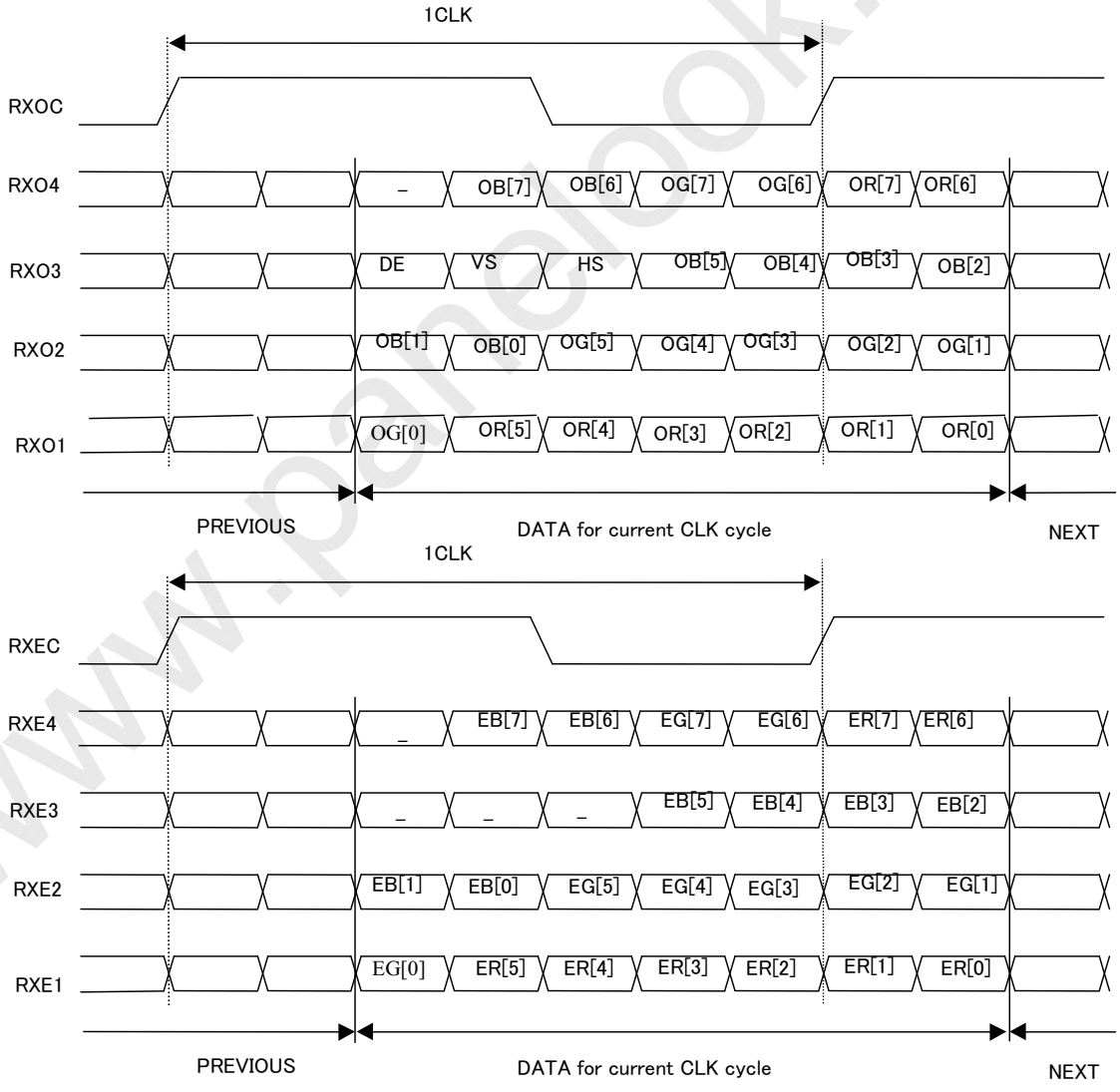


b. Vertical Signal



(3).LVDS Data

For 6Bit+Hi-FRC



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Color Data Assignment

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	0
	GREEN(255)	0	0	0	0	0	0	0	0	1	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	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	1
	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
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	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	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	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	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	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	0
	GREEN(1)	0	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	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	0
	GREEN(255)	0	0	0	0	0	0	0	0	1	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	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	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	0	1	0
	BLUE(254)	0	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	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.

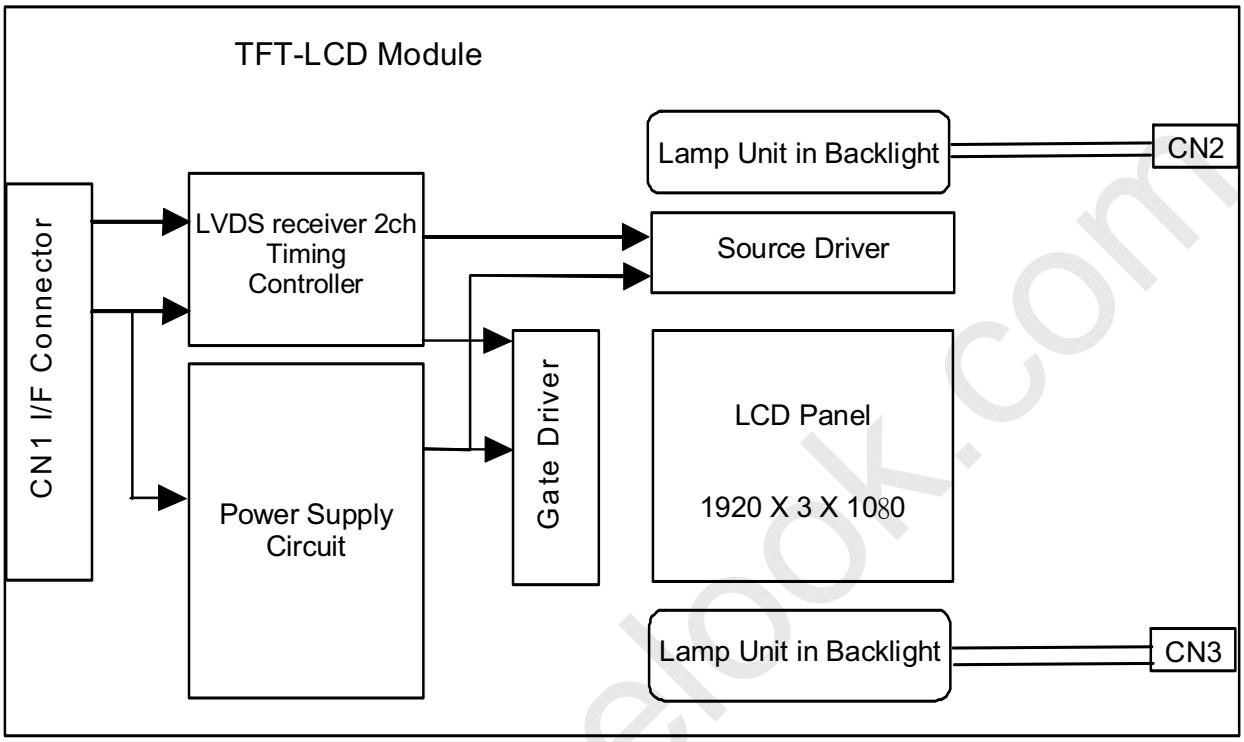
2) Data: 1-High, 0-Low.

3)For odd & even data also.

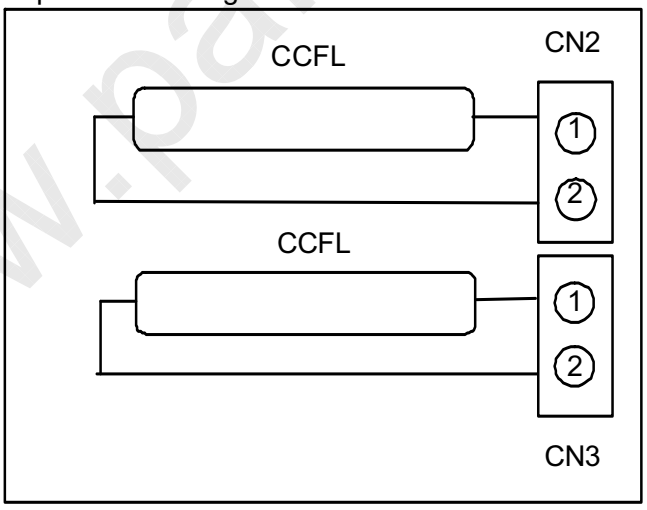
(4).Color Data Distribution

D(1,1)	D(2,1)	..	D(X,1)	..	D(1919,1)	D(1920,1)
D(1,2)	D(2,2)	..	D(X,2)	..	D(1919,2)	D(1920,2)
..	..	+	..	+	..	..
D(1,Y)	D(2,Y)	..	D(X,Y)	..	D(1919,Y)	D(1920,Y)
..	..	+	..	+	..	..
D(1,1079)	D(2, 1079)	..	D(X, 1079)	..	D(1919, 1079)	D(1920, 1079)
D(1, 1080)	D(2, 1080)	..	D(X, 1080)	..	D(1919, 1080)	D(1920,1080)

6. BLOCK DIAGRAM

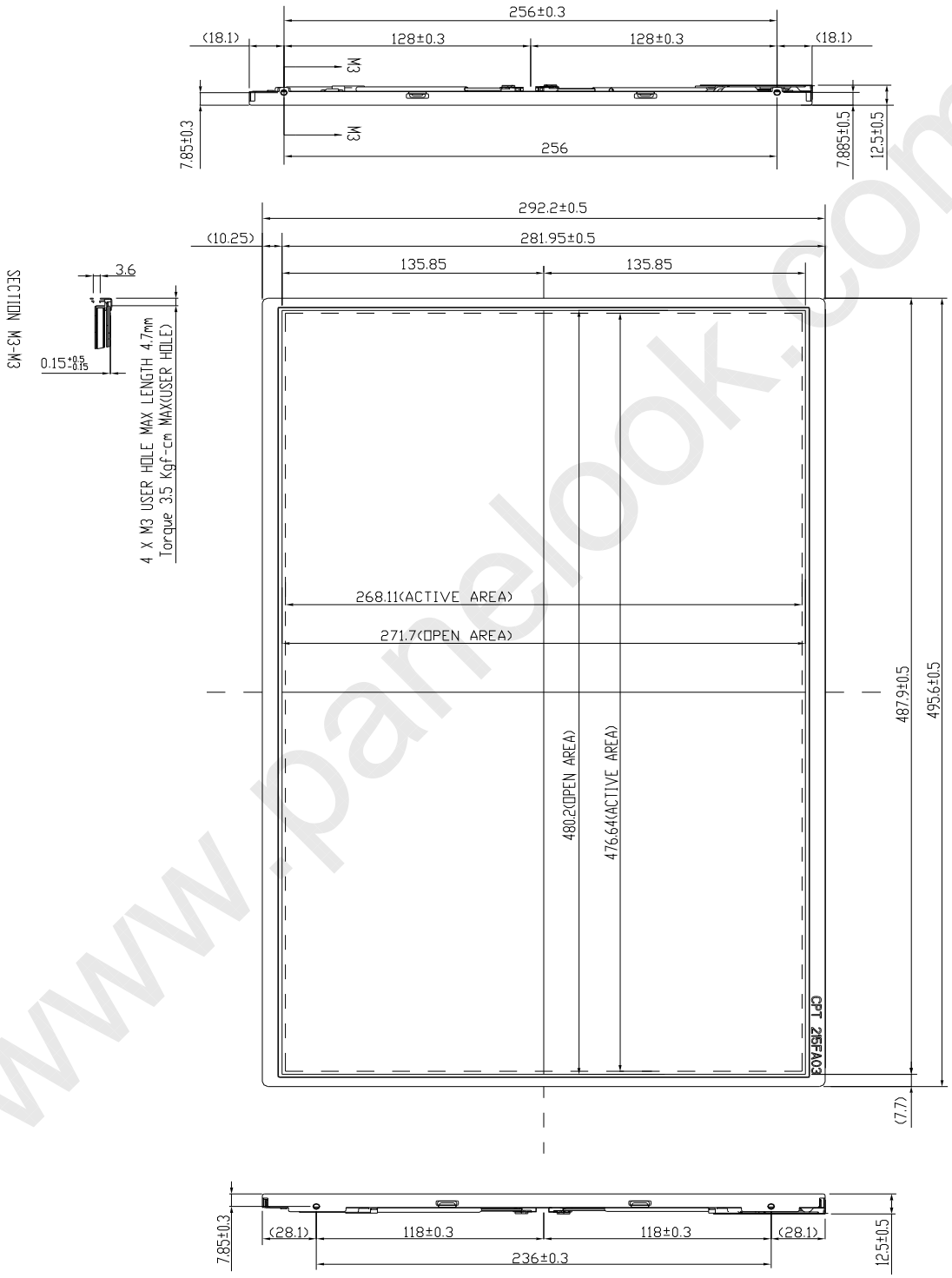


Lamp Uint in Backlight



7. MECHANICAL SPECIFICATION

(1) Front side (Tolerance is ± 0.5mm unless noted) [Unit:mm]



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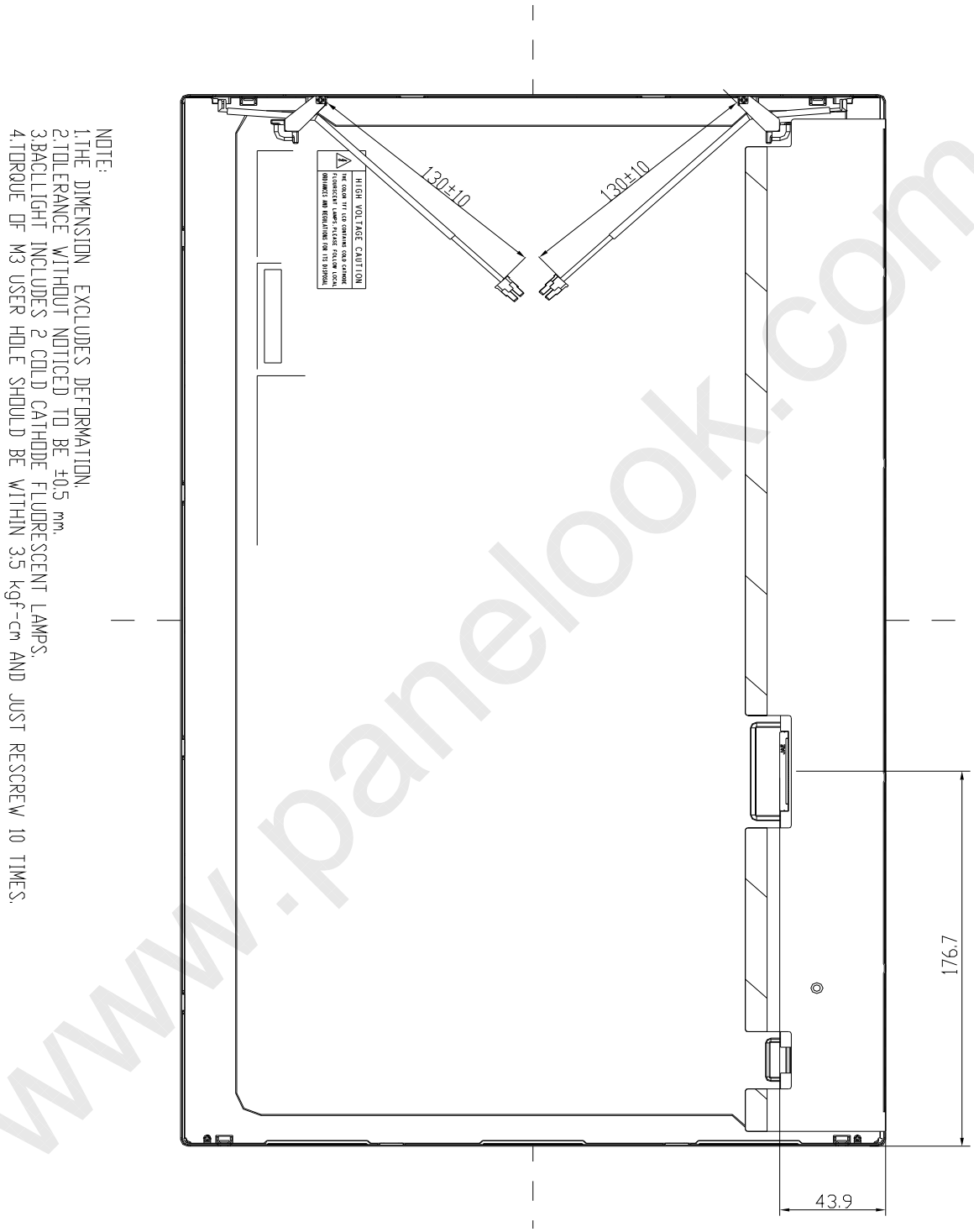
(2)Rear side (Tolerance is ±0.5mm unless noted) [Unit: mm]



8. OPTICAL CHARACTERISTICS

Ta=25℃, VCC=5.0V

ITEM		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	REMARK
Contrast (CEN)		CR	θ=ψ= 0°	800	1000	--	--	*1) 2)
Luminance (CEN)		L	θ=ψ= 0°	200	250	--	cd/m2	*1) 3)
9P Uniformity		ΔL	θ=ψ= 0°	75	--	--	%	*1) 3)
Response Time		Tr+Tf	θ=ψ= 0°	--	5	8	ms	*5)
Cross talk		CT	θ=ψ= 0°	--	--	1	%	*6)
View angle	Horizontal	ψ	CR≧10	75/-75	85/-85	--	Deg.	*4)
	Vertical	θ		70/-70	80/-80	--	Deg.	
	Horizontal	ψ	CR≧5	75/-75	85/-85	--	Deg.	
	Vertical	θ		75/-75	85/-85	--	Deg.	
Color Coordinates	White	x	θ=ψ= 0°	(0.283)	(0.313)	(0.343)	Color Coordinates	*3)
		y		(0.299)	(0.329)	(0.359)		
	Red	x		(0.622)	(0.652)	(0.682)		
		y		(0.303)	(0.333)	(0.363)		
	Green	x		(0.259)	(0.289)	(0.319)		
		y		(0.577)	(0.607)	(0.637)		
	Blue	x		(0.117)	(0.147)	(0.177)		
		y		(0.055)	(0.085)	(0.115)		
Gamut		CG	θ=ψ= 0°	70	72		%	
Gamma		γ	VESA	2.0	2.2	2.4	--	*7)

[Note]

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).

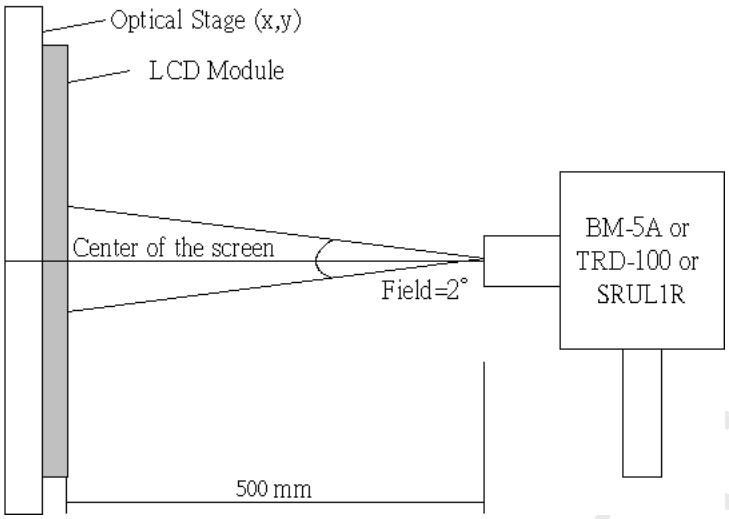
Measurement Condition: IL=7.5mA × 2

Inverter: CVT, model: 215FA03 , Frequency=50kHz.

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

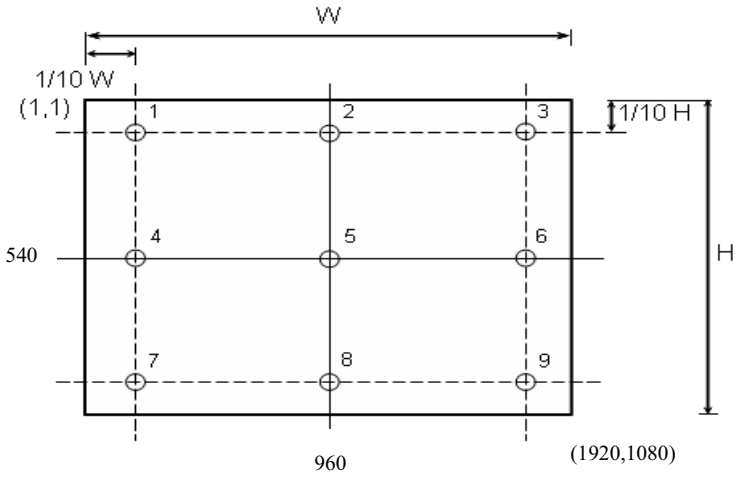
CR=ON (White) Luminance/OFF (Black) Luminance

3) Definition of Luminance and Luminance uniformity

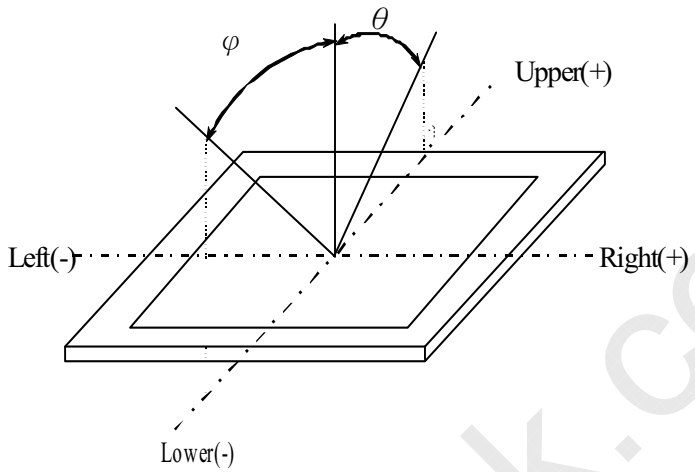
Central luminance: The white luminance is measured at the center position "5" on the screen, see Fig.1 below. And the measure time is 30 min after discharged.

9P Luminance (AVG): The white luminance is measured at measuring points 1 to 9, see Fig.1 below.

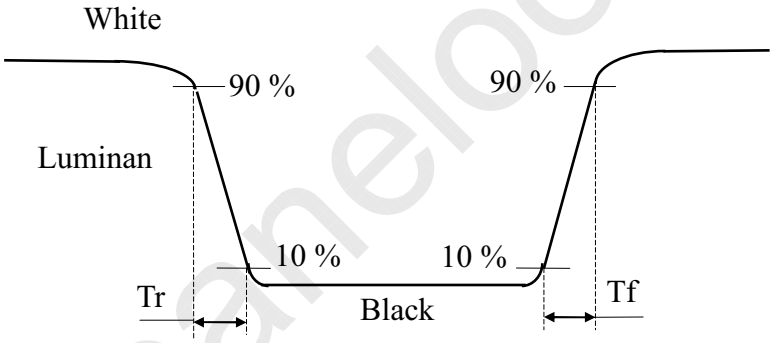
9P Uniformity: $\Delta L = (L_{MIN} / L_{MAX}) \times 100\%$



4).Definition of Viewing Angle (θ,ψ):



5) Definition of Response Time:



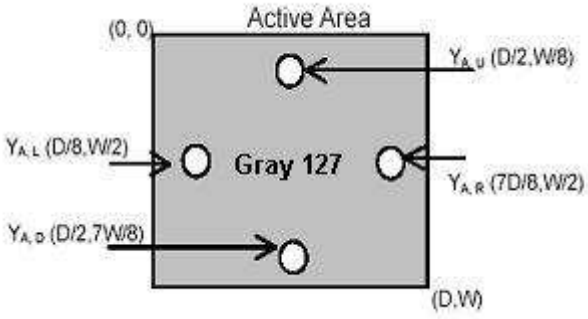
6) Definition of crosstalk:

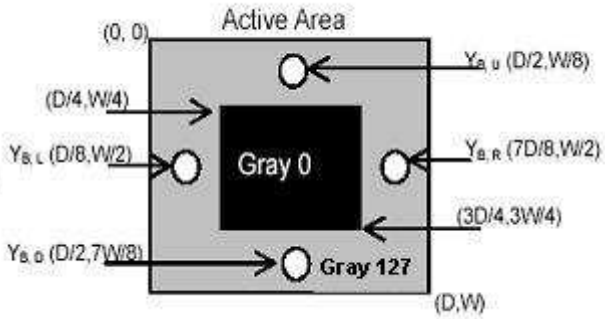
$CT = | Y_B - Y_A | / Y_A \times 100\ (\%)$

Y_A : The luminance of measured position at pattern A

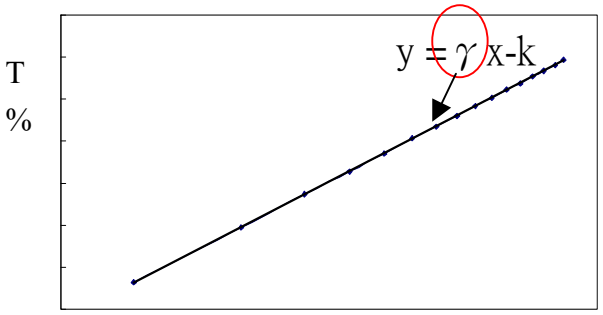
Y_B : The luminance of measured position at pattern B with Gray level 0

Pattern A Pattern B





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



Gray level (LOG)