Chunghwa Picture Tubes, Ltd.
Technical Specification

To : **YUPPIN CO., LTD.**
Date : **2004. 08. 17**

CPT TFT-LCD

CLAA190EA 03

ACCEPTED BY：

APPROVED BY	CHECKED BY	PREPARED BY
		TFT-LCD Product Planning Management General Division

Prepared by : TFT-LCD Product Planning Management Division

CHUNGHWA PICTUER TUBES, LTD.
1127 Hopin Rd., Padeh, Taoyuan, Taiwan 334, R.O.C.
TEL: +886-3-3675151 FAX: +886-3-377-3001

1. OVERVIEW

CLAA190EA03 is 19” color (48.19mm) TFT-LCD (Thin Film Transistor Liquid Crystal Display) module composed of LCD panel, LVDS driver ICs, control circuit and backlight. By applying 8 bit digital data, 1280ㄨ1024, 16.7 million-color images are displayed on the 19” diagonal screen. Interface of data and control signals is Typ. Inverter for backlight is not included in this module. General specification are summarized in the following table:

ITEM		SPECIFICATION
Display Area (mm)		376.32(H)x301.056(V) (19.0-inch diagonal)
Number of Pixels		1280 ㄨ 3(H) ㄨ 1024(V)
Pixel Pitch (mm)		0.294(H) ㄨ 0.294(V)
Color Pixel Arrangement		RGB vertical stripe
Display Mode		Normally white
Number of Colors		16777216
Optimum Viewing Angle		6 o’clock
Brightness (cd/m^2)		250
Viewing Angle	CR≧5	-85~85(H) , -85~85(V)
	CR≧10	-75~75(H) , -60~70(V)
Electrical Interface		LVDS
Consumption of Power (W)		31.5 W (Typ.)
Module Size (mm)		404.2(W) ㄨ 330.0(H) ㄨ 20.0(D) (Typ.)
Module Weight (g)		2700(Max.)
Backlight Unit		CCFL, 4 tables, edge-light (top , bottom)
Surface Treatment		Anti-glare , Surface-hardness : 3H

The LCD Products listed on this document are not suitable for use of aerospace equipment, submarine cables, and nuclear reactor control system and life support systems. If customers intend to use these LCD products for above application or not listed in "Standard" as follows, please contact our sales people 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 maximun values which, if exceeded, may cause faulty operation or damage to the unit.

ITEM	SYMBOL	MIN.	MAX.	UNIT	Remark
Power Supply Voltage For LCD	Vcc	-0.3	6.0	V	
Lamp Voltage	VL	652	798	Vrms	*5)
Lamp Current	IL	4.0	7.5	mArms	*6)
Lamp Frequency	FL	50	60	kHz	
ESD	VESDt	-200	200	V	
	VESDc	-8000	8000	V	
ICC Rush Current	IRUSH	--	3	A	*7)
Operation Temperature (Surrounding)	T_{op}	0	50	℃	*1) *2) *3) *4)
Storage Temperature	T_{stg}	-20	60	℃	*1) *2) *3)

[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.

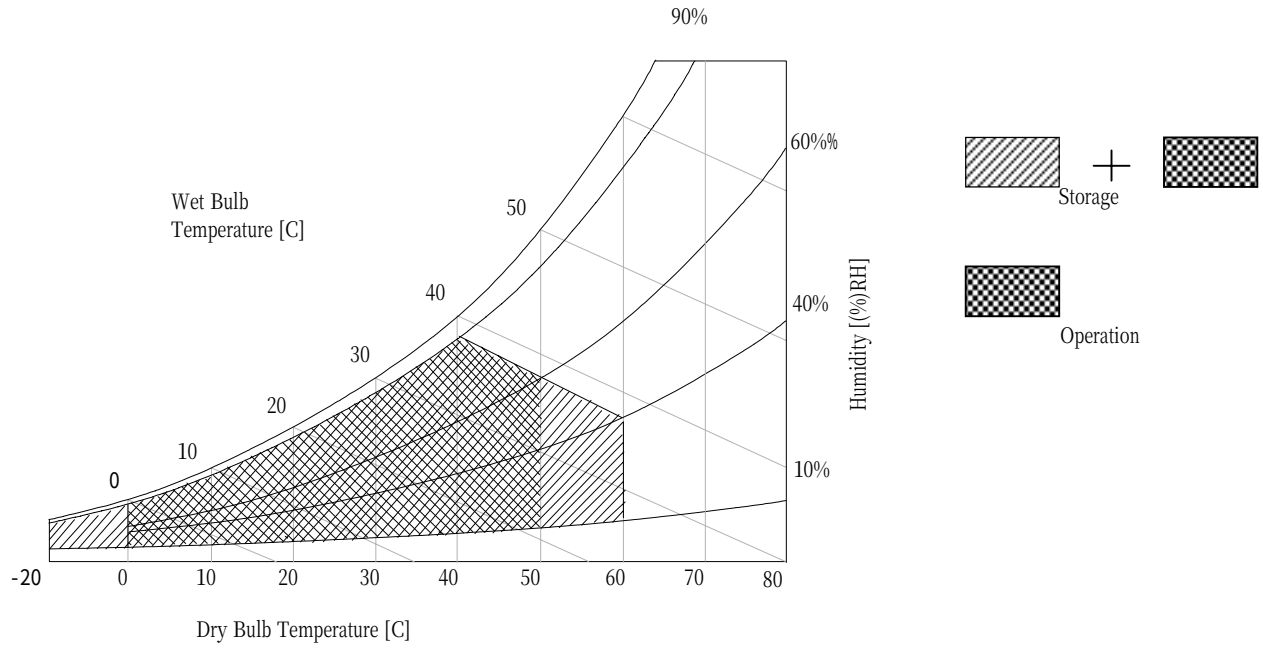
*3) If you use the product in a environment which over the definition of temperature and humidity too long to effect the result of eye-atching.

*4) If you operate the product in normal temperature range, the center surface of panel should be under 60℃.

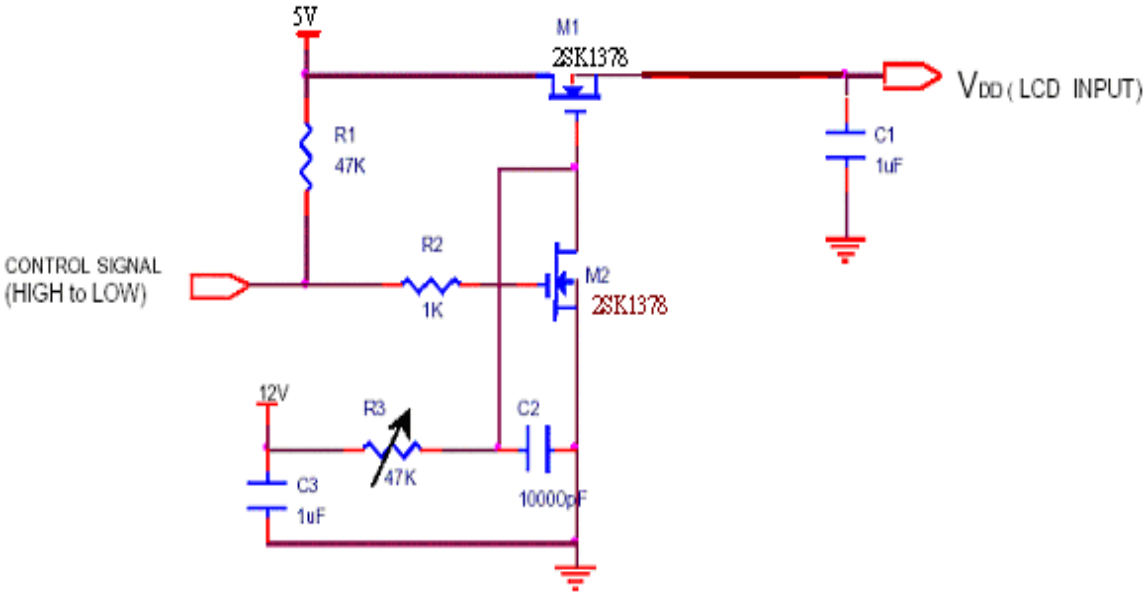
*5) The variance of voltage when lamp curvent is 7.0 mA.

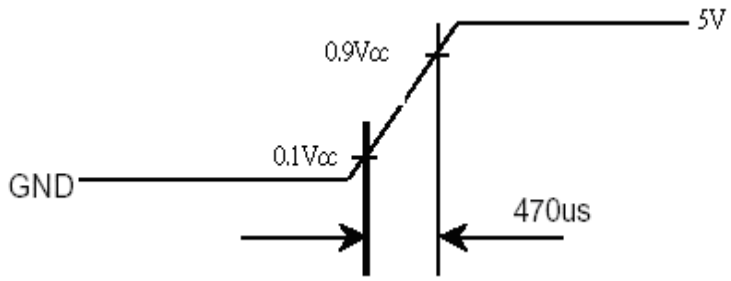
*6) The mininum of lamp curvent means that inverters can be using analog methods to tune brightness ranage, but we don't ensure the optical character the same to the typical value.

Humidity：
Humidity≦85%RH without condensation.
Relative Humidity ≦90% (Ta≦ 40℃)
Wet Bulb Temperature ≦39℃(Ta≧40℃)



*7) CONTROL SIGNAL: High (+5V)→Low (GND).
Rising Time of the input voltage should tune to 470 us from R3 and C2.





Rising Time

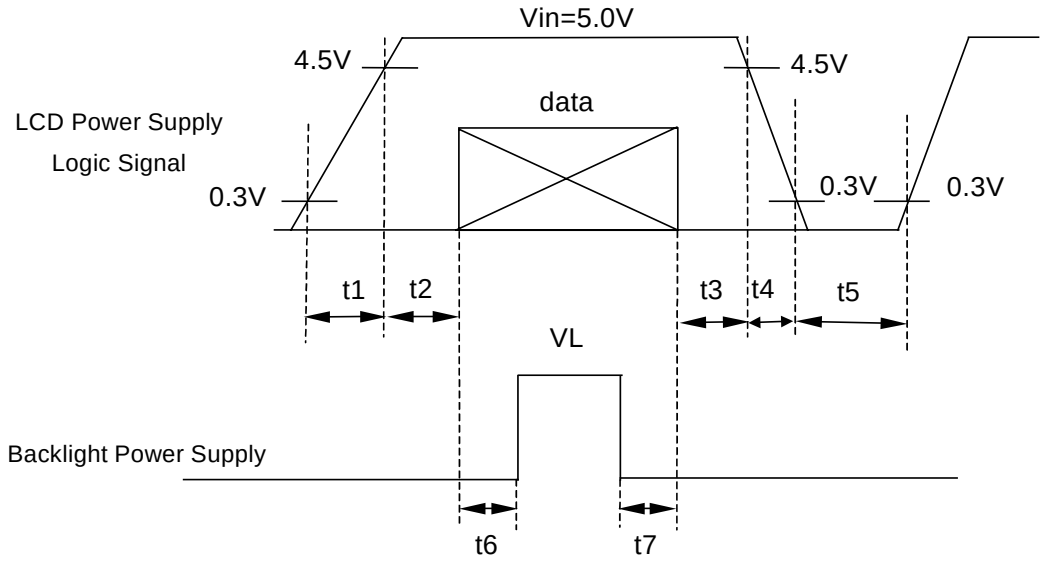
3. ELECTRICAL CHARACTERISTICS

(a). TFT-LCD Ta=25℃

ITEM		SYMBOL	MIN	TYP	MAX	UNIT	REMARK
LCD Power Supply Voltage		VCC	4.5	5.0	5.5	V	[Note 1]
LCD Power Supply Current	(a)256Gray	ICC	--	800	1000	mA	[Note 2]
	(b)Black		--	900	1100		
	(c White		--	700	800		
interface		LVDS	DSC383/385、THC63LVD823				

[Note 1]
Power、data sequence：

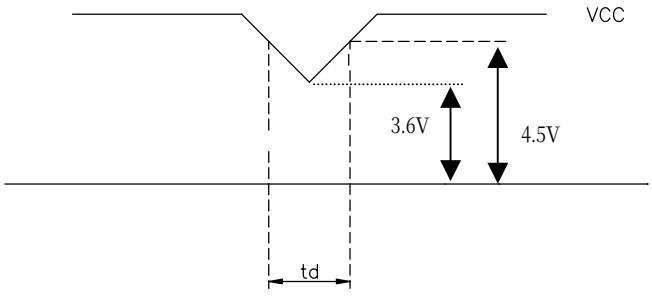
t1≦10 ms 1 sec≦t5
0＜t2≦50 ms 200 ms≦t6
0＜t3≦50 ms 200 ms≦t7
0＜t4≦50 ms



Data: RGB DATA, DCLK, DENA

VCC-dip state：

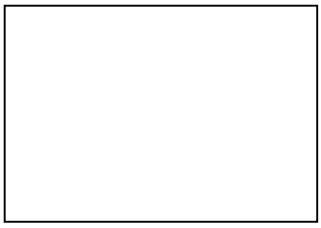
1) When 3.6 V≦VCC＜4.5 V, td≦10 ms.
2) VCC ＞ 4.5V , VCC-dip condition should also follow the VCC-turn-off condition.



[Note 2]
Typical current situation：
1024 line mode.
VCC=5.0 V , f_H=64 kHz , f_V=60 Hz , f_{CLK}=54 MHz.

(a)256 Gray Pattern

(b)Black Pattern



(c)White Pattern

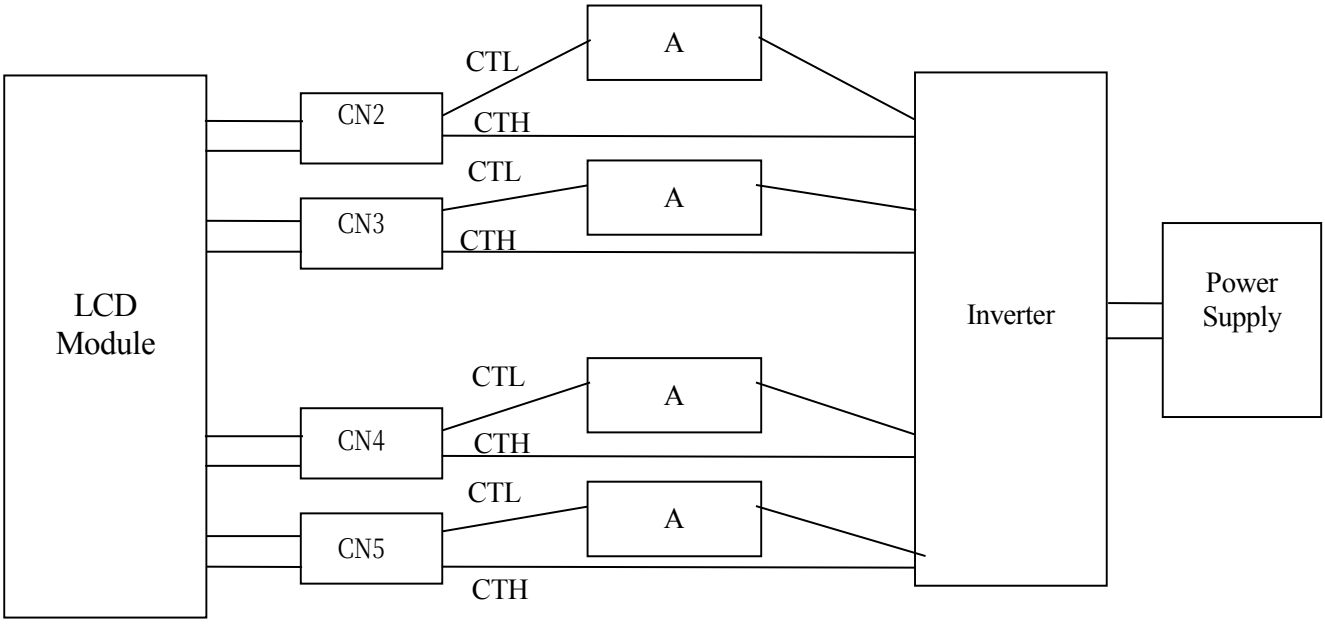
(b). Backlight

Ta=25℃

ITEM		SYMBOL	MIN	TYP	MAX	UNIT	REMARK
Lamp Voltage		VL	652	725	798	Vrms	*1) IL=7.0mA
Lamp Current		IL	3.5	7.0	7.5	mArms	*1) *2)
Inverter Frequency		FI	40	--	60	kHz	*4)
Lamp Life Time		LT	40,000	--	--	hr	*1) *2 *3) IL=7.0mA, Continuous Operation
			30,000	--	--		*1) *2 *3) IL=7.5mA, Continuous Operation
Turn on and off life		--	100000	--	--	times	*1) *2 *3) IL=7.0mA, Continuous Operation time cycle 30s
Starting Lamp Voltage	Ta=0°C	Vs	--		1690	Vrms	*5)
	Ta=25°C		--		1420		
Power consumption		PBL	--	5.08	--	Wattrms	VL*IL, IL=7.0mA/single lamp

[Note]
*1) All the values show the table are the definitions of single lamp.

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



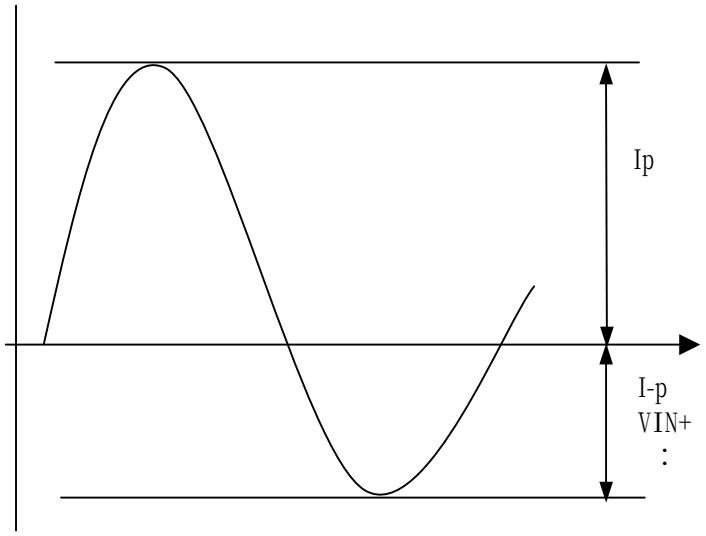
*3) Definition of the lamp life time：
Luminance (L) under 50% of specification starting lamp voltage

*4) Frequency in this range can mala the characterisitics of electric and optics maintain in +/- 10% except hue.Lamp frequency of inverter may produce interference with horizontal 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) The maximum light-up voltage is the maximum starting lamp voltage, although designment of inverter light-up voltage should be larger than starting lamp voltage or over to start lamp voltage.

*6) 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 forfill the conditions under the inverter designing-stage as below:

· The degrees of unbalance： ＜10%
· The ratio of wave height：＜√2 ±10%



Ip：high side peak

I-p：low side peak

A：The degrees of unbalance = | Ip ─ I-p | / Irms ×100 (%)
B：The ratio of wave height = Ip (or I-p) / Irms

4. INTERFACE PIN CONNECTION

(a). CN1
Outlet connector: FI-X30SSL-HF (JAE)

PIN	Symbol	Descripition
1	RO0M	Minus signal of odd channel 0(LVDS)
2	RO0P	Plus signal of odd channel 0(LVDS)
3	RO1M	Minus signal of odd channel 1(LVDS)
4	RO1P	Plus signal of odd channel 1(LVDS)
5	RO2M	Minus signal of odd channel 2(LVDS)
6	RO2P	Plus signal of odd channel 2(LVDS)
7	GND	Ground
8	ROCLKM	Minus signal of odd clock channel (LVDS)
9	ROCLKP	Plus signal of odd clock channel (LVDS)
10	RO3M	Minus signal of odd channel 3(LVDS)
11	RO3P	Plus signal of odd channel 3(LVDS)
12	RE0M	Minus signal of even channel 0(LVDS)
13	RE0P	Plus signal of even channel 0(LVDS)
14	GND	Ground
15	RE1M	Minus signal of even channel 1(LVDS)
16	RE1P	Plus signal of even channel 1(LVDS)
17	GND	Ground
18	RE2M	Minus signal of even channel 2(LVDS)
19	RE2P	Plus signal of even channel 2(LVDS)
20	RECLKM	Minus signal of even clock channel (LVDS)
21	RECLKP	Plus signal of even clock channel (LVDS)
22	RE3M	Minus signal of even channel 3(LVDS)
23	RE3P	Plus signal of even channel 3(LVDS)
24	GND	Ground
25	NC	Not connection
26	NC	Test pin for VCOM
27	NC	Not connection
28	VCC	Power supply input voltage +5V
29	VCC	Power supply input voltage +5V
30	VCC	Power supply input voltage +5V

ODD = first pixel data
EVEN = second pixel data

Remarks:
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.

(b). CN2~CN5 (BACKLIGHT)

LVDS Transmitter (DS90383, DS90385) Signal Interface to CLAA190EA03 (CN1)							
1st Device Odd pixel				2nd Device Even pixel			
Symbol	No	Symbol	No	Symbol	No	Symbol	No
TXOUT0-	48	RO0M	1	TXOUT0-	48	RE0M	12
TXOUT0+	47	RO0P	2	TXOUT0+	47	RE0P	13
TXOUT1-	46	RO1M	3	TXOUT1-	46	RE1M	15
TXOUT1+	45	RO1P	4	TXOUT1+	45	RE1P	16
TXOUT2-	42	RO2M	5	TXOUT2-	42	RE2M	18
TXOUT2+	41	RO2P	6	TXOUT2+	41	RE2P	19
TXCLKOUT-	40	ROCLKM	8	TXCLKOUT-	40	RECLKM	20
TXCLKOUT+	39	ROCLKP	9	TXCLKOUT+	39	RECLKP	21
TXOUT3-	38	RO3M	10	TXOUT3-	38	RE3M	22
TXOUT3+	37	RO3P	11	TXOUT3+	37	RE3P	23

(c). LVDS Interface (2)

LVDS Transmitter (THC63LVD823) Signal Interface to CLAA190EA03 (CN1)							
Device Output Pin CLAA190EA03 (CN1)							
First pixel Data				Second pixel Data			
Symbol	No	Symbol	No	Symbol	No	Symbol	No
TA1-	49	RO0M	1	TA2-	37	RE0M	12
TA1+	48	RO0P	2	TA2+	36	RE0P	13
TB1-	47	RO1M	3	TB2-	35	RE1M	15
TB1+	46	RO1P	4	TB2+	34	RE1P	16
TC1-	44	RO2M	5	TC2-	32	RE2M	18
TC1+	43	RO2P	6	TC2+	31	RE2P	19
TCLK1-	42	ROCLKM	8	TCLK2-	30	RECLKM	20
TCLK1+	41	ROCLKP	9	TCLK2+	29	RECLKP	21
TD1-	40	RO3M	10	TD2-	28	RE3M	22
TD1+	39	RO3P	11	TD2+	27	RE3P	23

(d). CN2~CN5 (BACKLIGHT)

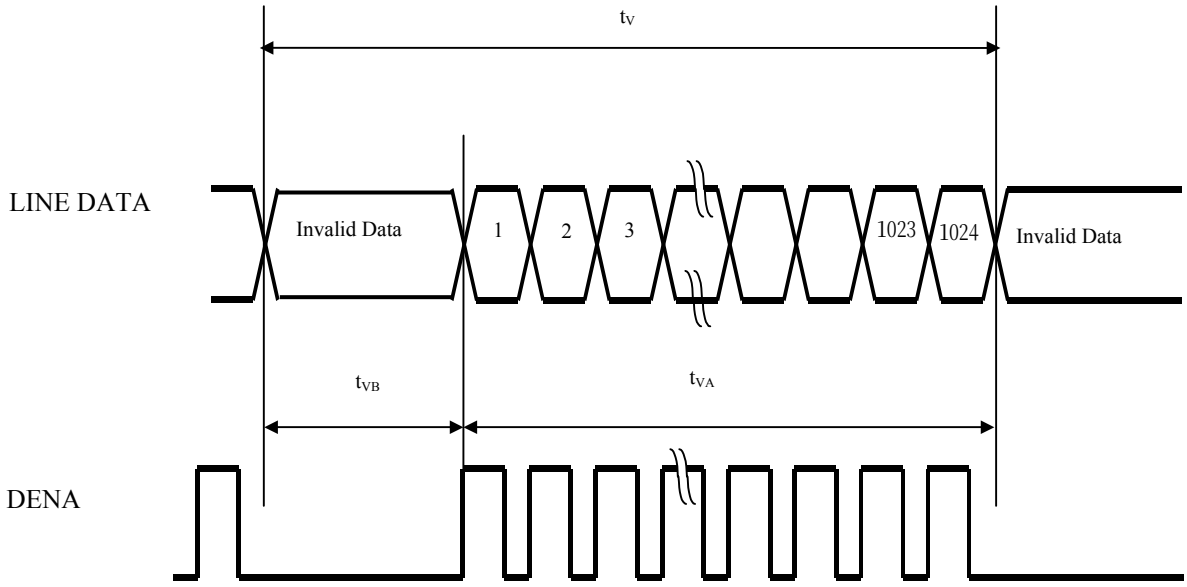
Backlight-side connector: BHSR-02VS-1 (JST)
Inverter-side connector: SM02-BHSS-1-TB

PIN NO	SYMBOL	FUNCTION
1	CTH	VBLH (High Voltage)
2	CTL	VBLL (Low Voltage)

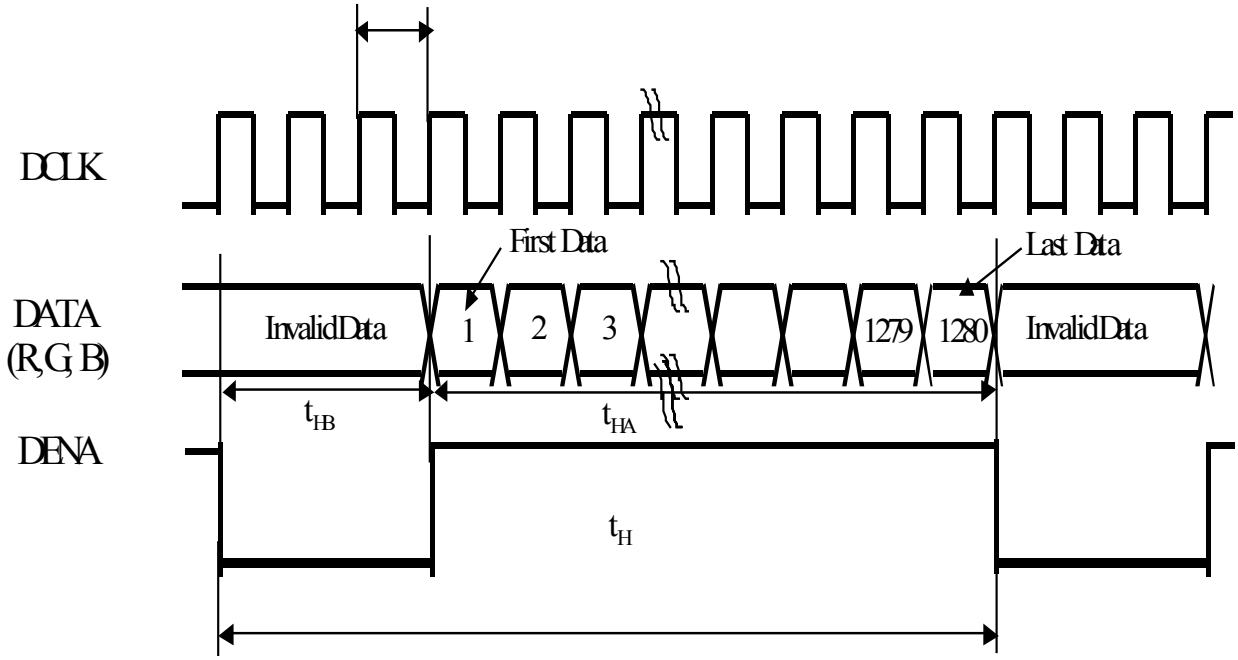
[Note]： VBLH-VBLL=VL

5. INTERFACE TIMING(DE only mode)

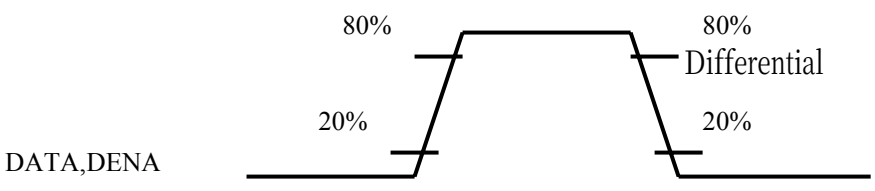
(1). Vertical signal:



(2). Horizontal signal:



(3)

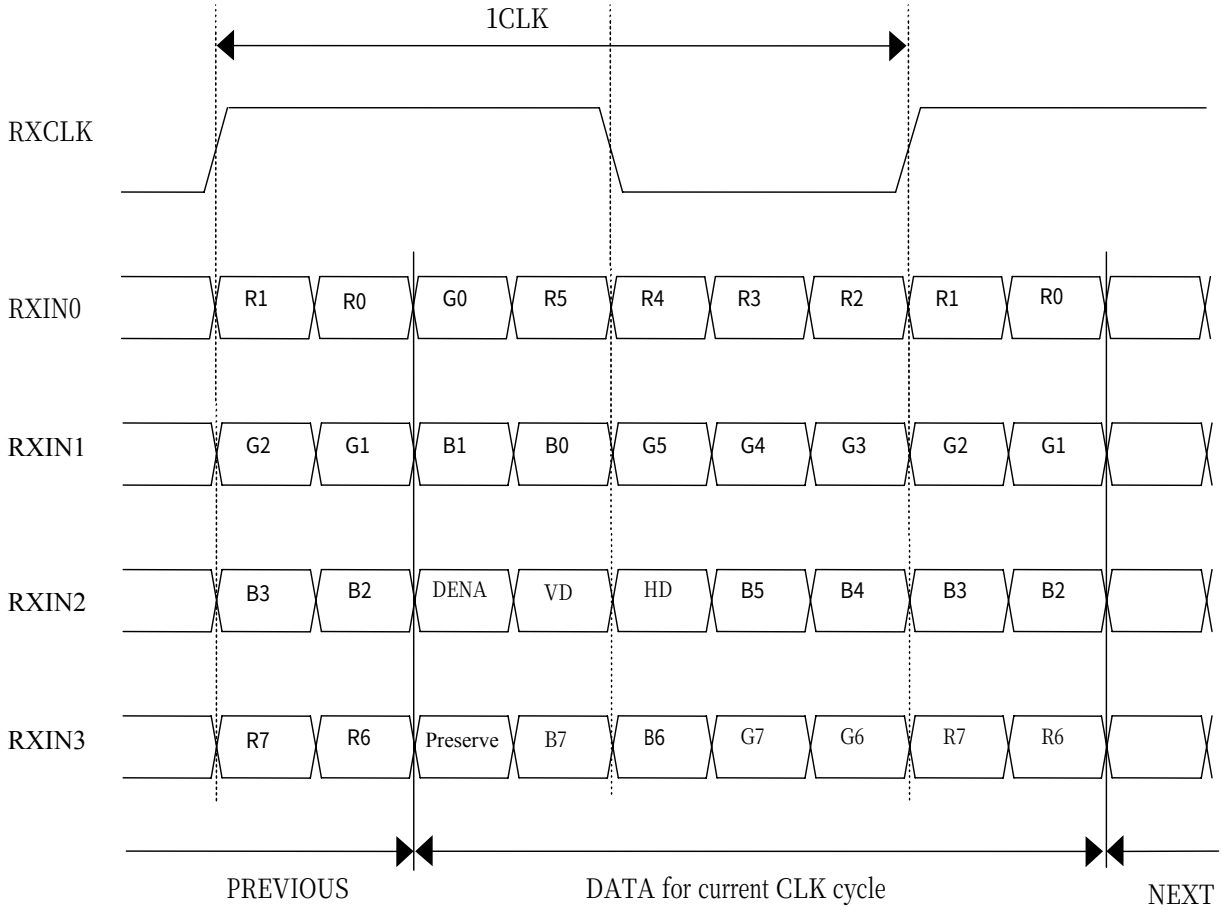


LVDS transition time =0.5ns(typ)

(4). Timing Chart (DE only mode)

ITEM				SYMBOL	MIN.	TYP.	MAX.	UNIT
Simutaneous Signal import sequence	DCLK		Freq.	f_{CLK}	45	54	67.5	MHz
			Cycle	t_{CLK}	--	18.5	--	ns
	DENA	Horizontal	Horizontal total time	t_H	710	844	--	t_{CLK}
			Horiaontal effective time	t_{HA}	640	640	640	t_{CLK}
			Horizontal blank time	t_{HB}	--	204	--	t_{CLK}
		Vertical	Frame Rate	Fr	55	60	75	Hz
			Vertical total time	t_V	1030	1066	--	t_H
			Vertical effective time	t_{VA}	1024	1024	1024	t_H
			Vertical blank time	t_{VB}	--	42	--	t_H
LVDS Signal mport sequence	CLK Freq.			fCLKin	—	54	67.5	MHz
	CLK Cycle			tCLKin		18.5	—	ns

(5) Data mapping



Remark: Data are in 8bit depth, and where the LSBs put on R0, G0, B0.

(6). 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

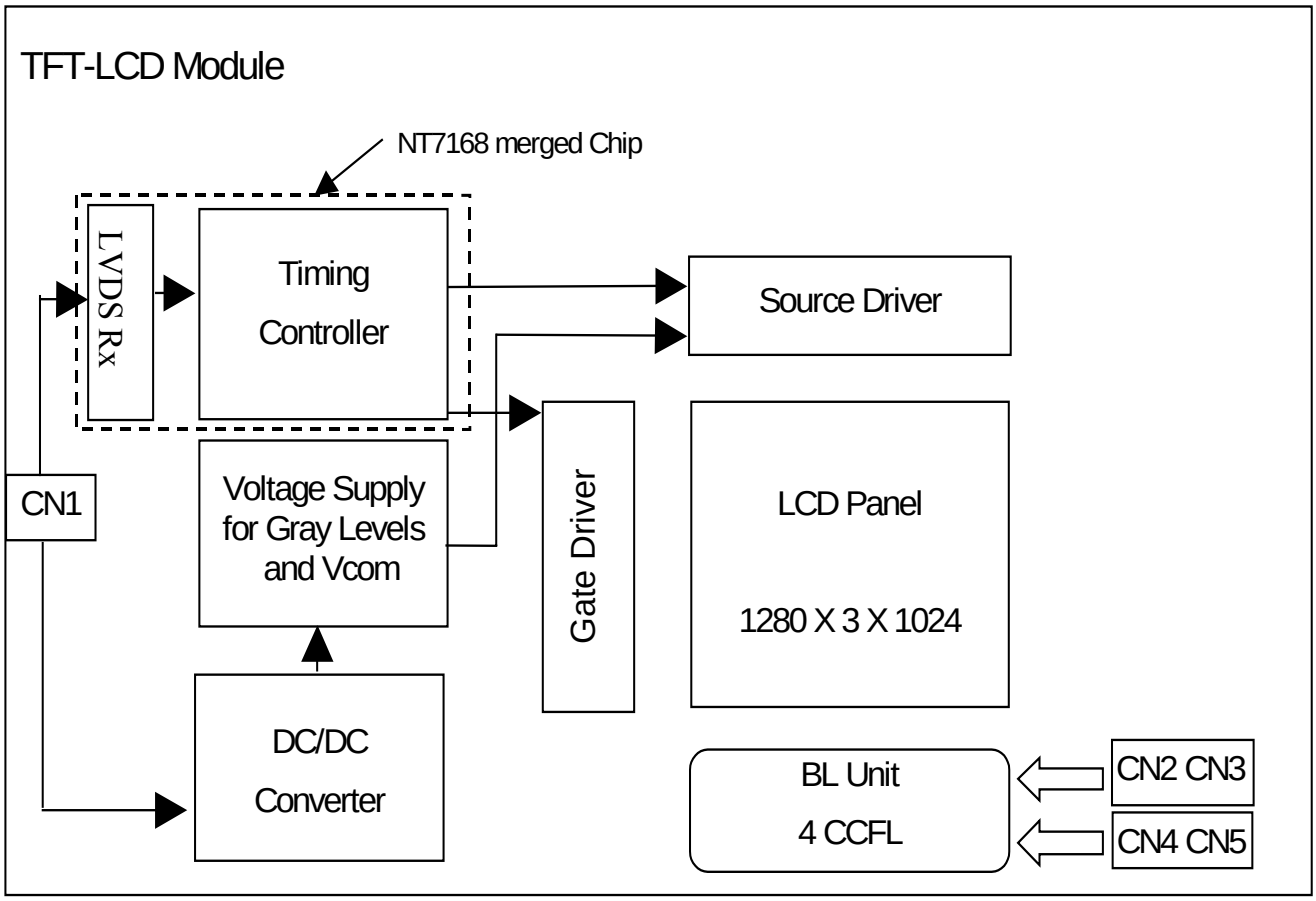
[Note]

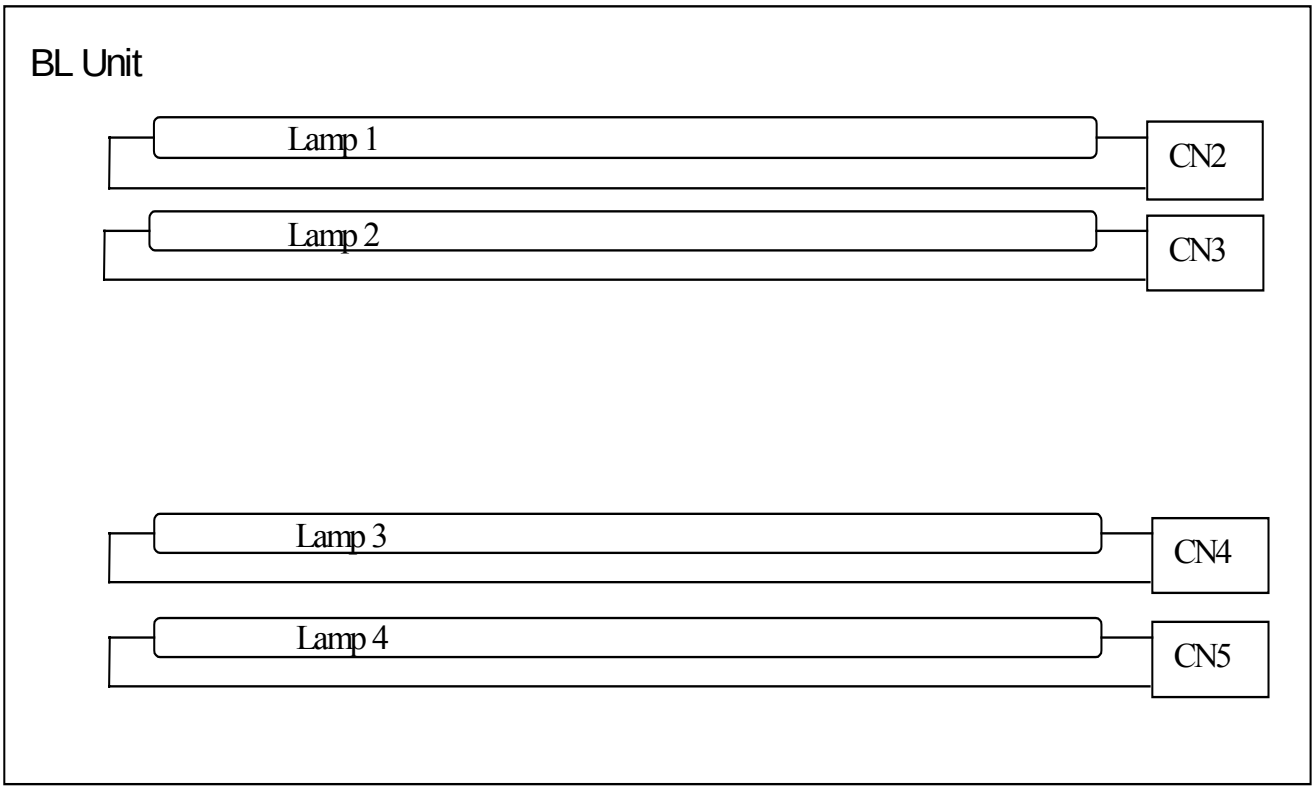
1) Definition of gray scale：
Color (n)：n indicates gray scale level; higher n means brighter level.

2) Data：1-High, 0-Low.

3) This assignments are suitable for odd and even data.

6. BLOCK DIAGRAM

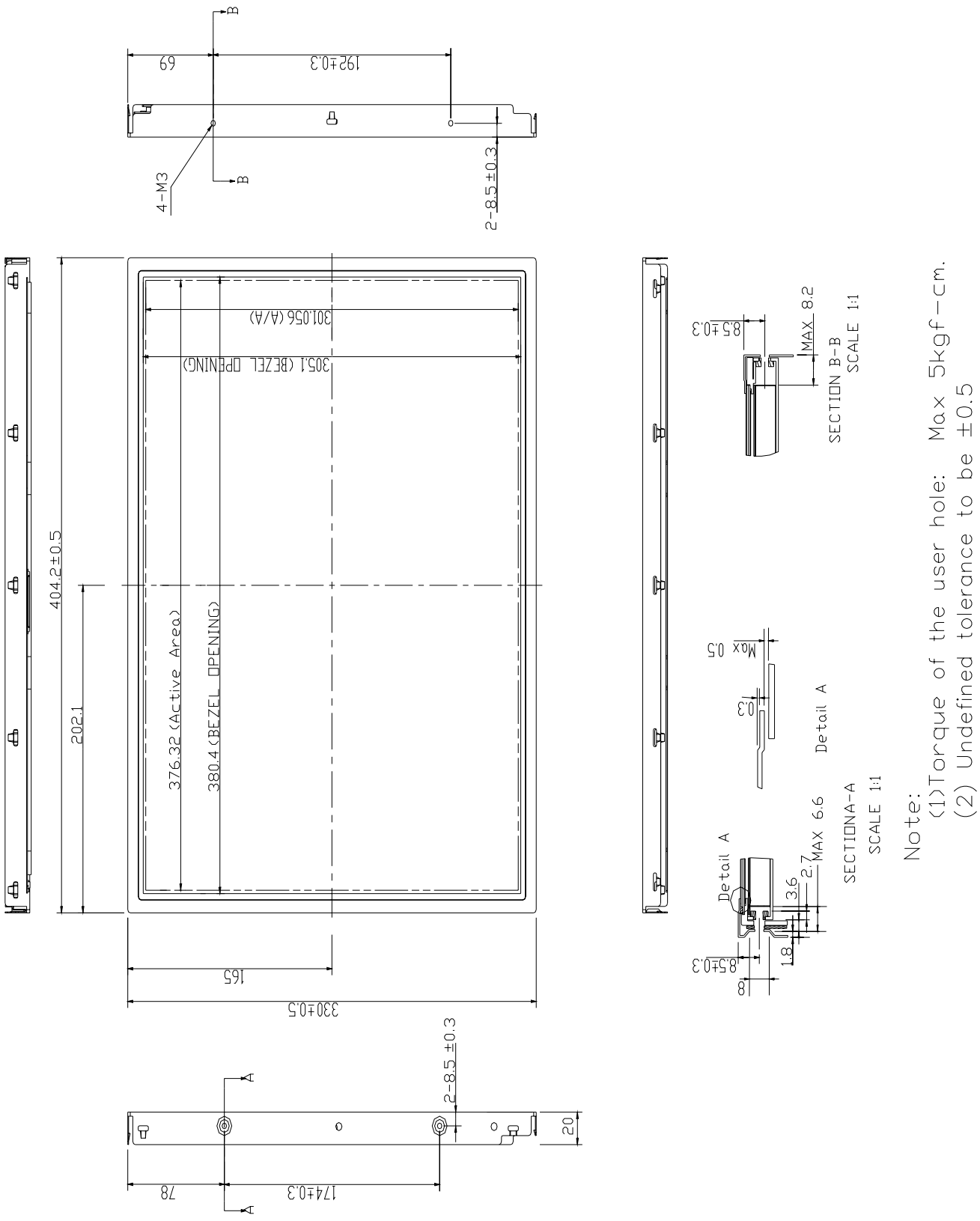




7. MECHANICAL SPECIFICATION

(1). Front side

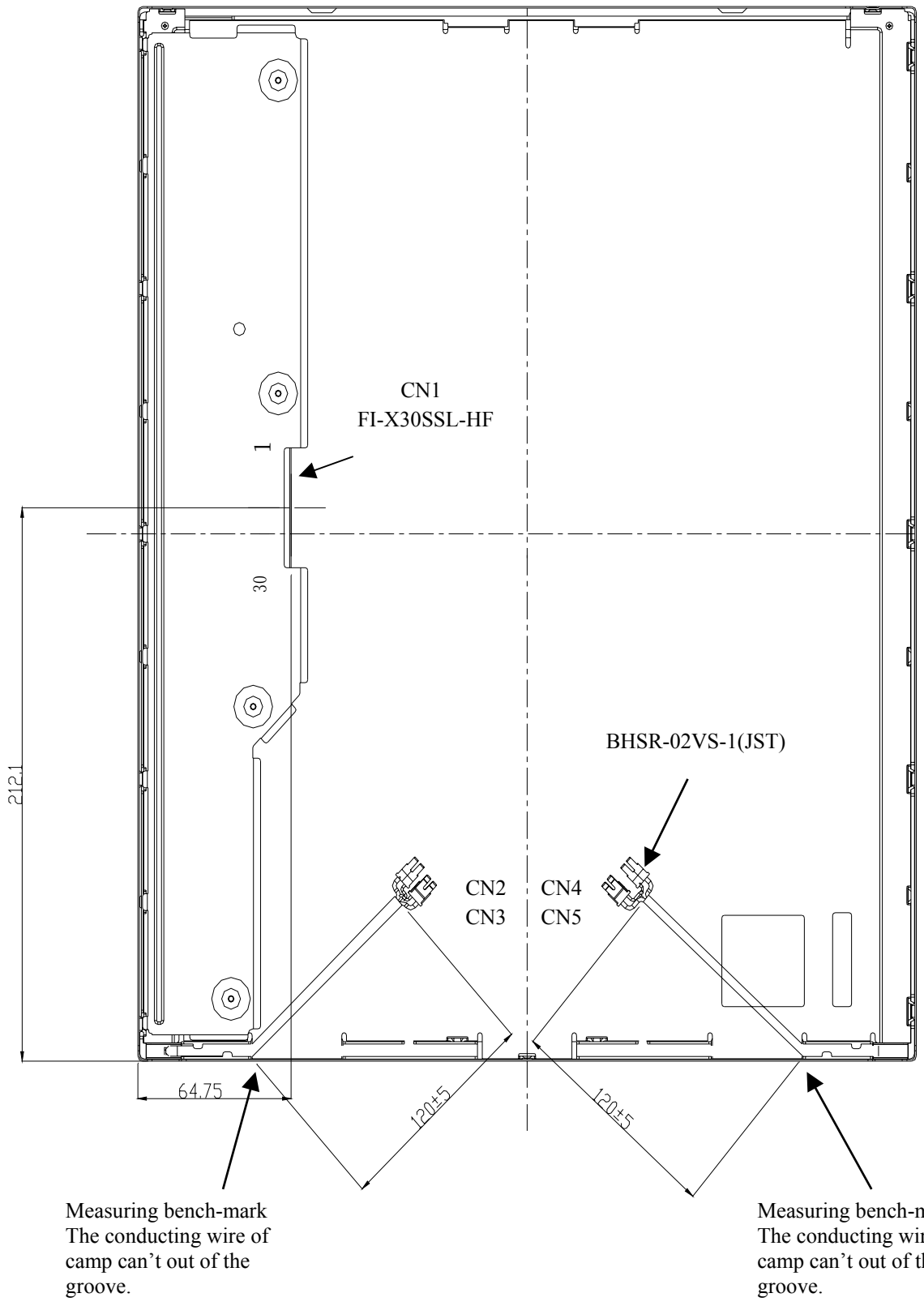
[Unit: mm]



(2). Rear side

The definition of lamp wire = 120 ± 5 mm (Don't let the lamp wire come off the wire holder , to stretch lamp wire when measure the length of lamp wire , to measure from the fired part to the bottom of connector pin.)

[Unit: mm]



8.OPTICAL CHARACTERISTICS

Ta = 25°C, VCC=5V

ITEM		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	Remarks
Contrast (CEN)		CR	θ= ψ =0° Point-5	400	500	--	--	*1)*2)*3)
Luminance (CEN)	9P Luminance (AVG)	Lw	θ= ψ =0°	200	250	--	cd/m^2	*2)*3)
	Uniformity	△Lw	θ= ψ =0°	--	--	25	%	*2)*3)
Contrast Uniformity		△CR	θ= ψ =0°	--	--	30	%	*1)*2)*3)
Response Time (White – Black)		tr+tf	θ= ψ =0°	--	12	22	ms	*3)*4)
Image sticking		tis	2 h	--	--	5 sec	--	*6)
View angle	Horizontal	θ	CR ≥ 10 Point-5	-65~65	-75~75	--	°	*2)*3)
	Vertical	ψ		-55~65	-60~70	--	°	*2)*3)
	Horizontal	θ	CR ≥ 5 Point-5	-75~75	-85~85	--	°	*2)*3)
	Vertical	ψ		-75~75	-85~85	--	°	*2)*3)
Crosstalk Ratio		CMR	θ= ψ =0°	--	--	1	%	*3)*7)
Color Temperature Coordinate	Red	Rx Ry	θ= ψ =0° Point-5	0.612 0.306	0.642 0.336	0.672 0.366	--	*2)*3)
	Green	Gx Gy		0.238 0.575	0.268 0.605	0.298 0.635		
	Blue	Bx By		0.113 0.026	0.143 0.056	0.173 0.086		
	White	Wx Wy		0.275 0.296	0.305 0.326	0.335 0.356		
Color Temperature		Tc		--	6500	--	K	*3)
Gamma		r		1.9	2.2	2.5	--	*8
Color Gamut		CG		69	72	--	%	*9)

[Note]
Measurement Condition： IL=7.0 mA
Definition of these measurement items is as follows:

*1) Definition of Contrast Ratio：〔These items are measured using BM-5A (TOPCON) under the dark room condition (no ambient light).〕

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

*2) Definition of Luminance and Luminance uniformity：〔These items are measured using BM-5A (TOPCON) under the dark room condition (no ambient light).〕

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

5P Luminance (AVG): The white luminance is measured at measuring points 5 , 10 , 11 , 12 , 13 see Fig.1 below.

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

$$L = (I\ MIN \div I\ MAX) \times 100$$

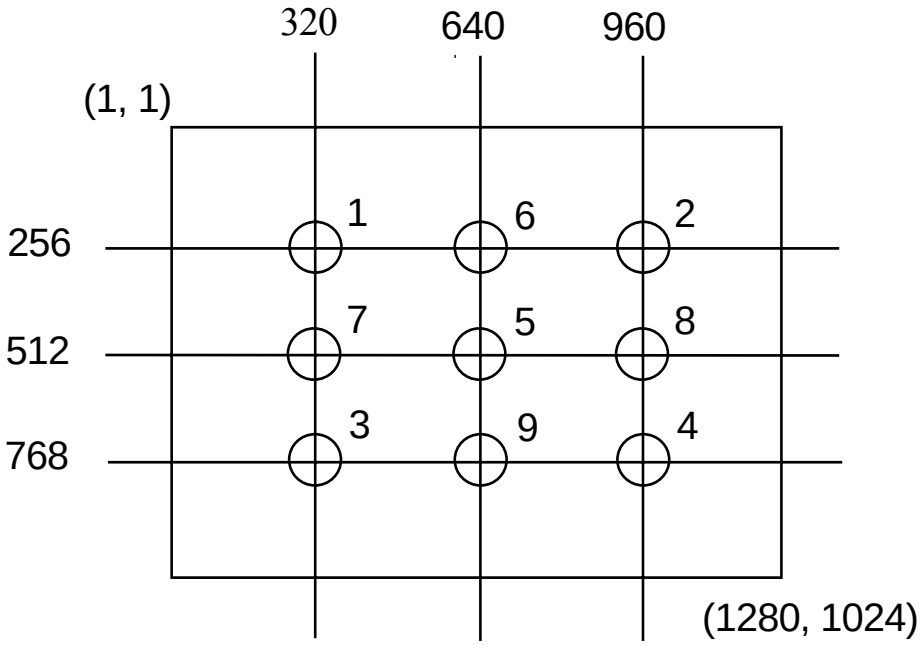


Figure 8-1. Measurement positions

*3) Definition of Viewing Angle(θ , ψ) : 〔 These items are measured using EZ-CONTRAST (ELDIM) under the dark room condition (no ambient light). 〕

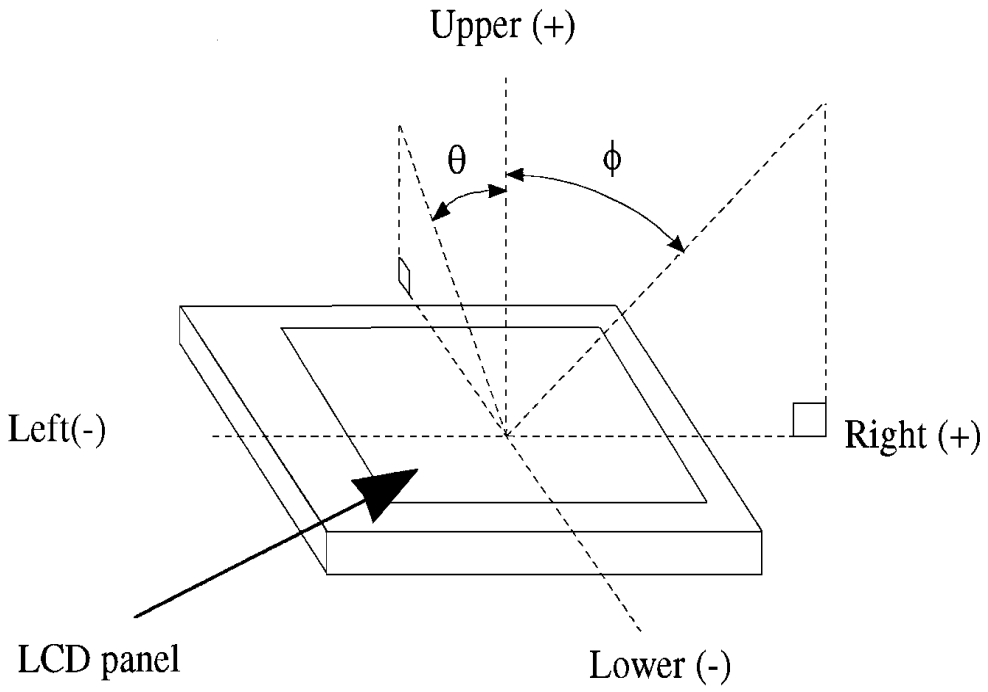


Figure 8-2. Definition of Viewing Angle

*4) Definition of Response Time (White – Black)

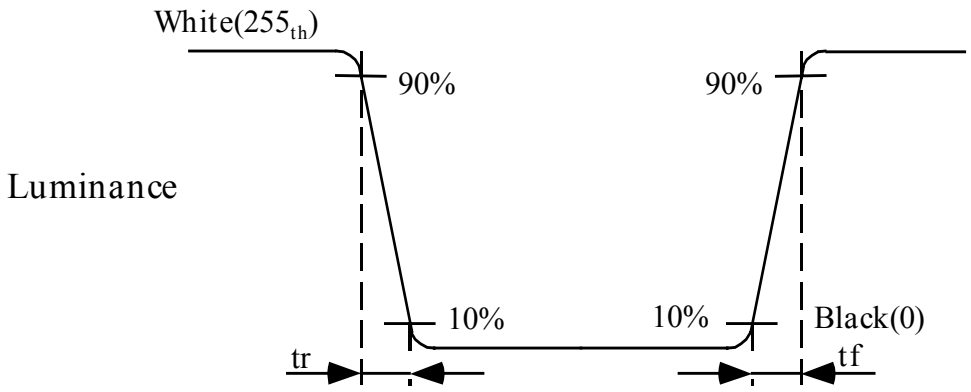


Figure 8-3. Definition of Response Time (White – Black)

*5) Definition of Response Time (Gray Scale Level between 32_{th} and 224_{th} at intervals of 32 levels)

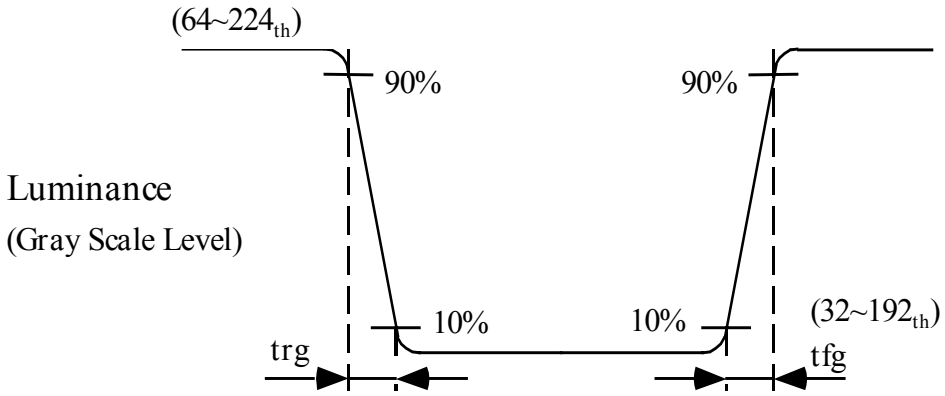
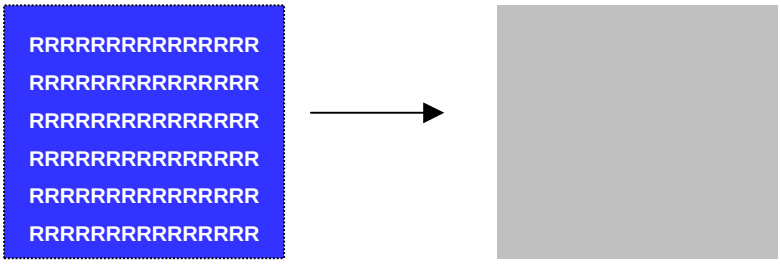


Figure 8-4. Definition of Response Time (Gray Scale Level)

*6) Image sticking test method:

From Continuous display pattern(white "R" with blue background) 2hours change to 128 gray level pattern .The previous image shall not persist more then 2 second at 25 C.



*7) Definition of Cross talk:

CMR = MAX ($|(LB1-LA)/LC| \times 100$, $|(LB2-LA)/LC| \times 100$)

LA： Pattern A(Half-Tone pattern) Measure point Luminance

LB1, LB2： Pattern B1、Pattern B2 Measure point Luminance

LC： Pattern C(white pattern) Measure point Luminance

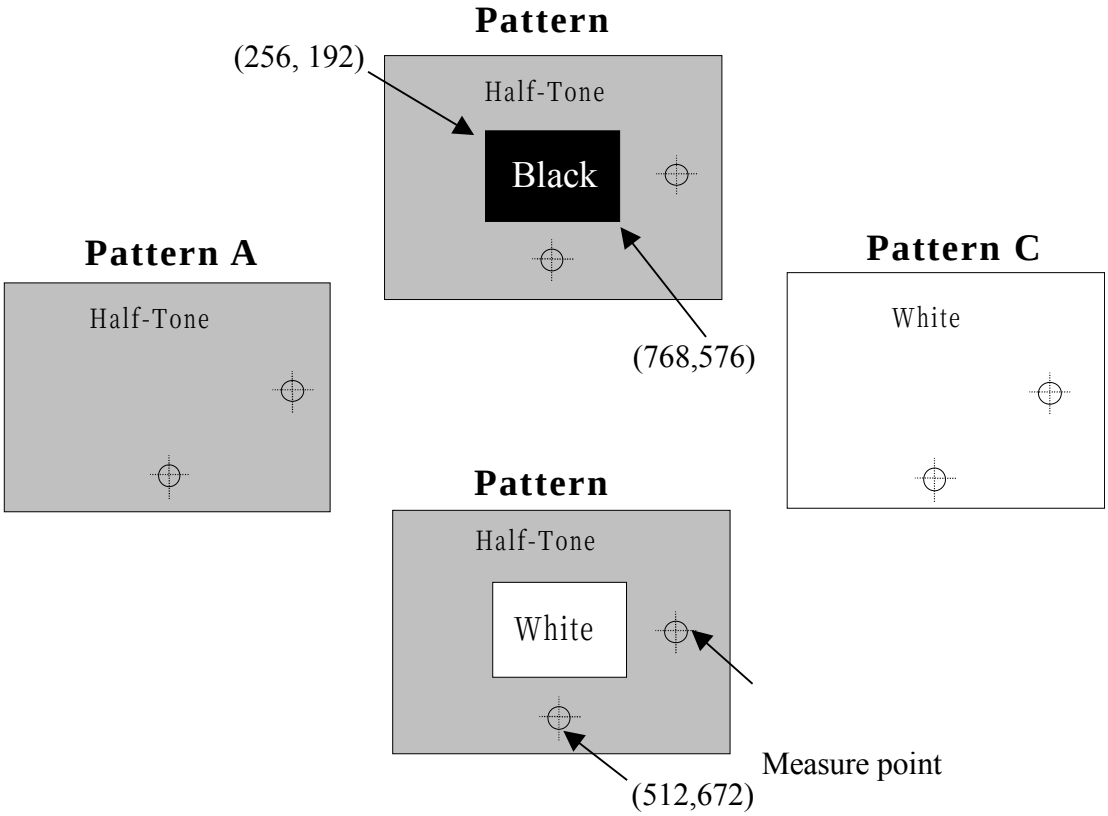
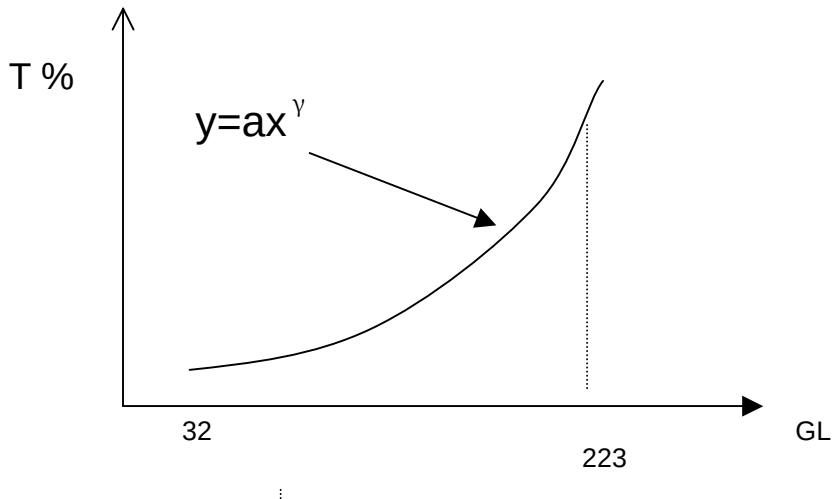


Figure 8-4. Cross talk

*8) Defination of Gamma (γ) , Gray level 32~223



*9) Definition of Color Gamut:

To measure RGB three sub-pixels color gamut coordinate at CIE coordinate chart from the center of module , to form a triangle area = A_{RGB}.

RGB three sub-pixels of NTSC at CIE coordinate chart to form a triangle area = N_{RGB}.

$$CG = \frac{A_{RGB}}{N_{RGB}} \times 100$$

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 (No condensation)
Low Temperature Operation	0°C; 240hrs
Low Temperature Storage	-20°C; 240hrs
Thermal Shock	Between -20°C(1hr) and 60°C(1hr); 100 Cycles

(2)Shock & Vibration

ITEMS	CONDITIONS
Shock (Non-Operation)	Shock level: 980m/s^2(100G) Waveform: half sinusoidal wave, 2ms Number of shocks: one shock input in each direction of three mutually perpendicular axes for a total of six shock inputs
Vibration (Non-Operation)	Vibration level: 9.8m/s^2(1.0G) zero to peak Waveform: sinusoidal Frequency range: 5 to 500 Hz Frequency sweep rate: 0.5 octave/min Duration: one sweep from 5 to 500Hz in each of three mutually perpendicular axis(each x,y,z axis: 1 hour, total 3 hours)

(3)ESD test

Test Item	Test statements
Connector	200 pF, 0 Ω, ±250 V By using contact-mode to discharge each pin one time and then check the module frame.
module	1.Under test conditions, by using air-mode to discharge each test point 25 times continueously and then check the module frame. 2. Under test conditions, by using contact-mode to discharge each test point of panel frame 25 times continueously and then check the module frame.

(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, obvious non-uniformity, or line defects.

10. HANDLING PRECAUTIONS FOR TFT-LCD MODULE

Please pay attention to the followings in handling- TFT-LCD products;

10.1 **ASSEMBLY** PRECAUTION

(1) Please use the mounting hole on the module side in installing and do not beading or wrenching LCD in assembling. And please do not drop, bend or twist LCD module in handling.

(2) Please design display housing in accordance with the following guidelines.

- Housing case must be destined carefully so as not to put stresses on LCD all sides and not to wrench module. The stresses may cause non-uniformity even if there is no non-uniformity statically.
- Keep sufficient clearance between LCD module back surface and housing when the LCD module is mounted. Approximately 1.0 mm of the clearance in the design is recommended taking into account the tolerance of LCD module thickness and mounting structure height on the housing.
- When some parts, such as, FPC cable and ferrite plate, are installed underneath the LCD module, still sufficient clearance is required, such as 0.5mm. This clearance is, especially, to be reconsidered when the additional parts are implemented for EMI countermeasure.
- Design the inverter location and connector position carefully so as not to give stress to lamp cable, or not to interface the LCD module by the lamp cable.
- Keep sufficient clearance between LCD module and the others parts, such as inverter and speaker so as not to interface the LCD module. Approximately 1.0mm of the clearance in the design is recommended.

(3) Please do not push or scratch LCD panel surface with any-thing hard. And do not soil LCD panel surface by touching with bare hands. (Polarizer film, surface of LCD panel is easy to be flawed.)

(4) Please do not press any parts on the rear side such as source TCP, gate TCP, control circuit board and FPCs during handling LCD module. If pressing rear part is unavoidable, handle the LCD module with care not to damage them.

(5) Please wipe out LCD panel surface with absorbent cotton or soft clothe in case of it being soiled.

(6) Please wipe out drops of adhesives like saliva and water on LCD panel surface immediately. They might damage to cause panel surface variation and color change.

(7) Please do not take a LCD module to pieces and reconstruct it. Resolving and reconstructing modules may cause them not to work well.

(8) Please do not touch metal frames with bare hands and soiled gloves. A color change of the metal frames can happen during a long preservation of soiled LCD modules.

(9) Please pay attention to handling lead wire of backlight so that it is not tugged in connecting with inverter.

10.2 OPERATING PRECAUTIONS

(1) Please be sure to turn off the power supply before connecting and disconnecting signal input cable.

(2) Please do not change variable resistance settings in LCD module. They are adjusted to the most suitable value. If they are changed, it might happen LCD does not satisfy the characteristics specification.

(3) Please consider that LCD backlight takes longer time to become stable of radiation characteristics in low temperature than in room temperature.

(4) A condensation might happen on the surface and inside of LCD module in case of sudden change of ambient temperature.

(5) Please pay attention to displaying the same pattern for very long time. Image might stick on LCD. If then, time going on can make LCD work well.

(6) Please obey the same caution descriptions as ones that need to pay attention to ordinary electronic parts.

10.3 PRECAUTIONS WITH ELECTROSTATICS

(1) This LCD module use CMOS-IC on circuit board and TFT-LCD panel, and so it is easy to be affected by electrostatics. Please be careful with electrostatics by the way of your body connecting to the ground and so on.

(2) Please remove protection film very slowly on the surface of LCD module to prevent from electrostatics occurrence.

10.4 STORAGE PRECAUTIONS

(1) When you store LCDs for a long time, it is recommended to keep the temperature between 0℃ ~40℃ without the exposure of sunlight and to keep the humidity less than 90%RH.

(2) Please do not leave the LCDs in the environment of high humidity and high temperature such as 60℃ 90%RH.

(3) Please do not leave the LCDs in the environment of low temperature; below -20℃.

10.5 SAFETY PRECAUTIONS

(1) When you waste LCDs, it is recommended to crush damaged or unnecessary LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.

(2) If any liquid leaks out of a damaged-glass cell and comes in contact with the hands, wash off throughly with soap and water.

10.6 OTHERS

(1) A strong incident light into LCD panel might cause display characteristics' changing inferior because of polarizer film, color filter, and other materials becoming inferior. Please do not expose LCD module direct sunlight Land strong UV rays.

(2) Please pay attention to a panel side of LCD module not to contact with other materials in preserving it alone.

(3) For the packaging box, please pay attention to the followings:

- Packaging box and inner case for LCD are designed to protect the LCDs from the damage or scratching during transportation. Please do not open except picking LCDs up from the box.
- Please do not pile them up more than 3 boxes. (They are not designed so.) And please do not turn over.
- Please handle packaging box with care not to give them sudden shock and vibrations. And also please do not throw them up.
- Packing box and inner case for LCDs are made of cardboard. So please pay attention not to get them wet. (Such like keeping them in high humidity or wet place can occur getting them wet.)