Chunghwa Picture Tubes, Ltd.
Technical Specification

TFT LCD
CLAA156WA01A

1. OVERVIEW

CLAA156WA01A is 15.6" color (16：9) TFT-LCD (Thin Film Transistor Liquid Crystal Display) module composed of LCD panel, LVDS driver ICs, control circuit and backlight. By applying 6 bit digital data, 1366×RGB (3) ×768, 262K-color images are displayed on the 15.6" diagonal screen. general specifications are summarized in the following table：

ITEM	SPECIFICATION
Display Area (mm)	344.232 (H)x193.536 (V) (15.6-inch diagonal)
Number of Pixels	1366 ×3(H)×768 (V)
Pixel Pitch (mm)	0.252 (H)×0.252(V)
Color Pixel Arrangement	RGB vertical stripe
Display Mode	Normally white
Number of Colors	262,144(6bits)(LVDS)
Gamut	60%(typ)
Optimum Viewing Angle	6 o'clock
Response Time (ms)	8ms (Typ)
Surface Treatment	Glare
Viewing Angle	40°、40° /15°、30°(Min.)
Brightness (cd/m^2)	220 cd/m^2 (5point)/6 mA (Typ.) 200 cd/m^2 (5point)/6 mA (Min.)
Uniformity	5point：80% 13point：(65%)
Consumption of Power (W)	6.35W（Max）
Module Size (mm)	359.8(W)×210(H)×6.2(D)（Max）
Module Weight (g)	520 (max)

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	REMARK
Power Supply Voltage for LCD	VCC	0	4.0	V	
Lamp voltage	VL	700	920	Vrms	
Lamp current	IL	2	6.5	mArms	*1). 2)
Lamp frequency	FL	40	80	kHz	
Operation Temperature	Top	0	50	℃	*3). 4). 5). 6)
Storage Temperature	Tstg	-25	65	℃	*3). 4). 5)
Delayed Discharge Time	TD	--	1	sec	*7)

【Note】

* 1) Product life-time relate to lamp current, please operate production follow statement at page 9
       〝(b)back light〞.

* 2) When lamp current over the definition of absolute max, product life-time will decay rapidly or
       operate unusual.

* 3) The relative temperature and humidity range are as below sketch, 90%RH Max. (Ta≦40℃)

* 4) The maximum wet bulb temperature ≦39℃(Ta＞40℃) and without dewing.

* 5) 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.

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

* 7) Delay discharge time test condition ：Starting lamp voltage=1650Vrms. (please follow statement at
       page 9 〝 (b) back light〞

Before test TD, lamp should operate at least 1min, and lamp current should follow typical lamp current
specification. To place panel at room temp. (25±2℃)below for 24hrs,nd then to measure TD with the same
starting lamp voltage in dark room.
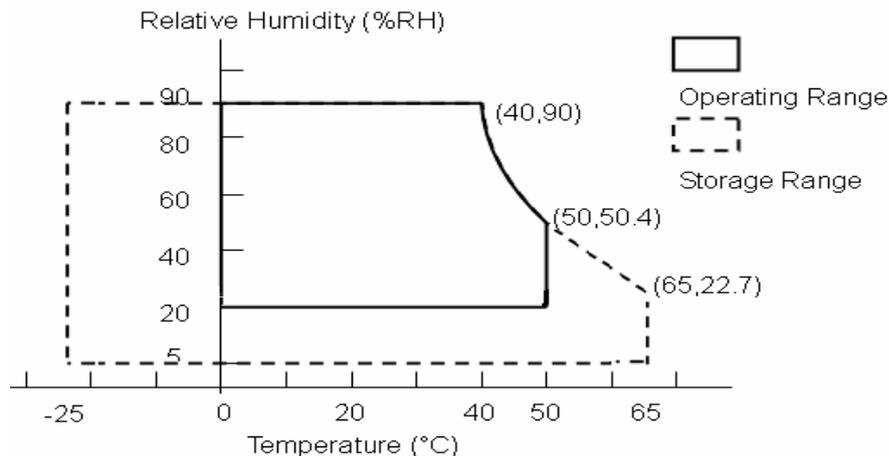
3. ELECTRICAL CHARACTERISTICS

(A) TFT LCD

TEM		SYMBOL	MIN	TYP	MAX	UNIT	REMARK
LCD POWER VOLTAGE		VCC	3.0	3.3	3.6	V	【Note 1】
LCD POWER CURRENT		ICC	-	400	500	mA	【Note 2】
Rush CRRENT		Irush	-	-	2	A	【Note 4】
LOGIC INPUT VOLTAGE (LVDS: IN+,IN-)	INPUT VOLTAGE	VIN	0	-	VCC	V	【Note 3】
	COMMON VOLTAGE	VCM	1.125	1.25	1.375	V	【Note 3】
	DIFFRENTIAL INPUT VOLTAGE	｜VID｜	250	350	450	mV	【Note 3】
	THRESHOLD VOLTAGE (HIGH)	VTH	-	-	100	mV	【Note 3】 When VCM = +1.2V
	THRESHOLD VOLTAGE (LOW)	VTL	-100	-	-	mV	
DIFFRENTIAL INPUT VOLTAGE TOLERANCE		△VID	-	-	35	mV	--
COMMON VOLTAGE TOLERANCE		△VCM	-	-	35	mV	--

【Note 1】Power Sequence：

$0.5 \text{ ms} \leqq t1 \leqq 10\text{ms}$	$1 \text{ sec} \leqq t4$
$0.01 \text{ ms} < t2 \leqq 50 \text{ ms}$	$200 \text{ ms} \leqq t5$
$0.01 \text{ ms} < t3 \leqq 50 \text{ ms}$	$200 \text{ ms} \leqq t6$

Data: RGB DATA, DCLK, HD, VD, DENA
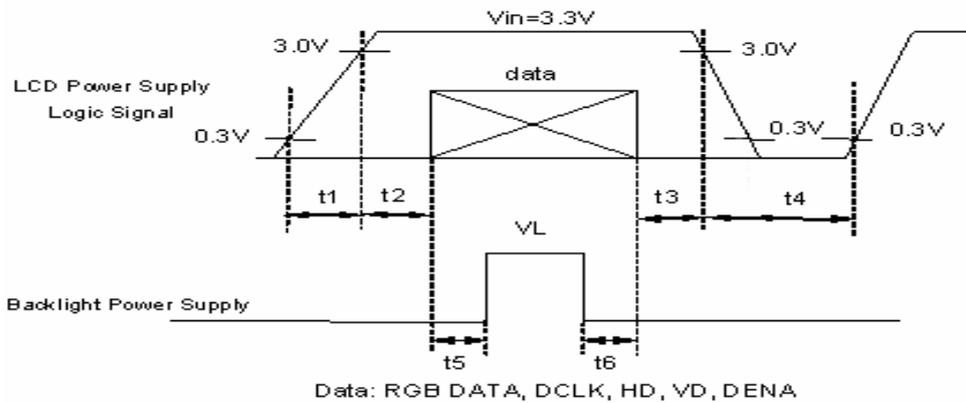
VCC-dip state

     (1)when $3.0 > \text{VCC} \geqq 2.7\text{V}$，$\text{td} \leqq 10$ ms

     (2)when $\text{VCC} < 2.7\text{V}$，VCC-dip condition should as the VCC-turn-off condition.
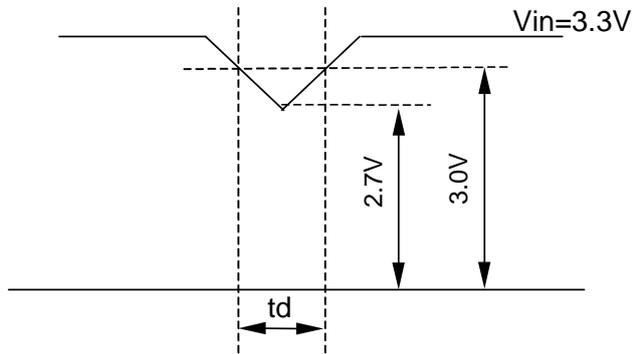

【Note 2】Typical value is $0 \sim 63$ gray level.(Horizontal line Pattern)

  768 line mode，VCC= +3.3V

  Circuit condition (Typ.)：

   VCC=3.3 V，f_V=60 Hz f_H=48.36 kHz，f_{CLK}=75.44 MHz

64-Gray
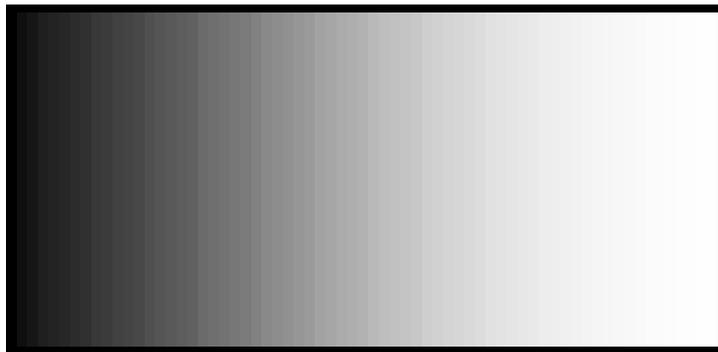
  Circuit condition (Max.)：

      VCC=3.3 V，f_V=60 Hz f_H=48.36 kHz，f_{CLK}=75.44 MHz
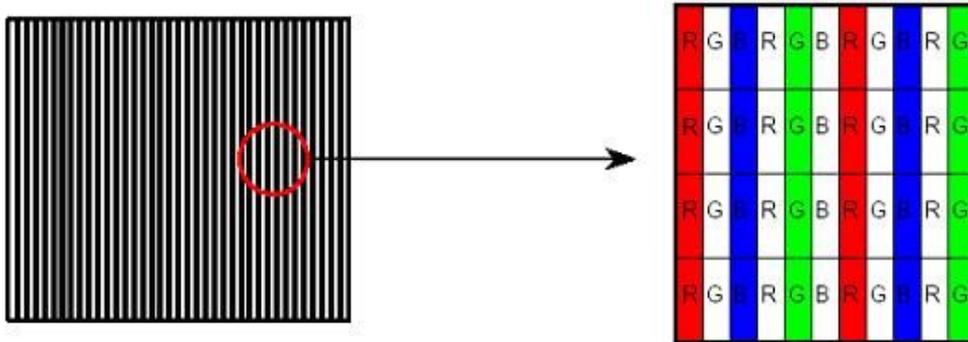
【Note 3】 LVDS Signal Definite：
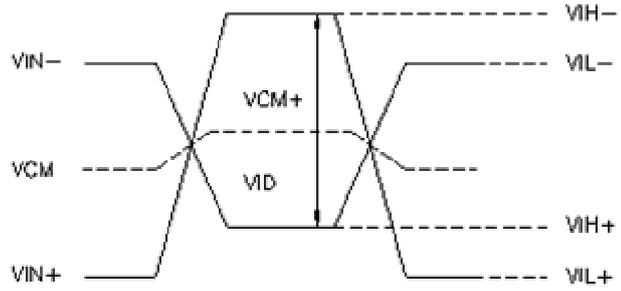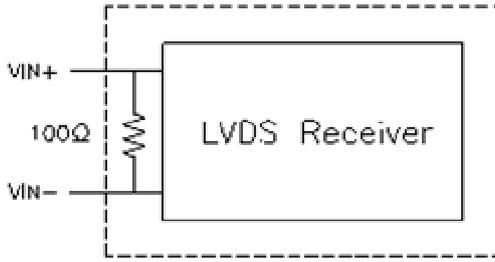
VIN+ ：Positive differential DATA ＆ CLK Input
VIN- ：Negative differential DATA ＆ CLK Input

$VID = VIN+ - VIN-$,
$\triangle VCM = |VCM+ - VCM-|$,
$\triangle VID = |VID+ - VID-|$,
$VID+ = |VIH+ - VIH-|$,
$VID- = |VIL+ - VIL-|$,
$VCM = (VIN+ + VIN-)/2$,
$VCM+ = (VIH+ + VIH-)/2$,
$VCM- = (VIL+ + VIL-)/2$,

Refer to Inverter rated voltage

[Note 4] Irush measure condition
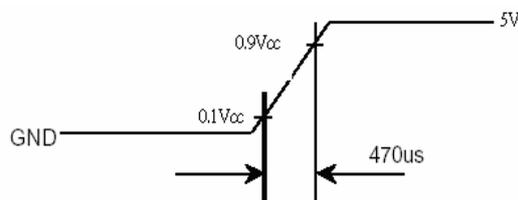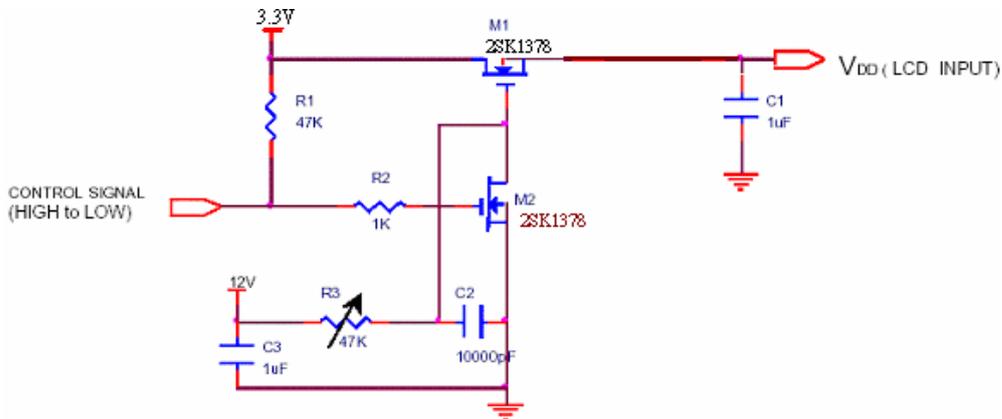
(B) BACK LIGHT

(a.) ELECTRICAL CHARACTERISTICS

Ta=25℃

| ITEM	SYMBOL	MIN	TYP	MAX	UNIT	REMARK
Lamp Voltage (IL=6.0mA)	VL	657	730	803	Vrms	IL=6.0mA
Lamp Current	IL	5.5	6.0	6.5	mArms	*1)
Inverter Frequency	FI	40	--	60	kHz	*2)
Lamp Initial Voltage	VS	1460	--	--	Vrms	Ta=25℃
		1600	--	--		Ta=0℃

(b) LAMP LIFE – TIME

ITEM	IL at 2.0 mA	IL at 6.0 mA	IL at 6.5 mA	UNIT	REMARK
LAMP LIFE-TIME (LT)	Min. 15,000	Min. 15,000	Min.15,000	hr	Continuous Operation*3)
Turn-on and turn-off Operation	--	Min.100,000	--	times	Continuous Operation *4)

*1)Measure method：Galvanometer connect to low voltage
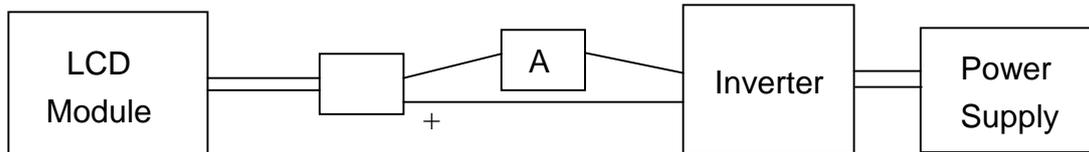
*2) Frequency in this range can make the characteristics of electric and optics maintain in +/- 10% except hue.

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.Under optimum operate frequency range (50~80 KHz), will not effect panel life-time and relability .

*3) The voltage above VS should be applied to the lamps for more than 1 second for start-up.

(Inverter open voltage must be more than lamp starting voltage.)

*4) Definition of the lamp life time：

    a. Luminance (L) under 50% of specification starting lamp voltage

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

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

*6) WL=IL x VL。(IL=6mA，Ta=25℃)

4. Connector Interface PIN & Function

(a) CN1 (Interface signal)

Outlet connector: FI-XB30SL-HF10 (JAE) ， GS23302-0011S-7F(Foxconn)

Link connector: FI-X30H (JAE, Link Type)

(Note) DDC: Display Data Requirements

(Note)Refer to page6、7、8、9之 Data Mapping

Pin No.	SYMBOL	FUNCTION
1	Vss	Ground
2	Vin	+3.3V Power
3	Vin	+3.3V Power
4	V_EDID	DDC 3.3V Power
5	NC	No connect
6	CLK_EDID	DDC Clock
7	DATA_EDID	DDC Data
8	R0N	minus signal of channel 0(LVDS)
9	R0P	plus signal of channel 0(LVDS)
10	Vss	Ground
11	R1N	minus signal of channel 1(LVDS)
12	R1P	plus signal of channel 1(LVDS)
13	Vss	Ground
14	R2N	minus signal of channel 2(LVDS)
15	R2P	plus signal of channel 2(LVDS)
16	Vss	Ground
17	RCLKN	minus signal of clock channel (LVDS)
18	RCLKP	plus signal of clock channel (LVDS)
19	Vss	Ground
20	NC	No connect
21	NC	No connect
22	VSS	Ground
23	NC	No connect
24	NC	No connect
25	VSS	Ground
26	NC	No connect
27	NC	No connect
28	VSS	Ground
29	NC	No connect
30	NC	No connect

(b) CN2 (BACKLIGHT)

Backlight-side connector: BHSR-02VS-1 (JST)

5. INTERFACE TIMING CHART

(1)(a). LVDS input time sequence

Horizontal sequence t_{CLK}

DCLK

DATA
(R,G, B)

First Data   Last Data

Invalid Data   1 2 3 ...... 1365 1366   Invalid Data

t_{HB} t_{HA}

DENA

t_H

(b) LCD input time sequence

Vertical sequence t_V

LINE DATA

Invalid Data   1 2 3 ...... 767 768   Invalid Data

t_{VB} t_{VA}
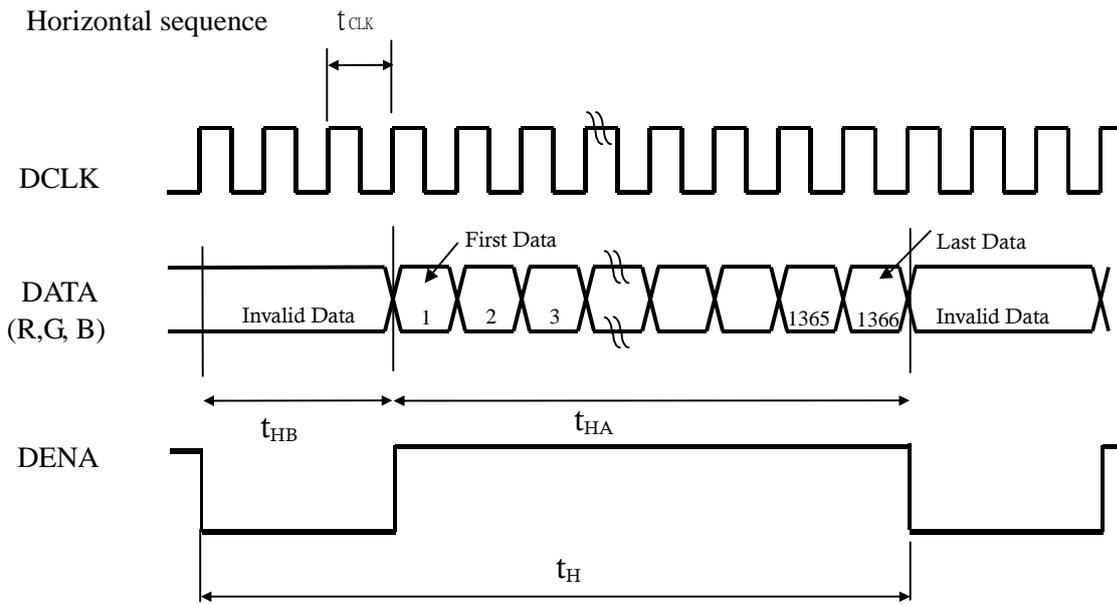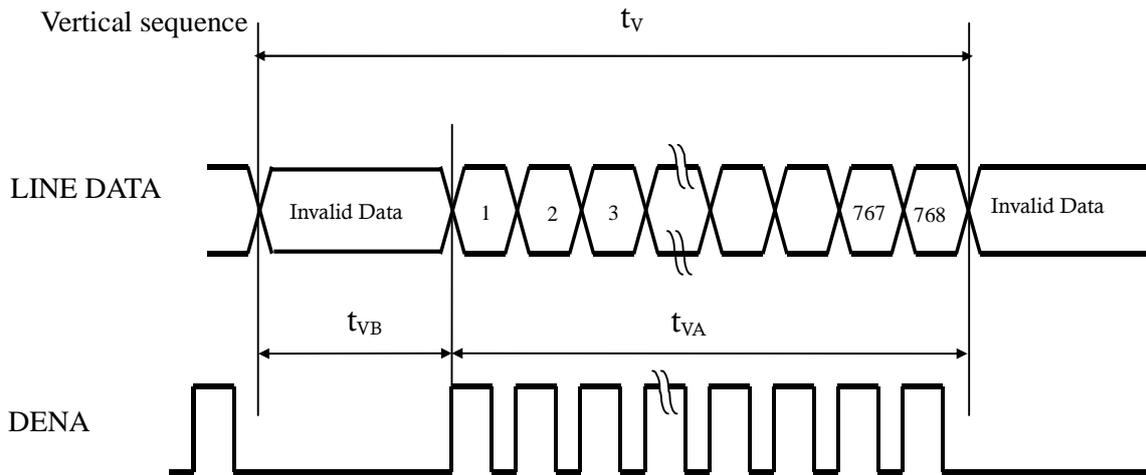
DENA

(2) Timing Chart

ITEM				SYNBOL	MIN	TYP	MAX	UNIT
LCD Timing	DCLK		Frequency	f_{CLK}	65.83	75.44	88.74	MHz
			Period	t_{CLK}	15.19	13.25	11.11	ns
	DENA	Horizontal	Horizontal total time	t_H	1414	1560	1700	t_{CLK}
			Horizontal Active time	t_{HA}	1366	1366	1366	t_{CLK}
			Horizontal Blank time	t_{HB}	48	194	334	t_{CLK}
		Vertical	Vertical total time	t_V	776	806	870	t_H
			Vertical Active time	t_{VA}	768	768	768	t_H
			Vertical Blank time	t_{VB}	8	38	114	t_H

【Note】

*1) Data is latched during DCLK falling period.

*2) HD、VD is negative.

*3) DENA (DATA ENABLE) usually is positive.

*4) During the whole blank period, DCLK should keep input.

　　During the vertical blank period, HD should keep input.

(3) DATA mapping

| 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(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue(63)	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(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	RED(63)	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(62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	Green(63)	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(62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

【Note】

1) Gray level:

Color(n)：n is level order; higher n means brighter level.

2) DATA:

1: high，0: low

6. BLOCK DIAGRAM
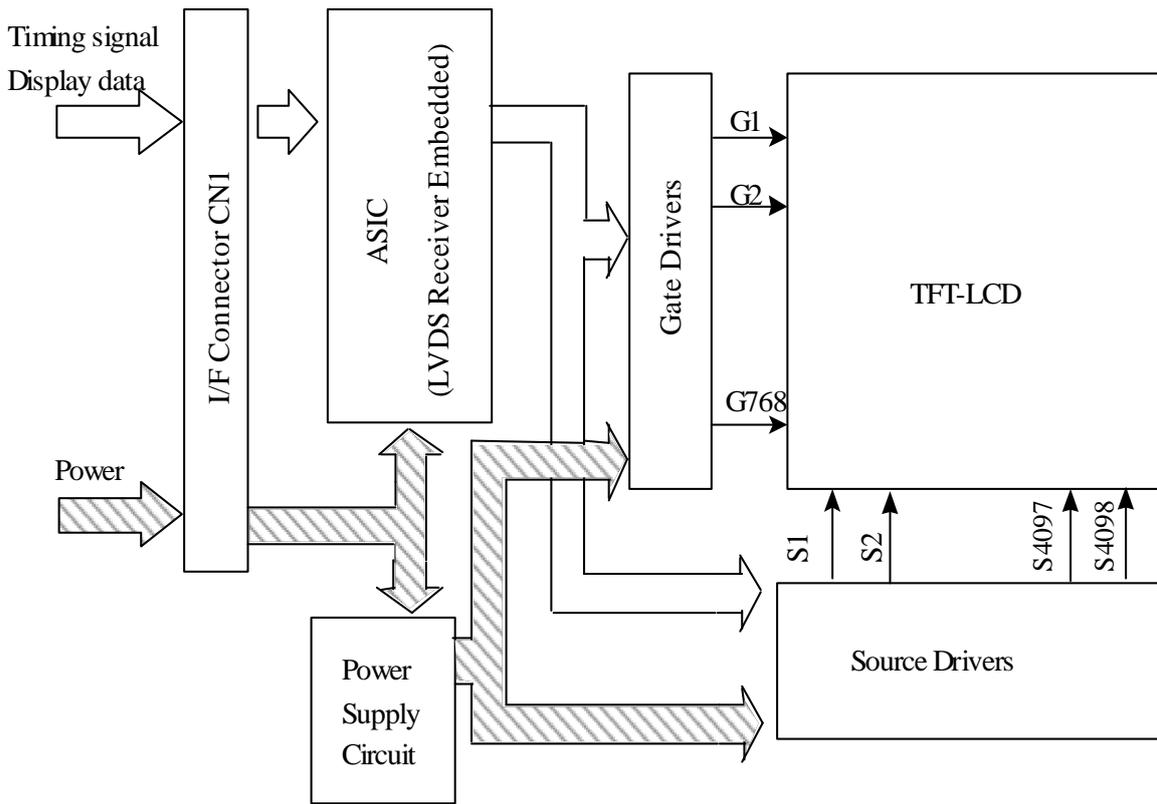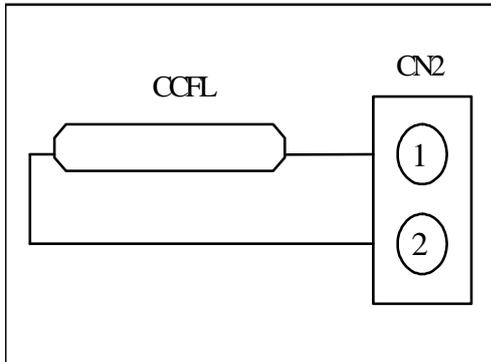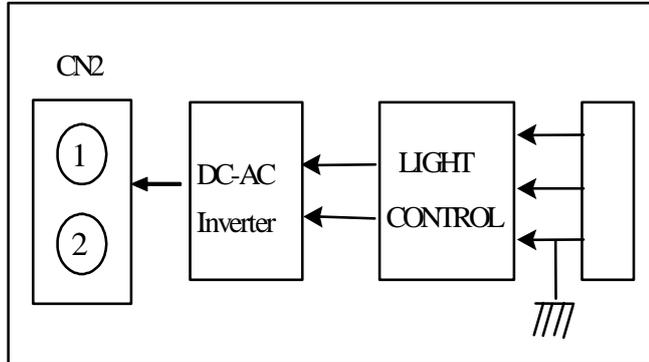
7. MECHANICAL SPECIFICATION

(1) Front side

The tolerance, not show in the figure, is ±0.5mm.   **[Unit： mm]**
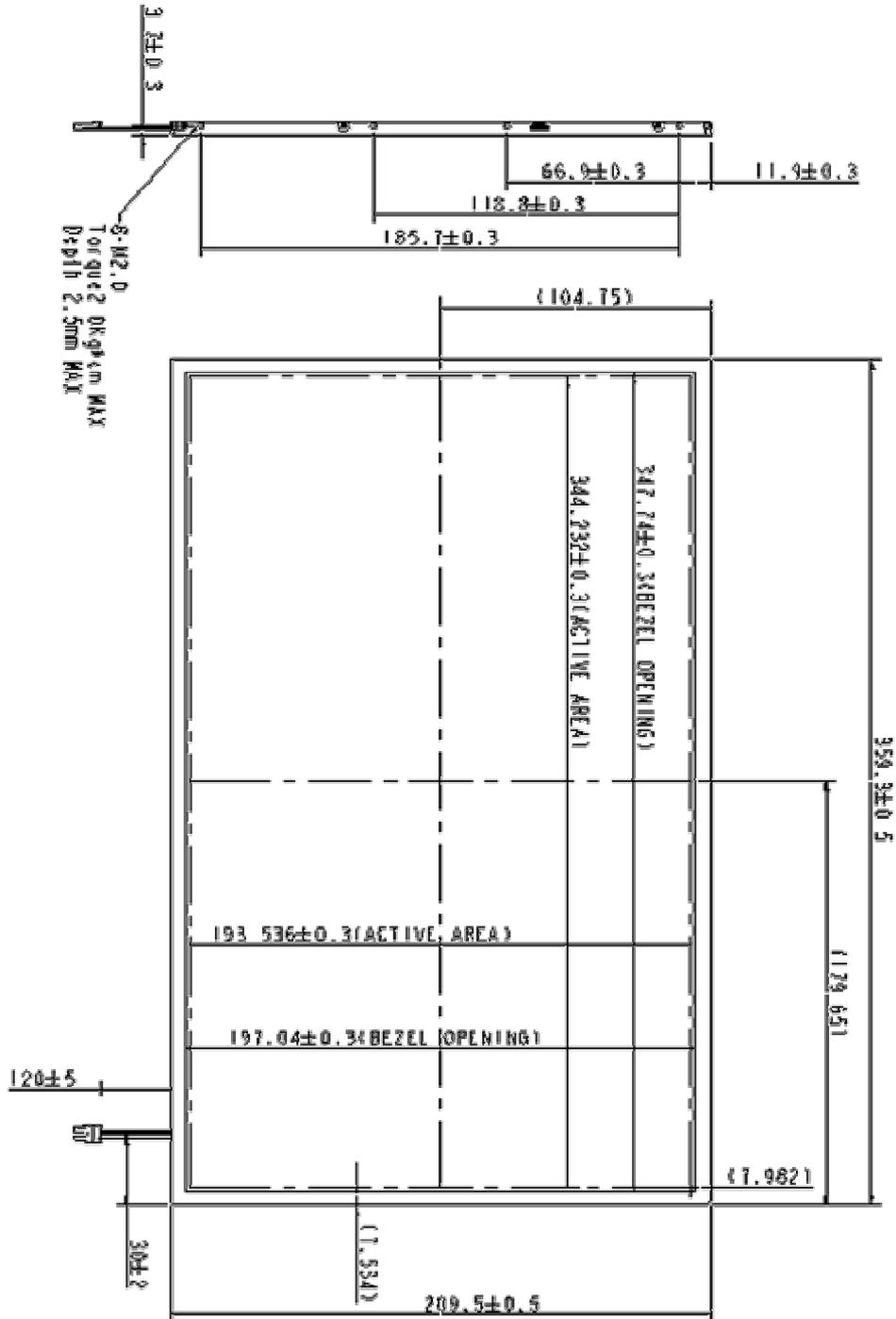
2) Rear side

The tolerance, not show in the figure, is ±0.5mm.   [Unit： mm]
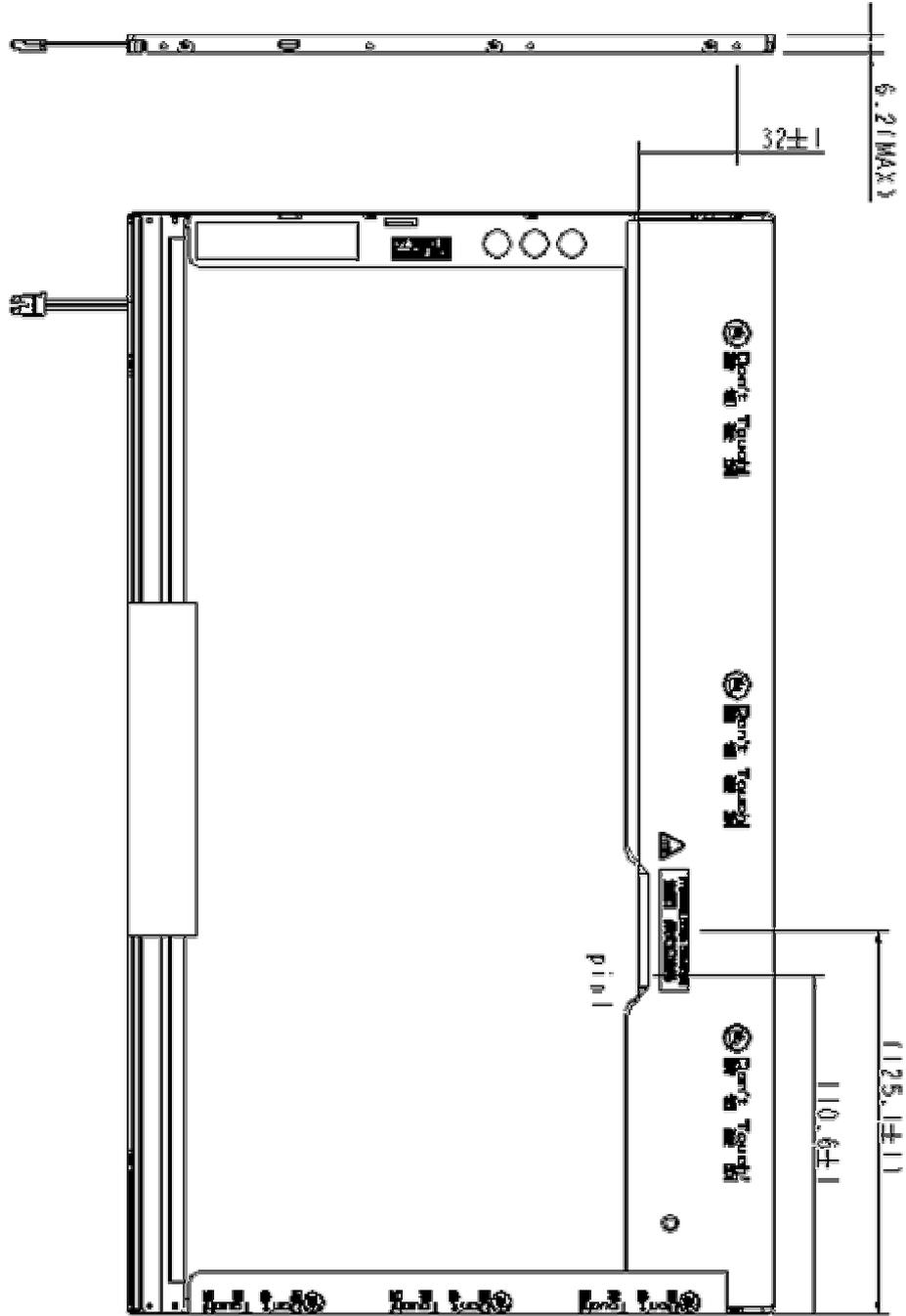
8. OPTICAL CHARACTERISTICS

Ta=25℃，VDD=3.3V

ITEM		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	REMARK
Contrast Ratio		CR	θ=ψ= 0°	500	600	-	--	*1) 2)
Luminance (5P)		L	θ=ψ= 0°	200	220	-	cd/m^2	*1) 3)
Uniformity(5P)		ΔL	θ=ψ= 0°	75	80	-	%	*1) 3)
Response Time		Tr	θ=ψ= 0°	-	3	6	ms	*5)
		Tf	θ=ψ= 0°	-	5	10	ms	*5)
Cross talk		CT	θ=φ= 0°*3	-	-	1	%	*6)
View angle	Horizontal	ψ	CR≧10	40/-40	45/-45	-	°	*4)
	Vertical	θ		15/-30	20/-35	-	°	*4)
Color Temperature Coordinate	W	X	θ=ψ= 0°	0.283	0.313	0.343	--	*3)
		Y		0.299	0.329	0.359		
	R	X		0.599	0.629	0.659	--	
		Y		0.303	0.333	0.363		
	G	X		0.262	0.292	0.312	--	
		Y		0.550	0.580	0.610		
	B	X		0.130	0.160	0.190	--	
		Y		0.066	0.096	0.126		
Gamut			θ=ψ= 0°	56%	60%	-	--	*7)
Gamma		γ	GL	2.0	2.2	2.4	--	--

Color coordinate and color gamut are measured by CS-1000, response time are 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=6.0mA

Inverter：SUMIDA / IV11145/T

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.
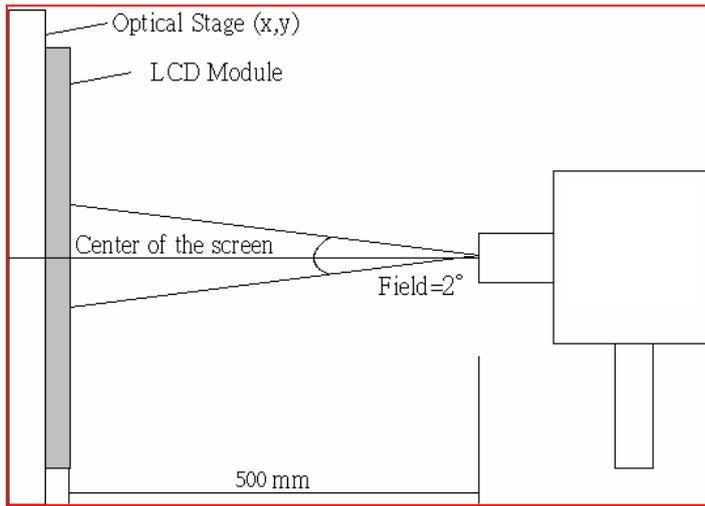
*2) Definition of Contrast Ratio

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 "55" on the screen, see Fig.1 below.

5P Luminance (AVG): The white luminance is measured at measuring points 33、37、55、73、77, see Fig.1 below.

5P Uniformity: $\Delta L = (Lmin / Lmax) \times 100\%$
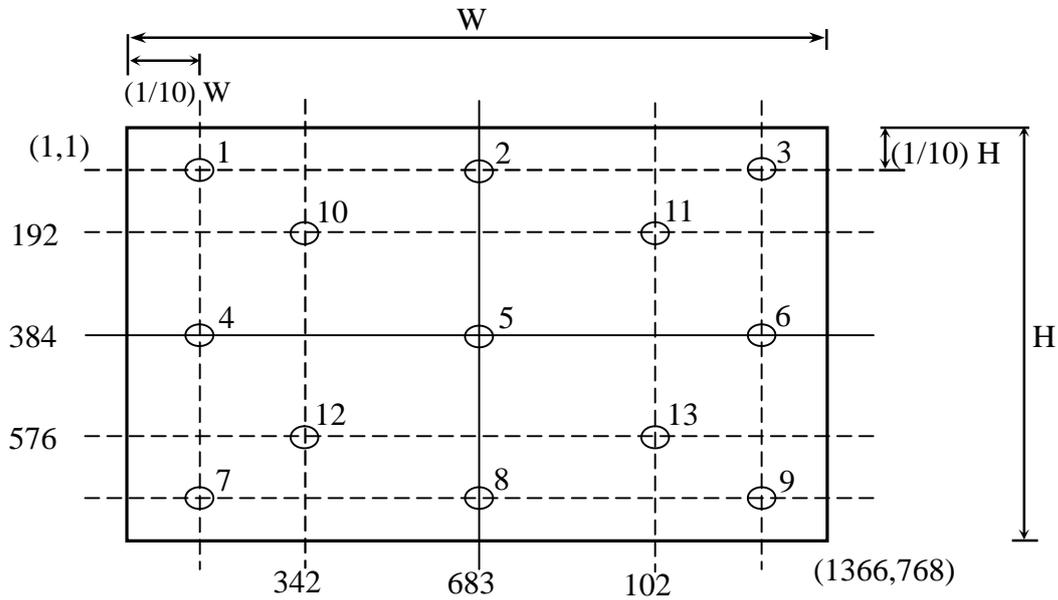
Fig.1 Measure point

*4) Definition of view angle(θ，ψ)

Upper(+)

θ

ψ

Left(-)
Gate Drive Side

Right(+)

LCD Panel

Lower(-)
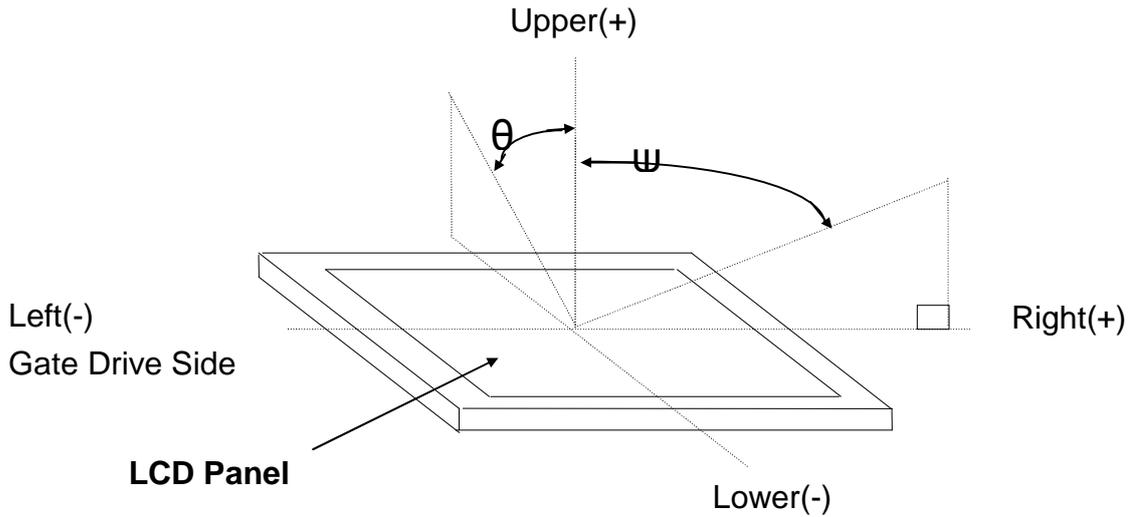
*5) Definition of response time

White

90 %   90 %

Luminanc

10 %   10 %

tr   Black   tf
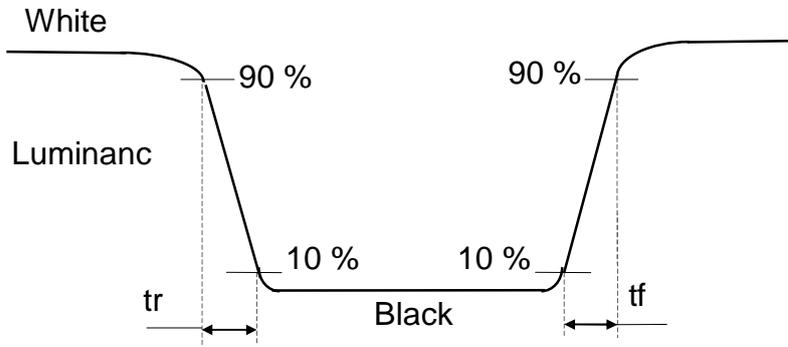
*6) Crosstalk Modulation Ratio:

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

$Y_A 、 Y_B$ measure position and definition

Y_A means luminance at gray level 32(exclude gray level 0 pattern)

Y_B means luminance at gray level 32(include gray level 0 pattern)

(0, 0)   Active Area

$Y_{A,U}$ (D/2,W/8)

$Y_{A,L}$ (D/8,W/2)   Gray 31

$Y_{A,R}$ (7D/8,W/2)

$Y_{A,D}$ (D/2,7W/8)

(D,W)

(0, 0)   Active Area

$Y_{B,U}$ (D/2,W/8)

(D/4,W/4)

$Y_{B,L}$ (D/8,W/2)   Gray 0

$Y_{B,R}$ (7D/8,W/2)

(3D/4,3W/4)

$Y_{B,D}$ (D/2,7W/8)   Gray 31

(D,W)
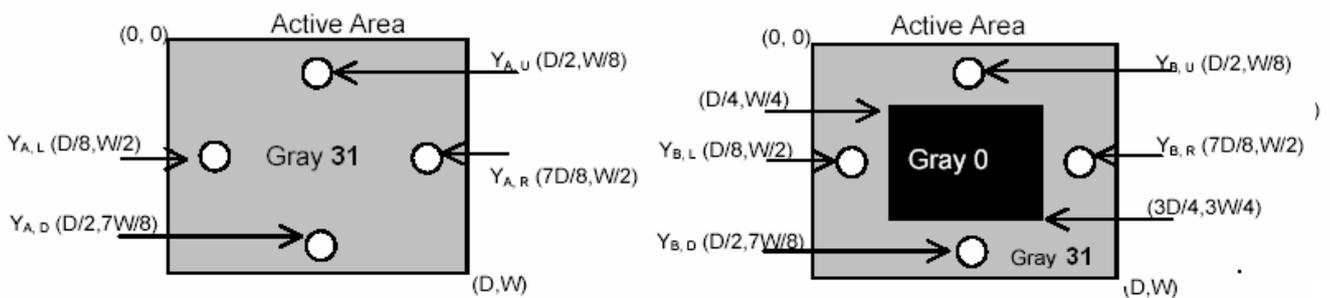
*7) Definition Gamma (VESA)

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 γ (from gray level: 0、4、8-----60、63).

$$y = \gamma x - k$$

LOG(△Y)

LOG（Gray Level）