Chunghwa Picture Tubes, Ltd.
Technical Specification

ATTo：奇之鑫
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TFT-LCD
CLAA070WP06 XG

Accepted by:

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1. OVERVIEW

CLAA070WP06 is 7” color TFT-LCD (Thin Film Transistor Liquid Crystal Display) module composed of LCD panel, MIPI driver ICs, control circuit and backlight. By applying 6 bit digital data, 800×RGB (3) ×1280, 16.7M-color images are displayed on the 7” diagonal screen. general specifications are summarized in the following table：

ITEM	SPECIFICATION
Display Area	94.2(H)x150.72(V) (mm) (7-inch diagonal)
Number of Pixels	800 ×3(H)×1280 (V)
Pixel Pitch	0.11775(H)×0.11775(V) (mm)
Color Pixel Arrangement	RGB vertical stripe
Display Mode	Normally Black
Number of Colors	16.7M(6bits + Hi-FRC)(MIPI)
Gamut	60%(Typ)
Optimum Viewing Angle	whole view
Response Time	30ms (Typ)
Surface Treatment	HC , Hardness：3H
Viewing Angle(CR>10)	85°、85° / 85°、85°(Min)
Brightness	400 cd/m^2 (Center) (Typ)
Uniformity	9point：80 %(Typ.)
Consumption of Power(Watt)	2.037 (max.)(LCD module)/1.537(Backlight)
Module Size(mm)	104.32 (H)×161.67(V)×2.3(D) (w/o FPCA) / 104.32 (H)×161.67(V)×3.85(D) (with FPCA)
Module Weight(g)	103g (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	NOTE
LCD Power Voltage	VDDI	-0.3	4.0	V	
	VCCI	-0.3	2	V	
Operation Temperature	Top	0	50	℃	*1). 2). 3). 4)
Storage Temperature	Tstg	-20	60	℃	*1). 2). 3)

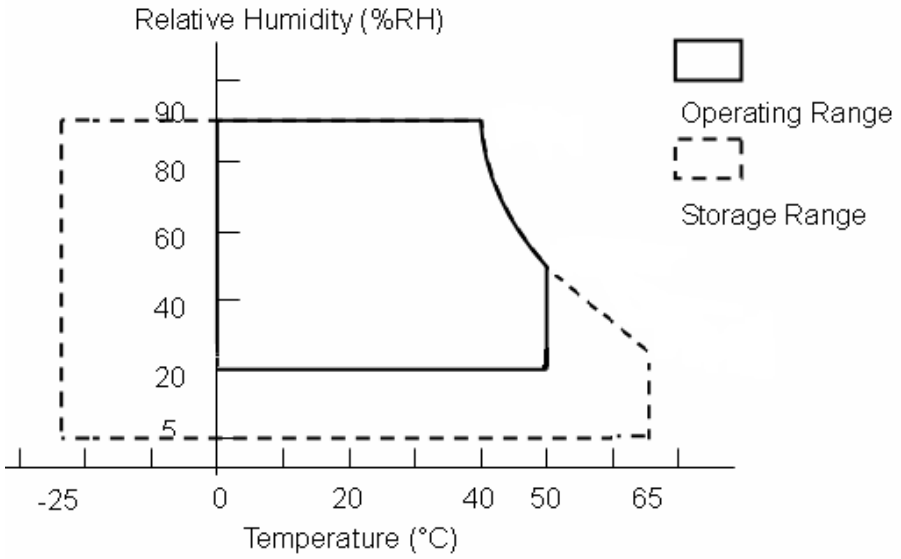
【Note】

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

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



3. ELECTRICAL CHARACTERISTICS

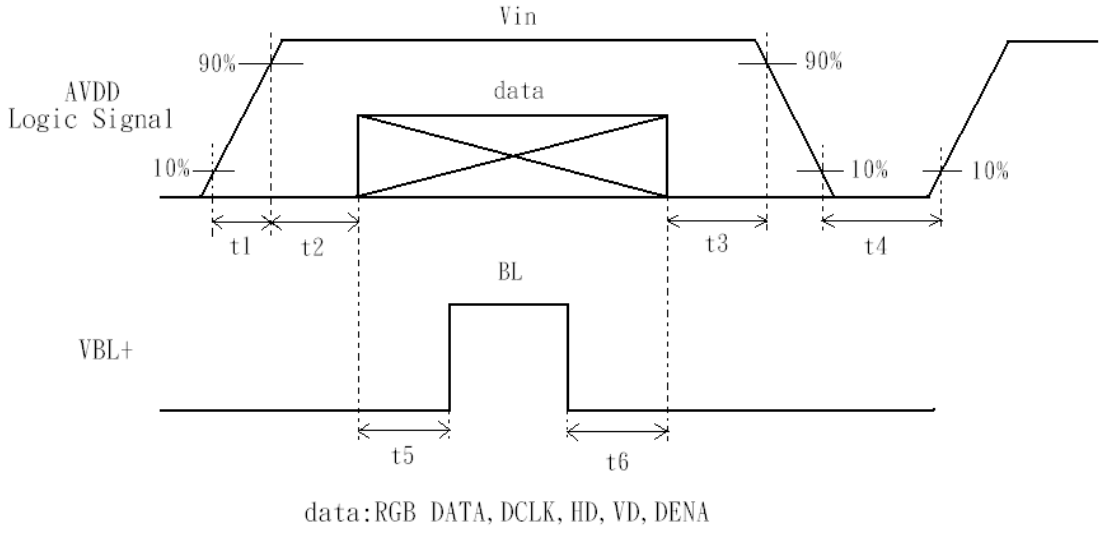
(A) TFT LCD

TEM	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
LCD Power Voltage	VDDI	3	3.3	3.6	V	*1)
	VCCI	1.7	1.8	1.95	V	
LCD Power Current	IDD	-	70		mA	*2)
	ICC	-	22		mA	
Rush Current	Irush	-	-	1	A	*4)

【Note】

*1) Power Sequence：

0.5 ms ≦t1≦10ms　　500 ms≦t4
0.01 ms＜t2≦50 ms　　200 ms≦t5
0.01 ms＜t3≦50 ms　　200 ms≦t6

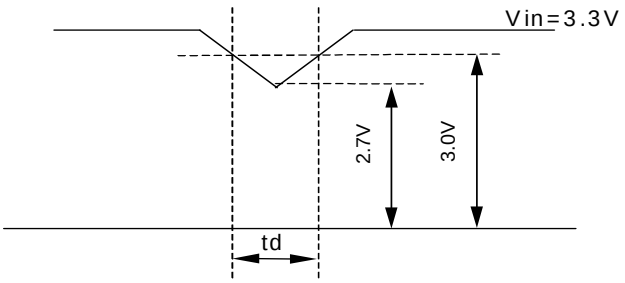


data:RGB DATA, DCLK, HD, VD, DENA

Vin-dip state

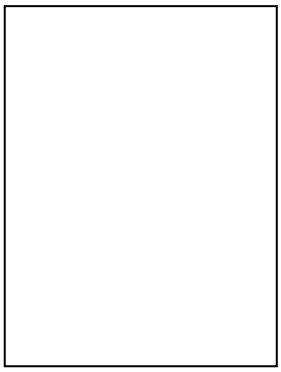
(1)when 3.0V＞Vin≧2.7V，td≦10 ms.

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

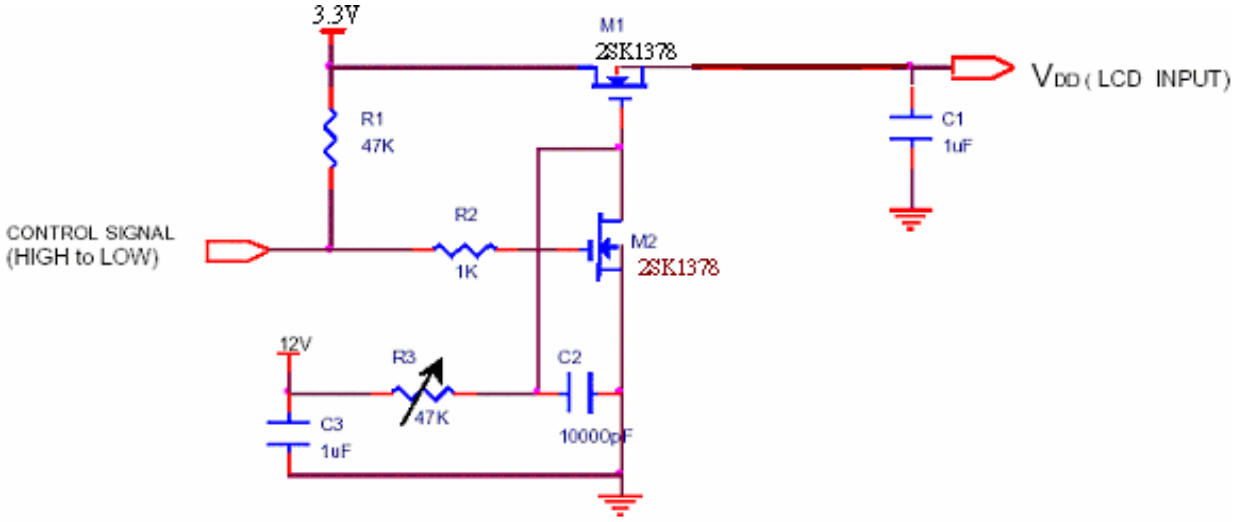


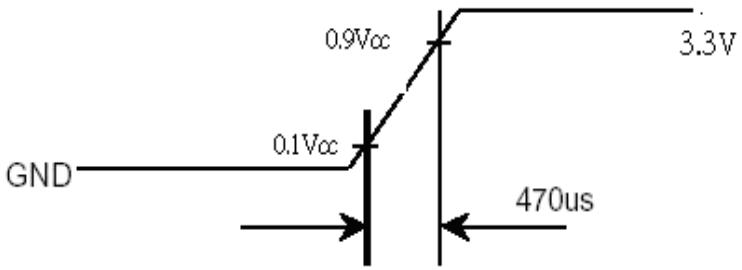
*2) Typ. value is White Pattern：1280 line mode。

Circuit condition (Max.)：VDDI=3.3 V，f_V=60 Hz，f_H=51.84 kHz，f_{CLK}=66.77 MHz



*3) Irush measure condition





(B) BACK LIGHT

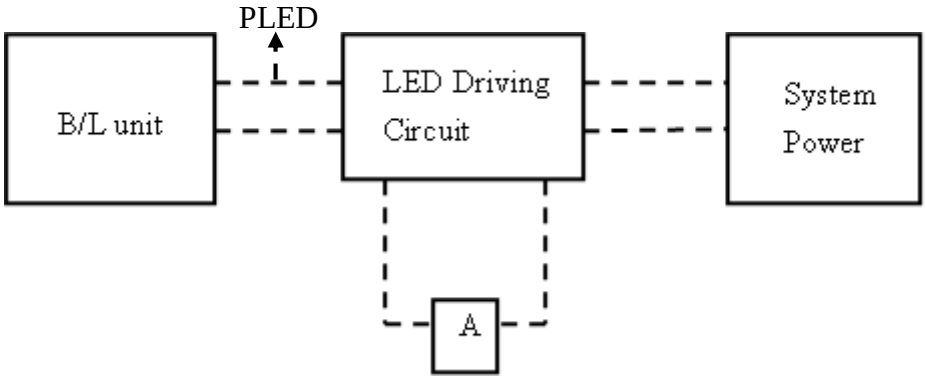
(a.) ELECTRICAL CHARACTERISTICS(Light Bar is arrayed for 5s *5 p)

Ta=25℃

ITEM	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Forward Voltage	VF		2.85	3	V	*2)I_F=20.5mA
Forward Current	IF	-	20.5	-	mA	
Power consumption	PLED	-	1.461	1.54	W	*2)*3)I_F=20.5mA

(b) LED LIFE – TIME

ITEM	Condition	min	typ	max	UNIT	NOTE
LIFE TIME	IF=20mA、Ta=25℃	10000	x	X	hrs	*4)



*3) Calculator value for reference $I_F \times V_F \times N$ = PLED

*4) Life time means that estimated time to 50% degradation of initial luminous intensity.

4. Connector Interface PIN & Function

FPC(Interface signal)

Pin No.	SYMBOL	FUNCTION
1	GND	Ground
2	VDDI	Power Supply, 3.3V±0.3V(Typical)
3	D0N	MIPI Input Data Pair
4	VDDI	Power Supply, 3.3V±0.3V (Typical)
5	D0P	MIPI Input Data Pair
6	VDDI	Power Supply, 3.3V±0.3V (Typical)
7	GND	Ground
8	GND	Ground
9	D1N	MIPI Input Data Pair
10	VCCI	Power Supply, 1.8V±0.1V (Typical)
11	D1P	MIPI Input Data Pair
12	VCCI	Power Supply, 1.8V±0.1V (Typical)
13	GND	Ground
14	GND	Ground
15	CLKN	MIPI Input Clock Pair
16	NC	NC (CPT test only)
17	CLKP	MIPI Input Clock Pair
18	NC	NC (CPT test only)
19	GND	Ground
20	NC	NC (CPT test only)
21	D2N	MIPI Input Data Pair
22	ANODE	LED Output
23	D2P	MIPI Input Data Pair
24	ANODE	LED Output
25	GND	Ground
26	CATHODE1	LED Feedback
27	D3N	MIPI Input Data Pair
28	CATHODE2	LED Feedback
29	D3P	MIPI Input Data Pair
30	CATHODE3	LED Feedback
31	GND	Ground
32	CATHODE4	LED Feedback
33	BISTB	Normal operation/BIST pattern select. **Normally pull high.** When BISTB = L, BIST When BISTB = H, Normal operation (H=1.8V±0.1V)
34	CATHODE5	LED Feedback

5. INTERFACE TIMING CHART

(1)(a)MIPI interface DC characteristic：

MIPI Interface DC characteristic						
(VDDI=3.0 to 3.6V, GND=AGND=0V, TA=-20 to +85℃)						
Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
MIPI Characteristic for High Speed Receiver						
Single-endedl input low voltage	VILHS	-40	-	-	mV	
Signle-endedl input high voltage	VIHHS	-	-	460	mV	
Common-mode voltage	VCMRXDC	155	-	330	mV	
Differential input impedance	ZID	80	100	125	ohm	
HS transmit differential voltage	|VOD|	140	200	250	mV	VOD=VDP-VDN
Receiver differential input low threshold	VIDTL	-	-	-70	mV	VDP<VDN
Receiver differential input high threshold	VIDTH	70	-	-	mV	VDP>VDN
MIPI Characteristic for Low Power Mode						
Pad signal voltage range	VI	-50	-	1350	mV	
Ground shift	VGNDSH	-50	-	50	mV	
Logic 0 input threshold	VIL	0	-	500	mV	
Logic 1 input threshold	VIH	1000	-	1350	mV	
Input hysteresis	VYST	25	-	-	mV	
Output low level	VOL	-150	-	150	mV	
Output high level	VOH	1.1	1.2	1.3	V	
Logic 0 contention threshold	VILCD,MAX	-	-	200	mV	
Logic 1 contention threshold	VIHCD,MIN	450	-	-	mV	

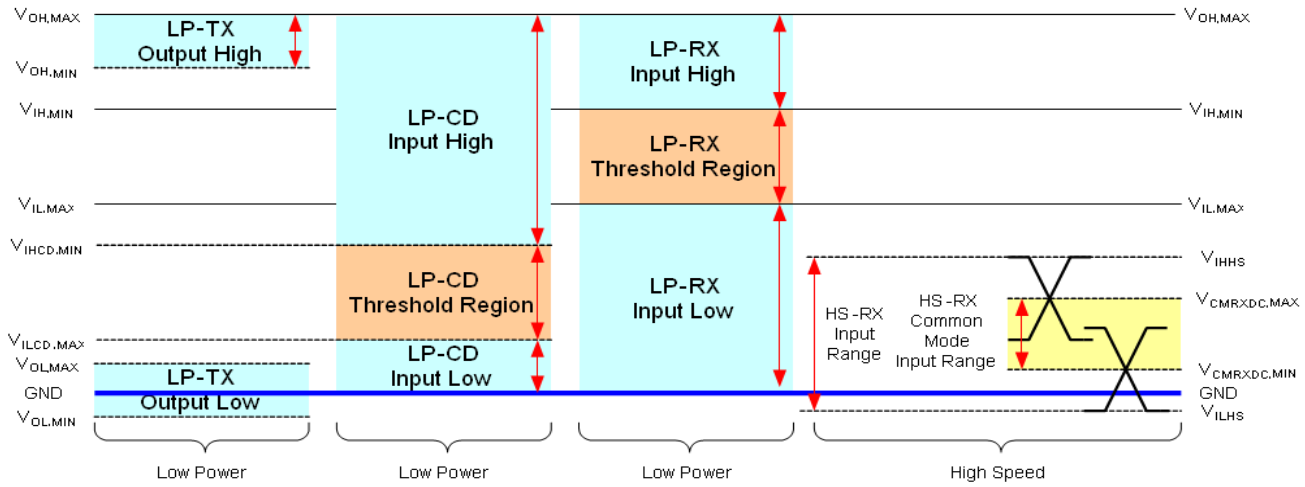


Figure1. MIPI DC Diagram

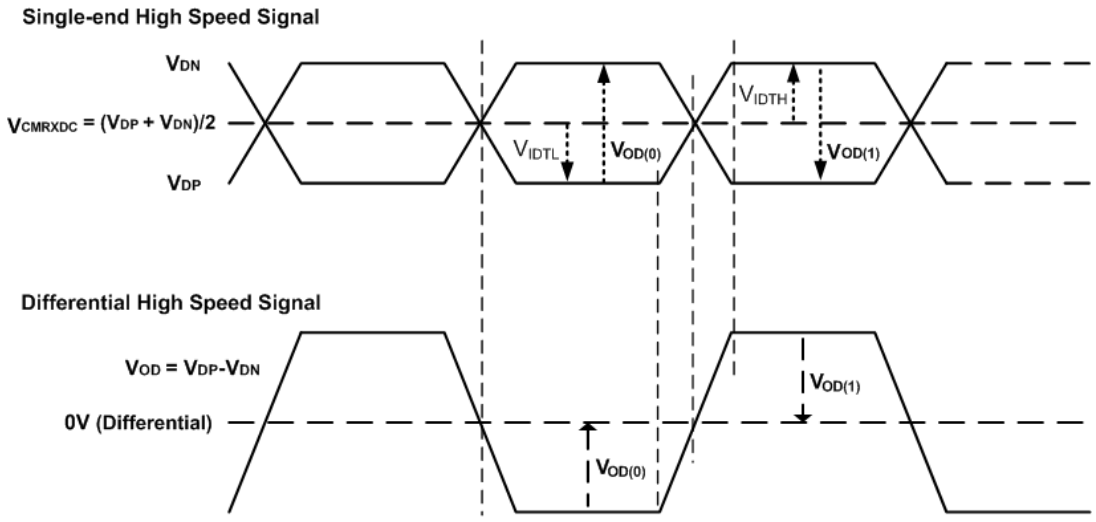


Figure2. Signal-ended and Resulting Differential HS Signals Diagram

(b) MIPI Interface AC Characteristic

MIPI AC Characteristic						
LP Transmission						
Parameter		Symbol	Min.	Typ.	Max.	Unit
15%-85% rise time and fall time		TRLP/TFLP	-	-	35	ns
30%-85% rise time(from HS to LP)		TREOT	-	-	35	ns
Pulse width of the LP exclusive-OR clock	First LP exclusive-OR clock pulse after STOP state or last pulse before stop state	TLP-PULSE-TX	50	-	-	ns
	All other pulses		50	-	-	ns
Period of the LP exclusive-OR clock		TLP-PER-TX	100	-	-	ns
Slew Rate@CLOAD=0pF		V/tSR	20	-	500	mV/ns
Slew Rate@CLOAD=5pF			20	-	200	mV/ns
Slew Rate@CLOAD=20pF			20	-	150	mV/ns
Slew Rate@CLOAD=70pF			20	-	100	mV/ns
Load Capacitance		CLOAD	-	-	70	pF

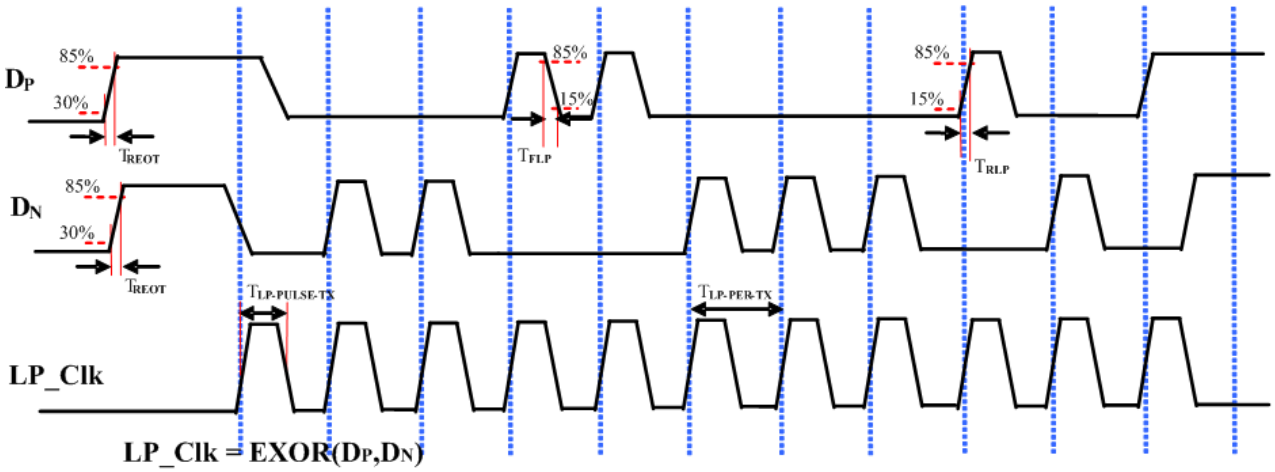


Figure3. LP Transmitter Timing Definitions

MIPI AC Characteristic						
High Speed Transmission						
Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
UI instantaneous	UIINST	2	-	5.56	ns	1,2
Data to Clock Skew [measured at transmitter]	TSKEW[TX]	-0.1	-	0.1	ns	3
Data to Clock Setup Time [measured at receiver]	TSETUP[RX]	0.9	-	-	ns	4
Data to Clock Hold Time [measured at receiver]	THOLD[RX]	0.9	-	-	ns	4
20%-80% rise time and fall time	tR/tF	150	-	-	ps	
		-	-	0.3	UIINST	

Note：
1.This value corresponds to a minimum 180 Mbps data rate.
2.The minimum UI shall not be violated for any single bit period, i.e., any DDR half cycle within a data brust.
3.Total silicon and package delay budget of 0.2ns.
4.Total setup and hold window for receiver of 1.8ns.

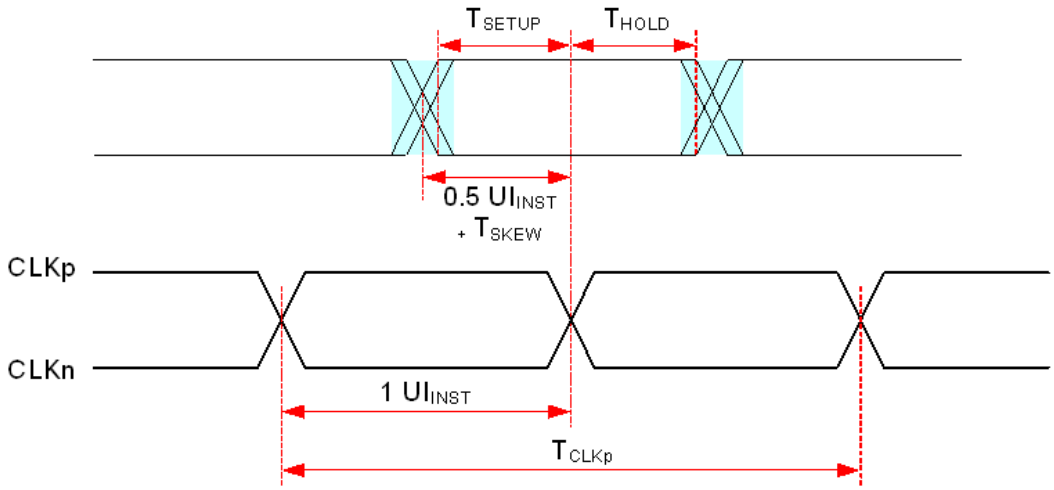


Figure4. Data to Clock Timing Definitions

(c) Terminal Resistor Setting(MIPI Initial Command)→Setting RAE to 0x0D.

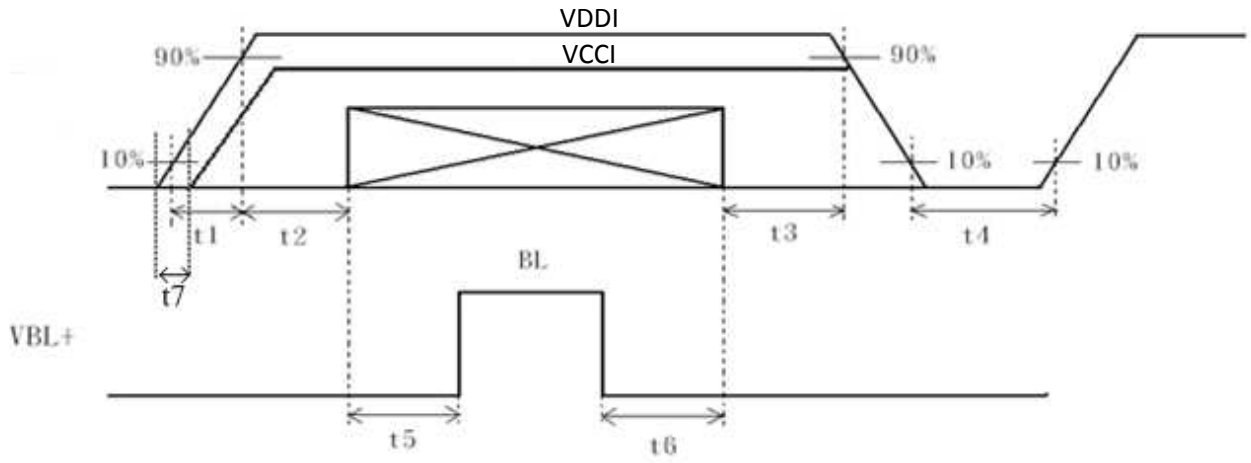
Address (MIPI I/F)	AEh					Access Attribute			R/W
						Number of Parameter(s)			1
Parameter	D[7]	D[6]	D[5]	D[4]	D[3]	D[2]	D[1]	D[0]	Default Value
	0	0	0	0	RTREM_ENL	RTREM_ENR	SWDIV	1	0Fh
Description	**RTREM_ENL:** SDLOC = 1 driver IC terminal resistor disenable/enable selection. RTERM_ENL = L, Terminal resistor disable. RTERM_ENL = H, Terminal resistor enable. (default) **RTREM_ENR:** SDLOC = 0 driver IC terminal resistor disenable/enable selection. RTERM_ENR = L, Terminal resistor disable. RTERM_ENR = H, Terminal resistor enable. (default) **SWDIV:** Differential input impedance selection. SWDIV = L, Differential input impedance(ZID) is 200ohm. SWDIV = H, Differential input impedance(ZID) is 100ohm. (default)									

(B) POWER SEQUENCE

Power On：VDDI , VCCI→Video &Logic Signal→BL

Power Off：BL→ Video &Logic Signal→ VDDI , VCCI

0.5 ms ≦t1≦10ms
0.01 ms＜t2≦50 ms
0.01 ms＜t3≦50 ms
500 ms≦t4
200 ms≦t5
200 ms≦t6
0ms≦t7≦5ms



data:RGB DATA, DCLK, HD, VD, DENA

(2) Timing Chart

ITEM				SYNBOL	MIN	TYP	MAX	UNIT
LCD Timing	Frame Rate			-	60	60	60	Hz
	DCLK		Frequency	f_{CLK}	66.3	66.8	85	MHz
	DENA	Horizontal	Horizontal total time	t_H	860	864	1026	t_{CLK}
			Horizontal Active time	t_{HA}	800	800	800	t_{CLK}
			Horizontal Blank time	t_{HB}	60	64	226	t_{CLK}
		Vertical	Vertical total time	t_V	1286	1288	1380	t_H
			Vertical Active time	t_{VA}	1280	1280	1280	t_H
			Vertical Blank time	t_{VB}	6	8	100	t_H

【Note】

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

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

(3) 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	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】

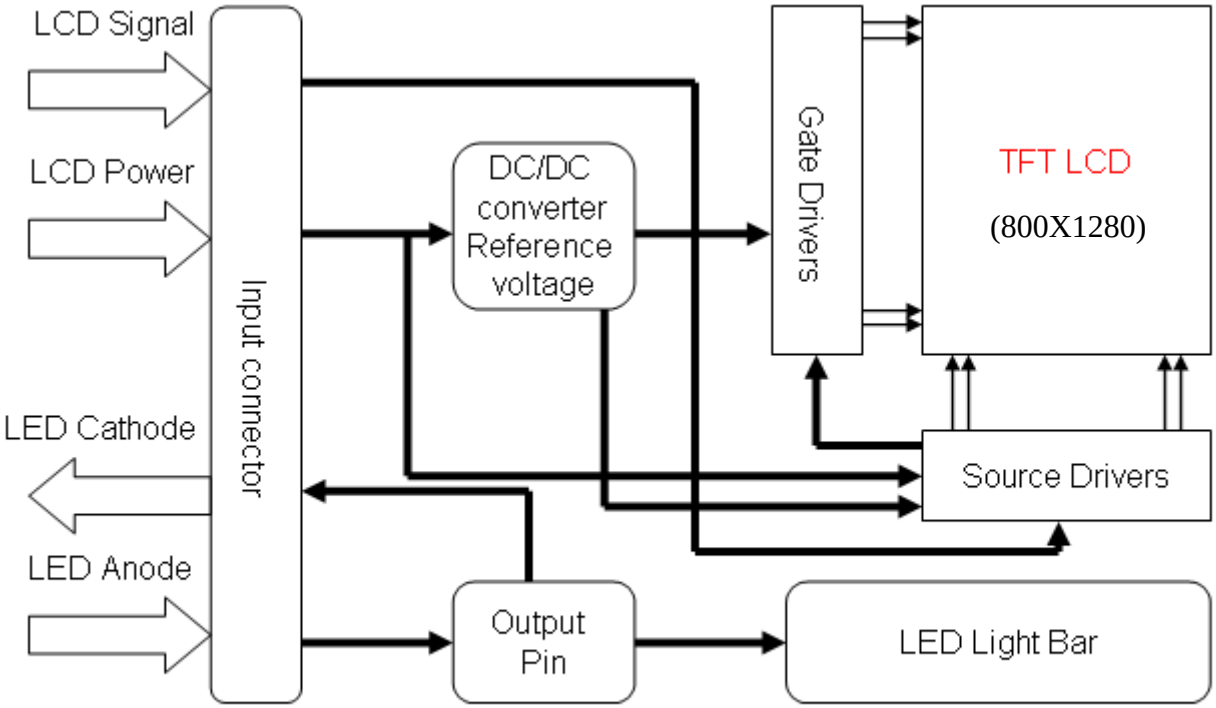
1) Gray level:

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

2) DATA:

1: high，0: low

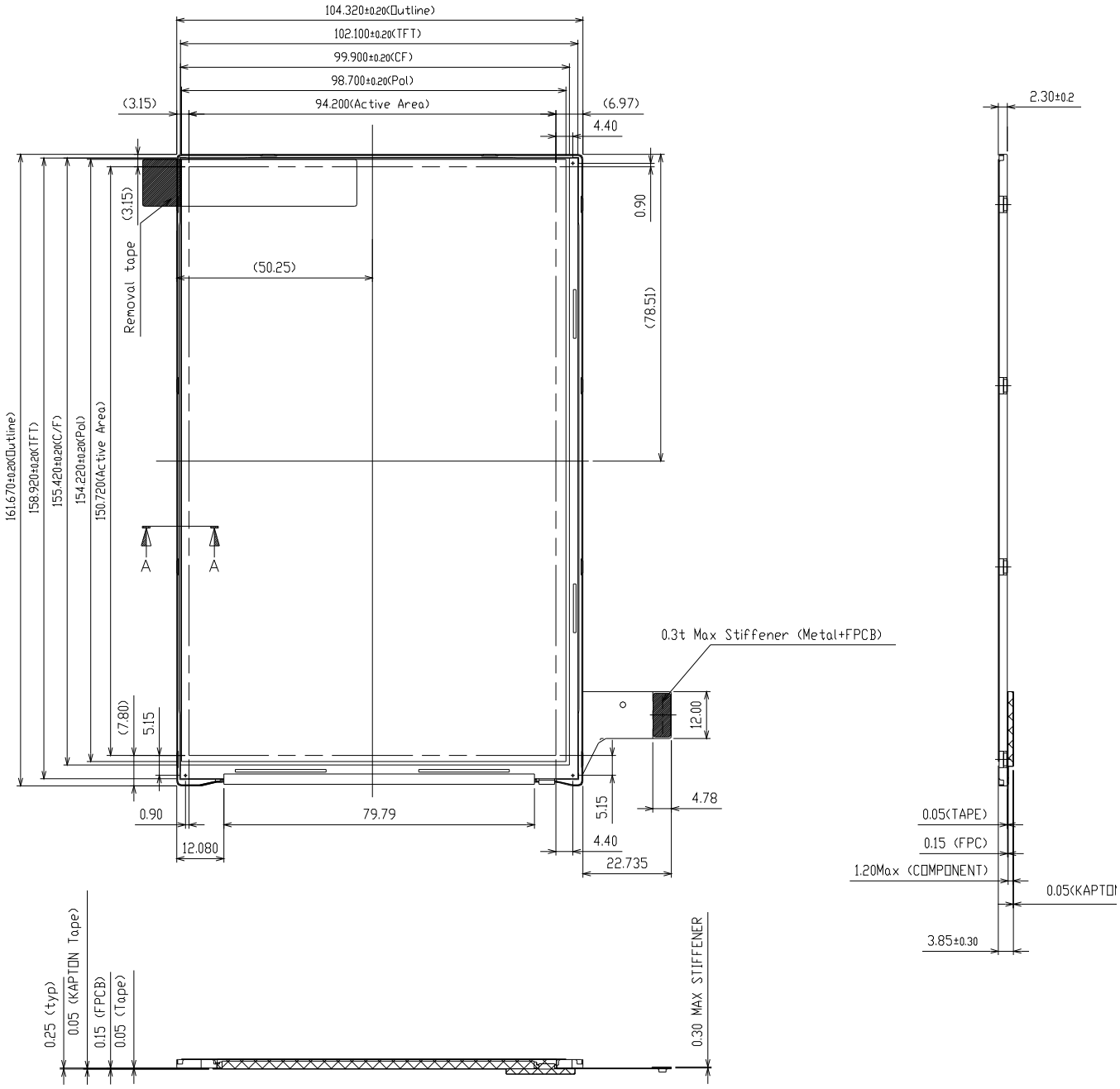
6. BLOCK DIAGRAM



7. MECHANICAL SPECIFICATION

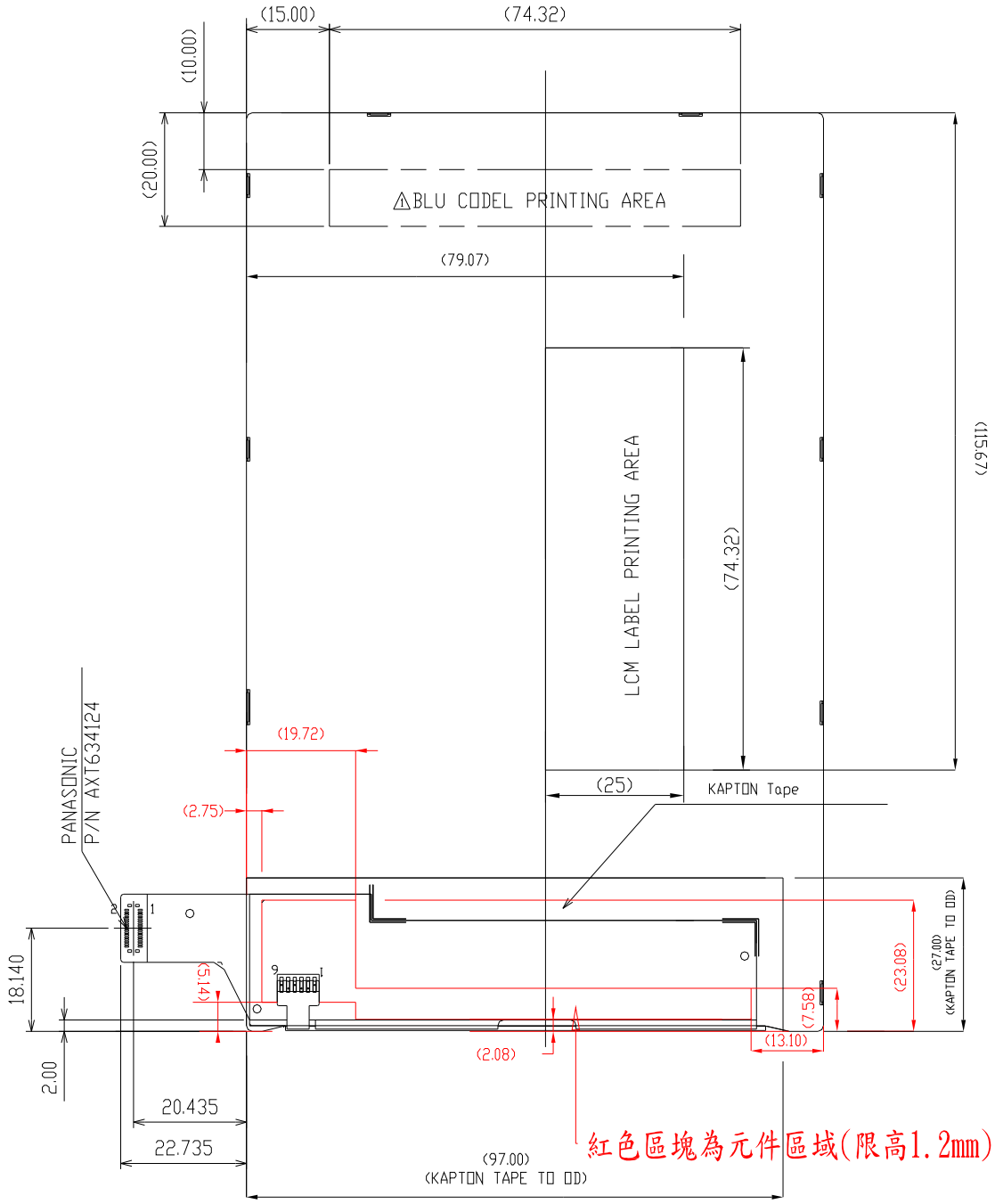
(1) Front side

The tolerance, not show in the figure, is ±0.2mm. **[Unit： mm]**



2) Rear side

The tolerance, not show in the figure, is ±0.2mm. **[Unit： mm]**



8. OPTICAL CHARACTERISTICS

Ta=25℃，VDDI=3.3V

ITEM		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	NOTE
Contrast Ratio		CR	θ=ψ= 0°	600	800	--	--	*1) 2)
Luminance (Center)		L	θ=ψ= 0°	300	400	--	cd/m^2	*1) 3)
Uniformity(9P)		ΔL	θ=ψ= 0°	72	80	--	%	*1) 3)
Response Time		Tr+Tf	θ=ψ= 0°	--	30	50	ms	*5)
Cross talk		CT	θ=ψ= 0°	--	--	2.5	%	*6)
View angle	Horizontal	Ψ	CR≧10	80/-80	85/-85	--	°	View angle
	Vertical	θ		80/-80	85/-85	--	°	
Color Temperature Coordinate	W	X	θ=ψ= 0°	0.280	0.310	0.340	--	Color Temperature Coordinate
		Y		0.300	0.330	0.360		
	R	X		TBD	TBD	TBD	--	
		Y		TBD	TBD	TBD		
	G	X		TBD	TBD	TBD	--	
		Y		TBD	TBD	TBD		
	B	X		TBD	TBD	TBD	--	
		Y		TBD	TBD	TBD		
Gamut			θ=ψ= 0°	--	60	--	%	
Gamma		γ	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=20.5mA(each LED)

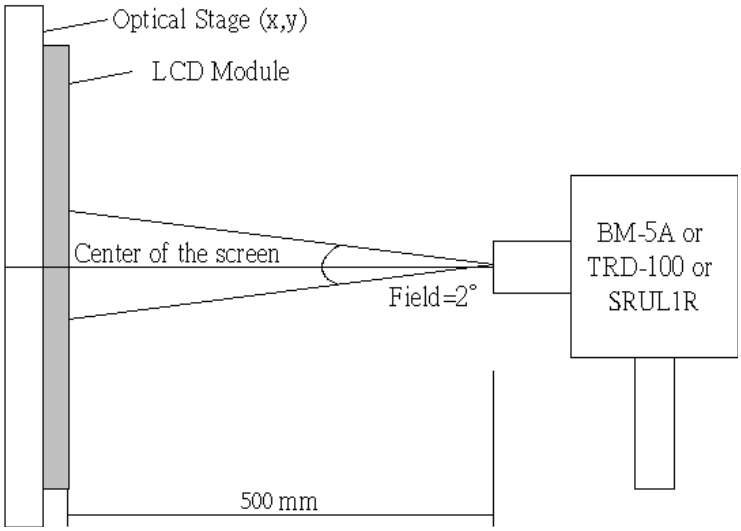
Definition of these measurement items is as follows:

***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

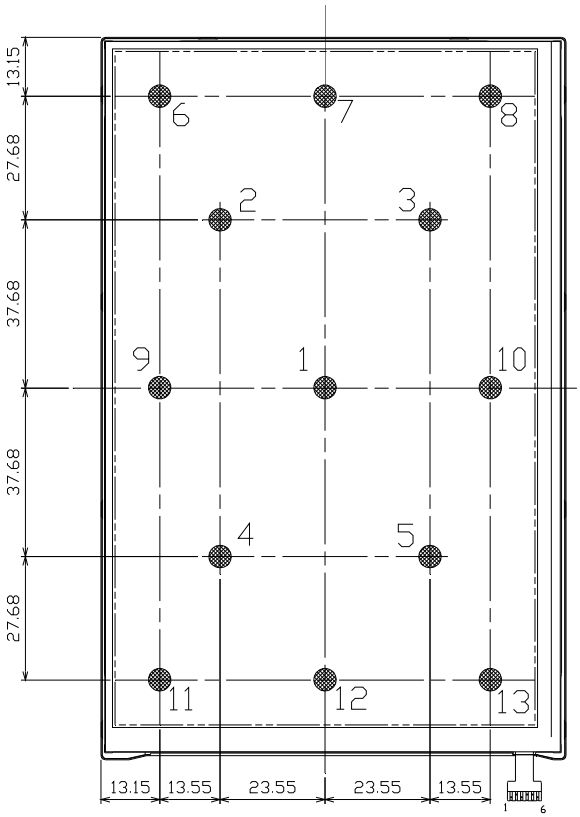


***3) Definition of Luminance and Luminance uniformity**

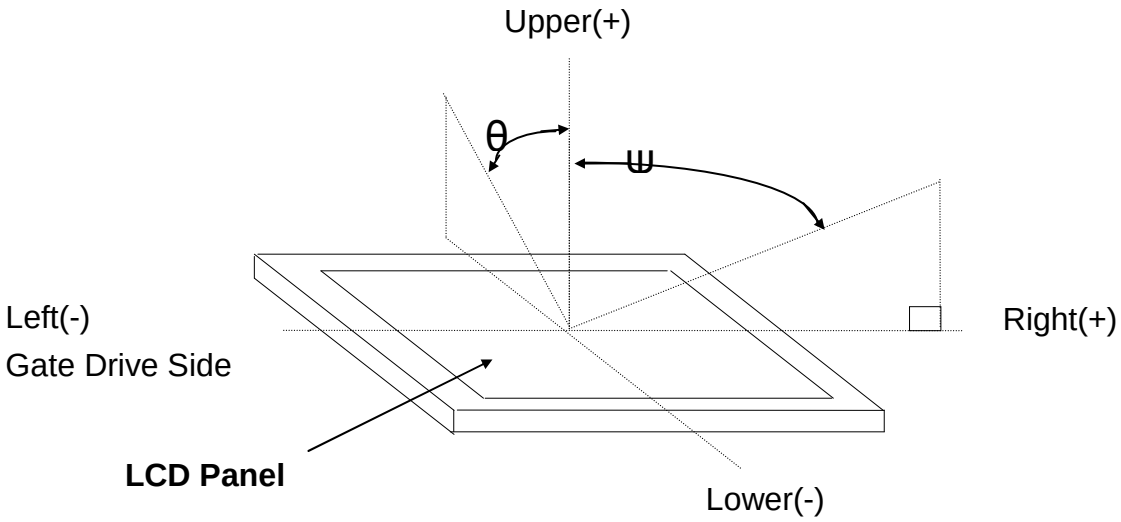
Central luminance: The white luminance is measured at the center position "1" on the screen, see Fig below.

5P Luminance (AVG): The white luminance is measured at measuring points 1~5 see Fig below.

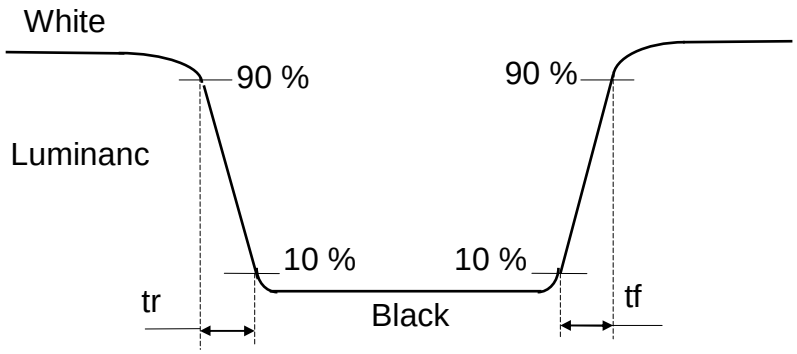
9P Uniformity: Δ L = (Lmin / Lmax) ×100% at measuring points 1~13 (except points 2.3.4.5) see fig below..



***4) Definition of view angle(θ，ψ)**



***5) Definition of response time**



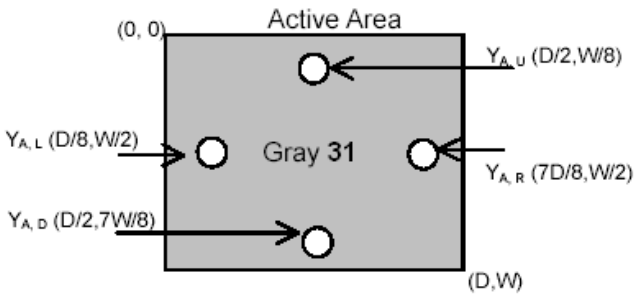
***6) Crosstalk Modulation Ratio:**

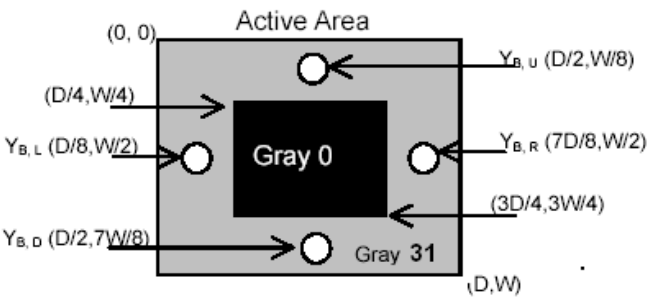
CT= $|Y_B - Y_A| / Y_{Ax} \times 100\%$

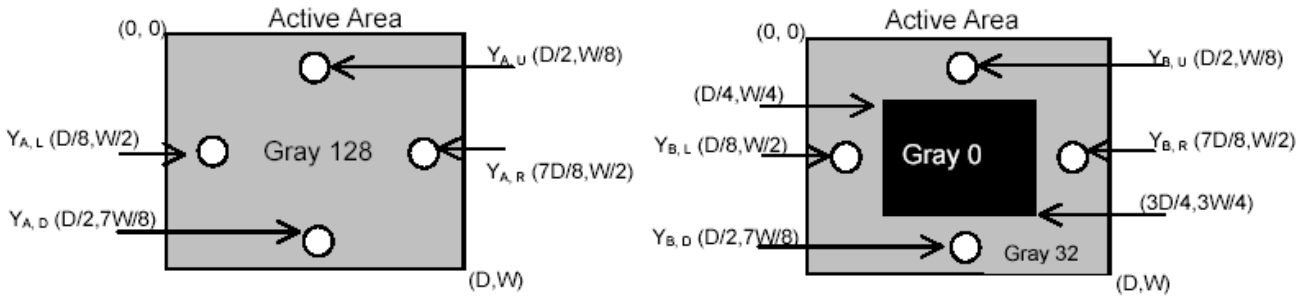
Y_A 、Y_B measure position and definition

Y_A means luminance at gray level 31(exclude gray level 0 pattern)

Y_B means luminance at gray level 31(include gray level 0 pattern)

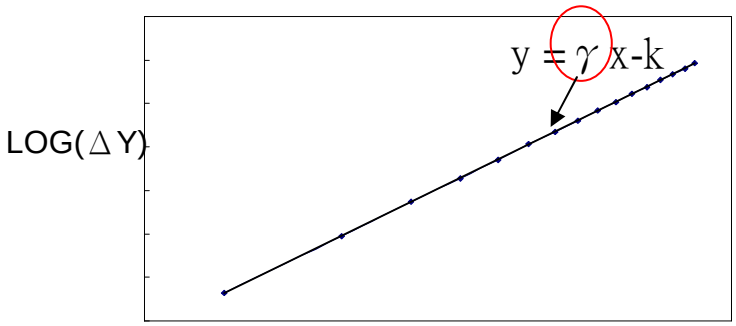






***7) Definition Gamma (VESA)**

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).



9. RELIABILITY TEST CONDITIONS

(1) Temperature、Humidity and Pressure

High Temp. Storage Test	60℃，240 Hrs
High Temp. Operating Test	50℃，240Hrs
Low Temp. Storage Test	-20℃，240 Hrs
Low Temp. Operating Test	0℃，240 Hrs
High Temp/ High Humidity Operating Test	40℃，90% RH，240Hrs
Thermal Shock Test	-20℃(0.5 Hr)~70℃(0.5 Hr)56 Cycles
Shock Test	980m/s2,Action time: 6ms, Time: 3 times for each direction, Direction:+/-X, +/-Y, +/-Z
ESD	150pF、330Ω、contact+-8KV/ Air+-15KV, NO DAMAGE
Package Vibration test	Frequency range: 10-55Hz, 1.2Grms, swep time: 1 minute, test period: 2 hours for each direction of X, Y, Z

(4) MTBF without B/L : 50,000 Hrs(min) lifetime.

(5) 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.

Fail：No display image, obvious non-uniformity, or line defects.