



SPECIFICATIONS

CUSTOMER : _____


MODEL NO. : **GFTO090AA1280720V**

VERSION : **A**

DATE : **2017.12.20**

CERTIFICATION : **ROHS**

CUSTOMER SIGN : _____

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1. OVERVIEW

This is 9" color TFT-LCD (Thin Film Transistor Liquid Crystal Display) module composed of LCD panel, driver ICs ,control circuit and LED backlight. By applying 1280×720 images are displayed on the 9" diagonal screen. Display 16.7M colors by R.G.B signal input.

General specification are summarized in the following table:

ITEM	SPECIFICATION			
Display Area (mm)	198.912(W) x 111.888H)			
Number of Pixels	1280(H) × 3 (RGB) ×720(V)			
Pixel Pitch (mm)	0.1554 (H) × 0.1554 (V)			
Color Pixel Arrangement	RGB vertical stripe			
Display Mode	Normally Black			
Number of Colors	16.7M(6bit+2bit HiFRC)			
Brightness (cd/m ²)	500nit(Typ)			
Response Time (ms)	25ms(Typ.) / 35ms(Max.)			
Optimum Viewing Direction	Full			
Contrast Ratio	900:1(Typ.)			
Viewing Angle (CR ≥ 10)	Up / Down: 85 / 85 degree			
	Left/ right: 85 / 85 degree			
Power Consumption (W)	3.78W(Typ)			
Interface connection	LVDS			
Module Size (mm)		Min.	Typ.	Max.
	Horizontal(H)	210.4	210.7	211
	Vertical(V)	123.8	124.1	124.4
	Depth(D) W/O FPC	5.7	6	6.3
Module Weight (g)	(250)(Typ)			
Backlight Unit	LED			
Surface Treatment	Anti-Glare			



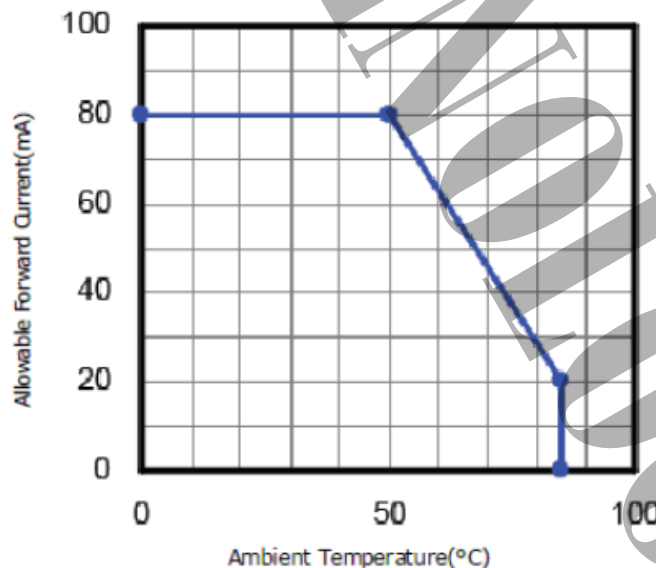
2. ABSOLUTE MAXIMUM RATINGS

The following are maximum values which, if exceeded, may cause faulty operation or damage to the unit.

Item	Symbol	Min.	Max.	Unit	Note
Digital Supply Voltage	DVDD DVDD_LVDS	-0.3	3.96	V	
Analog Supply Voltage	AVDD	-0.5	14.85	V	
Gate On Voltage	VGH	-0.3	40	V	
Gate Off Voltage	VGL	-20	0.3	V	
Gate On-Gate Off Voltage	VGH-VGL	12	40	V	
Signal Input Voltage	NIND0 ~ NIND3 PIND0 ~ PIND3 NINC,PINC	-0.5	5	V	
Forward Current (per LED)	If	-	80	mA	
Pulse forward current (per LED)	I _{fp}	-	240	mA	1、2、3
Operating temperature	Topa	-20	70	°C	4
Storage temperature	Tstg	-30	80	°C	4

Note :

- *1) If the product were used out of the operation and storage range, it will have quality issue.
- *2) I_{fp} Conditions : Pulse Width ≤ 10msec · Duty ≤ 1/10.
- *3) Each one of LED operation must be follow diagram of Ambient Temperature and Allowable Forward Current.



- *4) If users use the product out off the environmental operation range (temperature and humidity) , it will have visual quality concerns.



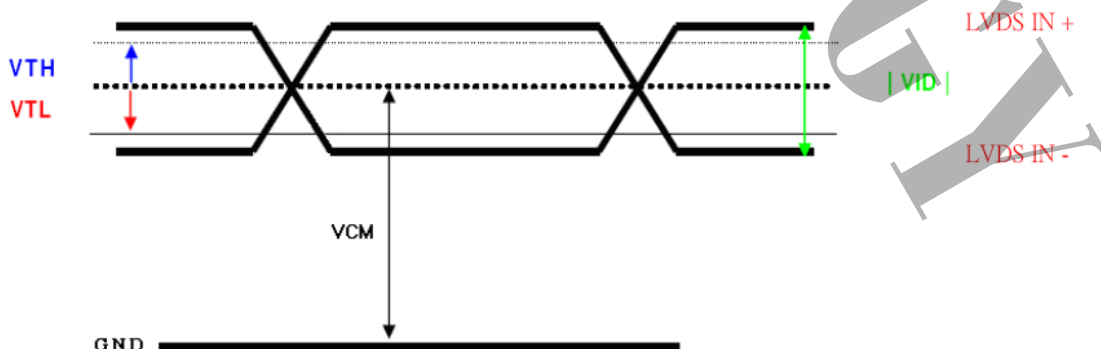
3. ELECTRICAL CHARACTERISTICS

3.1 TFT LCD

Ta=25°C

ITEM	SYMBOL	MIN	TYP	MAX	UNIT	NOTE
Digital Power Supply Voltage For LCD	DVDD	3	3.3	3.6	V	
Logic Input Voltage (LVDS:IN+,IN-)	VCM	$\frac{ VID }{2}$	-	$2.4 - \frac{ VID }{2}$	V	Note1
	VID	200	-	600	mV	Note1
	VTH	-	-	100	mV	VCM=1.2V
	VTL	-100	-	-	mV	Note1
1 Data time	UI	-	tclk*1/7	-	tclk	Note3
LVDS clock to data skew	tskew	-	-	300	ps	
input data eye width	teyew	1403	-	-	ps	
Analog Power Supply Voltage	AVDD	12.2	12.4	12.6	V	
Gate On Power Supply Voltage	VGH	21	22	23	V	
Gate Off Power Supply Voltage	VGL	-6.6	-6	-5.4	V	
Gamma Voltage	V1		12.14			Note2
	V2		11.595			Note2
	V3		9.725			Note2
	V4		8.995			Note2
	V5		8.385			Note2
	V6		6.93			Note2
	V7		6.88			Note2
	V8		5.88			Note2
	V9		5.71			Note2
	V10		4.25			Note2
	V11		3.64			Note2
	V12		2.87			Note2
	V13		1			Note2
	V14		0.34			Note2
Logic Input Voltage	VIH	0.7*DVDD	-	DVDD	V	
	VIL	GND	-	0.3*DVDD	V	
ITEM	VIL	GND	-	0.3*DVDD	V	NOTE

【Note1】 LVDS signal



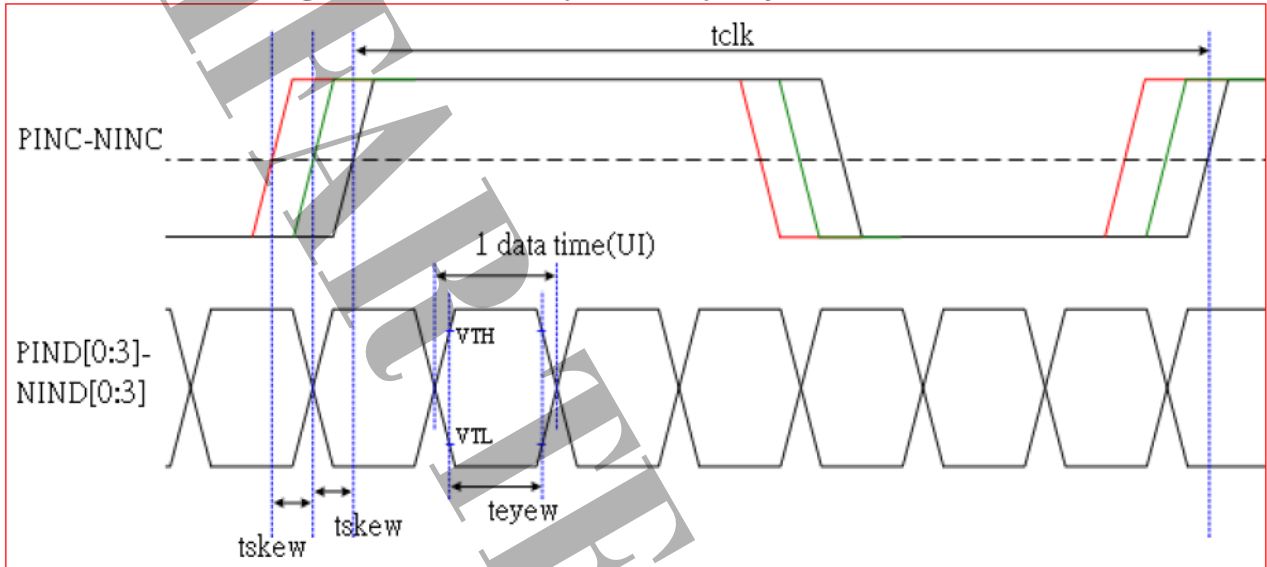
【Note2】 (1)Gamma voltage is the reference voltage for customer, it could be adjust by customer.



(2)The voltage of these pins must be: $AGND+0.1 < V14 < V13 < V12 < V11 < V10 < V9 < V8 < 0.6AVDD$;
 $0.4AVDD < V7 < V6 < V5 < V4 < V3 < V2 < V1 < AVDD-0.1$

【Recommend】 VCOM must be optimized according to each LCM. Please adjust VR to make the flicker level be minimum for getting excellent image.

【Note3】 The following condition is base on operation frequency at 71.3MHz



3.2 TFT-LCD Current Consumption

Item	Symbol	Condition	Min.	Typ.	Max.	Unit.	Note.
Gate on Current	IVGH	VGH =22V	-	0.5	1	mA	【Note1】
Gate off Current	IVGL	VGL= -6V	-	0.5	1	mA	【Note1】
Digital Current	IDVDD	DVDD = 3.3V	-	36	60	mA	【Note1】
Analog Current	IAVDD	AVDD = 12.4V	-	36	60	mA	【Note1】
Total Power Consumption	PC		-	579.2	970	mW	【Note1】

Note1: Typical: Under 256 gray pattern
 Maximum: Under White pattern



256 gray pattern



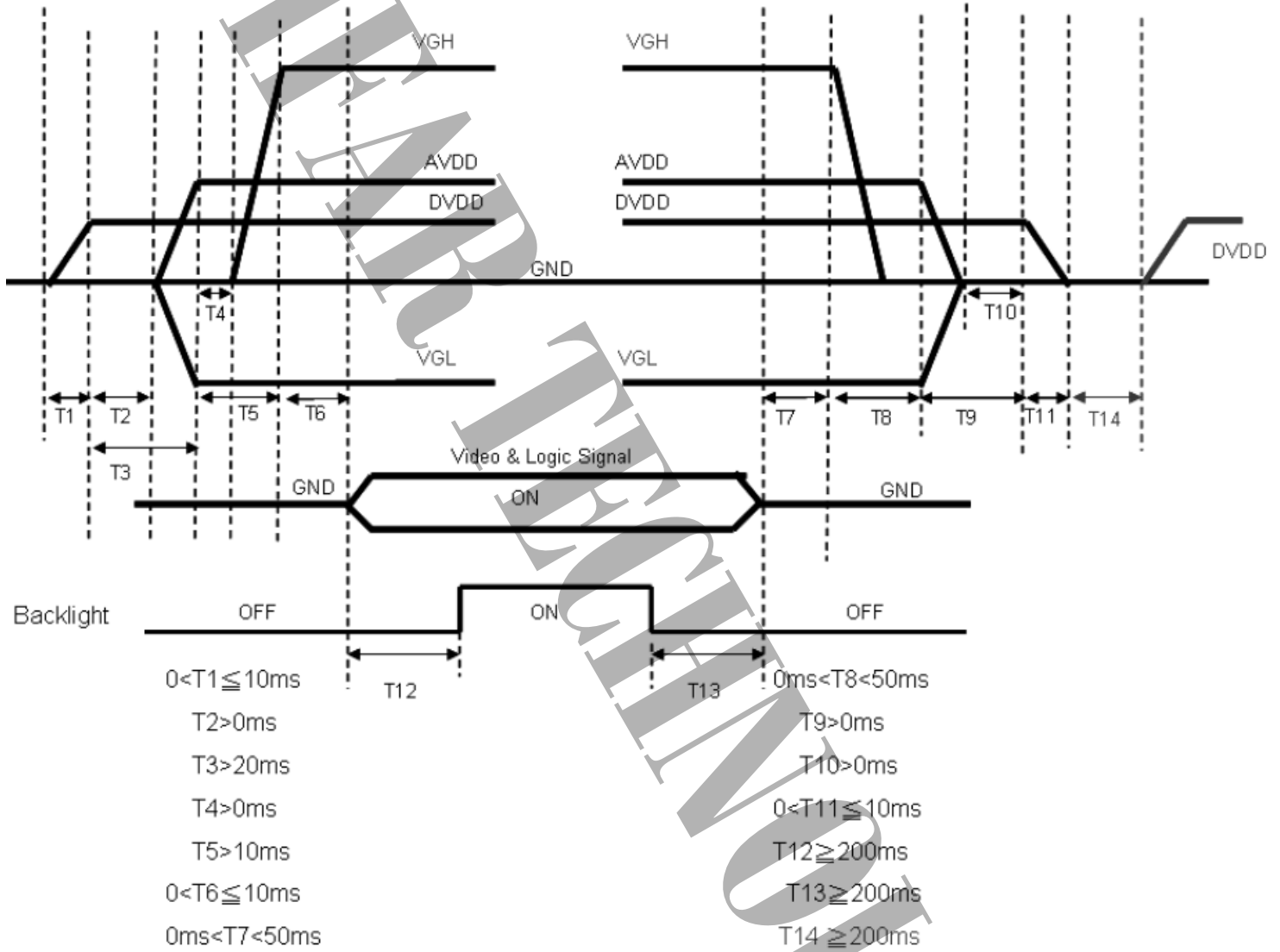
White Pattern



3.3 Power · Signal sequence

Power On : DVDD → AVDD/VGL → VGH → Video & Logic Signal → Backlight

Power Off : Backlight → Video & Logic Signal → VGH → AVDD/VGL → DVDD





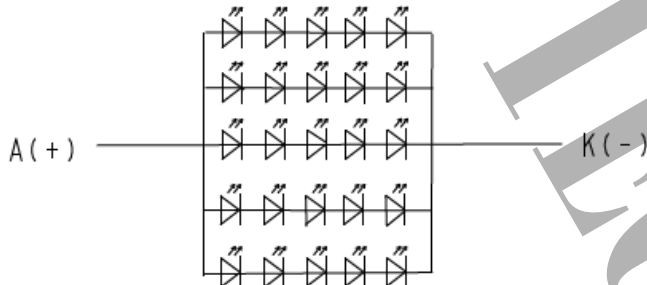
3.4 Backlight

Ta=25°C

ITEM	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT	NOTE
LED current	IL	Ta=25°C (40mA/serise)	--	200	--	mA	
LED voltage	VL	Ta=25°C (40mA/serise)	14.75	16	17.25	V	
Power consumption	WL	Ta=25°C (40mA/serise)	--	3.2	--	W	
LED Lifetime	-	Ta=25°C IF=40mA	20000			Hr	

Remarks :

*1)LED Circuit Diagram



*2) A : Anode(+), K : Cathode(-)

*3) Suggestion: Using the constant current control to avoid the leakage light and brightness quality issue.

*4) Definition of Led lifetime : Luminance < Initial luminance 50%.



4. INTERFACE CONNECTION

4.1 CN1 (Input Signal)

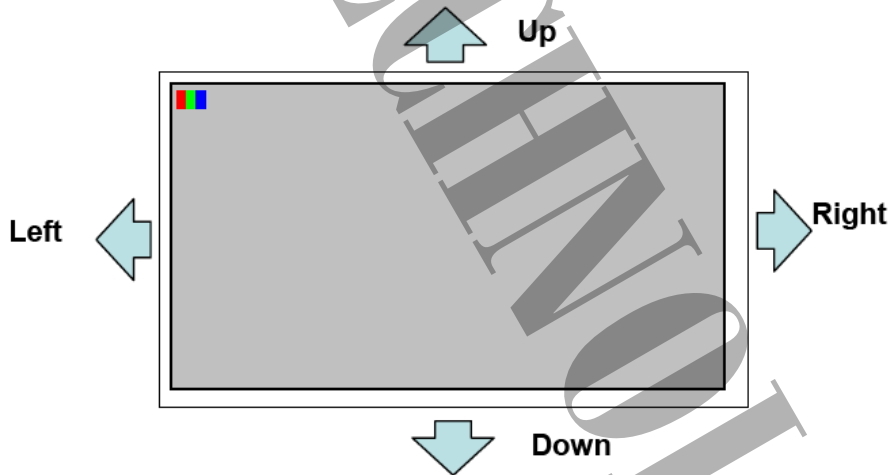
Pin NO.	Symbol	Description	Note
1	AGND	Analog ground	
2	AVDD	Analog power	
3	DVDD	Digital power	
4	GND	Digital ground	
5	NC	Not connect	
6	DVDD	Digital power	
7	GND	Digital ground	
8	V14	Gamma correction voltage reference	
9	V13	Gamma correction voltage reference	
10	V12	Gamma correction voltage reference	
11	V11	Gamma correction voltage reference	
12	V10	Gamma correction voltage reference	
13	V9	Gamma correction voltage reference	
14	V8	Gamma correction voltage reference	
15	GND	Digital ground	
16	DVDD_LVDS	LVDS power	
17	GND	Digital ground	
18	PIND3	Positive LVDS differential data input	
19	NIND3	Negative LVDS differential data input	
20	GND	Digital ground	
21	PINC	Positive LVDS differential clock input	
22	NINC	Negative LVDS differential clock input	
23	GND	Digital ground	
24	PIND2	Positive LVDS differential data input	
25	NIND2	Negative LVDS differential data input	
26	GND	Digital ground	
27	PIND1	Positive LVDS differential data input	
28	NIND1	Negative LVDS differential data input	
29	GND	Digital ground	
30	PIND0	Positive LVDS differential data input	
31	NIND0	Negative LVDS differential data input	
32	GND	Digital ground	
33	GND_LVDS	LVDS ground	
34	GRB	Global reset pin. Active low to enter reset state. Suggest to connecting with an RC reset circuit for stability. Normally pull high. (R=10KΩ · C=0.1μF)	
35	STBYB	Standby mode, normally pull high STBYB="1", normal operation STBYB="0", timing control, source driver will turn off, all output are high-Z	
36	SHLR	Left or right display control	Note 1
37	DVDD	Digital power	
38	UPDN	Up / down display control	Note 1
39	AGND	Analog ground	
40	AVDD	Analog power	
41	NC	NC	
42	DITH	Dithering function enable control. Normally pull low DITHER = "1", Enable internal dithering function DITHER = "0", Disable internal dithering function	Note 2
43	GND	Digital ground	
44	DVDD	Digital Power	
45	GND	Digital ground	
46	V7	Gamma correction voltage reference	
47	V6	Gamma correction voltage reference	
48	V5	Gamma correction voltage reference	
49	V4	Gamma correction voltage reference	



50	V3	Gamma correction voltage reference	
51	V2	Gamma correction voltage reference	
52	V1	Gamma correction voltage reference	
53	GND	Digital ground	
54	DVDD	Digital power	
55	SELB	6bit/8bit mode select, SELB = "0", LVDS input data is 8bits SELB = "1", LVDS input data is 6bits	Note 2
56	VGH	Positive power for TFT	
57	DVDD	Digital power for Gate IC	
58	VGL	Negative power for TFT	
59	GND	Digital ground for Gate IC	
60	NC	Not connect	

Note 1 : UPDN and SHLR control function

SHLR	UPDN	Data shifting
DVDD	GND	Left→Right , Up→Down(default)
GND	GND	Right→Left , Up→Down
DVDD	DVDD	Left→Right , Down→Up
GND	DVDD	Right→Left , Down→Up



4.2 CN2 (backlight)

Pin No.	SYMBOL	FUNCTION
1	A	Anode
2	K	Cathode

Note :

Input connector : BHSR-02VS-1(JST)

Outlet connector: SM02B-BHSS-1(JST)



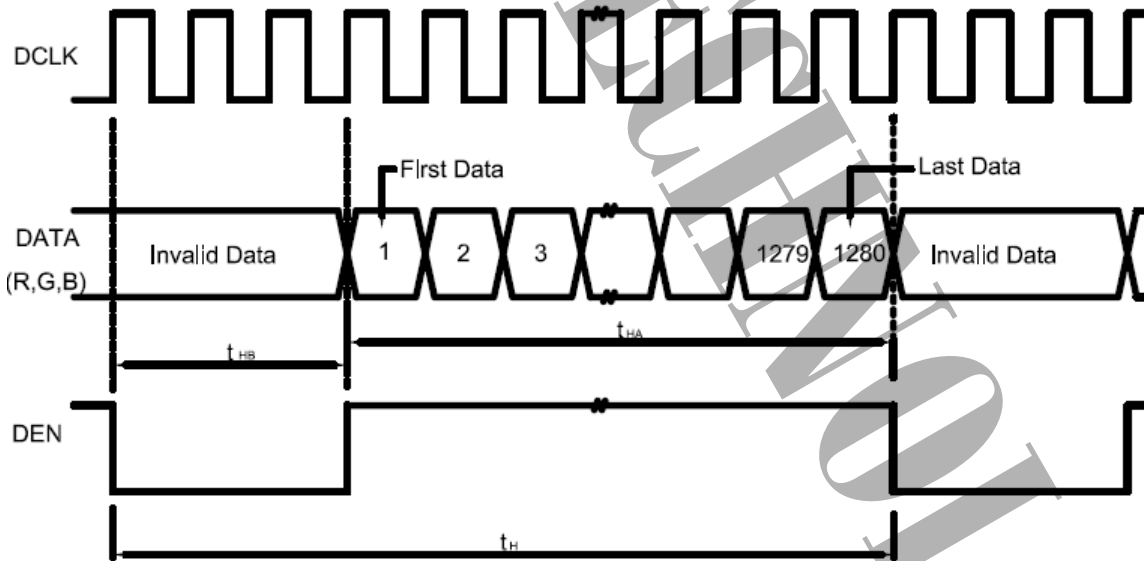
5. INPUT SIGNAL(DE ONLY MODE)

5.1 Timing Specification

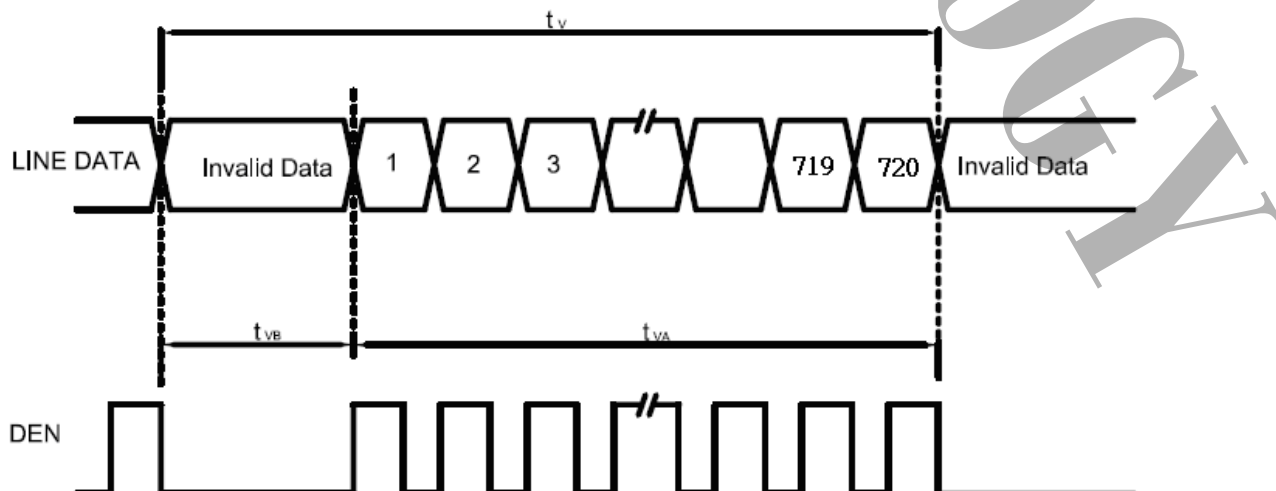
Item		Symbol	Min.	Typ.	Max.	Unit	
LVDS input signal sequence	CLK Frequency	1/tclk	63.5	67.3	71.3	MHz	
LCD input signal sequence (Input LVDS Transmitter)	Horizontal	Horizontal total Time	t_H	1450	1480	1500	tCLK
		Horizontal effective Time	t_{HA}	1280			tCLK
		Horizontal Blank Time	t_{HB}	170	200	220	tCLK
	Vertical	Vertical total Time	t_V	730	758	792	t_H
		Vertical effective Time	t_{VA}	720			t_H
		Vertical Blank Time	t_{VB}	10	38	72	t_H

5.2 Timing sequence(Timing chart)

5.2.1 Horizontal Timing Sequence



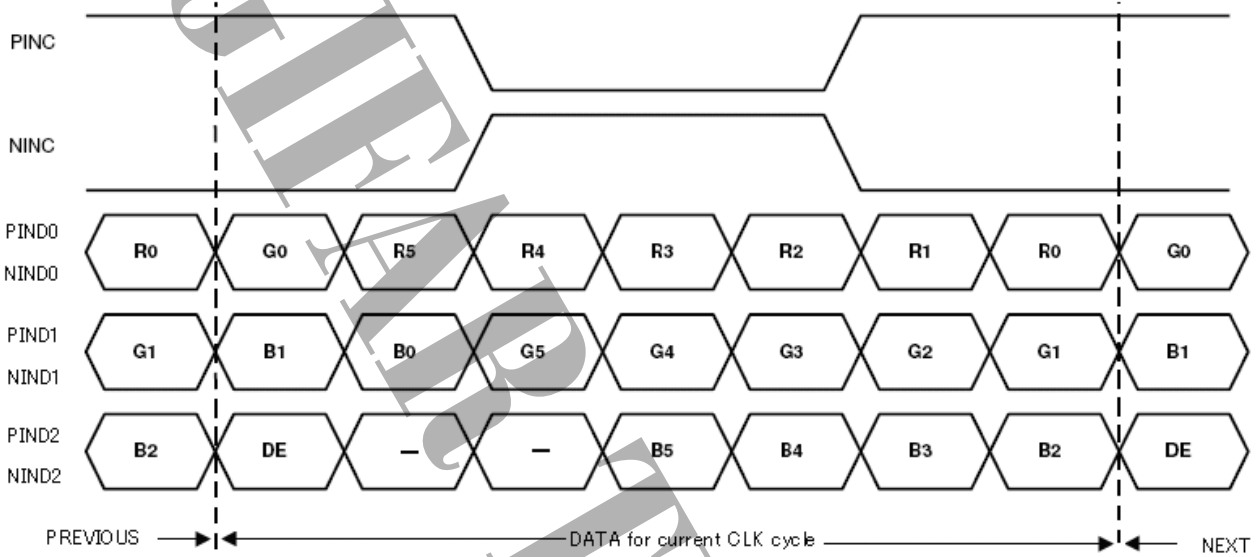
5.2.2 Vertical Timing Sequence



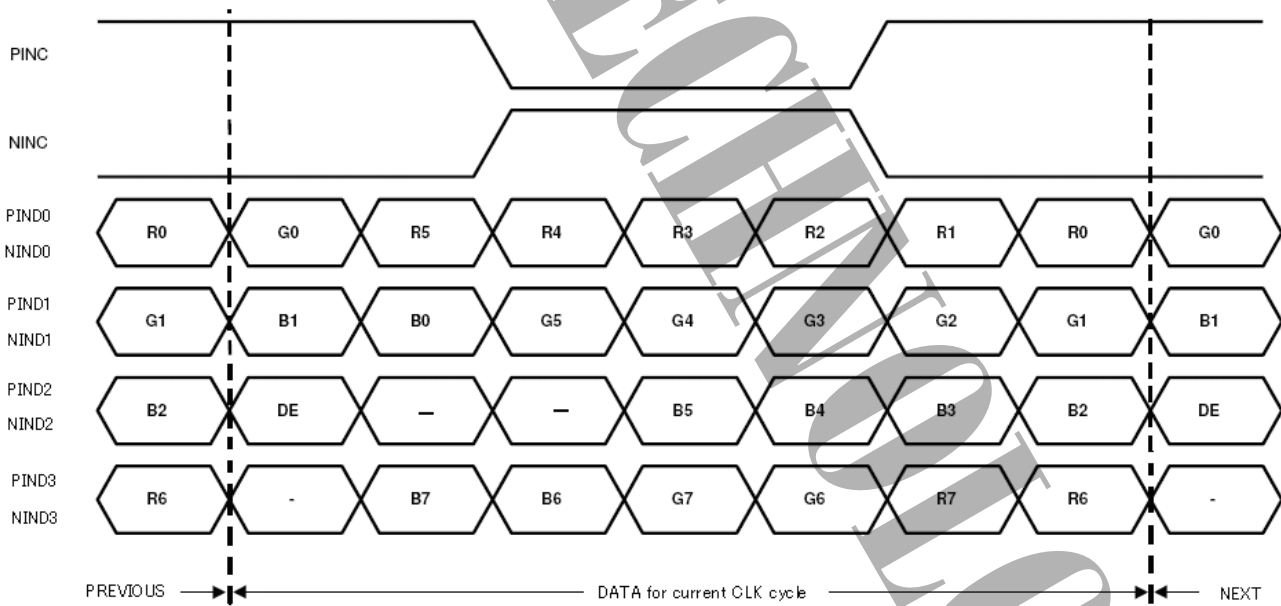


5.2.3 LVDS Input Data mapping

6 Bit LVDS input



8 Bit LVDS input





5.2.4 Color Data Reference

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	
	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	1	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	
	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	0	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	
	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	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	0	0	1	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		
	GREEN(254)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	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	
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	0	1		
	BLUE(254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	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	

【Note】

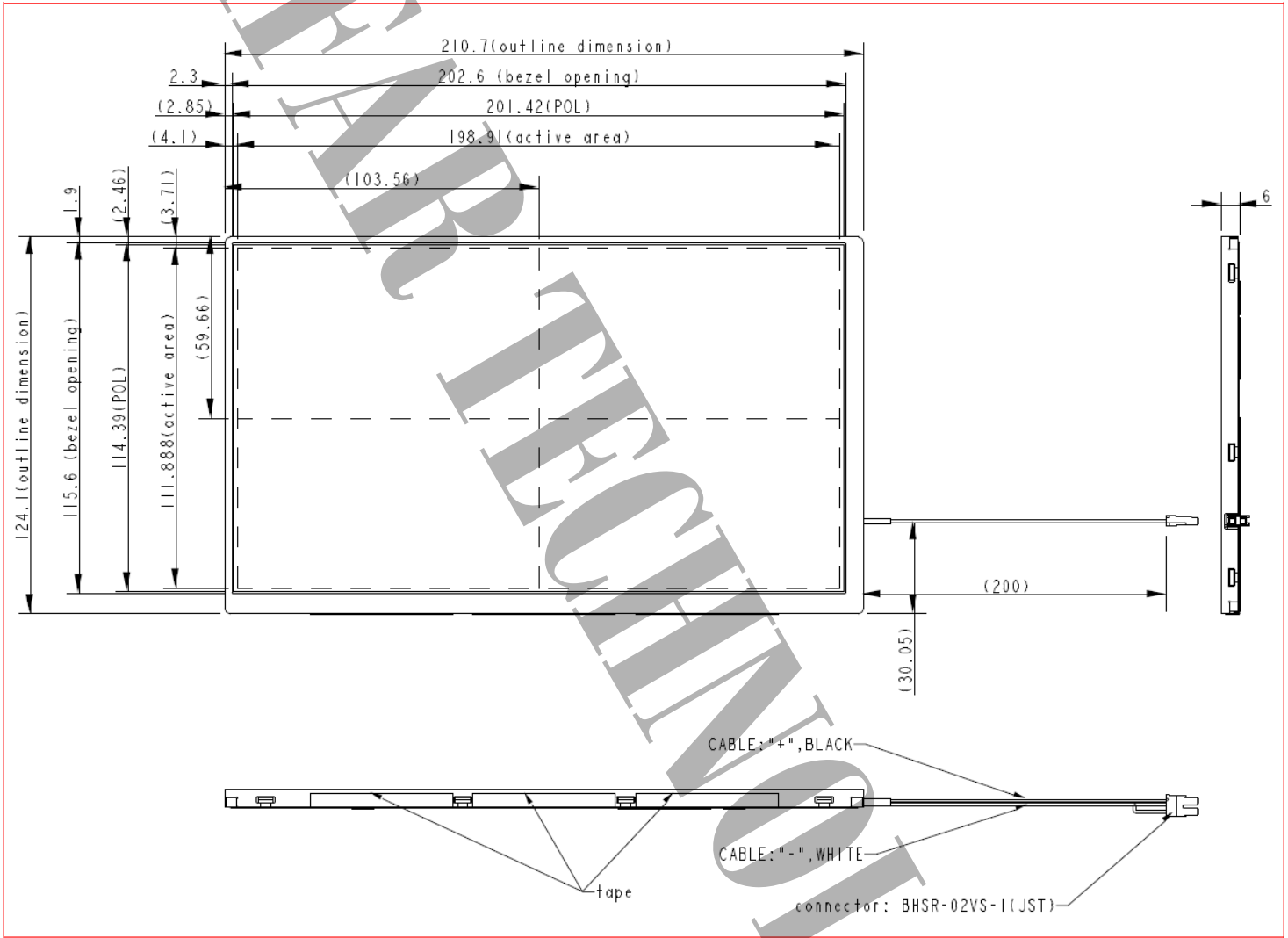
- 1) Gray level:
Color(n) : n is level order; higher n means brighter level.
- 2) DATA:
1: high , 0: low



6. MECHANICAL DIMENSION

6.1 Front Side

[Unit : mm]

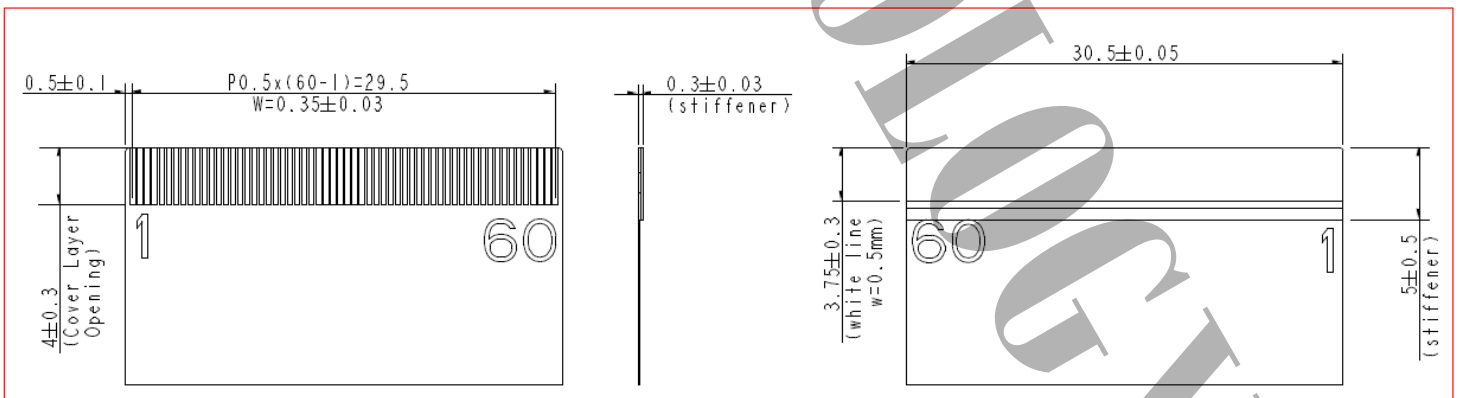
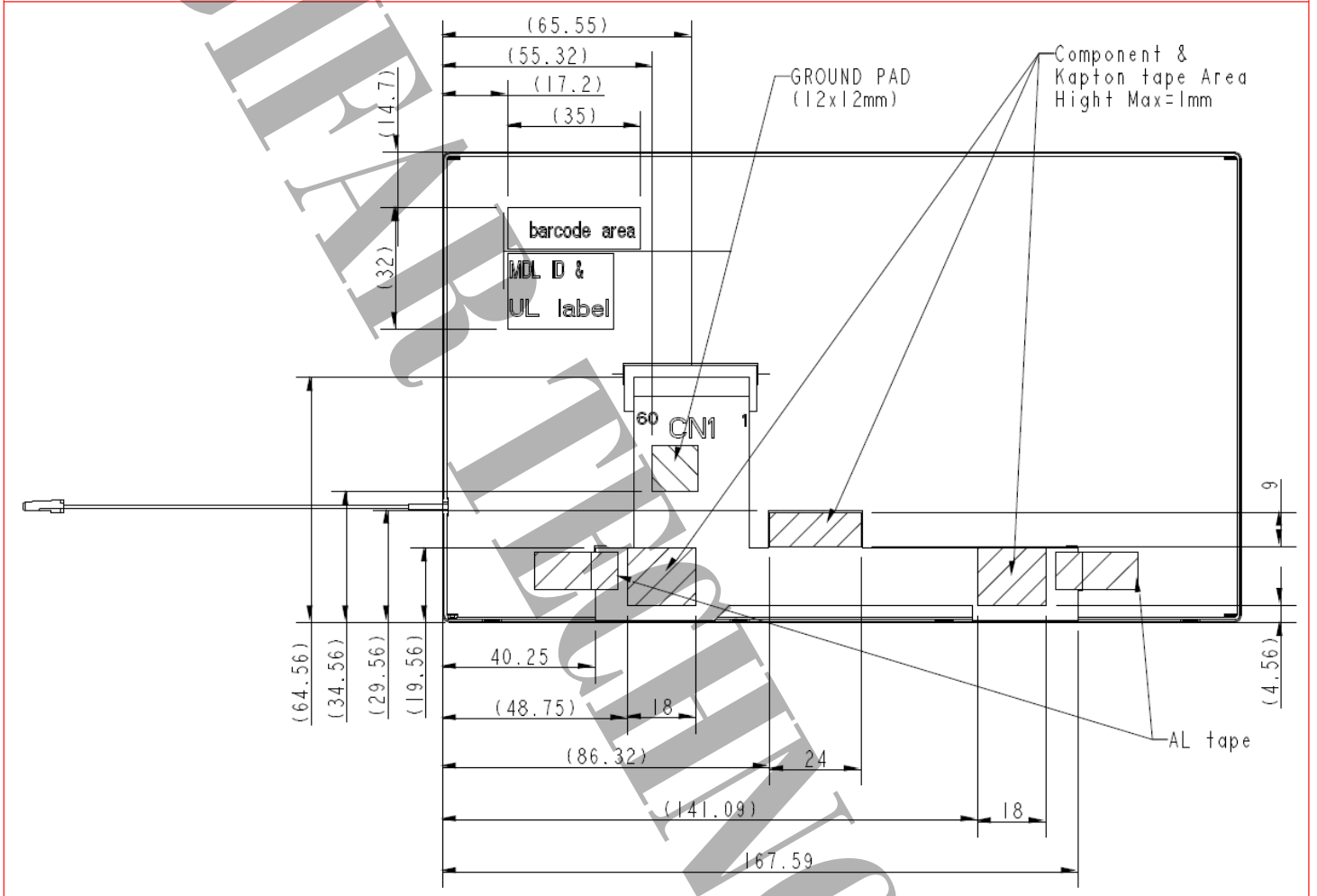


General tolerance $\pm 0.3\text{mm}$



6.2 Rear Side

[Unit : mm]



General tolerance $\pm 0.3mm$

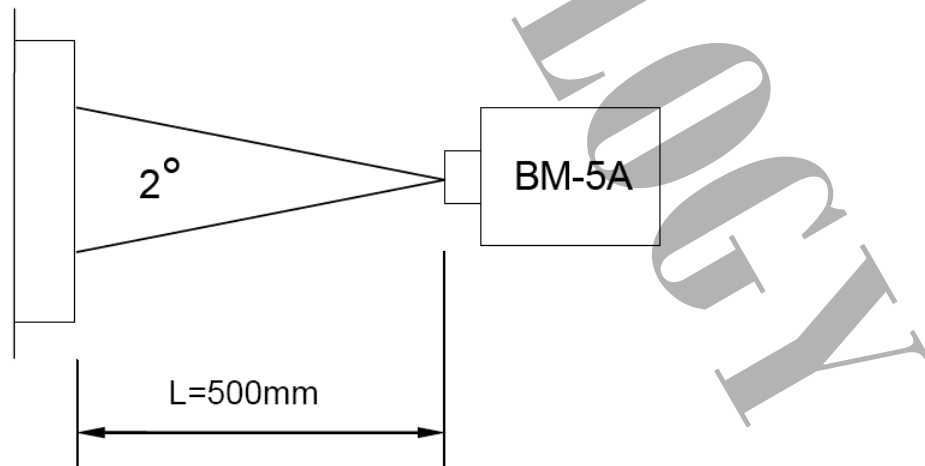


7. OPTICAL CHARACTERISTICS

Ta = 25°C

ITEM	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT	NOTE	
Contrast Ratio	CR	Point-5	600	900		--	1, 2, 3	
Luminance(CEN)	Lw	Point-5	400	500		cd/m ²	1, 3	
Luminance Uniformity	ΔL		70	80		%	1, 3	
Response Time (White - Black)	Tr +Tf	Point-5	-	25	35	ms	1, 3, 5	
NTSC	-	Point-5	65	70	-	%	1, 4	
Viewing Angle	Vertical	Upper(θ)	CR ≥ 10 Point-5	75	85	--	°	1, 4
		Down(θ)		75	85			1, 4
	Horizontal	Left(ψ)		75	85			1, 4
		Right(ψ)		75	85	--	°	1, 4
MDL Chromaticity	White	Wx Wy	Point-5	0.267 0.284	0.307 0.324	0.347 0.364	--	1, 3
	Red	Rx Ry		0.605 0.303	0.645 0.343	0.685 0.383		
	Green	Gx Gy		0.266 0.598	0.306 0.638	0.346 0.678		
	Blue	Bx By		0.105 0.063	0.145 0.103	0.185 0.143		

Note1: Measure condition : 25°C ± 2°C , 60 ± 10%RH , under 1 Lux in the dark room. BM-5A (TOPCON) , viewing angle 2° , IL=200mA (Backlight current) , measurement after lighting on 10 mins.



Note2: Definition of contrast ratio :

$$\text{Contrast Ratio (CR)} = (\text{White}) \text{ Luminance of ON} \div (\text{Black}) \text{ Luminance of OFF}$$



Note3: Definition of luminance : Measure white luminance on the point 5 as figure.7-1

Definition of Luminance Uniformity: Measure white luminance on the point1~9 as figure.7-1

$$\Delta L = [L(\text{MIN})/L(\text{MAX})] \times 100$$

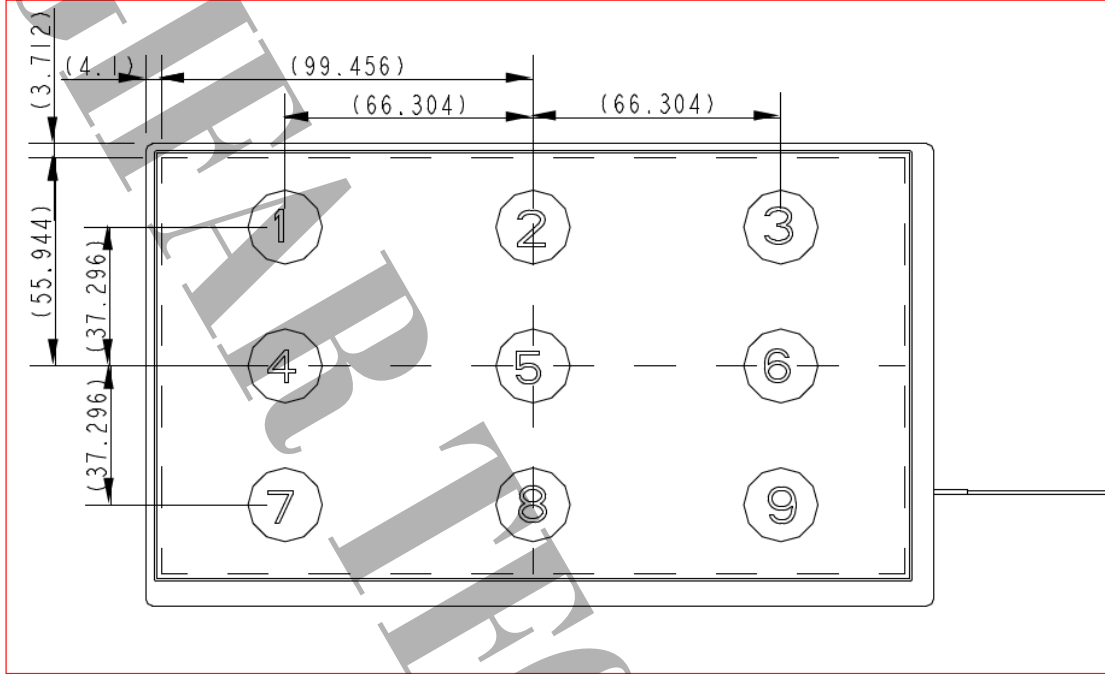


Fig.7-1 Measuring point

Note 4: Definition of Viewing Angle(θ, ψ), refer to Fig.7-2 as below :

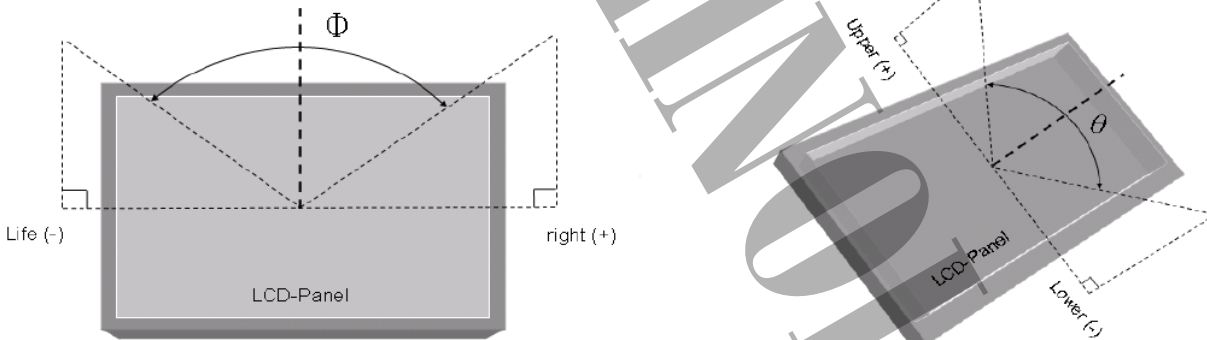


Fig.7-2 Definition of Viewing Angle

Note5: Definition of Response Time.(White-Black)

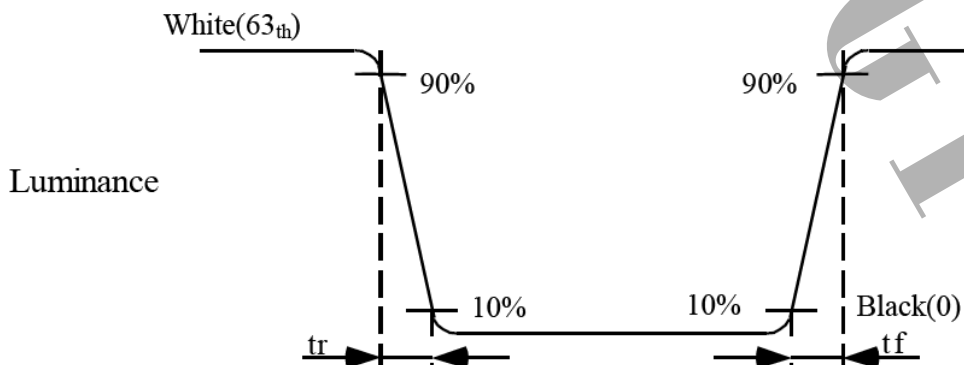


Fig.7-3 Definition of Response Time(White-Black)



8. RELIABILITY TEST

8.1. Temperature and humidity

TEST ITEMS	CONDITIONS	NOTE
High Temperature Operation	70°C , 240hrs	
High Temperature Storage	80°C , 240hrs	
High Temperature High Humidity Operation	60°C , 90%RH , 240hrs	No condensation
Low Temperature Operation	-20°C ; 240hrs	
Low Temperature Storage	-30°C ; 240hrs	
Thermal Shock	-30°C (0.5hr)~80°C (0.5hr) 200 Cycles	
Image Sticking	25 °C± 2 °C ; 2hrs	Note 1

Note 1. :

Condition of Image Sticking test : 25 °C± 2 °C

Operation with test pattern sustained for 2 hrs, then change to gray pattern immediately.

After 5 mins, the mura must be disappeared completely .

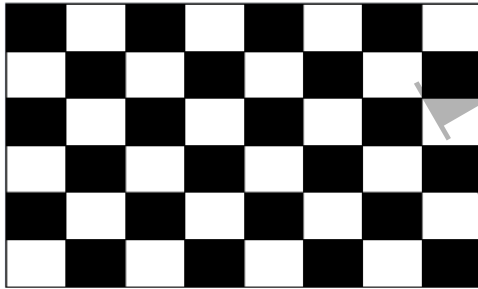


Image Sticking -pattern



Mid-Gray pattern

8.2 Shock and Vibration

TEST ITEMS	CONDITIONS
Shock (Non-operation)	<ul style="list-style-type: none"> ● Shock level: 980m/s²(equal to 100G). ● Waveform: half sinusoidal wave,6ms. ● Number of shocks: ±X,±Y,±Z axes for a total of six shock inputs.
Vibration (Non-operation)	<ul style="list-style-type: none"> ● Frequency range:8~33.3Hz ● Stoke : 1.3 mm ● Vibration: sinusoidal wave, perpendicular axis(both x, z axis: 2hrs ,y axis: 4hrs). ● Sweep: 2.9G,33.3 Hz -400 Hz ● Cycle time: 15 min

8.3 Electrostatic Discharge

TEST ITEM	CONDITIONS	Note
ESD	150pF , 330Ω , ±8kV&±15kV air& contact test	1
	200pF , 0Ω , ±200V contact test	2

Note: Measure

1: LCD glass and metal bezel

2: IF connector pins

8.4. Judgment standard

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

Pass: Normal display image and no line defect

Fail: No display image, or line defect.



9. WARRANTY

9.1 The period is within 12 months since the date of shipping out under normal using and storage conditions.

9.2 The warranty will be avoided in case of defect induced by customer