PRODUCT SPECIFICATION

PUBLICATION DATE: 08/31/2022

PART NUMBER: HDA1210WXPT-AH-I

CUSTOMER APPROVAL

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1. GENERAL DESCRIPTION

1.1 OVERVIEW

HDA1210WXPT-AH-I is a 12.1" TFT Liquid Crystal Display module with a LED Backlight unit and a PCAP touch panel. This module is LVDS interface and supports 1280 x 800 Wide-XGA wide-view mode and can display 262k/16.7M colors. The PCAP TP supports USB interface and I2C Interface.

1.2 GENERAL SPECIFICATIONS

Item	Specification	Unit	Note
Screen Size	12.1" real diagonal		
Driver Element	a-si TFT active matrix	-	-
Pixel Number	1280 x R.G.B. x 800	pixel	-
Pixel Pitch	0.204(H) x 0.204 (V)	mm	-
Pixel Arrangement	RGB vertical stripe	-	-
Display Colors	262k/16.7M	color	-
LCD Interface	LVDS (6/8bit)		
Transmissive Mode	Normally Black	-	-
Touch Panel	a PCAP TP (multi touch)		
Touch Panel Interface	USB interface & I2C Interface		
Bonding Method between TP &LCM	Air Bonding		
Surface Treatment	Glare type, 6H hard coating	-	-
Luminance, White	850	Cd/m^2	
Power Consumption	T.B.D.		

1.3 MECHANICAL SPECIFICATIONS

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal (H)	287.5	288	288.5	mm	(1)
	Vertical (V)	193.5	194	194.5	mm	
	Thickness (T)	11.68	12.18	12.68	mm	
View Area	Horizontal	262.12	262.32	262.52	mm	
	Vertical	164.2	164.4	164.6	mm	
Active Area	Horizontal	-	261.12	-	mm	
	Vertical	-	163.2	-	mm	
Weight		-	T.B.D.	T.B.D.	g	

Note (1) Please refer to the drawings for more information in the Sec. 8.

2. ABSOLUTE MAXIMUM RATINGS

2.1 ABSOLUTE RATINGS OF ENVIRONMENT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	TST	-20	70	ºC	(1)
Operating Ambient Temperature	TOP	-20	70	ºC	(1)

Note (1)

(a) 90 %RH Max. (Ta <= 40 ºC).

(b) Wet-bulb temperature should be 39 ºC Max.

(c) No condensation.

2.2 MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	VDD	-0.3	+4.0	V	
Logic Input Voltage	V_{IN}	-0.3	Vcc+0.3	V	
Power Supply for LED Backlight	LED A1~LEDA4	-0.3	23.1	V	(1), (2)

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

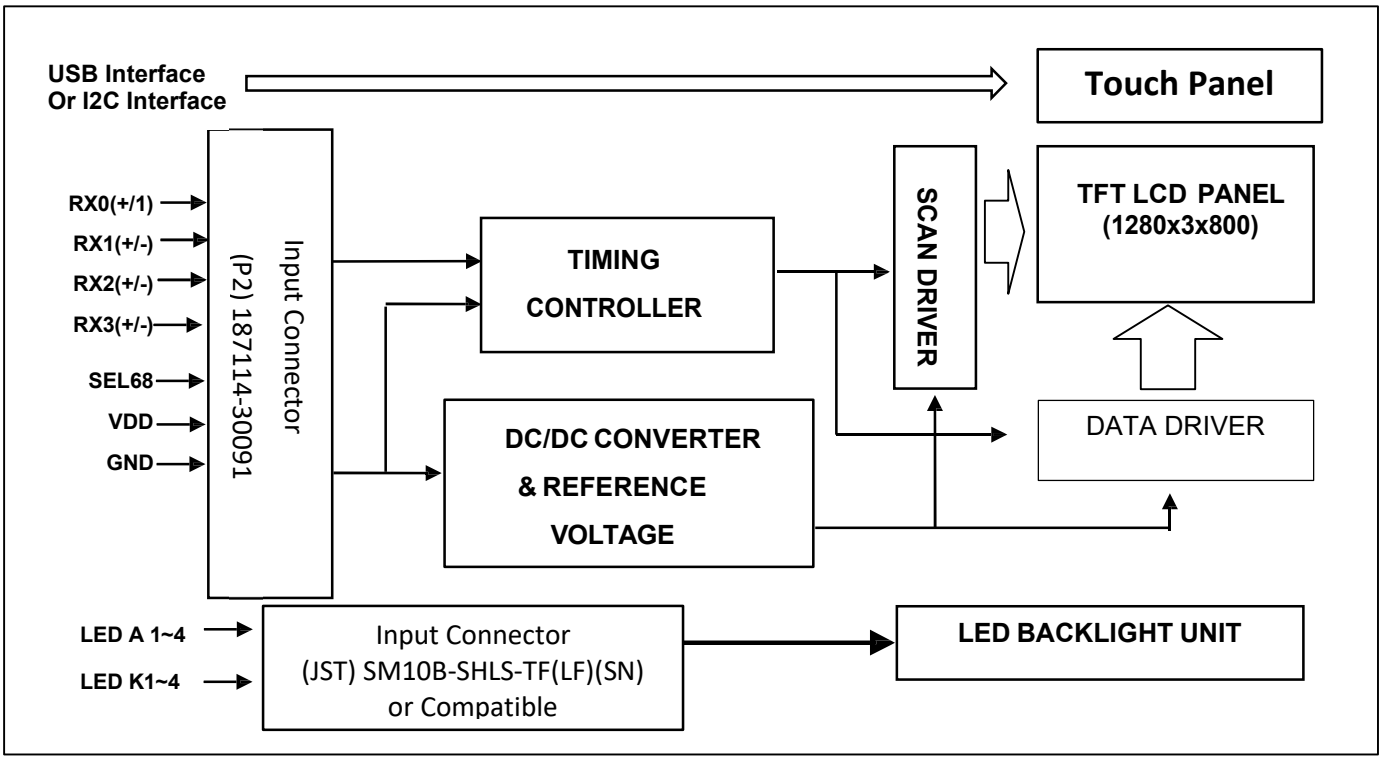
Note (2) Specified values are for LED (Refer to Section 3.2 for further information).

2.3 Touch Panel UNIT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage for TP USB Interface	VCC	-0.3	+5.5	V	
Power Supply Voltage for TP I2C Interface	VEE	-0.3	+3.5	V	

3. ELECTRICAL SPECIFICATIONS

3.1 FUNCTION BLOCK DIAGRAM



3.2 TFT LCD INTERFACE CONNECTIONS

PIN ASSIGNMENT：Connector Part No.: (P2) 187114-30091

Pin No.	Symbol	Description	Note
1	NC	No Connection or Ground	
2	NC	No Connection or Ground	
3	NC	No Connection or Ground	
4	NC	No Connection or Ground	
5	NC	No Connection or Ground	
6	NC	No Connection or Ground	
7	NC	No Connection or Ground	-
8	NC	No Connection or Ground	-
9	VCC	Power supply: +3.3V	
10	VCC	Power supply: +3.3V	-
11	GND	Ground	-
12	GND	Ground	-
13	RX0-	Negative transmission data of pixel 0	-
14	RX0+	Positive transmission data of pixel 0	-
15	GND	Ground	-
16	RX1-	Negative transmission data of pixel 1	-
17	RX1+	Positive transmission data of pixel 1	-
18	GND	Ground	-
19	RX2-	Negative transmission data of pixel 2	-
20	RX2+	Positive transmission data of pixel 2	-
21	GND	Ground	-
22	RXCLK-	Negative of clock	-
23	RXCLK+	Positive of clock	-
24	GND	Ground	-
25	RX3-	Negative transmission data of pixel 3	-
26	RX3+	Positive transmission data of pixel 3	-
27	GND	Ground	-
28	SEL6/8	LVDS 6/8 bit select function control, Low or NC → 6 bit Input Mode High → 8bit Input Mode	(2)
29	GND	Ground	-
30	NC	No Connection or Ground	-

Note (1) “Low” stands for 0V. “High” stands for 3.3V

3.2 BACKLIGHT INTERFACE CONNECTIONS

Connector P/N : (JST) SM10B-SHLS-TF(LF)(SN) or Compatible

Pin No.	Symbol	Description	Note
1	NC	No Connection	-
2	NC	No Connection	-
3	LED C1	LED cathode 1	-
4	LED A1	LED anode 1	
5	LED A2	LED anode 2	
6	LED C2	LED cathode 2	
7	LED C3	LED cathode 3	
8	LED A3	LED anode 3	
9	LED A4	LED anode 4	
10	LED C4	LED cathode 4	

3.3 TOUCH PANEL I2C INTERFACE CONNECTIONS

Connector P/N : (Molex) 53261-0671 or equivalent

Pin No.	Symbol	Description	Note
1	VEE	Power Supply for TP (3.3V)	-
2	SDA	I2C Data Signal	-
3	SCL	I2C Clock Signal	-
4	RST	Reset Signal	
5	INT	Interrupt Signal	
6	GND	Ground	

Note 1 : Control IC : (ILITEK) ILI2511

Note 2 : Support System : Windows 7/8/10, Linux and Android.

3.4 TOUCH PANEL INTERFACE CONNECTIONS

Connector P/N : (Molex) 53261-0471 or equivalent

Pin No.	Symbol	Description	Note
1	VCC	Power Supply for TP(+5V)	-
2	D-	USB Signal (-)	-
3	D+	USB Signal (+)	-
4	GND	Ground	

Note 1 : Control IC : (ILITEK) ILI2511

Note 2 : Support System : Windows 7/8/10, Linux and Android.

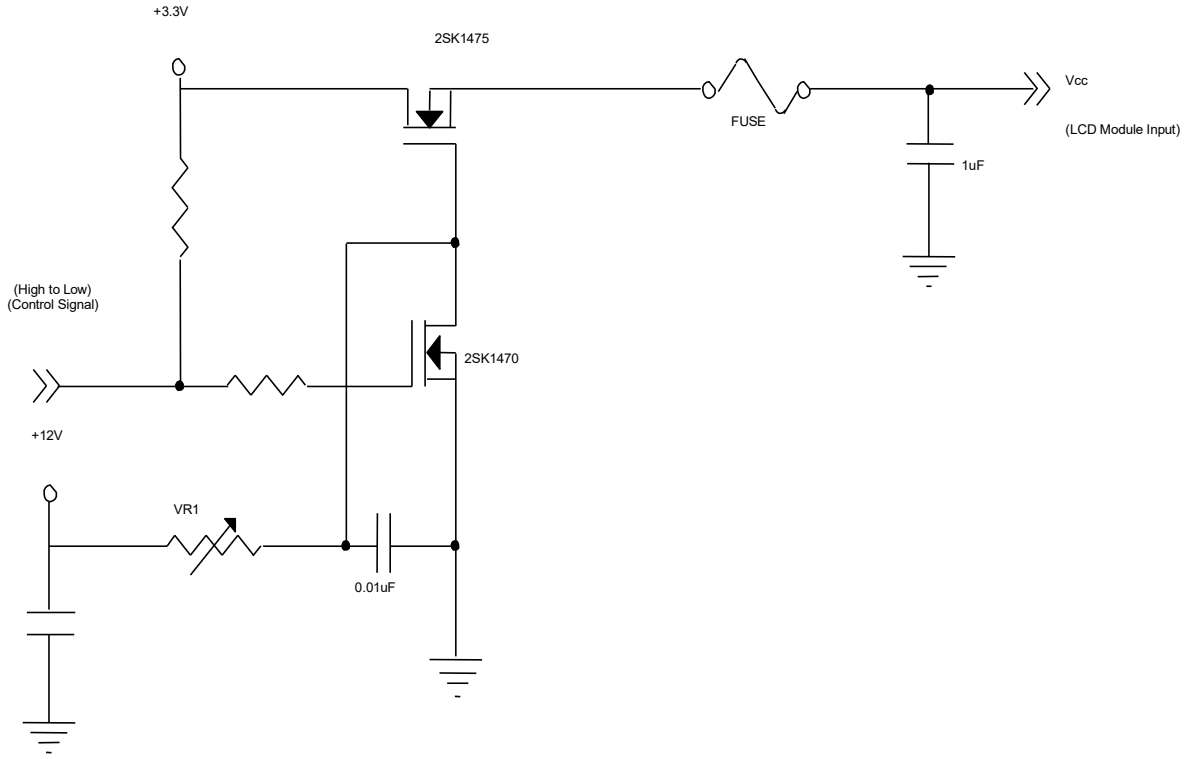
3.3 ELECTRICAL CHARACTERISTICS

3.3.1 ELETRONICS SPECIFICATION

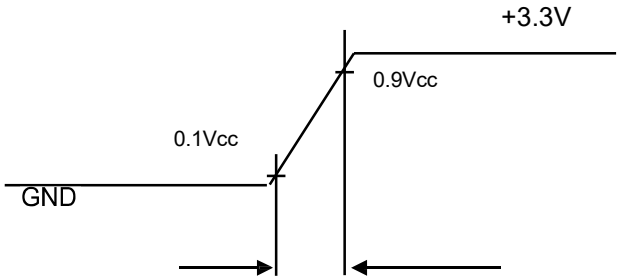
Parameter		Symbol	Value			Unit	Note
			Min.	Typ	Max.		
Power Supply Voltage		Vcc	3.0	3.3	3.6	V	-
Permissive Ripple Voltage		V_{RP}	-	50	-	mV	-
Rush Current		I_{RUSH}		1.5		A	(2)
Initial Stage Current		I_{IS}	-	-	1.0	A	(2)
Power Supply Current	White	-	400	440	480	mA	(3)a
	Black	-	260	290	320	mA	(3)b
LVDS Differential Input High Threshold		$V_{TH(LVDS)}$	+100	-	-	mV	V_{CM}=1.2V
LVDS Differential Input Low Threshold		$V_{TL(LVDS)}$	-	-	-100	mV	V_{CM}=1.2V
LVDS Common Mode Voltage		V_{CM}	1.125	-	1.375	V	
LVDS Differential Input Voltage		$\|V_{ID}\|$	100	-	600	mV	
Terminating Resistor		R_T	-	100	-	Ohm	

Note (1) The assembly should be always operated within above ranges.

Note (2) Measurement Conditions:

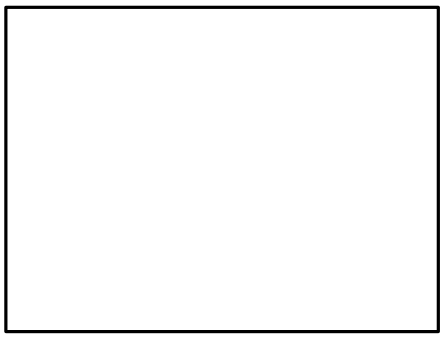


VCC rising time is 470us



Note (3) The specified power supply current is under the conditions at Vcc = 3.3 V, Ta = 25 ± 2 ºC, f_v = 60 Hz, whereas a power dissipation check pattern below is

a.White Pattern

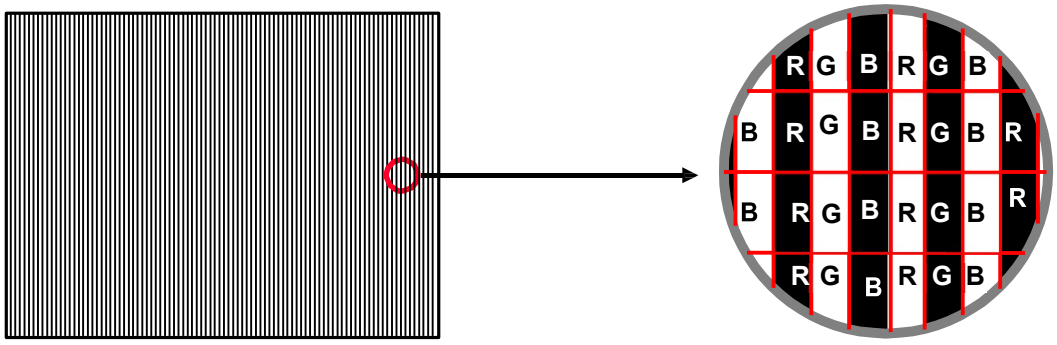


Active Area

b. Black Pattern

Active Area

c. Vertical Stripe Pattern



Active Area

3.3.2 BACKLIGHT UNIT

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Forward Voltage	LED A1~LEDA4	-	21.0	23.1	V	
Forward Current	ILED A1~ILEDA4	-	125	135	mA	(2)
Power Consumption	WLED	-	10.5	12.5	W	
LED Life Time	L_{BL}	30,000	50,000	-	Hrs	(1)

Note (1) The lifetime of LED is estimated data and defined as the time when it continues to operate under the conditions at Ta = 25 ±2 ºC and Duty 100% until the brightness becomes ≦ 50% of its original value. Operating LED at high temperature condition will reduce life time and lead to color shift.

Note (2) Constant Current Driving.

3.4 LVDS INPUT SIGNAL SPECIFICATIONS

3.4.1 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 6-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of color.

Color		Data Signal																	
		Red						Green						Blue					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue	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
Gray Scale Of Red	Red(0)/Dark	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(61)	1	1	1	1	0	1	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
Gray Scale Of Green	Green(0)/Dark	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
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	Green(61)	0	0	0	0	0	0	1	1	1	1	0	1	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
Gray Scale Of Blue	Blue(0)/Dark	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
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	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(61)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
	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) 0: Low Level Voltage, 1: High Level Voltage

The brightness of each primary color (red, green and blue) is based on the 8-bit gray scale data input for the color. The higher the binary input, the brighter the color. The table below provides the assignment of color.

Color		Data Signal																							
		Red								Green								Blue							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Colors	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	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	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	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
Gray Scale Of Red	Red(0) / Dark	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
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	Red(253)	1	1	1	1	1	1	0	1	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
Gray Scale Of Green	Green(0)/ Dark	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
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	Green(253)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	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
Gray Scale Of Blue	Blue(0) / Dark	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
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	Blue(253)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	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	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: 0: Low Level Voltage, 1: High Level Voltage

3.5 DISPLAY TIMING SPECIFICATIONS

The input signal timing specifications are shown as the following table and timing diagram.

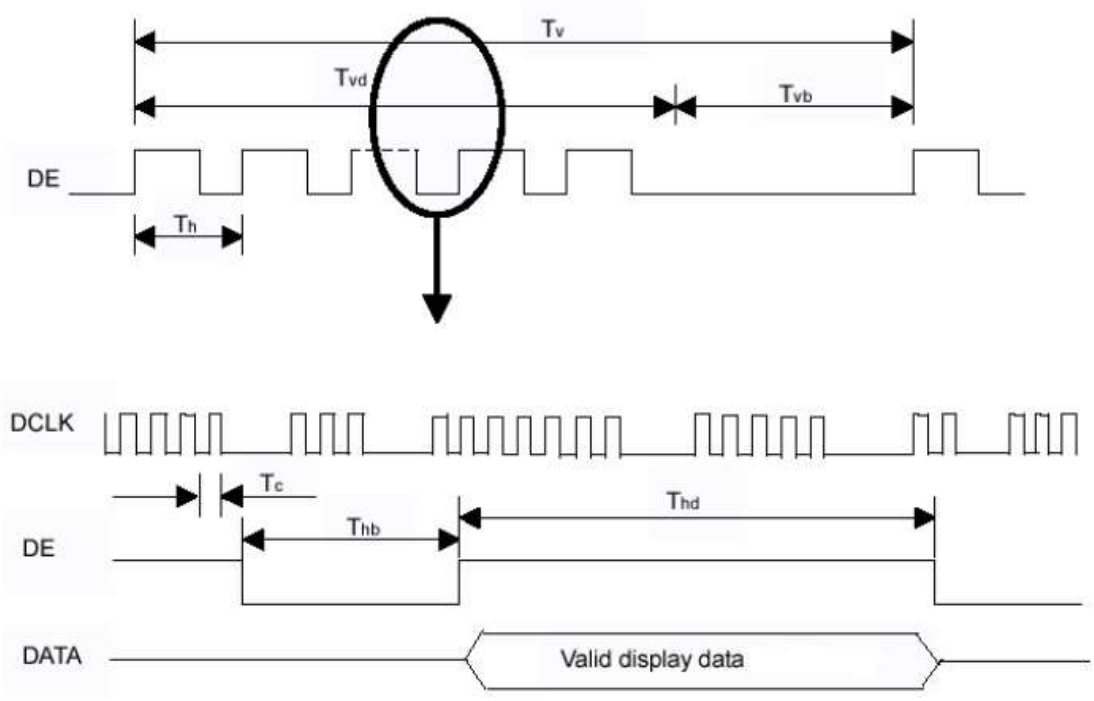
Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Clock	Frequency	Fc	66.1	71	74.7	MHz	-
	Period	Tc	13.4	14.1	15.1	ns	
	Input cycle to cycle jitter	T_{rcl}	---	---	200	ns	(a)
	Input Clock to data skew	TLVCCS	-0.02*Tc	---	0.02*Tc	ps	(b)
	Spread spectrum modulation range	F_{clkin_mod}	---	---	1.02*Fc	MHz	(c)
	Spread spectrum modulation frequency	F_{SSM}	---	---	200	KHz	
	High Time	T_{ch}	---	4/7	---	T_{ch}	
	Low Time	T_{cl}	---	3/7	---	T_{ch}	
Vertical Display Term	Frame Rate	Fr	---	60	---	Hz	Tv=Tvd+Tvb
	Total	Tv	810	823	830	Th	-
	Active Display	Tvd	800	800	800	Th	-
	Blank	Tvb	10	23	30	Th	-
Horizontal Display Term	Total	Th	1360	1440	1500	Tc	Th=Thd+Thb
	Active Display	Thd	1280	1280	1280	Tc	-
	Blank	Thb	80	160	220	Tc	-

Note: (1) Because this module is operated by DE only mode, Hsync and Vsync input signals are ignored.

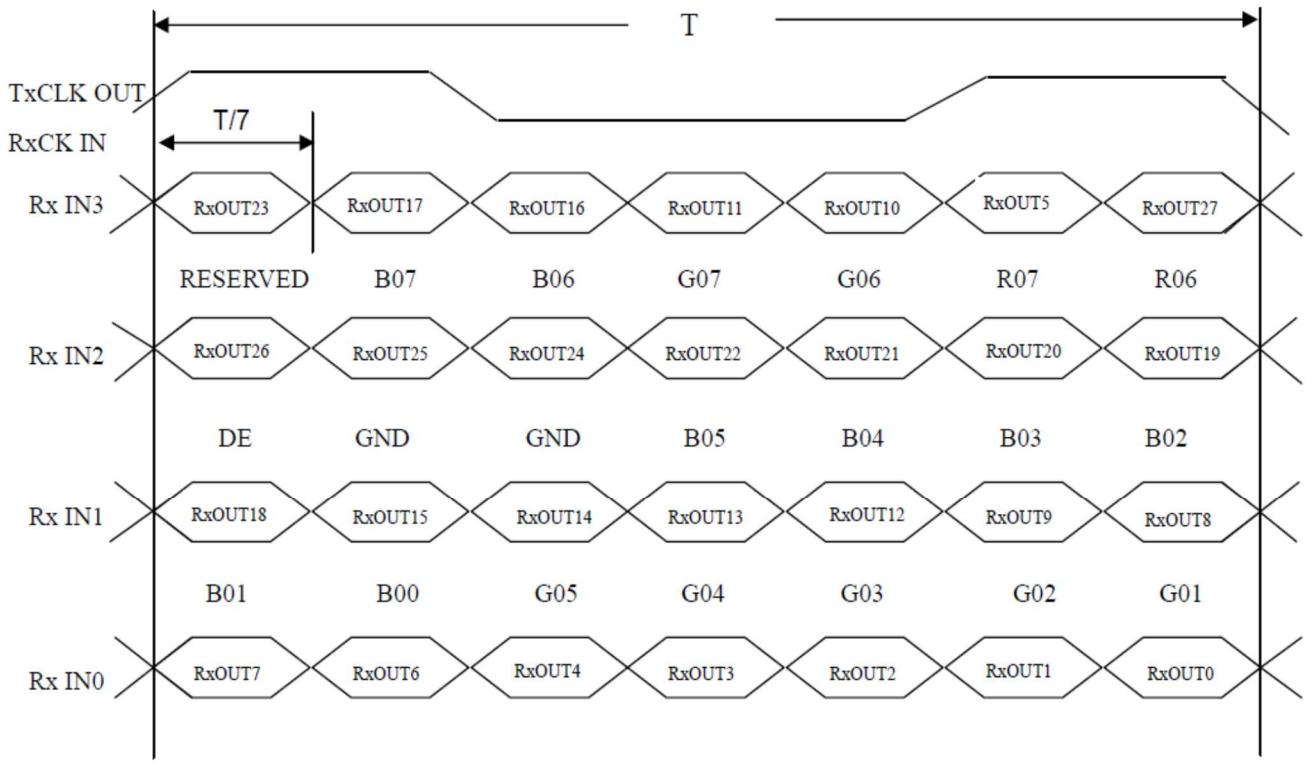
(2) Frame rate is 60Hz

(3) The Tv must be integer, otherwise, this module would operate abnormally.

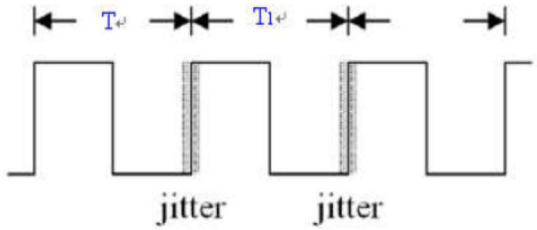
INPUT SIGNAL TIMING DIAGRAM



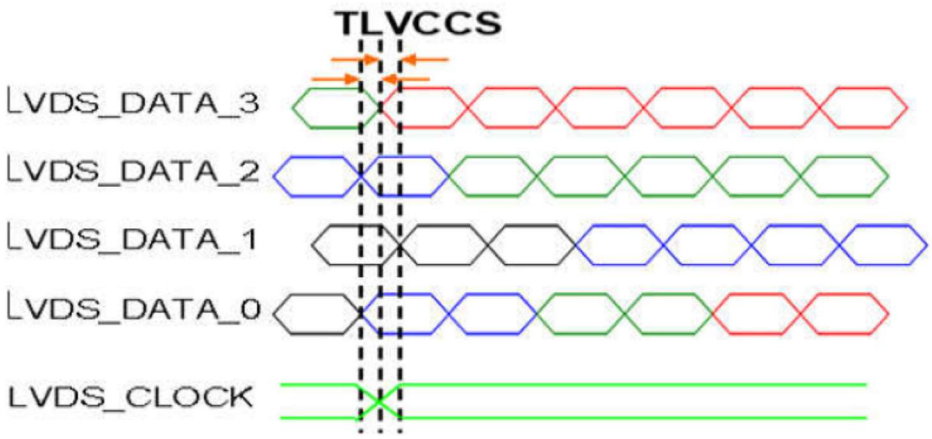
TIMING DIAGRAM of LVDS



Note (a) The input clock cycle-to-cycle jitter is defined as below figures. Trcl = I T_1 – TI



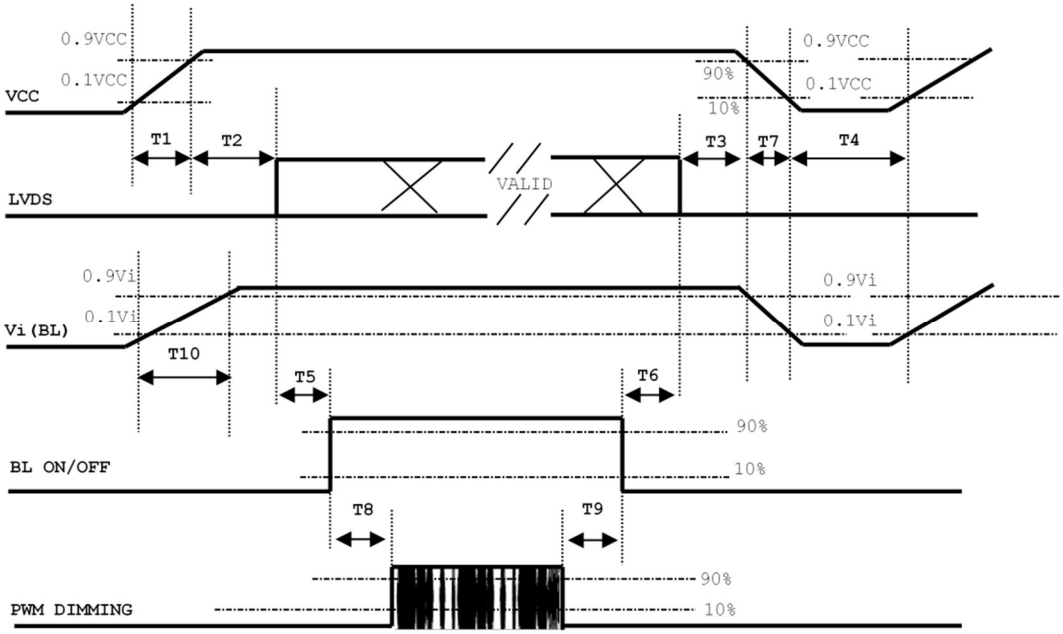
Note (b) Input Clock to data skew is defined as below figures.



3.6 POWER ON/OFF SEQUENCE

To prevent a latch-up or DC operation of LCD assembly, the power on/off sequence should be as the diagram below.

Power ON/OFF sequence



Note (1) Please avoid floating state of interface signal at invalid period.

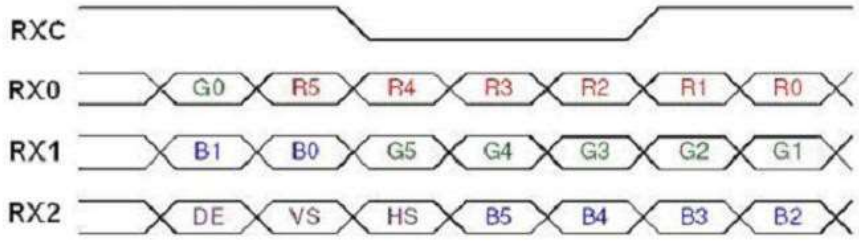
Note (2) When the interface signal is invalid, be sure to pull down the power supply of LCD VCC to 0 V.

Note (3) The Backlight converter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight converter power must be turned off before the power supply for the logic and the interface signal is invalid.

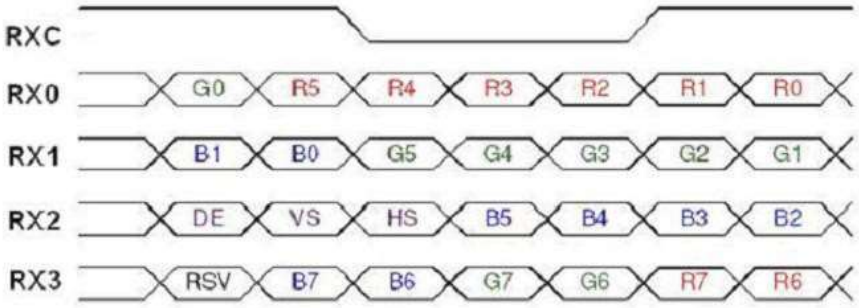
Parameter	Value			Units
	Min	Typ	Max	
T1	0.5	---	10	ms
T2	0	---	50	ms
T3	0	---	50	ms
T4	500	---	---	ms
T5	450	---	---	ms
T6	200	---	---	ms
T7	10	---	100	ms
T8	10	---	---	ms
T9	10	---	---	ms
T10	20	---	50	ms

The Input Data Format

SEL 6/8="Low" or "NC" for 6 Bits LVDS



SEL 6/8="High" for 8 Bits LVDS



Note (1) R/G/B data 7: MSB, R/G/B data 0: LSB Note (2)

Please follow PSWG

Signal Name	Description	Remark
R7	Red Data 7 (MSB)	Red-pixel Data
R6	Red Data 6	Each red pixel's brightness data consists of these
R5	Red Data 5	8 bits pixel data.
R4	Red Data 4	
R3	Red Data 3	
R2	Red Data 2	
R1	Red Data 1	
R0	Red Data 0 (LSB)	
G7	Green Data 7 (MSB)	Green-pixel Data
G6	GreenData 6	Each green pixel's brightness data consists of these
G5	GreenData 5	8 bits pixel data.
G4	GreenData 4	
G3	GreenData 3	
G2	GreenData 2	
G1	GreenData 1	
G0	GreenData 0 (LSB)	
B7	Blue Data 7 (MSB)	Blue-pixel Data
B6	Blue Data 6	Each blue pixel's brightness data consists of these
B5	Blue Data 5	8 bits pixel data.
B4	Blue Data 4	
B3	Blue Data 3	
B2	Blue Data 2	
B1	Blue Data 1	
B0	Blue Data 0 (LSB)	
RXCLKIN+ RXCLKIN-	LVDS Clock Input	
DE	Display Enable	
VS	Vertical Sync	
HS	Horizontal Sync	

4 OPTICAL CHARACTERISTICS

4.1 TEST CONDITIONS

Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	°C
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	V_{CC}	3.3	V
Convertor Voltage	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
Convertor Duty			

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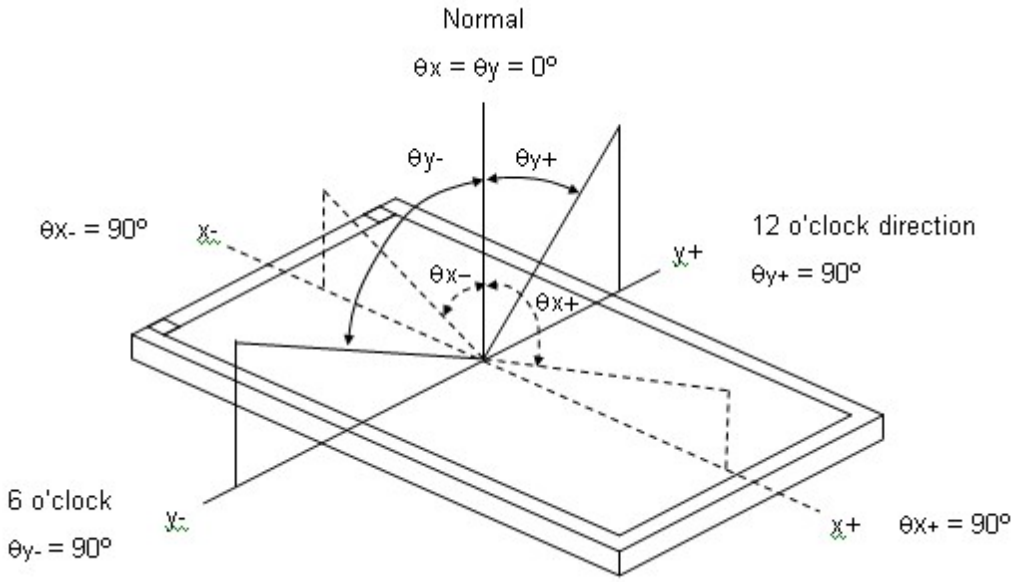
4.2 OPTICAL SPECIFICATIONS

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio		CR	θ_x=0°,θ_Y=0° Viewing Normal Angle		1000	-	-	(2),(5)
Response Time		T_R		-	12	17	ms	(3)
		T_F		-	8	13	ms	
Luminance of White (5P)		L_{AVE}		750	850	-	cd/m^2	(4),(5)
White Variation		δW		-	1.25		-	(5),(6)
Color Chromaticity	Red	Rx		Typ. -0.05	0.652	Typ. + 0.05	-	(1),(5)
		Ry			0.338		-	
	Green	Gx			0.326		-	
		Gy			0.608		-	
	Blue	Bx			0.15		-	
		By			0.053		-	
	White	Wx			0.313		-	
		Wy			0.329		-	
Viewing Angle	Horizontal	θ_x+	CR≥10	80	88	-	Deg.	(1),(5)
		θ_x-		80	88	-		
	Vertical	θ_Y+		80	88	-		
		θ_Y-		80	88	-		

Note (1) Definition of Viewing Angle (θx, θy):



Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

Contrast Ratio (CR) = L255 / L0;

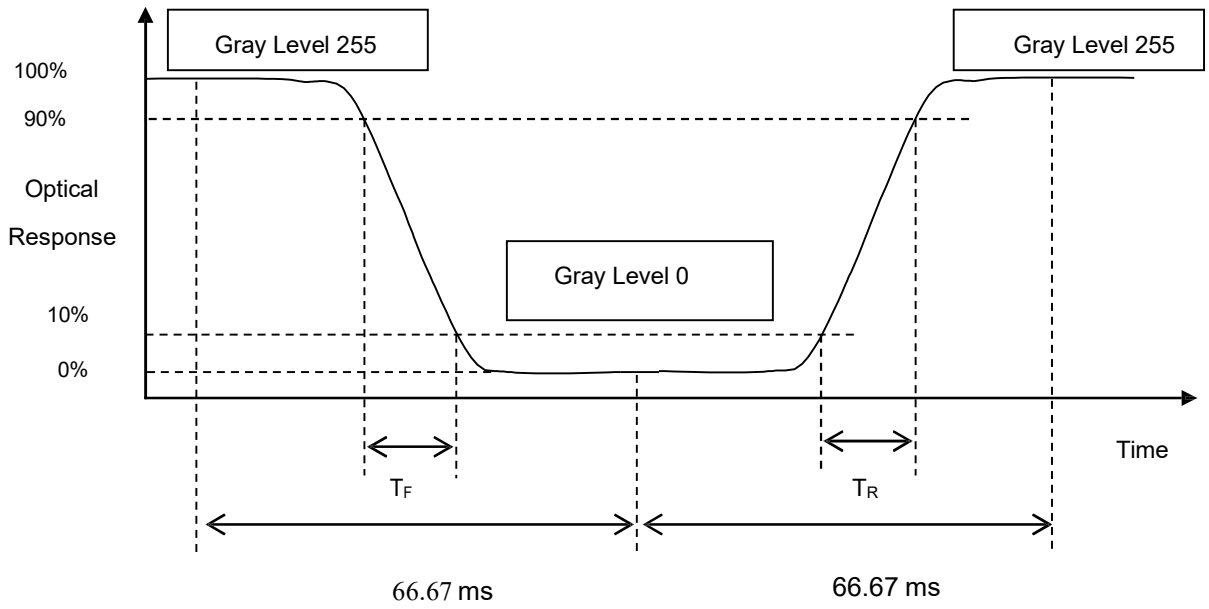
L63: Luminance of gray level 255;

L 0: Luminance of gray level 0;

CR = CR (5)

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (6).

Note (3) Definition of Response Time (T_R, T_F):



Note (4) Definition of Average Luminance of White (L_{AVE}):

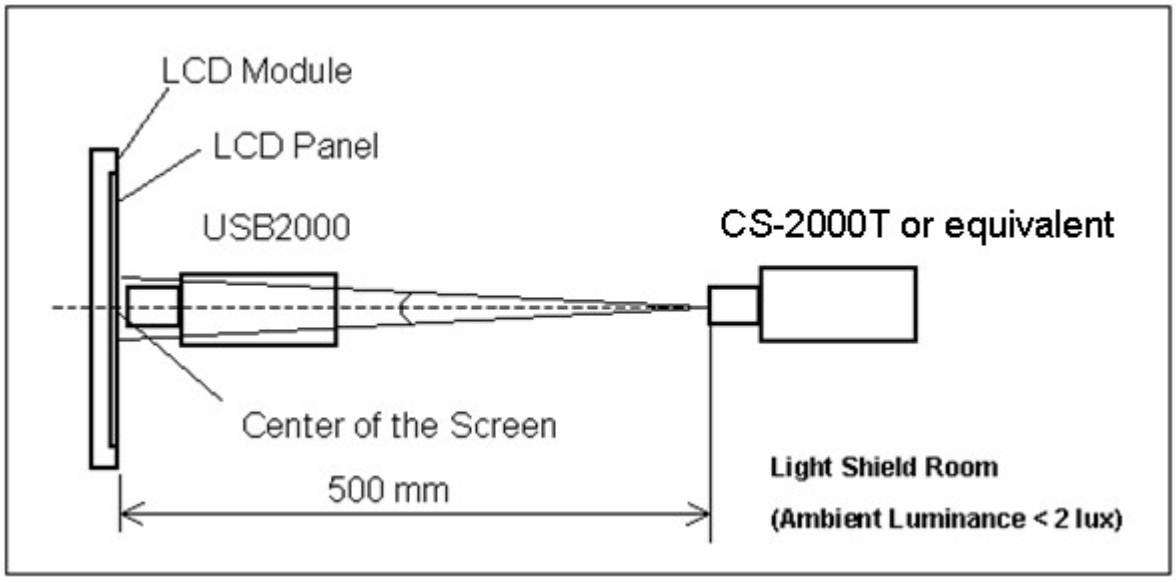
Measure the luminance of gray level 255 at 5 points

L_{AVE} = [L (1)+ L (2)+ L (3)+ L (4)+ L (5)] / 5

L (x) is corresponding to the luminance of the point X at Figure in Note (6).

Note (5) Measurement Setup:

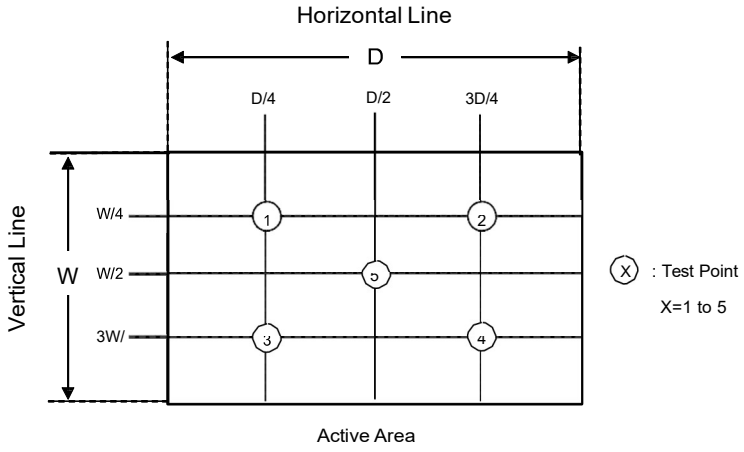
The LCD module should be stabilized at given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.



Note (6) Definition of White Variation (δW):

Measure the luminance of gray level 255 at 5 points

$$\delta W = \frac{\text{Maximum [L (1), L (2), L (3), L (4), L (5)]}}{\text{Minimum [L (1), L (2), L (3), L (4), L (5)]}}$$



5 Reliability Test Criteria

Test Item	Test Condition	Note
High Temperature Storage Test	70ºC, 240 hours	(1),(2) (4),(5)
Low Temperature Storage Test	-20ºC, 240 hours	
Thermal Shock Storage Test	-20ºC, 0.5hour←→70ºC, 0.5hour; 100cycles, 1hour/cycle	
High Temperature Operation Test	70ºC, 240 hours	
Low Temperature Operation Test	-20ºC, 240 hours	
High Temperature & High Humidity Operation Test	50ºC, 90%RH, 240hours	(1),(2) (4),(6)
Shock (Non-Operating)	50G, 11ms, half sine wave, 1 time for ± X, ± Y, ± Z direction	(2), (3)
Vibration (Non-Operating)	1.5G, 10 ~ 300 Hz sine wave, 10 min/cycle, 3 cycles each X, Y, Z direction	(2), (3)

Note (1) There should be no condensation on the surface of panel during test.

Note (2) Temperature of panel display surface area should be 70ºC Max.

Note (3) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.

Note (4) In the standard conditions, there is no function failure issue occurred. All the cosmetic specification is judged before reliability test.

Note (5) Before cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.

Note (6) Before cosmetic and function test, the product must have enough recovery time, at least 24 hours at room temperature.

6. QUALITY STANDARD

6.1 TEST CONDITIONS

Tests should be conducted under the following conditions. Ambient temperature : 25 ± 5°C

Humidity : 50 ± 25% RH.

6.2 SAMPLING PLAN

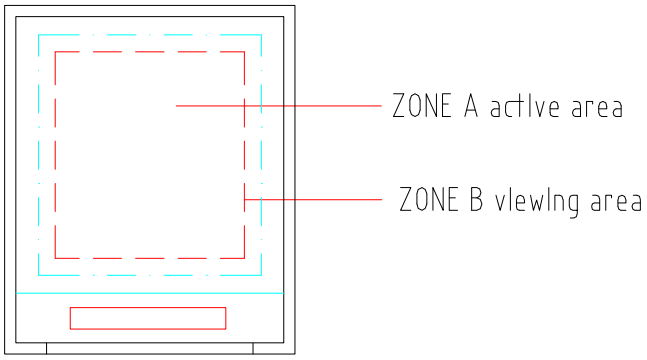
Sampling method shall be in accordance with MIL-STD-105E , level II, normal single sampling plan .

6.3 ACCEPTABLE QUALITY LEVEL

A major defect is defined as one that could cause failure to or materially reduce the usability of the unit for its intended purpose. A minor defect is one that does not materially reduce the usability of the unit for its intended purpose or is an infringement from established standards and has no significant bearing on its effective use or operation.

6.4 APPEARANCE

An appearance test should be conducted by human sight at approximately 30 cm distance from the LCD module under florescent light. The inspection area of LCD panel shall be within the range of following limits.



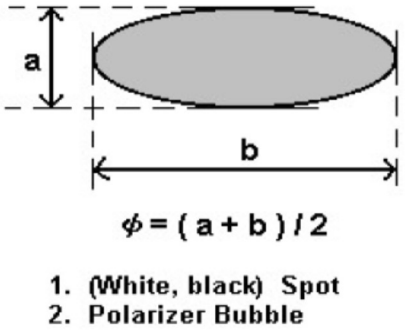
6.5 INCOMING INSPECTION STANDARD FOR TFT-LCD PANEL

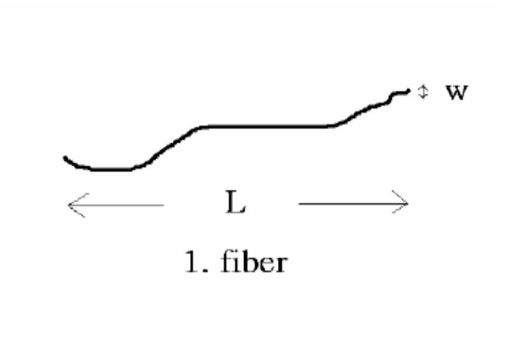
DEFECT TYPE			LIMIT			Note
VISUAL DEFECT	INTERNAL	SPOT	φ＜0.15mm		Ignore	(1)
			0.15mm≦φ≦0.5mm		N≦2	
			0.5mm＜φ		N=0	
		FIBER	0.03mm<W≦0.1mm, L≦5mm		N≦2	(1)
			0.1mm＜W, 5mm＜L		N=0	
		POLARIZER BUBBLE	φ＜0.15mm		Ignore	(1)
			0.15mm≦φ≦0.5mm		N≦2	
			0.5mm＜φ		N=0	
		Mura	It' OK if mura is slight visible through 6%ND filter			
ELECTRICAL DEFECT	BRIGHT DOT		A Grade			
			C Area	O Area	Total	(3)
			N≦0	N≦1	N≦1	(2)
	DARK DOT		N≦2	N≦2	N≦2	
	TOTAL DOT		N≦3			(2)
	TWO ADJACENT DOT		N≦0	N≦1pair	N≦1 pair	(4)
	THREE OR MORE ADJACENT DOT		NOT ALLOWED			
	LINE DEFECT		NOT ALLOWED			

(1) One pixel consists of 3 sub-pixels, including R,G, and B dot.(Sub-pixel = Dot)

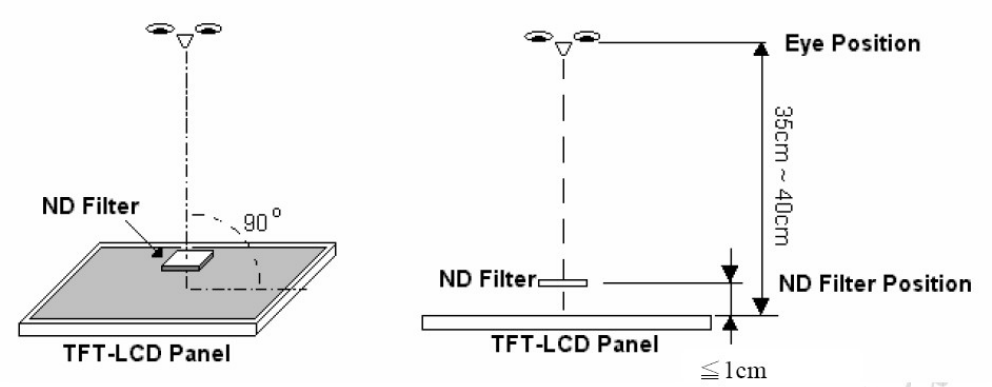
(2) LITTLE BRIGHT DOT ACCEPTABLE UNDER 6 % ND-Filter

Note(1) : W : Width[mm], L : Length[mm], N : Number, φ: Average Diameter

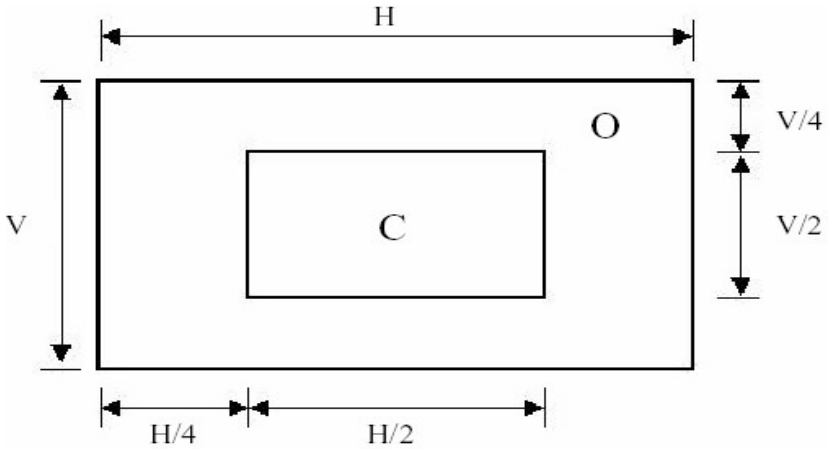




Note(2) : Bright dot is defined through 6% transmission ND Filter as following.



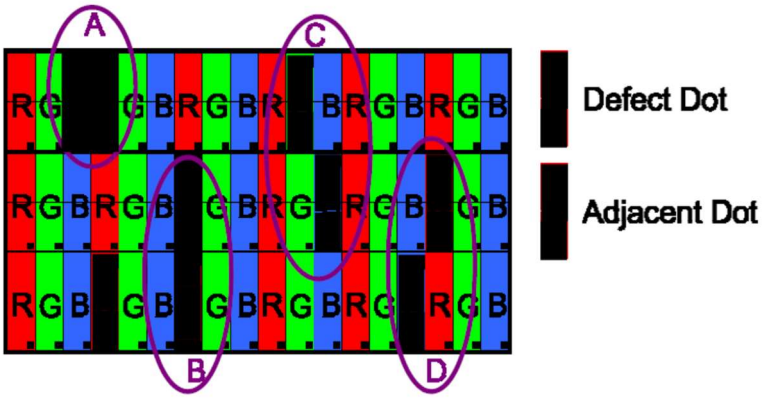
Note(3) : The Definition of C Area and O Area



C Area: Center of display area

O Area: Outer of display area

Note(4) : Judge defect dot and adjacent dot as following. Allow below (as A, B, C and D status) adjacent defect dots, including bright and dart adjacent dot. And they will be counted 2 defect dots in total quantity



a. The defects that are not defined above and considered to be problem shall be reviewed and discussed by both parties.

b. Defects on the Black Matrix, out of Display area, are not considered as a defect or counted

7. PRECAUTIONS

7.1 ASSEMBLY AND HANDLING PRECAUTIONS

- The module should be assembled into the system firmly by using every mounting hole. Be careful not to twist or bend the module.
- While assembling or installing modules, it can only be in the clean area. The dust and oil may cause electrical short or damage the polarizer.
- Use fingerstalls or soft gloves in order to keep display clean during the incoming inspection and assembly process.
- Do not press or scratch the surface harder than a HB pencil lead on the panel because the polarizer is very soft and easily scratched.
- If the surface of the polarizer is dirty, please clean it by some absorbent cotton or soft cloth. Do not use Ketone type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanently damage the polarizer due to chemical reaction.
- Wipe off water droplets or oil immediately. Staining and discoloration may occur if they left on panel for a long time.
- If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contacting with hands, legs or clothes, it must be washed away thoroughly with soap.
- Protect the module from static electricity, it may cause damage to the C-MOS Gate Array IC.
- Do not disassemble the module.
- Do not pull or fold the lamp wire.
- Pins of I/F connector should not be touched directly with bare hands.

7.2 STORAGE PRECAUTIONS

- High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storage conditions.
- It is dangerous that moisture come into or contacted the LCD module, because the moisture may damage LCD module when it is operating.
- It may reduce the display quality if the ambient temperature is lower than 10 ºC. For example, the response time will become slowly, and the starting voltage of lamp will be higher than the room temperature.

7.3 OPERATION PRECAUTIONS

- Do not pull the I/F connector in or out while the module is operating.
- Always follow the correct power on/off sequence when LCD module is connecting and operating. This can prevent the CMOS LSI chips from damage during latch-up.
- The startup voltage of Backlight is approximately 1000 Volts. It may cause electrical shock while assembling with converter. Do not disassemble the module or insert anything into the Backlight unit.

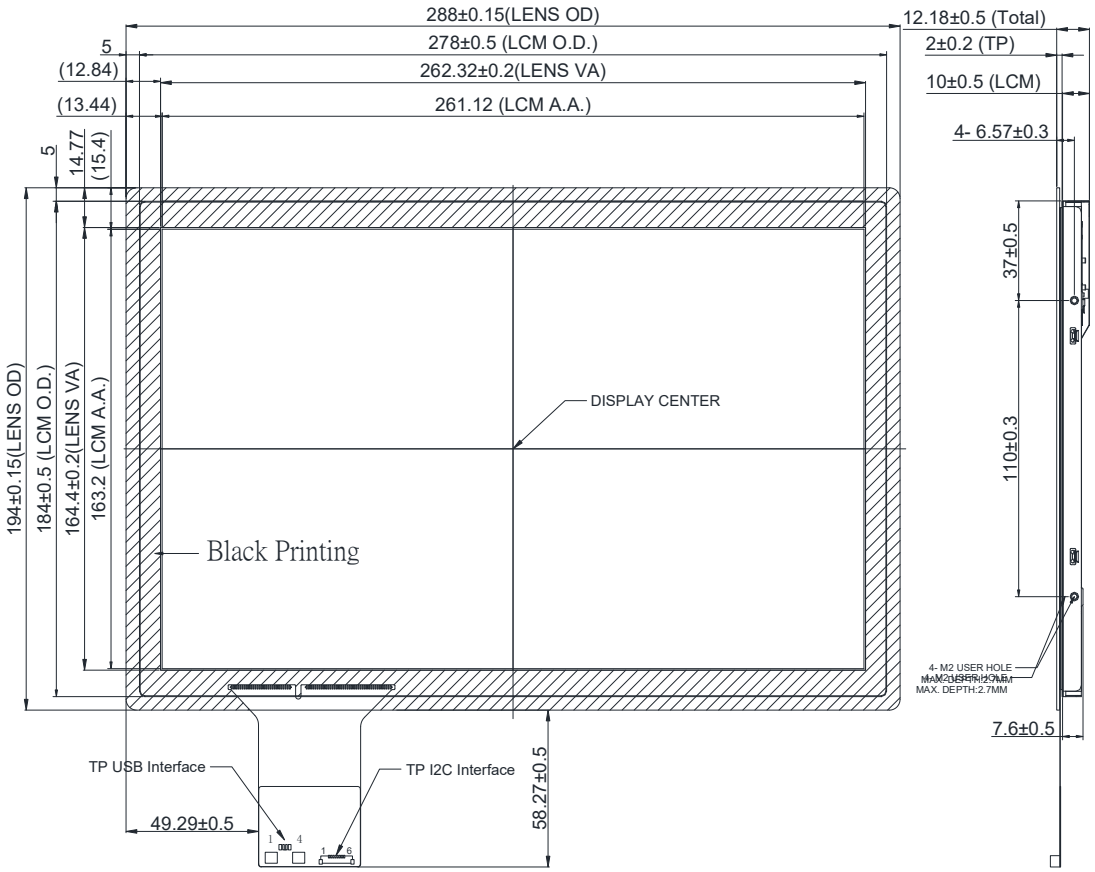
7.4 OTHER PRECAUTIONS

When fixed patterns are displayed for a long time, remnant image is likely to occur.

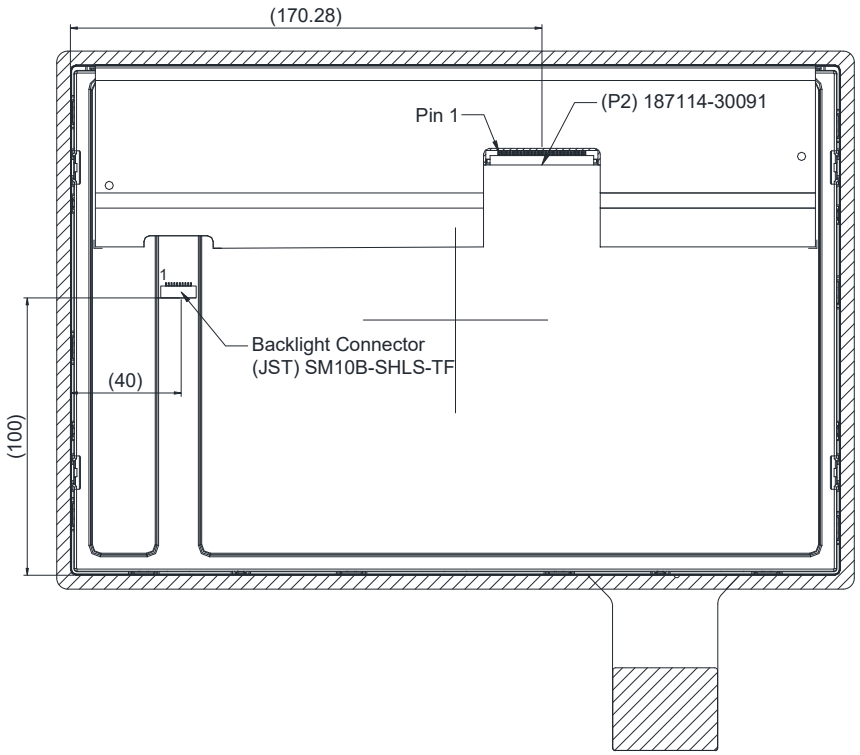
8. MECHANICAL CHARACTERISTICS

8.1 Front View and Side View

Unit : mm



8.2 Rear View



[Note] Tolerance is ±0.5mm unless noted