



SPECIFICATION FOR LCD MODULE

MODULE NO: AFD1024600C8L-10.1N6WTH
VERSION NO.: V1.0

Customer's Approval:

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	SIGNATURE	DATE
PREPARED BY		
CHECKED BY		
APPROVED BY		

RECORD OF REVISION

Version	Revised Date	Page	Content
V1.0	2014/01/13	--	First Issued

TABLE OF CONTENTS

No.	Content	Page
	TFT Module Specification	1
	RECORDS OF REVISION	2
	TABLE OF CONTENTS	3
1.	GENERAL DESCRIPTION	4
2.	MECHANICAL SPECIFICATION	5
3.	PIN DESCRIPTION	6
4.	ABSOLUTE MAXIMUM RATINGS	7
5.	BLOCK DIAGRAM	8
6.	RELATIONSHIP BETWEEN DISPLAYED COLOR AND INPUT	9
7.	ELECTRICAL CHARACTERISTICS	11
8.	OPTICAL CHARACTERISTICS	15
9.	RELIABILITY	18
10.	PRECAUTION RELATING PRODUCT HANDLING	23

1. GENERAL DESCRIPTION

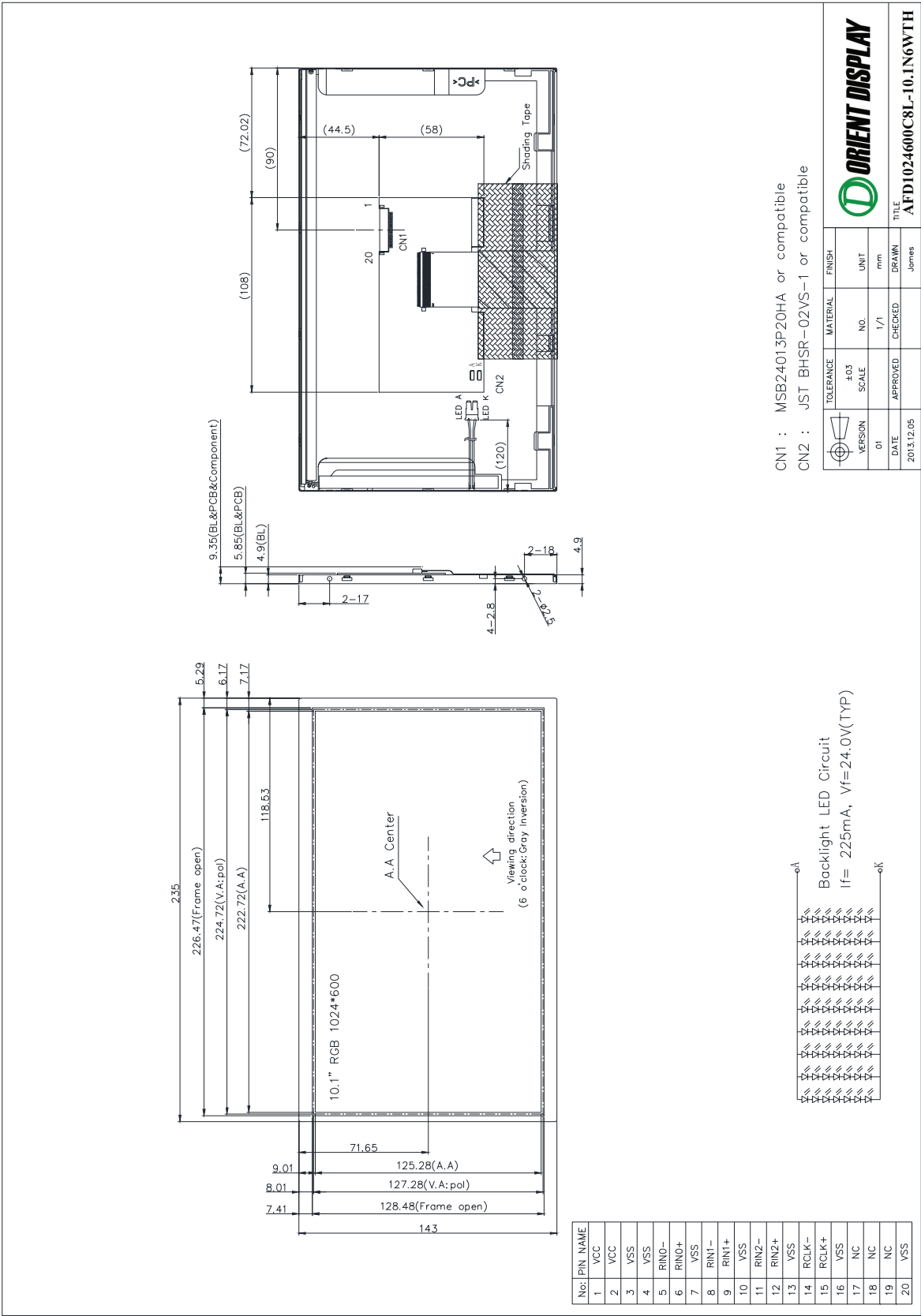
1.1 Description

The specifications is model AFD1024600C8L-10.1N6WTH is a color active matrix thin film transistor (TFT) liquid crystal display (LCD) that uses amorphous silicon TFT as a switching device. This model is composed of a TFT LCD panel, a driving circuit, a back light system. This TFT LCD has a 10.1 (16:9) inch diagonally measured active display area with WSGA (1024 horizontal by 600 vertical pixels) resolution.

1.2 Features:

No.	Item	Specification	Unit
1	Panel Size	10.1"	Inch
2	Number of Pixels	1024 (W) x RGB x 600 (H)	Pixels
3	Active Area	222.72 (W) × 125.28 (H)	mm
4	Pixel Pitch	0.2175 (W) x 0.2088 (H)	mm
5	Outline Dimension	235 (W) × 143 (H) × 4.9 (T)	mm
6	Number of Colors	262K	- -
7	Display Mode	TN / Normally White / Transmissive	- -
8	Viewing Direction	12 o'clock (best view)	- -
		6 o'clock (gray inversion)	
9	Display Format	RGB vertical stripe	- -
10	Surface Treatment	Anti-Glare (3H)	- -
11	Contrast Ratio	600 (Typ.)	- -
12	Luminance (cd/m ²)	1000 (Typ.)	cd/m2
13	Interface	LVDS 6 bit Interface	- -
14	Backlight	White LED	- -
15	Operation Temperature	-20 ~ 70	°C
16	Storage Temperature	-30 ~ 80	°C
17	Weight	TBD	g

2. MECHANICAL SPECIFICATION



3. PIN DESCRIPTION

3.1 TFT LCD Module (Connector Part No: MSB24013P20HA or equivalent)

Pin No.	Symbol	I/O	Function	Remark
1	VCC	P	Power Supply Logic voltage +3.3V	
2	VCC	P	Power Supply Logic voltage +3.3V	
3	VSS	P	Ground	
4	VSS	P	Ground	
5	RIN0-	I	Negative LVDS differential data input	
6	RIN0+	I	Positive LVDS differential data input	
7	VSS	P	Ground	
8	RIN1-	I	Negative LVDS differential data input	
9	RIN1+	I	Positive LVDS differential data input	
10	VSS	P	Ground	
11	RIN2-	I	Negative LVDS differential data input	
12	RIN2+	I	Positive LVDS differential data input	
13	VSS	P	Ground	
14	RCLK-	I	Negative LVDS differential clock input	
15	RCLK+	I	Positive LVDS differential clock input	
16	VSS	P	Ground	
17	NC	-	No connection	
18	NC	-	No connection	
19	NC	-	No connection	
20	VSS	P	Ground	

Note 1: VSS PIN must be grounding, cannot be floating.

3.2 Backlight Unit

Pin No.	Symbol	Function	Note
1	LEDA	Power Supply for LED backlight	Black
2	LEDK	GND for LED backlight	White

4. ABSOLUTE MAXIMUM RATINGS

4.1 Electrical Absolute Rating

4.1.1 TFT LCD Module

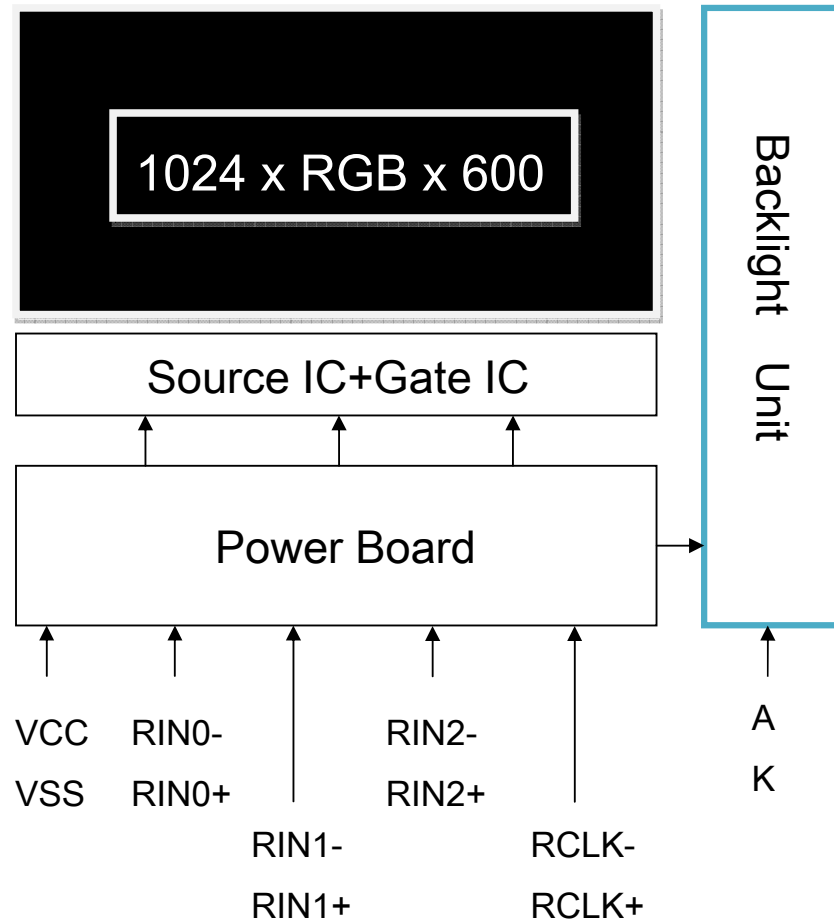
Item	Symbol	Values		Unit	Note
		Min	Max.		
Power supply voltage	VCC	-0.3	3.96	V	
Logic input voltage	VI	-0.3	VCC+0.3	V	

4.1.2 Environment Absolute Rating

Item	Symbol	Values			Unit	Note
		Min	Typ	Max.		
Operating Temperature	Topa	-20		70	°C	Ambient temperature
Storage Temperature	Tstg	-30		80	°C	

5. BLOCK DIAGRAM

5.1 TFT LCD Module

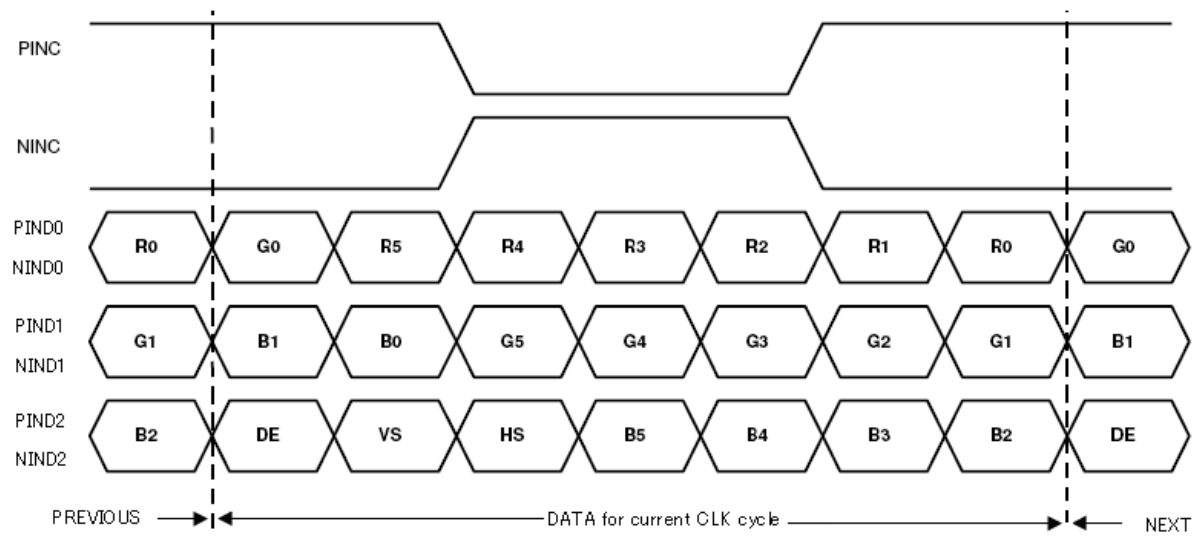


6. Relationship Between Displayed Color and Input

6.1 6 bit

		Color & Gray Scale	Data Signal																	
			R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic Color		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
Red		Black	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(31)	0	1	1	1	1	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
Green		Black	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(31)	0	0	0	0	0	0	0	1	1	1	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	1	1	1	1	1	1	0	0	0	0	0	0	
Blue		Black	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(31)	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	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	1	1	1	1	1	1	

6.2 Data Mapping

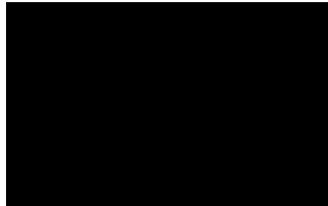


7. ELECTRICAL CHARACTERISTICS

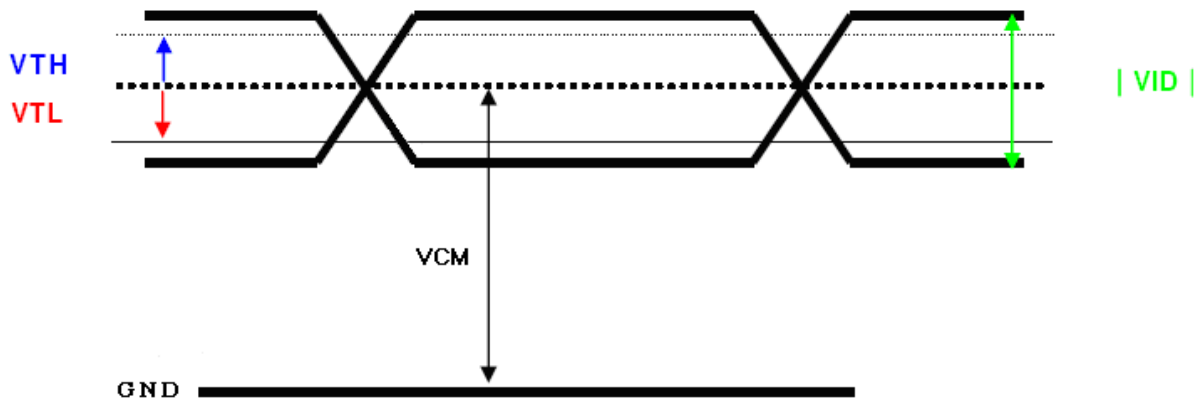
7.1 TFT LCD Module

Item		Symbol	Min.	Typ.	Max.	Unit	Note
Power supply		VCC	3.0	3.3	3.6	V	
Input Voltage for logic	Differential Input High Threshold	VTH			+100	mV	Note 2
	Differential Input Low Threshold	VTL	-100			mV	Note 2
Magnitude differential Input Voltage		VID	200	-	600	mV	Note 2
Differential input common mode voltage		VCM	VID /2	-	2.4- VID /2	V	
Power Supply current		ICC	-	(190)	(250)	mA	Note 1

Note 1: frame = 60Hz, Ta=25°C , Display pattern : Black pattern



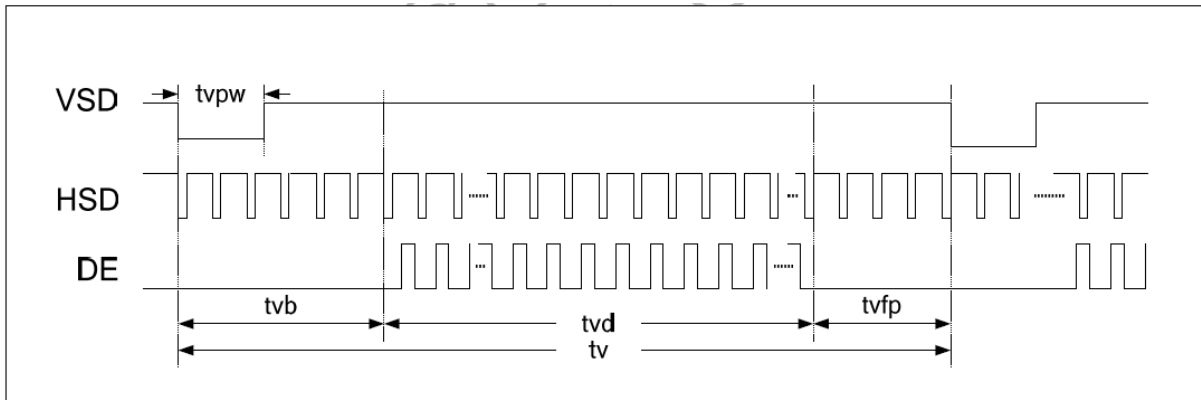
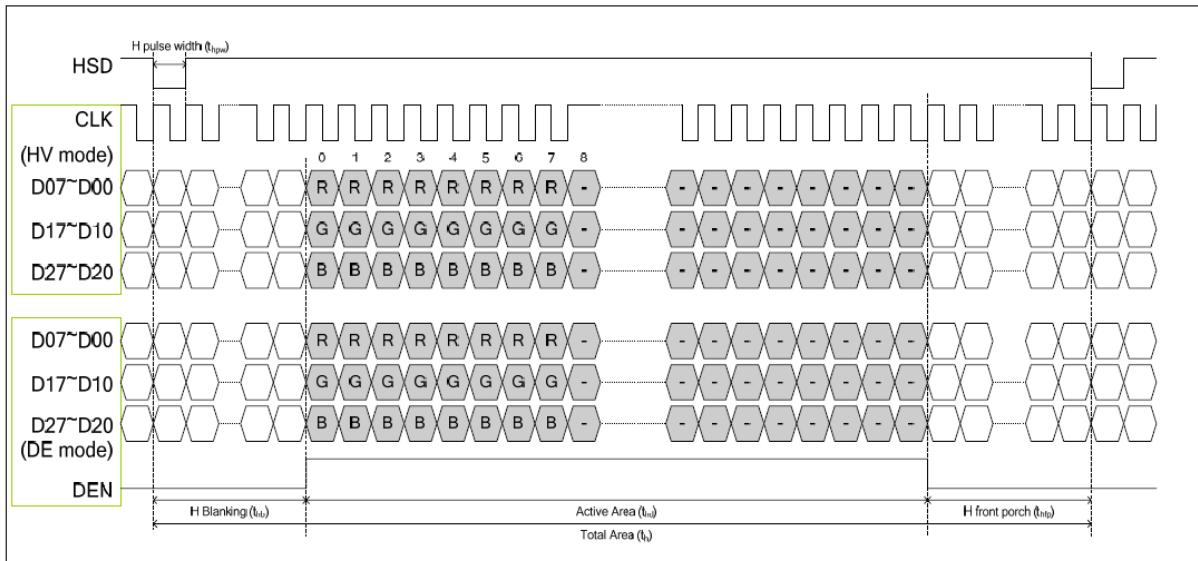
Note 2:



7.2 INTERFACE SPECIFICATIONS

7.2.1 DE mode Input signal characteristics

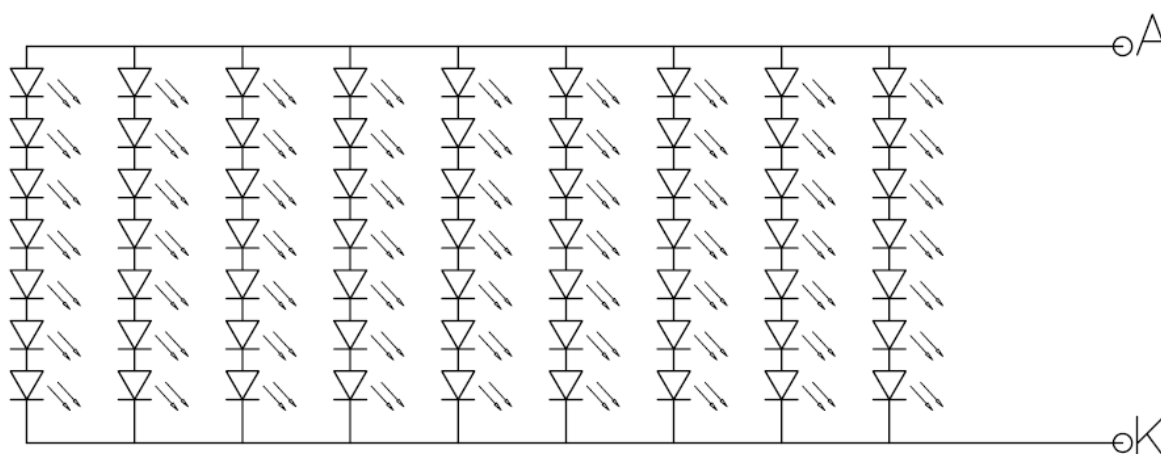
Signal	Parameter	Symbol	Min.	Typ.	Max.	Unit.	Note
DCLK	DCLK Frequency	fclk	45	51.2	57	MHz	
Horizontal	Horizontal display area	thd	-	1024	-	DCLK	
	HSD period time	th	1324	1344	1364	DCLK	
	HSD Blanking	thb+thfb	300	320	340	DCLK	
Vertical	Vertical display area	tvd	-	600	-	th	
	VSD period time	tv	625	635	645	th	
	VSD pulse width	tvb+tvfb	25	35	45	th	



7.3 Backlight Unit

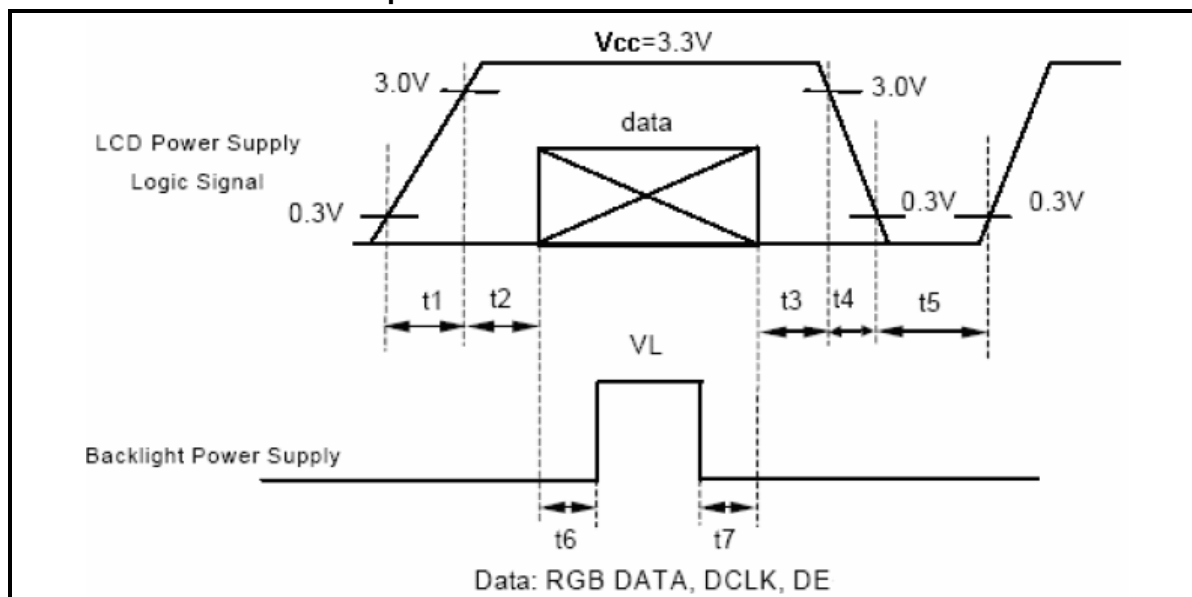
Item	Symbol	Value			Unit	Condition
		Min.	Typ.	Max.		
LED Voltage	VL	(21)	(23.1)	(24.5)	V	
LED Current	IF	-	225	-	mA	7S9P
Power Consumption	PBL	-	5.1975	-	W	
LED Life Time (25°C)	-	(20000)	-	-	hr	(1)

Note (1): The “LED life time” is defined as the module brightness decrease to 50% original brightness that the ambient temperature is 25°C 60% RH.



Backlight LED Circuit

7.4 Power On / Off Sequence



$t_1 \leq 10\text{ms} : 1\text{ sec} \leq t_5$

$50\text{ms} \leq t_2 : 200\text{ms} \leq t_6$

$0 < t_3 \leq 50\text{ms} : 200\text{ms} \leq t_7$

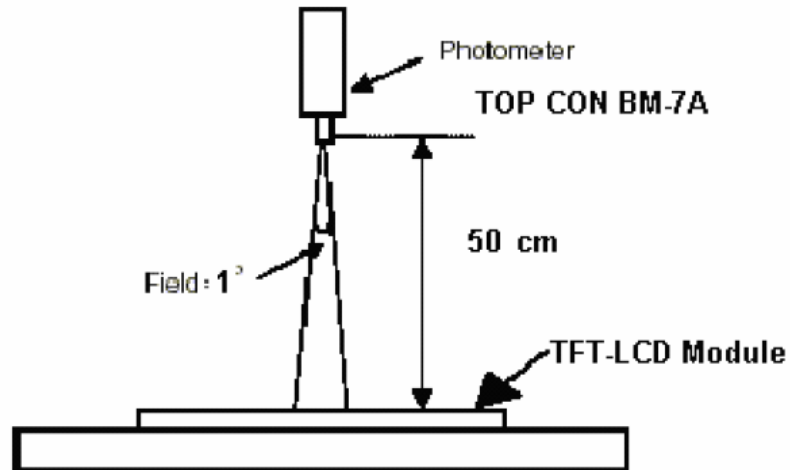
$0 < t_4 \leq 10\text{ms}$

8. OPTICAL CHARACTERISTICS

Item		Symbol	Condition	Min.	Typ.	Max.	Unit
Brightness		--	Note1, Note 3, ($\theta = 0^\circ$; Normal Viewing Angle)	800	1000	--	cd/m2
Uniformity		B-uni		70	80	-	%
Contrast Ratio		CR		500	600	--	--
Response Time		Tr		--	10	15	ms
		Tf		--	15	25	ms
Color Chromaticity	White	Wx		0.263	0.313	0.363	--
		Wy	0.279	0.329	0.379	--	
View angle	Horizontal	θ x+	Center CR≥10	60	70	--	
		θ x-		60	70	--	
	Vertical	θ Y+		40	50	--	
		θ Y-		50	60	--	
Image sticking		tis	2 hours	--	--	2	Sec

Note : The following optical specifications shall be measured in a darkroom or equivalent state (ambient luminance ≤ 1 lux, and at room temperature). The operation temperature is $25^\circ\text{C} \pm 2^\circ\text{C}$. The measurement method is shown in Note1.

Note1: The method of optical measurement:

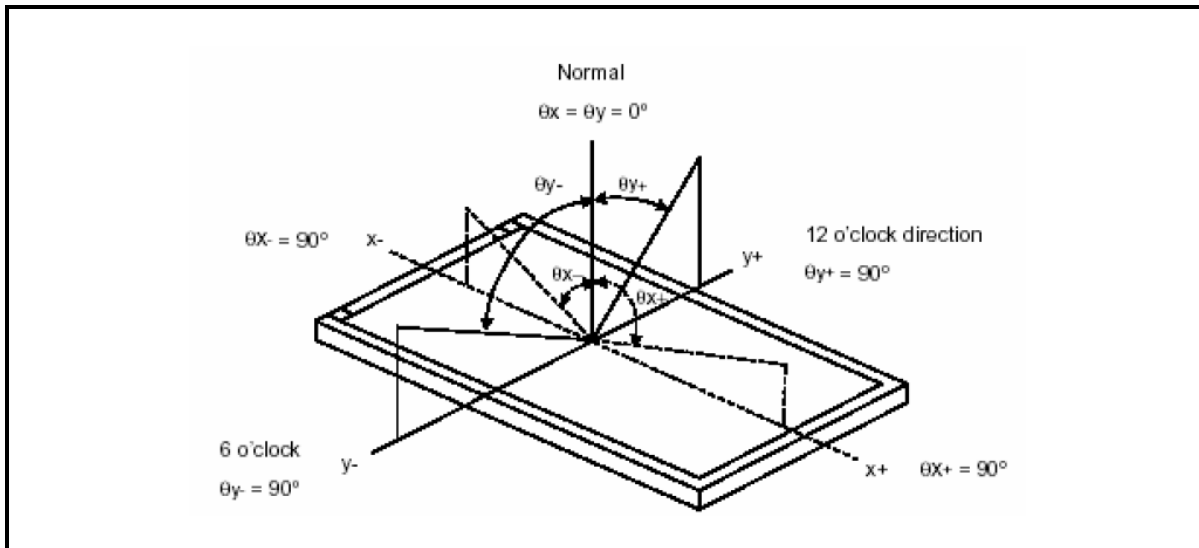


Note2: Measured at the center area of the panel and at the viewing angle of the $\theta_x = \theta_y = 0^\circ$

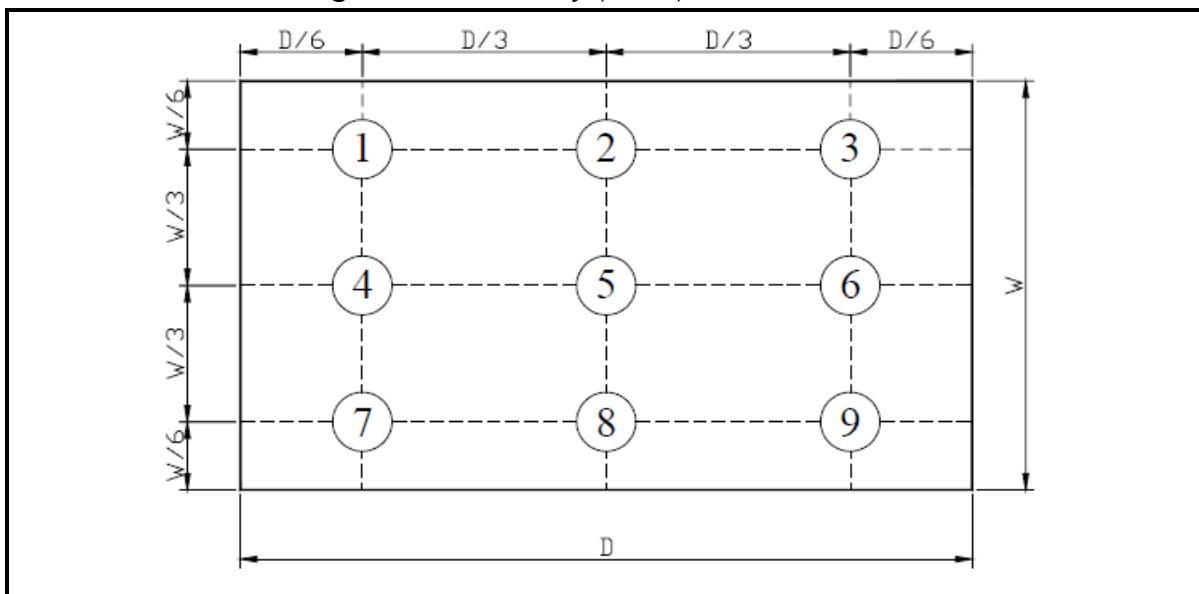
Note3: Definition of Contrast Ratio (CR):

CR = Luminance with all pixels in white state $\div$ Luminance with all pixels in Black state

Note4: Definition of Viewing Angle:



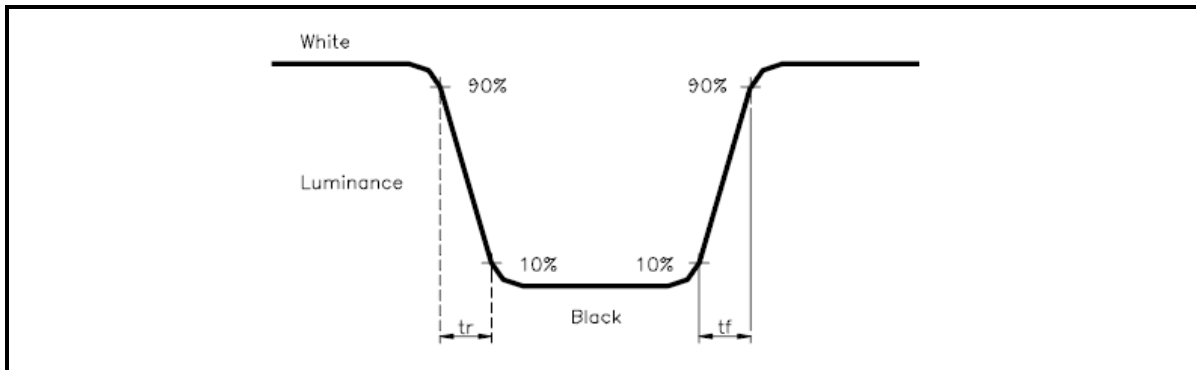
Note 5: Definition of Brightness Uniformity (B-uni):



B-uni = (Minimum luminance of 9 points ÷ Maximum luminance of 9 points) X 100%

Note 6: Definition of Response Time:

The Response Time is set initially by defining the “Rising Time (Tr)” and the “Falling Time (Tf)” respectively. Tr and Tf are defined as following figure



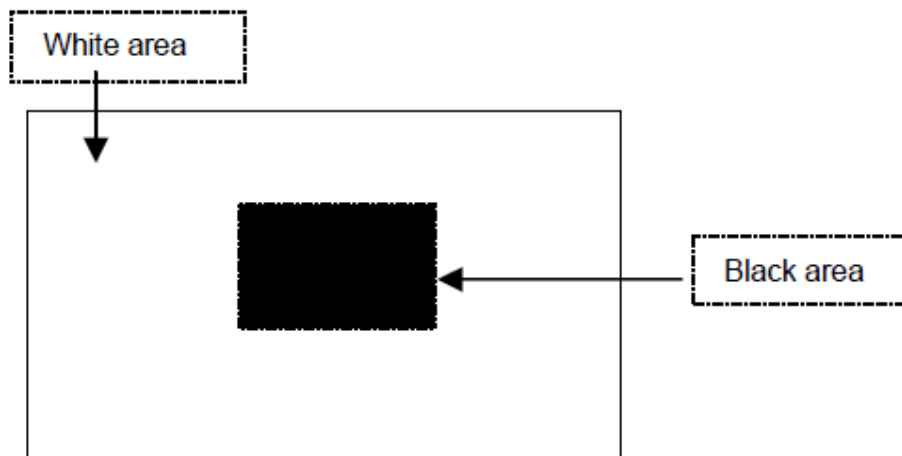
Note 7: Definition of Chromaticity:

The color coordinates (Wx,Wy),(Rx,Ry),(Gx,Gy),and (Bx,By) are obtained with all pixels in the viewing field at white, red, green, and blue states, respectively.

Note 8: Definition of Image sticking (tis):

Continuously display the test pattern shown in the figure below for 2 hours. Then display a completely white screen. The previous image shall not persist more than 2 sec at 25 °C

Image sticking pattern



9. RELIABILITY

9.1 Test Condition

9.1.1 Temperature and Humidity(Ambient Temperature)

Temperature : $25 \pm 5^{\circ}\text{C}$

Humidity : $65 \pm 5\%$

9.1.2 Operation

Unless specified otherwise, test will be conducted under function state.

9.1.3 Container

Unless specified otherwise, vibration test will be conducted to the product itself without putting it in a container.

9.1.4 Test Frequency

In case of related to deterioration such as shock test. It will be conducted only once.

9.2 TESTS

No.	ITEM	CONDITION CRITERION
1	High Temperature Storage	80°C, 240 hrs
2	Low Temperature Storage	-30°C, 240 hrs
3	High Temperature Operating	70°C, 240 hrs
4	Low Temperature Operating	-20°C, 240 hrs
5	High Temperature/Humidity Non-Operating	60°C, 90%RH, 240 hrs
6	Temperature Shock Non-Operating	-30°C $\longleftrightarrow$ 80°C (0.5hr each), 25 cycles
7	Vibration Test Non-Operating	Frequency:0 ~ 55 Hz Amplitude:1.5 mm Sweep Time:11min Test Period:6 Cycles for each Direction of X,Y,Z
8	Electro-static Discharge Non-Operating	150pF,330Ω Air:± 8KV;Contact: ±6KV 10 times/point;4 points/panel face

Note1: The test sample have recovery time for 24 hours at room temperature before the function check. In the standard conditions, there is no any touch panel function NG issue occurred.

9.3 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.

9.4 INCOMING INSPECTION STANDARDS

No.	Parameter	Criteria												
1	Operating	Display function: No Display malfunction (Major)												
		Contrast ratio (Black, White): Does not meet specified range in the spec. (Major) (Note:3)												
		Line Defect: No obvious Vertical and Horizontal line defect in bright, dark and colored. (Major) (Note:1)												
		Point Defect : Active area ≤ 5 dots (Minor) (Note:1)												
		<table><tr><th rowspan="2">Item</th><th>Acceptable number</th><th rowspan="2">Total</th></tr><tr><th>Active Area</th></tr><tr><td>Bright</td><td>2</td><td rowspan="2">5</td></tr><tr><td>Dark</td><td>4</td></tr></table>	Item	Acceptable number	Total	Active Area	Bright	2	5	Dark	4			
		Item		Acceptable number		Total								
			Active Area											
		Bright	2	5										
		Dark	4											
		Non-uniformity: Visible through 5%ND filter. (Minor)												
Foreign material in Black or White spots shape ($W>1/4L$)														
<table><tr><th>Zone Dimension</th><th>Acceptable number</th><th rowspan="4">Class Of Defects</th><th rowspan="4">AQL Level</th></tr><tr><td>D> 0.5</td><td>0</td></tr><tr><td>0.3 < D $\leq$ 0.5</td><td>5</td></tr><tr><td>D $\leq$ 0.3</td><td>*</td></tr></table>	Zone Dimension	Acceptable number	Class Of Defects	AQL Level	D> 0.5	0	0.3 < D $\leq$ 0.5	5	D $\leq$ 0.3	*				
Zone Dimension	Acceptable number	Class Of Defects			AQL Level									
D> 0.5	0													
0.3 < D $\leq$ 0.5	5													
D $\leq$ 0.3	*													
D = (Long + Short) / 2 *: Disregard														
Foreign Material in Line or spiral shape ($W\leq1/4L$) (Note: 4)														
<table><tr><th>L (mm)</th><th>Zone W(mm)</th><th>Acceptable number</th><th rowspan="4">Class Of Defects</th><th rowspan="4">AQL Level</th></tr><tr><td>L >5</td><td>W>0.1</td><td>0</td></tr><tr><td>0.5 < L $\leq$ 5</td><td>0.03 < W$\leq$0.1</td><td>5</td></tr><tr><td>L $\leq$0.5</td><td>W$\leq$0.03</td><td>*</td></tr></table>	L (mm)	Zone W(mm)	Acceptable number	Class Of Defects	AQL Level	L >5	W>0.1	0	0.5 < L $\leq$ 5	0.03 < W $\leq$ 0.1	5	L $\leq$ 0.5	W $\leq$ 0.03	*
L (mm)	Zone W(mm)	Acceptable number	Class Of Defects			AQL Level								
L >5	W>0.1	0												
0.5 < L $\leq$ 5	0.03 < W $\leq$ 0.1	5												
L $\leq$ 0.5	W $\leq$ 0.03	*												
L : Length W : Width *: Disregard														
2	External Inspection (non-operating)	Dimension: Outline (Major)												
		Bezel appearance: uneven (Minor)												
		Scratch on the polarize: (Note:2)												
		<table><tr><th>L (mm)</th><th>Zone W(mm)</th><th>Acceptable number</th><th rowspan="3">Class Of Defects</th><th rowspan="3">AQL Level</th></tr><tr><td>--</td><td>W>0.1</td><td>0</td></tr><tr><td>L $\leq$ 3</td><td>W$\leq$0.1</td><td>3</td></tr></table>	L (mm)	Zone W(mm)	Acceptable number	Class Of Defects	AQL Level	--	W>0.1	0	L $\leq$ 3	W $\leq$ 0.1	3	
		L (mm)	Zone W(mm)	Acceptable number	Class Of Defects			AQL Level						
		--	W>0.1	0										
		L $\leq$ 3	W $\leq$ 0.1	3										
		L : Length W : Width *: Disregard												
		Dent or bubble on the polarize (Note:2)												
		<table><tr><th>Zone Dimension</th><th>Acceptable number</th><th rowspan="3">Class Of Defects</th><th rowspan="3">AQL Level</th></tr><tr><td>D$\leq$0.3</td><td>*</td></tr><tr><td>D$\leq$0.5</td><td>3</td></tr></table>	Zone Dimension	Acceptable number	Class Of Defects	AQL Level	D $\leq$ 0.3	*	D $\leq$ 0.5	3				
Zone Dimension	Acceptable number	Class Of Defects	AQL Level											
D $\leq$ 0.3	*													
D $\leq$ 0.5	3													
D = (Long + Short) / 2 *: Disregard														

Class of defects	Major	AQL 0.65%	Definition
	Minor	AQL 1.5%	It is a defect that will not result in functioning problem with deviation classified.

Note1:

(a) Bright point defect is defined as point defect of R,G,B with area $>1/2$ pixel respectively

(b) Dark point defect is defined as visible in full white pattern.

(c) Definition of distribution of point defect is as follows:

- minimum separation between dark point defects should be larger than 5mm.
- minimum separation between bright point defects should be larger than 5mm.

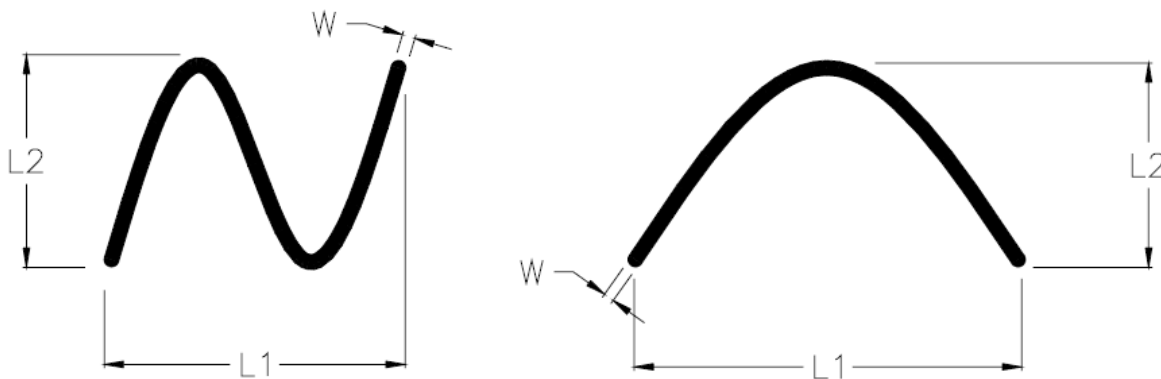
(d) Definition of joined bright point defect and joined dark point defect are as follows:

- Two or more joined bright point defects must be nil.
- Three joined dark point defects must be nil.
- Coupling of one dark and one bright point in junction is counted as one dark and bright spot with 1 pair maximum.
- Two Joined dark point is counted as two dark points with 2 pair maximum.

Note2: The external inspection should be conducted at the distance 30 ± 5 cm between the eyes of inspector and the panel.

Note3: Luminance measurement for contrast ratio is at the distance 50 ± 5 cm between the detective head and the panel with ambient luminance less than 1 lux. Contrast ratio is obtained at optimum view angle.

Note4: W-Width in mm , L-length of Max.(L1,L2) in mm.



9.5 Sampling Condition

Unless otherwise agree in written, the sampling inspection shall be applied to the incoming inspection of customer.

Lot size: Quantity of shipment lot per model.

Sampling type: normal inspection, single sampling

Sampling table: MIL-STD-105E

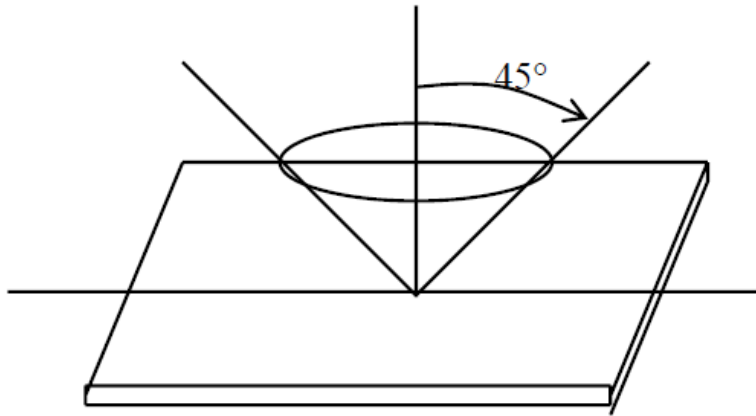
Inspection level: Level II

9.6 Inspection conditions

The LCD shall be inspected under 40W white fluorescent light.

$\theta \leq 45^\circ$ inspection under non-operating condition.

$\theta \leq 5^\circ$ inspection under operating condition



10. PRECAUTION RELATING PRODUCT HANDLING

10.1 SAFETY

- 10.1.1 If the LCD panel breaks , be careful not to get the liquid crystal to touch your skin.
- 10.1.2 If the liquid crystal touches your skin or clothes , please wash it off immediately by using soap and water.

10.2 HANDLING

- 10.2.1 Avoid any strong mechanical shock which can break the glass.
- 10.2.2 Avoid static electricity which can damage the CMOS LSI—When working with the module, be sure to ground your body and any electrical equipment you may be using.
- 10.2.3 Do not remove the panel or frame from the module.
- 10.2.4 The polarizing plate of the display is very fragile. So , please handle it very carefully, Do not touch, push or rub the exposed polarizing with anything harder than an HB pencil lead (glass , tweezers , etc.)
- 10.2.5 Do not wipe the polarizing plate with a dry cloth, as it may easily scratch the surface of plate.
- 10.2.6 Do not touch the display area with bare hands , this will stain the display area.
- 10.2.7 Do not use ketonics solvent & aromatic solvent. Use with a soft cloth soaked with a cleaning naphtha solvent.
- 10.2.8 To control temperature and time of soldering is $280 \pm 10^{\circ}\text{C}$ and 3-5 sec.
- 10.2.9 To avoid liquid (include organic solvent) stained on LCM.

10.3 STORAGE

- 10.3.1 Store the panel or module in a dark place where the temperature is $25^{\circ}\text{C} \pm 5^{\circ}\text{C}$ and the humidity is below 65% RH.
- 10.3.2 Do not place the module near organics solvents or corrosive gases.
- 10.3.3 Do not crush, shake, or jolt the module.