




# TFT Module Specification

## MODEL: 13-101HIECOHFO-S

< ◇ > PRELIMINARY SPECIFICATION

< ◆ > APPROVAL SPECIFICATION

CUSTOMER
APPROVED BY
DATE:

DESIGNED	CHECKED	APPROVED
		

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## RECORD OF REVISION

Version	Revised Date	Page	Content
V1.0	2022/05/11	--	First Issued
V1.1	2022/11/04	9,13	1. Update Timing table. 2. Update ICC current.

## TABLE OF CONTENTS

No.	Content	Page
	TFT Module Specification .....	1
	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.	TIMING CHARACTERISTICS .....	9
7.	ELECTRICAL CHARACTERISTICS .....	13
8.	OPTICAL CHARACTERISTICS .....	15
9.	RELIABILITY .....	18
10.	PRECAUTION RELATING PRODUCT HANDLING .....	23

## 1. GENERAL DESCRIPTION

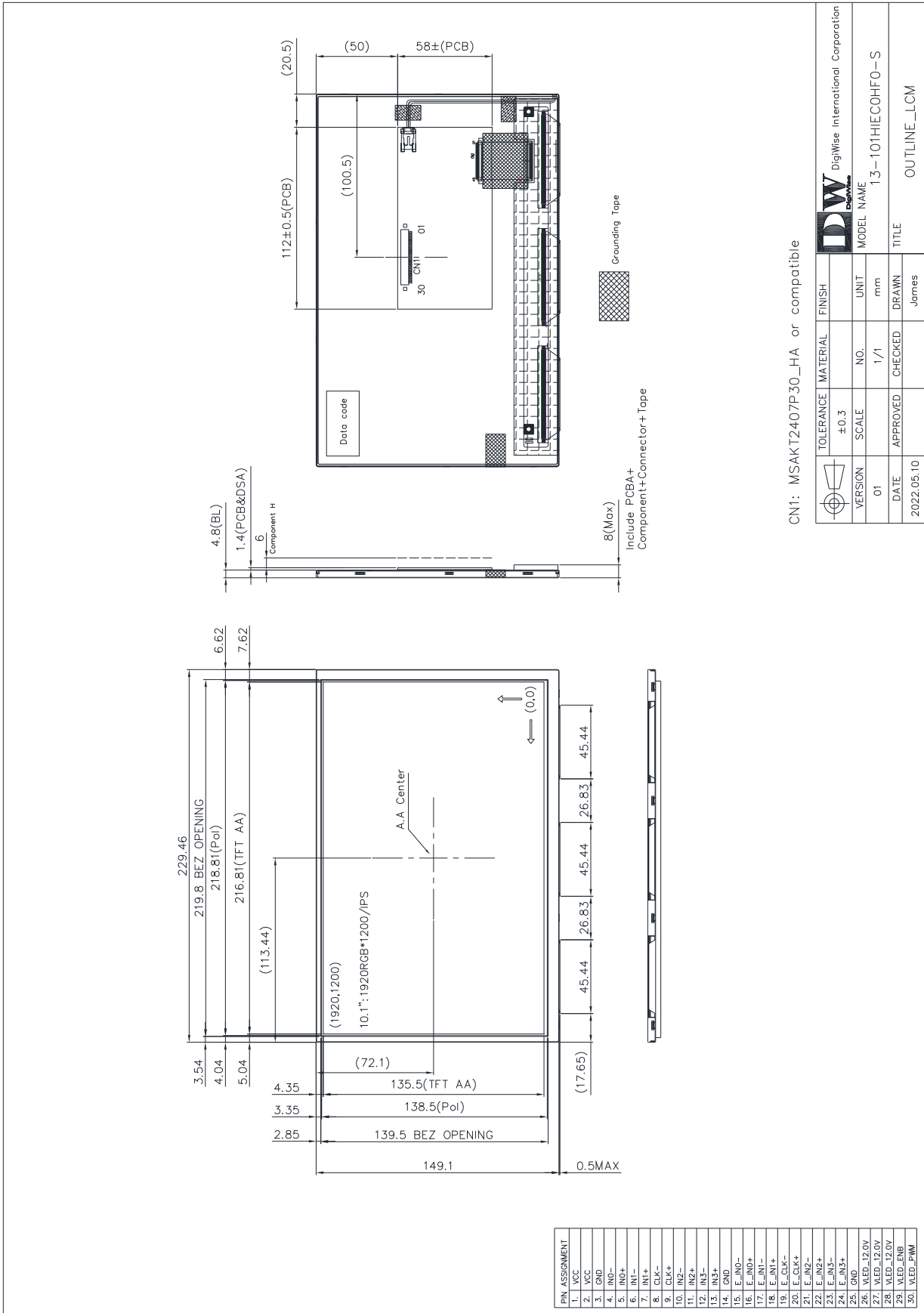
### 1.1 Description

The specification is model 13-101HIEC0HF0-S 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 backlight system. This TFT LCD has a 10.1 (16:10) inch diagonally measured active display area with WUXGA (1920 horizontal by 1200 vertical pixels) resolution.

### 1.2 Features:

No.	Item	Specification	Unit
1	Panel Size	10.1"	Inch
2	Number of Pixels	1920 (W) x RGB x 1200 (H)	Pixels
3	Active Area	216.81 (W) × 135.5 (H)	mm
4	Pixel Pitch	0.11292 (W) x 0.11292 (H)	mm
5	Outline Dimension	229.46 (W) × 149.1 (H) × 4.8 (T)	mm
6	Number of Colors	16.7M	- -
7	Display Mode	IPS / Normally Black / Transmissive	- -
8	View Direction	Free direction	- -
9	Display Format	RGB vertical stripe	- -
10	Surface Treatment	HC	- -
11	Contrast Ratio	900 (Typ.)	- -
12	Luminance (cd/m <sup>2</sup> )	1000 (Typ.)	cd/m <sup>2</sup>
13	Interface	LVDS Dual 8 bit	- -
14	Backlight	White LED	- -
15	Operation Temperature	-30 ~ 80	°C
16	Storage Temperature	-30 ~ 80	°C
17	Weight	(TBD)	g

2. MECHANICAL SPECIFICATION



### 3. PIN DESCRIPTION

#### 3.1 TFT LCD Module (Connector: MSAKT2407P30\_HA or equivalent)

Pin	Symbol	I/O	Function	Note
1	VCC	P	Power Supply Logic voltage +3.3V	
2	VCC	P	Power Supply Logic voltage +3.3V	
3	GND	P	Ground	
4	OIN0-	I	Odd LVDS Negative data signal (-)	
5	OIN0+	I	Odd LVDS Positive data signal (+)	
6	OIN1-	I	Odd LVDS Negative data signal (-)	
7	OIN1+	I	Odd LVDS Positive data signal (+)	
8	OCLK-	I	Odd LVDS Negative CLK signal (-)	
9	OCLK+	I	Odd LVDS Positive CLK signal (+)	
10	OIN2-	I	Odd LVDS Negative data signal (-)	
11	OIN2+	I	Odd LVDS Positive data signal (+)	
12	OIN3-	I	Odd LVDS Negative data signal (-)	
13	OIN3+	I	Odd LVDS Positive data signal (+)	
14	GND	P	Ground	
15	EIN0-	I	Even LVDS Negative data signal (-)	
16	EIN0+	I	Even LVDS Positive data signal (+)	
17	EIN1-	I	Even LVDS Negative data signal (-)	
18	EIN1+	I	Even LVDS Positive data signal (+)	
19	ECLK-	I	Even LVDS Negative CLK signal (-)	
20	ECLK+	I	Even LVDS Positive CLK signal (+)	
21	EIN2-	I	Even LVDS Negative data signal (-)	
22	EIN2+	I	Even LVDS Positive data signal (+)	
23	EIN3-	I	Even LVDS Negative data signal (-)	
24	EIN3+	I	Even LVDS Positive data signal (+)	
25	GND	P	Ground	
26	VLED_12V	P	Power Supply LED driver +12V	
27	VLED_12V	P	Power Supply LED driver +12V	
28	VLED_12V	P	Power Supply LED driver +12V	
29	VLED_ENB	I	Backlight on/off control signal	
30	VLED_PWM	I	Backlight dimming control signal	

#### 4. ABSOLUTE MAXIMUM RATINGS

##### 4.1 Electrical Absolute Rating

##### 4.1.1 TFT LCD Module

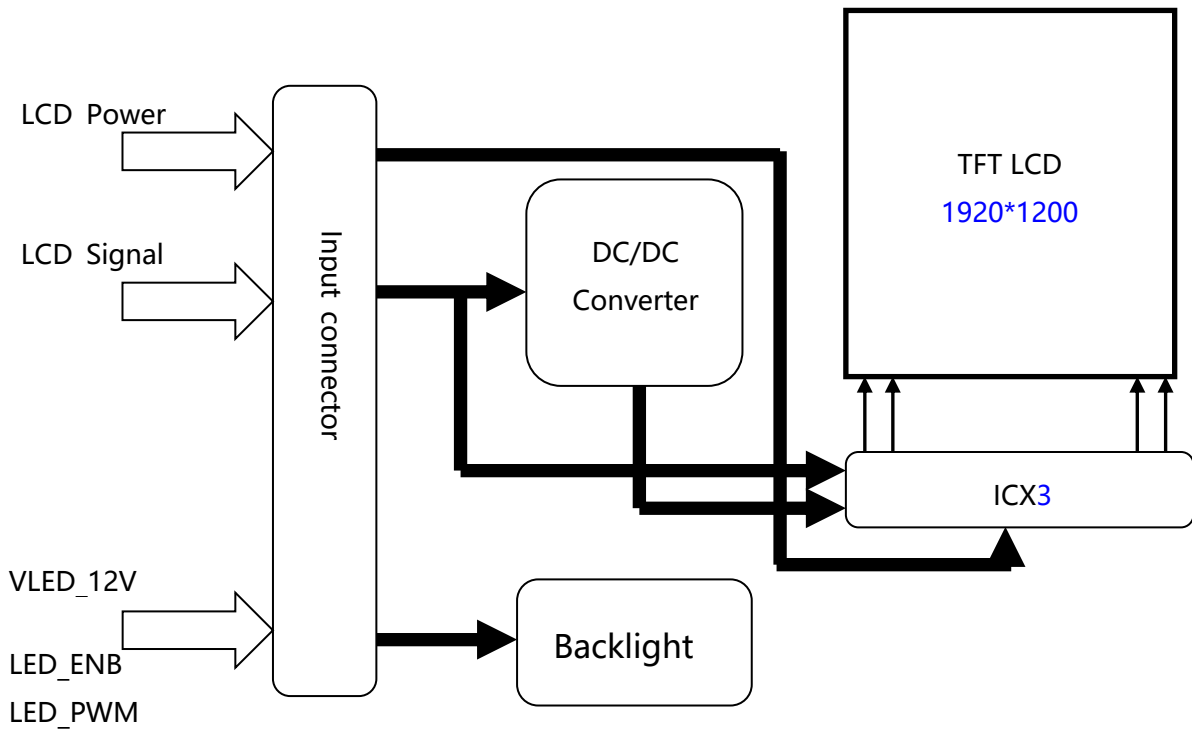
Item	Symbol	Values		Unit	Note
		Min	Max.		
Power supply voltage	VCC	-0	3.6	V	
	VLED_12V	11	13	V	

##### 4.1.2 Environment Absolute Rating

Item	Symbol	Values			Unit	Note
		Min	Typ	Max.		
Operating Temperature	Topa	-30		80	°C	(1)(2)(3)(4)
Storage Temperature	Tstg	-30		80	°C	(1)(2)(3)

## 5. BLOCK DIAGRAM

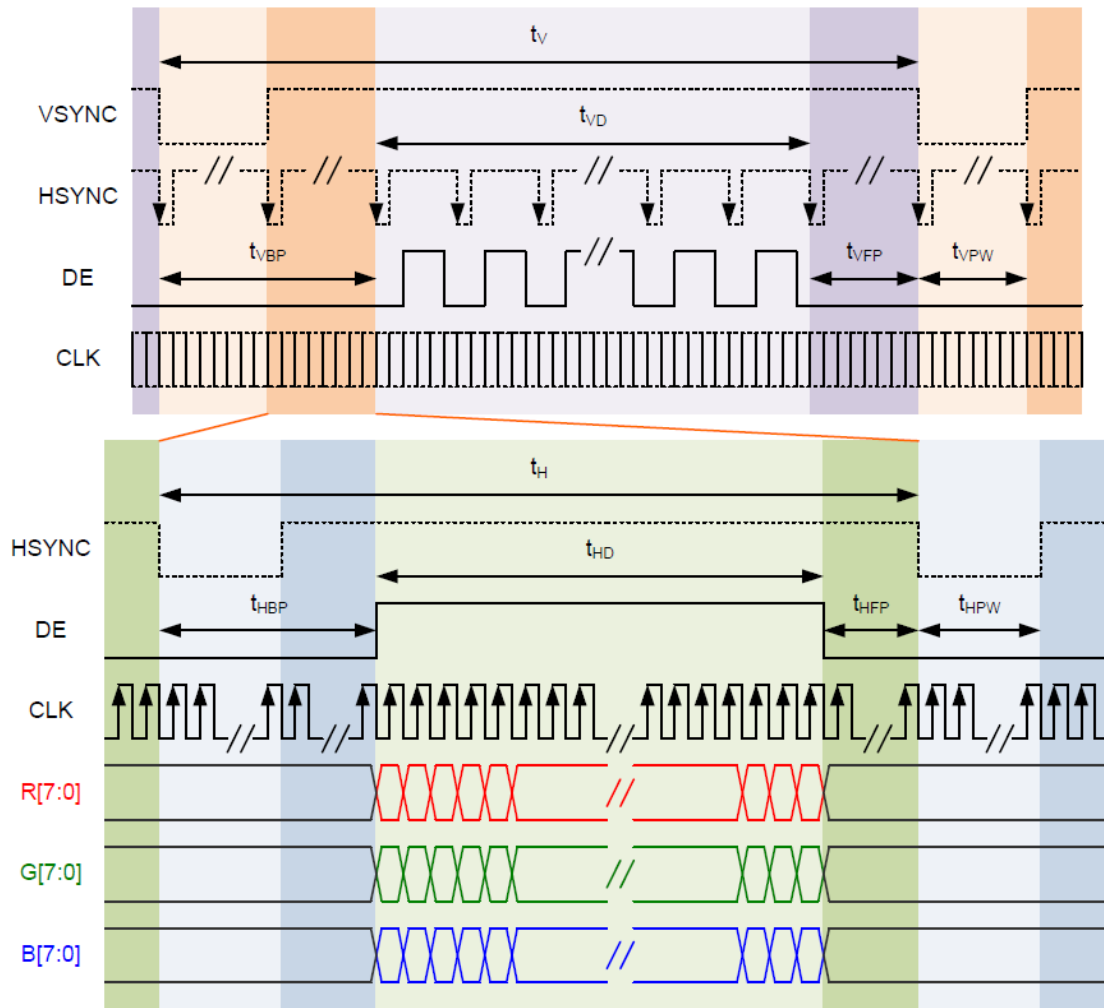
### 5.1 TFT LCD Module







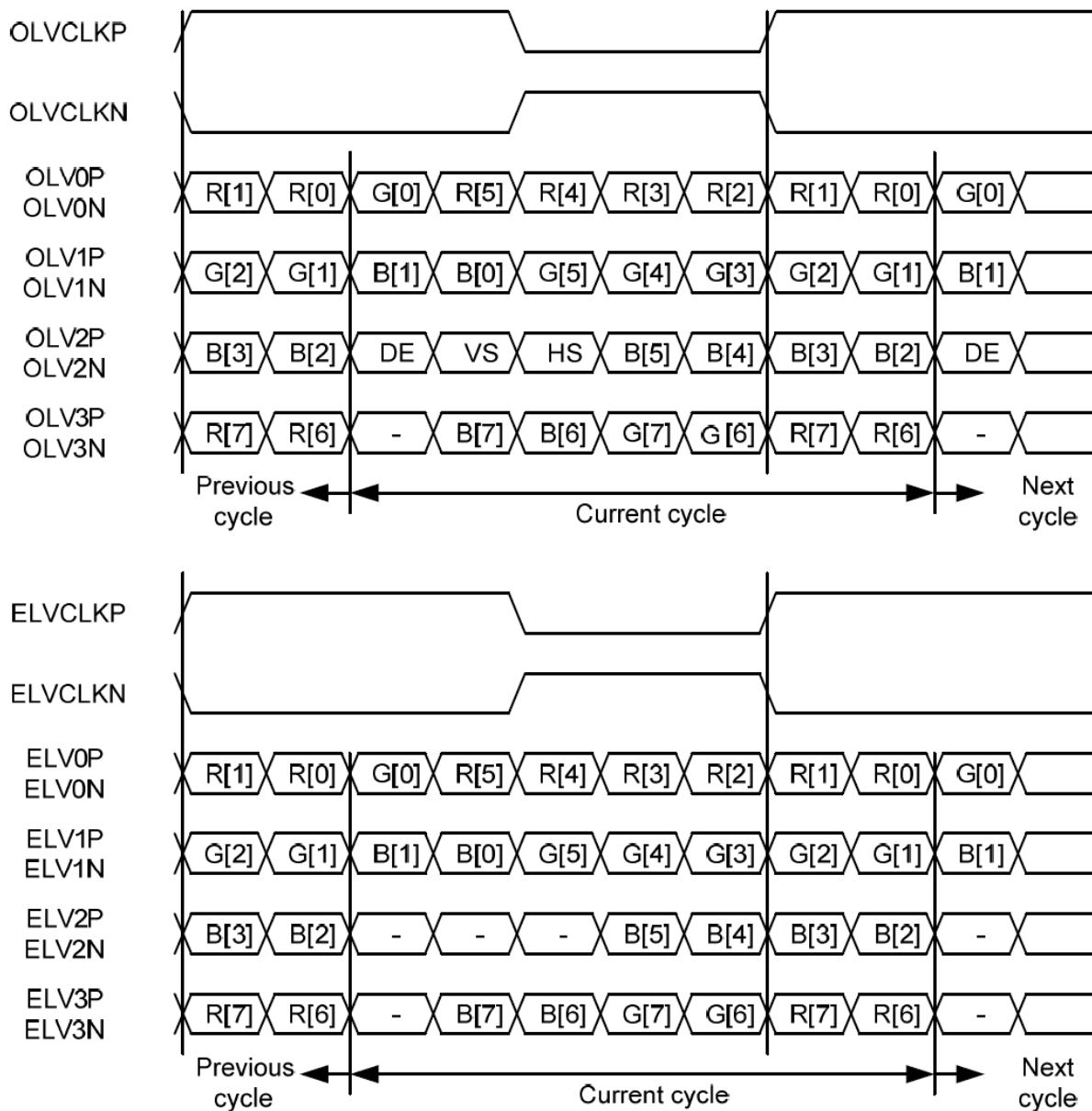
LVDS / Parallel RGB (DE Mode)



Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
CLK frequency	tCLK	73.7	75.7	78	Mhz	
Horizontal blanking time	tHBT	48	50	54	tCLK	tHBP + tHFP
Horizontal display area	tHD	960			tCLK	
Horizontal period	tH	1008	1010	1014	tCLK	
Horizontal pulse width	tHPW	2	2	2	tCLK	
Vertical blanking time	tVBT	40	50	60	tH	tVBP + tVFP
Vertical display area	tVD	1200			tH	
Vertical period	tV	1240	1250	1260	tH	
Vertical pulse width	tVPW	2	2	2	tH	
Frame rate	FR	59	60	61	Hz	

Note: ST5892B can't accept the tolerance of tVBT = +/- 1 in DE mode.

### 6.2 LVDS DATA (VESA) : Timing Chart



### 6.3 Data mapping

COLOR	INPUT DATA	R DATA								G DATA								B DATA							
		R7 MSB	R6	R5	R4	R3	R2	R1	R0 LSB	G7 MSB	G6	G5	G4	G3	G2	G1	G0 LSB	B7 MSB	B6	B5	B4	B3	B2	B1	B0 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	
	GREEN(255)	0	0	0	0	0	0	0	0	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	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	
	MAGENTA	1	1	1	1	1	1	1	1	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	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	
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	1	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		
	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	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	1	0	0	0	0	0	0	0	0		
	GREEN(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0		
	GREEN(254)	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0		
	GREEN(255)	0	0	0	0	0	0	0	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		
	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	1	0		
	BLUE(254)	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	1	1	1	1	1	1	1	1		

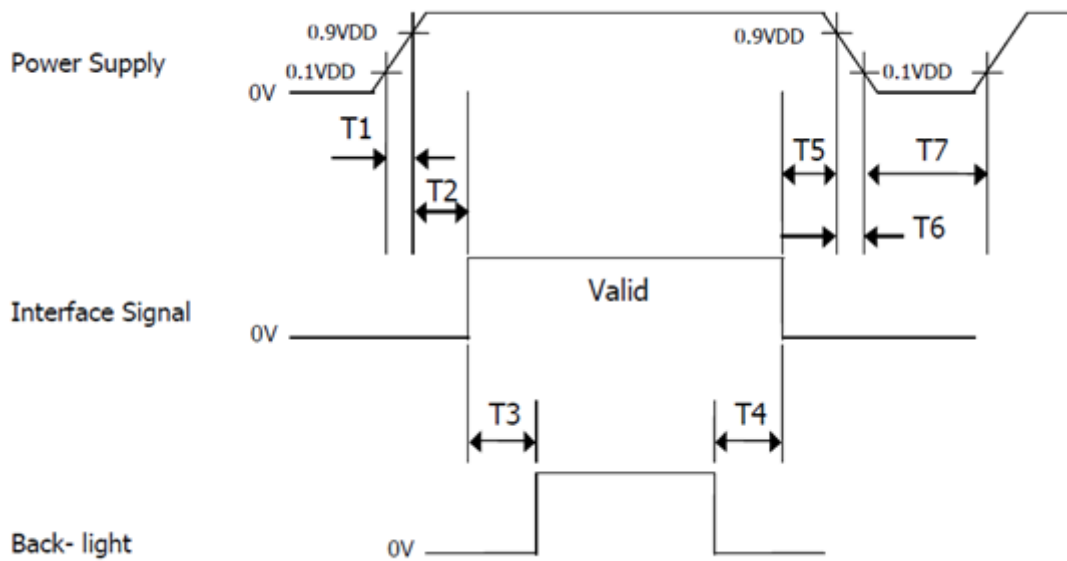
## 7. ELECTRICAL CHARACTERISTICS

### 7.1 TFT LCD Module

Item	Symbol	Values			Unit	Remark
		Min.	Typ.	Max.		
Supply Voltage	VCC	3.0	3.3	3.6	V	
	VLED	11	12	13	V	
	VRF	-	-	100	mV p-p	Ripple voltage
Differential Input High Threshold	VTH	-	-	+100	mV	Vcm=+1.2V
Differential Input Low Threshold	VTL	-100	-	-	mV	Vcm=+1.2V
Magnitude differential Input Voltage	VID	100	-	600	mV	
Common Mode Voltage	Vcm	0.7	1.2	1.6	V	
Common Mode Voltage Offest	$\Delta$ Vcm	-	-	50	mV	Vcm=+1.2V
Supply Current	ICC	-	300	360	mA	VCC=3.3V
	IDD	-	510	600	mA	VLED=12V
PWM frequency	PWM	100	-	8K	Hz	
PWM input voltage	VIH	1.6	-	-	V	
	VIL	-	-	0.8	V	
LED_EN input voltage	VIH	1.6	-	-	V	
	VIL	-	-	0.8	V	
LED life time		-	50000	-	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.

## 7.2 Power On / Off Sequence



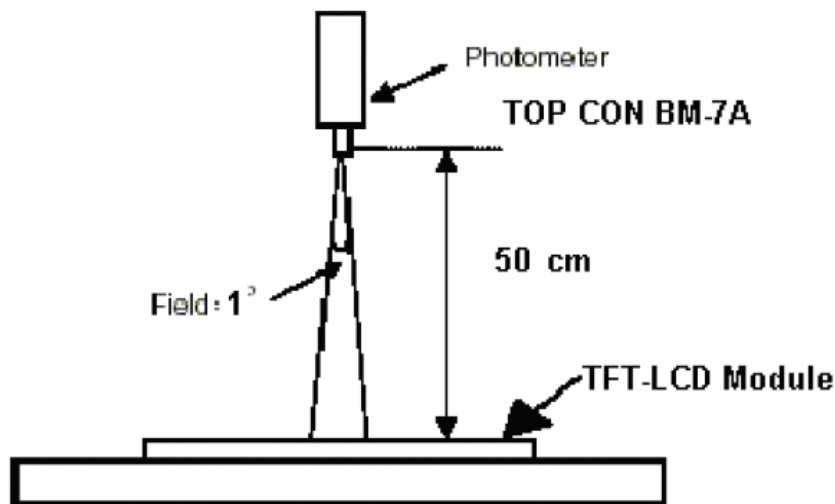
Parameter	Values			Units
	Min	Typ	Max	
T1	0	-	10	ms
T2	0	-	50	ms
T3	200	-	-	ms
T4	500	-	-	ms
T5	0	-	50	ms
T6	0	-	10	ms
T7	500	-	-	ms

### 8. OPTICAL CHARACTERISTICS

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Brightness	--	Note1, Note 3, ( $\theta = 0^\circ$ , Normal Viewing Angle)	800	1000	-	cd/m <sup>2</sup>
Uniformity	B-uni		75	-	-	%
Contrast Ratio	CR		700	900	-	-
Response Time	Tr		-	30	35	ms
	Tf					
Color Chromaticity	White	Wx	0.281	0.311	0.341	-
		Wy	0.327	0.357	0.387	-
View angle	Horizontal	$\theta x+$	70	80	-	
		$\theta x-$	70	80	-	
	Vertical	$\theta Y+$	70	80	-	
		$\theta Y-$	70	80	-	

Note : The following optical specifications shall be measured in a darkroom or equivalent state(ambient luminance  $\leq 1$  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.

Note 1: The method of optical measurement:

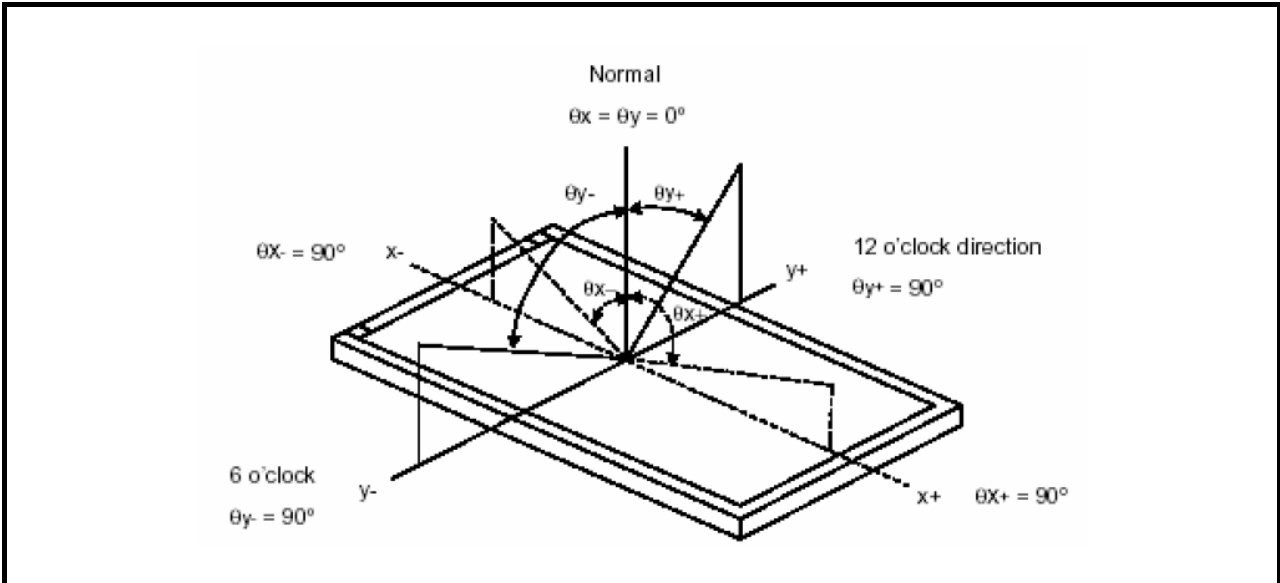


Note 2: Measured at the center area of the panel and at the viewing angle of the  $\theta x = \theta y = 0^\circ$

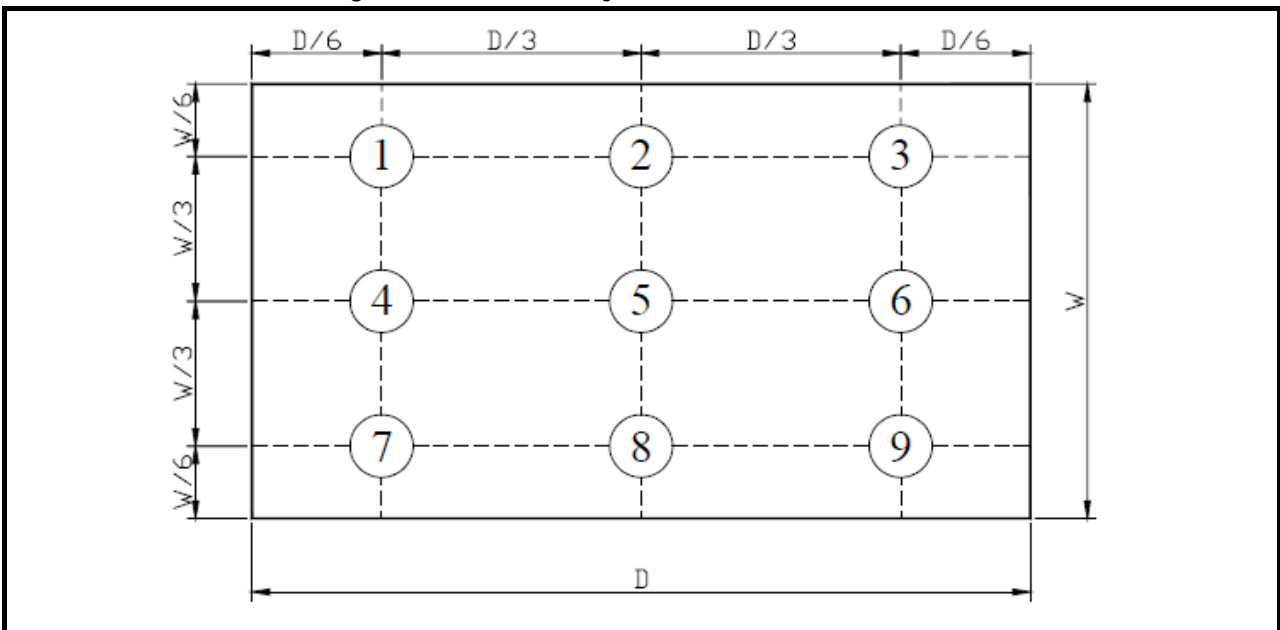
Note 3: Definition of Contrast Ratio (CR):

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

Note 4: Definition of Viewing Angle:



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

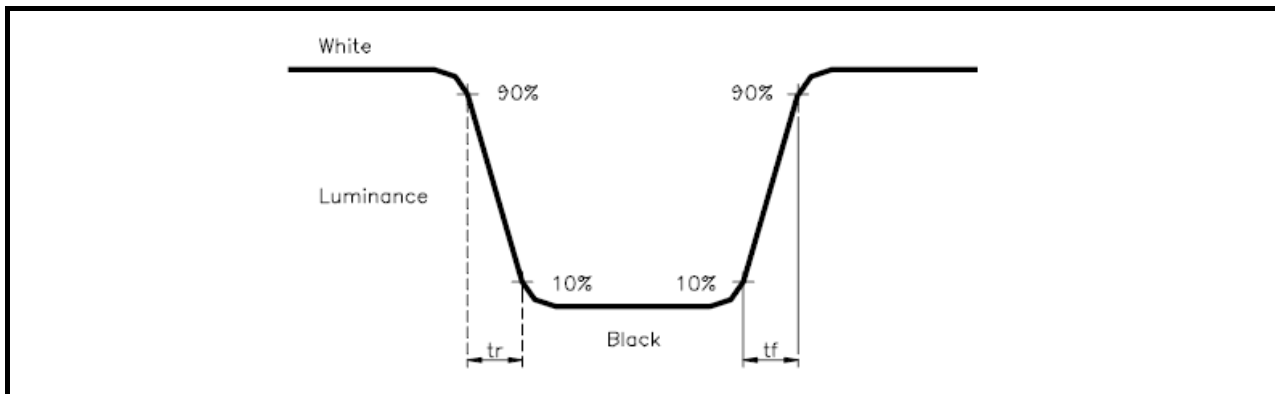


$$B\text{-uni} = (\text{Minimum luminance of 9 points} \div \text{Maximum luminance of 9 points}) \times 100\%$$



Note 6: Definition of Response Time:

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



Note 7: Definition of Chromaticity:

The color coordinates ( $W_x, W_y$ ), ( $R_x, R_y$ ), ( $G_x, G_y$ ), and ( $B_x, B_y$ ) are obtained with all pixels in the viewing field at white, red, green, and blue states, respectively.

9. RELIABILITY

9.1 Test Condition

9.1.1 Temperature and Humidity(Ambient Temperature)

Temperature : 25 ± 5°C

Humidity : 65 ± 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	80°C, 240 hrs
4	Low Temperature Operating	-30°C, 240 hrs
5	High Temperature/Humidity Non-Operating	50°C, 90%RH, 240 hrs
6	Temperature Shock Non-Operating	-20°C ←→ 70°C (0.5hr each), 20 cycles
7	Vibration Test Non-Operating	Frequency:0 ~ 33.3Hz Amplitude:1.3 mm Sweep Time:15min Test Period:6 Cycles for each Direction of X,Y,Z

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 $\leq 5$ dots (Minor) (Note:1)														
		<table border="1"> <thead> <tr> <th rowspan="2">Item</th> <th>Acceptable number</th> <th rowspan="2">Total</th> </tr> <tr> <th>Active Area</th> </tr> </thead> <tbody> <tr> <td>Bright</td> <td>2</td> <td rowspan="2">5</td> </tr> <tr> <td>Dark</td> <td>4</td> </tr> </tbody> </table>	Item	Acceptable number	Total	Active Area	Bright	2	5	Dark	4					
Item	Acceptable number	Total														
	Active Area															
Bright	2	5														
Dark	4															
2	External Inspection (non-operating)	Non-uniformity: Visible through 5%ND filter. (Minor)														
		Foreign material in Black or White spots shape ( $W > 1/4L$ )														
		<table border="1"> <thead> <tr> <th>Zone</th> <th>Acceptable number</th> <th>Class Of Defects</th> <th>AQL Level</th> </tr> </thead> <tbody> <tr> <td>D &gt; 0.5</td> <td>0</td> <td rowspan="3">Minor</td> <td rowspan="3">1.5</td> </tr> <tr> <td>0.3 &lt; D <math>\leq</math> 0.5</td> <td>5</td> </tr> <tr> <td>D <math>\leq</math> 0.3</td> <td>*</td> </tr> </tbody> </table> <p>D = (Long + Short) / 2 * : Disregard</p>	Zone	Acceptable number	Class Of Defects	AQL Level	D > 0.5	0	Minor	1.5	0.3 < D $\leq$ 0.5	5	D $\leq$ 0.3	*		
		Zone	Acceptable number	Class Of Defects	AQL Level											
		D > 0.5	0	Minor	1.5											
0.3 < D $\leq$ 0.5	5															
D $\leq$ 0.3	*															
Foreign Material in Line or spiral shape ( $W \leq 1/4L$ ) (Note: 4)																
<table border="1"> <thead> <tr> <th>L (mm)</th> <th>Zone</th> <th>Acceptable number</th> <th>Class Of Defects</th> <th>AQL Level</th> </tr> </thead> <tbody> <tr> <td>L &gt; 5</td> <td>W &gt; 0.1</td> <td>0</td> <td rowspan="3">Minor</td> <td rowspan="3">1.5</td> </tr> <tr> <td>0.5 &lt; L <math>\leq</math> 5</td> <td>0.03 &lt; W <math>\leq</math> 0.1</td> <td>5</td> </tr> <tr> <td>L <math>\leq</math> 0.5</td> <td>W <math>\leq</math> 0.03</td> <td>*</td> </tr> </tbody> </table> <p>L : Length W : Width * : Disregard</p>	L (mm)	Zone	Acceptable number	Class Of Defects	AQL Level	L > 5	W > 0.1	0	Minor	1.5	0.5 < L $\leq$ 5	0.03 < W $\leq$ 0.1	5	L $\leq$ 0.5	W $\leq$ 0.03	*
L (mm)	Zone	Acceptable number	Class Of Defects	AQL Level												
L > 5	W > 0.1	0	Minor	1.5												
0.5 < L $\leq$ 5	0.03 < W $\leq$ 0.1	5														
L $\leq$ 0.5	W $\leq$ 0.03	*														
2	External Inspection (non-operating)	Dimension: Outline (Major)														
		Bezel appearance: uneven (Minor)														
		Scratch on the polarize: (Note:2)														
		<table border="1"> <thead> <tr> <th>L (mm)</th> <th>Zone</th> <th>Acceptable number</th> <th>Class Of Defects</th> <th>AQL Level</th> </tr> </thead> <tbody> <tr> <td>--</td> <td>W &gt; 0.1</td> <td>0</td> <td rowspan="2">Minor</td> <td rowspan="2">1.5</td> </tr> <tr> <td>L <math>\leq</math> 3</td> <td>W <math>\leq</math> 0.1</td> <td>3</td> </tr> </tbody> </table> <p>L : Length W : Width * : Disregard</p>	L (mm)	Zone	Acceptable number	Class Of Defects	AQL Level	--	W > 0.1	0	Minor	1.5	L $\leq$ 3	W $\leq$ 0.1	3	
		L (mm)	Zone	Acceptable number	Class Of Defects	AQL Level										
--	W > 0.1	0	Minor	1.5												
L $\leq$ 3	W $\leq$ 0.1	3														
Dent or bubble on the polarize (Note:2)																
<table border="1"> <thead> <tr> <th>Zone</th> <th>Acceptable number</th> <th>Class Of Defects</th> <th>AQL Level</th> </tr> </thead> <tbody> <tr> <td>D <math>\leq</math> 0.3</td> <td>*</td> <td rowspan="2">Minor</td> <td rowspan="2">1.5</td> </tr> <tr> <td>D <math>\leq</math> 0.5</td> <td>3</td> </tr> </tbody> </table> <p>D = (Long + Short) / 2 * : Disregard</p>	Zone	Acceptable number	Class Of Defects	AQL Level	D $\leq$ 0.3	*	Minor	1.5	D $\leq$ 0.5	3						
Zone	Acceptable number	Class Of Defects	AQL Level													
D $\leq$ 0.3	*	Minor	1.5													
D $\leq$ 0.5	3															

Class of defects			Definition
	<b>Major</b>	AQL 0.65%	
<b>Minor</b>	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.

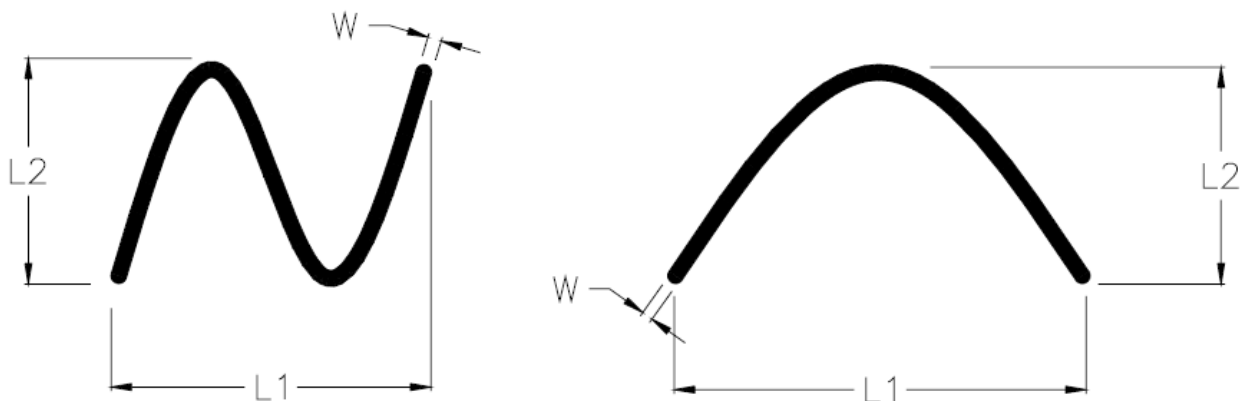
(d) Definition of joined bright point defect and joined dark point defect are as follows:

- 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  $30 \pm 5$  cm between the eyes of inspector and the panel.

Note3: Luminance measurement for contrast ratio is at the distance  $50 \pm 5$  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

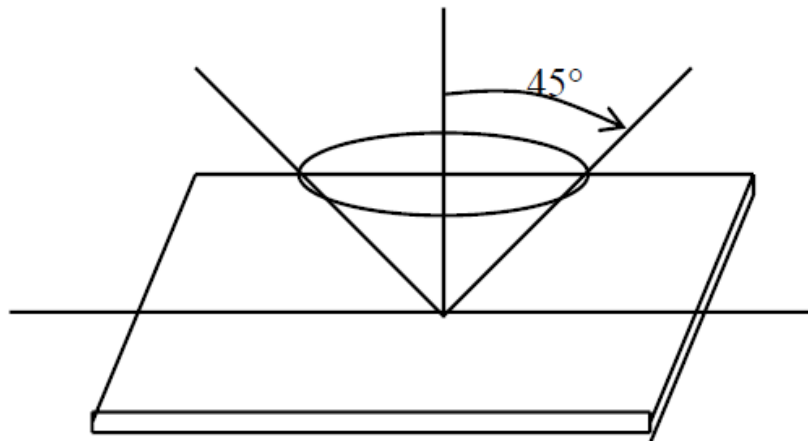
Inspection level: Level II

### 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.