



**Display Future Ltd**

[www.displayfuture.com](http://www.displayfuture.com)

## **LCD MODULE SPECIFICATION**

**Model: DF-TFN0347FB-F1**

**This module uses ROHS materials**

### **For customer acceptance**

Customer		date
Approved		
Comments		

The standard product specification may change without prior notice in order to improve performance or quality. Please contact Display Future Ltd for updated specification and product status before design for the standard product or release of the order.

Revision	1.0
Engineering	
Date	2018/01/4
Our Reference	

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## 1. Revision Record

[illegible]

## 2. General Description

### 2.1 Description

DF-TFN0347FB-F1 is a Transmissive type color active matrix liquid crystal display (LCD), which uses amorphous thin film transistor (TFT) as switching devices. This product is composed of a TFT LCD panel, driver IC, FPC and backlight unit .

The following table described the features of DF-TFN0347FB-F1.

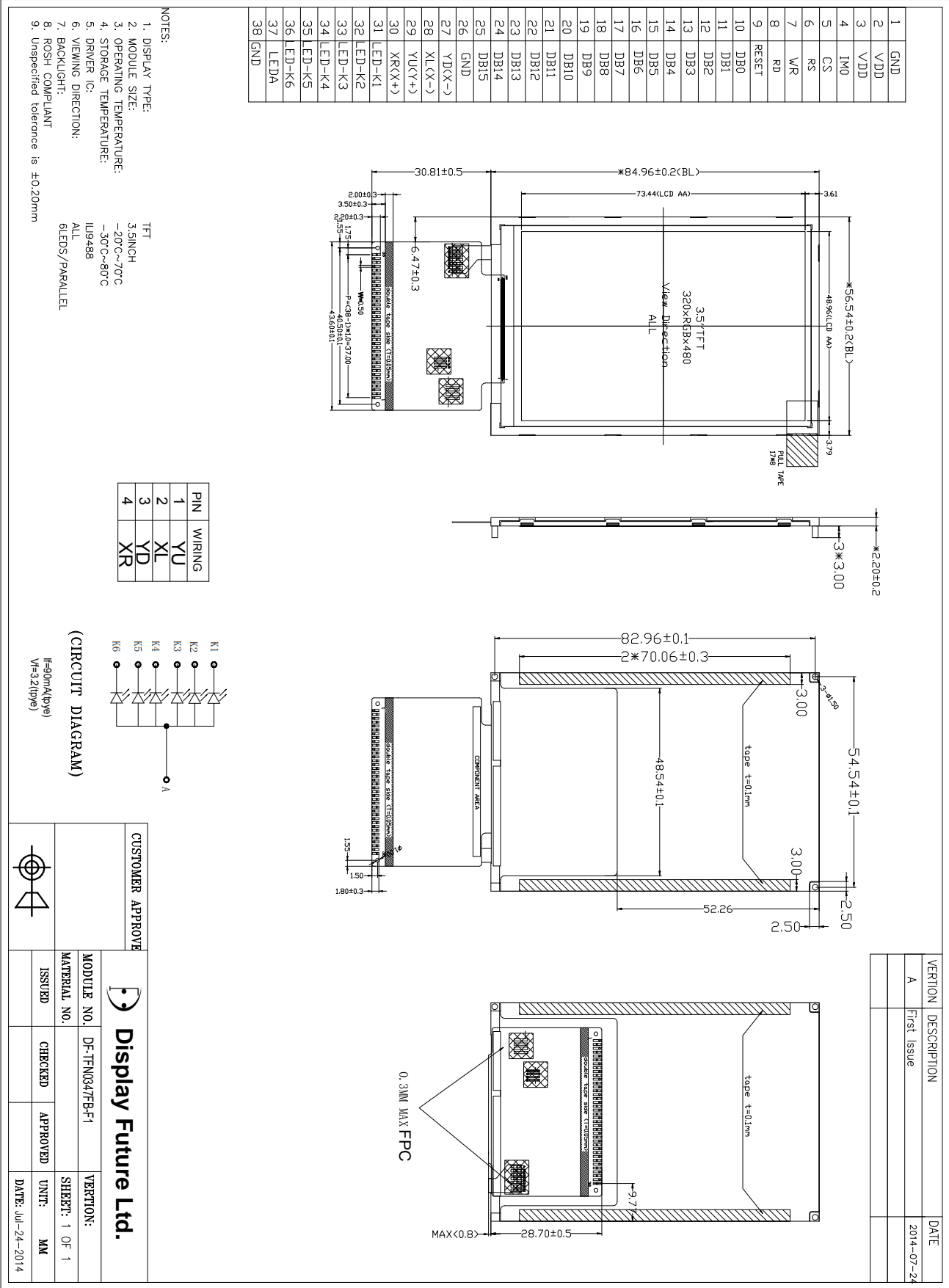
### 2.2 Application

Mobile phone, Multimedia products  
and other electronic Products

### 2.3 Features:

Features	Description	UNITS
LCD type	3.5'TFT	--
Dot arrangement	320 (RGB) × 480	dots
Driver IC	ILI9488	--
Color Depth	65K	
Interface	MCU 16 or 8 bit Interface	
View Direction	ALL	
Module size	56.54(W) × 84.96 (H) × 2.2(T)	mm
Active area	48.96(W) × 73.44 (H)	mm
Dot pitch	0.153 (W) × 0.153 (H)	mm
Back Light	6 White LED In parallel	--
With/Without TSP	Without TSP	
Weight(g)	TBD	

3. External Dimensions



## 4. Interface Description

PIN NO.	PIN NAME	DESCRIPTION
1	GND	System ground.
2-3	VDD	Power supply (+2.5V-3.6V).
4	IM0	8 or 16 Bit Interface select: IM0=0 16-Bit 8080 system Interface. DB0-DB15 is used. IM0=1 8-Bit 8080 system Interface. DB0-DB7 is used.
5	CS	Chip select input pin(" low" enable).
6	RS	This pin is used to select "data or command" When RS="1", data is selected. When RS="0", command is selected.
7	WR	Write signal input, Active" L "
8	RD	Read signal input, Active" L "
9	RESET	Reset input pin, When reset is "L", Initialization is executed.
10-25	DB0-DB15	16-Bit Data Bus. Note: Please fix unused pin to ground.
26	GND	System ground.
27	NC(YD)	NC(Touch Panel Down Side Wire.)
28	NC(XL)	NC(Touch Panel Left Side Wire.)
29	NC(YU)	NC(Touch Panel Up Side Wire.)
30	NC(XR)	NC(Touch Panel Right Side Wire.)
31-36	LEDK1-K6	Power supply for LED backlight Cathode input.
37	LEDA	Power supply for LED backlight Anode input.
38	GND	System ground.

## 5. Absolute Maximum Ratings

The absolute maximum ratings are listed in Table 41. When the ILI9488 is used beyond the absolute maximum ratings, it may be permanently damaged. Using the ILI9488 within the following limits of electrical characteristics is strongly recommended for normal operation. If these electrical characteristic conditions are exceeded during normal operation, the ILI9488 will malfunction and cause poor reliability.

**Table 41: Absolute maximum Ratings**

Item	Symbol	Unit	Value
Supply voltage(Analog)	VCI ~ DGND	V	-0.3 ~ +3.3
Supply voltage (VO)	IOVCC ~ DGND	V	-0.3 ~ +3.3
OTP Supply voltage	DDVDH ~ DGND	V	-0.3 ~ +7.0
Supply voltage	DDVDH ~ DGND	V	-0.3 ~ +6.0
Supply voltage	DDVDL ~ DGND	V	0.3 ~ -6.0
Supply voltage	VGH ~ DGND	V	-0.3 ~ +25
Supply voltage	VGL ~ DGND	V	0.3 ~ -16
Driver supply voltage	VCI - VCL	V	$\leq 6.0V$
Driver supply voltage	VGH-VGL	V	$\leq 32.0V$
Input voltage	VIN	V	-0.3 ~ IOVCC + 0.3
HS Input voltage	VHSIN	V	-0.3 ~ + 1.65
Operating temperature	Topr	℃	-30 ~ +70
Storage temperature	Tstg	℃	-55 ~ +110

**Note:** Even if the absolute maximum rating of one of the above parameters is exceeded only for a short while, the quality of the product may be degraded. Therefore, be sure to use the product within the range of the absolute maximum ratings.

## 6. Electrical Characteristics

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
<b>Power &amp; Operation Voltage</b>							
Analog operating voltage	VCI	-	2.5	2.8	3.3	V	
Logic operating voltage	IOVCC	-	1.65	1.8	3.3	V	Note 1, 2
OTP Supply voltage	DDVDH	-	-	7	-	V	Note 1
Logic High level input voltage	V <sub>IH</sub>	-	0.7*IOVCC		IOVCC	V	Note 1
Logic Low level input voltage	V <sub>IL</sub>	-	-0.3		0.3*IOVCC	V	Note 1
Logic High level output voltage TE, SDO (SDA), CABC PWM	V <sub>OH</sub>	I <sub>OH</sub> = -1.0mA	0.8*IOVCC		IOVCC	V	Note 1
Logic Low level output voltage TE, SDO (SDA), CABC PWM	V <sub>OL</sub>	I <sub>OL</sub> = +1.0mA	0		0.2*IOVCC	V	Note 1
Gate Driver High Voltage	V <sub>GH</sub>	-	10.0	-	20	V	
Gate Driver Low Voltage	V <sub>GL</sub>	-	-15.0	-	-6.0	V	
Driver Supply Voltage	-	V <sub>GH</sub> -V <sub>GL</sub>	16	-	32	V	
<b>Input and Output</b>							
Logic High Level Input Voltage	V <sub>IH</sub>	-	0.7*IOVCC	-	IOVCC	V	
Logic Low Level Input Voltage	V <sub>IL</sub>	-	DGND	-	0.3*IOVCC	V	
<b>VCOM Operation</b>							
DC VCOM Amplitude Voltage	V <sub>COM</sub>	-	-2.0	-	-0.06	V	Note 3
<b>Source Driver</b>							
Source Output Range	V <sub>sour</sub>	-	0.1	-	V <sub>REG1OUT</sub> -0.1	V	Note 4
Positive Gamma Reference Voltage	V <sub>REG1OUT</sub>	-	3.625	-	5.5	V	
Negative Gamma Reference Voltage	V <sub>REG2OUT</sub>	-	-5.5	-	-3.625	V	
Source Output Setting Time	T <sub>r</sub>	Below with 99% precision	-	10	-	uS	Note 3, 4
Output Deviation Voltage (Source Output channel)	V <sub>dev</sub>	S <sub>out</sub> ≥ 4.2V	-	-	20	mV	Note 3
		S <sub>out</sub> ≤ 0.8V	-	-	15	mV	-
Output Offset Voltage	V <sub>OFFSET</sub>	-	-	-	35	mV	Note 3
<b>Booster Operation</b>							
Booster (VCIx2) Voltage	DDVDH	-			6	V	
Booster (VCIx2) Voltage	DDVDL	-	-6			V	
Booster (VCIx2 Drop Voltage)	VCI1x2 drop	loading=1mA	-	-	5	%	
Gate Driver High Voltage	V <sub>GH</sub>	-	10.0	-	20	V	
Gate Driver Low Voltage	V <sub>GL</sub>	-	-15.0	-	-6.0	V	
<b>Standby mode current consumption (Ta = 25 °C, Interface: DBI and DPI)</b>							
Sleep in mode	VCI	VCI=2.8V	-	100	-	uA	
Deep Standby mode	VCI	IOVCC=1.8V	-	1	-	uA	

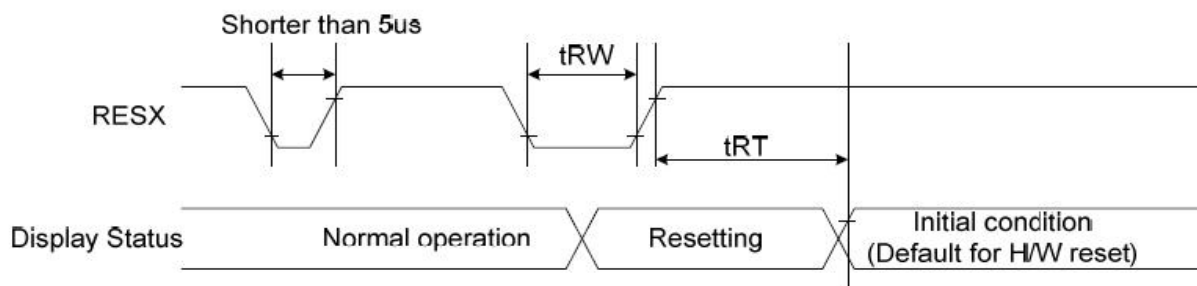
### Notes:

1. Ta = -30 to 70 °C (no damage up to 85°C (at maximum)), IOVCC=1.65V to 3.3V, VCI=2.5V to 3.3V, DGND=0V.
2. Supply the digital IOVCC voltage equal to or less than the analog VCI voltage.
3. Source channel loading = 10K $\Omega$ , 30pF/channel
4. The maximum value is between 10K $\Omega$ , 30pF/channel and Gamma setting value.



## 7. Timing Characteristics.

### 7.1 Reset Timing Characteristics.



Signal	Symbol	Parameter	Min	Max	Unit
RESX	$t_{RW}$	Reset pulse duration	10		$\mu\text{S}$
	$t_{RT}$	Reset cancel		5 (note 1,5)	mS
				120 (note 1,6,7)	mS

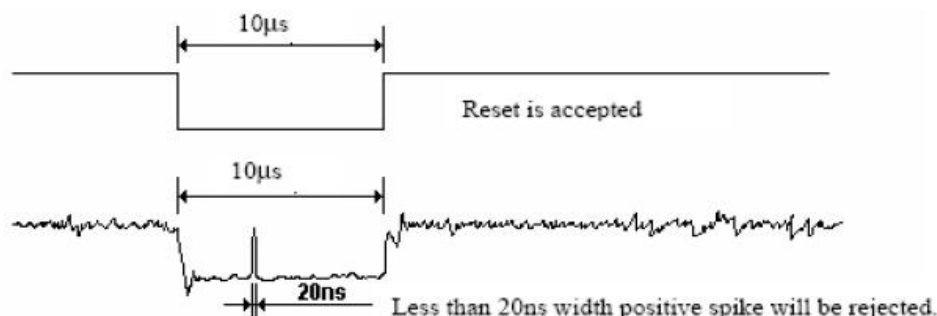
**Note 1:** The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from EEPROM to registers. This loading is done every time when there is HW reset cancel time ( $t_{RT}$ ) within 5 ms after a rising edge of RESX.

**Note 2:** Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below:

RESX Pulse	Action
Shorter than 5us	Reset Rejected
Longer than 9us	Reset
Between 5us and 9us	Reset starts

**Note 3:** During the Resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In -mode.) and then return to Default condition for Hardware Reset.

**Note 4:** Spike Rejection also applies during a valid reset pulse as shown below:

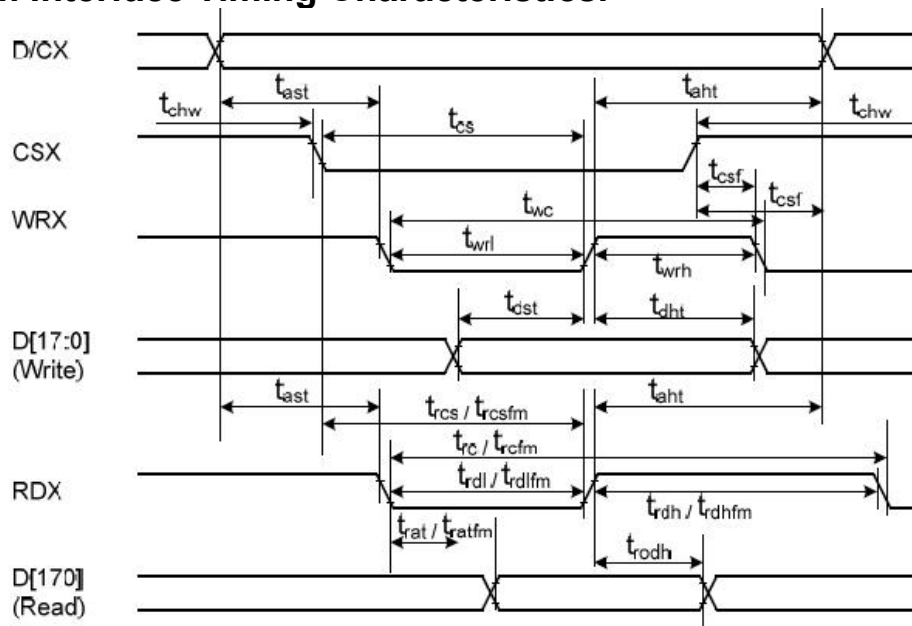


**Note 5:** When Reset applied during Sleep In Mode.

**Note 6:** When Reset applied during Sleep Out Mode.

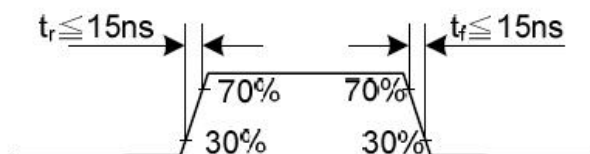
**Note 7:** It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

## 7.2. i80-System Interface Timing Characteristics.

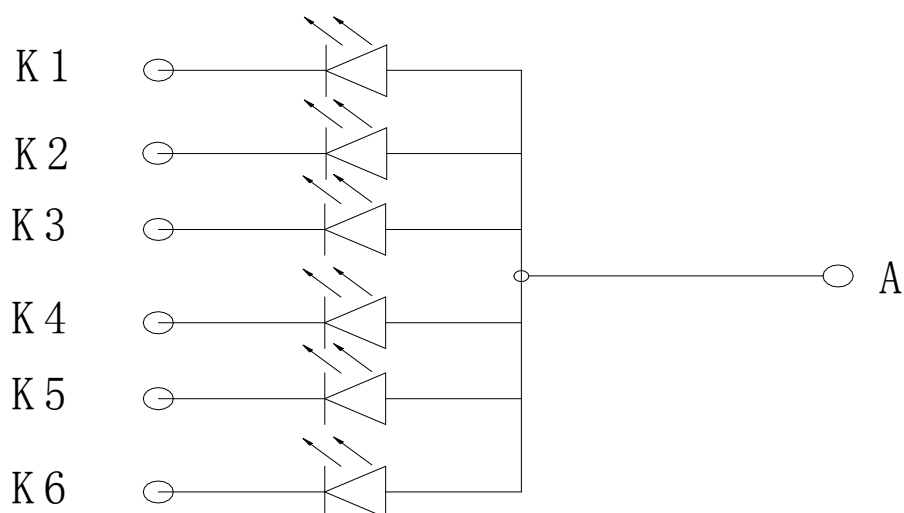


Signal	Symbol	Parameter	min	max	Unit	Description
DCX	tast	Address setup time	0	-	ns	-
	taht	Address hold time (Write/Read)	0	-	ns	-
CSX	tchw	CSX "H" pulse width	0	-	ns	-
	tcs	Chip Select setup time (Write)	15	-	ns	-
	trcs	Chip Select setup time (Read ID)	45	-	ns	-
	trcsfm	Chip Select setup time (Read FM)	355	-	ns	-
WRX	tcsf	Chip Select Wait time (Write/Read)	0	-	ns	-
	twc	Write cycle	50	-	ns	-
	twrh	Write Control pulse H duration	15	-	ns	-
RDX (FM)	twrl	Write Control pulse L duration	15	-	ns	-
	trcfm	Read Cycle (FM)	450	-	ns	When read from Frame Memory
	trdhfm	Read Control H duration (FM)	90	-	ns	
RDX (ID)	trdlfm	Read Control L duration (FM)	355	-	ns	
	trc	Read cycle (ID)	160	-	ns	When read ID data
	trdh	Read Control pulse H duration	90	-	ns	
	trdl	Read Control pulse L duration	45	-	ns	
DB[17:0], DB[15:0], DB[8:0] DB[7:0]	tdst	Write data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	tdht	Write data hold time	10	-	ns	
	trat	Read access time	-	40	ns	
	tratfm	Read access time	-	340	ns	
	trod	Read output disable time	20	80	ns	

Note: (1)  $T_a = -30$  to  $70^\circ\text{C}$ ,  $IOVCC=1.65\text{V}$  to  $3.6\text{V}$ ,  $V_{CI}=2.5\text{V}$  to  $3.6\text{V}$ ,  $AGND=DGND=0\text{V}$



## 8. Backlight Characteristics.



Item	Symbol	MIN	TYP	MAX	UNIT	Test Condition	Note
Supply Voltage	<b>V<sub>f</sub></b>	<b>3.0</b>	<b>3.2</b>	<b>3.4</b>	<b>V</b>	<b>I<sub>f</sub>=90 mA</b>	-
Supply Current	<b>I<sub>f</sub></b>	-	<b>90</b>	-	<b>mA</b>	-	-
Reverse Voltage	<b>V<sub>r</sub></b>	-	-	<b>5</b>	<b>V</b>	<b>10uA</b>	
Power dissipation	<b>P<sub>d</sub></b>	-	<b>282</b>	-	<b>mW</b>	-	
Luminous Intensity for LCM		<b>.260</b>	<b>300</b>	<b>340</b>	<b>Cd/m<sup>2</sup></b>	<b>I<sub>f</sub>=90 mA</b>	
Uniformity for LCM	-	<b>80</b>	-	-	<b>%</b>	<b>I<sub>f</sub>=90 mA</b>	
Life Time	-	<b>50000</b>	-	-	<b>Hr</b>	<b>I<sub>f</sub>=90 mA</b>	-
Backlight Color	<b>White</b>						

## 9.Optical Characteristics

Item		Symbol	Conditions	Specifications (typ)	Unit	Note
Transmittance		T%	Viewing normal angle $\theta_x = \theta_y = 0^\circ$	4.0	%	All left side data are based on CMI's following condition – 1.CG : NTSC 70% 2.AR : 67.5% 3.Light Source : CMI LED BLU 4.Machine : DMS 803 5. Vwhite > 5.0 V, Vdark < 0.4V 6. Polarizer : NPF-TEGQ1465DUHC
Contrast Ratio		CR		700	--	
Response Time		Ton+ Toff		30	ms	
Viewing Angle	Hor.	$\theta_{x+}$	Center CR>10	80	deg.	Under C light Simulation
		$\theta_{x-}$		80		
	Ver.	$\theta_{y+}$		80		
		$\theta_{y-}$		80		
CF only Chromaticity	Red	$X_R$	Viewing normal angle $\theta_x = \theta_y = 0^\circ$	0.654	--	
		$Y_R$		0.326	--	
	Green	$X_G$		0.271	--	
		$Y_G$		0.586	--	
	Blue	$X_B$		0.150	--	
		$Y_B$		0.083	--	
	White	$X_W$		0.306	--	
		$Y_W$		0.318	--	

\*Note (1) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

$$\text{Contrast Ratio (CR)} = L_{63} / L_0$$

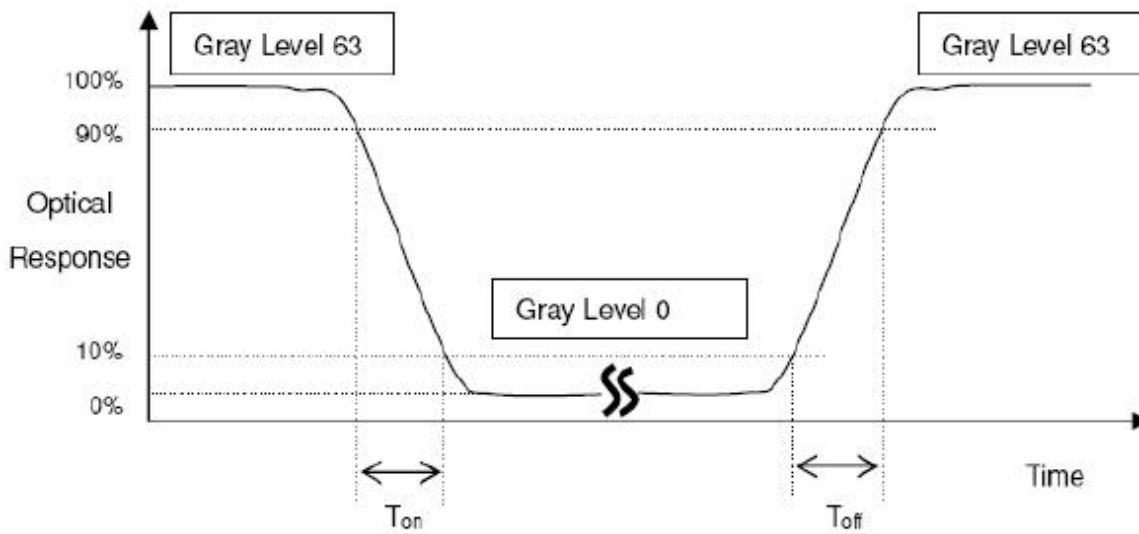
L63: Luminance of gray level 63

L0: Luminance of gray level 0

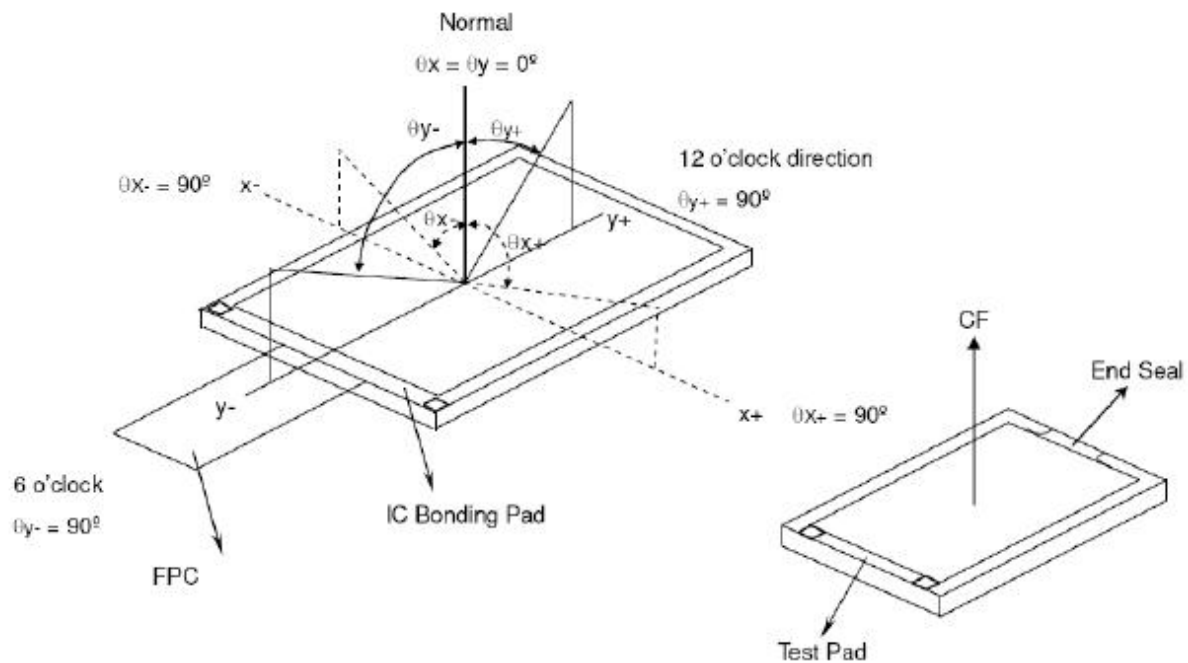
$$CR = CR (5)$$

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (5).

\*Note (2) Definition of Response Time (TR, TF):



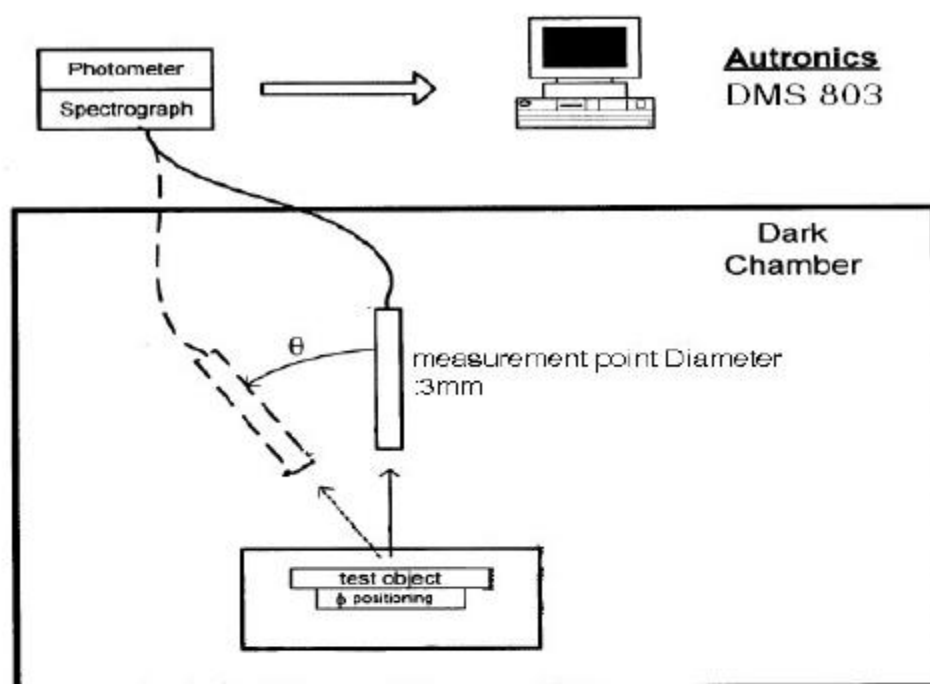
\*Note(3) Definition of Viewing Angle



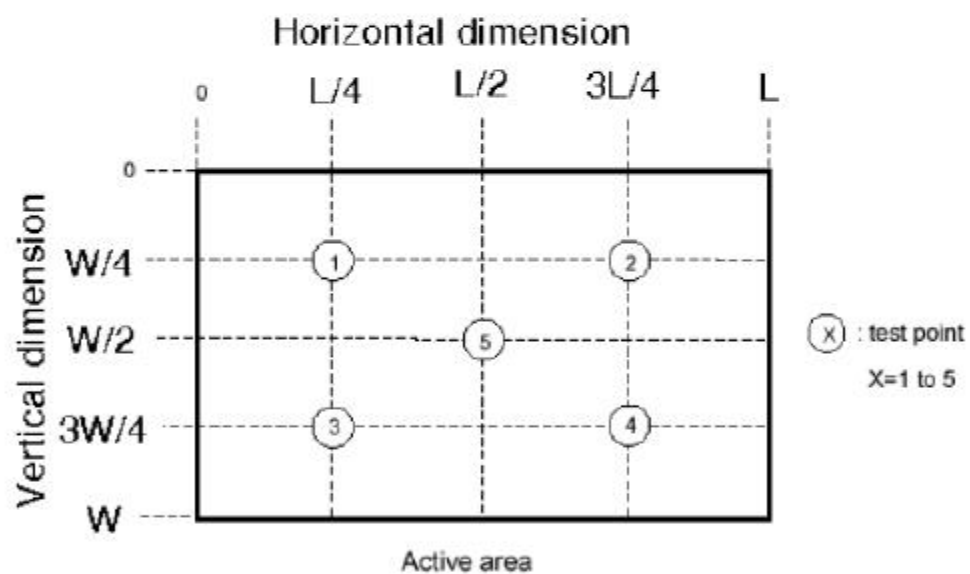
\*\*\* The above "Viewing Angle" is the measuring position with Largest Contrast Ratio; not for good image quality. View Direction for good image quality is Free. Module maker can increase the "Viewing Angle" by applying Wide View Film.

\*Note (4) Measurement Set-Up:

The LCD module should be stabilized at a 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 (5)





## 10. Reliability Test Conditions And Methods

N 0 .	TEST ITEMS	TEST CONDITION	INSPECTION AFTER TEST
①	High Temperature Storage	$80^{\circ}\text{C} \pm 2^{\circ}\text{C} \times 200\text{Hours}$	Inspection after 2~4hours storage at room temperature, the samples should be free from defects: 1, Air bubble in the LCD. 2, Sealleak. 3, Non-display. 4, Missing segments. 5, Glass crack. 6, Current IDD is twice higher than initial value. 7, The surface shall be free from damage. 8 The electric Characteristics requirements shall be satisfied.
②	Low Temperature Storage	$-30^{\circ}\text{C} \pm 2^{\circ}\text{C} \times 200\text{Hours}$	
③	High Temperature Operating	$70^{\circ}\text{C} \pm 2^{\circ}\text{C} \times 120\text{Hours}$	
④	Low Temperature Operating	$-20^{\circ}\text{C} \pm 2^{\circ}\text{C} / 120\text{Hours}$	
⑤	Temperature Cycle (Storage)	$-30^{\circ}\text{C} \pm 2^{\circ}\text{C} \longleftrightarrow 25^{\circ}\text{C} \longleftrightarrow 80^{\circ}\text{C} \pm 2^{\circ}\text{C}$ (30min) (5min) (30min) ← 1cycle → Total 10cycle	
⑥	Damp Proof Test	$50^{\circ}\text{C} \pm 5^{\circ}\text{C} \times 90\%\text{RH} \times 120\text{Hours}$	
⑦	Vibration Test	Frequency: $10\text{Hz} \sim 55\text{Hz} \sim 10\text{Hz}$ Amplitude: 1.5M X, Y, Z direction for total 3hours (Packing Condition)	
⑧	Drooping Test	Drop to the ground from 1M height one time every side of carton. (Packing Condition)	
⑨	ESD Test	Voltage: $\pm 8\text{KV}$ , R: $330\ \Omega$ , C: $150\text{PF}$ , Air Mode, 10times	

### REMARK:

- 1, The Test samples should be applied to only one test item.
- 2, Sample side for each test item is 5~10pcs.
- 3, For Damp Proof Test, Pure water (Resistance  $> 10\text{M}\ \Omega$ ) should be used.
- 4, In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judge as a good part.
- 5, EL evaluation should be excepted from reliability test with humidity and temperature: Some defects such as black spot/blemish can happen by natural chemical reaction with humidity and Fluorescence EL has.
- 6, Failure Judgment Criterion: Basic Specification Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

## ■ Inspection Standard

Defects are classified as major defects and minor defects according to the degree of defectiveness defined herein.

If the Customer has other agreements with Display Future Ltd for standards, please refer to that agreement.

### Inspection Condition

Room Temperature: 25±5°C.

Humidity: 65±5% RH. Illu-

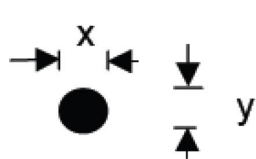
mination: 300 ~ 700 Lux.

Distance: 35±5 cm

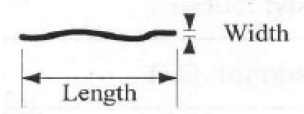
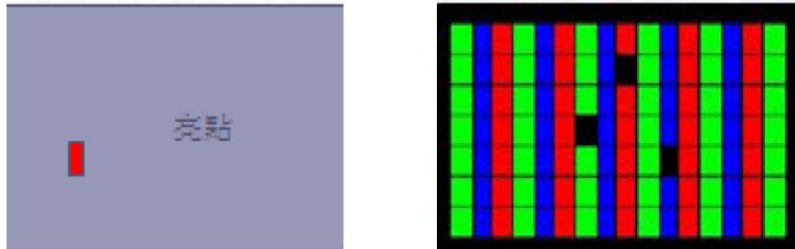
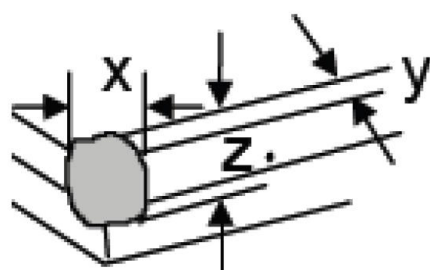
### Major defect.

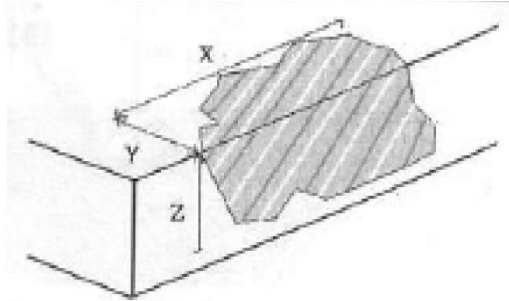
Item No	Items to be inspected	Inspection Standard
1	All functional defects	1) No display 2) Display abnormally 3) Short circuit 4) line defect
2	missing	Missing function component
3	Crack	Glass Crack

### Minor defect.

Item No	Items to be inspected	Inspection standard	
1	Spot Defect Including Black spot White spot Pinhole Foreign particle Polarizer dirt	For dark/white spot is defined:	
		$\varphi = (x + y) / 2$ 	
		Size $\varphi$ (mm)	Size $\varphi$ (mm)
		$\varphi \leq 0.15$	Ignore
		$0.15 < \varphi \leq 0.30$	3
		$0.30 < \varphi$	Not allowed

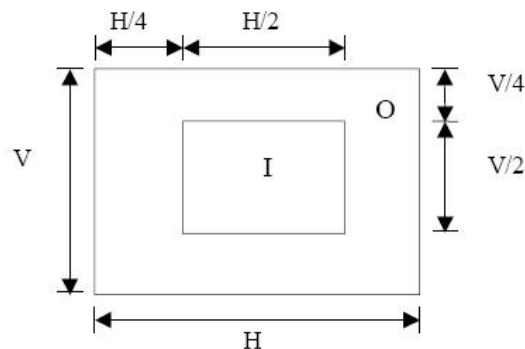


2	Line Defect Including Black line White line Scratch	Define:			
		Width(mm) Length(mm)	Acceptable Quantity		
		$W \leq 0.03$	Ignore		
		$0.03 < W \leq 0.05 \quad L \leq 4.0$	3		
		$0.03 < W \leq 0.08 \quad L \leq 4.0$	1		
3	Polarizer Dent/Bubble	Width(mm) Length(mm)	Acceptable Quantity		
		$\phi \leq 0.25$	Ignore		
		$0.2 < \phi \leq 0.3$	3		
		$0.3 < \phi \leq 0.5$	1		
		$0.5 < \phi$	0		
4.	Electrical Dot Defect	Bright and Black dot define:			
		Inspection pattern: Full white、Full black、Red、green and blue screens			
		Item	Acceptable Quantity		
			I area	O area	Total
		Black dot defect	1	3	3
		Bright dot defect	1	1	1
5	Glass defect	1.Corner Fragment:			
		Size(mm)	Acceptable Quantity		

		$X \leq 4.0\text{mm}$ $Y \leq 3.0\text{mm}$ $Z \leq T$	Ignore T: Glass thickness X: Length Y: Width Z: thickness
		2.Side Fragment: 	
		Size(mm)	Acceptable Quantity
		$X \leq 5.0\text{mm}$ $Y \leq 2.0\text{mm}$ $Z \leq T$	Ignore T: Glass thickness X: Length Y: Width $Z \leq T$ Z: thickness

## Note:

1. Dot defect is defined as the defective area of the dot area is larger than 50% of the dot area.
2. The distance between two bright dot defects (red, green, blue, and white) should be larger than 15mm.
3. The distance between black dot defects or black and bright dot defects should be more than 5mm apart.
4. The definitions of the inner display area  
And outer display area  
I: Inner display area  
O: Outer display area



## ■ PRECAUTIONS FOR USING LCD MODULES

### Handling Precautions

(1) The display panel is made of glass and polarizer. As glass is fragile. It tends to become or chipped during handling especially on the edges. Please avoid dropping or jarring. Do not subject it to a mechanical shock by dropping it or impact.

(2) If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.

(3) Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary. Do not touch the display with bare hands. This will stain the display area and degraded insulation between terminals (some cosmetics are determined to the polarizer).

(4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully. Do not touch, push or rub the exposed polarizers with anything harder than an HB pencil lead (glass, tweezers, etc.). Do not put or attach anything on the display area to avoid leaving marks on. Condensation on the surface and contact with terminals due to cold will damage, stain or dirty the polarizer. After products are tested at low temperature they must be warmed up in a container before coming is contacting with room temperature air.

(5) If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten cloth with one of the following solvents

- Isopropyl alcohol
- Ethyl alcohol

Do not scrub hard to avoid damaging the display surface.

(6) Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following.

- Water
- Ketone
- Aromatic solvents

Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading. Avoid contacting oil and fats.

(7) Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.

(8) Install the LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.

(9) Do not attempt to disassemble or process the LCD module.

(10) NC terminal should be open. Do not connect anything.

(11) If the logic circuit power is off, do not apply the input signals.

(12) Electro-Static Discharge Control, Since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC. To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

- Before remove LCM from its packing case or incorporating it into a set, be sure the module and your body have the same electric potential. Be sure to ground the body when handling the LCD modules.

- Tools required for assembling, such as soldering irons, must be properly grounded. make certain the AC power source for the soldering iron does not leak. When using an electric screwdriver to attach LCM, the screwdriver should be of ground potentiality to minimize as much as possible any transmission of electromagnetic waves produced sparks coming from the commutator of the motor.

- To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions. To reduce the generation of static electricity be careful that the air in the work is not too dried. A relative humidity of 50%-60% is recommended. As far as possible make the electric potential of your work clothes and that of the work bench the ground potential

- The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated

(13) Since LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive shocks to the module or making any alterations or modifications to it.

- Do not alter, modify or change the shape of the tab on the metal frame.
- Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.
- Do not damage or modify the pattern writing on the printed circuit board.
- Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector.
- Except for soldering the interface, do not make any alterations or modifications with a soldering iron.
- Do not drop, bend or twist LCM.

#### Handling precaution for LCM

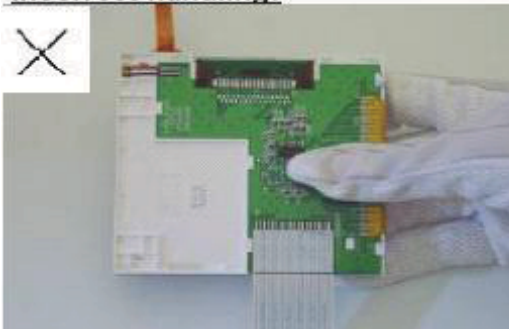
LCM is easy to be damaged.  
Please note below and be careful for handling!

##### **Correct handling:**

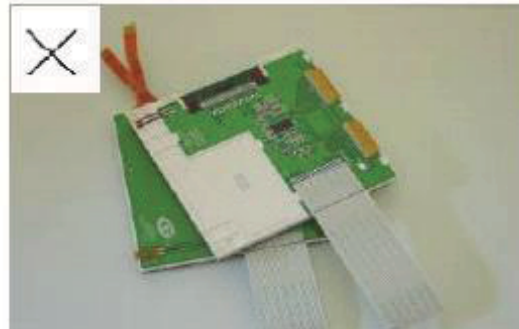


As above picture, please handle with anti-static gloves around LCM edges.

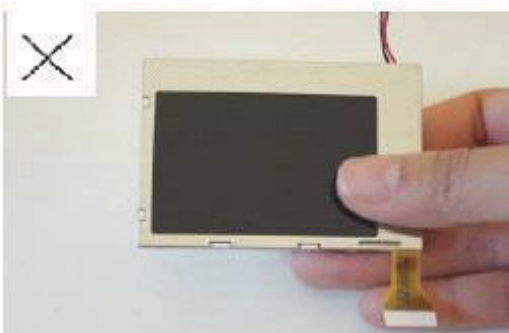
##### **Incorrect handling:**



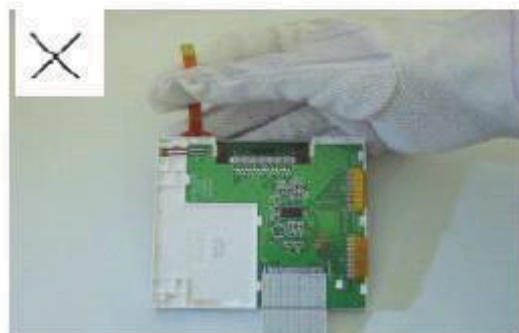
Please don't touch IC directly.



Please don't stack LCM.



Please don't hold the surface of panel.

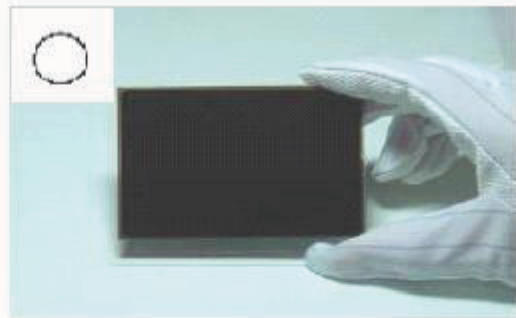


Please don't stretch interface of output, such as FPC cable.

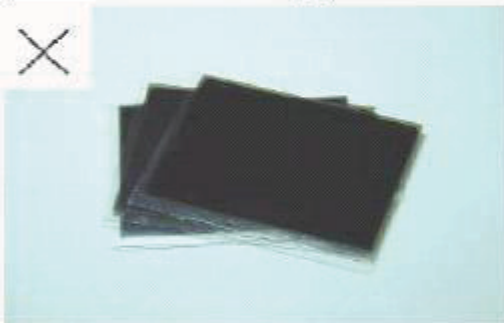
**Handling precaution for LCD**

LCD is easy to be damaged.

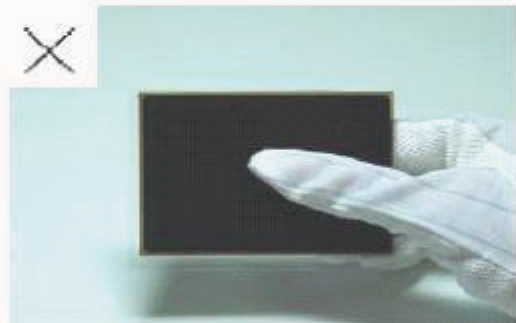
Please note below and be careful for handling!

**Correct handling:**

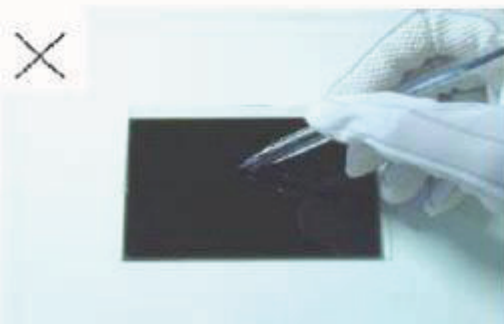
As above photo, please handle with anti-static gloves around LCD edges.

**Incorrect handling:**

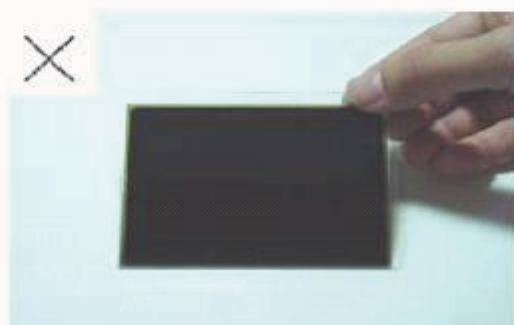
Please don't stack the LCDs.



Please don't hold the surface of LCD.



Please don't operate with sharp stick such as pens.



Please don't touch ITO glass without anti-static gloves.



## Storage Precautions

When storing the LCD modules, the following precaution is necessary.

- (1) Store them in a sealed polyethylene bag. If properly sealed, there is no need for the dessicant.
- (2) Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0°C and 35°C, and keep the relative humidity between 40%RH and 60%RH.
- (3) The polarizer surface should not come in contact with any other objects. (We advise you to store them in the anti-static electricity container in which they were shipped.

### Others

Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.

If the LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be regained by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.

To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity etc., exercise care to avoid holding the following sections when handling the modules.

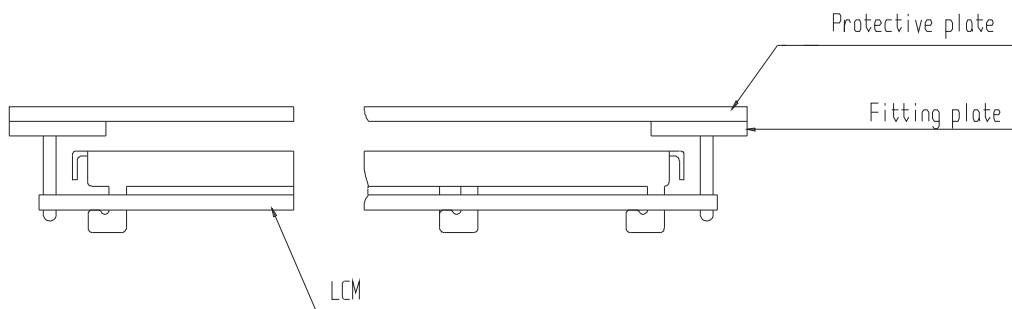
- Exposed area of the printed circuit board.
- Terminal electrode sections.

## USING LCD MODULES

### Installing LCD Modules

The hole in the printed circuit board is used to fix LCM as shown in the picture below. Attend to the following items when installing the LCM.

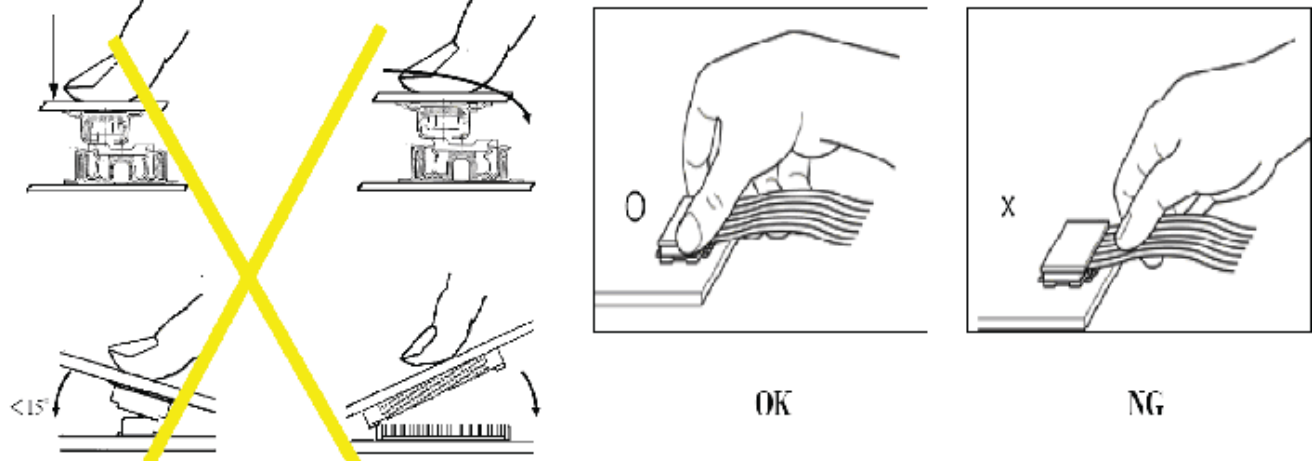
- (1) Cover the surface with a transparent protective plate to protect the polarizer and LC cell.



- (2) When assembling the LCM into other equipment, the spacer to the bit between the LCM and the fitting plate should have enough height to avoid causing stress to the module surface, refer to the individual specifications for measurements. The measurement tolerance should be  $\pm 0.1$ mm.

### Precaution for assemble the module with BTB connector:

Please note the position of the male and female connector position, don't assemble or assemble like the method which the following picture shows



**Precaution for soldering to the LCM**

	Hand soldering	Machine drag soldering	Machine press soldering
No ROHS product	290°C ~350°C. Time : 3-5S.	330°C ~350°C. Speed : 4-8 mm/s.	300°C ~330°C. Time : 3-6S. Press: 0.8~1.2Mpa
ROHS product	340°C ~370°C. Time : 3-5S.	350°C ~370°C. Time : 4-8 mm/s.	330°C ~360°C. Time : 3-6S. Press: 0.8~1.2Mpa

(1) If soldering flux is used, be sure to remove any remaining flux after finishing to soldering operation. (This does not apply in the case of a non-halogen type of flux.) It is recommended that you protect the LCD surface with a cover during soldering to prevent any damage due to flux spatters.

(2) When soldering the electroluminescent panel and PC board, the panel and board should not be detached more than three times. This maximum number is determined by the temperature and time conditions mentioned above, though there may be some variance depending on the temperature of the soldering iron.

(3) When remove the electroluminescent panel from the PC board, be sure the solder has completely melted, the soldered pad on the PC board could be damaged.

**Precautions for Operation**

(1) Viewing angle varies with the change of liquid crystal driving voltage (VLCD). Adjust VLCD to show the best contrast.

(2) It is an indispensable condition to drive LCD's within the specified voltage limit since the higher voltage then the limit cause the shorter LCD life. An electrochemical reaction due to direct current causes LCD's undesirable deterioration, so that the use of direct current drive should be avoided.

(3) Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them. However those phenomena do not mean malfunction or out of order with LCD's, Which will come back in the specified operating temperature.

(4) If the display area is pushed hard during operation, the display will become abnormal. However, it will return to normal if it is turned off and then back on.

(5) A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit. Usage under the maximum operating temperature, 50%RH or less is required.

(6) Input each signal after the positive/negative voltage becomes stable.

(7) Please keep the temperature within specified range for use and storage. Polarization degradation, bubble generation or polarizer peel-off may occur with high temperature and high humidity.

**Safety**

(1) It is recommended to crush damaged or unnecessary LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.

(2) If any liquid leaks out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

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**Limited Warranty**

Unless agreed otherwise between Display Future Ltd and customer, Display Future will replace or repair any of its LCD modules which are found to be functionally defective when inspected in accordance with LCD acceptance standards (copies available upon request) for a period of one year from date of production. Cosmetic/visual defects must be returned within 90 days of the shipment. Confirmation of such date shall be based on data code on the product.

The warranty liability of Display Future limited to repair and/or replacement on the terms set forth above. Display Future will not be responsible for any subsequent or consequential events.

**Return LCM under warranty**

No warranty can be granted if the precautions stated above have been disregarded. The typical examples of violations are :

- Broken LCD glass.
- PCB eyelet is damaged or modified.
- PCB conductors damaged.
- Circuit modified in any way, including addition of components.
- PCB tampered with by grinding, engraving or painting varnish.
- Soldering to or modifying the bezel in any manner.

Module repairs will be invoiced to the customer upon mutual agreement. Modules must be returned with sufficient description of the failures or defects. Any connectors or cable installed by the customer must be removed completely without damaging the PCB eyelet, conductors and terminals.

**■ PRIOR CONSULT MATTER**

- 1.①For Display Future standard products, we keep the right to change material and processes for improving the product, without notice to our customers.  
②For OEM products, if any change is needed, which may affect the product property, we will consult with our customer in advance.
2. If you have special requirement about reliability condition, please let us know before you start the test on our samples.