Display Future Ltd
www.displayfuture.com

LCD MODULE SPECIFICATION

Model: DF-TFN0145FB-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	

Revision record

VEV NO.	REV DATE	CONTENTS	Note
V1.0	**2014-11-24**	**NEW ISSUE**	

1. General Description

1.1 Description

DF-TFN0145FB-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-TFN0145FB-F1.

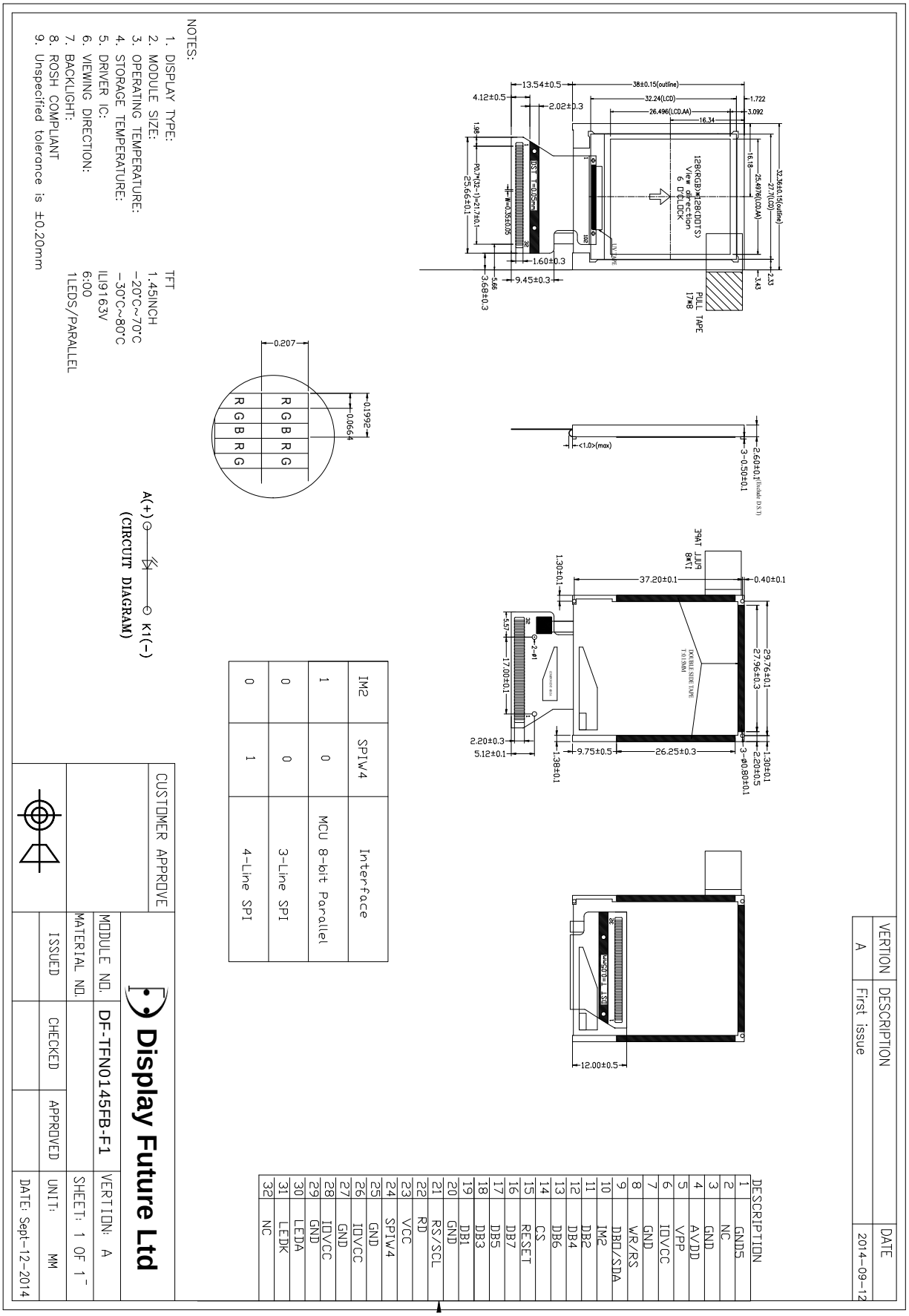
1.2 Application

Mobile phone, Multimedia products
and other electronic Products
Etc.

1.3 Features:

Features	Description	UNITS
LCD type	1.44"TFT	--
Dot arrangement	128（RGB）×128	dots
Driver IC	ILI9163V	--
Color Depth	65K	
Interface	CPU 8 bits/SPI	
Module size	32.36(W) ×38.00 (H)×2.60(T)	mm
Active area	25.4976(W) ×26.496(H)	mm
Dot pitch	0.1992 (W) ×0.207 (H)	mm
Back Light	1 White LED	--
With/Without TSP	Without TSP	
Weight(g)	TBD	

2. External Dimensions



3. Interface Description

PIN NO.	PIN NAME	DESCRIPTION
1	GND5	Ground.
2	NC	No Connection
3	GND	Ground.
4	AVDD	A power output pin for source driver block that is generated from power block.Connect a capacitor for stabilization.
5	VPP	Power supply When programming NVM,if not use ,please let this pin open
6	IOVCC	Power supply for interface logic circuits
7	GND	Ground.
8	WR/RS	Write enable in parallel interface WR: for 8080 MCU RS: for 4-wire SPI If not use,please connect to GND or IOVCC.
9	DB0/SDA	MCU Data Bus for D0/ SDA in SPI interface mode.
10	IM2	MCU Parallel interface bus and Serial interface select IM2='1';Parallel Interface IM2='0';Serial Interface
11	DB2	MCU Data Bus for DB2.
12	DB4	MCU Data Bus for DB4.
13	DB6	MCU Data Bus for DB6.
14	CS	Chip select input pin ("Low" enable).
15	RESET	Chip reset pin ("Low Active").
16	DB7	MCU Data Bus for DB7.
17	DB5	MCU Data Bus for DB5.
18	DB3	MCU Data Bus for DB3.
19	DB1	MCU Data Bus for DB1.
20	GND	Ground.
21	RS/SCL	Display data/Command selection pin in parallel and SCL in 3-pin SPI interface.If not used, please connect this pin to GND.
22	RD	Read enable in 8080-parallel interface
23	VCC	Power supply for analog circuit.
24	SPIW4	SPI interface selection pin SPI4W='0': 3-wire SPI. (default) SPI4W='1': 4-wire SPI.
25	GND	Ground.
26	IOVCC	Power supply for interface logic circuits
27	GND	Ground.
28	IOVCC	Power supply for interface logic circuits
29	GND	Ground.
30	LEDA	Power supply for LED backlight Anode input.
31	LEDK	Power supply for LED backlight Cathode input.
32	NC	No Connection

4. Absolute Maximum Ratings

The absolute maximum rating is listed on following table. When ILI9163V is used out of the absolute maximum ratings, the ILI9163V may be permanently damaged. To use the ILI9163V within the following electrical characteristics limit is strongly recommended for normal operation. If these electrical characteristic conditions are exceeded during normal operation, the ILI9163V will malfunction and cause poor reliability.

Item	Symbol	Unit	Value Note
Supply voltage	VCI	V	-0.3 ~ + 4.0
Supply voltage (Logic)	VDDI	V	-0.3 ~ + 3.3
Supply voltage (Digital)	VCC	V	-0.3 ~ + 2.0
Driver supply voltage	VGH-VGL	V	-0.3 ~ + 33.0
Logic input voltage range	VIN	V	-0.3 ~ VDDI + 0.3
Logic output voltage range	VO	V	-0.3 ~ VDDI + 0.3
Operating temperature	Topr	°C	-40 ~ + 85
Storage temperature	Tstg	°C	-55 ~ + 110
Notes: If the absolute maximum rating of even is one of the above parameters is exceeded even momentarily, the quality of the product may be degraded. Absolute maximum ratings, therefore, specify the values exceeding which the product may be physically damaged. Be sure to use the product within the range of the absolute maximum ratings.			

5. Electrical Characteristics

Item	Symbol	Unit	Condition	Min.	Typ.	Max.	Note
Power & Operation Voltage							
Analog Operating voltage	VCI	V	Operating voltage	2.5	2.78	4.0	Note2
Logic Operating voltage	VDDI	V	I/O supply voltage	1.65	1.8/2.78	3.3	Note2
Digital Operating voltage	VCC	V	Digital supply voltage		1.8		Note2
Gate Driver High voltage	VGH	V		10.0		16.0	Note3
Gate Driver Low voltage	VGL	V		-16.0		-7.5	Note3
Driver Supply voltage		V	| VGH-VGL |	19		32	Note3
Input/Output							
Logic High level input voltage	VIH	V		0.7VDDI		VDDI	Note1,2,3
Logic Low level input voltage	VIL	V		VSS		0.3VDDI	Note1,2,3
Logic High level output voltage	VOH	V	IOH = -1.0mA	0.8VDDI		VDDI	Note1,2,3
Logic High level output voltage	VOL	V	IOL = 1.0mA	VSS		0.2VDDI	Note1,2,3
Logic input leakage current	IIL	µA	VIN = VDDI or VSS	-0.1		+0.1	Note1,2,3
Sleep in current consumption	I_{SLP}	µA	VCI=VDDI=2.8V , Ta=25 °C			70	Note1,2,3
VCOM Operation							

VCOM High voltage	VCOMH	V	Ccom=12nF	2.5		5.0	Note 3
VCOM Low voltage	VCOML	V	Ccom=12nF	-2.5		0.0	Note 3
VCOM Amplitude voltage	VOMA	V	| VCOMH-VCOML |	4.0		5.5	Note 3
Source Driver							
Source output range	Vsout	V		0.1		AVDD-0.1	Note4
Gamma reference voltage	GVDD	V		3.0		5.0	Note3

Note 1: VDDI=1.65 to 3.3V, VCI=2.5 to 4.0V, AGND=GND=0V, Ta=-30 to 70℃ (to +85℃ no damage)

Note2: Please supply digital VDDI voltage equal or less than analog VCI voltage. (VDDI≤VCI)

Note2,3,4: When the measurements are performed with LCD module. Measurement Points are like below.

Note3: CSX, RDX, WRX, D[23:0], D/CX, RESX, TE, PCLK, VS, HS, DE, SDA, SCL, GM2, GM1, GM0, RCM1, RCM0, P68, IM2, IM1, IM0, SRGB, REV, SMX, SMY, RL, TB, IDM, SHUT, PREG, GS and Test pins.

Note5: Source channel loading = 10pF/channel, Gate channel loading = 50pF/channel

6.Timing Characteristics.

6.1 Reset Timing Characteristics.

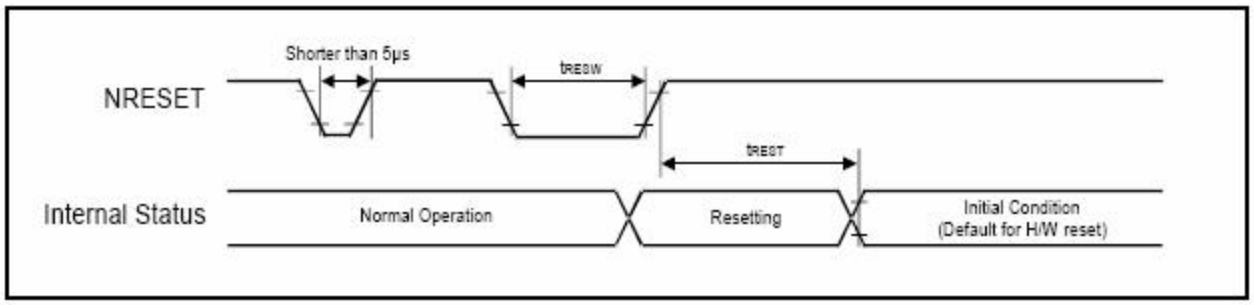


Figure 11. 6 Reset Input Timing

Symbol	Parameter	Related Pins	Min.	Typ.	Max.	Note	Unit
tRESW	Reset low pulse width(1)	NRESET	10	-	-	-	µs
tREST	Reset complete time(2)	-	-	-	5	When reset applied during Sleep In mode	ms
		-		-	120	When reset applied during Sleep Out mode	ms

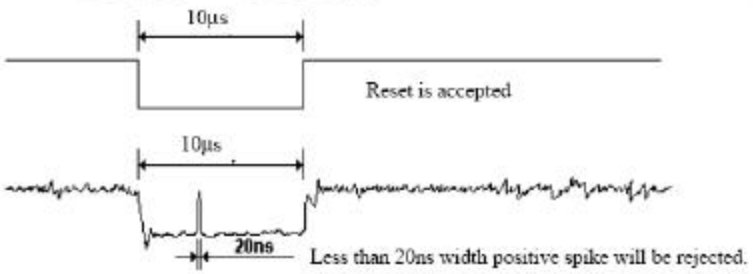
Note: (1) Spike due to an electrostatic discharge on !RES line does not cause irregular system reset according to the following table.

NRESET Pulse	Action
Shorter than 5µs	Reset Rejected
Longer than 10µs	Reset
Between 5µs and 10µs	Reset Start

(2) 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 H/W reset.

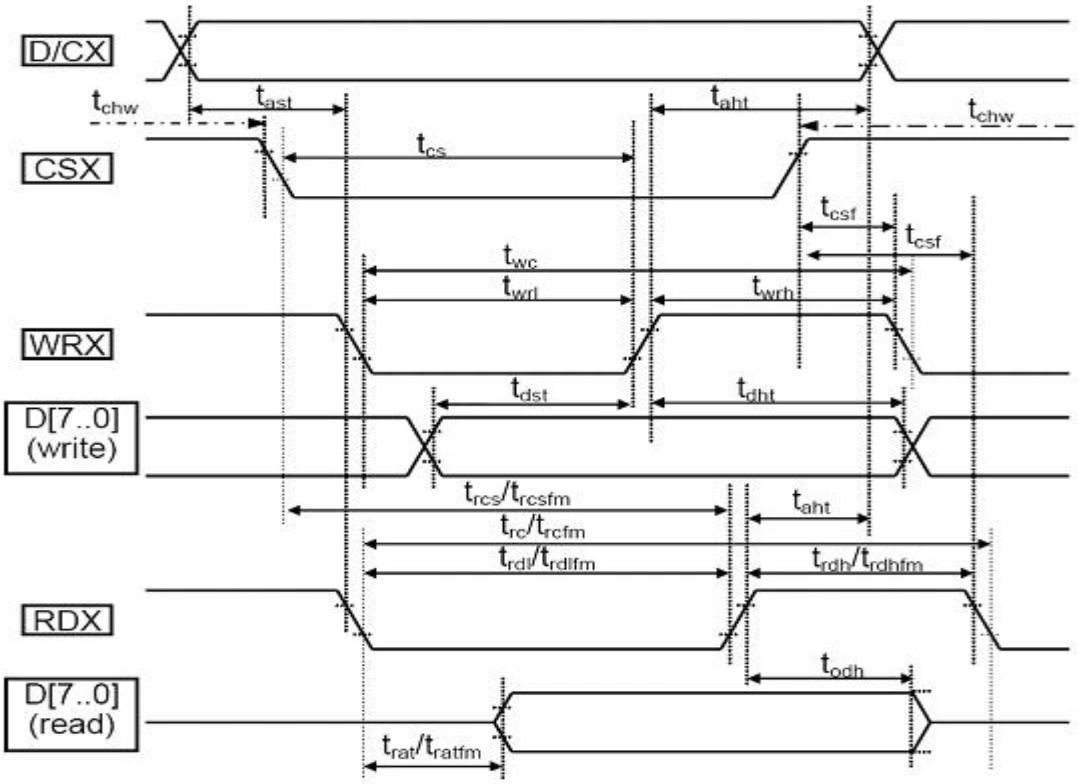
(3) During Reset Complete Time, ID2 and VCOMOF value in OTP will be latched to internal register during this period. This loading is done every time when there is H/W reset complete time (tREST) within 5ms after a rising edge of RESET.

(4) Spike Rejection also applies during a valid reset pulse as shown as below:



(5) It is necessary to wait 5msec after releasing RESET before sending commands. Also Sleep Out command cannot be sent for 120ms.

6.2. i80-System Interface Timing Characteristics.



Note: Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

Table AC characteristics of parallel CPU I/F in asynchronous mode

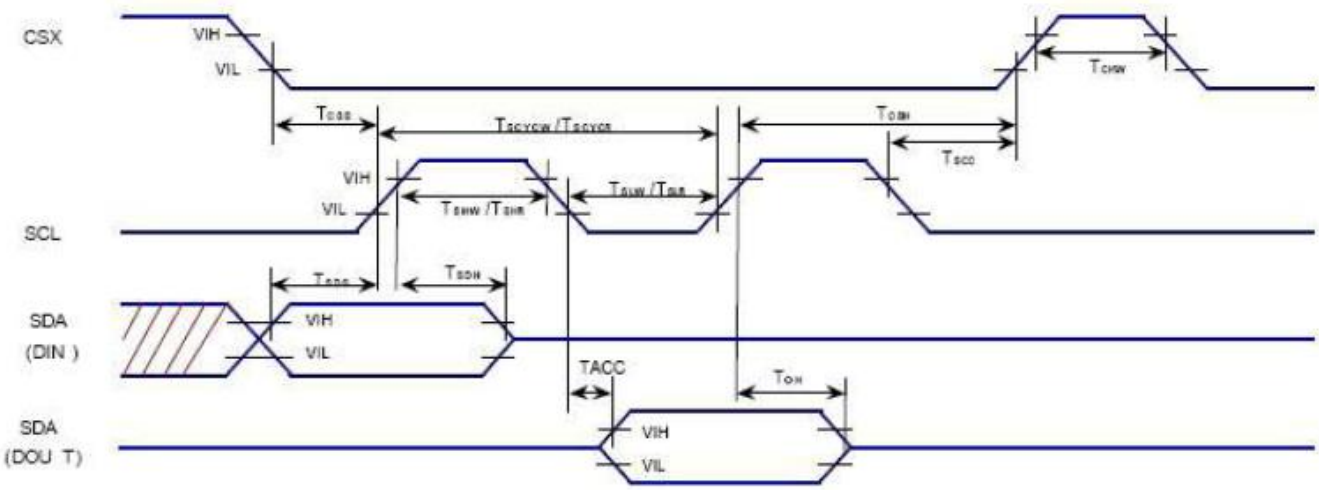
Signal	Symbol	Parameter	min	max	unit	description
D/CX	tast	Address setup time	0		ns	
	taht	Address hold time(Write/Read)	10		ns	
CSX	tchw	"S""H" Pulse Widtch	0		ns	
	tcs	Chip Select setup time (Write)	10		ns	
	trcs	Chip Select setup time (Read ID)	45		ns	
	trcsfm	Chip Select setup time (Read FM)	355		ns	
	tcsf	Chip Select Wait time(Write/read)	10		ns	
WRX	twc	Write cycle	66		ns	
	twrh	Controlpulse H duration	15		ns	
	twrl	Control pulse L duration	15		ns	
RDX	trc	Read cycle (ID)	160		ns	When read ID

	trdh	Control pulse H duration(ID)	90		ns	data
	trdl	Control pulse L duration(ID)	45		ns	
RDX	trcfm	Read cycle (FM)	450		ns	When read from frame memory
	trdhfm	Control pulse H duration (FM)	90		ns	
	trdlfm	Control pulse L duration (FM)	355		ns	
D[17..0]	tdst	Data setup time	10		ns	For maximum CL = 30pF For minimum CL = 8pF
	tdht	Data hold time	10		ns	
	trat	Read access time (ID)		40	ns	
	tratfm	Read access time (FM)		340	ns	
	todh	Output disable time	20	80	ns	

Note 1: VDDI 1.65 to 3.3V, VPNL=2.6 to 3.3V, AGND=GND=0V, Ta=-30 to 70 ℃ (to +85℃ no damage)

Note 2: This input signal rise time and fall time (tr, tf) is specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for input signals

6.3 3-pin Serial Interface Timing Characteristics.



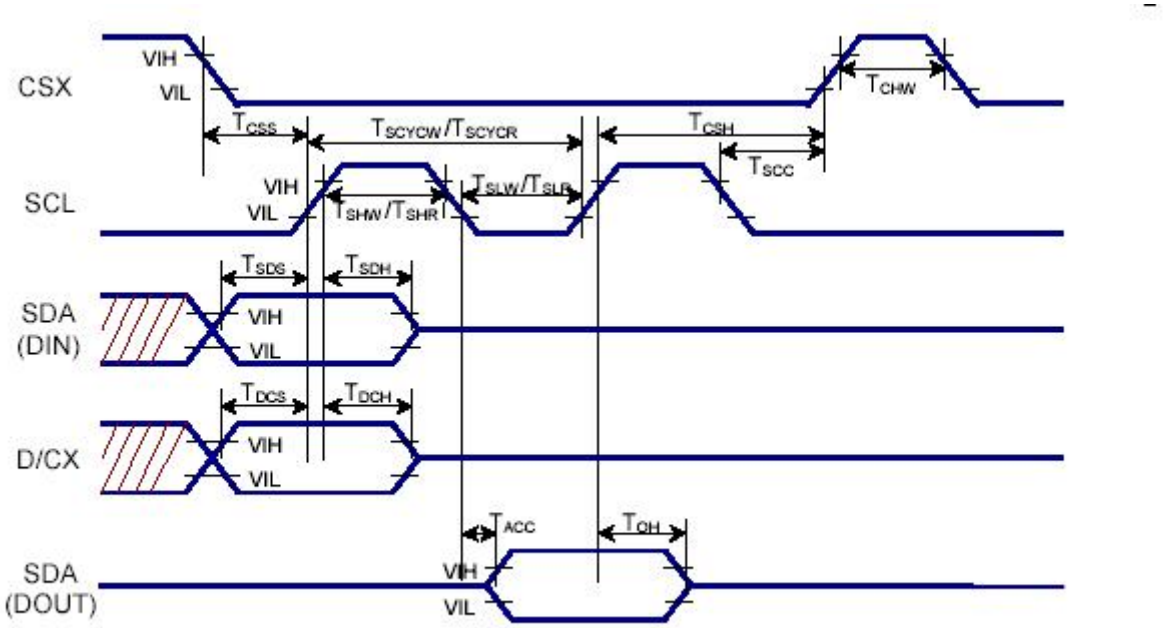
Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	TCSS	Chip select setup time	10		ns	
	TCSH	Chip select hold time	30		ns	
	TCHW	Chip select "H" pulse width	30		ns	
SCL	TSCYCW	Serial clock cycle(Write)	66		ns	
	TSHW	S"L""H" pulse width(Write)	15		ns	
	TSLW	S"L""L" pulse width(Write)	15		ns	
	TSCYCR	Serial clock cycle(Read)	150		ns	
	TSHR	S"L""H" pulse width(Read)	60		ns	
	TSLR	S"L""L" pulse width(Read)	60		ns	
SDA(DIN) (DOUT)	TSDS	Data setup time	5		ns	
	TSDH	Data hold time	5		ns	
	TACC	Access time	5	50	ns	For maximum CL = 30pF
	TOH	Output disable time	10		ns	For minimum CL = 8pF

Note 1: VDDI=1.65 to 3.3V, VCI=2.6 to 3.3V, AGND=GND=0V. Ta=-30 to 70℃ (to +85℃ no damage)

Note 2 : The input signal rise time and fall time(tr, tf) is specified at 15 ns or less.

Logic high and low levels are specified as 10% and 90% of VDDI for Input signals.

6.4 4-pin Serial Interface Timing Characteristics.



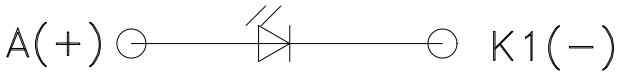
Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	TCSS	Chip select setup time	10		ns	
	TCSH	Chip select hold time	30		ns	
	TCHW	Chip select "H" pulse width	30		ns	
SCL	TSCYCW	Serial clock cycle(Write)	66		ns	
	TSHW	S"L""H" pulse width(Write)	15		ns	
	TSLW	S"L""L" pulse width(Write)	15		ns	
	TSCYCR	Serial clock cycle(Read)	150		ns	
	TSHR	S"L""H" pulse width(Read)	60		ns	
	TSLR	S"L""L" pulse width(Read)	60		ns	
D/CX	TDCS	D/CX setup time	5		ns	
	TDCH	D/CX hold time	5		ns	
SDA(DIN) (DOUT)	TSDS	Data setup time	5		ns	
	TSDH	Data hold time	5		ns	
	TACC	Access time	5	50	ns	For maximum CL = 30pF
	TOH	Output disable time	10		ns	For minimum CL = 8pF

Note 1: VDDI=1.65 to 3.3V, VCI=2.6 to 3.3V, AGND=GND=0V. Ta=-30 to 70℃ (to +85℃ no damage)

Note 2 : The input signal rise time and fall time(tr, tf) is specified at 15 ns or less.

Logic high and low levels are specified as 10% and 90% of VDDI for Input signals.

7. Backlight Characteristics.



(CIRCUIT DIAGRAM)

Item	Symbol	MIN	TYP	MAX	UNIT	Test Condition	Note
Supply Voltage	**Vf**	**3.0**	**3.2**	**3.4**	**V**	**If=15 mA**	**-**
Supply Current	**If**	**-**	**15**	**-**	**mA**	**-**	**-**
Reverse Voltage	**Vr**	**-**	**-**	**5**	**V**	**10uA**	
Power dissipation	**Pd**	**-**	**48**	**-**	**mW**	**-**	
Luminous Intensity for LCM		**120**	**140**	**-**	**Cd/m2**	**If=15 mA**	
Uniformity for LCM	**-**	**80**	**-**	**-**	%	**If=15 mA**	
Life Time	**-**	**50000**	**-**	**-**	**Hr**	**If=15 mA**	**-**
Backlight Color	**White**						

8.Optical Characteristics

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Transmittance (without Polarizer)		T(%)	—	—	17.5	—	—	
Contrast Ratio		CR	Θ=0 Normal viewing angle	400	500	—	—	(1)(2) Measuring with EWV Polarizer，Reference Only
Response time	Rising	T_R	—	—	4	8	msec	(1)(3)
	Falling	T_F		—	12	24		
Color gamut		S(%)			53		%	
Color chromaticity (CIE1931)	White	W_x		0.273	0.293	0.313		(1)(4) CF glass
		Wy		0.305	0.325	0.345		
	Red	Rx		0.616	0.636	0.656		
		Ry		0.308	0.328	0.348		
	Green	Gx		0.263	0.283	0.303		
		Gy		0.511	0.531	0.551		
	Blue	Bx		0.115	0.135	0.155		
		By		0.114	0.134	0.154		
Viewing angle	Hor.	$Θ_L$	CR>10	60	70	—		Measuring with EWV Polarizer，Reference Only
		$Θ_R$		60	70	—		
	Ver.	$Θ_U$		60	70	—		
		$Θ_D$		50	60	—		
Optima View Direction		12 O'clock						(5)

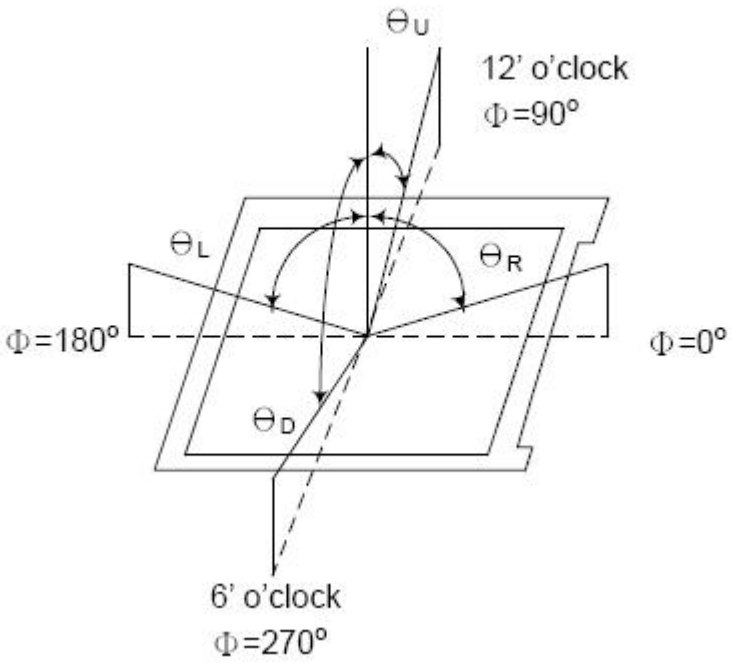
Measuring Condition

- Measuring surrounding : dark room
- Ambient temperature : 25±2°C
- 15min. warm-up time.

Measuring Equipment

- FPM520 of Westar Display technologies, INC., which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics.

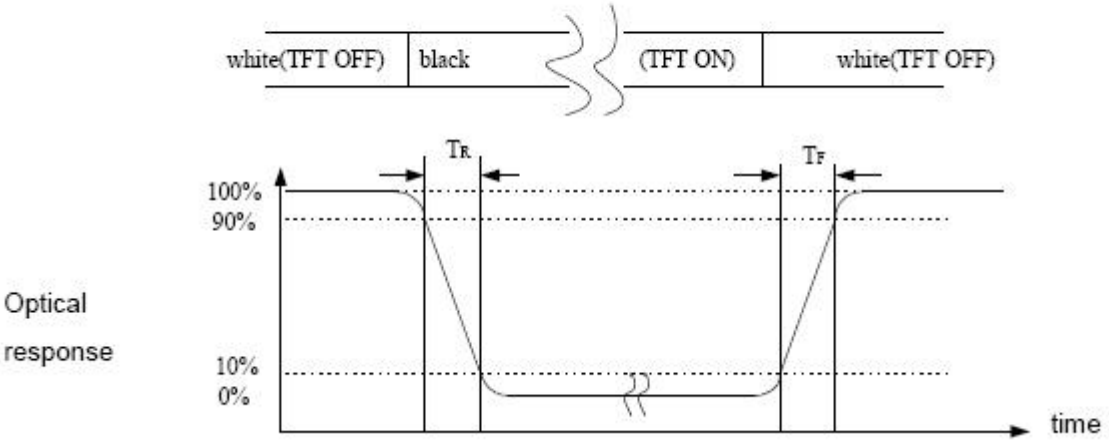
Note (1) Definition of Viewing Angle :



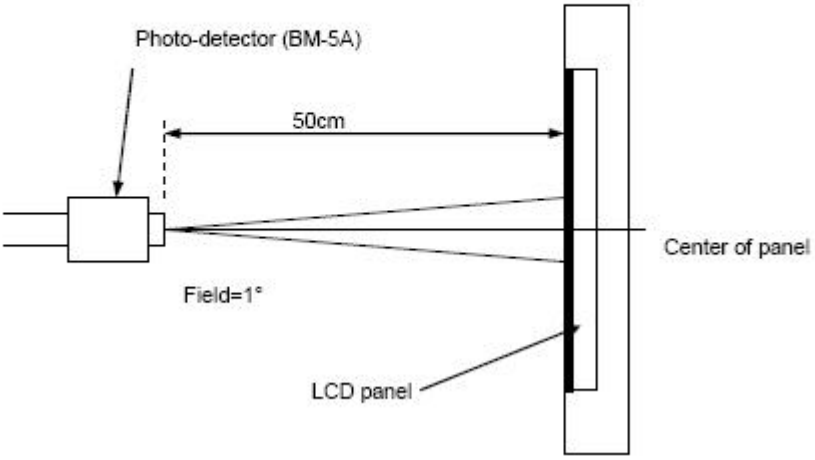
Note (2) Definition of Contrast Ratio(CR) :
measured at the center point of panel

$$CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$

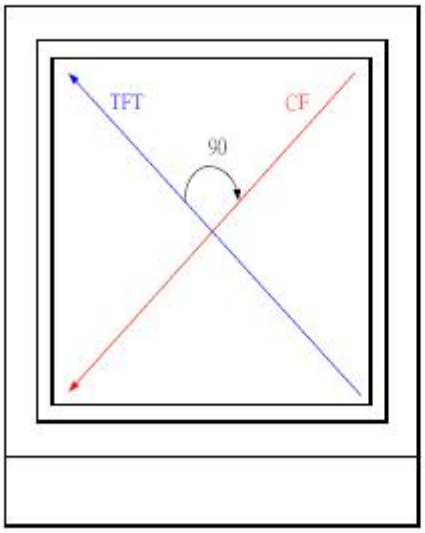
Note (3) Definition of Response Time : Sum of T_R and T_F



Note (4) Definition of optical measurement setup



Note (5) Rubbing Direction (The different Rubbing Direction will cause the different view direction.



TFT Face up

9. Reliability Test Conditions And Methods

NO.	TEST ITEMS	TEST CONDITION	INSPECTION AFTER TEST
①	High Temperature Storage	80℃±2℃×240Hours	Inspection after 2~4hours storage at room temperature, the samples should be free from defects: 1,Air bublle 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℃±2℃×240Hours	
③	High Temperature Operation	70℃±2℃×240Hours	
④	Low Temperature Operation	-20℃±2℃/240Hours	
⑤	Thermal Shock (Non-Operation)	-20℃±2℃ ⟺ 25℃ ⟺ 70℃±2℃ (30min) (5min) (30min) 1cycle Total 10cycle	
⑥	High Temperature and High Humidity Storage	40℃±5℃×90%RH×240Hours	
⑦	Electro Static Discharge (Operation)	C=150pF,R=330Ω， oints/panel Air:±8KV,5 times Contact:±4KV,5 times (Environment:15℃~35℃, 30%~60%,86Kpa~106Kpa)	
⑧	Vibration (Non-Operation)	Frequency:10Hz~55Hz~10Hz Amplitude:1.5M X,Y,Z direction for total 3hours (Packing Condition)	
⑨	Package Drop Test	Height:80cm 1 corner,3 edges,6 surfaces.	

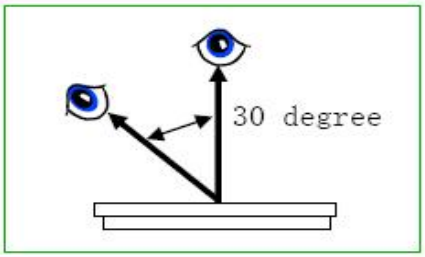
REMARK:
1,The Test samples should be applied to only one test item.
2,Sample side for each test item is 5~10pcs.
3,For Damp Proof Test,Pure water(Resistance＞10MΩ)should be used.
4, In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be 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.

10.Inspection Standard

This standard apply to TFT module specification.

1. Inspection condition:

Under daylight lamp 20~40W, product distance inspector'eye 30cm,incline degree 30° 。



2. Inspection standard

<table>
<tr><th>NO.</th><th>Item</th><th>Inspection standard</th><th>Rate</th></tr>
<tr><td>2.1</td><td>Dot</td><td>Case of Dot defect is below
① Bright Dot (whit spot) : “0”
② Dark Dot (black spot) : “0” (In case of Dark Dot on Main TFT LCD)
- NG if there's full Dot defect.
- Damaged less than the size of sub-pixel is not counted as defect
- Dots darker than the size of sub-pixel are not defined as bright dot defect

<table><tr><th>area
size （mm）</th><th>Acceptable number</th></tr><tr><td>Φ≤0.10</td><td>ignore</td></tr><tr><td>0.10＜Φ≤0.15</td><td>3</td></tr><tr><td>0.15＜Φ≤0.20</td><td>2</td></tr><tr><td>0.25＜Φ≤0.25</td><td>1</td></tr><tr><td>0.25＜Φ</td><td>0</td></tr></table></td><td rowspan="2">minor</td></tr>
<tr><td>2.2</td><td>line</td><td><table><tr><th colspan="2">Size （mm）</th><th>Acceptable number</th></tr><tr><td>ignore</td><td>W≤0.03</td><td>ignore</td></tr><tr><td>L≤4.0</td><td>0.03＜W≤0.04</td><td>2</td></tr><tr><td>L≤4.0</td><td>0.04＜W≤0.05</td><td>1</td></tr><tr><td></td><td>0.05＜W</td><td>Treat with dot non-conformance</td></tr></table></td></tr>
</table>

■ PRECAUTIONS FOR USING LCD MODULES

Handing 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

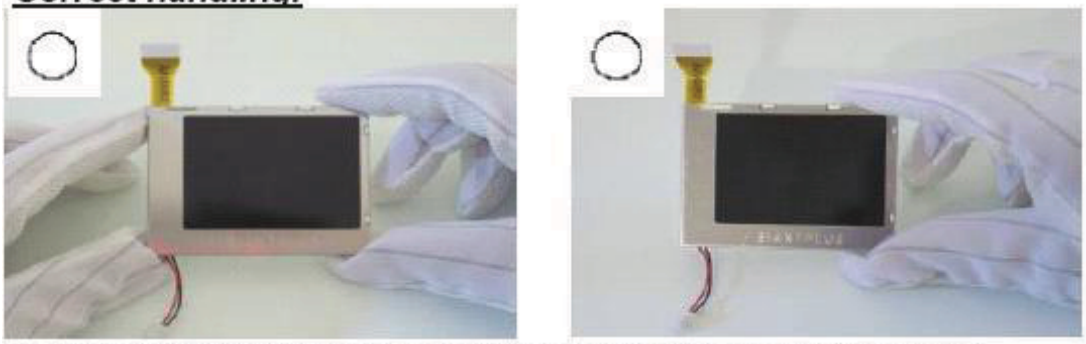
（13）Since LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive shocks to the module or making any alterations or modifications to it.

- 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

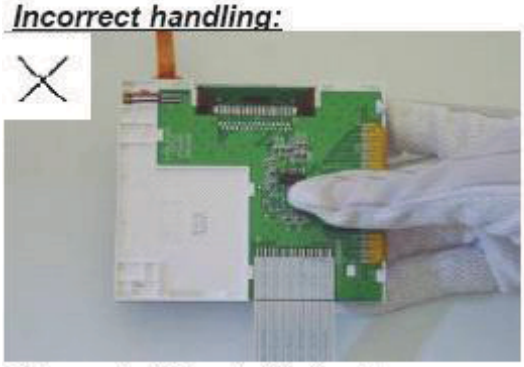
LCM is easy to be damaged.
Please note below and be careful for handling!

Correct handling:

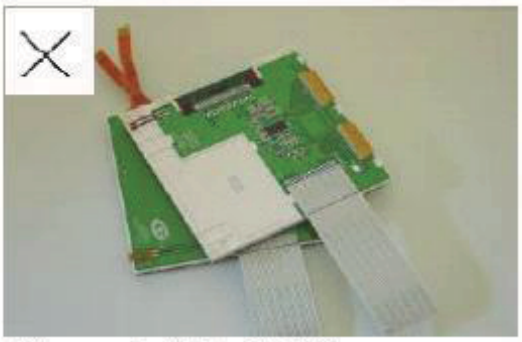


As above picture, please handle with anti-static gloves around LCM edges.

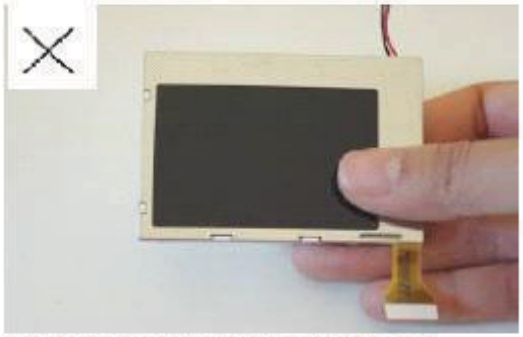
Incorrect handling:



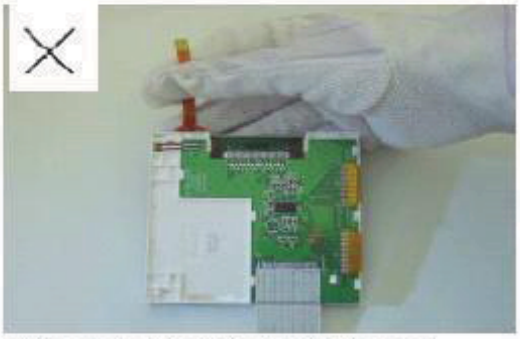
Please don't touch IC directly.



Please don't stack LCM.



Please don't hold the surface of panel.

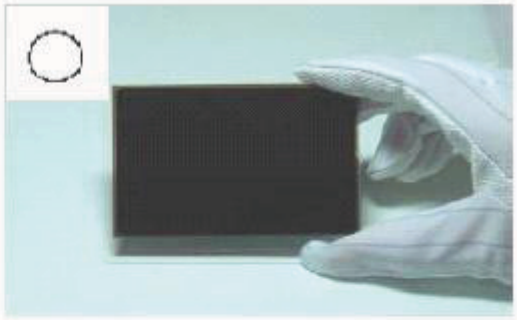


Please don't stretch interface of output, such as FPC cable.

Handling precaution for LCD

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

Correct handling:

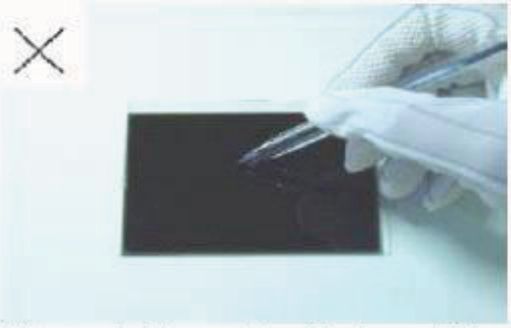


As above photo, please handle with anti-static gloves around LCD edges.

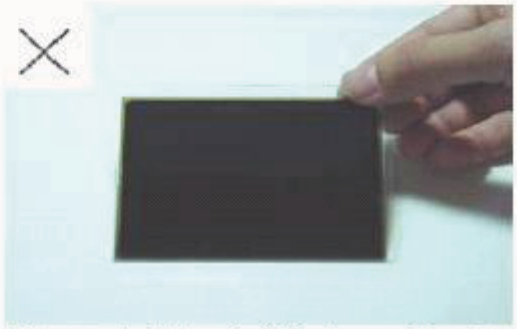
Incorrect handling:

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.

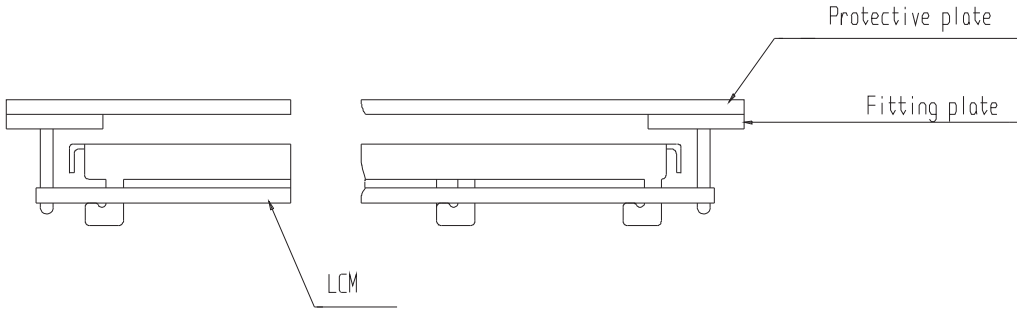
- Exposed area of the printed circuit board.
-Terminal electrode sections.

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.

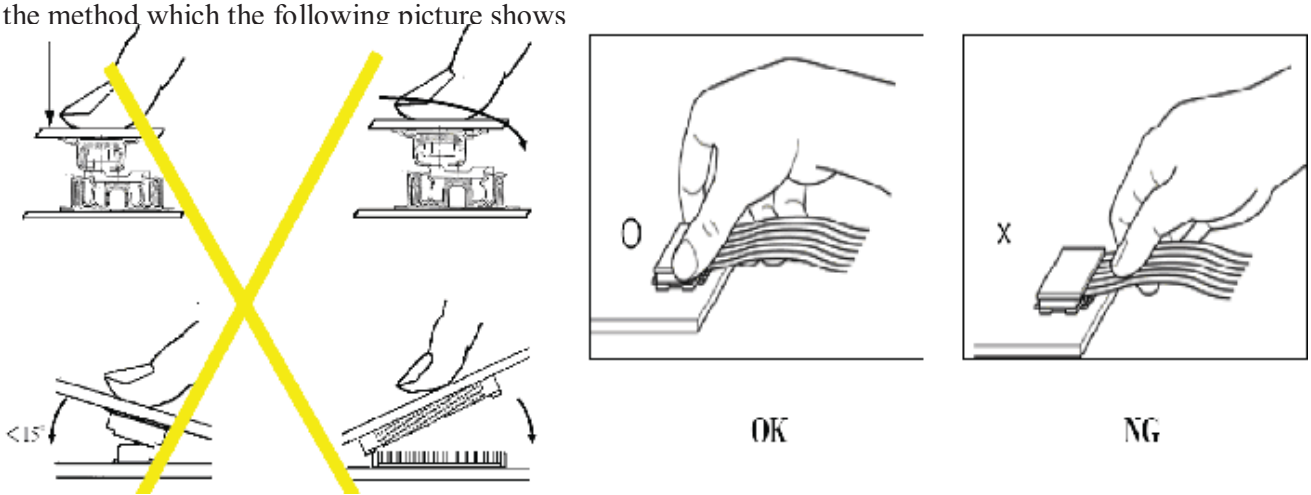
(1) Cover the surface with a transparent protective plate to protect the polarizer and LC cell.



(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 ±0.1mm.

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.