



深圳市福瑞达显示技术有限公司  
SHENZHEN FRIDA LCD CO.,LTD

Doc.No.: FRD350C45195-A-RT

REV : A

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**SPEC TITLE**  
DOCUMENT CONTROL SPECIFICATION

EFFECTIVE DATE : 2020.03.03

# PRODUCT SPECIFICATION

## TFT-LCD MODULE

### Model No: FRD350C45195-A-RT

<b>For Customer's Acceptance</b>	
<b>Approved by</b>	<b>Comment</b>

	<b>Signature</b>	<b>Date</b>
<b>Prepared by</b>		
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**1. Document Revision History :**

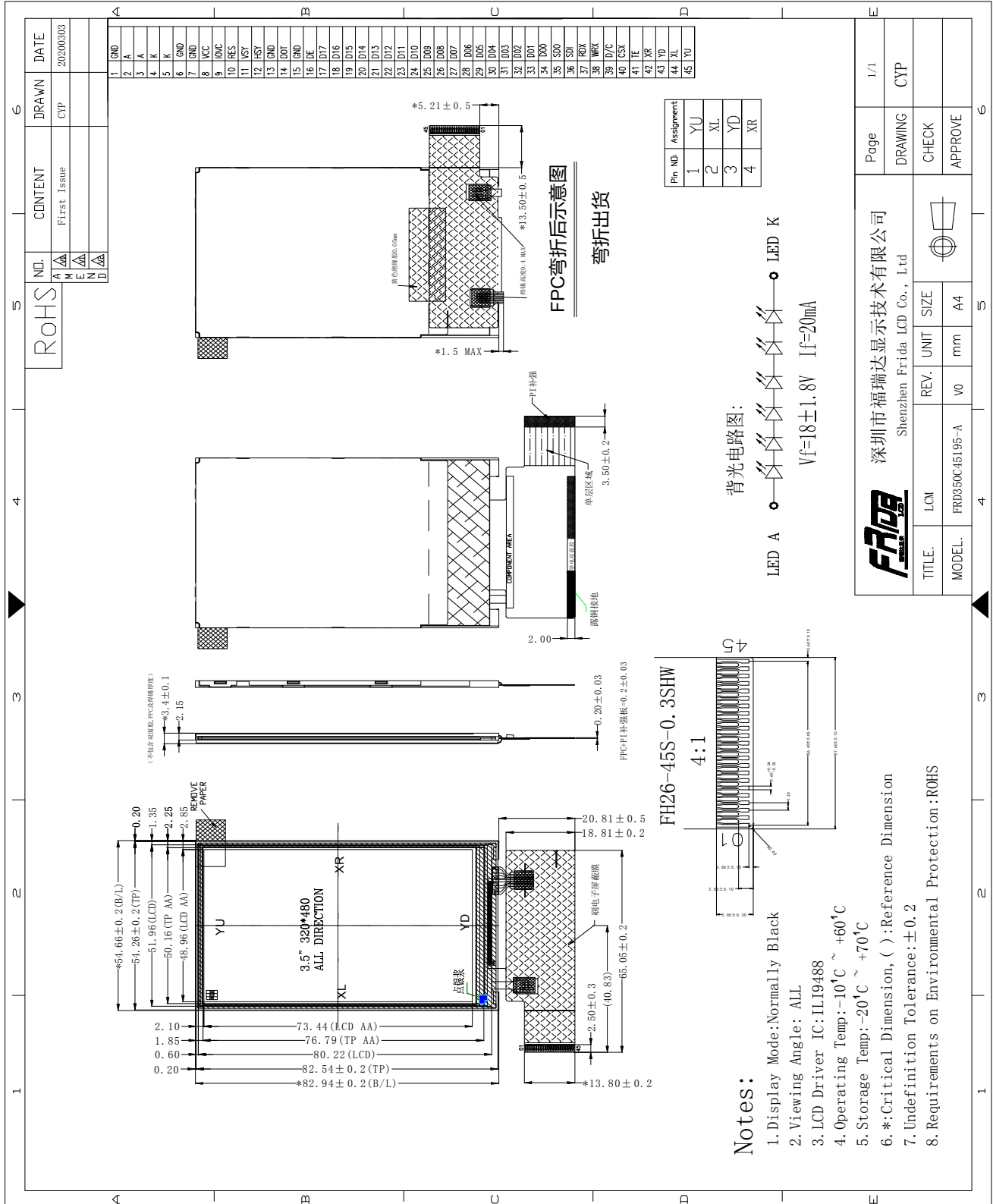
DOCUMENT REVISION	DATE	DESCRIPTION	PREPARED BY
A	2003-03-03	First Release.	



## 2. General Description

No	Item	Specification	Remark
1	Screen Size	3.5 inch	
2	Display Mode	Normally BLACK	
3	Resolution	320 × RGB × 480	
4	Active Area	48.96*73.44	
5	Outline Dimension	54.66*82.94*3.4	
6	Viewing Direction	ALL	
7	Driver IC	ILI9488	
8	Interface	MCU/SPI_RGB	
9	Back Light	White Led*6	
10	Touch Panel	RTP	

### 3. Outline Dimension





## 4. Interface Specification

Pin No	Symbol	Description	Note
1	GND	Ground.	
2-3	A	Power Supply For LED Backlight Anode Input.	
4-5	K	Power Supply For LED Backlight Cathode Input.	
6-7	GND	Ground.	
8	VCC	Power Supply For LCD.	
9	IOVC	Power Supply For I/O.	
10	RES	Reset Signal input pin.	
11	VSY	Frame synchronous signal for RGB interface operation.	
12	HSY	Line synchronous signal for RGB interface operation.	
13	GND	Ground.	
14	DOT	Dot clock signal for RGB interface operation.	
15	GND	Ground.	
16	DE	Data enable signal for RGB interface operation.	
17-22	D17-D12(R5-R0)	Red data (R0-LSB;R5-MSB)	
23-28	D11-D06(G5-G0)	Green data (G0-LSB; G5-MSB)	
29-34	D05-D00(B5-B0)	Blue data (B0-LSB;B5-MSB)	
35	SDO	Serial data output pin.	
36	SDI	Serial data input pin.	
37	RDX	Read strobe signal.	
38	WRX	MCU:Write strobe signal. SPI_RGB:Serial clock signal.	
39	D/C	Data / Command Selection pin.	
40	CSX	Chip selection signal pin.	
41	TE	Frame head pulse for tearing effect.	
42	XR	touch panel. RIGHT	
43	YD	touch panel. DOWN	
44	XL	touch panel. LEFT	
45	YU	touch panel. UP	

Note1:The reset voltage is consistent with the IOVC.



Note2:The interface mode can be selected by the following resistors.

IM2		IM1		IM0		Interface	Using function pins
R21 (IOVC)	R20 (GND)	R11 (IOVC)	R10 (GND)	R01 (IOVC)	R00 (GND)		
NC	0欧姆	NC	0欧姆	NC	0欧姆	MCU 18bit	CSX*D/C*WRX*RDY*RES*D00-D17
NC	0欧姆	NC	0欧姆	0欧姆	NC	MCU 9bit	CSX*D/C*WRX*RDY*RES*D00-D08
NC	0欧姆	0欧姆	NC	NC	0欧姆	MCU 16bit	CSX*D/C*WRX*RDY*RES*D00-D15
NC	0欧姆	0欧姆	NC	0欧姆	NC	MCU 8bit	CSX*D/C*WRX*RDY*RES*D00-D07
0欧姆	NC	NC	0欧姆	0欧姆	NC	3SPI RGB 18bit	CSX*WRX*SDI*SDO*DE*DOT*HSY*VSY*D00-D17 (default)
0欧姆	NC	0欧姆	NC	0欧姆	NC	4SPI RGB 18bit	CSX*D/C*WRX*SDI*SDO*DE*DOT*HSY*VSY*D00-D17

## 5. Absolute Maximum Ratings

### Electrical Maximum Ratings – for IC Only

Parameter	Symbol	Min.	Max.	Unit	Note
Power supply voltage (VCC)	VCC	-0.3	+3.3	V	1
Power supply voltage (IOVC)	IOVC	-0.3	+3.3	V	1

Note:

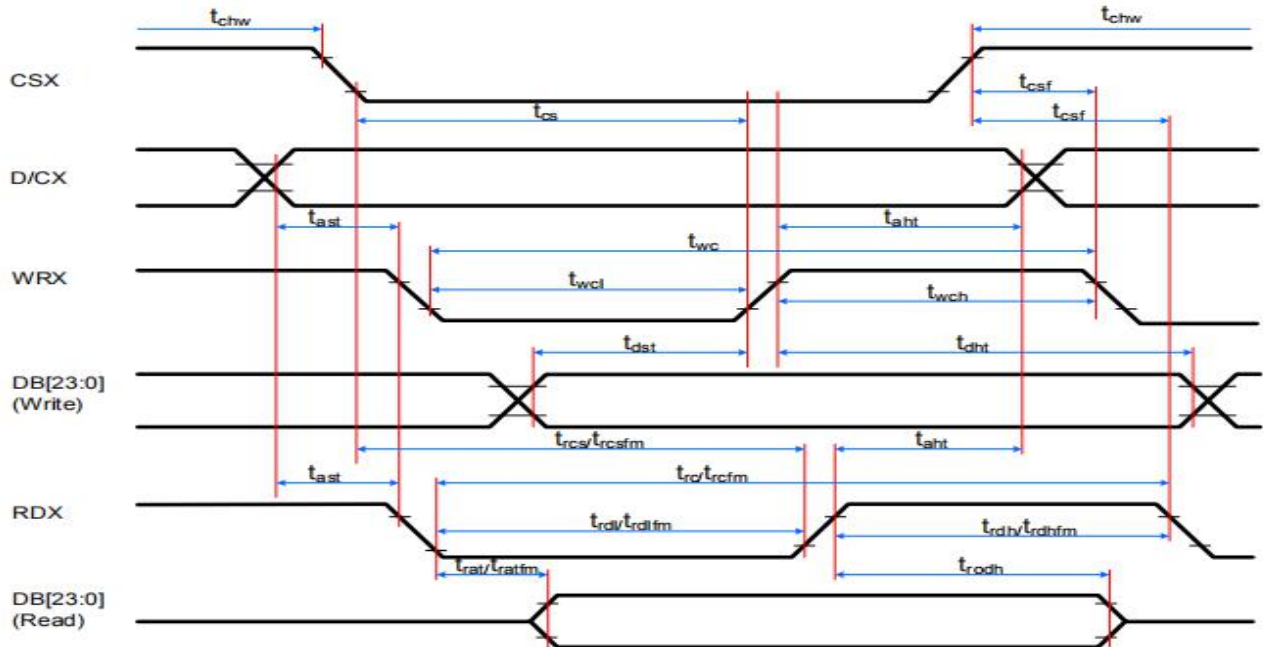
- 1.VCC, IOVC,GND must be maintained.
- 2.The modules may be destroyed if they are used beyond the absolute maximum ratings.

## 6. Electrical Specifications

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply voltage (analog)	VCC	-	2.5	2.8	3.3	V
Supply voltage (logic)	IOVC	-	1.65	1.8	3.3	V
Supply voltage of white LED backlight	VLED	Forward current =20mA Number of LED = 6	16.2	18	19.8	V

## 7. Timing Characteristics

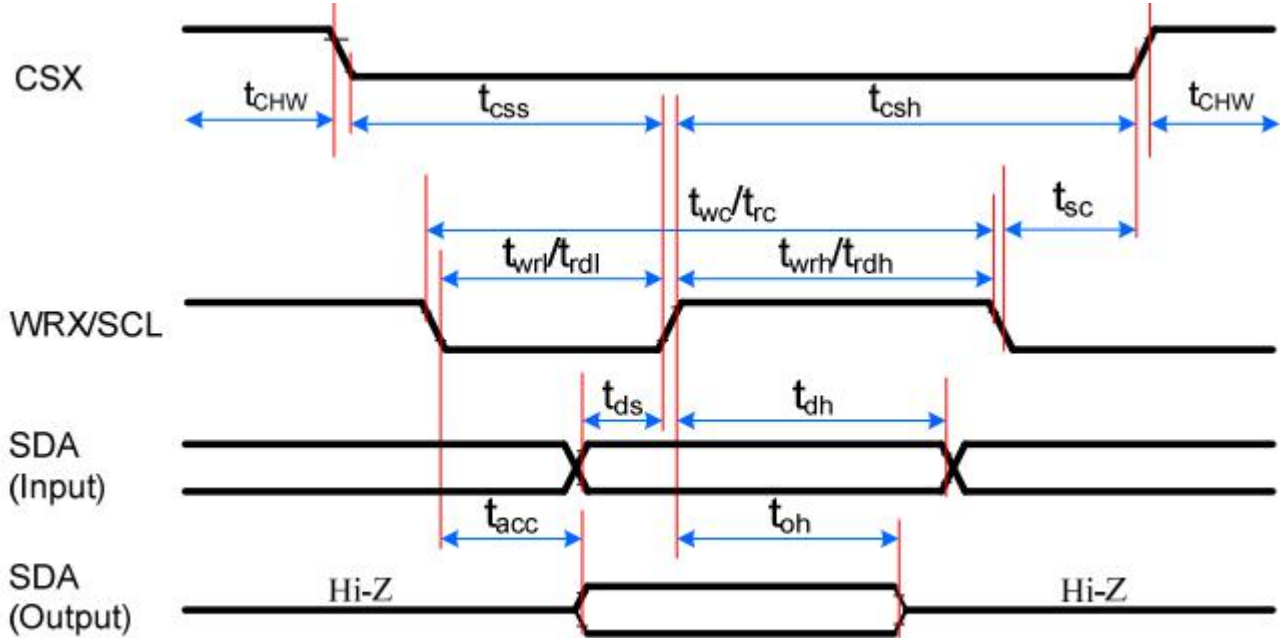
### 7.1 DBI Type B Timing Characteristics



Signal	Symbol	Parameter	min	max	Unit	Description
DCX	tast	Address setup time	0	-	ns	-
	that	Address hold time (Write/Read)	0	-	ns	-
CSX	tchwh	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	-
	tcsf	Chip Select Wait time (Write/Read)	0	-	ns	-
WRX	twc	Write cycle	40	-	ns	-
	twrh	Write Control pulse H duration	15	-	ns	-
	twrl	Write Control pulse L duration	15	-	ns	-
RDX (FM)	trcfm	Read Cycle (FM)	450	-	ns	When read from Frame Memory
	trdhfm	Read Control H duration (FM)	90	-	ns	
	trdlfm	Read Control L duration (FM)	355	-	ns	
RDX (ID)	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 [23:0], 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	

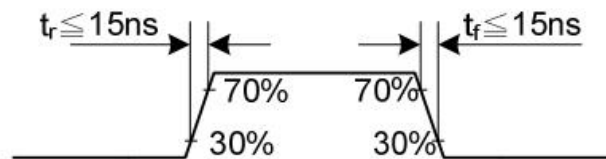


## 7.2 DBI Type C Option 1 (3-Line SPI System) Timing Characteristics

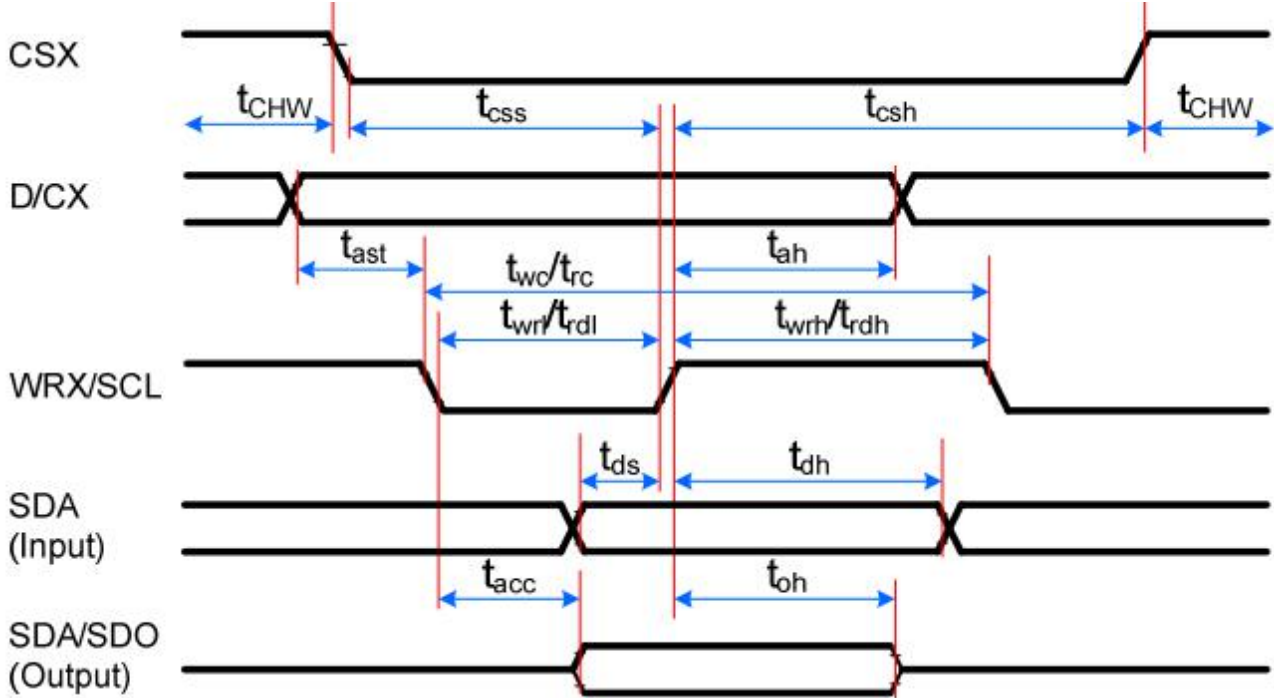


Signal	Symbol	Parameter	min	max	Unit	Description
CSX	t <sub>sc</sub>	SCL-CSX	15	-	ns	
	t <sub>chw</sub>	CSX H Pulse Width	40	-	ns	
	t <sub>css</sub>	Chip select time (Write)	60	-	ns	
	t <sub>csh</sub>	Chip select hold time (Read)	65	-	ns	
SCL	t <sub>wc</sub>	Serial Clock Cycle (Write)	66	-	ns	
	t <sub>wrh</sub>	SCL H Pulse Width (Write)	15	-	ns	
	t <sub>wrl</sub>	SCL L Pulse Width (Write)	15	-	ns	
	t <sub>rc</sub>	Serial Clock Cycle (Read)	150	-	ns	
	t <sub>rdh</sub>	SCL H Pulse Width (Read)	60	-	ns	
SDA (Input)	t <sub>ds</sub>	Data setup time (Write)	10	-	ns	
	t <sub>dh</sub>	Data hold time (Write)	10	-	ns	
SDA/SDO (Output)	t <sub>acc</sub>	Access time (Read)	10	50	ns	For maximum CL=30pF
	t <sub>oh</sub>	Output disable time (Read)	15	50	ns	For minimum CL=8pF

**Note:** Ta = -30 to 70 °C, IOVCC = 1.65V to 3.6V, VCI = 2.5V to 3.6V, AGND = DGND = 0V, T = 10+/-0.5ns

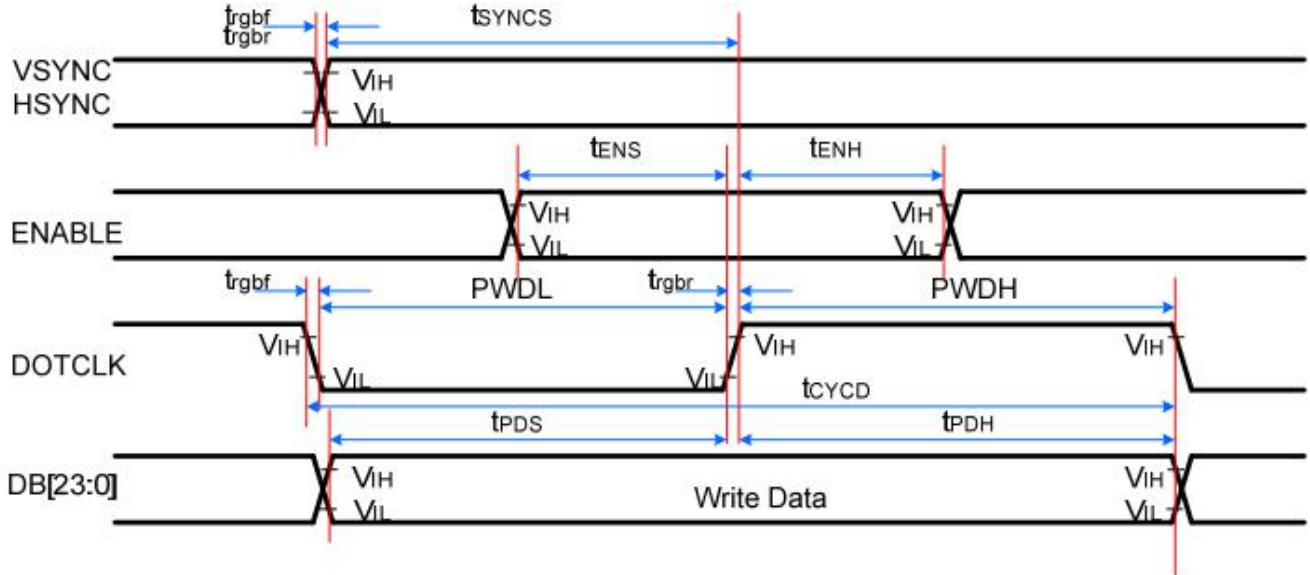


### 7.3 DBI Type C Option 3 (4-Line SPI System) Timing Characteristics



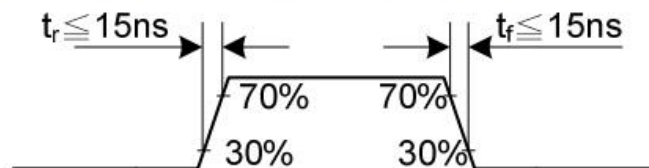
Signal	Symbol	Parameter	min	max	Unit	Description
CSX	tcss	Chip select time (Write)	15	-	ns	
	tcsh	Chip select hold time (Read)	15	-	ns	
	tCHW	CS H pulse width	40	-	ns	
SCL	twc	Serial clock cycle (Write)	50	-	ns	
	twrh	SCL H pulse width (Write)	10	-	ns	
	twrl	SCL L pulse width (Write)	10	-	ns	
	trc	Serial clock cycle (Read)	150	-	ns	
	trdh	SCL H pulse width (Read)	60	-	ns	
	trdl	SCL L pulse width (Read)	60	-	ns	
D/CX	tas	D/CX setup time	10	-	ns	
	tah	D/CX hold time (Write/Read)	10	-	ns	
SDA (Input)	tds	Data setup time (Write)	10	-	ns	
	tdh	Data hold time (Write)	10	-	ns	
SDA/SDO (Output)	tacc	Access time (Read)	10	50	ns	For maximum CL=30pF
	tod	Output disable time (Read)	15	50	ns	For minimum CL=8pF

7.4 DPI (Display Parallel 16-/18-/24-bit interface) Timing Characteristics.



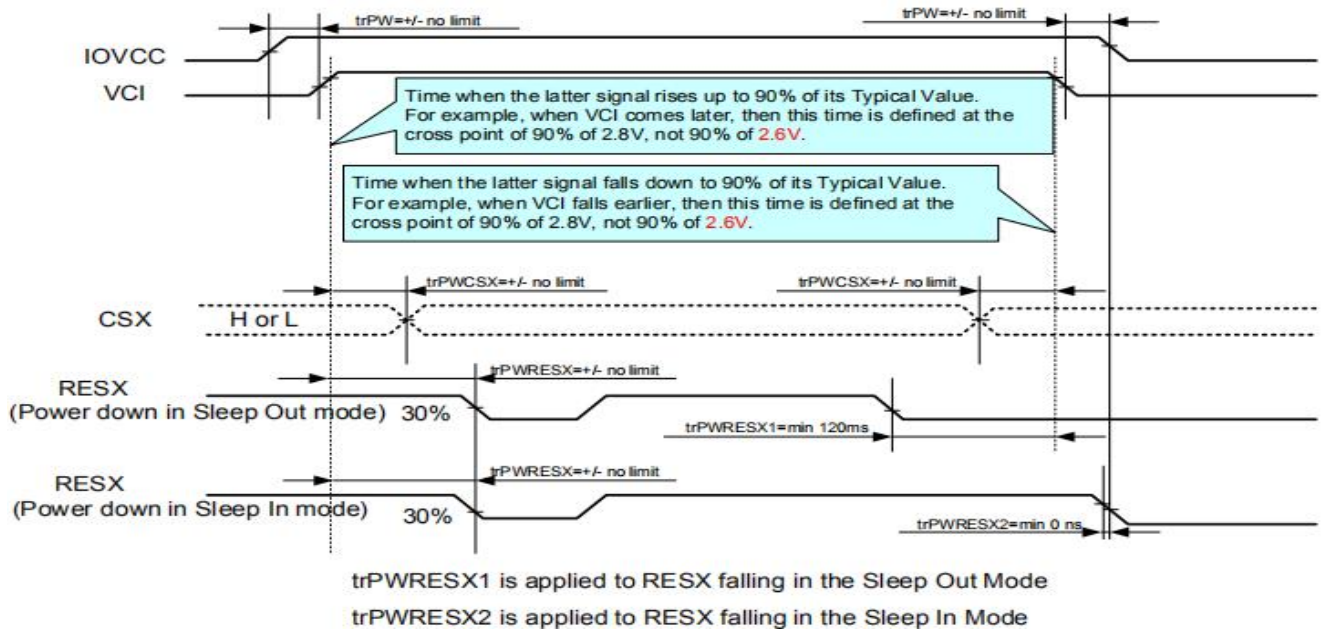
Signal	Symbol	Parameter	min	max	Unit	Description
VSYNC/ HSYNC	$t_{SYNCS}$	VSYNC/HSYNC setup time	15	-	ns	16-/18-/24-bit bus RGB interface mode
	$t_{SYNCH}$	VSYNC/HSYNC hold time	15	-	ns	
ENABLE	$t_{ENS}$	ENABLE setup time	15	-	ns	
	$t_{ENH}$	ENABLE hold time	15	-	ns	
DB [23:0]	$t_{POS}$	Data setup time	15	-	ns	
	$t_{PDH}$	Data hold time	15	-	ns	
DOTCLK	PWDH	DOTCLK high-level period	20	-	ns	
	PWDL	DOTCLK low-level period	20	-	ns	
	$t_{CYCD}$	DOTCLK cycle time	50	-	ns	
	$t_{r}, t_{f}$	DOTCLK,HSYNC,VSYNC rise/fall time	-	15	ns	

Note:  $T_a = -30$  to  $70$  °C,  $IOVCC = 1.65V$  to  $3.3V$ ,  $VCI = 2.5V$  to  $3.3V$ ,  $AGND = DGND = 0V$

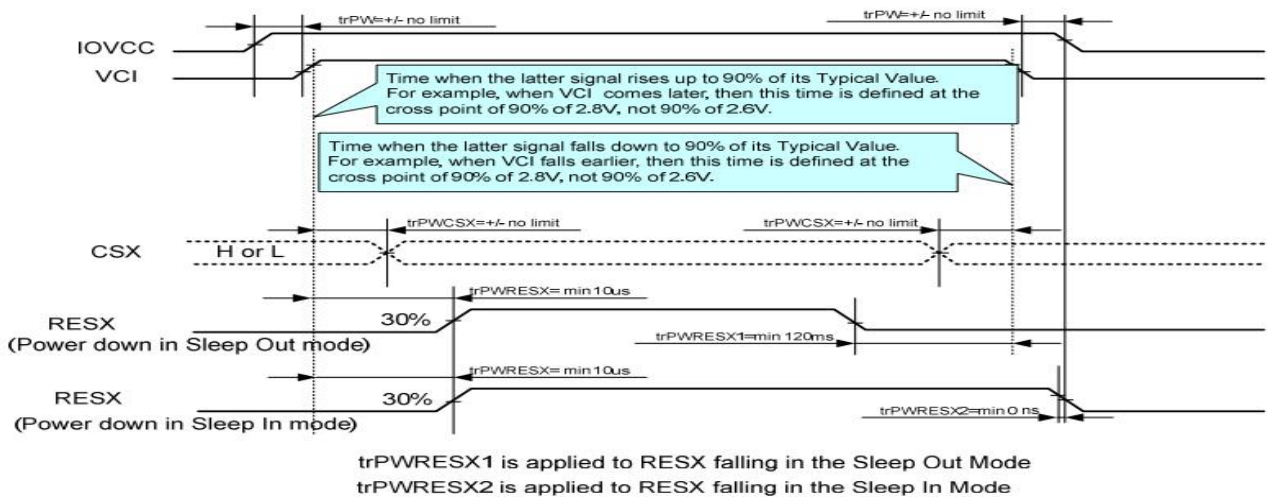


## 8. Power Supply Configuration

### 8.1 Case 1 - RESX Line is Held High or Unstable by Host at Power ON



### 8.1 Case 2 - RESX Line is Held Low by Host at Power ON



### 8.3 Uncontrolled Power Off

The Uncontrolled Power Off means the situation when a battery is removed without the controlled power off sequence. There will not be any damages on the display module, or the display module will not cause any damages on the host or lines of the interface. At an uncontrolled power off event, the ILI9488 will force the display to become blank and will not cause any abnormal visible effects within 1 second on the display and remains blank until "Power On Sequence" powers it up.

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## 9.Optical Specification

Item 项目	Symbol 符号	Condition 条件	Min 最小值	Typ 典型值	Max 最大值	Unit 单位	Note 备注
Response time 响应时间	Tr+Tf	$\Theta=0^{\circ}$ $\varnothing=0^{\circ}$ $T_a=25^{\circ}\text{C}$	-	30	-	ms	1
Contrast ratio 对比度	Cr		-	700	-	-	2
Color gamut 饱和度	S(%)		-	60	-	%	-
Luminance uniformity 均匀度	$\delta^{\circ}\text{WHITE}$		80	-	-	%	3
Viewing angle range 视角范围	$\Theta_{x+}$	$\text{CR} \geq 10$ $T_a=25^{\circ}\text{C}$	-	80	-	deg	4
	$\Theta_{x-}$		-	80	-	deg	
	$\Theta_{y+}$		-	80	-	deg	
	$\Theta_{y-}$		-	80	-	deg	
LCM Luminance LCM 亮度	Lv	$\Theta=0^{\circ}$ $\varnothing=0^{\circ}$ $T_a=25^{\circ}\text{C}$	-	400	-	$\text{Cd}/\text{m}^2$	5

Note1.Response time is the time required for the display to transition from White to black(Rise Time,Tr)and from black to white(Decay Time,Tf).For additional information see FIG1...

Note2.contrast Ratio(CR) is defined mathematically by the following formula ,For more information see FIG2.

Contrast Ratio(CR)=Average Surface Luminance with all white pixels/ Average Surface Luminance with all black pixels

Note3.The uniformity in surface luminance(WHITE) is determined by measuring luminance at each test position,and then dividing the maximum luminance of all white pixels by minimum luminance of all white pixels,For more information seeFIG2.

WHITE=Minimum Surface Luminance with all white pixels(P1,P2,.....)/Maximum Surface Luminance with all white pixels(P1,P2,.....)

Note4.Viewing angle is the angel at which contrast ratio is greater than a specific value.For TET module,the specific value of contrast ratio is 10.For monochrome and color stn module,the specific value of contrast ratio is2.The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface.For more information see FIG3

Note5. Surface luminance is the LCD surface luminance with all white pixels,For more information see FIG2.

LV=Average Surface Luminance with all white pixels(P1,P2,.....)

Note6.CIE(X,Y)chromaticity is the Center point value.For more information see FIG2.

Note7.For Viewing angle and response time testing,the testing date is base on Autronic-Melchers's ConScope.Series instruments.For contrast ratio,Surface Luminance,Luminance uniformity and CIE,the testing date is base on CS-2000 photo detector.

Note8.For TN type TFT transmissive module,Gray scale reverse occurs in the direction of panel viewing angle

FIG1. The definition of Response time

响应时间定义

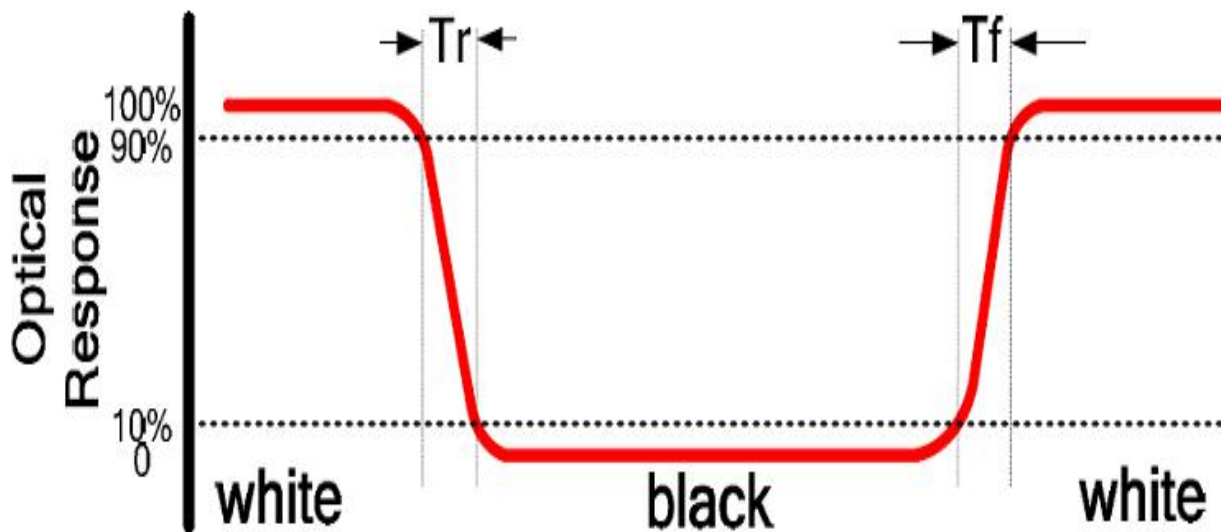


FIG2. Measuring method for Contrast ratio,surface luminance,Luminance

uniformity,CIE(X,Y)chromaticity.

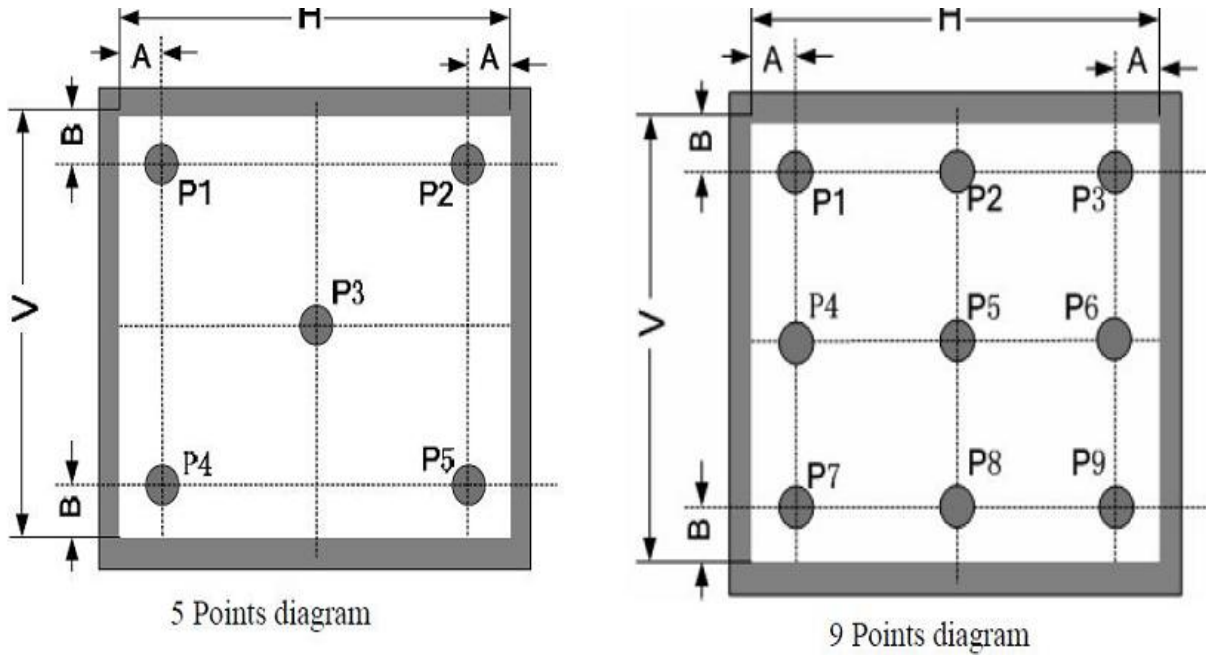
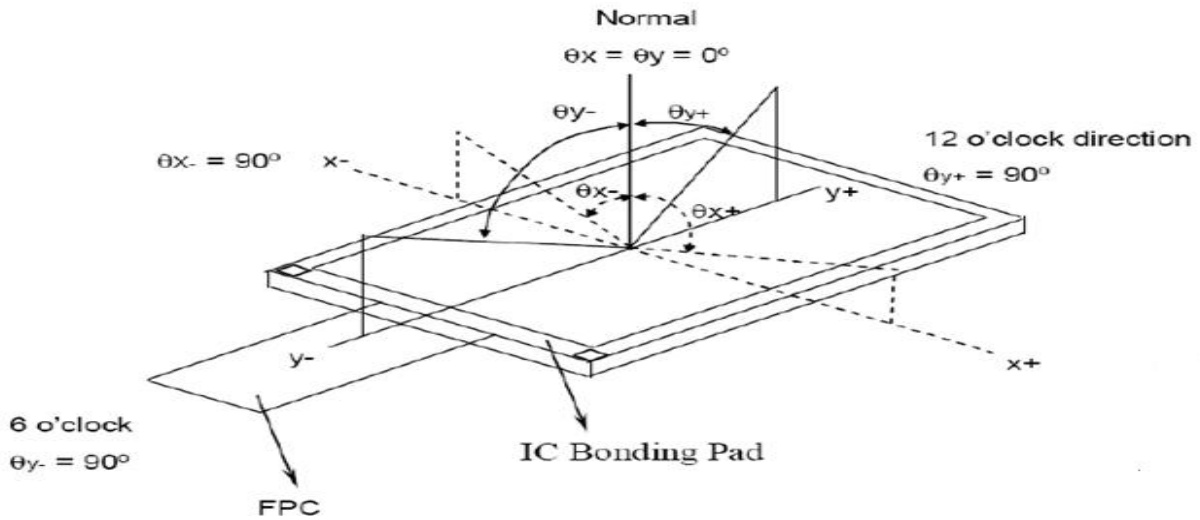


FIG3 The definition of viewing angle 视角定义

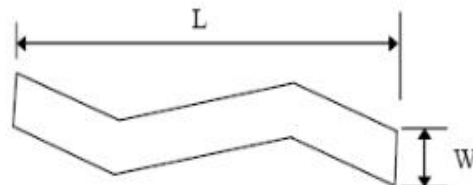
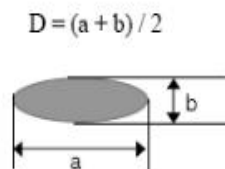


10.1 Appearance inspection

Item	Acceptable standards for defects	Defect level
Broken	Not allowed	critical defects
Cracks	Not allowed	critical defects
Insufficient UV glue entering	Not allowed	critical defects
Liquid crystal seal leakage	Not allowed	critical defects
Liquid crystal bubbles	Not allowed	critical defects
Surface scratch(mm)	$W \leq 0.02$ , ignored	minor defects
	$0.02 < W \leq 0.03$ $L \leq 2, N \leq 2$	
	$0.03 < W \leq 0.05$ $L \leq 1, N \leq 1$	
	$0.05 < W$ Not allowed	
Black/white spot(mm)	$D \leq 0.1$ , ignored; $0.1 < D \leq 0.15, N \leq 4$	minor defects
	$0.15 < D \leq 0.2, N \leq 2$ ; $0.2 < D$ , Not allowed	
The seal pollution	Not allowed	minor defects
Liquid crystal residues	Not allowed	minor defects
Surface stains	Stains that cannot be cleaned or erased are not allowed	minor defects
size	Refer to the product specification corresponding to each product, overall size(including length, Width, thickness) or partial size exceeding the drawing size is not allowed	major defects

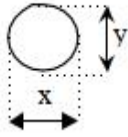
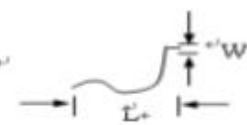
Remarks: 1)Surface scratches within 1.5mm of the glass edge are ignored;

2) D = diameter, L = length, W = width, N = qty;





10.2 Functional test criteria

Item	Judgment	Level																		
Display status	No Display、Incomplete image、line defect、wrong viewing angle、flickering、abnormal image , are not allowed.	major defects																		
	Display color, judged by approved samples, Or by limited samples	minor defects																		
	MURA or the phenomenon that is unable to describe in words, judged by ND 5% or limited samples	minor defects																		
Spot(bright/ dark)defect	Definition of spot defect: $\Phi = (x+y) / 2$ 	minor defects																		
	<table border="1"> <thead> <tr> <th rowspan="2">Size(mm)</th> <th colspan="2">acceptable qty</th> </tr> <tr> <th>Active area</th> <th>View area</th> </tr> </thead> <tbody> <tr> <td><math>\Phi \leq 0.1</math></td> <td>ignored</td> <td rowspan="4">ignored</td> </tr> <tr> <td><math>0.1 &lt; \Phi \leq 0.15</math></td> <td>2 ( gap <math>\geq 5</math> )</td> </tr> <tr> <td><math>0.15 &lt; \Phi \leq 0.2</math></td> <td>1</td> </tr> <tr> <td><math>0.2 &lt; \Phi</math></td> <td>Not allowed</td> </tr> </tbody> </table>		Size(mm)	acceptable qty		Active area	View area	$\Phi \leq 0.1$	ignored	ignored	$0.1 < \Phi \leq 0.15$	2 ( gap $\geq 5$ )	$0.15 < \Phi \leq 0.2$	1	$0.2 < \Phi$	Not allowed				
	Size(mm)			acceptable qty																
			Active area	View area																
	$\Phi \leq 0.1$		ignored	ignored																
	$0.1 < \Phi \leq 0.15$		2 ( gap $\geq 5$ )																	
$0.15 < \Phi \leq 0.2$	1																			
$0.2 < \Phi$	Not allowed																			
Black/white line	Definition of line defect: L: length, W: width 	minor defects																		
	<table border="1"> <thead> <tr> <th colspan="2">Size(mm)</th> <th colspan="2">Acceptable qty</th> </tr> <tr> <th>W(width)</th> <th>L(length)</th> <th>Active area</th> <th>View area</th> </tr> </thead> <tbody> <tr> <td><math>W \leq 0.03</math></td> <td>ignored</td> <td>ignored</td> <td rowspan="3">ignored</td> </tr> <tr> <td><math>0.03 &lt; W \leq 0.05</math></td> <td><math>L \leq 2.0</math></td> <td>3</td> </tr> <tr> <td><math>W &gt; 0.05</math></td> <td>-</td> <td>Not allowed</td> </tr> </tbody> </table>		Size(mm)		Acceptable qty		W(width)	L(length)	Active area	View area	$W \leq 0.03$	ignored	ignored	ignored	$0.03 < W \leq 0.05$	$L \leq 2.0$	3	$W > 0.05$	-	Not allowed
	Size(mm)		Acceptable qty																	
	W(width)		L(length)	Active area	View area															
	$W \leq 0.03$		ignored	ignored	ignored															
$0.03 < W \leq 0.05$	$L \leq 2.0$	3																		
$W > 0.05$	-	Not allowed																		

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## 11. Reliability Test Items

Item	Test Condition	Criterion
High Temperature Storage	70 °C, 48 hrs	Note1,Note2
Low Temperature Storage	-20 °C, 48 hrs	
High Temp. & High Humidity Storage	40 °C, 80% RH, 48hrs	
Thermal Shock (Static)	-20°C, 30 min /70°C, 30 min, 20 cycles	
High Temperature Operation	60 °C, 48 hrs	
Low temperature Operation	-10 °C, 48 hrs	

Note1: Evaluation should be tested after storage at room temperature for two hours.

Note2:

Pass: Normal display image no line defect.

Fail: No display image, or line defects.

Partial transformation of the module parts should be ignored.

## 12. Precautions

Please pay attentions to the followings as using the LCD module.

### Handling

- Do not apply strong mechanical stress like drop, shock or any force to LCD module. It may cause improper operation, even damage.
- Because the polarizer is very fragile and easy to be damaged, do not hit, press or rub the display surface with hard materials.
- Do not put heavy or hard material on the display surface, and do not stack LCD modules.



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- (d) If the display surface is dirty, please wipe the surface softly with cotton swab or clean cloth.
- (e) Avoid using Ketone type materials (e.g. Acetone), Toluene, Ethyl acid or Methyl chloride to clean the display surface. It might damage the touch panel surface permanently. The recommended solvents are water and Isopropyl alcohol.
- (f) Wipe off water droplets or oil immediately.
- (g) Protect the LCD module from ESD. It will damage the LSI and the electronic circuit.
- (h) Do not touch the output pins directly with bare hands.
- (i) Do not disassemble the LCD module.
- (j) Do not lift the FPC of Touch Panel.

**Storage**

- (a) Do not leave the LCD modules in high temperature, especially in high humidity for a long time.
- (b) Do not expose the LCD modules to sunlight directly.
- (c) The liquid crystal is deteriorated by ultraviolet. Do not leave it in strong ultraviolet ray for a long time.
- (d) Avoid condensation of water. It may cause improper operation.
- (e) Please stack only up to the number stated on carton box for storage and transportation. Excessive weight will cause deformation and damage of carton box.

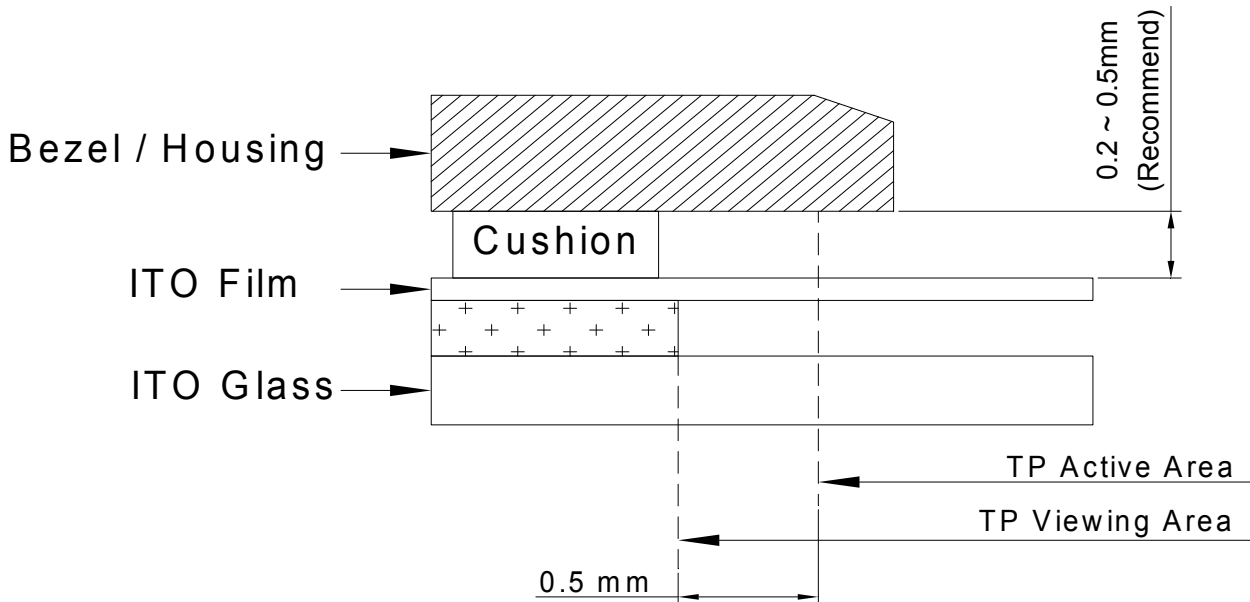
**Operation**

- (a) When mounting or dismounting the LCD modules, turn the power off.
- (b) Protect the LCD modules from electric shock.
- (c) The Driver IC control algorithms stated above should always obeyed to avoid damaging the LSI and electronic circuit.
- (d) Be careful to avoid mixing up the polarity of power supply for backlight.
- (e) Absolute maximum rating specified above has to be always kept in any case. Exceeding it may cause non-recoverable damage of electronic components or, nevertheless, burning.
- (f) When a static image is displayed for a long time, remnant image is likely to occur.
- (g) Be sure to avoid bending the FPC to an acute shape, it might break FPC.
- (h) Most of the touch screens have air vent to equalize the inside air pressure to the outside one. The air vent must be open and liquid contact must be avoided as the liquid may be absorbed if the liquid is accumulated near the air vent.

- (i) For the fragility of ITO film, it should avoid to use too tapering pen as the input material.

### Touch Panel Mounting Notes

- (a) If a cushion is used between bezel/housing and film must be choose as free as enough to absorb the expansion and contraction to avoid the distortion of film.
- (b) The cushion must be placed out of the Viewing Area.
- (c) Bezel/Housing edge must be posited between Key Area and Viewing Area. The edge enters the Key Area may cause unexpected input if the gap is too narrow or foreign particles like dusts exist between Bezel/Housing and ITO film.
- (d) Mounting example:



The corner part has conductivity. Do not touch any metal part after mounting.

### Others

- a) If the liquid crystal leaks from the panel, it should be kept away from the eyes or mouth.
- b) For the fragility of polarizer, it is recommended to attach a transparent protective plate over the display surface.
- c) It is recommended to peel off the protection film on the polarizer slowly so that the electrostatic charge can be minimized.