

 深圳市福瑞达显示技术有限公司 SHENZHEN FRIDA LCD CO.,LTD	Doc.No.: FRD200H24005-A	
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PRODUCT SPECIFICATION

TFT-LCD MODULE

Model No: FRD200H24005-A

For Customer's Acceptance	
Approved by	Comment

	Signature	Date
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Checked by	Wang jin	2020.03.30
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1. Document Revision History :

DOCUMENT REVISION	DATE	DESCRIPTION	PREPARED BY
A	2018-09-15	First Release.	
B	2019-08-31	Add Inspection Specifications	
C	2020-03-30	Update contact information	

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2. General Description

No	Item	Specification	Remark
1	Screen Size	2.0 inch	
2	Display Mode	Normally Black	
3	Resolution	240 × RGB × 320	
4	Active Area	30.60*40.80	mm
5	Outline Dimension	36.02*51.59*1.85	mm
6	Viewing Direction	ALL	
7	Driver IC	ST7789V2-G4-A	
8	Interface	MCU	
9	Back Light	White Led *3	
10	Touch Panel	-	

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4. Interface Specification

Pin No	Symbol	Description	Note
1	VLEDA	Power supply Anode input for backlight	
2	VLEDK	Ground/Power supply Cathode input for backlight	
3	GND	Ground	
4	VDD2.8V (VDD)	Power supply input for LCD	
5	IOVCC1.8V (IOVCC)	Power Supply For I/O.	
6	TE	Frame head pulse for tearing effect.	
7	RESET	Reset Signal input pin.	
8	CS	Chip selection signal.	
9	DC	MCU: Data / Command Selection pin. /4SPI/3SPI :Serial clock signal pin.	
10	WR	MCU : Write strobe signal. 4SPI : Data / Command Selection pin. 3SPI 2data lane: Second Data lane in 2 data lane serial interface.	
11	RD	Read strobe signal.	
12	SDA	Serial data input/output pin.	
13-20	DB0-DB7	MCU parallel interface data bus.	
21	IM0	interface mode select	Note1
22	IM1	interface mode select	Note1
23	IM2	interface mode select	Note1
24	GND	Ground.	

Note1:

IM2	IM1	IM0	Interface	Using function pins
0	0	0	MCU 8bit	CS, DC, WR, RD, RESET, DB0-DB7
1	0	1	3SPI	CS, DC, SDA, RESET,
1	0	1	3SPI 2data lane	CS, DC, WR, SDA, RESET,
1	1	0	4SPI RGB	CS, DC, WR, SDA, RESET,

1: IOVCC
0: GND

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5. Absolute Maximum Ratings

Electrical Maximum Ratings – for IC Only

Parameter	Symbol	Min.	Max.	Unit	Note	
Power supply voltage (VDD)	VDD	-0.3	+4.6	V	1	
Power supply voltage (IOVCC)	IOVCC	-0.3	+4.6	V	1	

Note:

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

6. Electrical Specifications

At Ta = 25 °C, VDD = 2.4V to 3.3V, IOVCC = 1.65V to 3.3V, GND=0V.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply voltage (analog)	VDD-GND	-	2.4	2.8	3.3	V
Supply voltage (logic)	IOVCC-GND		1.65	1.8	3.3	V
Supply current (Logic & LCD)	VCC	-	-	-	TBD	mA
Supply voltage of white LED backlight	VLED	Forward current =60mA Number of LED = 3	2.7	3.0	3.3	V

7. Timing Characteristics

7.4.1 8080 Series MCU Parallel Interface Characteristics: 18/16/9/8-bit Bus

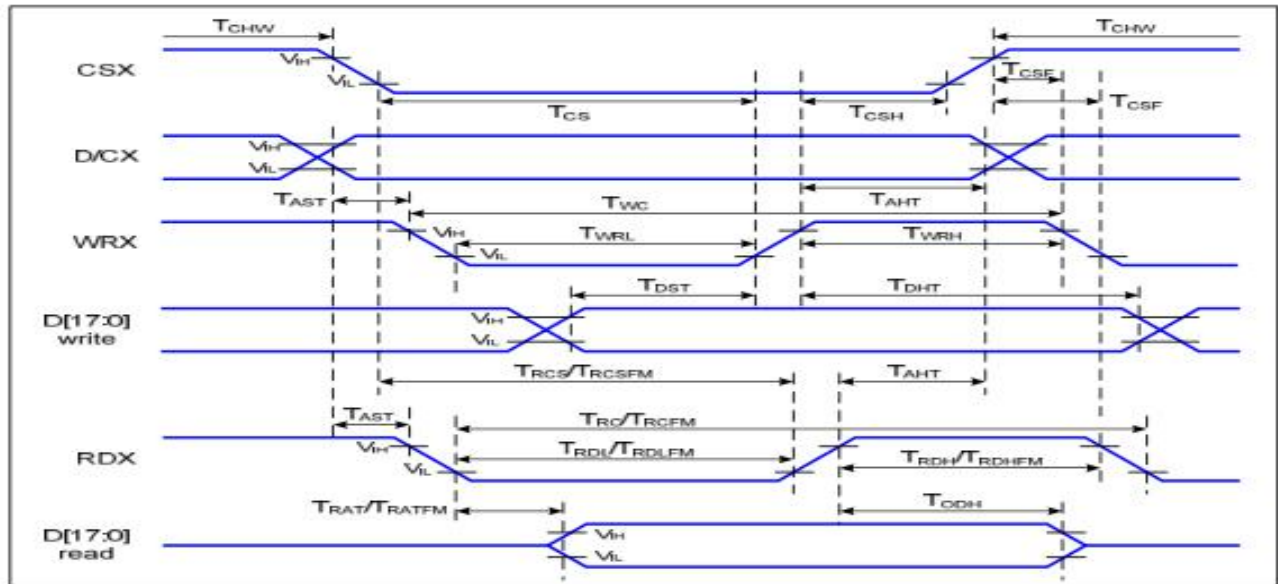


Figure 1 Parallel Interface Timing Characteristics (8080-Series MCU Interface)

VDD1=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=25°C

Signal	Symbol	Parameter	Min	Max	Unit	Description
D/CX	T _{AST}	Address setup time	0		ns	-
	T _{AHT}	Address hold time (Write/Read)	10		ns	
CSX	T _{CHW}	Chip select "H" pulse width	0		ns	-
	T _{CS}	Chip select setup time (Write)	15		ns	
	T _{RCS}	Chip select setup time (Read ID)	45		ns	
	T _{RCSFM}	Chip select setup time (Read FM)	355		ns	
	T _{CSF}	Chip select wait time (Write/Read)	10		ns	
	T _{CSH}	Chip select hold time	10		ns	
WRX	T _{WC}	Write cycle	66		ns	-
	T _{WRH}	Control pulse "H" duration	15		ns	
	T _{WRL}	Control pulse "L" duration	15		ns	
RDX (ID)	T _{RC}	Read cycle (ID)	160		ns	When read ID data
	T _{RDH}	Control pulse "H" duration (ID)	90		ns	
	T _{RDL}	Control pulse "L" duration (ID)	45		ns	
RDX (FM)	T _{RCFM}	Read cycle (FM)	450		ns	When read from frame memory
	T _{RDHF}	Control pulse "H" duration (FM)	90		ns	
	T _{RDLF}	Control pulse "L" duration (FM)	355		ns	
D[17:0]	T _{DST}	Data setup time	10		ns	For CL=30pF

7.4.2 Serial Interface Characteristics (3-line serial):

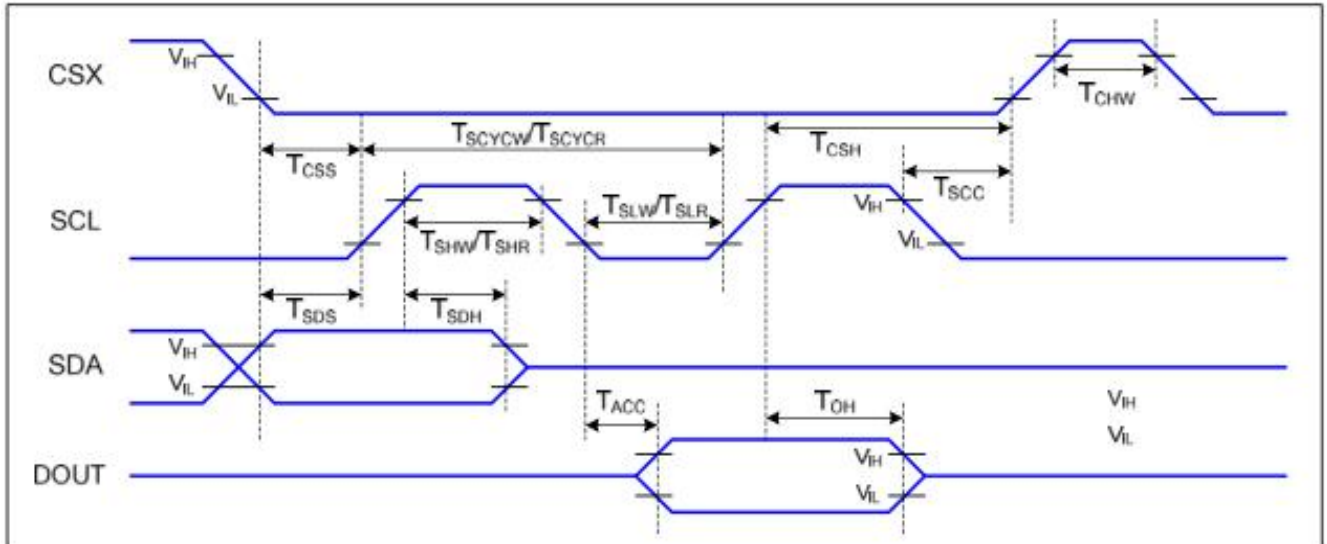


Figure 4 3-line serial Interface Timing Characteristics

$V_{DDI}=1.65$ to $3.3V$, $V_{DD}=2.4$ to $3.3V$, $AGND=DGND=0V$, $T_a=25^{\circ}C$

Signal	Symbol	Parameter	Min	Max	Unit	Description
CSX	T_{CSS}	Chip select setup time (write)	15		ns	
	T_{CSH}	Chip select hold time (write)	15		ns	
	T_{CSS}	Chip select setup time (read)	60		ns	
	T_{SCC}	Chip select hold time (read)	65		ns	
	T_{CHW}	Chip select "H" pulse width	40		ns	
SCL	T_{SCYCW}	Serial clock cycle (Write)	16		ns	
	T_{SHW}	SCL "H" pulse width (Write)	7		ns	
	T_{SLW}	SCL "L" pulse width (Write)	7		ns	
	T_{SCYCR}	Serial clock cycle (Read)	150		ns	
	T_{SHR}	SCL "H" pulse width (Read)	60		ns	
	T_{SLR}	SCL "L" pulse width (Read)	60		ns	
SDA (DIN)	T_{SDS}	Data setup time	7		ns	
	T_{SDH}	Data hold time	7		ns	
DOUT	T_{ACC}	Access time	10	50	ns	For maximum $CL=30pF$
	T_{OH}	Output disable time	15	50	ns	For minimum $CL=8pF$

Table 5 3-line serial Interface Characteristics

7.4.3 Serial Interface Characteristics (4-line serial):

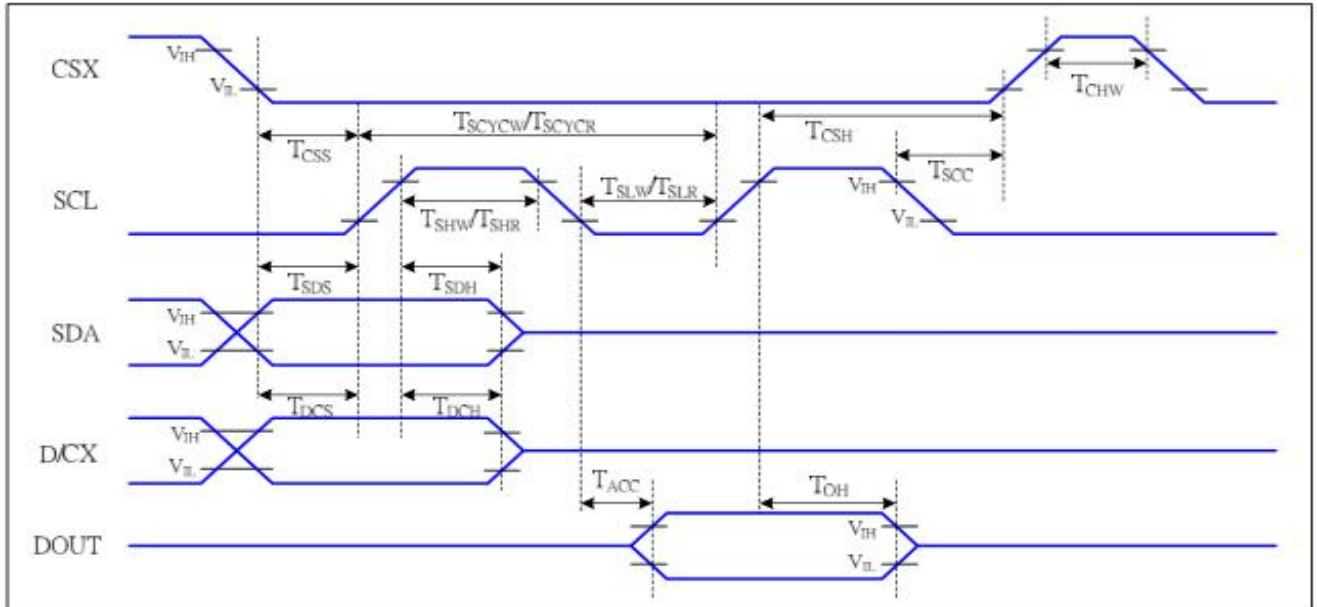


Figure 5 4-line serial Interface Timing Characteristics

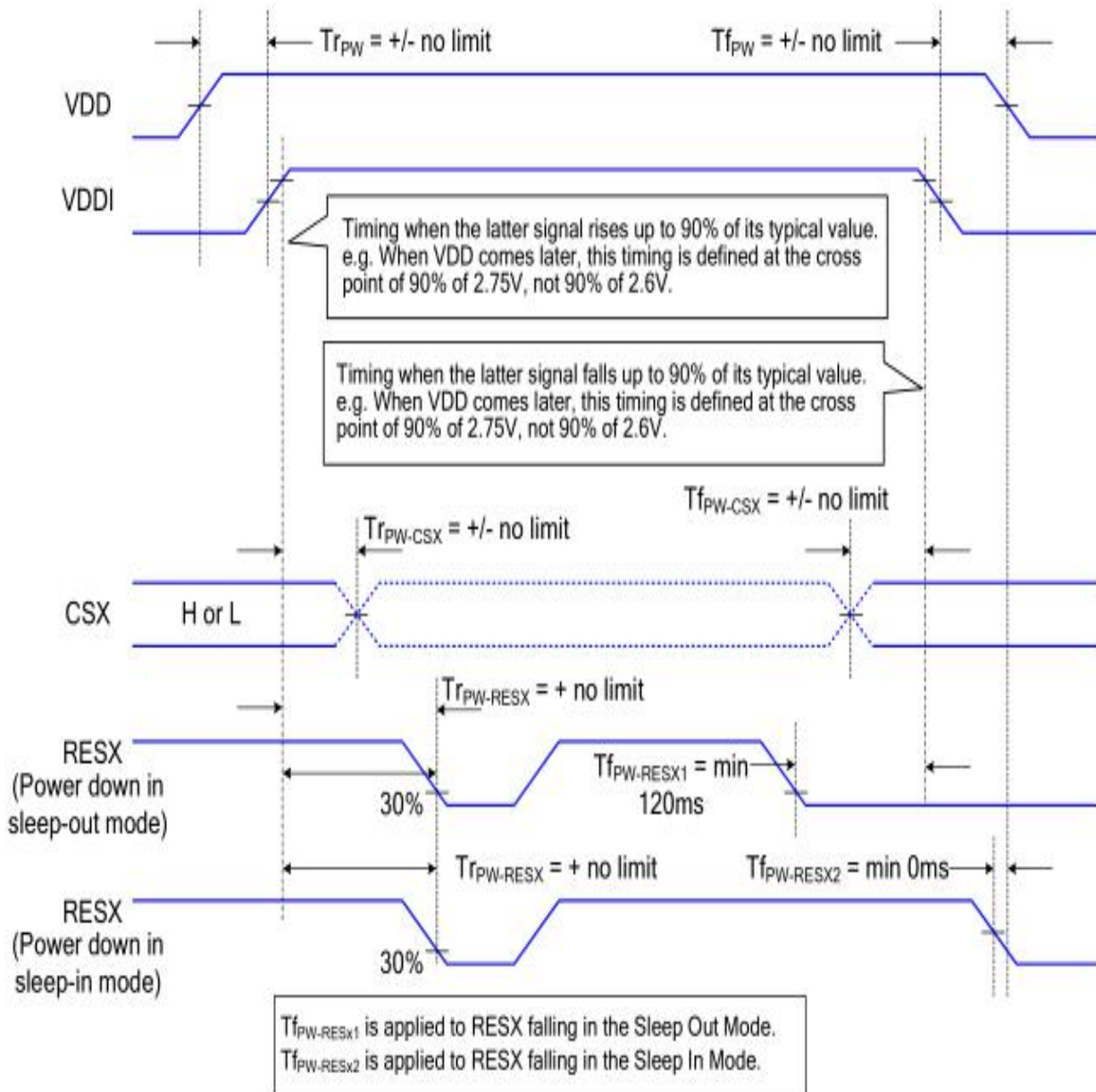
VDD1=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=25℃

Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	T _{css}	Chip select setup time (write)	15		ns	
	T _{csH}	Chip select hold time (write)	15		ns	
	T _{css}	Chip select setup time (read)	60		ns	
	T _{scc}	Chip select hold time (read)	65		ns	
	T _{chw}	Chip select "H" pulse width	40		ns	
SCL	T _{scyW}	Serial clock cycle (Write)	16		ns	-write command & data ram
	T _{shw}	SCL "H" pulse width (Write)	7		ns	
	T _{slw}	SCL "L" pulse width (Write)	7		ns	
	T _{scyR}	Serial clock cycle (Read)	150		ns	-read command & data ram
	T _{shr}	SCL "H" pulse width (Read)	60		ns	
	T _{slr}	SCL "L" pulse width (Read)	60		ns	
D/CX	T _{dcs}	D/CX setup time	10		ns	
	T _{dch}	D/CX hold time	10		ns	
SDA (DIN)	T _{sds}	Data setup time	7		ns	
	T _{sdh}	Data hold time	7		ns	
DOUT	T _{acc}	Access time	10	50	ns	For maximum CL=30pF
	T _{oh}	Output disable time	15	50	ns	For minimum CL=8pF

Table 6 4-line serial Interface Characteristics

8.Power Supply Configuration

The power on/off sequence is illustrated below



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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	$\Theta=0^{\circ}$ $\emptyset=0^{\circ}$ $T_a=25^{\circ}\text{C}$	-	30	40	ms	1
Contrast ratio 对比度	Cr		640	800	-	-	2
Color gamut 饱和度	S(%)		-	60	-	%	-
Luminance uniformity 均匀度	δ^{WHITE}		80	-	-	%	3
Viewing angle range 视角范围	Θ_{x+}	$CR \geq 10$ $T_a=25^{\circ}\text{C}$	-	80	-	deg	4
	Θ_{x-}		-	80	-	deg	
	Θ_{y+}		-	80	-	deg	
	Θ_{y-}		-	80	-	deg	
LCM Luminance LCM 亮度	Lv	$\Theta=0^{\circ}$ $\emptyset=0^{\circ}$ $T_a=25^{\circ}\text{C}$	-	200	-	Cd/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

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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,.....)

FIG1. The definition of Response time

响应时间定义

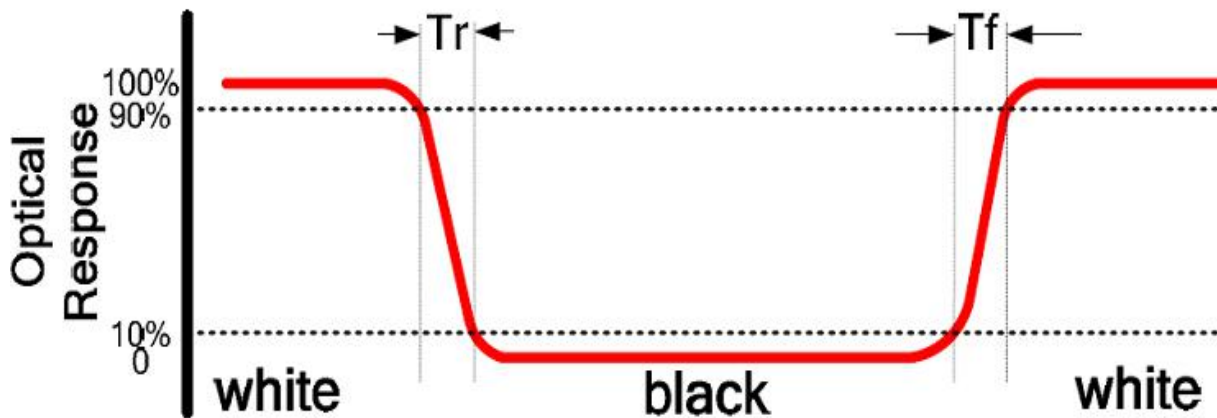


FIG2. Measuring method for Contrast ratio,surface luminance,Luminance

uniformity,CIE(X,Y)chromaticity.

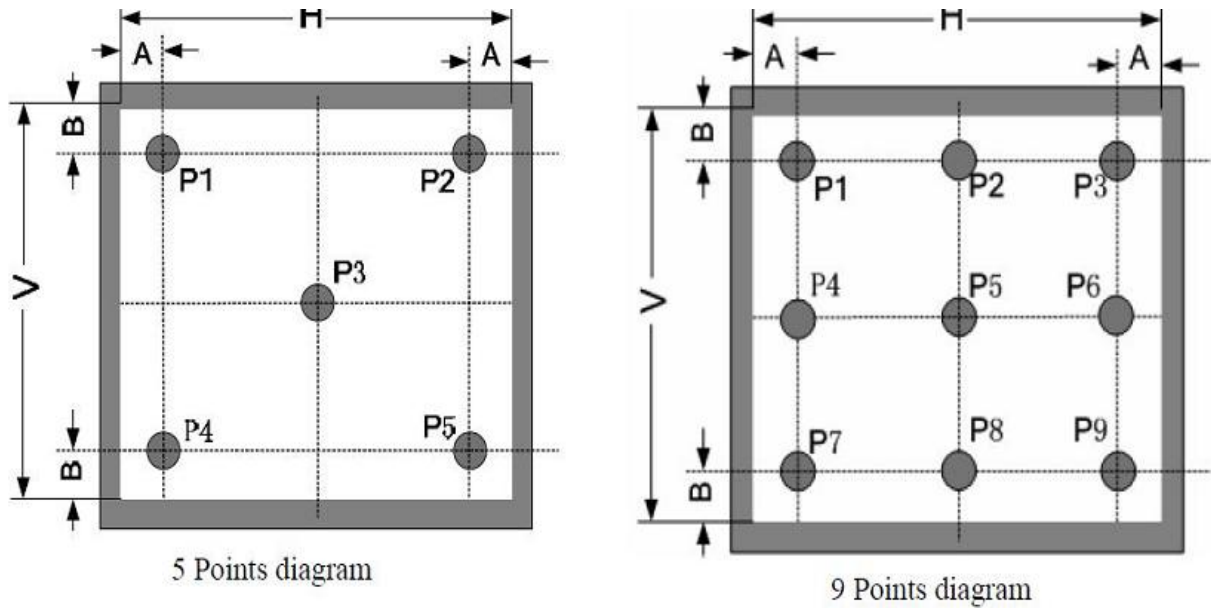
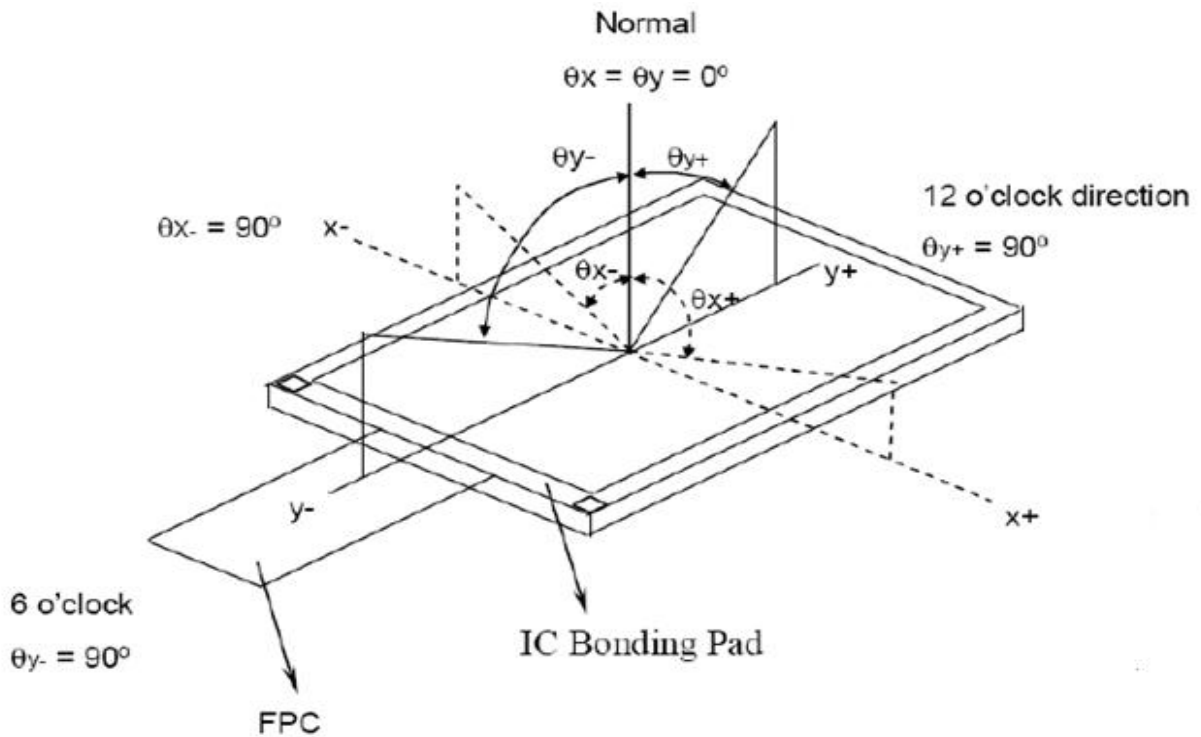


FIG3 The definition of viewing angle 视角定义



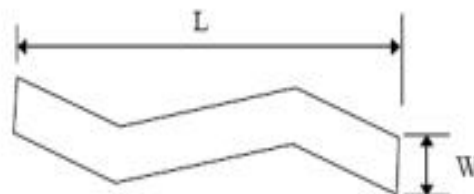
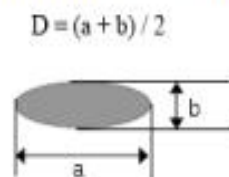
10. Inspection Specifications

10.1 Appearance inspection

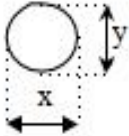
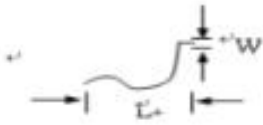
Item	Acceptable standards for defects	Defect level
Broken	Not allowed	critical defects
Cracks	Not allowed	critical defects
Insufficient UV glue entering	Not allowed	critical defects
Liquid crystal seal leakage	Not allowed	critical defects
Liquid crystal bubbles	Not allowed	critical defects
Surface scratch(mm)	$W \leq 0.02$, 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>$\Phi \leq 0.1$</td> <td>ignored</td> <td rowspan="4">ignored</td> </tr> <tr> <td>$0.1 < \Phi \leq 0.15$</td> <td>2 (gap≥ 5)</td> </tr> <tr> <td>$0.15 < \Phi \leq 0.2$</td> <td>1</td> </tr> <tr> <td>$0.2 < \Phi$</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 ≥ 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 ≥ 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>$W \leq 0.03$</td> <td>ignored</td> <td>ignored</td> <td rowspan="2">ignored</td> </tr> <tr> <td>$0.03 < W \leq 0.05$</td> <td>$L \leq 2.0$</td> <td>3</td> </tr> <tr> <td>$W > 0.05$</td> <td>-</td> <td>Not allowed</td> <td></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																
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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.
- If the display surface is dirty, please wipe the surface softly with cotton swab or clean cloth.
- Avoid using Ketone type materials (e.g. Acetone), Toluene, Ethyl acid or Methyl chloride to

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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.

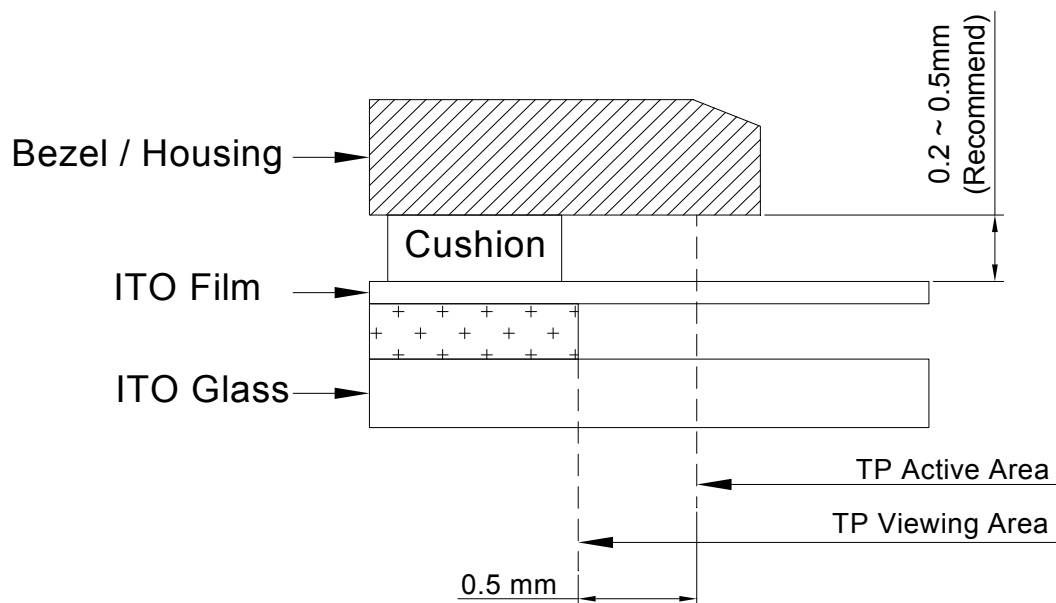
Operation

- (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.

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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.