![Orient Display logo]

Your Total LCD Solution Provider

http://www.orientdisplay.com

SPECIFICATION
FOR
TFT MODULE

MODULE NO: AFS240320TG-2.8-U100001
REVISION NO: 00

Customer's Approval:

	SIGNATURE	DATE
PREPARED BY (RD ENGINEER)	Fr. Li	2011-12-01
CHECKED BY	YLH	2011-12-01
APPROVED BY	Sean	2011-12-01

DOCUMENT REVISION HISTORY

Version	DATE	DESCRIPTION	CHANGED BY
00	Dec-01-2011	First Issue	

CONTENTS

1. Features & Mechanical Specifications

Item	Contents		Unit
	LCD		
LCD Type	TFT / Transmissive / Normal White		--
Viewing direction	12 O'clock		--
Backlight	4 Chip White LED in Series		--
Interface	3-wine SPI+RGB interface		--
Driver IC	ILI9341		--
Outline Dimension	50.0(W) × 69.2(H) × 4.0(T)		mm
Glass area (W×H×T)	46.2 × 64.75 × 1.0		mm
Active area (W×H)	43.2 × 57.6		mm
Number of Dots	240(RGB) × 320		--
Dot pitch (W×H)	0.06 × 0.180		mm
Pixel pitch (W×H)	0.180 × 0.180		mm
Operating Temperature	-20 ～ +70		℃
Storage temperature	-30 ～ +80		℃

2. Dimensional Outline
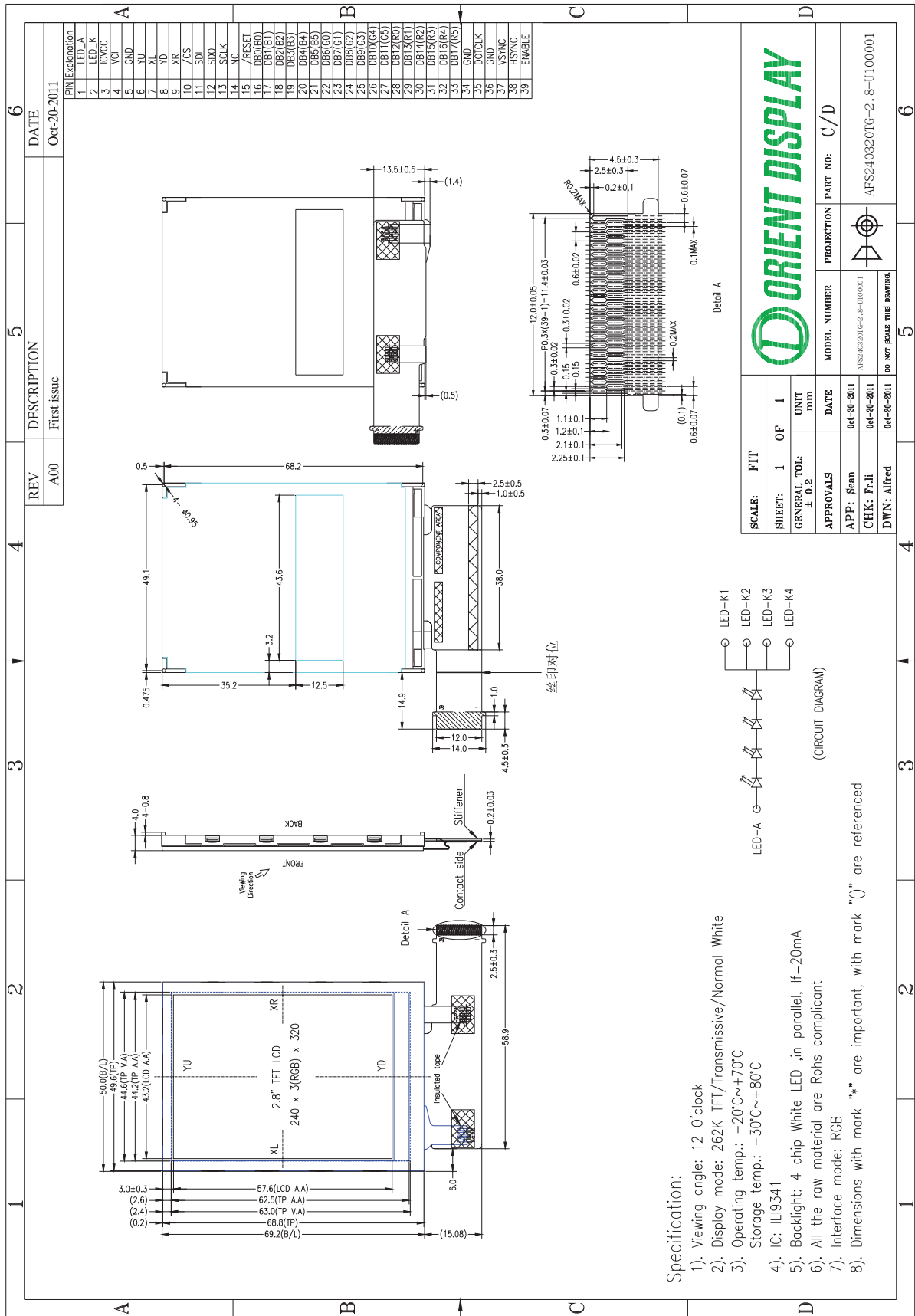
Figure 1. Dimensional outline

2. <u>Block Diagram</u>
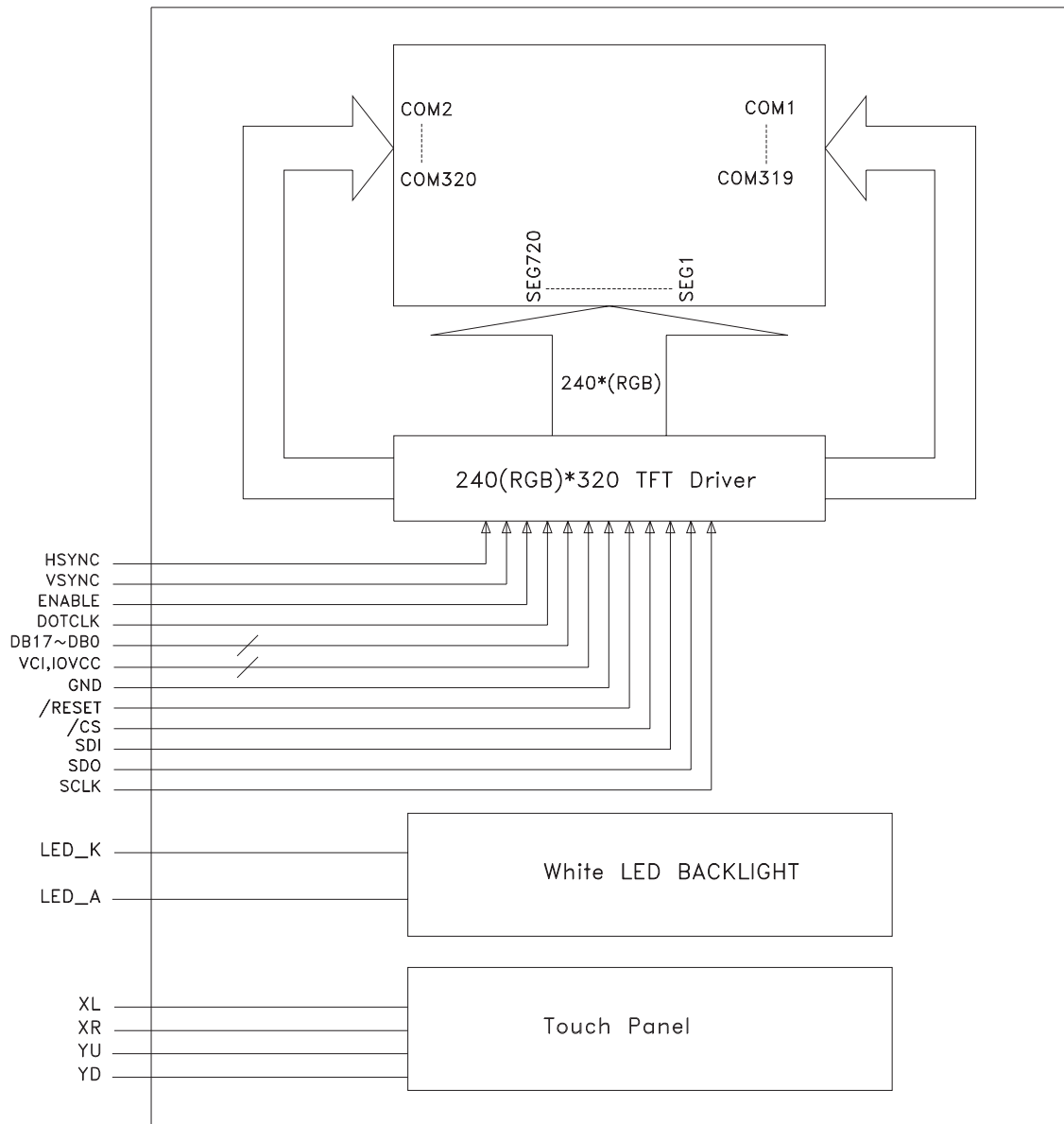
Figure 2. Block diagram

4. Pin Description

PIN No.	SYMBOL	Function
1	LED_A	Backlight LED Anode
2	LED_K	Backlight LED Cathode
3	IOVCC	power supply for interface logic circuits
4	VCI	power supply for analog circuit blocks
5	GND	Ground
6	YU	Touch Panel YU Position
7	XL	Touch Panel XL Position
8	YD	Touch Panel YD Position
9	XR	Touch Panel XR Position
10	/CS	Chip select input pin ("Low" enable).
11	SDI	Serial input signal.
12	SDO	Serial output signal.
13	SCLK	Serial clock
14	NC	No Connection
15	/RESET	Reset pin. (Active Low)
16~33	DB0~DB17	Data Bus
34	GND	Ground
35	DOTCLK	Dot clock signal for RGB interface operation
36	GND	Ground
37	VSYNC	Frame synchronizing signal for RGB interface operation
38	HSYNC	Line synchronizing signal for RGB interface operation.
39	ENABLE	Data enable signal for RGB interface operation.

5. Absolute Maximum Ratings

Item	Symbol	Rating	Unit
Supply Voltage range	VCI	-0.3 to +4.6	V
Supply Voltage range	IOVCC	-0.3 to +4.6	V
Operating Temperature range	TOP	-20 to +70	℃
Storage Temperature range	TST	-30 to +80	℃

6. Electrical Characteristics

DC Characteristics

Item	Symbol	Min.	Type.	Max.	Unit
Logic Supply Voltage	VCI	2.5	2.8	3.3	V
I/O Supply Voltage	IOVCC	1.65	2.8	3.3	V

7. Backlight Characteristics

White LED $\times$ 4 in Series **(Ta = 25°C)**

| Item	Symbol	Condition	Min	Typ	Max	Unit
Forward Voltage	VF	IF = 20mA	-	12.8	-	V
Uniformity	$\triangle$Bp	-	80	-	-	%
Luminance for LCD	Lv	IF = 20mA	3000	--	-	cd/m^2

8. Electro-Optical Characteristics

(Taransmittance、contrast、RT、viewing angle results are using CPT LC+ CPT EWV Polarizer +Corresponding Backlight, reference only)

ITEM		SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT	REMARK
Transmittance		T			(5.8)		%	
Contrast Ratio		CR	θ =ψ= 0°		(300)		--	Note 3
Response Time		Tr+ Tf	θ =ψ= 0°		(25)		ms	Note 4
Viewing Angle	Upper	θ	CR≧10		(60)		°	Note 5
	Down				(55)		°	
	Right	ψ			(50)		°	
	Left				(50)		°	
Color Filter Chromacicity	White	x	θ=φ= 0°	(0.288)	(0.308)	(0.328)	--	Note 6
		y		(0.319)	(0.339)	(0.359)	--	
		Y		(27.1)	(30.1)	(33.1)	--	
	Red	x	θ=φ= 0°	(0.632)	(0.652)	(0.672)	--	
		y		(0.311)	(0.331)	(0.351)	--	
		Y		(14.8)	(17.8)	(20.8)	--	
	Green	x	θ=φ= 0°	(0.294)	(0.314)	(0.334)	--	
		y		(0.555)	(0.575)	(0.595)	--	
		Y		(53.7)	(57.7)	(61.7)	--	
	Blue	x	θ=φ= 0°	(0.118)	(0.138)	(0.158)	--	
		y		(0.112)	(0.132)	(0.152)	--	
		Y		(11.8)	(14.8)	(17.8)	--	
	NTSC			--	(61)	--	%	

Note 1. Ambient condition：25℃±2℃，60±10%RH，under 10 Lunx in the darkroom。
Lighting the LCM and measuring after 10 minutes.
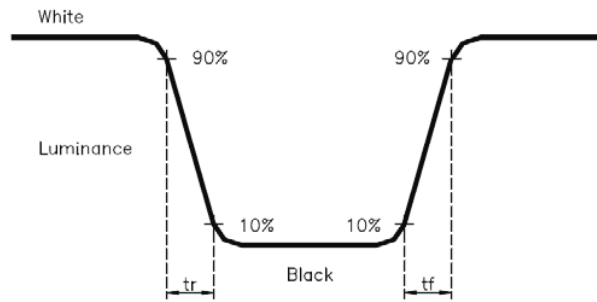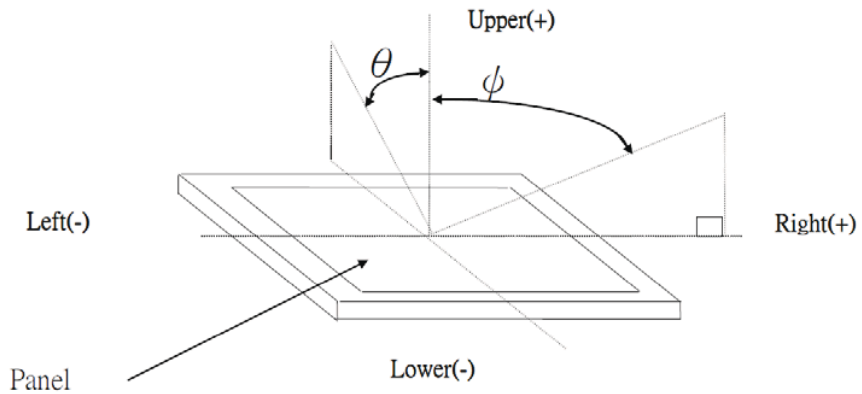Note 2.Measure device：BM-5AS (TOPCON)，viewing cone=1°，I_{Led}=20 mA。
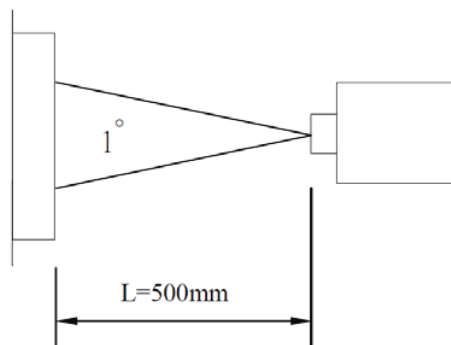
Note 3. Definition of Contrast Ratio：
CR = White Luminance (ON) / Black Luminance (OFF)

Note 4. Definition of response time：The response time is defined as the time interval between the 10% and 90% amplitudes.

Note 5. Definition of view angle(θ，ψ)：

Note 6. Light source: C light.

9. Instruction Description

Regulative Command Set

Command Function	D/CX	RDX	WRX	D17-8	D7	D6	D5	D4	D3	D2	D1	D0	Hex
No Operation	0	1	↑	XX	0	0	0	0	0	0	0	0	00h
Software Reset	0	1	↑	XX	0	0	0	0	0	0	0	1	01h
Read Display Identification Information	0	1	↑	XX	0	0	0	0	0	1	0	0	04h
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX				ID1 [7:0]					XX
	1	↑	1	XX				ID2 [7:0]					XX
	1	↑	1	XX				ID3 [7:0]					XX
Read Display Status	0	1	↑	XX	0	0	0	0	1	0	0	1	09h
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX			D [31:25]					X	00
	1	↑	1	XX	X		D [22:20]			D [19:16]			61
	1	↑	1	XX	X	X	X	X	X		D [10:8]		00
	1	↑	1	XX		D [7:5]		X	X	X	X	X	00
Read Display Power Mode	0	1	↑	XX	0	0	0	0	1	0	1	0	0Ah
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX			D [7:2]				0	0	08
Read Display MADCTL	0	1	↑	XX	0	0	0	0	1	0	1	1	0Bh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX			D [7:2]				0	0	00
Read Display Pixel Format	0	1	↑	XX	0	0	0	0	1	1	0	0	0Ch
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	RIM		DPI [2:0]		X		DBI [2:0]		06
Read Display Image Format	0	1	↑	XX	0	0	0	0	1	1	0	1	0Dh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	X	X	X	X	X		D [2:0]		00
Read Display Signal Mode	0	1	↑	XX	0	0	0	0	1	1	1	0	0Eh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX			D [7:2]				0	0	00
Read Display Self-Diagnostic Result	0	1	↑	XX	0	0	0	0	1	1	1	1	0Fh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX		D [7:6]	X	X	X	X	X	X	00
Enter Sleep Mode	0	1	↑	XX	0	0	0	1	0	0	0	0	10h
Sleep OUT	0	1	↑	XX	0	0	0	1	0	0	0	1	11h
Partial Mode ON	0	1	↑	XX	0	0	0	1	0	0	1	0	12h
Normal Display Mode ON	0	1	↑	XX	0	0	0	1	0	0	1	1	13h
Display Inversion OFF	0	1	↑	XX	0	0	1	0	0	0	0	0	20h
Display Inversion ON	0	1	↑	XX	0	0	1	0	0	0	0	1	21h
Gamma Set	0	1	↑	XX	0	0	1	0	0	1	1	0	26h
	1	1	↑	XX				GC [7:0]					01
Display OFF	0	1	↑	XX	0	0	1	0	1	0	0	0	28h
Display ON	0	1	↑	XX	0	0	1	0	1	0	0	1	29h
Column Address Set	0	1	↑	XX	0	0	1	0	1	0	1	0	2Ah
	1	1	↑	XX				SC [15:8]					XX
	1	1	↑	XX				SC [7:0]					XX
	1	1	↑	XX				EC [15:8]					XX
	1	1	↑	XX				EC [7:0]					XX
Page Address Set	0	1	↑	XX	0	0	1	0	1	0	1	1	2Bh
	1	1	↑	XX				SP [15:8]					XX
	1	1	↑	XX				SP [7:0]					XX
	1	1	↑	XX				EP [15:8]					XX
	1	1	↑	XX				EP [7:0]					XX

Command													
Memory Write	0	1	↑	XX	0	0	1	0	1	1	0	0	2Ch
	1	1	↑					D [17:0]					XX
Color SET	0	1	↑	XX	0	0	1	0	1	1	0	1	2Dh
	1	↑	1	XX					R00 [5:0]				XX
	1	↑	1	XX					Rnn [5:0]				XX
	1	↑	1	XX					R31 [5:0]				XX
	1	↑	1	XX					G00 [5:0]				XX
	1	↑	1	XX					Gnn [5:0]				XX
	1	↑	1	XX					G64 [5:0]				XX
	1	↑	1	XX					B00 [5:0]				XX
	1	↑	1	XX					Bnn [5:0]				XX
	1	↑	1	XX					B31 [5:0]				XX
Memory Read	0	1	↑	XX	0	0	1	0	1	1	1	0	2Eh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1					D [17:0]					XX
Partial Area	0	1	↑	XX	0	0	1	1	0	0	0	0	30h
	1	1	↑	XX				SR [15:8]					00
	1	1	↑	XX				SR [7:0]					00
	1	1	↑	XX				ER [15:8]					01
	1	1	↑	XX				ER [7:0]					3F
Vertical Scrolling Definition	0	1	↑	XX	0	0	1	1	0	0	1	1	33h
	1	1	↑	XX				TFA [15:8]					00
	1	1	↑	XX				TFA [7:0]					00
	1	1	↑	XX				VSA [15:8]					01
	1	1	↑	XX				VSA [7:0]					40
	1	1	↑	XX				BFA [15:8]					00
	1	1	↑	XX				BFA [7:0]					00
Tearing Effect Line OFF	0	1	↑	XX	0	0	1	1	0	1	0	0	34h
Tearing Effect Line ON	0	1	↑	XX	0	0	1	1	0	1	0	1	35h
	1	1	↑	XX	X	X	X	X	X	X	X	M	00
Memory Access Control	0	1	↑	XX	0	0	1	1	0	1	1	0	36h
	1	1	↑	XX	MY	MX	MV	ML	BGR	MH	X	X	00
Vertical Scrolling Start Address	0	1	↑	XX	0	0	1	1	0	1	1	1	37h
	1	1	↑	XX				VSP [15:8]					00
	1	1	↑	XX				VSP [7:0]					00
Idle Mode OFF	0	1	↑	XX	0	0	1	1	1	0	0	0	38h
Idle Mode ON	0	1	↑	XX	0	0	1	1	1	0	0	1	39h
Pixel Format Set	0	1	↑	XX	0	0	1	1	1	0	1	0	3Ah
	1	1	↑	XX	X	DPI [2:0]			X	DBI [2:0]			66
Write Memory Continue	0	1	↑	XX	0	0	1	1	1	1	0	0	3Ch
	1	1	↑					D [17:0]					XX
Read Memory Continue	0	1	↑	XX	0	0	1	1	1	1	1	0	3Eh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1					D [17:0]					XX
Set Tear Scanline	0	1	↑	XX	0	1	0	0	0	1	0	0	44h
	1	1	↑	XX	X	X	X	X	X	X	X	STS [8]	00
	1	1	↑	XX				STS [7:0]					00
Get Scanline	0	1	↑	XX	0	1	0	0	0	1	0	1	45h
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	X	X	X	X	X	X	GTS [9:8]		00
	1	↑	1	XX				GTS [7:0]					00
Write Display Brightness	0	1	↑	XX	0	1	0	1	0	0	0	1	51h
	1	1	↑	XX				DBV [7:0]					00

Command Function	D/CX	RDX	WRX	D17-8	D7	D6	D5	D4	D3	D2	D1	D0	Hex
Read Display Brightness	0	1	↑	XX	0	1	0	1	0	0	1	0	52h
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	DBV [7:0]								00
Write CTRL Display	0	1	↑	XX	0	1	0	1	0	0	1	1	53h
	1	1	↑	XX	X	X	BCTRL	X	DD	BL	X	X	00
Read CTRL Display	0	1	↑	XX	0	1	0	1	0	1	0	0	54h
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	X	X	BCTRL	X	DD	BL	X	X	00
Write Content Adaptive Brightness Control	0	1	↑	XX	0	1	0	1	0	1	0	1	55h
	1	1	↑	XX	X	X	X	X	X	X	C [1:0]		00
Read Content Adaptive Brightness Control	0	1	↑	XX	0	1	0	1	0	1	1	0	56h
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	X	X	X	X	X	X	C [1:0]		00
Write CABC Minimum Brightness	0	1	↑	XX	0	1	0	1	1	1	1	0	5Eh
	1	1	↑	XX	CMB [7:0]								00
Read CABC Minimum Brightness	0	1	↑	XX	0	1	0	1	0	1	1	1	5Fh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	CMB [7:0]								00
Read ID1	0	1	↑	XX	1	1	0	1	1	0	1	0	DAh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	Module's Manufacture [7:0]								XX
Read ID2	0	1	↑	XX	1	1	0	1	1	0	1	1	DBh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	LCD Module / Driver Version [7:0]								XX
Read ID3	0	1	↑	XX	1	1	0	1	1	1	0	0	DCh
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	LCD Module / Driver ID [7:0]								XX

Extended Command Set													
Command Function	D/CX	RDX	WRX	D17-8	D7	D6	D5	D4	D3	D2	D1	D0	Hex
RGB Interface Signal Control	0	1	↑	XX	1	0	1	1	0	0	0	0	B0h
	1	1	↑	XX	ByPass_MODE	RCM [1:0]		X	VSPL	HSPL	DPL	EPL	40
Frame Control (In Normal Mode)	0	1	↑	XX	1	0	1	1	0	0	0	1	B1h
	1	1	↑	XX	X	X	X	X	X	X	DIVA [1:0]		00
	1	1	↑	XX	X	X	X	RTNA [4:0]					1B
Frame Control (In Idle Mode)	0	1	↑	XX	1	0	1	1	0	0	1	0	B2h
	1	1	↑	XX	X	X	X	X	X	X	DIVB [1:0]		00
	1	1	↑	XX	X	X	X	RTNB [4:0]					1B
Frame Control (In Partial Mode)	0	1	↑	XX	1	0	1	1	0	0	1	1	B3h
	1	1	↑	XX	X	X	X	X	X	X	DIVC [1:0]		00
	1	1	↑	XX	X	X	X	RTNC [4:0]					1B
Display Inversion Control	0	1	↑	XX	1	0	1	1	0	1	0	0	B4h
	1	1	↑	XX	X	X	X	X	X	NLA	NLB	NLC	02
Blanking Porch Control	0	1	↑	XX	1	0	1	1	0	1	0	1	B5h
	1	1	↑	XX	0	VFP [6:0]							02
	1	1	↑	XX	0	VBP [6:0]							02
	1	1	↑	XX	0	0	0	HFP [4:0]					0A
	1	1	↑	XX	0	0	0	HBP [4:0]					14

Command													HEX
Display Function Control	0	1	↑	XX	1	0	1	1	0	1	1	0	B6h
	1	1	↑	XX	X	X	X	X	PTG [1:0]		PT [1:0]		0A
	1	1	↑	XX	REV	GS	SS	SM	ISC [3:0]				82
	1	1	↑	XX	X	X	NL [5:0]						27
	1	1	↑	XX	X	X	PCDIV [5:0]						XX
Entry Mode Set	0	1	↑	XX	1	0	1	1	0	1	1	1	B7h
	1	1	↑	XX	X	X	X	X	0	GON	DTE	GAS	07
Backlight Control 1	0	1	↑	XX	1	0	1	1	1	0	0	0	B8h
	1	1	↑	XX	X	X	X	X	X	X	X	X	XX
	1	1	↑	XX	X	X	X	X	TH_UI [3:0]				04
Backlight Control 2	0	1	↑	XX	1	0	1	1	1	0	0	1	B9h
	1	1	↑	XX	X	X	X	X	X	X	X	X	XX
	1	1	↑	XX	TH_MV [3:0]				TH_ST [3:0]				B8
Backlight Control 3	0	1	↑	XX	1	0	1	1	1	0	1	0	BAh
	1	1	↑	XX	X	X	X	X	X	X	X	X	XX
	1	1	↑	XX	X	X	X	X	DTH_UI [3:0]				04
Backlight Control 4	0	1	↑	XX	1	0	1	1	1	0	1	1	BBh
	1	1	↑	XX	X	X	X	X	X	X	X	X	XX
	1	1	↑	XX	DTH_MV [3:0]				DTH_ST [3:0]				C9
Backlight Control 5	0	1	↑	XX	1	0	1	1	1	1	0	0	BCh
	1	1	↑	XX	X	X	X	X	X	X	X	X	XX
	1	1	↑	XX	DIM2 [3:0]				X	DIM1 [2:0]			44
Backlight Control 7	0	1	↑	XX	1	0	1	1	1	1	1	0	BEh
	1	1	↑	XX	PWM_DIV [7:0]								0F
Backlight Control 8	0	1	↑	XX	1	0	1	1	1	1	1	1	BFh
	1	1	↑	XX	X	X	X	X	X	LEDONR	LEDONPOL	LEDPWMOPL	00
Power Control 1	0	1	↑	XX	1	1	0	0	0	0	0	0	C0h
	1	1	↑	XX	X	X	VRH [5:0]						26
Power Control 2	0	1	↑	XX	1	1	0	0	0	0	0	1	C1h
	1	1	↑	XX	X	X	X	X	X	BT [2:0]			00
VCOM Control 1	0	1	↑	XX	1	1	0	0	0	1	0	1	C5h
	1	1	↑	XX	X	VMH [6:0]							31
	1	1	↑	XX	X	VML [6:0]							3C
VCOM Control 2	0	1	↑	XX	1	1	0	0	0	1	1	1	C7h
	1	1	↑	XX	nVM	VMF [6:0]							C0
NV Memory Write	0	1	↑	XX	1	1	0	1	0	0	0	0	D0h
	1	1	↑	XX	X	X	X	X	X	PGM_ADR [2:0]			00
	1	1	↑	XX	PGM_DATA [7:0]								XX
NV Memory Protection Key	0	1	↑	XX	1	1	0	1	0	0	0	1	D1h
	1	1	↑	XX	KEY [23:16]								55
	1	1	↑	XX	KEY [15:8]								AA
	1	1	↑	XX	KEY [7:0]								66
NV Memory Status Read	0	1	↑	XX	1	1	0	1	0	0	1	0	D2h
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	X	ID2_CNT [2:0]			X	ID1_CNT [2:0]			XX
	1	↑	1	XX	BUSY	VMF_CNT [2:0]			X	ID3_CNT [2:0]			XX

					D7	D6	D5	D4	D3	D2	D1	D0	HEX
Read ID4	0	↑	1	XX	1	1	0	1	0	0	1	1	D3h
	1	↑	1	XX	X	X	X	X	X	X	X	X	XX
	1	↑	1	XX	0	0	0	0	0	0	0	0	00
	1	↑	1	XX	1	0	0	1	0	0	1	1	93
	1	↑	1	XX	0	1	0	0	0	0	0	1	41
Positive Gamma Correction	0	1	↑	XX	1	1	1	0	0	0	0	0	E0h
	1	1	↑	XX	X	X	X	X	VP0 [3:0]				08
	1	1	↑	XX	X	X	VP1 [5:0]						0E
	1	1	↑	XX	X	X	VP2 [5:0]						12
	1	1	↑	XX	X	X	X	X	VP4 [3:0]				05
	1	1	↑	XX	X	X	X	VP6 [4:0]					03
	1	1	↑	XX	X	X	X	X	VP13 [3:0]				09
	1	1	↑	XX	X	VP20 [6:0]							47
	1	1	↑	XX	VP36 [3:0]				VP27 [3:0]				86
	1	1	↑	XX	X	VP43 [6:0]							2B
	1	1	↑	XX	X	X	X	X	VP50 [3:0]				0B
	1	1	↑	XX	X	X	X	VP57 [4:0]					04
	1	1	↑	XX	X	X	X	X	VP59 [3:0]				00
	1	1	↑	XX	X	X	VP61 [5:0]						00
	1	1	↑	XX	X	X	VP62 [5:0]						00
	1	1	↑	XX	X	X	X	X	VP63 [3:0]				00
Negative Gamma Correction	0	1	↑	XX	1	1	1	0	0	0	0	1	E1h
	1	1	↑	XX	X	X	X	X	VN0 [3:0]				08
	1	1	↑	XX	X	X	VN1 [5:0]						1A
	1	1	↑	XX	X	X	VN2 [5:0]						20
	1	1	↑	XX	X	X	X	X	VN4 [3:0]				07
	1	1	↑	XX	X	X	X	VN6 [4:0]					0E
	1	1	↑	XX	X	X	X	X	VN13 [3:0]				05
	1	1	↑	XX	X	VN20 [6:0]							3A
	1	1	↑	XX	VN36 [3:0]				VN27 [3:0]				8A
	1	1	↑	XX	X	VN43 [6:0]							40
	1	1	↑	XX	X	X	X	X	VN50 [3:0]				04
	1	1		XX	X	X	X	VN57 [4:0]					18
	1	1		XX	X	X	X	X	VN59 [3:0]				0F
	1	1	↑	XX	X	X	VN61 [5:0]						3F
	1	1	↑	XX	X	X	VN62 [5:0]						3F
	1	1	↑	XX	X	X	X	X	VN63 [3:0]				0F
Digital Gamma Control 1	0	1	↑	XX	1	1	1	0	0	0	1	0	E2h
1st Parameter	1	1	↑	XX	RCA0 [3:0]				BCA0 [3:0]				XX
:	1	1	↑	XX	RCAx [3:0]				BCAx [3:0]				XX
16th Parameter	1	1	↑	XX	RCA15 [3:0]				BCA15 [3:0]				XX
Digital Gamma Control 2	0	1	↑	XX	1	1	1	0	0	0	1	1	E3h
1st Parameter	1	1	↑	XX	RFA0 [3:0]				BFA0 [3:0]				XX
:	1	1	↑	XX	RFAx [3:0]				BFAx [3:0]				XX
64th Parameter	1	1	↑	XX	RFA63 [3:0]				BFA63 [3:0]				XX
Interface Control	0	1	↑	XX	1	1	1	1	0	1	1	0	F6h
	1	1	↑	XX	MY_EOR	MX_EOR	MV_EOR	X	BGR_EOR	X	X	WEMODE	01
	1	1	↑	XX	X	X	EPF [1:0]		X	X	MDT [1:0]		00
	1	1	↑	XX	X	X	ENDIAN	X	DM [1:0]		RM	RIM	00

Note 1: Undefined commands are treated as NOP (00h) command.

10. AC Characteristics

10.1 Serial data Transfer Interface Characteristics
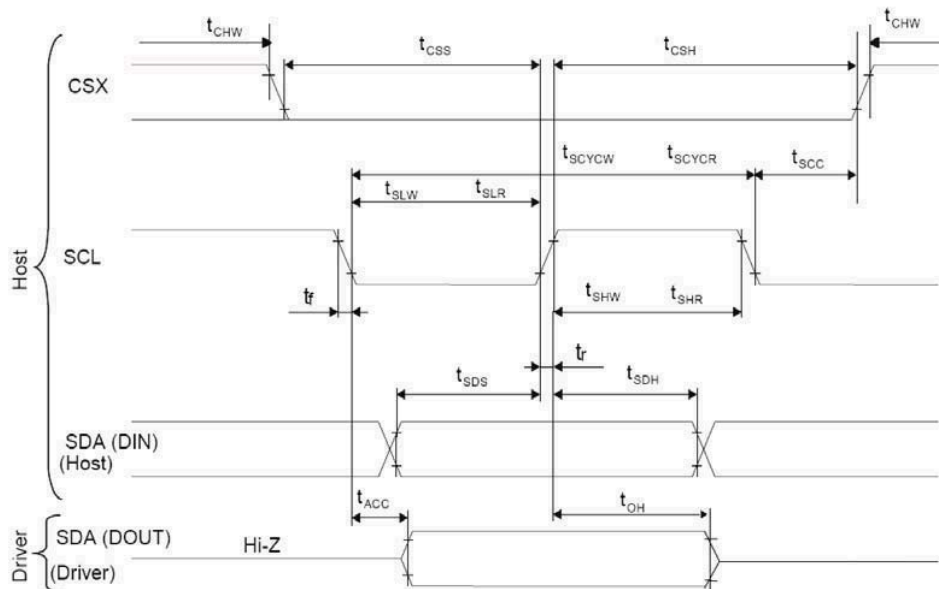
Signal	Symbol	Parameter	min	max	Unit	Description
SCL	tscycw	Serial Clock Cycle (Write)	100	-	ns	
	tshw	SCL "H" Pulse Width (Write)	40	-	ns	
	tslw	SCL "L" Pulse Width (Write)	40	-	ns	
	tscycr	Serial Clock Cycle (Read)	150	-	ns	
	tshr	SCL "H" Pulse Width (Read)	60	-	ns	
	tslr	SCL "L" Pulse Width (Read)	60	-	ns	
SDA / SDI (Input)	tsds	Data setup time (Write)	30	-	ns	
	tsdh	Data hold time (Write)	30	-	ns	
SDA / SDO (Output)	tacc	Access time (Read)	10	-	ns	
	toh	Output disable time (Read)	10	50	ns	
CSX	tscc	SCL-CSX	20	-	ns	
	tchw	CSX "H" Pulse Width	40	-	ns	
	tcss	CSX-SCL Time	60	-	ns	
	tcsh		65	-	ns	

Note: Ta = 25 ℃, VDDI=1.65V to 3.3V, VCI=2.5V to 3.3V, AGND=VSS=0V
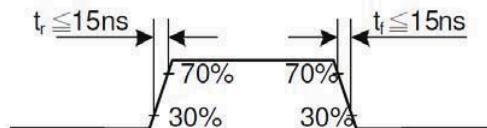
10.2 RGB Interface Characteristics
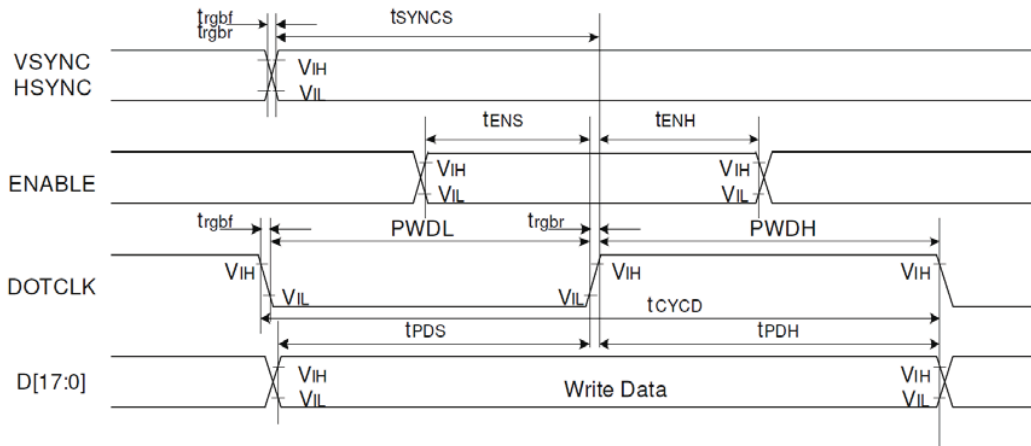
Signal	Symbol	Parameter	min	max	Unit	Description
VSYNC / HSYNC	t_{SYNCS}	VSYNC/HSYNC setup time	15	-	ns	
	t_{SYNCH}	VSYNC/HSYNC hold time	15	-	ns	
DE	t_{ENS}	DE setup time	15	-	ns	
	t_{ENH}	DE hold time	15	-	ns	
D[17:0]	t_{POS}	Data setup time	15	-	ns	18/16-bit bus RGB interface mode
	t_{PDH}	Data hold time	15	-	ns	
DOTCLK	PWDH	DOTCLK high-level period	15	-	ns	
	PWDL	DOTCLK low-level period	15	-	ns	
	t_{CYCD}	DOTCLK cycle time	100	-	ns	
	t_{rgbr}, t_{rgbf}	DOTCLK,HSYNC,VSYNC rise/fall time	-	15	ns	
VSYNC / HSYNC	t_{SYNCS}	VSYNC/HSYNC setup time	15	-	ns	
	t_{SYNCH}	VSYNC/HSYNC hold time	15	-	ns	
DE	t_{ENS}	DE setup time	15	-	ns	
	t_{ENH}	DE hold time	15	-	ns	
D[17:0]	t_{POS}	Data setup time	15	-	ns	6-bit bus RGB interface mode
	t_{PDH}	Data hold time	15	-	ns	
DOTCLK	PWDH	DOTCLK high-level pulse period	15	-	ns	
	PWDL	DOTCLK low-level pulse period	15	-	ns	
	t_{CYCD}	DOTCLK cycle time	100	-	ns	
	t_{rgbr}, t_{rgbf}	DOTCLK,HSYNC,VSYNC rise/fall time	-	15	ns	

Note: Ta = -30 to 70 ℃, VDDI=1.65V to 3.3V, VCI=2.5V to 3.3V, AGND=VSS=0V
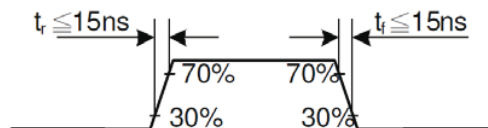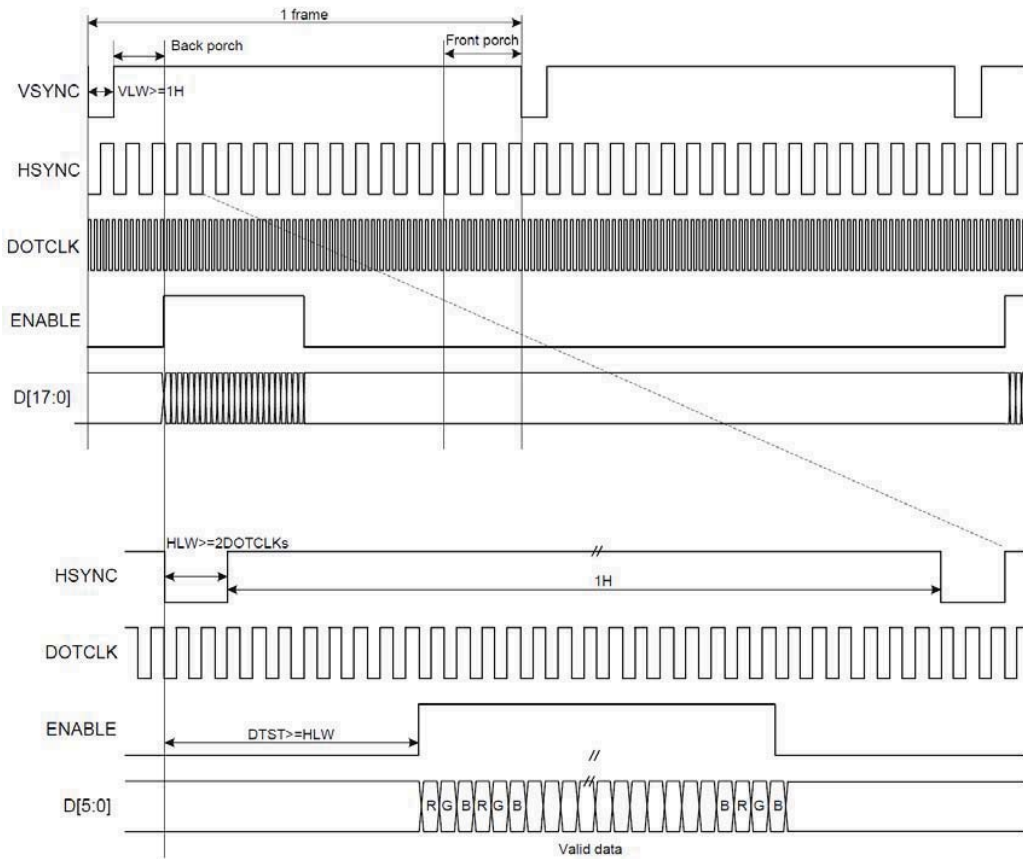
VLW : VSYNC Low Width
HLW : HSYNC Low Width
DTST : Data Transfer Startup Time

Parameters	Symbols	Condition	Min.	Typ.	Max.	Units
Horizontal Synchronization	Hsync		2	10	16	DOTCLK
Horizontal Back Porch	HBP		2	20	24	DOTCLK
Horizontal Address	HAdr		-	240	-	DOTCLK
Horizontal Front Porch	HFP		2	10	16	DOTCLK
Vertical Synchronization	Vsync		1	2	4	Line
Vertical Back Porch	VBP		1	2	-	Line
Vertical Address	VAdr		-	320	-	Line
Vertical Front Porch	VFP		3	4	-	Line

11.Quality Specifications

All The raw material are Rohs complicant.

11.1 Standard of the product appearance test

Manner of appearance test: The inspection should be performed in using 20W x 2 fluorescent lamps.

Distance between LCM and fluorescent lamps should be 100 cm or more. Distance between LCM

and inspector eyes should be 30 cm or more.

Viewing direction for inspection is 45° from vertical against LCM.
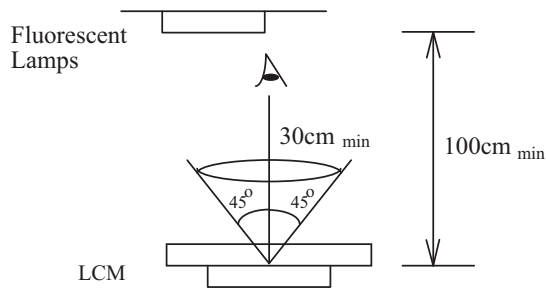
Definition of zone:
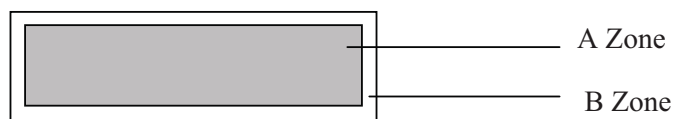
A Zone: viewing area

B Zone: outside viewing area

11.2 Specification of quality assurance
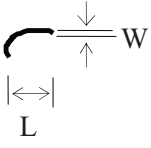
AQL inspection standard
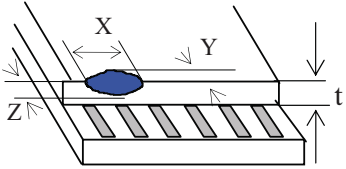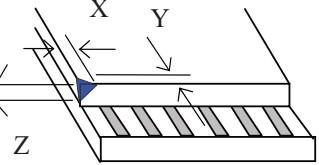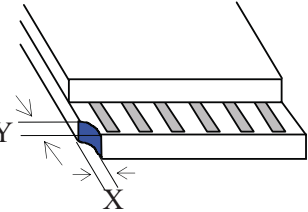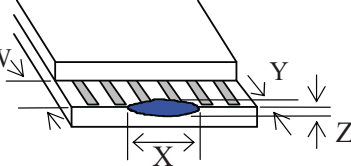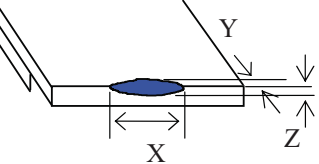
Sampling method: MIL-STD-105E, Level II, single sampling
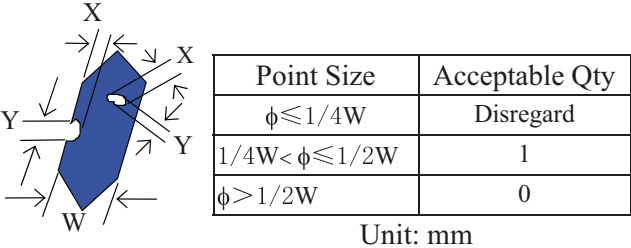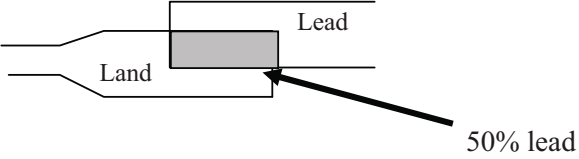
Defect classification (Note: * is not including)
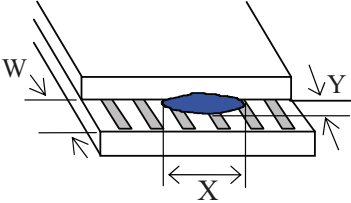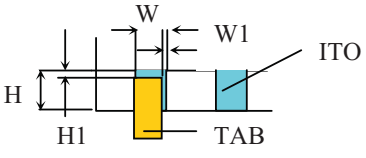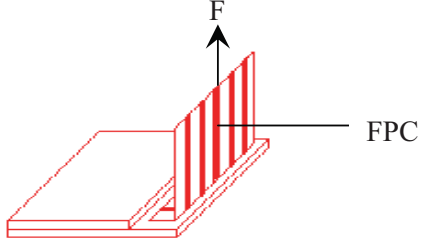
Classify		Item	Note	AQL
Major	Display state	Short or open circuit		0.65
		LC leakage		
		Flickering	1	
		No display		
		Wrong viewing direction		
		Contrast defect (dim, ghost)	2	
		Back-light	1,8	
	Non-display	Flat cable or pin reverse	10	
		Wrong or missing component	11	
Minor	Display state	Background color deviation	2	1.0
		Black spot and dust	3	
		Line defect, Scratch	4	
		Rainbow	5	
		Chip	6	
		Pin hole	7	
	Polarizer	Protruded	12	
		Bubble and foreign material	3	
	Soldering	Poor connection	9	
	Wire	Poor connection	10	
	TAB	Position, Bonding strength	13	

Note on defect classification

No.	Item	Criterion
1	Short or open circuit	Not allow
	LC leakage	
	Flickering	
	No display	
	Wrong viewing direction	
	Wrong Back-light	
2	Contrast defect	Refer to approval sample
	Background color deviation	

Point defect, Black spot, dust (including Polarizer) — No. 3

$\phi = (X+Y)/2$

Point Size	Acceptable Qty.
$\phi \leq 0.10$	Disregard
$0.10 < \phi \leq 0.20$	3
$0.20 < \phi \leq 0.25$	2
$0.25 < \phi \leq 0.30$	1
$\phi > 0.30$	0

Unit：mm

Line defect, Scratch — No. 4

Line		Acceptable Qty.
L	W	
---	$0.015 \geq W$	Disregard
$3.0 \geq L$	$0.03 \geq W$	2
$2.0 \geq L$	$0.05 \geq W$	
$1.0 \geq L$	$0.1 > W$	1
---	$0.05 < W$	Applied as point defect

Unit: mm

No.	Item	Criterion
5	Rainbow	Not more than two color changes across the viewing area.

No	Item	Criterion
6	Chip Remark: X: Length direction Y: Short direction Z: Thickness direction t: Glass thickness W: Terminal Width	Acceptable criterion | X	Y	Z
---	---	---
≤2	0.5mm	≤t/2 | Acceptable criterion | X	Y	Z
---	---	---
≤2	0.5mm	≤t | Acceptable criterion | X	Y	Z
---	---	---
≤3	≤2	≤t
shall not reach to ITO		| Acceptable criterion | X	Y	Z
---	---	---
Disregard	≤0.2	≤t | Acceptable criterion | X	Y	Z
---	---	---
≤5	≤2	≤t/3	

No.	Item	Criterion
7	Segment pattern W = Segment width $\phi = (X+Y)/2$	(1) Pin hole $\phi < 0.10mm$ is acceptable. <table><tr><td>Point Size</td><td>Acceptable Qty</td></tr><tr><td>$\phi \leqslant 1/4W$</td><td>Disregard</td></tr><tr><td>$1/4W < \phi \leqslant 1/2W$</td><td>1</td></tr><tr><td>$\phi > 1/2W$</td><td>0</td></tr></table> Unit: mm
8	Back-light	(1) The color of backlight should correspond its specification. (2) Not allow flickering
9	Soldering	(1) Not allow heavy dirty and solder ball on PCB. (The size of dirty refer to point and dust defect) (2) Over 50% of lead should be soldered on Land. Lead Land 50% lead
10	Wire	(1) Copper wire should not be rusted (2) Not allow crack on copper wire connection. (3) Not allow reversing the position of the flat cable. (4) Not allow exposed copper wire inside the flat cable.
11*	PCB	(1) Not allow screw rust or damage. (2) Not allow missing or wrong putting of component.

No	Item	Criterion
12	Protruded W: Terminal Width	 Acceptable criteria: $Y \leq 0.4$
13	TAB	1. Position $W1 \leq 1/3W$ $H1 \leq 1/3H$ 2 FPC bonding strength test P (=F/FPC bonding width) $\geq 650gf/cm$,(speed rate: 1mm/min) 5pcs per SOA (shipment)

14	Total no. of acceptable Defect	A. Zone
		
		  Maximum 2 minor non-conformities per one unit.
		  Defect distance: each point to be separated over 10mm
		
		B. Zone
		
		  It is acceptable when it is no trouble for quality and assembly
		  in customer's end product.

11.3 Reliability of LCM

Reliability test condition:

Item	Condition	Time (hrs)	Assessment
High temp. Storage	60°C	48	
High temp. Operating	50°C	48	
Low temp. Storage	-20°C	48	No abnormalities
Low temp. Operating	-10°C	48	in functions
Humidity	40°C/ 90%RH	48	and appearance
Temp. Cycle	-20°C ← 25°C →60°C (60 min ← 5 min → 60min)	10cycles	

Recovery time should be 24 hours minimum. Moreover, functions, performance and appearance shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions room temperature (20±8°C), normal humidity (below 65% RH), and in the area not exposed to direct sun light.

11.4 Precaution for using LCD/LCM

LCD/LCM is assembled and adjusted with a high degree of precision. Do not attempt to make any alteration or modification. The followings should be noted.

General Precautions:
1. LCD panel is made of glass. Avoid excessive mechanical shock or applying strong pressure onto the surface of display area.
2. The polarizer used on the display surface is easily scratched and damaged. Extreme care should be taken when handling. To clean dust or dirt off the display surface, wipe gently with cotton, or other soft material soaked with isoproply alcohol, ethyl alcohol or trichlorotriflorothane, do not use water, ketone or aromatics and never scrub hard.
3. Do not tamper in any way with the tabs on the metal frame.
4. Do not made any modification on the PCB without consulting Orient Display.
5. When mounting a LCM, make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
6. Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels and also cause rainbow on the display.
7. Be careful not to touch or swallow liquid crystal that might leak from a damaged cell. Any liquid crystal adheres to skin or clothes, wash it off immediately with soap and water.

Static Electricity Precautions:
1. CMOS-LSI is used for the module circuit; therefore operators should be grounded whenever he/she comes into contact with the module.
2. Do not touch any of the conductive parts such as the LSI pads; the copper leads on the PCB and the interface terminals with any parts of the human body.
3. Do not touch the connection terminals of the display with bare hand; it will cause disconnection or defective insulation of terminals.
4. The modules should be kept in anti-static bags or other containers resistant to static for storage.
5. Only properly grounded soldering irons should be used.
6. If an electric screwdriver is used, it should be grounded and shielded to prevent sparks.
7. The normal static prevention measures should be observed for work clothes and working benches.
8. Since dry air is inductive to static, a relative humidity of 50-60% is recommended.

Soldering Precautions:
1. Soldering should be performed only on the I/O terminals.
2. Use soldering irons with proper grounding and no leakage.
3. Soldering temperature: 280°C±10°C
4. Soldering time: 3 to 4 second.
5. Use eutectic solder with resin flux filling.
6. If flux is used, the LCD surface should be protected to avoid spattering flux.
7. Flux residue should be removed.

Operation Precautions:

1. The viewing angle can be adjusted by varying the LCD driving voltage Vo.
2. Since applied DC voltage causes electro-chemical reactions, which deteriorate the display, the applied pulse waveform should be a symmetric waveform such that no DC component remains. Be sure to use the specified operating voltage.
3. Driving voltage should be kept within specified range; excess voltage will shorten display life.
4. Response time increases with decrease in temperature.
5. Display color may be affected at temperatures above its operational range.
6. Keep the temperature within the specified range usage and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel-off or generate bubbles.
7. For long-term storage over 40°C is required, the relative humidity should be kept below 60%, and avoid direct sunlight.

Limited Warranty

Orient Display LCDs and modules are not consumer products, but may be incorporated by Orient Display's customers into consumer products or components thereof, Orient Display does not warrant that its LCDs and components are fit for any such particular purpose.

1. The liability of Orient Display is limited to repair or replacement on the terms set forth below. Orient Display will not be responsible for any subsequent or consequential events or injury or damage to any personnel or user including third party personnel and/or user. Unless otherwise agreed in writing between Orient Display and the customer, Orient Display will only replace or repair any of its LCD which is found defective electrically or visually when inspected in accordance with Orient Display general LCD inspection standard. (Copies available on request)
2. No warranty can be granted if any of the precautions state in handling liquid crystal display above has been disregarded. Broken glass, scratches on polarizer mechanical damages as well as defects that are caused accelerated environment tests are excluded from warranty.
3. In returning the LCD/LCM, they must be properly packaged; there should be detailed description of the failures or defect.