SPECIFICATION
FOR
LCD MODULE

MODULE NO: AFM240320HD-2.2-ZT00
REVISION NO: 02

Customer's Approval:

	SIGNATURE	DATE
PREPARED BY (RD ENGINEER)		2009-02-18
CHECKED BY		
APPROVED BY		

REVISION RECORD

Date	Rev.No.	Page	Revision Items	Prepared
2010.12.6	**V1.0**		The first release	

CONTENTS

1.NOTICE

1.1 announce

1.1.1 These specification sheets are the proprietary product of Orient Display and include materials protected under copyright of OD. Do not reproduce or cause any third party to reproduce them in any form or by any means, electronic or mechanical, for any purpose,in whole or in part,without theexpress written permission of OD. Orient Display assumes no responsibility for any problems related to any industrial property right of a third party resulting from the use of the device.

1.1.2 Do not use the device for equipment that requires an extreme level of reliability, such as aerospace applications, nuclear power control equipment and medical or other equipment for life support. OD assumes no responsibility for any damage resulting from the use of the device which does not comply with the instructions and the precautions specified in these specification sheets.

1.1.3 Contact and consult with a OD sales representative for any questions about this device.

1.2 For handling and system design

1.2.1 Do not scratch the surface of the polarizer film as it is easily damaged.

1.2.2 If the cleaning of the surface of the LCD panel is necessary, wipe it swiftly with cotton or other soft cloth. Do not use organic solvent as it damages polarizer.

1.2.3 Water droplets on polarizer must be wiped off immediatelyas they may cause color changes, or other defects if remained for a long time.

1.2.4 Since this LCD panel is made of glass, dropping the module or banging it against hard objects may cause cracks or fragmentation.

1.2.5 Certain materials such as epoxy resin (amine's hardener)or silicone adhesive agent(de-alcohol or de-oxym) emits gas to which polarizer reacts(color change).Check carefully that gas from materials used in system housing or packing do not hart polarizer.

1.2.6 Liquid crystal material will freeze below specified storage temperature range and it will not get back to normal quality even after temperature comes back within specified temperature range.Liquid crystal material will become isotropic above specified temperature range and may not get back to normal quality. Keep the LCD module always within specified temperature range.

1.2.7 Do not expose LCD module to the direct sunlight, or to strong ultraviolet light for long time.If the LCD driver IC is exposed to light, normal operation may be impeded. It is necessary

to design so that the light is shut off when the LCD module is mounted.

1.2.8　Do not disassemble the LCD module as it may cause permanent damage. Hold LCD very　carefully when placing LCD module into the system housing. Do not apply excessive stress or pressure to LCD module.

1.2.9 As this LCD module contains components sensitive to electrostatic discharge, be sure to follow the instructions in below.

①Operators

Operators must wear anti-static wears to prevent electrostatic charge up to and discharge from human body.

② Equipment and containers

Process equipment such　as conveyer, soldering iron, working bench and containers may possibly generate electrostatic charge up and discharge.Equipment must begrounded through 100Mohms resistance. Use ion blower.

③ Floor

Floor is an important part to leak static electricity which is generated　from　human　body or equipment. There is a possibility that the static electricity is charged to them without leakage .in case of insulating floor, so the countermeasure(electrostatic earth:$1 \times 108 \Omega$) should be made.

④ Humidity

Proper umidityof working roommay reduce the isk ofelectrostatic charge up and discharge. Humidity should be kept over 50% all the time.

⑤ Transportation/storage

Storage materials must be anti-static to prevent causing electrostatic discharge.

⑥ Others

Protective film is attached on the surface of LCD panel to prevent scratches or other damage.When removing this protective film, remove it slowly under proper anti-ESD control such as ion blower.

1.2.10 Do not hold or touch LCD panel to flex interconnection area as it may be damaged.As the binding material between LCD panel and flex　connector mentioned　in　　flex　　area contains an organic material, any type of organic solvents are not allowed to be used. Direct contact by fingers are also prohibited.

1.2.11 When carrying the LCD module, place it on the tray to protect from mechanical damage. It is recommended to use the conductive trays to protect the CMOS　components　from electrostatic discharge. When holding the module, hold the Plastic Frame of LCD module so that the panel ,TCP and other electric parts are not damaged. e.g. chart1
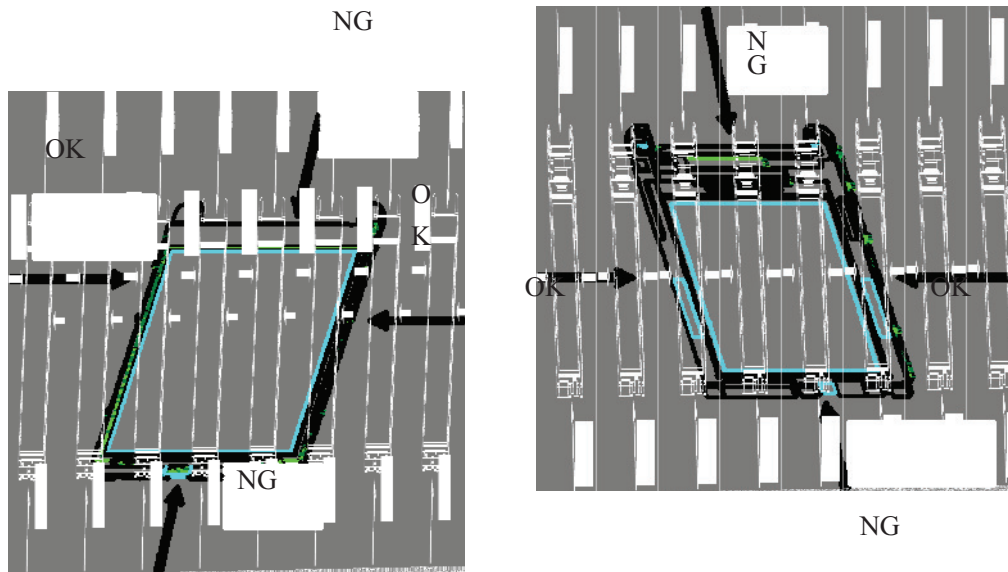
NG

N G

OK

O K

OK

OK

N G

NG

NG

chart1 Note : The LCD module illustration is general module image

1.2.12 Do not touch the FPC 's exposed base film and patterning area, slit part. Otherwise the circuit maybe damaged. Do not touch LSI chips as it may cause a trouble in the inner lead connection.

1.2.13 Place a protective cover on the LCD module to protect the glass panel from mechanical damages. 1.2.14 LCD panel is susceptible to mechanical stress and even the slightest stress will cause a color change

in background.So make sure the LCD panel is placed on flat plane without any continuous twisting, bending or pushing stress.

1.2.15 Protective film is placed onto the surface of LCD panel when it is shipped from factory. Make sure to peel it off before assembling the LCD module into the system. Be very careful not to damage LCD module by electrostatic discharge when peeling off this protective film. Ion blower and ground strap are recommended.

1.2.16 Make sure the mechanical   design of the system in which the LCD module will be assembled matches specified viewing angle of this LCD module.

1.3 For operating LCD module

1.3.1 Do not operate or store the LCD module under outside of specified environmental conditions.

1.3.2 As opto-electrical characteristics of LCD will be changed, dependent on the temperature, the confirmation of display quality and characteristics has to be done after

temperature is set at 25 °C and it becomes stable.

1.4 Precautions for Storage

1.4.1 Do not expose the LCD module to direct sunlight or strong ultraviolet light for long periods. Store

in a dark place.

1.4.2 The liquid crystal material will solidify if stored below the rated storage temperature and will becomean isotropic liquid if stored above the rated storage temperature, and may not

retain its original properties. Only store the module at normal temperature and humidity （25±5℃、60±10％ ＲＨ）in order to avoid exposing the front polarizer to chronic humidity.

1.4.3 Keeping method

NG

OK
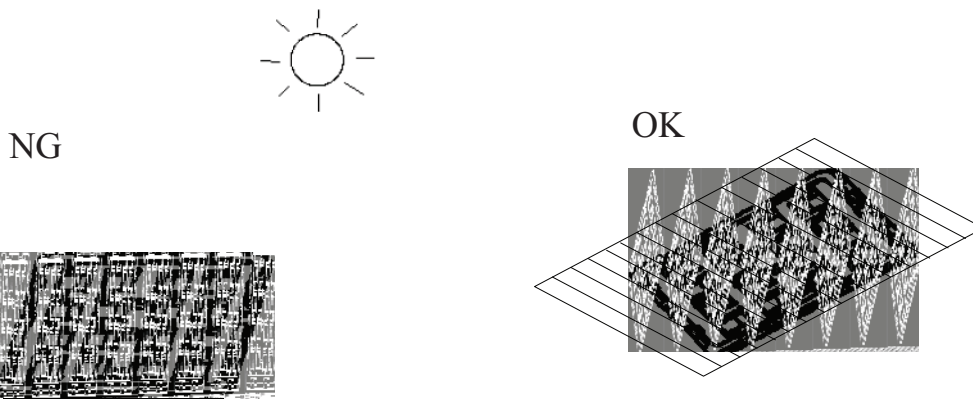
a.Don't keeping under the direct sunlight.   b.Keeping in the tray under the dark place

1.5 Other Notice

1.5.1 Generally, At power on, in order not to apply DC charge directly to LCD panel, supply logic voltage first and initialize LSI logic function including polarity alternation. Then supply voltage for LCD bias. At power off, in order not to apply DC charge directly to LCD panel, execute Power OFF sequence and Discharge command.

1.5.2 Don't touch to PWB surface, exposed IC chip, electric parts and other parts, to any electric, metallic materials.

1.5.3 No bromide specific fire-retardant material is used in this module.

1.5.4 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.

2.General Specifications

AFM240320HD-2.2-ZT00 is a color active matrix LCD module incorporating amorphous silicon TFT (Thin Film Transistor). It is composed of a color TFT-LCD panel, driver IC, FPC, and a back light unit . The AFM240320HD-2.2-ZT00 display area contains $240(RGB) \times 320$ pixels and can display up to 65K/262K colors. This product accords with RoHS environmental criterion.

Item	Contents	Unit	Note
LCD Type	TFT	-	
Display Color	65K/262K		1
LCD Duty	1/320	-	
Viewing Direction	6:00	O'Clock	
Active Area(W×H)	33.84×45.12	mm	
Number of Dots	$240(RGB) \times 320$	-	
Pixel Pitch(W×H)	0.141X0.141	mm	
Controller	ILI9340	-	
V_{DD}	2.8	V	
VDD2	1.8/2.8		
Outline Dimensions	Refer to outline drawing on next page		
Backlight	3-LED (white) parallel	-	-
Weight	TBD	g	
Interface	8/16 bits parallel bus	-	
Polarizer Mode	ECB Transflective	-	

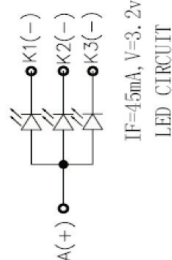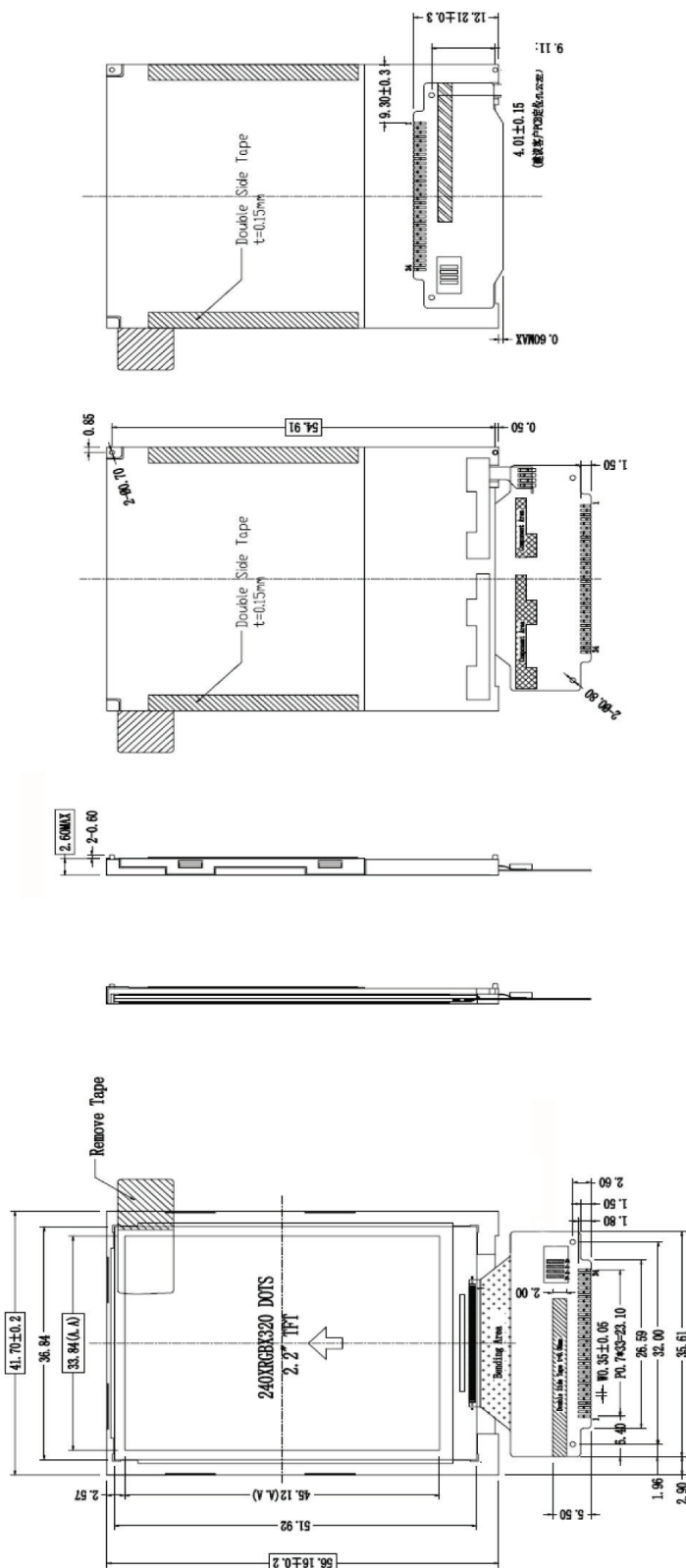Note 1:   Color tune is slightly changed by temperature and driving voltage.

Note 2:   Requirements on Environmental Protection: RoHS.

Note 3:   Customer should do assembly according to our FPC bending sketch in the outline drawing.

Note 4:   Please approve our spec before placing mass production order. Otherwise we will regard customer has approved the spec when we receive the first 2Kpcs or above   order from customer.

FPC INTERFACE

No.	PIN NAME
1	GND
2	VDD
3	VDD
4	CS
5	RS
6	WR
7	RD
8	DB0
9	DB1
10	DB2
11	DB3
12	DB4
13	DB5
14	DB6
15	DB7
16	DB8
17	DB9
18	DB10
19	DB11
20	DB12
21	DB13
22	DB14
23	DB15
24	RESET
25	IM0
26	GND
27	YD(Y-)
28	XL(X-)
29	YU(Y+)
30	XR(X+)
31	LED K3
32	LED K2
33	LED K1
34	LED A

Double Side Tape t=0.15mm

12.21±0.3

9.11.

9.30±0.3

4.01±0.15 (玻璃/FPC贴合凸出尺寸)

0.60MAX

54.91

0.85

2-Ø0.70

0.50

1.50

2-Ø0.60

2.60MAX 2-0.60

LED CIRCUIT

IF=45mA, V=3.2v

K1(-)
K2(-)
K3(-)

A(+)

Remove Tape

240XRGBX320 DOTS
2.2" TFT

41.70±0.2
36.84
33.84(A.A)

2.57
45.12(A.A)
51.92
56.16±0.2

2.60
1.50
1.80
2.00

W0.35±0.06
P0.7X33=23.10
26.59
32.00
35.61

5.40
1.96
2.90
5.50

Bonding Area
Double Side Tape t=0.15mm

NOTES:

1. DISPLAY TYPE: TFT
2. VIEWING DIRECTION: 6:00
3. LCD DRIVE IC: ILI9340
4. POLARIZER MODE: ECB Transflective
5. DRIVE METHOD: 1/220 DUTY
6. VDD: 2.8V
7. BACKLIGHT: 3-CHIP WHITE LED PARELLEL
8. OPERATING TEMP: -20℃ -- 70℃
9. STORAGE TEMP: -30℃ -- 80℃
10. UNMARKED TOLERANCE: ±0.30
11. CONTROL DIMENSIONS ☐
12. REQUIREMENTS ON ENVIRONMENTAL PROTECTION: ROHS

	DRAWN	BY: TCX	10-10-27	TITLE: AFM240320HD-2.2-ZT00	
	ME CHECKED BY: LZL		10-10-27		
	EE CHECKED BY: YZQ		10-10-27	DWG NO: G-1	UNT: mm
	APPROVED BY: PP		10-10-27	SCALE: 1:1	SHEET NO: 1 OF 1

G-1		NEW ISSUE	10-10-27
REV		DESCRIPTION	DATE

ORIENT DISPLAY

NOTE 1: FPC,BL,TP etc. may have not only one provider, appearance, silk-screen may exist difference.

NOTE 2:Customer's rind(handset rind etc.) and OD's standard module may exist interference , Customer should advise on TIANM FAE or RD change rind.

NOTE 3: Do not allow customers to do fall and pressure test

4. Circuit Block Diagram

TBD

5. Absolute Maximum Ratings(Ta=25℃)

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	VDD	-0.3	4.6	V	
Logic Signal Input /Output Voltage	VDD2	-0.3	4.6	V	1，2
Operating Temperature	Top	-20	+70	℃	
Storage Temperature	Tst	-30	+80	℃	

Notes:

1. If the module is above these absolute maximum ratings. It may become permanently damaged.
    Using the module within the following electrical characteristic conditions are also exceeded, the module will malfunction and cause poor reliability.

2. $V_{DD} > V_{SS}$ must be maintained.

6. Electrical Specifications and Instruction Code

6.1 Electrical characteristics(Vss=0V ,Ta=25℃)

Parameter		Symbol	Condition	Min	Typ	Max	Unit	Note
Input voltage	'H'	V_{IH}	VDD2= 1.8 ~ 3.3V	0.7 VDD2	-	VDD2	V	
	'L'	V_{IL}	VDD2= 1.8 ~ 3.3V	VSS	-	0.3VDD2	V	
Output Voltage	'H'	V_{OH}	I_{OH}=-1.0mA	0.8 VDD2	-	VDD2	V	
	'L'	V_{OL}	VDD2= 1.65 ~ 3.3V	VSS	-	0.2 VDD2	V	
Current Consumption		I_{CC1}	Normal mode	-	-	-	uA	1,3
		I_{CC2}	Standby mode	-	-	-	uA	2

Note:

1: Display full white. Backlight on state.

2: IC on standby mode.

3: the default voltage is 3.2V, for N lights in series, the power is that the current multiply N.

6.2 LED backlight specification(Vss=0V ,Ta=25℃)

Item		Symbol	Condition	Min	Typ	Max	Unit	Note
Supply voltage		V_f	I_f=60mA	2.9	3.2	3.5	V	1
Reverse voltage		V_r	-	-	-	-	V	
Forward current	Normal	I_{pn}	3-chip Parallel		45		mA	
	Dimming	I_{pd}						
Reverse Current		I_r	-	-	-	-	µA	
Uniformity		△Bp		80%	-			
Color coordinate	X		I_f=60mA	0.265	-	0.315	-	
	Y			0.265	-	0.315	-	

Note 1: The LED 's driver mode needs to be constant current mode.

6.3 Interface Signals

Pin No.	Symbol	I/O	Function
1.	GND	PG	Power ground
2.	VDD	I	Power Supply for Analog Circuit
3.	IOVDD	I	Logic Power Supply to the interface pins
4.	CS	I	Chip select signal
5.	RS	I	Register select signal
6.	WR	I	Write execution control pin
7.	RD	I	Read execution control pin
8.	DB0	I/O	
9.	DB1	I/O	
10.	DB2	I/O	
11.	DB3	I/O	
12.	DB4	I/O	
13.	DB5	I/O	
14.	DB6	I/O	
15.	DB7	I/O	16 bit Databus
16.	DB8	I/O	Unused pin fix to GND
17.	DB9	I/O	
18.	DB10	I/O	
19.	DB11	I/O	
20.	DB12	I/O	
21.	DB13	I/O	
22.	DB14	I/O	
23.	DB15	I/O	
24.	Reset	I	Reset pin
25.	I M0	I	8bit/16bit selection(IM0=1, 8bit; IM0=0, 16bit)
26.	G N D	PG	Power ground
27.	Y D	NC	
28.	X L	NC	
29.	Y U	NC	
30.	X R	NC	
31.	LED_K3	I	Cathode NO.3 for LED backlighting
32.	LED_K2	I	Cathode NO.2 for LED backlighting
33.	LED_K1	I	Cathode NO.1 for LED backlighting
34.	LED_A	I	Anode for LED backlighting

6.4 Interface Timing Chart

Note: Please refer to ILITEK'S ILI9340 data sheet for more details.
ILITEK'S ILI9340 INTERFACE PROTOCOL
 80 system CPU interface
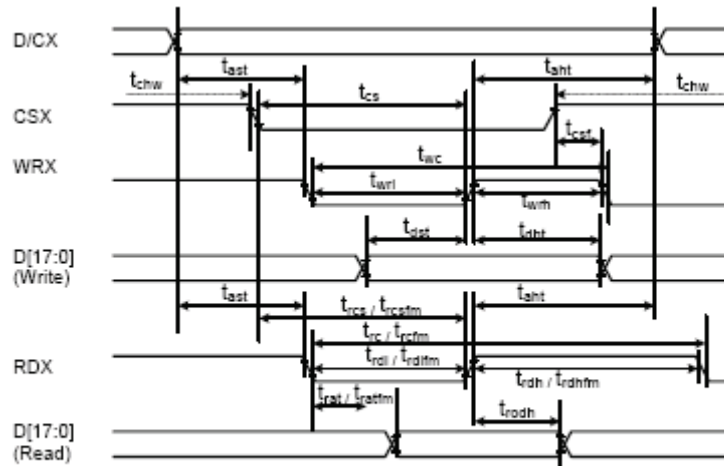
Signal	Symbol	Parameter	min	max	Unit	Description
DCX	tast	Address setup time	0	-	ns	
	taht	Address hold time (Write/Read)	10	-	ns	
CSX	tchw	CSX "H" pulse width	0	-	ns	
	tcs	Chip Select setup time (Write)	15	-	ns	
	trcs	Chip Select setup time (Read ID)	45	-	ns	
	trcsfm	Chip Select setup time (Read FM)	355	-	ns	
	tcsf	Chip Select Wait time (Write/Read)	10	-	ns	
WRX	twc	Write cycle	66	-	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	
	trdhfm	Read Control H duration (FM)	90	-	ns	
	trdlfm	Read Control L duration (FM)	355	-	ns	
RDX (ID)	trc	Read cycle (ID)	160	-	ns	
	trdh	Read Control pulse H duration	90	-	ns	
	trdl	Read Control pulse L duration	45	-	ns	
D[17:0], D[17:10]&D[8:1], D[17:10], D[17:9]	tdst	Write data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	tdht	Write data hold time	10	-	ns	
	trat	Read access time	-	40	ns	
	tratfm	Read access time	-	340	ns	
	trod	Read output disable time	20	80	ns	

Note: Ta = -30 to 70 °C, VDDI=1.65V to 3.3V, VCI=2.5V to 3.3V, VSS=0V.

System function Command List and 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													HEX
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				G63 [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

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Command													
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

7. Optical Characteristics

Item	Symbol		Condition	Min.	Typ.	Max.	Unit	Note
Brightness	Bp		θ=0° Φ=0°	-	200	-	Cd/m^2	1
Uniformity	△Bp			-	80%	-		1,2
Viewing Angle	θ1 (Φ=90° or270°)		Cr≥10	-50～+30			Deg	3
	θ2 (Φ=0° or 180°)			-60～+60				
Contrast Ratio	Cr		θ=0°		350		-	4
Response Time	t$_{on}$		25℃		20	30	ms	5
	t$_{off}$							
Color of CIE Coordinate	W	x	Brightness is on				-	1,6
		y					-	
	R	x					-	
		y					-	
	G	x					-	
		y					-	
	B	x					-	
		y					-	
NTSC Ratio				-	48%			

Note：The parameter is slightly changed by temperature, driving voltage and materiel.

Note 1: The data are measured after LEDs are turned on for 5 minutes. LCM displays full white. The brightness is the average value of 9 measured spots. Measurement equipment PR-705 (Φ8mm)

Measuring condition:
- Measuring surroundings: Dark room.
- Measuring temperature: Ta=25℃.
- Adjust operating voltage to get optimum contrast at the center of the display.

Measured value at the center point of LCD panel after more than 5 minutes while backlight turning on.

50cm

Detecter
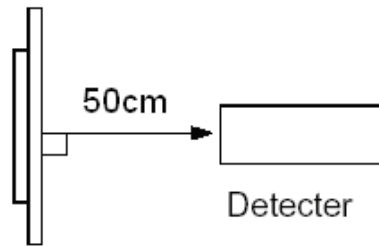
Note 2: The luminance uniformity is calculated by using following formula.

△Bp = Bp (Min.) / Bp (Max.)×100 (%)

Bp (Max.) = Maximum brightness in 9 measured spots

Bp (Min.) = Minimum brightness in 9 measured spots.
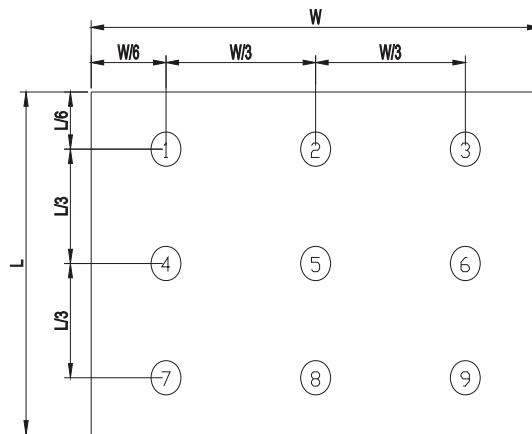
Measurement equipment PR-705 (Φ8mm)

Note 3: The definition of viewing angle:
Refer to the graph below marked by θ and Φ
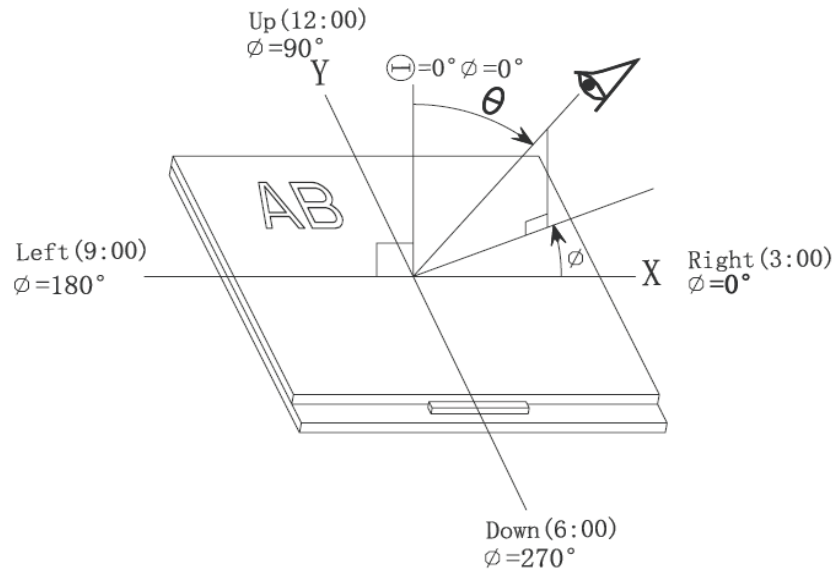
Note 4: The definition of contrast ratio (Test LCM using PR-705):

$$\text{Contrast Ratio(CR)} = \frac{\text{Luminance When LCD is at "White" state}}{\text{Luminance When LCD is at "Black" state}}$$

(Contrast Ratio is measured in optimum common electrode voltage)

Note 5: Definition of Response time. (Test LCD using DMS501):

The output signals of photo detector are measured when the input signals are changed from "black" to "white"(falling time) and from "white" to "black"(rising time), respectively. The response time is defined as the time interval between the 10% and 90% of amplitudes.Refer to figure as below.
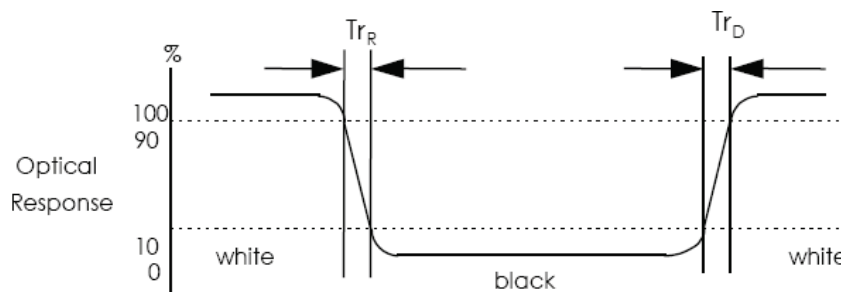
The definition of response time

Note 6: Definition of Color of CIE Coordinate and NTSC Ratio.

1931 CIE Chromaticity Diagram
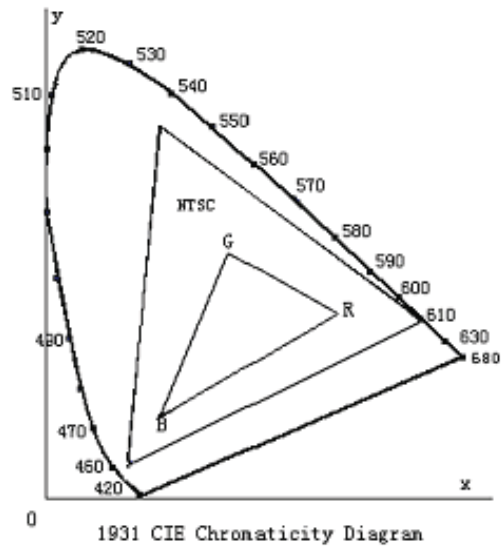
Color gamut:

$$S = \frac{\text{area of RGB triangle}}{\text{area of NTSC triangle}} \times 100\%$$

8. Reliability Test Items and Criteria

No	Test Item	Test condition	Criterion
1	High Temperature Storage	80℃±2℃ 96H Restore 2H at 25℃ Power off	After testing, cosmetic and electrical defects should not happen.
2	Low Temperature Storage	-30℃±2℃ 96H Restore 2H at 25℃ Power off	
3	High Temperature Operation	70℃±2℃ 96H Restore 2H at 25℃ Power on	
4	Low Temperature Operation	-20℃±2℃ 96H Restore 4H at 25℃ Power on	
5	High Temperature & Humidity Operation	60℃±2℃ 90%RH 96H Power on	
6	Temperature Cycle	−30℃←→25℃←→80℃ 30min 5min 30min after 10cycle, Restore 2H at 25℃ Power off	
7	Vibration Test	10Hz~150Hz, 100m/s^2, 120min	
8	Shock Test	Half-sine wave,300m/s^2,11ms	
9	Drop Test(package state)	800mm, concrete floor,1corner, 3edges, 6 sides each time	1.After testing, cosmetic and electrical defects should not happen. 2.the product should remain at initial place 3.Product uncovered or package broken is not permitted.

Note:Additional test Item proposed by customer shall be determined by mutual agreement between customer and Orient Display.
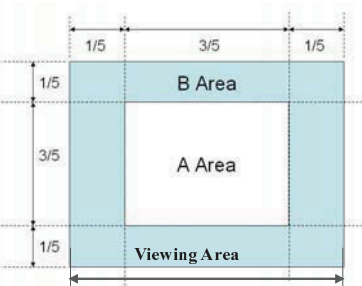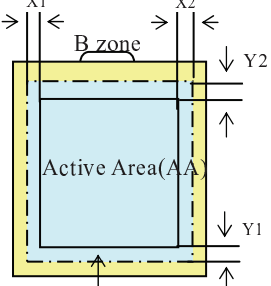
9 Quality level

9.1 Classification of defects

Major defects (MA): A major defect refers to a defect that may substantially degrade usability for product applications, including all functional defects(such as no display, abnormal display, open or missing segment, short circuit, missing component), outline dimension beyond the drawing, progressive defects and those affecting reliability.

Minor defects (MI): A minor defect refers to a defect which is not considered to be able to substantially degrade the product application or a defect that deviates from existing standards almost unrelated to the effective use of the product or its operation, such as black spot, white spot, bright spot, pinhole, black line, white line, contrast variation, glass defect, polarizer defect, etc.

9.2 Definition of inspection range

For dot defect of TFT LCD which is not smaller than 3 inches, dividing three areas to make a judgment (according to figure 1). A area : center of viewing area B area : periphery of viewing area C area : Outside viewing area For other defects, dividing two areas to make a judgment (according figure 2). A zone : Inside Viewing area B zone : Outside Viewing area X1(A.A~V.A): mm X2(A.A~V.A): mm Y1(A.A~V.A): mm Y2(A.A~V.A): mm	 Figure 1 Figure 2

9.3 Inspection items and general notes
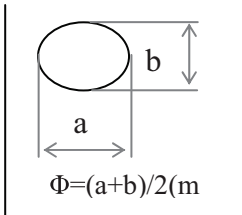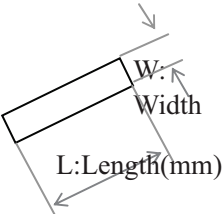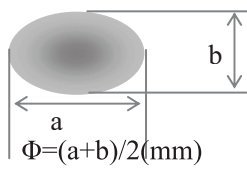

General notes	①Should any defects which are not specified in this standard happen, additional standard shall be determined by mutual agreement between customer and Orient Display.
	②Viewing area should be the area which Orient Display guarantees.
	③Limit sample should be prior to this Inspection standard.
	④Viewing judgment should be under static pattern.
	⑤Inspection conditions
	   Inspection distance: 250 mm (from the sample) Temperature : 25±5 ºC
	   Inspection angle : 45 degrees in 6 o'clock direction (all defects in viewing area should be inspected from this direction)	

Inspection items	Pinhole, Bright spot, Black spot, White spot, Black line, White Line, Foreign particle, Bubble	The color of a small area is different from the remainder. The phenomenon doesn't change with voltage
	Contrast variation	The color of a small area is different from the remainder. The phenomenon changes with voltage
	Polarizer defect	Scratch, Dirt, Particle, Bubble on polarizer or between polarizer and glass
	Dot defect (TFT LCD)	The pixel appears bright or dark abnormally when display
	Functional defect	No display, Abnormal display, Open or missing segment, Short circuit, False viewing direction

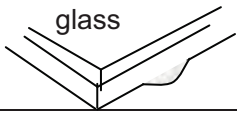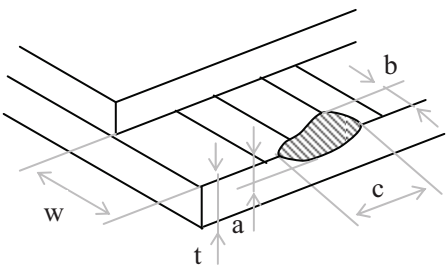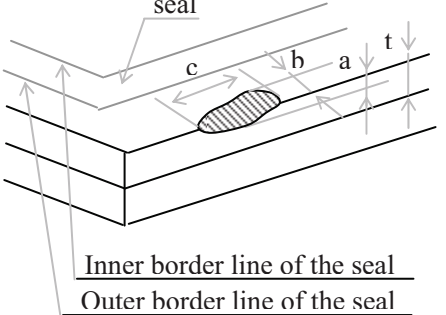|		
Glass defect	Glass crack, Shaved corner of glass, Surplus glass	
PCB defect	Components assembly defect	

9.4 Outgoing Inspection level
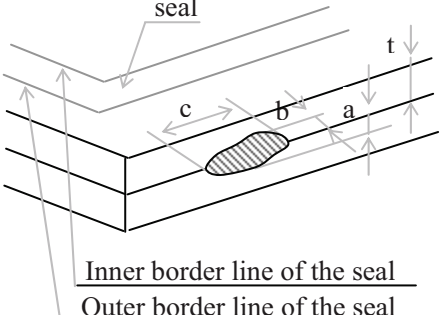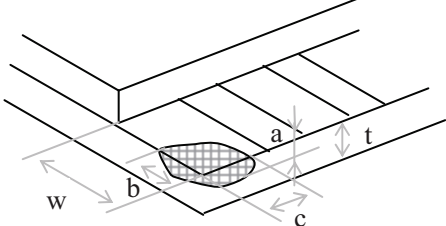
Outgoing Inspection standard	Inspection conditions	Inspection				
		Min.	Max.	Unit	IL	AQL
Major Defects	See 8.3 general notes	See 8.5			II	0.65
Minor Defects	See 8.3 general notes	See 8.5			II	1.5
Note：Sampling standard conforms to GB2828						
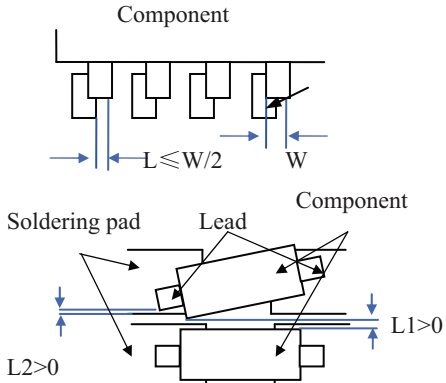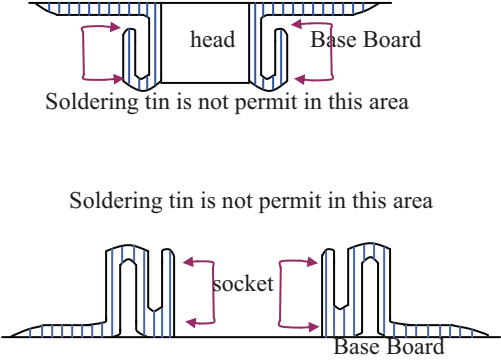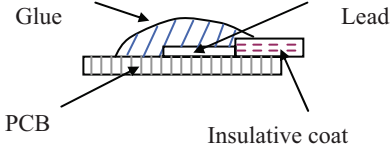
9.5 Inspection Items and Criteria

Inspection items			Judgment standard			
			Category		Acceptable number	
					A zone	B zone
1	Black spot, White spot, Bright Spot, Pinhole, Foreign Particle, Particle in or on glass, Scratch on glass	$\Phi=(a+b)/2(m$	A	$\Phi \leqq 0.10$	Neglected	Neglected
			B	$0.10<\Phi \leqq 0.15$	2	
			C	$0.15<\Phi \leqq 0.20$	1	
			D	$0.20<\Phi$	0	
			Total defective point(B,C)		3	
2	Black line, White line, and Particle Between Polarizer and glass, Scratch on glass	W: Width L:Length(mm)	A	$W \leqq 0.01$	Neglected	Neglected
			B	$0.01<W \leqq 0.03$ $L \leqq 3.0$	2	
			C	$0.03<W \leqq 0.05$ $L \leqq 3.0$	1	
			D	$0.05<W$	0	
			Total defective point(B,C)		3	
3	Contrast variation	$\Phi=(a+b)/2(mm)$	A	$\Phi \leqq 0.2$	Neglected	Neglected
			B	$0.2<\Phi \leqq 0.3$	2	
			C	$0.3<\Phi \leqq 0.4$	1	
			D	$0.4<\Phi$	0	
			Total defective point(B,C)		3	
4	Dot defect (if TFT LCD is used)	TFT LCD is smaller than 3 inches	LCD Class	Defect	A area	B area
						Neglected

				B	Bright dot		2		
					Dark dot		3		
					Total		4		
		TFT LCD between 3~10.4 inches	LCD Class	Defect		A area	B area		C area
									Neglected
			B	Bright dot		2	2		
				Dark dot		2	3		
				Total		6			

Notes:
Bright dot: in R、G、B or dark display figure, the pixel appears bright.
Dark dot: in R、G、B or white display figure, the pixel appears dark.
Defect area must be less than an half size of the dot.

5	Bubble inside cell		any size	none	none
6	Polarizer defect (if Polarizer is used)	Scratch ,damage on polarizer, Particle on polarizer or between polarizer and glass.	Refer to item 1 and item 2.		
		Bubble, dent and convex	A	$\Phi \leqq 0.3$	Neglected	Neglected
			B	$0.3 < \Phi \leqq 0.7$	2	
			C	$0.7 < \Phi$	0	

7	Surplus glass	Stage surplus glass	$b \leqq 0.3mm$
		Surrounding surplus glass	Should not influence outline dimension and assembling.

8	Open segment or open common	Not permitted
9	Short circuit	Not permitted
10	False viewing direction	Not permitted
11	Contrast ratio uneven	According to the limit specimen
12	Crosstalk	According to the limit specimen
13	Black /White spot(display)	Refer to item 1
14	Black /White line(display)	Refer to item 2

Inspection items			Judgment standard		Acceptable number
			Category(application: B zone)		
15	Glass defect crack	①The front of lead terminals	A	a≤ t, b≤1/5W, c≤3mm	Max.3 defects allowed
			B	Crack at two sides of lead terminals should not cover patterns and alignment mark	
		②Surrounding crack—non-contact side	b < Inner borderline of the seal		
		③ Surrounding crack— contact side	b < Outer borderline of the seal		
		④Corner	A	a ≦ t, b ≦ 3.0, c ≦ 3.0	
			B	Glass crack should not cover patterns u and alignment mark and patterns.	

①The front of lead terminals

②Surrounding crack—non-contact side
seal
Inner border line of the seal
Outer border line of the seal

③ Surrounding crack— contact side
seal
Inner border line of the seal
Outer border line of the seal

④Corner

		Inspection items	Judgment standard
			Category(application: B zone)
16	PCB defect	Component soldering: No cold soldering、short、open circuit、burr、tin ball The flat encapsulation component position deviation must be less than 1/3 width of the pin (Pic.1); the sheet component deviation: Pin deviates from the pad and contact with the near components is not permitted（Pic.2）	
		lead defect: The lead lack must be less than 1/3 of its width; The lead burr must be less than 1/3 of the seam; Impurities connect with the near leads is not permitted	
		Connector soldering: Soldering tin is at contact position of the plug and socket is not permitted No foundation is scald Serious cave distortion on plug and socket contact pin is not permitted	
		Glue on root of the speaker receiver and motor lead: The insulative coat of the lead must join into the PCB; the protected glue must envelop to the insulative coat.	

10. Precautions for Use of LCD Modules

10.1 Handling Precautions

10.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

10.1.2 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.

10.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

10.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

10.1.5 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:

  — Isopropyl alcohol

  — Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

  — Water

  — Ketone

  — Aromatic solvents

10.1.6 Do not attempt to disassemble the LCD Module.

10.1.7 If the logic circuit power is off, do not apply the input signals.

10.1.8 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

 a. Be sure to ground the body when handling the LCD Modules.

 b. Tools required for assembly, such as soldering irons, must be properly ground.

 c. To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

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

10.2 Storage precautions

10.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

10.2.2 The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

Temperature :   0℃ ～ 40℃

Relatively humidity: ≤80%

10.2.3 The LCD modules should be stored in the room without acid, alkali and harmful gas.

10.3 The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.