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SPECIFICATION
FOR
LCM MODULE

MODULE NO.: AFA320240C256-3.5-A03
DOC. REVISION00

Customer Approval:

	SIGNATURE	DATE
PREPARED BY (RD ENGINEER)		
PREPARED BY (QA ENGINEER)		
CHECKED BY		
APPROVED BY		

DOCUMENT REVISION HISTORY

Version	DATE	DESCRIPTION	CHANGED BY
00	2010-08-30	First issue	

CONTENTS

1. Functions & Features

1.1. Format	: 320x240 Dots
1.2. LCD mode	: Transmissive
1.3. Viewing direction	: 6 O'clock
1.4. Display color	: 256 colors
1.5. Operation temp	: -20~70 ℃
1.6. Storage temp	: -30~80℃
1.7. Power supply voltage (V_{DD})	: 3.3V
1.8. LED power voltage	: 3.3V
1.9. Backlight color	: White(LED)
1.10 LCM Contrast ratio	: 300:1
1.11 LCM Birghtness	: 200 nit(tye)
1.12.RoHS standard	

2. MECHANICAL SPECIFICATIONS

2.1. Module size	: 92.0mm(L)*78.4mm(W)*10.5(Max) mm (H)
2.2. Viewing area	: 73.3mm(L)*55.8mm(W)
2.3. Pixel size	: 73.0um(W)*219.0um(H)
2.4. Weight	: Approx.

3. BLOCK DIAGRAM

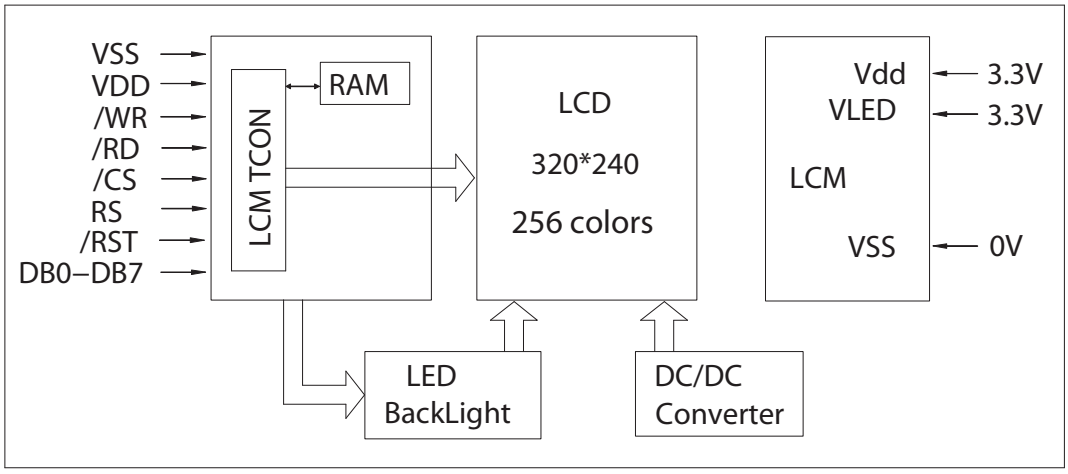


Figure 1. Block diagram

4. DIMENSIONAL OUTLINE

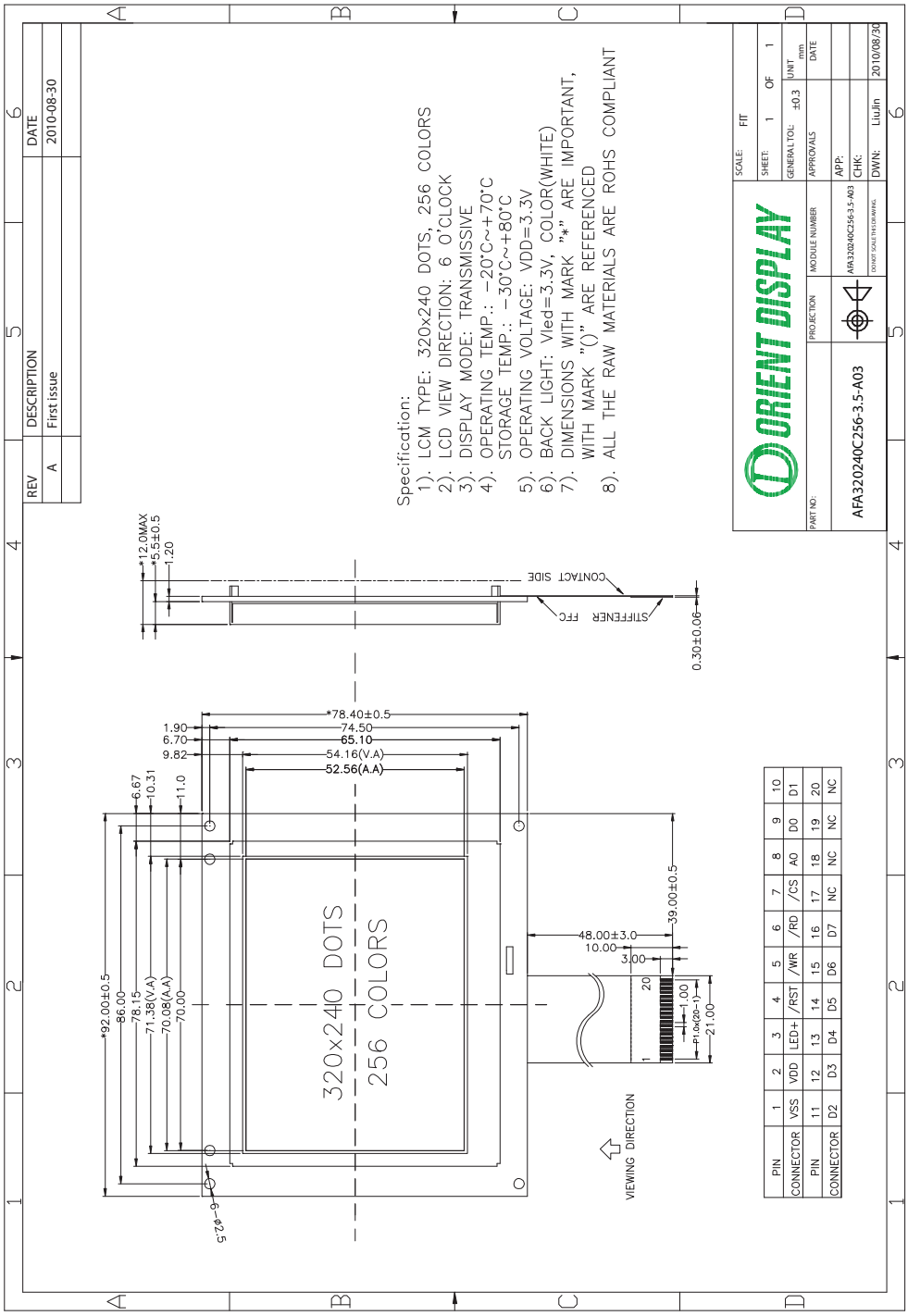


Figure 2. Dimensional outline

5. PIN DESCRIPTION

No.	Symbol	Function
1	VSS	GND
2	VDD	Logic supply voltage (3.3V)
3	LED+	Power supply for backlight(+3.3V)
4	/RST	Reset signal (L)
5	/WR	Write signal
6	/RD	Read signal
7	/CS	Chip enable signal
8	A0	Register selection (H:Data register, L:Instruction register)
9~16	D0~D7	Data bus line
17	NC	---
18	NC	---
19	NC	---
20	NC	---

6. MAXIMUM ABSOUTE LIMIT

Item	Symbol	MIN	MAX	Unit
Supply Voltage for Logic	V_{DD}	-0.3	5.0	V
Input Voltage	Vin	-0.3	V_{DD}+0.3	V
Supply Current （Without Backllight）	I_{DD}(Ta = 25°C)		75	mA
Supply Current for Backlight	I_F(Ta = 25°C)	---	130	mA
Reverse Voltage for Backlight	V_R(Ta = 25°C)	---	5.5	V
Operating Temperature	Top	-20	70	℃
Storage Temperature	Tst	-30	80	℃

7. ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage for Logic	V_{DD}-V_{SS}	Ta = 25°C	3.0	3.3	3.6	V
Input High Voltage	V_{IH}	Ta = 25°C	08V_{DD}	---	V_{DD}	V
Input Low Voltage	V_{IL}	Ta = 25°C	0	---	02V_{DD}	V
Output High Voltage	V_{OH}	Ta = 25°C	08V_{DD}	---	V_{DD}	V
Output Low Voltage	V_{OL}		0	---	02V_{DD}	V
Supply Current （Without Backllight）	I_{DD}	Ta = 25°C	--	65	75	mA

8. BACKLIGHT CHARACTERISTICS

Ta = 25°C

Item	Symbol	Condition	Min	Typ	Max	Unit
Forward Voltage	VF	Vled=3.3V	3.0	3.3	5.0	V
Forward Current	IR	Vled=3.3V	88	120	128	mA
Luminous Intensity (With LCD dots off)	IV	Vled=3.3V	150	200	---	Cd/m^2
LED Backlight Color	White					

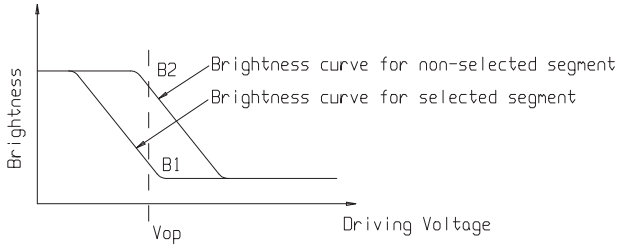
Item	Symbol	Condition	Min	Typ	Max	Unit
LED Life time	---	Ta = 25°C Humidity: 70% below Forward Current: 20mA	---	50,000	---	Hr

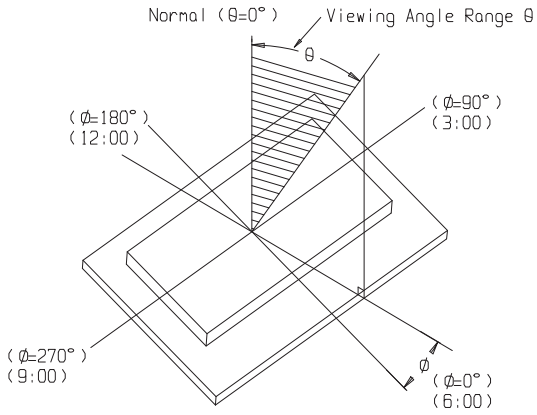
9. ELECTRO-OPTICAL CHARACTERISTICS

(VDD=3.3V,Vled=5.0V, Ta = 25°C)

Item	Symbol	Condition	Min	Typ	Max	Unit
Viewing angle (CR≥10)	θ_L	=180°(9 o'clock)	45	60	---	degree
	θ_R	=0°(3 o'clock)	45	60	---	
	θ_T	=90°(12 o'clock)	35	50	---	
	θ_B	=270°(6 o'clock)	40	55	---	
Response time	Ton	Normal θ= =0°	---	10	20	ms
	Toff		---	15	25	ms
Contrast ratio	Cr		150	300	---	---
Luminance	L1		150	200		Cd/m2

$$Cr=\frac{\text{Brightness of non-selected segment(B2)}}{\text{Brightness of selected segment(B1)}}$$





10. TIMING CHARACTERISTICS

10.1 Interface Timing

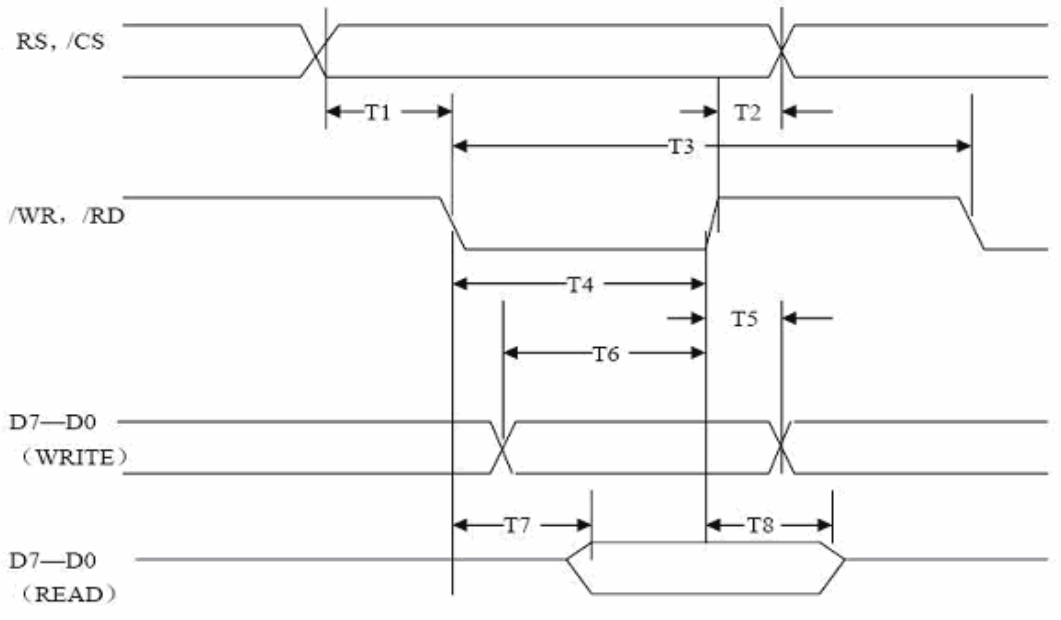


Figure 4. 8080 family Interface Timing

10.2 MCU Interface

Signal	Symbol	Parameter	VDD=33V		Unit	Condition
			Min	Max		
RS,/CS	T2	Address hold time	10	-	ns	CL=100pF
	T1	Address setup time	0	-	ns	
/WR,/RD	T3	System cycle time	350	-	ns	
	T4	Strobe pulsewidth	180	-	ns	
D0-D7	T5	Data hold time	80	-	ns	
	T6	Data setup time	120	-	ns	
	T7	/RD Access time	-	50	ns	
	T8	Output disable time	10	50	ns	

11. CONTROL AND DISPLAY INSTRUCTION

11.1 Instruction

Command (Hex)	Command Code /CS RS /WR /RD	D7 D6 D5 D4 D3 D2 D1 D0	Function
0x80	0 0 0 1 1	0 0 0 0 0 0 0 0	Display on glayer1 Read and Write on glayer1
0x81	0 0 0 1 1	0 0 0 0 0 0 0 1	Display and Read on glayer1 Write on glayer2
0x82	0 0 0 1 1	0 0 0 0 0 0 1 0	Display and Write on glayer1 Read on glayer2
0x83	0 0 0 1 1	0 0 0 0 0 0 1 1	Display on glayer1 Write and Read on glayer2
0x84	0 0 0 1 1	0 0 0 0 0 1 0 0	Display on glayer2 Read and Write on glayer1
0x85	0 0 0 1 1	0 0 0 0 0 1 0 1	Display and Write on glayer2 Read on glayer1
0x86	0 0 0 1 1	0 0 0 0 0 1 1 0	Display and Read on glayer2 Write on glayer1
0x87	0 0 0 1 1	0 0 0 0 0 1 1 1	Display on glayer2 Write and Read on glayer2
0x90	0 0 0 1 1	0 0 1 0 0 0 0 0	Black light off
0x91	0 0 0 1 1	0 0 1 0 0 0 0 1	Black light on
0xa0	0 0 0 1 1	0 1 0 0 0 0 0 0	Mix Mode off (Single layer display)
0xa1	0 0 0 1 1	0 1 0 0 0 0 0 1	Mix Mode 1 (Front: glay1, Rear: glay2) (Figure 5.)
0xa2	0 0 0 1 1	0 1 0 0 0 0 1 0	Mix Mode 2 (Front: glay2, Rear: glay1) (Figure 6.)
0xa3	0 0 0 1 1	0 1 0 0 0 0 1 1	Mix Mode 3 (Mix glay1 and glay2) (Figure 7.)
0xfc	0 0 0 1 1	1 1 1 1 1 1 0 0	display on
0xfd	0 0 0 1 1	1 1 1 1 1 1 0 1	display off
Address set X(0~320) Y(0~240)	0 0 0 1 0	0 0 0 0 0 0 0 ---	Write X Adderss(H)
	0 0 0 1	---	Write X Adderss(L)
	0 0 0 1	---	Write Y Adderss
Write data	0 1 0 1	---	Write display data
Read data	0 1 1 0	---	Read display data

Note: Continuum write display data, Address is increased by 1 automatically.

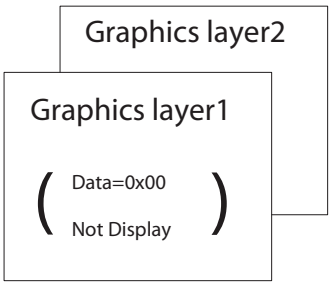


Figure 5.

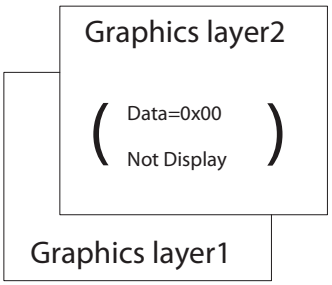


Figure 6.

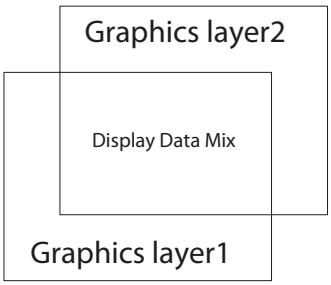


Figure 7.

11.2 Display Data format(256 Colors)

DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
R2	R1	R0	G2	G1	G0	B1	B0
MSB LSB RED (000~111)			MSB LSB GREEN(000~111)			MSB LSB BLUE(00~11)	

D7, D6,D5,D4,D3,D2,D1,D0 (0xXX)	DOT
1 1 1 1 1 1 1 1 (0xFF)	White
0 0 0 0 0 0 0 0 (0x00)	Back
1 1 1 0 0 0 0 0 (0xE0)	Red
0 0 0 1 1 1 0 0 (0x1C)	Green
0 0 0 0 0 0 1 1 (0x03)	Blue
1 1 1 1 1 1 0 0 (0xFC)	Yellow
1 1 1 0 0 0 1 1 (0xE3)	Purple
0 0 0 1 1 1 1 1 (0x1F)	Cyan

11.3 Porgram Example

```
// VDD=3.3V
 #include <reg51.h>
#define uint unsigned int
 #define uchar unsigned char


sbit CS      = P 3^2;
 sbit RS     = P  3^3;
 sbit WRR  = P3^4;
 sbit RDD  = P3^5;
 sbit RST   = P3^6;

  void wcomd(uchar ch)
 {
   RDD=1;RS=0; CS=0;
   P1=ch;
   WRR=0;
   WRR=1;
   CS=1;
 }

 void wdata(uchar ch)
 {
```

```
   RDD=1;RS=1; CS=0;
   P1=ch;
   WRR=0;
   WRR=1;
   CS=1;
}


unsigned char rdata(void)
{
   uchar ch;
   WRR=1;RS=1; CS=0;
   P1=0xff;
   RDD=0;
   ch=P1;
   RDD=1;
   CS=1;
   return(ch);
}

void waddr(uint xdat,uint ydat)
{
  uint xxh,xxl;
     xxh=xdat/256;
   xxl=xdat%256;
   wcomd(xxh);
   wcomd(xxl);
   wcomd(ydat);
}

void initial_tft()
{
   wcomd(0x91);                    //led light on
   wcomd(0xfc);                   //display on
   wcomd(0xa0);                    //mix mode off
}

 void disp_all(uchar xsdata)
{
   uint j,k;
   waddr(0x00,0x00);
   for(k=0;k<240;k++)
   {
      for(j=0;j<320;j++)
      { wdata(xsdata);}
   }
}


 void main(void)
{
    RST=0;delay(50);RST=1;delay(20);
    initial_tft();
    while(1)
```

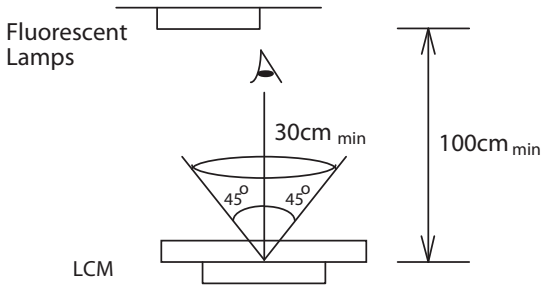
```
    {
     wcomd(0x80);                    //display glayer1 (0x80~0x83)
       disp_all(0xff);  delay(200);      //white
      disp_all(0x00); delay(200);      //black
      disp_all(0Xe0); delay(200);      //red
      disp_all(0x1c); delay(200);      //green
      disp_all(0x03); delay(200);      //blue
      ……..
    }
}
```

12.QUALITY SPECIFICATIONS

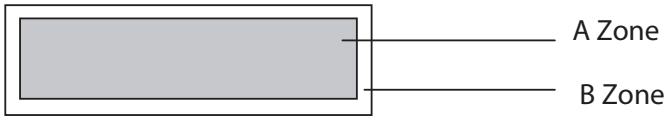
12.1 Standard of the product appearance test

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: Active display area (minimum viewing area).
B Zone: Non-active display area (outside viewing area).

12.2 Specification of quality assurance

AQL inspection standard

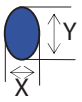
Sampling method: MIL-STD-105E, Level II, single sampling

Defect classification (Note: * is not including)

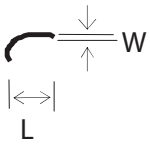
Classify	Item		Note	AQL
Major	Display state	Short or open circuit	1	0.65
		LC leakage		
		Flickering		
		No display		
		Wrong viewing direction		
		Contrast defect (dim, ghost)	2	
		Back-light	1,8	
	Non-display	Flat cable or pin reverse	10	
		Wrong or missing component	11	
Minor	Display state	Background 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

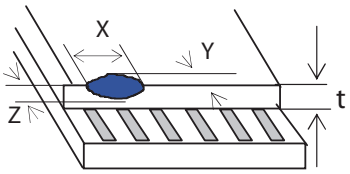
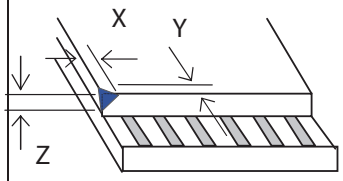
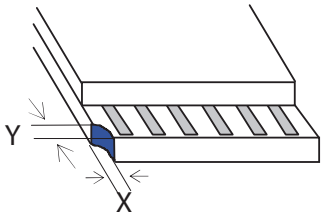
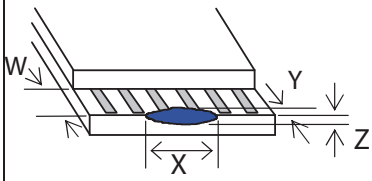
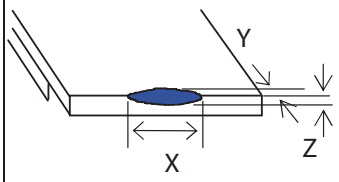
<table>
<tr><th>No.</th><th>Item</th><th>Criterion</th></tr>
<tr><td>1</td><td>Short or open circuit</td><td rowspan="6">Not allow</td></tr>
<tr><td></td><td>LC leakage</td></tr>
<tr><td></td><td>Flickering</td></tr>
<tr><td></td><td>No display</td></tr>
<tr><td></td><td>Wrong viewing direction</td></tr>
<tr><td></td><td>Wrong Back-light</td></tr>
<tr><td>2</td><td>Contrast defect</td><td rowspan="2">Refer to approval sample</td></tr>
<tr><td></td><td>Background color deviation</td></tr>
<tr><td>3</td><td>Point defect,
Black spot, dust
(including Polarizer)

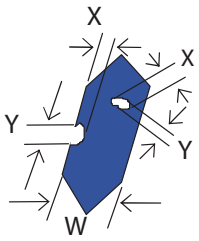
φ= (X+Y)/2</td><td> 

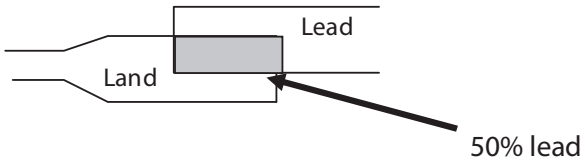
<table>
<tr><th>Point
Size</th><th>Acceptable Qty.</th></tr>
<tr><td>φ≤0.10</td><td>Disregard</td></tr>
<tr><td>0.10<φ≤0.20</td><td>3</td></tr>
<tr><td>0.20<φ≤0.25</td><td>2</td></tr>
<tr><td>0.25<φ≤0.30</td><td>1</td></tr>
<tr><td>φ>0.30</td><td>0</td></tr>
</table>
Unit： mm</td></tr>
<tr><td>4</td><td>Line defect,

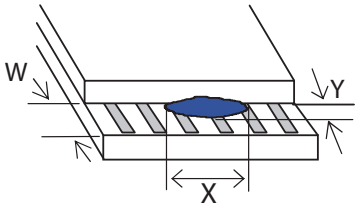
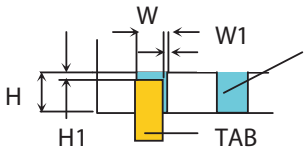
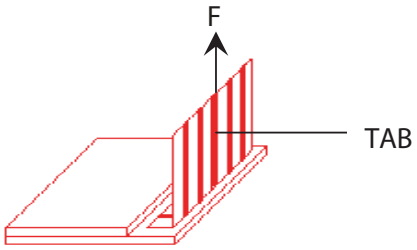
Scratch</td><td> 

<table>
<tr><th colspan="2">Line</th><th>Acceptable Qty.</th></tr>
<tr><td>L</td><td>W</td><td></td></tr>
<tr><td>---</td><td>0.015≥W</td><td>Disregard</td></tr>
<tr><td>5.0≥L</td><td>0.03 ≥W</td><td rowspan="2">2</td></tr>
<tr><td>5.0≥L</td><td>0.05 ≥W</td></tr>
<tr><td>5.0≥L</td><td>0.1 >W</td><td>1</td></tr>
<tr><td>---</td><td>0.05<W</td><td>Applied as point defect</td></tr>
</table>
Unit: mm</td></tr>
<tr><td>5</td><td>Rainbow</td><td>Not more than two color changes across the viewing area.</td></tr>
</table>

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

<table>
<tr><th>No.</th><th>Item</th><th>Criterion</th></tr>
<tr><td>7</td><td>Segment
pattern
W = Segment width
φ= (X+Y)/2</td><td>(1) Pin hole
φ< 0.10mm is acceptable.
 

<table>
<tr><th>Point Size</th><th>Acceptable Qty</th></tr>
<tr><td>φ≤1/4W</td><td>Disregard</td></tr>
<tr><td>1/4W< φ≤1/2W</td><td>1</td></tr>
<tr><td>φ>1/2W</td><td>0</td></tr>
</table>
Unit: m m</td></tr>
<tr><td>8</td><td>Back-light</td><td>(1) The color of backlight should correspond its specification.
(2) Not allow flickering</td></tr>
<tr><td>9</td><td>Soldering</td><td>(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.
 
</td></tr>
<tr><td>10</td><td>Wire</td><td>(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.</td></tr>
<tr><td>11*</td><td>PCB</td><td>(1) Not allow screw rust or damage.
(2) Not allow missing or wrong putting of component.</td></tr>
</table>

No	Item	Criterion
12	Protruded W: Terminal Width	 Acceptable criteria: Y ≤0.4
13	TAB	1. Position  W1≤1/3W H1≤1/3H 2 TAB bonding strength test  P (=F/TAB bonding width) ≥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.

12.3 Reliability of LCM

Reliability test condition:

Item	Condition	Time (hrs)	Assessment
High temp. Storage	80°C	48	No abnormalities in functions and appearance
High temp. Operating	70°C	48	
Low temp. Storage	-30°C	48	
Low temp. Operating	-20°C	48	
Humidity	40°C/ 90%RH	48	
Temp. Cycle	-20°C ← 25°C → 70°C (30 min ← 5 min → 30min)	10cycles	

Recovery time should be 24 hours minimum. Moreover, functions, performance and appearance ,etc. shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions room temperature (20±8°C), normal humidity (below 45±20% RH), and in the area not exposed to direct sun light. The life time is not content the life time of the LED (for the life time of LED which decay only 50%,in the industry the experience value is 50000 hours, but there are not any experimentation data to support this). .

12.4 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 make 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; ther efore 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 OD'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 limted 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 personnal 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 availble on request)
2. No warrenty 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.