



# **ORIENT DISPLAY**

Your Total LCD Solution Provider

## Specification for TFT

### AFR240320A0-2.2INTM

Revision V1.0



A	Orient Display
FR	TFT Type
240320	Resolution 240 x 320
A0	Serial A0
2.2	2.2", Module Dimension 41.7x56.16x2.6 mm
I	IPS Display
N	Top: -20~+70°C; Tstr: -30~+80°C
T	Transmissive/Normally Black
M	Medium Brightness, 450cd/m2
/	No Touch Panel
/	Controller R61516
/	MCU Interface





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# 1. Basic Information

## \* Description

This is a color active matrix TFT (Thin Film Transistor) LCD (liquid crystal display) that uses amorphous silicon TFT as a switching device. This model is composed of a transmissive type TFT-LCD Panel, driver circuit, back-light unit. The resolution of a 2.2" TFT-LCD contains 240X320 pixels, and can display up to 65K colors.

### 1.1 Features

-Low Input Voltage: 3.3V(TYP)

-Display Colors of TFT LCD: 65K colors

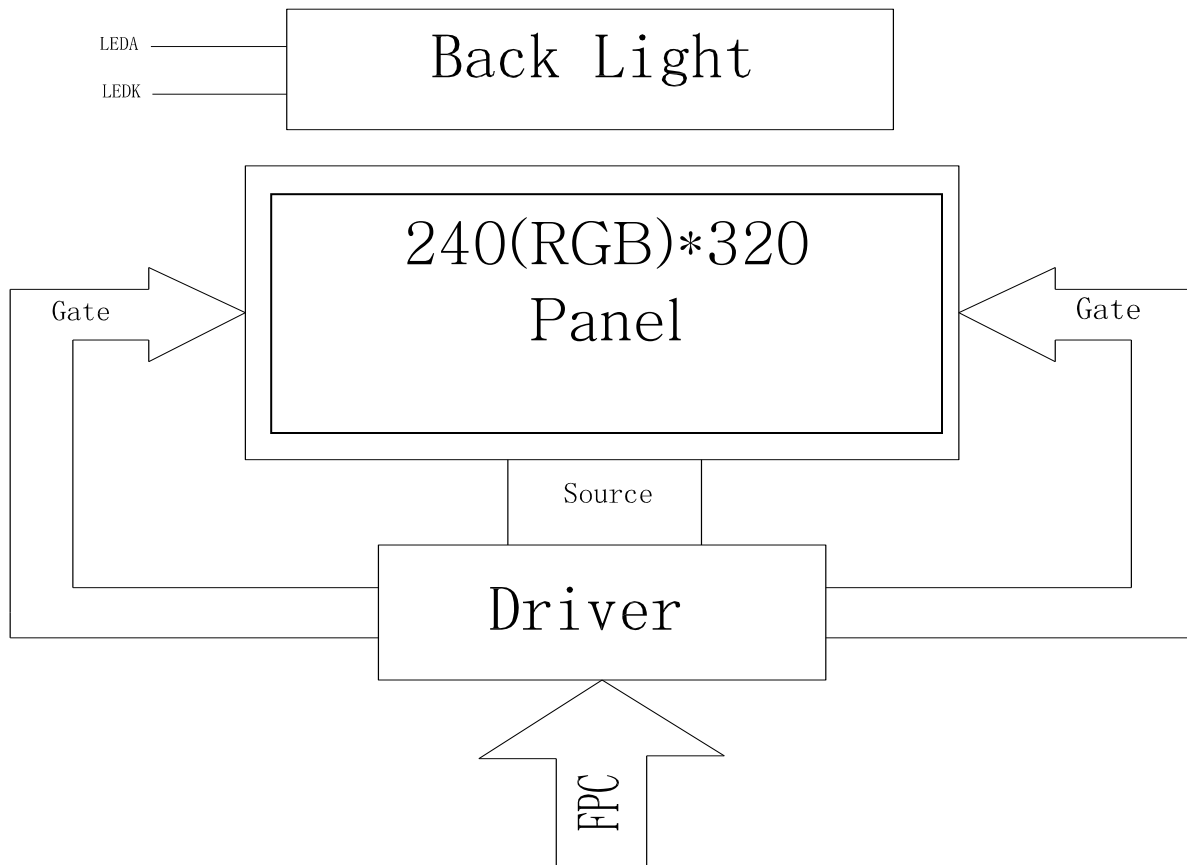
Interface: 8/16Bit MCU Interface

General Information Items	Specification	Unit	Note
	Main Panel		
Display area(AA)	33.84(H) *45.12(V) (2.2inch )	mm	-
Driver element	TFT active matrix	-	-
Display colors	65K	colors	-
Number of pixels	240(RGB)*320	dots	-
TFT Pixel arrangement	RGB vertical stripe	-	-
Pixel pitch	0.141 (H) x 0.141 (V)	mm	-
Viewing angle	ALL	o'clock	-
TFT Controller IC	ER61516	-	-
Display mode	Normally Black	-	-
Operating temperature	-20~+70	°C	-
Storage temperature	-30~+80	°C	-

### 1.2 Mechanical Information

Item		Min.	Typ.	Max.	Unit	Note
Module size	Horizontal(H)		41.70		mm	-
	Vertical(V)		56.16		mm	-
	Depth(D)		--	2.6	mm	-
Weight			TBD		g	-

## 2. Block Diagram





## 4. Input terminal Pin Assignment

NO.	SYMBOL	DISCRIPTION	I/O									
1	GND	Ground.	P									
2	XR	Touch panel Right Glass Terminal	A/D									
3	YD	Touch panel Bottom Film Terminal	A/D									
4	XL	Touch panel LEFT Glass Terminal	A/D									
5	YU	Touch panel Top Film Terminal	A/D									
6	NC											
7	NC											
8	NC											
9	IM0	<p>Interface select signal.</p> <table border="1"> <thead> <tr> <th>IM0</th> <th>Interface type</th> <th>DB Pin in use</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>DBI Tyb_ 16-bit interface</td> <td>DB15-DB0</td> </tr> <tr> <td>1</td> <td>DBI Tyb_ 8-bit interface</td> <td>DB7-DB0</td> </tr> </tbody> </table>	IM0	Interface type	DB Pin in use	0	DBI Tyb_ 16-bit interface	DB15-DB0	1	DBI Tyb_ 8-bit interface	DB7-DB0	I
IM0	Interface type	DB Pin in use										
0	DBI Tyb_ 16-bit interface	DB15-DB0										
1	DBI Tyb_ 8-bit interface	DB7-DB0										
10	RESET	<p>Reset pin. The R61516 is initialized when RESX is Low. Make sure to execute power-on reset when turning the power supply on.</p>	I									
11-16	NC											
17-32	DB15-DB0	16-bit bi-directional data bus in DBI Type B operation.	I/O									
33	CS	<p>Chip select signal. Low: Select (Accessible) High: Not select (Inaccessible) Make sure to connect to host processor. Follow AC timing to control the signal.</p>	I									
34	RS	<p>Command/data select signal Low: Select command High: Select data</p>	I									
35	WR	<p>Write strobe signal in DBI Type B operation. Write data when WRX is Low.</p>	I									
36	RD	<p>Read strobe signal. Read out data when RDX is Low.</p>	I									

37-38	NC		
39	IOVCC	Supply voltage(1.65-3.3V).	P
40	VCC	Supply voltage(3.3V).	P
41	LEDK	Cathode pin OF backlight	P
42	LEDA1	Anode pin of backlight	P
43	LEDA2	Anode pin of backlight	P
44	LEDA3	Anode pin of backlight	P
45	GND	Ground.	P



## 5.LCD Optical Characteristics

### 5.1 Optical Specification

Item	Symbol	Condition	Min.	Typ.	Max.	Unit.	Note	
Contrast Ratio	CR	$\Theta=0$	--	500	--			
Response time	Rising	$T_{R+T_F}$	Normal viewing angle	--	35	50	msec	Fig.3
	Falling							
Color gamut	S(%)			75		%		
Color Filter Chromaticity	White	$W_X$		0.287	0.327	0.367		
		$W_Y$		0.317	0.357	0.397		
	Red	$R_X$		0.611	0.631	0.651		
		$R_Y$		0.318	0.338	0.358		
	Green	$G_X$		0.313	0.333	0.353		
		$G_Y$		0.595	0.615	0.635		
	Blue	$B_X$		0.13	0.15	0.17		
		$B_Y$		0.024	0.044	0.064		
Viewing angle	Hor.	$\Theta_L$	CR>10		80	--	C/R>10 Fig.4	
		$\Theta_R$			80	--		
	Ver.	$\Theta_U$			80	--		
		$\Theta_D$			80	--		
Option View Direction	Free							

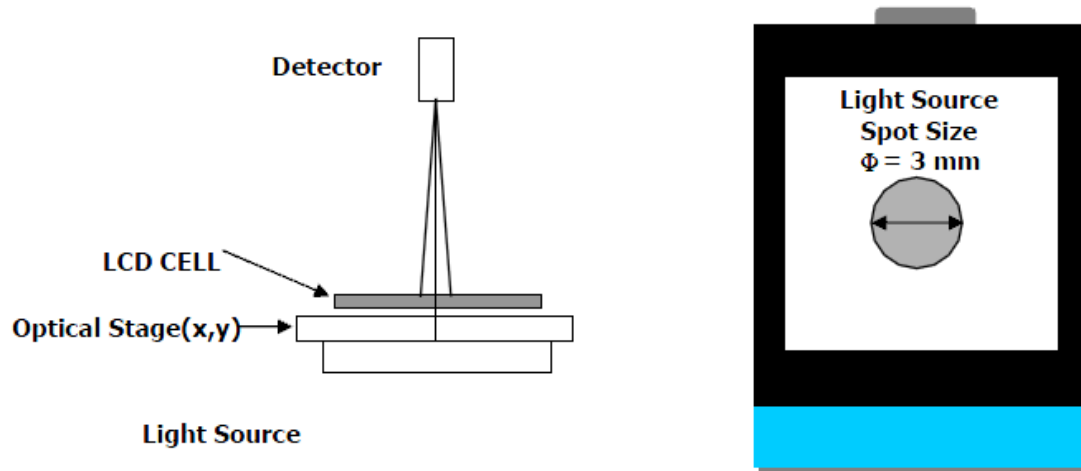
Notes : 1. Contrast Ratio(CR) is defined mathematically as :

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

- Surface luminance is the center point across the TFT-LCD surface 500 mm from the surface with all pixels displaying white. For more information see FIG 1.
- Response time is the time required for the display to transition from white to black(Rise Time,  $T_r$ ) and from black to white(Falling Time,  $T_f$ ). For additional information see FIG 3.
- Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the TFT-LCD surface. For more information see FIG 4.
- Optimum contrast is obtained by adjusting the TFT-LCD Threshold voltage( $V_{th}$  &  $V_{sat}$ )

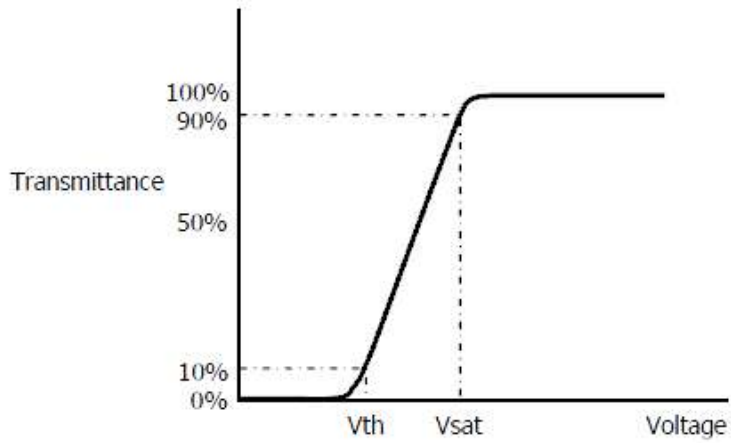
**FIG. 1 Optical Characteristic Measurement Equipment and Method**

**DMS 803 System**



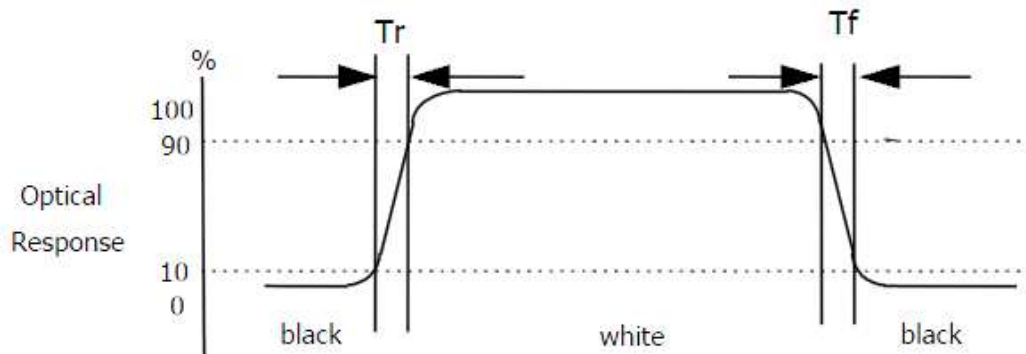
**<Transmissive Mode>**

**FIG. 2 The definition of  $V_{th}$  and  $V_{sat}$**



**FIG. 3 The definition of Response Time**

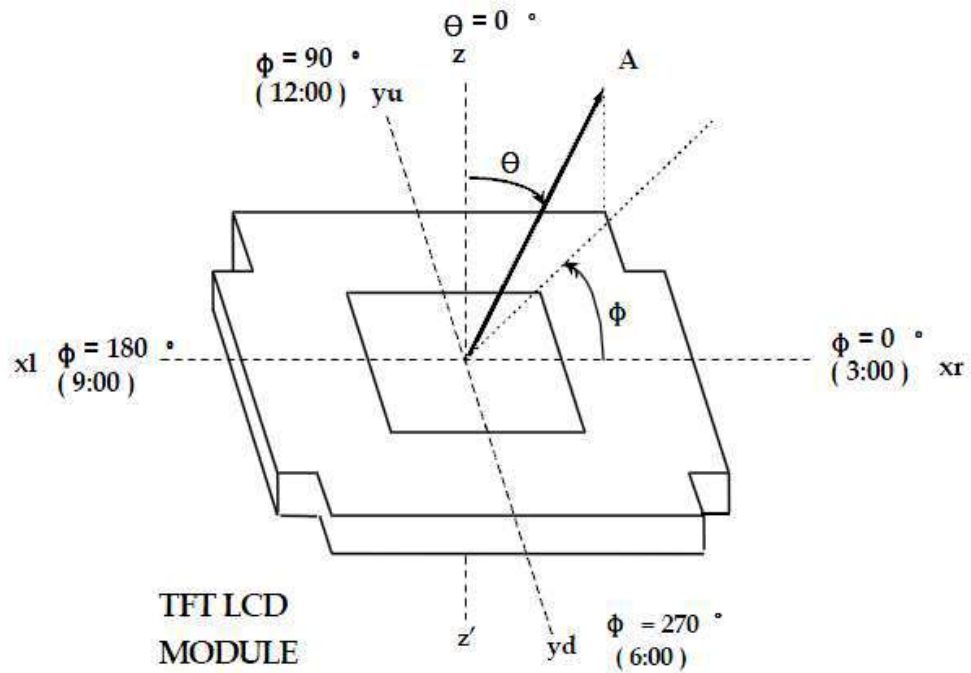
The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".



\* Voltage conditions for Response time  
Vgate : 22V DC  
Vdata : 0V~4.5V DC  
Vcom : 0V (Ground)

**FIG. 4 The definition of viewing angle**

<dimension of viewing angle range>



## 6. Electrical Characteristics

### 6.1 Absolute Maximum Rating (Ta=25 VSS=0V)

Characteristics	Symbol	Min.	Max.	Unit
Digital Supply Voltage	VCC	-0.3	4.6	V
Supply Voltage (Logic)	IOVCC	-0.3	4.6	
Operating temperature	T <sub>OP</sub>	-20	+70	°C
Storage temperature	T <sub>ST</sub>	-30	+80	°C

NOTE: If the absolute maximum rating of even is one of the above parameters is exceeded even momentarily, the quality of the product may be degraded. Absolute maximum ratings, therefore, specify the values exceeding which the product may be physically damaged. Be sure to use the product within the range of the absolute maximum ratings.

### 6.2 DC Electrical Characteristics

Characteristics	Symbol	Min.	Typ.	Max.	Unit	Note
Digital Supply Voltage	VCC	2.5	3.3	3.6	V	
Supply Voltage (Logic)	IOVCC	1.65	1.8	3.3		
Normal mode Current consumption	IDD	--	9	--	mA	
Level input voltage	V <sub>IH</sub>	0.7 IOVCC		IOVCC	V	
	V <sub>IL</sub>	GND		0.3 IOVCC	V	
Level output voltage	V <sub>OH</sub>	0.8 IOVCC		IOVCC	V	
	V <sub>OL</sub>	GND		0.2 IOVCC	V	

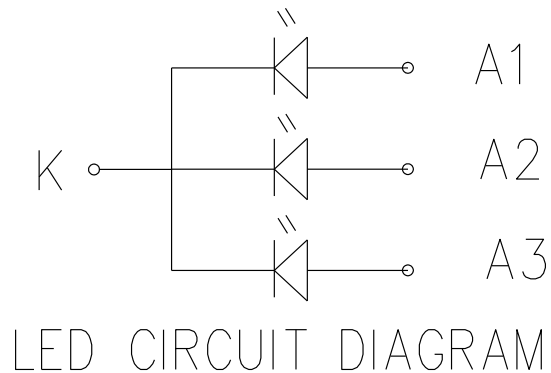
### 6.3 LED Backlight Characteristics

The back-light system is edge-lighting type with 3 chips White LED

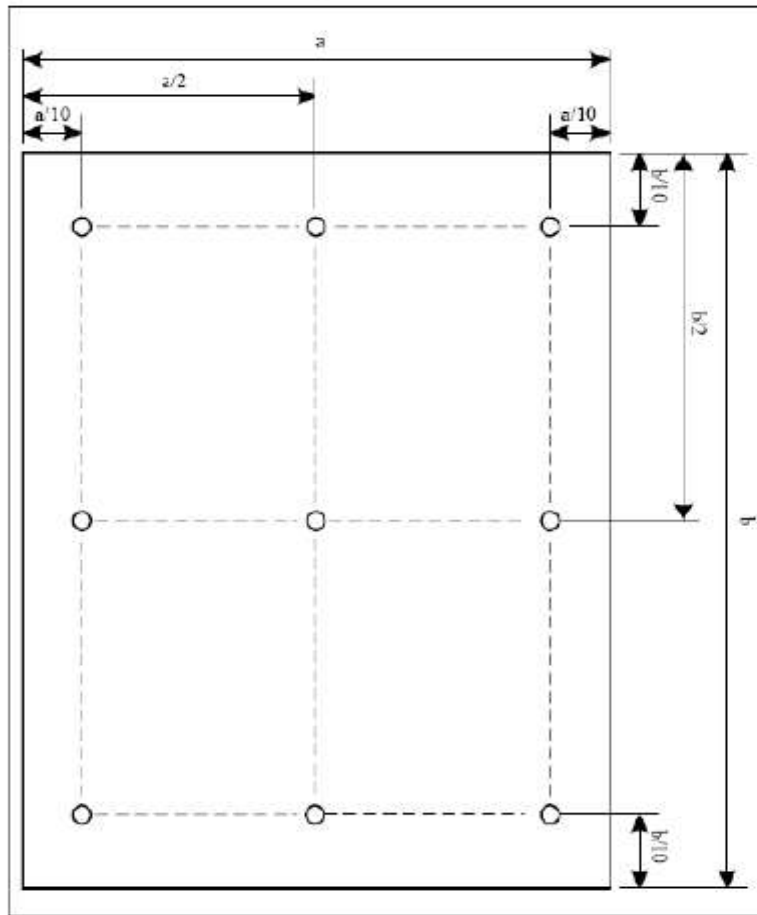
Item	Symbol	Min.	Typ.	Max.	Unit	Note
Forward Current	$I_F$	45	60	--	mA	
Forward Voltage	$V_F$	--	3.2	--	V	
LCM Luminance	$L_V$		450	--	cd/m <sup>2</sup>	Note3
LED life time	Hr	50000	--	--	Hour	Note1,2
Uniformity	AVg	80	--	--	%	Note3

Note (1) LED life time (Hr) can be defined as the time in which it continues to operate under the condition:  $T_a=25\pm 3\text{ }^\circ\text{C}$ , typical IL value indicated in the above table until the brightness becomes less than 50%.

Note (2) The “LED life time” is defined as the module brightness decrease to 50% original brightness at  $T_a=25\text{ }^\circ\text{C}$  and  $I_L=60\text{mA}$ . The LED lifetime could be decreased if operating  $I_L$  is larger than 60mA. The constant current driving method is suggested.



NOTE 3: Luminance Uniformity of these 9 points is defined as below:



$$\text{Uniformity} = \frac{\text{minimum luminance in 9 points (1-9)}}{\text{maximum luminance in 9 points (1-9)}}$$

$$\text{Luminance} = \frac{\text{Total Luminance of 9 points}}{9}$$





Item	Symbol	Unit	Test Condition	Min.	Max.
Address setup time	DCX	tast	ns	0	-
Address hold time (Write/Read)		taht	ns	10	-
Chip select setup time (Write)	CSX	tcs	ns	20	-
Chip select setup time (Read)		trcs	ns	170	-
Chip select wait time (Write/Read)		tcsf	ns	20	-
Write cycle time (Normal Write / High-speed write)	WRX	twc	ns	100/80	-
Write control pulse "High" period		twrh	ns	35	-
Write control pulse "Low" period		twrl	ns	35	-
Read cycle time	RDX	trc	ns	450	-
Read control pulse "High" period		trdh	ns	250	-
Read control pulse "Low" period		trdl	ns	170	-
Write data setup time	DB[17:0]	twds	ns	15	-
Write data hold time		twdh	ns	25	-
Read access time		tracc	ns	10	340
Output disable time		trod	ns	10	-
Rise / Fall time	-	tr/tf	ns	-	15

## 7.2 Reset Timing

Item	Symbol	Unit	Test Condition	Min.	Max.
Reset "Low" level width	tRW	us	Power On	10	—
Reset Time	tRT	ms		—	5

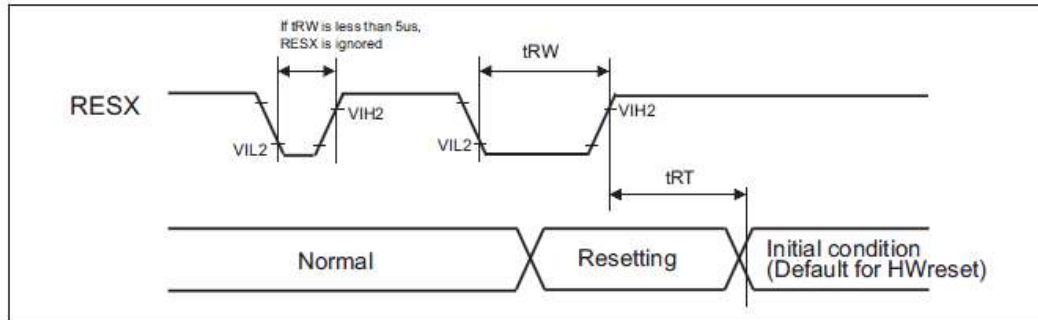


Figure D Reset Timing

## 8.LCD Module Out-Going Quality Level

### 8.1 VISUAL & FUNCTION INSPECTION STANDARD

#### 8.1.1 Inspection conditions

Inspection performed under the following conditions is recommended.

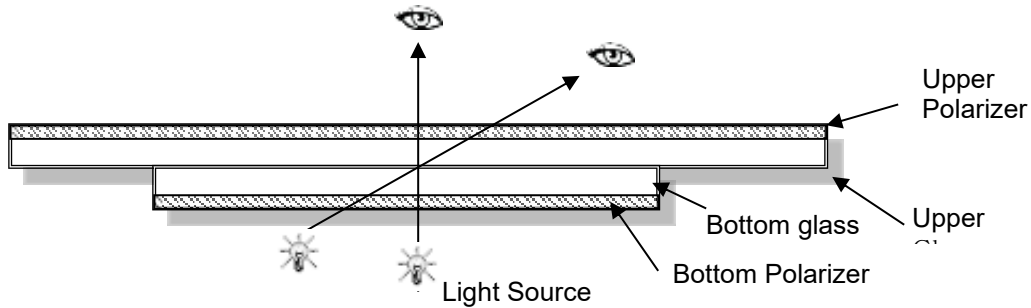
Temperature :  $25\pm 5^{\circ}\text{C}$

Humidity :  $65\%\pm 10\%\text{RH}$

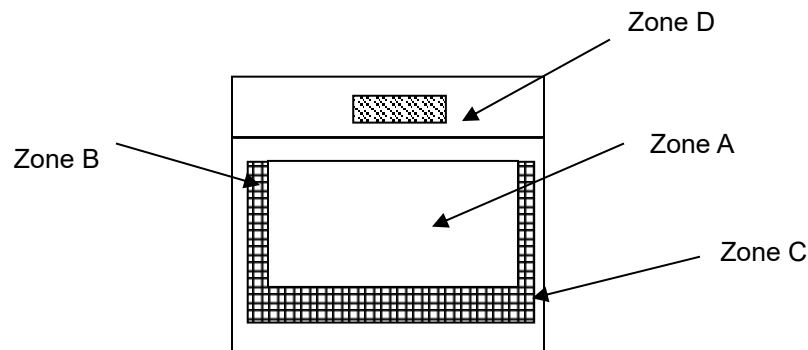
Viewing Angle : Normal viewing Angle.

Illumination: Single fluorescent lamp (300 to 700Lux)

Viewing distance:30-50cm



#### 8.1.2 Definition



Zone A : Effective Viewing Area(Character or Digit can be seen)

Zone B : Viewing Area except Zone A

Zone C : Outside (Zone A+Zone B) which can not be seen after assembly by customer .)

Zone D : IC Bonding Area

Note:As a general rule ,visual defects in Zone C can be ignored when it doesn't effect product function or appearance after assembly by customer

### 8.1.3 Sampling Plan

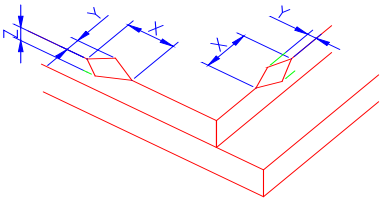
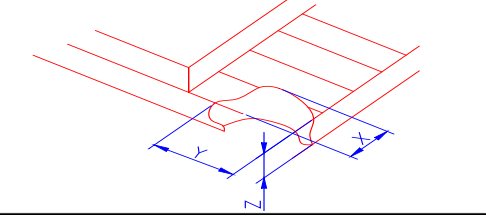
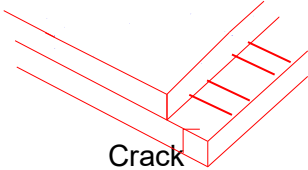
According to GB/T 2828-2003 ; , normal inspection, Class II  
AQL:

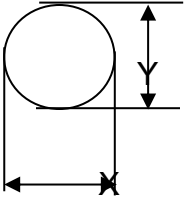
Major defect	Minor defect
0.65	1.5

LCD: Liquid Crystal Display , TP: Touch Panel , LCM: Liquid Crystal Module

No	Items to be inspected	Criteria	Classification of defects
1	Functional defects	1) No display, Open or miss line 2) Display abnormally, Short 3) Backlight no lighting, abnormal lighting. 4) TP no function	Major
2	Missing	Missing component	
3	Outline dimension	Overall outline dimension beyond the drawing is not allowed	
4	Color tone	Color unevenness, refer to limited sample	Minor
5	Spot Line defect	Light dot, Dim spot, Polarizer Bubble ; Polarizer accidented spot.	
6	Soldering appearance	Good soldering , Peeling off is not allowed.	
7	LCD/Polarizer/TP	Black/White spot/line, scratch, crack, etc.	



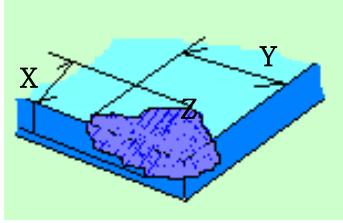
### 8.1.4 Criteria (Visual)

Number	Items	Criteria(mm)						
1.0 LCD Crack/Broken NOTE: X: Length Y: Width Z: Height L: Length of ITO, T: Height of LCD	(1) The edge of LCD broken	 <table border="1" data-bbox="740 573 1367 720"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤3.0mm</td> <td>&lt;Inner border line of the seal</td> <td>≤T</td> </tr> </tbody> </table>	X	Y	Z	≤3.0mm	<Inner border line of the seal	≤T
	X	Y	Z					
	≤3.0mm	<Inner border line of the seal	≤T					
(2) LCD corner broken	 <table border="1" data-bbox="786 1033 1321 1123"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤3.0mm</td> <td>≤L</td> <td>≤T</td> </tr> </tbody> </table>	X	Y	Z	≤3.0mm	≤L	≤T	
X	Y	Z						
≤3.0mm	≤L	≤T						
(3) LCD crack	 <p data-bbox="971 1417 1138 1480">Crack Not allowed</p>							

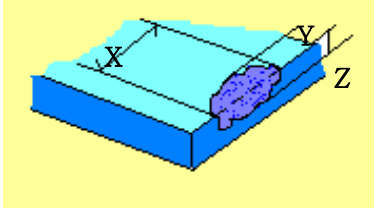
2.0	<p>Spot defect</p>  <p><math>\Phi=(X+Y)/2</math></p>	① light dot (LCD/TP/Polarizer black/white spot , light dot, pinhole, dent, stain)																							
		<table border="1"> <thead> <tr> <th rowspan="2">Zone Size (mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td><math>\Phi \leq 0.10</math></td> <td colspan="3">Ignore</td> </tr> <tr> <td><math>0.10 &lt; \Phi \leq 0.20</math></td> <td colspan="3">3( distance <math>\geq 10\text{mm}</math>)</td> </tr> <tr> <td><math>0.20 &lt; \Phi \leq 0.25</math></td> <td colspan="3">2</td> </tr> <tr> <td><math>\Phi &gt; 0.3</math></td> <td colspan="3">0</td> </tr> </tbody> </table>	Zone Size (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.10$	Ignore			$0.10 < \Phi \leq 0.20$	3( distance $\geq 10\text{mm}$ )			$0.20 < \Phi \leq 0.25$	2			$\Phi > 0.3$	0		
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② Dim spot (LCD/TP/Polarizer dim dot, light leakage, dark spot)																									
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$\Phi \leq 0.2$	Ignore																								
$0.3 < \Phi \leq 0.4$	3(distance $\geq 10\text{mm}$ )																								
$0.4 < \Phi \leq 0.5$	2																								
$\Phi > 0.5$	0																								

3.0	Line defect (LCD/TP /Polarizer backlight black/white line, scratch, stain)	<table border="1"> <thead> <tr> <th rowspan="2">Width(mm)</th> <th rowspan="2">Length(mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td><math>\Phi \leq 0.03</math></td> <td>Ignore</td> <td colspan="2">Ignore</td> <td rowspan="3">Ignore</td> </tr> <tr> <td><math>0.03 &lt; W \leq 0.04</math></td> <td><math>L \leq 3.0</math></td> <td colspan="2"><math>N \leq 2</math></td> </tr> <tr> <td><math>0.04 &lt; W \leq 0.05</math></td> <td><math>L \leq 2.0</math></td> <td colspan="2"><math>N \leq 1</math></td> </tr> <tr> <td><math>0.05 &lt; W</math></td> <td colspan="4">Define as spot defect</td> </tr> </tbody> </table>	Width(mm)	Length(mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.03$	Ignore	Ignore		Ignore	$0.03 < W \leq 0.04$	$L \leq 3.0$	$N \leq 2$		$0.04 < W \leq 0.05$	$L \leq 2.0$	$N \leq 1$		$0.05 < W$	Define as spot defect			
		Width(mm)			Length(mm)	Acceptable Qty																						
			A	B		C																						
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$0.05 < W$	Define as spot defect																											
4.0	Electronic Components SMT	Not allow missing parts, solderless connection, cold solder joint, mismatch, The positive and negative polarity opposite																										
5.0	Display color & Brightness	<ol style="list-style-type: none"> <li>Color: Measuring the color coordinates, The measurement standard according to the datasheet or samples.</li> <li>Brightness: Measuring the brightness of White screen, The measurement standard according to the datasheet or Samples.</li> </ol>																										

6.0	RTP Related	TP film bubble/accident spot	<table border="1"> <thead> <tr> <th rowspan="2">Size <math>\Phi</math>(mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td><math>\Phi \leq 0.1</math></td> <td colspan="2">Ignore</td> <td rowspan="4">Ignore</td> </tr> <tr> <td><math>0.1 &lt; \Phi \leq 0.2</math></td> <td colspan="2">3 (distance <math>\geq</math></td> </tr> <tr> <td><math>0.25 &lt; \Phi \leq 0.3</math></td> <td colspan="2">2</td> </tr> <tr> <td><math>\Phi &gt; 0.3</math></td> <td colspan="2">0</td> </tr> </tbody> </table>	Size $\Phi$ (mm)	Acceptable Qty			A	B	C	$\Phi \leq 0.1$	Ignore		Ignore	$0.1 < \Phi \leq 0.2$	3 (distance $\geq$		$0.25 < \Phi \leq 0.3$	2		$\Phi > 0.3$	0					
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Assembly deflection	beyond the edge of backlight $\leq 0.2\text{mm}$																										

		<p>Bulge (undulation included)</p>	<p>The ITO film plumped below 0.40mm, it's ok.</p> 						
		<p>Newton Ring</p>	<p>Newton Ring area &gt; 1/3 TP area NG</p> <p>Newton Ring area ≤ 1/3 TP area OK</p> 						
		<p>TP corner broken X : length Y : width Z : height</p>	<table border="1" data-bbox="678 1297 979 1402"> <tr> <td>X</td> <td>Y</td> <td>Z</td> </tr> <tr> <td>X ≤ 3mm</td> <td>Y ≤ 3mm</td> <td>Z &lt; COVER thickness</td> </tr> </table> <p>* *Circuitry broken is not allowed.</p> 	X	Y	Z	X ≤ 3mm	Y ≤ 3mm	Z < COVER thickness
X	Y	Z							
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			<table border="1"> <tr> <td>X</td> <td>Y</td> <td>Z</td> </tr> <tr> <td><math>X \leq 4\text{mm}</math></td> <td><math>Y \leq 2\text{mm}</math></td> <td><math>Z &lt; \text{COVER thickness}</math></td> </tr> </table>	X	Y	Z	$X \leq 4\text{mm}$	$Y \leq 2\text{mm}$	$Z < \text{COVER thickness}$	
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		<p>TP edge broken  X : length  Y : width  Z : height</p> <p>* Circuitry broken is not allowed.</p>								

Criteria ( functional items)

<p>Number</p> <p>1</p> <p>2</p> <p>3</p> <p>4</p> <p>5</p>	<p>Items</p> <p>No display</p> <p>Missing segment</p> <p>Short</p> <p>Backlight no lighting</p> <p>TP no function</p>	<p>Criteria (mm)</p> <p>Not allowed</p> <p>Not allowed</p> <p>Not allowed</p> <p>Not allowed</p> <p>Not allowed</p>
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## 9. Reliability Test Result

Item	Condition	Inspection after test
High Temperature Operating	70 °C ,96H	Inspection after 2~4hours storage at room temperature, the sample shall be free from defects: 1.Air bubble in the LCD; 2.Non-display; 3.Missing segments/line; 4.Glass crack; 5.Current IDD is twice higher than initial value.
Low Temperature Operating	-20 °C , 96HR	
High Temperature Storage	80 °C , 96HR	
Low Temperature Storage	-30 °C , 96HR	
High Temperature & High Humidity Storage	+60 °C , 90% RH ,96 hours.	
Thermal Shock (Non-operation)	-30 °C ,30 min ↔ 80 °C ,30 min, Change time:5min 20CYC.	
ESD test	C=150pF, R=330,5points/panel Air:±8KV, 5times; Contact:±6KV, 5 times; (Environment: 15 °C ~35 °C , 30%~60%).	
Vibration (Non-operation)	Frequency range:10~55Hz, Stroke:1.5mm Sweep:10Hz~55Hz~10Hz 2 hours for each direction of X.Y.Z. (6 hours for total) (Package condition).	
Box Drop Test	1 Corner 3 Edges 6 faces,80cm(MEDIUM BOX)	

Remark:

- 1.The test samples should be applied to only one test item.
- 2.Sample size for each test item is 5~10pcs.
- 3.For Damp Proof Test, Pure water(Resistance > 10MΩ) should be used.
- 4.In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judged as a good part.
- 5.Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

## 10. Cautions and Handling Precautions

### 10.1 Handling and Operating the Module

- (1) When the module is assembled, it should be attached to the system firmly. Do not warp or twist the module during assembly work.
- (2) Protect the module from physical shock or any force. In addition to damage, this may cause improper operation or damage to the module and back-light unit.
- (3) Note that polarizer is very fragile and could be easily damaged. Do not press or scratch the surface.
- (4) Do not allow drops of water or chemicals to remain on the display surface. If you have the droplets for a long time, staining and discoloration may occur.
- (5) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
- (6) The desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane. Do not use ketene type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
- (7) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs, or clothes, it must be washed away thoroughly with soap.
- (8) Protect the module from static; it may cause damage to the CMOS ICs.
- (9) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (10) Do not disassemble the module.
- (11) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (12) Pins of I/F connector shall not be touched directly with bare hands.
- (13) Do not connect, disconnect the module in the "Power ON" condition.
- (14) Power supply should always be turned on/off by the item 6.1 Power On Sequence & 6.2 Power Off Sequence

### 10.2 Storage and Transportation.

- (1) Do not leave the panel in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35 °C and relative humidity of less than 70%
- (2) Do not store the TFT-LCD module in direct sunlight.
- (3) The module shall be stored in a dark place. When storing the modules for a long time, be sure to adopt effective measures for protecting the modules from strong ultraviolet radiation, sunlight, or fluorescent light.
- (4) It is recommended that the modules should be stored under a condition where no condensation is allowed. Formation of dewdrops may cause an abnormal operation or a failure of the module. In particular, the greatest possible care should be taken to prevent any module from being operated where condensation has occurred inside.
- (5) This panel has its circuitry FPC on the bottom side and should be handled carefully in order not to be stressed.

