

# **SPECIFICATION FOR LCM MODULE**

**MODULE NO.: TFT-0107**

Customer Approval:

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

WRITTEN BY	CHECKED BY	APPROVED BY

- Notes:
- 1、 Please contact GTK before assigning your product based on this module specification.
  - 2、 To improve the quality of product, and this product specification is subject to change without any notice.



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## ■ GENERAL INFORMATION

Item of general information	Contents	Unit
LCD size	3.5 inch (Digital)	/
LCD type	TFT/TRANSMISSIVE normal white	
View direction	12 o'clock	
Resolution	320*3(RGB)*240	
Module size (W × H×T)	76.9(W)×63.9(H)×3.05(D)	mm <sup>3</sup>
Active area (W×H)	70.08(H)×52.56(V)	mm <sup>2</sup>
Pixel pitch (W × H)	0.219(H)×0.219(V)	mm <sup>2</sup>
Interface Type	RGB interface	/
Input voltage	3.3V	V
Module Power consumption	TBD	mw
Backlight Type	6 *LED	/

## ■ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Max	Unit
Power supply voltage	DVDD	-0.3	3.6	V
Logic Signal Input Level	V <sub>i</sub>	-0.3	DVDD+0.3	V
Operating temperature	T <sub>op</sub>	-20	70	°C
Storage temperature	T <sub>ST</sub>	-30	80	°C
Humidity	RH	-	90%(Max60 °C)	RH

## ■ ELECTRICAL CHARACTERISTICS

### DC CHARACTERISTICS

Parameter	Symbol	Min	Typ	Max	Unit
Supply Voltage	VDD	3.0	3.3	3.6	V
VCOM	VCOM	3.8	4.0	4.2	V
Current of power supply	IVDD	-	4	10	mA
	I <sub>AVDD</sub>	-	30	40	mA
	I <sub>GH</sub>	-	0.2	1.0	mA
	I <sub>GL</sub>	-	0.2	1.0	mA
Input voltage 'H' level	V <sub>IH</sub>	0.7DVDD	-	VDD	V
Input voltage 'L' level	V <sub>IL</sub>	0	-	0.3VDD	V

Note: Be sure to apply DVDD and VGL to the LCD first , then apply VGH.

## ■ BACKLIGHT CHARACTERISTICS

Item of backlight characteristics	Symbol	Min.	Typ.	Max.	Unit	Condition
Forward voltage	Vf	-	19.2	20	V	Note 1
Current for LED backlight	IL	-	20	22	mA	
LED life time	-	20,000	-	-	-	Note 2

Note 1: The LED Supply Voltage is defined by the number of LED at Ta=25°C and IL =20mA.

Note 2: The “LED life time” is defined as the module brightness decrease to 50% original brightness at Ta=25°C and IL =20mA. The LED lifetime could be decreased if operating IL is larger than 20mA.

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## ■ ELECTRO-OPTICAL CHARACTERISTICS

Item of electro-optical characteristics	Symbol	Condition	Min	Typ	Max	Unit	Remark	Note
Response time	Tr+ Tf	70	–	25	50	ms	Fig.1	4
Contrast ratio	Cr		400	500	–	---	FIG 2.	1
Luminance uniformity	δ WHITE		160	75	–	%	FIG 2.	3
Surface Luminance	Lv		250	275	–	cd/m <sup>2</sup>	FIG 2.	2
Viewing angle range	θ	∅ = 90°	40	50	–	deg	FIG 3.	6
		∅ = 270°	50	60	–	deg	FIG 3.	
		∅ = 0°	50	60	–	deg	FIG 3.	
		∅ = 180°	50	60	–	deg	FIG 3.	
CIE (x, y) chromaticity	Red x	θ=0° ∅=0° Ta=25°C	0.5550	0.6050	0.6550	-	FIG 2.	5
	Red y		0.3160	0.3660	0.4160	-		
	Green x		0.3094	0.3594	0.4094	-		
	Green y		0.5030	0.5530	0.6030	-		
	Blue x		0.1064	0.1564	0.2064	-		
	Blue y		0.1066	0.1566	0.2066	-		
	White x		0.2578	0.3178	0.3778	-		
	White y		0.2943	0.3543	0.4143	-		

Note1. Contrast Ratio(CR) is defined mathematically by the following formula. For more information see FIG 2.:

$$\text{Contrast Ratio} = \frac{\text{Average Surface Luminance with all white pixels (P 1,P2, P 3,P4, P5)}}{\text{Average Surface Luminance with all black pixels (P1, P2, P 3,P4, P5)}}$$

Note2. Surface luminance is the LCD surface from the surface with all pixels displaying white. For more information see FIG 2.

$$L_v = \text{Average Surface Luminance with all white pixels (P1, P2, P 3,P4, P5)}$$

Note3. The uniformity in surface luminance (δ WHITE) is determined by measuring luminance at each test position 1 through 5, and then dividing the maximum luminance of 5 points luminance by minimum luminance of 5 points luminance. For more information see FIG 2.

$$\delta \text{ WHITE} = \frac{\text{Minimum Surface Luminance with all white pixels (P}_1, \text{P}_2, \text{P}_3, \text{P}_4, \text{P}_5)}{\text{Maximum Surface Luminance with all white pixels (P}_1, \text{P}_2, \text{P}_3, \text{P}_4, \text{P}_5)}$$

Note4. Response time is the time required for the display to transition from White to black(Rise Time, Tr) and from black to white(Decay Time, Tf). For additional information see FIG 1..

Note5. CIE (x, y) chromaticity ,The x,y value is determined by screen active area position NO.5 For more information see FIG 2.

Note6. Viewing angle is the angle at which the contrast ratio is greater than 2. For TFT module 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 LCD surface. For more information see FIG 3.

Note7. For Viewing angle and response time testing, the testing data is base on Autronic-Melchers's ConoScope. Series Instruments. For contrast ratio, Surface Luminance, Luminance uniformity and CIE, the testing data is base on TOPCON's BM-5 photo detector or compatible.

Note8. For TFT module, Gray scale reverse occurs in the direction of panel viewing angle

FIG.1. The definition of Response Time

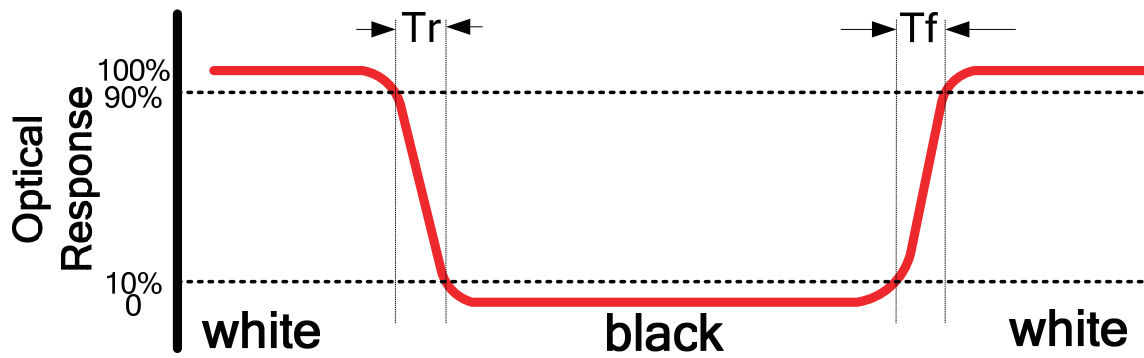


FIG.2. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity

A : 5 mm  
 B : 5 mm  
 H, V : Active Area  
 Light spot size  $\varnothing=5\text{mm}$ , 500mm distance from the LCD surface to detector lens  
 measurement instrument is TOPCON's luminance meter BM-5

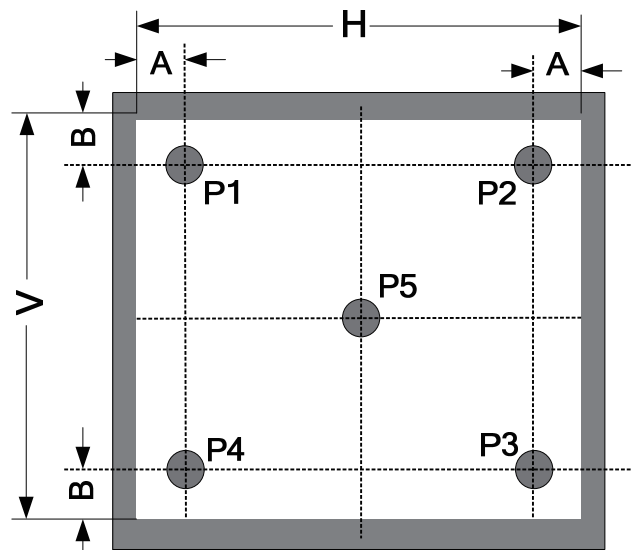
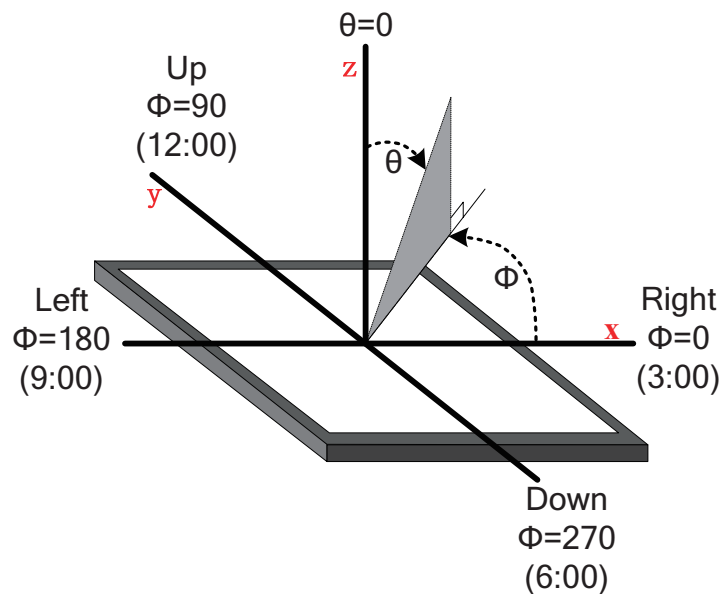


FIG.3. The definition of viewing angle





## INTERFACE DESCRIPTION

Pin	Symbol	I/O	Function	Remark
1	VBL-	I	Backlight LED Ground	
2	VBL-	I	Backlight LED Ground	
3	VBL+	I	Backlight LED Power	
4	VBL+	I	Backlight LED Power	
5	Y1	I	Top electrode ,	
6	X1	I	Right electrode	
7	NC		Not Use	
8	/RESET	-	Hardware Reset	
9	SPENA	I	SPI Interface Data Enable Signal	Note 3
10	SPCLK	I	SPI Interface Data Clock	Note 3
11	SPDAT	I	SPI Interface Data	Note 3
12	B0	I	Blue Data Bit 0	
13	B1	I	Blue Data Bit 1	
14	B2	I	Blue Data Bit 2	
15	B3	I	Blue Data Bit 3	
16	B4	I	Blue Data Bit 4	
17	B5	I	Blue Data Bit 5	
18	B6	I	Blue Data Bit 6	
19	B7	I	Blue Data Bit 7	
20	G0	I	Green Data Bit0	
21	G1	I	Green Data Bit1	
22	G2	I	Green Data Bit2	
23	G3	I	Green Data Bit3	
24	G4	I	Green Data Bit4	
25	G5	I	Green Data Bit5	
26	G6	I	Green Data Bit6	
27	G7	I	Green Data Bit7	
28	R0	I	Red Data Bit0 /DX0	Note 4
29	R1	I	Red Data Bit1 /DX1	Note 4
30	R2	I	Red Data Bit2 /DX2	Note 4
31	R3	I	Red Data Bit3 /DX3	Note 4
32	R4	I	Red Data Bit4 /DX4	Note 4
33	R5	I	Red Data Bit5 /DX5	Note 4
34	R6	I	Red Data Bit6 /DX6	Note 4
35	R7	I	Red Data Bit7 /DX7	Note 4

36	HSYNC	I	Horizontal Sync Input	
37	VSYNC	I	Vertical Sync Input	
38	DCLK	I	Dot Data Clock	
39	NC		Not Use	
40	NC		Not Use	
41	Vcc	I	Digital Power	
42	Vcc	I	Digital Power	
43	Y2	I	Bottom electrode	
44	X2	I	Left electrode	
45	NC		Not Use	
46	NC	-	Not Use	
47	NC		Not Use	
48	IF2	I	Control the input data format /floating	Note 1
49	IF1	I	Control the input data format	Note 1,5
50	IF0	I	Control the input data format	Note 1,5
51	NC		Not Use	
52	DE	I	Data Enable Input	Note 2
53	GND	I	Ground	
54	GND	I	Ground	

### Note:

1. The mode control (IF2) not use ,it can't control CCIR601 interface , If not use CCIR601 ,it can floating.
2. For digital RGB input data format, both SYNC mode and DE+SYNC mode are supported. If DE signal is fixed low, SYNC mode is used. Otherwise, DE+SYNC mode is used.Suggest used SYNC mode!
3. usually pull high.
4. IF select serial RGB or CCIR601/656 input mode is selected,only DX0-DX7 used,and the other short to GND, selected serial RGB · CCIR601/656 interface,DX BUS will enable,Digital input mode DX0 is LSB and DX7 is MSB.
5. Control the input data format

### IF2-0: Define the input interface mode.

IF2	IF1	IF0	Format	Operating Frequency
0	0	0	Parallel-RGB data format (only support stripe type color filter)	6.5MHz
0	0	1	Serial-RGB data format	19.5MHz
0	1	0	CCIR 656 data format (640RGB)	24.54MHz
0	1	1	CCIR 656 data format (720RGB)	27MHz
1	0	0	YUV mode A data format (Cr-Y-Cb-Y)	24.54MHz
1	0	1	YUV mode A data format (Cr-Y-Cb-Y)	27MHz
1	1	0	YUV mode B data format (Cb-Y-Cr-Y)	27MHz
1	1	1	YUV mode B data format (Cb-Y-Cr-Y)	24.54MHz

Input format	DOTCLK Freq (MHz)	Display Data	Active Area (DOTCLK)
YUV mode	24.54	640	1280
	27	720	1440

Mode	D[23:16]	D[15:8]	D[7:0]	IHS	IVS	DEN
ITU-R BT 656	D[23:16]	GND	GND	NC	NC	NC
ITU-R BT 601	D[23:16]	GND	GND	IHS	IVS	NC
8 bit RGB	D[23:16]	GND	GND	IHS	IVS	NC for HV Mode
						DEN for DEN Mode
24 bit RGB	R[7:0]	G[7:0]	B[7:0]	IHS	IVS	NC for HV Mode
						DEN for DEN Mode

# SPI timing Characteristics

PARAMETER	Symbol	Min.	Typ.	Max.	Unit
SPCK period	$T_{CK}$	60	-	-	ns
SPCK high width	$T_{CKH}$	30	-	-	ns
SPCK low width	$T_{CKL}$	30	-	-	ns
Data setup time	$T_{SUI}$	12	-	-	ns
Data hold time	$T_{HD1}$	12	-	-	ns
SPENA to SPCK setup time	$T_{CS}$	20	-	-	ns
SPENA to SPDA hold time	$T_{CE}$	20	-	-	ns
SPENA high pulse width	$T_{CO}$	50	-	-	ns
SPDA output latency	$T_{CB}$	-	1/2	-	$T_{CK}$

## SPI read timing

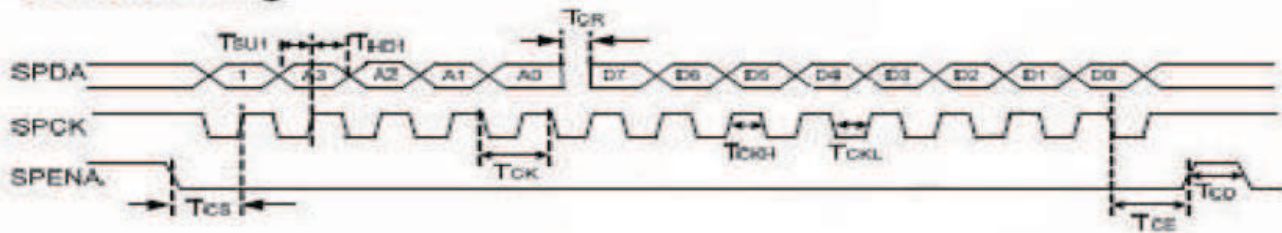


Figure8 SPI read timing

## SPI write timing

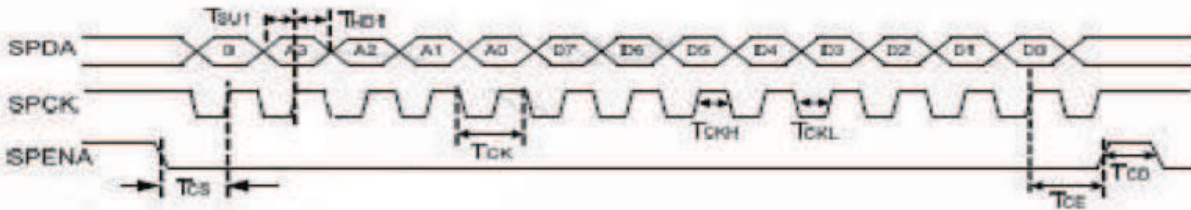


Figure9 SPI write timing

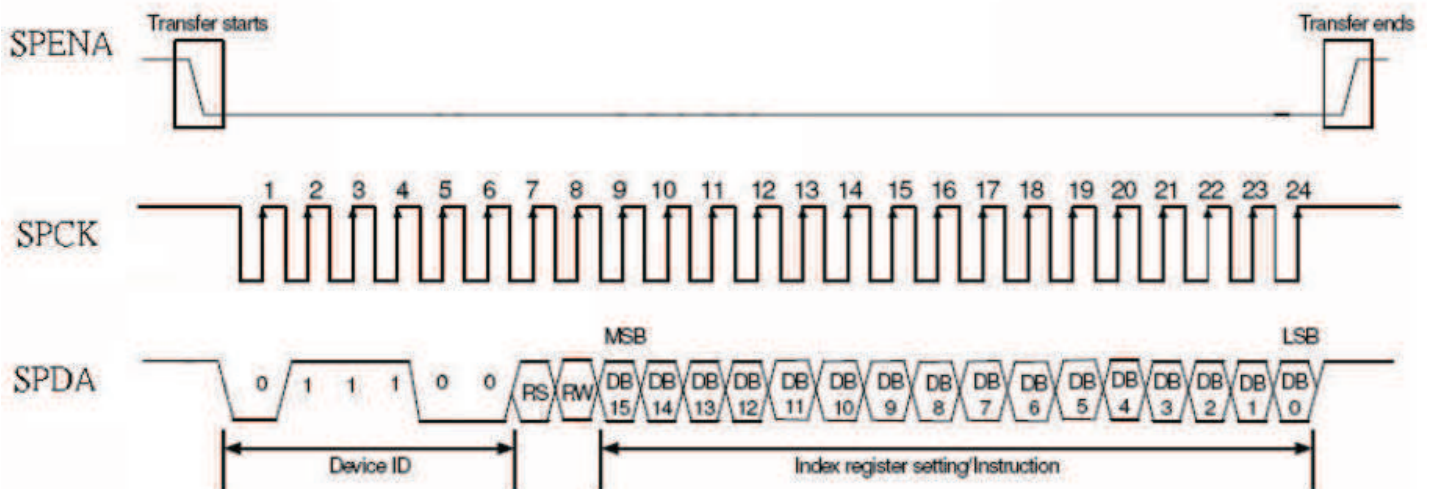
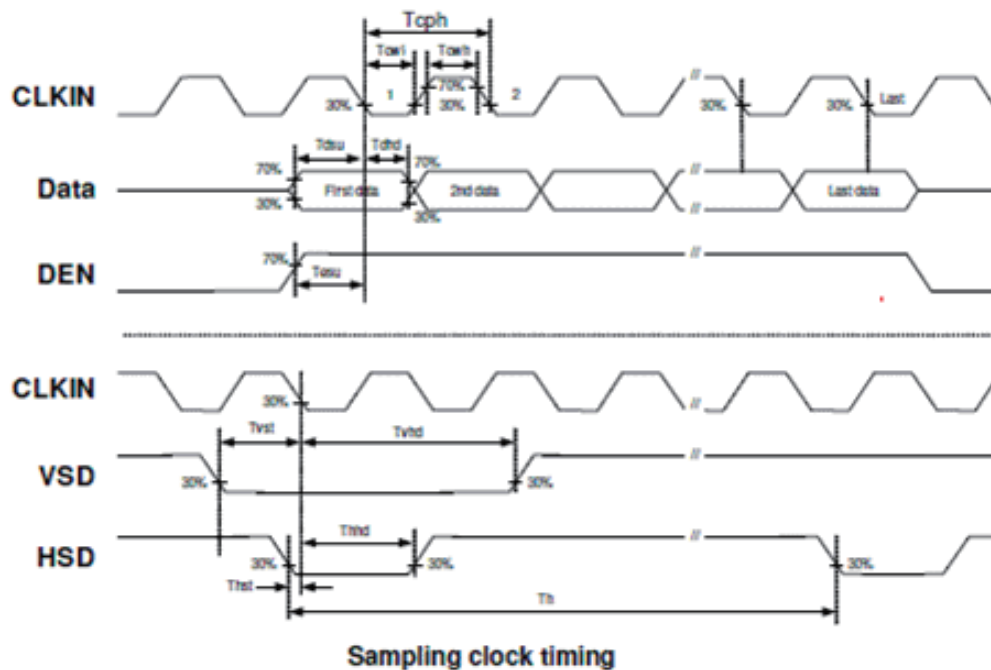


Figure10 SPI timing

## ■ AC CHARACTERISTICS

Item	Symbol	Min	Typ	Max	Unit	Remark
HS setup time	Thst	12	-	-	ns	
HS hold time	Thhd	12	-	-	ns	
VS setup time	Tvst	12	-	-	ns	
VS hold time	Tvhd	12	-	-	ns	
Data setup time	Tdsu	12	-	-	ns	
Data hold time	Tdhd	12	-	-	ns	
DE setup time	Tesu	12	-	-	ns	
DE hold time	Tehd	12	-	-	ns	
Dvdd power on slew rate	Tpor	-	-	20	ms	0 to 90% DVDD
RESET pulse width	Trst	1	-	-	us	
DCLK cycle time	Tcoh	20	-	-	ns	
DCLK pulse duty	Tcwh	40	50	60	%	

Timing Diagram of Interface Signal



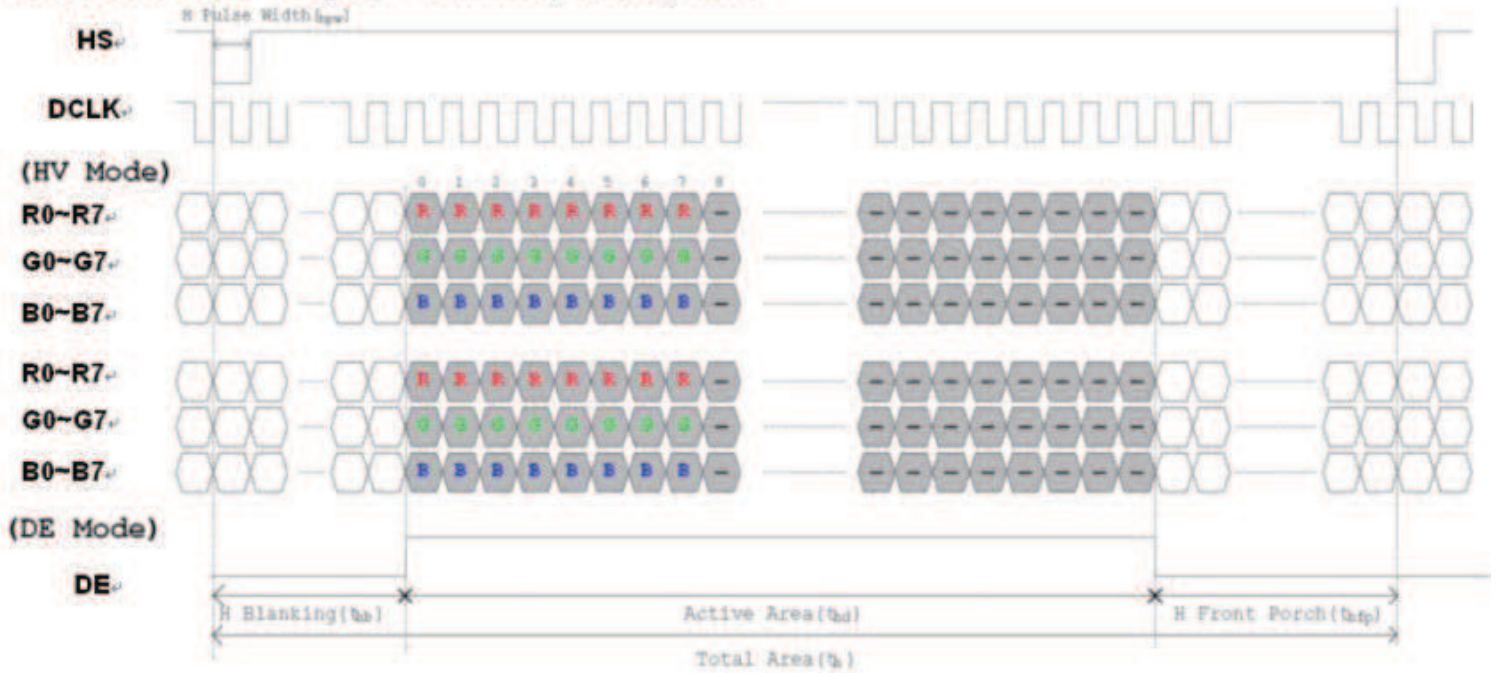
Sampling clock timing

Item	Symbol	Min	Typ	Max	Unit	Remark
Horizontal Display Area	thd	-	320	-	DCLK	
One horizontal line	th	-	408	-	DCLK	
HS pulse width	thpw	5	30	-	DCLK	
HS blanking	thb	-	38	-	DCLK	
HS front porch	thfp	-	20	-	DCLK	
Vertical Display Area	tv	-	240	-	TH	
VS period time	tv	-	262	-	TH	
VS pulse width	tvpw	1	3	-	TH	

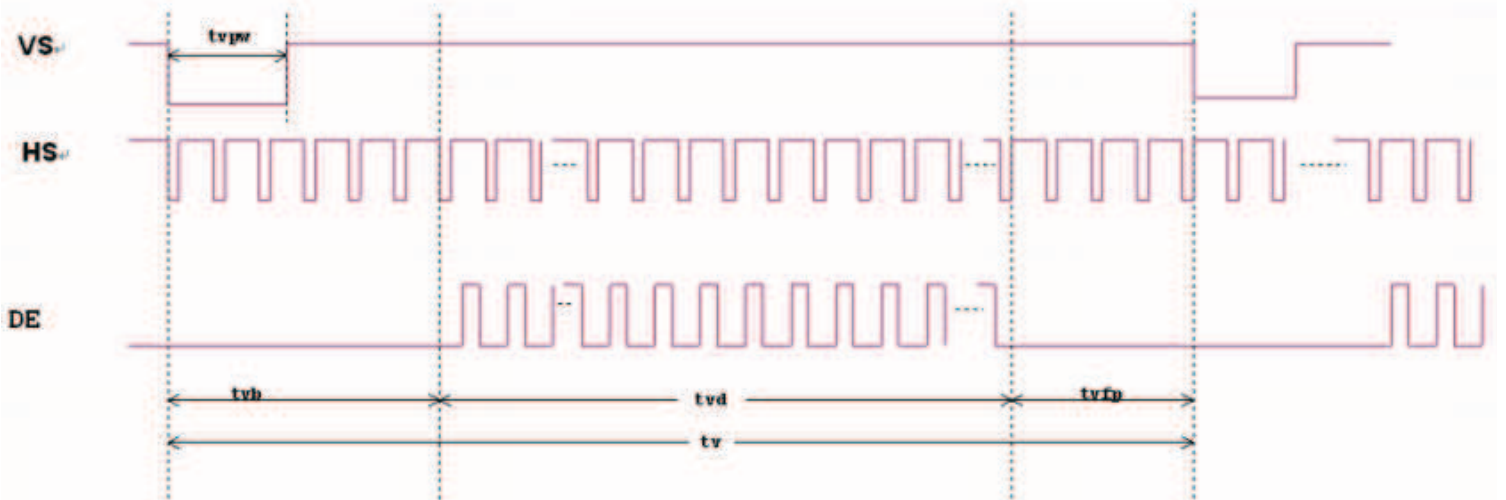


VS blanking	tvb	-	15	-	TH	
VS front porch	tvfp	2	4	-	TH	

### Horizontal input timing diagram.

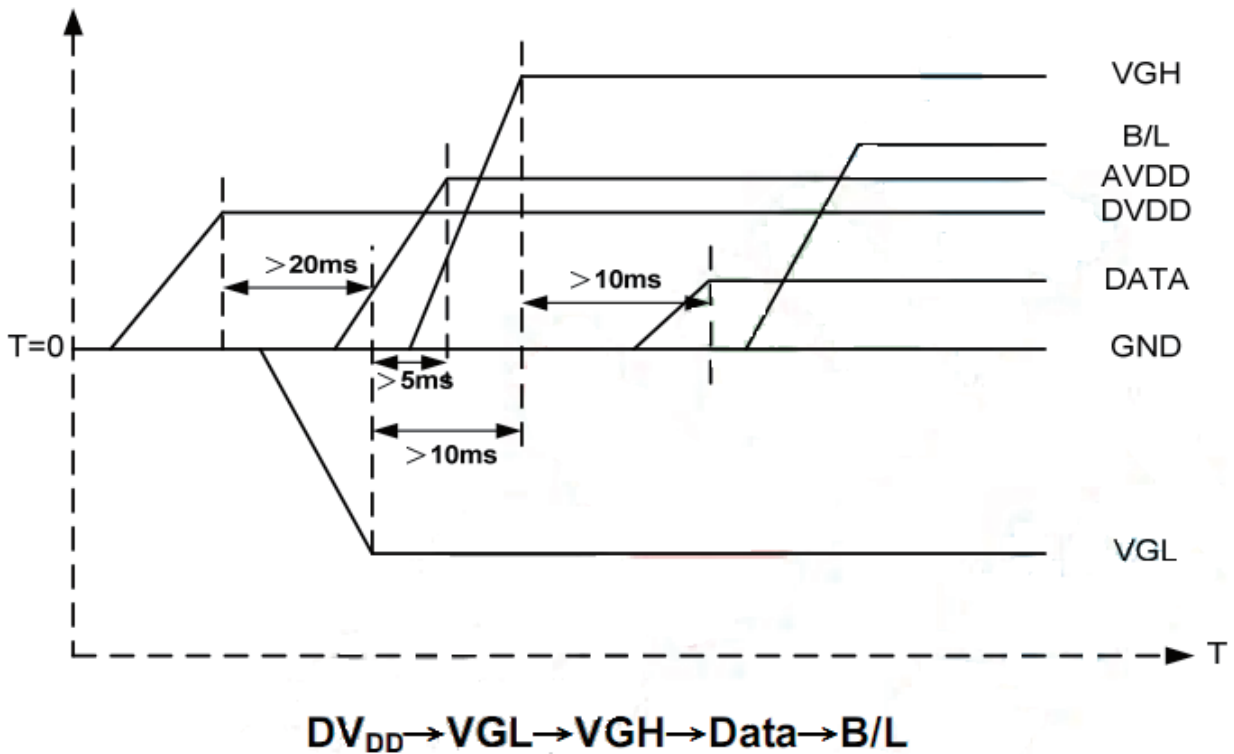


### Vertical input timing diagram.

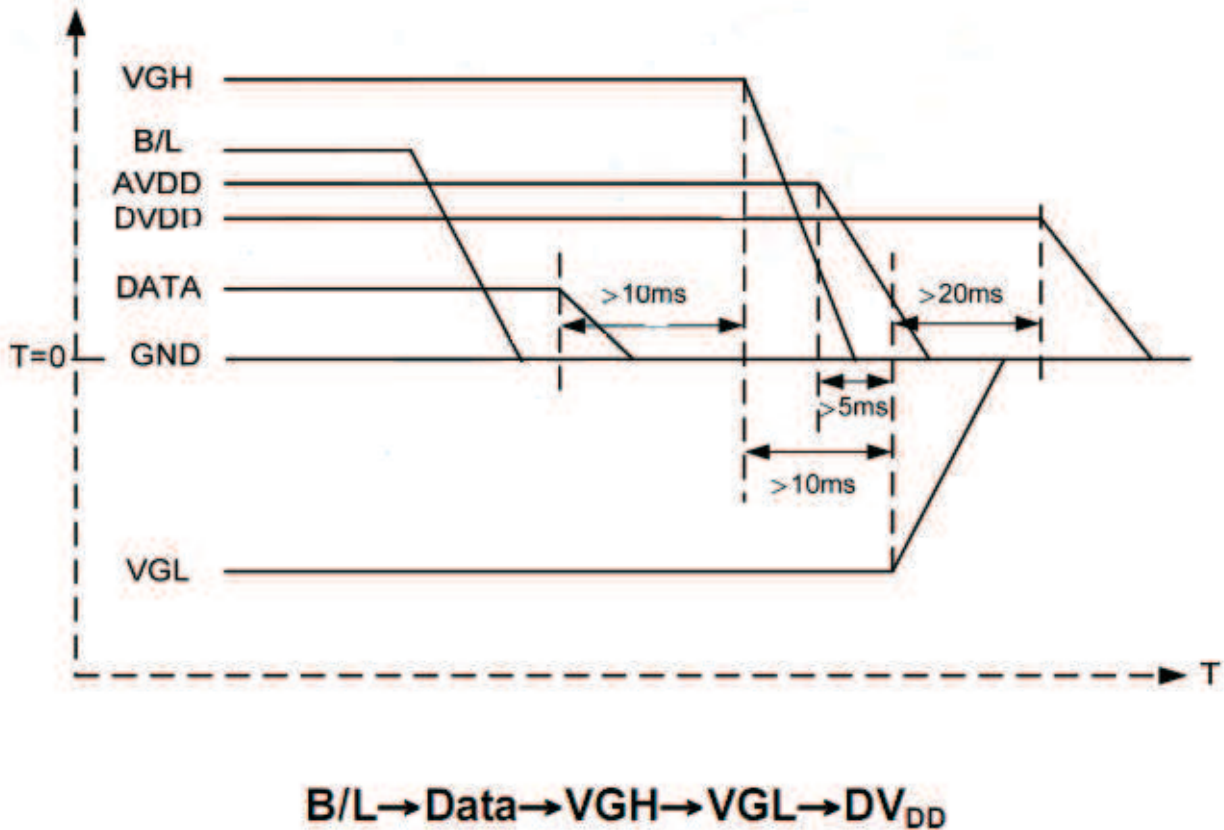


## ■ POWER SEQUENCE

### a. Power on:



### b. Power off:



Note: Data include R0~R7, B0~B7, GO~G7, U/D, L/R, DCLK, HS, VS, DE.

## ■ REFERENCE APPLICATION CIRCUIT

Please consult our technical department for detail information.



## ■ RELIABILITY TEST CONDITIONS

No.	Test Item	Test Condition	Inspection after test
1	High Temperature Storage	$80 \pm 2^{\circ}\text{C}/240$ hours	Inspection after 2~4hours storage at room temperature, the sample shall be free from defects: 1.Air bubble in the LCD; 2.Sealleak; 3.Non-display; 4.missing segments; 5.Glass crack; 6.Current Idd is twice higher than initial value.
2	Low Temperature Storage	$-30 \pm 2^{\circ}\text{C}/240$ hours	
3	High Temperature Operating	$70 \pm 2^{\circ}\text{C}/120$ hours	
4	Low Temperature Operating	$-20 \pm 2^{\circ}\text{C}/120$ hours	
5	Temperature Cycle	$-20 \pm 2^{\circ}\text{C} \sim 25 \sim 70 \pm 2^{\circ}\text{C} \times 10$ cycles (30min.) (5min.) (30min.)	
6	Damp Proof Test	$50^{\circ}\text{C} \pm 5^{\circ}\text{C} \times 90\%\text{RH}/120$ hours	
7	Vibration Test	Frequency: 10Hz~55Hz~10Hz Amplitude: 1.5mm, X, Y, Z direction for total 3hours (Packing condition)	
8	Dropping test	Drop to the ground from 1m height, one time, every side of carton. (Packing condition)	
9	ESD test	Voltage: $\pm 8\text{KV}$ R: $330\Omega$ C: $150\text{pF}$ Air discharge, 10time	

Remark:

- The test samples should be applied to only one test item.
- Sample size for each test item is 5~10pcs.
- For Damp Proof Test, Pure water(Resistance  $> 10\text{M}\Omega$ ) should be used.
- 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.
- EL evaluation should be excepted from reliability test with humidity and temperature: Some defects such as black spot/blemish can happen by natural chemical reaction with humidity and Fluorescence EL has.
- Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

## ■ INSPECTION CRITERION

This specification is made to be used as the standard acceptance/rejection criteria for Normal LCM Product.

### 1 Sample plan

Sampling plan according to GB/T2828.1-2003/ISO 2859-1 : 1999 and ANSI/ASQC Z1.4-1993, normal level 2 and based on:

Major defect: AQL 0.65

Minor defect: AQL 1.5

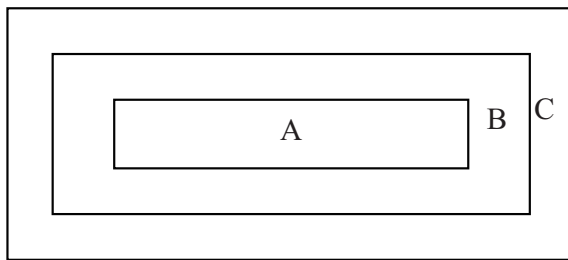
### 2. Inspection condition

● Viewing distance for cosmetic inspection is about 30cm with bare eyes, and under an environment of 20~40W light intensity, all directions for inspecting the sample should be within 45° against perpendicular line. (Normal temperature 20~25°C and normal humidity 60±15%RH).

● Driving voltage

The Vop value from which the most optimal contrast can be obtained near the specified Vop in the specification (Within ±0.5V of the typical value at 25°C.).

### 3. Definition of inspection zone in LCD.



Zone A: character/Digit area

Zone B: viewing area except Zone A (ZoneA+ZoneB=minimum Viewing area)

Zone C: Outside viewing area (invisible area after assembly in customer's product)

Fig.1 Inspection zones in an LCD.

Note: As a general rule, visual defects in Zone C are permissible, when it is no trouble for quality and assembly of customer's product.



## 4. Inspection Standard

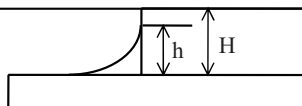
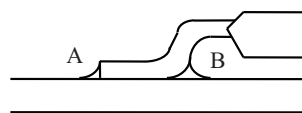
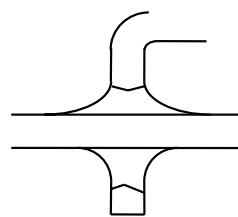
### 4.1 Major Defect

Item No	Items to be inspected	Inspection Standard	Classification of defects
4.1.1	All functional defects	1) No display 2) Display abnormally 3) Missing vertical, horizontal segment 4) Short circuit 5) Back-light no lighting, flickering and abnormal lighting.	Major
4.1.2	Missing	Missing component	
4.1.3	Outline dimension	Overall outline dimension beyond the drawing is not allowed.	

### 4.2 Cosmetic Defect

#### 4.2.1 Module Cosmetic Criteria

No.	Item	Judgement Criterion	Partition
1	Difference in Spec.	None allowed	Major
2	Pattern peeling	No substrate pattern peeling and floating	Major
3	Soldering defects	No soldering missing No soldering bridge No cold soldering	Major Major Minor
4	Resist flaw on Printed Circuit Boards	visible copper foil ( $\varnothing 0.5\text{mm}$ or more) on substrate pattern	Minor
5	Accretion of metallic Foreign matter	No accretion of metallic foreign matters (Not exceed $\varnothing 0.2\text{mm}$ )	Minor Minor
6	Stain	No stain to spoil cosmetic badly	Minor
7	Plate discoloring	No plate fading, rusting and discoloring	Minor
8	Solder amount	a. Soldering side of PCB Solder to form a 'Filet' all around the lead. Solder should not hide the lead form perfectly. (too much)	Minor
	1. Lead parts	b. Components side ( In case of 'Through Hole PCB' )  Solder to reach the Components side of PCB.	
	2. Flat packages	Either 'Toe' (A) or 'Seal' (B) of the lead to be covered by 'Filet'.  Lead form to be assume over solder.	
	3. Chips	$(3/2) H \geq h \geq (1/2) H$	Minor

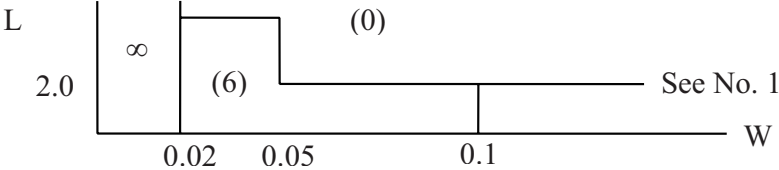
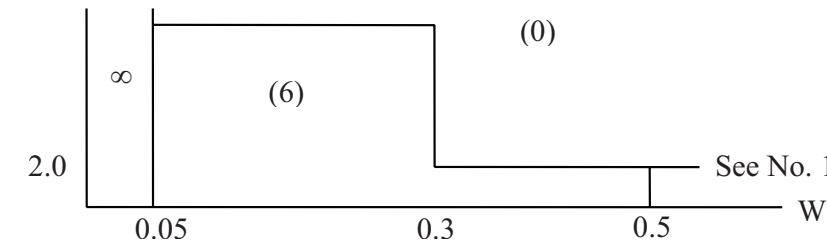


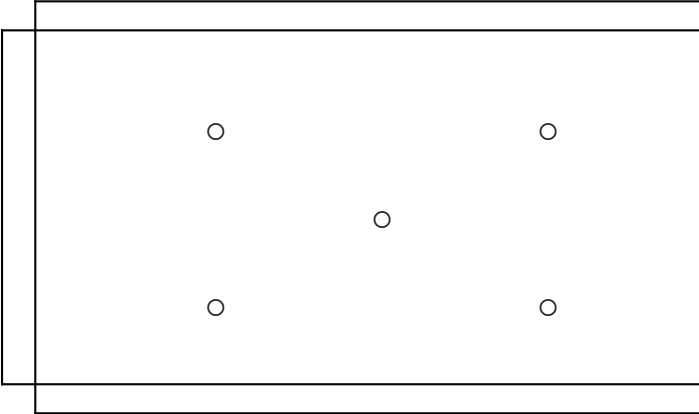
9	Solder splash	ball/Solder	a. The spacing between solder ball and the conductor or solder pad $h \geq 0.13\text{mm}$ The diameter of solder ball $d \leq 0.15\text{mm}$ .		Minor
			b. The quantity of solder balls or solder Splashes isn't beyond 5 in $600\text{mm}^2$ .		Minor
			c. Solder balls/Solder splashes do not violate minimum electrical clearance.		Major
			d. Solder balls/Solder splashes must be entrapped/encapsulated Or attached to the metal surface .		Minor
			NOTE: Entrapped/encapsulated/attached is intended to mean that normal service environment of the product will not cause a solder ball to become dislodged.		

#### 4.2.2 Cosmetic Criteria (Non-Operating)

No.	Defect	Judgment Criterion	Partition										
1	Spots	In accordance with <i>Screen Cosmetic Criteria (Operating) No.1.</i>	Minor										
2	Lines	In accordance with <i>Screen Cosmetic Criteria (Operating) No.2.</i>	Minor										
3	Bubbles in polarizer	<table border="1"> <thead> <tr> <th>Size : d mm</th> <th>Acceptable Qty in active area</th> </tr> </thead> <tbody> <tr> <td><math>d \leq 0.3</math></td> <td>Disregard</td> </tr> <tr> <td><math>0.3 &lt; d \leq 1.0</math></td> <td>3</td> </tr> <tr> <td><math>1.0 &lt; d \leq 1.5</math></td> <td>1</td> </tr> <tr> <td><math>1.5 &lt; d</math></td> <td>0</td> </tr> </tbody> </table>	Size : d mm	Acceptable Qty in active area	$d \leq 0.3$	Disregard	$0.3 < d \leq 1.0$	3	$1.0 < d \leq 1.5$	1	$1.5 < d$	0	Minor
Size : d mm	Acceptable Qty in active area												
$d \leq 0.3$	Disregard												
$0.3 < d \leq 1.0$	3												
$1.0 < d \leq 1.5$	1												
$1.5 < d$	0												
4	Scratch	In accordance with spots and lines operating cosmetic criteria. When the light reflects on the panel surface, the scratches are not to be remarkable.	Minor										
5	Allowable density	Above defects should be separated more than 30mm each other.	Minor										
6	Coloration	Not to be noticeable coloration in the viewing area of the LCD panels. Back-lit type should be judged with back-lit on state only.	Minor										
7	Contamination	Not to be noticeable.	Minor										

### 4.2.3 Cosmetic Criteria (Operating)

No.	Defect	Judgment Criterion	Partition																																												
1	Spots	<p>A) Clear</p> <table border="1" data-bbox="395 282 1310 647"> <thead> <tr> <th>Lcd size</th> <th>Size : d mm</th> <th>Acceptable Qty in active area</th> </tr> </thead> <tbody> <tr> <td rowspan="4">Lcd size <math>\leq 8.0'</math></td> <td><math>d \leq 0.1</math></td> <td>Disregard</td> </tr> <tr> <td><math>0.1 &lt; d \leq 0.2</math></td> <td>6</td> </tr> <tr> <td><math>0.2 &lt; d \leq 0.3</math></td> <td>2</td> </tr> <tr> <td><math>0.3 &lt; d</math></td> <td>0</td> </tr> <tr> <td rowspan="4">Lcd size <math>&gt; 8.0'</math></td> <td><math>d \leq 0.1</math></td> <td>Disregard</td> </tr> <tr> <td><math>0.1 &lt; d \leq 0.3</math></td> <td>10</td> </tr> <tr> <td><math>0.3 &lt; d \leq 0.5</math></td> <td>5</td> </tr> <tr> <td><math>0.5 &lt; d</math></td> <td>0</td> </tr> </tbody> </table> <p>Note : Including pin holes and defective dots which must be within one pixel size; Total defective point shall not exceed 6 pcs no more than 8 inch LCD and 10PCS for more than 8 inch LCD.</p> <p>B) Unclear</p> <table border="1" data-bbox="395 857 1310 1279"> <thead> <tr> <th>Lcd size</th> <th>Size : d mm</th> <th>Acceptable Qty in active area</th> </tr> </thead> <tbody> <tr> <td rowspan="4">Lcd size <math>\leq 8.0'</math></td> <td><math>d \leq 0.2</math></td> <td>Disregard</td> </tr> <tr> <td><math>0.2 &lt; d \leq 0.5</math></td> <td>6</td> </tr> <tr> <td><math>0.5 &lt; d \leq 0.7</math></td> <td>2</td> </tr> <tr> <td><math>0.7 &lt; d</math></td> <td>0</td> </tr> <tr> <td rowspan="5">Lcd size <math>&gt; 8.0'</math></td> <td><math>d \leq 0.2</math></td> <td>Disregard</td> </tr> <tr> <td><math>0.2 &lt; d \leq 0.5</math></td> <td>10</td> </tr> <tr> <td><math>0.5 &lt; d \leq 0.7</math></td> <td>3</td> </tr> <tr> <td><math>0.7 &lt; d \leq 1.0</math></td> <td>1</td> </tr> <tr> <td><math>1.0 &lt; d</math></td> <td>0</td> </tr> </tbody> </table> <p>Note : Total defective point shall not exceed 6 pcs for no more than 8 inch LCD and 10PCS for more than 8 inch LCD.</p>	Lcd size	Size : d mm	Acceptable Qty in active area	Lcd size $\leq 8.0'$	$d \leq 0.1$	Disregard	$0.1 < d \leq 0.2$	6	$0.2 < d \leq 0.3$	2	$0.3 < d$	0	Lcd size $> 8.0'$	$d \leq 0.1$	Disregard	$0.1 < d \leq 0.3$	10	$0.3 < d \leq 0.5$	5	$0.5 < d$	0	Lcd size	Size : d mm	Acceptable Qty in active area	Lcd size $\leq 8.0'$	$d \leq 0.2$	Disregard	$0.2 < d \leq 0.5$	6	$0.5 < d \leq 0.7$	2	$0.7 < d$	0	Lcd size $> 8.0'$	$d \leq 0.2$	Disregard	$0.2 < d \leq 0.5$	10	$0.5 < d \leq 0.7$	3	$0.7 < d \leq 1.0$	1	$1.0 < d$	0	Minor
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2	Lines	<p>A) Clear</p>  <p>Note : ( ) - Acceptable Qty in active area  L - Length (mm)  W - Width (mm)  <math>\infty</math> - Disregard</p> <p>B) Unclear</p>  <p>'Clear' = The shade and size are not changed by <math>V_{op}</math>.  'Unclear' = The shade and size are changed by <math>V_{op}</math>.</p>	Minor																																												

3	Rubbing line	Not to be noticeable.	Minor
4	Allowable density	Above defects should be separated more than 10mm each other.	Minor
5	Rainbow	Not to be noticeable.	Minor
6	Dot size	To be 95% ~ 105% of the dot size (Typ.) in drawing. Partial defects of each dot (ex. pin-hole) should be treated as 'Spot'. (see <i>Screen Cosmetic Criteria (Operating) No.1</i> )	Minor
7	Uneven brightness (only back-lit type module)	<p>Uneven brightness must be <math>B_{MAX} / B_{MIN} \leq 2</math></p> <p>- <math>B_{MAX}</math> : Max. value by measure in 5 points - <math>B_{MIN}</math> : Min. value by measure in 5 points</p> <p>Divide active area into 4 vertically and horizontally. Measure 5 points shown in the following figure.</p>  <p>○ : Measuring points</p>	Minor

Note :

(1) Size :  $d = (\text{long length} + \text{short length}) / 2$

(2) The limit samples for each item have priority.

(3) Complex defects are defined item by item, but if the numbers of defects are defined in above table, the total number should not exceed 10.

(4) In case of 'concentration', even the spots or the lines of 'disregarded' size should not allowed. Following three situations should be treated as 'concentration'.

- 7 or over defects in circle of  $\varnothing 5\text{mm}$ .
- 10 or over defects in circle of  $\varnothing 10\text{mm}$ .
- 20 or over defects in circle of  $\varnothing 20\text{mm}$ .

## ■ PACKING SPECIFICATION

Please consult our technical department for detail information.