

# LIQUID CRYSTAL DISPLAY MODULE

## Product Specification

<b>PRODUCT NUMBER</b>	<b>LR2218</b>
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INTERNAL APPROVALS		
Product Manager	Engineering	Document Control

Product No.	LR2218	REV. A
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**REVISION RECORD**

<b>Rev.</b>	<b>Date</b>	<b>Page</b>	<b>Par.</b>	<b>Comment</b>	<b>ECN no.</b>
A	08/30/07	--	--	Initial DCA Release	E3564

## 1 MAIN FEATURES

ITEM	CONTENTS	UNIT
Outline Dimension	182.0 (W) x 33.6 (H) x 10.6 Max (D)	mm
Display Format	2 Line x 40 Characters	-
Character Font Format	5 (W) x 8 (H) with attached cursor	dots
Driving Method	1/16	duty
Dot Size	0.6 (W) x 0.65 (H)	mm
Dot Pitch	0.65 (W) x 0.70 (H)	mm
Character Size	3.2 (W) x 5.55 (H)	mm
Active Display Area	147.5 (W) x 11.5 (H)	mm
Viewing Area	152.2 (W) x 16.5 (H)	mm
Operating Temperature	-20 ~ 70	°C
Storage Temperature	-30 ~ 80	°C
RoHS Compliant	Yes	-



### 3 ABSOLUTE MAXIMUM RATINGS

V<sub>SS</sub>=0V, Ta=25°C

Item		Symbol	Min	Max	Unit
Logic Supply Voltage		V <sub>DD</sub> - V <sub>SS</sub>	0	7.0	V
LC Driver Supply Voltage		V <sub>DD</sub> - V <sub>O</sub>	0	10	V
Operating Temperature		T <sub>OP</sub>	-20	+70 (note 3.3)	°C
Storage Temperature (note 3.1)		T <sub>ST</sub>	-30	+80	
Humidity:	Operating (@40°C)	-	-	85%	RH (note 3.2)
	Non-operating (@40°C)	-	-	95%	

Note 3.1: Tested to 100 hrs.

Note 3.2: Refers to non-condensing conditions.

Note 3.3: It is not recommended to operate EL lamp above 50°C.

### 4 ELECTRICAL CHARACTERISTICS

V<sub>DD</sub> = 5 ± 0.25V, Ta=25°C

Item	Symbol	Test Condition	Min	Typ	Max	Unit
Input "High" Voltage	V <sub>IH</sub>	-	2.2	-	V <sub>DD</sub>	V
Input "Low" Voltage	V <sub>IL</sub>	-	-	-	0.6	V
Output "High" Voltage	V <sub>OH</sub>	I <sub>OH</sub> =0.205mA	2.4	-	-	V
Output "Low" Voltage	V <sub>OL</sub>	I <sub>OL</sub> =1.2mA	-	-	0.4	V
Power Supply Current	I <sub>DD</sub>	V <sub>DD</sub> =5.0V	-	3	-	mA

## 5 RECOMMENDED LC DRIVE VOLTAGE ( $V_{DD}$ - $V_O$ )

$$V_{DD} = 5 \pm 0.25V$$

Temperature	STN-H
Ta = -20°C	4.7
Ta = 0°C	4.7
Ta = 25°C	4.7
Ta = 50°C	4.6
Ta = 70°C	4.5

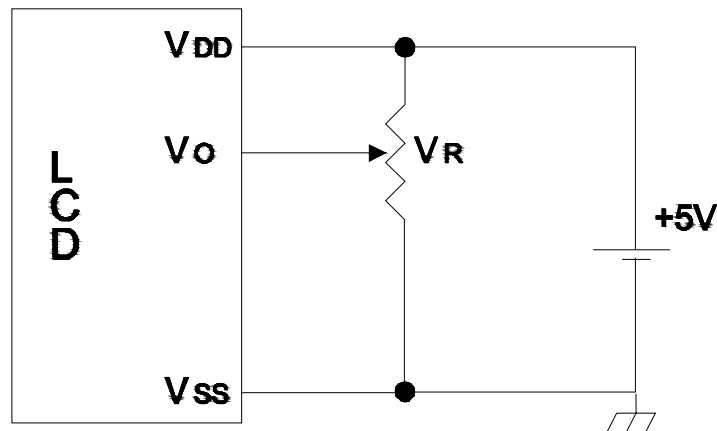
## 6 BACKLIGHT SPECIFICATIONS

Ta=20°C, 60% RH, Darkroom.

Item	Symbol	Typ	Max	Unit
EL Lamp Input Voltage	$V_{EL}$	100	150	Vrms
EL Lamp Input Current	$I_{EL}$	4.8	-	mA
EL Lamp Input Frequency	$F_{EL}$	400	800	Hz
Life to Half Initial Brightness	-	2500	3000	Hrs
Recommended Backlight Inverter	-	DAS5V7A	-	-

## 7 POWER SUPPLY

### •STN-H

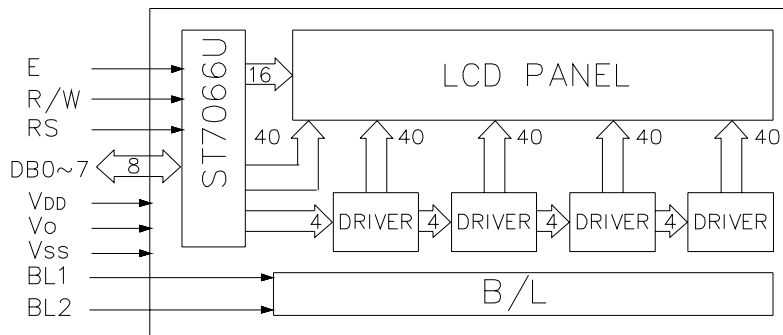


$V_R = 10K - 20K \text{ ohm}$

## 8 INTERFACE DESCRIPTION

Pin No.	Symbol	I/O	Function
1	V <sub>SS</sub>	-	Ground (0V)
2	V <sub>DD</sub>	-	Logic Supply Voltage (+5V)
3	V <sub>O</sub>	-	LC Drive voltage for contrast adjustment
4	RS	I	Register Select 0: Instruction Register 1: Data Register
5	R/W	I	Read / Write 0: Data Write (Module ← MPU) 1: Data Read (Module → MPU)
6	E	I	Enable Signal Active High (H → L)
7	DB0	I/O	Bi-directional data bus line 0
8	DB1	I/O	Bi-directional data bus line 1
9	DB2	I/O	Bi-directional data bus line 2
10	DB3	I/O	Bi-directional data bus line 3
11	DB4	I/O	Bi-directional data bus line 4
12	DB5	I/O	Bi-directional data bus line 5
13	DB6	I/O	Bi-directional data bus line 6
14	DB7	I/O	Bi-directional data bus line 7
15	N/C	-	No Connection
16	N/C	-	No Connection
BL1	V <sub>EL</sub>	-	EL backlight input voltage (from output of DC-AC inverter)
BL2	V <sub>EL</sub>	-	EL backlight input voltage (from output of DC-AC inverter)

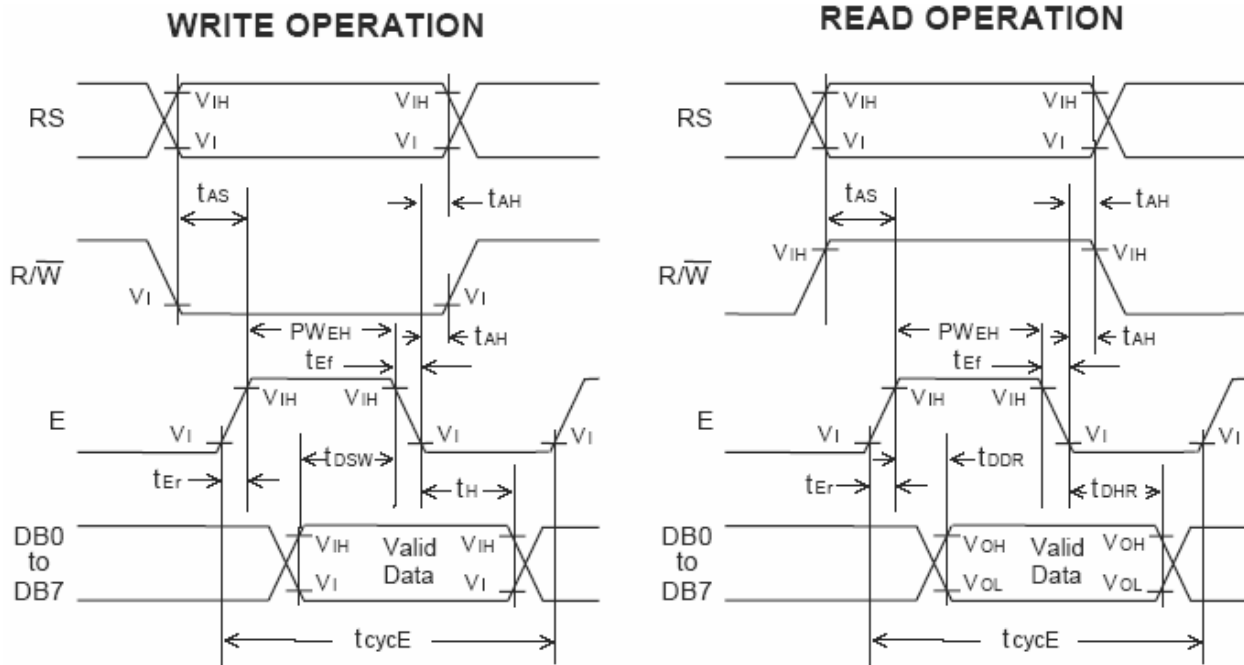
## 9 BLOCK DIAGRAM





## 10 TIMING CHARACTERISTICS

Item	Symbol	Min	Max	Unit
Enable cycle time	$T_{cycE}$	1.0	-	nS
Enable pulse width	$PW_{EH}$	450	-	nS
Enable rise / fall time	$t_{Er} / t_{Ef}$	-	25	nS
Address set-up time	$t_{AS}$	140	-	nS
Address hold time	$t_{AH}$	10	-	nS
Data delay time	$t_{DDR}$	-	320	nS
Data hold time (write)	$t_{DHW}$	10	-	nS
Data hold time (read)	$t_{DHR}$	20	-	nS
Data set-up time	$t_{DSW}$	195	-	nS



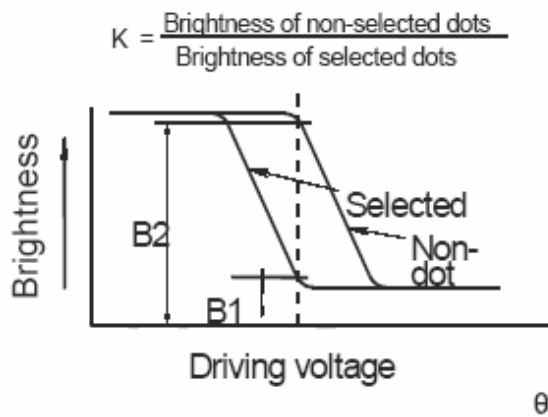
## 11 DD RAM ADDRESS vs. DISPLAY POSITION

Character	1	2	3	4	5	6	7	8	9	10	11	---	38	39	40
Line 1	00	01	02	03	04	05	06	07	08	09	0A	---	25	26	27
Line 2	40	41	42	43	44	45	46	47	48	49	4A	---	65	66	67

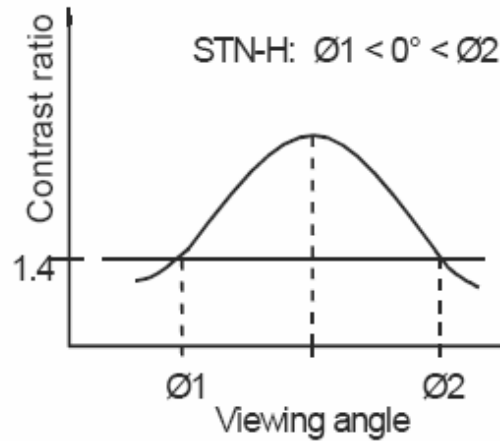
## 12 OPTICAL CHARACTERISTICS

Item	Symbol	Test Condition	Min	Typ	Max	Unit
Contrast ratio STN-H	K	$\theta=20^\circ$ $\Theta=0^\circ$	4	-	-	-
Viewing angle STN-H	$\theta_2$ - $\theta_1$	$\Theta=0^\circ$ $K \geq 1.4$	40	-	-	Deg
	$\theta$	$\theta=20^\circ$ $K=1.4$	$\pm 30$	-	-	
Response time	Rise	$\theta=20^\circ$ $\Theta=0^\circ$	-	150	250	mS
	Fall		-	150	250	

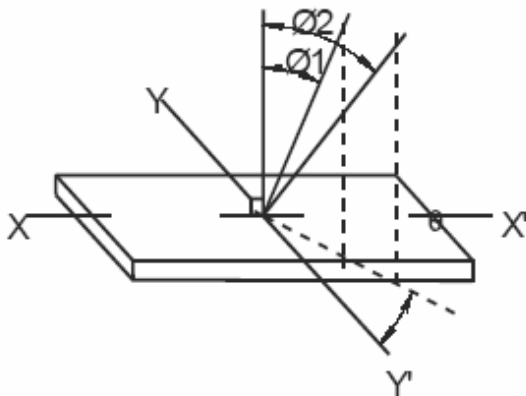
### DEFINITION OF CONTRAST RATIO



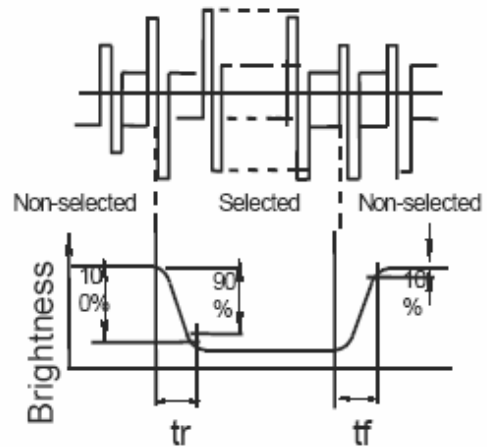
### CONTRAST VERSUS VIEWING



### DEFINITION OF ANGLES $\theta$ AND $\theta$



### DEFINITION OF OPTICAL RESPONSE



## 13 PART NUMBER DESCRIPTION

# LR2218①②2C40③④⑤

①

### **Polarizer Type**

A = Reflective: light background, no backlight

B = Transflective: light background with EL backlight

②

**Not applicable- LEAVE BLANK**

③

### **Fluid Type and Power Supply**

S =STN with +5VDC operation

H =STN with extended temperature ±5VDC operation

W = STN-H fluid with +5VDC operation (on-board negative voltage generation)

④

### **Fluid Type**

C = STN, STN-H with on-board temperature compensation circuitry

N = STN-H

⑤

### **Background Color for STN**

G = Gray background

Y = Yellow background

## 14 QUALITY ASSURANCE SPECIFICATION

### 14.1 CONFORMITY

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The performance, function and reliability of the shipped products conform to the Product Specification.

### 14.2 DELIVERY ASSURANCE

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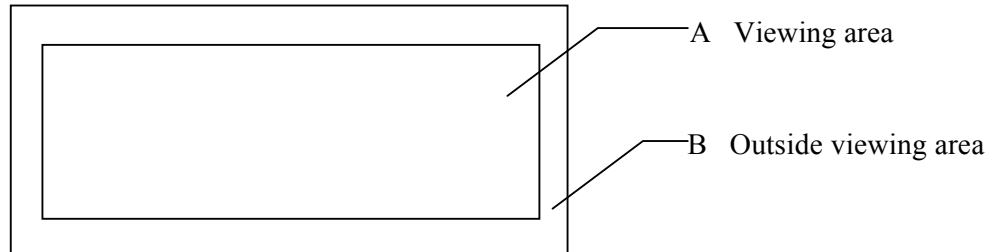
#### 5.2.1 Delivery inspection standards

- IPC-AA610, class 2 electronic assemblies standard

The quality assurance levels are shown below:

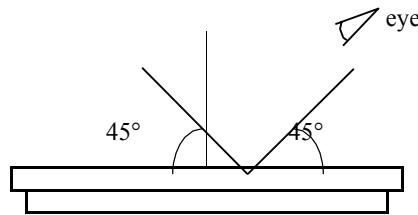
Rank	Item Inspected	Defect type	AQL	Remark
Major defect	Display	Non display	0.25%	Fit/Function defect
		Over current		
		Missing segment		
		Wrong viewing direction		
		Incorrect operating		
		Backlight OFF		
	Backlight flashing			
Dimension	PCB and bezel out of specification			
Minor defect	LCD	Black and white spot	1.0%	Appearance defect
		Black and white lines		
		Polariser scratch		
		Bubbles in polariser		
		Segment deformation, pin hole		
		Colour uniformity		
	COB	Glass chip		
		Wire bond pad exposed		
		Insufficient covering with resin (wire bond line exposed)		
	PCB	Bubble, dust on COB		
		Dust, solder ball on PCB		
Tray	Pad scratch			
	Particles	Every tray		
Total			1.0%	

### 5.2.2 Zone definition



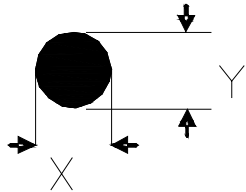
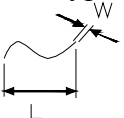
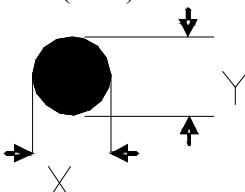
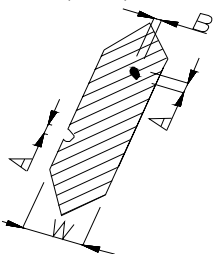
### 5.2.3 Visual inspection

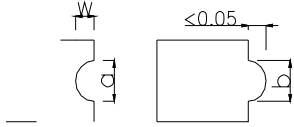
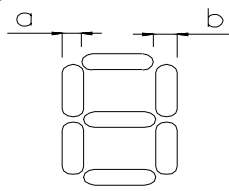
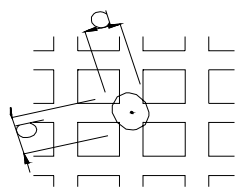
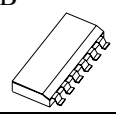
- Inspect under 2x20W or 40W fluorescent lamp (approximately 3000 lux) leaving 25 to 30 cm between the module and the lamp and 30 cm between the module and the eye (measuring position).
- Appearance is inspected at the best contrast voltage (best contrast is adjusted considering clearness and crosstalk on screen).
- Inspect the module at 45° right and left, top and bottom.
- Use the optimum viewing angle during the contrast inspection.



### 5.2.3.1 Standard of appearance inspection

units: mm

No.	Item	Criteria																																			
1	Black spot, White spot, dust	<p>Round type: as per following drawing  <math>\Phi = (X+Y)/2</math></p>  <table border="1"> <thead> <tr> <th colspan="3">Acceptable quantity</th> </tr> <tr> <th>size</th> <th>Zone A</th> <th>Zone B</th> </tr> </thead> <tbody> <tr> <td><math>\Phi &lt; 0.1</math></td> <td>Any number</td> <td rowspan="4">Any number</td> </tr> <tr> <td><math>0.1 &lt; \Phi &lt; 0.2</math></td> <td>2</td> </tr> <tr> <td><math>0.2 &lt; \Phi &lt; 0.25</math></td> <td>1</td> </tr> <tr> <td><math>0.25 &lt; \Phi</math></td> <td>0</td> </tr> </tbody> </table> <p>Line type: as per following drawing</p>  <table border="1"> <thead> <tr> <th colspan="4">Acceptable quantity</th> </tr> <tr> <th>Length</th> <th>Width</th> <th>Zone A</th> <th>Zone B</th> </tr> </thead> <tbody> <tr> <td>-</td> <td><math>W \leq 0.02</math></td> <td rowspan="2">Any number</td> <td rowspan="4">Any number</td> </tr> <tr> <td><math>L \leq 3.0</math></td> <td><math>0.02 &lt; W \leq 0.03</math></td> </tr> <tr> <td><math>L \leq 2.5</math></td> <td><math>0.03 &lt; W \leq 0.05</math></td> <td>2</td> </tr> <tr> <td>-</td> <td><math>0.05 &lt; W</math></td> <td>as round type</td> </tr> </tbody> </table> <p>Total acceptable quantity: 3</p>	Acceptable quantity			size	Zone A	Zone B	$\Phi < 0.1$	Any number	Any number	$0.1 < \Phi < 0.2$	2	$0.2 < \Phi < 0.25$	1	$0.25 < \Phi$	0	Acceptable quantity				Length	Width	Zone A	Zone B	-	$W \leq 0.02$	Any number	Any number	$L \leq 3.0$	$0.02 < W \leq 0.03$	$L \leq 2.5$	$0.03 < W \leq 0.05$	2	-	$0.05 < W$	as round type
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-	$0.05 < W$	as round type																																			
2	Polariser scratch	<p>Scratch on protective film is permitted  Scratch on polariser: same as No. 1</p>																																			
3	Polariser bubble	<p><math>\Phi = (X+Y)/2</math></p>  <table border="1"> <thead> <tr> <th colspan="3">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th>Zone A</th> <th>Zone B</th> </tr> </thead> <tbody> <tr> <td><math>\Phi &lt; 0.2</math></td> <td>Any number</td> <td rowspan="4">Any number</td> </tr> <tr> <td><math>0.2 &lt; \Phi &lt; 0.5</math></td> <td>2</td> </tr> <tr> <td><math>0.5 &lt; \Phi &lt; 1.0</math></td> <td>1</td> </tr> <tr> <td><math>1.0 &lt; \Phi</math></td> <td>0</td> </tr> </tbody> </table> <p>Total acceptable quantity: 3</p>	Acceptable quantity			Size	Zone A	Zone B	$\Phi < 0.2$	Any number	Any number	$0.2 < \Phi < 0.5$	2	$0.5 < \Phi < 1.0$	1	$1.0 < \Phi$	0																				
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4	Segment deformation	<p>1.a. Pin hole on segmented display</p> <p>W: segment width  <math>\Phi = (A+B)/2</math></p>  <table border="1"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Width</th> <th><math>\Phi</math></th> </tr> </thead> <tbody> <tr> <td><math>W \leq 0.4</math></td> <td><math>\Phi \leq 0.2</math> and <math>\Phi \leq 1/2W</math></td> </tr> <tr> <td><math>W &gt; 0.4</math></td> <td><math>\Phi \leq 0.25</math> and <math>\Phi \leq 1/3W</math></td> </tr> </tbody> </table> <p>Total acceptable quantity: 1 defect per segment  Pin holes with <math>\Phi</math> under 0.10 mm are acceptable.</p>	Acceptable quantity		Width	$\Phi$	$W \leq 0.4$	$\Phi \leq 0.2$ and $\Phi \leq 1/2W$	$W > 0.4$	$\Phi \leq 0.25$ and $\Phi \leq 1/3W$																											
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No.	Item	Criteria																												
5	Black spot, White spot, dust	<p>1b. Pin hole on dot matrix display</p>  <table border="1"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th></th> </tr> </thead> <tbody> <tr> <td>a, b &lt; 0.1</td> <td>Any number</td> </tr> <tr> <td><math>(a+b)/2 \le 0.1</math></td> <td>Any number</td> </tr> <tr> <td><math>0.5 &lt; \Phi &lt; 1.0</math></td> <td>3</td> </tr> </tbody> </table> <p>2. Segments / dots with different width</p>  <table border="1"> <thead> <tr> <th colspan="2">Acceptable</th> </tr> <tr> <th>a &gt; b</th> <th>a/b ≤ 4/3</th> </tr> <tr> <th>a &lt; b</th> <th>a/b &gt; 4/3</th> </tr> </thead> </table> <p>3. Alignment layer defect <math>\Phi = (a+b)/2</math></p>  <table border="1"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th></th> </tr> </thead> <tbody> <tr> <td><math>\Phi \le 0.4</math></td> <td>Any number</td> </tr> <tr> <td><math>0.4 &lt; \Phi \le 1.0</math></td> <td>5</td> </tr> <tr> <td><math>1.0 &lt; \Phi \le 1.5</math></td> <td>3</td> </tr> <tr> <td><math>1.5 &lt; \Phi \le 2.0</math></td> <td>2</td> </tr> </tbody> </table>	Acceptable quantity		Size		a, b < 0.1	Any number	$(a+b)/2 \le 0.1$	Any number	$0.5 < \Phi < 1.0$	3	Acceptable		a > b	a/b ≤ 4/3	a < b	a/b > 4/3	Acceptable quantity		Size		$\Phi \le 0.4$	Any number	$0.4 < \Phi \le 1.0$	5	$1.0 < \Phi \le 1.5$	3	$1.5 < \Phi \le 2.0$	2
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6	Colour uniformity	Level of sample for approval set as limit sample																												
7	Backlight	The backlight colour should correspond to the product specification Flashing and or unlit backlight is not allowed Dust larger than 0.25 mm is not allowed																												
8	COB	Exposed wire bond pad is not allowed Insufficient covering with resin is not allowed (wire bond line exposed) Dust or bubble on the resin are not allowed																												
9	PCB 	No unmelted solder paste should be present on PCB Cold solder joints, missing solder connections, or oxidation are not allowed No residue or solder balls on PCB are allowed Short circuits on components are not allowed																												
10	Tray particles	<table border="1"> <thead> <tr> <th></th> <th>Size</th> <th>Quantity</th> </tr> </thead> <tbody> <tr> <td rowspan="2">On tray</td> <td><math>\Phi &lt; 0.2</math></td> <td>Any number</td> </tr> <tr> <td><math>\Phi &gt; 0.25</math></td> <td>4</td> </tr> <tr> <td rowspan="2">On display</td> <td><math>\Phi \ge 0.25</math></td> <td>2</td> </tr> <tr> <td>L = 3</td> <td>1</td> </tr> </tbody> </table>		Size	Quantity	On tray	$\Phi < 0.2$	Any number	$\Phi > 0.25$	4	On display	$\Phi \ge 0.25$	2	L = 3	1															
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On display	$\Phi \ge 0.25$	2																												
	L = 3	1																												

## 15 HANDLING PRECAUTIONS

### *Safety*

If the LCD panel breaks, be careful not to get the liquid crystal fluid in your mouth or in your eyes. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and plenty of water.

### *Mounting and Design*

Place a transparent plate (e.g. acrylic, polycarbonate or glass) on the display surface to protect the display from external pressure. Leave a small gap between the transparent plate and the display surface.

When assembling with a zebra connector, clean the surface of the pads with alcohol and keep the surrounding air very clean. Design the system so that no input signal is given unless the power supply voltage is applied.

### *Caution during LCD cleaning*

Lightly wipe the display surface with a soft cloth soaked with Isopropyl alcohol, Ethyl alcohol or Trichlorotrifluoroethane. Do not wipe the display surface with dry or hard materials that will damage the polariser surface. Do not use aromatic solvents (toluene and xylene), or ketonic solvents (ketone and acetone).

### *Caution against static charge*

As the display uses C-MOS LSI drivers, connect any unused input terminal to VDD or VSS. Do not input any signals before power is turned on. Also, ground your body, work/assembly table and assembly equipment to protect against static electricity.

### *Packaging*

Displays use LCD elements, and must be treated as such. Avoid strong shock and drop from a height. To prevent displays from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity.

### *Caution during operation*

It is indispensable to drive the display within the specified voltage limit since excessive voltage shortens its life. Direct current causes an electrochemical reaction with remarkable deterioration of the display quality. Give careful consideration to prevent direct current during ON/OFF timing and during operation. Response time is extremely delayed at temperatures lower than the operating temperature range while, at high temperatures, displays become dark. However, this phenomenon is reversible and does not mean a malfunction or a display that has been permanently damaged. If the display area is pushed on hard during operation, some graphics will be abnormally displayed but returns to a normal condition after turning off the display once. Even a small amount of condensation on the contact pads (terminals) can cause an electro-chemical reaction which causes missing rows and columns. Give careful attention to avoid condensation.

### *Storage*

Store the display in a dark place where the temperature is  $25^{\circ}\text{C} \pm 10^{\circ}\text{C}$  and the humidity below 50%RH. Store the display in a clean environment, free from dust, organic solvents and corrosive gases. Do not crash, shake or jolt the display (including accessories).

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