

# LIQUID CRYSTAL DISPLAY MODULE

## Standard Product Specification

<b>PRODUCT NUMBER</b>	<b>LMR42315</b>
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Product Mgr	Engineering	Document Control

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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	08/31/06	--	--	Initial DCA Release, ROHS	E3231
B	10/04/07	7	3.2	Current consumption was changed	E3580
C	08/06/09	14,15	--	B/L spec updated	E4152
D	01/03/11	15	--	B/L LED lamp supplier change, Brightness changed	E4565
E	01/28/15	9	5	Change in LED B/L Brightness; from 180 cd/m <sup>2</sup> Typ. to 550 cd/m <sup>2</sup> Typ.	E5061

## 1 MAIN FEATURES

ITEM	CONTENTS	UNIT
Display Format	240 x 128	dots
Color	Monochrome	--
Overall Dimensions	144.0 (W) x 104.0 (H) x 13.6 Max. (D) without Negative Voltage and Temperature Compensation (NVTC) 144.0 (W) x 104.0 (H) x 16.4 Max. (D) with Negative Voltage and Temperature Compensation (NVTC)	mm
Viewing Area	114.0 (W) x 64.0 (H)	mm
Active Area	107.95 (W) x 57.55 (H)	mm
LCD Type	Reference Section 11, Page 20 – Part Number Description.	
Mode		
Viewing Angle	6	O'clock
Duty Ratio	1/128	duty
Bias	1/9	bias
Driver IC / Controller	Neotek NT7086 / Toshiba T6963	--
Backlight Type / Color	Edge LED / White	--
DC/DC Converter	Optional	--
Operating Temperature (Normal/Wide)	0 ~ +50 / -20 ~ +70	°C
Storage Temperature (Normal/Wide)	-20 ~ +70 / -30 ~ +80	°C
RoHS Compliant	Yes	--

Note:

1. The background color changes slightly depending on ambient temperature. This phenomenon is reversible. Ta ≤ 70°C: 75% RH max.
2. Ta ≤ 80°C: 75% RH max.



**3 ABSOLUTE MAXIMUM RATINGS**

$V_{SS}=0V, T_a=25^{\circ}C$

Item	Symbol	Condition	Min	Max	Unit
Power Supply Voltage	$V_{DD}$	$T_a = 25^{\circ}C, 50\pm 10\%RH$	0	7	V
Operating Temperature	$T_{OP}$	< 65% (Normal Temp.)	0	50	$^{\circ}C$
		< 65% (Wide Temp.)	-20	70	$^{\circ}C$
Storage Temperature	$T_{ST}$	< 65% (Normal Temp.)	-20	70	$^{\circ}C$
		< 65% (Wide Temp.)	-30	80	$^{\circ}C$
		< 48 hrs	20	90	%RH
		< 1000 hrs	20	65	%RH

## 4 ELECTRICAL CHARACTERISTICS

### 4.1 DC CHARACTERISTICS

$V_{SS}=0V, T_a=25^{\circ}C$

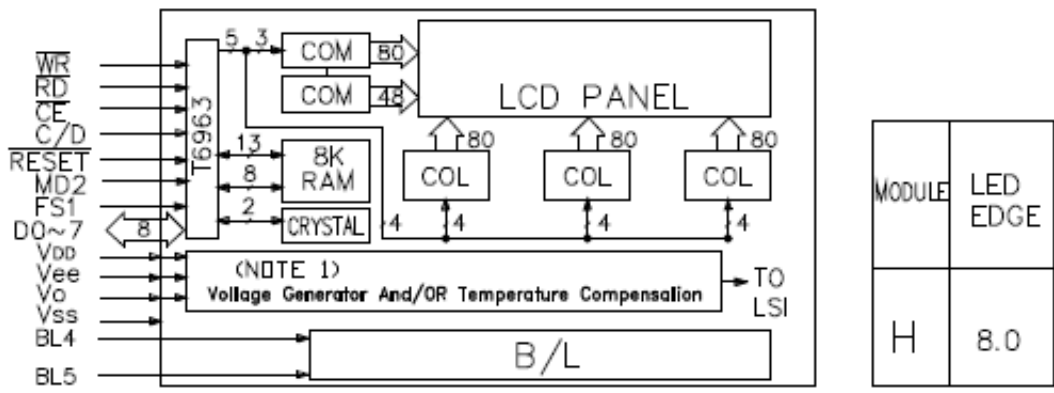
Item	Symbol	Min	Typ	Max	Unit
Operating Voltage	$V_{DD}$	4.75	--	5.25	V
Input Voltage	$V_{IH}$	$V_{DD}-2.2$	--	$V_{DD}$	V
	$V_{IL}$	0	--	0.8	V
LCD Driving Voltage	$V_{DD}-V_0$	8	--	28	V
Current Consumption	$I_{DD}$	--	12	--	mA
	$I_{EE}$	--	5	--	mA

### 4.2 RECOMMENDED LCD DRIVING VOLTAGE

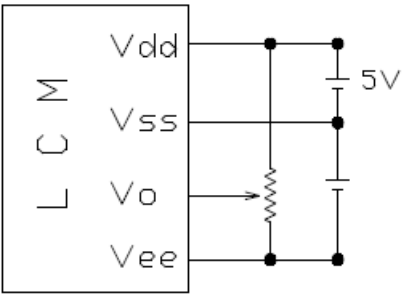
	Temperature	FSTN Temperature		STN Temperature	
		Normal	Wide	Normal	Wide
LCD Driving Voltage	$T_a = -20^{\circ}C$	N/A	16.8	N/A	16.0
	$T_a = 0^{\circ}C$	16.3	16.3	15.8	15.8
	$T_a = 25^{\circ}C$	16.1	16.1	15.6	15.6
	$T_a = 50^{\circ}C$	15.7	15.7	15.2	15.2
	$T_a = 70^{\circ}C$	N/A	15.1	N/A	14.8

- The  $I_{DD}$  is 65mA (max) if NV or NVTC is built in.
- When LCM has built in NVTC circuit, the driving voltage is for reference. The temperature compensation circuit will adjust the driving voltage automatically.
- Tolerance for the driving voltage is  $\pm 0.6V$ .

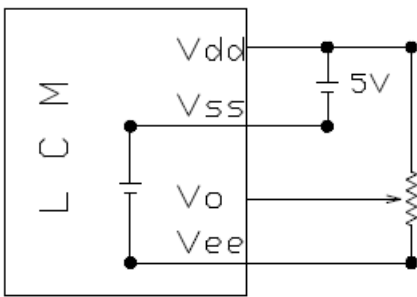
**4.3 BLOCK DIAGRAM**



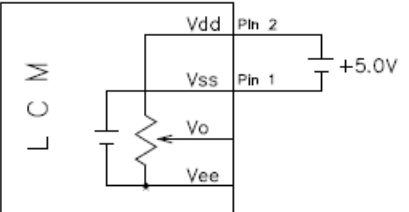
**4.4 POWER SUPPLY CIRCUIT**



Negative Voltage Not Built-in



Negative Voltage Built-in



Negative Voltage and Temperature Compensation Built-in

Recommended  $V_R$ : 10K ohm ~ 20 K ohm



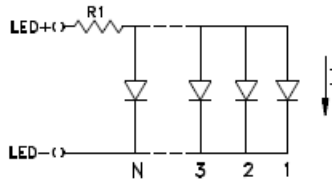
## 5 BACKLIGHT CHARACTERISTICS

Edge LED (White)

Item	Conditions	Standard			Unit
		Min.	Typ.	Max.	
Input Voltage	Ta=25°C	--	5	--	V (DC)
Current Consumption	Ta=25°C		140		mA
Average Brightness (B/L only) (Ta=25°C, IL=140mA)	Test when connecting after 3 min. Ta=25°C (max contrast)				
	White B/L	450	550	--	cd/m <sup>2</sup> (Note 2)
Brightness Uniformity	Ta=25°C, IL=140 mA	80	--	--	% (Note 3)
Lamp Life	Ta=25°C, IL=140 mA Humidity: 30%RH - 85%RH	--	40,000	--	Hrs (Note 4)
Operating Temperature	Humidity: 30%RH - 85%RH	-20	--	70	°C
Storage Temperature	Humidity: 30%RH - 85%RH	-30	--	80	°C

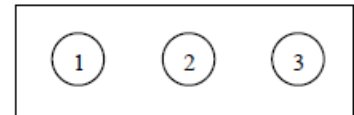
Note:

1. The limit resistor of LED B/L is built into the LED board.



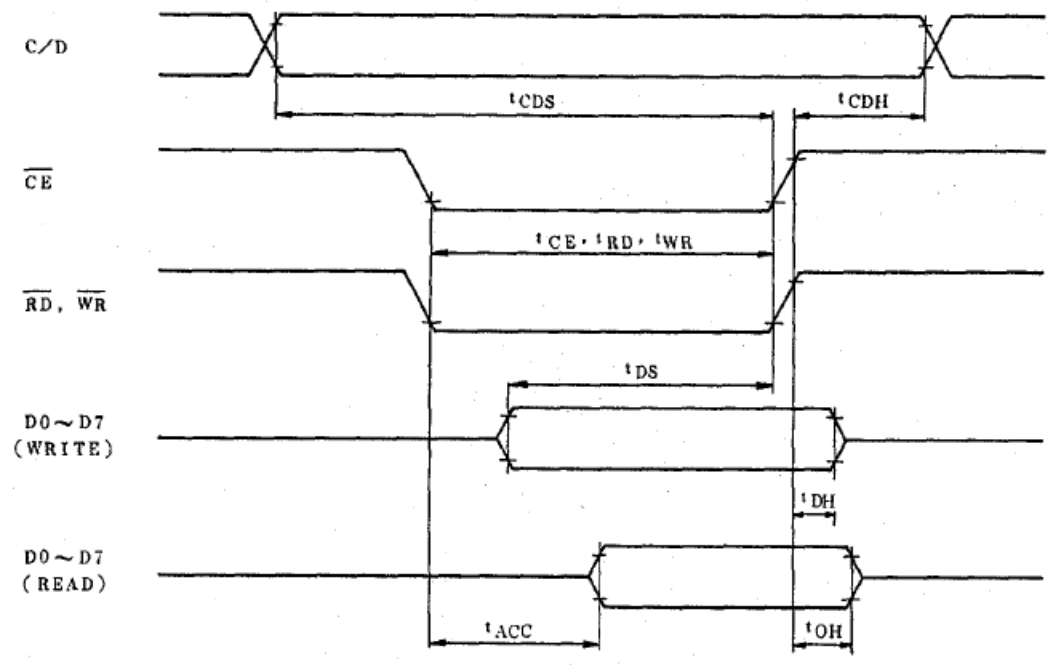
$$N = 7, I = 20 \text{ mA}$$

2. Average brightness of 3 points when B/L is used at the beginning.
3. Brightness uniformity = (MIN/MAX) x 100%
4. Half of the original average brightness



6 TIMING CHARACTERISTICS

Bus Timing



Unless otherwise specified, VDD=5.0V±10%, VSS=0V, Ta=-10~70°C

ITEM	SYMBOL	TEST CONDITION	MIN.	MAX.	UNIT
C/D Set Up Time	tCDS		100	-	ns
C/D Hold Time	tCDH		10	-	ns
CE, RD, WR Pulse Width	tCE, tRD, tWR		80	-	ns
Data Set Up Time	tDS		80	-	ns
Data Hold Time	tDH		40	-	ns
Access Time	tACC		-	150	ns
Output Hold Time	tOH		10	50	ns

6.1 CHARACTER FONT

F	/	2	0	1	0		8	9
E	.	>	N	<	M	:	8	9
D	—	=	M	U	W	Y	8	9
C	.	>	L	/	T	—	8	9
B	+	*	X	L	K	Y	8	9
A	*	=	J	N	J	N	8	9
9	>	8	H	Y	H	8	9	0
8	>	8	H	X	M	X	8	9
7	.	7	G	M	8	8	9	0
6	8	8	E	4	U	8	9	0
5	>	5	E	U	8	8	9	0
4	#	4	H	P	4	8	9	0
3	#	3	C	8	8	8	9	0
2	U	2	B	8	8	8	9	0
1	U	1	H	8	8	8	9	0
0		0	8	8	8	8	9	0
LSB MSB	0	1	2	3	4	5	6	7

## 7 INTERFACE PIN ASSIGNMENT

Pin No.	Symbol	Level	Function
1	V <sub>SS</sub> /LED(-)	--	Power Supply (0V, GND) / Cathode of LED B/L
2	V <sub>DD</sub>	--	Power supply for logic circuit
3	V <sub>o</sub>	--	Voltage Level for LCD contrast adjustment
4	C/D	H/L	WRITE MODE H: Command Write L: Data Write READ MODE H: Status Read L: Data Read
5	/RD	L	Data and Status Read Signal
6	/WR	L	Command and Data Write Signal
7-14	D0-D8	H/L	Display Data 0-8
15	/CE	L	Chip Enable Signal
16	/RESET	L	Reset Signal
17	V <sub>EE</sub>	--	Power Supply for LCD Drive
18	MD2	--	Terminals for selection of Columns
19	FS1	--	Terminals for selection of font **
20	LED (+)	H	Anode of LED B/L
BL4	LED (+)	H	Anode of LED B/L
BL5	LED (-)	L	Cathode of LED B/L

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MD2	H	L	FS1	H	L
Columns	32	40	Font	6X8	8X8

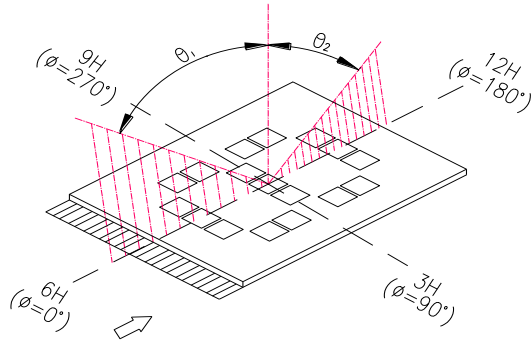
**8 OPTICAL CHARACTERISTICS**

Ta = 25 °C

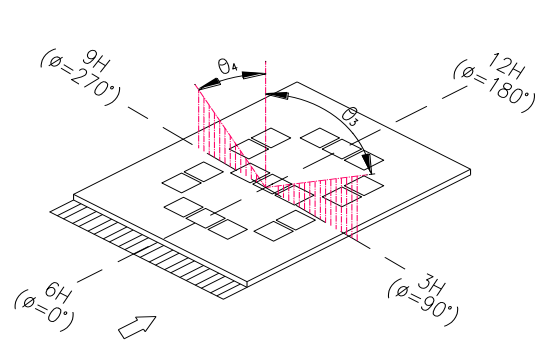
Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Viewing Angle	θ1 (down)	CR ≥ 2	--	30	--	deg	1
	θ2 (up)		--	20	--	deg	1
	θ3 (right)		--	30	--	deg	2
	θ4 (left)		--	30	--	deg	2
Contrast Ratio	CR	Ta = 25°C	3	5	--	-	3
Response Time	Tr		--	300	--	ms	4
	Tf		--	300	--		
Driving Method	Duty	1/128					
	Bias	1/9					
Viewing Direction	6 o'clock						

Note:

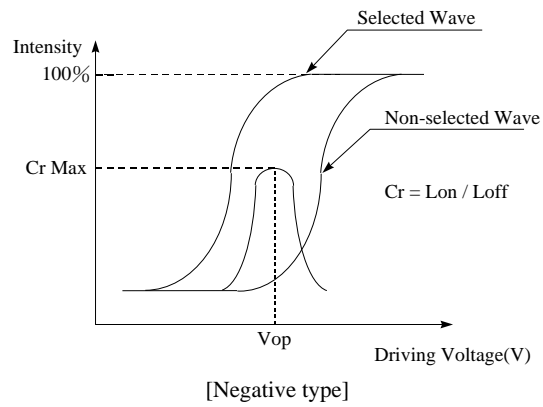
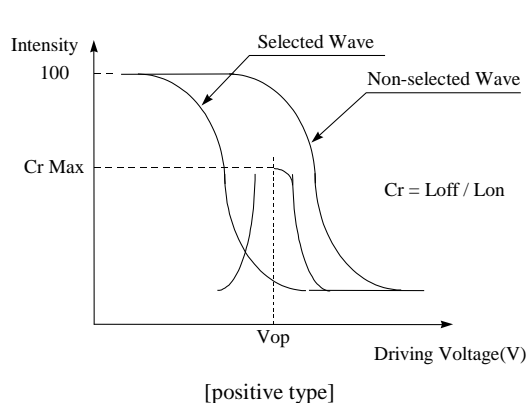
## 1. Definition of Viewing Angle $\theta_1$ & $\theta_2$



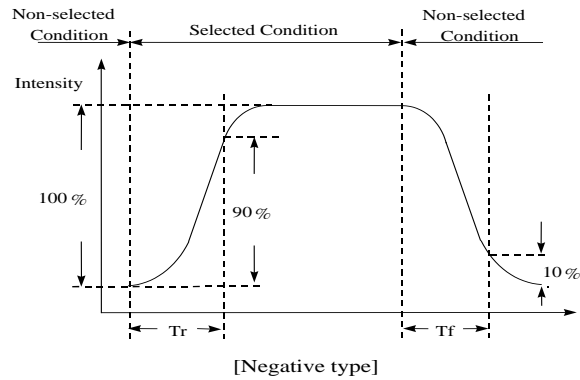
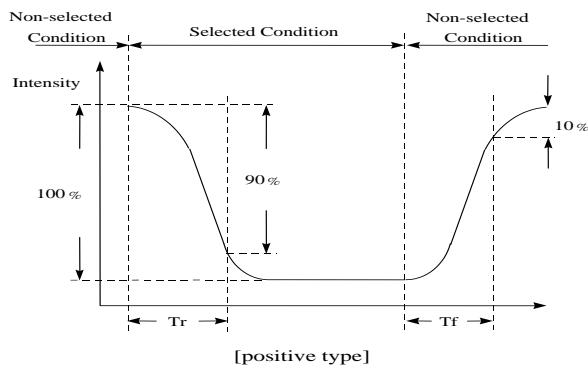
## 2. Definition of Viewing Angle $\theta_3$ & $\theta_4$



## 3. Definition of Contrast Ratio (CR)



## 4. Definition of Response Time



## 9 QUALITY ASSURANCE SPECIFICATION

### 9.1 CONFORMITY

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

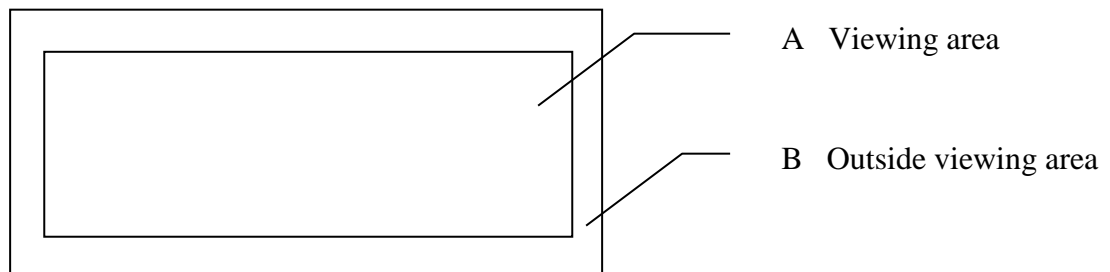
### 9.2 DELIVERY ASSURANCE

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#### 9.2.1 Delivery Inspection Standards

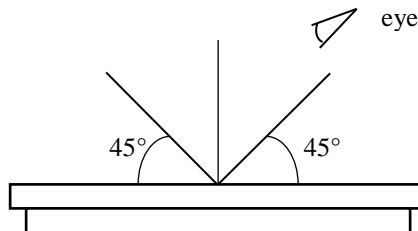
- IPC-AA610, class 2 electronic assemblies standard

#### 9.2.2 Zone definition



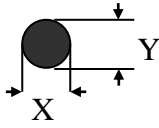
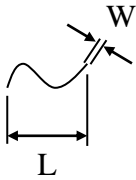
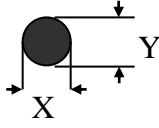
#### 9.2.3 Visual Inspection

- 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.

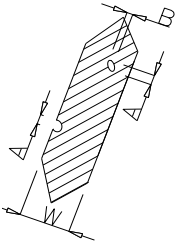
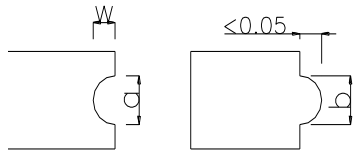
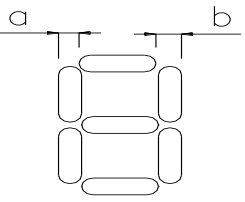
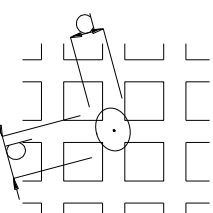


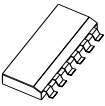
### 9.2.3.1 Standard of Appearance Inspection

Units: mm

Class	Item	Criteria																																			
Minor	Packing & Label	Outside & inside package																																			
Critical		Presence of product no., lot no., quantity																																			
		Product must not be mixed with others and quantity must not be different from that indicated on the label																																			
Major	Dimension	Product dimensions must be according to specification and drawing																																			
Major	Electrical	Product electrical characteristics must be according to specification																																			
Critical	LCD Display	Missing lines or wrong patterns on LCD display are not allowed																																			
Minor	Black spot, white spot, dust	<p>Round type: as per following drawing  <math>\varnothing = (X+Y)/2</math></p>  <table border="1" style="margin-left: 200px;"> <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>\varnothing &lt; 0.1</math></td> <td>Any number</td> <td rowspan="4">Any number</td> </tr> <tr> <td><math>0.1 &lt; \varnothing &lt; 0.2</math></td> <td>2</td> </tr> <tr> <td><math>0.2 &lt; \varnothing &lt; 0.25</math></td> <td>1</td> </tr> <tr> <td><math>0.25 &lt; \varnothing</math></td> <td>0</td> </tr> </tbody> </table> <p>Line type: as per following drawing</p>  <table border="1" style="margin-left: 200px;"> <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>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> <td rowspan="2">2</td> </tr> <tr> <td><math>L \leq 2.5</math></td> <td><math>0.03 &lt; W \leq 0.05</math></td> </tr> <tr> <td>--</td> <td><math>0.05 &lt; W</math></td> <td>As round type</td> </tr> </tbody> </table> <p style="text-align: center;">Total acceptable quantity: 3</p>	Acceptable quantity			Size	Zone A	Zone B	$\varnothing < 0.1$	Any number	Any number	$0.1 < \varnothing < 0.2$	2	$0.2 < \varnothing < 0.25$	1	$0.25 < \varnothing$	0	Acceptable quantity				Length	Width	Zone A	Zone B	--	$W \leq 0.02$	Any number	Any number	$L \leq 3.0$	$0.02 < W \leq 0.03$	2	$L \leq 2.5$	$0.03 < W \leq 0.05$	--	$0.05 < W$	As round type
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$L \leq 2.5$	$0.03 < W \leq 0.05$																																				
--	$0.05 < W$	As round type																																			
Minor	Polariser scratch	Scratch on protective film is permitted Scratch on polariser: same as No. 1																																			
Minor	Polariser bubble	<p><math>\varnothing = (X+Y)/2</math></p>  <table border="1" style="margin-left: 200px;"> <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>\varnothing &lt; 0.2</math></td> <td>Any number</td> <td rowspan="4">Any number</td> </tr> <tr> <td><math>0.2 &lt; \varnothing &lt; 0.5</math></td> <td>2</td> </tr> <tr> <td><math>0.5 &lt; \varnothing &lt; 1.0</math></td> <td>1</td> </tr> <tr> <td><math>1.0 &lt; \varnothing</math></td> <td>0</td> </tr> </tbody> </table> <p style="text-align: center;">Total acceptable quantity: 3</p>	Acceptable quantity			Size	Zone A	Zone B	$\varnothing < 0.2$	Any number	Any number	$0.2 < \varnothing < 0.5$	2	$0.5 < \varnothing < 1.0$	1	$1.0 < \varnothing$	0																				
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$0.5 < \varnothing < 1.0$	1																																				
$1.0 < \varnothing$	0																																				



Class	Item	Criteria																												
Minor	Segment deformation	<p>1.a. Pin hole on segmented display</p> <p>W: segment width  <math>\varnothing = (A+B)/2</math></p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Width</th> <th><math>\varnothing</math></th> </tr> </thead> <tbody> <tr> <td><math>W \leq 0.4</math></td> <td><math>\varnothing \leq 0.2</math> and <math>\varnothing \leq 1/2W</math></td> </tr> <tr> <td><math>W &gt; 0.4</math></td> <td><math>\varnothing \leq 0.25</math> and <math>\varnothing \leq 1/3W</math></td> </tr> </tbody> </table> <p>Total acceptable quantity: 1 defect per segment  Pin holes with <math>\varnothing</math> under 0.10 mm are acceptable</p>	Acceptable quantity		Width	$\varnothing$	$W \leq 0.4$	$\varnothing \leq 0.2$ and $\varnothing \leq 1/2W$	$W > 0.4$	$\varnothing \leq 0.25$ and $\varnothing \leq 1/3W$																				
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$W \leq 0.4$	$\varnothing \leq 0.2$ and $\varnothing \leq 1/2W$																													
$W > 0.4$	$\varnothing \leq 0.25$ and $\varnothing \leq 1/3W$																													
Minor	Segment deformation	<p>1b. Pin hole on dot matrix display</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <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 \leq 0.1</math></td> <td>Any number</td> </tr> <tr> <td><math>0.5 &lt; \varnothing &lt; 1.0</math></td> <td>3</td> </tr> </tbody> </table> <p>Total acceptable quantity: 7</p> <p>2. Segments / dots with different width</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">Acceptable</th> </tr> <tr> <th>a ≥ 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</p> <p><math>\varnothing = (a+b)/2</math></p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th></th> </tr> </thead> <tbody> <tr> <td><math>\varnothing \leq 0.4</math></td> <td>Any number</td> </tr> <tr> <td><math>0.4 &lt; \varnothing \leq 1.0</math></td> <td>5</td> </tr> <tr> <td><math>1.0 &lt; \varnothing \leq 1.5</math></td> <td>3</td> </tr> <tr> <td><math>1.5 &lt; \varnothing \leq 2.0</math></td> <td>2</td> </tr> </tbody> </table> <p>Total acceptable quantity: 7</p>	Acceptable quantity		Size		a, b < 0.1	Any number	$(a+b)/2 \leq 0.1$	Any number	$0.5 < \varnothing < 1.0$	3	Acceptable		a ≥ b	a/b ≤ 4/3	a < b	a/b > 4/3	Acceptable quantity		Size		$\varnothing \leq 0.4$	Any number	$0.4 < \varnothing \leq 1.0$	5	$1.0 < \varnothing \leq 1.5$	3	$1.5 < \varnothing \leq 2.0$	2
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Minor	Colour uniformity	Level of sample for approval set as limit sample																												
Critical	Backlight	The backlight colour should correspond to the product specification																												
Critical		Flashing and or unlit backlight is not allowed																												
Minor		Dust larger than 0.25 mm is not allowed																												
Major	COB	Exposed wire bond pad is not allowed																												
Major		Insufficient covering with resin is not allowed (wire bond line exposed)																												
Minor		Dust or bubble on the resin are not allowed																												

Class	Item	Criteria													
Major		No unmelted solder paste should be present on PCB													
Critical		Cold solder joints, missing solder connections, or oxidation are not allowed													
Minor		No residue or solder balls on PCB are allowed													
Critical		Short circuits on components are not allowed													
Minor	Tray particles	<table border="1" style="width: 100%; border-collapse: collapse; margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th style="text-align: center;">Size</th> <th style="text-align: center;">Quantity</th> </tr> </thead> <tbody> <tr> <td rowspan="2" style="text-align: center;">On tray</td> <td style="text-align: center;"><math>\varnothing &lt; 0.2</math></td> <td style="text-align: center;">Any number</td> </tr> <tr> <td style="text-align: center;"><math>\varnothing &gt; 0.25</math></td> <td style="text-align: center;">4</td> </tr> <tr> <td rowspan="2" style="text-align: center;">On display</td> <td style="text-align: center;"><math>\varnothing \geq 0.25</math></td> <td style="text-align: center;">2</td> </tr> <tr> <td style="text-align: center;">L = 3</td> <td style="text-align: center;">1</td> </tr> </tbody> </table>		Size	Quantity	On tray	$\varnothing < 0.2$	Any number	$\varnothing > 0.25$	4	On display	$\varnothing \geq 0.25$	2	L = 3	1
	Size	Quantity													
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	$\varnothing > 0.25$	4													
On display	$\varnothing \geq 0.25$	2													
	L = 3	1													

## 10 RELIABILITY TESTS

### 10.1 NORMAL TEMPERATURE LCM

Item	Condition	Note
High Temperature Operation	50°C ± 2°C for 240 hours	No abnormalities in function and appearance
Low Temperature Operation	0°C ± 2°C for 240 hours	
Thermal Shock (non-operation)	-20°C (30 min) → 25°C (5 min) → 70°C (30min) → 25°C (5min) for 5 cycles	
Vibration (non-operation)	10Hz - 55Hz 0.3mm / 1 Octave 55Hz – 500 Hz 3g / 1 Octave 20 cycles / axis	

### 10.2 WIDE TEMPERATURE LCM

Item	Condition	Note
High Temperature Operation	70°C ± 2°C for 240 hours	No abnormalities in function and appearance
Low Temperature Operation	-20°C ± 2°C for 240 hours	
Thermal Shock (non-operation)	-30°C (30 min) → 25°C (5 min) → 80°C (30min) → 25°C (5min) for 5 cycles	
Vibration (non-operation)	10Hz - 55Hz 0.3mm / 1 Octave 55Hz – 500 Hz 3g / 1 Octave 20 cycles / axis	

LCD is deemed to be failed when:

- Current consumption > 3 times initial value
- Damaged glass plug and/or polarizer on the LCD glass
- Non-operational display

### 10.3 LIFE TIME

Item	Description
1	Function, performance, appearance, etc. shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions of room temperature (25±10°C), normal humidity (45±20% RH), and in area not exposed to direct sunlight.

## 11 PART NUMBER DESCRIPTIONS FOR AVAILABLE OPTIONS

### LMR42315①②128G240③④⑤

①

#### **POLARIZER TYPE**

B = Transflective: light background with LED backlight

E = Transmissive: dark background with LED backlight

②

#### **BACKLIGHT COLOR**

W = White

③

#### **FLUID TYPE AND POWER SUPPLY**

D = STN with +5VDC and external negative voltage operation

S = STN with +5VDC operation (on-board negative voltage generation)

H = Wide temperature range with +5VDC external negative voltage operation

W = Wide temperature range: on-board negative voltage generator

④

#### **FLUID TYPE**

F = FSTN (Film Supertwisted Nematic)

N = STN, STN-H

C = With On-Board Temp. Comp. circuit.

⑤

#### **COLOR FOR STN FLUID**

B = Blue background (available for E polarizer type only)

G = Gray background (available for B polarizers types only)

Y = Yellow background (available for B polarizers types only)

**11.1 LABELLING & MARKING**

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Reference Section 11 – Part Number Description for Available Options: Page 20

DENSITRON LMR42315 Rev E TAIWAN YYMM
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## 12 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°C ± 10°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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