

LIQUID CRYSTAL DISPLAY MODULE

Product Specification

PRODUCT NUMBER	LMR4790BG4C40WNY
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INTERNAL APPROVALS		
Product Manager	Engineering	Document Control

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REVISION RECORD

Rev.	Date	Page	Par.	Comment	ECN no.
A	08/03/09	--	--	Initial DCA Release	E4150

1 MAIN FEATURES

ITEM	CONTENTS	UNIT
Outline Dimension	280.0 (W) x 88.0 (H) x 18.3 (D) (Array LED with NVTC)	mm
LCM Configuration	40 Characters x 4 Lines	dot
Active Area	239.2 (W) x 63.65 (H)	mm
Viewing Area	244.0 (W) x 68.0 (H)	mm
Display Type	STN-Yellow	-
Polarizer Mode	Transflective / Positive	-
Power Supply	+5V	Vdd
Controller	ST7066 Controller (ST7063 driver)	-
Duty Ratio	1/16	Duty
Bias	1/5	Bias
Backlight Color	Yellow Green	-
Operating Temperature	-20 ~ 70	°C
Storage Temperature	-30 ~ 80	°C
RoHS Complaint	Yes	-

2.2 LABELLING

DENSITRON R4790BG-WNY (Note 1) (Note 2)

(Note 1): Manufactured location: Taiwan or China

(Note 2): Manufactured date: YYMM

YY:

Year	2007	2008	2009	2010
Mark	07	08	09	10

MM:

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Mark	01	02	03	04	05	06	07	08	09	10	11	12

3 ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Conditions	Min	Max	Unit
Power Supply voltage	Vdd	Ta=25°C, 50±10%RH	0	7.0	V
Operating Temperature	Topr	<65% (wide temp)	-20	70	°C
Storage Temperature	Tstg	<65% (wide temp)	-30	80	°C
		<48 hrs	20	90	%RH
		<1000 hrs	20	65	

4 ELECTRICAL CHARACTERISTICS

4.1 DC CHARACTERISTICS

V_{SS} = 0V, T_a = 25°C

Item	Symbol	Min	Typ	Max	Unit
Operating voltage	V _{dd}	4.75	-	5.25	V
Input voltage	High	V _{iHC}	0.7V _{dd}	V _{dd}	V
	Low	V _{iLC}	0	0.6	V
LCD driving voltage	V _{dd-Vo}	3.0	V	10.	V

4.2 LCM CURRENT CONSUMPTION & DRIVING VOLTAGE

V_{dd} – V_{SS} = 5.0V

		STN Temperature	
		Normal	Wide
Supply Current, (I _{dd}) Typ., mA		-	8
Recommended LCD drive voltage			
LCD driving voltage (V _{dd} – V _{SS})	T _a = -20°C	-	8.1
	T _a = 0°C	-	7.9
	T _a = 25°C	-	7.8
	T _a = 50°C	-	7.7
	T _a = 70°C	-	7.6

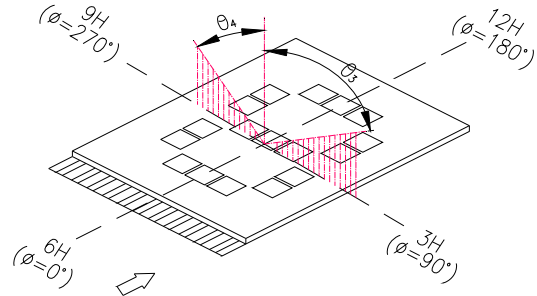
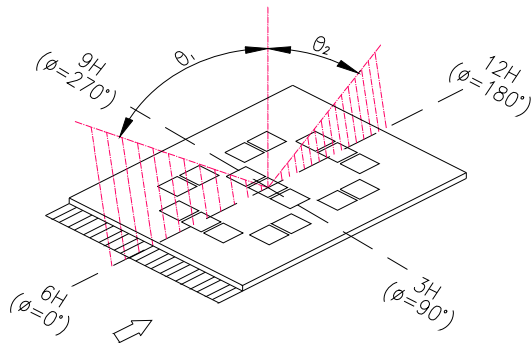
Note: R7 is 620 ohm.

5 OPTICAL CHARACTERISTICS

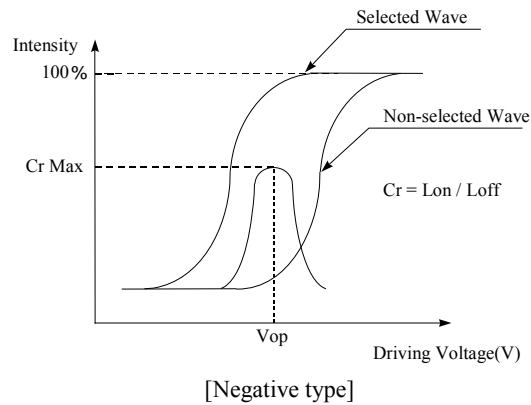
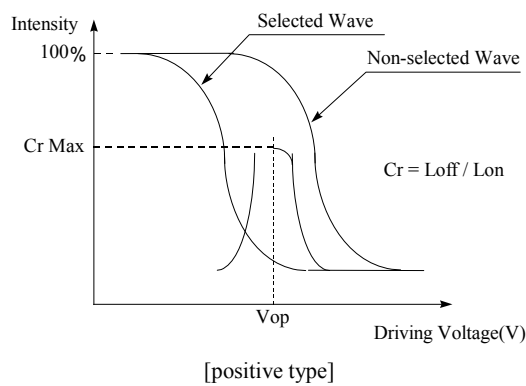
Item	Symbol	Condition	Typ	Max	Unit	Note
Viewing Angle	Θ1 (down)	CR ≥ 2	35	-	deg.	5.1
	Θ2 (up)	CR ≥ 2	25	-		
	Θ3 (right)	CR ≥ 2	30	-		5.2
	Θ4 (left)	CR ≥ 2	30	-		
Contrast Ratio	Cr	T _a =25°C	4	-	-	5.3
Response Time (rise)	Tr	T _a =25°C	350	800	ms	5.4
Response Time (fall)	Tf	T _a =25°C	400	950		
Driving Method	Duty	1/16				
	Bias	1/5				
LCD Type	STN					
Viewing Direction	6:00 O'clock					

Note 5.1: Definition of viewing angle θ_1 & θ_2

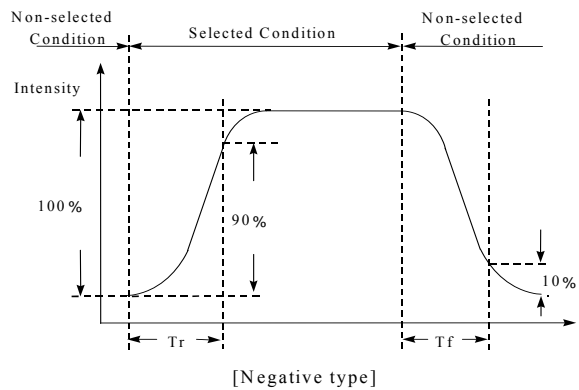
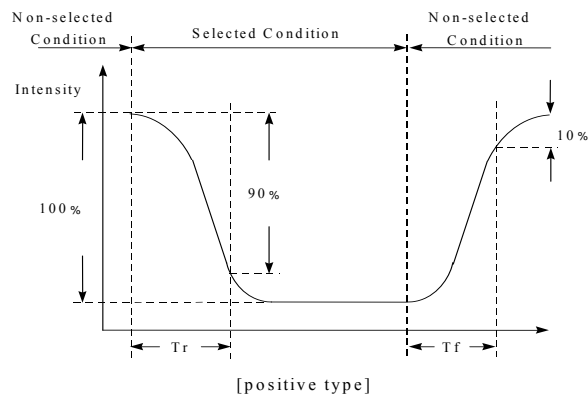
Note 5.2: Definition of viewing angle θ_3 & θ_4



Note 5.3: Definition of contrast ratio (CR)



Note 5.4: Definition of response time



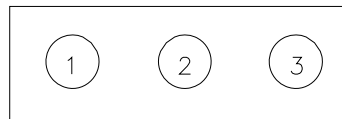
6 B/L CHARACTERISTICS

Item	Conditions	Min	Typ	Max	Units
Input Voltage	Ta=25°C	-	5.0	-	V(DC)
Current Consumption	Ta=25°C	-	2200	-	mA
Average Brightness (B/L only) (Ta=25°C, IL=1380mA)	Test when connecting after 3 min. Ta=25°C (max contrast)				cd/m ² (note 6.1)
	Yellow-Green array B/L	150	180	-	
Brightness Uniformity	Ta=25°C, IL=1380mA	80	-	-	% (note 6.2)
Lamp Life	Ta=25°C, I=1380mA Humidity: 30%RH~85%RH	-	50,000	-	Hrs (note 6.3)
Operating Temp.	Humidity: 30%RH~85%RH	-20	-	70	°C
Storage Temp.	Humidity: 30%RH~85%RH	-30	-	80	°C
Limit Resistor (R1)	Ta=25°C	-	0.47	-	OHM (note 6.4)

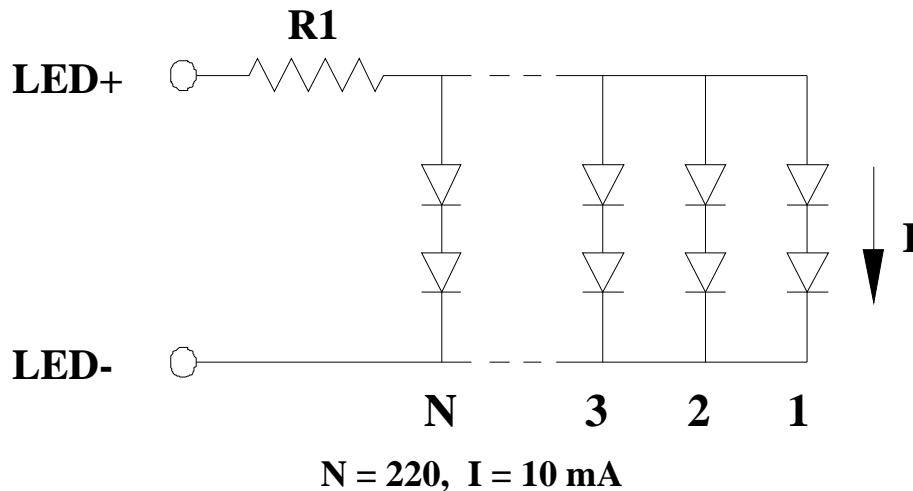
Note 6.1: Average brightness of 3 points when B/L is used at the beginning.

Note 6.2: Brightness uniformity = (MIN/MAX) x 100%.

Note 6.3: Half of the original average brightness



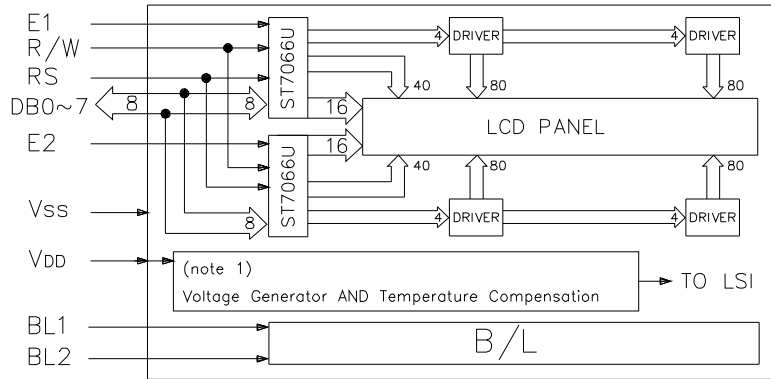
Note 6.4: R1= Built-in BL current limit resistor on LCD module.



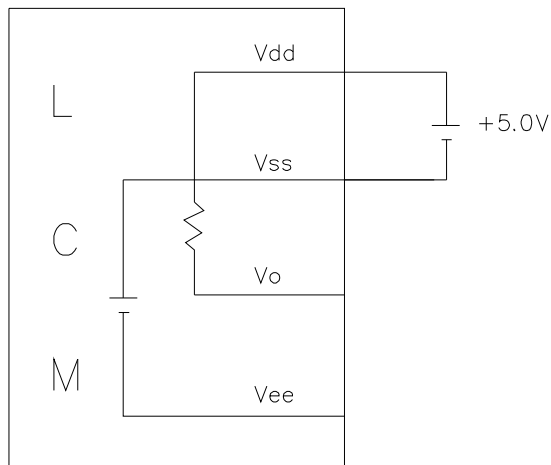
7 INTERFACE PIN ASSIGNMENT

Pin	Symbol	Level	Description
1	Vss	-	Ground (0V)
2	Vdd	-	Logic supply voltage (+5V)
3	N/A	-	No Connection
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	E1	I	Enable signal 1 active high (H-L)
7 ~ 14	DB0~7	I/O	Bi-directional data bus line 0 ~7
15	E2	I	Enable Signal 2 active high (H-L)
16	NC	-	No connection
BL1	LED (+)	-	Anode of LED B/L
BL2	LED (-)	-	Cathode of LED B/L

8 BLOCK DIAGRAM



9 RECOMMENDED POWER SUPPLY



Wide Temp.

Recommended Vr: 10K ohm ~ 20K ohm

10 TIMING CHARACTERISTICS

Please check ST7066 IC datasheet.

11 CHARACTER FONT

NO.7066-0A

b7-b4 b3-b0	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000	CG RAM (1)			0	1	2	3	4				5	6	7	8	9
0001	(2)		!	1	A	0	a	9			.	7	+	4	ä	q
0010	(3)		"	2	B	R	b	r			°	Y	×	p	ø	
0011	(4)		#	3	C	S	c	s			¡	U	τ	e	z	ø
0100	(5)		\$	4	D	T	d	t			˘	I	†	†	μ	Ω
0101	(6)		%	5	E	U	e	u			•	†	†	1	è	Ü
0110	(7)		&	6	F	V	f	v			ヲ	カ	ニ	ヨ	ρ	Σ
0111	(8)		'	7	G	W	g	w			ア	†	又	ウ	g	π
1000	(1)		(8	H	X	h	x			イ	ウ	※	リ	フ	×
1001	(2))	9	I	Y	i	y			ウ	†	リ	レ	リ	γ
1010	(3)		*	:	J	Z	j	z			エ	コ	ハ	レ	リ	†
1011	(4)		+	;	K	L	k	l			オ	サ	ヒ	ロ	×	†
1100	(5)		,	<	L	†	l	l			ホ	シ	フ	フ	†	†
1101	(6)		-	=	N	I	n	†			ユ	ズ	ハ	レ	レ	÷
1110	(7)		.	>	N	^	n	†			ヨ	セ	ホ	レ	†	†
1111	(8)		/	?	0	_	o	†			ッ	リ	マ	†	†	†

12 RELIABILITY TEST

12.1 RELIABILITY (NORMAL TEMP. LCM)

Test Item	Test Conditions	Note
High Temperature Operation	240 HR, 50°C ± 2°C	No abnormalities in function* and appearance**
Low Temperature Operation	240 HR, 0°C ± 2°C	No abnormalities in function* and appearance**
Thermal Shock Storage (None operation)	-20°C(30min)→25°C(5min)→70°C(30min)→25°C(5min) 5 cycle	No abnormalities in function* and appearance**
Vibration (None operation)	10Hz ~ 55Hz 0.3mm / 1 octave 55Hz ~ 500Hz 3g / 1 octave 20 cycle / per axis	No abnormalities in function* and appearance**

12.2 RELIABILITY (WIDE TEMP. LCM)

Test Item	Test Conditions	Note
High Temperature Operation	240 HR, 70°C ± 2°C	No abnormalities in function* and appearance**
Low Temperature Operation	240 HR, -20°C ± 2°C	No abnormalities in function* and appearance**
Thermal Shock Storage (None operation)	-30°C(30min)→25°C(5min)→80°C(30min)→25°C(5min) 5 cycle	No abnormalities in function* and appearance**
Vibration (None operation)	10Hz ~ 55Hz 0.3mm / 1 octave 55Hz ~ 500Hz 3g / 1 octave 20 cycle / per axis	No abnormalities in function* and appearance**

12.3 MTBF OF LIQUID CRYSTAL PANEL

50,000 hours, 90% confidence level at 25°C, 65%RH Max.

If any of the following occurs after the MTBF test, the LCD is deemed to be failed:

- Current consumption increase three times than initial value.
- Damaged glass plug and/or polarizer on the LCD glass.
- Non-operational display.

13 QUALITY ASSURANCE SPECIFICATION

13.1 CONFORMITY

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

13.2 DELIVERY ASSURANCE

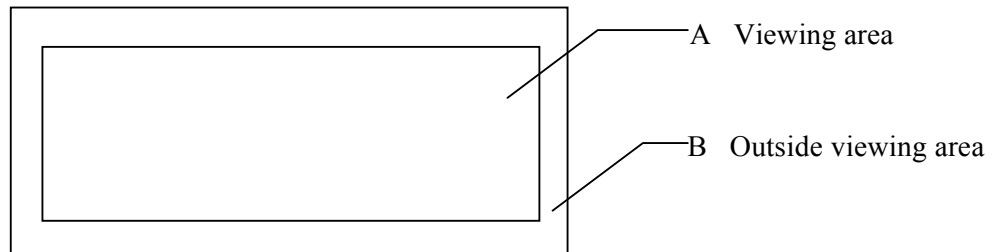
5.2.1 Delivery inspection standards

- IPC-AA610, class 2 electronic assemblies standard

The quality assurance levels are shown below:

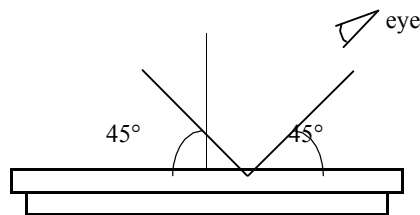
Rank	Item Inspected	Defect type	AQL	Remark
Major defect	Display	Non display	0.25%	Fit/Function defect
		Over current		
		Missing segment		
		Wrong viewing direction		
		Incorrect operating		
		Backlight OFF		
	Backlight flashing			
Dimension	PCB and bezel out of specification			
Minor defect	LCD	Black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

5.2.2 Zone definition



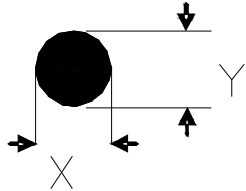
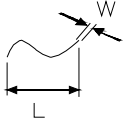
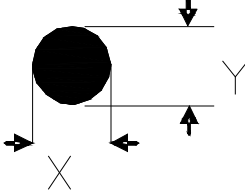
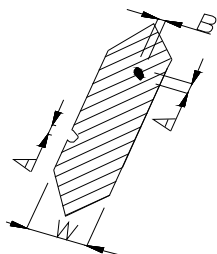
5.2.3 Visual inspection

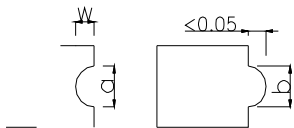
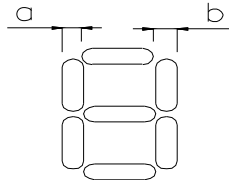
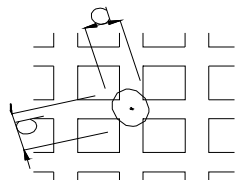
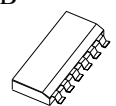
- Inspect under 2x20W or 40W fluorescent lamp (approximately 3000 lux) leaving 25 to 30 cm between the module and the lamp and 30 cm between the module and the eye (measuring position).
- Appearance is inspected at the best contrast voltage (best contrast is adjusted considering clearness and crosstalk 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 $\Phi = (X+Y)/2$</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>$\Phi < 0.1$</td> <td>Any number</td> <td rowspan="4">Any number</td> </tr> <tr> <td>$0.1 < \Phi < 0.2$</td> <td>2</td> </tr> <tr> <td>$0.2 < \Phi < 0.25$</td> <td>1</td> </tr> <tr> <td>$0.25 < \Phi$</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>$W \leq 0.02$</td> <td rowspan="2">Any number</td> <td rowspan="3">Any number</td> </tr> <tr> <td>$L \leq 3.0$</td> <td>$0.02 < W \leq 0.03$</td> </tr> <tr> <td>$L \leq 2.5$</td> <td>$0.03 < W \leq 0.05$</td> <td>2</td> </tr> <tr> <td>-</td> <td>$0.05 < W$</td> <td>as round type</td> <td></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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$L \leq 3.0$	$0.02 < W \leq 0.03$																																					
$L \leq 2.5$	$0.03 < W \leq 0.05$	2																																				
-	$0.05 < W$	as round type																																				
2	Polariser scratch	Scratch on protective film is permitted Scratch on polariser: same as No. 1																																				
3	Polariser bubble	<p>$\Phi = (X+Y)/2$</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>$\Phi < 0.2$</td> <td>Any number</td> <td rowspan="4">Any number</td> </tr> <tr> <td>$0.2 < \Phi < 0.5$</td> <td>2</td> </tr> <tr> <td>$0.5 < \Phi < 1.0$</td> <td>1</td> </tr> <tr> <td>$1.0 < \Phi$</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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$0.5 < \Phi < 1.0$	1																																					
$1.0 < \Phi$	0																																					
4	Segment deformation	<p>1.a. Pin hole on segmented display</p> <p>W: segment width $\Phi = (A+B)/2$</p>  <table border="1"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Width</th> <th>Φ</th> </tr> </thead> <tbody> <tr> <td>$W \leq 0.4$</td> <td>$\Phi \leq 0.2$ and $\Phi \leq 1/2W$</td> </tr> <tr> <td>$W > 0.4$</td> <td>$\Phi \leq 0.25$ and $\Phi \leq 1/3W$</td> </tr> </tbody> </table> <p>Total acceptable quantity: 1 defect per segment Pin holes with Φ under 0.10 mm are acceptable.</p>	Acceptable quantity		Width	Φ	$W \leq 0.4$	$\Phi \leq 0.2$ 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>$a, b < 0.1$</td> <td>Any number</td> </tr> <tr> <td>$(a+b)/2 \le 0.1$</td> <td>Any number</td> </tr> <tr> <td>$0.5 < \Phi < 1.0$</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> </thead> <tbody> <tr> <td>$a \geq b$</td> <td>$a/b \leq 4/3$</td> </tr> <tr> <td>$a < b$</td> <td>$a/b > 4/3$</td> </tr> </tbody> </table> <p>3. Alignment layer defect</p> <p>$\Phi = (a+b)/2$</p>  <table border="1"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th></th> </tr> </thead> <tbody> <tr> <td>$\Phi \leq 0.4$</td> <td>Any number</td> </tr> <tr> <td>$0.4 < \Phi \leq 1.0$</td> <td>5</td> </tr> <tr> <td>$1.0 < \Phi \leq 1.5$</td> <td>3</td> </tr> <tr> <td>$1.5 < \Phi \leq 2.0$</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		$a \geq b$	$a/b \leq 4/3$	$a < b$	$a/b > 4/3$	Acceptable quantity		Size		$\Phi \leq 0.4$	Any number	$0.4 < \Phi \leq 1.0$	5	$1.0 < \Phi \leq 1.5$	3	$1.5 < \Phi \leq 2.0$	2
Acceptable quantity																														
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$1.0 < \Phi \leq 1.5$	3																													
$1.5 < \Phi \leq 2.0$	2																													
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>$\Phi < 0.2$</td> <td>Any number</td> </tr> <tr> <td>$\Phi > 0.25$</td> <td>4</td> </tr> <tr> <td rowspan="2">On display</td> <td>$\Phi \geq 0.25$</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	$\Phi \geq 0.25$	2	$L = 3$	1															
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14 HANDLING PRECAUTIONS

SAFETY

- If the LCD panel breaks , be careful not to get the liquid crystal in your mouth and not to be injured by crushed glass.
- Take care not to be hurt by an edge and a splinter of glass.
- Vee and CCFT terminal are supplied high voltage , please watch out when you will touch around here.
- Turn off the LCM when set or remove a connector or cable.

FIRST AID

- If the LC material gets into eye(s) : Wash your eye(s) with running clean water for 15 minutes at least.
- If the LC material splashes on the skin : Wipe off and wash your skin with soap and running water.
- If the LC material is swallowed : Wash your mouth very well. Drink water and vomit with water what you swallow. Consult a doctor after first aid.

HANDLING

- Avoid Static electricity as this can damage the CMOS LSI.
- The LCD panel is plate glass, do not hit or crush it please.
- Do not remove the panel or frame from module.

MOUNTING AND DESIGN

- Mount the module by using the specified mounting part and holes.
- If conductive material touch the edge of PCB , LCM will be damaged.
- Keep the module dry. Avoid condensation , otherwise the transparent electrodes may break.

STORAGE

- Store the LCM in a dark place where the temperature is $25^{\circ}\text{C} \pm 10^{\circ}\text{C}$ and the humidity is below 65% RH
- Do not store the LCM near organic solvents or corrosive gases.

CLEANING

- Do not wipe the polarizing plates with a dry cloth, as it may scratch the surface.
- Wipe the LCM gently with a soft cloth soaked with a petroleum benzine.

15 PART NUMBER DESCRIPTION

LMR4790①4C40②③④

① **POLARIZER TYPE**

B = Transflective: Positive Light background.

② **BACKLIGHT COLOR**

G = Yellow-Green Array LED

③ **TEMPERATURE RANGE**

W = Wide temp. Range; on-board negative supply voltage generator

④ **FLUID TYPE**

N = STN/NTN

⑤ **BACKGROUND COLOR**

Y = Yellow mode STN/NTN