

LIQUID CRYSTAL DISPLAY MODULE

Standard Product Specification

PRODUCT NUMBER	LR4216
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INTERNAL APPROVALS				
Project Leader	Product Mgr	Quality Mgr	Electrical Eng	Document Control
Date:	Date:	Date:	Date:	Date:

- Approval for Specification only**
- Approval for Specification and Sample**

Sample no.:

Date:

ISIR no.:

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REVISION RECORD

Rev.	Date	Page	Chapt.	Comment	ECN no.
A	02/08/06	--	--	New DCA Standard Release	E3027

1 MAIN FEATURES

ITEM		CONTENTS
Display Format		2-Lines x 16-Characters
Colour		Monochrome
Overall Dimensions		84.0 (W) x 44.0 (H) x 14.6 Max (Array LED)
Viewing Area		60.0 (W) x 16.0 (H)
LCD Type		STN
Mode		Reflective – Positive
		Transflective - Positive
Viewing Angle		6:00
Duty Ratio		1/16
Driver IC		S6A0069
Backlight Type \ Color		Array LED \ Yellow-Green
DC/DC Converter		Built-In
Operating Temperature	Normal	0°C~+50°C
	Wide	-20°C~+70°C
Storage Temperature	Normal	-20°C~+70°C
	Wide	-30°C~+80°C
RoHS Compliant		Yes

2 MECHANICAL SPECIFICATION

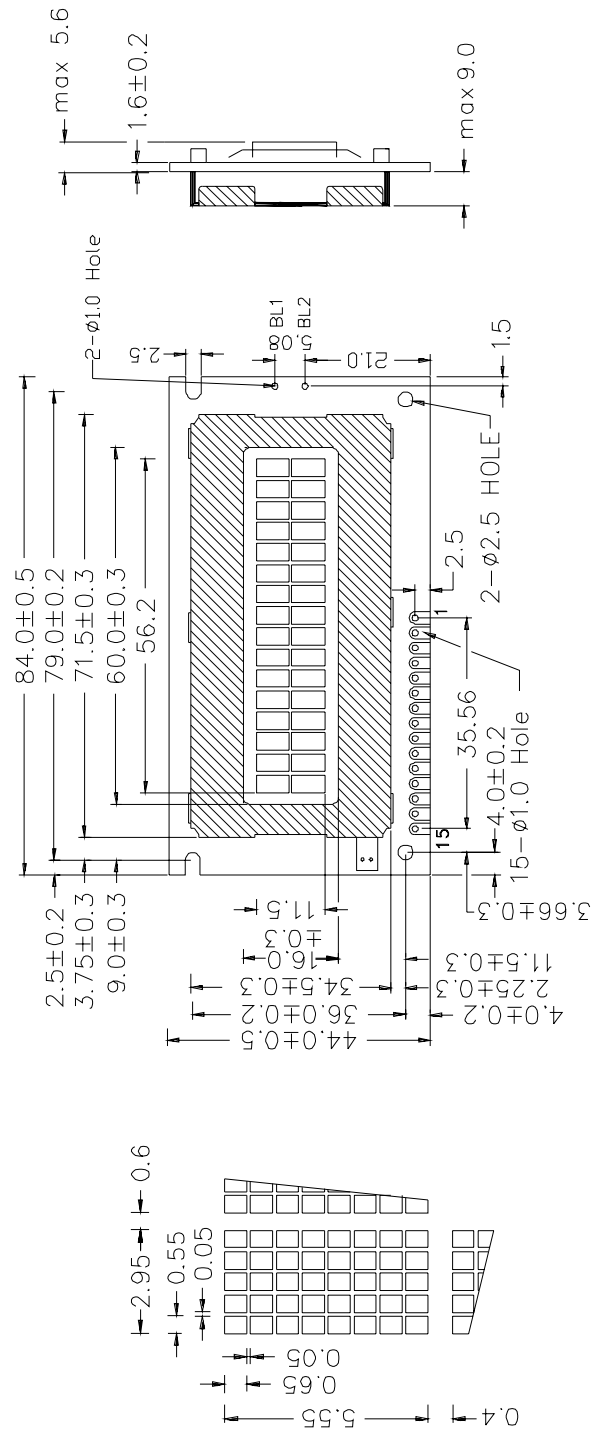
2.1 MECHANICAL CHARACTERISTICS

ITEM	CHARACTERISTIC	UNIT
Display Format	2-Lines x 16-Characters	
Overall Dimensions	84.0 (W) x 44.0 (H) x 14.6 Max (Array LED)	mm
Viewing Area	60.0 (W) x 16.0 (H)	mm
Active Area	56.2 (W) x 11.5 (H)	mm
Character Size	2.95 (W) x 5.55 (H)	mm
Character Pitch	3.55 (W) x 5.95 (H)	mm
Dot Size	0.55 (W) x 0.65 (H)	mm
Dot Pitch	0.60 (W) x 0.70 (H)	mm
IC Controller/Driver	S6A0069	

2.2 LABELLING & MARKING

DENSITRON LR4216 TAIWAN YYMM

2.3 MECHANICAL DRAWING



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3 ELECTRICAL SPECIFICATION

3.1 ABSOLUTE MAXIMUM RATINGS

VSS = 0 V, Ta = 25 °C

Item	Symbol	Min	Max	Unit	Note	
Power Supply Voltage	V _{DD}	0	7.0	V		
Power Supply for LCD	V _{DD} -V _O	3	10	V		
Operating Temperature	Normal	Top	0	+50	°C	Note 1
	Wide		-20	+70		
Storage Temperature	Normal	T _{st}	-20	+70	°C	Note 2
	Wide		-30	+80		

Note 1: Background colour changes slightly depending on ambient temperature. This phenomenon is reversible. Ta ≤ 70 °C: 75% RH max

Note 2: Ta ≤ 80 °C: 75% RH max

3.2 ELECTRICAL CHARACTERISTICS

VSS = 0 V, Ta = 25 °C

Item	Symbol	Condition	Min	Typ	Max	Unit
Power Supply for Logic	V _{DD}	Ta = 25 °C	4.75	--	5.25	V
Input Voltage	V _{IHC}	Ta = 25 °C	0.7 V _{DD}	--	V _{DD}	V
	V _{ILC}	Ta = 25 °C	0	--	0.55	V
LCD Module Driving Voltage	V _{DD} -V _O	Ta = 25 °C	3.0	--	10.0	V
Current Consumption (Normal/Wide Temp)	* I _{DD}	V _{DD} = 5V	--	1	--	mA

* I_{DD} measurement condition is for all pattern ON

3.3 RECOMMENDED LC DRIVE VOLTAGE (VDD-VO)

Vdd-Vss= 5.0V

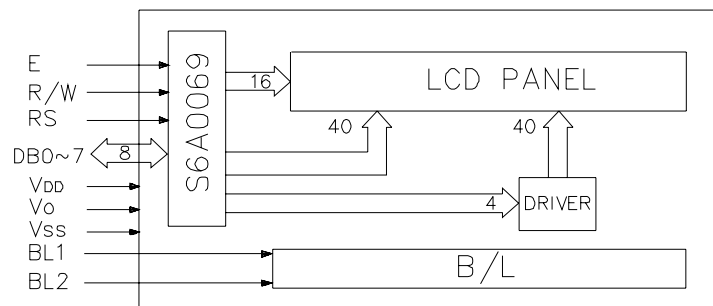
Temperature	STN	STN-H
Ta = -20°C	N/A	7.7
Ta = 0°C	4.8	7.3
Ta = 25°C	4.5	6.9
Ta = 50°C	4.3	6.4
Ta = 70°C	N/A	6.1

3.4 INTERFACE PIN ASSIGNMENT

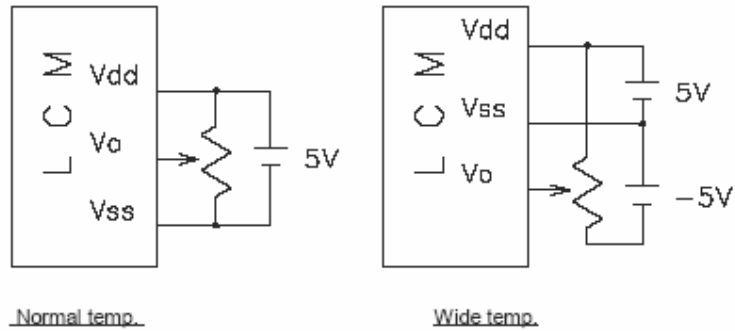
3.4.1 I/O PIN FUNCTION (ARRAY LED)

Pin No.	Function	Level	Description
1	VSS/LED(-)	-	Ground (0V) / Cathode of LED B/L
2	VDD	-	Logic Supply Voltage (+5V)
3	Vo	-	Voltage Level for LCD Control 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 ~ 14	DB0 ~ 7	I/O	Bi-directional data bus line 0 ~ 7
15	N/A	-	No connection
BL1	LED(+)		Anode of LED B/L
BL2	LED(-)		Cathode of LED B/L

3.5 BLOCK DIAGRAM



3.6 POWER SUPPLY CIRCUIT



RECOMMENDED V_R : 10K ohm ~ 20K ohm

3.7 CHARACTER GENERATOR ROM MAP

Please reference the manufacturers datasheet for S6A0069 controller.

3.8 TIMING CHARACTERISTICS

Please reference the manufacturers datasheet for S6A0069 controller.

4 OPTICAL SPECIFICATION

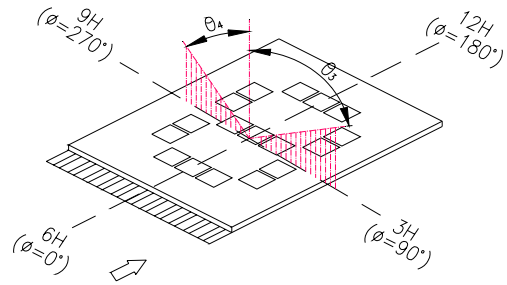
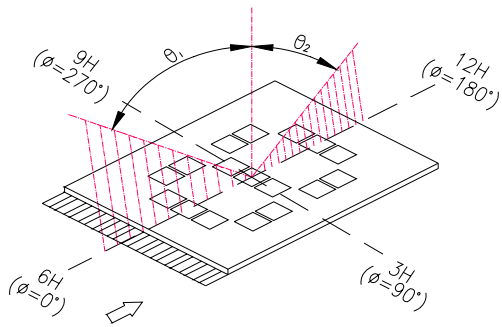
4.1 OPTICAL CHARACTERISTICS

Ta = 25 °C

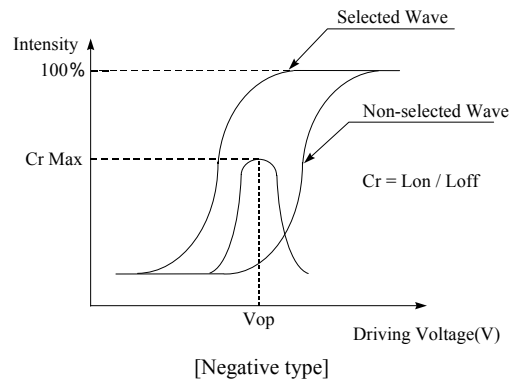
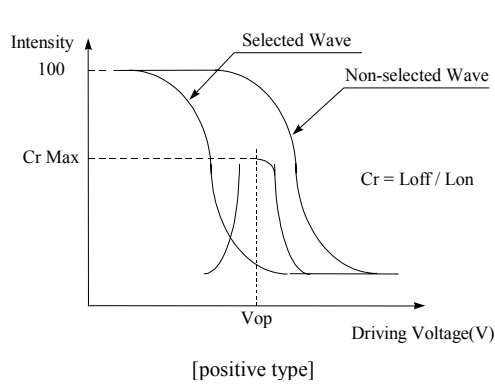
Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Viewing Angle	θ1	CR≥2	--	40	--	deg	1
	θ2	CR≥2	--	30	--	deg	1
	θ3	CR≥2	--	30	--	deg	2
	θ4	CR≥2	--	30	--	deg	2
Contrast Ratio	CR	Ta = 25 °C	2	4	--	-	3
Response Time	Tr	Ta = 25 °C	--	130	250	ms	4
	Tf	Ta = 25 °C	--	180	300		
Driving Method	Duty	1/16					
	Bias	1/4					
LCD Type	STN						
Viewing Direction	6:00						

Note 1: definition of viewing angle θ_1 & θ_2

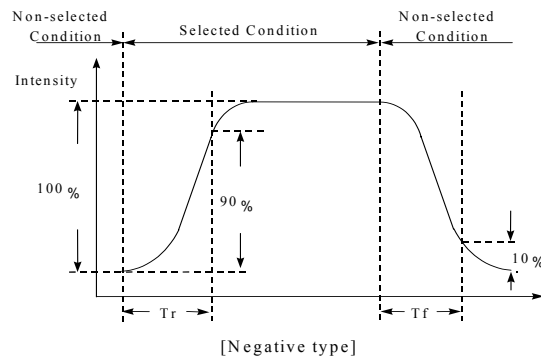
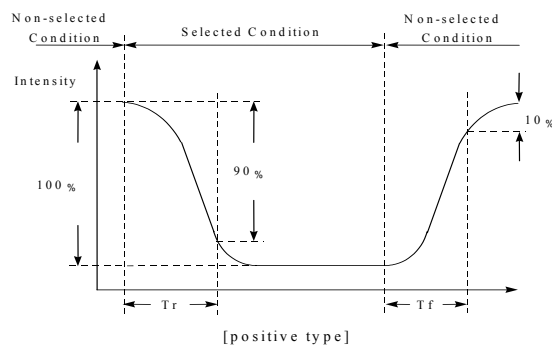
Note 2: definition of viewing angle θ_3 & θ_4



Note 3: definition of contrast ratio (CR)



Note 4: definition of response time



5 BACKLIGHT SPECIFICATION

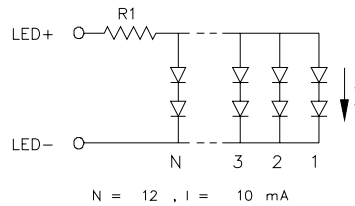
5.1 BACKLIGHT CHARACTERISTICS

5.1.1 ARRAY LED B/L OPERATING RANGE

Item	Conditions	Standard			Unit
		Min.	Typ.	Max.	
Input voltage	Ta = 25 C	---	5.0	---	V(DC)
Current consumption	Ta = 25 C		120		mA
Average brightness (B/L only) (Ta =25C, IL = 120 mA)	Test when connecting after 3 min. Ta=25C (max. contrast) Yellow-green array B/L	120	150	---	cd/m ² (Note 3)
Brightness uniformity	Ta = 25 C , IL = 120 mA	80	---	---	% (Note 4)
Lamp life	Ta = 25 C , IL = 120 mA Humidity : 30%RH ~ 85%RH	---	50,000	---	Hrs (Note 5)
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	---	6.2	---	OHM (Note 2)

Note

2: R1: Built-in BL current limit resistor On LCDM.



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

4 : Brightness uniformity = (MIN / MAX) x 100 %

5 : Half of the original average brightness



6 QUALITY ASSURANCE SPECIFICATION

6.1 CONFORMITY

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

6.2 DELIVERY ASSURANCE

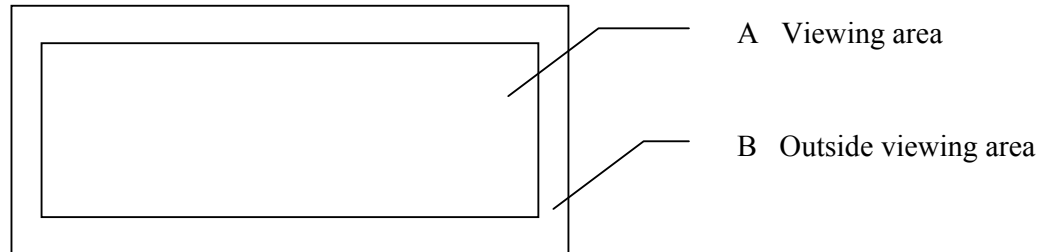
6.2.1 Delivery inspection standards

- MIL-STD-105E, general inspection level II, single sampling level;
- IPC-AA610 rev. C, class 2 electronic assemblies standard

The quality assurance levels are shown below:

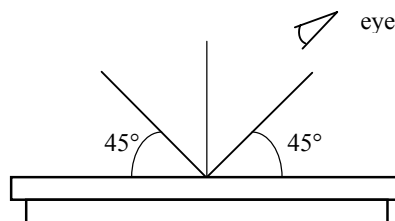
Class	AQL (%)
Critical defect	0.5%
Major defect	1.0%
Minor defect	1.5%
TOTAL	2.0%

6.2.2 Zone definition



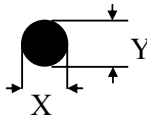
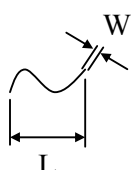
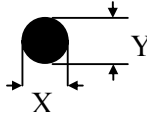
6.2.3 Visual inspection

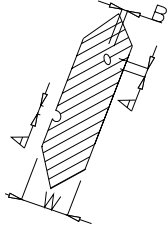
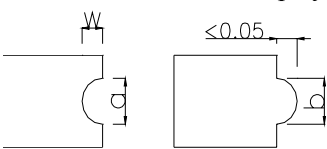
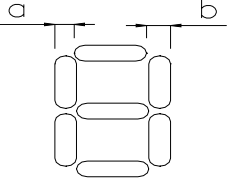
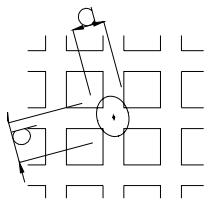
- Inspect under 2x20W or 40W fluorescent lamp (approximately 3000 lux) leaving 25 to 30 cm between the module and the lamp and 30 cm between the module and the eye (measuring position).
- Appearance is inspected at the best contrast voltage (best contrast is adjusted considering clearness and crosstalk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




6.2.3.1 Standard of appearance inspection

Units: mm

Class	Item	Criteria																																				
Minor	Packing & Label	Outside & inside package Presence of product no., lot no., quantity																																				
Critical		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 $\varnothing = (X+Y)/2$</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <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>$\varnothing < 0.1$</td> <td>Any number</td> <td rowspan="4">Any number</td> </tr> <tr> <td>$0.1 < \varnothing < 0.2$</td> <td>2</td> </tr> <tr> <td>$0.2 < \varnothing < 0.25$</td> <td>1</td> </tr> <tr> <td>$0.25 < \varnothing$</td> <td>0</td> </tr> </tbody> </table> <p>Line type: as per following drawing</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <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>Any number</td> <td rowspan="4">Any number</td> </tr> <tr> <td>$L \leq 3.0$</td> <td>$0.02 < W \leq 0.03$</td> <td>2</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> </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	$L \leq 2.5$	$0.03 < W \leq 0.05$	2	--	$0.05 < W$	As round type
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Size	Zone A	Zone B																																				
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$0.25 < \varnothing$	0																																					
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$L \leq 3.0$	$0.02 < W \leq 0.03$	2																																				
$L \leq 2.5$	$0.03 < W \leq 0.05$	2																																				
--	$0.05 < W$	As round type																																				
Minor	Polariser scratch	Scratch on protective film is permitted Scratch on polariser: same as No. 1																																				
Minor	Polariser bubble	<p>$\varnothing = (X+Y)/2$</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <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>$\varnothing < 0.2$</td> <td>Any number</td> <td rowspan="4">Any number</td> </tr> <tr> <td>$0.2 < \varnothing < 0.5$</td> <td>2</td> </tr> <tr> <td>$0.5 < \varnothing < 1.0$</td> <td>1</td> </tr> <tr> <td>$1.0 < \varnothing$</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 $\varnothing = (A+B)/2$</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> </thead> <tbody> <tr> <td>Width</td> <td>\varnothing</td> </tr> <tr> <td>$W \leq 0.4$</td> <td>$\varnothing \leq 0.2$ and $\varnothing \leq 1/2W$</td> </tr> <tr> <td>$W > 0.4$</td> <td>$\varnothing \leq 0.25$ and $\varnothing \leq 1/3W$</td> </tr> </tbody> </table> <p>Total acceptable quantity: 1 defect per segment Pin holes with \varnothing 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 $\varnothing \leq 1/3W$																				
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 $\varnothing \leq 1/3W$																													
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> </thead> <tbody> <tr> <td>Size</td> <td></td> </tr> <tr> <td>$a, b < 0.1$</td> <td>Any number</td> </tr> <tr> <td>$(a+b)/2 \leq 0.1$</td> <td>Any number</td> </tr> <tr> <td>$0.5 < \varnothing < 1.0$</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> </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>$\varnothing = (a+b)/2$</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> </thead> <tbody> <tr> <td>Size</td> <td></td> </tr> <tr> <td>$\varnothing \leq 0.4$</td> <td>Any number</td> </tr> <tr> <td>$0.4 < \varnothing \leq 1.0$</td> <td>5</td> </tr> <tr> <td>$1.0 < \varnothing \leq 1.5$</td> <td>3</td> </tr> <tr> <td>$1.5 < \varnothing \leq 2.0$</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		$a \geq b$	$a/b \leq 4/3$	$a < b$	$a/b > 4/3$	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
Acceptable quantity																														
Size																														
$a, b < 0.1$	Any number																													
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$1.0 < \varnothing \leq 1.5$	3																													
$1.5 < \varnothing \leq 2.0$	2																													
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"> <thead> <tr> <th></th> <th>Size</th> <th>Quantity</th> </tr> </thead> <tbody> <tr> <td rowspan="2">On tray</td> <td>$\varnothing < 0.2$</td> <td>Any number</td> </tr> <tr> <td>$\varnothing > 0.25$</td> <td>4</td> </tr> <tr> <td rowspan="2">On display</td> <td>$\varnothing \geq 0.25$</td> <td>2</td> </tr> <tr> <td>L = 3</td> <td>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													
On tray	$\varnothing < 0.2$	Any number													
	$\varnothing > 0.25$	4													
On display	$\varnothing \geq 0.25$	2													
	L = 3	1													

6.3 DEALING WITH CUSTOMER COMPLAINTS

6.3.1 Non-conforming analysis

Purchaser should supply Densitron with detailed data of non-conforming sample. After accepting it, Densitron should complete the analysis in two weeks from receiving the sample.

If the analysis cannot be completed on time, Densitron must inform the purchaser.

6.3.2 Handling of non-conforming displays

If any non-conforming displays are found during customer acceptance inspection which Densitron is clearly responsible for, return them to Densitron.

Both Densitron and customer should analyse the reason and discuss the handling of non-conforming displays when the reason is not clear.

Equally, both sides should discuss and come to agreement for issues pertaining to modification of Densitron quality assurance standard.

7 RELIABILITY TEST

7.1 NORMAL TEMPERATURE LCM

Test Item	Test Condition	Evaluation and assessment
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 cycles	No abnormalities in function* and appearance
Vibration	10 Hz~55 Hz 0.3mm / 1 Octave 55 Hz ~ 500 Hz 3g / 1 Octave 20 cycles per axis	No abnormalities in function* and appearance

7.2 WIDE TEMPERATURE LCM

Test Item	Test Condition	Evaluation and assessment
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)	-20°C (30min)->+25°C (5min)->+80°C (30min)->+25°C (5min) 5 cycles	No abnormalities in function* and appearance
Vibration	10 Hz~55 Hz 0.3mm / 1 Octave 55 Hz ~ 500 Hz 3g / 1 Octave 20 cycles per axis	No abnormalities in function* and appearance

7.3 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.

8 PART NUMBER DESCRIPTIONS FOR AVAILABLE OPTIONS

LR4216①②2C16③④⑤

- ① **Polarizer Type**
B = Transflective: light background with LED backlight
- ② **Backlight Color**
G = Yellow-green
A = Amber
R = Red
W = White
- ③ **Fluid Type and Power Supply**
C = TN with +5VDC or \pm 5VDC operation.
STN/NTN with \pm 5VDC operation
S = STN/NTN with +5VDC operation
H = Extended temp with \pm 5VDC operation
- ④ **Fluid Type/TN Viewing Direction**
B = TN with bottom (6 o'clock) viewing angle
T = TN with top (12 o'clock) viewing angle
S, N = STN/NTN
- ⑤ **TN Temperature Range or STN/NTN Background Color**
Blank = Standard temp TN
H = Extended temp TN
Y = Yellow mode STN/NTN (with A,B,F polarisers)
G = Yellow mode STN/NTN (with A,B,F polarisers)
B = Blue mode STN/NTN (with E polarisers)

9 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).