

LIQUID CRYSTAL DISPLAY MODULE

Product Specification

PRODUCT NUMBER	LER4328
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INTERNAL APPROVALS		
Product Manager	Engineering	Document Control

Product No.	LER4328	REV. A
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REVISION RECORD

Rev.	Date	Page	Par.	Comment	ECN no.
A	02/16/09	--	--	New DCA Specification	E3992

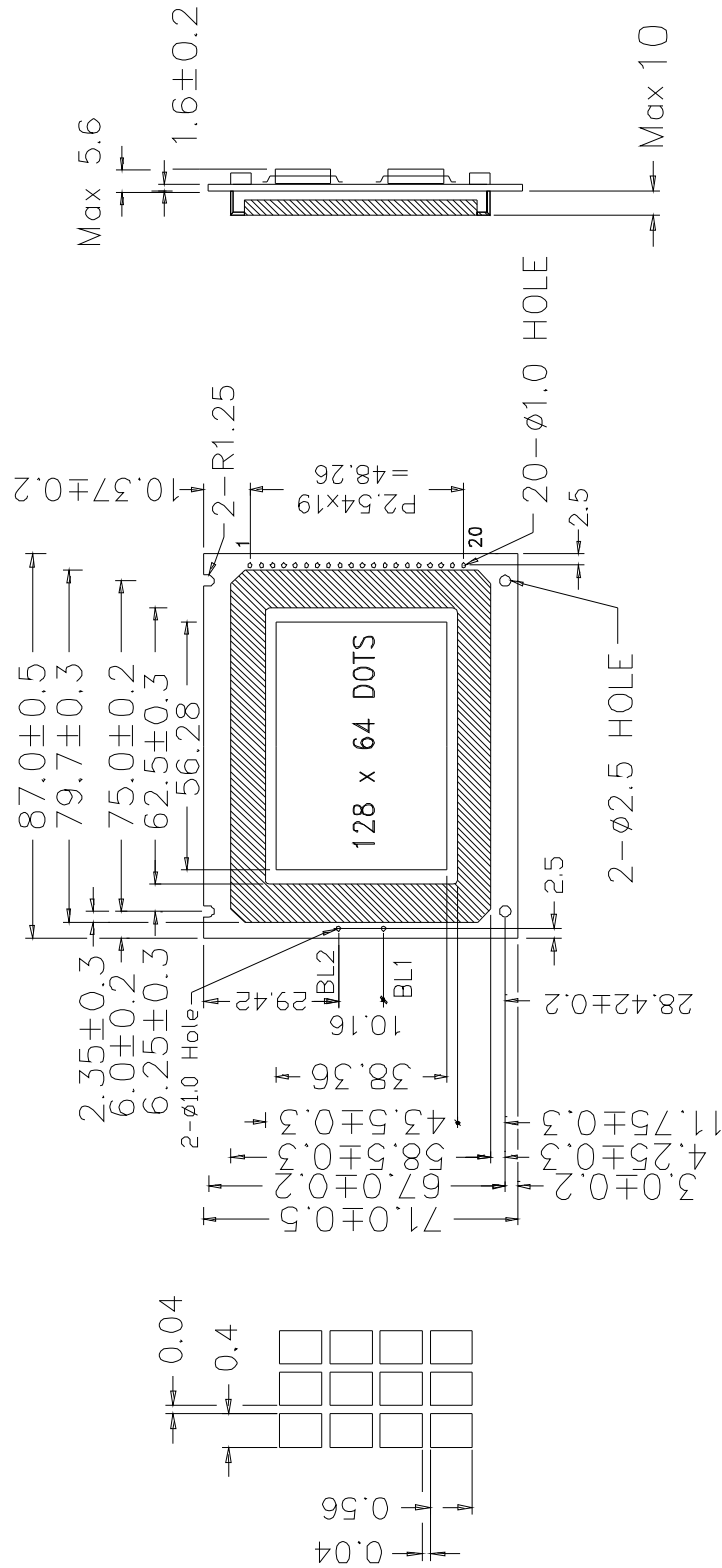
1 GENERAL SPECIFICATIONS

ITEM	DESCRIPTION	UNIT
Module Outline Dimensions	87.0 (W) x 71.0 (H) x 15.6 Max (D)	mm
Viewing Area	62.5 (W) x 43.5 (H)	mm
Active Display Area	56.28 (W) x 38.36 (H)	mm
Dot Configuration Format	128 (W) x 64 (H)	dots
Dot Dimensions	0.40 (W) x 0.56 (H)	mm
Dot Spacing	0.04 (W) x 0.04 (H)	mm
LCD Type	STN / Transflective / Positive	--
Backlight Type	Array LED / Yellow-Green	--
Duty Ratio	1/64	--
Bias Drive	1/9	--
Controller / Interface	Neotec NT7108 / 8-bit Parallel interface	--
Power Supply	Vdd	V
RoHS Complaint	Yes	--

2 FEATURES

- With Negative Voltage (NV).

3 MECHANICAL DRAWING



Unit:mm

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4 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% RH (Normal Temp.)	0	50	°C
		< 65% RH (Wide Temp.)	-20	70	
Storage Temperature	Tstg	< 65% RH (Normal Temp.)	-20	70	°C
		< 65% RH (Wide Temp.)	-30	80	
		< 48 hrs	20	90	% RH
		< 1000 hrs	20	65	% RH

5 ELECTRONIC CHARACTERISTICS

5.1 DC CHARACTERISTICS

(Vss = 0 V, Ta = 25°C)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit	
Operating Voltage	Vdd	--	4.75	--	5.25	V	
Input Voltage	High		Vihc	0.7Vdd	--	Vdd	V
	Low		Vilc	0	--	0.8	
LCD Driving Voltage	Vdd - Vo		8	--	17.0	V	

5.2 LCD CURRENT CONSUMPTION & DRIVING VOLTAGE

(Vdd – Vss = 5.0 V)

		STN TEMPERATURE	
		Normal Temp.	Wide Temp.
Supply Current, (Idd) Typ., mA		10	N/A
Supply Current, (Iee) Typ., mA		N/A	N/A
Recommended LCD Driving voltage			
LCD Driving Voltage (Vdd – Vo)	Ta = -20 °C		N/A
	Ta = 0 °C		14.4
	Ta = 25 °C		14.6
	Ta = 50 °C		14.8
	Ta = 70 °C		N/A

Note: Negative Voltage (NV) is built-in

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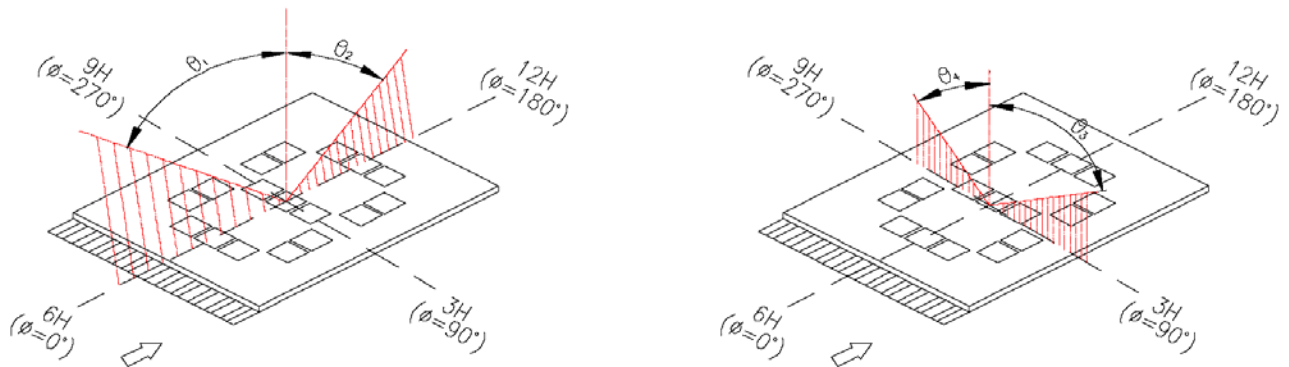
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6 OPTOELECTRONIC CHARACTERISTICS

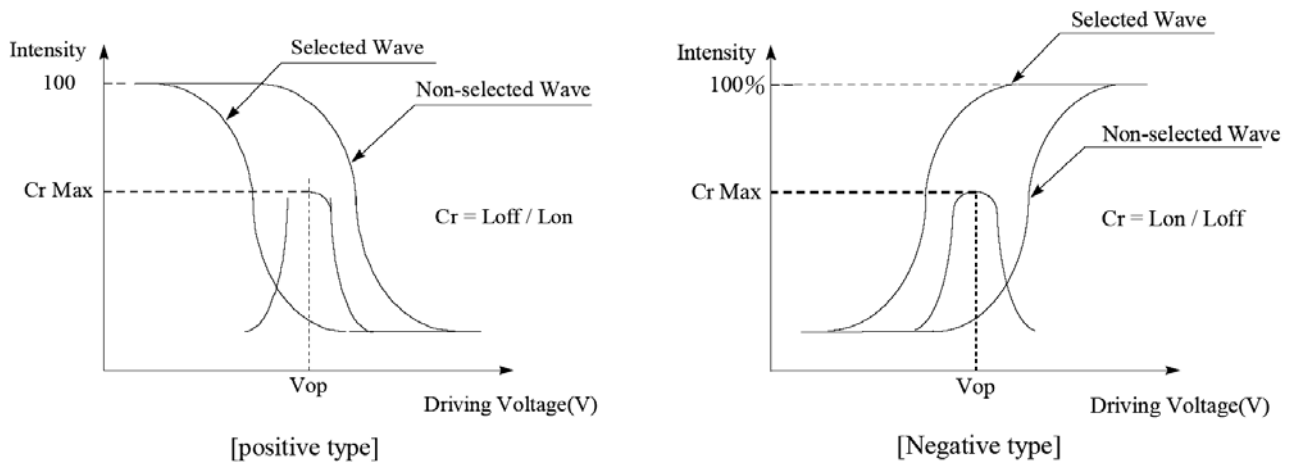
(Ta = 25°C)

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit	Note
Viewing Angle	θ1 (down)	CR ≥ 2	--	30	--	deg.	6.1
	θ2 (up)	CR ≥ 2	--	20	--	deg.	6.1
	θ3 (right)	CR ≥ 2	--	30	--	deg.	6.2
	θ4 (left)	CR ≥ 2	--	30	--	deg.	6.2
Contrast Ratio	CR	Ta = 25°C	3.0	--	--	--	6.3
Response Time	Tr	Ta = 25°C	--	--	300	ms	6.4
	Tf	Ta = 25°C	--	--	300		
Viewing Direction	6 O'clock						

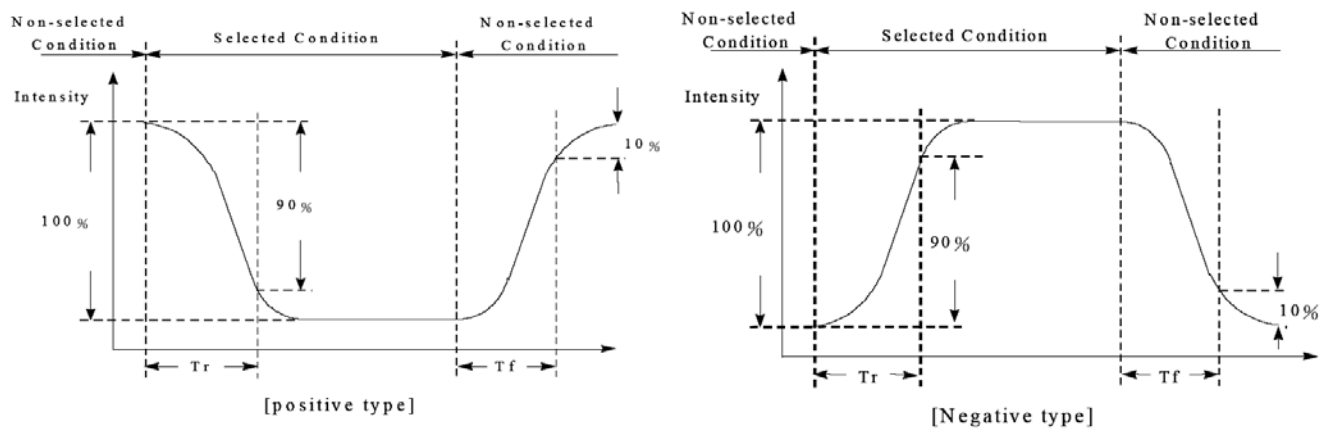
Note 6.1: Definition of Viewing angle, θ_1 & θ_2 Note 6.2: Definition of Viewing angle, θ_3 & θ_4



Note 6.3: Definition of Contrast Ratio (CR)



Note 6.4: Definition of Response Time



7 ARRAY LED BACKLIGHT ELECTRICAL CHARACTERISTICS

Item	Conditions	Min.	Typ.	Max.	Unit
Input voltage	Ta = 25°C	--	5.0	--	Vrms
Current consumption	Ta = 25°C	--	260	--	mA
Average brightness (B/L only)(Ta = 25°C, IL = 260 mA)	Test when connected for 3 min., Ta = 25 °C				cd/m ² (Note 7.1)
	Yellow-Green Array LED B/L	--	110	--	
Peak Emission Wavelength	Ta = 25°C , IL = 260 mA	565	570	575	nm
Brightness uniformity	Ta = 25°C , IL = 260 mA	80	--	--	% (Note 7.2)
Lamp life	Ta = 25°C , IL = 260 mA Humidity: 30% RH ~ 85% RH	--	50,000	--	Hrs (Note 7.3)
Operating Temp.	Humidity: 30% RH ~ 85% RH	-20	--	70	°C
Storage Temp.	Humidity: 30% RH ~ 85% RH	-30	--	80	°C
Limit Resistor (R2)	Ta = 25°C	--	4.5	--	Ohm (Note 7.4)

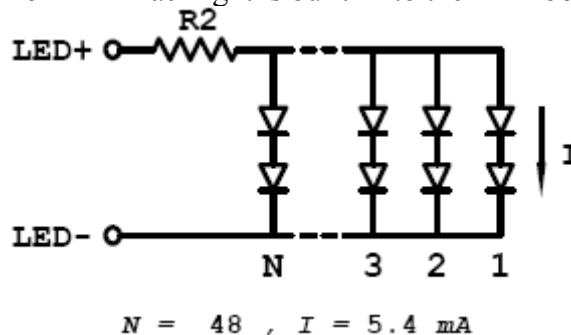
Note 7.1: Average brightness of 3 points when B/L is used at the beginning.

Note 7.2: Brightness uniformity = (MIN / MAX) x 100 %.

Note 7.3: Half of the original average brightness.



Note 7.4: The limit resistor R2 of LED Backlight is built-in to the LED board.



8 RELIABILITY TEST

8.1 RELIABILITY CHARACTERISTICS (NORMAL TEMP.)

Test Item	Test Condition	Remarks
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 (NO operation state)	-20 °C (30 min.) → 25 °C (5 min.) → 70 °C (30 min.) → 25 °C (5 min.) 5 cycles	No abnormalities in function and appearance
Vibration (No operation state)	10 Hz ~ 55 Hz 0.3 mm / 1 Octave 55 Hz ~ 500 Hz 3g / 1 Octave 20 cycles per axis	No abnormalities in function and appearance

8.2 RELIABILITY CHARACTERISTICS (WIDE TEMP.)

Test Item	Test Condition	Remarks
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 (NO operation state)	-30 °C (30 min.) → 25 °C (5 min.) → 80 °C (30 min.) → 25 °C (5 min.) 5 cycles	No abnormalities in function and appearance
Vibration (No operation state)	10 Hz ~ 55 Hz 0.3 mm / 1 Octave 55 Hz ~ 500 Hz 3g / 1 Octave 20 cycles per axis	No abnormalities in function and appearance

8.3 MTBF OF LIQUID CRYSTAL PANEL

50,000 hours, 90% Confidence Level at 25 °C and 65% RH Max.

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

- Current consumption increases three times the initial value.
- Damaged glass, plug and/or polarizer of the LCD.
- Non-operational display.

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9 OPERATING INSTRUCTIONS

9.1 I/O PIN FUNCTION (ARRAY LED B/L)

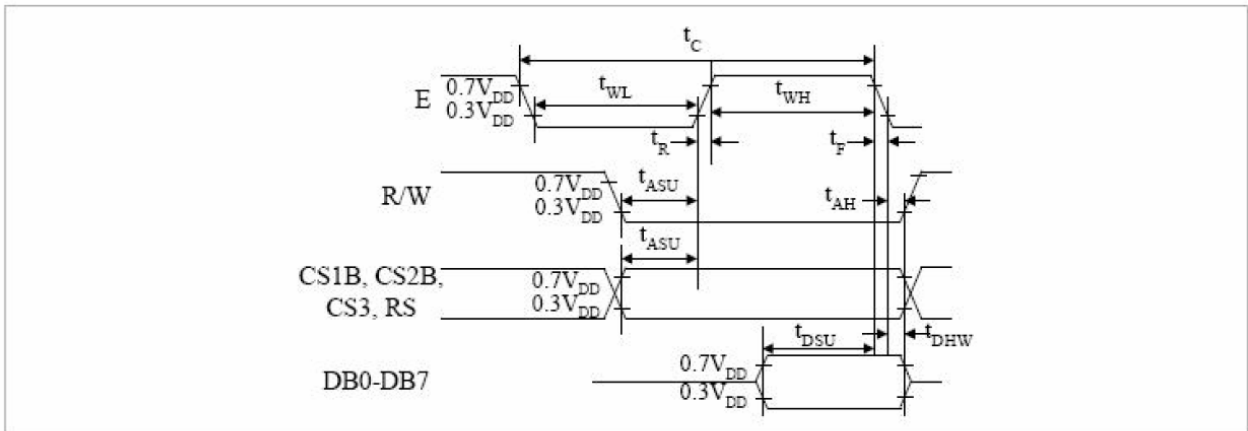
Pin No.	Function	Level	Description
1	Vss	---	Power Supply (0V,GND)
2	Vdd	---	Power Supply for Logic
3	Vo	---	Voltage Level for LCD Control Adjustment
4	RS	I	Register Select H -> DB<0:7> : Instruction Register L -> DB<0:7> : Display RAM data
5	R/W	I	Read / Write signal H : Data Write (at falling of E when CS1B=L , CS2B=L and CS3=H) L : Data Read (when E=H , CS1B=L , CS2B=L and CS3=H)
6	E	I	Enable Signal
7 ~ 14	DB0 ~ 7	I/O	Display Data 0 ~ 7
15	/CS1	I	Chip select 1
16	/RST	I	Reset signal
17	Vee	---	Alternative Power Supply
18	/CS2	I	Chip select 2
19	N/A	---	No connection
20	N/A	---	No connection
BL1	LED(+)	---	Anode of LED B/L
BL2	LED(-)	---	Cathode of LED B/L

9.2 AC CHARACTERISTICS – INTERFACE TIMING DIAGRAM

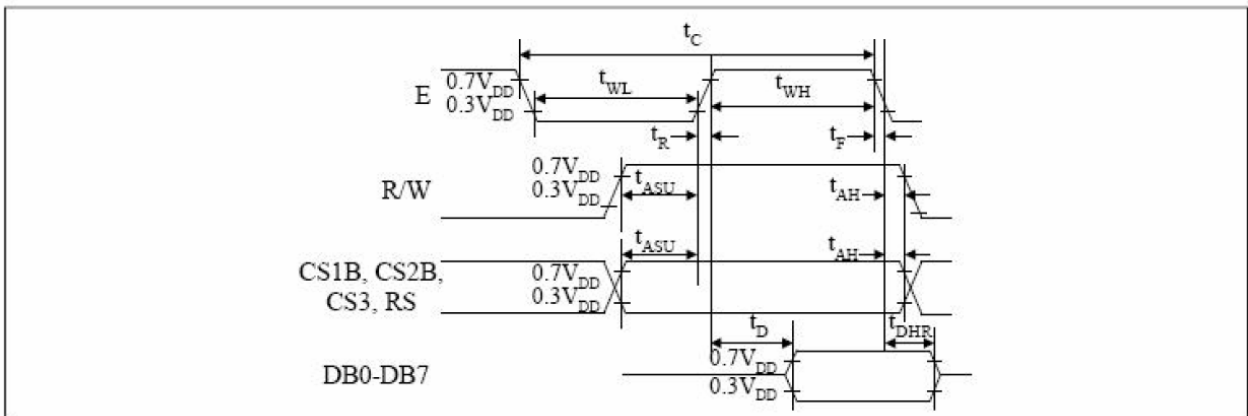
(V_{DD} = 5 V ± 10%, T_a = -30°C to +85°C)

MPU Interface

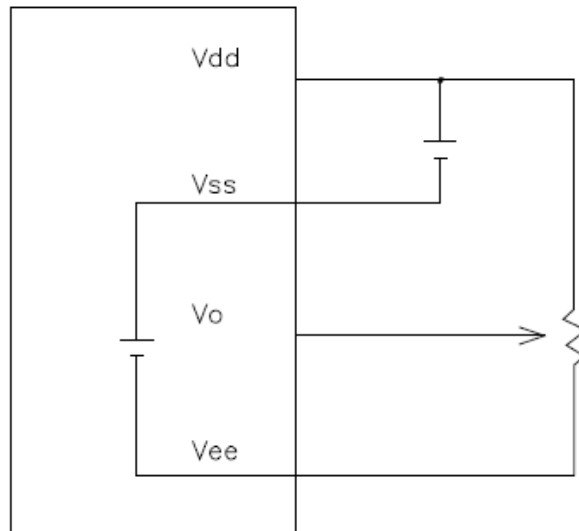
Characteristic	Symbol	Min	Type	Max	Unit
E cycle	t _C	1000	-	-	ns
E high level width	t _{WH}	450	-	-	
E low level width	t _{WL}	450	-	-	
E rise time	t _R	-	-	25	
E fall time	t _F	-	-	25	
Address set-up time	t _{ASU}	140	-	-	
Address hold time	t _{AH}	10	-	-	ns
Data set-up time	t _{DSU}	200	-	-	
Data delay time	t _D	-	-	320	
Data hold time (write)	t _{DHW}	10	-	-	
Data hold time (read)	t _{DHR}	20	-	-	



MPU Write Timing



10 POWER SUPPLY

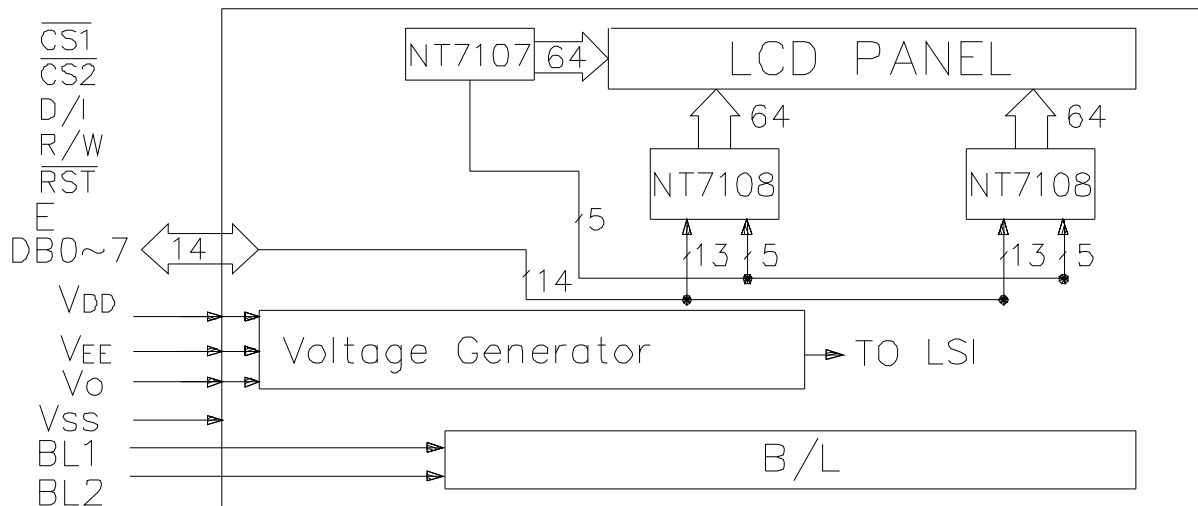


Negative Voltage built in

Note:

1. The Input Voltage for LCM ($V_{dd} - V_{ss}$) is 5 V.
2. The Recommended resistance of V_r is between 10k and 20k Ohms.

11 BLOCK DIAGRAM



12 LABELING DESCRIPTION

DENSITRON E
R4328BG-SNY
TAIWAN YMM

13 PART NUMBER DESCRIPTION FOR AVAILABLE OPTIONS

LER4328①②128G64③④⑤

- ① **Polarizer Type**
B = Transflective Positive Mode
- ② **Backlight Color**
G = Yellow-Green
- ③ **Fluid Type and Temperature Range**
S = Standard temp. range; on-board Negative voltage supply generator
- ④ **Fluid Type and Temperature Compensation**
N = STN
- ⑤ **Background Color**
Y = Yellow mode STN

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14 QUALITY ASSURANCE SPECIFICATION

14.1 CONFORMITY

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

14.2 DELIVERY ASSURANCE

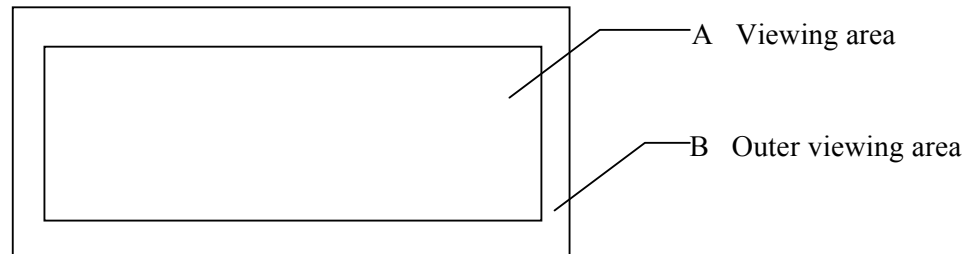
11.2.1 Delivery Inspection Standards

- IPC-AA610, Class 2 Electronic assemblies' standard.

The Quality assurance levels are shown below:

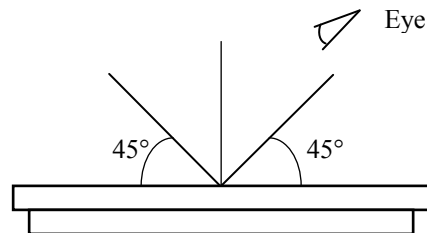
Rank	Item Inspected	Defect type	AQL	Remark
Major defect	Display	No display	0.25%	Fit/Function defect
		Over current		
		Missing segment		
		Wrong Viewing direction		
		Incorrect operation		
		No Backlight		
	Flickering Backlight			
	Dimensions	PCB and/or Bezel out of Specifications		
Minor defect	LCD	Black and White spots	1.0%	Appearance defect
		Black and White lines		
		Polarizer Scratches		
		Bubbles in Polarizer		
		Segment deformations, Pin holes		
		Color Defect		
		Glass Chips		
	COB	Wire Bonding Pad exposed		
		Insufficient covering with Resin (Wire Bonding line exposed)		
		Bubbles or Dust on COB		
	PCB	Dust or Solder balls on PCB		
		Pad Scratches		
	Tray	Particles		
Total			1.0%	

11.2.2 Zone Definition



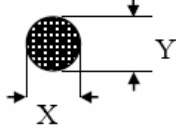
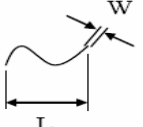
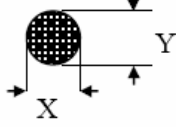
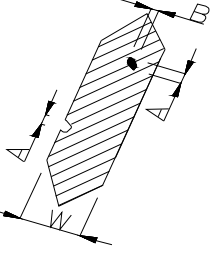
11.2.3 Visual Inspection

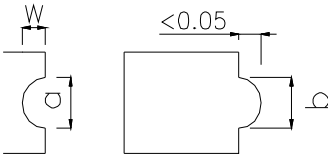
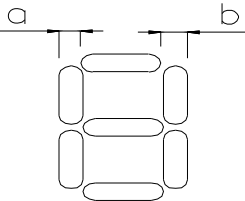
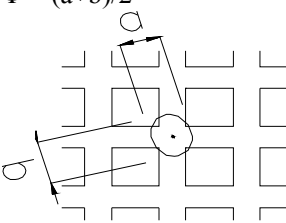
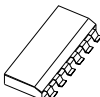
- ❖ Inspect under 2 x 20 W or one 40 W fluorescent lamp (approximately 3000 lux.) leaving 25 to 30 cm between the module and the lamp and 30 cm between the module and the eye. (Measuring position).
- ❖ Appearance is inspected at the best contrast voltage (best contrast is adjusted by considering clarity and crosstalk on the screen).
- ❖ Inspect the module at 45° right and left, top and bottom.
- ❖ Use the optimum viewing angle during the contrast inspection.



11.2.3.1 Standard of Appearance Inspection

Unit: mm

No.	Item	Criteria																															
1	Black spot, White spot, Dust	<p>Round type as shown: $\Phi = (X+Y)/2$</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>$\Phi < 0.2$</td> <td>Any number</td> <td rowspan="3">Any number</td> </tr> <tr> <td>$0.2 < \Phi < 0.25$</td> <td>2</td> </tr> <tr> <td>$0.25 < \Phi$</td> <td>0</td> </tr> </tbody> </table> <p>Line type as shown:</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>$W \leq 0.03$</td> <td>Any number</td> <td rowspan="3">Any number</td> </tr> <tr> <td>$L \leq 3$</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>Total acceptable quantity: 5</p>	Acceptable quantity			Size	Zone A	Zone B	$\Phi < 0.2$	Any number	Any number	$0.2 < \Phi < 0.25$	2	$0.25 < \Phi$	0	Acceptable quantity				Length	Width	Zone A	Zone B	-	$W \leq 0.03$	Any number	Any number	$L \leq 3$	$0.03 < W \leq 0.05$	2	-	$0.05 < W$	As round type
Acceptable quantity																																	
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$0.25 < \Phi$	0																																
Acceptable quantity																																	
Length	Width	Zone A	Zone B																														
-	$W \leq 0.03$	Any number	Any number																														
$L \leq 3$	$0.03 < W \leq 0.05$	2																															
-	$0.05 < W$	As round type																															
2	Polarizer Scratch	Scratch on Protective film is permitted. Scratch on Polarizer: Same as 1.																															
3	Polarizer Bubble	<p>$\Phi = (X+Y)/2$</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>$\Phi < 0.2$</td> <td>Any number</td> <td rowspan="4">Any number</td> </tr> <tr> <td>$0.2 < \Phi < 0.5$</td> <td>3</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: 4</p>	Acceptable quantity			Size	Zone A	Zone B	$\Phi < 0.2$	Any number	Any number	$0.2 < \Phi < 0.5$	3	$0.5 < \Phi < 1.0$	1	$1.0 < \Phi$	0																
Acceptable quantity																																	
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$0.2 < \Phi < 0.5$	3																																
$0.5 < \Phi < 1.0$	1																																
$1.0 < \Phi$	0																																
4	Segment Deformation	<p>I.a. Pin hole on segmented display:</p> <p>W: Segment Width</p> <p>$\Phi = (A+B)/2$</p>  <table border="1" style="margin-left: 200px;"> <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 $\Phi \leq 1/2 W$</td> </tr> <tr> <td>$W > 0.4$</td> <td>$\Phi \leq 0.25$ and $\Phi \leq (1/3)W$</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 $\Phi \leq 1/2 W$	$W > 0.4$	$\Phi \leq 0.25$ and $\Phi \leq (1/3)W$																							
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$W > 0.4$	$\Phi \leq 0.25$ and $\Phi \leq (1/3)W$																																

No.	Item	Criteria																												
4	Segment Deformation	<p>1.b. Pin hole on dot matrix display:</p>  <table border="1" data-bbox="876 325 1307 493"> <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>$0.5 < \Phi < 1.0$</td> <td>3</td> </tr> </tbody> </table> <p>Total acceptable quantity: 7</p> <p>2. Segments / dots with different width:</p>  <table border="1" data-bbox="876 703 1307 808"> <thead> <tr> <th colspan="2">Acceptable limits</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" data-bbox="876 955 1307 1155"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> </thead> <tbody> <tr> <td>Size</td> <td>-</td> </tr> <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	$(a+b)/2 \leq 0.1$	Any number	$0.5 < \Phi < 1.0$	3	Acceptable limits		$a \geq b$	$a/b \leq 4/3$	$a < b$	$a/b > 4/3$	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																														
Size	-																													
$a, b < 0.1$	Any number																													
$(a+b)/2 \leq 0.1$	Any number																													
$0.5 < \Phi < 1.0$	3																													
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Acceptable quantity																														
Size	-																													
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$0.4 < \Phi \leq 1.0$	5																													
$1.0 < \Phi \leq 1.5$	3																													
$1.5 < \Phi \leq 2.0$	2																													
5	Color Uniformity	Level of samples for approval is set as the limit.																												
6	Backlight	The backlight color should correspond to the product specification. Flashing / flickering and / or non-functioning backlight is not allowed. Dust larger than 0.25 mm is not allowed.																												
7	COB	Exposed wire bonding pad is not allowed. Insufficient covering with resin is not allowed. (Exposed Wire bonding line) Dust or bubbles on the resin are not allowed.																												
8	 PCB	Non-melted solder paste should not be present on the PCB. Cold solder joints, missing solder connections, or oxidation is not allowed. Residue or solder balls on the PCB are not allowed. Short circuits on components are not allowed.																												

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 polarizer 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 terminals 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 sunlight 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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