

LIQUID CRYSTAL DISPLAY MODULE

Standard Product Specification

PRODUCT NUMBER	LR4828
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INTERNAL APPROVALS		
Product Manager	Engineering	Document Control
Date:	Date:	Date:

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REVISION RECORD

Rev.	Date	Page	Chap.	Comment	ECN no.
A	10/23/06	--	--	Initial Standard Product Release, ROHS	E3283

1 DESCRIPTION & MAIN FEATURES

1.1 DESCRIPTION

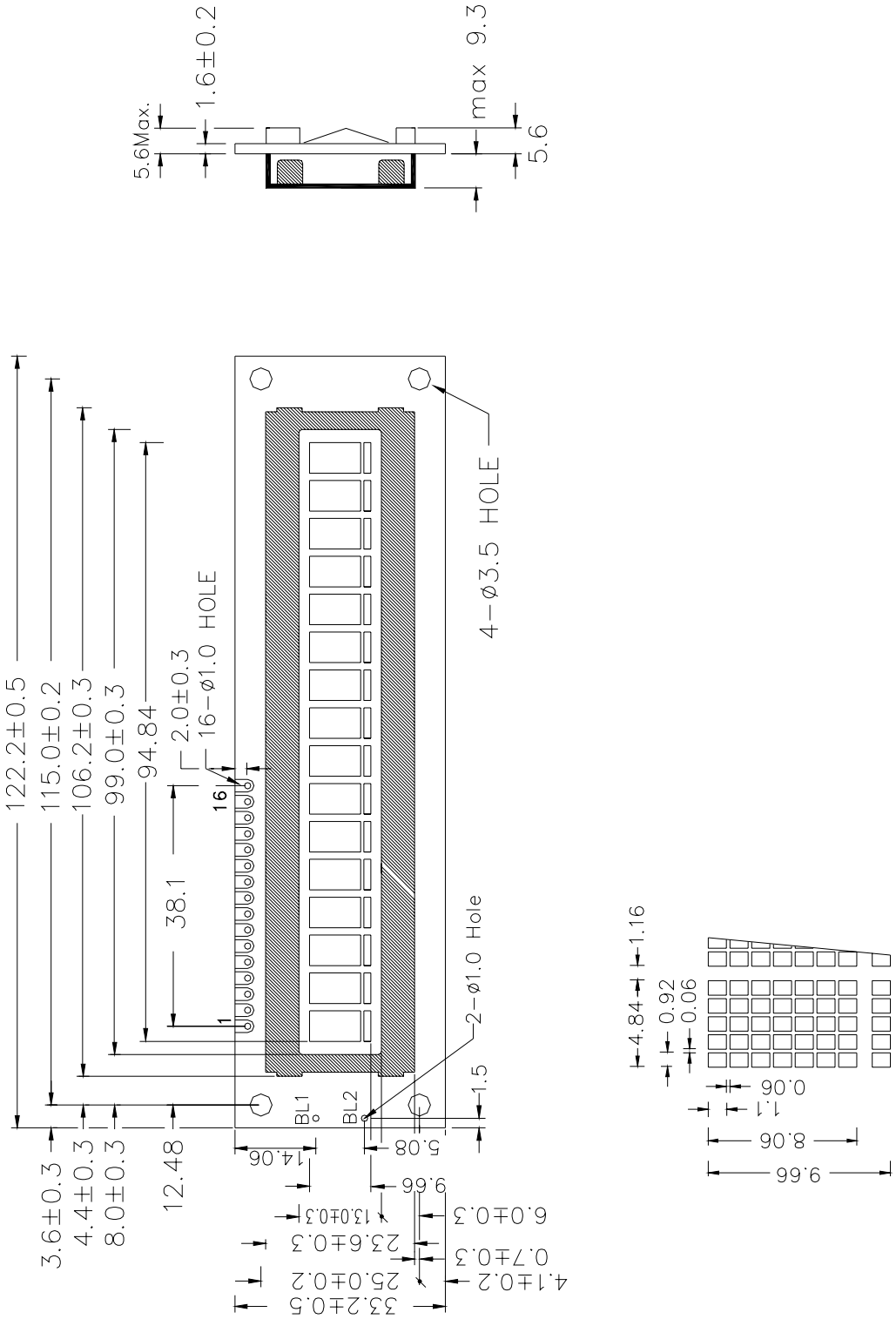
Dot matrix display module consisting of a Liquid Crystal Display, CMOS driver and controller LSI, printed circuit board and metal support frame and edge type Light Emitting Diode (LED) backlight.

Available LC fluids types are: STN (supertwisted nematic).

1.2 MECHANICAL CHARACTERISTICS

ITEM	SPECIFICATION	UNIT
Module Dimensions	122.2 (W) x 33.2 (H) x 14.9 max.(D)	mm
Display Format	1 Line x 16 Characters	--
Character Font Format	5 (W) x 7 (H) with attached cursor	dots
Duty Ratio	1/16	--
Dot Size	0.92 (W) x 1.1 (H)	mm
Dot Pitch	0.98 (W) x 1.16 (H)	mm
Character Size	4.84 (W) x 9.66 (H)	mm
Active Area	94.84 (W) x 9.66 (H)	mm
Viewing Area	99.0 (W) x 13.0 (H)	mm
ROHS Compliant	Yes	

1.3 MECHANICAL DRAWING



2 ELECTRICAL SPECIFICATION

2.1 ABSOLUTE MAXIMUM RATINGS

VSS = 0 V, Ta = 25 °C

Item	Symbol	Min	Max	Unit	Note
Power Supply Voltage	V _{DD}	0	7	V	
LC driver supply voltage	V _{DD} -V _O	0	10.0	V	
Operating Temperature	Top	-20	+70	°C	Note 1,3
Storage Temperature	Tst	-30	+80	°C	Note 2
Humidity: Operating (@40°C,	--	--	65%		Note 4
Humidity: Non-operating (@40°C.	--	--	90%		Note 4

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

Note 3: Tested to 100 hrs.

Note 4: Refers to non-condensing conditions.

Note 5: It is not recommended to operate EL lamp above 50°C.

2.2 ELECTRICAL CHARACTERISTICS

VSS = 0 V, Ta = 25 °C

Item	Symbol	Condition	Min	Typ	Max	Unit
Input Voltage	V _{IHC}	Ta = 25°C	2.2	--	V _{DD}	V
	V _{ILC}	Ta = 25°C	--	--	0.6	V
Output Voltage	V _{OH}	I _{OH} =0.205mA	2.4	--	--	V
	V _{OL}	I _{OL} =1.2mA	--	--	0.4	V
Current Consumption	* I _{DD}	V _{DD} = 5.0V	--	2.4	--	mA

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

2.3 RECOMMENDED LC DRIVE VOLTAGE (VDD-VO)

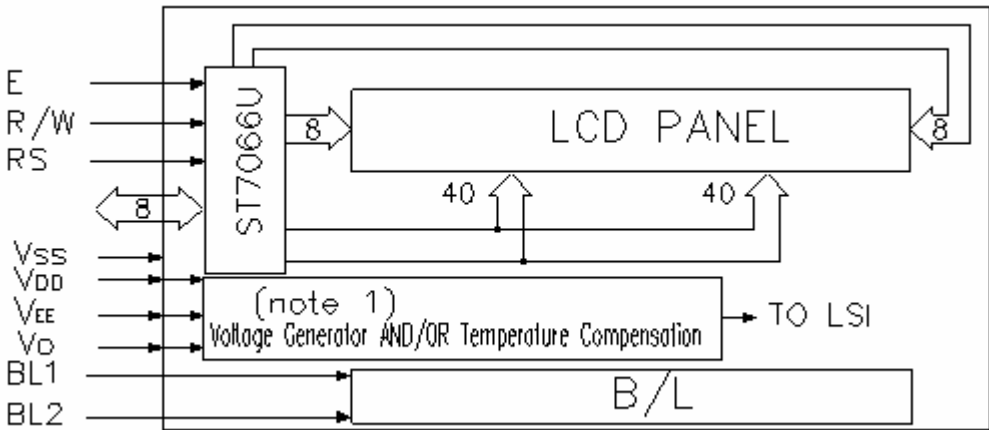
Temperature	STN
Ta = -20°C	--
Ta = 0°C	4.7
Ta = 25°C	4.4
Ta = 50°C	4.1
Ta = 70°C	--

2.4 INTERFACE PIN ASSIGNMENT

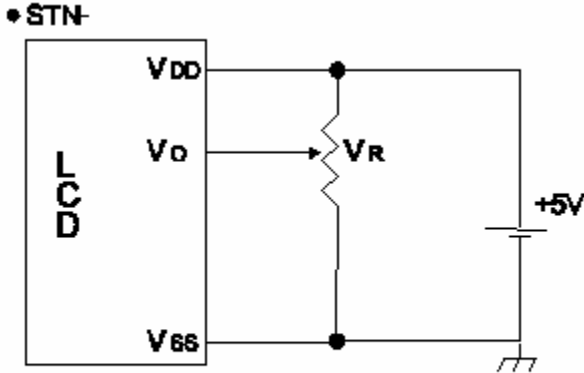
No.	Symbol	I/O	Function
1	V _{SS}	--	Ground (0V), LED-
2	V _{DD}	--	Logic Supply Voltage (+5V)
3	V _O	--	LC Drive voltage for contrast adjustment
4	RS	I	Register Select 0: Instruction Register 1: Data Register
5	R/W	I	Read / Write 0: Data Write (Module ← MPU) 1: Data Read (Module → MPU)
6	E	I	Enable Signal Active High (H → L)
7	DB0	I/O	Bi-directional data bus line 0
8	DB1	I/O	Bi-directional data bus line 1
9	DB2	I/O	Bi-directional data bus line 2
10	DB3	I/O	Bi-directional data bus line 3
11	DB4	I/O	Bi-directional data bus line 4
12	DB5	I/O	Bi-directional data bus line 5
13	DB6	I/O	Bi-directional data bus line 6
14	DB7	I/O	Bi-directional data bus line 7
15	V _{EE}	I/O	Negative voltage input for LC drive (Negative voltage output for modules with on-board negative voltage generator).

16	VLED-	--	Anode (+) LED backlight input voltage
BL1	VLED+	--	Anode (+) LED backlight input voltage
BL2	VLED-	--	Cathode (-) LED backlight input voltage

2.5 BLOCK DIAGRAM



2.6 POWER SUPPLY CIRCUIT



VR = 10K - 20K ohm

RECOMMENDED VR: 10Kohm ~ 20Kohm

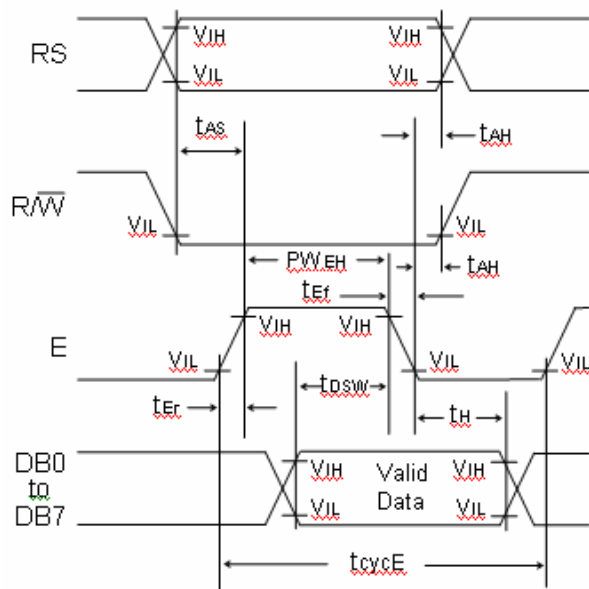
2.7 TIMING CHARACTERISTICS

Note: Please reference the manufacturer’s datasheet for the Sitronix ST7066U controller.

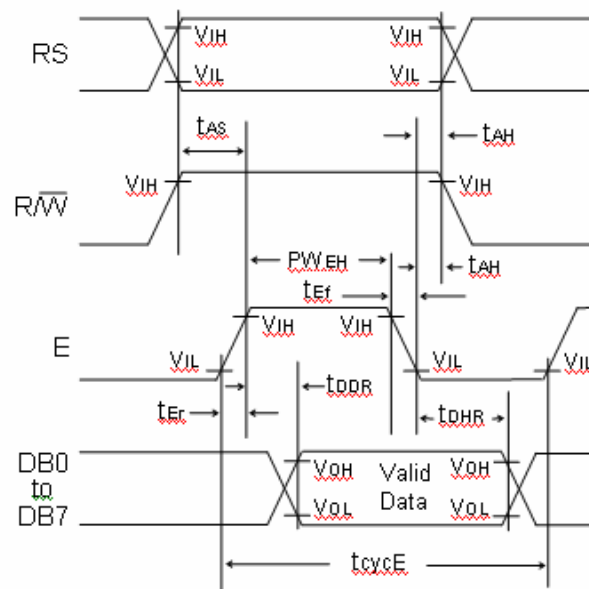
2.8 TIMING CHARACTERISTICS

Item	Symbol	Min.	Typ.	Max.	Unit
Enable cycle time	T_{cycE}	500	-	-	nS
Enable pulse width	PW_{EH}	230	-	-	nS
Enable rise / fall time	t_{Er}/t_{Ef}	-	-	20	nS
Address set-up time	t_{AS}	40	-	-	nS
Address hold time	t_{AH}	10	-	-	nS
Data delay time	t_{DDR}	-	-	160	nS
Data hold time (Write)	t_{DHW}	10	-	-	nS
Data hold time (Read)	t_{DHR}	5	-	-	nS
Data set-up time	t_{DSW}	80	-	-	nS

WRITE OPERATION



READ OPERATION



2.9 DD RAM ADDRESS vs. DISPLAY POSITION

Character	1	2	3	4	5	6	7	8	9	10	11	---	14	15	16
Line 1	00	01	02	03	04	05	06	07	40	41	42	---	45	46	47

3 OPTICAL SPECIFICATION

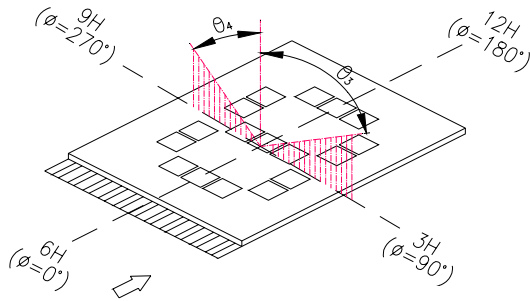
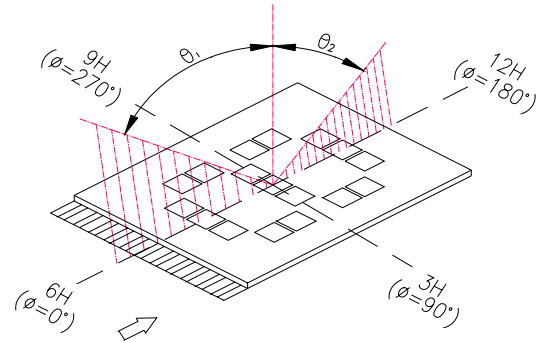
3.1 OPTICAL CHARACTERISTICS

Ta = 25 °C

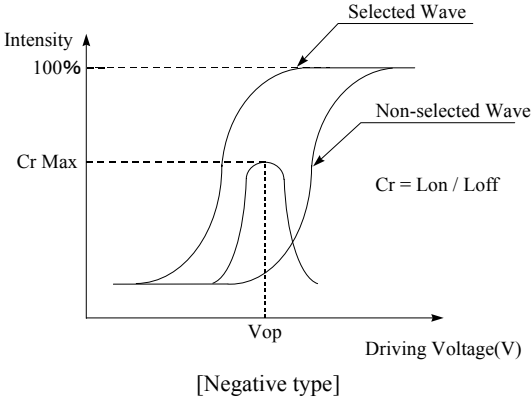
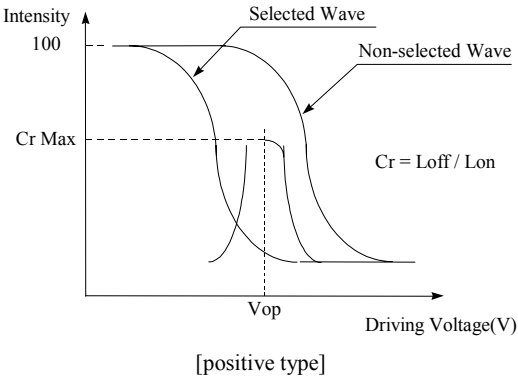
Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Viewing Angle	0°	θ1	CR≥2	--	30	--	deg 1
	180°	θ2	CR≥2	--	30	--	deg 1
	90°	θ3	CR≥2	--	40	--	deg 2
	270°	θ4	CR≥2	--	40	--	deg 2
Contrast Ratio	CR	Ta = 25 °C	4	--	--	-	3
Response Time	Tr	Ta = 25 °C	--	150	250	ms	4
	Tf	Ta = 25 °C	--	150	250		
Driving Method	Duty	1/16					
LCD Type	STN - Positive						
Viewing Direction	6:00						

Note 1: definition of viewing angle θ_1 & θ_2

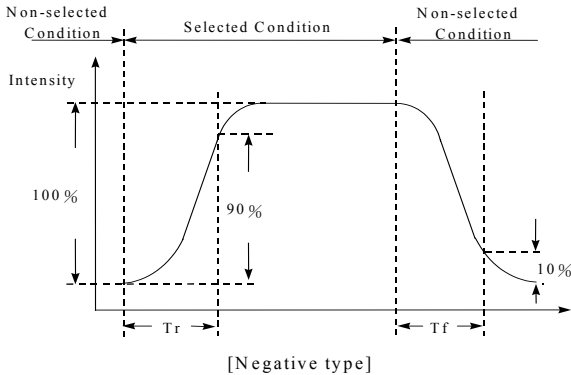
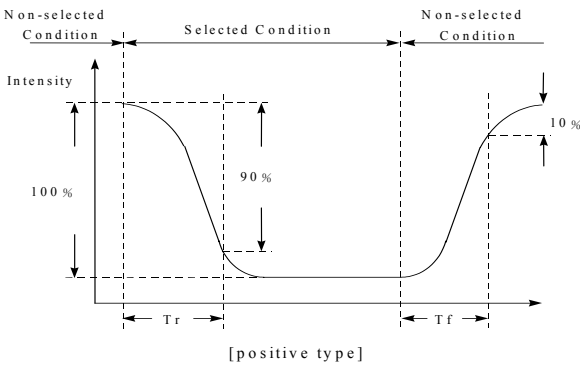
Note 2: definition of viewing angle θ_3 & θ_4



Note 3: definition of contrast ratio (CR)



Note 4: definition of response time

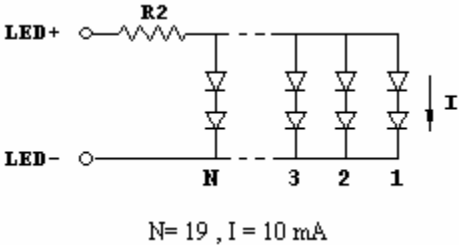


4 BACKLIGHT SPECIFICATION

4.1 BACKLIGHT CHARACTERISTICS

Ta=20°C,60%RH,Darkroom.

Item	Symbol	Typ.	Max.	Unit
LED lamp input voltage	VLED+	5	6	Vrms
LED lamp input current	ILED	190	200	mA
Build-in current limiting resistor	R1	-	-	Ohms, W
External current limiting resistor (recommended)	R2	4.3 Ohms, 1/2W	-	Ohms, W
Number of nodes	N	19	-	-



5 QUALITY ASSURANCE SPECIFICATION

5.1 CONFORMITY

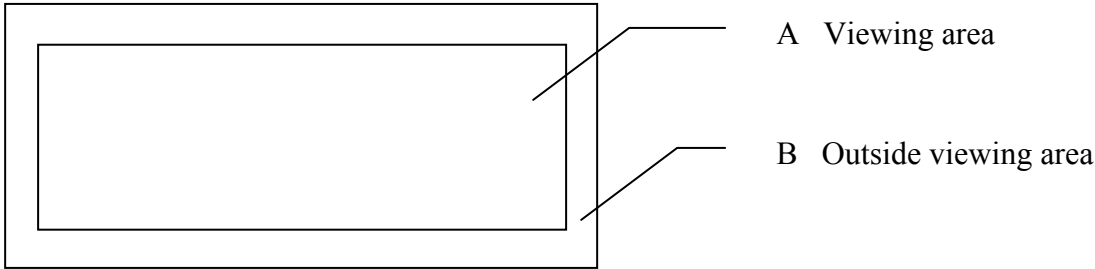
The performance, function and reliability of the shipped products conform to the Product Specification.

5.2 DELIVERY ASSURANCE

5.2.1 Delivery inspection standards

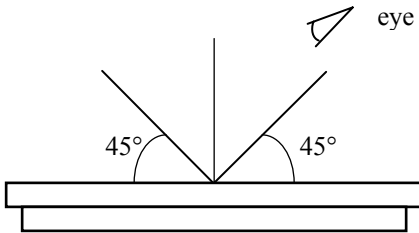
- IPC-AA610, class 2 electronic assemblies standard

5.2.2 Zone definition



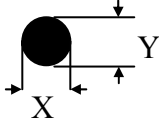
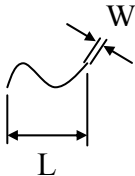
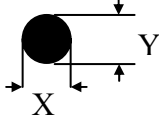
5.2.3 Visual inspection

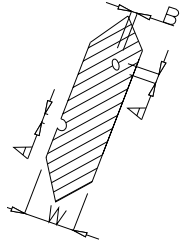
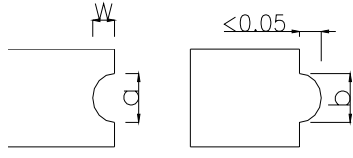
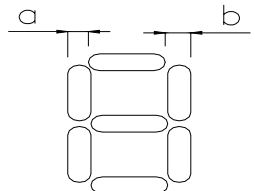
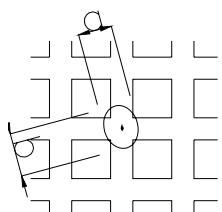
- Inspect under 2x20W or 40W fluorescent lamp (approximately 3000 lux) leaving 25 to 30 cm between the module and the lamp and 30 cm between the module and the eye (measuring position).
- Appearance is inspected at the best contrast voltage (best contrast is adjusted considering clearness and crosstalk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

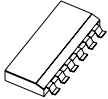


5.2.3.1 Standard of appearance inspection

Units: mm

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 rowspan="2">As round type</td> </tr> <tr> <td>--</td> <td>$0.05 < W$</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	$L \leq 2.5$	$0.03 < W \leq 0.05$	As round type	--	$0.05 < W$
Acceptable quantity																																					
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--	$W \leq 0.02$	Any number	Any number																																		
$L \leq 3.0$	$0.02 < W \leq 0.03$	2																																			
$L \leq 2.5$	$0.03 < W \leq 0.05$	As round type																																			
--	$0.05 < W$																																				
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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$1.0 < \varnothing$	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> <tr> <th>Width</th> <th>\varnothing</th> </tr> </thead> <tbody> <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 $\varnothing \leq 1/3W$																				
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Width	\varnothing																													
$W \leq 0.4$	$\varnothing \leq 0.2$ and $\varnothing \leq 1/2W$																													
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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>$a, b < 0.1$</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> <tr> <th>$a \geq b$</th> <th>$a/b \leq 4/3$</th> </tr> <tr> <th>$a < b$</th> <th>$a/b > 4/3$</th> </tr> </thead> </table> <p>3. Alignment layer defect $\varnothing = (a+b)/2$</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>$\varnothing \leq 0.4$</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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$0.4 < \varnothing \leq 1.0$	5																													
$1.0 < \varnothing \leq 1.5$	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 RELIABILITY SPECIFICATION

6.1 RELIABILITY TESTS

Test Item	Test Condition	Evaluation and assessment
Operation at High Temperature and Humidity	40°C±2°C 90% RH for 240 hours	No abnormalities in function* and appearance**
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	No abnormalities in function* and appearance**
High Temperature Storage	80°C±2°C for 240 hours	No abnormalities in function* and appearance**
Low Temperature Storage	-30°C±2°C for 240 hours	No abnormalities in function* and appearance**
Heat Shock	-30°C (30 min)→ 25°C (5min)→ +80 (30min)→ 25°C (5 min) 10 cycles	No abnormalities in function* and appearance**
Vibration	Sweep for 1 minute at 10Hz, 55Hz, 10Hz, amplitude 1.5mm for 15 minutes in the X, Y and Z directions.	No abnormalities in function* and appearance**
Drop Shock	One angle, three edges and six sides. 75cm above ground (no weight difference).	No abnormalities in function* and appearance**

* Current consumption < 2 times initial value

** Contrast > ½ initial value

6.2 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.

7 PART NUMBER DESCRIPTIONS FOR AVAILABLE OPTIONS

LR4828①②1C16③④⑤

① POLARISER OPTIONS

- A = Reflective: light background, no backlight.
- B = Transflective: light background, with backlight.
(EL or LED backlight).
- E = Transmissive: dark background, with backlight.
- F = Transmissive: light background, with backlight.

② LED BACKLIGHT COLOR

- G = Yellow-green
- A = Amber
- R = Red
- W = White

FORMAT: (1C16=1X16 module format)

③ FLUID TYPE AND POWER SUPPLY

- C = TN with +5VDC or ± 5 VDC operation.
- D = STN/NTN with +5VDC or ± 5 VDC operation.
- S = STN/NTN with +5VDC operation
- H = Extended temp with ± 5 VDC operation

④ FLUID TYPE AND TN VIEWING ANGLE

- B = TN with bottom (6 o'clock) viewing angle
- T = TN with top (12 o'clock) viewing angle
- N = STN/NTN

⑤ TN TEMPERATURE RANGE OR STN/NTN BACKGROUND COLOUR

- Blank = Standard temp TN
- H = Extended temp TN
- Y = Yellow mode STN/NTN (with A, B, F polarisers)
- G = Grey mode STN/NTN (with A, B, F polarisers)
- B = Blue mode STN/NTN (with E polarisers)

8 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).