LIQUID CRYSTAL DISPLAY MODULE

Standard Product Specification

PRODUCT NUMBER	LR2016

Product Mgr	Quality Mgr	Electrical Eng	Document Control
Bruno Recaldini Digitally signed by Bruno Recaldini DN: cn=Bruno Recaldini, c=GB, o=Densitron Technologies, ou=Product Management, email=bruno.recaldini@densitron.co.uk Reason: I am approving this document Date: 2006.03.16 19:36:32 Z			Digitally signed by Robert J. Mendoza DN: CN = Robert J. Mendoza, C = US, O = Densitron Technologies Reason: I am the author of this document Location: Santa Fe Springs, CA. Date: 2006.03.07 08:53:39 -08'00'
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	03/07/06	--	--	New DCA Standard Release	E3026

1 MAIN FEATURES

ITEM		CONTENTS
Display Format		2-Lines x 16-Characters
Colour		Monochrome
Overall Dimensions		84.0 (W) x 44.0 (H) x 11.3 Max (EL type)
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		EL \ Blue-Green
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

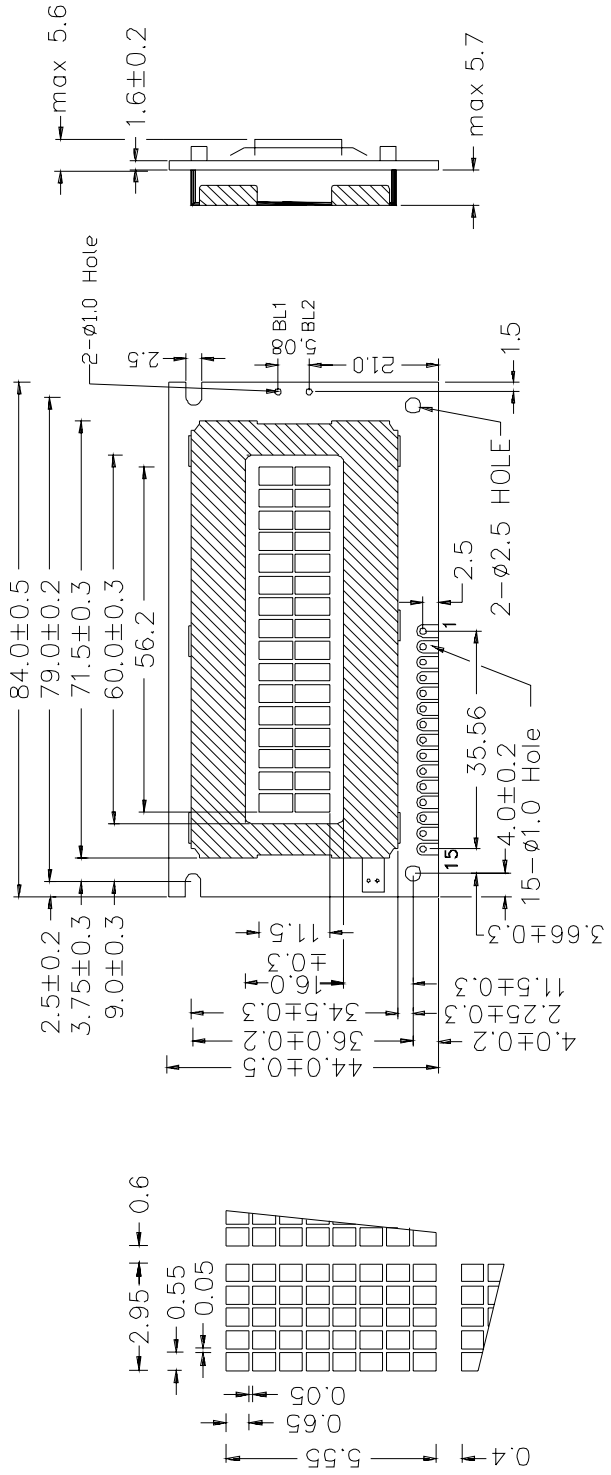
2.1 MECHANICAL CHARACTERISTICS

ITEM	CHARACTERISTIC	UNIT
Display Format	2-Lines x 16-Characters	
Overall Dimensions	84.0 (W) x 44.0 (H) x 11.3 Max (EL type)	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
LR2016
TAIWAN YYMM

2.3 MECHANICAL DRAWING



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	Tst	-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

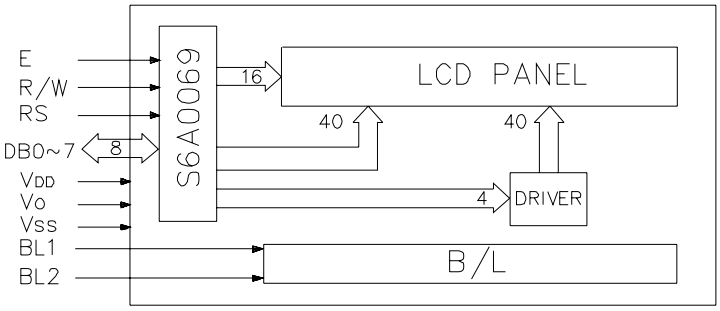
Temperature	STN	STN-H
Ta = -20°C	N\A	7.7
Ta = 0°C	4.8	7.3
Ta = 25°C	4.5	6.9
Ta = 50°C	4.3	6.4
Ta = 70°C	N\A	6.1

3.4 INTERFACE PIN ASSIGNMENT

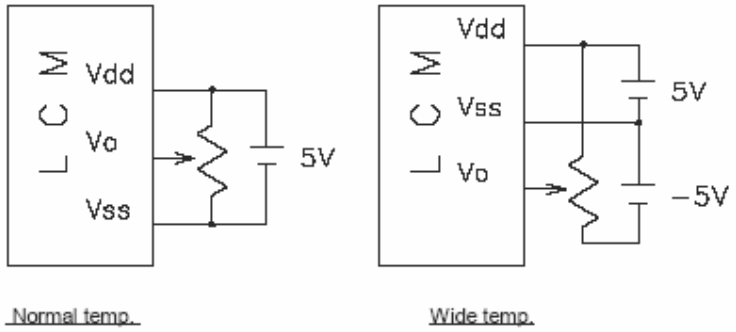
3.4.1 I/O PIN FUNCTION (EL)

Pin No.	Function	Level	Description
1	VSS	–	Ground (0V)
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	EL		EL B/L
BL2	EL		EL B/L

3.5 BLOCK DIAGRAM



3.6 POWER SUPPLY CIRCUIT



RECOMMENDED VR : 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.

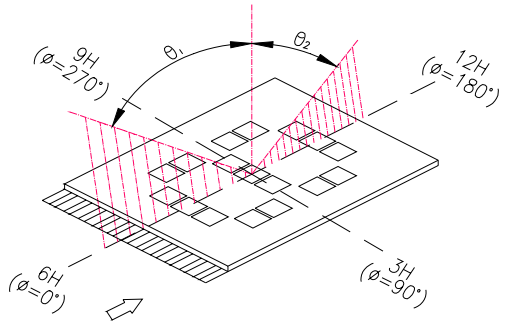
4 OPTICAL SPECIFICATION

4.1 OPTICAL CHARACTERISTICS

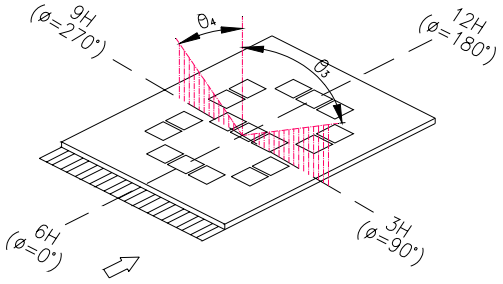
Ta = 25 °C

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						

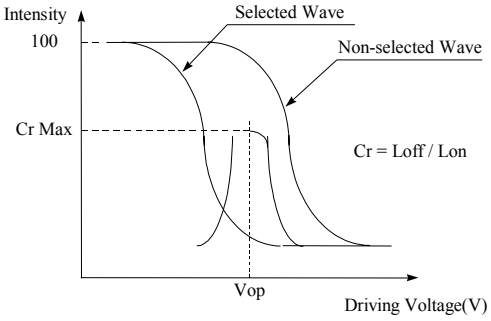
Note 1: definition of viewing angle θ1 & θ2



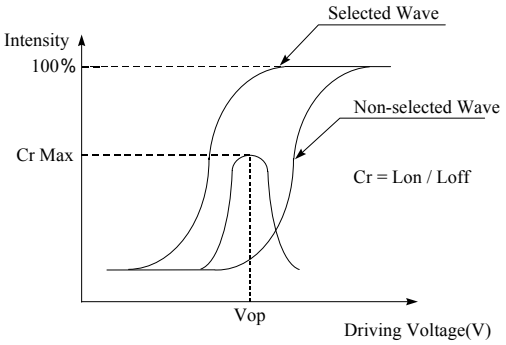
Note 2: definition of viewing angle θ3 & θ4



Note 3: definition of contrast ratio (CR)

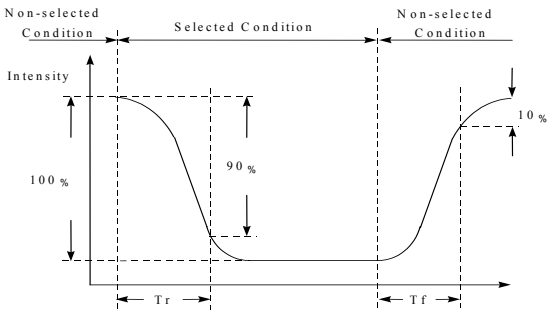


[positive type]

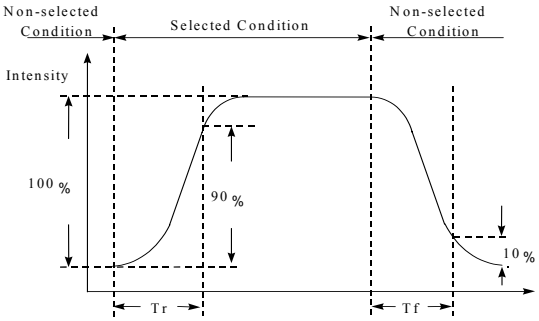


[Negative type]

Note 4: definition of response time



[positive type]



[Negative type]

5 BACKLIGHT SPECIFICATION

5.1 BACKLIGHT CHARACTERISTICS

5.1.1 EL B/L OPERATING RANGE

Item	Conditions	Standard			Unit
		Min.	Typ.	Max.	
Input voltage	Ta = 25 C (400 ~ 800 Hz)	---	100	---	Vrms
Current consumption	Ta = 25 C		1.7		mA
Average brightness (B/L only) (Ta=25C, I =1.7mA)	Test when connecting after 3 min. Ta=25C (max.contrast)	---	50	---	cd/m2 (Note 2)
Lamp life	Ta = 25 C , I = 1.7 mA Humidity : 30%RH ~ 85%RH	---	3,000	---	Hrs (Note 4)
Operating Temp.	Humidity : 30%RH ~ 85%RH	-20	---	70	C
Storage Temp.	Humidity : 30%RH ~ 85%RH	-30	---	80	C

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

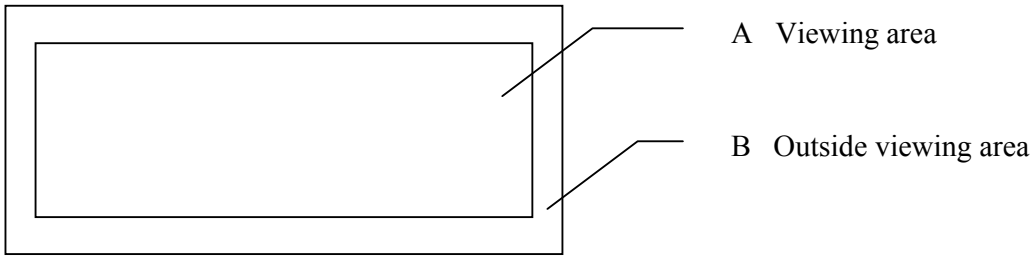
6.2.1 Delivery inspection standards

- 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:

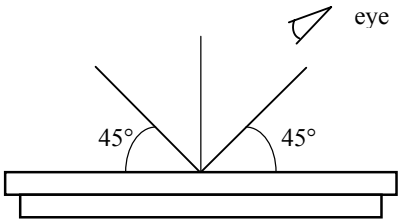
Class	**AQL (%)**
Critical defect	0.5%
Major defect	1.0%
Minor defect	1.5%
TOTAL	2.0%

6.2.2 Zone definition



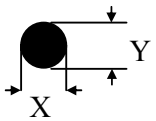
6.2.3 Visual inspection

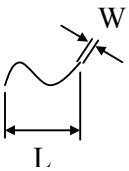
- Inspect under 2x20W or 40W fluorescent lamp (approximately 3000 lux) leaving 25 to 30 cm between the module and the lamp and 30 cm between the module and the eye (measuring position).
- Appearance is inspected at the best contrast voltage (best contrast is adjusted considering clearness and crosstalk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

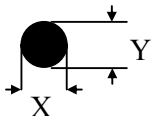


6.2.3.1 Standard of appearance inspection

Units: mm

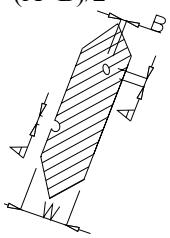
<table>
<tr><th>Class</th><th>Item</th><th>Criteria</th></tr>
<tr><td>Minor</td><td rowspan="2">Packing & Label</td><td>Outside & inside package | Presence of product no., lot no., quantity</td></tr>
<tr><td>Critical</td><td>Product must not be mixed with others and quantity must not be different from that indicated on the label</td></tr>
<tr><td>Major</td><td>Dimension</td><td>Product dimensions must be according to specification and drawing</td></tr>
<tr><td>Major</td><td>Electrical</td><td>Product electrical characteristics must be according to specification</td></tr>
<tr><td>Critical</td><td>LCD Display</td><td>Missing lines or wrong patterns on LCD display are not allowed</td></tr>
<tr><td>Minor</td><td>Black spot, white spot, dust</td><td>Round type: as per following drawing
∅ = (X+Y)/2
 

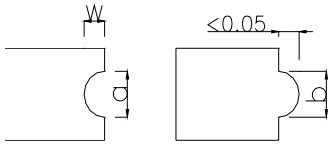
<table><tr><th colspan="3">Acceptable quantity</th></tr><tr><th>Size</th><th>Zone A</th><th>Zone B</th></tr><tr><td>∅<0.1</td><td>Any number</td><td rowspan="4">Any number</td></tr><tr><td>0.1<∅<0.2</td><td>2</td></tr><tr><td>0.2<∅<0.25</td><td>1</td></tr><tr><td>0.25<∅</td><td>0</td></tr></table>
Line type: as per following drawing
 

<table><tr><th colspan="4">Acceptable quantity</th></tr><tr><th>Length</th><th>Width</th><th>Zone A</th><th>Zone B</th></tr><tr><td>- -</td><td>W≤0.02</td><td>Any number</td><td rowspan="4">Any number</td></tr><tr><td>L≤3.0</td><td>0.02<W≤0.03</td><td rowspan="2">2</td></tr><tr><td>L≤2.5</td><td>0.03<W≤0.05</td></tr><tr><td>- -</td><td>0.05<W</td><td>As round type</td></tr></table>
Total acceptable quantity: 3</td></tr>
<tr><td>Minor</td><td>Polariser scratch</td><td>Scratch on protective film is permitted
Scratch on polariser: same as No. 1</td></tr>
<tr><td>Minor</td><td>Polariser bubble</td><td>∅ = (X+Y)/2
 

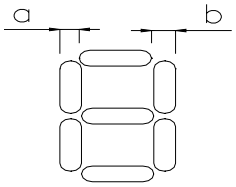
<table><tr><th colspan="3">Acceptable quantity</th></tr><tr><th>Size</th><th>Zone A</th><th>Zone B</th></tr><tr><td>∅<0.2</td><td>Any number</td><td rowspan="4">Any number</td></tr><tr><td>0.2<∅<0.5</td><td>2</td></tr><tr><td>0.5<∅<1.0</td><td>1</td></tr><tr><td>1.0<∅</td><td>0</td></tr></table>
Total acceptable quantity: 3</td></tr>
</table>

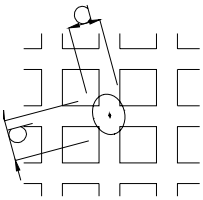
<table>
<tr><th>Class</th><th>Item</th><th>Criteria</th></tr>
<tr><td>Minor</td><td>Segment deformation</td><td>1.a. Pin hole on segmented display

W: segment width
∅ = (A+B)/2
 

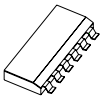
<table>
<tr><th colspan="2">Acceptable quantity</th></tr>
<tr><td>Width</td><td>∅</td></tr>
<tr><td>W≤0.4</td><td>∅≤0.2 and ∅≤1/2W</td></tr>
<tr><td>W>0.4</td><td>∅≤0.25 and ∅≤1/3W</td></tr>
</table>
Total acceptable quantity: 1 defect per segment
Pin holes with ∅ under 0.10 mm are acceptable</td></tr>
<tr><td>Minor</td><td>Segment deformation</td><td>1b. Pin hole on dot matrix display
 

<table>
<tr><th colspan="2">Acceptable quantity</th></tr>
<tr><td>Size</td><td></td></tr>
<tr><td>a,b<0.1</td><td>Any number</td></tr>
<tr><td>(a+b)/2≤0.1</td><td>Any number</td></tr>
<tr><td>0.5<∅<1.0</td><td>3</td></tr>
</table>
Total acceptable quantity: 7

2. Segments / dots with different width
 

<table>
<tr><th colspan="2">Acceptable</th></tr>
<tr><td>a≥b</td><td>a/b≤4/3</td></tr>
<tr><td>a<b</td><td>a/b>4/3</td></tr>
</table>
3. Alignment layer defect
∅ = (a+b)/2
 

<table>
<tr><th colspan="2">Acceptable quantity</th></tr>
<tr><td>Size</td><td></td></tr>
<tr><td>∅≤0.4</td><td>Any number</td></tr>
<tr><td>0.4<∅≤1.0</td><td>5</td></tr>
<tr><td>1.0<∅≤1.5</td><td>3</td></tr>
<tr><td>1.5<∅≤2.0</td><td>2</td></tr>
</table>
Total acceptable quantity: 7</td></tr>
<tr><td>Minor</td><td>Colour uniformity</td><td>Level of sample for approval set as limit sample</td></tr>
<tr><td>Critical</td><td rowspan="3">Backlight</td><td>The backlight colour should correspond to the product specification</td></tr>
<tr><td>Critical</td><td>Flashing and or unlit backlight is not allowed</td></tr>
<tr><td>Minor</td><td>Dust larger than 0.25 mm is not allowed</td></tr>
<tr><td>Major</td><td rowspan="3">COB</td><td>Exposed wire bond pad is not allowed</td></tr>
<tr><td>Major</td><td>Insufficient covering with resin is not allowed (wire bond line exposed)</td></tr>
<tr><td>Minor</td><td>Dust or bubble on the resin are not allowed</td></tr>
</table>

Class	Item	Criteria
Major	PCB 	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	

	Size	Quantity
On tray	∅<0.2	Any number
	∅>0.25	4
On display	∅≥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

LR2016①②2C16③④⑤

①

Polarizer Type

A = Reflective with no backlight
B = Transflective

②

Backlight Color

③

Fluid Type and Power Supply

S = STN/NTN with +5VDC operation
H = Extended temp with ±5VDC operation

④

Fluid Type/TN Viewing Direction

N = STN/NTN

⑤

TN Temperature Range or STN/NTN Background Color

Y = Yellow mode STN/NTN (with A,B,F polarisers)
G = Yellow mode STN/NTN (with A,B,F 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 Trichlorotriflorothane. 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).