

# LIQUID CRYSTAL DISPLAY MODULE

## Product Specification

<b>DENSITRON</b>	<b>STANDARD LCD MODULE</b>	
<b>PRODUCT NUMBER</b>	<b>LM/TS 3066 – LM/TS4066 – LM/TS6066</b>	
<b>DEFINITION</b>	<b>Display 320*240 dots</b>	<b>Date 19/04/04</b>

<b>INTERNAL APPROVALS</b>				
<b>Quality Mgr</b>	<b>Product Mgr</b>	<b>Project Leader</b>	<b>Mech. Eng</b>	<b>Electr. Eng</b>
<b>Date:</b>	<b>Date:</b>	<b>Date:</b>	<b>Date:</b>	<b>Date:</b>

# TABLE OF CONTENTS

<b>1</b>	<b>PART NUMBERING SYSTEM .....</b>	<b>4</b>
<b>2</b>	<b>MAIN FEATURES.....</b>	<b>5</b>
<b>3</b>	<b>MECHANICAL SPECIFICATION .....</b>	<b>6</b>
3.1	MECHANICAL CHARACTERISTICS.....	6
3.2	MECHANICAL DRAWING.....	7
<b>4</b>	<b>ELECTRICAL SPECIFICATION .....</b>	<b>8</b>
4.1	ABSOLUTE MAXIMUM RATINGS.....	8
4.2	ELECTRICAL CHARACTERISTICS .....	8
4.3	INTERFACE PIN ASSIGNMENT .....	9
4.4	BLOCK DIAGRAM.....	10
4.5	POWER SUPPLY CIRCUIT .....	10
4.6	TIMING CHARACTERISTICS.....	11
<b>5</b>	<b>OPTICAL SPECIFICATION .....</b>	<b>14</b>
<b>6</b>	<b>BACKLIGHT SPECIFICATION.....</b>	<b>16</b>
6.1	WHITE LED EDGE BACKLIGHT CHARACTERISTICS .....	16
6.2	CCFL BACKLIGHT CHARACTERISTICS .....	16
<b>7</b>	<b>QUALITY ASSURANCE SPECIFICATION .....</b>	<b>17</b>
7.1	CONFORMITY .....	17
7.2	DELIVERY ASSURANCE.....	17
7.2.1	<i>Delivery inspection standards.....</i>	<i>17</i>
7.2.2	<i>Zone definition .....</i>	<i>18</i>
7.2.3	<i>Visual inspection.....</i>	<i>18</i>
7.2.4	<i>Standard of appearance inspection.....</i>	<i>19</i>
<b>8</b>	<b>RELIABILITY SPECIFICATION.....</b>	<b>21</b>
<b>9</b>	<b>HANDLING PRECAUTIONS .....</b>	<b>22</b>

REVISION RECORD

<b>Rev.</b>	<b>Date</b>	<b>Page</b>	<b>Chapt.</b>	<b>Comment</b>	<b>ECR no.</b>
1	19/04/04			Initial Specification	

# 1 PART NUMBERING SYSTEM

**LM** ①066②③ – ④⑤⑥ ⑦

①

## **BACKLIGHT TYPE**

- 3 = Module without Backlight or with EL Backlight
- 4 = Module with LED Backlight
- 6 = Module with CCFL Backlight

②

## **POLARIZER TYPE**

- B = Transflective: light background
- E = Transmissive: dark background

③

## **BACKLIGHT COLOR**

- G = Yellow-Green (Standard)
- W = White LED
- None if CCFL Backlight

④

## **FLUID TYPE AND POWER SUPPLY**

- D = Standard temperature range with external negative voltage operation
- S = Standard temperature range with on-board negative voltage generation
- H = Wide temperature range with external negative voltage operation
- W = Wide temperature range with on-board negative voltage generator

⑤

## **TEMPERATURE COMPENSATION CIRCUIT**

- N = Without on board temperature compensation circuit
- C = With on board temperature compensation circuit

⑥

## **COLOR FOR STN FLUID**

- B = STN Blue background (available for E polarizer type only)
- G = STN Blue Pixels on Gray background for B polarizer types only
- Y = STN Blue Pixels on Yellow background for B polarizer types only
- F = FSTN Black Pixels or background depending on B or E polarizer type

⑦

## **ADDITIONAL OPTIONS**

- 12 = it is mentioned if top view angle is needed
- HL = High Luminosity for White LED Backlight if available

**“LM” AT THE BEGINNING OF THE PART NUMBER IS REPLACED BY “TS” IF THE MODULE HAS A TOUCH PANNEL**

## 2 MAIN FEATURES

ITEM	CONTENTS
Display Format	320 * 240 dos
Overall Dimensions	166.8×109.0×11.0(MAX)mm
Viewing Area	122.0×92.0mm
LCD type	STN / FSTN
Mode	Available in Reflective / Transflective / Transmissive
Viewing Angle	6 o'clock
Duty ratio	1/240
Driver IC	None
Backlight type	None / LED / CCFL
Backlight colour	White
DC/DC converter	None or Included
Operating temperature	From 0/+50°C to -20°/+70°C
Storage temperature	From -20°/+70°C to -30°/+80°C

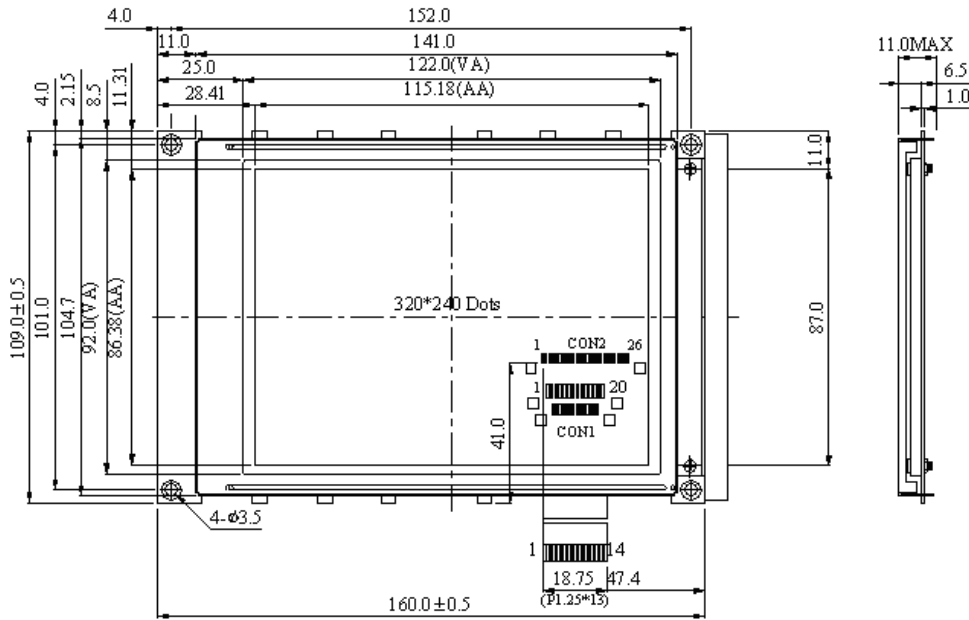
### 3 MECHANICAL SPECIFICATION

#### 3.1 MECHANICAL CHARACTERISTICS

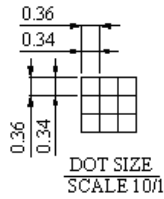
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ITEM	CHARACTERISTIC	UNIT
Display Format	320 * 240 dots	
Overall Dimensions	166.8×109.0×11.0(MAX)	mm
Viewing Area	122.0×92.0	mm
Active Area	115.17×86.37	mm
Dot Size	(L)0.34×(W)0.34	mm
Dot Pitch	(L)0.36×(W)0.36	mm
IC Controller/Driver	None	

### 3.2 MECHANICAL DRAWING



PIN NO.	SYMBOL
1	DB0
2	DB1
3	DB2
4	DB3
5	DISPOFF
6	FLM
7	M
8	LP
9	CP
10	Vdd
11	Vss
12	Vee
13	Vo
14	FGND
15	A
16	K
17	X1
18	X2
19	Y1
20	Y2



## 4 ELECTRICAL SPECIFICATION

### 4.1 ABSOLUTE MAXIMUM RATINGS

VSS = 0 V, Ta = 25 °C

Item	Symbol	Min	Typ	Max	Unit	Note
Power Supply Voltage	$V_{DD}-V_{SS}$	0	-	+6,5	V	
Power Supply for LCD	$V_{DD}-V_0$	0	-	32	V	
Input Voltage	$V_{in}$	$V_{SS}$	-	$V_{DD}$	V	
Operating Temperature	Top	0 -20	-	+50 +70	°C	Note 1
Storage Temperature	Tst	-20 -30	-	+70 +80	°C	Note 2
Static Electricity	Be sure that you are grounded when handling displays.					

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

### 4.2 ELECTRICAL CHARACTERISTICS

VSS = 0 V, Ta = 25 °C

Item	Symbol	Condition	Min	Typ	Max	Unit
Power Supply for Logic	$V_{DD}-V_{SS}$	Ta = 25 °C	4,75	5,0	5,25	V
Input Voltage	$V_{IL}$	Ta = 25 °C	0	-	0,2V <sub>DD</sub>	V
	$V_{IH}$	Ta = 25 °C	0,8V <sub>DD</sub>	-	V <sub>DD</sub>	V
Output Voltage	$V_{OL}$	Ta = 25 °C	0	-	0,4	V
	$V_{OH}$	Ta = 25 °C	V <sub>DD</sub> -0.4	-	V <sub>DD</sub>	V
LCD Module Driving Voltage	$V_{DD}-V_0$	Ta = -20 °C	-	-	26	V
		Ta = 25 °C	-	24	-	V
		Ta = 70 °C	22	-	-	V
Current Consumption	* I <sub>DD</sub>	V <sub>DD</sub> = 5V V <sub>LCD</sub> = -24V	-	87	-	mA

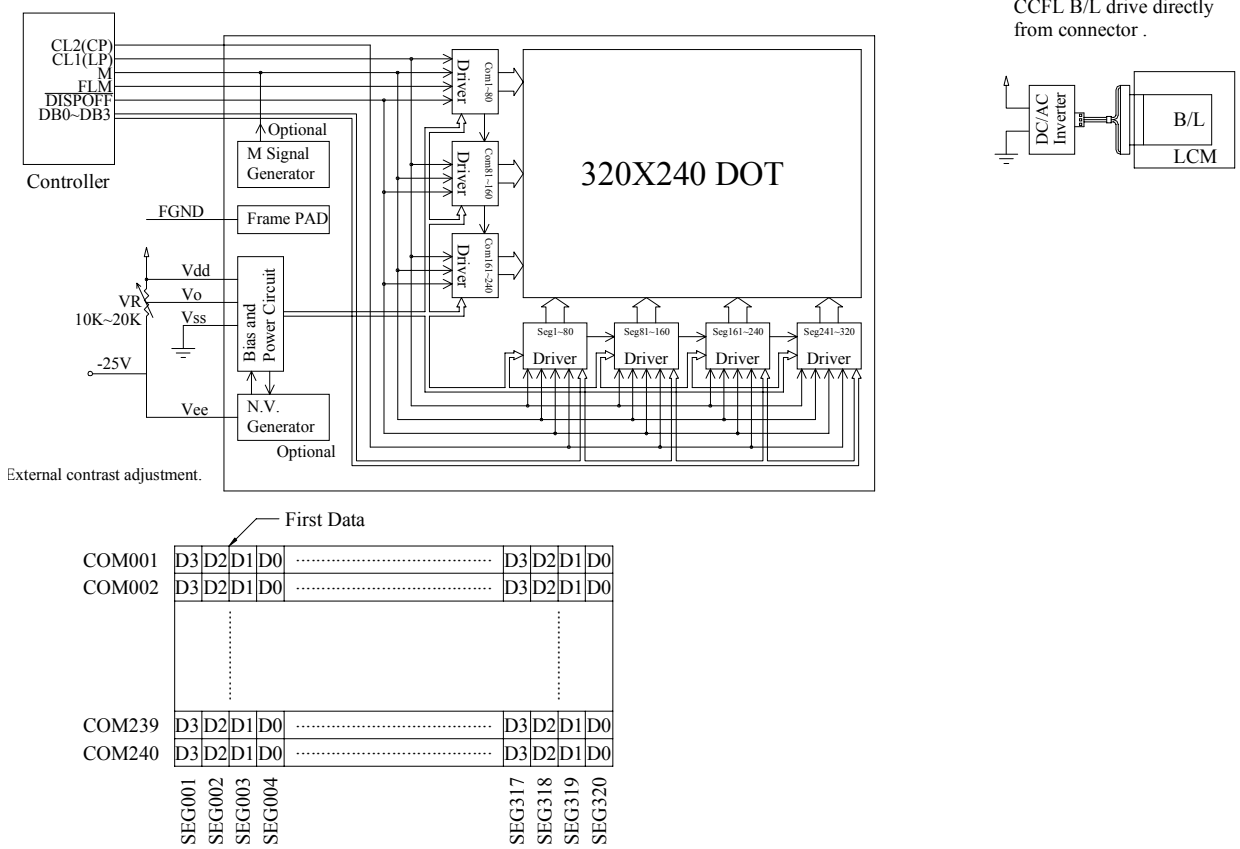
\* I<sub>DD</sub> measurement condition is for all pattern ON



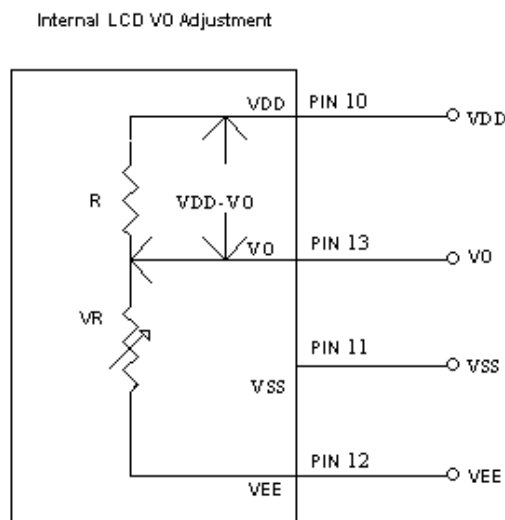
### 4.3 INTERFACE PIN ASSIGNMENT

No.	Symbol	I/O	Function
1	D0	H/L	Display data, bit0
2	D1	H/L	Display data, bit1
3	D2	H/L	Display data, bit2
4	D3	H/L	Display data, bit3
5	DISPOFF	H/L	H: Display ON, L: Display OFF
6	FLM	H/L	Scan start-up signal
7	M(N.C.)	H/L	Frame reverse signal(alternate signal)
8	CL1(LP)	H to L	Data latch pulse
9	CL2(CP)	H to L	Data shift pulse
10	V <sub>DD</sub>	5.0V	Power supply for Logic
11	V <sub>SS</sub>	0V	Ground
12	V <sub>EE</sub>	-	NC
13	V <sub>O</sub>	(Variable)	Driving voltage for LCD
14	FGND		Frame Ground
15	A		Supply power for LED +
16	K		Supply power for LED-
17	X1		NC
18	X2		NC
19	Y1		NC
20	Y2		NC

## 4.4 BLOCK DIAGRAM

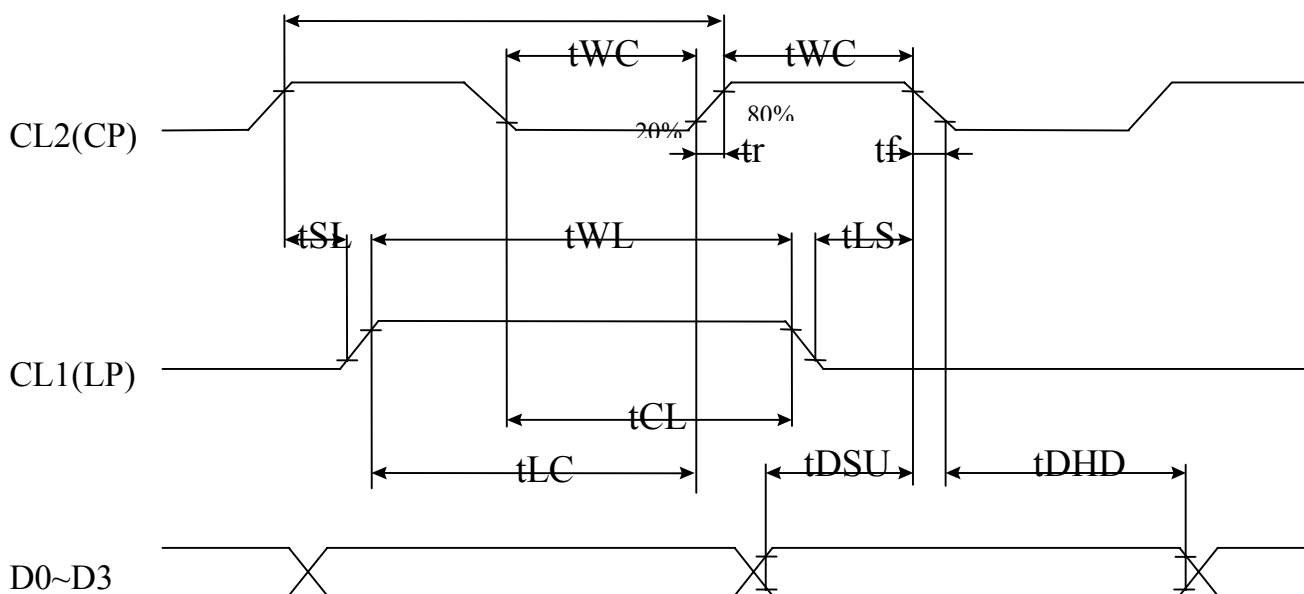


## 4.5 POWER SUPPLY CIRCUIT

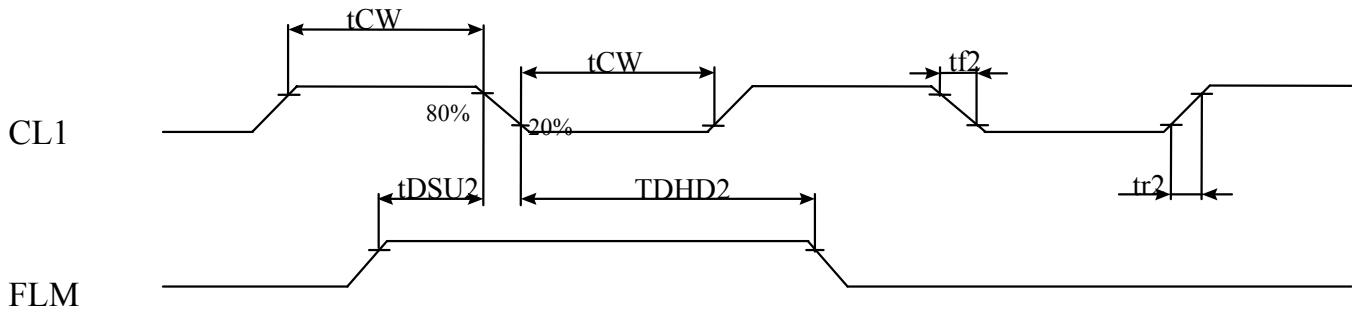


## 4.6 TIMING CHARACTERISTICS

Item	Symbol	Min	Typ	Max	Unit
Clock Cycle	tC	100	—	—	ns
CP Pulse Width	tWC	50	—	—	ns
LP Pulse Width	tWL	50	—	—	ns
Data Set Up Time	tDSU	30	—	—	ns
Data Hold Time	tDHD	30	—	—	ns
CP Rise/Fall Time	tr,tf	—	—	50	ns
CP to LOAD	tCL	80	—	—	ns
LOAD to CP	tLC	110	—	—	ns
LP Pulse Width	tLW	50	—	—	ns
CL1 Pulse Width	tCW	63	—	—	ns
Data Set Up Time	tDSU2	100	—	—	ns
Data Hold Time	tDHD2	100	—	—	ns
CL1 Rise/Fall Time	tr2,tf2	—	—	50	ns

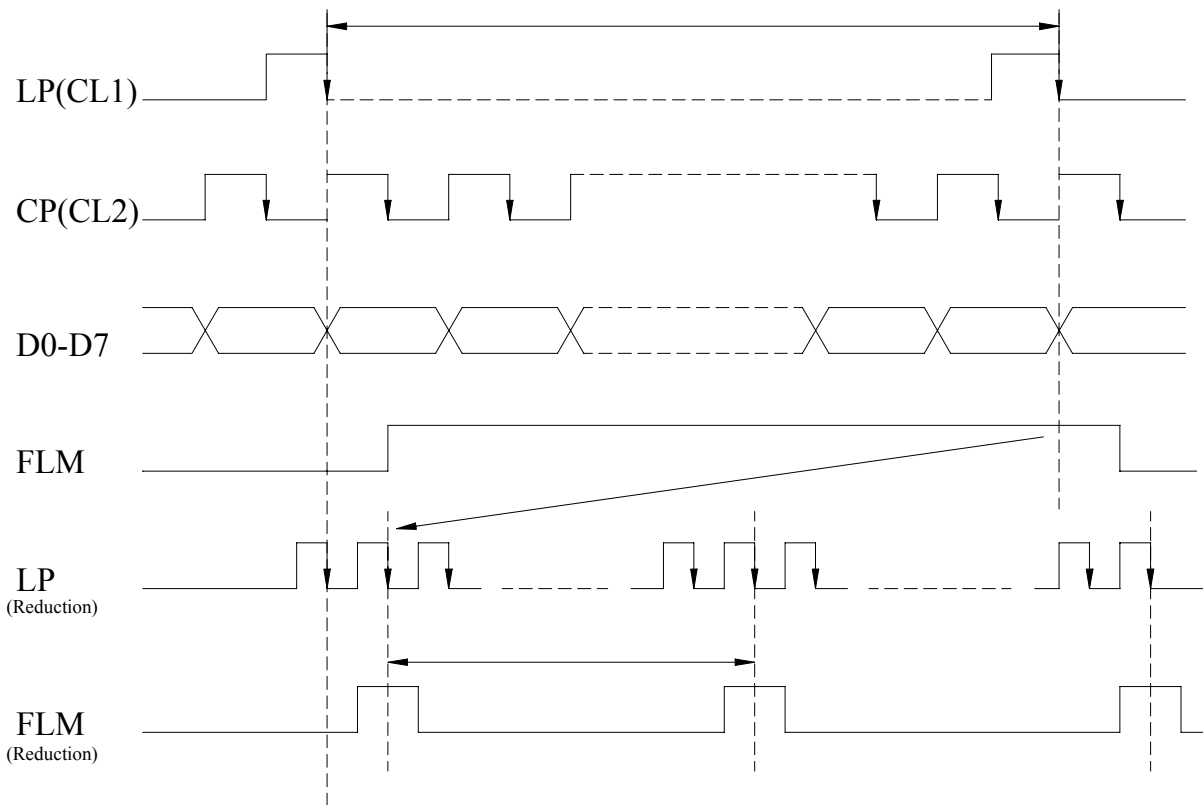


**Fig 1. SEGMENT TIMING**

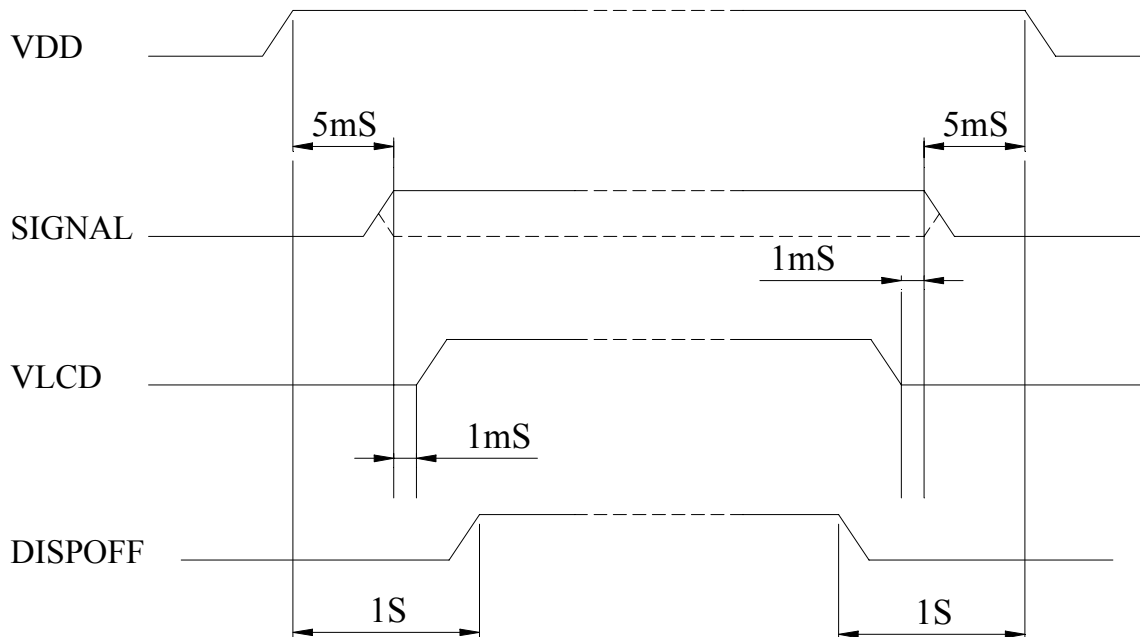


**Fig 2 COMMON TIMING**

### TIMING CHART OF INPUT SIGNAL



### POWER ON/OFF TIMING



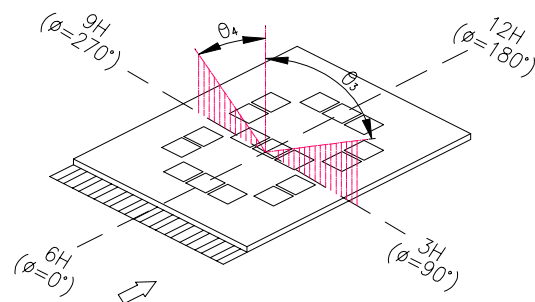
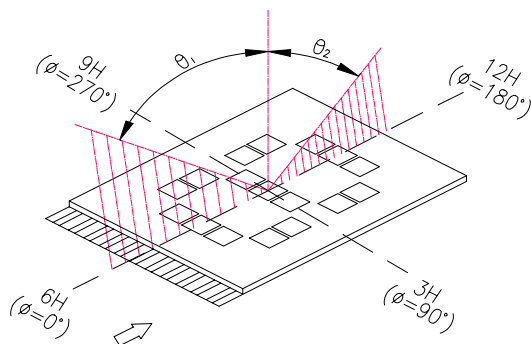
## 5 OPTICAL SPECIFICATION

Ta = 25 °C

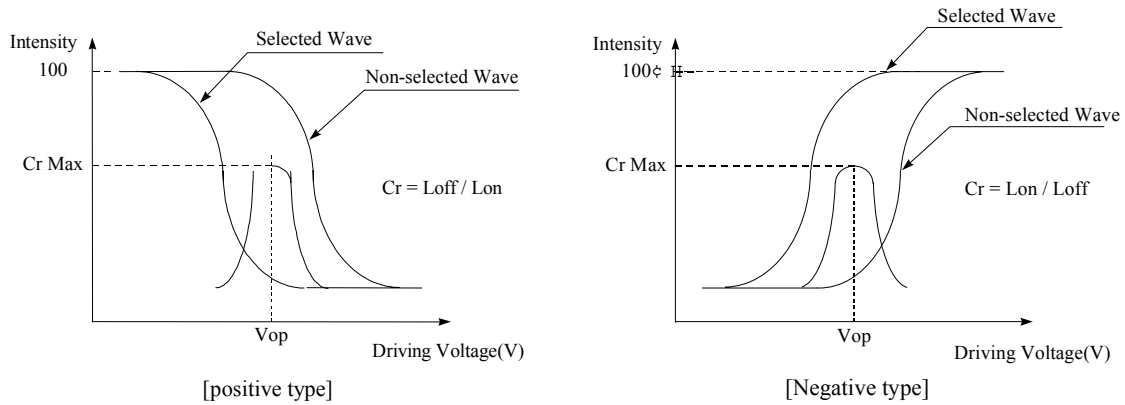
Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Viewing Angle in STN	$\theta_1$	CR $\geq$ 2	-	40	-	deg	1
	$\theta_2$	CR $\geq$ 2	-	20	-	deg	1
	$\theta_3$	CR $\geq$ 2	-	30	-	deg	2
	$\theta_4$	CR $\geq$ 2	-	30	-	deg	2
Viewing Angle in FSTN	$\theta_1$	CR $\geq$ 2	-	60	-	deg	1
	$\theta_2$	CR $\geq$ 2	-	30	-	deg	1
	$\theta_3$	CR $\geq$ 2	-	45	-	deg	2
	$\theta_4$	CR $\geq$ 2	-	45	-	deg	2
Contrast Ratio	CR	Ta = 25 °C	3	5	-	-	3
Response Time	Tr	Ta = 25 °C	-	200	300	ms	4
	Tf	Ta = 25 °C	-	150	200		
Driving Method	Duty	1/240					
Viewing Direction	6 O'CLOCK						

Note 1: definition of viewing angle  $\theta_1$  &  $\theta_2$

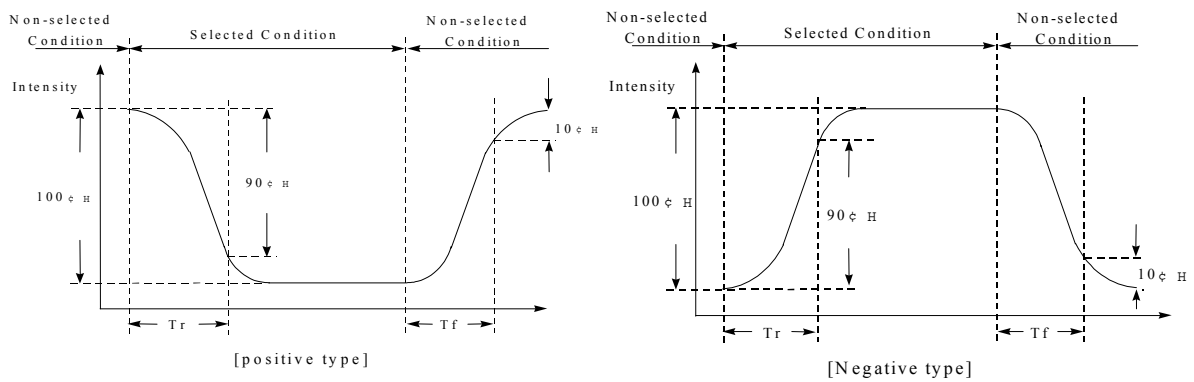
Note 2: definition of viewing angle  $\theta_3$  &  $\theta_4$



### Note 3: definition of contrast ratio (CR)



### Note 4: definition of response time



## 6 BACKLIGHT SPECIFICATION

### 6.1 WHITE LED EDGE BACKLIGHT CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Current	I	V = 3,5V	-	160	-	mA
Forward Voltage	V <sub>F</sub>	I <sub>F</sub> = 160mA	-	3,5	-	V
Reverse Voltage	V <sub>R</sub>		-	-	10	V
Luminous Intensity before through LCD	I <sub>V</sub>	I <sub>F</sub> = 160mA	-	60	-	cd/m <sup>2</sup>
Life time		I <sub>F</sub> = 160mA	-	50K	-	hrs
Colour	WHITE					

### 6.2 CCFL BACKLIGHT CHARACTERISTICS

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage	V	I = 5mA	-	328	-	V
Starting Voltage	V <sub>s</sub>	25°C	-	-	530	V
Supply Current	I		3	5,0	6	mA
Lamp Power	P	I x V	-	1,35	-	Wrms
Luminous Intensity	I <sub>V</sub>	I = 5mA	-	550	-	cd/m <sup>2</sup>
Chromaticity	(X) (Y)		-	0,340 0,370	-	
Life time		I <sub>F</sub> = 5mA	-	20K	-	hrs
Colour	WHITE					



## 7 QUALITY ASSURANCE SPECIFICATION

### 7.1 CONFORMITY

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

### 7.2 DELIVERY ASSURANCE

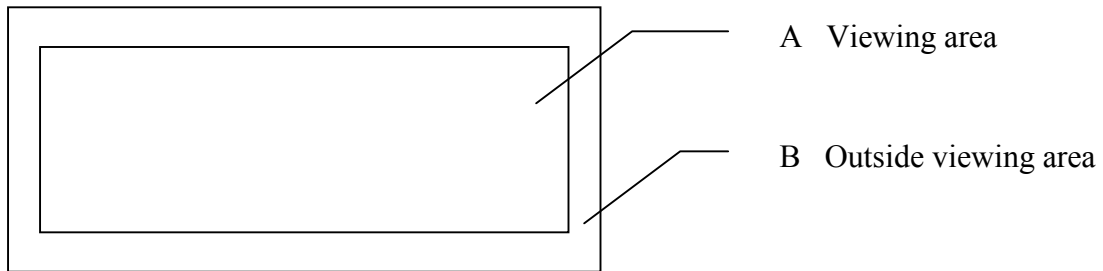
#### 7.2.1 Delivery inspection standards.

- 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:

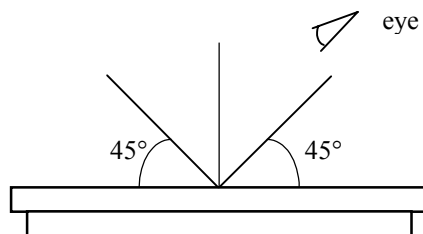
Rank	Item Inspected	Defect type	AQL	Remark
Critical defect	Display	Non display	0.65%	Display malfunction
		Over current		
		Missing segment		
		Wrong viewing direction		
	Backlight OFF			
	Dimension	PCB and bezel out of specification	0.65%	Assembly failure
Major defect	Display	Incorrect operating	1.0%	
	Backlight	Flashing, dust		
		Wrong colour		
Minor defect	LCD	Black and white spot	2.5%	Appearance defect
		Black and white lines		
		Polariser scratch		
		Bubbles in polariser		
		Segment deformation, pin hole		
		Colour uniformity		
	COB	Glass chip		
		Wire bond pad exposed		
		Insufficient covering with resin (wire bond line exposed)		
	PCB	Bubble, dust on COB		
		Dust, solder ball on PCB		
		Pad scratch		
Total			2.5%	

### 7.2.2 Zone definition



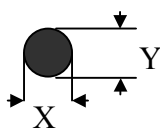
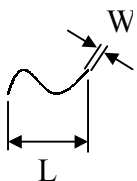
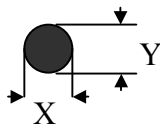
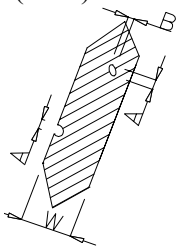
### 7.2.3 Visual inspection

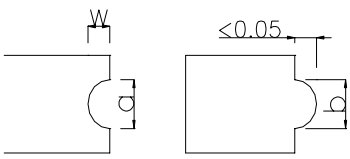
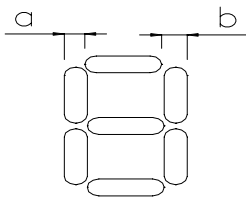
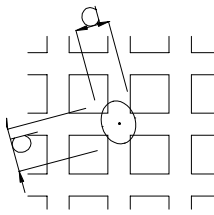
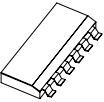
- Inspect under 2x20W or 40W fluorescent lamp (approximately 3000 lux) leaving 25 to 30 cm between the module and the lamp and 30 cm between the module and the eye (measuring position).
- Appearance is inspected at the best contrast voltage (best contrast is adjusted considering clearness and crosstalk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



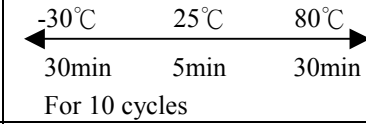
### 7.2.4 Standard of appearance inspection

Units: mm

No	Item	Criteria																																			
1	Black spot, white spot, dust	<p>Round type: as per following drawing  <math>\varnothing = (X+Y)/2</math></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><math>\varnothing &lt; 0.1</math></td> <td>Any number</td> <td rowspan="4">Any number</td> </tr> <tr> <td><math>0.1 &lt; \varnothing &lt; 0.2</math></td> <td>6</td> </tr> <tr> <td><math>0.2 &lt; \varnothing &lt; 0.3</math></td> <td>2</td> </tr> <tr> <td><math>0.3 &lt; \varnothing</math></td> <td>0</td> </tr> </tbody> </table> <p>Line type: as per following drawing</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><math>W \leq 0.02</math></td> <td>Any number</td> <td rowspan="4">Any number</td> </tr> <tr> <td><math>L \leq 3.0</math></td> <td><math>0.02 &lt; W \leq 0.03</math></td> <td rowspan="2">2</td> </tr> <tr> <td><math>L \leq 2.5</math></td> <td><math>0.03 &lt; W \leq 0.05</math></td> </tr> <tr> <td>--</td> <td><math>0.05 &lt; W</math></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	$0.1 < \varnothing < 0.2$	6	$0.2 < \varnothing < 0.3$	2	$0.3 < \varnothing$	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	$L \leq 2.5$	$0.03 < W \leq 0.05$	--	$0.05 < W$	As round type
Acceptable quantity																																					
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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																																			
$L \leq 2.5$	$0.03 < W \leq 0.05$																																				
--	$0.05 < W$	As round type																																			
2	Polariser scratch	Scratch on protective film is permitted Scratch on polariser: same as No. 1																																			
3	Polariser bubble	<p><math>\varnothing = (X+Y)/2</math></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><math>\varnothing &lt; 0.3</math></td> <td>Any number</td> <td rowspan="4">Any number</td> </tr> <tr> <td><math>0.3 &lt; \varnothing &lt; 1.0</math></td> <td>3</td> </tr> <tr> <td><math>1.0 &lt; \varnothing &lt; 1.5</math></td> <td>1</td> </tr> <tr> <td><math>1.5 &lt; \varnothing</math></td> <td>0</td> </tr> </tbody> </table> <p style="text-align: center;">Total acceptable quantity: 4</p>	Acceptable quantity			Size	Zone A	Zone B	$\varnothing < 0.3$	Any number	Any number	$0.3 < \varnothing < 1.0$	3	$1.0 < \varnothing < 1.5$	1	$1.5 < \varnothing$	0																				
Acceptable quantity																																					
Size	Zone A	Zone B																																			
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4	Segment deformation	<p>1.a. Pin hole on segmented display</p> <p>W: segment width  <math>\varnothing = (A+B)/2</math></p>  <table border="1" style="margin-left: 200px;"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Width</th> <th><math>\varnothing</math></th> </tr> </thead> <tbody> <tr> <td><math>W \leq 0.4</math></td> <td><math>\varnothing \leq 0.2</math> and <math>\varnothing \leq 1/2W</math></td> </tr> <tr> <td><math>W &gt; 0.4</math></td> <td><math>\varnothing \leq 0.25</math> and <math>\varnothing \leq 1/3W</math></td> </tr> </tbody> </table> <p style="text-align: center;">Total acceptable quantity: 1 defect per segment Pin holes with <math>\varnothing</math> 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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4	Segment deformation	<p>1b. Pin hole on dot matrix display</p>  <table border="1"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th></th> </tr> </thead> <tbody> <tr> <td><math>a, b &lt; 0.1</math></td> <td>Any number</td> </tr> <tr> <td><math>(a+b)/2 \leq 0.1</math></td> <td>Any number</td> </tr> <tr> <td><math>0.5 &lt; \varnothing &lt; 1.0</math></td> <td>3</td> </tr> </tbody> </table> <p>Total acceptable quantity: 7</p> <p>2. Segments / dots with different width</p>  <table border="1"> <thead> <tr> <th colspan="2">Acceptable</th> </tr> <tr> <th><math>a \geq b</math></th> <th><math>a/b \leq 4/3</math></th> </tr> <tr> <th><math>a &lt; b</math></th> <th><math>a/b &gt; 4/3</math></th> </tr> </thead> </table> <p>3. Alignment layer defect</p> <p><math>\varnothing = (a+b)/2</math></p>  <table border="1"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th></th> </tr> </thead> <tbody> <tr> <td><math>\varnothing \leq 0.4</math></td> <td>Any number</td> </tr> <tr> <td><math>0.4 &lt; \varnothing \leq 1.0</math></td> <td>5</td> </tr> <tr> <td><math>1.0 &lt; \varnothing \leq 1.5</math></td> <td>3</td> </tr> <tr> <td><math>1.5 &lt; \varnothing \leq 2.0</math></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
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5	Colour uniformity	Level of sample for approval set as limit sample																												
6	Backlight	<p>The backlight colour should correspond to the product specification</p> <p>Flashing and or unlit backlight is not allowed</p> <p>Dust larger than 0.25 mm is not allowed</p>																												
7	COB	<p>Exposed wire bond pad is not allowed</p> <p>Insufficient covering with resin is not allowed (wire bond line exposed)</p> <p>Dust or bubble on the resin are not allowed</p>																												
8	 PCB	<p>No unmelted solder paste should be present on PCB</p> <p>Cold solder joints, missing solder connections, or oxidation are not allowed</p> <p>No residue or solder balls on PCB are allowed</p> <p>Short circuits on components are not allowed</p>																												

## 8 RELIABILITY SPECIFICATION

Test Item	Test Condition	Description
High Temperature Operation	50°C or 70°C 200hrs	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.
Low Temperature Operation	0°C or -20°C 200hrs	Endurance test applying the electric stress under low temperature for a long time.
High Temperature Storage	70°C or 80°C 200hrs	Endurance test applying the high storage temperature for a long time.
Low Temperature Storage	-20°C or -30°C 200hrs	Endurance test applying the high storage temperature for a long time.
High Temperature & High Humidity Storage	80°C, 90%RH 96hrs	Endurance test applying the high temperature and high humidity storage for a long time.
Thermal Shock Test	 <p>For 10 cycles</p>	Endurance test applying the low and high temperature cycle. Burn In Test.
Vibration	10~22Hz→1.5mmp-p 22~500Hz→1.5G Total 0.5hrs	Endurance test applying the vibration during transportation and using.
ESD	VS=800V,RS=1.5kΩ CS=100pF	Endurance test applying the electric stress to the terminal.
Shock Test	50G Half sign wave 11 msed 3 times of each direction	Constructional and mechanical endurance test applying the shock during transportation.

## 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).