Display Elektronik GmbH

DATA SHEET

BCD MODULE

DEC 480160A DYH

8,7”
480 x160 Bi-Stable
Cholesteric Display

Product Specification Ver.: 3

30.07.2019

Revision Status

Version	Revise Date	Page	Content	Modified By
0	31.08.2018	-	First issued	MH
1	09.10.2018	4	Add sample NO.	MHI
2	09.11.2018	12	Increase each temperature refresh time and drive voltage	MHI
3	30.07.2019	4,5,9,12	Modify thickness of the glass, IDD, VOP, optical characteristics and related components; Update outline drawing	MHO

Table of Contents

1. Technology Description

BCD (Bi-stable Cholesteric Display) is a sunlight readable reflective LCD with extremely low power consumption characteristics. Due to the non-volatile memory feature of the technology, zero power is required to retain the image of the display. Energy is only required to change the displayed image. No backlighting is required, only ambient lighting from the surrounding is required. Readability when under direct sunlight is excellent and good contrast from viewing at very wide angles are possible.

2. Typical Applications

This module is intended for general purpose graphic and character display applications.Suggested uses include instrumentation, meeting name lable， remote control, electronic product or price label, point of sale display, general purpose indoor or outdoor signage and information display.

3. General Description

The Features of LCD are as follows

* Passive Matrix Bistable Cholesteric LCD Graphic Module
* Color : Black & Yellow
* Display Mode : BCD
* Driver / Controller IC : UCi7701c & UCi7702c *2
* Interface Input Data : Parallel Interface (8-Bit)
* Driving Scheme : Special BCD Driving Scheme
* Driving Method : 1/160 Duty, 1/7 Bias
* Viewing Direction : Full Viewing

4. Mechanical Specifications

The Mechanical Detail is shown in Fig. 1 and summarized in Table 1 below.

Table 1

Item	Specification	Unit
Module Size	229.50 x 66.80 x 4.40	mm
Viewing Area	219.50 Min x 56.80 Min	mm
Active Area	215.99 x 54.39	mm
Number of Dots	480 x 160 Dots	-
Dot Size	0.33 x 0.44	mm
Dot Pitch	0.34 x 0.45	mm

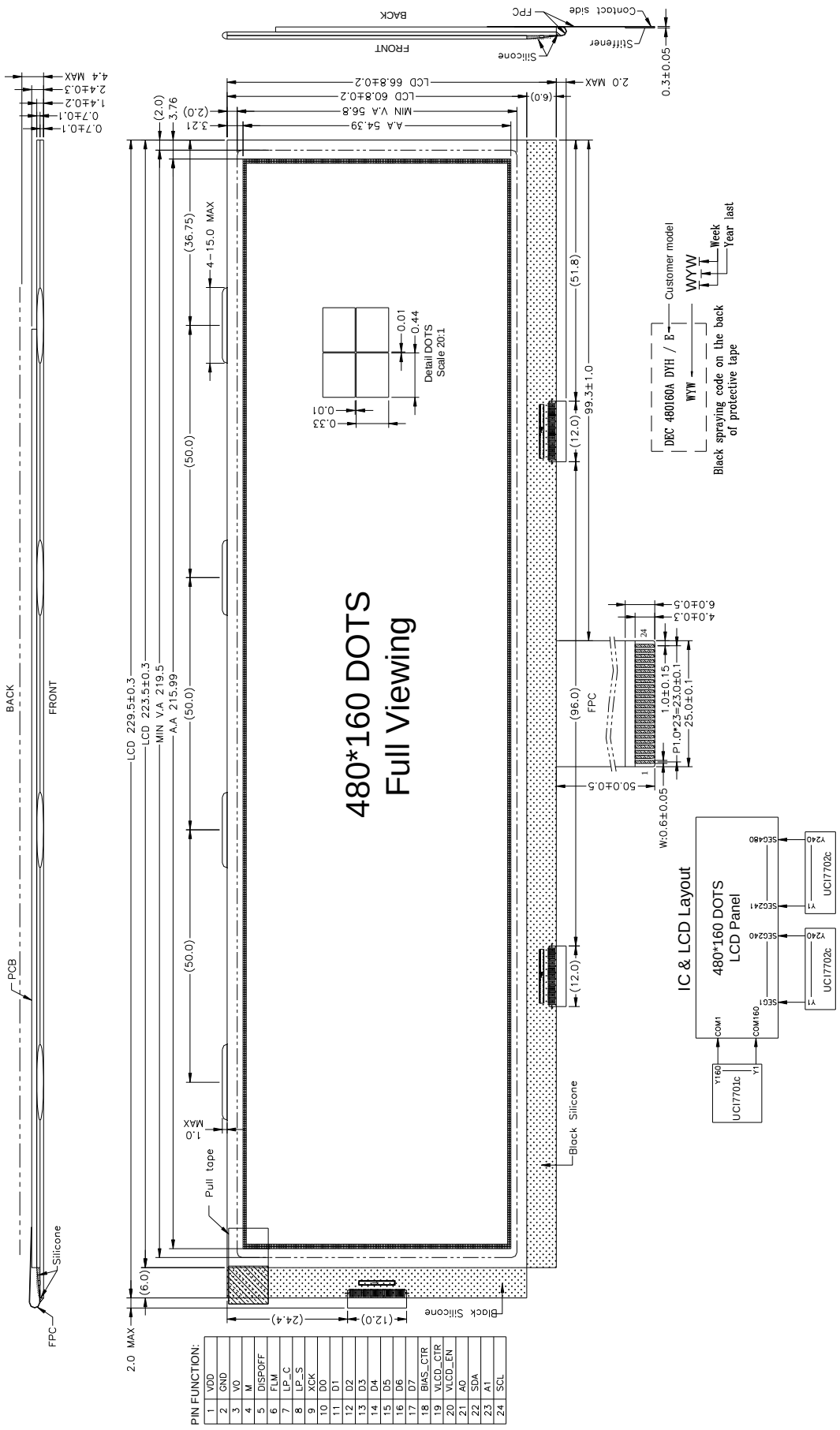


Figure 1: Module Specification

5. Interface Signals

Table 2

Pin No.	Pin Name	Function
1	VDD	Power supply
2	GND	Ground.
3	V0	Boas power supply pins for LCD drive voltage.
4	M	AC-converting signal input for LCD drive waveform.
5	DISPOFF	Control input for output of non-select level.
6	FLM	Frame signal.
7	LP_C	Shift clock input for shift register at common mode.
8	LP_S	Latch pulse input for display data at segment mode.
9	XCK	Clock input for taking display data at segment mode.
10-17	D0-D7	Input pin for display data 8-bit parallel input mode, input data into the 8 pins D0 ~ D7. Display data input.
18	BIAS_CTR	Bias control. High Bias while this pin is high.
19	VLCD_CTR	VLCD voltage control. High voltage while this pin is high.
20	VLCD_EN	VLCD output Enable. Active while this pin is high.
21	A0	Digital input. User-defined address bit 0.(NC)
22	SDA	Digital I/O. I2C-bus serial bidirectional data line; open-drain. (NC)
23	A1	Digital input. User-defined address bit 1. (NC)
24	SCL	Digital input. I2C-bus serial clock input. (NC)

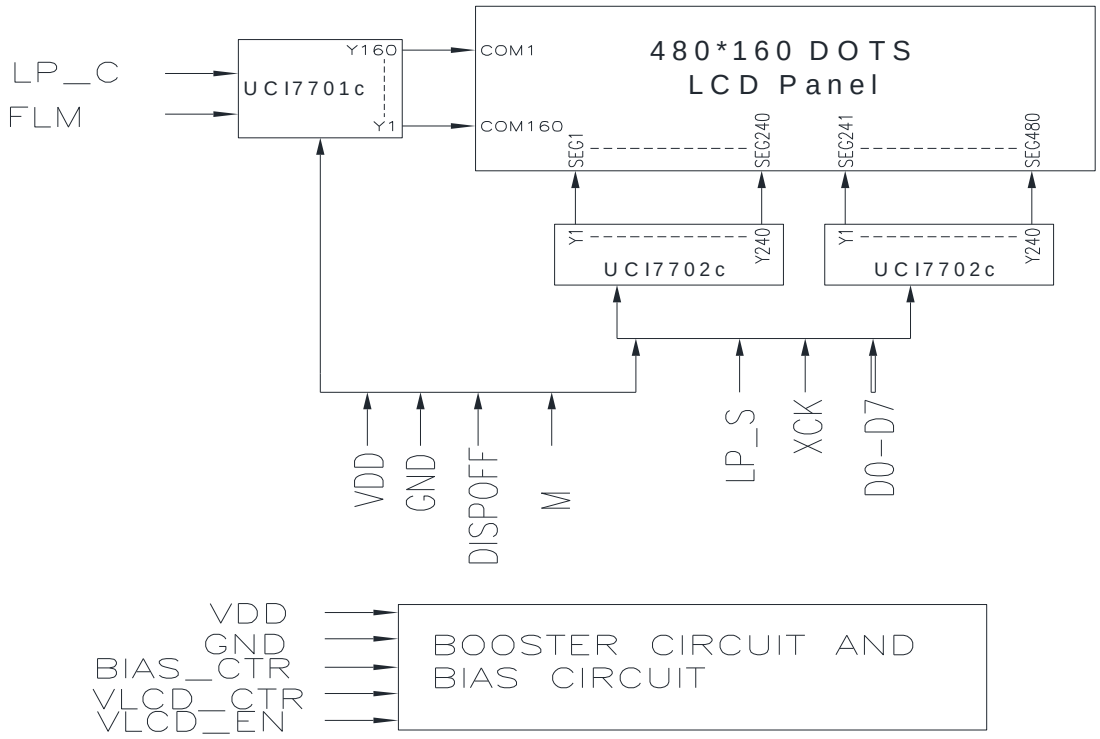


Figure 2: Block Diagram

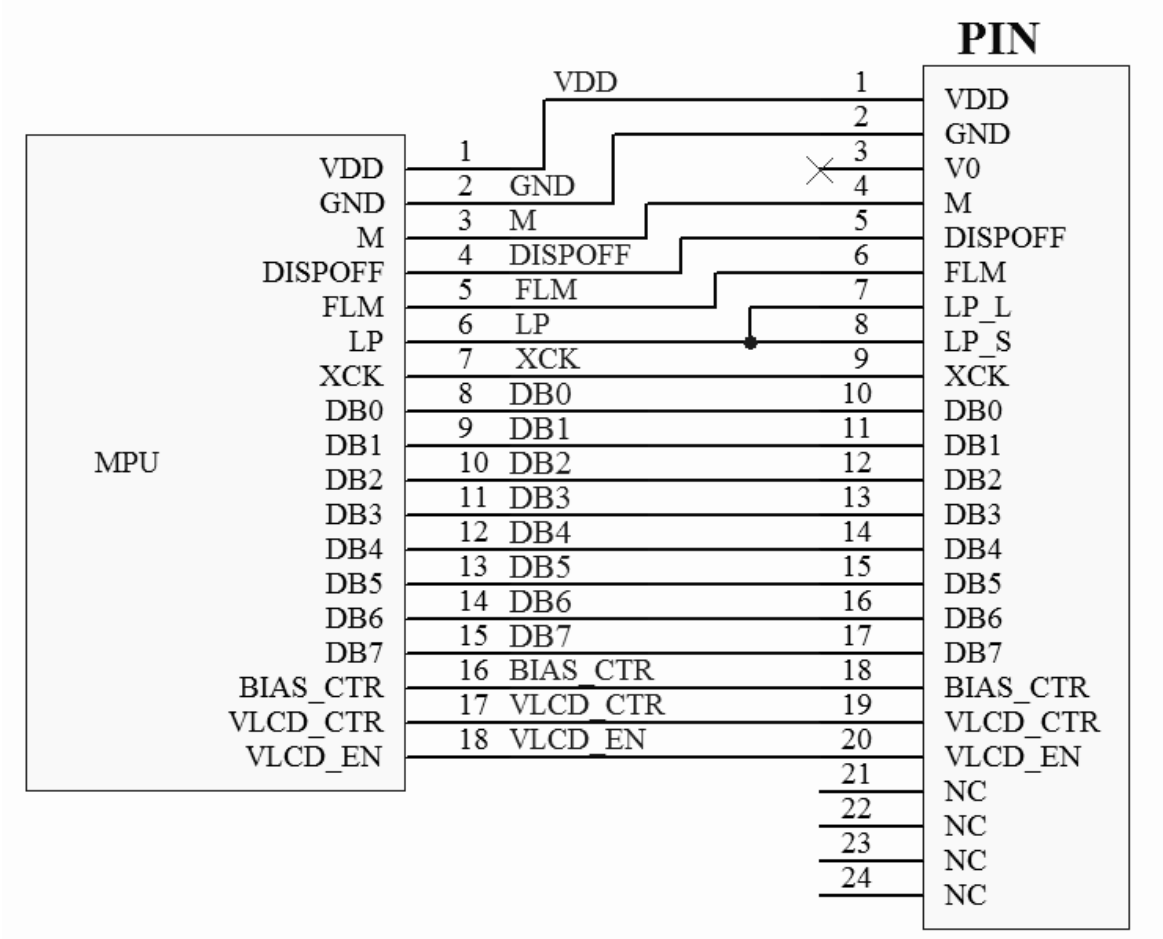


Figure 3: Circuit Diagram

6. Absolute Maximum Ratings

6.1 Electrical Maximum Ratings-For IC Only

Table3

Parameter	Symbol	Conditions	Min.	Max.	Unit
Supply Voltage	V_{DD}	TA=+25°C Referenced to V_{SS} = 0V	-0.3	+7.0	V
	V_0		-0.3	+45	V
Input Voltage	V_{in}		V_{ss} - 0.3	V_{DD} + 0.3	V

Note1: TA = +25°C.

Note2: The maximum applicable voltage on any pin with respect to VSS (0V).

Note3: The modules may be destroyed if they are used beyond the absolute maximum ratings.

6.2 Environmental Condition

Table4

Item	Operating temperature (Topr)		Storage temperature (Tstg)		Remark
	Min.	Max.	Min.	Max.	
Ambient Temperature	-20°C	+70°C	-30°C	+80°C	Dry
Humidity	90% max. RH for Ta ≤ 40°C < 50% RH for 40°C < Ta ≤ Maximum Operating Temperature				No Condensation
Packing Vibration(GB/T5170.14-2009)	Frequency Range:10Hz~50Hz Acceleration of Gravity:5G X,Y,Z 30 min for each Direction.				3 Directions

Note : Product cannot sustain at extreme storage conditions for long time.

7. Electrical Specifications

7.1 Typical Electrical Characteristics

At Ta = 25 °C, VDD = +5.0V± 5%, VSS=0V.

Table5

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply Voltage (System)	VDD-VSS	Ta =+25°C	4.75	5.0	5.25	V
	V0-VSS	Ta =+25°C	-	20	-	V
Input Signal Voltage Low	V_{IL}	Ta =+25°C	-	-	$0.2V_{DD}$	V
Input Signal Voltage High	V_{IH}	Ta =+25°C	$0.8V_{DDIO}$	-	-	V
Supply Current	IDD	VDD=5.0V	-	10.5	-	mA

* Internally Generated

7.2 TIMING Specifications

At Ta =+25°C, VDD = 5.0V ± 5%

Table 6

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Shift clock period	tWLP	250	-	-	ns	tr, tf ≦ 20ns
Shift clock "H" pulse width	tWLPH	15	-	-	ns	V_{DD} = +5.0V ± 10%
		30	-	-	ns	V_{DD} = +2.5 - +4.5V
Data setup time	tSU	30	-	-	ns	
Data hole time	tH	50	-	-	ns	
Input signal rise time	tr		-	50	ns	
Input signal fall time	tf		-	50	ns	
$\overline{\text{DISPOFF}}$ Removal time	tSD	100	-	-	ns	
$\overline{\text{DISPOFF}}$ enable pulse width	tWDL	1.2	-	-	µs	
Output delay time (1)	tDL	-	-	200	ns	CL = 15pF
Output delay time (2)	tpd1, tpd2	-	-	1.2	µs	CL = 15pF
Output delay time (3)	tpd3	-	-	1.2	µs	CL = 15pF

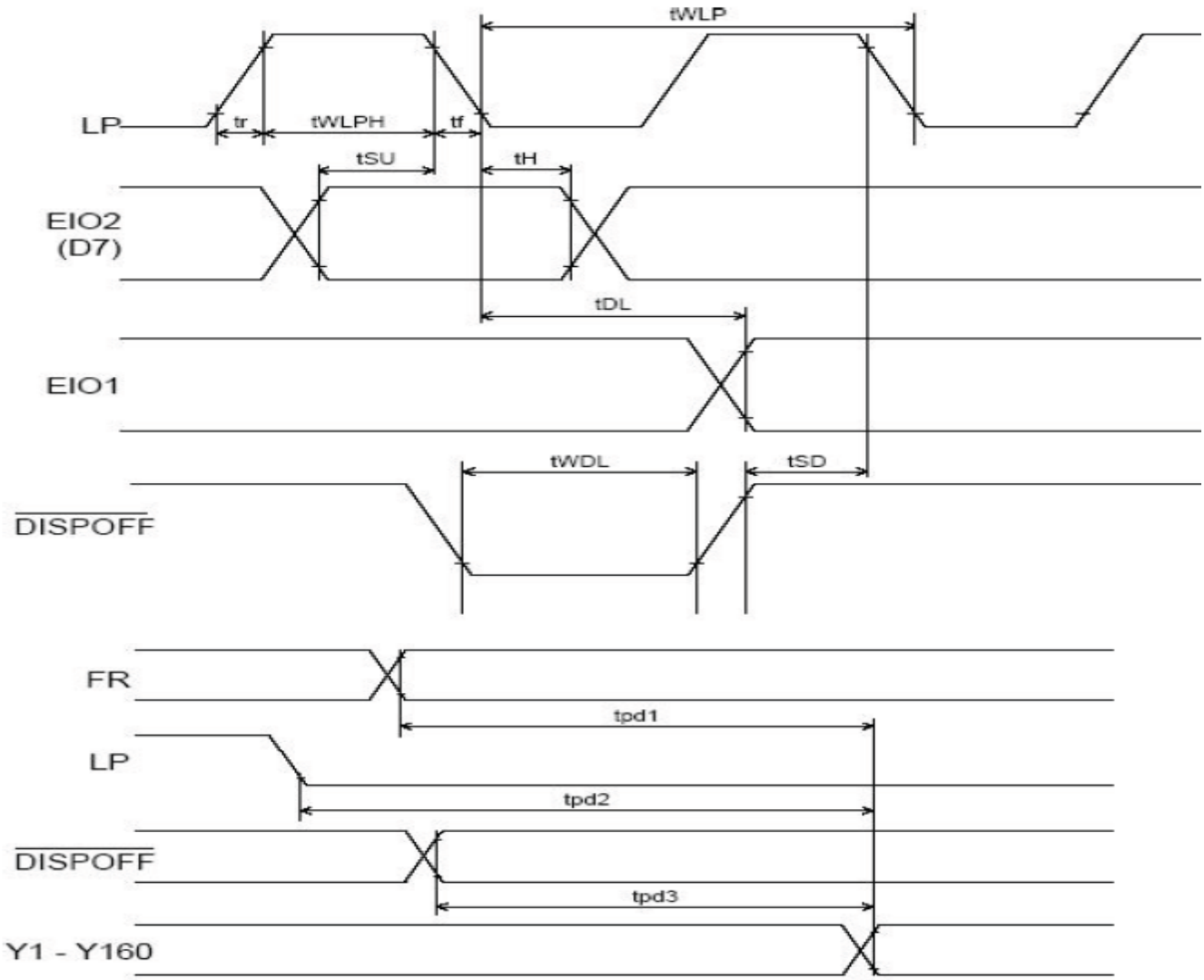


Figure 4: Timing Waveform of the Common Mode

Table 7

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Shift clock period	tWCK	50	-		ns	tr, tf ≦ 10ns, Note 1
Shift clock "H" pulse width	tWCKH	15	-		ns	
Shift clock "L" pulse width	tWCKL	15	-		ns	
Data setup time	tDS	10	-		ns	
Data hold time	tDH	12	-		ns	
Latch pulse "H" pulse width	tWLPH	15	-		ns	
Shift clock rise to Latch pulse rise time	tLD	0	-		ns	
Shift clock fall to Latch pulse fall time	tSL	30	-		ns	
Latch pulse rise to Shift clock rise time	tLS	25	-		ns	
Latch pulse fall to Shift clock rise time	tLH	25	-		ns	
Input signal rise time	tr		-	50	ns	Note 2
Input signal fall time	tf		-	50	ns	Note 2
Enable setup time	tS	10	-		ns	
$\overline{\text{DISPOFF}}$ Removal time	tSD	100	-		ns	
$\overline{\text{DISPOFF}}$ enable pulse width	tWDL	1.2	-		μs	
Output delay time (1)	tD		-	30	ns	CL = 15pF
Output delay time (2)	tpd1, tpd2		-	1.2	μs	CL = 15pF
Output delay time (3)	tpd3		-	1.2	μs	CL = 15pF

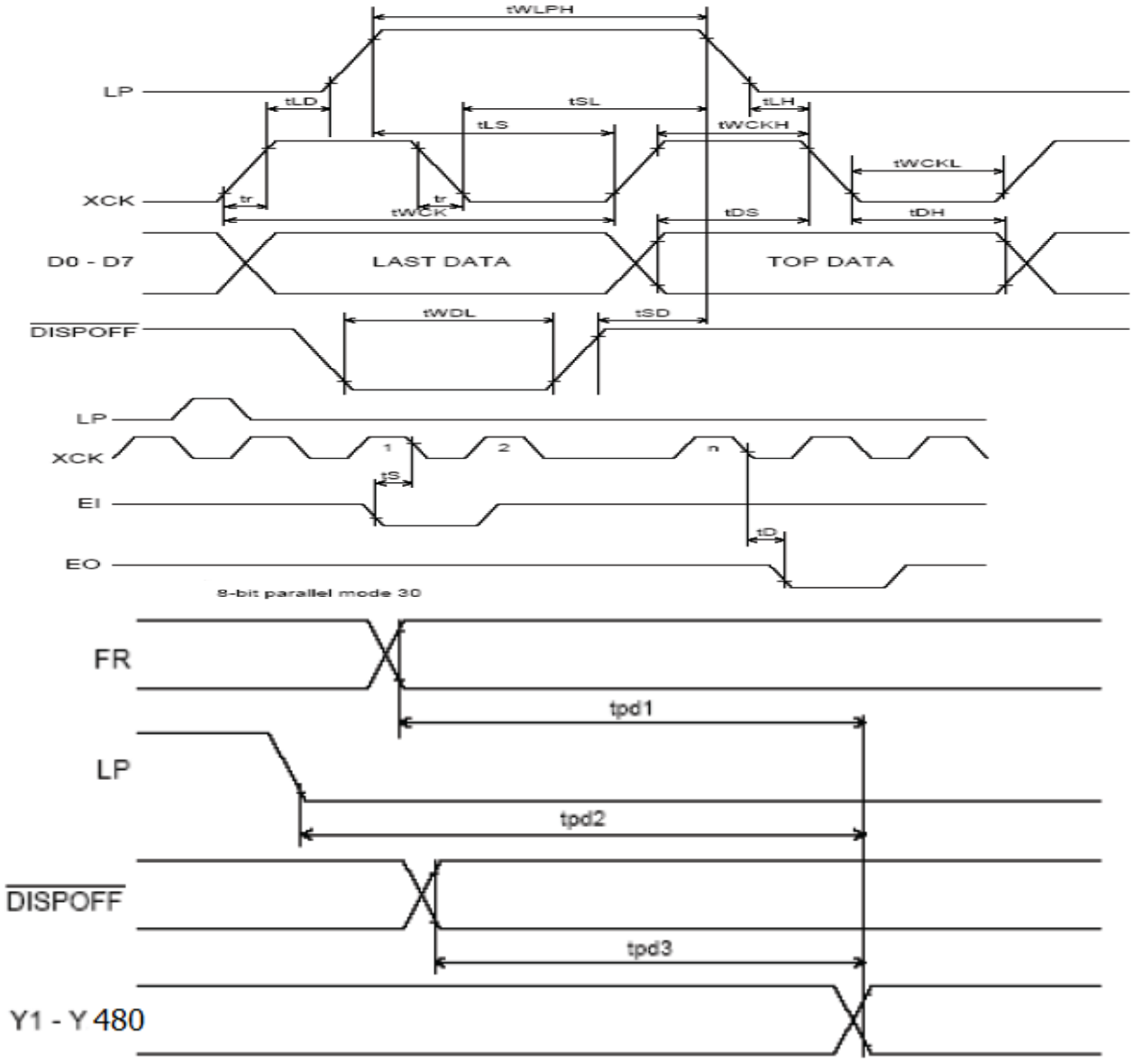


Figure 5: Timing Characteristics of Segment Mode

8. Optical Characteristics at 25°C

Table 8

Item	Symbol	Value			Unit	Condition	
		Min.	Typ.	Max.			
Image Refresh Time	-	-	12	-	S	VDD=5.0V, VLCD =24V At Ta = -20 °C	
	-	-	9	-	S	VDD=5.0V, VLCD =22.6V At Ta = -10 °C	
	-	-	7.5	-	S	VDD=5.0V, VLCD =21.2V At Ta = 0 °C	
	-	-	6	-	S	VDD=5.0V, VLCD =20.7V At Ta = +5 °C	
	-	-	5	-	S	VDD=5.0V, VLCD =20.0V At Ta = +25 °C	
	-	-	4.5	-	S	VDD=5.0V, VLCD =19.5V At Ta = +50 °C	
	-	-	4	-	S	VDD=5.0V, VLCD =18.6V At Ta = +70 °C	
Contrast Ratio	CR	-	6	-	-	-	
Optimum Viewing Area Cr ⩾ 2	θ1	-	>80	-	DEG	ϕ = 0°	Vop= Optimum Voltage
	θ2	-	>80	-			
	ϕ1	-	>80	-		ϕ = 0°	
	ϕ2	-	>80	-			

Notes: The above data are for reference only.

8.1 Optical Characteristics Definition

8.1.1 Viewing Angle

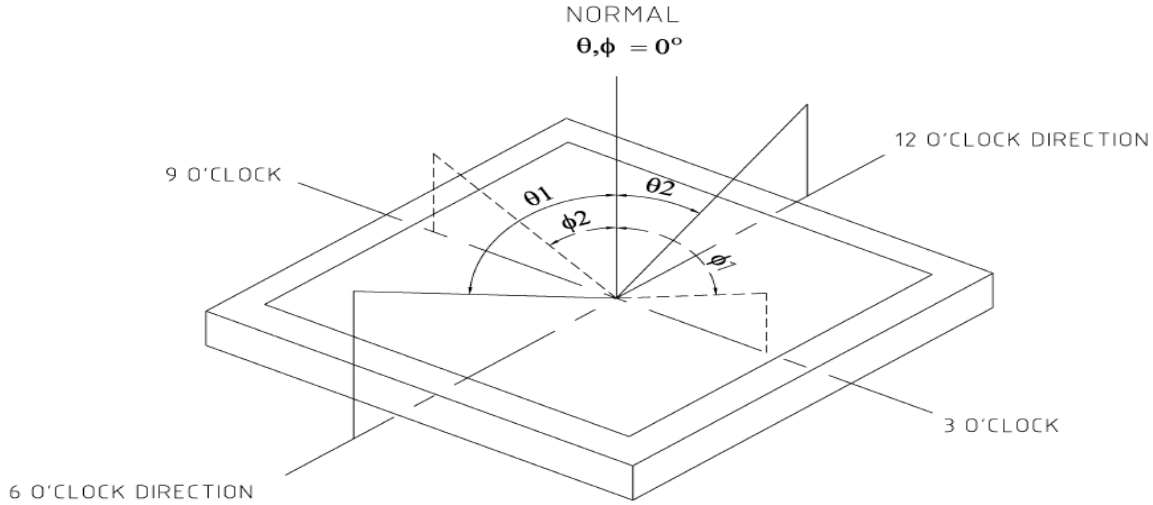
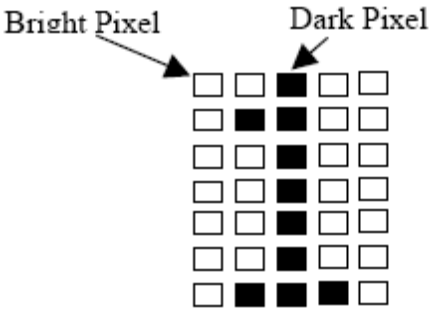


Figure 6

8.1.2 Contrast Ratio

B1 = pixel luminance at stable dark state
B2 = pixel luminance at stable bright state

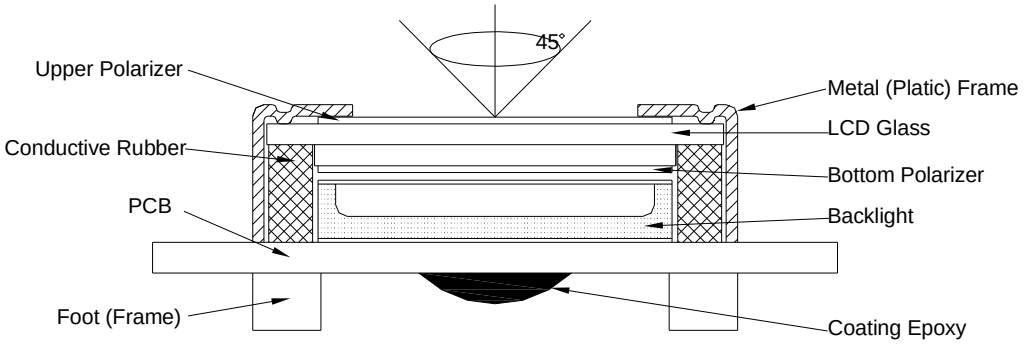
Contrast Ratio = B2/B1



9. Quality Specifications

9.1. LCM Appearance and Electric Inspection Condition

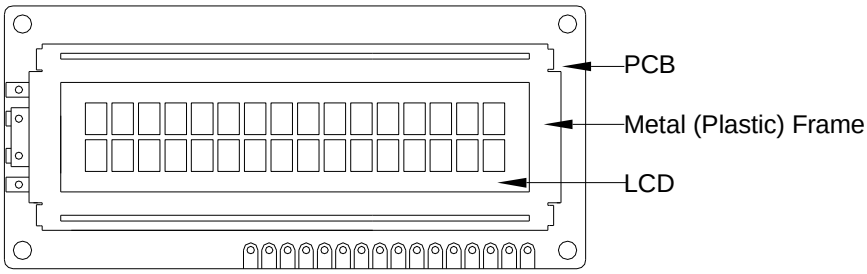
9.1.1 Inspection will be done by placing LCM 30cm away from inspector's eyeballs under normal illumination.



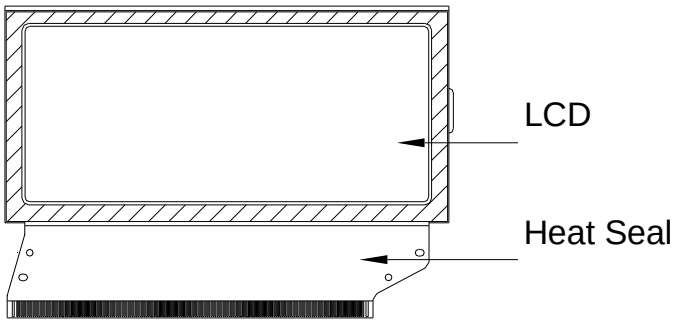
1. View Angle: with in 45°around perpendicular line.

9.2. Definition

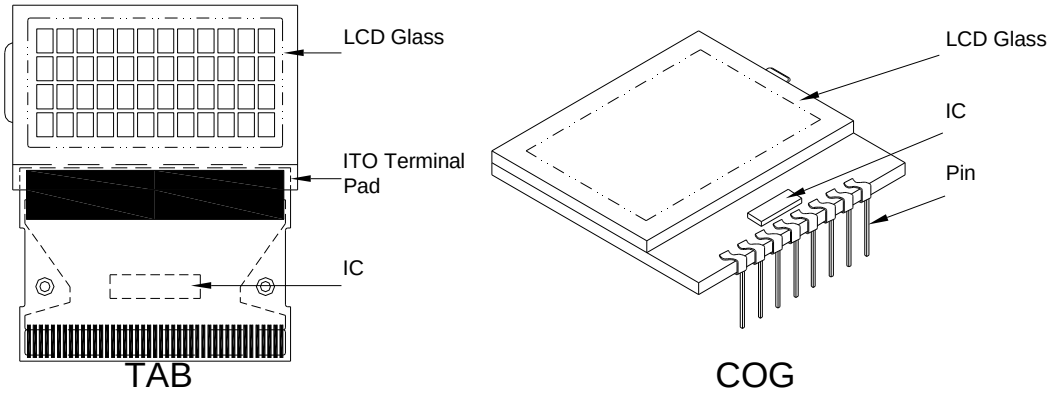
9.2.1 COB



9.2.2 Heat Seal



9.2.3 TAB and COG



9.3. Sampling Plan and Acceptance

9.3.1 Sampling Plan

MIL - STD - 105E (||) ordinary single inspection is used.

9.3.2 Acceptance

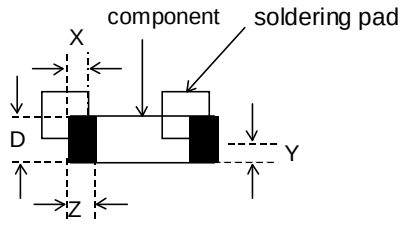
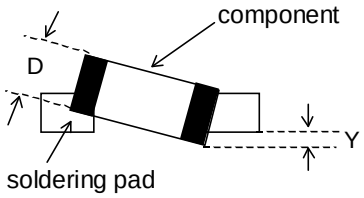
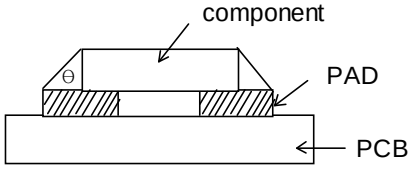
Major defect: AQL = 0.65%
Minor defect: AQL = 1.5%

9.4. Criteria

9.4.1 COB

Defect	Inspection Item	Inspection Standards	
Major	PCB copper flakes peeling off	Any copper flake in viewing Area should be greater than 1.0mm^2	Reject
Major	Height of coating epoxy	Exceed the dimension of drawing	Reject
Major	Void or hole of coating epoxy	Expose bonding wire or IC	Reject
Major	PCB cutting defect	Exceed the dimension of drawing	Reject

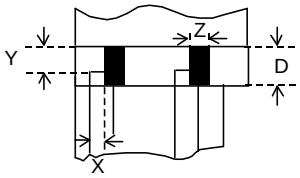
9.4.2 SMT

Defect	Inspection Item	Inspection Standards	
Minor	Component marking not readable		Reject
Minor	Component height	Exceed the dimension Of drawing	Reject
Major	Component solder defect (missing , extra, wrong component or wrong orientation		Reject
Minor	Component position shift 	X < 3/4Z Y > 1/3D	Reject Reject
Minor	Component tilt 	Y > 1/3D	Reject
Minor	Insufficient solder 	$\theta \leq 20°$	Reject

9.4.3 Metal (Plastic) Frame

Defect	Inspection Item	Inspection Standards		
Major	Crack / Breakage	Anywhere		Reject
Minor	Frame Scratch	W	L	Acceptable of Scratch
		w<0.1mm	Any	Ignore
		0.1≤w<0.2mm	L≤5.0mm	2
		0.2≤w<0.3mm	L≤3.0mm	1
		w≥0.3mm	Any	0
		Note : 1. Above criteria applicable to scratch lines with distance greater than 5mm. 2. Scratch on the back side of frame (not visible) can be ignored .		
Minor	Frame Dent , Prick $\Phi = \frac{L+W}{2}$			Acceptable of Dents / Pricks
		$\Phi \leq 1.0$mm		2
		$1.0 < \Phi \leq 1.5$mm		1
		$1.5\text{mm} < \Phi$		0
		Note : 1. Above criteria applicable to any two dents / pricks with distance greater than 5mm 2. Dent / prick on the back side of frame (not visible) can be ignored		
Minor	Frame Deformation	Exceed the dimension of drawing		
Minor	Metal Frame Oxidation	Any rust		

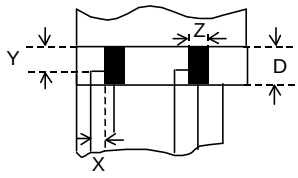
9.4.4 Flexible Film Connector (FFC)

Defect	Inspection Item	Inspection Standards	
Minor	Tilted Soldering	Within the angle +5°	Acceptable
Minor	Uneven Solder Joint /bump		Reject
Minor	Hole $\Phi = \frac{L+W}{2}$	Expose the conductive line	Reject
		Φ > 1.0mm	Reject
Minor	Position Shift 	Y > 1/3D	Reject
		X > 1/2Z	Reject

9.4.5 Screw

Defect	Inspection Item	Inspection Standards	
Major	Screw Missing / Loosen		Reject
Minor	Screw Oxidation	Any Rust	Reject
Minor	Screw Deformation	Difficult to accept Screw Driver	Reject

9.4.6 Heatseal ,TCP,FPC

Defect	Inspection Item	Inspection Standards	
Major	Scratch Expose Conductive Layer		Reject
Minor	HS Hole $\Phi = \frac{L+W}{2}$	Φ > 0.5mm	Reject
Major	Adhesion Strength	Less than the specification	Reject
Minor	Position shift 	Y > 1/3D	Reject
		X > 1/2Z	Reject
Major	Conductive Line Break		Reject

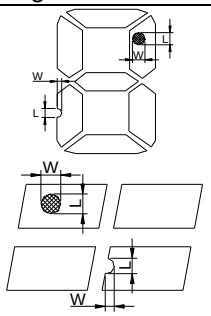
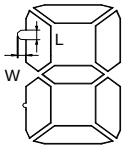
9.4.7 LED Backing Protective Film and Others

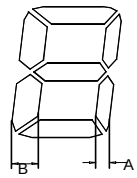
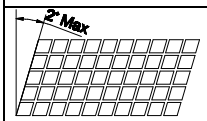
Defect	Inspection Item	Inspection Standards	
Minor	LED Dirty, Prick	Acceptable Number of Units	
		$\Phi \leq$0.10mm	Ignore
		0.10< $\Phi \leq$0.15mm	2
		0.15< $\Phi \leq$0.2mm	1
		Φ >0.2mm	0
		The distance between any two spots should be $\geq$5mm Any spot/dot/void outside of viewing area is acceptable	
Minor	Protective Film Tilt	Not fully Cover LCD	Reject
Major	COG Coating	Not fully Cover ITO Circuit	Reject

9.4.8 Electric Inspection

Defect	Inspection Item	Inspection Standards	
Major	Short		Reject
Major	Open		Reject

10. Inspection Specification of LCD

<table>
<tr><th>Defect</th><th colspan="2">Inspect Item</th><th colspan="6">Inspection Standards</th></tr>
<tr><td rowspan="4">Minor</td><td rowspan="4">Linear Defect</td><td rowspan="4">∗ Glass Scratch
∗ Polarizer Scratch
∗ Fiber and Linear material</td><td>W</td><td colspan="2">W≤0.03</td><td colspan="2">0.03<W≤0.05</td><td>W>0.05</td></tr>
<tr><td>L</td><td colspan="2">L<5</td><td colspan="2">L<3</td><td>Any</td></tr>
<tr><td>ACC. NO.</td><td colspan="2">1</td><td colspan="2">1</td><td>Reject</td></tr>
<tr><td>Note</td><td colspan="5">L is the length and W is the width of the defect</td></tr>
<tr><td rowspan="3">Minor</td><td rowspan="3">Black Spot and Polarizer Pricked</td><td rowspan="3">∗ Foreign material between glass and polarizer or glass and glass
∗ Polarizer hole or protuberance by external force</td><td>Φ</td><td>Φ≤0.1</td><td>0.1<Φ≤0.15</td><td>0.15<Φ≤0.2</td><td>Φ>0.2</td></tr>
<tr><td>ACC. NO.</td><td>3EA / 100mm²</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Note</td><td colspan="4">Φ is the average diameter of the defect.
Distance between two defects > 10mm.</td></tr>
<tr><td rowspan="3">Minor</td><td rowspan="3">White Spot and Bubble in polarizer</td><td rowspan="3">∗ Unobvious transparant foreign material between glass and glass or glass and polarizer
∗ Air protuberance between polarizer and glass</td><td>Φ</td><td>Φ≤0.3</td><td>0.3<Φ≤0.5</td><td>0.5<Φ</td></tr>
<tr><td>ACC. NO.</td><td>3EA / 100mm²</td><td>1</td><td>0</td></tr>
<tr><td>Note</td><td colspan="3">Φ is the average diameter of the defect.
Distance between two defects > 10mm.</td></tr>
<tr><td rowspan="4">Minor</td><td rowspan="4">Segment Defect</td><td rowspan="4"> 
</td><td>Φ</td><td>Φ≤0.10</td><td>0.10<Φ≤0.20</td><td>0.20<Φ≤0.25</td><td>Φ>0.25</td></tr>
<tr><td>ACC. NO.</td><td>3EA / 100mm²</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td rowspan="2">Note</td><td colspan="3">W is more than 1/2 segment width</td><td>Reject</td></tr>
<tr><td colspan="4">$\Phi = \frac{L + W}{2}$
Distance between two defect is 10mm</td></tr>
<tr><td rowspan="3">Minor</td><td rowspan="3">Protuberant Segment</td><td rowspan="3"> 

Φ = (L + W) / 2</td><td>Φ</td><td>Φ≤0.10</td><td>0.10<Φ≤0.20</td><td>0.20<Φ≤0.25</td><td>Φ>0.25</td></tr>
<tr><td>W</td><td>Glue</td><td>W≤1/2 Seg
W≤0.2</td><td>W≤1/2 Seg
W≤0.2</td><td>Ignore</td></tr>
<tr><td>ACC. NO.</td><td>3EA / 100mm²</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td rowspan="5">Minor</td><td rowspan="5">Assembly Mis-alignment</td><td rowspan="2"> 
</td><td colspan="5">1. Segment</td></tr>
<tr><td>B</td><td>B≤0.4mm</td><td>0.4<B≤1.0mm</td><td>B>1.0mm</td></tr>
<tr><td>B-A</td><td>B-A<1/2B</td><td>B-A<0.2</td><td>B-A<0.25</td></tr>
<tr><td>Judge</td><td>Acceptable</td><td>Acceptable</td><td>Acceptable</td></tr>
<tr><td> 
</td><td colspan="5">2. Dot Matrix</td></tr>
<tr><td colspan="5">Deformation>2°</td><td>Reject</td></tr>
<tr><td>Minor</td><td>Stain on LCD Panel Surface</td><td></td><td colspan="5">Accept when stains can be wiped lightly with a soft cloth or a similar one. Otherwise, judged according to the above items: “Black spot” and “White Spot”</td></tr>
</table>

11. Handling Precaution

(1) Mounting Method

The panel of the LCD Module consists of two thin glass plates with polarizers which easily get damaged since the Module is fixed by utilizing fitting holes in the printed circuit board. Extreme care should be taken when handling the LCD Modules.

(2) Caution of LCD handling & cleaning

When cleaning the display surface, use soft cloth with solvent (recommended below) and wipe lightly.

- Isopropyl alcohol
- Ethyl alcohol
- Trichloro trifloro thane

Do not wipe the display surface with dry or hard materials that will damage the polarizer surface.

Do not use the following solvent:

- Water
- Ketone
- Aromatics

(3) Caution against static charge

The LCD Module use C-MOS LSI drivers, so we recommend that you connect any unused input terminal to VDD or VSS, do not input any signals before power is turned on. And ground your body, Work/assembly table. And assembly equipment to protect against static electricity.

(4) Packaging

- Modules use LCD elements, and must be treated as such. Avoid intense shock and falls from a height.
- To prevent modules from degradation. Do not operate or store them exposed directly to sunshine or high temperature/humidity.

(5) Caution for operation

- It is indispensable to drive LCD's within the specified voltage limit since the higher voltage than the limit shorten LCD life. An electrochemical reaction due to direct current causes LCD deterioration, Avoid the use of direct current drive.
- Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them.However those phenomena do not mean malfunction or out of order with LCD's. Which will come back in the specified operating temperature range.
- If the display area is pushed hard during operation, some font will be abnormally displayed but it resumes normal condition after turning off once.
- A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit.

Usage under the relative condition of 40°C, 50%RH or less is reequired.

(6) Storage

In the case of storing for a long period of time (for instance.) For years) for the purpose or replacement use, The following ways are recommended.

- Storage in a polyethylene bag with sealed so as not to enter fresh air outside in it, And with no desiccant.
- Placing in a dark place where neither exposure to direct sunlight nor light is. Keeping temperature in the specified storage temperature range.
- Storing with no touch on polarizer surface by the anything else. (It is recommended to store them as they have been contained in the inner container at the time of delivery)

(7) Safety

- It is recommendable to crash damaged or unnecessary LCD into pieces and wash off liquid crystal by using solvents such as acetone and ethanol.

Which should be burned up later.

(8) Other

- After the product shipped, any product quality issues must be feedback within three months, otherwise, we will not be responsible for the subsequent or consequential events.