

**PRODUCT** : LCD MODULE

**MODEL NO.** : MFG-G128128DPFN-58W-E

**SUPPLIER** : TRULY SEMICONDUCTORS LTD.

**DATE** : May 17, 2007



CERT. No. 946535  
(ISO9001)



CERT. No. H002005  
(ISO14001)

# SPECIFICATION

Revision: 1.1

## MFG-G128128DPFN-58W-E

This module uses ROHS material

This specification maybe changed without any notice in order to improve performance or quality etc. Please contact TRULY R&D department for update specification and product status before design for this product or release the order.

**TRULY SEMICONDUCTORS LTD:**

**CUSTOMER:**

Quality Assurance Department: \_\_\_\_\_

Approved by:

Technical Department: \_\_\_\_\_

Approved by:



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<b>WRITTEN BY</b>	<b>CHECKED BY</b>	<b>APPROVED BY</b>
ZHOU ZHAO YU	GE JIAN YANG	XU XIN JIE

### GENERAL INFORMATION

Item	Contents	Unit
LCD Type	FSTN TRANSFLECTIVE	/
Viewing direction	6:00	O' Clock
Glass area (W × H)	36.30 × 43.20	mm <sup>2</sup>
Viewing area (W×H)	30.50 × 32.00	mm <sup>2</sup>
Active area (W×H)	27.25 × 29.81	mm <sup>2</sup>
Number of Dots	128 × 128	/
Dot size (W × H)	0.199 × 0.219	mm <sup>2</sup>
Dot pitch (W × H)	0.213 × 0.233	mm <sup>2</sup>
Driver IC	UC1610	/
Module Power consumption	2.8(type)	mw
Interface Type	System parallel/serial interface	/
Input voltage	2.8	V

### EXTERNAL DIMENSIONS

PIN	SYMBOL
1	NC
2	VBIAS
3	VLCBIN
4	VB0+
5	VBI+
6	VBI-
7	VB0-
8	VDD
9	VSS
10	BMI
11	BMO
12	RD
13	WR
14	CD
15	CS0
16	RST
17	D7
18	D6
19	D5
20	D4
21	D3
22	D2
23	D1
24	D0
25	NC

Customer No.: TRULY标准品

NOTES:  
 1.DRIVER IC :UC1610IGAB  
 2.TYPE : FSTN/TRANSFLECTIVE  
 3. OPERATING TEMPERATURE: -20°C TO +70°C  
 4. STORAGE TEMPERATURE: -30°C TO +80°C  
 5. FPC:TSE8241FPC-A1-E  
 6. 符合ROHS环保标准  
 TOLERANCE OF SEGMENTS TO EDGE OF GLASS ±0.2MM

CUSTOMER APPROVE		AMEND	
Mechanical	Electrical	△	
		△	
		△	
		△	
NO.	CONTENT	DATE	

NO.	NAME	QTY	Part No.
<b>TRULY SEMICONDUCTORS LTD.</b>			
TOLERANCE	PRODUCT NO.	DRAW NO.	REV
DECIMAL	MG128128-58	LCM0171	A
.x ± .30	DWN 林汉良 20060814	DSN 林汉良 20060814	
.xx ± .20	CHKD 许新杰 20060814	APPD 苏向阳 20060814	
∠ ± 1/4°	NOT IN SCALE UNIT mm SHEET: 1/1		

## ■ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Max	Unit
Supply voltage for logic	$V_{DD}$	-0.3	4.0	V
Input voltage	$V_{IN}$	-0.4	$V_{DD}+0.5$	
Operating temperature	$T_{OP}$	-20	70	°C
Storage temperature	$T_{ST}$	-30	80	°C

## ■ ELECTRICAL CHARACTERISTICS

### DC CHARACTERISTICS

Parameter	Symbol	Min	Typ	Max	Unit
Supply voltage for logic	$V_{DD}-V_{SS}$	2.7	2.8	2.9	V
Input Current	$I_{dd}$	-	1.0	2.0	mA
Operating voltage for LCD	$V_{OP}$	13.8	14.0	14.2	V
Input voltage 'H' level	$V_{IH}$	$0.8V_{DD}$	$V_{DD}$	$V_{DD}$	V
Input voltage 'L' level	$V_{IL}$	0	0	$0.2V_{DD}$	V
Output voltage 'H' level	$V_{OH}$	$0.8V_{DD}$	$V_{DD}$	$V_{DD}$	V
Output voltage 'L' level	$V_{OL}$	0	0	$0.2V_{DD}$	V

## ■ TIMING OF POWER SUPPLY

PLEASE REFER TO THE DRIVER IC SPECIFICATION.

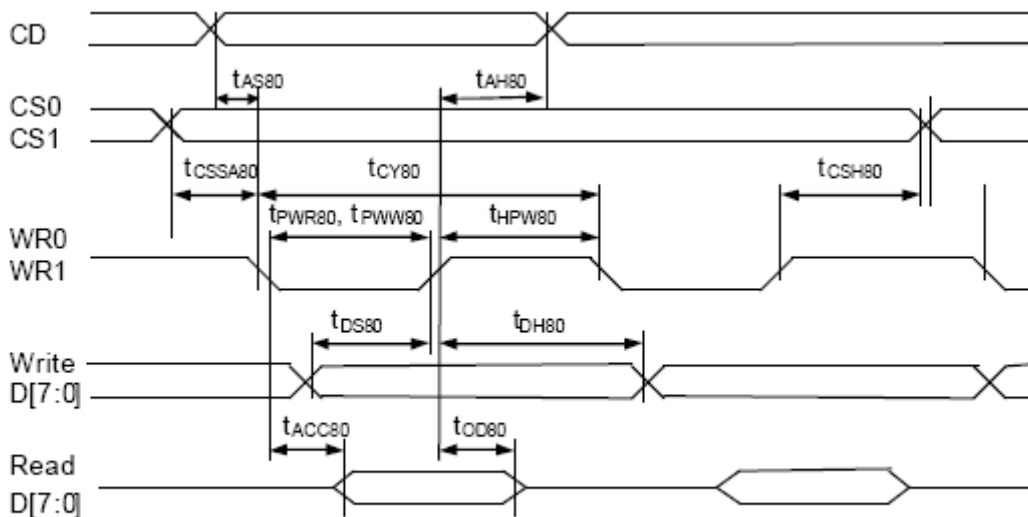


FIGURE 17: Parallel Bus Timing Characteristics (for 8080 MCU)

$(2.5V \leq V_{DD} < 3.3V, T_a = -30 \text{ to } +85^\circ\text{C})$ 

Symbol	Signal	Description	Condition	Min.	Max.	Units
$t_{ASS0}$ $t_{AHS0}$	CD	Address setup time Address hold time		5 15	-	nS
$t_{CYS0}$		System cycle time 8 bits bus (read) (write) 4 bits bus (read) (write)		140 80 140 80	-	nS
$t_{PWR0}$	WR1	Pulse width 8 bits (read) 4 bits		70 70	-	nS
$t_{PWW0}$	WR0	Pulse width 8 bits (write) 4 bits		40 40	-	nS
$t_{HPW0}$	WR0, WR1	High pulse width 8 bits bus (read) (write) 4 bits bus (read) (write)		70 40 70 40	-	nS
$t_{DSS0}$ $t_{DHS0}$	D0~D7	Data setup time Data hold time		30 15	-	nS
$t_{ACC0}$ $t_{OD0}$		Read access time Output disable time	$C_L = 100\text{pF}$	- 25	60 20	nS
$t_{CSSA0}$ $t_{CSH0}$	CS1/CS0	Chip select setup time		5 5		nS

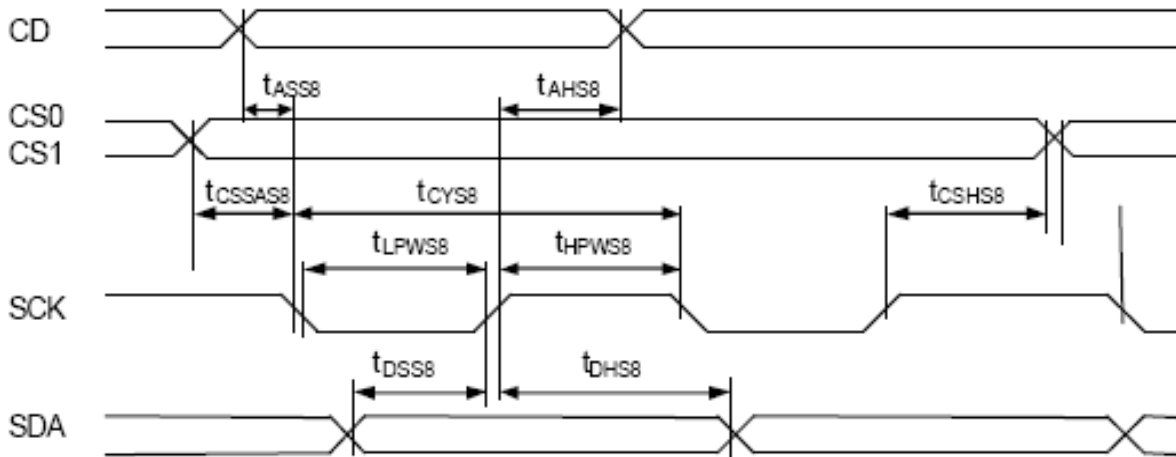


FIGURE 19: Serial Bus Timing Characteristics (for S8/ S8uc)

 $(2.5V \leq V_{DD} < 3.3V, T_a = -30 \text{ to } +85^\circ\text{C})$ 

Symbol	Signal	Description	Condition	Min.	Max.	Units
$t_{ASS8}$	CD	Address setup time		5	-	nS
$t_{AHS8}$	CD	Address hold time		15	-	nS
$t_{CYS8}$	SCK	System cycle time		80	-	nS
$t_{LPWS8}$	SCK	Low pulse width		35	-	nS
$t_{HPWS8}$	SCK	High pulse width		35	-	nS
$t_{DSS8}$ $t_{DHS8}$	SDA	Data setup time Data hold time		30 20	-	nS
$t_{CSSAS8}$ $t_{CSS8}$	CS1/CS0	Chip select setup time		5 10		nS

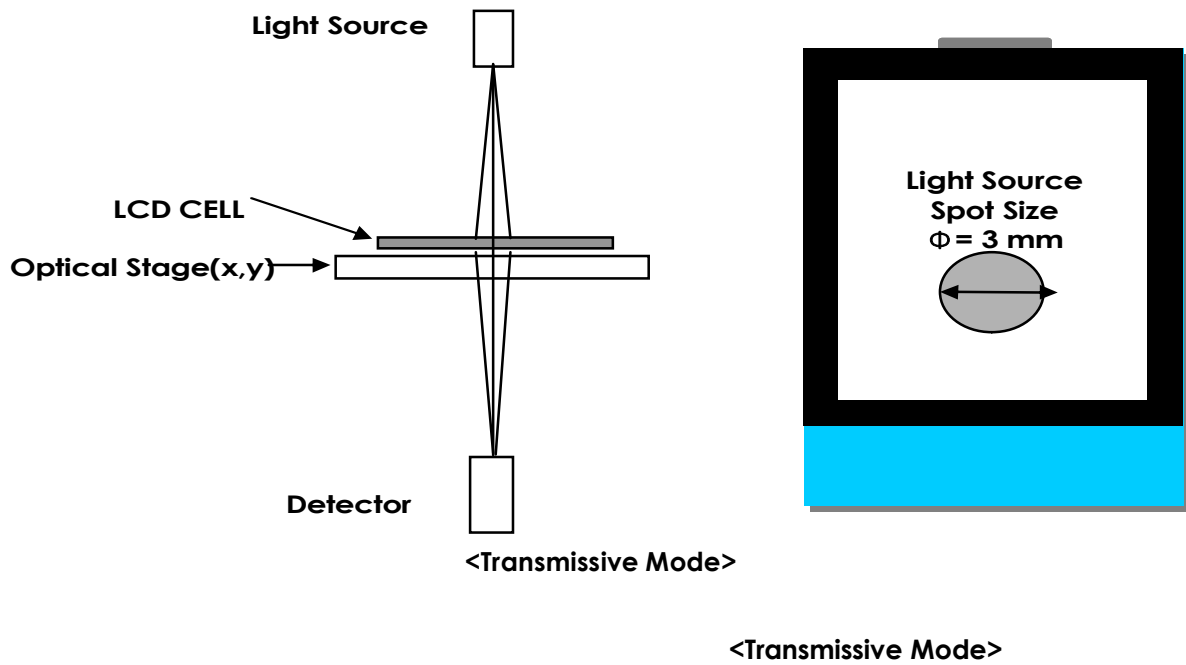
**■ELECTRO-OPTICAL CHARACTERISTICS**

Item	Symbol	Condition	Min	Typ	Max	Unit	Remark	Note
Response time	Tr	$\theta=0^\circ$	---	184	---	ms	FIG.3	1
	Tf	$\theta=0^\circ$ Ta=25°C	---	210	---	ms	FIG.3	1
Viewing angle range	$\theta$	$\theta = 90^\circ$	30	40	---	deg	FIG 5	2
		$\theta = 270^\circ$	40	50	---	deg		
		$\theta = 0^\circ$	30	40	---	deg		
		$\theta = 180^\circ$	30	40	---	deg		

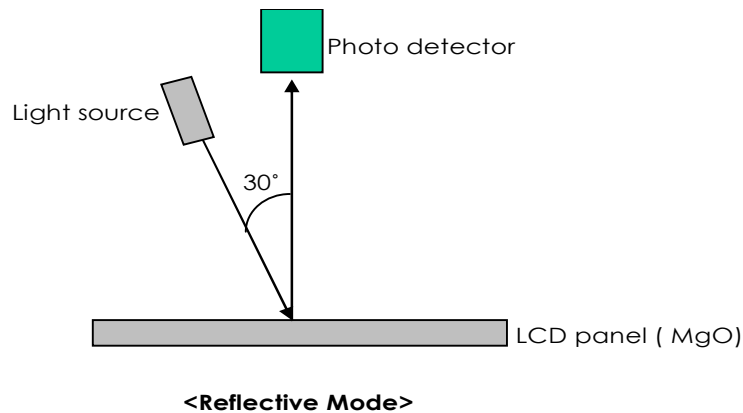
Note 1. Response time is the time required for the display to transition from White to black(Rise Time, Tr) and from black to white(Decay Time, Tf). For additional information see FIG 3.

Note 2. Viewing angle is the angle at which the contrast ratio is greater than 2. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG 5.

**FIG. 1 Optical Characteristic Measurement Equipment and Method**

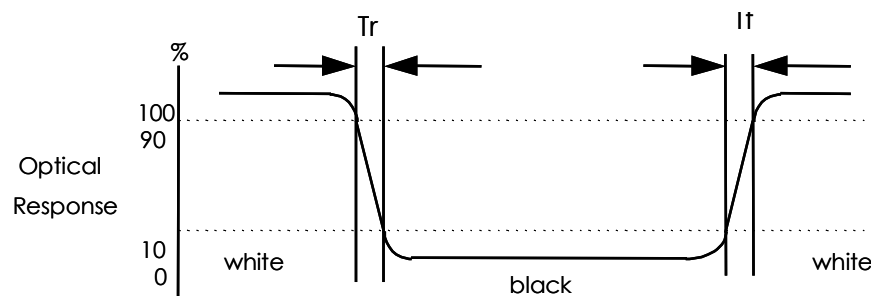


**FIG. 2 Measuring method for optical characteristics in Reflective mode**



**FIG. 3 The definition of Response Time**

The response time is defined as the following figure and shall be measured by switching the input signal for “black” and “white”.

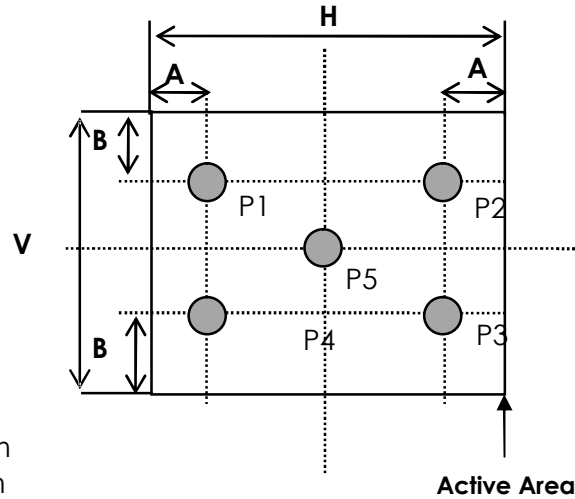


The values specified are at an approximate distance 500 mm from the LCD surface at a viewing angle of  $\Phi$  and  $\theta$  equal to  $0^\circ$ . Measurement condition : Refer to next pages ( B - light source , Halogen Lamp, with polarizer )

**FIG. 4 Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity**

<measuring point for luminance variation>

<measuring point for surface luminance>



A : 5 mm

B : 5 mm

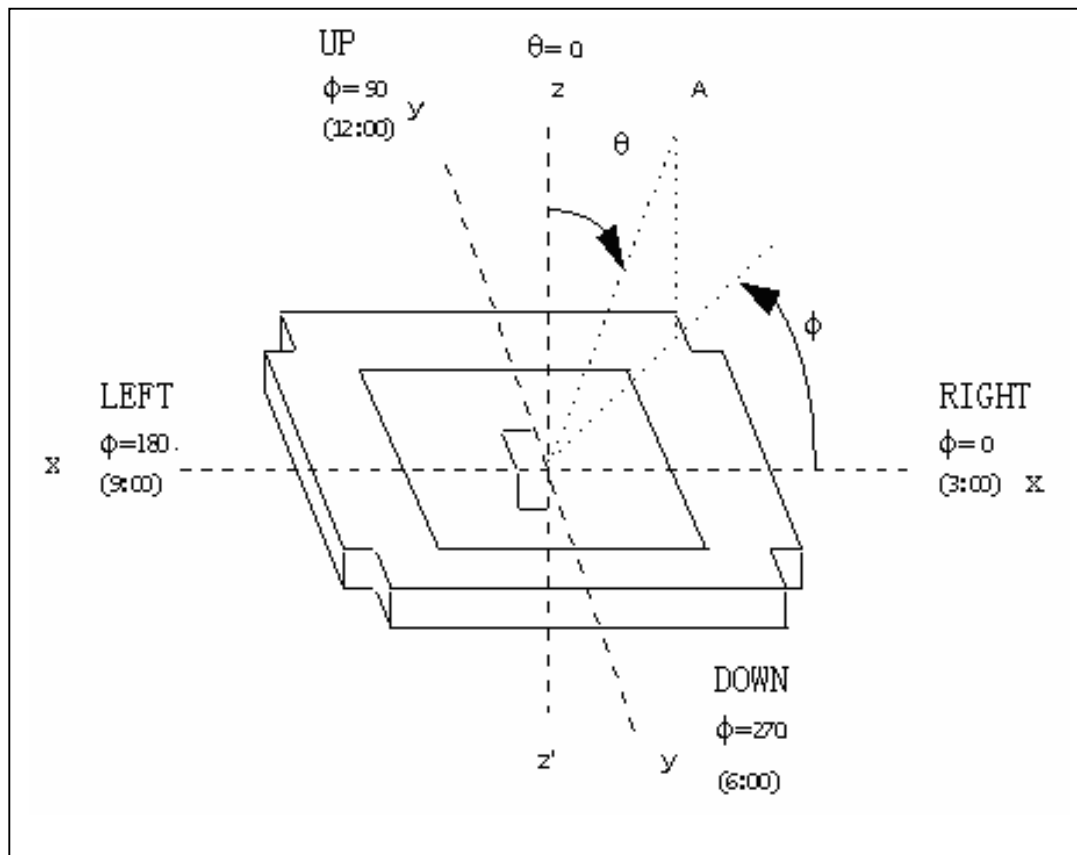
Light source spot size  $\varnothing=2\text{mm}$

H, V : Active Area

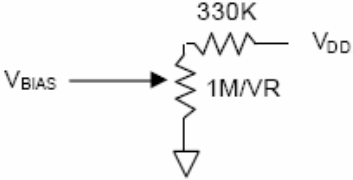
measurement device is TOPCON luminance meter BM-7

**FIG. 5 The definition of viewing angle**

<dimension of viewing angle range>



## ■ INTERFACE DESCRIPTION

Pin No.	Symbol	Level	Description																											
1	NC	-	No connection.																											
2	VBIAS	-	This is the reference voltage to generate the actual SEG driving voltage. 																											
3	VLCDIN	-	High voltage LCD power supply. By-pass capacitor CL is optional. It can be connected between VLCD and VSS. When CL is used, keep the trace resistance under 300 Ohm.(NOTE 1)																											
4	VB0+	-	LCD bias voltages. Connect capacitors of CBX value between VBX+ and VBX-.(NOTE 2)																											
5	VB1+																													
6	VB1-																													
7	VB0-																													
8	VDD	2.8V	Power supply.																											
9	VSS	VSS	Ground.																											
10	BM1	H/L	<table border="1"> <thead> <tr> <th>BM[1:0]</th> <th>D[7:6]</th> <th>Mode</th> </tr> </thead> <tbody> <tr> <td>1 0</td> <td>Data</td> <td>8080/8-bit</td> </tr> <tr> <td>0 0</td> <td>0 0</td> <td>8080/4-bit</td> </tr> <tr> <td>0 0</td> <td>1 0</td> <td>4-wire SPI w/ 8-bit token (S8: conventional)</td> </tr> <tr> <td>0 0</td> <td>1 1</td> <td>3-wire SPI w/ 8-bit token (S8uc: Ultra-Compact)</td> </tr> </tbody> </table>	BM[1:0]	D[7:6]	Mode	1 0	Data	8080/8-bit	0 0	0 0	8080/4-bit	0 0	1 0	4-wire SPI w/ 8-bit token (S8: conventional)	0 0	1 1	3-wire SPI w/ 8-bit token (S8uc: Ultra-Compact)												
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11	BM0																													
12	/RD	H/L	Read signal.																											
13	/WR	H/L	Write signal.																											
14	CD	H/L	Command or data select pin.																											
15	/CS0	H/L	Chip select input pin.																											
16	/RST	H/L	Reset input pin.																											
17~24	D7~D0	H/L	<table border="1"> <thead> <tr> <th>BM=1x (Parallel)</th> <th>BM=0x (Parallel)</th> <th>BM=00 (S8/S8uc)</th> </tr> </thead> <tbody> <tr> <td>D0</td> <td>D0/D4</td> <td>SCK</td> </tr> <tr> <td>D1</td> <td>D1/D5</td> <td>—</td> </tr> <tr> <td>D2</td> <td>D2/D6</td> <td>—</td> </tr> <tr> <td>D3</td> <td>D3/D7</td> <td>SDA</td> </tr> <tr> <td>D4</td> <td>—</td> <td>—</td> </tr> <tr> <td>D5</td> <td>—</td> <td>—</td> </tr> <tr> <td>D6</td> <td>0</td> <td>S8/S8uc</td> </tr> <tr> <td>D7</td> <td>0</td> <td>1</td> </tr> </tbody> </table>	BM=1x (Parallel)	BM=0x (Parallel)	BM=00 (S8/S8uc)	D0	D0/D4	SCK	D1	D1/D5	—	D2	D2/D6	—	D3	D3/D7	SDA	D4	—	—	D5	—	—	D6	0	S8/S8uc	D7	0	1
BM=1x (Parallel)	BM=0x (Parallel)	BM=00 (S8/S8uc)																												
D0	D0/D4	SCK																												
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D3	D3/D7	SDA																												
D4	—	—																												
D5	—	—																												
D6	0	S8/S8uc																												
D7	0	1																												
25	NC	-	No connection.																											

### NOTE 1:

CL: 0.06mF~0.3mF (25V) is appropriate for most applications.

### NOTE 2:

CB: 150~250x LCD load capacitance or 2mF (2V), whichever is higher.

## ■ APPLICATION CIRCUIT

Please consult our technical department for detail information.

## ■ INITIAL CODE

Please consult our technical department for detail information.

## ■ RELIABILITY TEST

No.	Test Item	Test Condition	Inspection after test
1	High Temperature Storage	80±2°C/200 hours	Inspection after 2~4hours storage at room temperature, the sample shall be free from defects: 1.Air bubble in the LCD; 2.Sealleak; 3.Non-display; 4.missing segments; 5.Glass crack; 6.Current Idd is twice higher than initial value.
2	Low Temperature Storage	-30±2°C/200 hours	
3	High Temperature Operating	70±2°C/120 hours	
4	Low Temperature Operating	-20±2°C/120 hours	
5	Temperature Cycle	-20 ± 2 °C ~25~70 ± 2 °C × 10cycles (30min.) (5min.) (30min.)	
6	Damp Proof Test	50°C ± 5°C × 90%RH/120 hours	
7	Vibration Test	Frequency: 10Hz~55Hz~10Hz Amplitude: 1.5mm, X, Y, Z direction for total 3hours (Packing condition)	
8	Drooping test	Drop to the ground from 1m height, one time, every side of carton. (Packing condition)	
9	ESD test	Voltage: ±8KV R: 330 Ω C: 150pF Air discharge, 10time	

**Remark:**

- 1.The test samples should be applied to only one test item.
- 2.Sample size for each test item is 5~10pcs.
- 3.For Damp Proof Test, Pure water(Resistance > 10MΩ) should be used.
- 4.In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judge as a good part.  
Using ionizer(an antistatic blower) is recommended at working area in order to reduce electro-static voltage.  
When removing protection film from LCM panel, peel off the tag slowly( recommended more than one second) while blowing with ionizer toward the peeling face to minimize ESD which may damage electrical cicuit.
- 5.EL evaluation should be excepted from reliability test with humidity and temperature:  
Some defects such as black spot/blemish can happen by natural chemical reaction with humidity and Fluorescence EL has.
- 6.Please use automatic switch menu(or roll menu) testing mode when test operating mode.

**■ INSPECTION CRITERION**

<b>TRULY</b> <sup>®</sup> OUTGOING QUALITY STANDARD	PAGE 1 OF 7
TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA	Mono COG Product
<p>This specification is made to be used as the standard acceptance/rejection criteria for Mono COG Product.</p> <p>1 sample plan</p> <p>Sampling plan according to GB/T2828.1-2003/ISO 2859-1 : 1999 and ANSI/ASQC Z1.4-1993, normal level 2 and based on:</p> <p>Major defect: AQL 0.65</p> <p>Minor defect: AQL 1.5</p> <p>2. Inspection condition</p> <p>Viewing distance for cosmetic inspection is 30cm with bare eyes, and under an environment of 800 lux(20W~40W) light intensity, all directions for inspecting the sample should be within 45° against perpendicular line.</p> <p>3. Definition of inspection zone in LCD.</p> <div data-bbox="491 1189 1015 1420" data-label="Diagram"><p>The diagram shows three nested rectangles representing inspection zones. The innermost rectangle is labeled 'A'. The middle rectangle is labeled 'B' on its right side. The outermost rectangle is labeled 'C' on its right side. This indicates that zone B encompasses zone A, and zone C encompasses zone B.</p></div> <p>Zone A: character/Digit area</p> <p>Zone B: viewing area except Zone A (ZoneA+ZoneB=minimum Viewing area)</p> <p>Zone C: Outside viewing area (invisible area after assembly in customer`s product)</p> <p>Fig.1 Inspection zones in an LCD.</p> <p>Note: As a general rule, visual defects in Zone C are permissible, when it is no trouble for quality and assembly of customer`s product.</p>	

OUTGOING QUALITY STANDARD	PAGE 2 OF 7
TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA	Mono COG Product

4. Major Defect

All functional defects such as open(or missing segment ), short and serious cosmetic defects Are classified as major defects.

5. Minor Defect

Except the Major defects above, cosmetic defects such as spot, glass defect are classified as minor defects.

Item No	Items to be inspected	Inspection Standard	Classification of defects																					
5.1	Spot defect (Defects in spot form, such as dark/white spot)	<table border="1"> <thead> <tr> <th data-bbox="424 853 651 976" rowspan="2">Size(mm) \ Zone</th> <th colspan="3" data-bbox="651 853 1134 913">Acceptable Qty</th> </tr> <tr> <th data-bbox="651 913 810 976">A</th> <th data-bbox="810 913 959 976">B</th> <th data-bbox="959 913 1134 976">C</th> </tr> </thead> <tbody> <tr> <td data-bbox="424 976 651 1066"><math>\Phi \leq 0.15</math></td> <td colspan="3" data-bbox="651 976 1134 1066">Acceptable(clustering of spot not allowed)</td> </tr> <tr> <td data-bbox="424 1066 651 1133"><math>0.15 &lt; \Phi \leq 0.20</math></td> <td data-bbox="651 1066 810 1133">1</td> <td data-bbox="810 1066 959 1133">2</td> <td data-bbox="959 1066 1134 1133" rowspan="3">Acceptable</td> </tr> <tr> <td data-bbox="424 1133 651 1200"><math>0.20 &lt; \Phi \leq 0.25</math></td> <td data-bbox="651 1133 810 1200">0</td> <td data-bbox="810 1133 959 1200">1</td> </tr> <tr> <td data-bbox="424 1200 651 1267"><math>\Phi &gt; 0.25</math></td> <td data-bbox="651 1200 810 1267">0</td> <td data-bbox="810 1200 959 1267">0</td> </tr> </tbody> </table> <p data-bbox="424 1323 1011 1406">Remarks: For dark/white spot, size <math>\Phi</math> is defined as <math>\Phi = (X+Y) / 2</math></p> <div data-bbox="756 1424 895 1570"> </div>	Size(mm) \ Zone	Acceptable Qty			A	B	C	$\Phi \leq 0.15$	Acceptable(clustering of spot not allowed)			$0.15 < \Phi \leq 0.20$	1	2	Acceptable	$0.20 < \Phi \leq 0.25$	0	1	$\Phi > 0.25$	0	0	Minor
Size(mm) \ Zone	Acceptable Qty																							
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OUTGOING QUALITY STANDARD		PAGE 3 OF 7																																
TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA		Mono COG Product																																
5. Cosmetic Defect																																		
Item No	Items to be inspected	Inspection Standard		Classification of defects																														
5.2	Line defect (Defects in line form)	<table border="1"> <thead> <tr> <th colspan="2">Size(mm)</th> <th colspan="2">Acceptable Qty</th> </tr> <tr> <th rowspan="2">L(Length)</th> <th rowspan="2">W(Width)</th> <th colspan="2">Zone</th> </tr> <tr> <th>A、 B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td><math>L \leq 10.0</math></td> <td><math>W \leq 0.01</math></td> <td>Acceptable</td> <td rowspan="6">Accep-ta-ble</td> </tr> <tr> <td><math>L \leq 3.0</math></td> <td><math>W \leq 0.03</math></td> <td>2</td> </tr> <tr> <td><math>L &gt; 3.0</math></td> <td><math>W \leq 0.03</math></td> <td>0</td> </tr> <tr> <td><math>L \leq 2.5</math></td> <td><math>0.03 &lt; W \leq 0.05</math></td> <td>2</td> </tr> <tr> <td><math>L &gt; 2.5</math></td> <td><math>0.03 &lt; W \leq 0.05</math></td> <td>0</td> </tr> <tr> <td></td> <td><math>W &gt; 0.05</math></td> <td colspan="2">Counted as spot defect (follows item 5.1)</td> </tr> </tbody> </table>		Size(mm)		Acceptable Qty		L(Length)	W(Width)	Zone		A、 B	C	$L \leq 10.0$	$W \leq 0.01$	Acceptable	Accep-ta-ble	$L \leq 3.0$	$W \leq 0.03$	2	$L > 3.0$	$W \leq 0.03$	0	$L \leq 2.5$	$0.03 < W \leq 0.05$	2	$L > 2.5$	$0.03 < W \leq 0.05$	0		$W > 0.05$	Counted as spot defect (follows item 5.1)		Minor
		Size(mm)		Acceptable Qty																														
		L(Length)	W(Width)	Zone																														
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		$L > 3.0$	$W \leq 0.03$	0																														
		$L \leq 2.5$	$0.03 < W \leq 0.05$	2																														
		$L > 2.5$	$0.03 < W \leq 0.05$	0																														
	$W > 0.05$	Counted as spot defect (follows item 5.1)																																
Remarks: The total of spot defect and line defect shall not exceed four.																																		
5.3	Orientation defect (such as misalignment of L.C)	Not allowed inside viewinw area(Zone A and Zone B)		Minor																														
5.4	Polarizer defect	5.4.1 Polarizer Position (i) Shifting in position should not exceed the glass outline dimension. (ii) Incomplete covering of the viewing area due to shifting is not allowed.																																

OUTGOING QUALITY STANDARD	PAGE 4 OF 7
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TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA	Mono COG Product
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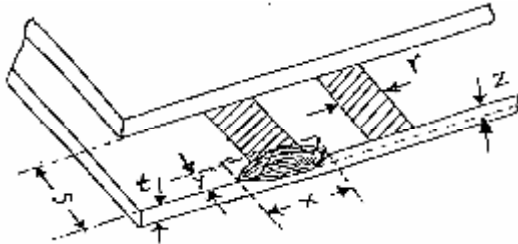
5. Cosmetic Defect

Item No	Items to be inspected	Inspection Standard	Classification of defects																							
5.4	Polarizer defect	5.4.2 Seratches, bubble or dent on glass/polarizer/Reflector, bubble between polarizers & reflector/glass: <table border="1" style="margin: 10px auto; border-collapse: collapse; text-align: center;"> <thead> <tr> <th rowspan="3">Zize(mm)</th> <th colspan="3">Acceptable Qty</th> </tr> <tr> <th colspan="3">Zone</th> </tr> <tr> <th>A</th> <th>B</th> <th>C</th> </tr> </thead> <tbody> <tr> <td><math>\Phi \leq 0.15</math></td> <td colspan="2">Acceptable</td> <td rowspan="4" style="font-size: 2em; vertical-align: middle;">Acceptable</td> </tr> <tr> <td><math>0.15 &lt; \Phi \leq 0.20</math></td> <td>3</td> <td>5</td> </tr> <tr> <td><math>0.20 &lt; \Phi \leq 0.30</math></td> <td>3</td> <td>5</td> </tr> <tr> <td><math>\Phi &gt; 0.30</math></td> <td>0</td> <td>0</td> </tr> </tbody> </table>	Zize(mm)	Acceptable Qty			Zone			A	B	C	$\Phi \leq 0.15$	Acceptable		Acceptable	$0.15 < \Phi \leq 0.20$	3	5	$0.20 < \Phi \leq 0.30$	3	5	$\Phi > 0.30$	0	0	Minor
Zize(mm)	Acceptable Qty																									
	Zone																									
	A	B	C																							
$\Phi \leq 0.15$	Acceptable		Acceptable																							
$0.15 < \Phi \leq 0.20$	3	5																								
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$\Phi > 0.30$	0	0																								
5.5	Segment deformity	5.5.1 Deformity (void or Excess) <ul style="list-style-type: none"> <li>(i) void in segment Accept for <math>A \leq 0.10\text{mm}</math></li> <li>(ii) Excess in segment Accept for <math>B &lt; 0.02\text{mm}</math></li> </ul> <div style="text-align: center; margin: 10px 0;"> </div> <ul style="list-style-type: none"> <li>(iii) Thicker and Thinner</li> </ul> Note: Permissible level $A-B \leq 0.10\text{mm}$ <div style="text-align: center; margin: 10px 0;"> </div> Remarks: where d =segment width	Minor																							

<b>TRULY</b> ® OUTGOING QUALITY STANDARD	PAGE 5 OF 7
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TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA	Mono COG Product
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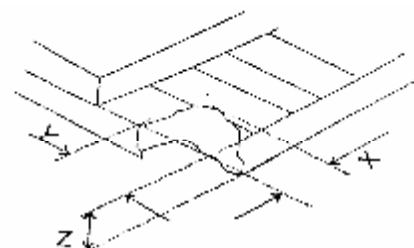
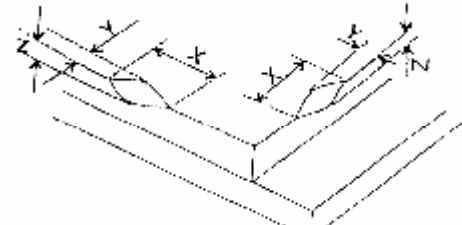
5. Cosmetic Defect

Item No	Items to be inspected	Inspection Standard	Classification of defects												
5.5	Segment deformity	5.5.2 PIN Hole Acceptable if the following cases are fulfill: $0.1 \leq \Phi \leq 0.25$ mm acceptable MAX 5/PCS where $\Phi = 1/2(X+Y)$	Minor												
5.6	Glass defect	5.6.1 glass protrusion (i) Maximum protrusion of outline should not exceed the maximum outline dimension in product drawing.	Major												
		5.6.2 Cracks on glass is not acceptable.													
		5.6.3 Chipped glass definition: r=contact pad width s=contact pab length t=glass thickness x=width of chipped area y=length of chipped area z=depth of chipped area a=dimension of glass length	Minor												
															
Fig. 2 glass chips on LCD. (i) Chips on contact pab(unit:mm)															
		<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th style="width: 33%;">X</th> <th style="width: 33%;">Y</th> <th style="width: 33%;">Z</th> </tr> </thead> <tbody> <tr> <td>acceptable</td> <td><math>\leq 0.3</math></td> <td><math>\leq t/2</math></td> </tr> <tr> <td><math>\leq a/8</math></td> <td><math>\leq 0.8</math></td> <td><math>\leq t</math></td> </tr> <tr> <td><math>\leq a/6</math></td> <td><math>\leq 0.5</math></td> <td><math>\leq t</math></td> </tr> </tbody> </table>	X	Y	Z	acceptable	$\leq 0.3$	$\leq t/2$	$\leq a/8$	$\leq 0.8$	$\leq t$	$\leq a/6$	$\leq 0.5$	$\leq t$	
X	Y	Z													
acceptable	$\leq 0.3$	$\leq t/2$													
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$\leq a/6$	$\leq 0.5$	$\leq t$													

<b>TRULY</b> ® OUTGOING QUALITY STANDARD	PAGE 6 OF 7
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TITLE:FUNCTIONAL TEST & INSPECTION CRITERIA	Mono COG Product
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5. Cosmetic Defect

Item No	Items to be inspected	Inspection Standard	Classification of defects																		
5.6	Glass defect	<p>(ii) Chips between top/bottom glass. Acceptable for chips not extend to seal part.</p> <p>(ii) chips inside viewing area:spot chips located inside viewing area should be treated as spot defect.</p> <p>(iii) Crack on corner</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">X</td> <td style="text-align: center;">Y</td> <td style="text-align: center;">Z</td> </tr> <tr> <td style="text-align: center;"><math>\leq 5.0</math></td> <td style="text-align: center;"><math>\leq S/3</math></td> <td style="text-align: center;">t</td> </tr> </table> <p>Notes: 1. Not to reach B zone                  2. Target mark must be remained.                  3. At least 2/3 of the electrode area should be remained .</p> <p>(iv) Usual surface cracks</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="text-align: center;">X</td> <td style="text-align: center;">Y</td> <td style="text-align: center;">Z</td> </tr> <tr> <td style="text-align: center;">Acceptable</td> <td style="text-align: center;"><math>\leq 0.3</math></td> <td style="text-align: center;">T/2</td> </tr> <tr> <td style="text-align: center;"><math>\leq A/6</math></td> <td style="text-align: center;"><math>\leq 1.5</math></td> <td style="text-align: center;">T/2</td> </tr> <tr> <td style="text-align: center;"><math>\leq A/8</math></td> <td style="text-align: center;"><math>\leq 1.0</math></td> <td style="text-align: center;">T</td> </tr> </table> <p>Notes: 1. Not to reach B zone                  2. The total number of the glass defect should not be more than five.</p>	X	Y	Z	$\leq 5.0$	$\leq S/3$	t	X	Y	Z	Acceptable	$\leq 0.3$	T/2	$\leq A/6$	$\leq 1.5$	T/2	$\leq A/8$	$\leq 1.0$	T	Minor
X	Y	Z																			
$\leq 5.0$	$\leq S/3$	t																			
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Acceptable	$\leq 0.3$	T/2																			
$\leq A/6$	$\leq 1.5$	T/2																			
$\leq A/8$	$\leq 1.0$	T																			

TITLE:FUNCTIONAL TEST &amp; INSPECTION CRITERIA

Mono COG Product

## 5. Cosmetic Defect

Item No	Items to be inspected	Inspection Standard	Classification of defects
5.7	Distance between foreign	The distance between the foreign dot must exceed 30mm.	
5.8	Total number of dot	The total number of luminous dot, dart defect, contamination particle, bubble, scratch defect, pinhole must not exceed 4/piece.	

## ■ PRECAUTIONS FOR USING LCD MODULES

### Handling Precautions

(1) The display panel is made of glass and polarizer. As glass is fragile. It tends to become or chipped during handling especially on the edges. Please avoid dropping or jarring. Do not subject it to a mechanical shock by dropping it or impact.

(2) If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.

(3) Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary. Do not touch the display with bare hands. This will stain the display area and degraded insulation between terminals (some cosmetics are determined to the polarizer).

(4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully. Do not touch, push or rub the exposed polarizers with anything harder than an HB pencil lead (glass, tweezers, etc.). Do not put or attach anything on the display area to avoid leaving marks on. Condensation on the surface and contact with terminals due to cold will damage, stain or dirty the polarizer. After products are tested at low temperature they must be warmed up in a container before coming is contacting with room temperature air.

(5) If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten cloth with one of the following solvents

- Isopropyl alcohol
- Ethyl alcohol

Do not scrub hard to avoid damaging the display surface.

(6) Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following.

- Water
- Ketone
- Aromatic solvents

Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading. Avoid contacting oil and fats.

(7) Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.

(8) Install the LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.

(9) Do not attempt to disassemble or process the LCD module.

(10) NC terminal should be open. Do not connect anything.

(11) If the logic circuit power is off, do not apply the input signals.

(12) Electro-Static Discharge Control, Since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC. To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

- Before remove LCM from its packing case or incorporating it into a set, be sure the module and your body have the same electric potential .Be sure to ground the body when handling the LCD modules.

- Tools required for assembling, such as soldering irons, must be properly grounded. make certain the AC power source for the soldering iron does not leak. When using an electric screwdriver to attach LCM, the screwdriver should be of ground potentiality to minimize as much as possible any transmission of electromagnetic waves produced sparks coming from the commutator of the motor.

- To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions. To reduce the generation of static electricity be careful that the air in the work is not too dried. A relative humidity of 50%-60% is recommended .As far as possible make the electric potential of your work clothes and that of the work bench the ground potential

- The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated

(13) Since LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive shocks to the module or making any alterations or modifications to it.

- Do not alter, modify or change the shape of the tab on the metal frame.
- Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.
- Do not damage or modify the pattern writing on the printed circuit board.
- Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector.
- Except for soldering the interface, do not make any alterations or modifications with a soldering iron.
- Do not drop, bend or twist LCM.

### **Storage Precautions**

When storing the LCD modules, the following precaution is necessary.

- (1) Store them in a sealed polyethylene bag. If properly sealed, there is no need for the dessicant.
- (2) Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0°C and 35°C.
- (3) The polarizer surface should not come in contact with any other objects. (We advise you to store them in the container in which they were shipped).

### **Others**

Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.

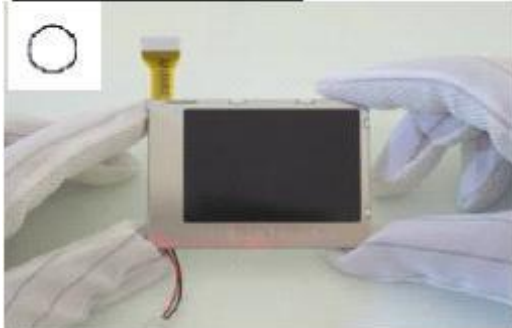
If the LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be regained by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.

To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity etc., exercise care to avoid holding the following sections when handling the modules.

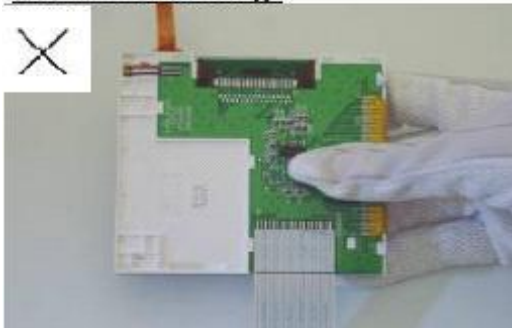
- Exposed area of the printed circuit board.
- Terminal electrode sections.

**Handling precaution for LCM**

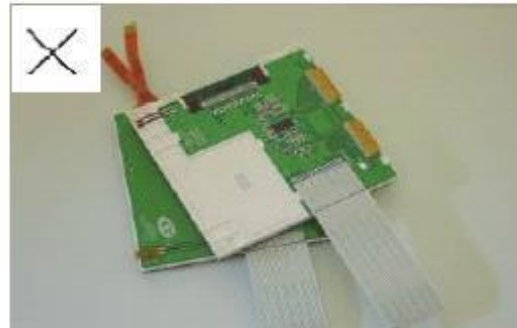
LCM is easy to be damaged.  
Please note below and be careful for handling!

**Correct handling:**

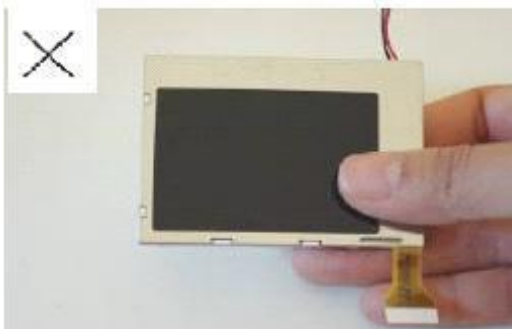
As above picture, please handle with anti-static gloves around LCM edges.

**Incorrect handling:**

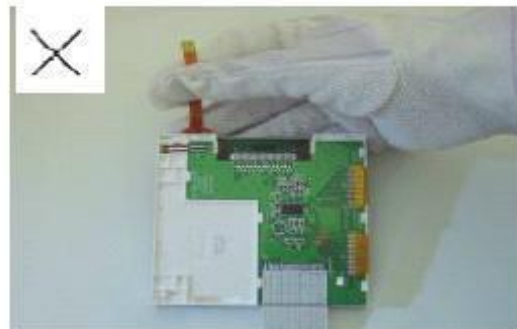
Please don't touch IC directly.



Please don't stack LCM.



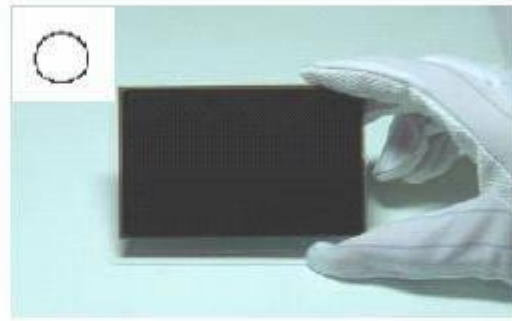
Please don't hold the surface of panel.



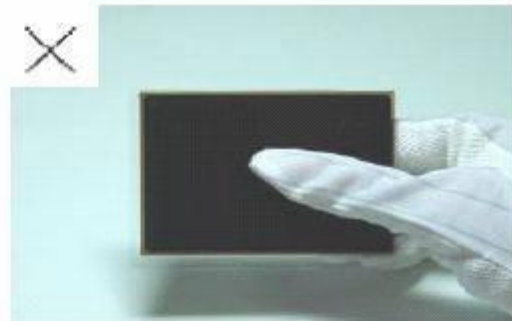
Please don't stretch interface of output, such as FPC cable.

**Handling precaution for LCD**

LCD is easy to be damaged.  
Please note below and be careful for handling!

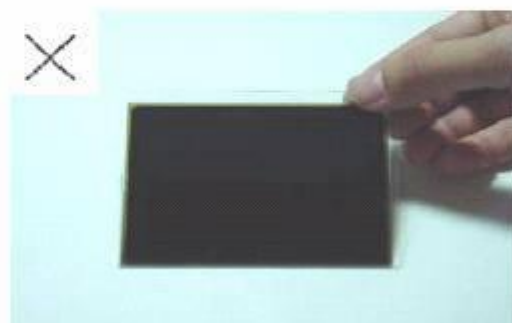
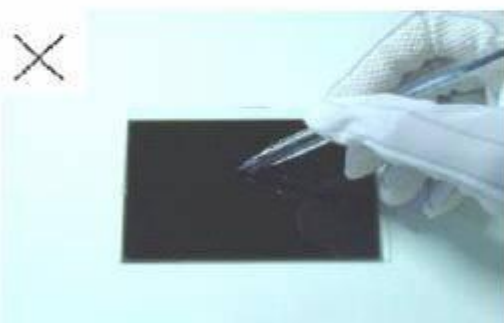
**Correct handling:**

As above photo, please handle with anti-static gloves around LCD edges.

**Incorrect handling:**

Please don't stack the LCDS.

Please don't hold the surface of LCD.



Please don't operate with sharp stick  
such as pens.

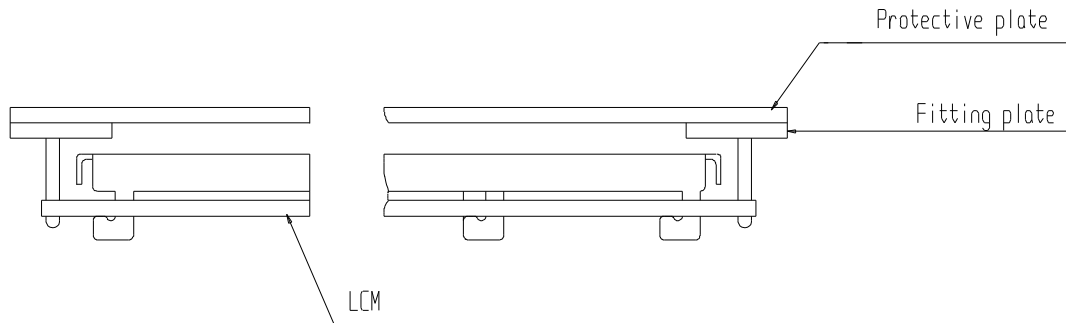
Please don't touch ITO glass without  
anti-static gloves.

**USING LCD MODULES**

**Installing LCD Modules**

The hole in the printed circuit board is used to fix LCM as shown in the picture below. Attend to the following items when installing the LCM.

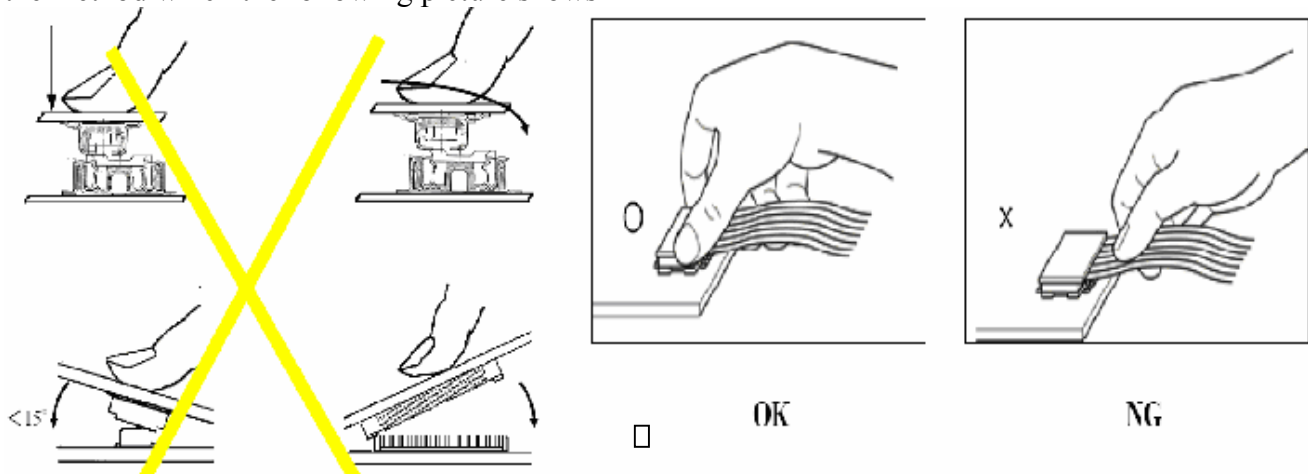
- (1) Cover the surface with a transparent protective plate to protect the polarizer and LC cell.



- (2) When assembling the LCM into other equipment, the spacer to the bit between the LCM and the fitting plate should have enough height to avoid causing stress to the module surface, refer to the individual specifications for measurements. The measurement tolerance should be  $\pm 0.1$ mm.

**Precaution for assemble the module with BTB connector:**

Please note the position of the male and female connector position, don't assemble or assemble like the method which the following picture shows



**Precaution for soldering to the LCM**

	Hand soldering	Machine drag soldering	Machine press soldering
No ROHS product	290°C ~350°C. Time : 3-5S.	330°C ~350°C. Speed : 4-8 mm/s.	300°C ~330°C. Time : 3-6S. Press: 0.8~1.2Mpa
ROHS product	340°C ~370°C. Time : 3-5S.	350°C ~370°C. Time : 4-8 mm/s.	330°C ~360°C. Time : 3-6S. Press: 0.8~1.2Mpa

- (1) If soldering flux is used, be sure to remove any remaining flux after finishing to soldering operation. (This does not apply in the case of a non-halogen type of flux.) It is recommended that you protect the LCD surface with a cover during soldering to prevent any damage due to flux spatters.

- (2) When soldering the electroluminescent panel and PC board, the panel and board should not be detached more than three times. This maximum number is determined by the temperature and time conditions mentioned above, though there may be some variance depending on the temperature of the soldering iron.

- (3) When remove the electroluminescent panel from the PC board, be sure the solder has completely melted, the soldered pad on the PC board could be damaged.

### Precautions for Operation

(1) Viewing angle varies with the change of liquid crystal driving voltage (VLCD). Adjust VLCD to show the best contrast.

(2) It is an indispensable condition to drive LCD's within the specified voltage limit since the higher voltage than the limit cause the shorter LCD life. An electrochemical reaction due to direct current causes LCD's undesirable deterioration, so that the use of direct current drive should be avoided.

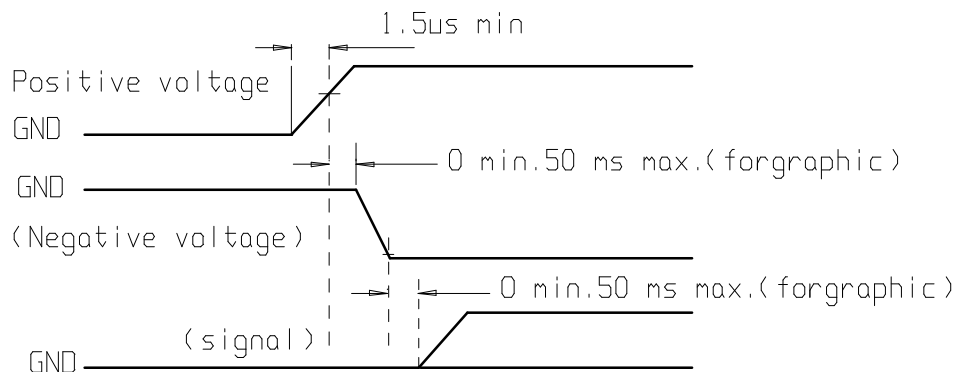
(3) Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them. However those phenomena do not mean malfunction or out of order with LCD's, Which will come back in the specified operating temperature.

(4) If the display area is pushed hard during operation, the display will become abnormal. However, it will return to normal if it is turned off and then back on.

(5) A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit. Usage under the maximum operating temperature, 50%RH or less is required.

(6) Input each signal after the positive/negative voltage becomes stable.

(7) Please keep the temperature within specified range for use and storage. Polarization degradation, bubble generation or polarizer peel-off may occur with high temperature and high humidity.



### Safety

(1) It is recommended to crush damaged or unnecessary LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.

(2) If any liquid leaks out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

### Limited Warranty

Unless agreed between TRULY and customer, TRULY will replace or repair any of its LCD modules which are found to be functionally defective when inspected in accordance with TRULY LCD acceptance standards (copies available upon request) for a period of one year from date of shipments. Cosmetic/visual defects must be returned to TRULY within 90 days of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of TRULY limited to repair and/or replacement on the terms set forth above. TRULY will not be responsible for any subsequent or consequential events.

### Return LCM under warranty

No warranty can be granted if the precautions stated above have been disregarded. The typical examples of violations are :

- Broken LCD glass.
- PCB eyelet is damaged or modified.
- PCB conductors damaged.
- Circuit modified in any way, including addition of components.
- PCB tampered with by grinding, engraving or painting varnish.
- Soldering to or modifying the bezel in any manner.

Module repairs will be invoiced to the customer upon mutual agreement. Modules must be returned with sufficient description of the failures or defects. Any connectors or cable installed by the customer must be removed completely without damaging the PCB eyelet, conductors and terminals.

**■ PACKING SPECIFICATION**

TBD

**■ PRIOR CONSULT MATTER**

- 1.①For Truly standard products, we keep the right to change material, process ... for improving the product property without notice on our customer.
- ②For OEM products, if any change needed which may affect the product property, we will consult with our customer in advance.
2. If you have special requirement about reliability condition, please let us know before you start the test on our samples.

**■ FACTORY****FACTORY NAME:** TRULY SEMICONDUCTORS LTD.**FACTORY ADDRESS:** Truly Industrial Area, ShanWei City,GuangDong,China**FACTORY PHONE:** 86-0660-3380061    **FAX:** 86-0660-3371772