

PRODUCT : LCD MODULE**MODEL NO.** : TFT400240-6-E**SUPPLIER** : TRULY SEMICONDUCTORS LTD.**DATE** : Oct 18, 2013CERT. No. QAC0946535
(ISO9001)CERT. No. HKG002005
(ISO14001)

SPECIFICATION

Revision: 1.0

TFT400240-6-E

This module uses ROHS material

If there is no special request from the customer, TRULY SEMICONDUCTORS LTD. will not reserve the tooling of the product under the following conditions:

1. There is no response from the customer in two years after TRULY SEMICONDUCTORS LTD. submit the samples.

2. There is no order in two years after the latest mass production.

And correlated data (including quality records) will be reserved for one year more after tooling is discarded.

TRULY SEMICONDUCTORS LTD:**CUSTOMER:**

Quality Assurance Department: _____

Approved by: _____

Technical Department: _____

Approved by:

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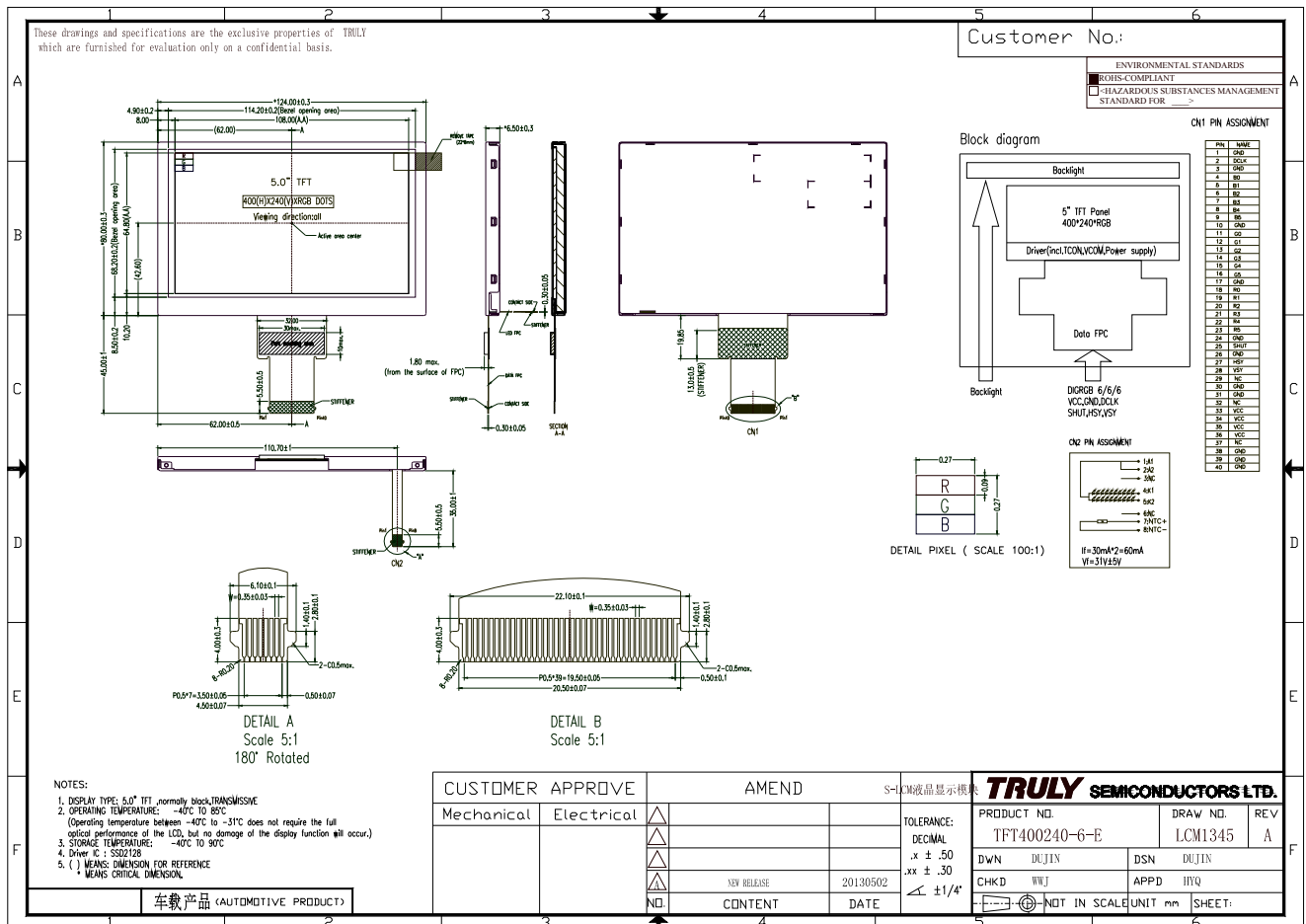
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WRITTEN BY	CHECKED BY	APPROVED BY
HUANG YAN XUE	HUANG WEN LIE	WENG MU RONG

■ GENERAL INFORMATION

Item of general information	Contents	Unit
LCD type	TFT/TRANSMISSIVE	/
Recommended Viewing Direction	Full viewing angle	O' Clock
Module area (W × H)	124.00×80.00×6.50	mm ²
Active area (W×H)	108.00×64.80	mm ²
Number of Dots	400×240	/
Pixel pitch (W × H)	0.27×0.27	mm ²
Driver IC	SSD2128	/
Backlight Type	LED	/
Module Power consumption	1.7(typical)	W
Interface Type	RGB interface	/
Input voltage	3.3	V

EXTERNAL DIMENSIONS



■ABSOLUTE MAXIMUM RATINGS

Parameter of absolute maximum ratings	Symbol	Min	Max	Unit
Supply voltage for logic	VCC	-0.3	4.0	V
Input voltage	VIN	-0.3	5.0	V
Operating temperature(Note 1)	Top	-40	85	°C
Storage temperature	TST	-40	90	°C
Humidity	RH	-	90%(Max60 °C)	RH

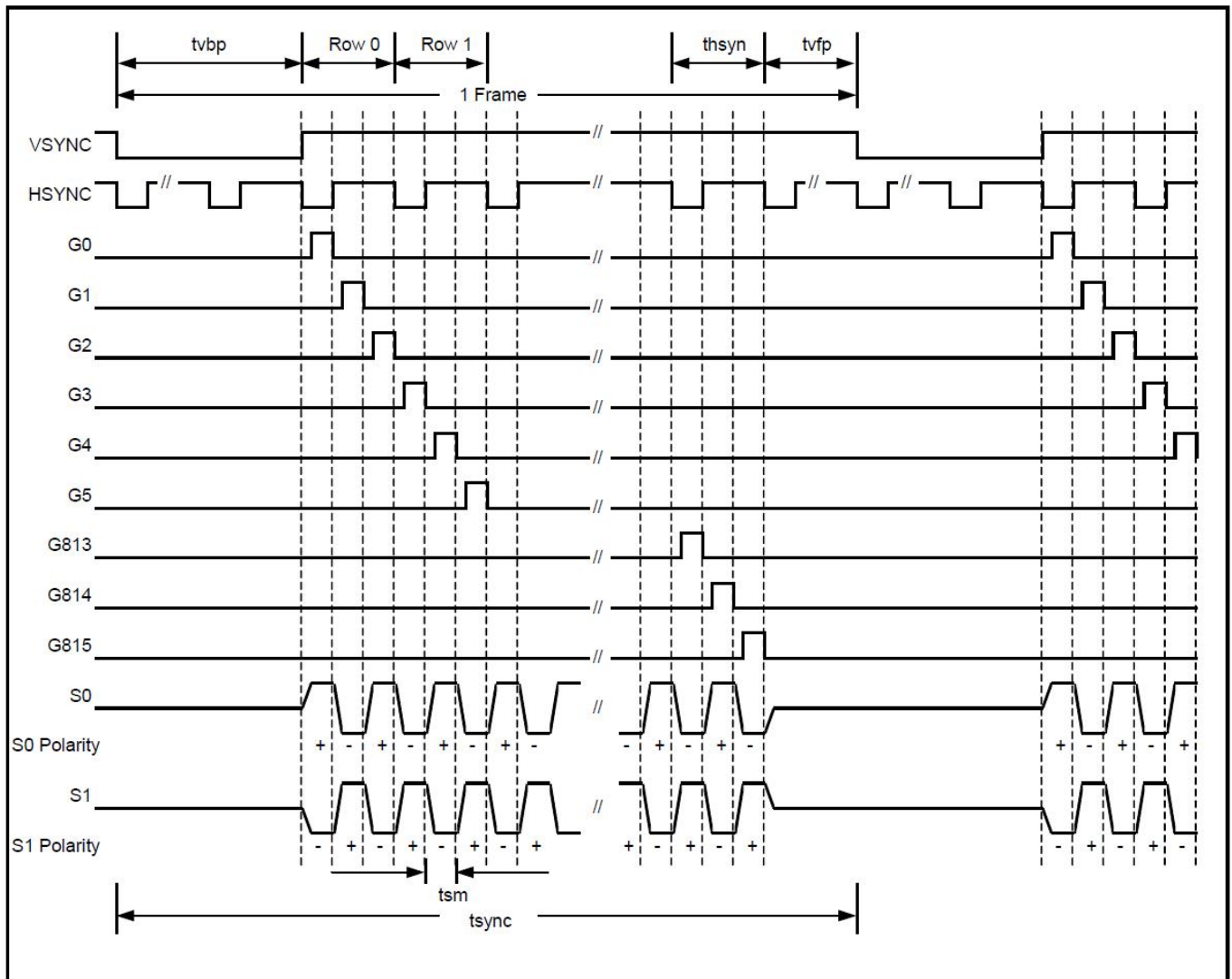
Note 1: -40°C to -31°C does not require the full optical performance of the LCD, but no damage of the display function will occur.

■ELECTRICAL CHARACTERISTICS**DC CHARACTERISTICS**

Parameter of DC characteristics	Symbol	Min	Typ	Max	Unit
Supply voltage for logic	VCC	2.5	3.3	3.5	V
Input Current	Idd	-	18	30	mA
Input voltage 'H' level	VIH	0.7VCC	-	VCC	V
Input voltage 'L' level	VIL	GND	-	0.3VCC	V
Output voltage 'H' level	VOH	0.7VCC	-	VCC	V
Output voltage 'L' level	VOL	GND	-	0.3VCC	V

■ TIMING OF POWER SUPPLY

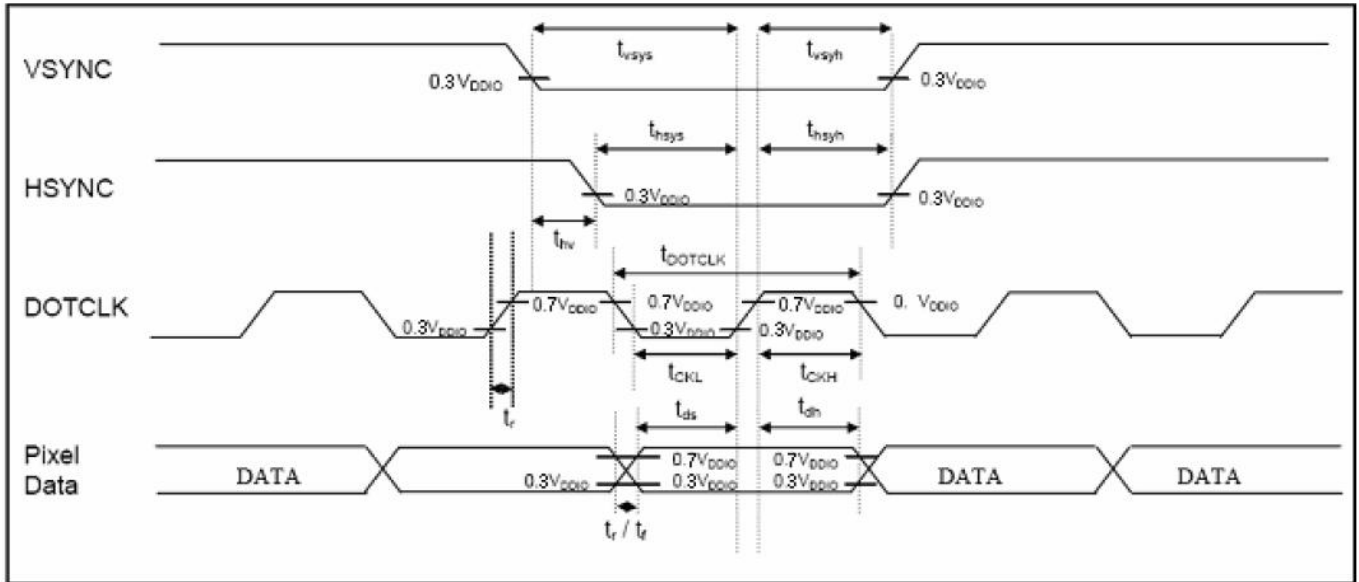
Display signal output timing



Note: Gate and source output timing (Dot inversion, gate non-overlapping)

Symbol	Parameter	Min	Typ	Max	Unit
t_{VSYNC}	1 / Frame Frequency	-	16.7	-	ms
t_{HSYNC}	1 / Line Frequency	-	61.3	-	us
t_{sm}	1 / Source Frequency	-	20.4	-	us
t_{vbp}	Delay time between each field	-	4	-	us
t_{vfp}	Delay time between each field	-	2	-	us

AC Characteristics (Unless otherwise specified, Voltage Referenced to VSS, VDDIO = 3.3V, TA = -40 to 95°C)



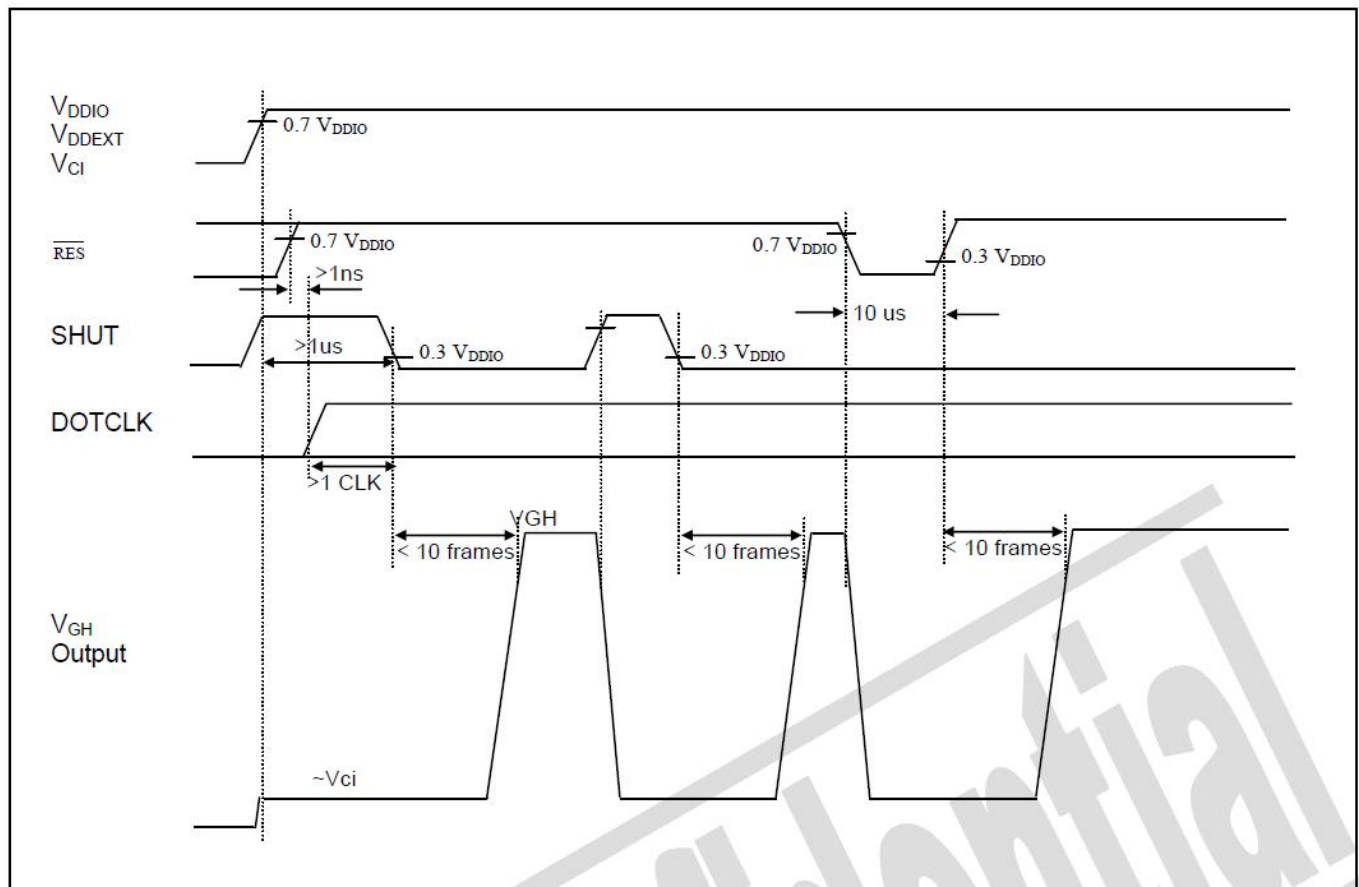
Note: Pixel Clock Timing

Characteristics	Symbol	Min	Typ	Max	Units
DOTCLK Frequency	24 bits parallel	-	-	14	MHz
	8 bits serial	-	-	42	MHz
DOTCLK Period	24 bits parallel	71.4	-	-	nSec
	8 bits serial	23.8	-	-	nSec
Pixel Clock Period	24 bits parallel	-	1	-	t _{DOTCLK}
	8 bits serial	-	3	-	t _{DOTCLK}
Pixel Clock Freq.	24 bits parallel	-	-	14	MHz
	8 bits serial	-	-	-	MHz
Vertical Sync Setup Time	t _{sys}	5	-	-	nSec
Vertical Sync Hold Time	t _{syh}	5	-	-	nSec
Horizontal Sync Setup Time	t _{hsys}	5	-	-	nSec
Horizontal Sync Hold Time	t _{hsyh}	5	-	-	nSec
Phase difference of Sync Signal Falling Edge	t _{hv}	0	-	480	t _{DOTCLK}
DOTCLK Low Period	t _{CKL}	18	-	-	nSec
DOTCLK High Period	t _{CKH}	18	-	-	nSec
Data Setup Time	t _{ds}	10	-	-	nSec
Data hold Time	t _{dh}	15	-	-	nSec
Reset pulse width	t _{RES}	10	-	-	uSec
Rise / Fall time	t _r / t _f	-	-	25	nSec

Note1: External clock source must be provided to DOTCLK pin of SSD2128A. The driver will not operate if absent of the clocking signal.

Note2: Tr/Tf apply to all logic input, RGB and SPI signals

Note3: Setup and hold time of DEN signal is same as Horizontal Sync signal i.e. 5nSec



Note: VGH Output against SHUT & RESB

Note1: The minimum cycle time of SHUT is 10 + 2 frames.

Note2: DOTCLK must be provided for boosting of VGH. The above timing diagram assumed voltages and DOTCLK are continuous supplied after power on.

Note3: VGH will be forced to VCI at the low stage of RES.

Note4: The minimum pulse width of RESET is 10us.

■ BACKLIGHT CHARACTERISTICS

Item of backlight characteristics	Symbol	Min.	Typ.	Max.	Unit	Condition
Forward voltage	Vf	27	31	35	V	If=30*2mA;Ta=25℃
Number of LED	-	-	2*10	-	Piece	-
Connection mode	P/S	-	Parallel/Serial	-	-	-

Using condition: constant current driving method If=30*2mA (+/-10%)

ELECTRO-OPTICAL CHARACTERISTICS

Item of electro-optical characteristics	Symbol	Condition	Min	Typ	Max	Unit	Remark	Note
Response time	Tr +Tf	Ta=25℃	-	30	45	ms	Fig.1	4
		Ta=-20℃	-	350	400			
		Ta=-30℃	-	800	1000			
Contrast ratio	Cr		650	800	-	---	FIG 2.	1
Luminance uniformity	δ WHITE	θ=0° ∅=0° Ta=25℃	80	90	-	%	FIG 2.	3
	δ BLACK		65	75	-			
Surface Luminance	Lv		500	650	-	cd/m ²	FIG 2.	2
Viewing angle range (CR>=100:1)	θ	∅ = 90°	60	-	-	deg	FIG 3.	6
		∅ = 270°	60	-	-	deg	FIG 3.	
		∅ = 0°	60	-	-	deg	FIG 3.	
		∅ = 180°	60	-	-	deg	FIG 3.	
NTSC ratio	---	---	-	65	-	%	-	-
CIE (x, y) chromaticity	Red x	θ=0° ∅=0° Ta=25℃	0.595	0.633	0.673	-	FIG 2.	5
	Red y		0.295	0.335	0.375			
	Green x		0.280	0.320	0.360			
	Green y		0.560	0.600	0.640			
	Blue x		0.110	0.150	0.190			
	Blue y		0.010	0.050	0.090			
	White x		0.278	0.318	0.358			
	White y		0.278	0.318	0.358			

Note 1. Contrast Ratio(CR) is defined mathematically as For more information see FIG 2.:

$$\text{Contrast Ratio} = \frac{\text{Average Surface Luminance with all white pixels (P}_1, P_2, P_3, \dots, P_9)}{\text{Average Surface Luminance with all black pixels (P}_1, P_2, P_3, \dots, P_9)}$$

Note 2. Surface luminance is the LCD surface from the surface with all pixels displaying white. For more information see FIG 2.

$$L_v = \text{Average Surface Luminance with all white pixels (P}_1, P_2, P_3, \dots, P_9)$$

Note 3. The uniformity in surface luminance, δ WHITE or δ BLACK is determined by measuring luminance at each test position 1 through 9, and then dividing the maximum luminance of 9 points luminance by minimum luminance of 9 points luminance. For more information see FIG 2.

$$\delta \text{ WHITE} = \frac{\text{Minimum Surface Luminance with all white pixels (P}_1, P_2, P_3, \dots, P_9)}{\text{Maximum Surface Luminance with all white pixels (P}_1, P_2, P_3, \dots, P_9)}$$

$$\delta \text{ BLACK} = \frac{\text{Minimum Surface Luminance with all black pixels (P}_1, P_2, P_3, \dots, P_9)}{\text{Maximum Surface Luminance with all black pixels (P}_1, P_2, P_3, \dots, P_9)}$$

Note 4. 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 1. The test equipment is Autronic-Melchers's ConoScope. Series

Note 5. CIE (x, y) chromaticity, The x,y value is determined by measuring luminance at each test position 1 through 5, and then make average value

Note 6. Viewing angle is the angle at which the contrast ratio is greater than 2. For TFT module the contrast ratio is greater than 10. 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 3.

FIG.1.The definition of Response Time

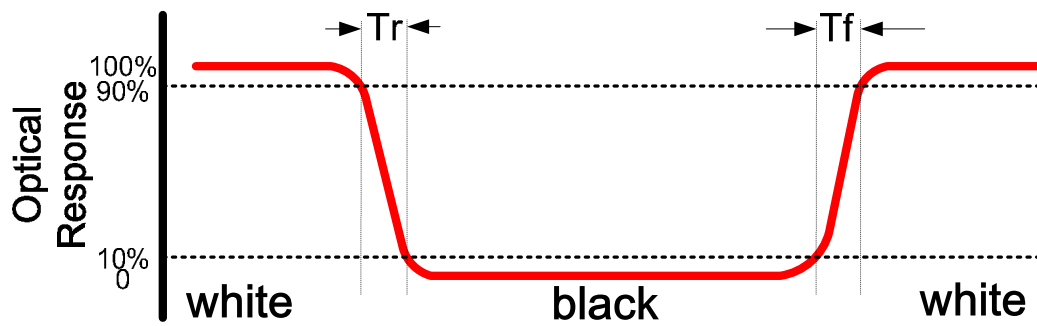


FIG. 2. Measuring method for Contrast ratio, surface luminance, Luminance uniformity , CIE (x, y) chromaticity

A : $H/6$

B : $V/6$

H,V : Active Area

Light spot size $\varnothing=5\text{mm}$, 500mm distance from the LCD surface to detector lens
measurement instrument is CS-2000

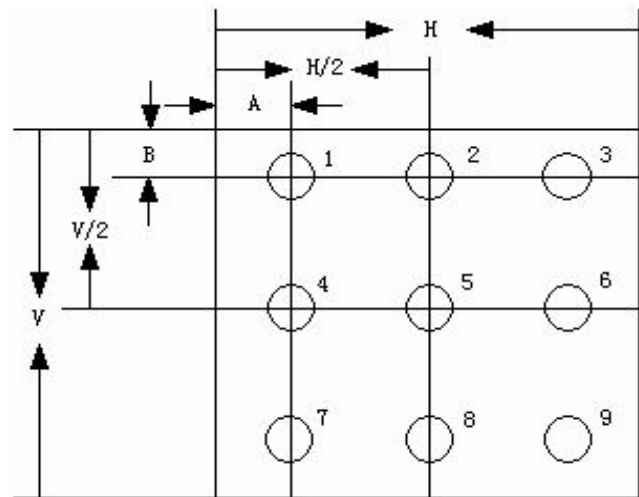
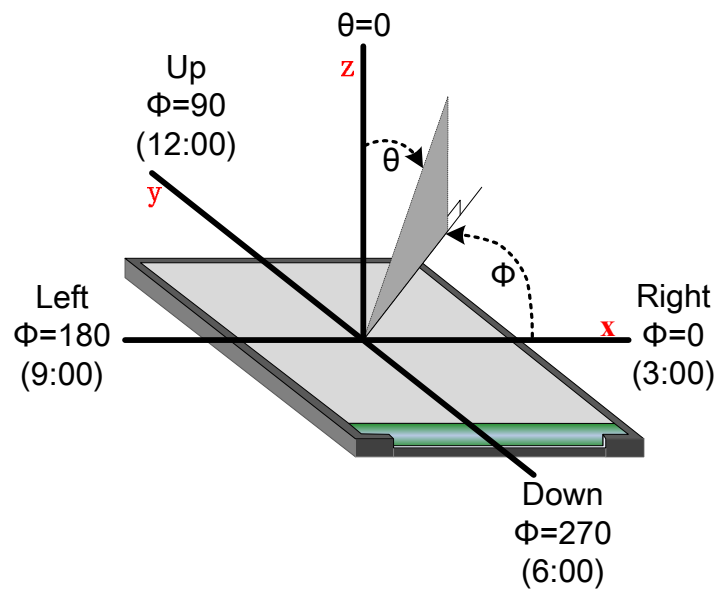


FIG.1. The definition of viewing angle



■ INTERFACE DESCRIPTION

Interface NO.	Symbol	I/O or connect to	Description	When not in use
1	GND	0v	Ground	-
2	DCLK	H/L	Dot clock signal for RGB interface	-
3	GND	0v	Ground	-
4	B0	H/L	Blue bus , B5 : MSB; B0 : LSB	-
5	B1			-
6	B2			-
7	B3			-
8	B4			-
9	B5			-
10	GND	0v	Ground	-
11	G0	H/L	Green bus , G5 : MSB; G0 : LSB	-
12	G1			-
13	G2			-
14	G3			-
15	G4			-
16	G5			-
17	GND	0v	Ground	-
18	R0	H/L	Green bus , G5 : MSB; G0 : LSB	-
19	R1			-
20	R2			-
21	R3			-
22	R4			-
23	R5			-
24	GND	0v	Ground	-
25	SHUT	H/L	Shutdown signal for TFT	-
26	GND	0v	Ground	-
27	HSY	H/L	Line synchronous signal for RGB interface	-
28	VSX	H/L	Frame synchronous signal for RGB interface	-
29	NC	--	No connection	-
30	GND	0v	Ground	-
31	GND	0v	Ground	-
32	NC	--	No connection	-
33	VCC	3.3v typ	Power supply for driver IC	-
34	VCC			-
35	VCC			-
36	VCC			-
37	NC	--	No connection	-
38	GND	0v	Ground	-
39	GND			-
40	GND			-

■ REFERENCE APPLICATION CIRCUIT

Please consult our technical department for detail information.

■ RELIABILITY

No.	Test Item	Test Condition	Inspection after test
1	High Temperature Storage	90±2℃/500 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 original value. 7.Reduction of the original contrast ratio of more than 50%
2	Low Temperature Storage	-40±2℃/500 hours	
3	High Temperature Operating	85±2℃/750 hours	
4	Low Temperature Operating	-30±2℃/240 hours	
5	Temperature Cycle	-40±2℃(30min.) ~25℃(5min.) 85±2℃(30min.)×100cycles	
6	Damp Proof Test	60℃±5℃×90%RH/240 hours	
7	Vibration Test	Frequency: 10Hz~55Hz~10Hz Amplitude : 1.5mm, X, Y, Z direction for total 1hours(Packing condition)	
8	Dropping test	Drop to the ground from 1m height, one time, every side of carton. (Packing condition)	
9	ESD test	Voltage:±15KV R: 330Ω C: 330pF Air discharge on panel 9 points, 3times per point ,no damage after test	
10	Life Time> 25℃±5℃, 45±5%RH, Not Direct Sun Light.	50000 Hours	


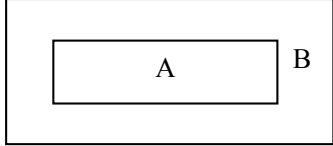
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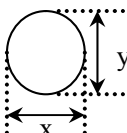
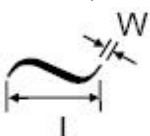
- 1.The test samples should be applied to only one test item.
- 2.Sample size for each test item is 5pcs.
- 3.For Damp Proof Test, Pure water(Resistance>10MΩ) should be used.
- 4.In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be 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 circuit.
- 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.

■ EMC CRITERIA

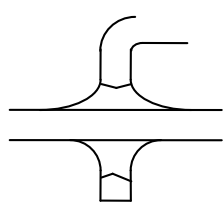
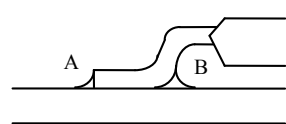
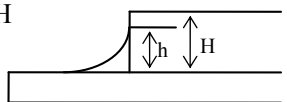
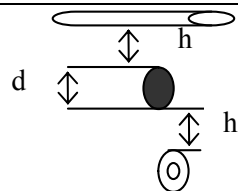
- Customer do the EMC testing based on a complete component (instrument cluster or central information display) level, if found any problem related to Truly module, Truly has responsibility to improve, Truly will not arrange the module level EMC testing since we don't have EMC lab, if it is a must, we will have to send to external lab to do the test, but needing customer pay the charge.

■ INSPECTION CRITERIA

	ADD LCM	Page 1 of 4
Outgoing Quality Standard		LCM Product
This specification is made to be used as the standard acceptance/rejection criteria for LCM Product.		
<p>1、 sample plan</p> <p>Sampling plan according to GB/T2828.1-2003/ISO;1999 and ANSI/ASQCZ1.4-1993,normal level II and based on:</p> <p>A non-conformance product:AQL0.65</p> <p style="padding-left: 150px;">B non-conformance product: AQL 1.5</p>		
<p>2、 Inspection condition</p> <p>Viewing distance for cosmetic inspection is 20~30cm with bare eyes, and under an environment of 800lux~2000lux (20W~40W) light intensity, all directions for inspecting the sample should be within 45° against perpendicular line. (Normal temperature 20~25°C and normal humidity 60±15%RH).</p>		
<p>3、 Definition</p>		
<p>3.1 Definition of inspection zone in LCD (Fig. 1)</p> <p>Zone A: Viewing area after assembly (reference V.A of the drawing)</p> <p>Zone B: Invisible area after assembly (reference other area except the V.A of the drawing)</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>		 <p>Fig.1 Inspection zones in an LCD</p>
<p>3.2 Non-conformance rank</p> <p>A non-conformance: All functional non-conformance such as open (or missing segment), short and serious cosmetic non-conformance are classified as A non-conformance.</p> <p>B non-conformance: Except the A non-conformance above, cosmetic non-conformance such as spot, polarizer non-conformance are classified as B non-conformance.</p>		
<p>3.3 Non-conformance product</p> <p>1) LCM with one A non-conformance is classified as A non-conformance product. LCM with one B non-conformance which out the inspection standard is classified as B non-conformance product.</p> <p>2) LCD with more than ten B non-conformances about the spot, line, polarizer and segment deformity which accord to the inspection standard is classified as B non-conformance.</p> <p>3.4 Note : The limit samples for each item have priority.</p>		

TRULY® 信利		ADD LCM		Page 2 of 4		
Outgoing Inspection Standard				LCM Product		
4、Inspection Standard						
Item NO.	Inspection content	Inspection standard		Non-conformance Rank	Judge	
4.1	Display function	4.1.1 No display		A	Non-conformance product	
		4.1.2 Missing component				
		4.1.3 Display abnormally				
		4.1.4 Missing vertical, horizontal segment				
		4.1.5 Short circuit				
		4.1.6 Back-light no lighting, flickering and abnormal lighting.				
4.2	LC Non-conformance	LC not full fill		A	Non-conformance product	
		LC leak				
		LC directional badness happens on the viewing area.				
4.3	Outline dimension	Overall outline dimension beyond the drawing.		A	Non-conformance product	
4.4	Spot on LCD Non-conformance (spot form non-conformance such as white or dark spot) 	Zone Size(mm)	Qty(unit: entries)		B	Non-conformance product
		A				
		Φ ≤0.15	Cluster spot			
		0.15 < Φ ≤0.20	>2			
		0.20 < Φ ≤0.25	>1			
		0.25 < Φ ≤1.0	>0			
		1.0 < Φ	>0		A	Non-conformance product
		注: Definition of spot sizeΦ: Φ= (X+Y) /2				
4.5	Line on LCD non-conformance (Line Shape Non-conformance) 	Size (mm)		Qty(unit: entries)	B	Non-conformance product
		L(length)	W(width)	A、B Zone		
		L ≤3.0	W ≤0.03	>2		
		L > 3.0	W ≤0.03	>0		
		L ≤2.5	0.03 < W ≤0.05	>2		
		L > 2.5	0.03 < W ≤0.05	>0		
		/	W > 0.05	As spot non-conformance (according to 4.4)	According to 4.4	

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Outgoing Inspection Standard				LCM Product	
4、Inspection Standard					
Item NO.	Inspection content	Inspection standard		Non-conformance Rank	Judge
4.6	Polarizer Non-conformance	4.6.1 Bubble between polarizer and glass.		B	Non-conformance product
		<div><div>Zone</div><div>Qty(unit: entries)</div></div>			
		<div><div>Size(mm)</div><div>A</div></div>			
		<div><div>0.15 < Φ ≤ 0.20</div><div>>5</div></div>			
		<div><div>0.20 < Φ ≤ 0.30</div><div>>3</div></div>			
		<div><div>0.3 < Φ ≤ 0.50</div><div>>1</div></div>			
		<div><div>Φ > 0.50</div><div>>0</div></div>			
4.6.2 Scratch: Same as 4.5 Line non-conformances.				According to 4.5	
4.7	Segment deformity non-conformance	4.7.1 void in segment A > 0.20mm		B	Non-conformance product
		4.7.2 Excess in segment B > 0.20mm			
		<div><div><div><div></div><div>A</div></div><div><div></div><div>B</div></div></div><div><div><div></div><div>d</div></div><div><div></div><div>d</div></div></div></div>			
		4.7.3 Stroke become wide A-d > d/3			
		4.7.4 Stroke become thin d-B > d/3			
<div><div><div><div></div><div>A</div></div><div><div></div><div>B</div></div></div><div><div><div></div><div>d</div></div><div><div></div><div>d</div></div></div></div>					
Remark : where d =segment width					
4.7.5 Pinhole: Same as 4.4 spot Non-conformance.				According to 4.4	
4.8	Pattern peeling	No substrate pattern peeling and floating		A	Non-conformance product
4.9	Soldering	No soldering missing		A	
		No soldering bridge		A	
		No cold soldering		B	
4.10	Plate discoloring	Plate fading, rusting and discoloring		B	

TRULY® 信利		ADD LCM		Page 4 of 4	
Outgoing Inspection Standard				LCM Product	
4、Inspection Standard					
Item NO.	Inspection content	Inspection standard		Non-conformance Rank	Judge
4.12	Resist flaw on Printed Circuit Boards	Visible copper foil on substrate pattern		B	Non-conformance product
		Size(mm)	Qty(unit: entries)		
		0 < Φ ≤ 0.5mm	Not limit		
		Φ > 0.50	> 0		
4.13	Accretion of metallic Foreign matter	Accretion of metallic foreign matters		B	Non-conformance product
		Size(mm)	Qty(unit: entries)		
		0 < Φ ≤ 0.2mm	Not limit		
		Φ > 0.20	> 0		
4.14	Lead parts	a. Soldering side of PCB Solder to form a ‘Filet’ all around the lead. Solder hide the lead form perfectly. (too much) b. Components side (In case of ‘Through Hole PCB’) 		B	Non-conformance product
	Flat packages	Either ‘Toe’ (A) or ‘Seal’ (B) of the lead to be covered by ‘Filet’. Lead form to be assume over solder. 		B	Non-conformance product
	Chips	(3/2) H < h or h < (1/2) H 		B	Non-conformance product
4.15	Solder ball/Solder splash	The spacing between solder ball and the conductor or solder pad h < 0.13mm. The diameter of solder ball d > 0.15mm 		B	Non-conformance product
		The quantity of solder balls or solder Splashes isn’t beyond 5 in 600 mm²		B	conformance product
		Solder balls/Solder splashes violate minimum electrical clearance		A	Non-conformance product
		Solder balls/Solder splashes must be entrapped/encapsulated or attached to the metal surface. NOTE: Entrapped/encapsulated/attached is intended to mean that normal service environment of the product will not cause a solder ball to become dislodged.		B	conformance product

■ PRECAUTIONS FOR USING LCD MODULES

1 Handling Precautions

- 1.1 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.
- 1.2 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.
- 1.3 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).
- 1.4 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 it. 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 in to contact with room temperature air.
- 1.5 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 alcoholDo not scrub hard to avoid damaging the display surface.
- 1.6 Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following.
 - Water
 - Ketone
 - Aromatic solventsWipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading. Avoid contact with oil and fats.
- 1.7 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.
- 1.8 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.
- 1.9 Do not attempt to disassemble or process the LCD module.
- 1.10 NC terminal should be open. Do not connect anything.
- 1.11 If the logic circuit power is off, do not apply the input signals.
- 1.12 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 removing 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 dry. 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.

1.13 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 the LCM.

2 Handling precaution for LCM

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

2.2 Correct handling:

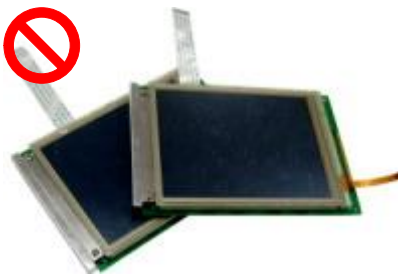


As above picture, please handle with anti-static gloves around LCM edges.

2.3 Incorrect handling:



Please don't touch IC directly.



Please don't stack LCM.



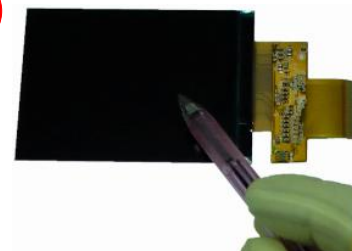
Please don't hold the surface of panel.



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



Please don't hold the surface of IC.



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

3 Storage Precautions

3.1 When storing the LCD modules, the following precaution are necessary.

- 3.1.1 Store them in a sealed polyethylene bag. If properly sealed, there is no need for the desiccant.
- 3.1.2 Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0°C and 35°C, and keep the relative humidity between 40%RH and 60%RH.
- 3.1.3 The polarizer surface should not come in contact with any other objects (We advise you to store them in the anti-static electricity container in which they were shipped).

3.2 Others

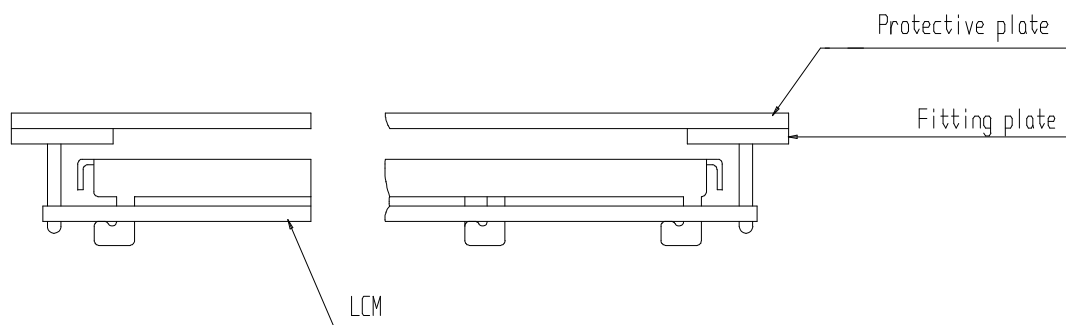
- 3.2.1 Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.
- 3.2.2 If the LCD modules have been operating 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.
- 3.2.3 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.
 - 3.2.3.1 - Exposed area of the printed circuit board.
 - 3.2.3.2 -Terminal electrode sections.

4 USING LCD MODULES

4.1 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.

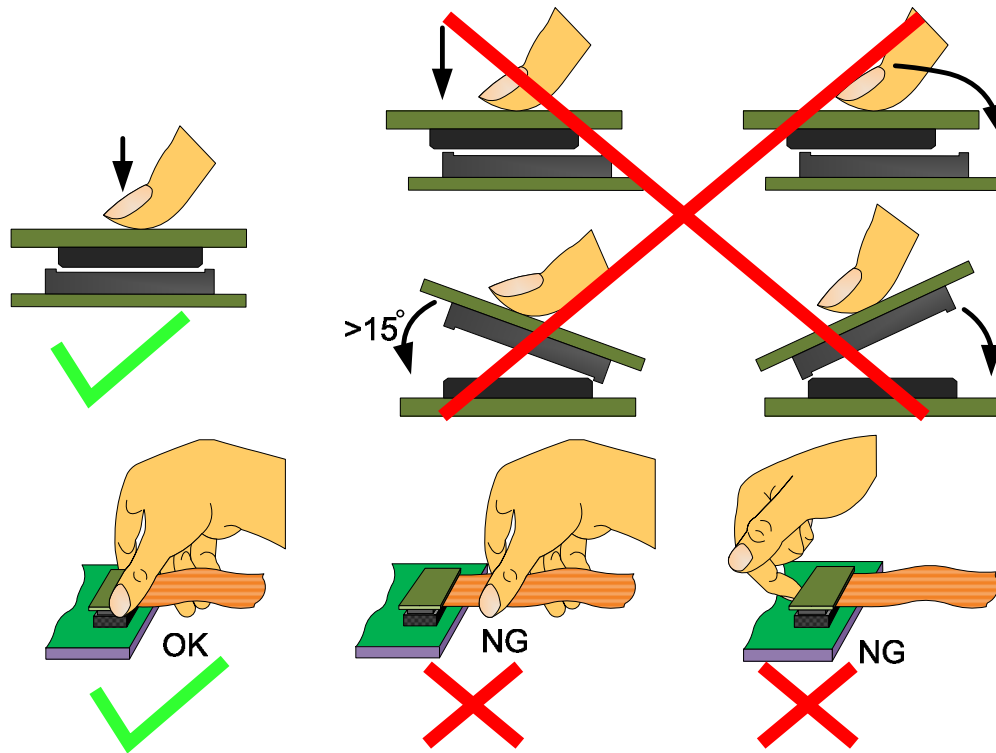
- 4.1.1 Cover the surface with a transparent protective plate to protect the polarizer and LC cell.



- 4.1.2 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 $\pm 0.1\text{mm}$.

4.2 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



4.3 Precaution for soldering the LCM

	Manual soldering	Machine drag soldering	Machine press soldering
No RoHS Product	290°C ~350°C. Time : 3-5S.	330°C ~350°C. Speed : 15-17 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. Speed : 15-17 mm/s.	330°C ~360°C. Time : 3-6S. Press: 0.8~1.2Mpa

- 4.3.1 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.
- 4.3.2 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.
- 4.3.3 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.

4.4 Precautions for Operation

- 4.4.1 Viewing angle varies with the change of liquid crystal driving voltage (VLCD). Adjust VLCD to show the best contrast.
- 4.4.2 It is an indispensable condition to drive LCD's within the specified voltage limit since the higher voltage then 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.
- 4.4.3 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.
- 4.4.4 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.
- 4.4.5 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.
- 4.4.6 Input logic voltage before apply analog high voltage such as LCD driving voltage when power on. Remove analog high voltage before logic voltage when power off the module. Input each signal after the positive/negative voltage becomes stable.
- 4.4.7 Please keep the temperature within the specified range for use and storage. Polarization degradation, bubble generation or polarizer peel-off may occur with high temperature and high humidity.

4.5 Safety

- 4.5.1 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.
- 4.5.2 If any liquid leaks out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

4.6 Limited Warranty

Unless agreed between TRULY and the 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 production. Cosmetic/visual defects must be returned to TRULY within 90 days of shipment. Confirmation of such date shall be based on data code on product. The warranty liability of TRULY limited to repair and/or replace on the terms set forth above. TRULY will not be responsible for any subsequent or consequential events.

4.7 Return LCM under warranty

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

4.7.1.1 - Broken LCD glass.

4.7.1.2 - PCB eyelet is damaged or modified.

4.7.1.3 -PCB conductors damaged.

4.7.1.4 - Circuit modified in any way, including addition of components.

4.7.1.5 - PCB tampered with by grinding, engraving or painting varnish.

4.7.1.6 - Soldering to or modifying the bezel in any manner.

4.7.2 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

Please consult our technical department for detail information.

■ PRIOR CONSULT MATTER

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

■ FACTORY CONTACT INFORMATION

FACTORY NAME: TRULY SEMICONDUCTORS LTD.

FACTORY ADDRESS: Truly Industrial Area, ShanWei City,GuangDong,China

P.C: 516600 **URL:** <http://www.truly.com.hk> <http://www.trulysemi.com>