PRODUCT	**：**	**LCD MODULE**
MODEL NO.	**：**	**TFT1920384-5-E**
VERSION	**：**	**0.2**
SUPPLIER	**：**	**TRULY OPTO-ELECTRONICS LTD.**
Customer	**：**	**Standard Products**

SPECIFICATION

This module uses ROHS material

<div style="border:1px solid">

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

1. There is no response from customer in two years after TRULY OPTO-ELECTRONICS LTD. submit the samples。

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

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

</div>

Customers are requested to read the specifications of the TRULY 's LCD module carefully，if have any question, please tell us to modify in time; When it's correct, please sign and seal the following form as the standard for the supply of both parties:

Customer approval	Accept ☐ refuse ☐
	Suggestion： Sign：_____ Seal：

REVISION RECORD

REV NO.	REV DATE	CONTENTS	REMARKS
0.1	2022-11-14	First release	/
0.5	2023-3-15	1、Update general information 2、Update backlight characteristics	1、P.4 2、P.7

WRITTEN BY	CHECKED BY	APPROVED BY
Nie Yang	Wang Hui	Wang Hui

CONTENTS

1) GENERAL INFORMATION

Item of general information	Contents	Unit
LCD Type	9.2inch Color TFT ，Transmissive	/
Display mode	Normally Black	/
Recommended Viewing Direction	ALL	0'Clock
Module Area (W × H×T)	240.45×60.24×6.79	mm³
Active Area (W×H)	229.25×45.85	mm²
Resolution ratio	1920×384×RGB	/
Pixel Pitch (W × H)	0.1194×0.1194	mm²
Backlight Type	LED	
Module Power Consumption	11.215(P$_{(BL)}$=10.72; P$_{(TFT)}$=0.495)	W
Interface Type	LVDS（8bit，VESA，SYNC mode）	/
Color Depth	16.7M	color
Input Voltage	VDD=3.3 Typ	V

2) EXTERNAL DIMENSIONS

正视图

FPC弯折出货

9.2" TFT
1920(H)X384(V)XRGB DOTS

LCD FPC PIN Defined

NO.	PIN NAME	NO.	PIN NAME
1	AG_GND	21	D1P
2	GND	22	D1N
3	VGH2	23	GND
4	NC	24	D0P
5	VDD_MTP	25	D0N
6	GND	26	GND
7	SPI_SDAO	27	STBYB
8	SPI_SDA	28	RESET
9	SPI_SCL	29	BIST
10	SPI_CSB	30	VDD
11	GND	31	GND
12	D3P	32	LEDK4
13	D3N	33	LEDK3
14	GND	34	LEDK2
15	D2P	35	LEDK1
16	D2N	36	LEDA
17	GND	37	LEDA
18	CLKP	38	NC
19	CLKN	39	TH+
20	GND	40	TH-

If= 95mA*4
(恒定电流测试)

Vf= 27.2 V typ

DETAIL PIXEL (SCALE 200:1)

A" DETAIL   (SCALE 2:1)

NOTES：
1. DISPLAY TYPE: 9.2" COLOR TFT , NORMALLY BLACK, TRANSMISSIVE
2. OPERATING TEMPERATURE： -40°C TO 85°C
3. STORAGE TEMPERATURE： -40°C TO 90°C
4. VIEWING ANGLE:WIDE VIEW ANGLE
5. FPC CONNECTOR: 101049-204050
6. ( ) MEANS: DIMENSION FOR REFERENCE
   * MEANS CRITICAL DIMENSION

CUSTOMER APPROVE		AMEND					TRULY		
Mechanical	Electrical					PRODUCT NO.		DRAW NO.	REV
					UNSPECIFIED TOLERANCE:	TFT1920384-5-E		LCM2670	A
					± 0.3	DWN 李智昕		DSN 李智昕	
			NEW RELEASE	20221110	∠ ±1°	CHKD 吴伟佳		APPD 王德维	
		NO.	CONTENT	DATE		NOT IN SCALE		UNIT mm	SHEET: 1/1

标准品 | 车载产品 (AUTOMOTIVE PRODUCT)

3) ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Max	Unit
LCD Input voltage	VDD	-0.3	4	V
Operating temperature	Top	-40	85	°C
Storage temperature	TST	-40	95	°C
Humidity	RH	-	90%(Max60 °C)	RH

4) DC CHARACTERISTICS

Parameter of DC characteristics	Symbol	Min	Typ	Max	Unit
Supply voltage	VDD	2.9	3.3	3.6	V
Input Current(VDD=3.3)	Idd	-	150	225	mA
Input voltage 'H' level	VIH	0.7VDD	-	VDD	V
Input voltage 'L' level	VIL	0	-	0.3VDD	V
Output voltage 'H' level	VOH	VDD-0.4	-	-	V
Output voltage 'L' level	VOL	-	-	GND+0.4	V

5)　BACKLIGHT CHARACTERISTICS

5.1 Backlight circuit diagram

Parameter	Driving conditions	Symbol	Min	Typ	Max	Unit
Range of forward voltage	Constant current If=95mA*4 Ta=85°C	Vf	22.7	26.6	30.6	V
	Constant current If=95mA*4 Ta=25°C	Vf	23.4	27.2	31.1	V
	Constant current If=95mA*4 Ta= -40°C	Vf	24.2	28.2	32.2	V
power consumption	Ta=25°C If=95mA*4	P	/	10.72	11.63	W
Numbers of LED	/	36				pieces
LED connection mode	/	9series×4paraller				

Using condition: constant current driving method If=(95*4)mA=380 mA (+/-10%), current fluctuation have no damage for LCD module, but if the designed current is lower than the typical value, LCD module's optical performance will decrease. Recommended to design backlight drive strictly according to typical values.

5.2 LED backlight configuration:

Ambient Temperature vs. Allowable LED Current
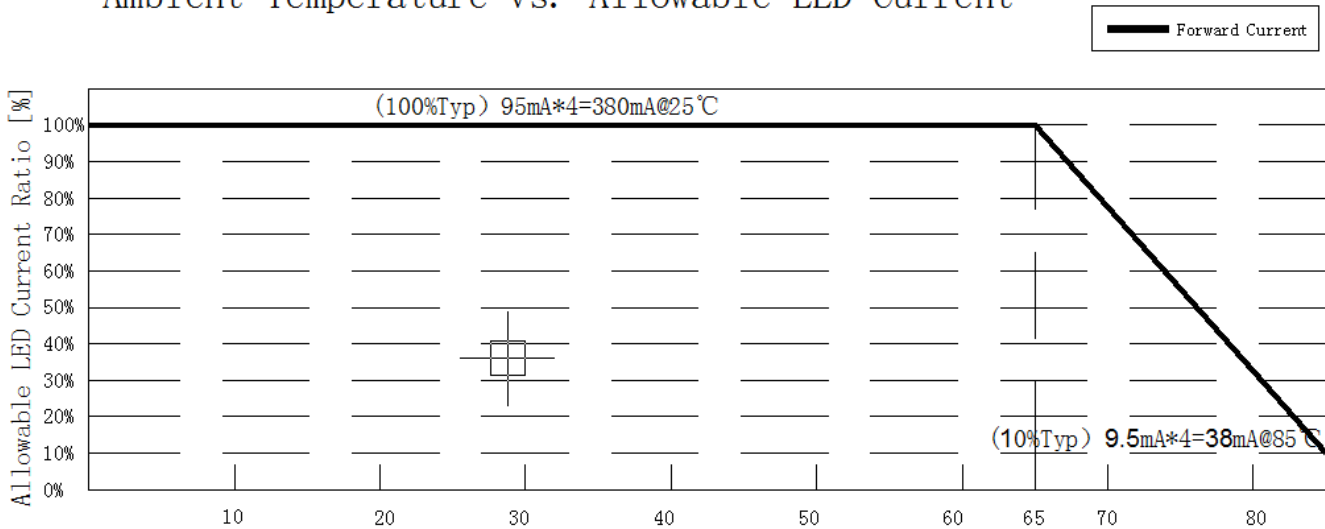
Backlight LED derating curve: （when temperature≥65℃，the backlight current of the LCD module needs to be reduced，In order to guarantee the LCD module working in safe temperature less than or equal to 65℃）

---

6) EXTERNAL INTERFACE

6.1 MODULE INTERFACE

No.	Pin Name	I/O	Description
1	AG_GND	P	Ground.
2	GND	P	Ground.
3	VGH2	/	TRULY test pin.let it open
4	NC	/	No connection.
5	VDD_MTP	/	TRULY test pin.let it open
6	GND	P	Ground.
7	SPI_SDAO	O	4-SPI Data output. if not use, connect to GND.
8	SPI_SDA	I	4-SPI Data input . if not use, connect to GND.
9	SPI_SCL	I	4-SPI CLK input. if not use, connect to GND.
10	SPI_CSB	I	4-SPI Chip select pin. if not use, connect to DVDD.
11	GND	P	Ground.
12	D3P	I	LVDS differential input 3+
13	D3N	I	LVDS differential input 3-
14	GND	P	Ground.
15	D2P	I	LVDS differential input 2+
16	D2N	I	LVDS differential input 2-
17	GND	P	Ground.
18	CLKP	I	LVDS differential clock positive input
19	CLKN	I	LVDS differential clock negative input
20	GND	P	Ground.
21	D1P	I	LVDS differential input 1+
22	D1N	I	LVDS differential input 1-
23	GND	P	Ground.
24	D0P	I	LVDS differential input 0+
25	D0N	I	LVDS differential input 0-
26	GND	P	Ground.
27	STBYB	I	Standby mode setting pin. Active low. H: Normal mode. L: Standby mode. Timing controller, output buffer ,DAC and power circuit are off.
28	RESET	I	Global reset pin ,active low
29	BIST	I	Built-in self test function, if not use, connect to GND. 'H': Enable 'L': Disable
30	VDD	P	Digital power 3.3V supply voltage.
31	GND	P	Ground.
32	LEDK4	P	LED Light, cathode -
33	LEDK3	P	LED Light, cathode -
34	LEDK2	P	LED Light, cathode -
35	LEDK1	P	LED Light, cathode -
36	LEDA	P	LED light, anode +
37	LEDA	P	LED light, anode +
38	NC	/	No connection.
39	TH+	/	Backlight thermistor+
40	TH-	/	Backlight thermistor-

7) REFERENCE APPLICATION CIRCUIT

Please consult our technical department for detail information.

8)   TIMING CHARACTERISTICS

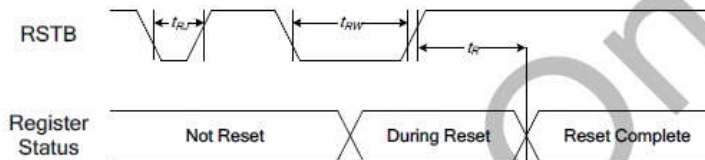### 8.1 Power Supply On/Off Sequence:
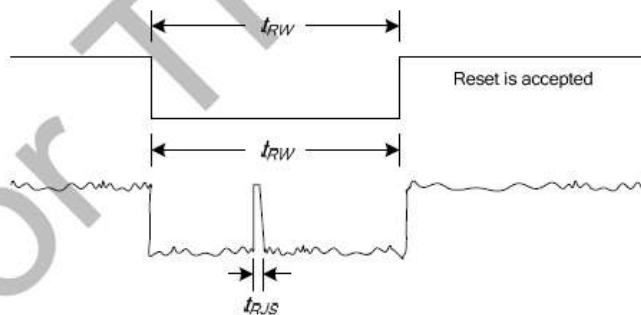
Power - On Timing Sequence
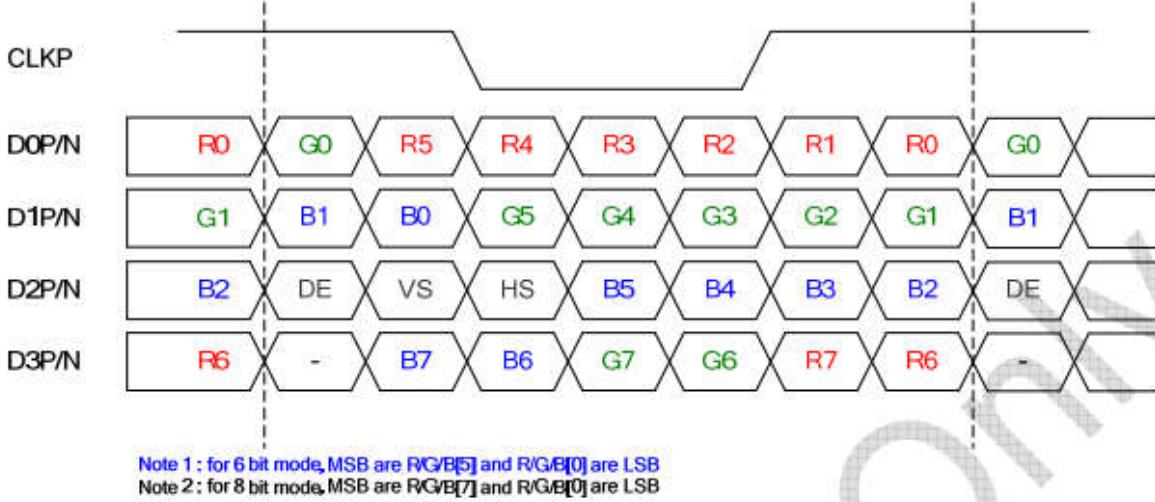

Power - off Timing Sequence
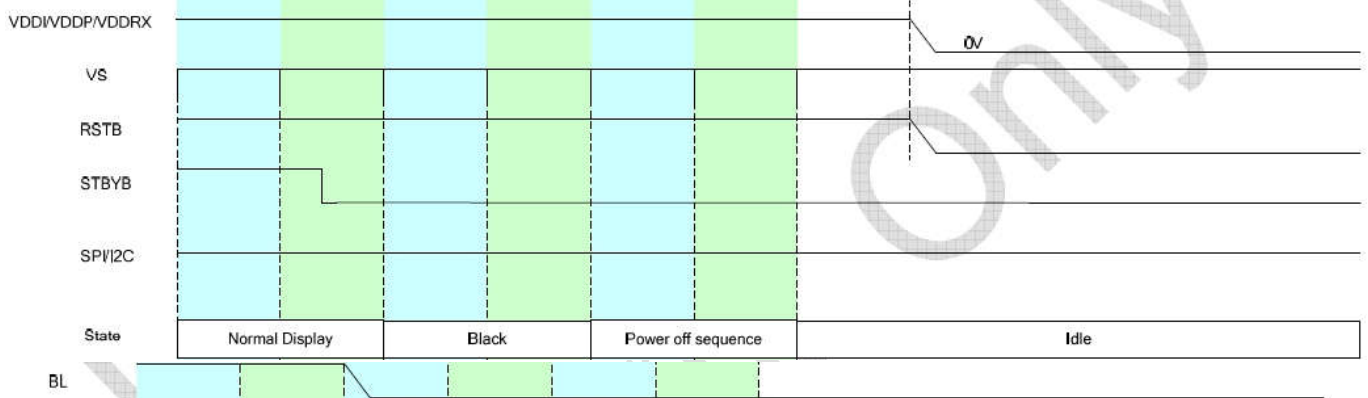
8.2 Reset timing:

VSSI = VSSRX = VSSP = 0V, VDDI = VDDP= VDDRX = 3.0 ~ 3.3V, Ta = -40 ~ 105°C

Item	Signal	Symbol	Condition	Rating		Unit
				Min.	Max.	
Reset time	RSTB	t_R		—	5	us
Reset "L" pulse width		t_{RW}		15	—	
Reset rejection		t_{RJ}		—	5	
Reset rejection (for noise spike)		t_{RJS}		—	10	ns

8. 3 Video timing

LVDS Interface timing:

Note 1 : for 6 bit mode, MSB are R/G/B[5] and R/G/B[0] are LSB
Note 2 : for 8 bit mode, MSB are R/G/B[7] and R/G/B[0] are LSB

LVDS input eye diagram:

Differential input high threshold voltage	R_{xVTH}	RxVCM = 1.2V (Note1)			0.1	V	LVDS Interface
Differential input low threshold voltage	R_{xVTL}		-0.1			V	LVDS Interface
Input voltage range (singled-end)	R_{xVIN}	(Note1)	0		VDD-1.0	V	LVDS Interface
Differential input common mode voltage	R_{xVCM}	(Note1)	0.6	1.2	2.4-$\lvert V_{ID}\rvert$/2	V	LVDS Interface
Differential input voltage	$\lvert V_{ID}\rvert$	(Note1)	0.2	0.4	0.6	V	LVDS
Differential input leakage current	RV_{xliz}	(Note1)	-10		10	uA	LVDS Interface
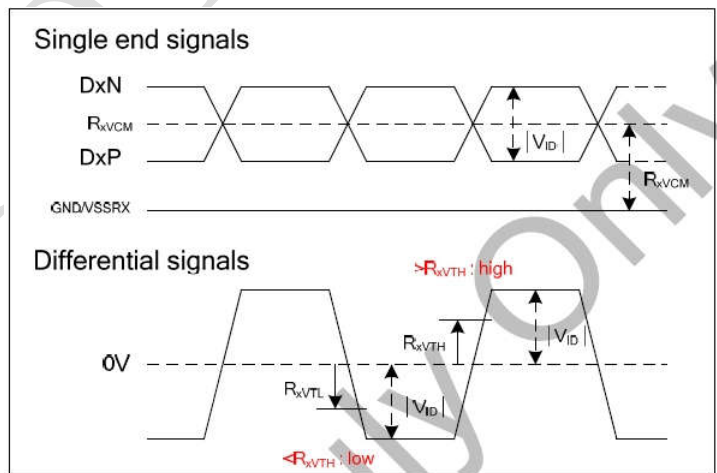
8.4 input signal timing:

SYNC only mode:
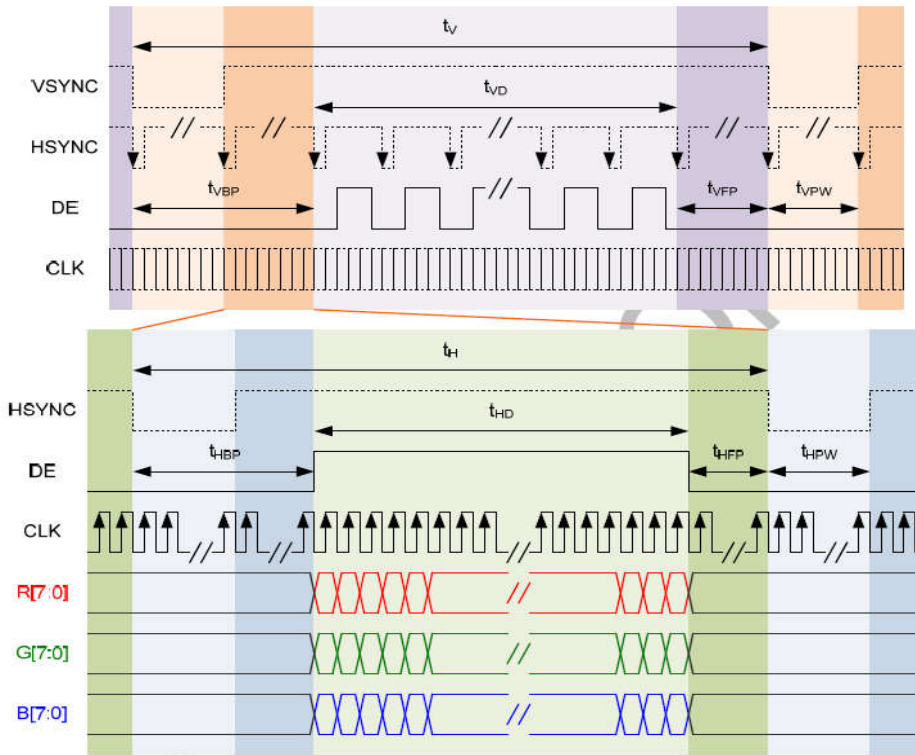
Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
CLK frequency	tCLK	50.5	51.7	60	Mhz	
Horizontal blanking time	tHBT	40	42	80	tCLK	tHBP + tHFP
Horizontal back porch	tHBP	20	20	20	tCLK	Include tHPW
Horizontal display area	tHD	1920			tCLK	
Horizontal front porch	tHFP	20	22	60	tCLK	
Horizontal period	tH	1960	1962	2000	tCLK	
Horizontal pulse width	tHPW	2	2	2	tCLK	
Vertical blanking time	tVBT	38	48	108	tH	tVBP + tVFP
Vertical back porch	tVBP	28	28	28	tH	Include tVPW
Vertical display area	tVD	384			tH	
Vertical front porch	tVFP	10	20	80	tH	
Vertical period	tV	422	432	492	tH	
Vertical pulse width	tVPW	2	2	2	tH	
Frame rate	FR	60	60	60	Hz	

9) RECOMMENDED INITIALIZATION TFT AND CTP

Please consult our technical department for detail information.

10) ELECTRO-OPTICAL CHARACTERISTICS

If=(95*4)mA;T=25℃

Parameter	Symbol	Condition		Min	Typ	Max	Unit	Remark	Note
Response time	Tr +Tf	θ=0° ∅=0°	25°C		25	35	ms	FIG 1	4
Contrast ratio	Cr	θ=0° ∅=0°	+25°C	800	1000		-	FIG 2	1
Luminance uniformity	δ	θ=0° ∅=0°	White	/	86		%	FIG 2.	3
Surface Luminance	Lv	Ta=25℃	/	/	/	2000	cd/m²		2
Viewing angle range (Cr>=10@ 25°C)	θ	∅ = 90°		70	80		deg	FIG 3.	6
		∅ = 270°		70	80				
		∅ = 0°		70	80				
		∅ = 180°		70	80				
NTSC ratio	NTSC	-			72		%	-	-
CIE (x, y) chromaticity	Red x	θ=0° ∅=0° Ta=25℃		0.6	0.650	0.7	-	FIG 2.	5
	Red y			0.288	0.338	0.388			
	Green x			0.255	0.305	0.355			
	Green y			0.562	0.612	0.662			
	Blue x			0.096	0.146	0.196			
	Blue y			0.027	0.074	0.127			
	White x			0.248	0.298	0.348			
	White y			0.283	0.333	0.383			

Note 1. Contrast Ratio(Cr) is defined mathematically by the following formula. For more information see FIG 2.

$$\text{Contrast Rao} = \frac{\text{Average Surface Luminance with all white pixels (P 1,P2, ...)}}{\text{Average Surface Luminance with all black pixels (P 1,P2, ...)}}$$

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

Lv = Average Surface Luminance with all white pixels (P 1,P2, ...)

Note 3. The luminance uniformity 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.

$$\delta \text{ WHITE} = \frac{\text{Minimum Surface Luminance with all white pixels} \quad (P1, P2, ...)}{\text{Maximum Surface Luminance with all white pixels} \quad (P1, P2, ...)}$$

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 DMS-803

Note 5. CIE (x, y) chromaticity, The x,y value is determined by measuring luminance at each test position 1 through9,and then make average value. For more information see FIG 2. The test equipment is CS2000.

Note 6. Viewing angle is the angle at which the contrast ratio is greater than 100. 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. Test equipment is ConoScope or DMS-803.

FIG.1. **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". This definition is valid for a positive (normally white) display. For a negative (normally black) display theopposite definition applies.
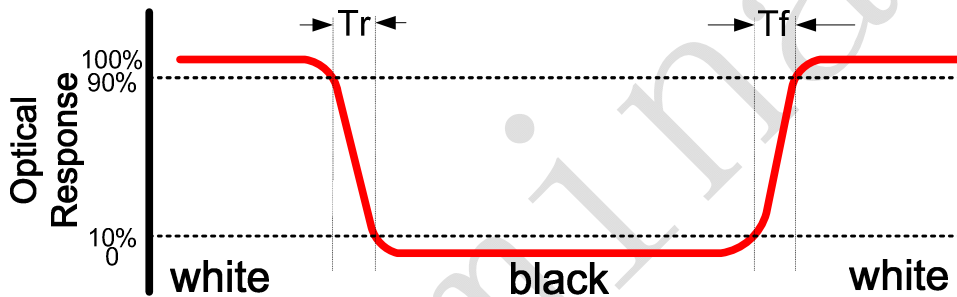
FIG.2. **Measuring method for Contrast ratio, surface luminance, Luminance uniformity ，CIE (x, y) chromaticity**

A : H/6
B : V/6
H,V :Active Area
Measurment insturment :CS-2000
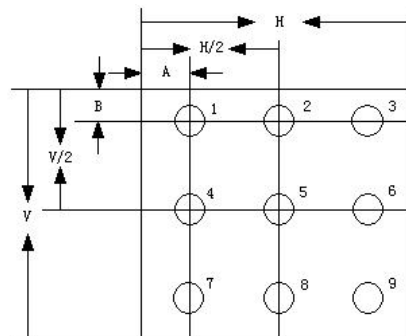
FIG.3. **The definition of viewing angle**
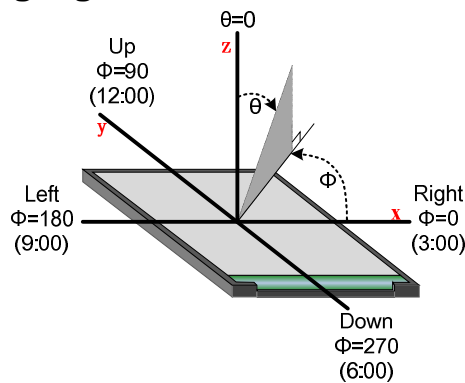
11) RELIABILITY TEST CONDITIONS

No.	Test Item	Test Condition	Inspection after test
1	High Temperature Storage	95±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℃/500 hours(BL current 10%typ)	
4	Low Temperature Operating	-40±2℃/500 hours	
5	Temperature Cycle storage	-40±2℃(30min.) ~25℃(5min.) 85±2℃(30min.)×100cycles	
6	Damp Proof Test operating	60℃±5℃×90%RH/500 hours	
7	ESD Test	Air discharge: C=150pF±10%,R=330Ω±10%, 5point/panel Air: +/-8KV, 10times	
8	Vibration test (Not-operation)	Frequency：10Hz~55Hz~10Hz Amplitude：1.5mm, X，Y，Z direction for total 3hours (Packing condition)	1. function test is OK. no fatal defects, such as not display. 2. no broken glass, chip, sealing loose, epoxy frame broken etc. 3. no structure loose fall off.

Remark:

1.The test samples should be applied to only one test item.

2.Sample size for each test item is 2~10pcs.

3.For Damp Proof Test, Pure water(Resistance＞10MΩ) should be used.

4.After tests been done, visual inspection will be implemented after 2~4hours storage at room temperature.Test samples at low temperature test conditions should be visual inspected immediately and judge there isbubble or not.

5. For ESD test, in case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judged as a good part.

6. Since there's no EMC lab in Truly, EMC test is recommended to implement by customer based on a complete component (like instrument cluster ,CID ,audio) level, if any problem related to display module, Truly will work together with customer for improvement. Truly will have to send to external lab for test if a EMC test report is required by customer, but needing customer pay the charge.

12) INSPECTION CRITERIA

1.0 Purpose:

This specification is made to be used as the standard acceptance / rejection criteria for TFT product.

2.0 Inspection method:

Ambient temperature & humidity ：20~25 ℃，55~70%RH

Visual inspection illumination：800lux~2000lux

Viewing angle ：U/D/L/R 30 degree

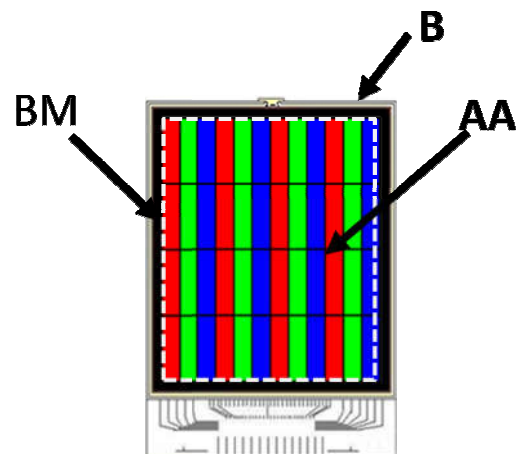Viewing distance ：60±5 cm

ND Filter: 5%
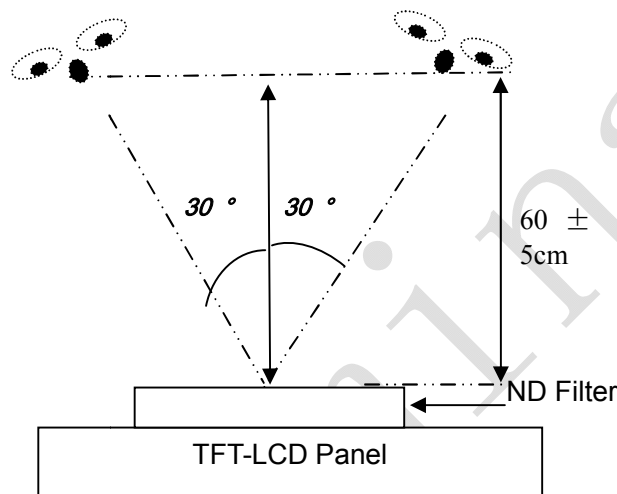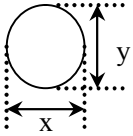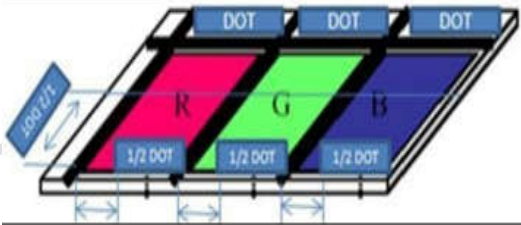
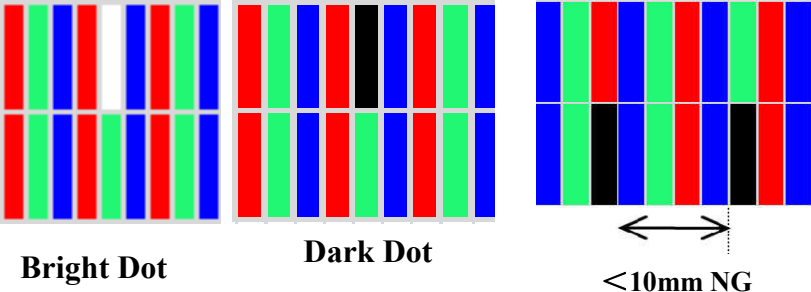

3.0 Definition:

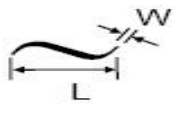A area: Viewing area after assembly.
    (Reference V.A of the drawing/AA+BM)

B area: Invisible area after assembly.
    (reference other area except
     the V.A of the drawing)

4. 0 Inspection specification

NO.	Inspection content	Inspection specification	
4.1	**Display function**	**TFT not display is not allowed.**	
		TFT Display abnormally is not allowed.	
		Missing segment is not allowed.	
4.2	**Liquid crystal nonconformance**	**Liquid crystal not fulfilled is not allowed.**	
		Liquid crystal leak is not allowed.	
NO.	Inspection content	Inspection specification	
4.3	**Spot nonconformance (Such as black spot、white spot、foreign matters)**	**A Area / Size(mm)**	**Acceptable QTY**
		Φ≤0.30	**Ignore**
		0.30＜Φ≤0.40	**10**
		0.40＜Φ≤0.50	**5**
		Φ＞0.50	**0**
		Remark: Definition of spot size Φ：Φ=(X+Y)/2	
4.4	**Electrical nonconformance**	**A Area / Symptom**	**Acceptable QTY**
		Bright(RGB) Sub- pixel	**2**
		Dark Sub- pixel	**5**
		Distance between Sub- pixel to Sub- pixel	**≥10mm**

Note:

Bright Dot   **Dark Dot**   **＜10mm NG**

a. One pixel consists of 3 sub-pixels, including R,G and B dot(Sub-pixel=Dot)
b. Bright dot：in the black screen ，one of R or G or B is bright ；bright area is more than 1/2 one dot
c. Dark dot ：in the white screen ，one of R or G or B is not bright，dark area is more than 1/2 one dot
d. Bright dot is defined through 5% transmission ND filter as 2.0:

4.5	Line nonconformance (such as black line、white line、foreign matters、polarizer scratch、glass scratch)	Size (mm)		A Area
		L(length)	W(width)	Acceptable QTY
		≤10	≤0.20	Ignore
		≤20	0.20＜W≤0.25	10
		/	＞0.25	0

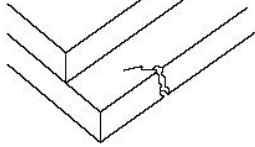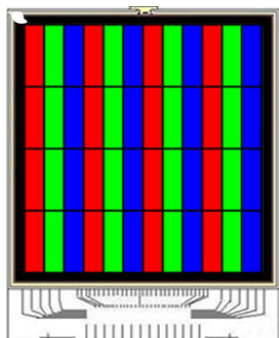| 4.6	Polarizer position and size	Shifting in position exceed the engineering drawing is not allowed.
		Incomplete covering smaller than the engineering drawing is not allowed.

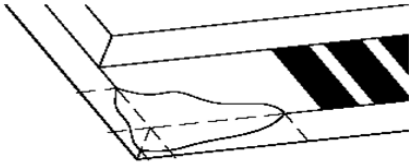| NO.	Inspection content	Inspection specification
4.7	Foreign on polarizer protect film	Foreign on polarizer protect film easier to clean is allowed.

4.8	Polarizer dent and bubble	A Area Size(mm)	Acceptable QTY
		Φ≤0.25	Ignore
		0.25＜Φ≤0.50	5
		0.50＜Φ≤1.0	3
		Φ＞1.0	0

Note:
1．All kinds of above nonconformance on B area are acceptable but where into A area must meet above inspection specification.
2．The distance between spots must exceed or equal 10mm.

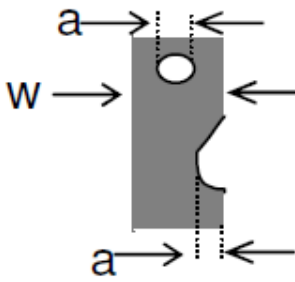| NO.	Inspection content	Inspection specification
4.9	TFT glass nonconformance (Unit: mm)	4.9.1 TFT cosmetic dimension is bigger or smaller than the engineering drawing limit size is not allowed.
		4.9.2 Glass crack on any glass position is not allowed.
		4.9.3 Glass chipped into epoxy frame is not allowed.

		4.9.4 Glass corner chipped on the contact pad：Glass chipped reach to the electro pad is not allowed
5.0	Mura(stripe)	Visible by ND5% filter, refer to limit samples.
5.1	Soldering	Follow IPC-A-610G standard, Class 2 Acceptance.
NO.	Inspection content	Inspection specification
5.2	FPC defect	1 Dent, pinhole width a<w/3. (w: circuitry width.) 2 Open circuit is unacceptable. 3 No oxidation, contamination and distortion.
5.3	Bezel	1 No rust, distortion on the Bezel. 2 No visible fingerprints, stains or other contamination

13)   PRECAUTIONS FOR USING LCD MODULES
1 Handing 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 alcohol
      Do 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 solvents
      Wipe 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.
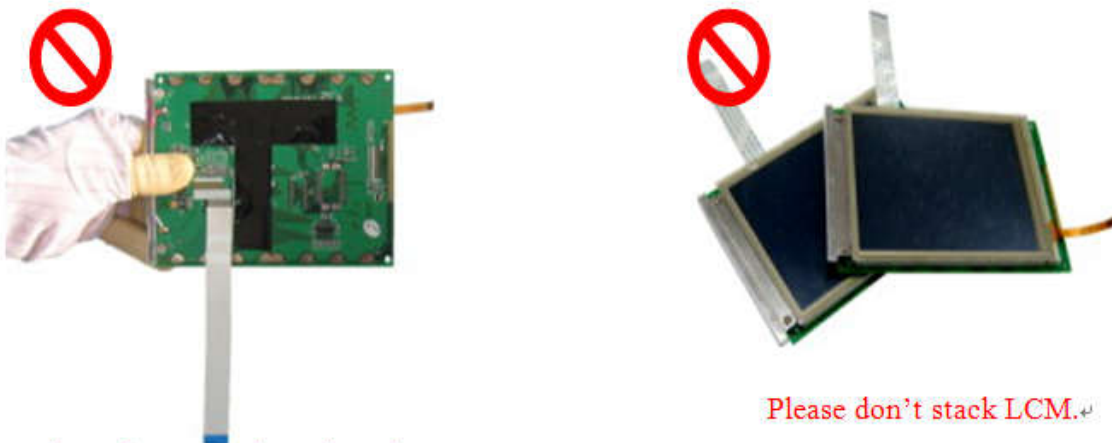
2 Handling precaution for LCM

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 False 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   Transportation Precautions

   3.2.1 During shipment, please handle with care. The packaging bag can not be broken, step on trap. Packaging Carton layer height can not be over two meters.

   3.2.2 The transportation process should pay attention to the waterproof and moisture-proof measures. Product can not be watering. Ethylene sealed bags can not be unsealed.

3.3   Others

   3.3.1 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.

   3.3.2 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.

   3.3.3 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.

      3.3.3.1 - Exposed area of the printed circuit board.

      3.3.3.2 -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.
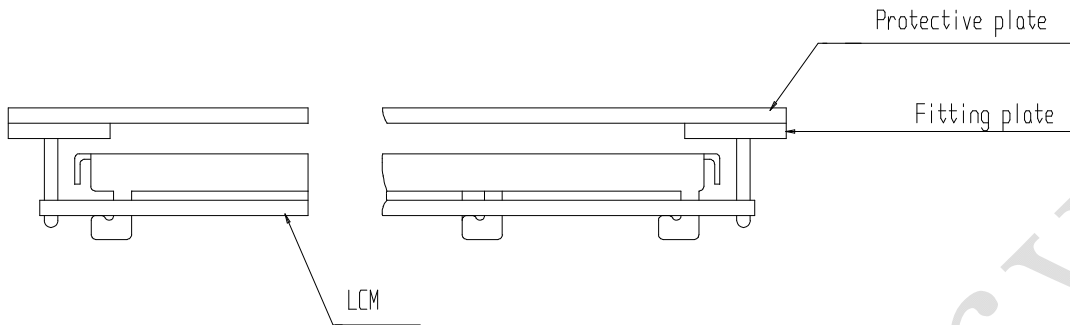
4.1.2 When assembling the LCM into other equipment, the spacer to the bit between the LCM and the fitting plate should have enough height to avoid causing stress to the module surface, refer to the individual specifications for measurements. The measurement tolerance should be ±0.1mm.

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
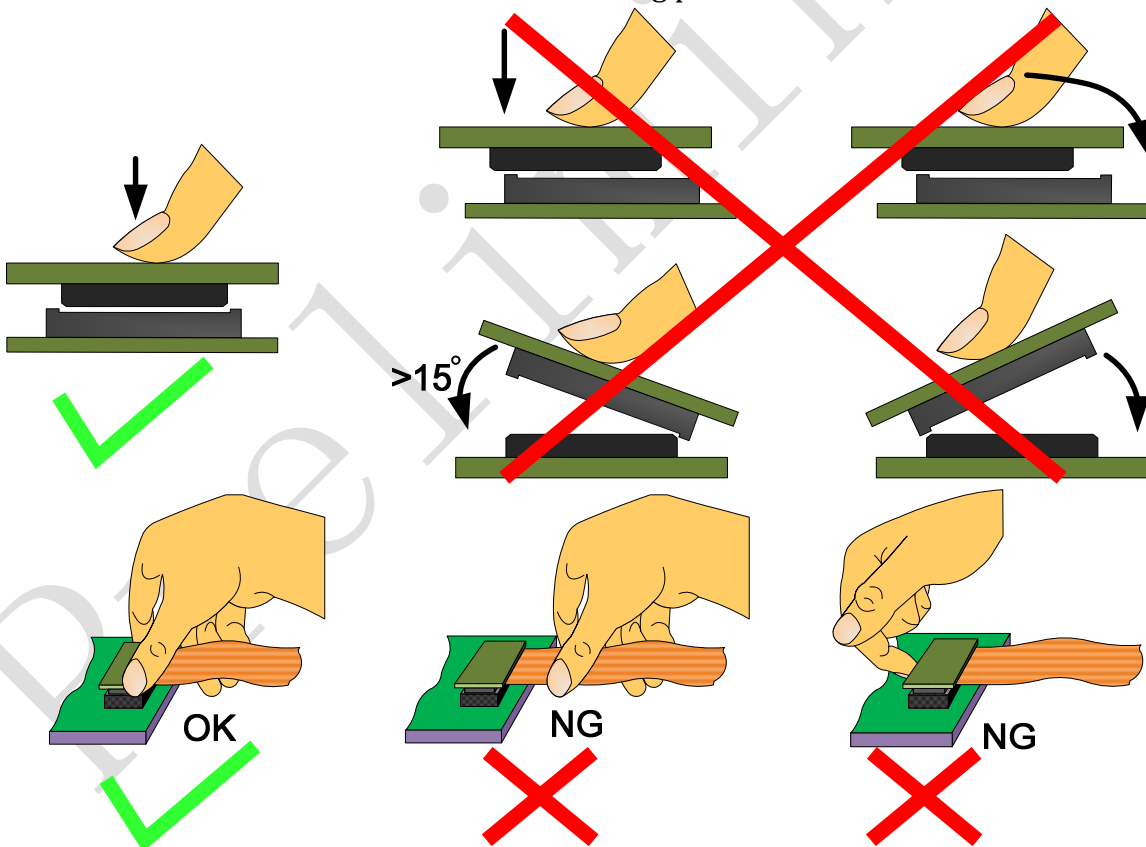
4.3   Precaution for soldering the LCM

---	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.

- 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.

14) PACKING SPECIFICATION

Please consult our technical department for detail information.

15) 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.

16) FACTORY CONTACT INFORMATION

1. **FACTORY NAME:** TRULY SEMICONDUCTORS LTD.
2. **FACTORY ADDRESS:** Truly Industrial Area, ShanWei City,GuangDong,China
3. **P.C**: 516600   **URL**: http://www.truly.com.hk   http://www.trulysemi.com