

Specification for Colour TFT Display module

7.0" Colour TFT Display module

Manufacturer	Truly Semiconductors LTD
Part n°	TFT800480-84-V1-E
Ordering n°	TFT800480-84-V1-E
Customer Part n°	n/a
Revision n°	1.1
Issue Date	2017/09/29

Customer's Approval

Company name	
Printed name	
Job title	
Signature	
Approval Stage:	<p>This product is approved for the following production stage: -</p> <ul style="list-style-type: none"> <input type="checkbox"/> Sample / Prototype <input type="checkbox"/> Pre-Production <input type="checkbox"/> Mass Production
Approval Date	

Supplied by Anders Electronics plc
 Manufactured by Truly Semiconductors LTD

PRODUCT	: LCD MODULE
MODEL NO.	: TFT800480-84-V1-E
VERSION	: 1.1
SUPPLIER	: TRULY SEMICONDUCTORS LTD.
CUSTOMER	: TRULY SEMICONDUCTORS LTD

SPECIFICATION

This module uses ROHS material

If there is no special request from customer, TRULY SEMICONDUCTORS Co., 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 SEMICONDUCTORS Co., 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.

TRULY SEMICONDUCTORS LTD:

Quality Assurance Department: _____

Approved by: _____

Technical Department: _____

CUSTOMER:

Approved by: _____

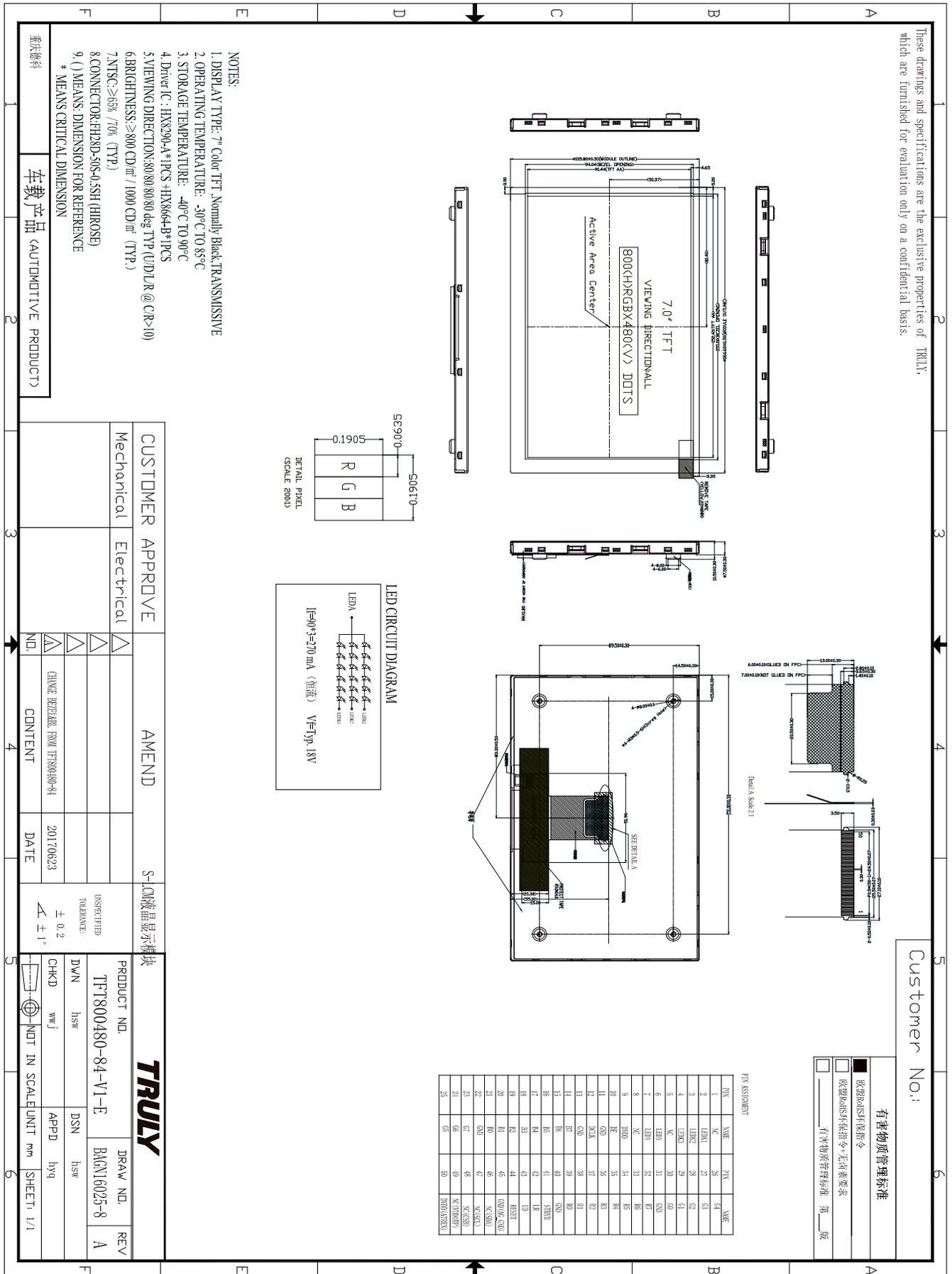
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1) GENERAL INFORMATION

Item of general information	Contents	Unit
LCD Type	7.0inch TFT, Normally Black, Transmissive	/
Recommended Viewing Direction	Wide view angle	O'Clock
Module Area (W × H×T)	166.60×105.80×7.50	mm ²
Active Area (W×H)	152.40×91.44	mm ²
Resolution ratio	800RGB×480	/
Pixel Pitch (W × H)	0.1905×0.1905	mm ²
Inversion Mode	2 dot inversion	/
Driver IC	(Source IC) HX8290-A-*1pcs+ (Gate IC) HX8664-B-*1pcs	/
Backlight Type	LED	/
Interface Type	RGB	/
Input Voltage	DVDD =3.3(typ)	V
Surface treatment	AG	/

2) EXTERNAL DIMENSIONS



3) ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Max	Unit
Supply voltage for logic	DVDD	-0.3	4.0	V
Supply voltage for OTP	VPP	-0.3	8.7	V
Digital input voltage	VIN	-0.3	DVDD+0.3	V
Operating temperature	Top	-30	85	°C
Storage temperature	TST	-40	90	°C
Humidity	RH	-	90%(Max60 °C)	RH

Note:

1. Operating temperature between -40°C and -31°C does not display the full optical performance of the LCD, but no damage of the display function will occur.
2. RH: relative humidity unit. Relative humidity is the ratio between absolute humidity and maximum humidity.

4) DC CHARACTERISTICS

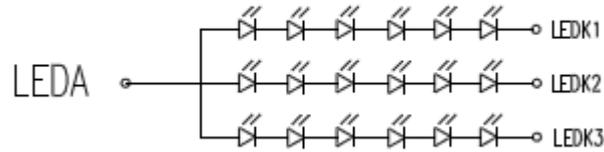
Parameter	Symbol	Min	Typ	Max	Unit
Supply voltage for logic	DVDD	3.2	3.3	3.4	V
Input voltage	Icc	-	66	99	mA
Input voltage 'H' level	VIH	0.7DVDD	-	DVDD+0.3	V
Input voltage 'L' level	VIL	GND-0.3	-	0.3DVDD	V
Output voltage 'H' level	VOH	DVDD-0.4	-	-	V
Output voltage 'L' level	VOL	GND	-	GND+0.4	V

Note:

1. The high and low level of input and output is the effective level, used for logic circuit to judge. 0.8VCC~VCC refers to the effective high level, 0~0.2VCC refers to the effective low level. The interception of the location relate to the driver chip.

5) **BACKLIGHT CHARACTERISTICS**

5.1 Backlight circuit diagram



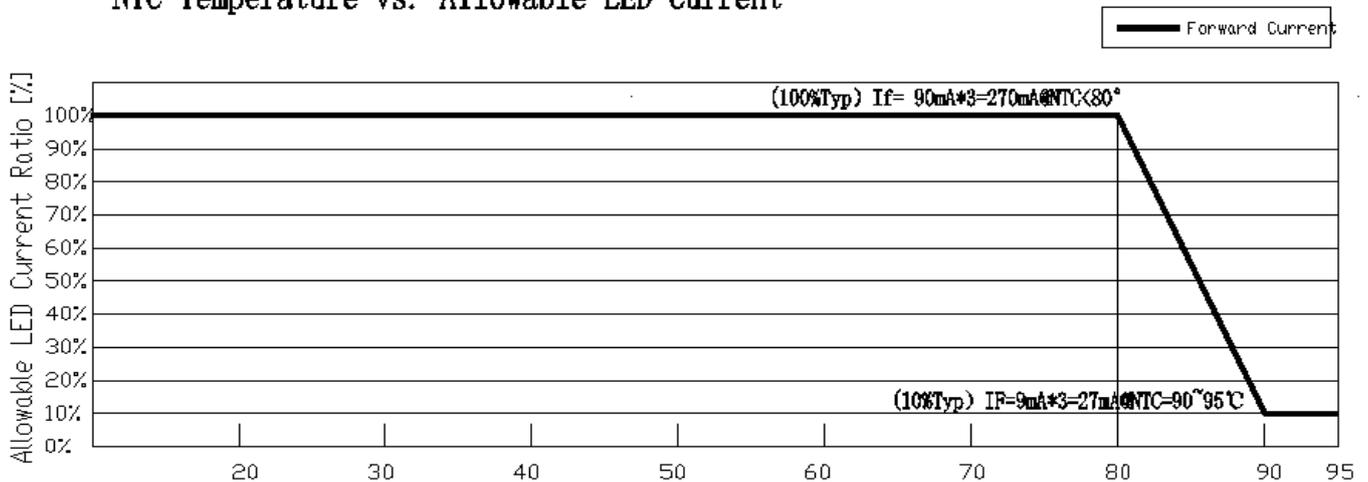
5.2 Backlight Parameter

Driving conditions	Parameter	Symbol	Min.	Typ.	Max.	Unit
Constant current 270 mA	Range of forward voltage	Vf	15.5	18	20.5	V
	Chain current	-	-	90	-	mA
Numbers of LED	18					pieces
LED connection mode	3paraller×6series					
Backlight life (Luminance decay 50%)	10000					hours

Note:

- Using condition: constant current driving method $I_f=90mA*3 (+/-10\%)$ -
- Backlight LED derating curve:

NTC Temperature vs. Allowable LED Current

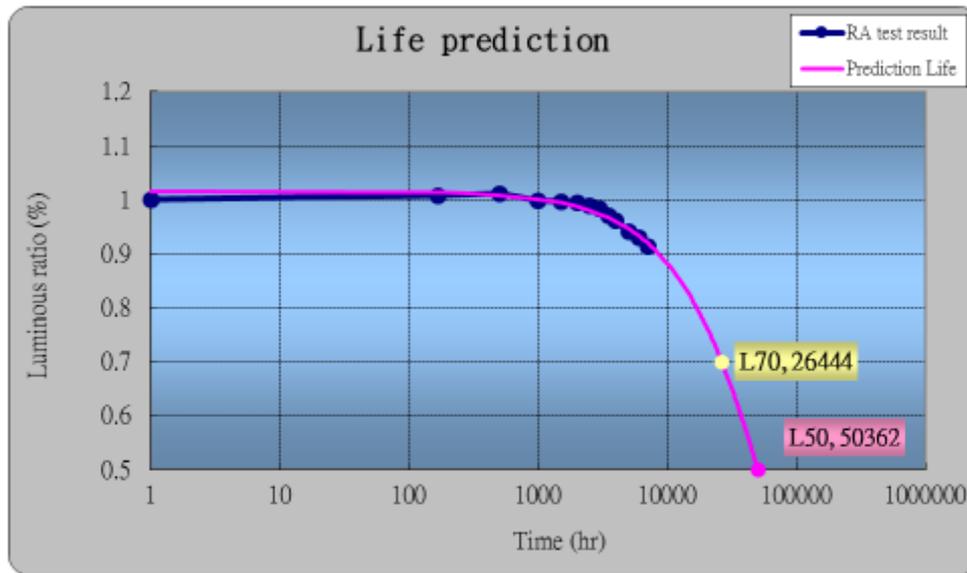


NTC Temperature [°C]

项目 Item	测定条件 Condition	符号 Symbol	最小值 min.	典型值 typ.	最大值 max.	单位 Unit
背光在运行温度中电压范围 Voltage Range for BL Operating Temperature	Ta=+85°C If=90mA*3=270mA	Vf	14.5	17	19.5	V
	Ta=+25°C If=90mA*3=270mA	Vf	15.5	18	20.5	V
	Ta=-40°C If=90mA*3=270mA	Vf	17	19.75	22.5	V

3 LED life.

Test Condition :Ta=25℃, IF=90mA



Life concept: When the LED luminous intensity attenuation to 50% at the beginning of the luminous intensity of time.

6) EXTERNAL INTERFACE

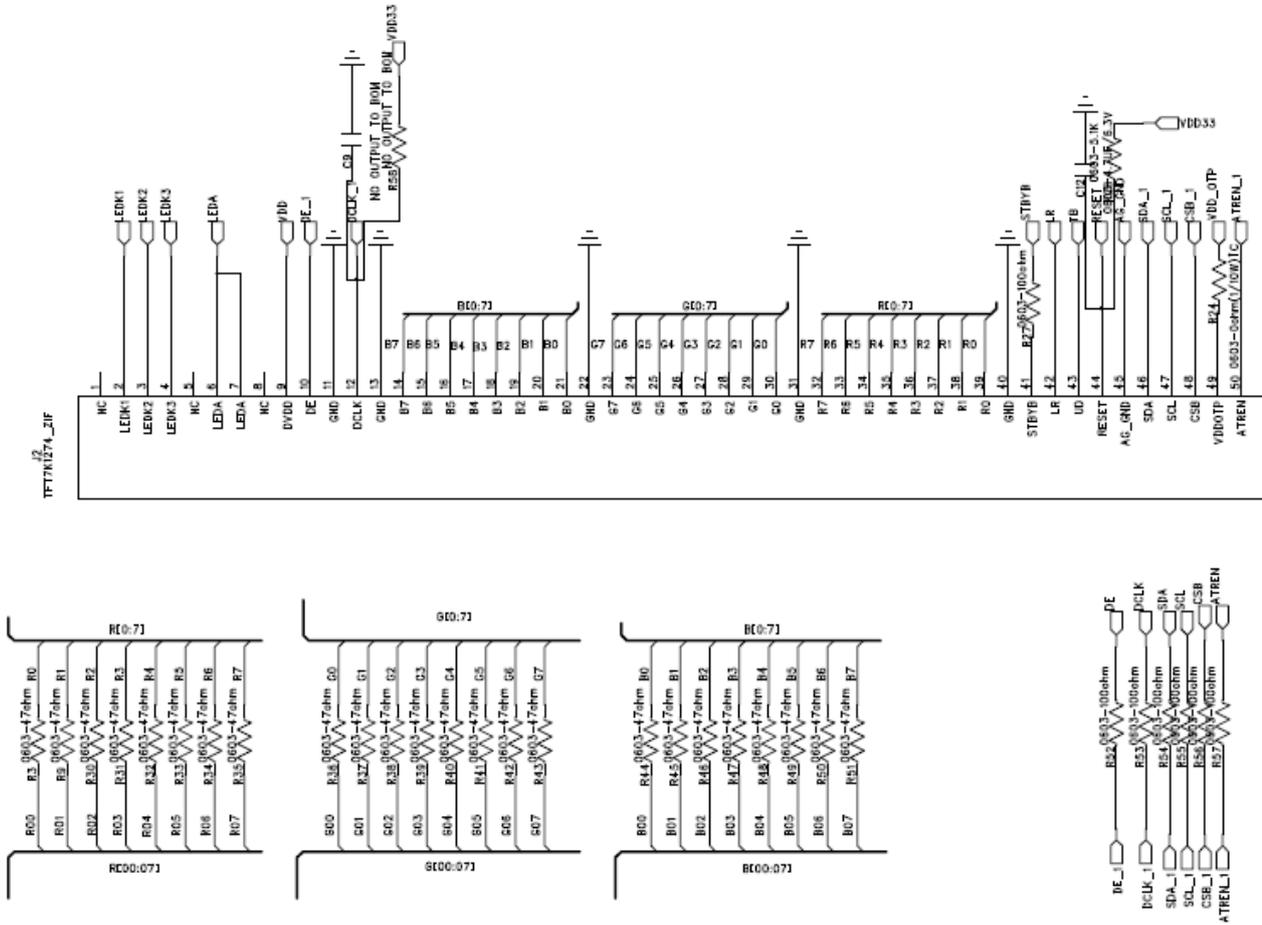
Pin No	Definition	Description
1	NC	No connection
2	LEDK1	Backlight cathode
3	LEDK2	Backlight cathode`
4	LEDK3	Backlight cathode
5	NC	No connection
6	LEDA	Backlight anode
7	LEDA	Backlight anode
8	NC	No connection
9	DVDD	Power supply
10	DE	Enabled RGB signal pin
11	GND	Ground
12	DCLK	Clock signal for the RGB
13	GND	Ground
14	B7	Data input pins for the RGB mode
15	B6	
16	B5	
17	B4	
18	B3	
19	B2	
20	B1	
21	B0	
22	GND	Ground
23	G7	Data input pins for the RGB mode
24	G6	
25	G5	
26	G4	
27	G3	
28	G2	
29	G1	
30	G0	
31	GND	Ground
32	R7	Data input pins for the RGB mode
33	R6	
34	R5	
35	R4	
36	R3	
37	R2	
38	R1	
39	R0	
40	GND	Ground
41	STBYB	Stendby mode setting pin .active low Timing controller,output buffer ,DAC and power circuit all off when STBYB is low
42	LR	Horizontal shift direction(source output)selection LR=1(default)
43	UD	Vertical shift direction(source output)selection UD=1(default)

44	RESET	Global reset pin ,active low
45	GND(AG_GND)	ground
46	SDA	Serial interface addresss and data input /output fo r SPI interface
47	SCL	Serial interface clock input for SPI interface
48	CSB	Serial interface chip enable signal for SPI interface
49	NC	No connection
50	ATREN	Enable auto reload OTP/EEPROM every 60frames Active high:enable auto reload OTP/EEPROM Active low: disable auto reload OTP/EEPROM

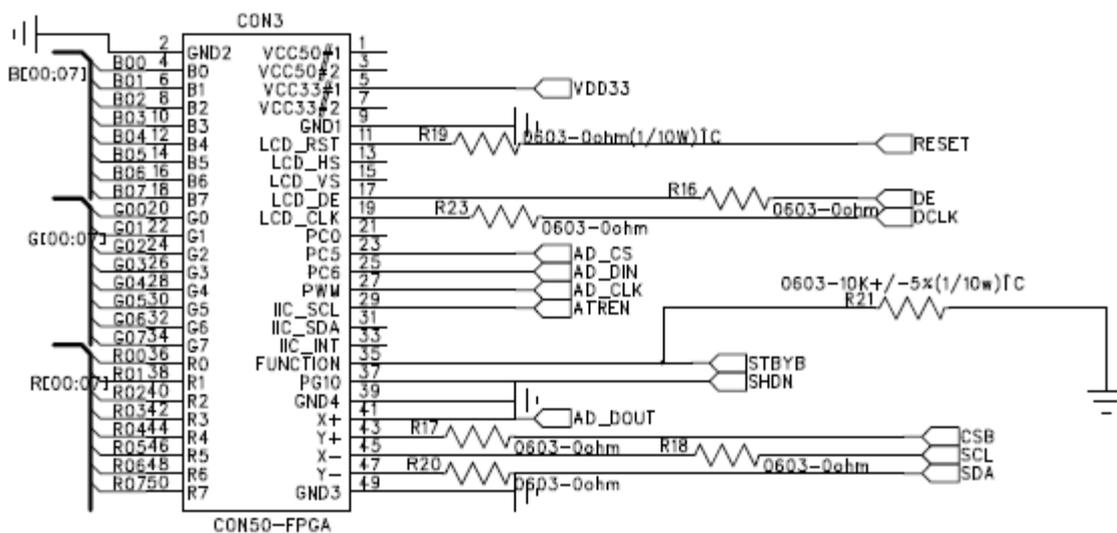
7) REFERENCE APPLICATION CIRCUIT

Please consult our technical department for detail information.

1.FPC Interface

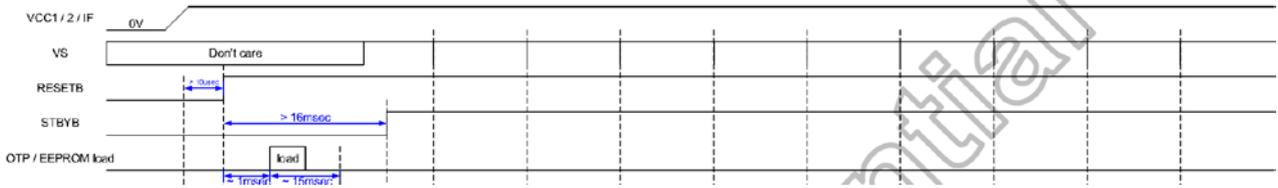


2.MCU Interface

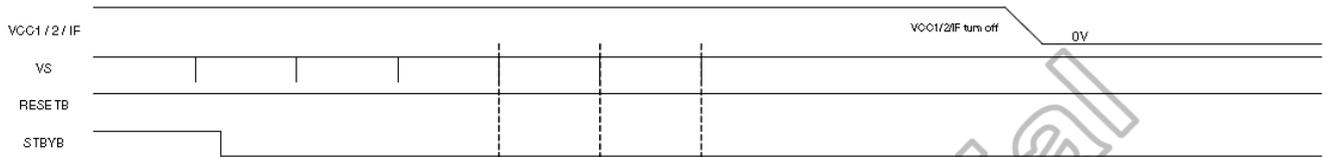


8) TIMING CHARACTERISTICS

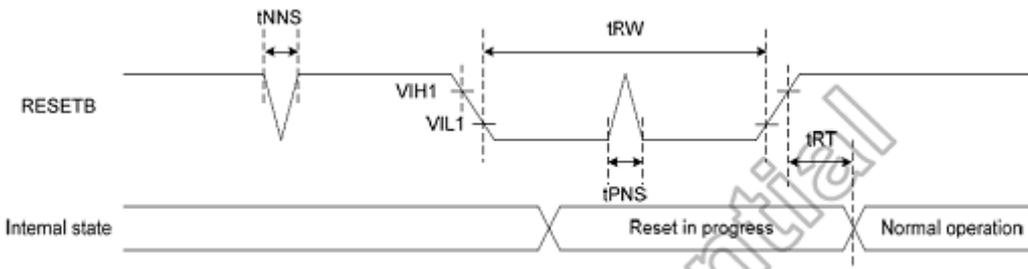
8.1 Power ON Timing



8.2 Power Off Timing



8.3 Reset Timing

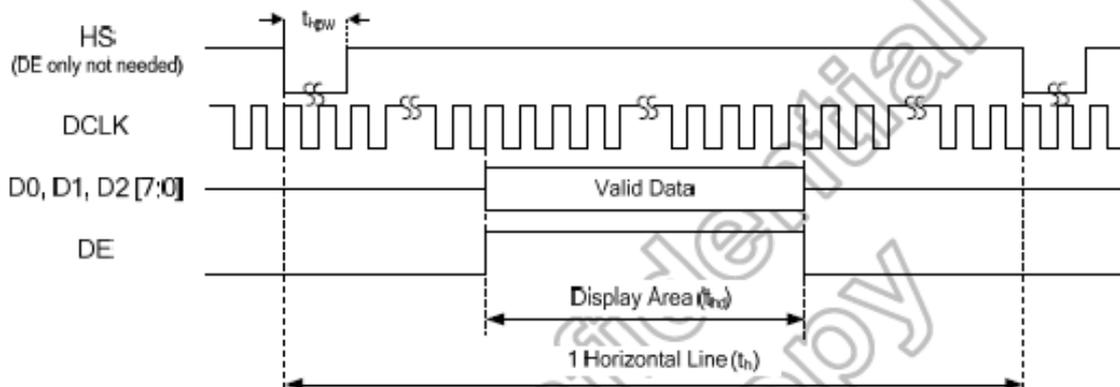


(VCC1=VCC2=2.7 to 3.6V, GND=0V, TA=-40 to +95 °C)

Signal	Parameter	Symbol	Spec.			Unit	Remarks
			Min.	Typ.	Max.		
RESETB	Reset pulse width	tRW	10	-	-	us	-
	Reset complete time	tRT	-	-	5	us	-
	Positive spike noise width	tPNS	-	-	100	ns	-
	Negative spike noise width	tNNS	-	-	100	ns	-

8.4 RGB interface timing

- Horizontal



• Vertical

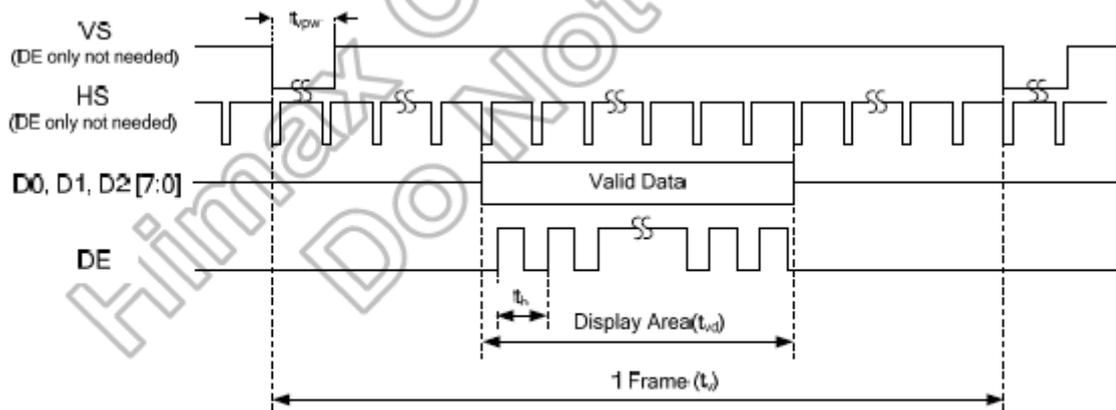


Figure 8.7: Vertical input timing at DE only mode

• AC electrical characteristics

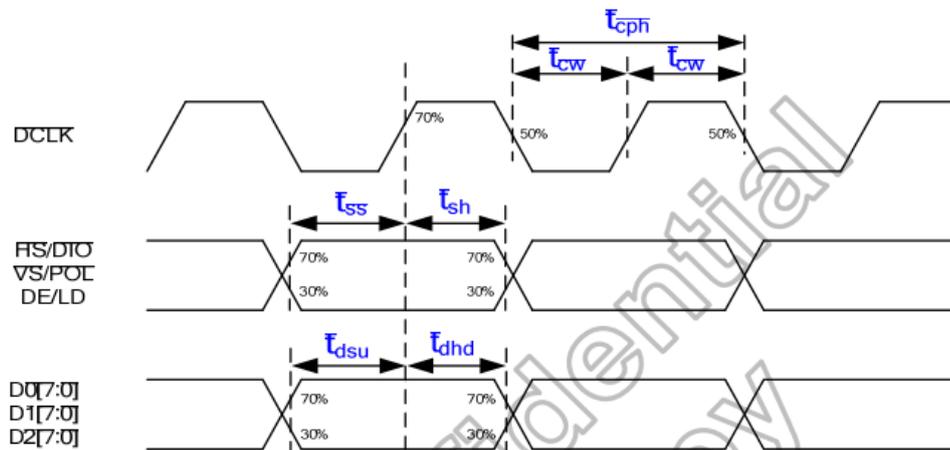


Figure 11.5: Input signal timing

(VCC1=VCC2=VCCIF=2.7V to 3.6V, VSS1=VSS2=VSSA=0V, T_{OP}=-40~95℃)

Parameter	Symbol	Spec.			Unit
		Min.	Typ.	Max.	
DCLK period	T _{cph}	16.67	-	-	ns
DCLK duty ratio	T _{cw}	40	50	60	%
Data setup time	T _{dsu}	5	-	-	ns
Data hold time	T _{dhd}	5	-	-	ns
VS/POL setup time	T _{ss}	5	-	-	ns
VS/POL hold time	T _{sh}	5	-	-	ns
HS/DIO setup time	T _{ss}	5	-	-	ns
HS/DIO hold time	T _{sh}	5	-	-	ns
DE/LD setup time	T _{ss}	5	-	-	ns
DE/LD hold time	T _{sh}	5	-	-	ns

Table 11.4: Input data/Sync. Parameters

9) RECOMMENDED INITIALIZATION

Please consult our technical department for detail information.

9.1 Windows parameter, only for your reference

```
#define LCD_WIDTH      24
#define LCD_XSIZE      800
#define LCD_YSIZE      480
```

Item	Symbol	Min	Typ	Max
Frequence	Frame	55Hz	60 Hz	70Hz
Clock frequence	DOTCLK	23.2M Hz	25.3M Hz	29.5M Hz

9.2 Initialization

9.2.1 driver IC initialization

```
void power_on()
{
power_on_dvdd(1);//power on (dvdd)
disable_Backlight(0);//backlight off
LCD_Reset(0);//reset low
WaitTime(50);//50ms
LCD_Reset(1);//reset high
WaitTime(50);//50ms
enable_DE(1);//
LCD_INIT_HX8290(void);//initial codes
enable_STBYB(1);//
enable_RGB(1);//enable RGB controlling signal HSYNC,VSYNC,DATA_ENABLE,CLK,data
WaitTime( 133 );//133ms
enable_Backlight(1);//backlight on
power_on_dvdd(1);//power on (dvdd)
}

void power_off()
{
disable_Backlight(0);//backlight off
WaitTime( 300 );//300ms
enable_STBYB(0);//Standby mode in
WaitTime( 80 );//80ms
disable_RGB(0);//disable RGB controlling signal HSYNC,VSYNC,DATA_ENABLE,CLK,data
//LCD_Reset(0);//reset low
WaitTime(40);//5ms
power_down_vcc(0);//power down vcc
}

void LCD_INIT_HX8290 (void)
{
LCDSPI_InitREG_HX8290(0x00,0x00);//page 0
LCDSPI_InitREG_HX8290(0x01,0x44);
LCDSPI_InitREG_HX8290(0x02,0x61);
LCDSPI_InitREG_HX8290(0x03,0x38);//0xF8
LCDSPI_InitREG_HX8290(0x04,0x00);
LCDSPI_InitREG_HX8290(0x05,0xCf);
LCDSPI_InitREG_HX8290(0x16,0x53);//Pass Hset
LCDSPI_InitREG_HX8290(0x17,0x20);//H=320 (800)
```

```

LCDSPI_InitREG_HX8290(0x00,0x01);//
LCDSPI_InitREG_HX8290(0x02,0x0D);//VSP=6.3
LCDSPI_InitREG_HX8290(0x03,0x0D);//VSN=6.3
LCDSPI_InitREG_HX8290(0x04,0x62);//VGH=17 VGL=-10
LCDSPI_InitREG_HX8290(0x05,0x0C);//vsdp=6.0v
LCDSPI_InitREG_HX8290(0x06,0x0C);//vsdn=-6.0v

LCDSPI_InitREG_HX8290(0x12,0x2F);//VGMPH=5.5
LCDSPI_InitREG_HX8290(0x13,0x0F);//VGMNH=-5.5
LCDSPI_InitREG_HX8290(0x14,0x00);//VGMPL/NL
LCDSPI_InitREG_HX8290(0x16,0x5B);//VCOM=
LCDSPI_InitREG_HX8290(0x00,0x02);//PAGE 2 ----P GAMMA
LCDSPI_InitREG_HX8290(0x01,0x00);
LCDSPI_InitREG_HX8290(0x02,0x04);
LCDSPI_InitREG_HX8290(0x03,0x08);
LCDSPI_InitREG_HX8290(0x04,0x18);
LCDSPI_InitREG_HX8290(0x05,0x23);
LCDSPI_InitREG_HX8290(0x06,0x14);
LCDSPI_InitREG_HX8290(0x07,0x13);
LCDSPI_InitREG_HX8290(0x08,0x19);
LCDSPI_InitREG_HX8290(0x09,0x23);
LCDSPI_InitREG_HX8290(0x0A,0x26);
LCDSPI_InitREG_HX8290(0x0B,0x26);
LCDSPI_InitREG_HX8290(0x0C,0x29);
LCDSPI_InitREG_HX8290(0x0D,0x21);
LCDSPI_InitREG_HX8290(0x0E,0x22);
LCDSPI_InitREG_HX8290(0x0F,0x31);
LCDSPI_InitREG_HX8290(0x10,0x2f);
LCDSPI_InitREG_HX8290(0x11,0x23);
LCDSPI_InitREG_HX8290(0x12,0x30);
LCDSPI_InitREG_HX8290(0x13,0x38);
LCDSPI_InitREG_HX8290(0x14,0x1E);

LCDSPI_InitREG_HX8290(0x00,0x03);//PAGE 2 ----P GAMMA
LCDSPI_InitREG_HX8290(0x01,0x00);
LCDSPI_InitREG_HX8290(0x02,0x04);
LCDSPI_InitREG_HX8290(0x03,0x08);
LCDSPI_InitREG_HX8290(0x04,0x18);
LCDSPI_InitREG_HX8290(0x05,0x23);
LCDSPI_InitREG_HX8290(0x06,0x14);
LCDSPI_InitREG_HX8290(0x07,0x13);
LCDSPI_InitREG_HX8290(0x08,0x19);
LCDSPI_InitREG_HX8290(0x09,0x23);
LCDSPI_InitREG_HX8290(0x0A,0x26);
LCDSPI_InitREG_HX8290(0x0B,0x26);
LCDSPI_InitREG_HX8290(0x0C,0x29);
LCDSPI_InitREG_HX8290(0x0D,0x21);
LCDSPI_InitREG_HX8290(0x0E,0x22);
LCDSPI_InitREG_HX8290(0x0F,0x31);
LCDSPI_InitREG_HX8290(0x10,0x2f);
LCDSPI_InitREG_HX8290(0x11,0x23);
LCDSPI_InitREG_HX8290(0x12,0x30);
LCDSPI_InitREG_HX8290(0x13,0x38);
LCDSPI_InitREG_HX8290(0x14,0x1E);

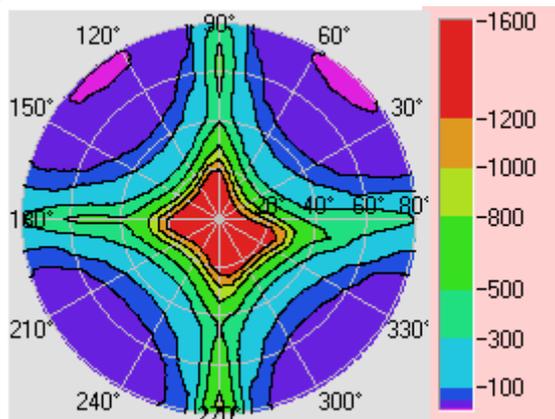
```

}

10) ELECTRO-OPTICAL CHARACTERISTICS

Parameter	Sym bol	Condition		Min	Typ	Max	Unit	Remark	N ot e
Response time	Tr +Tf	$\theta=0^\circ$ $\varnothing=0^\circ$	25°C	-	20	30	ms	FIG 1	4
			-30°C	-	370	555			
Contrast	Cr	$\theta=0^\circ$ $\varnothing=0^\circ$	+25°C	700	900	-		FIG 2	1
Luminance uniformity	δ	$\theta=0^\circ$ $\varnothing=0^\circ$	White	80	-	-	%	FIG 2.	3
			Black	60	-	-			
Surface Luminance	Lv	Ta=25°C		/	800	1000	-	cd/m ²	2
Viewing angle range (TFT: Cr>=10@ 25°C)	θ	$\varnothing = 90^\circ$		70	80	-	deg	FIG 3.	6
		$\varnothing = 270^\circ$		70	80	-			
		$\varnothing = 0^\circ$		70	80	-			
		$\varnothing = 180^\circ$		70	80	-			
NTSC ratio	-	-		-	70	-	%	FIG 4	-
Splash screen	-	-		-	-30	-25	dB	FIG 5	7
Gamma (L32~L224)	γ	$\theta=0^\circ$ $\varnothing=0^\circ$ Ta=25°C		1.8	2.2	2.6	-		8
CIE (x, y) chromaticity	Red x	$\theta=0^\circ$ $\varnothing=0^\circ$ Ta=25°C		0.5859	0.6359	0.6859	-	FIG 2.	5
	Red y			0.2799	0.3299	0.3799			
	Green x			0.2576	0.3076	0.3576			
	Green y			0.5804	0.6304	0.6804			
	Blue x			0.0969	0.1469	0.1969			
	Blue y			0.0121	0.0621	0.1121			
	White x			0.2393	0.2993	0.3593			
	White y			0.2556	0.3156	0.3756			

ISO-等对比度图(参考样)



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.

L_v = 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.

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

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.

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.

Note 7. Splash screen test condition and standard: First According to the customers' condition and measurement criterion. If there is no response from customers , according to 《Fliker and Crosstalk test method and judgment standard DOC-23B040-B》 to test. Flicker judgment standard:

Product type	Measurment method	Judgment standard
TFT Product	JEITA/VESA	≤-25dB
	Contrast method	≤10%
NON-TFT Product	JEITA/VESA	≤-20dB
	Contrast method	≤18%

If customers have special request andTruly follow the same, For more information see FIG 5.

Note 8. Gamma measurment standard: First using customer standard, If customers have no request, using TRULY Internal Standard(2.2 ± 0.4 based on between level 32 and 224), white and gray scale screen(not discriminate RGB). For more information see FIG 4 .

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 the opposite definition applies.

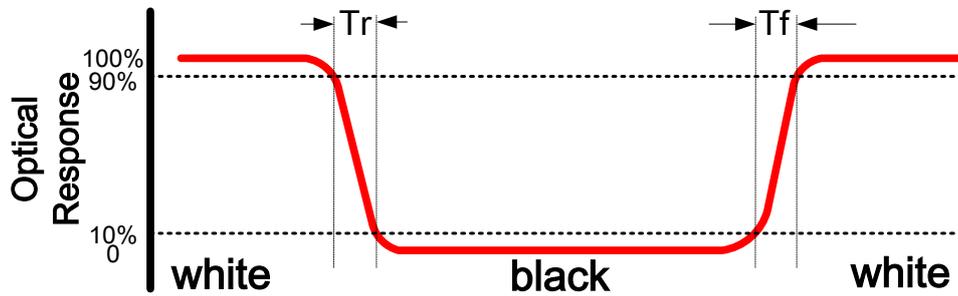


FIG.2. Measuring method for Contrast ratio, surface luminance, Luminance uniformity , CIE (x, y) chromaticity

A : H/6
 B : V/6
 H,V :Active Area
 Measurement instrument :CS-2000

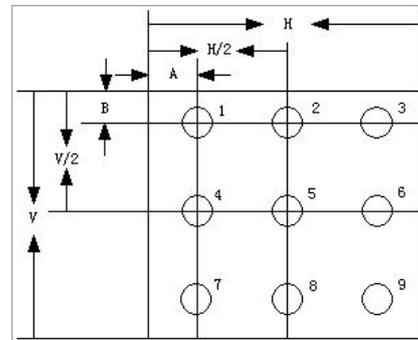


FIG.3. The definition of viewing angle

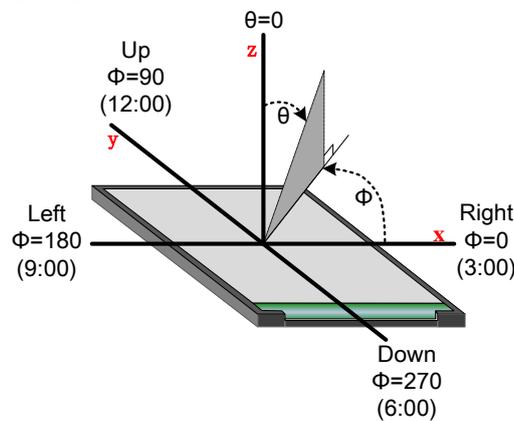


FIG.4. The definition of Gamma curve

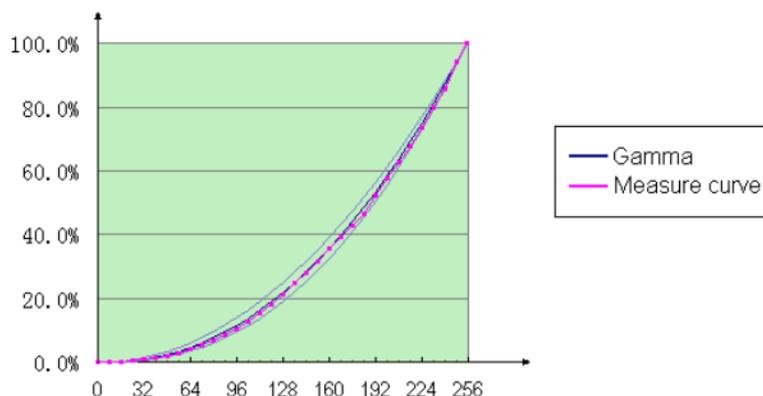
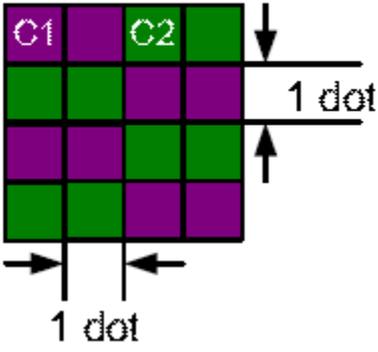
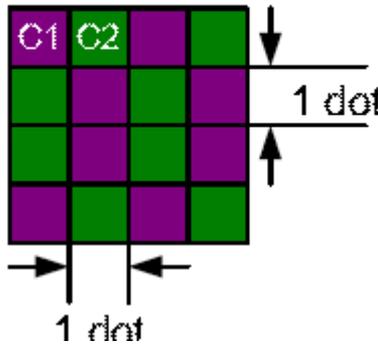


FIG.5. Testing of Splash screen

Choose picture: According to the model driver IC supports to choose picture such as 1+2 dot inversion , 2dot inversion ,

2dot inversion (full black/50%gray scale)	1+2 dot inversion ((full black /50%gray scale)
<p style="text-align: center;">2 dot inversion</p> 	<p style="text-align: center;">1+2 dot inversion</p> 

Measurement method:

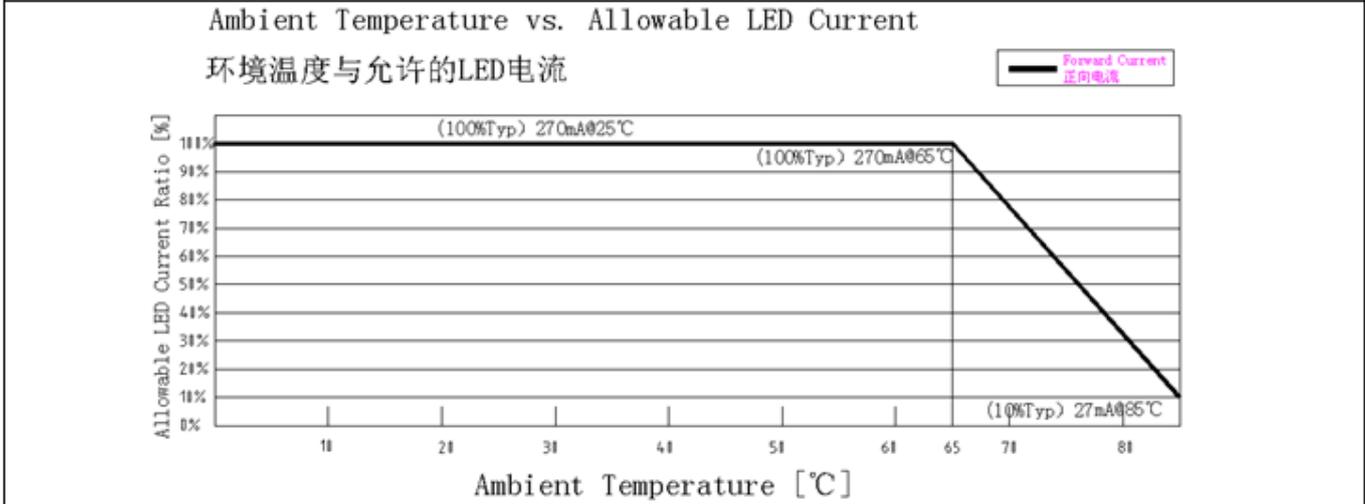
If there is special request to test picture and diagraph method from customer and we must do it , such as adoption contrast method or measure flicker value under the specially reversal way ,.General choice JEITA method,testing central point and record flicker DB value under corresponding frequency. .If the customer has a special request(such as increaser points of testing four corners) with takeing customer's request as standard.

Measurement instrument : ConoScope,DMS-803,QCT-200,CA-210,CA310,MSE

11) RELIABILITY TEST CONDITIONS

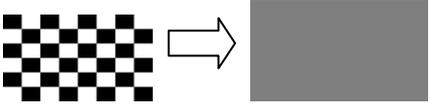
1.模块高温测试

背光电流曲线



2.测试条件

No.	Test Item	Test Condition	Sample size	Criteria
1	High Temperature Storage	High Temperature Storage: 90°C Storage time: 240h	5 pieces	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.reducing of the specified minimum contrast ratio from more than 50% 8. reducing of the specified minimum brightness from more than 50%
2	Low Temperature Storage	Low Temperature Storage: -40°C Storage time: 240h	5 pieces	
3	High Temperature Operating	High Temperature Operating: 85°C Operating time: 240h Backlight current:27ma	5 pieces	
4	Low Temperature Operating	Low Temperature Operating: -30°C Operating time: 240h Backlight current:270ma	5 pieces	
5	Temperature Cycle storage	-40°C (30min.)~25°C (5min.)~85°C (30min.)*10C	5 pieces	
6	High Temperature and high humidity Operating	Temperature: 60°C humidity: 90%RH Operating time: 240h	5 pieces	
7	UV exposure resistance	Xenon arc lamp, Light intensity: 1120W/m2. Chamber temperature: +40 °C Total 72hrs. According to IEC 68-2-5 Sa-A	5pieces	
8	Electro Static Discharge Test	Test environment: 18°C – 28°C temperatures, 30% – 40% humidity. Test pulse number: Each turn on electricity a point, plus or minus pole at least 3 Time, Each time partition 2。 Contact discharge: 150pF/330Ω。 Air discharge: 150pF/330Ω Discharge method: direct discharge Contact discharge ±4 Kv , function grade B	5 pieces	A class:The function that requests to limit inside the value in the technique is normal. B class:Function or function temporarily lower or lose, but ability by oneself instauration. C class:Function or function temporarily lower or lose, but request to operate personnel's intervention or system to reset. The C class is following:Result in because damage or data of

		Air discharge ±4 Kv, function grade B Air discharge ±8 Kv, function grade C Need to be measured module status: when connect the power, directly turn on electricity to module		equipments(component) or software throw to lose of can not recover to the function of normal appearance to lower or lose by oneself.
9	Testing of cripple shadow	65°C (Oven real temperature) Times: fixed 1 hours Chekboard image (total Number: 25~100) 	5 pieces	1.Immediately switch to 50% gray scale and take out to rub in the normal temperature environment;: cripple shadow disappear In 15 minutes or have no(each angle of view direction)
10	Testing of Vibration	Frequency: 10Hz~55Hz~10Hz Amplitude: 1.5mm, 1hour for each X, Y, Z direction。	5 pieces	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.
11	Heat Shock	-30°C ~ +80°C , 100 (0.5h) (0.5h) Non-Operation	5 pieces	1. Tested end ,screen display normal ,pearance is not transformation and break
12	Backlight life	+25°C MIN 10000, the brightness decreases to 50% of original level	5 pieces	2. each of performance index satisfy standard of design

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 is bubble 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:

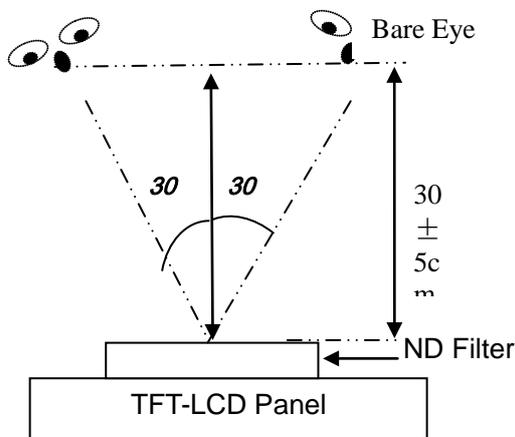
Ambient temperature & humidity : 20~25 °C, 55~70%RH

Visual checking illuminance : 800lux~2000lux

Function checking illuminance : <30 lux

Viewing angle : U/D/L/R 30 degree

Viewing distance : 35±5 cm



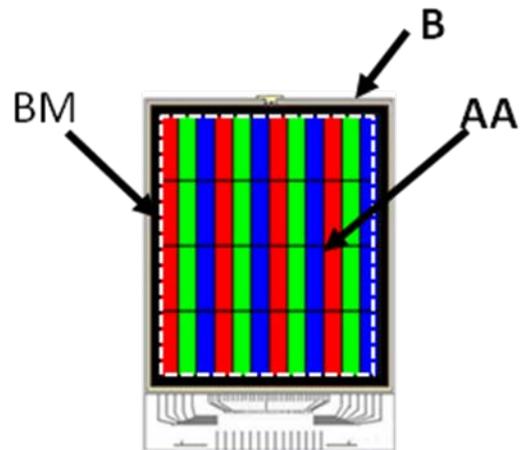
3.0 Definition:

A area: Viewing area after assembly.

(Reference V.A of the drawing/AA+BM)

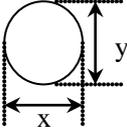
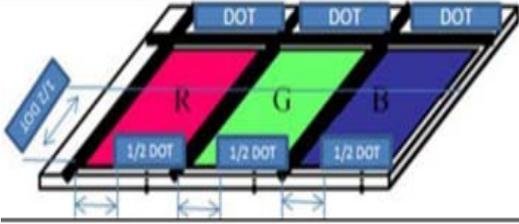
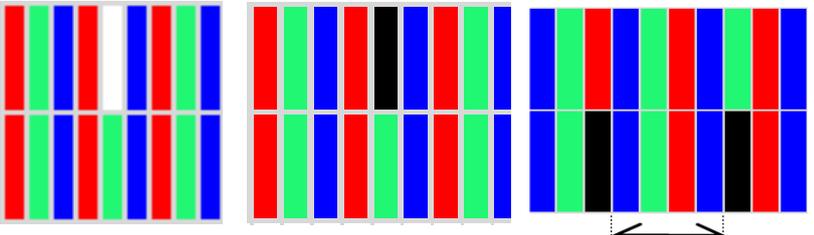
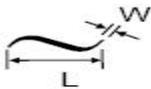
B area: Invisible area after assembly.

(reference other area except the V.A of the drawing)



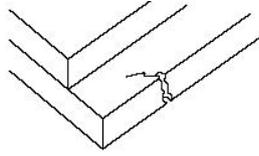
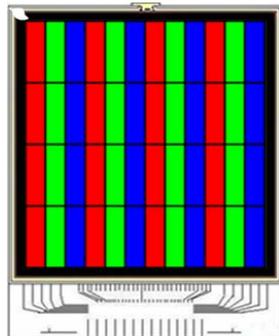
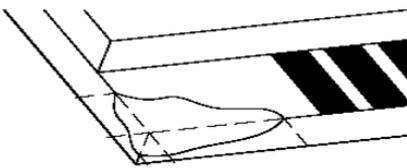
4. 0 Inspection specification

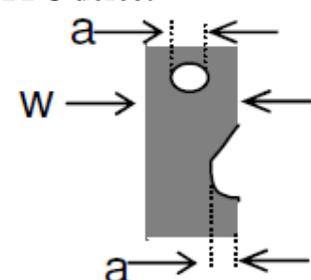
NO.	Inspection content	Inspection specification
4.1	Display function	TFT not display is not allowed.
		TFT Display abnormally is not allowed.
		Missing segment is not allowed.
4.2	Liquid crystal nonconformance	Liquid crystal not fulfilled is not allowed.
		Liquid crystal leak is not allowed.
NO.	Inspection content	Inspection specification
4.3	Spot nonconformance	A Area Acceptable QTY

	(Such as black spot、white spot、foreign matters) 	Size(mm)		
		$\Phi \leq 0.15$		Ignore
		$0.15 < \Phi \leq 0.4$		4
		$\Phi > 0.40$		0
		Remark: Definition of spot size Φ: $\Phi=(X+Y)/2$		
4.4	Dot(pixel defect) 	A Area	Acceptable QTY	
		Symptom		
		Bright(RGB) Sub- pixel	0	
		Dark Sub- pixel	4	
		Distance between Sub- pixel to Sub- pixel	$\geq 5mm$	
Note:				
 <p style="text-align: center;">Bright Dot Dark Dot <5mm NG</p>				
<p>a. One pixel consists of 3 sub-pixels, including R,G and B dot(Sub-pixel=Dot)</p> <p>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</p> <p>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</p> <p>d. Bright dot is defined through 5% transmission ND filter as 2.0:</p>				
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
		≤ 2	≤ 0.05	2
		≤ 1	$0.05 < W \leq 0.1$	1
		/	> 0.1	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.		
4.7	Foreign on polarizer protect film	Foreign on polarizer protect film easier to clean is allowed.		
4.8	Polarizer dent and	A Area	Acceptable QTY	

	bubble	Size(mm)	
		$\Phi \leq 0.20$	Ignore
		$0.20 < \Phi \leq 0.50$	3
		$0.50 < \Phi \leq 0.80$	2
		$\Phi > 0.80$	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 5mm.

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)	5% ND, limit samples (checking by end user picture.)
5.1	Soldering	Follow IPC-A-610G Class 2 Acceptance

5.2	<p>FPC defect</p> 	<p>1 Dent, pinhole width $a < w/3$. (w: circuitry width.) 2 Open circuit is unacceptable. 3 No oxidation, contamination and distortion.</p>
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5.3	Bezel	1 No rust, distortion on the Bezel. 2 No visible fingerprints, stains or other contamination
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13) 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 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:

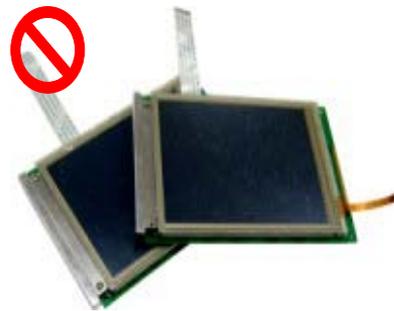


As above picture, please handle with anti-static gloves around LCM edges.

2.3 False handling:



Please don't touch IC directly.



Please don't stack LCM.



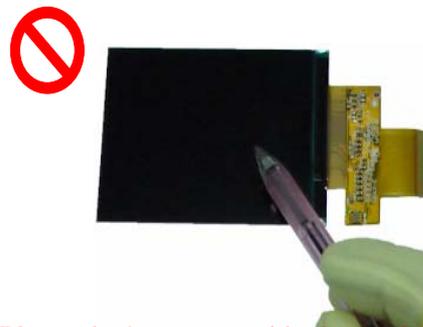
Please don't hold the surface of panel.



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

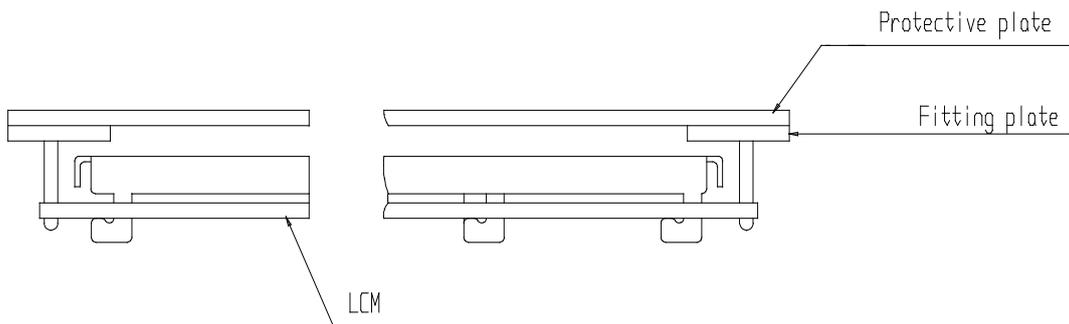
- 3.1 When storing the LCD modules, the following precaution are necessary.
 - 3.1.1 Store them in a sealed polyethylene bag. If properly sealed, there is no need for the desiccant.
 - 3.1.2 Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0°C and 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

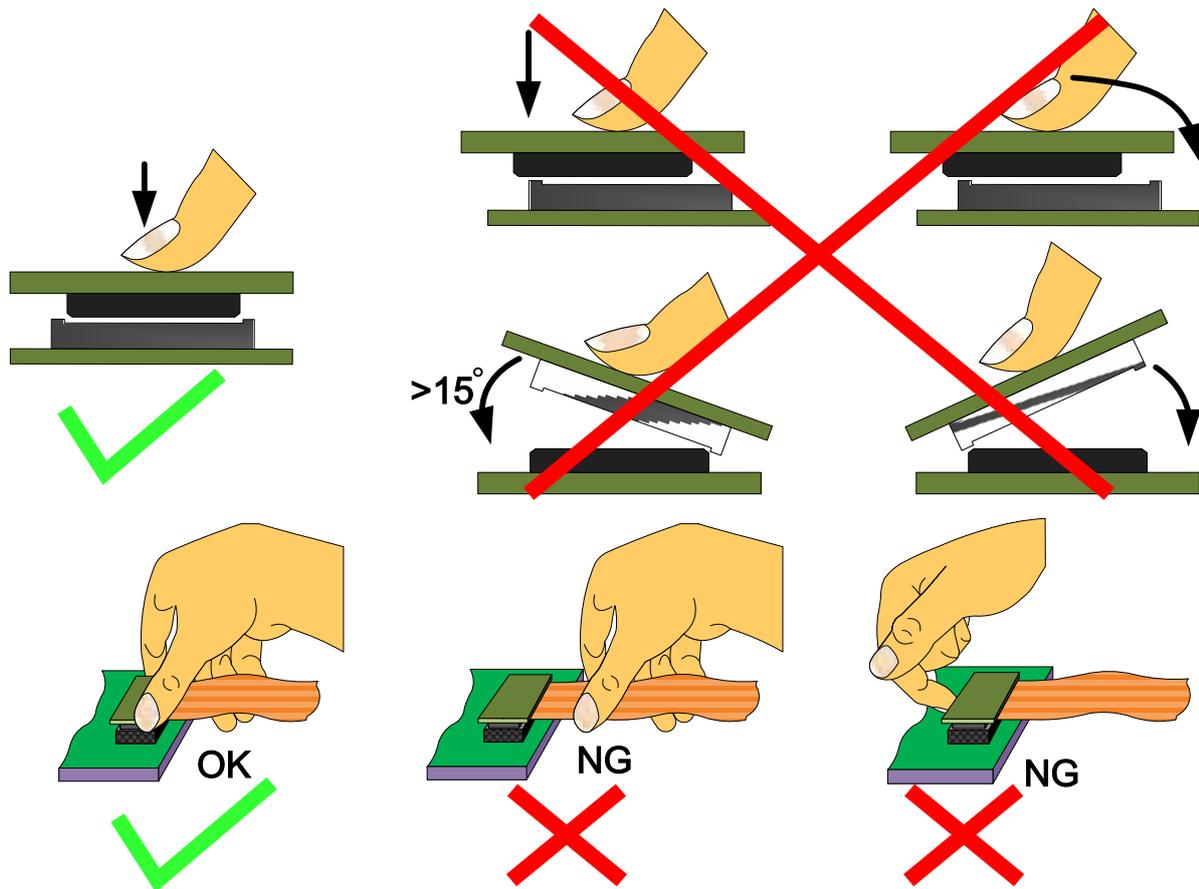
The hole in the printed circuit board is used to fix LCM as shown in the picture below. Attend to the following items when installing the LCM.

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