MULTI-INNO TECHNOLOGY CO., LTD.

www.multi-inno.com

LCD MODULE SPECIFICATION

Model: MI0700BUT-1

This module is ROHS compliant

For Customer's Acceptance:

Customer	
Approved by	
Comment	

The standard product specification may change without prior notice in order to improve performance or quality. Please contact Multi-Inno for updated specification and product status before design for the standard product or release of the order.	Revision	1.0
	Engineering	
	Date	2020-01-16
	Our Reference	

■ REVISION RECORD

REV NO.	REV DATE	CONTENTS	REVISED PAGE NO.
1.0	2020-01-16	First Release	

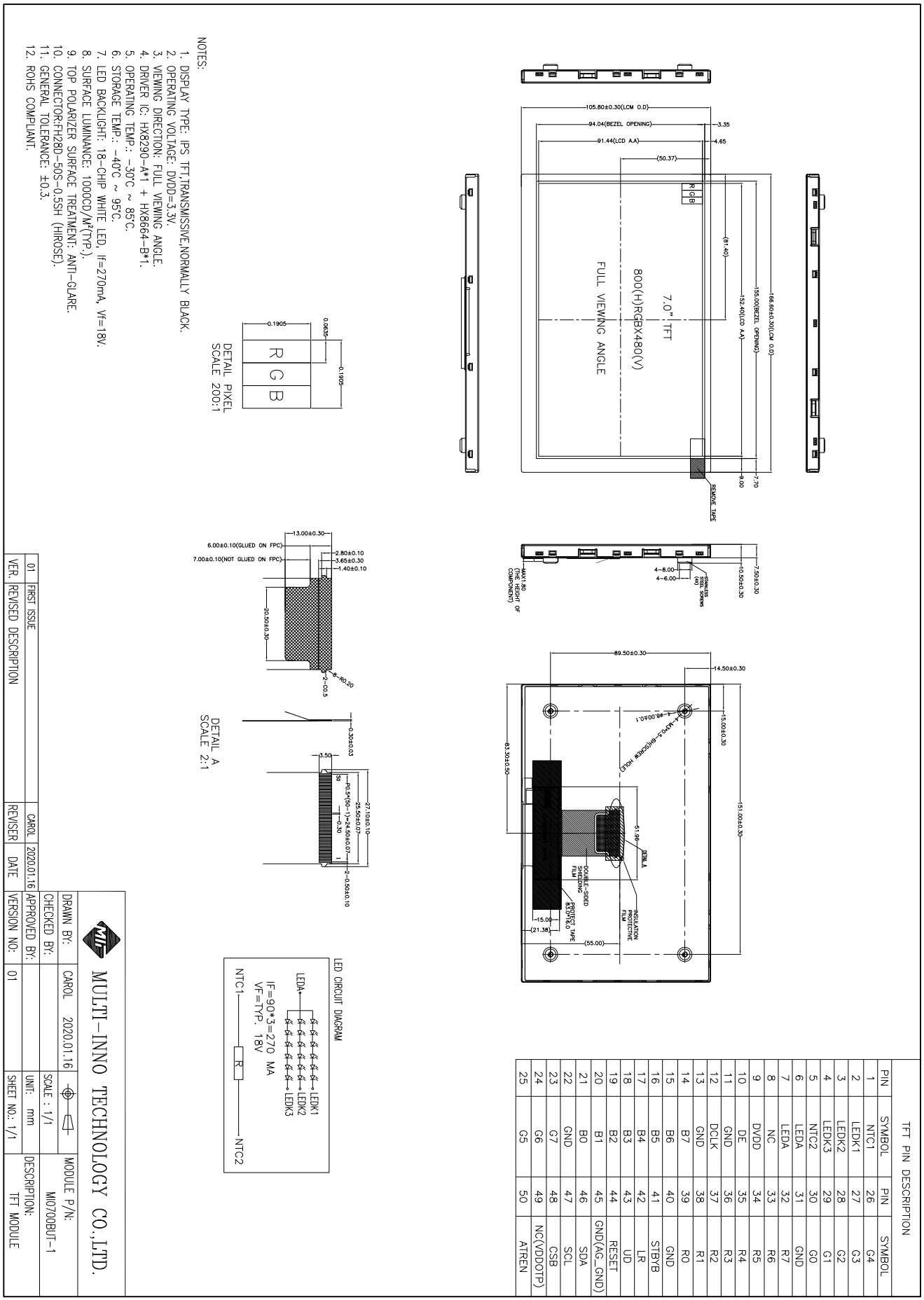
CONTENTS

■ GENERAL INFORMATION

Item	Specification	Unit
LCD Type	IPS TFT / Transmissive / Normally black	/
Size	7.0	Inch
Viewing Direction	Full viewing angle	O'clock
Gray Scale Inversion Direction	-	O'clock
LCM (W × H × D)	166.60 × 105.80 × 7.50	mm^3
Active Area (W × H)	152.40 × 91.44	mm^2
Pixel Pitch	0.1905 × 0.1905	mm^2
Number of Dots	800 (RGB) × 480	/
Driver IC	HX8290-A*1 + HX8664-B*1	/
Backlight Type	18LEDs	/
Interface Type	24-bit RGB + 3-wire SPI	/
Color Depth	16.7M	
Pixel Configuration	R.G.B Vertical Stripe	/
Top Polarizer Surface Treatment	Anti-glare	/
Input Voltage	3.3	V
With / Without TSP	Without TP	/
TP Surface Treatment	-	/
Weight	TBD	g

Note 1: ROHS compliant;
Note 2: LCM weight tolerance: ±5%.

■ EXTERNAL DIMENSIONS



NOTES:

1. DISPLAY TYPE: IPS TFT,TRANSMISSIVE,NORMALLY BLACK.
2. OPERATING VOLTAGE: DVDD=3.3V.
3. VIEWING DIRECTION: FULL VIEWING ANGLE.
4. DRIVER IC: HX8290-A*1 + HX8664-B*1.
5. OPERATING TEMP.: -30°C ~ 85°C.
6. STORAGE TEMP.: -40°C ~ 95°C.
7. LED BACKLIGHT: 18-CHIP WHITE LED, If=270mA, Vf=18V.
8. SURFACE LUMINANCE: 1000CD/M²(TYP.).
9. TOP POLARIZER SURFACE TREATMENT: ANTI-GLARE.
10. CONNECTOR:FH28D-50S-0.5SH (HIROSE).
11. GENERAL TOLERANCE: ±0.3.
12. ROHS COMPLIANT.

TFT PIN DESCRIPTION

PIN	SYMBOL	PIN	SYMBOL
1	NTC1	26	G4
2	LEDK1	27	G3
3	LEDK2	28	G2
4	LEDK3	29	G1
5	NTC2	30	G0
6	LEDA	31	GND
7	LEDA	32	R7
8	NC	33	R6
9	DVDD	34	R5
10	DE	35	R4
11	GND	36	R3
12	DCLK	37	R2
13	GND	38	R1
14	B7	39	R0
15	B6	40	GND
16	B5	41	STBYB
17	B4	42	LR
18	B3	43	UD
19	B2	44	RESET
20	B1	45	GND(AG_GND)
21	B0	46	SDA
22	GND	47	SCL
23	G7	48	CSB
24	G6	49	NC(VDDOTP)
25	G5	50	ATREN

VER.	REVISED DESCRIPTION	REVISER	DATE
01	FIRST ISSUE	CAROL	2020.01.16

MULTI-INNO TECHNOLOGY CO.,LTD.

DRAWN BY:	CAROL 2020.01.16	MODULE P/N:	
CHECKED BY:		MI0700BUT-1	
APPROVED BY:	SCALE : 1/1	DESCRIPTION:	
VERSION NO: 01	UNIT: mm	TFT MODULE	
	SHEET NO.: 1/1		

■ ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min.	Max.	Unit
Input Voltage	DVDD	-0.3	4.0	V
OTP Voltage	NC(VDDOTP)	-0.3	8.8	V
Digital Input Voltage	VIN	-0.3	DVDD+0.3	V
Operating Temperature	TOP	-30	85	℃
Storage Temperature	TST	-40	95	℃

Note 1: Absolute maximum ratings mean the product can withstand short-term, NOT more than 120hours. If the product is a long time to withstand these conditions, the life time would be shorter.

Note 2: Operating temperature between -40℃ to -31℃ does not specify the full optical performance of the LCD, but no damage of the display function will occur.

■ ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input Voltage	DVDD	3.2	3.3	3.4	V
Input Current	IDVDD	-	93	110	mA
Sleep Current	ISLEEP	-	TBD	TBD	uA
Input High-Level Voltage	VIH	0.7DVDD	-	DVDD+0.3	V
Input Low-Level Voltage	VIL	GND-0.3	-	0.3DVDD	V
Output High-Level Voltage	VOH	DVDD-0.4	-	DVDD	V
Output Low-Level Voltage	VOL	GND	-	GND+0.4	V

■ BACKLIGHT CHARACTERISTICS

1. Backlight Parameters

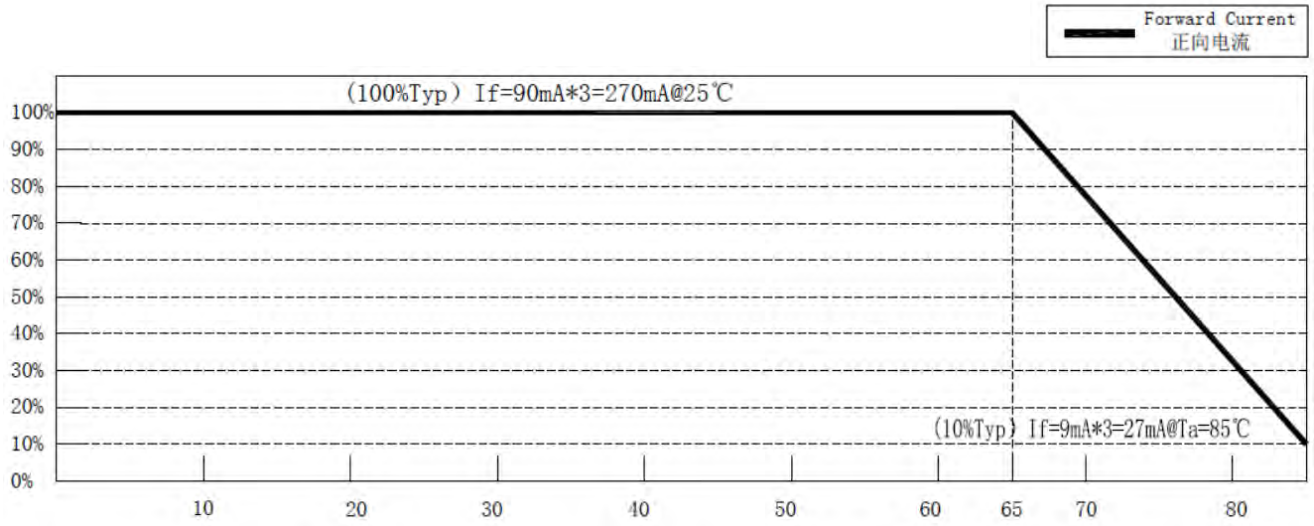
Parameter	Driving Conditions	Symbol	Min.	Typ.	Max.	Unit
Forward Voltage	Ta=+85℃ If=90mA*3	Vf	14.5	17.0	19.5	V
	Ta=+25℃ If=90mA*3		15.5	18.0	20.5	V
	Ta=-40℃ If=90mA*3		17.0	19.75	22.5	V
Forward Current	Ta=+25℃	If	-	270	285	mA
Power Consumption	Ta=-40~85℃ If=90mA*3	WBL	-	5.33	6.41	W
Operating Life Time		-	30000	50000	-	Hrs.

Note 1: Using condition: constant current driving method If=270mA (+/-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.

Note 2: Backlight LED derating curve: (when temperature≥70℃, 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 90℃)

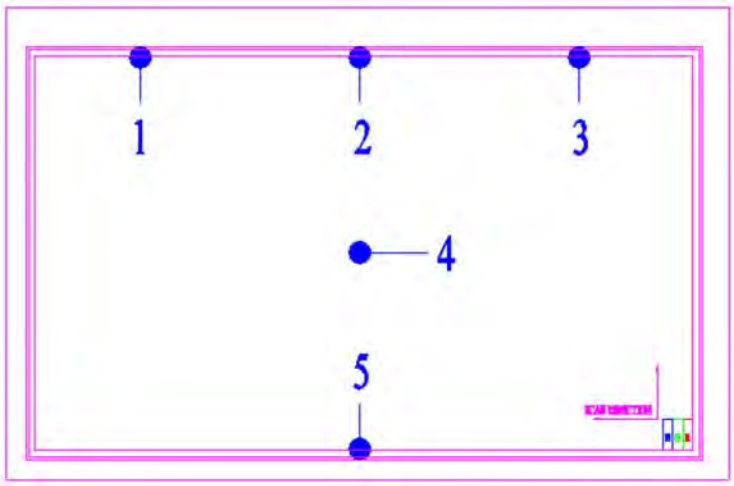
Test Parameter		Test Point							
Environment Temperature	If (mA)	1	2	3	4	5	Rntc	Tntc	Temperature Rise
Ta=25.19℃	270mA	40.3	41.65	38.95	40.76	38.01	4.026	51	16.46
Ta=65℃	270mA	79.57	81.53	78.78	80.58	78.21	1.246	90	16.53
Ta=85℃	27mA	88.11	89.48	87.07	89.16	87.2	1.305	89	4.48

Ambient Temperature vs. Allowable LED Current



Ambient Temperature [℃]

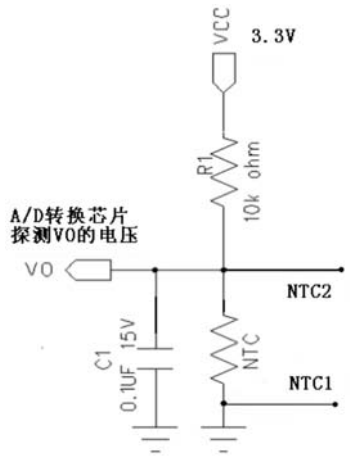
Test Point Diagram:



2. Thermal Resistor (NCP18XH103F03RB)

No.	Item	Specification	Condition
2.1	Resistance	10k ohm ± 1%	at 25℃, zero-power resistance
2.2	B-constant	3380K ± 1%	B-constant is calculated by zero-power resistance of thermistor in 25℃ and 50℃ (*1)
2.3	Permissive Operating Current	0.31mA	at 25℃ in still air (*2,*3)
2.4	Rated Electric Power	100mW	at 25℃ in still air (*2,*4)
2.5	Thermal Dissipation Constant	Approx. 10mW/℃	at 25℃ in still air (*2)
2.6	Operating Temperature Range	-40 ~ +125/℃	

Reference Application Circuit:



Calculation formula of Thermistor See below:

Rt=R * EXP(B*(1/T1-1/T2))

Formula interpretation:

1. Rt is Resistance of thermal resistor under the T1 temperature;
2. R is Resistance of thermal resistor under the T2(25℃) temperature (10K±1%);
3. The B value is the B-constant of the thermal resistor;
4. EXP is e^n;
5. T1 and T2 are K degrees (Kelvin temperature), K degree=273.15(absolute zero) +Celsius temperature. Such as: T2=273.15+25.

■ ELECTRO-OPTICAL CHARACTERISTICS

Parameter	Symbol	Condition		Min.	Typ.	Max.	Unit	Remark	Notes
Response Time	Tr + Tf	θ=0° Ø=0°	25°C	-	20	30	ms	FIG 1.	4
			0°C	-	100	150			
			-20°C	-	250	400			
			-30°C	-	400	600			
Contrast Ratio	Cr		25°C	800	1000	-	---	FIG 2.	1
Luminance Uniformity	δ White	θ=0° Ø=0° Ta=25°C	White	80	85	-	%	FIG 2.	3
			Black	60	-	-			
Surface Luminance	Lv		-	800	1000	-	cd/m²	FIG 2.	2
Viewing Angle Range	θ		Ø = 90°	75	80	-	deg	FIG 3.	6
			Ø = 270°	75	80	-	deg		
			Ø = 0°	75	80	-	deg		
			Ø = 180°	75	80	-	deg		
CIE (x,y) Chromaticity	Red x	θ=0° Ø=0° Ta=25°C		0.595	0.635	0.675	---	FIG 2.	5
	Red y			0.290	0.330	0.370			
	Green x			0.270	0.310	0.350			
	Green y			0.590	0.630	0.670			
	Blue x			0.105	0.145	0.185			
	Blue y			0.030	0.070	0.110			
	White x			0.260	0.300	0.340			
	White y			0.280	0.320	0.360			
NTSC	-			65	72	-	%	-	-
Flicker	FLK			-	-30	-25	dB	FIG 5.	7
Gamma (L32~L224)	γ			1.8	2.2	2.6	-	FIG 4	8

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

$$\text{Contrast Ratio} = \frac{\text{Average Surface Luminance with all white pixels (P1,P2, ……)}}{\text{Average Surface Luminance with all black pixels (P1,P2, ……)}}$$

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

Lv = Average Surface Luminance with all white pixels (P1,P2, …….)

Note 3. The luminance uniformity is determined by measuring luminance at each test position 1 through 9, and the maximum luminance of 9 points luminance by minimum luminance of 9 points luminance. For more information see FIG 2.

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

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 through 9, 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. For 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.

Note 7. Flicker test standard: First using customer's standard IF no, using the Mutli-Inno's internal standards. For more information see FIG 5. Test equipment is MSE or CA210.

Note 8. Gamma test standard: First using customer's standard IF no, using Multi-Inno Internal Standard: (2.2±0.4), white and gray scale screen (not show RGB). For more information see FIG 4. Test equipment is MSE or CA210.

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".

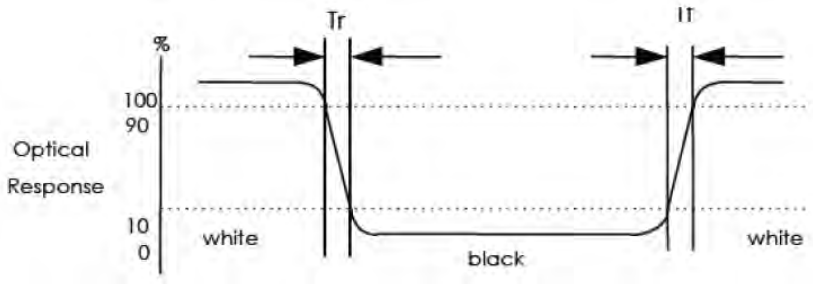


FIG 2. Measuring method for contrast ratio, surface luminance, Luminance uniformity, CIE (x,y) chromaticity.

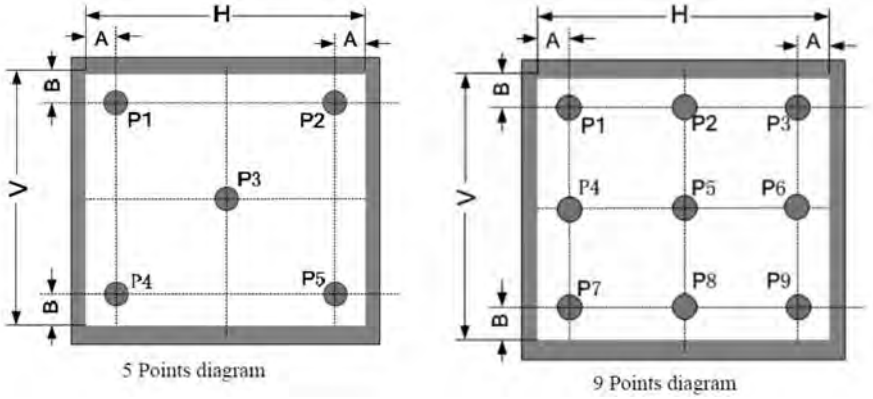


FIG 3. The definition of viewing angle

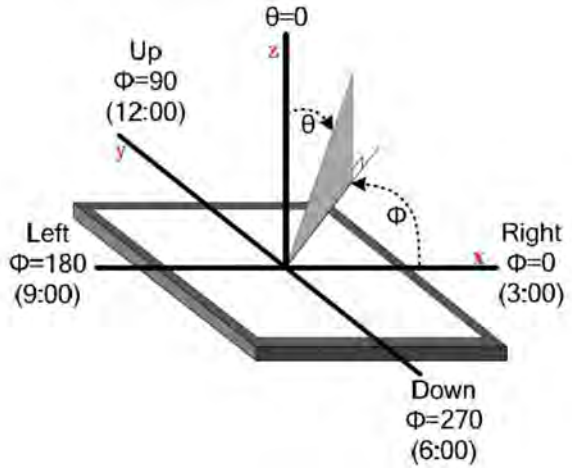


FIG 4. The definition of Gamma curve.

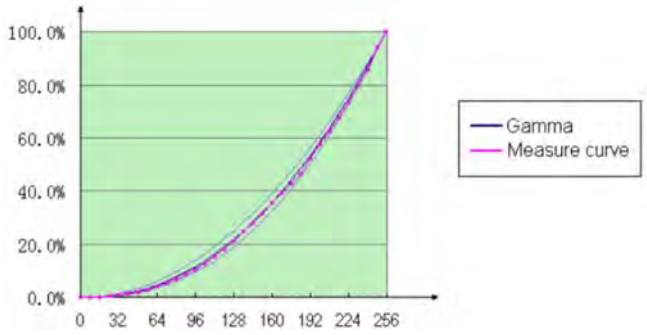


FIG 4. Flicker test.

Test Picture: According to the model driver IC supports to choose picture such as line inversion, dot inversion, frame inversion and sub-pixel inversion.
Measurement method: Testing the flicker value under specific flip model by comparison, JEITA and VESA measurements method. General choice JEITA method test the center point and record the flicker DB value under the Corresponding frequency (HZ). Measurement instrument: MSE, CA210. 

■ INTERFACE DESCRIPTION

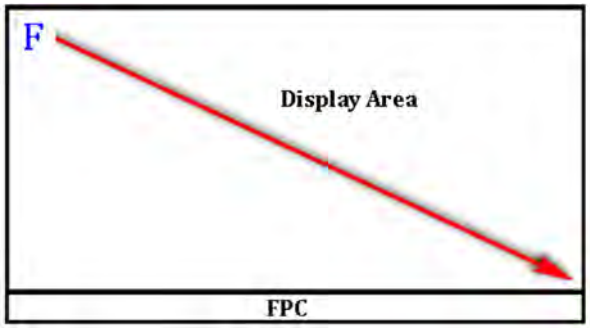
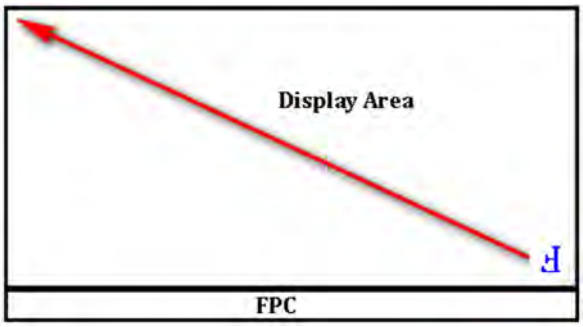
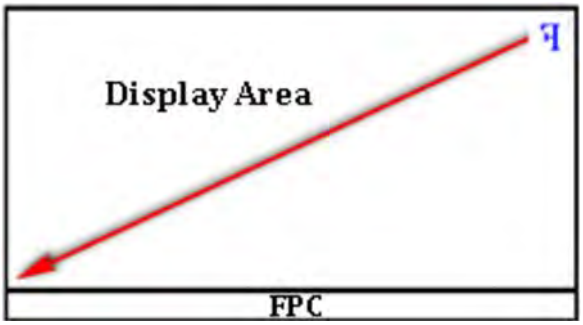
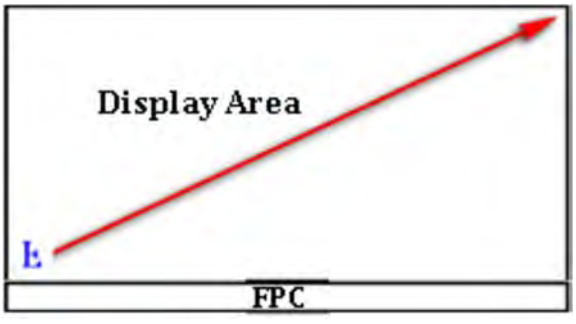
Pin No.	Symbol	I/O/P	Description
1	NTC1	I	Thermistor pin1.
2	LEDK1	P	Backlight cathode.
3	LEDK2	P	Backlight cathode.
4	LEDK3	P	Backlight cathode.
5	NTC2	I	Thermistor pin2.
6	LEDA	P	Backlight anode.
7	LEDA	P	Backlight anode.
8	NC	-	No connection.
9	DVDD	P	Power supply. (3.3V)
10	DE	I	Enabled RGB signal pin.
11	GND	P	Ground.
12	DCLK	I	Clock signal for the RGB.
13	GND	P	Ground.
14	B7	I	Blue data.
15	B6	I	
16	B5	I	
17	B4	I	
18	B3	I	
19	B2	I	
20	B1	I	
21	B0	I	
22	GND	P	Ground.
23	G7	I	Green data.
24	G6	I	
25	G5	I	
26	G4	I	
27	G3	I	
28	G2	I	
29	G1	I	
30	G0	I	
31	GND	P	Ground.
32	R7	I	Red data.
33	R6	I	
34	R5	I	
35	R4	I	
36	R3	I	
37	R2	I	
38	R1	I	
39	R0	I	
40	GND	P	Ground.

41	STBYB	I	Standby mode setting pin. Active low. H: Normal mode. L: Standby mode. Timing controller, output buffer, DAC and power circuit are off.
42	LR	I	Horizontal scan direction control PIN. Default: LR=H (Note 1)
43	UD	I	Vertical scan direction control PIN. Default: UD=H (Note 1)
44	RESET	I	Global reset pin, active low.
45	GND(AG_GND)	P	Ground.
46	SDA	I	3-SPI data input/output. When not use, connect to GND. (Note 2)
47	SCL	I	3-SPI CLK input. When not use, connect to GND. (Note 2)
48	CSB	I	3-SPI chip select pin. When not use, connect to DVDD. (Note 2)
49	NC(VDDOTP)	P	Test PIN. No connection, must be open.
50	ATREN	I	H: OTP mode; L: 3-SPI mode; Default H. When OTP mode or not use, open or set H. When use 3-SPI, must set L.

I: Input; O: Output; P: Power; H: High; L: Low.

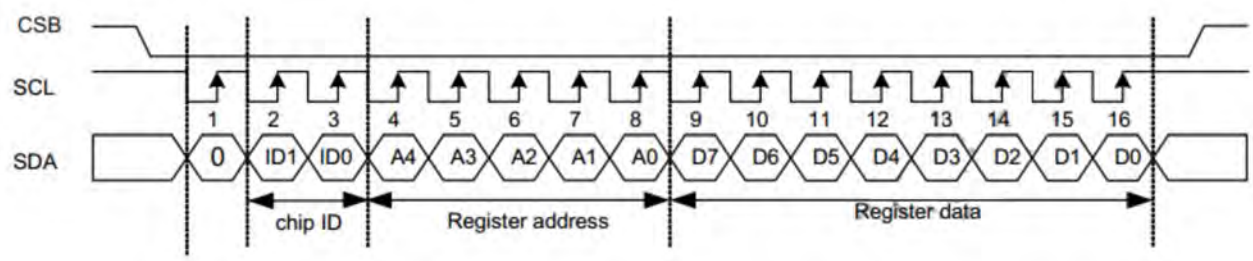
As above, definition of interface apply to OTP mode, if customers used initialization mode, Customer's car instruments need to dispose specially as SDA, SCA, CSB and ATREN.

Note 1: UD/LR Define: (Scan direction)

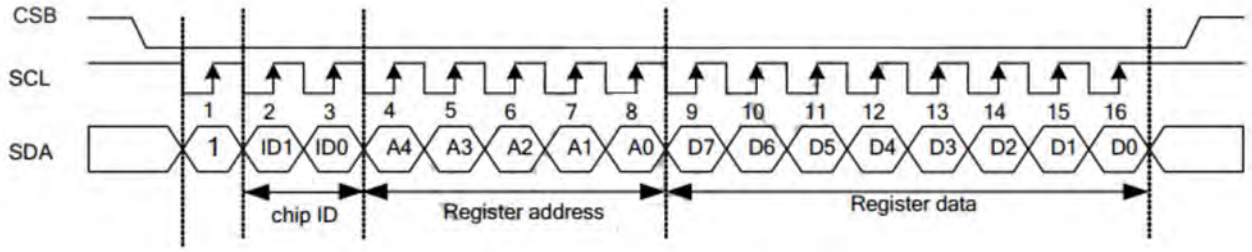
UD/LR=H (default)	UD/LR=L
	
UD=H, LR=L	**UD=L, LR=H**
	

Note 2: 3-SPI

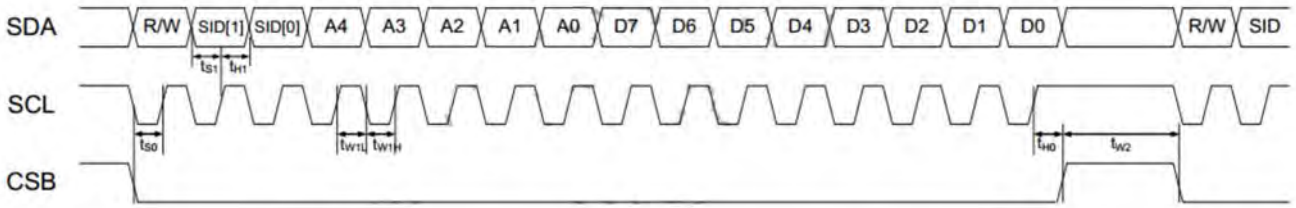
Write:



Read:



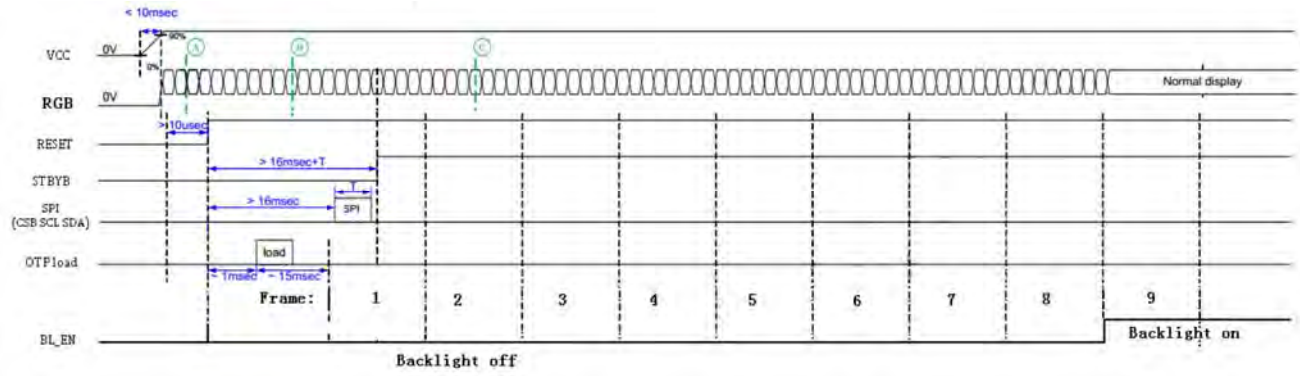
SPI Timing:



Parameter	Symbol	Conditions	Spec.			Unit
			Min.	Typ.	Max.	
SDA setup time	t_{S0}	CSB to SCL	60	-	-	ns
	t_{S1}	SDA to SCL	60	-	-	ns
SDA hold time	t_{H0}	CSB to SCL	60	-	-	ns
	t_{H1}	SDA to SCL	60	-	-	ns
Pulse width	t_{W1L}	SCL pulse width	75	-	-	ns
	t_{W1H}	SCL pulse width	75	-	-	ns
	t_{W2}	CSB pulse width	1	-	-	μs
Clock duty	-	-	40	50	60	%

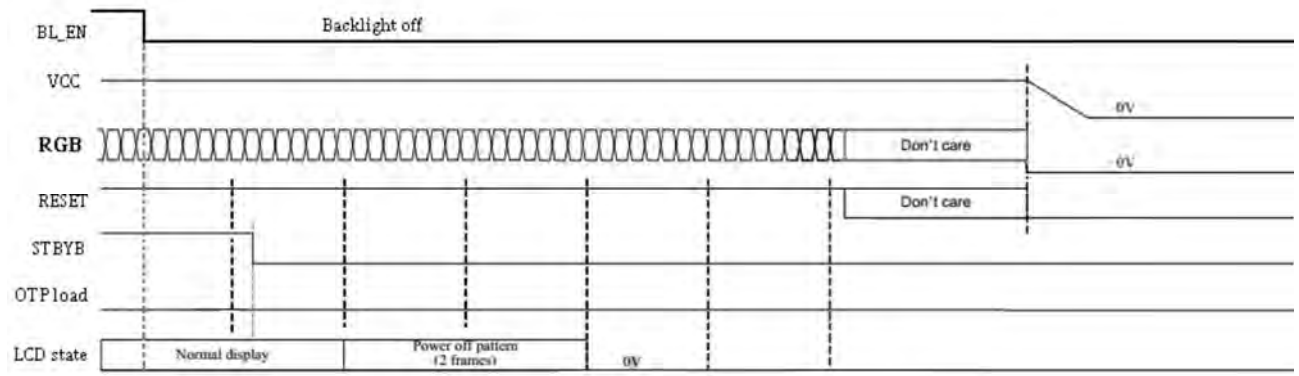
■ APPLICATION NOTES

1. Power ON Sequence



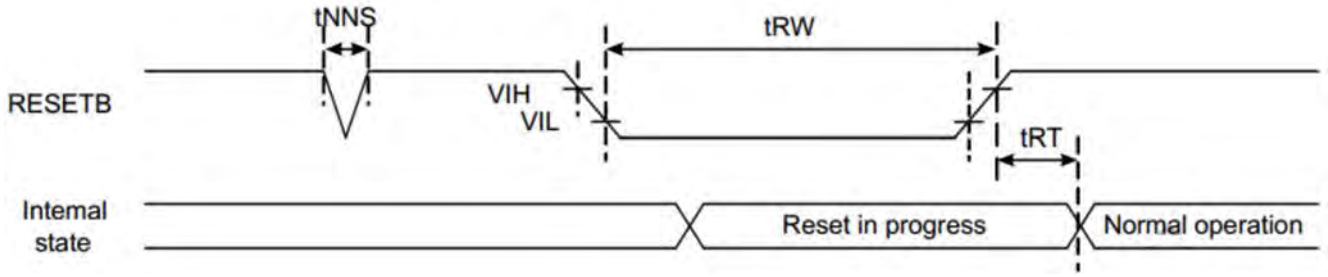
Note1: The application system can apply RGB signals from point A (VCC is ready and not reset completed), B (reset completed and in standby mode), or C (reset completed and non-standby mode).
Note2: At least 16ms after RESET is high, SPI can be set to access registers.
Note3: We suggest set initial code registers before STBYB rising (must observe Note 2) or program in OTP/EEPROM.
Note4: One frame is 16.7ms when frame frequency is 60Hz.
Note5: We recommend turn on the backlight when LCD Display normal. There is ≥8 frames.

2. Power OFF Sequence



Note1: When power off, we recommend turn off backlight first.
Note2: At least 7 frames are needed in power off flow.

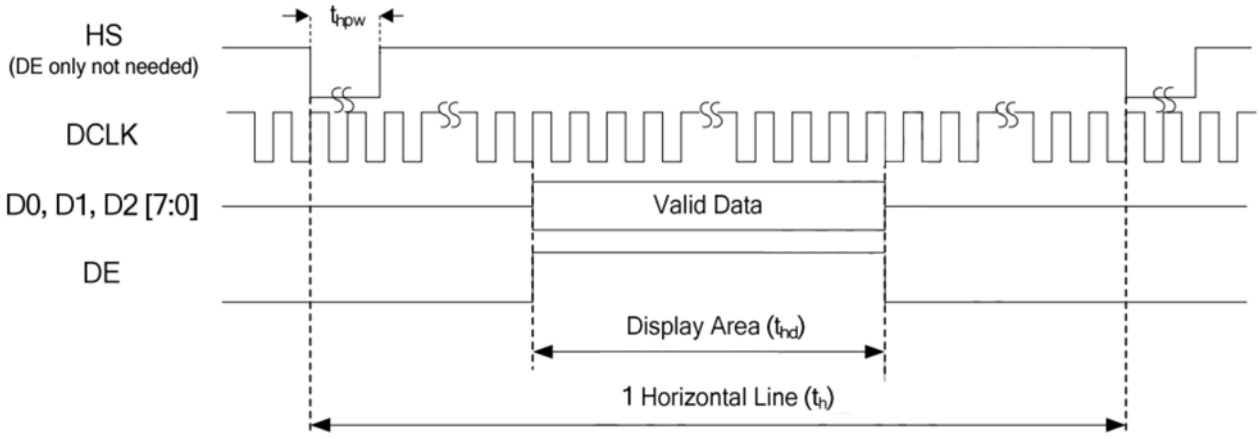
3. Reset Timing



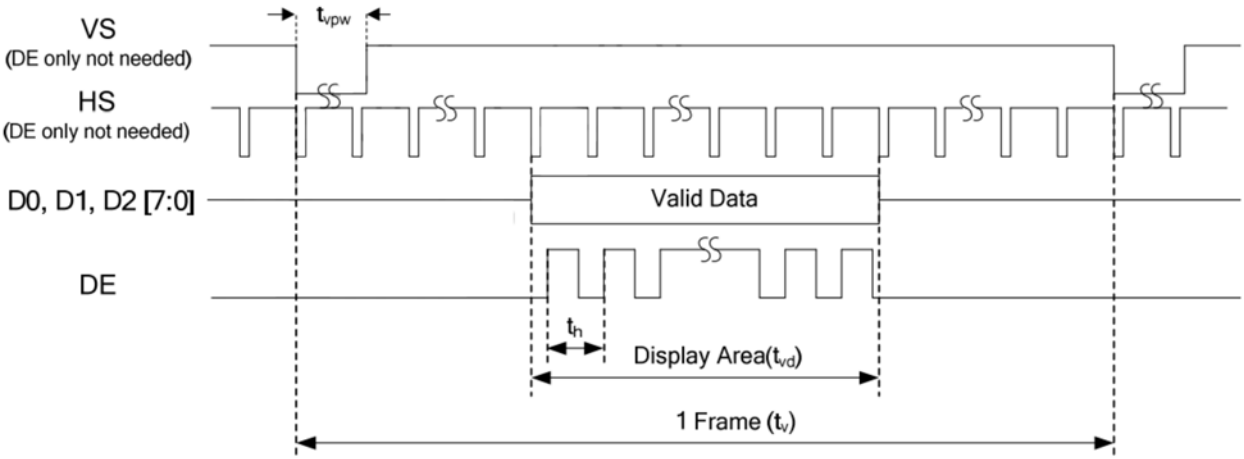
Signal	Parameter	Symbol	Spec.			Unit
			Min.	Typ.	Max.	
RESETB	Reset pulse width	tRW	10	-	-	μs
	Reset complete time	tRT	-	-	5	μs
	Negative spike noise width	tNNS	-	-	100	μs

4. RGB Interface Timing

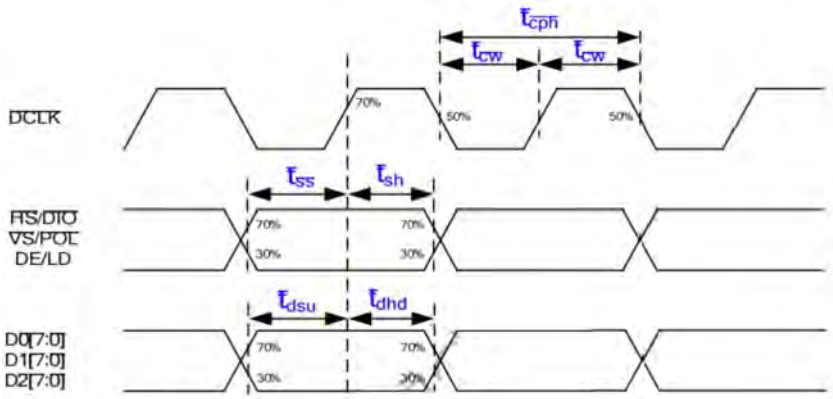
Horizontal



Vertical



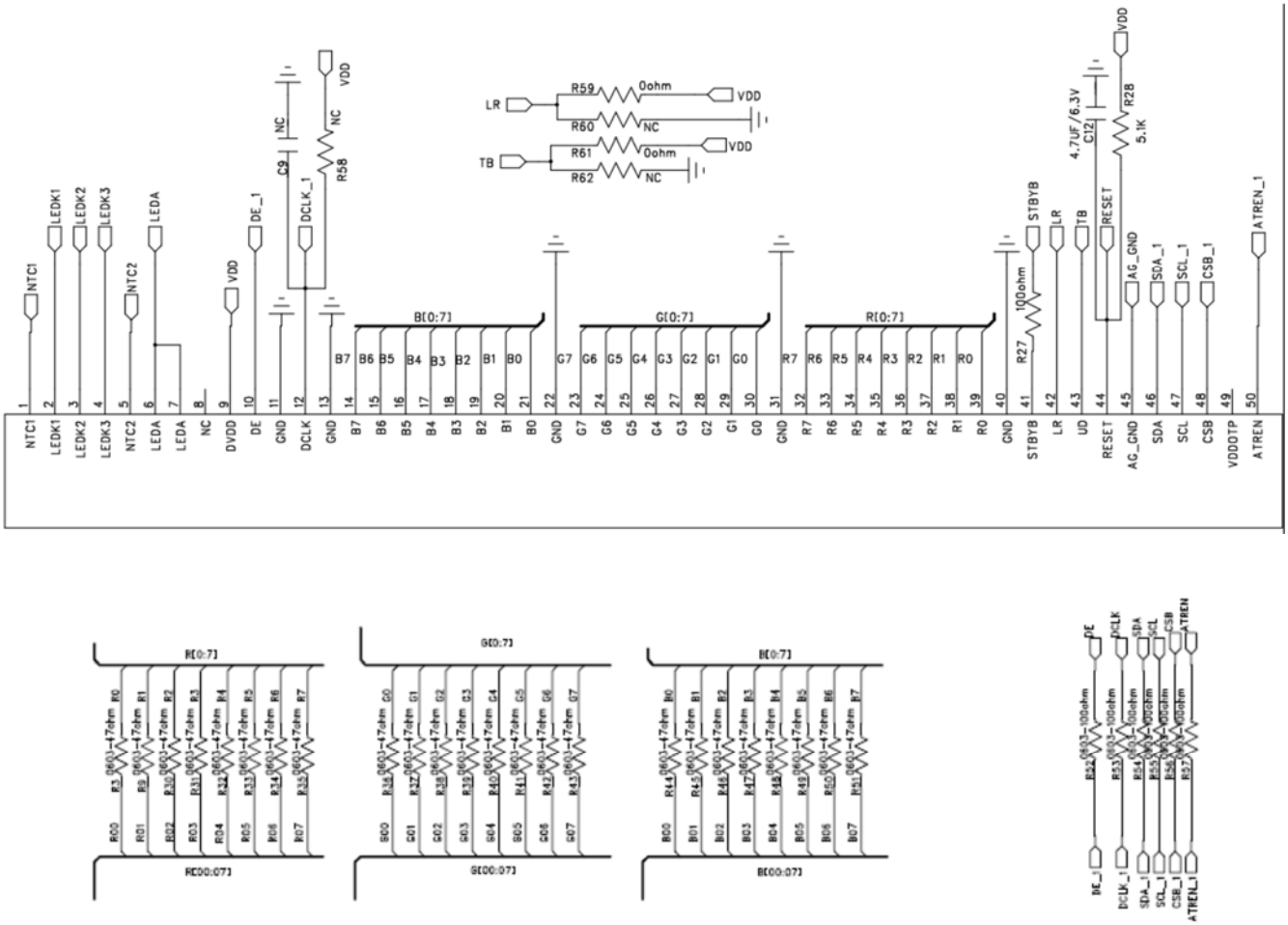
AC electrical characteristics



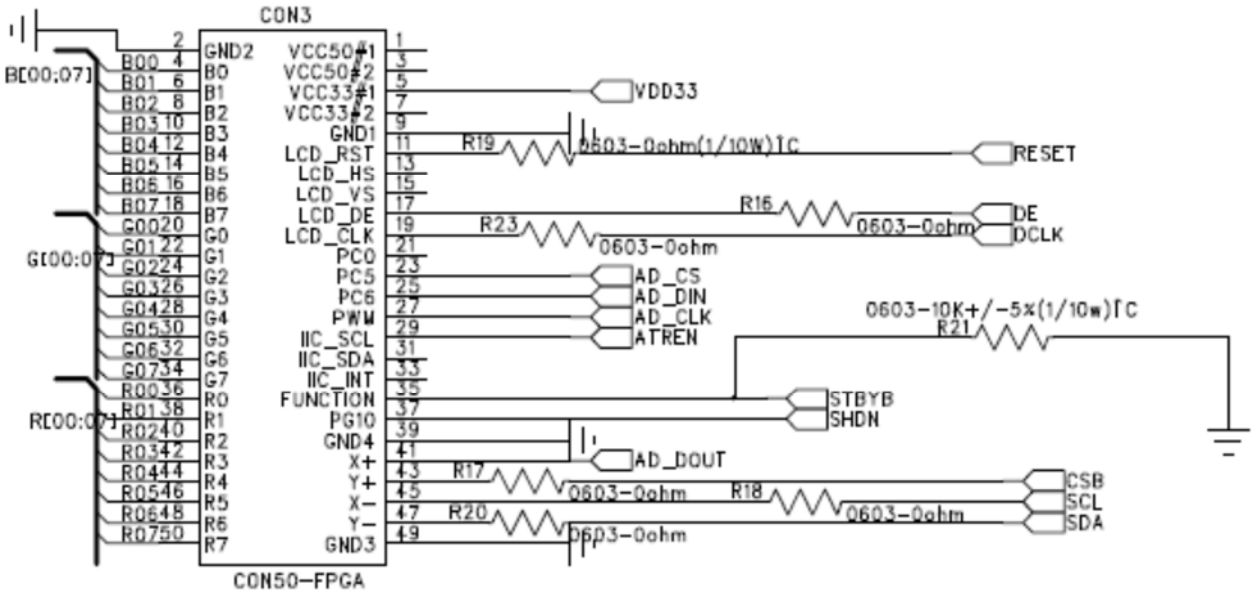
Parameter	Symbol	Spec.			Unit
		Min.	Typ.	Max.	
DCLK period	T_{cph}	16.67	-	-	ns
DCLK duty ratio	T_{CW}	40	50	60	%
Data setup time	T_{dsu}	5	-	-	ns
Data hold time	T_{dhd}	5	-	-	ns
VS/POL setup time	T_{ss}	5	-	-	ns
VS/POL hold time	T_{sh}	5	-	-	ns
HS/DIO setup time	T_{ss}	5	-	-	ns
HS/DIO hold time	T_{sh}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

■ REFERENCE APPLICATION CIRCUIT

1. FPC Interface



2. MCU Interface



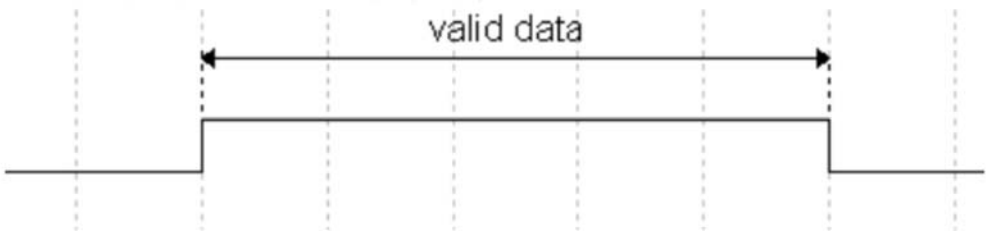
■ SOFTWARE SETTINGS

1. RGB Timing

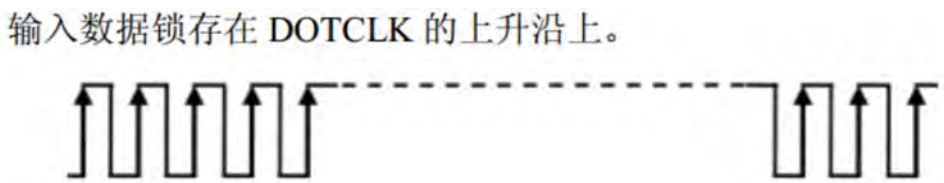
#define LCD_WIDTH	24	// Set LCD color digits, 24-bit or 18-bit		
#define LCD_XSIZE	800	// Set LCD horizontal resolution		
#define LCD_YSIZE	480	// Set LCD vertical resolution		
#define VBPD	4	// min2 5 max255		
#define VFPD	8	// min5 8 max260 8		
#define VSPW	3	// min1 3 max20		
#define HBPD	14	// min5 16 max255		
#define HFPD	26	// min24 26 max260 26		
#define HSPW	12	// min10 12 max255		
DOTCLK=Frame*(LCDWIDE + HBPD + HSPW)*(LCDHIGH + VBPD + VSPW)				
DE Mode	Item	Min.	Typ.	Max.
Frame Rate (Hz)	Frame	58	60	70
Clock Frequency (MHz)	DOTCLK	23.33	24.14	28.16

2. RGB Timing Polarity

DEN:



DOTCLK:



3. Power on code

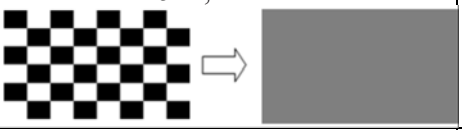
```
void power_on ( )
{
    power_down_vcc (1);    //Power on the system 3.3V
    V Backlight (0);          // Backlight is off by default
   // CSB power-up must be high by default, SCL SDA power-up by default is low. Can only operate
     after resetting and pulling up stable
    STBYB (0);              // Sleep power must be low by default

    RESET (0);              // Reset power on must be low by default, perform reset
    Delayms (20);           // ≥1ms

    RESET (1);             // Reset control is pulled high to end reset
    Delayms (20);          //≥20ms, wait for the reset to stabilize

    LCD_INIT ( );        // IC initialization
    Enable_RGB (1);   //enable LVDON/P~LVD3N/P & LVCLKN/P, LVDS Signal configuration
```

```
                        //including RGB controlling signal HSYNC,VSYNC,DATA
                        //ENABLE,CLK,data

    STBYB(1);          // Sleep control pulled up, display turned on
    Delayms(150);     //Better≥150ms 8frame

    Backlight(1);  //  Turn on the backlight
}
```

4. Power off code

```
void power off ( )
{
    Backlight(0);     // Backlight turns off first
    Delayms(300);   // Please adjust according to the time when the backlight is completely turned off
                       (the current is 0)

    STBYB(0);         // Sleep control pulled low to enable display
    Delayms(100);    //100ms wait for ≥ 5 frames

    Enable_RGB(0);      // Turn off RGB signals
    elayms(50);          //150ms wait for ≥ 3 frames

    RESET(0); // Reset control is pulled low to perform chip reset
    Delayms(5);

    power_down_vcc(0); // Power off the system 3.3V

}
```

■ RELIABILITY TEST

No.	Test Item	Test Condition	Remark
1	High Temperature Storage Test	95°C ± 2°C / 500Hrs. (Non-Operation)	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%; 8. reducing of the minimum brightness from more than 50%. ***Note:** After Damp Proof Test operating, the display function of test samples should be checked after 24hours.
2	Low Temperature Storage Test	-40°C ± 2°C / 500Hrs. (Non-Operation)	
3	High Temperature Operating Test	85°C ± 2°C / 500Hrs. (Operation) BL current: 27mA	
4	Low Temperature Operating Test	-30°C ± 2°C / 500Hrs. (Operation) BL current: 270mA	
5	High Temperature and High Humidity Operation Test	60°C, 90%RH 500Hrs. (Operation)	
6	Thermal Shock Test (Non-operating)	-40°C(30Min.) ~ +85°C(30Min.) 120Cycles	
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	
8	Electro Static Discharge Test	Air discharge: C=150pF±10%, R=330Ω±10%, 5point/panel Air: +/-15KV, 5times Contact discharge: C=150pF±10%, R=330Ω±10%, 5 point/panel Contact: +/-8KV, 5times	GB/T17626 (IEC61000) / ISO10605
9	Ghosting Test	25°C; 2hours 	Immediately switch to 50% gray scale and take out in the normal temperature environment observe: Ghosting disappear in 10 minute or no Ghosting.
10	Vibration Test	10Hz~55Hz~10Hz amplitude 1.5mm. 2hours for each X,Y,Z direction. (Packing Condition)	1. Functional test is normal, no fatal defects, such as not display. 2. No defects such as broken glass, chipping, loose sealing, epoxy frame cracks, etc. 3. No structural loosening and falling off.
11	Impact Test	980m/s2・6ms, ±X；±Y；±Z 3 times for each direction (JIS C0041, A-7 Condition C)	

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

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

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

Note 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.

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

Note 6: Since there's no EMC lab in Multi-Inno, 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, Multi-Inno will work together with customer for improvement. Multi-Inno will have to send to external lab for test if a EMC test report is required by customer, but needing customer pay the charge.

■ INSPECTION CRITERION

OUTGOING QUALITY STANDARD	PAGE 1 OF 4
TITLE: FUNCTIONAL TEST & INSPECTION CRITERIA	

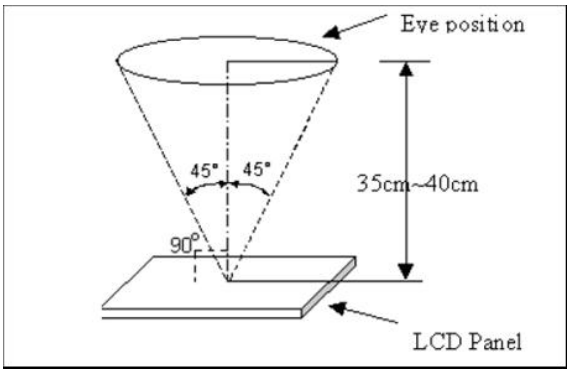
This specification is made to be used as the standard acceptance/rejection criteria for TFT module.

1. Sample Plan

1.1 Lot size: Quantity per shipment lot per model
1.2 Sampling type: Normal inspection, Single sampling
1.3 Inspection level: II
1.4 Sampling table: MIL-STD-105D
1.5 Acceptable quality level (AQL)
Major defect: AQL=0.65
Minor defect: AQL=1.50

2. Inspection Condition

2.1 Ambient conditions
a. Temperature: Room temperature 25±5℃
b. Humidity: (60±10) %RH
c. Illumination: Single fluorescent lamp non-directive (300 to 700 Lux)
2.2 Viewing distance
The distance between the LCD and the inspector's eyes shall be at least 35±5cm.
2.3 Viewing angle
U/D: 45° / 45°, L/R: 45° / 45°



3. Definition of Inspection Item

3.1 Definition of inspection zone in LCD module (LCM)

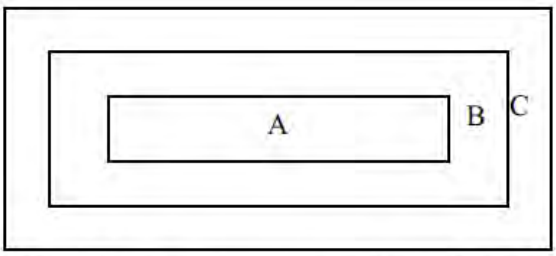


Fig.1 Inspection zones in an LCD

Zone A: Character / Digit area (Active area)
Zone B: Viewing area except Zone A (Zone A + Zone B=minimum viewing area)
Zone C: Outside viewing area (invisible area after assembly in customer's product)

OUTGOING QUALITY STANDARD	PAGE 2 OF 4
TITLE: FUNCTIONAL TEST & INSPECTION CRITERIA	

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. If any visual defect in Zone C is impermissible, customers need to inform us by written.

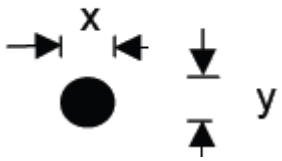
4. Inspection Plan

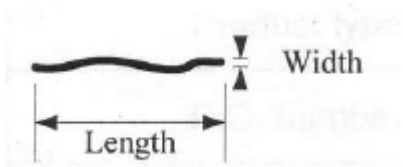
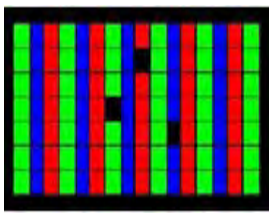
Defects are classified as major defects and minor defects according to the degree of defectiveness defined herein.

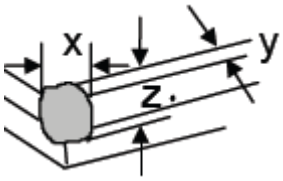
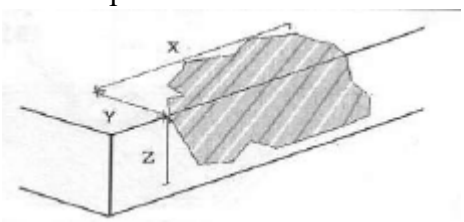
4.1 Major defect

Item No.	Items To Be Inspected	Inspection Standard
4.1.1	All Functional Defects	1) No display 2) Display abnormally 3) Short circuit 4) Line defect 5) Excess power consumption
4.1.2	Missing	Missing function component
4.1.3	Crack	Glass crack

4.2 Minor defect

<table>
<tr><th>Item No.</th><th>Items To Be Inspected</th><th colspan="2">Inspection Standard</th></tr>
<tr><td rowspan="5">4.2.1</td><td rowspan="5">Spot Defect
Including
Black spot
White spot
Pinhole
Foreign particle
Polarizer dirt</td><td colspan="2">For dark / white spot is defined
$\varphi = (x+y) / 2$
  </td></tr>
<tr><td>Size φ(mm)</td><td>Acceptable Quantity</td></tr>
<tr><td>φ ≤ 0.25
2mm(min) apart</td><td>Ignore</td></tr>
<tr><td>0.25 < φ ≤ 0.50
5mm(min) apart</td><td>5</td></tr>
<tr><td>0.50 < φ</td><td>Not allowed</td></tr>
</table>

<table>
<tr><td rowspan="5">4.2.2</td><td rowspan="5">Line Defect
Including
Black line
White line
Scratch</td><td colspan="2">Defined
 
</td></tr>
<tr><td>Width (mm)
Length (mm)</td><td>Acceptable Quantity</td></tr>
<tr><td>W ≤ 0.05 and L ≤ 10</td><td>Ignore</td></tr>
<tr><td>0.05 < W ≤ 0.08 and L ≤ 10
5mm(min) apart</td><td>5</td></tr>
<tr><td>0.08 < W ≤ 0.10 and L ≤ 5
5mm(min) apart</td><td>3</td></tr>
<tr><td rowspan="4">4.2.3</td><td rowspan="4">Polarizer
Dent / Bubble</td><td>0.10 < W or 10<L</td><td>Not allowed</td></tr>
<tr><td>Size φ(mm)</td><td>Acceptable Quantity</td></tr>
<tr><td>φ ≤ 0.30</td><td>Ignore</td></tr>
<tr><td>Non visible area</td><td>Ignore</td></tr>
<tr><td rowspan="6">4.2.4</td><td rowspan="6">Electrical Dot Defect</td><td>0.30 < φ ≤ 0.50
5mm(min) apart</td><td>5</td></tr>
<tr><td>0.50 < φ</td><td>Not allowed</td></tr>
<tr><td colspan="2">Bright and black dot define:
  and  </td></tr>
<tr><td colspan="2">Inspection pattern: Full white, Full black, Red, Green and Blue screens</td></tr>
<tr><td>Item</td><td>Acceptable Quantity</td></tr>
<tr><td>Black dot defect</td><td>5</td></tr>
<tr><td>Bright dot defect</td><td>2</td></tr>
<tr><td>Total Dot</td><td>5</td></tr>
</table>

<table>
<tr><td rowspan="5">4.2.5</td><td rowspan="5">Touch Panel Chips</td><td colspan="2">1. Corner chips:
  </td></tr>
<tr><td>Size (mm)</td><td>Acceptable Quantity</td></tr>
<tr><td>X ≤ 3mm
Y ≤ 3mm
Z ≤ T</td><td>Ignore
T: Glass thickness
X: Length
Y: Width
Z: Thickness</td></tr>
<tr><td colspan="2">2. Side chips:
  </td></tr>
<tr><td>Size (mm)</td><td>Acceptable Quantity</td></tr>
<tr><td>4.2.6</td><td>Touch Panel Newton Ring</td><td colspan="2">Compare with limit sample</td></tr>
<tr><td></td><td></td><td>X ≤ 5mm
Y ≤ 3mm
Z ≤ T</td><td>Ignore
T: Glass thickness
X: Length
Y: Width
Z: Thickness</td></tr>
</table>

Note: 1. Dot defect is defined as the defective area of the dot area is larger than 50% of the dot area.
2. The distance between black dot defects or black and bright dot defects should be more than 5mm apart. The distance between two bright dot defects should be more than 15mm apart.
3. Polarizer bubble is defined as the bubble appears on active display area. The defect of polarizer bubble shall be ignored if the polarizer bubble appears on the outside of active display area.
4. Mura is checker by 6% ND filter.
5. Foreign particle on the surface of the LCM should be ignore.

■ PRECAUTIONS FOR USING LCD MODULES

◆ Handing Precautions

1. The display panel is made of glass and polarizer. As glass is fragile. It tends to become or chipped during handling especially on the edges. Please avoid dropping or jarring. Dot not subject it to a mechanical shock by dropping it or impact.
2. If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.
3. Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary. Do not touch the display with bare hands. This will stain the display area and degraded insulation between terminals (some cosmetics are determined to the polarizer).
4. The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully. Do not touch, push or rub the exposed polarizers with anything harder than an HB pencil lead (glass, tweezers, etc.). Do not put or attach anything on the display area to avoid leaving marks on. Condensation on the surface and contact with terminals due to cold will damage, stain or dirty the polarizer. After products are tested at low temperature they must be warmed up in a container before coming is contacting with room temperature air.
5. If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten cloth with one of the following solvents.
   - Isopropyl alcohol
   - Ethyl alcohol

   Do not scrub hard to avoid damaging the display surface.
6. Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following.
   - Water
   - Ketone
   - Aromatic solvents
7. Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading. Avoid contacting oil and fats.
8. 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.
9. 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.
10. Do not attempt to disassemble or process the LCD module.
11. If the logic circuit power is off, do not apply the input signals.
12. Electro-Static Discharge Control. Since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC. To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
13. Electro-Static Discharge Control. Since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC. To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

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

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

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

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

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

- Do not alter, modify or change the shape of the tab on the metal frame.

- Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.

- Do not damage or modify the pattern writing on the printed circuit board.

- Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector.

- Except for soldering the interface, do not make any alterations or modifications with a soldering iron.

- Do not drop, bend or twist LCM.

◆ **Handing Precaution for LCM**

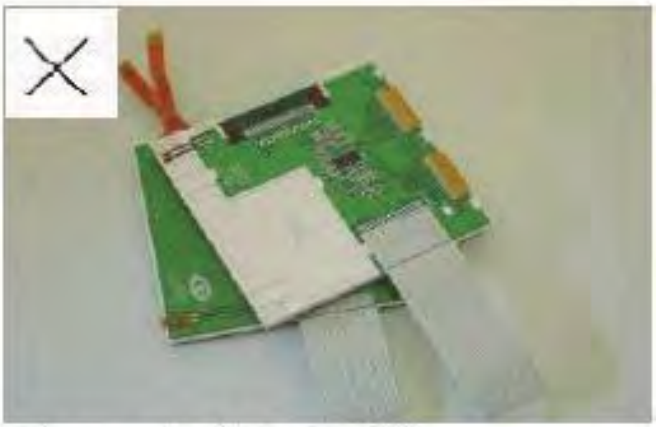
LCM is easy to be damaged.
Please note below and be careful for handling!

Correct handling:

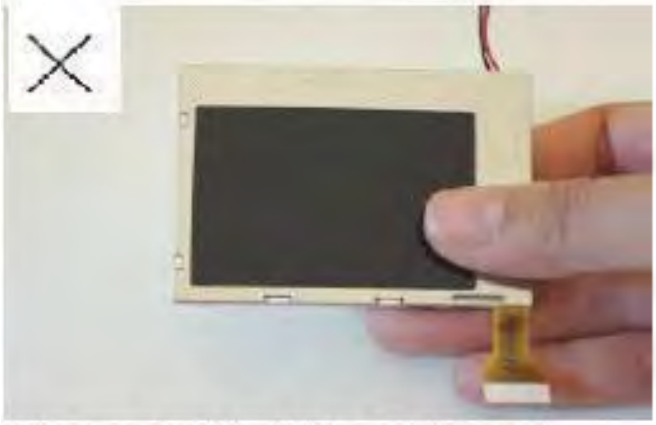
As above picture, please handle with anti-static gloves around LCM edges.

Incorrect handling:

Please don't touch IC directly.



Please don't stack LCM.



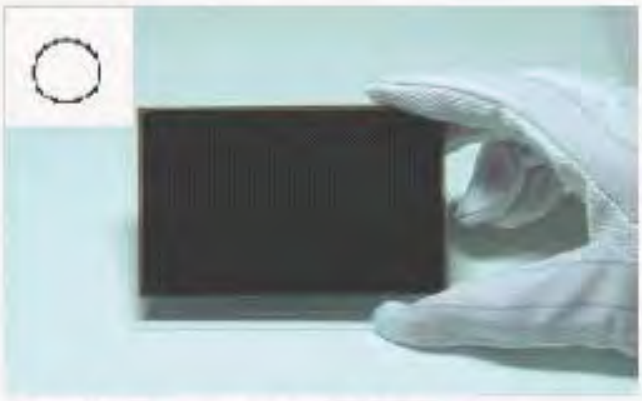
Please don't hold the surface of panel.

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

◆ **Handing Precaution for LCD**

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

Correct handling:

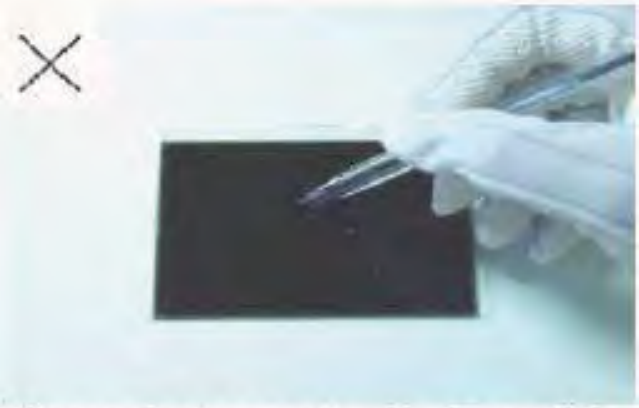


As above photo, please handle with anti-static gloves around LCD edges.

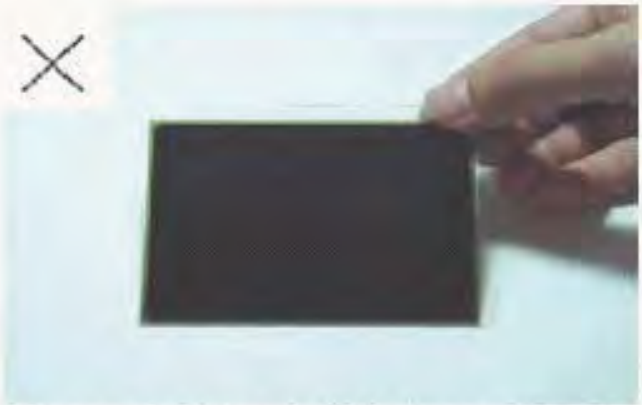
Incorrect handling:

Please don't stack the LCDS.

Please don't hold the surface of LCD.



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



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

◆ **Storage Precautions**

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

1. Store them in a sealed polyethylene bag. If properly sealed, there is no need for the dessicant.
2. Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0°C and 35°C, and keep the relative humidity between 40%RH and 60%RH.
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.

◆ **Others**

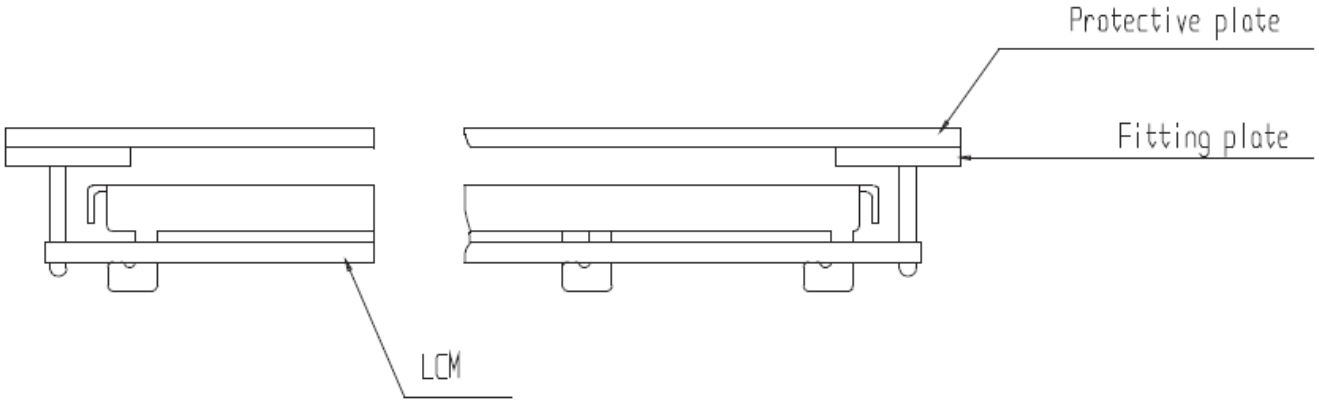
1. Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.
2. If the LCD modules have been operating for a 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. To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity etc., exercise care to avoid holding the following sections when handling the modules.
   - Exposed area of the printed circuit board.
   - Terminal electrode sections.

◆ **Using LCD Modules**

1. Installing LCD Modules

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

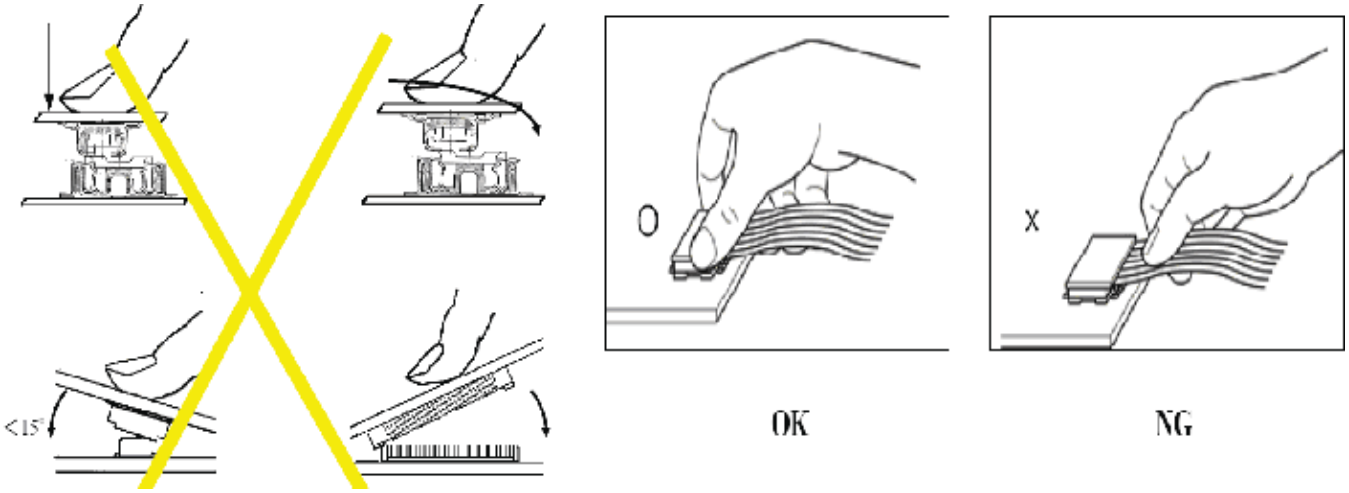
1.1.1 Cover the surface with a transparent protective plate to protect the polarizer and LC cell.



1.1.2 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.

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.



◆ **Precaution For Soldering To The LCM**

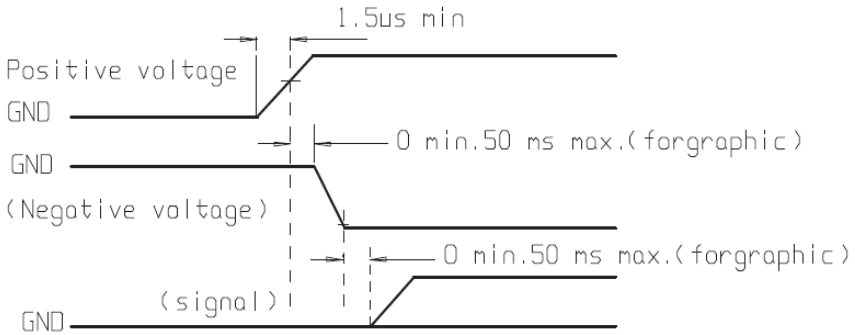
	Hand Soldering	Machine Drag Soldering	Machine Press Soldering
No ROHS Product	290°C ~ 350°C. Time: 3~5S.	330°C ± 350°C. Speed: 4~8mm/s.	300°C ± 330°C. Time: 3~6S. Press: 0.8~1.2Mpa
ROHS Product	340°C ~ 370°C. Time: 3~5S.	350°C ± 370°C. Speed: 4~8mm/s.	330°C ± 360°C. Time: 3~6S. Press: 0.8~1.2Mpa

1. If soldering flux is used, be sure to remove any remaining flux after finishing to soldering operation. (This does not apply in the case of a non-halogen type of flux.) It is recommended that you protect the LCD surface with a cover during soldering to prevent any damage due to flux spatters.
2. When soldering the electroluminescent panel and PC board, the panel and board should not be detached more than three times. This maximum number is determined by the temperature and time conditions mentioned above, though there may be some variance depending on the temperature of the soldering iron.
3. When remove the electroluminescent panel from the PC board, be sure the solder has completely melted, the soldered pad on the PC board could be damaged.

◆ **Precaution For Operation**

1. Viewing angle varies with the change of liquid crystal driving voltage (VLCD). Adjust VLCD to show the best contrast.
2. It is an indispensable condition to drive LCD's within the specified voltage limit since the higher voltage 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.
3. Response time will be extremely delayed at lower temperature than the operating temperature range and on the mean malfunction or out of order with LCD's. Which will come back in the specified operating temperature.
4. If the display area is pushed hard during operation, the display will become abnormal. However, it will return to normal if it is turned off and then back on.
5. A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit. Usage under the maximum operating temperature, 50%RH or less is required.
6. Input each signal after the positive/negative voltage becomes stable.

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



◆ **Safety**

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

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

◆ **Limited Warranty**

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

◆ **Return LCM Under Warranty**

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

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

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

■ PRIOR CONSULT MATTER

1. For Multi-Inno standard products, we keep the right to change material, process ... for improving the product property without notice on our customer.

2. For OEM products, if any change 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.