深圳市拓普微科技开发有限公司
SHENZHEN TOPWAY TECHNOLOGY CO., LTD.

LMT090DICFWD-ABA

LCD Module User Manual

Prepared by:	Checked by:	Approved by:
LINLI Date: 2019-06-01	Date:	Date:

Rev.	Descriptions	Release Date
0.1	Preliminary	2019-06-01

Table of Content

1. General Specification

Signal Interface :	LVDS (18bit VESA)
Display Mode :	Transmissive with Normally White
Screen Size :	9.0 inch
Outline Dimension :	226.9x 126.9 x 23.5(mm)(with mounting Bezel) (see outline drawing for details)
Active Area :	198.0x 111.69(mm)
Color Depth:	262K
Number of dots :	800x 3 (RGB) x 480
Dot Pitch :	0.2475x 0.2327(mm)
Pixel Configuration :	R.G.B. Vertical Stripe
Backlight :	White LED
Surface Treatment:	Anti-Glare Treatment
Viewing Direction :	6 o'clock (Gray scale Inversion) (*1) 12 o'clock (*2)
Operating Temperature :	-20 ~ +70°C
Storage Temperature :	-30 ~ +80°C

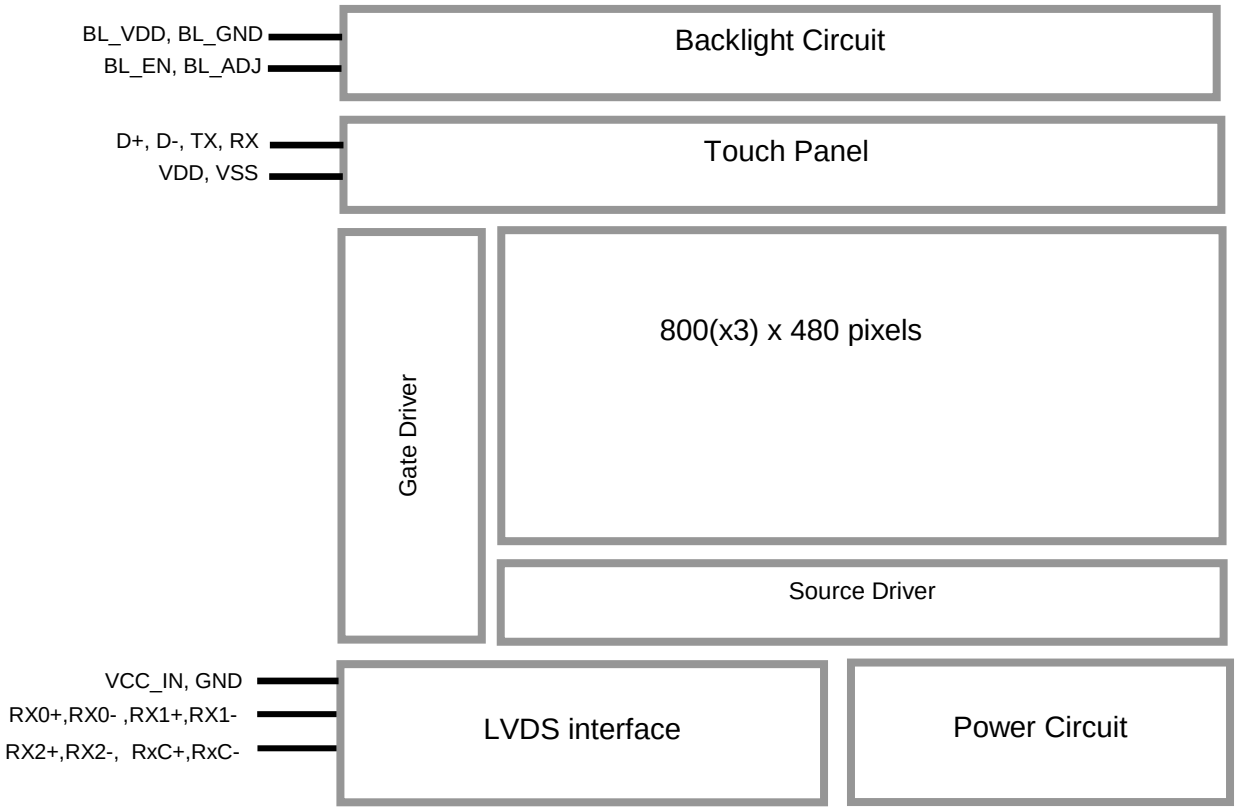
Note:

*1. For saturated color display content (eg. pure-red, pure-green, pure-blue or pure-colors -combinations).

*2. For "color scales" display content.

*3. Color tone may slightly change by temperature and driving condition.

2. Block Diagram



3. Terminal Function

3.1 K1 LVDS Terminal

Pin No.	Pin Name	IO	Descriptions
1	NC	-	No connection
2	NC	-	No connection
3	NC	-	No connection
4	NC	-	No connection
5	NC	-	No connection
6	RXC+	Input	LVDS receiver positive signal clock
7	NC	-	No connection
8	RXC-	Input	LVDS receiver negative signal clock
9	NC	-	No connection
10	RX2+	Input	LVDS receiver positive signal channel 2
11	NC	-	No connection
12	RX2-	Input	LVDS receiver negative signal channel 2
13	GND	Power	Ground
14	RX1+	Input	LVDS receiver positive signal channel 1
15	GND	Power	Ground
16	RX1-	Input	LVDS receiver negative signal channel 1
17	VCC_IN	Power	Positive Power Supply(3.3V)
18	RX0+	Input	LVDS receiver positive signal channel 0
19	VCC_IN	Power	Positive Power Supply(3.3V)
20	RX0-	Input	LVDS receiver negative signal channel 0

3.2 K2 Backlight Terminal

Pin No.	Pin Name	IO	Descriptions
1	BL_VDD	Power	Positive Power Supply(12.0V)
2	BL_EN	Input	Backlight Driver Control BLON=Hi , Backlight Booster enable BLON=Lo , Backlight Booster disable
3	BL_ADJ	Input	Backlight dimming control PWM may be used to adjust the output brightness BL_ADJ=Hi,100% Drive BL_ADJ=Lo,0% Drive
4	NC	-	No connection
5	NC	-	No connection
6	BL_GND	Power	Power Supply GND (0V)

3.3 K3 Touch Panel Controller Terminal

Pin No.	Pin Name	IO	Descriptions
1	VSS	Power	Power Supply GND (0V)
2	VDD	Power	Positive Power Supply(5.0V)
3	VSS	Power	Power Supply GND (0V)
4	D+	I/O	USB D+ signal
5	D-	I/O	USB D- signal
6	VSS	Power	Power Supply GND (0V)
7	VDD	Power	Positive Power Supply(5.0V)
8	VSS	Power	Power Supply GND (0V)
9	TX	Output	RS-232 TX signal
10	RX	Input	RS-232 RX signal

4. Absolute Maximum Ratings

Items	Symbol	Min.	Max.	Unit	Condition
Power Supply voltage	VCC_IN	-0.3	+3.6	V	
Backlight Supply voltage	BL_VDD	-0.3	+13	V	
USB Supply voltage	VDD	-0.3	+5.5	V	
Operating Temperature	T_{OP}	-20	70	°C	No Condensation
Storage Temperature	T_{ST}	-30	80	°C	No Condensation

Note:
*1. This rating applies to all parts of the module. And should not be exceeded.
*2. The operating temperature only guarantees operation of the circuit. The contrast, response speed, and the other specification related to electro-optical display quality is determined at the room temperature, T_{OP}=25℃
*3. Ambient temperature when the backlight is lit (reference value)
*4. Any Stresses exceeding the Absolute Maximum Ratings may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

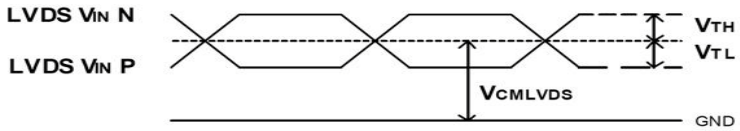
5. Electrical Characteristics

5.1 DC Characteristics(LVDS)

T_a=25°C

Items	Symbol	MIN.	TYP.	MAX.	Unit	Note
Supply Voltage	VCC_IN	3.0	3.3	3.6		
Differential Input High Threshold	VTH	-	-	100	mV	
Differential Input Low Threshold	VTL	-100	-	-	mV	
Differential Input common Mode voltage	VCMLVDS	-	1.2	-	V	
Operating Current	I_{VCC_IN}	-	150	-	mA	Note1

Note1:To test the current disspation,using the “ color bar ” testing pattern



LVDS DC timing diagram

5.2 DC Characteristics(Backlight)

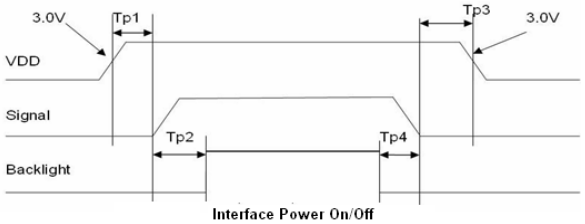
GND=0V,T_a=25°C

Items	Symbol	MIN.	TYP.	MAX.	Unit	Note
Supply Voltage	VDD	11.5	12.0	12.5	V	
Input High Voltage	V_{IH}	3.0		VCC_IN		BL_EN,BL_ADJ
Input Low Voltage	V_{IL}	GND		0.3		BL_EN,BL_ADJ
VDD Power Consumption	I_{dd}	-	200	-	mA	*1

Note1:
*1. Backlight brightness is 100%

5.3 POWER ON/OFF SEQUENCE

Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Note
VDD 5.0V to signal starting	Tp1	0	-	50	ms	
Signal staring to backlight on	Tp2	150	-	-	ms	
Signal off to VDD 3.0V	Tp3	0	-	50	ms	
Backlight off to signal off	Tp4	150	-	-	ms	



Interface Power On/Off

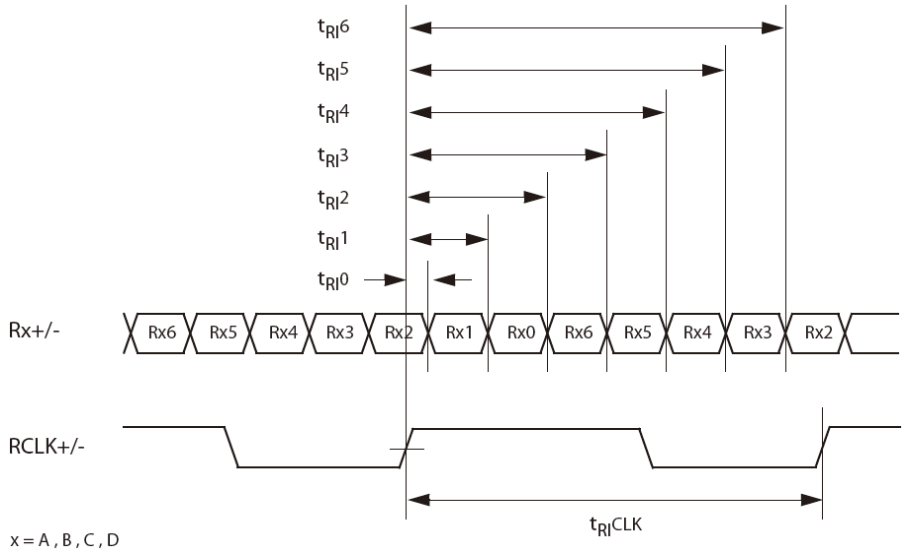
6. AC Characteristics

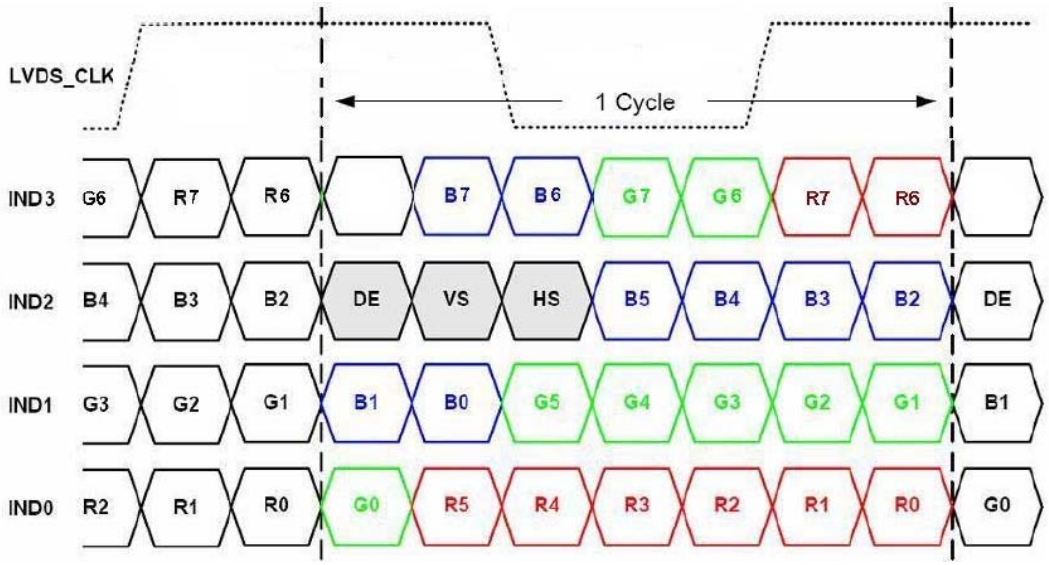
6.1 AC Characteristics(LVDS)

VCC_IN=3.3V,GND=0V,T_a=25°C

Item	Symbol	MIN.	TYP.	MAX.	Unit	Condition
Input CLK period	tRICLK	8.9	-	50	ns	
Input Data Position 0 (tRICLK = 8.9ns)	tRI0	-0.3	-	+0.3	ns	
Input Data Position 1 (tRICLK = 8.9ns)	tRI1	tRICLK/7-0.3	tRICLK/7	tRICLK/7+0.3	ns	
Input Data Position 2 (tRICLK = 8.9ns)	tRI2	2tRICLK/7-0.3	2tRICLK/7	2tRICLK/7+0.3	ns	
Input Data Position 3 (tRICLK = 8.9ns)	tRI3	3tRICLK/7-0.3	3tRICLK/7	3tRICLK/7+0.3	ns	
Input Data Position 4 (tRICLK = 8.9ns)	tRI4	4tRICLK/7-0.3	4tRICLK/7	4tRICLK/7+0.3	ns	
Input Data Position 5 (tRICLK = 8.9ns)	tRI5	5tRICLK/7-0.3	5tRICLK/7	5tRICLK/7+0.3	ns	
Input Data Position 6 (tRICLK = 8.9ns)	tRI6	6tRICLK/7-0.3	6tRICLK/7	6tRICLK/7+0.3	ns	

Input Clock and Data timing Diagram:



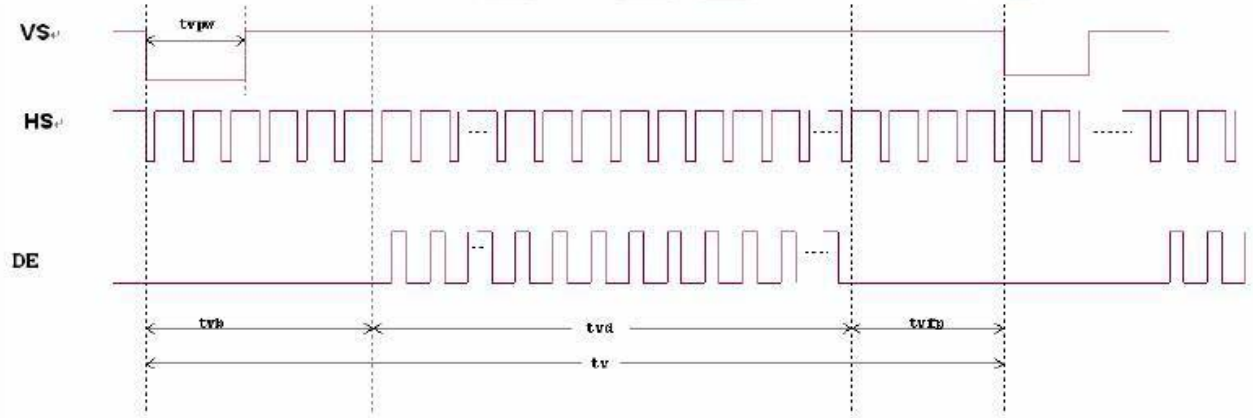


6.2 AC Characteristics(TFT)

Item	Symbol	MIN.	TYP.	MAX.	Unit	Remark
Horizontal Display Area	thd	-	800	-	DCLK	
DCLK Frequency	fclk	26.4	33.3	46.8	MHz	
One Horizontal Line	th	862	1056	1200	DCLK	
HS pulse width	thpw	1	-	40	DCLK	
HS Blanking	thb	46	46	46	DCLK	
HS Front Porch	thfp	16	210	354	DCLK	

Item	Symbol	Values			Unit	Remark
		MIN.	TYP.	MAX.		
Vertical Display Area	tvd	-	480	-	TH	
VS period time	tv	510	525	650	TH	
VS pulse width	tvpw	1	-	20	TH	
VS Blanking	tvb	23	23	23	TH	
VS Front Porch	tvfp	7	22	147	TH	

1 Horizontal input timing diagram.



Vertical input timing diagram.

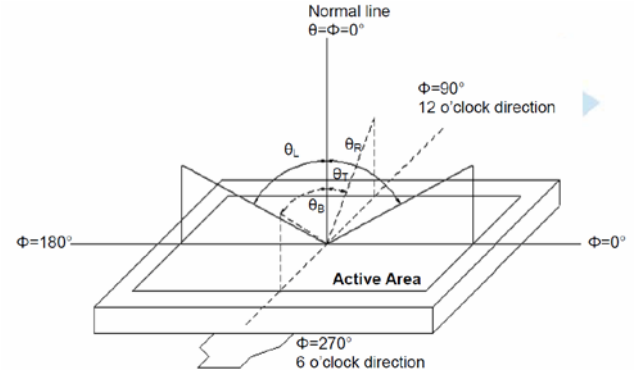
7. Optical Characteristics

Item		Symbol	Condition	MIN.	TYP.	MAX.	UNIT	Note.
Viewing angle		θ_L	(CR≥10)	60	70	-	degree	Note 2
		θ_R		60	70	-		
		θ_T		40	50	-		
		θ_B		60	70	-		
Contrast ratio		CR	$\theta = \Phi = 0^\circ$	500	600	-	-	Note 1,3
Response Time		T_{on}		-	10	20	msec	Note 1,4
		T_{off}			15	30	msec	
Chromaticlty	White	X	Backlight is on	0.260	0.310	0.360		Note 1,5
		Y		0.280	0.330	0.380		
	Red	X		0.540	0.590	0.640		
		Y		0.300	0.350	0.400		
	Green	X		0.298	0.348	0.398		
		Y		0.520	0.570	0.620		
	Blue	X		0.095	0.145	0.195		
		Y		0.060	0.110	0.160		
Luminance		L			200		cd/m^2	
NTSC				-	50	-	%	Note 5
Luminance uniformity		U		70	75	-	%	Note 1,7

Test Conditions:
1. IF= 220 mA, VF=9.3V, and the ambient temperature is 25. ℃
2. The test systems refer to Note 1 and Note 2.
3.Tested without touch panel .

Note 1:
The data are measured after LEDs are turned on for 5 minutes. LCM displays full white. The brightness is the average value of 9 measured spots. Measurement equipment SR-3A (1°)
Measuring condition:
- Measuring surroundings: Dark room
- Measuring temperature: Ta=25℃.
- Adjust operating voltage to get optimum contrast at the center of the display.

Note 2:
The definition of viewing angle:
Refer to the graph below marked by θ and Φ



Note 3:
The definition of contrast ratio (Test LCM using SR-3A (1°)):

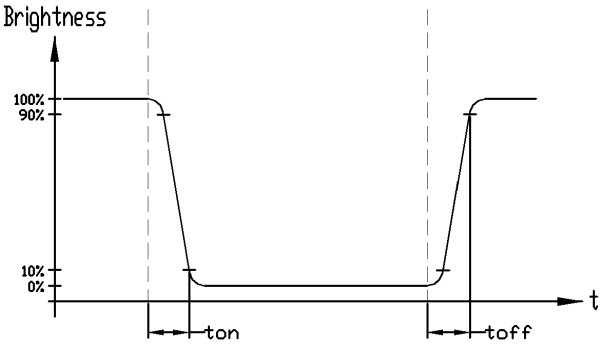
$$\text{Contrast Ratio(CR)} = \frac{\text{Luminance When LCD is at "White" state}}{\text{Luminance When LCD is at "Black" state}}$$

(Contrast Ratio is measured in optimum common electrode voltage)

Note 4:
Definition of Response time. (Test LCD using BM-7A(2°)):
The output signals of photo detector are measured

ctively.

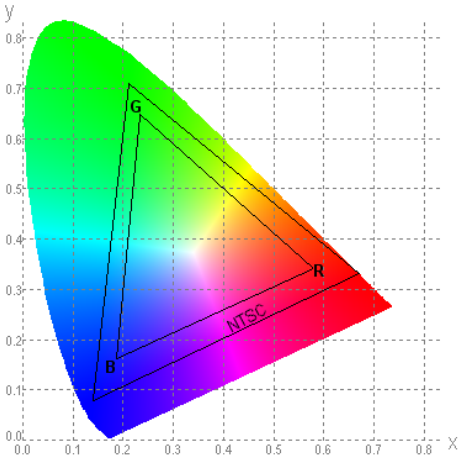
the time interval between the 10% and 90% of amplitudes.Refer to figure as below.



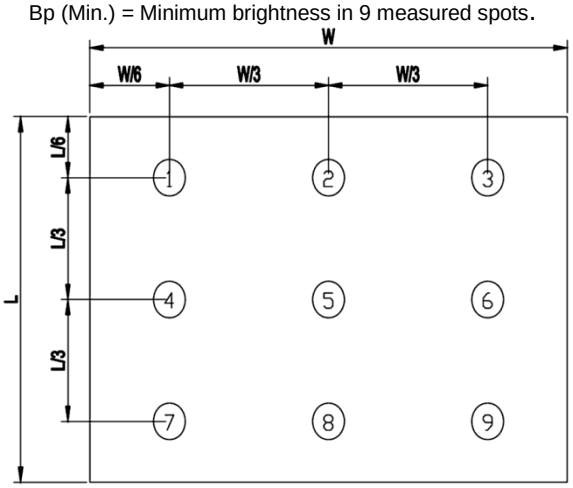
Note 5:
Definition of Color of CIE1931 Coordinate and NTSC Ratio.

Color gamut:

$$S = \frac{\text{Area of RGB triangle}}{\text{Area of NTSC triangle}} \times 100\%$$



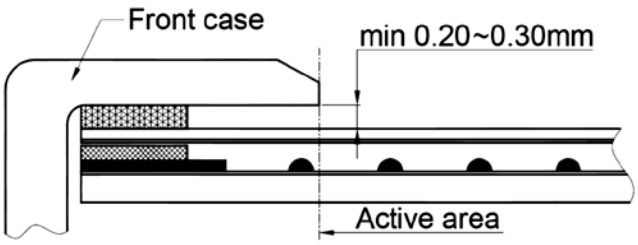
Note 6:
The luminance uniformity is calculated by using following formula.
△Bp = Bp (Min.) / Bp (Max.)×100 (%)
Bp (Max.) = Maximum brightness in 9 measured spots
Bp (Min.) = Minimum brightness in 9 measured spots.



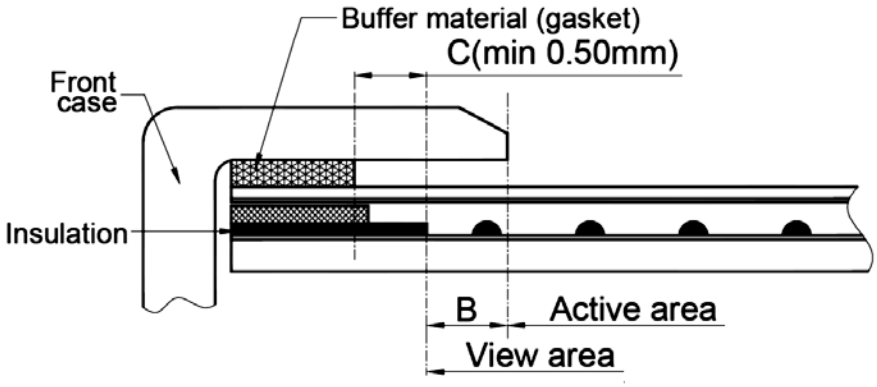
Note 7:
Measured the luminance of white state at center point

8. Resistive Touch Panel Design Precautions

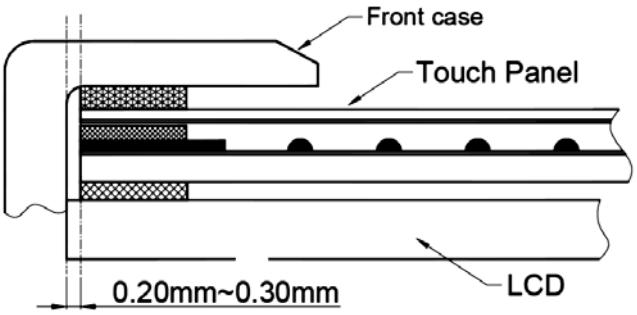
1. It should prevent front case touching the touch panel Active Area (A.A.) to prevent abnormal touch.
   It should left gab (e.g. 0.2~0.3mm) in between.



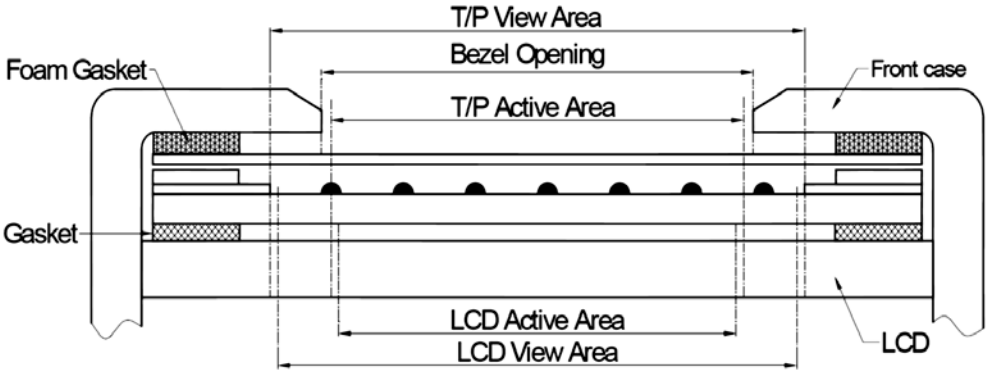
2. Outer case design should take care about the area outside the A.A.
   Those areas contain circuit wires which is having different thickness. Touching those areas could de-form the ITO film. As a result case the ITO cold be damaged and shorten its lifetime.
   It is suggested to protect those areas with gasket (between the front case and the touch panel).
   The suggested figures are B≥0.50mm; C≥0.50mm。



3. The front case side wall should keep space (e.g. 0.2 ~ 0.3mm) from the touch panel.



4. In general design,
   touch panel V.A. should be bigger than the LCD V.A.
   and touch panel A.A. should be bigger than the LCD A.A.



9. Precautions of using LCD Modules

Mounting

- Mounting must use holes arranged in four corners or four sides.
- The mounting structure so provide even force on to LCD module. Uneven force (ex. Twisted stress) should not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- It is suggested to attach a transparent protective plate to the surface in order to protect the polarizer. It should have sufficient strength in order to the resist external force.
- The housing should adopt radiation structure to satisfy the temperature specification.
- Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. Never rub with dust clothes with chemical treatment. Do not touch the surface of polarizer for bare hand or greasy cloth.(Some cosmetics deteriorate the polarizer.)
- When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzine. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer

Operating

- The spike noise causes the mis-operation of circuits. It should be within the ±200mV level (Over and under shoot voltage)
- Response time depends on the temperature.(In lower temperature, it becomes longer.)
- Brightness depends on the temperature. (In lower temperature, it becomes lower.) And in lower temperature, response time(required time that brightness is stable after turned on) becomes longer.
- Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- When fixed patterns are displayed for a long time, remnant image is likely to occur.
- Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimized the interference

Electrostatic Discharge Control

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

Strong Light Exposure

Strong light exposure causes degradation of polarizer and color filter.

Storage

When storing modules as spares for a long time, the following precautions are necessary.

- Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
- The polarizer surface should not come in contact with any other object. It is recommended that they be stored in the container in which they were shipped.

Protection Film

- When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.
- The protection film is attached to the polarizer with a small amount of glue. If some stress is applied to rub the protection film against the polarizer during the time you peel off the film, the glue is apt tore main on the polarizer. Please carefully peel off the protection film without rubbing it against the polarizer.
- When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of glue still on the polarizer after the protection film is peeled off.
- You can remove the glue easily. When the glue remains on the polarizer surface or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.

Transportation

The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.