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

LMT121DNGFWD-NNC

LCD Module User Manual

Prepared by:	Checked by:	Approved by:
Lin Li		
Date: 2019-06-24	Date:	Date:

Rev.	Descriptions	Release Date
0.1	Preliminary release	2019-06-24

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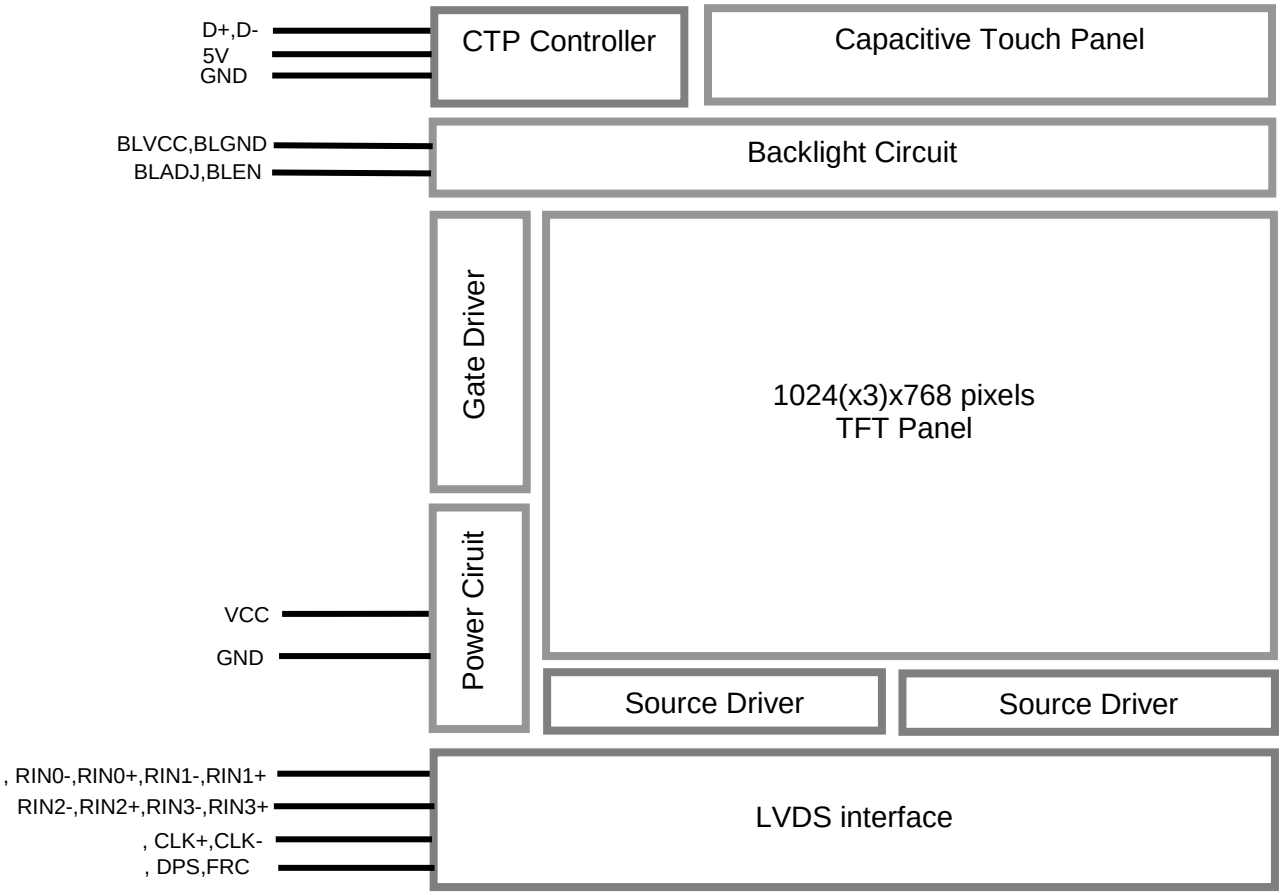
1. General Specification

TFT Interface :	LVDS (24bit or 18bit VESA)
CTP Interface:	Micro USB
Display Technology :	a-Si TFT active matrix
Display Mode :	Transmissive / Normal White
Screen Size(Diagonal) :	12.1”
Outline Dimension :	293.0x 232.0 x 15.9 (mm) (see attached drawing for details)
Active Area :	245.76 x 184.32 (mm)
Number of dots :	1024 x 3 (RGB) x 768
Pixel Pitch :	0.240 x 0.240 (mm)
Pixel Configuration :	RGB Vertical Stripe
Backlight :	LED
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 TFT Input Terminal (MSB240420HE)

Pin No.	Pin Name	I/O	Descriptions	
			Input data signal: 8bit	Input data signal:6bit
1	VCC	Power	Power Supply(3.3V)	
2	VCC			
3	GND	Power	Ground(0V)	
4	FRC	Input	High	Low or Open
5	RIN 0-	Input	LVDS receiver negative signal channel 0	
6	RIN 0+	Input	LVDS receiver positive signal channel 0	
7	GND	Power	Ground(0V)	
8	RIN 1-	Input	LVDS receiver negative signal channel 1	
9	RIN 1+	Input	LVDS receiver positive signal channel 1	
10	GND	Power	Ground(0V)	
11	RIN 2-	Input	LVDS receiver negative signal channel 2	
12	RIN 2+	Input	LVDS receiver positive signal channel 2	
13	GND	Power	Ground(0V)	
14	CLKIN-	Input	LVDS receiver negative signal clock	
15	CLKIN+	Input	LVDS receiver positive signal clock	
16	GND	Power	Ground(0V)	
17	RIN 3-	Input	LVDS receiver negative signal channel 3	Ground(0V)
18	RIN 3+	Input	LVDS receiver positive signal channel 3	
19	DPS	Input	Selection of scan direction High: Reverse scan Low or Open: Normal scan	
20	NC	--	--	

3.2 K2 Backlight Terminal(MSB24038P5)

Pin No	Pin Name	I/O	Descriptions
1	NC	--	No connection
2	BLADJ	Input	PWM Luminance control Hi:100%Drive Lo:0% Drive
3	BLEN	Input	Backlight ON/OFF control:5V-On/0v-Off
4	BLGND	Power	Ground(0V)
5	BLVCC	Power	Backlight Power Supply(12V)

3.3 K3 Capacitive Touch Panel Terminal(Micro USB)

Pin No	Pin Name	I/O	Descriptions
1	5V	Power	USB Power Supply(5V)
2	D-	I/O	USB D- signal
3	D+	I/O	USB D+ signal
4	GND	Power	Ground(0V)
5	GND	Power	Ground(0V)

4. Absolute Maximum Ratings

Items		Symbol	Rating	Unit	Remarks
Power supply voltage	LCD panel signal processing board	VCC	-0.3 to +3.96	V	Ta= 25℃
	LED driver	BLVCC	-0.3 to (+15.0)		
Input voltage for signals	Display signals ,Note1	VD	-0.5 to 3.96	V	
	Function signals ,Note2	VF	-0.5 to 3.96		
	Function signal for LED driver	BLADJ	-0.3 to (+15.0)	V	
		BLEN	-0.3 to (+15.0)	V	
Storage temperature		Tst	-30 to +80	℃	-
Operating temperature	Front surface	TopF	-20 to +70	℃	Note3
	Rear surface	TopR	-20 to +70	℃	Note4
Relative humidity Note5		RH	90	%	Ta ≤ 40℃
			85	%	40℃ < Ta ≤ 50℃
Absolute humidity ,Note5		AH	70,Note6	g/m3	Ta > 50℃

Note1:RIN0±,RIN1±,RIN2±,RIN3± and CLKIN±;
Note2:DPS and FRC;
Note3:Measured at LCD panel surface (including self-heat);
Note4:Measured at LCD module's rear shield surface (including self-heat);
Note5:No condensation;
Note6:Water amount at Ta= 50°C and RH= 85%.

5. Electrical Characteristics

5.1 Driving TFT LCD Panel

Ta=25℃

Items	Symbol	MIN.	TYP.	MAX.	Unit	Note
Power supply voltage	VCC	3.0	3.3	3.6	V	
Power supply current	ICC	-	300	740	mA	*1
Permissible ripple voltage	VRP	-	-	300	mV	For VCC
Differential input threshold voltage for LVDS receiver	VTL	-100	-	-	mV	VCM=1.25V,*2
	VTH	-	-	100	mV	
Terminating resistor	RT	-	100	-	Ω	
Input voltage for DPS and FRC signals	VFH	0.7VCC	-	VCC	V	
	VFL	0	-	0.3VCC	V	

Note:
*1: All black pattern
*2: Common mode voltage for LVDS receiver

5.2 Driving For Backlight

BLGND=0V,Top=25°C

Parameter	Symbol	MIN.	TYP.	MAX.	Unit	Note
Power supply voltage	BLVCC	10.8	12.0	13.2	V	Note 1
Power supply voltage	I_{BLVCC}	-	430	650 Note2	mA	At the maximum luminance control
Permissible ripple voltage	VRPD	-	-	200	mVp-p	For BLVCC,Note3
Input voltage for PWM signal	VDFH1	2.0	-	BLVCC	V	
	VDFL1	0	-	0.8	V	
Input voltage for BLEN signal	VDFH2	2.0	-	BLVCC	V	
	VDFL2	0	-	0.8	V	
PWM Input Frequency	f_{PWM}	200	-	20k	Hz	Note4,Note5
PWM duty ratio	DR_{PWM}	1	-	100	%	Note6,Note7
PWM pulse width	tPWH	5	-	-	us	

Note1:When designing of the power supply ,take the measures for the prevention of surge voltage.
Note2:This value excludes peak current such as overshoot current.
Note3:This power supply lines(BLVCC and GND)may have ripple voltage during luminance control of LED.There is the possibility that the ripple voltage produces acoustic noise and signal wave noise in audio circuit and so on.Put a capacitor between the power supply lines(BLVCC and GND) to reduce the noise is necessary .
Note4:A recommended fPWM value is as follows.

$$f_{PWM} = (2n-1)*fv/4$$

(n =integer,fv =frame frequency of LCD module)
Note5:Depending on the frequency used ,some noise may appear on the screen,please conduct a thorough evaluation,
Note6:While the BLEN signal is high ,do not set the tPWH(PWM pulse width) is less than 5us .It may cause abnormal working is the backlight .In this case,turn the backlight off and then on again by BLEN signal.
Note7:Regardless of the PWM frequency,both PWM duty radio and PWM pulse width must be always more than the minimum values

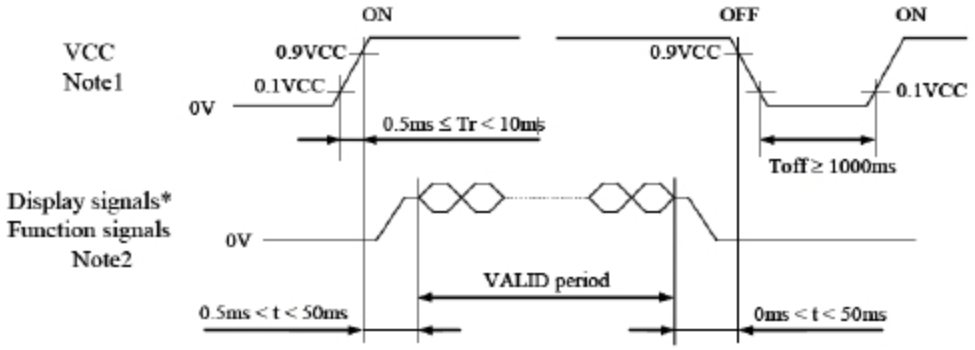
5.3 Capacitive Touch Panel

T_A=25℃

Items	Symbol	MIN.	TYP.	MAX.	Unit	Note
Power supply voltage	5V	4.5	5.0	5.5	V	
Power supply current	I_{5V}	-	TBD	-	mA	

5.4 Power supply voltage Sequence

5.4.1 LCD panel signal processing board

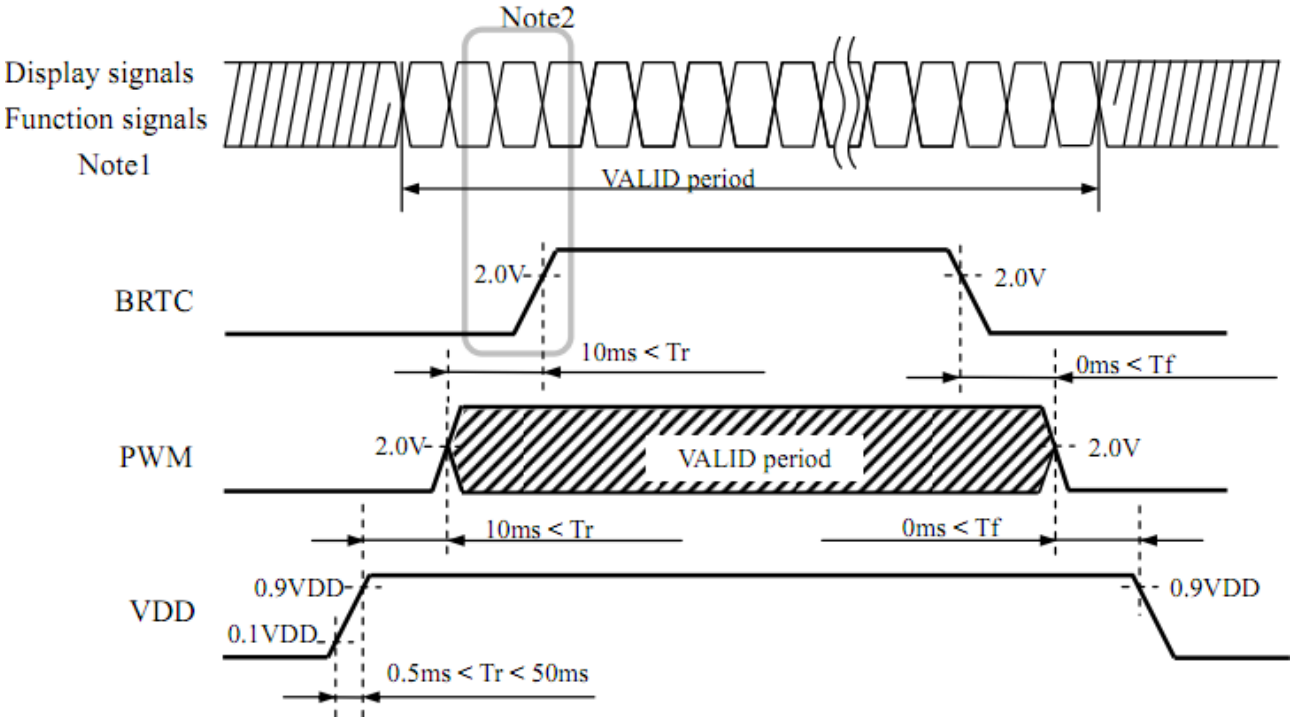


* These signals should be measured at the terminal of 100Ω resistance.

Note1: If there is a voltage variation(voltage drop) at the rising edge of VCC below 3.0V,there is a possibility that a product does not work due to a protection circuit.

Note2: Display signals (RIN0±,RIN1±,RIN2±,RIN3± and CLKIN±) and function signals(DPS and FRC) must be set to Low or High-impedance, except the VALID period (See above sequence diagram),in order to avoid the circuitry damage .If some of display and function signals of this product are cut while this product is working, even if the signal input to it once again, it might not work normally. If a customer stops the display and function signals, VCC also must be shut down.

5.4.2 LED Driver



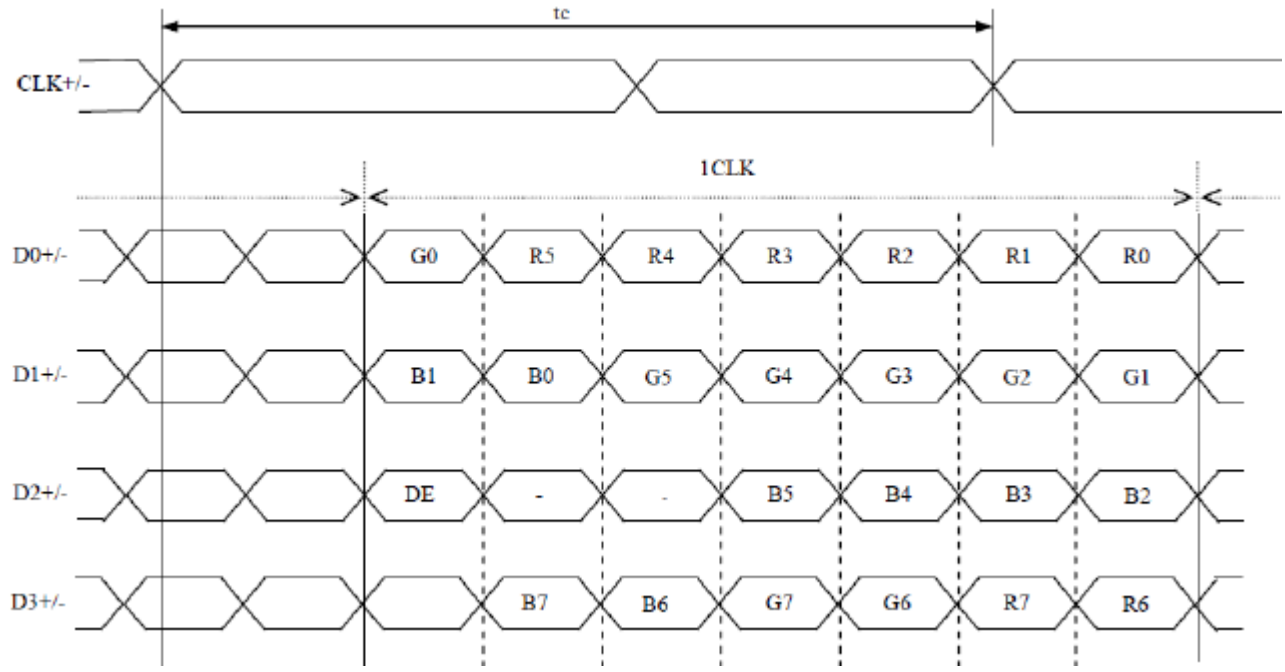
Note1:These are the display and function signals for LCD panel signal processing board.

Note2:The backlight should be turned on within the valid period of display and function signals,in order to avoid unstable data display.

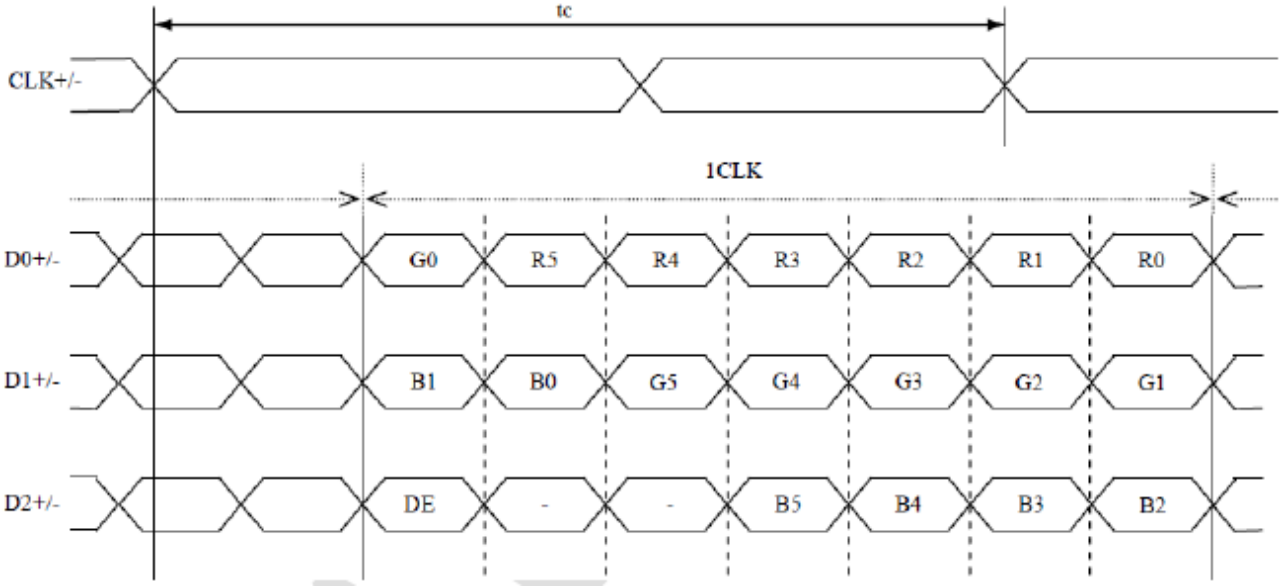
6. AC Characteristics

6.1 Input data mapping

(1) LVDS Input data signal: 8-bit



(2) LVDS Input data signal: 6-bit



6.2 Timing Characteristics

(Note1,Note2,Note3)

Parameter			Symbol	MIN.	TYP.	MAX.	Unit	Remarks
CLK	Frequency		1/tc	52.0	65.0	71.0	MHz	15.385ns (typ.)
	Duty ratio		-		-		-	-
	Rise time, Fall time		-				ns	
DATA	CLK-DATA	Setup time	-		-		ns	-
		Hold time	-				ns	
	Rise time, Fall time		-				ns	-
DE	Horizontal	Cycle	th	16.542	20.676	26.88	us	48.363kHz (typ.)
				1114	1344	1400	CLK	
		Display period	thd		1024		CLK	-
	Vertical (One frame)	Cycle	tv	13.34	16.666	20.0	ms	60.0Hz (typ.)
				780	806	845	H	
		Display period	tvd		768		H	
	CLK-DE	Setup time	-		-		ns	-
		Hold time	-				ns	
	Rise time, Fall time		-				ns	-

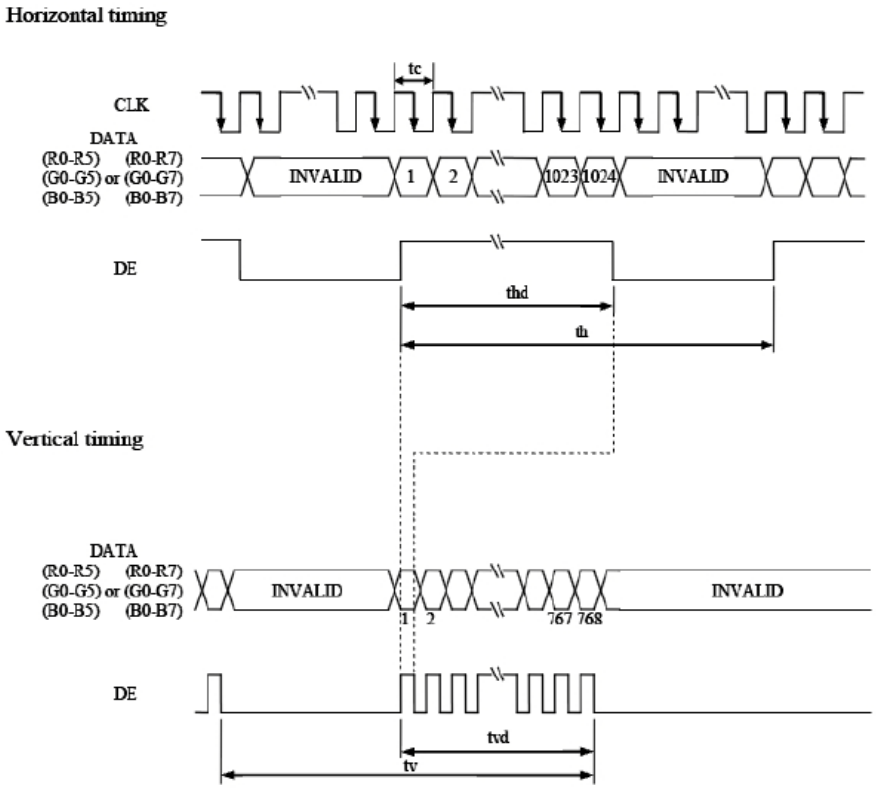
Note1:Definition of parameter is as follows.

tc = 1CLK，th = 1H

Note2:See the data sheet of LVDS transmitter.

ote3:Vertical cycle (tv) should be specified in integral multiple of Horizontal cycle (th).

6.3 Input signal timing chart



7. Physical Characteristics

7.1 Optical Characteristics

(Note*1,*2)

Parameter		Condition	Symbol	min.	typ.	max.	Unit	Measuring instrument	Remarks
Luminance		White at center θR= 0°, θL= 0°, θU= 0°, θD= 0°	L	250	350	-	cd/m2	BM-5A	-
Contrast ratio		White/Black at center θR= 0°, θL= 0°, θU= 0°, θD= 0°	CR	500	700	-	-	BM-5A	Note3
Luminance uniformity		White θR= 0°, θL= 0°, θU= 0°, θD= 0°	LU	-	1.25	(1.33)	-	BM-5A	Note6
Chromaticity	White	**x** coordinate	Wx	0.263	0.313	0.363	-	SR-3	Note5
		y coordinate	Wy	0.279	0.329	0.379	-		
	Red	**x** coordinate	Rx	-	TBD	-	-		
		y coordinate	Ry	-	TBD	-	-		
	Green	**x** coordinate	Gx	-	TBD	-	-		
		y coordinate	Gy	-	TBD	-	-		
	Blue	**x** coordinate	Bx	-	TBD	-	-		
		y coordinate	By	-	TBD	-	-		
Color gamut		θR= 0°, θL= 0°, θU= 0°, θD= 0° at center, against NTSC color space	C	48	55	-	%		
Response time		White to Black	Ton	-	(3)	(5)	ms	BM-5A -10000	Note4
		Black to White	Toff	-	(5)	(8)	ms		
Viewing angle	Right	θU= 0°, θD= 0°, CR≥ 10	θR	70	80	-	°	EZ Contrast	Note2
	Left	θU= 0°, θD= 0°, CR≥ 10	θL	70	80	-	°		
	Up	θR= 0°, θL= 0°, CR≥ 10	θU	70	80	-	°		
	Down	θR= 0°, θL= 0°, CR≥ 10	θD	70	80	-	°		

Note:

*1. The value above are initial Characteristics.

* 2: Measurement conditions are as follows.

Ta= 25℃, VCC= 3.3V, VDD= 12.0V, PWM duty ratio: 100%,

Display mode: XGA, Horizontal cycle= 1/48.363kHz, Vertical cycle= 1/60.0Hz,

DPS= Low or Open: Normal scan, FRC= High

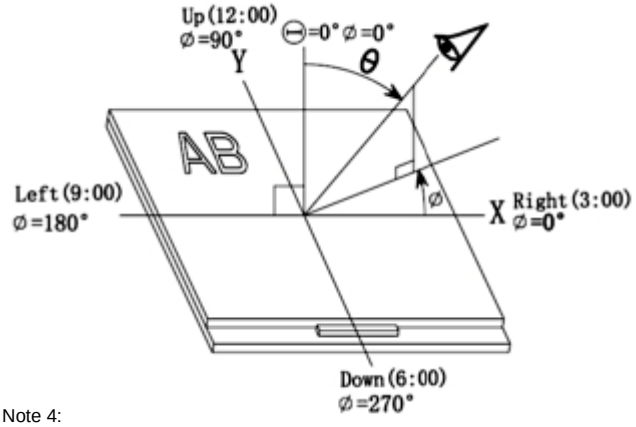
Note 1:

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:

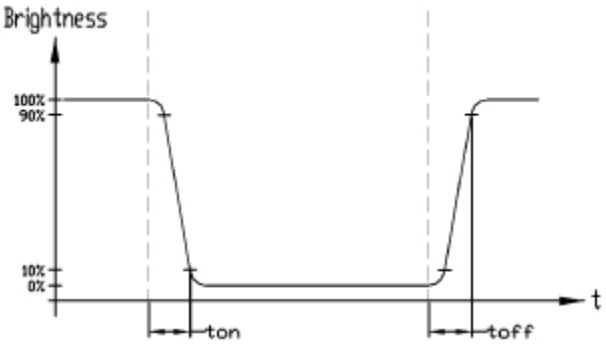
The definition of contrast ratio (Test LCM using SR-3A (1°)):

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

(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 when the input signals are changed from "black" to "white"(falling time) and from "white" to "black"(rising time), respectively.
The response time is defined as the time interval between the 10% and 90% of amplitudes.Refer to figure as below.

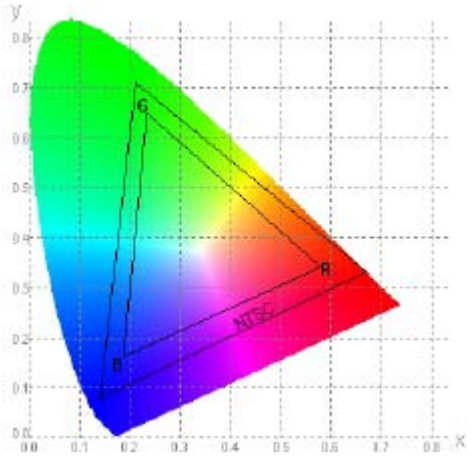


Note 5:

Definition of Color of CIE1931 Coordinate and NTSC Ratio

Color gamut:

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



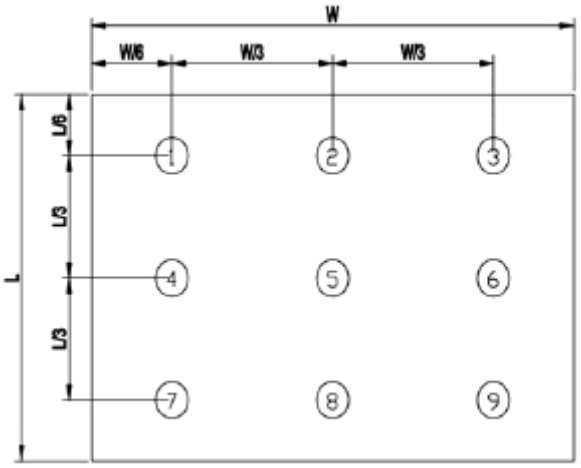
Note 6:

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. CTP Application Precautions

1. CTP Mounting Precaution

1.1 Bezel Mounting (Figure 1)

- The bezel window should be bigger than the CTP active area. It should be≥0.5mm each side.
- Gasket should be installed between the bezel and the CTP surface. The final gap should be about 0.5~1.0mm.
- It is recommended to provide an additional support bracket for backside support when necessary (e.g. slim type TFT module without mounding structure). They should only provide appropriate support and keep the module in place.
- The mounting structure should be strong enough to prevent external uneven force or twist act onto the module.

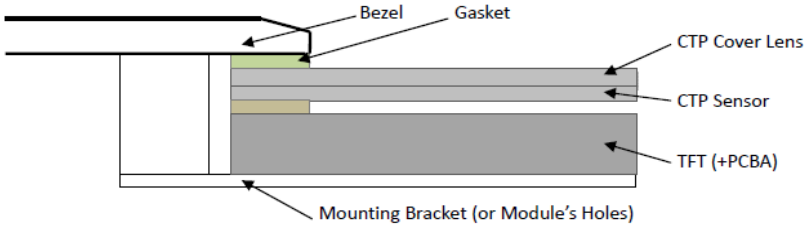


Figure 1

1.2 Surface Mounting (Figure 2)

- As the CTP assembling on the countersink area with double side adhesive. The countersink area should be flat and clean to ensure the double side adhesive installation result.
- The Bezel is recommend to keep a gap (≥0.3mm each side) around the cover lens for tolerance.
- It is recommended to provide an additional support bracket with gasket for backside support when necessary (e.g. TFT module without mounding structure). They should only provide appropriate support and keep the module in place.
- The mounting structure should be strong enough to prevent external uneven force or twist act onto the module.

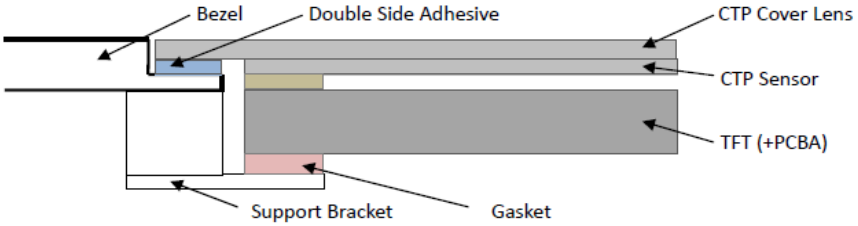


Figure 2

1.3 Additional Cover Lens Mounting (Figure 3)

- For the case of additional cover Lens mounting, it is necessary to recheck with the CTP specification about the material and thickness to ensure the functionality.
- It should keep a 0.2~0.3mm gap between the cover lens and the CTP surface..
- The cover lens window should be bigger than the active area of the CTP. It should be≥0.5mm each side.
- It is recommended to provide an additional support bracket for backside support when necessary (e.g. slim type TFT module without mounding structure). They should only provide appropriate support and keep the module in place.
- The mounting structure should be strong enough to prevent external uneven force or twist act onto the module.

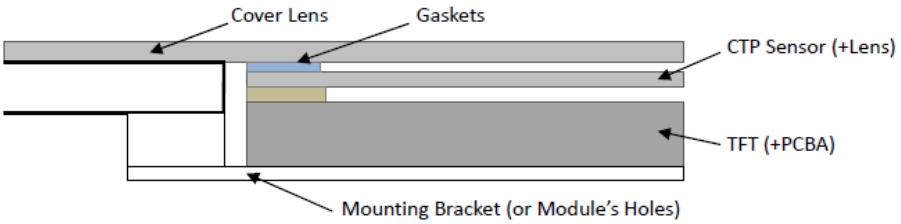


Figure 3

2. Handling Precautions

2.1 The product made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

2.2 Do not apply excessive or uneven force to the product since this may damage to the performance.

2.3 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with Isopropyl alcohol or Ethyl alcohol solvents. Solvents other than those mentioned above may damage the product. Especially, do not use Water, Ketone, Aromatic solvents.

2.4 Do not attempt to disassemble the CTP Module.

2.5 If the logic circuit power is off, do not apply the input signals.

2.6 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

a. Be sure to ground the body when handling the CTP Modules.

b. Tools required for assembly, such as soldering irons, must be properly ground.

c. To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

d. The CTP Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

3. Storage and Transportation Precautions

3.1 When storing the CTP modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

3.2 The CTP modules should be stored the required temperature range. If the CTP modules will be stored for a long time, the recommend condition is the temperature of 0~40 ℃ and relative humidity of ≤80%.

3.3 The LCD modules should be stored in the room without acid, alkali and harmful gas.

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

9. Precautions of Use of LCD Modules

9.1 Handling Precautions

10.1.1 The productis made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

10.1.2 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes,promptly wash it off using soap and water.

10.1.3 Do not apply excessive force to the product since this may damage to the performance;

10.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

10.1.5 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completelyclear, moisten cloth with one of the following solvents:

—Isopropyl alcohol

—Ethyl alcohol

Solvents other than those mentioned above may damage the product. Especially, do not use the following:

—Water

—Ketone

—Aromatic solvents

10.1.6 Do not attempt to disassemble the LCD Module.

10.1.7 If the logic circuit power is off, do not apply the input signals.

10.1.8 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

9.1.8.1. Be sure to ground the body when handling the LCD Modules.

9.1.8.2 Tools required for assembly, such as soldering irons, must be properly ground.

9.1.8.3 To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

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

9.2 Storage precautions

10.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

10.2.2 The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is:

Temperature : 0℃ ～40℃

Relatively humidity: ≤80%

10.2.3 The LCD modules should be stored in the room without acid, alkali and harmful gas.

9.3 Transportation Precautions

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