



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

LMT150DNGFWD-NNB-1

LCD Module User Manual

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0.1	Preliminary	2016-09-26
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1. General Specification

Signal Interface :	24bit LVDS (VESA) or 18bit LVDS
Display Technology :	a-Si TFT active matrix
Display Mode :	Transmissive with Normally White
Screen Size :	15.0 inch
Outline Dimension :	326.5 x 253.5 x 14.5(mm) (see outline drawing for details)
Active Area :	304.128x228.096 (mm)
Number of dots :	1024x 3 (RGB) x 768
Pixel Pitch :	0.264x 0.264(mm)
Pixel Configuration :	R.G.B. Stripe
Backlight :	White LED
Viewing Direction :	6 o'clock(Gray scale Inversion)(*1) 12 o'clock(*2)
Touch Panel:	5 wire resistive
Operating Temperature :	-20 ~ +70°C
Storage Temperature :	-30 ~ +80°C

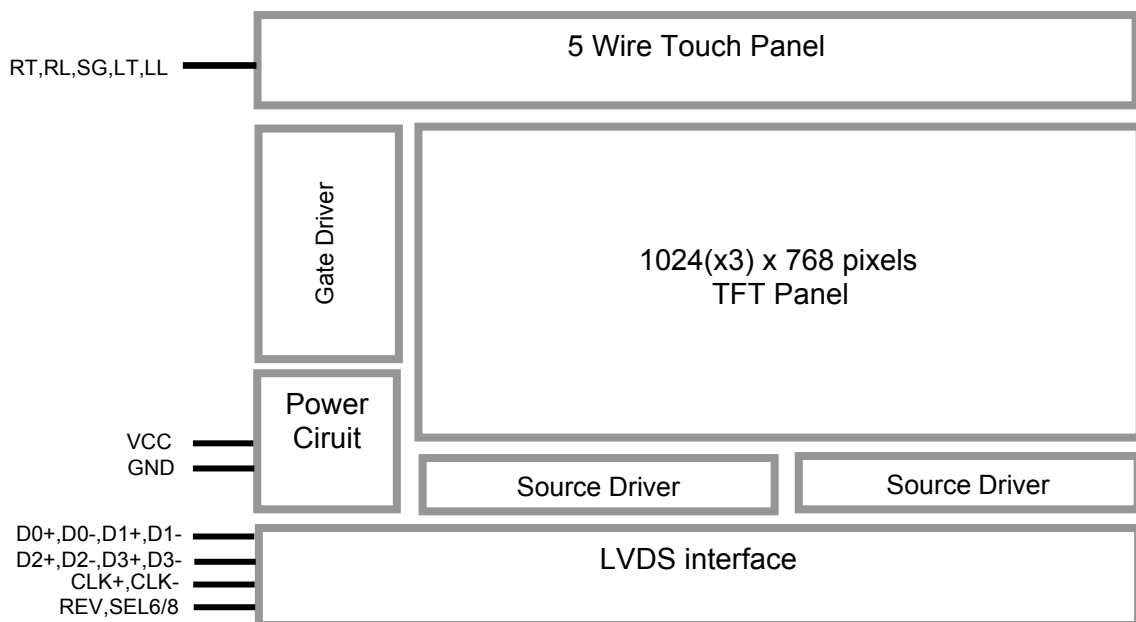
Note:

*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 Terminal (Socket 185083-20121 (P-TOW ELECTRIC TECHNOLOGYCO,LTD.))

Pin No.	Pin Name	IO	Descriptions	
			Input data signal: 24bit	Input data signal:18bit
1	VCC	Power	Power Supply	
2	VCC	Power		
3	GND	Power	Ground	
4	REV	Input	Selection of scan direction High: Reverse scan Low or Open: Normal scan	
5	D0-	Input	LVDS receiver negative signal channel 0	
6	D0+	Input	LVDS receiver positive signal channel 0	
7	GND	Power	Ground	
8	D1-	Input	LVDS receiver negative signal channel 1	
9	D1+	Input	LVDS receiver positive signal channel 1	
10	GND	Power	Ground	
11	D2-	Input	LVDS receiver negative signal channel 2	
12	D2+	Input	LVDS receiver positive signal channel 2	
13	GND	Power	Ground	
14	CLK-	Input	LVDS receiver negative signal clock	
15	CLK+	Input	LVDS receiver positive signal clock	
16	GND	Power	Ground	
17	D3-	Input	LVDS receiver negative signal channel 3	Ground
18	D3+	Input	LVDS receiver positive signal channel 3	
19	NC	--	Non connection	
20	SEL6/8	Input	Low	High or Open

3.2 K2 Backlight Terminal (MSB24038P5 (Produced by STM) or equivalent)

Pin No.	Pin Name	IO	Descriptions
1	NC	--	Non connection
2	BLADJ	Input	PWM Luminance control BLADJ= Hi,100% Drive BLADJ= Lo,0% Drive
3	BLEN	Input	Back light ON/OFF control:5V-On / 0V-Off
4	GND	Power	Ground
5	VDD	Power	Backlight Power Supply(12V)

3.3 Touch Panel Terminal

Pin No.	Pin Name	IO	Descriptions
1	RT	Passive	Top right corner sense Terminal
2	RL	Passive	Lower right corner sense Terminal
3	SG	Passive	TP Signal ground
4	LT	Passive	Top left corner sense Terminal
5	LL	Passive	Lower left corner sense Terminal

4. Absolute Maximum Ratings

GND=0V

Items	Symbol	Min.	Max.	Unit	Condition
Power voltage	VCC	-0.5	5.0	V	
Input voltage	V _{IN}	-0.5	5.0	V	
Operating Temperature	T _{OP}	-20	70	°C	Note1
Storage Temperature	T _{ST}	-30	80	°C	
Relative Humidity(*2)	RH	--	≤90	%	Ta≤40°C
		--	≤85	%	40°C<Ta≤50°C
		--	≤55	%	50°C<Ta≤60°C
		--	≤36	%	60°C<Ta≤70°C
		--	≤24	%	70°C<Ta≤80°C
Absolute Humidity	AH	--	≤70	g/m ³	Ta>50°C

Note:

*1. The temperature of panel display surface area should be -20° C Min and 70° C Max.

*2: a).Ta means the ambient temperature.

b).It is necessary to limit the relative humidity to the specified temperature range.

c).Condensation on the module is not allowed.

d).Wet-bulb temperature should be39° C Max. (Ta> 40° C)

e).90%RH Max. (Ta≤ 40° C)

*3. 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

VCC=3.3V,GND=0V,Ta=25°C

Items		Symbol	MIN.	TYP.	MAX.	Unit	Note
Power supply voltage		VCC	3.0	3.3	3.6	V	
Power supply ripple		Vp-p			200	mA	Including spike noise
Power supply current		ICC	--	550	--	mA	*1
Permissible ripple voltage		VRP	--	--	100	mV	
Differential input voltage		Vid	250	--	450	mV	
Differential input threshold voltage for LVDS receiver	High	VTH	--	--	100	mV	VCM = 1.25V *2
	Low	VTL	-100	--	--	mV	
Input voltage width for LVDS receiver		Vi	0	--	1.90	V	
Terminating resistor		RT	--	100	-	Ω	
Rush current		I _{rush}	--	-	1.5	A	*3
Input voltage for MSL signals	High	VFH	0.7VCC	--	VCC	V	
	Low	VFL	0	---	0.3VCC	V	

Note:

*1: Black mode, 65MHz, at VCC = 3.3V.

*2: Common mode voltage for LVDS receiver.

*3: Measurement Conditions.

5.2 Driving For Backlight

 $T_a=25^{\circ}\text{C}$

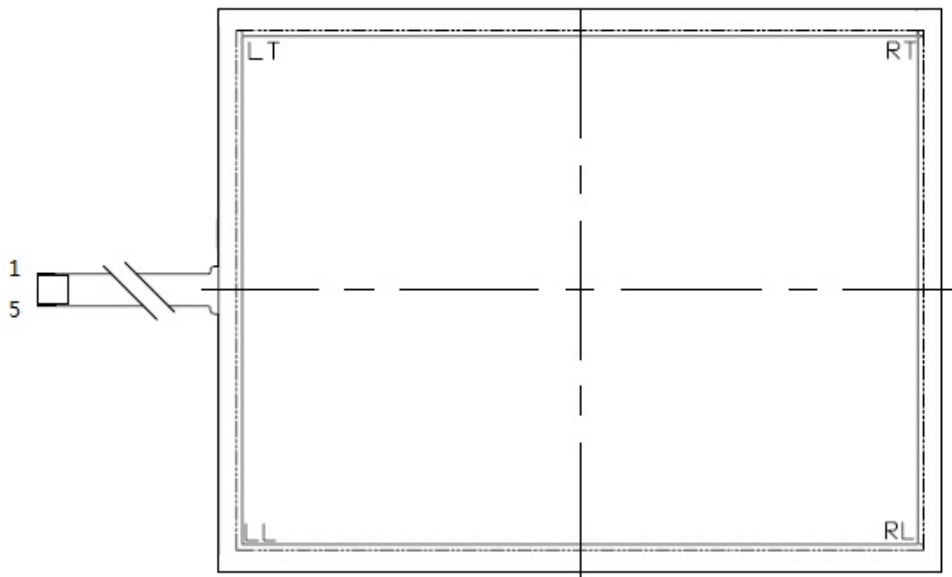
Items		Symbol	MIN.	TYP.	MAX.	Unit	Note
Power supply voltage		VDD	10.8	12.0	12.6	V	
Power supply current		IDD	--	705	--	mA	
Input voltage for BLADJ signal	High	VDFH1	2.0	--	5.0	V	
	Low	VDFL1	0	--	0.4	V	
Input voltage for BLEN signal	High	VDFH2	2.0	--	5.0	V	
	Low	VDFL2	0	--	0.4	V	
PWM frequency		fpwm	200	--	(20K)	Hz	BLADJ
PWM duty		--	5	--	100	%	BLADJ
Led life time		Hr	--	50000	--	Hour	*1

Note:

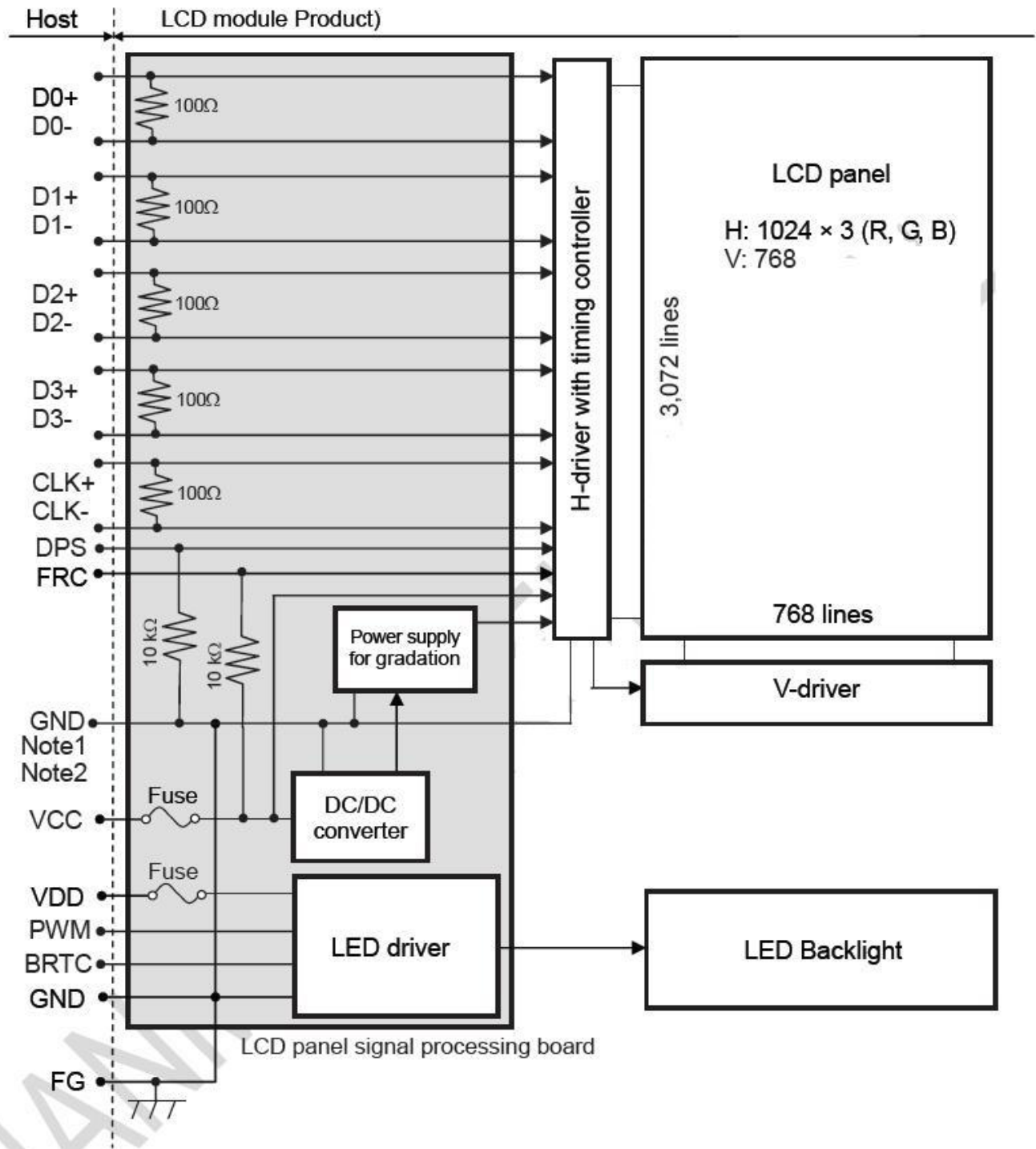
*1. Optical performance should be evaluated at $T_a=25^{\circ}\text{C}$.

5.3 Touch Panel Characteristics

Items		MIN.	TYP.	MAX.	Unit	Note
Operating Voltage		--	5.0	--	V	
Terminal resistance		--	400	--	Ω	Film T=0.188mm
		350	--	500	Ω	Glass T=1.8mm
Operating pressure		20	--	100	g	
Life Time		--	350,000,000	--		Click Time



5.4 Block Diagram



*1. Relations between GND (Signal ground and LED driver ground) and FG (Frame ground) in the LCD module are as follows

GND - FG	Connected
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*2. GND and FG must be connected to customer equipment's ground, and it is recommended that these grounds be connected together in customer equipment.

6. Display colors and input data information

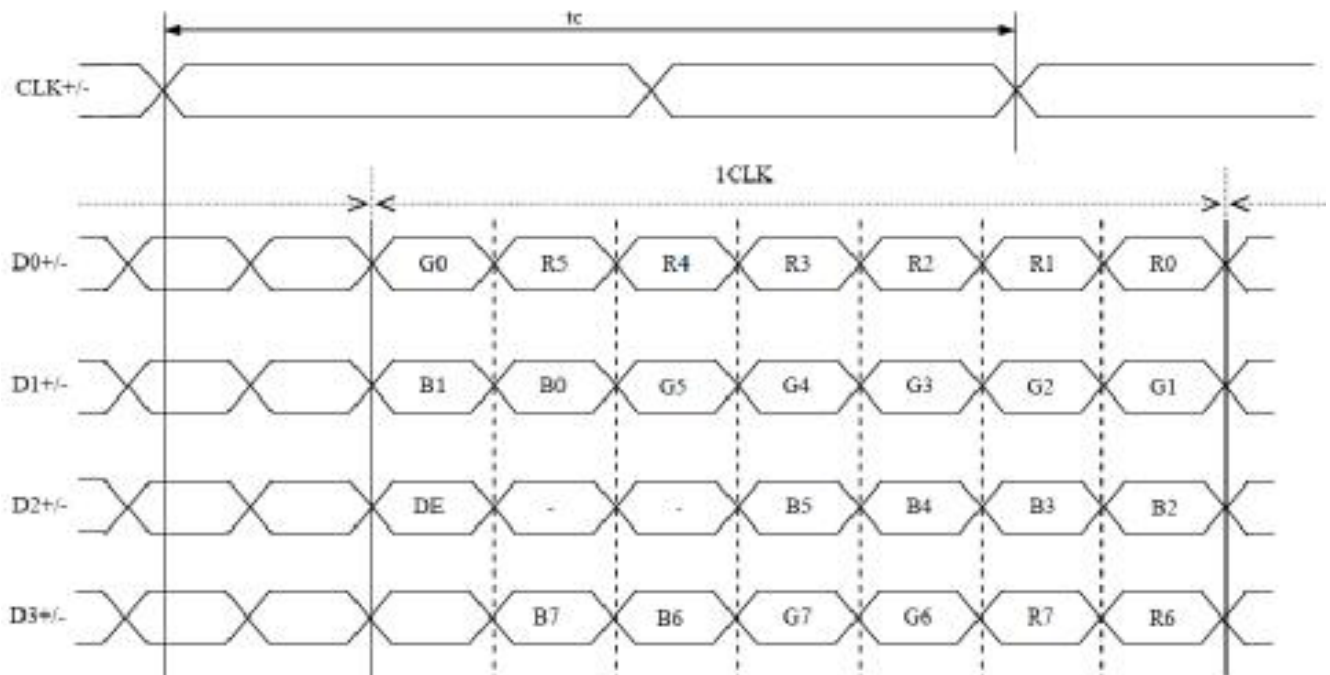
6.1 Display colors and data signal

This product can display in equivalent to 16,194,277 colors in 253 scales. Also the relation between display colors and input data signals is as the following table. And it can display in equivalent to 262,144 colors in 64 scales, without data signals R7, R6, G7, G6, B7, B6 in the following table.

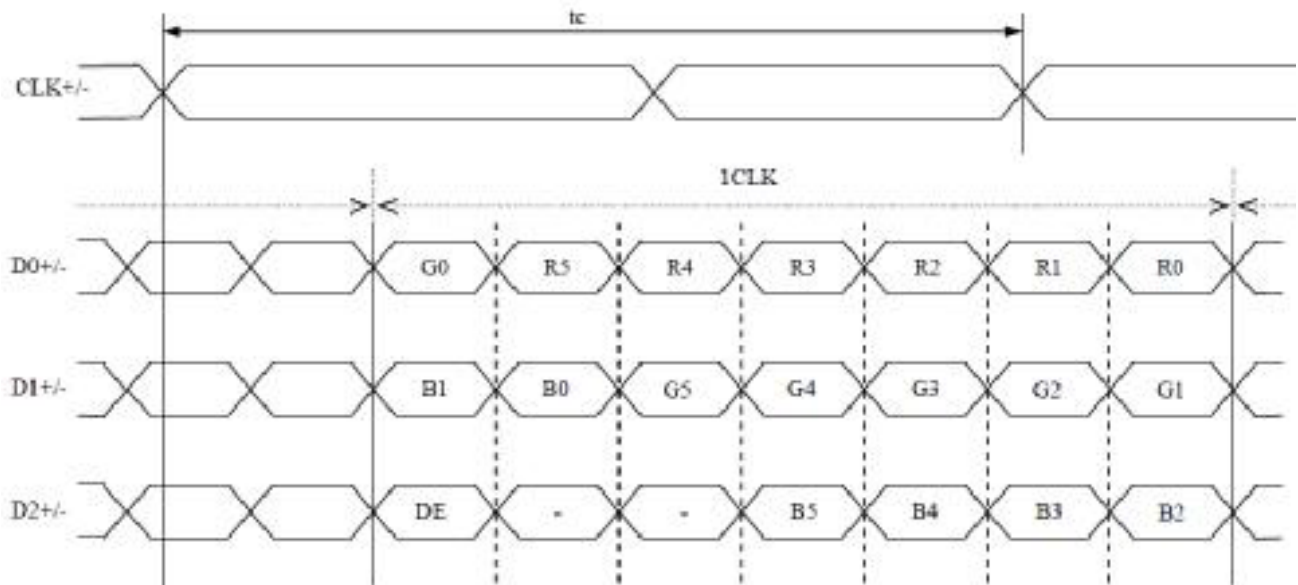
Display colors		Data signal (0:Low level, 1:High Level)																							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Red grayscale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Dark ↕	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Bright Red	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Green grayscale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Dark ↕	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	Bright Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
		0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Blue grayscale	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Dark ↕	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
	Bright Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

6.2 Data mapping

(1) LVDS Input data signal: 24bit(VESA mode)



(2) LVDS Input data signal: 18bit



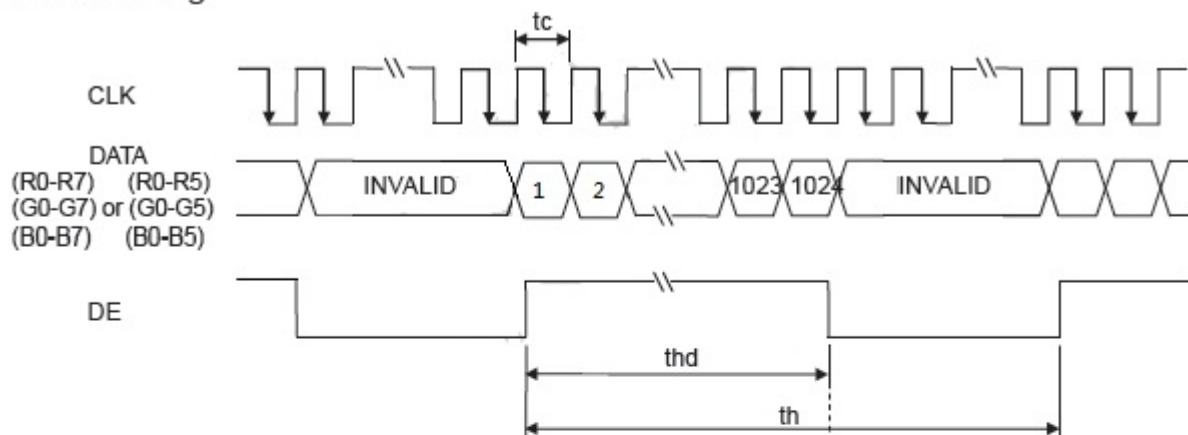
7. AC Characteristics

7.1 Timing Characteristics

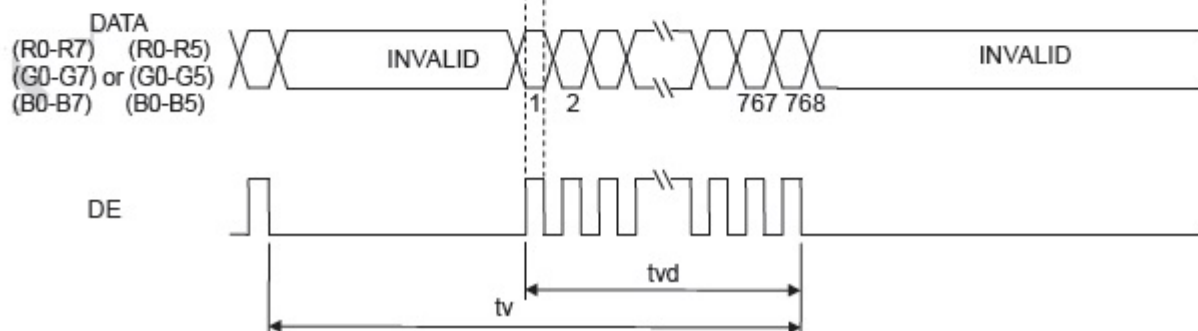
Parameter		Symbol	MIN.	TYP.	MAX.	Unit	Unit
Clock	Frequency	1/tc	52	56.88	71	MHz	17.58ns (typ)
		tc	19.23	17.58	14.08	Ns	
Horizontal signals	Cycle	th	1114	1200	1400	CLK	
	Display period	thd	1024				
Vertical signals	Cycle	tv	778	790	845	H	60.0Hz(typ)
	Display period	tvd	768				-

7.2 Input signal timing chart

Horizontal timing



Vertical timing



7.3 Pixel data alignment of display Image

The following chart is the coordinates of per pixel

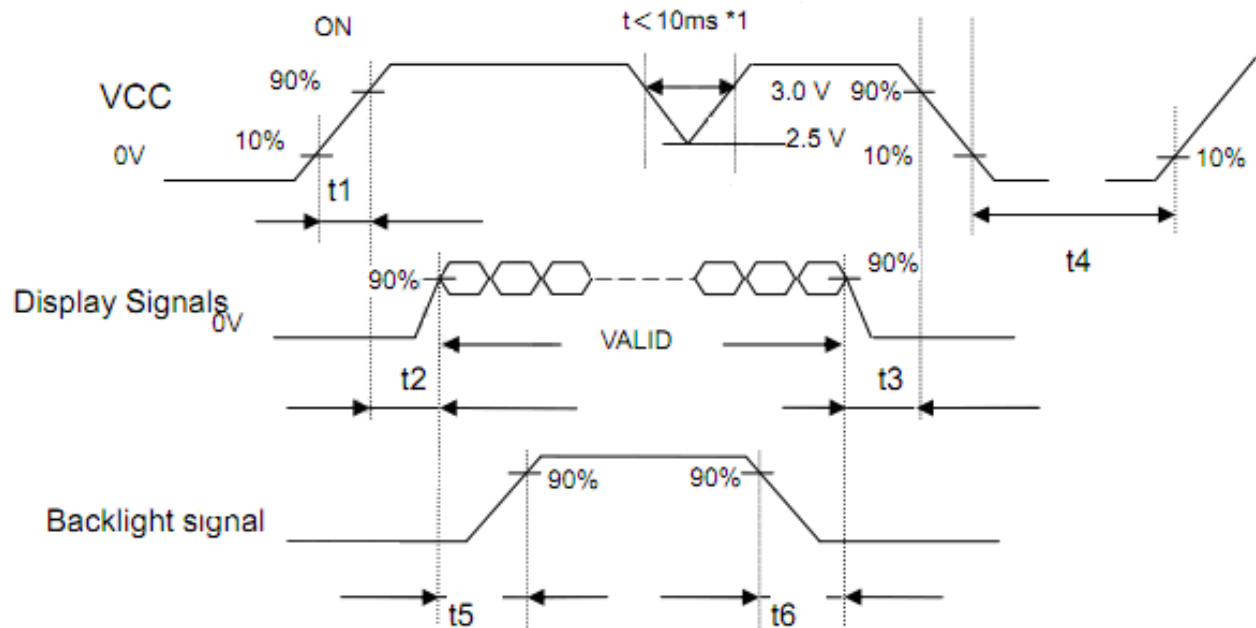
D(1,1)				D(1,1)	D(2,1)	D(3,1)	...	D(1024,1)
B	G	R		D(1,2)	D(2,2)	D(3,2)	...	D(1024,2)
				D(1,3)	D(2,3)	D(3,3)	...	D(1024,3)
				⋮	⋮	⋮	...	⋮
				⋮	⋮	⋮	...	⋮
				⋮	⋮	⋮	...	⋮
				D(1,768)	D(2,768)	D(3,768)	...	D(1024,768)

Note:

*1.Pixel arrangement is BGR strip when module's PCB side placed upward. It is suggested that Module's PCB side should place downward to compatible with RGB pixel arranging modules.

7.4 Power supply voltage sequence

6.4.1 The sequence of backlight and power



Timing Specifications:

- t1 :0.5ms<t1 <10ms;
- t2 :0.5 ms<t2 <50ms;
- t3 :0ms<t3 <50ms;
- t4 :t4 >1000ms;
- t5 :t5 >200ms;
- t6 :t6 >200ms;

8. Optical Characteristics

VDD=12V, VCC=3.3V, GND=0V, Ta=25°C

Item	Symbol	Condition	MIN.	TYP.	MAX.	UNIT	Note.
Viewing angle (CR≥10)	θ_L	9 o'clock	70	80	-	degree	*2
	θ_R	3 o'clock	70	80	-		
	θ_T	12 o'clock	70	80	-		
	θ_B	6 o'clock	70	80	-		
Response Time	T_{ON}	Normal $\theta=0^\circ$	-	8	12	msec	*3
	T_{OFF}		-	8	12	msec	
Contrast ratio	CR		600	800	-	-	*1
Color chromaticlty	W_X		0.263	0.313	0.363	-	
	W_Y		0.279	0.329	0.379	-	
Luminance	L		320	360	-	cd/m ²	*4
Luminance uniformity	Y_U		-	75	80	%	*4

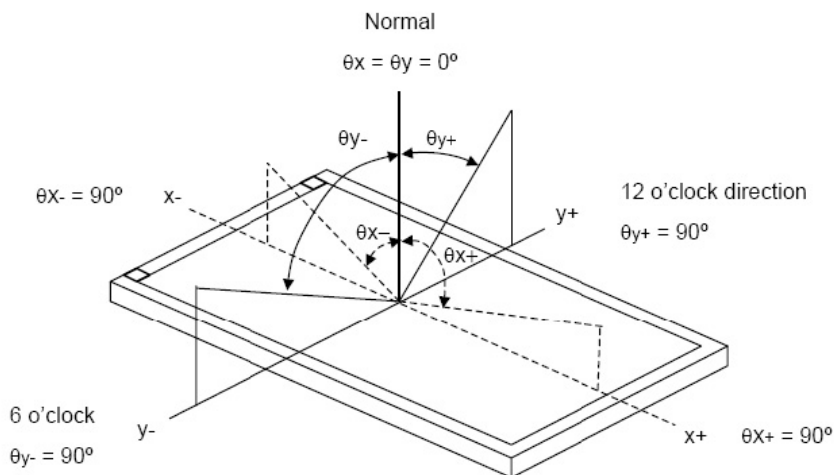
Note:

*1. Definition of Contrast Ratio

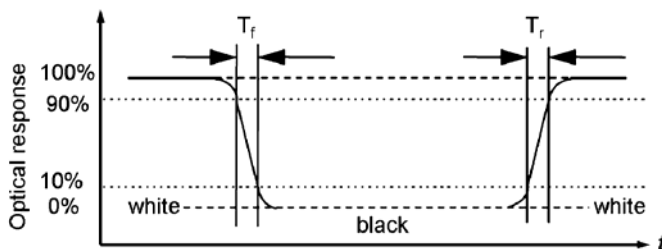
The contrast ratio could be calculate by the following expression:

Contrast Ratio (CR) = Luminanc with all pixels white / Luminance with all pixels black

*2 Definition of Viewing Angle



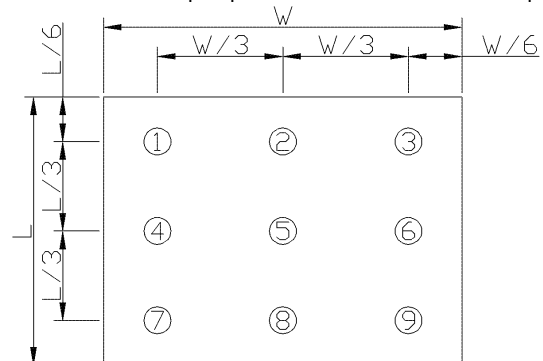
*3 Definition of response time



*4 Definition of Luminance Uniformity

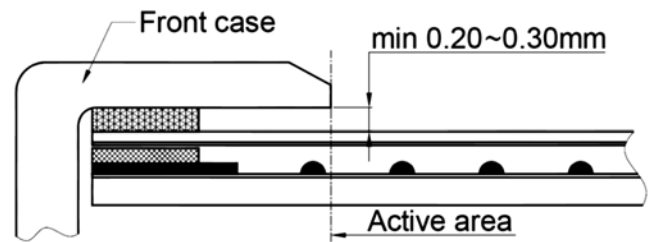
Luminance uniformity (Lu)=

Min. Luminance form pt1~pt9 / Max Luminance form Pt1~pt9

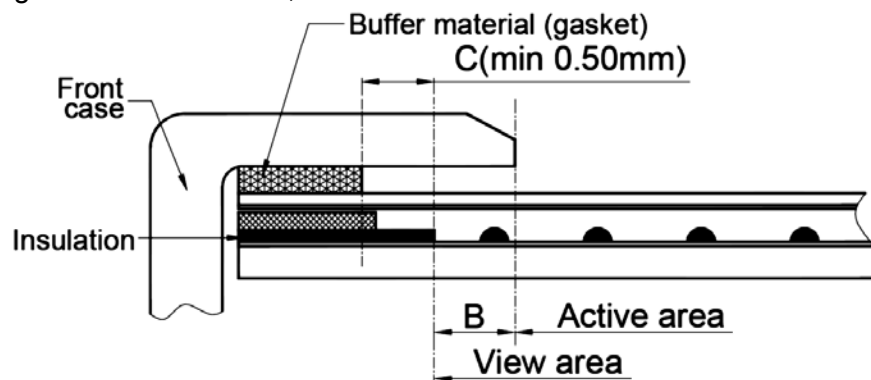


9. Touch panel Design Precautions

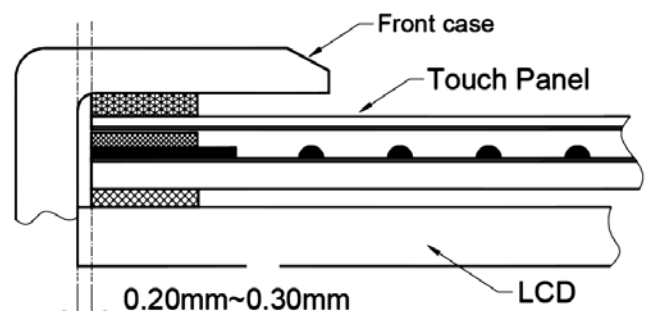
1. It should prevent front case touching the touch panel Active Area (A.A.) to prevent abnormal touch.
It should left gab (e.g. 0.2~0.3mm) in between.



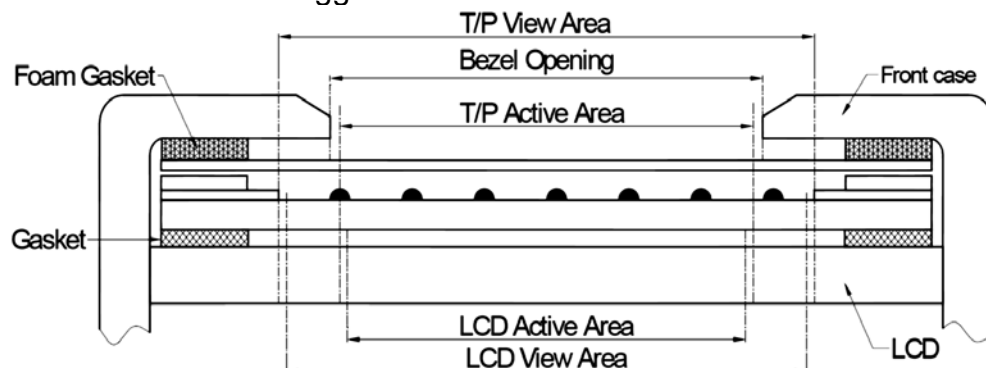
2. Outer case design should take care about the area outside the A.A.
Those areas contain circuit wires which is having different thickness. Touching those areas could deform the ITO film. As a result case the ITO cold be damaged and shorten its lifetime.
It is suggested to protect those areas with gasket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



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.



10. Precautions for Use of LCD Modules

10.1 Handling Precautions

- 8.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.
- 8.1.2 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.
- 8.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- 8.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.
- 8.1.5 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 one of the following solvents:
 - Isopropyl alcohol
 - Ethyl alcoholSolvents other than those mentioned above may damage the polarizer. Especially, do not use the following:
 - Water
 - Ketone
 - Aromatic solvents
- 8.1.6 Do not attempt to disassemble the LCD Module.
- 8.1.7 If the logic circuit power is off, do not apply the input signals.
- 8.1.8 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
 - 8.1.8.1 Be sure to ground the body when handling the LCD Modules.
 - 8.1.8.2 Tools required for assembly, such as soldering irons, must be properly ground.
 - 8.1.8.3 To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.
 - 8.1.8.4 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.

10.2 Storage precautions

- 8.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.
- 8.2.2 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°C ~ 40°C Relatively humidity: ≤80%
- 8.2.3 The LCD modules should be stored in the room without acid, alkali and harmful gas.

10.3 Transportation Precautions

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