

SPECIFICATIONS FOR LCD MODULE

CUSTOMER	
CUSTOMER PART NO.	
AMPIRE PART NO.	AMA-150B02-DI2510-G020
APPROVED BY	
DATE	

☒ Approved For Specifications

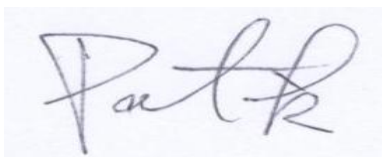
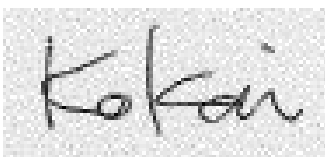

☐ Approved For Specifications & Sample

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RECORD OF REVISION

Revision Date	Page	Contents	Editor
2018/4/2	-	New Release	Emil

1. GENERAL DESCRIPTION

1.1 OVERVIEW

This 15.0" TFT Liquid Crystal Display module with LED Backlight units, 20 pins LVDS interface and PCAP touch screen. This module supports 1024 x 768 XGA modes and can display 16.7M/262k colors.

1.2 FEATURE

- XGA (1024 x 768 pixels) resolution.
- DE (Data Enable) only mode.
- LVDS Interface with 1pixel/clock.
- Wide operating temperature.
- RoHS compliance.
- PCAP touch screen with touchscreen controller.

1.3 APPLICATION

- TFT LCD Monitor
- Factory Application
- Amusement
- Vehicle

1.4 GENERAL SPECIFICATIONS

Item	Specifications	Unit	Note
Active area	304.1(H) x 228.1(V)	mm	(1)
Bezel Opening Area	307.4(H) x 231.3(V)	mm	
Driver Element	a-Si TFT active matrix		
Pixel Number	1024 x R.G.B x 768	pixel	
Pixel Pitch	0.297(H) x 0.297(W)	mm	
Pixel Arrangement	RGB vertical Stripe	-	
Display Colors	16.7M / 262K	color	
Display Mode	Normally Black / VA	-	
Module Power Consumption	8.6	W	Exclude touchscreen Max.
Interface of touch screen	IIC	-	
Thickness of cover glass	2	mm	

2. ABSOLUTE MAXIMUM RATINGS

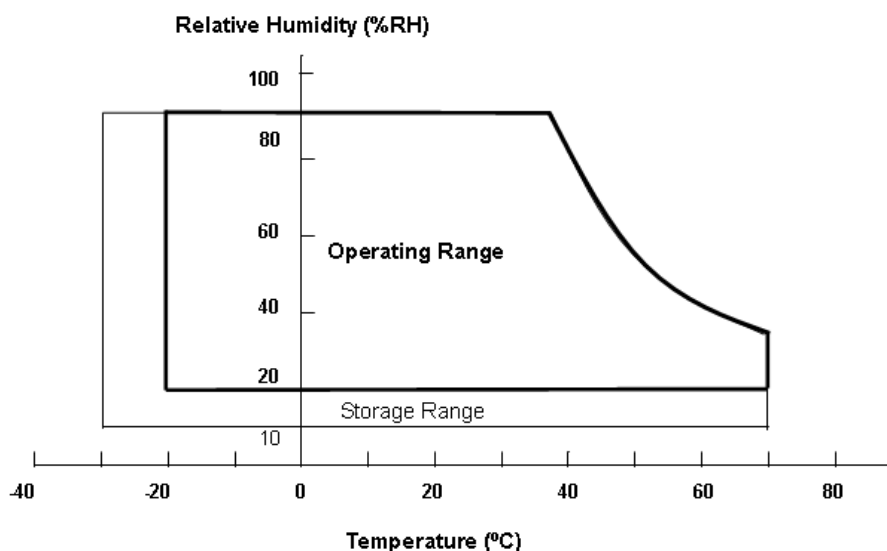
2.1 ABSOLUTE RATINGS OF ENVIRONMENT

Item	Symbol	Value		Unit	Note
Operating Ambient Temperature	T _{OP}	-20	+70	°C	(1)(2)(3)
Storage Temperature	T _{ST}	-30	+70	°C	

Note (1) Temperature and relative humidity range is shown in the figure below.

Note (2) 90 %RH Max. (Ta < 40°C).

Note (3) Wet-bulb temperature should be 39°C Max.



2.2 ELECTRICAL ABSOLUTE RATINGS

2.2.1 TFT LCD MODULE

Item	Symbol	Value		Unit	Note
Power Supply Voltage	VCC	-0.3	4	V	(1)
Power Supply Voltage	VDD	-0.3	6	V	

2.2.2 BACKLIGHT UNIT

Item	Symbol	Value		Unit	Note
Converter Voltage	V _i	-0.3	18	V	(1)(2)
Enable Voltage	EN		5.5	V	
Backlight Adjust	Dimming		5.5	V	

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

Note (2) Specified values are for lamp (Refer to 3.2 for further information).

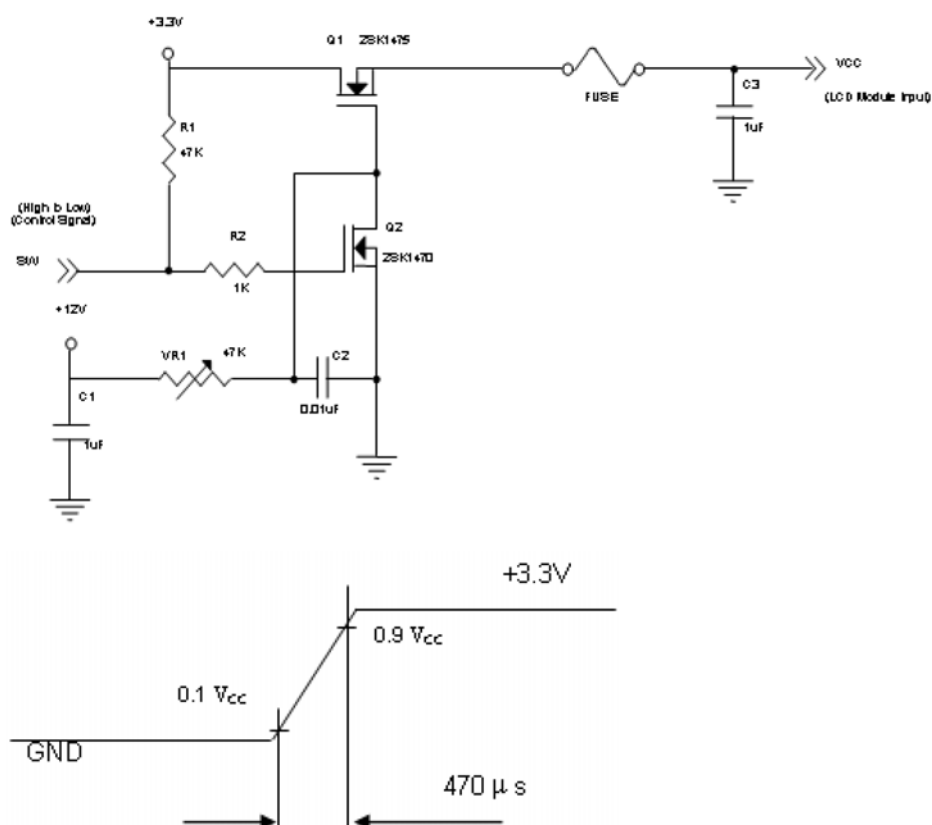
3. ELECTRICAL CHARACTERISTICS

3.1 TFT LCD MODULE

Parameter		Symbol	Values			Unit	Note
			MIN	TYP	MAX		
Power Supply Voltage		V _{CC}	3	3.3	3.6	V	-
Ripple Voltage		V _{RP}	-	-	100	mVp-p	-
Rush Current		I _{RUSH}	-	-	2	A	(2)
Power Supply Current	White	I _{CC}	-	800	960	mA	(3)a
	Black		-	670	800	mA	(3)b
LVDS differential input voltage		V _{id}	200	-	600	mV	-
LVDS common input voltage		V _{ic}	1	1.2	1.4	mV	-
Differential Input Voltage for LVDS Receiver Threshold	“H” Level	V _{IH}	-	-	100	mV	-
	“L” Level	V _{IL}	-100	-	-	mV	-
Terminating Resistor		R _T	-	100	-	ohm	-

Note (1) The module should be always operated within above ranges.

Note (2) Measurement Conditions:



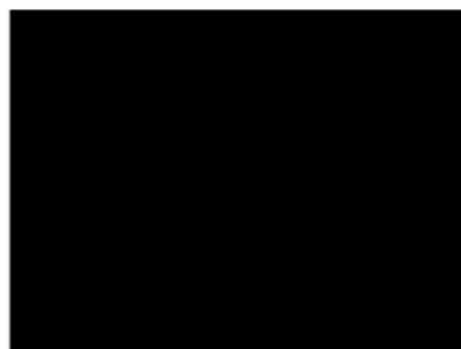
Note (3) The specified power supply current is under the conditions at $V_{DD}=3.3V$, $T_a = 25 \pm 2 \text{ }^{\circ}C$, DC Current and $f_v = 60 \text{ Hz}$, whereas a power dissipation check pattern below is displayed.

a. White Pattern



Active Area

b. Black Pattern



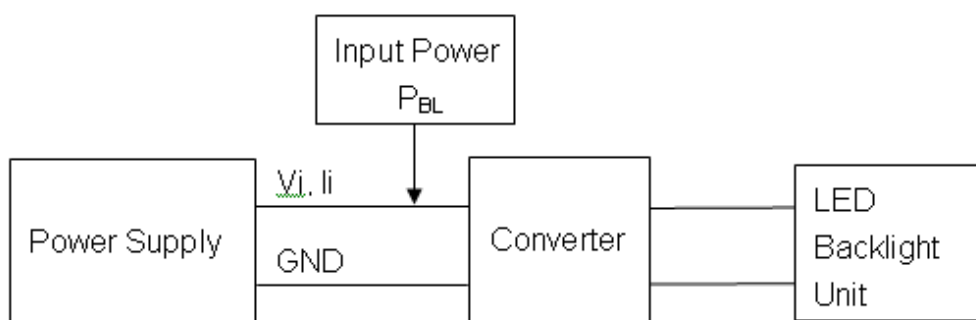
Active Area

3.2 BACKLIGHT UNIT

$T_a=25^{\circ}C$

Parameter		Symbol	Values			Unit	Note
			MIN	TYP	MAX		
Converter Power Supply Voltage		V_i	10.8	12	13.2	V	
Converter Power Supply Current		I_i	0.23	0.4	0.45	A	@ $V_i = 12V$ (Duty 100%)
Backlight Power Consumption		PBL	-	4.8	5.4	W	@ $V_i = 12V$ (Duty 100%)
EN Control Level	Backlight on	-	2	3.3	5	V	
	Backlight off		0	-	0.8	V	
PWM Dimming Control Level	PWM High Level	-	2	3.3	5	V	
	PWM Low Level		0	-	0.15	V	
PWM Dimming Control Duty Ratio		-	1	-	100	%	@200Hz
PWM Dimming Control Frequency		f_{PWM}	190	200	20k	Hz	(2)
LED Life Time		L_L	50k	70k	-	Hrs	(3)

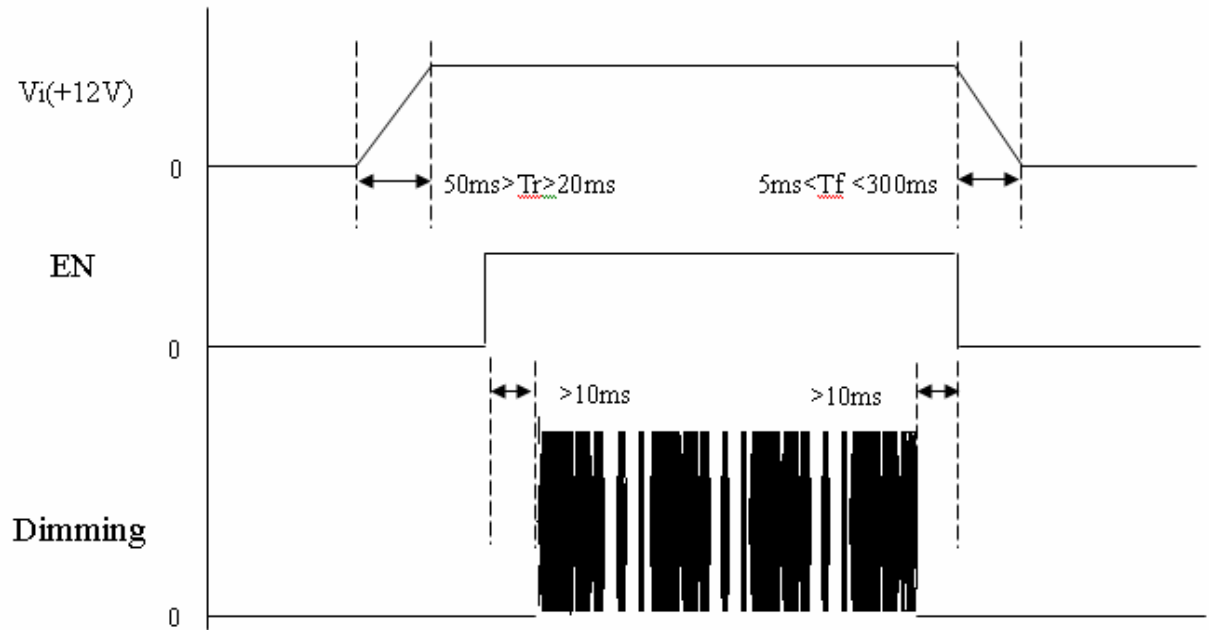
Note (1) LED current is measured by utilizing a high frequency current meter as shown below:



Note (2) At 20k Hz PWM control frequency , duty ratio range is restricted from 20% to 100%.

Note (3) The lifetime of LED is estimated data and defined as the time when it continues to operate under the conditions at $T_a = 25 \pm 2 \text{ }^{\circ}C$ and Duty 100% until the brightness becomes $\leq 50\%$ of its original value. Operating LED under high temperature environment will reduce life time and lead to color shift.

Power sequence and control signal timing are shown in the following figure

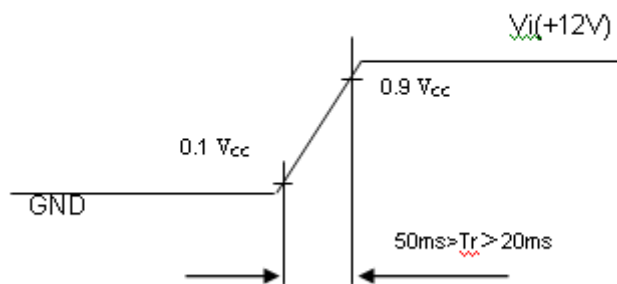


Note : While system is turned ON or OFF, the power sequences must follow as below descriptions

Turn ON sequence: $V_i(+12V)$ _ EN _ $Dimming$

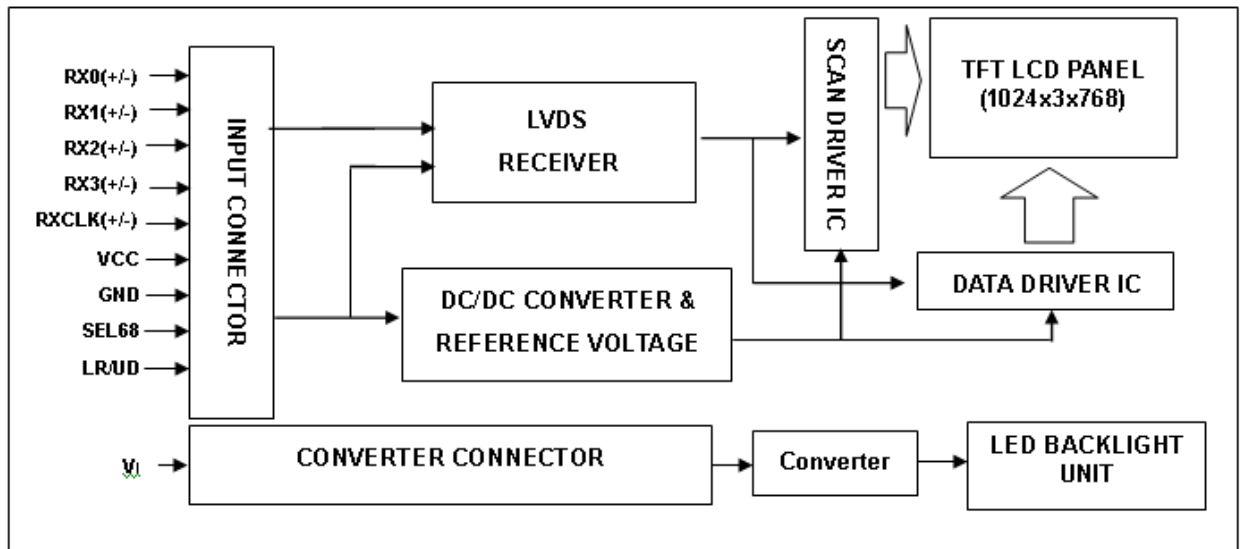
Turn OFF sequence: $Dimming$ _ EN _ $V_i(+12V)$

Note (4)



4. BLOCK DIAGRAM

4.1 TFT LCD MODULE



5. INPUT TERMINAL PIN ASSIGNMENT

5.1 TFT LCD MODULE

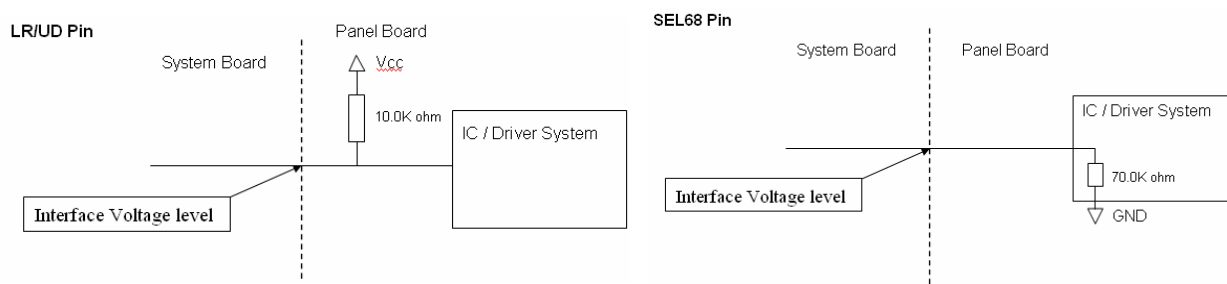
Pin No.	Symbol	Function	Polarity	Note
1	VCC	Power Supply +3.3V(typical)		
2	VCC	Power Supply +3.3V(typical)		
3	NC	No Connection		Note (4)
4	LR/UD	Reverse Scan Control H or NC = Normal Mode. L = Horizontal/ Vertical Reverse Scan		Note (3)
5	RX0-	LVDS Differential Data Input	Negative	
6	RX0+	LVDS Differential Data Input	Positive	
7	GND	Ground		
8	RX1-	LVDS Differential Data Input	Negative	
9	RX1+	LVDS Differential Data Input	Positive	
10	NC	No Connection		Note (4)
11	RX2-	LVDS Differential Data Input	Negative	
12	RX2+	LVDS Differential Data Input	Positive	
13	GND	Ground		
14	RXCLK-	LVDS Differential clock Input	Negative	
15	RXCLK+	LVDS Differential clock Input	Positive	
16	GND	Ground		
17	RX3-	LVDS Differential Data Input	Negative	
18	RX3+	LVDS Differential Data Input	Positive	
19	NC	No Connection		Note (4)
20	SEL68	LVDS 6/8 bit select function control, High → 6bit Input Mode Low or NC → 8bit Input Mode		Note (3)

Note (1) Connector Part No.: Cvilux CID520D1HR0-NH or equivalent.

Note (2) User's connector Part No.: Hirose DF14-20S-1.25C or equivalent.

Note (3) "Low" stands for 0V. "High" stands for 3.3V. "NC" stands for "No Connection".

Note (4) Pin3, Pin10, Pin19 input signals should be set to no connection or ground, this module would operate normally.

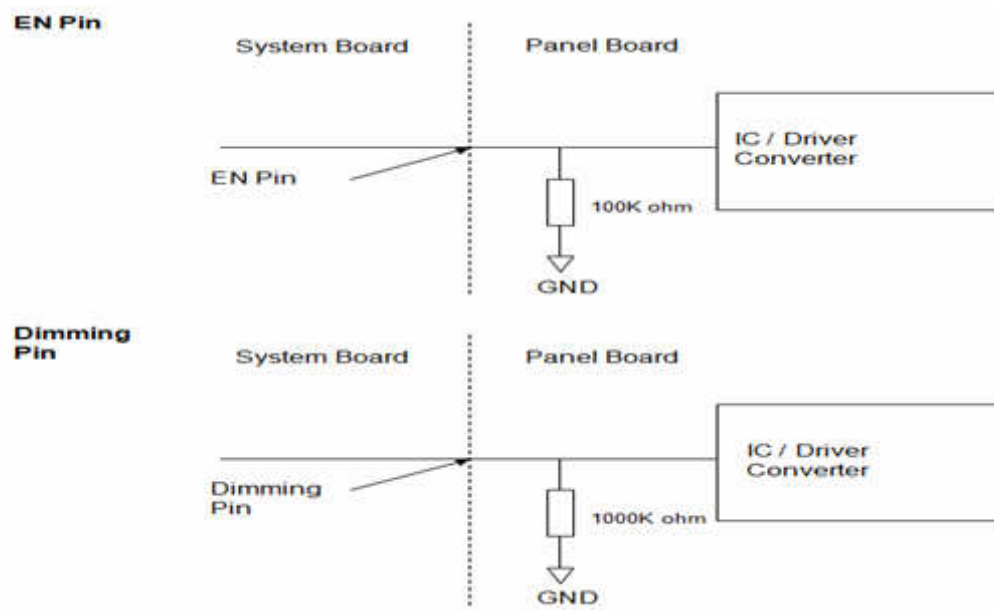


5.2 BACKLIGHT UNIT (Converter connector pin)

Pin No.	Symbol	Description	Remark
1	Vi	Converter input voltage	12V
2	V _{GND}	Converter ground	Ground
3	EN	Enable pin	3.3V
4	Dimming	Backlight Adjust	PWM Dimming (Hi: 3.3V _{DC} , Lo: 0V _{DC})
5	NC	Not Connect	

Note (1) Connector Part No.: CI4205M2HRP-NH (Cvilux) or equivalent.

Note (2) User's connector Part No.: CI4205SL000 (Cvilux) or equivalent.



5.3 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 8-bit gray scale data input for the color. The higher the binary input the brighter the color. The table below provides the assignment of color versus data input.

Color		Data Signal																							
		Red								Green								Blue							
		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 Colors	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
	Red	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	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	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
	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
	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
Gray Scale Of Red	Red(0) / Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(1)	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
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	Red(252)	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(252)	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Red(252)	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Gray Scale Of Green	Green(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Green(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
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	Green(252)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
	Green(252)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
Green(252)	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	
Gray Scale Of Blue	Blue(0) / Dark	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(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
	Blue(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
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	Blue(252)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
	Blue(252)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
Blue(252)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	

Note (1)0: Low Level Voltage, 1: High Level Voltage

6. INTERFACE TIMING

6.1 INPUT SIGNAL TIMING SPECIFICATIONS

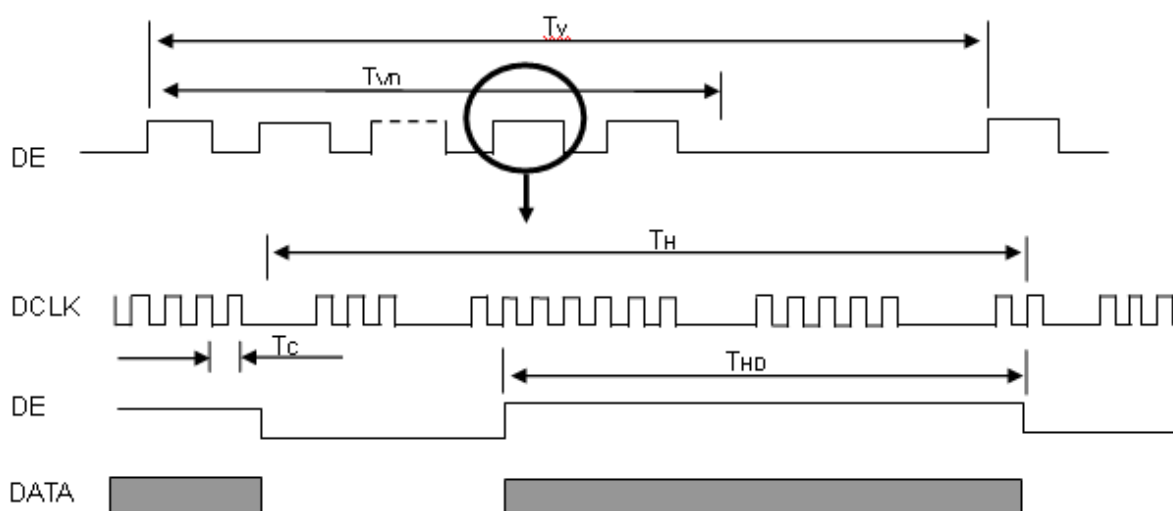
The input signal timing specifications are shown as the following table and timing diagram.

Signal	Item	Symbol	Values			Unit	Note
			MIN	TYP	MAX		
LVDS Clock	Frequency	F_C	53.35	65	80	Mhz	-
	Period	T_C	12.5	15.38	18.75	ns	-
	Input cycle to cycle jitter	T_{rd}	-	-	200	ns	(a)
	Input Clock to data skew	TLVCCS	$-0.02 \cdot T_C$	-	$0.02 \cdot T_C$	Ps	(b)
	Spread spectrum modulation range	F_{clkin_mod}	-	-	$1.02 \cdot F_C$	MHz	(c)
	Spread spectrum modulation frequency	F_{SSM}	-	-	200	KHz	
Vertical Display Term	Frame Rate	Fr	55	60	70	Hz	$T_v = T_{vd} + T_{vb}$
	Total	T_v	780	806	840	Th	-
	Active Display	T_{vd}	768	768	768	Th	-
	Blank	T_{vb}	$T_v - T_{vd}$	38	$T_v - T_{vd}$	Th	-
Horizontal Display Term	Total	T_h	1240	1344	1360	T_C	$T_h = T_{hd} + T_{hb}$
	Active Display	T_{hd}	1024	1024	1024	T_C	-
	Blank	T_{hb}	$T_h - T_{hd}$	320	$T_h - T_{hd}$	T_C	-

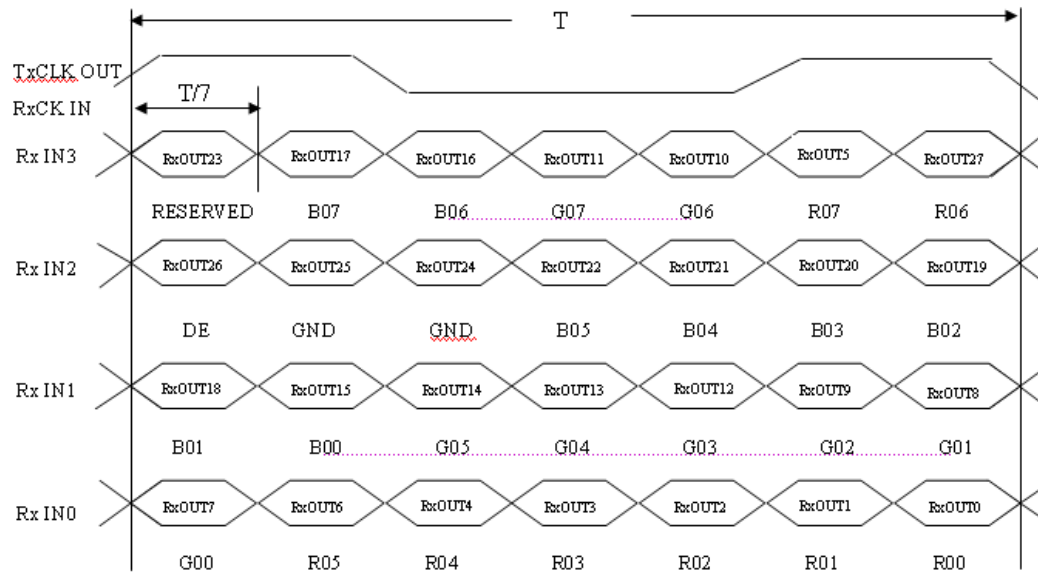
Note (1) Because this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module would operate abnormally.

Note (2) The $T_v(T_{vd} + T_{vb})$ must be integer, otherwise, the module would operate abnormally.

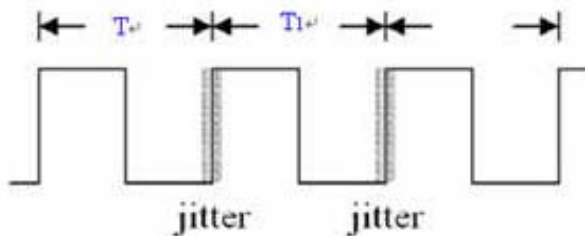
INPUT SIGNAL TIMING DIAGRAM



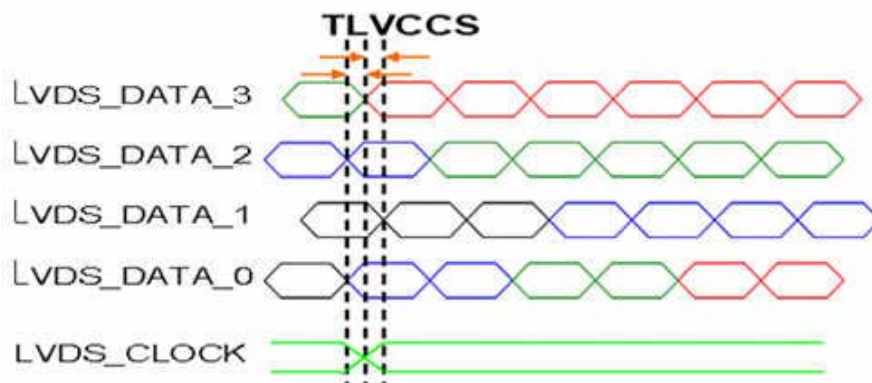
TIMING DIAGRAM of LVDS



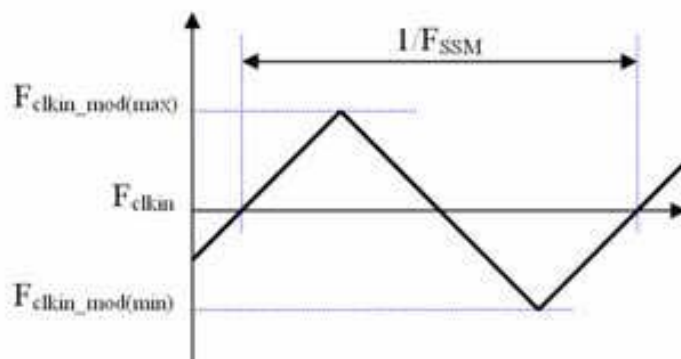
Note (a) The input clock cycle-to-cycle jitter is defined as below figures. $Trcl = |T1 - T1|$



Note (b) Input Clock to data skew is defined as below figures.

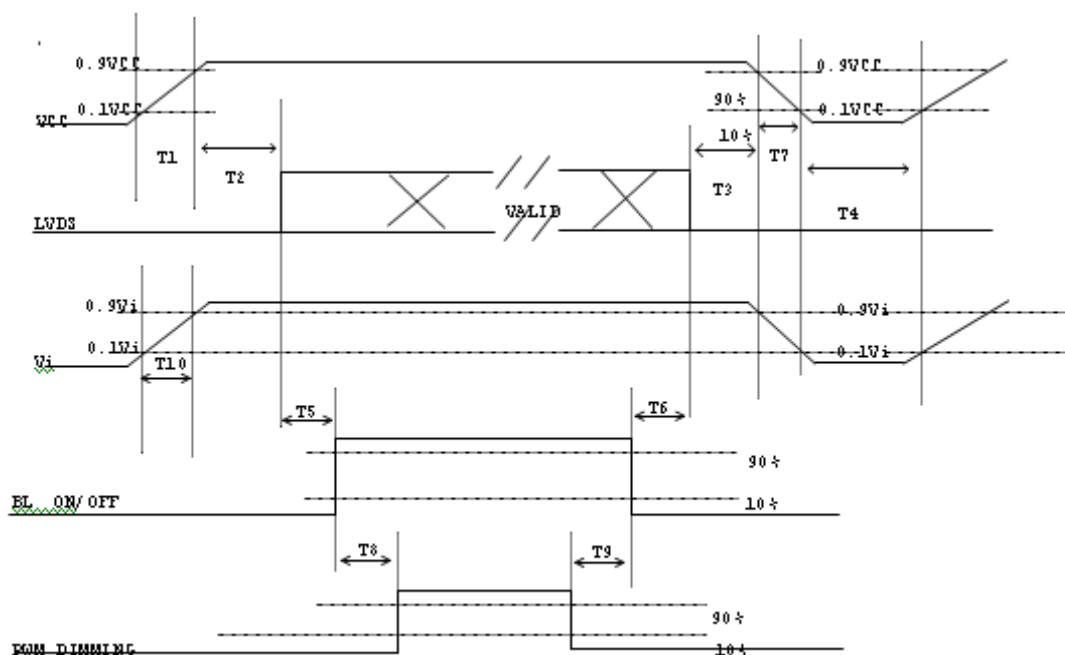


Note (c) The SSCG (Spread spectrum clock generator) is defined as below figures.



6.2 POWER ON/OFF SEQUENCE

To prevent a latch-up or DC operation of LCD assembly, the power on/off sequence should be as the diagram below.



Power ON/OFF sequence

Note (1) Please avoid floating state of interface signal at invalid period.

Note (2) When the interface signal is invalid, be sure to pull down the power supply of LCD VCC to 0 V.

Note (3) The Backlight converter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight converter power must be turned off before the power supply for the logic and the interface signal is invalid.

Parameter	Value			Units
	Min	Typ	Max	
T1	0.5	-	10	ms
T2	0	-	50	ms
T3	0	-	50	ms
T4	500	-	-	ms
T5	200	-	-	ms
T6	200	-	-	ms
T7	5	-	300	ms
T8	10	-	-	ms
T9	10	-	-	ms
T10	20		50	ms

6.3 SCANNING DIRECTION

The following figures show the image see from the front view. The arrow indicates the direction of scan.

Fig.1 Normal Scan

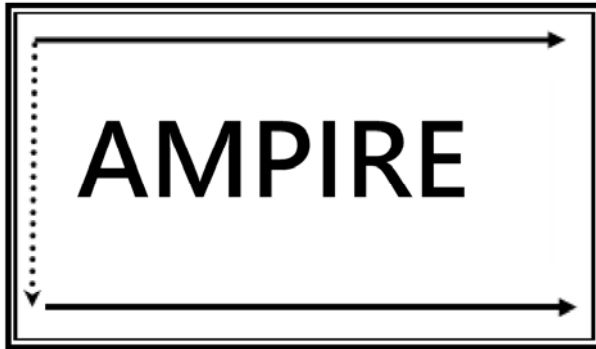


Fig.2 Reverse Scan

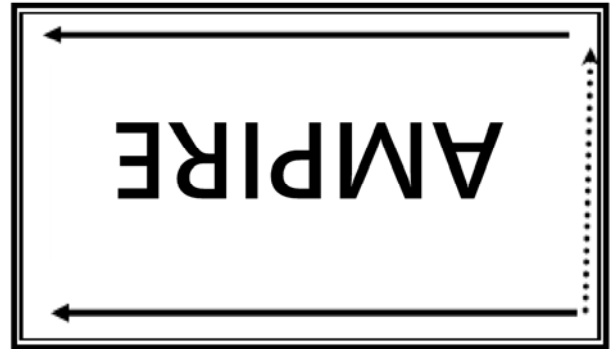


Fig. 1 Normal scan (pin 4, LR/UD = High or NC)

Fig. 2 Reverse scan (pin 4, LR/UD = Low)

7. OPTICAL CHARACTERISTICS

7.1 TEST CONDITIONS

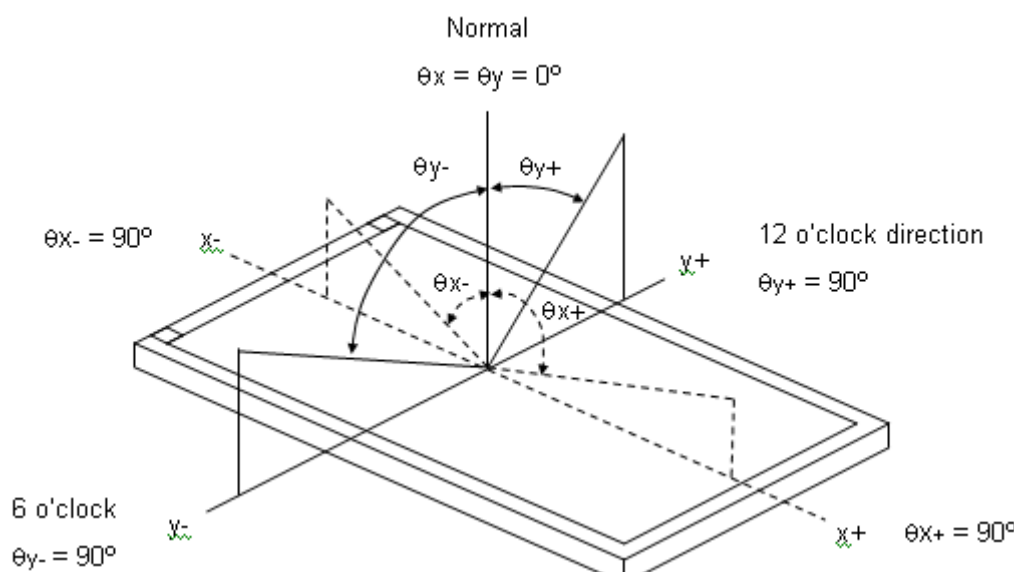
Item	Value	Unit
Ambient Temperature (Ta)	25±2	°C
Ambient Humidity (Ha)	50±10	%RH
Supply Voltage	According to typical value in "ELECTRICAL CHARACTERISTICS"	
Input Signal		
LED Light Bar Input Current Per Input Pin		

7.2 OPTICAL SPECIFICATIONS

The relative measurement methods of optical characteristics are shown in 7.2 and all items are measured at the center point of screen except white variation. The following items should be measured under the test conditions described in 7.1 and stable environment shown in Note (5).

Item		Symbol	Condition	MIN	TYP	MAX	Unit	Note
Color Chromaticity	Red	R _x	$\theta_x=0^\circ, \theta_y=0^\circ$ BM-7	Typ-0.05	0.0647	Typ-0.05	-	(1)(5)
		R _y			0.338			
	Green	G _x			0.321			
		G _y			0.606			
	Blue	B _x			0.157			
		B _y			0.039			
	White	W _x			0.313			
		W _y			0.329			
Center Luminance of White		L _C	200	255	-	cd/m2	(4)(5)	
Contrast Ratio		C _R	1300	2000	-		(2)(5)	
Response Time		T _R	$\theta_x=0^\circ, \theta_y=0^\circ$	-	16	21		(3)
		T _F		-	7	14		
White Variation		δW	$\theta_x=0^\circ, \theta_y=0^\circ$ BM-7	75	80	-	%	(5)(6)
Viewing Angle	Horizontal	θ _{x+}	CR ≥ 10	80	88	-	Deg	(1)(5)
		θ _{x-}		80	88	-		
	Vertical	θ _{y+}		80	88	-		
		θ _{y-}		80	88	-		

Note (1) Definition of Viewing Angle (θ_x, θ_y):



Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

$$\text{Contrast Ratio (CR)} = L_{255} / L_0$$

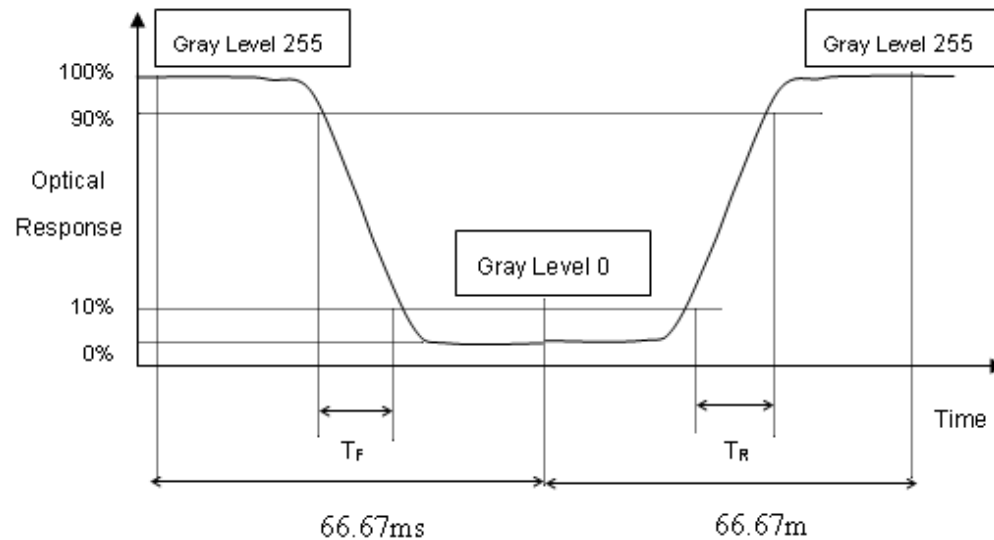
L255: Luminance of gray level 255

L0: Luminance of gray level 0

$$\text{CR} = \text{CR} (5)$$

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (6).

Note (3) Definition of Response Time (TR, TF):



Note (4) Definition of Luminance of White (Lc):

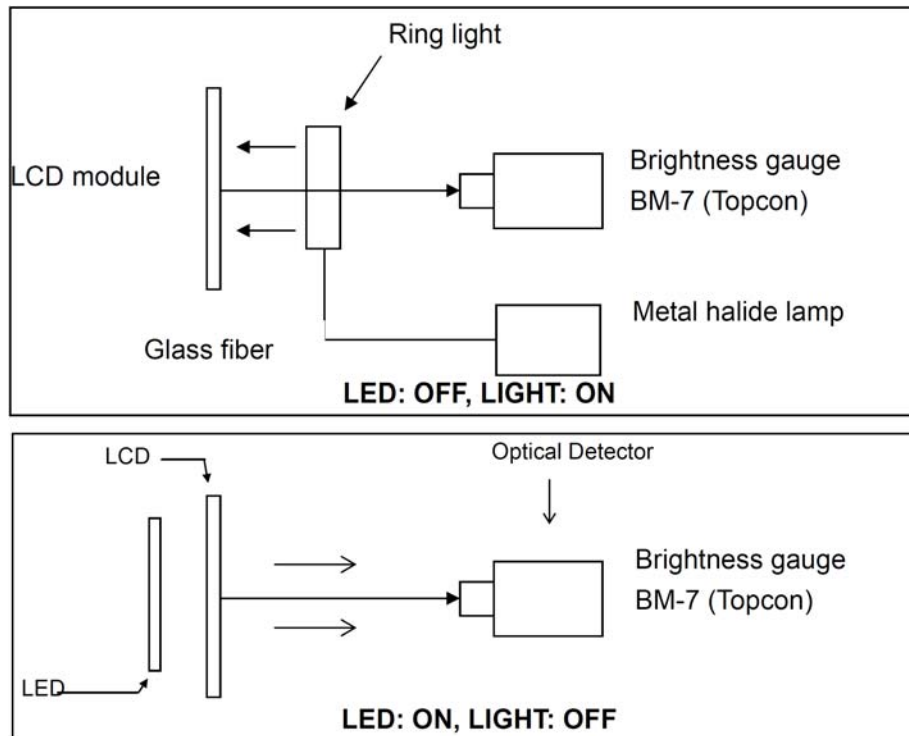
Measure the luminance of gray level 255 at center point

$$LC = L (5)$$

L (x) is corresponding to the luminance of the point X at Figure in Note (6).

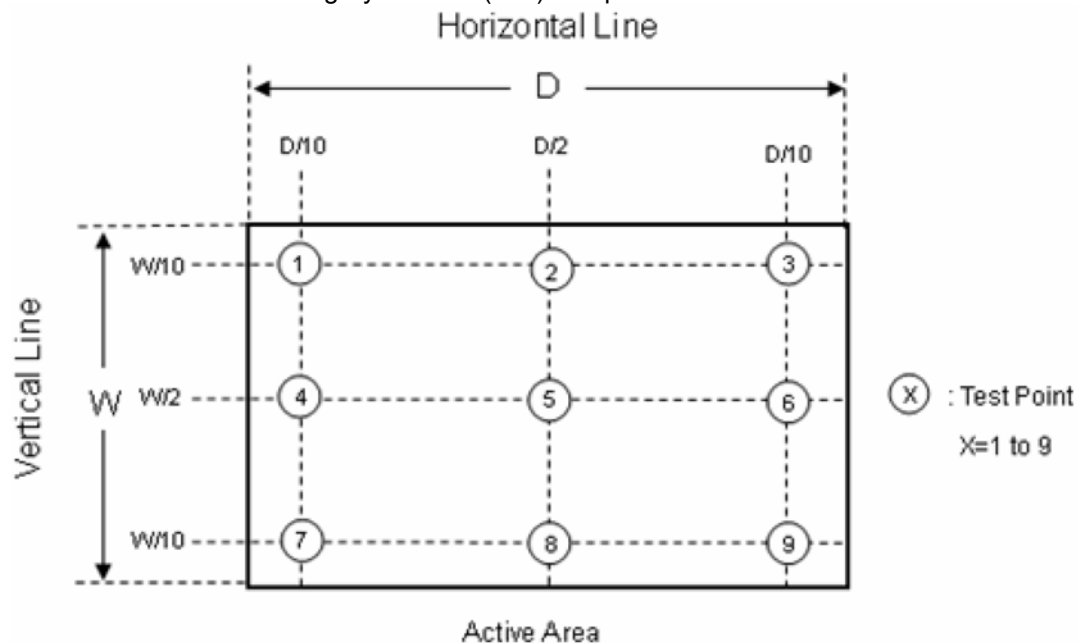
Note (5) Measurement Setup:

The LCD module should be stabilized at given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.



Note (6) Definition of White Variation (ΔW):

Measure the luminance of gray level 63 (255) at 9 points



$$\Delta L = [L(\text{min.}) \text{ of 5 points} / L(\text{max.}) \text{ of 5 points}] \times 100\%$$

8 Touch Panel Unit

8-1 Basic Characteristic

ITEM	SPECIFICATION
Type	Projective Capacitive Touch Panel
Activation	Multi-finger
X/Y Position Reporting	Absolute Position
Touch Force	No contact pressure required
Calibration	No need for calibration
Report Rate	Approx 100 points/sec
Interface/Protocol	IIC/V3.X
Control IC	IL12510
Conductive susceptibility IEC/EN61000-4-6	10Vrms
Radiated Susceptibility IEC/EN61000-4-3	30V/m
Cover Glass	2mm chemically strength glass with black border
Bonding method	CG to sensor: optical bonding
	TP module to LCM: tape bonding

8-2 Electrical Characteristic

8-2-1 IIC Interface

Specify the normal operating condition

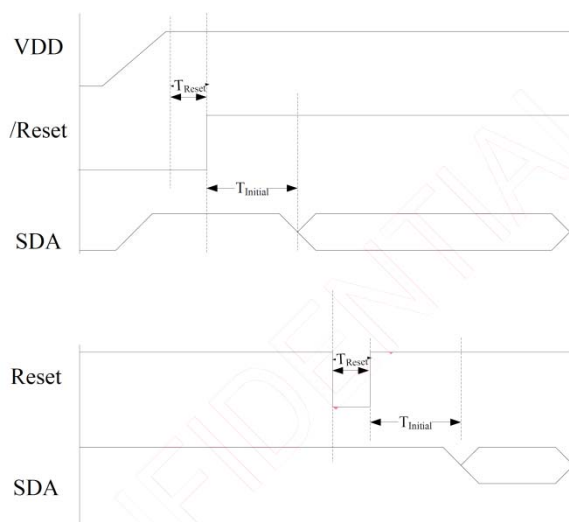
(GND=0V)

Item		Symbol	Min.	Typ.	Max.	Unit	Note
Power Supply Voltage		VIN	3	3.3	3.6	V	
Signal IIC Interface Logic level	Low	V _{IL}	0	-	0.3*VIN	V	
	High	V _{IH}	0.7*VIN	-	VIN	V	
Power Consumption		I _{VIN}		50		mA	Ref.

8-2-2 Pin definition

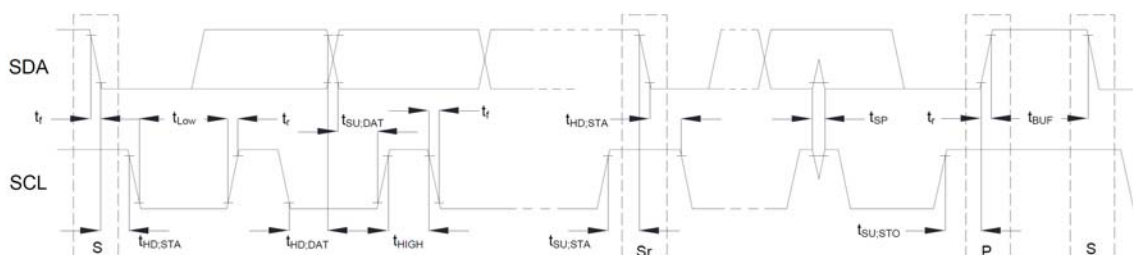
Pin	Name	Description
1	VIN	Power supply 3.3V
2	SCL	IIC Clock
3	SDA	IIC Data
4	/INT	Interrupt signal Active "Low"
5	RES	Reset touch panel controller Active "Low"
6	GND	Power GND

8-2-3 Power- on Timing Chart (IIC interface)



Symbol	Parameter	MIN.	MAX.	Unit
$T_{Initial}$	After powering-on or resetting the device, the device needs $T_{Initial}$ time to configure the system.	-	100	ms
T_{Reset}	/Reset pin low hold time	50	-	μ s

8-2-4 IIC AC Waveform



8-2-5 IIC Characteristics

Symbol	Parameter	100KHz			400KHz		
		Min	Max	Unit	Min	Max	Unit
f_{SCL}	SCL clock frequency	0	100	kHz	0	400	KHz
$t_{HD,STA}$	Hold time (repeated) START condition. After this period, the first clock pulse is generated	4.0	-	μ s	0.6	-	μ s
t_{LOW}	LOW period of the SCL clock	4.7	-	μ s	1.3	-	μ s
t_{HIGH}	HIGH period of the SCL clock	4.0	-	μ s	0.6	-	μ s
$t_{SU,STA}$	Set-up time for a repeated START condition	4.7	-	μ s	0.6	-	μ s
$t_{HD,DAT}$	Data hold time	0	3.45	μ s	0	0.9	μ s
$t_{SU,DAT}$	Data set-up time	250	-	ns	100	-	ns
t_r	Rise time of both SDA and SCL signals	-	1000	ns	-	300	ns
t_f	Fall time of both SDA and SCL signals	-	300	ns	-	300	ns
$t_{SU,STO}$	Set-up time for STOP condition	4.0	-	μ s	0.6	-	μ s
t_{BUF}	Bus free time between a STOP and START condition	4.7	-	μ s	1.3	-	μ s

8-2-6 Format Protocol

Protocol V3.X Command List

CMD Code	Name	Set /Get	Note	b7	b6	b5	b4	b3	b2	b1	b0	
0x10	Touch Information	Get		0: No touch 1: Last Report at ID 0 to ID 5 (include release status) 2: Last Report at ID 6 to ID 9 (include release status)								
			ID0	1: Touch Down, 0: Touch Off		0	X_High direction coordinate					
				X_Low direction coordinate								
				0		0	Y_High direction coordinate					
				Y_Low direction coordinate								
				Touch Pressure								
				ID1	1: Touch Down, 0: Touch Off		0	X_High direction coordinate				
			X_Low direction coordinate									
			0		0	Y_High direction coordinate						
			Y_Low direction coordinate									
			Touch Pressure									
			ID2		1: Touch Down, 0: Touch Off		0	X_High direction coordinate				
				X_Low direction coordinate								
				0		0	Y_High direction coordinate					
				Y_Low direction coordinate								
				Touch Pressure								
				ID3	1: Touch Down, 0: Touch Off		0	X_High direction coordinate				
					X_Low direction coordinate							
					0		0	Y_High direction coordinate				
					Y_Low direction coordinate							
					Touch Pressure							
					ID4	1: Touch Down, 0: Touch Off		0	X_High direction coordinate			
				X_Low direction coordinate								
				0		0	Y_High direction coordinate					
				Y_Low direction coordinate								
			Touch Pressure									

			ID5	1: Touch Down, 0: Touch Off	0	X_High direction coordinate
				X_Low direction coordinate		
				0	0	Y_High direction coordinate
				Y_Low direction coordinate		
				Touch Pressure		
0x14	Touch Information 2	Get	ID6	1: Touch Down, 0: Touch Off	0	X_High direction coordinate
				X_Low direction coordinate		
				0	0	Y_High direction coordinate
				Y_Low direction coordinate		
				Touch Pressure		
			ID7	1: Touch Down, 0: Touch Off	0	X_High direction coordinate
				X_Low direction coordinate		
				0	0	Y_High direction coordinate
				Y_Low direction coordinate		
				Touch Pressure		
			ID8	1: Touch Down, 0: Touch Off	0	X_High direction coordinate
				X_Low direction coordinate		
				0	0	Y_High direction coordinate
				Y_Low direction coordinate		
				Touch Pressure		
			ID9	1: Touch Down, 0: Touch Off	0	X_High direction coordinate
				X_Low direction coordinate		
				0	0	Y_High direction coordinate
				Y_Low direction coordinate		
				Touch Pressure		
0x20				The maximum X coordinate (bit 7:0)		
				The maximum X coordinate (bit 15:8)		
				The maximum Y coordinate (bit 7:0)		
				The maximum Y coordinate (bit 15:8)		
				The channel numbers of X direction		
				The channel numbers of Y direction		
				The maximum report points		

				The channel numbers of TouchKey / Scrolling Bar
				For Touch Key Application (Maximum supports 31 Touch Key) Byte 8 : The Touch Key number (<32) Byte 9: 0xFF
0x30	Enter Sleep Mode	Set		--
0x40	Firmware Version	Get		Chip ID Code
				Major firmware version
				Minor firmware version
				Release firmware version
				For Customer Firmware Version
				For Customer Firmware Version
				For Customer Firmware Version
				For Customer Firmware Version
0x42		Get		Major protocol version : 0x03
				Minor protocol version : XX
				Release protocol version : XX

Protocol V3.X Data Format

CMD Code	Name	Set / Get	Note	b7	b6	b5	b4	b3	b2	b1	b0
0x10	Touch Information	Get	Packet Number	0: No touch 1: Last Report at ID 0 to ID 5 (include release status) 2: Last Report at ID 6 to ID 9 (include release status)							
			ID0	1: Touch Down, 0: Touch Off	0	X_High direction coordinate					
		X_Low direction coordinate									
		0		0	Y_High direction coordinate						
		Y_Low direction coordinate									
		Touch Pressure									

			ID1	1: Touch Down, 0: Touch Off	0	X_High direction coordinate
				X_Low direction coordinate		
				0	0	Y_High direction coordinate
				Y_Low direction coordinate		
				Touch Pressure		
			ID2	1: Touch Down, 0: Touch Off	0	X_High direction coordinate
				X_Low direction coordinate		
				0	0	Y_High direction coordinate
				Y_Low direction coordinate		
				Touch Pressure		
			ID3	1: Touch Down, 0: Touch Off	0	X_High direction coordinate
				X_Low direction coordinate		
				0	0	Y_High direction coordinate
				Y_Low direction coordinate		
				Touch Pressure		
			ID4	1: Touch Down, 0: Touch Off	0	X_High direction coordinate

				X_Low direction coordinate		
				0	0	Y_High direction coordinate
				Y_Low direction coordinate		
				Touch Pressure		
			ID5	1: Touch Down, 0: Touch Off	0	X_High direction coordinate
				X_Low direction coordinate		
				0	0	Y_High direction coordinate
				Y_Low direction coordinate		
				Touch Pressure		

8-2-7 Interrupt Pin (INT) Control

When a finger touches on the sensor surface, the INT pin will be pull low. TP controller supports two different type control method.

Method 1(Polling): The \overline{INT} will continue to be low until the finger leaves the sensor surface.

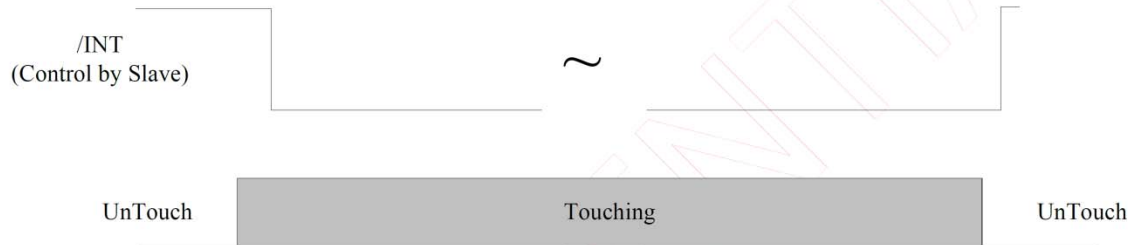


Fig 9: Method 1: \overline{INT} Pin Control Diagram (Finger Touch)

Method 2(Interrupt): The \overline{INT} will continue to be pull low until host read 0x10 command.

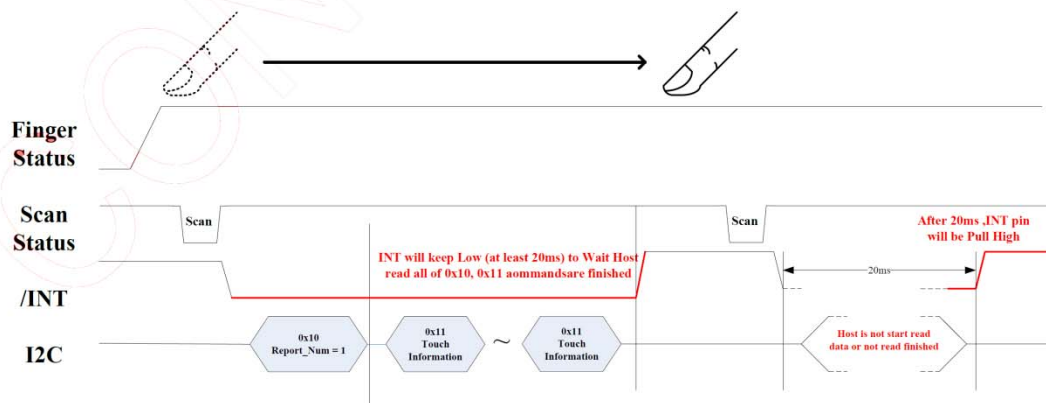


Fig 10: Method 2: \overline{INT} Pin Control Diagram (Finger Touch)

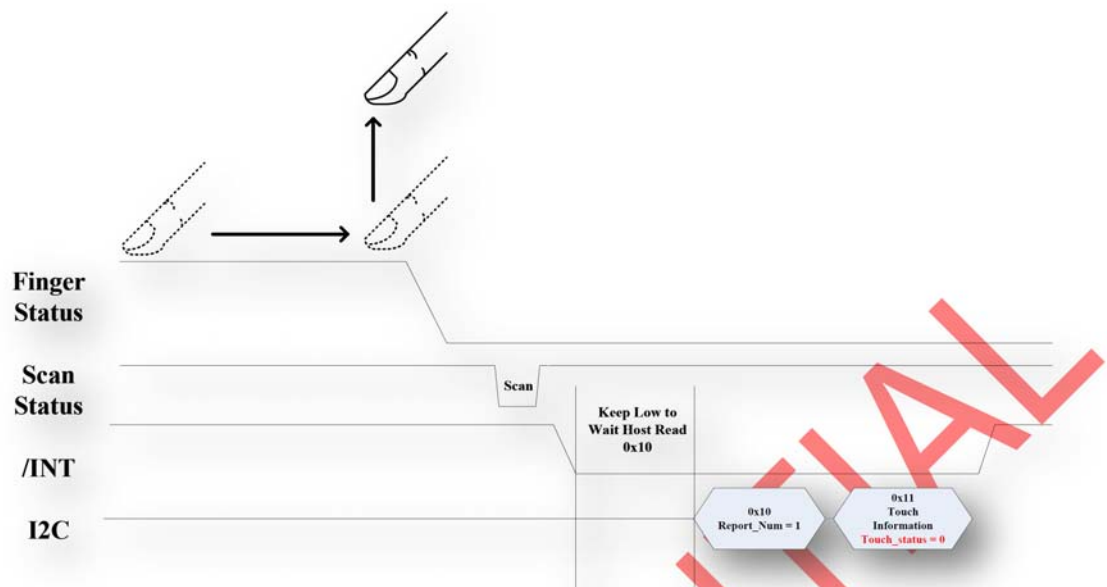


Fig 11: Method 2: $\overline{\text{INT}}$ Pin Control Diagram (Finger Release)

8-2-8 Device Address

MSB							LSB
1	0	0	0	0	0	1	0/1
Device Address							R/W

7-bit Device Address: 0x41

8-bit Device Read Address:0x83

8-bit Device Write Address:0x82

8-2-9 Data Transfer

Data is transferred over the IIC bus with 8-bit address and 8-bit data.

1	7	1	1	8	1	1
S	Slave Address	Wr	A	Data Byte	A	P

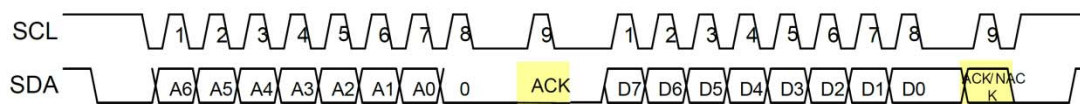
- S Start Condition
- Sr Repeated Start Condition
- Rd Read (bit value of 1)
- Wr Write (bit value of 0)
- A/NA Acknowledge (this bit position may be '0' for an ACK or '1' for a NACK)
- P Stop Condition
- | |
|-----|
| |
| |
| --- |

 Master-to-Slave
- | |
|-----|
| |
| |
| --- |

 Slave-to-Master
- | |
|-----|
| |
| |
| --- |

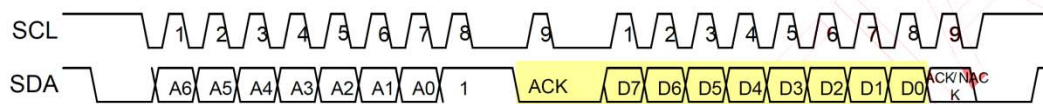
 Continue

I2C Write timing



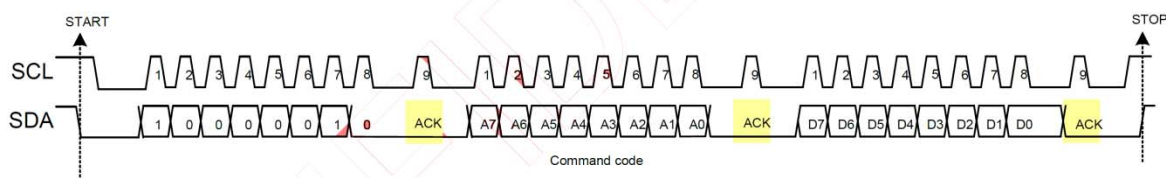
 => slave to master

I2C Read timing



 => slave to master

Byte Write



S	Slave Address	Wr	A	Command Code	A	Data Byte	A	P
---	---------------	----	---	--------------	---	-----------	---	---

: Byte Write

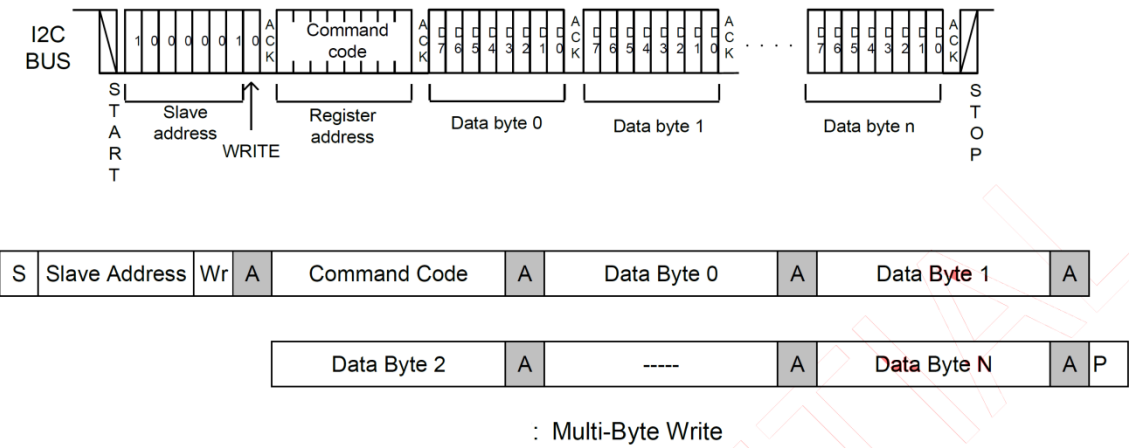
Byte Read

c

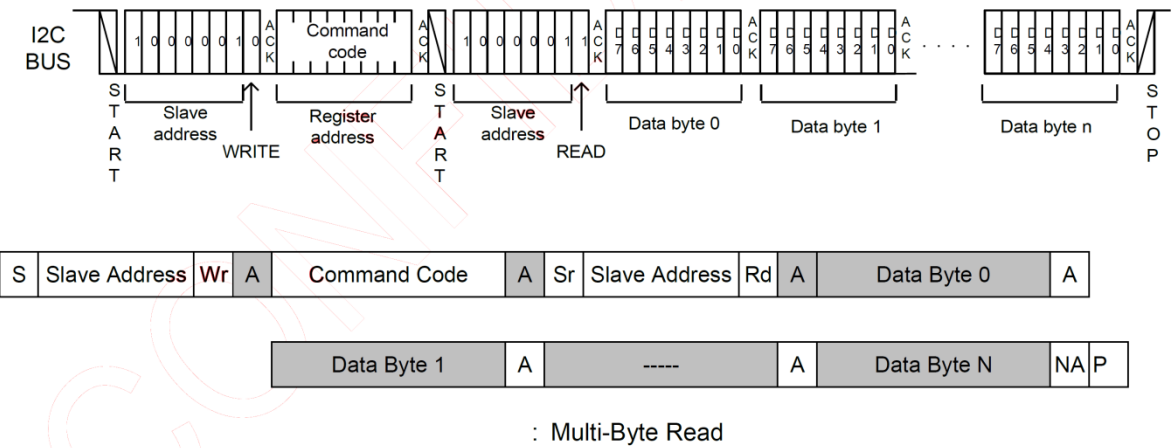
S	Slave Address	Wr	A	Command Code	A	Sr	Slave Address	Rd	A	Data Byte	A	P
---	---------------	----	---	--------------	---	----	---------------	----	---	-----------	---	---

: Byte Read

Multi-Byte Write



Multi-Byte Read



9. ELIABILITY TEST CONDITIONS

Test Item	Test Conditions	Note
High Temperature Operation	70°C , t=240 hrs	
Low Temperature Operation	-30°C , t=240 hrs	
High Temperature Storage	70°C , t=240 hrs	1,2
Low Temperature Storage	-20°C , t=240 hrs	1,2
Storage at High Temperature and Humidity	60°C, 90% RH , 240 hrs	1,2
Thermal Shock Test	-30°C (30min) ~ 70°C (30min) 100 cycles	1,2
Vibration Test (Packing)	Sweep frequency : 10 ~ 55 ~ 10 Hz/1min Amplitude : 0.75mm Test direction : X.Y.Z/3 axis Duration : 30min/each axis	2

Note 1 : Condensation of water is not permitted on the module.

Note 2 : The module should be inspected after 1 hour storage in normal conditions (15-35°C , 45-65%RH).

Note 3 : The module shouldn't be tested more than one condition, and all the test conditions are independent.

Note 4 : All the reliability tests should be done without protective film on the module.

10. GENERAL PRECAUTION

10-1 Safety

Liquid crystal is poisonous. Do not put it your mouth. If liquid crystal touches your skin or clothes, wash it off immediately by using soap and water.

10-2 Handling

1. The LCD panel is plate glass. Do not subject the panel to mechanical shock or to excessive force on its surface.
2. The polarizer attached to the display is easily damaged. Please handle it carefully to avoid scratch or other damages.
3. To avoid contamination on the display surface, do not touch the module surface with bare hands.
4. Keep a space so that the LCD panels do not touch other components.
5. Put cover board such as acrylic board on the surface of LCD panel to protect panel from damages.
6. Transparent electrodes may be disconnected if you use the LCD panel under environmental conditions where the condensation of dew occurs.
7. Do not leave module in direct sunlight to avoid malfunction of the ICs.

10-3 Static Electricity

1. Be sure to ground module before turning on power or operation module.
2. Do not apply voltage which exceeds the absolute maximum rating value.

10-4 Storage

1. Store the module in a dark room where must keep at $+25\pm 10^{\circ}\text{C}$ and 65%RH or less.
2. Do not store the module in surroundings containing organic solvent or corrosive gas.
3. Store the module in an anti-electrostatic container or bag.

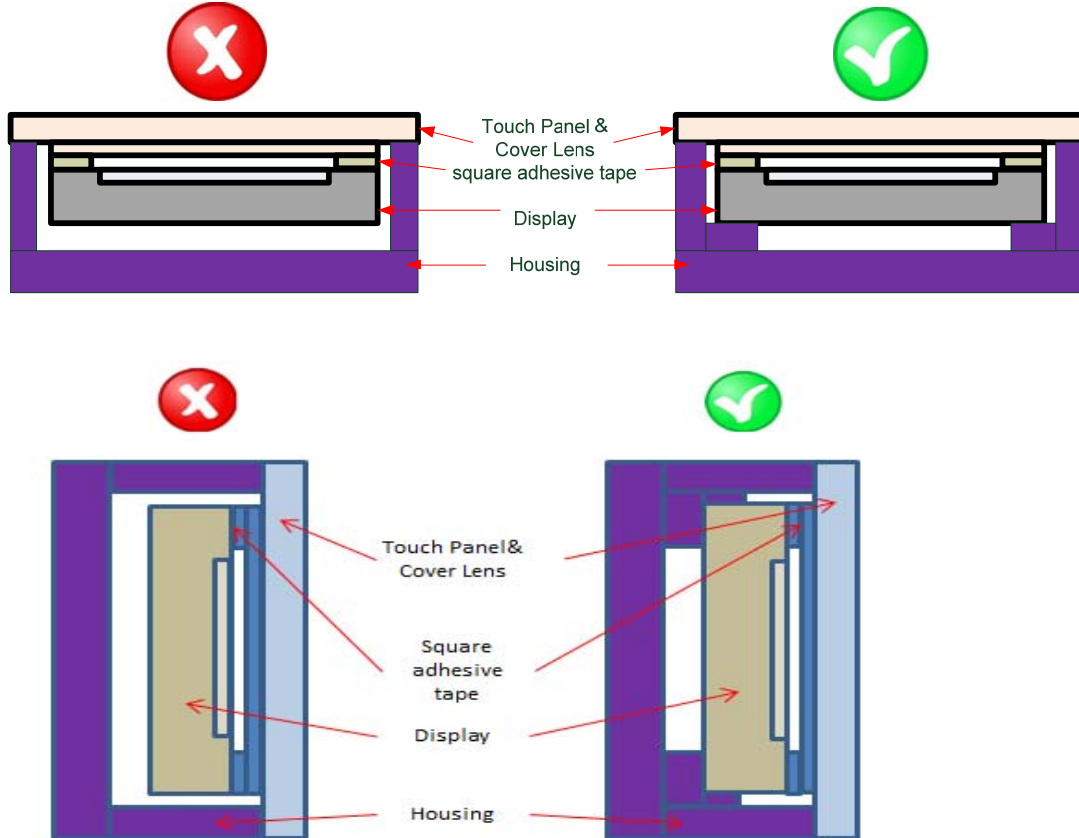
10-5 Cleaning

1. Do not wipe the polarizer with dry cloth. It might cause scratch.
2. Only use a soft sloth with IPA to wipe the polarizer, other chemicals might permanent damage to the polarizer.

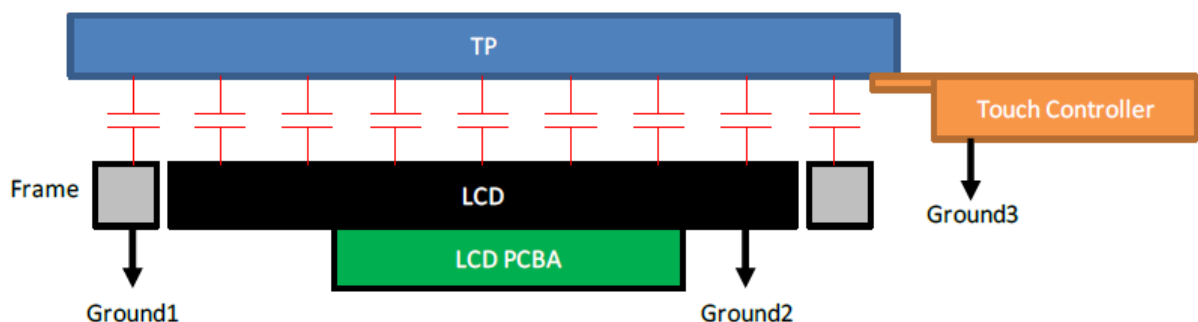
10-6 Mechanism (if the LCM using air bonding)

(1) Please mount LCD module by using mounting holes arranged in four corners tightly.

(2) The square adhesive tape which is between the touch panel and display can't provide well supporting in the long term and high ambient temperature condition. Whether upright or horizontal position the support holder which is in the back side of the display is needed. Do not let the display floating.



(3) TP needs to work in environment with stable stray capacitance. In order to minimize the variation in stray capacitance, all conductive mechanical parts must not be floating. Intermittent floating any conductive part around the touch sensor may cause significant stray capacitance change and abnormal touch function. It is recommended to keep all conductive parts having same electrical potential as the GND of the touch controller module.



GND1, GND2 and GND3 should be connected together to have the same ground

10-7 Others

1. AMIPRE will provide one year warrantee for all products and three months warrantee for all repairing products.
2. Do not keep the LCD at the same display pattern continually. The residual image will happen and it will damage the LCD. Please use screen saver

11. OUTLINE DIMENSION

