



晶采光電科技股份有限公司
AMPIRE CO., LTD.

SPECIFICATIONS FOR LCD MODULE

CUSTOMER	
CUSTOMER PART NO.	
AMPIRE PART NO.	AM-320240L4TMQW-B9H
APPROVED BY	
DATE	

- Approved For Specifications
- Approved For Specifications & Sample

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RECORD OF REVISION

Revision Date	Page	Contents	Editor
2015/8/7	--	New Release	Patrick
2015/8/27	8	Add LED life time	Patrick

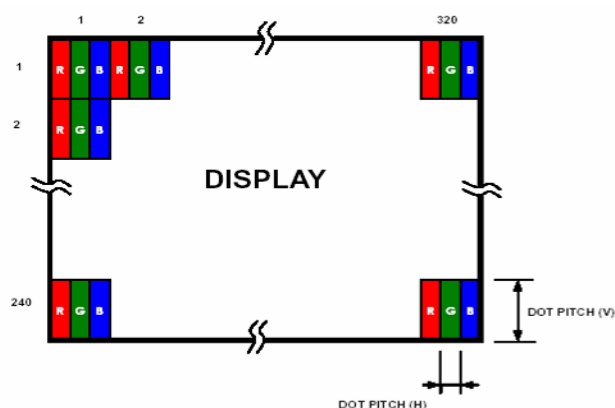
1 General Description and Features

3.5 inch Amorphous-TFT-LCD (Thin Film Transistor Liquid Crystal Display) module. This module is composed of a 3.5" TFT-LCD panel, a driver circuit and backlight unit.

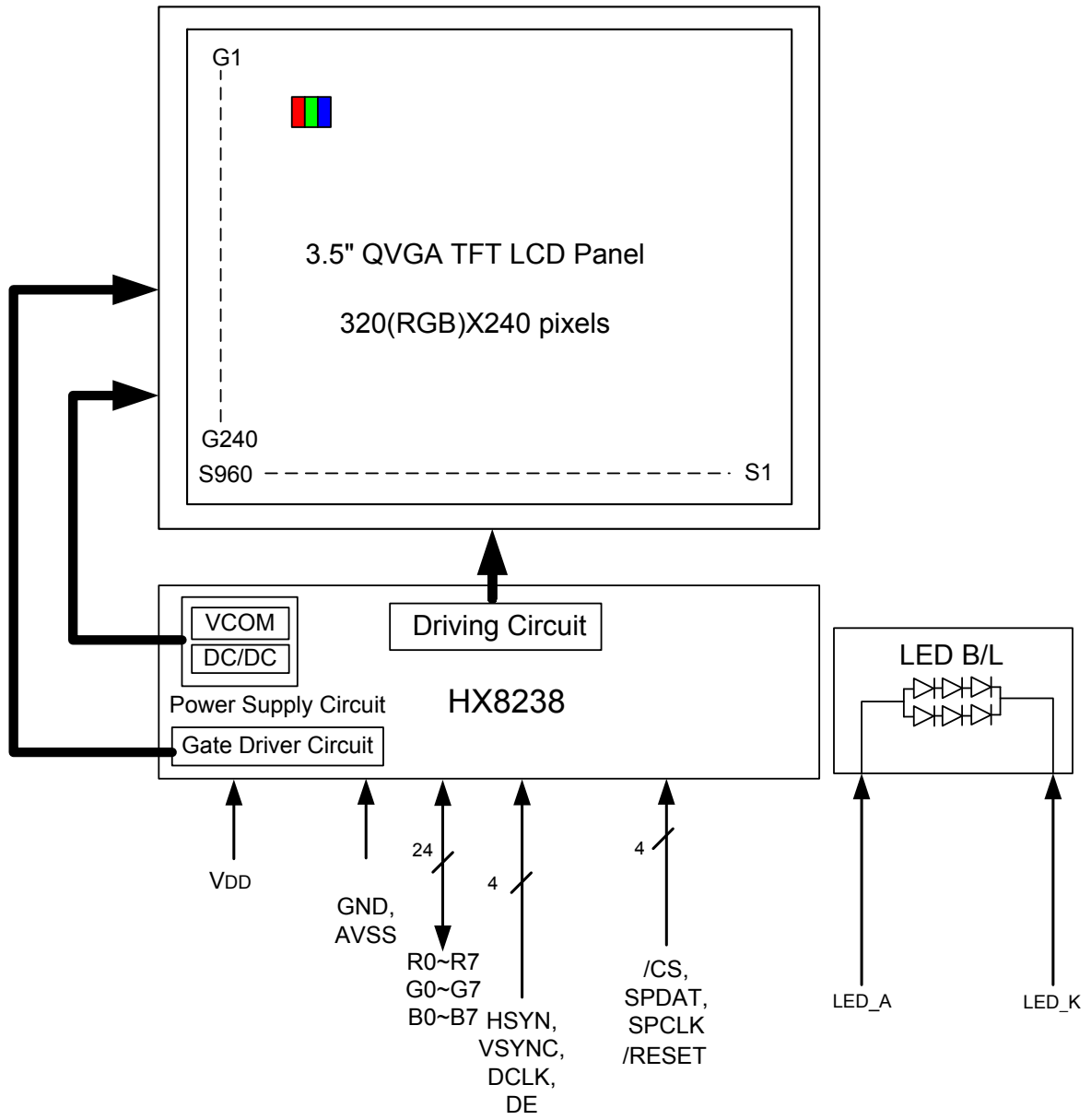
- 1.1 Construction: 3.5" a-Si color TFT-LCD, White LED Backlight and PCB.
- 1.2 Resolution (pixel): 320(R.G.B) X240.
- 1.3 Number of the Colors: 16M colors (R, G, B 8 bit digital each).
- 1.4 LCD type: Transmissive Color TFT LCD (normally White).
- 1.5 View Angle: 6 o'clock.(Gray Inversion)
- 1.6 24Bit RGB Interface.
- 1.7 Interface: 54 pin.
- 1.8 Power Supply Voltage: 3.3V single power input. Built-in power supply circuit.
- 1.9 LED Type Backlight.

2 Physical specifications

Item	Specifications	unit
Display Resolution	320(W) x 240(H)	dot
Active area	70.08 x 52.56	mm
Screen size	3.5(Diagonal)	inch
Dot pitch	0.073 (W) x 0.219 (H)	mm
Color configuration	R.G.B – stripe	
Overall Dimension	77.8(W) x 64.5(H) x 3.2(T)	mm
Input interface	digital 24-bits RGB	
Surface Treatment	Anti - glare(AG)	
Backlight unit	White LED	
Display Mode	Normally White/Transmissive	



3 Functional Block Diagram



4 Electrical Specifications

TFT LCD Panel FPC Descriptions

Pin no	Symbol	I/O	Description	Remark
1	VBL1-	I	Backlight LED	
2	VBL1-	I	Backlight LED	
3	VBL1+	I	Backlight LED	
4	VBL1+	I	Backlight LED	
5	SDO		Serial Data Output	Note1
6	/RESET		Hardware Reset	
7	/CS	I	Chip select	Note1
8	NC(Y2)	I	No connection	
9	NC(X1)	I	No connection	
10	NC(Y1)	I	No connection	
11	NC(X2)	I	No connection	
12.	B0	I	Blue Data Bit 0	
13.	B1	I	Blue Data Bit 1	
14.	B2	I	Blue Data Bit 2	
15.	B3	I	Blue Data Bit 3	
16.	B4	I	Blue Data Bit 4	
17.	B5	I	Blue Data Bit 5	
18.	B6	I	Blue Data Bit 6	
19.	B7	I	Blue Data Bit 7	
20.	G0	I	Green Data Bit 0	
21.	G1	I	Green Data Bit 1	
22.	G2	I	Green Data Bit 2	
23.	G3	I	Green Data Bit 3	
24.	G4	I	Green Data Bit 4	
25.	G5	I	Green Data Bit 5	
26.	G6	I	Green Data Bit 6	
27.	G7	I	Green Data Bit 7	
28.	R0	I	Red Data Bit 0	
29.	R1	I	Red Data Bit 1	
30.	R2	I	Red Data Bit 2	
31.	R3	I	Red Data Bit 3	
32.	R4	I	Red Data Bit 4	
33.	R5	I	Red Data Bit 5	
34.	R6	I	Red Data Bit 6	
35.	R7	I	Red Data Bit 7	
36.	HSYNC	I	Horizontal Sync Input	
37.	VSYNC	I	Vertical Sync Input	
38.	DCLK	I	Dot Data Clock	
39.	NC		Not Use	NC
40	NC		Not Use	NC
41	VCC	I	Digital Power	3.3V
42	VCC	I	Digital Power	3.3V
43	NC		Not Use	
44	NC		Not Use	
45	VGL		Keep NC.	

46	NC		Not Use	NC
47	VGH		Keep NC	VGH
48	NC		Not Use	
49	SPCLK	I	SPI Interface Data Clock	Note1
50	SPDAT	I	SPI Interface Data	Note1
51.	NC		Not Use	
52.	DE	I	Data Enable Input	
53.	AVSS	I	Ground	
54.	GND	I	Ground	

**Note1: Please use SPI Interface to enable DE Mode;
Keep Pin5, 49, 50 NC while SYNC Mode used.**

5 Basic Display Color and Gray Scale

Color		Input Color Data																							
		Red								Green								Blue							
		MSB				LSB				MSB				LSB				MSB				LSB			
		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(255)	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(255)	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(255)	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
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
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(253)	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(254)	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(255) Bright	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	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	1	0	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
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(253)	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
	Green(254)	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
Green(255) Bright	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	
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	0	1	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(253)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	1
	Blue(254)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0
Blue(255) Bright	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	

6 Absolute Maximum Ratings

If the operating condition exceeds the following absolute maximum ratings, the TFT LCD module may be damaged permanently.

6.1 Environmental Absolute max. ratings

Item	OPERATING		STORAGE		Remark
	MIN	MAX	MIN	MAX	
Temperature	-20	70	-30	80	Note2,3,4,5,6,7,8
Humidity	Note1		Note1		
Corrosive Gas	Not Acceptable		Not Acceptable		

Note1 : $T_a \leq 40^\circ\text{C}$: 85% RH max

$T_a > 40^\circ\text{C}$: Absolute humidity must be lower than the humidity of 85%RH at 40°C

Note2 : For storage condition T_a at $-30^\circ\text{C} < 48\text{h}$, at $80^\circ\text{C} < 100\text{h}$

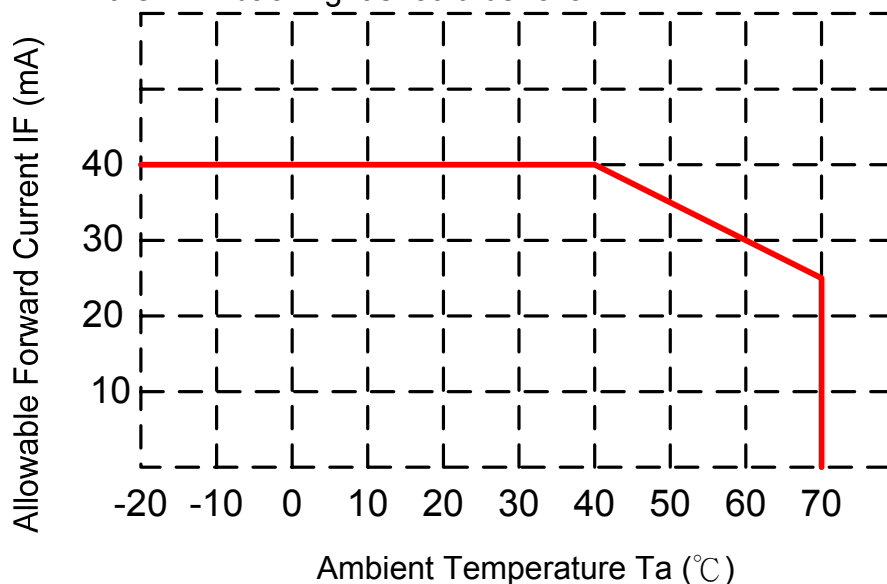
For operating condition T_a at $-20^\circ\text{C} < 100\text{h}$

Note3 : Background color changes slightly depending on ambient temperature. This phenomenon is reversible.

Note4 : The response time will be slower at low temperature.

Note5 : Only operation is guaranteed at operating temperature. Contrast , response time, another display quality are evaluated at $+25^\circ\text{C}$

Note6 : When LCM is operated over 40°C ambient temperature, the I_{LED} of the LED back-light should be follow :



Note7 : This is panel surface temperature, not ambient temperature.

Note8 : When LCM be operated over than 40°C , the life time of the LED back-light will be reduced.

6.2 Electrical Absolute max. ratings

Item	Symbol	Condition	Min.	Max.	Unit	Remark
Power voltage	VDD	VSS=0	-0.3	6.0	V	
Input voltage	V _{in}		-0.3	VDD+0.3	V	Note 1

Note1:Hsync, Vsync, DEN, DCLK, R0~R5, G0~G5, B0~B5

7 Electrical Characteristics

7.1 DC Electrical characteristic of the LCD

Typical operating conditions (VSS=0V)

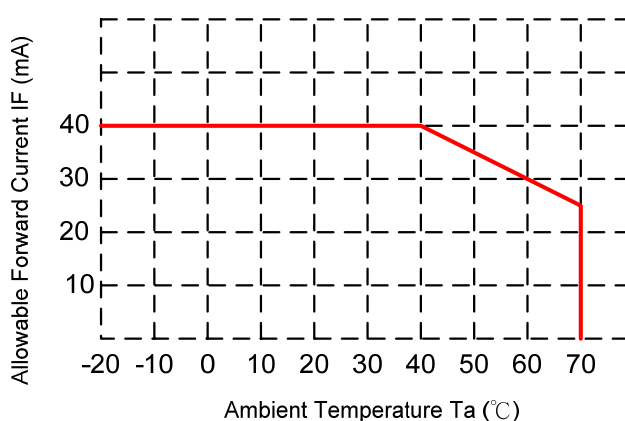
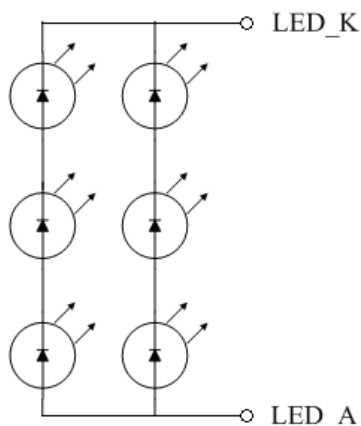
Item	Symbol	Min.	Typ.	Max.	Unit	Remark	
Power supply	VDD	3.0	3.3	3.6	V		
Input Voltage for logic	H Level	V _{IH}	0.7 VDD	-	VDD	V	Note 1
	L Level	V _{IL}	0	-	0.3 VDD	V	
Power Supply current	IDD		13	--	mA	Note 2	

Note1: Hsync, Vsync, DEN, DCLK, R0~R5, G0~G5, B0~B5

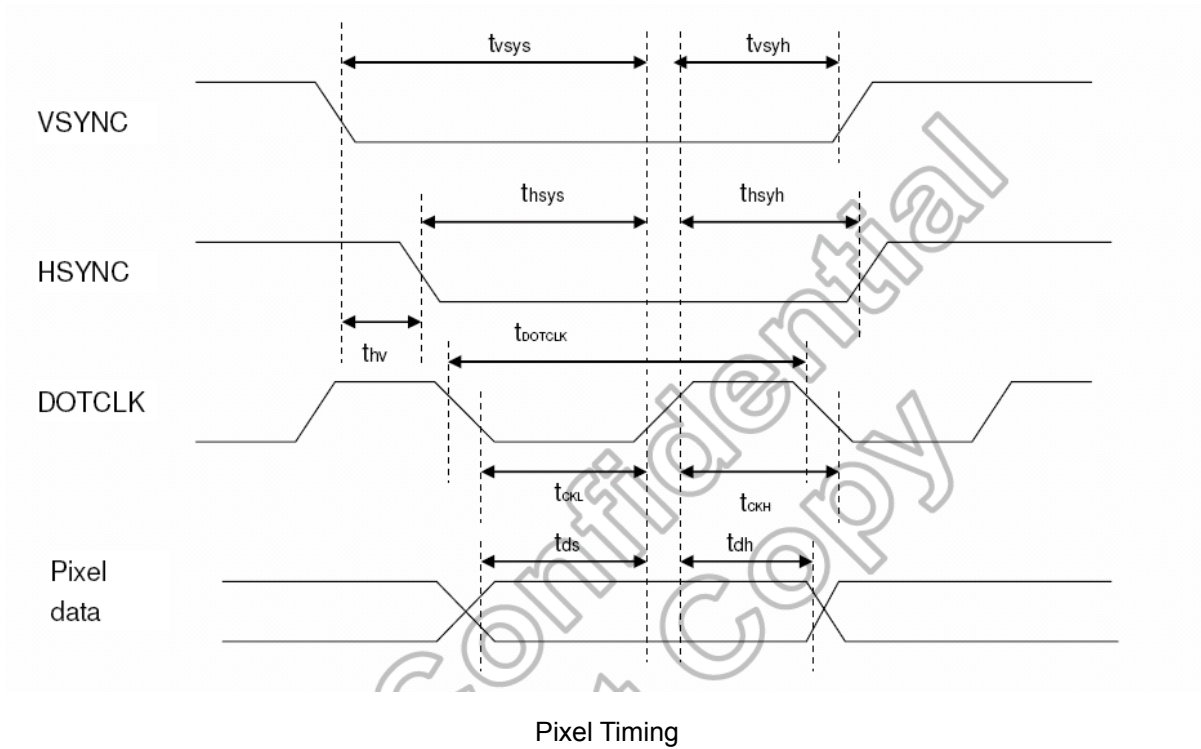
Note2: fv =60Hz , Ta=25°C , Display pattern : All Black

7.2 Electrical characteristic of LED Back-light

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
LED voltage	V _{AK}	-	9.6	-	V	I _{LED} =40mA, Ta=25°C
LED forward current	I _{LED}	--	40	-	mA	Ta=25°C
	I _{LED}	--	30	-	mA	Ta=60°C
LED life time			30K		Hr	Ta=25°C, Estimated data



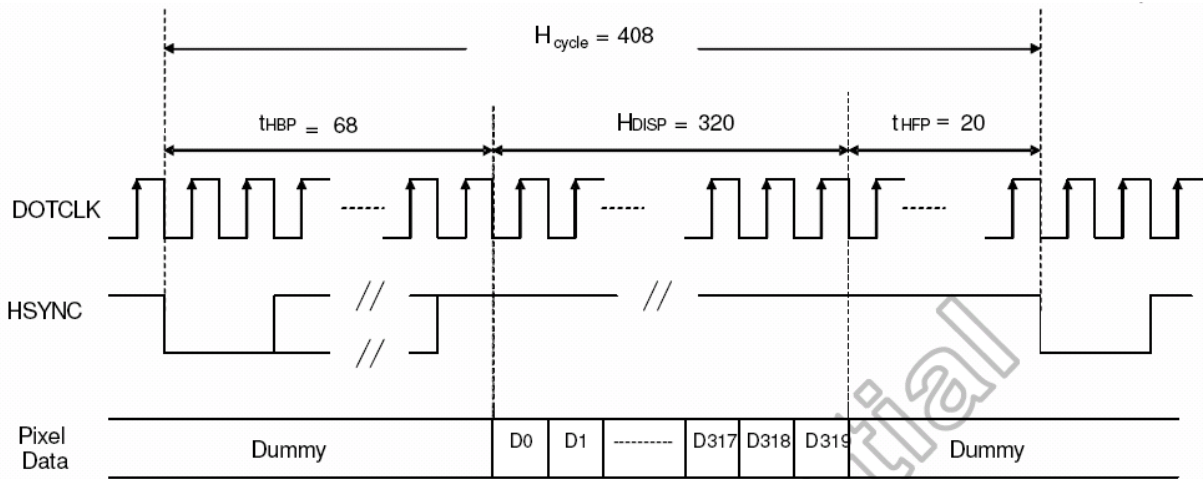
8 AC Timing characteristic of the LCD



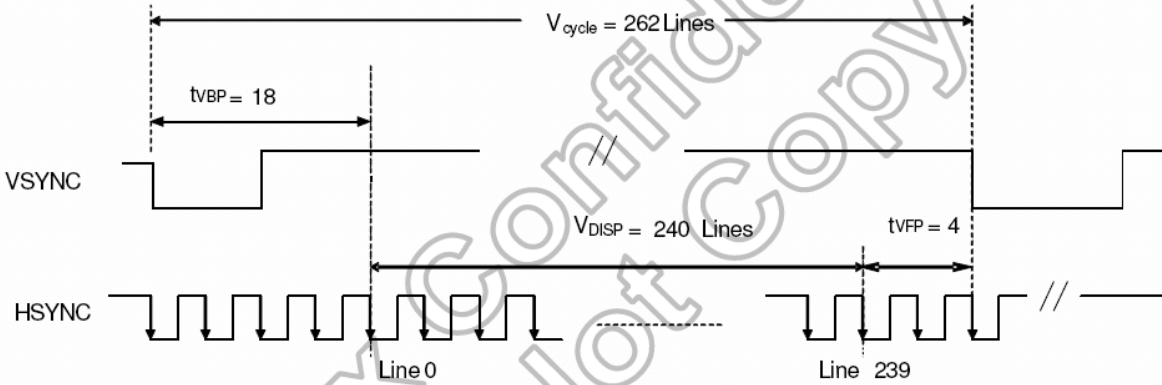
Characteristics	Symbol	Min		Typ		Max		Unit
		24 bit	8 bit	24 bit	8 bit	24 bit	8 bit	
DOTCLK Frequency	f _{DOTCLK}	-	-	6.5	19.5	10	30	MHz
DOTCLK Period	t _{DOTCLK}	100	33.3	154	51.3	-	-	ns
Vertical Sync Setup Time	t _{vsys}	20	10	-	-	-	-	ns
Vertical Sync Hold Time	t _{vsyh}	20	10	-	-	-	-	ns
Horizontal Sync Setup Time	t _{hsys}	20	10	-	-	-	-	ns
Horizontal Sync Hold Time	t _{hsyh}	20	10	-	-	-	-	ns
Phase difference of Sync Signal Falling Edge	t _{hv}	1		-		240		t _{DOTCLK}
DOTCLK Low Period	t _{CKL}	50	15	-	-	-	-	ns
DOTCLK High Period	t _{CKH}	50	15	-	-	-	-	ns
Data Setup Time	t _{ds}	12	10	-	-	-	-	ns
Data hold Time	t _{dh}	12	10	-	-	-	-	ns
Reset pulse width	t _{RES}	10		-		-		us

Note: External clock source must be provided to DOTCLK pin of HX8238-A. The driver will not operate if absent of the clocking signal.

Pixel Timing Table

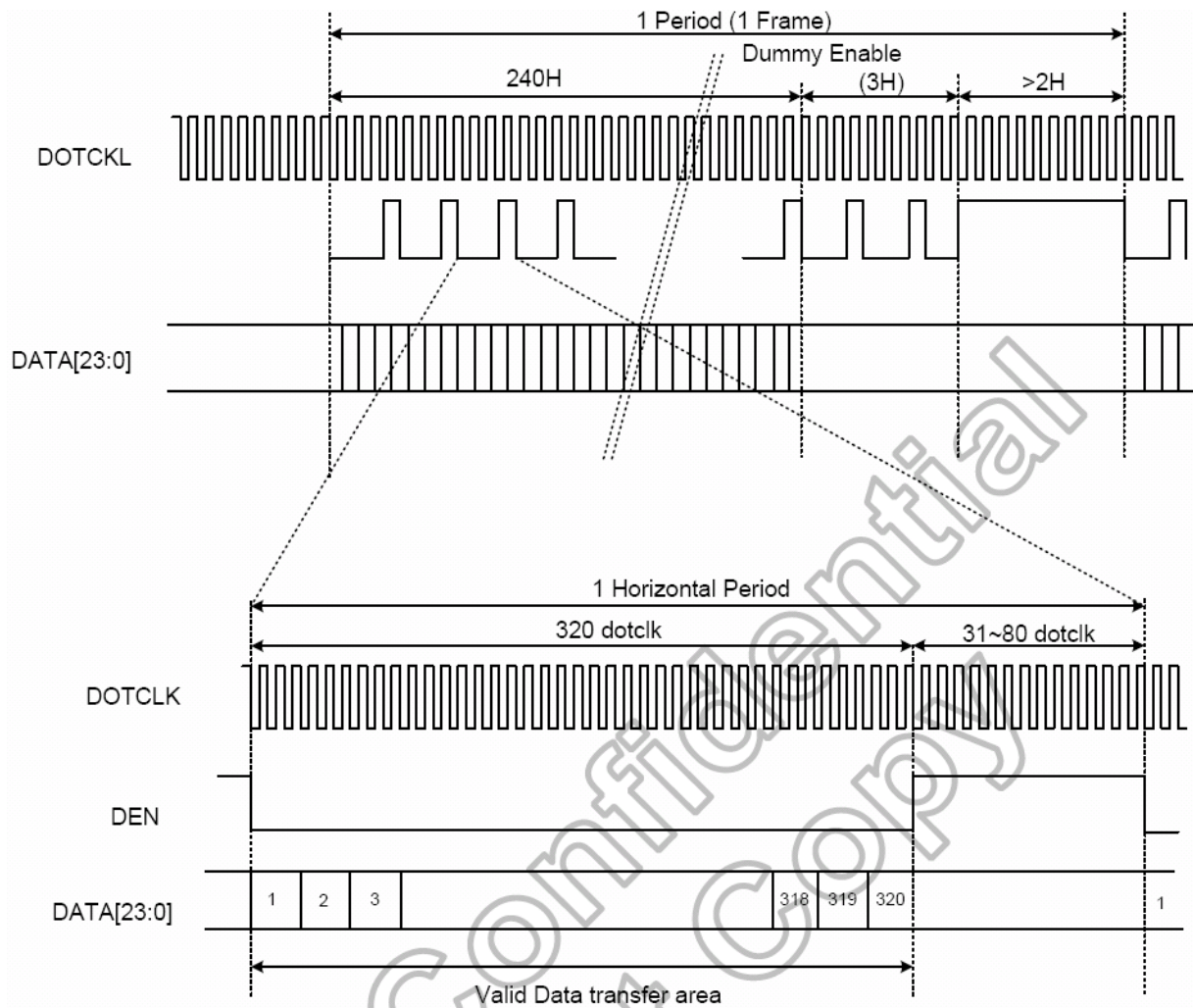


a) Horizontal Data Transaction Timing



b) Vertical Data Transaction Timing

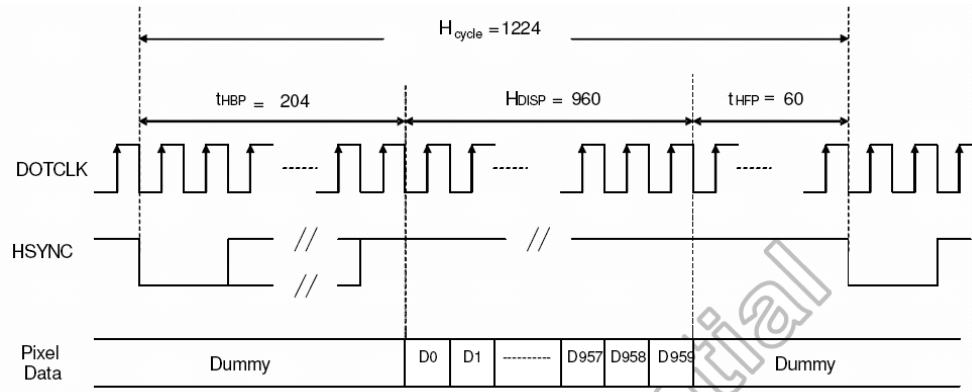
(a) Data Transaction Timing in Parallel RGB (24 bit) Interface (SYNC Mode)



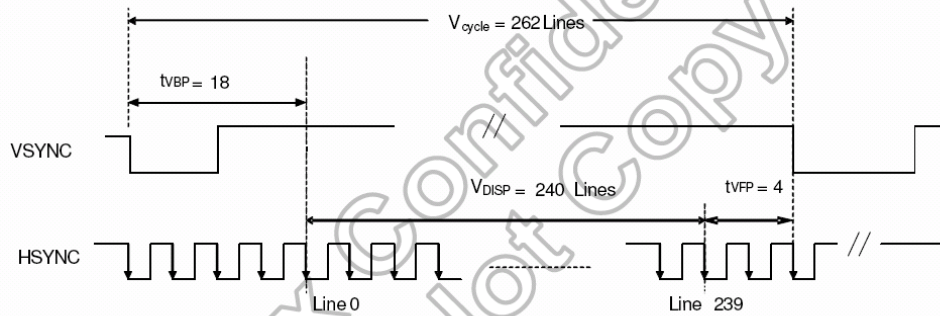
b) Data Transaction Timing in Parallel RGB (24 bit) Interface (DE Mode)

Characteristics	Symbol	Min		Typ		Max		Unit
		24 bit	8 bit	24 bit	8 bit	24 bit	8 bit	
DOTCLK Frequency	fDOTCLK	-	-	6.5	19.5	10	30	MHz
DOTCLK Period	tDOTCLK	100	33.3	154	51.3	-	-	ns
Horizontal Frequency (Line)	fH	-	-	14.9	-	22.35	-	KHz
Vertical Frequency (Refresh)	fV	-	-	60	-	90	-	Hz
Horizontal Back Porch	tHBP	-	-	68	204	-	-	tDOTCLK
Horizontal Front Porch	tHFP	-	-	20	60	-	-	tDOTCLK
Horizontal Data Start Point	tHBP	-	-	68	204	-	-	tDOTCLK
Horizontal Blanking Period	tHBP + tHFP	-	-	88	264	-	-	tDOTCLK
Horizontal Display Area	HDISP	-	-	320	960	-	-	tDOTCLK
Horizontal Cycle	Hcycle	-	-	408	1224	450	1350	tDOTCLK
Vertical Back Porch	tVBP	-	-	18	-	-	-	Lines
Vertical Front Porch	tVFP	-	-	4	-	-	-	Lines
Vertical Data Start Point	tVBP	-	-	18	-	-	-	Lines
Vertical Blanking Period	tVBP + tVFP	-	-	22	-	-	-	Lines
Vertical Display Area	NTSC	VDISP	-	240		-	-	Lines
	PAL			280(PALM=0)				
				288(PALM=1)				
Vertical Cycle	NTSC	Vcycle	-	262		350	-	Lines
	PAL			313				

Data Transaction Timing in Normal Operating Mode

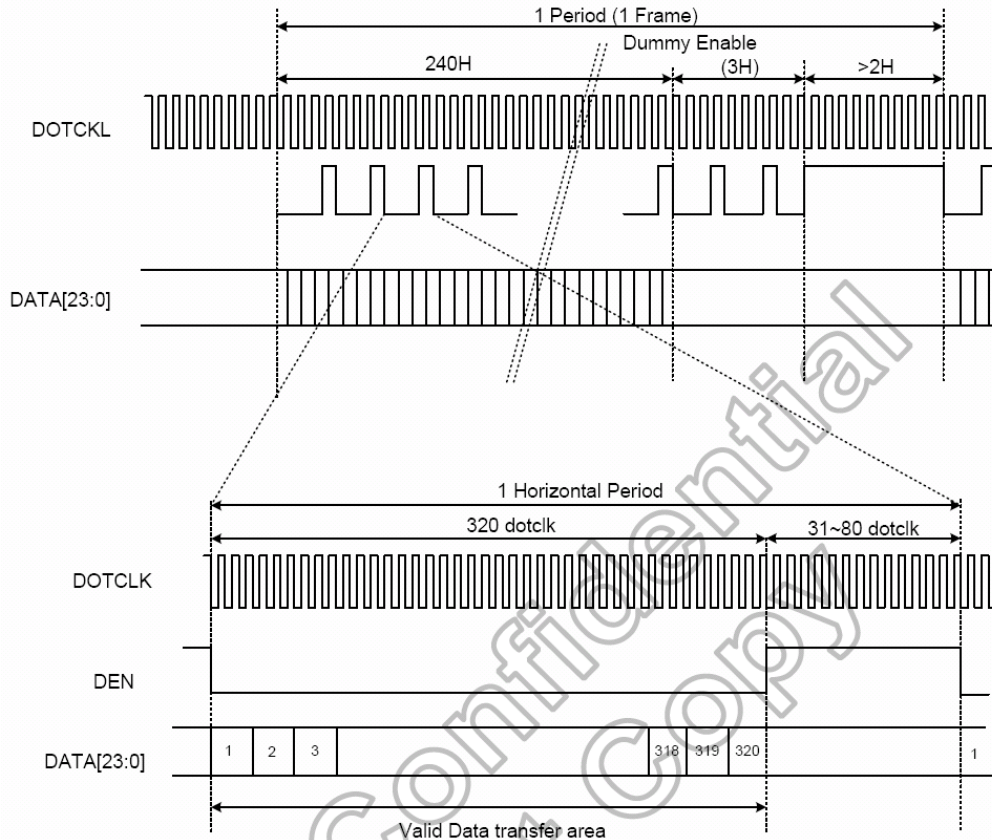


a) Horizontal Data Transaction Timing

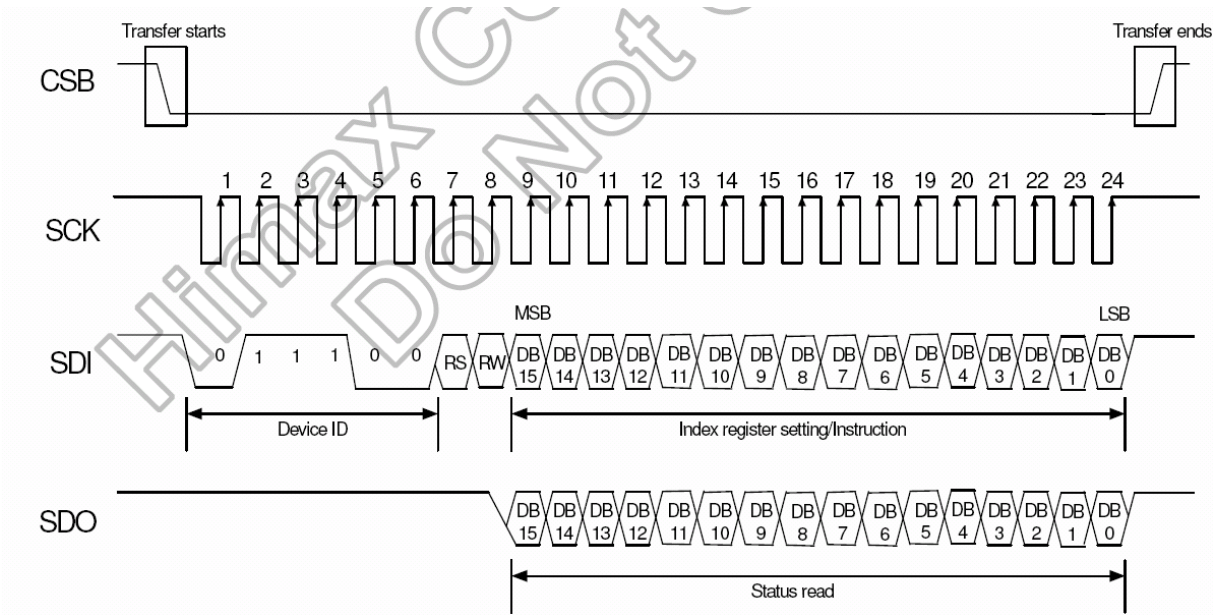


b) Vertical Data Transaction Timing

Data Transaction Timing in Serial RGB (8 bit) Interface (SYNC Mode)



Data Transaction Timing in Serial RGB (8 bit) Interface (DE Mode)



Timing chart for SPI

9 Optical specification

9.1 Optical characteristic of the LCD

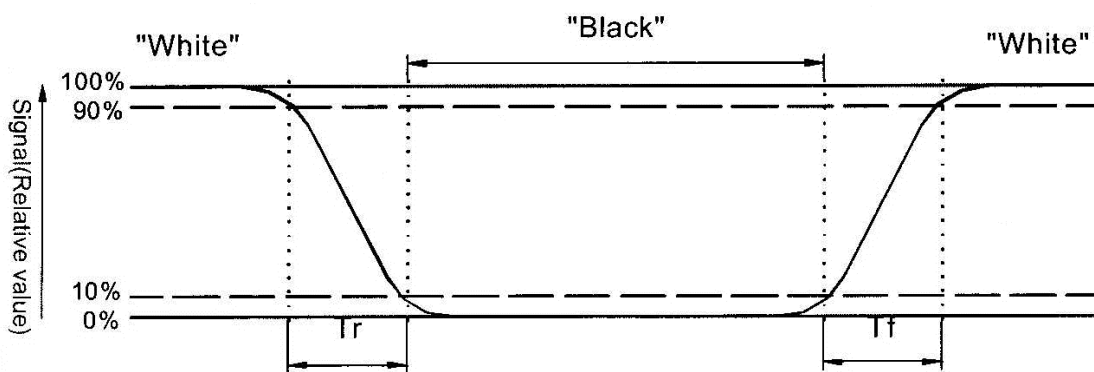
Item	Symbol	Conditon	Min.	Typ.	Max.	Unit	Remark
Response Time	T_r+T_f	$\Theta=0^\circ$		50	80	ms	Note 1,2,3,5
Contrast ratio	CR	At optimized viewing angle	-	300	-		Note 1,2,4,5
Viewing Angle	Top	$CR \geq 10$	-	50	-	deg.	Note1,2,5,6
	Bottom		-	70	-		
	Left		-	70	-		
	Right		-	70	-		
Brightness	Y_L	$I_{LED}=40mA$, $25^\circ C$	--	600	--	cd/m^2	Note 7
White chromaticity	XW	$I_{LED}=40mA$, $25^\circ C$	0.26	0.31	0.36		
	YW		0.27	0.32	0.37		

Note 1: Note 1: Ambient temperature= $25^\circ C$, and lamp current $I_{LED}=20mA$. To be measured in the dark room.

Note 2: To be measured on the center area of panel with a viewing cone of 1° by Topcon luminance meter BM-7, after 10 minutes operation.

Note 3. Definition of response time:

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 4. Definition of contrast ratio:

Contrast ratio is calculated with the following formula.

$$\text{Contrast ratio (CR)} = \frac{\text{Photo detector output when LCD is at "White" state}}{\text{Photo detector Output when LCD is at "Black" state}}$$

Note 5: White $V_i = V_{i50} + 1.5V$

Black $V_i = V_{i50} + 2.0V$

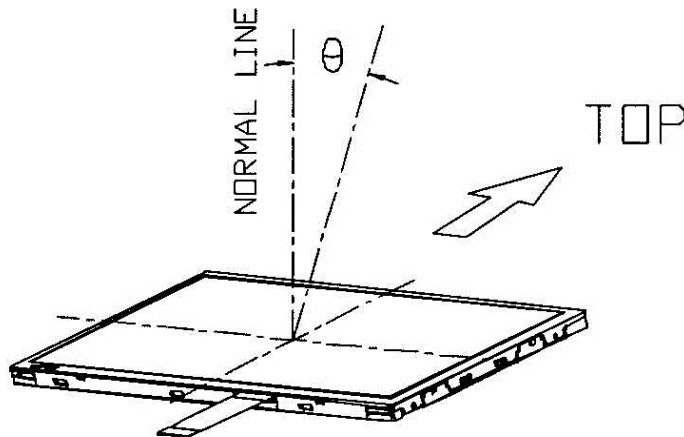
"±" means that the analog input signal swings in phase with V_{COM} signal.

" $\frac{-}{+}$ " means that the analog input signal swings out of phase with V_{COM} signal.

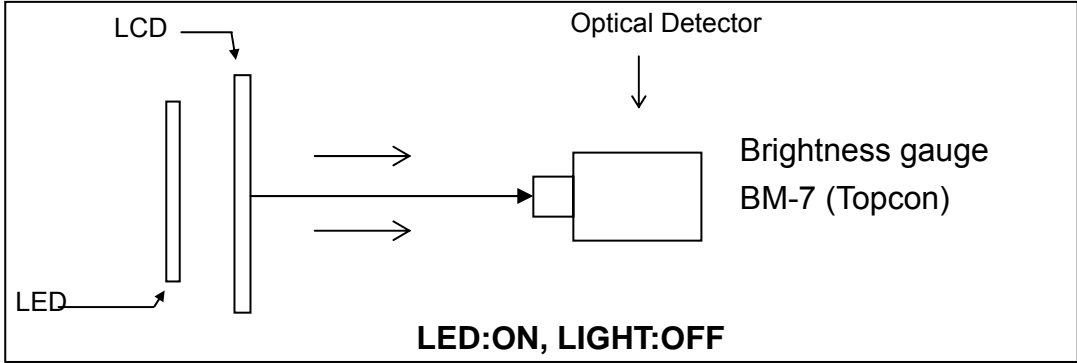
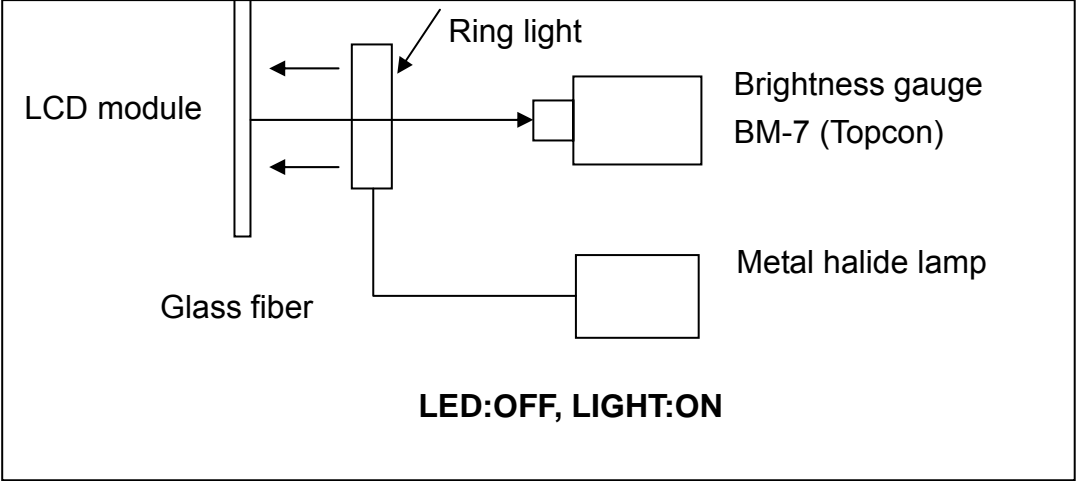
V_{i50} : The analog input voltage when transmission is 50%. The 100%

Transmission is defined as the transmission of LCD panel when all the input terminals of module are electrically opened.

Note 6. Definition of viewing angle, Refer to figure as below.



Note 7. Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.



10 RELIABILITY

Test Item	Test Conditions	Note
High Temperature Operation	70±3°C , t=96 hrs	
Low Temperature Operation	-20±3°C , t=96 hrs	
High Temperature Storage	80±3°C , t=96 hrs	1,2
Low Temperature Storage	-30±3°C , t=96 hrs	1,2
Humidity Test	40°C , Humidity 90%, 96 hrs	1,2
Thermal Shock Test	-30°C ~ 25°C ~ 80°C 30 min. 5 min. 30 min. (1 cycle) Total 5 cycle	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
Static Electricity	150pF 330 ohm ±8kV, 10times air discharge	

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

Note 2 : The module should be inspected after 1hour storage in normal conditions

(15-35°C , 45-65%RH).

Definitions of life end point :

- Current drain should be smaller than the specific value.
- Function of the module should be maintained.
- Appearance and display quality should not have degraded noticeably.
- Contrast ratio should be greater than 50% of the initial value.

11 USE PRECAUTIONS

11.1 Handling precautions

- 1) The polarizing plate may break easily so be careful when handling it. Do not touch, press or rub it with a hard-material tool like tweezers.
- 2) Do not touch the polarizing plate surface with bare hands so as not to make it dirty. If the surface or other related part of the polarizing plate is dirty, soak a soft cotton cloth or chamois leather in benzine and wipe off with it. Do not use chemical liquids such as acetone, toluene and isopropyl alcohol. Failure to do so may bring chemical reaction phenomena and deteriorations.
- 3) Remove any spit or water immediately. If it is left for hours, the suffered part may deform or decolorize.
- 4) If the LCD element breaks and any LC stuff leaks, do not suck or lick it. Also if LC stuff is stuck on your skin or clothing, wash thoroughly with soap and water immediately.

11.2 Installing precautions

- 1) To prevent breaking by static electricity from the human body and clothing, earth the human body properly using the high resistance and discharge static electricity during the operation. In this case, however, the resistance value should be approx. $1M\Omega$ and the resistance should be placed near the human body rather than the ground surface. When the indoor space is dry, static electricity may occur easily so be careful. We recommend the indoor space should be kept with humidity of 60% or more. When a soldering iron or other similar tool is used for assembly, be sure to earth it.
- 2) When installing the module and ICs, do not bend or twist them. Failure to do so may crack LC element and cause circuit failure.
- 3) To protect LC element, especially polarizing plate, use a transparent protective plate (e.g., acrylic plate, glass etc) for the product case.
- 4) Do not use an adhesive like a both-side adhesive tape to make LCD surface (polarizing plate) and product case stick together. Failure to do so may cause the polarizing plate to peel off.

11.3 Storage precautions

- 1) Avoid a high temperature and humidity area. Keep the temperature between 0°C and 35°C and also the humidity under 60%.
- 2) Choose the dark spaces where the product is not exposed to direct sunlight or fluorescent light.
- 3) Store the products as they are put in the boxes provided from us or in the same conditions as we recommend.

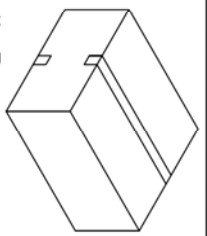
11.4 Operating precautions

- 1) Do not boost the applied drive voltage abnormally. Failure to do so may break ICs. When applying power voltage, check the electrical features beforehand and be careful. Always turn off the power to the LC module controller before removing or inserting the LC module input connector. If the input connector is removed or inserted while the power is turned on, the LC module internal circuit may break.
- 2) The display response may be late if the operating temperature is under the normal standard, and the display may be out of order if it is above the normal standard. But this is not a failure; this will be restored if it is within the normal standard.
- 3) The LCD contrast varies depending on the visual angle, ambient temperature, power voltage etc. Obtain the optimum contrast by adjusting the LC drive voltage.
- 4) When carrying out the test, do not take the module out of the low-temperature space suddenly. Failure to do so will cause the module condensing, leading to malfunctions.
- 5) Make certain that each signal noise level is within the standard (L level: 0.2V_{dd} or less and H level: 0.8V_{dd} or more) even if the module has functioned properly. If it is beyond the standard, the module may often malfunction. In addition, always connect the module when making noise level measurements.
- 6) The CMOS ICs are incorporated in the module and the pull-up and pull-down function is not adopted for the input so avoid putting the input signal open while the power is ON.
- 7) The characteristic of the semiconductor element changes when it is exposed to light emissions, therefore ICs on the LCD may malfunction if they receive light emissions. To prevent these malfunctions, design and assemble ICs so that they are shielded from light emissions.
- 8) Crosstalk occurs because of characteristics of the LCD. In general, crosstalk occurs when the regularized display is maintained. Also, crosstalk is affected by the LC drive voltage. Design the contents of the display, considering crosstalk.

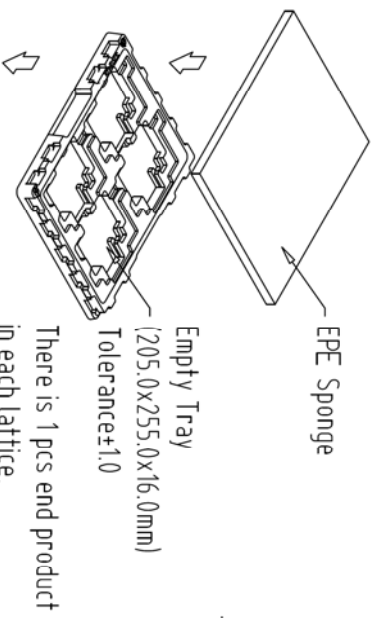
11.5 Other

- 1) Do not disassemble or take the LC module into pieces. The LC modules once disassembled or taken into pieces are not the guarantee articles.
- 2) The residual image may exist if the same display pattern is shown for hours. This residual image, however, disappears when another display pattern is shown or the drive is interrupted and left for a while. But this is not a problem on reliability.
- 3) AMIPRE will provide one year warrantee for all products and three months warrantee for all repairing products.

REV	REVISION RECORD	DATE NAME
0	NEW RELEASE	10-14-11 Henry

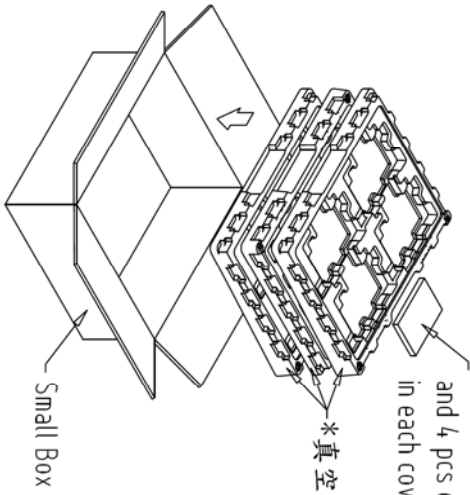
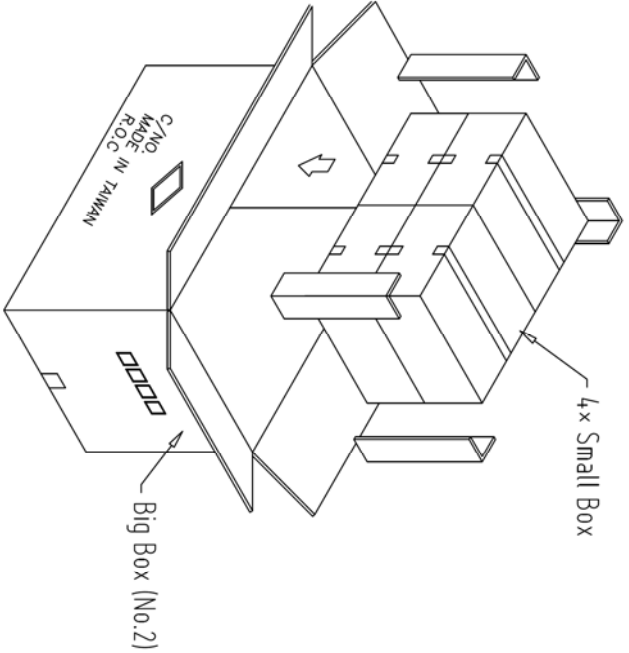


Small Box Size: LxWxH
(267.0x224.0x124.0mm)
Tolerance ±10.0



There is 1 pcs end product in each lattice, and 4 pcs end products in each cover.

*真空盒交錯堆疊



Big Box (No.2)
Size: LxWxH (491.0x300.0x295.0mm)
Tolerance ±10.0

4	320240LC
3	320240LB
2	320240LB
1	320240L4

AMPURE 晶采光電科技
適用品號

Note:
1 Tray=2x2=4Pcs.
2 Small Box=8xTray=32Pcs.(9 Tray)
3 Big Box=4xSmall Box=128Pcs.

1	交叉堆疊	7	TOLERANCE GRADE(±)	A	B	DIK. MM	DWN. Henry	DATE 10-14-11	TITLE 320240L (3.5")	DWG. NO. *111041SA	SHEET 1 OF 1
2		8									
3		9				IE NO.	CHK.	DATE			
4		10				PARTS NO. BOX 320240L2	APPD.	DATE			
5		11									
6		12									