

	PRODUCTION SPECIFICATION OF TFT LCD MODULE	Model No: M238HCS02 B2N
		OC PN: PN238CS02-2

**PRODUCTION SPECIFICATION
OF TFT LCD MODULE**

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CUSTOMER	
CONFIRMED BY	
APPROVED BY	

PREPARED BY	
CONFIRMED BY	



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Date	Rev.	Page	Old Description	New Description	Remark
2023.10.15	1.0	All	The specification was first issued		

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1. GENERAL DESCRIPTION

1.1 OVERVIEW

The specification is applied to 23.8" **FRAME LESS** module (M238HCS02 B2N) used HKC PN238CS02-2 opencell. This TFT Liquid Crystal Display open cell supports 1920 x 1080 FHD mode with 16.78M (8bit)colors. This product is with driver ICs and a 30-pins-connectors with LVDS interface.

1.2 General Specifications

Item	Specification	Unit	Note
Active Area	527.04(H)x296.46(V)	mm	
Module Size	544.80(H) x 320.50(V)*11.50(D)	mm	
Weight	2.4	kg	Max.
Driving Scheme	a-Si TFT Active Matrix	-	
Number of Pixels	1920 * 1080	pixel	
Pixel Pitch (Sub Pixel)	0.2745*0.2745	mm	
Pixel Arrangement	RGB Vertical Stripe	-	
Display Colors	16.78 M	color	8bit
Display Mode	Normally Black		
Module Brightness	380	Cd/m ²	
Color Chroma	R = (0.650, 0.337)		Typical value measured at DL BLU
	G = (0.314, 0.594)		
	B = (0.147, 0.057)		
	W = (0.305, 0.315)		
Contrast Ratio	1200:1(Typ.)		
View Angle (CR 10)	+89/-89 (H), +89/-89 (V) (Typ.)		
Surface Treatment	Anti-glare, Haze 2.5%, Hard Coating (3H)		

1.3 Mechanical Specification

Item		Min	Typ	Max	Unit	Note
Weight		-100	1850	+100	g	-
Module Size	Horizontal(H)	(TYP)-0.5	544.80	(TYP)+0.5	mm	1
	Vertical (V)		320.50		mm	
	Depth(D)		11.50		mm	

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2. Absolute Maximum Ratings

2.1 Absolute Ratings of Environment

Item	Symbol	Min.	Max.	Unit	Conditions
Operating Temperature	TOP	0	+50	[oC]	Note 3
Glass surface temperature (operation)	TGS	0	+65	[oC]	Note 3, Note 4
Operation Humidity	HOP	5	90	[%RH]	Note 3
Storage Temperature	TST	-20	+60	[oC]	
Storage Humidity	HST	5	90	[%RH]	

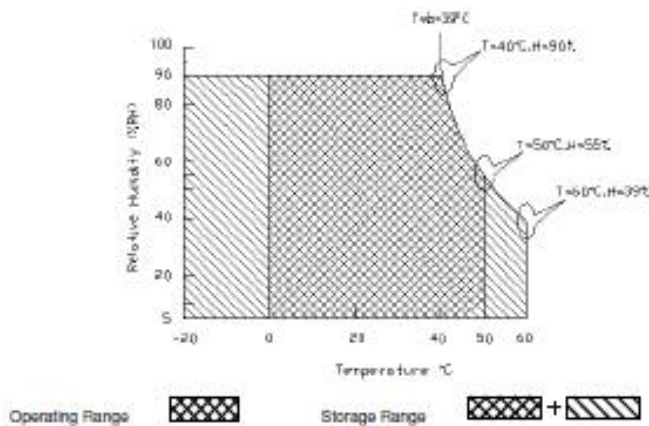
Note 1: With in Ta (25C)

Note 2: Permanent damage to the device may occur if exceeding maximum values.

Note 3: Temperature and relative humidity range are shown as the below figure.

1. 90% RH Max
2. Max wet-bulb temperature at 39

Note 4: Function Judged only



2.2 Backlight Unit

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
LED operation Voltage	V_{led}	56	-	64	V_{led}	
LED operation Current	I_{led}	-	240	-	mA	(1)
BackLight Power	P_{BL}	13.44	-	15.36	W	
Lift time	Lt	30000	40000	-	Hrs	

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.

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3. ELECTRICAL SPECIFICATIONS

3.1 ELECTRICAL CHARACTERISTICS

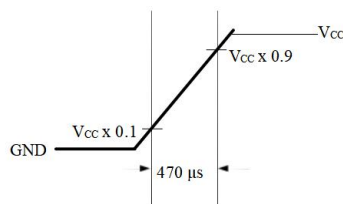
3.1.1 Open Cell Power Consumption (TA = 25 ± 2 °C)

Parameter	Symbol	Value			Unit	Note	
		Min.	Typ.	Max.			
Power Supply Voltage	V _{CC}	4.5	5.0	5.5	V		
Ripple Voltage	V _{RP}	-	-	600	mV	P-P	
Power Supply Current	White	-	0.57	0.65	A	(3.1)	
	Color bar H	-	0.7	0.9	A	(3.2)	
	Horizontal 1 line	-	1.0	1.4	A	(3.3)	
Power Consumption	PLCD	-	2.86	7.0	Watt	(4)	
Rush Current	I _{RUSH}	-	-	3	A	(2)	
-LVDS Interface	Differential Input Voltage	V _{ID}	100	-	600	mV	(5)
	Common Input Voltage	V _{CM}	1.0	-	1.4	V	
	Differential Input High Threshold Voltage	V _{TH}	0.1	-	-	V	
	Differential Input Low Threshold Voltage	V _{TL}	-	-	-0.1	V	
	Spread spectrum modulation range	Felkin_mod	Felkin-3%		Felkin+3%	MHz	
	Spread spectrum modulation frequency	F _{SSM}	30	100	200	KHz	
	Receiver Skew Margin	T _{RMS}	-400	-	400	ps	

Note (1) Measurement Conditions

Item	Symbol	Value	Unit
Temperature	A	25 ± 2	°C
Humidity	A	50 ± 10	%RH

Note (2) V_{CC} rising time=470us

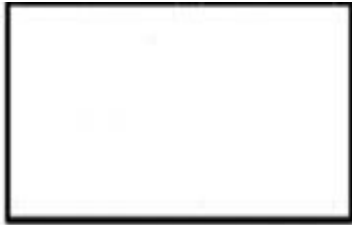


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Fig. 3.1 VCC rising time condition

Note (3) Test patterns

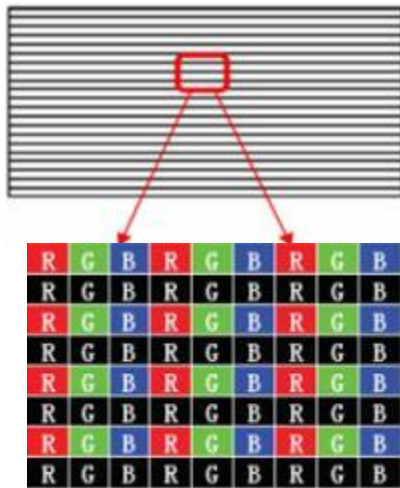
A. White Pattern



B. color bar H



C: Horizontal 1 line Pattern

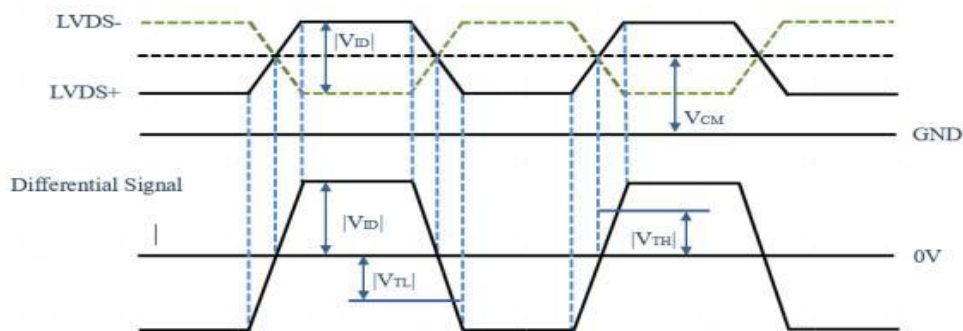


Note (4) The typical power consumption is specified at the pattern with the color bar H, refresh rate is 60Hz, VIN is 5V.
The max power consumption is specified at the pattern with the Horizontal 1 line , refresh rate is 75Hz, VIN is 5V.

Note (5) The LVDS input characteristics are as follows:

Differential Signal

Single-end Signals

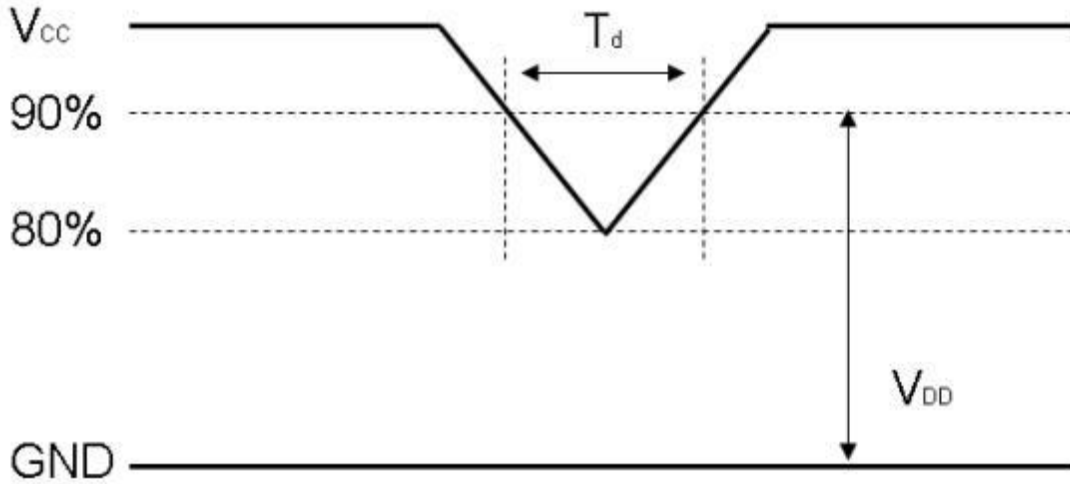


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Note(6) Definition of VDD Power Dip

The above conditions are for the glitch of the input voltage.

For stable operation of an LCD Module power, please follow them



$$4.5V \leq VDD \leq 5.5V$$

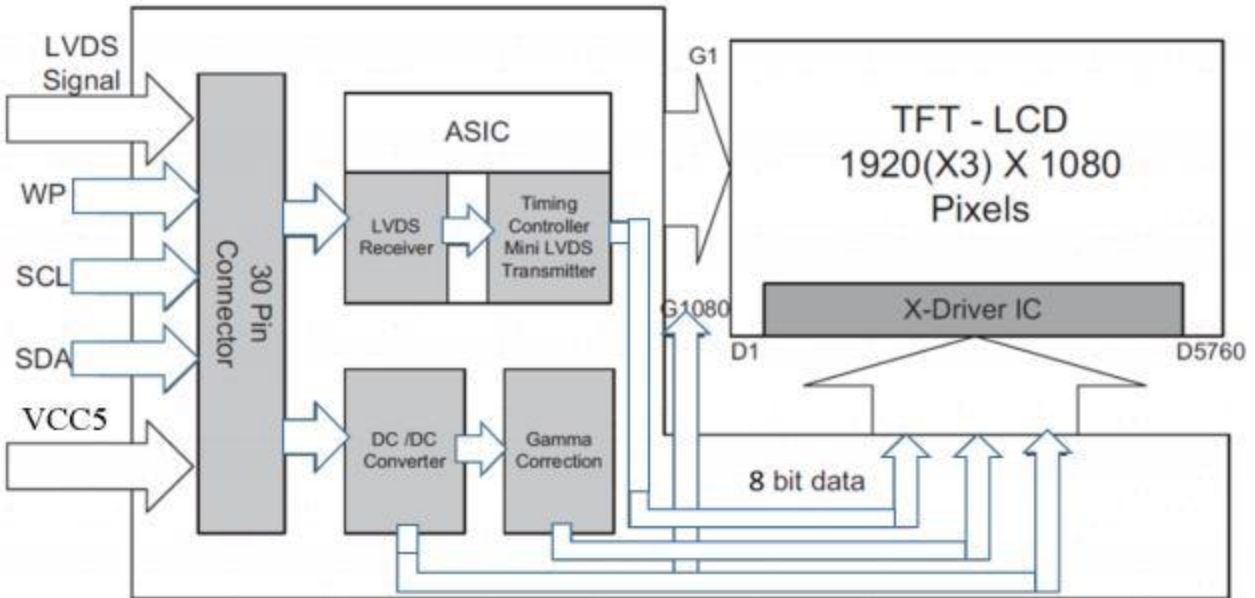
$$\text{If } VDD (\text{Typ.}) \times 80\% \leq VCC \leq VDD (\text{Typ.}) \times 90\%$$

$$\text{Then } 0 < Td < 20\text{ms}$$

3.2 Block Diagram

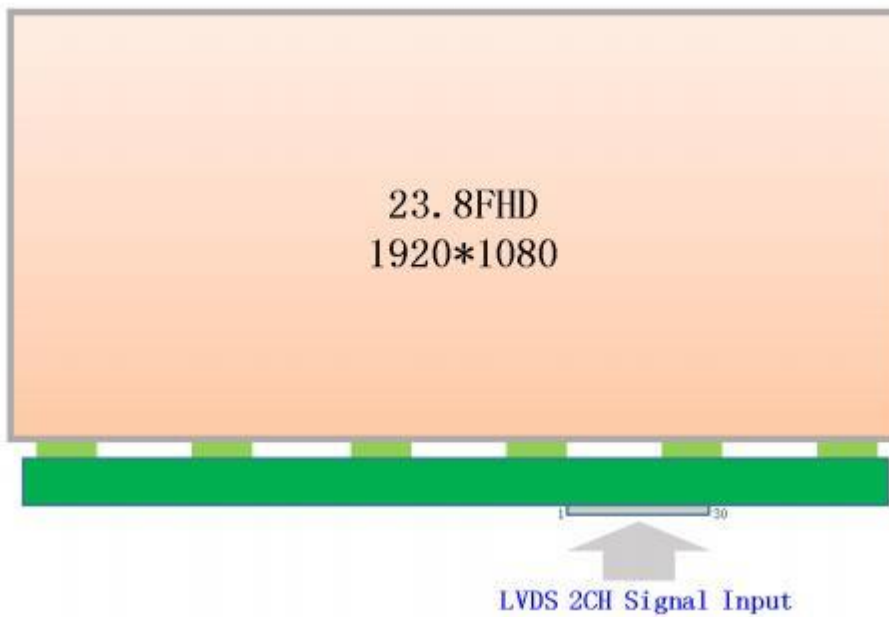
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The following shows the block diagram of the 23.8 inch Color TFT-LCD Module.



3.3 Block Diagram

3.3.1 Block Diagram of Interface



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3.3.2 Interface Pin Assignment For LVDS

CNN: TBD or equivalent

Pin No.	Symbol	Description	Note
1	RXO0-	LVDS Odd Data (-)	
2	RXO0+	LVDS Odd Data (+)	
3	RXO1-	LVDS Odd Data (-)	
4	RXO1+	LVDS Odd Data (+)	
5	RXO2-	LVDS Odd Data (-)	
6	RXO2+	LVDS Odd Data (+)	
7	GND	Power Ground	
8	RXOCLK-	LVDS Odd Clock (-)	
9	RXOCLK+	LVDS Odd Clock (+)	
10	RXO3-	LVDS Odd Data (-)	
11	RXO3+	LVDS Odd Data (+)	
12	RXE0-	LVDS Even Data (-)	
13	RXE0+	LVDS Even Data (+)	
14	GND	Power Ground	
15	RXE1-	LVDS Even Data (-)	
16	RXE1 ^W	LVDS Even Data (+)	
17	GND ^V	Power Ground	
18	RXE2 ^V -	LVDS Even Data (-)	
19	RXE2+	LVDS Even Data (+)	
20	RXECLK-	LVDS Even Clock (-)	
21	RXECLK+	LVDS Even Clock (+)	
22	RXE3-	LVDS Even Data (-)	
23	RXE3+	LVDS Even Data (+)	
24	NC	Reserved for LCD manufacture's use (WP)	
25	NC	Reserved for LCD manufacture's use (SCL)	
26	NC	Reserved for LCD manufacture's use (SDA)	
27	NC	Reserved for LCD manufacture's use (BIST)	
28	cc	Power supply +5.0V	
29	cc	Power supply +5.0V	
30	cc	Power supply +5.0V	

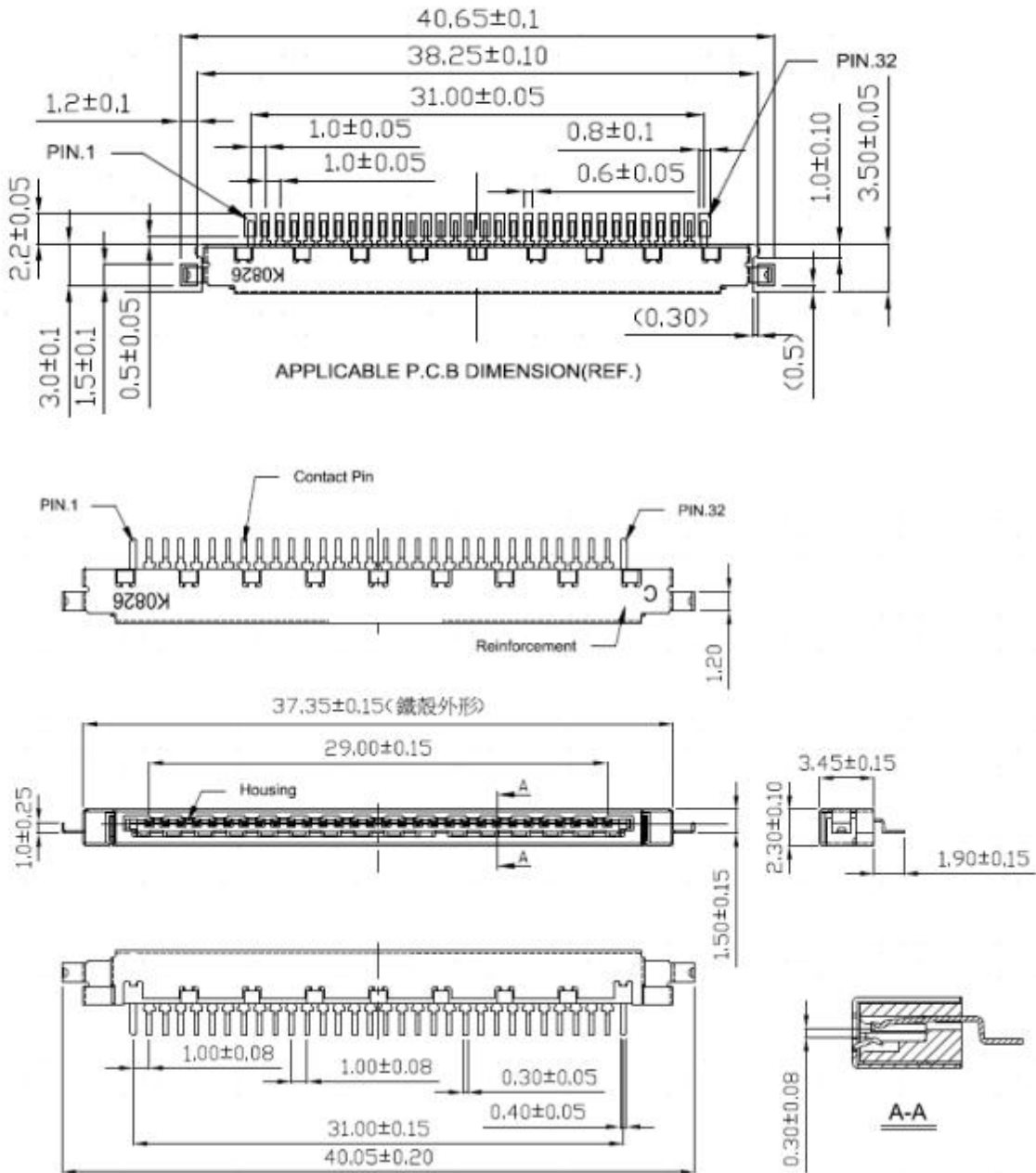


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Interface Connector Information

Item	Description
Manufacturer	XDYT
Connector model	SMT 3- 10522317-0

CNN: XDYT or equivalent



3.3.3 Built-in Self Test Patterns

The TCON is built in variable test patterns. The sequence and display time of test patterns could be set



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by EEPROM code. An example BIST pattern is as the following table.

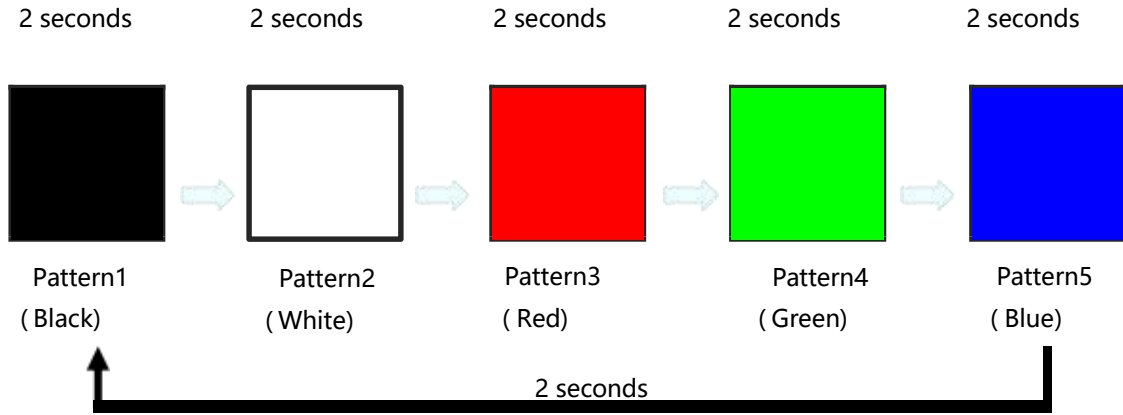


Figure 3.1 BIST patterns

Note: BIST_MODE pull high/low setting

L = Connect to GND, H =Connect to +3.3V

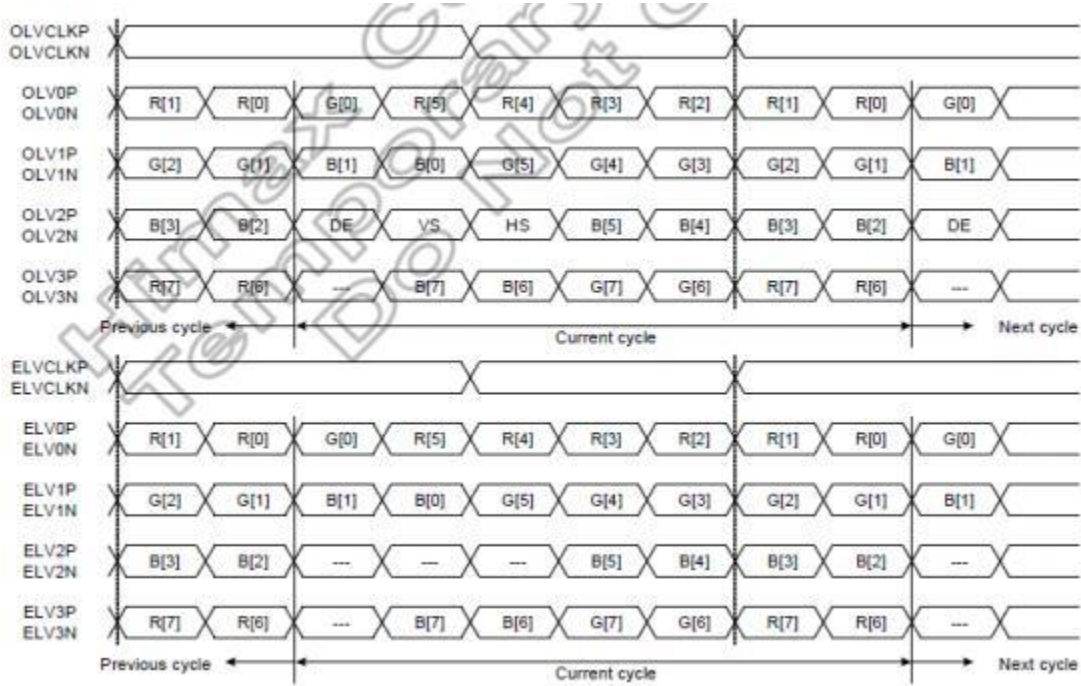
BIST_MODE	Note
L or Open	Available LVDS Signal input: Display LVDS Input Pattern No LVDS Signal or unavailable LVDS Signal input: Display Black Pattern
H	Available LVDS Signal input: Display LVDS Input Pattern No LVDS Signal or unavailable LVDS Signal input: Display Bist Pattern

3.3.4 Lvds data mapping type could be set by internal registers, and 8-bit data sequence is shown as following table.

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3.3 Backlight Electrical / Optical Characteristics

3.3.1 backlight connector

"CN2 : PH2.0-2P

Pin#	Signal Name
1	VDD-
2	VDD+

3.3.2 LED Bar

Parameter	Symbols	Min	Typ	Max	Unit
Forward Voltage (one circuit)	VF	2.8	-	3.6	MHz
Reverse Current (one circuit)	IR	-	-	10	μA
Forward Current	IF	-	90	120	Ma
Chromaticity Coordinates	X	0.285	0.291	0.297	
	Y	0.254	0.270	0.277	
Lumen	ℓ	36	38	40	LM
Viewing Angle	2θ1/2	-	120	-	Deg.
Number Of LED	Pcs	-	80	-	Pcs
Operation Voltage(LB)	VLB	56	-	64	V
Operation Current(LB)	ILB	-	240	-	mA
Power Consumption	PLB	13.44	-	15.36	W



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3.4. Timing spec

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

		Symbol	Min.	Typ.	Max.	Unit	Note
LVDS Clock Frequency		F _{CLK}	52.8	66	113.5	MHZ	(1)
Vertical Term	Frame Rate	F	48	60	100	HZ	
	Total	T _V	1099	1100	2392	T _H	
	Active Display	T _{VD}	1080			T _H	
	Blank	T _{VB}	19	20	1312	T _H	
Horizontal term	Total	T _H	999	1000	1010	T _{CLK}	
	Active Display	T _{HD}	960			T _{CLK}	
	Blank	T _{HV}	39	40	50	T _{CLK}	

Attention:

The module is operated in DE only mode ,H sync and V sync input signal have no effect on normal operation.

Note(1)Please make sure the range of pixel clock follows the following equations:

$$F_{CLK} \text{ (max)} \geq F_{max} \times T_v \times T_H$$

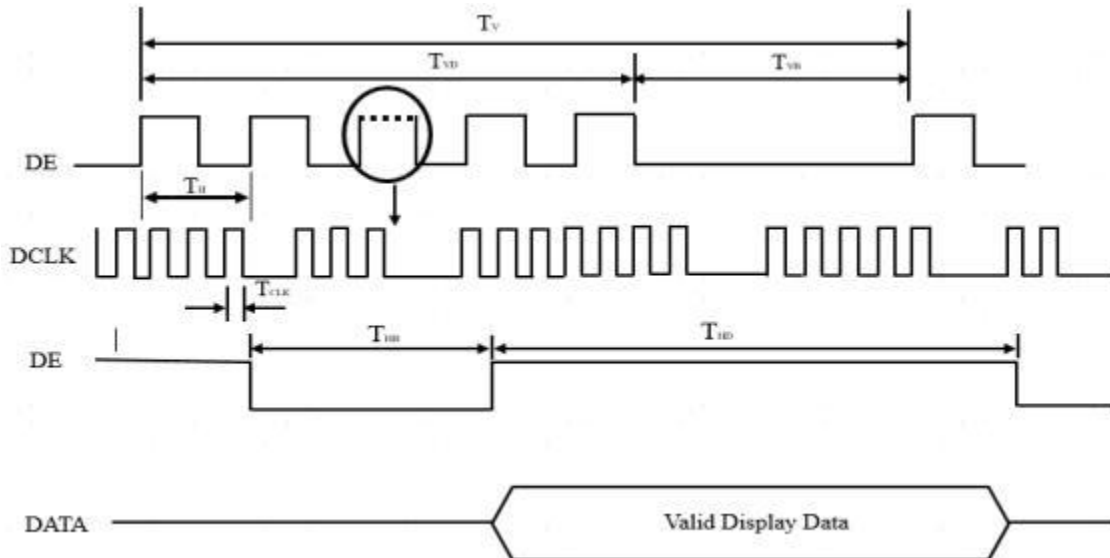


Fig 3.4.1 Signal timing diagram

3.5 Power On/Off Sequence

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

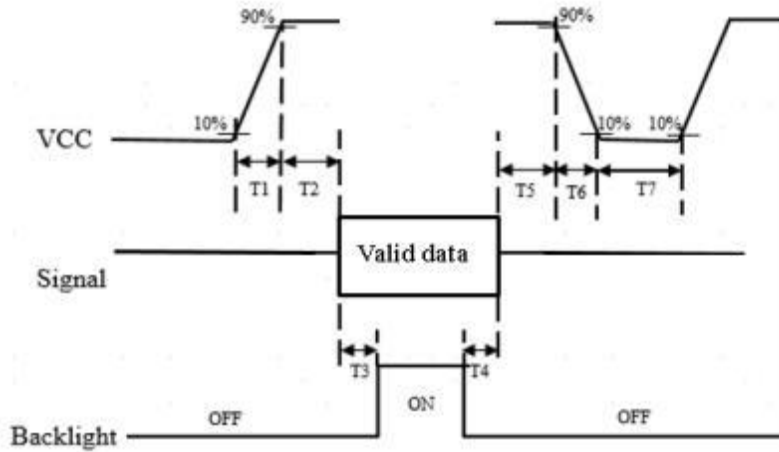


Fig.3.5.1 Power on/off sequence

Parameter	Values			Unit
	Min.	Typ.	Max.	
T1	0.5	-	10	ms
T2	0	30	50	ms
T3	450	-	-	ms
T4	100	250	-	ms
T5	0	20	50	ms
T6	0.1	-	100	ms
T7	1000			ms

Note:

- (1) The supply voltage of the external system for the module input should be the same as the definition .
- (2) To avoid some abnormal display noise, we suggest "Vcc falling time" to follow "T6" definition.
- (3) In case of Vcc is off level, please keep the level of input signals on the low or keep high impedance.

3.6 Flicker adjustment

- (1) Flicker must be optimized after module assembly and aging. Its patterns are as follow:

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sub pixel checker under 50% gray level

Sub pixel checker 128 gray

(2) Digital VCOM Modify Flow

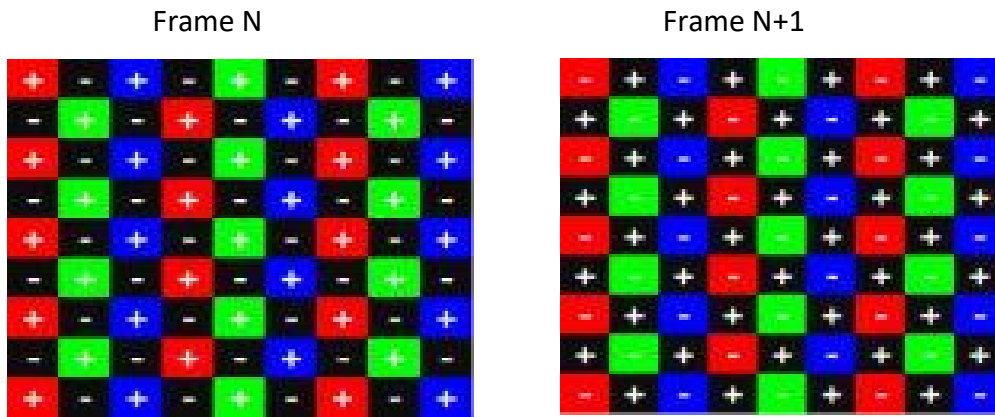
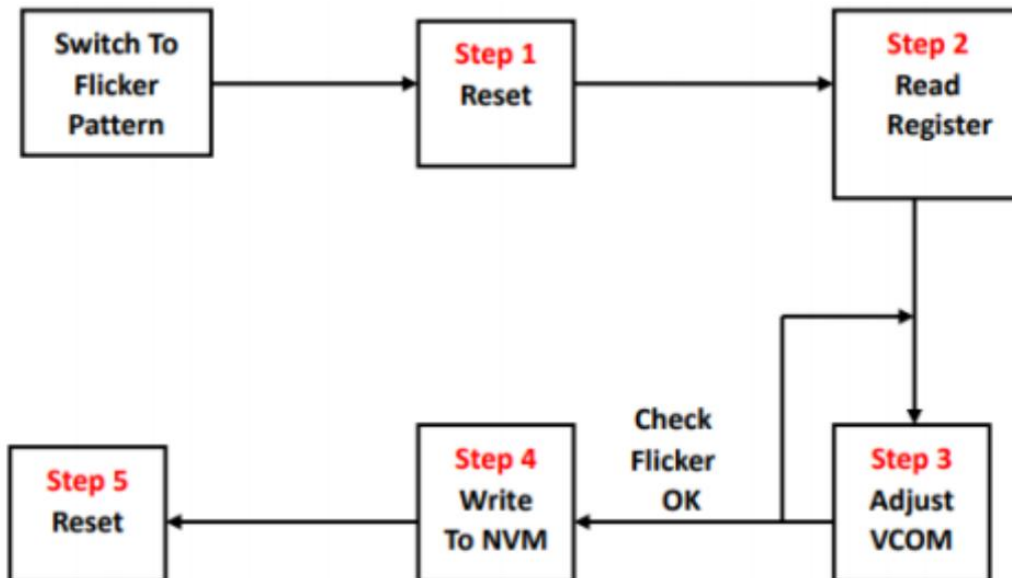


Figure 3.6.1 Bright sub-pixel=G127(50% grayscale); dark sub-pixel=G0 (0% grayscale)

(3) VCOM I2C Tuning Step



Note1: IC writes DAC data to EEPROM automatically after write protect function enabled, then IC will auto reload.

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(4) .About VCOM Adjustment(I2C Bus Format)

Step1: Reset (Load VCOM_NT EEPROM data to DAC register)

***Device Address is 0XE9(Reset Address) or 0XE8(Write Address)**

S	Slave Address	W	A	Register Address	A	Control Byte	A	P
	<u>1 1 1 0 1 0 0 0</u> 0			<u>0 0 0 0 0 0 0 0</u>		<u>0 0 0 1 0 0 1 0</u>		
	OXE8			OX00		OX12		
	Device Address			Control address		Reset+OUT_EN		

Step2 : Read VCOM (Read single control byte or VCOM_NT byte of data from DAC register)

***Data = 8Bits**

S	Slave Address	W	A	Register Address	SR	Slave Address	R	VCOM_NT Bit[7:1]	0	NA	P
	<u>1 1 1 0 1 0 0 0</u> 0			<u>0 0 0 0 0 0 0 1</u>		<u>1 1 1 0 1 0 0 1</u>		<u>X X X X X X X +0</u>			
	OXE8			OX01		OXE9					
	Device Address			Register Address		Device Address		VCOM_NT Data			

Step3 Adjust VCOM

***Data = 8Bits**

S	Slave Address	W	A	Register Address	A	VCOM_NT	0	A	P
	<u>1 1 1 0 1 0 0 0</u> 0			<u>0 0 0 0 0 0 0 1</u>		<u>00000000-11111110</u>			
	OXE8			OX01		OX00-OXFE (Bit0 is reserve bit)			
	Device Address			VCOM address		VCOM_NT Data			

Step4 Write To NVM (Write VCOM_NT DAC register into EEPROM)

S	Slave Address	W	A	Register Address	A	Control Byte (OX0A)	A	P
	<u>1 1 1 0 1 0 0 0</u> 0			<u>0 0 0 0 0 0 0 0</u>		<u>0 0 0 0 1 0 1 0</u>		
	OXE8			OX00		OX0A		
	Device Address			Control Address		WR_NVM +OUT_EN		

Step5 Reset

***Device Address is 0XE9(Reset Address) or 0XE8(Write Address)**

S	Slave Address	W	A	Register Address	A	Control Byte	A	P
	<u>1 1 1 0 1 0 0 0</u> 0			<u>0 0 0 0 0 0 0 0</u>		<u>0 0 0 1 0 0 1 0</u>		
	OXE8			OX00		OX12		
	Device Address			Control address		Reset+OUT_EN		

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3.7 Driver IC ESD Spec

If the LCD module is designed with the Plastic Bezel, we suggest ESD protection solutions should be applied to avoid IC damaged, as shown in Fig.3.7

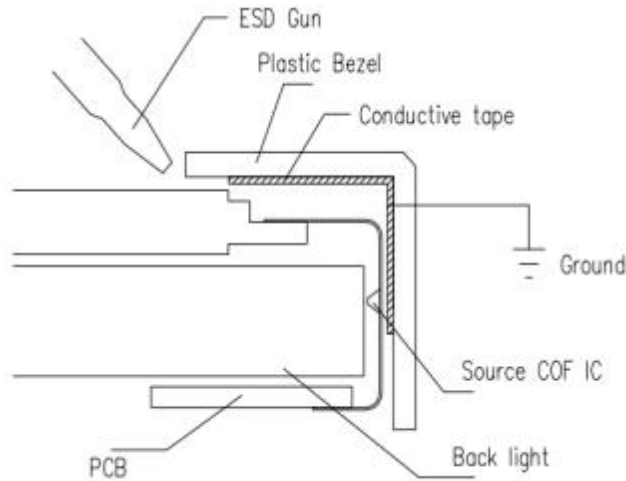


Fig.3.7

Fig.3.7 Source COF IC ESD protection

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4 Optical Characteristics

4.1 Test Condition

Item	Symbol	Value	Unit
Ambient Temperature	Ta	25 ± 2	°C
Ambient Humidity	Ha	50 ± 10	%RH
Supply Voltage	Vcc	5.0	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
LED Input Voltage	V _{LED}	58.3	V
LED Input Current	I _{LED}	240	mA
Power Consumption	Pw	14	W

4.2 Optical Characteristics

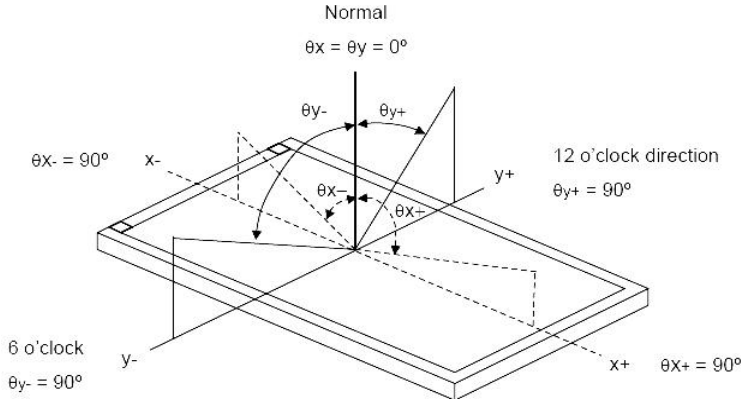
The relative measurement methods of optical characteristics are shown as below.

The following items should be measured under the test conditions described in 4.1

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note	
Contrast Ratio	CR	$\theta_x=0, \theta_y=0$, viewing normal angle	—	1200	—	—	—	
Response Time	TL		—	14	25	ms	Note 3	
Brightness uniformity	BU		70	75	—	—	Note 2	
Center Luminance of White	Lc		220	250	—	cd/m ²	—	
The color chromatic	Red		Rx	Typ. -0.03	0.650	Typ. +0.03	—	—
			Ry		0.330		—	—
	Green		Gx		0.330		—	—
			Gy		0.600		—	—
	Blue		Bx		0.148		—	—
			By		0.057		—	—
	White	Wx	0.305		—		—	
Wy		0.315	—	—				
Viewing Angle	Horizontal	θ_{x+}	CR \geq 10	—	89	—	Deg	Note 1
		θ_{x-}		—	89	—		
	Vertical	θ_{y+}		—	89	—		
		θ_{y-}		—	89	—		

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Note 1: The definition of viewing angle



Note 2: Definition of luminance , CR measured positions and brightness uniformity

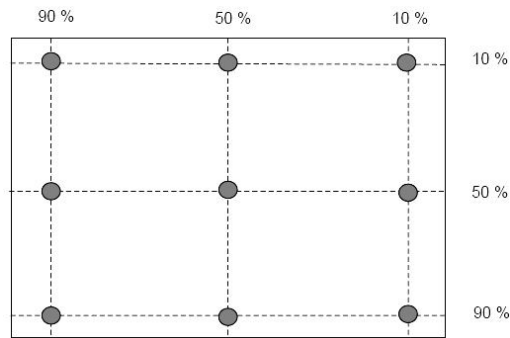
(a) Measure White luminance on the below 9 points and take the average value .

(b) CR : measures the same 9 points and take the average value .The Definition of Contrast Ratio is as follows :

$$CR = \frac{ON(\text{white L63})\text{Luminance}}{OFF(\text{Black L0})\text{Luminance}}$$

(c) The definition of White Vibration

$$\frac{\text{The minimum brightness of 9 dot}}{\text{The maximum brightness of 9 dot}} \times 100\%$$



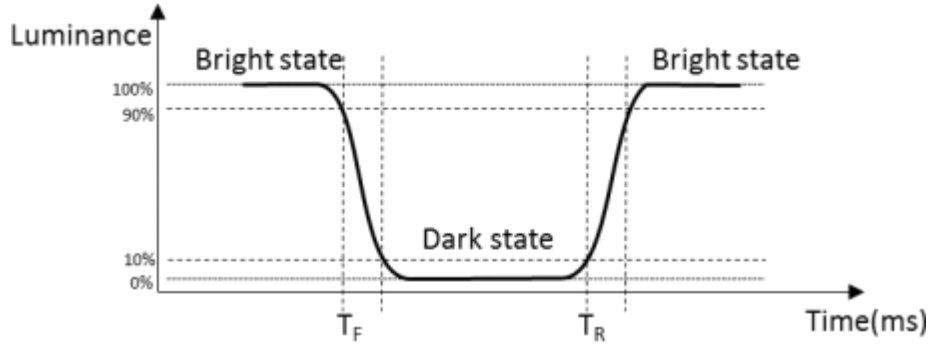
Note 3:Definition of Response Time (TR, TF):

Average of gray to gray response time (Tg) means the average switching time of luminance ratios among 0%,25%,50%,75%,and 100% to each other and optimized on frame rate = 60Hz.

Measured Response time		To				
		0%	25%	50%	75%	100%
From	0%		T _{0%to25%}	T _{0% to 50%}	T _{0% to 75%}	T _{0% to 100%}
	25%	T _{25% to 0%}		T _{25% to 50%}	T _{25% to 75%}	T _{25% to 100%}
	50%	T _{50% to 0%}	T _{50% to 25%}		T _{50% to 75%}	T _{50% to 100%}
	75%	T _{75% to 0%}	T _{75% to 25%}	T _{75% to 50%}		T _{75% to 100%}
	100%	T _{100% to 0%}	T _{100% to 0%}	T _{100% to 50%}	T _{100% to 75%}	

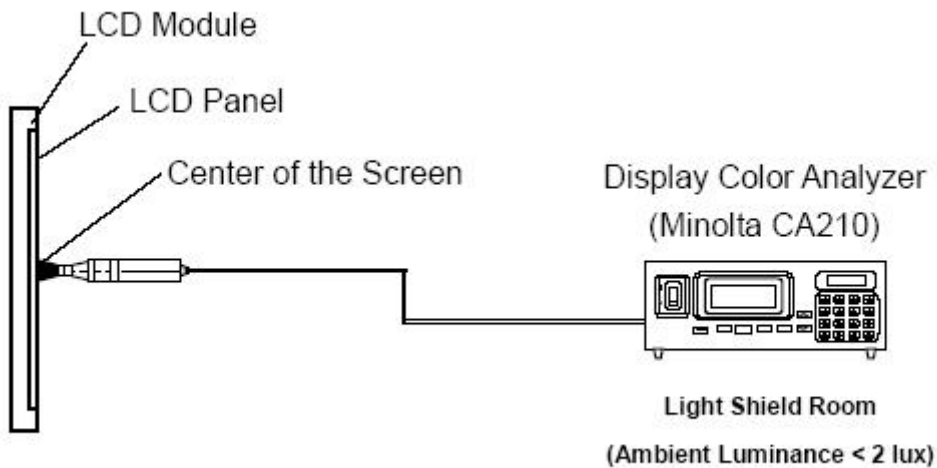


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Measured response time is determined by 10% to 90% brightness difference of rising (TR) or falling (TF) time.

Note 4: The measure method



- (a) : The measurement point is the center of the active area except for the measurement of Luminance Uniformity
- (b) : Photometer :CA-210

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5.0 Reliability Test

Environment test conditions are listed as following table.

Items	Required Condition	Note
Temperature Humidity Bias (THB)	Ta= 50°C , 80%RH, 240hours	
High Temperature Operation (HTO)	Ta= 50°C , 50%RH, 300hours	
Low Temperature Operation (LTO)	Ta= 0°C , 300hours	
High Temperature Storage (HTS)	Ta= 60°C , 300hours	
Low Temperature Storage (LTS)	Ta= -20°C , 300hours	
ESD (Electric Static Discharge) On/Off Test Thermal Shock Test (TST)	Air : 150 pF, 330Ω, ±8KV Contact: 150 pF, 330Ω, ±8KV On/10sec, Off/10sec, 30,000 cycles -20°C/30min, 60°C/30min, 100 cycles	

Note 1: The TFT-LCD module will not sustain damage after being subjected to 100 cycles of rapid temperature change. A cycle of rapid temperature change consists of varying the temperature from -20°C to 60°C, and back again. Power is not applied during the test. After temperature cycling, the unit is placed in normal room ambient for at least 4 hours before power on.

Note 2: EN61000-4-2, ESD class B: Certain performance degradation allowed

No data lost

Self-recoverable

No hardware failures.

	PRODUCTION SPECIFICATION OF TFT LCD MODULE	Model No: M238HCS02 B2N
		OC PN: PN238CS02-2

6.0 Shipping Label

6.1 Panel Label



6.2 Carton Label



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		OC PN: PN238CS02-2

7. Packaging

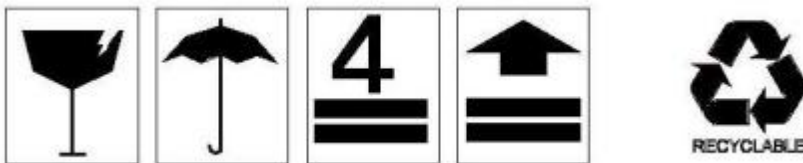
9.1 Carton(internal package)

- (1)Packaging Form
- (2) Packaging Method

(TBD)

Note 1) Acceptable number of piling : 10 sets

7.2 Packing Mark



	PRODUCTION SPECIFICATION OF TFT LCD MODULE	Model No: M238HCS02 B2N
		OC PN: PN238CS02-2

8. PRECAUTION

8.1 ASSEMBLY AND HANDLING PRECAUTIONS

- 1 Do not apply rough force such as bending or twisting to the module during assembly.
- 2 To assemble or install module into user's system can be in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.
- 3 It's not permitted to have pressure or impulse on the module because the LED panel and Backlight will be damaged.
- 4 Always follow the correct power sequence when LED module is connecting and operating. This can prevent damage to the CMOS LSI chips during latch-up.
- 5 Do not pull the I/F connector in or out while the module is operating .
- 6 Do not disassemble the module.
Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very
- 7 soft and easily scratched.
- 8 It is dangerous that moisture come into or contacted the LED module, because moisture may damage LED module when it is operating.
- 9 High temperature or humidity may reduce the performance of module. Please store LED module within the specified storage conditions.
- 10 When ambient temperature is lower than 10 °C may reduce the display quality. For example, the response time will become slowly.

8.2 SAFETY PRECAUTIONS

- 1 It is dangerous that moisture come into or contacted the LED module, because the moisture may damage LED module when it is operating.
- 2 If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth, in case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.
- 3 After the module's end of life, it is not harmful in case of normal operation and storage.

	PRODUCTION SPECIFICATION OF TFT LCD MODULE	Model No: M238HCS02 B2N
		OC PN: PN238CS02-2

9. Outline dimensions

