



SPECIFICATION FOR TFT LCD MODULE

CUSTOMER : _____

CUSTOMER MODULE : _____

HG MODEL : _____HG156FH039

☐ Preliminary Specification

☒ Final Specification

Customer Confirmation column:

Approved by : _____ Dept. : _____ Data : _____

Please return one of the copies of the specification with your signature to us within two weeks after you receive this document. If it is not returned, we will assume that you agree to the entire contents of this specification document.

Designed by	Checked by	Approved by



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1. GENERAL DESCRIPTION

1.1 General Description

The specification is applied to 15.6inch model (HG156FH039) TFT Liquid Crystal Display.

The matrix uses a-Si Thin Film Transistor as a switching device. This TFTLCD has a 15.6 inch diagonally measured active display area with FHD resolution (1,920 horizontal by 1080 vertical pixels array). All input signals are eDP1.2 interface compatible.

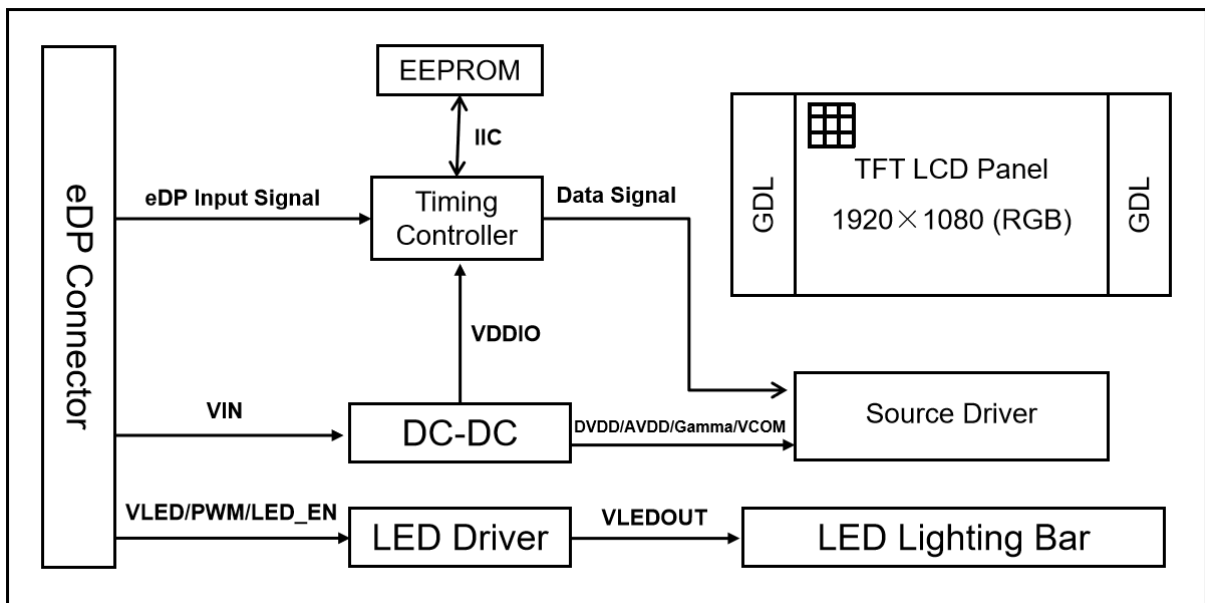


Figure 1.Drive Architecture

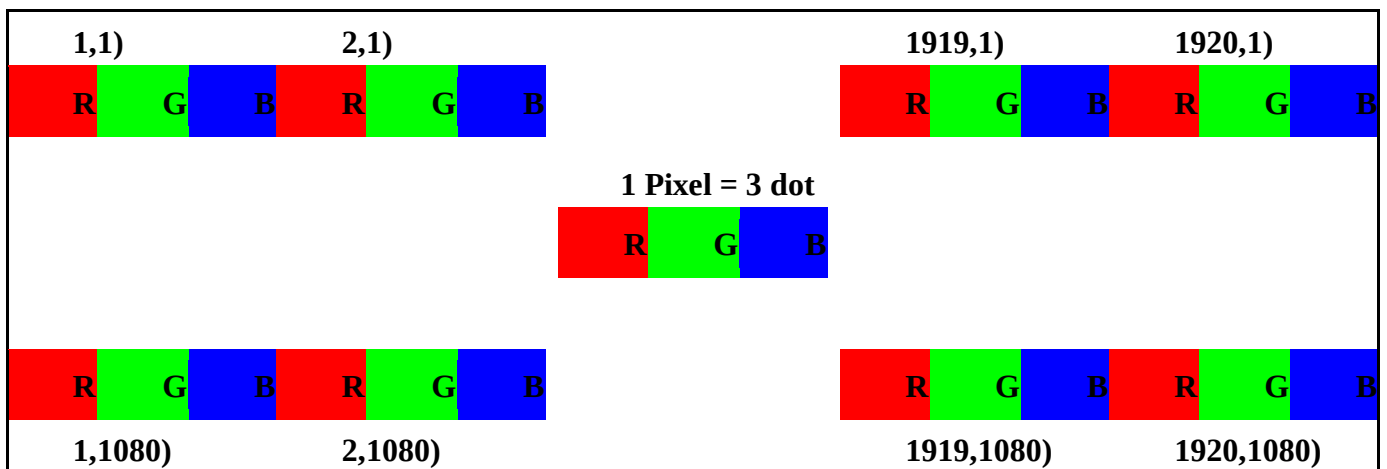


Figure 2.Pixel Mapping



1.2 Features

- (1) 2 lane eDP interface with 2.7 Gbps link rates
- (2) 16.7M(6bits+Hi FRC) color depth, color gamut 45%
- (3) Green product (RoHS & Halogen free product)
- (4) On board LED driving circuit
- (5) Adjust backlight brightness with DC mode

1.3 General Specifications

The followings are general specifications at the model HG156FH039.(listed in Table 1)

Table 1.General Specifications

Item		Specification	Unit	Note
Active area		344.16(H) × 193.59(V)	mm	-
Number of pixels		1920(H) × 1080(V)	pixels	-
Pixel pitch		0.17925(H) × 0.17925(V)	mm	-
Pixel arrangement		RGB Vertical stripe	-	-
Display colors		16.7M(6bits+Hi FRC)	-	-
Color gamut		NTSC 45% Typ. 42% Min.	-	-
Display mode		Normally black	-	-
Outline Dimension	WithoutPCBA	350.66 ± 0.3 (H)*205.24 ± 0.3(V)	mm	-
	WithPCBA	350.66 ± 0.3(H)*205.24 ± 0.5(V)	mm	
Surface treatment		Anti-Glare	-	-
Surface hardness		3H	-	-
Power consumption		PD:0.7 (Max)	W	@Mosaic
		B/L:3.6 (Max)	W	-
		Total:4.3 (Max)	W	@Mosaic



2. ABSOLUTE MAXIMUM RATINGS

2.1 Absolute Maximum Ratings

The followings are maximum values which, if exceed, may cause faulty operation or damage to the unit.

The operational and non-operational maximum voltage and current values are listed in Table 2.

Table 2.Absolute Maximum Ratings

T_a=25+/-5 ℃

Parameter	Symbol	Min.	Max.	Unit	Remarks
Logic Supply Voltage	V _{CC}	-0.3	4	V	(1),(2),(3),(4)
Logic Input Signal Voltage	V _{Signal}	-0.3	V _{CC}	V	
B/L Supply Voltage	V _{LED}	-0.3	24	V	
Operating Temperature	T _{OP}	0	50	℃	
Storage Temperature	T _{ST}	-20	60	℃	

Note (1) All the parameters specified in the table are absolute maximum rating values that may cause faulty operation or unrecoverable damage, if exceeded.

Note (2) All the contents of electro-optical specifications and display fineness are guaranteed under Normal Conditions. All the display fineness should be inspected under normal conditions. Normal conditions are defined as follow: Temperature: 25℃, Humidity: 50±10%RH.

Note (3) Unpredictable results may occur when it was used in extreme conditions. T_a= Ambient Temperature, T_{gs}= Glass Surface Temperature. All the display fineness should be inspected under normal conditions.

Note (4) Temperature and relative humidity range are shown in the figure below.

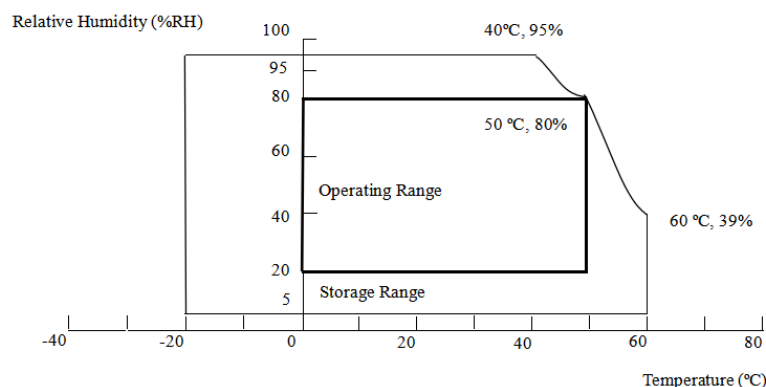


Figure 3. Absolute Ratings of Environment of the LCD Module



3. ELECTRICAL SPECIFICATIONS

3.1 Interface Connector

Table 3. Signal Connector Type

Item	Description
Manufacturer / Type	STM/MSAK24025P30

Table 4. Signal Connector Pin Assignment

PIN No.	SIGNAL NAME	DESCRIPTION
1	NC	No Connection
2	H_GND	Ground
3	LAN1_N	Complement Signal Link _Lane1
4	LAN1_P	True Signal Link _Lane1
5	H_GND	Ground
6	Lane0_N	Complement Signal Link _Lane0
7	Lane0_P	True Signal Link _Lane0
8	H_GND	High Speed Ground
9	AUXP	True Signal Link _Auxiliary Channel
10	AUXN	Complement Signal Link _Auxiliary Channel
11	H_GND	Ground
12	LCD_VCC	Power Supply, 3.3V (typ)
13	LCD_VCC	Power Supply, 3.3V (typ)
14	BIST	Panel self test enable
15	H-GND	Ground
16	H-GND	Ground
17	HPD	HPD(Hot Plug Detect) Signal Pin
18	BL_GND	LED ground
19	BL_GND	LED ground
20	BL_GND	LED ground
21	BL_GND	LED ground
22	BL_Enable	Backlight on/off Control pin
23	BL_PWM	Back light PWM Dimming
24	NC	No Connection



25	NC	No Connection
26	BL_PWR	LED Power Supply
27	BL_PWR	LED Power Supply
28	BL_PWR	LED Power Supply
29	BL_PWR	LED Power Supply
30	NC	No Connection

3.2 Signal Electrical Characteristics

Table 5. Display Port Main Link

Parameter	Description	Min.	Typ.	Max.	Unit
V_{CM}	Differential Common Mode Voltage	0	-	2	V
$V_{Diff\ P-P}$ Level	Differential Peak to Peak Voltage Level 1	120	-	-	mV

Note:

- (1) Input signals shall be low or Hi- resistance state when VDD is off.
- (2) It is recommended to refer the specifications of VESA Display Port Standard.

Figure 4. Display Port Main Link Signal

Figure 5. Display Port AUX_CH Signal

Table 6. Display Port AUX_CH

Parameter	Description	Min.	Typ.	Max.	Unit
V_{CM}	AUX Common Mode Voltage	0	-	2.0	V
$V_{Diff\ P-P}$	AUX Peak to peak voltage at a transmitting device	0.29	-	1.38	V
	AUX Peak to peak voltage at a receiving device	0.27	-	1.36	V

Note: Follow as VESA Display Port standard.

Table 7. Display Port V_{HPD}

Parameter	Description	Min.	Typ.	Max.	Unit
V_{HPD}	HPD Voltage	2.25	-	2.75	V

Note: Follow as VESA Display Port standard.



3.3 Interface Timings

Table 8. Interface Timings

Parameter	Symbol	Min.	Typ.	Max.	Unit
Clock Frequency	Fclk	-	138.8	-	MHz
H Total Time	HT	-	2080	-	Clocks
H Active Time	HA	1920			Clocks
V Total Time	VT	-	1112	-	Lines
V Active Time	VA	1080			Lines
Frame Rate	Fv	-	60	-	Hz

Note1: All reliabilities are specified for timing specification based on refresh rate of 60Hz.

3.4 Input Power Specifications

Input power specifications are as follows.

Table 9. Input Power Specifications

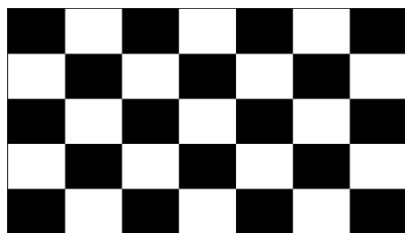
Parameter		Symbol	Min.	Typ.	Max.	Unit	Note
System Power Supply							
LCD Drive Voltage (Logic)		V _{CC}	3.0	3.3	3.6	V	(1),(2)
V _{CC} Current	mosaic Pattern	I _{VCC}	-	0.233	-	A	(1),(3)
V _{CC} Power Consumption	mosaic Pattern	P _{VCC}	-	-	0.7	W	
Rush Current		I _{rush}	-	-	1.5	A	(1),(4)
Allowable Logic/LCD Drive Ripple Voltage		V _{VCC-RP}	-	-	200	mV	(1)
LED Power Supply							
LED Driver Input Voltage		V _{LED}	5	12	21	V	(1),(2)
LEDPower Consumption		P _{LED}	-	-	3.6	W	(1),(5)
PWM Signal Voltage	High	V _{PWM}	2.5	-	V _{CC}	V	(1),(2)
	Low		-	-	0.4		
LED Enable Voltage	High	V _{LED_EN}	2.5	-	V _{CC}	V	
	Low		-	-	0.4		
Input PWM Frequency		F _{PWM}	200	-	2000	Hz	(1),(2),(6)
Duty Ratio		PWM	5	-	100	%	(1),(7)
LED Life Time		LT	15000	-	-	Hours	(1),(8)



Note (1) All of the specifications are guaranteed under normal conditions. Normal conditions are defined as follow: Temperature: 25°C, Humidity: 50 ± 10%RH.

Note (2) All of the absolute maximum ratings specified in the table, if exceeded, may cause faulty operation or unrecoverable damage. It is recommended to follow the typical value.

Note (3) The specified V_{CC} current and power consumption are measured under the $V_{CC}=3.3V$, $F_V=60Hz$ condition and 7*5 mosaic Pattern.



Note (4) The figures below is the measuring condition of V_{CC} Rush current can be measured when T_{rush} is 0.5ms.

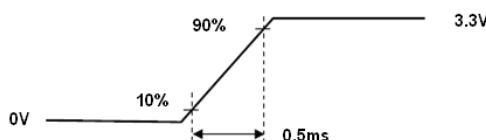


Figure 6. V_{CC} Rising Time

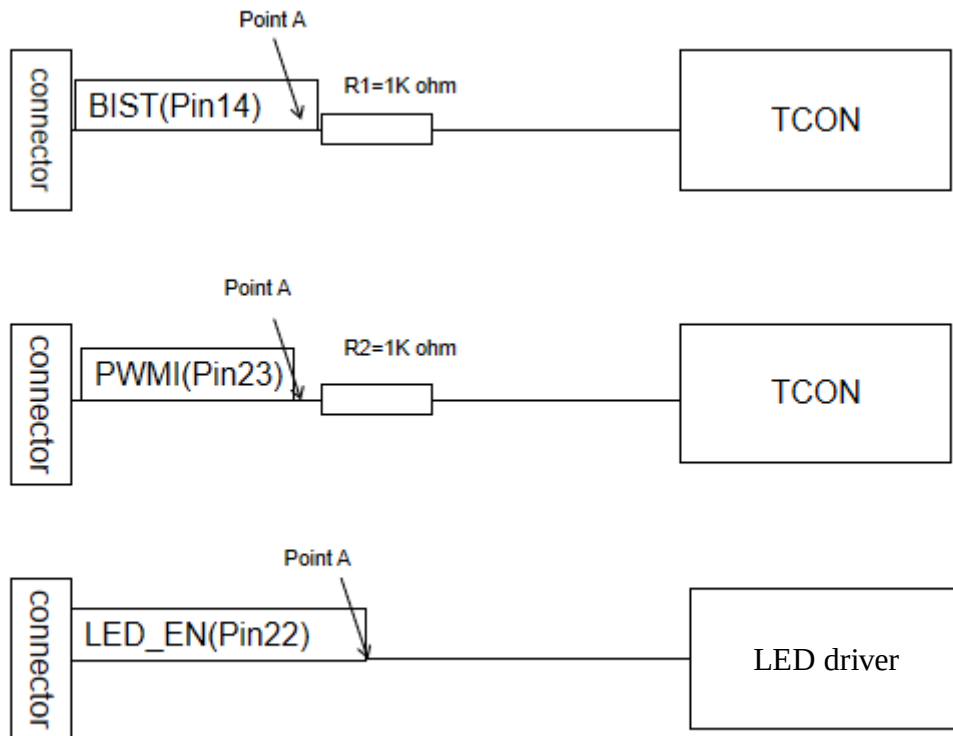
Note (5) The power consumption of LED Driver are under the $V_{LED}=12V$, Dimming of Max luminance.

Note (6) Although acceptable range as defined, the dimming ratio is not effective at all conditions. The PWM frequency should be fixed and stable for more consistent luminance control at any specific level desired.

Note (7) The operation of LED Driver below minimum dimming ratio may cause flickering or reliability issue.

Note (8) The life time is determined as the sum of the lighting time till the luminance of LCD at the typical LED current reducing to 50% of the minimum value under normal operating condition.

Note (9) Because there are voltage dividers on some control signal lines of the connector, please pay special attention when using it.



3.5 Power ON/OFF Sequence

Interface signals are also shown in the chart. Signals from any system shall be Hi-Z state or low level when V_{CC} voltage is off.

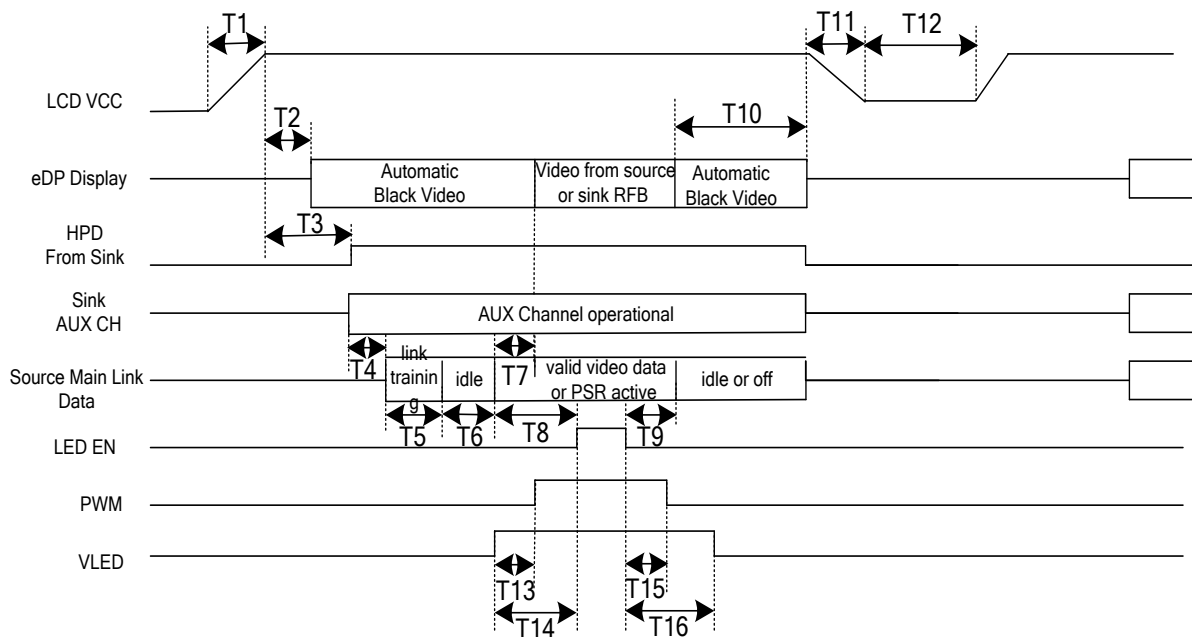




Figure 7. Power Sequence

Table 10. Power Sequencing Requirements

Parameter	Symbol	Min.	Typ.	Max.	Unit
V _{CC} Rise Time (10% to 90%)	T1	(0.5)	-	(10)	ms
Delay from V _{CC} to automatic Black Video generation	T2	(0)	-	(200)	ms
Delay from V _{CC} to HPD high	T3	(0)	-	(200)	ms
Delay from HPD high to link training initialization	T4	-	-	-	ms
Link training duration	T5	-	-	-	ms
Link idle	T6	-	-	-	ms
Delay from valid video data from Source to video on display	T7	(0)	-	(50)	ms
Delay from valid video data from Source to backlight enable	T8	(200)	-	-	ms
Delay from backlight disable to end of valid video data	T9	-	-	-	ms
Delay from end of valid video data from Source to V _{CC} off	T10	(0)	-	(500)	ms
V _{CC} fall time (90% to 10%)	T11	(0.5)	-	(10)	ms
V _{CC} off time	T12	(500)	-	-	ms
Delay from V _{LED} to PWM	T13	0	-	-	ms
Delay from V _{LED} to backlight enable	T14	0	-	-	ms
Delay from backlight disable to V _{LED} off	T15	0	-	-	ms
Delay from PWM off to V _{LED} off	T16	0	-	-	ms



3.6 Backlight Unit

Table 11. Signal Connector Type

Item	Description
Manufacturer / Type	STM/ FBSNL05001N10

Table 12. Recommended LED Driving Specifications

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
LED Forward Voltage	VF	-	-	3.0	V	
LED Forward Current	IF	-	15.5	-	mA	

Table 13. Pin Assignments of BLU Connector

Pin No.	Symbol	Description	Pin No.	Symbol	Description
1	Vout	LED anode connection	6	LED	LED cathode connection
2	Vout	LED anode connection	7	LED	LED cathode connection
3	NC	No Connection	8	LED	LED cathode connection
4	NC	No Connection	9	LED	LED cathode connection
5	LED	LED cathode connection	10	LED	LED cathode connection

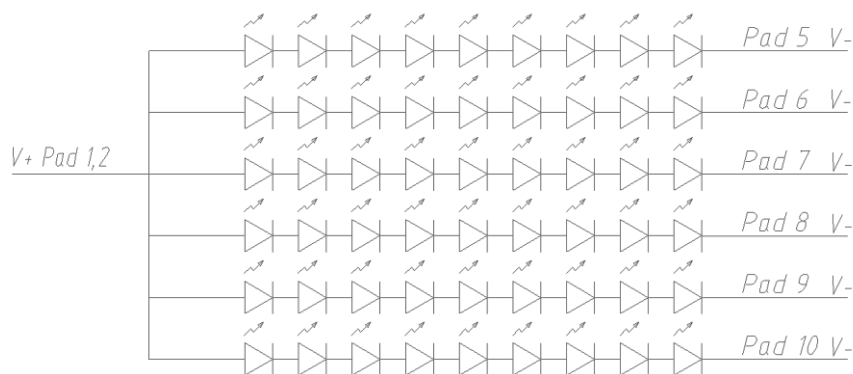


Figure 8. Recommended LED Structure



4. OPTICAL SPECIFICATION

4.1 The table below is the test condition of optical measurement.

Table 14. Test condition of optical measurement

Item	Symbol	Value	Unit
Ambient Temperature	TA	25±5	℃
Ambient Humidity	HA	50±10	% RH
Supply Voltage	V _{CC}	3.3±0.3	V
Driving Signal	Refer to the typical value in Chapter 3: ELECTRICAL SPECIFICATIONS		
Vertical Refresh Rate	Fv	60	Hz
Warm up time	Twarm	>15 min	min
Dark room	ED	<1 lux	lux

4.2 Optical Specifications

Table 15. Optical Specifications

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Color Chromaticity(CIE1931) Under@BLU	Red	Rx	$\theta_x=0^\circ, \theta_y=0^\circ$	Typ. -0.03	TBD	Typ. +0.03	-	(1)
		Ry			TBD			
	Green	Gx			TBD			
		Gy			TBD			
	Blue	Bx			TBD			
		By			TBD			
	White	Wx			0.313			
		Wy			0.329			
	Color Gamut				NTSC			
Luminance of White(5 Points)		Yw	$\theta_x=0^\circ, \theta_y=0^\circ$	212	250		cd/m2	(2)
White Luminance Uniformity(13 Points)		ΔY_{13}	$\theta_x=0^\circ, \theta_y=0^\circ$		1.4	1.6	%	(3)
Contrast Ratio		CR	$\theta_x=0^\circ, \theta_y=0^\circ$	800	1000	—	—	(4)
Response Time		Tg		-	20	25	ms	(5)
Viewing Angle	Horizontal	θ_{x+}	$CR \geq 10$ $\theta_x=0^\circ, \theta_y=0^\circ$	80	85	-	Deg.	(6)
		θ_{x-}		80	85	-		
	Vertical	θ_{y+}		80	85	-		
		θ_{y-}		80	85	-		



Notes:

(1)The color chromaticity coordinates specified in Table 15 shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the panel.

(2)Center Luminance of white is defined as luminance values of 5 point average across the LCD surface. Luminance shall be measured with all pixels in the view field set first to white. This measurement shall be taken at the locations shown in Figure 11 for a total of the measurements per display.

(3) The White luminance uniformity on LCD surface is then expressed as : $\Delta Y = \text{Minimum Luminance of 5 points} / \text{Maximum Luminance of 5 points}$ (see Figure 12).

(4) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression,

$$\text{Contrast Ratio (CR): } CR = \frac{CR_W}{CR_D}$$

CRW : Luminance of LCD module with full screen white pattern (255,255,255) at center point.

CRD : Luminance of LCD module with full screen Dark pattern (0,0,0) at center point.

Where the measure point of to the Contrast Ratio is the center of the panel.

(5) Definition of Response time (Tg):

Average switching time of luminance ratios among 10% and 90% to each other and is optimized on frame Rate =60Hz.

Table 16.Switching time of luminance ratios matrix

Measured Response time		To	
		10%	90%
From	10%		T _{10% to 90%}
	90%	T _{90% to 10%}	

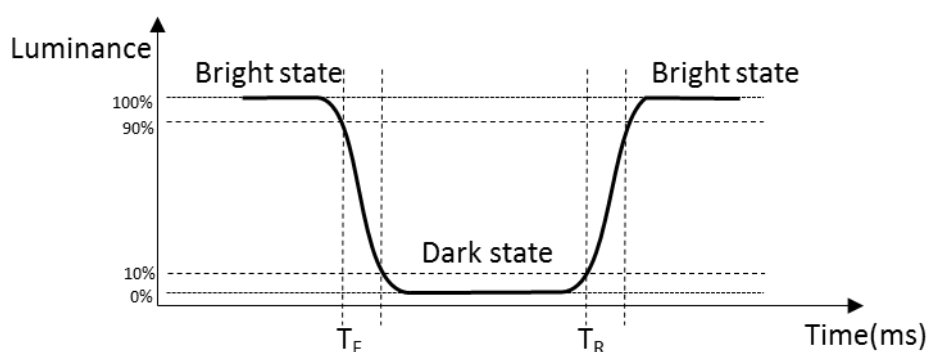


Figure 9. The definition of T_R and T_F

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



(6) Definition of Viewing angle:

As Note (4) the static contrast ratio definition, the viewing angles are defined at the angle that the contrast ratio is larger than 10 at four directions relative to the perpendicular direction of the HG module (two vertical angles: up θ_{y+} and down θ_{y-} ; and two horizontal angles: right θ_{x+} and left θ_{x-}). The standard setup of measurement is shown in Figure 10&11.

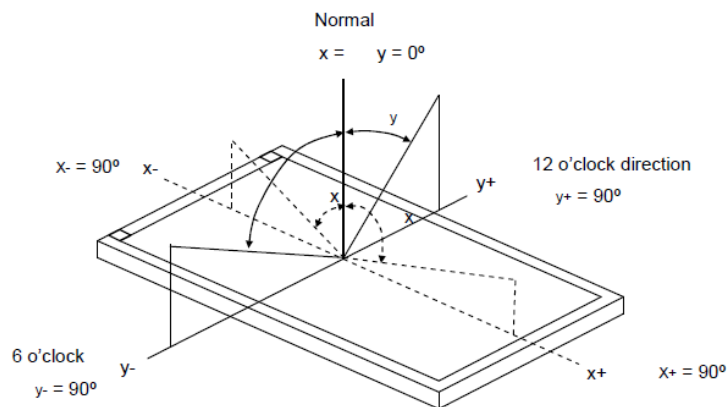


Figure 10. Definition of Viewing angle

4.3 Optical Measurements

SR-UL2

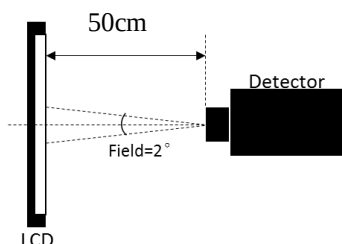


Figure 11.Measurement equipment

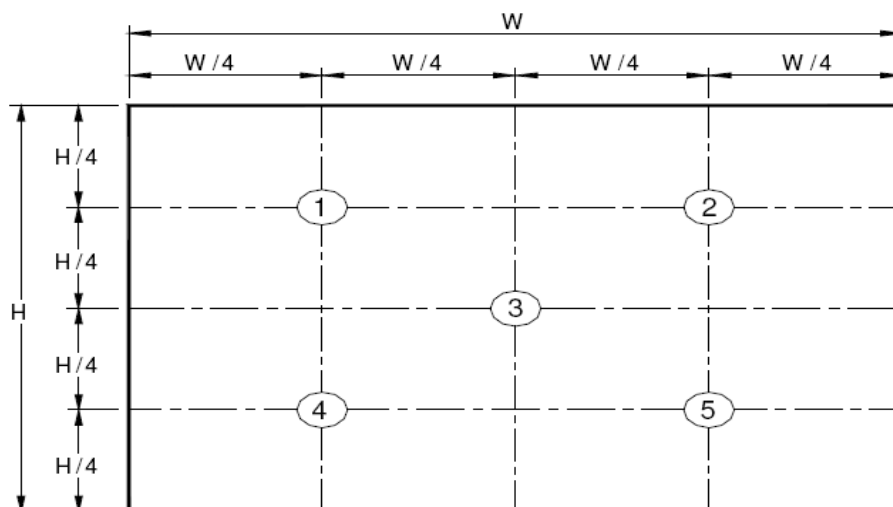


Figure 12.White Luminance Measurement Locations (5 points)



Center Luminance of white is defined as luminance values of 5 point average across the LCD surface. Luminance shall be measured with all pixels in the view field set first to white. This measurement shall be taken at the locations shown in Figure 11 for a total of the measurements per display.

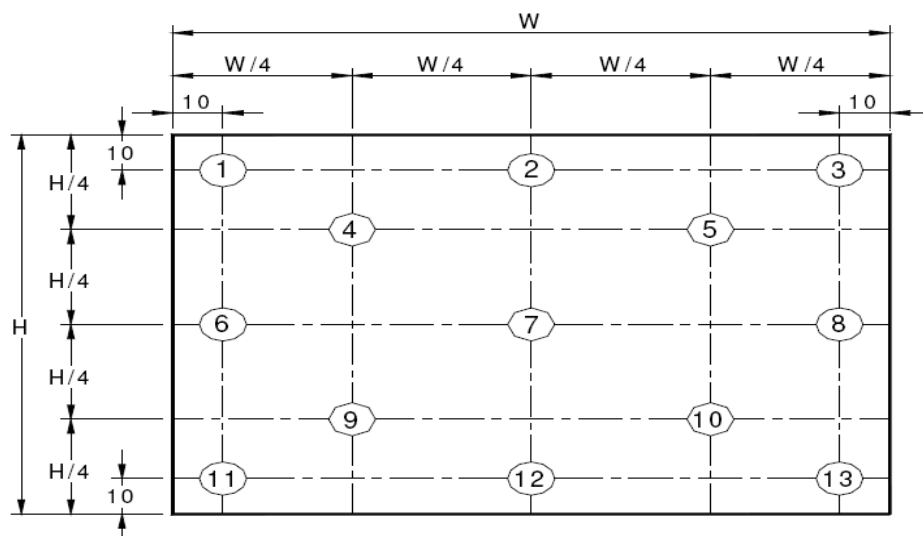
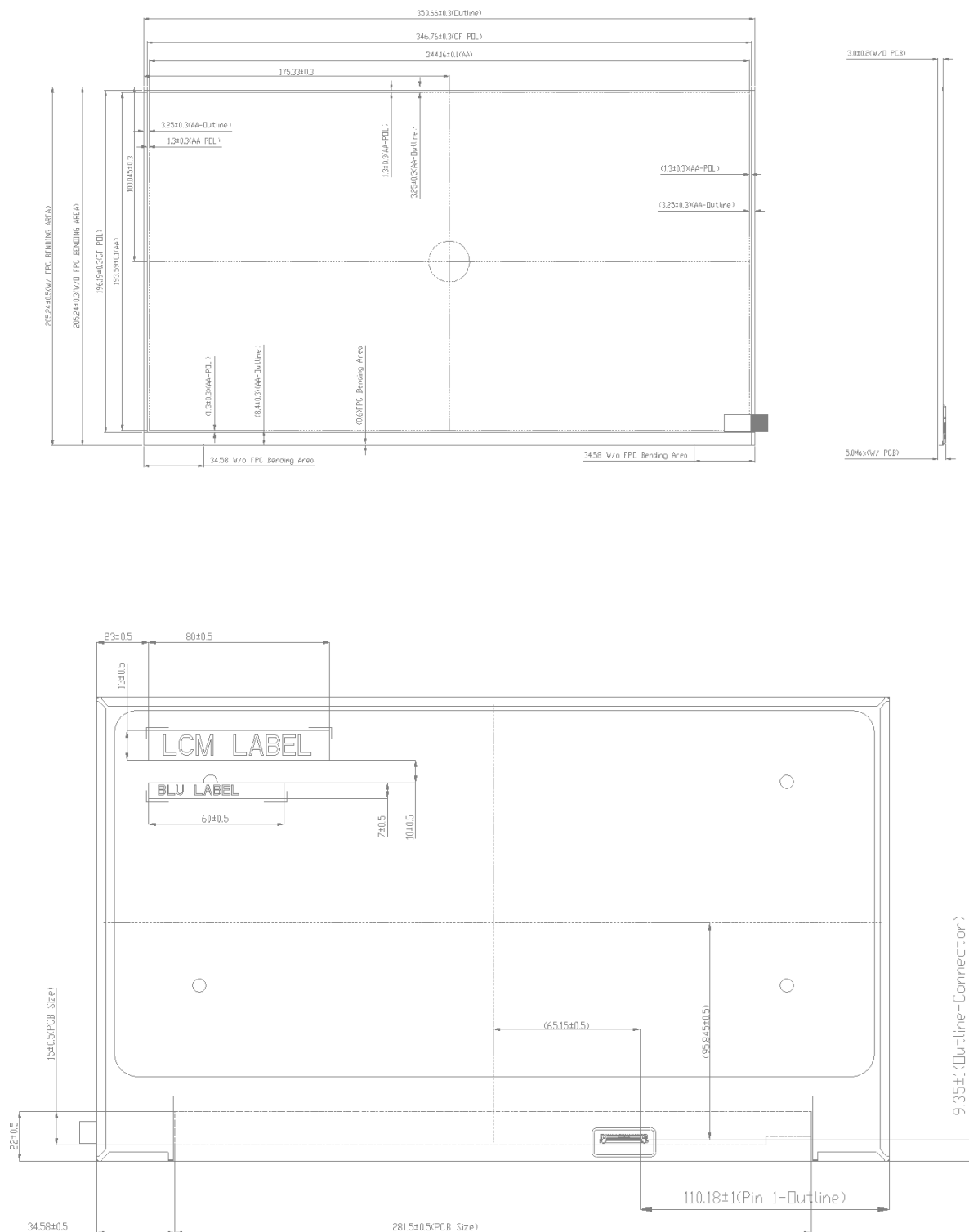


Figure 13. Uniformity Measurement Locations (13 points)

The White luminance uniformity on LCD surface is then expressed as: $\Delta Y_{13} = \text{Minimum Luminance of 13 points} / \text{Maximum Luminance of 13 points}$ (see Figure 12).



5.MECHANICAL OUTLINE DIMENSION





NOTES :

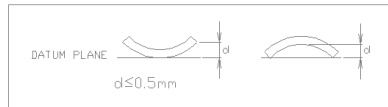
1.LCD MODULE INPUT CONNECTOR : ***

2.LCD HIGHEST PORTION MUST BE TOP POLARIZER

3.IN ORDER TO AVOID ABNORMAL DISPLAY, POOLING AND WHITE SPOT,NO OVERLAPPING IS SUGGESTED AT CABLES, ANTENNAS, CAMERA, WLAN, WAN OR FOREIGN OBJECTS OVER FPC, T-CON AND VR LOCATIONS.

4. LVDS CONNECTOR IS MEASURED AT PIN1 AND ITS MATING LINE.

5. MODULE WARPAGE SPEC 0.5mm MAX.



6. "(< >)" MARKS THE REFERENCE DIMENSIONS.

Table 17. Module Dimension Specifications

Item	Min.	Typ.	Max.	Unit
Width	350.36	350.66	350.96	mm
Height (Without PCB)	204.94	205.24	205.54	mm
Height (With PCB)	204.74	205.24	205.74	mm
Thickness (Without PCB)	2.8	3.0	3.2	mm
Thickness (With PCB)			5	mm
Weight	-		400	g

Note:

Outline dimension measure instrument: Vernier Caliper.



6. RELIABILITY TEST

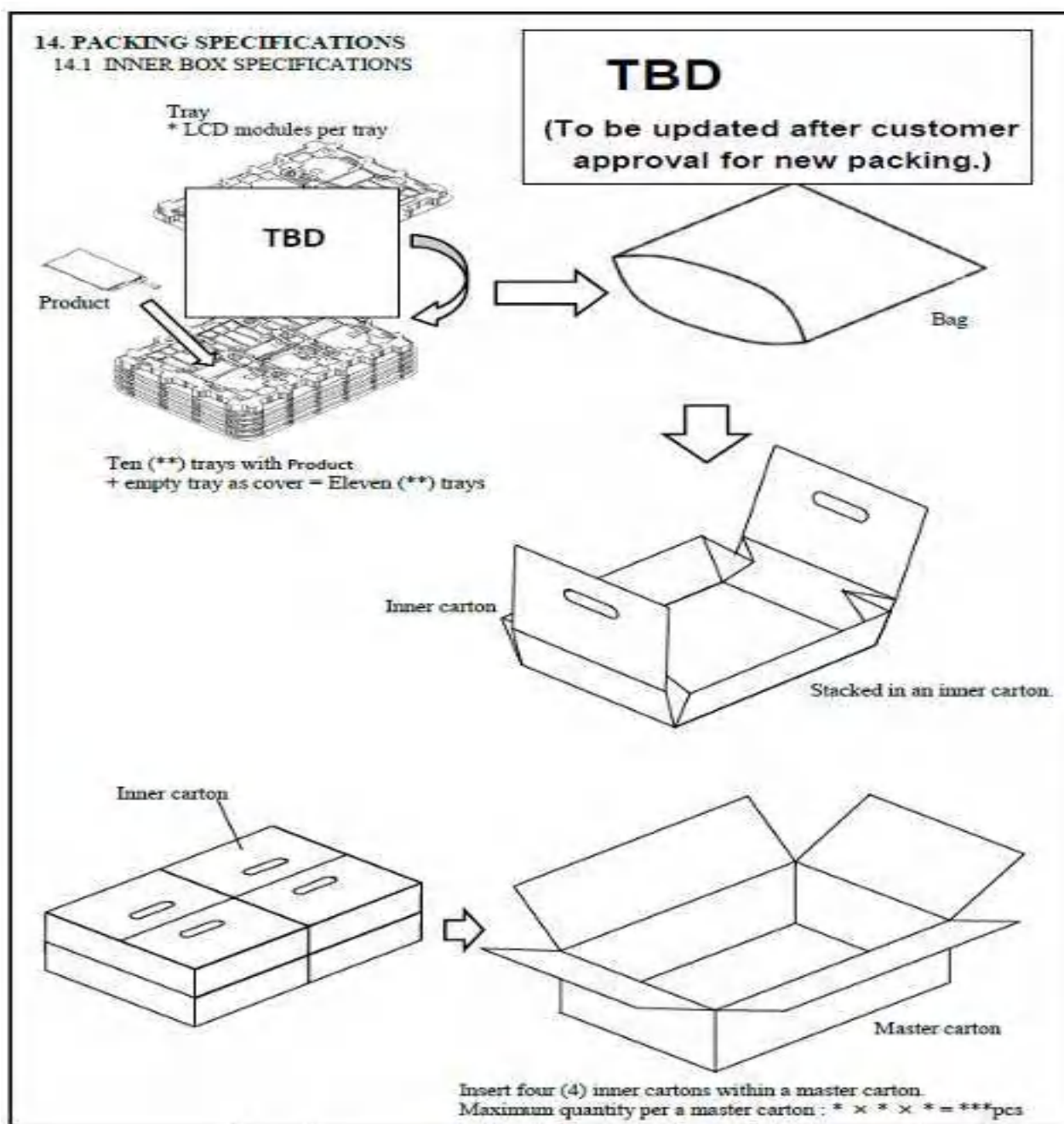
The reliability test items and its conditions are shown in below.

Table 18. Reliability Test

No	Test Items	Conditions
1	High temperature storage test	50°C, 48hrs
2	Low temperature storage test	-20°C, 48hrs
3	High temperature & high humidity operation test	50°C, 80%RH, 48hrs
4	Low temperature operation test	0°C, 48hrs
5	High temperature operation test	50°C, 48hrs
6	Thermal shock	-20~60°C , per 30min , 100cycle , storage



7. PACKAGE SPECIFICATION





8. GENERAL PRECAUTION

8.1 Using Restriction

This product is not authorized for using in life supporting systems, aircraft navigation control systems, military systems and any other appliance where performance failure could be life-threatening or lead to be catastrophic.

8.2 Operation Precaution

(1) The LCD product should be operated under normal conditions.

Normal conditions are defined as below:

Temperature: 25°C

Humidity: 50 ±10%

Display pattern: continually changing pattern (Not stationary)

(2) Brightness and response time depend on the temperature. (It needs more time to reach normal brightness in low temperature.)

(3) It is necessary for you to pay attention to condensation when the ambient temperature drops suddenly. Condensate water would damage the polarizer and electrical contacted parts of the module. Besides, smear or spot will remain after condensate water evaporating.

(4) If the absolute maximum rating value was exceeded, it may damage the module.

(5) Do not adjust the variable resistor located on the module.

(6) Sufficient suppression to the electromagnetic interference shall be done by system manufacturers.

Grounding and shielding may be important to minimize the interference.

(7) Image sticking may occur when the module displayed the same pattern for long time.

(8) Do not connect or disconnect the module in the “power on” condition. Power supply should always be turned on/off by the “power on/off sequence”

(9) Ultra-violet ray filter is necessary for outdoor operation.

8.3 Mounting Precaution

(1) All the operators should be electrically grounded and with Ion-blown equipment turning on when mounting or handling. Dressing finger-stalls out of the gloves is important for keeping the panel clean during the incoming inspection and the process of assembly.

(2) It is unacceptable that the material of cover case contains acetic or chloric. Besides, any other material that could generate corrosive gas or cause circuit break by electro-chemical reaction is not desirable.

(3) The case on which a module is mounted should have sufficient strength so that external force is not



transmitted to the module directly.

- (4) It is obvious that you should adopt radiation structure to satisfy the temperature specification.
- (5) It should be attached to the system tightly by using all holes for mounting, when the module is assembled. Be careful not to apply uneven force to the module, especially to the PCB on the back.
- (6) A transparent protective film needs to be attached to the surface of the module.
- (7) Do not press or scratch the polarizer exposed with anything harder than HB pencil lead. In addition, don't touch the pin exposed with bare hands directly.
- (8) Clean the polarizer gently with absorbent cotton or soft cloth when it is dirty.
- (9) Wipe off saliva or water droplet as soon as possible. Otherwise, it may cause deformation and fading of color.
- (10) Desirable cleaners are IPA (Isopropyl Alcohol) or hexane. Do not use Ketone type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
- (11) Do not disassemble or modify the module. It may damage sensitive parts in the LCD module, and cause scratches or dust remains. HG does not warrant the mod ule, if you disassemble or modify the module.

8.4 Handling Precaution

- (1) Static electricity will generate between the film and polarizer, when the protection film is peeled off. It should be peeled off slowly and carefully by operators who are electrically grounded and with Ion-blown equipment turning on. Besides, it is recommended to peel off the film from the bonding area.
- (2) The protection film is attached to the polarizer with a small amount of glue. When the module with protection film attached is stored for a long time, a little glue may remain after peeling.
- (3) If the liquid crystal material leaks from the panel, keep it away from the eyes and mouth. In case of contact with hands, legs or clothes, it must be clean with soap thoroughly.

8.5 Storage Precaution

When storing modules as spares for long time, the following precautions must be executed.

- (1) Store them in a dark place. Do not expose to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
- (2) The polarizer surface should not come in contact with any other object. It is recommended that they be stored in the container in which they were shipped.
- (3) It is recommended to use it in a short-time period, after it's unpacked. Otherwise, we would not guarantee the quality.

8.6 Others

When disposing LCD module, obey the local environmental regulations.