HL 海罗光电有限公司
Hello Lighting co., LTD

ISO 9001

SPECIFICATION
OF
LCD MODULE

MODULE NO.: HL024T01-01

Customer Approval:

☐ Accept ☐ Reject

	SIGNATURE	DATE
PREPARED BY		
CHECKED BY		
APPROVED BY		

DOCUMENT REVISION HISTORY

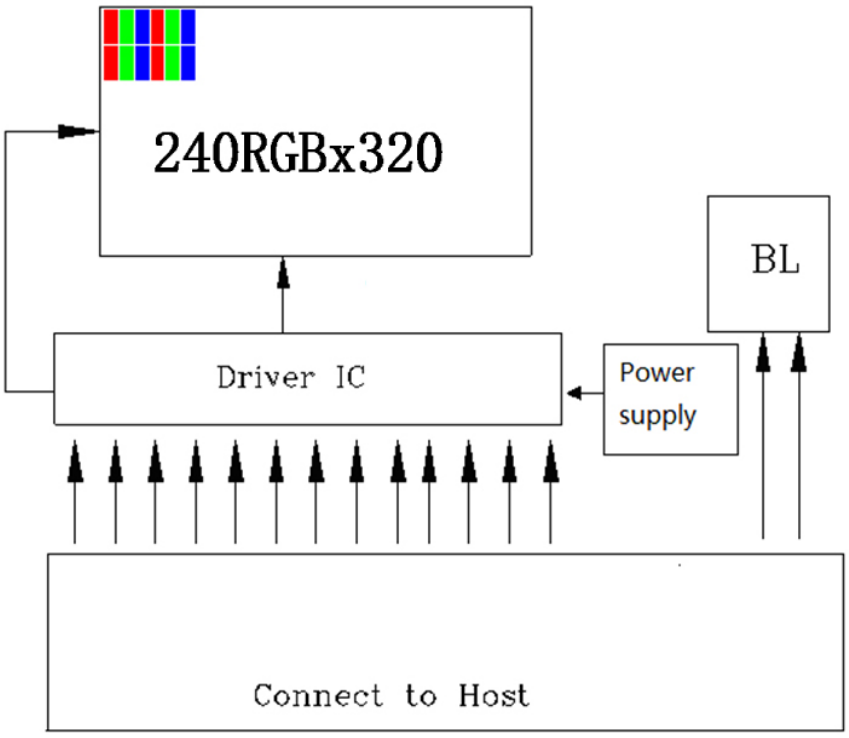
Sample Version	Doc. Version	DATE	DESCRIPTION	CHECKED BY
0001	A0	2023-08-29	First Release.	

1. MECHANICAL SPECIFICATIONS:

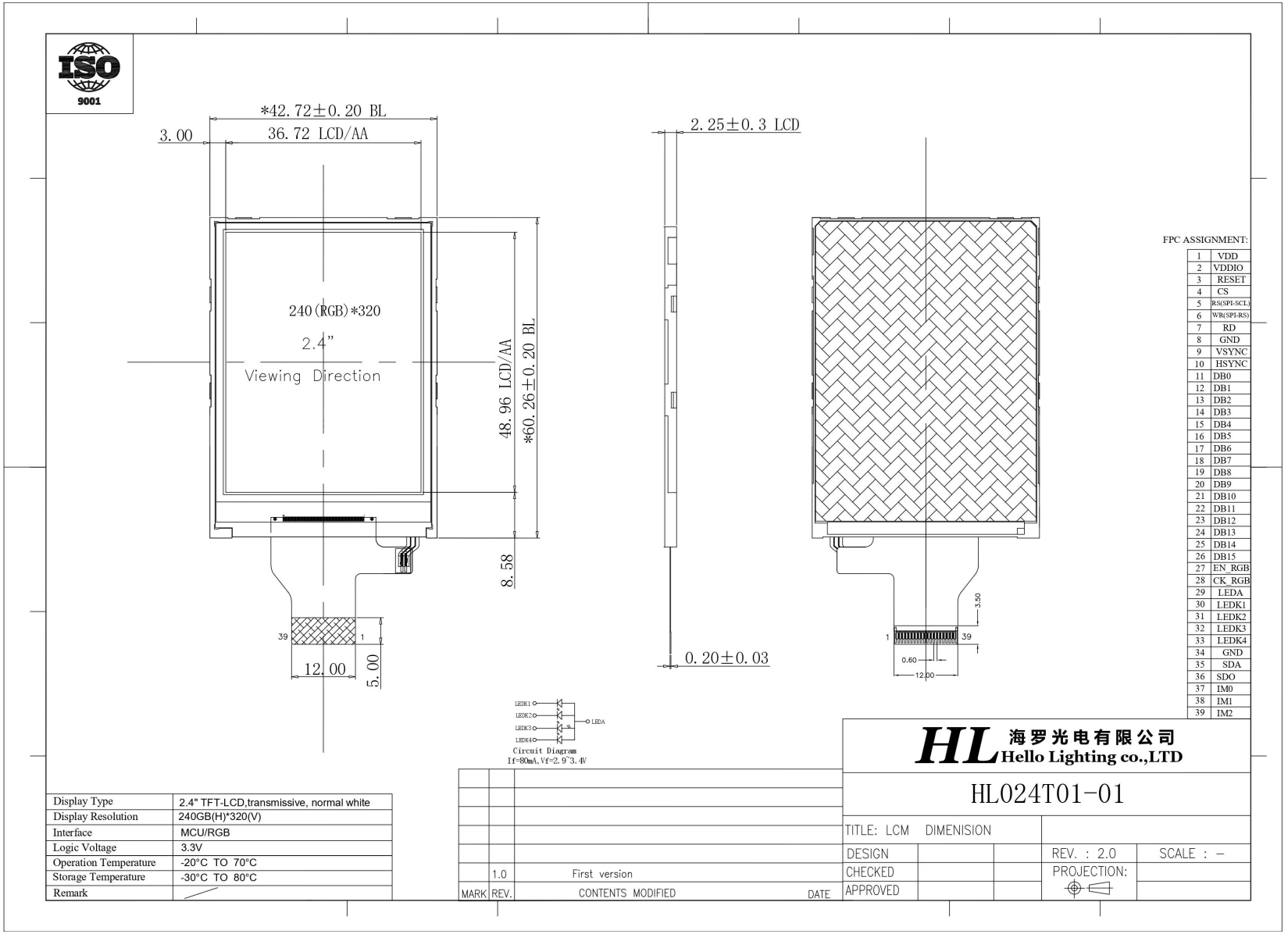
ITEM	SPECIFICATION	UNIT
OUTLINE DIMEMSIONS	42.72 (W) X60.26(H) X2.5(D)	mm
ACTIVEAREA	36.72 (W) X48.96(H)	mm
DISPLAY SIZE	2.4	inch
DOT PITCH	0.153mmX0.153mm	mm
NUMBER OF DOTS	240*（RGB）*320	-
DRIVER IC	ST7789V or EQU	-
LCD TYPE	TFT(65K/262K) TRANSFLECTIVE	-
BACKLIGHT TYPE	LED White	-
VIEWING DIRECTION	6:00	-

***See attached drawing for details.**

2.BLOCK DIAGRAM:



3.DIMENSIONAL



FPC ASSIGNMENT:

1	VDD
2	VDDIO
3	RESET
4	CS
5	RS(SPI-SCL)
6	WR(SPI-RS)
7	RD
8	GND
9	VSYNC
10	HSYNC
11	DB0
12	DB1
13	DB2
14	DB3
15	DB4
16	DB5
17	DB6
18	DB7
19	DB8
20	DB9
21	DB10
22	DB11
23	DB12
24	DB13
25	DB14
26	DB15
27	EN_RGB
28	CK_RGB
29	LEDA
30	LEDK1
31	LEDK2
32	LEDK3
33	LEDK4
34	GND
35	SDA
36	SDO
37	IM0
38	IM1
39	IM2

Display Type	2.4" TFT-LCD,transmissive, normal white
Display Resolution	240GB(H)*320(V)
Interface	MCU/RGB
Logic Voltage	3.3V
Operation Temperature	-20°C TO 70°C
Storage Temperature	-30°C TO 80°C
Remark	

MARK	REV.	CONTENTS MODIFIED	DATE
	1.0	First version	

海罗光电有限公司
Hello Lighting co.,LTD

HL024T01-01

TITLE: LCM DIMENSION

DESIGN | CHECKED | APPROVED

REV. : 2.0 | SCALE : –

PROJECTION:

4. PIN DESCRIPTION:

Pin define for TFT

NO.	PIN NAME	I/O	Description
1	VDD	P	Power supply for core
2	VDDIO	P	Power supply for IO
3	RESET	I	Reset signal
4	CS	I	Chip select input pin (“Low” enable). Fix this pin at IOVCC or GND when not in use
5	RS	I	This pin is used to select “Data or Command” in the parallel interface. When D/CX = ‘1‘, data is selected. When D/CX = ‘0‘, command is selected. This pin is used serial interface clock in 3-wire 9-bit / 4-wire 8-bit serial data interface. Fix this pin at IOVCC or GND when not in use.
6	WR	I	write signal Fix this pin at IOVCC or GND when not in use
7	RD	I	read signal Fix this pin at IOVCC or GND when not in use
8	GND	P	Power ground
9	VS	I	Vertial synchronizing signal for RGB interface operation. Fix this pin at IOVCC or GND when not in use.
10	HS	I	Herital synchronizing signal for RGB interface operation. Fix this pin at IOVCC or GND when not in use.
11	DB0	IO	Data bus
12	DB1	IO	
13	DB2	IO	
14	DB3	IO	
15	DB4	IO	
16	DB5	IO	
17	DB6	IO	
18	DB7	IO	
19	DB8	IO	
20	DB9	IO	
21	DB10	IO	
22	DB11	IO	
23	DB12	IO	
24	DB13	IO	
25	DB14	IO	

26	DB15	IO	
27	ENB	I	Data enable signal for RGB interface operation. Fix this pin at IOVCC or GND when not in use.
28	PCLK	I	Dot clock signal for RGB interface operation. Fix this pin at IOVCC or GND when not in use.
29	LEDA	P	Back light ANODE
30	LEDK1	P	Back light cathode
31	LEDK2	P	Back light cathode
32	LEDK3	P	Back light cathode
33	LEDK4	P	Back light cathode
34	GND	P	Power ground
35	SDA	O	SPI interface output pin. If not used, let this pin open.
36	SDO	O	Serial data output
37	IM0	I	IM3=0
38	IM1	I	IM[2:0]=0001 default
39	IM2	I	

note1:

IM2	IM1	IM0	Interface	Read Back Data Bus Selection
0	0	0	80-8bit parallel I/F	DB[7:0]
0	0	1	80-16bit parallel I/F	DB[15:0]
0	1	0	80-9bit parallel I/F	DB[8:0]
0	1	1	80-18bit parallel I/F	DB[17:0],
1	0	1	3-line 9bit serial I/F	SDA: in/out
			2 data lane serial I/F	SDA: in/out, WRX: in
1	1	0	4-line 8bit serial I/F	SDA: in/out

note2:

I : host to LCD

O: LCD to host

IO: host to LCD or LCD to host

P: power

5. MAXIMUM ABSOLTE LIMIT:

Item	Symbol	Value	Unit
Power supply voltage for core	VCI	-0.3~3.6	V
Power supply voltage for IO	IOVCC	-0.3~3.6	V
Power supply voltage for CTP	VDDCTP	-0.3~3.6	V
Input voltage	Vin	V_{DD}+0.3	V
Operating temperature	Topr	-20 to 70	°C
Storage temperature	Tstg	-30 to 80	°C

Note: Note1: Absolute maximum rating is the limit value beyond which the IC maybe broken. They do not assure operations.

Note2: Background color changes slightly depending on ambient temperature. This Phenomenon is reversible.

Ta≦70℃: 75%RH max

Ta>70℃: absolute humidity must be lower than the humidity of 75%RH at 70℃

Note3: Ta at -30℃ will be <48hr s, at 80 ℃ will be <120hrs

6.ELECTRICAL CHARACTERISTICS

6.1 DC Characteristics (Ta=25°C)

Item	Symbol	Min	Type	Max	Unit	Test condition
Power supply for core	VCI	2.7	3.3	3.5	V	-
Power supply for IO	IOVCC	1.65	1.8	3.4	V	
Power supply for CTP	VDDctp	2.7	3.3	3.5	V	-
Supply current	I_{DD}	-	TBD	-	mA	V_{DD}=3.3V,Ta=25°C
Input voltage	V_{IH}	0.7VDD	-	VDD	V	-
	V_{IL}	0	-	0.3VDD	V	
Input leakage current	I_{IL}	-1.0	-	1.0	μA	V_{IN}=V_{DD} or V_{SS}

Note: Voltage greater than above may damage the module.

All voltages are specified relative to V_{SS}=0V.

6.2 Backlight Electrical-optical Characteristics

1. Stander Lamp Styles(Edge Lighting Type):

The LED chips are distributed over the edge light area of the illumination unit, which gives the less power consumption:

2. The Main Advantages of the LED Backlight are as following:

2.1 The brightness of the backlight can simply be adjusted by a resistor or a potentiometer.

3. Data About LED Backlight:

Item	Symbol	MIN	TYP	MAX	UNIT	Test Condition	Note
Supply Voltage	Vf	3.0	3.2	3.4	V	If=80 mA	-
Supply Current	If	-	80	-	mA	-	-
Reverse Voltage	Vr	-	-	5	V	10uA	
Power dissipation	Pd	-	256	-	mW	-	
Uniformity for LCM	-	80	-	-	%	If=80mA	3
Life Time	-	30000	-	-	Hr	If=80 mA	-
Backlight Color	White						

NOTE:

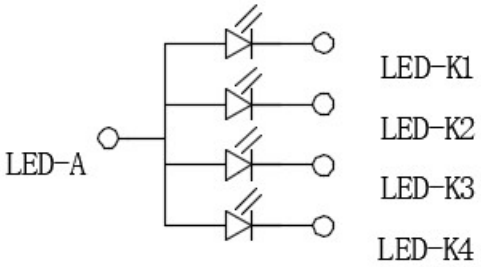
1. Average Luminous Intensity of P1-P9
2. Uniformity = Min/Max * 100%
3. LED life time defined as follows: The final brightness is at 70% of original brightness

Measured Method: (X*Y: Light Area)(Left Draft as follow)

Internal Circuit Diagram(Right Draft as follow)

(Effective spatial Distribution)

Hole Diameter ø 3mm ; 1 to 9 per Position Measured Luminous:



7.AC TIMING

Please refer to IC spec.

8. OPTICAL CHARACTERISTICS:

Driving the backlight

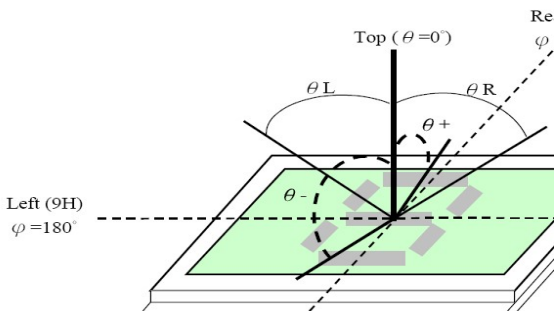
No.	ITEM		Symbol	Conditions	Specification			Unit	Note
					Min	Typ	Max		
1	Response Time		Tr+Tf	25℃	-	25	30	Ms	(1)(2)
2	Contrast Rate		Cr	θ=0, Normal viewing angle		150	-	-	(1)(3)
3	Viewing Angle	Hor.	θL	CR>10	-	50	-	Deg	-
			θR		-	40	-		
		Ver.	Θ+		-	40	-		
			Θ-		-	40	-		
4	Chromaticiry	White	x	Brightness is ON	0.278	0.298	0.318		
			y		0.311	0.331	0.51		
		Red	x		0.587	0.607	0.627		
			y		0.310	0.330	0.350		
		Green	x		0.258	0.278	0.298		
			y		0.526	0.546	0.566		
		Blue	x		0.121	0.141	0.161		
			y		0.138	0.158	0.178		
5	NTSC		S			50		%	
6	luminance		L			400		cd/m2	
7	Uniformity		U		80			%	

Measure Conditions:

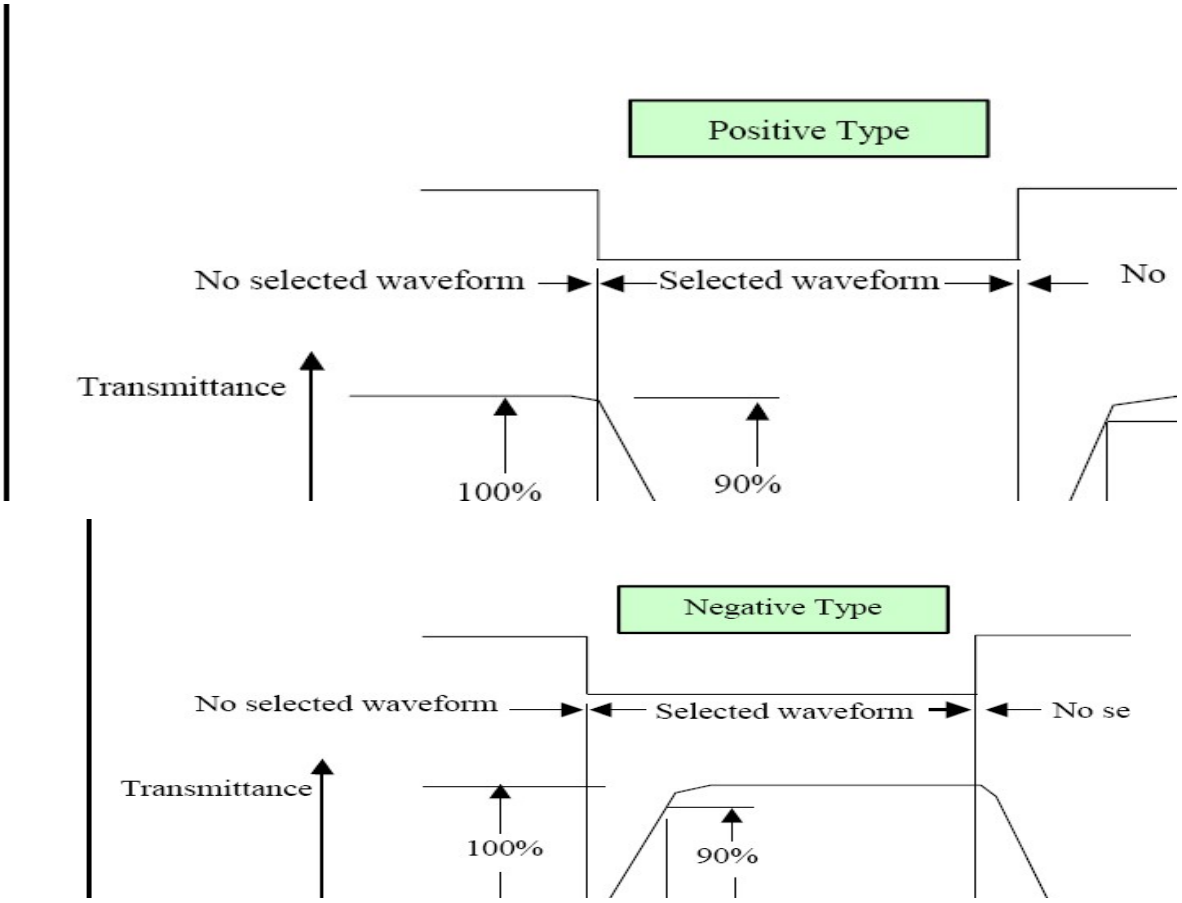
1. Measure surrounding : dark room;
2. Ambient temperature: 25±2℃;
3. 30min.warm-up time.

Note Definition:

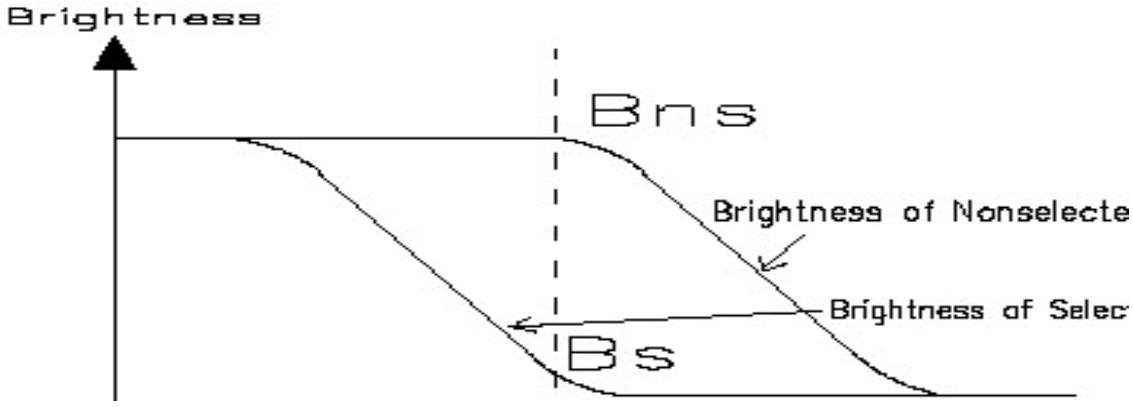
Note(1)Viewing angle range:



Note(2)Response Time:

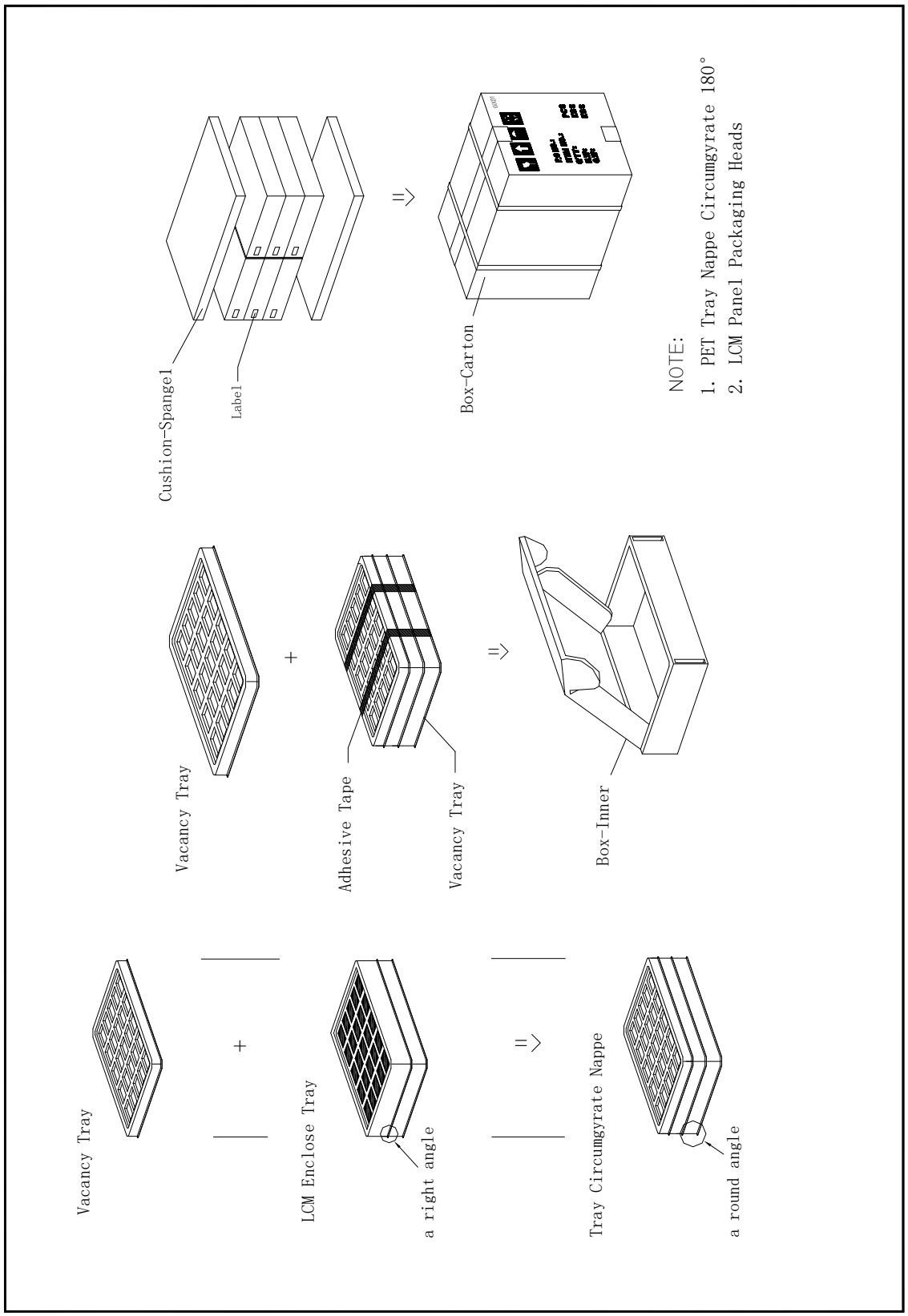


Note(3)Contrast Ratio Definition:



$$\text{Contrast Ratio (Cr)} = \frac{\text{Luminance with all pixel white}}{\text{Luminance with all pixel black}}$$

9.PACKAGE.


Cushion-Spangel
Label
Box-Carton
NOTE:
1. PET Tray Nappe Circumgyrate 180°
2. LCM Panel Packaging Heads
Vacancy Tray
Adhesive Tape
Vacancy Tray
Box-Inner
Vacancy Tray
LCM Enclose Tray
a right angle
Tray Circumgyrate Nappe
a round angle

10. STANDARD SPECIFICATION FOR RELIABILITY:

Item	Condition		Time (hrs)	Assessment
High temp. Storage	80°C		120	No abnormalities in functions and appearance
High temp. Operating	70°C		120	
Low temp. Storage	-30°C		120	
Low temp. Operating	-20°C		120	
Humidity	40°C/ 90%RH		120	
Thermal Shock Temp. Cycle	-20°C ← →70°C (0.5hour ← → 0.5 hour)		10cycles	
ESD Testing	HBM:	±8KV		330Ω/150PF
	MM:	±200V		200PF/0Ω

Functions, performance, appearance, etc. shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions room temperature (25±10℃), normal humidity (45±20% RH), and in area not exposed to direct sun light. (Life time of backlight, please refer to Data about backlight.)

Testing Conditions and Inspection Criteria:

For the final test the testing sample must be stored at room temperature for 24 hours, after the tests listed in up Table, Standard specifications for Reliability have been executed in order to ensure stability.

Item	**Test Model**	**In section Criteria**
Current Consumption	Refer To Specification	The current consumption should conform to the product specification.
Contrast	Refer To Specification	After the tests have been executed, the contrast must be larger than half of its initial value prior to the tests.
Appearance	Visual inspection	Defect free.

11.SPECIFICATION OF QUALITY ASSURANCE:

11.1 Purpose

This standard for Quality Assurance should affirm the quality of LCD Module products to supply.

11.2 Standard for Quality Test

a. Inspection:

Before delivering, the supplier should take the following tests, and affirm the quality of product.

b. Electro-Optical Characteristics:

According to the individual specification to test the product.

c. Test of Appearance Characteristics:

According to the individual specification to test the product.

d. Test of Reliability Characteristics:

According to the definition of reliability on the specification for testing products.

e. Delivery Test:

Before delivering, the supplier should take the delivery test.

(i) Test method: According to MIL-STD105E.General Inspection Level Ⅱ take a single time.

(ii) The defects classify of AQL as following:

Major defect: AQL = 0.65

Minor defect: AQL = 2.5

Total defects: AQL = 2.5

11.3. Nonconforming Analysis & Deal With Manners

a. Nonconforming Analysis:

(i) Purchaser should supply the detail data of non- conforming sample and the non- conforming.

(ii) After accepting the detail data from purchaser, the analysis of nonconforming should be finished in two weeks.

(iii) If supplier can not finish analysis on time, must announce purchaser before two weeks.

b. Disposition of nonconforming:

(i) If find any product defect of supplier during assembly time, supplier must change the good product for every defect after recognition.

(ii) Both supplier and customer should analyze the reason and discuss the disposition of nonconforming when the reason of nonconforming is not sure.

11.4. Agreement items

Both sides should discuss together when the following problems happen.

a. There is any problem of standard of quality assurance, and both sides think that it must be modified.

b. There is any argument item which does not record in the standard of quality assurance.

c. Any other special problem.

11.5 Standard of The Product Appearance Test

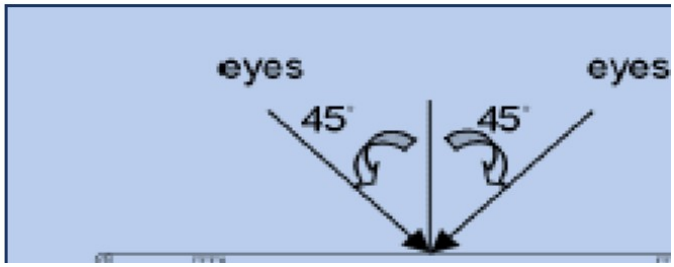
a. Manner of appearance test: This specification should be applied for both light on and off situation.

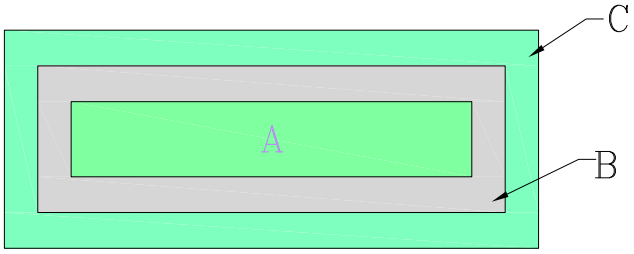
(i) The test must be under 20W × 2 or 40W fluorescent light, and the distance of view must be at 30±5cm.

(ii) When test the model of transmissive product must add the reflective plate.

(iii)The test direction is base on about around 10° of vertical line (Left graph)

(iiii)Temperature: 25±5℃ Humidity: 65±10%RH





(iv) Definition of area (Right graph)

A. Area: Viewing area. B. Area: Out of viewing area.(Outside viewing area)

b. Basic principle:

(i) It will accord to the AQL when the standard can not be described.

(ii) The sample of the lowest acceptable quality level must be discussed by both supplier and customer when any dispute happened.

(iii) Must add new item on time when it is necessary.

c. Standard of inspection: (Unit: mm)

Allowable limits defined in follow Dot defect Table should be met for each white, black , R, G, B raster. The limits apply to the entire area. Missing white in 60% or more of typical (one color, R or G or B) pixel aperture is defined as a bright defect, less than 60% is acceptable .Black spot in 60% or more of typical pixel aperture is defined as a dark defect, less than 60% is acceptable.

Dot defect table:

Item		White dot defect	Black dot defect	Total
1	Defect counts	3	3	3
2	Combined defect Counts	No combined dot defect allowed. Two Single dot defect that within 5mm during each dot defect should becounted as combined dot defect.		

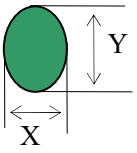
11.6 Inspection specification

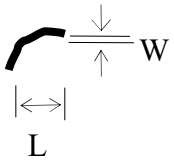
AQL inspection standard

Sampling method: MIL-STD-105E, Level II, single sampling

Classify	Item		Note	AQL
Major	Display state	Short or open circuit	1	0.65
		Contrast defect (dim, ghost)		
		LC leakage		
		Flickering		
		No display		
		Wrong viewing direction	2	
		Wrong Back-light	7	
	Non-display	Flat cable or pin reverse	9	
		Wrong or missing component	10	
Minor	Display state	Background color deviation	2	2.5
		Black spot and dust	3	
		Line defect	4	
		Scratch		
		Rainbow	5	
		Pin hole	6	
	Polarizer	Bubble and foreign material	3	
		Scratch	4	
	PCB,FPC	Scratch	4	
	Soldering	Poor connection	8	
	Wire	Poor connection	9	
	LCD	CHIP OUT	11	

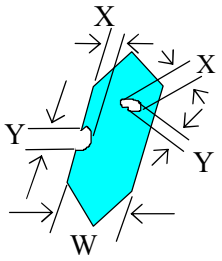
Note on defect classification:

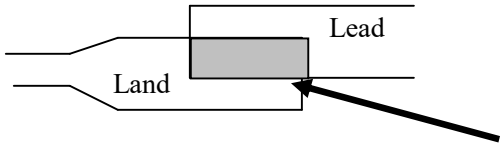
<table>
<tr><th>No.</th><th>Item</th><th>Criterion</th></tr>
<tr><td rowspan="6">1</td><td>Short or open circuit</td><td rowspan="6">Not allow</td></tr>
<tr><td>LC leakage</td></tr>
<tr><td>Flickering</td></tr>
<tr><td>No display</td></tr>
<tr><td>Wrong viewing direction</td></tr>
<tr><td>Wrong Back-light</td></tr>
<tr><td rowspan="2">2</td><td>Contrast defect</td><td rowspan="2">Refer to approval sample</td></tr>
<tr><td>Background color deviation</td></tr>
<tr><td>3</td><td>Point defect,
Black spot, dust (incl. Polarizer) ex.: dirt under polarizer,
Pinhole of reflector ,glass scratch, dirt under glass,scratch on polarizer
ϕ = (X+Y)/2</td><td> 

<table>
<tr><td>Point Size</td><td>Acceptable Qty.</td></tr>
<tr><td>ϕ≤0.20</td><td>Disregard</td></tr>
<tr><td>0.20<ϕ≤0.25</td><td>3</td></tr>
<tr><td>0.25<ϕ≤0.30</td><td>2</td></tr>
<tr><td>ϕ>0.30</td><td>0</td></tr>
</table>
Unit：mm</td></tr>
<tr><td>4</td><td>Line defect</td><td> 

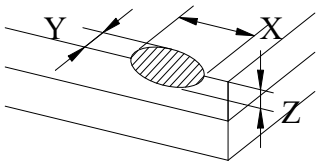
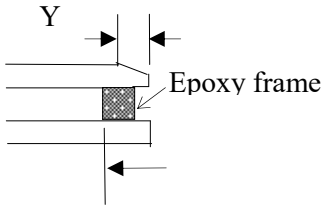
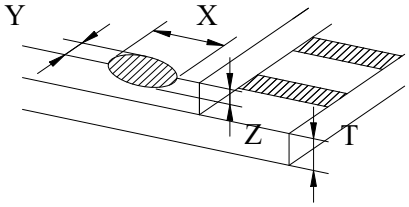
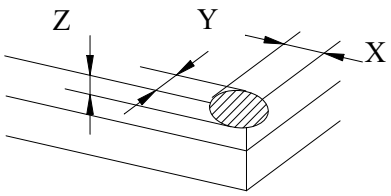
<table>
<tr><td></td><td>Line</td><td>Acceptable Qty.</td></tr>
<tr><td>L</td><td>W</td><td></td></tr>
<tr><td>---</td><td>0.015≥W</td><td>Disregard</td></tr>
<tr><td>3.0≥L</td><td>0.03≥W</td><td rowspan="2">2</td></tr>
<tr><td>2.0≥L</td><td>0.05≥W</td></tr>
<tr><td>1.0≥L</td><td>0.1 > W</td><td>1</td></tr>
<tr><td>---</td><td>0.05<W</td><td>Applied as point defect</td></tr>
</table>
Unit: mm</td></tr>
<tr><td>5</td><td>Rainbow</td><td>Not more than two color changes across the viewing area</td></tr>
</table>

No.	Item	Criterion

<table>
<tr>
<td>6</td>
<td>Segment pattern
W = Segment width
ϕ = (X+Y)/2</td>
<td>(1) Pin hole
ϕ < 0.10mm is acceptable.
 

<table>
<tr><td>Point Size</td><td>Acceptable Qty</td></tr>
<tr><td>ϕ≤1/4W</td><td>Disregard</td></tr>
<tr><td>1/4W< ϕ≤1/2W</td><td>1</td></tr>
<tr><td>ϕ > 1/2W</td><td>0</td></tr>
</table>
Unit: mm</td>
</tr>
<tr>
<td>7</td>
<td>Back-light</td>
<td>(1) The color of backlight should correspond its specification.
(2) Not allow flickering</td>
</tr>
<tr>
<td>8</td>
<td>Soldering</td>
<td>(1) Not allow heavy dirty and solder ball on PCB or FPC.
(The size of dirty refer to point and dust defect)
(2) Over 50% of lead should be soldered on Land.
 

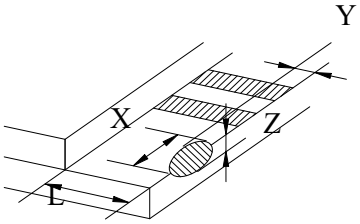
50% lead</td>
</tr>
<tr>
<td>9</td>
<td>Wire</td>
<td>(1) Copper wire should not be rusted
(2) Not allow crack on copper wire connection.
(3) Not allow reversing the position of the flat cable.
(4) Not allow exposed copper wire inside the flat cable.</td>
</tr>
<tr>
<td>10</td>
<td>PCB,FPC</td>
<td>(1) Not allow screw rust or damage.
(2) Not allow missing or wrong putting of component.</td>
</tr>
</table>

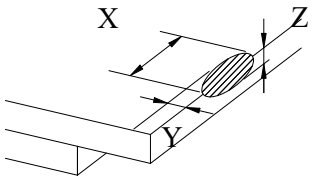
11	LCD	**2.1.1 chip on the surface**     Note: A:LCD Length X / Y / Z >1/8A / ≤0.3mm / ≤1/2T ≤1/8A / Not enter into epoxy frame / ≤T ≤1/8A / Not enter into the inner edge of epoxy / ≤1/2T

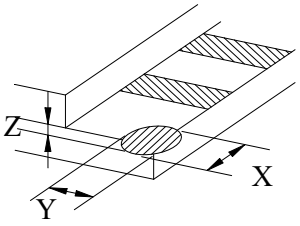
11

LCD

2.1.2 Chip on the terminal





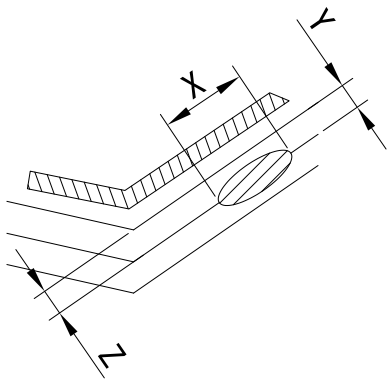


X	Y	Z
>1/8A	≤0.3mm	≤1/2T
≤1/8A	≤1/2L	≤T
≤1/8A&≤1mm	≤L	≤T
≤1/8A&≤2mm	≤L	≤1/2T

Note: A:LCD Length.

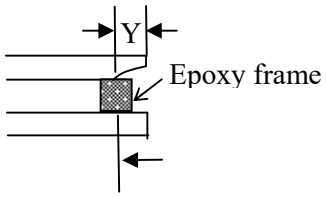
the distance between crack and contact pad must be greater than the width of 1st contact pad.

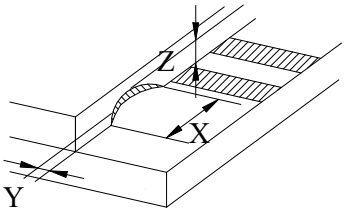
2.1.3 Chip out on between side



11

LCD

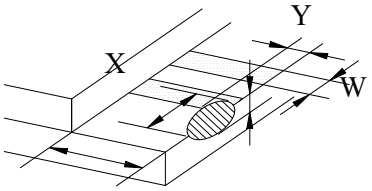




X	Y	Z
≤ 1/8A	Not enter into epoxy frame	Z≤2T
	Not enter into 1/2 epoxy frame	Z≤1/2T

Note: A : LCD Length

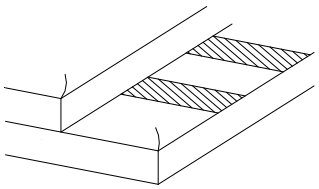
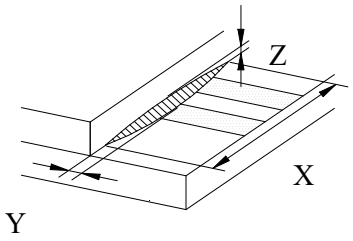
2.1.4 including corner chip and side chip



L

Note: A:LCD Length

X	Y	Z
>1/8A	≤1/6L	≤1/2T
≤1/8A	≤1/3L	
≤1/4W	≤2/3L	

<table>
<tr><td rowspan="2">11</td><td rowspan="2">LCD</td><td>2.2 Chip out
 
1) Chip out is that crackles extend to inner edge.
2) Crackles round epoxy frame will be rejected.
3) Chip out on the terminal will be rejected: Z=T length >1mm or Z<T length >2mm
4) The chip out at ITO will be rejected.</td></tr>
<tr><td>2.3 Poor cutting
 

<table>
<tr><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>>1/8 A</td><td>≤0.3</td><td>≤1/2T</td></tr>
<tr><td>≤1/8 A</td><td>According to drawing</td><td>1/2T≤Z≤T</td></tr>
</table>
Note : A: LCD Length.</td></tr>
<tr><td>12</td><td>SMT</td><td>According to the <Acceptable of electronic assemblies>
IPC-A-610C class 2 stander. Component missing or function defect are Major defect ,the others are Minor defect.</td></tr>
<tr><td colspan="3">Any one out of the specification will be rejected.</td></tr>
</table>

12. GENERAL PRECAUTIONS

(1) Mounting Method

The panel of the LCD Module consists of two thin glass plates with polarizers which easily get damaged since the Module is fixed by utilizing fitting holes in the printed circuit board. Extreme care should be taken when handling the LCD Modules.

(2) Caution of LCD handling & cleaning

When cleaning the display surface, use soft cloth with solvent (recommended below) and wipe lightly.

- Isopropyl alcohol
- Ethyl alcohol
- Trichlorotrifloroethane

Do not wipe the display surface with dry or hard materials that will damage the polarizer surface. Do not use the following solvent:

- Water
- Ketone
- Aromatics

(3) Caution against static charge

The LCD Module use C-MOS LSI drivers, so we recommend that you connect any unused input terminal to VDD or VSS, do not input any signals before power is turned on. And ground your body, Work/assembly table. And assembly equipment to protect against static electricity.

(4) Packaging

Modules use LCD elements, and must be treated as such. Avoid intense shock and falls from a height.

- To prevent modules from degradation. Do not operate or store them exposed directly to sunshine or high temperature/humidity.

(5) Caution for operation

- It is indispensable to drive LCD's within the specified voltage limit since the higher voltage than the limit shorten LCD life. An electrochemical reaction due to direct current causes LCD deterioration, Avoid the use of direct current drive.
- Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them.

However those phenomena do not mean malfunction or out of order with LCD's which will come back in the specified operating temperature range.

- If the display area is pushed hard during operation, some font will be abnormally displayed but it resumes normal condition after turning off once.
- As light dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal

open circuit.

Usage under the relative condition of 40°C, 50%RH or less is required.

(6) Storage

In the case of storing for a long period of time (for instance, for years) for the purpose or replacement use, The following ways are recommended.

- Storage in a polyethylene bag with sealed so as not to enter fresh air outside in it, And with no desiccant.
- Placing in a dark place where neither exposure to direct sunlight nor light is.

Keeping temperature in the specified storage temperature range.

- Storing with no touch on polarizer surface by the anything else. (It is recommended to store them as they have been contained in the inner container at the time of delivery)

(7) Safety

- It is recommendable to crash damaged or unnecessary LCD into pieces and wash off liquid crystal by using solvents such as acetone and ethanol which should be burned up later.
- When any liquid crystal leaked out of a damaged glass cell comes in contact with your hands, please wash it off well with soap and water.

Hello Lighting co., ltd reserves the right to change this specification.
www.hello-lighting.com
- END -