

# Osptek Display

## LCD TFT SPECIFICATION

Model No:

**LCM1602A-14**

*osptek*<sup>®</sup>

## RECORDS OF REVISION

Date	Rev.	Description	Page	Design by
2017/5/15	0	New Sample.	-	-



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The logo for Osptek, featuring a stylized bird or wing shape above the word "osptek" in a lowercase, sans-serif font with a registered trademark symbol.

## Features

Item	Standard Value
Display Type	16characters × 2 lines
LCD Type	STN, NEGATIVE (BLUE) ,TRANSMISSIVE
Driver Condition	LCD Module : 1/16Duty , 1/5Bias
Viewing Direction	6 O'clock
Backlight Type	SIDE WHITE
Interface	SPI/I2C interface
Driver IC	AIP31068L

## Mechanical Specifications

Item	Standard Value	Unit
Outline Dimension	80(L) * 36(W) * 13.0(T)	mm
Viewing Area	64.5(L) * 14.5( W)	mm
Dot size	0.54(W) × 0.60(H)	mm
Dot pitch	0.59(W) × 0.65(H) <sup>®</sup>	mm
Character size	2.9(W) × 5.15(H)	mm

## Absolute Maximum Ratings

Item	Symbol	Condition	Min.	Max.	Unit
System Power Supply Voltage	VDD	-	-0.3	5.5	V
LCD Driver Supply Voltage	VLCD	-	VDD-12	VDD-0.3	V
Input Voltage	V <sub>IN</sub>	-	-0.3	VDD + 0.3	V
Operating Temperature	T <sub>OP</sub>	-	-20	70	°C
Storage Temperature	T <sub>ST</sub>	-	-30	80	°C
Storage Humidity	H <sub>D</sub>	Ta < 40 °C	20	70	%RH

## DC Electrical Characteristics

VDD = 5.0V ± 0.2V, GND = 0V, Ta = 25°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Logic Supply Voltage	VDD	-	3.0	5.0	5.5	V
Input High Voltage	V <sub>IH</sub>	-	0.8VDD	-	VDD	V
Input Low Voltage	V <sub>IL</sub>	-	GND	-	0.3VDD	V
Output High Voltage	V <sub>OH</sub>	-	0.7VDD	-	VDD	V
Output Low Voltage	V <sub>OL</sub>	-	GND	-	0.2VDD	V

## Backlight Characteristics

LCD Module without LED Backlight

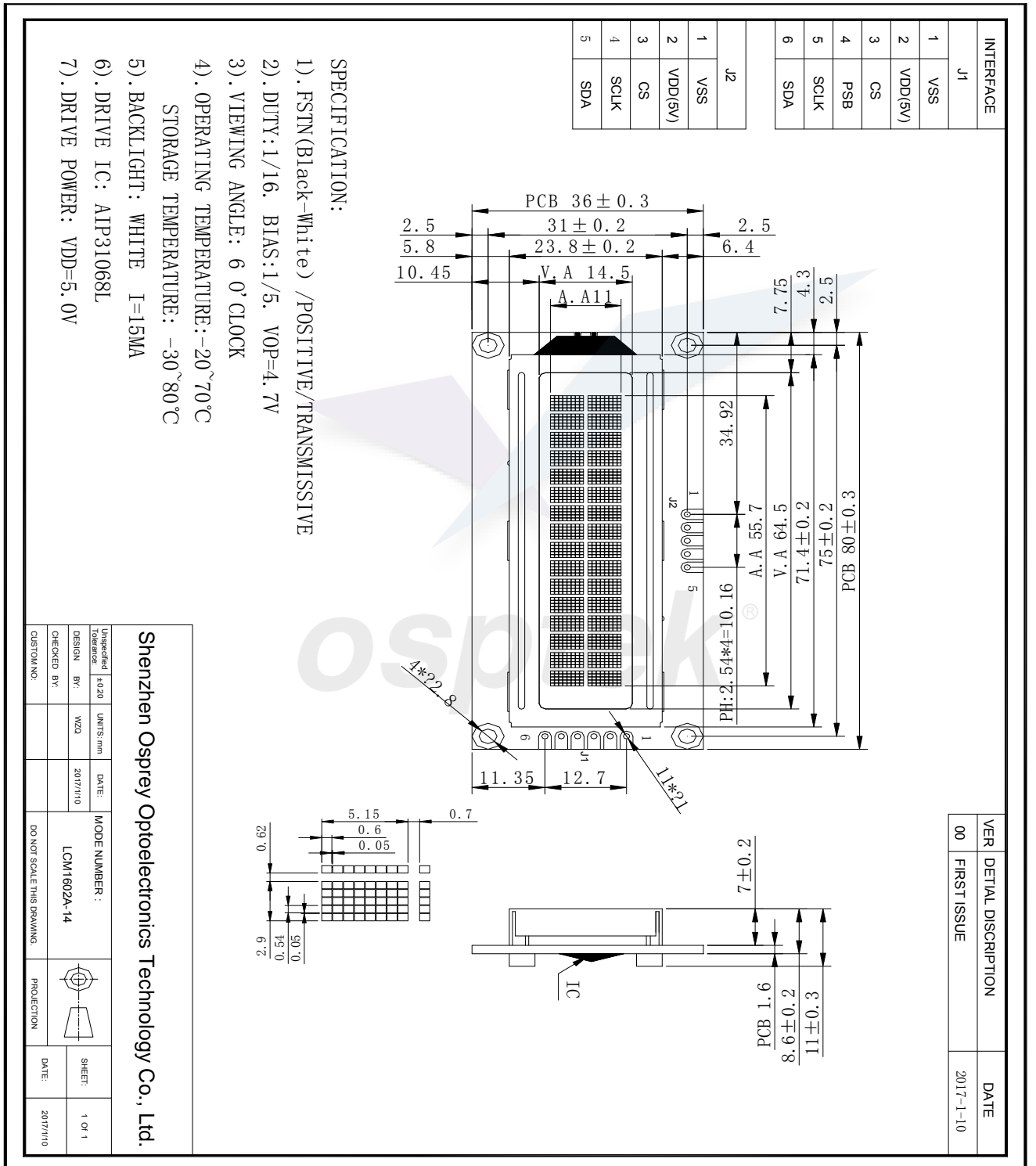
Electrical / Optical Characteristics

Ta = 25°C

Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Forward Voltage	V <sub>f</sub>	I <sub>f</sub> =20mA	4.8	5.0	5.2	V
Reverse Current	I <sub>r</sub>	I <sub>f</sub> =5v			--	uA
Average Brightness	I <sub>V</sub>	I <sub>f</sub> =20mA				cd/m <sup>2</sup>
Wavelength (Without LCD)	λ <sub>d</sub>	I <sub>f</sub> =20mA	--	--	--	nm
Luminous Intensity (without LCD)	L <sub>v</sub> Sub	I <sub>f</sub> =20mA				cd/m <sup>2</sup>
Uniformity	Δ%	I <sub>V</sub> Min / I <sub>V</sub> Max *100%	--	-	-	%
Color	WHITE					

# Counter Drawing

## LCM Mechanical Diagram



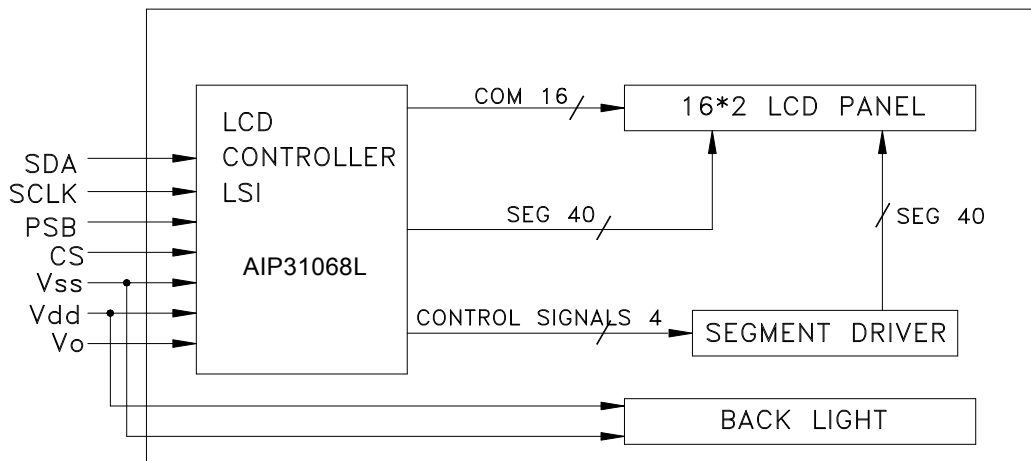
## Interface Pin Description

### J1

No.	Symbol	Function
1	VSS	Ground (0V)
2	VDD	Supply Voltage for Logic (+5.0V )
3	CS	Chip select pin. "L" : 3-Line Interface, "open" : I2C Interface
4	PSB	"H" : I2C Interface, "L" : 3-Line Interface
5	SCLK	serial clock
6	SDA	serial data input

### J2

No.	Symbol	Function
1	VSS	Ground (0V)
2	VDD	Supply Voltage for Logic (+5.0V )
3	CS	Chip select pin. "L" : 3-Line Interface, "open" : I2C Interface
4	SCLK	serial clock
5	SDA	serial data input



## Timing Characteristics

### DC Characteristics

参数名称	符号	测试条件	最小	典型	最大	单位
工作电压	$V_{DD}$	—	4.5	—	5.5	V
电源电流	$I_{DD}$	内部振荡或者外部时钟 ( $V_{DD}=5V$ , $f_{osc}=250KHz$ )	—	0.55	0.8	mA
输入电压 1 (除了 OSC1)	$V_{IH1}$	—	2.5	—	$V_{DD}$	V
	$V_{IL1}$	—	-0.3	—	0.6	
输入电压 2 (OSC1)	$V_{IH2}$	—	$V_{DD}-1.0$	—	$V_{DD}$	
	$V_{IL2}$	—	-0.2	—	1.0	
输出电压 1 (DB0~DB7)	$V_{OH1}$	$I_{OH}=-0.205mA$	2.4	—	—	
	$V_{OL1}$	$I_{OL}=1.2mA$	—	—	0.4	
输出电压 2(除了 DB0~DB7)	$V_{OH2}$	$I_O=-40uA$	$0.9V_{DD}$	—	—	
	$V_{OL2}$	$I_O=40uA$	—	—	$0.1V_{DD}$	
输入漏电流	$I_{IKG}$	$V_{IN}=0V\sim V_{DD}$	-1	—	1	uA

低输入电流	$I_{IL}$	$V_{IN}=0V$ $V_{DD}=5V$ (上拉)	-50	-125	-250		
内部时钟频率 (外部 RF)	$f_{OSC1}$	$R_f=91K\Omega\pm 2\%$ , $V_{DD}=5V$	190	270	350	KHz	
外部时钟频率	$f_{osc}$	—	125	270	410	KHz	
	duty	—	45	50	55	%	
	$t_r, t_f$	—	—	—	0.2	us	
COM 端导通电阻	$R_{COM}$	$I_O = \pm 50uA$ , VLCD = 4.0V COM1 - COM16			20	K $\Omega$	
SEG 端导通电阻	$R_{SEG}$	$I_O = \pm 50uA$ , VLCD = 4.0V SEG1 - SEG40			30		
LCD 驱动电压	$V_{LCD1}$	$V_{DD}-V_5$	1/5 偏置	3.0	—	11.0	V
	$V_{LCD2}$		1/4 偏置	3.0	—	11.0	



## AC Characteristics

参数名称	符号	测试条件	最小	典型	最大	单位
SCL时钟周期	$t_{SCYC}$	三线通讯 (见图3)	100	-	-	ns
SCL高脉冲宽度	$t_{SHW}$		20	-	-	
SCL低脉冲宽度	$t_{SLW}$		160	-	-	
SCL上升/下降时间	$t_r, t_f$		-	-	20	
数据建立时间	$t_{SDS}$		10	-	-	
数据保持时间	$t_{SDH}$		10	-	-	
CSB-SCL时间	$t_{CSS}$		20	-	-	
	$t_{CSH}$	350	-	-		
SCL时钟频率	$f_{SCLK}$	两线通讯 (见图4)	-	-	400	KHz
SCL低脉冲宽度	$t_{LOW}$		1.3	-	-	us
SCL高脉冲宽度	$t_{HIGH}$		0.6	-	-	us
数据建立时间	$t_{SU-DAT}$		100	-	-	ns
数据保持时间	$t_{HD-DAT}$		0	-	0.9	us
SCL/SDA上升/下降时间	$t_r, t_f$		20	-	300	ns
START建立时间	$t_{SU-STA}$		0.6	-	-	us
START保持时间	$t_{HD-STA}$		0.6	-	-	us
STOP建立时间	$t_{SU-STO}$		0.6	-	-	us
STOP、START间隔时间	$t_{BUF}$		1.3	-	-	us

Timing Diagram  
3-LINT SPI mode

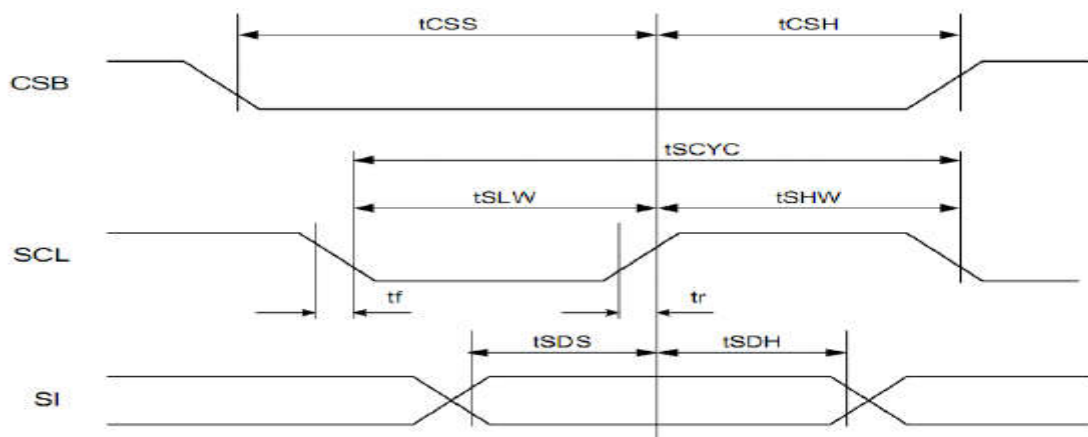


图 3、三线通讯时序图

2-LINT IIC mode

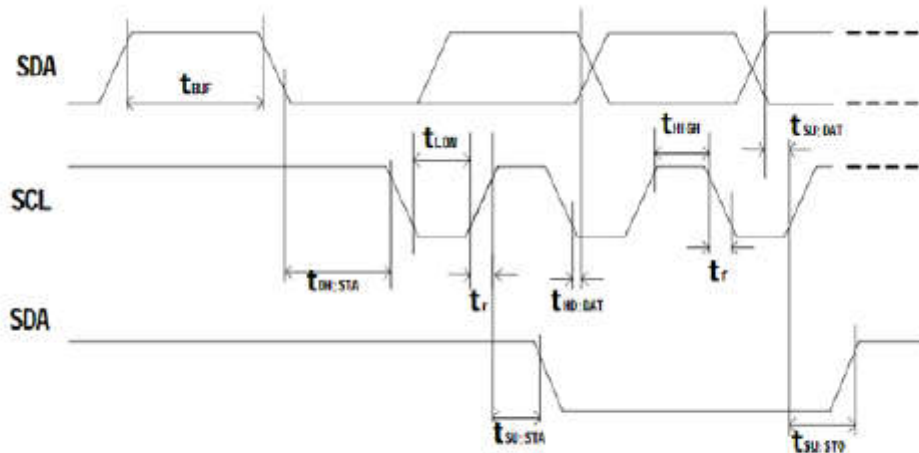


图 4、两线通讯时序图

## Instruction Table

◆ Display Control Instruction

指令	RS	D7	D6	D5	D4	D3	D2	D1	D0	执行时间 fosc=270KHz	描述
清除显示	0	0	0	0	0	0	0	0	1	1.53ms	将 20H 写入 DDRAM, 将地址计数器中的地址 00H 设置为 DDRAM 地址
返回	0	0	0	0	0	0	0	1	-	1.53ms	将地址计数器中的地址 00H 设置为 DDRAM 地址, 并将光标恢复至初始位置, DDRAM 的内容保持不变。
输入模式设置	0	0	0	0	0	0	1	I/D	SH	39us	设置光标移方向, 并允许整个显示移动
显示开/关	0	0	0	0	0	1	D	C	B	39us	设置显示、光标, 光标的闪烁控制位。
移位	0	0	0	0	1	S/C	R/L	-	-	39us	设置光标移动, 显示移动方向的控制位, DDRAM 数据保持不变。
功能设置	0	0	0	1	-	N	F	-	-	39us	设置显示行数(N: 2行/1行), 显示字体 (F: 5×11 点阵/5×8 点阵)

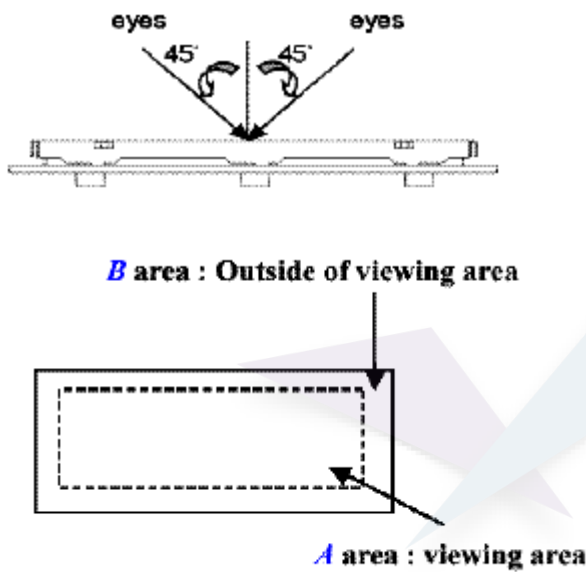
设置 CG RAM 地址	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	39us	在地址计数器内设置 CGRAM 地址
设置 DD RAM 地址	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	39us	在地址计数器内设置 DDRAM 地址
写数据	1	D7	D6	D5	D4	D3	D2	D1	D0	43s	写数据至内部 RAM (DDRAM/CGRAM)

## Character Generator ROM

Upper bit Lower bit	LLLL	LLLH	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HHLH	HHLH	HHLH	HHLH	HHLH	HHLH
LLLL CG RAM (1)				0aP`P												
LLLH (2)		!	1A0a9													
LLHL (3)		"	2BRbn													
LLHH (4)		#	3C5cs													
LHLL (5)		\$	4DTdt													
LHLH (6)		%	5EUeu													
LHHL (7)		&	6FUFU													
LHHH (8)		'	7GWgw													
HLLL (1)		<	8HXhx													
HLLH (2)		)	9IYiy													
HHLH (3)		*	JZjz													
HHLH (4)		+	KKk<													
HHLL (5)		,	<L#ll													
HHLH (6)		-	Mm>													
HHLH (7)		.	>N^n>													
HHLH (8)		/	?O_o+													

# Inspection Specification

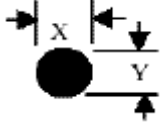
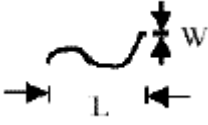
- ◆ Inspection Standard : MIL-STD-105E Table Normal Inspection Single Sampling Level II .
- ◆ Equipment : Gauge、MIL-STD、Powertip Tester、Sample
- ◆ Defect Level : Major Defect AQL 0.4; Minor Defect AQL 1.5 .
- ◆ OUT Going Defect Level : Sampling .
- ◆ Manner of appearance test :
  - (1). The test be under 40W×2 fluorescent light ' and distance of view must be at 30 cm.
  - (2). The test direction is base on about around 45° of vertical line. (Fig. 1)
  - (3). Definition of area . (Fig. 2)




◆ Specification:

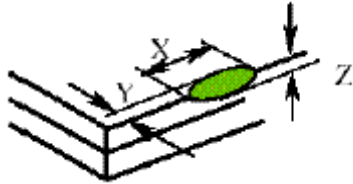

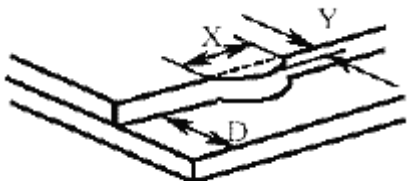
NO	Item	Criterion	level
01	Product condition	1.1 The part number is inconsistent with work order of Production.	Major
		1.2 Mixed production types.	Major
		1.3 Assembled in inverse direction.	Major
02	Quantity	2.1 The quantity is inconsistent with work order of production.	Major
03	Outline dimension	3.1 Product dimension and structure must conform to Structure diagram.	Major
04	Electrical Testing	4.1 Missing line character、dot and icon.	Major
		4.2 No function or no display.	Major
		4.3 Output data is error.	Major
		4.4 LCD viewing angle defect.	Major
		4.5 Current consumption exceeds product specifications.	Major
05	Black or white dot、scratch、contamination Round type	5.1 Round type: 5.1.1 display only : • White and black spots on display $\leq 0.25\text{mm}$ , no more than Four white or black spots present. • Densely spaced : NO more than two spots or lines within 3mm	Minor

◆ Specification :

NO	Item	Criterion	level
05	<p>Black or white dot、scratch、contamination</p> <p>Round type</p>  <p><math>\Phi = (x+y)/2</math></p> 	<p>5.1.2 Nom-display :</p> <p>Dimension (diameter : <math>\Phi</math>)</p> <p>Acceptance(Q'ty)</p> <p><math>\Phi \leq 0.20\text{mm}</math></p> <p>Accept no dense</p> <p><math>0.10\text{mm} &lt; \Phi \leq 0.20\text{mm}</math> 3</p> <p><math>0.20\text{mm} &lt; \Phi \leq 0.25\text{mm}</math> 2</p> <p>Total 4</p> <p>5.1.3 Line type:</p> <p>Dimension (diameter : <math>\Phi</math>)</p> <p>Acceptance (Q'ty)</p> <p>Length width A area B area</p> <p>---</p> <p><math>w \leq 0.03\text{mm}</math></p> <p>Accept no dense Don't count</p> <p><math>L \leq 3.0\text{mm}</math></p> <p><math>0.03\text{mm} &lt; \Phi \leq 0.05\text{mm}</math> 4</p> <p>Don't count</p> <p><math>L \leq 2.5\text{mm}</math></p> <p><math>0.05\text{mm} &lt; \Phi \leq 0.075\text{mm}</math></p> <p>Don't count</p> <p>---</p> <p><math>w &gt; 0.075\text{mm}</math></p> <p>As round type</p>	Minor

06	Polarizer Bubble	<p>Dimension (diameter : <math>\Phi</math>)</p> <p>A area</p> <p>Acceptance(Q'ty)</p> <p>B area  <math>\Phi \leq 0.20\text{mm}</math>  Accept no dense  Don't count</p> <p><math>0.20\text{mm} &lt; \Phi \leq 0.50\text{mm}</math>  3  Don't count</p> <p><math>0.50\text{mm} &lt; \Phi \leq 1.00\text{mm}</math>  2  Don't count</p> <p><math>\Phi &gt; 1.00\text{mm}</math>  0  Don't count</p> <p>Total quantity  4  Don't count</p>	Minor
07	The crack of glass	<p>● Glass Crack:  7.1 Crack on the circuit of electrode terminal :</p>  <p>X  Y  Z</p> <p>Front  <math>X \leq 1/5 a</math>  <math>Y \leq 1/2 D</math>  <math>Z \leq t</math></p> <p>Back</p> <p>Neglect</p>	Minor

◆ Specification :

NO	Item	Criterion	Level
07	<p>The crack of glass</p> <p>X: The length of Crack</p> <p>Y: The width of crack</p> <p>Z: The thickness of crack</p> <p>D: terminal length</p> <p>T: The thickness of glass</p> <p>A : The length of glass</p>	<p>● Glass Crack:</p> <p>7.2 General glass crack and corner edge:</p> <p>7.2.1</p>  <p>X Y Z Neglect Out A area Neglect</p> <p>7.2.2</p>  <p>X Y Z Neglect Out A area Neglect</p>	Minor
		<p>7.3 Glass remain:</p>  <p>X Y</p> <p>Neglect <math>\leq 1/3 d</math></p>	Minor

◆ Specification :

NO	Item	Criterion	Level
07	<p>The crack of glass</p> <p>X: The length of Crack</p> <p>Y: The width of crack</p> <p>Z: The thickness of crack</p> <p>D: terminal length</p> <p>T: The thickness of glass</p> <p>A : The length of glass</p>	<p>7.4 Corner crack and medial crack:</p> <p>Crack can't enter viewing area</p> $\begin{aligned} X &\leq 1/5a \\ Y &\leq 1/2t \\ Z &\leq 1/5a \end{aligned}$ <p>Crack can't exceed the half of width of SP width of SP</p> $1/2t < Z \leq 2t$	Minor
08	Backlight elements	<p>8.1 Backlight can't work normally.</p> <p>8.2 Backlight doesn't light or color is wrong.</p> <p>8.3 Illumination source flickers when lit.</p>	Major
09	General appearance	<p>9.1 pin type must match type in specification sheet</p> <p>9.2 No short circuits in components on PCB or FPC</p> <p>9.3 Product packaging must the same as specified on packaging specification sheet.</p> <p>9.4 The folding and peeled off in polarizer are not acceptable</p> <p>9.5 The PCB or FPC between B/L assembled distance (PCB or FPC) is <math>\leq 1.5\text{mm}</math></p>	Major