

# APEX

APEX SCIENCE & ENGINEERING CORP

( OPTOELECTRONIC DIV. )




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## HG121280W

## ROHS

## DATA SHEET

Acceptance

ISSUE	VERSION	APPROVER	CHECKER	ENGINEER
	<b>A</b>			

<b>Messrs.</b>			
<b>Product Specification</b>	<b>Model:</b>	<b>HG121284OW</b>	<b>Rev. NO.</b>
			<b>Issued Date.</b>
			<b>A</b>
			<b>Feb .05 ,20</b>

## REVISION RECORD

REV.	REVISION DESCRIPTION	REV. DATE	REMARK
A	■ INITIAL RELEASE	2020. 02. 05	

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## **1. SCOPE**

The purpose of this specification is to define the general provisions and quality requirements that apply to the supply of display cells manufactured by APEX. This document, together with the Module Assembly Drawing, is the highest-level specification for this product. It describes the product, identifies supporting documents and contains specifications.

## **2. WARRANTY**

APEX warrants that the products delivered pursuant to this specification (or order) will conform to the agreed specifications for twelve (12) months from the shipping date ("Warranty Period"). APEX is obligated to repair or replace the products which are found to be defective or inconsistent with the specifications during the Warranty Period without charge, on condition that the products are stored **in the original packages at 25 °C±5 °C, 55%±10%RH** or used as the conditions specified in the specifications.

Nevertheless, APEX is not obligated to repair or replace the products without charge if the defects or inconsistency are caused by the force majeure or the reckless behaviors of the customer.

After the Warranty Period, all repairs or replacements of the products are subject to charge.

## **3. FEATURES**

- Small molecular organic light emitting diode.
- Color : White
- Panel resolution : 128x128
- Driver IC : SSD1327
- Excellent quick response time.
- Extremely thin thickness for best mechanism design : 1.41 mm
- High contrast : 2000:1
- Wide viewing angle : 160°
- Strong environmental resistance.
- 8-bit 6800-series Parallel Interface, 8-bit 8080-series Parallel Interface, Serial Peripheral Interface, I<sup>2</sup>C Interface.
- Wide range of operating temperature : -40 to 70 °C
- Anti-glare polarizer.

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#### **4. MECHANICAL DATA**

NO	ITEM	SPECIFICATION	UNIT
1	Dot Matrix	128 x 128	dot
2	Dot Size	0.19 (W) x 0.19 (H)	mm <sup>2</sup>
3	Dot Pitch	0.21 (W) x 0.21 (H)	mm <sup>2</sup>
4	Aperture Rate	82	%
5	Active Area	26.86 (W) x 26.86 (H)	mm <sup>2</sup>
6	Panel Size	33.8 (W) x 36.5 (H)	mm <sup>2</sup>
7*	Panel Thickness	1.22 ± 0.1	mm
8	Module Size	33.8 (W) x 43.7 (H) x 1.41 (T)	mm <sup>3</sup>
9	Diagonal A/A size	1.5	inch
10	Module Weight	3.48 ± 10%	gram

\* Panel thickness includes substrate glass, cover glass and UV glue thickness.

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## 5. MAXIMUM RATINGS

ITEM	MIN	MAX	UNIT	Condition	Remark
Supply Voltage ( $V_{CI}$ )	-0.3	4	V	Ta = 25 °C	IC maximum rating
Supply Voltage ( $V_{CC}$ )	8	19	V	Ta = 25 °C	IC maximum rating
Operating Temp.	-40	70	°C	-	-
Storage Temp	-40	85	°C	-	Note (2)

Note:

- (1) Maximum ratings are those values beyond which damages to the OLED module may occur. The OLED functional operation should be restricted to the limits in the section 6. Electrical Characteristics tables.
- (2) The defined temperature ranges do not include the polarizer. The maximum withstood temperature of the polarizer should be 80 °C.

## 6. ELECTRICAL CHARACTERISTICS

### 6.1 D.C ELECTRICAL CHARACTERISTICS

SYMBOL	PARAMETERS	TEST CONDITION	MIN	TYP	MAX	UNIT
$V_{CC}$	Driver power supply (for OLED panel)	Ta = 25 °C	14.5	15	15.5	V
$V_{CI}$	Low voltage power supply	Ta = 25 °C	2.6	-	3.5	V
$V_{OH}$	High logic output level	I <sub>out</sub> =100uA,	0.9* $V_{CI}$	-	$V_{CI}$	V
$V_{OL}$	Low logic output level	I <sub>out</sub> =100uA,	0	-	0.1* $V_{CI}$	V
$V_{IH}$	High logic input level	I <sub>out</sub> =100uA,	0.8* $V_{CI}$	-	$V_{CI}$	V
$V_{IL}$	Low logic input level	I <sub>out</sub> =100uA,	0	-	0.2* $V_{CI}$	V

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## 6.2 ELECTRO-OPTICAL CHARACTERISTICS

### PANEL ELECTRICAL SPECIFICATIONS

PARAMETER	MIN	TYP.	MAX	UNITS	COMMENTS
Normal mode current consumption (ICC)	-	32	34	mA	All pixels on (1)
Standby mode current consumption (ICC)	-	3	4	mA	Standby mode 10% pixels on (2)
Normal mode power consumption	-	480	510	mW	All pixels on (1)
Standby mode power consumption	-	45	60	mW	Standby mode 10% pixels on (2)
Pixel Luminance	70	90		cd/m <sup>2</sup>	Display Average
Standby Luminance		20		cd/m <sup>2</sup>	
CIE <sub>x</sub> (White)	0.23	0.27	0.31		CIE1931
CIE <sub>y</sub> (White)	0.25	0.29	0.33		CIE1931
Dark Room Contrast	2000:1				
Viewing Angle	160			degree	
Response Time		10		μs	

(1) Normal mode condition :

- Driving Voltage : 15V
- Contrast setting : 0x77
- Frame rate : 105Hz
- Duty setting : 1/128

(2) Standby mode condition :

- Driving Voltage : 15V
- Contrast setting : 0x14
- Frame rate : 105Hz
- Duty setting : 1/128

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## **7. LIFETIME SPECIFICATION**

ITEM	MIN	UNIT	Condition	Remark
Life Time	10,000	Hrs	100 cd/m <sup>2</sup> , 50% alternating checkerboard	Note (1)
Life Time	11,000	Hrs	90 cd/m <sup>2</sup> , 50% alternating checkerboard	Note (2)
Life Time	12,000	Hrs	80 cd/m <sup>2</sup> , 50% alternating checkerboard	Note (3)

Note:

(A) Under Vcc = 15V, Ta = 25°C, 50% RH.

(B) Life time is defined the amount of time when the luminance has decayed to less than 50% of the initial measured luminance.

(1) Setting of 100 cd/m<sup>2</sup> :

- Contrast setting : 0x9b
- Frame rate : 105Hz
- Duty setting : 1/128

(2) Setting of 90 cd/m<sup>2</sup> :

- Contrast setting : 0x77
- Frame rate : 105Hz
- Duty setting : 1/128

(3) Setting of 80 cd/m<sup>2</sup> :

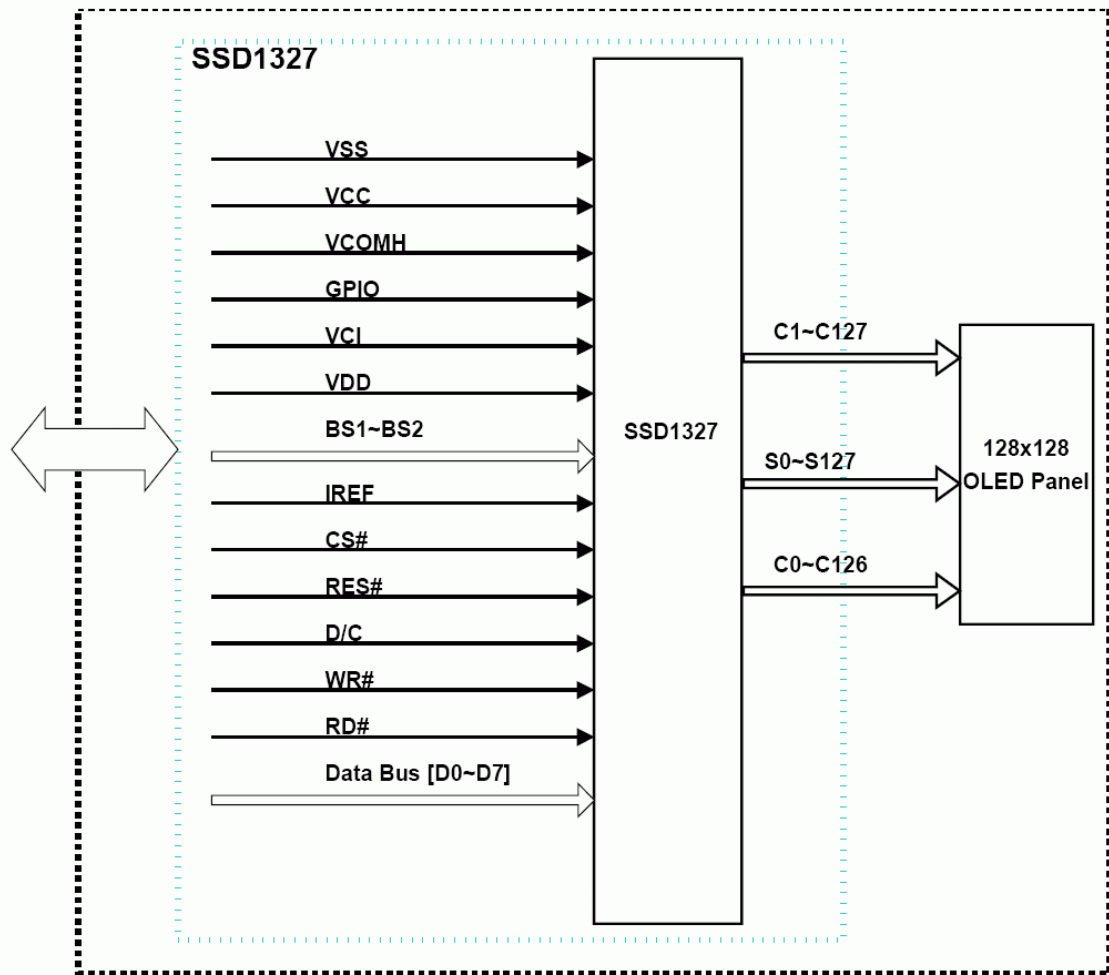
- Contrast setting : 0x60
- Frame rate : 105Hz
- Duty setting : 1/128



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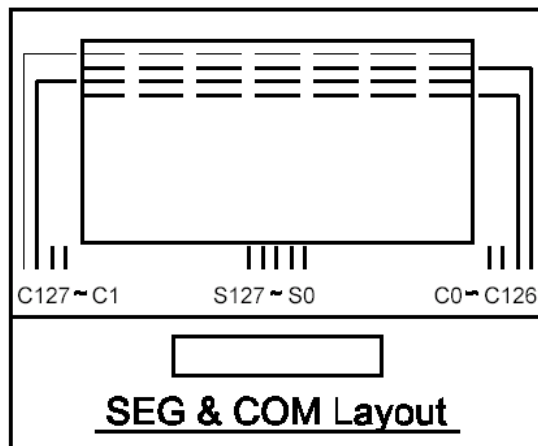
## 8. INTERFACE

### 8.1 FUNCTION BLOCK DIAGRAM



RiTdisplay 128X128 OLED Module

### 8.2 PANEL LAYOUT DIAGRAM



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### 8.3 PIN ASSIGNMENTS

PIN NAME	PIN NO	DESCRIPTION
VSS	1	Ground.
VCC	2	Power supply for analog circuit.
VCOMH	3	Com Voltage Output. A capacitor should be connected between this pin and V <sub>SS</sub> .
GPIO	4	General I/O port.
VCI	5	Power supply for logic circuit.
VDD	6	A capacitor should be connected between this pin and V <sub>SS</sub> .
BS1	7	MCU bus interface selection pins.
BS2	8	MCU bus interface selection pins.
VSS	9	Ground.
IREF	10	Reference current input pin. A resistor should be connected between this pin and V <sub>SS</sub> .
CS#	11	Chip select input.
RES#	12	Reset signal input. When it's low, initialization of SSD1327 is executed.
D/C	13	Data/ Command control. Pull high for write/read display data. Pull low for write command or read status.
WR#	14	MCU interface input. Data write operation is initiated when it's pull low.
RD#	15	MCU interface input. Data read operation is initiated when it's pull low.
D0	16	Data bus(for parallel interface)
D1	17	
D2	18	
D3	19	
D4	20	
D5	21	
D6	22	
D7	23	
VCC	24	Power supply for analog circuit.
VSS	25	Ground.

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### 8.4 GRAPHIC DISPLAY DATA RAM ADDRESS MAP

The GDDRAM is a bit mapped static RAM holding the bit pattern to be displayed. The size of the RAM is 128x128x4 bits. For mechanical flexibility, re-mapping on both Segment and Common outputs can be selected by software. The GDDRAM address maps below tables show some examples on using the command “Set Re-map” A0h to re-map the GDDRAM. In the following tables, the lower nibble and higher nibble of D0, D1, D2 ... D8189, D8190, D8191 represent the 128x128 data bytes in the GDDRAM.

The GDDRAM map under the following condition:

- Command “Set Re-map” A0h is set to:
  - Disable Column Address Re-map (A[0]=0)
  - Disable Nibble Re-map (A[1]=0)
  - Enable Horizontal Address Increment (A[2]=0)
  - Disable COM Re-map (A[4]=0)
- Display Start Line=00h
- Data byte sequence: D0, D1, D2 ... D8191

GDDRAM address map 1

		SEG0	SEG1	SEG2	SEG3		SEG124	SEG125	SEG126	SEG127	
		00		01			3E		3F		
COM0	00	D0[3:0]	D0[7:4]	D1[3:0]	D1[7:4]		D62[3:0]	D62[7:4]	D63[3:0]	D63[7:4]	
COM1	01	D64[3:0]	D64[7:4]	D65[3:0]	D65[7:4]		D126[3:0]	D126[7:4]	D127[3:0]	D127[7:4]	
COM126	7E	D8064[3:0]	D8064[7:4]	D8065[3:0]	D8065[7:4]		D8126[3:0]	D8126[7:4]	D8127[3:0]	D8127[7:4]	
COM127	7F	D8128[3:0]	D8128[7:4]	D8129[3:0]	D8129[7:4]		D8190[3:0]	D8190[7:4]	D8191[3:0]	D8191[7:4]	

SEG Outputs  
Column Address  
(HEX)

COM Outputs      Row Address (HEX)

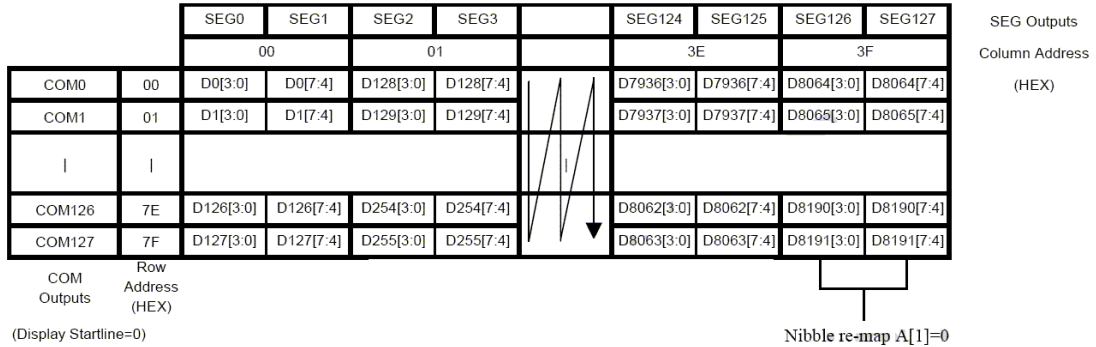
Nibble re-map A[1]=0

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The GDDRAM map under the following condition:

- Command “Set Re-map” A0h is set to:
  - Disable Column Address Re-map (A[0]=0)
  - Disable Nibble Re-map (A[1]=0)
  - Enable Vertical Address Increment (A[2]=1)
  - Disable COM Re-map (A[4]=0)
- Display Start Line=00h
- Data byte sequence: D0, D1, D2 ... D8191

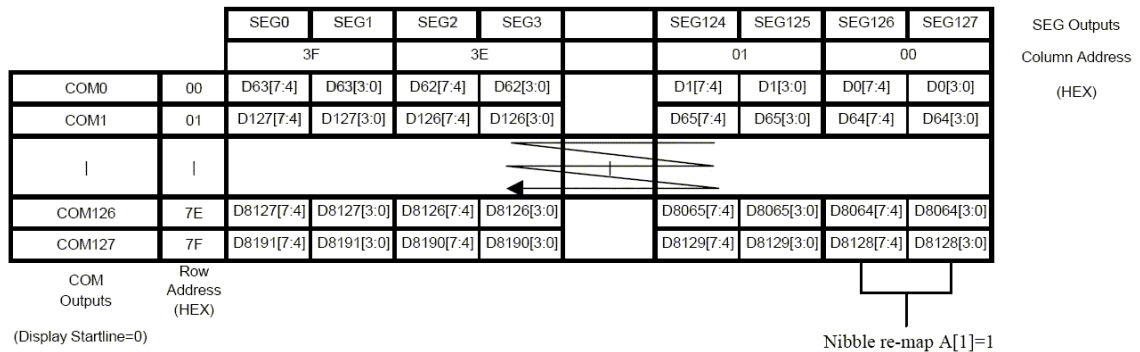
**GDDRAM address map 2**



The GDDRAM map under the following condition:

- Command “Set Re-map” A0h is set to:
  - Enable Column Address Re-map (A[0]=1)
  - Enable Nibble Re-map (A[1]=1)
  - Enable Horizontal Address Increment (A[2]=0)
  - Disable COM Re-map (A[4]=0)
- Display Start Line=00h
- Data byte sequence: D0, D1, D2 ... D8191

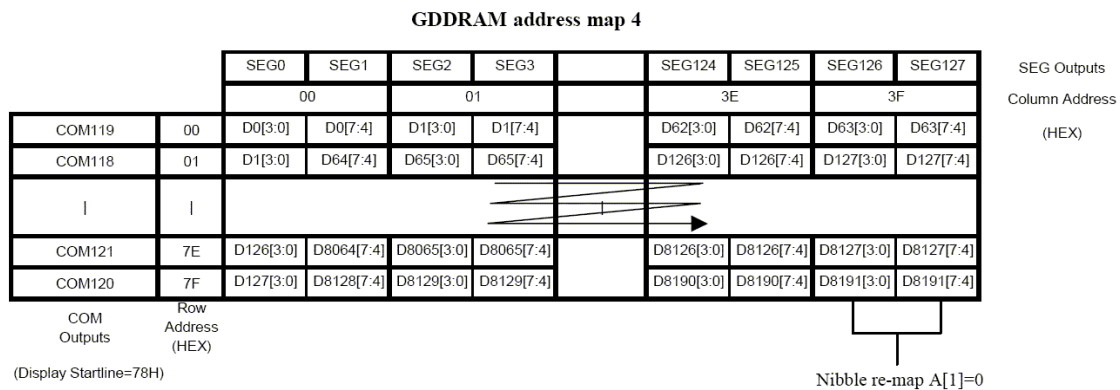
**GDDRAM address map 3**



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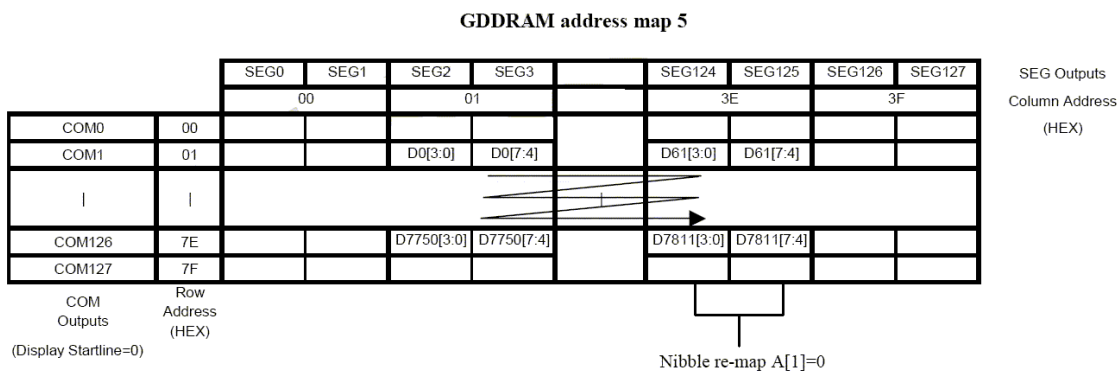
The example in which the display start line register is set to 10h with the following condition:

- Command “Set Re-map” A0h is set to:
  - Disable Column Address Re-map (A[0]=0)
  - Disable Nibble Re-map (A[1]=0)
  - Enable Horizontal Address Increment (A[2]=0)
  - Enable COM Re-map (A[4]=1)
- Display Start Line=78h (corresponds to COM119)
- Data byte sequence: D0, D1, D2 ... D8191



The GDDDRAM map under the following condition:

- Command “Set Re-map” A0h is set to:
  - Disable Column Address Re-map (A[0]=0)
  - Disable Nibble Re-map (A[1]=0)
  - Enable Horizontal Address Increment (A[2]=0)
  - Disable COM Re-map (A[4]=0)
- Display Start Line=00h
- Column Start Address=01h
- Column End Address=3Eh
- Row Start Address=01h
- Row End Address=7Eh
- Data byte sequence: D0, D1, D2 ... D7811



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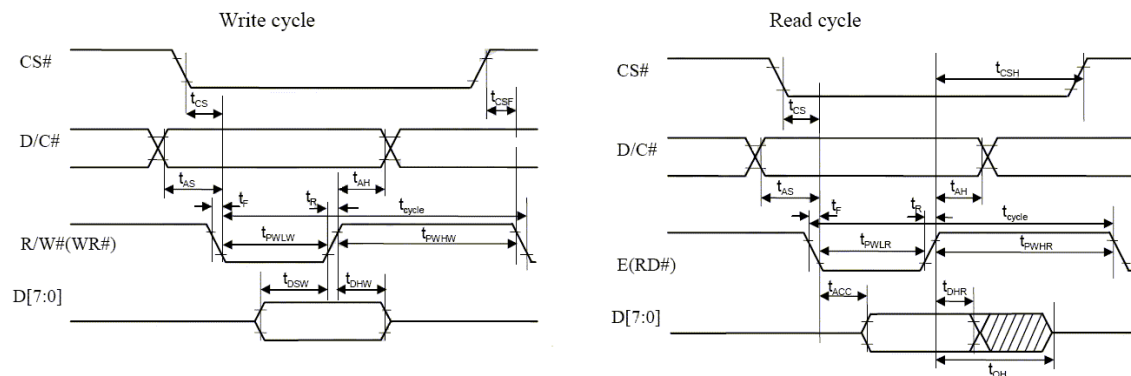
## 8.5 INTERFACE TIMING CHART

### 8080-Series MCU Parallel Interface Timing Characteristics

( $V_{DD} - V_{SS} = 2.4$  to  $2.6V$ ,  $V_{CI} = 3.3V$ ,  $T_A = 25^\circ C$ )

Symbol	Parameter	Min	Typ	Max	Unit
$t_{cycle}$	Clock Cycle Time	300	-	-	ns
$t_{AS}$	Address Setup Time	10	-	-	ns
$t_{AH}$	Address Hold Time	0	-	-	ns
$t_{DSW}$	Write Data Setup Time	40	-	-	ns
$t_{DHW}$	Write Data Hold Time	7	-	-	ns
$t_{DHR}$	Read Data Hold Time	20	-	-	ns
$t_{OH}$	Output Disable Time	-	-	70	ns
$t_{ACC}$	Access Time	-	-	140	ns
$t_{PWLR}$	Read Low Time	150	-	-	ns
$t_{PWLW}$	Write Low Time	60	-	-	ns
$t_{PWHR}$	Read High Time	60	-	-	ns
$t_{PWHW}$	Write High Time	60	-	-	ns
$t_R$	Rise Time	-	-	15	ns
$t_F$	Fall Time	-	-	15	ns
$t_{CS}$	Chip select setup time	0	-	-	ns
$t_{CSH}$	Chip select hold time to read signal	0	-	-	ns
$t_{CSF}$	Chip select hold time	20	-	-	ns

### 8080-series MCU parallel interface characteristics



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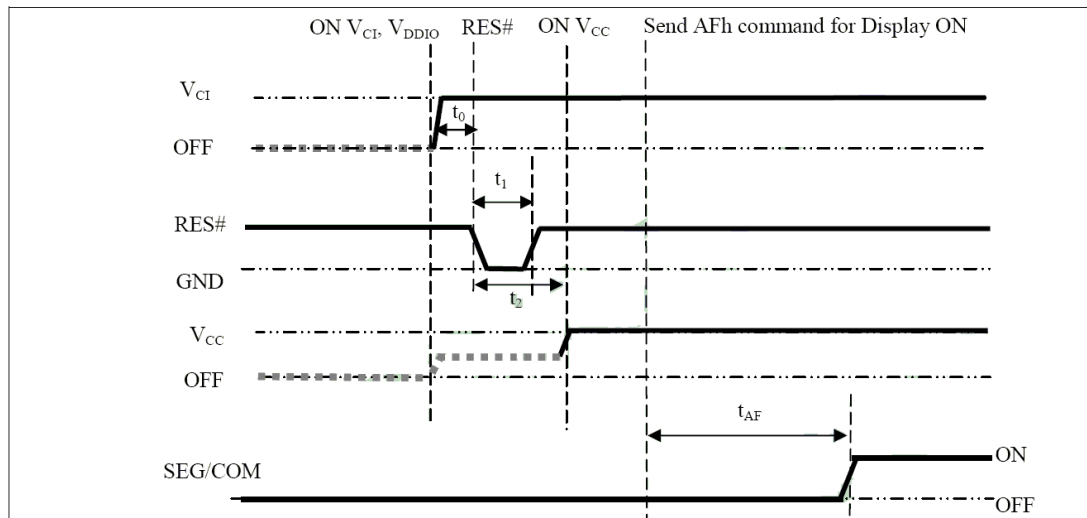
## 9. POWER ON / OFF SEQUENCE & APPLICATION CIRCUIT

### 9.1 POWER ON / OFF SEQUENCE

#### Power ON sequence:

1. Power ON  $V_{CI}$ .
2. After  $V_{CI}$  becomes stable, set wait time at least 1ms ( $t_0$ ) for internal  $V_{DD}$  become stable. Then set RES# pin LOW (logic low) for at least 100us ( $t_1$ )<sup>(4)</sup> and then HIGH (logic high).
3. After set RES# pin LOW (logic low), wait for at least 100us ( $t_2$ ). Then Power ON  $V_{CC}$ .<sup>(1)</sup>
4. After  $V_{CC}$  become stable, send command AFh for display ON. SEG/COM will be ON after 200ms( $t_{AF}$ ).

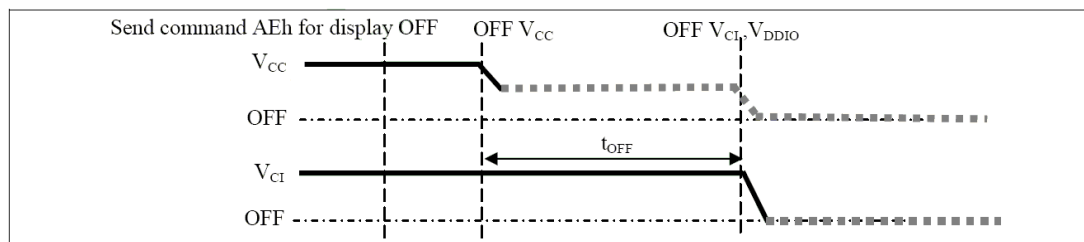
The Power ON sequence.



#### Power OFF sequence:

1. Send command AEh for display OFF.
2. Power OFF  $V_{CC}$ .<sup>(1), (2), (3)</sup>
3. Wait for  $t_{OFF}$ . Power OFF  $V_{CI}$ . (where Minimum  $t_{OFF}=80ms$ <sup>(5)</sup>, Typical  $t_{OFF}=100ms$ )

The Power OFF sequence

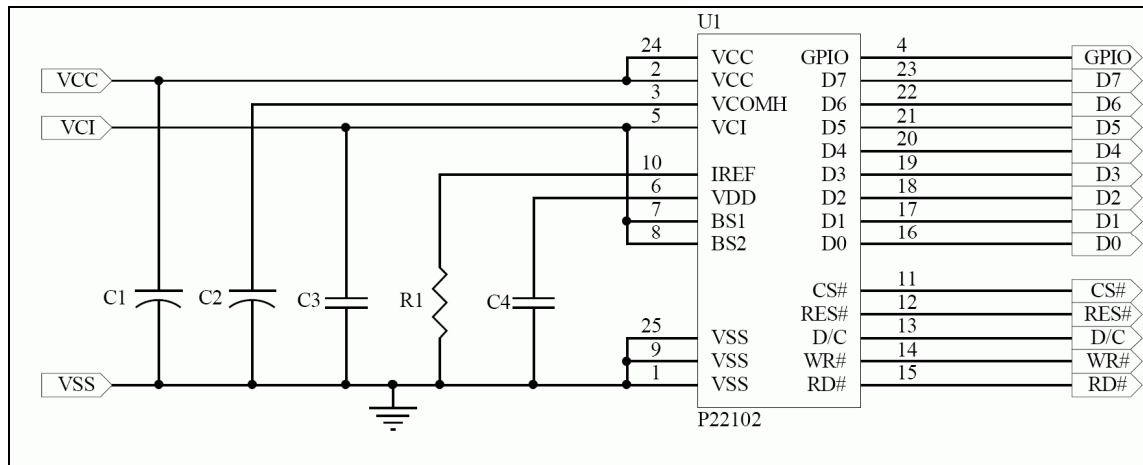


#### Note:

- (1) Since an ESD protection circuit is connected between  $V_{CI}$  and  $V_{CC}$ ,  $V_{CC}$  becomes lower than  $V_{CI}$  whenever  $V_{CI}$  is ON and  $V_{CC}$  is OFF as shown in the dotted line of  $V_{CC}$  in above figures.
- (2)  $V_{CC}$  should be kept disable when it is OFF.
- (3) Power pins ( $V_{CI}$ ,  $V_{CC}$ ) can never be pulled to ground under any circumstance.
- (4) The register values are reset after  $t_1$ .
- (5)  $V_{CI}$  should not be Power OFF before  $V_{CC}$  Power OFF

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## 9.2 APPLICATION CIRCUIT



### Component:

C1, C2: 4.7uF/35V(Tantalum type) or VISHAY (572D475X0025A2T)

C3, C4: 1uF/16V(0603)

R1: 1M ohm (0603) 1%

**This circuit is for 8080 8bits interface.**

## 9.3 COMMAND TABLE

Refer to IC Spec.: SSD1327



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## **10. RELIABILITY TEST CONDITIONS**

No.	Items	Specification	Quantity
1	High temp. (Non-operation)	85 °C, 240hrs	5
2	High temp. (Operation)	70 °C, 120hrs	5
3	Low temp. (Operation)	-40 °C, 120hrs	5
4	High temp. / High humidity (Operation)	65 °C, 90%RH, 120hrs	5
5	Thermal shock (Non-operation)	-40 °C ~85 °C (-40 °C /30min; transit /3min; 85 °C /30min; transit /3min) 1cycle: 66min, 100 cycles	5
6	Vibration	Frequency : 5~50HZ, 0.5G Scan rate : 1 oct/min Time : 2 hrs/axis Test axis : X, Y, Z	1 Carton
7	Drop	Height: 120cm Sequence : 1 angle 、 3 edges and 6 faces Cycles: 1	1 Carton
8	ESD (Non-operation)	Air discharge model, ±8kV, 10 times	5

### **Test and measurement conditions**

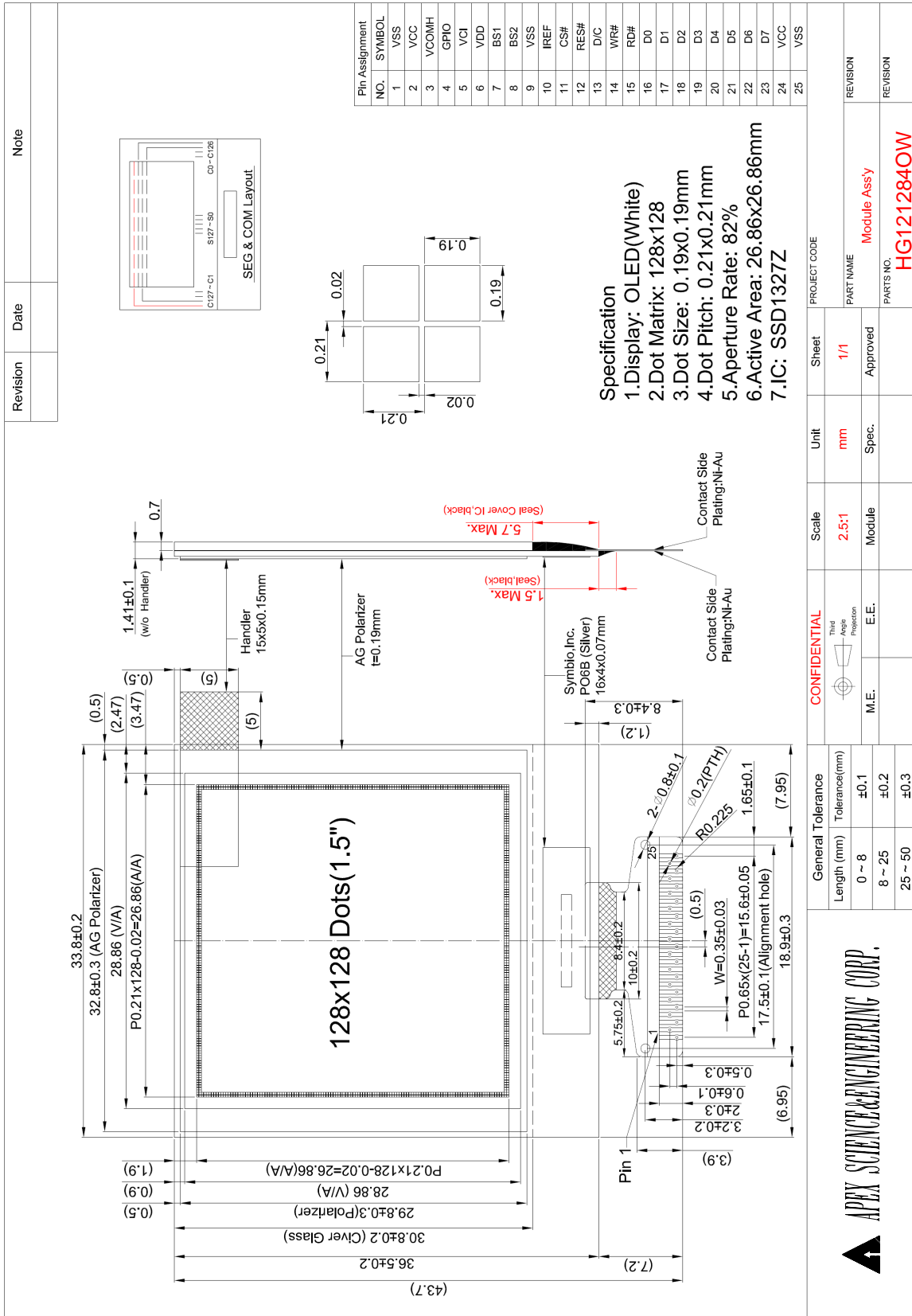
1. All measurements shall not be started until the specimens attain to temperature stability.
2. The degradation of Polarizer are ignored for item 1, 4 & 5.

### **Evaluation criteria**

1. The function test is OK.
2. No observable defects.
3. Luminance: > 50% of initial value.
4. Current consumption: within ± 50% of initial value.

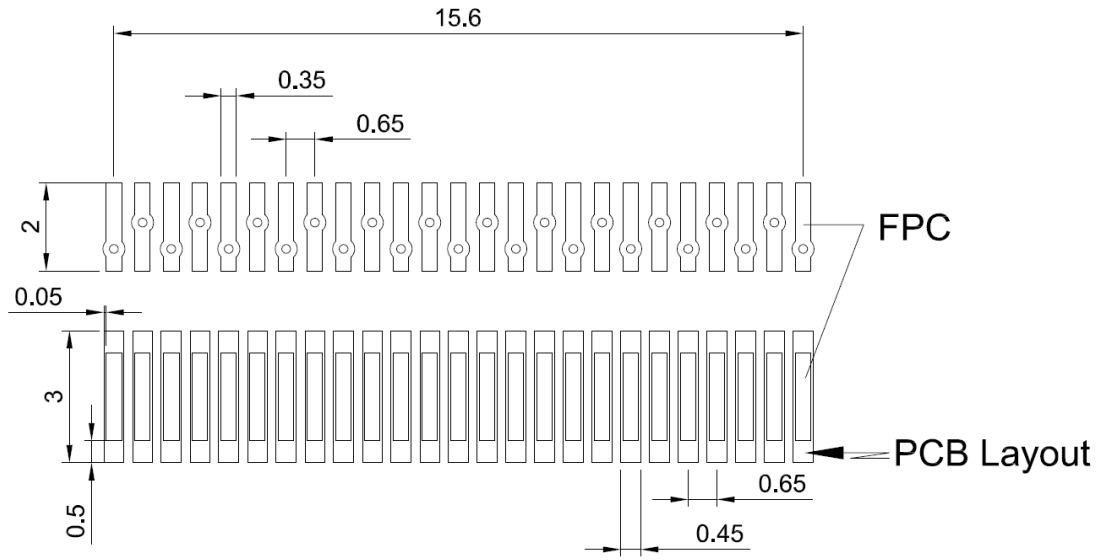
# 11. EXTERNAL DIMENSION

## 11.1 MODULE ASSEMBLY DRAWING

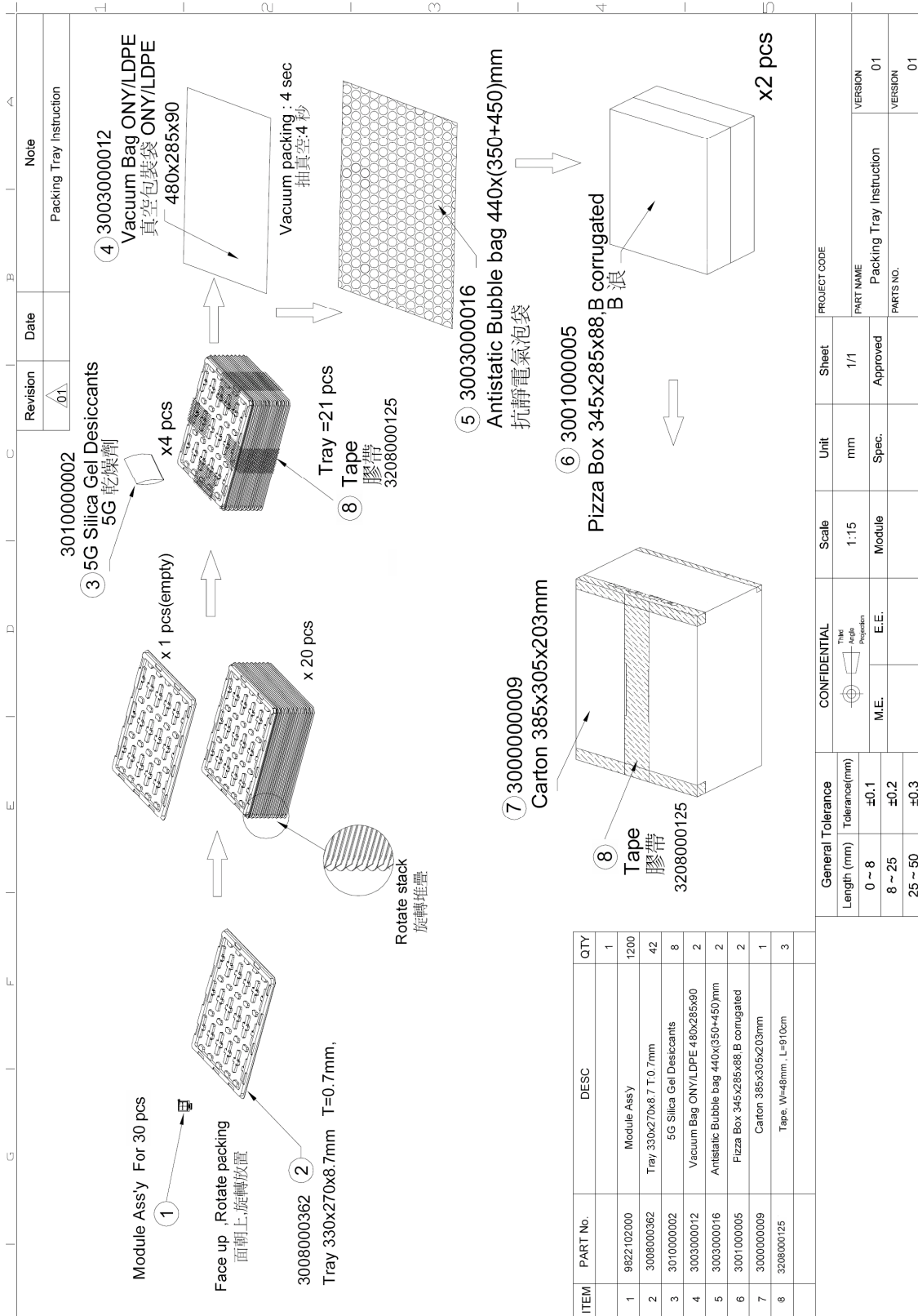


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### 11.2 FOOTPRINT DRAWING



## 12. PACKING SPECIFICATION



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### **13. OUTGOING INSPECTION PROVISION**

#### **1. 抽樣方法 / SAMPLING METHOD**

- (1) MIL-STD-1916 / 驗證水準 level III / 正常檢驗 / 單次樣品檢驗  
MIL-STD-1916 / inspection level III / normal inspection / single sample inspection
- (2) 主要缺陷 Level III ; 次要缺陷 Level II  
Major Level III ; Minor Level II

MIL-STD-1916 樣本代字對照表							
批量	驗證水準 (VL)						
	VII	VI	V	IV	III	II	I
2 ~ 170	A	A	A	A	A	A	A
171 ~ 288	A	A	A	A	A	A	B
289 ~ 544	A	A	A	A	A	B	C
545 ~ 960	A	A	A	A	B	C	D
961 ~ 1632	A	A	A	B	C	D	E
1633 ~ 3072	A	A	B	C	D	E	E
3073 ~ 5440	A	B	C	D	E	E	E
5441 ~ 9216	B	C	D	E	E	E	E
9217 ~ 17408	C	D	E	E	E	E	E
17409 ~ 30720	D	E	E	E	E	E	E
≥ 30721	E	E	E	E	E	E	E

#### **2. 檢驗條件 / INSPECTION CONDITION**

檢查和測量在下列條件下進行的，除非另有規定。

The inspection and measurement are performed under the following conditions, unless otherwise specified.

溫度 / Temperature: 25±5 °C

濕度 / Humidity: 50±10%R.H.

壓力 / Pressure: 860~1060hPa (mbar)

檢驗員拿的面板和眼睛之間的距離 / Distance between the panel and eyes of the inspector ≥ 30cm

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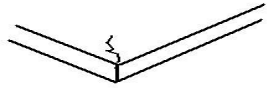
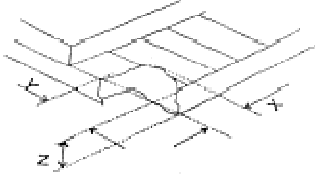
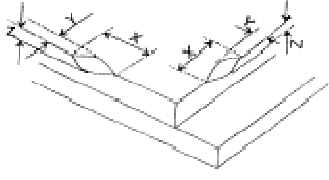
### 3. 品質檢驗規格 / SPECIFICATION FOR QUALITY CHECK

#### 3.1 缺陷分類 / DEFECT CLASSIFICATION

嚴重度 Severity	檢驗項目 Inspection Item	缺陷 Defect	備註 Remark
主要缺陷 Major Defect	1. 面板 Panel	(1) 無顯示 Non-displaying	
		(2) 線缺陷 Line defects	
		(3) 故障 Malfunction	
		(4) 玻璃破損 Glass cracked	
	2. 軟板 Film	(1) 軟板尺寸超規 Film dimension out of specification	不能組裝 Can not be assembled
	3. 尺寸 Dimension	(1) 外形尺寸超規 Outline dimension out of specification	
次要缺陷 Minor Defect	1. 面板 Panel	(1) 玻璃刮傷 Glass scratch	外觀缺陷 Appearance defect
		(2) 玻璃切割異常 Glass cutting NG	
		(3) 玻璃崩邊、崩角 Glass chip	
	2. 偏光板 Polarizer	(1) 偏光板刮傷 Polarizer scratch	
		(2) 表面汙漬 Stains on surface	
		(3) 偏光板氣泡 Polarizer bubbles	
	3. 顯示 Displaying	(1) 暗點、亮點、髒污 Dim spot·Bright spot·dust	
	4. 軟板 Film	(1) 損傷 Damage	
		(2) 異物 Foreign material	

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### 3.2 出貨規格 / OUTGOING SPECIFICATION

項目 Item	描述 Description	標準 Criterion	允收 水準 AQL															
I. 面板 Panel	1. 玻璃刮傷 Glass scratch	<table border="1"> <thead> <tr> <th>寬 / Width (mm) W</th> <th>長 / Length (mm) L</th> <th>容許個數 number of pieces permitted</th> </tr> </thead> <tbody> <tr> <td><math>W \leq 0.03</math></td> <td>忽略 Ignore</td> <td>忽略 Ignore</td> </tr> <tr> <td><math>0.03 &lt; W \leq 0.05</math></td> <td><math>L \leq 1</math></td> <td>1</td> </tr> <tr> <td><math>0.05 &lt; W</math></td> <td>-----</td> <td>無 None</td> </tr> <tr> <td>顯示區外 beyond A.A.</td> <td>-----</td> <td>忽略 Ignore</td> </tr> </tbody> </table>	寬 / Width (mm) W	長 / Length (mm) L	容許個數 number of pieces permitted	$W \leq 0.03$	忽略 Ignore	忽略 Ignore	$0.03 < W \leq 0.05$	$L \leq 1$	1	$0.05 < W$	-----	無 None	顯示區外 beyond A.A.	-----	忽略 Ignore	次要 Minor
	寬 / Width (mm) W	長 / Length (mm) L	容許個數 number of pieces permitted															
	$W \leq 0.03$	忽略 Ignore	忽略 Ignore															
$0.03 < W \leq 0.05$	$L \leq 1$	1																
$0.05 < W$	-----	無 None																
顯示區外 beyond A.A.	-----	忽略 Ignore																
2. 玻璃破損 Glass crack	<p>(1) 裂紋 / Crack 擴展裂紋是不能接受的。 Propagation crack is not acceptable.</p> 	主要 Major																
3. 玻璃崩邊、崩角 Glass chip	<p>(1) 崩角 / Chip on corner</p>  <p>(2) 崩邊 / Chip on edge</p> 	次要 Minor																

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項目 Item	描述 Description	標準 Criterion	允收 水準 AQL																
I. 面板 Panel	3. 玻璃崩邊、崩角 Glass chip	<table border="1"> <thead> <tr> <th>崩角 Chip on corner</th> <th>Size (mm)</th> <th>崩邊 Chip on edge</th> <th>Size (mm)</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>≤1.5</td> <td>X</td> <td>≤3.0</td> </tr> <tr> <td>Y</td> <td>≤2.0</td> <td>Y</td> <td>≤1.0</td> </tr> <tr> <td>Z</td> <td>≤t</td> <td>Z</td> <td>≤t</td> </tr> </tbody> </table> <p>備註 / Note:            1. t = 玻璃厚度               t = glass thickness            2. 崩邊或崩角延伸到 ITO 導線是不能接受的。            Chip on the corner extending into the ITO contact is not acceptable.</p>	崩角 Chip on corner	Size (mm)	崩邊 Chip on edge	Size (mm)	X	≤1.5	X	≤3.0	Y	≤2.0	Y	≤1.0	Z	≤t	Z	≤t	次要 Minor
	崩角 Chip on corner	Size (mm)	崩邊 Chip on edge	Size (mm)															
X	≤1.5	X	≤3.0																
Y	≤2.0	Y	≤1.0																
Z	≤t	Z	≤t																
	4. 尺寸 Dimension	請參閱圖紙的規範。 Refer to the drawing of the spec	主要 Major																
II. 偏光板 Polarizer	1. 刮傷 Scratch	點狀按照“項目 II-3 偏光板氣泡”的標準。 Spot type in accordance with the criteria of “Item II-3. Polarizer bubble”. 線狀按照“項目 I-1 玻璃刮傷”的標準。 Line type in accordance with the criteria of “Item I-1. Glass scratch”.	次要 Minor																
	2. 表面汙漬 Stains on surface	表面汙漬無法用軟布或類似的清潔物輕輕擦拭去除。 Stains cannot be removed even when wiped lightly with a soft cloth or similar cleaning.	次要 Minor																
	3. 偏光板氣泡 Polarizer bubble	<p style="text-align: right;">(mm)</p> <table border="1"> <thead> <tr> <th>尺寸 Size</th> <th>容許個數 number of pieces permitted</th> </tr> </thead> <tbody> <tr> <td><math>\Phi \leq 0.2</math></td> <td>忽略 Ignore</td> </tr> <tr> <td><math>0.2 &lt; \Phi \leq 0.5</math></td> <td>2</td> </tr> <tr> <td><math>0.5 &lt; \Phi</math></td> <td>0</td> </tr> <tr> <td>顯示區外 beyond A.A.</td> <td>忽略 Ignore</td> </tr> </tbody> </table>	尺寸 Size	容許個數 number of pieces permitted	$\Phi \leq 0.2$	忽略 Ignore	$0.2 < \Phi \leq 0.5$	2	$0.5 < \Phi$	0	顯示區外 beyond A.A.	忽略 Ignore	次要 Minor						
尺寸 Size	容許個數 number of pieces permitted																		
$\Phi \leq 0.2$	忽略 Ignore																		
$0.2 < \Phi \leq 0.5$	2																		
$0.5 < \Phi$	0																		
顯示區外 beyond A.A.	忽略 Ignore																		



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項目 Item	描述 Description	標準 Criterion	允收 水準 AQL											
III. 顯示 Displaying	1. 耗電 Power consumption	該模組的工作電流消耗不應超出產品規格書的規範。 The module operating current consumption should not go beyond the standard indicated in Product Specification	主要 Major											
	2. 像素尺寸 Pixel size	顯示像素的尺寸的公差應規格的±25%之內。 The tolerance of display pixel dimension should be within ±25% of specification.	次要 Minor											
	3. 顏色 Color	依據產品規格。 Refer to the product specification.	主要 Major											
	4. 亮度 Luminance	依據產品規格。 Refer to the product specification.	主要 Major											
	5. 暗點、亮點、 髒污 Dimming spot、Lighting spot、Dust	1. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>平均直徑 Average diameter D:(mm)</th> <th>容許個數 number of pieces permitted</th> </tr> </thead> <tbody> <tr> <td>D ≤ 0.1</td> <td>忽略 Ignore</td> </tr> <tr> <td>0.1 &lt; D ≤ 0.15</td> <td>1</td> </tr> <tr> <td>0.15 &lt; D ≤ 0.2</td> <td>1</td> </tr> <tr> <td>0.2 &lt; D</td> <td>0</td> </tr> <tr> <td>顯示區外 beyond A.A.</td> <td>忽略 Ignore</td> </tr> </tbody> </table> <p>D=(長邊直徑 + 短邊直徑)/2 D=(long diameter + short diameter)/2 像素暗點是不允許。 Pixel off is not allowed.</p>	平均直徑 Average diameter D:(mm)	容許個數 number of pieces permitted	D ≤ 0.1	忽略 Ignore	0.1 < D ≤ 0.15	1	0.15 < D ≤ 0.2	1	0.2 < D	0	顯示區外 beyond A.A.	忽略 Ignore
平均直徑 Average diameter D:(mm)	容許個數 number of pieces permitted													
D ≤ 0.1	忽略 Ignore													
0.1 < D ≤ 0.15	1													
0.15 < D ≤ 0.2	1													
0.2 < D	0													
顯示區外 beyond A.A.	忽略 Ignore													

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項目 Item	描述 Description	標準 Criterion			允收 水準 AQL	
III. 顯示 Displaying	5. 暗點、亮點、 髒污 Dimming spot、Lighting spot、Dust	2.	寬 width(mm) W	長 length(mm) L	容許個數 number of pieces permitted	次要 Minor
			$W \leq 0.03$	忽略 Ignore	忽略 Ignore	
			$0.03 < W \leq 0.05$	$L \leq 1$	3	
			$0.05 < W$	-----	無 None	
			顯示區外 beyond A.A.	-----	忽略 Ignore	
IV. 軟板 Film	1. 尺寸 Dimension	軟板尺寸超規。 Film dimension out of Spec.			主要 Major	
	2. 損傷 Damage	破損；深刮傷；深摺痕；深壓痕或其他損害是不能接受的。 Crack; deep scratch; deep fold; deep pressure mark or other damage is not acceptable.			次要 Minor	
	3. 異物 Foreign material	導電異物附著在導線，軟板和玻璃之間的異物是不能接受的。 Conductive foreign material sticking to the leads, foreign material between film and glass are not acceptable.			次要 Minor	

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## **14. APPENDIXES**

### **APPENDIX 1: DEFINITIONS**

#### **A. DEFINITION OF CHROMATICITY COORDINATE**

The chromaticity coordinate is defined as the coordinate value on the CIE 1931 color chart for R, G, B, W.

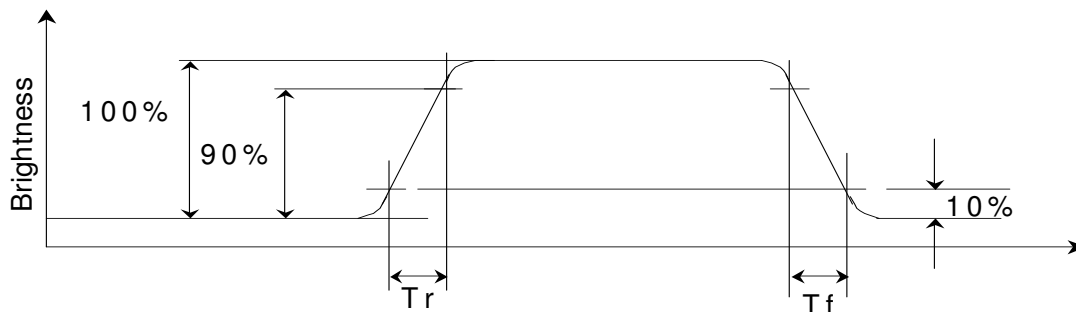
#### **B. DEFINITION OF CONTRAST RATIO**

The contrast ratio is defined as the following formula:

$$\text{Contrast Ratio} = \frac{\text{Luminance of all pixels on measurement}}{\text{Luminance of all pixels off measurement}}$$

#### **C. DEFINITION OF RESPONSE TIME**

The definition of turn-on response time  $T_r$  is the time interval between a pixel reaching 10% of steady state luminance and 90% of steady state luminance. The definition of turn-off response time  $T_f$  is the time interval between a pixel reaching 90% of steady state luminance and 10% of steady state luminance. It is shown in Figure 2.

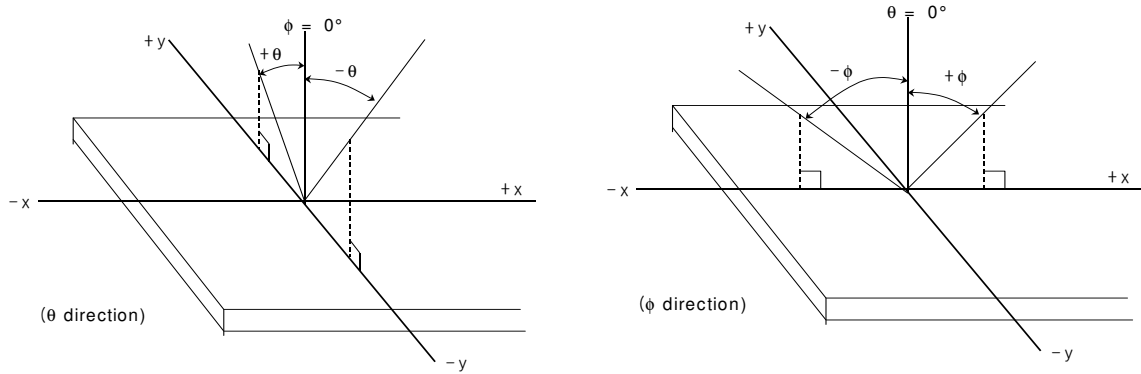


**Figure 2 Response time**

<b>Messrs.</b>			
<b>Product Specification</b>	<b>Model:</b>	<b>HG121284OW</b>	<b>Rev. NO.</b>
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#### D. DEFINITION OF VIEWING ANGLE

The viewing angle is defined as Figure 3. Horizontal and vertical (H & V) angles are determined for viewing directions where luminance varies by 50% of the perpendicular value.



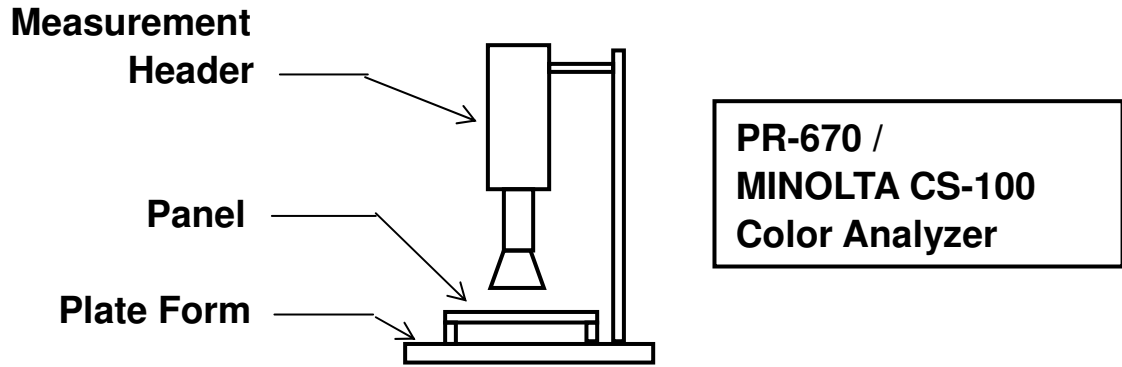
**Figure 3 Viewing angle**

<b>Messrs.</b>			
<b>Product Specification</b>	<b>Model:</b>	<b>HG121284OW</b>	<b>Rev. NO.</b>
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**APPENDIX 2: MEASUREMENT APPARATUS**

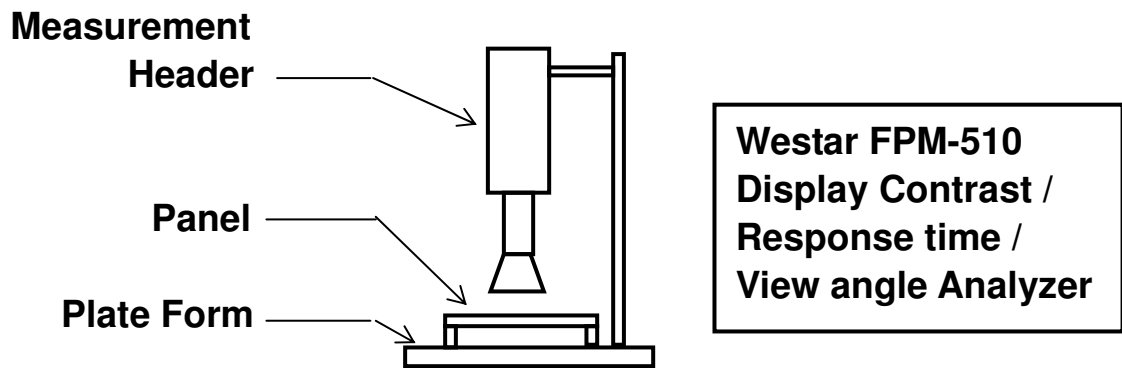
**A. LUMINANCE/COLOR COORDINATE**

PHOTO RESEARCH PR-670, MINOLTA CS-100



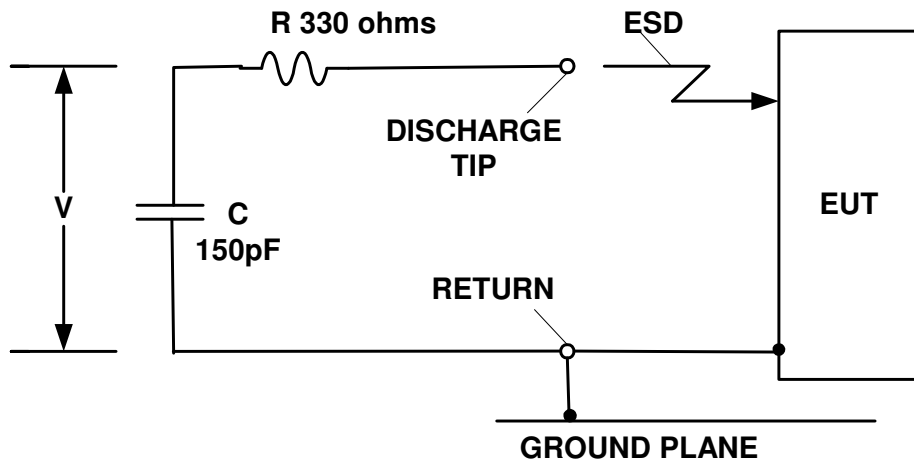
**B. CONTRAST / RESPONSE TIME / VIEWING ANGLE**

WESTAR CORPORATION FPM-510



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### C. ESD ON AIR DISCHARGE MODE



## *Precautions for Storage and Reliability Test*

### 1. Storage

Store the packed cartons or packages at  $25^{\circ}\text{C}\pm 5^{\circ}\text{C}$ ,  $55\%\pm 10\%\text{RH}$ . Do not store the OLED module under direct sunlight or UV light. For best panel performance, unpack the cartons and start the production of the panels within six months after the reception of them.

### 2. Reliability Test

APEX only guarantees the reliability of the OLEDs under the test conditions and durations listed in the specification.