

# OLED DISPLAY MODULE

## Product Specification

<b>CUSTOMER</b>	<b>Standard</b>	
<b>PRODUCT NUMBER</b>	<b>DD-12864WE-1A</b>	
<b>CUSTOMER APPROVAL</b>		<b>Date</b>

INTERNAL APPROVALS		
Product Mgr	Doc. Control	Electr. Eng
<b>Bruno Recaldini</b>	<b>Anthony Perkins</b>	<b>Bazile Peter</b>
Date: 27 Nov 06	Date: 27 Nov 06	Date: 27 Nov 06

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REVISION RECORD

<b>Rev.</b>	<b>Date</b>	<b>Page</b>	<b>Chapt.</b>	<b>Comment</b>	<b>ECR no.</b>
A	27 Nov 06			First Issue	

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# 1 MAIN FEATURES

ITEM	CONTENTS
Display Format	128 x 64 Dots
Overall Dimensions	Glass 26.70 x 19.26 x 2.10 mm
Colour	Monochrome White
Active Area	21.74 x 10.86 mm
Viewing Area	23.74 x 12.86 mm
Display Mode	Passive Matrix (0.96")
Driving Method	1/64 duty
Driver IC	SH1101A
Operating temperature	-30 ~ +70
Storage temperature	-40 ~ +80

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## 2 MECHANICAL SPECIFICATION

### 2.1 MECHANICAL CHARACTERISTICS

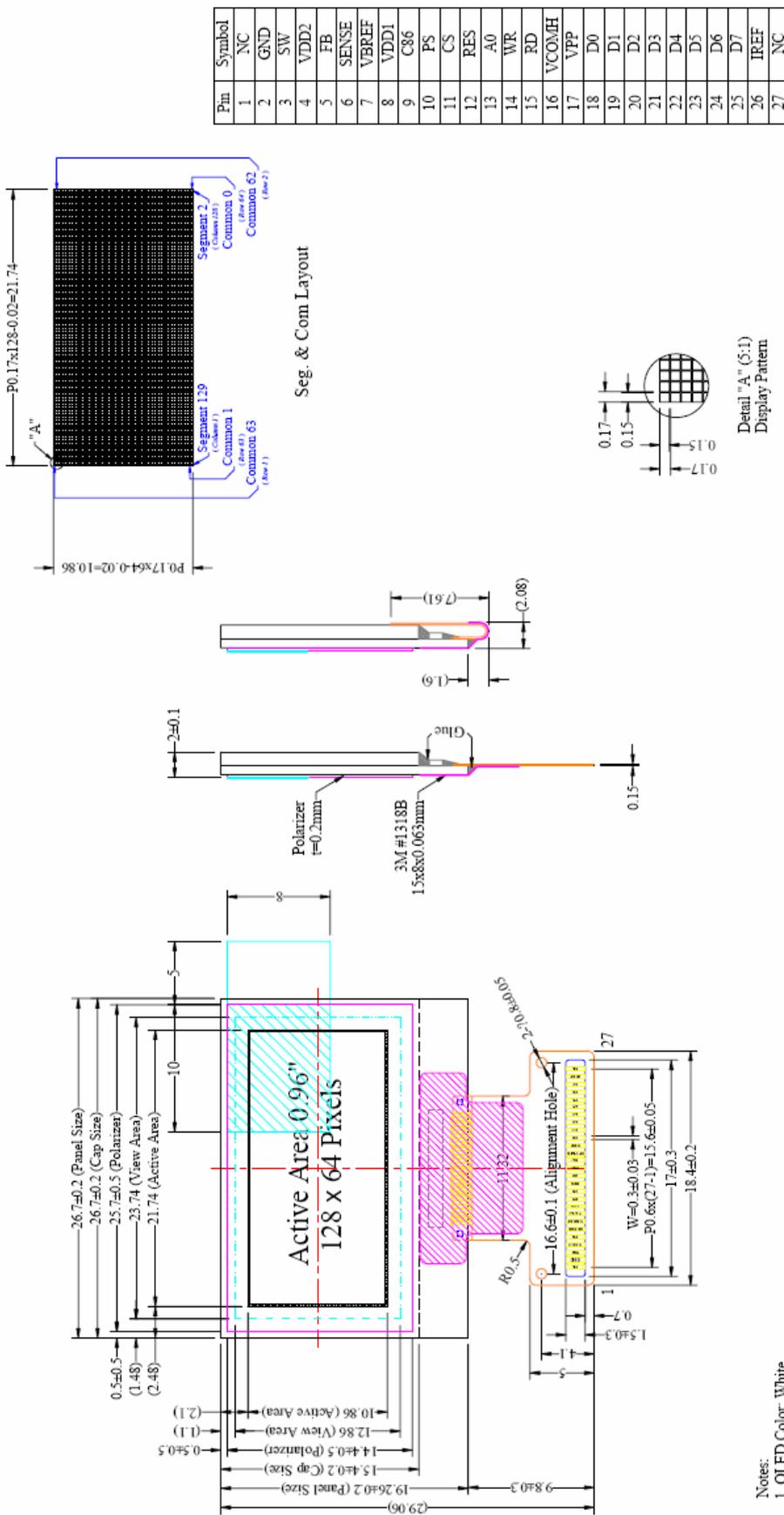
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ITEM	CHARACTERISTIC	UNIT
Display Format	128 x 64 Dots	Dots
Overall Dimensions	Glass 26.70 x 19.26 x 2.10	mm
Viewing Area	23.74 x 12.86	mm
Active Area	21.74 x 10.86	mm
Dot Size	0.15 x 0.15	mm
Dot Pitch	0.17 x 0.17	mm
Weight	2	g
IC Controller/Driver	SH1101A	

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## 2.2 MECHANICAL DRAWING



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### 3 ELECTRICAL SPECIFICATION

#### 3.1 ABSOLUTE MAXIMUM RATINGS

VSS = 0 V, Ta = 25 °C

Item	Symbol	Min	Max	Unit	Note
Supply Voltage	V <sub>DD1</sub>	-0.3	3.5	V	Note 1, 2
Driver Supply Voltage	V <sub>PP</sub>	0	15	V	
Operating Temperature	Top	-30	70	°C	
Storage Temperature	Tst	-40	80	°C	
Static Electricity	Be sure that you are grounded when handling displays.				

Note 1: All the above voltages are on the basis of “GND=0V”.

Note 2: When this module is used beyond the above absolute maximum ratings, permanent damage to the module may occur. Also for normal operations it's desirable to use this module under the conditions according to Section 3.2 “Electrical Characteristics”. If this module is used beyond these conditions the module may malfunction and the reliability could deteriorate.

### 3.2 ELECTRICAL CHARACTERISTICS

Characteristics	Symbol	Conditions	Min	Typ	Max	Unit
Supply Voltage	V <sub>DD1</sub>		2.6	2.8	3.5	V
DC/DC Supply Voltage	V <sub>DD2</sub>		2.6	-	3.5	V
Driver Supply Voltage	V <sub>PP</sub>		8	9	10	V
High Level Input	V <sub>IHC</sub>	I <sub>OUT</sub> =0.5mA, 3.3MHz	0.8xV <sub>DD1</sub>	-	V <sub>DD1</sub>	V
Low Level Input	V <sub>ILC</sub>		0	-	0.2 x V <sub>DD1</sub>	V
High Level Output	V <sub>OHC</sub>		0.8 x V <sub>DD1</sub>	-	V <sub>DD1</sub>	V
Low Level Output	V <sub>OLC</sub>		0	-	0.2 x V <sub>DD1</sub>	V
Operating current for VDD1	I <sub>DD1</sub>	Note 4	-	180	320	μA
		Note 5	-	180	320	
Operating current for VPP	I <sub>PP</sub>	Note 4	-	5.6	8	mA
		Note 5	-	8	11	
Sleep mode current for VDD1	I <sub>DD1 SLEEP</sub>		-	<1	1	μA
Sleep mode current for VCC	I <sub>CC SLEEP</sub>		-	<1	1	μA

Note 4 VDD1 = 2.8V, VPP = 9V, Frame rate = 150Hz, Contrast setting = 0x64, 50% display area turned on.

Note 5 VDD1 = 2.8V, VPP = 9V, Frame rate = 150Hz, Contrast setting = 0x64, 100% display area turned on.

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### 3.3 INTERFACE PIN ASSIGNMENT

No.	Symbol	Function												
1	N.C.	No Connection												
2	GND	Ground This is the ground pin. It also acts as a reference for the logic pins, the OLED driving voltages and the analogue circuits. It must be connected to external ground												
3	SW	Output for connected external NMOS This output pin drives the gate of the external NMOS of the booster circuit.												
4	VDD2	Power supply for DC/DC converter circuit This is the power supply pin for the internal buffer of the DC/DC voltage converter. It must be connected to VDD when the converter is used. It must be floated when the converter is not used												
5	FB	Feedback Input for DC/DC converter circuit This pin is the feedback resistor input of the booster circuit. It is used to adjust the booster output voltage level (VCC)												
6	SENSE	Input for connected External NMOS This pin connects to the source current pin of the external NMOS of the booster circuit.												
7	VBREF	Voltage reference for DC/DC converter circuit This pin is the internal voltage reference of booster circuit. A Stabilization capacitor typ 1µF should be connected to VSS.												
8	VDD1	Power supply for logic circuit This is a voltage supply pin. It must be connected to external source.												
9	C86	Communicating protocol select These pins are MCU interface selection input. See the following table:												
10	PS	<table border="1"> <thead> <tr> <th></th> <th>6800-parallel</th> <th>8080-parallel</th> <th>Serial</th> </tr> </thead> <tbody> <tr> <td>C86</td> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>PS</td> <td>1</td> <td>1</td> <td>0</td> </tr> </tbody> </table>		6800-parallel	8080-parallel	Serial	C86	0	1	0	PS	1	1	0
	6800-parallel	8080-parallel	Serial											
C86	0	1	0											
PS	1	1	0											
11	CS	Chip select This pin is the chip select input. The chip is enabled for MCU communication only when CS# is pulled low.												
12	RES	Power reset for controller and driver This pin is reset signal input. When the pin is low initialization of the chip is executed.												
13	A0	Data/Command Control This pin is data/command control pin. When the pin is pulled high, the input D7~D0 is treated as display data. When the pin is pulled low, the input at D7~D0 will be transferred to the command register. For detail relationship to MCU interface signals please refer to the Timing Characteristics Diagrams												
14	WR	Read/Write select or write This pin is MCU interface input. When interfacing to a 6800-series microprocessor this pin will be used as Read/Write (R/W#) selection input. Pull this pin to "High" for Read mode and pull it to "Low" for Write mode. When 8080 interface mode is selected this pin will be the Write (WR#) input. Data write operation is initiated when this pin is pulled low and the CS# is pulled low.												

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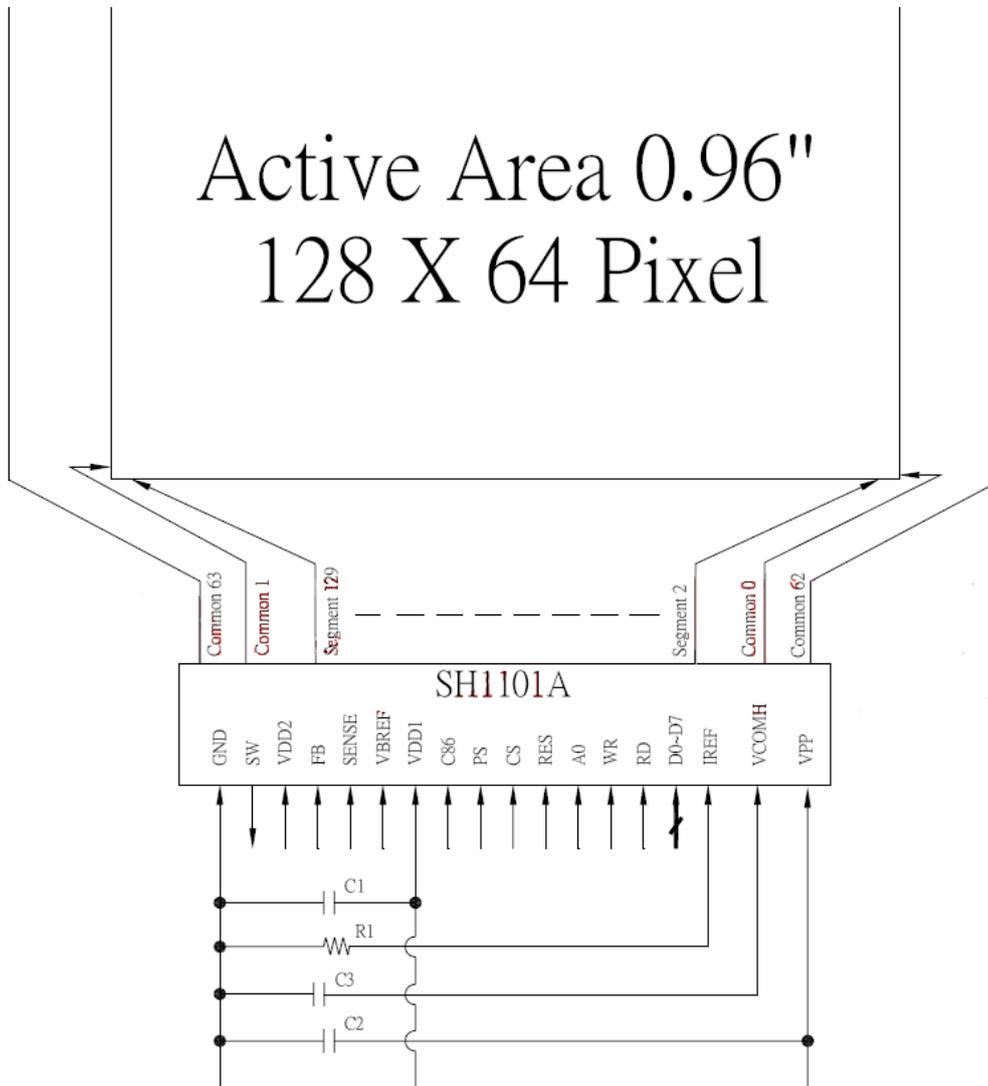
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15	RD	<p><b>Read/Write enable or Read</b> This pin is MCU interface input. When interfacing to a 6800-series microprocessor this pin will be used as the Enable (E) signal. Read/Write operation is initiated when this pin is pulled high and the CS# is pulled low. When connecting to a 8080-series microprocessor this pin receives the Read (RD#) signal. Data read operation is initiated when this pin is pulled low and CS# is pulled low</p>
16	VCOMH	<p><b>Voltage output high level for COM signal</b> This pin is the input pin for the voltage output high level for COM signals. A capacitor should be connected between this pin and VSS.</p>
17	VPP	<p><b>Power Supply for OLED Panel</b> This is the most positive voltage supply pin of the chip. It can be supplied externally or generated internally by using internal DC/DC voltage converter</p>
18	D0~D7	<p><b>Host data Input/Output bus</b> These pins are 8-bit bi-directional data bus to be connected to the microprocessors data bus. When serial mode is selected D1 will be the serial data input SDIN and D0 will be the serial clock input SCLK.</p>
19		
20		
21		
22		
23		
24		
25		
26	IREF	<p><b>Current reference for brightness adjustment</b> This pin is segment current reference pin. A resistor should be connected between this pin and VSS. Set the current at 10µA</p>
27	N.C.	No Connection

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### 3.4 BLOCK DIAGRAM



MCU Interface Selection: PS and C86

Pins connected to MCU interface: D7~D0, RD, WR, A0, RES and CS.

\*VBREF, SENSE, FB, VDD2 and SW should be left float when using external DC/DC converter.

C1, C2, C3: 4.7μF

R1: 910 kΩ,  $R1 = (\text{Voltage at IREF} - \text{GND}) / \text{IREF}$

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### 3.5 TIMING CHARACTERISTICS

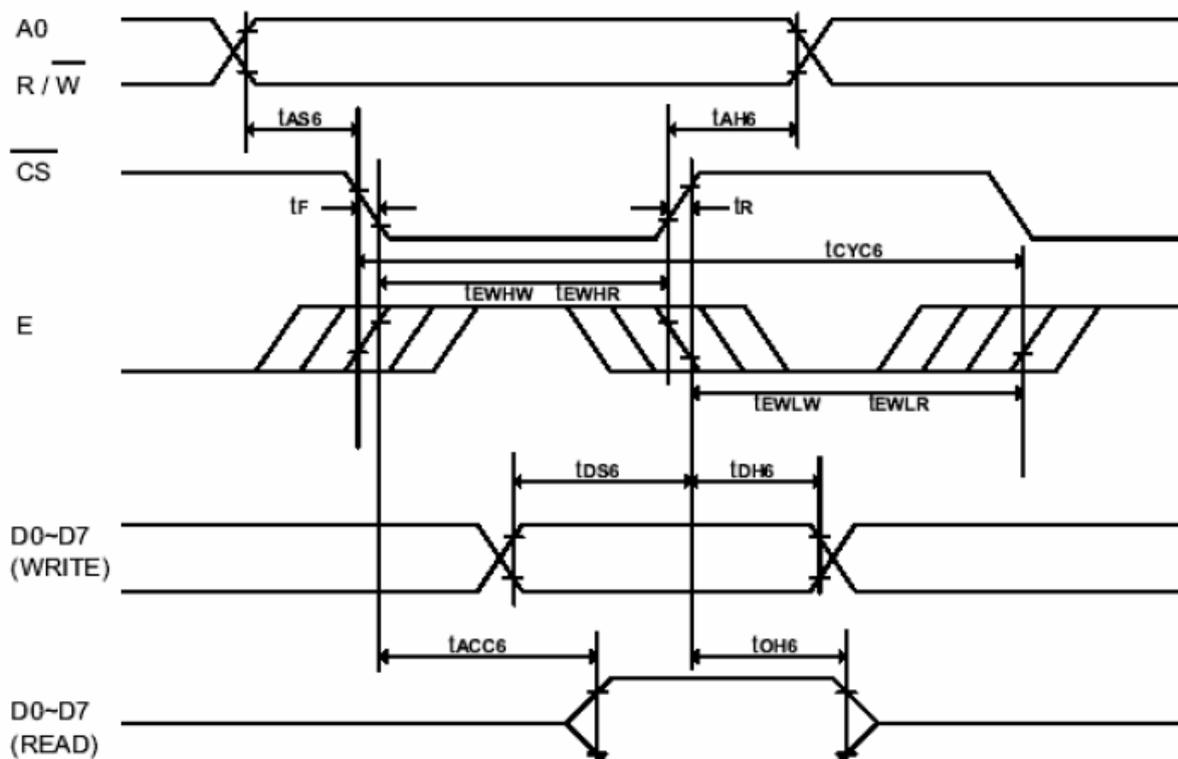
#### 3.5.1 AC CHARACTERISTICS

##### 3.5.1.1 6800-Series MPU Parallel Interface Timing Characteristics

VDD = 2.8V, Ta = 25°C

Characteristics	Symbol	Min	Max	Unit
System cycle time	tCYC6	300	-	nS
Address setup timing	tAS6	0	-	
Address hold time	tAH6	0	-	
Write Data Setup time	tDS6	40	-	
Write Data Hold time	tDH6	15	--	
Output Disable time	tOH6	10	70	
Access time	tACC6	-	140	
Enable H pulse width (Write)	tEWHW	100	-	
Enable H pulse width (Read)	tEWHR	120	-	
Enable L pulse width (Write)	tEWLW	100	-	
Enable L pulse width (Read)	tEWLR	100	-	
Rise time	tR	-	15	
Fall time	tF	-	15	

All the timing should be based on 30% and 70% of VDD1 - VSS



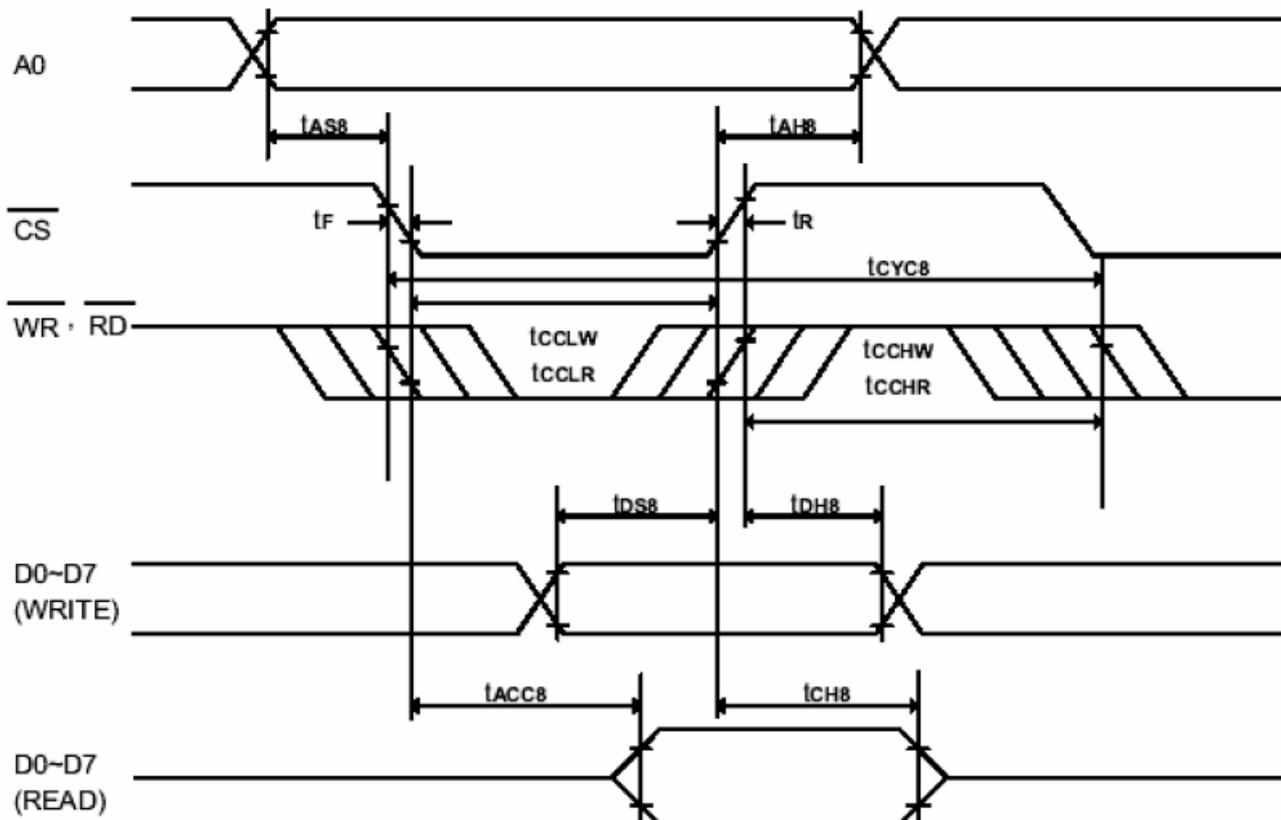
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### 3.5.1.2 8080-Series MPU Parallel Interface Timing Characteristics

Characteristics	Symbol	Min	Max	Unit
System cycle time	tCYC8	300	-	nS
Address setup timing	tAS8	0	-	
Address hold time	tAH8	0	-	
Write Data Setup time	tDS8	40	-	
Write Data Hold time	tDH8	15	-	
Output Disable time	tCH8	10	70	
/RD Access time	tACC8	-	140	
Control L pulse width (WR)	tCCLW	100	-	
Control L pulse width (RD)	tCCLR	120	-	
Control H pulse width (WR)	tCCHW	100	-	
Control H pulse width (RD)	tCCHR	100	-	
Rise time	tR	-	15	
Fall time	tF	-	15	

**All the timing should be based on 30% and 70% of  $V_{DD1} - V_{SS}$**



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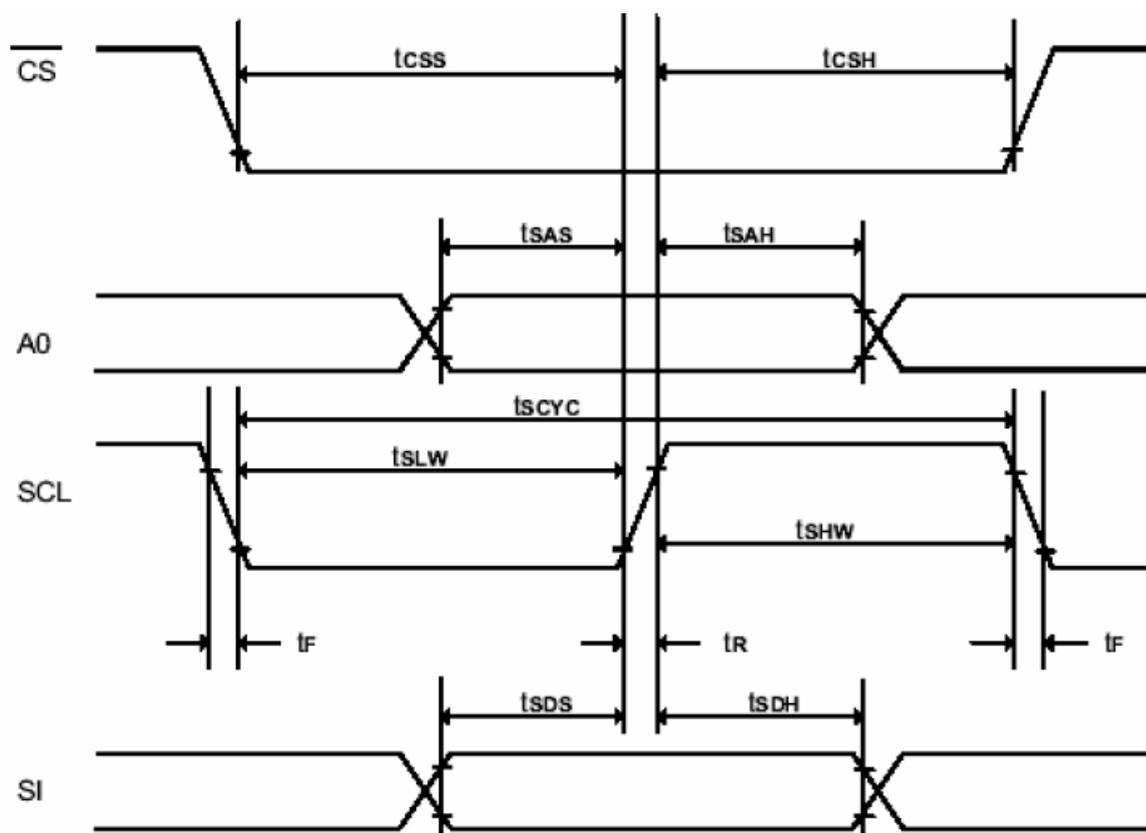
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### 3.5.1.3 Serial Interface Timing Characteristics

VDD = 2.8V, Ta = 25°C

Characteristics	Symbol	Min	Max	Unit
Serial Clock Cycle Time	TSCYC	250	-	nS
Address Setup Time	TSAS	150	-	
Address Hold Time	TSAH	150	-	
Data Setup Time	TSDS	100	-	
Data Hold Time	TS DH	100	-	
/CS Setup Time	TCSS	120	-	
/CS Hold Time	TCSH	60	-	
Serial clock H pulse width	TSHW	100	-	
Serial clock L pulse width	TSLW	100	-	
Rise Time	tR	-	15	
Fall Time	tF	-	15	

\* All the timing should be based on 30% and 70% of V<sub>DD</sub> - V<sub>SS</sub>



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## 4 OPTICAL SPECIFICATION

### 4.1 OPTICAL CHARACTERISTICS

Characteristics	Symbol	Condition	Min	Typ	Max	Unit
Brightness(White)	L <sub>br</sub>		40	60	-	cd/m <sup>2</sup>
C.I.E.(White)	(X)		0.28	0.32	0.36	-
	(Y)		0.29	0.33	0.37	
Dark Room Contrast	CR		-	>100:1	-	-
Viewing Angle			>160	-	-	degree

Optical measurement with polarizer is taken at 1/64 duty, 150Hz Frame Rate, 0x64 Contrast setting.

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## 5 FUNCTIONAL SPECIFICATION

### 5.1 COMMANDS

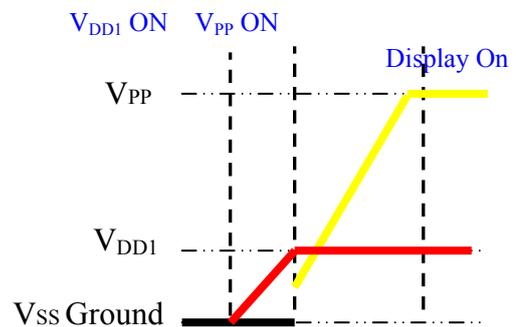
Please refer to the Technical Manual for the SH1101A

### 5.2 POWER UP/DOWN SEQUENCE

To protect panel and extend the panel lifetime, the driver IC power up/down routine should include a delay period between high voltage and low voltage power sources during turn on/off. It gives the panel enough time to complete the action of charge and discharge before/after the operation.

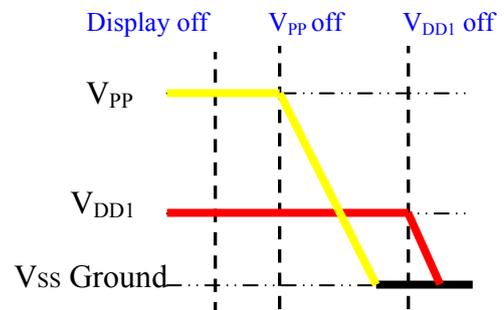
#### 5.2.1 POWER UP SEQUENCE

1. Power up  $V_{DD1}$
2. Delay 100ms at least (when reset is finished)
3. Send Display off command
4. Clear Screen
5. Power up  $V_{PP}$
6. Delay 100ms (when  $V_{DD1}$  is stable)
7. Send Display on command



#### 5.2.2 POWER DOWN SEQUENCE

1. Send Display off command
2. Power down  $V_{PP}$
3. Delay 100ms (When  $V_{PP}$  reach 0 and panel is completely discharges)
4. Power down  $V_{DD1}$



### 5.3 RESET CIRCUIT

When RES# input is low, the chip is initialized with the following status:

1. Display is OFF
2. 132x64 Display mode
3. Normal segment and display data column and row address mapping (SEG0 mapped to column address 00H and COM0 mapped to row address 00H)
4. Shift register data clear in serial interface
5. Display start line is set at display RAM address 0
6. Column address counter is set at 0
7. Normal scan direction of the COM outputs
8. Contrast control register is set at 80H
9. Internal booster is selected

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## 5.4 ACTUAL APPLICATION EXAMPLE

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Command usage and explanation of an actual example

<Initialisation Setting>

Set Display Clock Divide Ratio / Oscillator Frequency  
(11010101 with XXXXXXXX)

Set Display Offset  
(11010011 with \*\*XXXXXX)

Set Multiplex Ratio  
(10101000 with \*\*XXXXXX)

Set DC/DC On/Off  
(10101101 with 1000101X)  
10001010=>0x8A (Off)

Set Display Start Line  
(01XXXXXX)

Set Segment Re-map  
(1010000X)

Set COM Output Scan Direction  
(1100X\*\*\*)

Set COM Pins Hardware Configuration  
(11011010 with 000X0010)  
00010010=>0x12 (Alternative Mode)

Set Contrast Control Register  
(10000001 with XXXXXXXX)

Set Entire Display On/Off (1010010X)  
10100100=>0xA4 (Normal)

Set Normal/Inverse Display (1010011X)  
10100110=>0xA6 (Normal)

Set Display On/Off (1010111X)  
10101111=> 0xAF (Turns On)

<Display Boundary Settings>

Set Page Address (1011XXXX)  
10110000=>0xB0

Set Lower Column Address  
(0000XXXX)

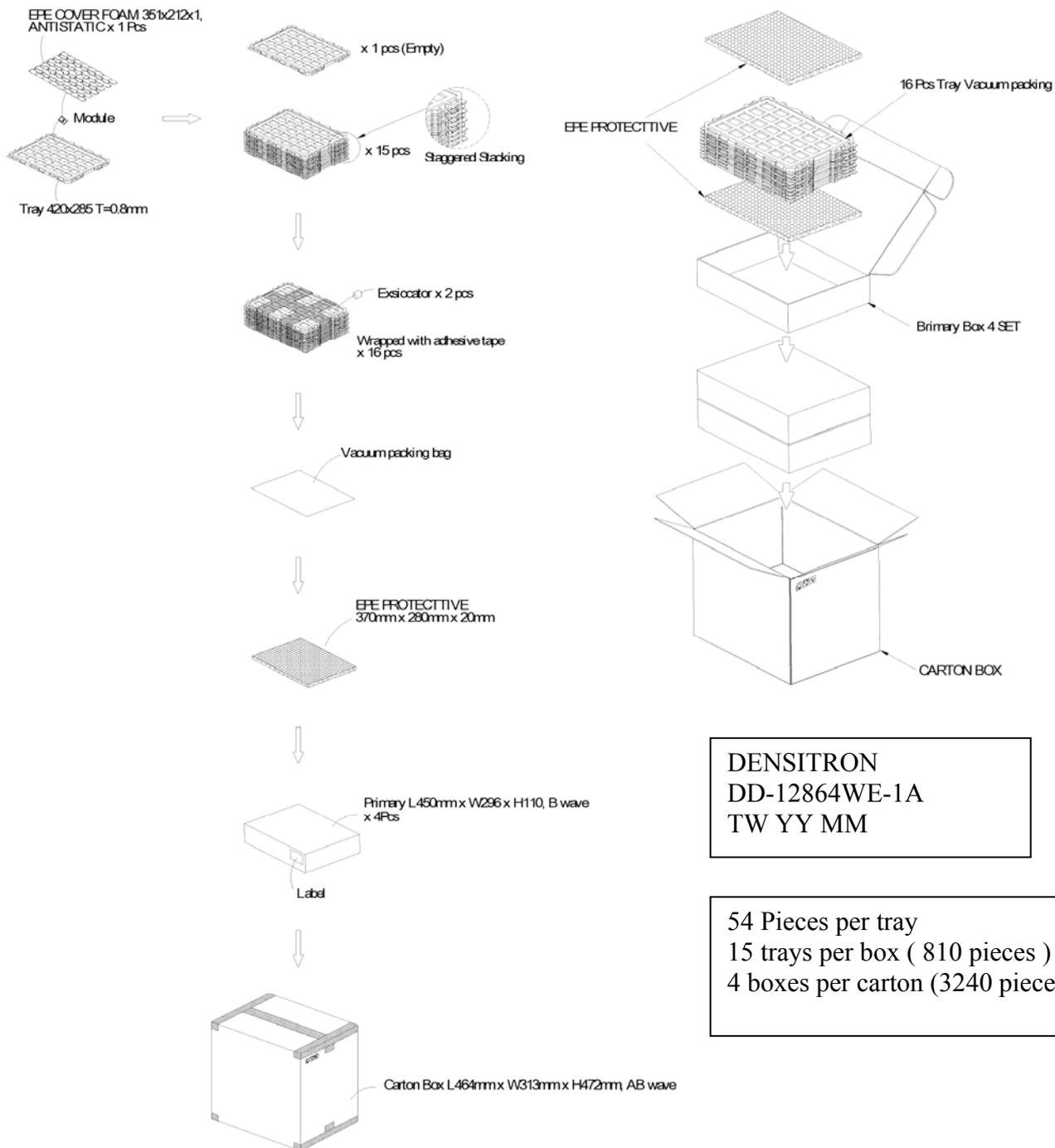
Set Higher Column Address  
(0001XXXX)

If the noise is accidentally occurred at the displaying window during the operation, please reset the display in order to recover the display function.

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## 6 PACKAGING AND LABELLING SPECIFICATION



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## 7 QUALITY ASSURANCE SPECIFICATION

### 7.1 CONFORMITY

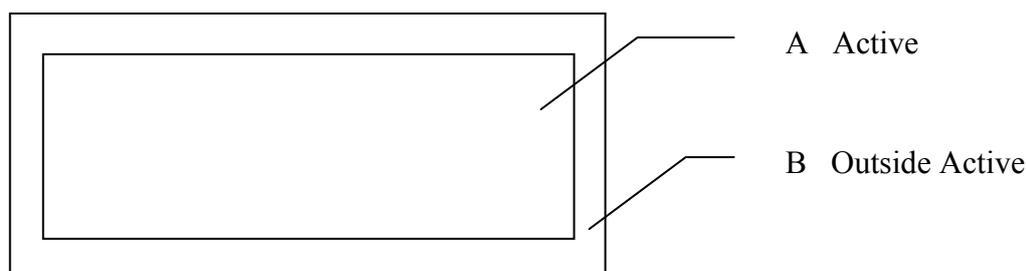
The performance, function and reliability of the shipped products conform to the Product Specification.

### 7.2 DELIVERY ASSURANCE

#### 7.2.1 DELIVERY INSPECTION STANDARDS

IPC-AA610, class 2 electronic assemblies standard

#### 7.2.2 Zone definition



#### 7.2.3 Visual inspection

Test and measurement to be conducted under following conditions □

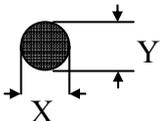
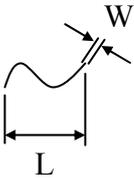
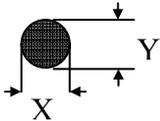
Temperature:	23±5°C
Humidity:	55±15%RH
Fluorescent lamp:	30 W
Distance between the Panel & Eyes of the Inspector:	≥30cm
Distance between the Panel & the lamp:	≥50cm

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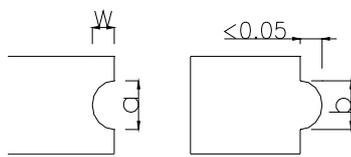
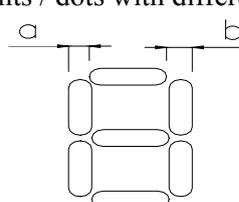
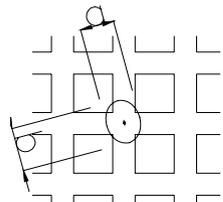
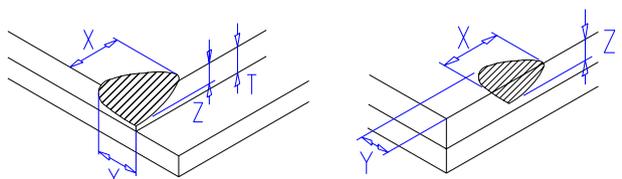
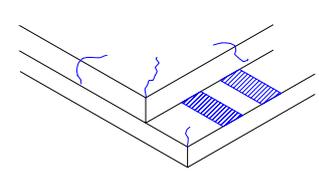
### 7.2.4 Standard of appearance inspection

Units: mm

Class	Item	Criteria																																	
Minor	Packing & Label	Outside & inside package   Presence of product no., lot no., quantity																																	
Critical		Product must not be mixed with others and quantity must not be different from that indicated on the label																																	
Major	Dimension	Product dimensions must be according to specification and drawing																																	
Major	Electrical	Product electrical characteristics must be according to specification																																	
Critical	OLED Display	Missing lines, short circuits or wrong patterns on OLED display are not allowed																																	
Minor	Black spot, white spot, dust	<p>Round type: as per following drawing  <math>\varnothing = (X+Y)/2</math></p>  <table border="1" style="margin-left: 200px;"> <thead> <tr> <th colspan="3">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th>Zone A</th> <th>Zone B</th> </tr> </thead> <tbody> <tr> <td><math>\varnothing &lt; 0.1</math></td> <td>Any number</td> <td rowspan="4">Any number</td> </tr> <tr> <td><math>0.1 &lt; \varnothing &lt; 0.2</math></td> <td>3</td> </tr> <tr> <td><math>0.2 &lt; \varnothing &lt; 0.25</math></td> <td>1</td> </tr> <tr> <td><math>0.25 &lt; \varnothing</math></td> <td>0</td> </tr> </tbody> </table> <p>Line type: as per following drawing</p>  <table border="1" style="margin-left: 200px;"> <thead> <tr> <th colspan="4">Acceptable quantity</th> </tr> <tr> <th>Length</th> <th>Width</th> <th>Zone A</th> <th>Zone B</th> </tr> </thead> <tbody> <tr> <td>--</td> <td><math>W \leq 0.05</math></td> <td>Any number</td> <td rowspan="3">Any number</td> </tr> <tr> <td><math>L &lt; 2.0</math></td> <td><math>W \leq 0.1</math></td> <td>3</td> </tr> <tr> <td><math>L &gt; 2.0</math></td> <td></td> <td>0</td> </tr> </tbody> </table> <p style="text-align: center;">Total acceptable quantity: 3</p>	Acceptable quantity			Size	Zone A	Zone B	$\varnothing < 0.1$	Any number	Any number	$0.1 < \varnothing < 0.2$	3	$0.2 < \varnothing < 0.25$	1	$0.25 < \varnothing$	0	Acceptable quantity				Length	Width	Zone A	Zone B	--	$W \leq 0.05$	Any number	Any number	$L < 2.0$	$W \leq 0.1$	3	$L > 2.0$		0
Acceptable quantity																																			
Size	Zone A	Zone B																																	
$\varnothing < 0.1$	Any number	Any number																																	
$0.1 < \varnothing < 0.2$	3																																		
$0.2 < \varnothing < 0.25$	1																																		
$0.25 < \varnothing$	0																																		
Acceptable quantity																																			
Length	Width	Zone A	Zone B																																
--	$W \leq 0.05$	Any number	Any number																																
$L < 2.0$	$W \leq 0.1$	3																																	
$L > 2.0$		0																																	
Minor	Polariser scratch	Scratch on protective film is permitted Scratch on polariser: same as No. 1																																	
Minor	Polariser bubble	<p><math>\varnothing = (X+Y)/2</math></p>  <table border="1" style="margin-left: 200px;"> <thead> <tr> <th colspan="3">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th>Zone A</th> <th>Zone B</th> </tr> </thead> <tbody> <tr> <td><math>\varnothing &lt; 0.5</math></td> <td>Any number</td> <td rowspan="2">Any number</td> </tr> <tr> <td><math>\varnothing &gt; 0.5</math></td> <td>0</td> </tr> </tbody> </table>	Acceptable quantity			Size	Zone A	Zone B	$\varnothing < 0.5$	Any number	Any number	$\varnothing > 0.5$	0																						
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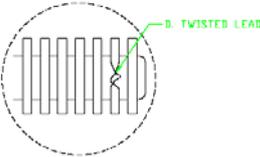
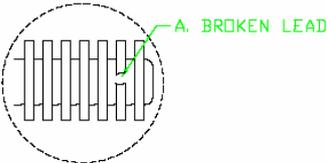
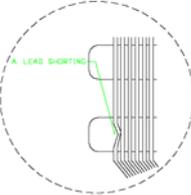
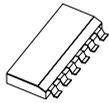
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Class	Item	Criteria																												
Minor	Segment deformation	<p>1b. Pin hole on dot matrix display</p>  <table border="1" data-bbox="1005 380 1404 560"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th></th> </tr> </thead> <tbody> <tr> <td><math>a, b &lt; 0.1</math></td> <td>Any number</td> </tr> <tr> <td><math>(a+b)/2 \le 0.1</math></td> <td>Any number</td> </tr> <tr> <td><math>0.5 &lt; \varnothing &lt; 1.0</math></td> <td>3</td> </tr> </tbody> </table> <p>Total acceptable quantity: 7</p> <p>2. Segments / dots with different width</p>  <table border="1" data-bbox="1005 761 1404 873"> <thead> <tr> <th colspan="2">Acceptable</th> </tr> </thead> <tbody> <tr> <td><math>a &gt; b</math></td> <td><math>a/b \le 4/3</math></td> </tr> <tr> <td><math>a &lt; b</math></td> <td><math>a/b &gt; 4/3</math></td> </tr> </tbody> </table> <p>3. Alignment layer defect</p> <p><math>\varnothing = (a+b)/2</math></p>  <table border="1" data-bbox="1005 940 1404 1164"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th></th> </tr> </thead> <tbody> <tr> <td><math>\varnothing \le 0.4</math></td> <td>Any number</td> </tr> <tr> <td><math>0.4 &lt; \varnothing \le 1.0</math></td> <td>5</td> </tr> <tr> <td><math>1.0 &lt; \varnothing \le 1.5</math></td> <td>3</td> </tr> <tr> <td><math>1.5 &lt; \varnothing \le 2.0</math></td> <td>2</td> </tr> </tbody> </table> <p>Total acceptable quantity: 7</p>	Acceptable quantity		Size		$a, b < 0.1$	Any number	$(a+b)/2 \le 0.1$	Any number	$0.5 < \varnothing < 1.0$	3	Acceptable		$a > b$	$a/b \le 4/3$	$a < b$	$a/b > 4/3$	Acceptable quantity		Size		$\varnothing \le 0.4$	Any number	$0.4 < \varnothing \le 1.0$	5	$1.0 < \varnothing \le 1.5$	3	$1.5 < \varnothing \le 2.0$	2
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$1.5 < \varnothing \le 2.0$	2																													
Minor	Panel Chipping	<p><math>X \le 1/6</math> Panel length  <math>Y \le 1</math>  <math>Z \le T</math></p> 																												
Minor	Panel Cracking	<p>Cracks not allowed</p> 																												
Minor	Copper exposed (pin or film)	Not allowed if visible by eye inspection																												
Minor	Film or Trace Damage	Not allowed if affect electrical function																												

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Class	Item	Criteria													
Minor	Contact Lead Twist	Not allowed 													
Minor	Contact Lead Broken	Not allowed 													
Minor	Contact Lead Bent	Not allowed if bent lead causes short circuit 													
		Not allowed if bent lead extends horizontally more than 50% of its width 													
Minor	Colour uniformity	Level of sample for approval set as limit sample													
Major	 PCB	No unmelted solder paste should be present on PCB													
Critical		Cold solder joints, missing solder connections, or oxidation are not allowed													
Minor		No residue or solder balls on PCB are allowed													
Critical		Short circuits on components are not allowed													
Minor	Tray particles	<table border="1"> <thead> <tr> <th></th> <th>Size</th> <th>Quantity</th> </tr> </thead> <tbody> <tr> <td rowspan="2">On tray</td> <td><math>\varnothing &lt; 0.2</math></td> <td>Any number</td> </tr> <tr> <td><math>\varnothing &gt; 0.25</math></td> <td>4</td> </tr> <tr> <td rowspan="2">On display</td> <td><math>\varnothing \geq 0.25</math></td> <td>2</td> </tr> <tr> <td><math>L = 3</math></td> <td>1</td> </tr> </tbody> </table>		Size	Quantity	On tray	$\varnothing < 0.2$	Any number	$\varnothing > 0.25$	4	On display	$\varnothing \geq 0.25$	2	$L = 3$	1
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	$L = 3$	1													

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## ***7.3 DEALING WITH CUSTOMER COMPLAINTS***

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### **7.3.1 Non-conforming analysis**

Purchaser should supply Densitron with detailed data of non-conforming sample.  
 After accepting it, Densitron should complete the analysis in two weeks from receiving the sample.  
 If the analysis cannot be completed on time, Densitron must inform the purchaser.

### **7.3.2 Handling of non-conforming displays**

If any non-conforming displays are found during customer acceptance inspection which Densitron is clearly responsible for, return them to Densitron.  
 Both Densitron and customer should analyse the reason and discuss the handling of non-conforming displays when the reason is not clear.  
 Equally, both sides should discuss and come to agreement for issues pertaining to modification of Densitron quality assurance standard.

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## 8 RELIABILITY SPECIFICATION

### 8.1 RELIABILITY TESTS

Test Item	Test Condition	Evaluation and assessment
High Temperature Operation	70°C±2, 120 hours	No abnormalities in function and appearance
Low Temperature Operation	-30°C±2, 120 hours	No abnormalities in function and appearance
High Temperature Storage	80°C±2, 120 hours	No abnormalities in function and appearance
Low Temperature Storage	-40°C±2, 120 hours	No abnormalities in function and appearance
High Temperature & High Humidity Storage(Operation)	60°C±2, 90%RH, 120 hours	No abnormalities in function and appearance
Thermal Shock	24 cycle of -40°C 1 Hour, 85°C 1 Hour. 60 Mins dwell	No abnormalities in function and appearance

- The brightness should be greater than 50% of the initial brightness.
- The samples used for above tests do not include polarizer.
- No moisture condensation is observed during tests.

#### 8.1.1 FAILURE CHECK STANDARD

After the completion of the described reliability test, the samples were left at room temperature for 2 hrs prior to conducting the failure test at 23±5 °C; 55±15% RH

### 8.2 LIFE TIME

Item	Description
1	Function, performance, appearance, etc. shall be free from remarkable deterioration more than 10,000 hours under 70 cd/m <sup>2</sup> brightness and storage conditions of room temperature (25±10 °C), normal humidity (45±20% RH), and in area not exposed to direct sunlight.
2	End of lifetime is specified as 50% of initial brightness.

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## 9 HANDLING PRECAUTIONS

### *Safety*

If the panel breaks, be careful not to get the organic substance in your mouth or in your eyes.  
If the organic substance touches your skin or clothes, wash it off immediately using soap and plenty of water.

### *Mounting and Design*

Place a transparent plate (e.g. acrylic, polycarbonate or glass) on the display surface to protect the display from external pressure. Leave a small gap between the transparent plate and the display surface.

Design the system so that no input signal is given unless the power supply voltage is applied.

### *Caution during OLED cleaning*

Lightly wipe the display surface with a soft cloth soaked with Isopropyl alcohol, Ethyl alcohol or Trichlorotrifluoroethane.

Do not wipe the display surface with dry or hard materials that will damage the polariser surface.

Do not use aromatic solvents (toluene and xylene), or ketonic solvents (ketone and acetone).

### *Caution against static charge*

As the display uses C-MOS LSI drivers, connect any unused input terminal to  $V_{DD}$  or  $V_{SS}$ . Do not input any signals before power is turned on.

Also, ground your body, work/assembly table and assembly equipment to protect against static electricity.

### *Packaging*

Displays use OLED elements, and must be treated as such. Avoid strong shock and drop from a height.

To prevent displays from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity.

### *Caution during operation*

It is indispensable to drive the display within the specified voltage limit since excessive voltage shortens its life.

### *Other Precautions*

When a display module is operated for a long of time with fixed pattern may remain as an after image or slight contrast deviation may occur.

Nonetheless, if the operation is interrupted and left unused for a while, normal state can be restored.

Also, there will be no problem in the reliability of the module.

### *Storage*

Store the display in a dark place where the temperature is  $25^{\circ}\text{C} \pm 10^{\circ}\text{C}$  and the humidity below 50%RH.

Store the display in a clean environment, free from dust, organic solvents and corrosive gases.

Do not crash, shake or jolt the display (including accessories).

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