

OLED DISPLAY MODULE

Product Specification

CUSTOMER	STANDARD	
PRODUCT NUMBER	DD-2864BY-2A	
CUSTOMER APPROVAL		Date

INTERNAL APPROVALS	
Product Mgr	Document Control
Bruno Recaldini	Anthony Perkins
Date: Feb 22. 06	Date: Feb 22. 06

- Approval for Specification only
- Approval for Specification and Sample

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REVISION RECORD

Rev.	Date	Page	Chapt.	Comment	ECR no.
A	18.02.06			Production Release	

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1 MAIN FEATURES

ITEM	CONTENTS	
Display Format	128 x 64 Dots	
Overall Dimensions(W*H*T)	Glass	30 x 20.16 x 1.8 mm
Active Area(W*H)	23.02 x 11.86 mm	
Viewing Area(W*H)	25.02 x 13.86 mm	
Display Mode	Passive Matrix (1.02")	
Display Colour	Area Colour	Blue + Yellow
Driving Method	1 / 64 duty	
Driver IC	SSD1303 (COF)	
Operating temperature	-20°C ~ +70°C	
Storage temperature	-30°C ~ +80°C	

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2 MECHANICAL SPECIFICATION

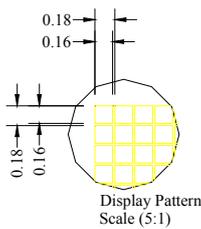
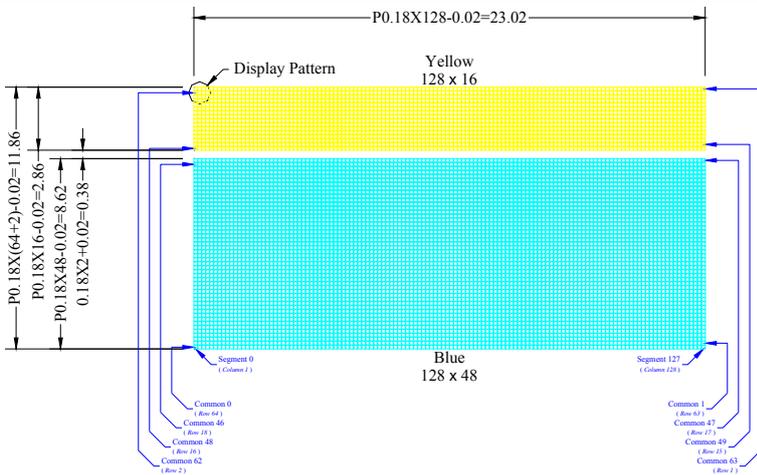
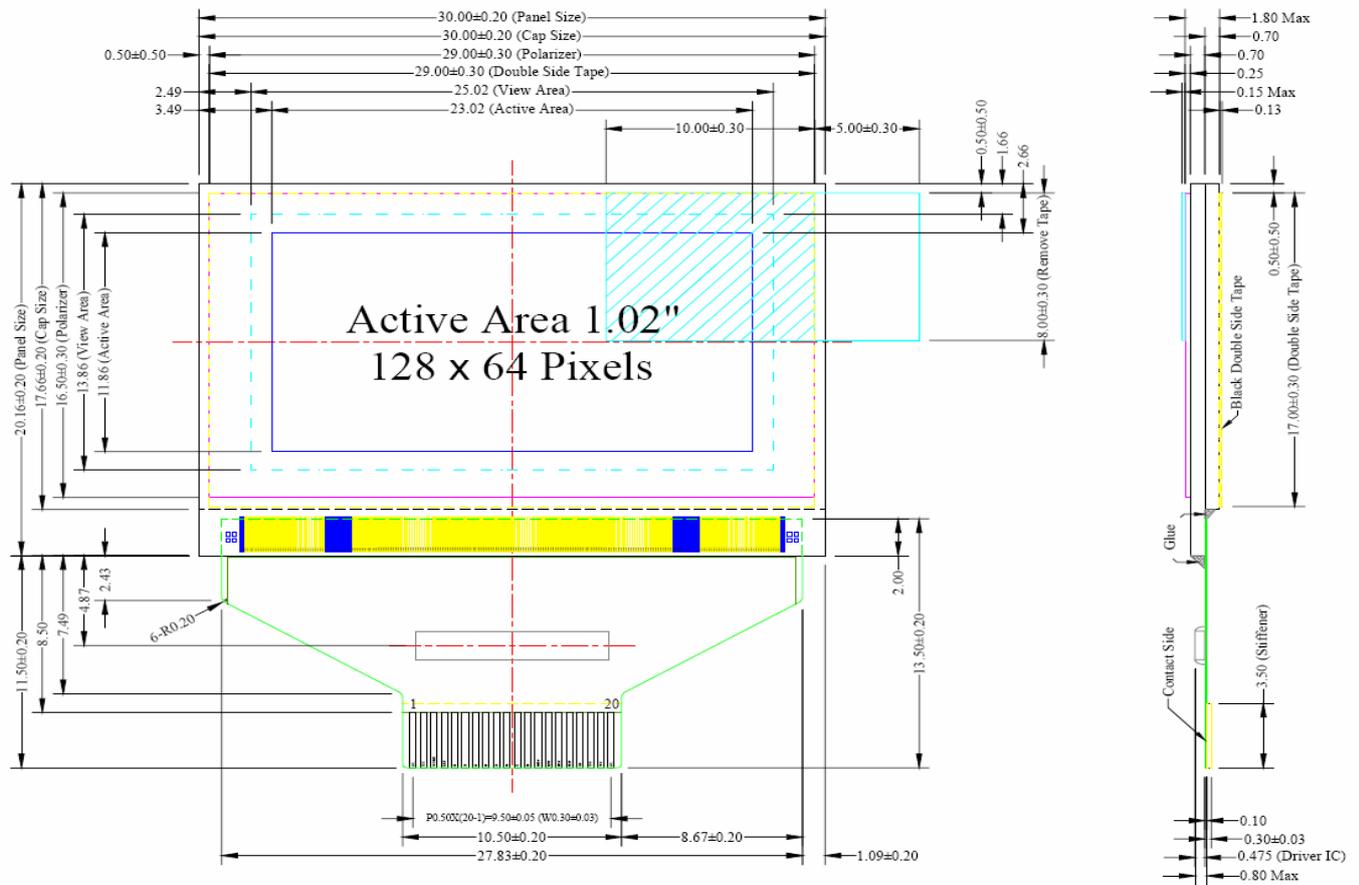
2.1 MECHANICAL CHARACTERISTICS

ITEM	CHARACTERISTIC	UNIT
Display Format	128 x 64	Dots
Overall Dimensions	Glass 30 x 20.16 x 1.8	mm
Dot Size	0.16 x 0.16	mm
Dot Pitch	0.18 x 0.18	mm
Weight	2.0	g
IC Controller/Driver	SSD1303 (COF)	

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2.2 MECHANICAL DRAWINGS



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3 ELECTRICAL SPECIFICATION

3.1 ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Min	Max	Unit	Note
Supply Voltage	V_{DD}	-0.3	4	V	Note 1,2
Driver Supply Voltage	V_{CC}	0	15	V	
Operating Temperature	T_{op}	-20	70	°C	-
Storage Temperature	T_{st}	-30	80	°C	-
Static Electricity	Be sure that you are grounded when handling displays.				

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

Note 2: When this module is used beyond the above absolute maximum ratings, permanent breakage of the module may occur. Also, for normal operations, it’s desirable to use this module under the conditions according to Section 3 “Electrical Characteristics”. If this module is used beyond these conditions, malfunctioning of the module can occur and the reliability of the module may deteriorate.

3.2 ELECTRICAL CHARACTERISTICS

3.2.1 DC CHARACTERISTICS

Characteristics	Symbol	Min	Typ	Max	Unit
Supply Logic	V_{DD}	2.6	2.8	3.5	V
Driver Supply Voltage	V_{CC}	8	9	10	V
High Level Input	V_{IH}	$0.8 \times V_{DD}$	-	V_{DD}	V
Low Level Input	V_{IL}	0	-	$0.2 \times V_{DD}$	V
High Level Output	V_{OH}	$0.9 \times V_{DD}$	-	V_{DD}	V
Low Level Output	V_{OL}	0	-	$0.1 \times V_{DD}$	V
V_{DD} Current	I_{DD}	Note 1	2.0	4.5	mA
V_{CC} Current	I_{CC}	Note 1	6.0	10.4	mA
		Note 2	9.8	14.7	mA

Note ⁽¹⁾: $V_{DD} = 2.8V$, $V_{CC} = 9V$, Frame rate = 100Hz, Contrast settings = 0xFF, 50% display area turned on.

Note ⁽²⁾: $V_{DD} = 2.8V$, $V_{CC} = 9V$, Frame rate = 100Hz, Contrast setting = 0xFF, 100% display area turned on.

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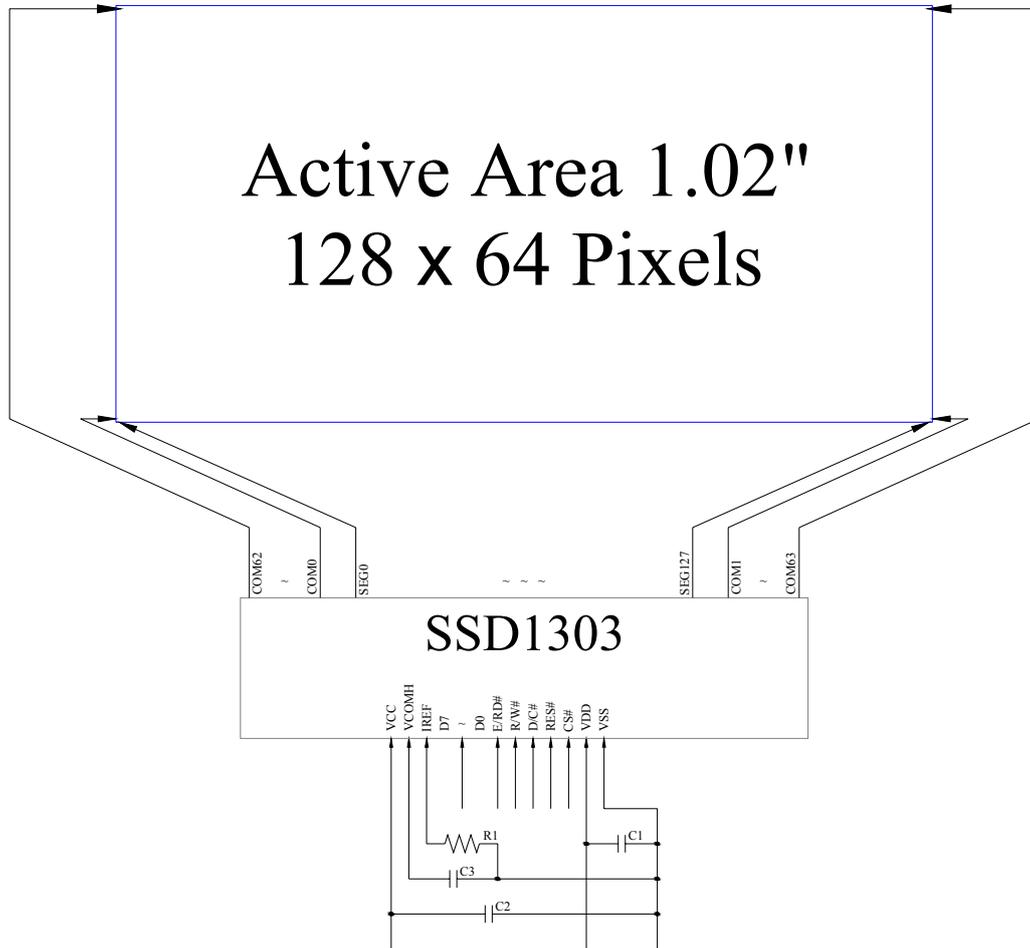
3.3 INTERFACE PIN ASSIGNMENT

No.	Symbol	I/O	Function
1	N.C.	-	Reserved Pin (Supporting Pin). The supporting pin can reduce the influences from stresses on the function pins.
2	VCC	I/O	Power Supply for Panel. 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.
3	VCOMH	I/O	Voltage Output High Level for COM Signal. This pin is the input pin for the voltage output high level for COM signal. A capacitor should be connected between this pin and VSS.
4	IREF	I	Current Reference for Brightness Adjustment. This pin is segment current reference pin. A resistor should be connected between this pin and VSS. Set the current at 10uA.
5~12	D7~D0	I/O	Host Data Input/Output Bus. These pins are 8-bit bi-directional data bus to be connected to the microprocessor's data bus.
13	E/RD#	I	Read/Write Enable or Read. This pin receives the Read (RD#) signal. Data read operation is initiated when this pin is pulled low and CS# is pulled low.
14	R/W#	I	Read/Write Select or Write. This pin is the Write (WR#) input. Data write operation is initiated when this pin is pulled low and CS# is pulled low.
15	D/C#	I	Data/Command Control. This pin is Data/Command control pin. When the pin is pulled high, the input at 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 signal, please refer to the Timing Characteristics Diagrams.
16	RES#	I	Power Reset for Controller and Driver. This pin is reset signal input. When the pin is low, initialization of the chip executed.
17	CS#	I	Chip Select. This pin is the chip select input. The chip is enabled for MCU communication only when CS# is pulled low.
18	VDD	-	Power Supply for Logic Circuit This is a voltage supply pin. It must be connected to external source.
19	VSS	I	Ground This is a 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.
20	N.C.	-	Reserved Pin (Supporting Pin). The supporting pin can reduce the influences from stresses on the function pins.

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3.4 BLOCK DIAGRAM



Pins connected to MCU interface: D7~D0, E/RD#, R/W#, D/C#, RES#, and CS#

C1, C3: 4.7µF

C2: 10µF

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

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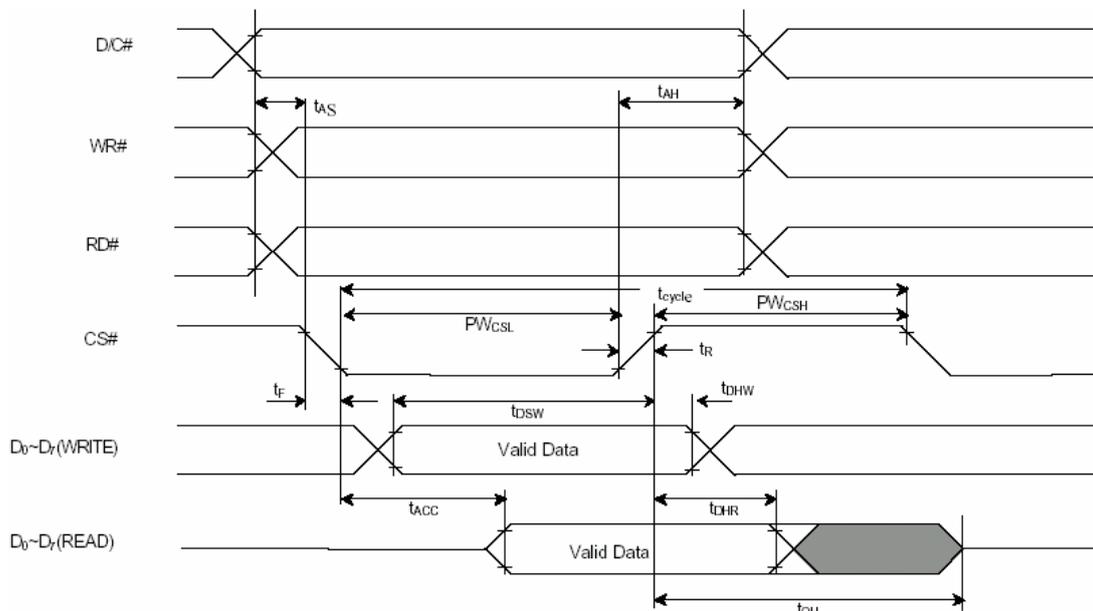
3.5 TIMING CHARACTERISTICS

3.5.1 AC CHARACTERISTICS

8080-Series MPU Parallel Interface Timing Characteristics:

Symbol	Description	Min	Max	Unit
t_{cycle}	Clock Cycle Time	300	-	ns
t_{AS}	Address Setup Time	0	-	ns
t_{AH}	Address Hold Time	0	-	ns
t_{DSW}	Write Data Setup Time	40	-	ns
t_{DHW}	Write Data Hold Time	15	-	ns
t_{DHR}	Read Data Hold Time	20	-	ns
t_{OH}	Output Disable Time	-	70	ns
t_{ACC}	Access Time	-	140	ns
PW_{CSL}	Chip Select Low Pulse Width (Read)	120	-	ns
	Chip Select Low Pulse Width (Write)	60	-	ns
PW_{CSH}	Chip Select High Pulse Width (Read)	60	-	ns
	Chip Select High Pulse Width (Write)	60	-	ns
t_{R}	Rise Time	-	15	ns
t_{F}	Fall Time	-	15	ns

- All the timings should be based on 30% and 70% of $V_{\text{DD}}-\text{GND}$.



4 OPTICAL SPECIFICATION

4.1 OPTICAL & ELECTRICAL CHARACTERISTICS

Characteristics	Symbol	Condition	Min	Typ	Max	Unit
Brightness	L _{br}	With Polarizer	35	60	-	cd/m ²
C.I.E.(Blue)	(X)	Without Polarizer	0.12	0.16	0.20	-
	(Y)		0.22	0.26	0.30	
C.I.E.(Yellow)	(X)	Without Polarizer	0.43	0.47	0.51	-
	(Y)		0.46	0.50	0.54	
Frame Rate			-	100	-	F/sec
Dark Room Contrast	CR	Shown as below	-	>1:100	-	-
View Angle			>160	-	-	degree

Note 3: Optical measurement taken at 1/64 duty, 100Hz Frame Rate, 0xFF Contrast Setting.

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5 FUNCTIONAL SPECIFICATION

5.1 COMMANDS

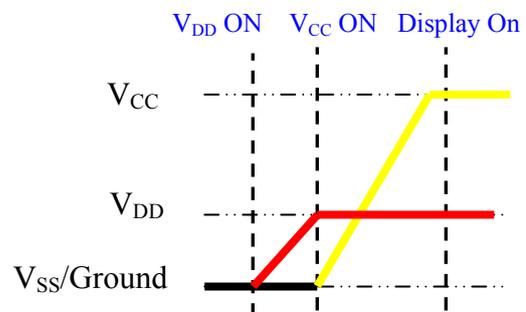
Please refer to the Technical Manual for the SSD1303.

5.1.1 POWER UP/DOWN SEQUENCE

To protect panel and extend the panel life time, 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.

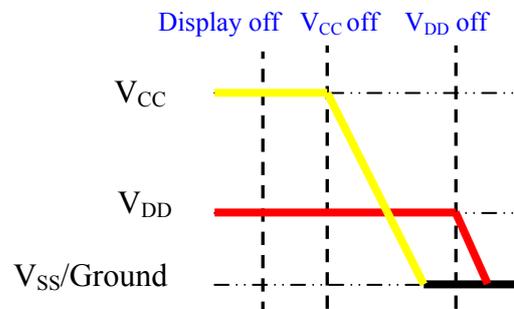
5.1.2 POWER UP SEQUENCE :

1. Power up V_{DD}
2. Send Display off command
3. Clear Screen
4. Power up V_{CC}
5. Delay 100ms
(When V_{DD} is stable)
6. Send Display on command



5.1.3 POWER DOWN SEQUENCE :

1. Send Display off command
2. Power down V_{CC}
3. Delay 100ms
(when V_{CC} is reach 0 and panel is completely discharges)
4. Power down V_{DD}



5.1.4 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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5.1.5 ACTUAL APPLICATION EXAMPLE

Command usage and explanation of an actual example

< Initialization Setting >

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

Set Display Offset
(11010011 with **XXXXXX)
* XXXXXX = 64 – Dummy Line from Common 0

Set Multiplex Ratio
(10101000 with **XXXXXX)

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

Set Area Colour Mode & Low Power Display Mode
(11011000 with 00XX0X0X)
00000101 => 0x05 (Mono & Low Power Save Mode)

Set Display Start Line
(01XXXXXX)

Set Segment Re-map
(1010000X)

Set COM Output Scan Direction
(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 Setting >

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.

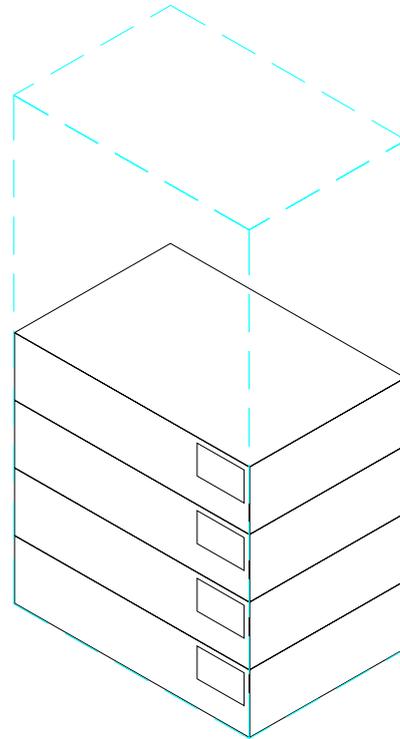
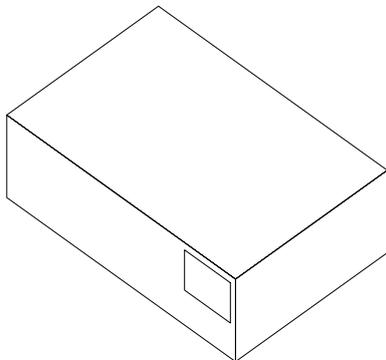
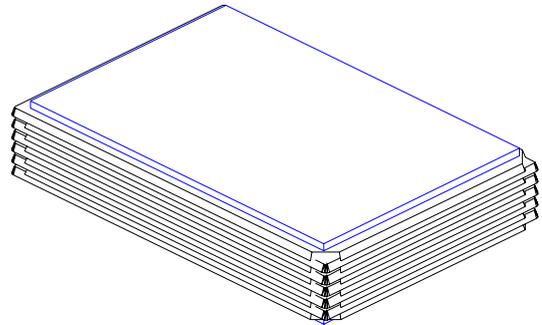
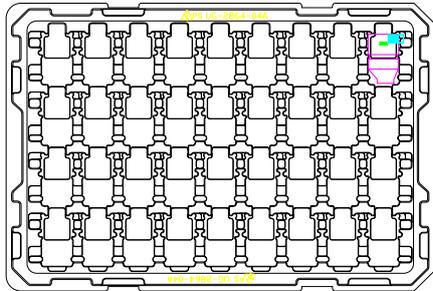
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6 PACKAGING AND LABELLING SPECIFICATION

6.1 PACKAGING

Each display module will be placed on the antistatic tray and up to 600 units at the maximum will be packaged into the inner carton box.



The Master Carton Box is the unit package to deliver to each customer. The Master Carton Box contains 4 inner carton boxes.

6.2 LABELLING & MARKING

DENSITRON DD-2864BY-2A TW YY MM

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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

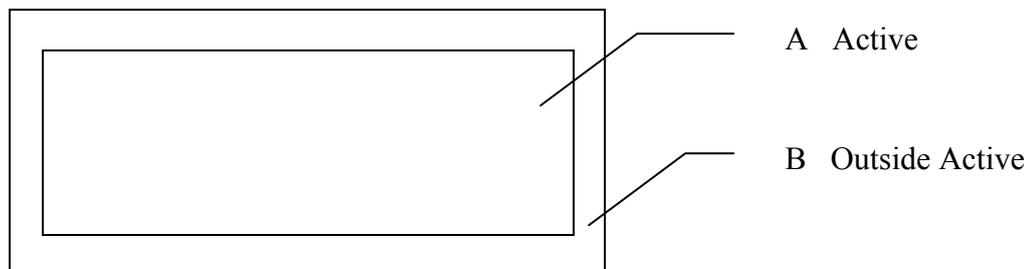
7.2.1 DELIVERY INSPECTION STANDARDS

MIL-STD-105E, general inspection level II, single sampling level;
IPC-AA610 rev. C, class 2 electronic assemblies standard

The quality assurance levels are shown below:

Class	AQL (%)
Critical defect	0.5%
Major defect	1.0%
Minor defect	1.5%
TOTAL	2.0%

7.2.2 Zone definition



7.2.3 Visual inspection

Test and measurement to be conducted under following conditions :

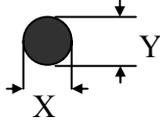
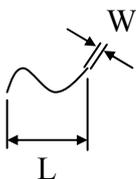
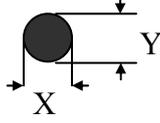
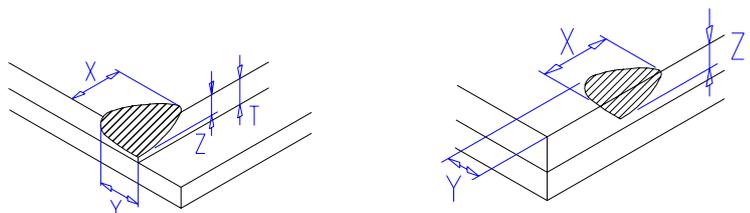
Temperature:	23±5°C
Humidity:	55±15%RH
Fluorescent lamp:	30 W
Distance between the Panel & Eyes of the Inspector:	≧30cm
Distance between the Panel & the lamp:	≧50cm

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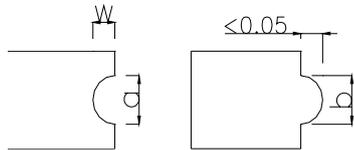
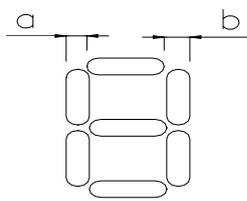
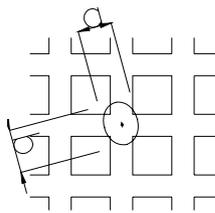
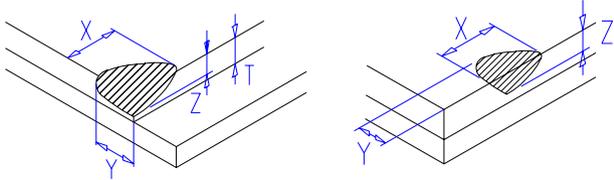
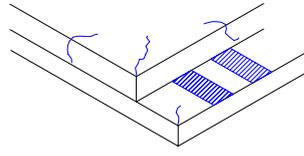
7.3 Standard of appearance inspection

Units: mm

No	Item	Criteria																																				
1	Black spot, white spot, dust	<p>Round type: as per following drawing $\varnothing = (X+Y)/2$</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>$\varnothing < 0.1$</td> <td>Any number</td> <td rowspan="4">Any number</td> </tr> <tr> <td>$0.1 < \varnothing < 0.2$</td> <td>3</td> </tr> <tr> <td>$0.2 < \varnothing < 0.25$</td> <td>1</td> </tr> <tr> <td>$0.25 < \varnothing$</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>$W \leq 0.02$</td> <td>Any number</td> <td rowspan="3">Any number</td> </tr> <tr> <td>$L \leq 3.0$</td> <td>$0.02 < W \leq 0.03$</td> <td rowspan="2">2</td> </tr> <tr> <td>$L \leq 2.5$</td> <td>$0.03 < W \leq 0.05$</td> </tr> <tr> <td>--</td> <td>$0.05 < W$</td> <td>As round type</td> <td></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	--	$W \leq 0.02$	Any number	Any number	$L \leq 3.0$	$0.02 < W \leq 0.03$	2	$L \leq 2.5$	$0.03 < W \leq 0.05$	--	$0.05 < W$	As round type	
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--	$W \leq 0.02$	Any number	Any number																																			
$L \leq 3.0$	$0.02 < W \leq 0.03$	2																																				
$L \leq 2.5$	$0.03 < W \leq 0.05$																																					
--	$0.05 < W$	As round type																																				
2	Polarizer scratch	<p>Scratch on protective film is permitted Scratch on polarizer: same as No. 1</p>																																				
3	Polarizer bubble	<p>$\varnothing = (X+Y)/2$</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>$\varnothing < 0.1$</td> <td>Any number</td> <td rowspan="4">Any number</td> </tr> <tr> <td>$0.1 < \varnothing < 0.2$</td> <td>3</td> </tr> <tr> <td>$0.2 < \varnothing < 0.25$</td> <td>1</td> </tr> <tr> <td>$0.25 < \varnothing$</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																					
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$0.25 < \varnothing$	0																																					
4	Panel Chipping	<p style="text-align: center;">$X \leq 1/6$ Panel Length $Y \leq 1$ $Z \leq T$</p> 																																				

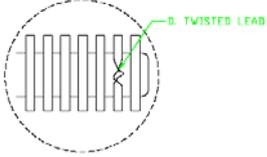
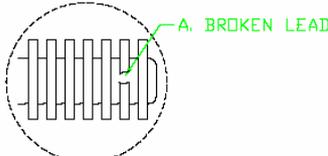
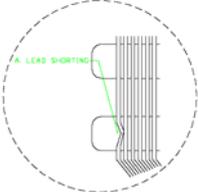
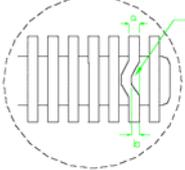
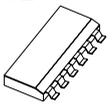
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Class	Item	Criteria																												
Minor	Segment deformation	<p>1b. Pin hole on dot matrix display</p>  <table border="1" data-bbox="1002 392 1404 571"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th></th> </tr> </thead> <tbody> <tr> <td>$a, b < 0.1$</td> <td>Any number</td> </tr> <tr> <td>$(a+b)/2 < 0.1$</td> <td>Any number</td> </tr> <tr> <td>$0.5 < \varnothing < 1.0$</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="1002 779 1404 884"> <thead> <tr> <th colspan="2">Acceptable</th> </tr> <tr> <th>$a \geq b$</th> <th>$a/b \leq 4/3$</th> </tr> <tr> <th>$a < b$</th> <th>$a/b > 4/3$</th> </tr> </thead> </table> <p>3. Alignment layer defect $\varnothing = (a+b)/2$</p>  <table border="1" data-bbox="1002 952 1404 1176"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th></th> </tr> </thead> <tbody> <tr> <td>$\varnothing \leq 0.4$</td> <td>Any number</td> </tr> <tr> <td>$0.4 < \varnothing \leq 1.0$</td> <td>5</td> </tr> <tr> <td>$1.0 < \varnothing \leq 1.5$</td> <td>3</td> </tr> <tr> <td>$1.5 < \varnothing \leq 2.0$</td> <td>2</td> </tr> </tbody> </table> <p>Total acceptable quantity: 7</p>	Acceptable quantity		Size		$a, b < 0.1$	Any number	$(a+b)/2 < 0.1$	Any number	$0.5 < \varnothing < 1.0$	3	Acceptable		$a \geq b$	$a/b \leq 4/3$	$a < b$	$a/b > 4/3$	Acceptable quantity		Size		$\varnothing \leq 0.4$	Any number	$0.4 < \varnothing \leq 1.0$	5	$1.0 < \varnothing \leq 1.5$	3	$1.5 < \varnothing \leq 2.0$	2
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Minor	Panel Chipping	<p>$X \leq 1/6$ Panel length $Y \leq 1$ $Z \leq T$</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		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		Size		Quantity	
			On tray	$\varnothing < 0.2$	Any number	
				$\varnothing > 0.25$	4	
			On display	$\varnothing \geq 0.25$	2	
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7.4 DEALING WITH CUSTOMER COMPLAINTS

7.4.1 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.

7.4.2 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	-20°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	-30°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	10 cycle of -30°C 30 min R.T. 5 min, 80°C 30 min	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 ordinary operating 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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