

OLED DISPLAY MODULE

Product Specification

CUSTOMER	Standard	
PRODUCT NUMBER	DD-12833YW-2A	
CUSTOMER APPROVAL		Date

INTERNAL APPROVALS		
Product Mgr	Doc. Control	Electr. Eng
Elijah Ebo	Anthony Perkins	Bazile Peter
Date: 28/01/2008	Date: 28/01/2008	Date: 28/01/2008

- Approval for Specification only
- Approval for Specification and Sample

Sample no.:

Date:

ISIR no.:

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REVISION RECORD

Rev.	Date	Page	Chapt.	Comment	ECR no.
A	28 Jan 08			First issue	

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1 MAIN FEATURES

ITEM	CONTENTS
Display Format	128 x 33 dots
Colour	Yellow Monochrome
Overall Dimensions	62.30 x 22.60 x 2.00 mm
Viewing Area	57.02 x 15.18 mm
Screen Size	2.23"
Mode	Passive Matrix
Duty ratio	1/33
Driver IC	SSD1303
Operating temperature	-30~ 85°C
Storage temperature	-40~ 90°C

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2 MECHANICAL SPECIFICATION

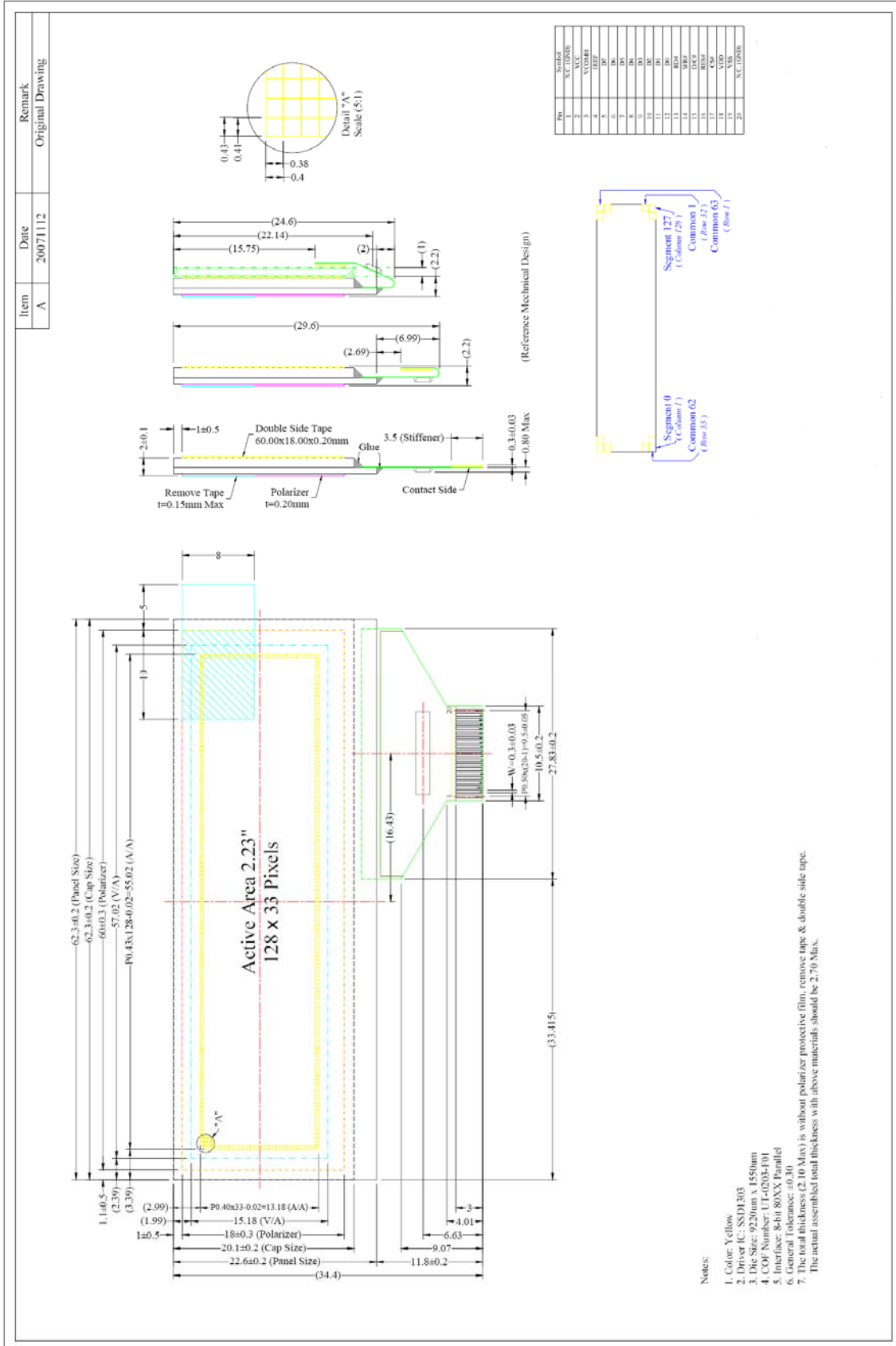
2.1 MECHANICAL CHARACTERISTICS

ITEM	CHARACTERISTIC	UNIT
Display Format	128 x 33	dots
Overall Dimensions	62.30 x 22.60 x 2.00	mm
Viewing Area	57.02 x 15.18	mm
Active Area	55.02 x 13.18	mm
Dot Size	0.41 x 0.38	mm
Dot Pitch	0.43 x 0.40	mm
Weight	6.15	g
IC Controller/Driver	SSD1303	

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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
Power Supply Voltage	V _{DD}	-0.3	4.0	V	1, 2
OLED Power Supply	V _{CC}	0	15	V	1, 2
Operating Temperature	T _{OP}	-30	85	°C	
Storage Temperature	T _{STG}	-40	90	°C	
Static Electricity	Be sure that you are grounded when handling displays.				

Note 1: All the above voltages are on the basis of “VSS = 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 is desirable to use this module under the conditions according to Section 3.2. “Electrical Characteristics” and 4.1 “Optical 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

VSS = 0 V, Ta = 25 °C

Item	Symbol	Condition	Min	Typ	Max	Unit
Power Supply for Logic	V _{DD}	Ta = 25 °C	2.4	2.8	3.5	V
Input Voltage	V _{IL}	I _{out} = 100μA, 3.3MHz	0	-	0.2×V _{DD}	V
	V _{IH}	I _{out} = 100μA, 3.3MHz	0.8×V _{DD}	-	V _{DD}	V
Driving Supply Voltage	V _{CC}	Ta = 25 °C	11	12	13	V
Output Voltage	V _{OL}	I _{out} = 100μA, 3.3MHz	0	-	0.1×V _{DD}	V
	V _{OH}	I _{out} = 100μA, 3.3MHz	0.9×V _{DD}	-	V _{DD}	
V _{DD} Current	I _{DD}	Note 1		180	300	μA
		Note 2		180	300	μA
V _{CC} Current	I _{CC}	Note 1		11.5	14.4	mA
		Note 2		16.5	20.7	mA
Sleep Mode Current for V _{DD}	I _{DD, SLEEP}		-	1	5	μA
Sleep Mode Current for V _{CC}	I _{CC, SLEEP}		-	1	5	μA

Note 1: V_{DD} = 2.8V, V_{CC} = 12V, 50% Display Area Turn on.

Note 2: V_{DD} = 2.8V, V_{CC} = 12V, 100% Display Area Turn on.

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3.3 INTERFACE PIN ASSIGNMENT

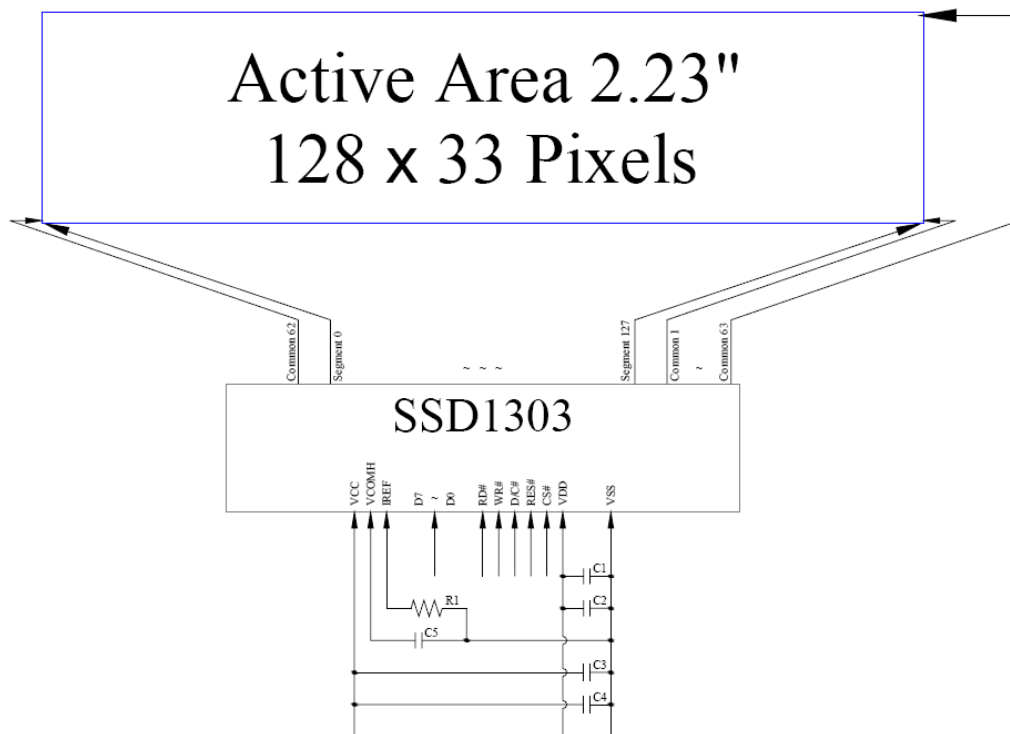
No.	Symbol	I/O	Function
1	N.C. (GND)	-	<i>Reserved Pin (Supporting Pin)</i> The supporting pins can reduce the influences from stresses on the function pins. These pins must be connected to external ground.
2	VCC	P	<i>Power Supply for OEL Panel</i> This is the most positive voltage supply pin of the chip. It must be supplied externally.
3	VCOMH	O	<i>Voltage Output High Level for COM Signal</i> 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.
4	IREF	O	<i>Current Reference for Brightness Adjustment</i> This pin is segment current reference pin. A resistor should be connected between this pin and VSS. Set the current lower than 10 μ A.
5~12	D7~D0	I/O	<i>Host Data Input/Output Bus</i> These pins are 8-bit bi-directional data bus to be connected to the microprocessor's data bus.
13	RD#	I	<i>Read/Write Enable or Read</i> When connecting to an 80XX-microprocessor, this pin receives the Read signal. Data read operation is initiated when this pin is pulled low and CS# is pulled low.
14	WR#	I	<i>Read/Write or Write Select</i> When 80XX interface mode is selected, this pin will be the Write input. Data write operation is initiated when this pin is pulled low and the CS# is pulled low.
15	D/C#	I	<i>Data/Command Control</i> 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 signals, please refer to the timing Characteristics Diagrams.
16	RES#	I	<i>Power Reset for Controller and Driver</i> This pin is reset signal input. When the pin is low, initialization of the chip is executed.
17	CS#	I	<i>Chip Select</i> This pin is the chip select input. The chip is enabled for MCU communication only when CS# is pulled low.
18	VDD	P	<i>Power Supply for Logic Circuit</i> This is a voltage supply pin. It must be connected to external source.
19	VSS	P	<i>Ground of OEL system</i> This is the ground pin. It also acts as the reference for the logic pins, the OEL driving voltages, and the analog circuits. It must be connected to external ground.
20	N.C. (GND)	-	<i>Reserved Pin (Supporting Pin)</i> The supporting pins can reduce the influences from stresses on the function pins. These pins must be connected to external ground.

Connector Type: 20 way ZIF
Omron: XF2J-2024-11A

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3.4 BLOCK DIAGRAM



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

C1, C3: 0.1 μ F

C2: 4.7 μ F

C4: 10 μ F

C5: 4.7 μ F/25V Tantalum Capacitor

R1: 910k Ω , $R1 = (\text{Voltage at IREF} - VSS)/IREF$

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3.5 TIMING CHARACTERISTICS

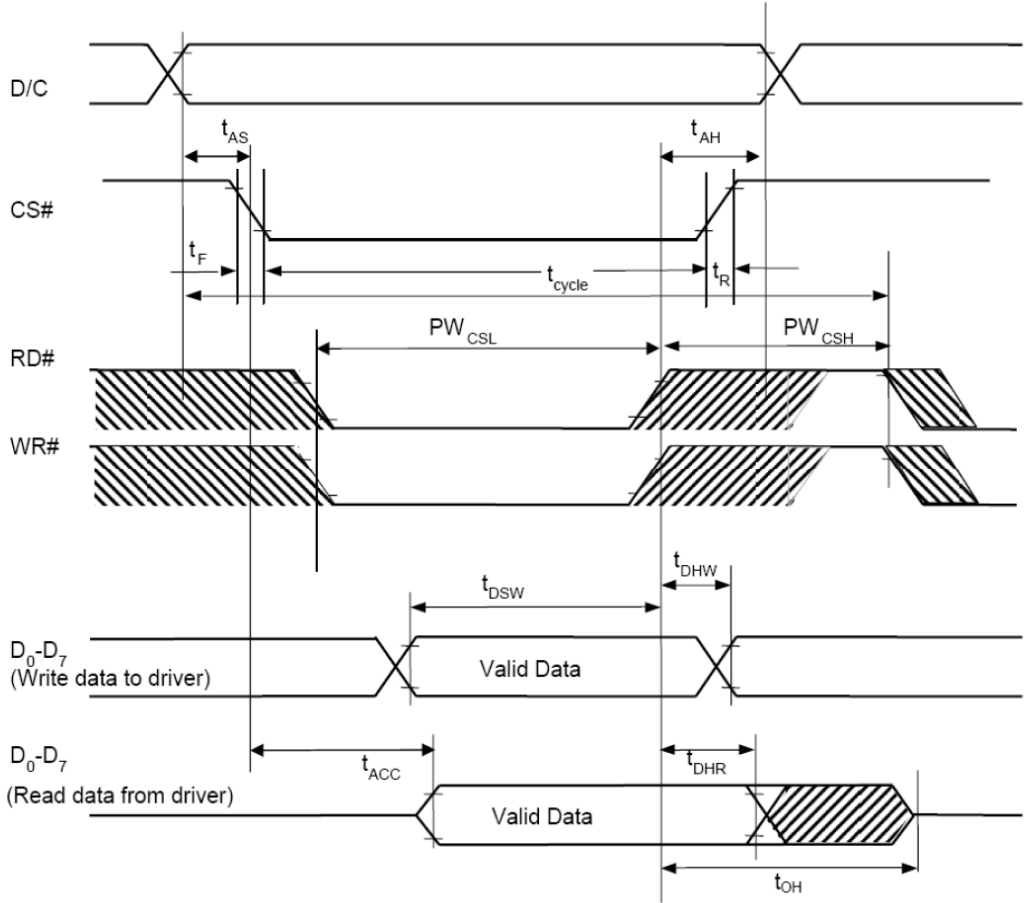
3.5.1 68XX-Series MPU Parallel Interface Timing Characteristics

Characteristics	Symbol	Min	Typ	Max	Unit
Clock Cycle Time	t _{cycle}	300	-	-	ns
Address Setup Time	t _{AS}	0	-	-	ns
Address Hold Time	t _{AH}	0	-	-	ns
Write Data Setup Time	t _{DSW}	40	-	-	ns
Write Data Hold Time	t _{DHW}	7	-	-	ns
Read Data Hold Time	t _{DHR}	20	-	-	ns
Output Disable Time	t _{OH}	-	-	70	ns
Access Time	t _{ACC}	-	-	140	ns
Chip Select Low Pulse Width (Read)	PW _{CSL}	150	-	-	ns
Chip Select Low Pulse Width (Write)		60	-	-	ns
Chip Select High Pulse Width (Read)	PW _{CSH}	60	-	-	ns
Chip Select High Pulse Width (Write)		60			
Rise Time	t _R	-	-	40	ns
Fall Time	t _F	-	-	40	ns

* (V_{DD} – V_{SS} = 2.4V to 3.5V, T_a = 25°C)

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4 OPTICAL SPECIFICATION

4.1 OPTICAL CHARACTERISTICS

Ta = 25 °C

Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Brightness	L _{BR}	With Polarizer	60	80	-	cd/m ²	Note1
C.I.E. (Yellow)	(x)	Without Polarizer	0.44	0.48	0.52		Note1
	(y)		0.46	0.50	0.54		Note1
Contrast Ratio	CR	Ta = 25 °C, dark room	-	>2000:1	-	-	Note1
Viewing Angle			>160	-	-	degree	Note1

Note1: Optical measurement taken at V_{DD} = 2.8V, V_{CC} = 12V.
Software configuration follows Section 5.4 Initialization

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5 APPLICATION NOTES

5.1 COMMANDS

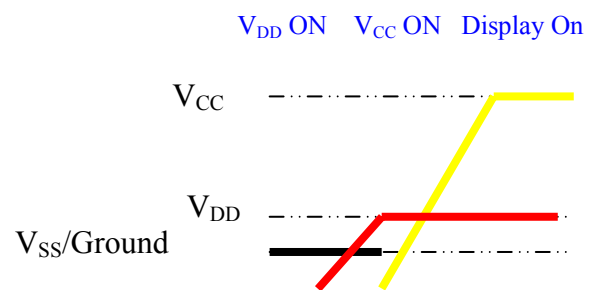
Refer to the Technical Manual for the SSD1303

5.2 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.

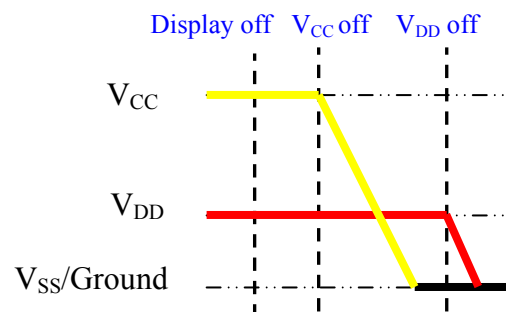
5.2.1 POWER UP SEQUENCE

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



5.2.2 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}



5.3 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. DC/DC enabled

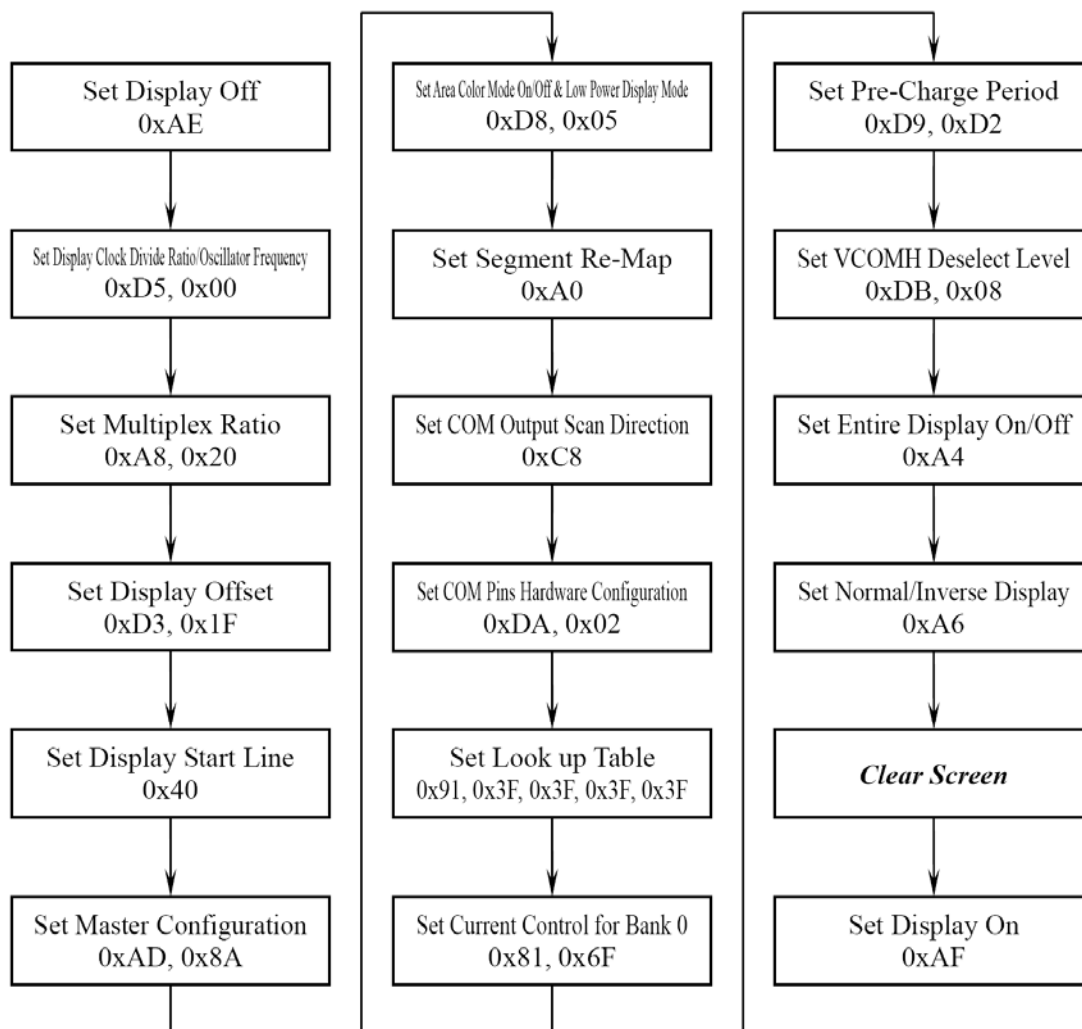
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5.4 APPLICATION EXAMPLE

Command usage and explanation of an actual example

<Initialization Setting>

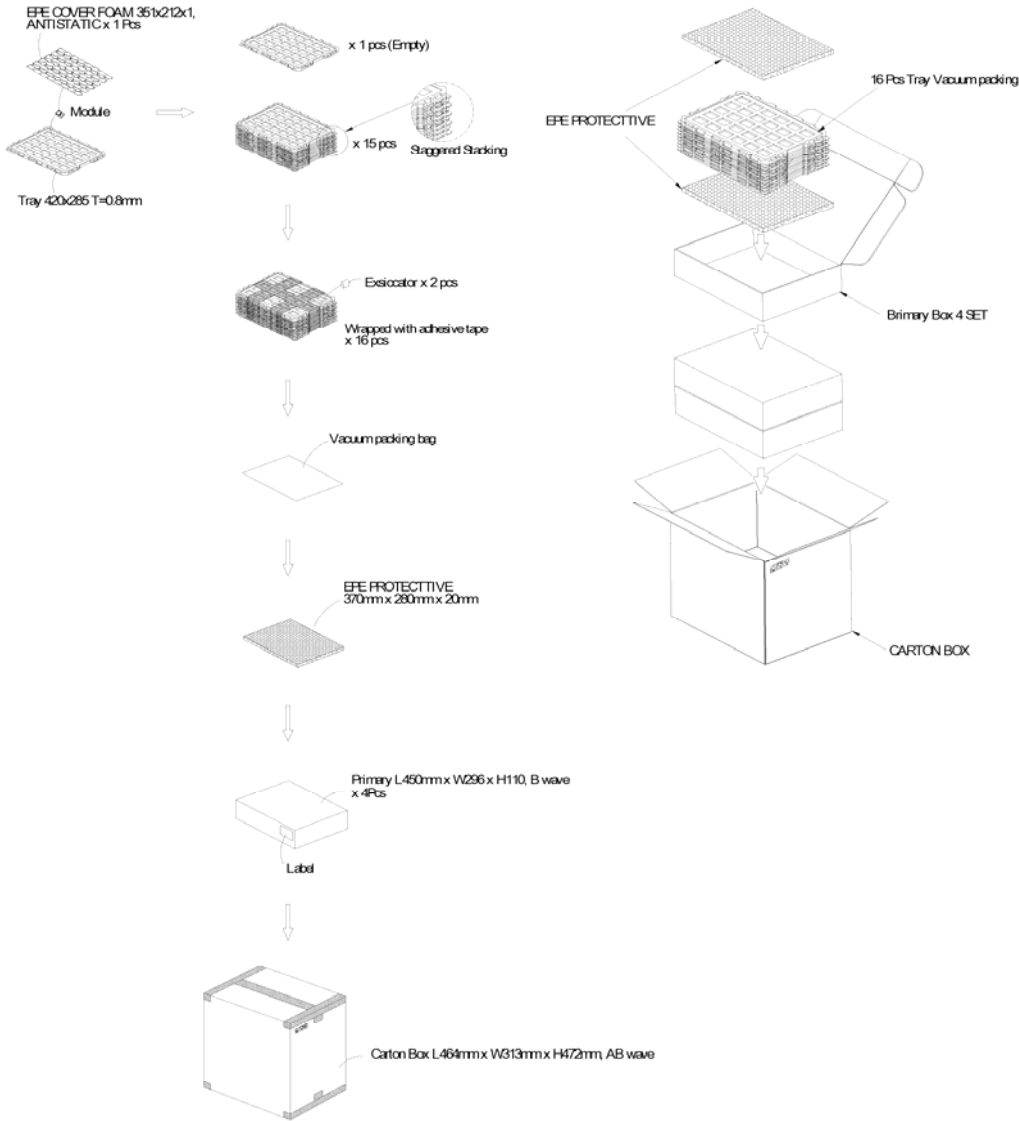


If the noise is accidentally occurred at the displaying window during the operation, please reset the display in order to recover the display function.

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6 PACKAGING AND LABELLING SPECIFICATION



6.1 LABELLING & MARKING

<p>DENSITRON</p> <p>TW YYMM</p>

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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

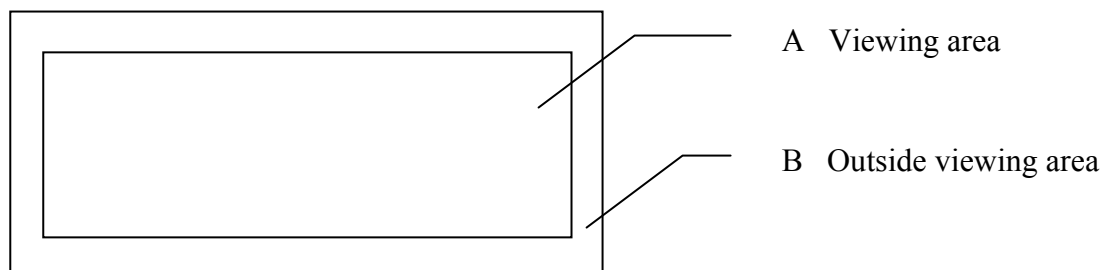
7.2.1 Delivery inspection standards

- 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:

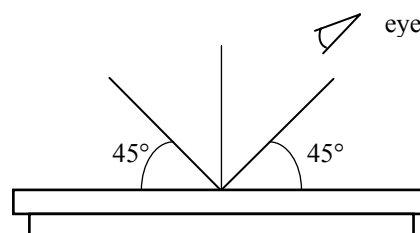
Class	AQL (%)
Critical defect	0.5%
Major defect	1.0%
Minor defect	1.5%
TOTAL	2.0%

7.2.2 Zone definition



7.2.3 Visual inspection

- Inspect under 30W fluorescent lamp leaving 50 cm between the module and the lamp and 30 cm between the module and the eye (measuring position).
- Appearance is inspected at the best contrast voltage (best contrast is adjusted considering clearness and crosstalk on screen).
- Inspect the module at 45° right and left, top and bottom.
- Use the optimum viewing angle during the contrast inspection.

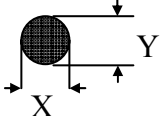
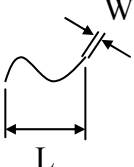
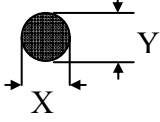


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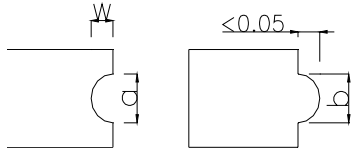
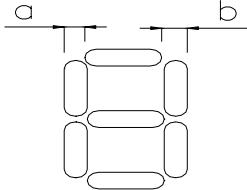
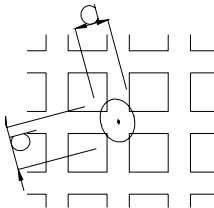
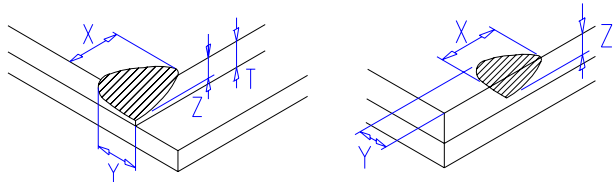
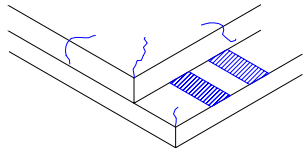
7.2.3.1 Standard of appearance inspection

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	LCD Display	Missing lines or wrong patterns on LCD display are not allowed																																	
Minor	Black spot, white spot, dust	<p>Round type: as per following drawing $\varnothing = (X+Y)/2$</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <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: auto; margin-right: auto;"> <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>$W \leq 0.05$</td> <td>Any number</td> <td rowspan="3">Any number</td> </tr> <tr> <td>$L \leq 2.0$</td> <td>$W \leq 0.1$</td> <td>3</td> </tr> <tr> <td>$L > 2.0$</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	$L \leq 2.0$	$W \leq 0.1$	3	$L > 2.0$		0
Acceptable quantity																																			
Size	Zone A	Zone B																																	
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$L \leq 2.0$	$W \leq 0.1$	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>$\varnothing = (X+Y)/2$</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <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>$\varnothing < 0.5$</td> <td>Any number</td> <td rowspan="2">Any number</td> </tr> <tr> <td>$\varnothing > 0.5$</td> <td>0</td> </tr> </tbody> </table> <p style="text-align: center;">Total acceptable quantity: 3</p>	Acceptable quantity			Size	Zone A	Zone B	$\varnothing < 0.5$	Any number	Any number	$\varnothing > 0.5$	0																						
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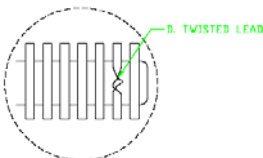
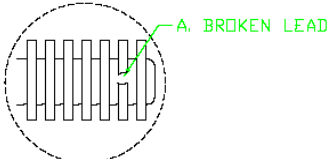
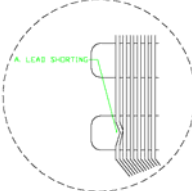
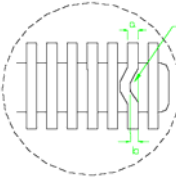
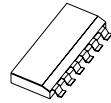
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Class	Item	Criteria																												
Minor	Segment deformation	<p>1b. Pin hole on dot matrix display</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th></th> </tr> </thead> <tbody> <tr> <td>$a, b < 0.1$</td> <td>Any number</td> </tr> <tr> <td>$(a+b)/2 \le 0.1$</td> <td>Any number</td> </tr> <tr> <td>$0.5 < \varnothing < 1.0$</td> <td>3</td> </tr> </tbody> </table> <p style="text-align: right;">Total acceptable quantity: 7</p> <p>2. Segments / dots with different width</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">Acceptable</th> </tr> </thead> <tbody> <tr> <td>$a \geq b$</td> <td>$a/b \leq 4/3$</td> </tr> <tr> <td>$a < b$</td> <td>$a/b > 4/3$</td> </tr> </tbody> </table> <p>3. Alignment layer defect $\varnothing = (a+b)/2$</p>  <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2">Acceptable quantity</th> </tr> <tr> <th>Size</th> <th></th> </tr> </thead> <tbody> <tr> <td>$\varnothing \le 0.4$</td> <td>Any number</td> </tr> <tr> <td>$0.4 < \varnothing \le 1.0$</td> <td>5</td> </tr> <tr> <td>$1.0 < \varnothing \le 1.5$</td> <td>3</td> </tr> <tr> <td>$1.5 < \varnothing \le 2.0$</td> <td>2</td> </tr> </tbody> </table> <p style="text-align: right;">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		$a \geq b$	$a/b \leq 4/3$	$a < b$	$a/b > 4/3$	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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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 affects 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	<table border="1"> <thead> <tr> <th></th> <th>Size</th> <th>Quantity</th> </tr> </thead> <tbody> <tr> <td rowspan="2">On tray</td> <td>$\varnothing < 0.2$</td> <td>Any number</td> </tr> <tr> <td>$\varnothing > 0.25$</td> <td>4</td> </tr> <tr> <td rowspan="2">On display</td> <td>$\varnothing \geq 0.25$</td> <td>2</td> </tr> <tr> <td>L = 3</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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7.3 DEALING WITH CUSTOMER COMPLAINTS

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	85°C, 500 hrs	No abnormalities in function* and appearance Brightness > ½ initial value
Low Temperature Operation	-30°C, 500 hrs	
High Temperature Storage	90°C, 500 hrs	
Low Temperature Storage	-40°C, 500 hrs	
High Temperature & High Humidity Storage	60°C, 90% RH, 500 hrs	
Thermal Shock Storage	-40°C ↔ 85°C, 100 cycles 30 mins dwell	

- 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 within 10,000 hours under ordinary operating and storage conditions of room temperature (25±10 °C), normal humidity, 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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