OLED DISPLAY MODULE

Product Specification

CUSTOMER	**STANDARD**	
PRODUCT NUMBER	**DD-2832BE-1A**	
CUSTOMER APPROVAL		**Date**

INTERNAL APPROVALS		
Product Mgr	Mech. Eng	Electr. Eng
Bruno Recaldini	Pat Chang	**Eric**
Date: Aug.04.'05	Date: Aug.04.05'	Date: Aug.04.05'

☐ **Approval for Specification only**

☐ **Approval for Specification and Sample**

TABLE OF CONTENTS

REVISION RECORD

Rev.	Date	Page	Chapt.	Comment	ECR no.
A	Apr-11-05’			Production Release	
B	Aug-04-05’	7 14	3.2.1 4.1	Added Power Consumption Added Frame Rate	ECR_DE035

1 MAIN FEATURES

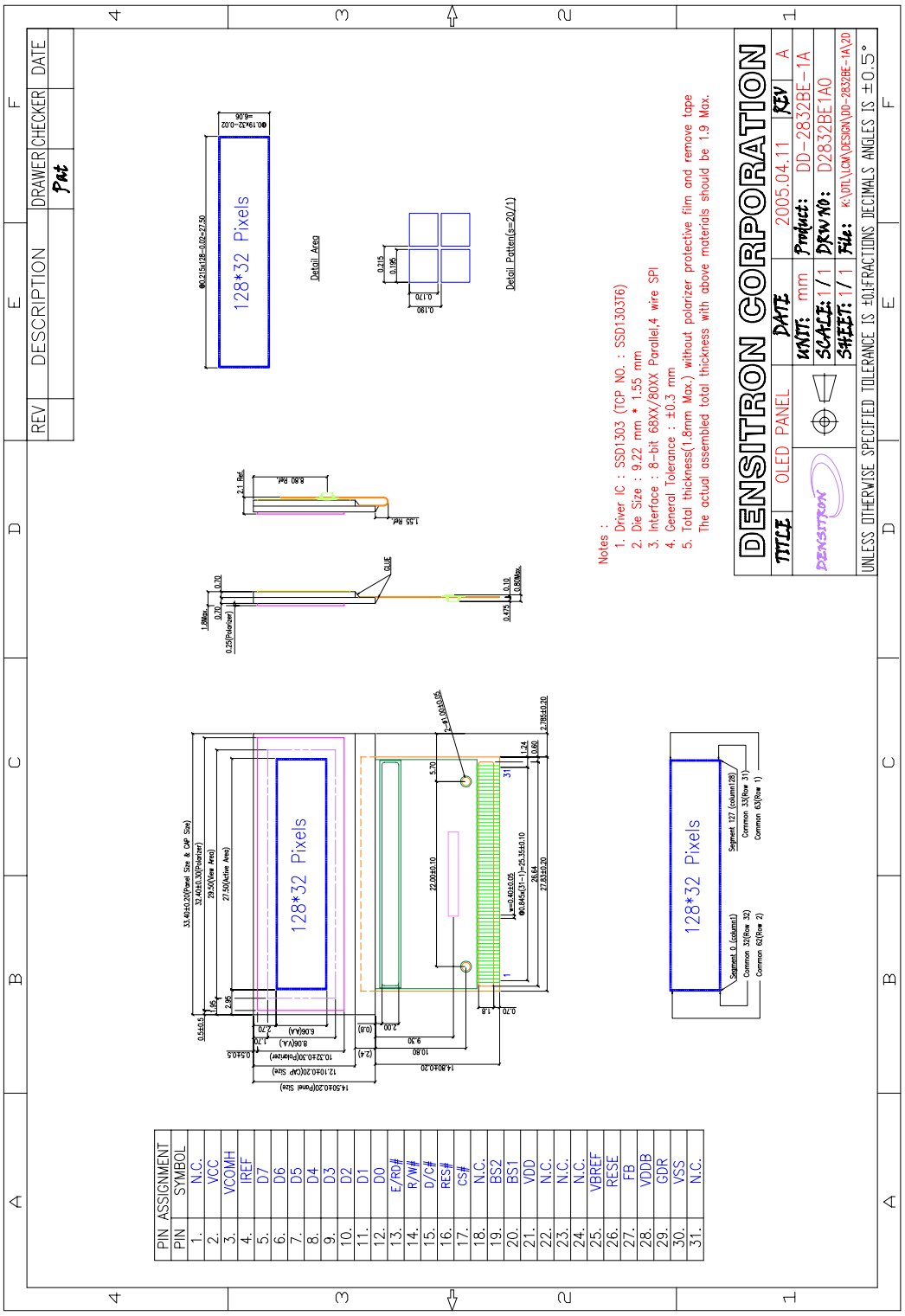
ITEM	CONTENTS
Display Format	128 x 32 Dots
Overall Dimensions(W*H*T)	33.4 x 14.5 x 1.8 mm
Active Area(W*H)	27.50 x 6.06 mm
Viewing Area(W*H)	29.50 x 8.06 mm
Display Mode	Passive Matrix (1.11")
Display Colour	Blue
Driving Method	1 / 32 duty
Driver IC	SSD1303T6 (TCP)
Operating temperature	-20℃ ~ +70℃
Storage temperature	-30℃ ~ +80℃

2 MECHANICAL SPECIFICATION

2.1 MECHANICAL CHARACTERISTICS

ITEM	CHARACTERISTIC	UNIT
Display Format	128 x 32	Dots
Overall Dimensions	33.4 x 14.5 x 1.8	mm
Viewing Area(W*H)	29.50 x 8.06	mm
Active Area(W*H)	27.50 x 6.06	mm
Dot Size	0.195 x 0.17	mm
Dot Pitch	0.215 x 0.19	mm
Weight	2.0	g
IC Controller/Driver	SSD1303 (TCP No. : SSD1303T6)	

2.2 MECHANICAL DRAWING



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	Vcc	0	15	V	
Operating Temperature	Top	-20	70	°C	-
Storage Temperature	Tst	-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}	7.0	7.5	8.0	V
High Level Input	V_{IH}	$0.8xV_{DD}$	-	V_{DD}	V
Low Level Input	V_{IL}	0	-	$0.2xV_{DD}$	V
High Level Output	V_{OH}	$0.9xV_{DD}$	-	V_{DD}	V
Low Level Output	V_{OL}	0	-	$0.1xV_{DD}$	V
Power Consumption	P	-	$52^{(1)}$ $95^{(2)}$	-	mW

Note $^{(1)}$: 50% pixels ON

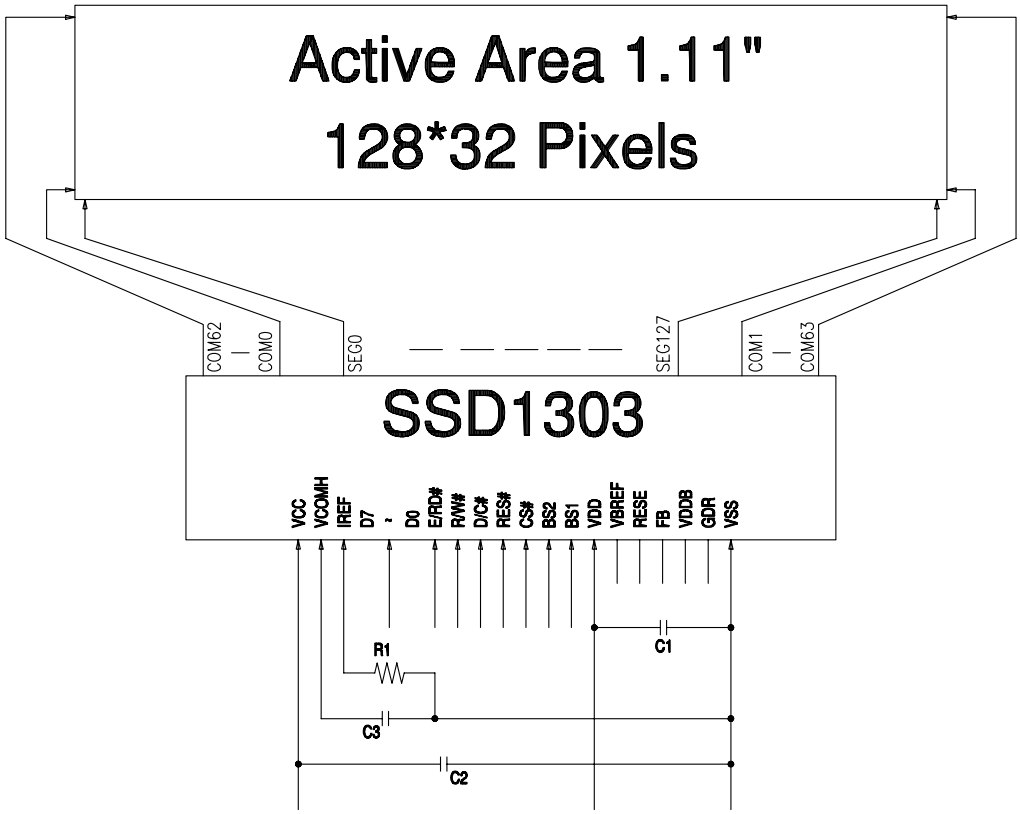
Note $^{(2)}$: 100% pixels ON

3.3 INTERFACE PIN ASSIGNMENT

No.	Symbol	I/O	Function
1	N.C.	-	Reserved Pin (Supporting Pin). The supporting pins 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	D7	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. When serial mode is selected, D1 will be the serial data input SDIN and D0 will be the serial clock input SCLK.
6	D6	I/O	
7	D5	I/O	
8	D4	I/O	
9	D3	I/O	
10	D2	I/O	
11	D1	I/O	
12	D0	I/O	
13	E/RD#	I	Read/Write Enable or Read. This pin is MCU interface input. When interface 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 an 8080-microprecessor, 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 MCU interface input. When interface 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 CS# ispulled 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.

<table>
<tr><td>16</td><td>RES#</td><td>I</td><td>Power Reset for Controller and Driver.
This pin is reset signal input. When the pin is low, initialization of the chip executed.</td></tr>
<tr><td>17</td><td>CS#</td><td>I</td><td>Chip Select.
This pin is the chip select input. The chip is enabled for MCU communication only when CS# is pulled low.</td></tr>
<tr><td>18</td><td>N.C.</td><td>-</td><td>Reserved Pin.
The N.C. pins between function pins are reserved for compatible and flexible design.</td></tr>
<tr><td>19</td><td>BS2</td><td rowspan="2">I</td><td rowspan="2">Communicating Protocol Select.
These pins are MCU interface selection input. See the following table:
<table>
<tr><td></td><td>6800-parallel</td><td>8080-parallel</td><td>Serial</td></tr>
<tr><td>BS1</td><td>0</td><td>1</td><td>0</td></tr>
<tr><td>BS2</td><td>1</td><td>1</td><td>0</td></tr>
</table></td></tr>
<tr><td>20</td><td>BS1</td></tr>
<tr><td>21</td><td>VDD</td><td>I</td><td>Power Supply for Logic Circuit.
This is a voltage supply pin. It must be connected to external source.</td></tr>
<tr><td>22</td><td>N.C.</td><td>-</td><td>Reserved Pin.
The N.C. pins between function pins are reserved for compatible and flexible design.</td></tr>
<tr><td>23</td><td>N.C.</td><td>-</td><td>Reserved Pin.
The N.C. pins between function pins are reserved for compatible and flexible design.</td></tr>
<tr><td>24</td><td>N.C.</td><td>-</td><td>Reserved Pin.
The N.C. pins between function pins are reserved for compatible and flexible design.</td></tr>
<tr><td>25</td><td>VBREF</td><td>I/O</td><td>Voltage Reference for DC/DC Converter Circuit.
This pin is the internal voltage reference of booster circuit. A stabilization capacitor, typ. 1uF, should be connected to VSS.</td></tr>
<tr><td>26</td><td>RESE</td><td>I</td><td>Input for Connected External NMOS.
This pin connects to the source current pin of the external NMOS of the booster circuit.</td></tr>
<tr><td>27</td><td>FB</td><td>I</td><td>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).</td></tr>
<tr><td>28</td><td>VDDB</td><td>I</td><td>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.</td></tr>
<tr><td>29</td><td>GDR</td><td>O</td><td>Output for Connected External NMOS.
This output pin drives the gate of the external NMOS of the booster circuit.</td></tr>
<tr><td>30</td><td>VSS</td><td>I</td><td>Ground of System.
This is a ground pin. It also acts as a reference for the logic pins, the driving voltage and the analog circuit. It must be connected to external ground.</td></tr>
<tr><td>31</td><td>N.C.</td><td>-</td><td>Reserved Pin (Supporting Pin).
The supporting pins can reduce the influences from stresses on the function pins.</td></tr>
</table>

3.4 BLOCK DIAGRAM



MCU Interface Selection: BS1 and BS2

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

* VBREF, RESE, FB, VDDB, GDR and VSSB should be left float.

C1, C3 : 4.7μF

C2 : 10 μF

R1 : 910kΩ, R1 = (Voltage at IREF – BGGND) / IREF

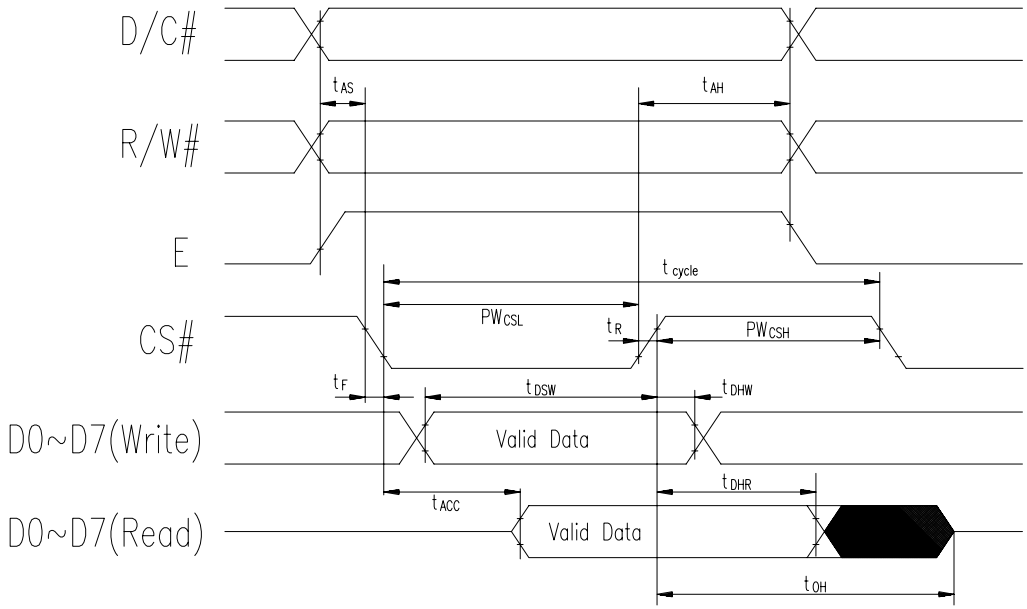
3.5 TIMING CHARACTERISTICS

3.5.1 AC CHARACTERISTICS

3.5.1.1 6800-Series MPU Parallel Interface Timing Characteristics:

Characteristics	Symbol	Min	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}	15	-	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) Chip Select Low Pulse Width (Write)	PW_{CSL}	120 60	-	ns
Chip Select High Pulse Width (Read) Chip Select High Pulse Width (Write)	PW_{CSH}	60 60	-	ns
Rise Time	t_R	-	15	ns
Fall Time	t_F	-	15	ns

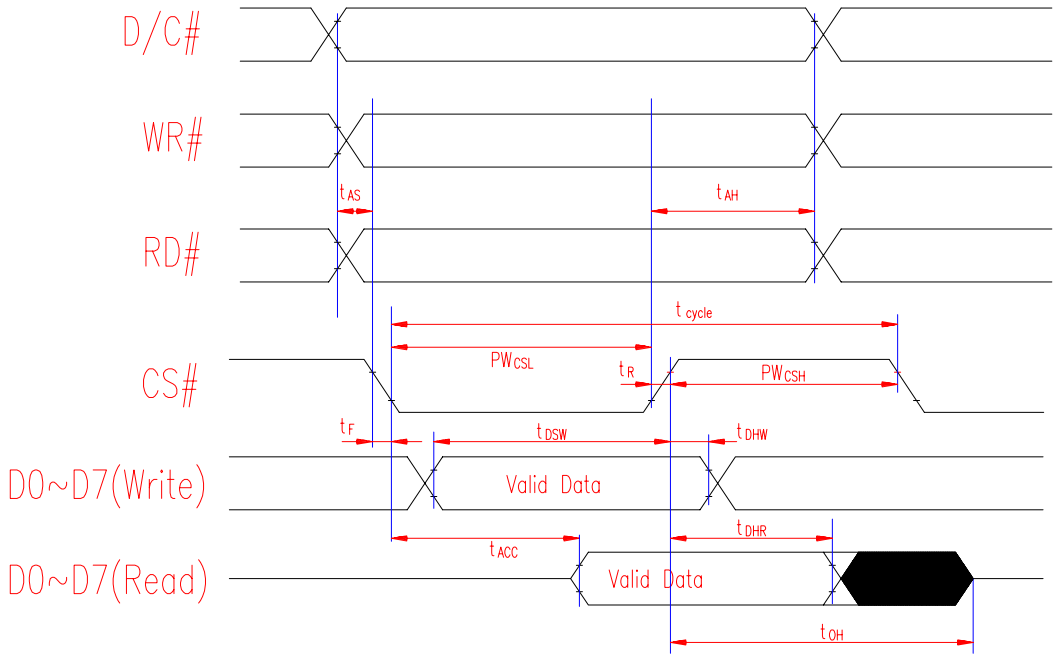
**** All the timing should be based on 30% and 70% of V_{DD}-GND.***



3.5.1.2 8080-Series MPU Parallel Interface Timing Characteristics:

Characteristics	Symbol	Min	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}	15	-	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) Chip Select Low Pulse Width (Write)	PW_{CSL}	120 60	-	ns
Chip Select High Pulse Width (Read) Chip Select High Pulse Width (Write)	PW_{CSH}	60 60	-	ns
Rise Time	t_R	-	15	ns
Fall Time	t_F	-	15	ns

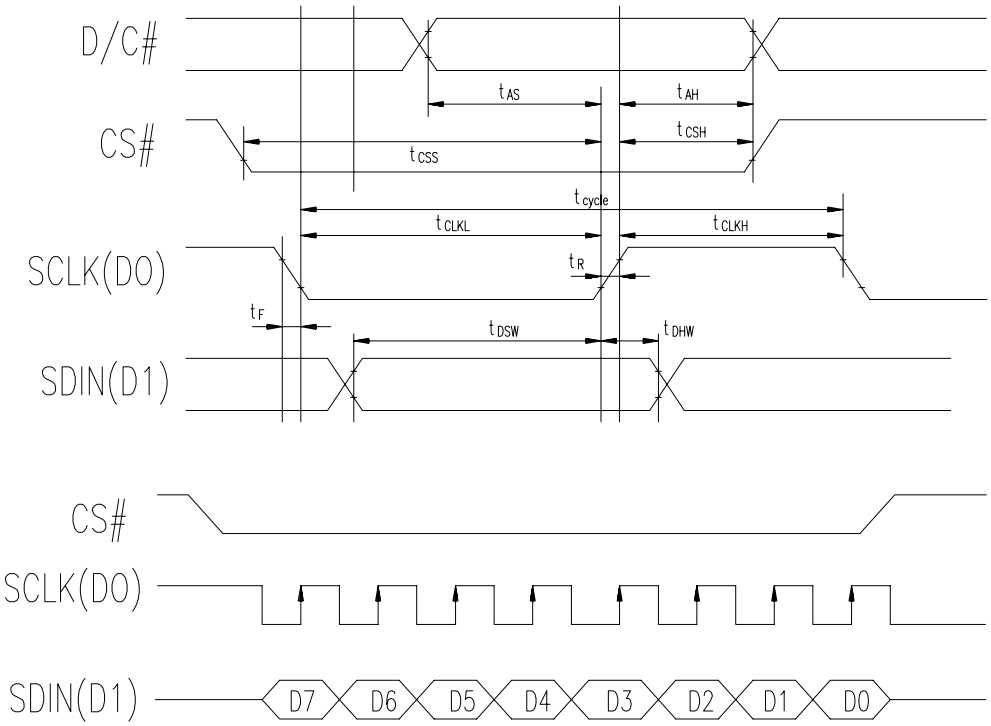
**** All the timing should be based on 30% and 70% of V_{DD}-GND.***



3.5.1.3 Serial Interface Timing Characteristics:

Characteristics	Symbol	Min	Max	Unit
Clock Cycle Time	t_{cycle}	250	-	ns
Address Setup Time	t_{AS}	150	-	ns
Address Hold Time	t_{AH}	150	-	ns
Chip Select Setup Time	t_{CSS}	120	-	ns
Chip Select Hold Time	t_{CSH}	60	-	ns
Write Data Setup Time	t_{DSW}	100	-	ns
Write Data Hold Time	t_{DHW}	100	-	ns
Clock Low Time	t_{CLKL}	100	-	ns
Clock High Time	t_{CLKH}	100		ns
Rise Time	t_R	-	15	ns
Fall Time	t_F	-	15	ns

**** All the timing should be based on 30% and 70% of V_{DD}-GND.***



4 OPTICAL SPECIFICATION

4.1 OPTICAL 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)		0.20	0.24	0.28	
Frame Rate				150		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.

5 FUNCTIONAL SPECIFICATION

5.1 COMMANDS

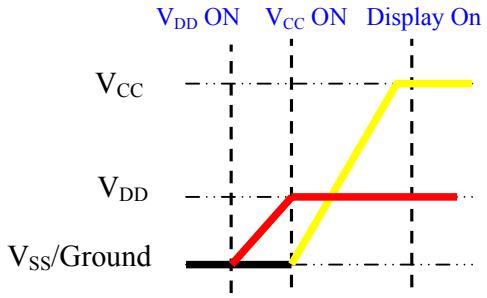
Please refer to the Technical Manual for the SSD1303.

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.

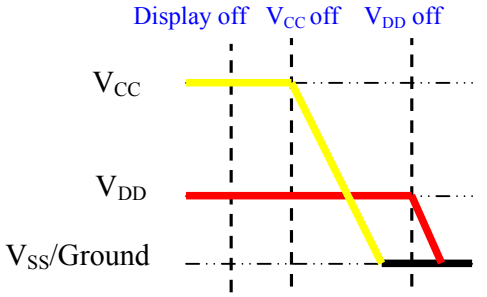
5.2.1 POWER UP SEQUENCE：

1. Power up V_{DD}
2. Send Display off command
3. Clear Screen
4. Power up V_{CC}
5. Delay 100ms
   (When V_{DD} is stable)
6. 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. 128x32 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

5.4 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.

6 PACKAGING AND LABELLING SPECIFICATION

6.1 PACKAGING

6.1.1 Material

	Item	Part code	Dimensions (mm)	Unit weight (kg)	Quantity
1	Module	DD-2864BE-1A	33.4*14.5*1.8	0.002	2400
2	Tray	*****	***	0.010	64
3	Inner box	*****	***	0.250	4
4	Carton	*****	***	1.100	1
5	Inner box bag	*****	***	***	***
6	Total weight	7.54 Kg		± 5%	

6.1.2 Specification and quantity

Modules x tray	Quantity per row	8	x	Quantity per column	5	=	40
Modules per box	Quantity per tray	40	x	Quantity of trays	15	=	600
Total no. of modules	Quantity per box	600	x	Quantity of boxes	4	=	2400

6.2 LABELLING & MARKING

DENSITRON
DD-2832BE-1A
TW YY MM

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;

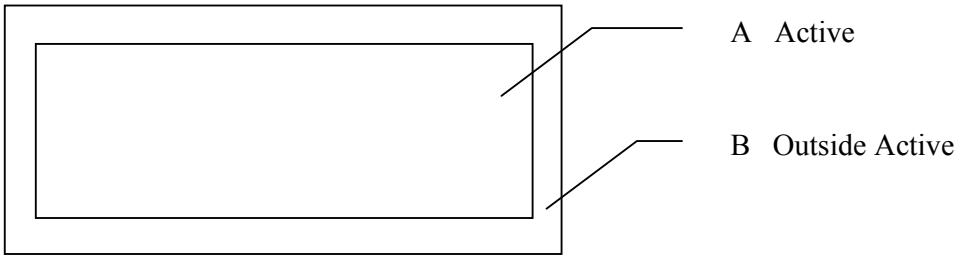
The quality assurance levels are shown below:

Rank	Item Inspected	Defect type	AQL	Remark
Major defect	Display	Non display	0.65%	Fit/Function defect
		Flicker		
		Missing Line or Pixel		
		Wrong Display		
		Cross Talk *		
Minor defect	Display	Black and white spot	1.0%	Appearance defect
		Polarizer scratch		
		Bubbles **		
		Dirt, Greasy Dirt		
		Colour uniformity		
		Foreign Material		
		Dent		
		Total	1.0%	

* In display which manifests itself has the other shadowing, ghosting or streaking.

** Distance between any 2 defects should over 10mm.

7.2.2 Zone definition



7.2.3 Visual inspection

Test and measurement were conducted under the following conditions：

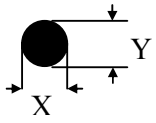
Temperature： 23±5℃

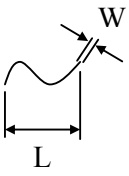
Humidity： 55±15%RH

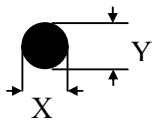
Distance between the Panel & Eyes of the Inspector：≧30cm

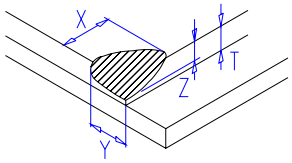
7.2.3.1 Standard of appearance inspection

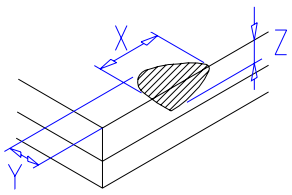
Units: mm

<table>
<tr><th>No</th><th>Item</th><th>Criteria</th></tr>
<tr><td>1</td><td>Black spot, white spot, dust</td><td>
Round type: as per following drawing
∅ = (X+Y)/2


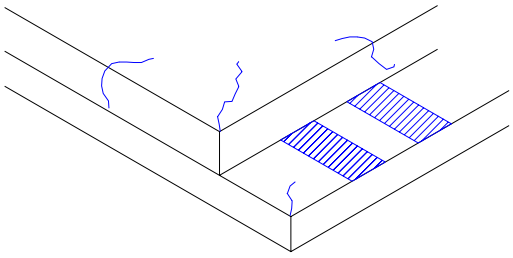
<table>
<tr><th colspan="3">Acceptable quantity</th></tr>
<tr><td>Size</td><td>Zone A</td><td>Zone B</td></tr>
<tr><td>∅<0.1</td><td>Any number</td><td rowspan="4">Any number</td></tr>
<tr><td>0.1<∅<0.2</td><td>3</td></tr>
<tr><td>0.2<∅<0.25</td><td>1</td></tr>
<tr><td>0.25<∅</td><td>0</td></tr>
</table>
Line type: as per following drawing


<table>
<tr><th colspan="4">Acceptable quantity</th></tr>
<tr><td>Length</td><td>Width</td><td>Zone A</td><td>Zone B</td></tr>
<tr><td>- -</td><td>W≤0.02</td><td>Any number</td><td rowspan="4">Any number</td></tr>
<tr><td>L≤3.0</td><td>0.02<W≤0.03</td><td rowspan="2">2</td></tr>
<tr><td>L≤2.5</td><td>0.03<W≤0.05</td></tr>
<tr><td>- -</td><td>0.05<W</td><td>As round type</td></tr>
</table>
Total acceptable quantity: 3
</td></tr>
<tr><td>2</td><td>Polarizer scratch</td><td>Scratch on protective film is permitted
Scratch on polarizer: same as No. 1</td></tr>
<tr><td>3</td><td>Polarizer bubble</td><td>
∅ = (X+Y)/2


<table>
<tr><th colspan="3">Acceptable quantity</th></tr>
<tr><td>Size</td><td>Zone A</td><td>Zone B</td></tr>
<tr><td>∅<0.1</td><td>Any number</td><td rowspan="4">Any number</td></tr>
<tr><td>0.1<∅<0.2</td><td>3</td></tr>
<tr><td>0.2<∅<0.25</td><td>1</td></tr>
<tr><td>0.25<∅</td><td>0</td></tr>
</table>
Total acceptable quantity: 3
</td></tr>
<tr><td>4</td><td>Panel Chipping</td><td>
X≦1/6 Panel Length
Y≦1
Z≦T




</td></tr>
</table>

5	Panel Crack	Any crack is not allowable. 

7.2.4 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.

7.2.5 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.

8 RELIABILITY SPECIFICATION

8.1 CONTENTS OF RELIABILITY TESTS

Test Item	Test Condition	Evaluation and assessment
High Temperature Operation	70°C±2, 240 hours	No abnormalities in function and appearance
Low Temperature Operation	-20°C±2, 240 hours	No abnormalities in function and appearance
High Temperature Storage	80°C±2, 240 hours	No abnormalities in function and appearance
Low Temperature Storage	-30°C±2, 240 hours	No abnormalities in function and appearance
High Temperature & High Humidity Storage	60°C±2, 90%RH, 240 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 the above tests do not include polarizer.
* No moisture condensation is observed during tests.

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.
3	The storage period is warrantable of more than 20,000hr from the date of invoice under normal room conditions as stated below. Temperature: 23 ± 5°C. Humidity: 55 ± 15 %RH. In case of the seal of cartoon not opened

8.3 FAILURE CHECK STANDARD

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

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 Trichlorotriflorothane.
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°C ± 10°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).