OLED DISPLAY MODULE DATASHEET

Datasheet Release Date 2018-02-16
for
CFAL12832E-W-B1

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1. General Information

Datasheet Revision History
Datasheet Release: **2018-02-16** Datasheet for the CFAL12832E-W-B1 OLED graphic display module.

Product Change Notifications
You can check for or subscribe to Part Change Notices for this display module on our website.

Variations
Slight variations between lots are normal (e.g., contrast, color, or intensity).

Volatility
This display module has volatile memory.

Disclaimer
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2. Module Description

This is a white monochrome OLED graphic display module. This display has a built-in Solomon Systech SSD1305 controller.

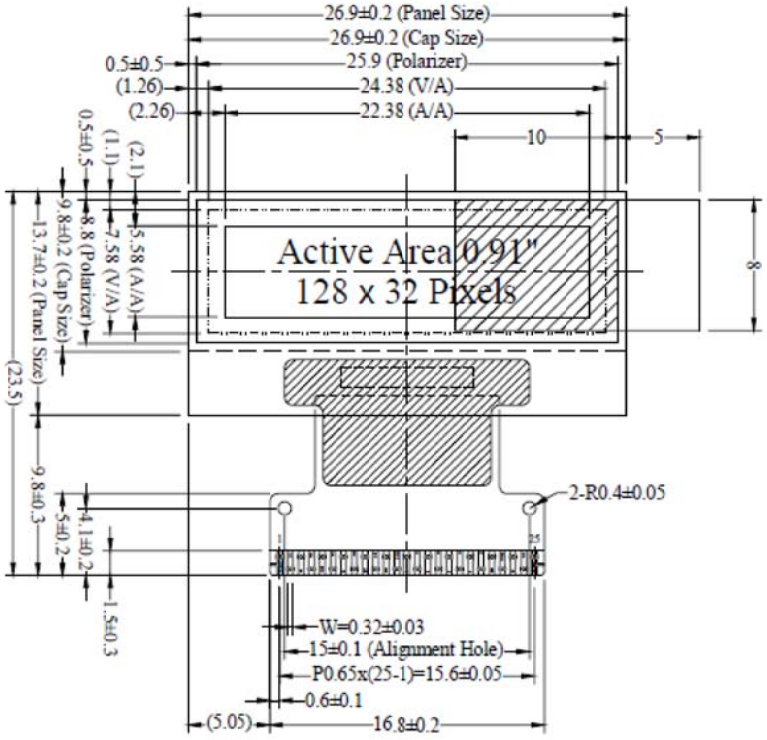
Please see Solomon Systech SSD1305 LCD Datasheet for further reference.

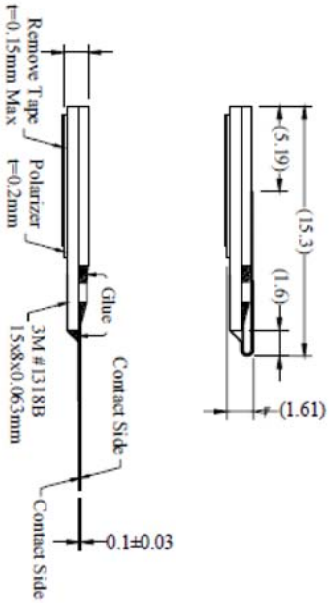
3. Features

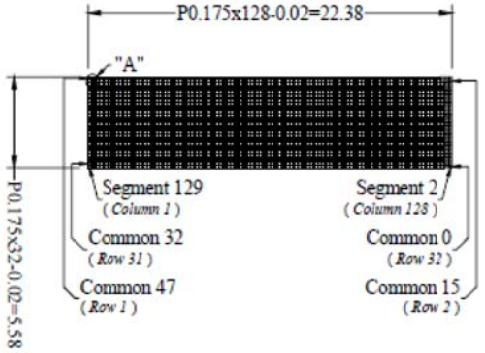
- 128*64 Dot Matrix
- Built-in Controller: SSD1305 (or equivalent)
- +3V Power Supply
- 1/32 Duty
- Interface: 8-Bit Parallel / SPI

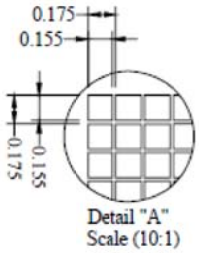
4. Mechanical Data

Item	Specification (mm)	Specification (inch, reference)
Overall Width and Height	26.9 (W) x 15.26 (H) x 1.45 (D)	1.059 (W) x 0.601 (H) x 0.057 (D)
Viewing Area	24.38 (W) x 7.58 (H)	0.960 (W) x 0.298 (H)
Active Area	22.38 (W) x 5.58 (H)	0.881 (W) x 0.220 (H)
Pixel Size	0.155 (W) x 0.155 (H)	0.006 (W) x 0.006 (H)
Pixel Pitch	0.175 (W) x 0.175 (H)	0.007 (W) x 0.007 (H)
Weight (Typical)	1.17 grams	0.04 ounces









Notes:

1. Color: White
2. Driver IC: SSD1305
3. Interface:8-bit 68XX/80XX Parallel, 4-wire SPI, I2C
4. General Tolerance: ±0.30
5. The total thickness (1.55 Max) is without polarizer protective film & remove tape. The actual assembled total thickness with above materials should be 1.80 Max.

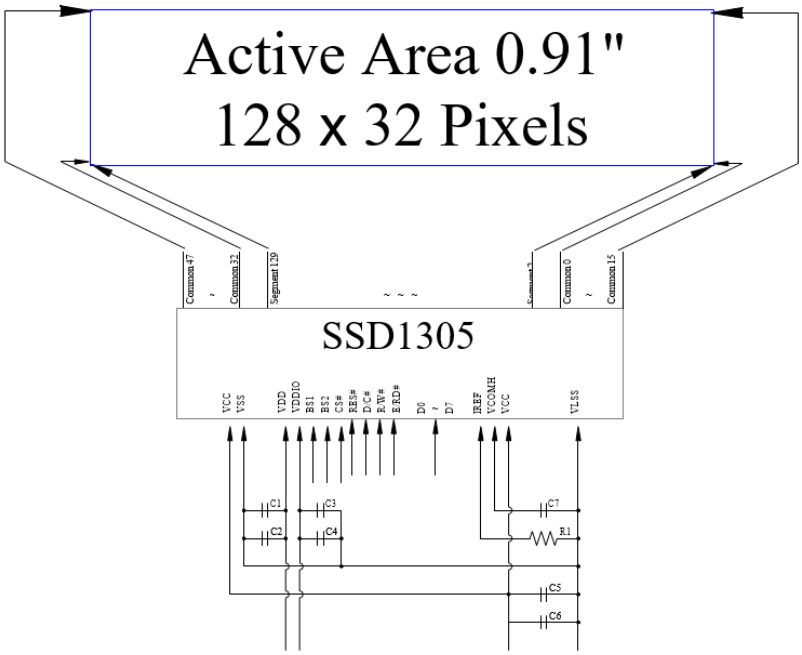
Crystalfontz	PART NUMBER(S) CFAL12832E-W-B1	SCALE Not to Scale	
	DRAWING NUMBER CFAL12832E-W-B1 master	UNITS Millimeters	DATE 2018-02-16

6. Interface Pin Function

<table>
<tr><th>Pin</th><th>Symbol</th><th>Level</th><th>Function</th></tr>
<tr><td>1</td><td>NC</td><td>-</td><td>Reserved Pin (Supporting Pin)
The supporting pins can reduce the influences from stresses on the function pins. These pins must be connected to external ground.</td></tr>
<tr><td>2</td><td>V_{CC}</td><td>P</td><td>Power Supply for OEL Panel
This is the most positive voltage supply pin of the chip. It must be supplied externally.</td></tr>
<tr><td>3</td><td>V_{SS}</td><td>P</td><td>Ground of Logic Circuit
This is a ground pin. It also acts as a reference for the logic pins. It must be connected to an external ground.</td></tr>
<tr><td>4</td><td>V_{DD}</td><td>P</td><td>Power Supply for Core Logic Operation
This is a voltage supply pin. It must be connected to an external source.</td></tr>
<tr><td>5</td><td>V_{DDIO}</td><td>P</td><td>Power Supply for Interface Logic Level
This is a voltage supply pin. It should be match with MCU interface voltage level. It must always be equal or lower than VDD.</td></tr>
<tr><td>6</td><td>BS1</td><td>I</td><td rowspan="2">Communicating Protocol Select
These pins are MCU interface selection input. See the following table:
<table>
<tr><th></th><th>68XX- Parallel</th><th>80XX- Parallel</th><th>Serial</th><th>I^2C</th></tr>
<tr><td>BS1</td><td>0</td><td>1</td><td>0</td><td>1</td></tr>
<tr><td>BS2</td><td>1</td><td>1</td><td>0</td><td>0</td></tr>
</table></td></tr>
<tr><td>7</td><td>BS2</td><td>I</td></tr>
<tr><td>8</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>9</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 is executed.</td></tr>
<tr><td>10</td><td>D/C#</td><td>I</td><td>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 signals, please refer to the Timing Characteristics Diagrams. When the pin is pulled high and serial interface mode is selected, the data at SDIN is treated as data. When it is pulled low, the data at SDIN will be transferred to the command register. In I^2C mode, this pin acts as SA0 for slave address selection.</td></tr>
<tr><td>11</td><td>R/W#</td><td>I</td><td>Read/Write Select or Write
This pin is MCU interface input. When interfacing to a 68XX-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 80XX 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.</td></tr>
<tr><td>12</td><td>E/RD#</td><td>I</td><td>Read/Write Enable or Read
This pin is MCU interface input. When interfacing to a 68XX-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 80XX-microprocessor, this pin receives the Read (RD#) signal. Data read operation is initiated when this pin is pulled low and CS# is pulled low. When serial interface is selected, this pin must be connected to V_{SS}.</td></tr>
<tr><td>13-20</td><td>D0-D7</td><td>I/O</td><td>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 SD_{IN} and D0 will be the serial clock input SCLK. When I^2C mode is selected, D2 & D1 should be tired together and serve as SDA_{OUT} & SDA_{IN} in application and D0 is the serial clock input SCL.</td></tr>
<tr><td>21</td><td>I_{REF}</td><td>I</td><td>Current Reference for Brightness Adjustment
This pin is segment current reference pin. A resistor should be connected between this pin and V_{SS}. Set the current lower than 10µA.</td></tr>
</table>

Pin	Symbol	Level	Function
22	V_{COMH}	O	**Voltage Output High Level for COM Signal** This pin is the input pin for the voltage output high level for COM signals. A capacitor should be connected between this pin and V_{SS}.
23	V_{CC}	P	**Power Supply for OEL Panel** This is the most positive voltage supply pin of the chip. It must be supplied externally.
24	V_{LSS}	P	**Ground of Analog Circuit** This is an analog ground pin. It should be connected to V_{SS} externally.
25	NC (GND)	-	**Reserved Pin (Supporting Pin)** The supporting pins can reduce the influences from stresses on the function pins. These pins must be connected to external ground.

7. Block Diagram



8. Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit	Notes
Supply Voltage for Logic	V_{DD}	-0.3	3.5	V	(1)(2)(3)
Supply Voltage for I/O Pins	V_{DDIO}	-0.3	V_{DD}+0.5	V	(1)(2)(3)
Supply Voltage for Display	V_{CC}	0	11	V	(1)(2)(3)
Operating Temperature	T_{OP}	-30	+70	°C	-
Storage Temperature	T_{STG}	-40	+80	°C	-

Notes:
(1) These are stress ratings only. Extended exposure to the absolute maximum ratings listed above may affect device reliability or cause permanent damage. Above voltages are based on V_{SS}=0V.
(2) Functional operation should be restricted to the limits in the Electrical Characteristics table below.
(3) This device may be light sensitive. Caution should be taken to avoid exposure of this device to any light source during normal operation.

9. Electrical Characteristics

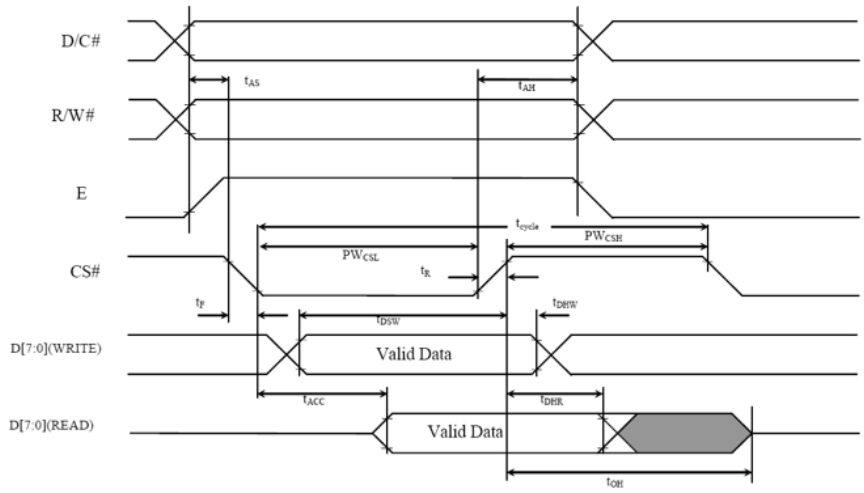
Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage for Logic	V_{DD}	-	2.4	2.8	3.5	V
Supply Voltage for I/O Pins	V_{DDIO}	-	1.6	1.8	V_{DD}	V
Supply Voltage for Display	V_{CC}	Note 1	-	7.5	8	V
High-level Input	V_{IH}	I_{OUT} = 100µA, 3.3MHz	0.8 x V_{DDIO}	-	V_{DDIO}	V
Low-level Input	V_{IL}	I_{OUT} = 100µA, 3.3MHz	0	-	0.2 x V_{DDIO}	V
High-level Output	V_{OH}	I_{OUT} = 100µA, 3.3MHz	0.9 x V_{DDIO}	-	V_{DDIO}	V
Low-level Output	V_{OL}	I_{OUT} = 100µA, 3.3MHz	0	-	0.1 x V_{DDIO}	V
Operating Current for V_{DD}	I_{DD}	-	-	180	300	mA
Operating Current for V_{CC}	I_{CC}	-	Note 2	4	5	mA
			Note 3	6.4	8	
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: Brightness (L_{br}) and Supply Voltage for Display (V_{CC}) are subject to the change of the panel characteristics and the customer's request.
Note 2: V_{DD} = 2.8V, V_{CC} = 7.5V, 50% Display Area Turn on.
Note 3: V_{DD} = 2.8V, V_{CC} = 7.5V, 100% Display Area Turn on.

10. AC Characteristics

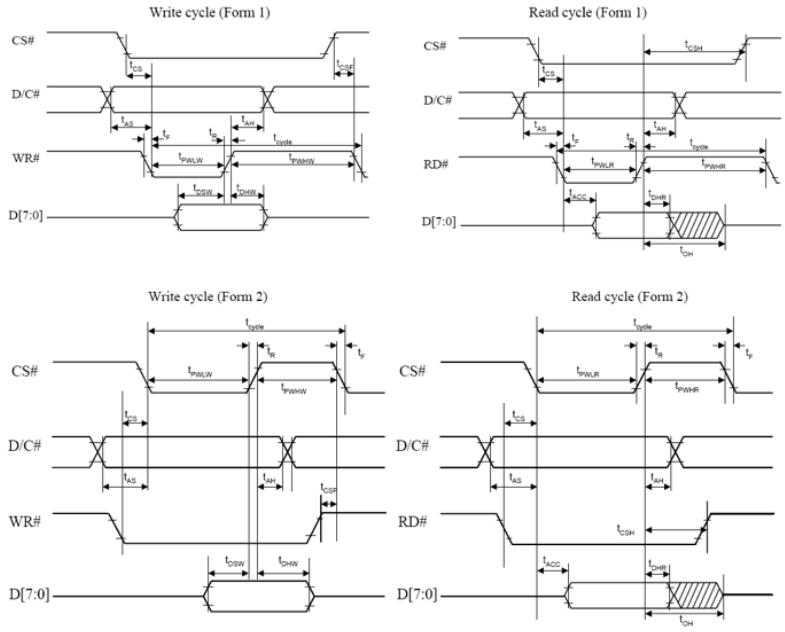
10.1. 68XX-Series MPU Parallel Interface Timing Characteristics

V_{DD}-V_{SS} = 2.4V to 3.5V, V_{DDIO} = V_{DD}, T_a = 25°C				
Symbol	**Description**	**Min**	**Max**	**Unit**
t_{CYCLE}	System 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	7	-	ns
t_{DHR}	Write Data Hold Time	20	-	ns
t_{OH}	Output Disable Time	-	-	ns
t_{ACC}	Access Time	-	70	ns
PW_{CSL}	Chip Select Low Pulse Width (Read)	120	-	ns
	Chip Select Low Pulse Width (Write)	60		
PW_{CSH}	Chip Select High Pulse Width (Read)	60	-	ns
	Chip Select High Pulse Width (Write)	60		
t_R	Rise Time	-	15	ns
t_F	Fall Time	-	15	ns



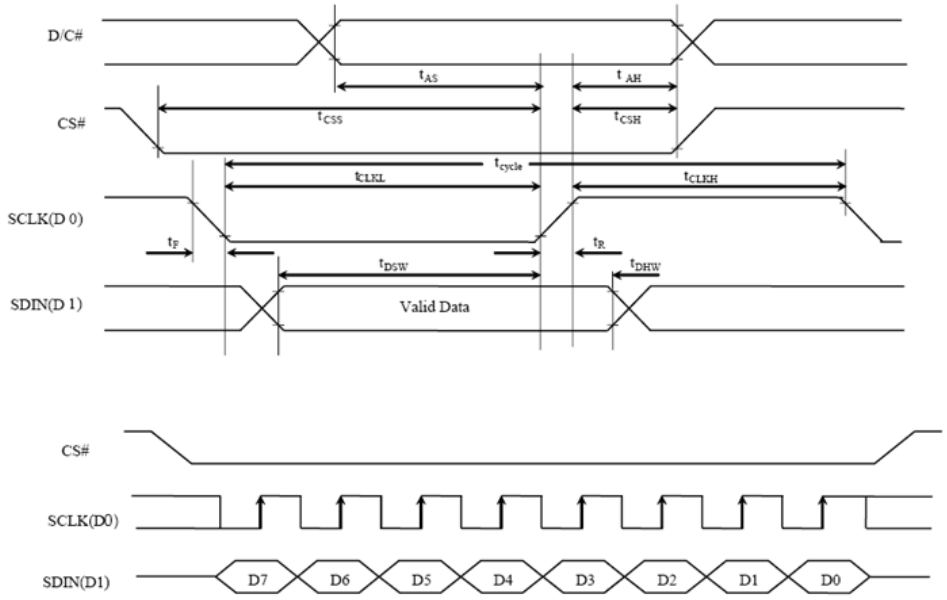
10.2. 80XX-Series MPU Parallel Interface Timing Characteristics

V_{DD}-V_{SS} = 2.4V to 3.5V, V_{DDIO} = V_{DD}, T_a = 25°C				
Symbol	**Description**	**Min**	**Max**	**Unit**
t_{CYCLE}	System Cycle Time	300	-	ns
t_{AS}	Address Setup Time	10	-	ns
t_{AH}	Address Hold Time	0	-	ns
t_{DSW}	Write Data Setup Time	40	-	ns
t_{DHW}	Write Data Hold Time	7	-	ns
t_{DHR}	Read Data Hold Time	20	-	ns
t_{OH}	Output Disable Time	-	70	ns
t_{ACC}	Access Time	-	140	ns
t_{PWLR}	Read Low Time	120	-	ns
t_{PWLW}	Write Low Time	60	-	ns
t_{PWHR}	Read High Time	60	-	ns
t_{PWHW}	Write High Time	60	-	ns
t_{CSS}	Chip Select Setup Time	0	-	ns
t_{CSH}	Chip Select Hold Time to Read Signal	0	-	ns
t_{CSF}	Chip Select Hold Time	20	-	ns
t_R	Rise Time	-	15	ns
t_F	Fall Time	-	15	ns



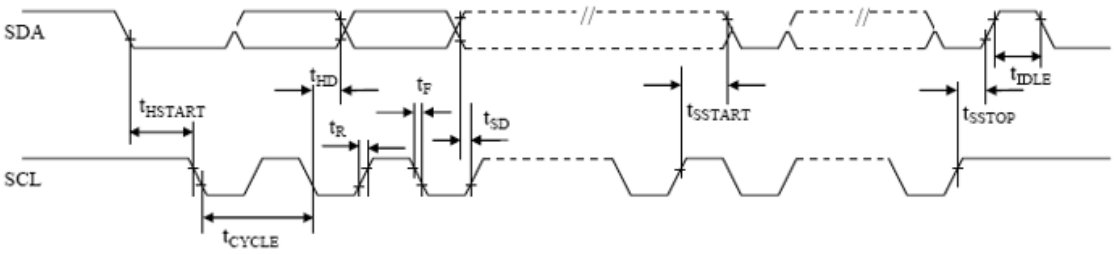
10.3. Serial Interface Timing Characteristics

V_{DD}-V_{SS} = 2.4V to 3.5V, V_{DDIO} = V_{DD}, T_a = 25°C				
Symbol	**Description**	**Min**	**Max**	**Unit**
t_{CYCLE}	System Cycle Time	250	-	ns
t_{AS}	Address Setup Time	150	-	ns
t_{AH}	Address Hold Time	150	-	ns
t_{CSS}	Chip Select Setup Time	120	-	ns
t_{CSH}	Chip Select Hold Time	60	-	ns
t_{DSW}	Write Data Setup Time	50	-	ns
t_{DHW}	Write Data Hold Time	15	-	ns
t_{CLKL}	Serial Clock Low Time	100	-	ns
t_{CLKH}	Serial Clock High Time	100	-	ns
t_R	Rise Time	-	15	ns
t_F	Fall Time	-	15	ns



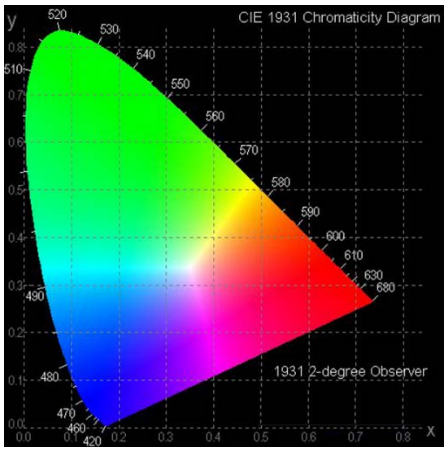
10.4. I²C Interface Timing Characteristics

V_{DD}-V_{SS} = 2.4V to 3.5V, V_{DDIO} = V_{DD}, T_a = 25°C				
Symbol	**Description**	**Min**	**Max**	**Unit**
t_{CYCLE}	System Cycle Time	2.5	-	us
t_{HSTART}	Start Condition Hold Time	0.6	-	us
t_{HD}	Data Hold Time (for "SDA_{OUT}" Pin)	0	-	ns
	Data Hold Time (for "SDA_{IN}" Pin)	300		
t_{SD}	Data Setup Time	100	-	ns
t_{SSTART}	Start Condition Setup Time (Only Relevant for a Repeated Start Condition)	0.6	-	us
t_{SSTOP}	Stop Condition Setup Time	0.6	-	us
t_R	Rise Time for Data and Clock Pin	-	300	ns
t_F	Fall Time for Data and Clock Pin	-	300	ns
t_{IDLE}	Idle Time Before a New Transmission Can Start	1.3	-	us



11. Optical Characteristics

Optical measurements taken at V_{DD} = 2.8V, V_{CC} = 7.5V						
Item	**Symbol**	**Condition**	**Min**	**Typ**	**Max**	**Unit**
View Angle	-	-	>160	-	-	deg
Contrast Ratio	CR	Dark Room	-	>2000:1	-	-
Brightness	L_{br}	without polarizer	60	80	-	cd/m2
CIEx (White)	(CIE1931)		0.28	0.32	0.36	-
CIEy (White)	(CIE1931)		0.29	0.33	0.37	-



12. OLED Lifetime

Item	Conditions	Min	Typ	Notes
Operating Lifetime	Ta=25°C Initial 50% check board brightness Typical Value	20,000 Hrs.	-	(1)(2)(3)

Notes:
(1) Lifetime is defined as the amount of time when the luminance has decayed to <50% of the initial value.
(2) This analysis method uses life data obtained under accelerated conditions to extrapolate an estimated Probability Density Function (PDF) for the product under normal use conditions.
(3) Screen saving mode will extend OLED lifetime.

13. OLED Module Precautions

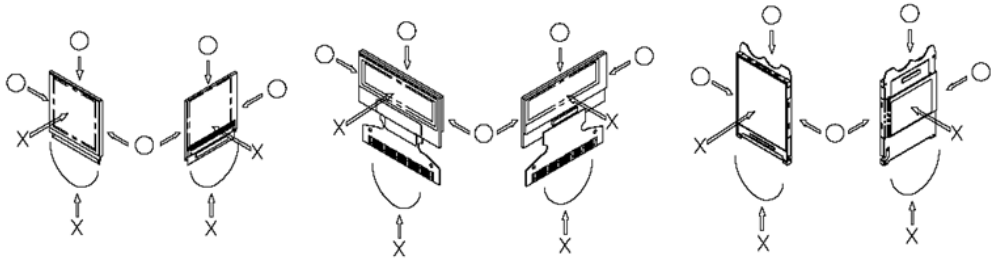
The precautions below should be followed when using OLED modules to help ensure personal safety, module performance, and compliance of environmental regulations.

13.1. Modules

- Avoid applying excessive shocks to module or making any alterations or modifications to it.
- Do not make extra holes on the printed circuit board, modify its shape or change the components of OLED display module.
- Do not disassemble the OLED display module.
- Do not operate the OLED display module above the absolute maximum rating.
- Do not drop, bend or twist the OLED display module.
- Soldering: only to the I/O terminals.
- Store in an anti-static electricity container and clean environment.
- It is common to use the "screen saver" to extend the lifetime of the OLED display module.
  - Do not use the fixed information for long periods of time in real application.
  - Do not use fixed information in OLED panel for long periods of time to extend "screen burn" effect time.
- Crystalfontz has the right to change the passive components, including R2 and R3 adjust resistors. (Resistors, capacitors and other passive components will have different appearance and color caused by the different supplier.)
- Crystalfontz have the right to change the PCB Rev. (In order to satisfy the supplying stability, management optimization and the best product performance, etc., under the premise of not affecting the electrical characteristics and external dimensions, Crystalfontz has the right to modify the version.).

13.2. Handling Precautions

- Since the display panel is made of glass, do not apply mechanical impacts such as dropping from a high position.
- If the display panel is accidently broken, and the internal organic substance leaks out, be careful not to inhale or touch the organic substance.
- If pressure is applied to the display surface or its neighborhood of the OLED display module, the cell structure may be damaged, so be careful not to apply pressure to these sections.
- The polarizer covering the surface of the OLED display module is soft and can be easily scratched. Please be careful when handling the OLED display module.
- Clean the surface of the polarizer covering the OLED display module if it becomes soiled using following adhesion tape.
  - Scotch Mending Tape No. 810 or an equivalent
  - Never breathe the soiled surface or wipe the surface using a cloth containing solvent such as ethyl alcohol, since the surface of the polarizer will become cloudy.
  - The following liquids/solvents may spoil the polarizer:
    - Water
    - Ketone
    - Aromatic Solvents
- Hold the OLED display module very carefully when placing the OLED display module into the system housing.
- Do not apply excessive stress or pressure to the OLED display module. And, do not over bend the film with electrode pattern layouts. These stresses will influence the display performance. Also, be sure to secure the sufficient rigidity for the outer cases.



- Do not apply stress to the LSI chips and the surrounding molded sections.
- Do not disassemble or modify the OLED display module.
- Do not apply input signals while the logic power is off.
- Pay sufficient attention to the working environments when handing the OLED display module to prevent occurrence of element breakage accidents by static electricity.
  - Be sure to make human body grounding when handling OLED display modules.
  - Be sure to ground tools to use for assembly such as soldering irons.
  - To suppress generation of static electricity, avoid carrying out assembly work under dry environments.
  - Protective film is being applied to the surface of the display panel of the OLED display module. Be careful since static electricity may be generated when exfoliating the protective film.
- Protection film is being applied to the surface of the display panel and removes the protection film before assembling it. At this time, if the OLED display module has been stored for a long period of time, residue adhesive material of the protection film may remain on the surface of the display panel after the film has been removed. In such a case, remove the residue material by the method discussed above.
- If electric current is applied when the OLED display module is being dewed or when it is placed under high humidity environments, the electrodes may become corroded. If this happens proceed with caution when handling the OLED display module.

13.3. Storage Precautions

- When storing the OLED display modules put them in static electricity preventive bags to avoid exposure to direct sunlight and fluorescent lamps. Also avoid high temperature and high humidity environments and low temperatures (less than 0°C) environments. (We recommend you store these modules in the packaged state when they were shipped from Crystalfontz). Be careful not to let water drops adhere to the packages or bags, and do not let dew gather on them.
- If electric current is applied when water drops are adhering to the surface of the OLED display module the OLED display module may have become dewed. If a dewed OLED display module is placed under high humidity environments it may cause the electrodes to become corroded. If this happens proceed with caution when handling the OLED display module.

13.4. Designing Precautions

- The absolute maximum ratings are the ratings that cannot be exceeded for OLED display module. If these values are exceeded, panel damage may happen.
- To prevent occurrence of malfunctioning by noise pay attention to satisfy the V_{IL} and V_{IH} specifications and, at the same time, to make the signal line cable as short as possible.
- We recommend that you install excess current preventive unit (fuses, etc.) to the power circuit (V_{DD}). (Recommend value: 0.5A)
- Pay sufficient attention to avoid occurrence of mutual noise interference with the neighboring devices.
- As for EMI, take necessary measures on the equipment side.
- When fastening the OLED display module, fasten the external plastic housing section.
- If the power supply to the OLED display module is forcibly shut down, by such errors as taking out the main battery while the OLED display panel is in operation, we cannot guarantee the quality of this OLED display module.
  - Connection (contact) to any other potential than the above may lead to rupture of the IC.

13.5. Disposing Precautions

- Request the qualified companies to handle the industrial wastes when disposing of the OLED display modules. Or, when burning them, be sure to observe the environmental and hygienic laws and regulations.

13.6. Other Precautions

- When an OLED display module is operated for a long period of time with a fixed pattern, the fixed pattern may remain as an after image or a slight contrast deviation may occur.
  - If the operation is interrupted and left unused for a while, normal state can be restored.

  - This will not cause a problem in the reliability of the module.
- To protect the OLED display module from performance drops by static electricity rapture, etc., do not touch the following sections whenever possible while handling the OLED display modules.
  - Pins and electrodes
  - Pattern layouts such as the TCP & FPC
- With this OLED display module, the OLED driver is being exposed. Generally speaking, semiconductor elements change their characteristics when light is radiated according to the principle of the solar battery. Consequently, if this OLED driver is exposed to light, malfunctioning may occur.
  - Design the product and installation method so that the OLED driver may be shielded from light in actual usage.
  - Design the product and installation method so that the OLED driver may be shielded from light during the inspection processes.
- Although this OLED display module stores the operation state data by the commands and the indication data, when excessive external noise, etc. enters into the module, the internal status may be changed. Therefore, it is necessary to take appropriate measures to suppress noise generation or to protect from influences of noise on the system design.
- We recommend that you construct its software to make periodical refreshment of the operation statuses (re-setting of the commands and re-transference of the display data), to cope with catastrophic noise.
- Resistors, capacitors, and other passive components will have different appearance and color caused by the different supplier.
- Crystalfontz has the right to upgrade and modify the product function.
- The limitation of FPC bending: