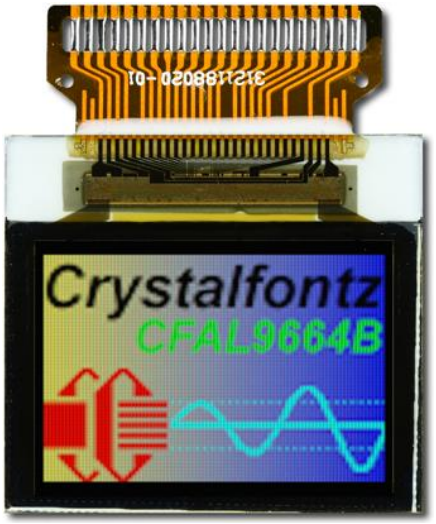
OLED DISPLAY MODULE DATASHEET



CFAL9664B-F-B1

Datasheet Release 2021-06-08

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1. General Information

Datasheet Revision History
Datasheet Release: 2021-06-08 Datasheet for the CFAL9664B-F-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 full color OLED graphic display module with an extremely wide viewing angle of >160° and low-power consumption.

This module is engineered for high volume production. It uses a "TAB" (tape automated bonding) style flex tail. The TAB connector is soldered directly to corresponding pads on your PCB using a hot-bar soldering machine. High volume contract manufacturers will be familiar with this type of construction and its assembly methods. The TAB style connection requires no separate connector, so the cost is very low, and the ultra-thin profile of the display is maintained.

This display has a built-in Solomon SSD1331Z controller.

Compared to most LCD modules, this OLED module has a quicker response time and an extremely wide viewing angle. At the low end of an STN LCD's temperature range, a module's contrast will typically be poor and the response time will be very slow. Unlike an STN LCD module, contrast does not diminish and response time is good at the lower end of an OLED module's operating temperature range, allowing it to operate in cold environments without a heater.

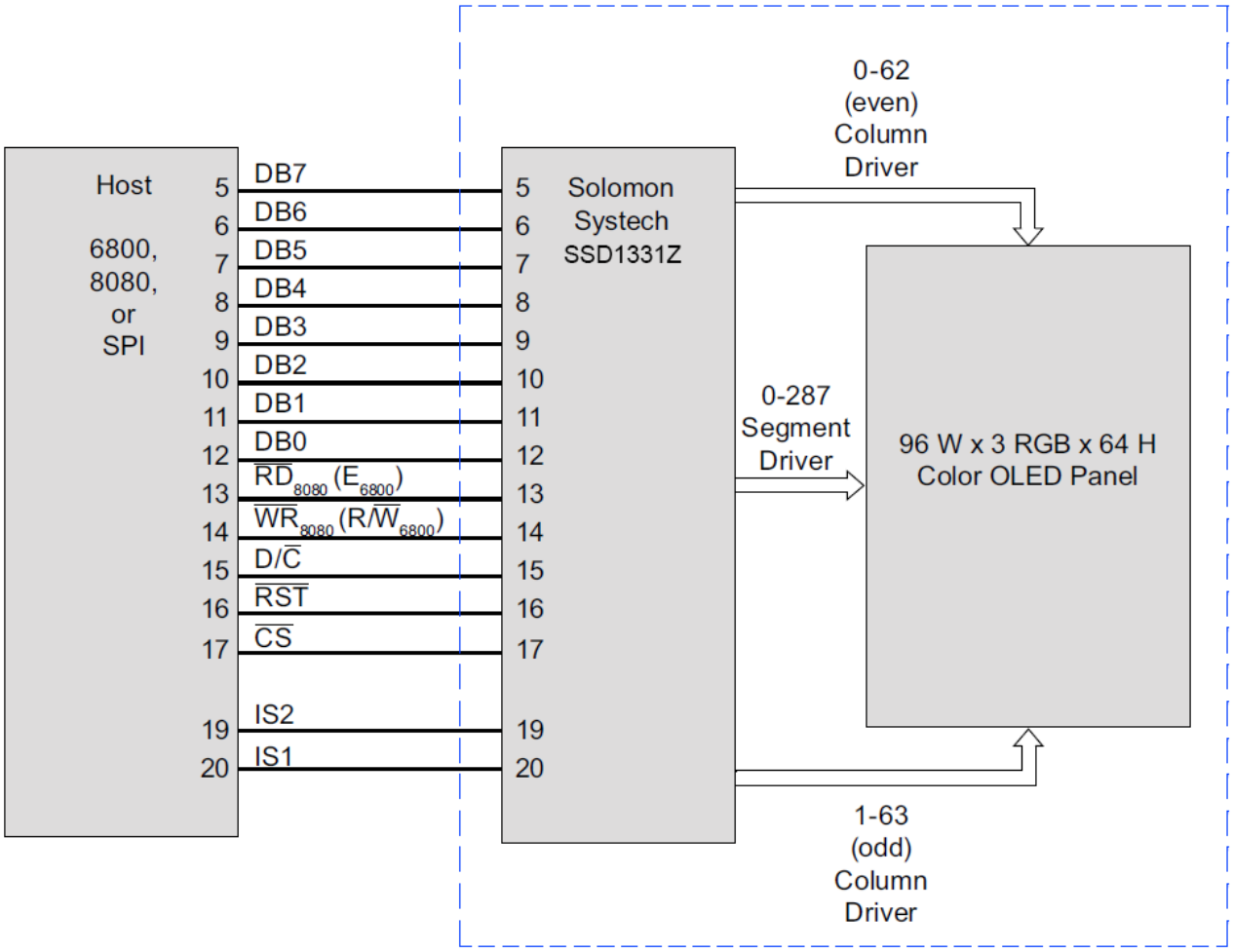
3. Features

- 96*64 RGB dot matrix OLED chip-on-glass module
- 8-bit parallel (8080 or 6800) or SPI Interface
- Built-in Solomon Systech SSD1331Z Controller
- 65K full color emissive display
- Extremely wide viewing angle (>160°)
- +3V nominal power supply
- Wide temperature operation of -20° to +70°C
- RoHS compliant.

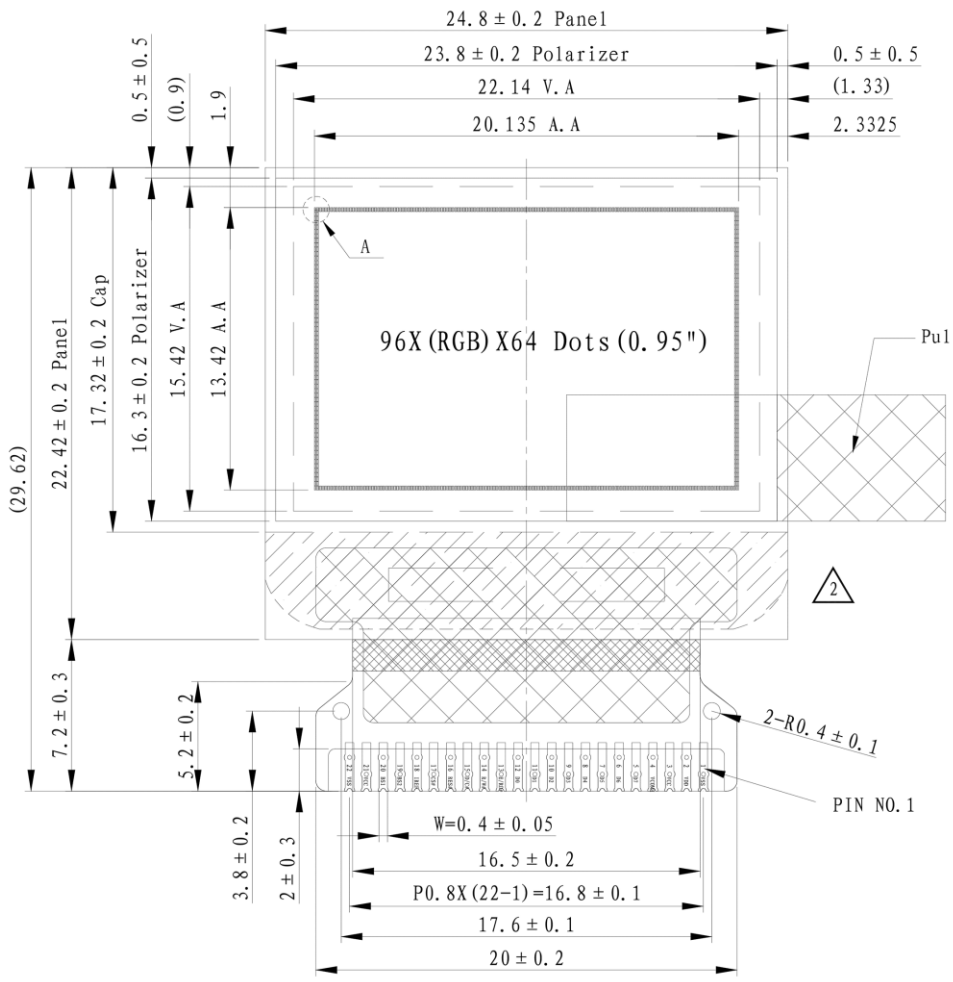
4. Mechanical Data

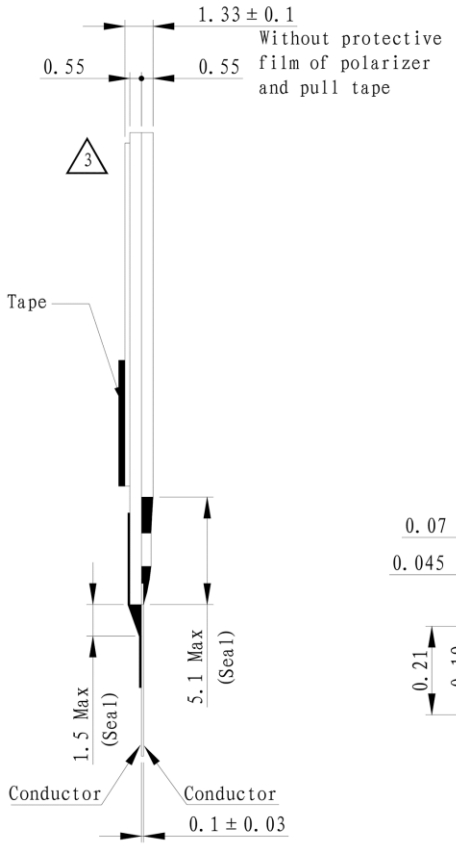
Item	Specification (mm)	Specification (inches, reference)
Module Dimension (with FPC)	24.80 (W) x 29.62 (H) x 1.33 (D)	0.976 (W) x 1.66 (H) x 0.052 (D)
Module Dimension (without FPC)	24.80 (W) x 22.42 (H)	0.976 (W) x 0.883 (H)
Viewing Area	22.14 (W) x 15.42 (H)	0.872 (W) x 0.607 (H)
Active Area	20.14 (W) x 13.42 (H)	0.793 (W) x 0.528 (H)
Dot Pitch	0.07 (W) x 0.21 (H)	0.003 (W) x 0.008 (H)
Dot Size	0.05 (W) x 0.19 (H)	0.002 (W) x 0.007 (H)
Module Pin Pitch	0.8	0.031
Weight (Typical)	1.46 grams	0.051 ounces

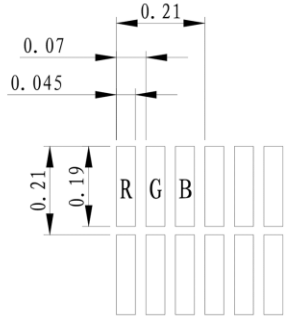
5. System Block Diagram



6. Mechanical Drawing







Pin Assignment	
NO.	SYMBOL
1	VSS
2	VDD
3	VCC
4	VCOMH
5	D7
6	D6
7	D5
8	D4
9	D3
10	D2
11	D1
12	D0
13	E/RD#
14	R/W#
15	D/C#
16	RES#
17	CS#
18	IREF
19	BS2
20	BS1
21	VCC
22	VSS

Tolerance is ±0.3 mm unless specified.

Crystalfontz America, Inc. www.crystalfontz.com/products	Part No.(s): CFAL9664B-F-B1	Scale: Not to scale	Drawing Number: CFAL9664B	
		Units: Millimeters		

7. Interface Pin Function

Pin No.	Symbol	Level	Function
1	GND	0v	Ground
2	V_{LOGIC}	+3.0v	Power Supply Input. Must be connected to an external source.
3	V_{PANEL}		Driver Supply Input. Only high voltage input on chip. Power must be supplied externally. Power Up – Display must be powered up and initialized before power is applied to the pin. Power Down – Power must be removed from this signal before the display is powered off. **NOTE**: You must observe power sequencing for this signal.
4	V_{COMH}		High level voltage output for common signals. A low ESR capacitor should be connected between this pin and GND. **IMPORTANT**: Do not connect external power supply directly to this pin.
5	DB7	H/L	Bidirectional data bus connects to 8-bit standard host data bus. In **6800** parallel mode: Pin 14 is used as R/W_{6800}. Pin 13 is used as E_{6800}. Data is input or output on DB0-DB7. In **8080** parallel mode: Pin 14 is used as WR_{8080}. Pin 13 is used as RD_{8080}. Data is input or output on DB0-DB7. In **SPI** mode, D0 will be SCLK, D1will be SDI and D2 should be left open.
6	DB6	H/L	
7	DB5	H/L	
8	DB4	H/L	
9	DB3	H/L	
10	DB2	H/L	
11	DB1	H/L	
12	DB0	H/L	
13	RD_{8080} (E_{6800})	H/L	Host Interface Input. **8080 Host**: Active low. Signal on the data bus is latched at the rising edge of RD. **6800 Host**: Enable control signal input active high. E=High: Read or Write operation is active. E=Low: No operation.
14	WR_{8080} (R/W_{6800})	H/L	Host Interface Input. **8080 Host**: Active low. Signal on the data bus is latched at the rising edge of WR signal. **6800 Host**: Read/Write control signal output. R/W=High: Read (Host ◄— Module). R/W=Low: Write (Host —► Module).
15	D/C	H/L	Data/Command Control. Determines whether data bits are data or command. 1 – High: Addresses the data register. 0 – Low: Addresses the command register.
16	RST	H/L	Reset Signal. **Low**: Display controller is reset. The RST pin should be pulsed low shortly after power is applied. **High**: Controller chip is not selected. Host interface signals are ignored by the controller.
17	CS	H/L	Chip Select Input. **Low**: Controller chip is selected. Communications with host is possible. **High**: Controller chip is not selected. Host interface signals are ignored by the controller.
18	I_{REF}	H/L	Segment output current reference for brightness adjustment. A resistor should be connected between this pin and GND. Used to set the current.

<table>
<tr><th>Pin No.</th><th>Symbol</th><th>Level</th><th>Direction</th><th>Function</th></tr>
<tr><td>19</td><td>BS2</td><td>H/L</td><td>I</td><td rowspan="2"><table><tr><th>BS1</th><th>BS2</th><th>Interface Mode</th></tr><tr><td>0</td><td>0</td><td>Serial</td></tr><tr><td>0</td><td>1</td><td>6800 Parallel</td></tr><tr><td>1</td><td>0</td><td>Not Allowed</td></tr><tr><td>1</td><td>1</td><td>8080 Parallel</td></tr></table></td></tr>
<tr><td>20</td><td>BS1</td><td>H/L</td><td>I</td></tr>
<tr><td>21</td><td>V_{PANEL}</td><td></td><td></td><td>Driver Supply Input. Only high voltage input on chip. Power must be supplied externally.
Power Up – Display must be powered up and initialized before power is applied to the pin.
Power Down – Power must be removed from this signal before the display is powered off.

NOTE: You must observe power sequencing for this signal.</td></tr>
<tr><td>22</td><td>GND</td><td>0v</td><td></td><td>Power Supply and Signal Ground. Must be connected to an external ground.</td></tr>
</table>

8. Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
Supply Voltage for Logic	V_{LOGIC}	-0.3	4.0	V
Supply Voltage for Driver	V_{PANEL}	0	18	V
Operating Temperature	T_{OP}	-30	+70	°C
Storage Temperature	T_{ST}	-30	+80	°C
Humidity	RH	0	90	%

Note: These are stress ratings only. Extended exposure to the absolute maximum ratings listed above may affect device reliability or cause permanent damage. Functional operation should be restricted to the limits in the Electrical Characteristics table below.

9. Electrical Characteristics

Item	Symbol	Condition	Min	Typ	Max
Supply Voltage for Logic	V_{LOGIC}	-	+2.4v	+2.7v	3.5v
Supply Voltage for Driver	V_{PANEL}		+12.5v	+13v	13.5v
Normal Mode Power Consumption		All pixels on V_{LOGIC} = 2.7v V_{PANEL} = 13v Frame Rate = 105 Hz Contrast Setting = 0x08		169 mW	195 mW
High-level Input	V_{IH}	-	0.8 x V_{LOGIC}	-	V_{LOGIC}
Low-level Input	V_{IL}	-	0v (GND)	-	0.2 x V_{LOGIC}
High-level Output	V_{OH}	-	0.9 x V_{LOGIC}	-	V_{LOGIC}
Low-level Output	V_{OL}	-	0v (GND)	-	0.1 x V_{LOGIC}
NOTE: The V_{PANEL} input must be a stable value with no ripple or noise.					

10. Optical Characteristics

Item	Symbol	Condition	Min	Typ	Max
View Angle	-	-	-	≥160°	-
Contrast Ratio	CR	Dark	≥2000:1	-	-
Response Time	-	-	-	<1 ms	-
Luminous Intensity (IV)	L_{BR}	With Polarizer	80 cd/m^2	100 cd/m^2	-
White Chromaticity	X	X,Y (CIE 1931)	0.26	0.30	0.34
	Y		0.28	0.32	0.36
Red Chromaticity	X		0.61	0.65	0.69
	Y		0.30	0.34	0.38
Green Chromaticity	X		0.25	0.29	0.33
	Y		0.54	0.58	0.62
Blue Chromaticity	X		0.10	0.14	0.18
	Y		0.12	0.16	0.20
Aperture	65%				

11. OLED Lifetime

Item	Conditions	Min	Notes
Operating Lifetime	Ta=25°C 50% checkerboard test pattern	10,000 hours	(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.

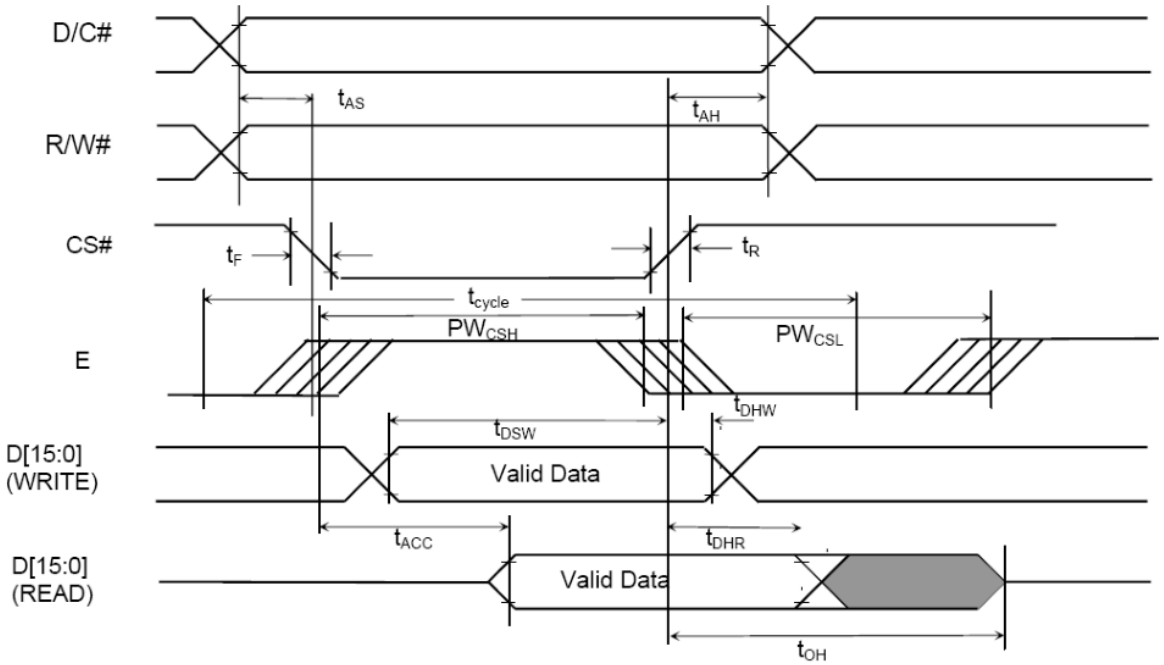
(3) Screen saving mode will extend OLED lifetime.

12. AC Electrical Characteristics

12.1. 6800-Series MPU Parallel Interface Timing Characteristics

Symbol	Parameter	Min	Typ	Max	Unit
t_{cycle}	Clock Cycle Time (write)	130			ns
PW_{CSL}	Control Pulse Low Width (write)	60			ns
PW_{CSH}	Control Pulse High Width (write)	60			ns
t_{cycle}	Clock Cycle Time (read)	200			ns
PW_{CSL}	Control Pulse Low Width (read)	100			ns
PW_{CSH}	Control Pulse High Width (read)	100			ns
t_{AS}	Address Setup Time	0			ns
t_{AH}	Address Hold Time	10			ns
t_{DSW}	Data Setup Time	40			ns
t_{DHW}	Data Hold Time	10			ns
t_{ACC}	Data Access Time			140	ns
t_{OH}	Output Hold Time			70	ns
t_R	Rise Time			15	ns
t_F	Fall Time			15	ns

(VDD - VSS = 2.4V to 3.5V, TA = 25°C)

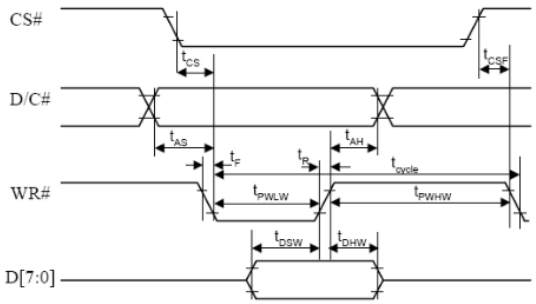


12.2. 8080-Series MPU Parallel Interface Timing Characteristics

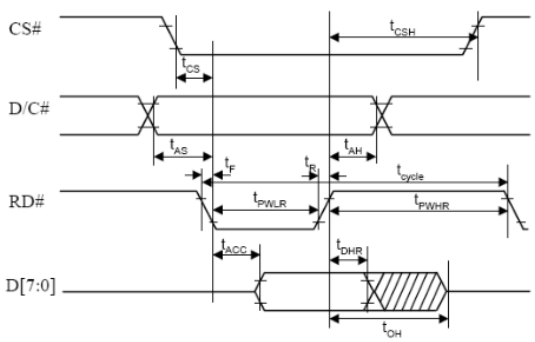
Symbol	Parameter	Min	Typ	Max	Unit
t_{CYCLE}	Clock Cycle Time	130			ns
t_{AS}	Address Setup Time	10			ns
t_{AH}	Address Hold Time	0			ns
t_{DSW}	Write Data Setup Time	40			ns
t_{DHW}	Write Data Hold Time	10			ns
t_{DHR}	Read Data Hold Time	20			ns
t_{OH}	Output Disable Time			70	ns
t_{ACC}	Access Time			140	ns
t_{PWLR}	Read Low Time	150			ns
t_{PWLW}	Write Low Time	60			ns
t_{PWHR}	Read High Time	60			ns
t_{PWHW}	Write High Time	60			ns
t_R	Rise Time			15	ns
t_F	Fall Time			15	ns
t_{CS}	Chip Select Setup Time	0			ns
t_{CSH}	Chip Select Hold Time (read)	0			ns
t_{CSF}	Chip Select Hold Time	20			ns

(VDD - VSS = 2.4V to 3.5V, TA = 25°C

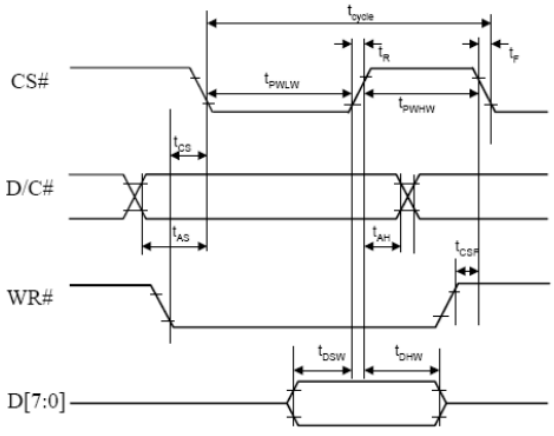
Write cycle (Form 1)



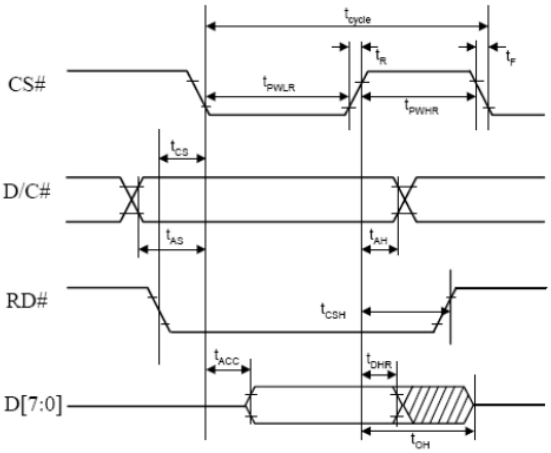
Read cycle (Form 1)



Write cycle (Form 2)



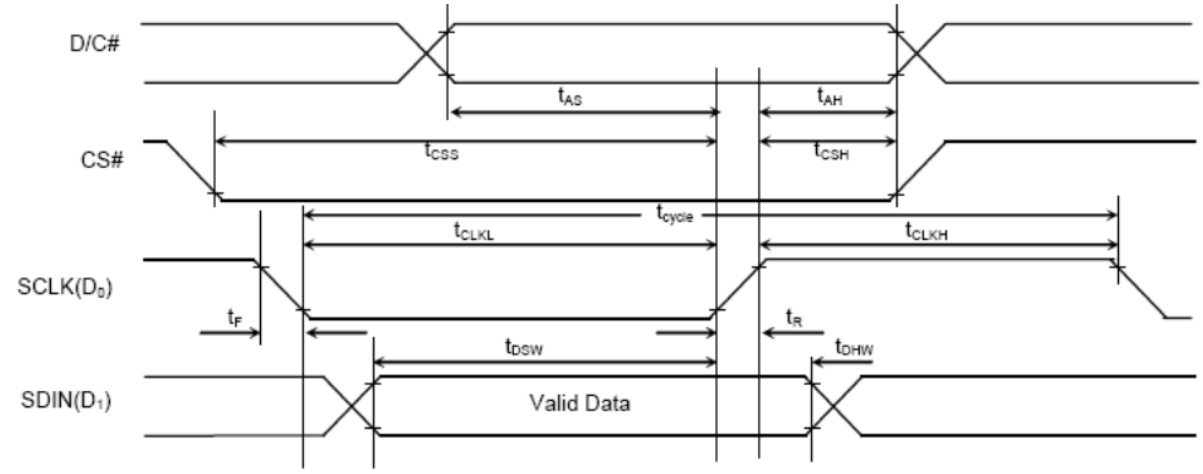
Read cycle (Form 2)

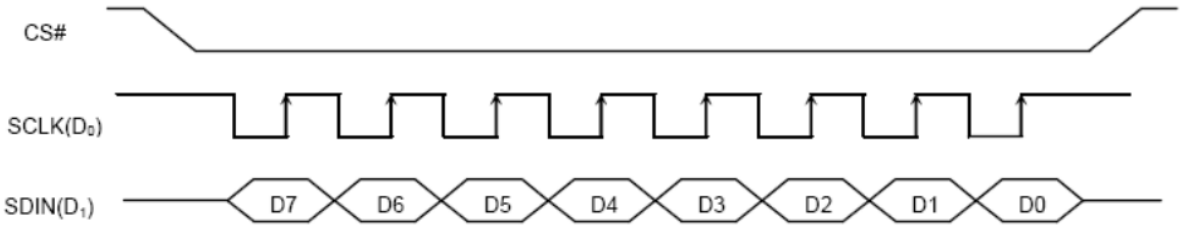


12.3. Serial Interface Timing Characteristics

Symbol	Parameter	Min	Typ	Max	Unit
t_{CYCLE}	Clock Cycle Time	150			ns
t_{AS}	Address Setup Time	40			ns
t_{AH}	Address Hold Time	40			ns
t_{CS}	Chip Select Setup Time	75			ns
t_{CSH}	Chip Select Hold Time (read)	60			ns
t_{DSW}	Write Data Setup Time	40			ns
t_{DHW}	Write Data Hold Time	40			ns
t_{CLKL}	Clock Low Time	75			ns
t_{CLKH}	Clock High Time	75			ns
t_R	Rise Time			15	ns
t_F	Fall Time			15	ns

(VDD - VSS = 2.4V to 3.5V, TA = 25°C)

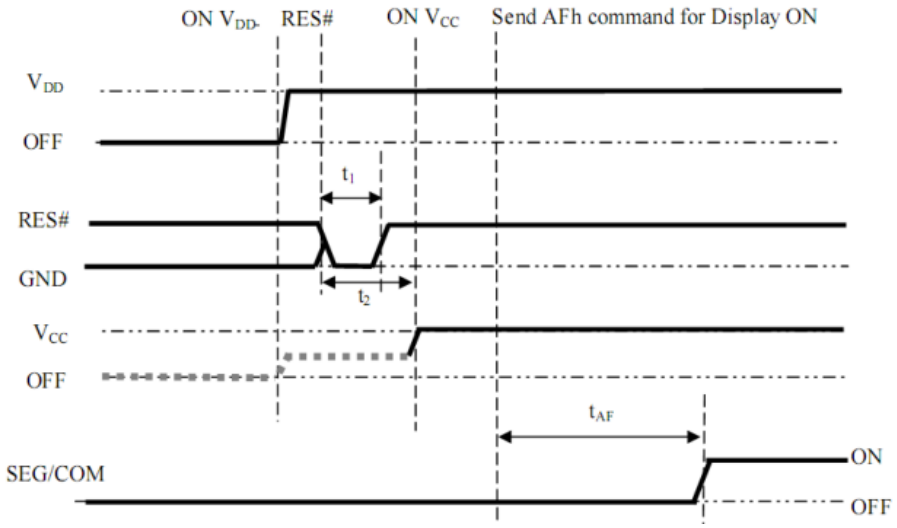




13. Functional Specification

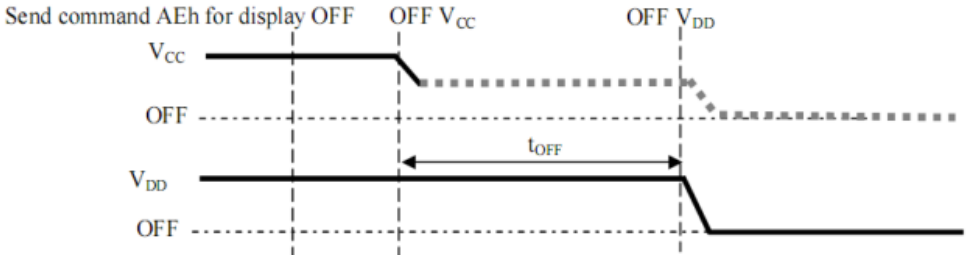
13.1. Power On Sequence

1. Power on V_{DD}.
2. After V_{DD} become stable, set RES pin low (logic low) for at least 3us (t_1)[4] and then high (logic high).
3. Set RES# pin low (logic low), wait for at least 3us (t_2), then power on V_{CC}[1].
4. After V_{CC} become stable, send command AFh for display on. SEG/COM will be on after 100ms(t_{AF}).



13.2. Power Off Sequence

1. Send command AEh for display off.
2. Power off V_{CC} [1],[2],[3].
3. Power off V_{DD} after t_{OFF} [5]. (Typical t_{OFF}=100ms)



Notes:

(1) Since an ESD protection circuit is connected between V_{DD} and V_{CC}, V_{CC} becomes lower than V_{DD} whenever V_{DD} is on and V_{CC} is off as shown in the dotted line of V_{CC} in above figures.

(2) V_{CC} should be kept float (disable) when it is off.

(3) Power pins (V_{DD} ,V_{CC}) can never be pulled to ground under any circumstance.

(4) The register values are reset after t_1.

(5) V_{DD} should not be power off before V_{CC} power off.

14. 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.

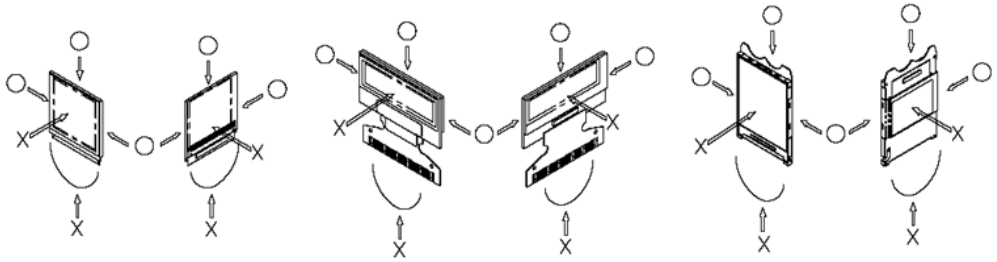
14.1. Modules

- 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.).

14.2. 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.

14.3. 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.

14.4. 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.

14.5. 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.

14.6. 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: