



Crystalfontz America, Incorporated

GRAPHIC OLED MODULE SPECIFICATIONS



Crystalfontz Model Number	CFAL12822A-Y-B1
Hardware Version	Version A, April 2009
Data Sheet Version	Revision 1.1, December 2009
Product Pages	www.crystalfontz.com/product/CFAL12822AYB1.html

Crystalfontz America, Incorporated

12412 East Saltese Avenue
Spokane Valley, WA 99216-0357

Phone: 888-206-9720

Fax: 509-892-1203

Email: techinfo@crystalfontz.com

URL: www.crystalfontz.com



REVISION HISTORY

HARDWARE	
2009/04/27	Current hardware version: vA New module.

DATA SHEET	
2009/12/21	<p>Current Data Sheet version: v1.1 Since last Data Sheet (v1.0):</p> <ul style="list-style-type: none"> ● Wherever listed, corrected specification of overall module depth in inches. Module dimensions did not change. <ul style="list-style-type: none"> - Changed maximum from “0.89” to “0.09” inches. - Changed nominal from “0.85” to “0.08” inches. ● Fixed broken cross-reference for Absolute Maximum Ratings (Pg. 15). ● Corrected mention of “TFT” to “OLED” in APPENDIX C: OLED MODULE TERMS AND SYMBOLS (Pg. 31).
2009/11/12	<p>Data Sheet version: v1.0 Since last Data Sheet (no version number, unmarked Preliminary):</p> <ul style="list-style-type: none"> ● Moved specifications into standard Graphic OLED template. ● In Physical Characteristics (Pg. 8) (previously “General Specifications”): <ul style="list-style-type: none"> - Corrected “Viewing Area” <i>height</i> from “13.7” to “13.85” millimeters. Viewing Area is unchanged and was correct in the 2009/04/13 Contour Drawing of the Preliminary version. - Changed “Module Dimension” <i>height</i> from “23.5” millimeters (which is OLED panel height) to “33.52” (OLED panel with FFC fold) and “59.50” (OLED panel with FFC unfolded). - Expanded “Module Dimension” <i>depth</i> description from “2.15” to <i>nominal depth</i> “2.15” and <i>maximum depth</i> “2.25” millimeters. - Added specifications for “Diagonal”, “FFC Bend Radius”, “Module Connector Pitch”, and “Weight”. ● Deleted “Contour Drawing” date 2008/12/29 on page 7. This was an outdated duplicate of a second Contour Drawing date 2009/04/13 on page 8. Descriptions in second Contour Drawing were updated. No dimensions changed. See Module Outline Drawings (Pg. 9). ● In Absolute Maximum Ratings (Pg. 15): <ul style="list-style-type: none"> - Changed V_{LOGIC} (Logic Supply Voltage) minimum from “-0.3v” to “2.4v”. - Added V_{PANEL} (Driver Supply Voltage) and Humidity specifications. ● Expanded “Precautions in use of OLED Modules” with important information on design, hot bar soldering, and cleaning. See CARE AND HANDLING PRECAUTIONS (Pg. 22).



DATA SHEET	
<i>Continued from previous page.</i>	
2009/11/12	<ul style="list-style-type: none">● Clarified and expanded electrical characteristics. See DC Characteristics (Pg. 16). Slight change in V_{IH} specification from "+2.4v" to "+2.64v".● In Details of Interface Pin Function (Pg. 17), used CrystalFontz standard terms for signals and improved descriptions.● Improved illustrations include adding:<ul style="list-style-type: none">- More details in System Block Diagram (Pg. 12).- Circuit example using Micrel MIC2290 for V_{PANEL} (see Circuit Example – Externally Supplied for Display (Pg. 13)).- Illustration to explain Power Up and Power Down Sequencing (Pg. 14).- Photo with pins labeled (see Photo Reference for ZIF Connector Pin Functions (Pg. 19)).- Definition of Viewing Angle in Optical Characteristics (Pg. 20).● Also added these new sections:<ul style="list-style-type: none">- MAIN FEATURES (Pg. 6).- ESD (Electro-Static Discharge) (Pg. 19).- MODULE RELIABILITY AND LONGEVITY (Pg. 21).- APPENDIX A: QUALITY ASSURANCE STANDARDS (Pg. 24).- APPENDIX B: SAMPLE CODE (Pg. 28).- APPENDIX C: OLED MODULE TERMS AND SYMBOLS (Pg. 31).- APPENDIX D: SOLOMON SYSTECH SSD1305 CONTROLLER SPECIFICATION SHEET (Pg. 36).● Deleted information that is repeated in the appended controller specifications.● This module can be ordered as part of a CFA10009 demonstration board kit. The <i>CFA10009 User Guide</i> was added at the end of this Data Sheet.
2009/04/27	Data Sheet version: No version number (unmarked Preliminary) New Data Sheet.



The Fine Print

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MAIN FEATURES

DEMONSTRATION AND EVALUATION PLATFORM

This module is available installed on a CrystalFontz CFA-10009 Demonstration PCB. The [DMO-L12822AYB1](#) kit has everything you need to easily demonstrate and experiment with the module. The kit can also be used as a reference for your designs.

COMPARISON TO LCD (LIQUID CRYSTAL DISPLAY) MODULE

The CFAL12822A-Y-B1 is a monochrome 128 x 22 dot matrix Organic Light-Emitting Diode (OLED) display module. The small size, and ultrathin form factor of the CFAL12822A-Y-B1 makes it possible to use this OLED module in applications where it would be difficult or impossible to fit a traditional LCD module. The module's small size makes it possible to use the CFAL12822A-Y-B1 in space constrained applications such as a status display on a disk drive or server blade. Because of the low power requirements, the CFAL12822A-Y-B1 is suitable in battery powered portable devices such as remote controls and scientific meters (for example, temperature, sound, and gas detection).

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.

FEATURES

- 128 x 22 module consists of an OLED panel, a COG (Chip On Glass) driver IC, and an FFC (Flat Flexible Cable) that mates with a ZIF connector.
- Module Dimensions
 - Active Area is 2.36" diagonal, 58.85 (W) x 11.85 (H) millimeters (2.32" (W) x 0.47" (H)).
 - Overall module dimension with FFC *unfolded* is 65.00 (W) x 59.50 (H) x 2.25 maximum (D) mm (2.56" (W) x 2.34" (H) x 0.09" maximum (D)).
 - Overall module dimension with FFC *folded* is 65.00 (W) x 33.52 (H) x 2.25 maximum (D) mm (2.56" (W) x 1.32" (H) x 0.09" maximum (D)).
- 8-bit parallel (8080 or 6800) interface or SPI Interface.
- Built-in Solomon Systech [SSD1305](#) or compatible controller.
- Emissive monochrome display. Display yellow pixels on dark area or dark pixels on yellow area (if operating with display pixels reversed/inverted).
- CFAL12822A-Y-B1 mates with standard 0.5 mm 24-pin ZIF sockets such as [OR721CT-ND](#), [OR709CT-ND](#), and [OR877CT-ND](#).
- Very high contrast ratio.
- Extremely wide viewing angle is >160°.
- Wide temperature operation is -20°C to +70°C.
- RoHS compliant.



MODULE CLASSIFICATION INFORMATION

CFA L 128 22 A - Y - B1
① ② ③ ④ ⑤ ⑥ ⑦

①	Brand	CrystalFontz America, Inc.
②	Display Type	L – OLED
③	Number of Pixels (Width)	128 pixels
④	Number of Pixels (Height)	22 pixels
⑤	Model Identifier	A
⑥	Display Color	Y – Yellow
⑦	Special Codes 1	B1 – Manufacturer's codes



MECHANICAL SPECIFICATIONS

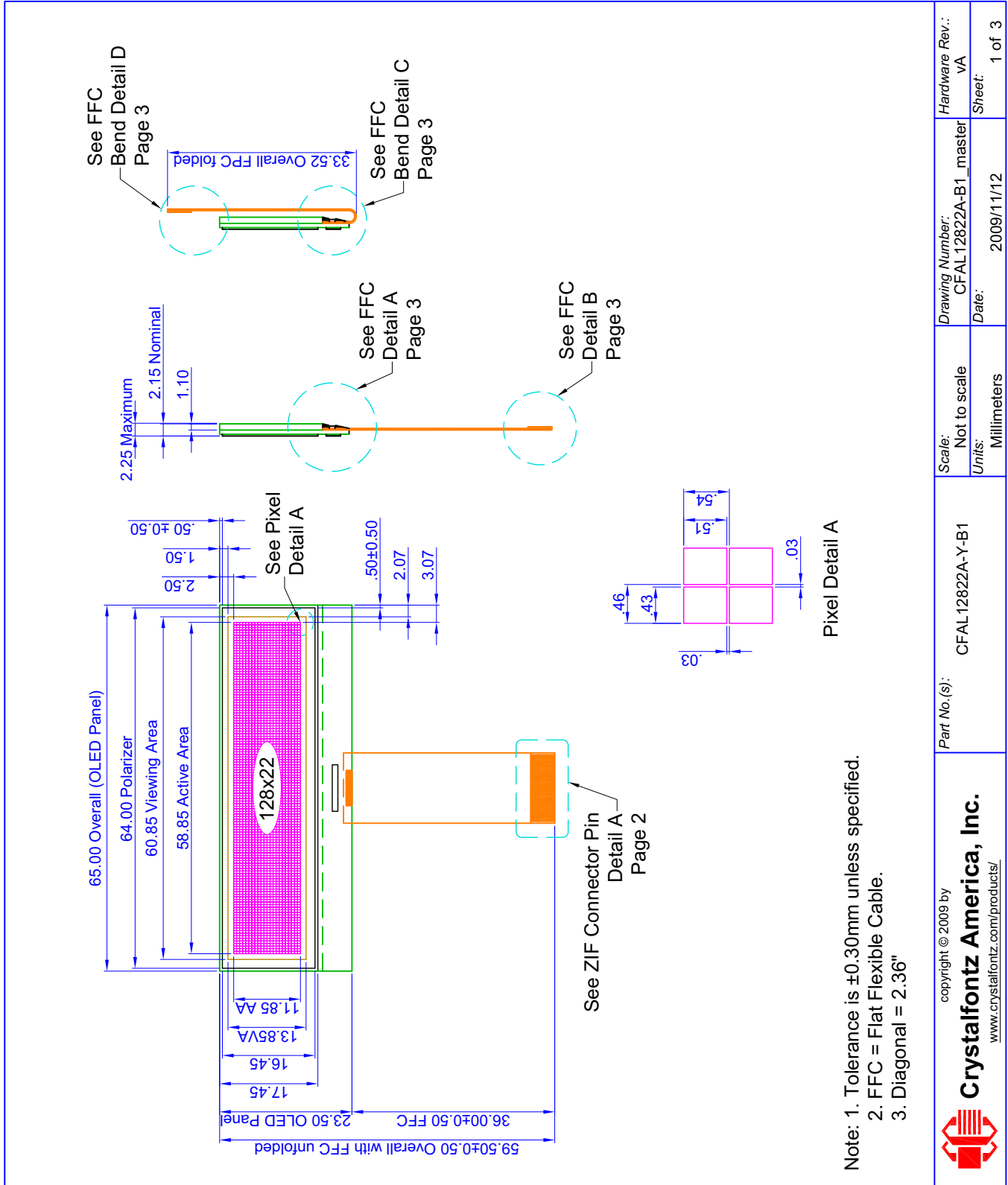
PHYSICAL CHARACTERISTICS

ITEM	SIZE
Pixels	
Number of Pixels	128 x 22 pixels = 2,816 pixels
Pixel Size	0.43 (W) x 0.51 (H) mm
Pixel Pitch	0.46 (W) x 0.54 (H) mm
Viewing Area Width and Height	Millimeters: 60.85 (W) x 13.85 (H) mm Inches: 2.40" (W) x 0.55" (H)
Active Area	
Diagonal	Inches: 2.36"
Width and Height	Millimeters: 58.85 (W) x 11.85 (H) mm Inches: 2.32" (W) x 0.47" (H)
Overall Module Outline Dimensions	
Width	Millimeters: 65.00 mm Inches: 2.56"
Height with FFC unfolded	Millimeters: 59.50 mm Inches: 2.34"
Height with FFC folded	Millimeters: 33.52 mm Inches: 1.32"
FFC Bend Radius	>R 1.28 mm
Module Depth	Maximum: Millimeters: 2.25 mm Inches: 0.09" Nominal: Millimeters: 2.15 mm Inches: 0.08"
Module Connector Pitch	Standard 0.5mm 24-pin ZIF socket
Weight	5 grams (typical)

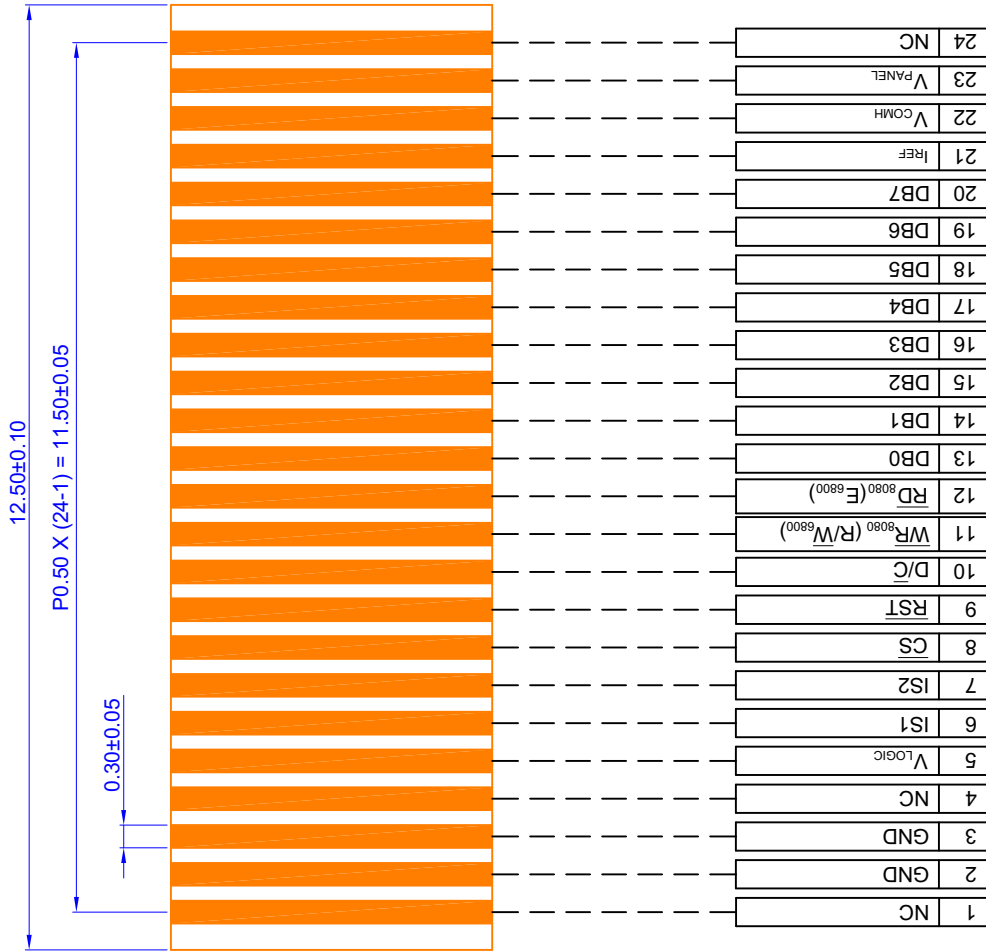


MODULE OUTLINE DRAWINGS

Figure 1. Module Outline Drawings (next 3 pages)



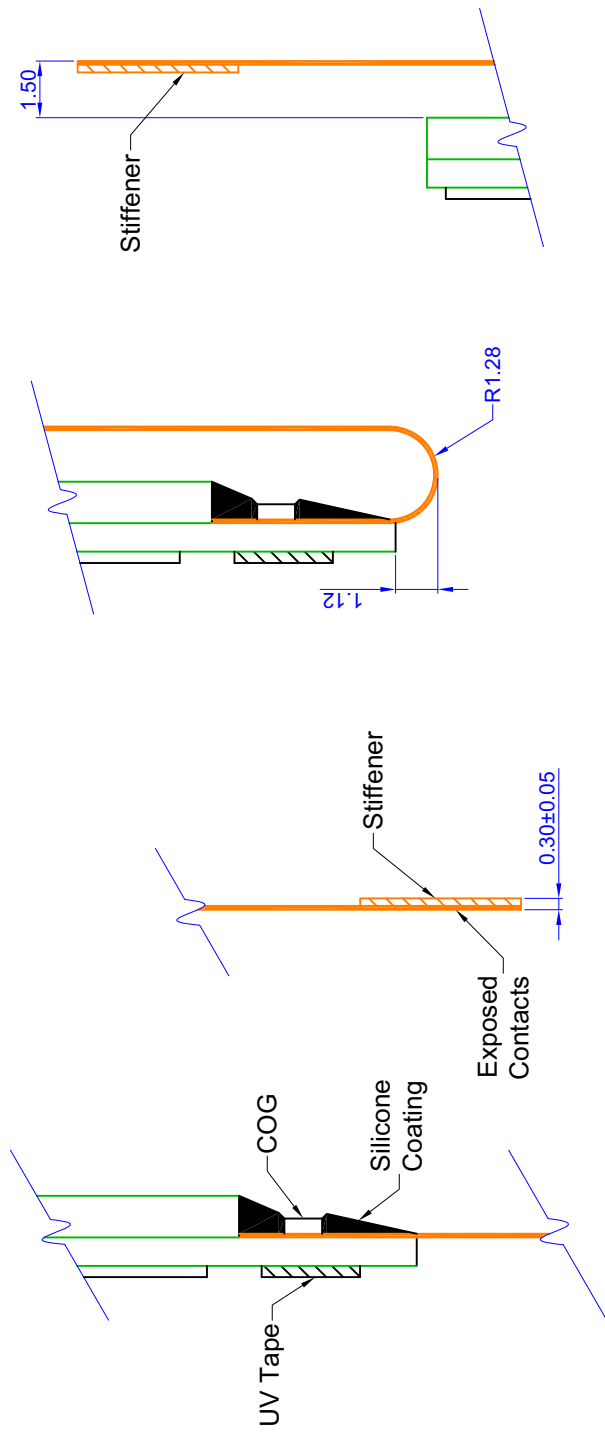
Part No. (s): CFAL12822A-Y-B1	Scale: Not to scale	Drawing Number: CFAL12822A-B1_master	Hardware Rev.: vA
	Units: Millimeters	Date: 2009/11/12	Sheet: 1 of 3



(A) ZIF Connector Pin Detail

- Note: 1. Tolerance is ±0.30mm unless specified.
 2. FFC = Flat Flexible Cable.
 3. Diagonal = 2.36"

 CrystalFontz America, Inc. www.crystalfontz.com/products/	Part No.(s):	CFAL12822A-Y-B1	Scale:	Not to scale	Drawing Number:	CFAL12822A-B1_master	Hardware Rev.:	vA
	copyright © 2009 by		Units:	Millimeters	Date:	2009/11/12	Sheet:	2 of 3



(D) FFC Bend Detail

(C) FFC Bend Detail

(B) FFC Detail

(A) FFC Detail

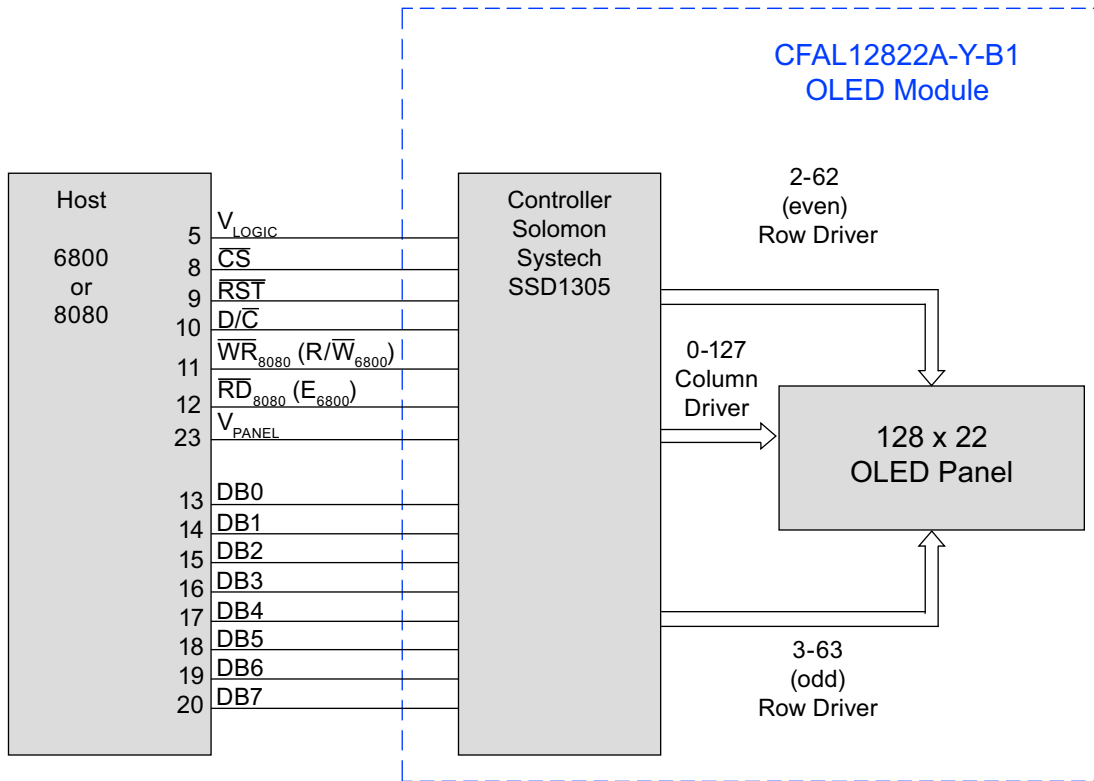
- Note: 1. Tolerance is ± 0.30 mm unless specified.
 2. FFC = Flat Flexible Cable.
 3. Diagonal = 2.36"

 CrystalFontz America, Inc. <small>copyright © 2009 by www.crystalfontz.com/products/</small>	Part No.(s): CFAL12822A-Y-B1	Scale: Not to scale Units: Millimeters	Drawing Number: CFAL12822A-B1_master Date: 2009/11/12	Hardware Rev.: vA Sheet: 3 of 3



ELECTRICAL SPECIFICATIONS

SYSTEM BLOCK DIAGRAM



Note: Some pins omitted.

Figure 2. System Block Diagram



CIRCUIT EXAMPLE – EXTERNALLY SUPPLIED FOR DISPLAY

The [Micrel MIC2290](#) is one of many possible V_{PANEL} supply solutions.

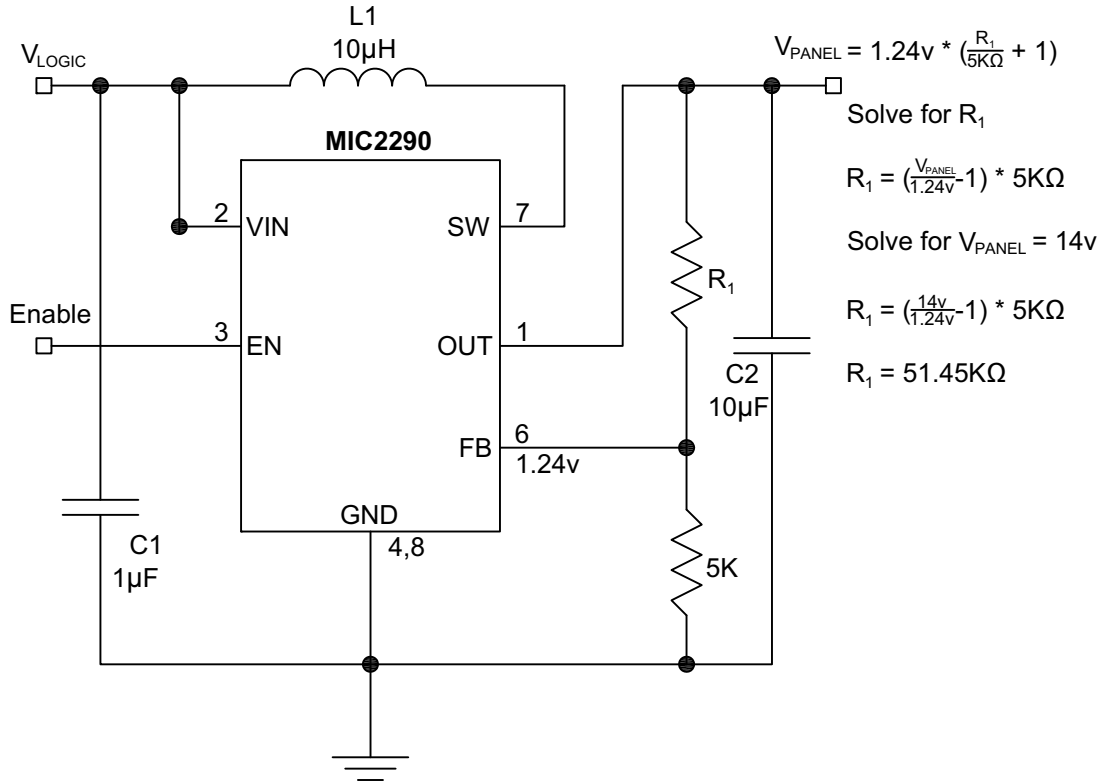


Figure 3. Circuit Example – External Supply for Display

Please refer to the Micrel MIC2290 datasheet for design details. See <http://micrel.com/page.do?page=/product-info/products/mic2290.shtml>.



POWER UP AND POWER DOWN SEQUENCING

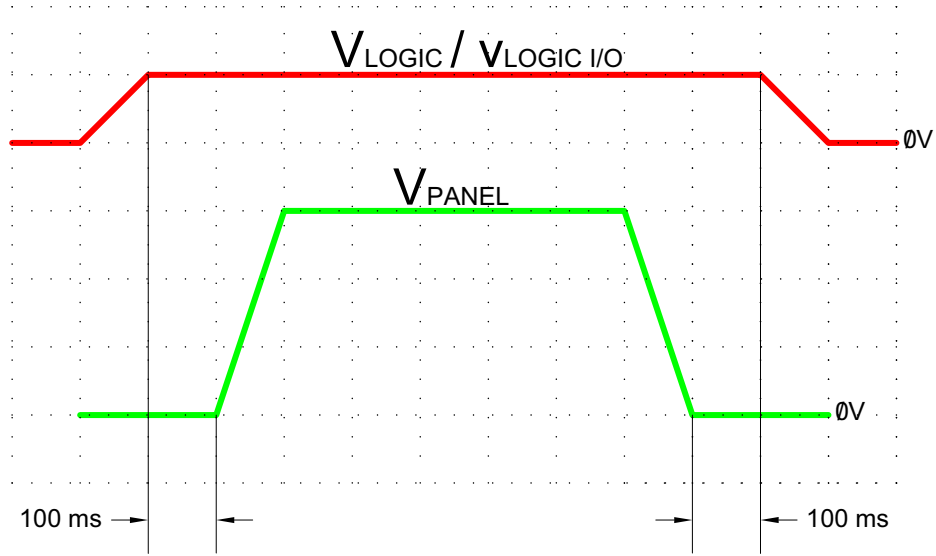


Figure 4. Power Up and Power Down Sequencing



ABSOLUTE MAXIMUM RATINGS

ABSOLUTE MAXIMUM RATINGS	SYMBOL	MINIMUM	MAXIMUM
Operating Temperature*	T _{OP}	-20°C	+70°C
Storage Temperature*	T _{ST}	-30°C	+80°C
Humidity	RH	0%	90%
Logic Supply Voltage	V _{LOGIC}	+2.4v	+3.5v
Driver Supply Voltage	V _{PANEL}	+12v	+16v
<i>*Prolonged exposure at temperatures outside of this range may cause permanent damage to the module.</i>			



DC CHARACTERISTICS

DC CHARACTERISTICS	TEST CONDITION	SYMBOL	MINIMUM	TYPICAL	MAXIMUM
Logic Supply Voltage	$T_{OP} = -20^{\circ}C$ to $+70^{\circ}C$	V_{LOGIC}	+2.4v	+3.0v	+3.5v ¹
OLED Driver Supply Voltage ²	$T_{OP} = -20^{\circ}C$ to $+70^{\circ}C$	V_{PANEL}	+12v	+14v	+16v
Input High Voltage		V_{IH}	$+0.8v \times V_{Logic}$ For $V_{Logic} = +3.3v$ $V_{IH} = +0.8v \times +3.3v = +2.64v$		V_{Logic}
Input Low Voltage		V_{IL}	0v (GND)		$+0.2v \times V_{Logic}$ For $V_{Logic} = +3.3v$ $V_{IL} = +0.2v \times +3.3v = +0.66v$
Output High Voltage	$I_{OUT} = 100\mu A$ 3.3MHz	V_{OH}	$+0.9v \times V_{Logic}$ For $V_{Logic} = +3.3v$ $V_{OH} = +0.9v \times +3.3v = +2.97v$		V_{Logic}
Output Low Voltage	$I_{OUT} = 100\mu A$ 3.3MHz	V_{OL}	0v (GND)		$+0.1v \times V_{Logic}$ For $V_{Logic} = +3.3v$ $V_{OL} = +0.1v \times +3.3v = +0.33v$
Total Power	All pixels on $V_{LOGIC} = +3.0v$ $V_{PANEL} = +14.0v$ 80 cd/m ² $T_{OP} = 25^{\circ}C$	P_T		154 mW	300 mW

¹Do not exceed +3.5v maximum.

²The V_{PANEL} input must be a stable value with no ripple or noise.

This is a summary of the module's major operating parameters. For detailed information see [APPENDIX D: SOLOMON SYS-TECH SSD1305 CONTROLLER SPECIFICATION SHEET \(Pg. 36\)](#).



DETAILS OF INTERFACE PIN FUNCTION

PIN	SIGNAL	LEVEL	DIRECTION	DESCRIPTION															
1	NC			No Connection															
2	GND	0v		Ground. Must be connected to an external ground.															
3	GND	0v		Ground. Must be connected to an external ground.															
4	NC			No Connection															
5	V _{LOGIC}	+2.4v to +3.5v		Power supply input. Must be connected to an external source.															
6	IS1	H/L	I	<table border="1"> <thead> <tr> <th>IS1</th> <th>IS2</th> <th>Interface Mode</th> </tr> </thead> <tbody> <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> </tbody> </table>	IS1	IS2	Interface Mode	0	0	Serial	0	1	6800 Parallel	1	0	Not Allowed	1	1	8080 Parallel
IS1	IS2	Interface Mode																	
0	0	Serial																	
0	1	6800 Parallel																	
1	0	Not Allowed																	
1	1	8080 Parallel																	
7	IS2	H/L	I																
8	$\overline{\text{CS}}$	H/L	I	Chip select input. <i>Low:</i> Controller chip is selected. Communications with the host MPU is possible. <i>High:</i> Controller chip is not selected. MPU interface signals are ignored by the controller.															
9	$\overline{\text{RST}}$	L	I	Reset signal. <i>Low:</i> Display controller is reset. The $\overline{\text{RST}}$ pin should be pulsed low shortly after power is applied. <i>High:</i> The RST pin should be brought high for normal operation.															
10	D/ $\overline{\text{C}}$	H/L	I	Data/Command control. Determines whether data bits are data or command. <i>1 – High:</i> Addresses the data register. <i>2 – Low:</i> Addresses the command register.															
11	$\overline{\text{WR}}_{8080}$ ($\text{R}/\overline{\text{W}}_{6800}$)	H/L	I	Host interface input. <i>8080 Host:</i> Active low. Signal on the data bus is latched at the rising edge of $\overline{\text{WR}}$ signal. <i>6800 Host:</i> read/write control signal output. $\text{R}/\overline{\text{W}} = \text{High}$: Read (Host←Module) $\text{R}/\overline{\text{W}} = \text{Low}$: Write (Host→Module)															



PIN	SIGNAL	LEVEL	DIRECTION	DESCRIPTION
12	\overline{RD}_{8080} (E_{6800})	H/L	I	Host interface input. <i>8080 Host:</i> Active low. Signal on the data bus is latched at the rising edge of \overline{WR} signal. <i>6800 Host:</i> Enable control signal input active high. <i>E = High:</i> Read or Write Active <i>E = Low:</i> No Read or Write Active
13	DB0	H/L	I/O	Bidirectional data bus connects to 8-bit standard host data bus. <i>In serial mode (IS1=0, IS2=0):</i> DB0 serves as the serial clock input signal (SCL) and DB1 serves as the serial data input pin (SI). DB2-DB7 are high impedance. In serial mode, data can be written to the display but not read. Pin 11 (\overline{WR}_{8080} (R/\overline{W}_{6800})) and pin12 (\overline{RD}_{8080} (E_{6800})) are unused and should be tied low. <i>In 6800 Parallel mode:</i> Pin 11 is used as R/\overline{W}_{6800} . Pin 12 is used as E_{6800} . Data is input or output on DB0-DB7. <i>In 8080 Parallel mode:</i> Pin 11 is used as \overline{WR}_{8080} . Pin 12 is used as \overline{RD}_{8080} . Data is input or output on DB0-DB7.
14	DB1	H/L	I/O	
15	DB2	H/L	I/O	
16	DB3	H/L	I/O	
17	DB4	H/L	I/O	
18	DB5	H/L	I/O	
19	DB6	H/L	I/O	
20	DB7	H/L	I/O	
21	I_{REF}		O	Segment output current reference for brightness adjustment. A resistor should be connected between this pin and GND. Set the current at 10 μ A.
22	V_{COMH}		O	High level voltage output for common signals. A low ESR capacitor should be connected between this pin and GND. Do not connect external power supply directly to this pin.
23	V_{PANEL}	+12v to +16v	I	Only high voltage input on chip. Power must be supplied externally. <i>Note: You must observe power sequencing for this pin.</i> <i>Power Up</i> – Display must be powered up and initialized before power is applied to the pin. <i>Power Down</i> – Power must be removed from this pin before the display is powered off.
24	NC			No Connection



PHOTO REFERENCE FOR ZIF CONNECTOR PIN FUNCTIONS

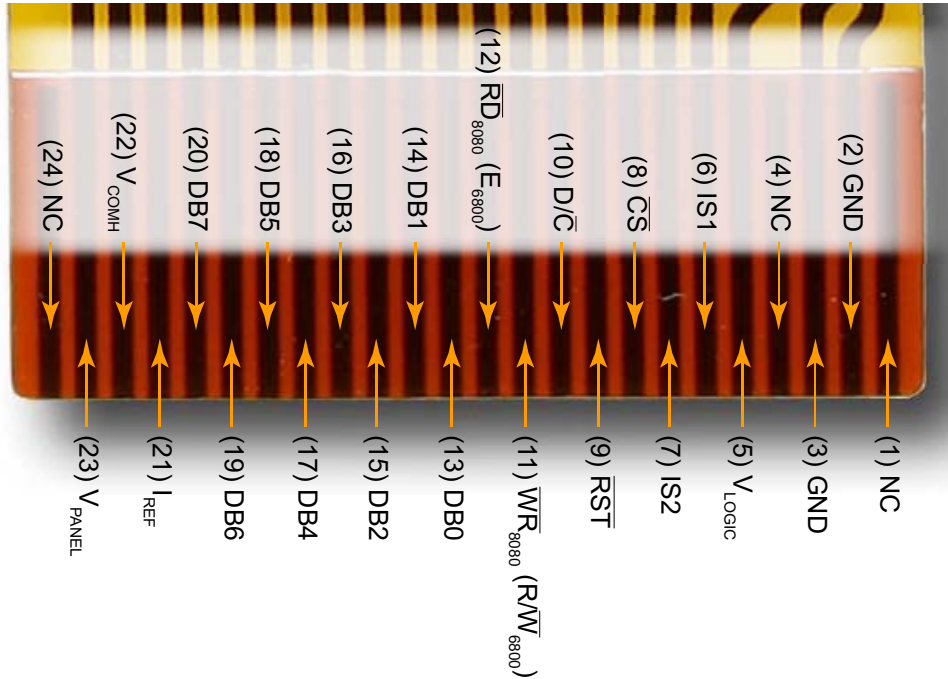


Figure 5. Back View of ZIF Connector Pins (Labeled)

ESD (ELECTRO-STATIC DISCHARGE)

The circuitry is industry standard CMOS logic and susceptible to ESD damage. Please use industry standard antistatic precautions as you would for any other static sensitive devices such as expansion cards, motherboards, or integrated circuits. Ground your body, work surfaces, and equipment.



OPTICAL SPECIFICATIONS

OPTICAL CHARACTERISTICS

ITEM	SYMBOL	TEST CONDITION	MINIMUM	TYPICAL	MAXIMUM
Viewing Angle				>160°	
Dark Room Contrast Ratio ¹	CR	80 cd/m ²		>100:1	
Response Time ²				<1 ms	
Luminous Intensity (IV)	L _{BR}	with polarizer		80 cd/m ²	
Duty	1/64				

¹Contrast Ratio = (brightness with pixels light)/(brightness with pixels dark).
²Response Time: The amount of time it takes a pixel to change from active to inactive or back again.

Definition of Viewing Angle

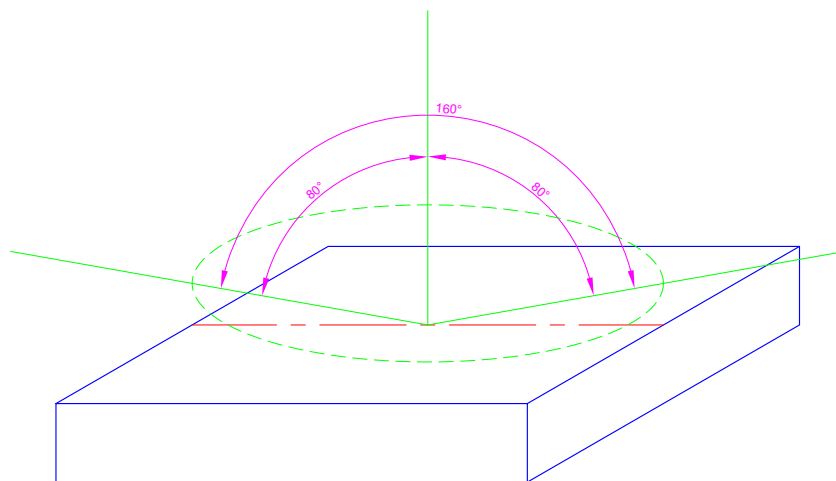


Figure 6. CFAL12822A-Y-B1 has a 160° Viewing Angle



OLED CONTROLLER INTERFACE

This module uses a Solomon Systech SSD1305 or compatible controller. For your reference, we added [APPENDIX D: SOLOMON SYSTECH SSD1305 CONTROLLER SPECIFICATION SHEET \(Pg. 36\)](#) to this Data Sheet.

MODULE RELIABILITY AND LONGEVITY

MODULE RELIABILITY

ITEM	SPECIFICATION
CFAL12822A-Y-B1	10,000 hours >50% of initial brightness at typical brightness for a new module.

OLED displays are an emissive technology. Each pixel is susceptible to dimming based on its individual use (burn-in). Frequently used pixels will dim more quickly than pixels that are not used as often. Please avoid using a bright, static, high-contrast image for a long time. If you want to leave the display powered on, please use scrolling text or alternating images to "wear level" the pixels. To conserve power and display lifetime, turn off or dim the display when it is not in use.

MODULE LONGEVITY (EOL / REPLACEMENT POLICY)

Crystalfontz is committed to making all of our modules available for as long as possible. For each module we introduce, we intend to offer it indefinitely. We do not preplan a module's obsolescence. The majority of modules we have introduced are still available.

We recognize that discontinuing a module may cause problems for some customers. However, rapidly changing technologies, component availability, or low customer order levels may force us to discontinue ("End of Life", EOL) a module. For example, we must occasionally discontinue a module when a supplier discontinues a component or a manufacturing process becomes obsolete. When we discontinue a module, we will do our best to find an acceptable replacement module with the same fit, form, and function.

In most situations, you will not notice a difference when comparing a "fit, form, and function" replacement module to the discontinued module. However, sometimes a change in component or process for the replacement module results in a slight variation, perhaps an improvement, over the previous design.

Although the replacement module is still within the stated Data Sheet specifications and tolerances of the discontinued module, changes may require modification to your circuit and/or firmware. Possible changes include:

- *Controller.* A new controller may require minor changes in your code.
- *Component tolerances.* Module components have manufacturing tolerances. In extreme cases, the tolerance stack can change the visual or operating characteristics.

Please understand that we avoid changing a module whenever possible; we only discontinue a module if we have no other option. We will post Part Change Notices on the product's webpage as soon as possible. If interested, you can subscribe to future part change notifications.



CARE AND HANDLING PRECAUTIONS

For optimum operation of the module and to prolong its life, please follow the precautions below. Excessive voltage will shorten the life of the module. You must drive the display within the specified voltage limit. (See [Absolute Maximum Ratings \(Pg. 15\)](#)).

ESD (ELECTRO-STATIC DISCHARGE)

The circuitry is industry standard CMOS logic and susceptible to ESD damage. Please use industry standard antistatic precautions as you would for any other static sensitive devices such as expansion cards, motherboards, or integrated circuits. Ground your body, work surfaces, and equipment.

DESIGN AND MOUNTING

- CFAL12822A-Y-B1 mates with standard 0.5 mm 24-pin ZIF sockets such as [OR721CT-ND](#), [OR709CT-ND](#), and [OR877CT-ND](#).
- The exposed surface of the “glass” is actually a polarizer laminated on top of the glass. To protect the soft plastic polarizer from damage, the module ships with a protective film over the polarizer. Please peel off the protective film slowly. Peeling off the protective film abruptly may generate static electricity.
- The polarizer is made out of soft plastic and is easily scratched or damaged. When handling the module, avoid touching the polarizer. Finger oils are difficult to remove.
- To protect the soft plastic polarizer from damage, place a transparent plate (for example, acrylic, polycarbonate, or glass) in front of the module, leaving a small gap between the plate and the display surface. We use GE HP-92 Lexan, which is readily available and works well.
- Do not disassemble or modify the module.
- Do not reverse polarity to the power supply connections. Reversing polarity will immediately ruin the module.
- Use care to keep the exposed terminals clean. Contamination, including fingerprints, may make the reliability of the connection poor.
- Sharp bends can damage the FFC. Do not crease FFC. Do not bend FFC tightly against the edge of the OLED panel.
- Do not repeatedly bend the FFC beyond its elastic region.

AVOID SHOCK, IMPACT, TORQUE, OR TENSION

- Do not expose the module to strong mechanical shock, impact, torque, or tension.
- Do not drop, toss, bend, or twist the module.
- Do not place weight or pressure on the module.



CLEANING

- The polarizer (laminated to the glass) is soft plastic. The soft plastic is easily scratched or damaged. Be very careful when you clean the polarizer.
- Do not clean the polarizer with liquids. Do not wipe the polarizer with any type of cloth or swab (for example, Q-tips).
- Use the removable protective film to remove smudges (for example, fingerprints) and any foreign matter. If you no longer have the protective film, use standard transparent office tape (for example, Scotch® brand “Crystal Clear Tape”). If the polarizer is dusty, you may carefully blow it off with clean, dry, oil-free compressed air.

OPERATION

- We do not recommend connecting this module to a PC's parallel port as an "end product." This module is not "user friendly" and connecting it to a PC's parallel port is often difficult, frustrating, and can result in a "dead" display due to mishandling. For more information, see our forum thread at <http://www.crystalfontz.com/forum/showthread.php?s=&threadid=3257>.
- Your circuit should be designed to protect the module from ESD and power supply transients.
- Observe the operating temperature limitations: from -20°C minimum to +70°C maximum with minimal fluctuations. Operation outside of these limits may shorten the life and/or harm the display.
- Operate away from dust, moisture, and direct sunlight.

STORAGE AND RECYCLING



- Store in an ESD-approved container away from dust, moisture, and direct sunlight, fluorescent lamps, or any ultraviolet ray.
- Observe the storage temperature limitations: from -30°C minimum to +80°C maximum with minimal fluctuations. Rapid temperature changes can cause moisture to form, resulting in permanent damage.
- Do not allow weight to be placed on the modules while they are in storage.
- Please recycle your outdated Crystalfontz modules at an approved facility.



APPENDIX A: QUALITY ASSURANCE STANDARDS

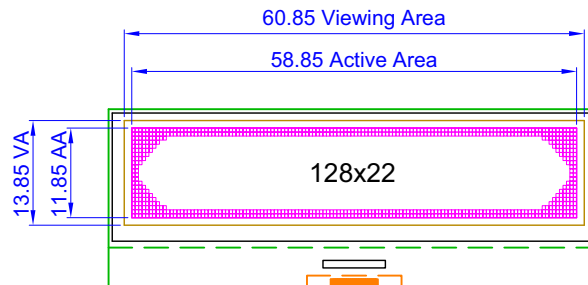
INSPECTION CONDITIONS

- Environment
 - Temperature: $25\pm 5^{\circ}\text{C}$
 - Humidity: 30~85% RH (noncondensing)
- For visual inspection of active display area
 - Source lighting: two 20-Watt or one 40-Watt fluorescent light
 - Display adjusted for best contrast
 - Viewing distance: 30 ± 5 cm (about 12 inches)
 - Viewing angle: inspect at 45° angle of vertical line right and left, top and bottom

COLOR DEFINITIONS

We try to describe the appearance of our modules as accurately as possible. For the photos, we adjust for optimal appearance. Actual display appearance may vary due to (1) different operating conditions, (2) small variations of component tolerances, (3) inaccuracies of our camera, (4) color interpretation of the photos on your monitor, and/or (5) personal differences in the perception of color.

DEFINITION OF ACTIVE AREA AND VIEWING AREA





ACCEPTANCE SAMPLING

DEFECT TYPE	AQL*
Major	$\leq 65\%$
Minor	$< 1.0\%$
* Acceptable Quality Level: maximum allowable error rate or variation from standard	

DEFECTS CLASSIFICATION

Defects are defined as:

- Major Defect: results in failure or substantially reduces usability of unit for its intended purpose
- Minor Defect: deviates from standards but is not likely to reduce usability for its intended purpose



ACCEPTANCE STANDARDS

#	DEFECT TYPE	CRITERIA			MAJOR / MINOR	
1	Electrical defects	1. No display, display malfunctions, or shorted segments. 2. Current consumption exceeds specifications.			Major	
2	Viewing area defect	Viewing area does not meet specifications.			Major	
3	Blemishes or foreign matter on display segments		<i>Defect Size</i>	<i>Acceptable Qty</i>	Minor	
			≤ 0.30 mm	3		
			≤ 2 defects within 10 mm of each other			
4	Dark lines or scratches in display area		<i>Defect Width</i>	<i>Defect Length</i>	<i>Acceptable Qty</i>	Minor
			≤ 0.03 mm	≤ 3.0 mm	3	
			0.03 to 0.05	≤ 2.0 mm	2	
			0.05 to 0.08	≤ 2.0 mm	1	
			0.08 to 0.10	≤ 3.0 mm	0	
			≥ 0.10	> 3.0 mm	0	
5	Bubbles between polarizer film and glass		<i>Defect Size</i>	<i>Acceptable Qty</i>	Minor	
			≤ 0.20 mm	Ignore		
			0.20 to 0.40 mm	3		
			0.40 to 0.60 mm	2		
			≥ 0.60 mm	0		
6	Display pattern defect		<i>Pixel Size</i>	<i>Acceptable Qty</i>	Minor	
			$((A+B)/2) \leq 0.20$ mm	≤ 3 total defects ≤ 2 pinholes per digit		
			$C > 0$ mm			
			$((D+E)/2) \leq 0.25$ mm			
			$((F+G)/2) \leq 0.25$ mm			



#	DEFECT TYPE	CRITERIA	MAJOR / MINOR
7	PCB defects	1. Oxidation or contamination on connectors.* 2. Wrong parts, missing parts, or parts not in specification.* 3. Jumpers set incorrectly. 4. Solder (if any) on bezel, LED pad, zebra pad, or screw hole pad is not smooth. *Minor if display functions correctly. Major if the display fails.	Minor
8	Soldering defects	1. Unmelted solder paste. 2. Cold solder joints, missing solder connections, or oxidation.* 3. Solder bridges causing short circuits.* 4. Residue or solder balls. 5. Solder flux is black or brown. *Minor if display functions correctly. Major if the display fails.	Minor



APPENDIX B: SAMPLE CODE

SOURCES FOR DRIVER LIBRARIES

Graphic driver libraries may save a lot of time and help you develop a more professional product. Possible library sources are [easyGUI](#), [en.radzio.dxp.pl](#), [Gwentech](#), [Micrium](#), [RAMTEX](#), and [Segger emWin](#).

SAMPLE CODE

This code will initialize the display and then show an image, toggling between inverted and not inverted. You can download the complete source from this link: <http://www.crystalfontz.com/products/document/1827/CFAL12822A.zip>.

Note: Please observe V_{PANEL} sequencing as described in [Details of Interface Pin Function \(Pg. 17\)](#). See also [Power Up and Power Down Sequencing \(Pg. 14\)](#).

```
#include <avr/io.h>
#include <util/delay.h>

//This is the display memory.
volatile unsigned char display[8][132]; //1024 bytes

// all on PORTC
#define OLED_DC (1 << 7)
#define OLED_RW (1 << 6)
#define OLED_E (1 << 5)
#define OLED_CS (1 << 4)
#define OLED_RES(1 << 2)

uint8_t logo[8][132] =
{
SEE FULL LISTING
};/*****/
void delay(uint32_t twait)
{
    while (twait--)
        asm volatile ("nop");
}
/*****/
void oled_cmd(uint8_t cmd)
{
    PORTA = cmd;// set up data on bus

    PORTC &= ~(OLED_DC | OLED_RW | OLED_CS);// command mode, write mode, chip select

    // toggle E
    PORTC |= OLED_E;
    PORTC &= ~OLED_E;

    PORTC |= OLED_CS;// remove chip select
}
/*****/
void oled_dat(uint8_t dat)
{
    PORTA = dat;// set up data on bus

    PORTC |= OLED_DC;// data mode
    PORTC &= ~(OLED_RW | OLED_CS);// write mode, chip select

    // toggle E
```



```
PORTC |= OLED_E;
PORTC &= ~OLED_E;

PORTC |= OLED_CS; // remove chip select
}
/*****/
void oled_clr(uint8_t color)
{
    int i,p;

    oled_cmd(0x40);

    for (p=0;p<8;p++) // pages
    {
        oled_cmd(0xb0 + p);
        oled_cmd(0x10);
        oled_cmd(0x00);
        for (i=0;i<132;i++)
        {
            oled_dat(color);
        }
    }
}
/*****/
typedef uint8_t bitmap_t[8][132];

void bmp(bitmap_t b)
{
    int i,j, index;

    for (j=0;j<8;j++)
    {
        oled_cmd(0xB0+j);
        oled_cmd(0x04);
        oled_cmd(0x10);

        for(i=0;i<128;i++)
            oled_dat( b[j][i] );
    }
}
/*****/
int main( void )
{
    PORTD = 0; // all off

    DDRD |= (1<<3); // VPP output

    DDRA = 0xFF;

    //6800 mode
    PORTC = 0b11011110;

    DDRC = 0xFE;

    delay(20000L);

    PORTC &= ~OLED_RES;
    delay(10000);
    PORTC |= OLED_RES;

    delay(20000);

    // enable VPP
    PORTD |= (1<<3);
}
```



```
    delay(200000L);

    oled_cmd(0xae); //Set Display ON/OFF
    oled_cmd(0xad); //master configuration
    oled_cmd(0x8e); //second byte

oled_cmd(0xa8); //Set Mux
oled_cmd(0x16); //22 mux

oled_cmd(0x40); //display start line 0

oled_cmd(0x81); //set contrast control
oled_cmd(0x40); //second byte

    oled_cmd(0xd5); //Set Display Clock Divide Ratio/Oscillator Frequency
    oled_cmd(0x20); //105hz

    oled_cmd(0xd8); //Set Area Color Mode ON/OFF & LowPower Display Mode
    oled_cmd(0x00); //second byte

oled_cmd(0xaf); //Set Display ON

    delay(5000L);

    oled_clr(0);

    delay(20000L);

    while (1)
    {
        bmp(logo);
        delay(5000000L);
        oled_cmd(0xa7); //Inverse display
        bmp(logo);
        delay(5000000L);
        oled_cmd(0xa6); //Normal display
    }

    return 0;
}
```



APPENDIX C: OLED MODULE TERMS AND SYMBOLS

CrystalFontz Symbol	Equivalent	Equivalent	Equivalent	Description
C				Capacitor
cd/m ²	nit			Candela meter squared is the standard unit of measurement for luminous intensity (photometric brightness).
CIE				A color model based on human perception developed by the CIE (Commission Internationale de l'Eclairage) committee.
CLS				Clock select pin.
COF	COT	TAB		Chip On Flex. Controller is on the FPC. Similar in appearance to "TAB". The flex circuit on COF is typically much thinner than the flex of a "flex tail".
COG				Chip On Glass. Controller is on the glass panel.
COM				Common driver. Common signal output for OLED display.
CR				Contrast Ratio = (brightness with pixels light)/ (brightness with pixels dark).
\overline{CS}	CS#			Chip select input. <i>Low</i> : Controller chip is selected. Communications with host is possible. <i>High</i> : Controller chip is not selected. Host interface signals are ignored by the controller.
D				Diode
DB0 ~ DBn	D0 ~ Dn			Bidirectional databus connects to 8-bit standard host databus. When serial interface is selected, DB0 serves as the serial clock input signal (SCL) and DB1 serves as the serial data input signal (SI). DB2 to DBn are set to high impedance.
D/ \overline{C}	RS	A0	CD or D/C#	Data/Command control. Determines whether data bits are data or command. <i>1 – High</i> : Addresses the data register. <i>0 – Low</i> : Addresses the command register.
ESD				Electro-Static Discharge. Sudden and brief electrical current that flows between two objects. ESD between a human and a TFT module can cause permanent damage.



Crystalfontz Symbol	Equivalent	Equivalent	Equivalent	Description															
FB				Feedback input for the booster circuit. Use to adjust booster output voltage level, V_{PANEL} .															
FG				Frame Ground.															
FFC				Flat Flex Cable used for Touch Screen and ZIF connection. Also called "pigtail". Crystalfontz does not use this term to mean "Flat Flexible Circuit".															
FPC				Flexible Printed Circuit. Also called "flex tail". Typically much thicker than the "flex" film of COF (Chip On Flex).															
GDR				Gate Drive. Output signal drives the gate of the external NMOS of the booster circuit.															
GND	V_{SS}			Ground. Must be connected to an external ground.															
I_{LOGIC}	I_{DD}			Operating current for V_{LOGIC} .															
$I_{\text{LOGIC, SLEEP}}$	$I_{\text{DD, SLEEP}}$			Sleep mode current for V_{LOGIC} .															
I_{PANEL}	I_{CC}			Supply current for V_{PANEL} .															
$I_{\text{PANEL, SLEEP}}$	$I_{\text{CC, SLEEP}}$			Sleep mode current for V_{PANEL} .															
I_{REF}				Segment output current reference for brightness adjustment. A resistor should be connected between this pin and GND. Used to set the current.															
I/O				Input/Output.															
IS1	BS1	C86	M80	<table border="1"> <thead> <tr> <th>IS1</th> <th>IS2</th> <th>Interface Mode</th> </tr> </thead> <tbody> <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> </tbody> </table>	IS1	IS2	Interface Mode	0	0	Serial	0	1	6800 Parallel	1	0	Not Allowed	1	1	8080 Parallel
IS1	IS2	Interface Mode																	
0	0	Serial																	
0	1	6800 Parallel																	
1	0	Not Allowed																	
1	1	8080 Parallel																	
IS2	BS2	P/S	$\overline{\text{MS}}$, MS, or M/S#																
L_{BRNORMAL}	IV			Luminous Intensity Brightness, NORMAL operation.															
$L_{\text{BRSTANDBY}}$	IV			Luminous Intensity Brightness, STANDBY.															
mm				Millimeter or millimetre. Unit of length equal to one thousandth of a meter. 1 millimeter = 0.0394 inches.															



Crystalfontz Symbol	Equivalent	Equivalent	Equivalent	Description
mW				Milliwatt is equal to one thousandth of a Watt. Watts = Volts x Amps.
NC	nc			No Connection.
OLED				Organic light-emitting diode
P _{OPERATION}	P _T			Normal mode Power consumption
P _{STANDBY}				Standby mode Power consumption.
Q				Transistor, including FET and MOSFET.
R				Resistor
\overline{RD}_{8080} (E ₆₈₀₀)	\overline{RD} (E)	E (\overline{RD})	E	Host interface input. 8080 Host: Active low. Signal on the databus is latched at the rising edge of \overline{RD} . 6800 Host: Enable control signal input active high. E = High: Read or Write operation is active E = Low: No operation
RH	Rh			Relative Humidity
RoHS				Restriction of Hazardous Substances Directive, an environmental standard.
\overline{RST}	\overline{RES}	RST#	RES#	Reset signal. Low: Display controller is reset. The \overline{RST} pin should be pulsed low shortly after power is applied. High: The \overline{RST} pin should be brought high for normal operation.
SCL	SCK			Serial Clock signal.
SEG				Segment driver. Segment signal output for OLED display.
SENSE				Source current for external NMOS of booster circuit.
SI	SDA	MOSI		Serial data Input signal.
SW				Switch output drives the gate of the external NMOS of the booster circuit.
T _a	TA			"Ambient temperature" is the temperature of the air that surrounds a component.
T _{OP}				OPerating temperature.
T _{ST}	T _{STG}			Storage Temperature.



CrystalFontz Symbol	Equivalent	Equivalent	Equivalent	Description
V_{BREF}				Internal voltage reference for booster circuit. A decoupling capacitor, typically 1 μ F, should be connected to GND.
V_{COMH}				High level voltage output for common signals. A low ESR capacitor should be connected between this pin and GND. Do not connect external power supply directly to this pin.
V_{IH}	V_{ICH}			High level input voltage.
V_{IL}	V_{LCH}			Low level input voltage.
V_{LOGIC}	V_{DD}	V_{DD1}	V_{CC}	Power supply input. Must be connected to an external source.
$V_{LOGIC I/O}$	$V_{DD I/O}$	$V_{I/O}$	V_{CCIO}	Supply voltage for I/O signals.
V_{OH}	V_{OHC}			High level output voltage.
V_{OL}	V_{OLC}			Low level output voltage.
V_{PANEL}	V_{PP}	V_{CC}		<p>Driver supply voltage. Only high voltage input on chip. Power must be supplied externally. <i>Note: You must observe power sequencing for this signal.</i> <i>Power Up</i> – Display must be powered up and initialized before power is applied to the signal. <i>Power Down</i> – Power must be removed from this signal before the display is powered off.</p>



CrystalFontz Symbol	Equivalent	Equivalent	Equivalent	Description
V_{REF}				Voltage reference pin for pre-charge voltage in driving OLED device. Voltage should be set to match with the OLED driving voltage in current drive phase. It can either be supplied externally or by connecting to V_{PANEL} .
V_{SL}				Segment voltage reference pin. This pin should be left open.
\overline{WR}_{8080} (R/\overline{W}_{6800})	R/\overline{W} (\overline{WR})	\overline{WR} (R/\overline{W})	$R/\overline{W}\#$	Host interface input. <i>8080 Host:</i> Active low. Signal on the databus is latched at the rising edge of \overline{WR} signal. <i>6800 Host:</i> Read/Write control signal output. R/\overline{W} = High: Read (Host←Module) R/\overline{W} = Low: Write (Host→Module)



APPENDIX D: SOLOMON SYSTECH SSD1305 CONTROLLER SPECIFICATION SHEET

The complete *Solomon Systech 132 x 64 Dot Matrix OLED/PLED Segment/Common Driver with Controller Data Sheet* (70 pages) follows.