GRAPHIC OLED MODULE DATA SHEET

Preliminary Data Sheet Release Date 2014-07-22
for
CFAL12864N-A-B4

Crystalfontz America, Incorporated

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Data Sheet Revision History

Preliminary Data Sheet Release: 2014-07-22
Revised PHYSICAL CHARACTERISTICS (Pg. 5) and MODULE OUTLINE DRAWING (Pg. 6). Depth of CFAL12864N-A-B4 display module changed from 1.2 millimeters to 1.4 millimeters.

Preliminary Data Sheet Release: 2014-06-09
Preliminary Data Sheet for the CFAL12864N-A-B4 display module.

About Variations

We work continuously to improve our products. Because display technologies are quickly evolving, these products may have component or process changes. Slight variations (for example, contrast, color, or intensity) between lots are normal. If you need the highest consistency, whenever possible, order and arrange delivery for your production runs at one time so your displays will be from the same lot.

The Fine Print

Certain applications using Crystalfontz America, Inc. products may involve potential risks of death, personal injury, or severe property or environmental damage (“Critical Applications”). CRYSTALFONTZ AMERICA, INC. PRODUCTS ARE NOT DESIGNED, INTENDED, AUTHORIZED, OR WARRANTED TO BE SUITABLE FOR USE IN LIFE-SUPPORT APPLICATIONS, DEVICES OR SYSTEMS OR OTHER CRITICAL APPLICATIONS. Inclusion of Crystalfontz America, Inc. products in such applications is understood to be fully at the risk of the customer. In order to minimize risks associated with customer applications, adequate design and operating safeguards should be provided by the customer to minimize inherent or procedural hazard. Please contact us if you have any questions concerning potential risk applications.

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All specifications in Data Sheets and on our website are, to the best of our knowledge, accurate but not guaranteed. Corrections to specifications are made as any inaccuracies are discovered.

Company and product names mentioned in this publication are trademarks or registered trademarks of their respective owners.

About Volatility

The Crystalfontz CFAL12864N-A-B4 module has volatile memory.

CONTENTS

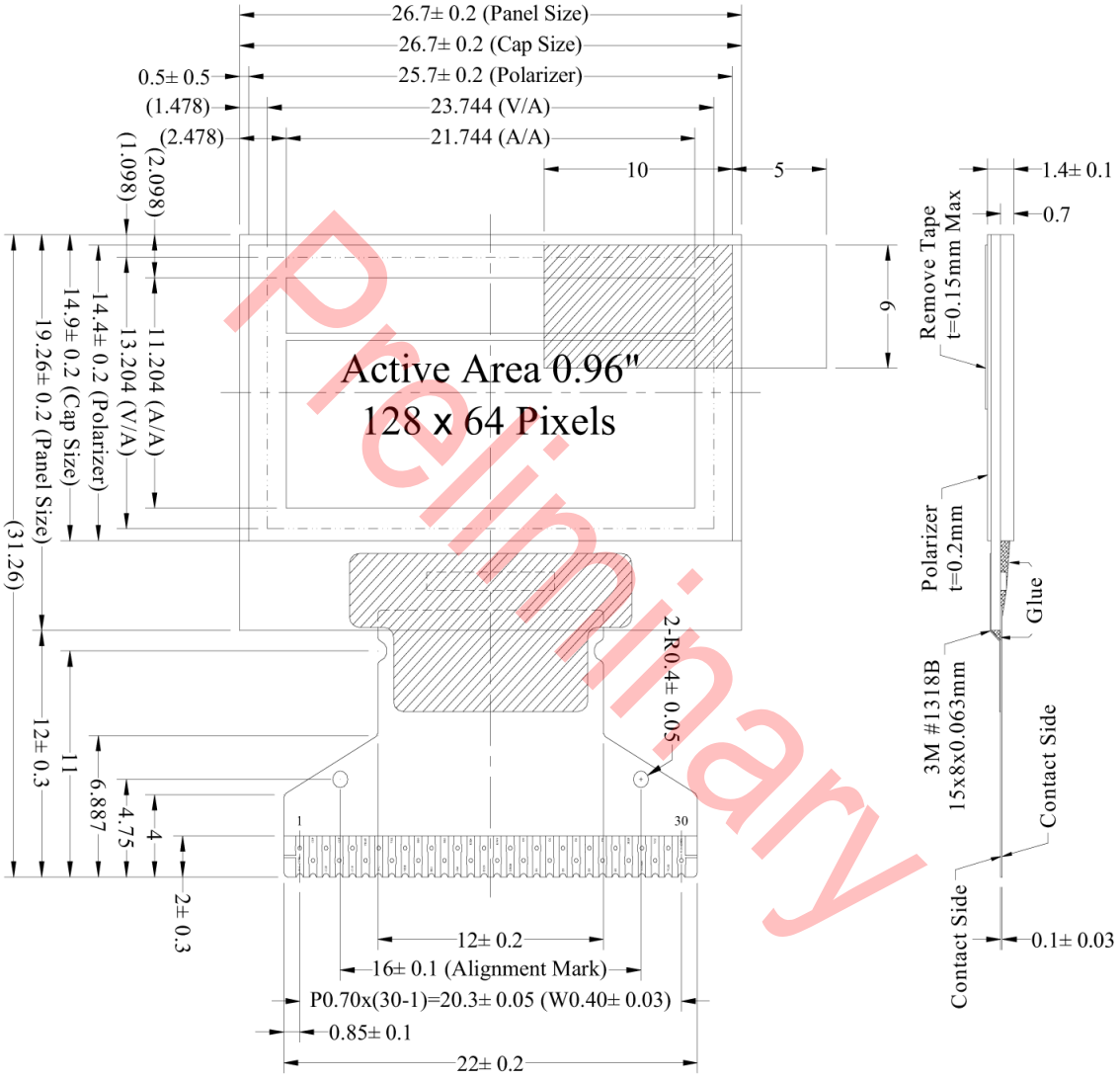
PHYSICAL CHARACTERISTICS

No.	Items	Specification	Unit
1	Display Mode	Passive Matrix OLED	-
2	Display Color	Monochrome (Yellow & Blue)	-
3	Duty	1/64	-
4	Resolution	128 (H) x 64 (V)	Pixel
5	Active Area	21.744 (W) x 11.204 (H)	mm
6	Outline Dimension	26.70 (W) x 19.26 (H) x 1.4 (D)	mm
7	Pixel Pitch	0.17 (W) x 0.17 (H)	mm
8	Pixel Size	0.154 (W) x 0.154 (H)	mm
9	Driver IC	SSD1306	-
10	Interface	8-bit parallel,3-/4-wire SPI,I2C	-
11	Weight	1.54	g

ADDITIONAL FEATURES

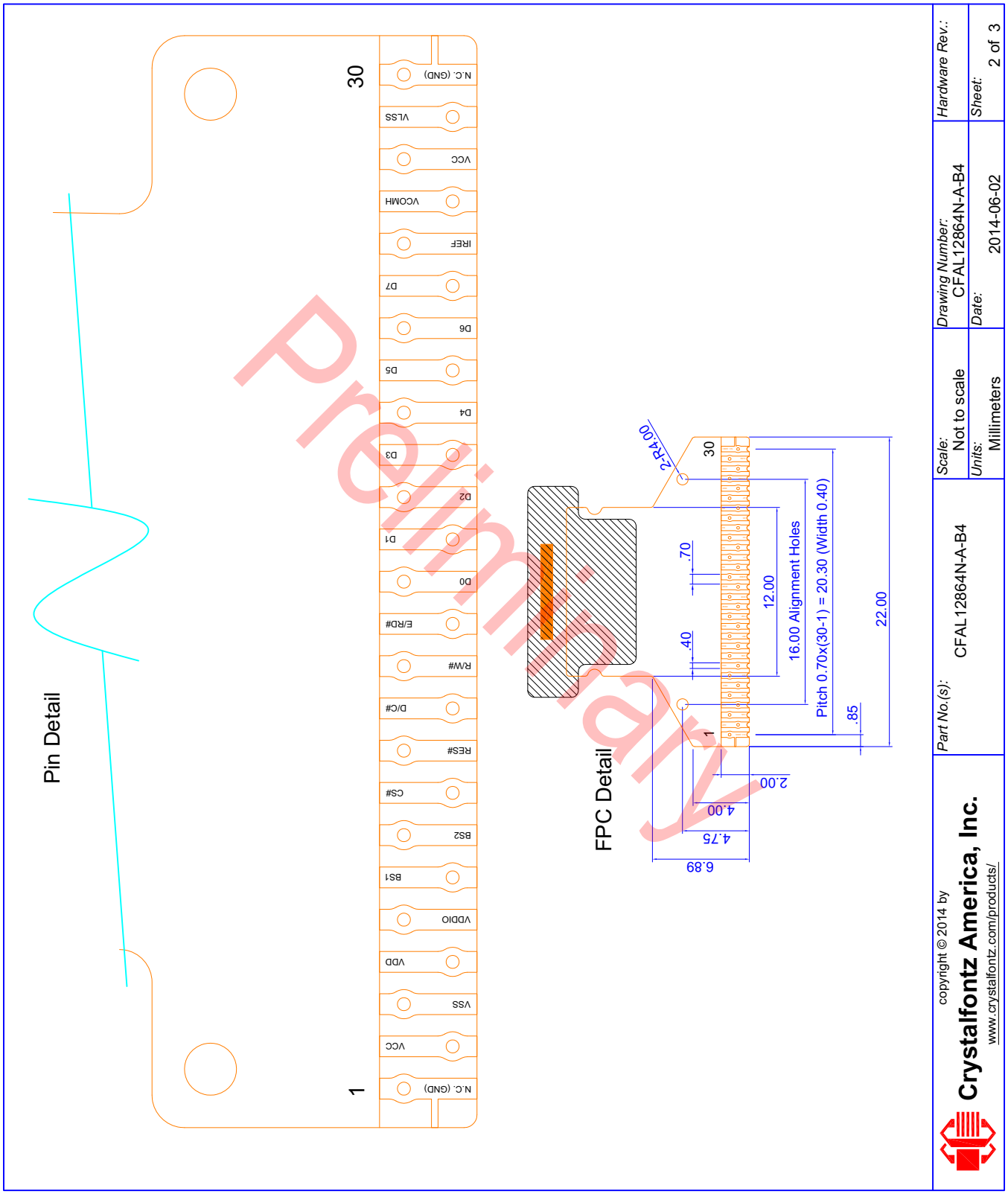
- These modules have a Solomon Systech SSD1306 128 x 64 Dot Matrix OLED/PLED Segment/Common Driver with Controller. For interface information and other details, see controller datasheets on our website.
- RoHS compliant. Factory is ISO certified.

MODULE OUTLINE DRAWING



Notes:

1. Color: Light Blue & Yellow
2. Driver IC: SSD1306
3. Interface:
   8-bit 68XX/80XX Parallel, 3-/4-wire SPI, I2 C


Pin Detail
30
1
N.C. (GND)
VLSS
VCC
VCOMH
IREF
D7
D6
D5
D4
D3
D2
D1
D0
E/RD#
R/W#
D/C#
RES#
CS#
BS2
BS1
VDDIO
VDD
VSS
VCC
N.C. (GND)
FPC Detail
2-R4.00
30
1
.70
.40
12.00
16.00 Alignment Holes
Pitch 0.70x(30-1) = 20.30 (Width 0.40)
.85
22.00
2.00
4.00
4.75
6.89
Preliminary
Hardware Rev.:
Sheet: 2 of 3
Drawing Number: CFAL12864N-A-B4
Date: 2014-06-02
Scale: Not to scale
Units: Millimeters
Part No.(s): CFAL12864N-A-B4
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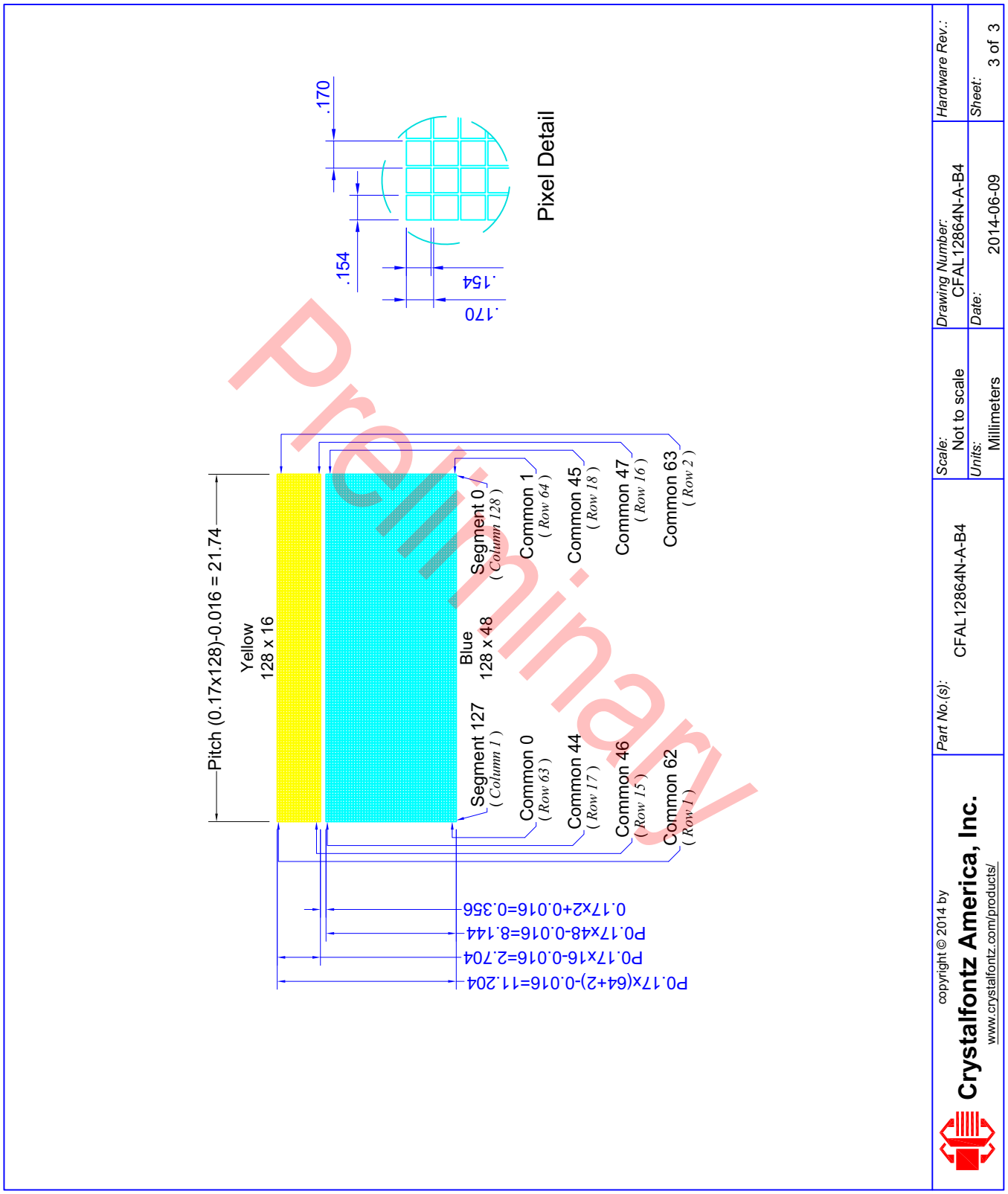
Pixel Detail
.170
.154
.154
.170
Pitch (0.17x128)-0.016 = 21.74
Yellow
128 x 16
Blue
128 x 48
Segment 0
(Column 128)
Segment 127
(Column 1)
Common 1
(Row 64)
Common 0
(Row 63)
Common 45
(Row 18)
Common 44
(Row 17)
Common 47
(Row 16)
Common 46
(Row 15)
Common 63
(Row 2)
Common 62
(Row 1)
P0.17x(64+2)-0.016=11.204
P0.17x16-0.016=2.704
P0.17x48-0.016=8.144
0.17x2+0.016=0.356
Preliminary
Part No.(s):
CFAL12864N-A-B4
Scale:
Not to scale
Units:
Millimeters
Drawing Number:
CFAL12864N-A-B4
Date:
2014-06-09
Hardware Rev.:
Sheet:
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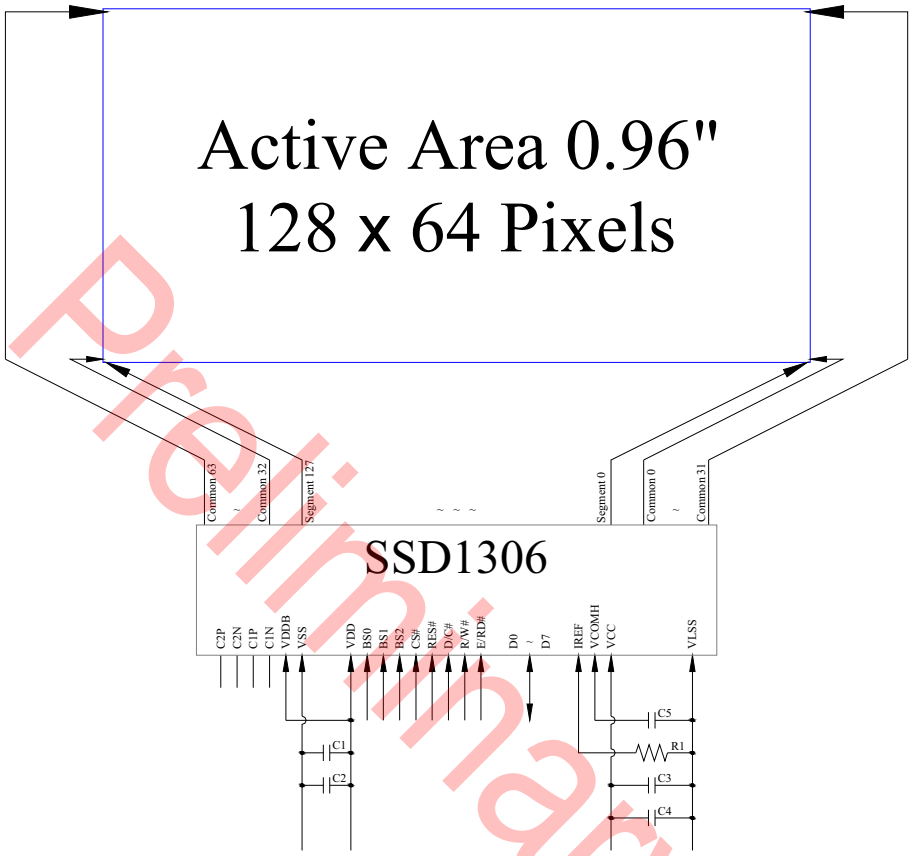
BLOCK DIAGRAM

1.1 V_{CC} Supplied Externally



MCU Interface Selection: BS0, BS1 and BS2
Pins connected to MCU interface: CS#, RES#, D/C#, R/W#, E/RD#, and D0~D7

C1, C3: 0.1µF
C2: 4.7µF
C4, C5: 4.7µF / 16V X7R
R1: 910kΩ, R1 = (Voltage at IREF - VSS) / IREF

DETAILS OF INTERFACE PIN FUNCTIONS

Pin Number	Symbol	I/O	Function
Power Supply			
9	VDD	P	**Power Supply for Logic** This is a voltage supply pin. It must be connected to external source.
8	VSS	P	**Ground of Logic Circuit** This is a ground pin. It acts as a reference for the logic pins. It must be connected to external ground.
28	VCC	P	**Power Supply for OEL Panel** This is the most positive voltage supply pin of the chip. A stabilization capacitor should be connected between this pin and V_{SS} when the converter is used. It must be connected to external source when the converter is not used.
29	VLSS	P	**Ground of Analog Circuit** This is an analog ground pin. It should be connected to V_{SS} externally.
Driver			
26	IREF	I	**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 at 12.5µA maximum.
27	VCOMH	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}.
DC/DC Converter			
6	VBAT	P	**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 external source when the converter is used. It should be connected to V_{DD} when the converter is not used.
4 / 5 2 / 3	C1P / C1N C2P / C2N	I	**Positive Terminal of the Flying Inverting Capacitor** **Negative Terminal of the Flying Boost Capacitor** The charge-pump capacitors are required between the terminals. They must be floated when the converter is not used.
Interface			
10 11 12	BS0 BS1 BS2	I	**Communicating Protocol Select** These pins are MCU interface selection input. See the following table: BS0 / BS1 / BS2 I^2C: 0 / 1 / 0 3-wire SPI: 1 / 0 / 0 4-wire SPI: 0 / 0 / 0 8-bit 68XX Parallel: 0 / 0 / 1 8-bit 80XX Parallel: 0 / 1 / 1
14	RES#	I	**Power Reset for Controller and Driver** This pin is reset signal input. When the pin is low, initialization of the chip is executed. Keep this pin pull high during normal operation.
13	CS#	I	**Chip Select** This pin is the chip select input. The chip is enabled for MCU communication only when CS# is pulled 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. When the pin is pulled high and serial interface mode is selected, the data at SDIN will be interpreted 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. For detail relationship to MCU interface signals, please refer to the Timing Characteristics Diagrams.
17	E/RD#	I	**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 or I^2C mode is selected, this pin must be connected to V_{SS}.

DETAILS OF INTERFACE PIN FUNCTIONS, CONT'D

Pin Number	Symbol	I/O	Function
Interface(Continued)			
16	R/W#	I	**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. When serial or I^2C mode is selected, this pin must be connected to V_{SS}.
18~25	D0~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. 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. Unused pins must be connected to V_{SS} except for D2 in serial mode.
Reserve			
7	N.C.	-	**Reserved Pin** The N.C. pin between function pins are reserved for compatible and flexible design.
1, 30	N.C. (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 as the ESD protection circuit.

OPTICAL CHARACTERISTICS

Color Coordinate	Blue	CIE x	0.10	0.14	0.18	-	Without Polarizer
		CIE y	0.20	0.24	0.28		
Color Coordinate	Yellow	CIE x	0.43	0.47	0.51	-	Without Polarizer
		CIE y	0.45	0.49	0.53		

ABSOLUTE MAXIMUM CHARACTERISTICS

Items	Symbol	Min	Typ.	Max	Unit
Supply voltage for logic	V_{DD}	-0.3	-	4	V
Supply voltage for display	V_{CC}	0	-	16.0	V
Supply voltage for DC/DC	V_{DDB}	-0.3	-	5.0	V
Operating temperature	T_{OP}	-40	-	80	℃
Storage temperature	T_{ST}	-40	-	80	℃

RECOMMENDED DC CHARACTERISTICS

Items	Symbol	Conditions	Min	Typ.	Max	Unit
Supply voltage for logic	V_{DD}		1.65	2.8	3.3	V
Supply voltage for display (Supplied externally)	V_{CC}	Note 5	11.5	12.0	12.5	V
Supply voltage for DC/DC	V_{BAT}	Internal DC/DC enable	3.5	-	4.2	V
Supply voltage for display (Generated by internal DC/DC)	V_{CC}	Note 5	7.0	-	7.5	V
High level input	V_{IH}		0.8 x V_{DD}	-	V_{DD}	V
Low level input	V_{IL}		0	-	0.2 x V_{DD}	V
High level output	V_{OH}	I_{OUT} = 100µA, 3.3MH	0.9 x V_{DD}	-	V_{DD}	V
Low level output	V_{OL}	I_{OUT} = 100µA, 3.3MH	0	-	0.1x V_{DD}	V
Operating current for V_{DD}	I_{DD}		-	180	300	µA
Operating current for V_{CC} (V_{CC} Supplied externally)	I_{CC}	Note 6	-	12.3	16.0	mA
Operating current for V_{DDB} (V_{CC} Generated by internal DC/DC)	I_{BAT}	Note 7	-	25.6	32.0	mA
Sleep mode current for V_{DD}	$I_{DD,SLEEP}$		-	1	5	µA
Sleep mode current for V_{CC}	$I_{CC,SLEEP}$		-	2	10	µA

Note 5: Supply Voltage for Display (V_{CC}) are subject to the change of the panel characteristics and the customer's request.

Note 6: V_{DD} = 2.8V, V_{CC} = 12V, 100% Display Area Turn on.

Note 7: V_{DD} = 2.8V, V_{CC} = 7.25V, 100% Display Area Turn on.

* Software configuration follows Actual Application Example .

ESD (ELECTRO-STATIC DISCHARGE)

The circuitry is industry standard CMOS logic and is 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.

PRODUCT RELIABILITY AND LONGEVITY

MODULE RELIABILITY

PART NUMBER	SPECIFICATION
CFAL12864N-A-B4	Brightness will be >50% of a new module's initial brightness for at least 50,000 hours of operation when supply to each LED is below 90 mA.

Under operating and storage temperature specification limitations, humidity noncondensing) RH up to 65%, and no exposure to direct sunlight. Value listed above is approximate and represent typical lifetime.

The white LEDs dim over time, especially if driven with high currents. The dimming may not be noticeable when a single display is installed. However, if a new display is installed next to a display that has been on continuously for a very long time, you will see the difference. To preserve the lifetime of white LEDs, we recommend that white LED backlights are dimmed or turned off when not needed. Also, please do not use more current than you need to achieve your brightness requirements.

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:

- *Backlight LEDs.* Brightness may be affected (perhaps the new LEDs have better efficiency) or the current they draw may change (new LEDs may have a different VF).
- *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 web page 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* in ABSOLUTE MAXIMUM CHARACTERISTICS (Pg. 12).

HANDLING CAUTION FOR MODULES SHIPPED IN TRAYS

If you receive modules packed in trays, handle trays carefully by supporting the entire tray. Trays were made to immobilize the modules inside their packing carton. Trays are not designed to be rigid. Do not carry trays by their edges; trays and modules may be damaged.

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

- 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 HP-92 Lexan, which is readily available and works well.
- Do not disassemble or modify the module.
- Solder only to the I/O terminals. Use care when removing solder so you do not damage the PCB.
- Use care to keep the exposed terminals clean.
- Do not reverse polarity to the power supply connections. Reversing polarity will immediately ruin the module.
- Use care to keep the exposed terminals clean.
- Sharp bends can damage the FPC. Do not crease FPC. Do not bend FPC tightly against the edge of the display module’s panel.

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.

CAUTION

All electronics may contain harmful substances. Avoid contamination by using care to avoid damage during handling. If any residues, gases, powders, liquids, or broken fragments come in contact with your skin, eyes, mouth, or lungs, immediately contact your local poison control or emergency medical center.

HOW TO CLEAN

1. Turn display off.
2. 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”).
3. If the polarizer is dusty, you may carefully blow it off with clean, dry, oil-free compressed air.
4. If you must clean with a liquid, never use glass cleaners, as they may contain ammonia or alcohol that will damage the touch screen or polarizer over time. Never apply liquids directly on the polarizer. Long contact with moisture may permanently spot or stain polarizer. Use filtered water to slightly moisten a clean lint-free microfiber cloth designed for cleaning optics. (For example, use a cloth sold for cleaning plastic eyeglasses.)
5. The plastic is easily scratched or damaged. Use a light touch as you clean the polarizer. Wipe gently.
6. Use a dry microfiber cloth to remove any trace of moisture before turning on the CFAL12864N-A-B4.
7. Gently wash the microfiber cloths in warm, soapy water and air dry before reuse.

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: a minimum of -40°C to a maximum of +80°C noncondensing with minimal fluctuation. Operation outside of these limits may shorten life and/or harm display. Changes in temperature can result in changes in contrast.
  - At lower temperatures of this range, response time is delayed.
  - At higher temperatures of this range, display becomes dark. (You may need to adjust the contrast.)
- Operate away from dust, moisture, and direct sunlight.
- For the CFAL12864LX-G with white LEDs, adjust backlight brightness so the display is readable but not too bright. Dim or turn off the backlight during periods of inactivity to conserve the white LED backlight lifetime.

STORAGE AND RECYCLING

- Store in an ESD-approved container away from dust, moisture, and direct sunlight, fluorescent lamps, or any ultraviolet ray with humidity less than 90% noncondensing.
- Observe the storage temperature limitations: from -40°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 modules at an approved facility.

APPENDIX A: QUALITY ASSURANCE STANDARDS

INSPECTION CONDITIONS

- Environment
  - Temperature: 25±5°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 display modules as accurately as possible. For the photos, we adjust the backlight (if any) and contrast 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.

ACCEPTANCE SAMPLING

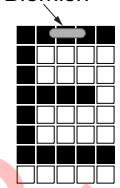
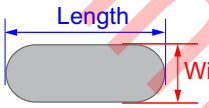
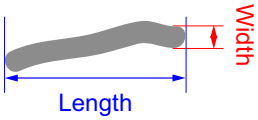
DEFECT TYPE	AQL*
Major	≤.65%
Minor	<1.0%
* Acceptable Quality Level: maximum allowable error rate or variation from standard	

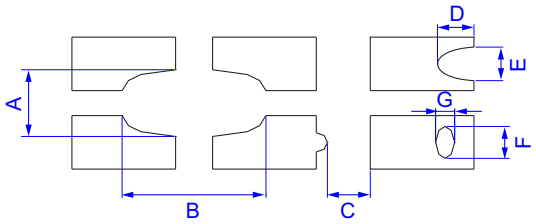
DEFECTS CLASSIFICATION

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	ACCEPTANCE STANDARDS 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	Contrast adjustment defect	Contrast adjustment fails or malfunctions.			Major
4	Blemishes or foreign matter on display segments		*Defect Size* ≤0.30 mm ≤2 defects within 10 mm of each other	*Acceptable Qty* 3	Minor
5	Blemishes or foreign matter outside of display segments	Defect Size = (Width + Length)/2 	*Defect Size* ≤0.15 mm 0.15 to 0.20 mm 0.20 to 0.25 mm > 0.30 mm	*Acceptable Qty* Ignore 3 2 1	Minor
6	Dark lines or scratches in display area 	*Defect Width* ≤0.03 mm 0.03 to 0.05 0.05 to 0.08 0.08 to 0.10 ≥0.10	*Defect Length* ≤3.0 mm ≤2.0 mm ≤2.0 mm ≤3.0 mm >3.0 mm	*Acceptable Qty* 3 2 1 0 0	Minor
7	Bubbles between polarizer film and glass		*Defect Size* ≤0.20 mm 0.20 to 0.40 mm 0.40 to 0.60 mm ≥0.60 mm	*Acceptable Qty* Ignore 3 2 0	Minor

<table>
<tr><th>#</th><th>DEFECT TYPE</th><th>ACCEPTANCE STANDARDS CRITERIA (Continued)</th><th>MAJOR / MINOR</th></tr>
<tr><td>8</td><td>Display pattern defect</td><td> 

<table>
<tr><th>Dot Size</th><th>Acceptable Qty</th></tr>
<tr><td>((A+B)/2)≤0.20 mm</td><td rowspan="4">≤3 total defects
≤2 pinholes per digit</td></tr>
<tr><td>C>0 mm</td></tr>
<tr><td>((D+E)/2)≤0.25 mm</td></tr>
<tr><td>((F+G)/2)≤0.25 mm</td></tr>
</table></td><td>Minor</td></tr>
<tr><td>9</td><td>Backlight defects</td><td>1. Light fails or flickers.*
2. Color and luminance do not correspond to specifications.*
3. Exceeds standards for display’s blemishes, foreign matter, dark lines or scratches.
*Minor if display functions correctly. Major if the display fails.</td><td>Minor</td></tr>
<tr><td>10</td><td>PCB defects (if module has PCB)</td><td>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.</td><td>Minor</td></tr>
<tr><td>11</td><td>Soldering defects</td><td>1. Unmelted solder paste.
2. Cold solder joints, missing solder connections, or oxidation.*
3. Solder bridges causing short circuits.*
4. Solder balls.
*Minor if display functions correctly. Major if the display fails.</td><td>Minor</td></tr>
</table>