Crystalfontz

CFAF800480E1-050SN-A2

EVE BT817 Processor
4-Wire QUAD SPI
800x480 Pixel Resolution
Sunlight Readable

TFT GRAPHIC DISPLAY MODULE WITH GRAPHIC ACCELERATOR BOARD DATASHEET

Datasheet Release Date 2021-06-17
for
CFAF800480E1-050SN-A2

Crystalfontz America, Inc.

CONTENTS

1. General Information

Datasheet Revision History
Datasheet Release: 2021-06-17 Datasheet for the CFAF800480E1-050SN-A2 TFT 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.

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2. Introduction

The Crystalfontz CFAF800480E1-050SN-A2 is an accelerated display module for embedded systems based around the FTDI/BridgeTek FT817 EVE (Embedded Video Engine) graphics accelerator.

Traditionally, there are two options for connecting a TFT to an embedded system: first to choose a very powerful processor that could support a frame buffer and RGB interface or second, to write directly to TFT controller's frame buffer. Both of these methods rely on software to render graphics primitives. A simple non-anti-aliased image may take hundreds or even thousands of write operations. Sometimes, read-modify-write operations are required which doubles (or more) the necessary number of commands- further slowing the display performance.

Additionally, these methods require a lot GPIOs or GPIO configured as the RGB interface, often requiring a larger processor package. There are examples of using SPI to control small TFT LCDs, but even on small displays the performance suffers.

Text poses another problem for traditional implementations of TFTs. Fonts require a lot of memory to store and rendering them to the frame buffer can be complex- especially if they need to be anti-aliased or rotated. The traditional solution is to support just a few bitmapped, non-anti-aliased fonts rendered only on the horizontal and vertical. Need to angle a font to put labels on some data? Not without a very complete and complex (and typically big and slow) graphic library.

Now imagine a display that solves the problems with traditional TFTs. One that accepts high-level commands, so writing just a few instructions completely describes a line. As long as we're imagining - what if that line was fully anti-aliased and fully adjustable in width? How about writing a few more commands and rendering beautiful anti-aliased text from a wide selection of fonts at any angle?

This daydream is now a reality with the CFAF800480E1-050SN-A2 thanks to the FTDI/BridgeTek FT817 EVE graphics accelerator at the heart of the module. Embedded systems with 8-bit processors can now have beautiful and responsive displays that do not tax the host processor.

Ready to live the dream? Our demo code for the CFAF800480E1-050SN-A2 is available on the product page and is written to fit on the Seeeduino v4.2 (a 3.3v clone of the Arduino Uno). As always, our source code is freely supplied and our displays are fully supported.

3. Module Information

This module comprises the CFAF800480E1-050SN mounted on a graphics accelerator board (CFA10100). The graphics accelerator board boasts the FTDI/Bridgetek FT817 Embedded Video Engine (EVE). The CFAF800480E1-050SN-A2 is a 16M color 5-inch TFT graphic display module with a white LED backlight. This display has in-plane switching (IPS), and is sunlight readable. Driving the display is a built-in ST7262 LCD driver.

4. Features

4.1. TFT Display Module Features

- 5-inch 800x480 TFT LCD
- In Plane Switching – free viewing angle
- High bright at 1000 cd/m2
- Built-in Display Driver: ST7262 (or equivalent)
- Operating Temperature: -20° - 70°C
- Storage Temperature: -30° - 80°C
- FTDI/BridgeTek FT817 EVE graphics accelerator
- SPI, QSPI
- Single +3.3V power supply possible
  o Backlight supply works best at 5v, but can be operated at 3.3v
- Six 2-56 threaded mounting standoffs for simple mechanical design

4.2. EVE Graphics Accelerator Features

- Supports multiple widgets for simplified design implementation
- User interface design software (PC) simplifies the design process
- Enhanced sketch processing
- Anti-aliasing of primitive displayed objects for higher-quality graphics
- Assorted graphical effects such as alpha-blending, shadows, transitions, wipes, etc.
- Programmable interrupt controller provides interrupts to host MCU
- Support playback of motion-JPEG encoded AVI videos
- Mono audio channel output with wave playback and built-in sound synthesizer
- PWM output for display backlight dimming control

4.3. Module Information

The display, backlight, and audio features are all controlled via the Embedded Video Engine (EVE) which appears to the host MCU as a memory-mapped SPI device. The host MCU sends commands and data over the EVE SPI serial protocol.

For detailed BridgeTek datasheets and other development information, see the Embedded Video Engine Documentation / Resources section below.

4.4. Embedded Video Engine Documentation / Resources

- FT81x Datasheet: https://www.crystalfontz.com/controllers/FTDI/FT81x/
- BridgeTek Screen Designer Software: https://brtchip.com/eve-toolchains/
- BridgeTek Forum: http://www.brtcommunity.com/index.php?board=7.0
- FTDI FT810 Datasheets: https://brtchip.com/datasheets/#toggle-id-3
- FTDI Application Notes: https://www.ftdichip.com/Support/Documents/AppNotes.htm
- FTDI C232HM USB-SPI cable: https://www.ftdichip.com/Products/Cables/USBMPSSE.htm

4.5. Embedded Video Engine Programmer's Model

The diagram below is a basic overview of the EVE programming model showing data flow paths to and from the SPI host interface to the memory and processing blocks of the embedded video engine.

FT81x Programmer's Model

Project / Part Number:	Date: 2019-04-06	Filename: -	Revision: -
FT81x Programmer's Model	Web: -		Sheet: 1 of 1

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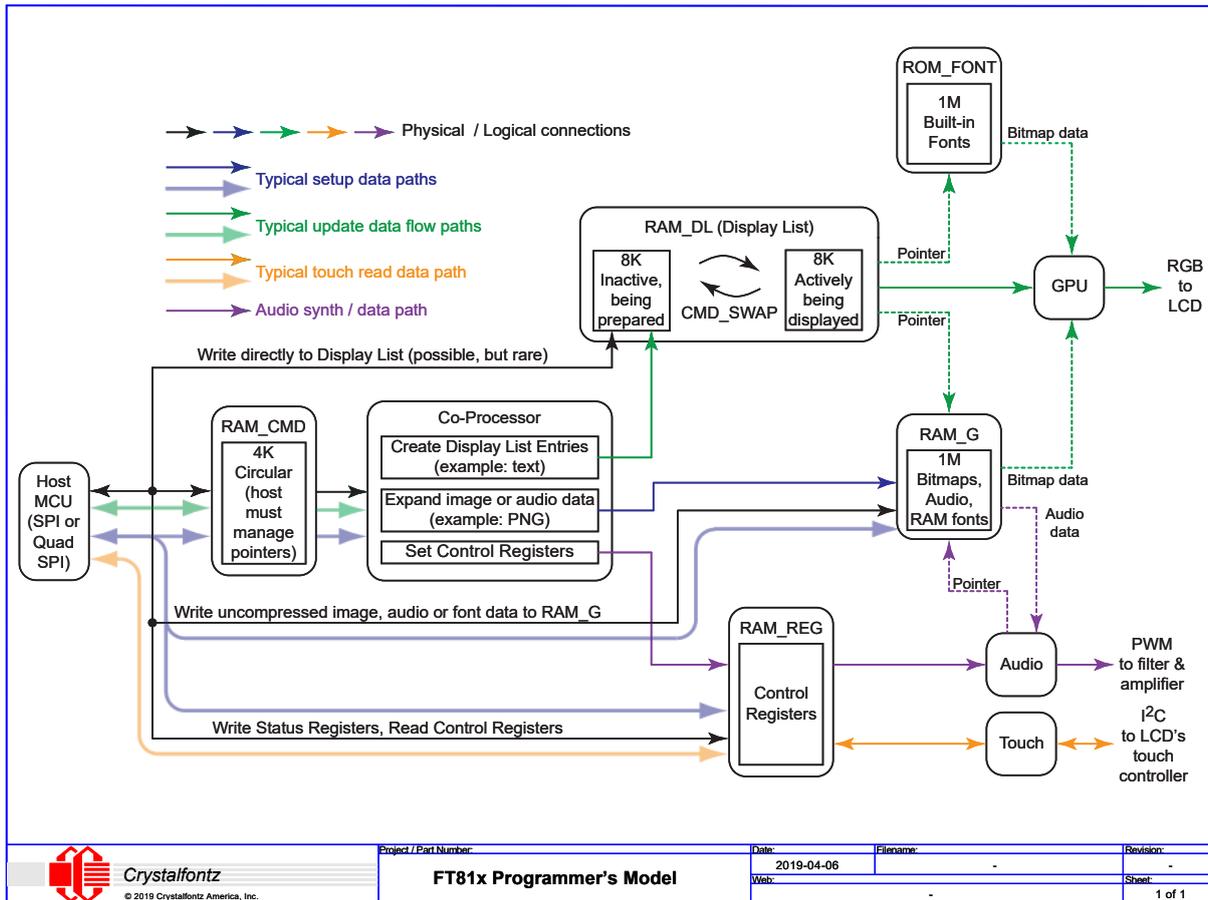
5. Mechanical Data

Item	Specification (mm)	Specification (inch, reference)
Overall Width, Height, and Depth	120.7 x 75.8 x 8.75	4.75 x 2.98 x 0.344
Viewing Area	110.0 (W) x 66.8 (H)	4.330 (W) x 2.630 (H)
Active Area	108.0 (W) x 64.8 (H)	4.252 (W) x 2.551 (H)
Pixel Pitch	0.135 (W) x 0.135 (H)	0.0053 (W) x 0.0053 (H)
Weight (Typical)	90 grams	3.2 ounces

6. Mechanical Drawing

Units: millimeters
Tolerance: ±0.3
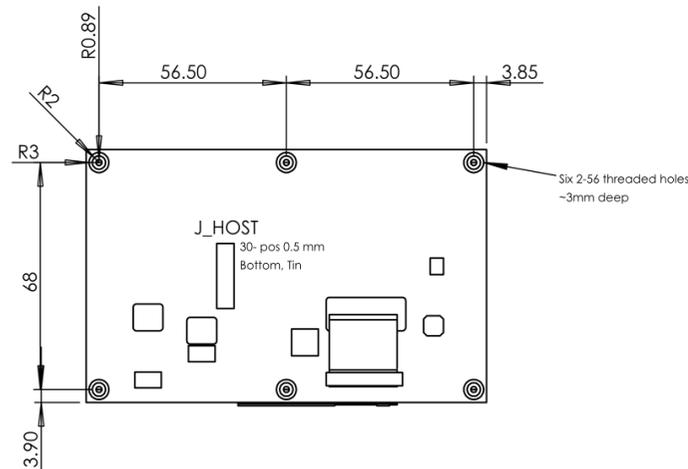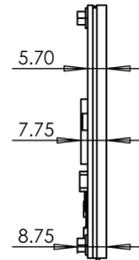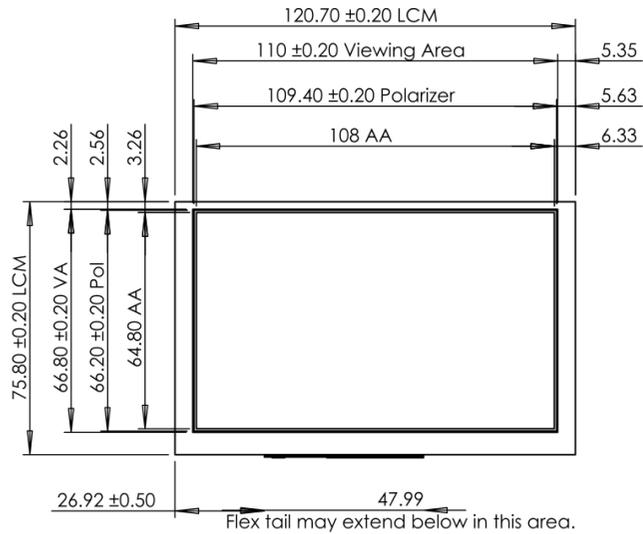
J_HOST Pin	Fuction
1	GND
2-3	3v3
4	GND
5-6	3v3
7	GND
8	SCK
9	GND
10	MOSI/D0
11	GND
12	MISO/D1
13	GND
14	GPIO0/D2
15	GND
16	GPIO1/D3
17	GND
18	FT_CS
19	GND
20	INT
21	GPIO2
22	PD
23	FT_AUDIO
24	GND
25-26	BLPWR
27	GND
28-29	BLPWR
30	GND

Part Number:	Date:	Filename:	Revision:
	2021-06-16	CFAF800480E1-050SN-A2 mm.pdf	v1.0
CFAF800480E1-050SN-A2	Web:		Sheet:
		www.crystalfontz.com/product/cfaf800480e1050sna2	1 of 1

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7. Interface Pin Function

Host data connection and power supply are achieved via a single 30 pin, 0.5 mm, tin flat-cable connector (labeled J_HOST) on the rear of the module. Any 30 pin FFC-FPC ZIF cable with a 0.5mm pitch and bottom contacts will be compatible with this module. We suggest the 6" WR-FFC-Y50 or the 12" WR-FFC-Y51.

J_HOST Connection			
Pin	**Symbol**	**Signal Direction**	**Function**
1	GND		Ground [1]
2	3V3		Logic Power Supply [1]
3	3V3		Logic Power Supply [1]
4	GND		Ground [1]
5	3V3		Logic Power Supply [1]
6	3V3		Logic Power Supply [1]
7	GND		Ground [1]
8	SCK	Input	SPI Clock
9	GND		Ground [1]
10	MOSI / D0	Input	SPI Single Mode: SPI MOSI SPI Dual/Quad Mode: SPI Data Line 0
11	GND		Ground [1]
12	MISO / D1	Output	SPI Single Mode: SPI MISO SPI Dual/Quad Mode: SPI Data Line 1
13	GND		Ground [1]
14	GPIO0 / D2	Input / Output	SPI Single/Dual Mode: General Purpose IO0 SPI Quad Mode: SPI Data Line 2
15	GND		Ground [1]
16	GPIO1 / D3	Input / Output	SPI Single/Dual Mode: General Purpose IO1 SPI Quad Mode: SPI Data Line 3
17	GND		Ground [1]
18	nCS	Input	SPI Slave Chip-Select
19	GND		Ground [1]
20	nINT	Output	Interrupt to Host
21	GPIO2		General purpose IO2
22	nPD	Input	Chip Power Down Mode
23	AUDIO PWM	Output	Audio PWM
24	GND		Ground [1]
25	BLPWR		Backlight Power Supply [1]
26	BLPWR		Backlight Power Supply [1]
27	GND		Ground [1]
28	BLPWR		Backlight Power Supply [1]
29	BLPWR		Backlight Power Supply [1]
30	GND		Ground [1]

Note: It is recommended that these pins are all connected to their respective power source. Not doing so may produce unpredictable results or damage the display module.

8. Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
Supply Voltage for Logic	V_{DD}	-0.5	3.96	V
Operating Temperature	T_{OP}	-20	70	°C
Storage Temperature	T_{STG}	-30	80	°C

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. TFT Electrical Characteristics

Item	Symbol	Min	Typ	Max	Unit
Logic Power Supply	V_{Logic}	3.0	3.3	3.6	V
Input Logic High	VIH	$0.7 * V_{Logic}$	-	V_{Logic}	V
Input Logic Low	VIL	GND	-	$0.3 * V_{Logic}$	V
Output Logic High	VOH	V_{Logic}-0.4	-	V_{Logic}	V
Output Logic Low	VOL	GND	-	GND + 0.4	V
Logic Supply Current	IVDD	-	20	-	mA

10. Optical Characteristics

Item		Symbol	Condition	Min	Typ	Max	Unit
Response Time		$T_r + T_f$	-	-	30	40	ms
Contrast Ratio		(CR)	-	800	1000	-	-
Viewing Angle	Horizontal	θL	CR ≧ 10	-	80	-	Degree
		θR		-	80	-	
	Vertical	θT		-	80	-	
		θB		-	80	-	
Luminance		L	-	900	1000	-	cd/m²
Chromaticity	Red	R_X	T_a=25°	0.565	0.615	0.665	CIE1931
		R_Y		0.286	0.336	0.386	
	Green	G_X		0.342	0.392	0.443	
		G_Y		0.502	0.552	0.602	
	Blue	B_X		0.090	0.140	0.190	
		B_Y		0.075	0.125	0.175	
	White	W_X		0.290	0.340	0.390	
		W_Y		0.311	0.361	0.411	

11. Backlight Characteristics

Item	Symbol	Min	Typ	Max	Unit
Supply Voltage	BLPWR	2.7	5.0	5.5	V
Supply Current (BLPWR= 3.3v)	I$_{BLPWR}$	-	70	-	mA
Supply Current (BLPWR=5v)	I$_{BLPWR}$	-	140	-	mA
LED Lifetime			30000		hours

Notes:

(1) Backlight high voltage does not need to be supplied separately; input voltage is boosted by module.

(2) Typical voltage value is 5V. Using a voltage below 4V will cause the maximum brightness of the LCD to be lower.

(3) Lifetime is defined as the amount of time when the luminance has decayed to <50% of the initial value, and this value is provided as an estimate only.
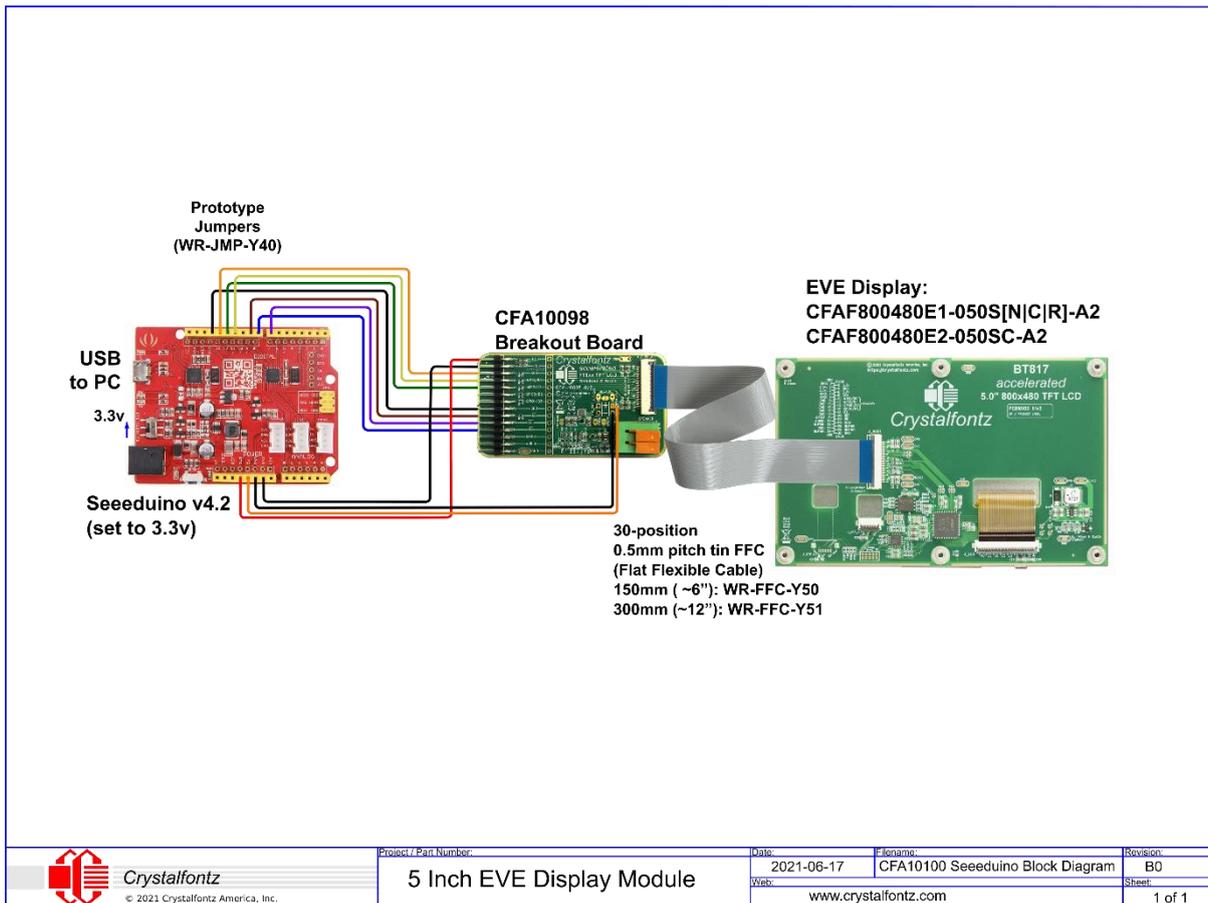
12. Getting Started

In earlier stages of development, consider the complete CFAF800480E1-050SN-A2-2 kit, which includes:

- A CFAF800480E1-050SN-A2 display module
- A CFA10098 EVE adapter board
- A 30-position, 0.5mm pitch flat flex cable (such as the 6" WR-FFC-Y50 or the 12" WR-FFC-Y51)
- 0.1" female-to-female jumper wires (WR-JMP-Y40)
- Seeeduino v4.2 (CFAPN15062)

The CFAF800480E1-050SN-A2-2 ships connected as shown (though the FFC may be disconnected to prevent breakages):

	Project / Part Number:	Date:	Filename:	Revision:
Crystalfontz © 2021 Crystalfontz America, Inc.	5 Inch EVE Display Module	2021-06-17	CFA10100 Seeeduino Block Diagram	B0
		Web: www.crystalfontz.com		Sheet: 1 of 1

If your kit ships with the flex cable disconnected, take note of the orientation of the flat-flex-cable, and use of the locking clip in the following photos.

12.1. Getting Started with your CFAF800480E1-050SN-A2-2 Kit

12.1.1. Components
- CFAF800480E1-050SN-A2 display module
- CFA10098 EVE adapter board
- Flat-flex-cable (6" WR-FFC-Y50 or 12" WR-FFC-Y51)
- 0.1" female-to-female jumper wires (WR-JMP-Y40)
- Seeeduino v4.2 (CFAPN15062)
- USB Cable (WR-USB-Y27)
- Bench supply set to 3.3v, rated for at least 1000mA
-

12.1.2. Hardware Procedure
- Following the Seeeduino Block Diagram, above, connect the components.
- Connect the USB cable to your PC

12.1.3. Firmware Procedure
- Download and install Arduino IDE software (or equivalent IDE)
- Download the example sketch available on the product page, and open it in the Arduino IDE.
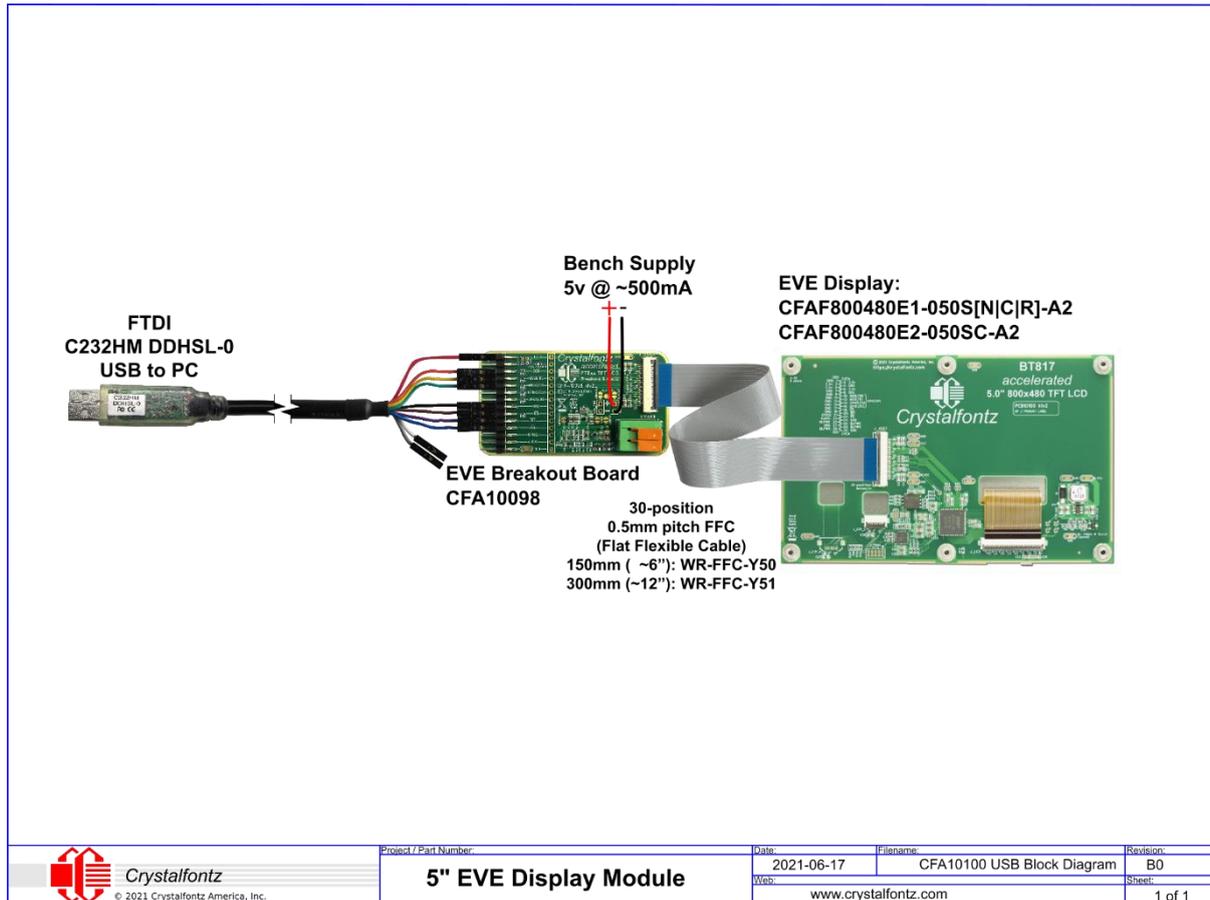- Build and upload the sketch to the Seeeduino

12.2. Getting started with the CFAF800480E1-050SN-A2 and a Windows PC

12.2.1. Components
- CFAF800480E1-050SN-A2 display module
- CFA10098 EVE adapter board
- Flat-flex-cable (6" WR-FFC-Y50 & 12" WR-FFC-Y51)
- FTDI C232HM-DDHSL-0 USB to SPI cable
- Bench supply set to 5v, rated for at least 500mA

12.2.2. Hardware Procedure
- Connect the CFA10098 to the CFAF800480E1-050SN-A2 using the FFC
- Connect the CFA10098 to the C232HM-DDHSL-0 USB adapter
- Connect 5v from a bench supply (rated for at least 500mA) to the CFA10098
- Connect the USB to SPI cable to your Windows PC

		Date:	Filename:	Revision:
Project / Part Number:		2021-06-17	CFA10100 USB Block Diagram	B0
Crystalfontz © 2021 Crystalfontz America, Inc.	**5" EVE Display Module**	Web: www.crystalfontz.com		Sheet: 1 of 1

12.2.3. Software Procedure:

- Download and install the FTDI PC demonstration application from Bridgetek's website.
- Download, open, build and run the example EVE application available on GitHub.

To modify and compile the FTDI PC demonstration program, download Visual Studio.

12.3. Getting started, hardware, with CFAF800480E1-050SN-A2 and your PCB

12.3.1. Components

- CFAF800480E1-050SN-A2 display module
- ZIF connector: 30-position, 0,5mm pitch, tin contact mounted to your custom PCB
- Flat-flex-cable (6" WR-FFC-Y50 & 12" WR-FFC-Y51)

12.3.2. Procedure

- Connect the FFC to the ZIF connector on your PCB
- Connect the FFC to the ZIF connector on the CFAF800480E1-050SN-A2

    Note that the power supply must be able to supply enough current to drive the backlight.

12.4. Troubleshooting

Please contact support@crystalfontz.com for help troubleshooting your module.

13. Care and Handling Precautions

For optimum operation of the CFAF800480E1-050SN-A2 and to prolong its life, please follow the precautions described below.

13.1. ESD (Electrostatic Discharge)

If present, the USB D+ & D- lines have enhanced ESD protection following industry standard USB2 practice.

The remainder of the circuitry is industry standard CMOS logic and susceptible to ESD damage. Use industry standard antistatic precautions, as for any other static sensitive device such as expansion cards, motherboards, or integrated circuits. Ground your body, work surfaces, and equipment.

13.2. Design and Mounting

- The exposed surface of the display is either a touch-sensitive panel or a polarizer laminated on top of the glass. To protect the surface from damage, the module ships with a protective film over the display. Please peel off the protective film slowly. Peeling off the protective film abruptly may generate static electricity.
- If the display does not have a touch-sensitive panel, 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.
- Do not disassemble or modify the module.
- Do not modify the six tabs of the metal bezel or make connections to them.
- Do not reverse polarity to the power supply connections. Reversing polarity will immediately ruin the module.

13.3. Mechanical 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.

13.4. LCD Panel Breakage

- If the LCD panel breaks, be careful to not get the liquid crystal fluid in your mouth or eyes.
- If the liquid crystal fluid touches your skin, clothes, or work surface, wash it off immediately using warm soapy water.

13.5. Cleaning

- The display surface can easily be scratched or become hazy, so use extra care when you clean it.
- Do not clean the display surface with liquids.
- If the display surface becomes dusty, carefully blow it off with clean, dry, oil-free compressed air.
- 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 above methods are not adequate, gently wipe using a very soft, clean, dry, lint free cloth (such as a microfiber towelette).
- Contact with moisture may permanently spot or stain the polarizer.

13.6. Operation

- Protect the module from ESD and power supply transients.
- Observe the operating temperature limitations: a minimum of -20°C to a maximum of +70°C with minimal fluctuation. Operation outside of these limits may shorten life and/or harm display.
- 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.
- 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 backlight lifetime.

13.7. Storage and Recycling

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