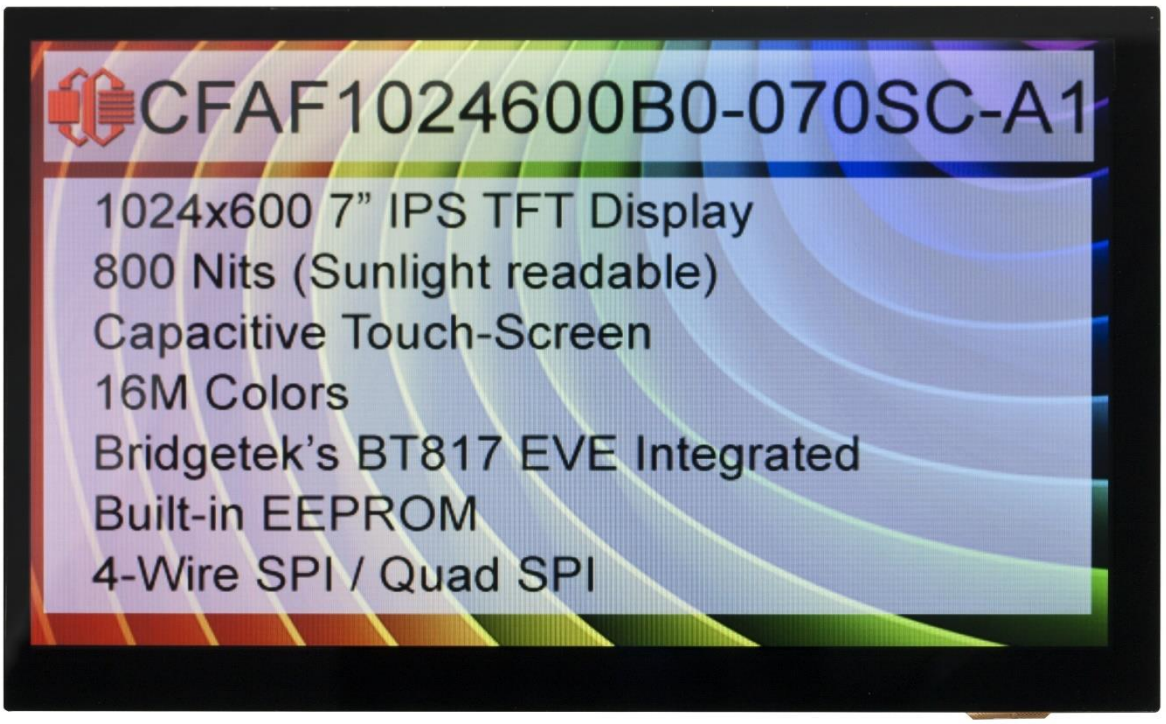
TFT GRAPHIC DISPLAY MODULE WITH GRAPHIC ACCELERATOR BOARD DATASHEET



Datasheet Release Date 2023-04-19
for
CFAF1024600B0-070SC-A1

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1. General Information

Datasheet Revision History
Datasheet Release: 2023-04-19 Datasheet for the CFAF1024600B0-070SC-A1 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 CFAF1024600B0-070SC-A1 is a 7” accelerated display module for embedded systems. It centers around the FTDI/BridgeTek BT817 EVE4 (Embedded Video Engine) graphics accelerator.

The traditional options for connecting a TFT to an embedded system make beautiful graphics a challenge. Traditionally, the choices were a very powerful processor that could support a frame buffer and RGB interface or, to write directly to TFT controller’s frame buffer. These methods both 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 GPIO 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.

The BT817 enables this display module to solve these problems of traditional TFT implementation. By accepting high-level commands, just a few instructions can completely describe a line of text. Further, it is fully anti-aliased and adjustable in width. Additionally, a wide selection of fonts is available, and displaying fonts at any angle no longer poses a problem. Embedded systems with 8-bit processors can now have beautiful and responsive displays that do not tax the host processor.

Our demo code for the CFAF1024600B0-070SC-A1 was written to fit on the Seeeduino (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

The CFAF1024600B0-070SC-A1 is a 16M color 7-inch TFT graphic display module with a white LED backlight and capacitive touch panel. This module comprises the CFAF1024600B0-070SC mounted to a graphic accelerator board (CFA10108). The graphic accelerator board includes the FTDI/ Bridgetek BT817 Embedded Video Engine (EVE).

This display has in-plane switching (IPS), and is sunlight readable. The EVE chip handles all communication with the display and touchscreen. See the BT817 datasheet for further reference.

4. Features

4.1. TFT Display Module Features

- 7-inch 1024x600 TFT LCD
- In Plane Switching – free viewing angle
- 5-point Capacitive touch
- High bright at 850 cd/m2
- Operating Temperature: -20° – 70°C
- Storage Temperature: -30° – 80°C
- FTDI/BridgeTek BT817 EVE graphics accelerator
- SPI, QSPI
- Single +3.3V power supply (backlight supply can be 3.3v to 5v)
- 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, touch, 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.

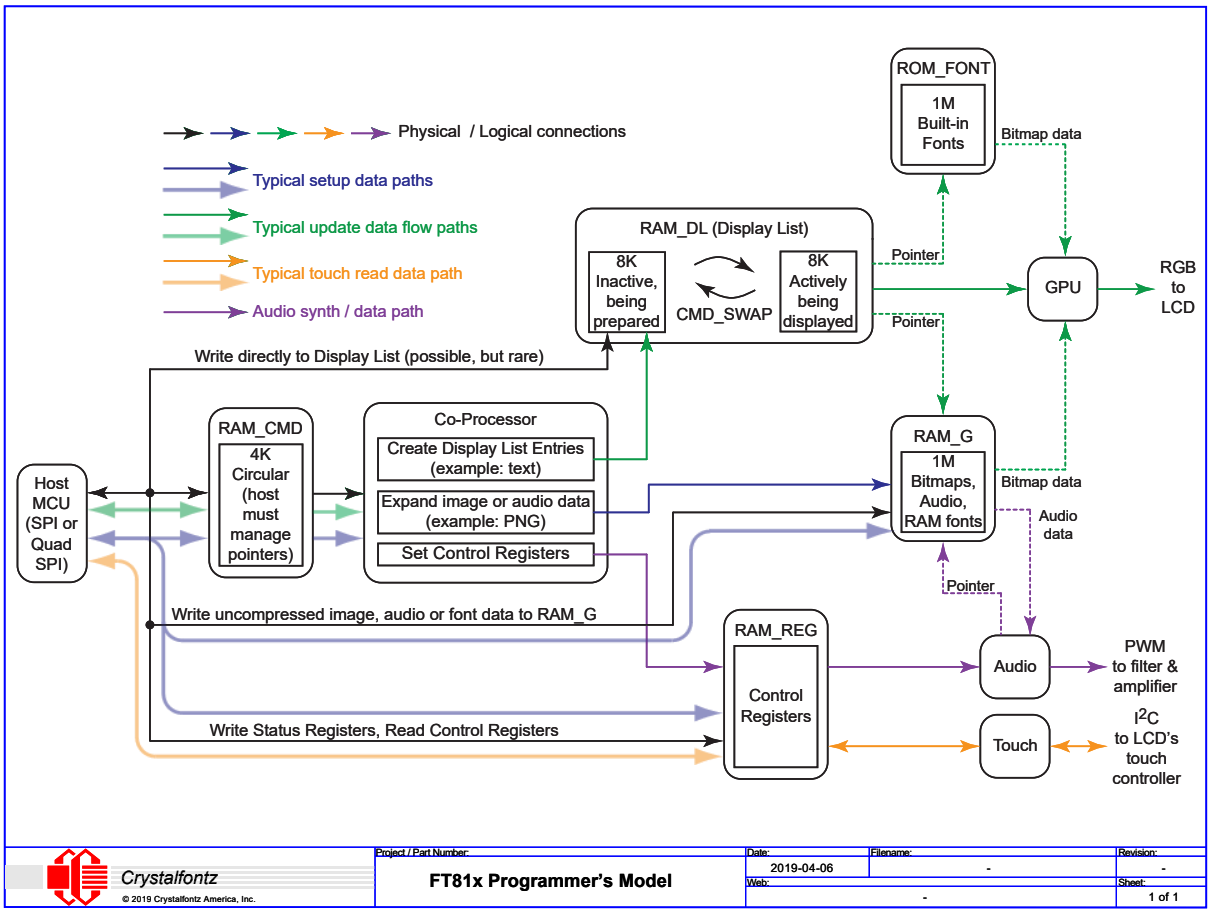
For detailed BridgeTek datasheets and other development information, see the Embedded Video Engine Documentation / Resources section below.

4.4. Embedded Video Engine Documentation / Resources

- BT817 Datasheet: https://www.crystalfontz.com/controllers/Bridgetek/BT81x/
- BridgeTek Screen Designer Software: https://brtchip.com/eve-toolchains/
- BridgeTek Forum: http://www.brtcommunity.com/index.php?board=7.0
- BridgeTek Resources: https://brtchip.com/bt81x/
- 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

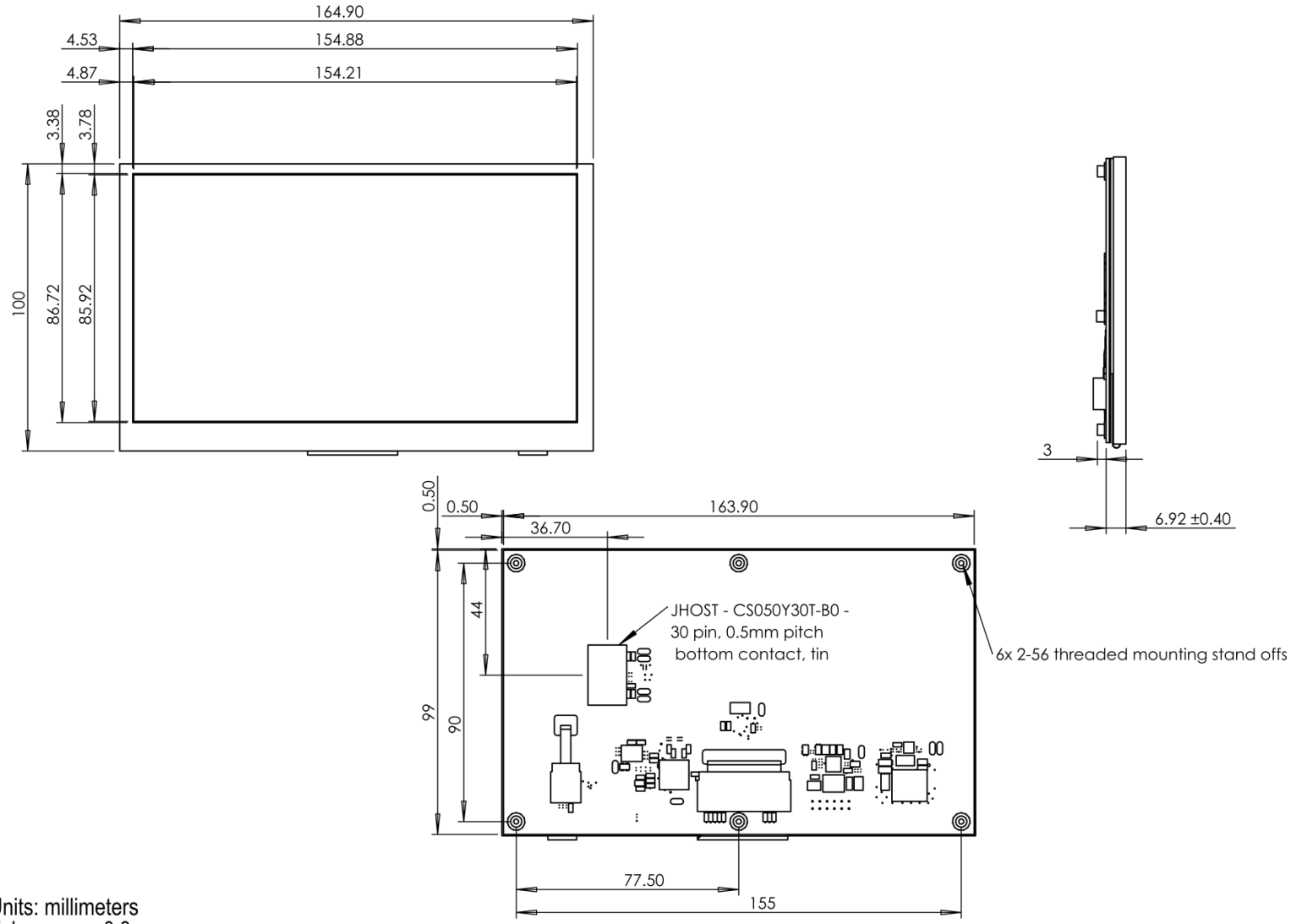
The diagram below is a basic overview of the EVE programming model showing data flow paths to and from the SPI host interface to the memory and processing blocks of the embedded video engine.



5. Mechanical Data

Item	Specification (mm)	Specification (inch, reference)
Overall Width, Height, and Depth	164.90 x 100.00 x 6.92	6.49 x 3.94 x 0.27
Viewing Area	154.88 x 86.72	6.10 x 3.41
Active Area	154.21 x 85.92	6.07 x 3.38
Pixel Pitch	0.0502 x 0.1432	0.002 x .006
Weight (Typical)	211 grams	7.4 ounces

6. Mechanical Drawing



Units: millimeters
Tolerance: ±0.3

Crystalfontz © 2021 Crystalfontz America, Inc.	Part Number: CFAF1024600B0-070SC-A1	Date: 2021-11-23	Filename: CFAF1024600B0-070SC-A1 mm.pdf	Revision: v1.0
		Web: www.crystalfontz.com/product/CFAF1024600B0-070SC-A1		Sheet: 1 of 1

7. Interface Pin Function

Host data connection and power supply are achieved via J_HOST, a 30-pin flat-cable connector 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, such as 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	3V3	0	4	V
Backlight Power Voltage	BLPWR	2.7	5.5	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. Electrical Characteristics

Item	Symbol	Min	Typ	Max	Unit
Supply Voltage for Logic	3V3	3.0	3.3	3.6	V
Logic Supply Current	I_{DD}	-	30	-	mA
High-level Input	V_{IH}	2.0	-	3V3	V
Low-level Input	V_{IL}	GND	-	0.8	V
High-level Output	V_{OH}	3V3– 0.5	-	-	V
Low-level Output	V_{OL}	GND	-	GND + 0.4	V

10. Optical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit
View Angle	(V)θ	-	-	170	-	deg
	(H)φ	-	-	170	-	deg
Contrast Ratio	CR	-	-	800	-	-
Response Time	$T_{rise}+T_{fall}$	-	-	30	40	ms
Surface Luminance		θ =0	-	850	-	cd/m2

11. Backlight Characteristics

Item	Symbol	Min	Typ	Max	Unit
Supply Voltage	BLPWR	3.0	5.0	5.5	V
Supply Current	I_{BLPWR}	40	120	200	mA
LED Lifetime			40000		hours

Notes:
(1) Typical voltage value is 5.0v. Using a voltage below 4.0v will result in a lower maximum brightness of the LCD. The firmware derates the maximum backlight current linearly for BLVCC below 4v. At 4v, a maximum of 100% is possible. At 3v the maximum is about 53%.
(2) 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.

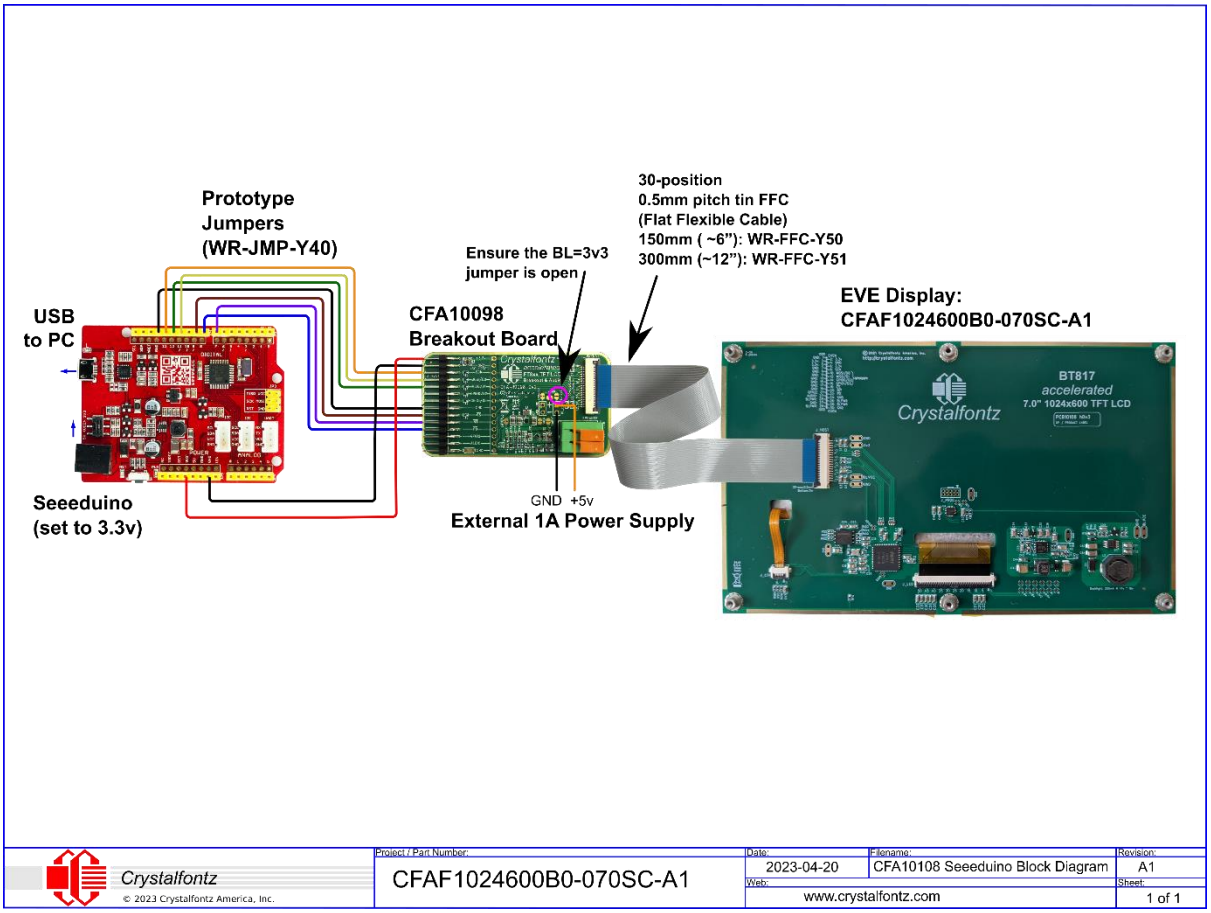
12. Getting Started

12.1. Getting Started with a CFAF1024600B0-070-A1-2

In earlier stages of development, consider the complete CFAF1024600B0-070-A1-2 kit, which includes everything needed to demonstrated the display (excluding power sources).

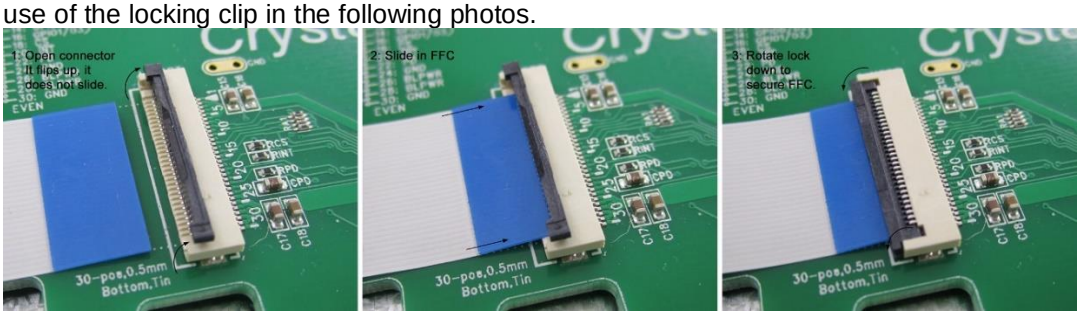
12.1.1. Components

- CFAF1024600B0-070SC-A1 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 (e.g., WR-JMP-Y40)
- Seeeduino (CFAPN15062)
- USB Cable (WR-USB-Y27)



The CFAF1024600B0-070-A1-2 ships connected as shown (though the FFC may be disconnected to prevent breakages):

If the 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.



12.1.2. Hardware Procedure

- Following the Seeeduino Block Diagram, above, connect the components.
- Open the BL=3v3 jumper.
- Supply 5.0v from a bench supply (rated for at least 1000mA) to the CFA10098 for the backlight
- Connect the USB cable to the PC

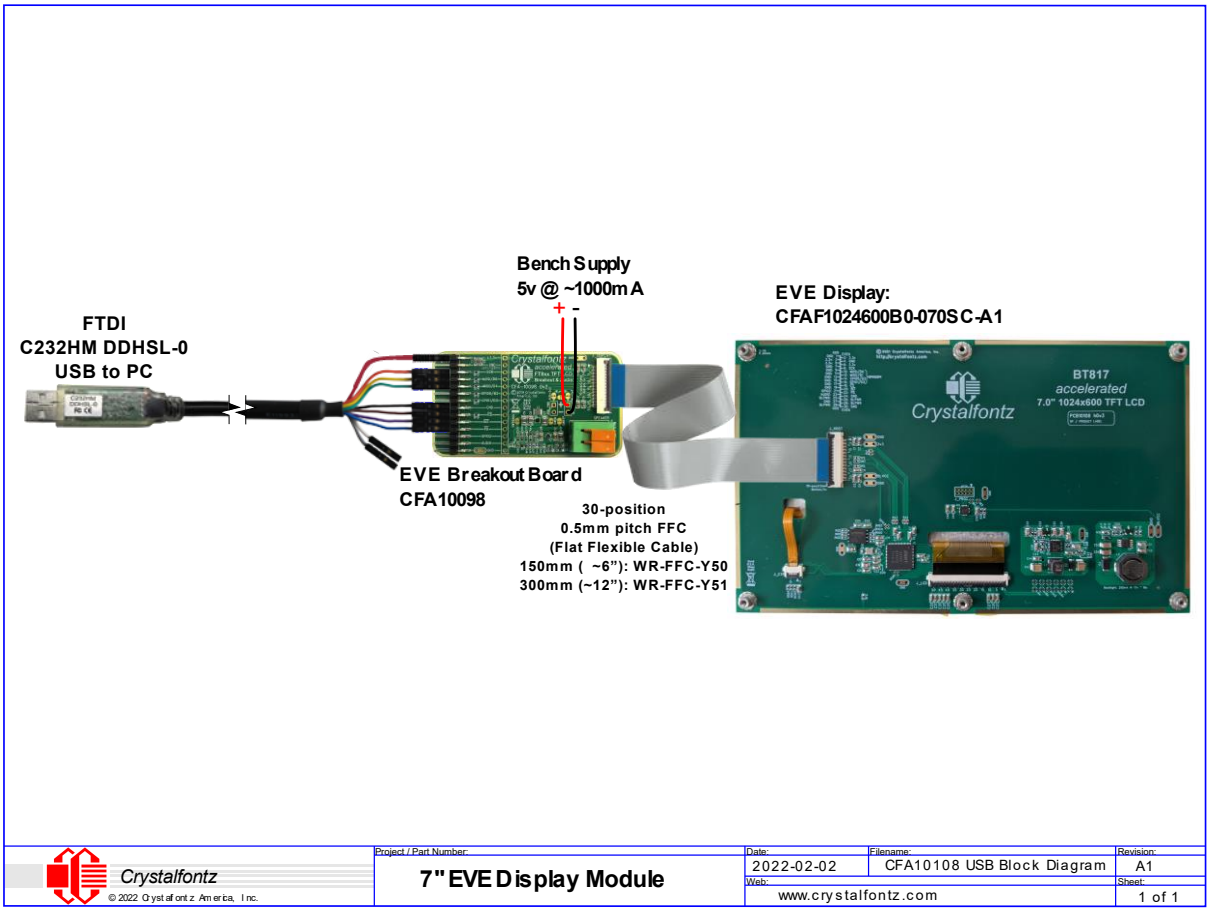
12.1.3. Firmware Procedure

- 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 CFAF1024600B0-070SC-A1 and a Windows PC

12.2.1. Components

- CFAF1024600B0-070SC-A1 display module
- CFA10098 EVE breakout 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 1A



12.2.2. Hardware Procedure

- Connect the CFA10098 to the CFAF1024600B0-070SC-A1 using the FFC
- Connect the CFA10098 to the C232HM-DDHSL-0 USB adapter
- Connect 5v from a bench supply to the CFA10098
- Connect the USB to SPI cable to a Windows PC

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. Visual Studio is required to modify and compile the FTDI PC demonstration program.

12.3. Getting started with the CFAF1024600B0-070SC-A1 and a Custom PCB

12.3.1. Components

- CFAF1024600B0-070SC-A1 display module
- ZIF connector: 30-position, 0.5mm pitch, tin contact mounted to the custom PCB
- Flat-flex-cable (6" WR-FFC-Y50 & 12" WR-FFC-Y51)

12.3.2. Hardware Procedure

- Connect the FFC to the ZIF connector on the PCB
- Connect the FFC to the ZIF connector on the CFAF1024600B0-070SC-A1

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 CFAF1024600B0-070SC-A1 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 this 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 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.