



3.5" TFT DISPLAY MODULE
WITH EVE GRAPHICS ACCELERATOR
DATASHEET



CFAF320240F-035T-TS-A1-1

Datasheet Release: 2020-01-08

Revision A0

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1. General Information

Datasheet Revision History

Datasheet Release: 2020-01-08
Datasheet for the CFAF320240F-035T-TS-A1-1 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 CFAF320240F-035T-TS-A1-1 is a revolutionary new accelerated display for embedded systems based on the FTDI/BridgeTek FT810 EVE (Embedded Video Engine) graphics accelerator.



There are two traditional 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 simply 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.

Now image 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 adjustable in width? How about writing just 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 CFAF320240F-035T-TS-A1-1 thanks to the FTDI/BridgeTek FT810 EVE graphics accelerator at the heart of the module. Embedded systems with 8-bit processors can now have beautiful and responsive displays and touch support that do not tax the host processor.

Ready to live the dream? Our demo code for the CFAF320240F-035T-TS-A1-1 was written to fit on the Seeeduino v4.2 (a 3.3v version of the Arduino Uno). As always, our source code is freely supplied and our displays are fully supported.



3. Key Features

3.1. Module Features

- 3.5-inch 320x240 TFT LCD panel
- Resistive touch sensing screen
- FTDI/BridgeTek FT810 EVE graphics accelerator
- SPI Single or Quad host interface
- Compact 30-position 0.5mm flat-cable ZIF host connection
- Threaded mounting standoffs for simple mechanical design
- Compact form-factor, overall size is no larger than LCD
- Single +3.3V power supply (backlight supply can be 3.3v to 6v)

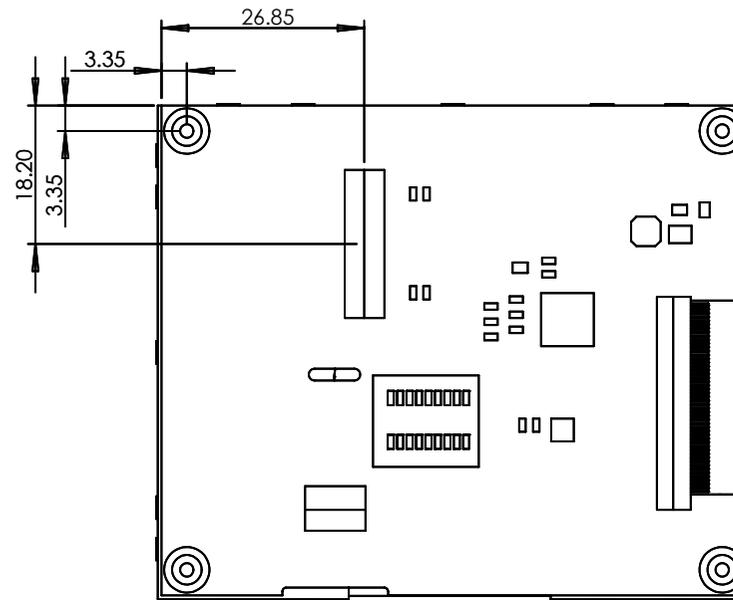
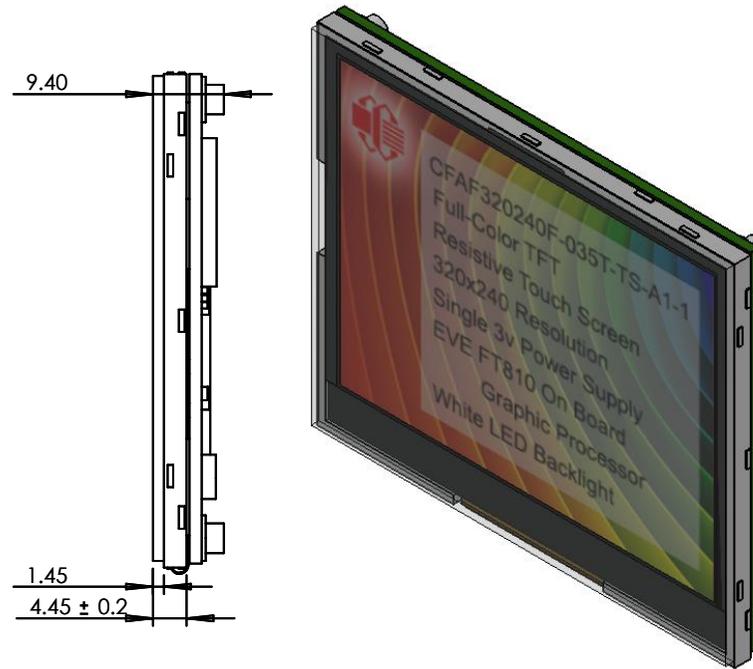
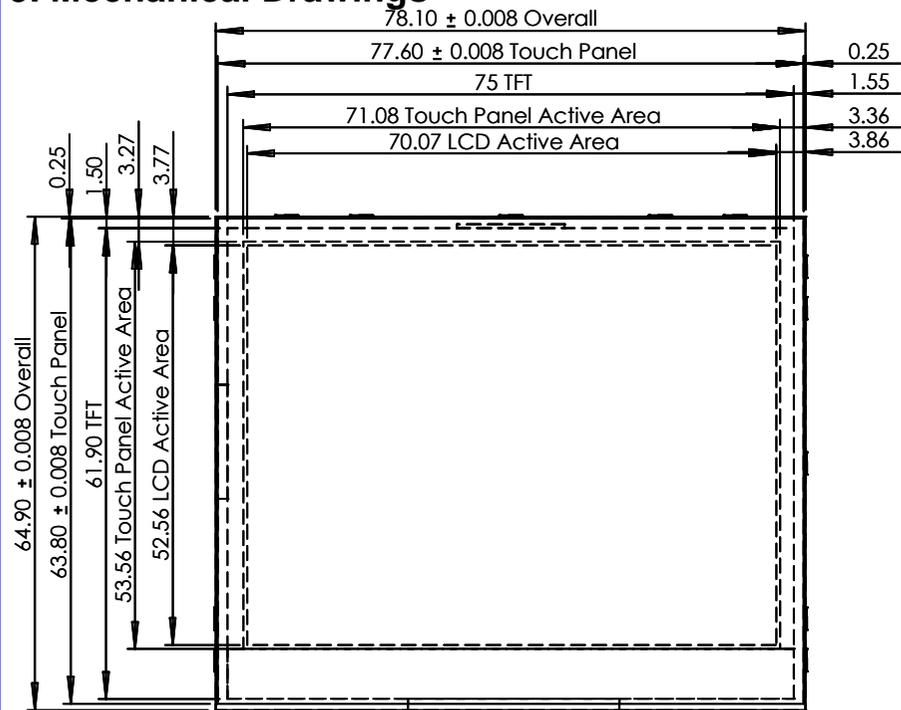
3.2. EVE Graphics Accelerator Features

- Support multiple widgets for simplified design implementation
- User interface design software (PC) simplifies the design process
- Hardware engine can recognize touch tags and track touch movement
- 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. Mechanical Data

| Item | Specification (mm) | Specification (inch) |
|--------------------------|---------------------------------|--------------------------------|
| Overall Module Dimension | 78.1 (W) x 64.90 (H) x 9.40 (D) | 3.07 (W) x 2.56 (H) x 0.37 (D) |
| Viewing Area | 72.08 (W) x 54.56 (H) | 2.84 (W) x 2.15 (H) |
| Active Area | 70.08 (W) x 52.56 (H) | 2.76 (W) x 2.07 (H) |
| Dot Pitch | 0.219 (W) x 0.219 (H) | 0.0086 (W) x 0.0086 (H) |
| Weight (Typical) | 52.3 grams | 1.845 ounces |

5. Mechanical Drawings



Units: mm
 Tolerance: ±0.3



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Part Number:

CFAF320240F-035T-TS-A1-1

Date:

2020-01-07

Filename:

CFAF320240F-035T-TS-A1-1 mm.pdf

Revision:

v1.0

Web:

www.crystalfontz.com/product/cfaf320240f035ttsa11

Sheet:

1 of 1



6. Module Details

6.1. General Information

The CFAF320240F-035T-TS-A1-1 is a 3.5-inch TFT display module based around a FTDI/BridgeTek FT810 Embedded Video Engine (EVE).

All display, touch sensing, backlight control and audio features are controlled via the Embedded Video Engine 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.

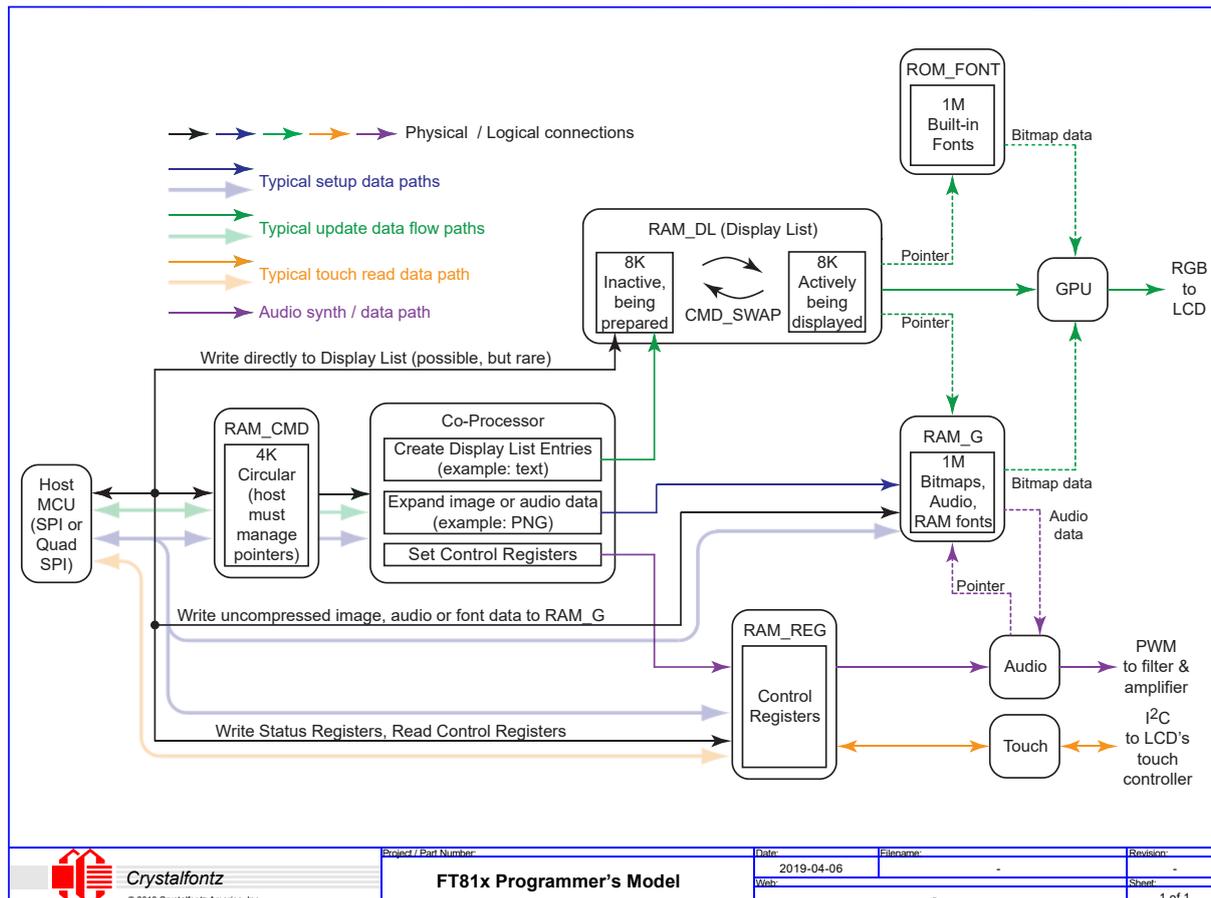
For detailed BridgeTek datasheets and other development information, see the Embedded Video Engine Documentation / Resources section below.

6.2. Embedded Video Engine Documentation / Resources

- BridgeTek FT810 Datasheet: <https://brtchip.com/ft81x/>
- BridgeTek Application Notes: <https://brtchip.com/application-notes/>
- BridgeTek Screen Designer Software: <https://brtchip.com/eve-toolchains/>
- BridgeTek Forum: <http://www.brtcommunity.com/index.php?board=7.0>
- FTDI FT810 Datasheets: <https://www.ftdichip.com/Products/ICs/FT81X.html>
- FTDI Application Notes: <https://www.ftdichip.com/Support/Documents/AppNotes.htm>
- FTDI C232HM USB-SPI cable: <https://www.ftdichip.com/Products/Cables/USBMPSSSE.htm>

6.3. 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.





6.4. Interface Pin Function

Host data connection and power supply is achieved via a single 30 pin 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.

| 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⁾ |

Notes:

1. 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.



6.5. Absolute Maximum Ratings

| Parameter | Symbol | Min | Max | Unit |
|------------------------|-----------------|-----|-----|------|
| Logic Power Supply | 3V3 | 0.0 | 4.0 | V |
| Backlight Power Supply | BLPWR | 0.0 | 6.0 | V |
| Operating Temperature | T _{OP} | -20 | +70 | °C |
| Storage Temperature | T _{ST} | -30 | +80 | °C |

Notes:

- These are stress ratings only. Extended exposure to the absolute maximum ratings listed above may affect device reliability or cause permanent damage.
- Temp. ≤60°C, 90% RH Maximum Temp. >60°C Absolute humidity < 90% RH at 60°C

6.6. Electrical Characteristics

| Item | Symbol | Min | Typ | Max | Unit |
|----------------------|------------------|------|------|------|------|
| Logic Power Supply | 3V3 | 2.97 | 3.30 | 3.63 | V |
| Input Logic High | V _{IH} | 2.0 | - | - | V |
| Input Logic Low | V _{IL} | - | - | 0.8 | V |
| Logic Supply Current | I _{3V3} | - | 70 | - | mA |

6.7. Backlight Characteristics

| Item | Symbol | Conditions | Min | Typ | Max | Unit |
|----------------|--------|--------------------|-----|--------|-----|-------------------|
| Supply Voltage | BLPWR | | - | 9.6 | - | V |
| Supply Current | IBLPWR | | 30 | 40 | - | mA |
| Luminance | L | | 280 | 330 | - | Cd/m ² |
| LED Lifetime | | at 100% brightness | - | 50,000 | - | hours |

6.8. Optical Characteristics

| Item | Symbol | Condition | Min | Typ | Max | Unit |
|--------------------|--------------------------------|--------------|--------|--------|--------|------|
| Response Time | T _r +T _f | | - | 25 | - | ms |
| Contrast Ratio | (CR) | θ=0° | 200 | 300 | - | - |
| White Chromaticity | W _x | Backlight On | 0.2425 | 0.2825 | 0.3225 | ms |
| | W _y | | 0.2821 | 0.3021 | 0.3421 | ms |
| Viewing Direction | 12 o'clock | | | | | |



7. Getting Started

7.1. Getting started with the CFAF320240F-035T-TS-A1-2 kit

Components Required:

- Crystalfontz the CFAF320240F-035T-TS-A1-1 display module
- Crystalfontz [CFA10098](#) EVE adapter board
- Appropriate flat-flex-cable (6" [WR-FFC-Y50](#) & 12" [WR-FFC-Y51](#))
- 0.1" female-to-female jumper wires (Crystalfontz [WR-JMP-Y40](#))
- Seeeduino v4.2 (Crystalfontz [CFAPN15062](#))
- USB Cable (Crystalfontz [WR-USB-Y27](#))
- Bench supply set to 3.3v, rated for at least 1000mA

Hardware Procedure:

- Following the Example Connection Diagrams below, connect the components.
- Supply 3.3v from a bench supply (rated for at least 1000mA) to the CFA10098
- Connect the USB cable to your PC

Firmware Procedure:

- Download and install [Arduino IDE](#) software.
- Download the [example sketch available on GitHub](#), and open it in the Arduino IDE.
- Build and upload the sketch to the Seeeduino

7.2. Getting started with the CFAF320240F-035T-TS-A1-1 and a Windows PC

Components Required:

- Crystalfontz the CFAF320240F-035T-TS-A1-1 display module
- Crystalfontz [CFA10098](#) EVE adapter board
- Appropriate flat-flex-cable (6" [WR-FFC-Y50](#) & 12" [WR-FFC-Y51](#))
- FTDI [C232HM-DDHSL-0](#) USB to SPI cable
- Bench supply set to 3.3v, rated for at least 1000mA

Hardware Procedure:

- Connect the CFA10098 to the CFAF320240F-035T-TS-A1-1 using the FFC (see the 7.5 below)
- Connect the CFA10098 to the C232HM-DDHSL-0 USB adapter
- Connect 3.3v from a bench supply (rated for at least 1000mA) to the CFA10098
- Connect the USB to SPI cable to your Windows PC

Software Procedure:

- Download and install the FTDI PC demonstration application from [this website](#).
- Download, open, build and run the example EVE application [available on GitHub](#).

In order to modify and compile the FTDI PC demonstration program, you will need to download Visual Studio. You can use the free version but you may need to register with Microsoft.



7.3. Getting started, hardware, with CFAF320240F-035T-TS-A1-1 and your PCB

Components Required:

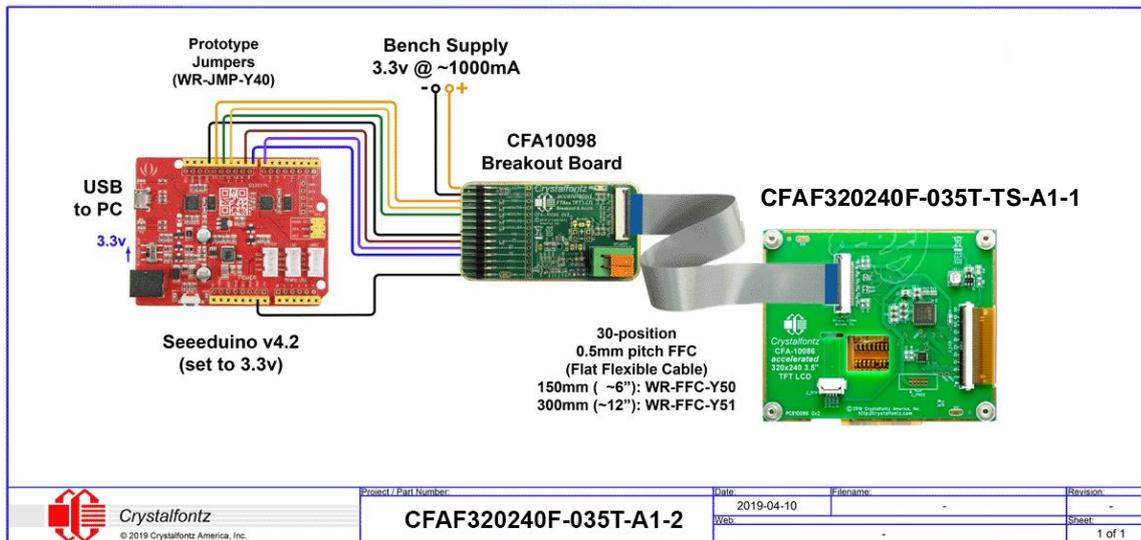
- CrystalFontz CFAF320240F-035T-TS-A1-1 display module
- Appropriate ZIF connector: 30-position, 0,5mm pitch, tin contact mounted to your custom PCB
- Appropriate flat-flex-cable (6" [WR-FFC-Y50](#) & 12" [WR-FFC-Y51](#))

Procedure:

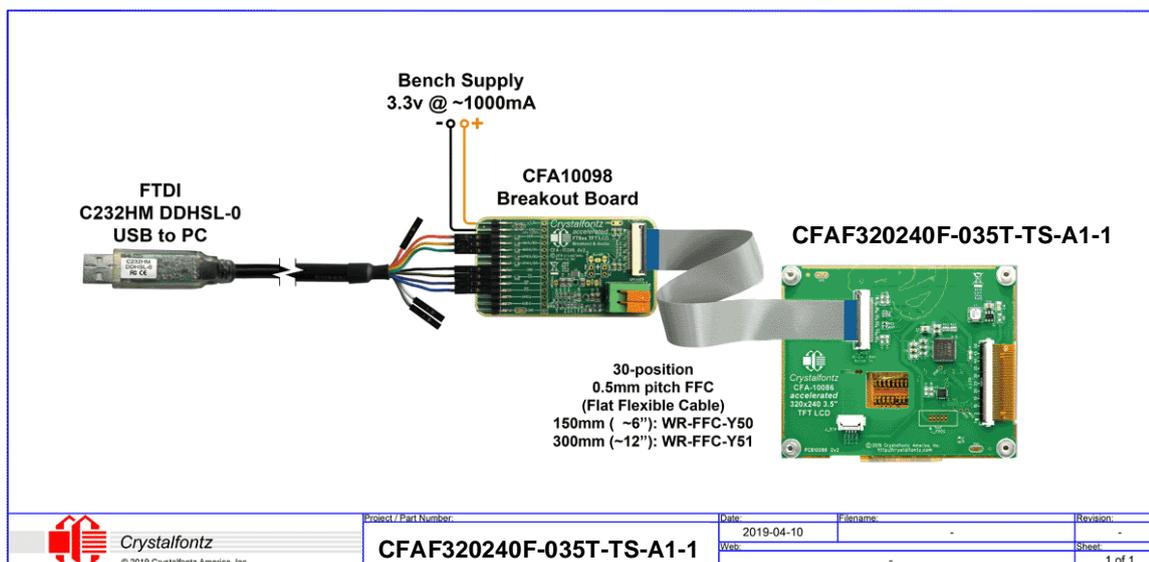
- Connect the FFC to the ZIF connector on your PCB
- Connect the FFC to the ZIF connector on the CFAF320240F-035T-TS-A1-1 FFC (see the 7.5 below)

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

7.4. Example Connection Diagrams



A1-2 Series comprising: CFAF320240F-035T-TS-A1- CFA10098 – Seedeuino

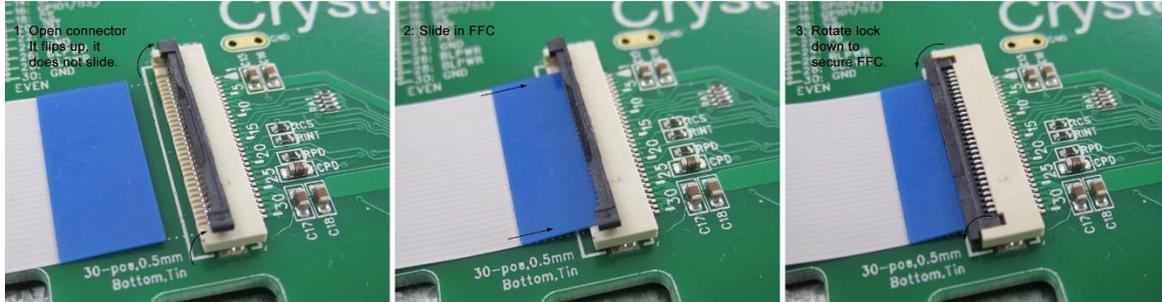


CFAF320240F-035T-TS-A1-1- CFA10098 - USB to PC



7.5. ZIF Connector Use With Flat-Flex-Cable (FFC)

Please take note of the orientation of the flat-flex-cable, and use of the locking clip in the following photos.



7.6. Troubleshooting

The CFAF320240F-035T-TS-A1-1 ships with jumper JTEST opened. When JTEST is open, the TFT will initialize to black and the backlight will be off until VSYNC activity is detected. Closing the jumper will cause the TFT to initialize to a boot screen with the backlight on until VSYNC activity is detected.

8. Care and Handling Precautions

For optimum operation of the CFAF320240F-035T-TS-A1-1 and to prolong its life, please follow the precautions described below.

8.1. 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 devices such as expansion cards, motherboards, or integrated circuits. Ground your body, work surfaces, and equipment.

8.2. 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.

8.3. 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.

8.4. 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.



8.5. 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.

8.6. 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.

8.7. 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.