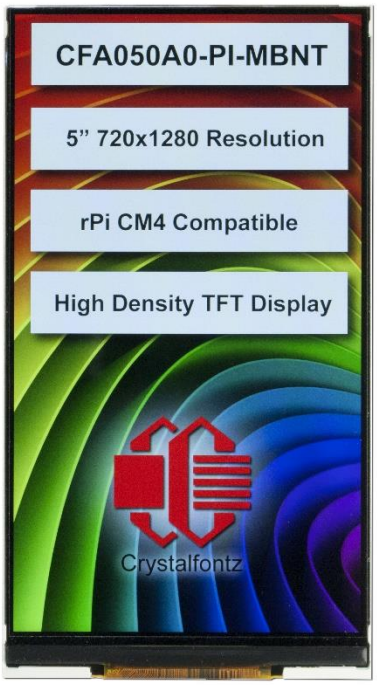
# CFA050A0-PI-MBxT Family

# TFT GRAPHIC DISPLAY MODULES WITH GRAPHIC ACCELERATOR BOARD DATASHEET

**CFA050A0-PI-MBCT**
**CFA050A0-PI-MBNT**

**Datasheet Release Date 2024-03-14**



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# 1. General Information

| Datasheet Revision History |
|---|
| Datasheet Release: 2024-03-14<br>Datasheet for the CFA050A0-PI-MBxT Family 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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|---|
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# 2. Introduction

This family of modules takes the complexity out of designing a high-resolution display into an end product or hobby project. With the potential to utilize 32 separate GPIOs, PCIe, USB, and Ethernet, the possibilities are endless.

The module integrates a full color, 5-inch, 720x1280 resolution TFT display with a Raspberry Pi CM4 or other compatible compute module. It has a 40-pin header similar to the standard Raspberry Pi header allowing Pi HATs to be plugged in. It also has an additional expansion header with USB, Ethernet, PCIe, USB, and additional GPIOs for daughter boards or cables to be used.

The high PPI and In-Plane Switching (IPS) make this a sharp looking display at any angle. Fully integrated into the Raspberry Pi OS, all it takes are some overlays in the config.txt file to get this display up and running.

The following touch options are available:
CFA050A0-PI-MB**C**T – Capacitive touchscreen
CFA050A0-PI-MB**N**T – No touchscreen

# 3. Features

## 3.1. TFT Display Module Features

- Raspberry Pi CM4 compatible
  - TFT Display works after a quick edit to the config.txt file
- 294 PPI, 720x1280, 5” TFT display with cap-touch or non-touch options
- 40-pin Raspberry Pi compatible header for Pi Hats
- Built in RTC (CR1225 not included)
- Micro USB
- Expansion Header with USB, PCIe, Ethernet, and GPIOs for daughter boards
- 2mm Barrel jack for power
- Flexibility to power via 5V or to integrate a power regulator for any input voltage
- Operating Temperature: -20° - 70°C
- 9 mounting nuts
  - 4 to secure the compute module: M2.5-0.45, 1.5mm depth
  - 4 to mount to an enclosure: M2.5-0.45, 4.0mm depth
  - 1 to secure a J13 expansion board: M2.5-0.45, 4.0mm depth

## 3.2. Mechanical Data

| Item | | Specification (mm) | Specification (inch, reference) |
|---|---|---|---|
| Active Area | | 62.1 x 110.4 | 2.89 x 5.02 |
| Pixel Pitch | | 0.08625 x 0.08625 | 0.003 x 0.003 |
| CFA050A0-PI-MB**C**T | Weight (Typical) | 104.4 grams | 3.68 ounces |
| | Overall Width, Height, and Depth | 73.3 x 127.6 x 20.0 | 2.89 x 5.02 x 0.79 |
| CFA050A0-PI-MB**N**T | Weight (Typical) | 71.7 grams | 2.53 ounces |
| | Overall Width, Height, and Depth | 66.1 x 120.4 x 18.4 | 2.6 x 4.74 x 0.72 |

## 3.3. Raspberry Pi CM4 Features

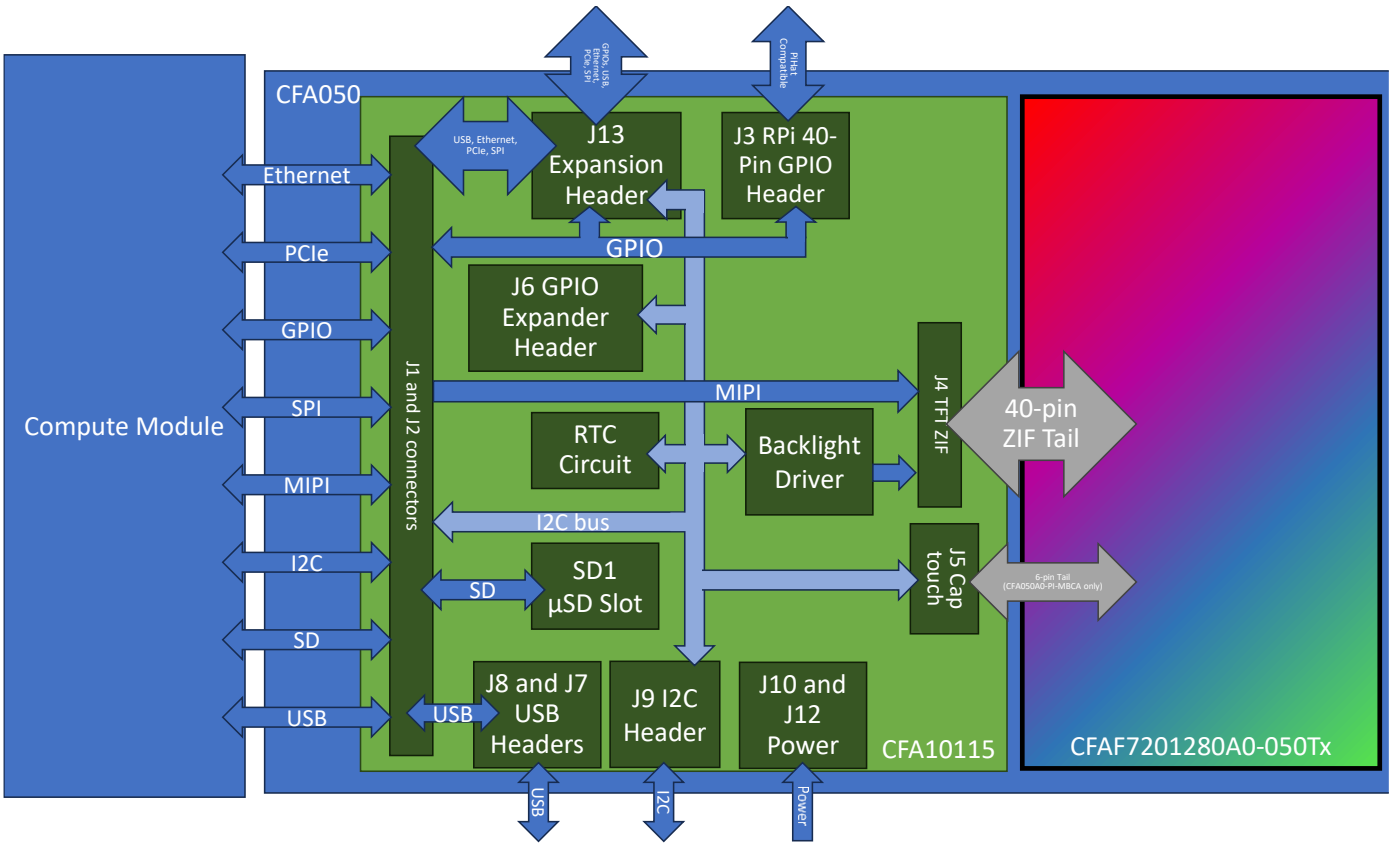
- For more information on the CM4, visit their page here: https://www.raspberrypi.com/products/compute-module-4/?variant=raspberry-pi-cm4001000

## 3.4. Crystalfontz Documentation / Resources

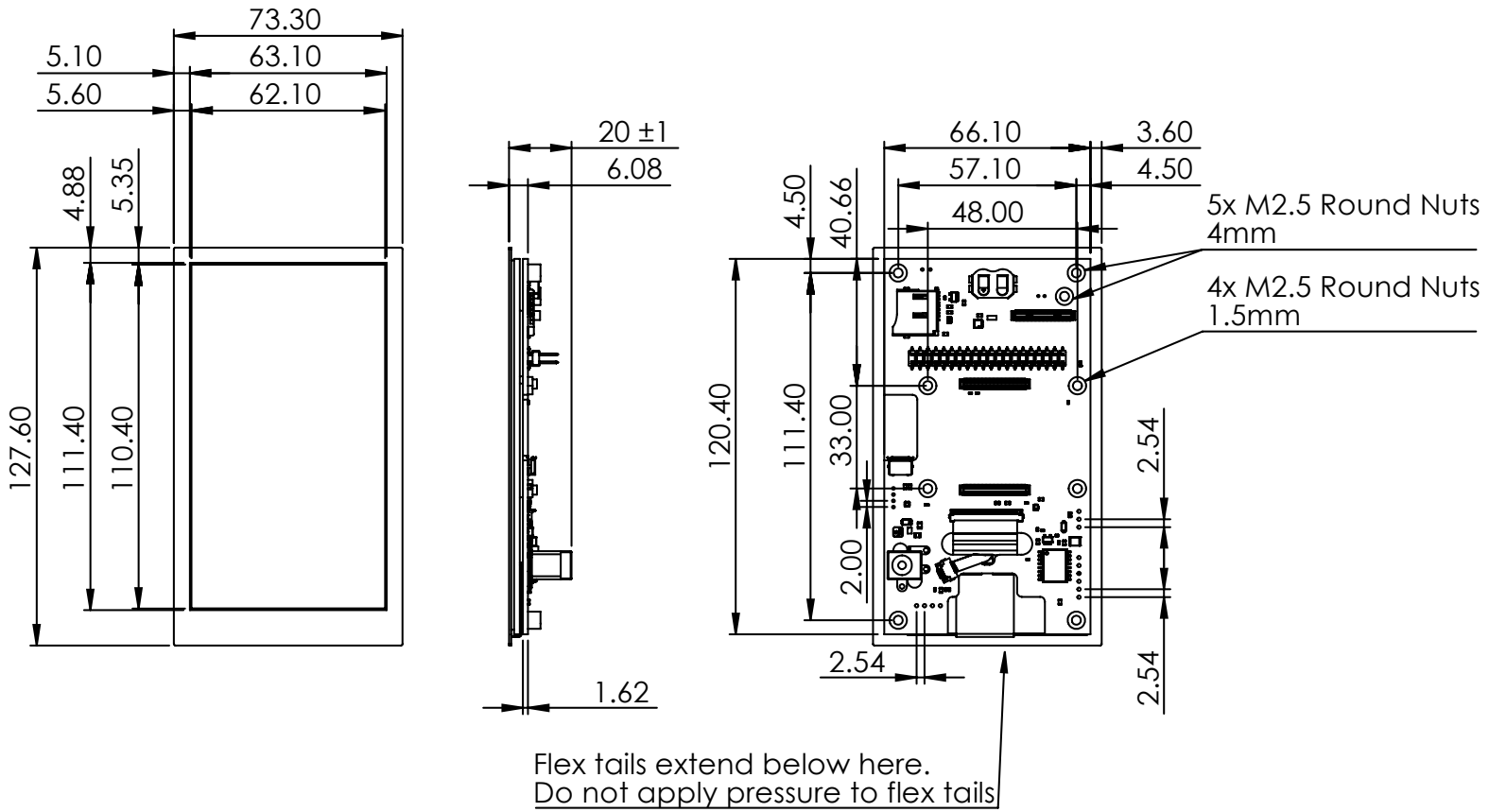
- OS Setup: https://github.com/crystalfontz/CFA050_PI_M/blob/main/OS-Setup.md
- General instructions: https://github.com/crystalfontz/CFA050_PI_M

## 3.5. Block Diagram

The diagram below is a basic overview of the CFA10115 PCB used to create the modules in the CFA050A0-PI-MBxT Family.



# 4. Mechanical Drawing - CFA050A0-PI-MBCT

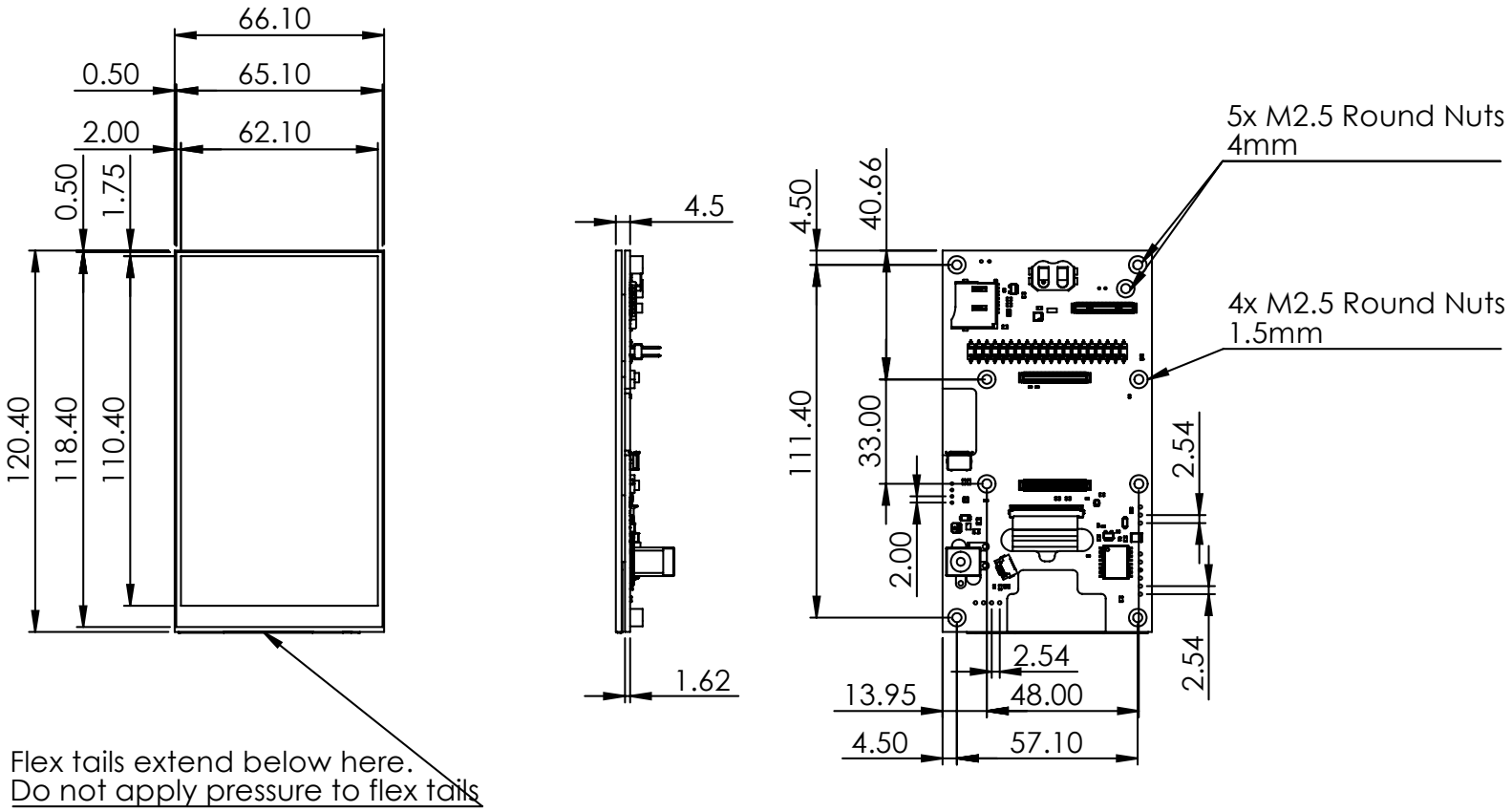



| | |
|---|---|
| Touchscreen | Capacitive |
| Brightness | 250 nits |
| Viewing Direction | ANY |
| Operating Temperature | -20 to 70C |
| Voltage Levels | Logic: 3.3v |

Units: millimeters
Tolerance: ±0.3mm

| | | | | |
|---|---|---|---|---|
| Crystalfontz | Part Number: | Date: | Filename: | Revision: |
| ©2024 Crystalfontz America, Inc. | CFA050A0-PI-MBCA | 3/13/2024 | CFA050A0-PI-MBCA.pdf | 1.0 |
| | | Web: | | Sheet: |
| | | www.crystalfontz.com/CFA050A0-PI-MBCA | | 1 of 1 |

## 5. Mechanical Drawing - CFA050A0-PI-MBNT




| | |
|---|---|
| Touchscreen | None |
| Brightness | 300 nits |
| Viewing Direction | ANY |
| Operating Temperature | -20 to 70C |
| Voltage Levels | Logic: 3.3v |

Units: millimeters
Tolerance: ±0.3mm

| | | | |
|---|---|---|---|
| Crystalfontz ©2024 Crystalfontz America, Inc. | Part Number: CFA050A0-PI-MBNA | Date: 3/13/2024 | Filename: CFA050A0-PI-MBNA.pdf |
| | | Web: www.crystalfontz.com/CFA050A0-PI-MBNA | Revision: 1.0 |
| | | | Sheet: 1 of 1 |

# 6. Header Functions

There are six external headers:

1. **J3** – Standard 40 pin 0.1” pitch connector. Compatible with the Raspberry Pi header used on their standard modules. Populated on the base part.
2. **J6** – Standard 6 pin 0.1” pitch connector. Breaks out extra GPIOs from the I/O expander chip, PCF8574ADWR. Non-populated on the base part.
3. **J7** – Standard 4 pin 2mm header. Breaks out the USB pins for alternate USB connections Non-populated on the base part.
4. **J9** – Standard 4 pin 0.1” pitch connector. Breaks out I2C. Non-populated on the base part.
5. **J10** – 2mm Barell Jack by CUI Devices. Provides power to the compute module and display. JMP6 can be closed to connect this to 5V or a regulator can be used at J12 or J13. Populated on the base part.
6. **J12** – Standard 3 pin 0.1” pitch connector. Breaks out J10_PWR and VDD to be used with a voltage regulator. Non-populated on the base part.
7. **J13** – Fine pitch 90 pin header in the same family of headers used on the compute module. It is the DF40HC(4.0)-90DS-0.4V(51) by Hirose. Breaks out several GPIOs, USB, Ethernet, PCIe, I2C, SPI, and all power nets. Populated on the base part.

| J3 Connection with CM4 | | |
|---|---|---|
| **Pin** | **Symbol** | **Function** |
| 1 | VCC | 3.3V supplied by the Raspberry Pi. Do not provide external 3.3V. |
| 2 | VDD | 5V power. Must be supplied externally. |
| 3 | GPIO2 | General Purpose IO. Consult the compute module’s datasheet for additional uses. |
| 4 | VDD | 5V power. Must be supplied externally. |
| 5 | GPIO3 | General Purpose IO. Consult the compute module’s datasheet for additional uses. |
| 6 | GND | Ground. |
| 7 | GPIO4 | General Purpose IO. Consult the compute module’s datasheet for additional uses. |
| 8 | GPIO14 | General Purpose IO. Consult the compute module’s datasheet for additional uses. |
| 9 | GND | Ground. |
| 10 | GPIO15 | General Purpose IO. Consult the compute module’s datasheet for additional uses. |
| 11 | GPIO17 | General Purpose IO. Consult the compute module’s datasheet for additional uses. |
| 12 | GPIO18 | General Purpose IO. Consult the compute module’s datasheet for additional uses. |
| 13 | GPIO27 | General Purpose IO. Consult the compute module’s datasheet for additional uses. |
| 14 | GND | Ground. |
| 15 | GPIO22 | General Purpose IO. Consult the compute module’s datasheet for additional uses. |
| 16 | GPIO23 | General Purpose IO. Consult the compute module’s datasheet for additional uses. |
| 17 | VCC | 3.3V supplied by the Raspberry Pi. Do not provide external 3.3V. |
| 18 | GPIO24 | General Purpose IO. Consult the compute module’s datasheet for additional uses. |
| 19 | GPIO10 | General Purpose IO. Consult the compute module’s datasheet for additional uses. |
| 20 | GND | Ground. |
| 21 | GPIO9 | General Purpose IO. Consult the compute module’s datasheet for additional uses. |
| 22 | GPIO25 | General Purpose IO. Consult the compute module’s datasheet for additional uses. |
| 23 | GPIO11 | General Purpose IO. Consult the compute module’s datasheet for additional uses. |
| 24 | GPIO8 | General Purpose IO. Consult the compute module’s datasheet for additional uses. |
| 25 | GND | Ground. |
| 26 | GPIO7 | General Purpose IO. Consult the compute module’s datasheet for additional uses. |
| 27 | ID_SD | Reserved for HAT ID EEPROM. Do not connect with anything else. |
| 28 | ID_SC | Reserved for HAT ID EEPROM. Do not connect with anything else. |

| | | |
|---|---|---|
| 29 | GPIO5 | General Purpose IO. Consult the compute module's datasheet for additional uses. |
| 30 | GND | Ground. |
| 31 | GPIO6 | General Purpose IO. Consult the compute module's datasheet for additional uses. |
| 32 | GPIO12 | General Purpose IO. Consult the compute module's datasheet for additional uses. |
| 33 | GPIO13 | General Purpose IO. Consult the compute module's datasheet for additional uses. |
| 34 | GND | Ground. |
| 35 | GPIO19 | General Purpose IO. Consult the compute module's datasheet for additional uses. |
| 36 | GPIO16 | General Purpose IO. Consult the compute module's datasheet for additional uses. |
| 37 | GPIO26 | General Purpose IO. Consult the compute module's datasheet for additional uses. Used by default as the Touch Point Interrupt for the capacitive touch screen. JMP_G26 needs to be closed to connect this to the compute module. |
| 38 | GPIO20 | General Purpose IO. Consult the compute module's datasheet for additional uses. |
| 39 | GND | Ground. |
| 40 | GPIO21 | General Purpose IO. Consult the compute module's datasheet for additional uses. |

| **J6 Connection with CM4** | | |
|---|---|---|
| **Pin** | **Symbol** | **Function** |
| 1 | U2_GPIO2 | Expansion GPIO. See GPIO section of the README.md doc. |
| 2 | U2_GPIO3 | Expansion GPIO. See GPIO section of the README.md doc. |
| 3 | U2_GPIO4 | Expansion GPIO. See GPIO section of the README.md doc. |
| 4 | U2_GPIO5 | Expansion GPIO. See GPIO section of the README.md doc. |
| 5 | U2_GPIO6 | Expansion GPIO. See GPIO section of the README.md doc. |
| 6 | U2_GPIO7 | Expansion GPIO. See GPIO section of the README.md doc. |

| **J7 Connection with CM4** | | |
|---|---|---|
| **Pin** | **Symbol** | **Function** |
| 1 | USB_VDD | USB Power. See jumper configuration to connect to VDD. |
| 2 | USB_N | USB data negative signal. |
| 3 | USB_P | USB data positive signal. |
| 4 | GND | Ground |

Note: See jumper configuration section to set USB to J7 or J13. USB is defaulted to J7.

| **J9 Connection with CM4** | | |
|---|---|---|
| **Pin** | **Symbol** | **Function** |
| 1 | VCC | 3.3V supplied by the Raspberry Pi. Do not provide external 3.3V. |
| 2 | SCL0 | Clock line for I2C. |
| 3 | SDA | Data line for I2C. |
| 4 | VDD | 5V power. Must be supplied externally. |

| **J12 Connection with CM4** | | |
|---|---|---|
| **Pin** | **Symbol** | **Function** |
| 1 | J10_PWR | External power connected to the J10 header. By default this is not connected to any net. Consult the Jumper Configuration section of this datasheet for connection information. |
| 2 | GND | Ground. |
| 3 | J12_PWR | 5V Power. Connected by JMP5 to VDD by default. |

| J13 Expansion Header | | |
|---|---|---|
| **Pin** | **Symbol** | **Function** |
| 1,3,5,7,9,11 | J10_PWR | External power connected to the J10 header. By default this is not connected to any net. Consult section 7 for more information. |
| 13,15,17,19,21,23 | VDD | 5V power. Must be supplied externally. |
| 25,27,29,31,33,35 | VCC | 3.3V supplied by the Raspberry Pi. Do not provide external 3.3V. |
| 2,4,10,14,20,26,32, 44,50,56,62,67,68,73 74,79,80,85,88,90 | GND | Ground. |
| 36,38,40,41,42,43,45, 46,47,48,49,51,52,53, 54,55,58,60,64,66 | NC | Do Not Use. Reserved for future features. |
| 6 | SDA0 | Data line for I2C. |
| 8 | SCL0 | Clock line for I2C. |
| 12 | PCIe_CLK_REQ | PCIe clock request pin. |
| 16 | PCIe_CLK_P | PCIe clock positive signal. |
| 18 | PCIe_CLK_N | PCIe clock negative signal. |
| 22 | PCIe_RX_P | PCIe Rx positive signal. |
| 24 | PCIe_RX_N | PCIe Rx negative signal. |
| 28 | PCIe_TX_P | PCIe Tx positive signal. |
| 30 | PCIe_TX_N | PCIe Tx negative signal. |
| 34 | PCIe_nRST | PCIe reset pin. |
| 37 | nEXTRST | External Reset. Low when the compute module is powered off. Pulled high when the compute module is powered on. |
| 39 | GLOBAL_EN | Global Enable. Pull low to power off. |
| 57 | GPIO10 | General Purpose IO. Consult the compute module's datasheet for additional uses. |
| 59 | GPIO9 | General Purpose IO. Consult the compute module's datasheet for additional uses. |
| 61 | GPIO11 | General Purpose IO. Consult the compute module's datasheet for additional uses. |
| 63 | GPIO8 | General Purpose IO. Consult the compute module's datasheet for additional uses. |
| 65 | USB_SEL | USB Select. L = USB at micro USB and J7 headers. H = USB at J13 Expansion Header. Default = Pulled low with 10k resistor. |
| 69 | USB_P | USB data positive signal. |
| 70 | ETH_P3_P | Ethernet P3 data positive signal. |
| 71 | USB_N | USB data negative signal. |
| 72 | ETH_P3_N | Ethernet P3 data negative signal. |
| 75 | ETH_P1_P | Ethernet P1 data positive signal. |
| 76 | ETH_P2_P | Ethernet P2 data positive signal. |
| 77 | ETH_P1_N | Ethernet P1 data negative signal. |
| 78 | ETH_P2_N | Ethernet P2 data negative signal. |
| 81 | ETH_P0_P | Ethernet P0 data positive signal. |
| 82 | ETH_nLED3 | Ethernet LED 3. |
| 83 | ETH_P0_N | Ethernet P0 data negative signal. |
| 84 | ETH_nLED2 | Ethernet LED 2. |
| 86 | ETH_nLED1 | Ethernet LED 1. |
| 87 | ETH_SYNC_IN | Ethernet SYNC input pin. |
| 89 | ETH_SYNC_OUT | Ethernet SYNC output pin. |

# 7. Jumper Configurations

The module has nine jumpers that can be configured.

1. **JMP1** – USB_VDD -> J10_PWR
   Open (default): No Effect.
   Closed: Connects USB_VDD to J10_PWR. Useful if you want to drive the USB power rail with the J10 barrel jack.

2. **JMP2** – USB_VDD -> VDD
   Open: No Effect.
   Closed (default): Connects USB_VDD to VDD. Close if you want to the USB power rail connected to VDD.

3. **JMP3** – USB_OTG_ID -> USB_ID
   Open: CM4 internal resistor makes the USB a peripheral by default.
   Closed (default): Connects USB_ID to USB_OTG_ID on the compute module. Tells the CM4 whether it's the host or a peripheral based on which type of USB cable is connected.

4. **JMP4** – USB_OTG_ID -> GROUND
   Open (default): CM4 internal resistor makes the USB a peripheral by default.
   Closed: Pulls USB_OTG_ID on the compute module to ground.

5. **JMP5** – USB SELECT PIN
   Open (default): USB connects to J7 and micro USB.
   Closed: USB connects to J13.

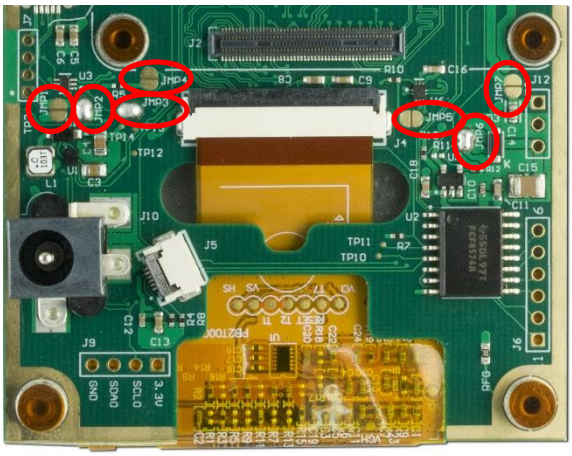
6. **JMP6** – J12_PWR -> VDD
   Open: No Effect.
   Closed (default): Connects 5V power from J12 to VDD.

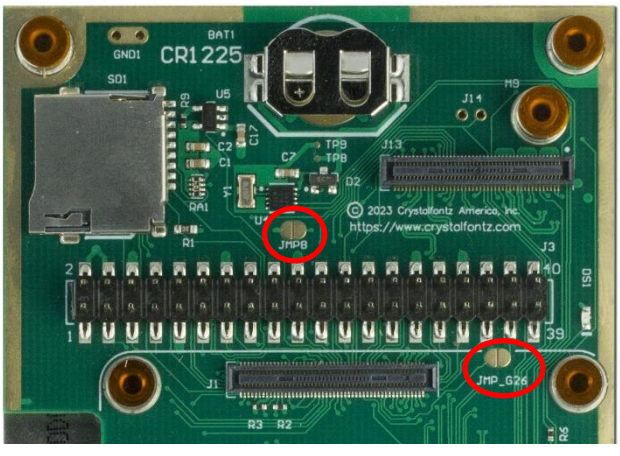
7. **JMP7** – J10_PWR -> VDD
   Open (default): No Effect.
   Closed: Connects VDD to J10_PWR

8. **JMP8** – EEPROM WRITE PROTECTION
   Open (default): No Effect.
   Closed: Connects EEPROM_nWP to ground to prevent writing to the EEPROM.

9. **JMP_G26** – GPIO26 -> J13
   Open (default): GPIO26 not connected to J3. Used by default as the Touch Point Interrupt for the capacitive touch screen.
   Closed: Connects GPIO26 to the pin 37 on J3.

Below are images of the jumper locations.



# 8. Electrical Characteristics

## 8.1. Absolute Maximum Ratings

| Parameter | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| Main Supply Voltage | $V_{DD}$ | -0.5 | 6 | V |
| Aux Supply Voltage | $V_{CC}$ | -0.5 | 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.

## 8.2. Electrical Characteristics

| Item | Symbol | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Main Supply Voltage | $V_{DD}$ | - | 4.75 | 5.0 | 5.25 | V |
| Aux Supply Voltage | $V_{CC}$ | - | 2.7 | 3.3 | 3.6 | V(1) |
| Operating Current | $I_{DD}$ | $V_{DD}$ = 5V BL = 100% | - | 266 | 293 | mA(2) |
| | | $V_{DD}$ = 5V BL = 0% | - | 62 | - | mA(2) |
| High-level Input | $V_{IH}$ | - | 0.7 x $V_{CC}$ | - | $V_{CC}$ | V(3) |
| Low-level Input | $V_{IL}$ | - | - | - | 0.3 x $V_{CC}$ | V(3) |

(1) This voltage is to be supplied by the compute module.
(2) This does not include the compute module power. Consult the appropriate compute module datasheet for the additional power requirements.
(3) This is the logic for the additional ICs which are all powered at 3.3V. This includes the Backlight Driver, Expansion GPIO IC, RTC IC, and other supporting ICs.

# 9. Optical Characteristics

| Item | | Symbol | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| Response Time | | $T_r$ | θ=0° Φ=0° | - | 10 | 15 | ms |
| | | $T_f$ | | - | 20 | 25 | |
| Contrast Ratio | | (CR) | - | 640 | 800 | - | - |
| Viewing Angle | Horizontal | θL | CR≧10 | - | 80 | - | Degree |
| | | θR | | - | 80 | - | |
| | Vertical | θT | | - | 80 | - | |
| | | θB | | - | 80 | - | |
| Luminance | | L | θ=0° Φ=0° Cap Touch | 200 | 250 | - | cd/m² |
| | | | θ=0° Φ=0° Non-Touch | 250 | 300 | - | |
| Color Chromaticity | White | $W_X$ | | 0.283 | 0.303 | 0.323 | |
| | | $W_Y$ | | 0.303 | 0.323 | 0.343 | |

# 10. Module Precautions

The precautions below should be followed when using LCD modules to help ensure personal safety, module performance, and compliance of environmental regulations.

## 10.1. 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.

## 10.2. 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.

## 10.3. 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.

## 10.4. 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.

## 10.5. 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.

## 10.6. 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.

## 10.7. 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.