# mangOH™ Red

# Developer's Guide

**IMAGE TO BE REPLACED
WITH DV3 WHEN AVAILABLE**

41110401
Rev 1

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| Revision number | Release date | Changes |
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| 1 | May 2016 | Document created |

# Contents

# 1: Introduction

The mangOH Red open-source hardware development platform for CF3 modules incorporates several hardware interfaces and a standardized IoT Expansion Card slot for expanded functionality.

This developer's guide describes the mangOH Red's architecture and provides details on how to develop applications for CF3 modules.

For the full mangOH Red documentation suite, refer to mangoh.io.

# 2: Hardware

This chapter describes the mangOH Red platform's hardware components and interfaces.

## mangOH Red Hardware Overview

Figure 2-1 provides an overview of the mangOH Red's hardware components relative to the CF3 module, and Figure 2-2 on page 7 and Figure 2-3 on page 8 shows their physical locations.

For additional details, see the following documents available at mangoh.io:

- mangOH Red User Guide—Instructions on setting up the hardware components
- Sierra Wireless CF3 module-specific Product Technical Specification documents
- AirPrime Embedded Module Common Flexible Form Factor (CF3) Specification
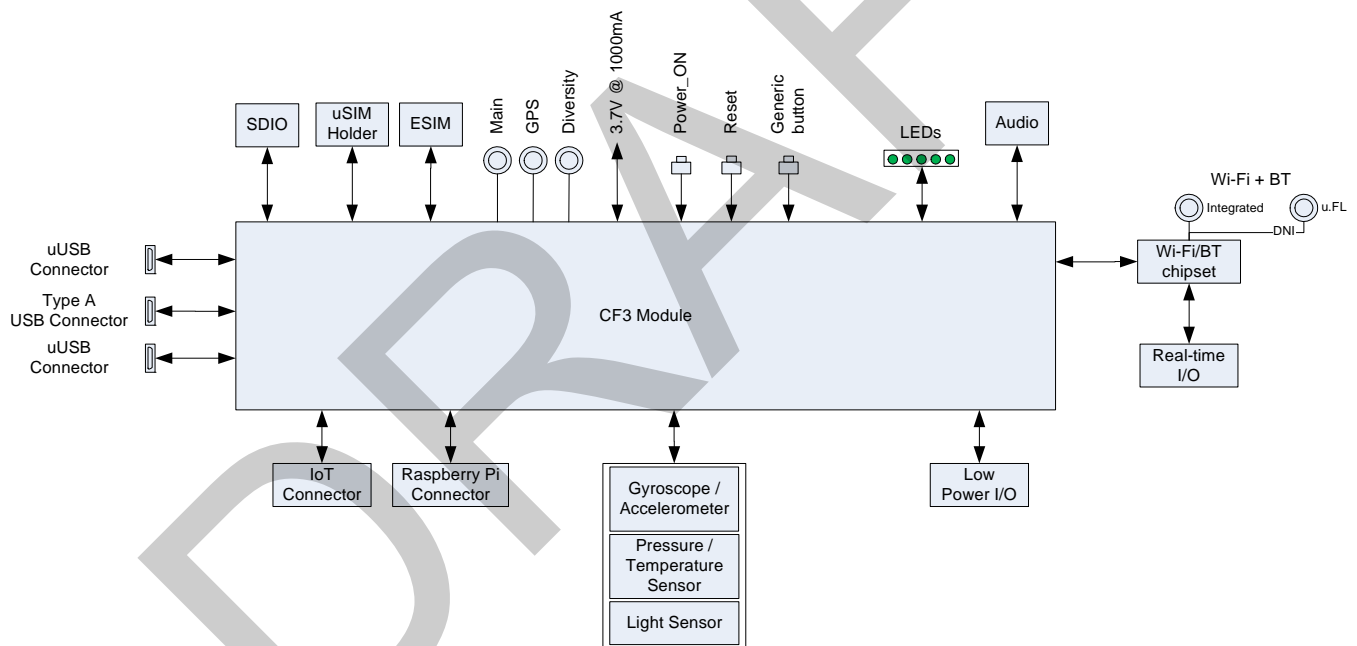


*Figure 2-1: mangOH Red Hardware Components Overview*

1—Pluggable IoT connector (CN306 (IOT0))
2—Power supply select (CN804)
3—Battery connector (CN802)
4—Signals control (SW401)
5—Main antenna (CN301)
6—GNSS antenna (CN303)
7—Diversity antenna (CN302)
8—Wi-Fi/Bluetooth antenna (ANT1000)
9—USB Host (CN304)
10—Audio (CN500)
11—μUSB Console connector (CN305)
12—Raspberry PI RevB-compatible header (CN307)
13—Generic button (SW200)
14—PWR_ON switch (SW402)
15—Reset switch (SW400)
16—CF3 module socket (J200)
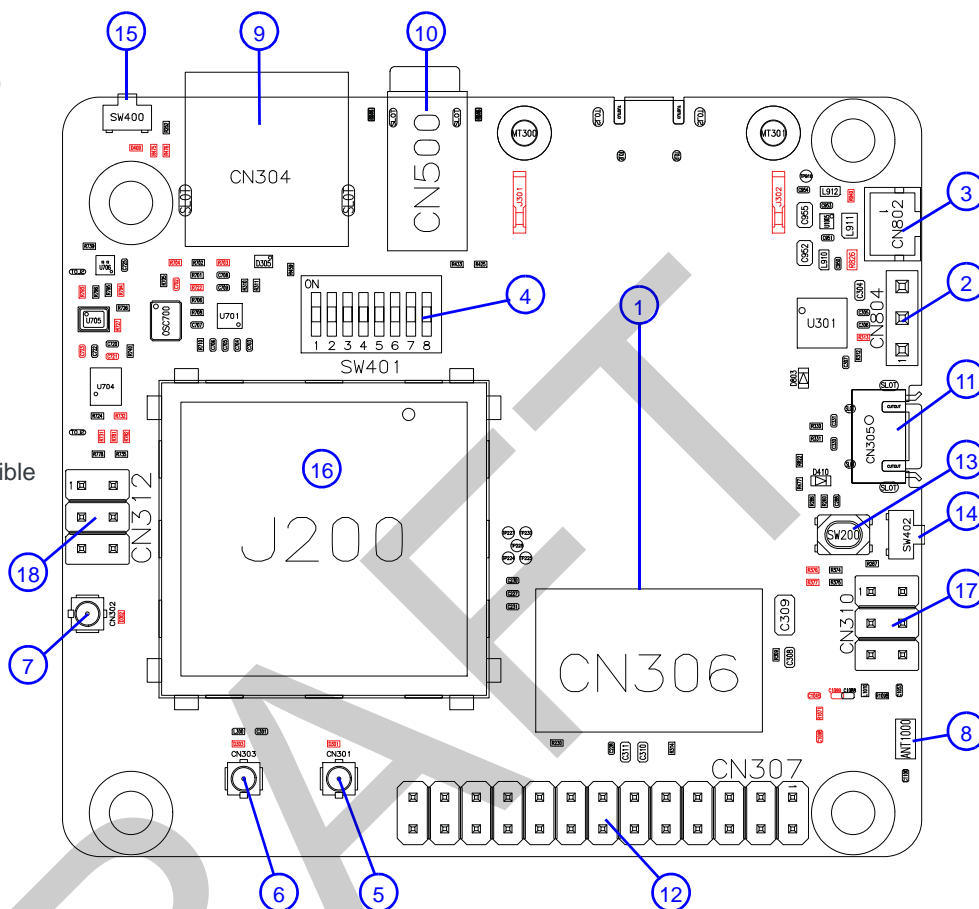17—Real Time I/O (CN310)
18—Low Power I/O (CN312)



*Figure 2-2: mangOH Red—Top Side Switches/Connectors*

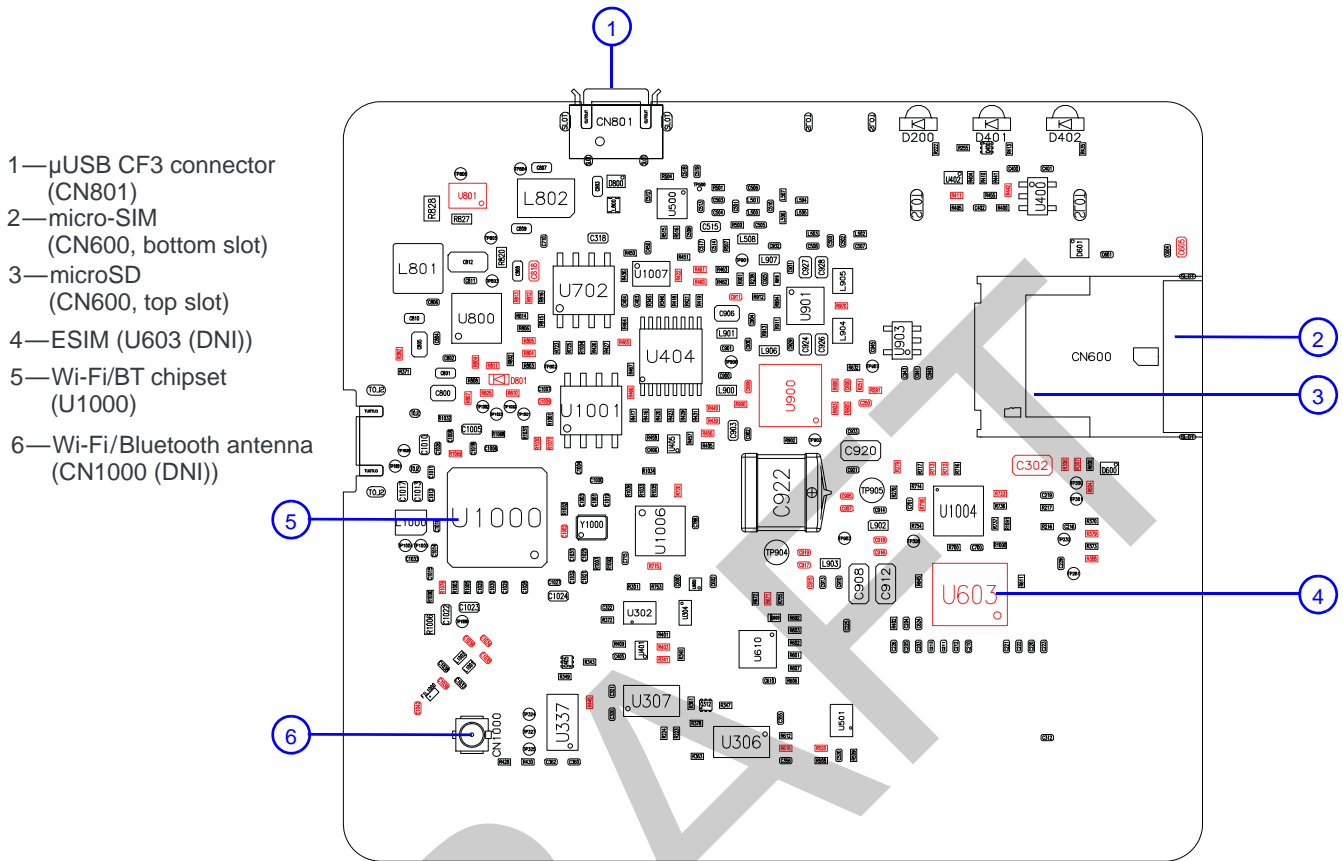*Note: For reference only. For latest schematic, visit mangoh.io.*

1—µUSB CF3 connector
(CN801)
2—micro-SIM
(CN600, bottom slot)
3—microSD
(CN600, top slot)
4—ESIM (U603 (DNI))
5—Wi-Fi/BT chipset
(U1000)
6—Wi-Fi/Bluetooth antenna
(CN1000 (DNI))



*Figure 2-3:  mangOH Red—Bottom Side Switches/Connectors*

*Note:  For reference only. For latest schematics, visit mangoh.io.*

# mangOH Red Hardware Architecture

The mangOH Red platform provides several hardware components, including:

- CF3 module socket
- Wi-Fi/BT chipset (MediaTek Wi-Fi+Bluetooth)
- Pluggable IoT Connector (socket for IoT Expansion Card)
- Raspberry Pi Rev B-compatible 26-pin connector
- Several I/O connectors (SIM, SD, Audio, USB, etc.)

Figure 2-4 illustrates the mangOH Red's hardware architecture (connectors and signals). The following sections describe these features in greater detail:

- mangOH Red Hardware Components on page 11—Components available to the CF3 module and Wi-Fi/BT chipset.
- CF3 Module Signals on page 16—CF3 module connections to hardware components.
- Wi-Fi/BT Chipset on page 28—Wi-Fi/BT chipset connections to hardware components.
- IoT Connector Interfaces on page 30—IoT Expansion Card signal connections to the hardware components.
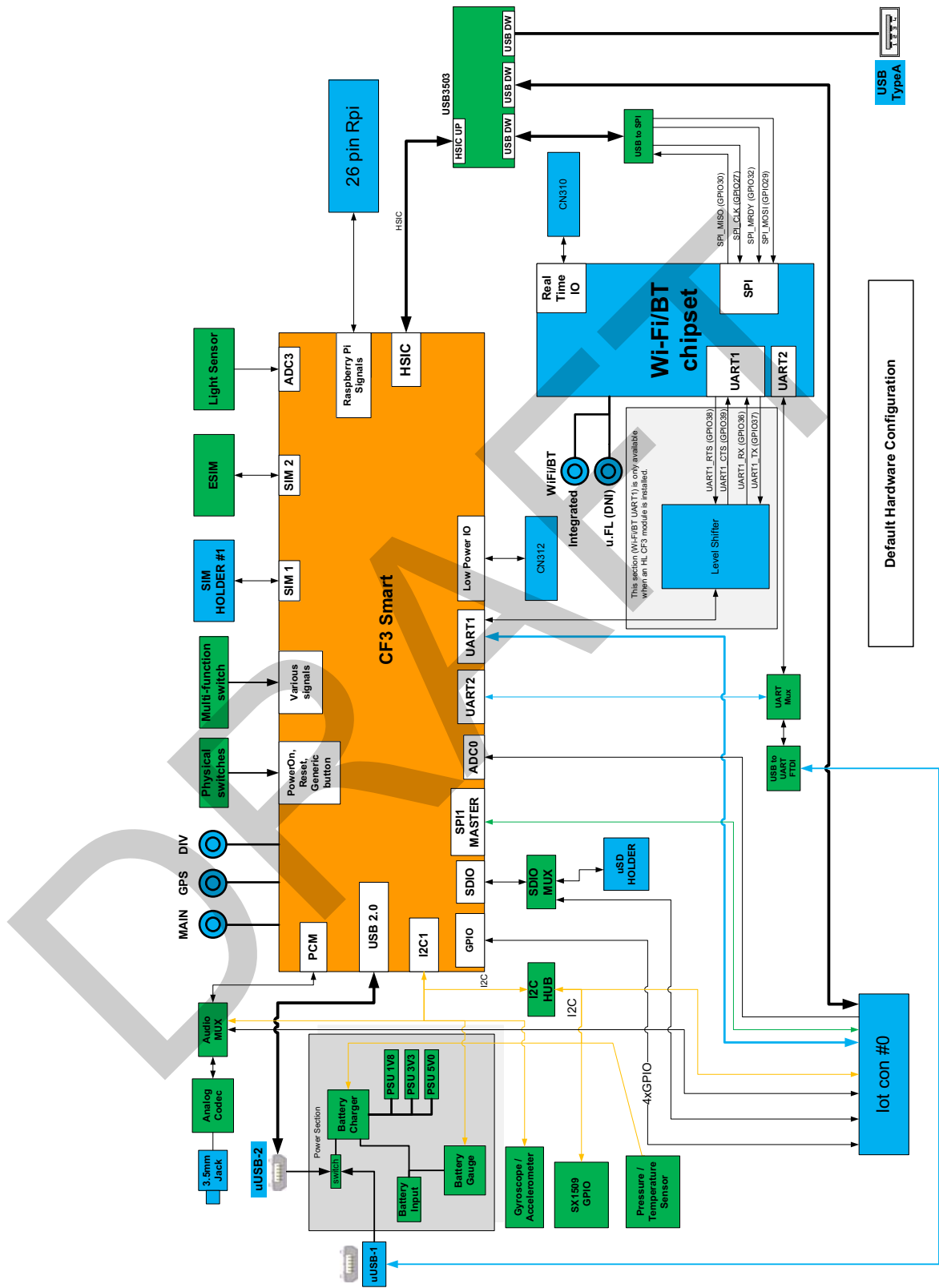
*Figure 2-4: mangOH Red Hardware Architecture (Default)*

# mangOH Red Hardware Components

Key mangOH Red hardware components and their connections to the CF3 module and/or Wi-Fi/BT chipset are listed in Table 2-1 on page 11.

The mangOH Red's default configuration enables specific interfaces when the platform boots. For interface details, see:

- MUXing on page 16
- CF3 Module Signals on page 16
- Wi-Fi/BT Chipset on page 28
- IoT Connector Interfaces on page 30
- Reset Methods on page 31
- Power Management on page 31

**Table 2-1:  mangOH Red Hardware Components**

| Type and Designator[a] | Description | Signals/Module Pins | Notes |
|---|---|---|---|
| Modules/Processors/etc. | | | |
| CF3 module (J200) | For details, see CF3 Module Signals on page 16. | | |
| IOT0 (CN306) | IoT Expansion Card | Connections to multiple CF3 module interfaces. | For details, see IoT Expansion Card on page 14. |
| Wi-Fi/BT chipset (U1000) | MediaTek Wi-Fi/BT chipset with ARM Cortex-M4 application processor | For details, see Wi-Fi/BT Chipset on page 28. | |
| Card slots | | | |
| Micro-SIM (CN600) | Micro-SIM/microSD holder (bottom slot) | CF3 UIM1 (Pins: 26–29) | Purpose: UIM used to establish mobile network connection. For details, see UIM1 on page 27. |
| micro-SD (CN600) | Micro-SIM/microSD holder (top slot) | CF3 SDIO (Pins: 161–166) | Purpose: Provide access to microSD card. For details, see: • SDIO on page 23 • MUXing on page 16 |
| ESIM (U603) | Embedded SIM | CF3 UIM2 (Pins 55–58) | Purpose: Built-in UIM used to establish mobile network connection. For details, see UIM2 on page 27. *Note:  eSIM is DNI.* |

**Table 2-1: mangOH Red Hardware Components (Continued)**

| Type and Designator[a] | Description | Signals / Module Pins | Notes |
|---|---|---|---|
| USB-type connectors | | | |
| micro-USB (CN801) | CF3 USB micro-USB connector | • USB (Pins: 12, 13, 16)<br>• Power (if selected) | Purpose:<br>• Direct connection to CF3 USB<br>• Power supply when selected by the Power Supply Selection Jumper (CN804). See mangOH Red User Guide for details.<br>For details, see USB 2.0 on page 27. |
| micro-USB (CN305) | Console USB micro-USB connector | • UART2 (Pins: 96–99)<br>• Power (if selected) | Purpose:<br>• Console—Connects to CF3 module console or Wi-Fi/BT chipset console<br>• Power supply when selected by the Power Supply Selection Jumper (CN804). See mangOH Red User Guide for details.<br>For details, see UART2 on page 25. |
| USB Host (CN304) | USB Type A connector | HSIC (Pins: 14, 15) | Purpose: Provides USB host capability to CF3 module.<br>For details, see HSIC (USB/Ethernet) on page 19. |
| RF, Audio, Raspberry Pi connectors | | | |
| RF Antennas Main (CN301) GNSS (CN303) Diversity (CN302) | u.FL connectors | CF3 RF (Pins: 49 (Main), 38 (GNSS), 31 (Diversity)) | For details, see RF on page 23. |
| Wi-Fi/Bluetooth Antennas (Integrated—ANT1000; u.FL—CN1000 (DNI)) | Antenna | Wi-Fi/BT chipset RF | For details, see Wi-Fi/BT Chipset on page 28. |
| Audio (CN500) | 3.5 mm connector | CF3 digital audio signals (Pins: 30–33) | Purpose: Provide audio capability to CF3 module.<br>For details, see:<br>• Audio (Analog and PCM) on page 17<br>• MUXing on page 16 |
| Raspberry Pi (CN307) | 26-pin Rev B-compatible connector | • CF3 HSIC signals (via SPI or USB (DNI))<br>• Wi-Fi/BT chipset SPI | For details, see Raspberry Pi Rev B-compatible Connector on page 21. |
| Other ICs and components | | | |
| Gyroscope/ Accelerometer (U704) | Integrated BMI160 inertial measurement module | CF3 I2C1 interface | Purpose: Provides rotational, linear motion, and gravitational force measurements for use in (for example) gaming, mapping, navigation, and optical image stabilitization applications.<br>For details, see I2C1 on page 20. |

**Table 2-1: mangOH Red Hardware Components (Continued)**

| Type and Designator[a] | Description | Signals/Module Pins | Notes |
|---|---|---|---|
| Pressure sensor/ Temperature sensor (U705) | Integrated BMP280 barometric pressure sensor | CF3 I2C1 interface | Purpose: Provides barometric pressure, altitude, and temperature measurements for use in (for example) GPS navigation, indoor/outdoor navigation, and weather forecasting applications.<br>For details, see I2C1 on page 20. |
| Light sensor (U706) | Integrated PNJ4K01F ambient light sensor | CF3 ADC3 | Purpose: Provide ambient light measurements for use in (for example) brightness control systems.<br>For details, see Raspberry Pi Rev B-compatible Connector on page 21. |
| GPIO/PWM expander (U1004) | Integrated SX1509 expander | CF3 I2C1 interface | Purpose: Provides additional GPIOs.<br>For details, see:<br>• GPIO Expander on page 19<br>• I2C1 on page 20 |
| Low Power I/O connector (CN312) | 6-pin header | CF3 ADC1/ADC2<br>CF3 GPIOs (if resistors are populated)<br>CF3 UIM2_DET | Purpose: Connect low-power input sources to CF3 module.<br>For details, see ADC on page 16. |
| Real-time I/O connector (CN310) | 6-pin header | Wi-Fi/BT chipset user-configurable multi-purpose pins (for ADC, GPIO, PWM, I2C, etc.) | Purpose: Connect input sources to Wi-Fi/BT chipset for use by its real-time application processor.<br>(Multi-purpose pin details forthcoming.)<br>For details, see Wi-Fi/BT Chipset on page 28. |
| LEDs | | | |
| IoT Expansion Card 0 (D401) | Green LED | GPIO expander I/O_8 via LED_CARD_DETECT_IOT0 | Purpose: Indicates IoT Expansion Card is in slot IOT0. |
| Rx/Tx (CF3 module) (D402) | Green LED | CF3 TX_ON | Purpose: Indicates CF3 module is transmitting/receiving. |
| WLAN Connected (D200) | Green LED | CF3 WWAN_LED_N | Purpose: Indicates device is connected to a WLAN (will be OFF when LowPower Mode is enabled). |
| VCC_3V3 (D803) | Green LED | VCC_3V3 | Purpose: Indicates device is powered on. |
| Generic (user-defined) (D410) | Green LED | CF3 GPIO34 (via expander WP_GPIO_7_lvl) | Purpose: User-defined (programmable) |

**Table 2-1: mangOH Red Hardware Components (Continued)**

| Type and Designator[a] | Description | Signals / Module Pins | Notes |
|---|---|---|---|
| Platform controls | | | |
| Multi-switch (SW401) | Module signals control | Eight dipswitches: | |
| | | 1. PWR_ON | Enable/disable CF3 module's POWER_ON signal |
| | | 2. WIFI_UART1_TX | Enable (On)/disable (Off) firmware download (recovery mode) to the CF3 module. Similar functionality to TP1_BOOT. |
| | | 3. VCC_3V7_ULPM | When device is in ULPM:<br>• OFF—only the CF3 module is receiving power.<br>• ON—the CF3 module + accessories receive power |
| | | 4. HL_MODE | Used with pin 8 (LowPower_RESET) to indicate whether in HL mode or WP mode<br>• ON—HL mode<br>• OFF—WP mode |
| | | 5. BATT_TS+ | Enable (On)/disable (off) battery charging |
| | | 6. CONS_DIR | Console USB connectors connects to:<br>• OFF—CF3 module console<br>• ON—Wi-Fi/BT chipset console<br>Note: To download firmware to the:<br>• CF3 module—Set CONS_DIR Off and TP1_BOOT On.<br>• Wi-Fi/BT chipset—Set CONS_DIR On and WIFI_UART_TX On. |
| | | 7. TP1_BOOT | Enable (On)/disable (Off) CF3 module's TP1 (boot) signal. |
| | | 8. LowPower_RESET | Used with pin 4 to indicate whether in HL mode or WP mode<br>• ON—WP mode<br>• OFF—HL mode<br>For details, see Power Management on page 31. |

a. Board designators (e.g. CN311, SW401, etc.) are for reference against the published mangOH Red schematic. For component locations on the board, see Figure 2-2 on page 7 and Figure 2-3 on page 8.

## IoT Expansion Card

mangOH Red includes one IoT Expansion Card slot (IOT0), which has an IoT Connector (CN306) that connects to the CF3's signals as detailed in Table 2-2.

This slot provides full support for the IoT Expansion Card specification.

By default, specific signals are enabled when the mangOH Red boots. For additional information, including default configuration and how to temporarily change it, see IoT Connector Interfaces on page 30.

For detailed specifications, see the Project mangOH IoT Expansion Card Design Specification available at mangoh.io.

**Table 2-2: IoT Expansion Card Signal Connections to CF3 Module**

| IoT Signals | CF3 Signal(s) | | Notes |
| :---: | :---: | :---: | :--- |
| | Signal | Path | |
| USB | HSIC (Pins 14, 15) | Single | Purpose: Data transfer; application control<br>For details, see HSIC (USB/Ethernet) on page 19. |
| UART | UART1 (Pins 2, 9) | MUX | Purpose: Data transfer<br>For details, see:<br>• UART1 on page 24<br>• MUXing on page 16 |
| SPI | SPI1 (Pins 51–54) | Yes | Purpose: Data transfer<br>For details, see:<br>• SPI1 on page 24<br>• MUXing on page 16 |
| I2C | I2C1 (Pins 1, 66) | Hub | Purpose: Data transfer (standard mode). Higher speeds possible if supported by host application.<br>For details, see I2C1 on page 20. |
| GPIOs 1–4 | GPIO (7, 8, 13, 42) | Single | Purpose: Customer-defined data communication<br>For details, see CF3 GPIOs on page 17. |
| SDIO | SDIO (Pins 161–166) | Yes | Purpose: Data transfer<br>For details, see:<br>• SDIO on page 23<br>• MUXing on page 16 |
| ADC0 | ADC0 (Pin 25) | Single | Purpose: General purpose ADC output to host application (e.g. indicate when a sensor has triggered)<br>For details, see ADC on page 16. |
| Power | Power | n/a | Default configuration—Receives three power inputs:<br>• 5.0V @ 500 mA<br>• 3.3V @ 1 A<br>• 1.8V @ 200 mA<br>For details, see Power Management on page 31. |
| PCM | PCM | Single | Purpose: Digital audio interface |
| RESET_IOT0 | GPIO2 | | Purpose: Data transfer<br>For details, see CF3 GPIOs on page 17. |
| PPS | DR_SYNC | | Purpose: Clock signal used to manage timing for sensor nodes (or other devices) that are connected to the expansion card.<br>The signal is a stratum 1 clock input from the host application, where the host application operates as a stratum 1 time source connected to GPS (a stratum 0 source). |
| CARD_DETECT_IOT0 | GPIO33 | | Purpose: Data transfer<br>For details, see CF3 GPIOs on page 17. |

# MUXing

Several interfaces use MUXing (simple switches) to associate multiple hardware connectors with a single signal from the CF3 module, or multiple signals with a single hardware connector.

The following sections describe these MUX implementations

- MUX
  - Audio (Analog and PCM) on page 17
  - SDIO on page 23
  - UART2 on page 25
- Hubs
  - HSIC (USB/Ethernet) on page 19
  - I2C1 on page 20

# CF3 Module Signals

This section describes how CF3 module signals connect to the platform hardware (described in mangOH Red Hardware Components on page 11).

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**Important:** *CF3 module signal availability depends on the module type—some modules may not implement certain Extension signals from the CF3 specification.*

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# ADC

The mangOH Red supports four CF3 module ADC (Analog to Digital converter) signal sources (ADC0-ADC3).

The ADC signals connect to the following sources, as shown in Figure 2-5:

- ADC0—IoT Connector 0 (CN1000, slot IOT0), pin 20
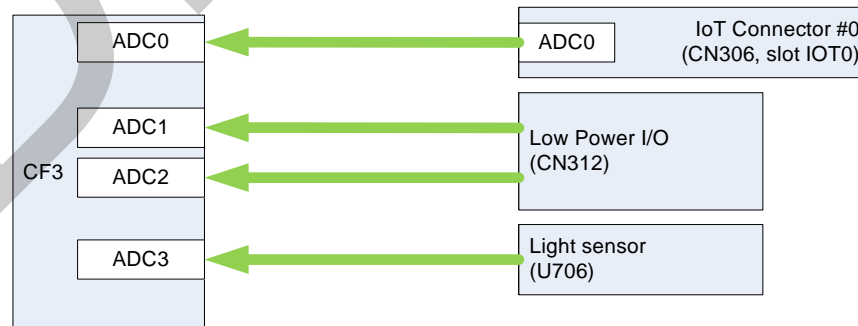- ADC1, ADC2—Low Power I/O (CN312), pins 4 and 5
- ADC3—Light sensor (U706), pin 6



*Figure 2-5: ADC Configuration*

# Audio (Analog and PCM)

The mangOH Red supports the CF3 module PCM (digital) audio signals. The signals connect via a Mux (analog switch) to the following sources, as shown in Figure 2-6 on page 17:

- 3.5 mm analog audio jack (Default configuration)
- IoT connector (Alternate configuration)

The audio interface configuration can be modified as described in Table 2-3.

**Table 2-3:  Audio Interface Configuration Changes**

| Change type | Change effect | Method | Change duration |
|---|---|---|---|
| Hardware | Mux—Use default or alternate configuration | Populate/depopulate resistors on the Mux:<br>• R508 pulls signal low (default configuration)<br>• R520 pulls signal high (alternate configuration) | Selected configuration used every time device boots up. |
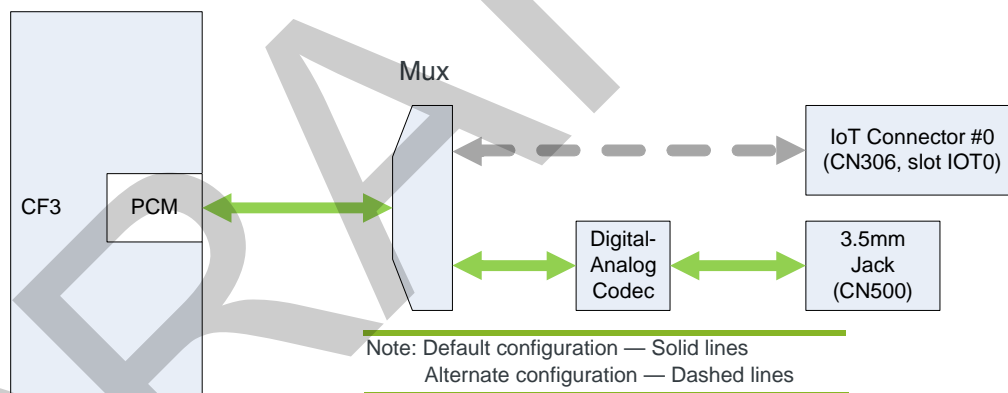


*Figure 2-6:  Audio Configuration*

# CF3 GPIOs

The mangOH Red supports several CF3 module GPIOs, as shown in Figure 2-7 on page 18.

Notes:

- Six GPIOs connect to the IoT slot (for card detect, card reset, and four for use as GPIOs).
- One GPIO (GPIO32) connects to the NINT (active low interrupt) output signal from a GPIO expander (U1004).

*Note:  The mangOH Red uses a GPIO expander for additional I/O functions. See GPIO Expander on page 19.*
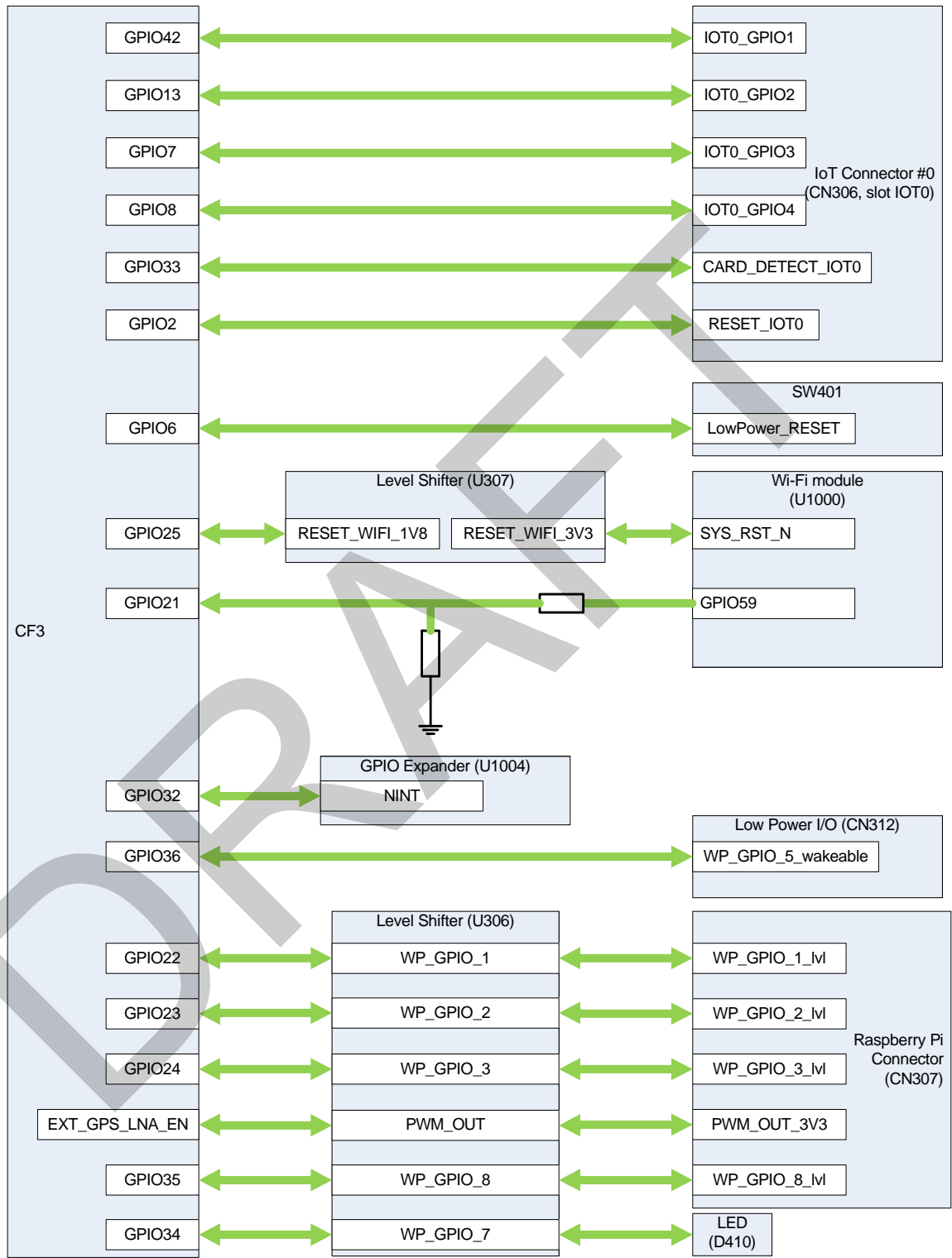
*Figure 2-7: GPIO Configuration*

# GPIO Expander

The mangOH Red includes one SX1509 16-channel GPIO/PWM expander (U1004), as detailed in Table 2-4. The expander provides additional GPIOs (carried over the CF3 module's I2C1 interface) that are used for internal I/O functions such as driving LEDs, resetting board components, etc.

For detailed specifications, see the mangOH Red schematics at mangoh.io.

**Table 2-4:  GPIO Expander Signals**

| Desig | Pin | Signal Name | Purpose |
|-------|-----|-------------|---------|
| U1004 | I/O_0 | BOARD_REV3 | Three pins together indicate the board revision |
| | I/O_1 | BOARD_REV1 | |
| | I/O_2 | BOARD_REV2 | |
| | I/O_3 | GPIO_EXP_RPI_1 | Raspberry PI connector, pin 16 |
| | I/O_4 | GPIO_EXP_RPI_2 | Raspberry PI connector, pin 18 |
| | I/O_5 | MTK_TO_WP_UART_EN | Enable MTK recovery mode from WP (0), or connects CF3 UART1 to Wi-Fi/BT chipset UART0 (1) |
| | I/O_6 | WIFI_UART1_TX | Wi-Fi/BT chipset UART Tx—Normal (0), or MTK recovery mode (1) for firmware downloads/recovery |
| | I/O_7 | GPIO_EXP_RPI_3 | Raspberry PI connector, pin 22 |
| | I/O_8 | LED_CARD_DETECT_IOT0 | Indicates whether IoT expansion card is present |
| | I/O_9 | SDIO_SEL | Connect SD interface to IoT0 (0) or SD card (1) |
| | I/O_10 | Power_Fail_Indicator | Indicate power fail |
| | I/O_11 | SENSOR_INT1 | Accelerometer/gyroscope sensor interrupt |
| | I/O_12 | SENSORT_INT2 | Accelerometer/gyroscope sensor interrupt |
| | I/O_13 | PCM_EXP1_SEL | Connect PCM interface to IoT0 or to PCM codec (audio) |
| | I/O_14 | Generic_Push_Button | SW200 generic pushbutton |
| | I/O_15 | CONS_DIR | Use with MTK_TO_WP_UART_EN to choose UART source -- CF3 module or Wi-Fi/BT chipset |

# HSIC (USB/Ethernet)

The mangOH Red supports CF3 module HSIC signals, which connect through a USB hub controller to the following sources, as shown in Figure 2-8 on page 20:

- SPI interface:
  - Wi-Fi/BT chipset (U1000) and Raspberry Pi Connector (CN307), via USB to SPI bridge (U1006).

*Note: The Wi-Fi/BT chipset uses SPI2_CS0, and Raspberry Pi connector uses SPI2_CS1/ SPI2_CS2.*

- USB interface:
  - IoT Connector 0 (CN306)
    or
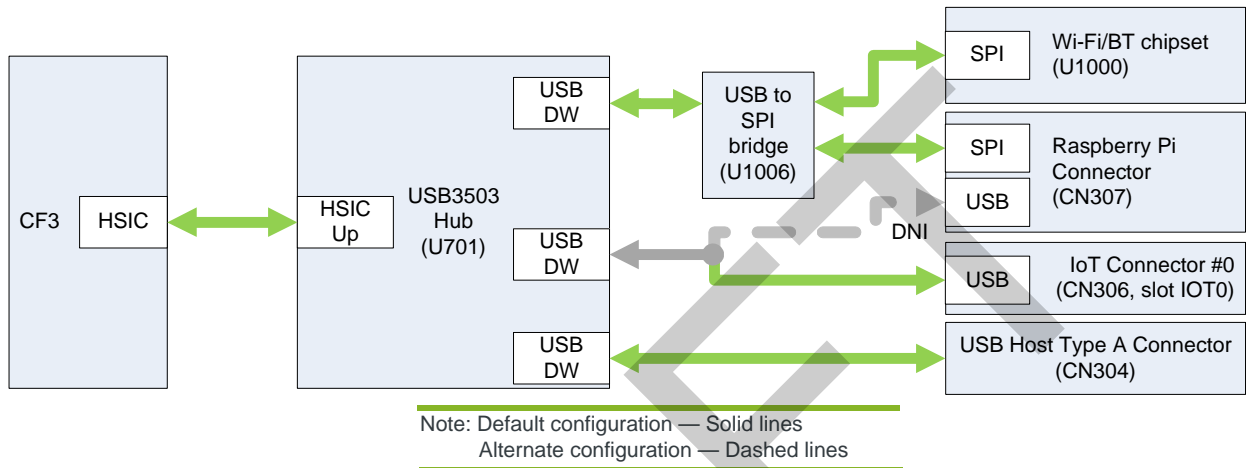    (DNI) Raspberry Pi Connector (CN307)
  - USB Host connector (CN304)



Note: Default configuration — Solid lines
Alternate configuration — Dashed lines

*Figure 2-8:  HSIC Configuration*

## I2C1

The mangOH Red supports CF3 module I2C1 signals, which connect to the following sources (directly or via an expander), as shown in Figure 2-9 on page 21:

- Audio codec (U500)
- Pressure sensor (U705)—Accessible via API commands.
- Accelerometer/Gyroscope/Temperature sensor (U704)—Accessible via API commands.
- Battery charger (U800)—Accessible via API commands.
- Battery gauge (U801)—Accessible via API commands.
- IoT Connector 0 (CN306)
- Raspberry Pi connector (CN307)
- GPIO/PWM expander (U1004)—Used internally on the mangOH Red for I/O functions such as driving LEDs, resetting board components, etc. (see GPIO Expander on page 19)

  For detailed information, refer to mangOH Red schematics available at man-goh.io.
- USB Hub controller (U701)

All signal sources are enabled by default.

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*Note:  The mangOH Red I2C interface operates in a single-master/multi-slave setup.*

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*Note: By default, the CF3 I2C interface is connected as shown in Figure 2-9. The board can be modified to connect the Wi-Fi/BT chipset I2C interface to the I2C expander and gyroscope/accelerometer sensor by populating/depopulating appropriate resistors.*
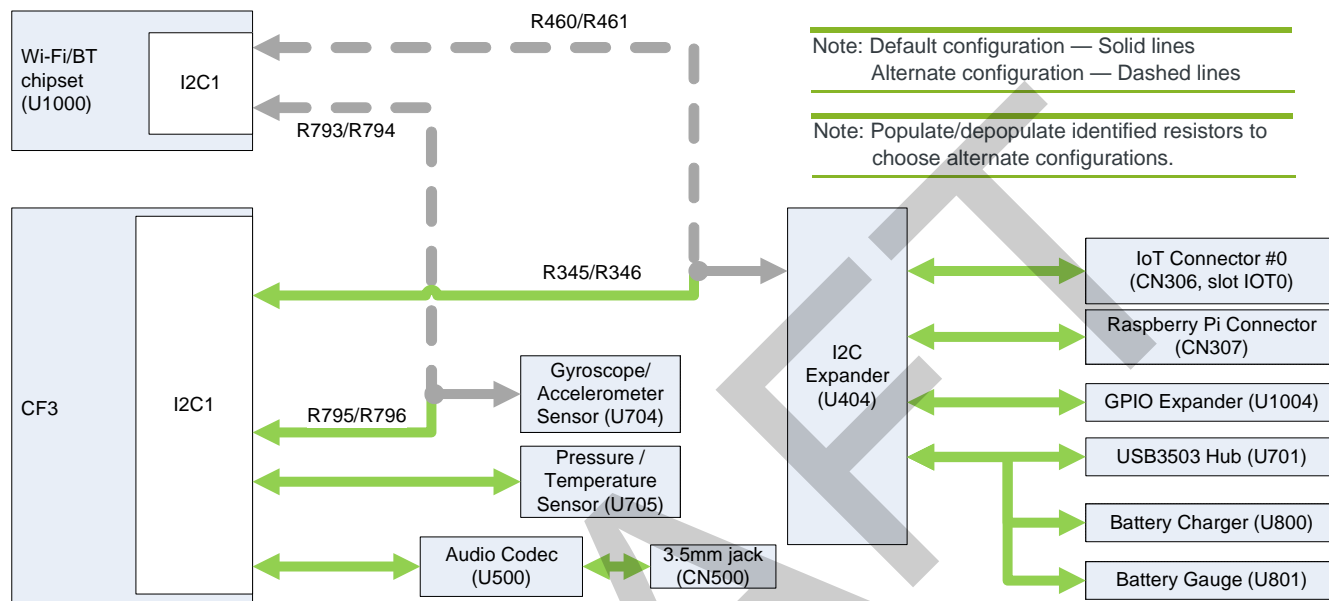


*Figure 2-9: I2C1 Configuration*

# Light Sensor

The mangOH Red provides a light sensor (U706) that connects to the CF3 module's ADC3 signal, as shown in Figure 2-5 on page 16.

# Raspberry Pi Rev B-compatible Connector

The mangOH Red provides a 26-pin Raspberry Pi RevB-compatible connector (CN307).

The mangOH Red provides the Raspberry Pi primary signals (alternate Raspberry Pi signals are not supported) as shown in Figure 2-10 on page 22. These signals connect the mangOH Red's hardware components to a Raspberry Pi attached to the connector, as shown in Figure 2-11 on page 22.
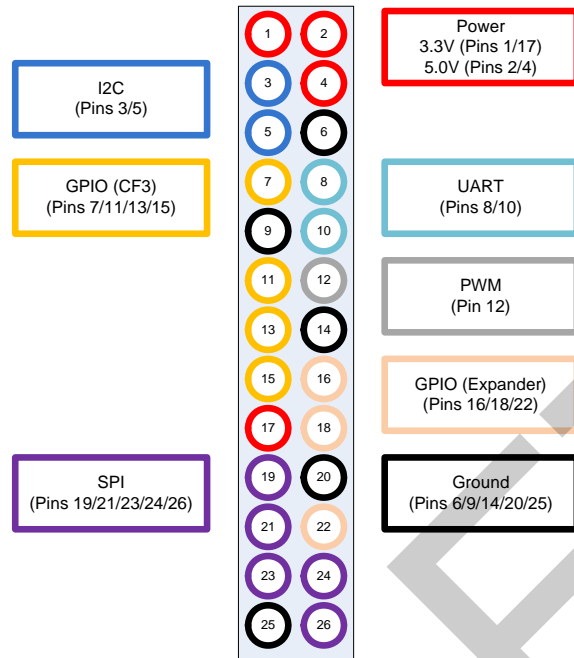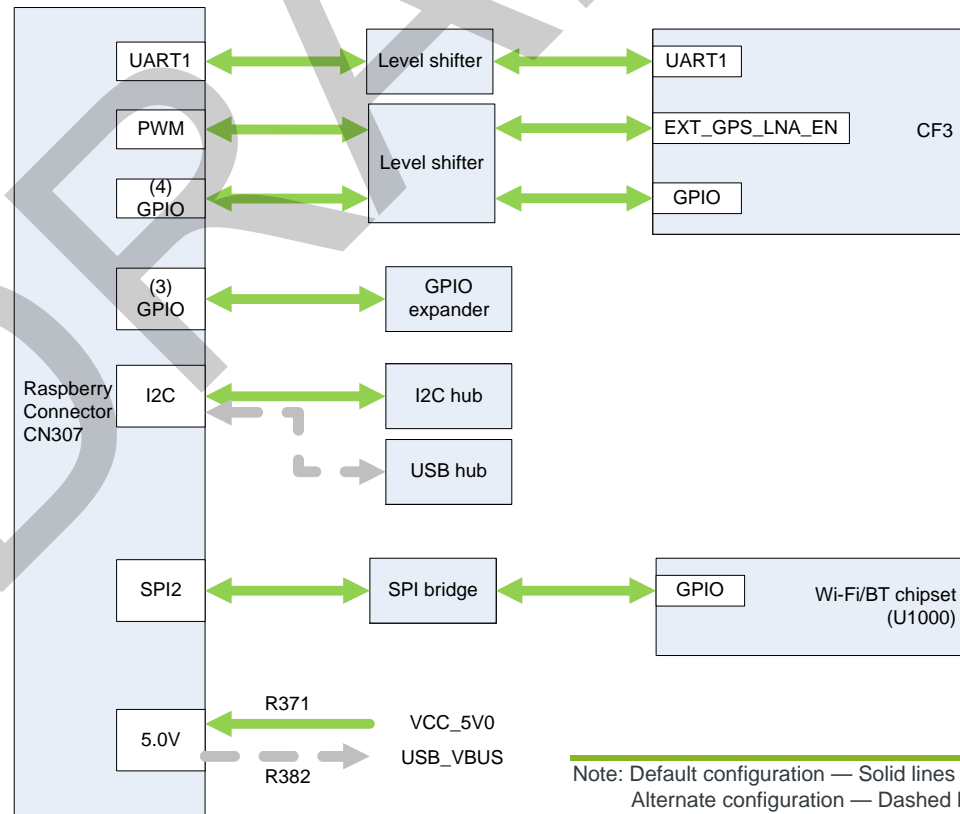
*Figure 2-10: Raspberry Pi Signal Groups*



*Figure 2-11: Raspberry Pi Connections*

# RF

The mangOH Red provides u.FL connectors that connect to the CF3 module's RF signals:

- RF_MAIN—CN301
- RF_GPS—CN303
- RF_DIV—CN302

Power for these signals can be enabled/disabled as described in Table 2-5.

**Table 2-5:  CF3 GPIO Interface Configuration Changes**

| Change type | Change effect | Method | Change duration |
|---|---|---|---|
| Software | Enable/disable RF power for CF3 module | AT command<br>Legato API | |
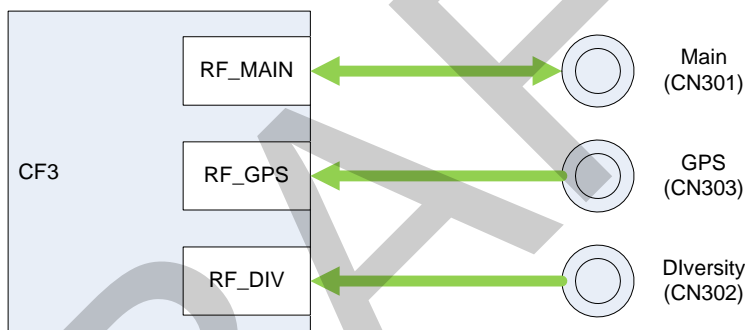


*Figure 2-12:  CF3 module RF Connections*

# SDIO

The mangOH Red supports the CF3 module SDIO signals, which connect via a MUX to the following sources, as shown in Figure 2-13 on page 24:

- microSD holder (CN600)—Default configuration
- IOT Connector 0 (CN306)

The SDIO interface configuration can be modified as detailed in Table 2-6.

**Table 2-6:  SDIO Interface Configuration Changes**

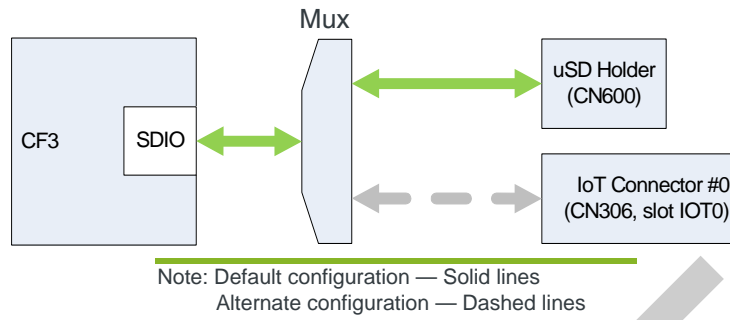| Change type | Change effect | Method | Change duration |
|---|---|---|---|
| Software | • Use default or alternate configu-ration. | API command | Selected configuration used every time device boots up. |

*Figure 2-13: SDIO Configuration*

## SPI1

The mangOH Red supports the CF3 module SPI1 signals, which connect to the following source, as shown in Figure 2-14:
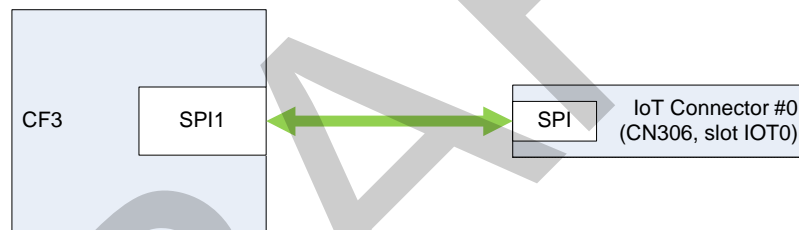
- IOT Connector 0 (CN306)



*Figure 2-14: SPI1 Configuration*

## UART1

The mangOH Red supports the CF3 module's UART1 signals, which connect to the following sources, as shown in Figure 2-15 on page 25:

- IoT Connector 0 (CN306)—Default configuration
- Raspberry Pi connector (CN307)
- Wi-Fi/BT chipset (Note, the level shifter must be ON. In the default board configuration, the level shifter is OFF.)

*Note: At any one time, use only the IoT expansion card UART or the Raspberry Pi UART, not both.*
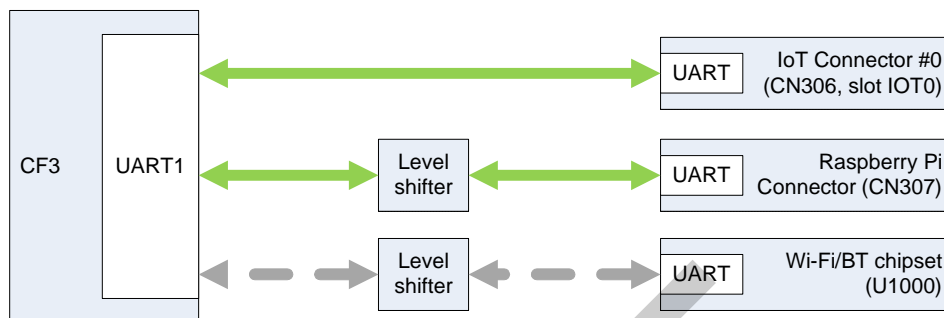
*Figure 2-15: UART1 Configuration*

# UART2

The mangOH Red supports the CF3 module's UART2 signals, which connect via a MUX to the following sources, as shown in Figure 2-16 on page 26:

- Console USB connector (CN305)—UART2 connects to the physical Console USB connector when both MTK_TO_WP_UART_EN and CONS_DIR are low.
- Wi-Fi/BT chipset's UART signal (U1000)—CF3 module's UART2 and Wi-Fi/BT chipset's UART0 are linked when MTK_TO_WP_UART_EN signal is pulled high.

# UART Console Connections

The mangOH Red supports the following console connections for the CF3 module (UART2) and Wi-Fi/BT chipset (UART0), as shown in Figure 2-16 on page 26:

- CF3 module UART2 to Console USB connector (CN305)
- Wi-Fi/BT chipset UART0 to Console USB connector (CN305)
- Direct connect between CF3 module UART2 and Wi-Fi/BT chipset UART0

**Table 2-7: UART Console Connection Options**

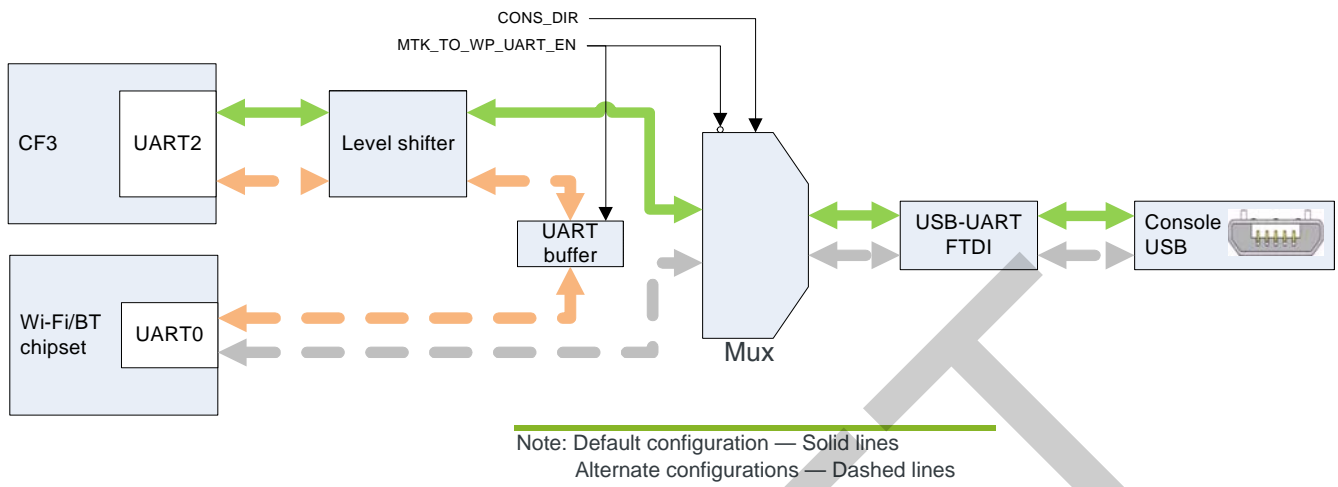| Connection | CONS_DIR (SW401 pin 6) | MTK_TO_WP_UART_EN (API) |
|---|---|---|
| CF3 module UART2 to Console USB | Pull low (Pin OFF) | Pull low |
| Wi-Fi/BT chipset UART0 to Console USB | Pull high (Pin ON) | Pulll low |
| CF3 module UART2 to Wi-Fi/BT chipset UART0 | n/a | Pull high |

*Figure 2-16: UART Console Connections*

# UIM Signals

The mangOH Red supports both CF3 module UIM interfaces (UIM1, UIM2), where UIM1 is a removable SIM, and UIM2 is an embedded SIM (DNI).

The default boot configuration is shown in Figure 2-17 on page 26.

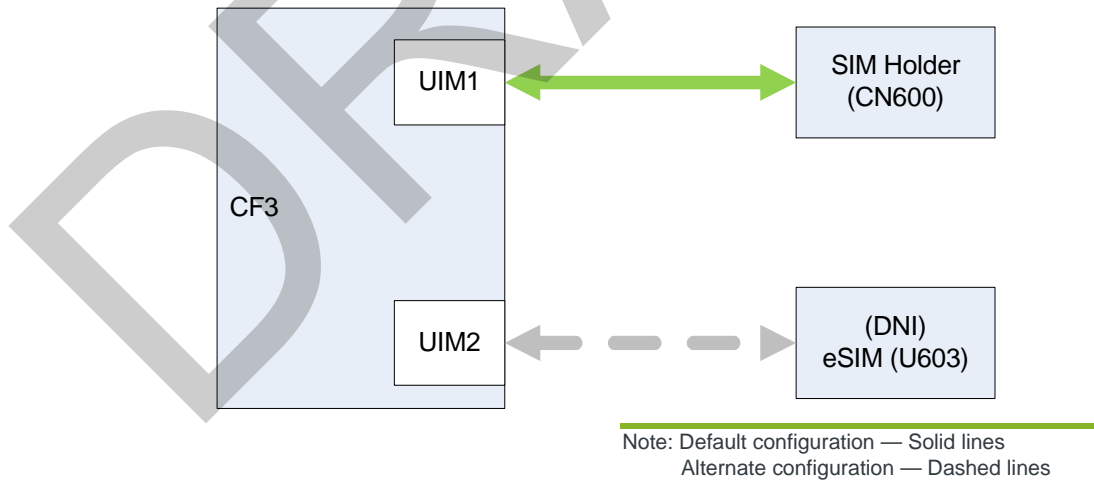*Note: Throughout this document, 'UIM' is used to refer to UIM, USIM, SIM, UICC.*



*Figure 2-17: SIM Interfaces Configuration*

### UIM1

The CF3 module's UIM1 signal connects to the micro-SIM holder (CN600).

*Note: The CF3 module's UIM1_DET signal indicates when a SIM is present in the holder.*

### UIM2

*Note: The mangOH Red does not ship with an eSIM (the component is DNI). For details, refer to the mangOH Red schematics available at mangoh.io.*

The CF3 module's UIM2 signal connects to the eSIM (U603).

*Note: The corresponding UIM2_DET signal pin is reserved for future use.*

## USB 2.0

The CF3 module's USB signal connects directly to the mangOH Red's CF3 USB micro-USB connector (CN305) as shown in Figure 2-18, for control by a connected computer.

*Note: The micro-USB connector also acts as a power source, if selected. See Power Management on page 31.*

The USB 2.0 interface configuration can be modified as detailed in Table 2-8.

**Table 2-8: USB 2.0 Interface Configuration Methods**

| Change type | Change effect | Method | Change duration |
|---|---|---|---|
| Hardware | • Jumper on pins closest to CF3 USB—Select CF3 USB power<br>• Jumper on pins closest to Console USB—Select Console USB power<br>• Jumper off—Use battery if connected, otherwise no power supplied | Position jumper on CN804 to choose CF3 USB or CONSOLE USB connector to supply power.<br><br>*Note: mangOH Red ships with CF3 USB power selected (jumper on pins closest to CF3 USB connector).* | mangOH Red uses the selected power supply until the jumper changes. |
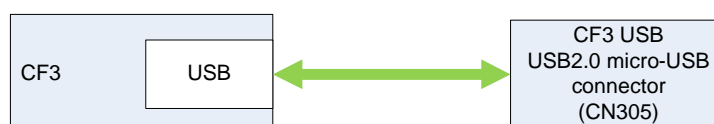


*Figure 2-18: USB_2.0 Configuration*

# Wi-Fi/BT Chipset

The mangOH Red incorporates a Wi-Fi/BT chipset (MediaTek Wi-Fi+Bluetooth) that provides the following functionality:

- RF—Wi-Fi/Bluetooth/WLAN connections via an integrated 2.4 GHz antenna
- IOT0 connection via Wi-Fi/BT chipset's UART1
- Application processor—Real-time application processing using the mangOH Red's real-time I/O connector, via GPIO, ADC, and I2C interfaces.
- Access to mangOH Red's accelerometer/gyroscope/temperature sensor via GPIO interface
- Access to Raspberry Pi connector via SPI interface
- Wi-Fi/BT chipset console connection to either the Console USB connector or the CF3 module console, including ability to receive firmware downloads from either source.
- Optional debug connector (CN400, DNI) to use for serial wire debugging

The Wi-Fi/BT chipset can connect to several components on the mangOH Red, as show in
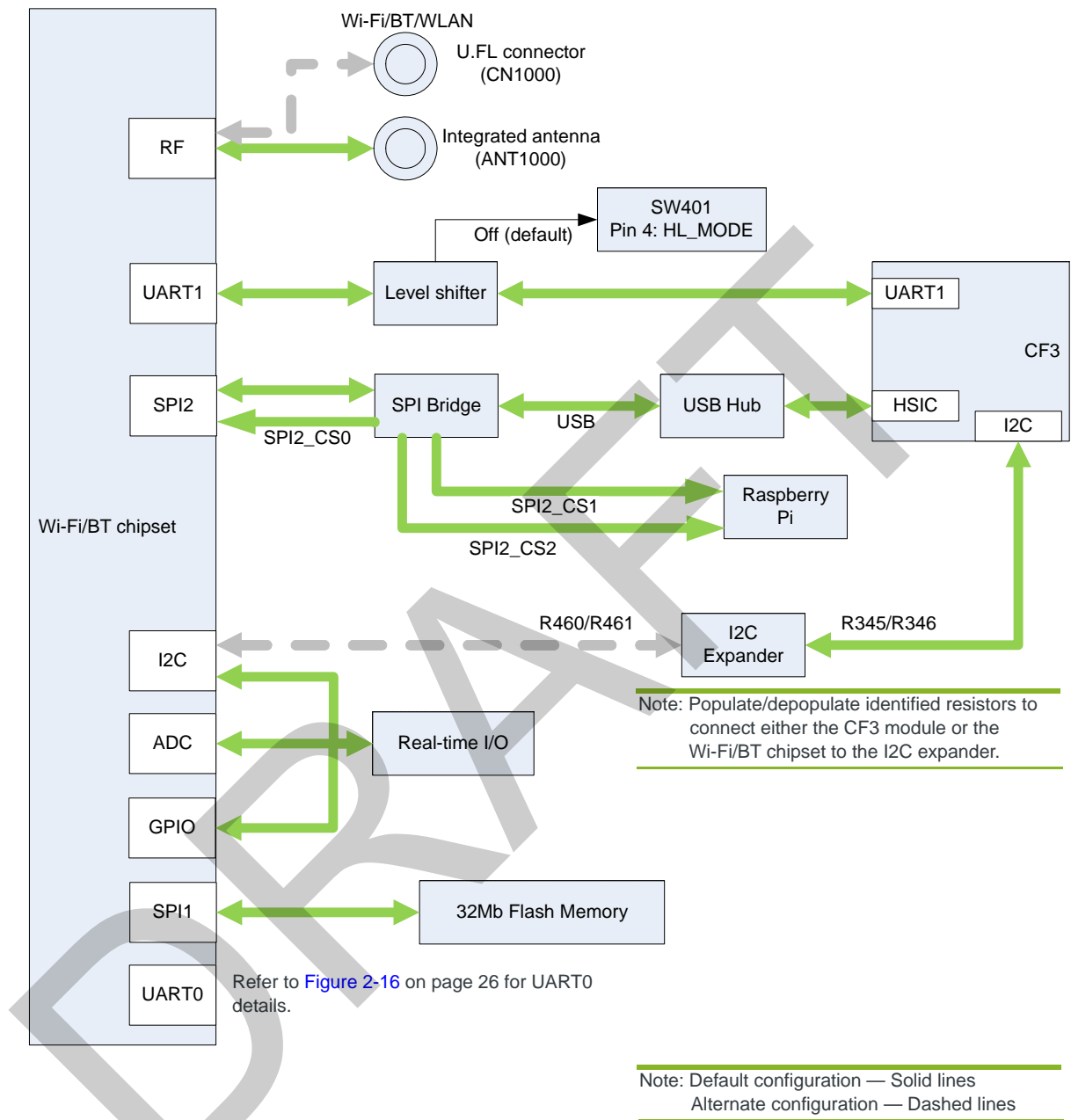
*Figure 2-19: Wi-Fi/BT Chipset Connections*

# IoT Connector Interfaces

The mangOH Red provides one IoT Connector (CN306, slot IOT0), which supports the signals defined in the Project mangOH IoT Expansion Card Design Specification, as detailed in Table 2-2 on page 15.

The default configuration (enabled signals) for the IoT Connector is shown in Figure 2-20.

The IoT Connector interface configuration can be modified as detailed in Table 2-9.

**Table 2-9: IoT Connector Interface Configuration Changes**

| Change type | Change effect | Method | Change duration |
|---|---|---|---|
| Software | Enable/disable identified signal(s) on a specific IoT Connector. | API command | Modifies running configuration until device reboots or another change is made. |

Note: Default configuration — Solid lines
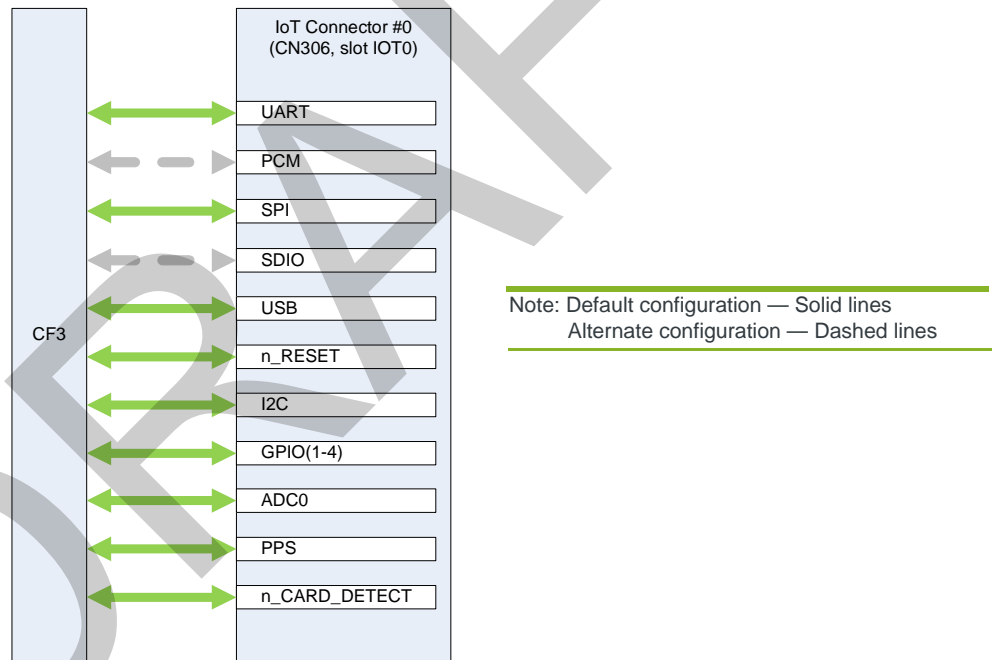Alternate configuration — Dashed lines

*Figure 2-20: IoT Connector Configuration*

# Reset Methods

The mangOH Red supports hardware and software resets of the entire board or certain components of the board, as shown in Figure 2-21:

**Table 2-10: Reset Methods**

| Board Components to Reset | Reset Method |
|---|---|
| Entire board, including CF3 module | • SW401 pin 4 ON<br>• Press Reset button (SW400) |
| Entire board, excluding CF3 module | • SW401 pin 4 OFF<br>• Press Reset button (SW400) |
| IOT Expansion Card | CF3_IOT0_RESET<br>or<br>Use an API command to trigger the CF3 module signal GPIO_IOT0_RESET. |
| Wi-Fi/BT chipset | CF3_GPIO_WIFI_RESET |

For detailed specifications showing how full or partial resets are enabled, see the mangOH Red schematics available at mangoh.io.
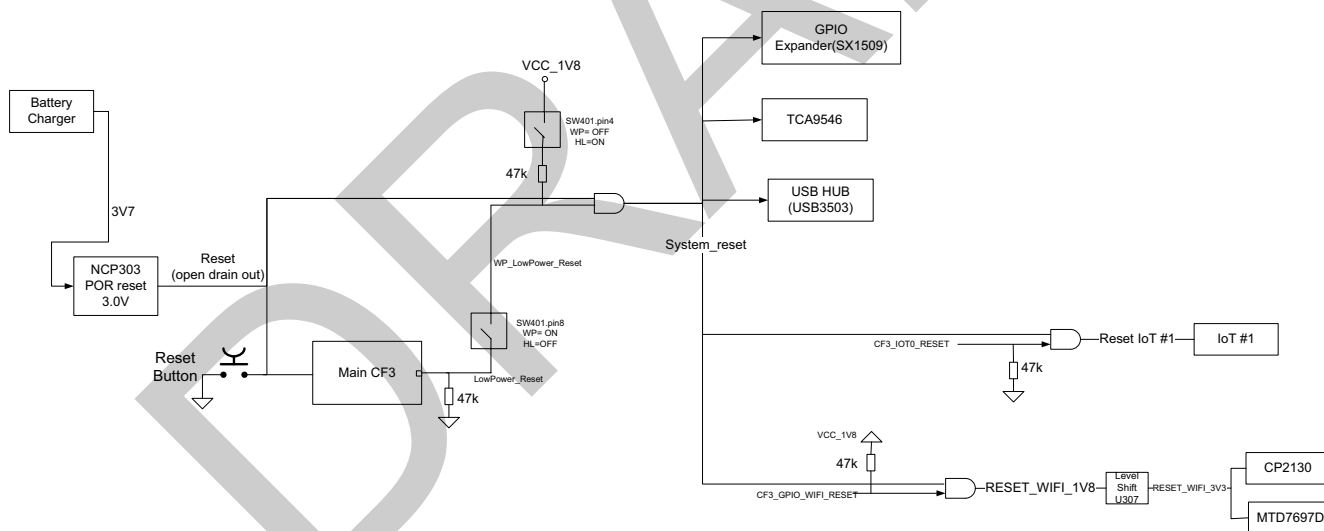


*Figure 2-21: Reset Methods*

# Power Management

The mangOH Red has two primary power supplies (CF3 USB connector and CONSOLE USB connector), and a rechargeable backup battery power supply option.

Figure 2-22 illustrates these power supplies, their voltage/current specifications, and how they supply various components on the mangOH Red platform.

A multi-function switch (SW401) controls some power-related features (see Multi-switch (SW401) on page 14), including:

- Pin 1 (PWR_ON)—Enable/disable CF3 module's POWER_ON_signal
- Pin 3 (VCC_3V7_ULPM)—In ULPM, enable/disable power to accessories (CF3 module always receives power)
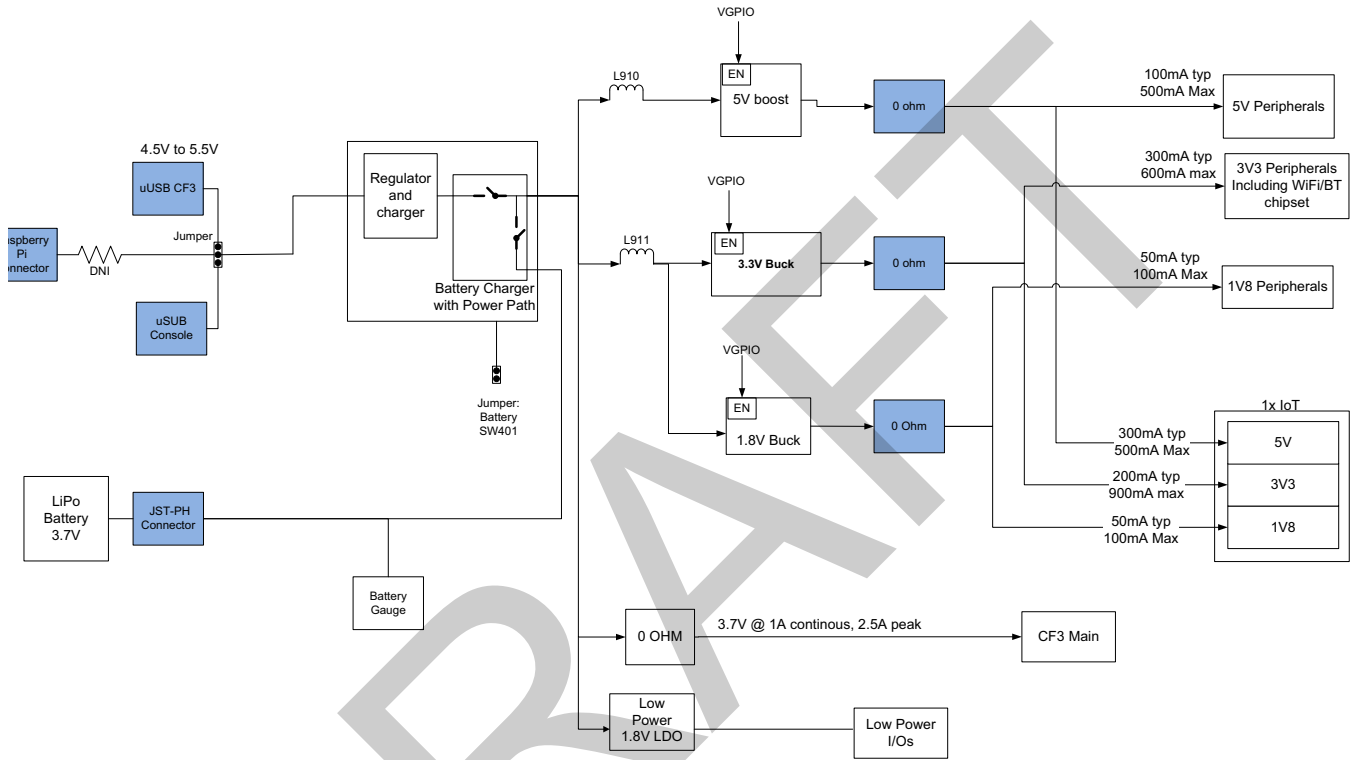- Pin 5 (BATT_TS+)—Enable/disable backup battery charging



*Figure 2-22: Power Management*