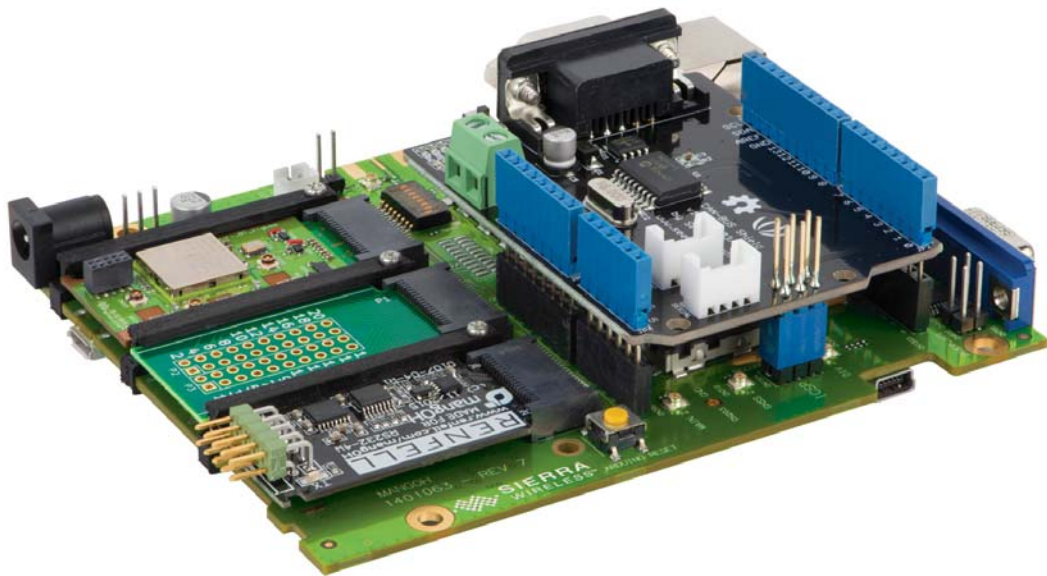




mangOH™ green

# Developer's Guide



4118384  
Rev 0

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## Revision History

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# 1: Introduction

# 1

The mangOH green is an open-source hardware development platform for CF3 modules that incorporates several hardware interfaces and standardized IoT (Internet of Things) connector slots for expanded functionality.

The purpose of this developer's guide is to describe the mangOH green's architecture and provide details on how to develop applications for CF3 modules.

The standard mangOH green documentation suite, available at [mangoh.io](http://mangoh.io), includes:

- mangOH green Getting Started Guide
- mangOH green User Guide
- **mangOH green Developer's Guide** (This document)
- mangOH green AirVantage Developer's Guide (forthcoming)
- Project mangOH IoT Connector Design Specification
- Product Specifications for Sierra Wireless IoT connectors (forthcoming)

## 2: Hardware

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

### mangOH green Hardware Overview

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

For additional details, see the following documents available at [mangoh.io](http://mangoh.io).

- Sierra Wireless CF3 module Product Specifications
- CF3 specification
- mangOH green User Guide for instructions on setting up the hardware components

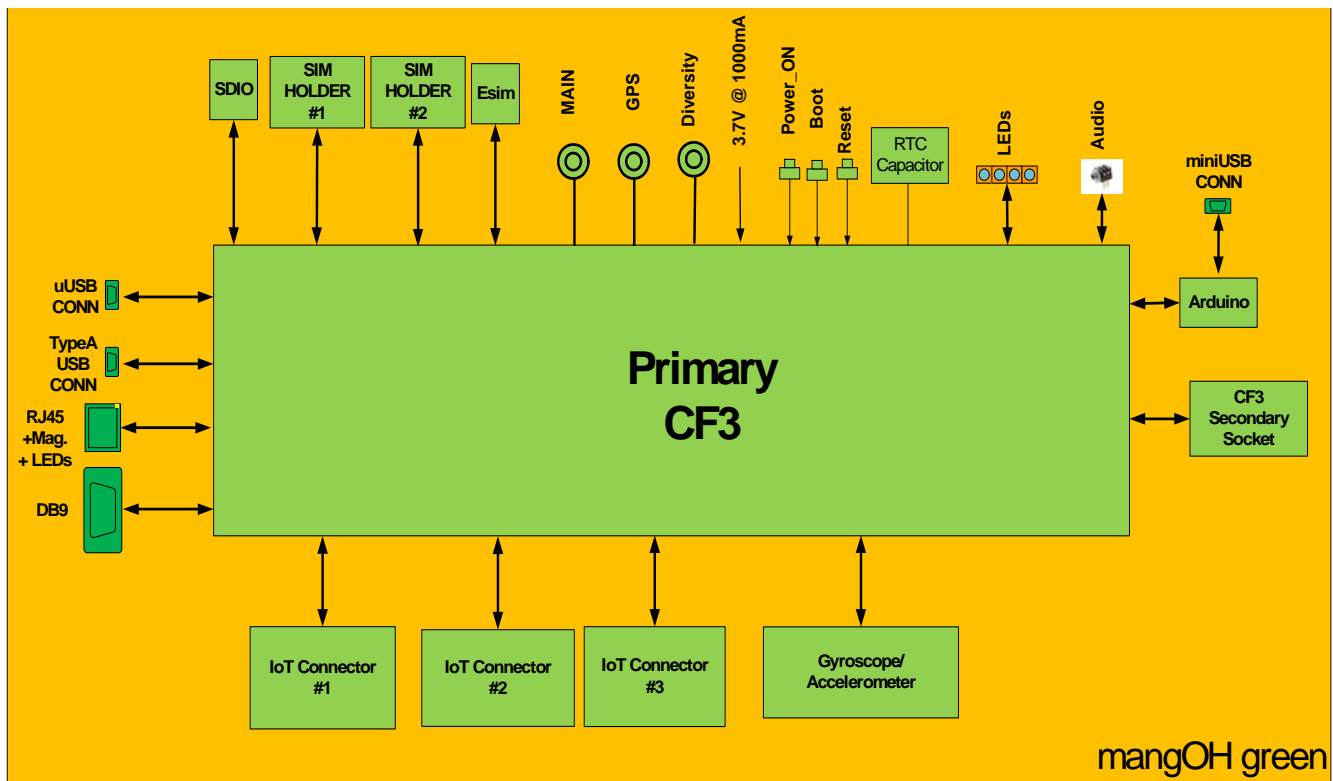


Figure 2-1: mangOH green Hardware Components Overview

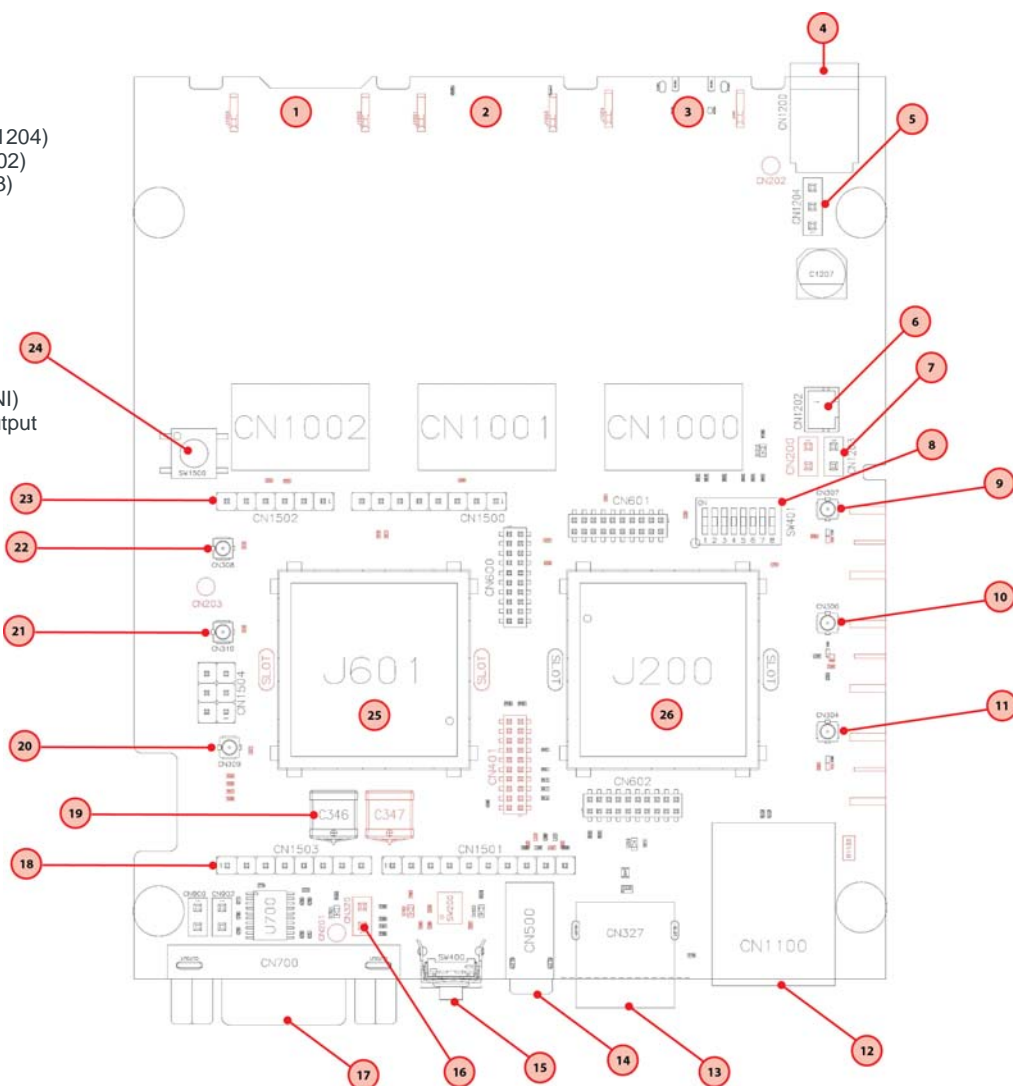


Figure 2-2: mangOH green—Top Side Switches/Connectors

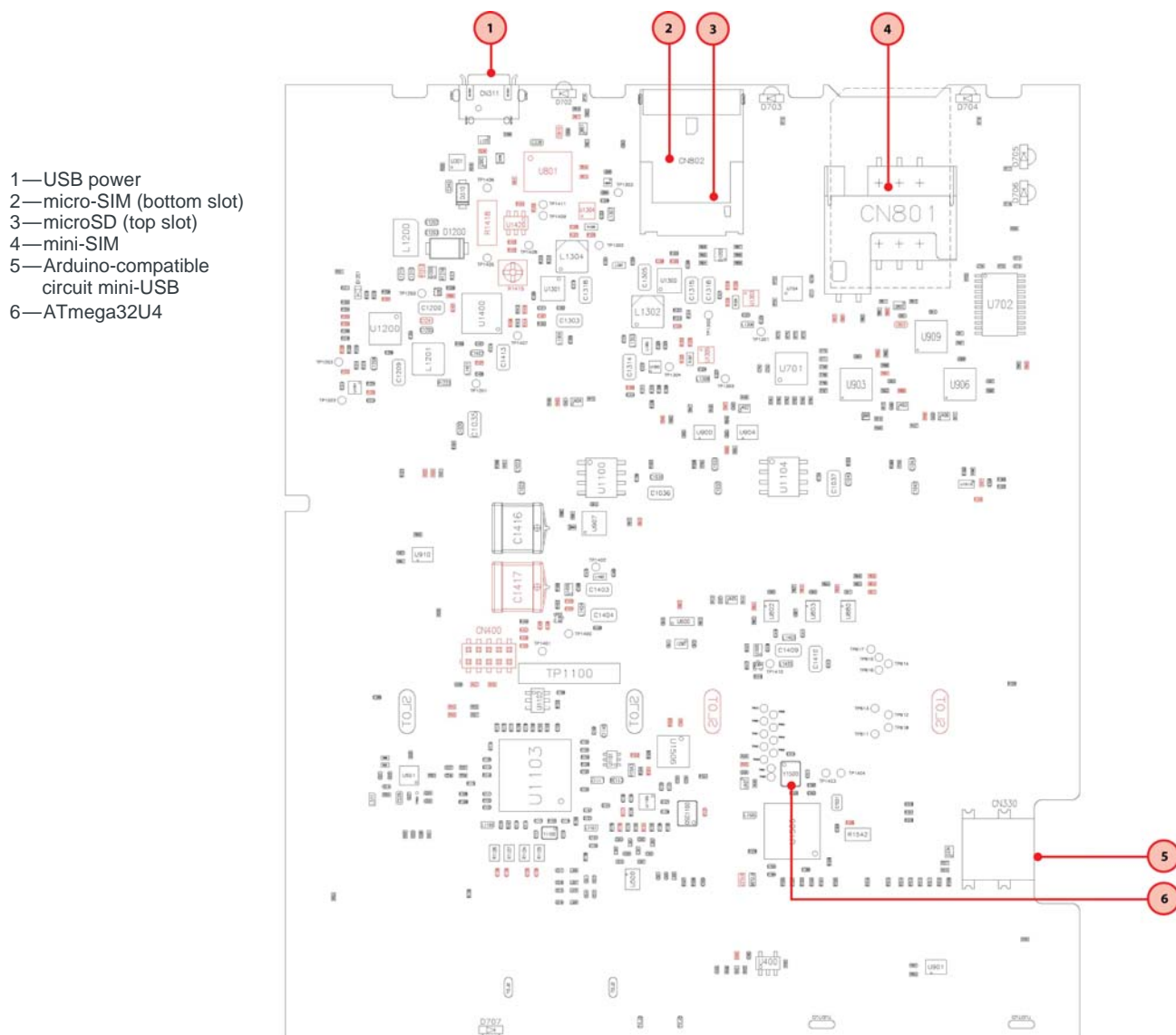


Figure 2-3: mangOH green—Bottom Side Switches/Connectors

Note: For reference only. For latest schematic, visit [mangoh.io](http://mangoh.io).



## mangOH green Hardware Architecture

The mangOH green platform provides several hardware components, including:

- CF3 module sockets (main and secondary)
- Pluggable IoT connector sockets
- Integrated Arduino-compatible circuit with an on-board ATmega32U4 microcontroller
- Several I/O connectors (SIM, SD, Audio, USB, Ethernet, etc.)

Figure 2-4 illustrates the hardware architecture of the mangOH green platform (connectors and signals), and the following sections describe their interfaces in greater detail:

- [mangOH green Hardware Components](#) on page 10—Describes the hardware components available to the CF3 modules and Arduino-compatible circuit.
- [Primary CF3 Module Signals](#) on page 16—Describes how Primary CF3 module signals connect to the mangOH green hardware components.
- [Secondary CF3 Module Signals](#) on page 29—Describes how Secondary CF3 module signals connect to the mangOH green hardware components.
- [IOT Interfaces](#) on page 30—Describes how IoT connector signals connect to the mangOH green hardware components.

### Detailed Architecture

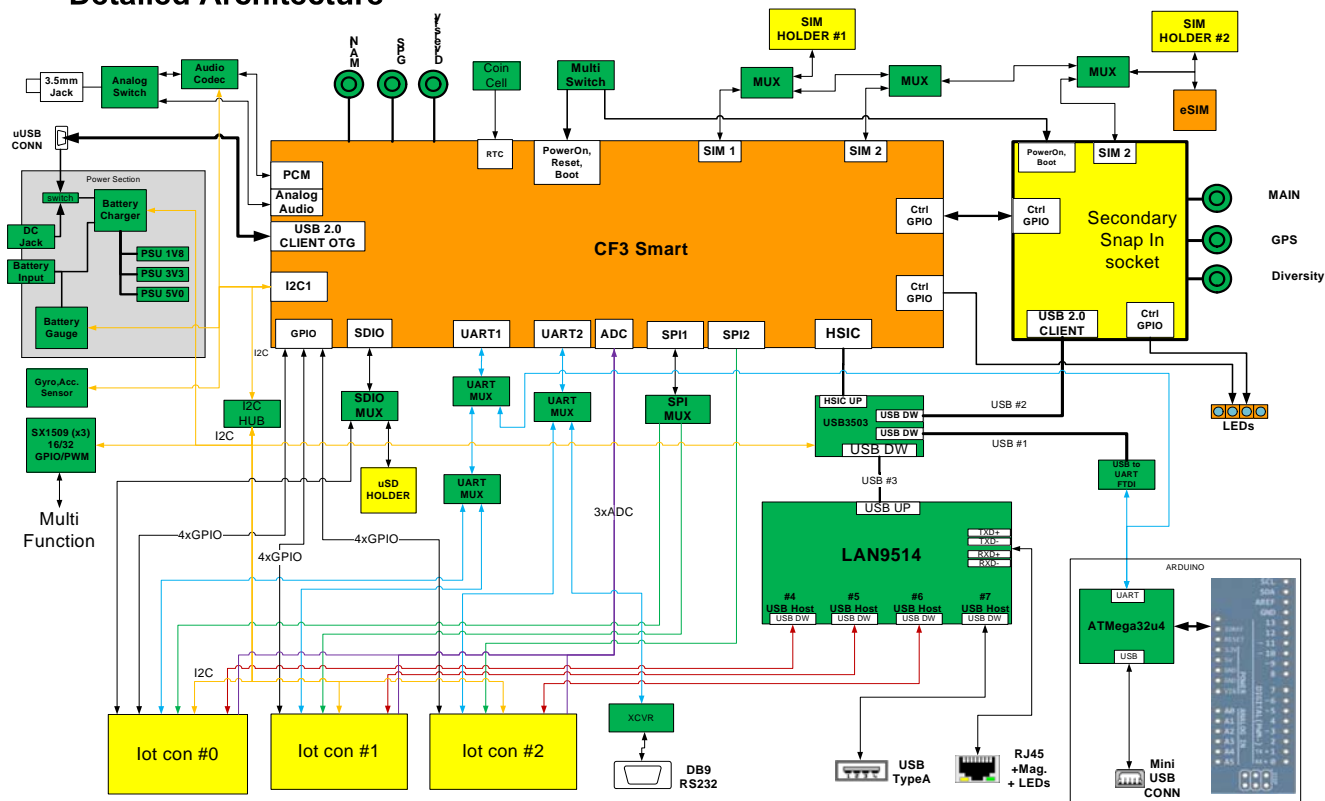


Figure 2-4: mangOH green Hardware Architecture

## mangOH green Hardware Components

The mangOH green hardware components that interact with installed CF3 modules and with the integrated Arduino-compatible circuit are listed in [Table 2-1](#) on page 10. Details shown include:

- Hardware component type, PCB schematic designator, and description
- CF3 module signal(s) connected to the hardware component
- Component to signal path type
  - Single—Component connects directly to one signal only.
  - MUX—A hardware switch that connects one component to one of several signals, or one of several components to one signal.
  - Hub—One signal is connected to multiple components via a signal expander.
- Notes (purpose, usage, etc.)
- Links to detailed descriptions

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

- [MUXing](#) on page 15
- [Primary CF3 Module Signals](#) on page 16
- [Secondary CF3 Module Signals](#) on page 29
- [IOT Interfaces](#) on page 30
- [Arduino-compatible Circuit Signals](#) on page 31
- [Reset Methods](#) on page 32
- [Power Management](#) on page 33

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

mangOH green Components		CF3/Arduino-compatible Circuit Signal(s)			
Type and Designator <sup>a</sup>	Description	Signal(s) and Module Pins	Path <sup>b</sup>	Notes	See also ...
Modules/Processors/etc.					
Primary CF3 (J200)	See <a href="#">Primary CF3 Module Signals</a> on page 16 for details.				
Secondary CF3 (J601)	See <a href="#">Secondary CF3 Module Signals</a> on page 29 for details.				
IOT0, IOT1, IOT2 (CN1000, CN1001, CN1002)	IoT connectors	Multiple connections to Primary CF3 and Secondary CF3 interfaces.	See <a href="#">IoT Connectors</a> on page 14 for details.		

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

mangOH green Components		CF3/Arduino-compatible Circuit Signal(s)		Notes	See also ...
Type and Designator <sup>a</sup>	Description	Signal(s) and Module Pins	Path <sup>b</sup>		
ATmega32U4 (U1500)	Microcontroller for integrated Arduino-compatible circuit	Primary CF3 HSIC interface (Pins: 14, 15)	Hub	Purpose: <ul style="list-style-type: none"> <li>Control interface for Arduino-compatible circuit.</li> <li>Connects to mini-USB for direct interaction with computer</li> <li>UART interface to a UART-USB converter, that connects to a USB3503 hub, for control by primary CF3 module.</li> </ul>	<a href="#">Arduino-compatible Circuit Signals</a> on page 31
Card slots					
Mini-SIM (CN801)	Mini-SIM holder	Primary CF3 UIM1 (Pins: 26–29)	Single	Purpose: UIM required to establish mobile network connection.	<a href="#">UIM1</a> on page 27
Micro-SIM (CN802)	Micro-SIM/ microSD holder (bottom slot)	<ul style="list-style-type: none"> <li>Primary CF3 UIM2 (Pins: 55–58)</li> <li>Primary CF3 UIM1 (Pins: 26–29)</li> <li>Secondary CF3 UIM1 (Pins: 55–58)</li> </ul>	MUX	Purpose: UIM required to establish mobile network connection through primary CF3, or through secondary CF3 for dual data streams.	<ul style="list-style-type: none"> <li><a href="#">UIM2</a> on page 28</li> <li><a href="#">UIM1</a> on page 27</li> <li><a href="#">Secondary CF3 Module Signals</a> on page 29</li> <li><a href="#">MUXing</a> on page 15</li> </ul>
micro-SD (CN802)	Micro-SIM/ microSD holder (top slot)	Primary CF3 SDIO (Pins: 161–166)	MUX	Purpose: Provide access to microSD card.	<ul style="list-style-type: none"> <li><a href="#">SDIO</a> on page 23</li> <li><a href="#">MUXing</a> on page 15</li> </ul>
USB-type connectors					
micro-USB (CN311)	micro-USB connector	<ul style="list-style-type: none"> <li>Primary CF3 USB (Pins: 12, 13, 16)</li> <li>Power (if selected)</li> </ul>	Single	Purpose: <ul style="list-style-type: none"> <li>Direct connection to primary CF3 module USB signals</li> <li>Power supply when selected by the Power Supply Selection Jumper (CN1204). See mangOH green User Guide for details.</li> <li>USB OTG</li> </ul>	<a href="#">USB 2.0</a> on page 28
mini-USB (CN330)	mini-USB connector	ATmega32U4 USB	Single	Purpose: Interact directly with Arduino-compatible circuit from connected computer.	<a href="#">Arduino-compatible Circuit Signals</a> on page 31

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

mangOH green Components		CF3/Arduino-compatible Circuit Signal(s)		Notes	See also ...
Type and Designator <sup>a</sup>	Description	Signal(s) and Module Pins	Path <sup>b</sup>		
USB Host (CN327)	USB Type A connector	Primary CF3 HSIC (Pins: 14, 15)	Hub	Purpose: Provides USB host capability to primary CF3 module.	<a href="#">HSIC (USB/Ethernet)</a> on page 21
Cable connectors					
Ethernet (CN1100)	RJ-45 connector	Primary CF3 HSIC (Pins: 14, 15)	Hub	Purpose: Provides Ethernet connection to primary CF3 module.	<a href="#">HSIC (USB/Ethernet)</a> on page 21
RS-232 (CN700)	DB9 serial connector	Primary CF3 UART2 (Pins: 96–99)	MUX	Purpose: Provide a serial connection over the DB9 connector.	<ul style="list-style-type: none"> <li><a href="#">UART2</a> on page 26</li> <li><a href="#">MUXing</a> on page 15</li> </ul>
RF and Audio connectors					
RF Antennas Main (CN307) GNSS (CN306) Diversity (CN304)	u.FL connectors	Primary CF3 RF (Pins: 49 (Main), 38 (GNSS), 31 (Diversity))	Single		<a href="#">RF</a> on page 23
Audio (CN500)	3.5 mm connector	Primary CF3 digital or analog audio signals (Pins: 17–20 (analog), 30–33 (digital))	MUX	Purpose: Provide audio capability to primary CF3 module.	<ul style="list-style-type: none"> <li><a href="#">Audio (Analog and PCM)</a> on page 17</li> <li><a href="#">MUXing</a> on page 15</li> </ul>
Other ICs and components					
Gyroscope + Accelerometer (U704)	Integrated LSM6DS3 inertial module	Primary CF3 I2C1 interface (Pins: 1, 6)	Hub	Purpose: Provides rotation and acceleration measurements to primary CF3 module.	<a href="#">I2C1</a> on page 22
RTC capacitor (CN320) <sup>c</sup>	Keep-alive circuit	BAT_RTC (Pin 21)	Single	Purpose: Keeps the real time clock powered when DC, USB, and battery power are not provided.	
GPIO/PWM expanders	Integrated SX1509 expanders	Primary CF3 I2C1 interface (Pins: 1, 6)	Hub	Purpose: Provides additional GPIOs.	<ul style="list-style-type: none"> <li><a href="#">GPIO Expanders</a> on page 19</li> <li><a href="#">I2C1</a> on page 22</li> </ul>
LEDs					
VCC_3V7 (D1210)	Green LED	VCC_3V7		Purpose: Indicates device is powered on.	
Rx (Arduino-compatible circuit) (D1501)	Green LED	RXLED/SS		Purpose: Indicates Arduino-compatible circuit is receiving.	

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

mangOH green Components		CF3/Arduino-compatible Circuit Signal(s)		Notes	See also ...
Type and Designator <sup>a</sup>	Description	Signal(s) and Module Pins	Path <sup>b</sup>		
Tx (Arduino-compatible circuit) (D1500)	Green LED	TXLED		Purpose: Indicates Arduino-compatible circuit is transmitting.	
User-controlled (D702)	Green LED	%%check dv3 leds on schematic		Purpose: User controls on/off behavior.	
V_SYS_BAT (D1201)	Green LED	V_SYS_BAT		Purpose: Indicates battery is charging.	
Rx/Tx (Primary CF3 module) (D705)	Green LED	2G_TX_ON		Purpose: Indicates primary CF3 module is transmitting/receiving.	
RF Disabled (D707)	Green LED	W_DISABLE_N		Purpose: Indicates RF power is disabled for primary CF3 module.	
Platform controls					
Multi-switch (SW401)	Module signals control	Eight dipswitches:			• mangOH green User Guide
		1. POWER_ON (Pri CF3 Pin 59)	Single	Enable/disable primary CF3 module's POWER_ON signal	
		2. Reserved	Single	Reserved for future use	
		3. W_DISABLE_N (Pri CF3 Pin 151)	Single	Enable/disable RF power for primary CF3 module	• <a href="#">RF</a> on page 23
		4. SIM2_Detect (Pri CF3 Pin 65)	Single	Manual switch to indicate when a second SIM card is inserted/removed.	• <a href="#">UIM Signals</a> on page 27
		5. SW_PWR_ON (Sec CF3 Pin 59)	Single	Enable/disable secondary CF3 module's POWER_ON signal.	
		6. S_TP1_BOOT (Sec CF3 Pin 47)	Single	Enable/disable secondary CF3 module's TP1 (boot) signal.	
		7. TP1_BOOT (Pri CF3 Pin 47)	Single	Enable/disable primary CF3 module's TP1 (boot) signal.	
		8. RESET_IN_N (Pri CF3 Pin 11)	Single	Hold reset signal low until primary module fully boots.	

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

b. Single (dedicated); MUX (simple switch); Hub (signal expander)

c. By default, RTC capacitor is not installed. See mangOH green schematic for details if you want to install it.

## IoT Connectors

mangOH green includes three IoT connector slots (IOT0, IOT1, IOT2) that connect to the primary CF3's signals as detailed in [Table 2-2](#).

In general, these slots support IoT Connector specification signals as follows:

- IOT0—Full support
- IOT1, IOT2—Partial support

By default, specific signals are enabled for each slot when the mangOH green boots. For additional information, including default configurations and how to temporarily change them, see [IoT Interfaces](#) on page 30.

For detailed information about IoT connectors, see the Project mangOH IoT Connector Design Specification available at [mangoh.io](http://mangoh.io).

**Table 2-2: IoT Connector Signal Connections to Primary CF3 Module**

IoT Signal	CF3 Signal(s)		Notes	Supported?			See also
	Signal	Path		IoT 0	IoT 1	IoT 2	
USB	HSIC (Pins 14, 15)	Single	Purpose: Data transfer; application control	Yes	Yes	Yes	<a href="#">HSIC (USB/Ethernet)</a> on page 21
UART	UART1 (Pins 2, 9)	MUX	Purpose: Data transfer	Yes	Yes	No	<ul style="list-style-type: none"> <li>• <a href="#">UART1</a> on page 25</li> <li>• <a href="#">MUXing</a> on page 15</li> </ul>
	UART2 (Pins 96–99)	Yes	Purpose: Data transfer	No	No	Yes	<ul style="list-style-type: none"> <li>• <a href="#">UART2</a> on page 26</li> <li>• <a href="#">MUXing</a> on page 15</li> </ul>
SPI	SPI1 (Pins 51–54)	Yes	Purpose: Data transfer	Yes	Yes	No	<ul style="list-style-type: none"> <li>• <a href="#">SPI1</a> on page 24</li> <li>• <a href="#">MUXing</a> on page 15</li> </ul>
	SPI2 (Pins 92–95)	Single	Purpose: Data transfer	No	No	Yes	<a href="#">SPI2</a> on page 25
I2C	I2C1 (Pins 1, 6)	Hub	Purpose: Data transfer (standard mode). Higher speeds possible if supported by host application.	Yes	Yes	Yes	<a href="#">I2C1</a> on page 22
GPIO	GPIO	Single	Purpose: Customer-defined data communication	Yes	Yes	Yes	<a href="#">Primary CF3 GPIOs</a> on page 17
SDIO	SDIO (Pins 161–166)	Yes	Purpose: Data transfer	Yes	No	No	<ul style="list-style-type: none"> <li>• <a href="#">SDIO</a> on page 23</li> <li>• <a href="#">MUXing</a> on page 15</li> </ul>

**Table 2-2: IoT Connector Signal Connections to Primary CF3 Module (Continued)**

IoT Signal	CF3 Signal(s)		Notes	Supported?			See also
	Signal	Path		IoT 0	IoT 1	IoT 2	
ADC0	ADC0 (Pin 25)	Single	Purpose: General purpose ADC output to host application (e.g. indicate when a sensor has triggered)	Yes	No	No	<a href="#">ADC</a> on page 16
	ADC1 (Pin 24)	Single	Purpose: General purpose ADC output to host application (e.g. indicate when a sensor has triggered)	No	Yes	No	<a href="#">ADC</a> on page 16
	ADC2 (Pin 107)	Single	Purpose: General purpose ADC output to host application (e.g. indicate when a sensor has triggered)	No	No	Yes	<a href="#">ADC</a> on page 16
Power	Power	n/a	Receives three power inputs: <ul style="list-style-type: none"> <li>• 5.0V @ 500 mA</li> <li>• 3.3V @ 200 mA</li> <li>• 1.8V @ 50 mA</li> </ul>	Yes	Yes	Yes	<a href="#">Power Management</a> on page 33

## MUXing

Several interfaces use MUXing (simple switches) to associate multiple hardware connectors with a single CF3 or Arduino-compatible circuit signal, or multiple CF3/Arduino-compatible circuit 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
  - [SPI1](#) on page 24
  - [UART1](#) on page 25
  - [UART2](#) on page 26
  - [UIM Signals](#) on page 27
- Hubs
  - [HSIC \(USB/Ethernet\)](#) on page 21
  - [I2C1](#) on page 22

## Primary CF3 Module Signals

This section describes how the primary CF3 module's signals connect to the platform hardware described in [mangOH green Hardware Components](#) on page 10.

---

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

---

### ADC

mangOH green provides three ADC (Analog to Digital converter) signal sources (ADC0, ADC1, ADC2) defined by the CF3 specification.

---

*Note: The CF3 specification includes ADC3, which is not supported by the mangOH green.*

---

The primary CF3 module's ADC signals connect directly to the mangOH green IoT connectors (pin 20), as shown in [Figure 2-5](#) on page 16:

- ADC0—IOT Connector 0 (CN1000)
- ADC1—IOT Connector 1 (CN1001)
- ADC2—IOT Connector 2 (CN1002)

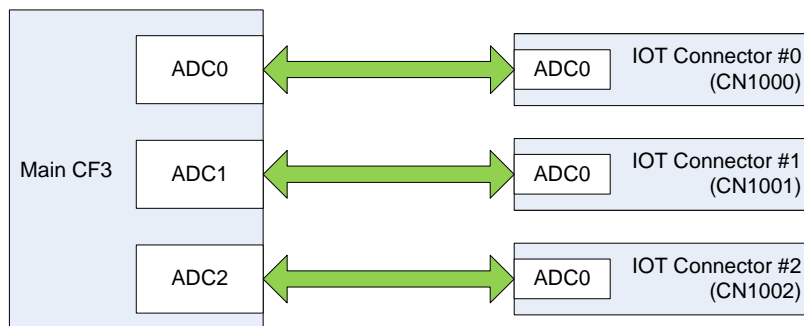


Figure 2-5: ADC Configuration



## Audio (Analog and PCM)

The primary CF3 module's audio signals—analogue and PCM (digital)—connect via an analog switch to the mangOH green's 3.5 mm analog audio jack as shown in [Figure 2-6](#) on page 17.

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
Software	Mux1—Use default or alternate configuration.	API command	Modifies running configuration until device reboots or another change is made.
Hardware	Mux1—Use default or alternate configuration	Set resistor on Mux1: <ul style="list-style-type: none"> <li>Low—Default</li> <li>High—Alternate</li> </ul>	Selected configuration used every time device boots up.

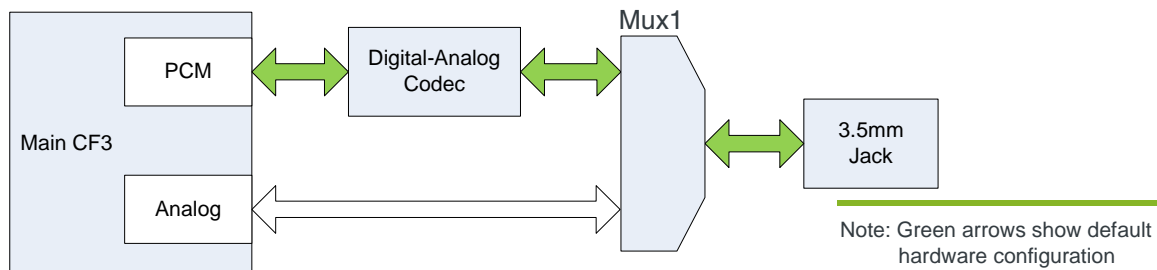


Figure 2-6: Audio Configuration

## Primary CF3 GPIOs

The mangOH green connects a subset of the GPIOs defined in the CF3 specification, as shown in [Figure 2-7](#) on page 18 (it does not connect to any other GPIOs defined in the CF3 specification):

- Each GPIO signal passes through a debug connector.  
By default, the debug connectors (CN601, CN602) are not installed. To use them, you must solder on appropriate connectors. For location and details, see the mangOH green schematics at [mangoh.io](http://mangoh.io).
- Twelve of the GPIOs connect to IOT slots (four for each slot)
- One GPIO (GPIO2) is connected to the NINT (active low interrupt) output signal from a GPIO expander (U906). To enable this signal a jumper must be placed on CN900.

*Note: The mangOH green uses GPIO expanders for additional I/O functions. See [GPIO Expanders](#) on page 19.*

The CF3 GPIO configuration can be modified as described in [Table 2-4](#).

**Table 2-4: CF3 GPIO Interface Configuration Changes**

Change type	Change effect	Method	Change duration
Jumper	<ul style="list-style-type: none"><li>Off—Connect GPIO2 to GPIO expander NINT signal</li><li>Off—Not connected</li></ul>	Install a jumper on CN900 to connect GPIO2 to NINT	Remains in effect until jumper is added or removed.

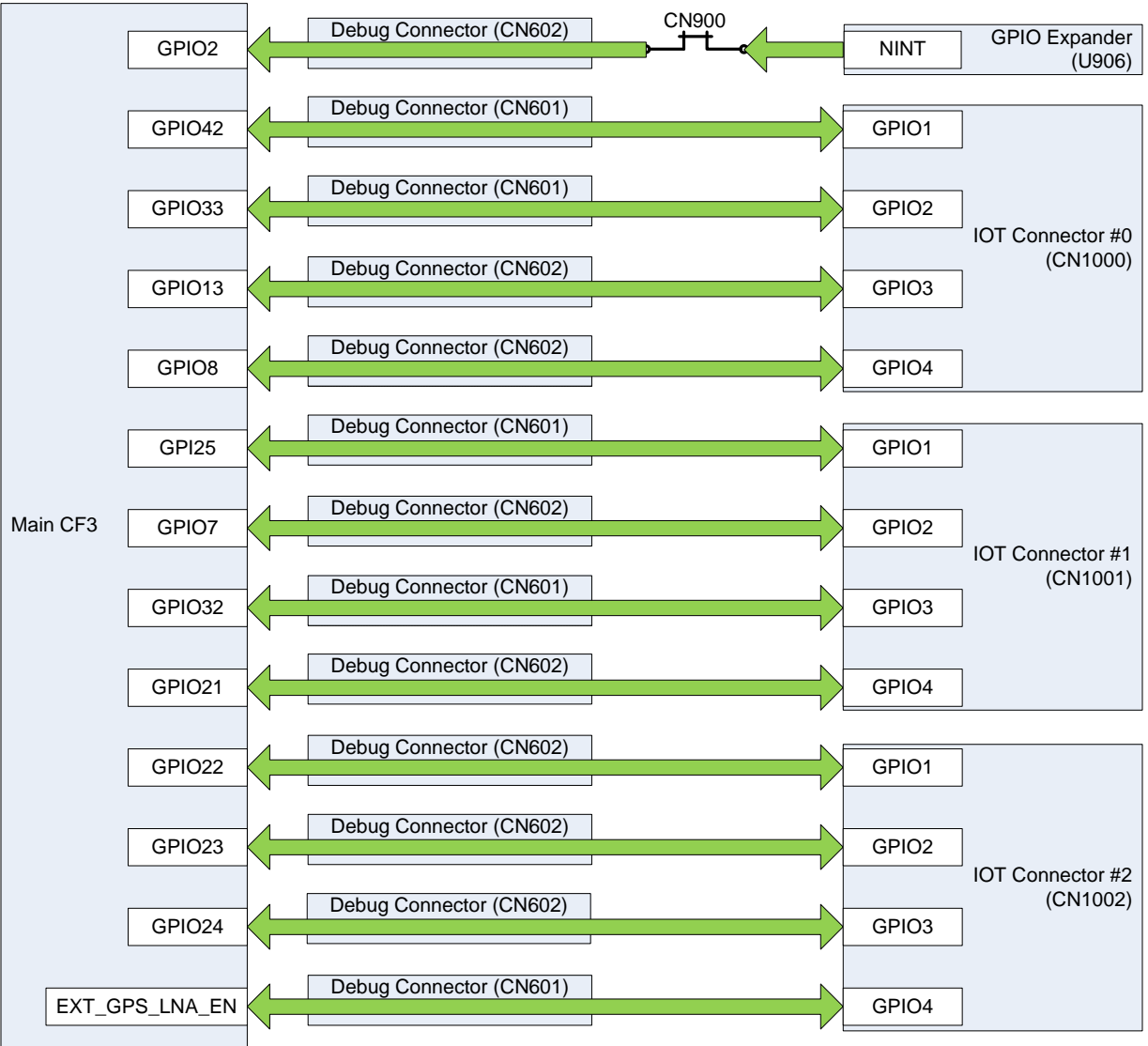


Figure 2-7: GPIO Configuration

Note: CF3 pin 43 (EXT\_LNA\_GPS\_EN) is not currently available for use by IOT connector 2.

## GPIO Expanders

The mangOH green includes three SX1509 16/32 GPIO/PWM expanders, as detailed in [Table 2-5](#). These provide additional GPIOs (over the primary CF3 module's I2C1 interface) used for internal I/O functions such as driving LEDs, resetting board components, etc.

For detailed specifications, see the mangOH green schematics at [mangoh.io](http://mangoh.io).

**Table 2-5: GPIO Expander Signals**

Desig	GPIO	Pin	Signal Name	Purpose
U903	I/O_0	27	ARDUINO_RESET_Level shift	Arduino-compatible circuit reset (connected to reset button (SW1500))
	I/O_1	28	BattChgr_PG_N	Indicate 'power good' from battery charger
	I/O_2	1	BattGauge_GPIO	Query battery charge level
	I/O_3	2	LED_ON	Set HIGH to disable LEDs on-board (see U702 on schematic)
	I/O_4	5	ATmega_reset_GPIO	Arduino-compatible circuit reset (via system reset)
	I/O_5	6	connect_to_AV_LED	Input from onboard function button used to connect to AirVantage server
	I/O_6	7	PCM_ANALOG_SELECT	S/W control (via API) to select either digital or analog audio for primary CF3
	I/O_7	8	connect_to_AV_LED	LED to indicate AirVantage connection
	I/O_8	13	Board_rev_res1	User-configurable
	I/O_9	14	Board_rev_res2	User-configurable
	I/O_10	15	UART_EXP1_ENn	UART multiplexer control (internal)
	I/O_11	16	UART_EXP1_IN	UART multiplexer control (internal)
	I/O_12	17	UART_EXP2_IN	UART multiplexer control (internal)
	I/O_13	20	SDIO_SEL	SDIO multiplexer control (internal)
	I/O_14	21	SPI_EXP1_ENn	SPI multiplexer control (internal)
	I/O_15	22	SPI_EXP1_IN	SPI multiplexer control (internal)

**Table 2-5: GPIO Expander Signals (Continued)**

Desig	GPIO	Pin	Signal Name	Purpose
U906	I/O_0	27	GPIOEXP_INT1	Interrupt input from other GPIO expander (internal)
	I/O_1	28	Battery_detect	Input that indicates whether a battery is connected to the mangOH green
	I/O_2	1	GPIO_SCF3_RESET	Reset Secondary CF3
	I/O_3	2	LED_CARD_DETECT_IOT0	Input that indicates when IOT connector is in slot 0
	I/O_4	5	LED_CARD_DETECT_IOT1	Input that indicates when IOT connector is in slot 1
	I/O_5	6	LED_CARD_DETECT_IOT2	Input that indicates when IOT connector is in slot 2
	I/O_6	7	UIM2_PWM_SELECT	SIM cards multiplexer (internal)
	I/O_7	8	UIM2_M2_S_SELECT	SIM cards multiplexer (internal)
	I/O_8	13	TP900	Test point
	I/O_9	14	SENSOR_INT1	Interrupt from accel sensor (internal)
	I/O_10	15	SENSOT_INT2	Interrupt from accel sensor (internal)
	I/O_11	16	CARD_DETECT_IOT0	Indicates IoT connector is in slot0
	I/O_12	17	CARD_DETECT_IOT2	Indicates IoT connector is in slot2
	I/O_13	20	CARD_DETECT_IOT1	Indicates IoT connector is in slot1
	I/O_14	21	GPIOEXP_INT3	Interrupt input from other GPIO expander (internal)
	I/O_15	22	BattChgr_INT_N	Interrupt line from battery charger (internal)
U909	I/O_0	27	USB_HUB_INTn	Interrupt line from USB hub (internal)
	I/O_1	28	HUB_CONNECT	HUB connect signal (internal)
	I/O_2	1	GPIO_IOT2_RESET	Send reset signal to IoT connector in slot 2
	I/O_3	2	GPIO_IOT1_RESET	Send reset signal to IoT connector in slot 1
	I/O_4	5	GPIO_IOT0_RESET	Send reset signal to IoT connector in slot 0
	I/O_5	6	TP901	Test point
	I/O_6	7	TP902	Test point
	I/O_7	8	TP903	Test point
	I/O_8	13	UART_EXP2_ENn	UART multiplexer control (internal)
	I/O_9	14	PCM_EXP1_ENn	PCM multiplexer control (internal)
	I/O_10	15	PCM_EXP1_SEL	PCM multiplexer control (internal)
	I/O_11	16	ARD_FTDI	CF3 to Arduino-compatible circuit serial port transceiver reset
	I/O_12	17	TP904	Test point
	I/O_13	20	TP905	Test point
	I/O_14	21	TP906	Test point
	I/O_15	22	RS232_Enable	Enable/disable console port (DB9 connector)

## HSIC (USB/Ethernet)

The primary CF3 module's HSIC signal connects through a pair of hub controllers to the following sources, as shown in [Figure 2-8](#) on page 21:

- USB1—Connects via a USB–UART FTDI (bridge) to the Arduino-compatible circuit's ATmega32U4 UART signal
- USB2—Connects to the secondary CF3 module's USB2.0 CLIENT
- USB3— Connects to a USB Hub controller for:
  - USB4—IOT Connector 0 (CN1000)—Connects to USB signal
  - USB5—IOT Connector 1 (CN1001)—Connects to USB signal
  - USB6—IOT Connector 2 (CN1002)—Connects to USB signal
  - USB7—USB Host connector (CN327)
  - RJ45 (Ethernet) connector (CN1100)

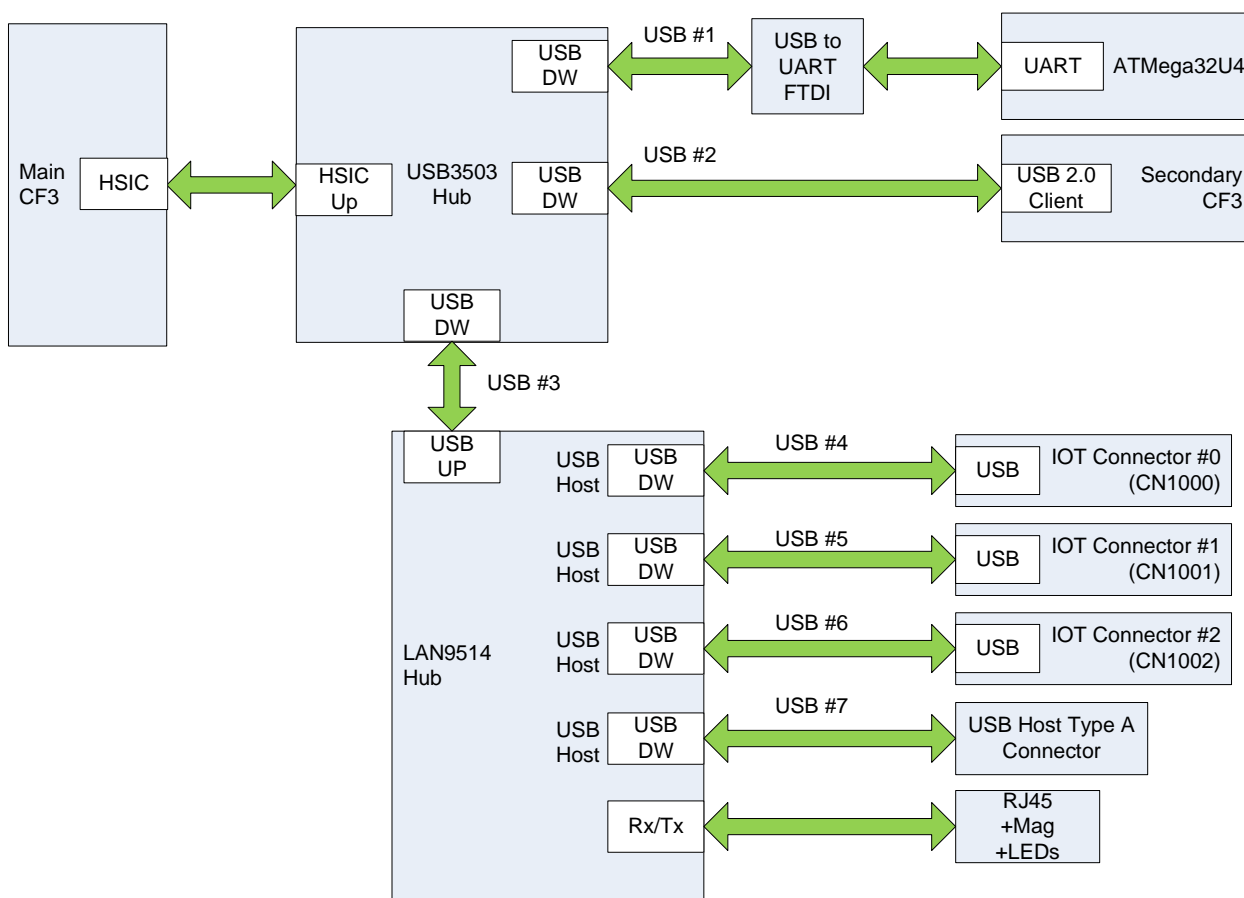


Figure 2-8: HSIC Configuration

## I2C1

The primary CF3 module's I2C1 signal connects to a hub that expands to the following sources, as shown in [Figure 2-9](#) on page 22:

- GPIO/PWM expanders—Used internally on the mangOH green for I/O functions such as driving LEDs, resetting board components, etc. For detailed information, refer to mangOH green schematics available at [mangoh.io](http://mangoh.io).
- Accelerometer/Gyroscope—Accessible via API commands.
- Battery gauge—Accessible via API commands.
- Battery charger—Accessible via API commands.
- IOT Connector 0 (CN1000)
- IOT Connector 1 (CN1001)
- IOT Connector 2 (CN1002)
- Audio codec (U501)

All signal sources are enabled by default.

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

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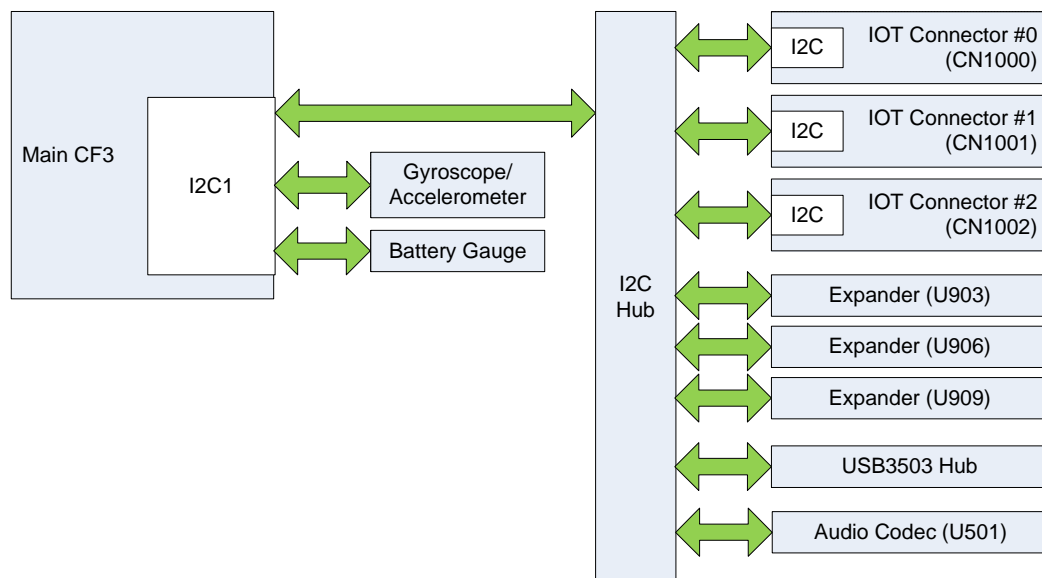


Figure 2-9: I2C1 Configuration

## RF

The primary CF3 module's RF signals (RF\_MAIN, RF\_GPS, RF\_DIV) connect directly to the following u.FL connectors on the mangOH green:

- RF\_MAIN—CN307
- RF\_GPS—CN306
- RF\_DIV—CN304

Power for these signals can be enabled/disabled as described in [Table 2-6](#).

**Table 2-6: CF3 GPIO Interface Configuration Changes**

Change type	Change effect	Method	Change duration
Hardware	Enable/disable RF power for primary CF3 module	Set SW401 switch 3 (W_DISABLE_N): <ul style="list-style-type: none"> <li>• OFF—Enable RF power (Default configuration)</li> <li>• ON—Disable RF power</li> </ul>	Until switch position changes

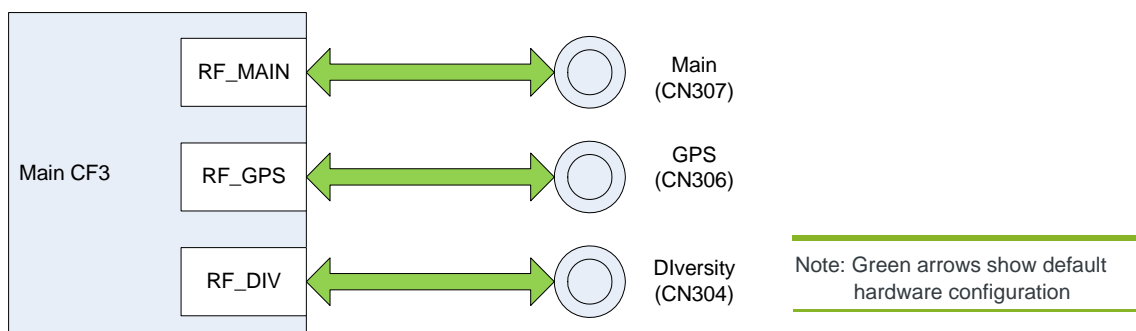


Figure 2-10: Primary CF3 module RF Connections

## SDIO

The primary CF3 module's SDIO signal connects via a MUX to one of the following sources, as shown in [Figure 2-11](#) on page 24:

- microSD holder (CN802)—Default configuration
- IOT slot 0 (CN1000)

The SDIO interface configuration can be modified as detailed in [Table 2-7](#).

**Table 2-7: SDIO Interface Configuration Changes**

Change type	Change effect	Method	Change duration
Software	<ul style="list-style-type: none"> <li>• Use default or alternate configuration.</li> </ul>	API command	Selected configuration used every time device boots up.
Hardware	<ul style="list-style-type: none"> <li>• Jumper off—Use uSD holder</li> <li>• Jumper on—Use IOT Connector #0</li> </ul>	Place or remove jumper on CN902 to select configuration.	Selected configuration used every time device boots up.

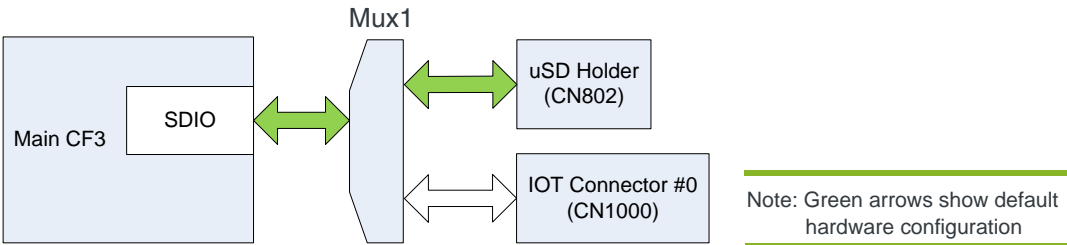


Figure 2-11: SDIO Configuration

## SPI1

The primary CF3 module's SPI1 signal connects via a MUX to one of the following sources, as shown in [Figure 2-12](#):

- IOT Connector 0 (CN1000)—Default configuration
- IOT Connector 1 (CN1001)

The SPI1 interface configuration can be modified as detailed in [Table 2-8](#).

**Table 2-8: SPI1 Interface Configuration Changes**

Change type	Change effect	Method	Change duration
Software	Mux1—Use default or alternate configuration.	API command	Modifies running configuration until device reboots or another change is made.
Hardware	Mux1—Use default or alternate configuration	Set resistor on Mux1: <ul style="list-style-type: none"><li>• Low—Alternate</li><li>• High—Default</li></ul>	Selected configuration used every time device boots up.

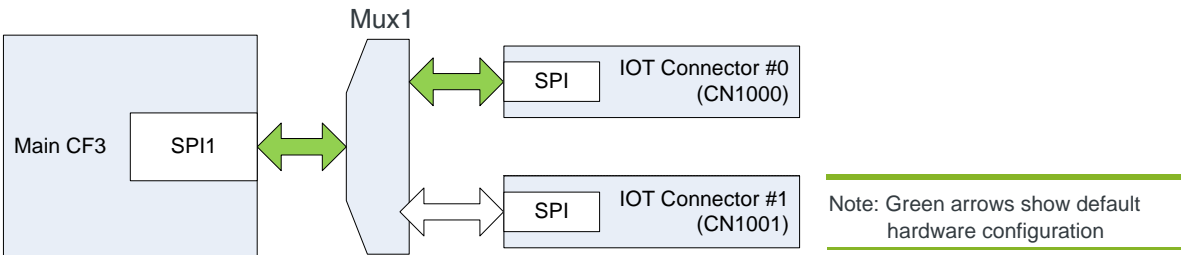


Figure 2-12: SPI1 Configuration



## SPI2

The primary CF3 module's SPI2 signal connects directly to the mangOH green's IOT connector 2 (CN1002) as shown in [Figure 2-13](#).

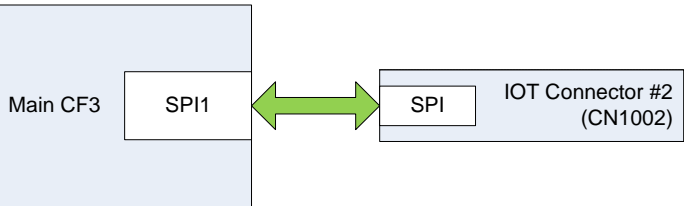


Figure 2-13: SPI2 Configuration

## UART1

The primary CF3 module's UART1 signal connects through MUXes to one of the following sources, as shown in [Figure 2-14](#) on page 26:

- IOT Connector 0 (CN1000)—Default configuration
- IOT Connector 1 (CN1001)
- ATmega32U4 (U1500)

The UART1 interface configuration can be modified as detailed in [Table 2-9](#).

**Table 2-9: UART1 Interface Configuration Changes**

Change type	Change effect	Method	Change duration
Software	<ul style="list-style-type: none"><li>• Mux1—Use default or alternate configuration.</li><li>• Mux2—Use default or alternate configuration.</li></ul>	API command	Modifies running configuration until device reboots or another change is made.
Hardware	Mux1—Use default or alternate configuration	Set resistor on Mux1: <ul style="list-style-type: none"><li>• Low—Default</li><li>• High—Alternate</li></ul>	Selected configuration used every time device boots up.
		SW401 Dipswitch 6 (UART_CTRL) <ul style="list-style-type: none"><li>• ON—IOT</li><li>• OFF—ATmega32U4</li></ul>	Selected configuration used until switch position changes.
	Mux2—Use default or alternate configuration	Set resistor on Mux2: <ul style="list-style-type: none"><li>• Low—Alternate</li><li>• High—Default</li></ul>	Selected configuration used every time device boots up.

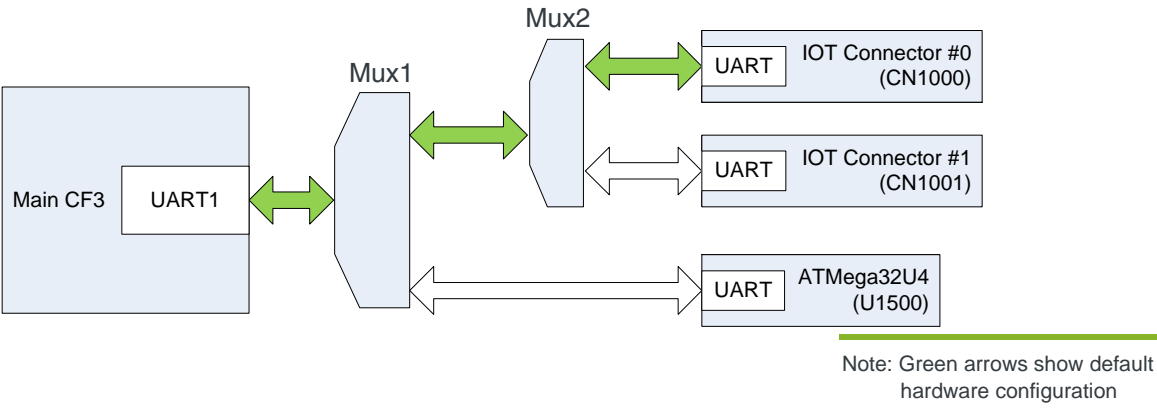


Figure 2-14: UART1 Configuration

## UART2

The primary CF3 module's UART2 signal connects via a MUX to one of the following sources, as shown in [Figure 2-15](#):

- RS-232 DB9 serial connector (CN700)—Default configuration
- IOT Connector 2 (CN1002)

The UART2 interface configuration can be modified as detailed in [Table 2-10](#).

**Table 2-10: UART2 Interface Configuration Changes**

Change type	Change effect	Method	Change duration
Software	Mux1—Use default or alternate configuration.	API command	Modifies running configuration until device reboots or another change is made.
Hardware	Mux1—Use default or alternate configuration	Set resistor on Mux1: <ul style="list-style-type: none"><li>• Low—Default</li><li>• High—Alternate</li></ul>	Selected configuration used every time device boots up.

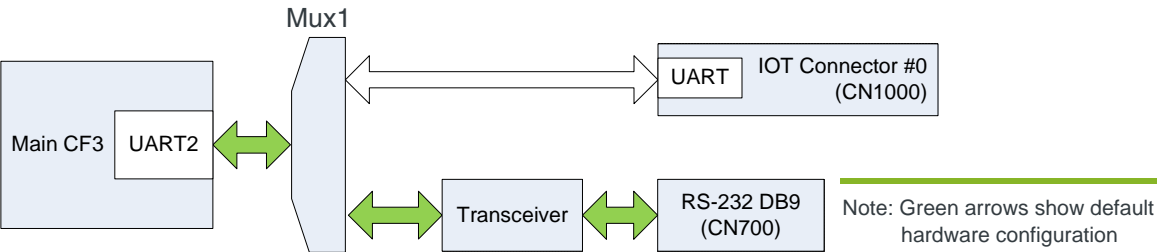


Figure 2-15: UART2 Configuration

## UIM Signals

The mangOH green implements both UIM interfaces (UIM1, UIM2) defined by the CF3 specification. [Figure 2-16](#) on page 27 shows the default configuration used when the board boots.

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

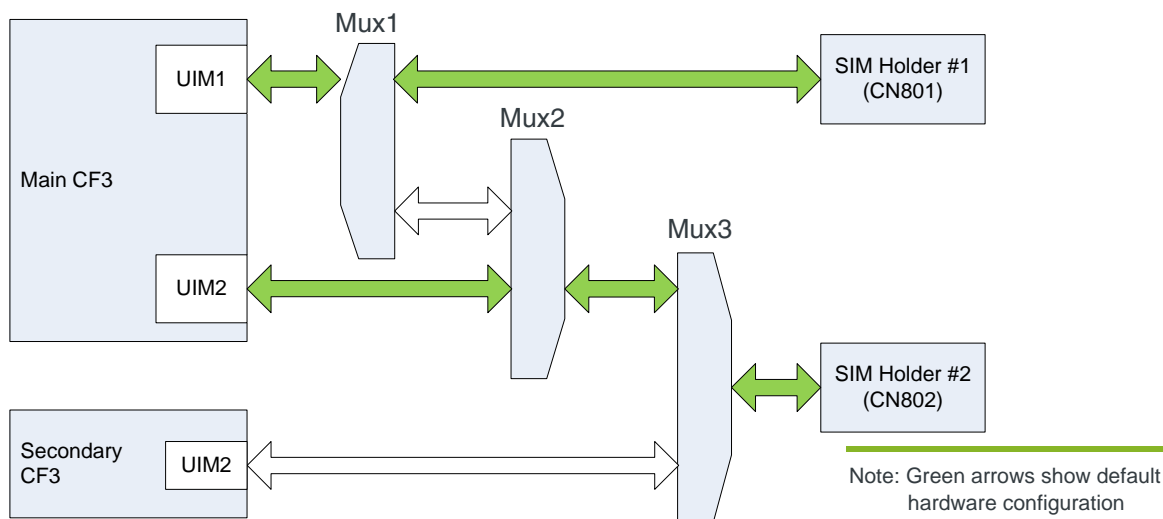


Figure 2-16: SIM Interfaces Configuration

The UIM interface configuration can be modified as detailed in [Table 2-11](#).

**Table 2-11: UIM Interface Configuration Changes**

Change type	Change effect	Method	Change duration
Software	<ul style="list-style-type: none"> <li>Mux2—Use default or alternate configuration.</li> <li>Mux3—Use default or alternate configuration.</li> </ul>	API command	Modifies running configuration until device reboots or another change is made.
Hardware	Mux1, Mux2, Mux3—Use default or alternate configuration	Set resistor on Mux: <ul style="list-style-type: none"> <li>Low—Default</li> <li>High—Alternate</li> </ul>	Selected configuration used every time device boots up.

## UIM1

The primary CF3 module’s UIM1 signal connects through multiplexers (as shown in [Figure 2-16](#) on page 27) to:

- mini-SIM holder (CN801)—Default connection
- micro-SIM holder (CN802)

*Note: The primary CF3 module’s UIM1\_DET signal will indicate when a SIM is present in the holder.*

To switch the connected component, see [Table 2-11](#).

## UIM2

The primary CF3 module's UIM2 signal connects through multiplexers (as shown in [Figure 2-16](#) on page 27) to:

- micro-SIM holder (CN802)—Default connection
- Note: If CN802 has been connected to the secondary CF3 module's UIM2 signal, then the primary CF3 module's UIM2 is unused.

*Note: The primary CF3 module's UIM2\_DET signal must be triggered using SW401 switch\_4 to indicate when a SIM is present in the holder. Set switch 4 to:*

- OFF—Indicate that a SIM is in the holder (Default setting)*
- ON—Indicate that the holder is empty*

To switch the connected component, see [Table 2-11](#) on page 27.

## USB 2.0

The primary CF3 module's USB signal connects directly to the mangOH green's micro-USB connector (CN311) as shown in [Figure 2-17](#), for control by a connected computer.

*Note: The micro-USB connector also acts as a power source, if selected. See [Power Management](#) on page 33.*

The USB 2.0 interface configuration can be modified as detailed in [Table 2-12](#).

**Table 2-12: USB 2.0 Interface Configuration Changes**

Change type	Change effect	Method	Change duration
Hardware	<ul style="list-style-type: none"><li>Jumper on pins closest to DC jack—Select DC Power</li><li>Jumper on pins furthest from DC jack—Select USB Power</li><li>Jumper off—Use battery if connected, otherwise no power supplied</li></ul>	Position jumper on CN1204 to choose DC or USB power.  <i>Note: mangOH green ships with DC power selected (jumper on pins closes to DC jack).</i>	mangOH green uses the selected power supply until the jumper changes.



*Figure 2-17: USB\_2.0 Configuration*

# Secondary CF3 Module Signals

This section describes how the secondary CF3 module’s signals connect to the platform hardware described in [mangOH green Hardware Components](#) on page 10.

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

## RF

The secondary CF3 module’s RF signals (RF\_MAIN, RF\_GPS, RF\_DIV) connect directly to the following u.FL connectors on the mangOH green:

- RF\_MAIN—CN309
- RF\_GPS—CN310
- RF\_DIV—CN308

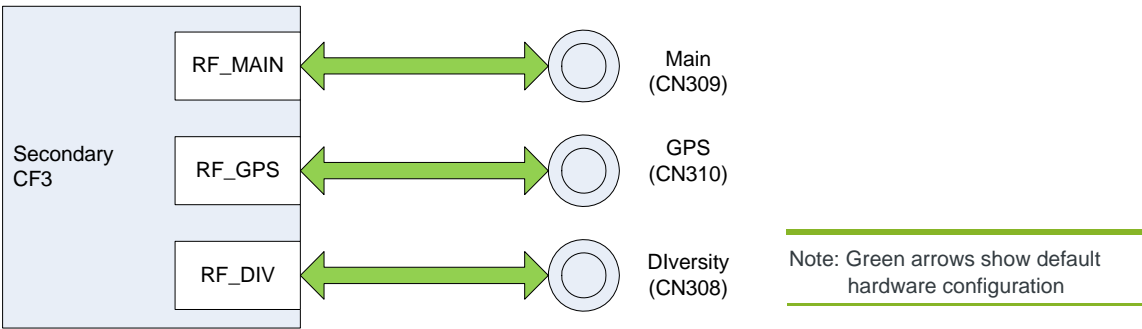


Figure 2-18: Secondary CF3 module RF Connections

## UIM2

The secondary CF3 module’s UIM2 signal connects through a multiplexer (as shown in [Figure 2-16](#) on page 27) to:

- micro-SIM holder (CN802)

*Note: By default, this holder is connected to the primary CF3 module’s UIM2 signal.*

To switch the connected component, see [Table 2-11](#) on page 27.

## USB 2.0

The secondary CF3 module’s USB signal connects through a hub controller to the primary CF3 module’s HSIC signal, as shown in [Figure 2-8](#) on page 21.

# IOT Interfaces

The mangOH green provides three IOT connector slots that each support a set of the signals defined in the Project mangOH IoT Connector Design Specification, as detailed in [Table 2-2](#) on page 14.

The default configurations (enabled signals) for these module connectors are shown in [Figure 2-19](#).

The IOT interface configurations can be modified as detailed in [Table 2-13](#).

**Table 2-13: Audio 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.

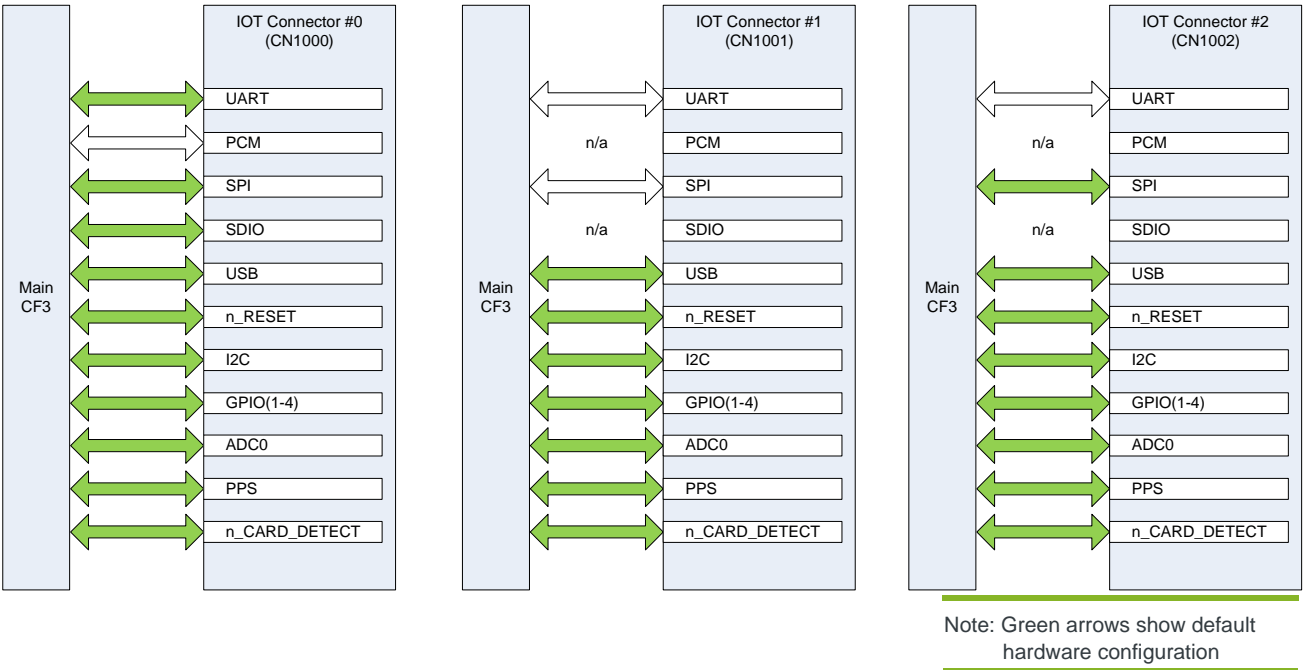


Figure 2-19: IoT Connector Configuration

## Arduino-compatible Circuit Signals

The mangOH green's integrated Arduino-compatible circuit is accessed via an on-board ATmega32U4 micro-controller (U1500):

- UART—The ATmega32U4's UART signal connects through a USB–UART FTDI (bridge) to the primary CF3 module's HSIC signal, as shown in [Figure 2-8](#) on page 21.
- USB—The ATmega32U4's USB signal connects directly to a mini-USB connector (CN330) for control by a connected computer.

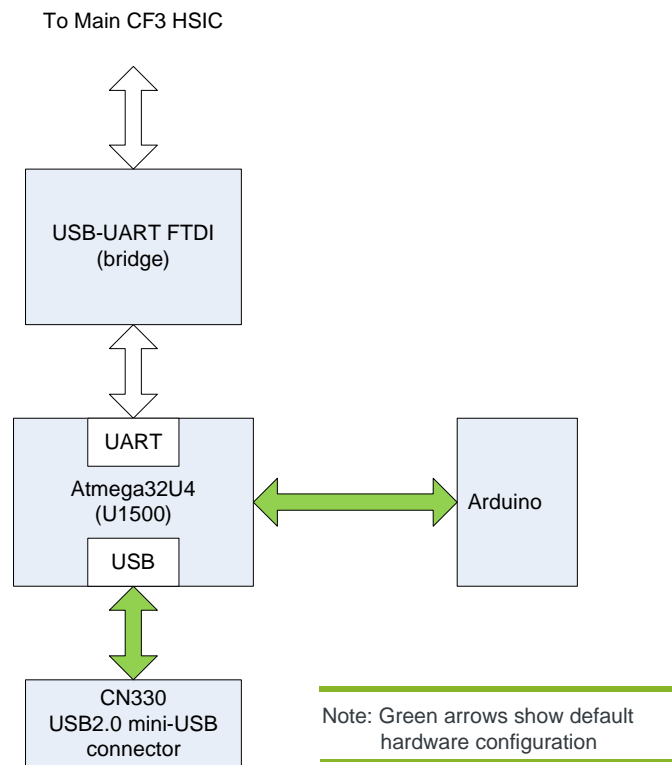


Figure 2-20: Arduino-compatible Circuit Signals

## Reset Methods

The mangOH green supports hardware and software resets of the entire board or certain parts of the board, as shown in [Figure 2-21](#):

- Reset entire board, including the primary CF3 module, via the primary CF3 module's RESET\_IN\_N signal:
  - Hardware (manual)—Press the Reset button (SW400)).
  - Hardware (automatic)—When the low current detector is triggered.

When the board resets, it stays in the reset state as long as low current is detected.
- Reset everything except the primary CF3 module:
  - Software—Use an API command to trigger GPIO6 (primary CF3 module pin 46), which connects to the mangOH green's System\_reset.
- Reset individual IOT connectors:
  - Software—Use an API command to trigger specific GPIO expander signals:
    - GPIO\_IOT0\_RESET—Reset IoT connector in slot 0.
    - GPIO\_IOT1\_RESET—Reset IoT connector in slot 1.
    - GPIO\_IOT2\_RESET—Reset IoT connector in slot 2.
- Reset the secondary CF3 module—use an API command to trigger the GPIO\_SCF3\_RESET expander signal, which connects to the secondary CF3 module's RESET\_IN\_N signal.

For detailed specifications showing how full or partial resets are enabled, see the mangOH green schematics available at [mangoh.io](http://mangoh.io).

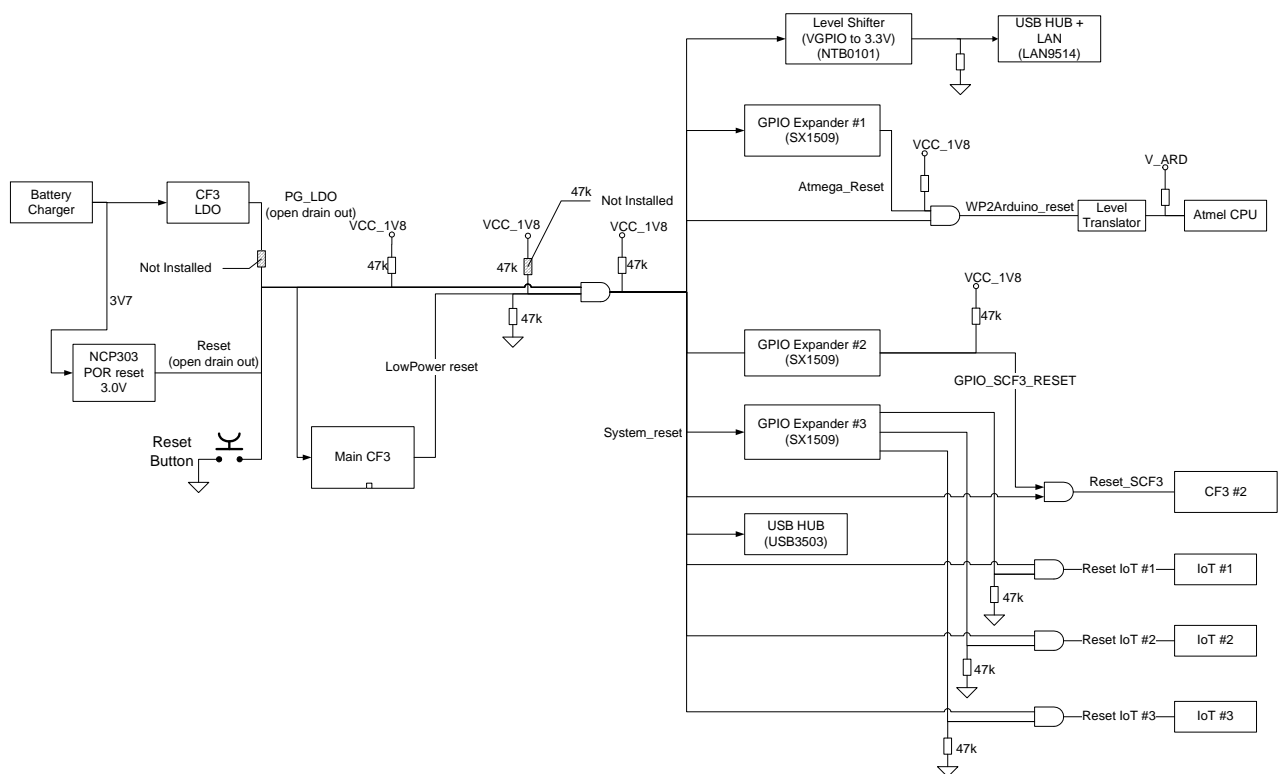


Figure 2-21: Reset Methods



## Power Management

The mangOH green has two primary power supplies (DC power and USB), 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 green platform.

A multi-function switch (SW401) controls some power-related features (see [Multi-switch \(SW401\)](#) on page 13), including:

- Switch 1—Enables/disables primary CF3 module's POWER\_ON signal.
- Switch 5—Enables/disables secondary CF3 module's POWER\_ON signal.

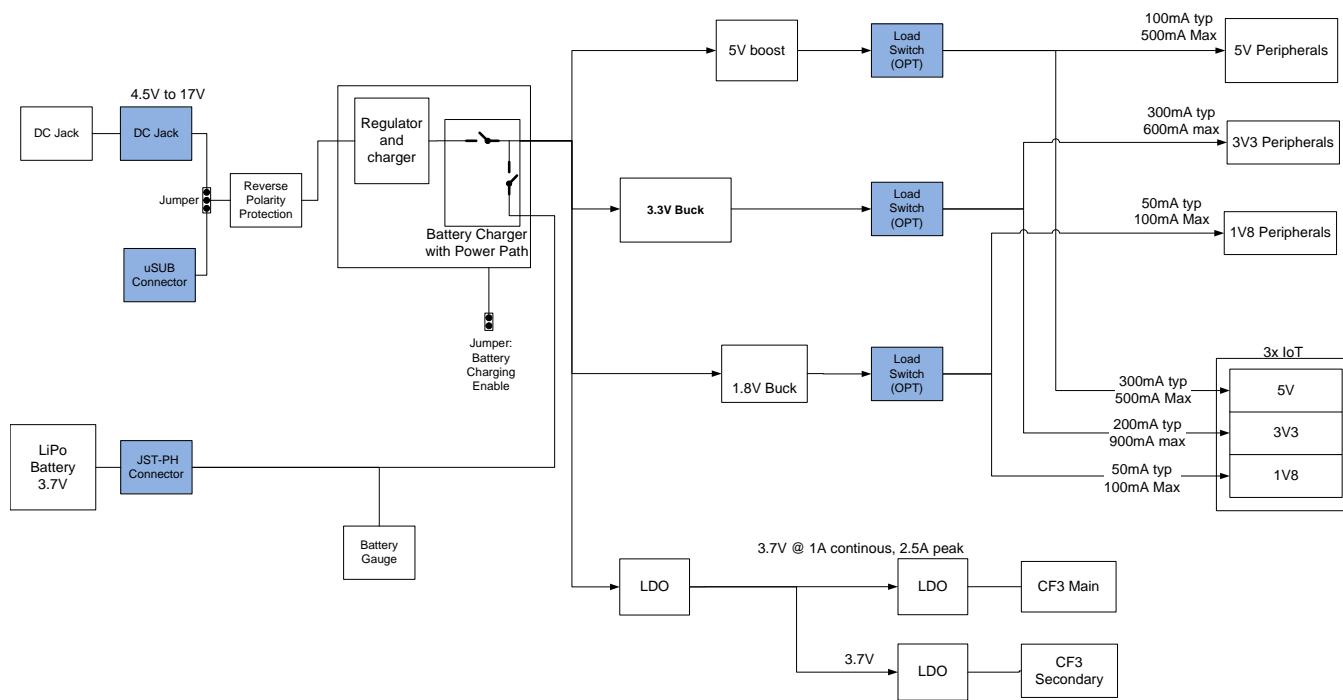


Figure 2-22: Power Management