



Project mangOH

User Guide



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Rev 2

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Revision History

Revision number	Release date	Changes
1	June 2015	Creation (limited release)
2	December 2015	Added default configurations for DIP switches, antennas, and interfaces

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>> 1: Introduction

1

This user guide explains how to set up and begin using the mangOH platform with CF3 form-factor modules.

Once you have the mangOH platform set up, visit mangoh.io for developer documentation, code samples, and other materials.

mangOH Platform Components and Accessories

Table 1-1 details the required and optional components needed to begin using the mangOH platform in your development environment.

Table 1-1: mangOH Platform Development Kit





Item	Details
mangOH platform	Pre-configured development board. The mangOH platform supports CF3 form-factor modules. 
Micro-USB cable	Connects computer to the mangOH platform for communication and to provide power for non-transmitting tests. 
Power supply	<ul style="list-style-type: none">• Output voltage: 4.5V to 17V• 10 W or higher• The mangOH platform will operate with USB power, but DC power may be required to make and establish a full-speed mobile network connection. 
Antenna	Main RF antenna 

Table 1-1: mangOH Platform Development Kit


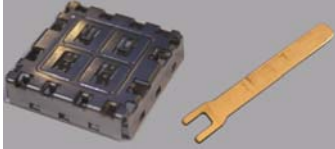
Item	Details
GNSS Antenna	GNSS (GPS/GLONASS) active antenna 
CF3 module cover and cover removal tool	Industrial-quality snap-in module cover, plus cover removal tool to disconnect the cover from the mangOH platform. 

Table 1-2: Additional Components and Accessories (not included)




Item	Details
Sierra Wireless CF3 form factor 'Smart' module (or compatible 3rd-party module)	Used in the primary CF3 socket, the module includes a wireless processor running Legato, an open source Linux based O/S & framework for IoT. 
Sierra Wireless CF3 form factor 'Essential' or 'Smart' module (or compatible 3rd-party module)	Used in the secondary CF3 socket, the module includes a wireless modem that needs to be associated to an application processor in the primary CF3 socket. (In this socket, only the inner pins of the CF3 footprint are used.) 
Eurocard case and mangOH platform faceplates	The mangOH platform fits in a Eurocard standard size casing (100x120mm). 3D-printable files for faceplates are available at mangoh.io .
Drivers, Terminal emulation software	<ul style="list-style-type: none"> Terminal emulator application (e.g. Tera Term, Hyperterm)—Used to communicate with the mangOH platform. Arduino Software (IDE—Integrated Development Environment)—Used to write code ('sketches') and upload them to the mangOH platform's Arduino board. Available at www.arduino.cc. Developer Studio—Sierra Wireless IDE used to build applications for the Legato application framework running on the primary CF3 module. Available at mangoh.io. Sample code—Sample Arduino sketches and Legato applications are available at mangoh.io. Legato driver—Windows Legato drivers for Sierra Wireless CF3 modules. Available at mangoh.io.
Mini-USB cable	Connects computer directly to the Arduino Leonardo board that is incorporated into the mangOH platform 

Table 1-2: Additional Components and Accessories (not included) (Continued)




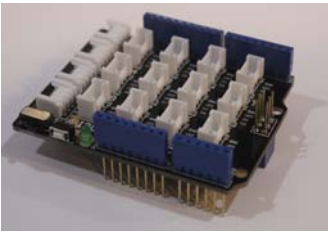
Item	Details
Mini-SIM card	<p>You need to supply a mini-SIM card with an active account, or a test card for use with a call box.</p>  <p><i>Note: Throughout this document, 'SIM' refers to 'SIM' and 'USIM'.</i></p>
Micro-SIM card	<p>If the primary CF3 module supports using two SIMs at the same time ('dual-SIM'), you can use a micro-SIM card with an active account, or a test card for use with a call box.</p> 
Audio cable (3.5 mm)	Audio output cable
Ethernet cable	Ethernet cable (Cat5 or better) for use with the mangOH platform's 100 Mbps Ethernet connector
RS-232 DB9 cable	Serial cable used for console output
Battery	<p>Rechargeable Li-Ion or Li-Polymer battery (3V7 nominal) for use when USB/DC power supply is unavailable</p> 
Arduino shields	<p>Plug-in boards for the mangOH platform's built-in Arduino board</p> 

Table 1-3: mangOH-compatible CF3 Modules^a

Module series	Notes
AirPrime WP8548	<p>All interfaces fully supported with the following exceptions:</p> <ul style="list-style-type: none"> • UART2—Functions as a 2-wire interface. UART_CTS and UART_RTS are not enabled. • SPI2—Non-functional • GPIO—Some signals are non-functional: <ul style="list-style-type: none"> • GPIO_Lowpower1 • GPIO_Lowpower2 • GPIO20/SWD_CLK • GPIO31/SWD_DIO • IoT_GPIO4 functionality to be enabled at later date
AirPrime WP75xx	

a. Refer to Product Technical Specification documents for detailed module information.

>> 2: Setup and Installation

2

Safe Handling Recommendations

To help prevent accidental damage to the mangOH platform:

- Hold the board by the edges to avoid possible ESD damage.
- Avoid touching the CF3 module sockets (J200, J601). These pins can be damaged if they catch on clothing or other materials.

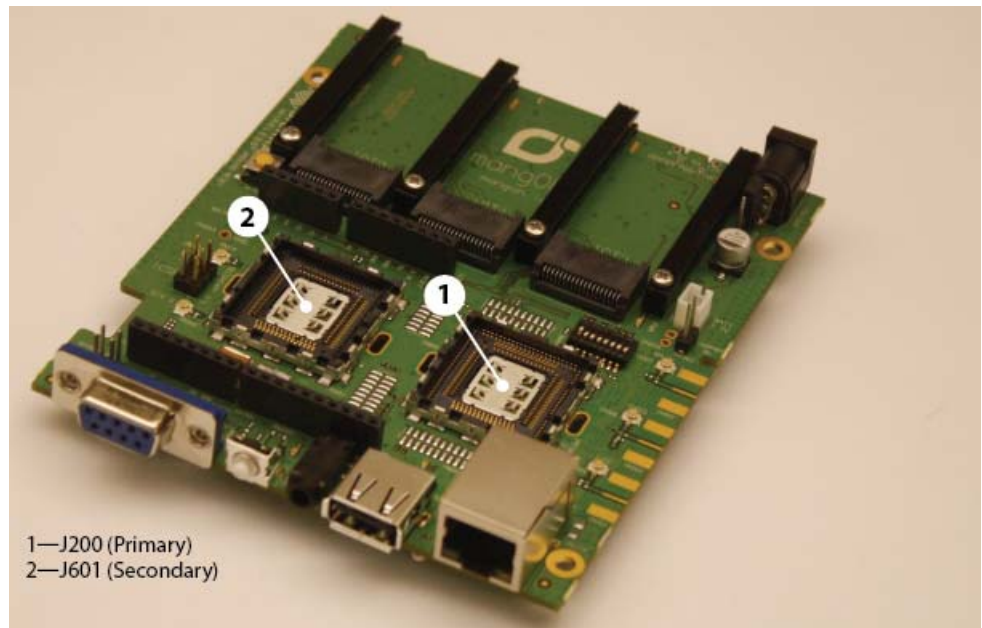


Figure 2-1: Safe Handling Recommendations—CF3 Socket Locations (Do Not Touch)

- Mount the mangOH platform in a case, or attach standoffs (not included) to the mounting holes at each corner of the board to avoid damage to components on the bottom side of the board.



Figure 2-2: Case-mounted mangOH Platform

Initial Setup

To begin using the mangOH platform, set up your hardware and software:

1. Insert a suitable CF3 form factor module in the primary socket. See [Insert/Remove Embedded Modules](#) on page 12.
2. [Select Primary Power Supply](#). See page 16.
3. If you will be establishing a mobile network connection, insert a mini-SIM. See [Insert SIM Card\(s\)](#) on page 18.
4. [Connect Antenna\(s\)](#). See page 21.
5. [Install / Update Windows Drivers](#). See page 36.
6. Connect the mangOH platform to your computer using the USB cable provided.
If you selected USB power in [Step 2](#), the power LED lights up.
7. If you selected the DC power supply in [Step 2](#), plug a DC wall adapter into the DC barrel jack. (The wall adapter must meet the requirements in [Table 1-1](#) on page 7.)
The power LED lights up when power is supplied.
8. [Install a Terminal Emulator](#). See page 37.

The mangOH platform is now ready to be used.

- For information on additional hardware features, see [Hardware Setup and Operation](#) on page 12.
- For instructions on writing a sample first program, see [Write Your First Program](#) on page 37.

>> 3: Hardware Setup and Operation

3

This chapter describes how to install various components on the mangOH platform, and how to configure and control features using connectors and switches.

Insert/Remove Embedded Modules

The mangOH platform has two CF3 form factor module sockets

- Primary (J200)—The primary module includes a wireless modem and application processor. All pins are used.
- Secondary (J601)—The secondary module, if used, includes a wireless modem that is associated with the primary module. Only the inner ring pins (of the CF3 footprint) are used.

To insert a CF3 form factor module:

1. Place the mangOH platform face-up.

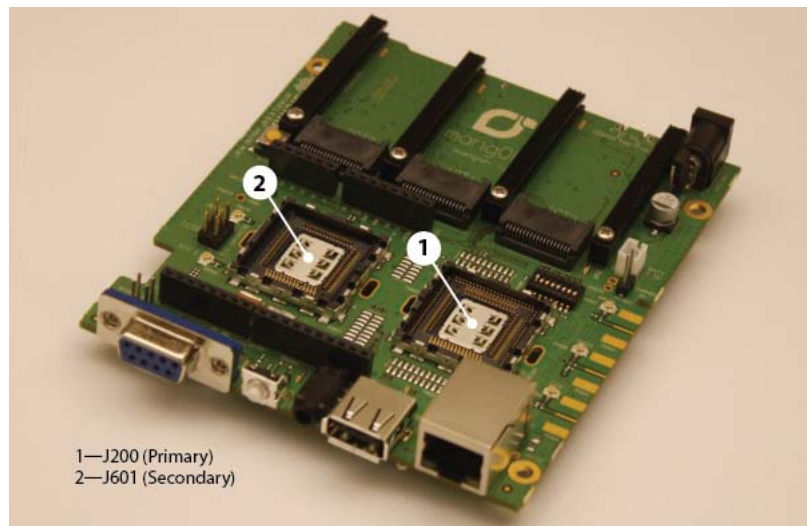


Figure 3-1: mangOH Platform—Top View

2. Hold the module above the socket and line up the polarity marks on the module and socket. (Primary module installation shown.)

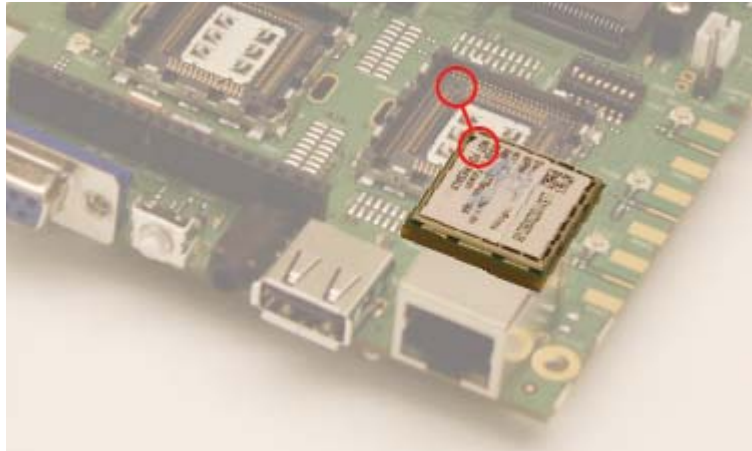


Figure 3-2: CF3 Module Positioning

3. Place the module onto the socket. The module should drop into place when you have it aligned properly. Do not insert at an angle as this may damage the socket pins.



Figure 3-3: CF3 Module Inserted

4. Attach the module cover:
 - a. Hold the module cover above the CF3 module and line up the polarity marks on the module and cover.

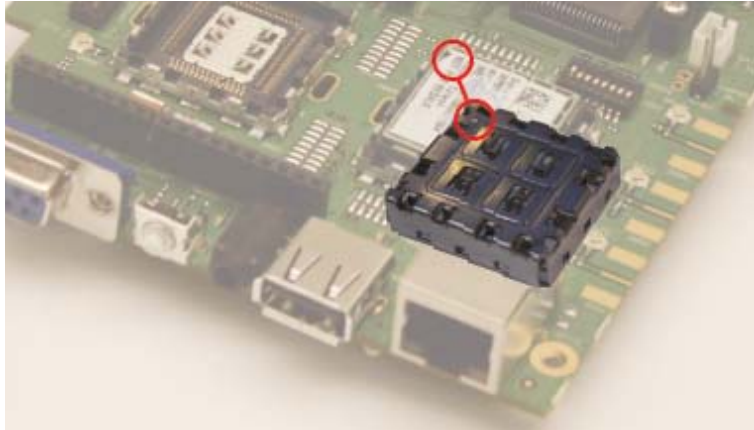


Figure 3-4: Installing Module Cover

- b. Place the cover on the module, then press down carefully until you hear the cover click into place. Make sure all sides of the cover have clicked into place.



Figure 3-5: Installing Module Cover

To remove a CF3 form factor module (primary module displayed below):

1. Remove the module cover using the module cover removal tool—Starting at one corner, insert the tool in the pair of holes and carefully pry the cover away from the module.
2. Repeat at the other locations (there are pairs of pry holes on each side).

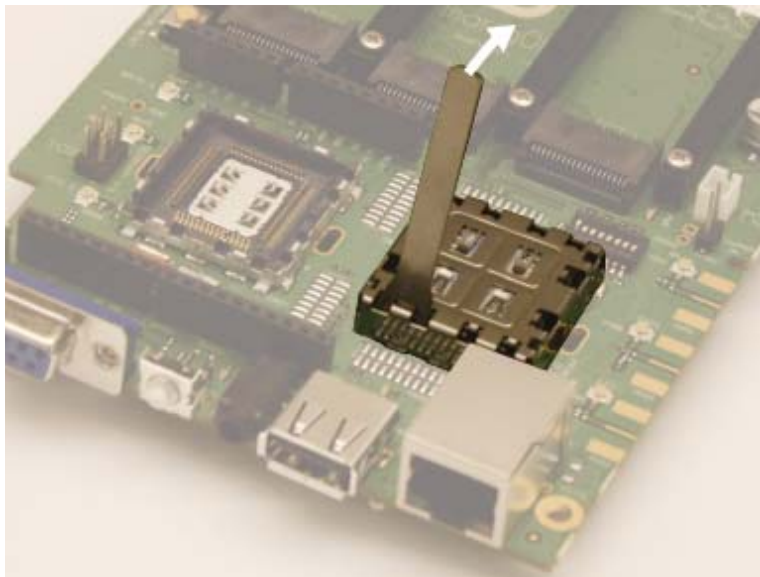


Figure 3-6: Removing the Module Cover

- 3. Lift the cover off the module.
- 4. Carefully pinch the module and pull it straight up out of the socket.

Power Supply

The mangOH platform has the following supplies:

Table 3-1: mangOH Platform Power Supplies

Supply		Details
Primary	DC power	Primary (Required if you want to maintain a full-speed mobile network data connection)
	USB	Primary
Backup	Battery	An optional Li-Ion or Li-polymer (3V7 nominal) rechargeable battery can be installed to power the board if the primary power supply fails.

Select Primary Power Supply

To select the primary power supply:

1. Place the mangOH platform face-up and locate the power supply jumper pins (CN1204).

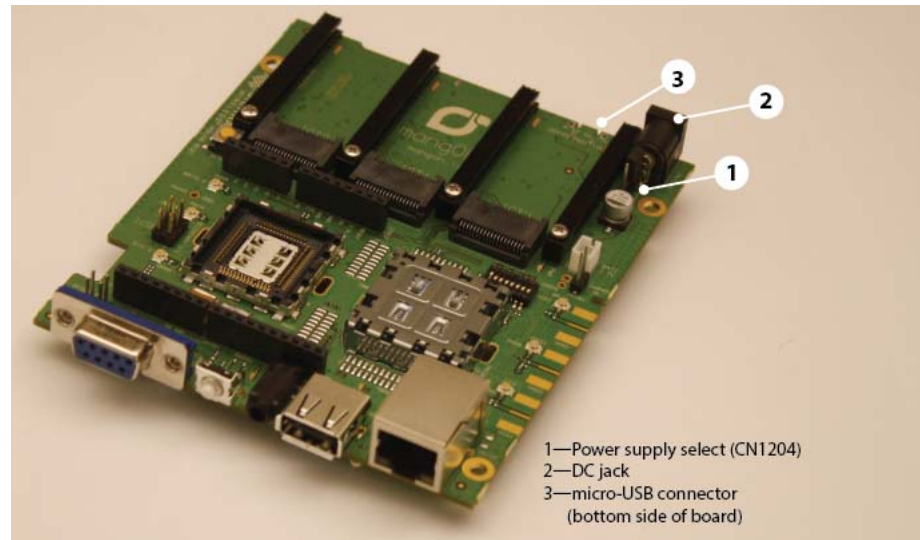


Figure 3-7: Power Supply Select (CN1204)

2. Select the power source:
 - USB power—Place a jumper across the two pins farthest from the DC power jack.
 - DC power—Place a jumper across the pins closest to the DC power jack.

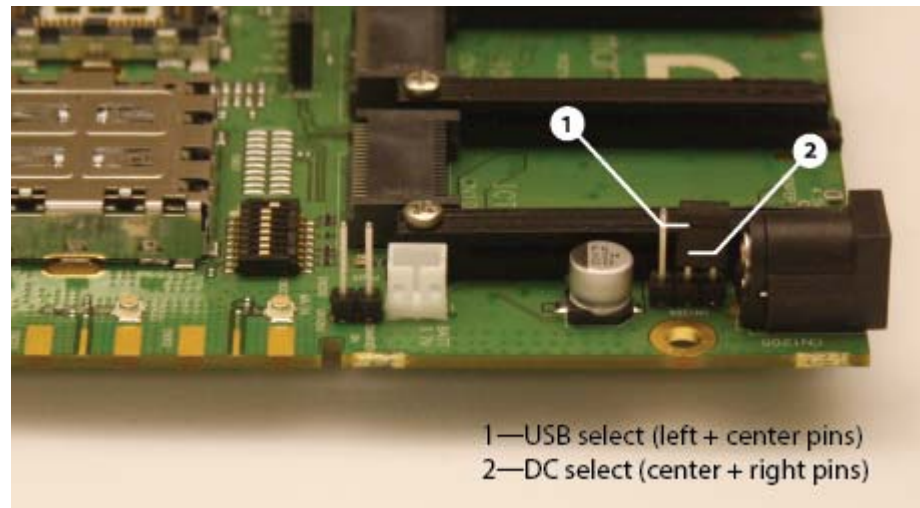


Figure 3-8: Power Source Select (DC power shown)

Connect Battery Backup

To connect an optional rechargeable Li-Ion/Li-Polymer battery:

1. Connect the battery to CN1202.

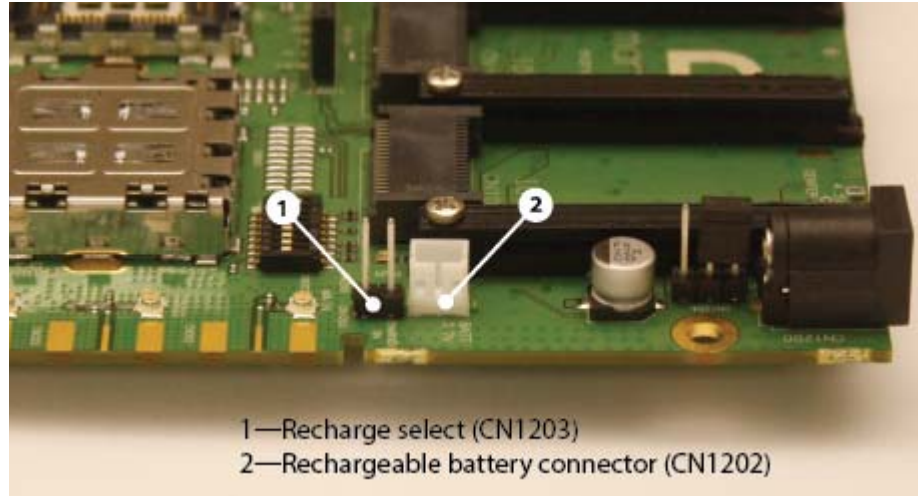


Figure 3-9: Battery Backup (CN1202/CN1203)

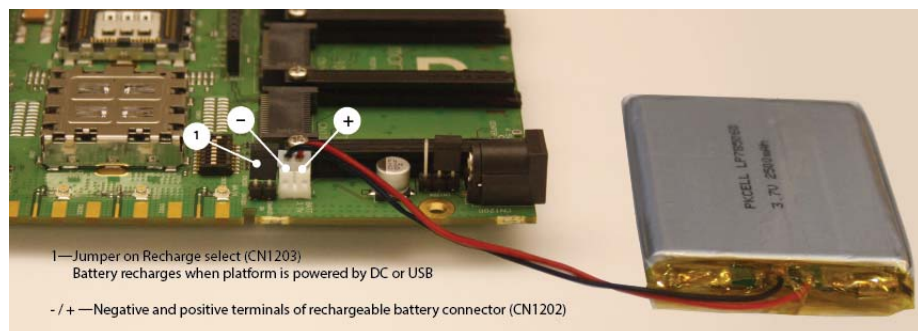


Figure 3-10: mangOH Platform With Rechargeable Battery Connected

2. If you want the battery to recharge while connected to the board, place a jumper across the pins on CN1203 (Recharge select).

Caution: If a rechargeable battery is not connected to the board, make sure to remove the jumper from CN1203.

Caution: The board is designed to use a rechargeable Li-Ion or Li-polymer battery. Regular (non-rechargeable) batteries are NOT recommended. However, if a regular battery is used, DO NOT place a jumper on CN1203 as this will damage the battery and possibly the board.

RTC Capacitor

The mangOH platform has a capacitor that maintains the RTC.

To enable the ability to manually discharge the capacitor, install a switch on CN320. The capacitor can then be discharged by pressing this switch.

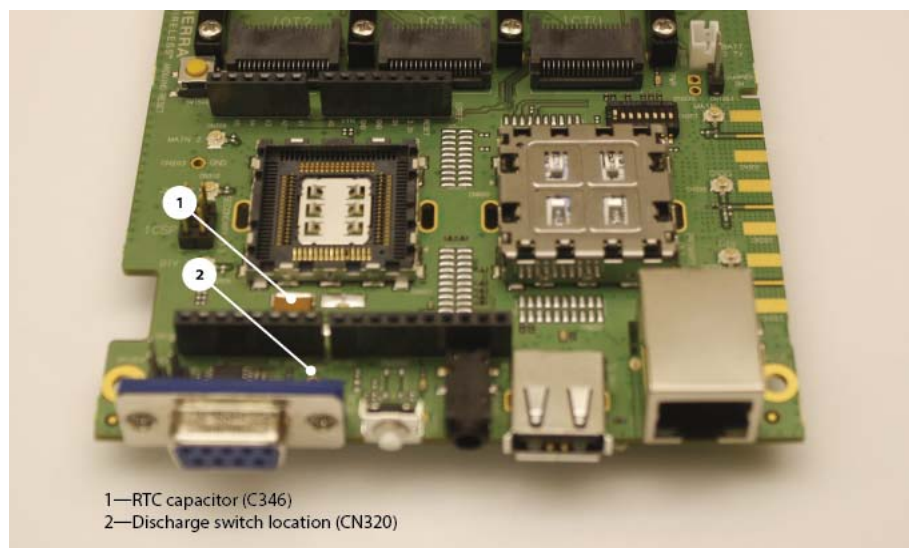


Figure 3-11: RTC Capacitor

Insert SIM Card(s)

The mangOH platform supports dual SIM functionality (if supported by the CF3 module).

Table 3-2: SIM connectors

Type	Connector	Details
Mini-SIM	CN801	Hot-swappable By default, a SIM detect switch is activated when a mini-SIM is inserted or removed. For details, see Table 3-6 on page 31.
Micro-SIM	CN802	Not hot-swappable

To use a UMTS/LTE CF3 module to establish a mobile network connection, you must install one (or two) SIM cards:

- Live card(s) with active accounts, *or*
- Test card(s) for use with a call box (for example, an Agilent 8960 or Rohde & Schwarz CMU200)

Note: A SIM card is not required if you want to connect to a LAN using the Ethernet port.

To install the SIM card(s):

1. Place the Dev Kit face-down (as shown).

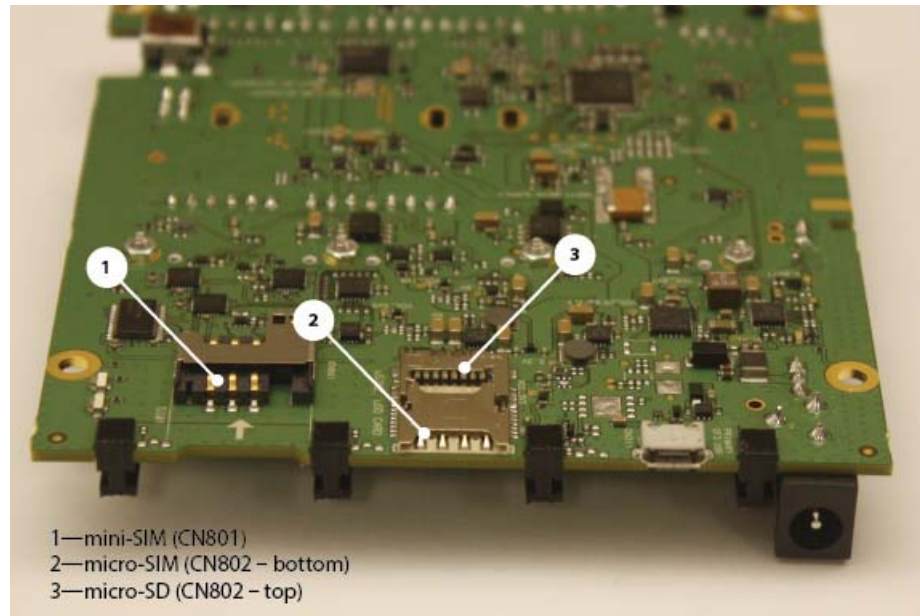


Figure 3-12: SIM Connector and micro-SD Locations

2. Insert the SIM card(s) face-down into the desired slot(s)—note the locations of the notched corners of the cards in [Figure 3-13](#). (The mini-SIM is inserted with the flat end first, and the micro-SIM is inserted with the notched end first.)

Important: CN802 is a dual-connector—a micro-SIM can be placed in the lower slot, and a micro-SD can be placed in the upper slot.

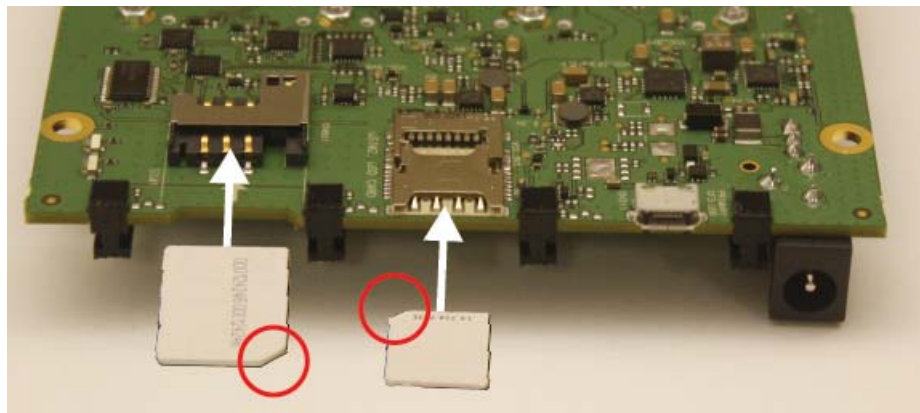


Figure 3-13: SIMs—Inserting

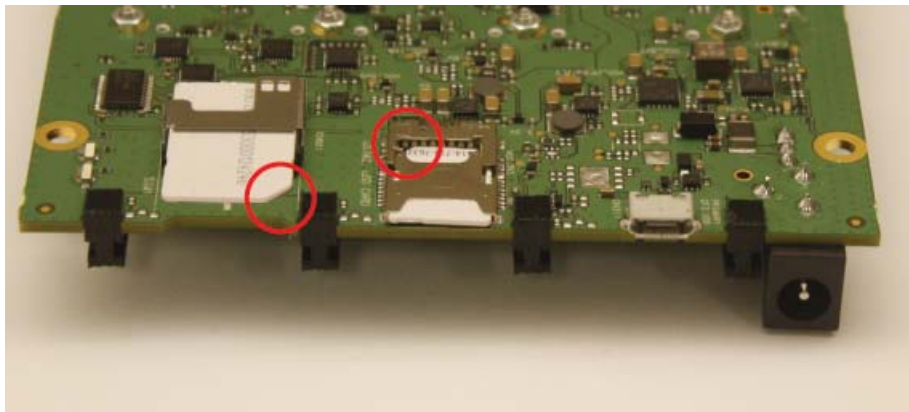


Figure 3-14: SIMs—Inserted

Insert microSD Card

The mangOH platform includes a microSD card slot in the top part of CN802.

To install a microSD card:

1. Place the Dev Kit face-down (as shown).

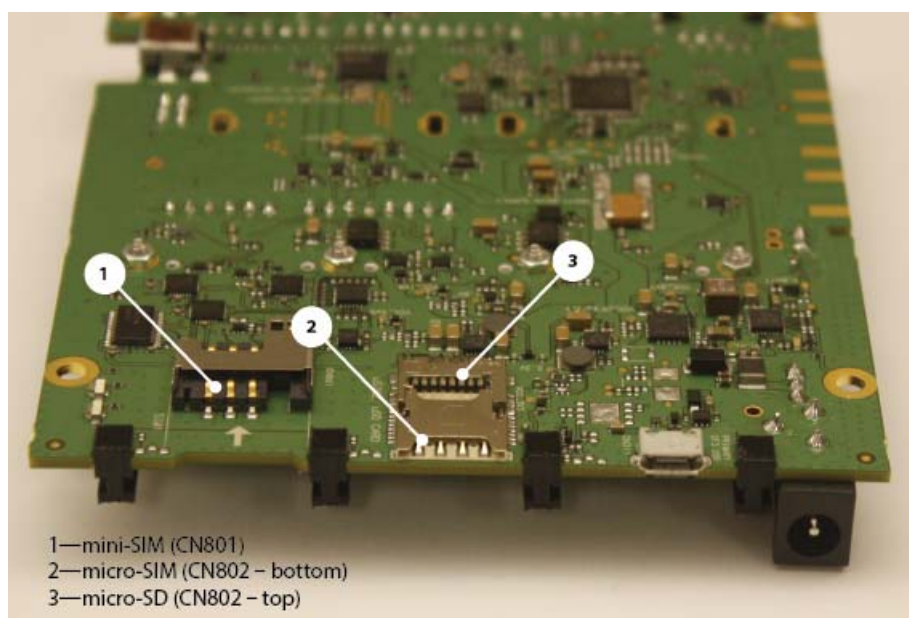


Figure 3-15: SIM Connector and microSD Locations

2. Insert the microSD card face-up into the top slot of CN802.

Important: CN802 is a dual-connector—a micro-SIM can be placed in the lower slot, and a micro-SD can be placed in the upper slot.

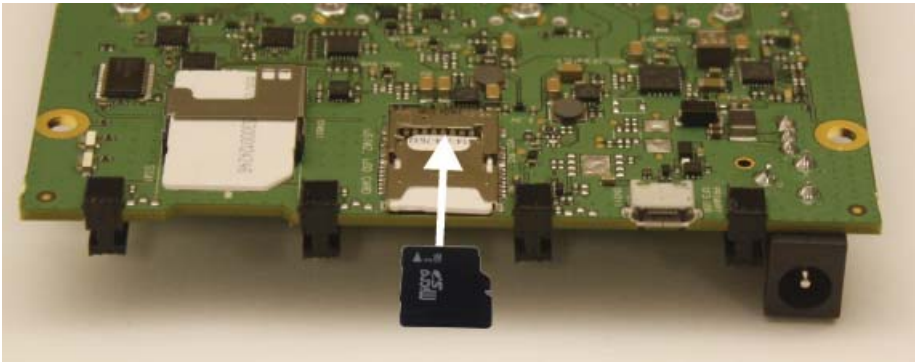


Figure 3-16: microSD—Inserting

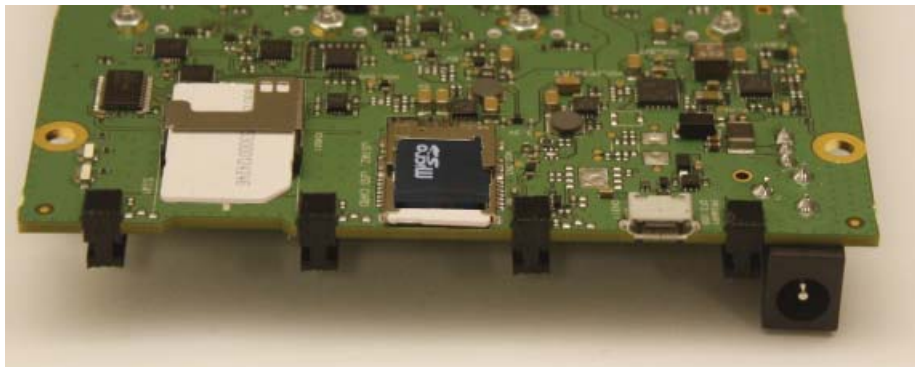


Figure 3-17: microSD—Inserted

Connect Antenna(s)

The mangOH platform includes three antenna ports.

Table 3-3: Antenna Ports

Type	Connector ^a	Details
Main	CN307	Required to establish a mobile network data connection
Diversity	CN304	Used only if primary CF3 supports diversity.
GNSS	CN306	<ul style="list-style-type: none">• Required to enable GNSS functionality• Active• 3.3 V bias voltage

a. U.FL connectors

Note: If needed, the board can be configured to use SMA connectors. For details, see [Table 3-6](#) on page 31.

To connect an antenna to the Main, Diversity, or GNSS antenna connector:

1. Place the mangOH platform face-up.

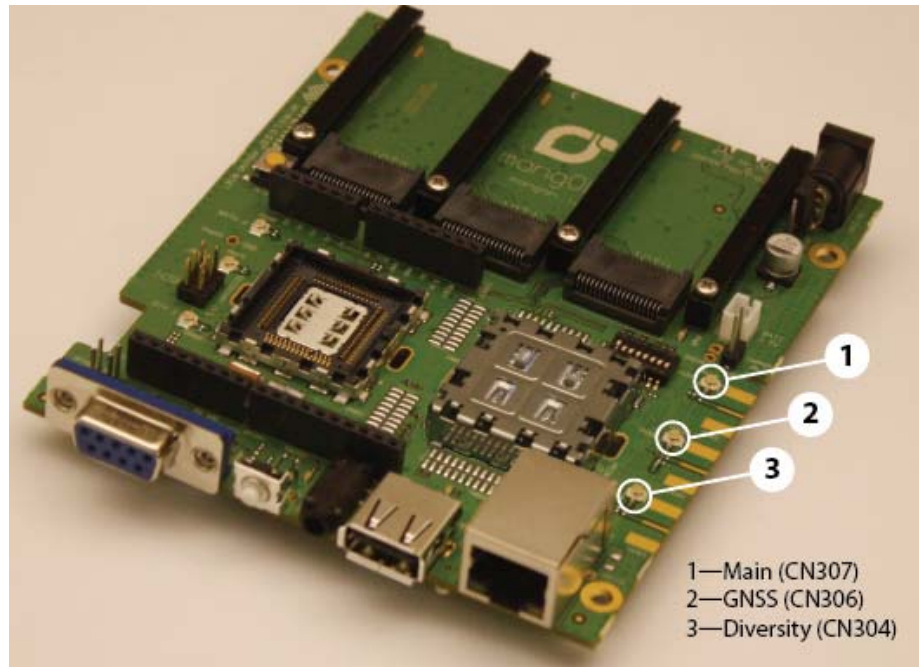


Figure 3-18: Antenna Connector Locations

2. Attach the antenna cable's female connector to the board's male connector and press firmly to get a secure connection.
(Note that female connectors are rated for a limited number of reconnects before the connector wears out, so should be left connected if possible. Use a U.FL extraction tool to put less strain on the connector during removal.)

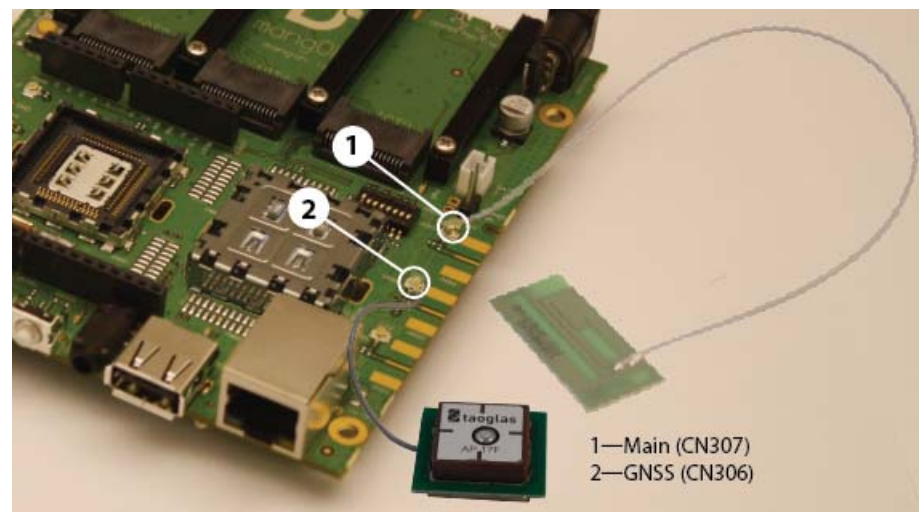


Figure 3-19: Main and GNSS Antennas Connected

Insert/Remove IoT Modules

The mangOH platform includes three single-width IoT module slots.

If the board uses module mounting rails and you want to use a double-width (2-slot) or triple-width (3-slot) IoT module, remove the rails between the slots you will be using.

Caution: Handle IoT modules carefully to make sure components are not accidentally damaged, and hold modules by their edges to avoid possible ESD damage.

To install an IoT module in any IoT slot (slots do not have to be filled in any order):

1. If possible, remove power from the mangOH platform. (This is a recommended step in case the IoT module is not hot-swappable or needs a reset.)
2. Check the IoT module to make sure you know which side is the top. (Modules must not be inserted upside-down.)
3. Slide the IoT module into the rails until it meets the connector, then press firmly to seat the module into the connector.

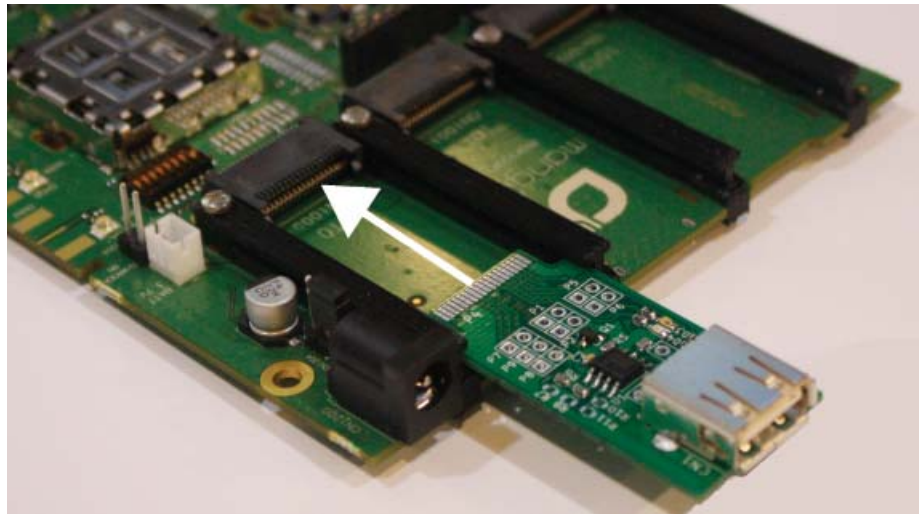


Figure 3-20: IoT Module Insertion



Figure 3-21: IoT Module Inserted

To remove an IoT module:

1. Pull the module straight out, making sure not to touch module components (to prevent physical or ESD damage).

Arduino

The mangOH platform includes a built-in Arduino Leonardo board (Arduino connector for use with Arduino shields, and an Atmega32 microcontroller).

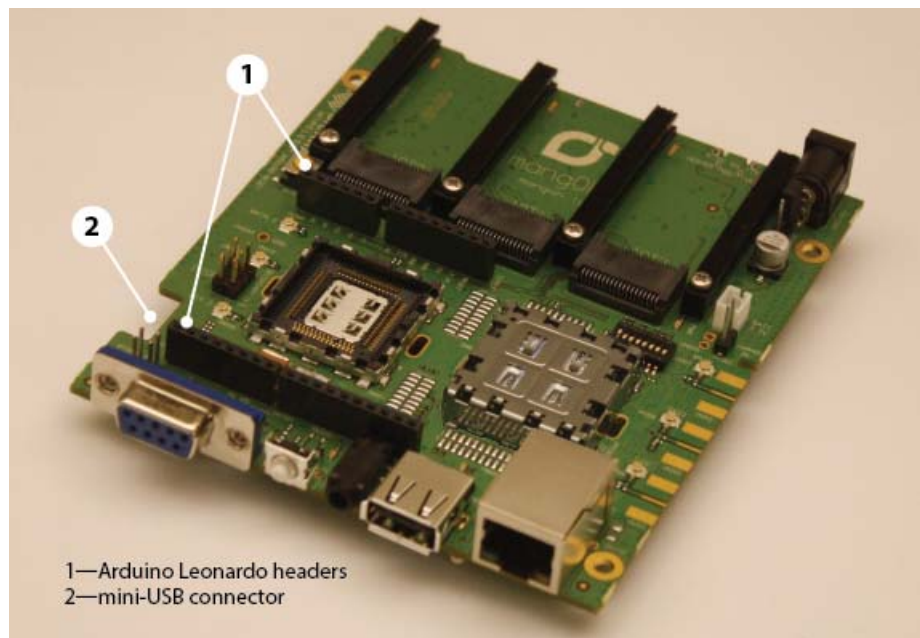


Figure 3-22: Arduino Leonardo

The Arduino can be controlled via the primary smart module in J200, or directly via a mini-USB cable connection from your computer.

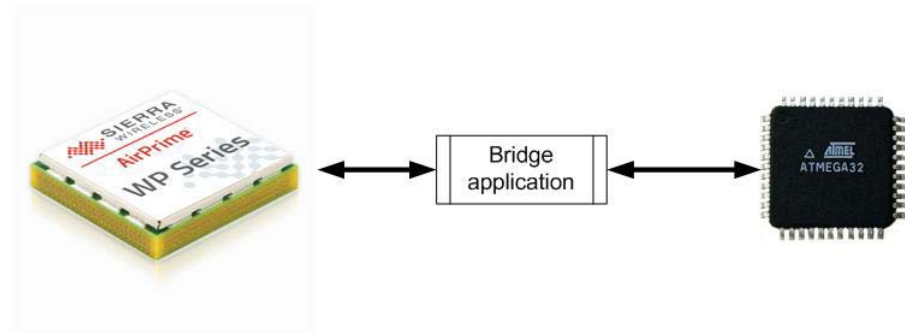


Figure 3-23: Arduino Control by Primary CF3 Module

By default, the Arduino UART is configured to connect to the primary smart module's USB using an FTDI conversion chip (UART to USB). For details, see [Table 3-6](#) on page 31.

Connect Arduino Shield

To connect an Arduino shield to the mangOH platform:

1. Position the shield above the Arduino headers. (Note that the two rows of headers have different numbers of pins—make sure to position the LCD correctly.)

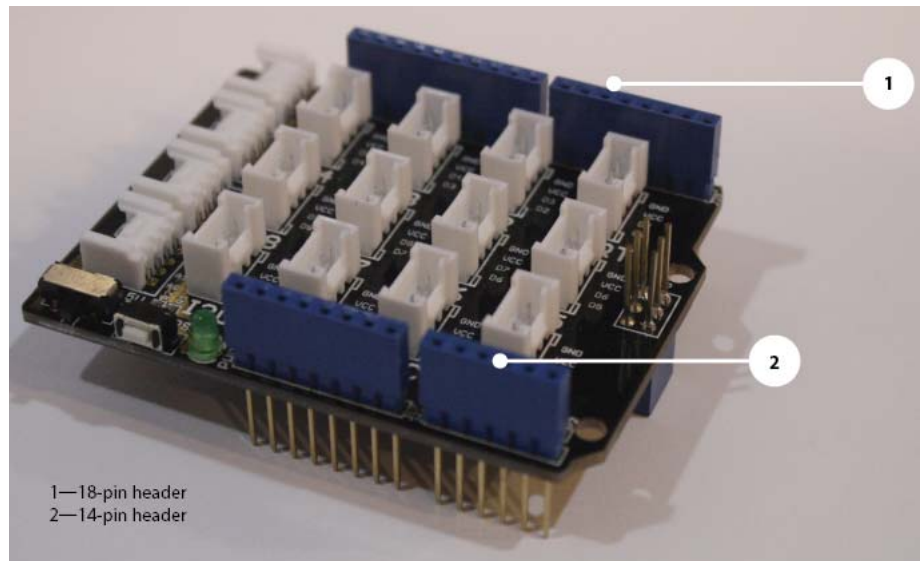


Figure 3-24: Arduino Shield Example

2. Hold the shield by its edges and press straight down into the headers.

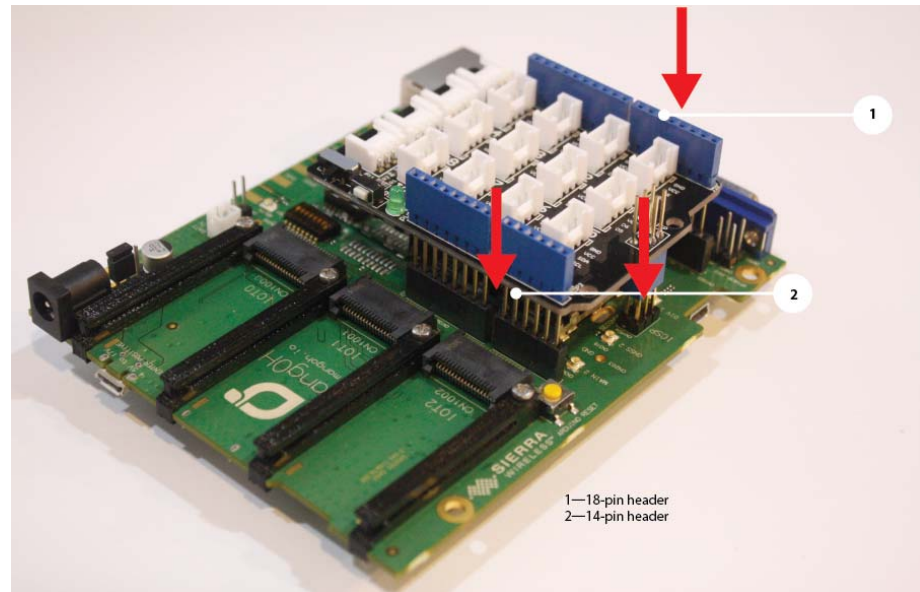


Figure 3-25: Installing an Arduino Shield

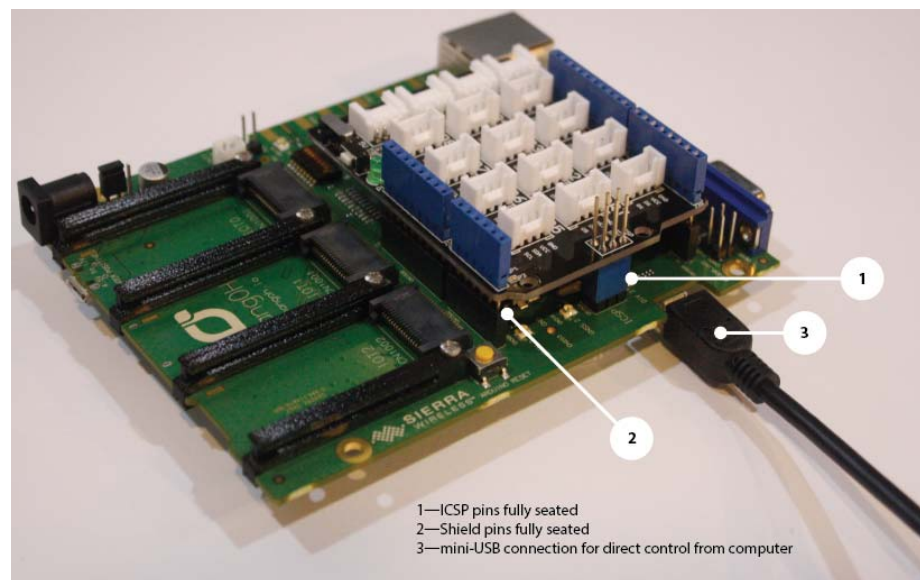


Figure 3-26: Arduino Shield Installed on mangOH Platform

Audio Connection

The mangOH platform includes a 3.5 mm audio output jack for use with audio-enabled CF3 modules.

By default, the audio jack is connected to the onboard mangOH codec, and is configured for use with a CTIA/AHJ-compatible headset. For details, see [Table 3-6](#) on page 31.

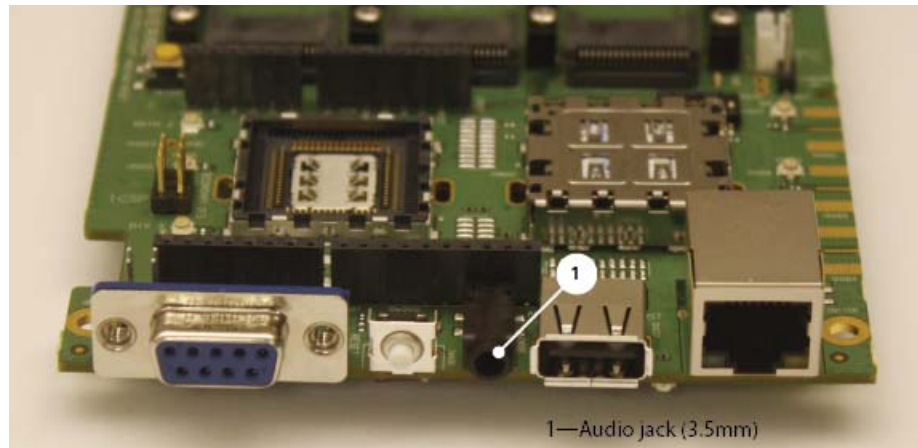


Figure 3-27: Audio Output Jack

Ethernet Connection

The mangOH platform includes a 100 Mbps Ethernet port that may be used to connect the board to a LAN.

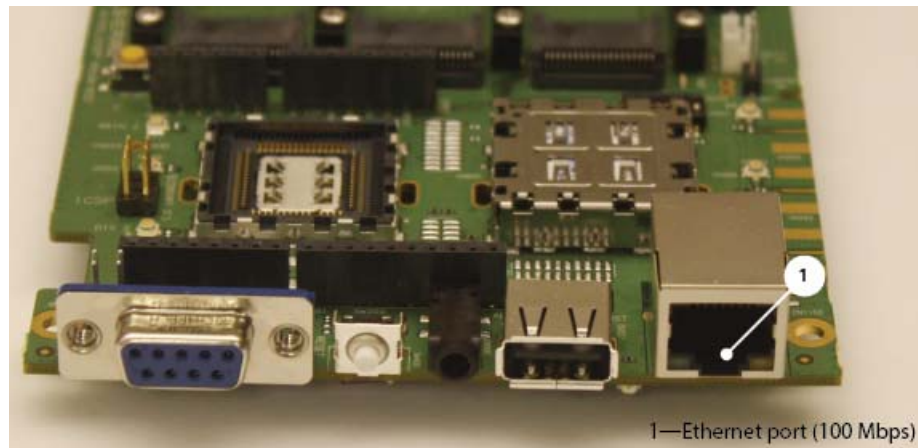
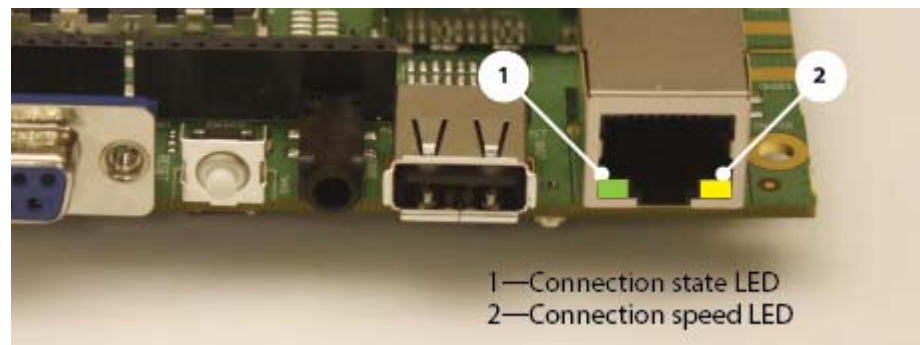


Figure 3-28: Ethernet Port

The connector has two LEDs that exhibit the behavior described in the following table.

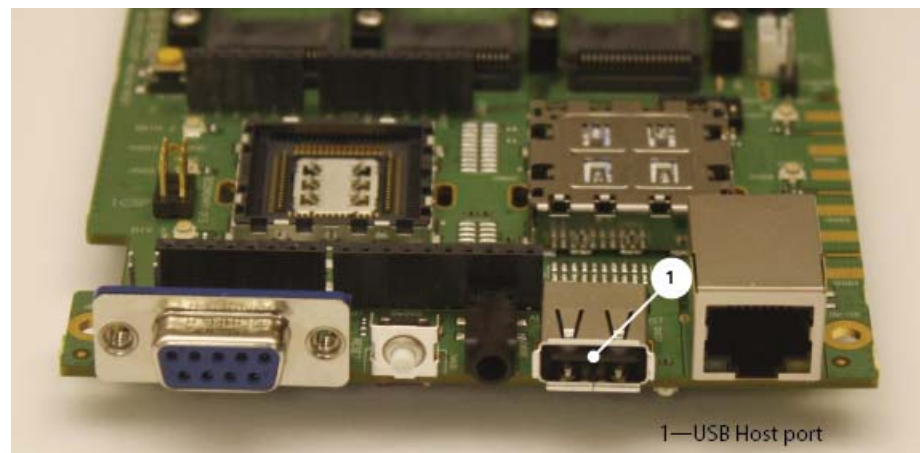
Table 3-4: Ethernet LED indicators

Pattern	Purpose	Description
Green (Left side)	Connection state	<ul style="list-style-type: none">• Solid—Connected• Blinking—Connected and transmitting/receiving• Off—No connection
Amber (Right side)	Connection speed	<ul style="list-style-type: none">• On—100 Mbps• Off—10 Mbps

*Figure 3-29: Ethernet Port LEDs*

USB Host Connection

The mangOH platform includes a USB Host port (USB 2.0) for attaching a peripheral device, memory stick, etc.

*Figure 3-30: USB Host Port*

RS-232 Console Output Connection

The mangOH platform includes an RS-232 DB9 connector for console output. By default, this port is enabled and configured to connect to the primary module's UART2.

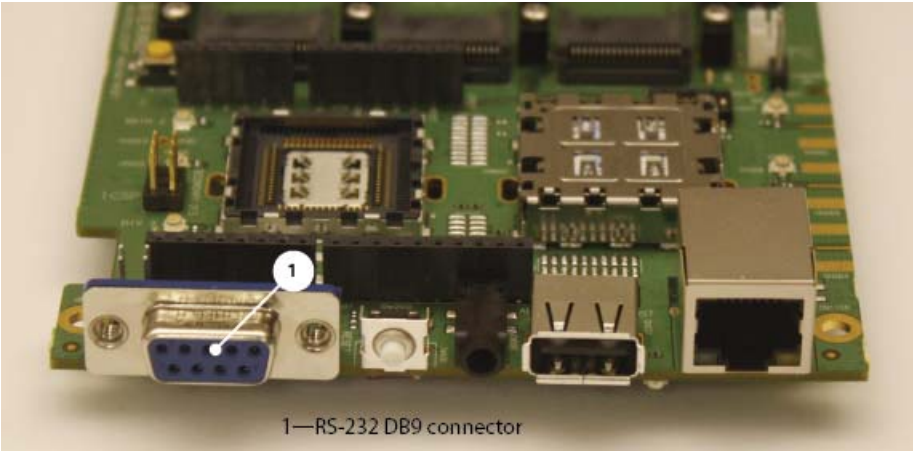


Figure 3-31: RS-232 Console Output Connection

LED Indicators

The mangOH platform includes several LED indicators.

Table 3-5: mangOH Platform LEDs

LED	Description
Power	On when power is supplied by any power source (USB, DC, battery)
Battery charging	On when the battery is recharging
Arduino Rx/Tx	On when the Arduino is sending (Tx) or receiving (Rx) data
RF Rx/Tx	On when the CF3 module is sending (Tx) or receiving (Rx) data
W_DISABLE_N	On when RF power is %%disabled enabled
User-controlled	User can control on/off behavior

renamed 4.
Repositioned 5.
Added 7.

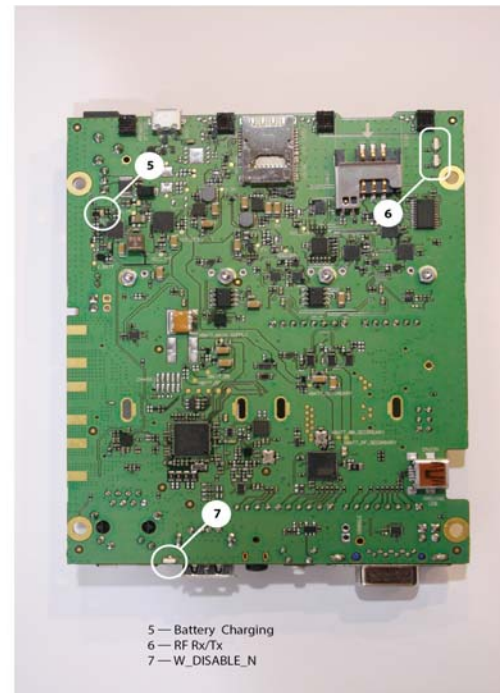
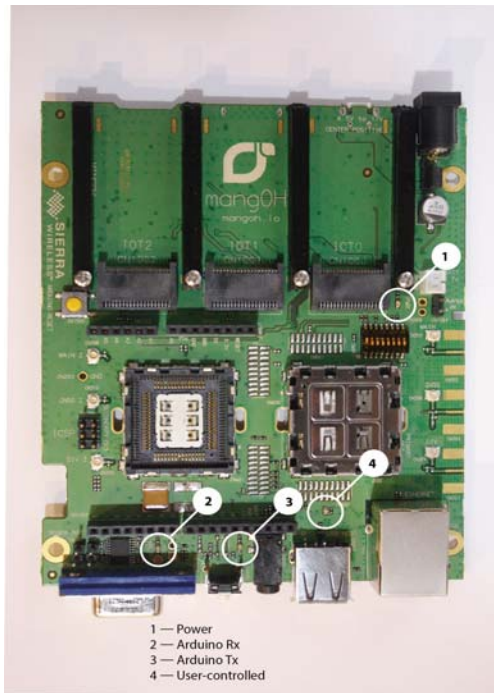


Figure 3-32: LED Indicators

Reset Switches

The mangOH platform includes two reset switches:

- Board reset (SW400)—Press and hold for 5 seconds to reset the board (including the Arduino board)
Note that when the board is resetting, the reset signal is held LOW until the primary module is fully booted.
- Arduino reset (SW1500)—Press and hold for 5 seconds to reset the Arduino board.

For details on resetting the mangOH platform or specific application blocks, see the Developer's Guide.

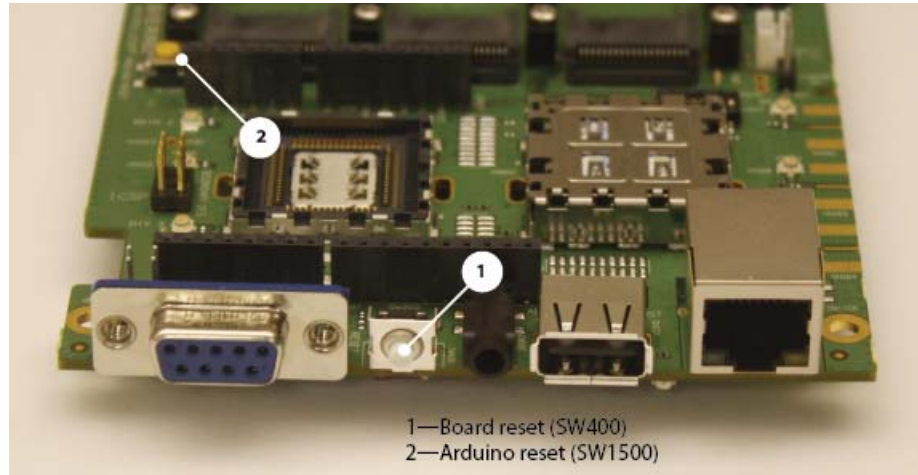


Figure 3-33: Reset Switches

mangOH Platform Configuration

Default Configuration

The mangOH platform's default configuration is described in [Table 3-6](#).

Table 3-6: mangOH Platform Default Configuration

Component/ Switch	Default Configuration/Behavior	Notes
Antenna connectors (Main, Diversity, GPS)	<ul style="list-style-type: none"> U.FL connectors 3.3 V bias voltage for active antennas 	SMA connectors can be added, if required, by a user who is proficient at soldering. For details, refer to the mangOH platform schematic available at mangoh.io .
Audio connector (CN500)	<ul style="list-style-type: none"> Connected to onboard mangOH codec CTIA/AHJ-compatible headset 	Reconfiguration to use an OMTP-compatible headset requires soldering.
RS-232 connector (CN700)	<ul style="list-style-type: none"> Enabled Connected to WP85 UART2 	Reconfiguration is possible using a software command.
LEDs	All LEDs are enabled and will exhibit their default behaviors	
System reset signal (RESET_IN_N)	Held LOW until WP85xx module is fully booted	Peripherals on the mangOH platform are not activated until the module is fully booted.
SIM1/SIM2 Detect	<ul style="list-style-type: none"> SIM1 Detect uses physical sensor to detect SIM card insertion/removal SIM2—No Detect. For testing purposes, SIM2 status can be toggled to indicate inserted/removed by using onboard signals. 	
SD connector (CN802)	Connected to WP85	Board can be configured using a software command to connect WP85 SDIO signals to IOT1 instead of SD connector.

Table 3-6: mangOH Platform Default Configuration (Continued)

Component/ Switch	Default Configuration/Behavior	Notes
Peripheral interfaces (UART, SPI, I2C, etc.)	See the Developer's Guide for details.	
Arduino UART	Connected to WP85 USB using FTDI conversion chip (UART to USB)	Board can be configured using a software command to connected Arduino UART to WP UART1
SW401	<ul style="list-style-type: none"> POWER_ON (Dip 1) = ON (Disabled) SW_PWR_ON (Dip 5) = ON (Disabled) All others = OFF 	

Switch and Jumper Configuration Options

The mangOH platform uses several switches and jumpers to configure the board and CF3 module's operation, as detailed below in [Table 3-7](#) through [Table 3-10](#).

To locate these switches and jumpers, see [Figure 3-34](#) on page 34 and [Figure 3-35](#) on page 35.

Table 3-7: CN1204—Board Power Select^a

Power supply selection	Jump 1–2	Jump 2–3
USB power, through micro-USB port (CN311—USB port)	Yes	
DC power, through DC barrel jack (CN1200—barrel jack power)		Yes

a. Required: Select one option only (Jump 1–2 or Jump 2–3). For details, see [Select Primary Power Supply](#) on page 16.

Table 3-8: CN1203—Battery Recharge Select

Battery recharge behavior	Jump 1–2
Battery will recharge while power is supplied by USB or DC	Yes ^a
Battery will not recharge	No

a. IMPORTANT: Jumper must not be used if there is no battery connected. For details, see [Connect Battery Backup](#) on page 17.

Table 3-9: SW401—Module Signals Control

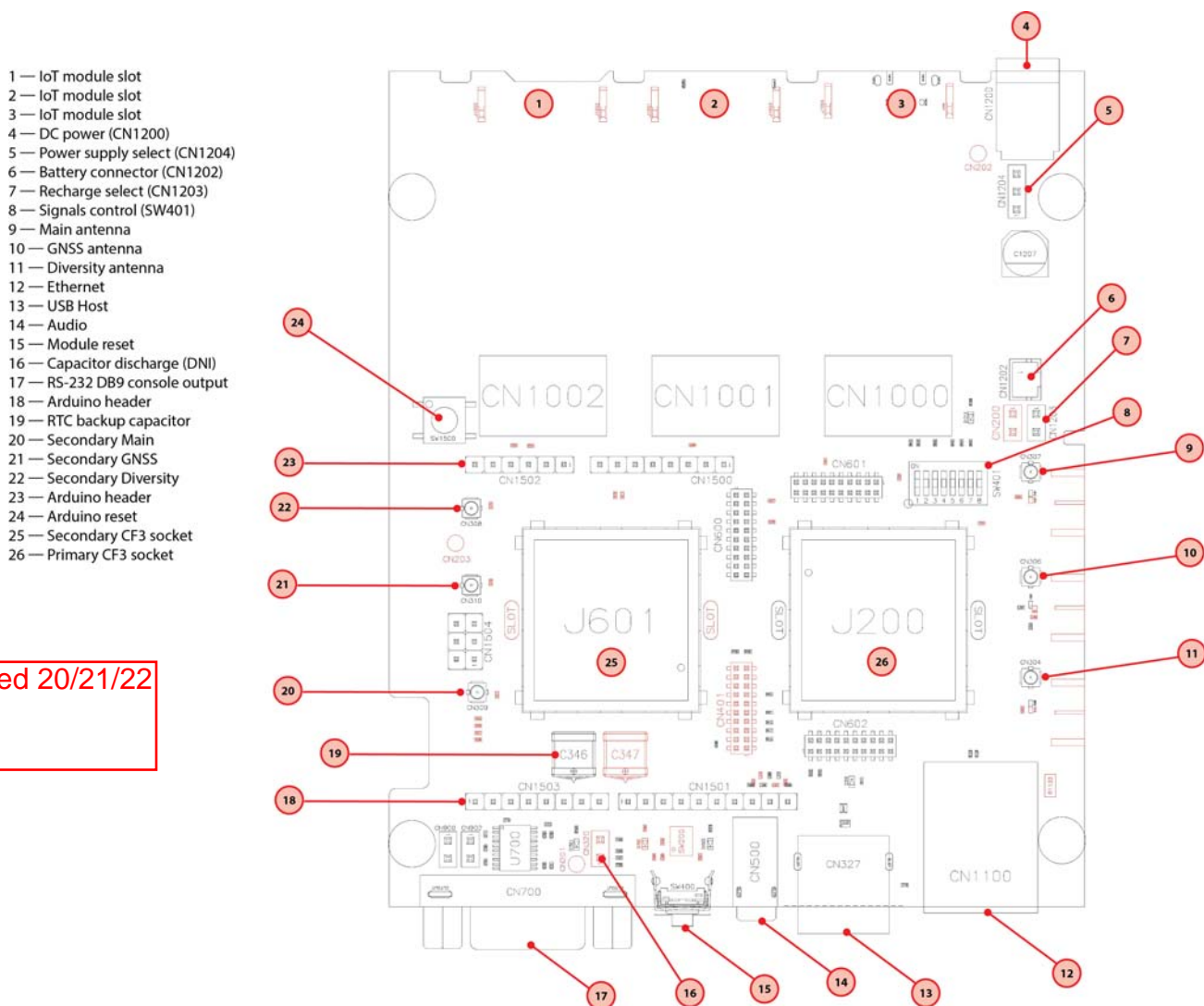
Signal	Dip	On/Off	State
POWER_ON	1	On (Default)	Enable POWER_ON signal for primary module (J200)
		Off	Disable POWER_ON signal
Reserved	2	On	tbd
		Off (Default)	tbd

Table 3-9: SW401—Module Signals Control (Continued)

Signal	Dip	On/Off	State
W_DISABLE_N	3	On	Disable RF power
		Off (Default)	Enable RF power
Reserved	4	On	tbd
		Off (Default)	tbd
SW_PWR_ON	5	On (Default)	Enable POWER_ON signal for secondary module (J601)
		Off	Disable POWER_ON signal
S_TP1_BOOT	6	On	Enable TP1_BOOT functionality for secondary module. Pull the signal low to enter download mode for firmware updates.
		Off (Default)	Secondary module functions normally.
TP1_BOOT	7	On	Enable TP1_BOOT functionality for primary module. Pull the signal low to enter download mode for firmware updates.
		Off (Default)	Primary module functions normally.
RESET_IN_N	8	On	Signal is low until WP85 full boot.
		Off (Default)	tbd

Table 3-10: SW1501—Arduino USB Port Assignment

Function	Position	State
Arduino USB port assignment	1	Arduino USB port connected to Main CF3 socket
	2	Arduino USB port connected to CN330



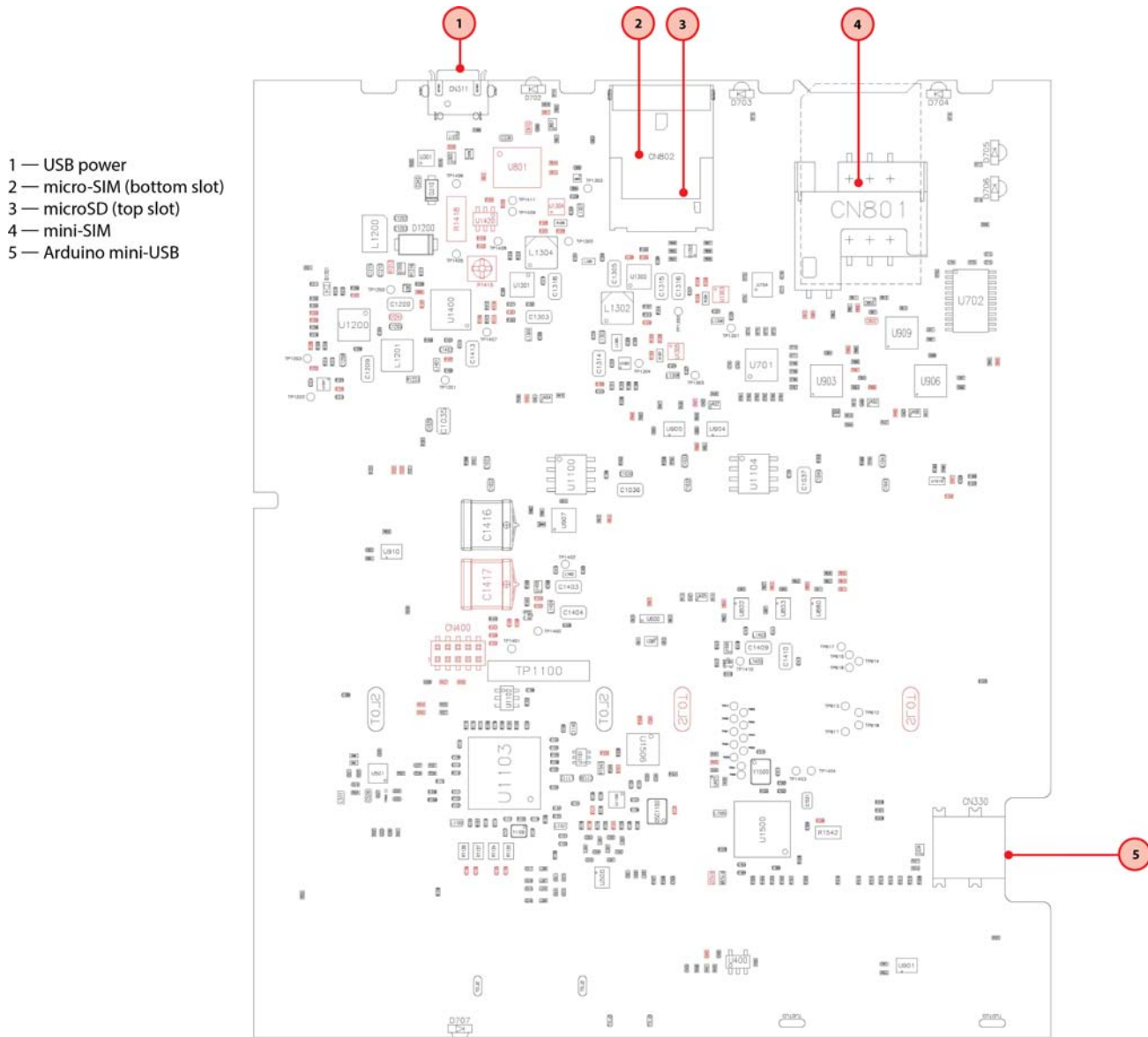


Figure 3-35: mangOH Platform Assembly - Bottom Side Switches/Connectors

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

4: Software Setup

4

This chapter describes software resources that you will need on your computer to access the mangOH platform and develop applications for its CF3 module and embedded Arduino board.

Sample applications and instructional materials are available from the sites mentioned in this chapter. For detailed information on developing for the mangOH platform, see the mangOH Platform Developer's Guide and related documents (available from mangoh.io).

Install / Update Windows Drivers

If you are using a Windows computer, you will need to install drivers for the CF3 module that you install in your mangOH platform.

1. Visit mangoh.io to download the Windows drivers and driver installation instructions for your CF3 module.
2. Install the Windows drivers.
3. When the mangOH platform is connected via USB to the computer, display the Device Manager (Control Panel > System > Device Manager).

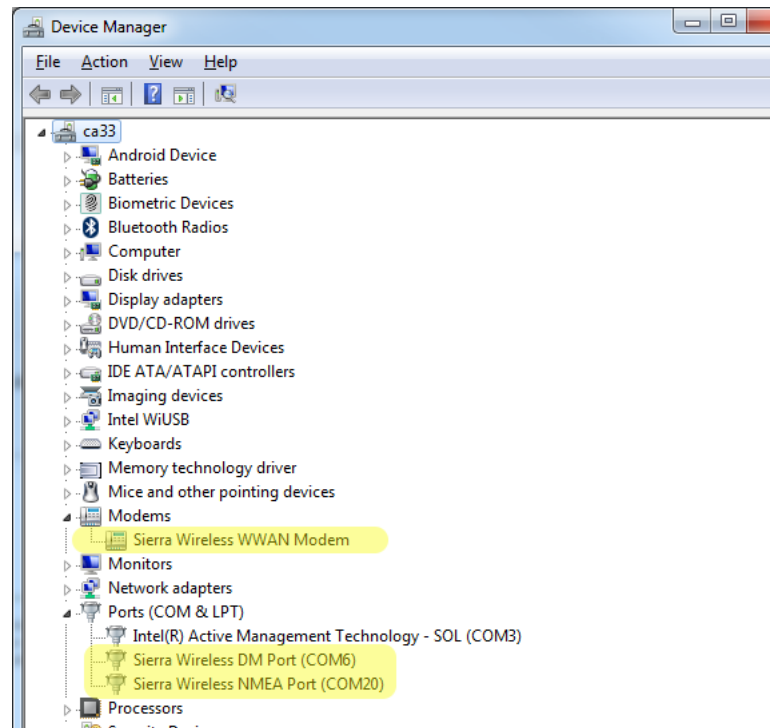


Figure 4-1: Windows Device Manager

If the drivers installed correctly, you will see the following items listed:

- Modems > Sierra Wireless WWAN Modem (This is the module in socket J200.)
- Ports [COM & LPT] > Sierra Wireless DM Port
- Ports [COM & LPT] > Sierra Wireless NMEA Port (This is the port that you will use to communicate with the module from your terminal emulator.)

Install a Terminal Emulator

To communicate with the mangOH platform, you need to use a terminal emulator program such as Tera Term or HyperTerminal®.

When you have an emulator installed, use it to connect to the mangOH platform:

- Port—Serial modem COM port (for Sierra Wireless devices, this is the Sierra Wireless NMEA Port)
- Baud rate—115200

Install the Arduino IDE

To work with the mangOH platform's embedded Arduino device, you must download and install the Arduino IDE available at www.arduino.cc.

Install the Legato Developer Studio

To create Legato applications for the CF3 module, download and install the Open AT Developer Studio (IDE) available at mangoh.io.

Download Firmware Updates

Firmware updates will be made available for download from mangoh.io.

Write Your First Program

For instructions on building applications, including writing a 'Hello World' program to test your mangOH platform, visit mangoh.io.