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Assembling your MCCI Catena 4450 DIY Kit

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PROPRIETARY NOTICE AND DISCLAIMER

Document Release History

Draft 1	2018-02-21	Initial Draft
Draft 2	2018-02-23	Improve input configuration instructions
Draft 3	2018-03-01	Add overall assembly image
Rev A	2018-06-30	Official release

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1 Introduction

This document explains how to assemble the Catena 4450 DIY Kit.

1.1 Getting support

Support is available through the MCCI support portal community forums. Browse to https://portal.mcci.com.

1.2 Soldering

If you have not soldered before, we recommend searching out a suitable YouTube training video.

- The IPC Hand Soldering Demo is an excerpt from a formal training program: https://youtu.be/lpgMY1JeOAA

- Less formal, but also useful is this demo of through-hole soldering: https://youtu.be/rYWwKe8f2kc

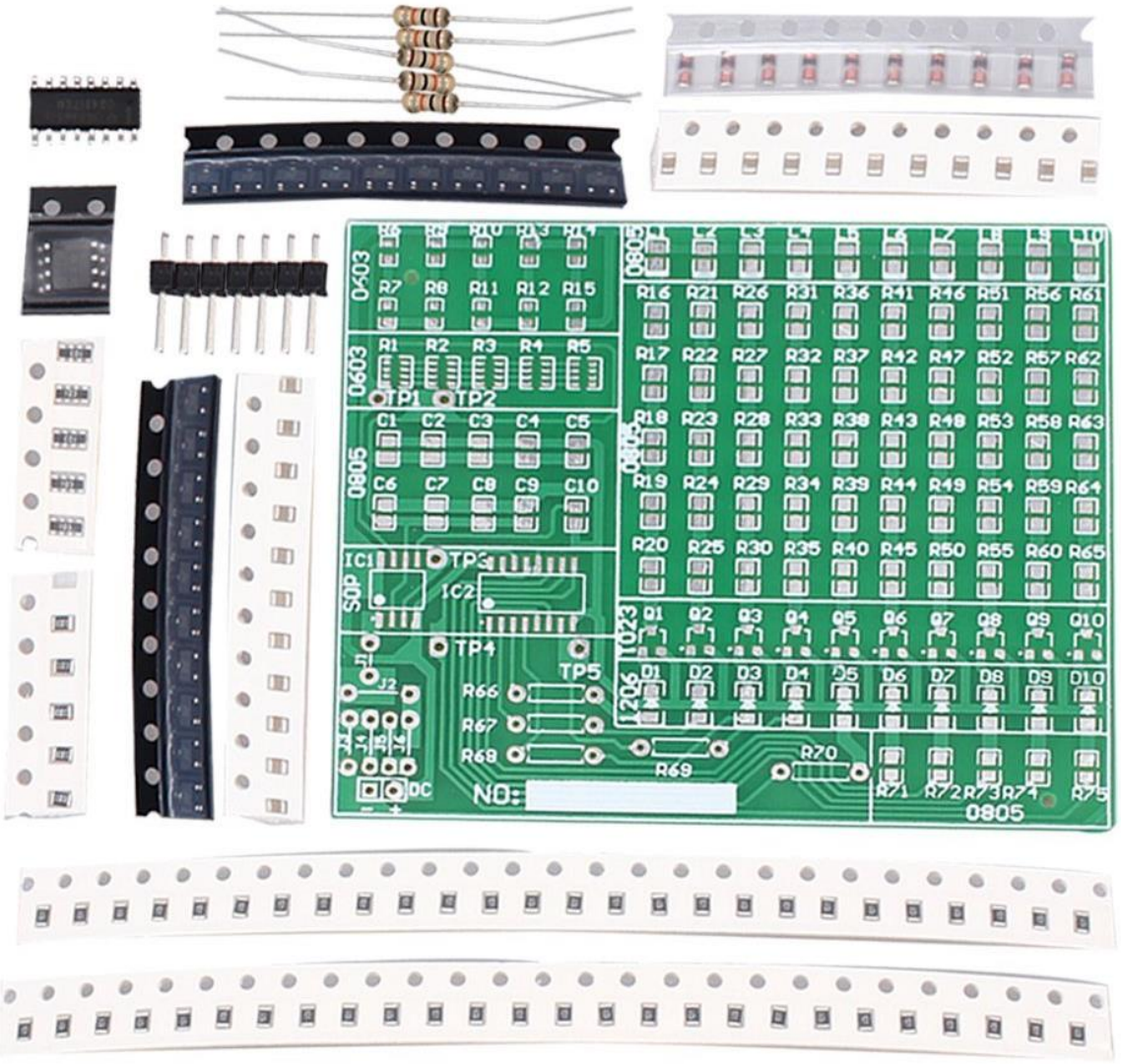
- If you are planning on using external sensors, you'll need to mount some surface-mount resistors (see section 3.1.1). If you've not done surface-mount soldering before, the following video is helpful: https://youtu.be/PU7wLcuqc-I.

  You might also want to get a practice board for SMT soldering. These are quite inexpensive. For example, the Icstation DIY Electronics SMD SMT kit looks good, but shipping time is 2 to 3 weeks. Check the MCCI Store, we might start stocking it. See Figure 1 for a representative photo.

  A very similar product, more expensive, but available with Amazon Prime: the WHDTS Training Suite. Don't be bothered by the mediocre reviews; you probably don't need to use the result or do all the soldering; you just want to practice soldering the components.

Be green! MCCI uses only lead-free processes, and we recommend you do the same. Buy lead-free solder, and run your irons at 330 to 350 degrees C.

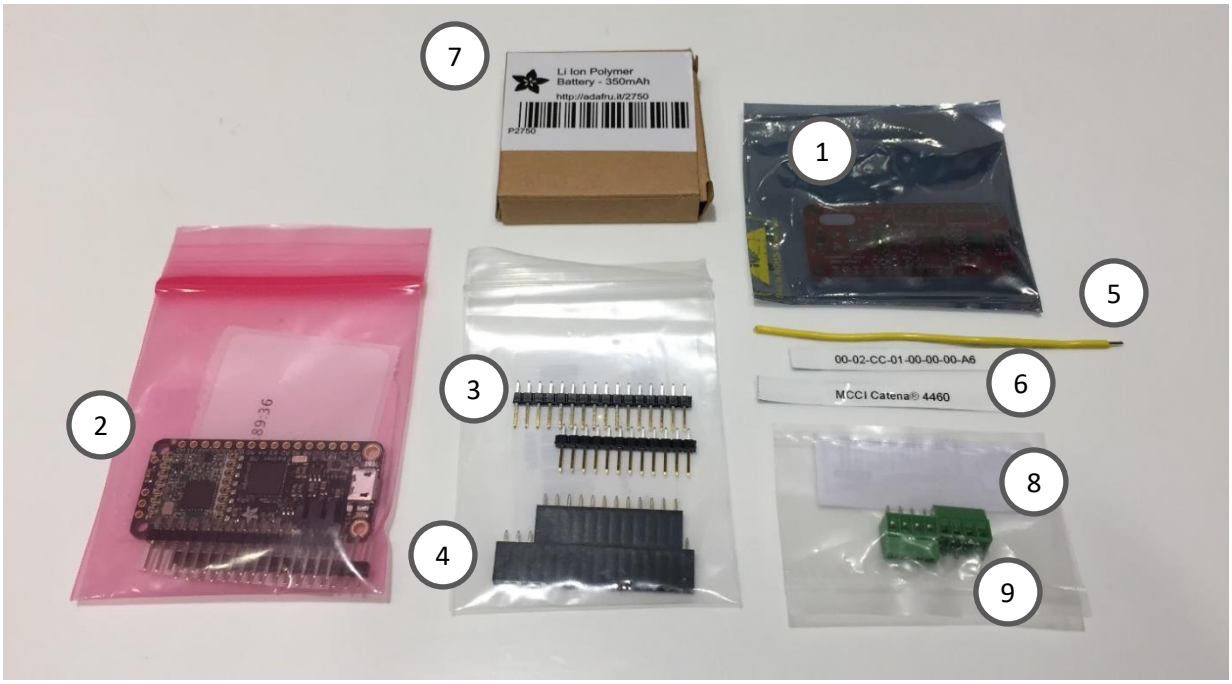
Figure 1. Sample Solder Practice Board



2 Kit Contents

Start by unpacking the contents of your kit. You should find items corresponding to the item below.

Figure 2. Kit Contents

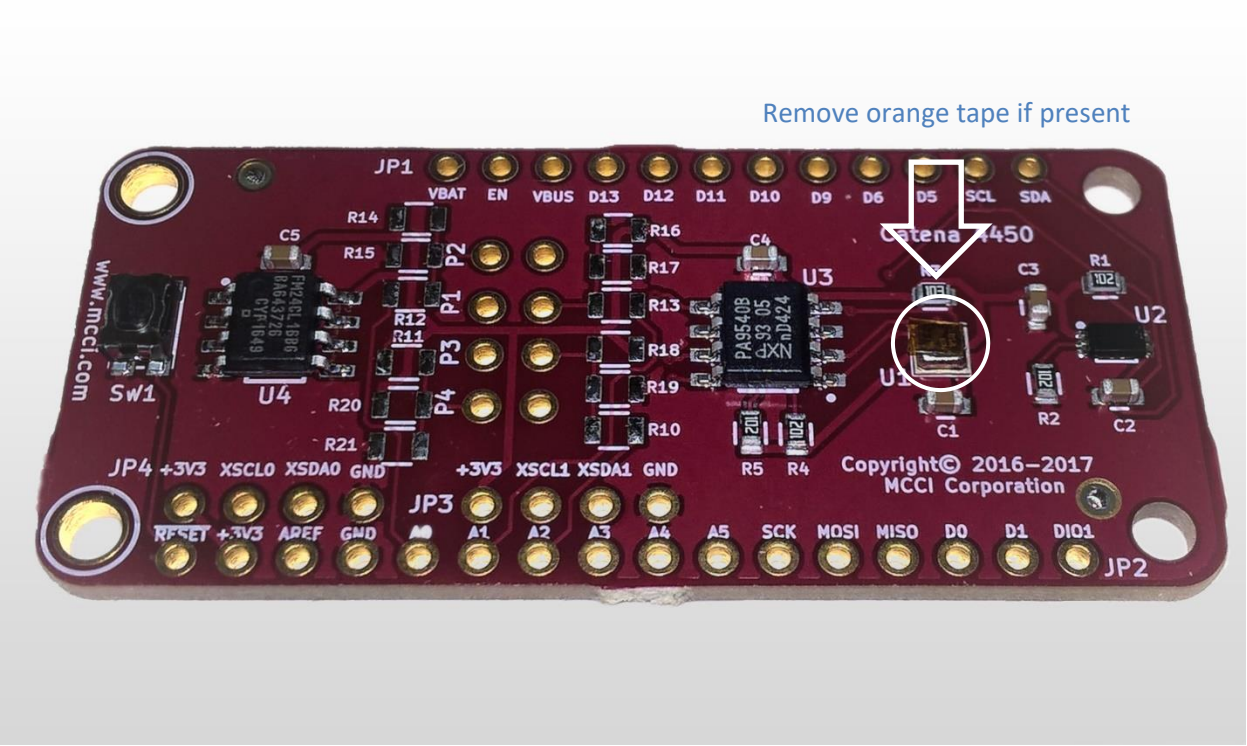


2.1 MCCI Catena 4450 (item 1)

The MCCI Catena 4450 (100001136) is a sensor shield board for Adafruit Feather M0. It has a Bosch BME280 pressure, humidity, and temperature sensor, a Rohm BH1750 lux sensor, a 2K-byte FRAM for configuration storage, and an I2C Multiplexer.

Check U1 (the temperature sensor) carefully. During manufacturing, a piece of orange tape may have been attached to the top to protect it. If it's still attached, please remove it using a fingernail to gently lift the tape off the top of U1. Discard the tape.

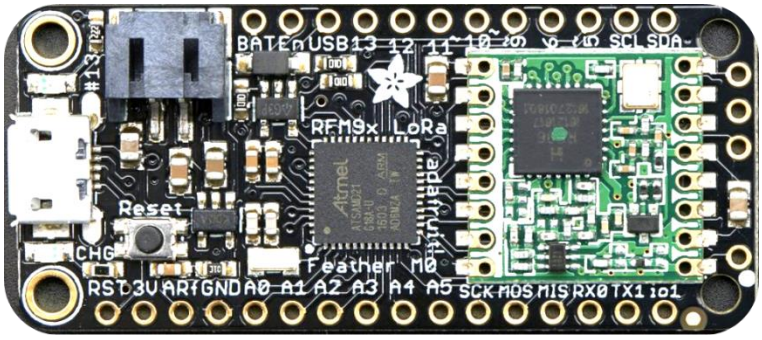
Figure 3 Catena 4450



2.2 Adafruit Feather M0 (item 2)

The Adafruit Feather M0 RFM95 LoRa Radio (123001004) can be used for either 868 MHz or 915 MHz transmission/reception. The heart of the Feather M0 is an ATSAMD21G18 ARM Cortex M0 processor, clocked at 48 MHz and at 3.3V logic. This chip has 256K of FLASH and 32K of RAM. This chip comes with built in USB, so it has USB-to-Serial program & debug capability built in, hence there is no need for an FTDI-like chip.

Figure 4 Feather M0 RFM95 LoRa



2.3 Male Pin Headers (item 3)

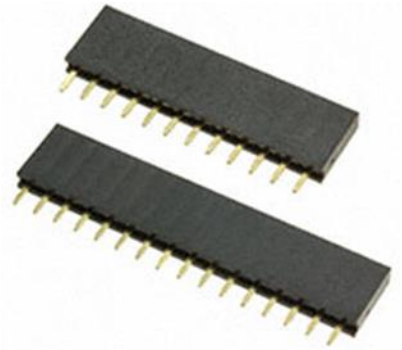
12-pin (123001009) & 16-pin male headers (123001011) have a pitch of 0.1" (2.54mm). These two pin headers are essential to mate with the Female Pin headers of Adafruit Feather M0 and Catena 4450.

Figure 5 12-pin & 16-pin Male Headers

2.4 Female Pin Headers (item 4)

12-pin and 16-pin female connector (123001013) of 0.1" pitch are used to mate the Feather M0 and Catena 4450 boards.

Figure 6 12-pin & 16pin Female Headers



2.5 Whip Antenna (item 5)

Either one or three quarter-wavelength whip antennas are provided in your kit, depending on the build date. They are color-coded by frequency band.

Yellow	Americas, Asia, Australia 915 MHz ISM bands (always included)
Green	Europe 868 MHz band
Blue	India 865 MHz band

2.6 Labels (item 6)

Two labels are provided to be affixed to the bottom of the Feather M0.

- Serial Number Label – Each unit has a unique serial number (EUI-64) assigned by MCCI. We recommend that you place it on the bottom of the Feather M0 board.
- "MCCI Catena 4450" – this identifies the model of the complete assembly. Again, we recommend that you place this on the bottom of the Feather M0 board.

2.7 Lithium Polymer Ion Battery (item 7)

This battery (123001003) is thin, light and powerful. The output ranges from 4.2V when completely charged to 3.7V when discharged. This battery has a capacity of 350mAh for a total of about 1.3Wh. It connects to the JSTPH jack on the Feather M0. The Feather will charge the battery when power is available through the USB connector.

Figure 7 LiPo Battery

2.8 0805 Surface-Mount Resistors (item 8)

The Catena 4450 can be configured for a variety of different external sensors by attaching the appropriate surface mount resistors. For your convenience, we include 8 each of four different values of resistor: zero-ohm shunts, 100 ohm, 1000 ohm, and 4700 ohm.

If you don't need external sensors yet, or if you haven't identified which ones you need, set these aside for later. You can always come back and add them.

2.9 Pair of 1x04 Screw Terminals (item 9)

The 1x4 screw terminal blocks (123001012) have a pitch of 0.1" (2.54mm), which can be used as alternatives to standard male or female headers of 0.1". They help in connecting external sensors to the 4450.

Figure 8 Pair of 1x04 Screw Terminals

NOTE: If you don't need external sensors yet, or if you haven't identified which ones you need, set these aside for later. You'll have to install resistors to match your sensor, and it's much easier to install the resistors if the screw terminals are not yet installed.

3 Assembly Instructions

Assembly proceeds in three steps.

1. Assemble the Catena 4450 wing
2. Assemble the Adafruit Feather M0 LoRa
3. Final assembly

3.1 Assemble the Catena 4450 wing

1. Attach the 12-pin & 16-pin Male Headers on JP1 and JP2 of Catena 4450 board respectively.

    i. Solder one or two posts on each strip, to tack the header in place
    ii. Adjust the vertical and horizontal alignment
    iii. Solder the remaining posts for reliable electrical contact.

2. If you're not going to use external sensors attached via the screw terminals, stop here; save the resistors and screw terminals in case you need them later. Otherwise refer to the next section for help in deciding what to do.

(**Note: The orange plastic seal from the BME–280 (U1) should be removed for proper operation.** This seal is intended for protection during manufacturing)

3.1.1 Configuring the Input Resistor Network for External Sensors

Each screw terminal block provides power (3.3V) and ground, and two undedicated terminals. Each undedicated terminal has a position for a pull-up resistor, a pull-down resistor, and a series (protection) resistor. Refer to Figure 9, Figure 10, and Table 1.

Figure 9. Input Network

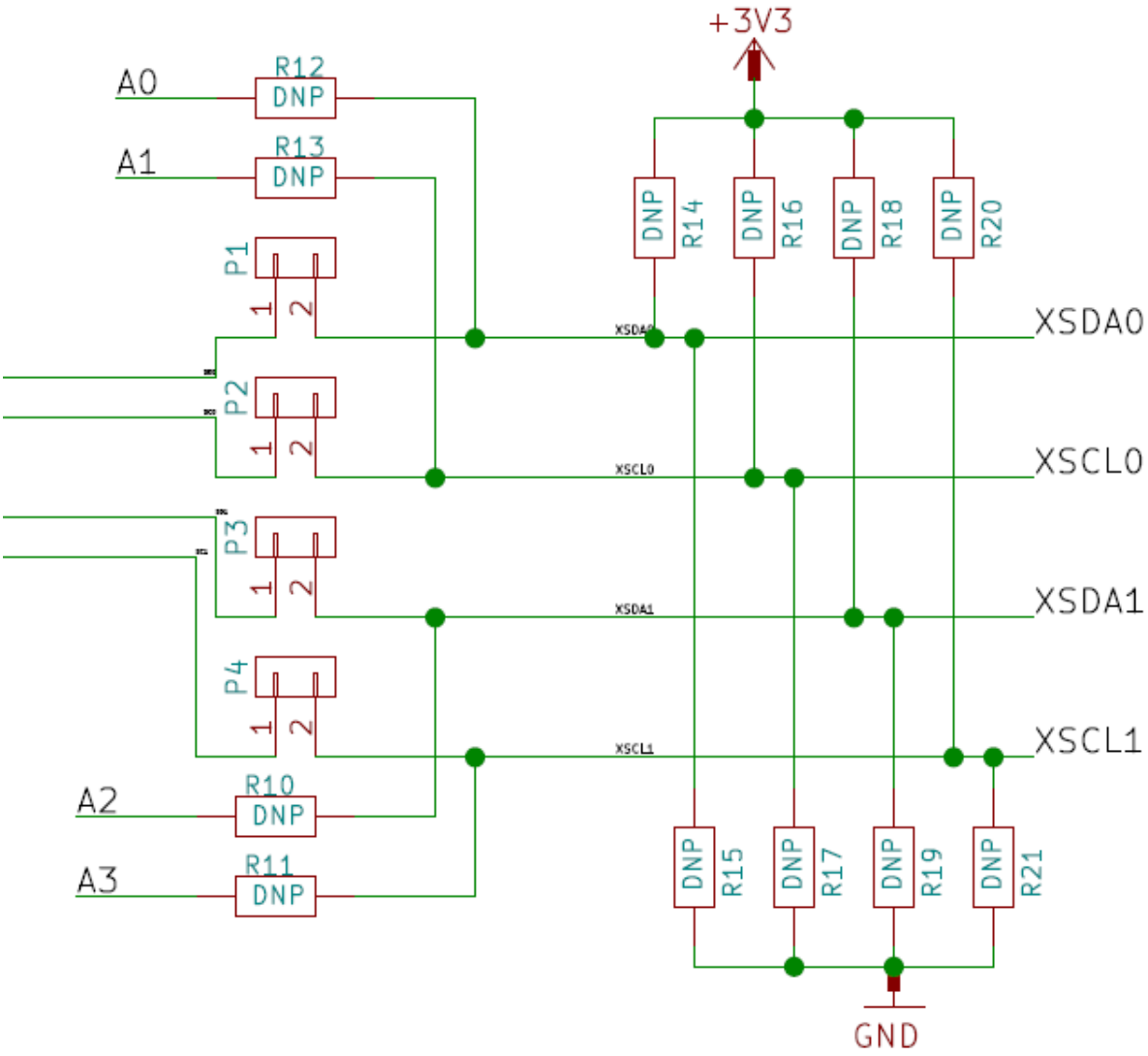


Figure 10. Terminal Block Configuration

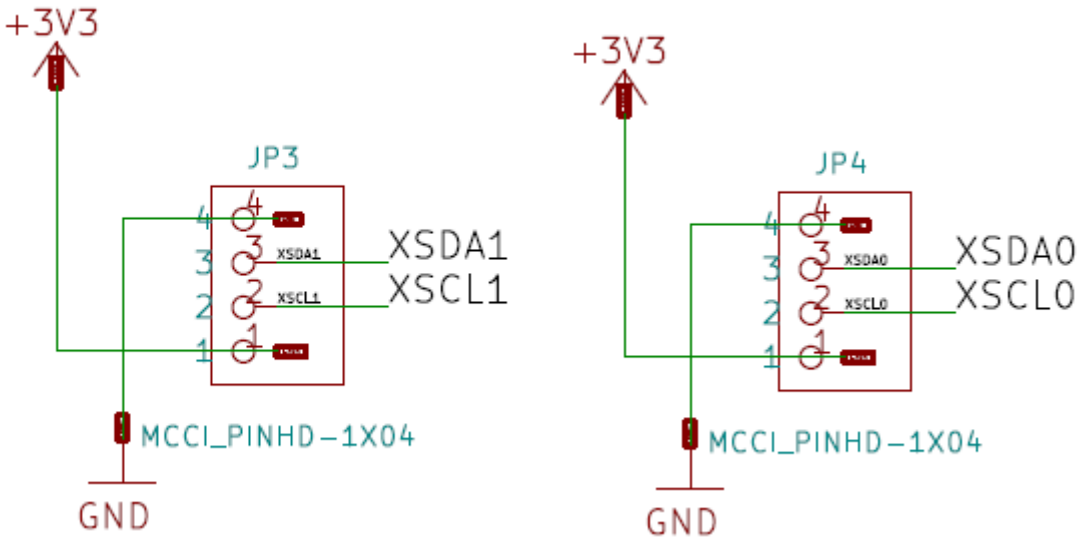


Table 1. Screw Terminal Resistor Mapping

Screw-terminal position	Conventional Number	Signal	Pull-up	Pull-down	Series	Arduino Signal	I2C Jumper
JP4-1	1	3.3V	-	-	-	-	-
JP4-2	2	XSCL0	R16	R17	R13	A1	P2
JP4-3	3	XSDA0	R14	R15	R12	A0	P1
JP4-4	4	GND	-	-	-	-	
JP3-1	5	3.3V	-	-	-	-	
JP3-2	6	XSCL1	R20	R21	R11	A3	P4
JP3-3	7	XSDA1	R18	R19	R10	A2	P3
JP3-4	8	GND	-	-	-	-	

Refer to the schematics at https://mcci.io/Catena4450-Schematic and to the design of your sensor(s) to determine the resistor configuration you want.

To electrically connect your sensor to the CPU, you need to at least populate the series resistor position. Normally we recommend use of 100-ohm resistors, but 0-ohm resistors are sometimes also used. If you are connecting an external I2C device, we recommend use of the I2C multiplexer; see next section for details.

In addition, some sensors need pull-up or pull-down resistors. If your sensor uses 3.3V, then this is easy; place the appropriate resistor value on the pull-up or pull-down for your sensor.

- For normally-open dry-contact closures, MCCI recommends a 1K pullup in the pull-up position, and a 100-ohm resistor in series with the input.

- For OneWire temperature sensors like the Adafruit DS18B20 Waterproof sensor, MCCI recommends a 4.7K resistor in the pull-up position, and a 100-ohm resistor in series with the input. Only one data input is needed. The sensor also needs power and ground, which are available in the indicated positions.

- Soil sensors like the Adafruit Weather-Proof Temperature/Humidity Sensor need two data inputs, in addition to power and ground. MCCI recommends a 4.7K or 10K resistor on the input that's connected to the blue Data line, and 100-ohm series resistors for both Clock and Data.

3.1.2 The I2C Multiplexer

Many external sensors use I2C. To simplify the use of external I2C sensors, we included an I2C buffer/Multiplexer chip.

To configure JP4 for use with I2C, you need to populate P1 and P2; to configure JP3, you populate P3 and P4. If you are running long wires to your sensor, you will need a pullup resistor on the XSCL0 / JP4-2 terminal (or XSCL1 / JP3-2). The exact value to be used depends on wire length and sensor; contact MCCI for advice.

3.1.3 Install the screw terminals

If you have configured the input network for external sensors, you may want to install screw terminals. (Or you may want to directly solder the sensor to the board, or use external connectors.)

If you want to use screw terminals, here are the instructions.

1. Normally, the 16-pin header leads project a few millimeters above the board on the component side after installation. Trim excess length in the area where the screw terminals will be attached, so that the screw terminals will sit flush on the board.

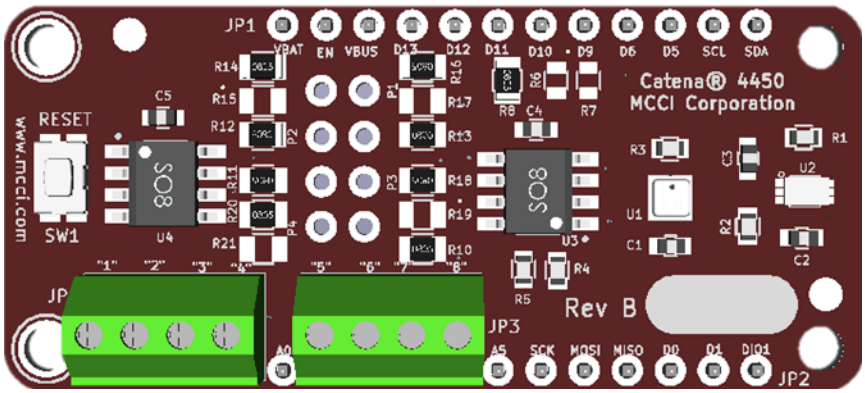
2. Attach the Pair of 1x04 Screw Terminals on JP3 and JP4 respectively.

    i. Solder one post

    ii. Adjust for proper alignment and good cosmetics

    iii. Solder the remaining posts

Figure 11 Catena 4450 M102 Assembled Unit

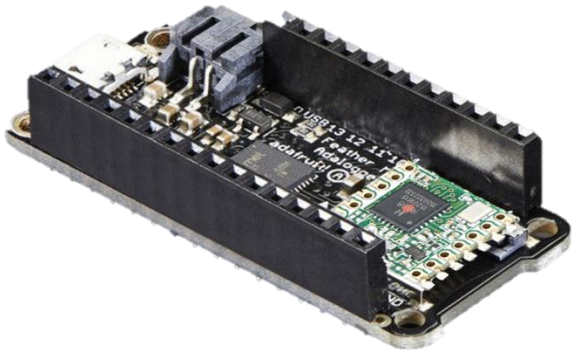


3.2 Assemble the Adafruit Feather M0 LoRa

Adafruit Feather M0 (123001071) assembly instructions are given below :

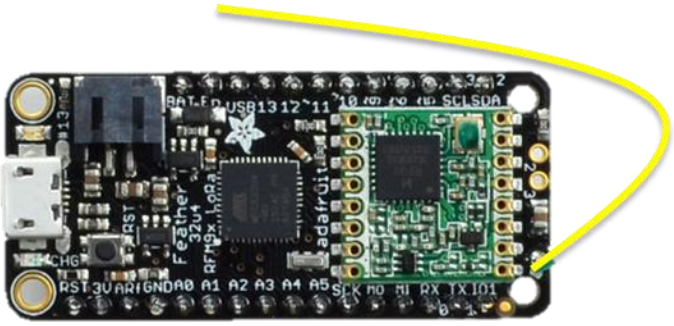
1. Attach the 12-pin & 16pin Female Headers
    i. Solder on or two posts on each strip, to tack the header in place
    ii. Adjust the vertical and horizontal alignment
    iii. Solder the remaining posts for reliable electrical contact

Figure 12 Feather M0 with Pin headers



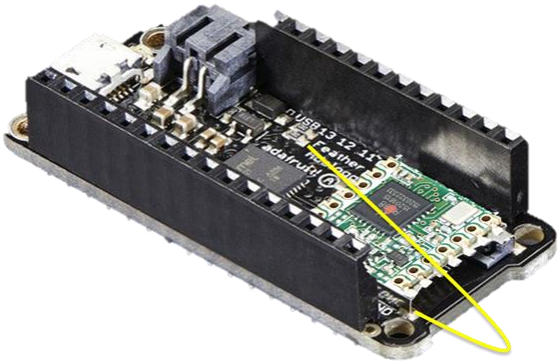
2. Attach the antenna.
    i. Choose the antenna according to your desired operating band: yellow for 900-923 MHz, green for 868 MHz, blue for 865 MHz.
    ii. Solder the antenna into the ANT pad on the very right-hand edge of the Feather. We recommend that you insert the wire from the component side, so that you're soldering on the reverse side of the board.

Figure 13 Feather M0 with Whip Antenna



Note: Inspect that the solder on the antenna joint has flowed properly

Figure 14 Adafruit Feather M0 assembly with Antenna

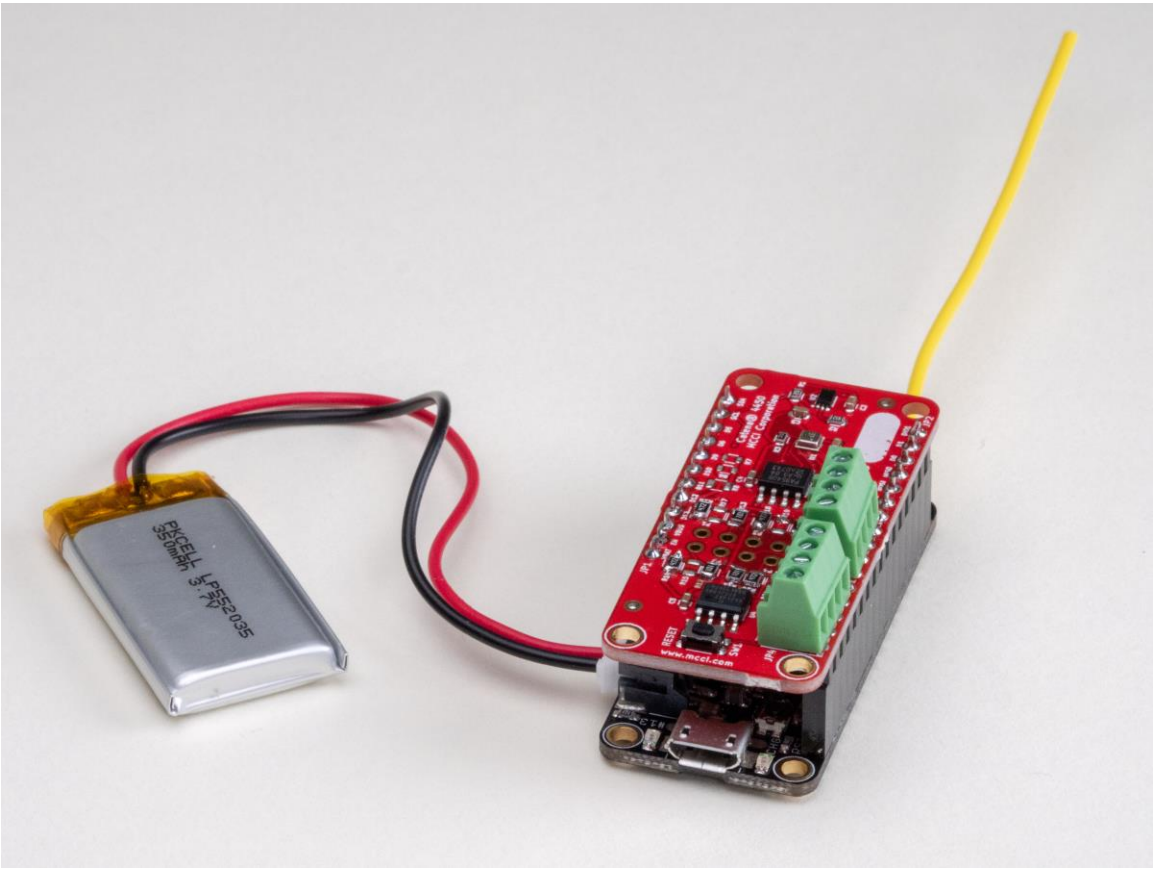


3.3 Catena 4450 overall assembly

JP1 and JP2 of Catena 4450 should be mated with JP3 and JP1 of Adafruit feather M0 board. Confirm the boards are mated properly.

The assembled unit is shown below:

Figure 15. Catena 4450 DIY Overall Assembly



Then follow the instructions at https://github.com/mcci-catena, particularly https://github.com/mcci-catena/Catena-Sketches/tree/master/catena4450m101_sensor, to download test software and provision your board for use with The Things Network.