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Catena 4612/4611 User Manual

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PROPRIETARY NOTICE AND DISCLAIMER

Document Release History

Rev A	2019-03-01	Initial Release
Rev B	2020-02-18	Updated the Pinout

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1 Introduction

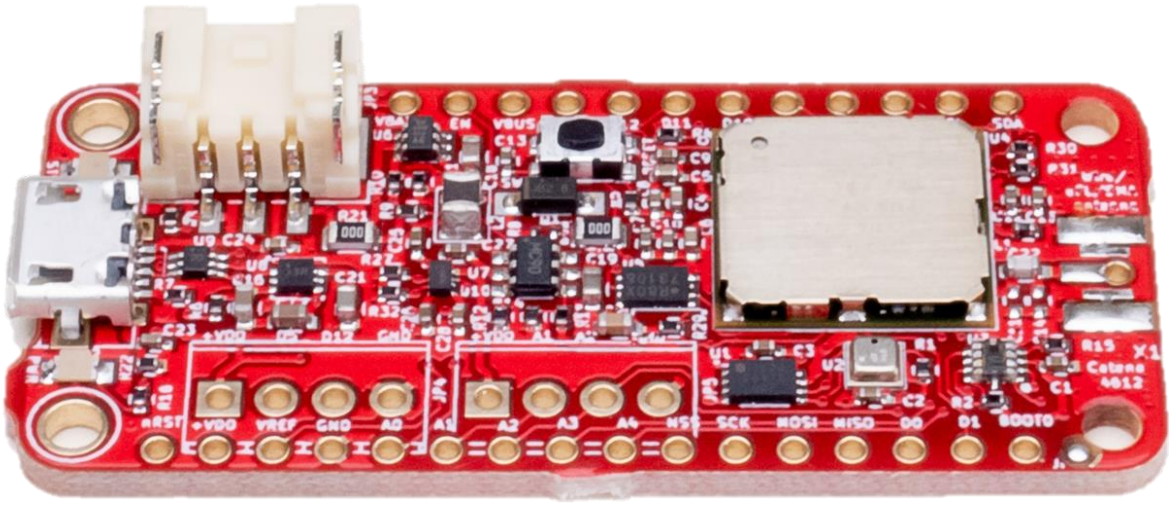
The MCCI Catena® 4612 and 4611 is a complete single-board IoT device for LoRaWAN™ technology projects.

Based on the Murata CMWX1ZZABZ-078, and designed to be compatible with the Adafruit Feather family of development boards and accessories, the Catena 4612/4611 is a great platform for LoRaWAN investigation and deployment. It works well with The Things Network, or any LoRaWAN 1.0 or 1.1 network in the 865 to 923 MHz range.

Lightweight and small (roughly 2" by 0.9"), the 4612/4611 needs no external components to measure and send temperature, pressure, humidity, and Lux, powered from USB or two AAA cells.

Because of the embedded FRAM, the Catena 4612/4611 fully meets the requirements of LoRaWAN 1.1, without worrying about EEPROM wear out or wear-leveling, both for ABP and OTAA.

Figure 1 Catena 4612



2 Specifications and Features

The specifications and features of Catena 4612/4611 are given below:

The difference between 4611 and 4612 are given in Table 1

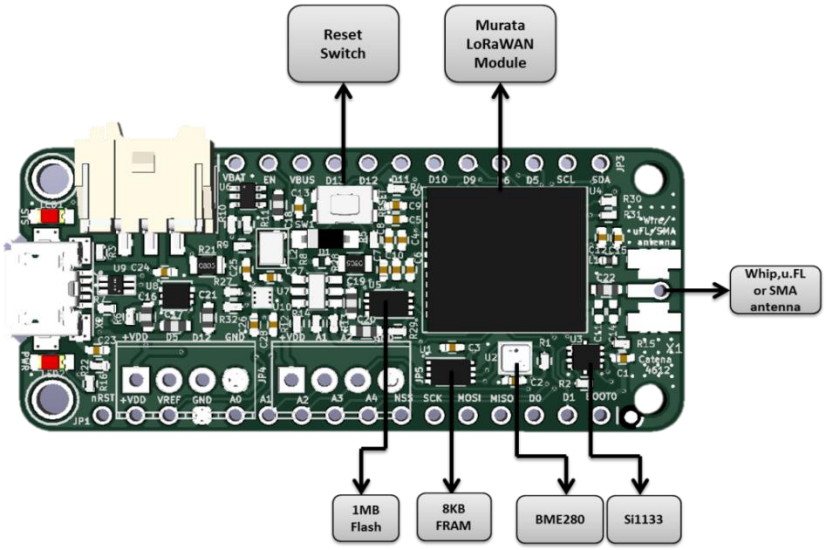
Table 1 Difference between 4612 and 4611

Specification	Catena 4612	Catena 4611
Boost regulator IC	MCP16252	MCP16251
Boost Regulator	Can be controlled	Always On
Behaviour	VDD on the I/O ports change based on A0 (either 0 or 1)	VDD is always 3.3V
Uses	Power consumption is less, since it can be controlled	Low power mode

Murata LoRaWAN module

- Semtech SX1276 LoRa radio
- STM32L082 CPU (Cortex M0+, 32 MHz, 192K flash, 20K RAM)
- High quality RF engineering
- Certified for US and EU
- Compatible with IN866, AS923, AU921 bands

Figure 2 Catena 4612/4611 Description



Integrated sensors

- Pressure
- Temperature
- Humidity
- Lux

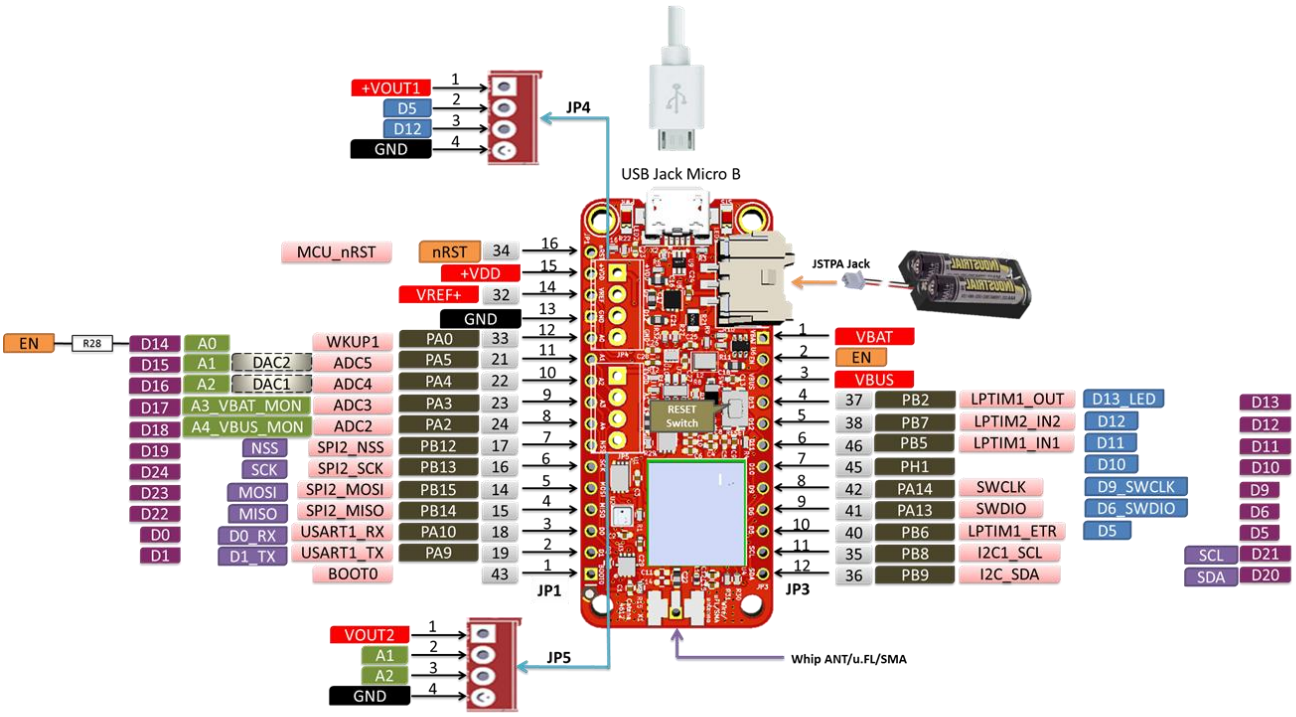
2.1 Additional Features

- Powered from primary (disposable) batteries (such as 2x AAA cells)
- 30uA current draw in standby
- 8K bytes FRAM for LoRaWAN provisioning info and frame counters -- power can be removed completely without requiring a new join to the network, and without losing uplink and downlink count values (required for LoRaWAN 1.1)
- 1M byte SPI Flash for bulk data storage, future FUOTA firmware storage, etc.
- Software-controlled boost converter allows dynamically raising voltage to 3.3V for analog measurement and powering internal sensors
- USB or SWD for download and debug
- Pin-compatible with Adafruit Feather M0 family of boards (some limitations because the of functional differences between the Murata module and the Atmel SAMD21 CPU used in the Feather M0)
- Arduino-compatible
- Provisions for screw terminals for pulse, analog or digital I/O
- Whip, u.FL, or SMA antenna
- Open source hardware and software (https://github.com/mcci-catena)
- MCCI provides a full Arduino board-support package, available here.
- MCCI also provides libraries to allow rapid prototyping and experimenting, including an open-source LoRaWAN stack that supports the EU868, US915, AS923, AU921 and IN866 regional plans.
- ST Micro tools may also be used.
- The Catena 4612 works well with and is tested with The Things Network (an open-source, user-owned IoT network based on LoRaWAN); but can be used with any LoRaWAN-compatible network.

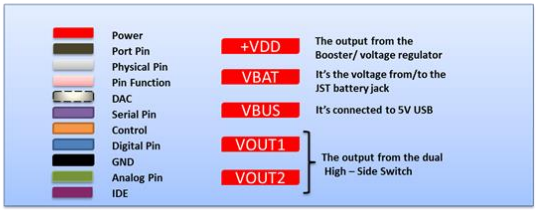
3 Catena 4612/4611 Pinouts

Catena 4612/4611 Pinout is given below:

Figure 3 Catena 4612/4611 Pinouts



Model	U2 and U3 (On-board Sensors)	U7 (Booster IC)	R28 (Booster regulator control Enable)	Boost Regulator default configuration		Notes
				R12	R8	
4611	BME280, Si1133	MCP16251	DNP	DNP	10K	Boost Regulator always ON. So VDD is always 3.3 until shutdown or EN is low
4612	BME280, Si1133	MCP16252	0	100K	DNP	Boost Regulator default state is OFF. A0 high enables boost regulator and boosts VDD to 3.3V. If A0 is low battery voltage is VDD.
4617	HS3001, Si1133	MCP16252	0	100K	DNP	Boost Regulator default state is OFF. A0 high enables boost regulator and boosts VDD to 3.3V. If A0 is low battery voltage is VDD.
4618	SHT31, Si1133	MCP16252	0	100K	DNP	Boost Regulator default state is OFF. A0 high enables boost regulator and boosts VDD to 3.3V. If A0 is low battery voltage is VDD.

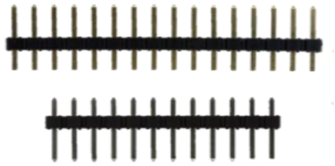


4 Hardware Requirements

4.1 PinHeaders

12-pin & 16-pin male headers (123001009 & 12301011) have a pitch of 0.1" (2.54mm).

Figure 4 12-pin & 16-pin Male Headers



4.2 1x04 Screw Terminals

The 1x4 screw terminal blocks (123001012) has a pitch of 0.1” (2.54mm), and can be used as an alternative to standard male or female headers of 0.1”. They help in connecting external sensors to the 4612.

Figure 5 1x04 Screw Terminals

4.3 Antenna

Whip Antenna, u.FL and SMA Antennas can be used. The antenna specifications are shown in Table 2

Figure 6 Whip Antenna

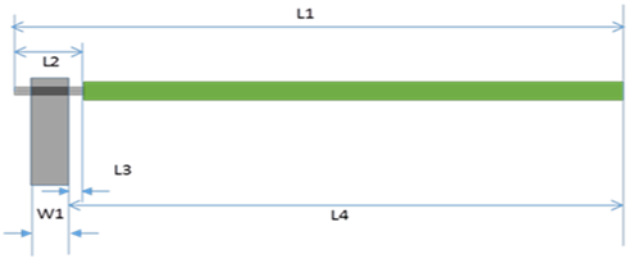


Table 2 Antenna Specification

Parameters	Reference	US Version	EU Version	IN Version	AU Version	AS Version
Wire Color		Yellow	Green	Blue	Yellow	Yellow
Reference Number		123001007	123001069	123001070	123001007	123001007
Wire length	L1	88.6	84.2	88.9	82	82
Tolerance	-	+/- 0.3 mm	+/- 0.3 mm	+/- 0.3 mm	+/- 0.3 mm	+/- 0.3 mm
Board thickness	W1	1.5748	1.5748	1.5748	1.5748	1.5748
Tin length	L2	3 mm	3 mm	3 mm	3 mm	3 mm
Tin tolerance	-	+/- 0.03 mm	+/- 0.03 mm	+/- 0.03 mm	+/- 0.03 mm	+/- 0.03 mm
Slop from soldering	L3	1.5 mm	1.5 mm	1.5 mm	1.5 mm	1.5 mm
Minimum length	-	80.9	80.9	85.6	80.9	80.9
Maximum length	-	82.9	82.9	86.6	82.9	82.9
Typical length	L4	81.9	81.9	87.6	81.9	81.9
Minimum f	-	903.83 MHz	903.83 MHz	855.33 MHz	915 MHz	920 MHz
Maximum f	-	928.80 MHz	928.80 MHz	875.87 MHz	928 MHz	925 MHz
Typical f	-	915 MHz	915 MHz	866 MHz	921 MHz	923 MHz

4.4 Programming Requirements

4.4.1 ST-LINK/V2 in-circuit debugger/programmer

The ST-LINK/V2 (123001120) is an in-circuit debugger and programmer for the STM8 and STM32 microcontroller families. The single wire interface module (SWIM) and JTAG/serial wire debugging (SWD)

interfaces are used to communicate with any STM8 or STM32 microcontroller located on an application board.

Figure 7 ST Link Programmer

4.4.2 USB to Serial Cable

USB to Serial Cable (123001121) is used for Configuring the device with TTN and also for monitoring the device performance on the Serial Monitor.

Figure 8 USB to Serial Cable

Note: The Serial cable configurations are mentioned in the Table 2

5 Software Requirements

To proceed with Catena 4612/4611 setup and test procedure, the below software tools are required.

- **Arduino IDE** for windows can be downloaded from below link:
  - https://www.arduino.cc/en/Main/Software
- **ST-Link Debugger driver** for windows can be downloaded from the link below:
  - https://www.st.com/en/development-tools/st-link-v2.html
- **USB to Serial converter** for windows
- **Zadig** tool is required for programming Catena 4612 the tool can be downloaded from the link below:
  - https://zadig.akeo.ie

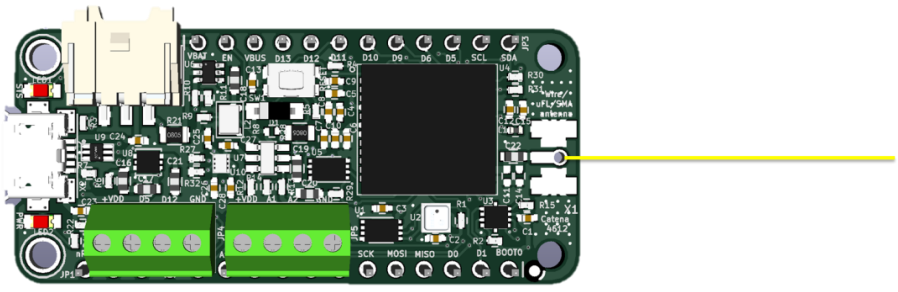
- **Basic libraries required**
  - Catena-Arduino-Platform
  - Catena-mcciadk
  - arduino-lorawan
  - arduino-lmic
  - BH1750
  - Adafruit_BME280_Library
  - Adafruit_FRAM_I2C
  - Adafruit_Sensor

6 Assembly Instructions

1) Catena 4612/4611 board assembling procedures are listed below:
   a. Attach the 12-pin & 16-pin Male Headers on JP1 and JP2 of Catena 4612/4611 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
   b. Trim excess length of the 16-pin header in the area of screw terminals.
   c. Solder the Whip antenna as per the Antenna Specification mentioned in Table 2.
   d. Attach the 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

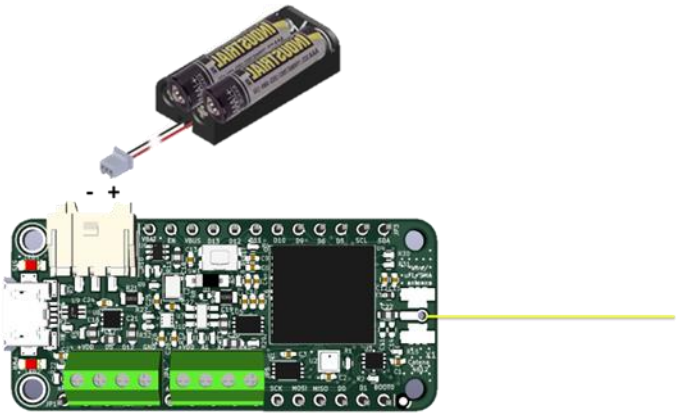
NOTE: Catena 4610 Base do not require male pin headers and screw terminals to be soldered (only whip antenna is sufficient for base board). However, user can solder them based on their setup requirement.

Figure 9 Catena 4612 after soldering components



   e. Connect the Battery to the X3 of the board.

Figure 10 Catena 4612 with Battery



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

2) Catena 4612/4611 Serial connection.
User can prefer **Generic Serial** for **Serial Interface** when USB cable is not used in the setup. MCCI preferred using USB to Serial Cable TTL-232R-RPI and it has been used for Serial monitor. The color code and the pin configuration detail are listed in the Table 2

Figure 11 Catena 4612 Serial Configuration

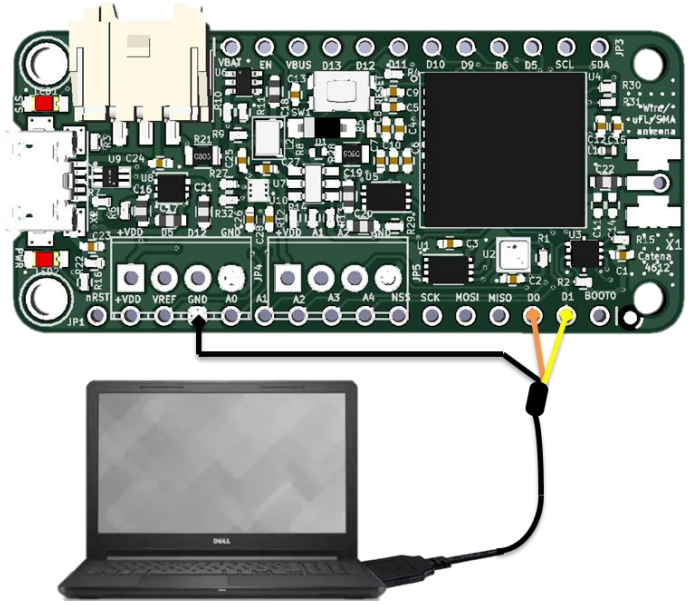


Table 3 USB to Serial Connection

Catena4612 (JP1)	USB - Serial cable (color)
GND	Black
D0_RX	Orange
D1_TX	Yellow

7 Configurations of Catena 4612

7.1 Library Installation

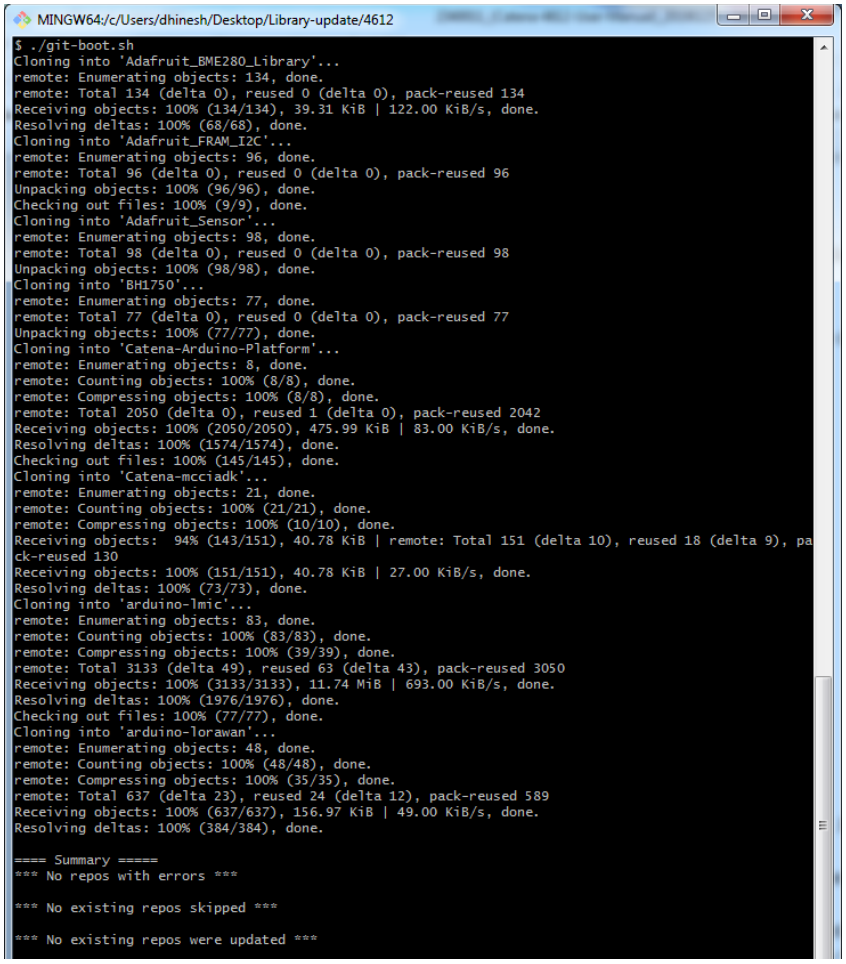
Catena 4612 simple sketch requires the following libraries:

- Catena-Arduino-Platform
- Catena-mcciadk
- arduino-lorawan
- arduino-lmic
- Adafruit_BME280_Library
- BH1750
- Adafruit_FRAM_I2C
- Adafruit_Sensor

The above libraries can be cloned from https://github.com/mcci-catena or by executing the shell script *"git-boot.sh"* in the directory.

It's easy to run, provided you're on Windows, macOS, or Linux, and provided you have git installed. We tested on Windows with git bash from https://git-scm.org, on macOS 10.11.3 with the git and bash shipped by Apple, and on Ubuntu 16.0.4 LTS (64-bit) with the built-in bash and git from apt-get install git. Refer the Figure 12 to clone using the script git-boot.sh.

Figure 12 Cloning libraries using the script



7.2 Arduino IDE Setup

Now follow the below steps to upload the test sketch using Arduino IDE:

1. Open the Arduino IDE. Go to File>Preferences>Settings. Add *"https://github.com/mcci-catena/arduino-boards/raw/master/BoardManagerFiles/package_mcci_index.json"* to the list in Additional Boards Manager URLs.
2. If you already have entries in that list, use a comma (,) to separate the entry you're adding from the entries that are already there.
3. Next, open the board manager. Tools>Board:...Search for MCCI's BSPs
4. Install the latest BSP for MCCI Catena STM32 to add support for Catena 4612 in Arduino IDE.
5. **MCCI Catena STM32 Boards** should be installed from the Boards Manager.
6. Once the board has been installed, **Catena 4612** board has to be selected under **MCCI Catena STM32 Boards**.

Figure 13 BSP Search

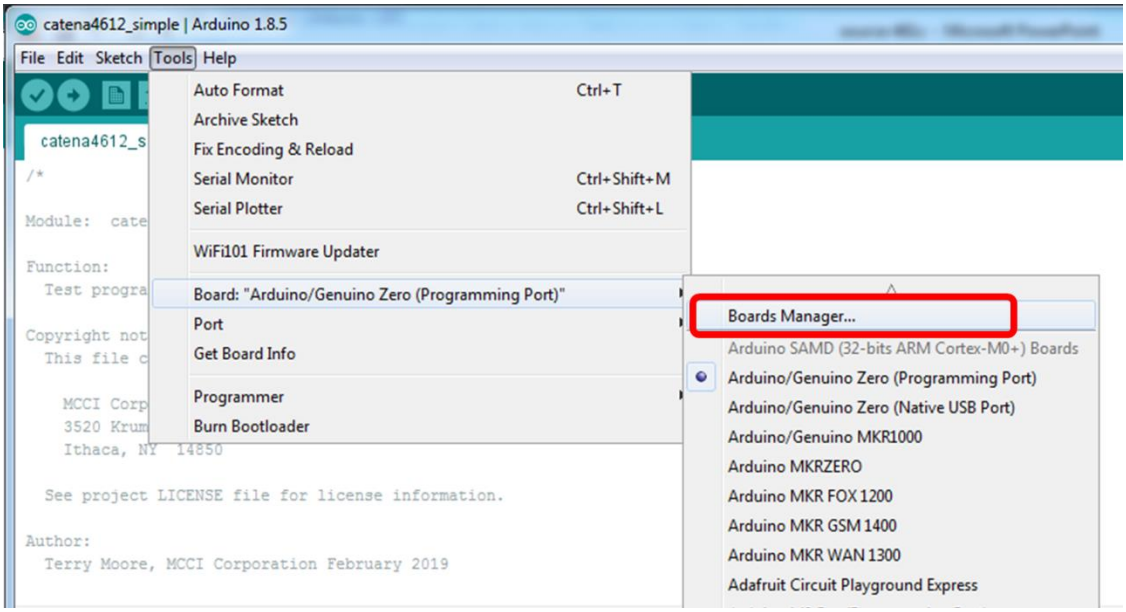


Figure 14 BSP Installation

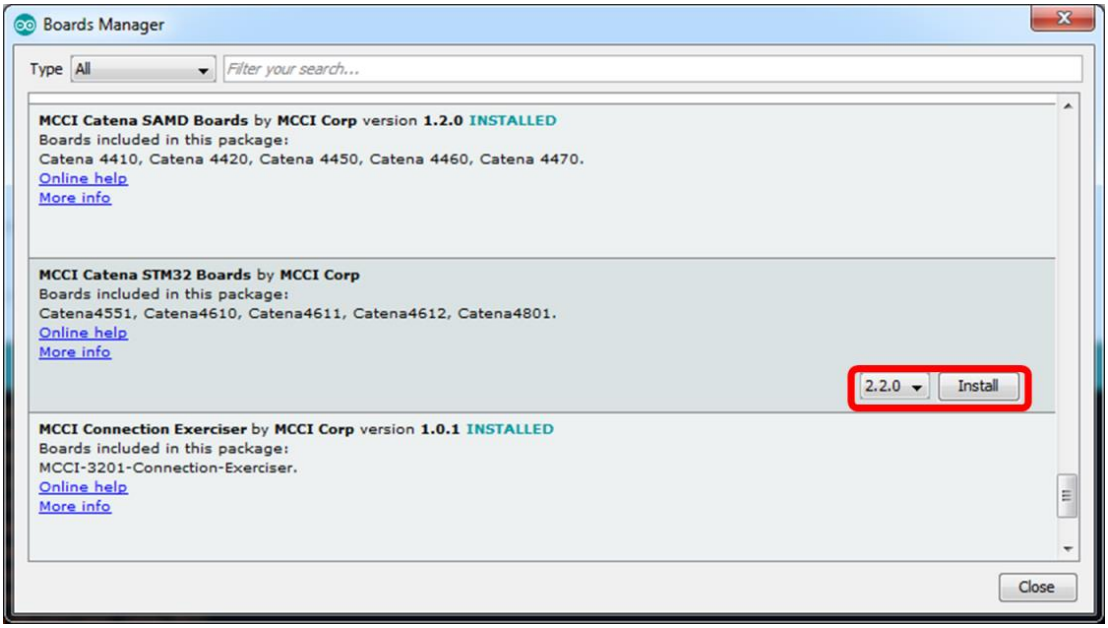
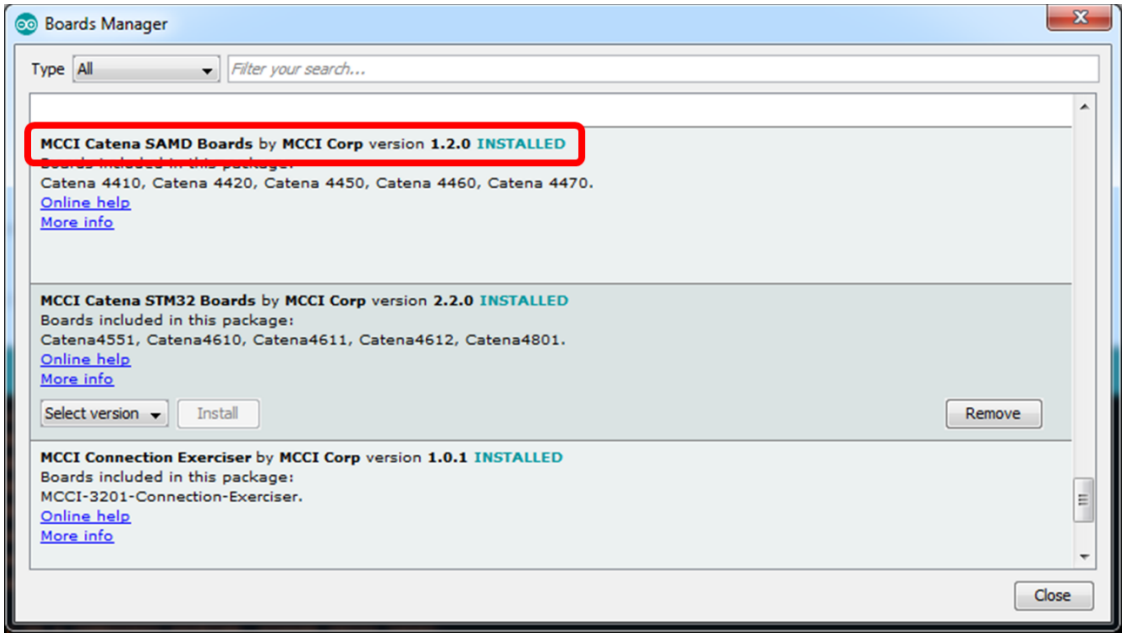


Figure 15 BSP Installed



7. Enable USB Serial in the serial interface menu from the Tools tab.
8. Choose your desired system clock and LoRaWAN region
9. Compile and Upload your sketch

7.3 Programming Methods

Catena 4612 programming includes two methods

I. DFU
II. ST-Link

7.3.1 ST-LinK

Catena 4612 uses ST-Link V2 programmer for programming the firmware. Below is the connection between 4612 and ST-Link programmer

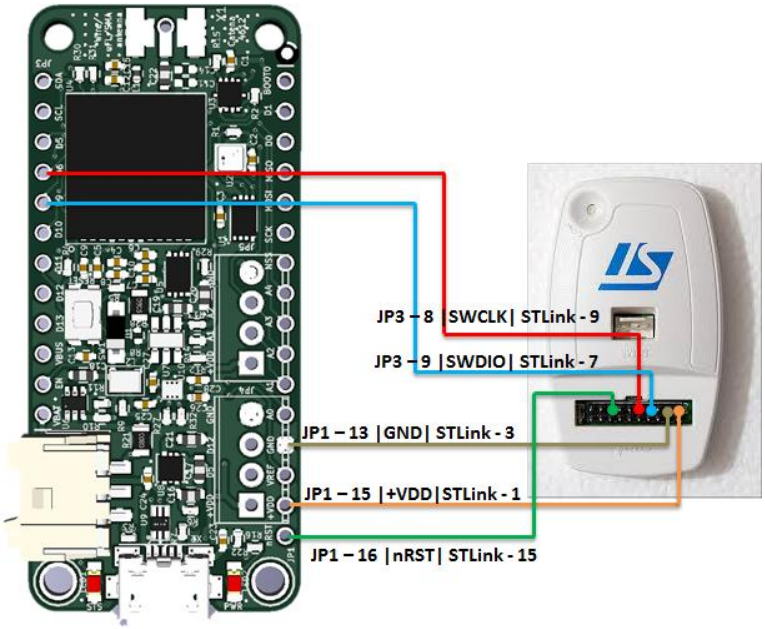
Figure 16 Catena 4612 connection with PC using STLink Debugger

Pin configurations of the ST-Link debugger with Catena 4612 are mentioned in Table 4

Table 4 Catena 4612 to STLink connection

Catena 4612 ST-Link connection		
Pin Names	**ST-Link Pin Numbers**	**4612 Pin Numbers**
+VDD	Pin 1	JP1 - 15
GND	Pin 3	JP1 - 13
SWDIO	Pin 7	JP3 - 9
SWCLK	Pin 9	JP3 - 8
nRST	Pin 15	JP1 - 16

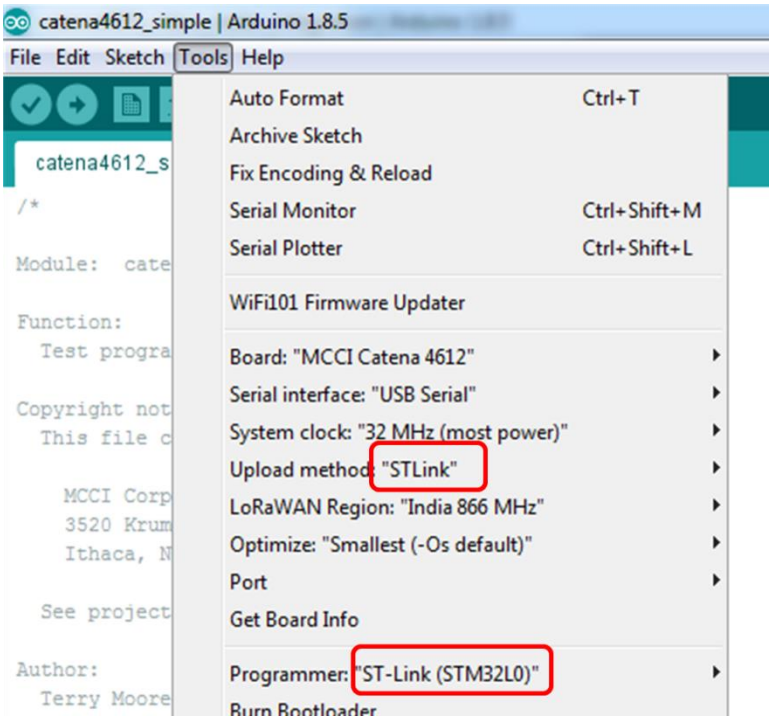
Figure 17 Catena 4612 connection with ST Link programmer



Before uploading the code select the following options from Arduino IDE.

TOOLS --> UPLOAD METHOD - STLink" && PROGRAMMER - "STLink (STM32L0)"

Figure 18 Configuration for upload using STLink programmer



7.3.2 DFU

1. Program the Catena 4612 using DFU mode, this mode requires Zadig tool the download link is mentioned above.
2. Once the tool is downloaded, BOOT0 and +VDD pins should be Shorted using the jumper wire

Figure 19 Catena 4612 DFU Mode Connection

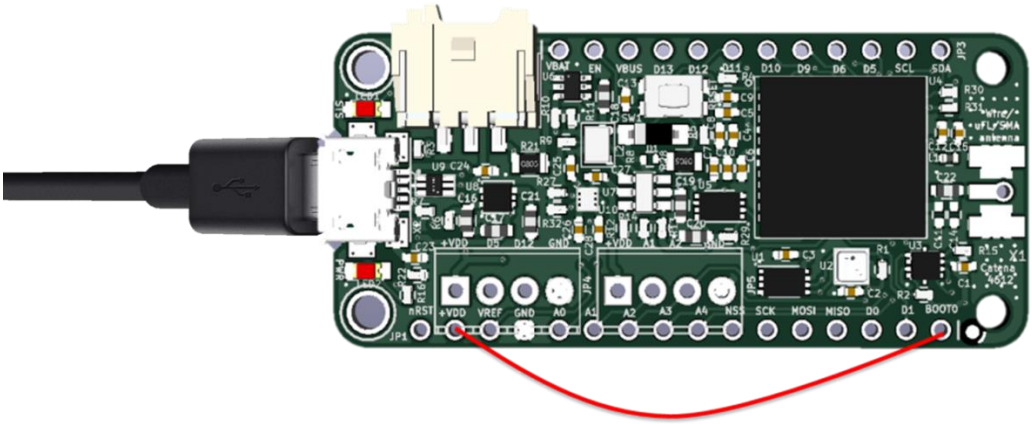
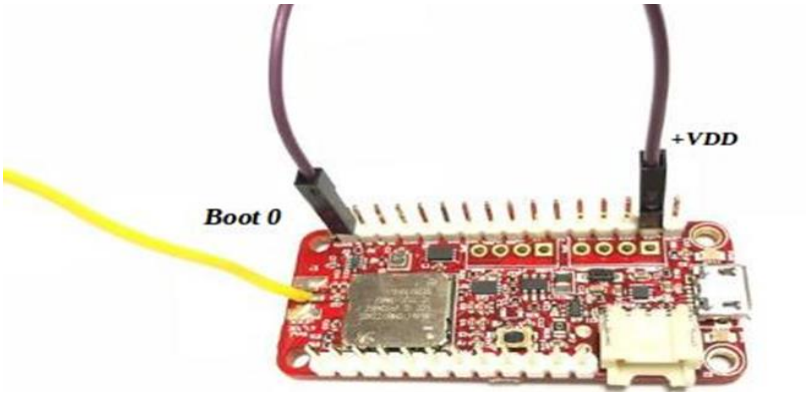
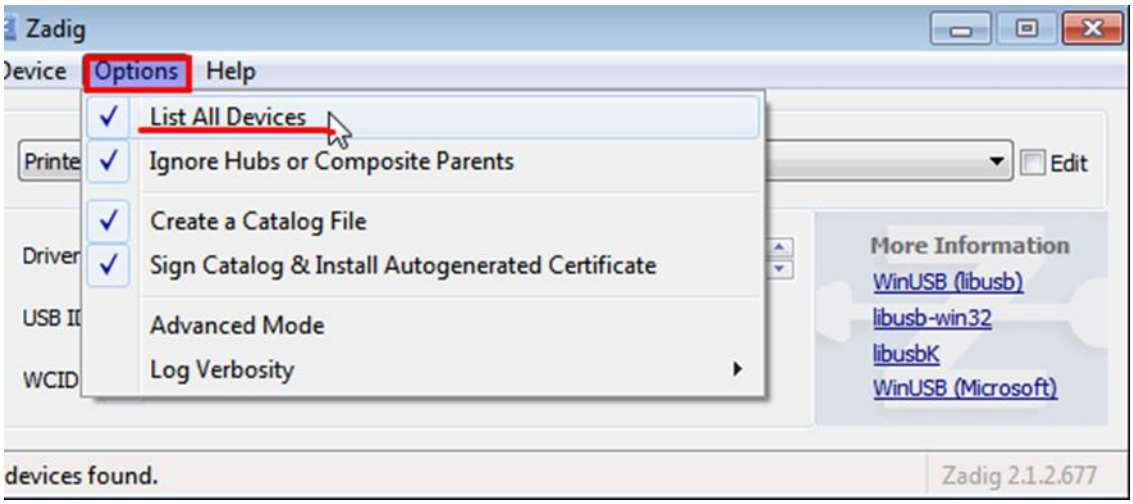


Figure 20 DFU mode Example



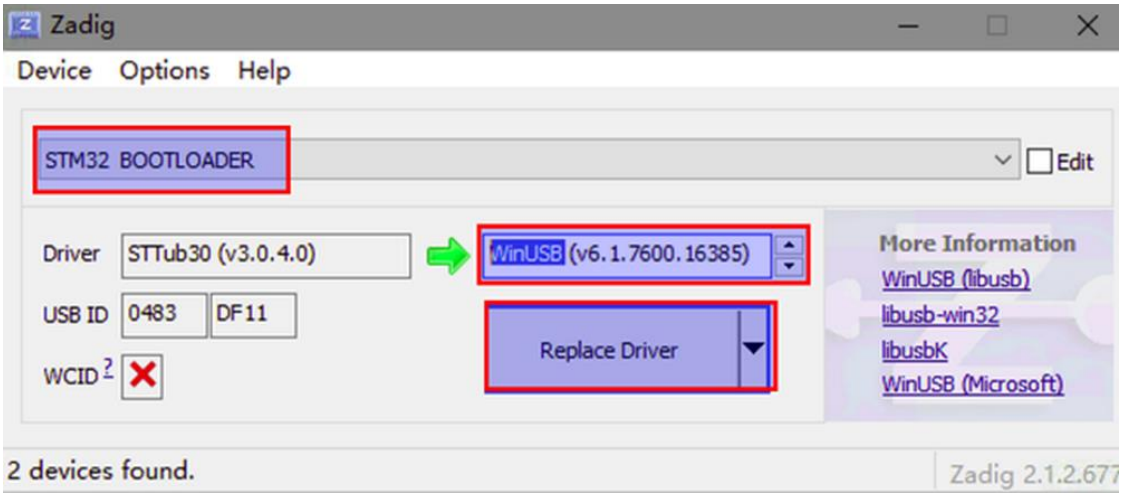
3. Now reboot Catena 4612 using USB cable.
4. On the Zadig terminal - Select **Options -> List All devices as shown**

Figure 21 Zadig Device Selection



5. Select STM32 BOOTLOADER from the device dropdown
6. Select WinUSB (v6.1.7600.16385) as new driver
7. Click Replace Driver

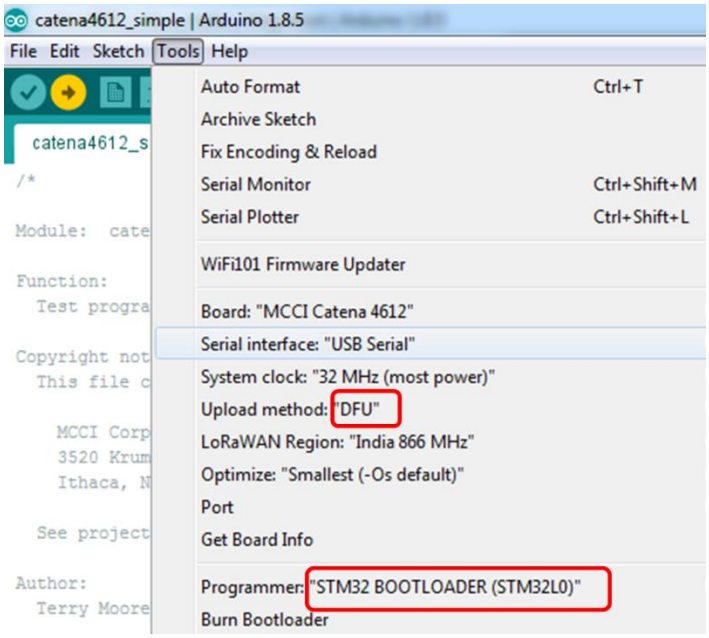
Figure 22 Zadig driver replacement



8. Before uploading the code select the following options from Arduino IDE.

TOOLS --> UPLOAD METHOD - DFU" && PROGRAMMER - "STM 32 BOOTLOADER"

Figure 23 Configuration for upload using DFU mode



Now the Sketch can be compiled and uploaded using DFU mode.

7.4 Provisioning Steps

After upload the sketch.
Please follow the provisioning steps mentioned in the below link

https://github.com/mcci-catena/Catena-Sketches/tree/master/catena4450m101_sensor#provision-your-catena-4450

Note: use platformguid "915decfa-d156-4d4f-bac5-70e7724726d8"

7.5 TTN Registration Steps

Please follow the steps mentioned in the below link to create an application in The Things Network

https://github.com/mcci-catena/Catena-Sketches/tree/master/catena4450m101_sensor#getting-started-with-the-things-network