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## Catena 4610 User Manual

*Engineering Report 234001177*  
*Rev B*  
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Rev A	2019-03-01	Initial Release
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## 1 Introduction

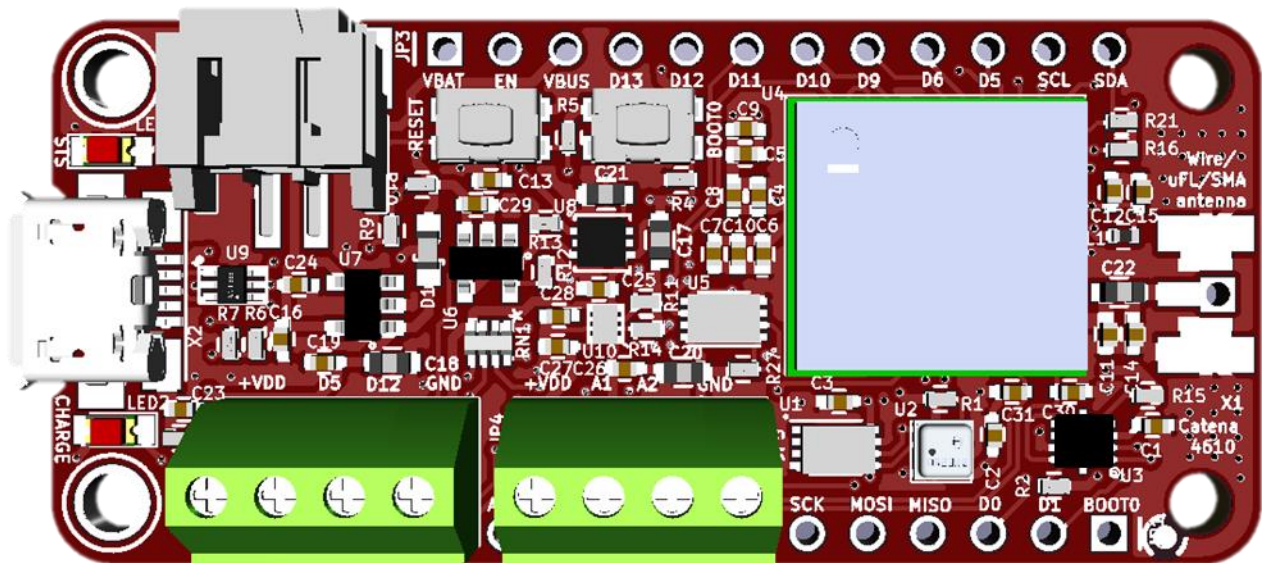
The MCCI Catena® 4610 is a complete single-board IoT device for LoRaWAN™ technology projects.

Based on the Murata [CMWX1ZZABZ-078](#), and designed to be compatible with the [Adafruit Feather](#) family of development boards and accessories, the Catena 4610 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 4610 needs no external components to measure and send temperature, pressure, humidity, and lux, powered from USB or any Feather-compatible LiPo (Lithium-Polymer) battery.

Because of the embedded FRAM, the Catena 4610 fully meets the requirements of LoRaWAN 1.1, without worrying about EEPROM wearout or wear-leveling, both for ABP and OTAA.

Figure 1 Catena 4610



## 2 Specifications and Features

The specifications and features of Catena 4610 is given below:

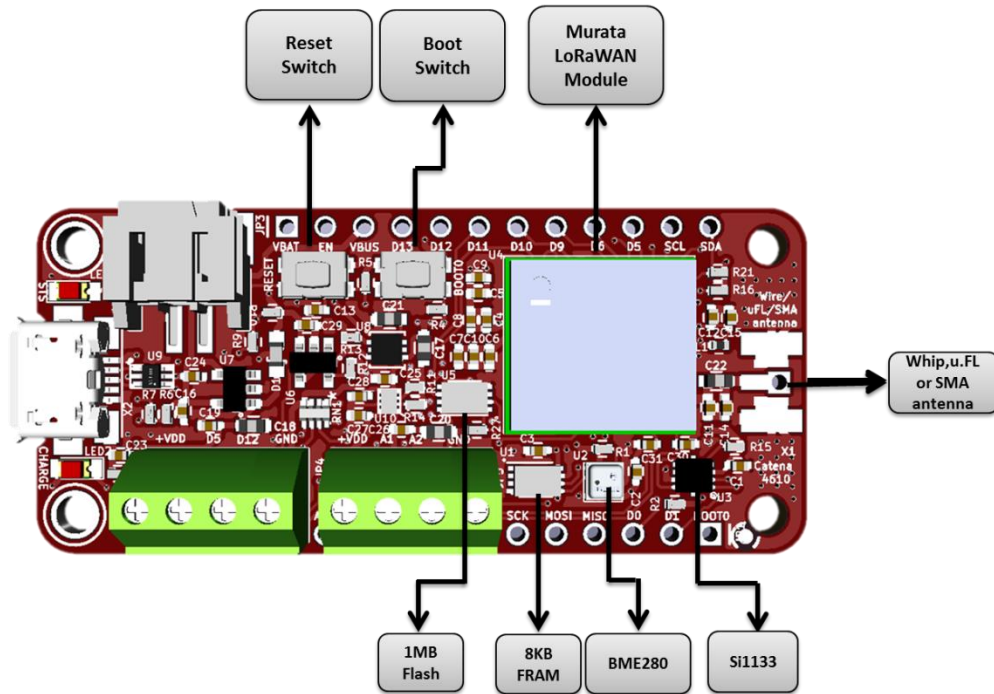
Murata LoRaWAN module

## Catena 4610 User Manual

### Engineering Report 234001177 Rev B

- 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 4610 Description



#### Integrated sensors

- Pressure
- Temperature
- Humidity
- Light

## 2.1 Additional Features

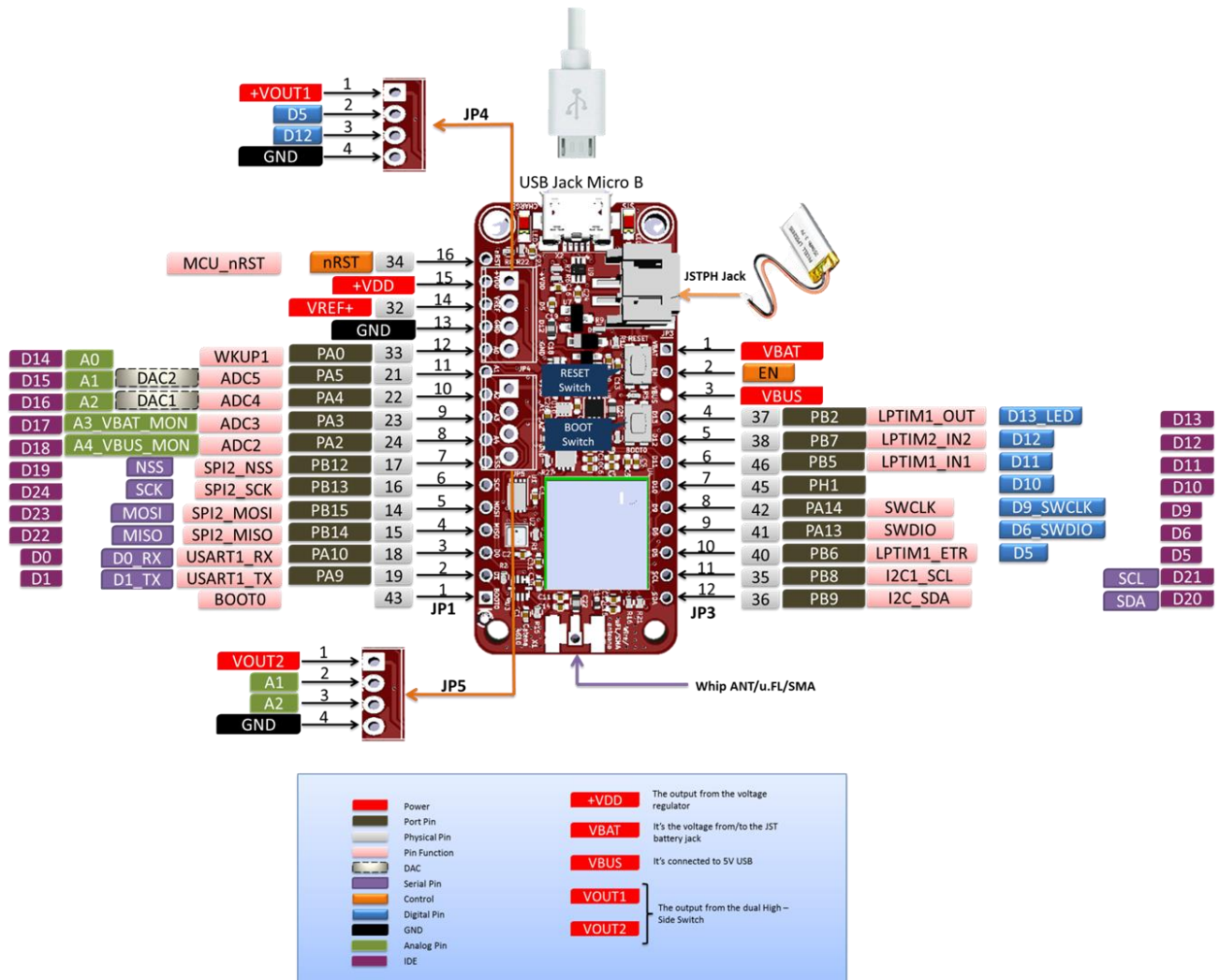
- Powered from secondary 4V LiPo batteries (such as Adafruit's 350 mAh battery) (Note: in contrast to the Catena 4612, this model targets LiPo batteries only. If you need primary/disposable batteries, please consider the 4612).
- 100uA current draw in stand by
- 8K bytes FRAM for LoRaWAN provisioning 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 FoTA 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 of the functional differences between the Murata module and the Atmel SAMD21 CPU used in the Feather M0)
- Arduino-compatible
- Compatible with the MCCI Catena 4450 and Catena 4612 IoT devices
- Designed for use with The Things Network (open-source, user-owned IoT network based on LoRaWAN); but can be used with any LoRaWAN-compatible network
- Provisions for screw terminals for pulse, analog or digital I/O
- Software-controlled switches for external power output to screw terminals
- 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 4610 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 4610 Pinouts**

Catena 4610 Pinout is given below:

Figure 3 Catena 4610 Pinout



## 3.1 Logic Pins

### 3.1.1 Connector JP1

JP1 is a 16 pin connector which has General Purpose I/O pin.

PIN #	Pin Function	Analog Pin	Digital Pin	Purpose	Description
2	USART1_TX		D1	D1_TX	Transmit pin for Serial1
3	USART1_RX		D0	D0_RX	Receive pin for Serial1
4	SPI2_MISO		D22	MISO	
5	SPI2_MOSI		D23	MOSI	
6	SPI2_SCK		D24	SCK	



<b>7</b>	SPI2_NSS		D19	NSS	
<b>8</b>	ADC2	A4	D18	A4_VBUS_MON	Used to Monitor the VBUS
<b>9</b>	ADC3	A3	D17	A3_VBAT_MON	Used to Monitor the Battery Voltage(VBAT)
<b>10</b>	ADC4/DAC1	A2	D16	A2	GPIO
<b>11</b>	ADC5/DAC2	A1	D15	A1	GPIO
<b>12</b>		A0	D14	A0	GPIO

### 3.1.2 Connector JP3

<b>PIN #</b>	<b>Pin Function</b>	<b>Analog Pin</b>	<b>Digital Pin</b>	<b>Purpose</b>	<b>Description</b>
<b>4</b>	LPTIM1_OUT		D13	D13_LED	Status LED
<b>5</b>	LPTIM2_OUT		D12	D12	GPIO
<b>6</b>	LPTIM1_IN		D11	D11	
<b>7</b>			D10		
<b>8</b>	SWCLK		D9	D9_SWCLK	Used for the purpose of programming the board using ST-Link Programmer
<b>9</b>	SWDIO		D6	D6_SWDIO	Used for the purpose of programming the board using ST-Link programmer
<b>10</b>	LPTIM1_ETR		D5	D5	
<b>11</b>	I2C1_SCL			SCL	I2C Clock pin
<b>12</b>	I2C1_SDA			SDA	I2C Data pin

### 3.1.3 Connector JP4 & JP5

In JP4 and JP5, screw terminals can be connected. These connectors have GPIO pins with a power pin (VOUT1, VOUT2) and GND. These pins can be used for the customized usage by the user.

<b>Connector</b>	<b>Pin</b>
<b>JP4</b>	D4, D12
<b>JP5</b>	A1,A2

### 3.2 Power Pin

PIN #	Connector Ref #	Pin Function	Description
14	JP1	VREF+	Reference Voltage same as the logic Voltage (3.3V)
15	JP1	VDD	The output from the voltage regulator
3	JP3	VBUS	5V comes from USB
1	JP3	VBAT	Voltage from the battery
1	JP4	VOUT1	Output voltage from the Dual High Side Switch
1	JP5	VOUT2	Output voltage from the Dual High Side Switch

### 3.3 Other Pins

PIN #	Connector Ref #	Pin Function	Description
1	JP1	BOOT0	Boot Pin – Helps to send the board in Boot mode (enumerate as Bootloader) for programming
16	JP1	nRST	Reset pin – Helps to reset the board.
2	JP3	EN	To enable the 3.3V voltage regulator

## 4 Power Source

Any power source which provides 3.3V can be used to power Catena – 4610.

In our application, we can use a Lithium polymer battery. **Red Wire** of the battery to the Power Supply and the **Black wire** to the Ground



## 5 Antenna Options

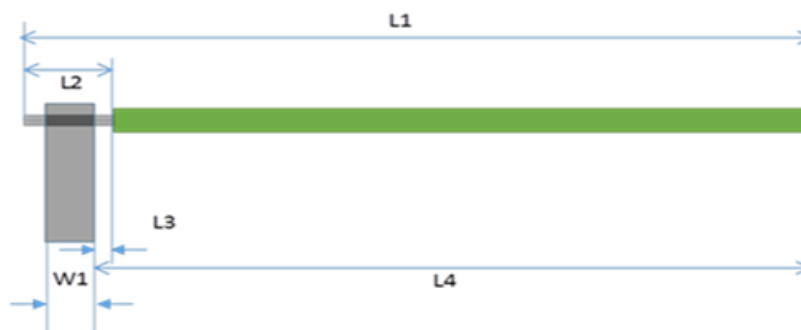
Catena devices to communicate over network, any of the following three Antennas can be used.

- Whip Antenna
- u.FL
- SMA

### 5.1 Whip Antenna

The antenna specifications are shown in Table 1

Figure 4 Whip Antenna



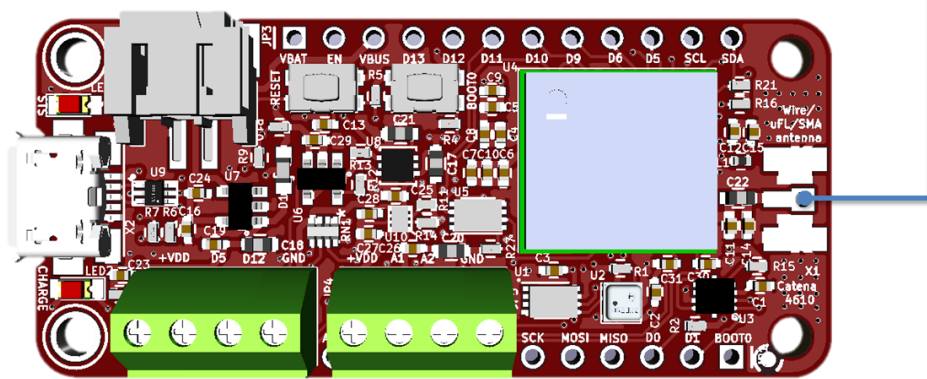


Table 1 Antenna Specification

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

## 5.2 U.FL

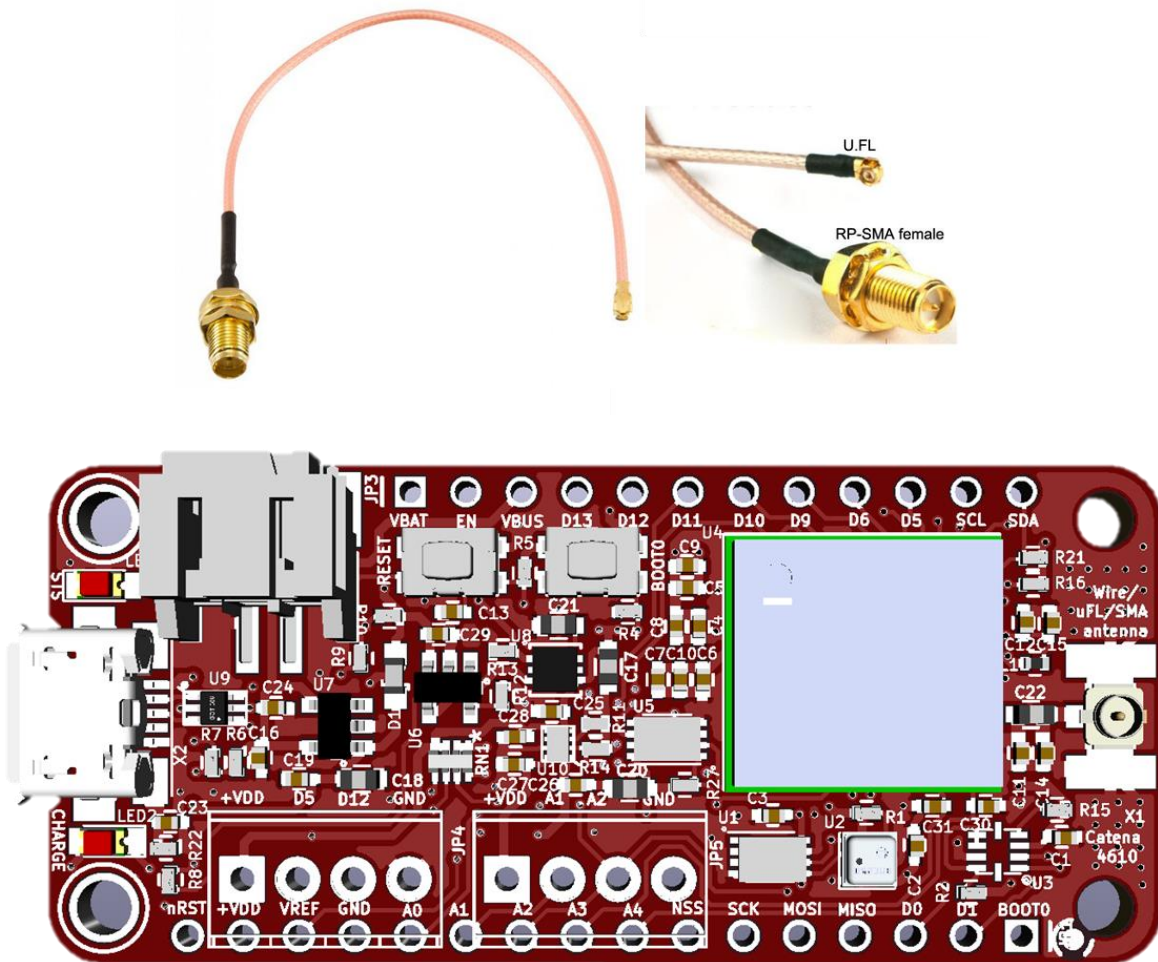
If wants to use u.FL antenna, then have to install u.FL SMT Connector in the board as in **Error! Reference source not found.**.. Then connects the u.FL antenna to the board.

NOTE: User can also connect an SMA antenna with the help of u.FL/SMA adapter cable.

Figure 5 uFL antenna



### Figure 6 uFL/SMA adapter cable

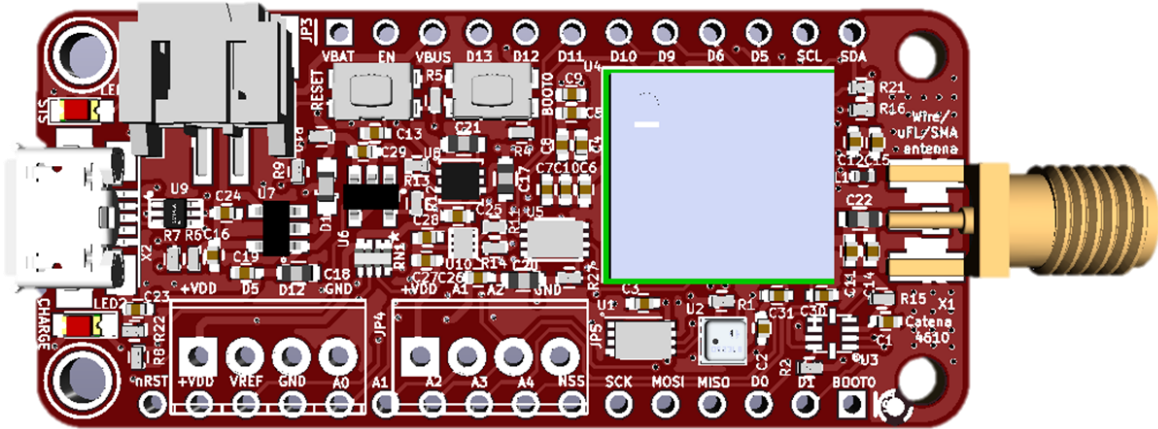


### 5.3 SMA

If the user wants to install an SMA connector to the Catena board to use SMA antenna. Then install the SMA connector as shown in **Error! Reference source not found.**

### Figure 7 SMA antenna





## 6 Additional Accessories

Catena 4610 can also have some of the optional accessories for their connectors to have easy interface.

### 6.1 Programming Requirements

#### 6.1.1 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 8 ST Link Programmer



#### 6.1.2 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 9 USB to Serial Cable



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

## 7 Software Requirements

To proceed with Catena 4610 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 4610 the tool can be downloaded from the link below:
  - <https://zadig.akeo.ie>
- **Catena-Sketches** for examples of all Catena devices (**catena4612\_simple.ino** and **catena461x\_test01.ino** can be used for **Catena 4610**). Use command “*git clone https://github.com/mcci-catena/Catena-Sketches.git*” to clone Catena Sketches.
- **Basic libraries required**
  - [Catena-Arduino-Platform](#)
  - [Catena-mcciadk](#)
  - [arduino-lorawan](#)
  - [arduino-lmic](#)
  - [Adafruit BME280 Library](#)
  - [Adafruit FRAM I2C](#)
  - [Adafruit Sensor](#)

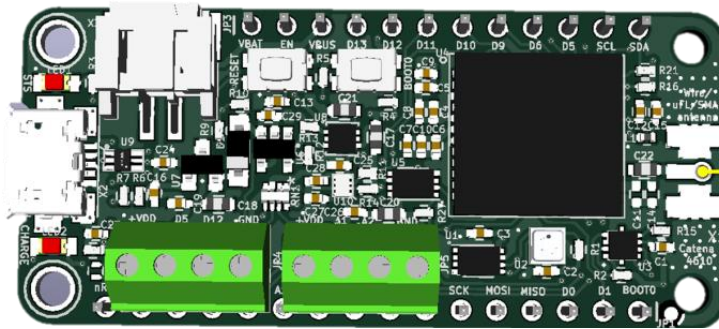
## 8 Assembly Instructions

- 1) Catena 4610 board assembling procedures are listed below:
  - a. Attach the **Error! Reference source not found.** on JP1 and JP2 of Catena 4610 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 1.
- d. Attach the **Error! Reference source not found.** on JP3 and JP4 respectively.
  - i. Solder one post
  - ii. Adjust for proper alignment and good cosmetics
  - iii. Solder the remaining posts

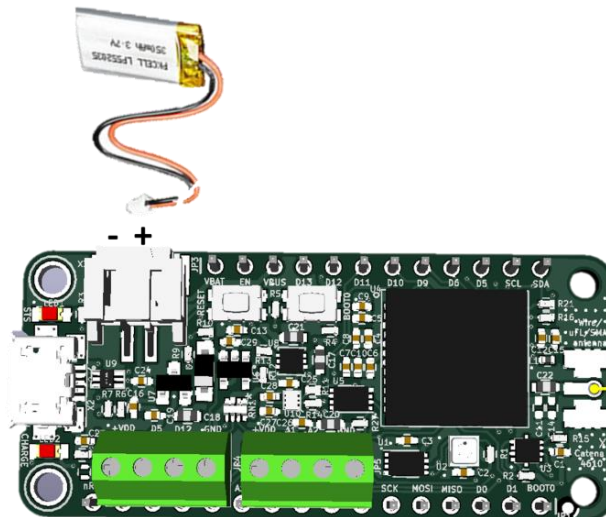
**NOTE: Catena 4610 Base do not require male pin headers and screw terminals to be soldered (only whip antenna is sufficient for base board).** However, user can solder them based on their setup requirement.

Figure 10 Catena 4610 after soldering components



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

Figure 11 Catena 4610 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 4610 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 12 Catena 4610 Serial Configuration

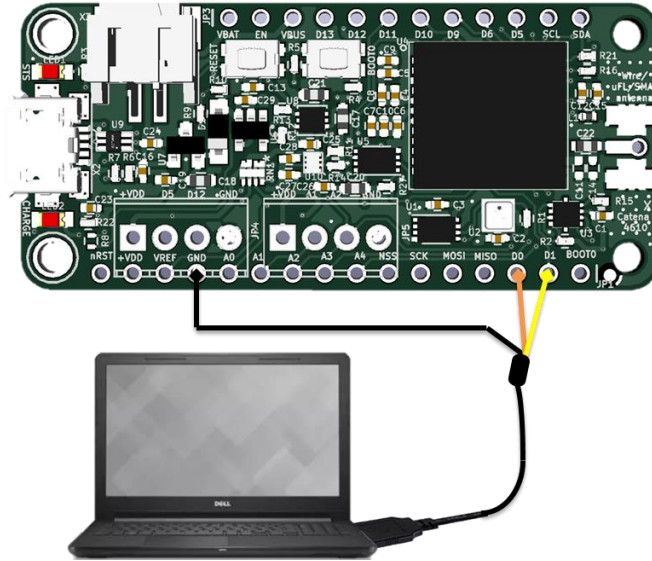


Table 2 USB to Serial Connection

Catena4610 (JP1)	USB - Serial cable (color)
GND	Black
D0_RX	Orange
D1_TX	Yellow

## 9 Configurations of Catena 4610

### 9.1 Library Installation

Catena 4610 simple sketch requires the following libraries:

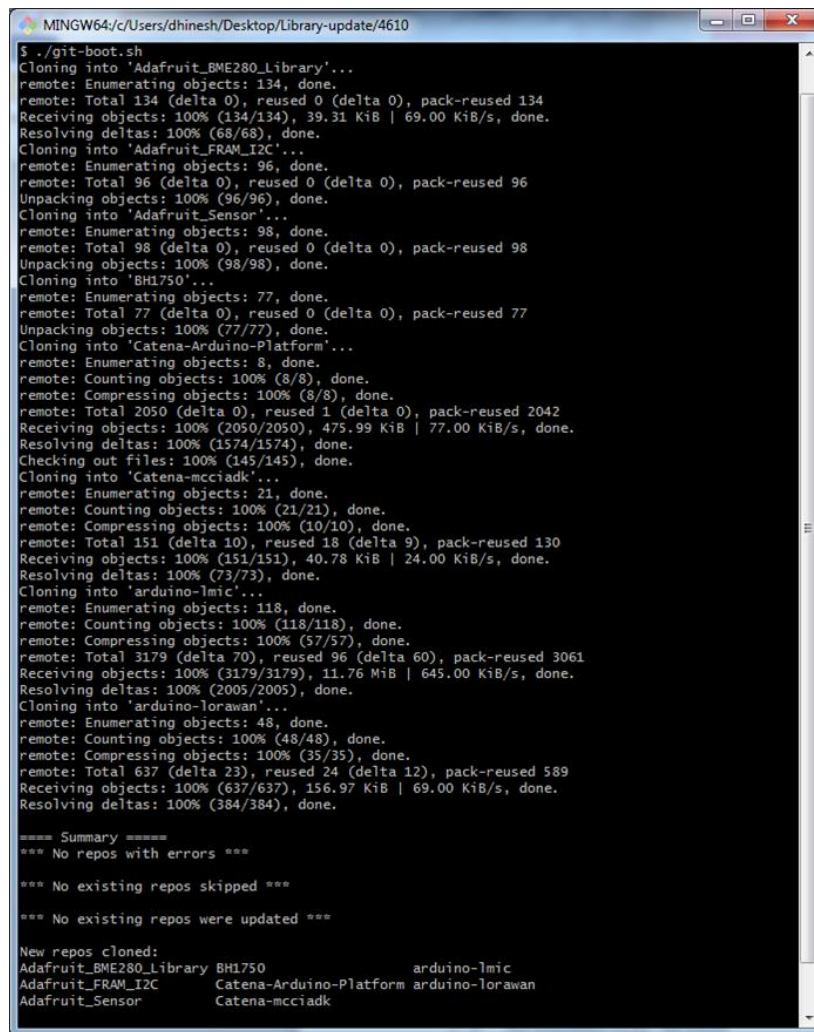
- Catena-Arduino-Platform
- Catena-mcciadk
- arduino-lorawan
- arduino-lmic
- Adafruit\_BME280\_Library

- 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 13 to clone using the script git-boot.sh.

Figure 13 Cloning libraries using the script



```
MINGW64/c/Users/dhinesh/Desktop/Library-update/4610
$ ./git-boot.sh
Cloning into 'Adafruit_BME280_Library'...
remote: Enumerating objects: 134, done.
remote: Total 134 (delta 0), reused 0 (delta 0), pack-reused 134
Receiving objects: 100% (134/134), 39.31 KiB | 69.00 KiB/s, done.
Resolving deltas: 100% (68/68), done.
Cloning into 'Adafruit_FRAM_I2C'...
remote: Enumerating objects: 96, done.
remote: Total 96 (delta 0), reused 0 (delta 0), pack-reused 96
Unpacking objects: 100% (96/96), done.
Cloning into 'Adafruit_Sensor'...
remote: Enumerating objects: 98, done.
remote: Total 98 (delta 0), reused 0 (delta 0), pack-reused 98
Unpacking objects: 100% (98/98), done.
Cloning into 'BH1750'...
remote: Enumerating objects: 77, done.
remote: Total 77 (delta 0), reused 0 (delta 0), pack-reused 77
Unpacking objects: 100% (77/77), done.
Cloning into 'Catena-Arduino-Platform'...
remote: Enumerating objects: 8, done.
remote: Counting objects: 100% (8/8), done.
remote: Compressing objects: 100% (8/8), done.
remote: Total 2050 (delta 0), reused 1 (delta 0), pack-reused 2042
Receiving objects: 100% (2050/2050), 475.99 KiB | 77.00 KiB/s, done.
Resolving deltas: 100% (1574/1574), done.
Checking out files: 100% (145/145), done.
Cloning into 'Catena-mcciadc'...
remote: Enumerating objects: 21, done.
remote: Counting objects: 100% (21/21), done.
remote: Compressing objects: 100% (10/10), done.
remote: Total 151 (delta 10), reused 18 (delta 9), pack-reused 130
Receiving objects: 100% (151/151), 40.78 KiB | 24.00 KiB/s, done.
Resolving deltas: 100% (73/73), done.
Cloning into 'arduino-lmic'...
remote: Enumerating objects: 118, done.
remote: Counting objects: 100% (118/118), done.
remote: Compressing objects: 100% (57/57), done.
remote: Total 3179 (delta 70), reused 96 (delta 60), pack-reused 3061
Receiving objects: 100% (3179/3179), 11.76 MiB | 645.00 KiB/s, done.
Resolving deltas: 100% (2005/2005), done.
Cloning into 'arduino-lorawan'...
remote: Enumerating objects: 48, done.
remote: Counting objects: 100% (48/48), done.
remote: Compressing objects: 100% (35/35), done.
remote: Total 637 (delta 23), reused 24 (delta 12), pack-reused 589
Receiving objects: 100% (637/637), 156.97 KiB | 69.00 KiB/s, done.
Resolving deltas: 100% (384/384), done.

==== Summary ====
*** No repos with errors ***
*** No existing repos skipped ***
*** No existing repos were updated ***

New repos cloned:
Adafruit_BME280_Library BH1750 arduino-lmic
Adafruit_FRAM_I2C Catena-Arduino-Platform arduino-lorawan
Adafruit_Sensor Catena-mcciadc
```

## 9.2 Arduino IDE Setup

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

1. Open the example [catena4612\\_simple](#) in Arduino IDE. Go to File>Preferences>Settings. Add

*"[https://github.com/mcci-catena/arduino-boards/raw/master/BoardManagerFiles/package\\_mcci\\_index.json](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 4610 in Arduino IDE.
5. **MCCI Catena STM32 Boards** should be installed from the Boards Manager.
6. Once the board has been installed, **Catena 4610** board has to be selected under **MCCI Catena STM32 Boards**.

Figure 14 BSP Search

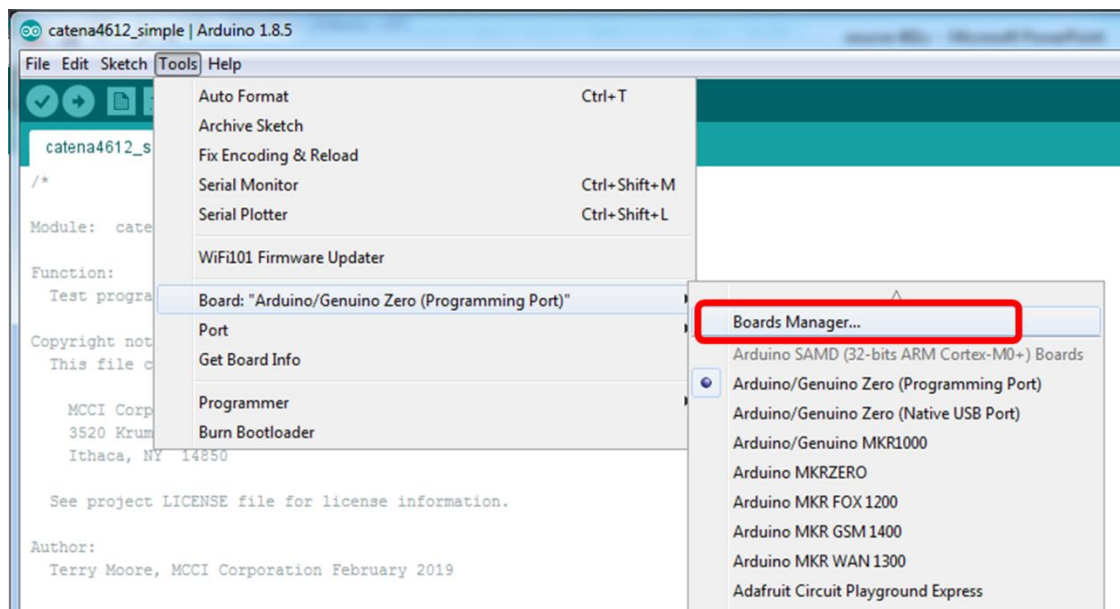


Figure 15 BSP Installation



Figure 16 BSP Installed

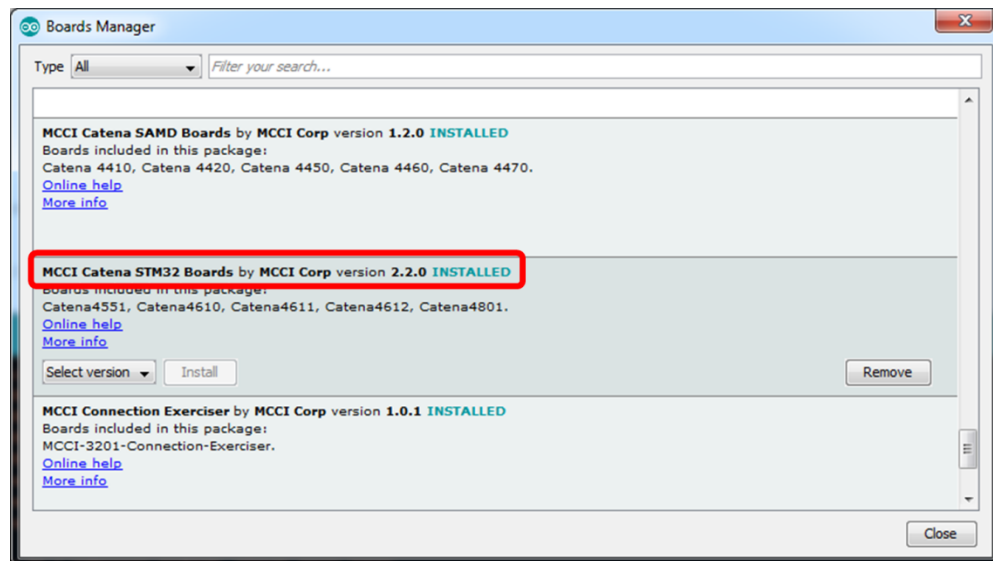
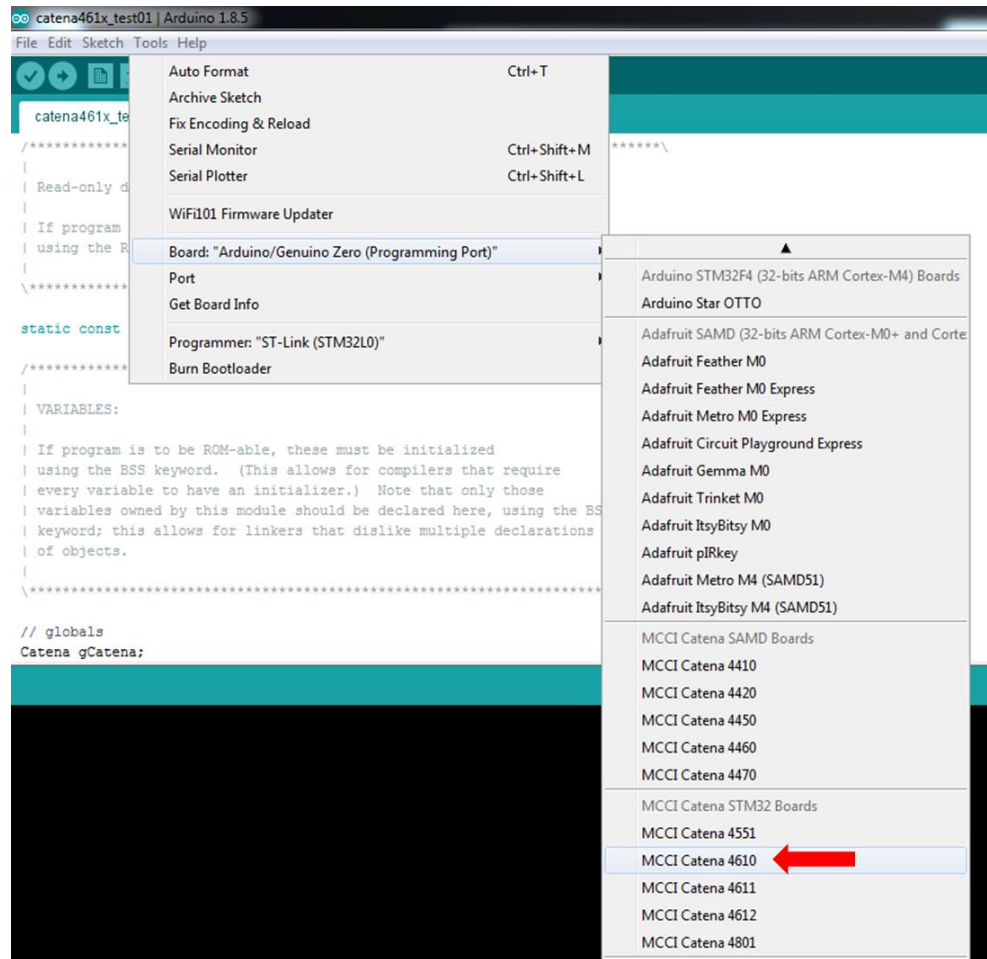


Figure 17 Selection of device from list of boards



7. Enable USB Serial/Generic 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

## 9.3 Programming Methods

Catena 4610 programming includes two methods

- I. ST-Link
- II. DFU

### 9.3.1 ST-Link

Catena 4610 uses ST-Link V2 programmer for programming the firmware. Below is the connection between 4610 and ST-Link programmer

Figure 18 Catena 4610 connection with PC using STLink Debugger



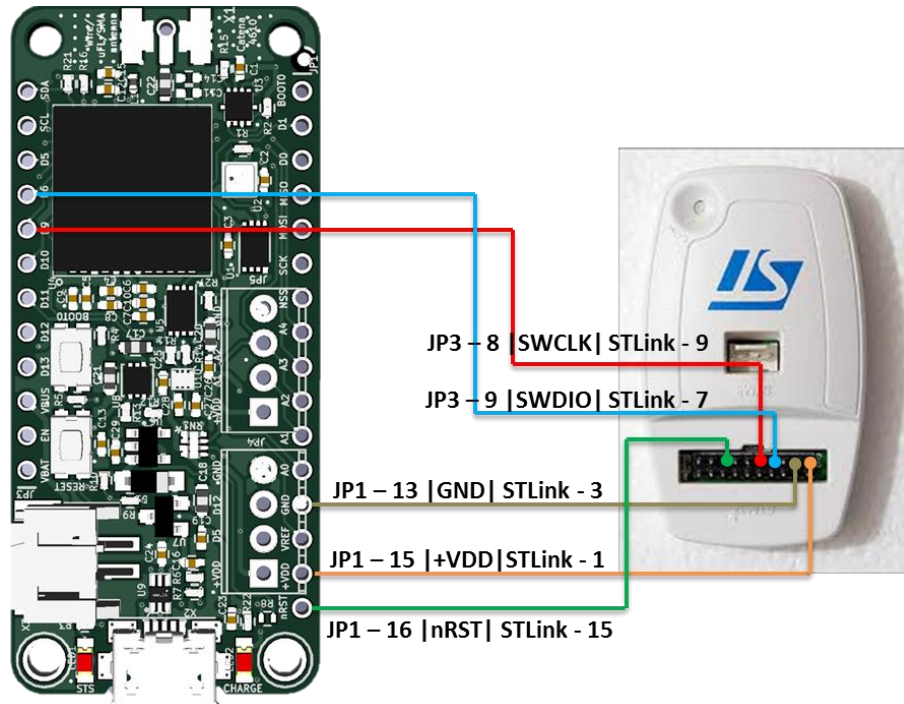
Pin configurations of the ST-Link debugger with Catena 4610 are mentioned in Table 3

Table 3 Catena 4610 to STLink connection

Catena 4610 ST-Link connection		
Pin Names	ST-Link Pin Numbers	4610 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



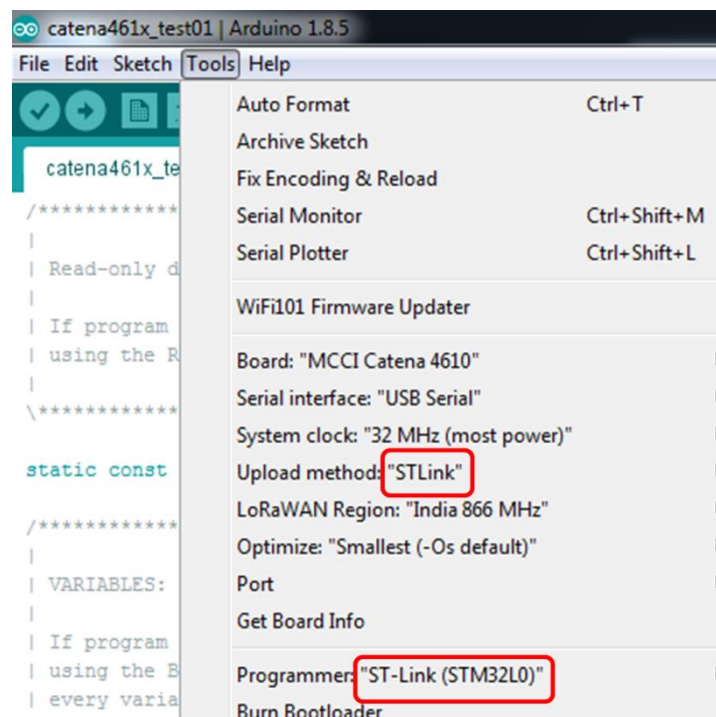
Figure 19 Catena 4610 connection with ST Link programmer



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

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

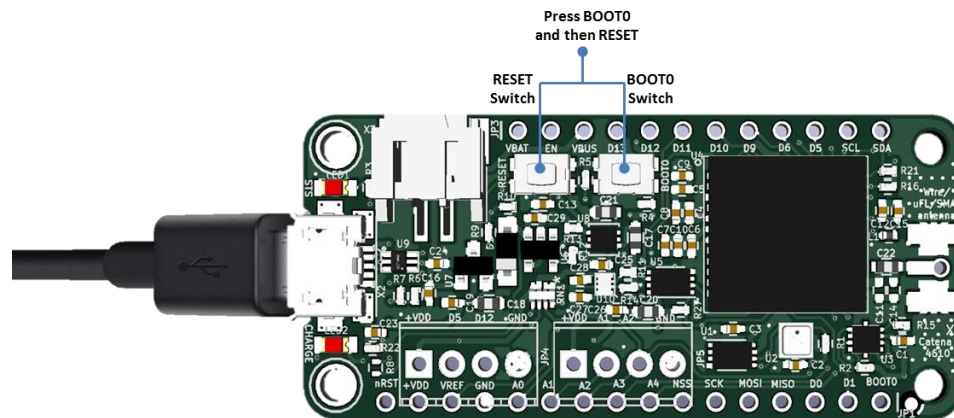
Figure 20 Configuration for upload using STLink programmer



### 9.3.2 DFU

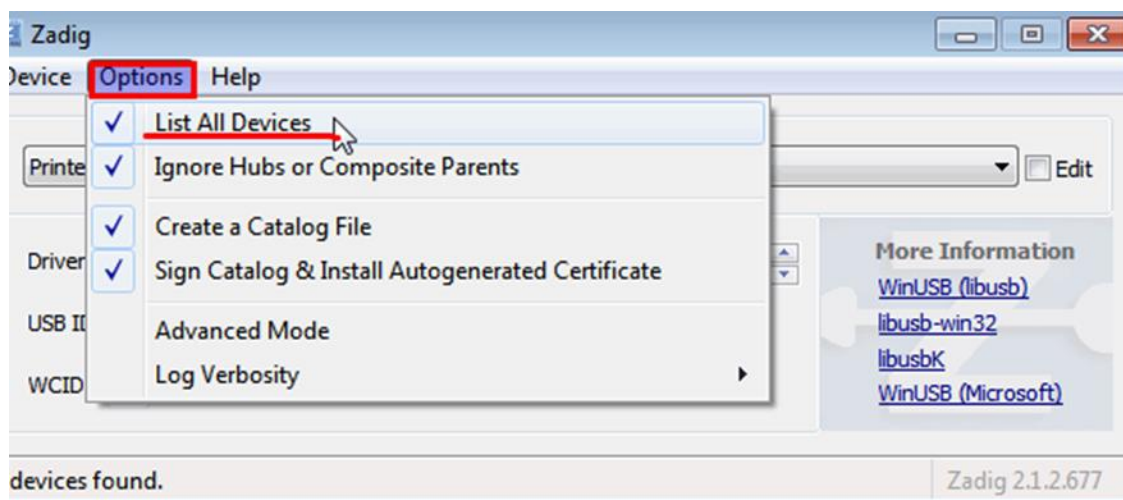
1. Program the Catena 4610 using DFU mode, this mode requires Zadig tool the download link is mentioned above.
2. Once the tool is downloaded, Catena 4610 have to be configured to DFU mode (STM Bootloader) by pressing button BOOT0 and then RESET immediately.

Figure 21 Catena 4610 DFU Mode Connection



3. On the Zadig terminal - Select **Options -> List All devices** as shown

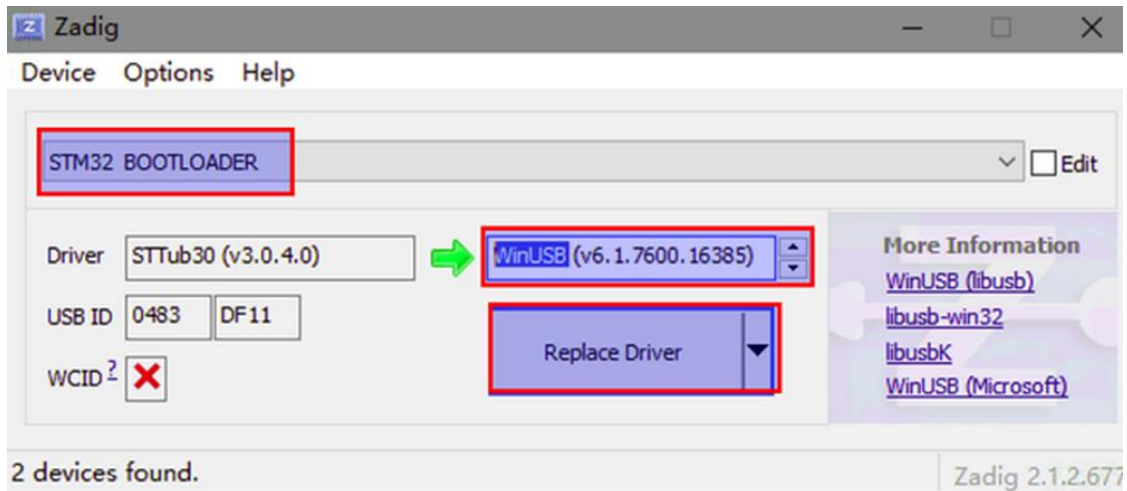
Figure 22 Zadig Device Selection



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



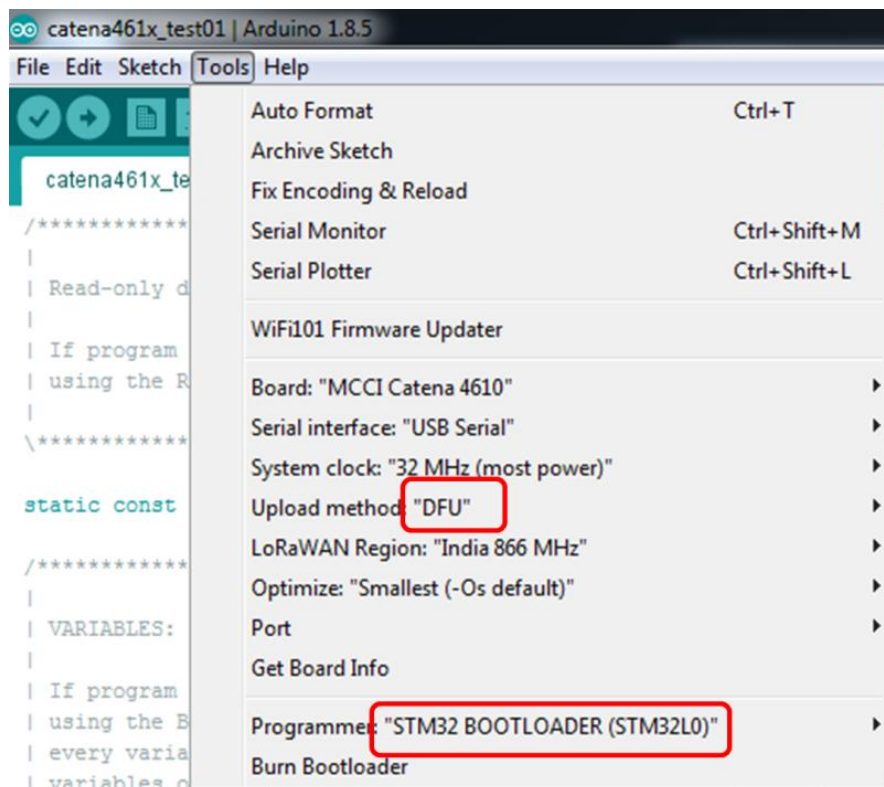
Figure 23 Zadig driver replacement



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

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

Figure 24 Configuration for upload using DFU mode



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

## **9.4 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](https://github.com/mcci-catena/Catena-Sketches/tree/master/catena4450m101_sensor#provision-your-catena-4450)

**Note: use platformguid “53ca094b-b888-465e-aa0e-e3064ec56d21”**

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