



CAT NB2 NB-IOT & GNSS USB DONGLE

USB Dongle BG95-M3 Technical Specifications & User Manual



Purpose of the Document

The purpose of this document is to explain the technical specifications and manual for using the Cat NB2 NB-IoT & GNSS USB Dongle.

Document History

Version	Author	Date	Description
A	5G HUB	08.12.2020	Initial Document
B	5G HUB	02.28.2021	Add download Section
C	5G HUB	05.17.2022	Add Arduino support Section

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1 Package contents:

1.1 Cat NB2 NB-IoT USB Dongle Package:

- Cat NB2/Cat M USB dongle with LTE & GNSS antenna connectors.

1.2 Download

Arduino software can be downloaded from the following website:

[5G-NB-IoT/KitSketches at master · 5ghub/5G-NB-IoT \(github.com\)](https://github.com/5ghub/5G-NB-IoT)

To use the board with Arduino IDE and starts running Arduino projects and sketches, install the following software:

Install Arduino IDE for Windows from the following web site

<https://www.arduino.cc/en/Main/Software>

Download and Install LTE&GNSS modem driver for Windows OS:

<https://github.com/5ghub/5G-NB-IoT/tree/master/Driver>

Download and Install QNavigator and QCOM tools for Quectel BG95 here:

<https://github.com/5ghub/5G-NB-IoT/tree/master/Tools>

Download and install Arduino library (**5G-NB-IoT_Arduino.zip**) here:

<https://github.com/5ghub/5G-NB-IoT>

All the following software can be installed from the GitHub location here:

<https://github.com/5ghub/5G-NB-IoT>

[LTE cellular connectivity on Windows OS for BG95](#)

2 General Description

2.1 Overview

The Cat NB2 USB dongle is a cellular and GPS modem in an USB stick form factor. The USB dongle has UFL connectors for LTE & GNSS antennas. The board is a powerful board that features a microcontroller and wireless modem. The microcontroller is an Atmel's SAMD21G18A MCU which features a 32-bit ARM Cortex® M0+ core. The wireless modem is BG95-M3 which is an embedded Cat NB2 wireless communication module. BG95 wireless modem provides a maximum data rate of 588 Kbps downlink and 1119 Kbps uplink. It provides data connectivity on LTE-FDD/GSM/EGPRS networks. It also provides GNSS to meet customers' specific application demands

The USB dongle provides rich sets of Internet protocols, industry-standard interfaces (USB/UART/I²C/Status Indicator) and abundant functionalities. The board offer a high integration level and enables integrators and developers to easily design their applications and take advantage of the board low power consumption, many functionalities, and USB drivers for Windows 7/8/8.1/10, Linux and Android.

The USB dongle is a rich hardware board that can be used for the 4G LTE wireless technology and enables a variety of smart applications for devices. It enables large number of applications such as wireless POS, smart metering, tracking, smart transportation, smart buildings, smart city, and smart homes.

The board is also compatible with Arduino and Arduino software (IDE). Arduino sketches and examples are provided with the kit and additional sketches can be developed and uploaded to the board.

2.2 Key Features

- Atmel ATSAMD21G18 MCU
- Quectel BG95-M3 Cat NB2/Cat M NB-IoT module
- UFL connectors for LTE & GNSS antenna
- Supports LTE NB-IoT and Machine Type Communications (MTC)
- Supports EGPRS
- Global Frequency Band B1/B2/B3/B4/B5/B8/B12/B13/B18/B19/B20/B25/B28/B66/B71/B85 (B26/B27 for Cat.M1) for LTE and 850/900/1800/1900MHz for EGPRS
- Supports the protocols TCP/UDP/PPP/ SSL/ TLS/ FTP(S)/ HTTP(S)/ NITZ/ PING/ MQTT
- Supports SMS
- Supports GNSS technology (GPS, GLONASS, BeiDou/Compass, Galileo, QZSS)
- Compact board size of 65.1 mm x 32mm
- Nano USIM card slot
- Arduino IDE Compatible
- Works with Windows, Linux, or Android
- Ready for smart applications and development (smart home, smart city, smart transportation, smart metering, smart farming, smart waste management, asset tracking, location, navigation, mapping, and timing applications). Application such as Gas Detector, Soil PH Tester, Optical Sensor, Machinery Alarm System, Irrigation Controller, Elevator, Asset Tracking Electronics, Person/Pet Tracking, Water/Gas Metering, Smart Parking System, Fire Hydrant, Smoke Alarm, Trash Bin, Street Lighting
- The board can be powered via the USB connector

- Each of the 14 general purpose I/O pins on the board can be used for digital input or digital output using [pinMode\(\)](#), [digitalWrite\(\)](#), and [digitalRead\(\)](#) functions. Pins used for PWM can be using [analogWrite\(\)](#) function. All pins operate at 3.3 volts. Each pin can source or sink a maximum of 10 mA and has an internal pull-up resistor (disconnected by default) of 20-60 K ohm.

2.3 Overview Diagrams



Figure 1. USB Dongle Overview Diagram – Top View

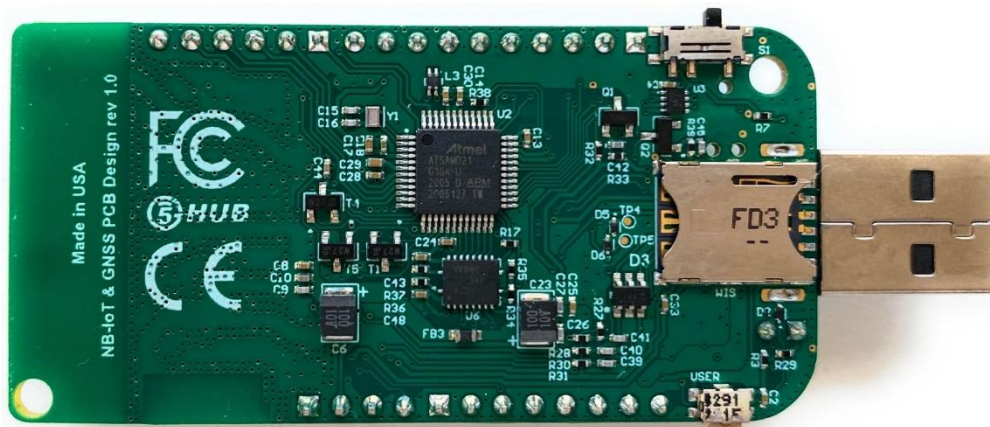


Figure 2. USB Dongle Overview Diagram – Bottom View

2.4 Physical Characteristics

The width and length of the USB dongle is 32 mm (width) by 65.1 mm (length). The board have two screw holes in each corner that allows the board to be attached to a surface or case.

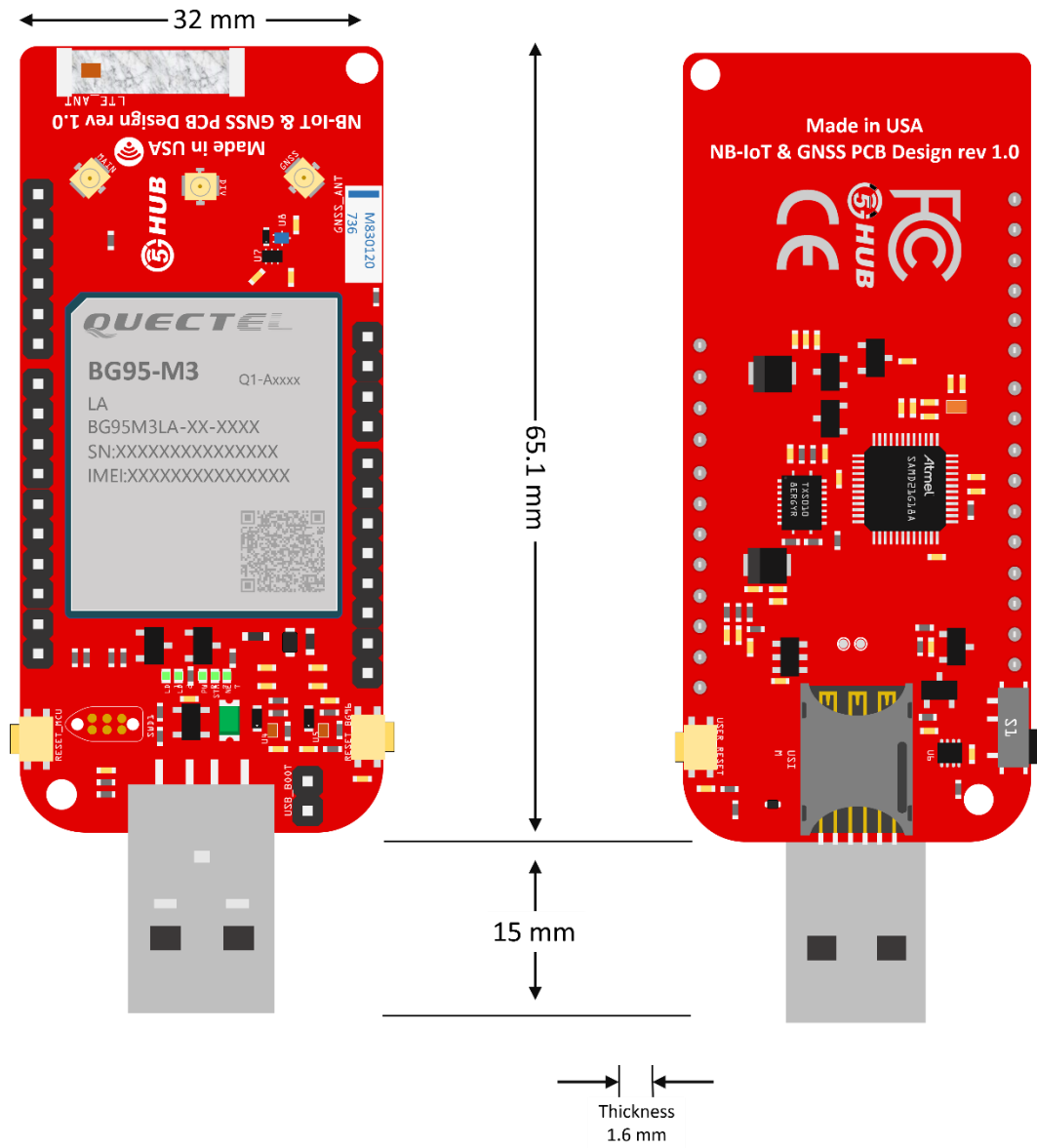


Figure 3. Physical Characteristics.

2.5 Peripherals – Key Components

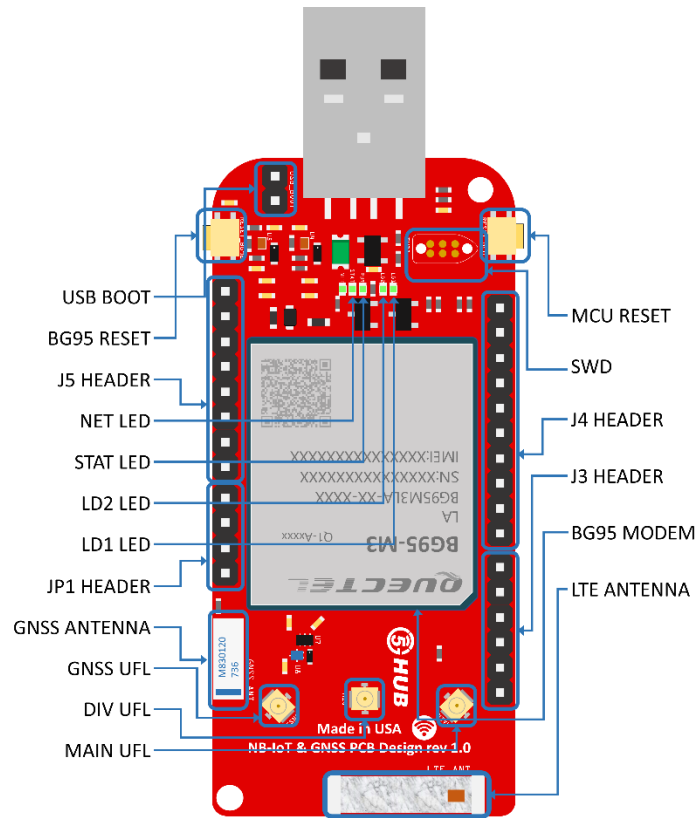


Figure 4. USB Dongle Top Side – Key Components

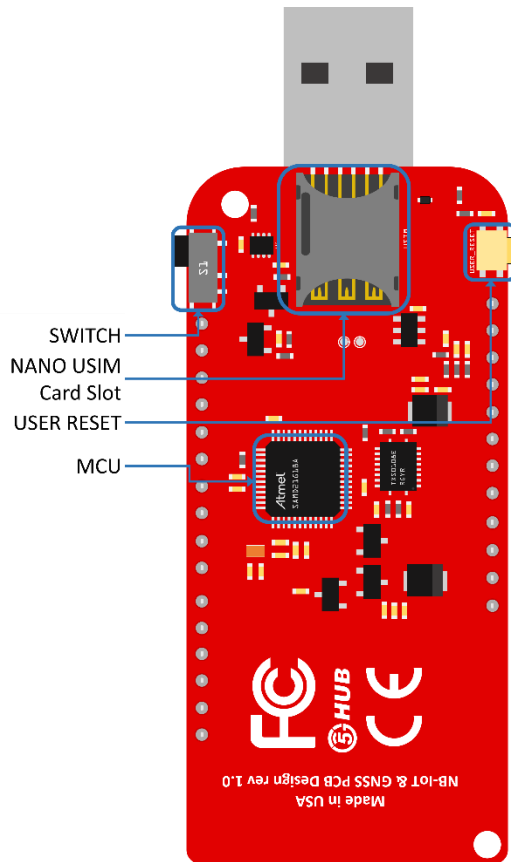


Figure 5. USB Dongle Bottom Side – Key Components

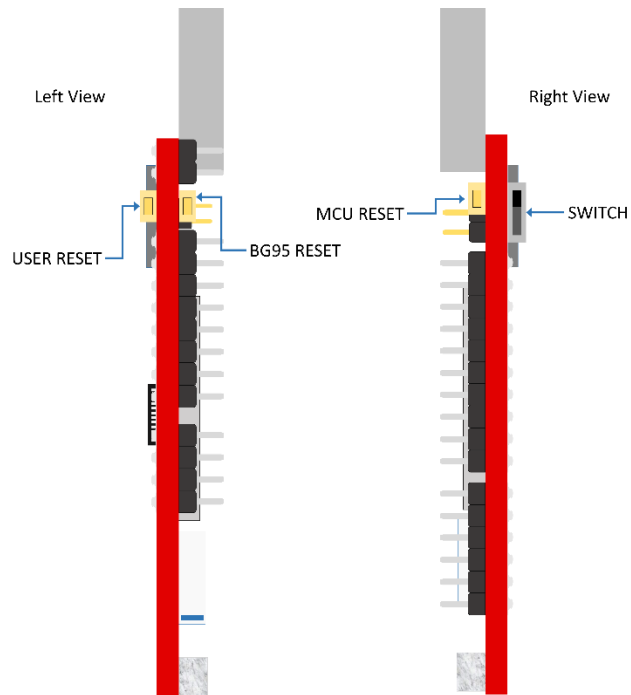


Figure 6. USB Dongle Side View – Key Components

2.6 Peripherals – IO Connections

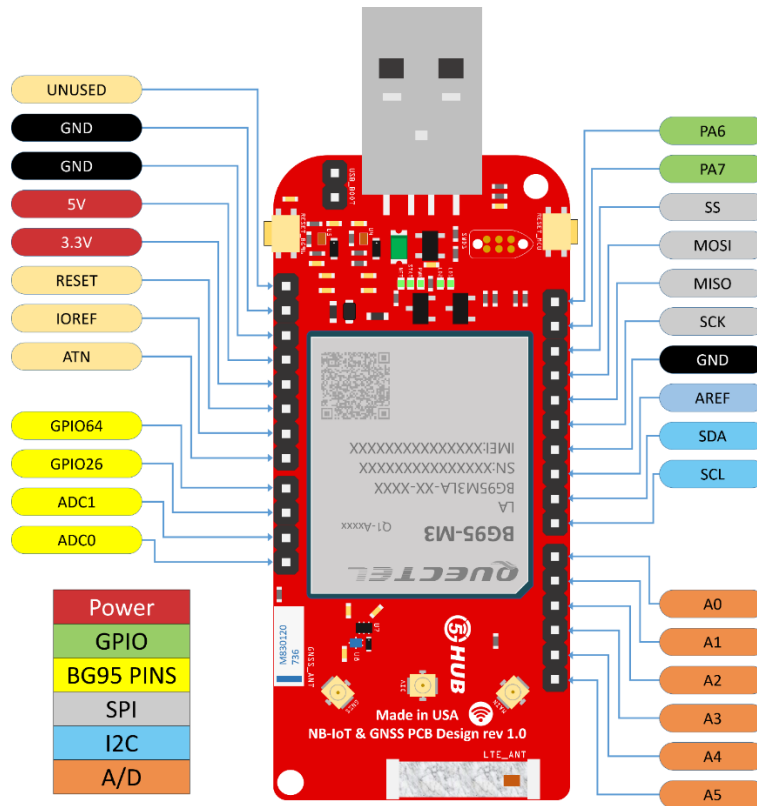


Figure 7. USB Dongle Connectors

* I²C interface lines might be configured as USART interface (SDA line can work then as USART TXD and SCL line can work as USART RXD)

** MOSI and SCK lines might be configured as USART interface (MOSI line can work then as USART TXD and SCK line can work as USART RXD)

2.7 Hardware Specification

Technical Specification	
Microcontroller (MCU)	Atmel ATSAMD21G18, 32-Bit ARM Cortex M0+
Clock Speed	48 MHz
Flash Memory	256 KB
SRAM	32 KB
NB-IoT Module	Quectel BG95-M3
Dimension	30 mm (width) by 65 mm (length)
Weight	22 grams
Power Supply	USB (5V)
LED	LED1, LED2, Status LED, Netlight LED
Interfacing Logic Voltage Level (Operating Voltage)	3.3V
Voltage output	5V, 3.3V
RESET buttons	Two; one for MCU and one for BG95
User-defined Button	1 connected to MCU
USB Switch	1 switch to connect to MCU directly or BG95 directly
General-purpose digital I/O Pins	14 (A0-A5, PA6, PA7, SS, MOSI, MISO, SCK, SDA, SCL)
GPIO	2 connected to BG95
ADC	2 connected to BG95
USB	1
I ² C	1
SPI	1
UART	1
ADC pins	6 (8/10/12-bit ADC channels)
DAC pin	1 (10-bit DAC)
External interrupts	14 (All general-purpose PINs)
PWM pin	6
DC Current per I/O Pin	10 mA
JTAG Debug	Cortex Debug Connector (Single Wire Debug)
USIM	Nano
GNSS	GPS, GLONASS, BeiDou/Compass, Galileo, QZSS
Antenna	1 main antenna and 1 GPS antenna
Band	LTE-FDD: B1/B2/B3/B4/B5/B8/B12/B13/B18/B19/B20/B25/B28/B66/B71/B85 (B26/B27 for Cat.M1) GSM/EGPR: 850/900/1800/1900MHz
Certification	FCC, IC, CE
Mobile Operator Certification	Verizon, AT&T, T-Mobile, Vodafone, Rogers, Telus, China telecom, China Mobile, China Unicom

Notes:

- UART can be programmed through any of general-purpose pins.
- SPI can be programmed through any of general-purpose pins.

2.8 PIN Description

PIN	DIRECTION	Description
USB Connector	I	The USB dongle is powered from the USB port (3.8V-5V)
LED1 (USER)	O	LED which can be controlled from MCU (D25). When the pin is HIGH value, the LED is on, when the pin is LOW, it is off
LED2 (USER)	O	LED which can be controlled from MCU (D26). When the pin is HIGH value, the LED is on, when the pin is LOW, it is off
LED (NET)	O	Indicate the BG95 operation status
LED (STAT)	O	Indicate the BG95 network activity status
MCU RESET button	I	Reset the MCU
BG95 RESET button	I	Reset the BG95 module
User Button	I	Connected to digital pin, D0, of MCU and can be used for user-defined purposes
USB Switch	I	1 switch to connect to MCU directly or BG95 directly
IOREF	O	Provides the voltage reference with which the MCU operates. A device can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs for working with the 5V or 3.3V
3.3V	O	3.3V generated by the on-board regulator. Maximum current drawn is 3A. The regulator also provides power to the MCU and BG95
5V	O	5V generated from the board. The board is supplied with power from USB connector (typical 5V)
GND		Ground
A0	IO	Six analog inputs which can provide up to 12 bits of resolution (i.e. 4096 different values). By default, each input measures from ground to 3.3 volts, though is it possible to change the upper end of their range using the AREF pin A0 can also be used as a DAC output and provides a 10 bit voltage output with analogWrite() function Analog pins can be used as GPIOs
A1	IO	
A2	IO	
A3	IO	
A4	IO	
A5	IO	
SCL	IO	I ² C. The SCL (clock line). Can be used as GPIO
SDA	IO	I ² C. The SDA (data line). Can be used as GPIO
AREFA	I	Input reference voltage for the analog inputs used for either the ADC or the DAC
SCK	IO	SPI Interface. Can be used as GPIO
MISO	IO	SPI Interface. Can be used as GPIO
MOSI	IO	SPI Interface. Can be used as GPIO
SS	IO	SPI Interface. Can be used as GPIO
PA7	IO	GPIO. Can be used as GPIO

PA6	IO	GPIO. Can be used as GPIO
Cortex Debug Connector	IO	Using Single Wire Debug to burn bootloader and debug the board
ADC0	I	Connected to BG95. General purpose analogue to digital converter
ADC1	I	Connected to BG95. General purpose analogue to digital converter
GPIO26	IO	Connected to BG95. General purpose IO
GPIO64	IO	Connected to BG95. General purpose IO
USIM	I	Used to insert a Nano USIM. Connected to BG95
USB Boot	I	Connected to BG95. Force the BG95 to enter emergency download mode

Precaution

The USB dongle runs at 3.3V. The maximum voltage that the I/O pins can tolerate is 3.3V. Applying voltages higher than 3.3V to any I/O pin could damage the board

2.9 BG95 chipset

All functionality of the BG95 chipset shall be implemented excluding the following features. That is, the following features are not supported **Error! Reference source not found.****Error! Reference source not found..**

- Audio, Earphone, and Codes are not supported.
- PCM and I²C are not supported
- PSM_IND and AP_READY are not supported

2.10 Interface between SAM21D and BG95

The Microcontroller communicates with the BG95 through UART interfaces:

- **UART1:** (PA12/PA13/PA14/PA15). Used for data transmission and AT command communication 115200bps by default. The default frame format is 8N1 (8 data bits, no parity, 1 stop bit) Support RTS and CTS hardware flow control.
- **UART3:** (PB23/PB22). Used for outputting GNSS data or NEMA sentences 115200bps baud rate.

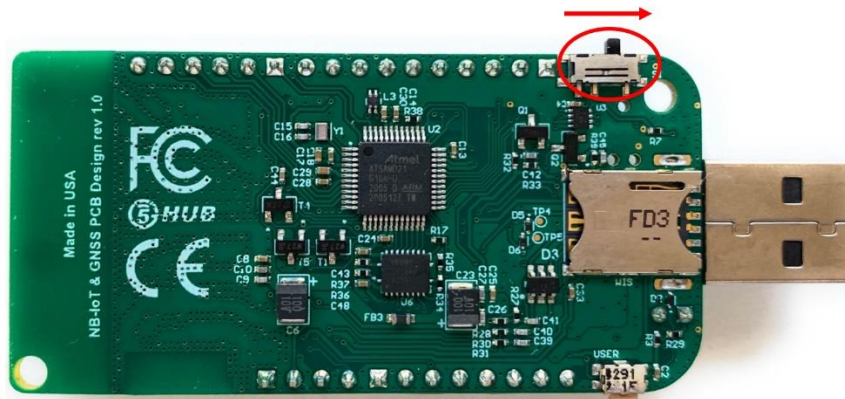
3 Using the Board with Arduino IDE

3.1 Installing the Software

To use the board with Arduino IDE and starts running Arduino projects and sketches, install the following software:

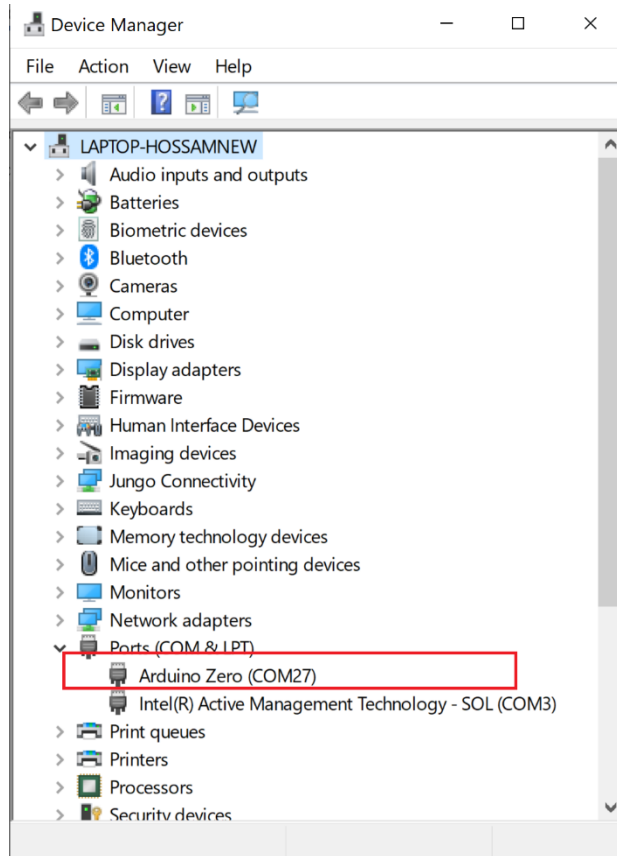
3.2 Setting Up the Board

Gently move the switch S1 upward to put the board in Arduino mode as in the picture below.



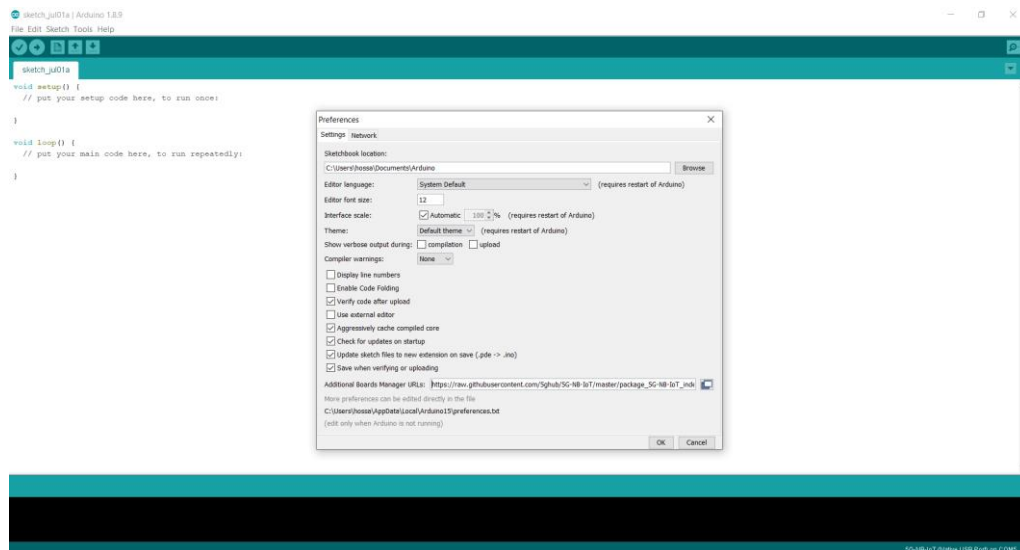
3.3 Setting Up Arduino IDE

- 1- Insert the USB dongle into the USB port of a computer. Launch Windows device manager and you shall see the Arduino board as below.

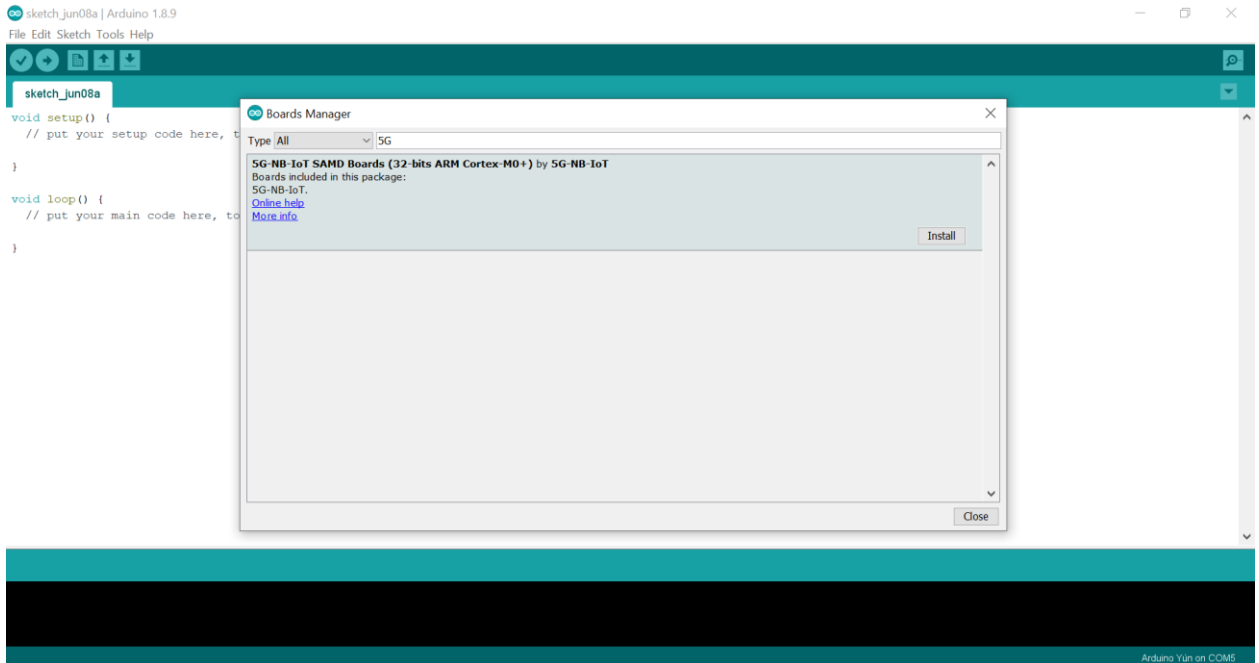


2- Launch Arduino IDE and choose **File->Preferences**. In the Additional Boards Manager URLs, insert the following URL:

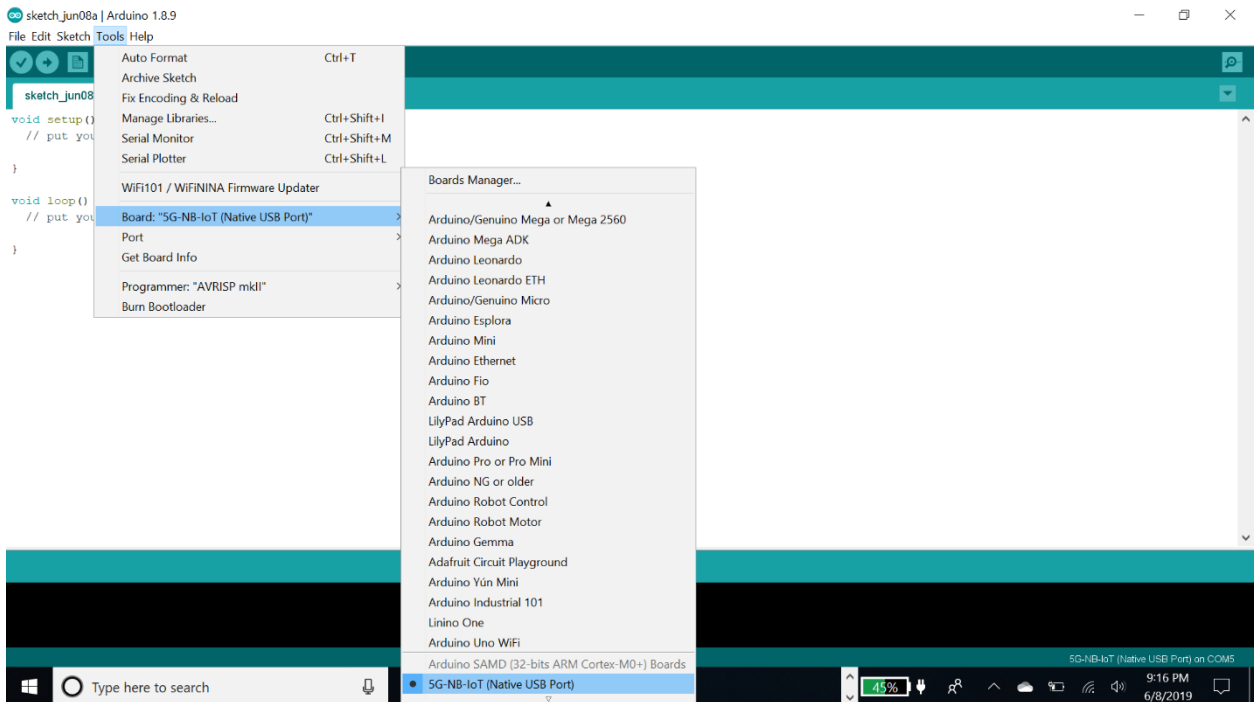
https://raw.githubusercontent.com/5ghub/5G-NB-IoT/master/package_5G-NB-IoT_index.json



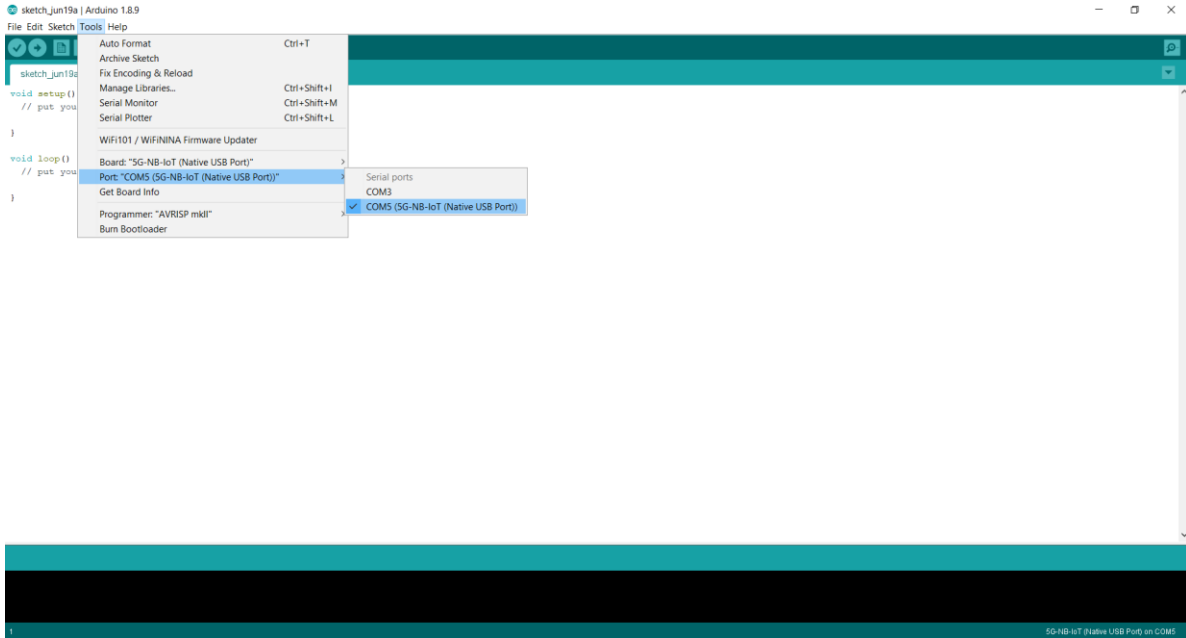
3- In Arduino IDE, choose **Tools->Board->Boards Manager**, select and install "5G-NB-IoT SAMD Boards".



4- Choose “5G NB-IoT (Native USB Port)”

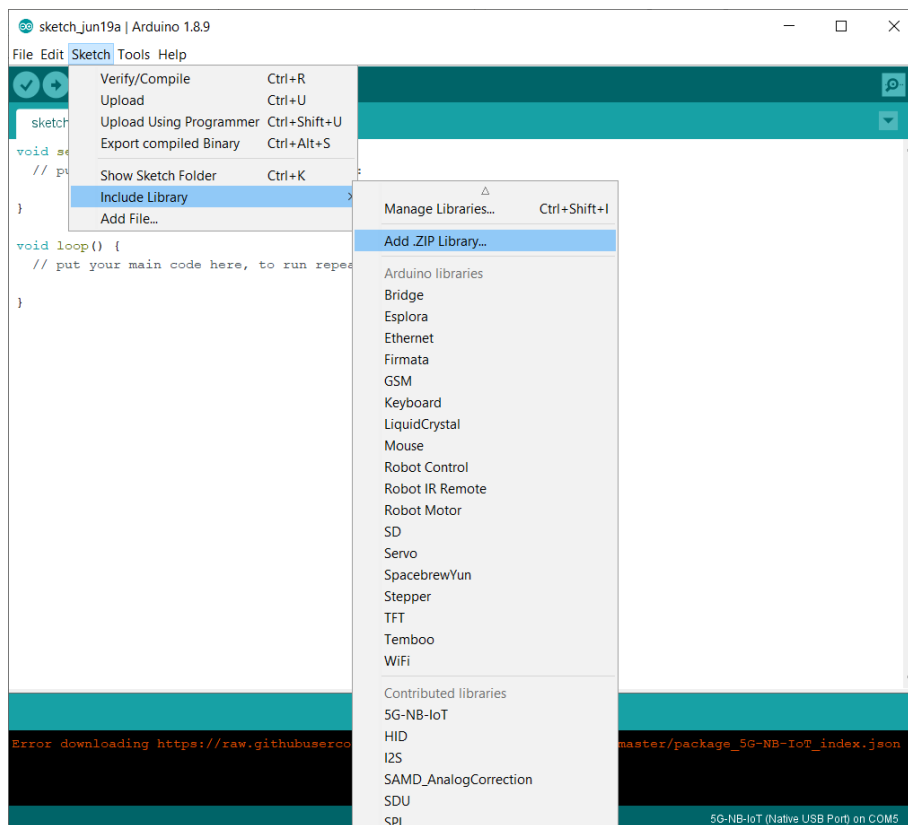


5- In the Arduino IDE, Choose **Port** and select the serial port where the board appears.



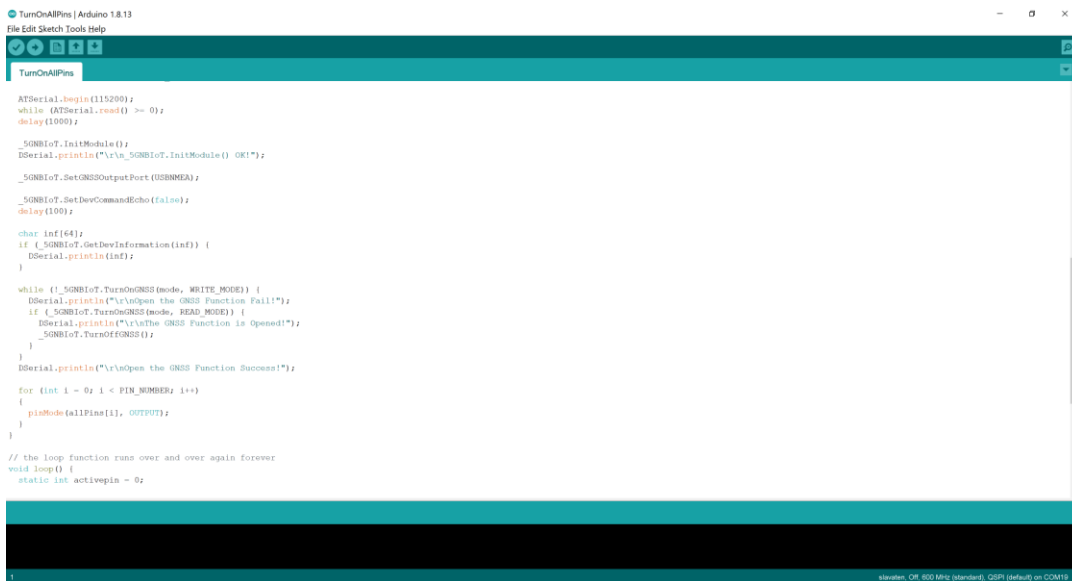
6- In the Arduino IDE, Choose **Sketch->Include Library->Add .Zip Library** and select the file **5G-NB-IoT_Arduino.zip**

You are now ready to start running Arduino sketches and projects.



3.4 Running Arduino Sketch

- 1- Using Arduino IDE, open any Arduino sketch such as **TurnOnAllPins.ino**, choose **Sketch->Upload** and it will run on the USB dongle.



```
TurnOnAllPins | Arduino 1.8.13
File Edit Sketch Tools Help

TurnOnAllPins

ATSerial.begin(115200);
while (ATSerial.read() >= 0);
delay(1000);

_SONBiOT.InitModule();
DSerial.println("\n\n_SONBiOT.InitModule() OK!");
_SONBiOT.SetGNSSOutputPort (GSNNMEA);

_SONBiOT.SetDevCommandEcho (false);
delay(1000);

char inf[64];
if (_SONBiOT.GetDevInformation(inf) {
  DSerial.println(inf);
}

while (!_SONBiOT.TurnOnGNSS(mode, WRITE_MODE)) {
  DSerial.println("\n\nOpen the GNSS Function Fail!");
  if (_SONBiOT.TurnOnGNSS(mode, READ_MODE)) {
    DSerial.println("\n\nThe GNSS Function is Opened!");
    _SONBiOT.TurnOffGNSS();
  }
}
DSerial.println("\n\nOpen the GNSS Function Success!");

for (int i = 0; i < PIN_NUMBER; i++)
{
  pinMode(allPins[i], OUTPUT);
}

// the loop function runs over and over again forever
void loop() {
  static int activepin = 0;
```