USB MODEM LTE CAT 4/CAT1 & GNSS

USB Modem EG95NA, EG95EX, EG91NA, EG91NAX Technical Specifications & User Manual

Purpose of the Document

The purpose of this document is to explain the technical specifications and manual for using the LTE Cat 4/Cat 1 USB modem.

Document History

Version	Author	Date	Description
A	5G HUB	08.12.2020	Initial Document
B	5G HUB	09.12.2023	Add EG95NA, EG95EX, and EG91NAX

Table of Contents

1 Package contents:

1.1 LTE Cat. 4 USB Modem Package:

- USB modem with LTE & Diversity & GNSS antenna connectors.
- USB modem comes with either one of the following modem modules:
    - EG95NA: Cat 4 for North America
    - EG95EX: Cat 4 for Europe, Middle East, and Africa
    - EG91NAX: Cat 1 for North America

1.2 Download

Arduino software can be downloaded from the following website:
5G-NB-IoT/KitSketches at master · 5ghub/5G-NB-IoT (github.com)

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

2 General Description

2.1 Overview

The LTE Cat 4 USB modem is a cellular and GPS modem in a USB stick form factor. The USB modem has UFL connectors for LTE & Diversity & 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 EG9x which is an embedded LTE Cat 4 or LTE Cat 1 wireless communication module. EG9x wireless modem provides a maximum data rate of 150Mbps downlink and 50 Mbps uplink for Cat 4 and 10 Mbps downlink and 5 Mbps uplink for Cat 1. It provides data connectivity on LTE-FDD/HSPA/WCDMA networks. It also provides GNSS to meet customers' specific application demands.

The USB modem provides rich sets of Internet protocols, industry-standard interfaces (USB/UART/I^2C/Status Indicator) and abundant functionalities. The board offers 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 modem 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 many 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

- Microchip SAMD21G18 ARM Cortex® M0+ MCU
- Quectel EG95NA (Cat 4) or EG95EX (Cat 4) or EG91NAX (Cat 1) module
- Supports LTE/HSPA/WCDMA
- Supports GPS, GLONASS, BeiDou, Galileo, QZSS
- LTE & Diversity & GNSS UFL antenna connector
- Supports receiver diversity (MIMO 2x2)
- Nano USIM card slot
- Supports the protocols TCP/UDP/PPP/ SSL/ TLS/ FTP(S)/ HTTP(S)/ NITZ/ PING/ MQTT
- Supports SMS
- Supports AT commands
- Compact board size of 65.1 mm x 32mm
- Window, Linux, Android software drivers
- Arduino IDE Compatible
- 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 RF Bands:

- EG95NA: North America
  - LTE-FD: B2/B4/B5/B12/B13
  - WCDMA: B2/B4/B5
  - GSM/EDGE: -
- EG95EX: Europe, Middle East, Africa
  - LTE-FD: B1/B3/B7/B8/B20/B28
  - WCDMA: B1/B8
  - GSM/EDGE: B3/B8
- EG91NAX: North America
  - LTE-FD: B2/B4/B5/B12/B13/B25/B26
  - WCDMA: B2/B4/B5
  - GSM/EDGE: -

2.4 Overview Diagrams

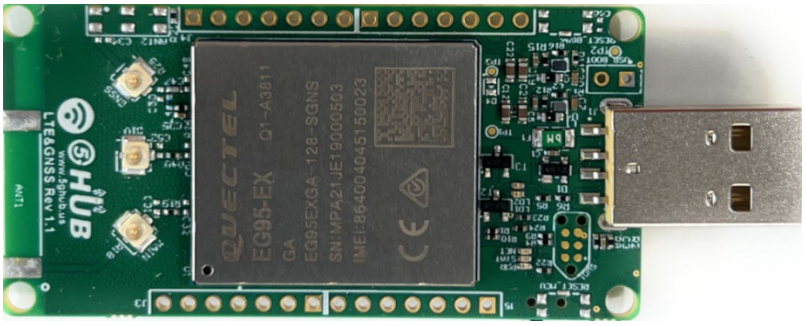


Figure 1. USB Modem Overview Diagram (EG95NA/EG95EX/EG91NAX)– Top View

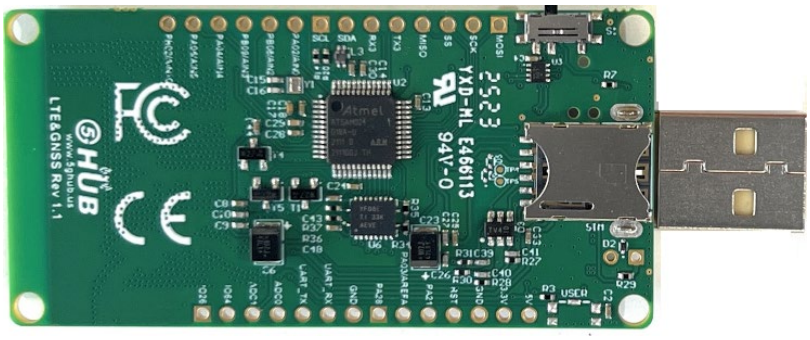


Figure 2. USB Modem Overview Diagram (EG95NA/EG95EX/EG91NAX)– Bottom View

2.5 Physical Characteristics

The width and length of the USB modem is 32 mm (width) by 65 mm (length). The board have two screw holes in each corner that allows the board to be attached to a surface or case.

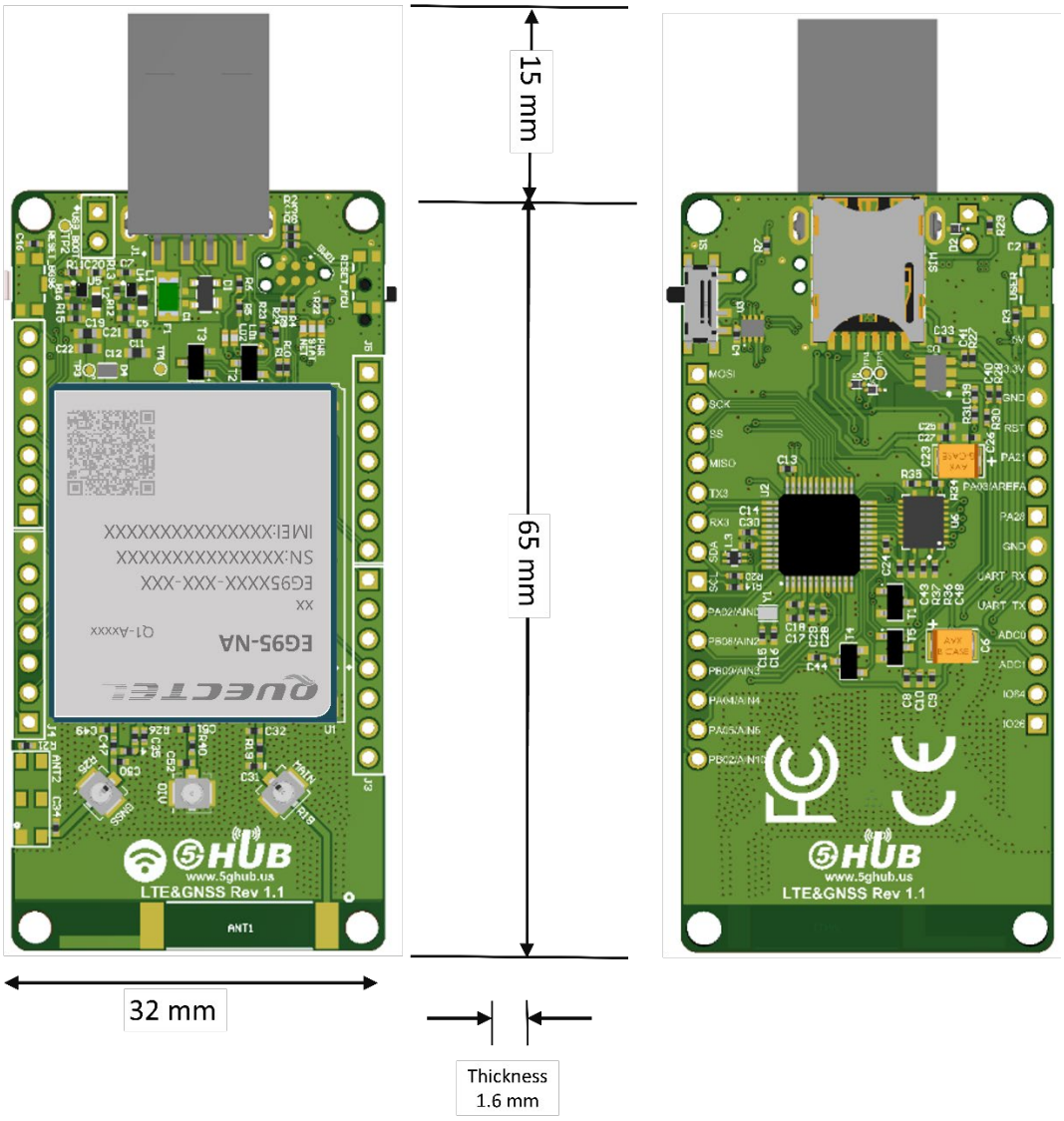


Figure 3. Physical Characteristics.

2.6 Peripherals – Pin out

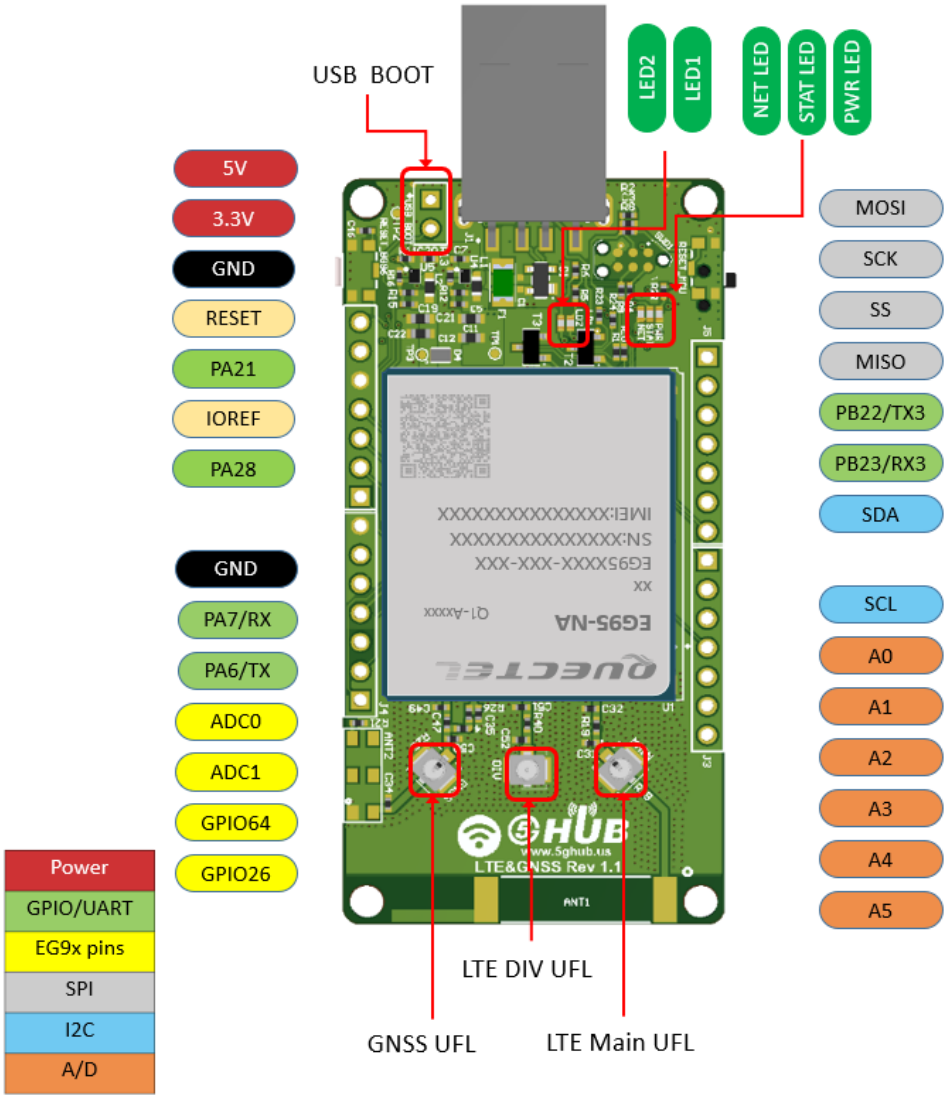


Figure 4. USB Modem Top Side (EG9x)

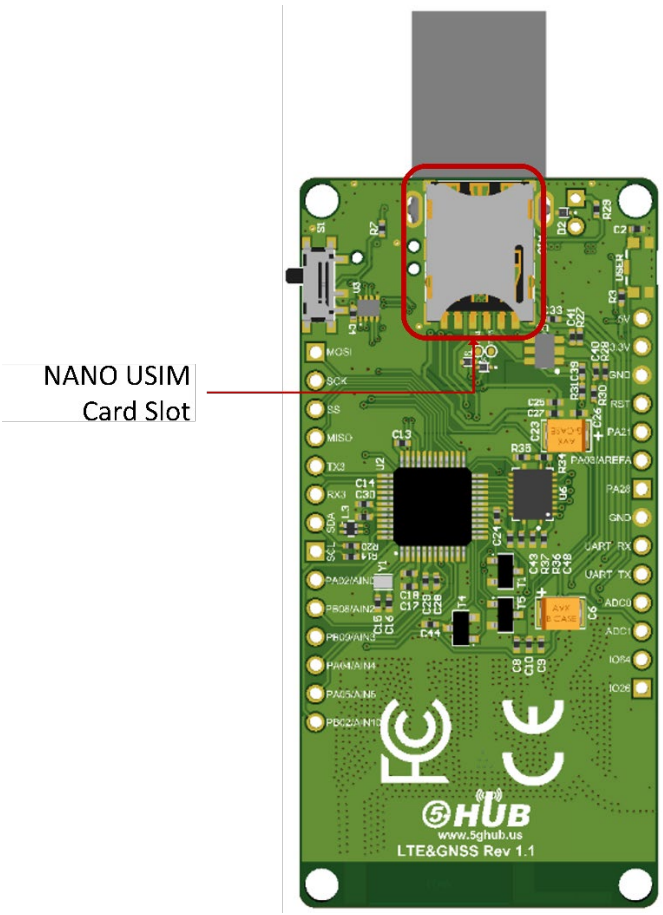


Figure 5. USB Modem Bottom Side

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 EG95NA/EG95EX/EG91NAX
Dimension	32 mm (width) by 65 mm (length)
Weight	22 grams
Power Supply	USB (5V)
LED	LED1, LED2, PWR LED, Status LED, Netlight LED
Interfacing Logic Voltage Level (Operating Voltage)	3.3V
Voltage output	5V, 3.3V
RESET buttons	Not Mounted
User-defined Button	Not Mounted
USB Switch	1 switch to connect to MCU directly or EG9x directly
General-purpose digital I/O Pins	14 (A0-A5, PA6, PA7, SS, MOSI, MISO, SCK, SDA, SCL)
GPIO	2 connected to EG95NA/EG95EX/EG91NAX
ADC	2 connected to EG95NA/EG95EX/EG91NAX
USB	1
I^2C	1
SPI	1
UART	2
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, 1 Diversity, and 1 GNSS
Band	LTE-FDD: B2/B4/B5/B12/B13 HSPA/WCDMA: B2/B4/B5
Certification	GCF/ FCC/ PTCRB/ IC
Mobile Operator Certification	Verizon/AT&T/T-Mobile/Telus/U.S. Cellular/Rogers/Telus

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 modem 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 EG9x operation status
LED (STAT)	O	Indicate the EG9x network activity status
MCU RESET button	I	Not mounted
EG95 RESET button	I	Not mounted
User Button	I	Not mounted
USB Switch	I	1 switch to connect to MCU directly or EG95 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 EG9x
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^2C. The SCL (clock line). Can be used as GPIO
SDA	IO	I^2C. The SDA (data line). Can be used as GPIO
AREFA	I	Input reference voltage for the analog inputs used for either he 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
TX/TX3	IO	GPIO or UART
RX/RX3	IO	GPIO or UART
PA21/PA28	IO	GPIO
Cortex Debug Connector	IO	Using Single Wire Debug to burn bootloader and debug the board

ADC0	I	Connected to EG95. General purpose analogue to digital converter
ADC1	I	Connected to EG95. General purpose analogue to digital converter
GPIO26	IO	Connected to EG95. General purpose IO
GPIO64	IO	Connected to EG95. General purpose IO
USIM	I	Used to insert a Nano USIM. Connected to EG95
USB Boot	I	Connected to EG9x. Force the EG9x to enter emergency download mode

Precaution

The USB modem 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 EG95NA/EG95EX/EG91NAX chipset

All functionality of the EG9x module shall be implemented excluding the following features. That is, the following features are not supported:

- Audio, Earphone, and Codes are not supported.
- PCM and I^2C are not supported.
- PSM_IND and AP_READY are not supported.

2.10 Interface between SAM21D and EG95NA/EG95EX/EG91NAX

The Microcontroller communicates with the EG95 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.
- **RI/DCD:** (PB10/PB11).

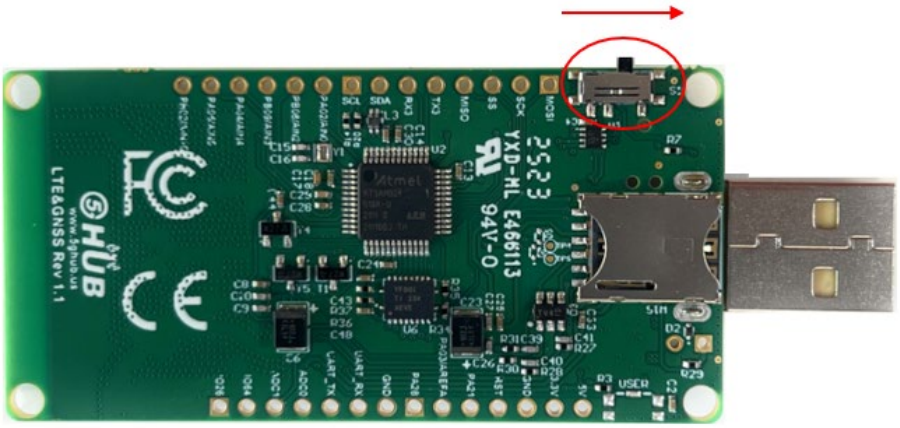
3 Using the Board with Arduino IDE

3.1 Installing the Software

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

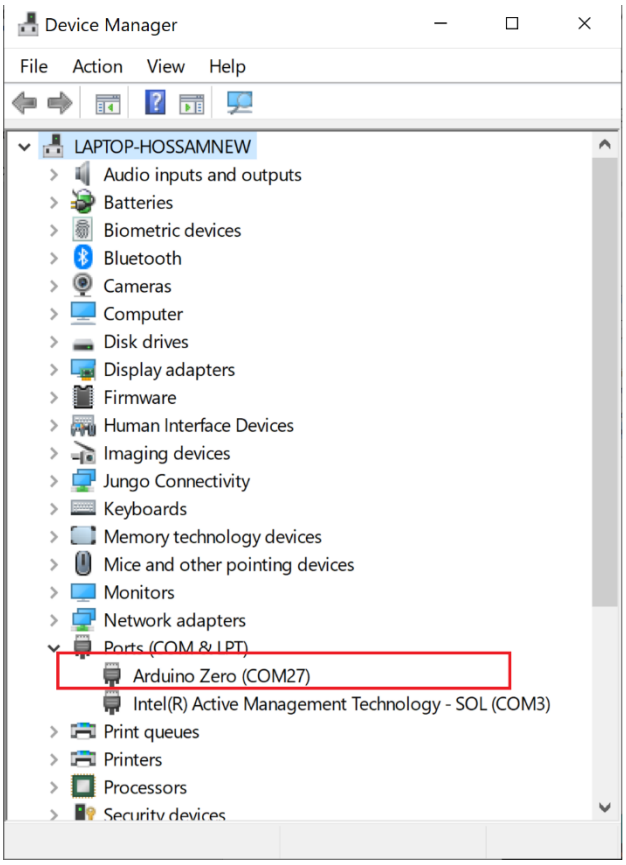
3.2 Setting Up the Board

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

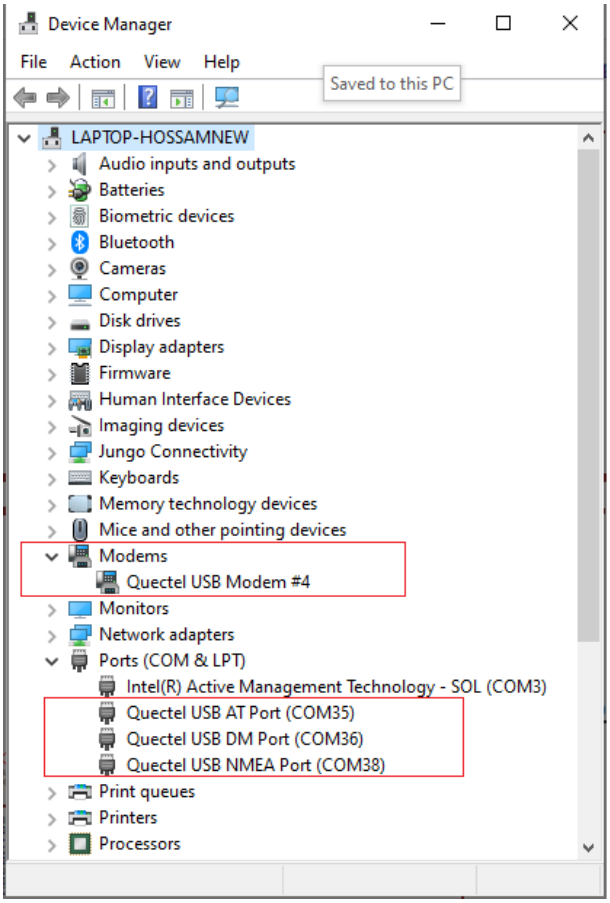


3.3 Setting Up Arduino IDE

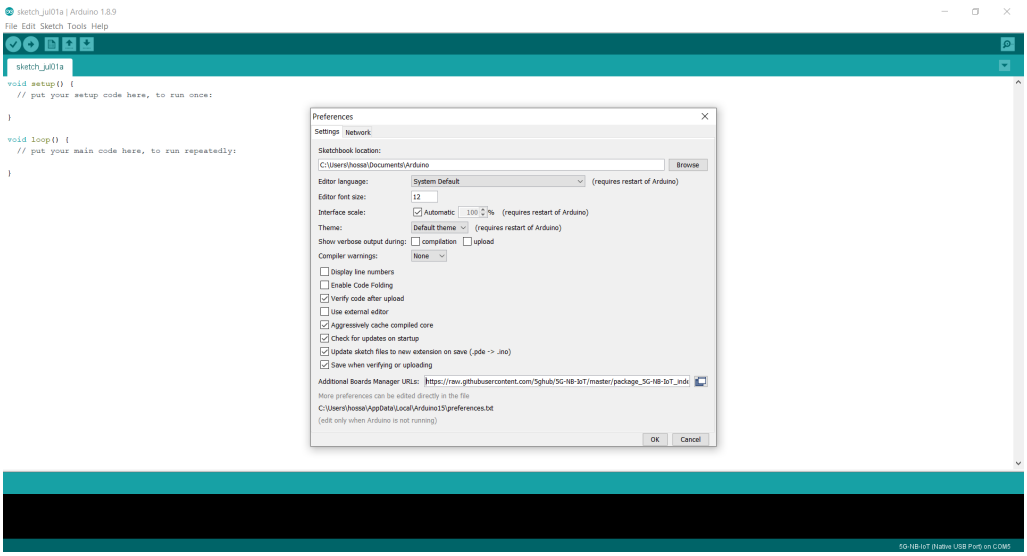
1- Insert the USB modem into the USB port of a computer. Launch Windows device manager and you shall see the Arduino board as below.



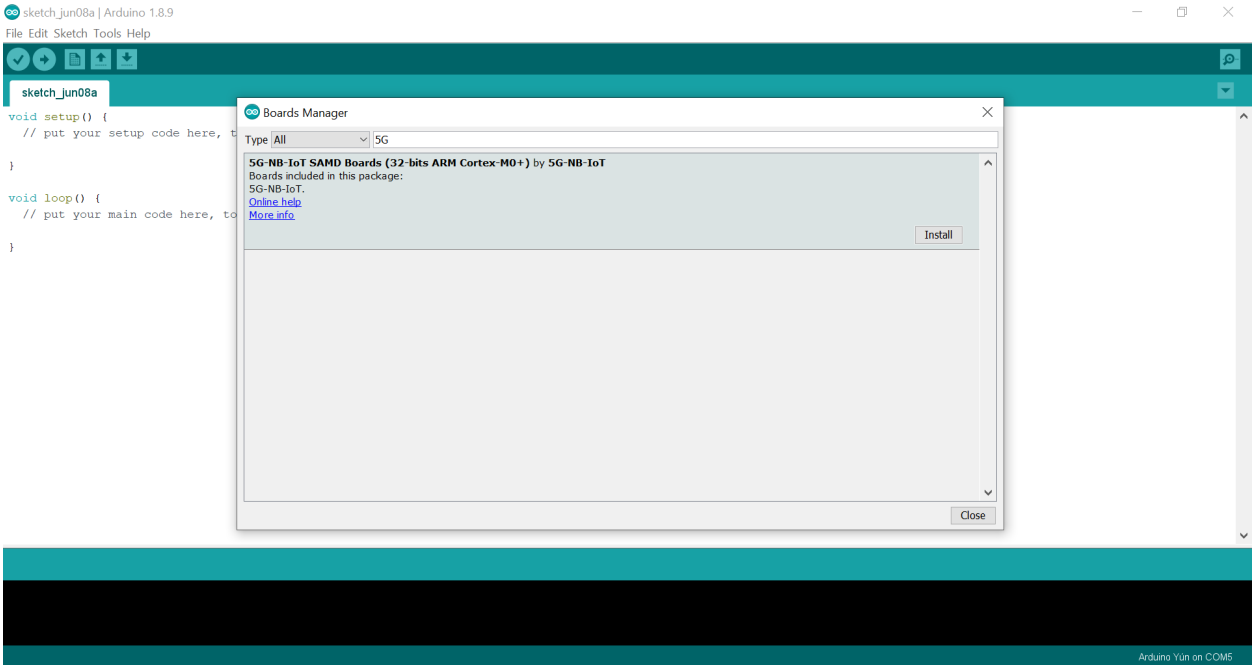
When the switch is positioned into the EG9x USB, Windows device manager shows the following ports



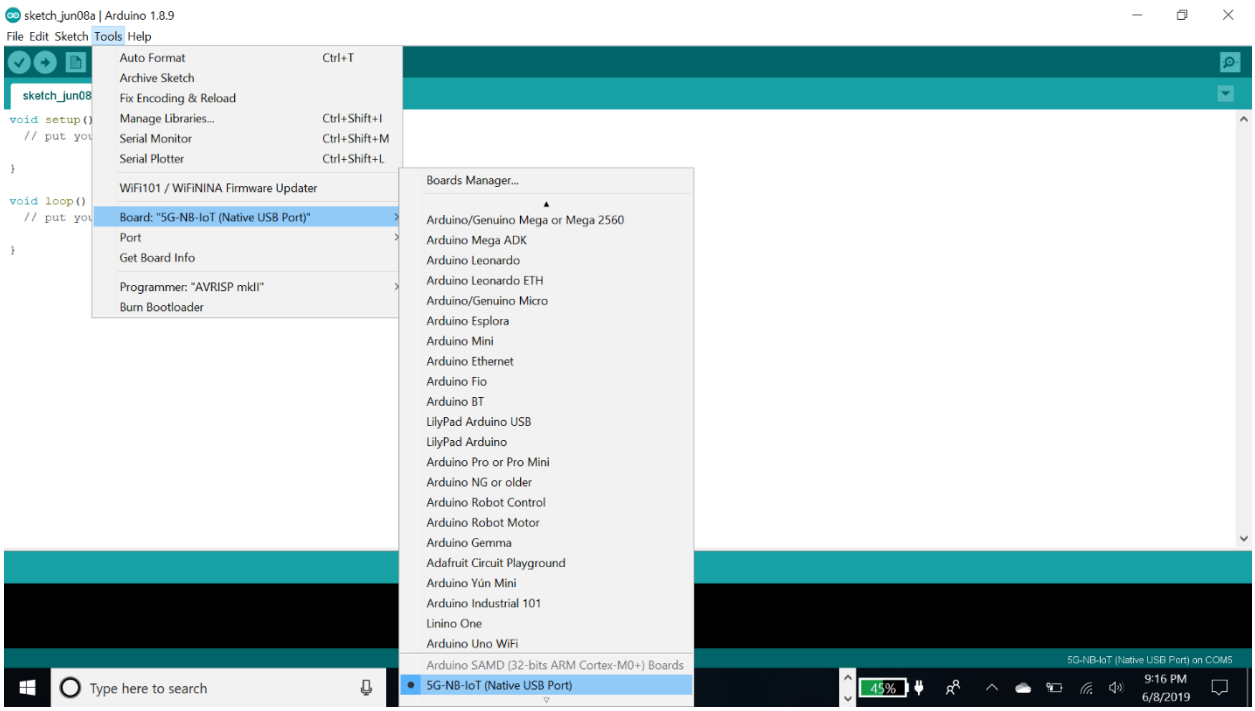
2- Launch Arduino IDE and choose **File->Preferences**. In the Additional Boards Manager URLs, insert the following URL:
https://raw.githubusercontent.com/5ghub/5G-NB-IoT/master/package_5G-NB-IoT_index.json



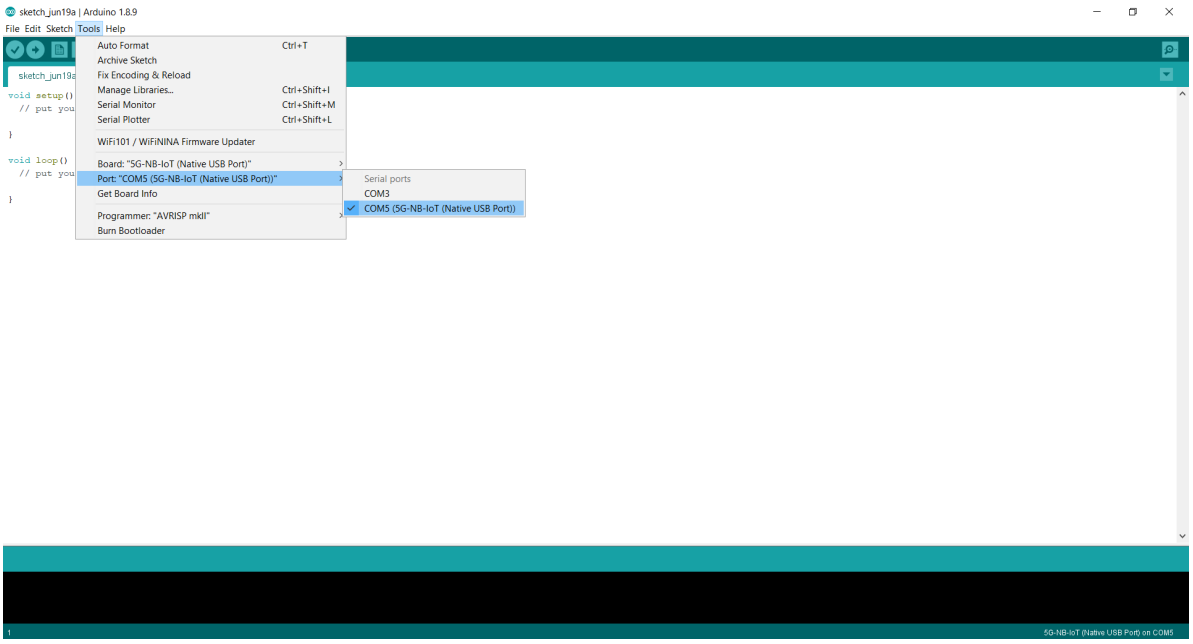
3- In Arduino IDE, choose **Tools->Board->Boards Manager**, select and install "**5G-NB-IoT SAMD Boards**".



4- Choose "**5G NB-IoT (Native USB Port)**"

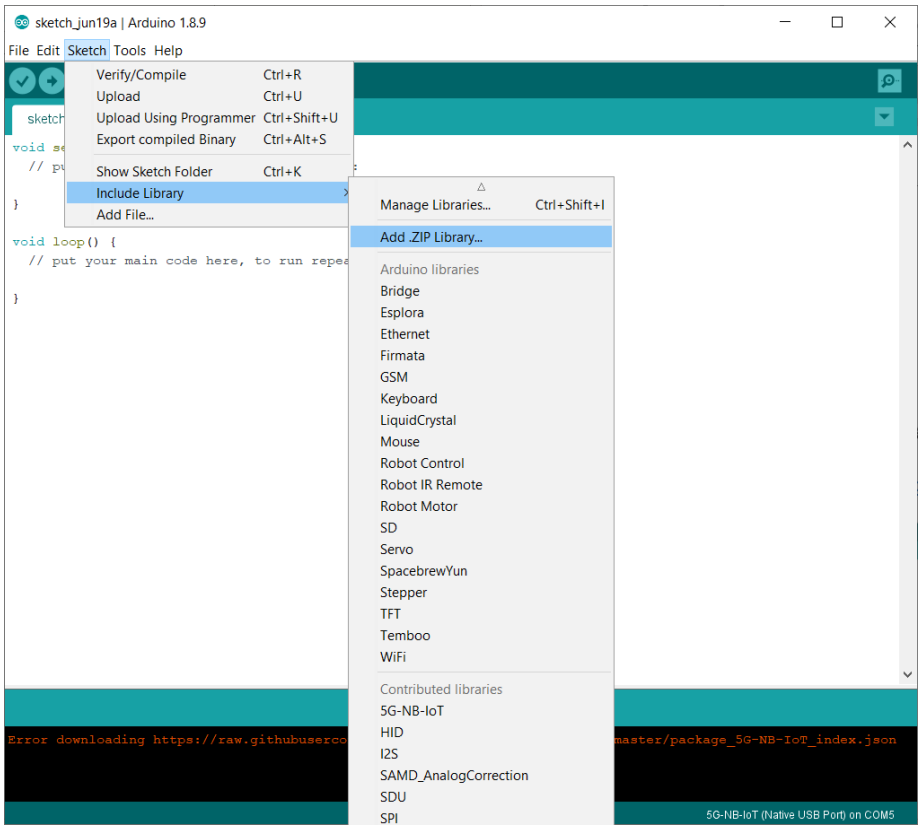


5- In the Arduino IDE, Choose **Port** and select the serial port where the board appears.



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 modem.