



simsquare Cat.M1 Module

Hands-On Guide

- Arduino -

version 1.0

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- CAT.M1 Features
- CAT.M1 Hardware Component and Architecture
- CAT.M1 How-to Guide for Development(AT Command)
- CAT.M1 Practice (Download, Basic, Socket, Cloud)

1. Cat.M1 Generic Features - LPWA

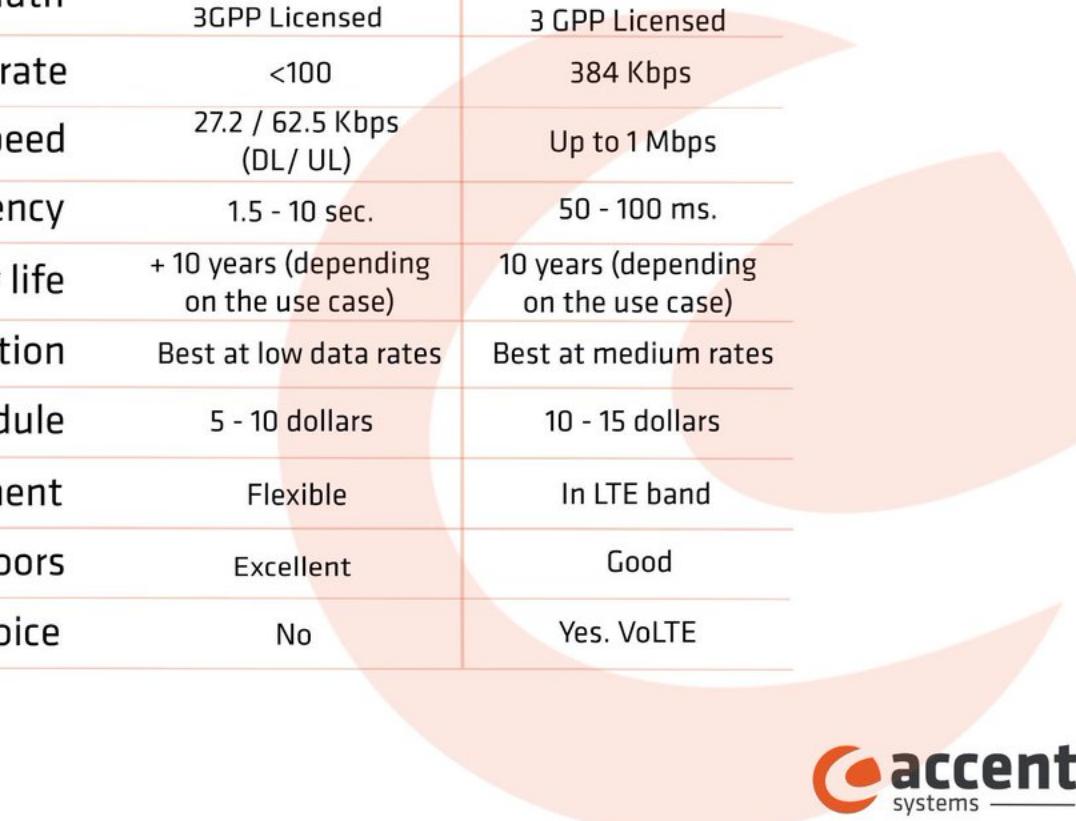
LPWA – the technical knockout

	NON-CELLULAR		CELLULAR	
	LoRaWAN	Sigfox	NB-IoT	LTE-M
Bandwidth	125kHz	100Hz	200kHz	1.08MHz
Coverage	165dB	165dB	164dB	156dB
Cell capacity	40,000	1 million	200,000	1 million
Payload capacity	243 bytes	12 / 8 bytes (UL / DL)	1600 bytes	-
Battery life	15+ yrs	15+ yrs	10+ yrs	10+ yrs
Throughput	50kbps	600bps	200kbps	1mbps
Two-way comms	Yes	Yes	Yes	Yes
Security	AES 128 bit	AES 128 bit	3GPP (128-256 bit)	3GPP (128-256 bit)
Localisation	Yes (TDOA)	Yes (RSSI)	Yes (3GPP Rel 14)	Yes (3GPP Rel 14)

Source: ABI Research

1. Cat.M1 Generic Features - Cat.M1 & NB-IoT

TECHNOLOGY COMPARISON		
NB-IOT VS. LTE-M		
	NB-IOT	LTE-M
Bandwidth	180 KHz 3GPP Licensed	1.4 MHz 3 GPP Licensed
Peak data rate	<100	384 Kbps
Uplink / Downlink speed	27.2 / 62.5 Kbps (DL/ UL)	Up to 1 Mbps
Latency	1.5 - 10 sec.	50 - 100 ms.
Battery life	+ 10 years (depending on the use case)	10 years (depending on the use case)
Power consumption	Best at low data rates	Best at medium rates
Cost per module	5 - 10 dollars	10 - 15 dollars
Frequency deployment	Flexible	In LTE band
Penetration in indoors	Excellent	Good
Voice	No	Yes. VoLTE

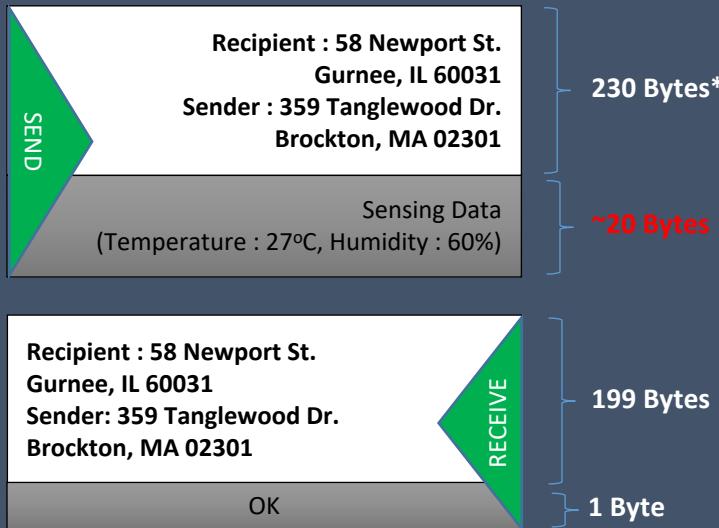


 accent
systems

2. CAT.M1 Feature from SW Developer's Perspective

TCP Sample of 1-time data transmission

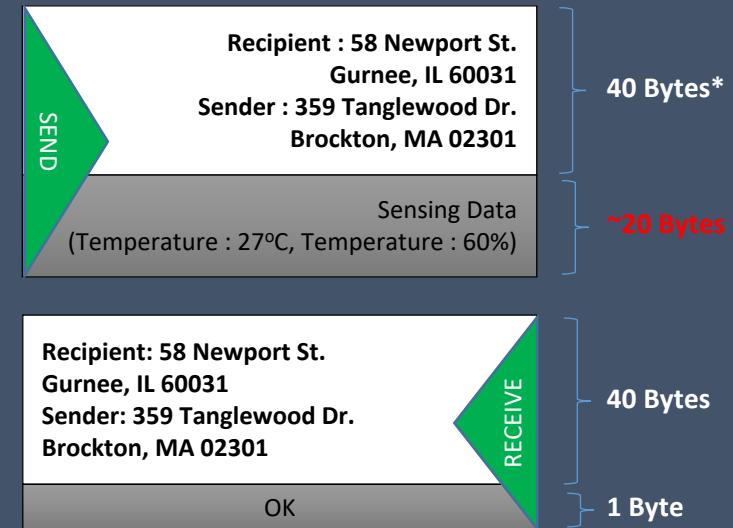
"TCP Packet Header(Address Info) + Data to SEND"



TCP Header Packet Size (SEND) : 230byte
TCP Header Packet Size (RECEIVE) : 199byte

UDP Sample of 1-time data transmission

"UDP Packet Header(Address info) + Data to SEND"



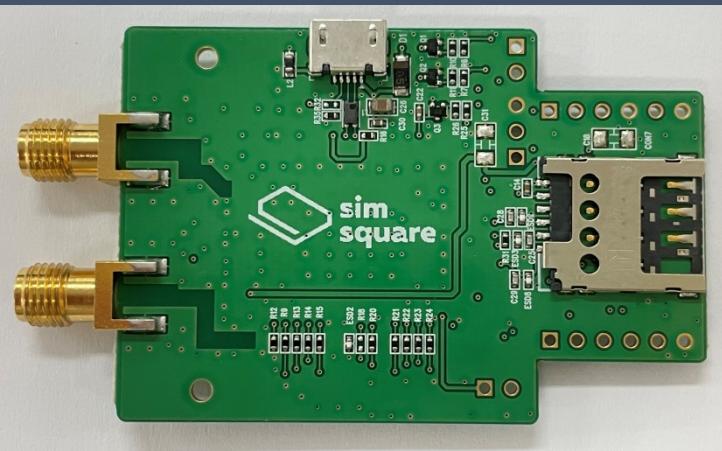
UDP Header Packet Size (SEND) : 40byte
UDP Header Packet Size (RECEIVE) : 40byte

BG96 TCP(IP) AT Commands Manual V1.1

Send Size The maximum data length is 1460 bytes

Read Size The maximum data length is 1500 bytes

3. CAT.M1 Hardware Components and Architecture



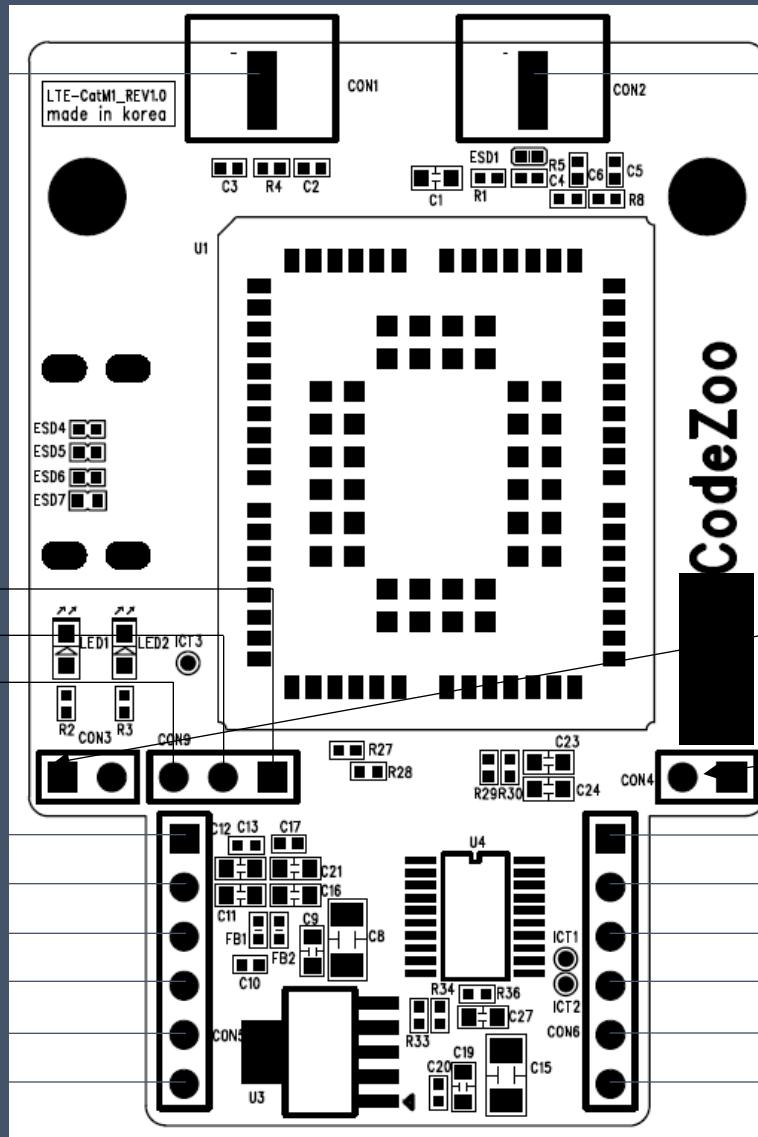
3. CAT.M1 Hardware Components and Architecture

LTE_ANTENNA

GNSS_ANTENNA

GNSS_TXD
GNSS_RXD
GND

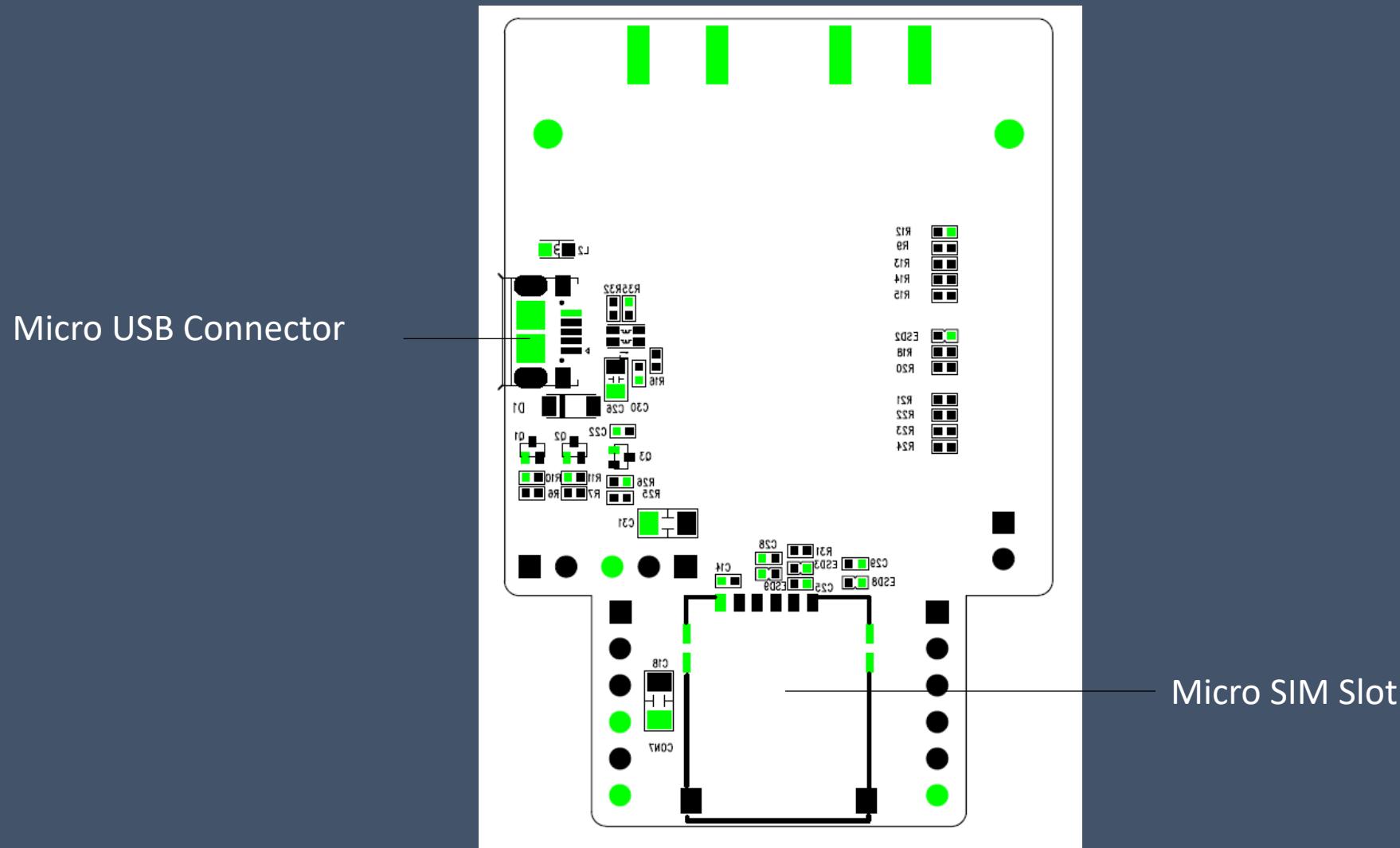
STATUS
POWER_KEY
RI(Ring Indicator)
GND
+3.3V
GND



TTL LEVEL SELECT (3.3 or 5V)
CON3 (CLOSE) & CON4 (OPEN) 3.3V
CON3 (OPEN) & CON4 (CLOSE) 5V

CTS
RTS
TXD
RXD
+5V
GND

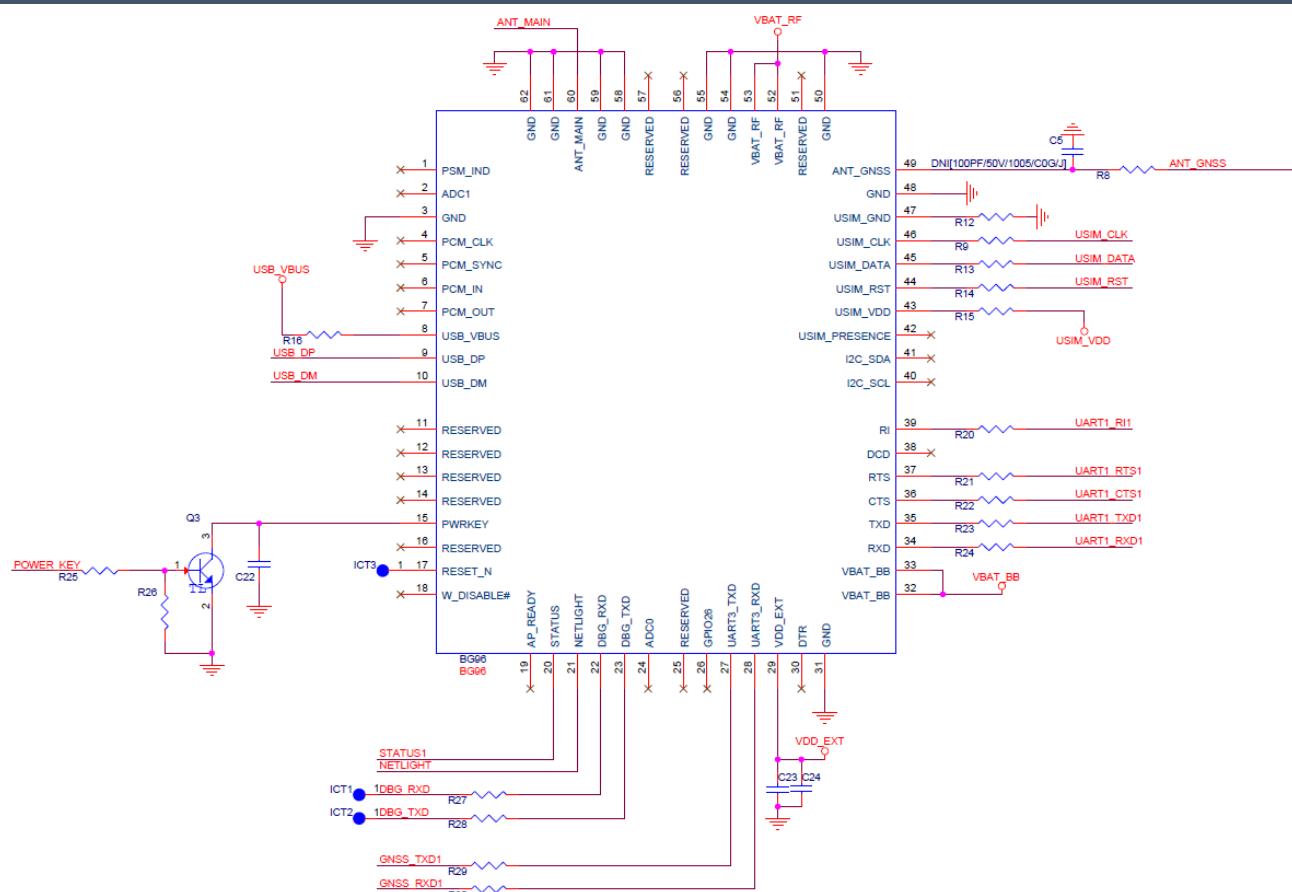
3. CAT.M1 Hardware Components and Architecture



3. CAT.M1 Hardware Components and Architecture

Classification	Standard
1. Product Name	CodeZoo LTE-CAT.M1 Board
2. Product Model	CZ-CATM1
3. Product Manufacturer	CodeZoo
4. Module Model/Vendor	BG96 / Quectel
5. Chipset Model/Vendor	MDM9206 / Qualcomm
6. Dimension [mm]	Width(38.0)*Height(65.0)*Depth(4.0)
7. Function	LTE communication module
8. Power Supply Type	USB, 3.3~5V
9. Voltage/Ampere	(5 V), (0.25A)
10. Antenna Type	Available in separate unit
11. Frequency Band	LTE Cat1

3. CAT.M1 Hardware Components and Architecture



> Circuit map download (dxf file included)

https://github.com/codezoo-ltd/CodeZoo_CATM1_Arduino/tree/master/Schematics_Dimension/

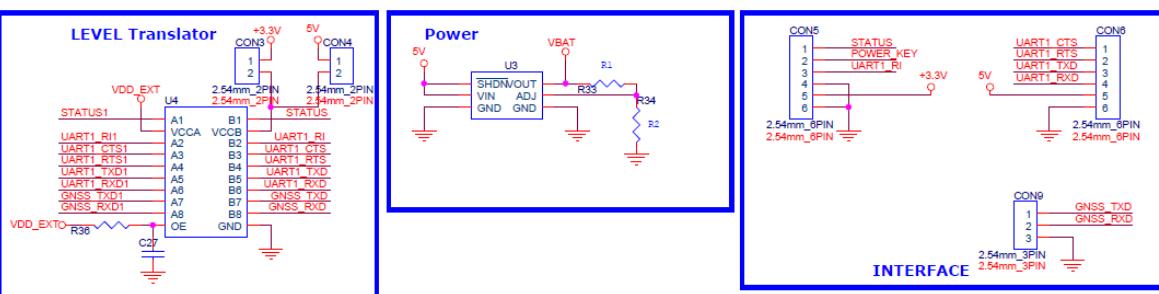
BG96 Module 회로도.pdf

> Manual download(Hardware, Software)

https://github.com/codezoo-ltd/CodeZoo_CATM1_Arduino/tree/master/BG96_Manual

> Product Specifications (datasheet)

https://github.com/codezoo-ltd/CodeZoo_CATM1_Arduino/tree/master/Product_Specification



4. CAT.M1 How-to Guide for Development? (AT Command)

The “AT” or “at” prefix must be set at the beginning of each command line. To terminate a command line

enter <CR>. Commands are usually followed by a response that includes

“<CR><LF><response><CR><LF>”. Throughout this document, only the responses are presented,

“<CR><LF>” are omitted intentionally.

4. CAT.M1 How-to Guide for Development? (AT Command)

Table 1: Types of AT Commands and Responses

Test Command	AT+<x>=?	This command returns the list of parameters and value ranges set by the corresponding Write Command or internal processes.
Read Command	AT+<x>?	This command returns the currently set value of the parameter or parameters.
Write Command	AT+<x>=<...>	This command sets the user-definable parameter values.
Execution Command	AT+<x>	This command reads non-variable parameters affected by internal processes in the UE.

4. CAT.M1 How-to Guide for Development? (AT Command)

1.5. Unsolicited Result Code

As an Unsolicited Result Code and a report message, URC is not issued as part of the response related to an executed AT command. URC is issued by BG96 without being requested by the TE and it is issued

automatically when a certain event occurs. Typical events leading to URCs are incoming calls (**RING**),

received short messages, high/low voltage alarm, high/low temperature alarm, etc.

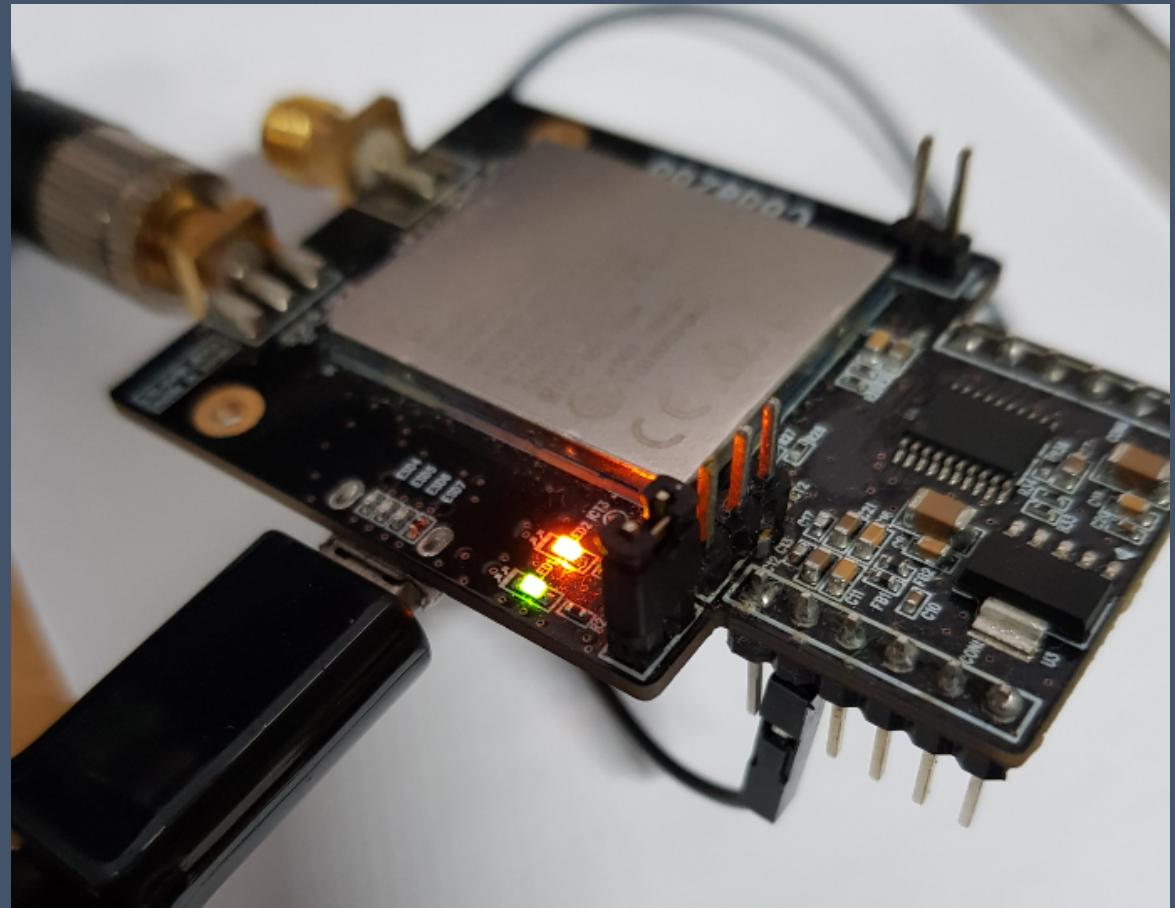
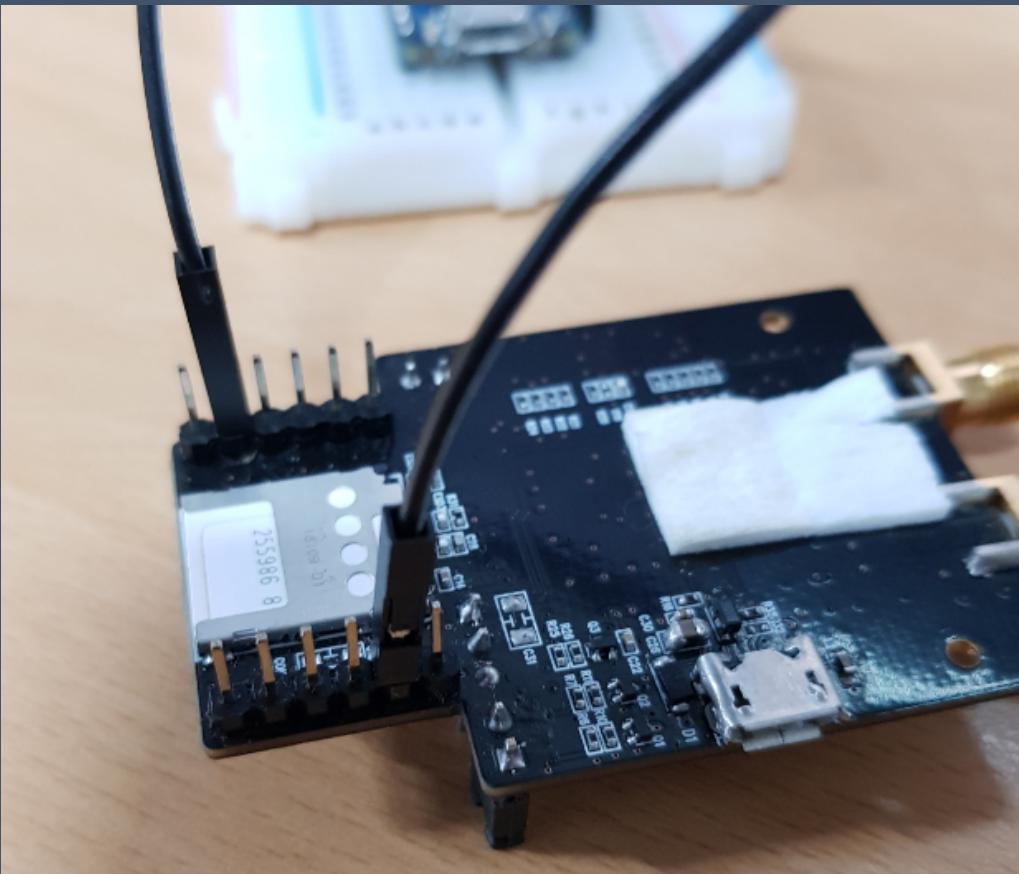
How to make processing routines in response to unsolicited messages ?

1. Interrupt
2. RTOS task
3. Software architecture depending on situations

4. CAT.M1 How-to Guide for Development (AT Command)

AT Command test procedures once it's connected via USB

1. Connect No. 5 from left on bottom to No.2 from right on top as in the photo below
2. Install USB driver (https://github.com/codezoo-ltd/CodeZoo_CATM1_Arduino/tree/master/Driver/
Quectel_LTE5G_Windows_USB_Driver_V2.1.zip PC
3. Connect Micro USB cable to PC



4. CAT.M1 How-to Guide for Development (AT Command)

2.9. AT+CGSN Request Product Serial Number Identification

The command returns International Mobile Equipment Identity (IMEI). It is identical with AT+GSN.

AT+CGSN Request Product Serial Number Identification

Test Command

AT+CGSN=?

Response

OK

Execution Command

AT+CGSN

Response

<IMEI>

OK

Maximum Response Time

300ms

Reference

3GPP TS 27.007

Parameter

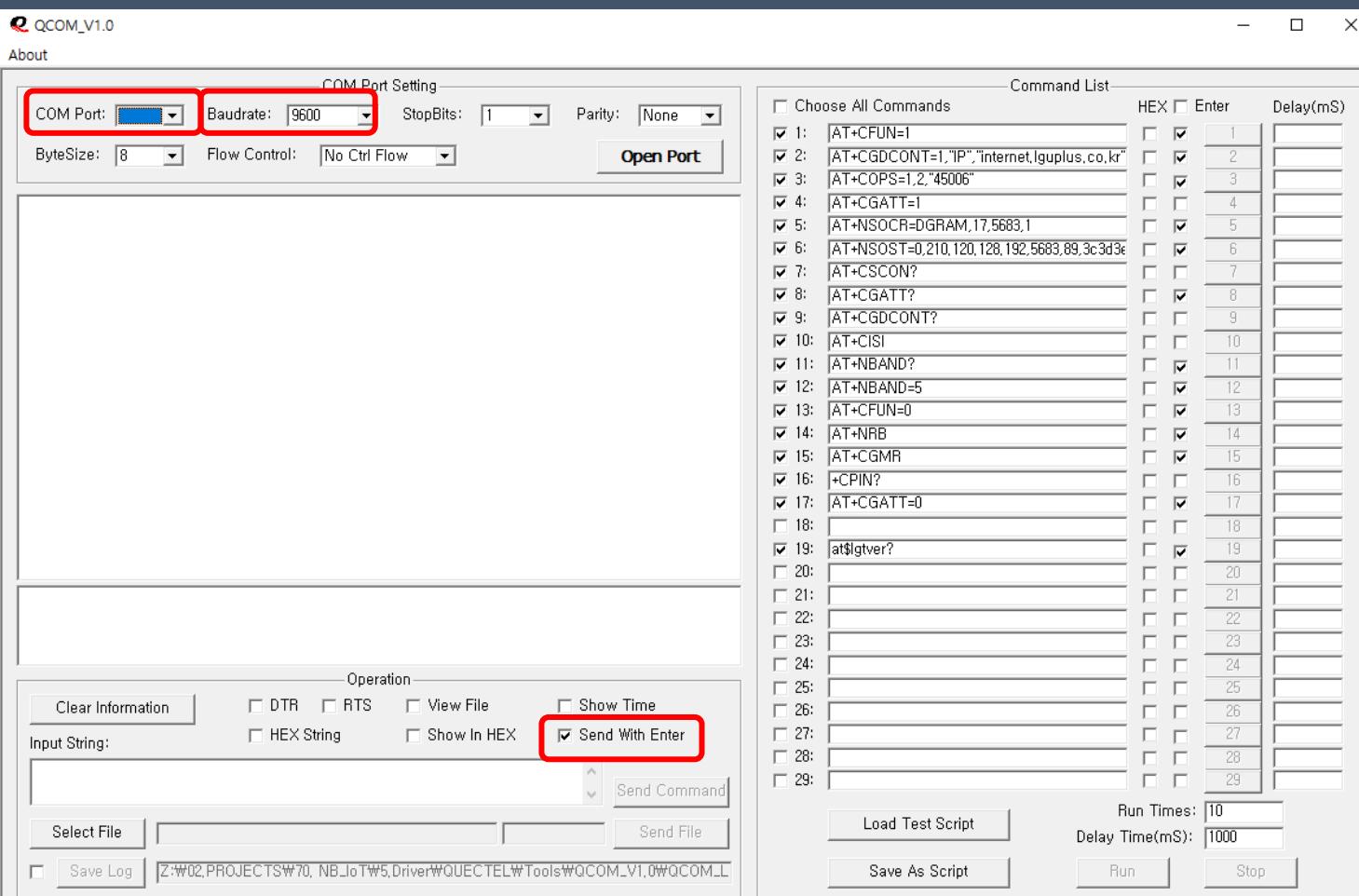
<IMEI> IMEI of the ME

NOTE

The serial number (IMEI) varies with the individual ME device.

Quectel_BG96_AT_Commands
_Manual_V2.3.pdf, 18page

4. CAT.M1 How-to Guide for Development (AT Command)

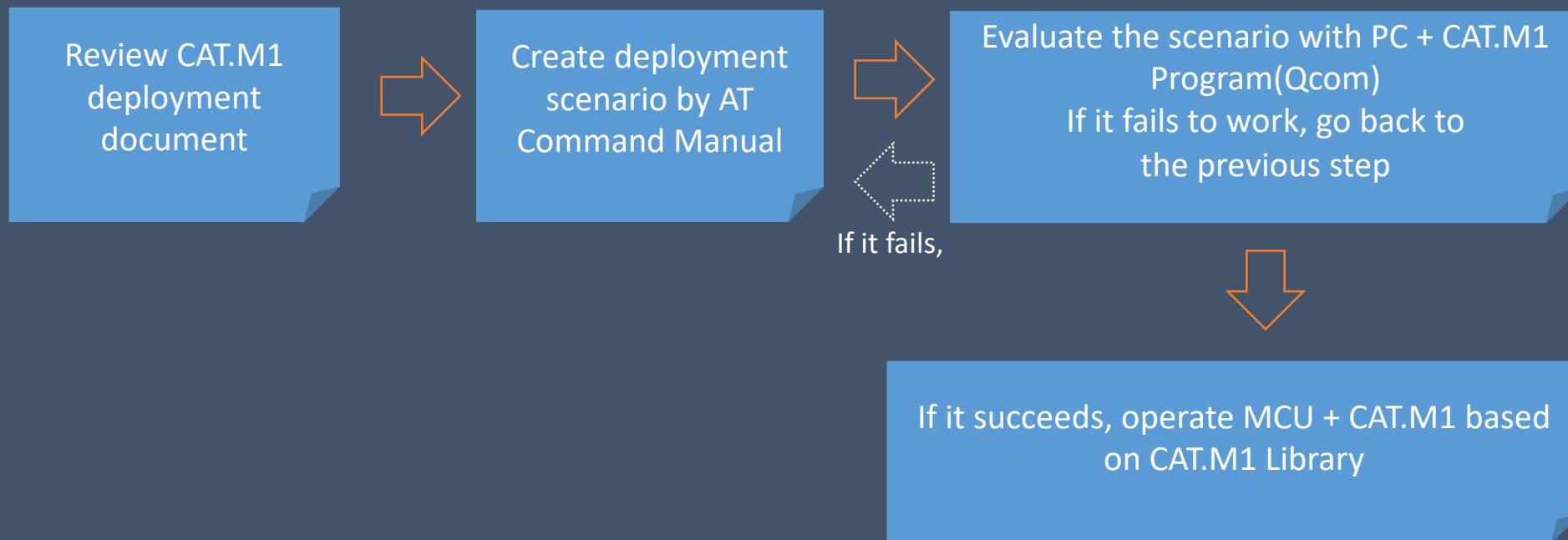


https://github.com/codezoo-ltd/CodeZoo_CATM1_Arduino/tree/master/Tool/

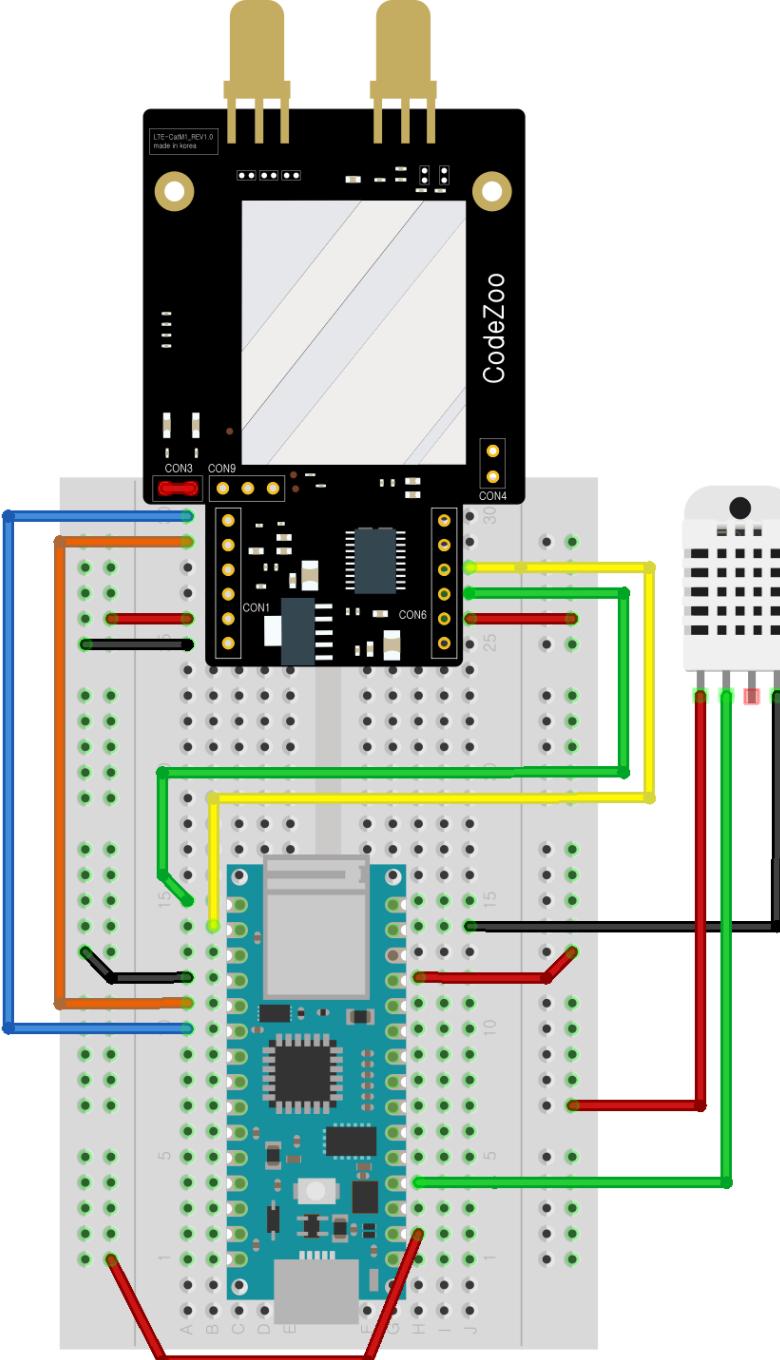
QCOM_V1.6.zip needs to be unzipped

1. COM Port : Device Manager > Port > AT Port
2. Baudrate : 115200bps
3. Send With Enter should be checked

4. CAT.M1 How-to Guide for Development(AT Command)

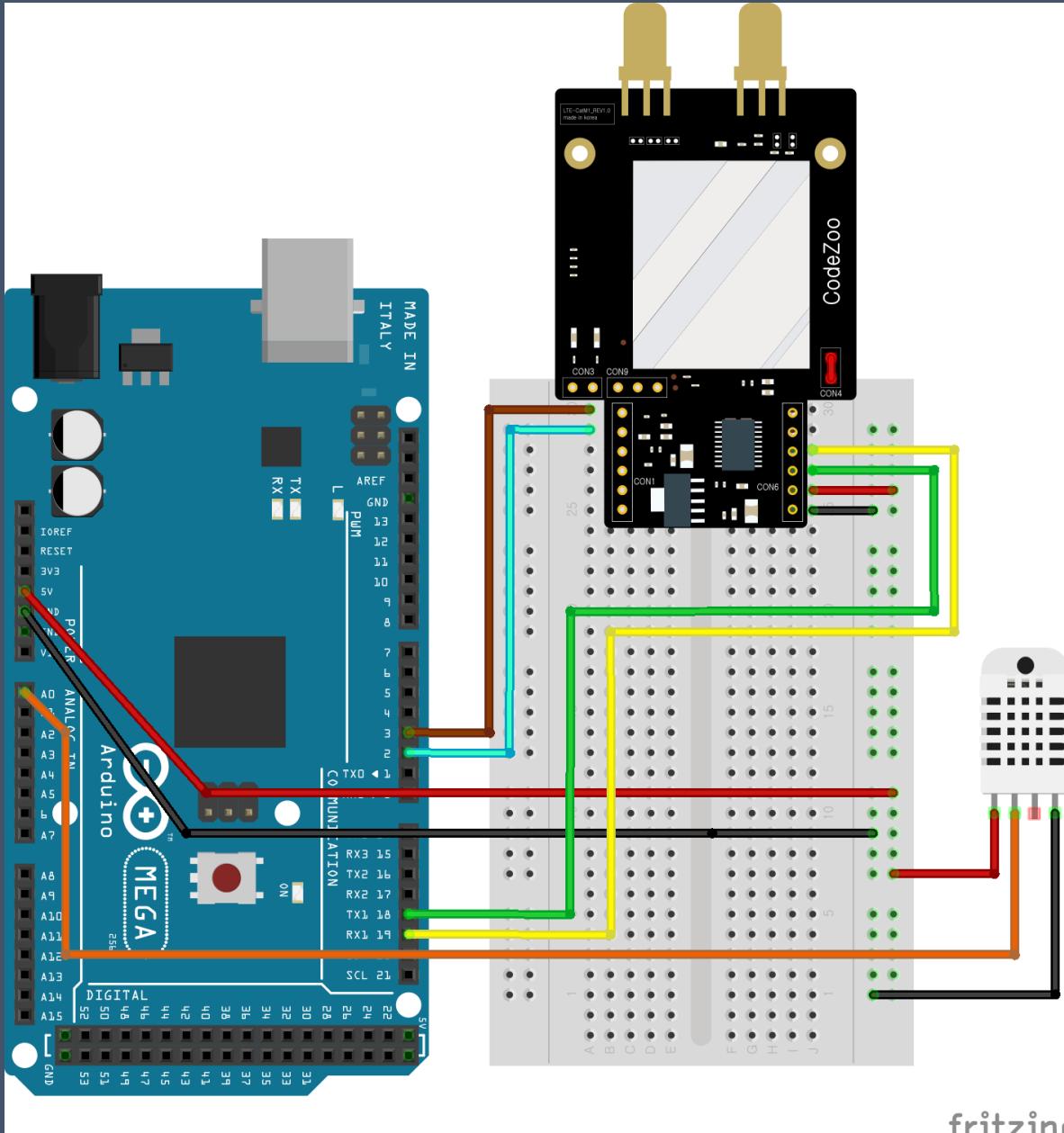


5. CAT.M1 Practice



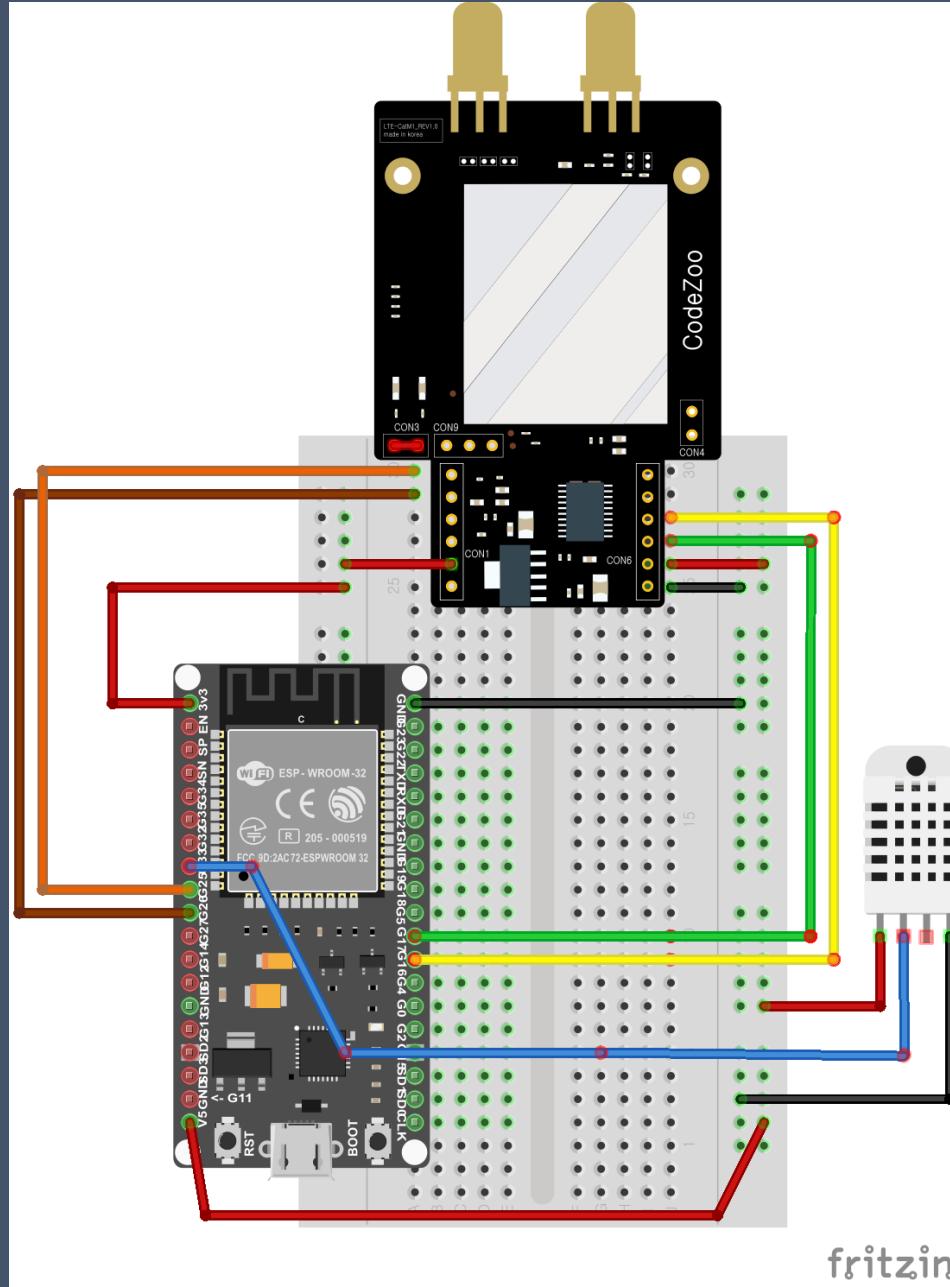
Arduino Nano 33 IoT
circuit map

5. CAT.M1 Practice



Arduino MEGA2560
circuit map

5. CAT.M1 Practice

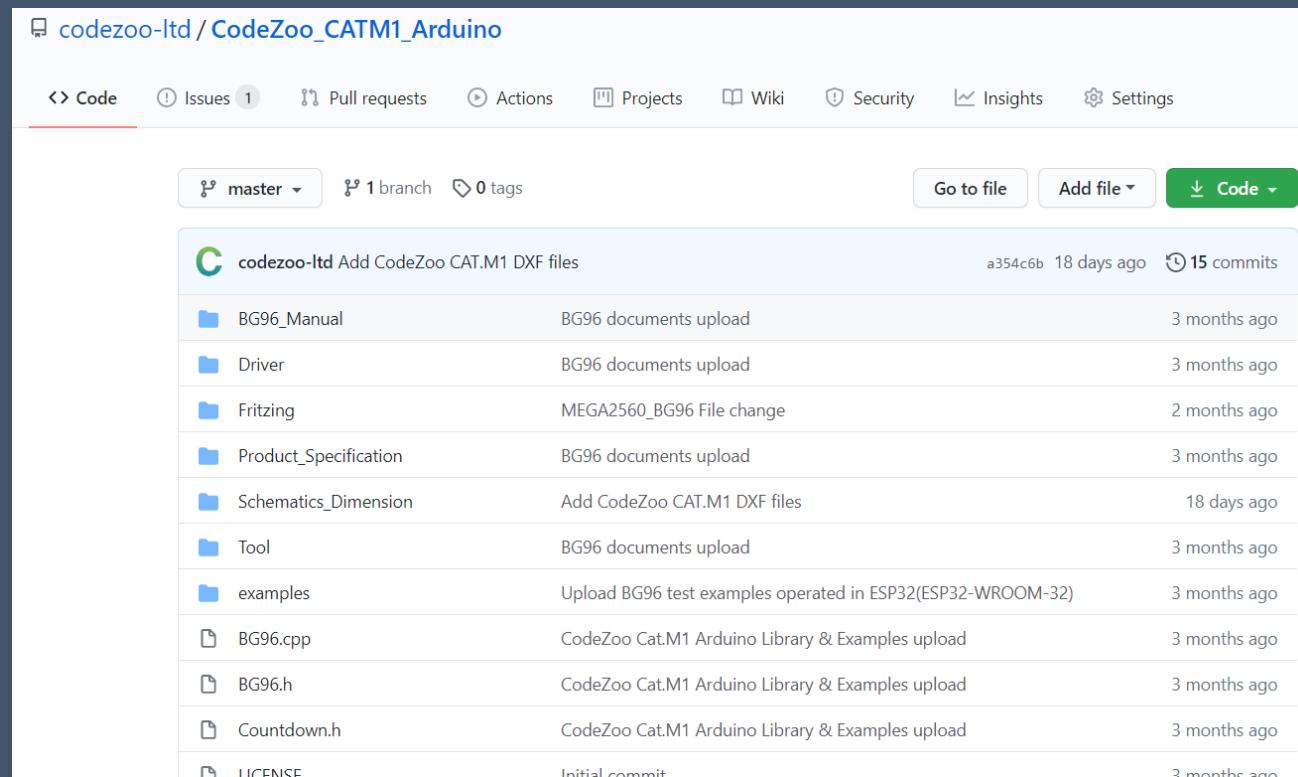


ESP32
circuit map

fritzing

5. CAT.M1 Practice (Download - Dev Resources)

https://github.com/codezoo-ltd/CodeZoo_CATM1_Arduino



codezoo-ltd / [CodeZoo_CATM1_Arduino](#)

Code Issues Pull requests Actions Projects Wiki Security Insights Settings

master 1 branch 0 tags Go to file Add file Code

Codezoo-ltd	Add CodeZoo CAT.M1 DXF files	a354c6b 18 days ago	15 commits
BG96_Manual	BG96 documents upload	3 months ago	
Driver	BG96 documents upload	3 months ago	
Fritzing	MEGA2560_BG96 File change	2 months ago	
Product_Specification	BG96 documents upload	3 months ago	
Schematics_Dimension	Add CodeZoo CAT.M1 DXF files	18 days ago	
Tool	BG96 documents upload	3 months ago	
examples	Upload BG96 test examples operated in ESP32(ESP32-WROOM-32)	3 months ago	
BG96.cpp	CodeZoo Cat.M1 Arduino Library & Examples upload	3 months ago	
BG96.h	CodeZoo Cat.M1 Arduino Library & Examples upload	3 months ago	
Countdown.h	CodeZoo Cat.M1 Arduino Library & Examples upload	3 months ago	
LICENSE	Initial commit	3 months ago	

5. CAT.M1 Practice (Download)

Screenshot of a GitHub repository page for "RooneyJang Deleting Fritzing Files".

The repository has 1 branch and 0 tags.

Code navigation buttons: Go to file, Add file, Code (highlighted).

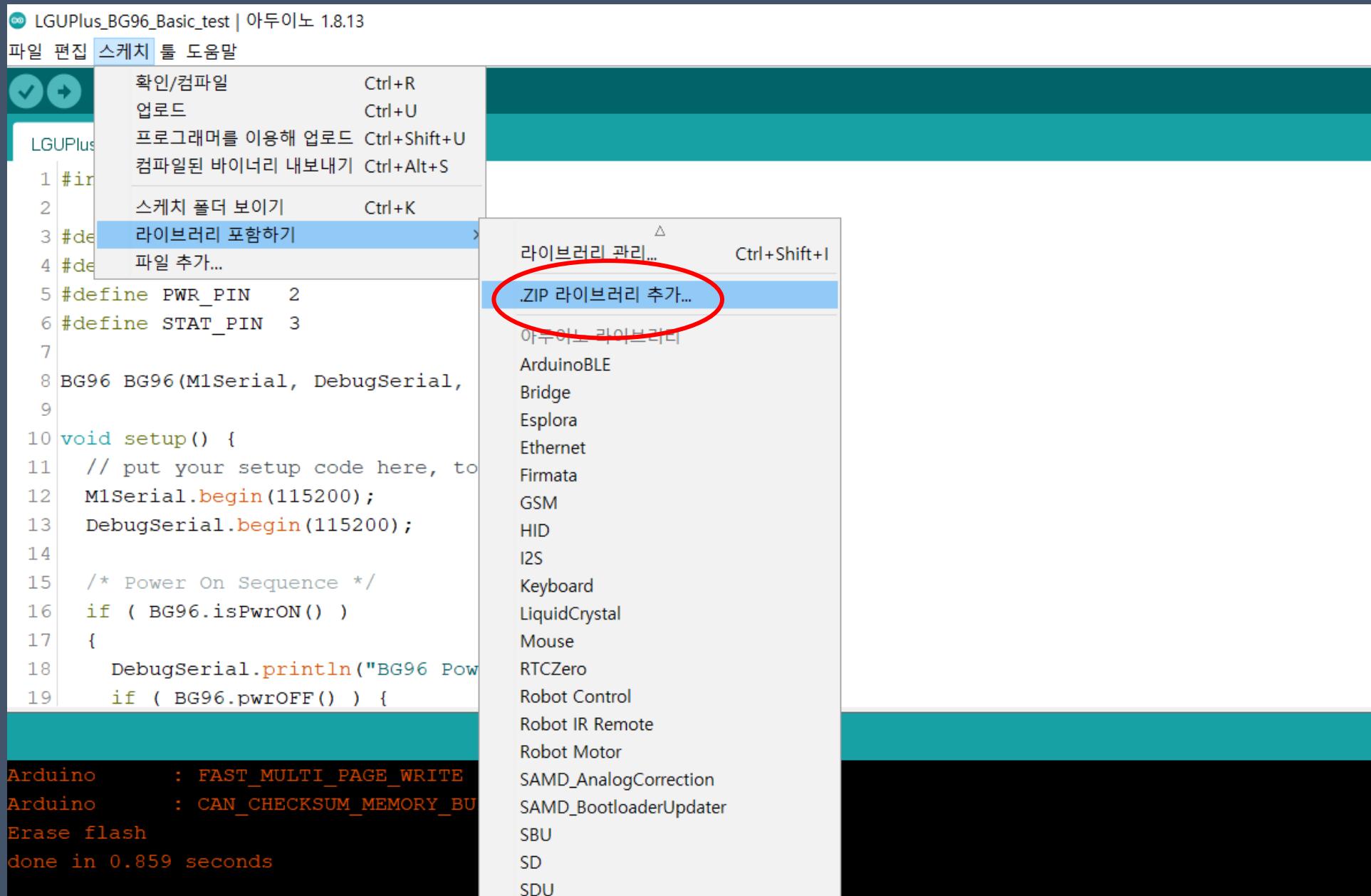
Clone options: Clone with HTTPS (with Use SSH link), Use Git or checkout with SVN using the web URL (https://github.com/jbmaster50/LGUPlus_).

Download option: Download ZIP (highlighted with a red oval).

File list:

File	Commit Message	Last Commit
BG96_Manual	LGU+ CAT.M1 OpenSource Intial Comm	2 months ago
OS_Driver	LGU+ CAT.M1 OpenSource Intial Comm	2 months ago
Schematics_Dimension	LGU+ CAT.M1 OpenSource Intial Comm	2 months ago
Window_Tool	LGU+ CAT.M1 OpenSource Intial Comm	2 months ago
examples	Wrong Comment Fix	2 months ago
BG96.cpp	LGU+ CAT.M1 OpenSource Intial Commit	2 months ago
BG96.h	LGU+ CAT.M1 OpenSource Intial Commit	2 months ago
Countdown.h	LGU+ CAT.M1 OpenSource Intial Commit	2 months ago
README.md	Update README.md	5 hours ago

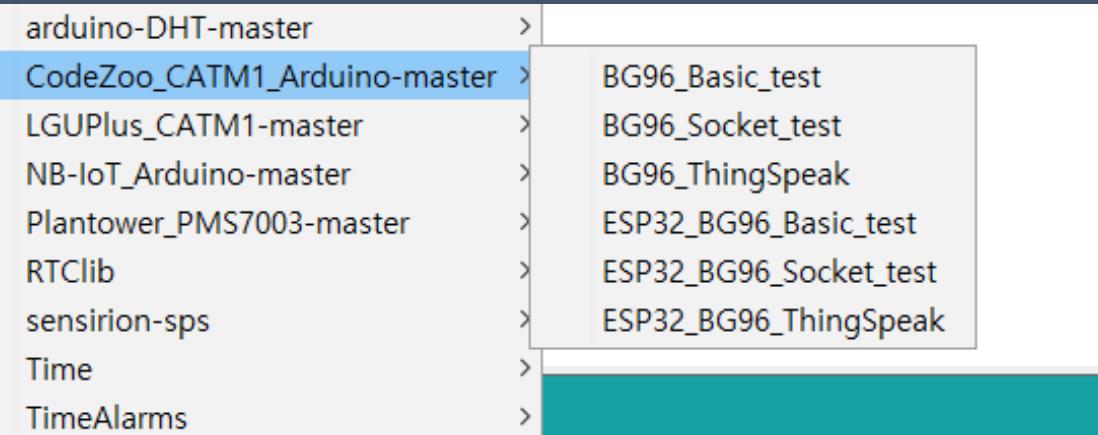
5. CAT.M1 Practice (Download)



5. CAT.M1 Practice (Examples)

CatM1 examples

5. CAT.M1 Practice (Examples)



1. Basic_test : CATM1 modem basic settings test
 2. Socket_test : TCP, UDP Socket test interworking with Echo Server
 3. ThingSpeak : Upload of Temperature/Humidity Data to *ThingSpeak.com* using DHT22 Sensor in designated time and Interval/frequency
- (*) Please refer to ESP32_*** examples when using ESP32

5. CAT.M1 Practice (Examples)

Thing Speak.com (TCP & HTTP Protocol)

<Source Code>

https://github.com/codezoo-ltd/CodeZoo_CATM1_Arduino/tree/master/examples/BG96_ThingSpeak

(*)ESP32_BG96_ThingSpeak when using ESP32

<Library that should be installed prior to the test>

DHT22 Sensor Temperature & Humidity

<https://github.com/markruys/arduino-DHT>

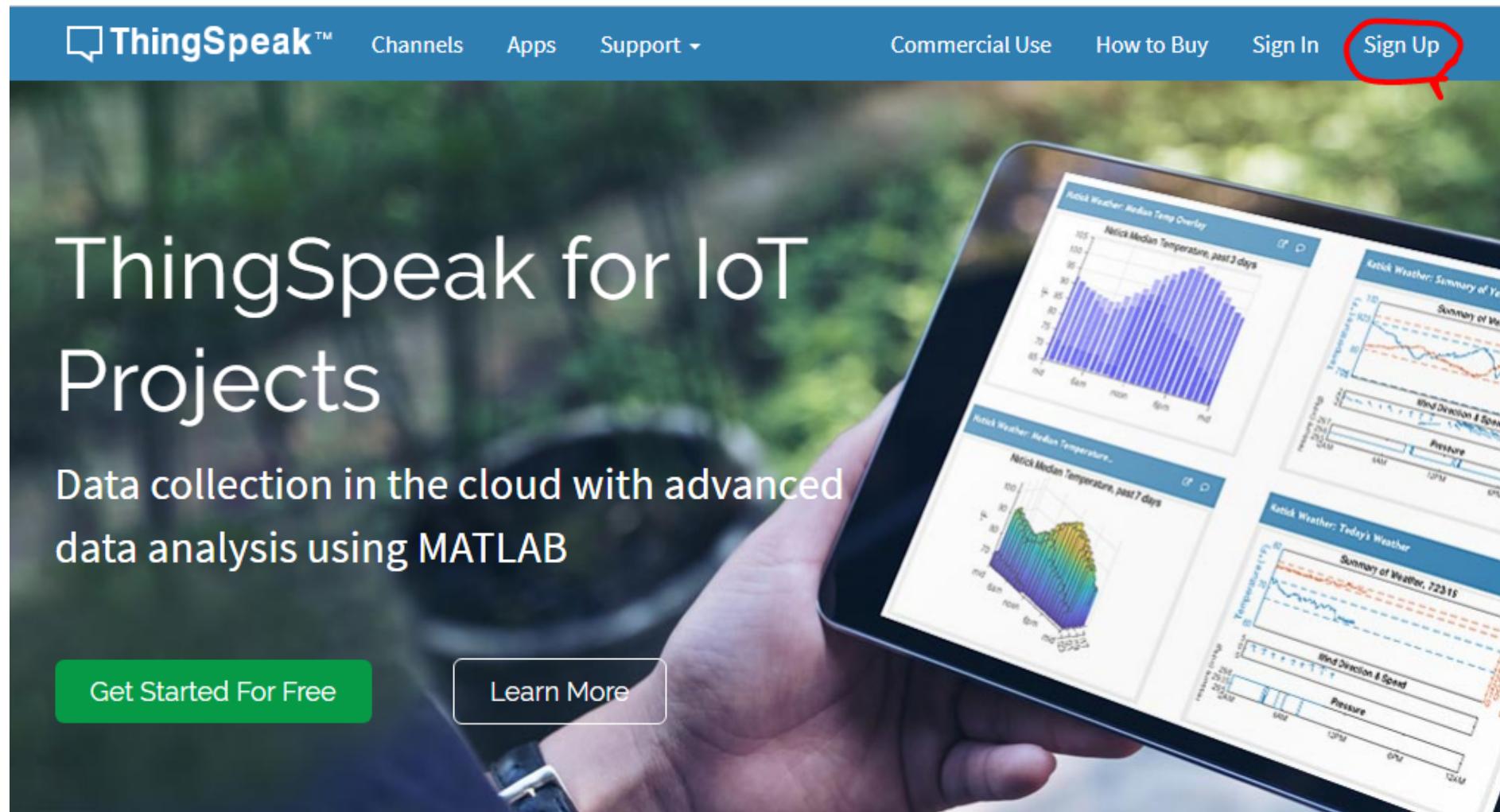
Time

<https://github.com/PaulStoffregen/Time>

TimeAlarms

<https://github.com/PaulStoffregen/TimeAlarms>

ThingSpeak.com (TCP & HTTP Protocol)



ThingSpeak.com (TCP & HTTP Protocol)

ThingSpeak™

Channels Apps Support Commercial

My Channels

New Channel

Name Created Updated

CodeZoo_NB-IoT	2019-08-18	2019-08-18 15:54
----------------	------------	------------------

My Channels

Watched Channels

Public Channels

Search by tag

Private View Public View Channel Settings Sharing AI

Channel Settings

Percentage complete 30%

Channel ID 875206

Name Test_NB_IoT_Class

Description

Field 1 Temperature

Field 2 Humidity

Field 4

Field 5

Field 6

ThingSpeak.com (TCP & HTTP Protocol)

Private View Public View Channel Settings Sharing API Keys Data Import / Export

Write API Key

Key

[Generate New Write API Key](#)

Read API Keys

Key

Note

[Save Note](#) [Delete API Key](#)

[Generate New Read API Key](#)

Help

API keys enable you to write data to a channel or read data from a private channel. API keys are auto-generated when you create a new channel.

API Keys Settings

- **Write API Key:** Use this key to write data to a channel. If you feel your key has been compromised, click [Generate New Write API Key](#).
- **Read API Keys:** Use this key to allow other people to view your private channel feeds and charts. Click [Generate New Read API Key](#) to generate an additional read key for the channel.
- **Note:** Use this field to enter information about channel read keys. For example, add notes to keep track of users with access to your channel.

API Requests

[Write a Channel Feed](#)

```
GET https://api.thingspeak.com/update?api_key=HFO5PQ-REFKQ9JM
```

```
GET https://api.thingspeak.com/channels/875206/feeds.j
```

Copy “GET.....” and paste it on the web browser to verify if Data was updated to ThingSpeak.com

5. CAT.M1 Practice (Examples)

Modify Arduino source codes

```
15  /*
16   * Be careful !!!
17   * Keep the communication cycle with ThingSpeak.com for at least 3 minutes.
18   */
19 #define ALARM_CYCLE 3600 /* Seconds, 1hour */
20 //#define ALARM_CYCLE 180 /*Seconds, 3min */
21
```

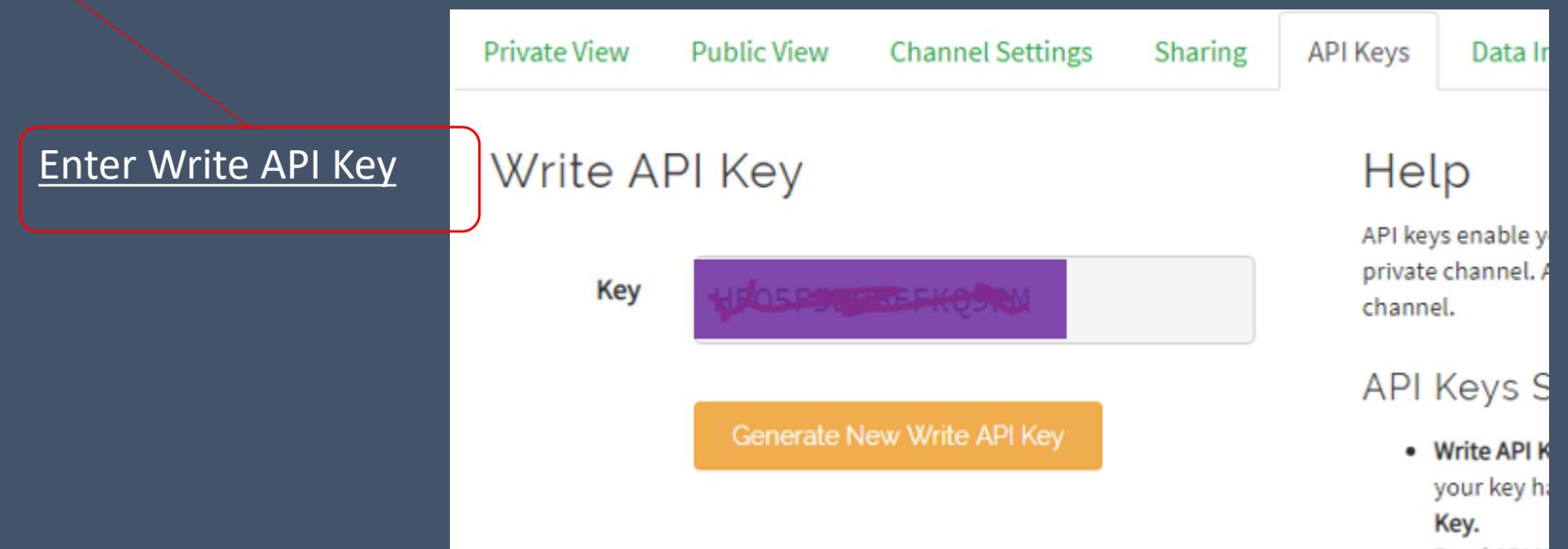
Send data from the Sensor every hour (3600 sec)

Send data from the Sensor at the minimum interval of
3 minutes (180 sec)

5. CAT.M1 Practice (Examples)

Modify Arduino source codes

```
22 String WApiKey = "*****";           //Thing Speak Write API Key 16Character  
23 float temp = 0.0;                  //Stores temperature value  
24 float humi = 0.0;                 //Stores humidity value  
25
```



Test result examples

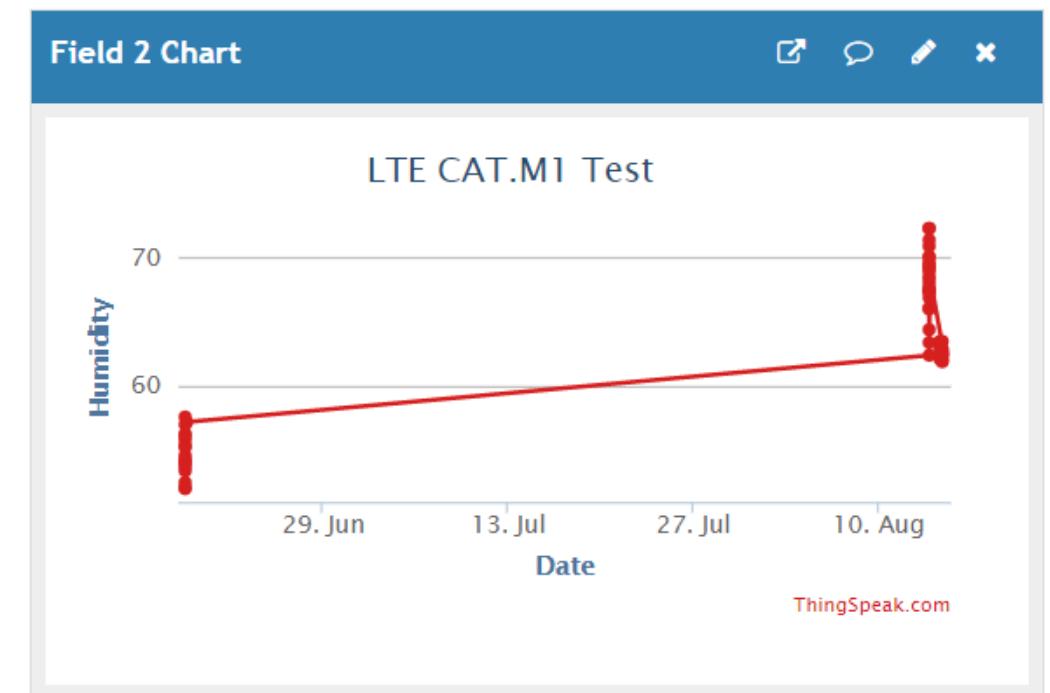
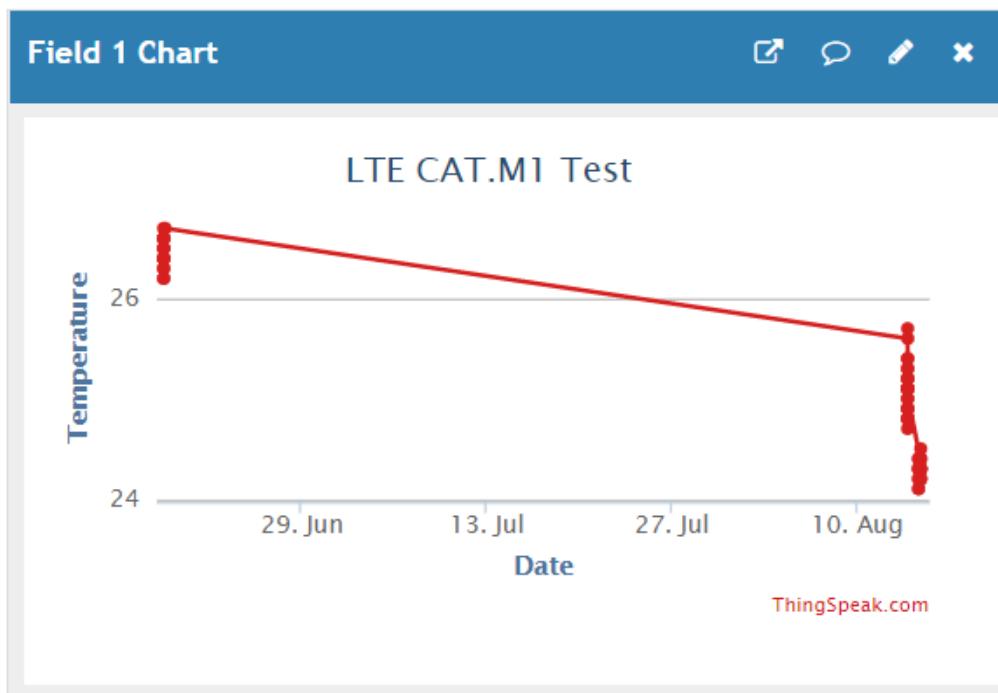
Channels 5 of 4 >

Channel Stats

Created: 6 months ago

Last entry: 21 days ago

Entries: 366



Thank You!