



simsquare Cat.M1 Module Hands-On Guide

- Raspberry Pi (with Python) -

version 1.0

info@simsquare.net

www.simsquare.net

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

1. Cat.M1 Generic Features - LPWA

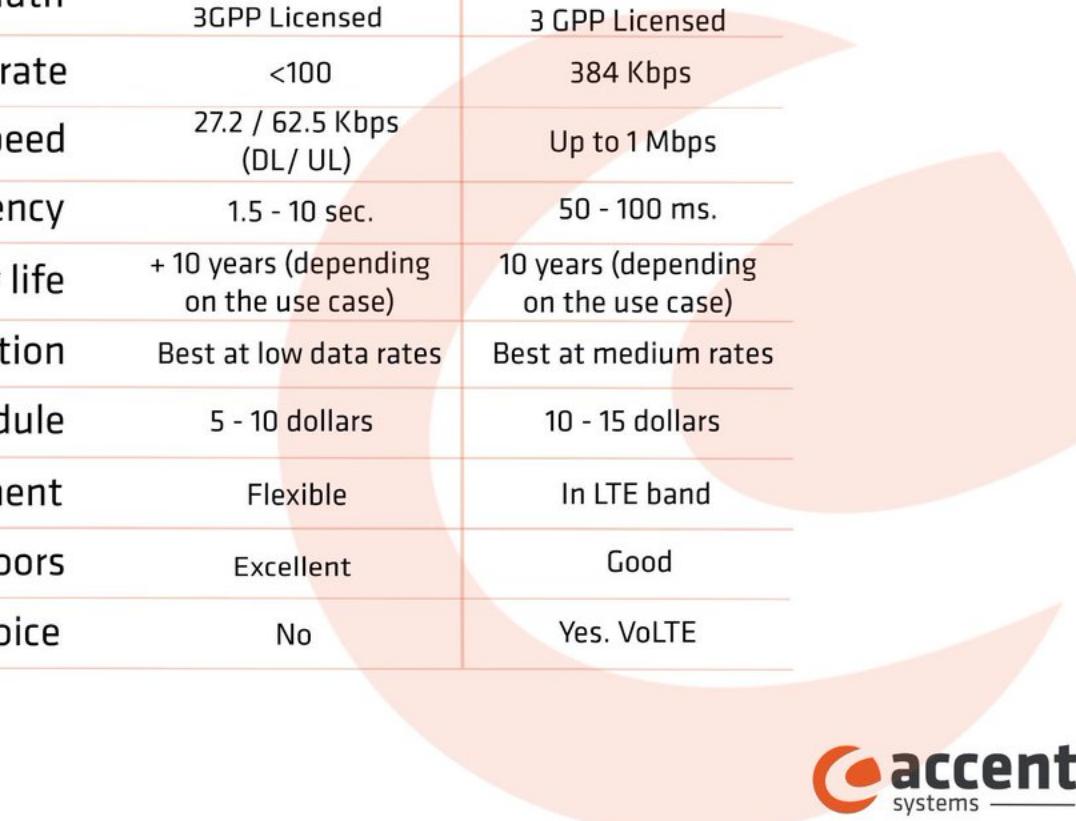
LPWA – the technical knockout

	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

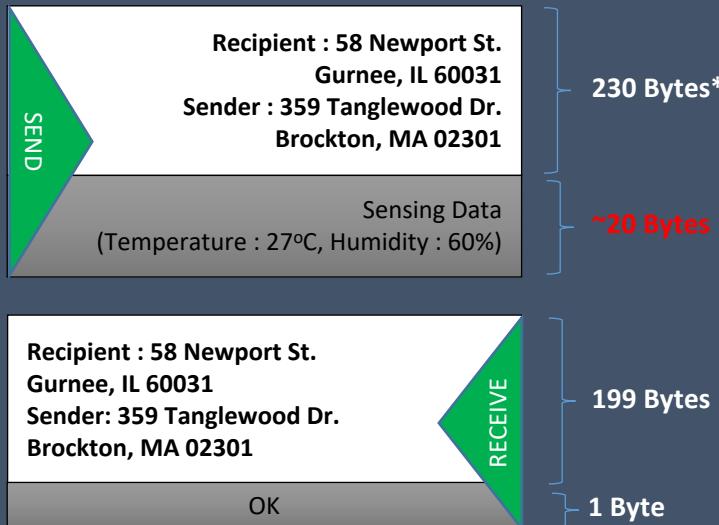


accent
systems

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

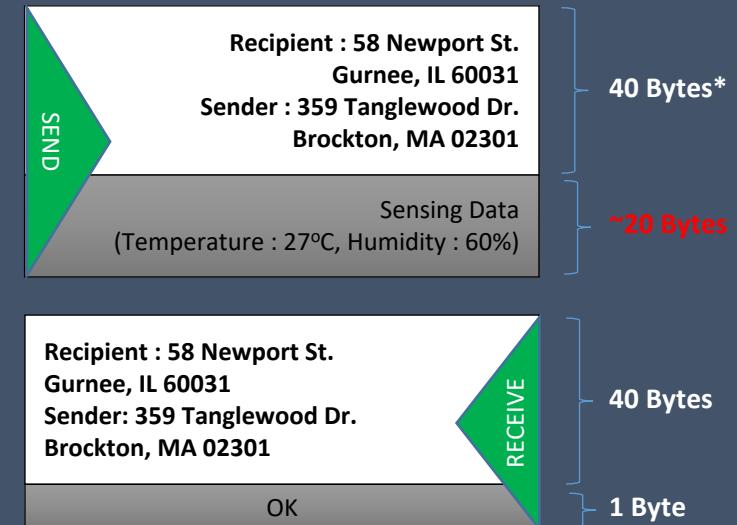
TCP Sample of 1-time data transmission

“TCP Packet Header(Address Info) + Data to SEND”



UDP Sample of 1-time data transmission

“UDP Packet Header(Address info) + Data to SEND”



TCP Header Packet Size (SEND) : 230byte

TCP Header Packet Size (RECEIVE) : 199byte

UDP Header Packet Size (SEND) : 40byte

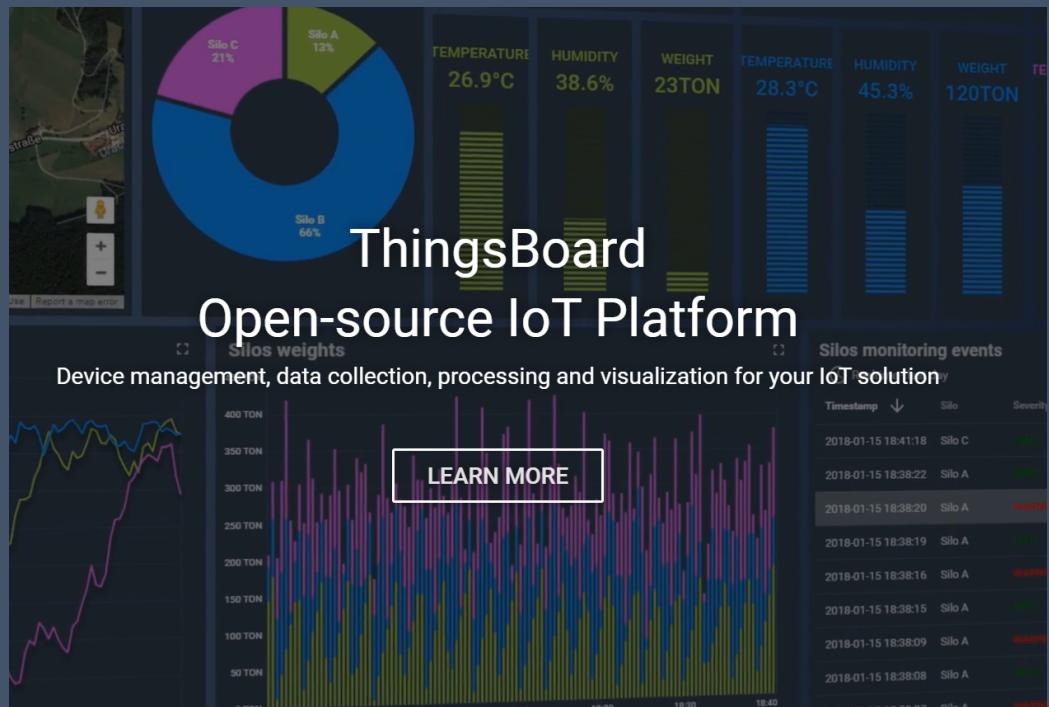
UDP Header Packet Size (RECEIVE) : 40byte

BG96 TCP(IP) AT Commands Manual V1.1

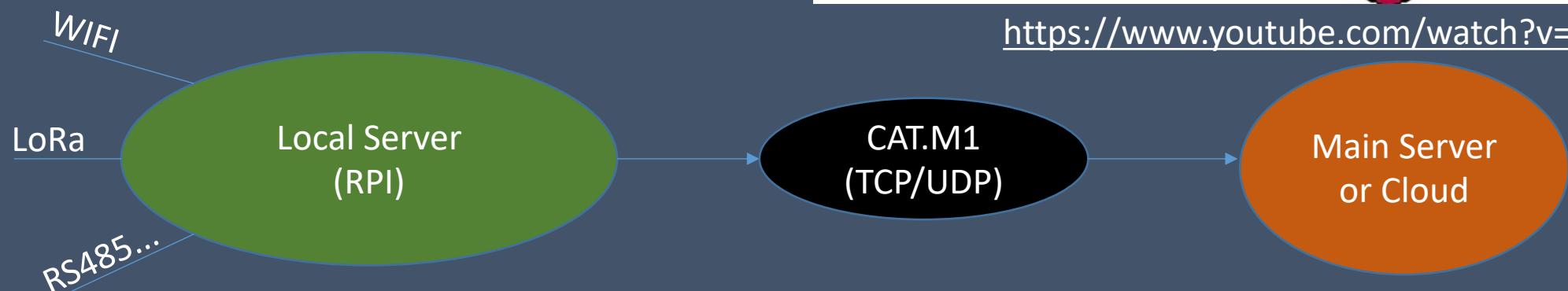
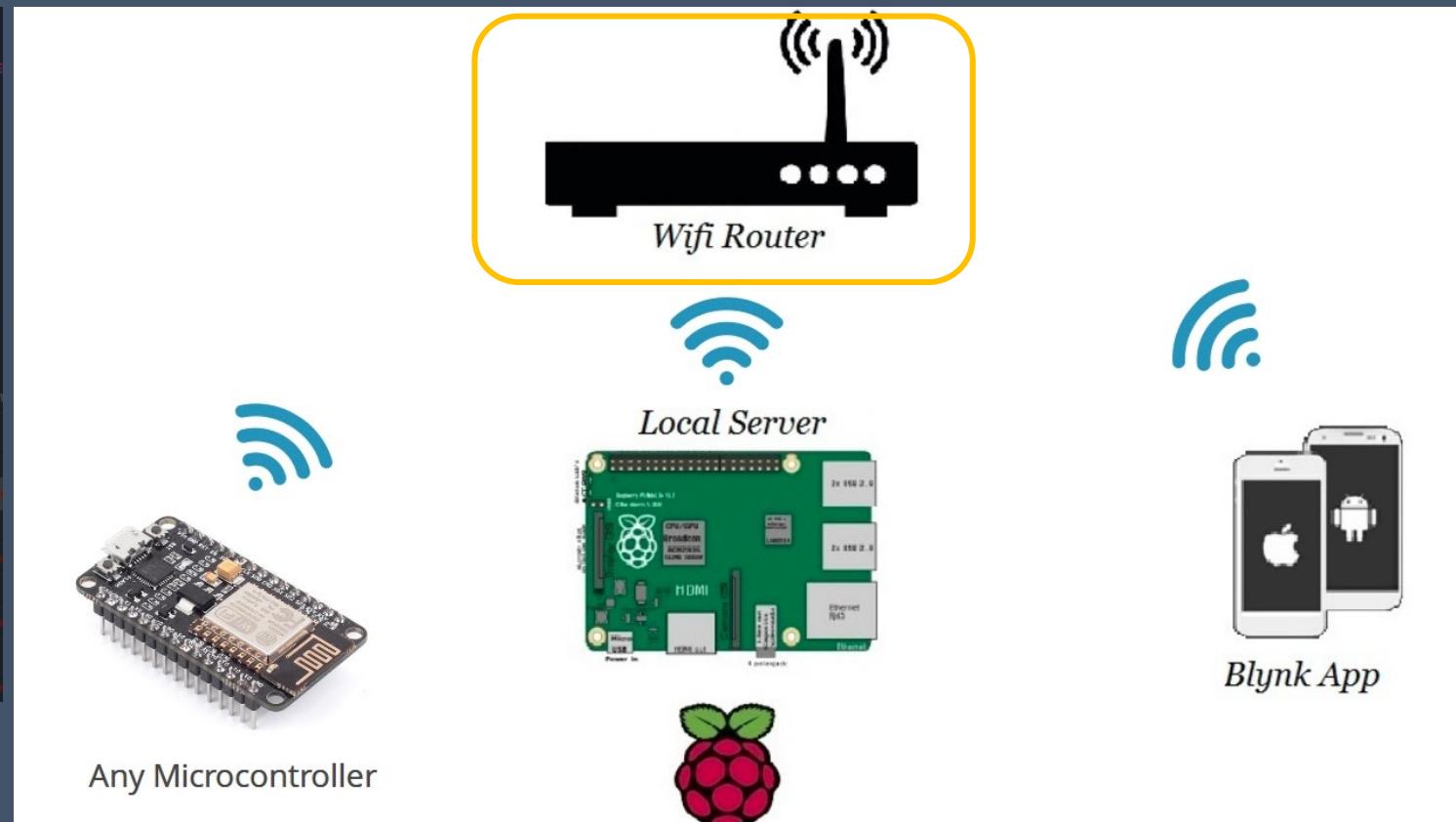
Send Size The maximum data length is 1460 bytes

Read Size The maximum data length is 1500 bytes

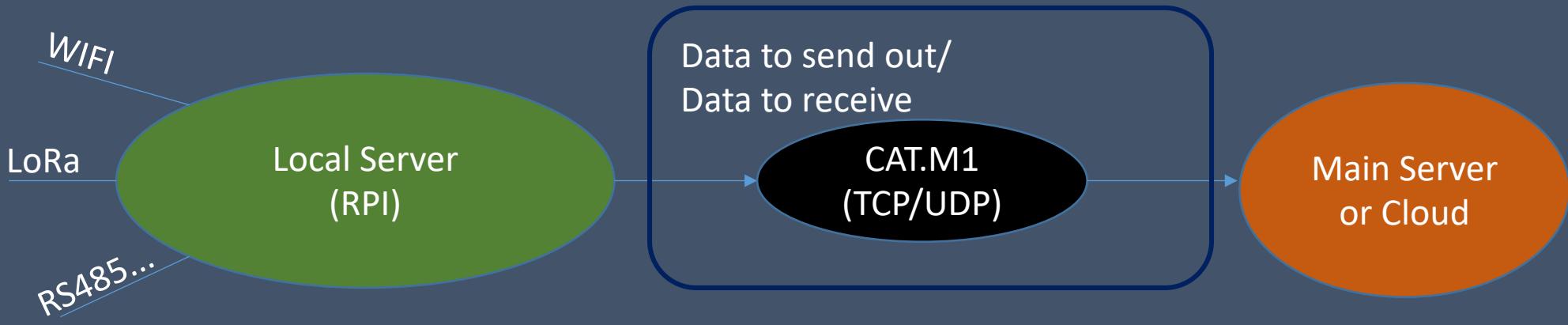
3. RaspberryPi CAT.M1 Software Features



<https://thingsboard.io/>



3. RaspberryPi CAT.M1 Software Features



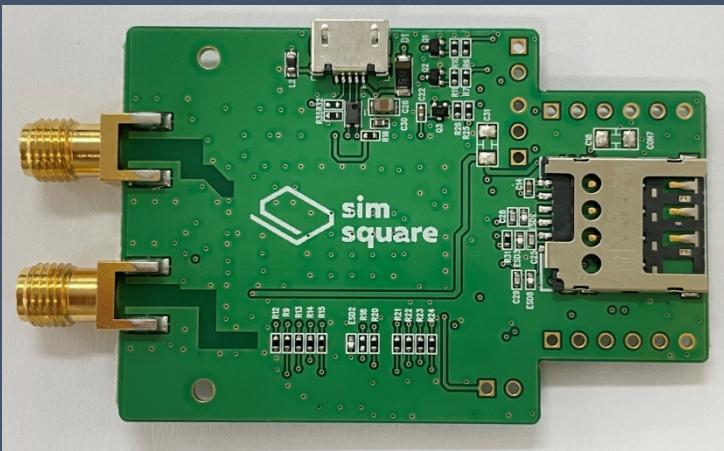
<http://news.samsungdisplay.com/16707>



<https://www.industrynews.co.kr/news/articleView.html?idxno=28113>

<http://www.libelium.com/>

4. CAT.M1 Hardware Components and Architecture



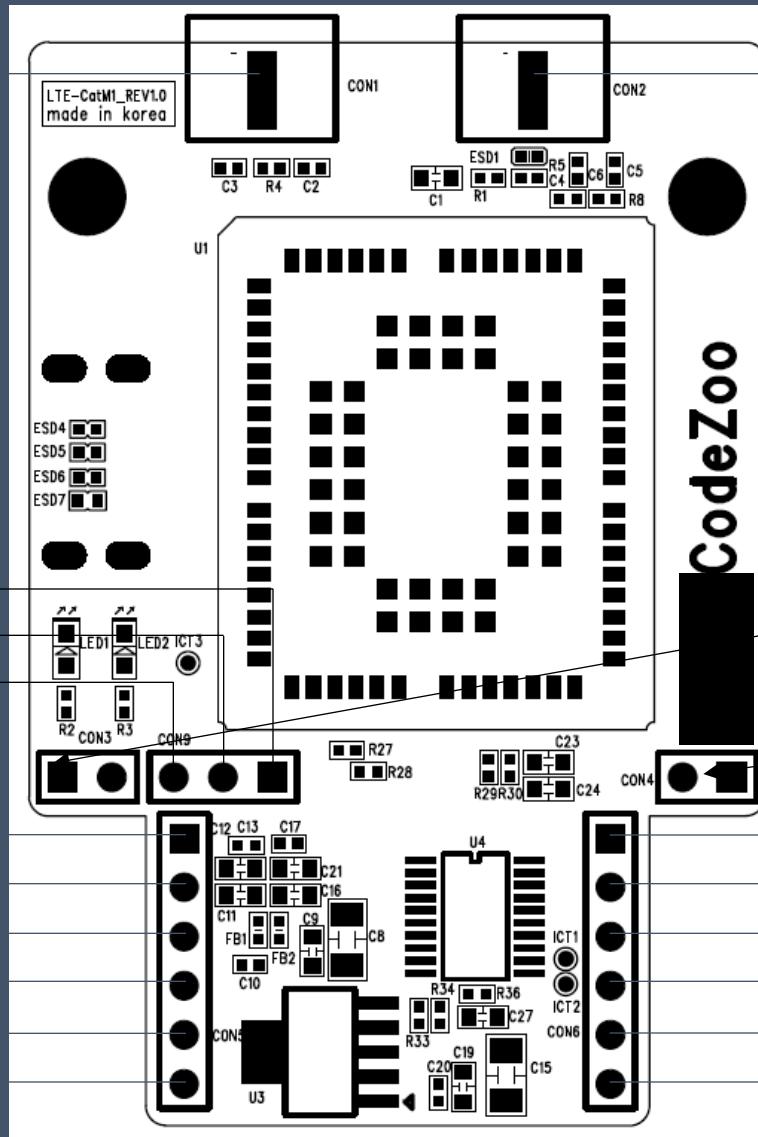
4. CAT.M1 Hardware Components and Architecture

LTE_ANTENNA

GNSS_ANTENNA

GNSS_TXD
GNSS_RXD
GND

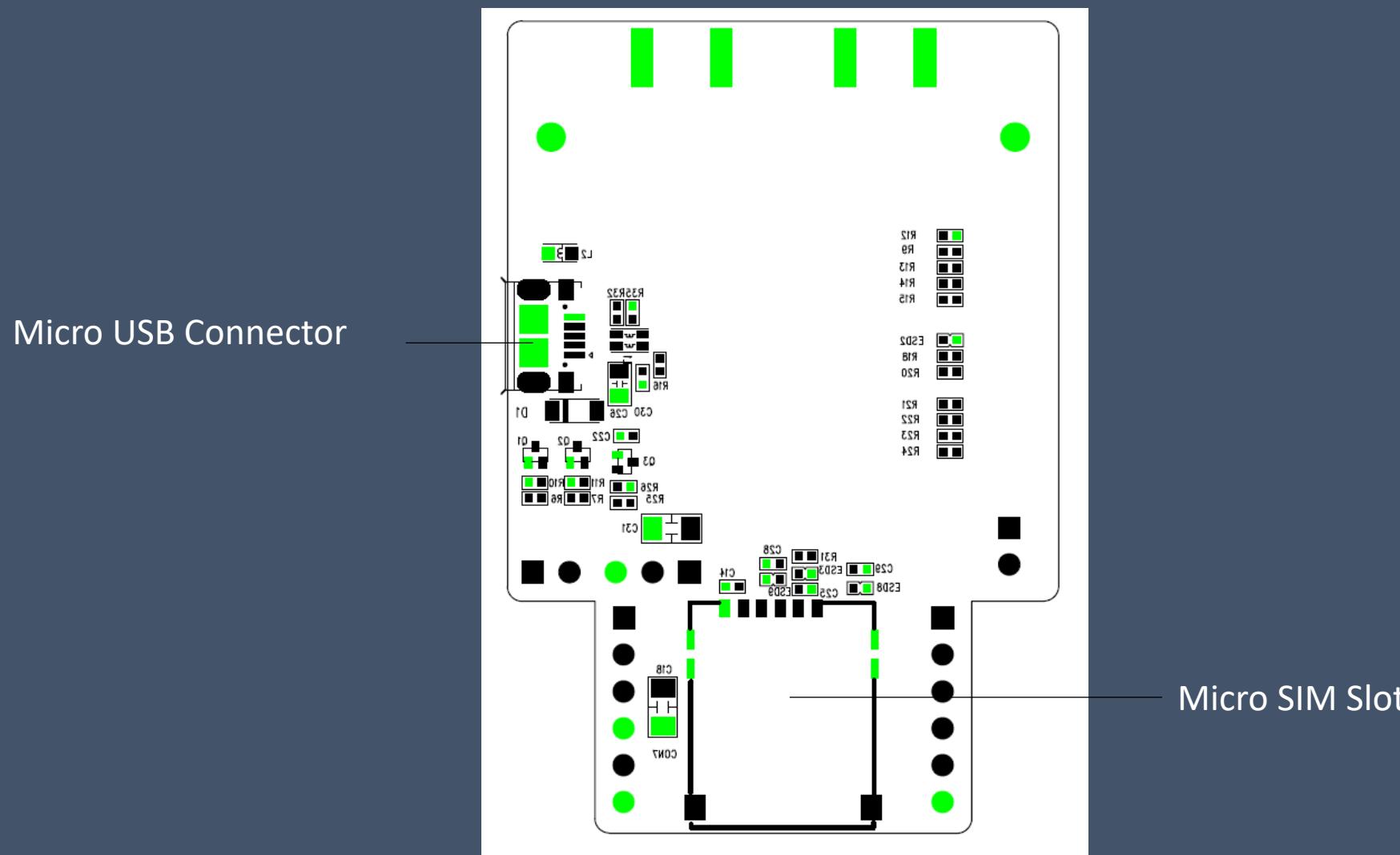
STATUS
POWER_KEY
RI(Ring Indicator)
GND
+3.3V
GND



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

CTS
RTS
TXD
RXD
+5V
GND

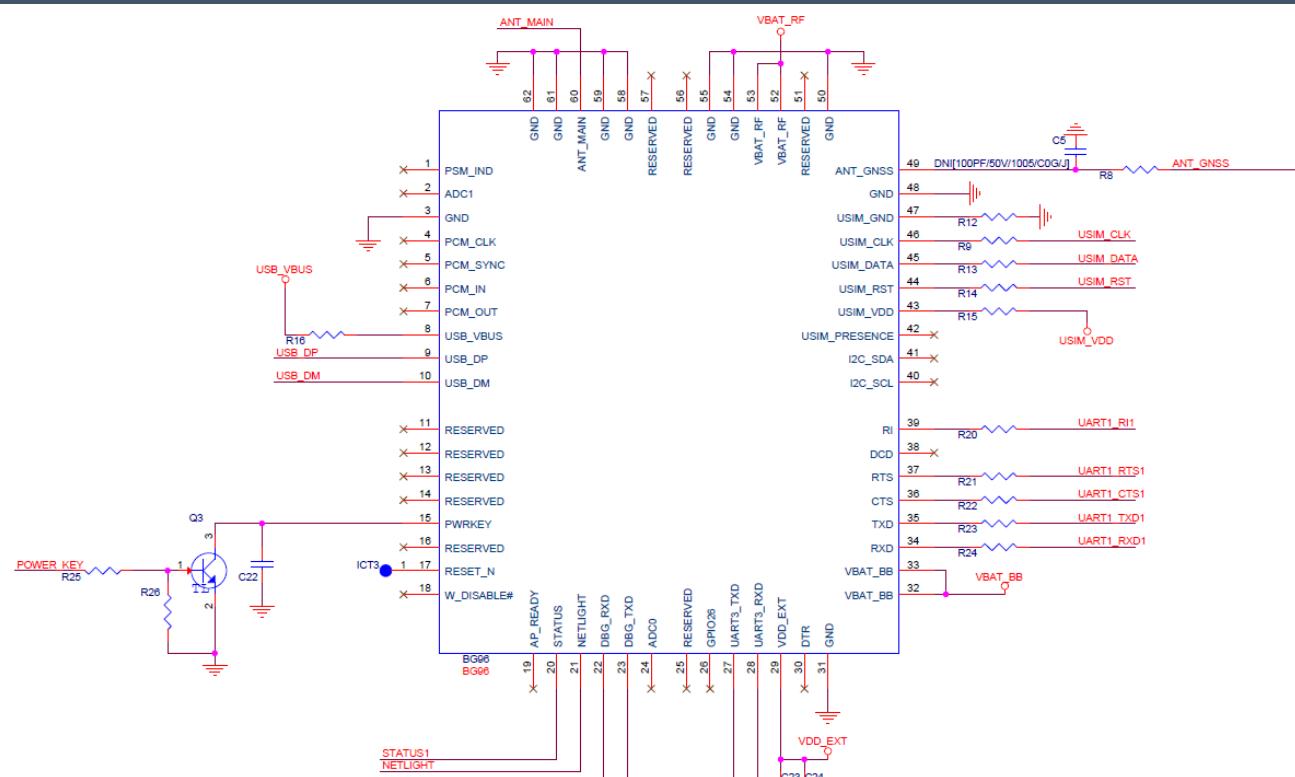
4. CAT.M1 Hardware Components and Architecture



4. 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

4. CAT.M1 Hardware Components and Architecture



> Circuit map download (dxf file included)

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

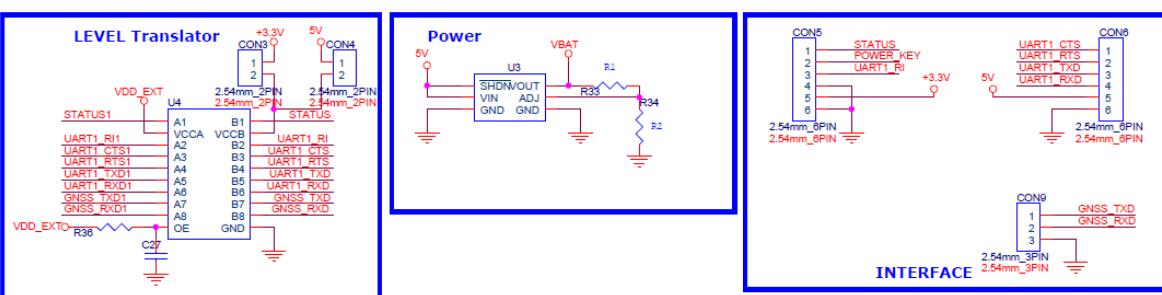
BG96 Module 호로도.pdf

> 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



5. 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.

5. 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.

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

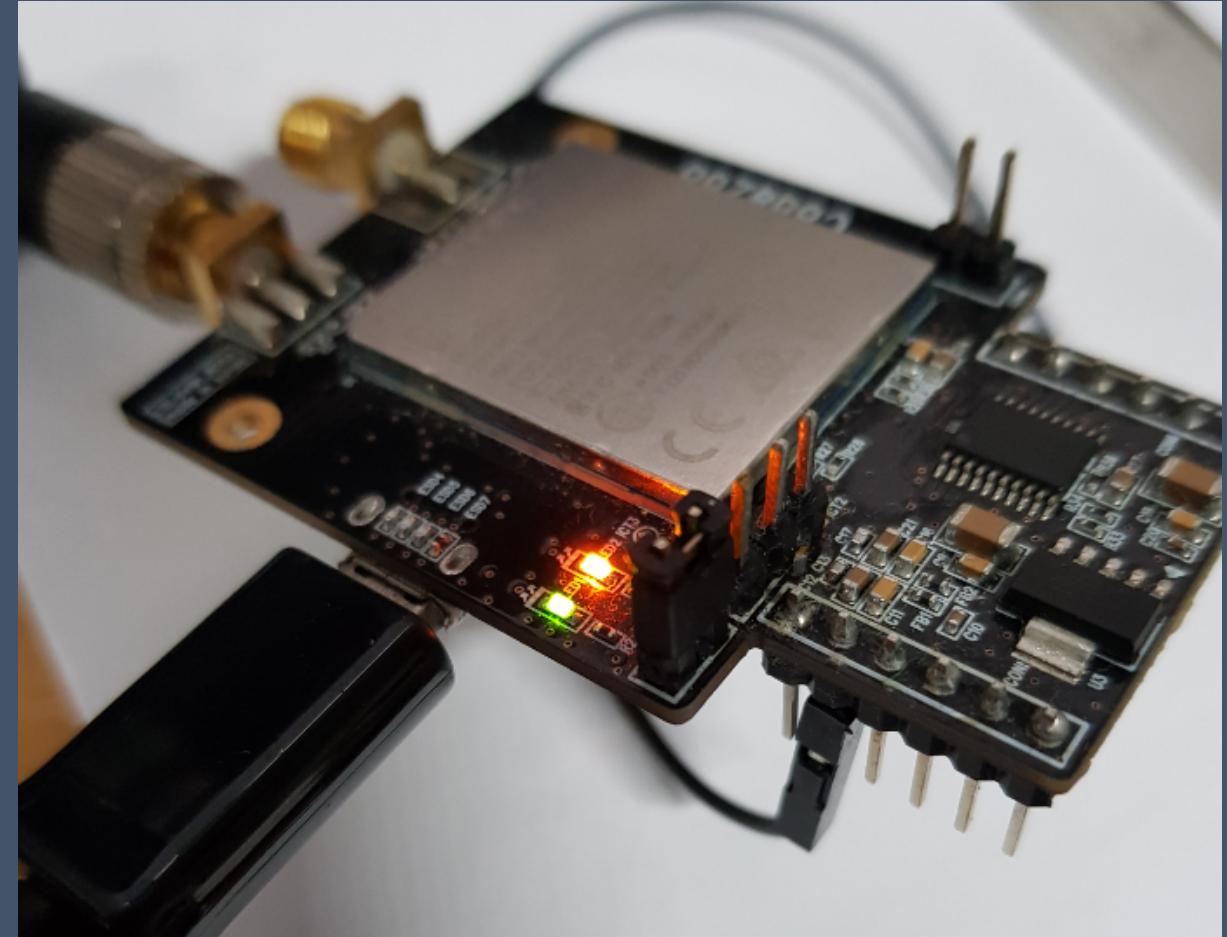
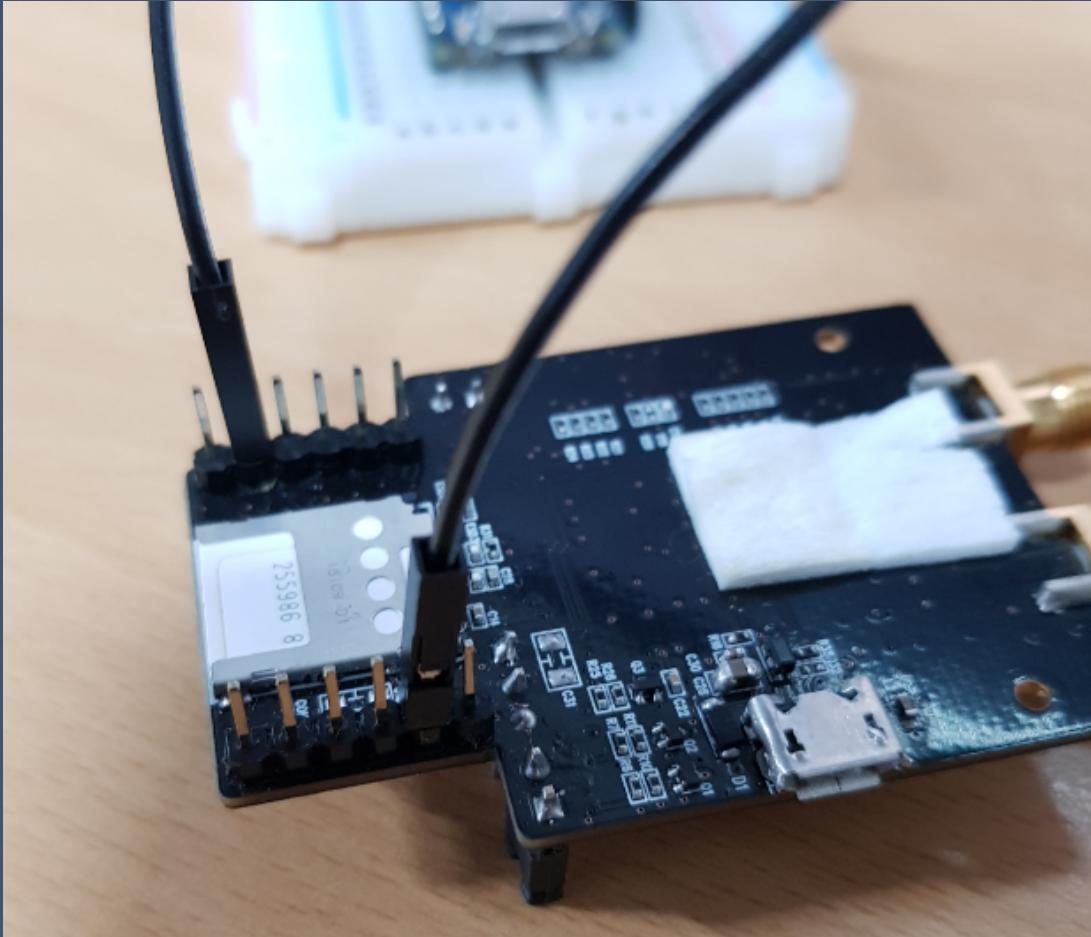
1.5. Unsolicited Result Code

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. Python thread
2. Daemon process상황에 맞는 소프트웨어 설계

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



5. 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

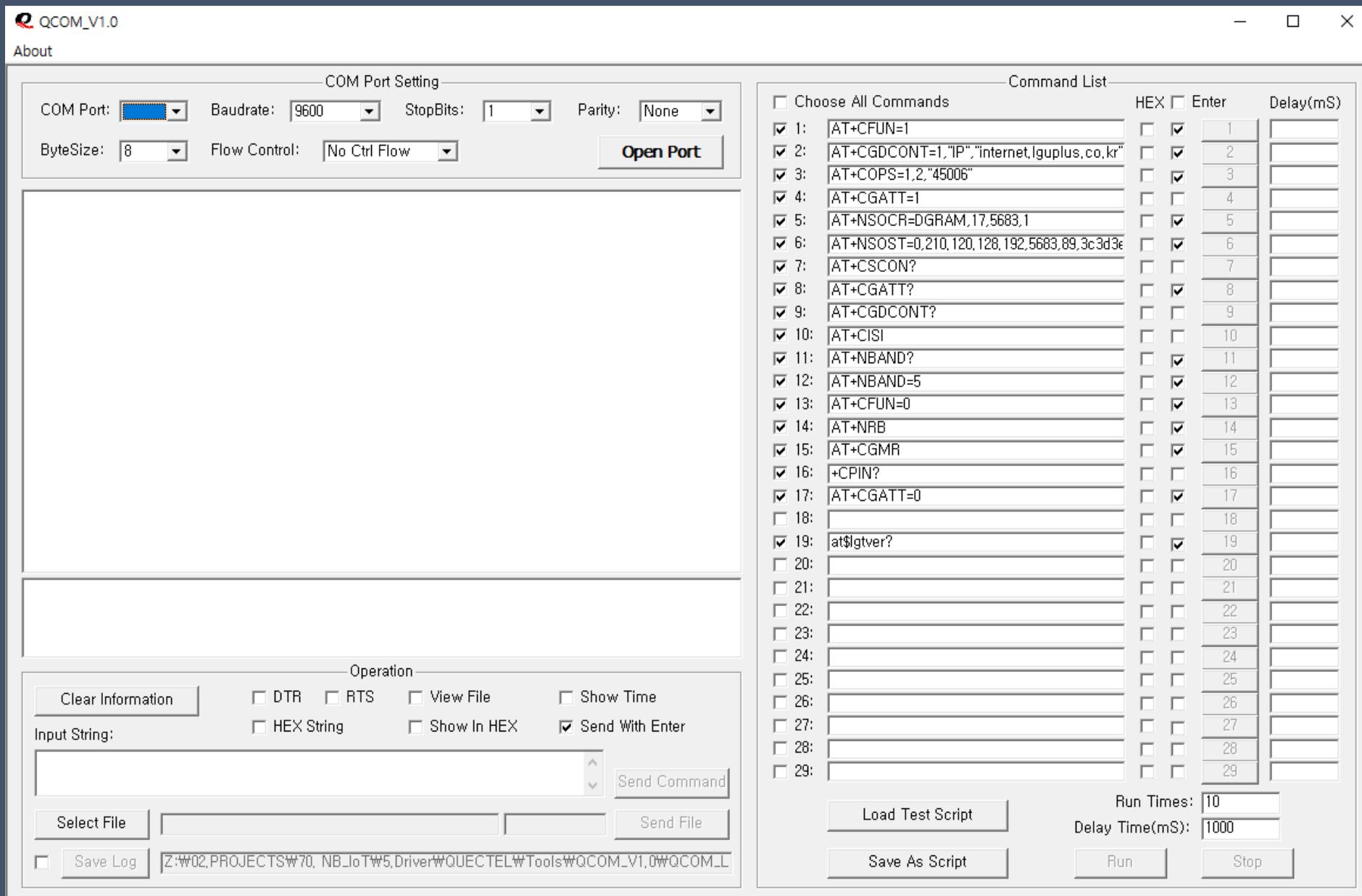
<IMEI> IMEI of the ME

NOTE

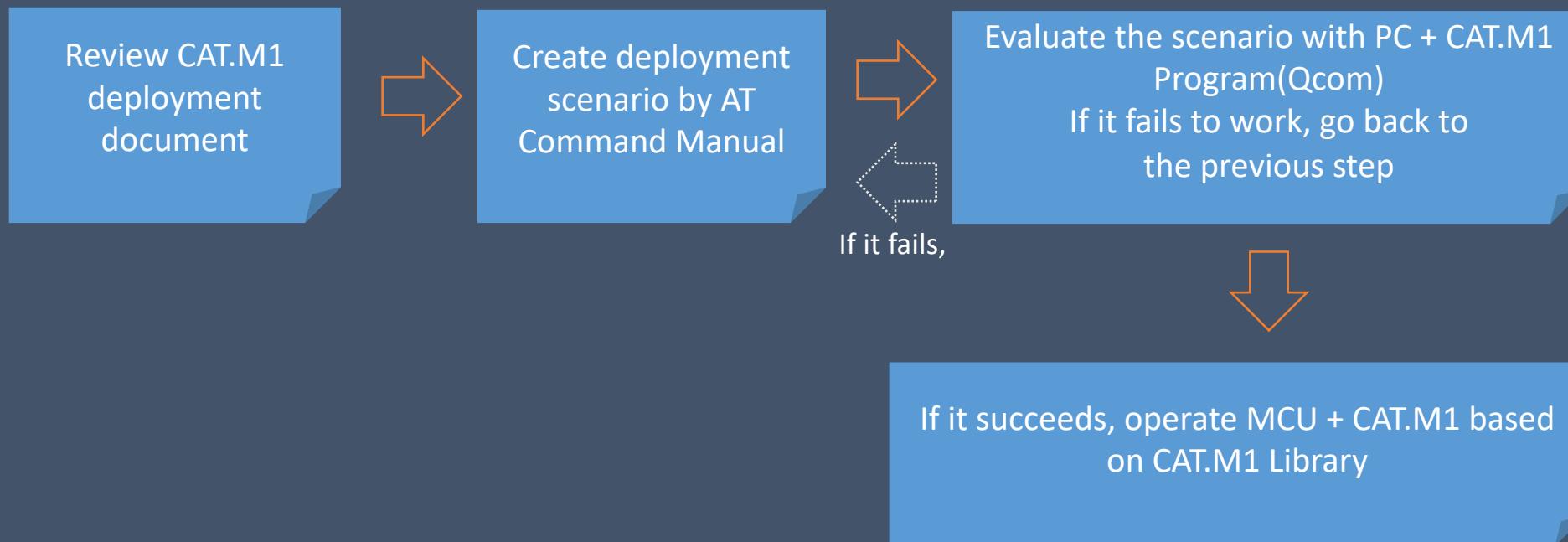
The serial number (IMEI) varies with the individual ME device.

Quectel_BG96_AT_Commands
_Manual_V2.3.pdf, 18page

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



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



6. CAT.M1 practice (RPI3 Raspberry Pi OS install)

Downloads

Raspberry Pi OS (previously called Raspbian) is our official operating system for **all** models of the Raspberry Pi.

Use **Raspberry Pi Imager** for an easy way to install Raspberry Pi OS and other operating systems to an SD card ready to use with your Raspberry Pi:

- [Raspberry Pi Imager for Windows](#)
- [Raspberry Pi Imager for macOS](#)
- [Raspberry Pi Imager for Ubuntu](#)

Version: 1.4

Install **Raspberry Pi Imager** to **Raspberry Pi OS** by running

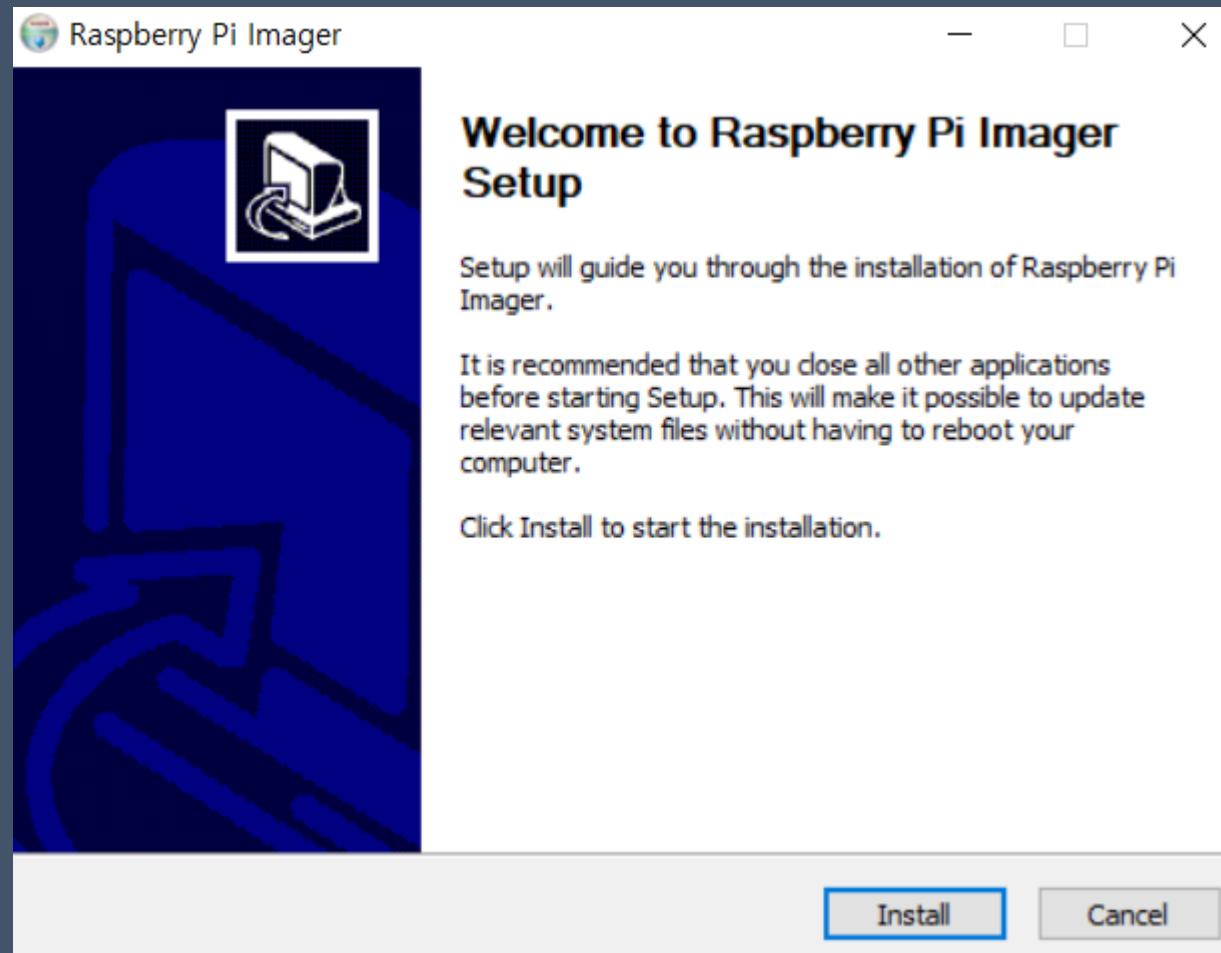
```
sudo apt install rpi-imager
```

 in a terminal window

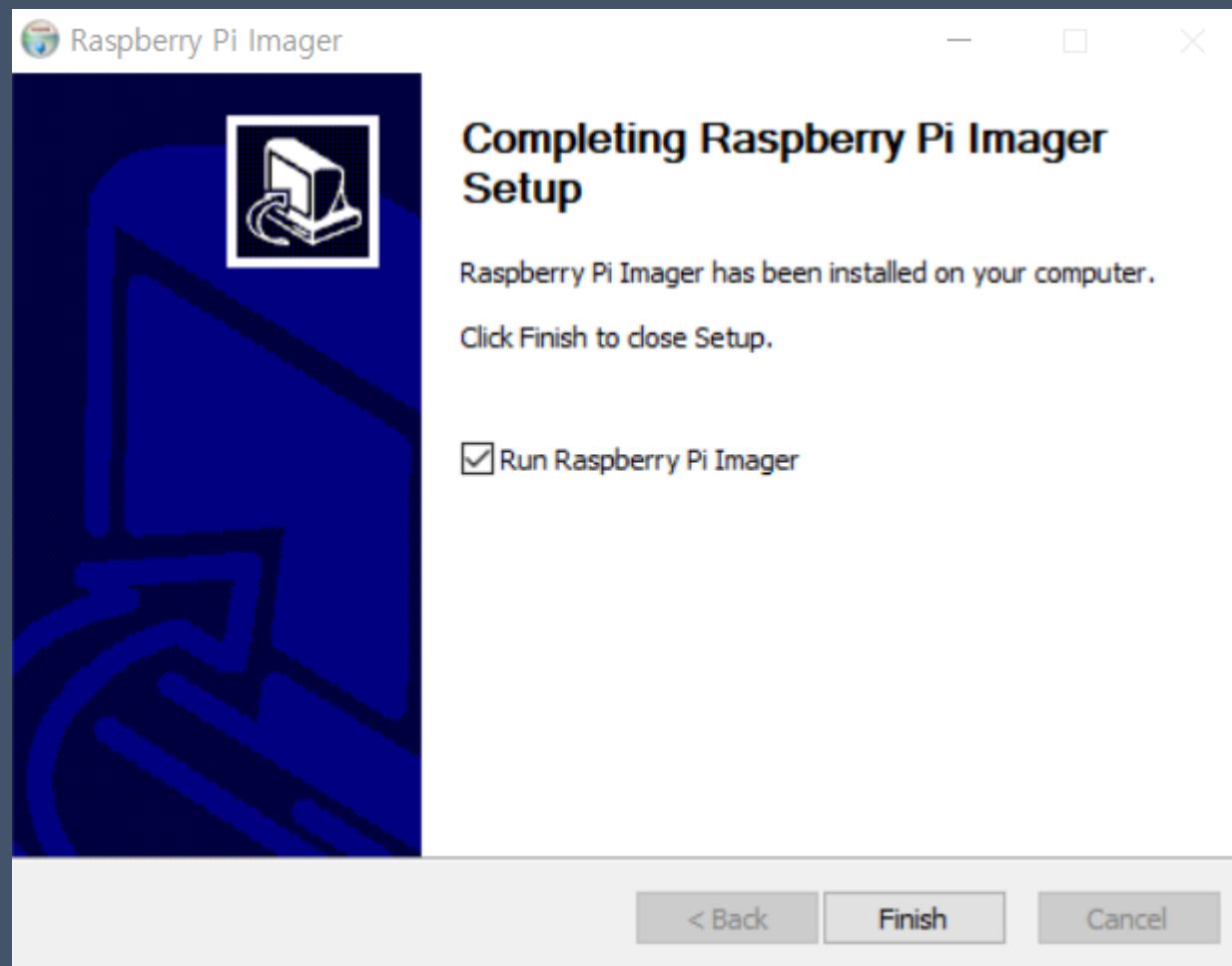
Alternatively, use the links below to download OS images which can be manually copied to an SD card.

<https://www.raspberrypi.org/downloads/>

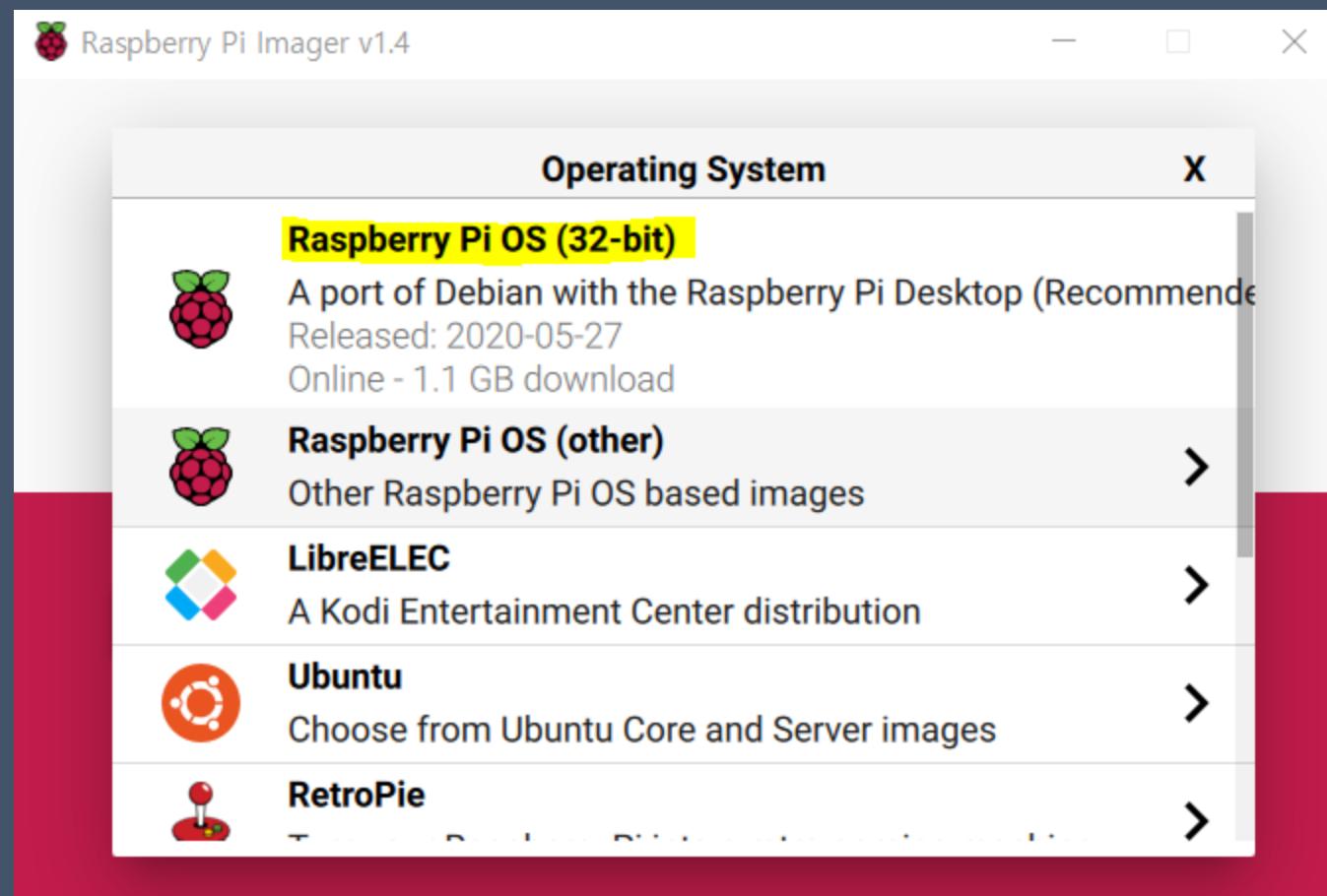
6. CAT.M1 practice (RPI3 Raspberry Pi OS install)



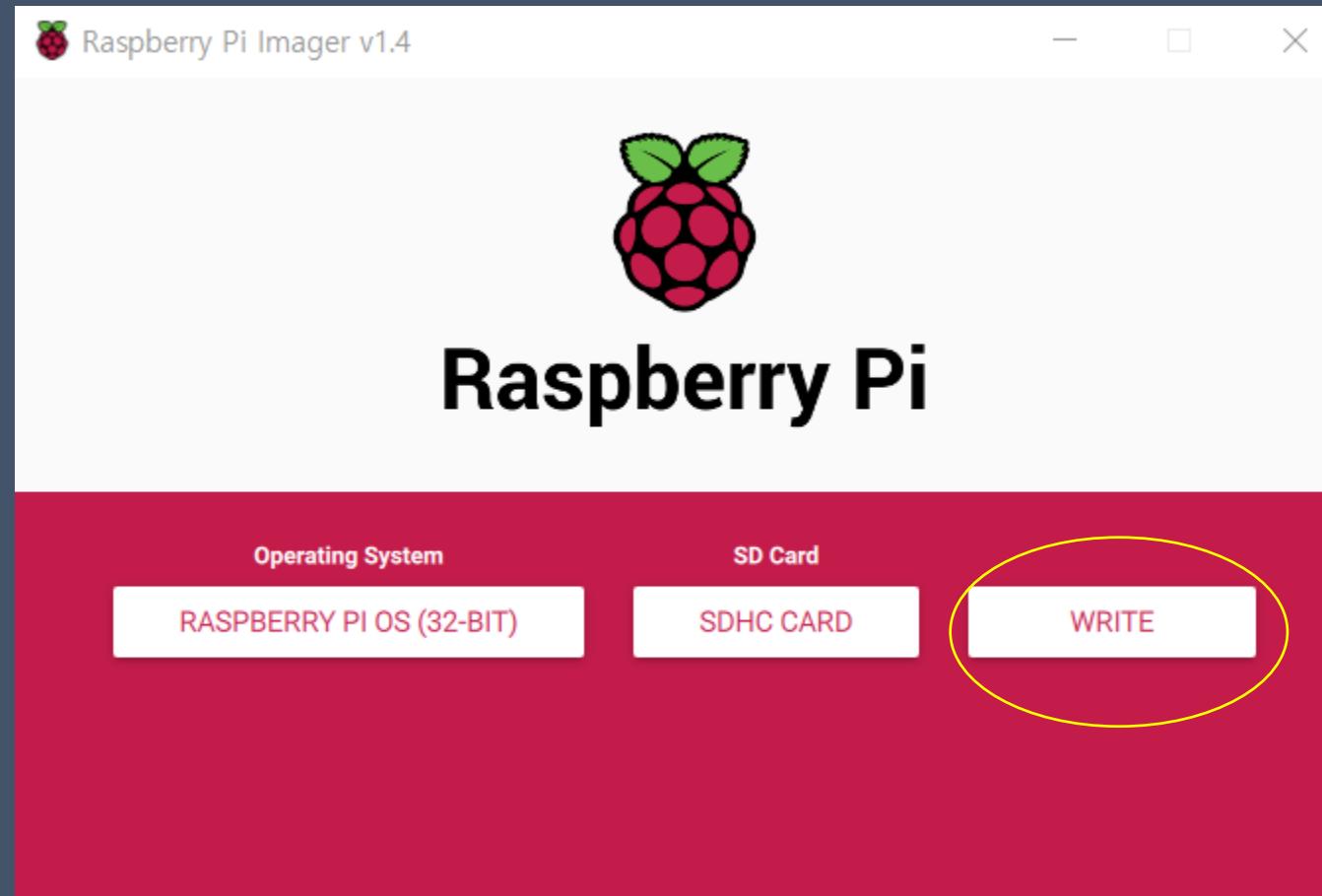
6. CAT.M1 practice (RPI3 Raspberry Pi OS install)



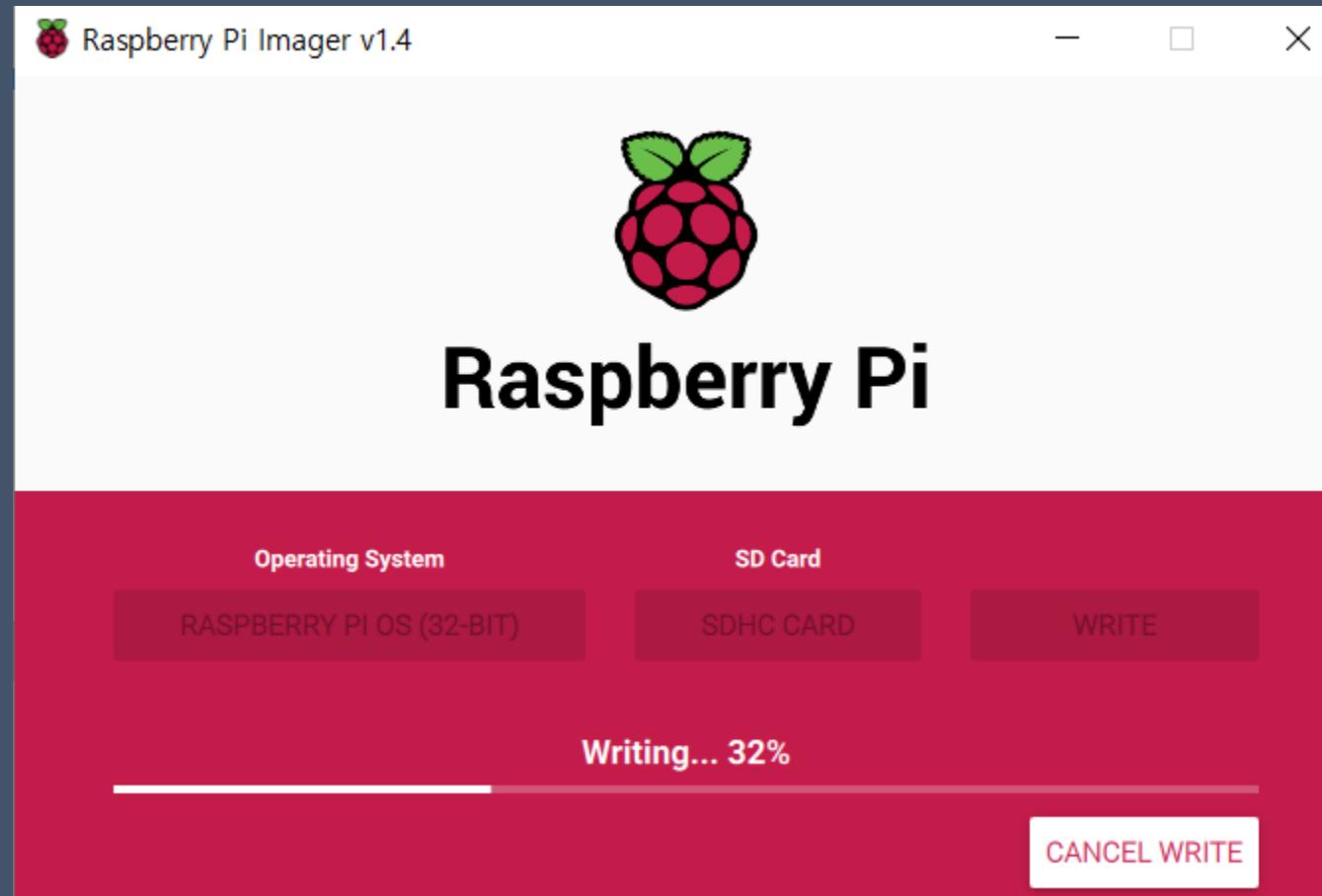
6. CAT.M1 practice (RPI3 Raspberry Pi OS install)



6. CAT.M1 practice (RPI3 Raspberry Pi OS install)



6. CAT.M1 practice (RPI3 Raspberry Pi OS install)

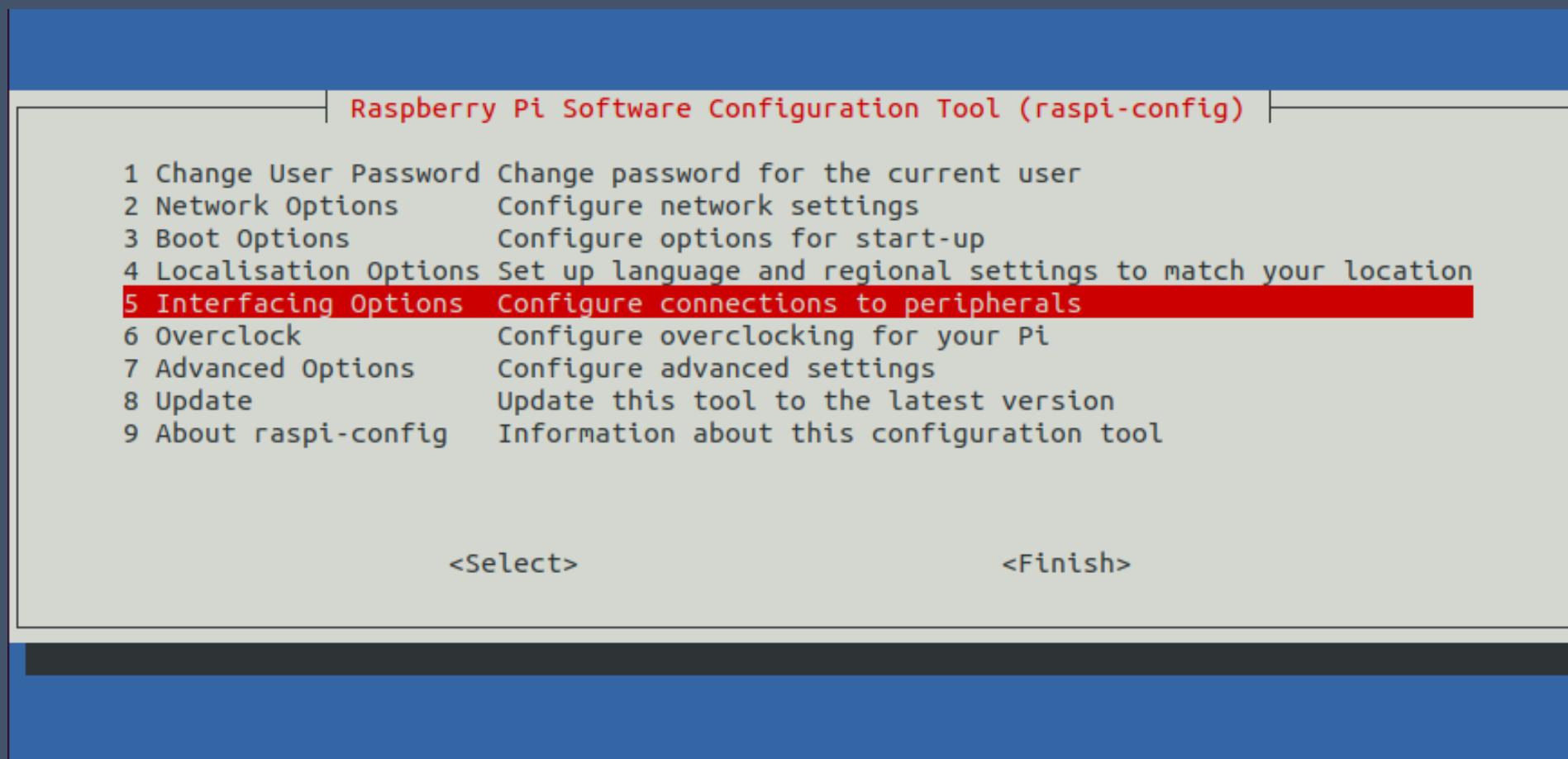


6. CAT.M1 practice (RPI3 Raspberry Pi OS install)

Configure Serial Port and do the following in Raspberry Pi Terminal.

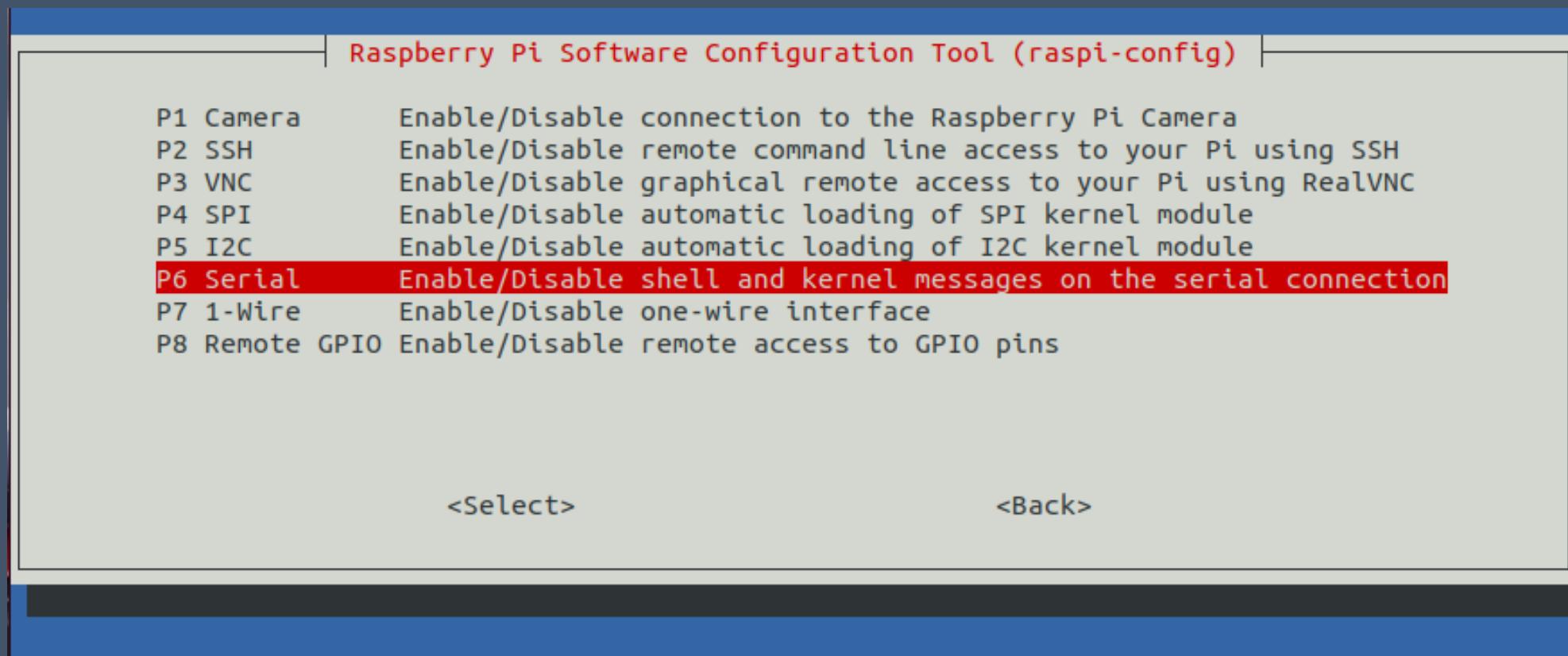
\$ sudo raspi-config

5. Interfacing Options 선택

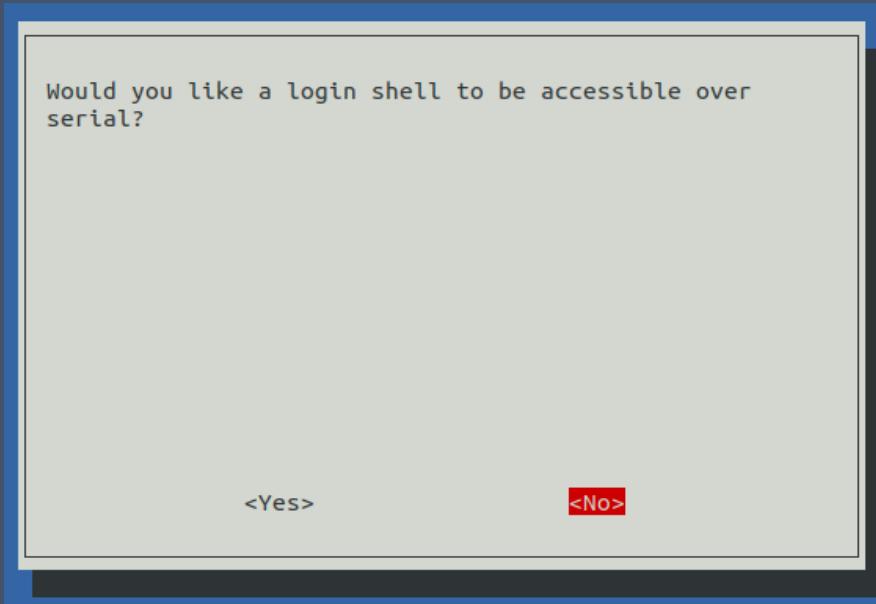


6. CAT.M1 practice (RPI3 Raspberry Pi OS install)

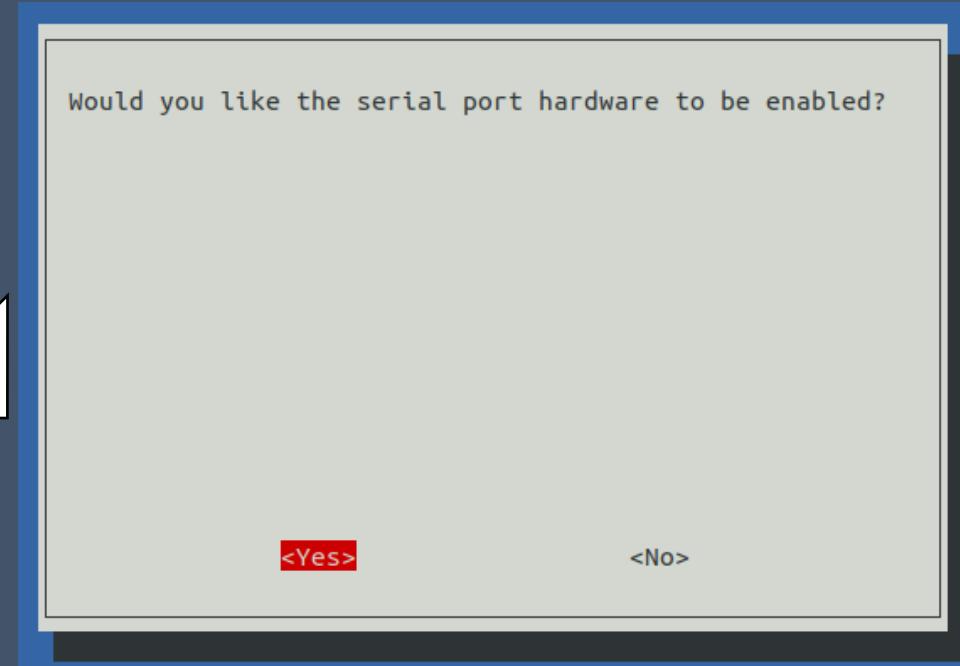
Select P6 Serial



6. CAT.M1 practice (RPI3 Raspberry Pi OS install)

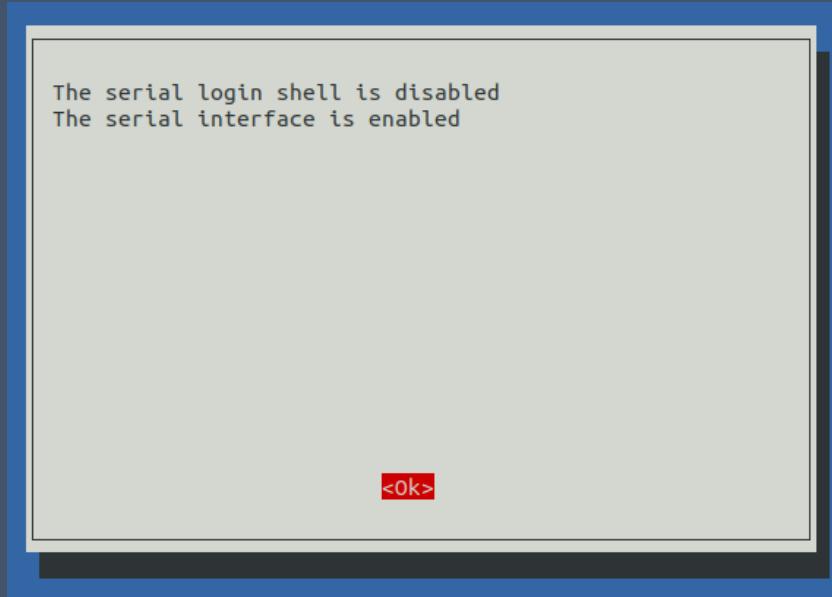


Select <No>

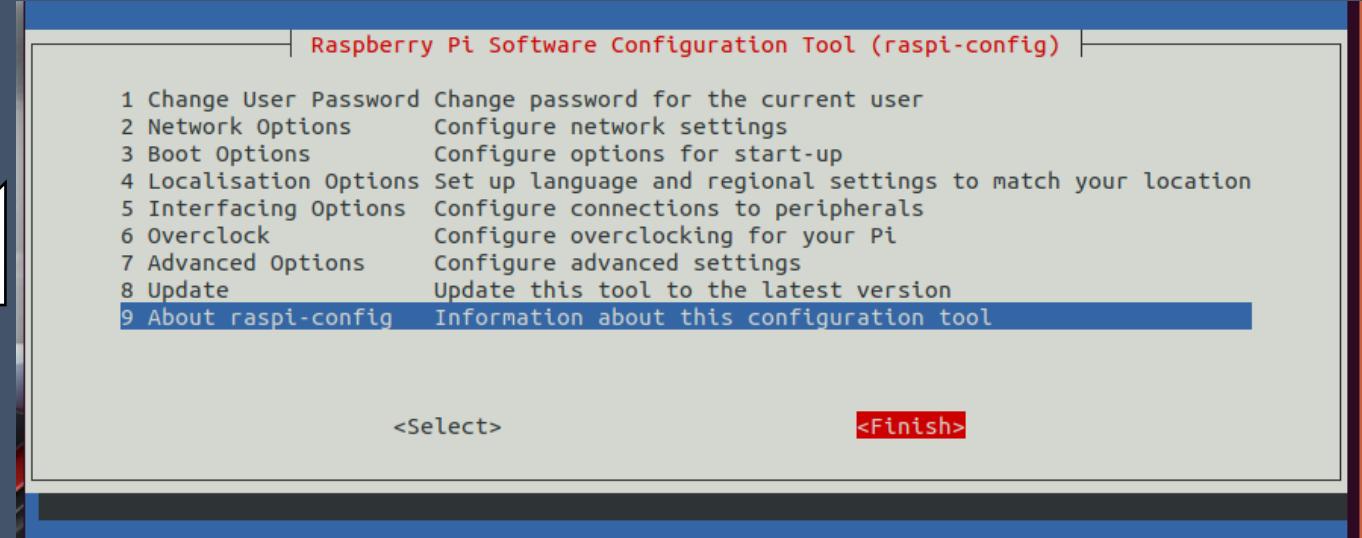
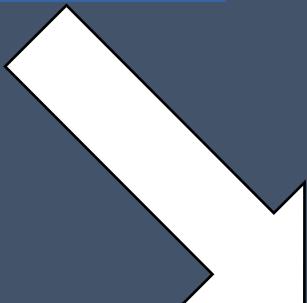


Select <Yes>

6. CAT.M1 practice (RPI3 Raspberry Pi OS install)



Select <OK>



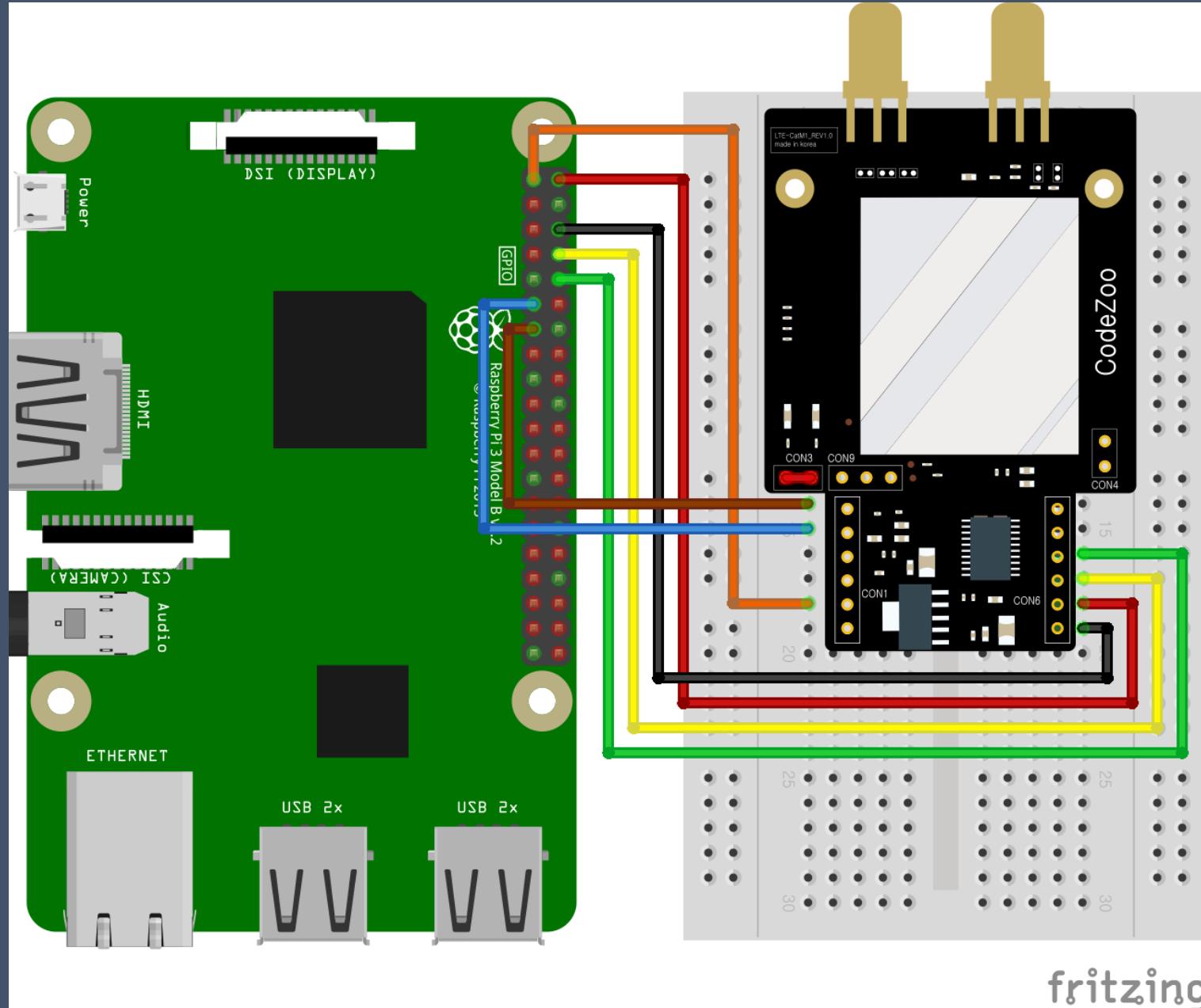
Select <Finish>

6. CAT.M1 practice (RPI3 Raspberry Pi OS install)

Reboot Raspberry Pi and the file "/dev/ttyS0" will be created.

```
pi@raspberrypi:~ $  
pi@raspberrypi:~ $ ls /dev/ttyS0  
/dev/ttyS0  
pi@raspberrypi:~ $ █
```

6. CAT.M1 practice - circuit map



6. CAT.M1 practice – download

https://github.com/codezoo-ltd/CAT.M1_RaspberryPi

The screenshot shows the GitHub repository page for 'CAT.M1_RaspberryPi' owned by 'codezoo-ltd'. The repository has 1 branch and 0 tags. The master branch has 6 commits. The README.md file is open, showing the title 'CAT.M1_RaspberryPi' and the subtitle 'LTE CAT.M1 BG96 RaspberryPi Open Source (with Python)'.

Codezoo-ltd / **CAT.M1_RaspberryPi**

Code Issues Pull requests Actions Projects Wiki Security Insights Settings

master 1 branch 0 tags Go to file Add file Code

C codezoo-ltd Update README.md ... 129d1f1 28 minutes ago 6 commits

File	Description	Time Ago
CZCATM1	indent error & Hex Encoding error Fix	2 hours ago
LICENSE	Initial commit	6 months ago
README.md	Update README.md	28 minutes ago
catm1Test.py	Test Complete version 1.0	5 months ago
socketTest.py	Test Complete version 1.0	5 months ago

README.md

CAT.M1_RaspberryPi

LTE CAT.M1 BG96 RaspberryPi Open Source (with Python)

6. CAT.M1 practice – download

codezoo-ltd / **CAT.M1_RaspberryPi**

Code Issues 1 Pull requests Actions Projects Wiki Security Insights Settings

master 1 branch 0 tags Go to file Add file Code

codezoo-ltd Update README.md ...

CZCATM1	indent error & Hex Encoding error Fix
LICENSE	Initial commit
README.md	Update README.md
catm1Test.py	Test Complete version 1.0
socketTest.py	Test Complete version 1.0

Clone with HTTPS Use SSH
Use Git or checkout with SVN using the web URL.
https://github.com/codezoo-ltd/CAT.M1_ 

Open with GitHub Desktop

Download ZIP

5 months ago

README.md

CAT.M1_RaspberryPi

LTE CAT.M1 BG96 RaspberryPi Open Source (with Python)

6. CAT.M1 practice (example)

```
jbmaster@jbmaster:~/work$ git clone https://github.com/codezoo-ltd/CAT.M1_RaspberryPi.git
Cloning into 'CAT.M1_RaspberryPi'...
remote: Enumerating objects: 27, done.
remote: Counting objects: 100% (27/27), done.
remote: Compressing objects: 100% (19/19), done.
remote: Total 27 (delta 7), reused 17 (delta 5), pack-reused 0
Unpacking objects: 100% (27/27), done.
jbmaster@jbmaster:~/work$
```

6. CAT.M1 practice – example

```
jbmaster@jbmaster:~/work/CAT.M1_RaspberryPi$ ls -al
total 32
drwxr-xr-x  4 jbmaster jbmaster 4096  8월 18 03:24 .
drwxr-xr-x 39 jbmaster jbmaster 4096  8월 18 03:24 ..
-rw-r--r--  1 jbmaster jbmaster   529  8월 18 03:24 catm1Test.py
drwxr-xr-x  2 jbmaster jbmaster 4096  8월 18 03:24 CZCATM1
drwxr-xr-x  8 jbmaster jbmaster 4096  8월 18 03:24 .git
-rw-r--r--  1 jbmaster jbmaster 1064  8월 18 03:24 LICENSE
-rw-r--r--  1 jbmaster jbmaster  210  8월 18 03:24 README.md
-rw-r--r--  1 jbmaster jbmaster 1246  8월 18 03:24 socketTest.py
jbmaster@jbmaster:~/work/CAT.M1_RaspberryPi$ python3 catm1Test.py
```

Thank you!