

## Quick Guide – How to connect and setup the components for Pi 3

### 4. Preparing Serial Port(s) for GPS and Communication Network

#### Prerequisite

##### a. Install pyserial software

You must install the latest pyserial library for Python.

```
sudo pip3 install pyserial
```

##### b. Install Terminal Software

The terminal software is not installed by default for Raspberry Pi. You need to install the software manually through the command line.

Choose the terminal software (e.g. minicom, picocom or putty) that you are familiar with, and install it.

```
sudo apt install minicom
```

```
sudo apt install picocom
```

```
sudo apt install putty
```

By default, the Raspberry Pi uses the serial port for the “console” login and via a software service called “getty”. If you are using the serial port for anything other than the console you need to disable it. This will be slightly different depending on whether you are running a Raspberry Pi 3 or not.

##### c. Disabling Getty Service

For Raspberry Pi 3's the command is referencing /dev/ttyS0:

```
sudo systemctl stop serial-getty@ttyS0.service
```

```
sudo systemctl disable serial-getty@ttyS0.service
```

The “disable” will stop it loading at reboots.

You also need to remove the console from the **cmdline.txt** using the following command:

```
sudo nano /boot/cmdline.txt
```

You will see something like this:

## Quick Guide – How to connect and setup the components for Pi 3

```
dwc_otg.lpm_enable=0 console=serial0,115200 console=tty1 root=/dev/mmcblk0p2  
rootfstype=ext4 elevator=deadline fsck.repair=yes root wait
```

remove the text:

```
console=serial0,115200
```

Or anything involving console= that isn't console=tty1, remove it.

**Caution:** Make sure NOT to accidentally add a line break to that file, it should remain all ONE LINE with spaces between the options, but no space around any = symbol.

### d. Swapping the assignment of serial ports for Bluetooth and UART (Optional)

For Pi 3, by right you should be able to access the serial port via `/dev/serial1` or `/dev/ttyS0`. This port is mapped by default to the mini UART which is less accurate than the high-performance port (`/dev/ttyAMA0`). You don't have to do this to Pi 4 and Pi 5 as it has got five UARTS (`/dev/ttyAMA__`). The additional UART on Pi4-5 are real UARTS, much better than the mini UART.

If you don't want to use Bluetooth, and you want that high-performance (`/dev/ttyAMA0`) port back on the GPIO, you can do this via a device overlay called "`pi3-miniuart-bt`" i.e. use the mini-uart on `/dev/ttyS0` for Bluetooth.

To use add the following line to the `/boot/config.txt`

```
sudo nano /boot/config.txt
```

and add (at the end of the file):

```
dtoverlay=pi3-miniuart-bt
```

Save and reboot for changes to take effect.

```
sudo reboot
```

You should see the activation message for `pi3-miniuart-bt` on the top right corner of your main desktop screen after startup.

Note: Please test the UART after you have installed the HAT on your Pi board to ensure that it is properly working.

## Quick Guide – How to connect and setup the components for Pi 3

### 5. SIM7000E NB-IOT HAT (via Serial Port)

#### a. Installation

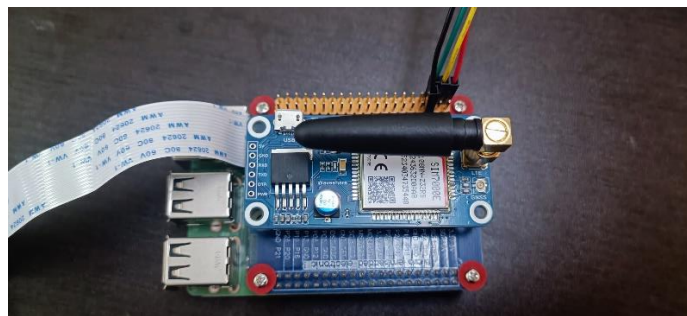
Connect your SIM 7000E NB-IOT HAT to the Raspberry Pi's 40-pin connector. Make sure the orientation is correct, and all pins nicely fit into the connector.



Connecting with Raspberry Pi 4



Connecting with Raspberry Pi Zero



Connecting with Raspberry Pi 3 and IO Expansion Board

**Warning:** When plug in the 40-pin connector, the antenna should be away from your USB and Ethernet ports. **DO NOT** reverse the 40-pin connector of the RPi hat, or off by one! This may result in electrical damage to your RPi and/or HAT.

#### b. Testing the Module SIM 7000E NB-IOT Module

Once everything is properly connected. Power on your Raspberry Pi and connect to the serial port using your favorite terminal software, e.g. minicom.

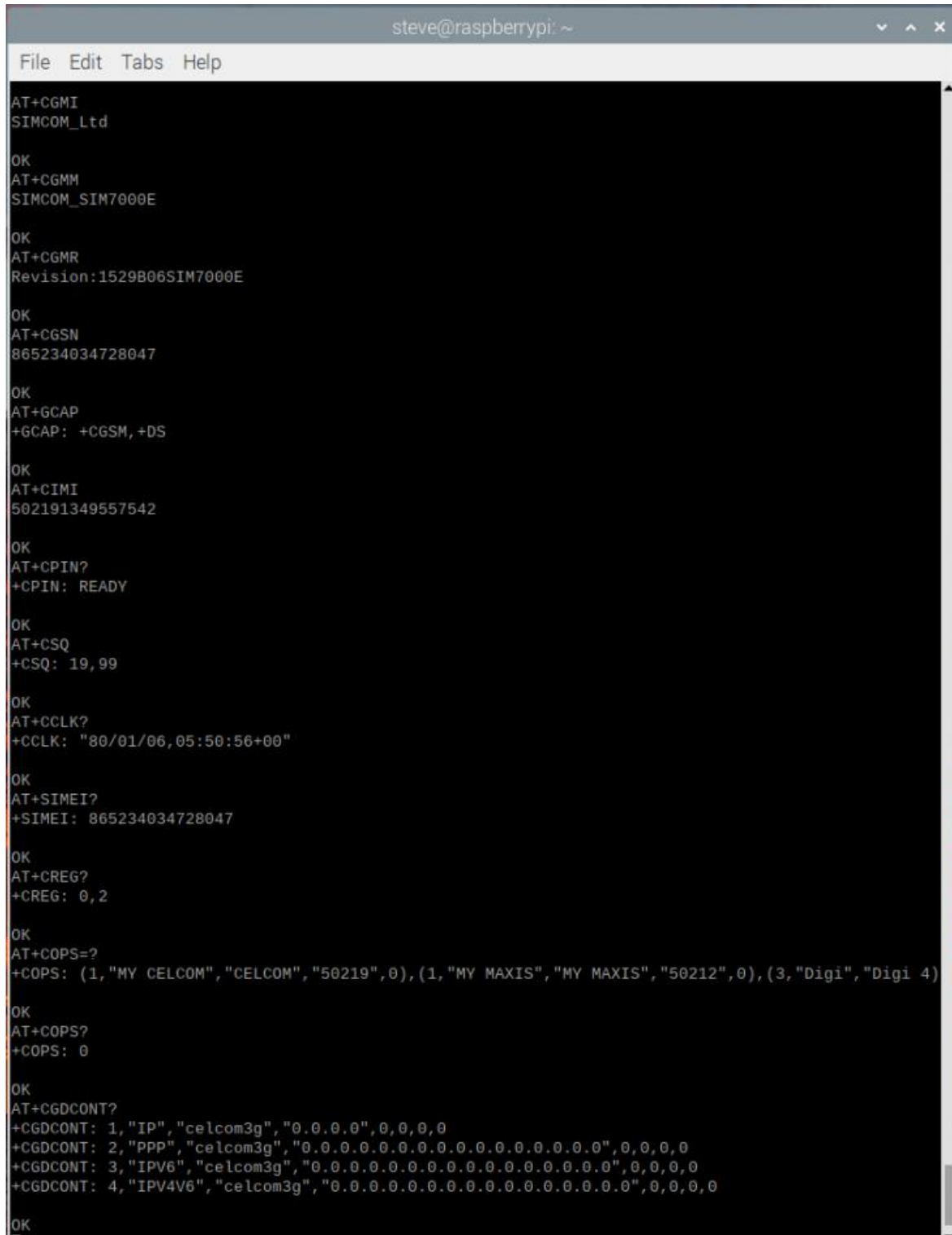
```
minicom -D /dev/ttyAMA0
```

You can then issue AT commands to the serial port to set up or get appropriate responses. AT commands existed long time ago since the introduction of modem. The tradition was

## Quick Guide – How to connect and setup the components for Pi 3

passed on to the current communication devices, with many new proprietary commands and variations. Try to issue the following AT commands in the terminal.

E.g. **AT+CGMI** //Note there should be no space between the + symbol.



```
steve@raspberrypi: ~  
File Edit Tabs Help  
AT+CGMI  
SIMCOM_Ltd  
  
OK  
AT+CGMM  
SIMCOM_SIM7000E  
  
OK  
AT+CGMR  
Revision:1529B06SIM7000E  
  
OK  
AT+CGSN  
865234034728047  
  
OK  
AT+GCAP  
+GCAP: +CGSM,+DS  
  
OK  
AT+CIMI  
502191349557542  
  
OK  
AT+CPIN?  
+CPIN: READY  
  
OK  
AT+CSQ  
+CSQ: 19,99  
  
OK  
AT+CCLK?  
+CCLK: "80/01/06,05:50:56+00"  
  
OK  
AT+SIMEI?  
+SIMEI: 865234034728047  
  
OK  
AT+CREG?  
+CREG: 0,2  
  
OK  
AT+COPS=?  
+COPS: (1,"MY CELCOM","CELCOM","50219",0),(1,"MY MAXIS","MY MAXIS","50212",0),(3,"Digi","Digi 4")  
  
OK  
AT+COPS?  
+COPS: 0  
  
OK  
AT+CGDCONT?  
+CGDCONT: 1,"IP","celcom3g","0.0.0.0",0,0,0,0  
+CGDCONT: 2,"PPP","celcom3g","0.0.0.0.0.0.0.0.0.0.0.0.0.0",0,0,0,0  
+CGDCONT: 3,"IPV6","celcom3g","0.0.0.0.0.0.0.0.0.0.0.0.0.0",0,0,0,0  
+CGDCONT: 4,"IPV4V6","celcom3g","0.0.0.0.0.0.0.0.0.0.0.0.0.0",0,0,0,0  
  
OK
```

## Quick Guide – How to connect and setup the components for Pi 3

The usual response that you will get after every command is ok. If there is an error, consult the [official website](#) or [AT user manual](#) for more information. If you do not get a response, check your connections and OS settings.

For live network testing, you can also try the following commands. Note that the MQTT commands differ from one model to another. For instance, there is no MQTTSTART and MQTTSTOP in SIM 7000E below.

AT Command	Response	Description
AT+CNMP=38	OK	13: GSM only; 38: LTE only (when using NB-IOT network)
AT+CMNB=2	OK	1: CAT-M; 2: NB-IOT
AT+NBSC=1	OK	0: Close; 1: Open
AT+CSQ	+CSQ: 20,0 OK	Signal quality. The first param (Max 31). Stronger signal=bigger value
AT+CGREG?	+CGREG: 0,1 OK	Network registration. If 2nd param of response is 1 or 5 = registered
AT+CGACT?	+CGACT: 1,1 OK	Auto activation of PDN
AT+COPS?	+COPS: 0,0,"operator",9 OK	Check operator info. 9 is NB-IOT network
AT+CGCONTRDP	+CGCONTRDP: 1,5,"apnname","10.250.0.213.255 .255.255.0" OK	Get APN and IP address from network
MQTT commands	Response	Description
AT+CNACT=1," <a href="#">cmnet</a> "	OK  +APP PDP: ACTIVE	Open wireless connection parameter <a href="#">cmnet</a> is APN. Set the APN values according to different sim providers.
AT+CNACT?	+CNACT: 1,"10.181.182.177" OK	Get local IP
AT+SMCONF="URL", "test.mosquitto.org","1883"	OK	Set up server URL
AT+SMCONF="KEEPTIME",60	OK	Set MQTT time to connect server
AT+SMCONN	OK	
AT+SMSUB="update",1	OK	Subscription to "update" topic
AT+SMPUB="update","5",1,1 > <a href="#">hello</a>	OK  +SMSUB: "update","hello"	Send 5-character message for "update" topic. Get data on server
AT+SMUNSUB="update"	OK	Unsubscribe from "update"
AT+SMDISC	OK	Disconnect MQTT

## Quick Guide – How to connect and setup the components for Pi 3

AT+CNACT=0	OK  +APP PDP: DEACTIVE OK OK	Disconnect wireless
------------	--	---------------------

MQTTs commands	Response	Description
CA certs,client certs and keys are mandatory for secure connections. Before you proceed, you must upload the certs to the EFS memory of SIM7000 using the <b>QPST Tool</b> available from <a href="#">here</a> or visit the <a href="#">wiki</a> . You may skip this part if you do not intend to use SSL.		
AT+CSSLCFG="CONVERT",1, "clientcert.pem", "key.pem"	OK	"clientcert.pem" is the client certificate, "key.pem" is key of client certificate.
AT+CSSLCFG="CONVERT",2, "cacert.pem"	OK	"cacert.pem" is the root ca certificate.
AT+CNACT=1," <a href="#">cmnet</a> "	OK  +APP PDP: ACTIVE	Open wireless connection parameter <a href="#">cmnet</a> is APN. Set the APN values according to different sim providers.
AT+CNACT?	+CNACT: 1,"10.181.182.177"  OK	Get local IP
AT+SMCONF="URL", "test.mosquitto.org","8883"	OK	Set up server URL
AT+CMCONF="KEEPTIME",60	OK	Set MQTT time to connect server
AT+SMSSL=1,rootCA.pem, cert.pem	OK	Set ca certificate and cert certificate name
AT+SMCONN	OK	Connect to Server
AT+SMSUB="update",1	OK	Subscription to "update" topic
AT+SMPUB="update","5",1,1 > <a href="#">holla</a>	OK  +SMSUB: "update","hello"	Send 5-character message for "update" topic. Get data on server
AT+SMUNSUB="update"	OK	Unsubscribe from "update"
AT+SMDISC	OK	Disconnect MQTT
AT+CNACT=0	OK  +APP PDP: DEACTIVE OK OK	Disconnect wireless

Note 1: You need to be familiar with several commands for Network, Packet Domain, Internet Service, SSL, MQTT(S) or HTTP(S) and GNSS.

## Quick Guide – How to connect and setup the components for Pi 3

Note 2: You will need an **active NB-IOT Sim Card** installed in the sim slot to connect to the NB-IOT service. You can still use any 4G Sim Card to perform command testing, but since this HAT mainly operates on **CAT-M or NB-IOT band**, you cannot issue any connection, send or receive commands.

### 6. SIM A7670SA 4G LTE Module (via Serial Port)

#### a. Installation

Connect your SIM A7670SA module to the Raspberry Pi as follows.

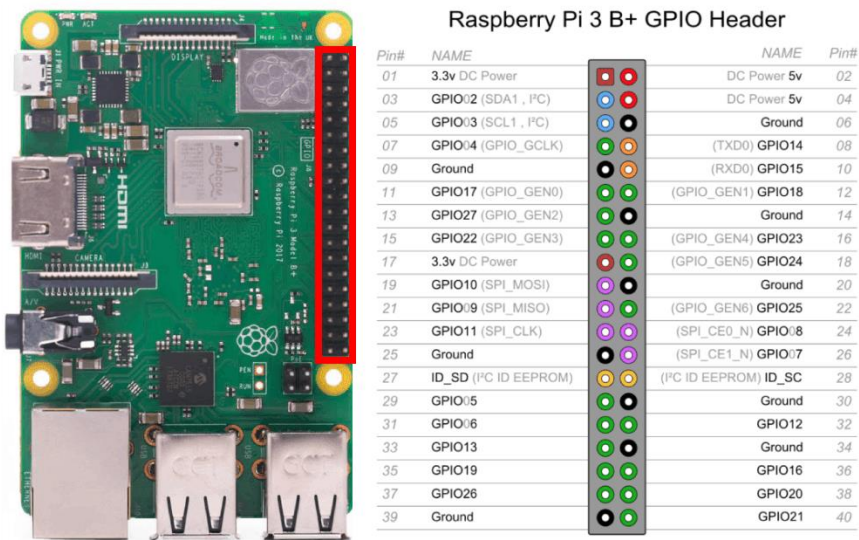


Figure: Raspberry Pi 3 B+ GPIO Header Pinout



## Quick Guide – How to connect and setup the components for Pi 3

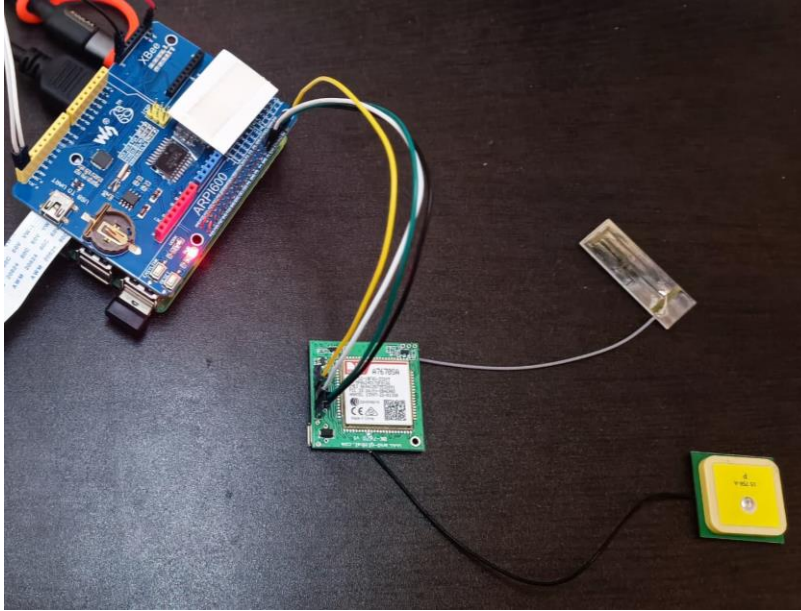


Figure: ARPI600 hat on top of Raspberry Pi 3 B+. Note the pin positions are the same.

Raspberry Pi	SIM A7670SA
Pin 2 or 4 (5v)	V
Pin 6 (Ground)	G (there are two, connect either one)
Pin 8 (TXD0)	R
Pin 10 (RXD0)	T

Please ensure that the antennas for GPS and LTE are installed properly. The IPX micro connectors are quite fragile, so please do not apply too much force. It may damage the connector. Check out this video for the assembly and disassembly steps.

<https://youtu.be/HbBDx2X7x0w>

You can do it by hand, but please make sure the round connector is 100% flat, and fully covers the IPX female head fully covers the IPX male round surface. E.g.





## Quick Guide – How to connect and setup the components for Pi 3

### b. Testing the SIM 7670SA Module

Once everything is properly connected. Power on your Raspberry Pi and connect to the serial port using your favorite terminal software, e.g. minicom.

```
minicom -D /dev/ttyAMA0
```

You can then issue AT commands to the serial port to set up or get appropriate responses. AT commands existed long time ago since the introduction of modem. The tradition was passed on to the current communication devices, with many new proprietary commands and variations.

Try to issue the following AT commands in the terminal.

```
// Manufacturer Identification
AT+CGMI

// Model
AT+CGMM

// Firmware Revision
AT+CGMR

// Product Serial Number
AT+CGSN

// Request overall capabilities
AT+GCAP

// Read ICCID from SIM card
AT+CICCID

// Request international mobile subscriber identity
AT+CIMI

// Check SIM PIN - if response is READY means ME is not pending for any password
AT+CPIN?

// Query signal quality – need an active line
AT+CSQ

//Query Real-time Clock
AT+CCLK?

// Get the IMEI for the module
AT+SIMEI?
```

## Quick Guide – How to connect and setup the components for Pi 3

```
// Network registration - 0,1 means registered home network
AT+CREG?

// Operator selection – this one will take a long time, be patient, please wait.
AT+COPS=?
AT+COPS?

// Define PDP context
AT+CGDCONT?

// Testing Ping Destination Address
AT+CPING="www.google.com",1,4,64,1000,10000,255
```

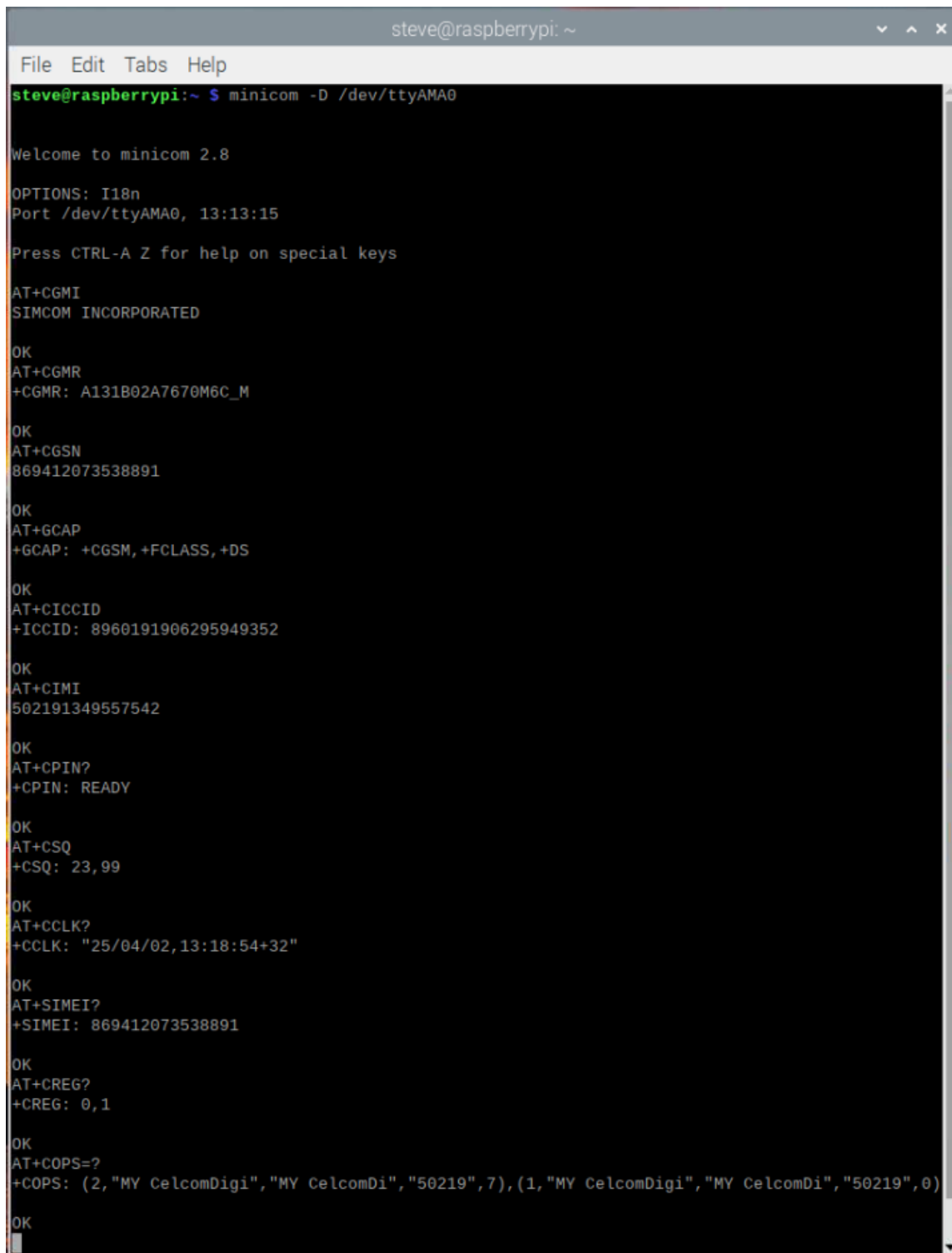
The usual response that you will get after every command is ok. If there is an error, consult the [A76XX Series AT Command Manual V1.06](#) for more information.

If you do not get a response, check your connections and OS settings.

Note 1: You need to be familiar with several commands for Network, Packet Domain, Internet Service, SSL, MQTT(S) or HTTP(S) and GNSS.

Note 2: You will need an active 4G Sim Card installed in the sim slot to connect to the LTE service.

## Quick Guide – How to connect and setup the components for Pi 3



```
steve@raspberrypi: ~
File Edit Tabs Help
steve@raspberrypi:~ $ minicom -D /dev/ttyAMA0

Welcome to minicom 2.8

OPTIONS: I18n
Port /dev/ttyAMA0, 13:13:15

Press CTRL-A Z for help on special keys

AT+CGMI
SIMCOM INCORPORATED

OK
AT+CGMR
+CGMR: A131B02A7670M6C_M

OK
AT+CGSN
869412073538891

OK
AT+GCAP
+GCAP: +CGSM,+FCLASS,+DS

OK
AT+CICCID
+ICCID: 8960191906295949352

OK
AT+CIMI
502191349557542

OK
AT+CPIN?
+CPIN: READY

OK
AT+CSQ
+CSQ: 23,99

OK
AT+CCLK?
+CCLK: "25/04/02,13:18:54+32"

OK
AT+SIMEI?
+SIMEI: 869412073538891

OK
AT+CREG?
+CREG: 0,1

OK
AT+COPS=?
+COPS: (2,"MY CelcomDigi","MY CelcomDi","50219",7),(1,"MY CelcomDigi","MY CelcomDi","50219",0)

OK
```

## Quick Guide – How to connect and setup the components for Pi 3

```
AT+COPS=?
+COPS: (2,"MY CelcomDigi","MY CelcomDi","50219",7),(1,"MY CelcomDigi","MY CelcomDi","50219",0)
OK
AT+COPS?
+COPS: 0,2,"50219",7
OK
AT+CGDCONT?
+CGDCONT: 1,"IP","celcom3g","10.178.19.3",0,0,,,
OK
AT+CPING="www.google.com",1,4,64,1000,10000,255
OK
+CPING: 1,142.251.223.68,92,85,58
+CPING: 1,142.251.223.68,92,15,58
+CPING: 1,142.251.223.68,92,15,58
+CPING: 1,142.251.223.68,92,25,58
+CPING: 3,4,4,0,15,85,28
AT
OK
CTRL-A Z for help | 115200 8N1 | NOR | Minicom 2.8 | VT102 | Offline | ttyAMA0
```

## 7. Writing Python Code to access the GPS and Communication Modules

Coming soon