



M.2-USB ADAPTOR

M.2-USB Adaptor Technical Specifications & User Manual



Purpose of the Document

The purpose of this document is to explain the technical specifications and manual for using the M.2-USB adaptor.

Document History

Version	Author	Date	Description
A	5G HUB	06.02.2021	Initial Document

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1 Package Content

1.1 M.2-USB Adaptor:

- Raspberry PI HAT for M.2 to USB adaptor.

1.2 Download

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>

2 General Description

2.1 Overview

The M.2 to USB adaptor hardware board is a rectangular board (about 65x56mm) that has four mounting holes in the (nicely rounded) corners and a USB connector that can be plugged into a USB port. It also aligns with the mounting holes on the Raspberry Pi B+, has a 40W GPIO header and supports the special autoconfiguration system that allows automatic GPIO setup and driver setup. The automatic configuration is achieved using 2 dedicated pins (ID_SD and ID_SC) on the 40W B+ GPIO header that are reserved for an I2C EEPROM. The EEPROM holds the board manufacturer information, GPIO setup and a thing called a “device tree” fragment – basically a description of the attached hardware that allows Linux to automatically load the required drivers.

The M.2-to-USB adaptor can be used as a standalone adaptor that can be plugged into a USB port. It can be also used with the Raspberry Pi (RP) model B+. The adaptor fits as a HAT (Hardware Attached on Top). A HAT is an add-on board for RP model B+ that conforms to a specific set of rules that will make life easier for users and enable use of different M.2 form factor and hardware LTE Cat 6/Cat 8/Cat 12 chipsets (EM06, EM12) with raspberry Pi.

2.2 Key Features

The M.2 to USB adaptor has following features:

- Has M.2 interface can be used with LTE Cat 6/Cat 8/Cat 12 modules (EM06/EM12)
- Dual micro SIM card slots making it ideal for multiple mobile operators support. The dual SIM card slots can easily be reachable on the upside and downside of the board and switching between the two SIM cards
- Fully compatible with Raspberry Pi models that have the 40-pin GPIO header (4, 3, 2, B+, A+, Zero)
- Easy-to-use, simple setup, plug-and-play
- QMI and PPP are supported
- Clip-in M.2 socket compatible with worldwide LTE/UMTS/HSPA+ and GSM/GPRS/EDGE coverage with regional or global modules which work with different frequencies & carriers
- Supports 4G/LTE module (e.g Quectel EM06 and EM12) that can reach 600 Mbps downlink and 150 Mbps uplink data rates
- Used with 4G/LTE modules that support Carrier Aggregation (CA)
- Can be used as a standalone with PC/Laptop over USB port, without stacking with Raspberry Pi
- Can be powered from an external 5V source by exposed power pins, directly from Raspberry Pi 5V GPIO headers, or via USB
- HAT can provide adjustable 3.3V or 3.8 V to the M.2 socket
- M.2 socket and GPIO support I2C
- The power of the whole board electronics can be disabled for low-power consumption use cases
- The modules (EM06, EM12) have built-in GNSS(GPS/GLONASS) receiver for geo-location applications
- Uses a GPIO connector that spaces the HAT at least 8mm from the Pi (i.e. uses spacers 8mm or larger)
- Conforms to the RP HAT requirements
- Conforms to the HAT mechanical specification

2.3 Interfaces

- M.2 interface
- USB 2.0 with High Speed up to 480Mbps
- Dual micro USIM card slot
- 40W GPIO to the raspberry PI

2.4 Software Features

The M.2-USB adaptor does not need or has a driver. Rather The host computer (such as RPi) needs the driver of the compatible module that will be used with the HAT. For example, if you are using Quectel EM06/EM12 with the HAT, then your host device should have the driver for Quectel modules.

Nowadays, most of the Linux kernel comes with the required drivers installed as a result the modules are recognized.

The M.2-USB adaptor is compatible with the following boards. Note that the M.2-USB adaptor can be connected to these board via the USB.

- Raspberry Pi 4, 3, 2, B+, A+, Zero
- Asus Tinker Board
- Rock 64*
- Orange Pi*
- Samsung ARTIK's Eagleye board
- Latte Panda

2.5 General Features

- Temperature Range: -40°C ~ +80°C
- Dimensions: 65 mm x 56 mm x 9 mm
- Weight: Approx. 12g
- Supply Voltage: 3.3V - 5V.

2.6 Key Applications

1. Environmental sensing and monitoring
2. Traffic monitoring
3. Video/Music Streaming
4. Large Data Downloads and Uploads
5. LTE Dongle/Router
6. Mobile Internet Hotspot
7. GPS Tracking
8. Security & Asset tracking
9. Smart city, smart building, smart transportation, and smart agriculture.
10. Smart Parking

2.7 Overview Diagrams

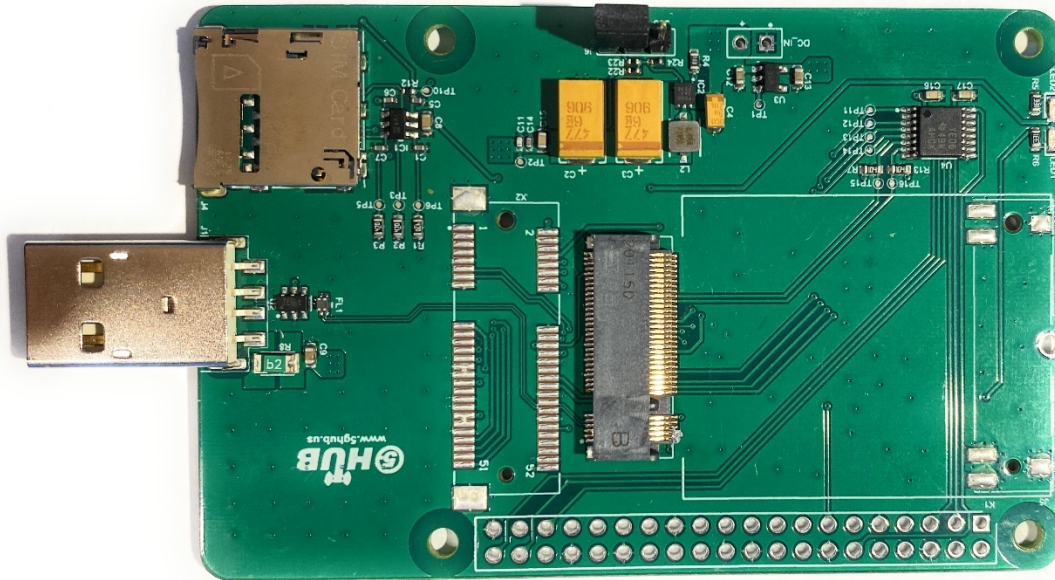


Figure 1. M.2-USB Adaptor Top View.

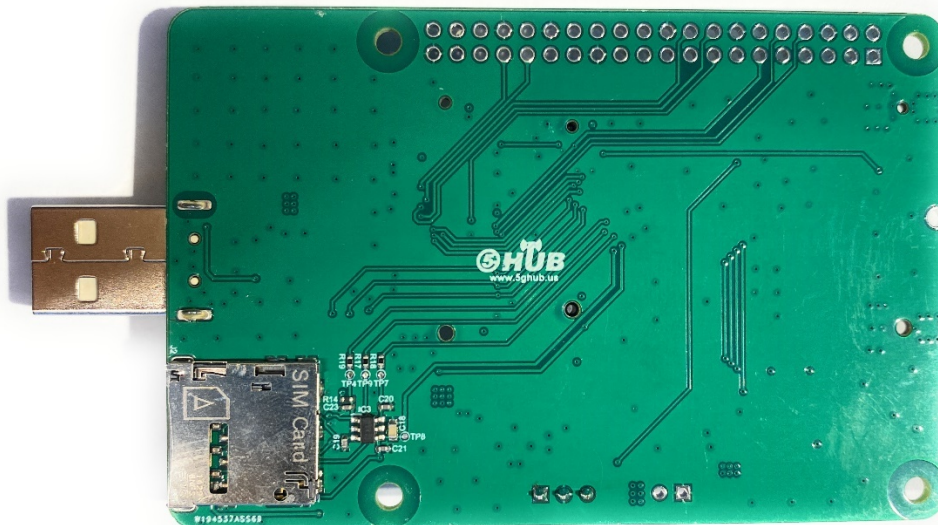


Figure 2. M.2-USB Adaptor Bottom View.

2.8 M.2-USB Adaptor and GPIO Interface to RASPBERRY PI

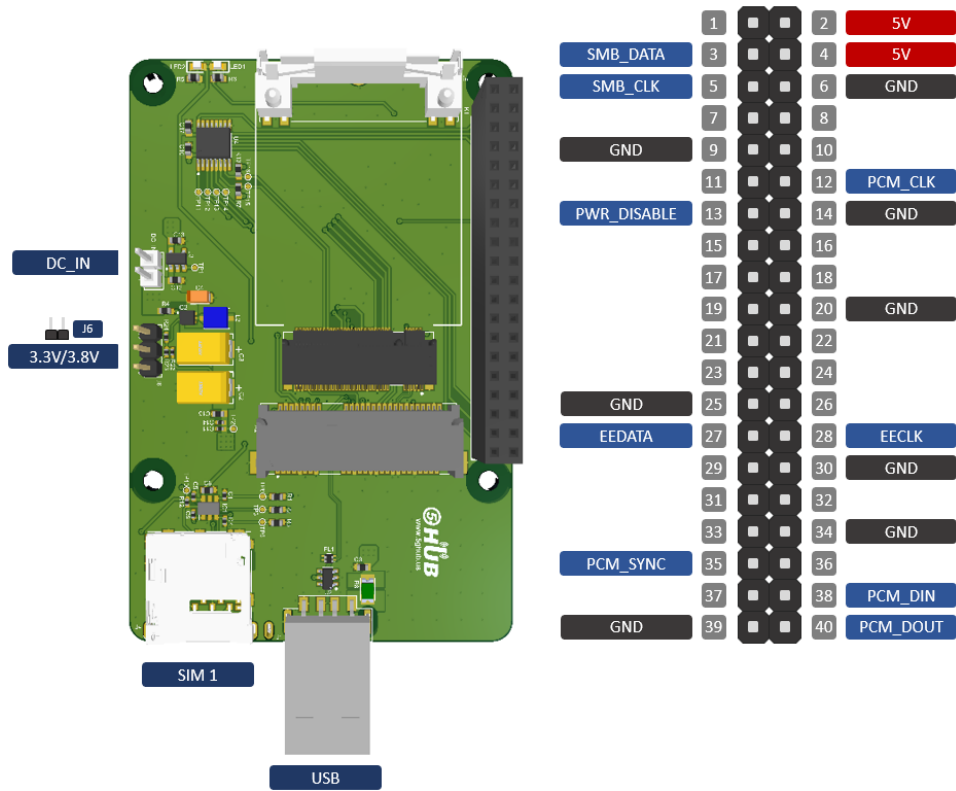


Figure 3. M.2-USB Adaptor Top View.

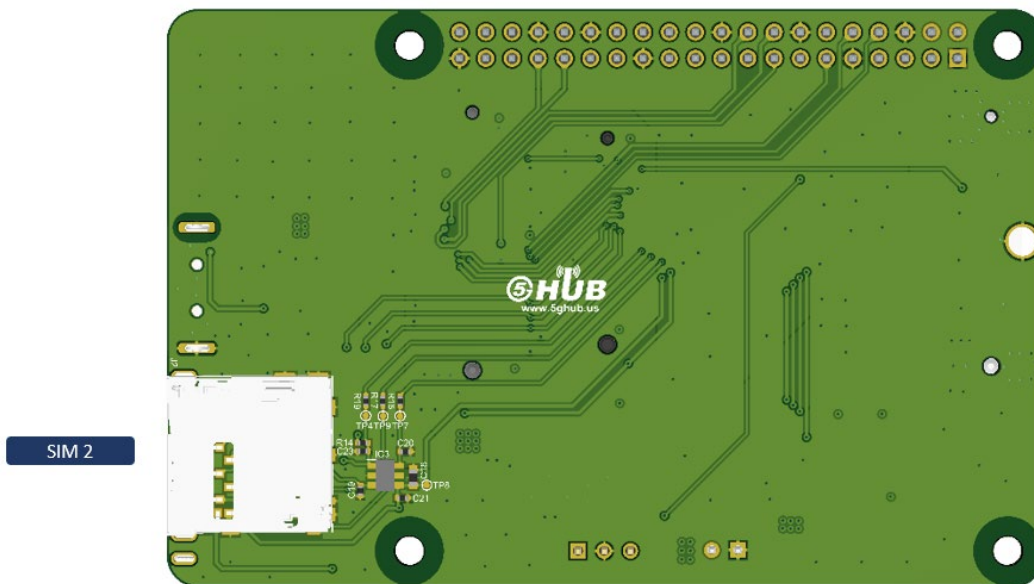


Figure 4. M.2-USB Adaptor Bottom View.

2.9 M.2-USB Adaptor HAT Pin Diagram and Assignment

The M.2-USB adaptor has M.2 socket. The physical connections and signal levels of the M.2 socket complies with M.2 card electromechanical specification and has the following interfaces:

- Power supply
- Dual (U)SIM interface
- USB interface
- PCM and I2C interfaces
- 40 Pin GPIOs for Raspberry Interface

The M.2 socket accepts M.2 cards and has the following signals:

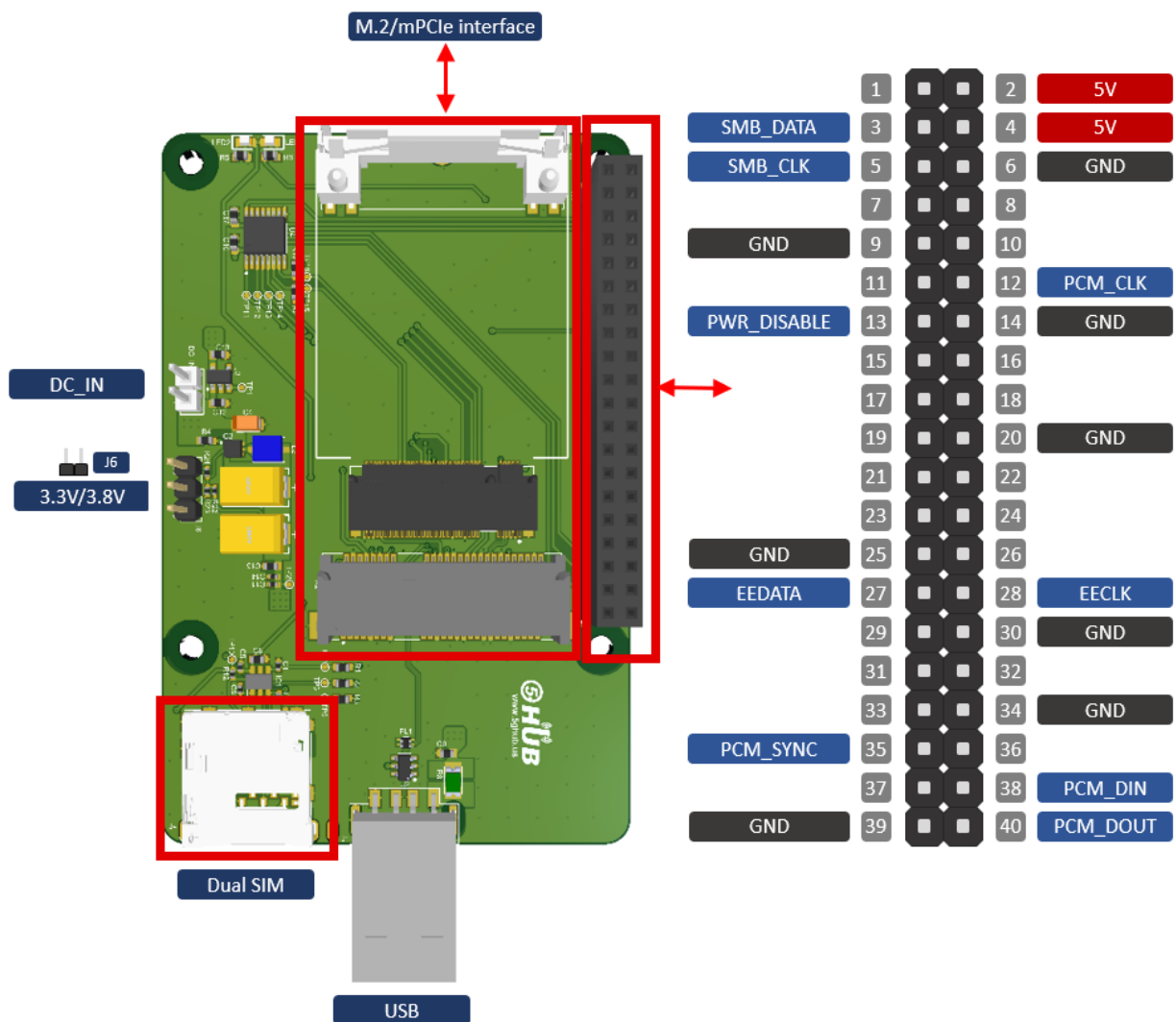


Figure 5. M.2-USB Adaptor Pin Assignment

2.10 M.2-USB Adaptor Pin Description

Table 1: PIN Assignments

Pin #	Pin Name	Pin Direction	Pin Functionality
1	NC		
2	VCC_3V3	I	3.0V~4.4V, typically 3.3V DC supply
3	GND		
4	VCC	I	Mini card ground
5	GND		
6	FULL_CARD_POWER_OFF#	I	VCC
7	USB_DP	IO	USB differential data (+)
8	W_DISABLE1#	I	Airplane mode control
9	USB_DM	IO	USB differential data (-)
10	WWAN_LED#	OD	LED signal for indicating the network status of the module
11	GND		
12-19	Notch		
20	PCM_CLK	IO	PCM clock signal
21	NC		
22	PCM_IN	I	PCM data input
23	NC	OD	
24	PCM_OUT	O	PCM data output
25	DPR	DI	Dynamic power reduction.High level by default.
26	NC	DI	
27	GND		
28	PCM_SYNC	IO	PCM data frame synchronization signal
29	NC		
30	USIM1_RESET	IO	(U)SIM1 card reset
31	NC		
32	DO	(U)SIM1 card clock	
33	GND	GND	
34	USIM1_DATA	IO	(U)SIM1 card data
35	NC		
36	USIM1_VDD	PO	Power supply for (U)SIM1 card
37	NC		
38	NC		
39	GND		
40	NC		
41	NC		
42	USIM2_DATA	IO	(U)SIM2 card data
43	NC		
44	USIM2_CLK	DO	(U)SIM2 card clock
45	GND		
46	USIM2_RESET	DO	(U)SIM2 card reset
47	NC		

48	USIM2_VDD	PO	Power supply for (U)SIM2 card
49	NC		
50	NC		
51	GND		
52	NC		
53	NC		
54	NC		
55	NC		
56	I2C_SDA	IO	I2C serial data. Used for external codec
57	GND		
58	I2C_SCL	DO	I2C serial clock. Used for external codec
59	NC		
60	RESERVED		
61	NC		
62	RESERVED		
63	NC		
64	RESERVED		
65	NC		
66	NC		
67	RESET#	DI	System reset. Active low.
68	NC		
69	NC		
70	VCC	I	
71	GND		
72	VCC	I	
73	GND		
74	VCC		
75	NC		

2.11 Switching between Two SIM Card

The M.2-USB adaptor has dual SIM card slots which provides great benefits to use two SIM cards from different mobile operator networks to connect to the cellular network. To switch or use one of the SIM card, use the following AT commands on the EM06 and EM12 modules.

Table 2: AT Command for Dual SIM operations (EM06 module).

```
[2021-04-03_09:42:24:158] ATI
[2021-04-03_09:42:24:158] Quectel
[2021-04-03_09:42:24:158] EM06
[2021-04-03_09:42:24:158] Revision: EM06ALAR03A05M4G

[2021-04-03_09:42:24:158] OK
[2021-04-03_09:42:27:371] AT+QDSIM?           // This means module is using SIM 1
[2021-04-03_09:42:27:371] +QDSIM: 0

[2021-04-03_09:42:27:371] OK
[2021-04-03_09:42:30:253] AT+CPIN?
[2021-04-03_09:42:30:253] +CPIN: READY

[2021-04-03_09:42:30:253] OK
[2021-04-03_09:42:33:620] AT+QCCID
[2021-04-03_09:42:33:620] +QCCID: 89883070000004778443

[2021-04-03_09:42:33:620] OK
```

```

[2021-04-03_09:43:03:700] AT+QDSIM=1 // This means to switch to SIM 2
[2021-04-03_09:43:03:715] OK
[2021-04-03_09:43:18:789] AT+CFUN=1,1 // This means to restart the module
[2021-04-03_09:43:18:789] OK
[2021-04-03_09:43:51:235] +CPIN: READY

[2021-04-03_09:43:51:235] +QUSIM: 1

[2021-04-03_09:43:51:235] +QIND: SMS DONE

[2021-04-03_09:43:51:235] +QIND: PB DONE
[2021-04-03_09:44:00:121] AT+QDSIM?
[2021-04-03_09:44:00:121] +QDSIM: 1

[2021-04-03_09:44:00:121] OK
[2021-04-03_09:44:11:473] AT+QDSIM?
[2021-04-03_09:44:11:473] +QDSIM: 1

[2021-04-03_09:44:11:473] OK
[2021-04-03_09:44:17:093] AT+CPIN?
[2021-04-03_09:44:17:093] +CPIN: READY

[2021-04-03_09:44:17:093] OK
[2021-04-03_09:44:20:467] AT+QCCID
[2021-04-03_09:44:20:467] +QCCID: 89011703278453751680

[2021-04-03_09:44:20:467] OK

```

Table 3: AT Command for Dual SIM operations (EM12 module).

```

[2021-04-03_09:27:59:435] ATI
[2021-04-03_09:27:59:435] Quectel
[2021-04-03_09:27:59:435] EM12
[2021-04-03_09:27:59:435] Revision: EM12GPAR01A20M4G
[2021-04-03_09:27:59:435] OK

[2021-04-03_09:28:21:656] AT+QUIMSLOT? // This means module is using SIM 1
[2021-04-03_09:28:21:656] +QUIMSLOT: 1
[2021-04-03_09:28:21:656] OK

[2021-04-03_09:28:31:273] AT+QCCID
[2021-04-03_09:28:31:273] +QCCID: 89883070000004778443
[2021-04-03_09:28:31:273] OK

[2021-04-03_09:28:37:041] AT+QUIMSLOT=2 // This means to switch to SIM 2
[2021-04-03_09:28:37:041] OK
[2021-04-03_09:28:37:056] +CPIN: NOT READY
[2021-04-03_09:28:41:066] +CPIN: READY

[2021-04-03_09:28:41:066] +QUSIM: 1
[2021-04-03_09:28:41:643] +QIND: SMS DONE
[2021-04-03_09:28:41:769] +QIND: PB DONE
[2021-04-03_09:28:46:893] AT+CPIN?
[2021-04-03_09:28:46:893] +CPIN: READY
[2021-04-03_09:28:46:893] OK

[2021-04-03_09:28:51:190] AT+QUIMSLOT?
[2021-04-03_09:28:51:190] +QUIMSLOT: 2
[2021-04-03_09:28:51:190] OK

[2021-04-03_09:28:59:183] AT+QCCID
[2021-04-03_09:28:59:183] +QCCID: 89011703278453751680

[2021-04-03_09:28:59:183] OK

```

2.12 Connecting on Windows OS

To use the EM06/EM12 as a modem on Windows operating system, issue the following AT command:

```
[2021-05-09_17:12:17:761]AT+QCFG="USBNET",0  
[2021-05-09_17:12:17:761]OK
```

This will make the EM06/EM12 to appear as a cellular device on Windows Task manager. You are now ready to connect to the Internet.

