Techship

M.2 key B to Mini PCIe Adapter Series Hardware Guide

Revision 1.4 - 2022-03-07

APPLICABLE MODELS

Article Nr	Model	Description
11315	**MP101-S**	Techship M.2 key B to mPCIe adapter (USB2)
11316	**MP201-S**	Techship M.2 key B to mPCIe adapter (USB2 + USB3)
11317	**MP301-S**	Techship M.2 key B to mPCIe adapter (USB2 + PCI Express x1)

DOCUMENT REVISIONS

Version	Date	Comment	Author
R1.0	2021-10-08	First release	Jörgen Storvist
R1.1	2021-11-22	Minor clarifications	Jörgen Storvist
R1.2	2021-12-09	Added operational temperature, card height	Jörgen Storvist
R1.3	2022-02-14	Extended the SIM card information section	Jörgen Storvist
R1.4	2022-03-07	Corrected Telit AT commands examples in SIM section	Jörgen Storvist

HARDWARE REVISIONS

Version	Date	Comment
PCB V1.0	2021-04	Initial sample version
PCB V1.1	2021-09	Added M.2 socket pin 20 pull-down resistor

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CONTENTS

1 INTRODUCTION

This document describes the Techship M.2 key B to miniPCIe adapter series mechanical and electrical specifications and the differences between available variants of the adapters. The latest product descriptions, datasheets and hardware guides are available on Techship.com product specific pages.

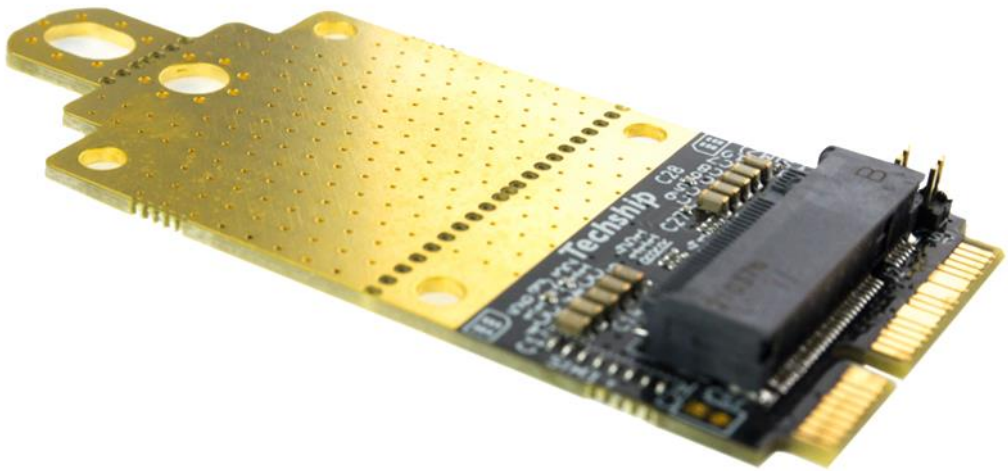
2 PRODUCT DESCRIPTION

The Techship M.2 key B to miniPCIe adapter series have been designed to bridge the gap between different slot-in card form factors, sizes, data signal interfaces and voltage levels used by cellular data cards and host boards.
Cross compatibility while trying to meet the design requirements for most of first generation 5G cellular data cards among the vendors have been emphasized. For example:

- On-board jumpers for controlling data interface selection signals.
- Thermal ground planes exposed for thermal pads between cellular module and adapter.
- Ceramic capacitors on power supply lanes for improved supply voltage stability and interference filtering.

The adapter allows host boards with and existing miniPCIe half size or full-size connector to integrate M.2 key B cellular modules with card lengths 42, 50 and 52mm.

It also implements two SIM card holders for both primary SIM card signals and secondary SIM card signals in the M.2 socket. The SIM card signals from the miniPCIe edge connector are also interconnected to the primary SIM holder signals and M.2 socket SIM interface.



2.1 Adapter variants

2.1.1 11315 MP101-S (USB2 data interface variant)

This adapter variant interconnects the USB2 data interface signals between the miniPCIe edge connector and the M.2 socket.

2.1.2 11316 MP201-S (USB2 + USB3 data interface variant)

This adapter variant interconnects the USB2 and USB3 data interfaces between the miniPCIe edge connector and the M.2 socket.

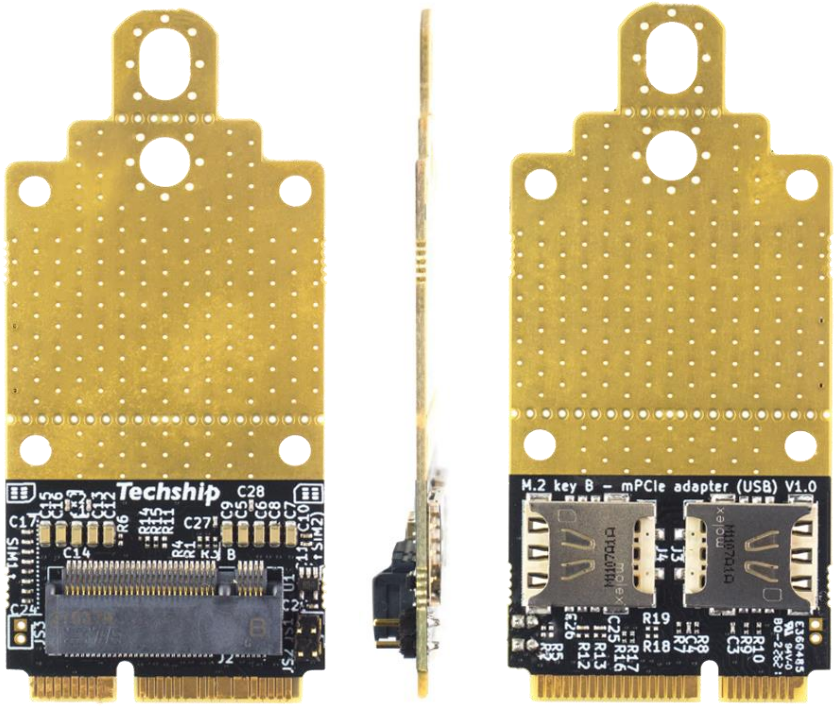
2.1.3 11317 MP301-S (USB2 + PCIe data interface variant)

This adapter variant interconnects the USB2 and PCI Express data interface signals between the miniPCIe edge connector and the M.2 socket.

2.1.4 Adapter variant selection guide

In the miniPCIe socket standard USB2 interface have dedicated pin locations, while PCI Express and USB3 interfaces share pin locations, therefore only one of them can be present in socket. Check what data interfaces your host board have in the miniPCIe socket against the data interfaces your M.2 cellular data card can support and pick adapter variant based on guide below.

Host side miniPCIe signal interfaces	11315 MP101-S (USB2 interface)	11317 MP301-S (USB2, PCIe interfaces)	11316 MP201-S (USB2, USB3 interfaces)
USB2	**Supported** USB2 signals routed	**Supported** USB2 signals routed	**Supported** USB2 signals routed
USB3	**Not supported** USB3 signals not routed	**Not supported** USB3 signals not routed	**Supported** USB3 signals routed
PCI Express	**Not supported** PCIe signals not routed	**Supported** PCIe signals routed	**Not supported** USB3 signal pins routed to PCIe signals



3 MECHANICAL SPECIFICATION

Operational temperature range:

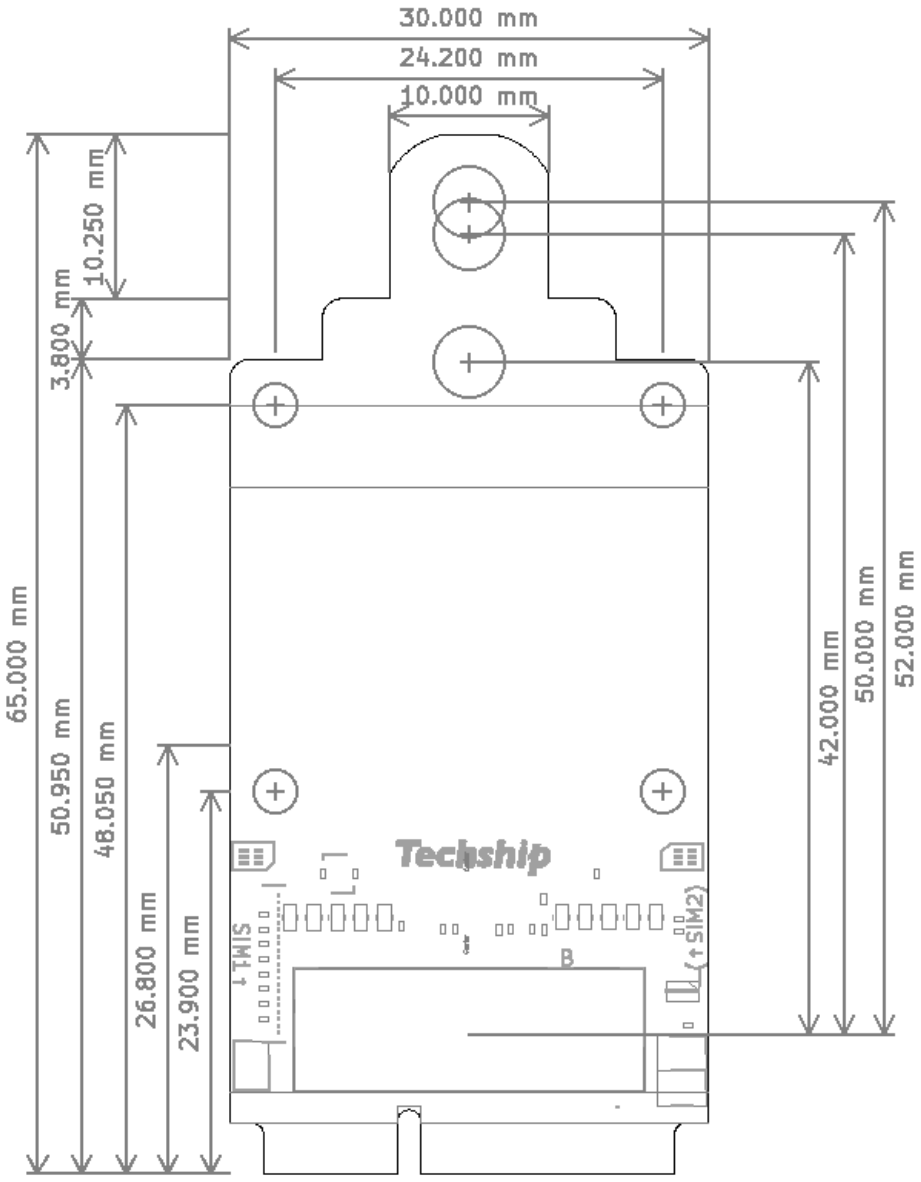
- Adapter (variant with SIM holders): -20°C to 80°C
- Adapter (variant without SIM holders): -40°C to 80°C

3.1 Dimensions

Height, adapter, overall: 7mm (without cellular module)

- Top side components: 4.5mm
- PCB thickness: 1mm
- Bottom side components: 1.5mm
- M.2 data card attach screw spacer: 2.5mm
- M.2 socket card rise height: 2.5mm

Length, overall: 65 mm
Width, overall: 30 mm



4 ELECTRICAL SPECIFICATION

4.1 Power supply

The adapter interconnect power supply pins from the miniPCIe edge connector to the power supply pins in the M.2 socket. Ceramic capacitors with a combined capacitance of approximately 470uF have been added for improved voltage stability during high current load peaks to prevent voltage drops.
The power supply trace design includes a set of filtering capacitors for cancelling common high frequency interferences created by cellular data cards during full power RF transmissions at certain radio frequencies.
The adapter has an on-board 1.8V LDO step-down regulator for pin-header control signals.

ATTENTION - Ensure that your host boards miniPCIe socket can provide the correct voltage level and sufficient power output described in the cellular data card vendors hardware guide.

4.2 Cellular data-card device compatibility

The M.2 key B form factor is a standardized form factor, but many cellular data card vendors implement vendor specific features bound to specific signals in the M.2 socket, especially seen on 5G cellular data cards. Our design aim to support the general functionalities of most M.2 cellular data cards while vendor specific functions might not be supported.

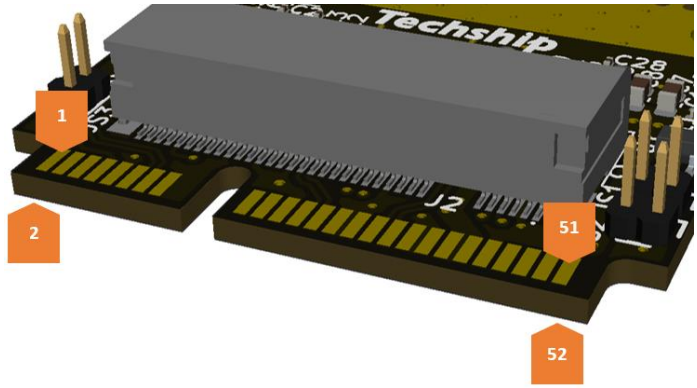
ATTENTION - Ensure that you disable SIM card hot-swap functionality in your data card software/firmware to have SIM card loaded at power-on without SIM card detect signal.

Basic functionality and compatibility tested on the following 5G cellular data card devices:

- Telit FN980 (Single SIM interface supported, primary SIM holder)
- Sierra Wireless EM9191 / EM7690 (Single SIM interface supported, primary SIM holder)
- Simcom SIM8202G-M.2 / SIM8202E-M.2 (Dual SIM interfaces supported)

4.3 Pin-out mapping for the miniPCIe slot-in edge

4.3.1 MiniPCIe pin number locations



4.3.2 MiniPCIe top side contact pads (odd numbers)

Pin #	MP201-S (USB2/3)	MP101-S (USB2)	MP301-S (USB2/PCIe)	Remark
1			**WAKE#**	
3-5				
7			**CLKREQ#**	
9	Ground	Ground	Ground	
11			**REFCLK-**	
13			**REFCLK+**	
15	Ground	Ground	Ground	
17-19				
21	Ground	Ground	Ground	
23	**HOST_USB3_RX-**		**PERn0**	See note 1
25	**HOST_USB3_RX+**		**PERp0**	See note 1
27	Ground	Ground	Ground	
29	Ground	Ground	Ground	
31	**HOST_USB3_TX-**		**PETn0**	
33	**HOST_USB3_TX+**		**PETp0**	
35	Ground	Ground	Ground	
37	Ground	Ground	Ground	
39	VCC	VCC	VCC	
41	VCC	VCC	VCC	
43	Ground	Ground	Ground	
45-51				

Note 1 – 11317 MP301-S (USB2+PCIe variant)
PERp0 and PERn0 polarity switched for simplified PCB trace layout. All PCI-Express receivers incorporate automatic lane polarity inversion (see PCI Express Base Specification).

4.3.3 MiniPCIe bottom side contact pads (even numbers)

Pin	MP201-S (USB2/3)	MP101-S (USB2)	MP301-S (USB2/PCIe)	Remark
2	VCC	VCC	VCC	
4	Ground	Ground	Ground	
6				
8	SIM1-PWR	SIM1-PWR	SIM1-PWR	Connected via R10 resistor
10	SIM1-DATA	SIM1-DATA	SIM1-DATA	Connected via R9 resistor
12	SIM1-CLK	SIM1-CLK	SIM1-CLK	Connected via R8 resistor
14	SIM1-RESET	SIM1-RESET	SIM1-RESET	Connected via R7 resistor
16				
18	Ground	Ground	Ground	
20	W_DISABLE#	W_DISABLE#	W_DISABLE#	
22			**PERST#**	
24	VCC	VCC	VCC	
26	Ground	Ground	Ground	
28-32				
34	Ground	Ground	Ground	
36	USB2_D-	USB2_D-	USB2_D-	
38	USB2_D+	USB2_D+	USB2_D+	
40	Ground	Ground	Ground	
42	LED_WWAN#	LED_WWAN#	LED_WWAN#	
44-48				
50	Ground	Ground	Ground	
52	VCC	VCC	VCC	

4.4 Pin-out mapping for the on-board M.2 key B socket

4.4.1 M.2 key B pin number locations

4.4.2 M.2 key B top side contact pads (odd numbers)

Pin	MP201-S (USB2/3)	MP101-S (USB2)	MP301-S (USB2/PCIe)	Remark
1				
3	Ground	Ground	Ground	
5	Ground	Ground	Ground	
7	USB2_D+	USB2_D+	USB2_D+	
9	USB2_D-	USB2_D-	USB2_D-	
11	Ground	Ground	Ground	
13-19	(M.2 key B)	(M.2 key B)	(M.2 key B)	
21-25				
27	Ground	Ground	Ground	
29	**HOST_USB3_RX-**			
31	**HOST_USB3_RX+**			
33	Ground	Ground	Ground	
35	**HOST_USB3_TX-**			
37	**HOST_USB3_TX+**			
39	Ground	Ground	Ground	
41			**PERp0**	See note 1
43			**PERn0**	See note 1
45	Ground	Ground	Ground	
47			**PETn0**	
49			**PETp0**	
51	Ground	Ground	Ground	
53			**REFCLK-**	
55			**REFCLK+**	
57	Ground	Ground	Ground	
59-65				
67	RESET#	RESET#	RESET#	Connected to JS3 (not populated)
69				
71	Ground	Ground	Ground	
73	Ground	Ground	Ground	
75				

Note 1 – USB2+PCIe variant

PERp0 and PERn0 polarity switched for simplified PCB trace layout. All PCI-Express Receivers incorporate automatic Lane Polarity Inversion (see PCI Express Base Specification)

4.4.3 M.2 key B bottom side contact pads (even numbers)

Pin	MP201-S (USB2/3)	MP101-S (USB2)	MP301-S (USB2/PCIe)	Remark
2	VCC	VCC	VCC	
4	VCC	VCC	VCC	
6	POWER_OFF#	POWER_OFF#	POWER_OFF#	100Kohm pull-up resistor to VCC
8	W_DISABLE#	W_DISABLE#	W_DISABLE#	
10	LED_WWAN#	LED_WWAN#	LED_WWAN#	
12-18	(M.2 key B)	(M.2 key B)	(M.2 key B)	
20	(PCIE_DIS)	(PCIE_DIS)	(PCIE_DIS)	Connected to jumper JS1, see note 2
22	(VBUS_SENSE)	(VBUS_SENSE)	(VBUS_SENSE)	Connected to jumper JS2, see note 3
24-28				
30	SIM1-RESET	SIM1-RESET	SIM1-RESET	
32	SIM1-CLK	SIM1-CLK	SIM1-CLK	
34	SIM1-DATA	SIM1-DATA	SIM1-DATA	
36	SIM1-PWR	SIM1-PWR	SIM1-PWR	
38				
40				SIM2_DET - No detect switch on sim holder
42	SIM2-DATA	SIM2-DATA	SIM2-DATA	Connected via R15 resistor
44	SIM2-CLK	SIM2-CLK	SIM2-CLK	Connected via R14 resistor
46	SIM2-RESET	SIM2-RESET	SIM2-RESET	Connected via R13 resistor
48	SIM2-PWR	SIM2-PWR	SIM2-PWR	Connected via R12 resistor
50			**PERST#**	
52			**CLKREQ#**	
54			**PEWAKE#**	
56-64				
66				SIM1_DET - No detect switch on sim holder
68				
70	VCC	VCC	VCC	
72	VCC	VCC	VCC	
74	VCC	VCC	VCC	

Note 2 – All variants

Vendor specific signal, connected through 10KOhm resistor to JS1 pin header, use jumper for 1.8V signal pull-up. 20Kohm ground pull-down resistor.

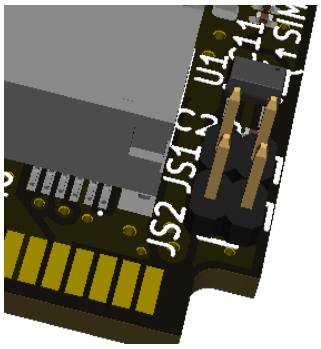
Note 3 – All variants

Vendor specific signal, connected through 10KOhm resistor to JS2 pin header, use jumper for 1.8V signal pull-up. No ground pull-down resistor.

4.5 Signal pin-header jumpers

Some M.2 cellular data card vendors use select signals in the M.2 socket to choose the active data interface used between the host system and the cellular modules. Normally USB2 or USB3 have been the primary data interface for cellular data cards, but since introduction of 5G cellular data cards some vendors primarily defaults to using PCI Express data interface instead.

- JS1 – pin-header, use jumper to pull M.2 socket pin 20 signal high with 1.8V DC, otherwise pulled to ground.
- JS2 – pin-header, use jumper to pull M.2 socket pin 22 signal high with 1.8V DC.
- JS3 – pin-header (component not assembled)
  Connectects to M.2 socket pin 67 RESET# signal. If linked, signal is pulled low to ground.



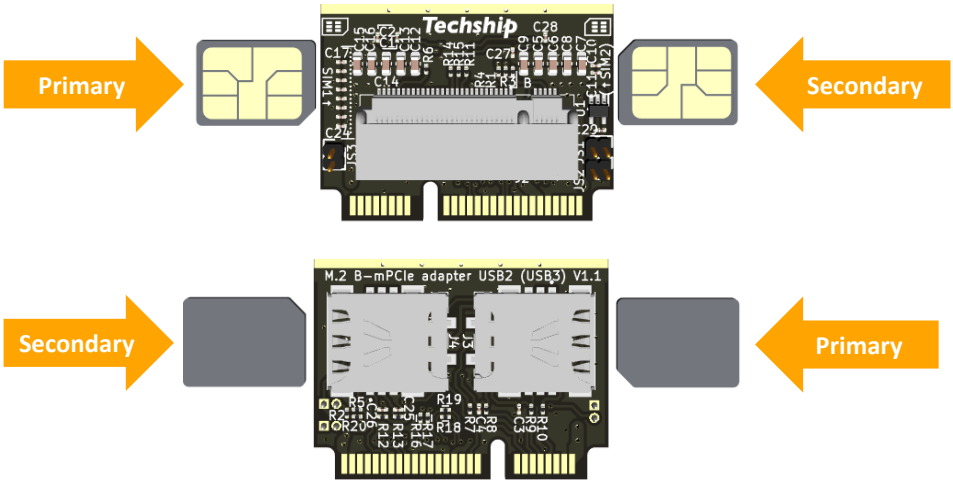
Sierra Wireless EM9190, EM9191, EM7690 defaults to PCI Express data interface. To activate usage of USB2/USB3 data interface instead, assemble jumpers on the JS1 and JS2 pin-headers.

Telit FN980 HW rev. 1 defaults to USB2/USB3 data interface. By AT commands the data interface selection with electrical signal can be activated. After activation the data card defaults to low and PCI Express interface will be selected.

Telit FN980/FN980m HW rev. 2.1 have data interface selection signal functionality always active. The interface selection signal is internally pulled high by data card and defaults to USB2/USB3 data interface. To activate PCI Express data interface, leave JS1 and JS2 pin-headers without jumpers to have M.2 socket pin 20 pulled to ground/low. The pull-down resistor is included from adapter PCB version 1.1.

4.6 SIM card interfaces

Two 4FF nano SIM card holders are available on bottom side of adapter PCB. The SIM card holders do not include SIM card detect signal switches. The SIM card notch should always be rotated inwards, and the SIM card contact pads facing towards the adapter PCB.



The primary (SIM1) SIM card holder is connected to the primary SIM interface in the M.2 socket. It is also interconnected in parallel with the primary SIM signals from the miniPCIe edge connector through zero-ohm resistors.
The secondary (SIM2) SIM card holder is connected to the secondary SIM interface in the M.2 socket through zero-ohm resistors. Not all cellular data cards do support a secondary SIM card interface. Refer to the data card vendor hardware guide for details about interfaces supported.

ATTENTION – Ensure that you disable SIM card hot-swap functionality in your cellular card software/firmware e.g. by AT commands. By doing so, the SIM card can be loaded at power-on without the SIM card detect signal indicating a SIM card present. AT commands can also be used to reload the SIM interface and select active SIM interface (if dual SIM interfaces are supported by module).

Examples below of how to disable SIM card hot swap functionality for primary SIM card interface. Always relate to the data card vendors own documentation for full AT command details.

Cellular module	Configuration
Telit FN980, LN920 series	AT#SIMDET=0 AT#HSEN=0,0 AT#REBOOT
Sierra Wireless EM91, EM76, EM74, EM75 series	AT!UIMS=0 AT#ENTERCND=”A710” AT!CUSTOM=”SIMHOTSWAPDIS”,3 AT!RESET
Fibocom FM150 series	AT+GTDUALSIM=0 AT+MSMPD=0 AT+CFUN=1,1
Simcom SIM8200, SIM8202 series	AT+UIMHOTSWAPON=0,1 AT+UIMHOTSWAPON=0,2 AT+SMSIMCFG=1,1 AT+CRESET
Quectel RM500Q	AT+QUIMSLOT=1 AT+QSIMDET=0,1 AT+CFUN=1,1