

# M519-SRK Getting Started Guide

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# 1 Introduction

## 1.1 Overview

This M519 Starter Kit (SRK) has been designed to help developers to create NFC/RFID HF systems based on the SpringCard SpringSeed M519 OEM NFC/RFID HF Module.

The SRK allows to connect and use the M519 either through its USB or Serial interfaces directly from a desktop/laptop system or from an embedded computer board, as well as from a low-end microcontroller-based system thanks to the breakout pads.

To work on contactless smart card or NFC/RFID HF applications, the SRK comes with three antennas of assorted size and a set of contactless cards, making it easy for customers to observe the practical communication range that could be achieved with either antenna.

To work on contact smart card applications, the SRK features 3 different expansion boards, that hold either one ID-000 slot for a SIM/SAM card, or one ID-1 / plain size plus 4 ID-000 slots.

This document is the user manual for the M519-SRK. It will guide you through the process of setting up and operating the M519 and its Starter Kit, exploring their features, and beginning the development of your application.

## 1.2 Related Documents

### 1.2.1 Documents available as PDF

Reference	Title / Description
PFT22217	M519 Data Sheet and Integration Guide
PNA23174	Using the M519 in PC/SC Coupler mode over a Serial interface
PNA23207	Using the M519 in PC/SC Coupler mode over a USB interface
PNA23208	Using the M519 in Smart Reader or RFID Scanner mode
PNA23189	Using the M519 in SpringProx Legacy mode

### 1.2.2 Online Material

Documentation of the SpringCore firmware.

<https://docs.springcard.com/books/SpringCore/Welcome>

SpringCard Tech Zone, the blog of the R&D Team

<https://tech.springcard.com/>

## 1.3 Order codes

Order code	Model	MOQ
SC23113	M519-SRK	1 piece

## 2 Content of the Kit

### The M519-SRK contains:

- 1 **M519-SRK mother board** (EAS22094) with a M519 module soldered,
- 1 USB type A to type C cable,
- 1 USB type A to type mini-B cable,
- 1 69x45mm RF antenna (**ANT-S6945**)
- 1 25x25mm RF antenna (**ANT-S2525**)
- 1 80x80mm RF antenna (**ANT-S8080**)
- 1 daughter board featuring one ID-1 smart card slot and four ID-000 SIM/SAM slots (TDA8026 as physical interface) (**M-EXT-SC5**),
- 1 daughter board featuring one ID-000 SIM/SAM slot, supporting all power classes A, B, C (TDA8035 as physical interface) (**M-EXT-SC1**),
- 1 daughter board featuring one ID-000 SIM/SAM slot, supporting power class B only (direct interface) (**M-EXT-DIR**),
- 1 SpringField Florida (RF field detector + NFC type 2 Tag),
- 1 SpringTower (RF field meter),
- A set of contactless cards (NXP Mifare UltraLight, NXP Desfire, etc),
- Google SmartTap and Apple VAS passes, to be received by email.

### To use the M519-SRK, you may also need:

- A cable with a JST SR 8 pin male plug, if you want to operate the M519 through the UART-TTL interface,
- A 12V DC power supply.

These items are not included in the kit. Contact SpringCard if you want to buy them separately.

## 3 Hardware and pinout

### 3.1 Identifying the boards

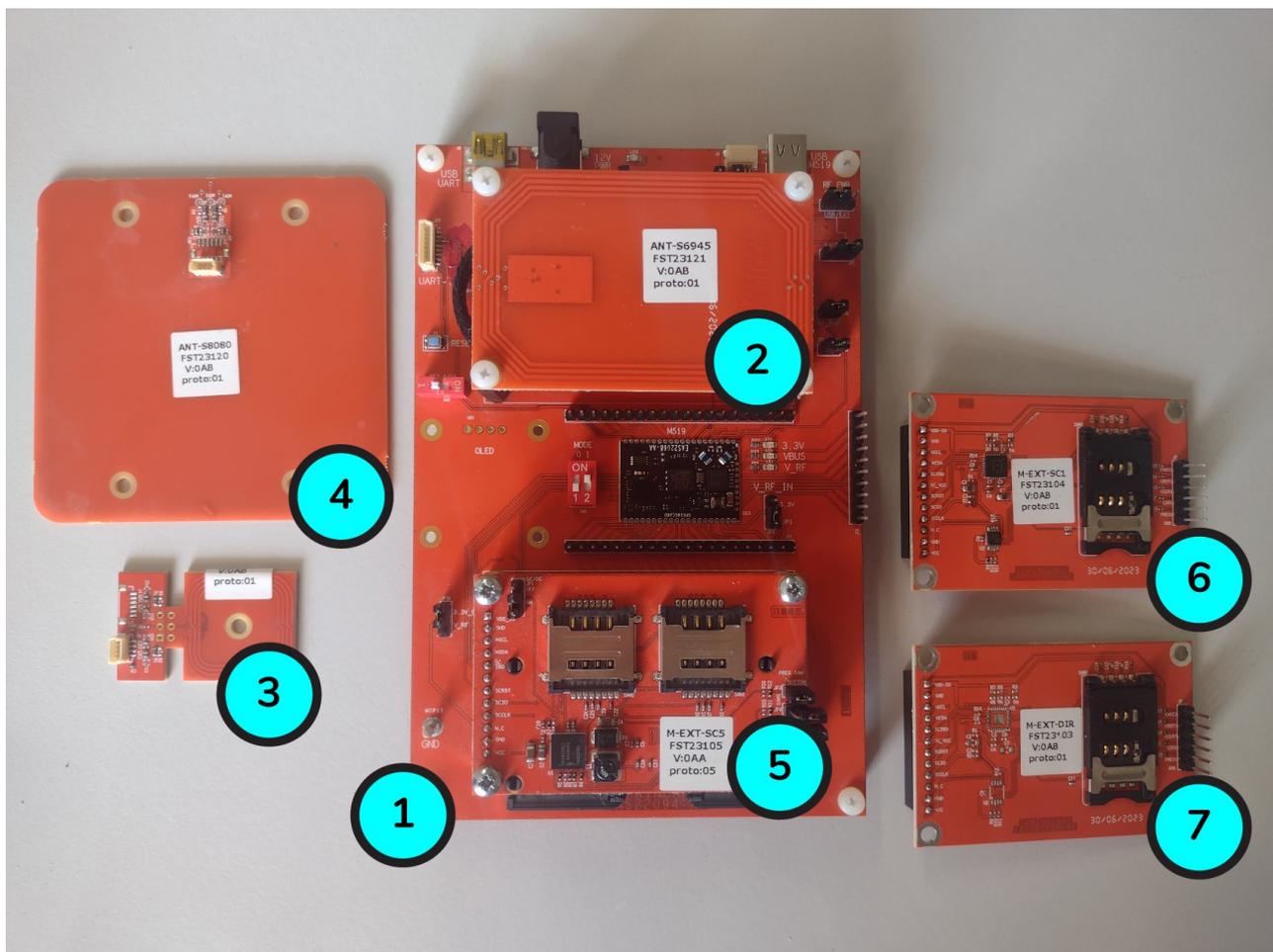


Illustration 1: Picture of all the board in the M519-SRK kit

Reference	Description
# 1	M519-SRK mother board
# 2	ANT-S6945
# 3	ANT-S2525
# 4	ANT-S8080
# 5	M-EXT-SC5
# 6	M-EXT-SC1
# 7	M-EXT-DIR

### 3.2 Overview of the mother board

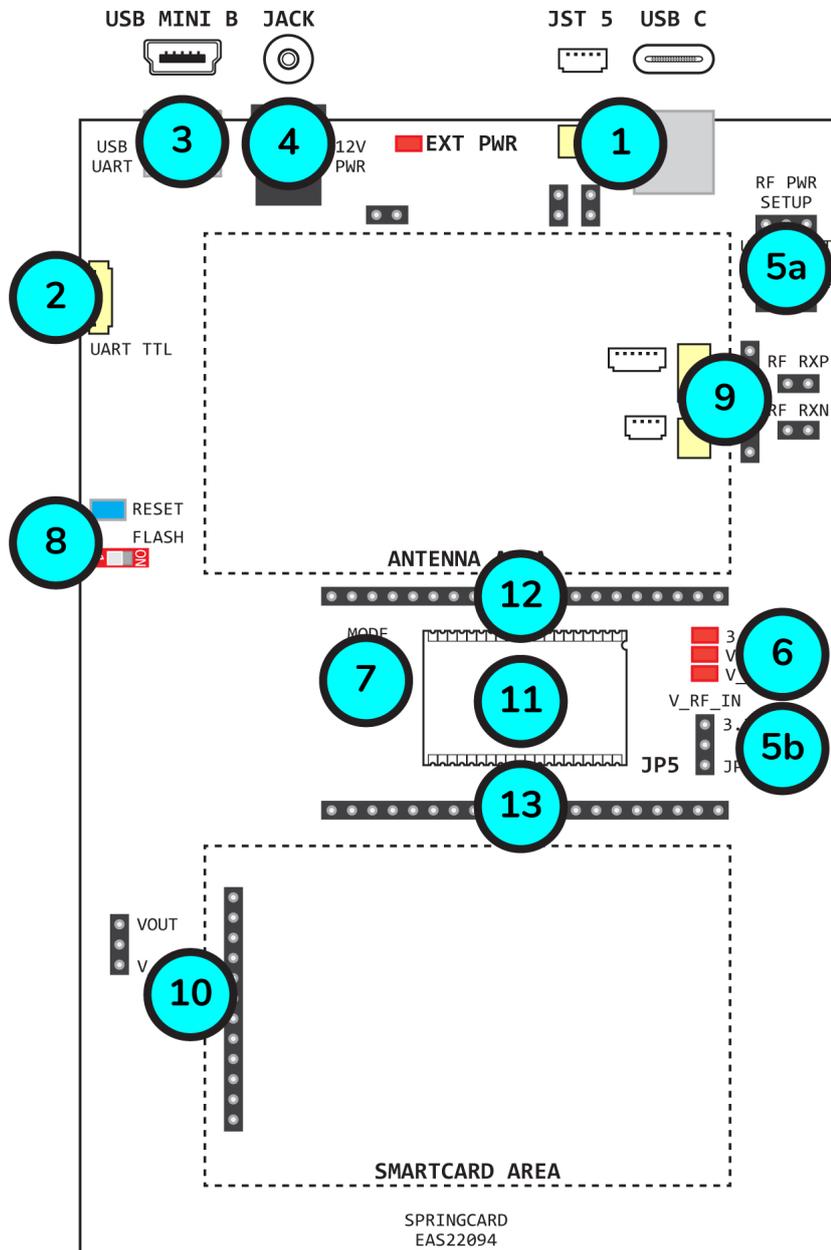


Illustration 2: Drawing of the M519-SRK mother board, with the identification of the main functions

Reference	Description
# 1	USB host interface (USB-C and JST 5)
# 2	Serial host interface (JST 8)
# 3	Alternate serial host interface, FTDI USB to serial bridge (USB mini-B)
# 4	Power jack and LED
# 5	Power configuration jumpers
# 6	Power status LEDs
# 7	MODE0 and MODE1 configuration switches
# 8	/RESET button and /FLASH switch
# 9	Antenna interface
# 10	Smart card interface
# 11	M519 OEM module
# 12	M519 west-bound header
# 13	M519 east-bound header

### 3.3 Default configuration

The M519-SRK is delivered with this default configuration:

- The 69x45mm RF antenna (**ANT-S6945**) is mounted (and connected to **J12** on the mother board),
- The daughter board featuring one ID-1 smart card slot and four ID-000 SIM/SAM slots (TDA8026 as physical interface) (**M-EXT-SC5**) is mounted,
- The configuration jumpers and switches on the mother board as set as follow:

Reference	Description
<b>JP1</b>	Right ("JP4" position)
<b>JP2</b>	Closed
<b>JP3</b>	Closed
<b>JP4</b>	Left ("USB" position)
<b>JP5</b>	Bottom ("JP1" position)
<b>JP10</b>	Closed
<b>JP11</b>	Closed
<b>JP14</b>	Bottom ("V_RF" position)
<b>FLASH</b>	Left (OFF position)
<b>MODE0</b>	Bottom (OFF position)
<b>MODE1</b>	Bottom (OFF position)

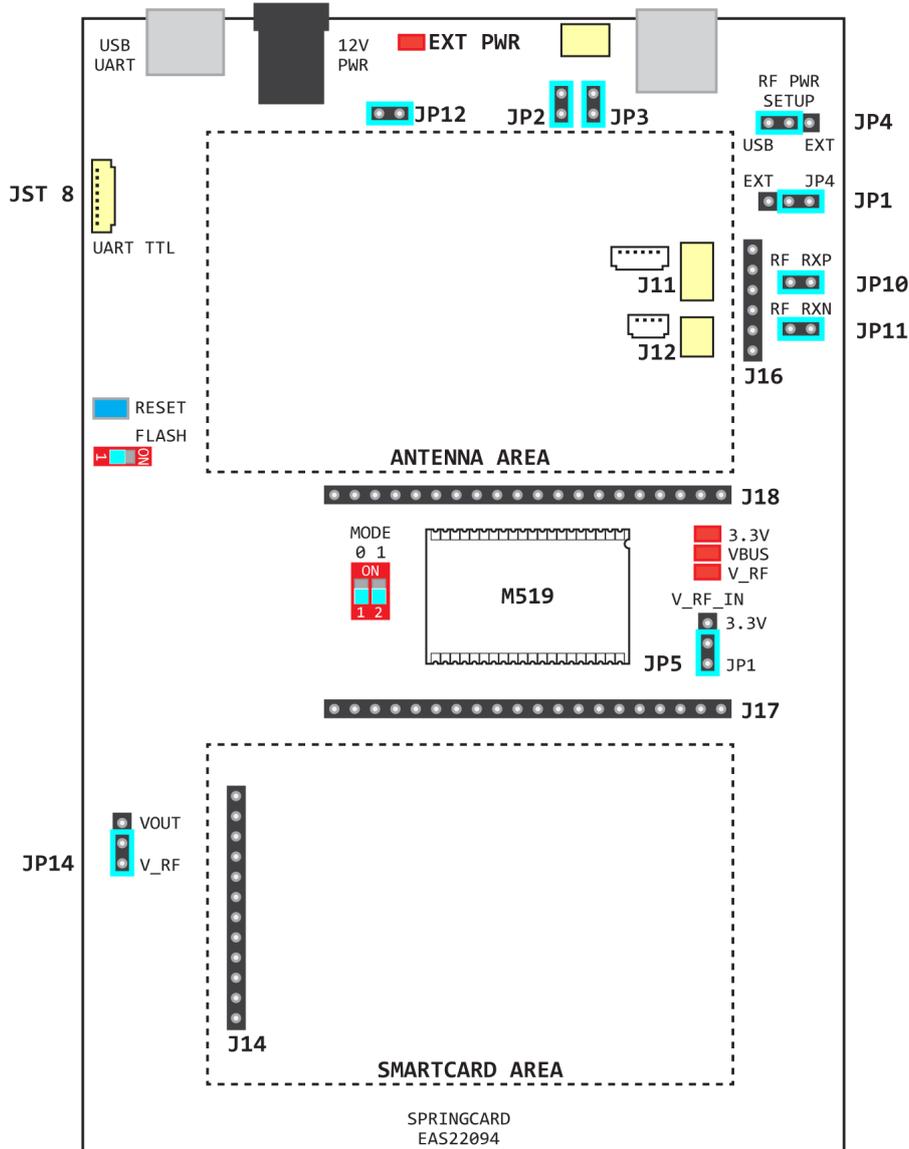


Illustration 3: Default position for the configuration jumpers and switches

In the following chapters, any change that is required in the position of a jumper or a switch will be explicitly described and explained. Step-by-step tutorials and application notes assume that the initial state is the default configuration.

**Warning:** Do not change the position of the jumpers that are left undocumented/RFU.

### 3.4 M519 module headers

Headers **J17** and **J18**, located around the M519 module, replicates the module's pinout.

Use these headers to monitor the signals or to connect the module to some other electronics. For instance, some application notes give examples on how to connect the M519 module with a Raspberry Pico directly, using these headers and jumper wires.

**Warning:** Respect all details of the M519 electrical specification when connecting an external device through jumper wires; prevent conflicts with the parts that are on the M519-SRK itself, by letting the relevant configuration jumpers open, and removing the antenna and smart card boards if needed.

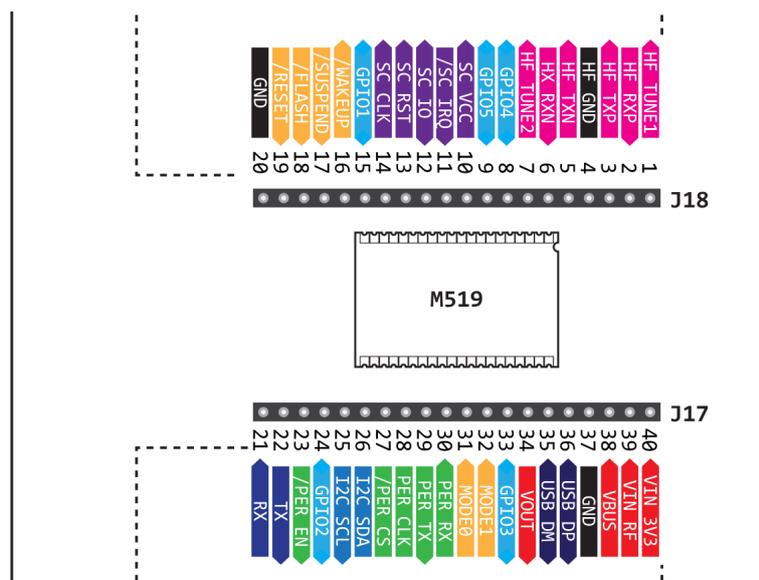


Illustration 4: M519 pinout, as replicated on headers J18 and J17

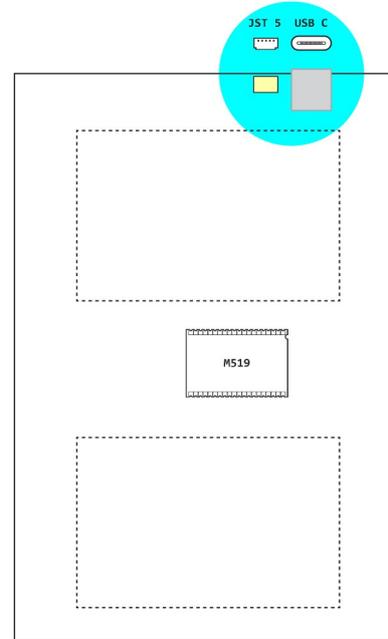
### 3.5 USB interface

**J4** “USB-M519” is an USB-C connector, dedicated to connecting the M519 with its host, using USB as primary interface.

The SRK and the M519 may be powered by VBUS at once.

**J5** is a SM05B-SRSS-TB JST 5-position connector. It is an alternative option to connect the SRK with the USB host.

**Warning:** Never connect both **J4** and **J5** in the same time.

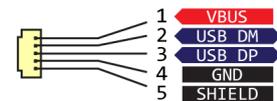


#### 3.5.1 USB-C

Use a standard USB-C cable (not provided) to connect the SRK to the host using J4.

Refer to USB specifications for reference.

#### 3.5.2 J5 pinout

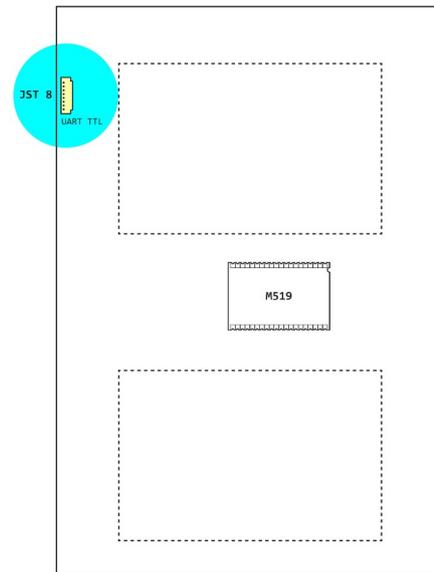


Pin	Symbol	Type	Description
# 1	<b>VBUS</b>	USB	Digital power supply + USB presence, 5V
# 2	<b>USB_DM</b>	USB	USB D- signal
# 3	<b>USB_DP</b>	USB	USB D+ signal
# 4	<b>GND</b>	Ground	Ground signal inside the USB cable
# 5	<b>SHIELD</b>	Ground	Shield of the USB cable

### 3.6 Serial interface

**J20** is a BM08B-SRSS-TB(LF)(SN) JST 8-position connector. It is dedicated to connecting the M519 with its host, using the Serial port as primary interface.

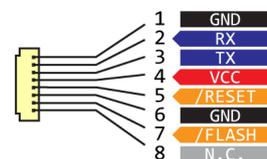
The VCC (5V) power input may be used to power the SRK and the M519 at once (VIN\_3V3 for the module is generated from VCC by a DC/DC located on the mother board).



#### Warnings:

- The SERIAL TX and SERIAL RX lines operate at TTL/CMOS level. Do not attempt to connect **J20** to a computer's RS-232 port, or to a RS-485 interface directly.
- The SERIAL TX and SERIAL RX are buffered between the **J20** connector and the M519 (and the J17 header). Thanks to the buffers, RX and TX lines on J20 are 3V, 5V-tolerant, where M519's RX and TX lines are limited to 3V only.
- The host Serial interface may be implemented either with **J20** "UART-TTL", or with the FTDI USB to Serial bridge that is available on the USB-mini B connector **J6** "USB-UART". Do not connect anything on "UART-TTL" when "USB-UART" is connected.

### 3.6.1 J20 pinout



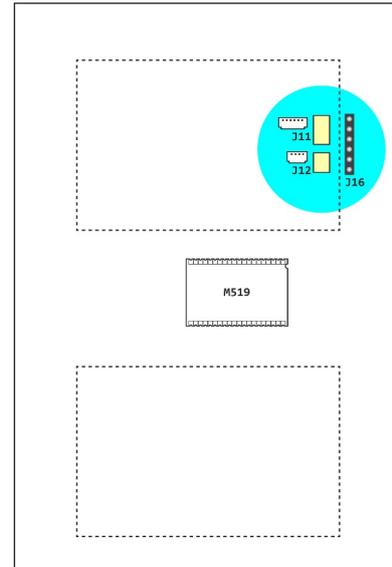
Pin	Symbol	Type	Description
# 1	GND	Ground	
# 2	RX	In	Main UART, host to module
# 3	TX	Out	Main UART, module to host
# 4	VCC	Power	External power supply 5V
# 5	/RESET	In	Reset the module
# 6	GND	Ground	
# 7	/FLASH	In	Force DFU (bootloader) mode upon reset
# 8	N.C.		Leave unconnected

### 3.7 Antenna interface

As a NFC/RFID HF coupler (PCD/VCD), the M519 needs a coil antenna to communicate with the contactless cards using inductive coupling over a 13.56MHz carrier. Chapter 7 introduces the principles of antenna sizing/designing, and the precautions to be taken during the integration to ensure correct operation of the system.

On the M519-SRK, there are three different options to connect the external antenna: **J12**, **J11** and **J16**.

All the three antennas supplied in the kit connect through **J12**.



#### Warnings:

- Never connect more than one antenna at the same time.
- Always totally unpower (unplug) the M519-SRK before changing the antenna to prevent damaging the M519 RF frontend.

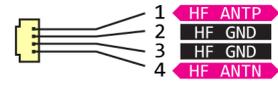
#### Note:

**J12**, **J11** and **J16** accept only antennas that have no integrated filter separating the RX signals from the TX signals. Therefore, they have only two active RF lines:

- **HF\_ANT\_P**, that is connected to both **HF\_TXP** and **HF\_RXP** on the M519,
- **HF\_ANT\_N**, that is connected to both **HF\_TXN** and **HF\_RXN** on the M519,

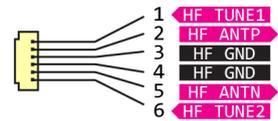
To ensure the connection of the P / N signals, jumpers **JP10** and **JP11** must always be closed (default configuration).

### 3.7.1 J12 pinout



Pin	Symbol	Type	Description
# 1	HF_ANTP	Analog	Antenna driver and receiver (plus side)
# 2	HF_GND	Analog	Antenna ground
# 3	HF_GND	Analog	Antenna ground
# 4	HF_ANTN	Analog	Antenna driver and receiver (minus side)

### 3.7.2 J11 pinout



Pin	Symbol	Type	Description
# 1	HF_TUNE1	Analog	Antenna self-tuning capacitor 1
# 2	HF ANT P	Analog	Antenna driver and receiver (plus side)
# 3	HF_GND	Analog	Antenna ground
# 4	HF_GND	Analog	Antenna ground
# 5	HF ANT N	Analog	Antenna driver and receiver (minus side)
# 6	HF_TUNE2	Analog	Antenna self-tuning capacitor 2

### 3.7.3 J16 pinout



Illustration 5: Pinout on header J16 (interface to NFC/RFID HF antenna)

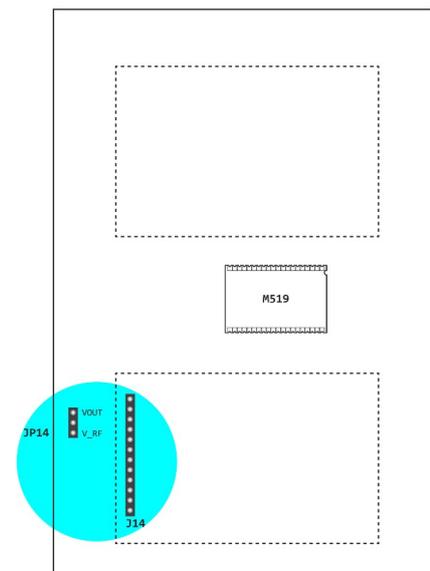
Pin	Symbol	Type	Description
# 1	HF_TUNE1	Analog	Antenna self-tuning capacitor 1
# 2	HF_ANTP	Analog	Antenna driver and receiver (plus side)
# 3	HF_GND	Analog	Antenna ground
# 4	HF_GND	Analog	Antenna ground
# 5	HF_ANTN	Analog	Antenna driver and receiver (minus side)
# 6	HF_TUNE2	Analog	Antenna self-tuning capacitor 2

## 3.8 Smart card interface

Once associated to the appropriate physical interface (ID-1 or ID-000 slot), the M519 is a contact smart card coupler.

Chapter 8 introduces how the M519 recognizes and uses the physical smart card interfaces. Such interfaces should be connected through **J14**. The three smart card daughter boards provided with the kit can be directly plugged onto this header.

**JP14** controls whether the power supply of the smart card daughter boards is taken from the VOUT output (3.3V) of the M519 module, or taken from its V\_RF\_IN input (default configuration).



### 3.8.1 J14 pinout

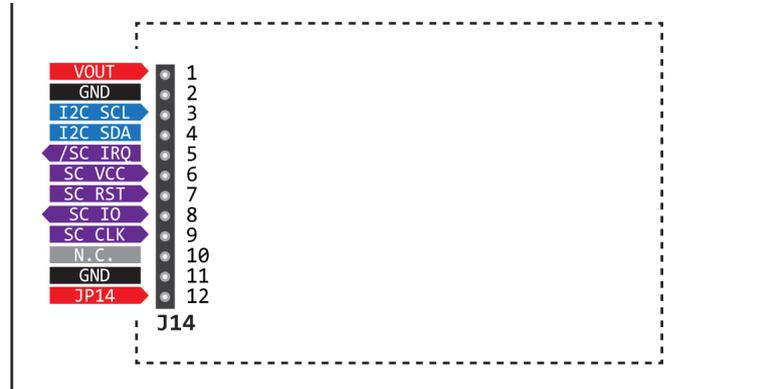


Illustration 6: Pinout on header J14 (interface to smart card daughter boards)

Pin	Symbol	Type	Description
# 1	VOUT	Power	3.3V output, max 100mA, to power the peripherals
# 2	GND	Ground	
# 3	I2C_SCL	Out	I <sup>2</sup> C SCL (master)
# 4	I2C_SDA	In/Out	I <sup>2</sup> C SDA (master)
# 5	/SC_IRQ	In	Card status / TDA8026 interruption
# 6	SC_VCC	Out	Card VCC signal <sup>1</sup>
# 7	SC_RST	Out	Card RST signal
# 8	SC_IO	In/Out	Card I/O signal
# 9	SC_CLK	Out	Card CLK signal (4MHz) / TDA8026 master clock (16MHz)
# 10	N.C.		Leave unconnected
# 11	GND	Ground	
# 12	JP14	Power	See 3.8.2

1 It could be noticed that, despite the name, this is not a power line. The actual card power supply is created by the interface IC (see 3.8.2); SC\_VCC only controls whether the power is applied or not.

### 3.8.2 Power supply for the smart card daughter boards

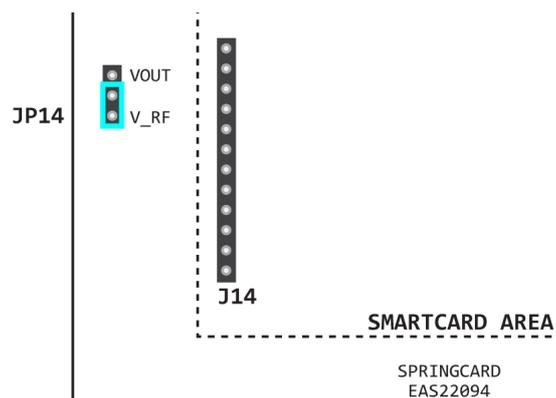
The smart card daughter boards require two power signals:

- The “digital” power supply, that feeds the ICs that are on the board.
- The “card” power supply, that is used by the smart card interface IC to power the smart card(s). The smart card interface ICs have DC/DC converters to cover all the smart card power classes (A: 5V, B: 3.3V, C:1.8V) and to switch easily along them.

The “digital” power supply always comes from the 3.3V / 100mA output of the M519 (VOUT signal). This ensure that the I<sup>2</sup>C bus is at the right voltage, and is OK because the interface ICs need only a few mA to power their digital core.

On the other hand, the “card” power supply must be ready to provide at least 50mA per card (that’s 250mA for one ID-1 plus four ID-000 slots)<sup>2</sup>. Therefore, this power supply must directly be taken from the external power source — namely V\_RF\_IN on the module. The voltage level could be either 5V (operation with an USB host) or 3.3V (operation with a Serial host), this makes no difference because the interface ICs have their DC/DC converters.

**JP14** controls the “card” power supply. For normal operation, it shall always remain on the bottom (“V\_RF”) position.



2 Most smart cards will never require that amount of power (today’s cards have a typical consumption under 20mA), but the system must be designed to comply with the standards and be sized to cope with all situations.

## 4 Selecting the host interface

The M519 operates differently depending on which interface the host uses to communicate with it.

The module knows which is its primary host interface by probing the power source upon reset:

- If a voltage is present on VBUS (USB 5V line), then the host interface is USB,
- Otherwise, the M519 selects its Serial port as host interface.

The power source for the RF interface must be set in coherence with the host interface:

- If the host interface is USB, the RF interface shall be powered at 5V (i.e. VIN\_RF shall be connected to VBUS),
- If the host interface is Serial, the RF interface shall be powered at 3.3V (i.e. VIN\_RF shall be connected to VIN\_3V3).

There are plenty of jumpers to move on the SRK board to set the host interface and the level of VIN\_RF. Please follow the detailed instructions in the next paragraphs.

**Warning:** Always totally unpower (unplug) the M519-SRK before changing the power configuration to prevent damaging the M519 or the SRK.

### 4.1 HW configuration for USB operation

1. Disconnect any existing connection (USB or serial), unplug power jack,
2. On **JP4** “RF PWR SETUP”, set the jumper to the “USB” position,
3. On **JP1**, set the jumper to the “JP4” position,
4. On **JP5** “V\_RF\_IN”, set the jumper to the “JP1” position,
5. Connect the SRK to the host computer through **J4** “USB M519” using an USB type C cable. Alternatively, you may use JST **J5** connector and a suitable cable,
6. If everything is OK, the three LEDs “3.3V”, “VBUS” and “V\_RF” light on once the computer has powered an enumerated the M519 as an USB device.

## 4.2 HW configuration for Serial operation, using the USB UART (FTDI chip)

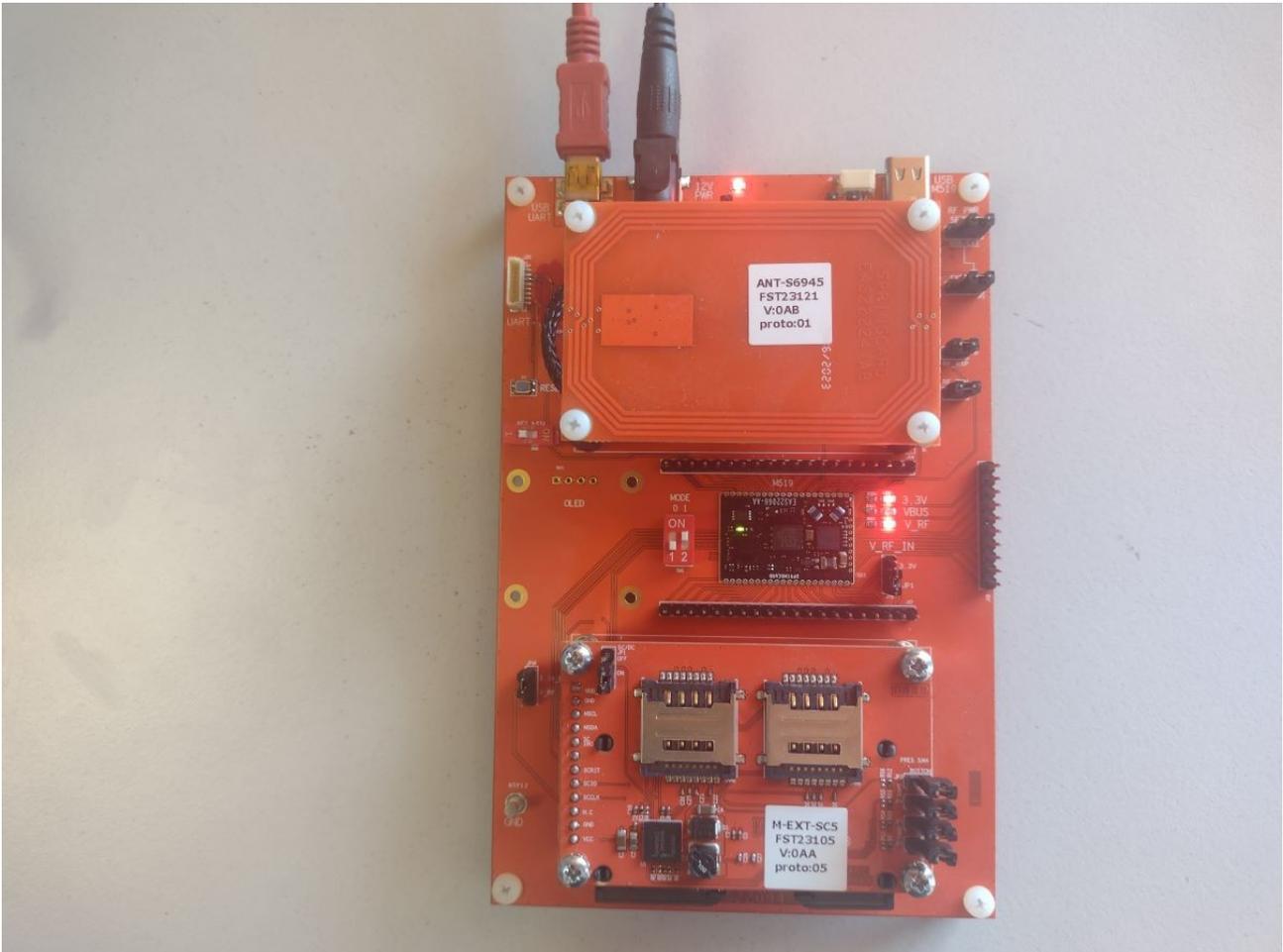
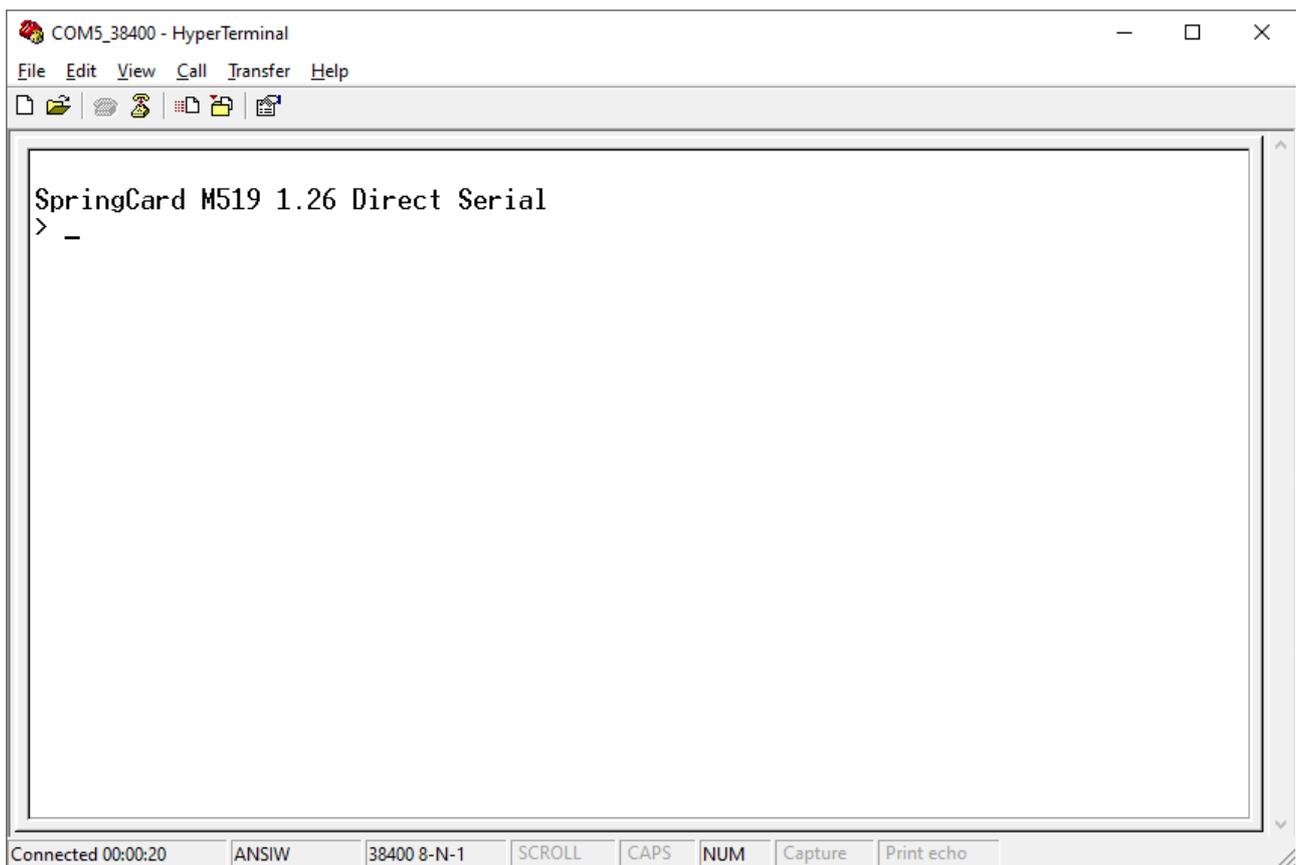


Illustration 7: M519-SRK connected to the PC through its FTDI USB to Serial bridge

1. Disconnect any existing connection (USB or serial), unplug power jack,
2. On **JP4** “RF PWR SETUP”, set the jumper to the “EXT” position,
3. On **JP1**, set the jumper to the “JP4” position,
4. On **JP5** “V\_RF\_IN”, set the jumper to the “JP1” position,
5. Power the SRK by connecting a 12V DC power supply to the power jack labelled “12V PWR”. The power supply shall be able to deliver at least 500mA,
6. If everything is OK, the two LEDs “3.3V” and “V\_RF” light on. LED “VBUS” remains off,

7. Connect the “USB UART” USB mini-B connector to a USB port of the computer. Operating systems like Windows, macOS and Linux should enumerate the FTDI chip, find a driver automatically, and mount the device as a communication port. If this is not the case, visit FTDI’s web site to download and install their driver manually (<https://ftdichip.com/drivers/>),
8. Open a terminal software over the newly installed (virtual) communication port. Parameters are:
  - Baudrate: 38400bps,
  - Format: 8 data bits, 1 stop bit, no parity, no flow control.
9. Press the <ENTER> key. The M519 shall provide its prompt in return.



*Illustration 8: Hyper Terminal software, showing the prompt of a M519 with default parameters connected over a Serial interface*

### 4.3 HW configuration for Serial operation, using the UART-TTL (JST connector)

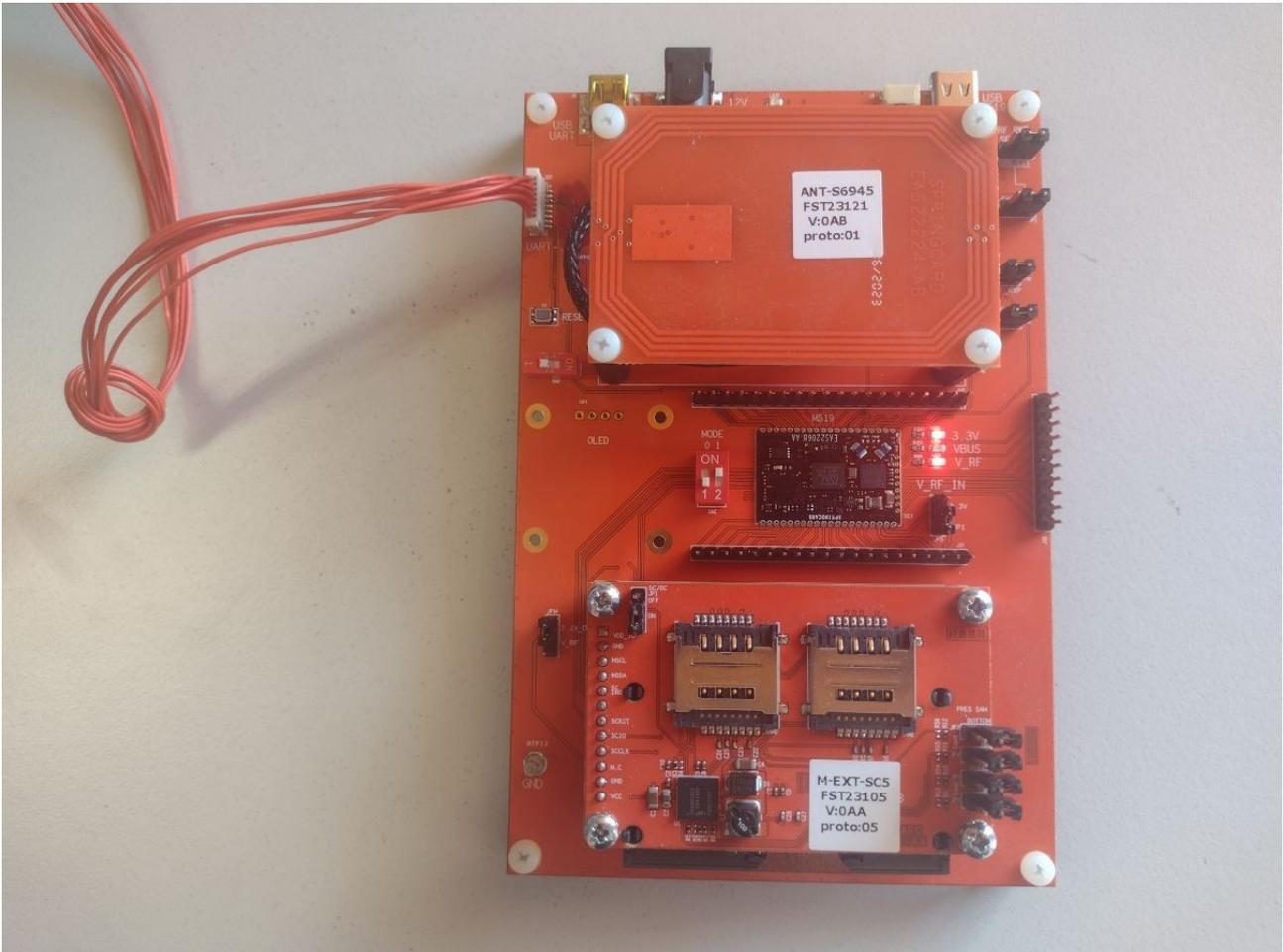


Illustration 9: M519-SRK connected and powered through its JST 8 connector

1. Disconnect any existing connection (USB or serial), unplug power jack,
2. On **JP4** “RF PWR SETUP”, set the jumper to the “EXT” position,
3. On **JP1**, set the jumper to the “JP4” position,
4. On **JP5** “V\_RF\_IN”, set the jumper to the “JP1” position,
5. Connect the host UART (3V level) and the power supply (5V DC) to the JST PH 8-pin connector “UART”,
6. If everything is OK, the two LEDs “3.3V” and “V\_RF” light on. LED “VBUS” remains off,

7. Open a terminal software over the communication port. Parameters are:
  - Baudrate: 38400bps,
  - Format: 8 data bits, 1 stop bit, no parity, no flow control.
8. Press the <ENTER> key. The M519 shall provide its prompt in return.
  - Baudrate: 38400bps,
  - Format: 8 data bits, 1 stop bit, no parity, no flow control.

#### 4.4 Direct connection to the module

1. Disconnect any existing connection (USB or serial), unplug power jack,
2. Open jumper **JP5** “V\_RF\_IN”,
3. Use jumper wires to connect your system to the M519 directly.

For instance, the following picture shows a Raspberry Pico W used as host “computer” with the M519-SRK.

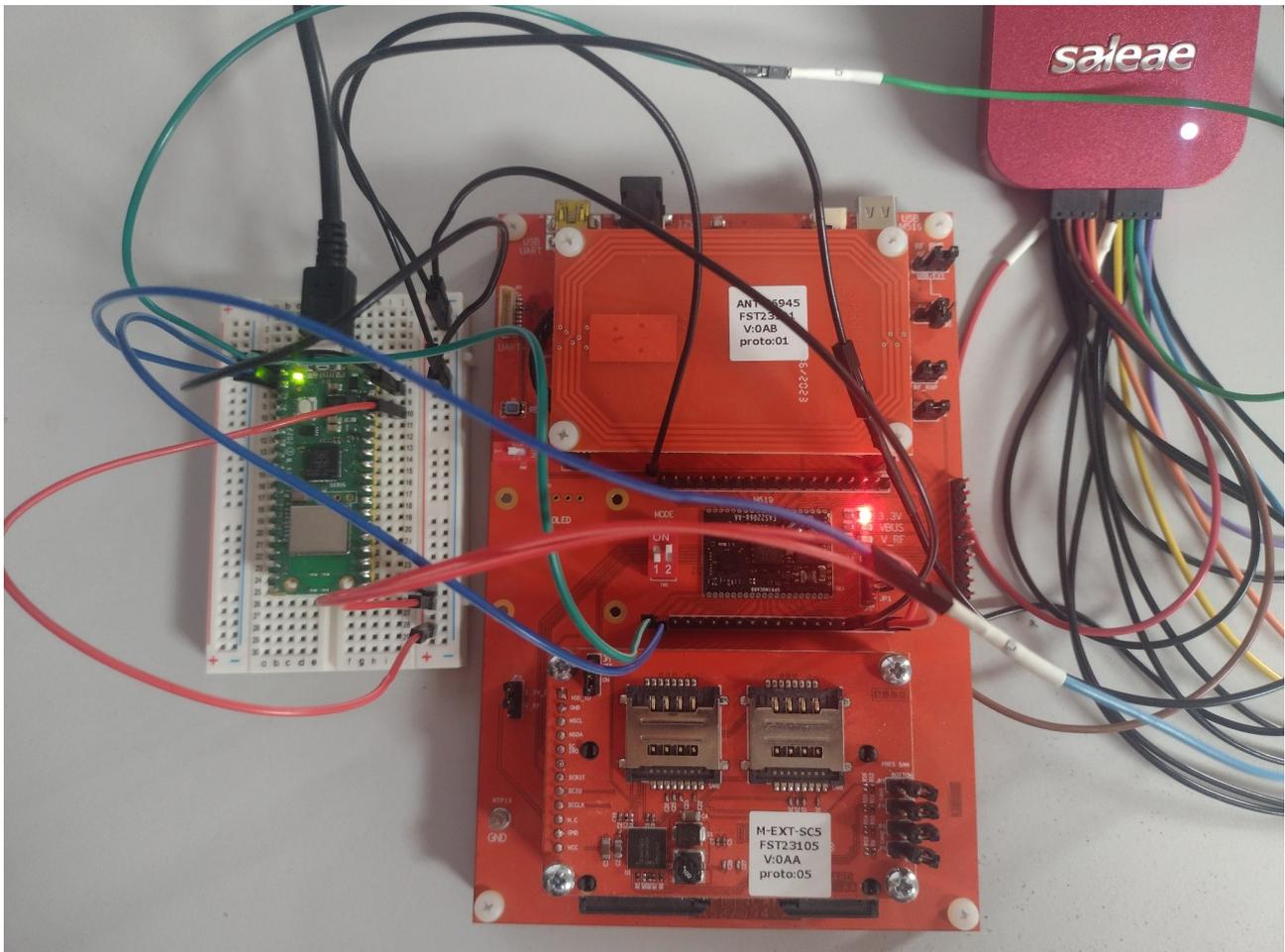


Illustration 10: Raspberry Pico W, M519-SRK and Logic analyser (Saleae)

## 5 Selecting the operating mode

The M519 supports different operating modes: PC/SC Coupler (CCID protocol), Smart Reader, RFID Scanner (same Smart Reader but using HID keyboard protocol), etc.

The module knows which is its operating mode by probing its MODE0 and MODE1 pin upon reset, and by reading the configuration stored in its non-volatile memory:

- If a specific configuration is assigned by MODE0, MODE1, the M519 activates the corresponding profile(s) and protocol(s),
- Otherwise, the M519 uses the profile(s) and protocol(s) selected in register  $\mu 02C0$ .

### 5.1 Operating mode selected by HW

#### 5.1.1 PC/SC Coupler

1. Select either USB or Serial host interface as described in chapter 4 .
2. Set “MODE0” switch to the OFF position and “MODE1” switch to the ON position,
3. Press the “RESET” button to activate the new configuration.

If the host interface is USB, the M519 enumerates as a CCID device, and the corresponding PC/SC driver is activated. Use it as any other PC/SC “reader”.

If the host interface is Serial, proceed with Application Note [PNA23174].

#### 5.1.2 RFID Scanner (USB)

The RFID Scanner (USB HID keyboard profile) is available only when the host interface is USB.

1. Select the USB host interface as described in chapter 4 .
2. Set “MODE0” switch to the ON position and “MODE1” switch to the OFF position,
3. Press the “RESET” button to activate the new configuration.

The M519 enumerates as a HID keyboard device, and the corresponding driver is activated.

Use SpringCard Companion or another configuration method to

- Configure the M519 with the same keyboard layout as the main keyboard of your computer (default is QWERTY),
- Define the Smart Reader template(s) you want to use.

### 5.1.3 Smart Reader (Serial)

The Smart Reader mode (not RFID Scanner) is available only when the host interface is Serial.

1. Select the Serial host interface as described in chapter 4 .
2. Set “MODE0” switch to the ON position and “MODE1” switch to the OFF position,
3. Press the “RESET” button to activate the new configuration.

Open a terminal software with the usual parameters (38400:8:1:N) to see the data coming from the M519.

Use SpringCard Companion or another configuration method to

- Select the protocol for the Smart Reader data stream (default is \$SCRDR),
- Define the Smart Reader template(s) you want to use.

### 5.1.4 SpringCore Direct, fail-safe mode

1. Select either USB or Serial host interface as described in chapter 4 .
2. Set both “MODE0” and “MODE1” switches to the ON position,
3. Press the “RESET” button to activate the new configuration.

If the host interface is USB, the M519 enumerates as a SpringCore Direct device, and a generic driver is activated. Use it with the SpringCore Tools or SpringCard Companion.

If the host interface is Serial, use the device with the SpringCore Tools or with its “human console” shell.

## 5.2 Operating mode selected in NVM

1. Write the expected operating mode in register  $_H02C0$ :

[https://docs.springcard.com/books/SpringCore/Non\\_volatile\\_memory/Configuration/Main\\_configuration/Profile](https://docs.springcard.com/books/SpringCore/Non_volatile_memory/Configuration/Main_configuration/Profile)

See § 6.1 and 6.2 on how to write a new configuration in the M519. Alternatively, you may use the shell (“human console”) to alter a configuration.

2. Set both “MODE0” and “MODE1” switches to the OFF position,
3. Press the “RESET” button to activate the new configuration.

## 5.3 Bootloader

To M519 features a bootloader. The bootloader may be activated by driving the /FLASH pin of the M519 to low level, e.g. placing the **SW2** switch of the SRK to the ON position.

The bootloader is activated only when the M519 performs a cold reset (press **S1** to do so or cycle power).

For normal operation, the **SW2** switch shall always be kept on the OFF position.

**Remark:** most operating modes allow the host application to write a new firmware into the M519 through its "normal" communication protocol. This allows to flash the device without using the bootloader (hence without having to drive its /FLASH input).

## 6 Configuration and firmware upgrade

The M519 is a versatile device. In most use cases, it shall be configured carefully before being able to deliver the expected service to the host application.

The flexibility of the configuration covers:

- The main operating mode of the module (has seen in § 5.2 ),
- The behaviour of the NFC/RFID HF interface: enabled protocols, allowed bitrates, power level, compliance with the standards (ISO, EMV, CEN/TS 16794 or RCTIF, NFC Forum) and many options for fine-tuning the digital (protocol-level) and analog (RF) behaviours,
- The behaviour of the smart card interface(s): allowed bitrates, power class, compliance with the standards (ISO, EMV),
- The behaviour of the host interface: keyboard layout and typing speed for HID keyboard, protocol for Smart Reader operation, optimization of the CCID subsystem for different hosts/drivers,
- And more.

All configuration registers are listed and detailed here:

[https://docs.springcard.com/books/SpringCore/Non\\_volatile\\_memory/Configuration](https://docs.springcard.com/books/SpringCore/Non_volatile_memory/Configuration)

The two preferred options for setting the configuration are SpringCard Companion and SpringCoreConfig.

This chapter also covers the firmware upgrade procedure, that could be performed with SpringCard Companion and SpringCoreFlash.

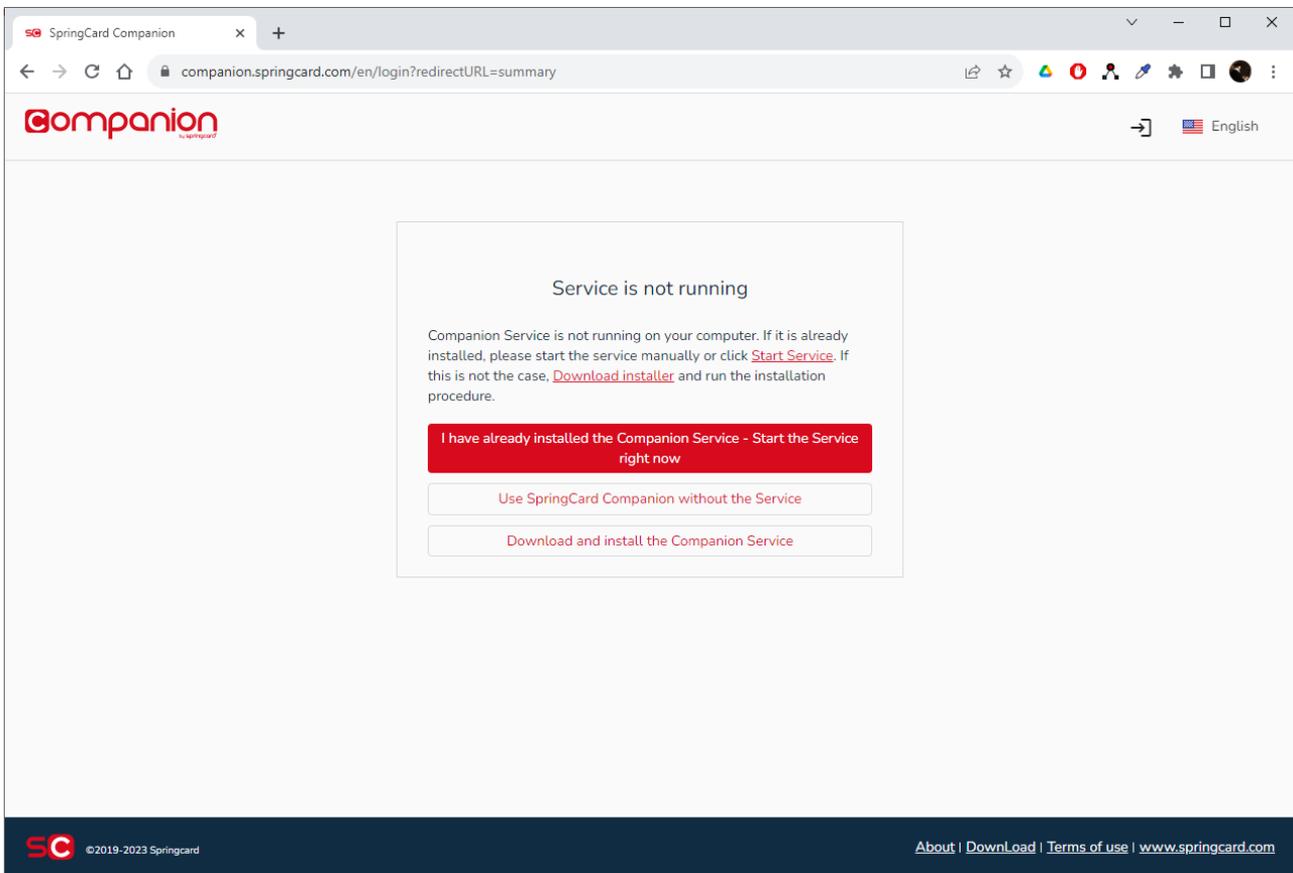
### 6.1 Using SpringCard Companion

SpringCard Companion is a complete management solution for SpringCard devices. It combines the power of the cloud for data storage, the convenience of a web application, and a local service to access the devices.

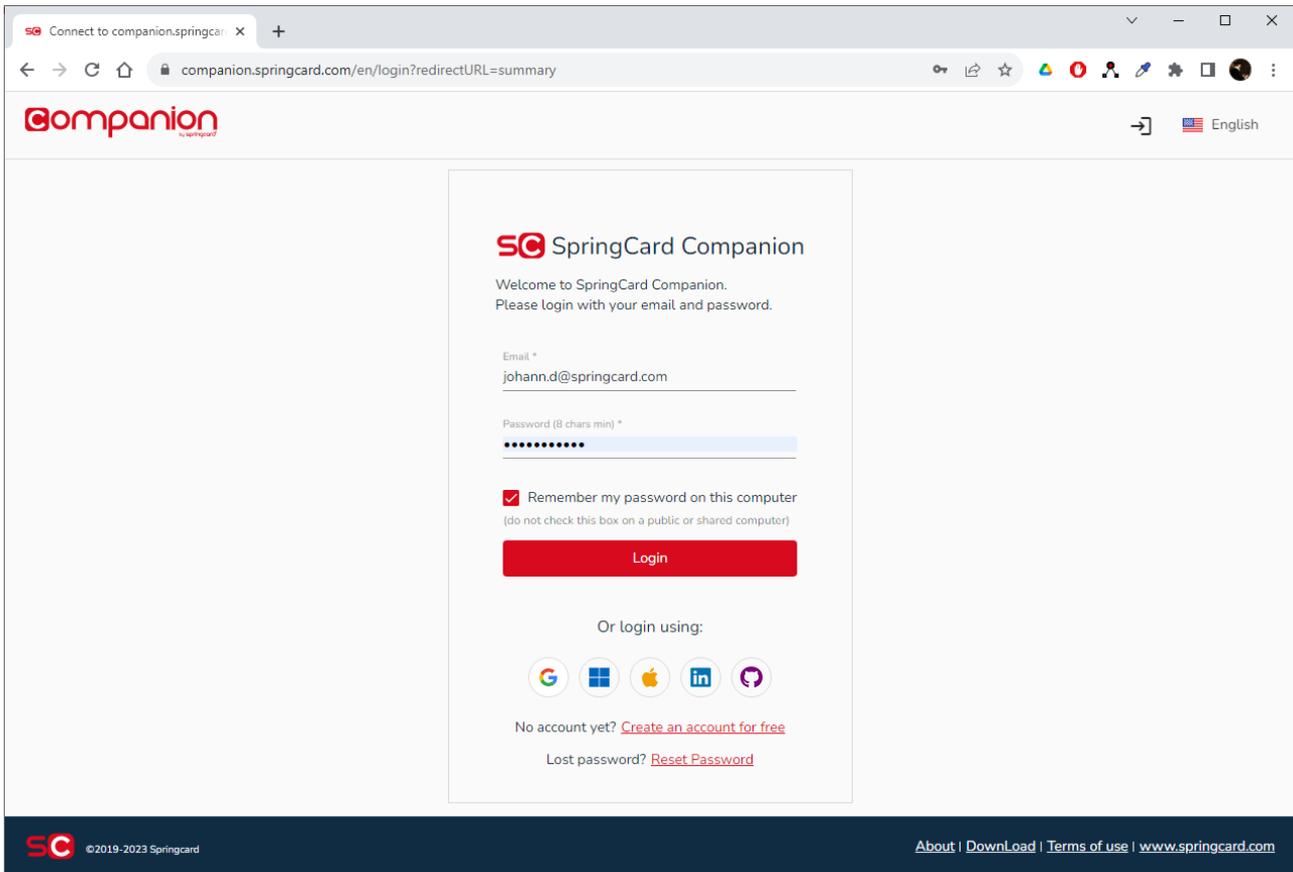
Currently, the Companion Service is currently available for Microsoft Windows only.

### 6.1.1 Getting Started with SpringCard Companion

- Open a web browser and go to <https://companion.springcard.com> .
- If the SpringCard Companion Service is not already running on your computer, click “Download and install the Companion Service”. You may also download it directly at <https://www.springcard.com/en/download/find/file/sn20030> . Otherwise, click “Start the Service right now”.



- Once the service is up and running, the Companion web application shows its login screen.

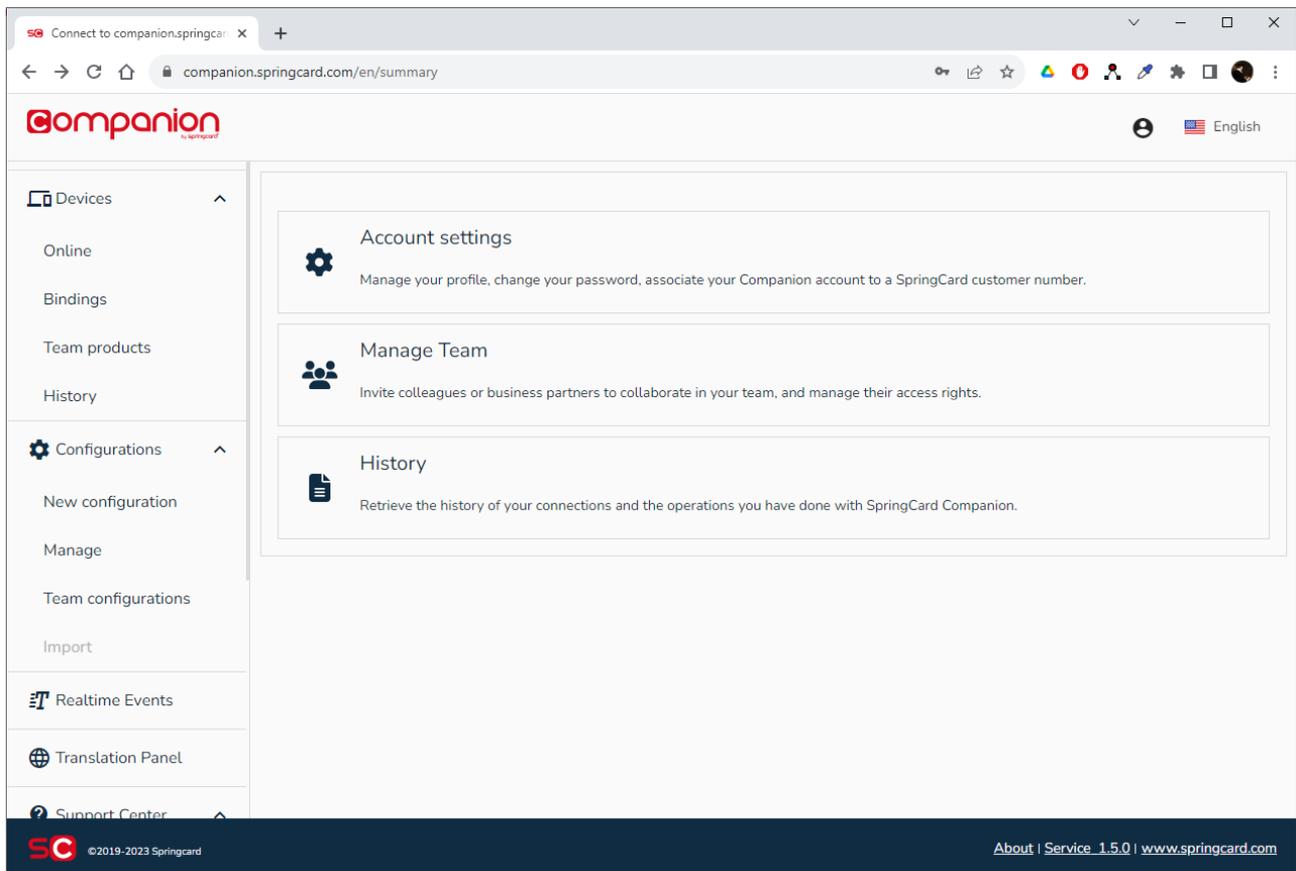


- Log in with your Companion account.

You must create an account (it's free) in case you don't already have one.

You may also use a 3rd-party authentication service to get identified (Google, Microsoft, Apple, LinkedIn or GitHub oAuth services are supported; your email address is the only information shared between the oAuth service provider and SpringCard).

- The Companion web application now shows its main screen. Click the “Devices → Online” entry in the menu to see the devices that are connected to your computer.



### 6.1.2 Using SpringCard Companion with an USB device

The Companion service is able to enumerate all the compliant USB devices. If the M519-SRK is connected through USB, it appears immediately on the “Online” screen.

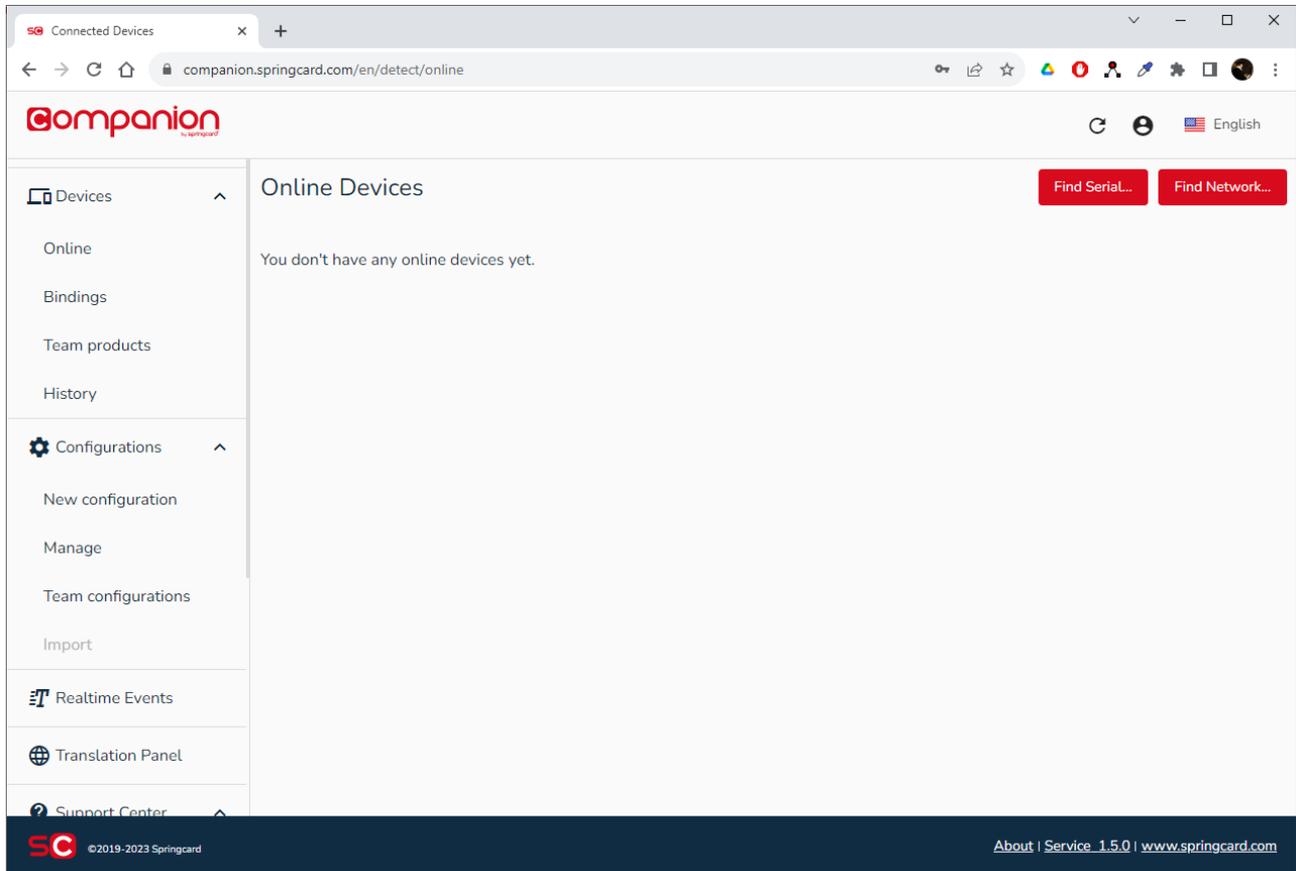
### 6.1.3 Using SpringCard Companion with a Serial device

Since Serial devices are not plug’n’play, the Companion service is not able to enumerate automatically. More than that, on USB the concept of compound devices makes it possible for the Companion service to communicate with the module using the Direct protocol even if another profile has been selected, but that is impossible with serial devices.

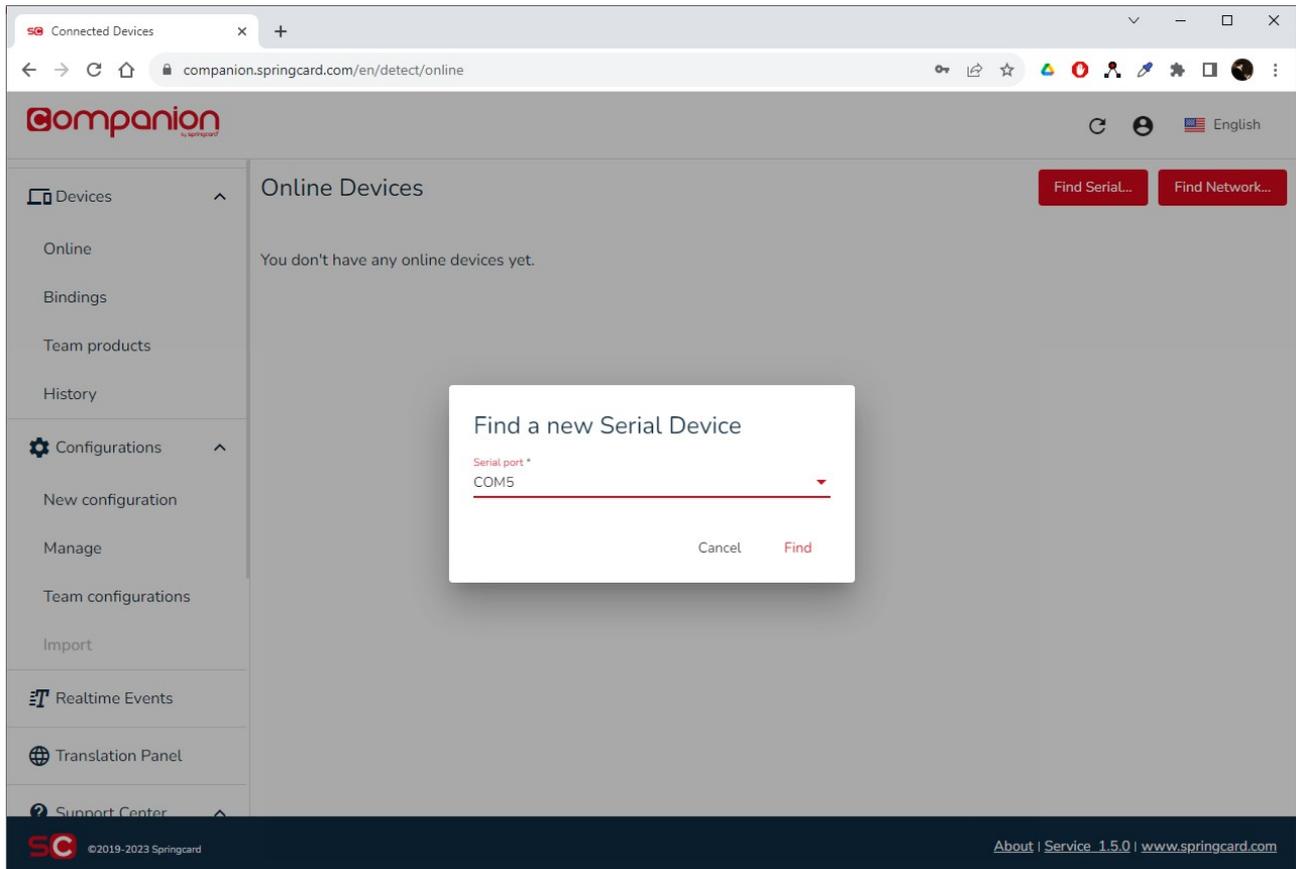
Therefore, if the M519-SRK is connected through a serial port, you must

1. Enforce the Direct protocol, fail-safe mode. Refer to § 5.1.4 to do so,

2. Explicitly tell Companion which serial port the device is connected to, using the following procedure:



- Click the “Find Serial...” button



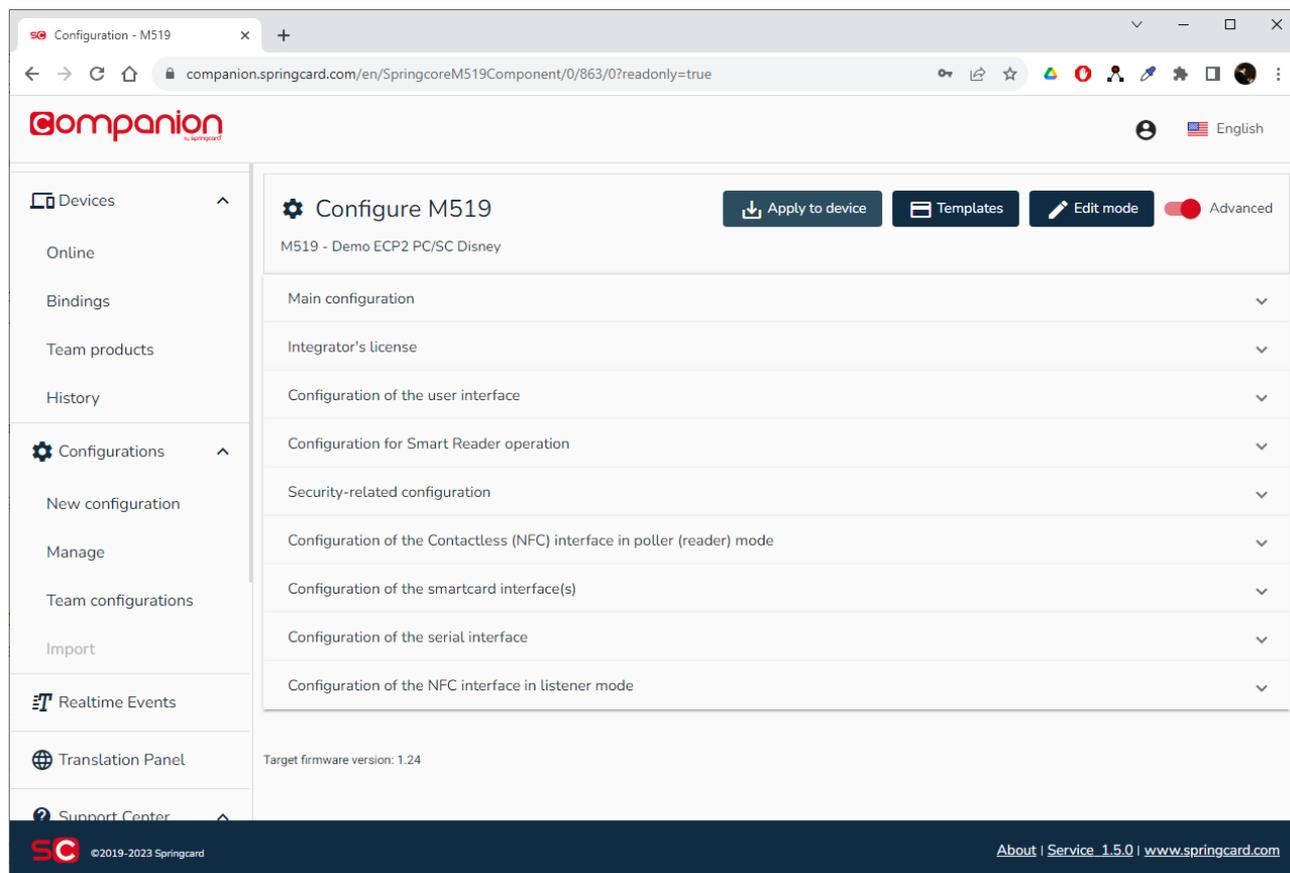
- In the drop-down list, select the serial communication port, and click “Find”.
- The software takes a few seconds to recognize the device, then the screen reloads and the M519 appears in the list:

The screenshot shows the 'Companion' web interface for SpringCard. The browser address bar displays 'companion.springcard.com/en/detect/online'. The page title is 'Online Devices'. On the left, there is a navigation menu with options: Devices (Online, Bindings, Team products, History), Configurations (New configuration, Manage, Team configurations, Import), Realtime Events, Translation Panel, and Support Center. The main content area shows a table with one device entry: 'SpringCard M519'. The table has columns for Serial Number, Version (1.26), Channel (SERIAL), and Mode (Unknown). Below the table, there is a configuration ID: 'FA1E1ACO-84F8-FFC8-FE4B-34DF632BE961'. To the right of the table, there are buttons for 'Wink' and 'Actions'. At the top right of the main content area, there are buttons for 'Find Serial...' and 'Find Network...'. The footer contains the SpringCard logo, copyright information '©2019-2023 Springcard', and links for 'About | Service 1.5.0 | www.springcard.com'.

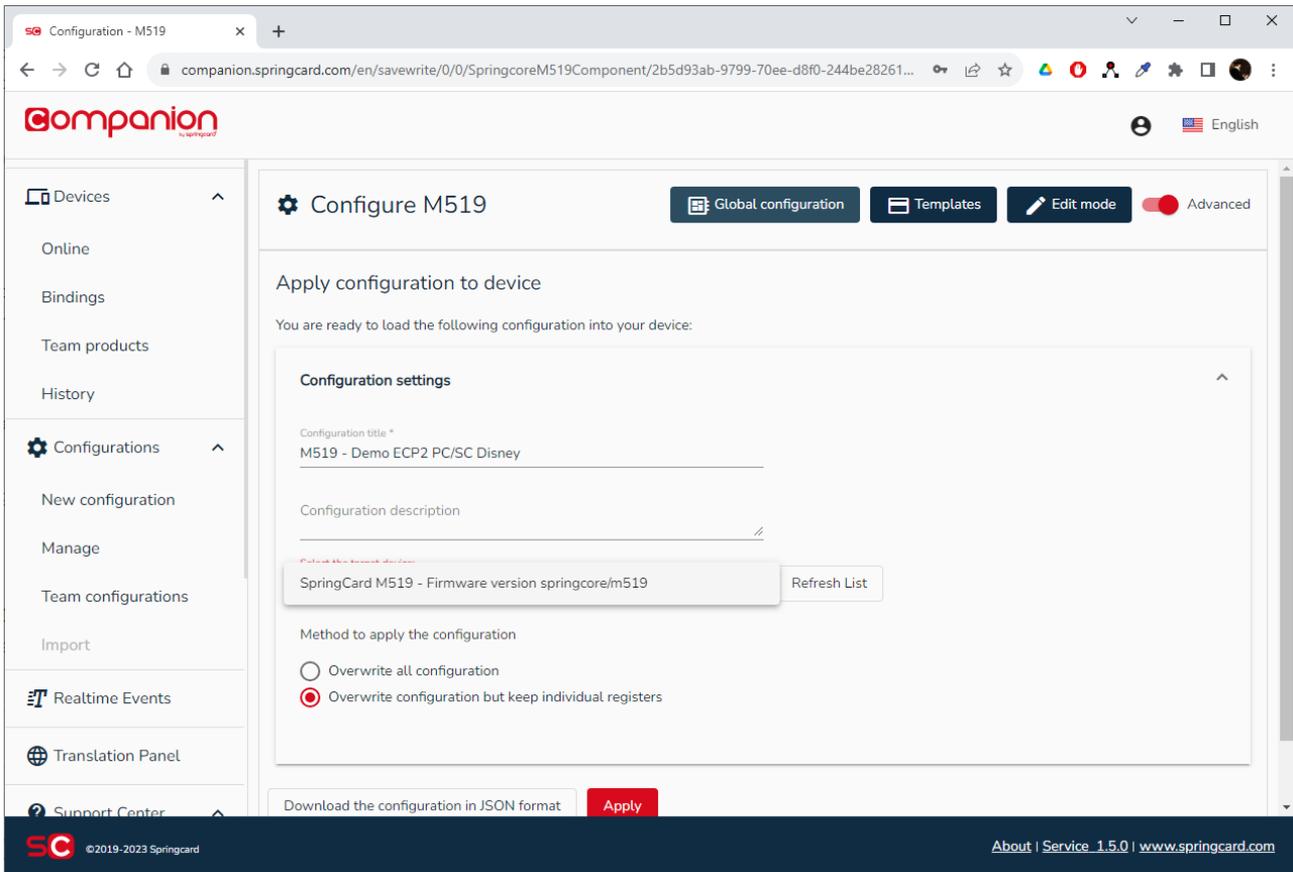
- Proceed with § 6.1.4 or § 6.1.5 .

## 6.1.4 Writing a configuration

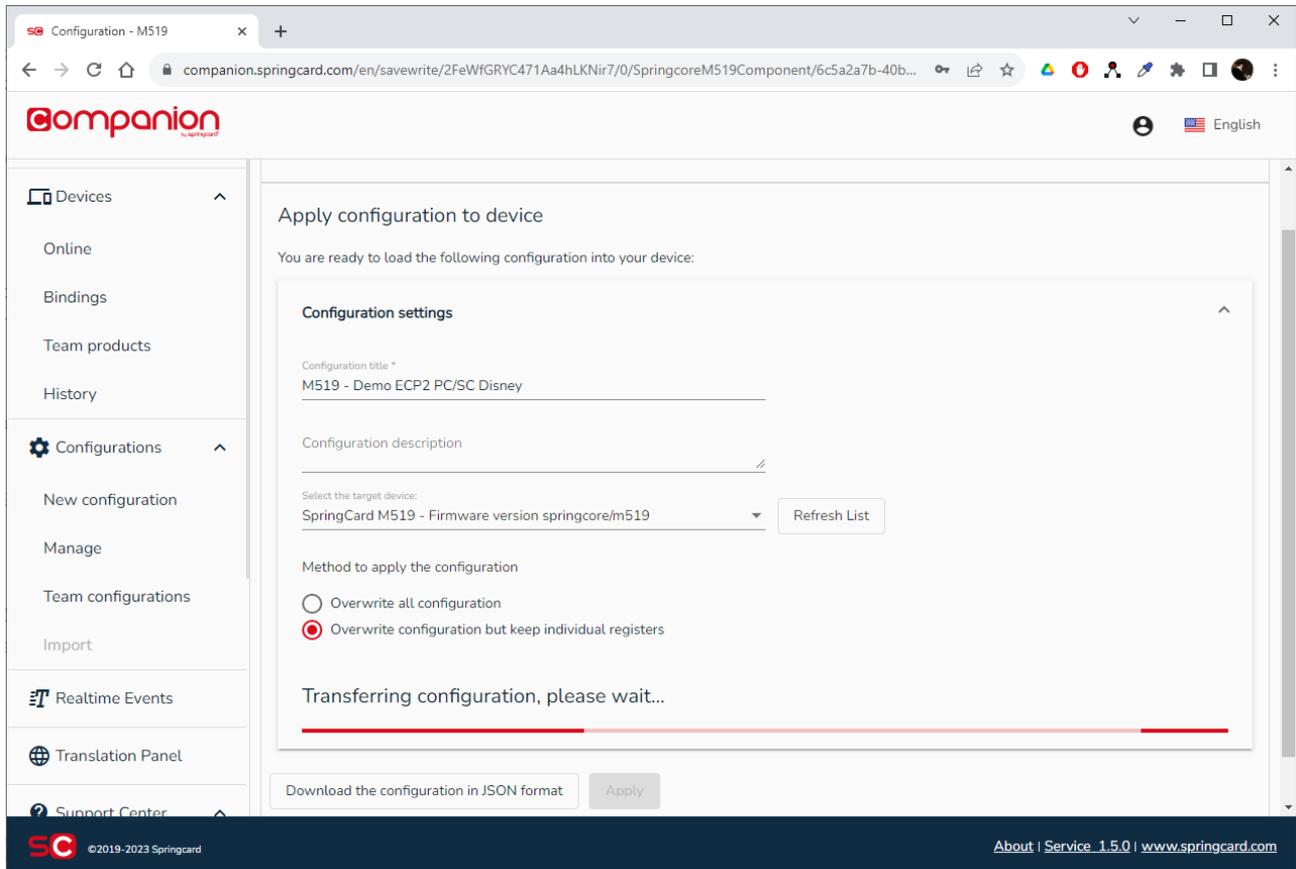
- Click the “Actions” button associated to the M519, then click the “Configure device” entry in the pop-up menu.
- Create a new configuration, or select an existing configuration that is compliant with the M519.
- Once you have a configuration ready, click the “Apply to device” button.



- In the “Select the target device” drop-down list, select the currently connected M519.



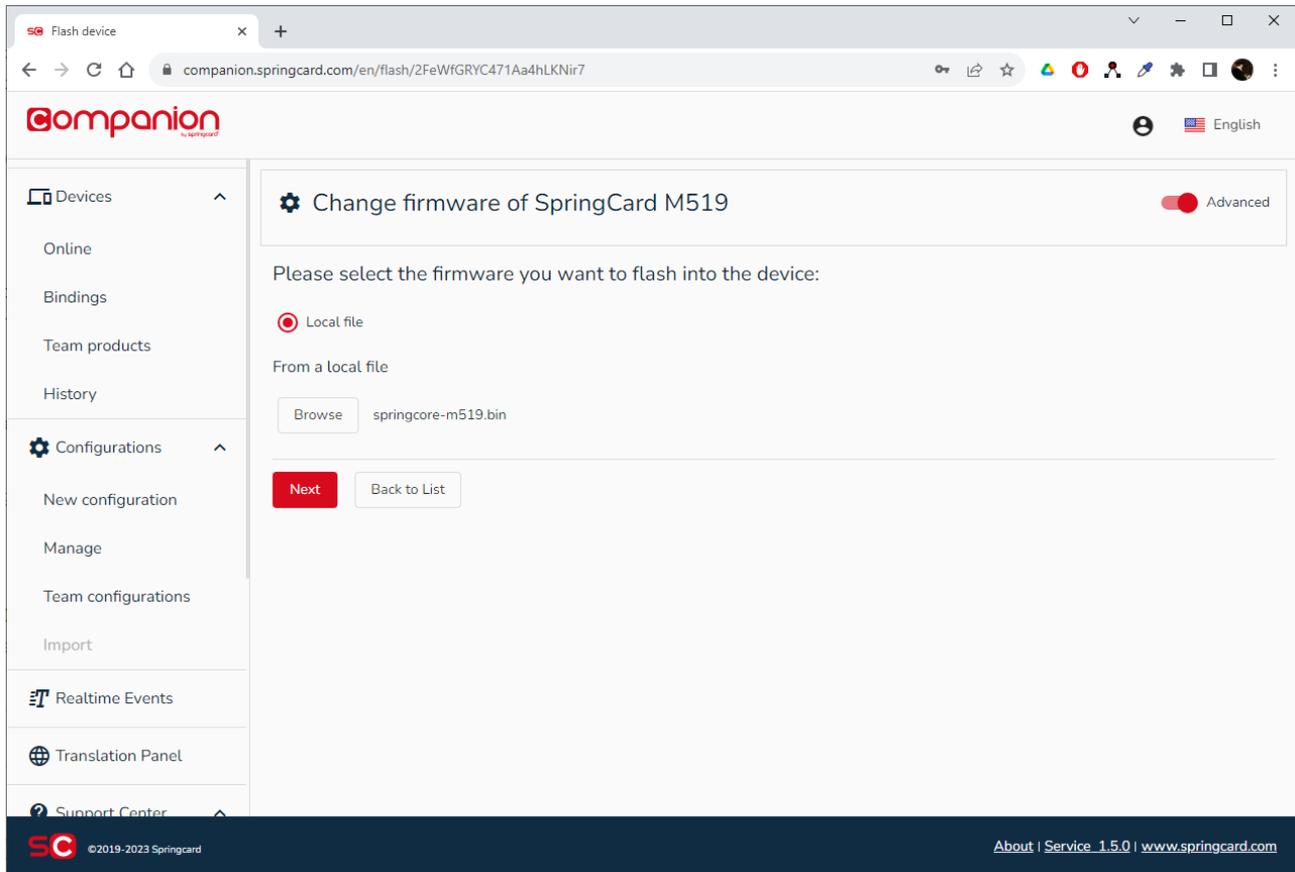
- Click the “Apply” button.
- The Companion web application shows the message “Transferring configuration, please wait” while the Companion Service writes the new configuration into the M519. The device resets at the end of the procedure.



**NB:** For security and privacy reasons, Companion is not able to read-back the current configuration.

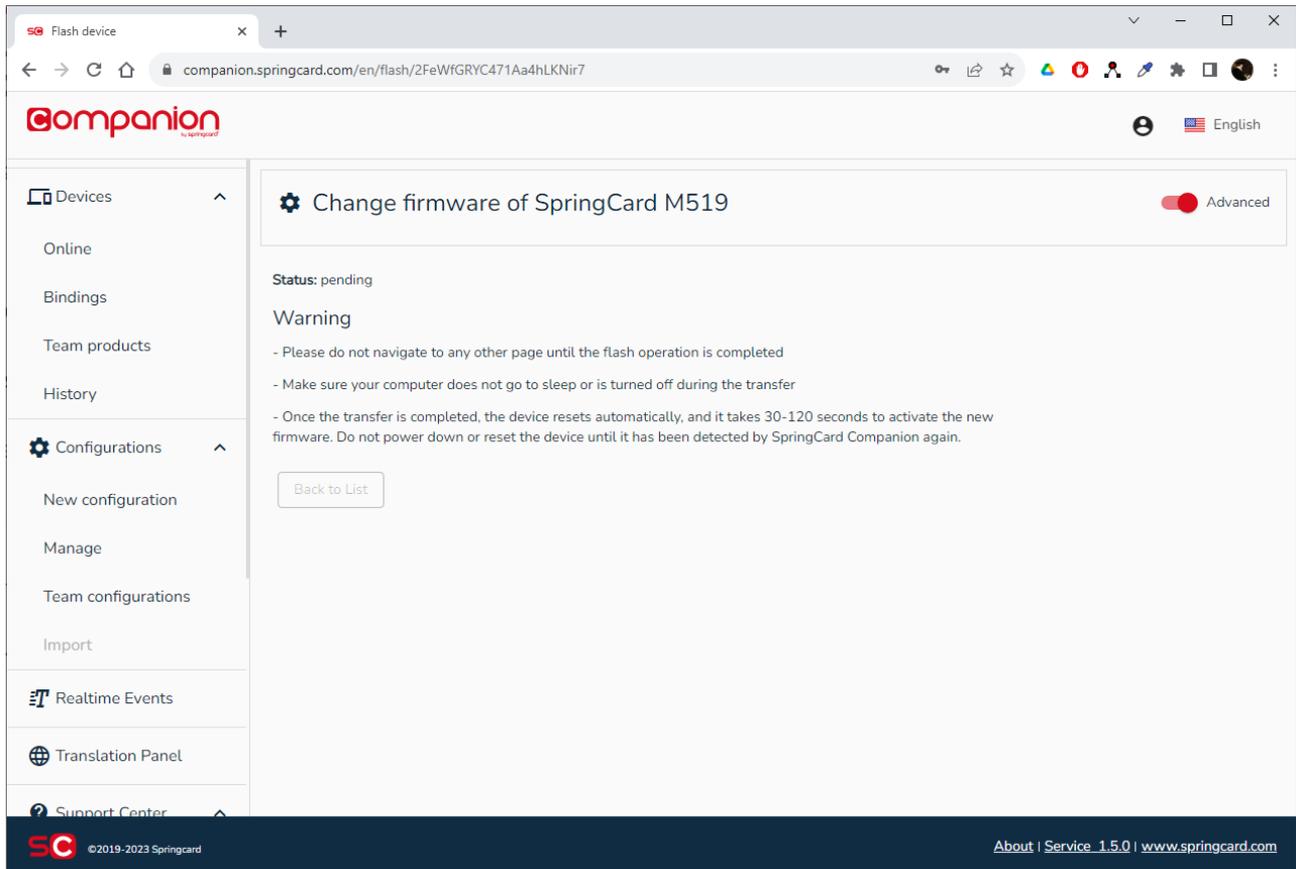
### 6.1.5 Flashing the firmware

- Click the “Actions” button associated to the M519, then click the “Flash” entry in the pop-up menu.
- Select the firmware you want to flash into the module and click “Next”.



- Wait until the new firmware is transmitted to the module. At the end of the transfer, the device resets at twice or three time:
  - On first reset, the bootloader copies the new firmware into the ROM of the microcontroller,
  - On second reset, the new firmware starts. If required, it flashes the peripherals (PN5190 namely),
  - If any peripheral has been flashed, the firmware resets again.

**Warning:** Do not power down the M519-SRK or press the reset button until the firmware upgrade has been completely terminated (green LED on the M519 is OFF).



## 6.2 Using SpringCoreConfig

### 6.2.1 Getting started with SpringCoreConfig

Download the SpringCore Tools SQ20029 ZIP archive from SpringCard's web site:

<https://www.springcard.com/fr/download/find/file/sq20029>

Unzip the archive in a local directory. Open a console (shell) into this directory.

```

C:\Windows\System32\cmd.exe
Microsoft Windows [version 10.0.19045.3324]
(c) Microsoft Corporation. Tous droits réservés.

C:\SpringCard\SpringCore Tools>dir *.exe
Le volume dans le lecteur C s'appelle OS
Le numéro de série du volume est 1A01-F4BC

Répertoire de C:\SpringCard\SpringCore Tools

05/06/2023  16:32                55 296 SpringCoreConfig.exe
05/06/2023  16:32                36 864 SpringCoreControl.exe
05/06/2023  16:32                41 472 SpringCoreFlash.exe
05/06/2023  16:32                36 352 SpringCoreHCE.exe
05/06/2023  16:32                47 616 SpringCoreMasterCard.exe
05/06/2023  16:32                37 888 SpringCoreRDR.exe
05/06/2023  16:32                58 880 SpringCoreSE.exe
05/06/2023  16:32                72 192 SpringCoreTool.exe
            8 fichier(s)                386 560 octets
            0 Rép(s) 29 008 809 984 octets libres

C:\SpringCard\SpringCore Tools>
    
```

Enter the command `SpringCoreConfig --help` to read the integrated documentation.

```

C:\Windows\System32\cmd.exe
C:\SpringCard\SpringCore Tools>SpringCoreConfig --help

SpringCoreConfig version 23.14
Build: 23.14.8556.29768, using SpringCoreDirect.dll 23.14.8556.29768
Copyright © SpringCard SAS, France, 2019-2022 all rights reserved
Running on Windows X64 (Microsoft Windows 10.0.19045 )
Framework is .NET Framework 4.8.9166.0 X86

Usage:
SpringCoreConfig [PARAMETERS] [[OPTIONS]]

Writing a configuration into the device:

Use a local configuration file:
SpringCoreConfig --file <FILE> [OPTIONS]
<FILE> must be a valid CFG or JSON file

Use a remote configuration file:
SpringCoreConfig --url <URL> [OPTIONS]
<URL> must target a valid CFG or JSON file
Supported schemes are http:// and https://

OPTIONS after --file or --url:
    
```

## 6.2.2 Using SpringCoreConfig over USB

Connect the M519 as a USB device, as detailed in § 4.1 .

Enter the command `SpringCoreConfig --direct --list-descr` to validate the presence of the device, and show its meta-data (description).

```

C:\Windows\System32\cmd.exe
C:\SpringCard\SpringCore Tools>SpringCoreConfig --direct --list-descr
Found 1 possibly SpringCore compliant device(s):
0: SpringCard M519
   Serial Number: EDE6222CB78E
   Version:      1.26
   Firmware:    springcore/m519
   Revision:    1.26-72-gc6bf9b5c-dirty
   ConfigId:    00000000-0000-0000-0000-000000000000
   Path:       \\?\usb#vid_1c34&pid_6120#ede6222cb78e#{c3b50bd1-8d68-4196-8fcc-04b8a3b4837e}
Success
    
```

The Direct protocol is normally available with all profiles, but if the M519 is not found by SpringCoreConfig, set both MODE switches to the ON position and reset the module, to make sure it is in SpringCore Direct, fail-safe mode (§ 5.1.4 ).

`--direct` is the connection string. In the following paragraphs, pass the same connection string as the first parameter. If you have more than one SpringCore device connected to the computer, they will be listed one by one. Use `--direct=<INDEX>` as connection string to precise the one you want to use.

### 6.2.3 Using SpringCoreConfig over a Serial port

Connect the M519 as a serial device, as detailed in either § 4.2 or § 4.3 . Set both MODE switches to the ON position before resetting the M519, to make sure the module is in SpringCore Direct, fail-safe mode (§ 5.1.4 ).

Enter the command `SpringCoreConfig --serial=COM5 --list-descr` to validate the connection with the device, and show its meta-data (description).

```

C:\Windows\System32\cmd.exe
C:\SpringCard\SpringCore Tools>SpringCoreConfig --serial=COM5 --list-descr
RequireSerialDevice on COM5
SpringCard M519
   Serial Number: EDE6222CB78E
   Version:      1.26
   Firmware:    springcore/m519
   Revision:    1.26-72-gc6bf9b5c-dirty
   ConfigId:    00000000-0000-0000-0000-000000000000
   Path:       COM5
Success
    
```

`--serial=COM5` is the connection string. In the following paragraphs, pass the same connection string as the first parameter.

## 6.2.4 Changing one register

Pass the command `--write <ADDRESS>=<VALUE>` to SpringCoreConfig to change one register. ADDRESS and VALUE must be specified in hexadecimal.

Example:

```
SpringCoreConfig [CONNECTION STRING] --write 02C0=00
```

(write `00` into register `02C0`, to select the Direct protocol).

## 6.2.5 Writing a complete configuration

You may download a configuration file from SpringCard Companion, or use a configuration file provided by SpringCard or an other party. Configuration files use either the JSON or the CFG format.

Pass the command `--file <FILENAME>` to SpringCoreConfig to apply the complete configuration defines in the file into the M519. The module resets at the end of the writing to apply the new configuration immediately.

Example:

```
SpringCoreConfig [CONNECTION STRING] --file m519-pcsc.cfg
```

# 6.3 Using SpringCoreFlash

## 6.3.1 Getting started with SpringCoreFlash

Download the SpringCore Tools SQ20029 ZIP archive from SpringCard's web site:

<https://www.springcard.com/fr/download/find/file/sq20029>

Unzip the archive in a local directory. Open a console (shell) into this directory.

```

C:\Windows\System32\cmd.exe
Microsoft Windows [version 10.0.19045.3324]
(c) Microsoft Corporation. Tous droits réservés.

C:\SpringCard\SpringCore Tools>dir *.exe
Le volume dans le lecteur C s'appelle OS
Le numéro de série du volume est 1A01-F4BC

Répertoire de C:\SpringCard\SpringCore Tools

05/06/2023  16:32                55 296 SpringCoreConfig.exe
05/06/2023  16:32               36 864 SpringCoreControl.exe
05/06/2023  16:32               41 472 SpringCoreFlash.exe
05/06/2023  16:32               36 352 SpringCoreHCE.exe
05/06/2023  16:32               47 616 SpringCoreMasterCard.exe
05/06/2023  16:32               37 888 SpringCoreRDR.exe
05/06/2023  16:32               58 880 SpringCoreSE.exe
05/06/2023  16:32               72 192 SpringCoreTool.exe
            8 fichier(s)             386 560 octets
            0 Rép(s) 29 008 809 984 octets libres

C:\SpringCard\SpringCore Tools>
    
```

Enter the command `SpringCoreFlash --help` to read the integrated documentation.

```

C:\Windows\System32\cmd.exe

C:\SpringCard\SpringCore Tools>SpringCoreFlash --help

SpringCoreFlash
SpringCoreFlash version 23.14
Build: 23.14.8633.28366, using SpringCoreDirect.dll 23.14.8633.28365
Copyright © SpringCard SAS, France, 2019-2022 all rights reserved
Running on Windows X64 (Microsoft Windows 10.0.19045 )
Framework is .NET Framework 4.8.9166.0 X86

Usage:

SpringCoreFlash --file <FIRMWARE FILE> [OPTIONS]

<FILE> must be a valid firmware file (.bin) provided by SpringCard

Advanced uses:

Show the file's meta-data
SpringCoreFlash --file-meta <FIRMWARE FILE>

Show the file's details
SpringCoreFlash --file-details <FIRMWARE FILE>
SpringCoreFlash --dump-details <FIRMWARE FILE>

COMMON OPTIONS:
    
```

## 6.3.2 Using SpringCoreFlash with an USB device

Connect the M519 as a USB device, as detailed in § 4.1 .

Enter the command `SpringCoreFlash --direct --list-descr` to validate the presence of the device, and show its meta-data (description).

```

C:\Windows\System32\cmd.exe
C:\SpringCard\SpringCore Tools>SpringCoreFlash --direct --list-descr
Found 1 possibly SpringCore compliant device(s):
0: SpringCard M519
   Serial Number: EDE6222CB78E
   Version:      1.26
   Firmware:    springcore/m519
   Revision:    1.26-72-gc6bf9b5c-dirty
   ConfigId:    00000000-0000-0000-0000-000000000000
   Path:       \\?\usb#vid_1c34&pid_6120#ede6222cb78e#{c3b50bd1-8d68-4196-8fcc-04b8a3b4837e}
Success
    
```

The Direct protocol is normally available with all profiles, but if the M519 is not found by SpringCoreConfig, set both MODE switches to the ON position and reset the module, to make sure it is in SpringCore Direct, fail-safe mode (§ 5.1.4).

`--direct` is the connection string. In the following paragraphs, pass the same connection string as the first parameter. If you have more than one SpringCore device connected to the computer, they will be listed one by one. Use `--direct=<INDEX>` as connection string to precise the one you want to use.

### 6.3.3 Using SpringCoreFlash with a Serial device

Connect the M519 as a serial device, as detailed in either § 4.2 or § 4.3. Set both MODE switches to the ON position before resetting the M519, to make sure the module is in SpringCore Direct, fail-safe mode (§ 5.1.4).

Enter the command `SpringCoreConfig --serial=COM5 --list-descr` to validate the connection with the device, and show its meta-data (description).

```

C:\Windows\System32\cmd.exe
C:\SpringCard\SpringCore Tools>SpringCoreFlash --serial=COM5 --list-descr
RequireSerialDevice on COM5
SpringCard M519
   Serial Number: EDE6222CB78E
   Version:      1.26
   Firmware:    springcore/m519
   Revision:    1.26-72-gc6bf9b5c-dirty
   ConfigId:    00000000-0000-0000-0000-000000000000
   Path:       COM5
Success
    
```

`--serial=COM5` is the connection string. In the following paragraphs, pass the same connection string as the first parameter.

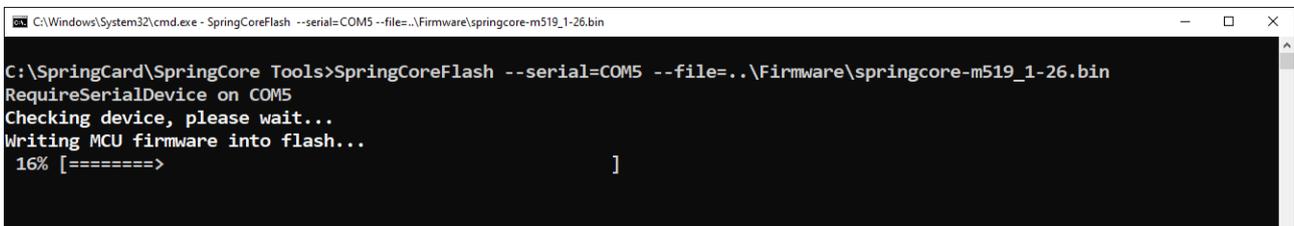
### 6.3.4 Flashing the firmware

You may download a firmware file from [files.springcard.com/firmwares/springcore/](https://files.springcard.com/firmwares/springcore/), or use a specific firmware file provided by SpringCard. The extension of a SpringCore firmware file is BIN.

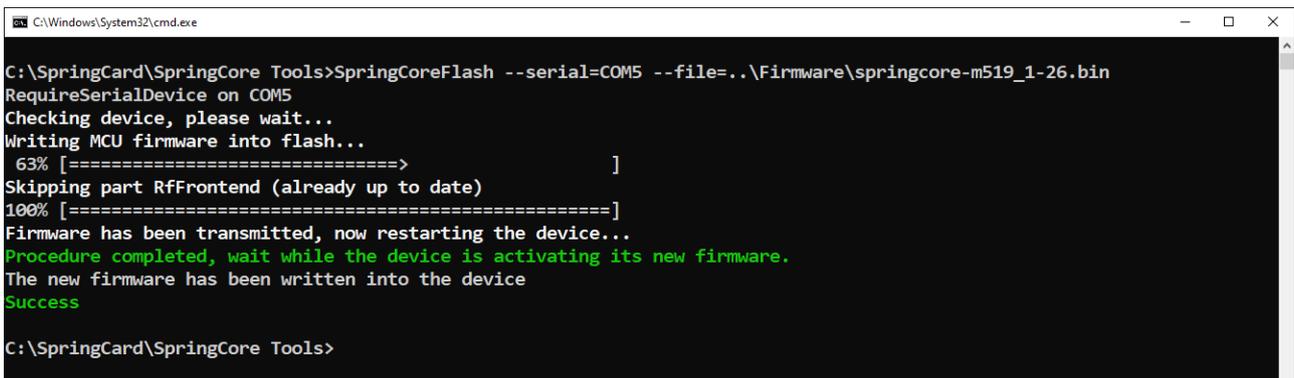
Pass the command `--file <FILENAME>` to SpringCoreFlash to flash the M519. The module resets at least twice at the end of the writing.

Example:

```
SpringCoreFlash [CONNECTION STRING] --file m519-pcsc.cfg
```



```
C:\Windows\System32\cmd.exe - SpringCoreFlash --serial=COM5 --file=..\Firmware\springcore-m519_1-26.bin
C:\SpringCard\SpringCore Tools>SpringCoreFlash --serial=COM5 --file=..\Firmware\springcore-m519_1-26.bin
RequireSerialDevice on COM5
Checking device, please wait...
Writing MCU firmware into flash...
16% [=====> ]
```



```
C:\Windows\System32\cmd.exe
C:\SpringCard\SpringCore Tools>SpringCoreFlash --serial=COM5 --file=..\Firmware\springcore-m519_1-26.bin
RequireSerialDevice on COM5
Checking device, please wait...
Writing MCU firmware into flash...
63% [=====> ]
Skipping part RfFrontend (already up to date)
100% [=====]
Firmware has been transmitted, now restarting the device...
Procedure completed, wait while the device is activating its new firmware.
The new firmware has been written into the device
Success
C:\SpringCard\SpringCore Tools>
```

**Warning:** Do not interrupt the flashing process. Never power down the module or press the reset button until the process has come to an end (green LED on the M519 is OFF again).

## 7 RF antenna selection and integration

The M519-SRK comes with three different antennas. This allows to observe the impact of antenna size on the practical operating range and power consumption during the evaluation of the M519.

### Warnings:

- Always totally unpower (unplug) the M519-SRK before changing the RF antenna.
- Always run the configuration procedure (§ 7.2 ) after having changed the antenna.
- Do not start the M519-SRK without any antenna.

### 7.1 Selecting the best antenna for your application

“Long range” or *far field* radio technologies like Bluetooth, WiFi or RFID UHF, where only the electric field (E) is involved, may work with miniature antennas that may even be embedded in small form-factor modules.

On the other hand, NFC/RFID HF is a *near field* radio technology where only the magnetic field (B) is involved and the card/tag uses power harvesting, which requires a (rather) high field strength. The antenna is an inductive coil, that must be carefully designed to reach the expected operating range in the target environment and with the target cards or tags. Its antenna can't be miniaturized too much, because the typical operating distance (i.e. the distance where the field is strong enough to remotely power the card/tag) is in the same order as its diameter or diagonal. Therefore, the M519 must be associated to an external antenna, specifically designed with all the constraints of the application in mind.

The M519-SRK comes with three antennas, that are likely to cover most use cases:

- The 69x45mm antenna (ANT-S6945) gives the flexibility to use all classes of contactless cards/tags (see ISO/IEC 14443-1 for the definition of the classes). With a properly tuned class 1 (ID-1 size) card/tag, the typical operating range is 5 to 80mm. All NFC mobile phones are likely to be supported as well.

- The 25x25mm antenna (ANT-S2525) supports all the classes of cards/tags but with a limited operating range, namely 5 to 35mm only. NFC mobile phones that feature ALM (active load modulation) are likely to be supported, but it may be difficult to operate 'passive' mobile phones with this antenna.
- The 80x80mm antenna (ANT-S8080) has the greatest operating range, namely 10mm to 125mm with properly tuned class 1 (ID-1 size) cards/tags, but it may be difficult to operate the smallest classes (classes 5 and 6) with this antenna.

**Warning:** While the RF field is strongest at close distances, there's often a “dead zone” or communication gap when the card is placed extremely close to the reader's antenna. This is due to an unfavourable signal-to-noise ratio (SNR) where the load-modulation (signal from the card/tag) is overshadowed by the strong carrier. Taking this into account is crucial when designing the final product. For instance, if there's a mechanical overlay (like a protective casing or decorative panel) in front of the reader's antenna, its thickness and material properties should be chosen to ensure that the NFC card doesn't get too close to the antenna, thus avoiding the dead zone to ensure a correct user experience.

## 7.2 Configuring the M519 for the antenna

Different antenna have a different impedance and different RF characteristics. The PN5190 NFC/RFID HF frontend IC in the M519 must be configured, in order to adapt its behaviour to the very antenna that it is driving.

The M519-SRK comes with three antennas, and the settings for these antennas are all stored in the M519's firmware. Every time you change the antenna, you must instruct the M519 to activate the corresponding configuration.

**Warning:** Using the M519 with an antenna that is not coherent with the settings of the PN5190

- breaks compliance with ISO/IEC 14443 and 15693 and give an inconsistent operating range
- is likely to break CE/FCC conformity as well
- causes overheating of the module, of the antenna and/or of the matching circuit.

If you are developing a custom antenna, contact SpringCard Sales team, and have our experts validate your antenna and create the RF settings that your manufacturing system or software solution must inject into the M519 for correct operation with your antenna.

### 7.2.1 Antenna configurations implemented in the M519 firmware

Configuration	Description
# 0	Unset / Custom (do not use this value with the SRK)
# 1	ANT-S6945 — balanced antenna, 69x45mm (default)
# 2	ANT-S2525 — balanced antenna, 25x25mm
# 3	ANT-S8080 — balanced antenna, 80x80mm

### 7.2.2 Using the product shell (“human” console)

- Follow § 4.2 to get connected to the shell of the M519 (this procedure uses the Serial interface of the module, but through USB for convenience).
- Enter the command `rccfg` to know which configuration is currently active.
- Enter the command `rccfg 1` to activate configuration #1, `rccfg 2` to activate configuration #2, or `rccfg 3` to activate configuration #3.

### 7.2.3 Using SpringCoreTool

- Download the SpringCore Tools SQ20029 ZIP archive from SpringCard’s web site:

<https://www.springcard.com/fr/download/find/file/sq20029>

Unzip the archive in a local directory. Open a console (shell) into this directory.

- Enter the command

```
SpringCoreTool [CONNECTION STRING] micore-get-config
```

to know which configuration is currently active.

(see § 6.2.2 , 6.2.3 , 6.3.2 or 6.3.3 for the understanding of [CONNECTION STRING]).

- Enter the command

```
SpringCoreTool [CONNECTION STRING] micore-set-config [NUMBER]
```

to activate configuration #[NUMBER].

## 7.2.4 Using your own software

An implementer who uses the M519 as the contactless core inside a “final” product may invoke the CTRL\_MICORE command during the manufacturing process.

## 7.3 Precautions for antenna integration

Do not place metal or conductive material between the coupler and the card.

*Rationale: Electro-magnetic field does not cross a conductor (shielding effect).*

Do not place metal or conductive material in the vicinity of the antenna, even if it is behind the antenna or on the sides.

*Rationale: The alternating magnetic field induces eddy currents (Foucault's currents) within conductors. These currents decrease the field level.*

Do not place another coupler in the vicinity of a coupler.

*Rationale: Collision of carrier makes the card unable to receive uplink communication. Out-of-phase induced currents may damage the transmitters.*

Do not place a display or an active electronic device in the vicinity of a coupler.

*Rationale: TFT displays, LCD screens, USB devices... may radiate unwanted electro-magnetic waves that are in the bandwidth of the NFC/RFID HF system.*

## 7.4 Designing your own antenna

Please refer to [PFT22217] “M519 Data Sheet and Integration Guide” and to the related Application Note.

## 8 Smart card daughter boards

The three smart card daughter boards that come with the kit must be placed (on at a time) on header **J14**.

When starting-up, the M519 uses the following algorithm to detect the smart card interface:

- If /SC\_IRQ is asserted (LOW level) at startup, then the presence of a smart card in direct connection is assumed (§ 8.3).
- If a NXP TDA8026 is found on the I<sup>2</sup>C bus, then this interface is activated (§ 8.1 ). SC\_CLK is activated at 16MHz to feed the TDA8026.
- If a NXP PCA9536 is found the I<sup>2</sup>C bus (but no TDA8026), then the presence of a TDA8035 is assumed (§ 8.2 ). SC\_CLK is activated at 4MHz to feed the TDA8035.
- If /SC\_IRQ is low and neither a TDA8026 nor a PCA9536 are found on the I<sup>2</sup>C bus, then the M519 totally disables its (contact) smart card subsystem.

**Warning:** Always totally unpower (unplug) the M519-SRK before changing or removing the smart card daughter board.

### 8.1 M-EXT-SC5 (ID-1 + 4 x ID-000 board, TDA8026)

NXP TDA8026 is an analog interface for addressing multiple smart card slots from a single controller.

SpringCard M-EXT-SC5 is a daughter board using the NXP TDA8026 as physical smart card interface. It features one ID-1 smart card slot and four ID-000 SIM/SAM slots.

For details, please consult the data sheet at NXP's:

<https://www.nxp.com/products/security-and-authentication/contact-readers/multiple-smart-card-slot-interface:TDA8026ET>

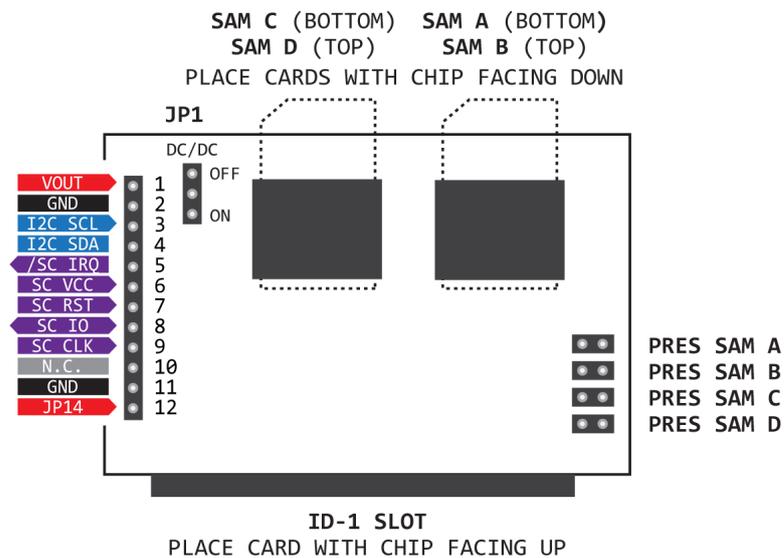


Illustration 11: M-EXT-SC5 drawing

### 8.1.1 ID-1 slot

The ID-1 slot is located under the board. Insert the smart card with chip facing up.

The ID-1 slot has a card presence switch, and the TDA8026 notifies the M519 in real-time (using /SC\_IRQ) every time a card is inserted or ejected from this slot. In PC/SC Coupler mode, this allows the M519 to notify the host immediately.

### 8.1.2 ID-000 slots

There are two groups of two ID-000 drawers for SIM/SAM cards (see illustration 11). The ID-000 drawers have no card presence switch; therefore, four jumpers are provided to tell the TDA8026 whether a card is present or not in the slot (“PRES SAM A”, “PRES SAM B”, etc).

The TDA8026 notifies the M519 in real-time (using /SC\_IRQ) every time a card is inserted or ejected from slot “SAM A” only. In PC/SC Coupler mode, this allows the M519 to notify the host immediately.

For slots “SAM B”, “SAM C” and “SAM D”, the presence of the card is read only during startup. Place the SAM card inside the slot and close the corresponding jumper before

powering-up the M519-SRK. Do not remove a SAM and do not open a jumper while the device is powered-up.

**Warning:** Since slots B, C or D have no real-time monitoring of the presence of the card, the card VCC supply will not be shut down when a card is ejected. This is likely to damage the card. Always totally unpower (unplug) the M519-SRK before manipulating (insert/eject) the cards in the B, C or D slots.

## 8.2 M-EXT-SC1 (ID-000, TDA8035)

NXP TDA8035 is a low-power, single-slot analog smart card interface.

SpringCard M-EXT-SC1 is a daughter board based on the NXP TDA8035 (and an NXP PCA9536 to drive the card power). This board features one ID-000 SIM/SAM slot.

For details, please consult the data sheet at NXP's:

<https://www.nxp.com/products/security-and-authentication/contact-readers/high-integrated-and-low-power-smart-card-interface:TDA8035HN>

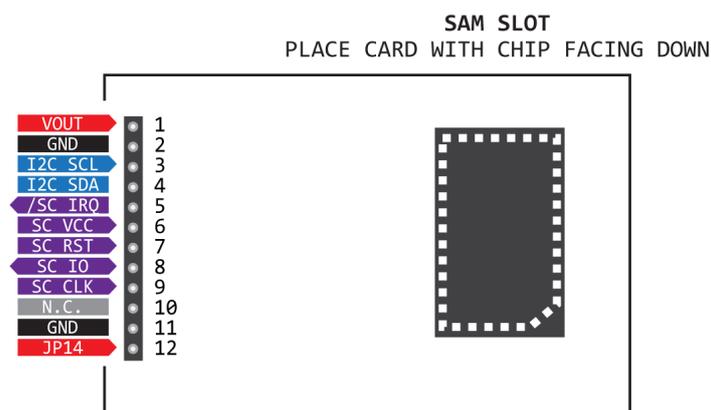


Illustration 12: M-EXT-SC1 drawing

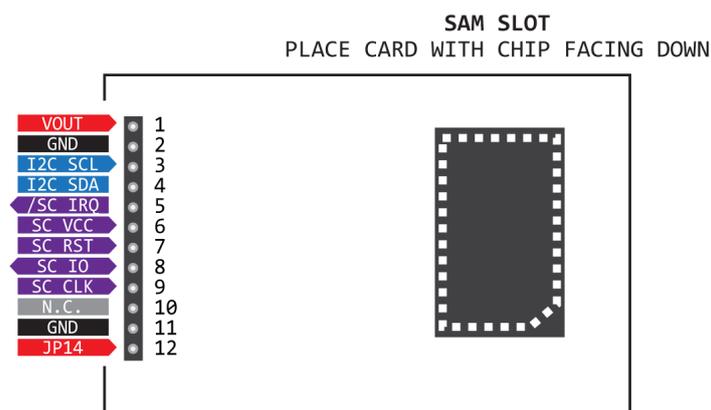
Pay attention that M-EXT-SC1 and M-EXT-DIR are made of the same PCB; they differ only in their BOM. Check the label to make sure you are using the right board.

There is a single hinged ID-000 drawer for a SIM/SAM card.

This drawer has a card presence switch, and the TDA8035 notifies the M519 in real-time (using /SC\_IRQ) every time a card is inserted or ejected from this slot. In PC/SC Coupler mode, this allows the M519 to notify the host immediately.

### 8.3 M-EXT-DIR (ID-000, direct connection)

SpringCard M-EXT-DIR is a daughter board that features one ID-000 SIM/SAM slot in direct connection to the smart card signals of the M519.



*Illustration 13: M-EXT-DIR drawing*

The presence switch of the slot connects /SC\_IRQ to the Ground when a card is inserted. The /SC\_IRQ is probed by the M519 upon startup to detect whether a smart card direct interface shall be enumerated, or not. Therefore, if a SIM/SAM card is present when the M519 starts, the slot is added to the list of PC/SC slots; if there is no card when the M519 starts, the list of slots remain empty.

Pay attention that M-EXT-DIR and M-EXT-SC1 are of the same PCB; they differ only in their BOM. Check the label to make sure you are using the right board.

The difference with M-EXT-SC1 is that the TDA8035 has a DC/DC and is able to operate the cards at either 5V (class A), 3.3V (class B) or 1.8V (class C), where only 3.3V (class B) cards can be operated with M-EXT-DIR.

Also the TDA8035 implements enhanced ESD (> 8kV) protection and a protection against short circuits/overcurrent, where there is nothing in M-EXT-DIR to protect the pins of the M519 module.

**Warnings:**

- Since this interface does not have a real-time monitoring of the presence of the card, the card VCC supply will not be shut down if the card is ejected. This is likely to damage the card and the M519. Always totally unpower (unplug) the M519-SRK before manipulating (insert/eject) the card in the slot.
- Make sure that the card works at 3.3V and will not drain too much power from SC\_VCC, SC\_RST, SC\_CLK and SC\_IO.

## 8.4 Designing your own smart card board

Please refer to [PFT22217] “M519 Data Sheet and Integration Guide” and to the related Application Note.

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