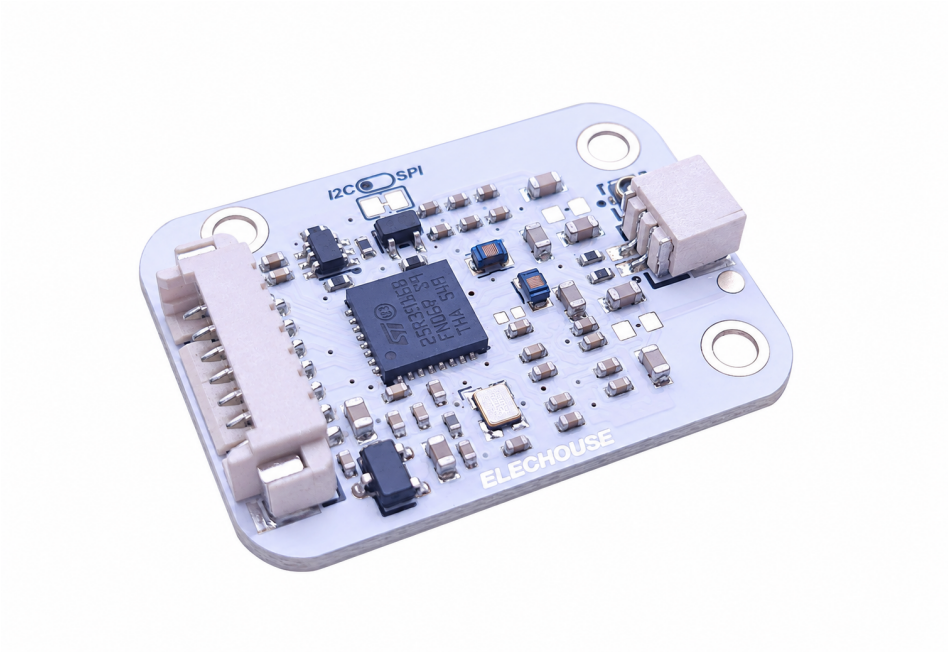
ST25R3916B Mini V2

Product Datasheet

13.56 MHz NFC reader module with external antenna



ST25R3916B Mini V2 product view. Refer to the following CAD views for connection and modification locations.

The ELECHOUSE ST25R3916B Mini V2 is a compact, single-antenna 13.56 MHz NFC reader module with I²C and SPI host interfaces. ST1.0 2P, spare IPEX and solder points share the same antenna network. Connect one external antenna at a time.

Main improvements in V2

Improvement	Benefit
More stable power supply	An improved power design provides more stable module operation.
I²C by default	Ready for I²C communication in the factory configuration.
Improved pull-up circuit	Reduced loading on SPI signals for more stable communication.
Spare IPEX antenna connector	An additional antenna connection option alongside the existing connector.

Approximately 27 × 20 mm · 3.3-5 V DC supply · Default I²C · Selectable SPI

02 Specifications and Version Comparison

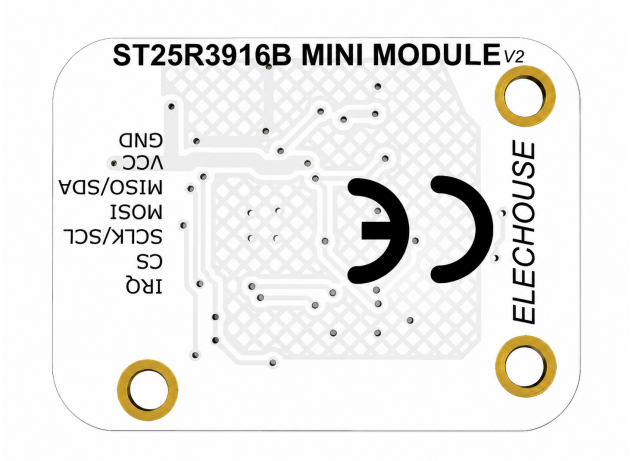
Parameter	Specification
Reader IC	ST25R3916B
Operating frequency	13.56 MHz
Reader protocols	NFC-A (ISO 14443A) / NFC-B (ISO 14443B) / NFC-V (ISO 15693)
Supply voltage range	3.3-5 V DC
Antenna architecture	Single antenna; all connection locations share one channel
Included antenna	52 × 5.5 mm / 700 nH FPC with anti-metal backing film; other antennas sold separately
Host interfaces	I²C (default) / SPI
I²C address	0x50 (7-bit)
I²C clock	100 kHz (recommended setting)
SPI mode	Mode 1 (CPOL=0, CPHA=1), MSB first
Maximum SPI clock	10 MHz
Digital interface level	Nominal 3.0 V; do not connect directly to 5 V GPIOs
Board size	Approximately 27 × 20 mm
Mounting holes	Three holes, approximately Ø2.11 mm diameter
Host connector	7 pins, 1.25 mm pitch
Antenna connections	ST1.0 2P connector, spare IPEX connector and solder points

Supply voltage and digital signal level are different. Check logic compatibility with the host before connection. Use short leads for high-speed SPI and meet the interface timing and load requirements.

Upgrading from V1 to V2

Item	Mini V1	Mini V2
Factory interface	SPI	I²C
Power and communication	Original design	Improved power and pull-up circuits; more stable SPI
Antenna connection	Existing antenna connector	Existing connector retained; spare IPEX added
Mechanical layout	Approximately 27 × 20 mm	Board size, holes and existing connector positions unchanged

03 Pinout and Host Connections



Rear view: left-side labels run from top to bottom as GND, VCC, MISO/SDA, MOSI, SCLK/SCL, CS and IRQ. CAD rendering.

Pin	Board label	I²C connection	SPI connection
1	IRQ	Host interrupt input	Host interrupt input
2	CS	Leave unconnected	Chip select, active low
3	SCLK / SCL	Host SCL	Host SCLK
4	MOSI	Leave unconnected	Host MOSI
5	MISO / SDA	Host SDA	Host MISO
6	VCC	3.3-5 V DC input	3.3-5 V DC input
7	GND	Host ground	Host ground

Connection notes

Switch off the module and host before wiring. Connect their grounds together and verify the cable order against the board labels rather than cable colors. IRQ is an active-high interrupt output and should connect to a host input.

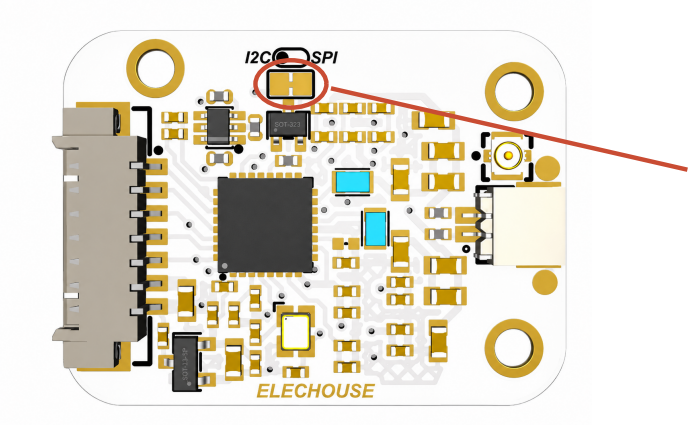
The module includes I²C pull-ups; additional pull-ups are normally unnecessary. Avoid driving signal lines while the module is unpowered.

VCC is the power input and does not determine the permitted signal voltage. Use suitable level shifting with a 5 V host, and check input/output compatibility with a 3.3 V host as well.

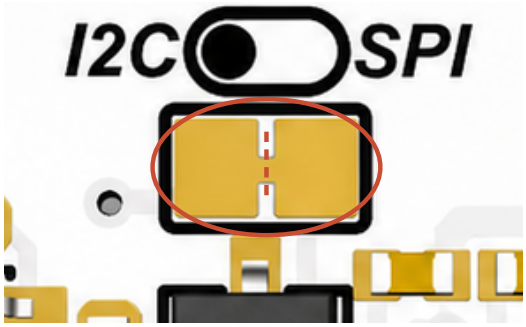
04 Changing from I²C to SPI

The module ships in I²C mode. To select SPI, cut the thin copper bridge between the two jumper pads below the I2C / SPI marking on the front. The dashed red line in the enlarged view marks the cut location.

1 Locate the mode jumper



2 Cut the thin bridge



Dashed red line = cut location

Power off first; verify the cut

I²C · Factory closed



Keep the copper bridge

SPI · Bridge cut



Verify bridge is open

I²C · Solder restored



Bridge pads with solder

Procedure

1. Disconnect power to the module and host and secure the board on a stable work surface.

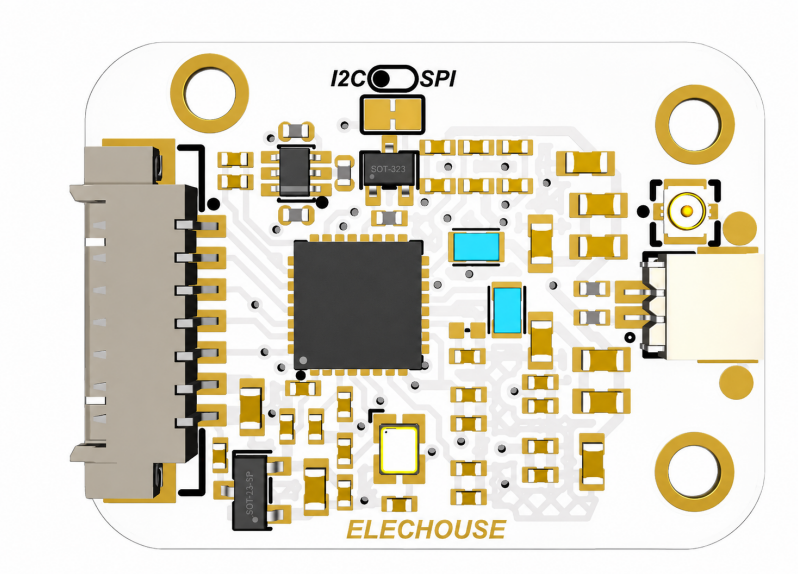
2. Use a sharp hobby knife to make light passes across the thin copper bridge at the marked cut, until it is severed. Avoid gouging the board or nicking adjacent traces.

3. Remove debris and, with power still off, use a multimeter to confirm the two pads are no longer connected by a near-zero-resistance bridge.

4. Connect the SPI signals, power up again and select SPI Mode 1 in the software.

To restore I²C, disconnect power, bridge the two pads with a small amount of solder, verify continuity and power-cycle. The enlarged and connection-state drawings are illustrative. Modify only the indicated bridge.

05 Antenna Connections and Installation



Front view: the round connector at the right is the spare IPEX; the white connector is the ST1.0 2P antenna connector. CAD rendering.

Connection	Use
ST1.0 2P antenna connector	Connect a matching external antenna; location unchanged from V1.
Spare IPEX antenna connector	An alternative connection for a compatible antenna cable.
Antenna solder points	For custom antennas or direct soldered connections.

V2 is a single-antenna version. ANT1 / ANT2 are the two terminals of one antenna. ST1.0 2P, IPEX and solder points share this pair; connect one antenna only. The IPEX outer contact belongs to the antenna network, not power ground, and must not be connected to GND.

Default antenna and options

The included antenna is a 52 × 5.5 mm / 700 nH FPC type with anti-metal backing film. Other antennas are sold separately, and custom sizes are available. Optimization for a specified antenna, tag or combination is a customization service evaluated for the application.

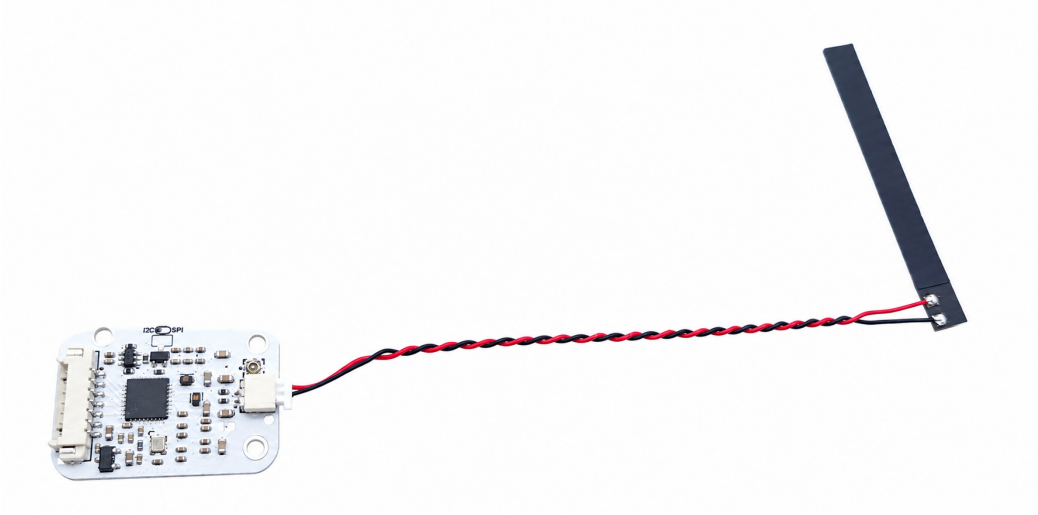
Purchase alternative antennas for evaluation:
https://www.elechouse.com/product/13-56mhz-nfc-rfid-flexible-antenna-10-pack/

The linked product supplies 10 pieces of one selected antenna type, with 10 cm bare wire leads and no connector fitted. Solder or adapt the connection as appropriate. The general matching configuration is not optimal for every antenna; verify performance with the selected antenna and device.

Disconnect power before connecting or changing the antenna. Avoid metal obstruction and strong interference sources, confirm cable routing before fastening, and verify the reading and writing area in the final device.

06 External Antenna Examples

The included antenna is a 52 × 5.5 mm FPC type with anti-metal backing film. Other antennas are sold separately. Choose the shape and size for the enclosure and target card, connecting one antenna at a time. The images use different scales and are not dimensional drawings.



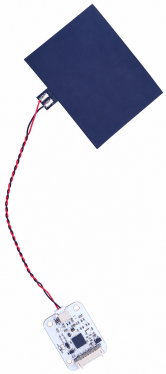
Default antenna: 52 × 5.5 mm / 700 nH



Large PCB antenna example



Round antenna example

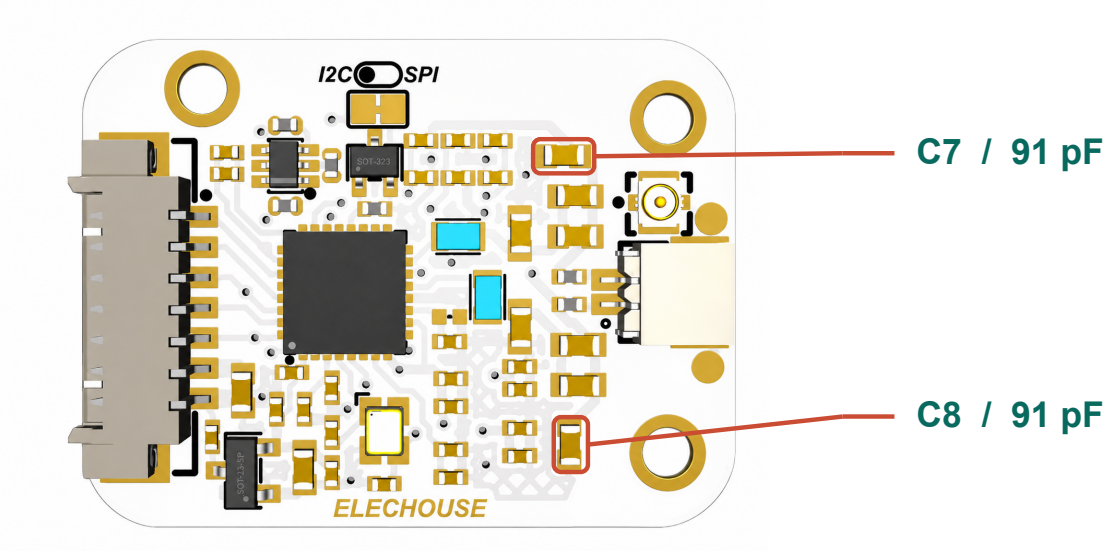


Rectangular antenna example

Included antenna: 52 × 5.5 mm / 700 nH FPC with anti-metal backing film. Other antennas are sold separately. Custom sizes and optimization for a specified antenna or tag are customization services.

07 Antenna and Tag Customization

C7 and C8 both form part of the same single-antenna matching network. The general matching configuration is not optimal for every antenna. Adjust the two capacitors below when optimizing for a specified antenna.



Front CAD rendering · Red boxes identify the two matching capacitors

Location	Default value	Purpose
C7	91 pF	Antenna matching adjustment
C8	91 pF	Antenna matching adjustment

Adjustment and service

Changing C7 and C8 can optimize matching for a particular antenna. Choose values for the antenna, cable, tags and installation rather than antenna size alone. After modification, recheck reading, writing distance and operating current.

The module can be optimized for different antennas, tags or a specified combination. This is a customization service requiring antenna/tag specifications, target range and installation details for evaluation. Custom antenna sizes are also available.

C7 / C8 identify only the two physical locations on this page. The image is a CAD rendering. Both default to 91 pF; no single replacement pair is recommended for every antenna. Component replacement requires power off and appropriate soldering skills.

08 Read/Write Range by Antenna and Tag

Distances and dimensions in mm

The table records V2 results with eight antennas and six card/tag types. The antenna-tuning results have been updated. All numbers are read/write distances. NC means no valid read/write distance was recorded; it is not zero.

Antenna (mm)	S50 Ø25	ISO 15693 Ø25	S50 85 × 55	ISO 15693 85 × 55	ISO 14443B 85 × 55	NTAG213 6 × 17
52 × 5.5 FPC (default)	25	35	45	65	6	10
311 × 215 × 0.8 PCB	40	130	200	260	110	NC
283 × 187 × 0.8 PCB	70	140	200	320	100	NC
50 × 40 FPC	55	60	105	140	50	20
40 × 20 FPC	30	38	40	55	5	9
25 × 10 FPC	5	20	5	20	12	18
Ø27 FPC	20	45	50	32	25	18
Ø13 FPC	10	10	10	40	NC	10

After tuning, the 311 × 215 mm and 283 × 187 mm PCB antennas have read/write ranges of 110 mm and 100 mm respectively with 85 × 55 mm ISO 14443B cards.

Antenna and tag conditions

Neither the 311 × 215 mm nor the 283 × 187 mm PCB antenna has anti-metal backing film. All six FPC antennas have the film fitted.

The Ø25 S50 is a round MIFARE S50 tag. The NTAG213 is a 6 × 17 mm anti-metal tag. The specific ISO 15693 tag ICs are not identified.

Choose for the target card

The included 52 × 5.5 mm FPC antenna with anti-metal backing film appears in the first row. Other antennas are sold separately. Select for card size, protocol and required distance, then verify performance in the final installation.

These results are selection references for the listed combinations, not guaranteed distances for every card or installation. Supply voltage, test position, firmware version and actual test date are not specified in the source record. Recheck after changing cables, backing film or installation.

09 Power Supply and Consumption

3.3-5 V DC supply

Connect the positive supply to VCC and ground to GND, with a common module/host ground. Use a stable DC source and allow current headroom for RF operation and startup. Digital IO is nominally 3.0 V and must not connect directly to 5 V GPIOs.

Typical consumption (V1 reference data)

The values below are retained from Mini V1 measurements with a 5 V input, SPI interface and external antenna. They cover only the module input, excluding host and USB consumption, and serve as power-planning references for V2.

Operating state	Mean current	Mean power
Initial power-down	8.58 µA	0.0427 mW
Card-present polling (250 ms interval)	27.12 mA	129.99 mW
Sustained RF field	187.33 mA	881.81 mW
Repeated UID reading (20 ms interval)	101.28 mA	480.89 mW
Return to power-down	8.00 µA	0.0398 mW

The V1 records show about 8-9 µA mean power-down current, 187.33 mA mean sustained-RF current, and a maximum observed current of 189.57 mA at 100 Hz sampling. These are not guaranteed V2 limits or simultaneous power results for the new antenna-range tests.

Low-power use and supply selection

The sleep references apply to the V1 SPI test conditions and are not a sleep-current specification for V2 in default I²C mode. Antenna, RF drive, polling interval and interface mode affect actual current. Measure the intended configuration for battery-powered applications.

Keep supply leads short and contacts secure. For resets or intermittent communication, check module voltage, grounding and wiring, then reduce bus speed for diagnosis. Do not use mean current as the maximum supply-current requirement.

10 Quick Start 1: Download and Install

Prepare Arduino IDE and the Espressif ESP32 board package. This guide uses an ESP32-S3 host with the module in its factory I²C mode.

Software download links

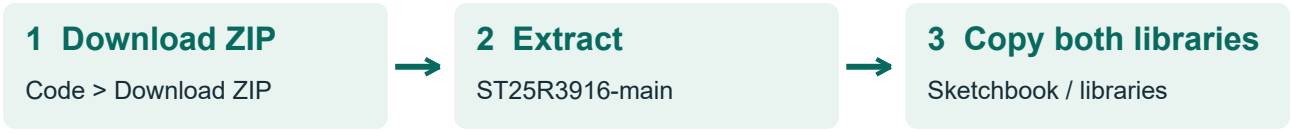
Arduino IDE download: https://www.arduino.cc/en/software/

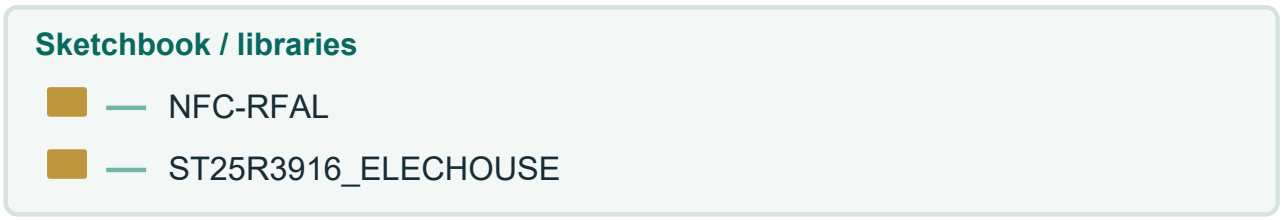
ESP32 board package installation: https://docs.espressif.com/projects/arduino-esp32/en/latest/installing.html

Software repository and instructions: https://github.com/wilson-elechouse/ST25R3916

Download the complete ZIP: https://github.com/wilson-elechouse/ST25R3916/archive/refs/heads/main.zip

Dedicated I²C example directory: https://github.com/wilson-elechouse/ST25R3916/tree/main/ST25R3916_ELECHOUSE/examples/I2C





Install both library folders

1. Download and extract the ZIP, then open the extracted ST25R3916-main folder.

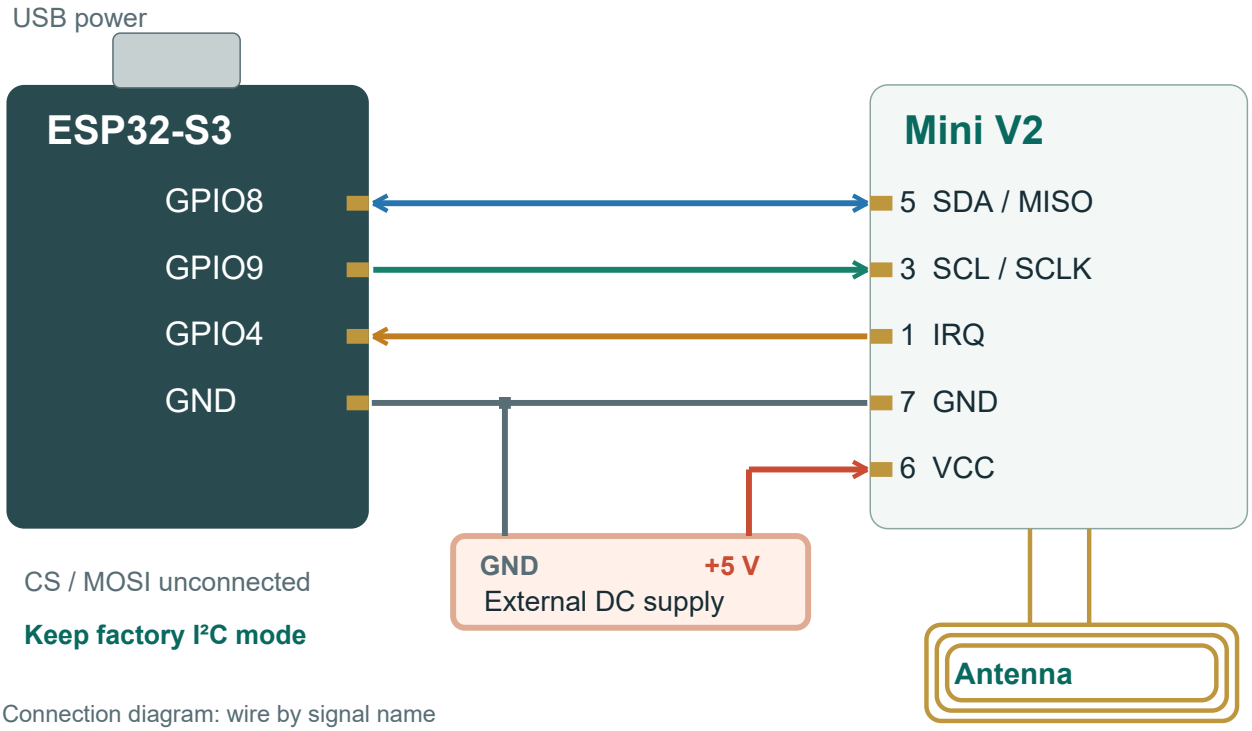
2. Copy the complete NFC-RFAL and ST25R3916_ELECHOUSE folders into the libraries folder inside your sketchbook.

3. Find the sketchbook location in Arduino IDE Preferences. Create its libraries folder if necessary, then restart the IDE after copying.

Copy the two library folders from inside the archive; ST25R3916-main itself is not a single Arduino library.

11 Quick Start 2: I²C Wiring

Connect the ESP32-S3 and Mini V2 as shown. The host is powered by USB and the module by an external 5 V DC supply; their grounds must be common. Switch off all power before wiring.



Connection diagram: wire by signal name

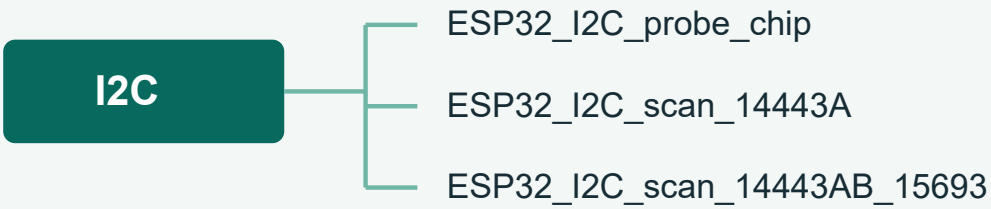
ESP32-S3 / supply	Mini V2 signal	Module pin
GPIO8	SDA / MISO	5
GPIO9	SCL / SCLK	3
GPIO4	IRQ	1
External +5 V	VCC	6
Host ground and supply negative	GND	7
Leave unconnected	CS / MOSI	2 / 4

This is a connection diagram, not a physical pin-layout drawing. Wire by the rear-side signal labels and pin table. Connect one antenna only. No LED connection is required for this guide.

12 Quick Start 3: Select an I²C Example

Open a dedicated sketch from the I²C directory. These sketches already initialize I²C; there is no library-wide SPI/I²C switch to change. Edit the sketch pin settings only if your wiring differs.

ST25R3916_ELECHOUSE / examples



Example folder	Purpose
ESP32_I2C_probe_chip	First connection check: inspect the 0x50 acknowledgement and initialization result.
ESP32_I2C_scan_14443A	Detect ISO 14443A tags, such as S50 and NTAG.
ESP32_I2C_scan_14443AB_15693	Multi-protocol discovery; choose this for SLIX2 / ISO 15693.

In Arduino IDE, choose File > Open. Browse to an example folder under ST25R3916_ELECHOUSE/examples/I2C and open its matching .ino file. Run probe_chip first, then open the appropriate reader example.

ESP32-S3 settings

Sketch setting	Value for this diagram	Meaning
kPinSda	8	Data on GPIO8
kPinScl	9	Clock on GPIO9
kPinIrq	4	Interrupt input on GPIO4
kI2cClockHz	100000UL	100 kHz
kI2cAddress	0x50U	Keep the default address

With an ESP32-S3 board selected and this wiring, these are already the sketch defaults. For other GPIOs, edit kPinSda, kPinScl and kPinIrq in the ESP32-S3 branch near the top of the sketch, keeping code and wiring consistent.

13 Quick Start 4: Upload, Read and Troubleshoot

Upload and open the serial monitor

1. Under Tools > Board, select the actual ESP32-S3 board, such as ESP32S3 Dev Module, and select its port.

2. Check that the sketch pins match the wiring, upload ESP32_I2C_probe_chip and set the serial monitor to 115200 baud.

3. Confirm acknowledgement at 0x50 and successful initialization. This sketch checks communication only; it does not poll cards.

4. Open and upload the selected I²C reader example. Present a supported tag to the antenna and read its type and UID in the serial monitor.

Expected serial output · 115200 baud

```
probe:   endTransmission() = 0 (ACK)
         rfalInitialize() = ERR_NONE (0)
scan:    I2C ACK probe (0x50): 0    ISO14443A ID: <UID>
```

For ISO 15693 tags, the multi-protocol example prints ISO15693 ID. UID contents and length depend on the tag. Use serial output to confirm detection; no particular host-board LED is required.

Troubleshooting

Symptom	Action
Library / header not found	Check that both libraries are directly inside libraries without an extra wrapper folder, then restart the IDE.
No acknowledgement at 0x50	Check SDA/SCL order, power, common ground and the factory I²C mode.
Probe passes but no tags	The probe does not poll tags. Upload a scan example for the tag protocol, check the antenna and move the tag closer.
Initialization fails	Check IRQ wiring, board selection and sketch pins, then power-cycle.