ST25R3916B NFC Module

High-performance 13.56 MHz NFC and HF RFID reader module with onboard PCB antenna, default SPI interface, optional I2C mode, and ST25R3916 variant comparison.

READER IC **ST25R3916B**	RF BAND **13.56 MHz NFC / HF RFID**
HOST INTERFACE **SPI default, I2C after solder bridge**	SUPPLY INPUT **5 V module input**
PCB SIZE **42.81 mm x 40.26 mm**	ANTENNA **Integrated PCB loop antenna**

Document version: V0.3 Draft
Updated: 2026-07-18
Primary SKU: NFC_ST25R3916B

Variant family: ST25R3916 and ST25R3916B modules
Product page: www.elechouse.com/product/st25r3916b-nfc-module/

1. Overview

The ELECHOUSE ST25R3916B NFC Module is a compact high-performance NFC and HF RFID reader module based on the STMicroelectronics ST25R3916B reader IC. It is designed for embedded NFC reader projects that need strong RF performance, ISO 15693 / NFC-V support, ISO 14443A/B support, FeliCa support, and direct MCU control through SPI or I2C.

The module includes an onboard PCB antenna and RF matching network. The default host interface is SPI. I2C operation is available by solder-bridging the onboard pad marked I2C. The ST25R3916B version uses the newer B-series reader IC and updated active wave shaping (AWS) capacitor arrangement.

> This is a module-level datasheet. It does not replace the STMicroelectronics ST25R3916B chip datasheet. Final product performance depends on host firmware, antenna environment, enclosure, nearby metal, cable routing, and production validation.

2. Product Variants and Hardware Differences

The ST25R3916 and ST25R3916B modules use the same PCB layout family and very similar module-level design. The populated reader IC and selected RF/AWS-related component values differ between variants.

Item	ST25R3916 NFC Reader Module	ST25R3916B NFC Module
SKU	NFC_ST25R3916	NFC_ST25R3916B
Reader IC	STMicroelectronics ST25R3916	STMicroelectronics ST25R3916B
Chip generation	Original ST25R3916 generation	Newer B-series generation
PCB layout family	Same PCB layout family	Same PCB layout family
EMVCo target	EMVCo 3.0 analog and digital at chip level	EMVCo PCD L1 3.2a analog and digital at chip level
ASK modulation depth	5% to 40%	0% to 82%
AWS / VDD_AM hardware setup	Original ST25R3916 AWS / overshoot-undershoot setup	Enhanced B-series AWS design; do not place 2.2 uF on VDD_AM; C18 removed
C17	10 nF	22 nF
C18	Original ST25R3916 BOM option	Not populated / removed for ST25R3916B AWS setup
Host interface	SPI by default; solder-bridge the onboard I2C pad to select I2C mode	SPI by default; solder-bridge the onboard I2C pad to select I2C mode
Software library	ELECHOUSE ST25R3916 software family	Same ELECHOUSE ST25R3916 software family
Recommended choice	Existing ST25R3916 projects or designs already validated with the original module	New designs that prefer the newer B-series reader IC and updated AWS hardware setup

3. Module Specifications

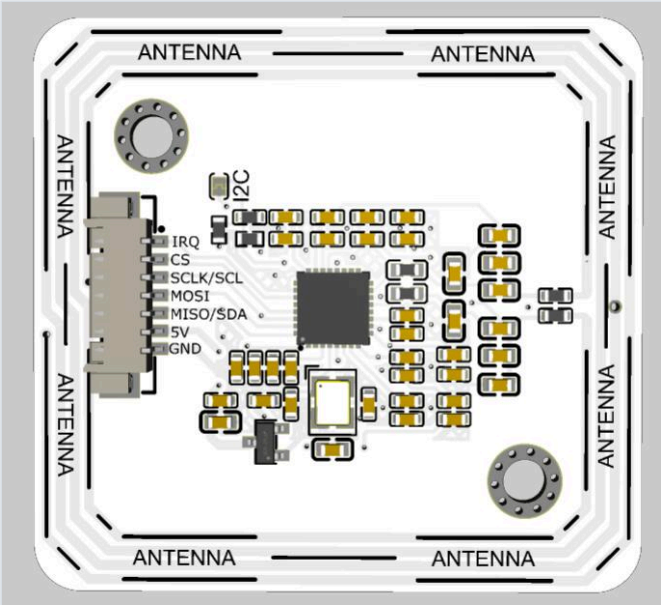
Parameter	Value / Recommendation
Product name	ELECHOUSE ST25R3916B NFC Module
Reader IC	STMicroelectronics ST25R3916B
Operating frequency	13.56 MHz NFC / HF RFID band
Host interface	SPI by default; solder-bridge the onboard pad marked I2C to select I2C mode
Supply input	5 V module input
Host logic recommendation	3.3 V host logic recommended for quick start and ESP32 examples
Antenna	Onboard PCB antenna with RF matching network
Supported reader technologies	ISO 14443A/B, ISO 15693 / NFC-V, FeliCa / NFC-F, NFC Forum Type 1-5 tag technologies, depending on host software stack
Card emulation at IC level	NFC-A and NFC-F card-emulation support. Application behavior requires host firmware and protocol-stack implementation.
PCB dimensions	42.81 mm x 40.26 mm
Connector / cable	MX1.25 7P board connector, 1.25 mm pitch. Matching cable / housing: JST1.25 7P or equivalent.
2D mechanical file	DXF, AutoCAD 2007 format. Download 2D dimension file
Product weight	0.04 kg shipping/product-page reference
Operating temperature	-30°C to +85°C
Storage temperature	-40°C to +85°C
Operating humidity	20% to 90% RH, non-condensing
Storage humidity	5% to 90% RH, non-condensing. Store in ESD shielding bags in a dry, temperature-controlled environment.
Compliance	CE and RoHS certificate packages are available from the ELECHOUSE product resources.

4. Connector Pinout

The module uses an MX1.25 7P board connector. The same physical pins are used for SPI and I2C-mode wiring, with function changes after I2C mode configuration.

Connector Item	Specification / Compatible Reference
Board connector	MX1.25 7P / 1.25 mm pitch SMT board connector, 7-pin. Compatible reference: Molex PicoBlade 53398-0771 or equivalent.
Matching cable / housing	JST1.25 7P / 7-pin matching housing. Compatible reference: Molex PicoBlade 51021-0700 or equivalent with pre-crimped terminal wires.
Related PN716x module reference	Same connector family as the ELECHOUSE PN716x module datasheet, changed from 8P to 7P for this module pinout.

Pin	Signal	SPI Function	I2C Function
1	IRQ	Interrupt output	Interrupt output
2	CS / BSS	SPI chip select, active low	Not used for standard I2C wiring
3	SCLK / SCL	SPI clock	I2C clock
4	MOSI	Host-to-module SPI data	Not used for standard I2C wiring
5	MISO / SDA	Module-to-host SPI data	I2C data
6	5V	Module power input	Module power input
7	GND	Ground	Ground



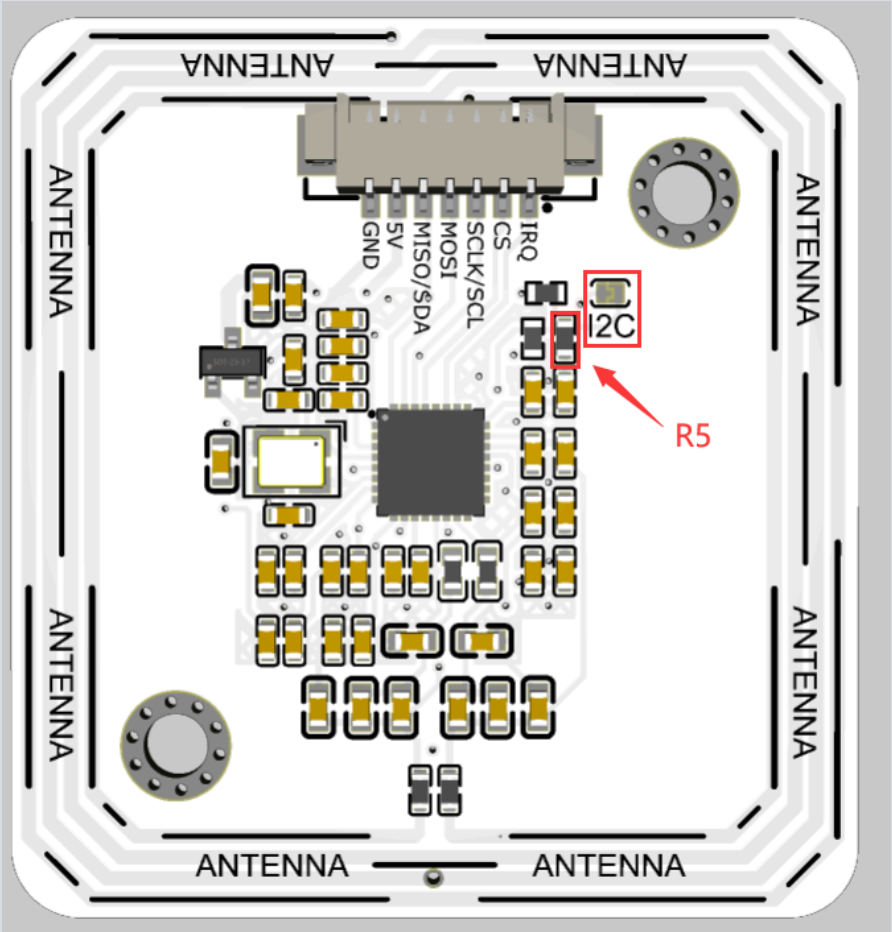
Connector-side reference. Pin order must be checked against the actual board orientation during carrier-board design.

5. Power Supply and Interface Mode

Item	Requirement / Behavior
Module input	Use the 5V pin as the module supply input. The module includes onboard regulation for the reader IC I/O supply domain.
Host logic	3.3 V host logic is recommended for ESP32 and typical embedded MCU bring-up.
Default interface	SPI mode is the default quick-start mode.
I2C mode	Solder-bridge the onboard pad marked I2C before using I2C examples. Without this solder bridge, the module remains in default SPI mode.
I2C pull-ups	SCL and SDA are pulled up to the onboard 3.3 V rail in I2C mode.
I2C low-power option	For minimum I2C-mode current, R5 can be removed after the I2C pad is solder-bridged. This reduces approximately 0.7 mA, about 2.3 mW at 3.3 V.

Item	Requirement / Behavior
IRQ	Connect IRQ to a host GPIO interrupt input for RFAL polling flows and low-power wake-up applications.
Ground	Host and module must share a common ground.

> For first bring-up, use SPI mode and a known-good example from the ELECHOUSE ST25R3916 library. To use I2C, solder-bridge the onboard pad marked I2C first.



R5 location reference. In I2C mode, after solder-bridging the pad marked I2C, removing R5 can reduce the I2C pull-up related current by approximately 0.7 mA.

6. Power Consumption

6.1 Initial Summary

This revision replaces the earlier host-current subtraction estimates with a direct measurement at the module +5 V input. One ST25R3916B module was tested in default SPI mode at 100 samples/s while an independently powered ESP32-S3 controlled the operating states.

POWER-DOWN (VIN APPLIED)	READY, RF OFF	NORMAL UID POLLING	CONTINUOUS RF FIELD
~10 µA	**5.16 mA**	**24.34 mA**	**71.95 mA**
Observed complete-module input current	Mean at 4.957 V module input	Mean; card present; pulsed load	344.55 mW mean sustained load

> **Initial conclusion:** Power-down is a powered standby state, not physical disconnection of VIN, so a small nonzero current is expected. The complete module input current was approximately 10 µA. Ready mode is about 5.2 mA, and RF activity dominates consumption.

> Characterization data from one module sample, not production limits. The two Power-down capture means were 8.07 µA and 9.68 µA, but the meter's +5 digits term is significant at this level; use approximately 10 µA as the practical summary. The 100 Hz observed maxima can miss transients shorter than 10 ms.

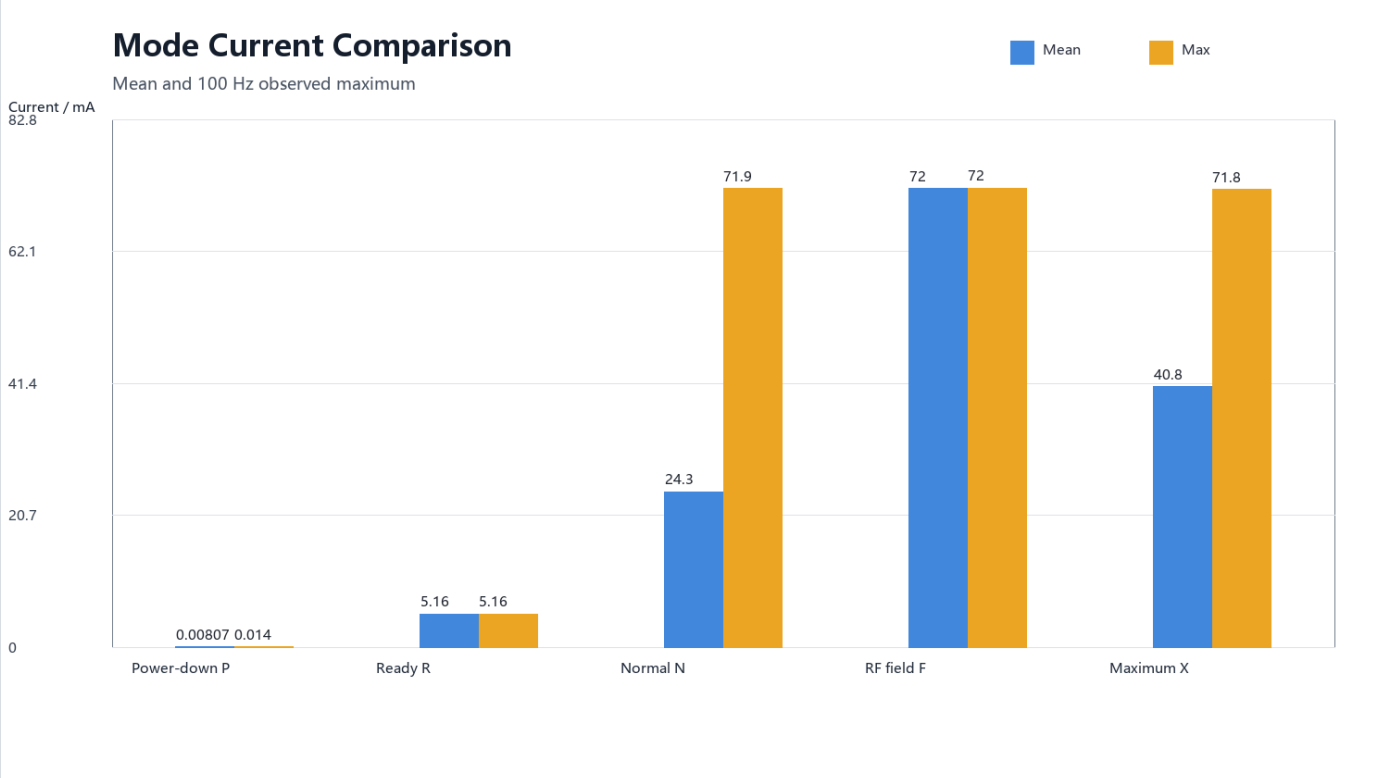


Figure 6-1. Direct-module mean current and observed maximum current. Power-down P is measured with the module +5 V input still applied; its microamp-level value is examined separately in Figure 6-3.

6.2 Detailed Mode Results and Waveform

Operating State	Mean Voltage	Mean Current	P95 Current	Observed Max	Mean Power	Observed Max Power
Power-down P (VIN applied)	4.9702 V	8.07 µA	10 µA	14 µA	0.040 mW	0.070 mW
Ready R, RF off	4.9571 V	5.159 mA	5.162 mA	5.164 mA	25.57 mW	25.60 mW
Normal N, card-present polling	4.8945 V	24.34 mA	71.42 mA	71.94 mA	117.74 mW	347.31 mW
RF field F, continuously on	4.7887 V	71.95 mA	71.99 mA	72.00 mA	344.55 mW	344.88 mW
Maximum X, repeated UID transactions	4.8531 V	40.83 mA	71.70 mA	71.83 mA	196.74 mW	343.20 mW
Return P verification (VIN applied)	4.9689 V	9.68 µA	12 µA	14 µA	0.048 mW	0.070 mW

Figure 6-2. Synchronized module input voltage, current, and power over the full test sequence. P denotes Power-down with VIN applied; N and X are pulsed UID workloads; F holds the RF field continuously on.

> The module input fell by about 181 mV from the first power-down capture to continuous RF field operation. This drop includes source, wiring, connector, and meter-shunt impedance and is not attributed to the module alone.

6.3 Power-down (VIN Applied) Detail

In this datasheet, **Power-down does not mean that the module supply is disconnected.** VIN remains applied while the ST25R3916B oscillator, RF functions, and main regulators are disabled. The device retains the low-power circuitry required for power-on reset and register-interface access, so a small static current is normal.

> **Why current remains:** the measured value is the complete module +5 V input current, not IC-only current. It can include ST25R3916B Power-down current, the quiescent current of the onboard 5 V-to-3.3 V regulator, board and interface leakage, and meter uncertainty. Near-zero input current requires removal of VIN and prevention of back-powering through the host interface pins.

Power-down was captured at the start and repeated after the active sequence. The mean results were 8.07 µA and 9.68 µA, with a 14 µA observed maximum. Because the meter's +5 digits term is material in this range, use approximately 10 µA observed rather than treating either mean as a precise specification.

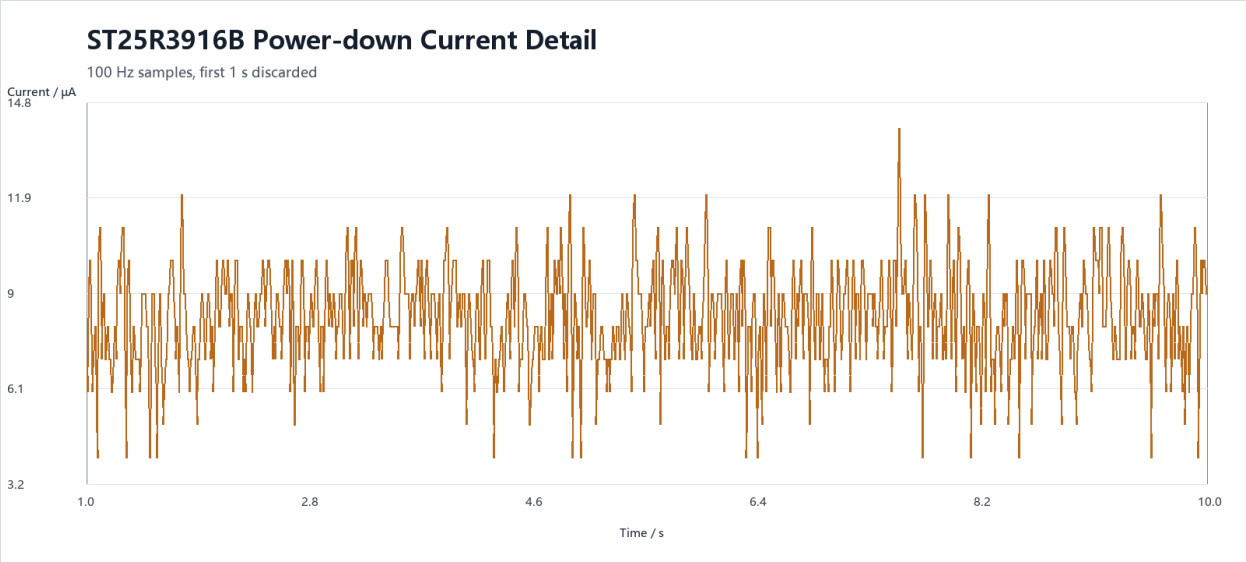


Figure 6-3. First power-down capture after discarding the first 1 s. Mean 8.07 µA; median 8 µA; P95 10 µA; observed range 4-14 µA.

6.4 Test Basis and State Definitions

The values in this chapter describe current drawn at the complete module's +5 V input. They include the NFC reader IC and the module-level power path; they are not interchangeable with IC-only limits measured under STMicroelectronics datasheet conditions.

Test Basis

DUT and interface	ELECHOUSE ST25R3916B NFC module, default SPI mode, onboard antenna
Supply measurement point	P5S1 v2.2 meter directly in series with the module +5 V input; host powered separately
Power-down definition	VIN applied; IC in Power-down state; not equivalent to supply removal or a hardware load switch being open
Sampling	100 Hz; 7,300 samples; median interval 10 ms; no CRC errors
Card and workload	ISO14443A card on the antenna during N and X; continuous successful UID reads with zero reported errors
Statistics window	First 1 s and final 0.2 s of each phase excluded from steady-state statistics
Meter accuracy note	Current accuracy specified as ±(0.1% + 5 digits); the digits term is significant relative to a roughly 10 µA reading

Low-Power State Comparison

State	VIN	What remains active	Current interpretation
Power-down P	Applied	Minimum standby circuitry, power-on reset, and register-interface access; no periodic card detection	Approximately 10 µA measured at this module's +5 V input
Autonomous Wake-up	Applied	Low-power RC oscillator and configured periodic amplitude/phase measurements	Not measured in this run; normally higher than pure Power-down and configuration-dependent
Supply off	Removed	Nothing, provided host-interface pins do not back-power the module	Not measured; this is the state normally associated with near-zero supply current

> **Design implication:** use Power-down when fast register access from a powered module is required. If the application requires essentially zero module current, disconnect VIN with a load switch and ensure SPI/I2C/GPIO pins cannot source current into the unpowered module.

7. Low-Power Wake-up

The ST25R3916B supports autonomous low-power wake-up using antenna-based amplitude and phase detection. In a battery-powered product, the recommended system approach is to keep the host MCU in sleep mode and let the ST25R3916B detect card approach, then wake the host through IRQ.

Mode	Behavior	Module Recommendation
Amplitude detection	Briefly turns on the RF field and detects amplitude/load change caused by nearby cards or tags.	Recommended basic autonomous wake-up path.
Phase detection	Measures phase shift caused by a nearby object or card in the antenna field.	Useful in more difficult RF environments when combined with amplitude detection.
Capacitive sensing	Supported at IC level on suitable pins/electrodes.	Do not advertise as a standard module feature unless the required electrodes are exposed and validated.

> Wake-up mode is not the same as Power-down: its low-power RC oscillator and periodic antenna measurements add average current. For battery-powered products, use IRQ to wake the host MCU and characterize the selected wake period and sensing configuration at module level.

8. NFC / RF Capabilities

The ST25R3916B reader IC provides broad 13.56 MHz NFC/HF RFID capability. Final feature availability depends on the host firmware, RFAL integration, and application protocol stack.

Protocol / Tag Family	Technology	Module Capability	Important Note
MIFARE Classic	ISO 14443A-based	Detection, UID, authentication/read/write when supported by library and keys	Requires correct keys and MIFARE Classic software support.
MIFARE DESFire EV1/EV2/EV3	ISO 14443A / ISO-DEP	Low-level ISO-DEP communication path	Secure file access requires APDUs, authentication, and key management.
NTAG 213/215/216	ISO 14443A / NFC Forum Type 2	Read/write with Type 2 tag software support	Write behavior depends on tag lock/password configuration.
ISO 14443B / Type 4B	ISO 14443B / ISO-DEP	Detection and ISO-DEP communication when software support is implemented	Payment applications require compliant EMV software and certification.
FeliCa / NFC-F	JIS X 6319 / NFC-F	Reader/writer capability at IC level	Application behavior depends on selected FeliCa service/system and host software.
ISO 15693 / NFC-V	ISO 15693	Inventory, UID, read/write with supported tags and examples	Reading distance depends heavily on tag antenna size and environment.
NFC-A / NFC-F card emulation	Card-emulation modes	IC-level active load modulation support	NFC Forum Type 4 / HCE behavior requires host-side protocol stack.

9. Read Range Test Data

The ST25R3916 and ST25R3916B modules use the same PCB layout family and similar onboard antenna design. The following read-range table is used as module-family reference data. Values are typical observed results under ELECHOUSE test conditions and are not guaranteed minimum read distances.

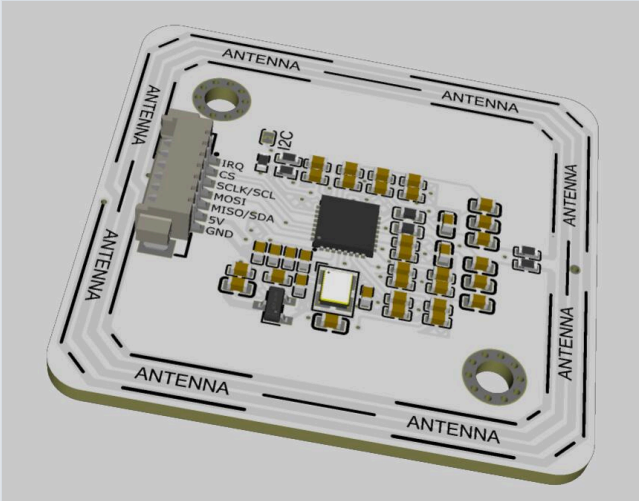
Tag / Card	Standard / Technology	Tag Size	Typical Read Range
Topaz 512	ISO 14443A / NFC Type 1	8.5 x 5.4 cm	5.5 cm
NTAG213	ISO 14443A / NFC Type 2	8.5 x 5.4 cm	6.5 cm
NTAG216	ISO 14443A / NFC Type 2	8.5 x 5.4 cm	6.5 cm
FeliCa	NFC-F / Type 3	8.5 x 5.4 cm	5.0 cm
MIFARE DESFire 4K/8K	ISO 14443-4A / Type 4	8.5 x 5.4 cm	2.8 cm
NTAG424 DNA	ISO 14443A / Type 4	8.5 x 5.4 cm	5.0 cm
ISO 14443-4B card	ISO 14443B / Type 4B	8.5 x 5.4 cm	2.3 cm
ICODE SLI-S	ISO 15693 / Type 5	8.5 x 5.4 cm	9.5 cm
ICODE SLIX2	ISO 15693 / Type 5	8.5 x 5.4 cm	11.0 cm
ICODE SLI-X	ISO 15693 / Type 5	8.5 x 5.4 cm	9.5 cm
Anti-metal MIFARE Classic tag	ISO 14443A	5 x 5 cm	2.2 cm
Anti-metal MIFARE Classic round tag	ISO 14443A	Dia. 3 cm	0.9 cm
Anti-metal NTAG213 tag	ISO 14443A	4 x 2.5 cm	2.2 cm
Anti-metal ISO15693 tag	ISO 15693	4 x 2.5 cm	2.3 cm

> Read range varies with tag antenna size, tag orientation, enclosure design, ferrite or shielding material, nearby metal, cable routing, firmware configuration, RF noise, and production tolerance.

10. Mechanical Information

Parameter	Value
PCB dimensions	42.81 mm x 40.26 mm
Original measurement	1685.5 mil x 1585 mil
2D mechanical file	DXF, AutoCAD 2007 format
3D model	Available from ELECHOUSE product download resources

2D mechanical file:
ST25R3916_ST25R3916B_NFC_Module_2D_Dimension_DXF.dxf



3D rendering reference. Use the official 2D/3D mechanical files for carrier-board layout and enclosure design.

11. Installation Guidelines

Condition	Recommendation
Metal behind the read-card area	For best antenna performance, keep metal vertically behind the read-card area at least 50 mm away. If less than 50 mm is unavoidable, add a ferrite absorber sheet and validate read range in the final enclosure.
Ferrite absorber sheet	Typical reference: 0.1-0.3 mm thickness, real permeability mu' about 60-150 at 13.56 MHz. Final material choice must be validated in the product enclosure.
Cable routing	Route the connection cable straight away from the connector and keep it outside the PCB antenna boundary when possible. If crossing the antenna area is unavoidable, cross at about 90 degrees. Avoid closed loops or bundled excess wire inside the active RF field area.
Card orientation	Place card/tag antenna parallel to the module antenna for best coupling. Small tags and anti-metal tags can have much shorter read range.
Card-specific tuning	For applications with a fixed card/tag type, strict read-distance requirements, or difficult RF installation, ELECHOUSE can provide card-specific matching and tuning as a customization service.
Initial bring-up	Use default SPI mode, short wiring, common ground, stable 5 V input, and a known supported tag.

12. Software and Resources

Resource	URL / Note
ST25R3916B product page	https://www.elechouse.com/product/st25r3916b-nfc-module/
ST25R3916 product page	https://www.elechouse.com/product/st25r3916_nfc_reader/

Resource	URL / Note
ST25R3916 documentation	https://www.elechouse.com/docs/st25r3916/
ESP32 SPI test guide	https://www.elechouse.com/docs/st25r3916-esp32-spi-test-guide/
ESP32 I2C quick start	https://www.elechouse.com/docs/st25r3916-esp32-i2c-quick-start/
GitHub library	https://github.com/wilson-elechouse/ST25R3916
Schematic reference	https://www.elechouse.com/wp-content/uploads/2026/01/st25r3916_schematic.pdf
3D dimension file	https://www.elechouse.com/wp-content/uploads/2025/04/ELECHOUSE_ST25R3916_3D.zip
2D dimension file	https://www.elechouse.com/wp-content/uploads/2026/07/ST25R3916_ST25R3916B_NFC_Module_2D_Dimension_DXF.dxf
CE certificate package	https://www.elechouse.com/wp-content/uploads/2026/06/ELECHOUSE_ST25R3916B_CE.zip
RoHS certificate package	https://www.elechouse.com/wp-content/uploads/2026/06/ELECHOUSE_ST25R3916B_ROSH.zip

13. Notes

- This datasheet describes the ELECHOUSE module and does not replace the STMicroelectronics chip datasheet.
- Chapter 6 power values are direct-module characterization data from one sample at the +5 V input. Power-down is a VIN-applied standby state, not physical disconnection of the module supply.
- Read-range values are typical observed reference values. They are not production test limits unless separately agreed for a specific project.
- ST25R3916 and ST25R3916B modules use the same PCB layout family. The ST25R3916B variant uses the B-series AWS hardware setup, including the C17/C18/VDD_AM changes described in this datasheet.
- Payment-terminal compliance is not implied by module-level chip capability. Final EMVCo or payment certification depends on the complete product design, antenna, enclosure, firmware, software stack, and lab testing.
- I2C mode requires solder-bridging the onboard pad marked I2C. SPI remains the recommended first bring-up path.

14. Revision History

Revision	Date	Description
V0.3 Draft	2026-07-18	Clarified Power-down as VIN-applied standby and added expected-current, module-path, measurement-uncertainty, supply-off, and Wake-up distinctions.
V0.2 Draft	2026-07-18	Added direct-module 100 Hz power characterization and the three-page Chapter 6.
V0.1 Draft	2026-07-08	Initial ST25R3916B NFC Module datasheet draft.