NFC / RFID
ST25 product overview

MMY Division

June 2019

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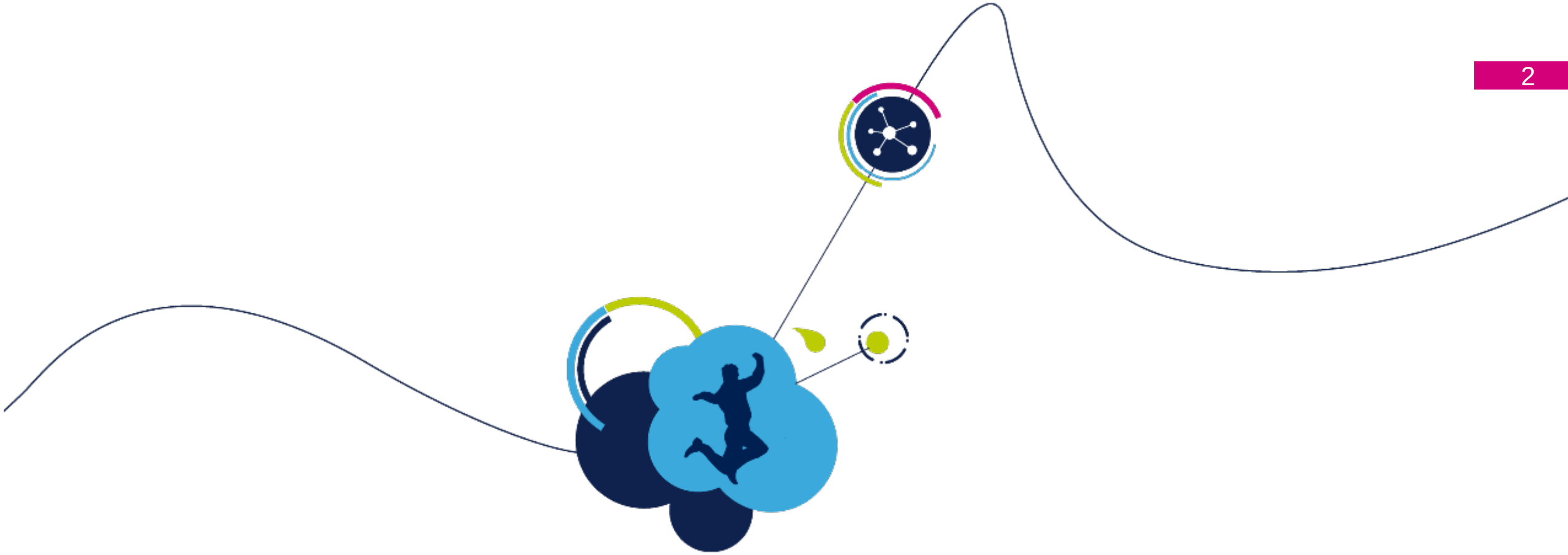


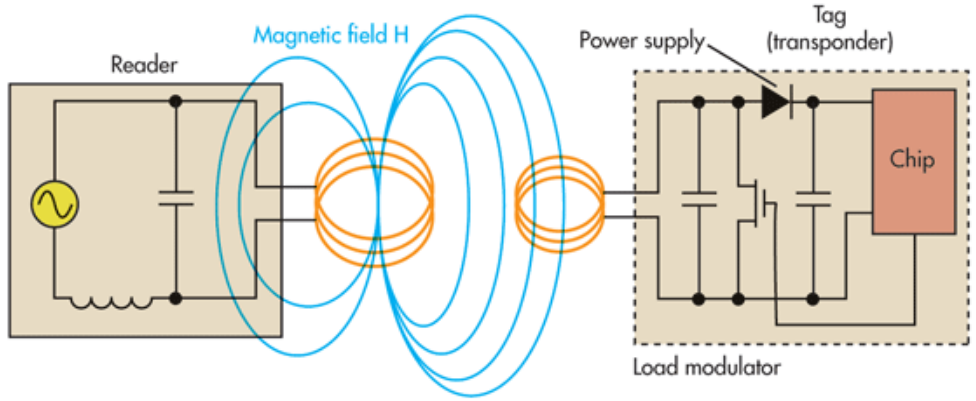
What is NFC?

Radio Frequency IDentification

RFID is a short range contactless communication technology

Employs an active reader/writer and a passive tag/transponder

- LF & HF readers use inductively coupled magnetic fields to power and communicate with the tag.
- UHF readers use electromagnetic (radio) waves and “backscattering” to power and communicate with the tag



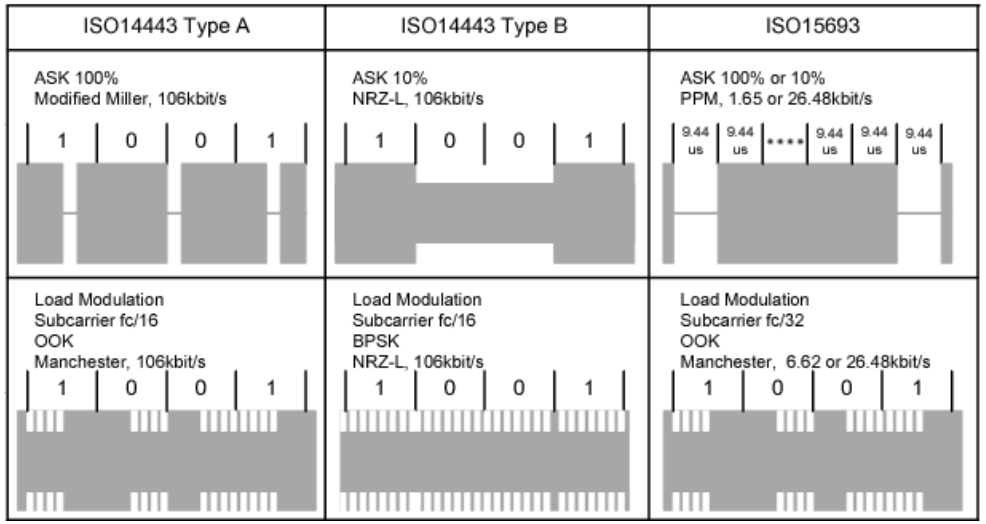
Operating Range and Frequency Bands

Proximity (few cm) or Vicinity (1m)

- Low Frequency (LF): 120-150 KHz
- High Frequency (HF): 13.56 MHz

Long Range (up to 10M)

- Ultra-High Frequency (UHF): 433 to 960 MHz



NFC Technology at a Glance

An interactive technology enabling engagement with IoT devices

- Near Field Communication, a short range wireless technology
  - Operating at 13.56MHz
  - Based on the RFID HF standard (ISO14443 & ISO15693)
- Interactive and zero power, enabling convenient connection to the Internet of Things

➔ NFC-enabled mobile phone can engage with items by a simple tap

- NFC is maintained by the NFC Forum
  - Ensures Interoperability between devices
  - Standardized use cases (web link, Bluetooth handover,…)
- Fast growing deployment in Mobile phone
  - In 2018, two in three phones to come with NFC
  - NFC is used for ApplePay, and in 2017 Apple added support of NFC reader mode from iOS11 onward. In iOS 12 it is in the OS and can run as a background task

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NFC in Depth

- Requires an action such as bringing your card/phone near the reader in order to use
- NFC operating modes
  - Read/Write (reader-to-passive tag/card)
  - **Card Emulation (e.g. Apple Pay, Android Pay, Samsung Pay)**
  - **Peer-to-Peer (e.g. reader-to-reader, phone-to-phone)**
- Maximum data transfer rate is 424 kbps
  - Tags are typically 106 kbps or 26 kbps
  - Proprietary reader-to-reader modes can go +6 Mbps
- Applications include Bluetooth/WiFi pairing, access control, payments, electronic passports, ticketing
- Various combinations of memory and security
- Standards and specifications
  - ISO14443A, ISO14443B, Sony FeliCa, ISO15693

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NFC Forum Tag Types

ST Tags

	Type 1	Type 2	Type 3	Type 4	Type 5
Products	BROADCOM “Topaz”	NXP NTAG MIFARE	SONY “FELICA”	ST25T(A&B) NXP DESFire	ST25TV NXP iCode
Specification	ISO 14443-A	ISO 14443-A	JIS X 6319-4	ISO 14443-A/B	ISO15693
Data Rate	106 kbit/s	106 kbit/s	212/424 kbit/s	106-424 kbit/s	26kbit/s
Protocol	Specific command Set	Specific command Set	FeliCa protocol	ISO 14443-4 ISO 7816-4	ISO/IEC 21481
Cost	Low	Low	Moderate	Moderate	Low
Use cases	Tags with small and fixed memory for single applications		Flexible tags with larger memory offering multi-application capabilities.		Long range tags with multiple applications
Memory type	Memory cards		CPU cards/Memory Cards0		Memory Cards

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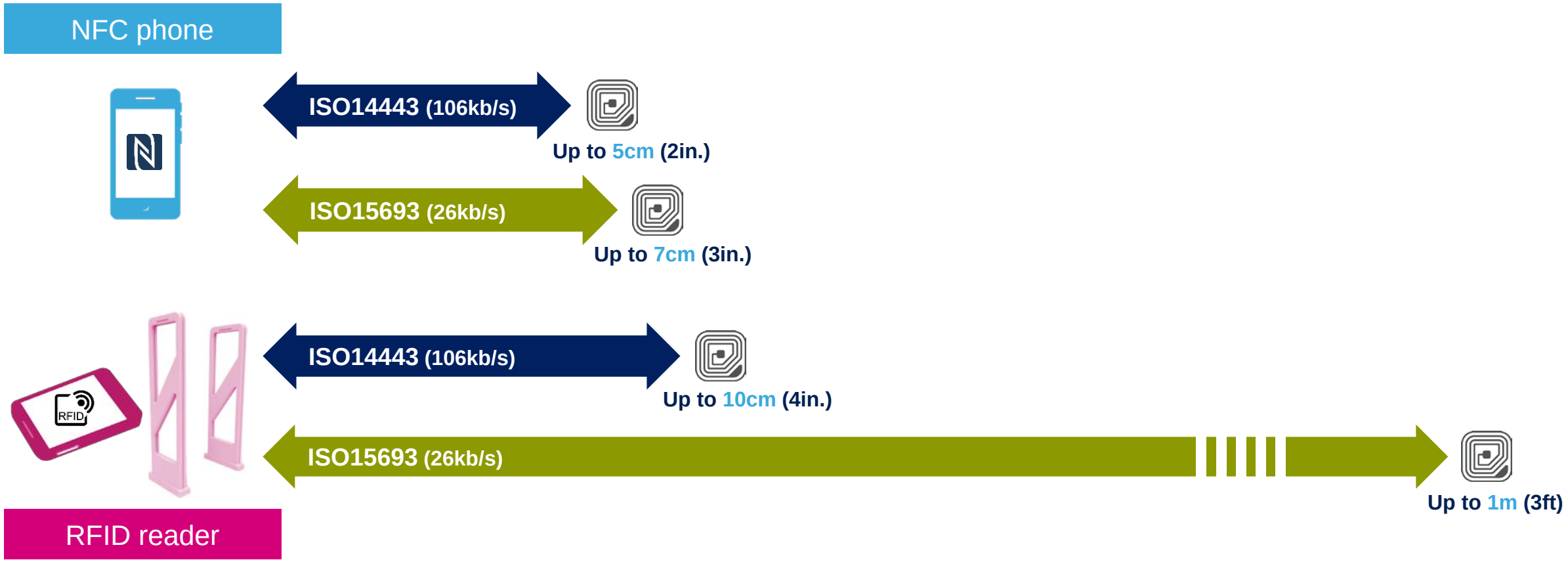
Typical NFC / RFID range



- ISO14443 is called « **short range** » standard while with higher RF speed
- ISO15693 is called « **long range** » standard

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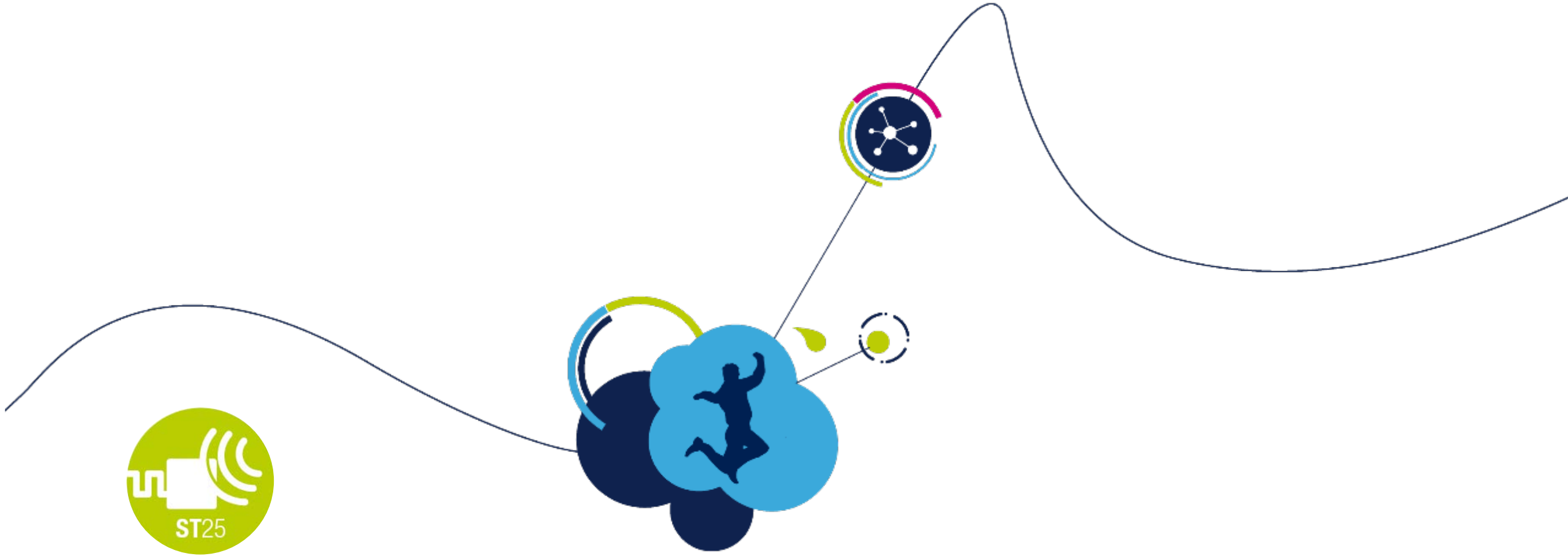

ST25 Series Overview

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ST25 Portfolio

One-stop-shop for Tags and Readers

Tags			Dynamic Tags			HF Readers			UHF Readers
ST25TA	ST25TB	ST25TV	M24SR	ST25DV I2C	ST25DV PWM	ST25R95	ST25R3911B ST25R3912 ST25R3913	ST25R3916	ST25RU3993
ISO14443-A 106kbps NFC Type 4	ISO14443-B 106Kbps	ISO15693 up to 53Kbps NFC Type 5	ISO14443-A 106kbps NFC Type 4	ISO15693 up to 53kbps NFC Type 5	ISO15693 up to 53kbps NFC Type 5	ISO14443-A/B ISO15693	ISO14443-A/B Felica ISO15693 ISO18092	ISO14443-A/B Felica ISO15693 ISO18092	ISO18000 6c & b Gen2 Protocol
EEPROM 512b-64Kb 200 year retention 1M cycles	EEPROM 512b-64Kb 40 year retention 1M cycles	EEPROM 512b-64Kb 200 year retention 1M cycles	EEPROM 2Kb-64Kb 200 year retention 1M cycles	EEPROM 256 SRAM FIFO 4Kb-64Kb 40 year retention 1M cycles	EEPROM 2Kb 40 year retention 100K cycles	Reader/Writer Card Emulation	Reader/Writer P2P EMVco & PBOC	Reader/Writer P2P Card Emulation EMVco & PBOC	Reader / Writer -90dBm sensitivity Internal VCO
TruST25 128b password 20b counter UID RF Detect	32b counter Lock OTP bits UID	TruST25 64b password 16b counter UID Tamper Detect	128b password RF disable RF Detect UID	Fast X-fer Mode 64b password E-harvest RF Detect UID	TruST25 64b password UID		VHBR Auto Antenna Tune Dynamic PWR Out Multi-antenna	VHBR 2D Auto Antenna Tune Dynamic PWR Out Multi-antenna	Dense Reader Mode Linear RSSI Automatic PSRR Auto ACK
			I2C 1MHz 1.7V-5.5V	I2C 1MHz 1.8V-5.5V	2x PWM 488-31.25 kHz 1.8V-5.5V	SPI & UART 2Mbps 2.7V-5.5V 230mW	SPI 6Mbps 2.4V-5.5V 1W – 1.4W	SPI 6Mbps I2C 3.4Mbps 2.4V-5.5V 1.7W	SPI 10Mbps 1.65V-5.5V 0-20dBm

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Certification & Interoperability Status

	Tags			Dynamic tags			
	ST25TV	ST25TA	ST25TB	ST25DV-I2C	ST25DV-PWM	M24LR	M24SR
NFC Forum	NFC Forum CERTIFIED	NFC Forum CERTIFIED	Not for NFC applications (RFID, ticketing)	NFC Forum CERTIFIED	NFC Forum CERTIFIED	Legacy product, not focusing on NFC applications	All parameters OK except chaining during write operations (**)
Android	✓	✓	Not for NFC applications (RFID, ticketing)	✓	✓	✓	✓
iOS	✓	✓	Not for NFC applications (RFID, ticketing)	✓	✓	✓ (*)	✓

(*) M24LR: 04E interoperable with iOS11 - 16E and 64E not iOS. ST25DV16K or ST25DV64K as replacement product for iOS interoperability

(**) Chaining during write operations is not used by Smartphones

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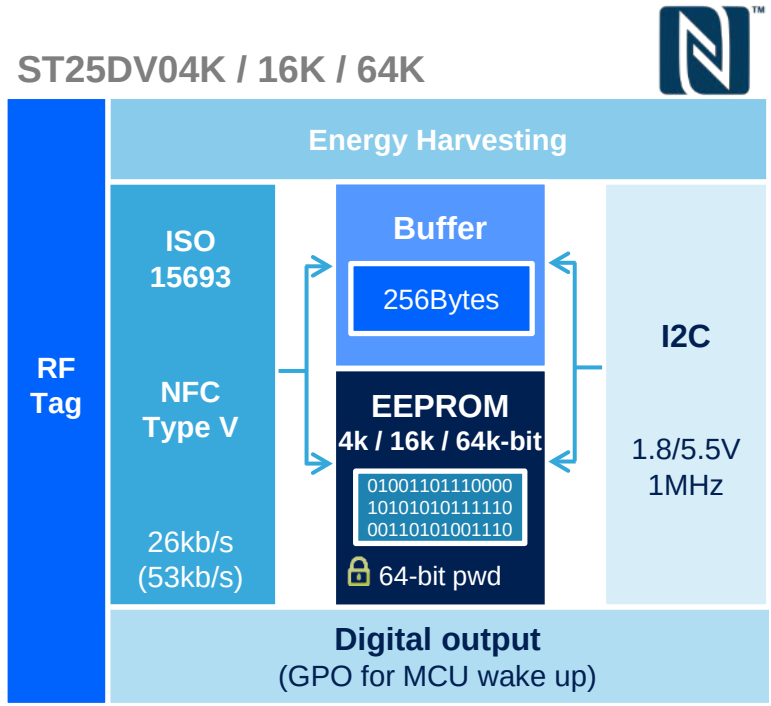
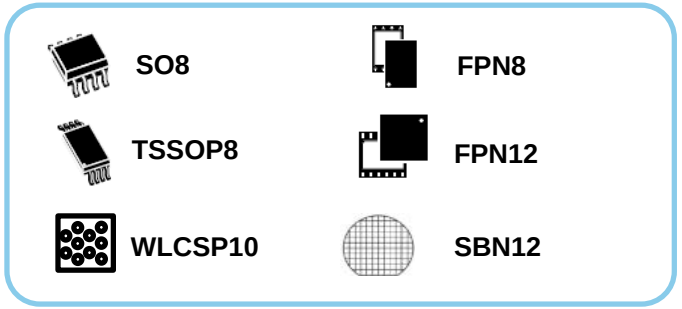
Focus on ST25DV Type5 Dynamic Tag

NFC Tag with I²C interface

	ST25DV series
Contactless Interface	ISO15693 / NFC Forum Type 5
RF speed	up to 53kbps (26kbps std)
Single supply voltage	1.8V to 5.5V
Serial Interface	I2C @1MHz
Extra Features	GPO: 7 interrupts modes (OD or CMOS) Energy Harvesting Low Power Mode (<1uA stby)
Memory format & size	EEPROM data - 4 / 16 / 64-kbit
Data retention	40-year at +55°C
Fast Transfer Mode	256 Bytes memory buffer
Erase/Write cycles	1M cycles
Data protection	Password 64-bit
Temperature range	-40°C to +85°C
Package	SO8/TSSOP8/FPN8-12/WLCSP/SBN12





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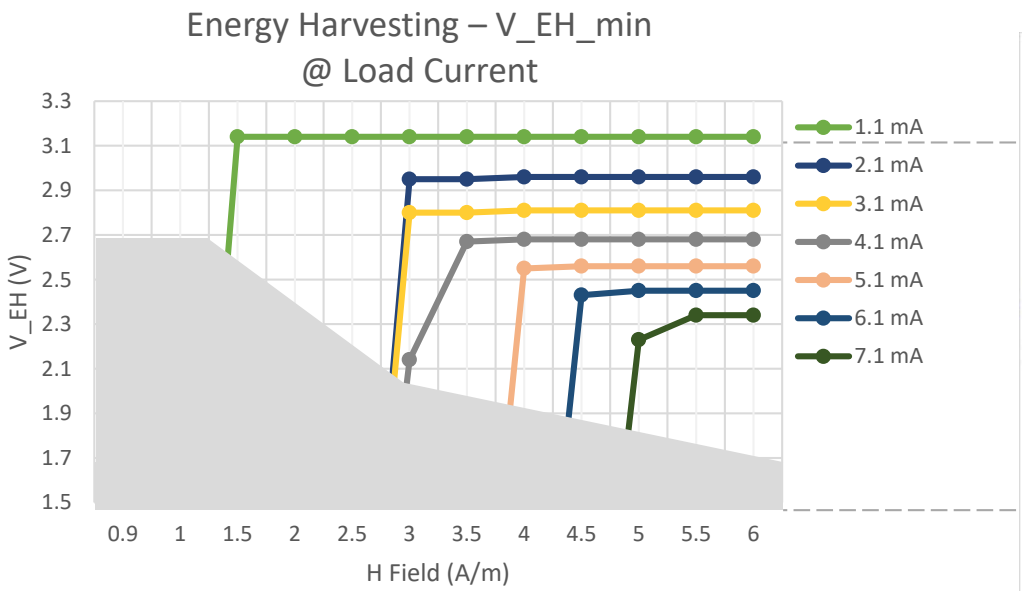
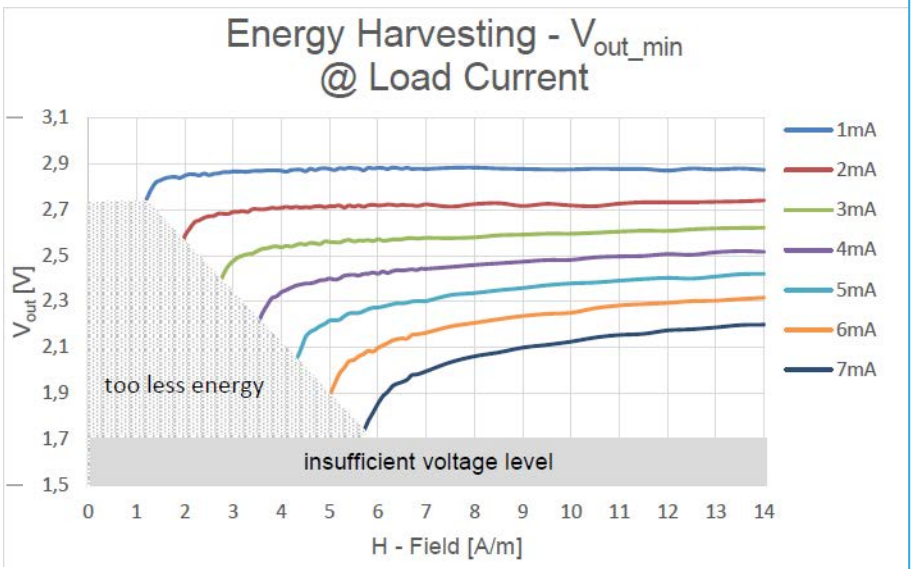
Energy Harvesting benchmark

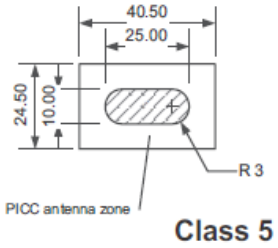
ST25DV-I2C vs Competition (ISO Class 5 antenna)

ST25DV-I2C



Competition NFC Tag with E-Harvest





- Comparison showing the superior Energy Harvesting capabilities of the ST25DV-I2C compared to the competition with the same antenna class 5

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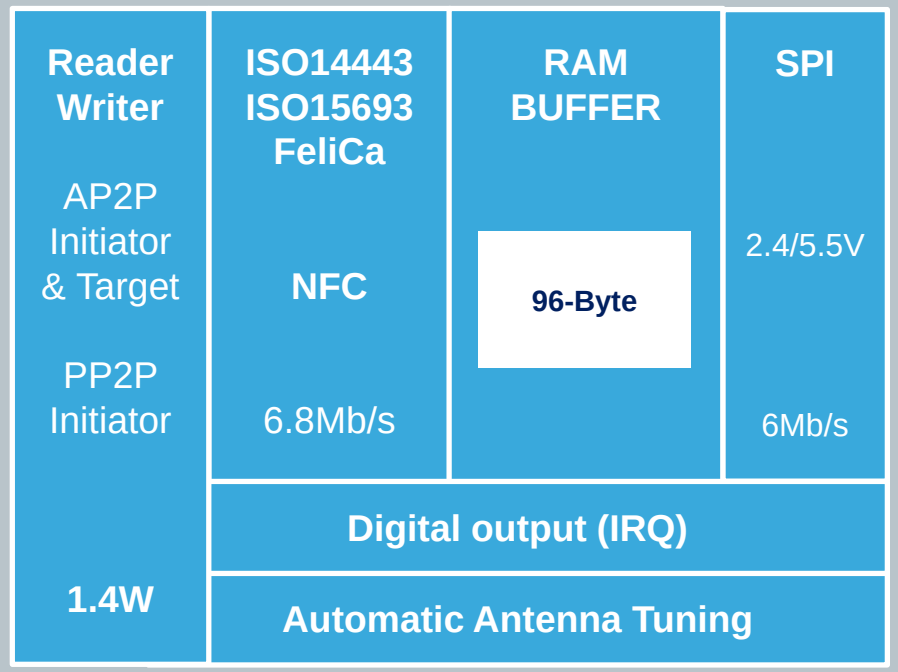
ST25R3911B NFC / RFID Reader

1.4W High Power NFC Reader Solution

ST25R3911B



QFN32

Wafer

Use cases

- Ideal for **Payment** applications
- Access Control, Gaming, eGovernment,

Key Features

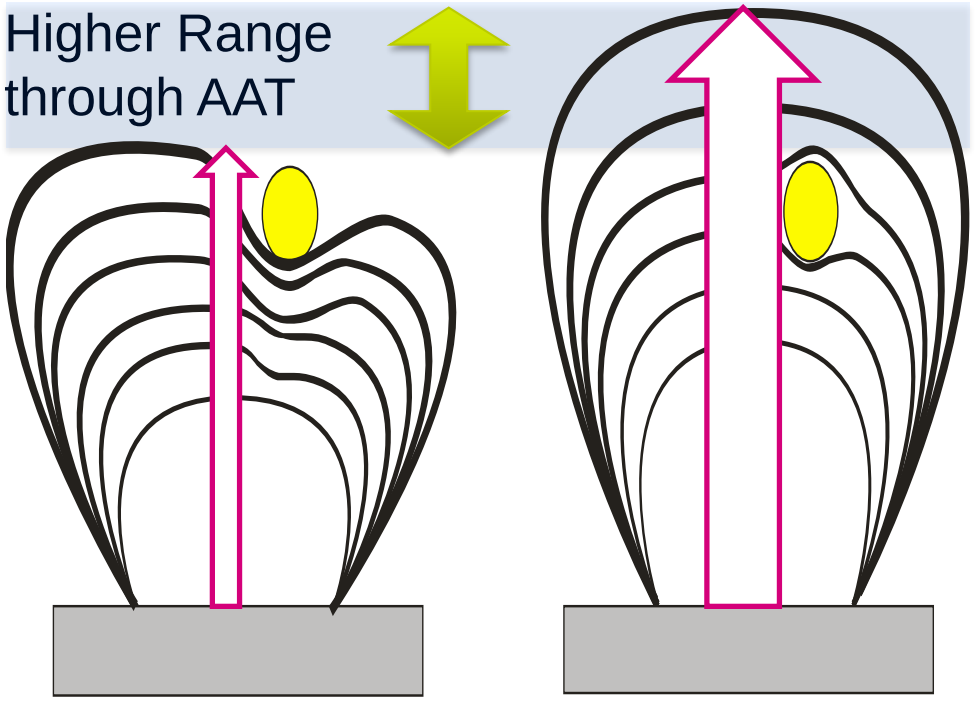
- All NFC modes supported (ISO14443, ISO15693, FeliCa) with P2P
- **1.4W** output power at 5V
- **EMVCo** & **PBOC** certification without external power amplifier
- **Automatic Antenna Tuning**
- **Low Power Wakeup**
- **Very High Bit Rate** support up to **6.8Mb/s**
- -40°C to **125°C** temperature range

Key Benefits

- Low power operation & Stand-by mode (capacitive wake-up)
- 2 antennas operation at the same time
- Enhanced fast transfer rate for Passport application

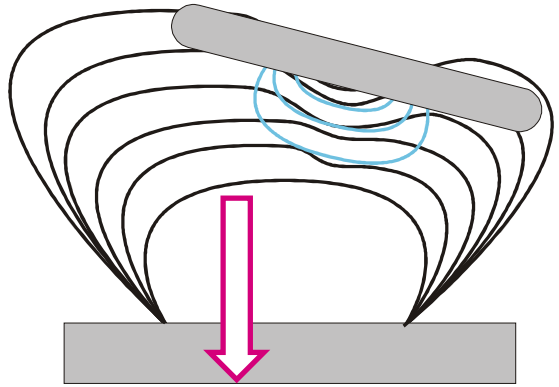
Automatic Antenna Tuning

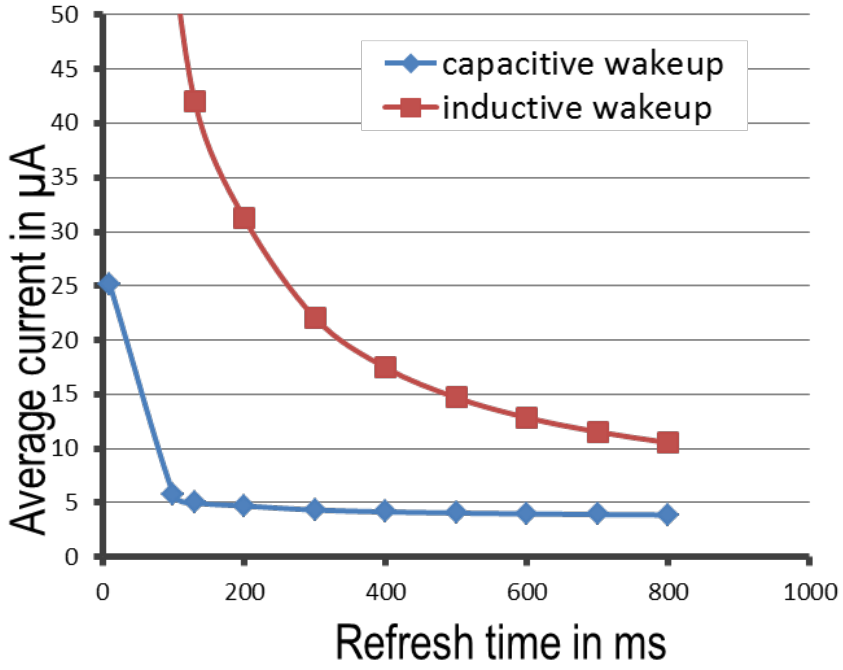
- AAT increases Range & Field strength
  - AAT increases the range of an HF reader in bad environmental conditions and sustains maximum output power to the field with best efficiency
- AAT compensated for environment
  - Automatic antenna tuning analyses the phase shift of the antenna and retunes automatically
- AAT reduces production cost
  - The antenna can be tuned with an automatic procedure during production to fine adjust the design to different housings.
- Multiple Tags / Cards placement
  - Multiple NFC tags or cards in the field can be compensated to transfer a maximum of power for each.



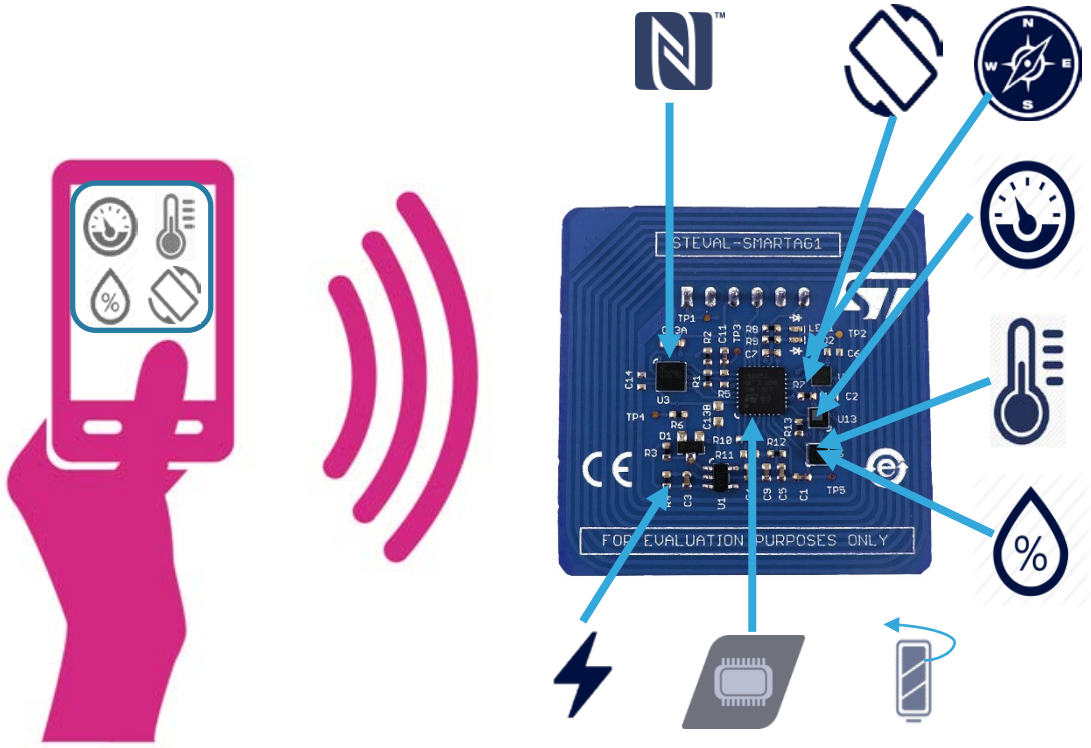
Low Power Wakeup

- Internal wakeup circuitry
  - The ST25R series includes a fully programmable wakeup scheme including cycle time and sensitivity
  - No MCU required to run the wakeup; Capacitive & Inductive wakeup can be serially combined in for sophisticated wakeup scripts
  - Allows for flexible tuning to maximize vehicle battery life while maintaining responsiveness
- Capacitive wakeup
  - ST25R series with this feature can detect capacitive changes (e.g. the approach of a hand, etc.)
- Inductive wakeup
  - The inductive wakeup is dedicated to detect approaching NFC cards or phones





NFC-enabled sensor node

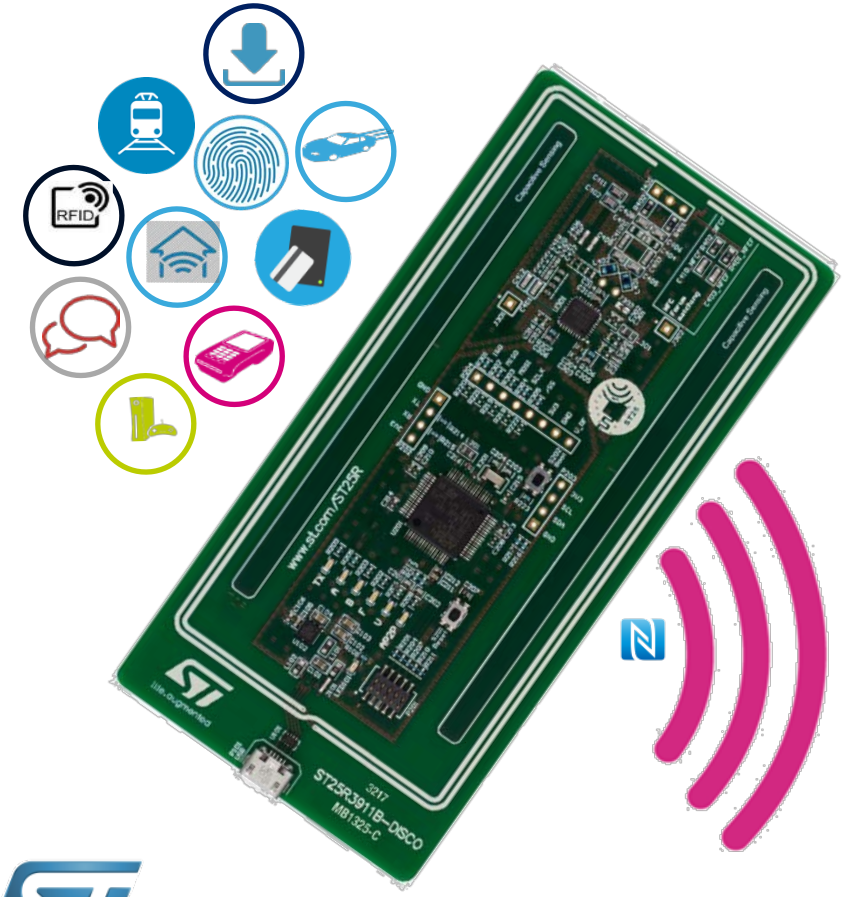


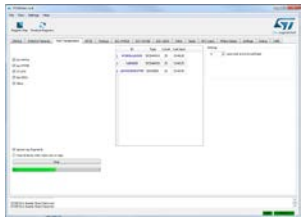
Board features

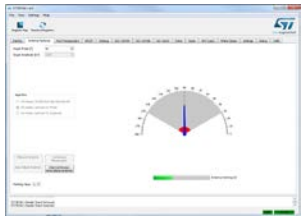
- ST25DV64K dynamic NFC tag
- STM32L031K6 ultra-low-power ARM Cortex-M0+
- LIS2DW12 three-axis linear accelerometer
- LPS22HB piezo-resistive absolute pressure sensor
- HTS221 humidity and temperature sensor
- STLQ015 low drop linear regulator power management

NFC Reader Eval Board

ST25R3911B-DISCOVERY







Ideal for Battery operated systems, Access control, Accessory Identification, Gaming, IoT GateWays, Qi+NFC, Payment, and Automotive

Key Features: 1.4W output power with high efficiency, Antenna Auto Tuning, Dynamic Power Output, Low power card wakeup, SPI, AP2P, VHBR

A dedicated PC GUI interface allows to configure and evaluate ST25R3911B Features & performances.

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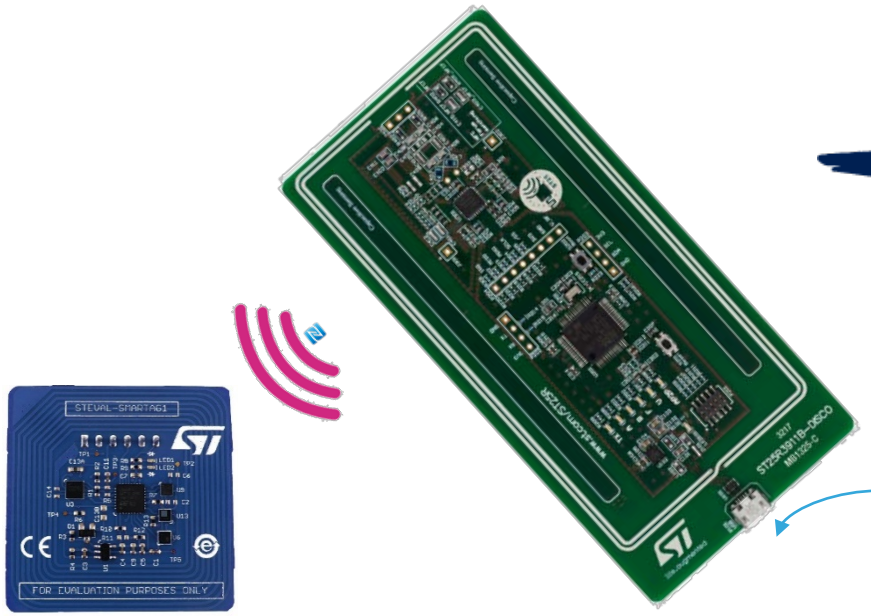
PC GUI Managed Demo

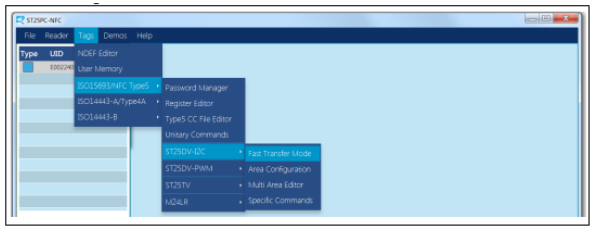
STSW-ST25PC001

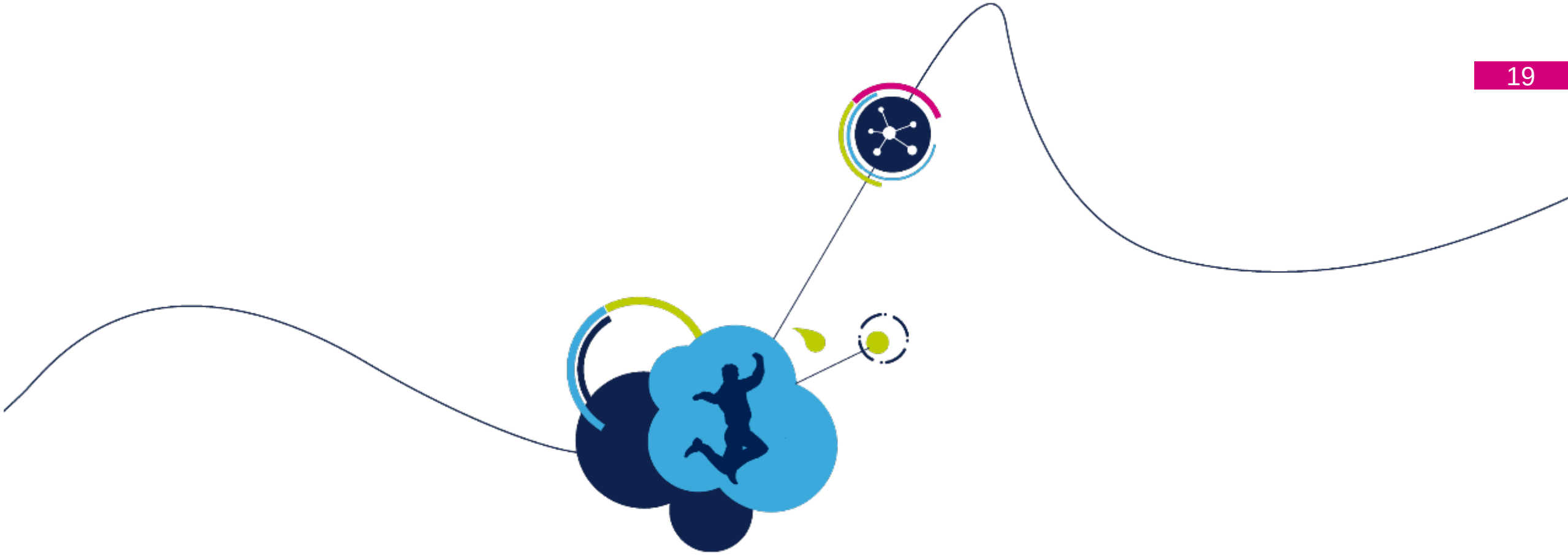


STEVAL-SMARTAG1

ST25R3911B-Disco
NFC/RFID Reader Kit

ST25PC001
PC GUI





SmarTag Demo

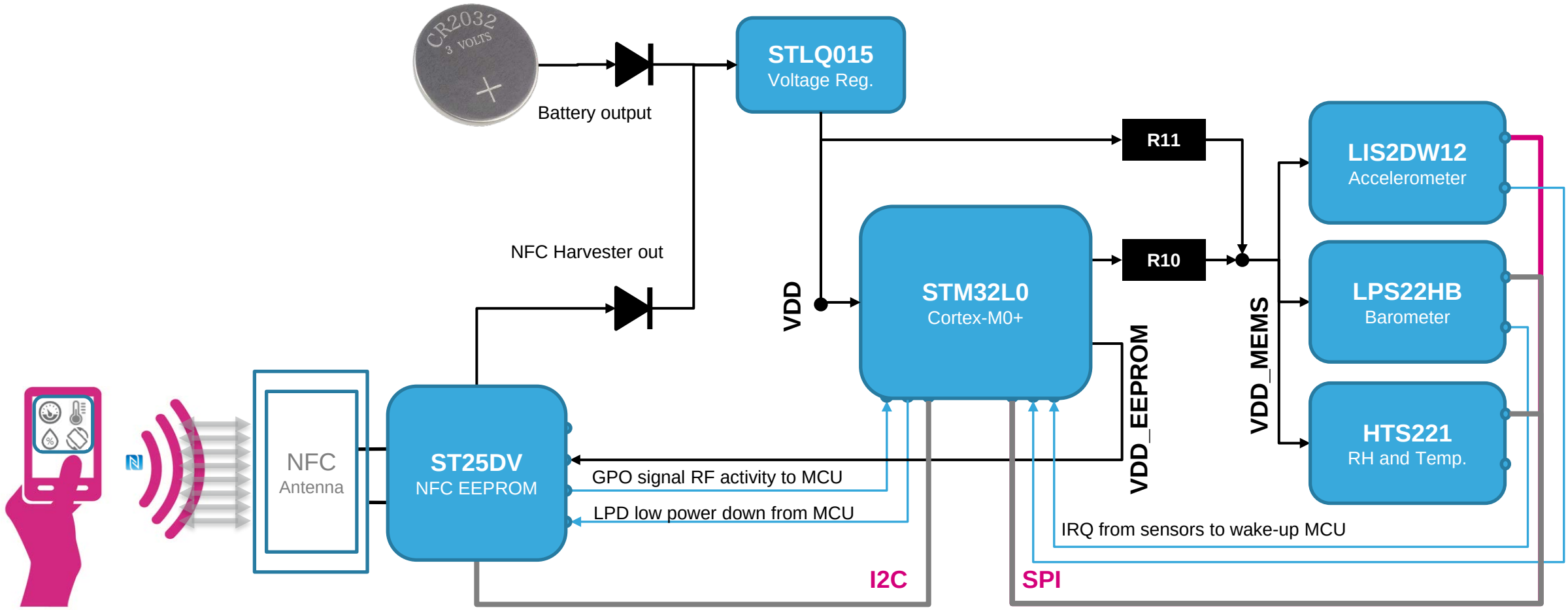
ST NFC Sensor TAG

NFCSensorTAG is **a NFC enabled sensor node** that can sense temperature, humidity, pressure, vibration, motion and **transmit the data when triggered by an NFC reader**. It is a **reference platform** that can be scaled down/up based on requirement of final applications and use cases.

An **alternative way of connectivity** for applications that:

- Are extremely **low POWER** (also full passive) and **low COST**;
- Require small real estate (**reduced BOM**) and **fast implementation**;
- Do **NOT** require **Real-Time Remote** monitoring (Near Field Communication)

SmartTag Block Diagram



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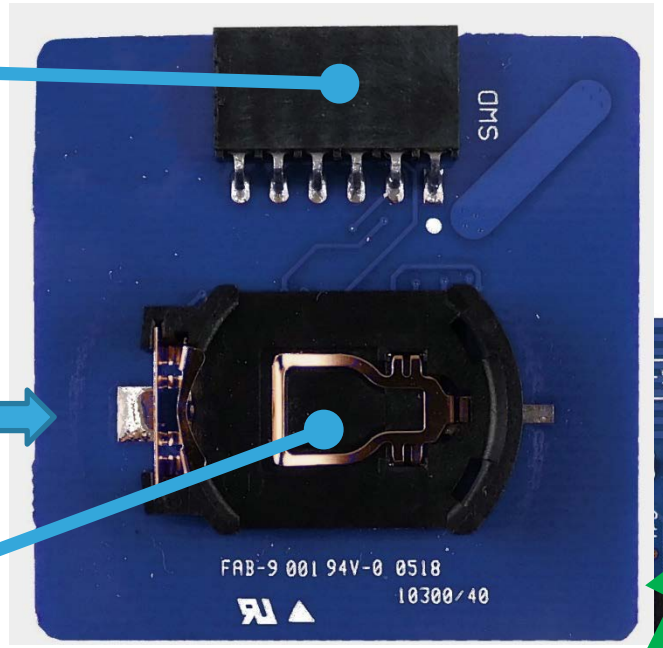
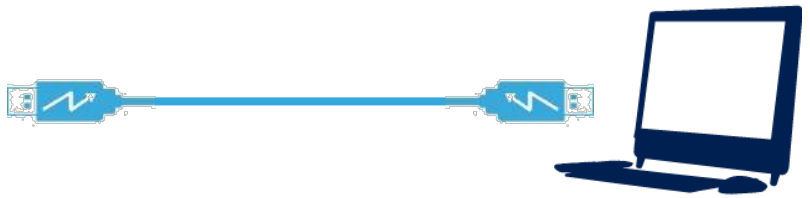
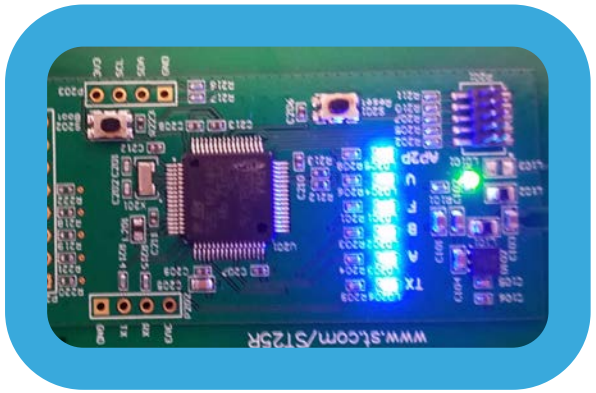
Install battery and connect reader

SWD connector
To ST-Link/V2





Battery holder
CR2032

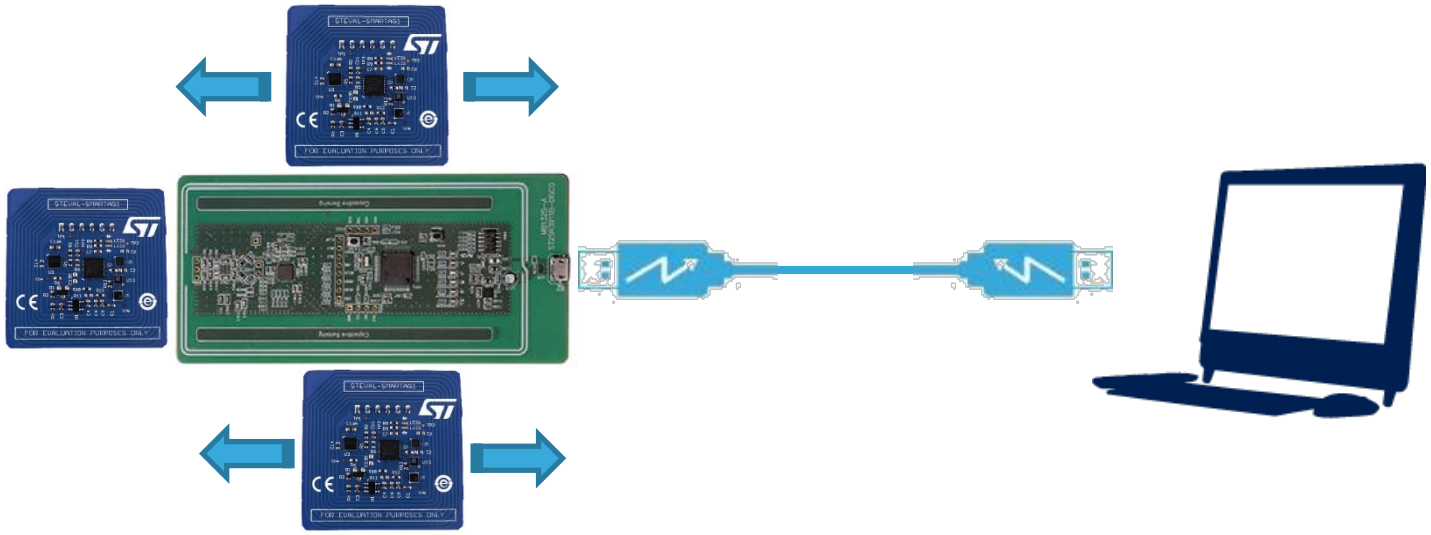


After 8 seconds, LED1 should blink every 5 seconds

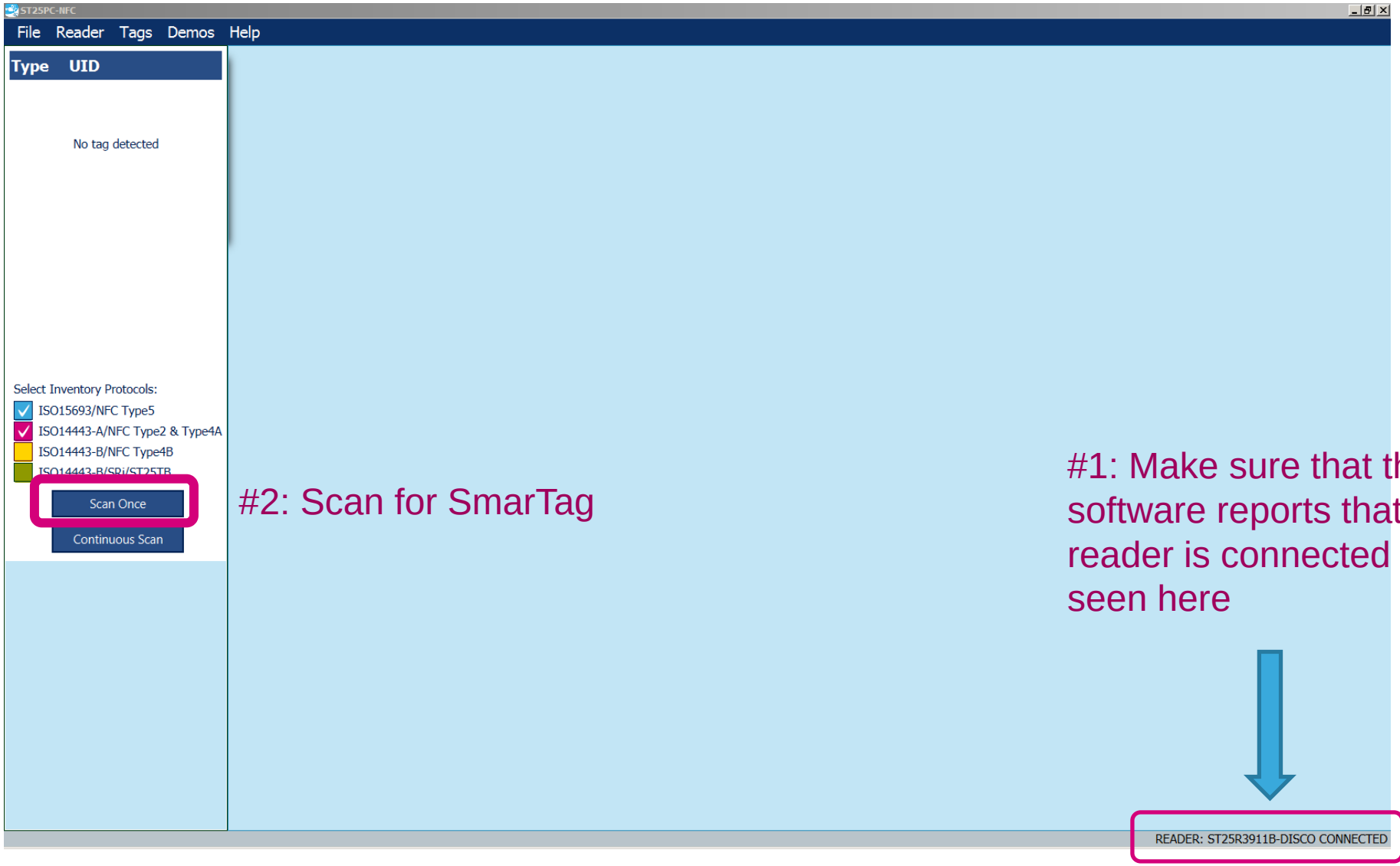
Tag Placement while reading

Important Note:
You can place the tag on top or under the ST25R3911B ONLY if there is insulation between them.

Or you will risk shorting out the components!



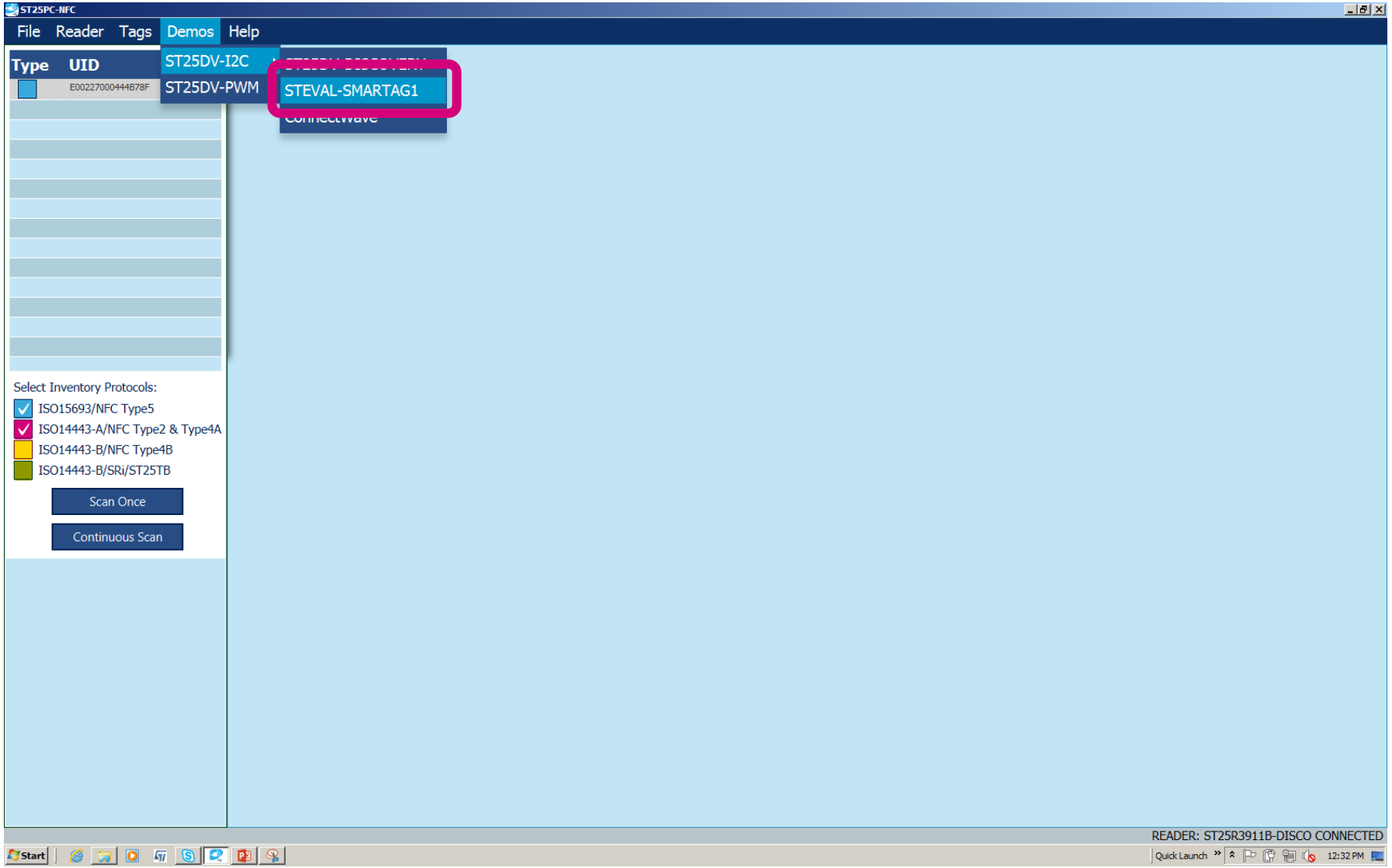
Running the ST25PC-NFC Application



#2: Scan for SmarTag

#1: Make sure that the software reports that the reader is connected as seen here

Run the sensor tag demo



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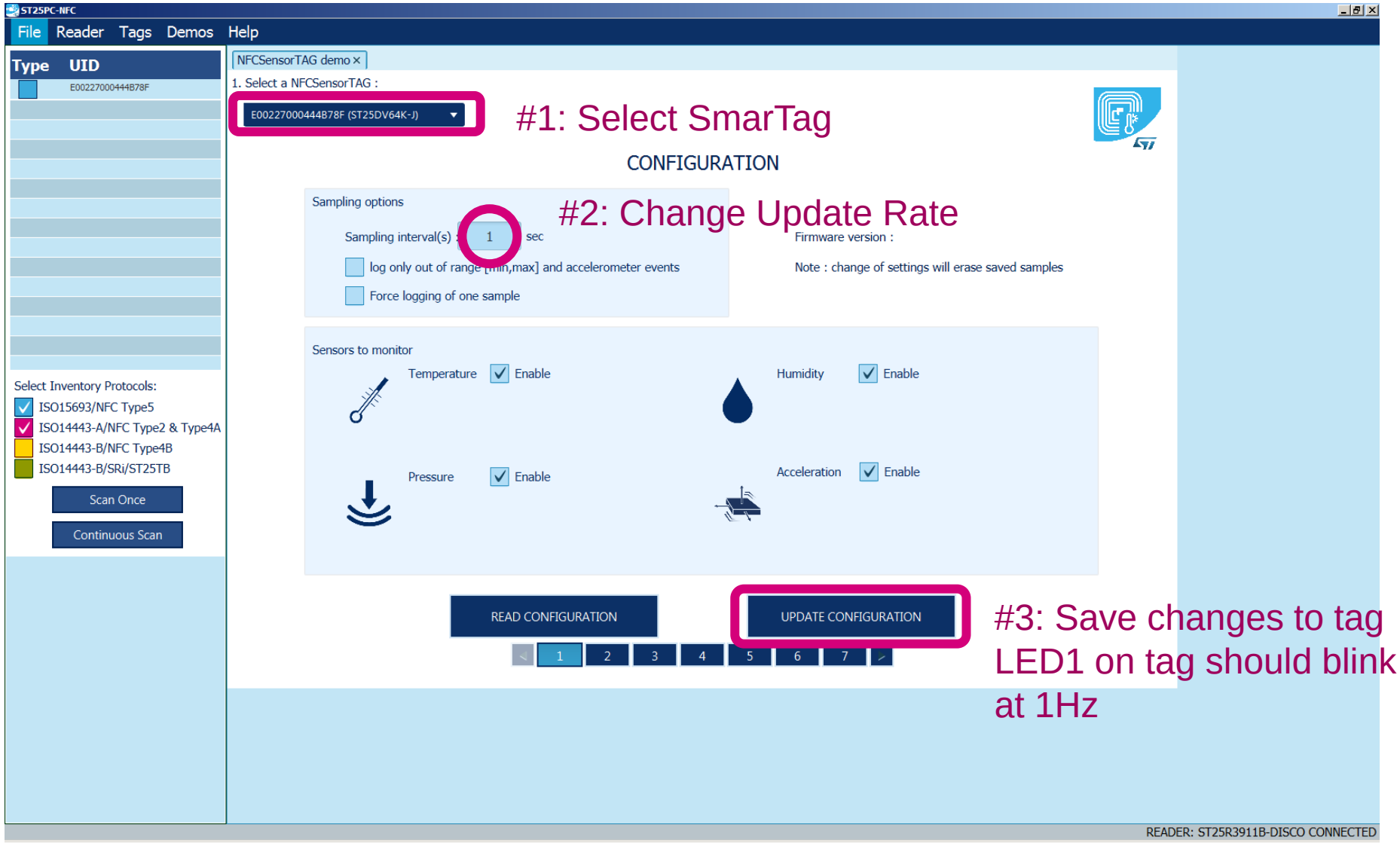
SmarTag Configuration Settings



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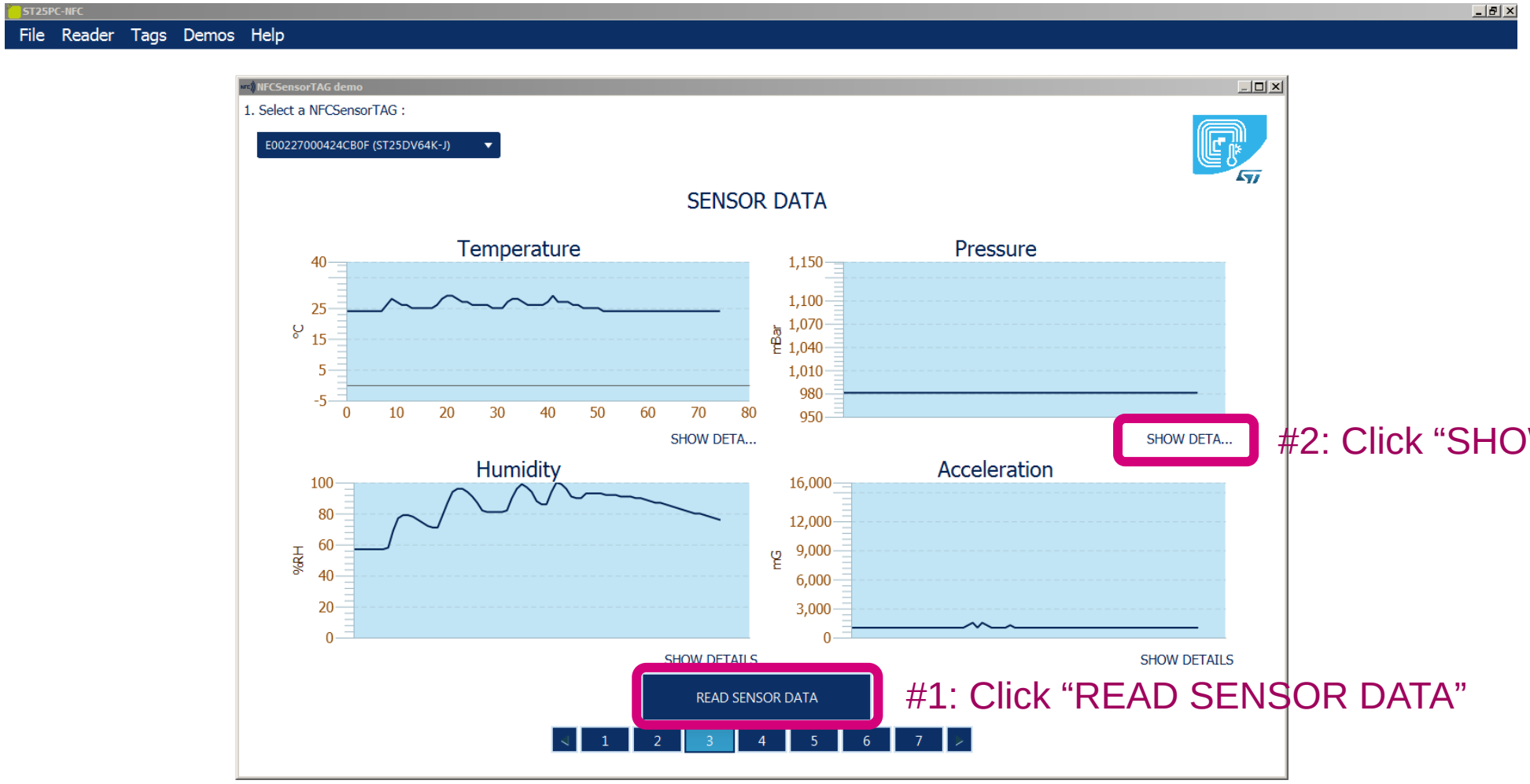
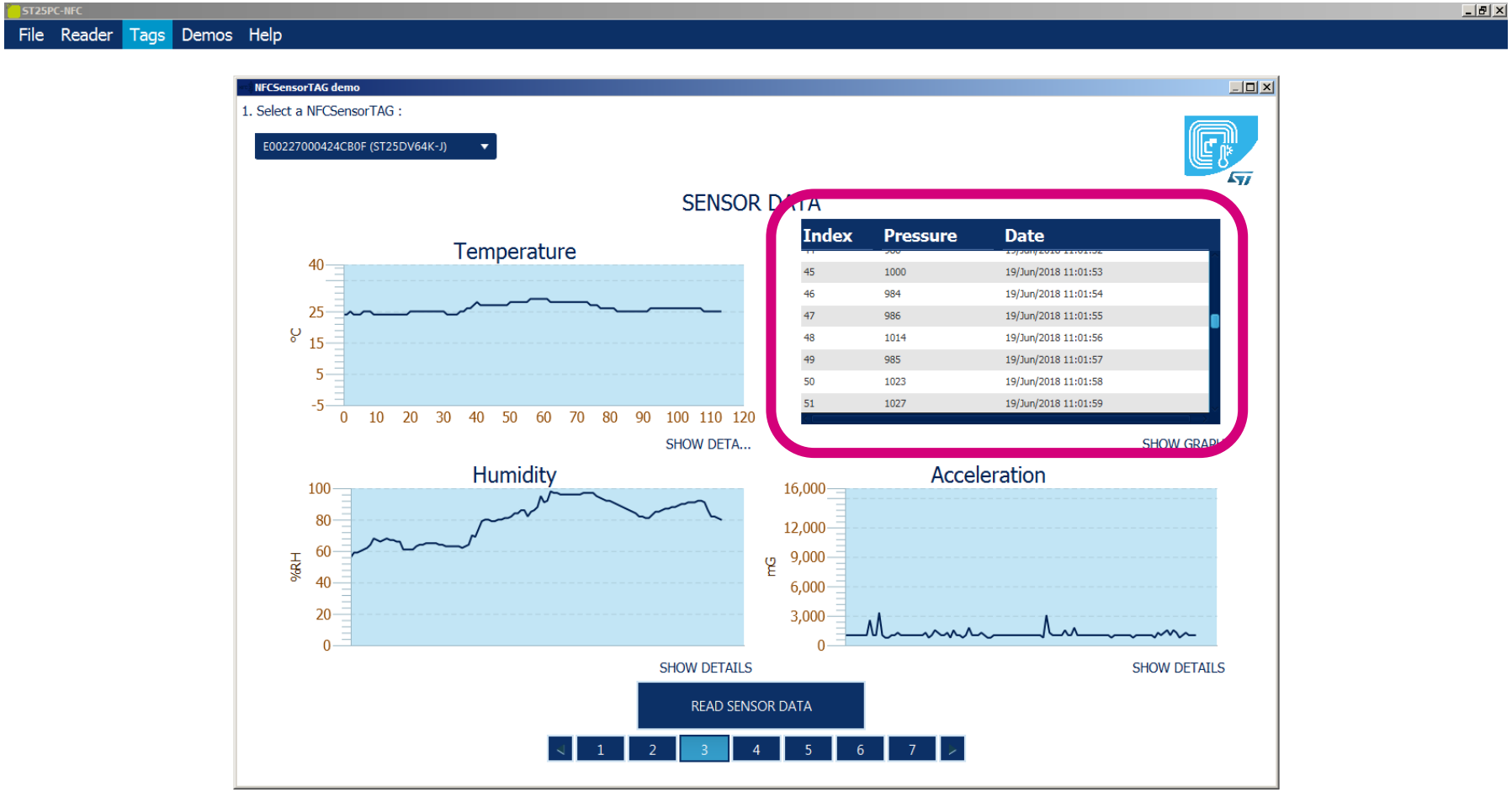
My sample data



#2: Click “SHOW DETAILS”

#1: Click “READ SENSOR DATA”

Show Details Panel



Log data when outside min-max

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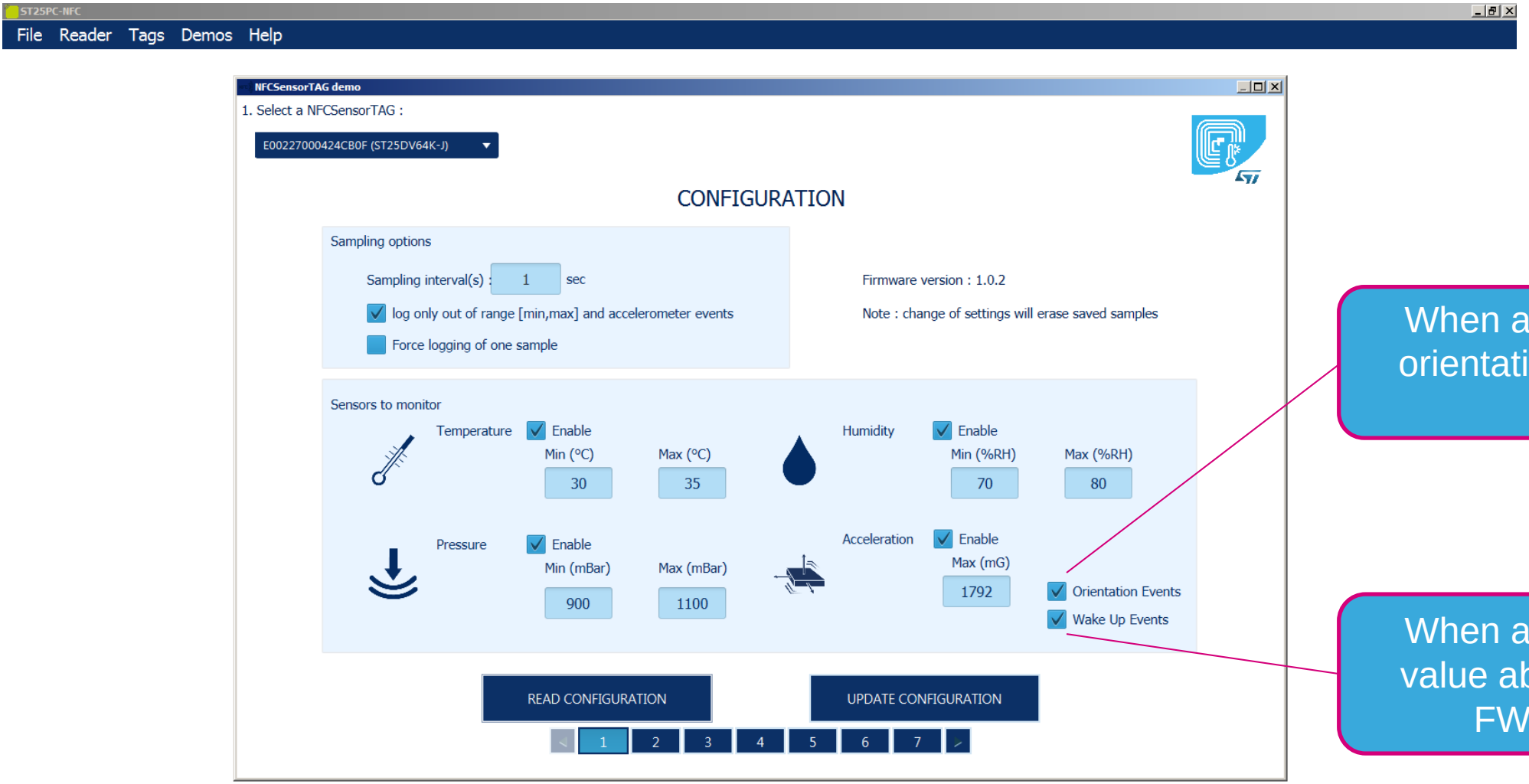
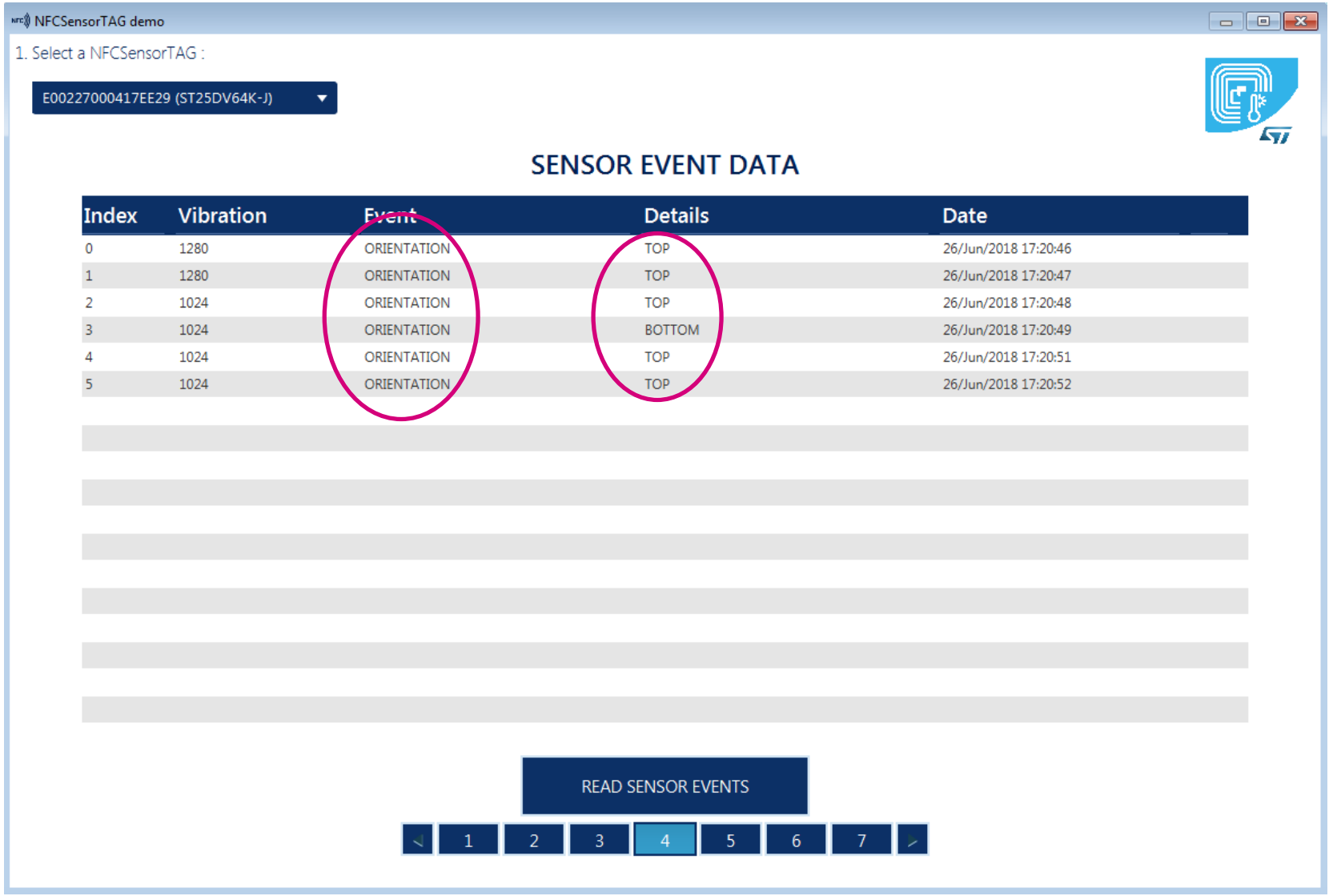
Event Driven Logging



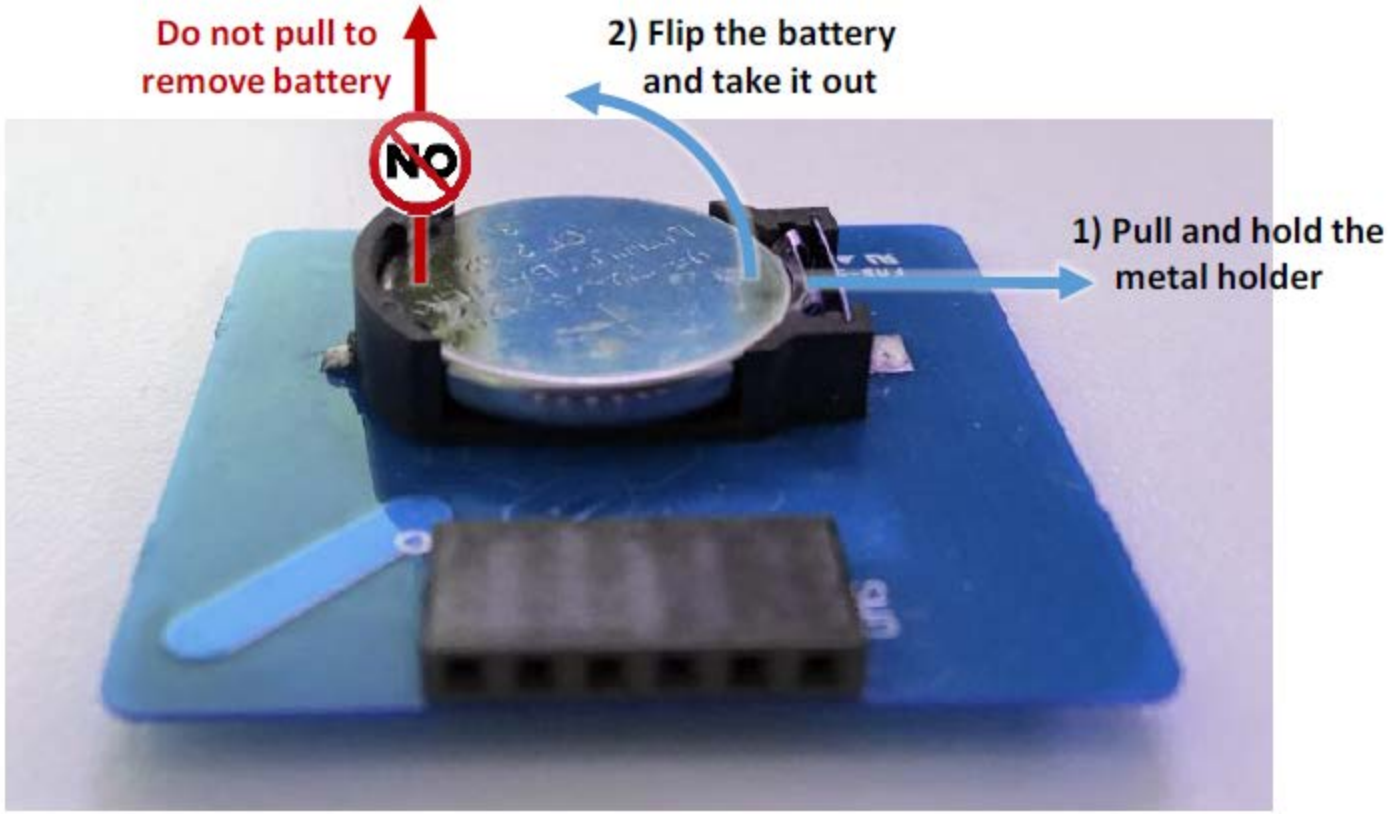
When accelerometer detects orientation change, it logs the data.

When accelerometer detects value above 4G (value set by FW), it logs the data

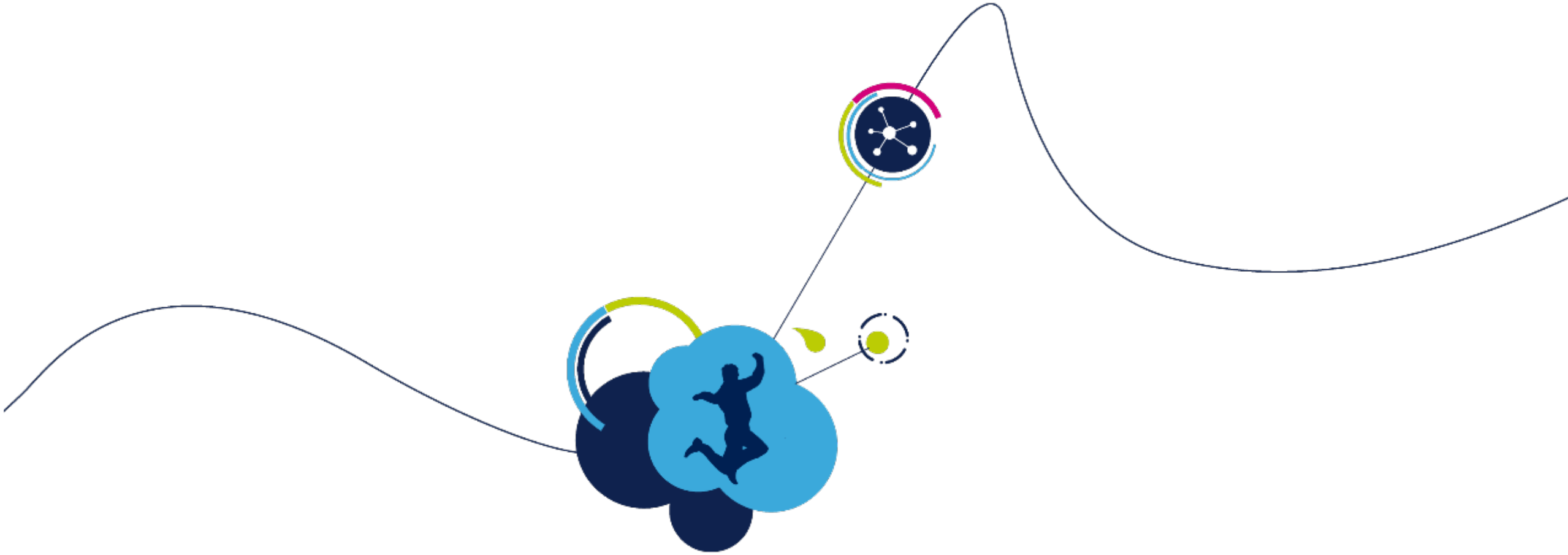
Setting threshold event for single sensor



Correct way to remove coin cell battery



Single Shot Reading (Battery-less)



Smart Phone Support

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ST25SDK in a nutshell

ST25 SDK

Software library to be used in Java applications

What do I get from ST25 SDK?

Why shall I use it?

Multiplatform

Can be run by any platform supporting JVM (Windows, Android, Linux, Mac)

Some components can be re-used for iOS

Flexibility

Abstraction for NFC Forum & ISO Commands
Abstraction for Tags, and Readers

RF commands isolated from UI interface
Code can be reused in other Java applications

Datasheet is optional. Tag features documented in API (Javadoc)

To accelerate and ease your development

ST25 SDK in a nutshell

What form does the ST25SDK take?

A public archive file (zip) containing:

st25sdk.jar Java library file
API documentation (HTML Javadoc files)
Native libraries for reader board (CR95HF, ST25R3911B-DISCO)
Basic applications source code (Windows PC, Android) + executable)
Helper classes

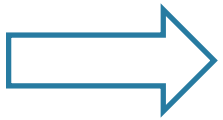
How do I get the latest ST25 SDK package?

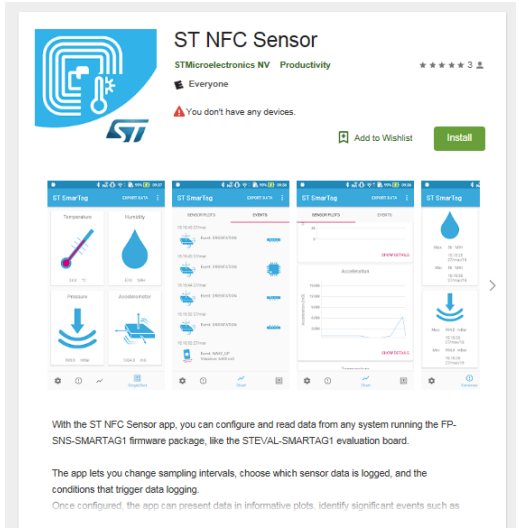
http://st.com/st25sdk

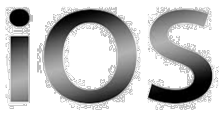
What if I wish more documentation?

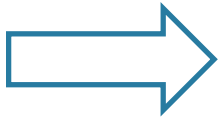
Data brief + User Manual on st.com

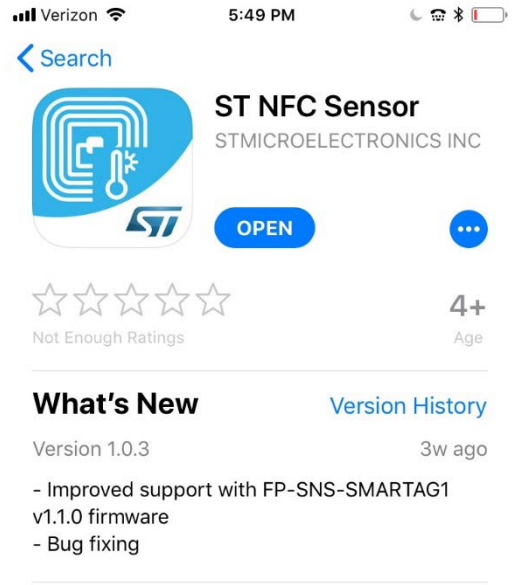
Smartphone APK











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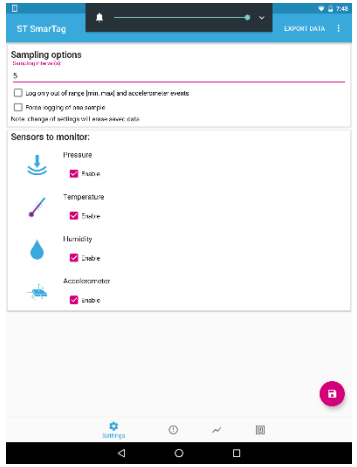
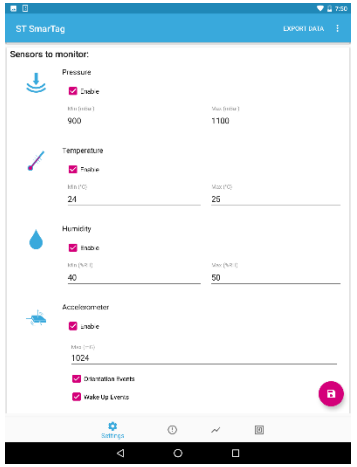
Android App

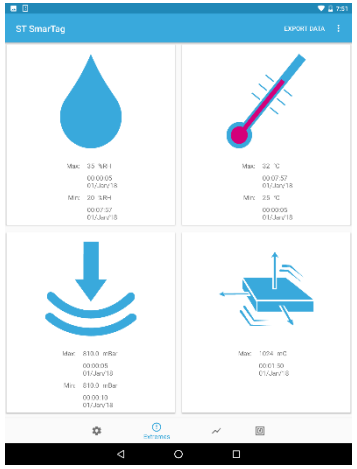


Continuous Log

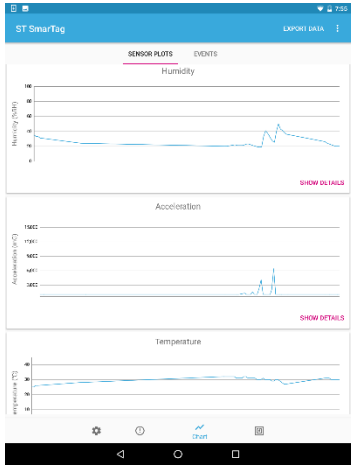
Out of Thresholds



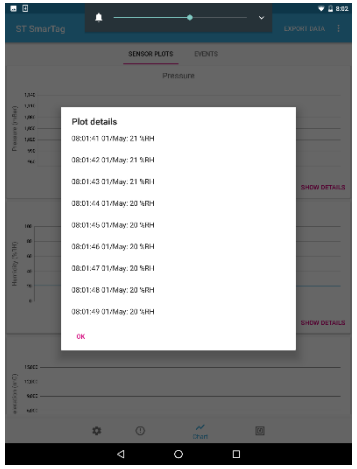
Min Max Rec



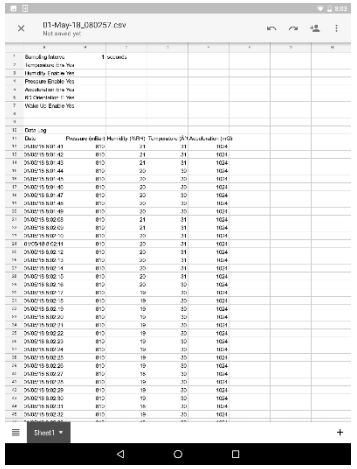
Data Plot



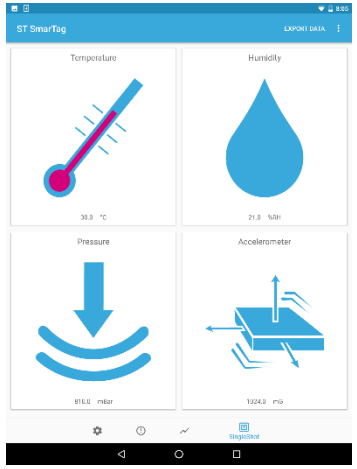
Plot Details



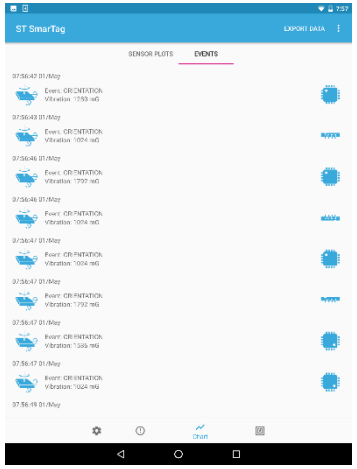
Data Export



One Shot EH



Event Logging



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iOS support of NFC tag reader mode

- A new core NFC function of Apple iOS11 adds support for NFC tag reading to iPhone7 and iPhone7 Plus as well as the new iPhone8 and 8 Plus and iPhoneX
- iOS11 use cases
  - Read tags of **types 1 through 5** with NDEF (*)
  - Need iOS application (not «native» as Android)
- Download the NFC Sensor Tag App on iTunes

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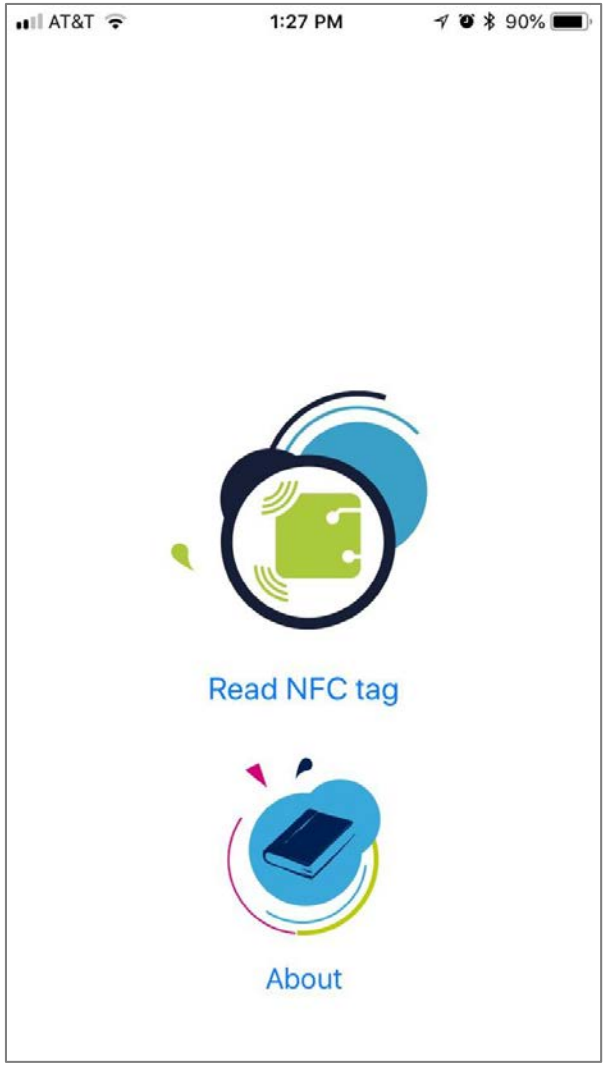
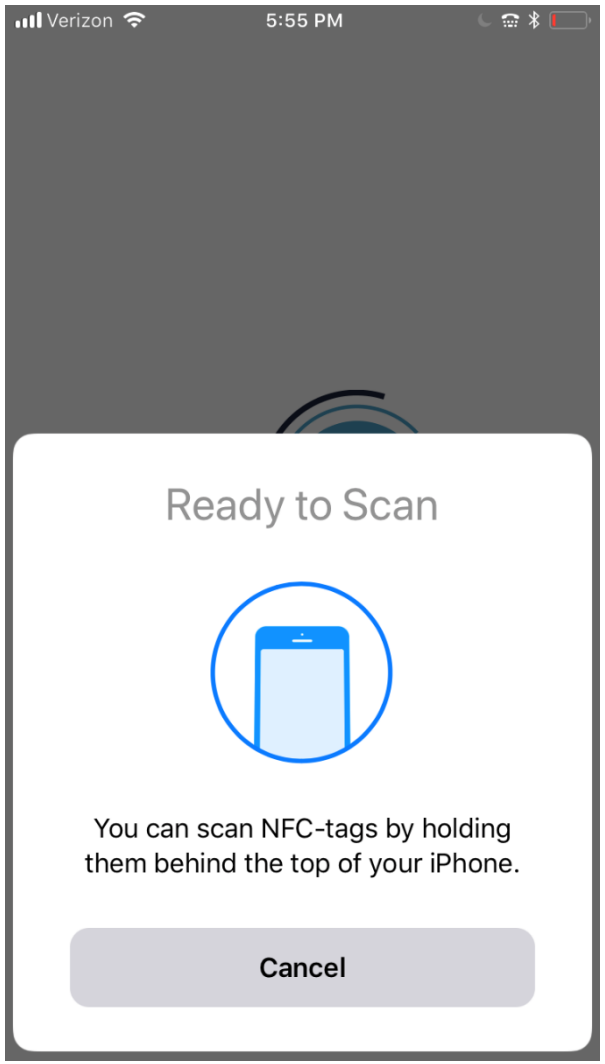
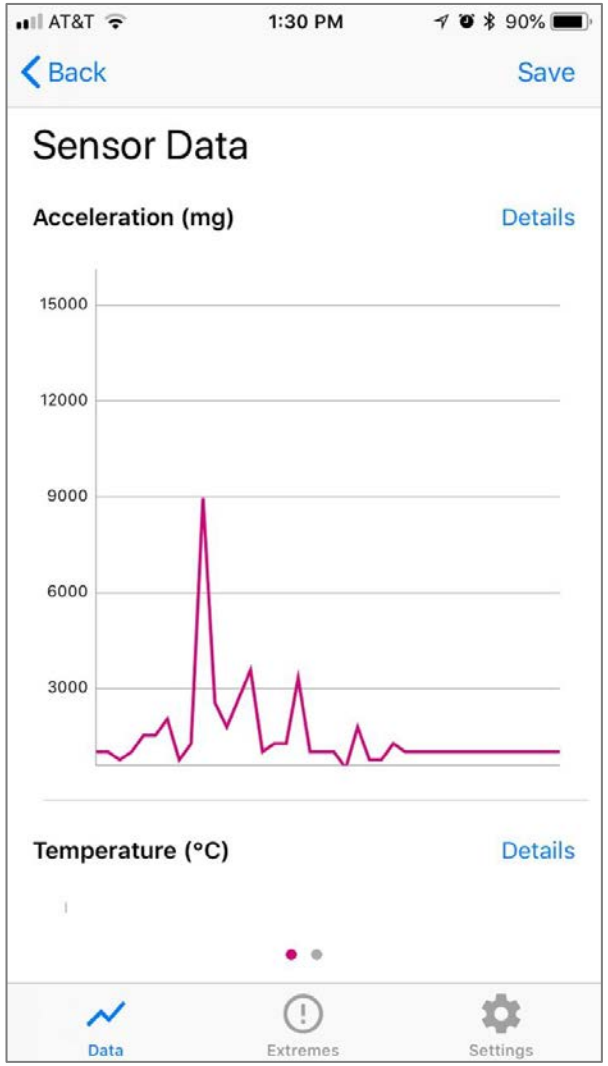
(*) NDEF: NFC Data Exchange Format

iPhone App







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