

NFC / RFID ST25 product overview

MMY division

June 2017





Sticker tag from partner

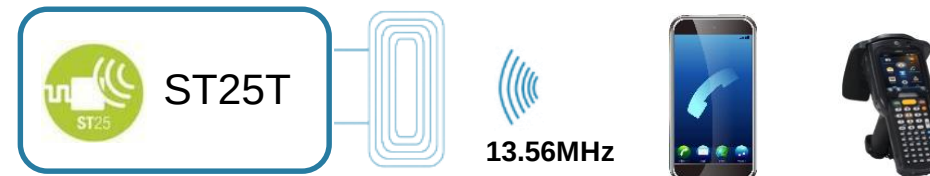
ST25 : NFC comprehensive solutions

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Ticketing, Gaming, Medical, Brand protection, Access control, ...

NFC Tags

- **NFC forum tag type 4** based on **ISO14443-A** RF interface
- EEPROM memory density from 512-bit to 64-Kbit with built-in NDEF message support
- High-speed RF operation (106 Kbit/s)
- Data protection with **128-bit password** in Read and Write access
- Optional user-programmable CMOS output (Field detect, Write In Progress, RF busy,...)



Industrial, Consumer, Metering, Appliance, ...

NFC Dynamic Tags

- ISO/IEC **15693** and NFC Forum **Type 5 tag** contactless interface
- EEPROM memory density from 4 to 64 Kbits
- Fast Transfer mode thanks to 256-byte buffer (RAM)
- **Energy harvesting feature**
- **64-bit password protection**
- GPO interruption pin configurable on multiple RF events
- Simple antenna design, backward compatible with **M24LR** series



POS & mPOS Terminals

EMVCO Readers

The ST25R HF **reader series** provides multiprotocol support for **13.56 MHz NFC / RFID** communications as **ISO / IEC 14443 Type A or B**, **ISO / IEC 15693**, **ISO / IEC 18092**, **FeliCa** and **NFC Forum** protocols.

- The **95HF** products are suitable for a wide spectrum of applications.
- **ST25R39xx** devices provide a complete solution for **payment** and **POS** with the ST25R3911B/12/13 boasting **EMVCo & PBOC** certifications while the ST25R3914/15 are full **AEC-Q100 grade 1 automotive** grade.
- The ST25RU **UHF reader** series provides multiprotocol support for the **840-960 MHz UHF** band compliant with **ISO 18000 6c & b**, **ISO 29143** and **UHF EPC GEN2 RAIN** standards.



Readers



Gaming, Medical, Brand protection, Access control, ...





ST25 series
Tags, Dynamic tags
and Readers



ST25 Tags and Dynamic Tags DNA

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Comprehensive portfolio

Feature-rich

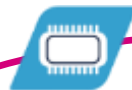
- 13.56MHz interface
- I2C interface
- Energy harvesting
- 20-bit Counter
- Field Detect GPO

High volume & quality

- In-house manufacturing
- Leveraging Automotive EEPROM quality
- Leveraging Consumer EEPROM volume

Standard compliant

- NFC Forum
- ISO14443
- ISO15693



Front-End
& Back-End
Manufacturing



Best-In-Class memory

- Up to 200 year retention
- 1M erase-write cycles
- From 512bit to 64-Kbit
- 128-bit password





ST25 series
Tags, Dynamic tags
and Readers



ST25 Readers DNA

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Comprehensive portfolio

High performing HF Readers

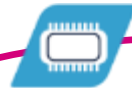
- 13.56 MHz frequency
- Very High Bit Rate (6.8Mbit/s)
- Automatic Antenna Tuning
- Multi Antenna support
- High and Dynamic power output (1.4W)
- Capacitive / Inductive wake up
- Operating temperature -40°C to +125°C

High performing UHF Readers

- 840-960 MHz frequency range
- High Receive Sensitivity (-90dBm)
- Low noise Voltage Controlled Oscillator
- Integrated Dense Reader Mode filters
- Tag movement detection

Standard Compliant

- NFC Forum
- ISO14443
- ISO15693
- ISO18092
- ISO18000



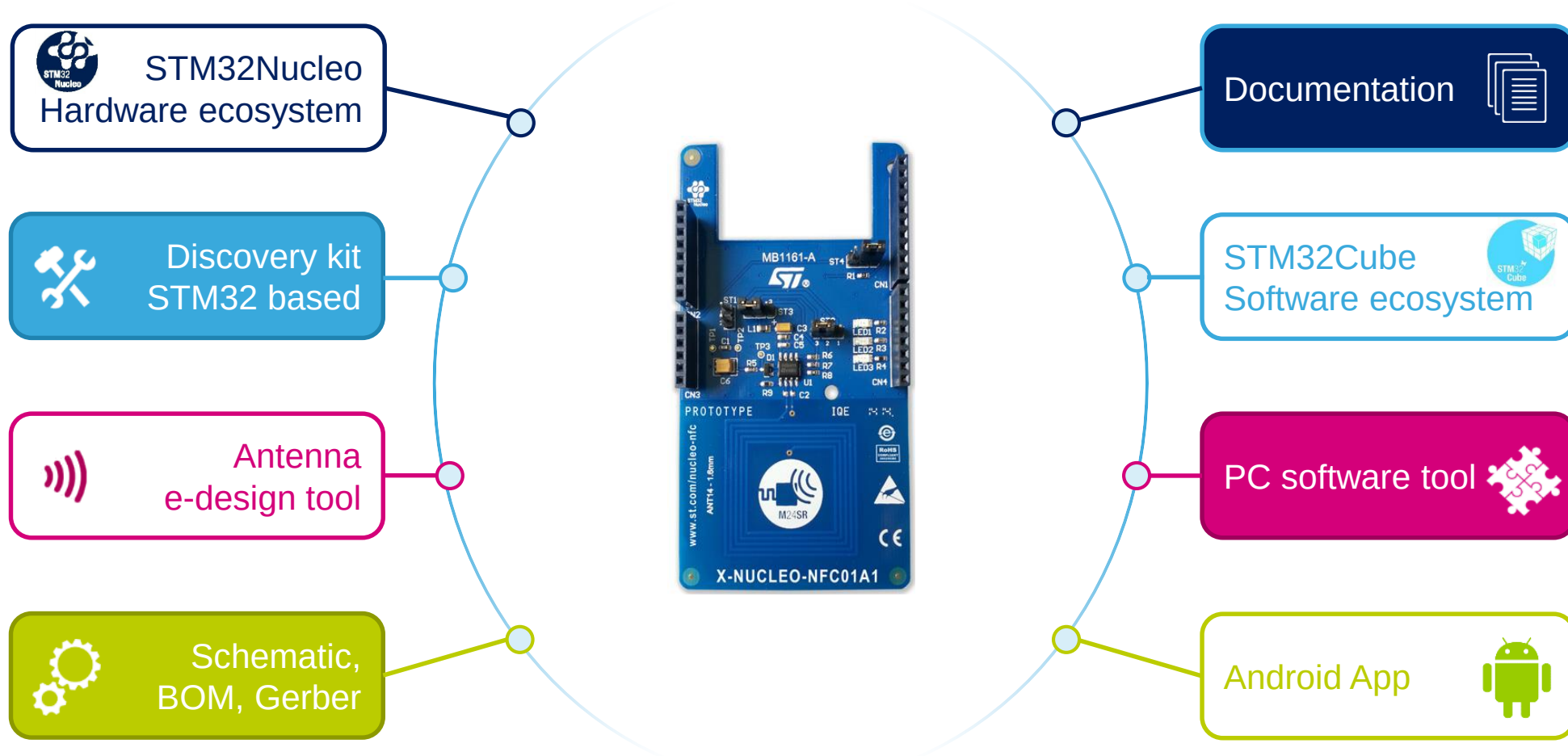
Certification

- EMVco
- PBOC
- AECQ100





Easy-to-use and customer-oriented



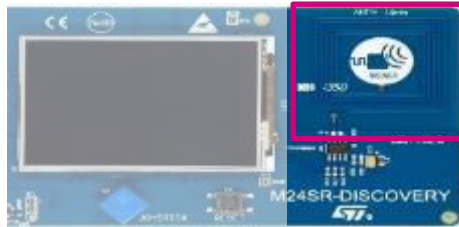


Easy antenna integration

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Just need a loop antenna

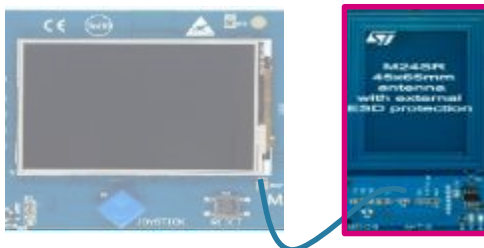
On-board antenna



On-board inductor



Off-board



Sticker tag (*)



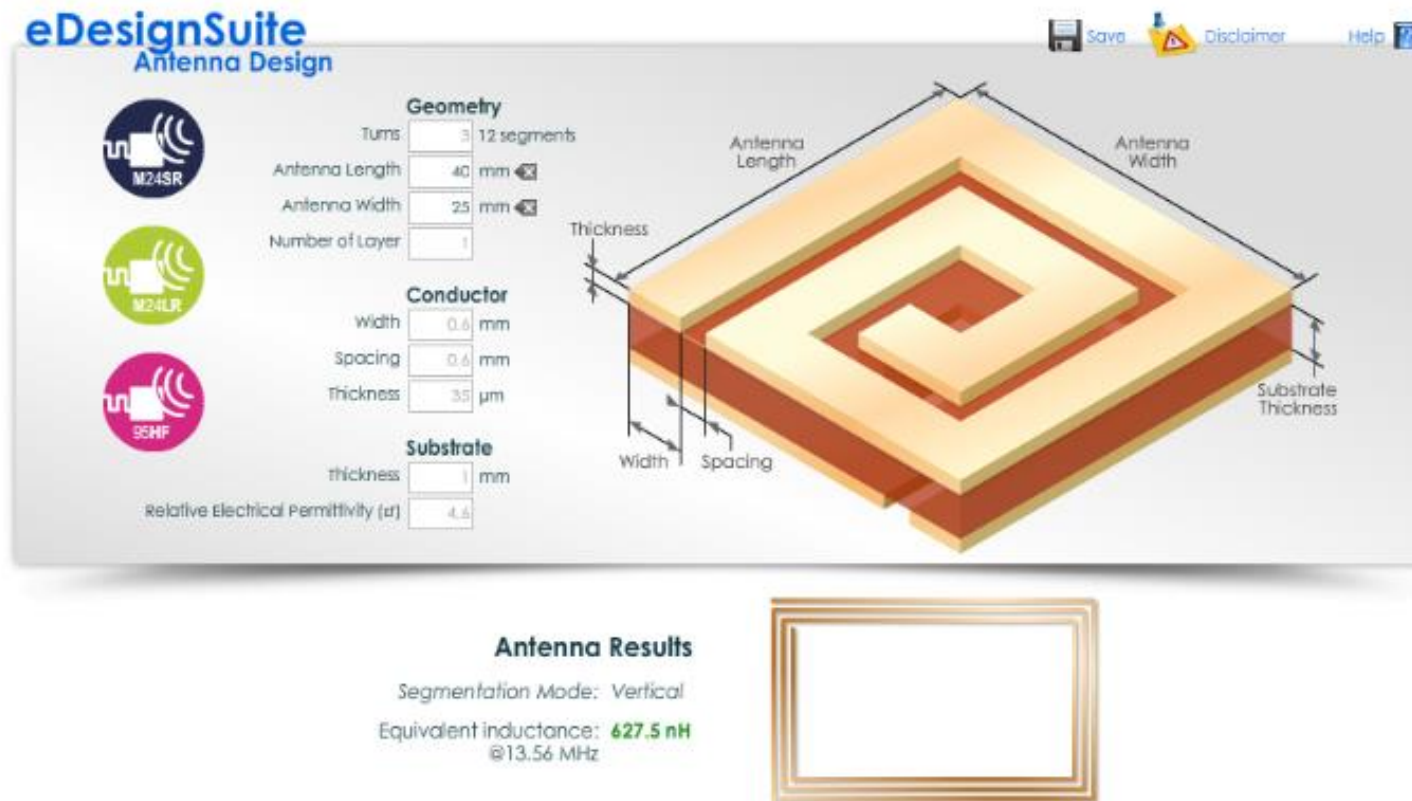
(*) from partner



Antenna e-design tool

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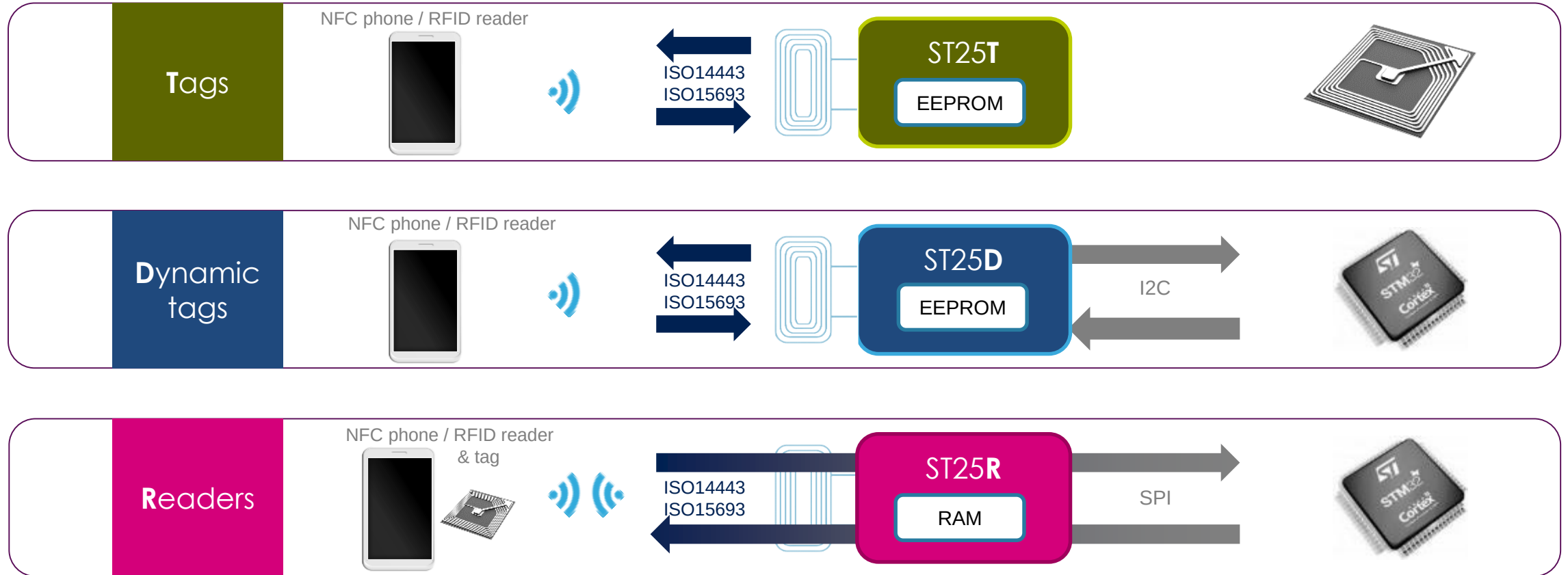
Fast and easy prototyping





ST25 product families

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ST25 portfolio

One-stop-shop for tags and readers

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Tags			Dynamic tags			HF Readers			UHF Readers	
ST25TA	ST25TB	ST25TV	M24SR	M24LR	ST25DV	CR95HF ST95HF	ST25R3909 * ST25R3910	ST25R3911B - ST25R3915	ST25RU3991 * ST25RU3992 *	ST25RU3993 ST25RU3980
ISO14443-A 106kb/s NFC type 4	ISO14443-B 106kb/s	ISO15693 up to 53kb/s NFC type 5	ISO14443-A 106kb/s NFC type 4	ISO15693 up to 53kb/s	ISO15693 up to 53kb/s NFC type 5	ISO14443-A/B ISO15693	ISO14443-A/B ISO15693 FeliCa	ISO14443-A/B FeliCa ISO15693 ISO18092	ISO18000 6c & b Gen2 Protocol	ISO18000 6c & b Gen2 Protocol
EEPROM 512b-64Kbit 40-year 1Mcycles	EEPROM 512b -Kbit 40-year 1Mcycles	EEPROM 2K & 64Kbit 40-year 1Mcycles	EEPROM 2Kbit to 64Kbit 200-year 1Mcycles	EEPROM 4Kbit to 64Kbit 40-year 1Mcycles	256Bytes buffer EEPROM 4Kbit to 64Kbit 40-year 1Mcycles	Reader / Writer Card Emulation	Reader / Writer Limited P2P	Reader / Writer P2P EMVco & PBOC AECQ100	Reader / Writer -66/86dBm sensitivity Internal VCO	Reader / Writer -90dBm sensitivity Internal VCO
128bit password 20bit counter UID Field Detect	32bit counters Lock OTP bits UID	32bit password UID	128bit password RF disable Field Detect	32bit password E-harvesting Field Detect	Fast transfer mode 64bit password E-harvesting Field Detect	-	AAT	VHBR AAT Multi Antenna Dynamic output power	Low noise VCO DRM compliant	Dense Reader Mode Linear RSSI Automatic PSRR Auto ACK
			I2C 2.7V - 5.5V 1MHz	I2C 1.8V - 5.5V 400kHz	I2C 1.8V - 5.5V 1MHz	2Mbit/s SPI & UART 2.7V - 5.5V 230mW	6Mbit/s SPI 2.4V - 3.6V 700mW max	6Mbit/s SPI 2.4V - 5.5V 1 - 1.4W max	2Mbit/s SPI 4.1V - 5.5V 0/20dBm Output	5Mbit/s SPI 2.7V - 3.6V 0/20dBm Output

(*) NRND: Not Recommended for New Design



RFID technologies at a glance

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RFID	LF	HF 	UHF 
Coupling mode	Inductive	Inductive	Electro-magnetic backscatter
Operating frequency	125kHz – 134kHz	13.56MHz	860MHz – 960MHz
Antenna	Coil	Coil	Dipole
Max operating distance	up to 1m	Vicinity: <1.5m Proximity: <10cm	~10m
Regulation	Worldwide harmonized	Worldwide harmonized	Different regulations per country
Standards	ISO14223 ISO18000-2	ISO14443 A/B ISO15693 ISO18092 ISO18000-3 NFC Forum	ISO18000-6 B/C EPC Class 1 Gen 2
Environmental influences	Small influence on operating distance Works in metal and industrial environment	Small influence on operating distance Works in metal and industrial environment	Influence on operating distance by reflection and absorption (metal and liquids)
Applications	Animal tagging	Product identification Public transport / Libraries Access control	Pallets and container ID Retail / Logistics Authentication



NFC technology at a glance

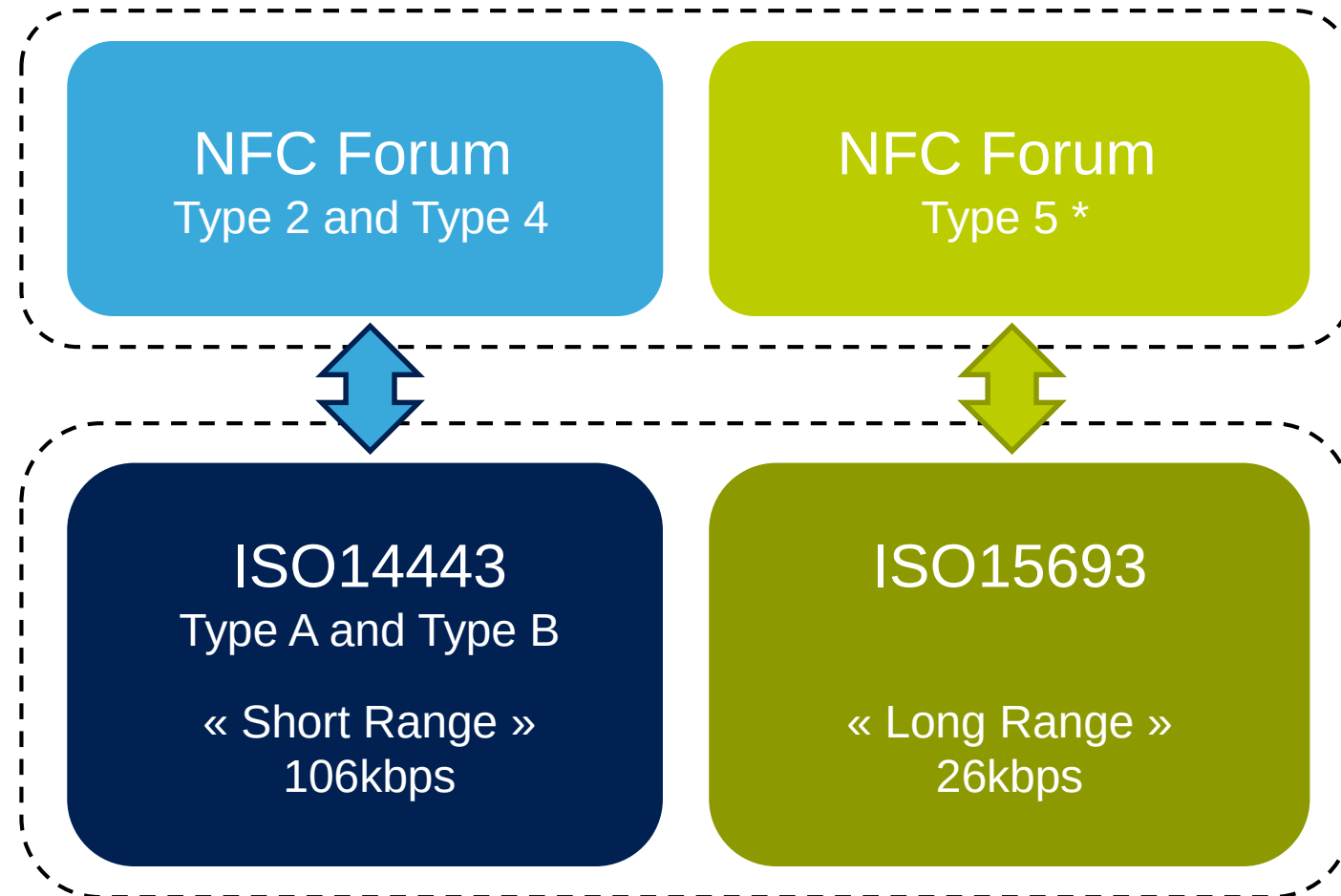
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- Near Field Communication, a **short range** wireless technology operating at **13.56MHz** based on the RFID HF standard (ISO14443 & ISO15693)
- **Interactive** and **zero power**, enabling convenient connection to the Internet of Things
- NFC is developed by the NFC Forum
 - **To ensure interoperability between devices**
 - **Makes complex devices simpler to use:**
 - Standard NFC data format (NDEF); ie URL hyperlink
 - Built-in handover in Android & Windows
- Fast growing deployment in Mobile
 - **In 2016, more than 60% of smartphones are compatible with NFC**
 - **NFC is the back-bone technology for ApplePay**



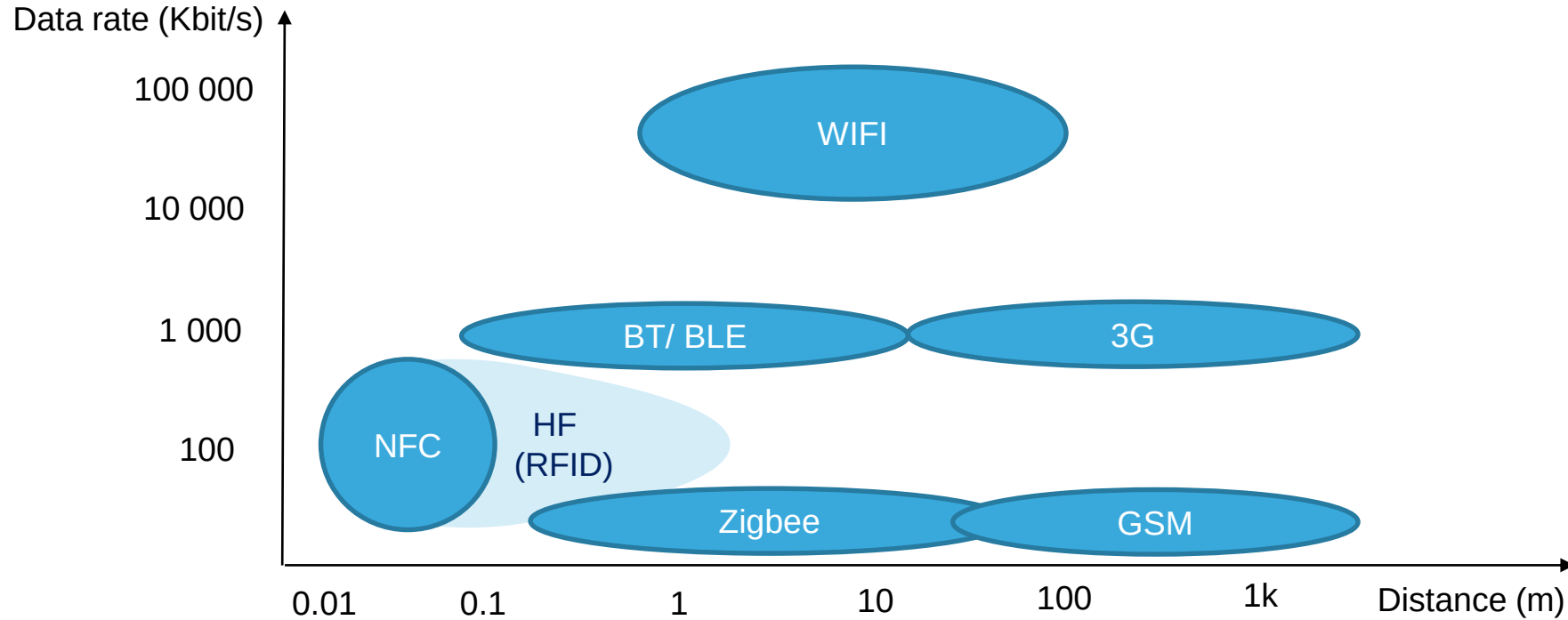


NFC specification
→ Upper layer SW



RFID HF ISO standards
→ HW / SW protocol

(*) ISO15693 integrated in NFC Forum specifications in October 2015 as NFC Forum type 5 (aka type V)

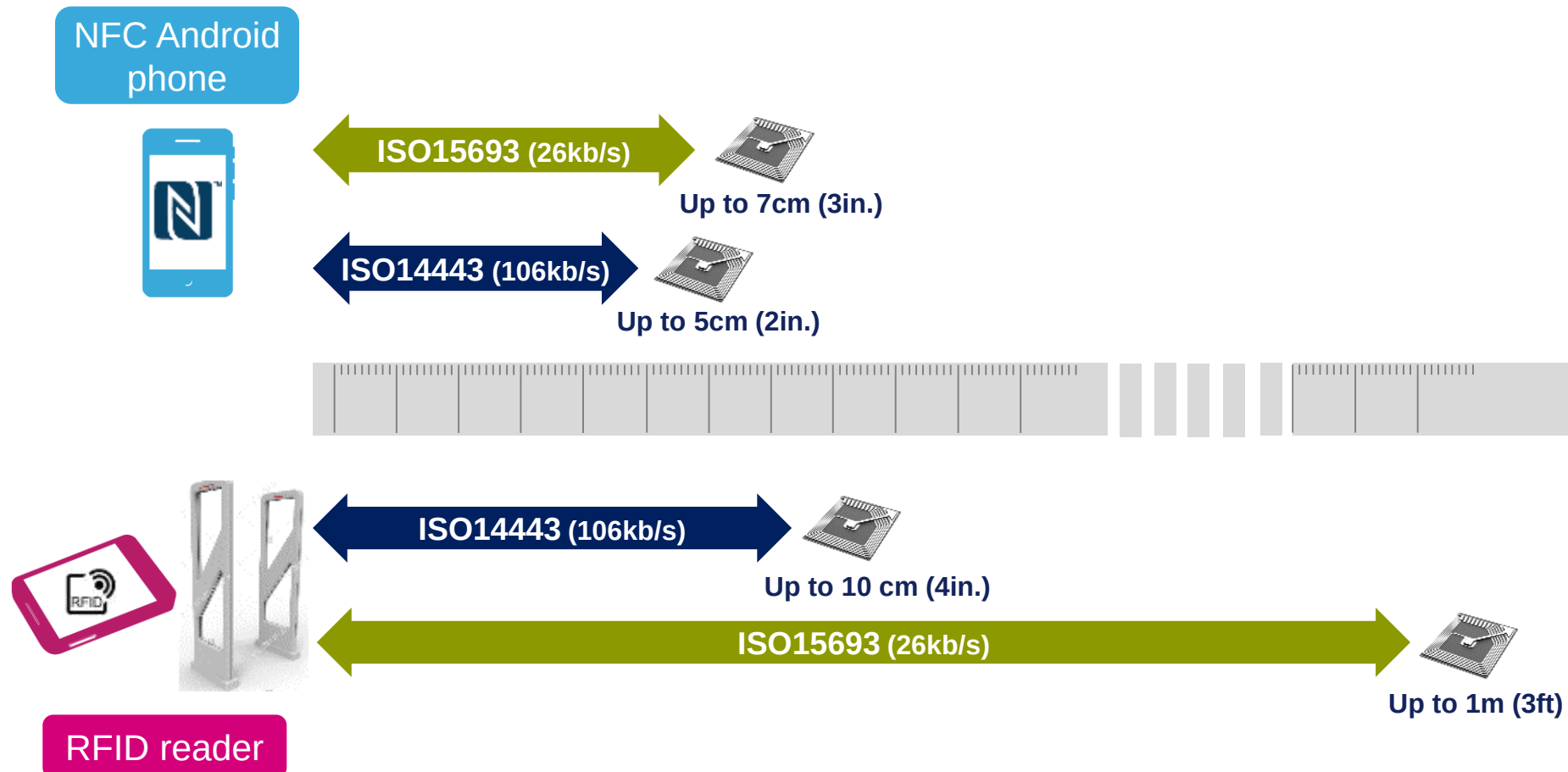


- NFC is a flavor of RFID
 - Subset of RFID HF standard: 13.56 MHz
- NFC is complementary in the wireless spectrum
 - Short distance, Low data-rate & Zero power for applications
- NFC is complementary to Wi-Fi and Bluetooth technologies
 - Tap & Pair: convenient pairing use case



Typical RF range

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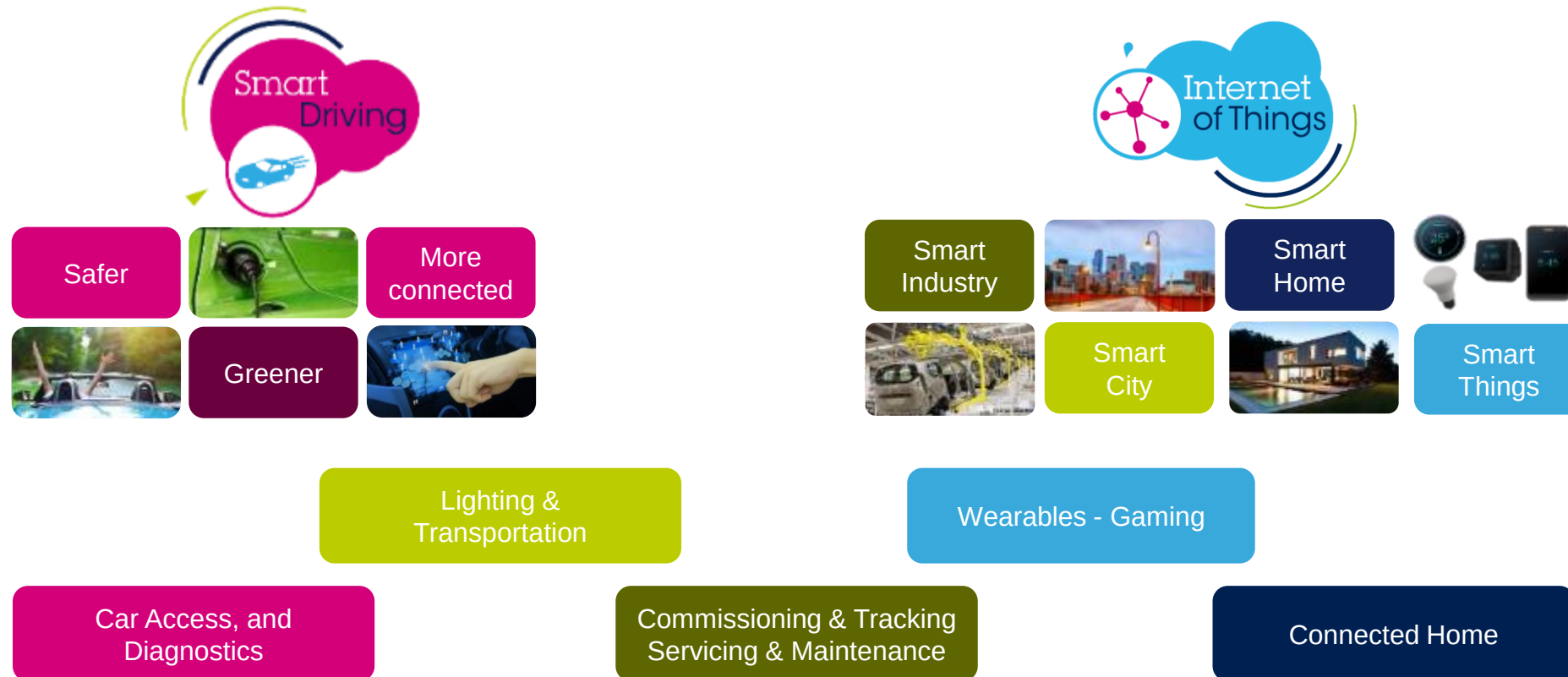


- ISO15693 is called « long range » standard
- ISO14443 is called « short range » standard while with higher RF speed



ST25 matching ST strategy

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ST25 series enriching our lives!

Key applications targeted

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ST25 – Mass market approach

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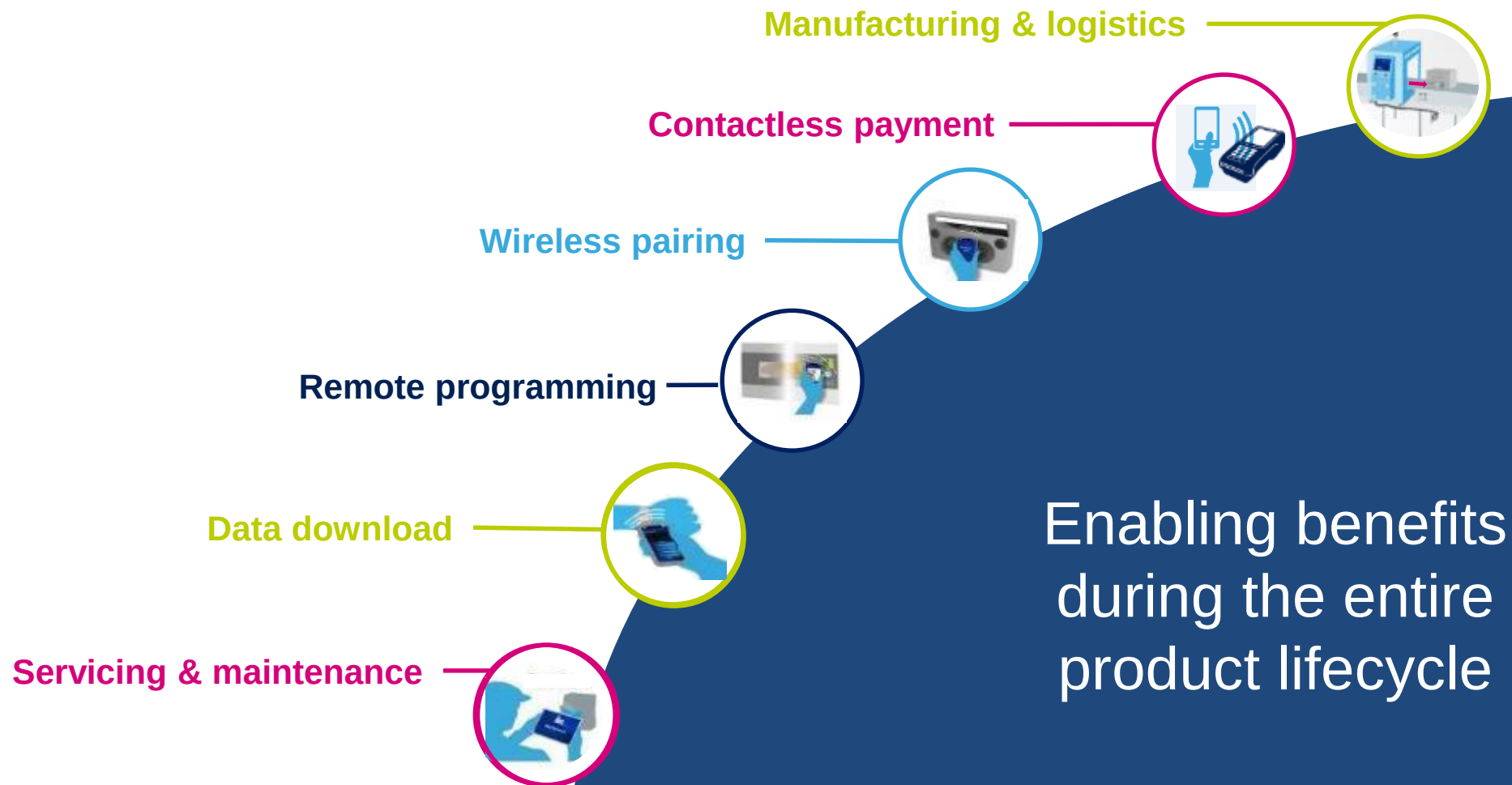


ST25 series
Tags, Dynamic tags
and Readers



ST25 value proposition

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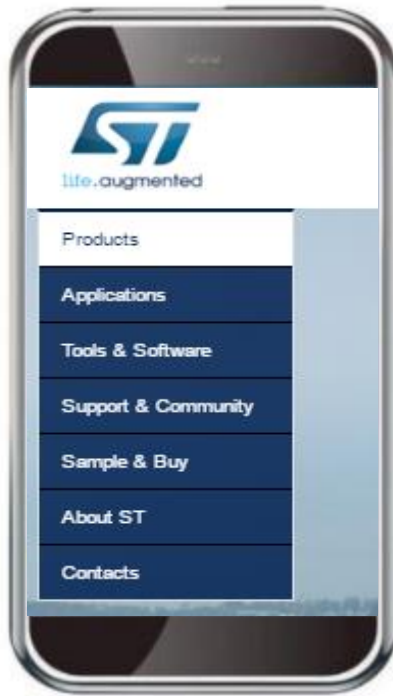


Key use cases for Tags and Dynamic Tags



URL link “tap & get web page”

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« Tap & get web page »



Built-in technology

Native support with NFC phone (NDEF)

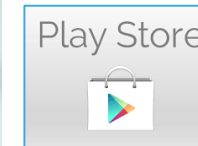
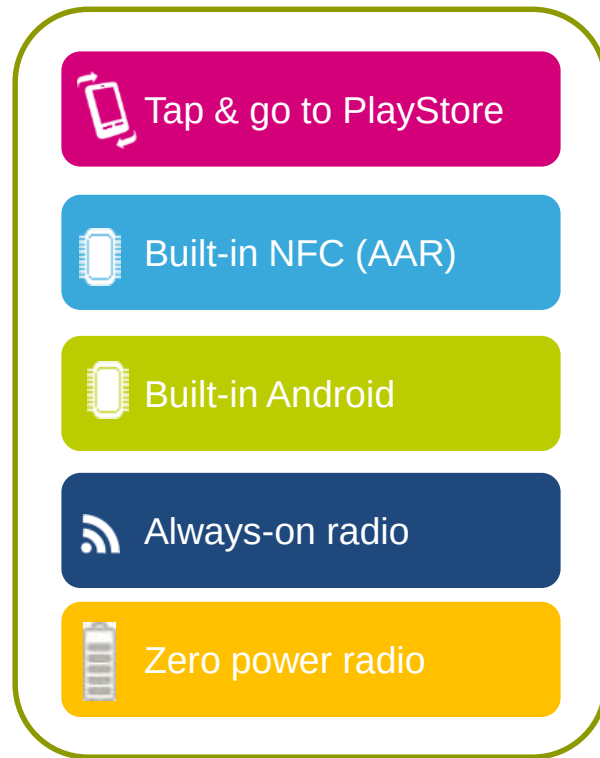
ST25 solution: tag





Android application “tap & download”

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Native support with NFC phone (NDEF)

ST25 solutions: tag / tag with field detect / tag with I2C





e-warranty card & customer registration

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Pre-program activation email in ST25 product
NFC built-in support in Android phones



« Tap & register »

To: customer.service@st.com

Subject: warranty activation #627123A58-A

Dear customer service,

I would like to activate the warranty card for item serial number #627123A58-A and apply for the 2-year program.

Native support with NFC phone (NDEF)

ST25 solutions: tag / tag with field detect / tag with I2C





Business card (vcard)

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« Tap & download vcard »



Built-in technology



Native support with NFC phone (NDEF)

ST25 solution: tag





Wireless pairing “tap & connect”

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Ease pairing by simple tap

Just wave your phone to pair



Multi-user management

Tap your phone to give or take control

Plug & play technology



Standard NFC data format (NDEF)

Built-in handover in Android & Windows



Zero impact on power budget

*ST25 NFC tag interface is zero power
and features field detect*



Native support with NFC phone (NDEF)

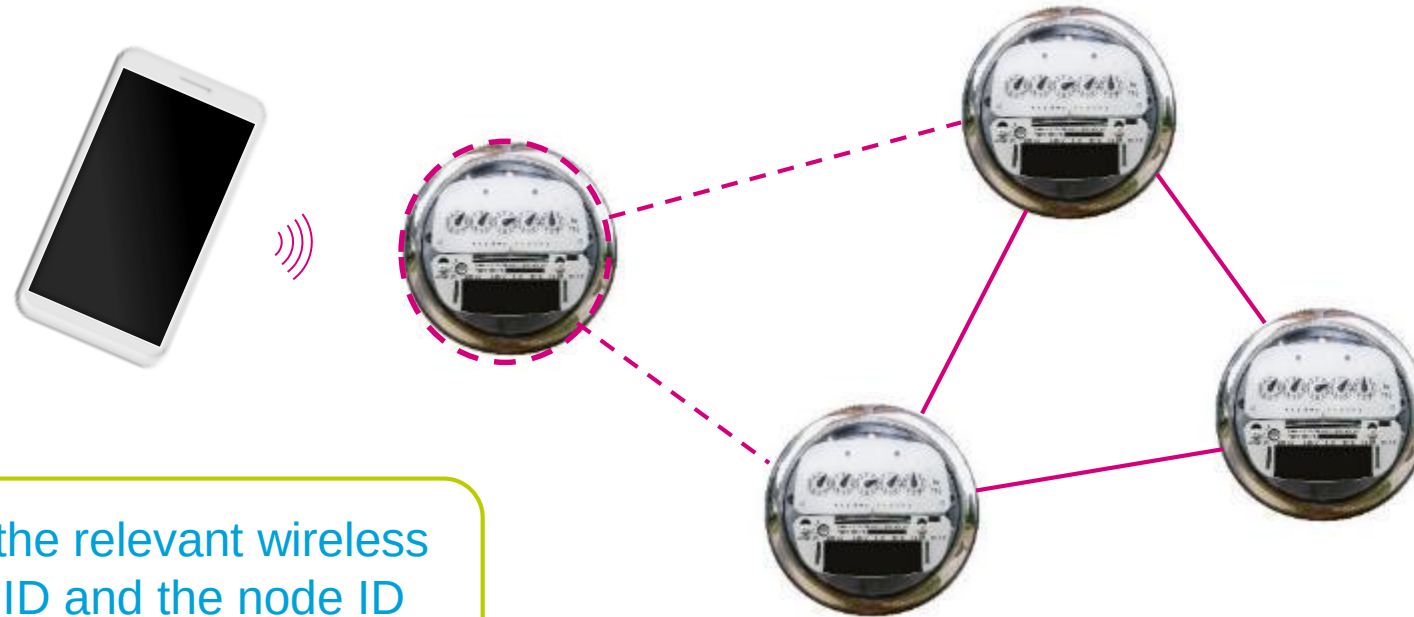
ST25 solutions: tag / tag with field detect / tag with I2C





Device commissioning within Wireless Networks

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Program the relevant wireless network ID and the node ID during installation

ST25 solution: tag with I2C





ST25 solution: tag with I2C



Seamless User Interface simplicity!

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Phone screen and App
as user interface

Bidirectional data exchange
From and to your device



Download data log or
upload new settings

From your device's
cradle to grave

ST25 solution: tag with I2C



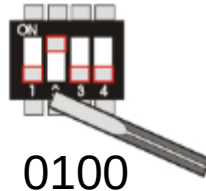


Device programming in production

Go contactless!

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“DIP switch / resistor” type of setting



- Device needs to be **powered**
- Programming device needs to be **plugged**



Contactless setting



- **In-the-box** programming
- **Simple** and **flexible**

ST25 solution: tag with I2C





Servicing & maintenance

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Download records history, update parameters even if device powered off !

Convenient

- Contactless connectivity
- Use smartphone / tablet display as user interface
- Operates even if device is off

Reliable

- Safe storage with reliable EEPROM
- Up to 1M erase-write cycles
- Up to 200year data retention

Cost effective

- NFC tag interface
- EEPROM & contactless interface in one device
- BOM = 1 loop antenna



ST25 solution: tag with I2C





Battery-less designs...

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Energy harvesting
from NFC RF field



NFC connectivity



Up to 5mA
with NFC reader

ST one-stop-shop
with low power MCU
and sensors

ST25 solution: tag with I2C and energy harvesting





ST25 series overview



One product line, many benefits

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Interactivity with NFC phones
With built-in use cases triggering
« Tap & ... »

Always-On, Zero power radio
NFC field, with energy harvesting
capability



Interoperability with
RFID readers

Highly reliable memory
1M cycles
up to 200years retention





ST25 series
Tags, Dynamic tags
and Readers



ST25 Tags and Dynamic Tags DNA

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Comprehensive portfolio

Feature-rich

- 13.56MHz interface
- I2C interface
- Energy harvesting
- 20-bit Counter
- Field Detect GPO

High volume & quality

- In-house manufacturing
- Leveraging Automotive EEPROM quality
- Leveraging Consumer EEPROM volume

Standard compliant

- NFC Forum
- ISO14443
- ISO15693



Front-End
& Back-End
Manufacturing



Best-In-Class memory



- Up to 200 year retention
- 1M erase-write cycles
- From 512bit to 64-Kbit
- 128-bit password





ST25 series
Tags, Dynamic tags
and Readers



ST25 Readers DNA

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Comprehensive portfolio

High performing HF Readers

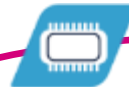
- 13.56 MHz frequency
- Very High Bit Rate (6.8Mbit/s)
- Automatic Antenna Tuning
- Multi Antenna support
- High and Dynamic power output (1.4W)
- Capacitive / Inductive wake up
- Operating temperature -40°C to +125°C

High performing UHF Readers

- 840-960 MHz frequency range
- High Receive Sensitivity (-90dBm)
- Low noise Voltage Controlled Oscillator
- Integrated Dense Reader Mode filters
- Tag movement detection

Standard Compliant

- NFC Forum
- ISO14443
- ISO15693
- ISO18092
- ISO18000



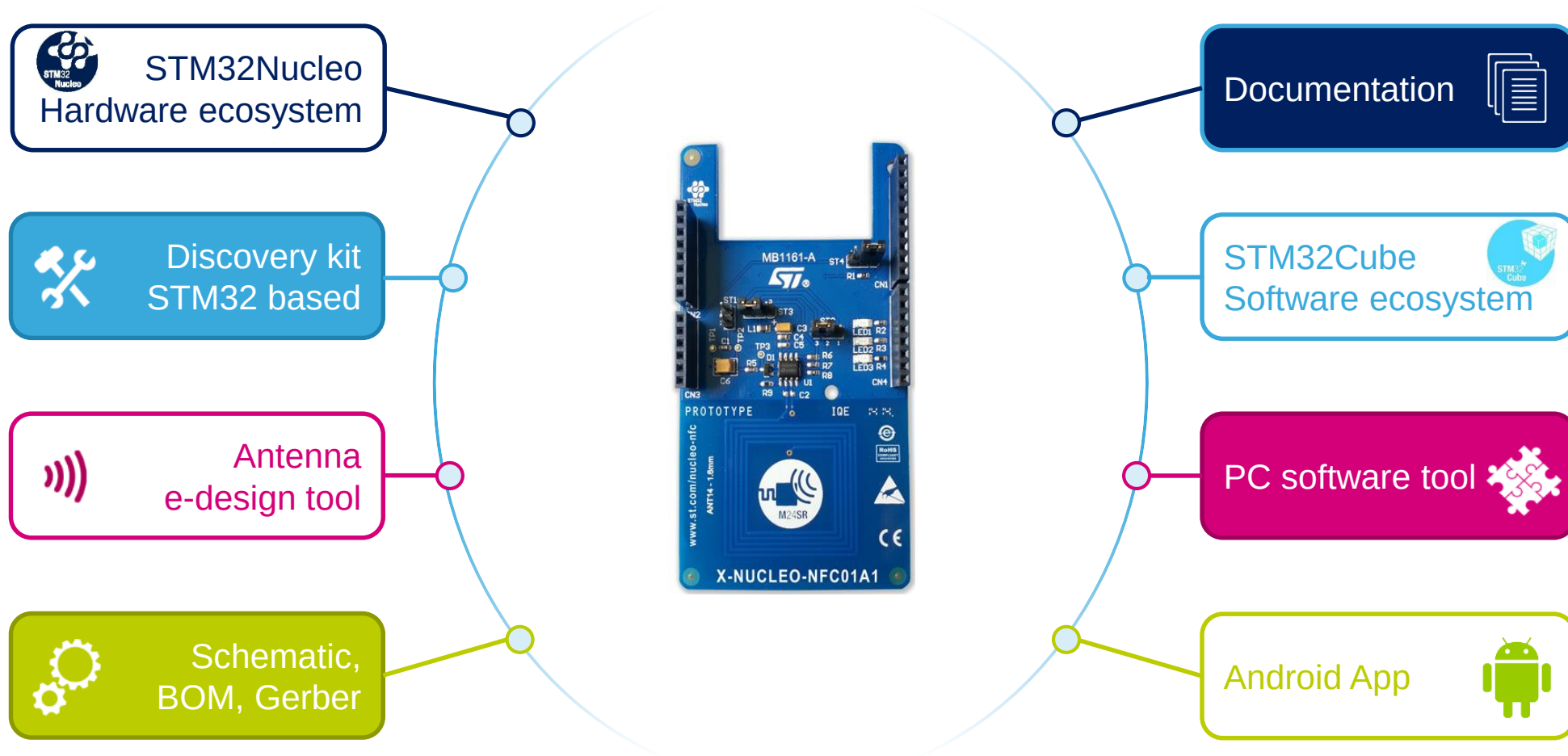
Certification

- EMVco
- PBOC
- AECQ100





Easy-to-use and customer-oriented



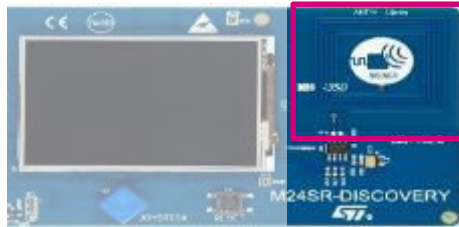


Easy antenna integration

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Just need a loop antenna

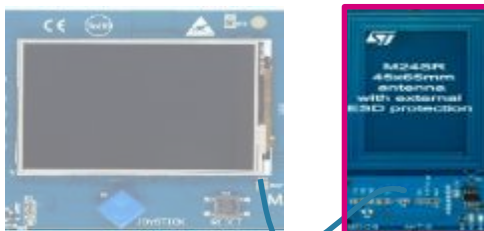
On-board antenna



On-board inductor



Off-board



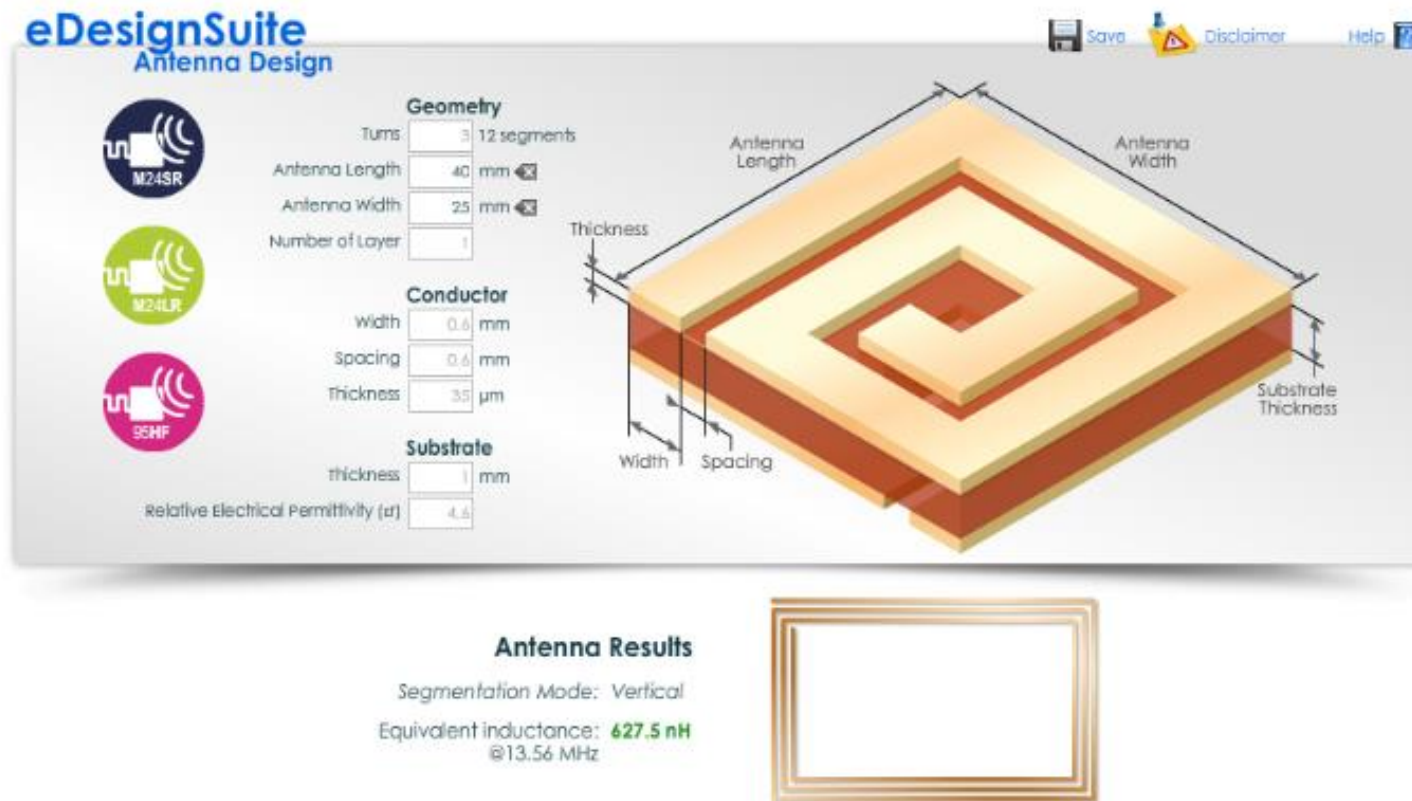
Sticker tag (*)



(*) from partner



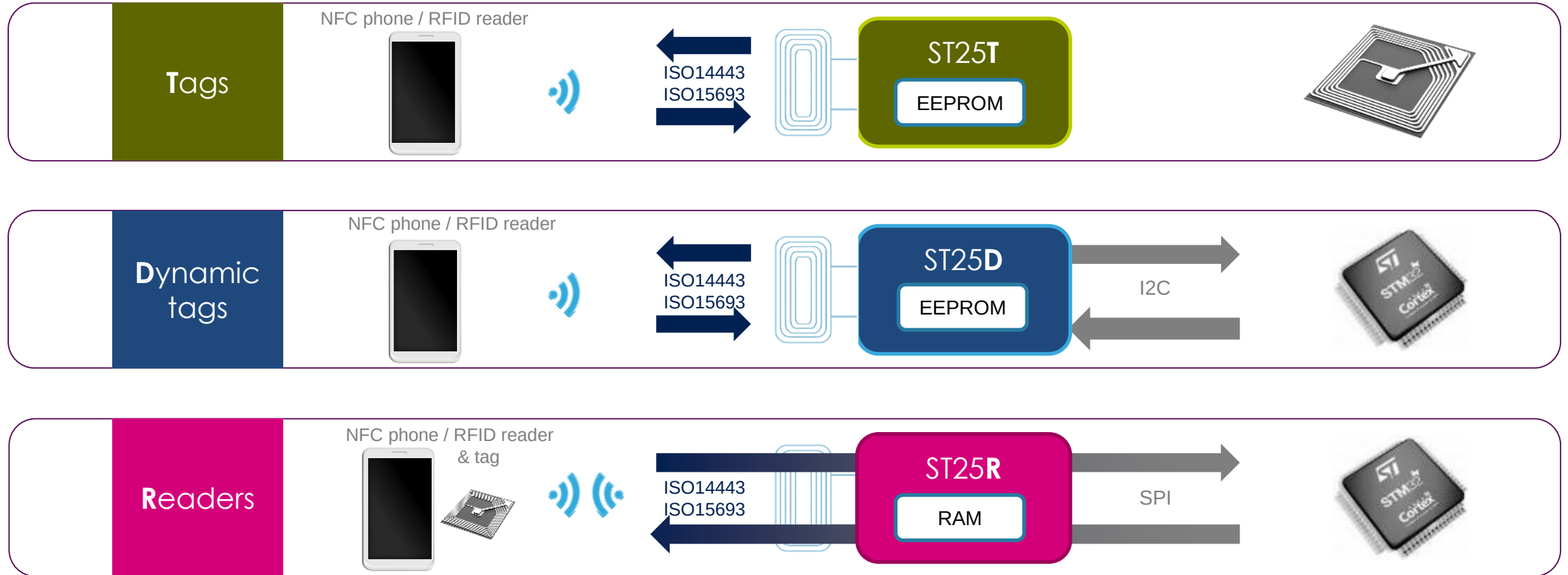
Fast and easy prototyping





ST25 product families

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ST25 portfolio

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One-stop-shop for tags and readers

Tags			Dynamic tags			HF Readers			UHF Readers	
ST25TA	ST25TB	ST25TV	M24SR	M24LR	ST25DV	CR95HF ST95HF	ST25R3909 * ST25R3910	ST25R3911B - ST25R3915	ST25RU3991 * ST25RU3992 *	ST25RU3993 ST25RU3980
ISO14443-A 106kb/s NFC type 4	ISO14443-B 106kb/s	ISO15693 up to 53kb/s NFC type 5	ISO14443-A 106kb/s NFC type 4	ISO15693 up to 53kb/s	ISO15693 up to 53kb/s NFC type 5	ISO14443-A/B ISO15693	ISO14443-A/B ISO15693 FeliCa	ISO14443-A/B FeliCa ISO15693 ISO18092	ISO18000 6c & b Gen2 Protocol	ISO18000 6c & b Gen2 Protocol
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128bit password 20bit counter UID Field Detect	32bit counters Lock OTP bits UID	32bit password UID	128bit password RF disable Field Detect	32bit password E-harvesting Field Detect	Fast transfer mode 64bit password E-harvesting Field Detect	-	AAT	VHBR AAT Multi Antenna Dynamic output power	Low noise VCO DRM compliant	Dense Reader Mode Linear RSSI Automatic PSRR Auto ACK
			I2C 2.7V - 5.5V 1MHz	I2C 1.8V - 5.5V 400kHz	I2C 1.8V - 5.5V 1MHz	2Mbit/s SPI & UART 2.7V - 5.5V 230mW	6Mbit/s SPI 2.4V - 3.6V 700mW max	6Mbit/s SPI 2.4V - 5.5V 1 - 1.4W max	2Mbit/s SPI 4.1V - 5.5V 0/20dBm Output	5Mbit/s SPI 2.7V - 3.6V 0/20dBm Output

(*) NRND: Not Recommended for New Design



Product ID cards



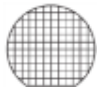
ST25T – RFID Tags



LRI2K



RF Tag	ISO 15693	EEPROM 2K-bit
	Long Range 26kb/s (53kb/s)	010011011100001 101010101111101 001101010011100 64-bit UID



SBN18: sawn and
bumped inked 8" wafer,
180µm thickness

• Use cases

- Asset tracking
- Gaming
- Brand recognition, product identification
- Maintenance, repair and operations

• Key features

- **ISO15693**
- **NFC Forum Type 5**
- Long range with RFID reader
- RF tuning capacitor up to 97pF for tiny antenna design

• Key benefits

- Temperature range -20°C to +85°C
- 40 years data retention, 1M cycles erase/write



ST25TV64K RFID tags

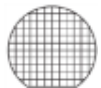
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ST25TV64K



RF Tag	ISO 15693	EEPROM 64K-bit
	Long Range 26kb/s (53kb/s)	010011011100001 101010101111101 001101010011100 64-bit UID 64-bit pwd



SBN12: sawn and
bumped inkless 8" wafer,
120µm thickness

• Use cases

- Asset tracking
- Gaming
- Brand recognition, product identification
- Maintenance, repair and operations

• Key features

- **ISO15693**
- **NFC Forum Type 5**
- Long range with RFID reader
- Data protection thanks to 32-bit password

• Key benefits

- Temperature range -40°C to +85°C
- 40 years data retention, **1M cycles** erase/write



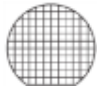
ST25TB RFID tags

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ST25TB512 / ST25TB02K / ST25TB04K

RF Tag	ISO 14443-B	EEPROM 512bit / 2K / 4K-bit
	Short Range 106kb/s	010011011100001 101010101111101 001101010011100  64-bit UID 32-bit counter x2



SBN12: sawn and
bumped inkless 8" wafer,
120µm thickness

• Use cases

- Mass transit and **Transport**
- Event ticketing
- Asset tracking
- Brand protection, identification

• Key features

- Fast data transfer (ISO14443-B)
- Large and flexible counting capability with anti-tearing feature
- ST25TB512-AT version dedicated to Transport

• Key benefits

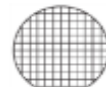
- Temperature range **-40°C to +85°C**
- 40 years data retention, **1M cycles** erase/write



RFID tag product family

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	LRI2K	ST25TV64K	ST25TB512 ST25TB02K ST25TB04K
Contactless Interface	ISO15693 NFC Forum Type 5	ISO15693 NFC Forum Type 5	ISO14443B
RF range	Long range Up to 100cm	Long range Up to 100cm	Short range Up to 10cm
RF speed	26kbps (53kbps)	26kbps (53kbps)	106kbps
Memory format	EEPROM data	EEPROM data	EEPROM data
Memory size	2-Kbit	64-Kbit	512-bit & 2 / 4-Kbit
Data protection	Write protect lock	Password 32-bit	OTP bits
Counter	NA	NA	Counter 32-bit
RF tuning capacitor	21pF & 97pF	27.5pF	64pF
Temperature range	-20°C to +85°C	-40°C to +85°C	-40°C to +85°C
Package	SBN18 ²	SBN12 *	SBN12 *



² SBN18: Die form, sawn and Bumped wafer, 180µm thickness, inked 8" wafer

* SBN12: Die form, sawn and Bumped wafer, 120µm thickness, inkless 8" wafer

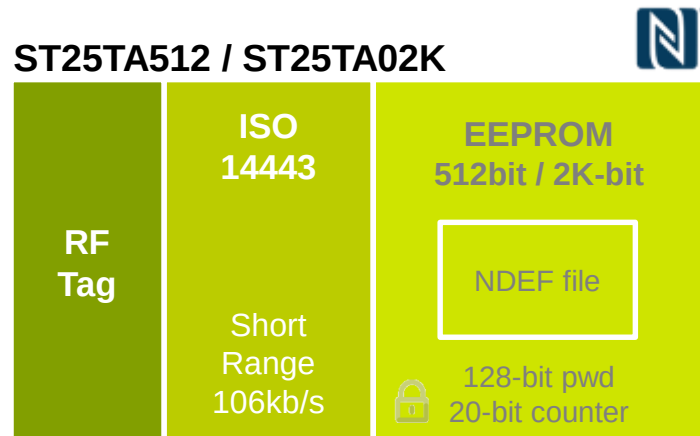


ST25T – NFC Tags



ST25TA low density NFC tags

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- Use cases
 - NFC token, NFC tag
 - Smart poster, Gaming
 - NFC business card (name card, vcard)
- Key features
 - **NFC type 4** (ISO14443 Type A)
 - High speed operations (106kb/s)
 - NDEF memory format
 - Data protection thanks to 128-bit password
 - Counter 20-bit
- Key benefits
 - Optimized PCB footprint
 - 50pF internal RF tuning capacitor allowing small antenna design
 - **200 years** data retention, 1M cycles erase/write



ST25TA02K-P / -D NFC tag

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ST25TA02K-P / -D



RF Tag	ISO 14443	EEPROM 2K-bit
	Short Range 106kb/s	NDEF file 128-bit pwd 20-bit counter
Digital output (GPO for MCU wake up)		



FPN5



FPN8



SBN12: sawn and bumped inkless 8" wafer, 120µm thickness

• Use cases

- Convenient wireless **pairing**

- Bluetooth pairing
- Wifi static pairing

• Key features

- NFC type 4 (ISO14443 Type A)
- NDEF memory format
- Data protection thanks to 128-bit password
- -P: CMOS_P GPO (active high, no external resistor)
- -D: Open Drain GPO (active low)

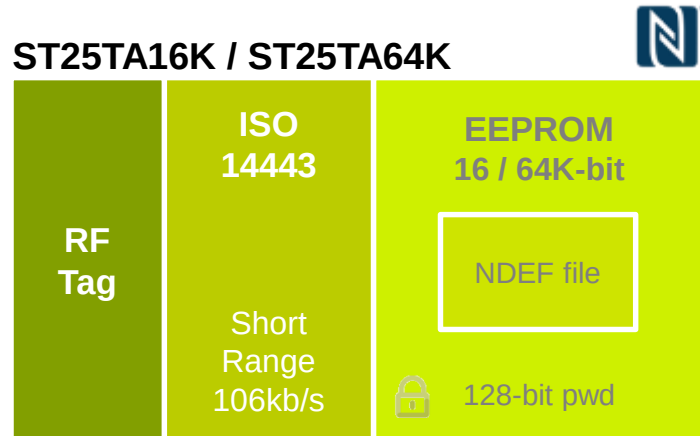
• Key benefits

- Tiny **FPN5** package (1.7x1.4mm)
- 50pF internal RF tuning capacitor allowing small antenna design
- 200 years data retention, 1M cycles erase/write



ST25TA high density NFC tags

49



- Use cases

- Smart poster, Gaming
- NFC token
- NFC business card (name card, vcard) with ID picture, web-link, extra digital contents

- Key features

- **NFC type 4** (ISO14443 Type A)
- High speed operations (106kb/s)
- NDEF memory format
- Data protection thanks to 128-bit password

- Key benefits

- **Large memory size** (up to 64Kbit)
- Same RF antenna design as M24SR product
- 200 years data retention, 1M cycles erase/write



NFC tag product family

50



ST25TA16K
ST25TA64K

ST25TA512
ST25TA02K

ST25TA02K-P
ST25TA02K-D

Contactless Interface

ISO14443A, NFC Type 4

RF range

Short range (up to 10cm)

RF speed

106kbps

Memory format

EEPROM (preformatted NDEF file)

Memory size

16 / 64-Kbit

512-bit / 2-Kbit

2-Kbit

Data protection

128-bit password

Digital output
(GPO for MCU wake-up)

NA

Field detect
CMOS_P or Open-drain

Counter

NA

20-bit counter

RF tuning capacitor

25pF

50pF

Temperature range

-40°C to +85°C

Package

SBN12 *

FPN5 / FPN8
/ SBN12 *



* SBN12: Die form, sawn and Bumped wafer, 120µm thickness, inkless 8" wafer

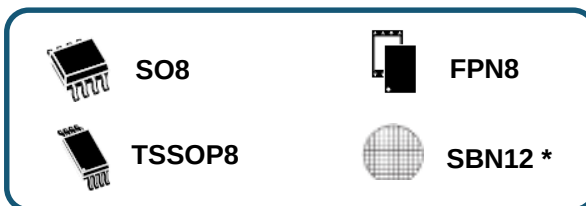
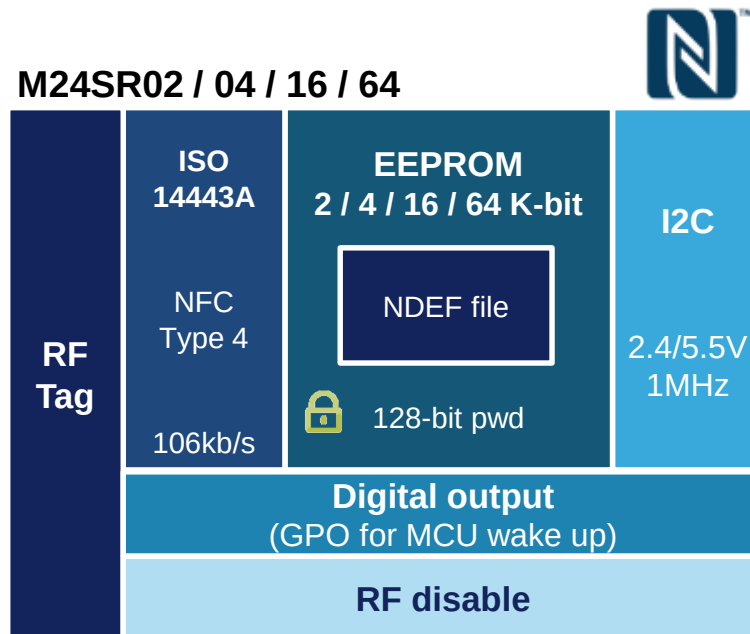


ST25D – Dynamic Tags



M24SR dynamic NFC tags

52



* : sawn and bumped inkless 8" wafer, 120µm thickness
(for M24SR02 and M24SR64)

- Use cases

- Convenient wireless pairing (Bluetooth, WiFi)
- Dynamic data exchange with NFC phone
 - User settings update, information log download,...

- Key features

- **NFC Type 4** (ISO14443 Type A)
- High speed operations (106kb/s)
- NDEF memory format
- Data protection (128-bit password)

- Key benefits

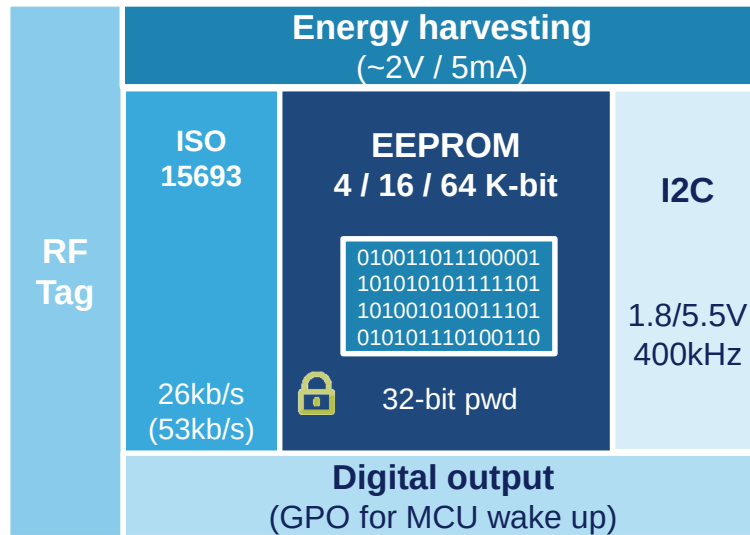
- Easy of use (limited BOM, 8-pin package)
- Flexible interrupt pin (configurable GPO)
- **200 years** data retention, **1M cycles** erase/write



M24LR dynamic NFC / RFID tags

53

M24LR04E / 16E / 64E

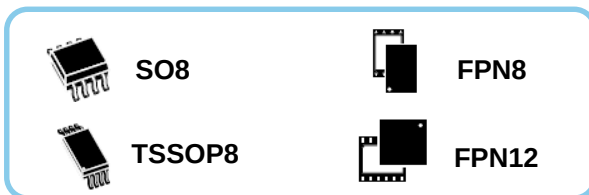
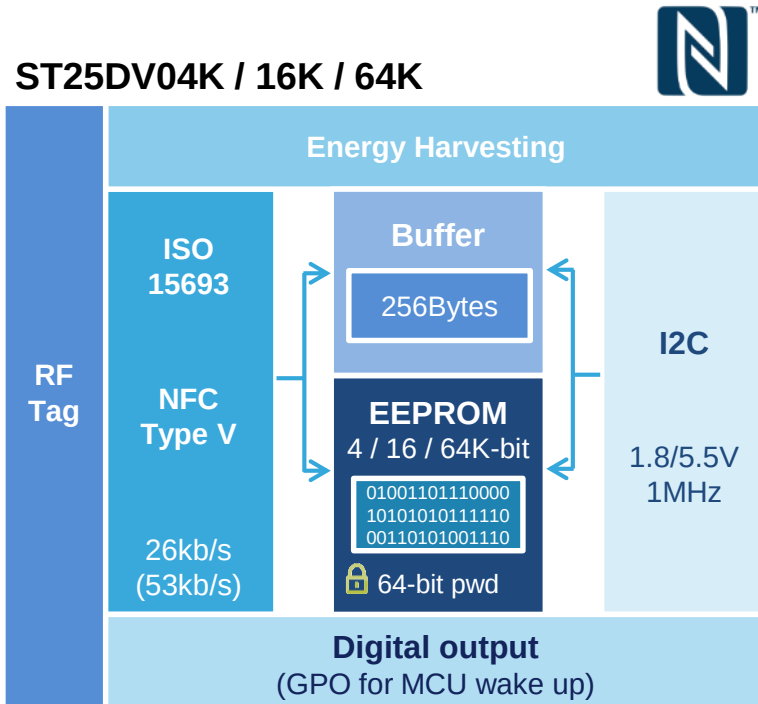


- Use cases
 - Dynamic data exchange with NFC phone
 - Battery-less applications
 - Parameter upgrade with RFID readers
- Key features
 - Energy harvesting through RF
 - ISO15693 long-range RFID (with high power RFID readers)
- Key benefits
 - Easy of use (limited BOM, 8-pin package)
 - Flexible interrupt pin for MCU wake-up
 - Cost optimized discovery kit with Android app
 - 40 years data retention, 1M cycles erase/write



ST25DV new dynamic NFC tag

54



- Use cases

- Dynamic data exchange with NFC phones and HF readers in long range
 - Fast data transfer for MCU FW upgrade, data exchange, parameters settings and update, data log download,...
- Battery less applications

- Key Features

- **ISO15693** and **NFC Type V** + annexes 3 & 4
- Long range operations, up to 53kb/s speed
- **Fast data transfer** thanks to 256 Bytes buffer
- Low Power mode, < 1μA power consumption in Standby
- **Energy harvesting** function through RF

- Key Benefits

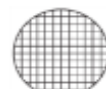
- Smart applications using a **flexible interrupt GPO**
- Enhanced protection with multiple **64-bit passwords**
- Cost optimized discovery kit with Android app
- Same 27.5pF internal RF tuning capacitor, as in M24LR



Dynamic NFC / RFID tags

55

	M24SR series	M24LR series	ST25DV series
Contactless Interface	ISO14443A NFC Type 4	ISO15693 NFC compatible	ISO15693 NFC Type 5
RF range	Short range (up to 10cm)	Long range (up to 1m)	Long range (up to 1m)
RF speed	106kbps	26kbps	26kbps
Serial Interface	I2C @1MHz	I2C @400kHz	I2C @1MHz
Fast Transfer mode	No	No	Yes (256B buffer)
Energy Harvesting	No	Yes	Yes
Digital output	Open-Drain GPO	Open-Drain GPO	OD or CMOS GPO
Extra features	RF Disable	-	Low Power mode
Memory format	EEPROM (preformatted NDEF file)	EEPROM data	EEPROM data
Memory size	2 / 4 / 16 / 64-Kbit	4 / 16 / 64-Kbit	4 / 16 / 64-Kbit
Data protection	Password 128-bit	Password 32-bit	Password 64-bit
Temperature range	-40°C to +85°C	-40°C to +85°C	-40°C to +85°C
Package	SO8 / TSSOP8 / FPN8 / SBN12 *	SO8 / TSSOP8 / FPN8	SO8 / TSSOP8 / FPN8 / FPN12

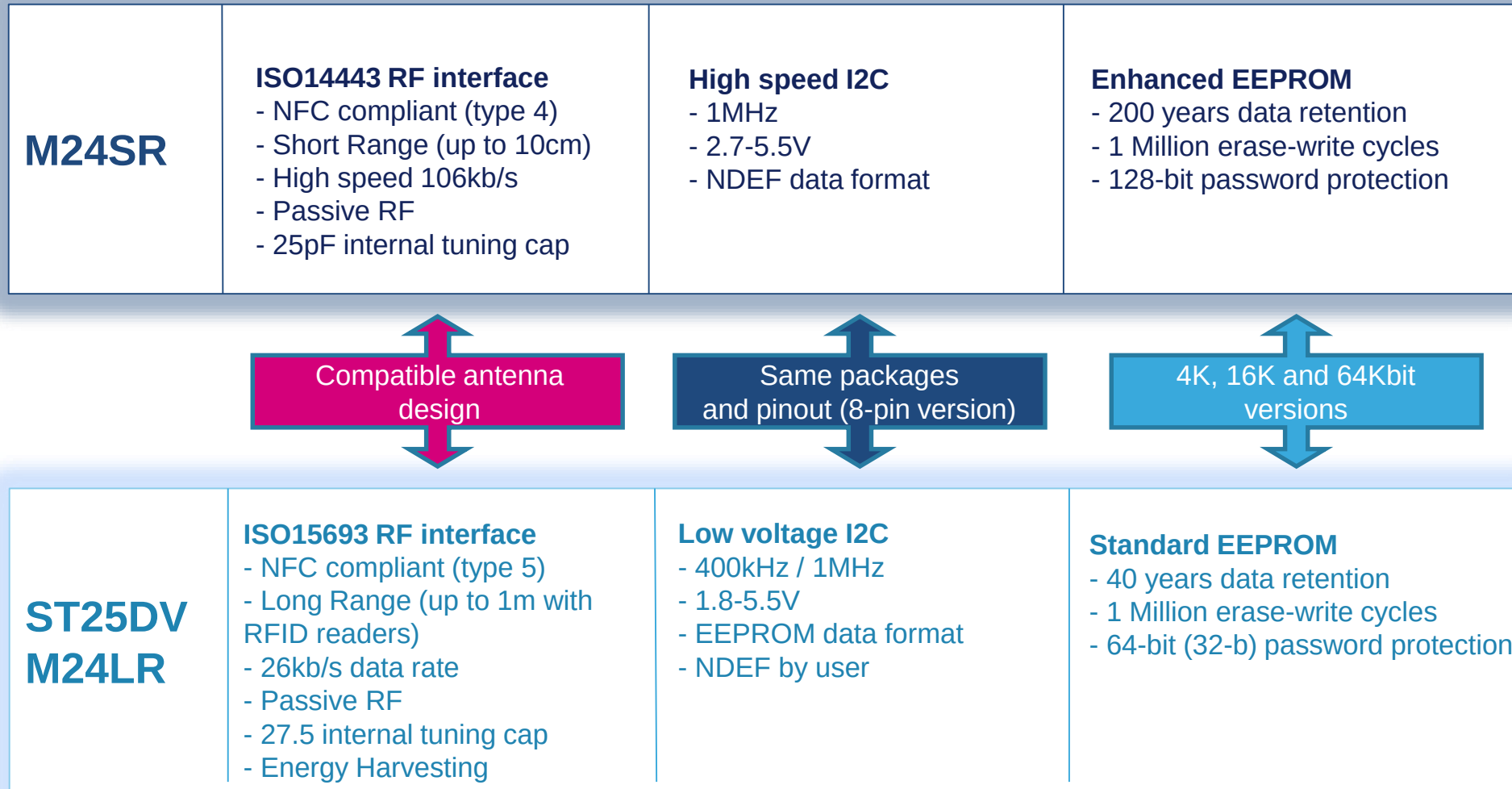


* SBN12: Die form, sawn and Bumped wafer, 120µm thickness, inkless 8" wafer



Design compatibility

56





RF tuning capacitance

57

Product	ST25DV / M24LR	M24SR
Standard	ISO15693	ISO14443
Main carrier frequency	13.56MHz	13.56MHz
Data sub-carrier frequency	+ 424kHz	+ 848kHz
Optimal frequency tuning	13.6MHz – 14MHz	14MHz – 14.4MHz
Internal capacitor (measured at 0.5V)	28.5pF / 27.5pF	25pF
Recommended internal capacitor value for antenna design	30pF / 29pF	27pF

- The M24SR chip has a lower the internal capacitor value than the ST25DV / M24LR's one (25pF versus 27.5pF/28.5pF) in order to allow the usage of the same antenna design.

M24LR 40x20mm
rectangular antenna



M24SR 40x20mm
rectangular antenna





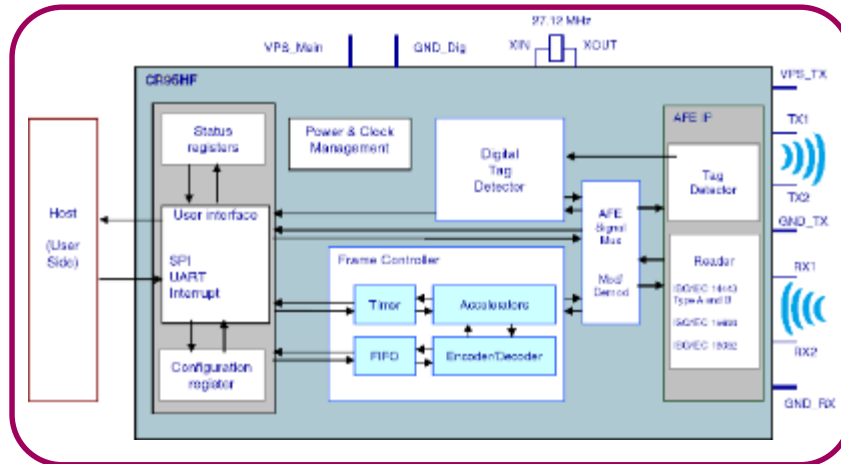
ST25R – HF Readers



CR95HF NFC / RFID reader

59

CR95HF



QFN32

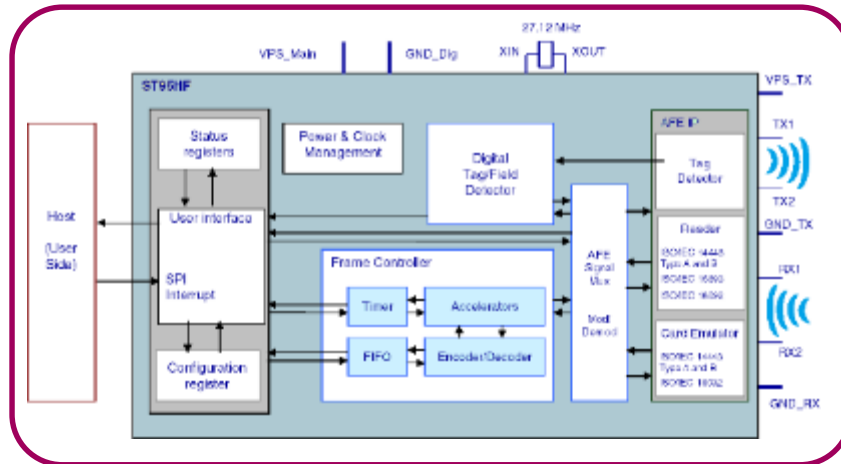
- Use cases
 - RFID / NFC reader
 - Product identification or authentication
 - Product configuration (parameter settings)
 - Access Control, Digital Door Locks
 - Medical, industrial & production reader equipment
- Key features
 - All NFC modes supported (ISO14443, ISO15693, FeliCa)
 - Low power modes
 - Fast data transfer (up to 848kb/s)
- Key benefits
 - Simple implementation / limited BOM
 - Easy-to-use evaluation / development kits
 - Reference designs, application notes
 - Cost effective solution



ST95HF NFC transceiver

60

ST95HF



QFN32

• Use cases

- Dynamic data exchange between a NFC phone and a NFC device
 - User settings update, information log download, firmware upgrade...
- Dynamic wireless pairing with hand-over

• Key features

- Reader-Writer (R/W) and **Card Emulation (CE)** modes supported
- All NFC modes supported in reader mode (ISO14443, ISO15693, FeliCa)
- Fast data transfer (up to 848kb/s)

• Key benefits

- Simple implementation / limited BOM
- Easy-to-use evaluation / development kits
- Reference designs, application notes
- Cost effective solution

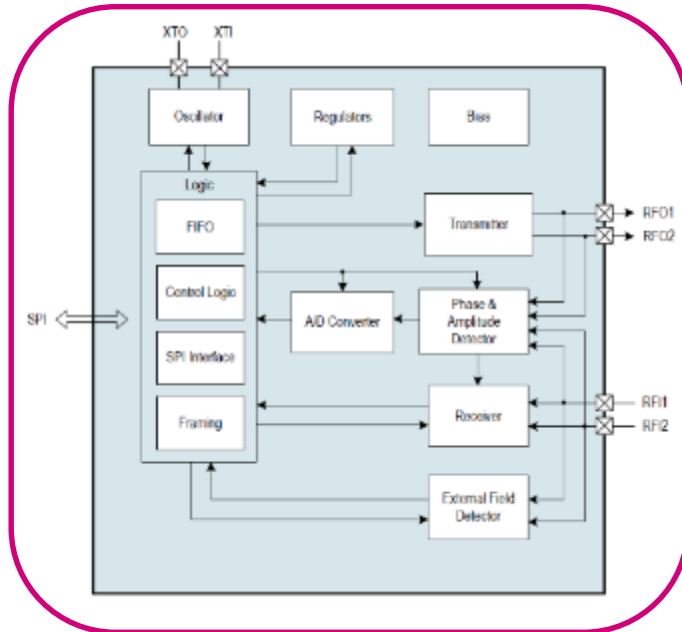


ST25R3910 HF Readers

700mW cost – perf balanced solution

61

ST25R3910



QFN32

• Use cases

• HF RFID Reader

- Access Control, Product Authentication, Handheld devices

• Best balance between cost and performance

- Ideal for applications where the reader antenna is directly driven (no 50Ω cable)

• Key features

- Data framing for ISO14443A/B
- 700mW output power at 3.3V
- **Automatic Antenna Tuning**

• Key benefits

- High Output Power
- Fast data transfer (up to 848kb/s)
- Good price / performance ratio
- Reference designs, application notes

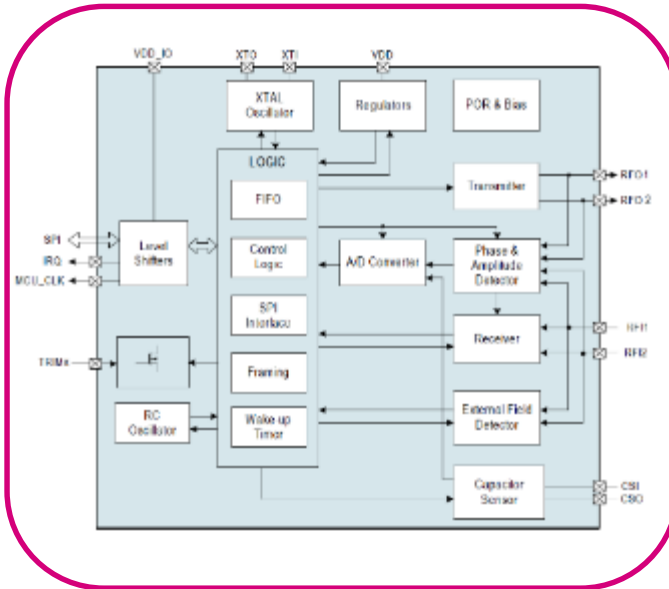


ST25R3911B NFC / RFID Reader

1.4W High Power Payment reader solution

62

ST25R3911B



QFN32



Wafer

• Use cases

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

• Key features

- NFC forum compatible (no passive target)
- **1.4W** output power at 5V
- Passes **EMVco** & **PBOC** certification without external power amplifier
- Automatic Antenna Tuning
- **VHBR** support up to 6.8Mb/s
- -40°C to **125°C** temperature range

• Key benefits

- Low power operation & standby
- Works in challenging environment
- Enhanced fast transfer rate for Passport
- Easy-to-use evaluation / development kits
- Reference designs, application notes

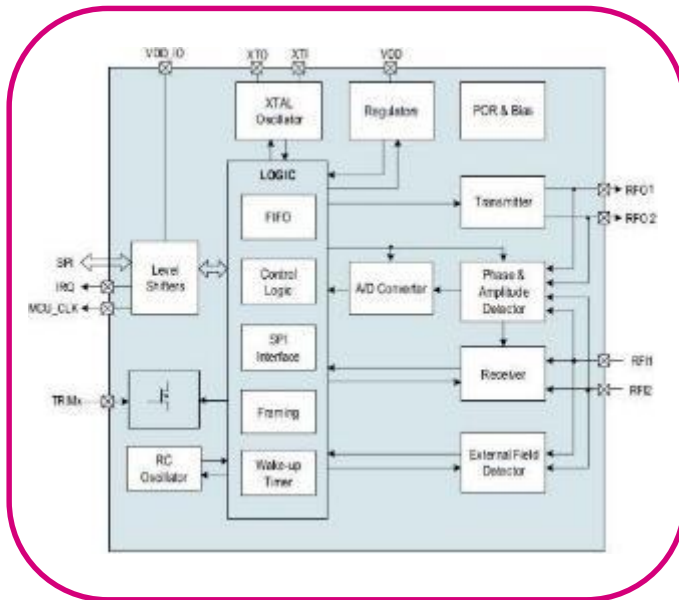


ST25R3912-13 NFC / RFID Reader

Smallest Footprint, High Power solution

63

ST25R3912 / 13



QFN32

WLCSP

• Use cases

- Ideal for **Payment** with small handheld mPOS
- Access Control, Gaming

• Key features

- NFC forum compatibility (no passive target)
- Passes **EMVco** & **PBOC** certification without external power amplifier
- 1W output power at 5V
- Inductive Wake up and AAT (AS3913 only)
- Small 3x2.8 **WLCSP** package (3912 only)
- -40°C to 125°C temperature range

• Key benefits

- No need of external boost
- Low power operation & Standby
- Support market Standard Crypto
- Smallest Footprint
- Easy-to-use evaluation / development kits
- Reference designs, application notes

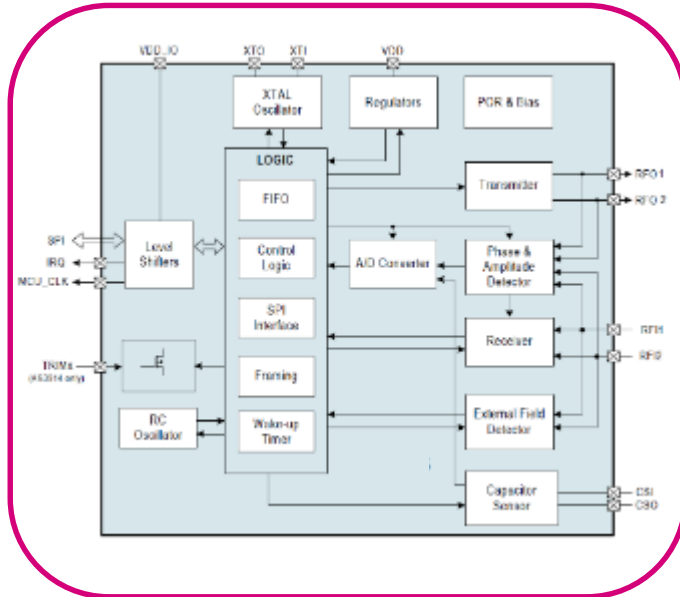


ST25R3914-15 NFC / RFID Reader

High Power Automotive solution

64

ST25R3914 / 15



QFN32

• Use cases

- Ideal for **Automotive** applications
 - keyless entry and start and driver authentication
- Data transfer, pairing, in car payment

• Key features

- NFC forum compatibility (no passive target)
- **AEC-Q100 grade 1** certified
- 1W output power at 5V
- Capacitive / Inductive Wake up
- Antenna Auto Tuning (3914 only)
- -40°C to **125°C** temperature range

• Key benefits

- No external power amplifier required
- Low power operation & Standby
- Reliable performance even in metallic environment
- Faster design times
- Easy-to-use evaluation / development kits
- Reference designs, application notes



ST25R HF readers

65

	CR95HF ST95HF	ST25R3910	ST25R3911B	ST25R3912	ST25R3913	ST25R3914	ST25R3915
Description	Entry-Level Reader	Mid-Range Reader	High-Perf Reader & NFC initiator suited for Payment / Passport applications			High-Perf Reader & NFC initiator suited for Automotive	
Reader/Writer mode	ISO14443A/B ISO15693 Felica	ISO14443A/B ISO15693 & FeliCa by Transparent mode	ISO14443A/B ISO15693 FeliCa			ISO14443A/B ISO15693 FeliCa	
Card emulation mode	Yes (ST95HF)	-	-			-	
P2P mode	-	-	Yes			Yes	
RF speed	848kbps	848kbps	6.8Mbps (VHBR)	848kbps		848kbps	
Market certification	-	-	Payment : EMVco, PBOC, mini-pay			Automotive AEC-Q100 Grade 1	
Advanced features	Ind wake-up	AAT, Ind wake-up	AAT, DPO, Cap & Ind wake-up	DPO, Ind wake-up	AAT, DPO, Ind wake-up	AAT, DPO, Cap & Ind wake-up	DPO, Cap & Ind wake-up
Interface	SPI 2Mbps UART (CR95HF)	SPI 6Mbps	SPI 6Mbps			SPI 6Mbps	
Power supply	2.7V - 5.5V	2.4V - 3.6V	2.4V – 5.5V			2.4V – 5.5V	
Output power	0.23W	0.7W	1.4W	1.0W		1.0W	
Temperature range	-25°C to +85°C	-40°C to +85°C	-40°C to +125°C	-40°C to +125°C		-40°C to +125°C	
Package	VFQFPN32 (5x5mm)	32-pin QFN (5x5mm)	32-pin QFN (5x5 mm) / Wafer	32-pin QFN (5x5 mm) / WLCSP	32-pin QFN (5x5 mm)	32-pin QFN (5x5 mm)	

VHBR: Very High Baud Rate
P2P: Peer to Peer mode
AAT: Automatic Antenna Tuning

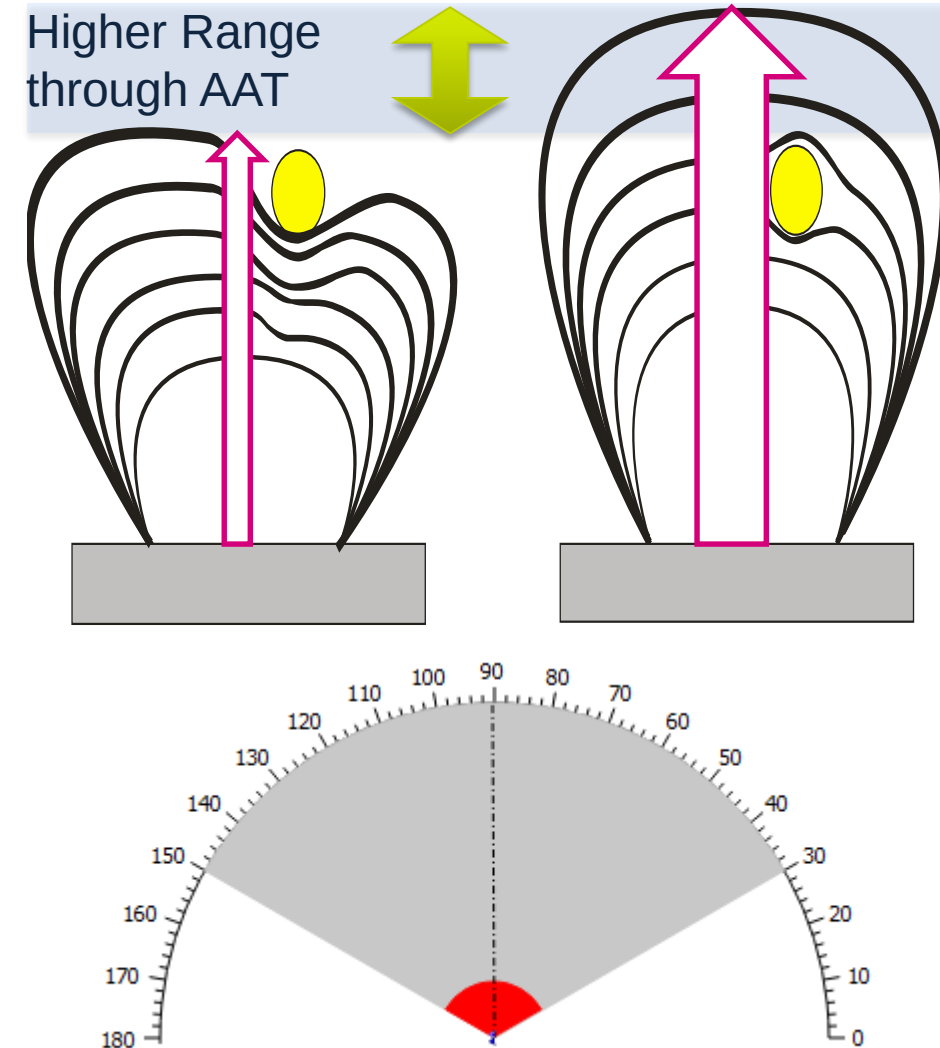
Cap & Ind wake-up: Capacitive & Inductive wake-up
VHBR: Very High Baud Rate
DPO: Dynamic Power Output



Automatic Antenna Tuning

66

- **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 Tag placement**
 - Multiple tags in the field can be compensated to transfer a maximum of power for each.
 - Ideal for **Gaming** applications.

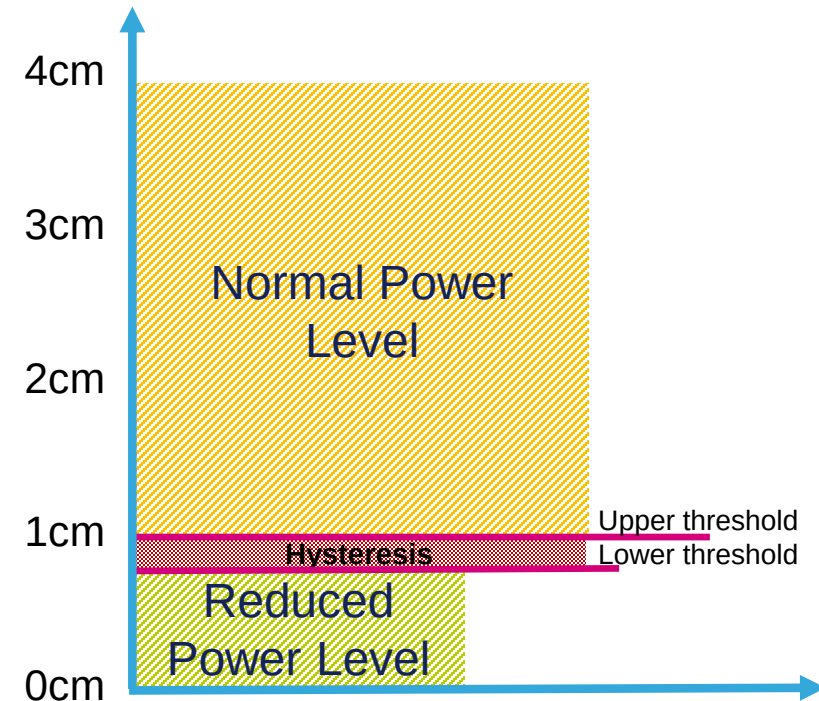




Dynamic Power Output

67

- **Achieve min/max power limits easier**
 - The ST25R reader allows to adjust the output power dynamically via Dynamic Power Output control.
- **Optimal performance from weak to strong card response**
 - The ST25R reader allows to adopt to different power level of card responses via Active Gain Control.
- **Improved noise immunity**
 - Squelch feature allows to scale the signal level to have improved immunity against noise.

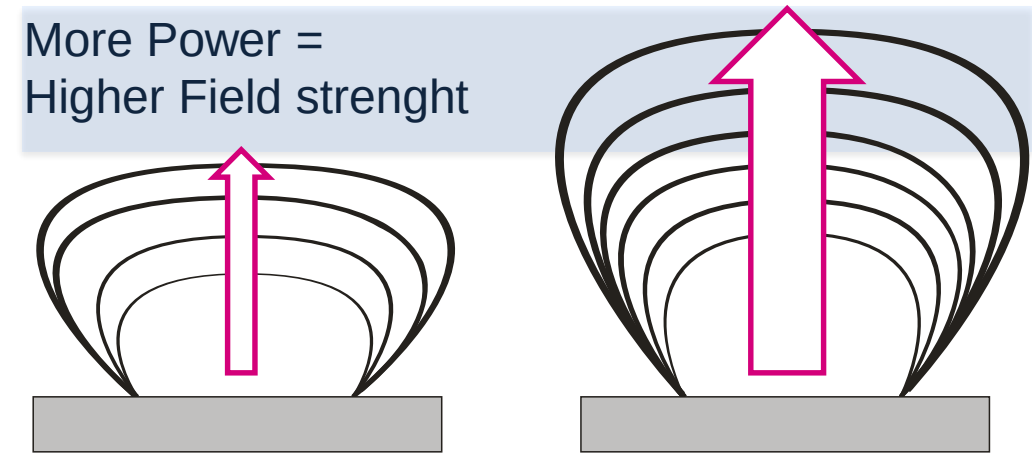




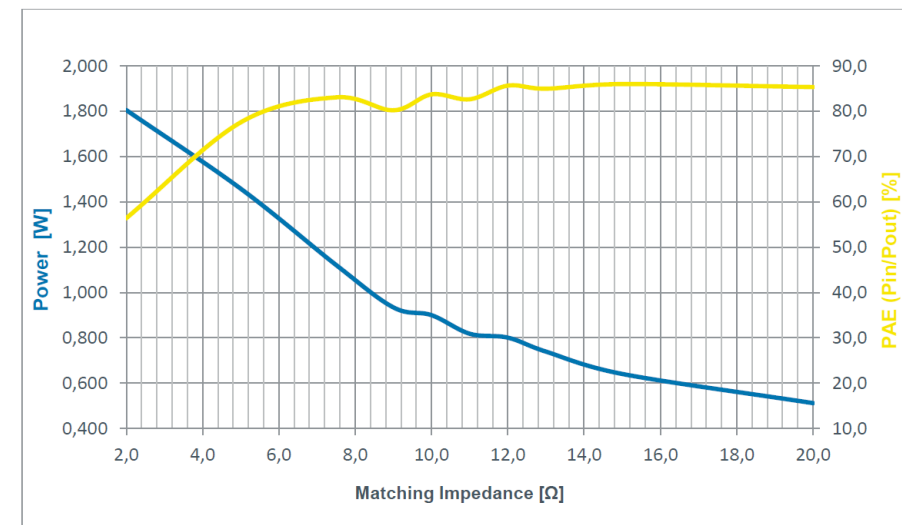
Highest Output Power & Efficiency

68

- **No external Booster required for POS**
 - The ST25R reader includes low impedance drivers capable of generating **>1W** of output power.
 - **EMVco certification** easily possible without external boosters.
- **Maximum transferred Power**
 - “Slave” devices like interface tags are able to harvest far more energy for batteryless devices.
 - Ideal for sophisticated **NextGen Gaming** platforms.
- **Ideal for Challenging Environment**
 - The ST25R reader is able to operate in metal encapsulation like **doorlocks**.



ST25R3911B Efficiency Graph





Low Power Wakeup

69

- **Internal wakeup circuitry**

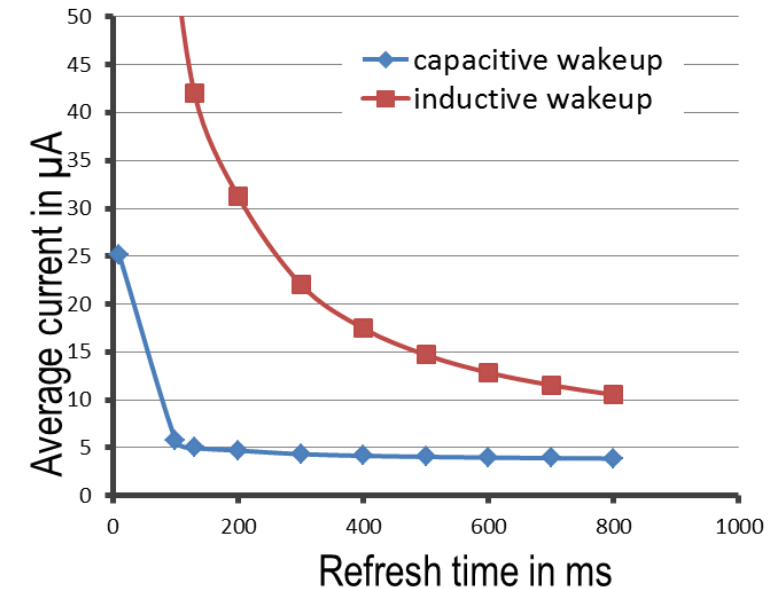
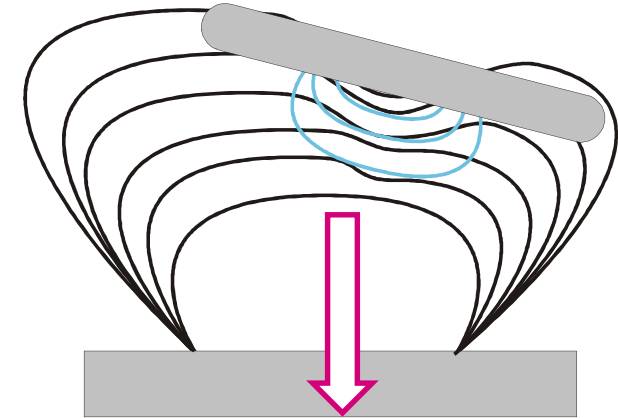
- The ST25R reader includes a fully programmable wakeup scheme. All relevant parameters like cycle time & sensitivity can be programmed.
- No MCU required to run the wakeup.
- Capacitive & Inductive wakeup can be combined for sophisticated wakeup scripts.

- **Capacitive wakeup**

- The ST25R reader can detect capacitive changes like for example the approach of a hand.

- **Inductive wakeup**

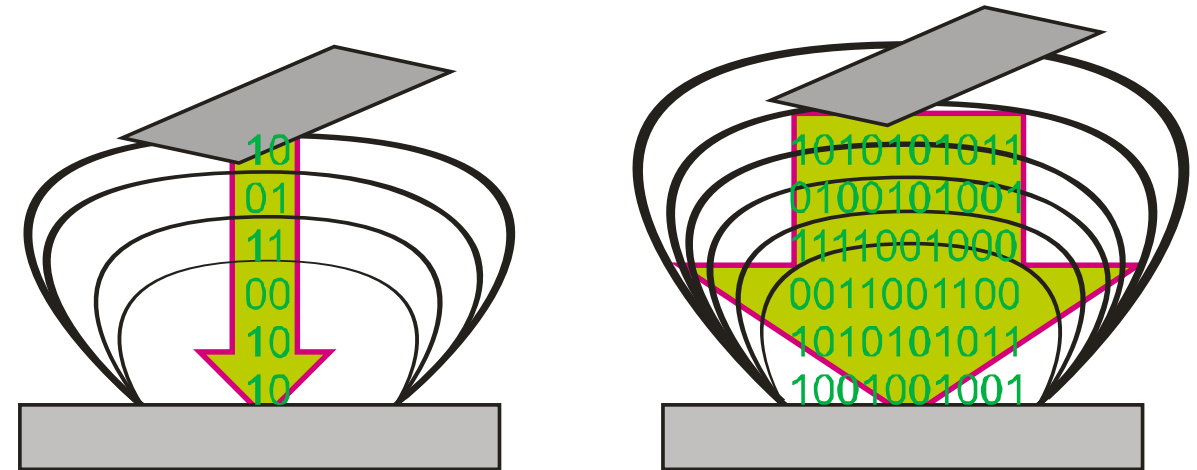
- The inductive wakeup is dedicated to detect approaching cards only.





- Very High Baud Rate (VHBR) technology allows the exchange of large amounts of data between a contactless smartcard and a reader. Faster data rates create potential for new applications of NFC.
- ST25R3911B allows to implement VHBR communication without additional external components required.
- VHBR is ideal for **eGovernment & Passport** applications
 - The ST25R reader increases the maximum bitrate from 848kbit/s to maximum 6.8Mbit/s.
 - **8x less** transfer time benefits the waiting time at **boarder control** and allows to increase stored data on **eGovernment / Healthcare / Passport** applications.

8x Faster data transfer





ST25R – UHF Readers

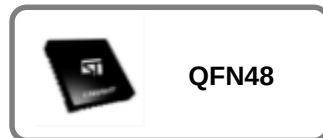
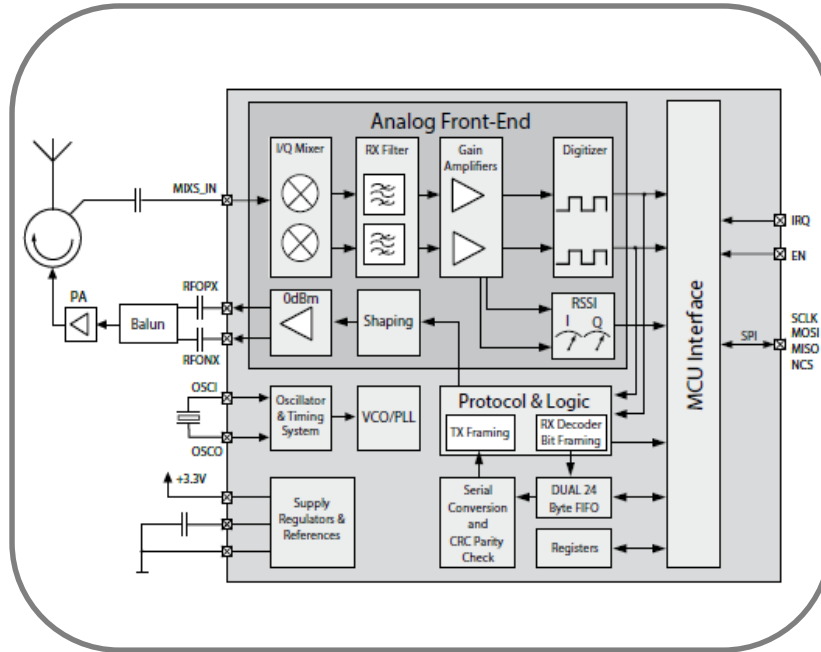


ST25RU3980 UHF RFID Reader

for Fast Moving Consumer Goods (FMCG)

72

ST25RU3980



QFN48

• Use Cases

- Embedded consumer/industrial
 - Beverage dispensing, Access control
 - Authentication/calibration
 - Retail/Pharmaceutical
- Fast Moving Consumer Goods
- Gaming, Portable Data Capture

• Key features

- Fixed Single ended Rx input & 0dBm output power
- Receive sensitivity of **-90dBm**
- 1 tag discovery per 500msec (no anti-collision)
- Low voltage architecture 2.7 – 3.6V
- Power consumption down to 65mA

• Key benefits

- **Reduced** overall **BOM** costs/count
- Robust against poor antenna
- Competitive pricing for reduced functionality
- Prolonging battery life
- Easy-to-use evaluation / development kits

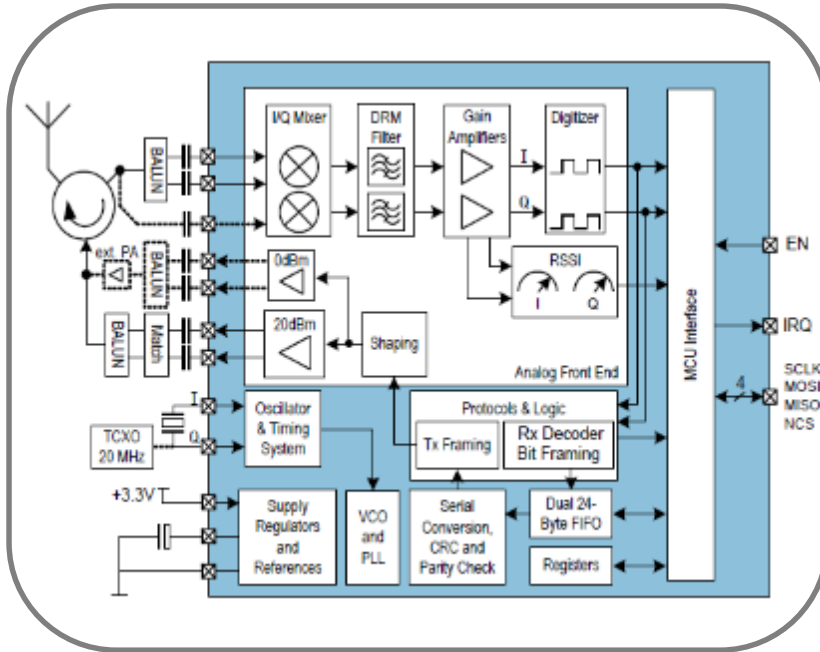


ST25RU3993 UHF RFID Reader

with Dense Reader Mode for battery handheld

73

ST25RU3993



QFN48

• Use cases

- **Retail**, Stationary Readers
- Industrial PDA's, Authentication
- Tablets/Smartphones, Dongles/Snap Ons
- Portable Data Capture

• Key features

- Low voltage architecture 2.7 – 3.6V
- Power consumption down to 65mA
- Receive sensitivity of **-90dBm**
- Dense Reader Mode filtering on board
- Tag movement detection

• Key benefits

- Ideal for **mobile** applications
- Prolonging battery life
- Robust against poor antenna
- Works in a dense reader environment
- Easy-to-use evaluation / development kits
- Reference designs, application notes



ST25R UHF readers

74

	ST25RU3993	ST25RU3980
Description	UHF RFID Reader suited for Mobile and Fast Moving Consumer Goods applications	
Contactless interface	ISO18000-6c/b	ISO18000-6c without anti-collision
Market certification	EPC Gen 2	-
Sensitivity	-90dBm	
Advanced features	Internal VCO Dense Reader Mode Linear RSSI & Phase Bit Automatic PSRR regulation Auto ACK	
Interface	SPI 5Mbps	
Power supply	2.7V - 3.6V	
Output power	0dBm / 20dBm	0dBm
Temperature range	-40 to +85°C	
Package	48-pin QFN (7x7 mm)	

VCO: Voltage Controlled Oscillator
RSSI: Received Signal Strength Indicator

PSRR: Power Supply Rejection Ratio
ACK: ACKnowledge



Product part number



ST25T part numbers

76

ST25T NFC / RFID tags

ST25TB	Package	512bit	2Kbit	4Kbit
RFID tag RF ISO14443B (-AT for Transport)	SBN12 SBN12	ST25TB512-AC6G6 ST25TB512-AT6G6	ST25TB02K-AC6G6	ST25TB04K-AB6G6

ST25TA	Package	512bit	2Kbit	16Kbit	64Kbit
NFC tag RF ISO14443A	SBN12	ST25TA512-AC6G5	ST25TA02K-AC6G5	ST25TA16K-AB6G5	ST25TA64K-AB6G5

ST25TA -P / -D	Package	2Kbit GPO CMOS-P	2Kbit GPO Open Drain
NFC tag RF ISO14443A + GPO	FPN5 SBN12	ST25TA02K-PC6H5 ST25TA02K-PC6B5	ST25TA02K-DC6H5

ST25TV / LR	Package	2Kbit	64Kbit
RFID tag RF ISO15693	SBN18 SBN12	LRI2K-SBN18/1GE LRI2K-SBN18/3GE	ST25TV64K-AP6B3



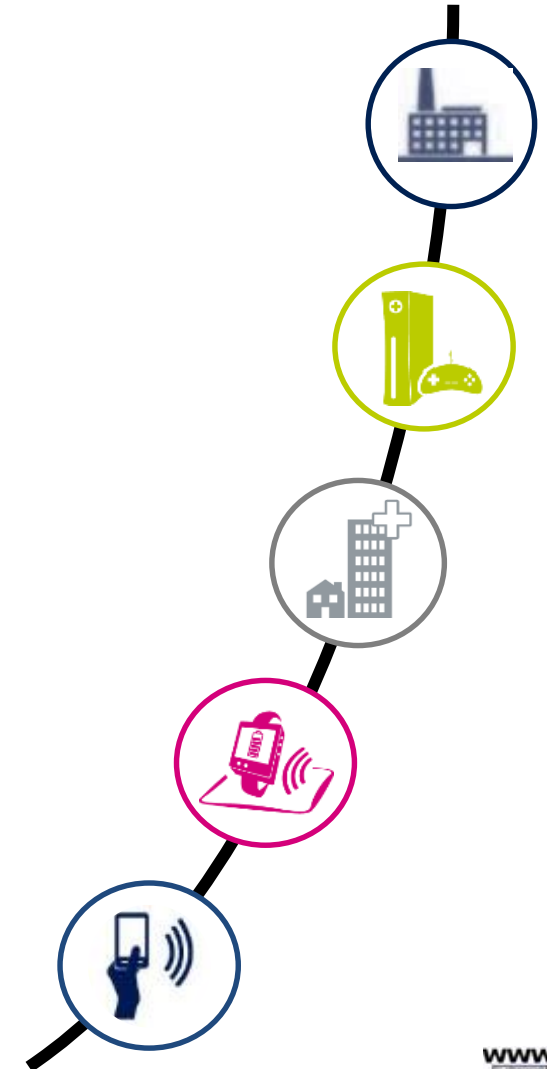


ST25D dynamic NFC / RFID tags

M24SR	Package	2Kbit	4Kbit	16Kbit	64Kbit
Dynamic NFC tag RF ISO14443A + I2C IF + GPO + RF disable	SO8	M24SR02-YMN6T/2	M24SR04-YMN6T/2	M24SR16-YMN6T/2	M24SR64-YMN6T/2
	TSSOP8	M24SR02-YDW6T/2	M24SR04-YDW6T/2	M24SR16-YDW6T/2	M24SR64-YDW6T/2
	FPN8	M24SR02-YMC6T/2	M24SR04-YMC6T/2	M24SR16-YMC6T/2	M24SR64-YMC6T/2
	SBN12	M24SR02-YSB12I/2			M24SR64-YSB12I/2

M24LR	Package	4Kbit	16Kbit	64Kbit
Dynamic NFC / RFID tag RF ISO15693 + I2C IF + GPO + Energy harvesting	SO8	M24LR04E-RMN6T/2	M24LR16E-RMN6T/2	M24LR64E-RMN6T/2
	TSSOP8	M24LR04E-RDW6T/2	M24LR16E-RDW6T/2	M24LR64E-RDW6T/2
	FPN8	M24LR04E-RMC6T/2	M24LR16E-RMC6T/2	M24LR64E-RMC6T/2

ST25DV	Package	4Kbit	16Kbit	64Kbit
Dynamic NFC / RFID tag RF ISO15693 + I2C IF + Fast Transfer Mode + GPO + Energy harvesting	SO8	ST25DV04K-IER6S3	ST25DV16K-IER6S3	ST25DV64K-IER6S3
	TSSOP8	ST25DV04K-IER6T3	ST25DV16K-IER6T3	ST25DV64K-IER6T3
	FPN8	ST25DV04K-IER6C3		
	FPN12	ST25DV04K-JFR6D3	ST25DV16K-JFR6D3	ST25DV64K-JFR6D3





ST25R part numbers

78

ST25R HF NFC / RFID readers

95HF	Package	Features	Part Number
Entry-Level HF Readers	QFN32	Reader / Writer (R/W) R/W & Card emulation (CE)	CR95HF-VMD5T ST95HF-VMD5T

ST25R3909-10	Package	Features	Part Number
Mid-Range HF Readers	QFN32 QFN32	No AAT AAT	ST25R3909-BQTT * ST25R3910-BQFT

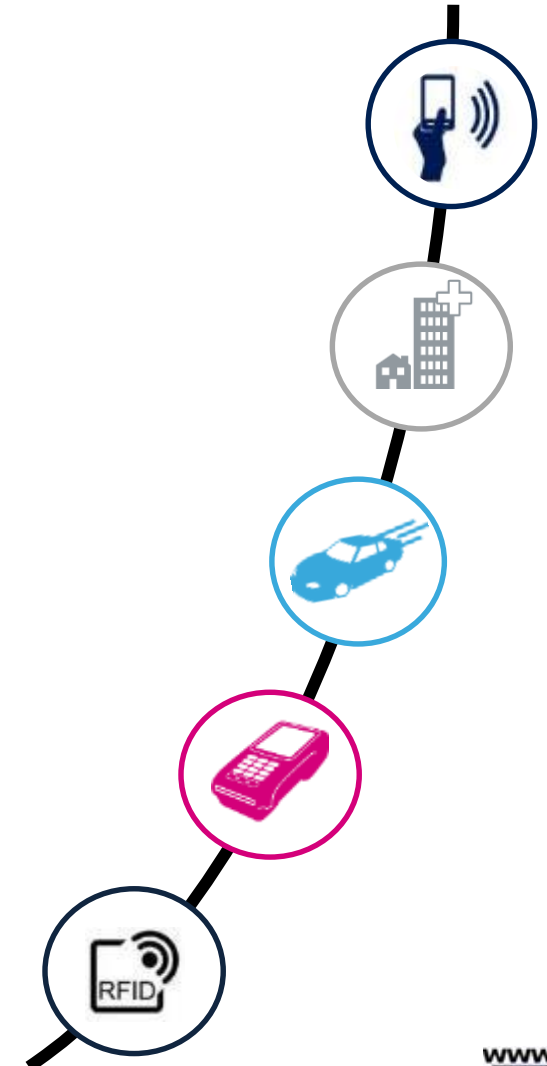
ST25R3911B-12-13	Package	Features	Part Number
High-Perf HF Readers for POS & mPOS	QFN32	VHBR & AAT	ST25R3911B-AQFT
	Wafer	VHBR & AAT	ST25R3911B-ASWB
	QFN32	No VHBR / No AAT	ST25R3912-AQFT
	WLCSP	No VHBR / No AAT	ST25R3912-AWLT
	QFN32	VHBR / No AAT	ST25R3913-AQFT

ST25R3914-15	Package	Features	Part Number
High-Perf HF Readers for Automotive	QFN32	VHBR & AAT VHBR / No AAT	ST25R3914-AQFT ST25R3915-AQFT

ST25RU UHF RFID readers

ST25RU3991-92	Package	Features	Part Number
UHF Readers	QFN64 QFN64	Standard Dense reader mode	ST25RU3991-BQFT * ST25RU3992-BQFT *

ST25RU3993-80	Package	Features	Part Number
UHF Readers for Handheld devices	QFN48 QFN48	Fast moving consumer good Dense reader mode	ST25RU3980-BQFT ST25RU3993-BQFT





Evaluation boards



CLOUD ST25TA board

80

- CLOUD ST25TA evaluation board
 - ST25TA02K-P NFC/RFID tag IC in UDFPN5 package
 - Ready-to-Use printed circuit board
 - 18mm diameter 12 turns antenna
 - 256-Byte (2-kbit) NDEF EEPROM
 - Configurable General Purpose Output (Field Detection) with connector on PCB



Reference

CLOUDST25TA02K-P

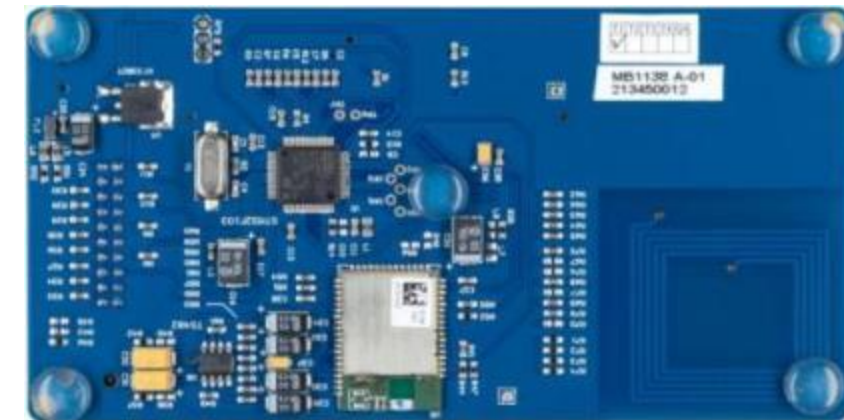


M24SR Discovery kit

81

- M24SR evaluation and demonstration board
 - M24SR64 dynamic NFC tag IC
 - 30x30mm 5 turns double layer antenna
 - STM32F1 micro-controller
 - LCD color display + Joystick + LEDs
 - USB & JTAG connectors
 - BT / audio module with audio headset

Reference
M24SR-DISCO-PREM



<http://www.st.com/web/en/catalog/tools/PF259659>



M24SR Nucleo shield

82

- M24SR Nucleo shield board for fast prototyping
 - M24SR64 dynamic NFC tag IC
 - 31x30mm 5 turns double layer antenna
 - Compatible with STM32 Nucleo boards
 - I2C interface to MCU through Arduino connector
 - Open drain output for MCU wake-up
 - Powered through the Arduino UNO R3 connector
 - 3 general purpose color LEDs

Reference

X-NUCLEO-NFC01A1





M24SR ANT7 board

83

- ANT7-T-M24SR evaluation board
 - M24SR64 dynamic NFC tag
 - 14x14mm, 13.56 MHz dual layer etched antenna
 - I2C test points to connect to MCU
 - GPO Open drain user configurable output to indicate an ongoing RF operation (GPO)
 - Digital RF disable input (DIS)

Reference

ANT7-T-M24SR





M24LR Discovery kit

84

- M24LR evaluation and demonstration board
 - M24LR04E dynamic NFC tag IC
 - 20x40mm 9 turns antenna
 - STM8L152 micro-controller
 - LCD display
 - I2C & SWIP connectors
 - Temperature sensor
- CR95HF reader board
 - CR95HF NFC multi-protocol reader IC
 - 47x34 mm 2 turns double layer antenna etched on PCB and associated tuning circuitry
 - STM32F1 micro-controller
 - USB & JTAG connectors



Reference

M24LR-DISCOVERY



M24LR Nucleo shield

85

- M24LR Nucleo shield board for fast prototyping
 - M24LR04E Dynamic NFC/RFID tag IC
 - 30x30mm 5 turns double layer antenna etched
 - Energy harvesting feature
 - Compatible with STM32 Nucleo boards
 - I2C interface to MCU through Arduino connector
 - Open drain output for MCU wake-up
 - Powered through the Arduino UNO R3 connector
 - 3 general purpose LEDs

Reference

X-NUCLEO-NFC02A1





M24LR ANT7 board

86

- ANT7-T-M24LR evaluation board
 - M24LR04E-R dynamic NFC tag
 - 14x14mm, 13.56 MHz dual layer etched antenna
 - I2C test points to connect to MCU
 - GPO RF WIP / RF BUSY (RF)
 - Analog Energy Harvesting output (EH)

Reference

ANT7-T-M24LR



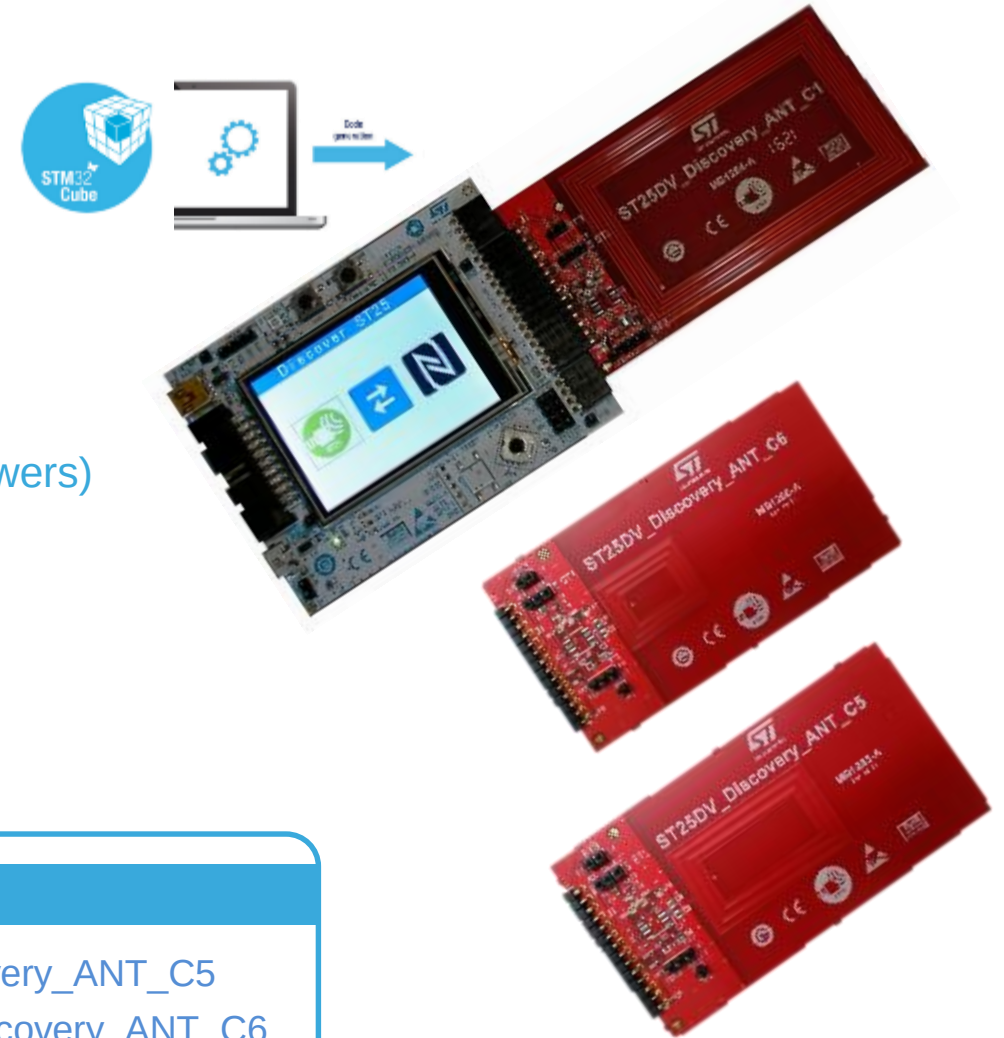


ST25DV Discovery kit

87

- ST25DV evaluation and demonstration board

- ST25DV04K dynamic NFC tag IC
- STM32F415 micro-controller 
- 2.4" TFT LCD Touch screen
- USB + LEDs / JTAG Through USB
- I2C & SWIP connectors
- Daughter board connector (UART/SPI/I2C/GPO/EH/Powers)
- WiFi, BLE modules options
- 3 antennas options, all single layers
 - 46 x 76mm - 6 tours (Class - 1)
 - 39 x 23mm - 10 tours (Class - 5)
 - 24 x 18.5mm - 14 tours (Class - 6)



References

ST25DV-DISCO: ST25DX_Discovery_Mboard + ST25DV_Discovery_ANT_C5

ANT-1-6-ST25DV : ST25DV_Discovery_ANT_C1 + ST25DV_Discovery_ANT_C6



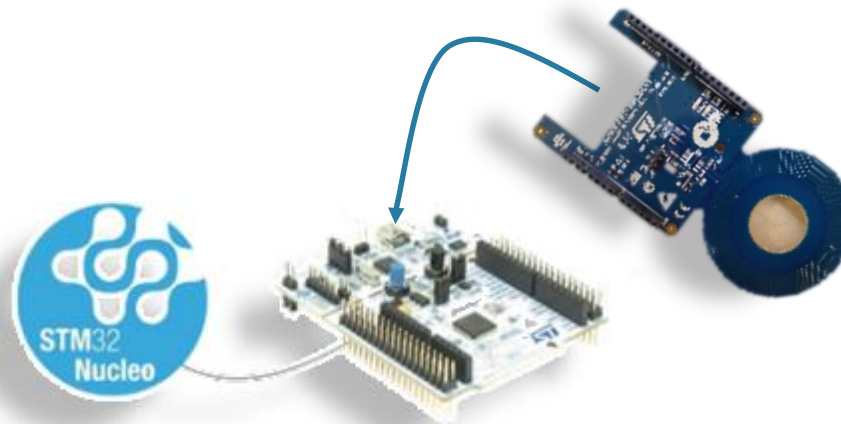
ST25DV Nucleo shield

88

- ST25DV Nucleo board for fast prototyping
 - ST25DV04K Dynamic NFC tag IC
 - NFC antenna: Ø 54mm, 8 turns single layer 13.56 MHz inductive antenna etched on the PCB
 - Energy harvesting, Low power mode
 - Open drain output GPO : set & reset, pulse sending, Field Detect, RF_Busy / RF_Write (EEPROM), RF put and get message (memory Buffer)
 - Compatible with STM32 Nucleo boards
 - Equipped with Arduino UNO R3 connector
 - 3 general purpose LEDs

Reference

X-NUCLEO-NFC04A1

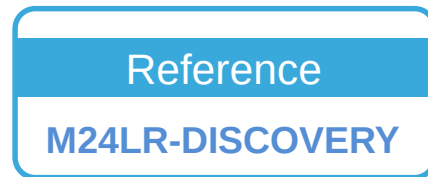




CR95HF Discovery kit

89

- CR95HF evaluation board is part of the M24LR discovery kit
 - CR95HF NFC multi-protocol reader IC
 - 47x34 mm 2 turns double layer antenna etched on PCB and associated tuning circuit
 - STM32F1 micro-controller
 - USB & JTAG connectors



<http://www.st.com/web/en/catalog/tools/PF253360>



CR95HF Nucleo shield

90

- CR95HF Nucleo shield board for fast prototyping
 - CR95HF NFC multi-protocol reader IC
 - 47x34mm 4 turns antenna etched on PCB and associated tuning circuit
 - Communication interfaces with a Host Controller
 - Serial peripheral interface (SPI) Slave interface
 - Universal asynchronous receiver/transmitter (UART)
 - Up to 528-byte command/reception buffer
 - Optimized power management
 - Powered through the Arduino UNO R3 connector
 - 4 general purpose LEDs

Reference

X-NUCLEO-NFC03A1





ST95HF Discovery kit

91

- ST95HF evaluation & demonstration board
 - ST95HF NFC transceiver IC
 - 47x34mm 4 turns antenna
 - STM32F1 micro-controller
 - LCD color display + Joystick + LEDs
 - USB & JTAG connectors

Reference
EVAL-ST95HF





Thank You !