ST25 NFC/RFID
Product Features and Competitiveness

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Dec 2019

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RFID Technologies at a Glance

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: up to 1m Proximity: up to 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 RAIN RFID
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 / Payment	Pallets and container ID Retail / Logistics Authentication
ST solutions		**X**	**X**

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ST NFC Portfolio

Covering all NFC application needs and leveraging a rich ecosystem

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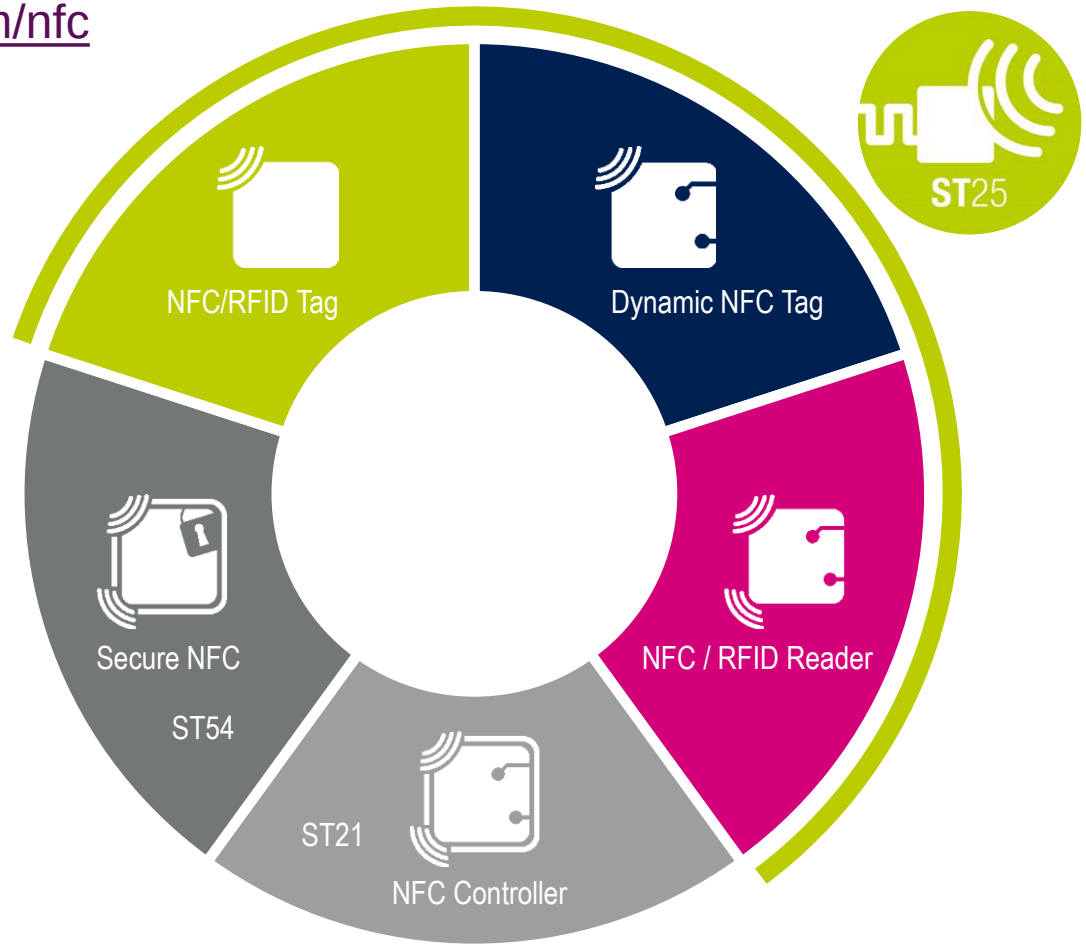

ST is Member of NFC Forum, RAIN Alliance and ISO organizations as well as the CCC and WPC Alliances

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ST25 Portfolio

One-stop-shop for Tags and Readers

Tags			Dynamic Tags				HF Readers				UHF Readers
ST25TA	**ST25TB**	**ST25TV**	**M24SR**	**M24LR**	**ST25DV-I2C**	**ST25DV-PWM**	**ST25R95 ***	**ST25R3911B ST25R3912 ST25R3913**	**ST25R3914 ST25R3915**	**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	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	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 4Kb-64Kb 40 year retention 1M cycles	256B Buffer EEPROM 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 AEC-Q100	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	32b password E-Harvesting RF Detect UID	Fast X-fer Mode 64b password E-Harvesting RF Detect UID	TruST25 64b password UID		VHBR Auto Ant. Tune Dynamic power out Multi-antenna	Auto Ant. Tune Dynamic power out Multi-antenna	Active waveshaping 2D Auto Ant. Tune Dynamic power out Multi-antenna	Dense Reader Mode Linear RSSI Automatic PSRR Auto ACK
			I2C 1MHz 1.7V-5.5V	I2C 400kHz 1.8V-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 2.4V-5.5V 1W	SPI 6Mbps I2C 3.4Mbps 2.4V-5.5V 1.7W	SPI 10Mbps 1.65V-5.5V 0-20dBm

*: same as former CR95HF / ST95HF

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ST25DV
Dynamic Tag

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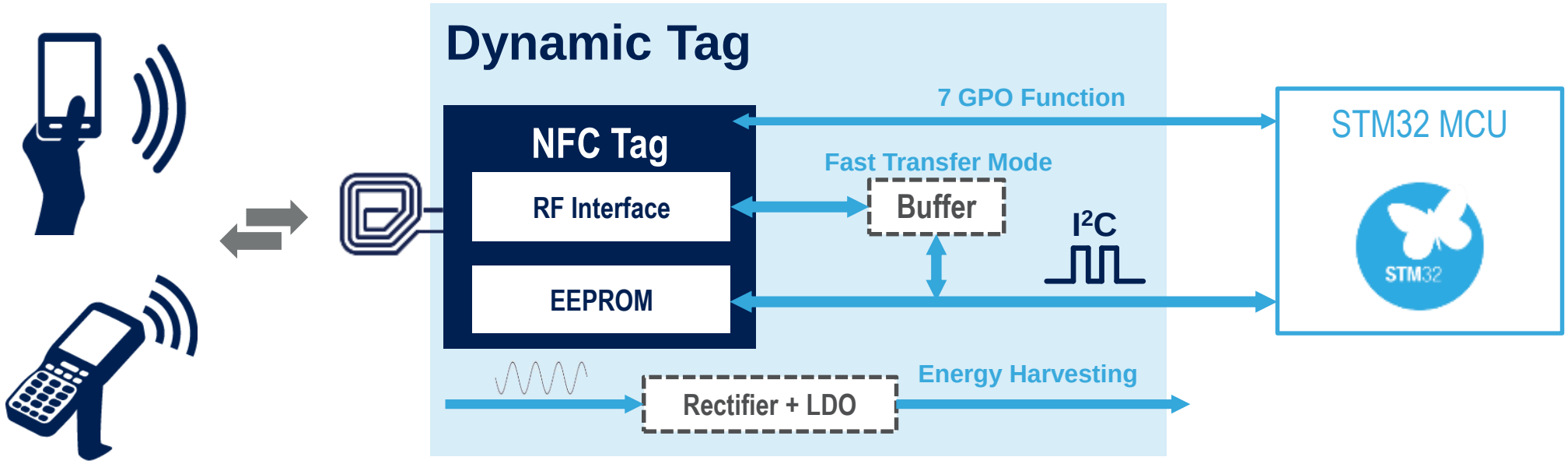
What is Dynamic Tag?

Making your application more Simple and Flexible



I2C fast interface

- Data configuration
- Connection pairing

Fast Transfer Mode

- Firmware upgrade

Energy Harvesting

- Sensor tag
- E-ink card

Rich GPO Function

- System wakeup

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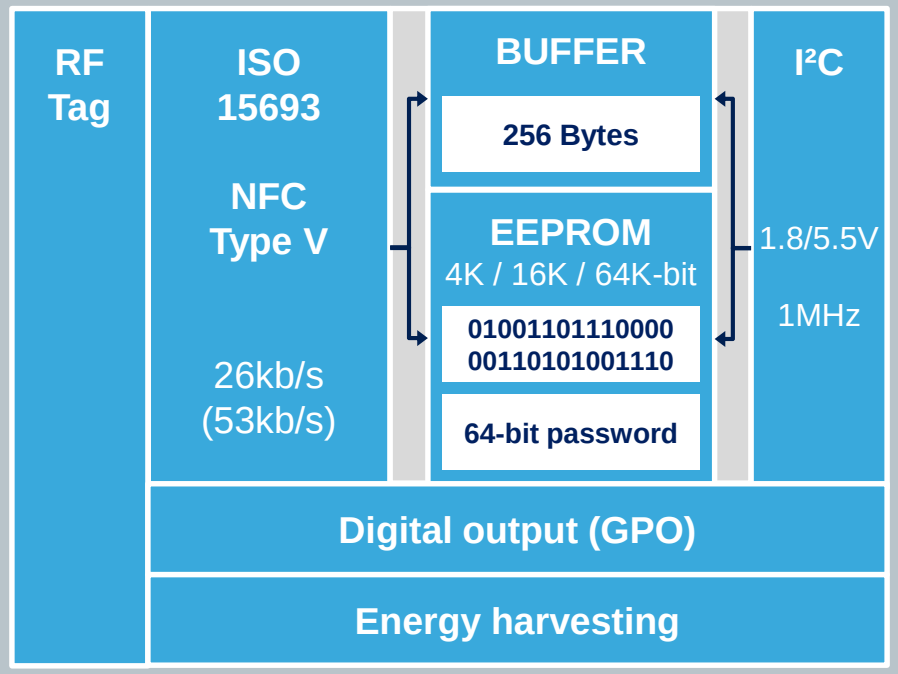
Dynamic NFC / RFID Tags

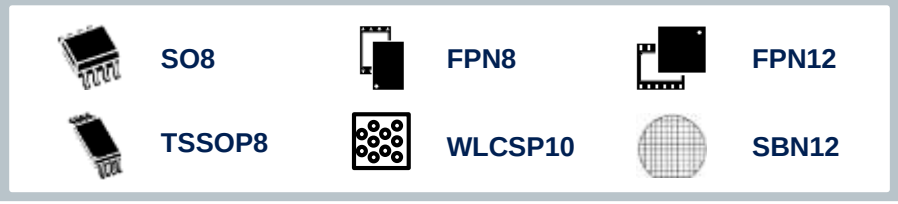
	M24SR	M24LR	ST25DV-I2C	ST25DV-PWM
Contactless Interface	ISO14443A NFC Type 4	ISO15693 NFC compatible	ISO15693 NFC Type 5	ISO15693 NFC Type 5
RF range	Short range (up to 10cm)	Long range (up to 1m)	Long range (up to 1m)	Long range (up to 1m)
RF speed	106kbps	26kbps	26kbps	26kbps
Serial Interface	I2C @1MHz	I2C @400kHz	I2C @1MHz	No
Fast Transfer mode	No	No	Yes (256B buffer)	No
Energy Harvesting	No	Yes	Yes	No
Digital output	Open-Drain GPO	Open-Drain GPO	OD or CMOS GPO	2x PWM
Extra features	RF Disable	-	Low Power mode	-
Memory format	EEPROM (preformatted NDEF)	EEPROM data	EEPROM data	EEPROM data
Memory size	2k / 4k / 16k / 64k-bit	4k / 16k / 64k-bit	4k / 16k / 64k-bit	2k-bit
Data protection	Password 128-bit	Password 32-bit	Password 64-bit	Password 64-bit Digital signature
Temperature range	-40°C to +85°C -40°C to +105°C (85°C RF)	-40°C to +85°C	-40°C to +85°C -40°C to +125°C (105°C RF)	-40°C to +85°C (105°C RF)
Package	SO8 / TSSOP8 / FPN8 / SBN12 *	SO8 / TSSOP8 / FPN8	SO8 / TSSOP8 / FPN8 / FPN12 / WLCSP10 / SBN12 ²	SO8 / TSSOP8

² SBN12: Die form, sawn and Bumped wafer, 120µm thickness, inkless 8” wafer

ST25DV-I2C
Dynamic NFC Tag

ST25DV04K / 16K / 64K





Use cases

- Fast data exchange with NFC phones / HF readers. Long range
  - Fast data transfer for MCU FW upgrade, Fast data exchange
  - Parameters settings and update, with in the box programming
  - Datalog download
- Battery less applications

Key Features

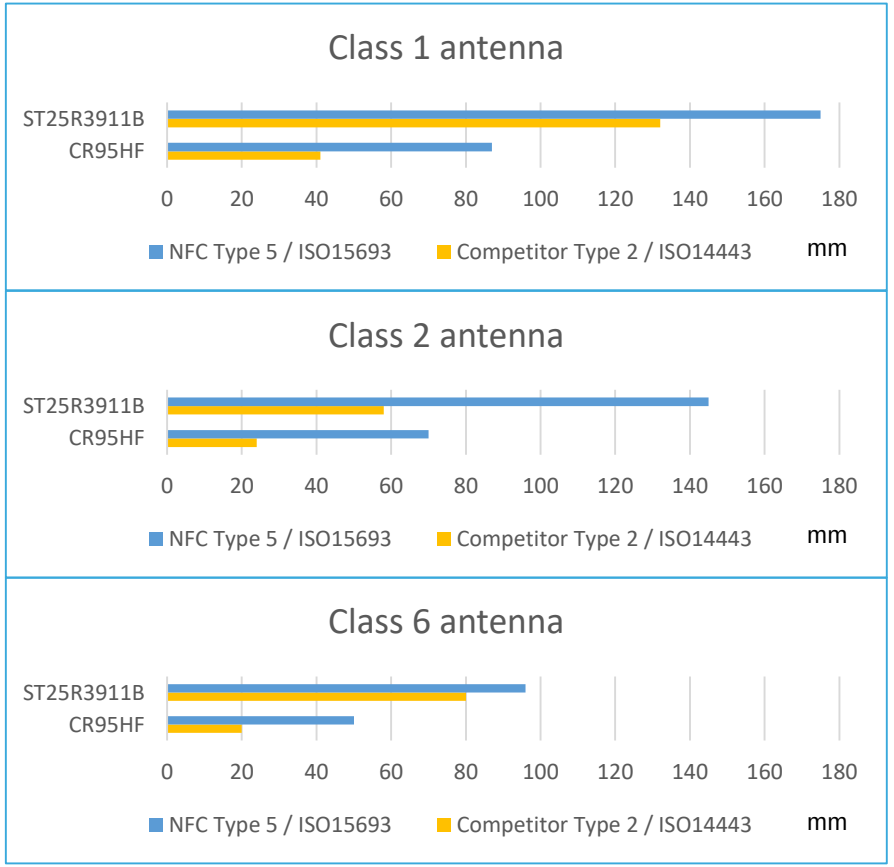
- **ISO15693** and **NFC Type V**
- **Fast data transfer** thanks to 256 Bytes buffer
- Low Power mode, < 1µA power consumption in Standby
- -40 to **+125°C** (I2C) industrial Grade 8 temperature range
- **Energy harvesting** function through RF

Key Benefits

- Smart applications using a **flexible interrupt GPO**
- Enhanced protection with multiple **64-bit passwords**
- Same 28.5pF internal RF tuning capacitor, as in M24LR

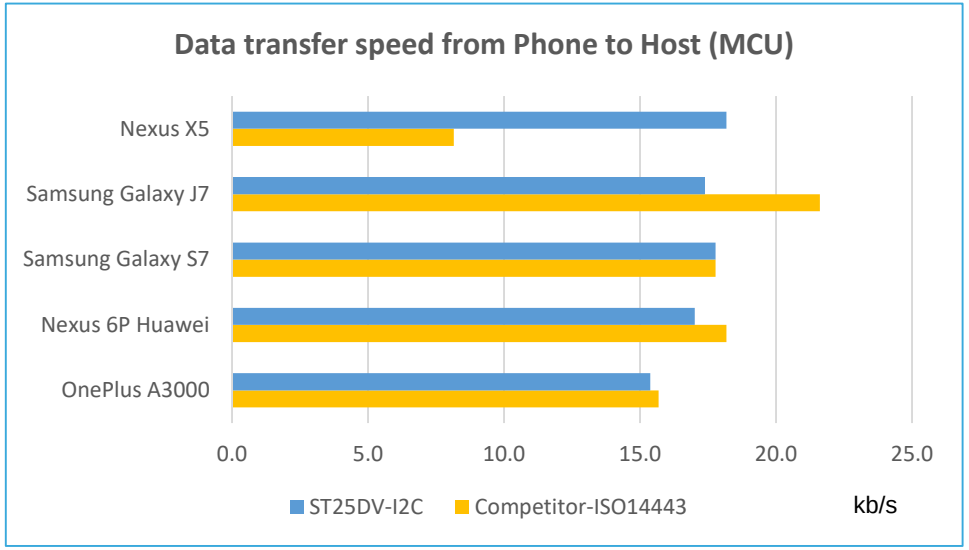
Performance Advantage

Read range



- ST25DV-I2C / ISO15693 has **better RF reading distances** than NFC Type2 / ISO14443

Fast transfer speed



Test Condition: 100kBytes data transferred

- ST25DV-I2C has **equivalent data transfer speed** to NFC Type2 / ISO14443 I2C tag
- Even with lower RF speed (26kbit/s instead of 106kbit/s), thanks to its wider buffer size of **256Bytes**

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ST25DV-PWM
Dynamic NFC Tag

ST25DV02K-W1 / -W2

Use cases

- Targeted industrial applications such as Lighting LED driver, Motor control, Power supply unit

Key Features

- **ISO15693** and **NFC Type V**
- 2K-bit memory
- Up to **2 PWM** signal (push pull)
- Up to 15 bits resolution (62.5ns resolution step)
- Power Supply 1.8V - 5.5V
- -40°C to **+105°C** (PWM) temperature range
- **TruST25 Digital Signature**

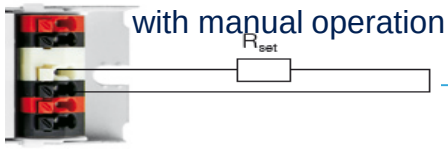
Key Benefits

- 2 in 1 chip, putting NFC connectivity with PWM functionality
- Cost optimized solution to address low end Lighting market
  - Significant BOM reduction as no MCU is required to drive the system

ST25DV-PWM in Lighting Market

High-end segment

Previous



MCU (32-bit) — PWM — **LED power stage (MOSFET)**

New

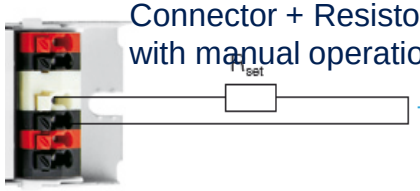
ST25DV-I2C / M24LR
ISO15693 tag

I2C — **MCU (32-bit)** — PWM — **LED power stage (MOSFET)**

With MCU on board

Low-end segment

Previous



LED driver IC (analog)

New

ST25DV-PWM
ISO15693 tag

PWM — **RC + ampli** — **LED driver IC (analog)**

Without MCU on board

Patents pending

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ST25R
High Performance NFC Reader

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ST25R HF Readers

	ST25R95	ST25R3911B	ST25R3912	ST25R3913	ST25R3914/15	ST25R3916
Description	Entry-Level NFC Reader	High-Performance NFC Forum Reader	Mid-Range NFC Forum Reader	Mid-Range NFC Forum Reader	Automotive Grade NFC Forum Reader	High-performance NFC Universal Device & EMVCo Reader
Reader/Writer mode	ISO14443A/B ISO15693 Felica	ISO14443A/B ISO15693 FeliCa	ISO14443A/B ISO15693 FeliCa	ISO14443A/B ISO15693 FeliCa	ISO14443A/B ISO15693 FeliCa	ISO14443A/B ISO15693 FeliCa
Card emulation mode	Yes	-	-	-	-	Yes
AP2P mode	-	Initiator & Target	Initiator & Target	Initiator & Target	Initiator & Target	Initiator & Target
PP2P mode	-	Initiator	Initiator	Initiator	Initiator	Initiator & Target
RF speed	424kbps	6.8Mbps (VHBR)	848kbps	848kbps	848kbps	848kbps
Market certification	-	Payment (EMVco, PBOC, mini-pay)	Payment (EMVco, PBOC, mini-pay)	Payment (EMVco, PBOC, mini-pay)	Automotive AEC-Q100	Payment (EMVco, PBOC, mini-pay)
Advanced features	IWU	AAT, DPO, CIWU	DPO, IWU	AAT, DPO, IWU	AAT (3914), DPO, CIWU	AAT, DPO, NSR, DSA, AWS, CIWU, EMD
HW interface	SPI 2Mbps	SPI 6Mbps	SPI 6Mbps	SPI 6Mbps	SPI 6Mbps	SPI 6Mbps
SW interface	RFAL Unified Software Library for Frontends					
Power supply	2.7V - 5.5V	2.4V – 5.5V	2.4V – 5.5V	2.4V – 5.5V	2.4V – 5.5V	2.4V – 5.5V
Output power	0.23W	1.4W	1.0W	1.0W	1.0W	1.6W
Temperature range	-25°C to +85°C	-40°C to +125°C	-40°C to +125°C	-40°C to +125°C	-40°C to +125°C	-40°C to +125°C
Package	32-pin QFN (5x5mm)	32-pin QFN (5x5mm) / Wafer	32-pin QFN / WF 32-pin QFN (5x5mm) / WLCSP-30	32-pin QFN / WF 32-pin QFN (5x5mm)	32-pin QFN / WF 32-pin QFN (5x5mm)	WF 32-pin QFN (5x5mm) / WLCSP-36

VHBR: Very High Baud Rate
P2P: Peer to Peer mode
AAT: Automatic Antenna Tuning
AWS: Active Wave Shaping
EMD: Automatic EMD suppression
VHBR: Very High Baud Rate
DPO: Dynamic Power Output
CIWU: Capacitive & Inductive Wakeup
DSA: Drive Slope Adjustment
NSR: Noise Suppression Receiver
IWU: Inductive Wakeup

ST25 Readers Picking Map

Choose the right Reader for your application

ST95HF ST25R668

Entry Level

- Cost effective
- ST95
  - All standard support
  - Card Emulation
- 668:
  - Felica not support
  - Better RF performance

Smart Lock

Access control

ST25R3912 ST25R3913

General Purpose

- All standard support
- 3912: WLCSP package available
- 3913: Support AAT

Transport

Home Appliance

ST25R3914 ST25R3915

Automotive

- AEC-Q100 compliance
- High receiver sensitivity facilitate small antenna design and low-power card detection
- 3914: Support AAT

Automotive

ST25R3911B ST25R3916

Payment

- High-Performance suitable for POS application
- 3911B – EMVCo 2.6
- 3916 – **EMVCo 3.0**
  - Card Emulation

POS

Industrial

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ST25R3916 NFC Reader

High-performance & **EMVCo** Reader

ST25R3916

Reader Writer	ISO14443 ISO15693 FeliCa ISO18092	RAM BUFFER	SPI / I2C
AP2P PP2P	NFC	512-Byte	2.4/5.5V
CE	848 kb/s		
1.6 W	**DPO:** Dynamic Power Output **CIWU:** Capacitive & Inductive Wake Up **AWS:** Active Wave shaping **NSR:** Noise Suppression Receiver **A²T:** 2D Automatic Antenna Tuning **DSO:** Driver Slope Adjustment **EMD:** Automatic EMD Error Handling		

QFN32

Use cases

- Ideal for **Payment** applications
- Access Control, Gaming, IOT and pairing

Key Features

- NFC Forum Device
- **1.6W** output power at 5V
- **Active Wave Shaping (AWS)**
- 2D Automatic Antenna Tuning
- Noise Suppression Receiver
- -40°C to **125°C** junction temperature range

Key Benefits

- Low power operation & Standby mode (capacitive wake-up)
- Works in challenging environment like noisy LCD displays
- Ideal for passing newest **EMVCo 3.0**

ST25R3916 Benefits

NSR: Noise Suppression Receiver

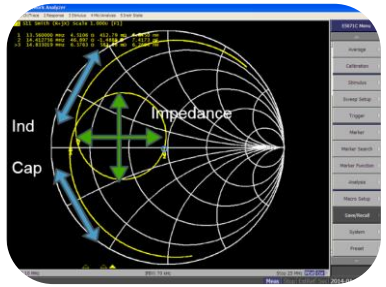
More robust against noise:

Decoding at high noise level with up to 19.3dB better SNR.

Cheap/noisy LCD possible for EMVCo POS terminals.

AAT: Automatic Antenna Tuning

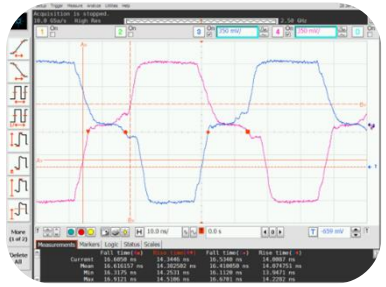
Easiest environmental/lifetime compensation:



Automatic adjustment of the tuning resonance and matching impedance driving adjustable parallel and serial capacitors.

DSA: Driver Slope Adjustment

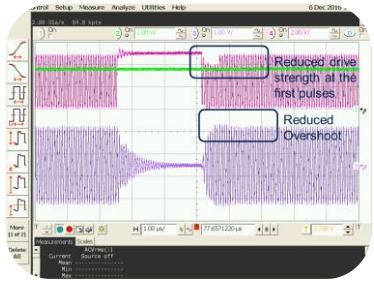
Easier FCC approval:



Programmable Push/Pull driver slope, minimizes high frequency EMC noise.

AWS: Active Wave Shaping

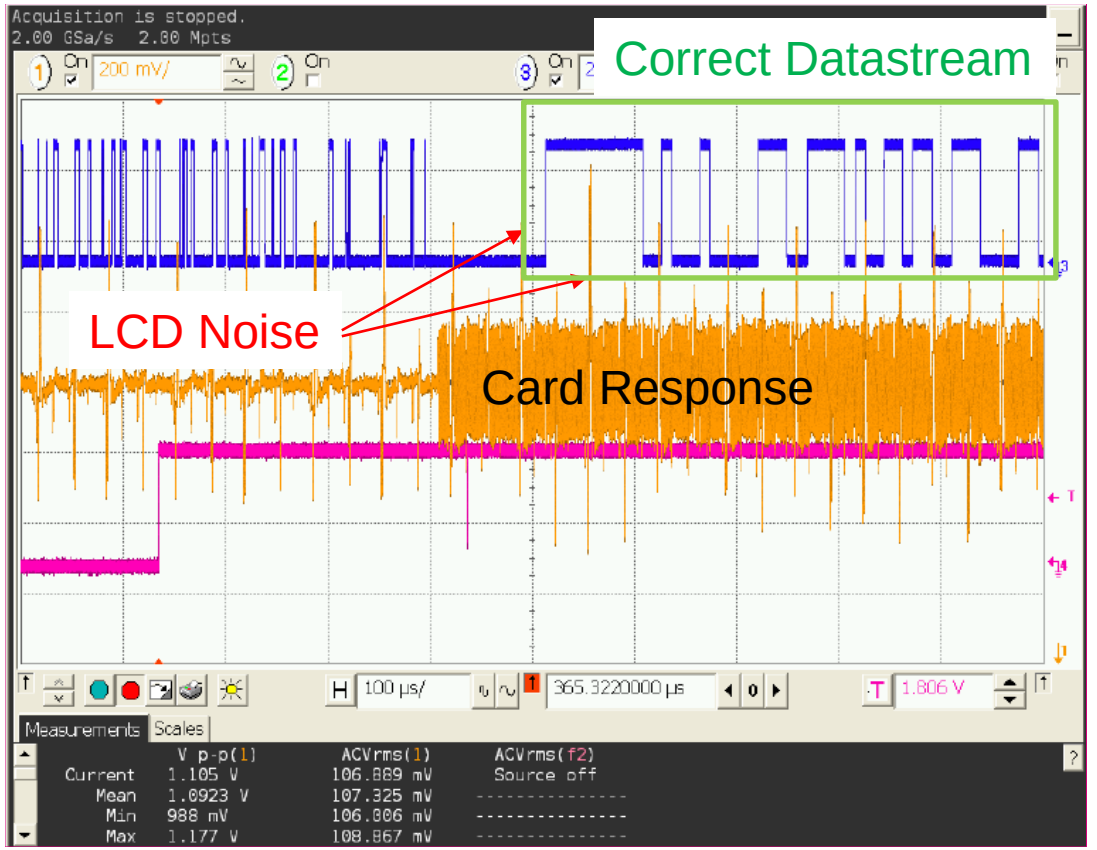
Faster/easier NFC Forum/EMVCo analog approval:



Under/Overshoot can be reduced to achieve required wave shaping easily and fast.

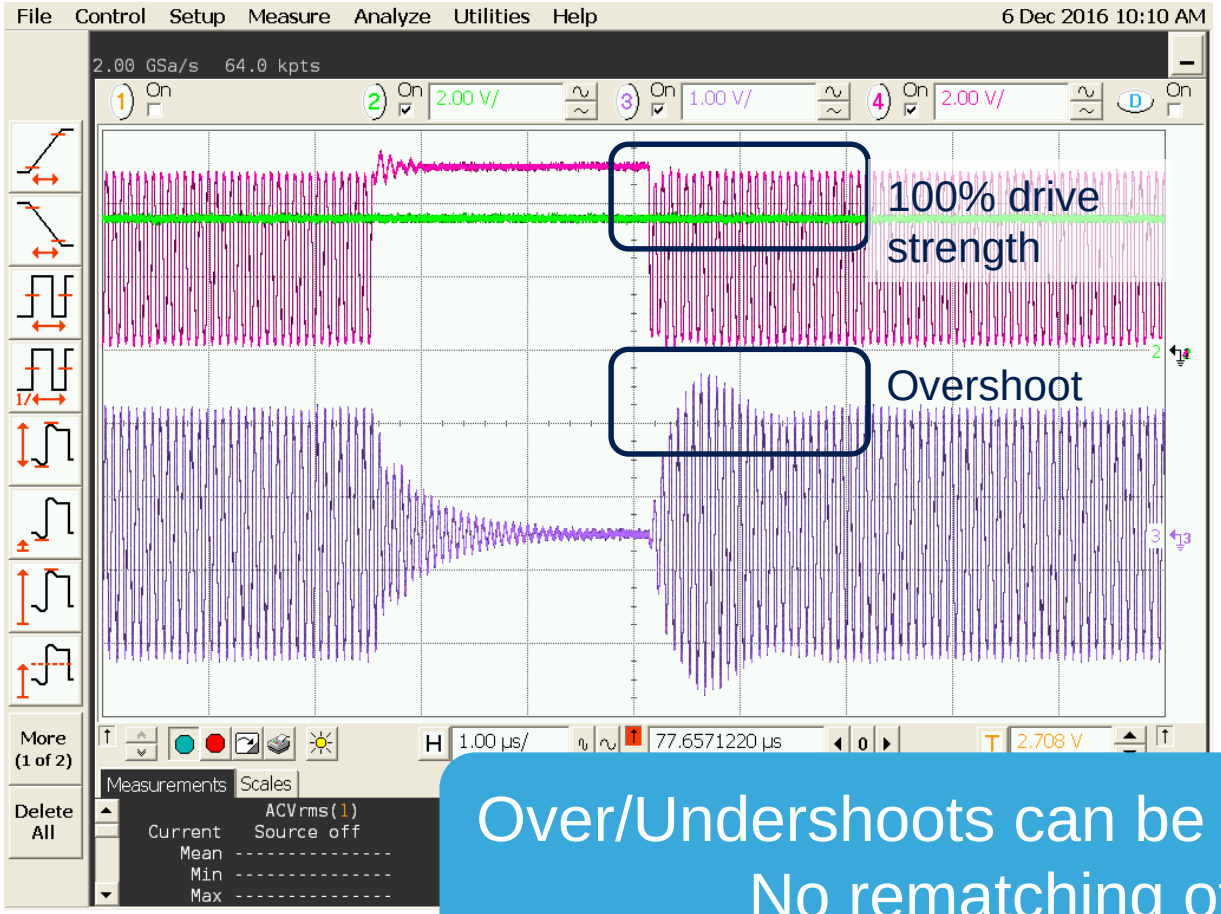
NSR: Noise Suppression Receiver

- Proper decoding
  - Proper decoding still possible even though LCD noise level exceeds card signal strength
  - ANS jumps in as soon as the receiver locks on a card response.
- Noise immunity compared to non NSR
  - Type A 106 display noise immunity improved by a factor of **3.3** vs ST25R3911B
  - Type B 106 display noise immunity improved by a factor of **9.2** vs ST25R3911B

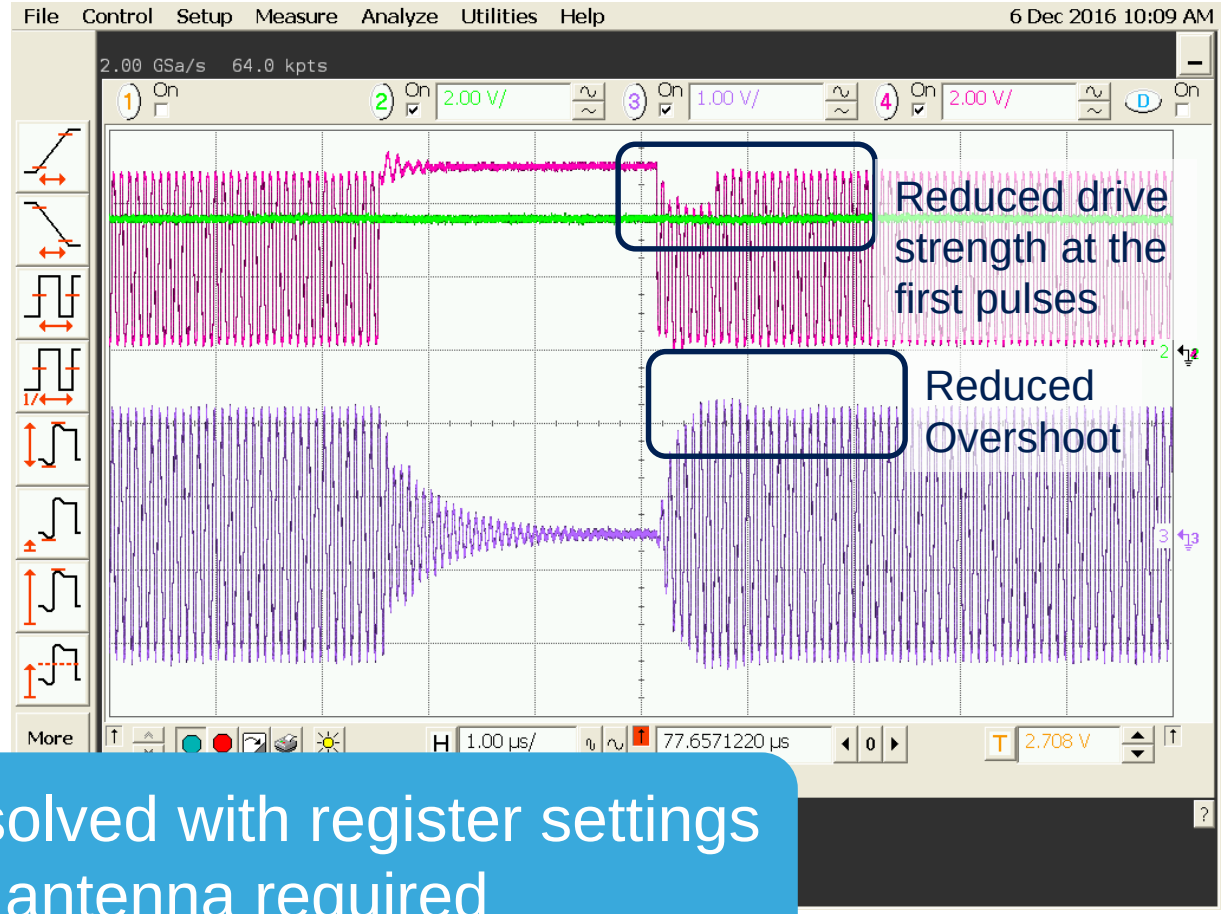


AWS: Active Waveshaping

- Traditional A 106 modulation pulse



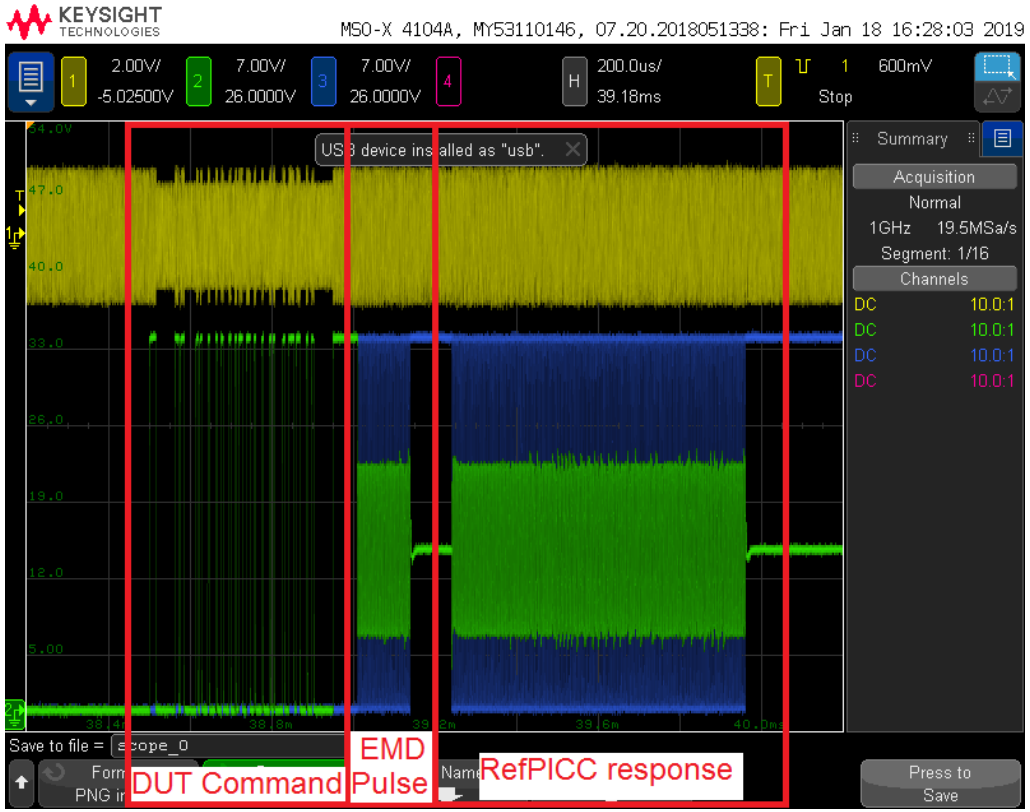
- Improved A 106 modulation pulse with Over/Undershoot Protection



Over/Undershoots can be solved with register settings
No rematching of antenna required

EMD: Automatic EMD Suppression

- Automatic PCD EMD handling
  - When the ST25R3916 receives a PICC frame it is checked for transmission errors. Transmission errors are detected in real time and if the number of received bytes when a transmission error is detected is less than 4, then the PCD shall ignore the transmission and be ready to receive a new PICC frame.
- Increased Robustness
  - EMD handling enhances the robustness of the contactless communication between ST25R3916 and the PICC against PICC generated electromagnetic disturbance (EMD)



EMVCo 3.0 Development Kit

ST25R3916-EMVCO evaluation board

- **ST25R3916 + STM32L476**
- USB interface for Windows PC connection with EMVCo L1 software provided
- Facilitate product development for EMVCo 3.0 certification

Features:

- Onboard 73 mm x 65 mm, two turn antenna
- LCD display
- Free EMVCo L1 software and sources
- Free Schematics, Layout, and Gerber files

Available on request

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ST25RU3993

High Performance UHF Reader

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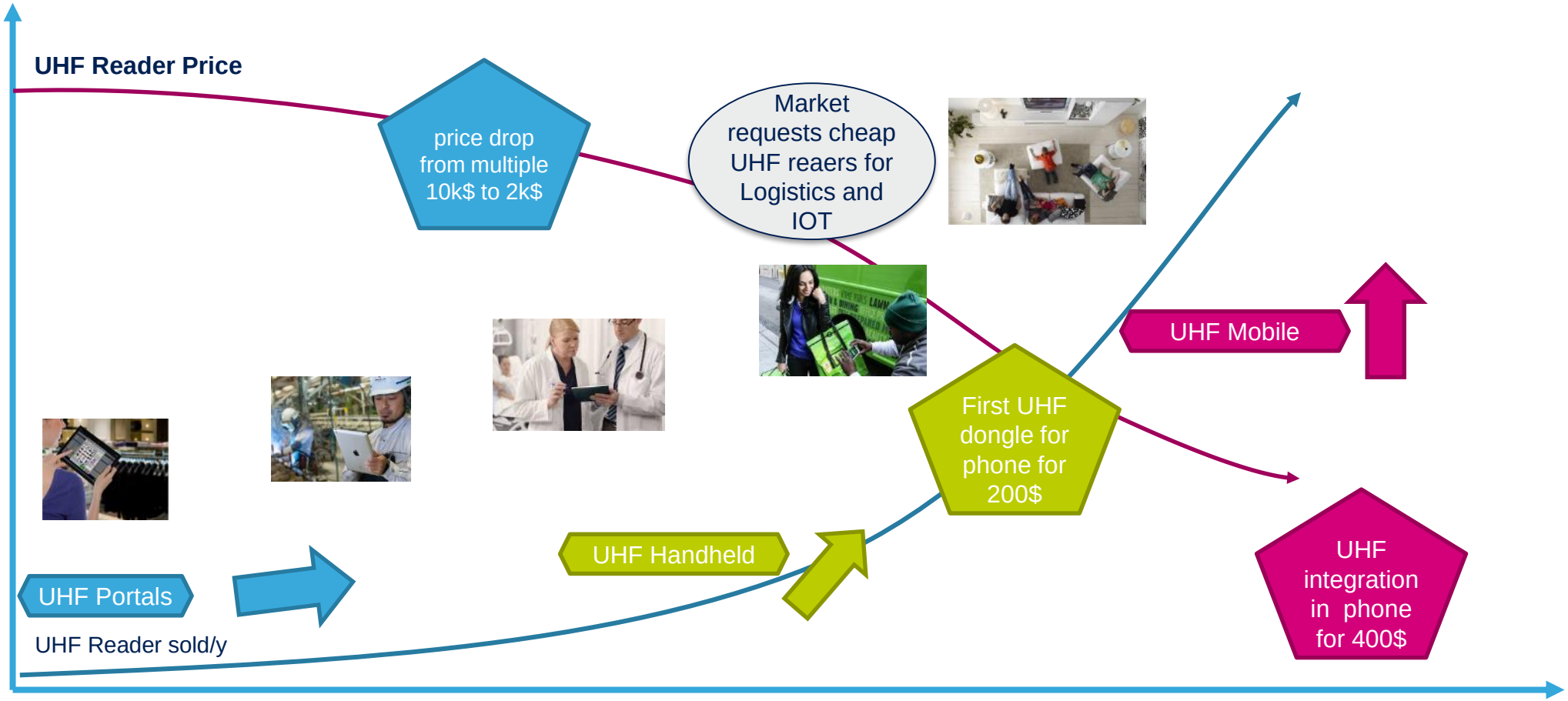
UHF Reader Market Trend



The demand on high performance, but lower price UHF reader chip would be stronger!

UHF Applications

Medical

- Patient tracking
- Asset management
- Automated inventory
- Access Control

Manufacturing

- Intelligent sensing
- Item level tracking
- Inventory/Asset managment
- Manufacturing optimization

Retail

- Automated Inventory Control
- Security/ Loss Prevention
- Door to Door tracking
- Authentication

Smart Home

- Intelligent Sensing
- Smart Appliance
- Asset Management

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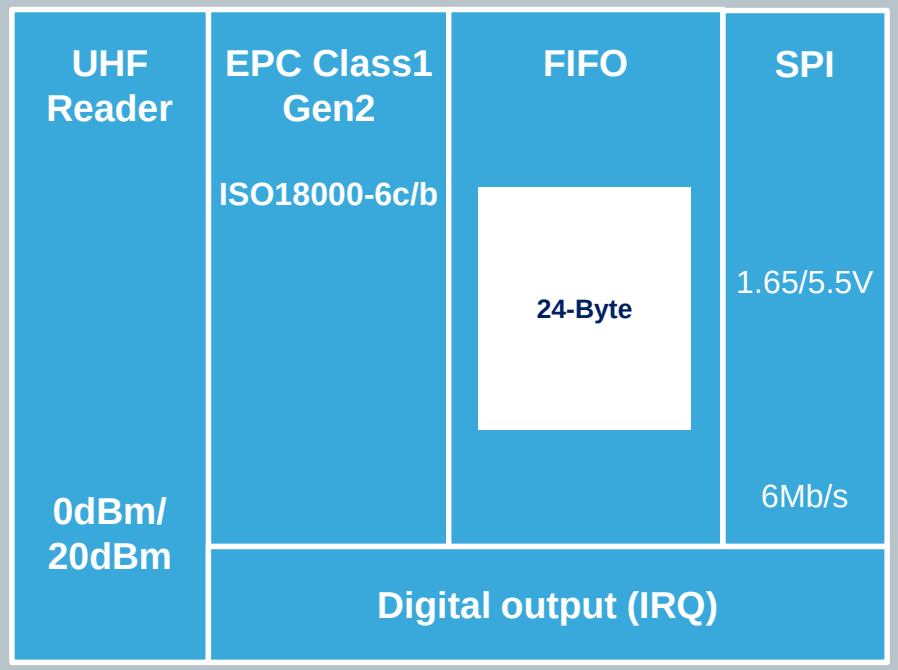
ST25RU3993 UHF RFID Reader

with Dense Reader Mode for Battery Handheld



QFN48

Use cases

- **Retail**, Stationary readers
- Industrial PDA‘s, Authentication
- Tablets / Smartphones, Dongles / Snap Ons, Handheld readers
- Portable Data Capture

Key Features

- **Dense Reader Mode filtering** on board
- Fixed Single ended Rx input & **0dBm/20dBm** output power
- Receive sensitivity of **-90dBm**
- Power consumption down to 65mA

Key Benefits

- Ideal for **mobile** applications
- Prolonging battery life & robust against poor antenna
- Works in a dense reader environment

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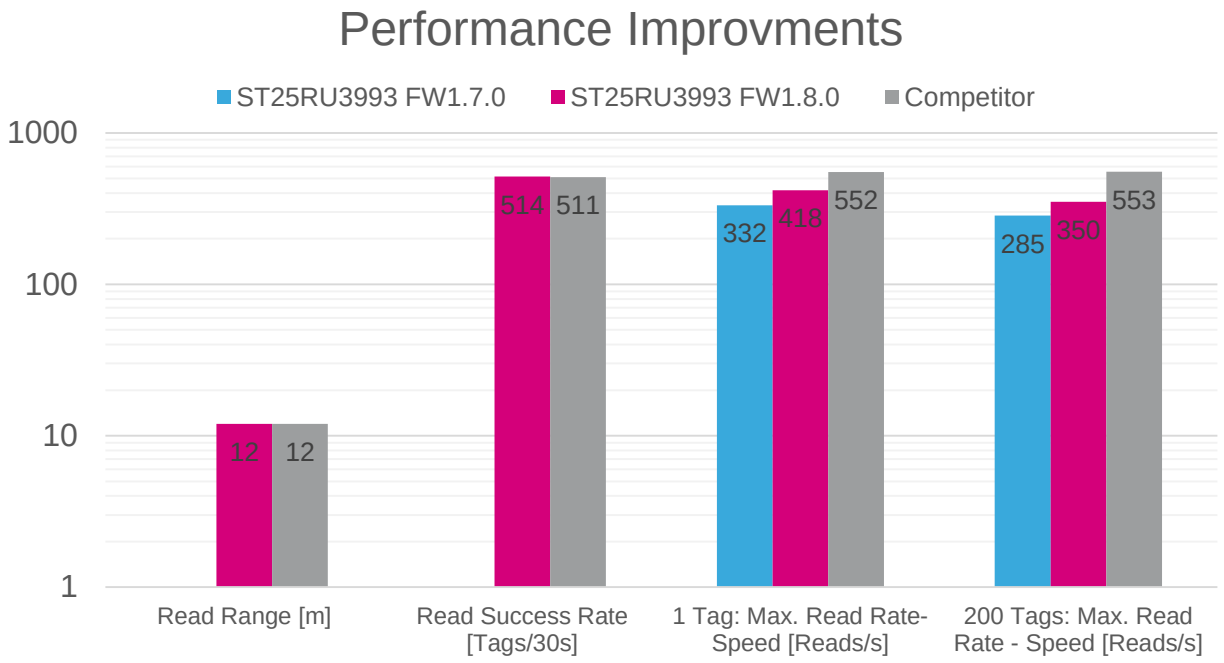
Tag Reading Performance



Settings	ST25RU3993	Competitor
Tari [µs]	6.25	6.25
BLF [kHz]	320	640
Encoding	Miller 2	FM0

Performance optimization kept on going

- Reading range
  - Up to 10m+ with 10cm*10cm antenna
  - Could be longer with higher RF output power
- Reading speed
  - Improved to **400+** reads/s
- Multi-tag reading (after unti-collision)
  - Performance close to competitor

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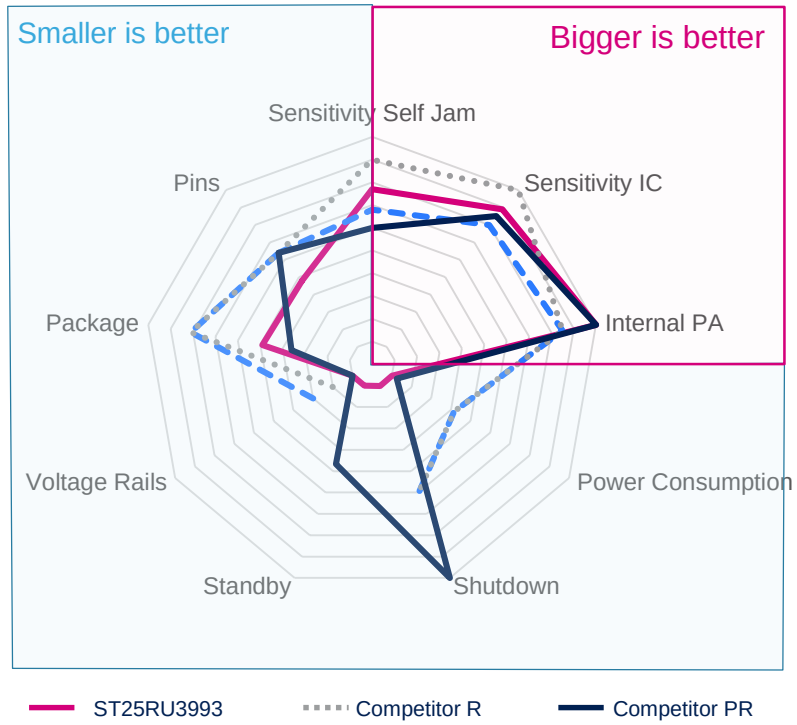
Feature Comparision



Performance & Features	ST25RU3993	High-End Competitor	Low-end Competitor
Receiver Sensitivity (without self-jammer)	★★★★☆ -90dBm	★★★★★ -93dBm	★★☆☆ -85dBm
Inventory speed	★★★★☆	★★★★★	★★☆☆☆
Multi-tag ability	★★★★☆	★★★★★	★★☆☆☆
Power consumption	★★★★☆	★★★☆☆	★★☆☆☆
Standard support	★★★★☆ Private protocol support	★★☆☆☆	★★☆☆☆
External circuit simplicity	★★☆☆☆	★★★☆☆	★★★☆☆
BOM Cost	★★★☆☆	★☆☆☆☆	★★★★☆

Suitable applications:

- Request low power consumption: Mobile, Handheld
- Request excellent multi-tag reading (unti-collision) performance, but cost effective readers

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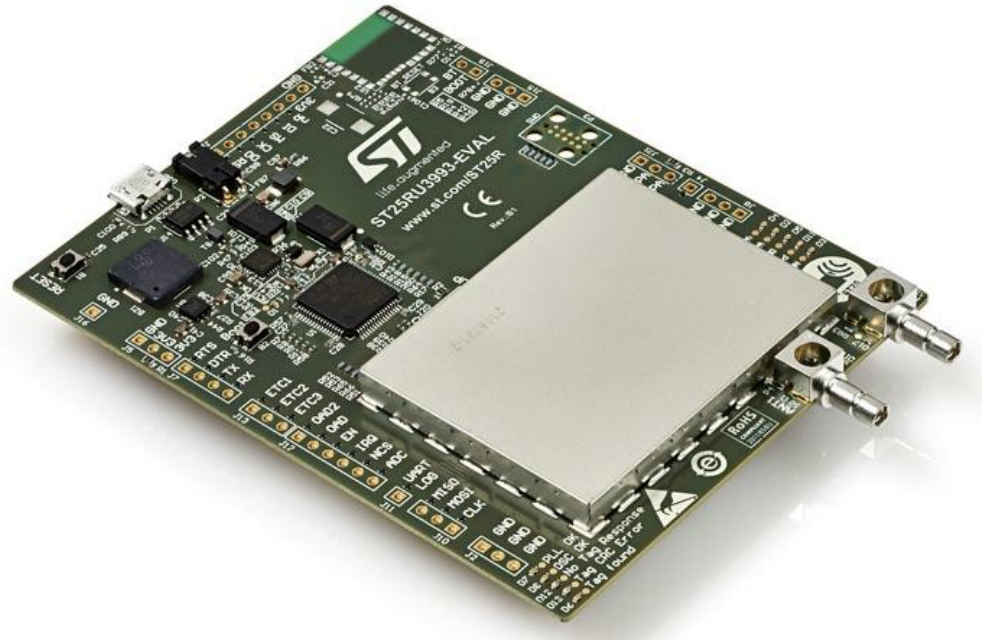
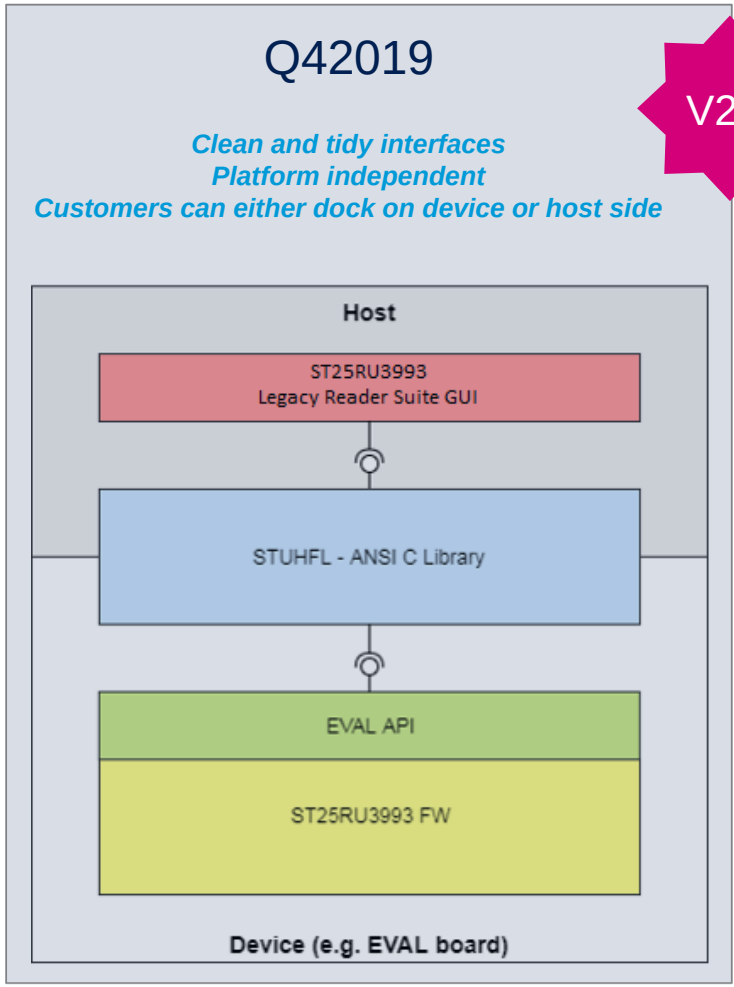
ST25RU3993 Developing Resource

What can ST provide to customers on UHF?

- Easy-to-use evaluation / development kits
- Reference designs and rich application notes
- Software source code



ST25RU3993-EVAL evaluation board @CE compliant



Firmware structure based on STM32L4

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