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ST25DV-I2C product presentation





Main ST25DV-I2C market segments

Smart industry



Factory automation,
Industrial lighting

Smart Home



Home automation,
Security Systems

Smart City



Metering, Street Lighting

Smart Things



Healthcare, Wellness

Smart Banking



CVV credit card, Badge



ST25DV-I2C combined use cases

Device programming in production



- **In-the-box** quick programming thanks to **Long range**
- **Simple and flexible**

Servicing and maintenance



- Download records history **contactless**
- **Update** parameters even if device is off
- Quick **FW upgrade** via **Fast Transfer Mode**

End user experience



- Access to **Web page** (URL link)
- Get link for Android **application** (AAR)
- e-warranty card & customer **registration**

Pairing for wireless network



- **ID Activation**
- Parameter **settings**

Convenient data logging



- **Data download**
- **Data tracking**

Battery less applications



- Product without battery thanks to **Energy Harvesting** feature



Typical NFC type 5 range

NFC phones



ISO15693 (26kb/s)

Up to 7 cm / 3in.



ST25DV-I2C

EEPROM

RFID readers



Up to 40cm / 1.3ft

ISO15693 (26kb/s)

Up to 1.0 m / 3ft



ST25DV-I2C

EEPROM

Reduce your antenna dimension and make your product more robust thanks to ISO15693



ST25DV-I2C product

ST25DV-I2C chip belongs to ST25 NFC / RFID Tags & Readers family

- **ST25DV-I2C main features**

- NFC Forum Tag Type 5 certified / ISO15693 RF interface
- Two-wire, slave I²C up to 1MHz interface (I²C fast mode) - 1.8V to 5.5V
- Up to 64kbit EEPROM memory
- Multiple 64-bit passwords for data protection
- 40 years data retention & 1Mcycles erase/write
- 7 Interrupts modes, configurable on dedicated GPO pin (MCU wake-up, ...)
- Energy harvesting through RF
- Fast Transfer Mode, thanks to 256 Bytes buffer
- Extended temperature range, industrial grade 8
- 8 pin, 10 or 12 pin package versions and WLCSP package



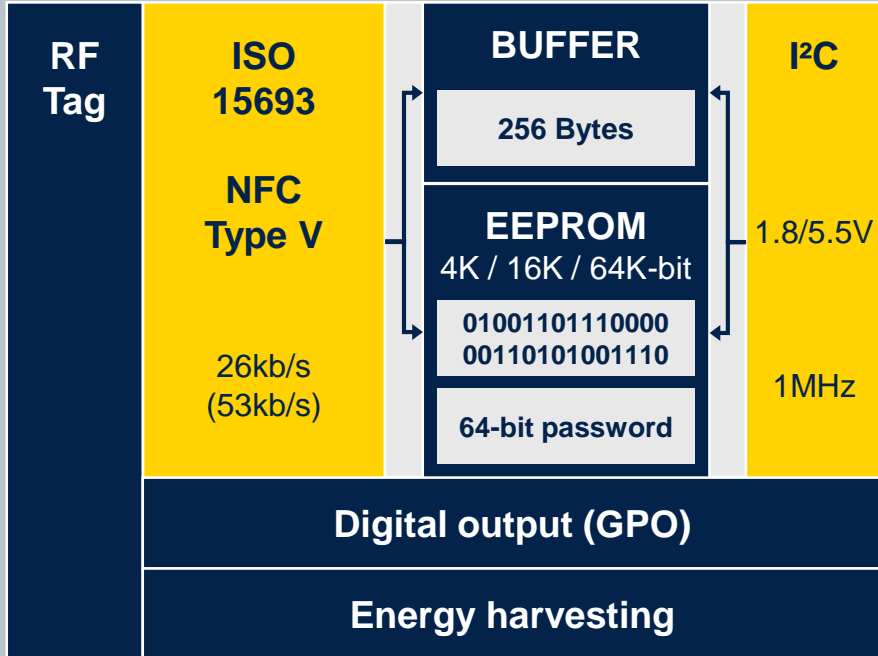
- ST25DV-I2C is the natural evolution of M24LR series



ST25DV-I2C Dynamic NFC tag



ST25DV04K / 16K / 64K



Use cases

- Fast data exchange with NFC phones / HF readers
 - Fast data transfer for MCU FW upgrade, fast data exchange
 - Parameters settings and update, with in the box programming
 - Datalog download



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

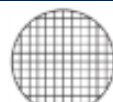
- Smart applications using a **flexible interrupt GPO**
- Enhanced protection with multiple **64-bit passwords**
- Same 28.5pF internal RF tuning capacitor, as in M24LR



ST25DV-I2C key features

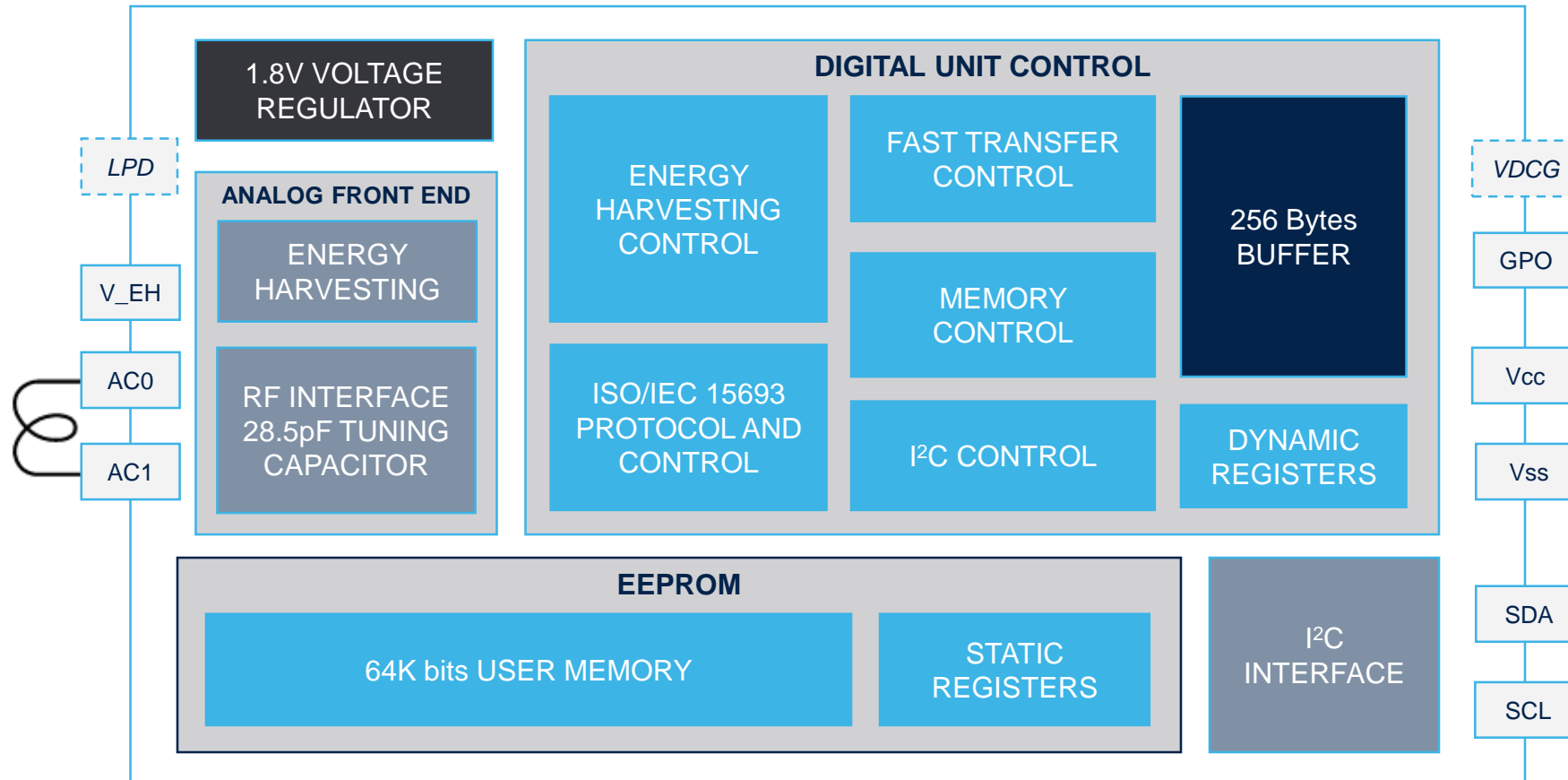
ST25DV-I2C

Contactless Interface	ISO15693 / NFC Forum Type 5 + annexes 3 & 4
RF range	Long range (up to 1m)
RF speed	26kbps (up to 53kbps)
Single supply voltage	1.8V to 5.5V
Serial Interface	I2C @1MHz
Fast Transfer mode	Yes (256B buffer)
Extra features	GPO: 7 interrupts modes (Open Drain or CMOS) Energy Harvesting Low Power mode
Memory format & size	EEPROM data - 4k / 16k / 64k-bit
Data retention	40-year at 55°C
Erase/Write cycles	1M cycles at +25°C / 600k cycles at + 85°C 500k cycles at +105°C / 400k cycles at +125°C
Data protection	Password 64-bit
Temperature range	Grade 6: -40°C to +85°C Grade 8: -40°C to +125°C (105°C RF)
Package	SO8 / TSSOP8 / FPN8 / FPN12 / WLCSP10 / SBN12*





ST25DV-I2C block diagram



**LPD, VDCG pin are only available with FPN12 and WLCSP10 package version*



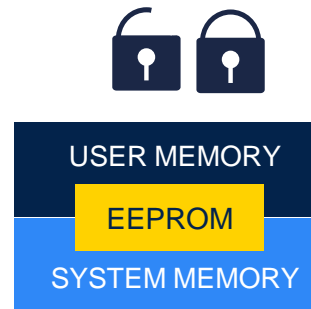
ST25DV-I2C data protection

- User and System memory data protection thanks to a password
 - Password size 64-bit → $1.8 \cdot 10^{19}$ combinations



Access from RF

- 3x passwords
- Each memory area can be individually protected by 1 out of 3 available passwords.
- Each area can have a Read / Write access conditions set (area 1 always readable).



Access from I2C

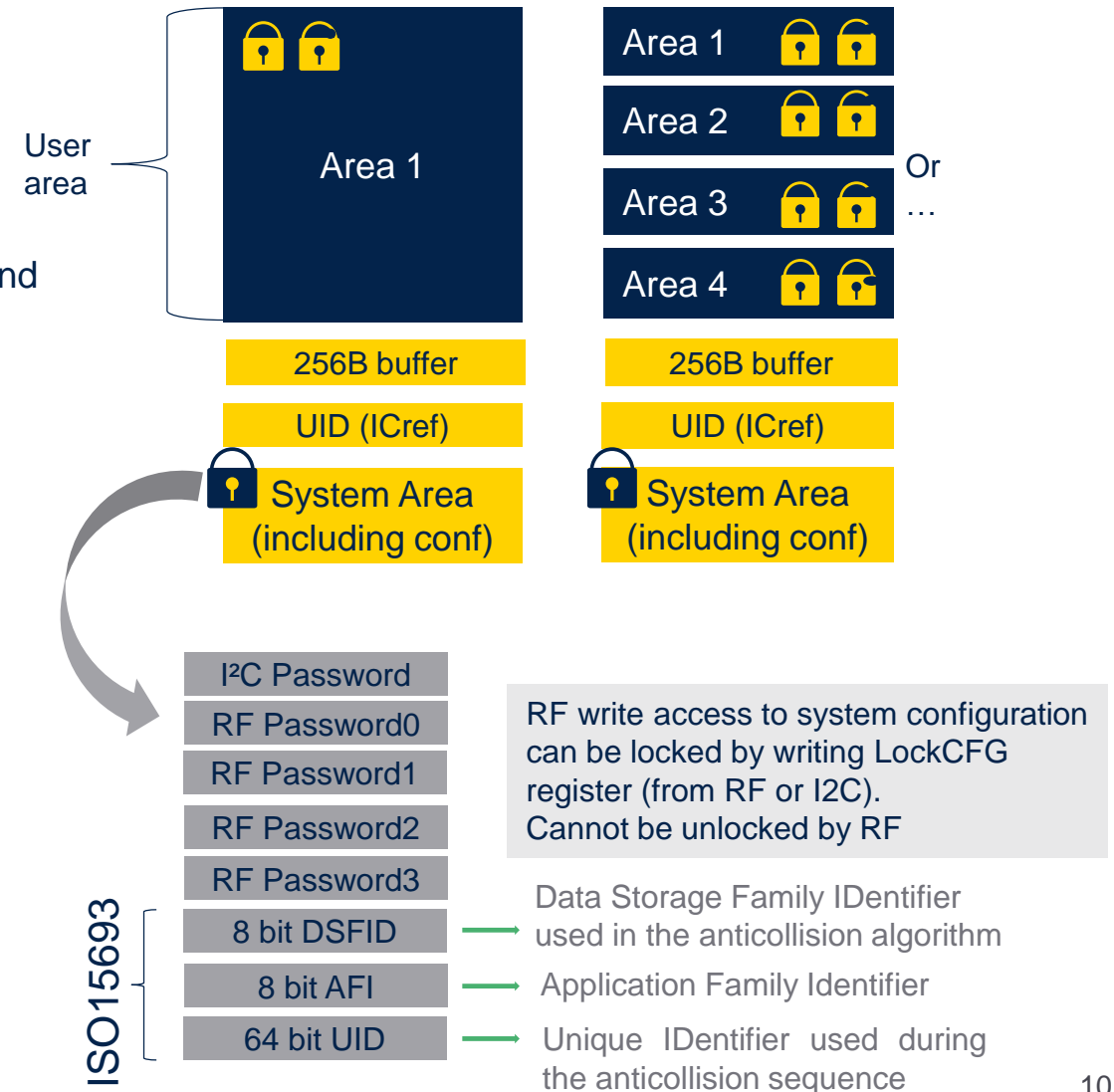
- 1x password
- Each memory area can be individually protected by 1 available password.
- Each area can have a Read / Write access conditions set (area 1 always readable).

+ 1x configuration password to access configuration bytes in system memory (specific from RF, but same password as memory access password from I2C)



ST25DV-I2C memory mapping & password management

- High EEPROM density
 - 04k-bit / 16k-bit / 64k-bit
- User EEPROM area configurable in flexible areas (up to 4, granularity 32 bytes)
 - Each area is individually read-/write- protected by password command
→ **64-bit password**
- System EEPROM area
 - Access protected by **64-bit password** (Write)
- Specific block used to store a **64-bit UID**
 - Unique Identifier accessible from I²C (read only)
 - Its value is written by ST on the production line
 - used during the anticollision sequence (Inventory)
- 256 Bytes buffer
 - Dedicated Fast Transfer mode
 - Need Vcc ON to be accessible
 - When enabled, write access to user memory (EEPROM) is disabled
- 5 additional **64-bit** blocks that stores:
 - 1 I²C password (only accessible from I²C)
 - 1 RF configuration password (access from RF),
 - 3 RF area access password codes (access from RF)

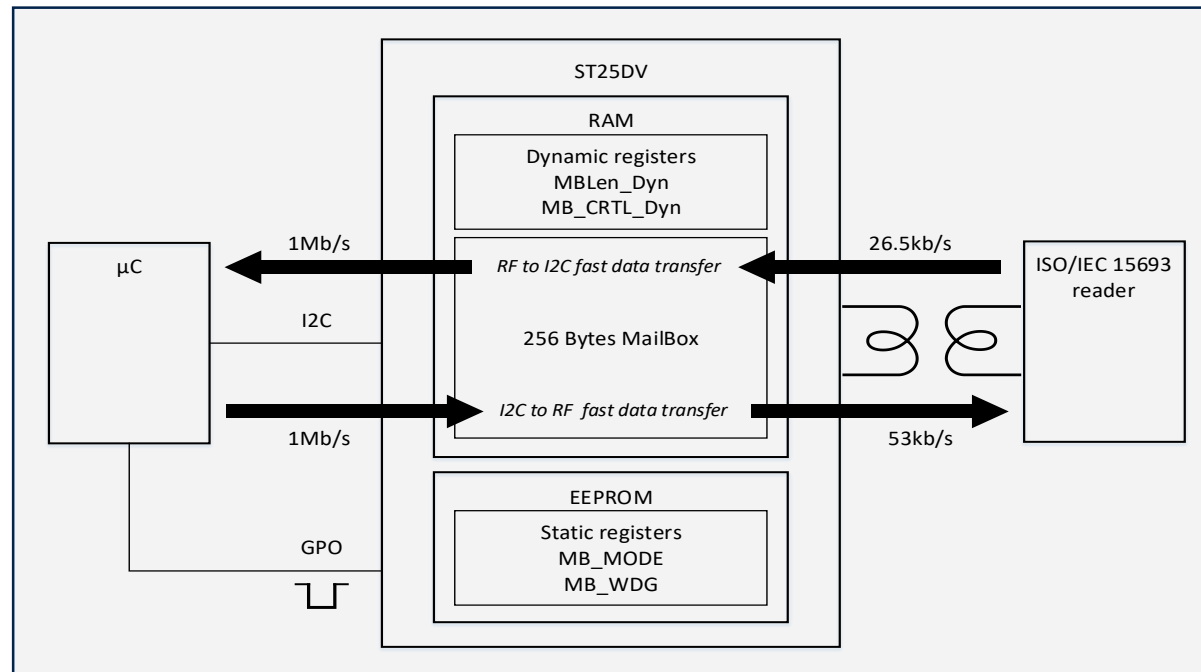




ST25DV-I2C fast transfer mode

- Fast Transfer Mode Overview

- Fast data transfer between μC and RF reader, ensured through 256 bytes buffer
- RF link up to 53Kb/s (26.5kb/s in write) / I2C link up to 1Mb/s
- Interruption on GPO pin to wake μC on message read and/or message write.
- Status register to inform RF reader or μC of current message status.
- Programmable watchdog to automatically release the system.



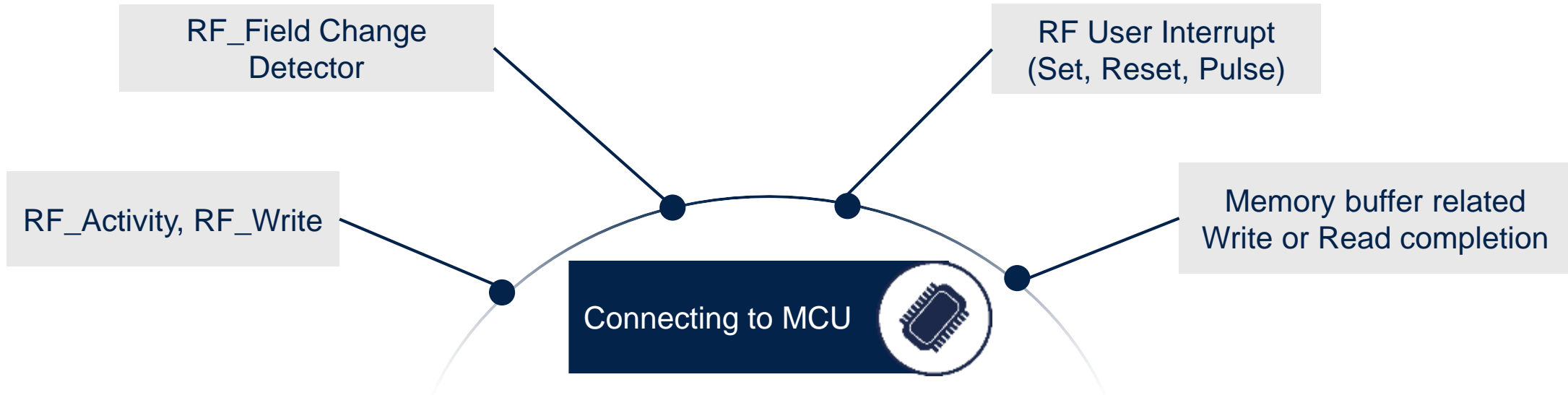
Prerequisites

Vcc ON supply must be active to use the 256 Bytes buffer system

Put message is only possible when buffer is empty and enabled



ST25DV-I2C - flexible interrupts for more usages



GPO pin → one pin, several options

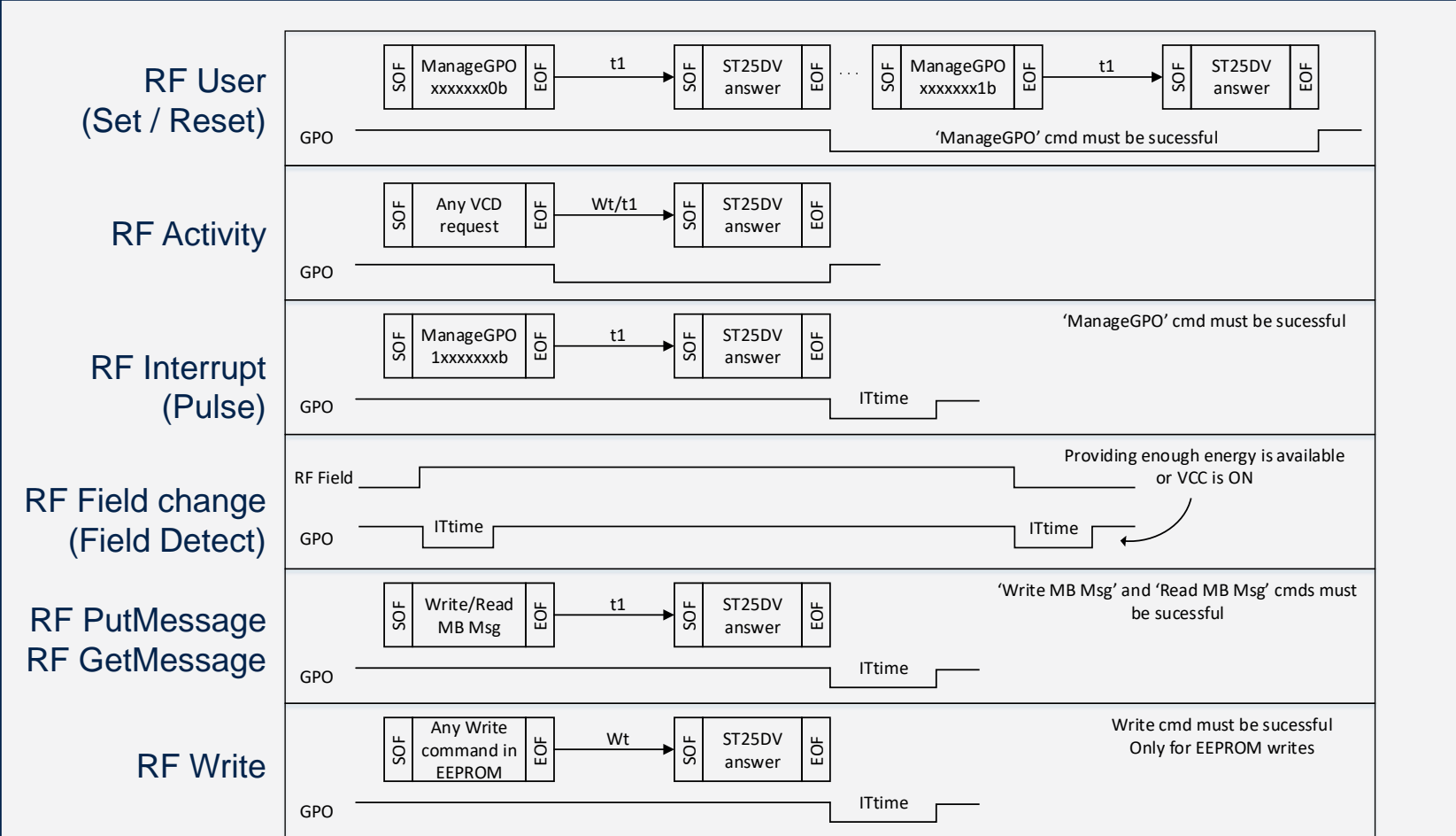
- User set / reset, pulse
 - Microcontroller wake up
- RF related actions
 - Signaling RF activity / write from RF into EEPROM.
- 256 Bytes memory buffer related
 - End of message write or end of message read in memory buffer
- Field detect
- Output in Open Drain or CMOS

Open-Drain GPO:
External pull-up resistor
(>4.7 KΩ)



ST25DV-I2C - GPO interruptions

- GPO Interruption Chronograms



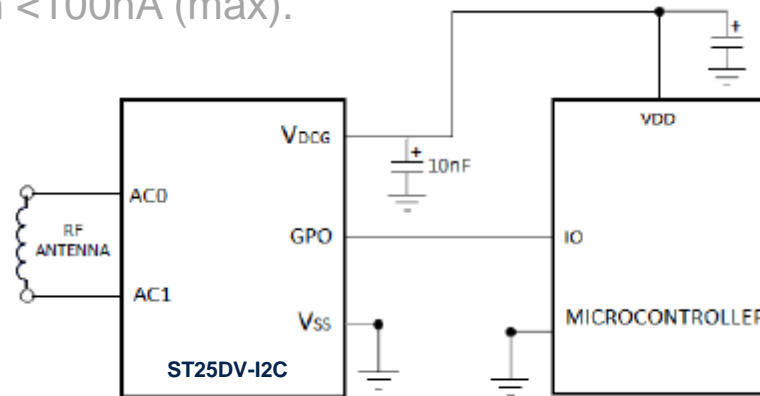
Open drain version. CMOS version signal is inverted



ST25DV-I2C - GPO output options

- GPO CMOS

- CMOS interrupt active at High level
- Signal moving from Low to high level (rising edge)
- No need of any external pull-up resistor or RC filtering or transistor.
 - The capacitor (10nF) on VDCG power supply is recommended but not mandatory.
- VDCG and Vss required. VDCG to power CMOS GPO output
 - Current leakage on VDCG pin <100nA (max).



- GPO Open Drain

- Open drain interrupt active at Low level
- Need external pull up resistor, >4.7 K Ω

CMOS interrupt signal
=> Active High



Open-Drain interrupt signal
=> Active Low





ST25DV-I2C - I2C interface

- I²C (Inter-Integrated Circuit) is typically used for connecting ST25DV-I2C to a micro-controller. It features:
 - Slave I²C serial interface supports 1MHz protocol (I²C fast mode)
 - Single supply voltage: 1.8V to 5.5V
 - Random and sequential read modes
 - Automatic address increment
 - Byte and multiple-bytes write modes (up to 256 bytes, 4 bytes pages internally)
 - No roll over, no cross zone border
- I²C uses only two lines
 - Serial Clock (SCL)
 - Input signal used to strobe all data in and out of the device
 - Serial Data (SDA), Open drain
 - Bidirectional signal is used to transfer data in or out of the device
 - Pull-up resistor must be connected from SDA to Vcc



energy harvesting for battery less design

- The ST25TV04K-PE offers Energy Harvesting mode to power external components
 - Part of the non necessary RF power received by the ST25TV04K-PE on the AC0-AC1 RF input is delivered through the V_EH pin in order to supply external devices.

- The **analog output pin** will be able to deliver the analog voltage **V_EH** whenever the RF field strength is sufficient

- Delivery of Harvest Energy (**up to a few tens μW**) on V_EH pin depends on the value of the EH_enable bit located in the dynamic register EH_Dyn
- Harvest Energy is available at host as soon as surplus energy is available (just limited by RF communication needs)
- Available Energy depends on antenna, Reader's modulation rate, load and whether RF communication is simultaneously required



Energy harvesting
from NFC RF field

NFC connectivity

Up to a few mA
with NFC reader

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





Energy harvesting capabilities

- The ST25TV04K-PE offers Energy Harvesting suited for your battery less application
 - Guidelines
 - Reader's **AM= 100%** (NFC Forum & ISO15693)

H_EH	A/m rms	1	1,5	2	2,5	3	3,5	4	4,5	5
V_EH	V	3,25	3,25	3,2	3,15	3,1	2,99	3,05	3,13	3,31
I_EH	mA	0,7	0,7	0,9	1,1	1,3	1,9	2,1	2,7	3,1
P_EH	mW	2,275	2,275	2,88	3,465	4,03	5,681	6,405	8,451	10,26

- Reader's **AM= 10%** (ISO15693)

H_EH	A/m rms	1	1,5	2	2,5	3	3,5	4	4,5	5
V_EH	V	3,25	3,25	3,2	3,15	3,1	2,99	3,05	3,13	3,31
I_EH	mA	0,7	0,7	0,9	1,1	1,3	1,9	2,5	3,3	4,3
P_EH	mW	2,275	2,275	2,88	3,465	4,03	5,681	7,625	10,33	14,23

Energy Harvesting is still available in this zone, but no RF communication possible

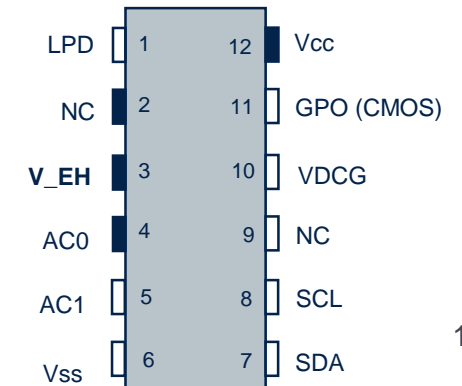
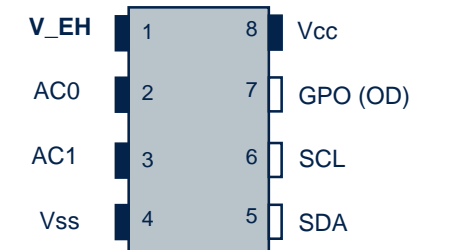




Energy harvesting configuration

- The ST25DV-I2C offers Energy Harvesting mode to power external components through the analog output pin V_EH.
- The Energy Harvesting mode allows to deliver a part of the non necessary RF power received by the ST25DV-I2C on the AC0-AC1 RF inputs in order to supply external devices.
 - To deliver supply voltage on V_EH pin, the RF field must be present (Field_ON) and Energy harvesting must be enabled (EH_EH = 1)
 - In case the RF field strength is insufficient or when Energy harvesting mode is disabled, the analog output pin V_EH goes into high-Z state and Energy Harvesting mode is automatically stopped.
- Delivered power is dependent on field power and load
- Power is delivered at V_EH pin as soon as RF_Field is present and sufficient
- 2 control registers (no additional configuration required):
 - EH_MODE allows to force Energy Harvesting at boot or on demand (R/W)
 - EH_CTRL_Dyn allows to switch Energy Harvesting on the fly, whatever the EH_MODE

EH_CTRL_Dyn	Bit description
EH_EN	enable or disable energy harvesting on the fly (R/W)
EH_ON	indicates if energy is delivered on V_EH pin
Field_ON	indicates if RF field is present (RO)
Vcc_ON	indicates if VCC supply is provided (RO)





RF interface & tuning capacitance

- The internal RF tuning capacitance is 28.5pF which is allowing antenna design from Class 1 to Class 6 form factor.

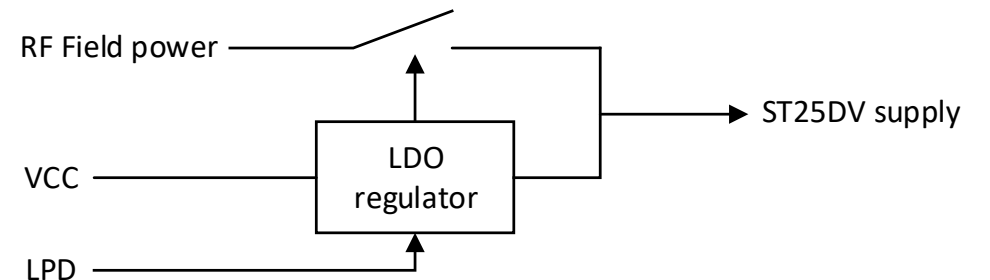
	ST25DV-I2C
Standard	Based on ISO15693 + amendments 3 & 4 NFC Forum type V
Main carrier frequency	13.56MHz
Data sub-carrier frequency	+ 424KHz
Optimal frequency tuning	13.6MHz – 14MHz
Internal capacitor (measured at 0.5V)	28.5pF (*)
Recommended internal capacitor value for antenna design	29pF
Down link speed	Up to 53kbits/s
Single block programming time	< 5ms
Multiple block programming time (max 4 blocks)	< 20ms

(*) equivalent to 27.5pF internal capacitor value as for M24LR



Power management & low power mode

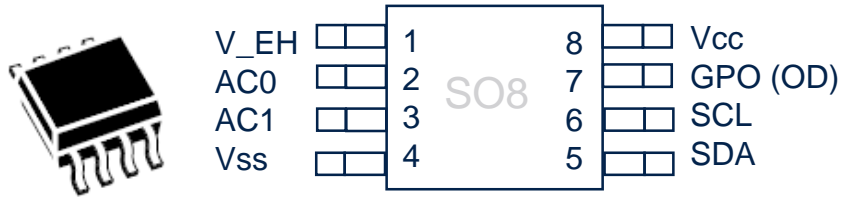
- Power supply
 - 2 possible supply sources: RF field and VCC
 - ST25DV-I2C is supplied by VCC, if present
 - Access to user memory and system configuration is possible with RF and/or VCC
 - Access memory buffer is possible only if VCC is present
 - VCC: 1.8V to 5.5V. Internal LDO regulator on VCC
- Low power mode (with FPN12 and WLCSP10 packages)
 - LPD pin is used to control LDO regulator
 - When set high, LDO is disabled (power consumption $\sim 1\mu\text{A}$ at $V_{CC}=1.8\text{V}$)
 - ➔ I2C access is disabled (but RF access still possible)



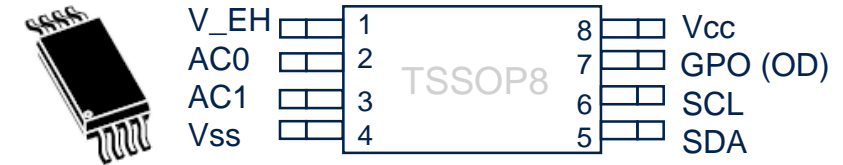


ST25DV-I2C – various packages

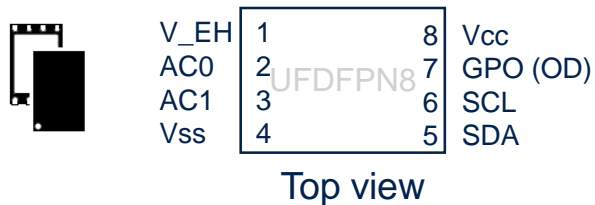
- SO8N Package (4.9x3.9mm)



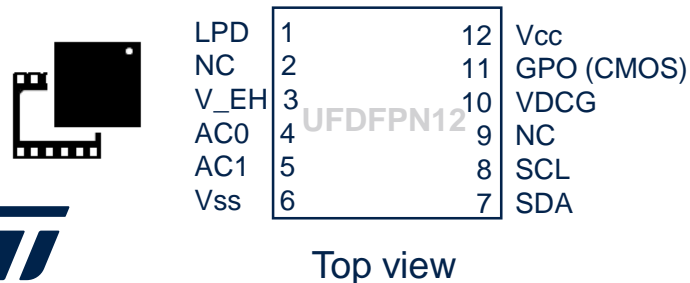
- TSSOP8 Package (3x4.4mm)



- UFDFPN8 Package (2x3mm)



- UFDFPN12 Package (3x3mm)



3 pinouts available

8 pins : SO8, TSSOP8, UFDFPN8
Open Drain GPO (needs external pull-up)

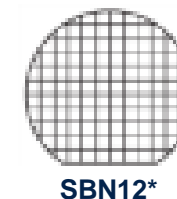
10 pins: WLCSP
CMOS GPO (with VDCG supply pin), LPD input

12 pins : UFDFPN12
CMOS GPO (with VDCG supply pin), LPD input

- WLCSP Package (1.5x1.7mm), thin, 10 bumps, 400um pitch



- Sawn & Bumped wafer

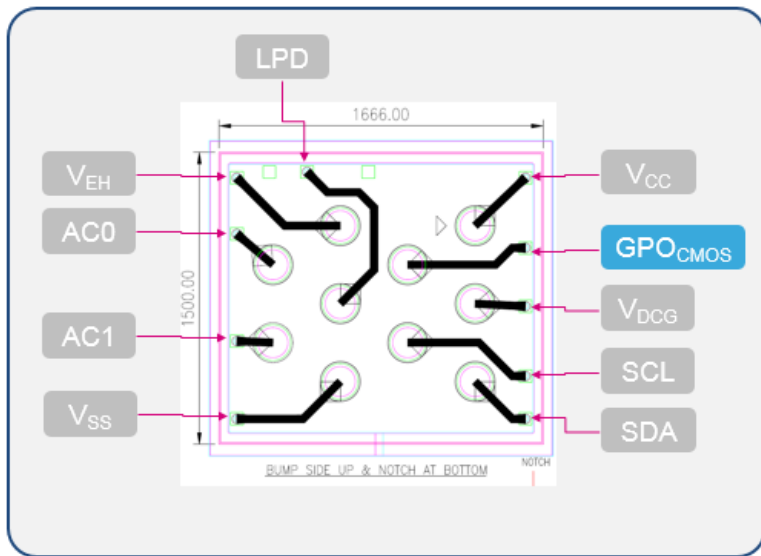


* : sawn and bumped inkless 8" wafer, 120um thickness

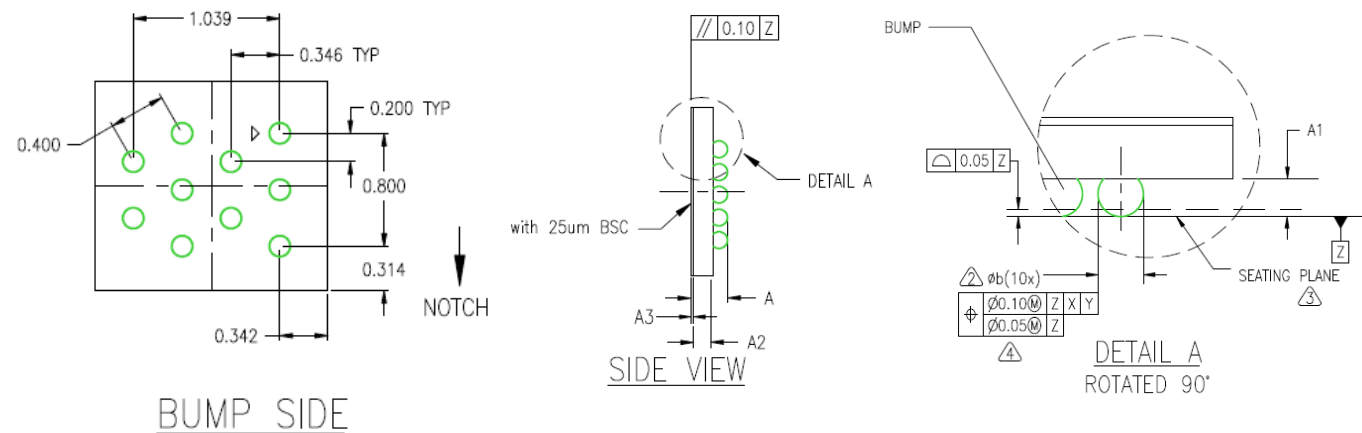


ST25DV-I2C in WLCSP

- ST25DV04K in WLCSP
 - Layout → 10 bumps, 400 μ m pitch
 - Bump metallurgy → SAC 405
 - Backside coating → 25 μ m, black



Dimensions			
DIMENSION	MINIMUM	NOMINAL	MAXIMUM
A	0.265	0.295	0.325
A1	0.080	0.095	0.110
A2	0.150	0.175	0.200
A3	-	0.025	-
b	0.155	0.185	0.215
NUMBER OF BUMPS: 10			





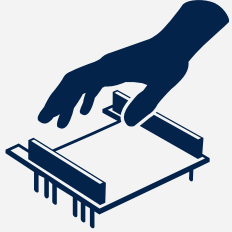
Product part numbers



ST25DV-I2C	Package	4k-bit	16k-bit	64k-bit
Dynamic NFC Type 5 Tag ISO15693 + I2C IF + GPO + Fast Transfer Mode + Energy Harvesting + Extended Temperature	SO8 SO8 TSSOP8 TSSOP8 UFDFPN8 UFDFPN8 UFDFPN12 UFDFPN12 WLCSP10	ST25DV04K-IER6S3 ST25DV04K-IER8S3 ST25DV04K-IER6T3 ST25DV04K-IER8T3 ST25DV04K-IER6C3 ST25DV04K-IER8C3 ST25DV04K-JFR6D3 ST25DV04K-JFR8D3 ST25DV04K-JFR6L3	ST25DV14K-IER6S3 ST25DV16K-IER8S3 ST25DV16K-IER6T3 ST25DV16K-IER8T3 ST25DV16K-JFR6D3	ST25DV64K-IER6S3 ST25DV64K-IER8S3 ST25DV64K-IER6T3 ST25DV64K-IER8T3 ST25DV64K-JFR6D3 ST25DV64K-JFR8D3



ST25DV-I2C rich eco-system



- Discovery kits based on STM32 MCU
- STM32 Nucleo boards ecosystem
- STM32Cube software ecosystem



- Antenna e-design tool
- Schematic, BOM, Gerber



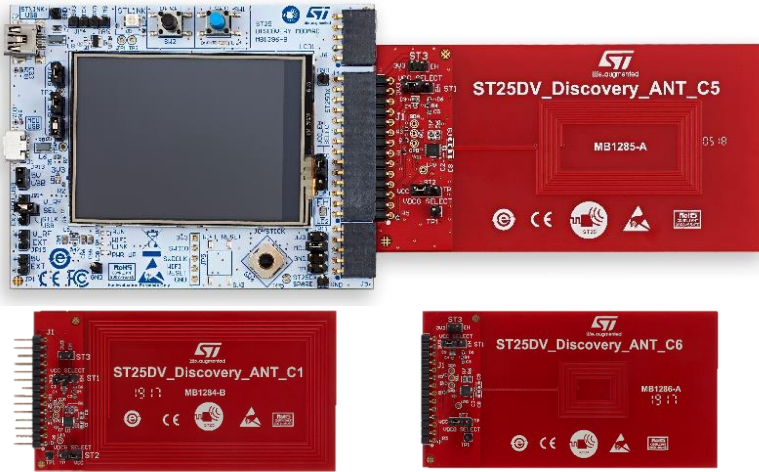
- Android and iOS ST25 NFC tap app
- PC software tool
- MCU drivers firmware



- Documentation
- e2e community
- Webinar / MOOC
- Training



ST25DV-I2C evaluation boards



ST25DV-DISCOVERY
ANT-1-6-ST25DV



X-NUCLEO-NFC04A1



ANT7-T-ST25DV04K

ST25DV-I2C discovery kit

- **ST25DV04K** Dynamic NFC tag IC
- 40x24mm 10 turns antenna (ANT Class5)
- STM32F405 MCU
- 2.4" TFT LCD Touch screen
- I2C & SWIP connectors
- Daughter board connector
- 45x75mm (Class1) & 18x24 mm (Class6)

ST25DV-I2C Nucleo shield

- **ST25DV04K** Dynamic NFC tag IC
- Ø54mm 8 turns single layer antenna Energy harvesting, Low Power mode, GPO
- Compatible with STM32 Nucleo boards
- I2C interface to MCU & Powered through Arduino™ connector

ST25DV-I2C Tiny Antenna

- **ST25DV04K** Dynamic NFC tag IC
- Ready-to-use PCB including:
- 14x14 mm, dual layer etched antenna
- I2C test points
- RF event configurable GPO
- Analog energy harvesting (EH) output



ST25DV-I2C discovery kit optional modules

BLE module



http://www.st.com/content/st_com/en/products/wireless-connectivity/bluetooth-bluetooth-low-energy/spbtle-rf.html

WiFi module



http://www.st.com/content/st_com/en/products/wireless-connectivity/wi-fi/spwf01sa.html

Mother Board	WiFi	BLE	Connector HE10	Card usage
Card Disco Kit	No	No	No	Card for distribution
Card full	Yes	Yes	Yes	Card for demo



ST25DV-I2C hardware development tool usage



	X-NUCLEO	Discovery kit
Typical use case	Flexible prototyping, Community	
Hardware	<ul style="list-style-type: none">• ST25DV-I2C antenna plug for Nucleo eco system• Compatible with any STM32 mother board	<ul style="list-style-type: none">• Dedicated to ST25DV-I2C• Ready to use• Stand Alone system• Up to three antennas
Extension possibilities	+ + +	+ +
Connectivity	Arduino™ ST Morpho	ST
Software	ST25DV-I2C start-up Deliveries for Nucleo	Demo SW flashed Demo use cases SW deliveries available



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Solutions for NFC / RFID tags & readers



ST25 SIMPLY MORE CONNECTED



Thank you

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