

ST25DV-I2C product presentation

June 2018





ST25DV-I2C Product

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- ST25DV-I2C chip belongs to ST25 NFC / RFID Tags & Readers family
- ST25DV-I2C product is Dynamic Tag with following 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 → **NEW**
 - 8 pin or 10 or 12 pin package versions → **NEW**: WLCSP package added





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 card




CVV credit card, Badge



ST25DV-I2C Combined Use Cases



Device programming in production



programming
e



- **Simple and flexible**

Servicing & Maintenance



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

End user experience



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

Commissioning for Wireless industrial 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 phone



ISO15693 (26kb/s)



Up to 7cm (3in.)



RFID reader

ISO15693 (26kb/s)



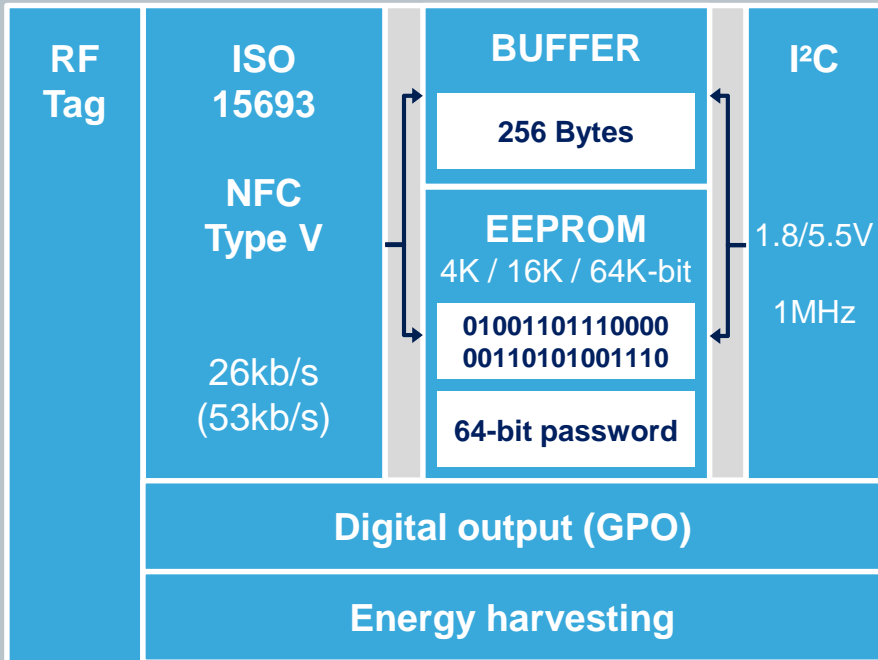
Up to 1m (3ft)



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



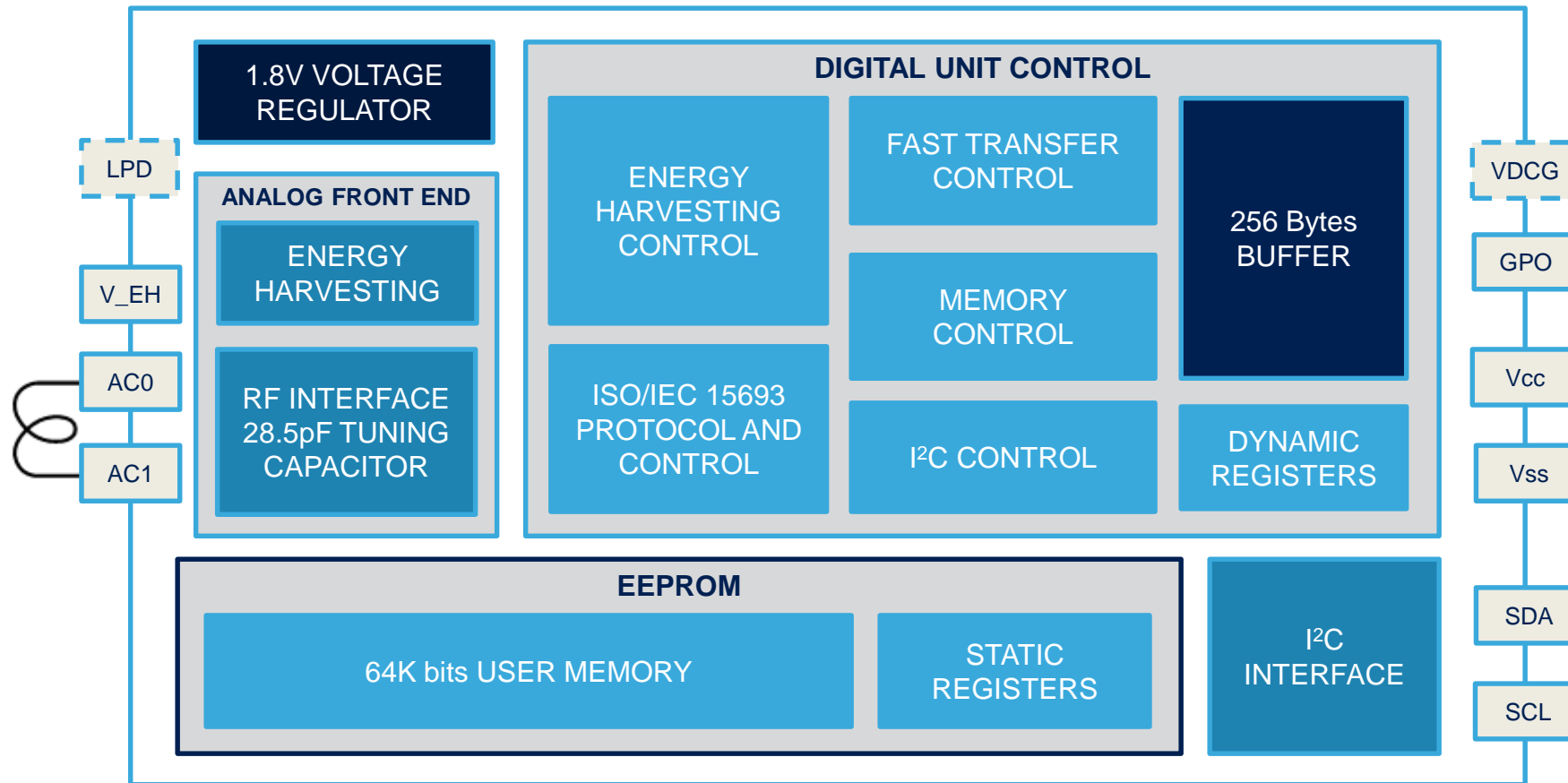
ST25DV-I2C Key Features

ST25DV-I2C series

| | |
|---------------------------------|---|
| Contactless Interface | ISO15693 / NFC Forum Type 5 + annexes 3 & 4 |
| RF range | Long range, up to 100cm |
| RF speed | up to 53kbps (26kbps standard) |
| Single supply voltage | 1.8V to 5.5V |
| Serial Interface | I2C @1MHz |
| Extra Features | GPO: 7 interrupts modes (Open Drain or CMOS) Energy Harvesting Low Power Mode |
| Memory format & size | EEPROM data - 4 / 16 / 64-kbit |
| 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 |
| Fast Transfer Mode | 256 Bytes memory Buffer |
| Data protection | Password 64-bit |
| Temperature range | Grade 6: -40°C to +85°C Grade 8: -40°C to +125°C (+105°C for RF) |
| Package | SO8 / TSSOP8 / FPN8 / FPN12 / WLCSP10 / SBN12 |



ST25DV-I2C Block Diagram



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



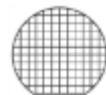
ST25DV-I2C vs M24LR / M24SR (1/2)

| | M24SR series | M24LR series | ST25DV-I2C 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 100cm) | Long range (up to 100cm) |
| RF speed | 106kbps | up to 53kbps (26kbps standard) | up to 53kbps (26kbps standard) |
| Serial Interface | I2C @1MHz | I2C @400kHz | I2C @1MHz |
| Fast Transfer mode | No | No | Yes, FIFO buffer (256-Byte) |
| Energy Harvesting | No | Yes | Yes |
| Digital output | Open-Drain GPO | Open-Drain GPO | OD or CMOS GPO |
| Extra features | RF Disable | - | Low Power mode |



ST25DV-I2C vs M24LR / M24SR (2/2)

| | M24SR series | M24LR series | ST25DV-I2C series |
|---------------------------|---|--|--|
| Memory format | EEPROM (preformatted NDEF) | 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 |
| Data retention | 200 years at +55°C | 40 years at +55°C | 40 years at +55°C |
| Erase/Write cycles | 1M cycles at +25°C 600k cycles at +85°C 500k cycles at +105°C | 1M cycles at +25°C 100k cycles at +85°C | 1M cycles at +25°C 600k cycles at +85°C 500k cycles at +105°C 400k cycles at +125°C |
| 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) |
| Package | SO8 / TSSOP8 / FPN8 / SBN12 | SO8 / TSSOP8 / FPN8 / SBN12 * | SO8 / TSSOP8 / FPN8 / FPN12 / WLCSP10 / SBN12 * |



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



Design Compatibility

| | | | |
|--------------|---|--|--|
| M24SR | ISO14443 RF interface <ul style="list-style-type: none">- NFC compliant (type 4)- Short Range (up to 10cm)- High speed 106kb/s- Passive RF- 25pF internal tuning cap | High speed I2C <ul style="list-style-type: none">- 1MHz- 2.7-5.5V- NDEF data format | Enhanced EEPROM <ul style="list-style-type: none">- 200 years data retention- 1 Million erase-write cycles- 128-bit password protection |
|--------------|---|--|--|

Compatible antenna design

Same packages and pinout (8-pin version)

4K, 16K and 64Kbit versions

| | | | |
|-----------------------------------|--|---|---|
| ST25DV-I2C M24LR | ISO15693 RF interface <ul style="list-style-type: none">- NFC compliant (type 5)- Long Range (up to 1m with RFID readers)- 26kb/s data rate- Passive RF- 27.5pF / 28.5pF equivalent internal tuning cap- Energy Harvesting | Low voltage I2C <ul style="list-style-type: none">- 400kHz / 1MHz- 1.8-5.5V- EEPROM data format- NDEF by user | Standard EEPROM <ul style="list-style-type: none">- 40 years data retention- 1 Million erase-write cycles- 64-bit (32-bit) password protection |
|-----------------------------------|--|---|---|



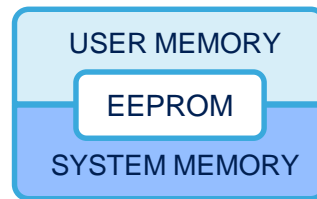
- User and System memory data protection thanks to a password
 - Password size 64-bit → 1.8 10¹⁹ combinations



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

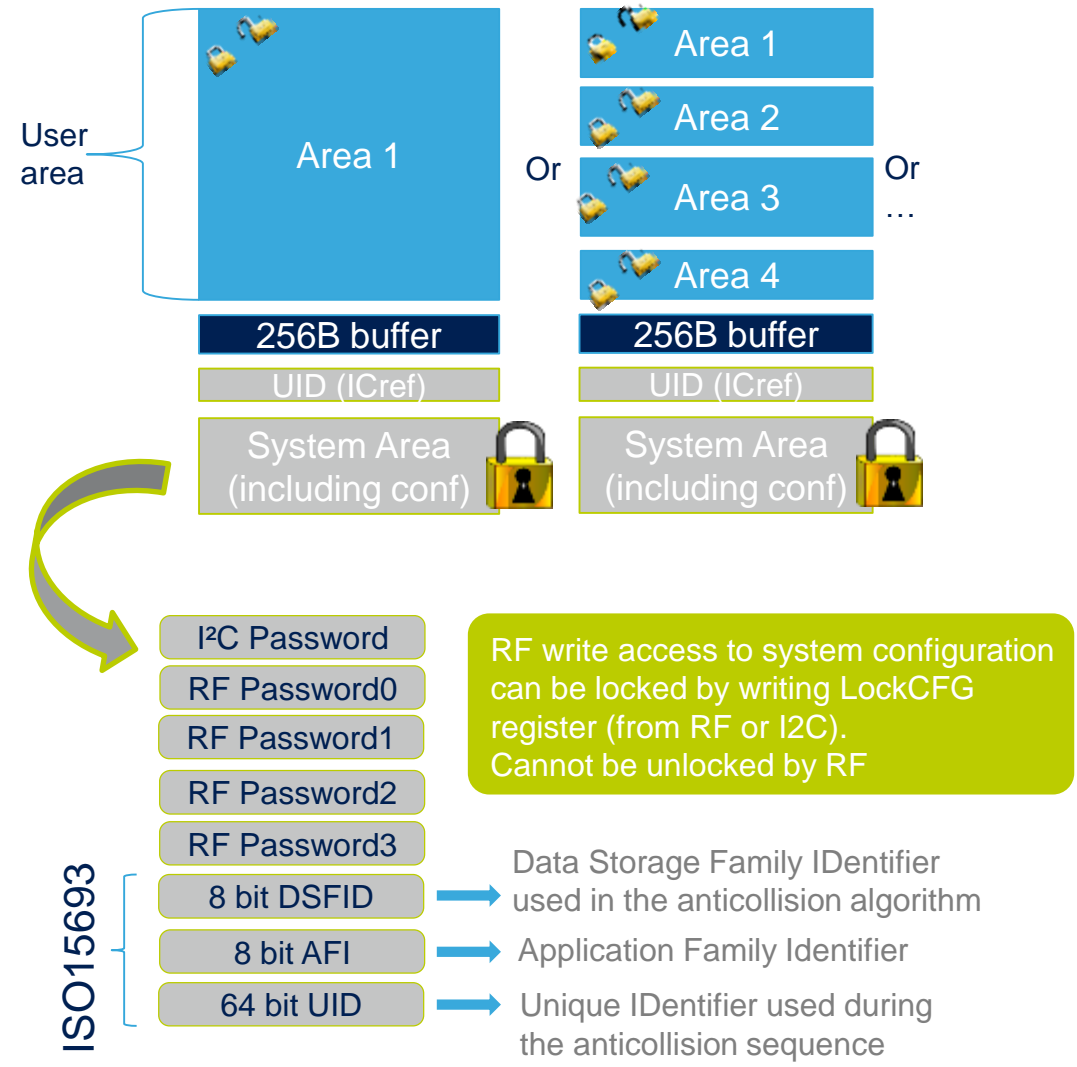
- 1x password
- Write access can be protected thanks to the I2C password.
- Read access is always allowed (no data protection).

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



Memory Mapping & Pwd Management

- High Density EEPROM
 - 4-kbit, 16-kbit, 64-kbit
- 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 form 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)



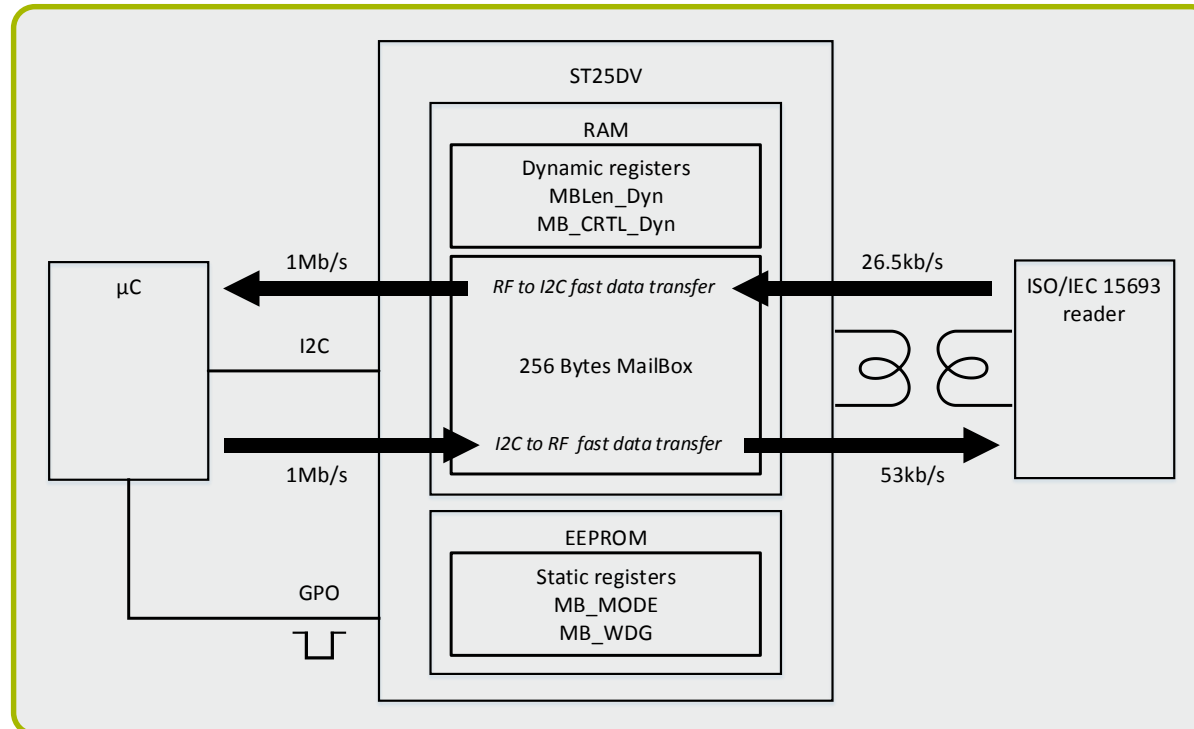


Fast Transfer Mode

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• Fast Transfer Mode Overview

- Fast data transfer between μ C 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 μ C on message read and/or message write.
- Status register to inform RF reader or μ C of current message status.
- Programmable watchdog to automatically release the system.



Prerequisites

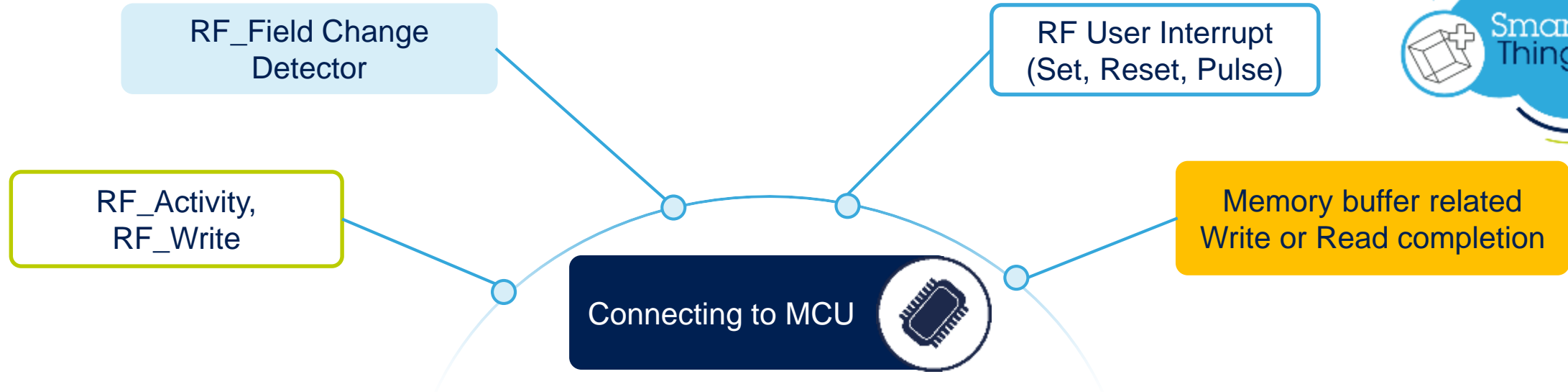
Vcc ON supply must be active to use the 256 Bytes buffer system

Put message is only possible when buffer is empty and enabled



Flexible Interrupts for More Usages

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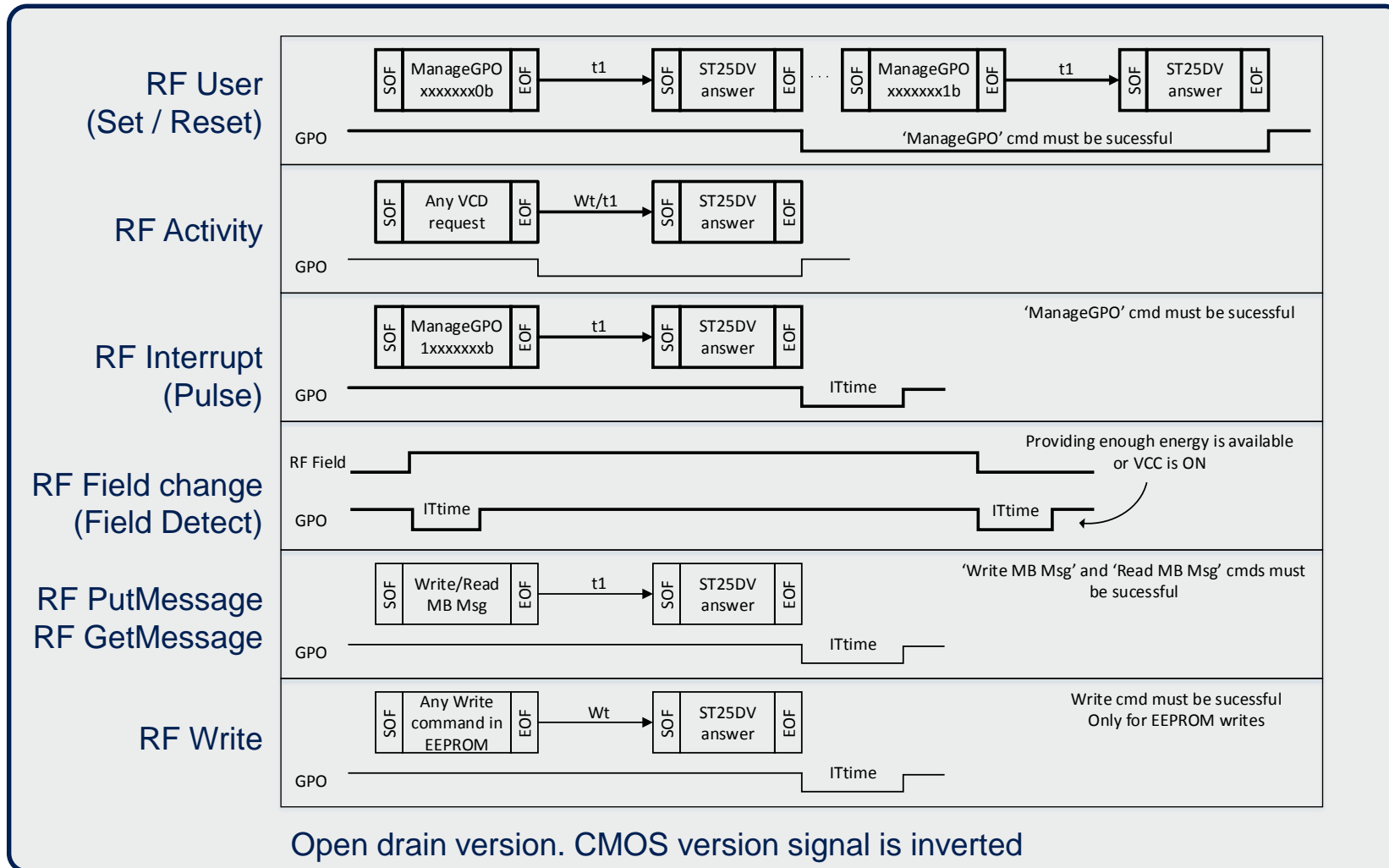
GPO pin → one pin, several options

- 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)



- GPO Interruption Chronograms



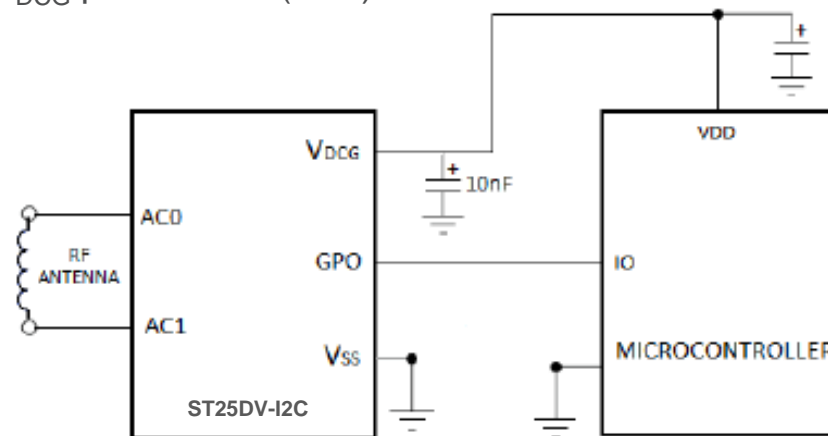


GPO Output Options

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• 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 V_{DCG} power supply is recommended but not mandatory.
- V_{DCG} and V_{SS} required. V_{DCG} to power CMOS GPO output
 - Current leakage on V_{DCG} pin <100nA (max).



CMOS interrupt signal
=> Active High



Open-Drain interrupt signal
=> Active Low



• GPO Open Drain

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



- 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 - Batteryless Design

- The ST25DV-I2C offers Energy Harvesting mode to power external components
 - Part of the non necessary RF power received by the ST25DV-I2C 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

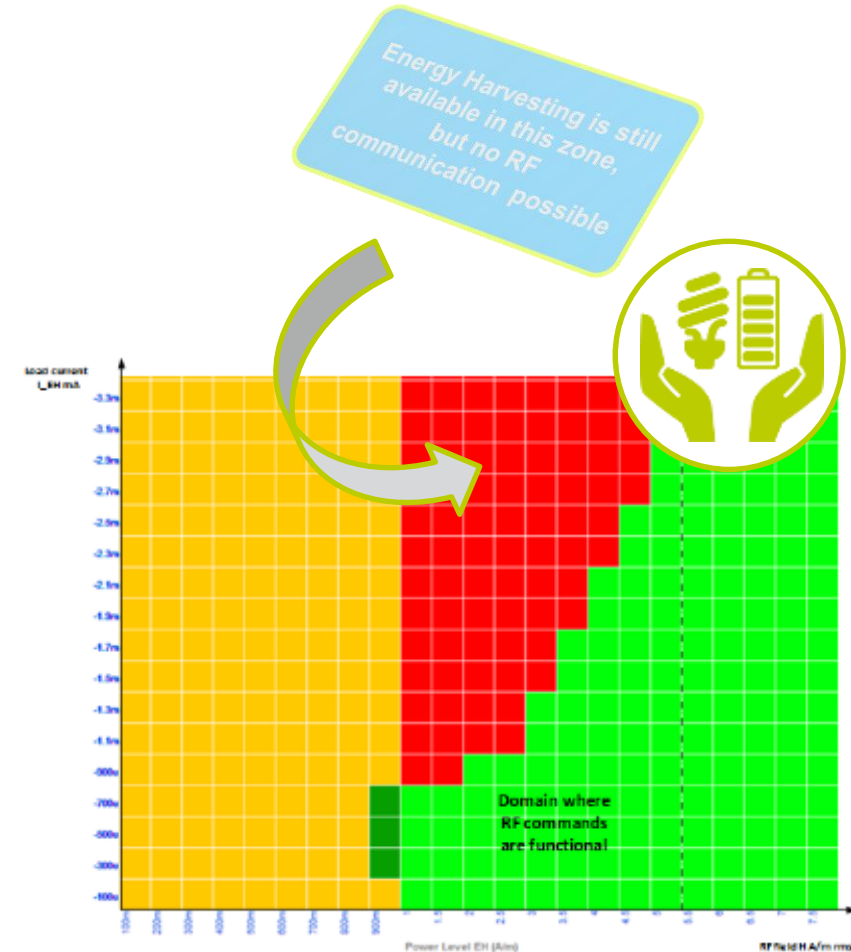
- The ST25DV-I2C offers Energy Harvesting suited for your battery less application
 - Guidelines

- 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 |

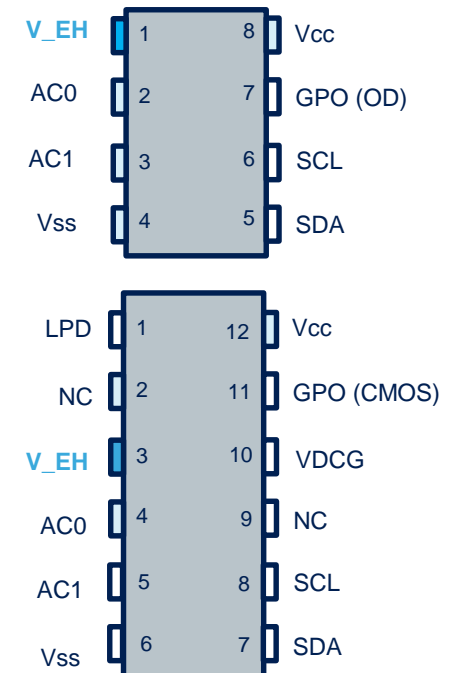




Energy Harvesting Configuration

- The ST25DV 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 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.

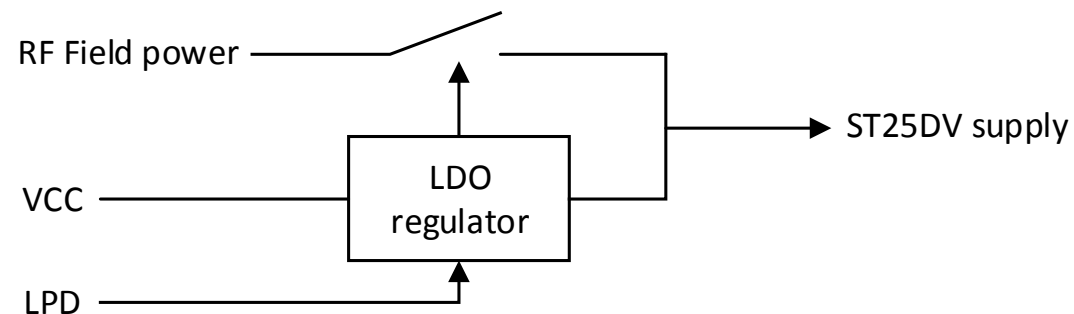
| | ST25DV |
|--|--|
| Standard | Based on ISO15693 + amendments 3 & 4 NFC Forum type V |
| Main carrier frequency | 13.56MHz |
| Data sub-carrier frequency | + 424kHz |
| Optimal frequency tuning | 13.6MHz – 14MHz |
| Internal capacitor (measured at 0.5V) | 28.5pF (*) |
| Recommended internal capacitor 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

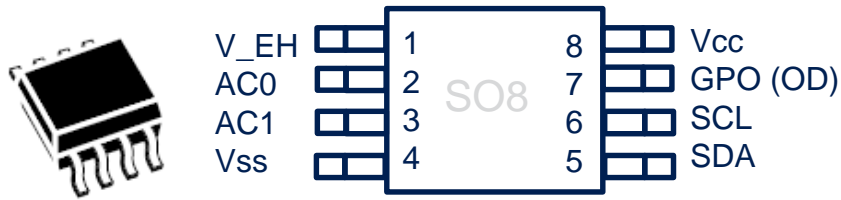
- Power supply
 - 2 possible supply sources: RF field and VCC.
 - ST25DV is supplied by VCC, if present.
 - Access to user memory and system configuration is possible with RF and/or VCC
 - Access memory buffer is possible only if VCC is present.
 - VCC: 1.8V to 5.5V. Internal LDO regulator on VCC.
-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





Packages

• SO8N Package (4.9x3.9mm)



• UFDFPN8 Package (2x3mm)



• UFDFPN12 Package (3x3mm)



3 available pinouts

8 pins : SO8, TSSOP8, UFDFPN8

Open Drain GPO (needs external pull-up)

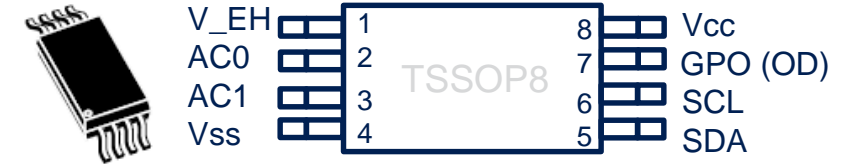
10 pins: WLCSP

CMOS GPO (with VDCG supply pin), LPD input

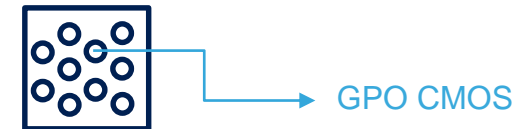
12 pins : UFDFPN12

CMOS GPO (with VDCG supply pin), LPD input

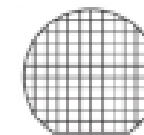
• TSSOP8 Package (3x4.4mm)



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



• Sawn & Bumped wafer



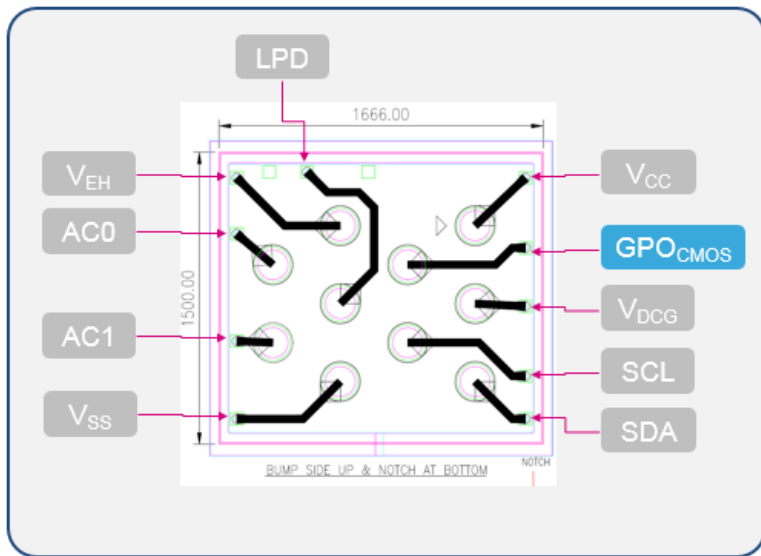
SBN12 *

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

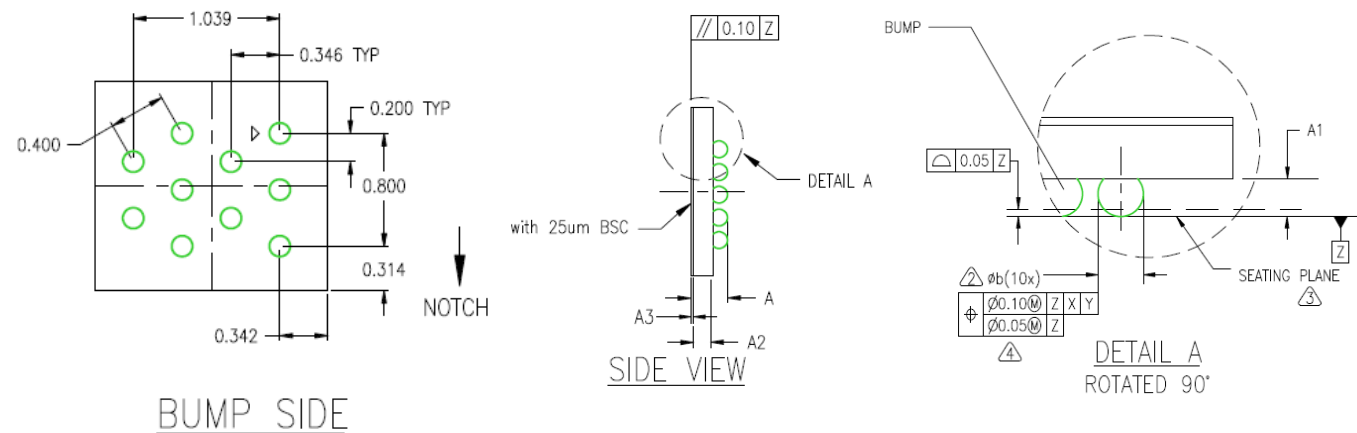


ST25DV04K in WLCSP

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



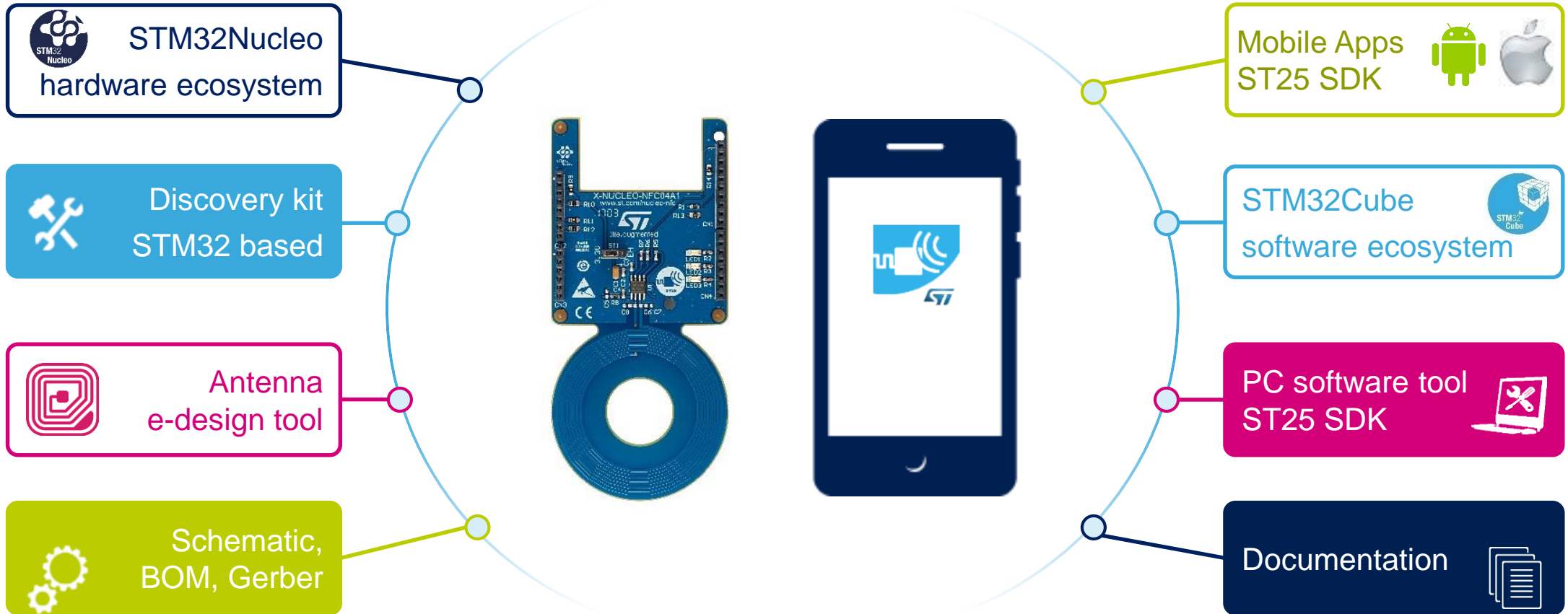
| Dimensions | | | |
|---------------------|---------|---------|---------|
| DIMENSION | MINIMUM | NOMINAL | MAXIMUM |
| A | 0.265 | 0.295 | 0.325 |
| A1 | 0.080 | 0.095 | 0.110 |
| A2 | 0.150 | 0.175 | 0.200 |
| A3 | - | 0.025 | - |
| b | 0.155 | 0.185 | 0.215 |
| NUMBER OF BUMPS: 10 | | | |





ST25DV-I2C Support Eco-system

Easy-to-use and customer-oriented





ST25DV-I2C Evaluation Boards

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



ST25DV-DISCOVERY

ST25DV-I2C Nucleo shield

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



X-NUCLEO-NFC04A1

ST25DV-I2C Antenna kit

- ST25DV04K Dynamic NFC tag IC
- Ready-to-use PCB including:
- 45x75mm (ST25DV_Discovery_ANT_C1)
- 18x24 mm (ST25DV_Discovery_ANT_C6)
- Energy Harvesting output (Vout)
- Mates with ST25Dx_Discovery MBoard



ANT-1-6-ST25DV



Discovery Kit Optional Modules

BLE module



| 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 |

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



Hardware Development Tools Usage

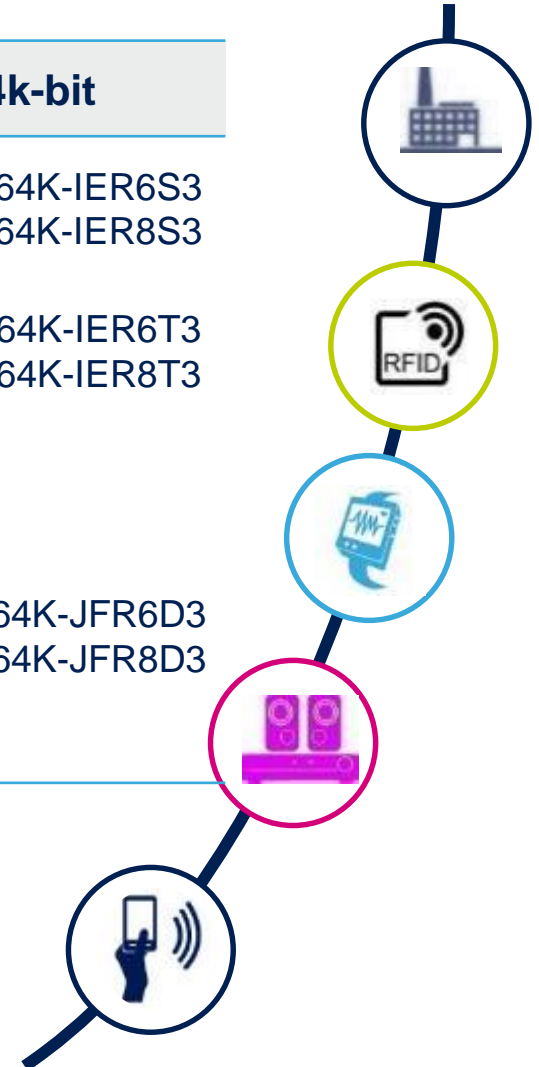


| | X Nucleo | Discovery kit |
|--------------------------------|--|--|
| Typical use case | Flexible prototyping, Community | |
| Hardware | <ul style="list-style-type: none">• ST25DV-I2C antenna plug for Nucleo eco system• Compatible with any STM32 mother board | <ul style="list-style-type: none">• 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 |



Product Part Numbers

| ST25DV-I2C | Package | 4k-bit | 16k-bit | 64k-bit |
|--|---------|--------------------------------------|--------------------------------------|--------------------------------------|
| Dynamic NFC / RFID tag RF ISO15693 interface + I2C interface + Fast Transfer Mode + GPO + Energy harvesting + Extended temperature | SO8 | ST25DV04K-IER6S3 ST25DV04K-IER8S3 | ST25DV16K-IER6S3 ST25DV16K-IER8S3 | ST25DV64K-IER6S3 ST25DV64K-IER8S3 |
| | TSSOP8 | ST25DV04K-IER6T3 ST25DV04K-IER8T3 | ST25DV16K-IER6T3 ST25DV16K-IER8T3 | ST25DV64K-IER6T3 ST25DV64K-IER8T3 |
| | FPN8 | ST25DV04K-IER6C3 ST25DV04K-IER8C3 | | |
| | FPN12 | ST25DV04K-JFR6D3 ST25DV04K-JFR8D3 | ST25DV16K-JFR6D3 | ST25DV64K-JFR6D3 ST25DV64K-JFR8D3 |
| | WLCSP10 | ST25DV04K-JFR6L3 | | |



Solutions for NFC / RFID Tags and Readers



Thank You!

