Introduction
The X-NUCLEO-NFC04A1 dynamic NFC/RFID tag IC expansion board is based on the ST25DV04K NFC Type V/RFID tag IC with a dual interface 4 Kbits EEPROM that also features an I²C interface. It can be powered by the pin of Arduino connector or directly by the received carrier electromagnetic field.

The X-NUCLEO-NFC04A1 expansion board is compatible with the Arduino™ UNO R3 connector pin assignment and can easily be plugged onto any STM32 Nucleo board. Various expansion boards can also be stacked to evaluate different devices operating together with the dynamic NFC tag.

The board also features an antenna with a 54 mm iso 24.2 diameter, single layer, copper etched on PCB.

Figure 1: X-NUCLEO-NFC04A1 expansion board
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1  Getting started

1.1  Hardware and software requirements
To operate correctly, the X-NUCLEO-NFC04A1 expansion board must be connected to the STM32 Nucleo board as shown below.

Figure 2: X-NUCLEO-NFC04A1 expansion board plugged to an STM32 Nucleo board

The STM32 Nucleo firmware and the relative documentation are available at www.st.com.

The X-NUCLEO-NFC04A1 is designed to be used with any STM32 Nucleo board, even if complete testing has been performed using the NUCLEO-L053R8 (based on the ultra-low power STM32L053R8) and the NUCLEO-F401RE (hosting the dynamically efficient STM32F401RE).

To use the STM32 Nucleo development boards with the X-NUCLEO-NFC04A1 expansion board, the following software and hardware specifications are required:

- a PC/Laptop with Microsoft Windows ® 7 and above to install the software package (X-CUBE-NFC4)
- a type A to Mini-B USB cable to connect the STM32 Nucleo board to the PC/Laptop
- the X-CUBE-NFC4 software package (available on www.st.com)

1.2  Board setup
To set up the board:

1.  Check that the jumper on the X-NUCLEO-NFC04A1 ST1 connector is in place. This jumper provides the required voltage to the device on the board\(^a\).

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\(^a\) See Section 2.1.1: "Power supply option" for further details.
Connect the X-NUCLEO-NFC04A1 on top of the STM32 Nucleo board as shown in Figure 2: "X-NUCLEO-NFC04A1 expansion board plugged to an STM32 Nucleo board".

Power the STM32 Nucleo board using the Mini-B USB cable.

Program the firmware in the STM32 Nucleo board using the provided firmware example.

Reset the MCU board using the reset button available on the STM32 Nucleo board.
The evaluation kit is ready to be used.
2 Hardware description and configuration

The X-NUCLEO-NFC04A1 expansion board allows the user to test the functionality of the ST25DV04K NFC Type V/RFID tag IC with a dual-interface 4 kBit electrically erasable programmable read-only memory (EEPROM) that also features an I²C interface.

The EEPROM is organized in blocks of 512 bytes, arranged by pages of 4 bytes in I²C mode, and in 128 blocks of 4 bytes in RF mode. It can be powered by STM32 Nucleo board or directly by the received carrier electromagnetic field.

The ST25DV04K features a low power down (LPD) pin, a general purpose output (GPO) and an energy harvesting feature that lets you output the energy coming from the RF field on the Vout analog pin and acts on ST1 jumper to enable it.

The ST25DV04K can act as a mailbox in fast transfer mode in both directions between the RF terminal (such as an e-reader or a smart phone) and the microcontroller through the I²C. In this case, messages are stored in the RAM instead of EEPROM. This mode allows exchanging up to 256 byte payload data via RF and I²C interfaces.

A user configurable output pin can also be used as an interrupt for the microcontroller, and toggles during field change (e.g., RF Busy, MailBox filled, EEPROM update, RF user Interrupt and RF User Set/Reset).

ST25DV04K device standby current consumption can be further lowered using the Low Power Down input pin that switches the ST25DV04K internal LDO off.

These functions can be exploited using the firmware package contained in the X-CUBE-NFC4 software.

The STM32 Nucleo and the X-NUCLEO-NFC04A1 boards are connected through connectors CN5, CN6, CN8 and CN9, as detailed in the following tables.

| Table 1: Interconnections between the STM32 Nucleo board and the X-NUCLEO-NFC04A1 expansion board (left side) |
|--------------------------------------------------|-----------------|-----------------|-----------------|
| Signal   | Connector | Pin number | STM32 Nucleo board (MCU port) | X-NUCLEO-NFC04A1 expansion board |
| NC       | CN6 Power | 1          | -                            | -                            |
| IOREF    |           | 2          | -                            | 3V3                          |
| RESET    |           | 3          | -                            | -                            |
| 3V3      |           | 4          | -                            | 3V3                          |
| 5V       |           | 5          | -                            | -                            |
| GND      |           | 6          | -                            | GND                          |
| GND      |           | 7          | -                            | GND                          |
| VIN      |           | 8          | -                            | -                            |
| A0       | CN8       | 1          | PA0                          | -                            |

a available even when RF is disabled

b See Table 2: "Interconnections between the STM32 Nucleo board and the X-NUCLEO-NFC04A1 expansion board (right side)"

c To program the microcontroller on the STM32 Nucleo board refer to user manuals UM1724, "STM32 Nucleo-64 board", and UM1725, "Description of STM32F4 HAL and LL drivers", available on www.st.com.
### 2.1 Power supply and GPIO connection options

#### 2.1.1 Power supply option

The on-board jumper (ST1) allows the user to select the ST25DV power source: external (STM32 Nucleo board power supply) or ST25DV energy harvesting, indicated on the board silkscreen with 3.3 V and EH respectively.
### 2.1.2 GPIO option

The ST25DV_LP and ST25DV_GPO optional signals can be disconnected from the STM32 Nucleo board by removing, respectively, R11 and R1 resistors.

The same option applies to the lines driving the three general purpose LEDs (MCU_LED1, MCU_LED2 and MCU_LED3) that can be dedicated to other purposes (by removing R2, R3 and R4, respectively).²

² Refer to Section 3: “X-NUCLEO-NFC04A1 expansion board component placement, block diagram and schematics”. In case these connections are modified the firmware must be updated to enable proper use of the STM32 Nucleo resources.
3 X-NUCLEO-NFC04A1 expansion board component placement, block diagram and schematics

Figure 3: X-NUCLEO-NFC04A1 expansion board component placement

- Arduino R3 connectors
- ST25DV04K
Figure 4: X-NUCLEO-NFC04A1 block diagram

Figure 5: X-NUCLEO-NFC04A1 LED and power supply schematic diagram
Figure 6: STM32 Nucleo Arduino connectors

Figure 7: ST25DV04K schematic diagram
### Bill of materials

Table 3: X-NUCLEO-NFC04A1 bill of materials

<table>
<thead>
<tr>
<th>Item</th>
<th>Q. ty</th>
<th>Ref.</th>
<th>Part / Value</th>
<th>Description</th>
<th>Manufacturer</th>
<th>Order code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>C1</td>
<td>4.7 μF, 16 V ±10%, SMD_293D-A_REFLOW</td>
<td>Capacitor</td>
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<tr>
<td>2</td>
<td>1</td>
<td>C2</td>
<td>100 nF, 16 V, X7R, ±5%, SMD_C_0603_REFLOW</td>
<td>Ceramic capacitor</td>
<td></td>
<td></td>
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<tr>
<td>3</td>
<td>2</td>
<td>C4, C9</td>
<td>10 nF, 50 V NPO ±5%, SMD_C_0603_REFLOW</td>
<td>Ceramic capacitor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>C5, C6, C7, C8</td>
<td>10 nF, 50 V NPO ±5%, SMD_C_0603_REFLOW_NC</td>
<td>Ceramic capacitor (not mounted)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>CN5</td>
<td>HDR1X10</td>
<td>Extra-long 10 pin female-male strip</td>
<td>SAMTEC</td>
<td>SSQ-110-03-L-S</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>CN6, CN9</td>
<td>HDR1X8</td>
<td>Extra-long 8 pin female-male strip</td>
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<td>SSQ-108-03-L-S</td>
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<tr>
<td>7</td>
<td>1</td>
<td>CN8</td>
<td>HDR1X6</td>
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<td>Item</td>
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<td>Manufacturer</td>
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<tr>
<td>19</td>
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<td>U1</td>
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<td>ST25DV04</td>
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<td>2.54</td>
<td>Jumper</td>
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Federal Communications Commission (FCC) and Industry Canada (IC) compliance statements

5.1 FCC Compliance Statement

5.1.1 Part 15.19
This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

5.1.2 Part 15.105
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interferences by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

5.1.3 Part 15.21
Any changes or modifications to this equipment not expressly approved by STMicroelectronics may cause harmful interference and void the user's authority to operate this equipment.

5.2 IC Compliance Statement

5.2.1 Compliance Statement
This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation.
6 Revision history

Table 4: Document revision history

<table>
<thead>
<tr>
<th>Date</th>
<th>Version</th>
<th>Changes</th>
</tr>
</thead>
</table>
| 16-Jun-2017| 1       | Initial release.
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