

# UM1799 User manual

# Getting started with X-NUCLEO-NFC03A1 NFC card reader board based on CR95HF for STM32 Nucleo

#### Introduction

The X-NUCLEO-NFC03A1 is an NFC (Near Field Communication) card reader evaluation board based on the CR95HF, designed for expansion of STM32 Nucleo boards.

The CR95HF is an integrated circuit (IC) for contactless applications. It provides the 13.56 MHz air interface, frame coding and decoding for standard applications such as NFC. The CR95HF communicates with the Host through UART or SPI interface.

The X-NUCLEO-NFC03A1 is compatible with the Arduino<sup>™</sup> UNO R3 connector assignment.

This expansion board can be plugged into the Arduino<sup>™</sup> UNO R3 connectors of any STM32 Nucleo board. The different expansion boards can be easily stacked to allow users to evaluate different devices with NFC card reader.

The board (see Figure 1) features:

- on-board NFC card reader IC: CR95HF
- 47 mm x 34 mm, four turns, single layer 13.56 MHz inductive antenna etched on PCB, and associated tuning circuit
- · four general purpose LEDs



Figure 1. NFC card reader board based on CR95HF

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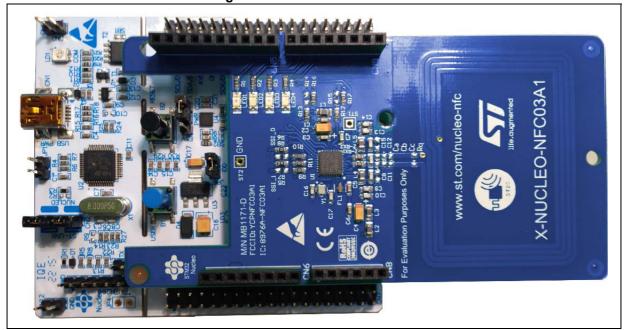
## 1 Getting started

This section describes the hardware and system requirements for the X-NUCLEO-NFC03A1 evaluation board.

## 1.1 Hardware requirements

The X-NUCLEO-NFC03A1 is an expansion board that can be used with STM32 Nucleo boards. To operate correctly it must be connected to the STM32 Nucleo board, as shown in *Figure 2*.

Figure 2. X-NUCLEO-NFC03A1 board plugged on an STM32 Nucleo board through Arduino <sup>™</sup> UNO R3 connectors



The X-NUCLEO-NFC03A1 is designed to for use with any STM32 Nucleo board, although complete testing has been performed using the NUCLEO-F401RE hosting the STM32 microcontroller.

The STM32 Nucleo firmware and the related documentation are available at http://www.st.com/stm32nucleo.

# 1.2 System requirements

To use the Nucleo boards with the X-NUCLEO-NFC03A1 expansion board the following software and hardware are required:

- Windows® PC (XP, Vista, 7, 8) to install the firmware package
- USB type A to Mini-B USB cable to connect the Nucleo board to the PC

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To install the board firmware package (order code: X-CUBE-NFC3) the PC must have:

- 128 MB of RAM
- 40 MB of hard disk space.

The X-CUBE-NFC3 firmware and the related documentation are available on www.st.com.

## 1.3 Setting up the board

To set up the board, perform the following steps:

- 1. Connect the X-NUCLEO-NFC03A1 on the Nucleo board from the top as shown in *Figure 2*
- 2. Power the Nucleo board using the Mini-B USB cable delivered with the board
- 3. Program the firmware in the STM32 on the Nucleo board using the provided example
- 4. Reset the MCU board using the reset button available on the Nucleo board
- 5. The evaluation kit is ready to be used.

# 2 Hardware description

This section describes the X-NUCLEO-NFC03A1 features and provides information to better understand the board schematic diagrams (detailed in Section 4: Schematics).

### 2.1 X-NUCLEO-NFC03A1 board

The board allows the user to test the functionality of the CR95HF integrated circuit. The CR95HF supports reader/writer mode and supports following communication protocols:

- ISO/IEC 14443 Type A and B
- ISO/IEC 15693
- ISO IEC18092
- MIFARE<sup>®</sup> Classic<sup>(a)</sup>

Its functionality can be exploited using the firmware package contained in the X-CUBE- NFC3. It is fundamental to program the microcontroller on the STM32 Nucleo board. Refer to user manuals UM1724 and UM1725, available on <a href="https://www.st.com">www.st.com</a>.

The CR95HF integrated circuit module and the STM32 Nucleo board are connected through connectors CN5, CN6, CN8 and CN9 (see *Table 1* and *Table 2* for details).

Table 1. Interconnections between the two boards (left side)

Signal	Connector	Pin number	NUCLEO-F401RE (MCU port)	X-NUCLEO-NFC03A1 (expansion board)		
NC		1	-	-		
IOREF		2	-	3V3		
RESET		3	-	-		
3V3	CN6	4	-	3V3		
5V	Power	5	-	-		
GND		6	-	GND		
GND	1	7	-	GND		
VIN		8	-	-		
-						
A0		1	PA0	-		
A1		2	PA1	-		
A2	CN8 Analog	3	PA4	-		
A3		4	PB0	-		
A4		5	PC1/PB9	-		
A5		6	PC0/PB8	-		

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Hardware description UM1799

Table 2. Interconnections between the two boards (right side)

Signal	Connector	Pin number	NUCLEO-F401RE (MCU port)	X-NUCLEO-NFC03A1 (expansion board)		
D15		10	PB8	-		
D14		9	PB9	-		
AREF		8	-	-		
GND		7	-	GND		
D13	CN5	6	PA5	SPI_CLK		
D12	Digital	5	PA6	SPI_MISO		
D11		4	PA7	SPI_MOSI		
D10		3	PB6	SPI_CS_NFC		
D9		2	PC7	Interface pin		
D8		1	PA9	-		
-						
D7		8	PA8	MCU_LED1		
D6		7	PB10	MCU_LED2		
D5		6	PB4	MCU_LED2		
D4	CN9	5	PB5	MCU_LED2		
D3	Digital	4	PB3	-		
D2		3	PA10	UART_RX/IRQ_OUT		
D1		2	PA2	-		
D0		1	PA3	-		

## 2.2 Host interface and GPIO connection

The X-NUCLEO-NFC03A1 board contains the CR95HF-VMD5T chip and is powered by the STM32 Nucleo board. The CR95HF is driven by the microcontroller either via the SPI link or via the UART link, selection is ensured by the microcontroller at CR95HF reset.

The four LEDs connected to the microcontroller GPIOs are general purpose.

#### 2.3 X-NUCLEO-NFC03A1 component placement

Figure 3 shows the component placement on the X-NUCLEO-NFC03A1 board.

General purpose **LEDs** CR95HF-VMD5T MN MB1171-D GND FCCID YCPNFC03A1I IC: 8976A-NFC03A1 CN4 Matching circuitry www.st.com/nfc-rfid 47 mm x 34 mm 4 turns antenna X-NUCLEO-NFC03A1

Figure 3. X-NUCLEO-NFC03A1 component placement

MS41417V1

# 3 Component description

### 3.1 CR95HF

The CR95HF-VMD5T is an integrated transceiver IC for contactless applications. It manages frame coding and decoding in Reader mode for applications such as NFC proximity and vicinity standards, and embeds an analog front end to provide the 13.56 MHz air interface. The CR95HF supports ISO/IEC 14443 Type A and Type B, ISO/IEC 15693 (single or double subcarrier) and ISO/IEC 18092 communication protocols.

Table 3. CR95HF details

Feature	Description		
Sales type	CR95HF-VMD5T		
Package	32 leads, 5x5 VFQFPN		
Operating voltage	2.7 to 5.5 Volts		

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Figure 4. Nucleo connectors

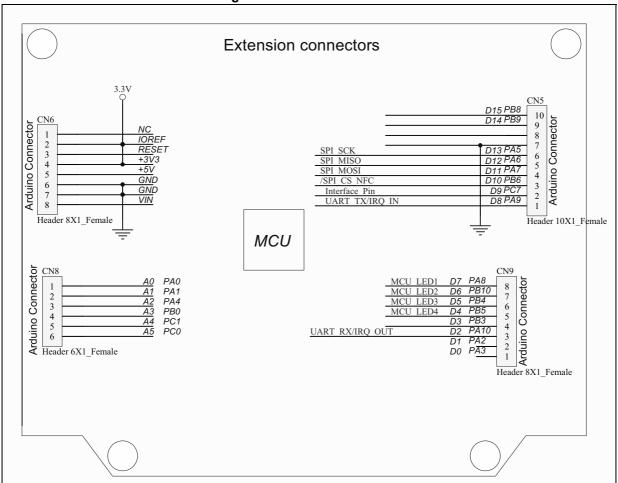
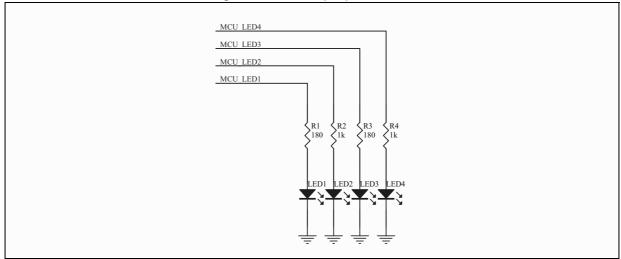
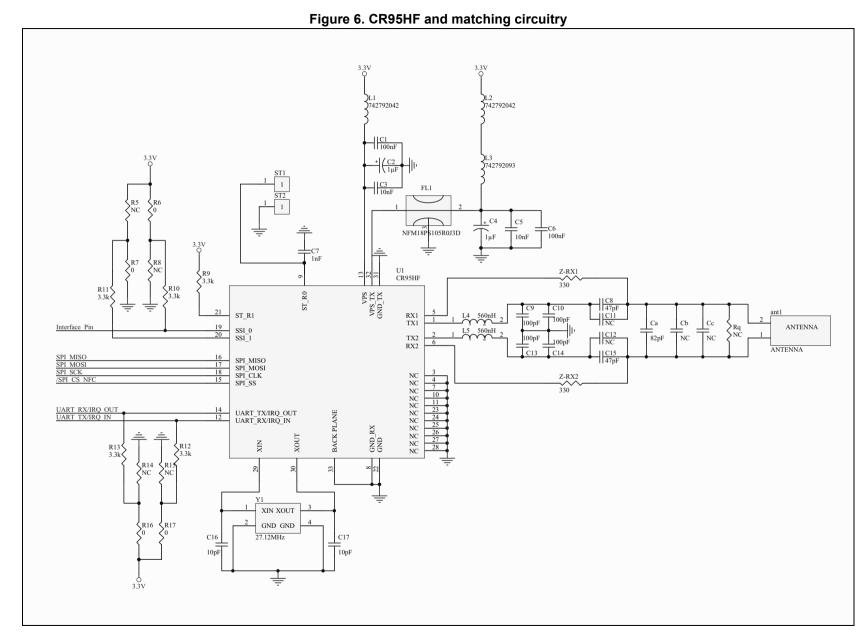


Figure 5. General purpose LEDs







UM1799 Bill of materials

# 5 Bill of materials

Table 4. Bill of materials

Туре	Qty	Description	Reference	Package	Manufacturer	Part number
IC	1	Transceiver	U1	VFQFPN32 5x5	STMicroelectronics	CR95HF- VMD5TLBE
Crystal	1	EXS00A- CS01188 27.12 MHz	Y1	NX2016	NDK	NX2016SA 27.12 MHz EXS00A-CS01188
LED	2	Green LED	LED1, LED3	LED-1206	Dialight	5988270107F
	2	Blue LED	LED2, LED4	LED-1206	Dialight	5988291107F
Filter	1	Suppression 1 µF 6.3 V DC	FL1	NFM18PS	Murata	NFM18PS105R0J3D
	2	Ferrite CMS 600 Ω	L1, L2		Würth Elektronik	742792042
Inductor	1	Ferrite CMS 2200 Ω	L3	0805		742792093
	2	SMD 560 nH	L4, L5		Murata	LQM21NNR56K10D
	5	CMS 0.1 W 5% NC	R5, R8, R14, R15, Rq		-	-
	4	CMS 0.1 W 5% 0 Ω	R6, R7, R16, R17		-	-
Resistor	2	CMS 0.1 W 5% 180 Ω	R1, R3	0603	-	-
Resistor	2	CMS 0.1 W 5% 330 Ω	Z-RX1, Z-RX2	0003	-	-
	2	CMS 0.1 W 5% 1 kΩ	R2, R4		-	-
	5	CMS 0.1 W 5% 3.3 kΩ	R9, R10, R11, R12, R13		-	-

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Table 4. Bill of materials (continued)

Туре	Qty	Description	Reference	Package	Manufacturer	Part number
	4	MLCC NP0 50 V 2% NC	C11, C12, Cb, Cc		Murata	-
	2	MLCC NP0 50 V 5% 10 pF	C16, C17		-	-
	2	MLCC NP0 50 V 2% 39 pF	C8, C15			GRM1885C1 H390GA01
	1	MLCC NP0 50 V 2% 82pF	Са	0603	Murata 0603	GRM1885C1 H820GA01
Capacitor	4	MLCC NP0 50 V 2% 100 pF	C9, C10, C13, C14	0603		GRM1885C1 H101GA01
	1	MLCC NP0 50 V 5% 1 nF	C7		-	-
	2	MLCC NP0 50 V 5% 10 nF	C3, C5		-	-
	2	MLCC NP0 50 V 5% 100 nF	C1, C6		-	-
	2	Tantalum SMD POL 10% 1µF 16 V	C2, C4	293D-A	-	-
	1	2.54 mm Single row 10 ways	CN1	10P_FEMALE		SSQ-110-03-L-S
Receptacle	1	2.54 mm Single row 6 ways	CN3	6P_FEMALE	Samtec	SSQ-106-03-L-S
	1	2.54 mm Single row 8 ways	CN2, CN4	8P_FEMALE		SSQ-108-03-L-S
Connector	2	1PT	ST1, ST2	CON_1PTS	FCI	77311-401-36LF

# Federal Communications Commission (FCC) and Industry Canada (IC) compliance statements

## 6.1 FCC Compliance Statement

#### 6.1.1 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.

#### 6.1.2 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.

#### 6.1.3 FCC ID

FCC ID: YCPNFC03A1

## 6.2 Formal notices required by the Industry Canada ("IC")

## 6.2.1 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.

#### 6.2.2 Declaration de Conformité

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

#### 6.2.3 IC ID

IC ID: 8976A-NFC03A1

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# 7 Revision history

**Table 5. Document revision history** 

Date	Revision	Changes		
24-Jul-2014	1	Initial release.		
02-Sept-2014	2	Changed classification to confidential.		
04-May-2016	3	Changed document classification. Updated document title. Updated Introduction and Section 4: Schematics. Updated Figure 1: NFC card reader board based on CR95HF. Removed former Section 1: Description, Section 2: Features and Section 3: Hardware and layout description. Added Section 1: Getting started, Section 2: Hardware description, Section 3: Component description, Section 5: Bill of materials and Section 6: Federal Communications Commission (FCC) and Industry Canada (IC) compliance statements.		
13-Jun-2016	4	Updated document title. Updated Figure 1: NFC card reader board based on CR95HF. Updated Section 6.2.3: IC ID.		

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