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

Introduction

The X-NUCLEO-NFC03A1 is an NFC card reader evaluation board based on CR95HF integrated circuit to allow expansion of the STM32 Nucleo boards. The CR95HF is card reader IC for contact-less application that provides the 13.56MHz air interface, frame coding and decoding for standard application such as Near Field Communication (NFC) and that communicates with the Host through UART or SPI interface. X-NUCLEO-NFC03A1 is compatible with the Arduino UNO R3 connector assignment.

This expansion board can be plugged into the Arduino UNO R3 connectors of any STM32 Nucleo board. The different expansion boards can be easily stacked to allow evaluation of different devices with NFC card reader.

The board has the following features:

- On-board NFC card reader IC: CR95HF
- 47 x 34 mm, 4 turns, single layer 13.56 MHz inductive antenna etched on PCB and associated tuning circuit.
- 4 general purpose LEDs

Figure 1: NFC card reader board based on CR95HF IC

# Contents

1 Getting started

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

1.1 Hardware requirements

The X-NUCLEO-NFC03A1 is an expansion board for use with STM32 Nucleo boards. To function correctly, the X-NUCLEO-IDB05A1 must be connected to the STM32 Nucleo board as shown in *Figure 2: "X-NUCLEO-NFC03A1 plugged into an STM32 Nucleo board through the Arduino UNO R3 connector"* below.

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

Figure 2: X-NUCLEO-NFC03A1 plugged into an STM32 Nucleo board through the Arduino UNO R3 connector
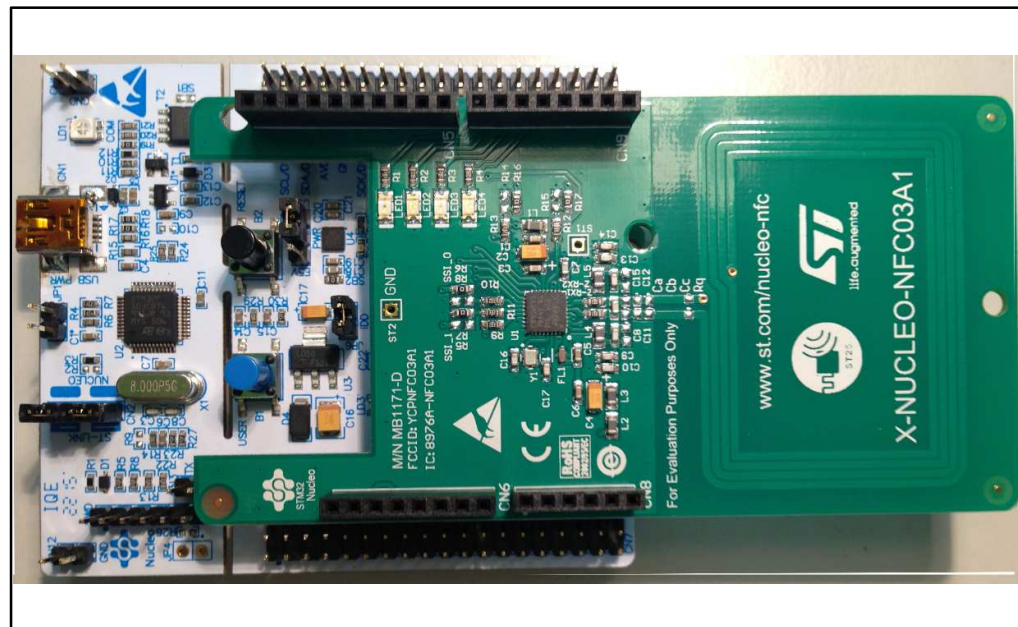
The interconnection between the STM32 Nucleo and the X-NUCLEO-NFC03A1 has been designed to permit the use of any STM32 Nucleo board, although complete testing has been performed using the NUCLEO-F401RE hosting the dynamic efficiency STM32.

1.2 System requirements

Using the Nucleo boards with the X-NUCLEO-NFC03A1 expansion board requires the following software and hardware:

- 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

Installation of the board firmware package (order code: X-CUBE-NFC3) on the user's PC requires the following:

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

The X-CUBE-NFC3 firmware and related documentation is 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: "X-NUCLEO-IDB05A1 plugged into an STM32 Nucleo board through the Arduino UNO R3 connector"*
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 firmware 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-NFC3A1 features and provides information which could be useful to understand the board schematic diagrams.

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 ® Classic.

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. Please refer to user manuals UM1724 and UM1725, available on www.st.com.

The CR95HF integrated circuit module and the STM32 Nucleo board are connected through connectors CN5, CN6, CN8 and CN9 (see *Table 1: "Interconnection between STM32 Nucleo board and X-NUCLEO-NFC03A1 left-side connectors"* for details).

Table 1: Interconnection between STM32 Nucleo board and X-NUCLEO-NFC03A1 left-side connectors

Signal Name	NC	IOREF	RESET	3V3	5V	GND	GND	VIN		A0	A1	A2	A3	A4	A5
	Left connector														
Connector Name	CN6 Power									CN8 Analog					
Pin#	1	2	3	4	5	6	7	8		1	2	3	4	5	6
NUCLEO-L053R8 (MCU Port)										PA0	PA1	PA4	PB0	PC1/ PB9	PC0/ PB8
X-NUCLEO-NFC03A1 expansion board		3V3		3V3		GND	GND								

Table 2: Interconnection between STM32 Nucleo board and X-NUCLEO- NFC03A1 right-side connectors

Signal Name	D15	D14	AREF	GND	D13	D12	D11	D10	D9	D8		D7	D6	D5	D4	D3	D2	D1	D0
Right connector																			
Connector Name	CN5 Digital											CN9 Digital							
Pin#	10	9	8	7	6	5	4	3	2	1		8	7	6	5	4	3	2	1
NUCLEO-L053R8 (MCU Port)	PB8	PB9			PA5	PA6	PA7	PB6	PC7	PA9		PA8	PB10	PB4	PB5	PB3	PA10	PA2	PA3
X-NUCLEO-NFC03A1 expansion board				GND	SPI_CLK	SPI_MISO	SPI_MOSI	SPI_CS_NFC	Interface_Pin	UART_TX/IRQ_IN		MCU_LED1	MCU_LED2	MCU_LED2	MCU_LED2	UART_RX/IRQ_OUT			

2.2   Host interface and GPIO connection

The X-NUCLEO-NFC03A1 board contains the CR95HF-VMD5T chip and is powered by STM32 Nucleo Board. Chip is driven by the microcontroller either via the SPI link or the UART link, selection is ensured by microcontroller at CR95HF reset.
Four LEDS connected to microcontroller GPIOs are general purpose.

2.3 X-NUCLEO-NFC03A1 component placement

The following diagram shows the component placement on the X-NUCLEO-NFC03A1 board.

Figure 3: X-NUCLEO-NFC03A1 component placement details

General Purpose LEDs

CR95HF-VMD5T chip

Matching circuitry

47*34 mm 4 turns antenna

3 Component description

The board has the following devices.

3.1 CR95HF integrated circuit

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

The part numbers used to develop this application are shown in *Table 4: "SPBTLE-RF details"*.

Table 4: CR95HF details

Feature	Description
Sales type	CR95HF-VMD5T
Package	32-lead, 5*5 VFQFPN
Operating voltage	2.7 to 5.5V

4   Formal notices required by the U.S. Federal Communications Commission ("FCC")

4.1. FCC Compliance Statement

4.1.1. 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.

4.1.2. Part 15.19

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.

4.1.3. Part 15.19

FCC ID: YCPNFC03A1

5 Formal notices required by the Industry Canada ("IC")

5.1. 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.

5.2. 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.

5.3. IC ID

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.

IC ID: 8976A-NFC03A1

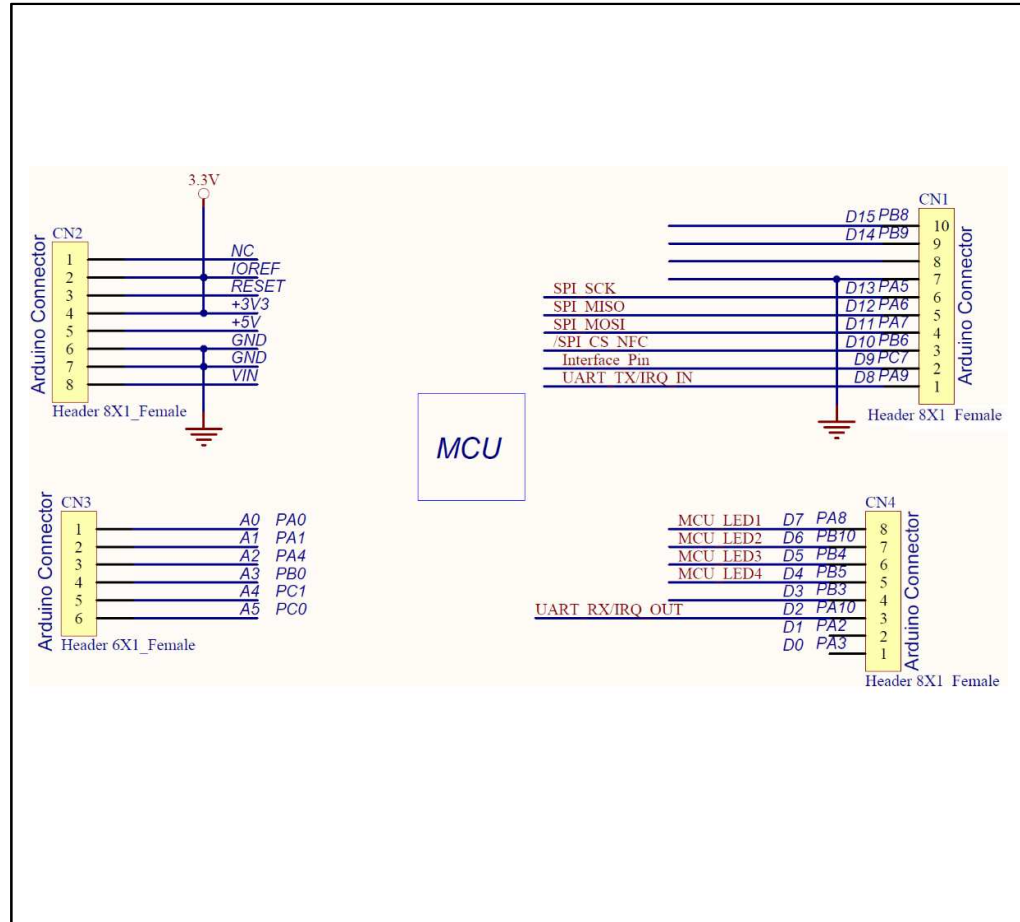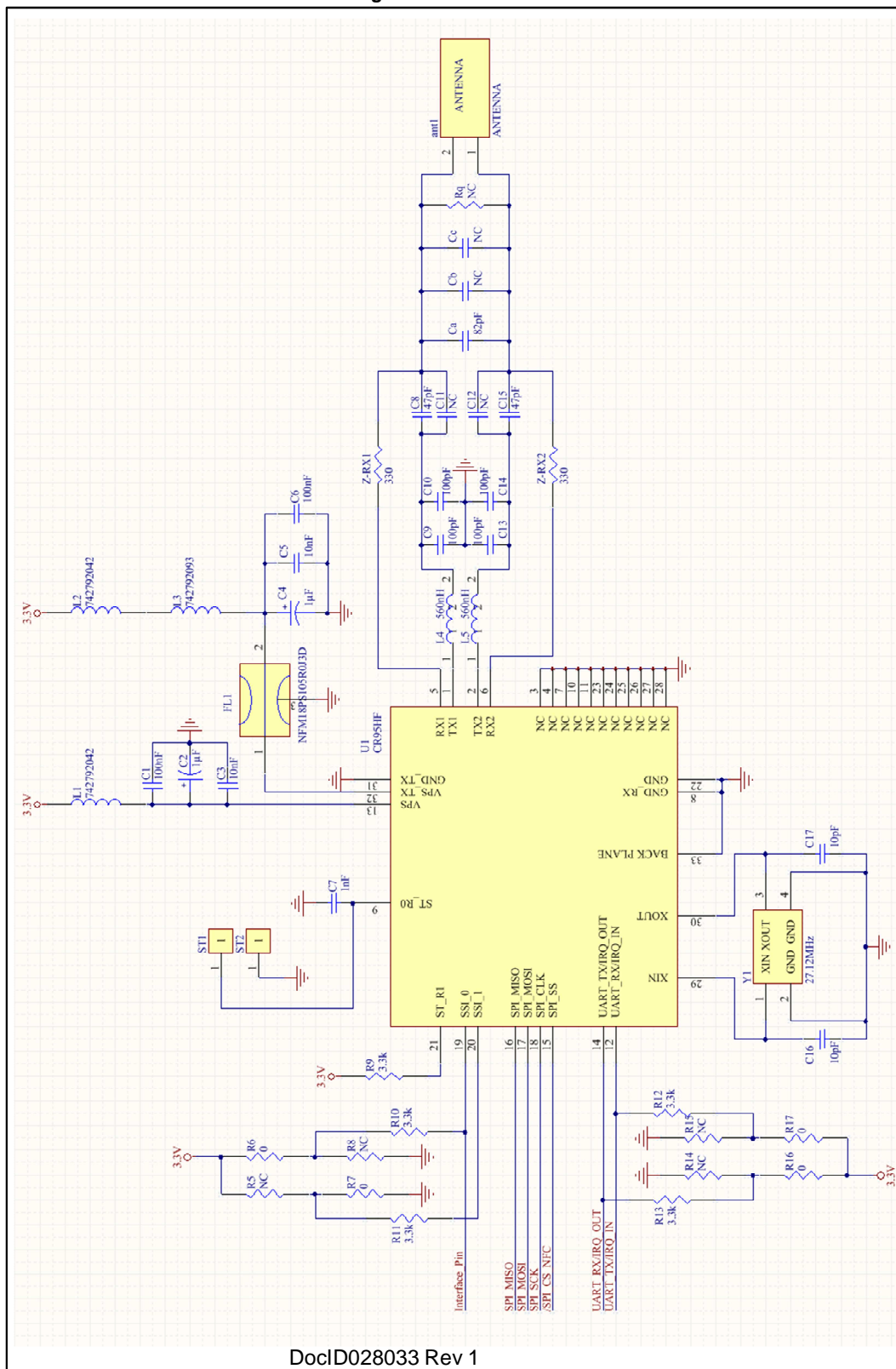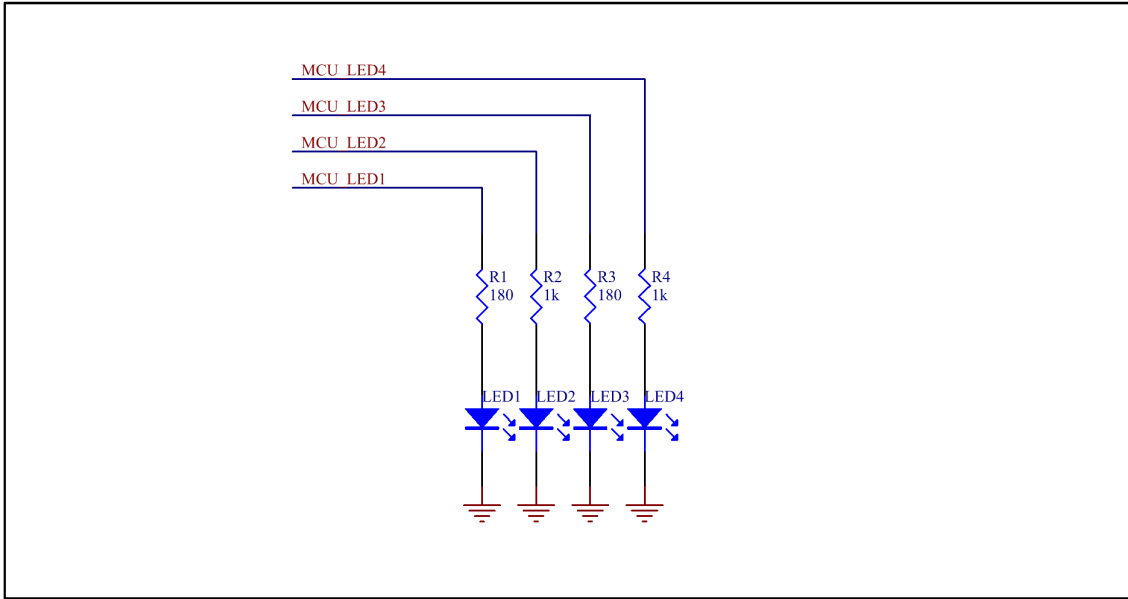# 6 Hardware schematic diagrams

Figure 4: Nucleo connectors

Figure 5: CR95HF

Figure 6: General Purpose LEDs

7 Bill of material

Qty	Description	Ref.	Package	Manufacturer 1	Part#1
1	CR95HF	U1	VFQFPN32_5x5	STMicroelectronics	CR95HF-VMD5TLBE
1	NX2016SA EXS00A-CS01188 27.12MHz	Y1	NX2016	NDK	NX2016SA 27.12MHz EXS00A-CS01188
2	LED, 1206, GREEN Green Led	LED1, LED3	LED-1206	DIALIGHT	5988270107F
2	LED, 1206, BLUE Blue Led	LED2, LED4	LED-1206	DIALIGHT	5988291107F
1	FILTER, SUPPRESSION, 0603, 1UF, 6.3VDC NFM18PS105R0J3D	FL1	NFM18PS	Murata	NFM18PS105R0J3D
2	FERRITE CMS 600OHM. 0805 742792042	L1, L2	0805	WURTH ELEKTRONIK	742792042
1	FERRITE CMS 2200OHM. 0805 742792093	L3	0805	WURTH ELEKTRONIK	742792093
2	Inductor SMD 0805, LQM21NNR56K10D 560nH	L4, L5	0805	Murata	LQM21NNR56K10D
4	CONDENSATEUR MLCC 0603 NP0 50V 2% NC	C11, C12, Cb, Cc	0603	Murata	
2	CONDENSATEUR MLCC 0603 NP0 50V 5% 10pF	C16, C17	0603		
2	CONDENSATEUR MLCC 0603 NP0 50V 2% 39pF	C8, C15	0603	Murata	GRM1885C1H390GA01
1	CONDENSATEUR MLCC 0603 NP0 50V 2% 82pF	Ca	0603	Murata	GRM1885C1H820GA01
4	CONDENSATEUR MLCC 0603 NP0 50V 2% 100pF	C9, C10, C13, C14	0603	Murata	GRM1885C1H101GA01
1	CONDENSATEUR MLCC 0603 NP0 50V 5% 1nF	C7	0603		
2	CONDENSATEUR MLCC 0603 NP0 50V 5% 10nF	C3, C5	0603		
2	CONDENSATEUR MLCC 0603 NP0 50V 5% 100nF	C1, C6	0603		
2	293D TANTAL SMD POL CAP 1uF 16V 10% Boitier A 1µF	C2, C4	293D-A		
5	Resistance CMS 0603 0,1W 5% NC	R5, R8, R14, R15, Rq	0603		
4	Resistance CMS 0603 0,1W 5% 0	R6, R7, R16, R17	0603		
2	Resistance CMS 0603 0,1W 5% 180	R1, R3	0603		
2	Resistance CMS 0603 0,1W 5% 330	Z-RX1, Z-RX2	0603		
2	Resistance CMS 0603 0,1W 5% 1k	R2, R4	0603		
5	Resistance CMS 0603 0,1W 5% 3.3k	R9, R10, R11, R12, R13	0603		
1	RECEPTACLE, 2.54MM, SINGLE ROW, 10WAY	CN1	1*10P_FEMALE	Samtec	SSQ-110-03-L-S
1	RECEPTACLE, 2.54MM, SINGLE ROW, 6 WAY	CN3	1*6P_FEMALE	Samtec	SSQ-106-03-L-S
2	RECEPTACLE, 2.54MM, SINGLE ROW, 8WAY	CN2, CN4	1*8P_FEMALE	Samtec	SSQ-108-03-L-S
2	Connector 1PT	ST1, ST2	CON_1PTS	FCI	77311-401-36LF

8 Revision history

Table 8: Document revision history

Date	Revision	Changes
03-Apr-2016	1	First draft

IMPORTANT NOTICE – PLEASE READ CAREFULLY