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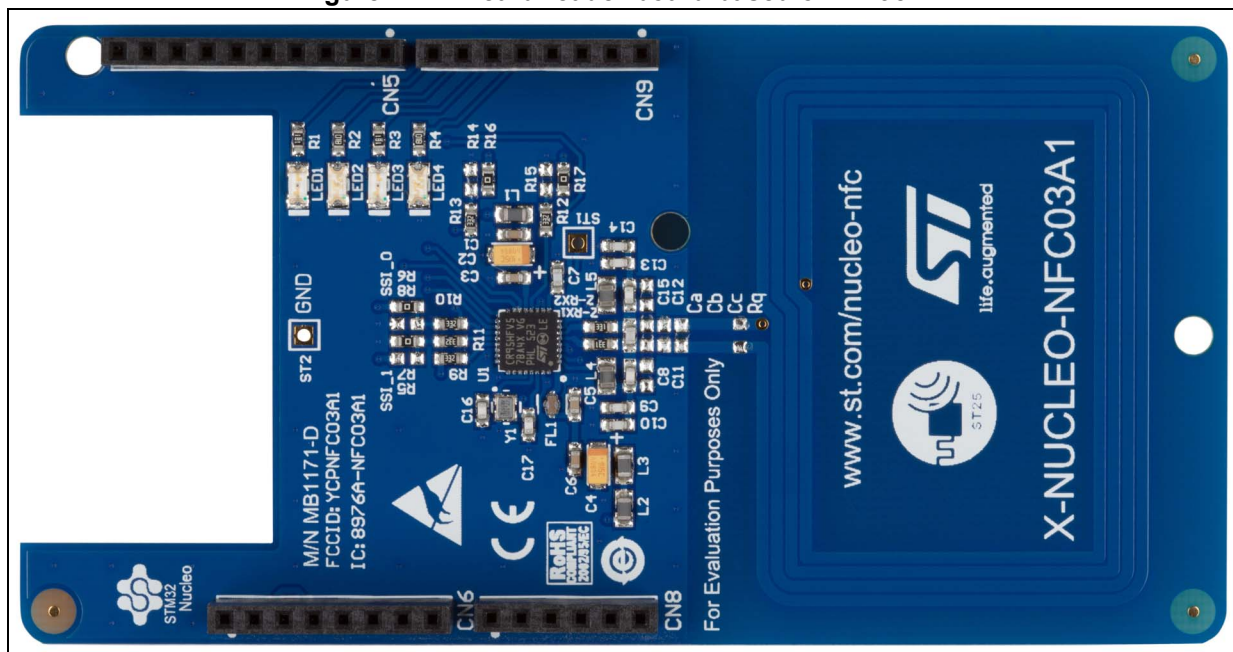
The X-NUCLEO-NFC03A1 is compatible with the Arduino™ UNO R3 connector assignment.

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 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™ UNO R3 connectors
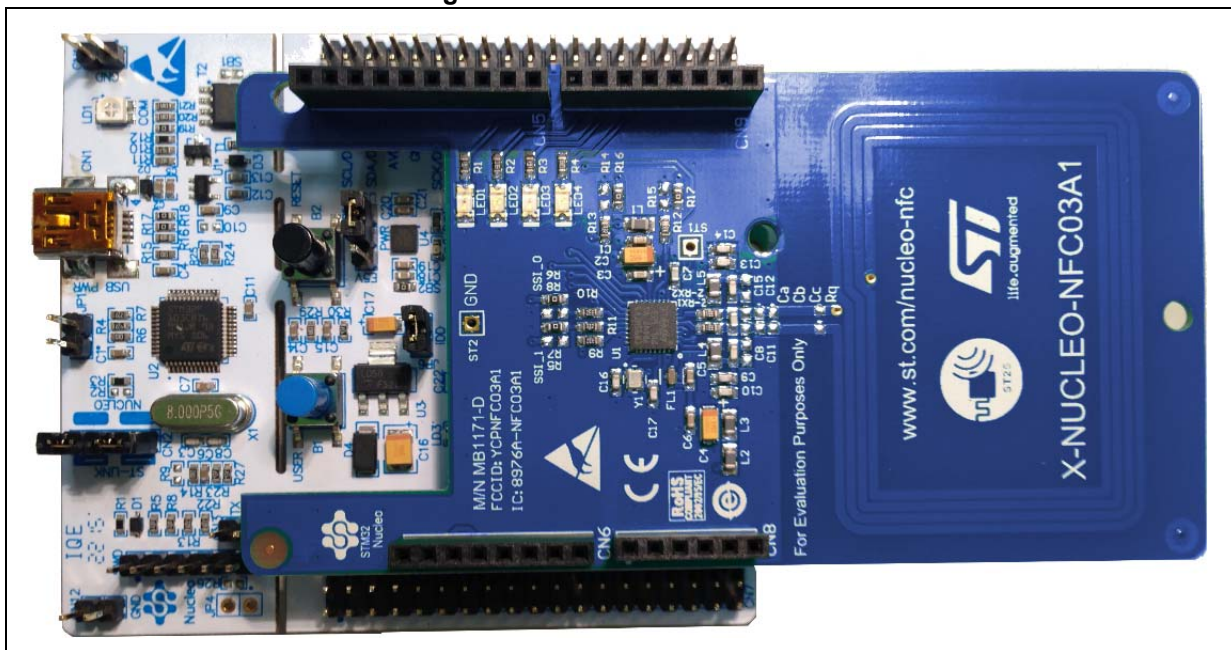
The X-NUCLEO-NFC03A1 is designed to for use with any STM32 Nucleo board, although complete testing has been performed using the NUCLEO-F401RE hosting the STM32 microcontroller.

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

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® Classic[a]

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 *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* 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	CN6 Power	1	-	-
IOREF		2	-	3V3
RESET		3	-	-
3V3		4	-	3V3
5V		5	-	-
GND		6	-	GND
GND		7	-	GND
VIN		8	-	-
-				
A0	CN8 Analog	1	PA0	-
A1		2	PA1	-
A2		3	PA4	-
A3		4	PB0	-
A4		5	PC1/PB9	-
A5		6	PC0/PB8	-

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a. MIFARE and MIFARE Classic are registered trademarks of NXP B.V. and are used under license.

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 Digital	6	PA5	SPI_CLK
D12		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 Digital	5	PB5	MCU_LED2
D3		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.

Figure 3. X-NUCLEO-NFC03A1 component placement
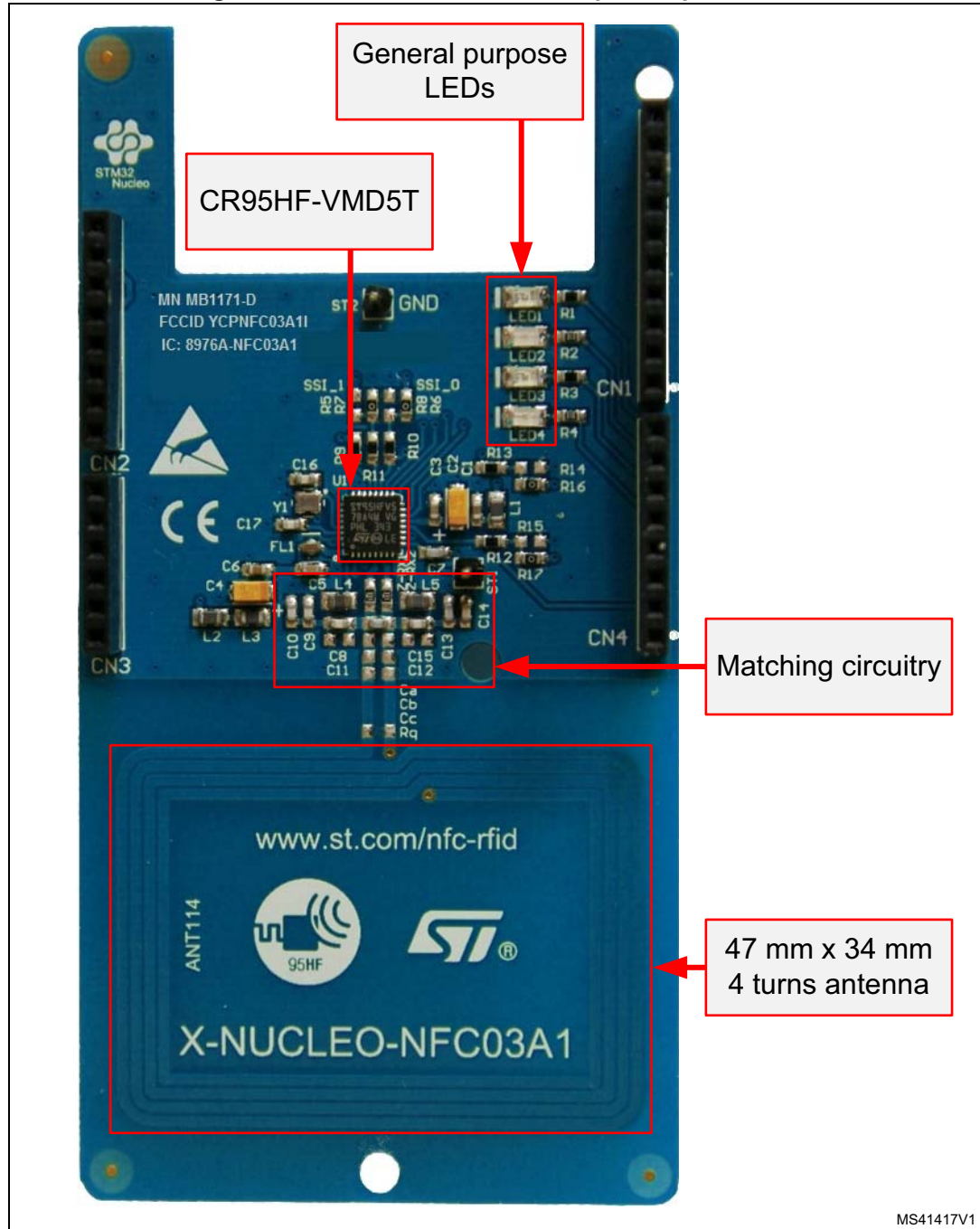
3 Component description

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

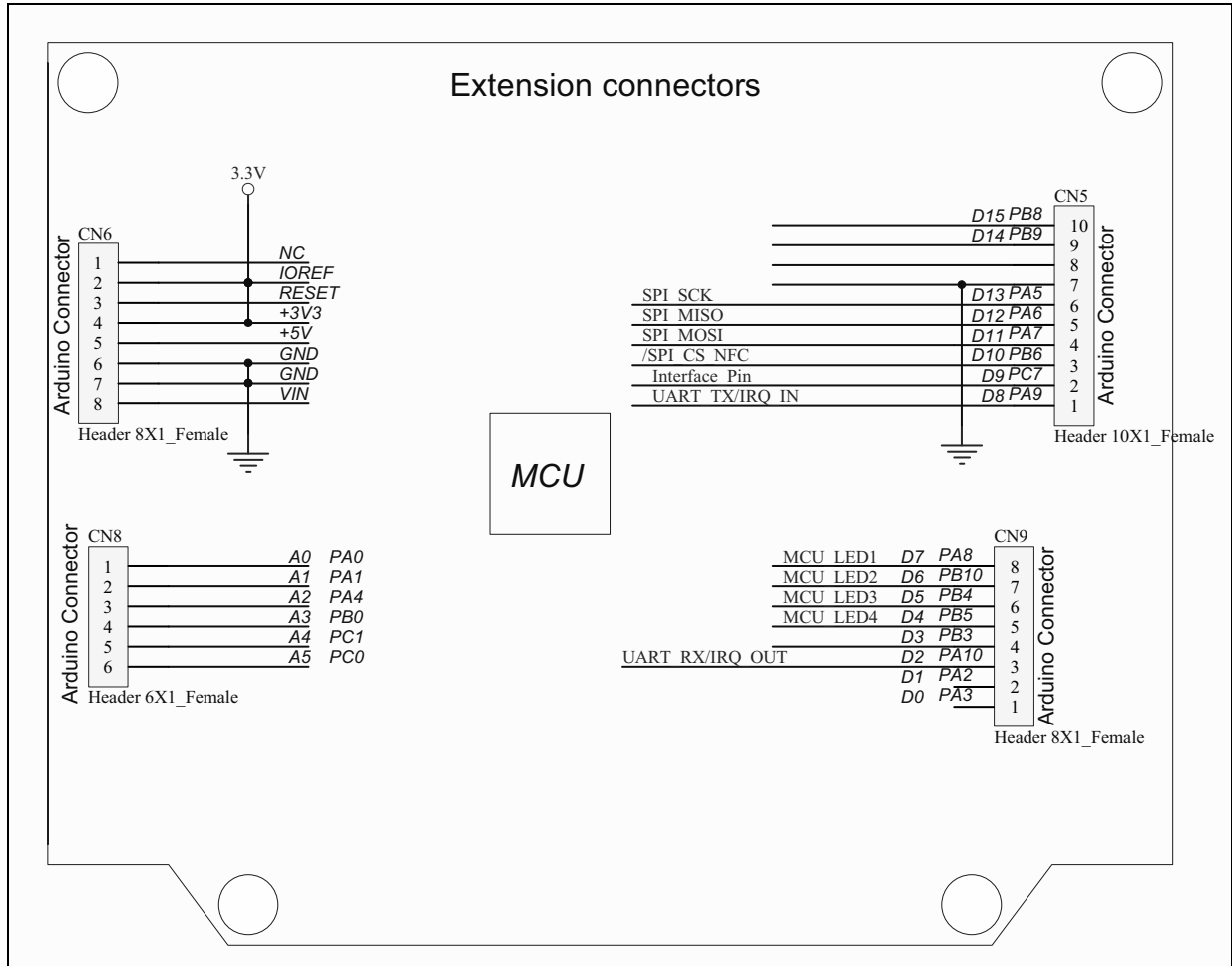# 4 Schematics

Figure 4. Nucleo connectors
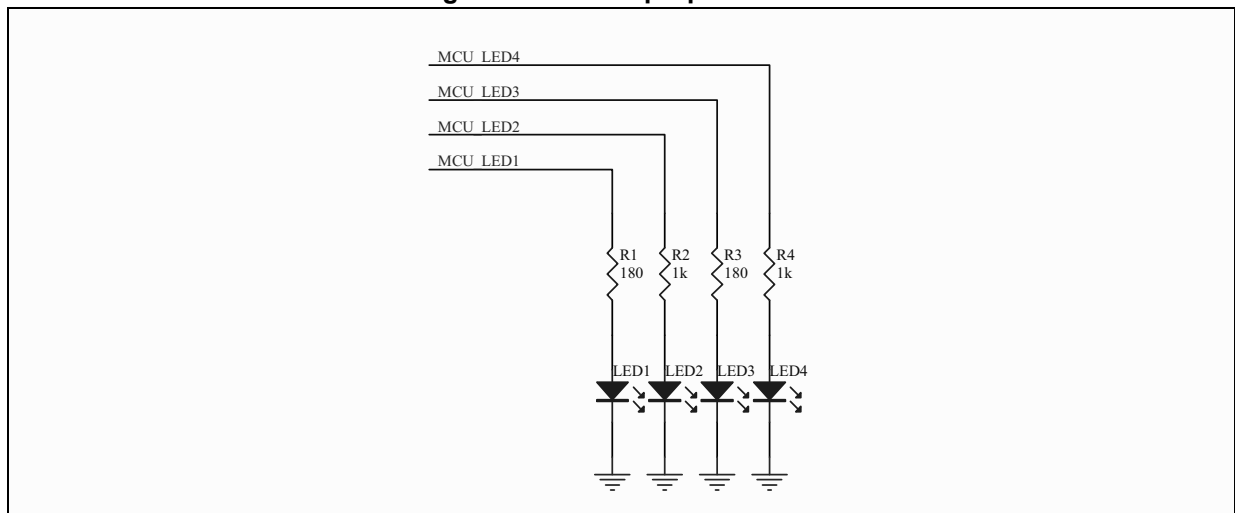

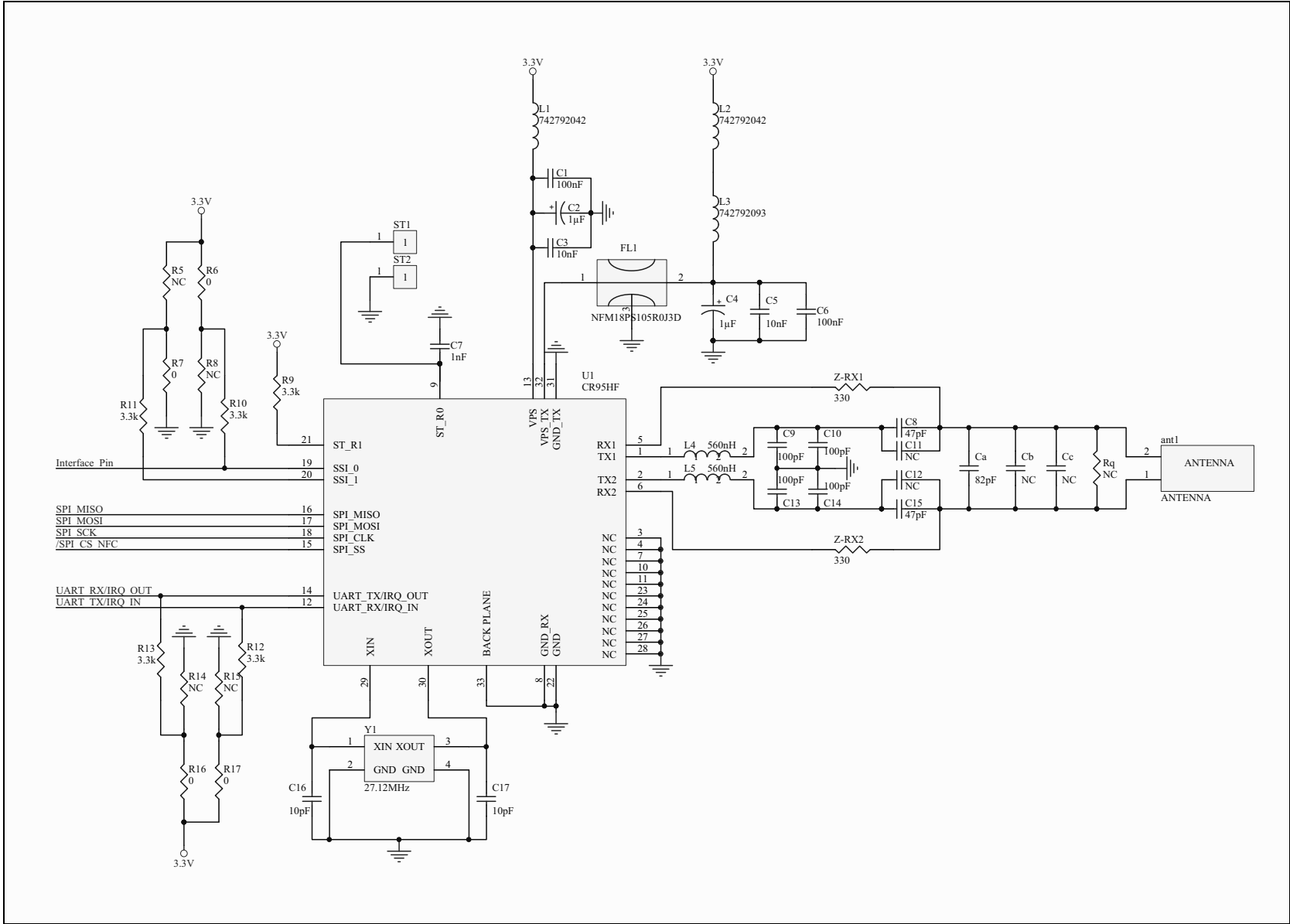**Figure 5. General purpose LEDs**

Figure 6. CR95HF and matching circuitry

5 Bill of materials

Table 4. Bill of materials

Type	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		5988291107F
Filter	1	Suppression 1 µF 6.3 V DC	FL1	NFM18PS	Murata	NFM18PS105R0J3D
Inductor	2	Ferrite CMS 600 Ω	L1, L2	0805	Würth Elektronik	742792042
	1	Ferrite CMS 2200 Ω	L3			742792093
	2	SMD 560 nH	L4, L5		Murata	LQM21NNR56K10D
Resistor	5	CMS 0.1 W 5% NC	R5, R8, R14, R15, Rq	0603	-	-
	4	CMS 0.1 W 5% 0 Ω	R6, R7, R16, R17		-	-
	2	CMS 0.1 W 5% 180 Ω	R1, R3		-	-
	2	CMS 0.1 W 5% 330 Ω	Z-RX1, Z-RX2		-	-
	2	CMS 0.1 W 5% 1 kΩ	R2, R4		-	-
	5	CMS 0.1 W 5% 3.3 kΩ	R9, R10, R11, R12, R13		-	-

Table 4. Bill of materials (continued)

Type	Qty	Description	Reference	Package	Manufacturer	Part number
Capacitor	4	MLCC NP0 50 V 2% NC	C11, C12, Cb, Cc	0603	Murata	-
	2	MLCC NP0 50 V 5% 10 pF	C16, C17		-	-
	2	MLCC NP0 50 V 2% 39 pF	C8, C15		Murata	GRM1885C1 H390GA01
	1	MLCC NP0 50 V 2% 82pF	Ca			GRM1885C1 H820GA01
	4	MLCC NP0 50 V 2% 100 pF	C9, C10, C13, C14			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	-	-
Receptacle	1	2.54 mm Single row 10 ways	CN1	10P_FEMALE	Samtec	SSQ-110-03-L-S
	1	2.54 mm Single row 6 ways	CN3	6P_FEMALE		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

6 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

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*.

IMPORTANT NOTICE – PLEASE READ CAREFULLY