

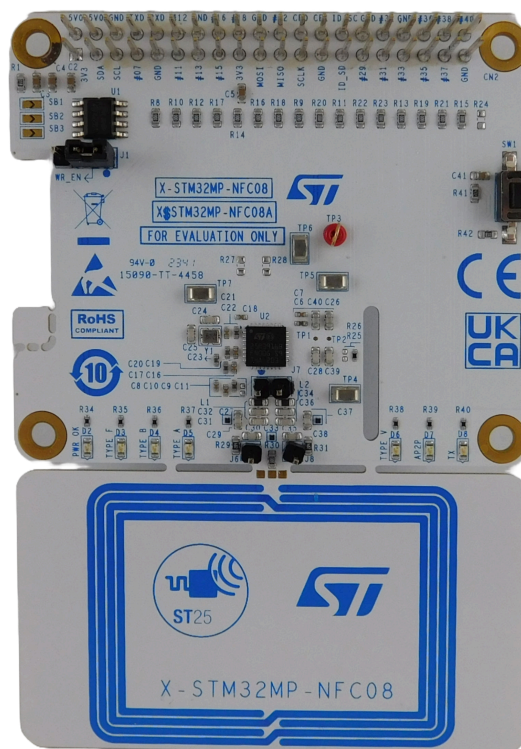
Getting started with the X-STM32MP-NFC08 NFC card reader expansion board

Introduction

Then X-STM32MP-NFC08 is an NFC card reader evaluation board having an NFC card reader IC. It includes an antenna etched on the PCB and associated tuning circuit, general-purpose LEDs, and switches.

It embeds the [ST25R3916B](#) NFC card reader IC, which is a high-performance NFC universal device supporting NFC initiator, NFC target, NFC reader, and NFC card emulation modes.

Figure 1. X-STM32MP-NFC08 evaluation board



The [ST25R3916B](#) device includes an advanced analog front end (AFE) and a highly integrated data framing system for: ISO 18092 passive and active initiator, ISO 18092 passive and active target, NFC-A/B (ISO 14443A/B) reader including higher bit rates, NFC-F (FeliCa™) reader, NFC-V (ISO 15693) reader up to 53 kbps, and NFC-A / NFC-F card emulation.

The X-STM32MP-NFC08 interfaces with the STM32MP microprocessor via 40-pin GPIO connector pins using SPI, I²C, and GPIO interfaces for various components. It is compatible with [STM32MP157F-DK2](#), [STM32MP135F-DK](#) and Raspberry Pi's GPIO connector layout.

1 Safety and compliance information

The evaluation board is powered using a standard 3.3 V supply from a GPIO connector available on [STM32MP157F-DK2](#) and [STM32MP135F-DK](#).

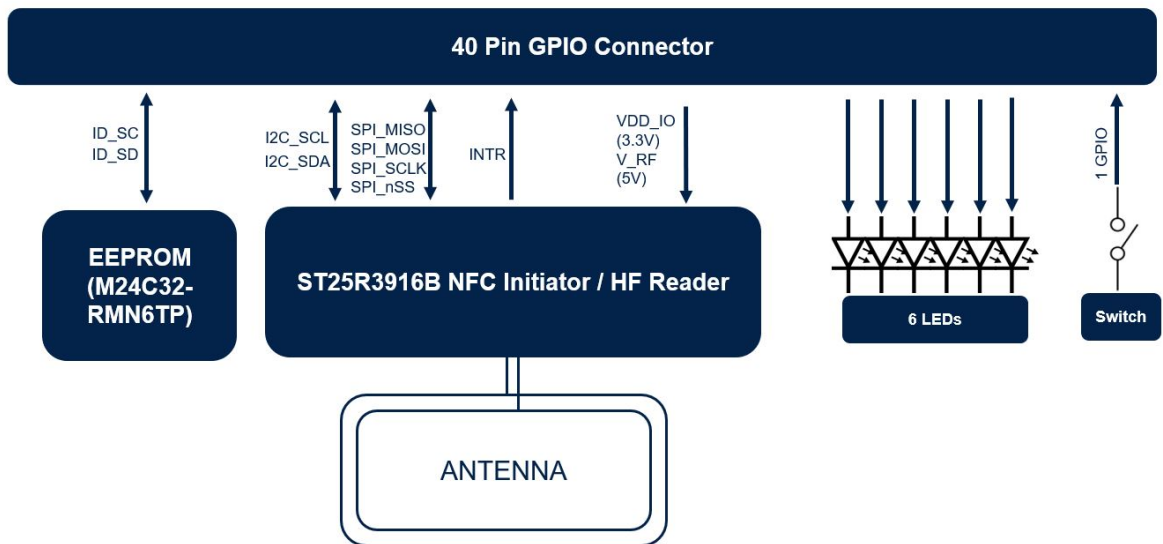
2 Overview

The X-STM32MP-NFC08 is an STM32 MPU expansion board that includes ST25R3916B NFC initiator/HF reader. The expansion board interfaces with the main board via GPIO pins for SPI, I²C interface and interrupts. Six LEDs and one switch are available on the board for Tag detection and user interface.

The X-STM32MP-NFC08 expansion board has the following key features:

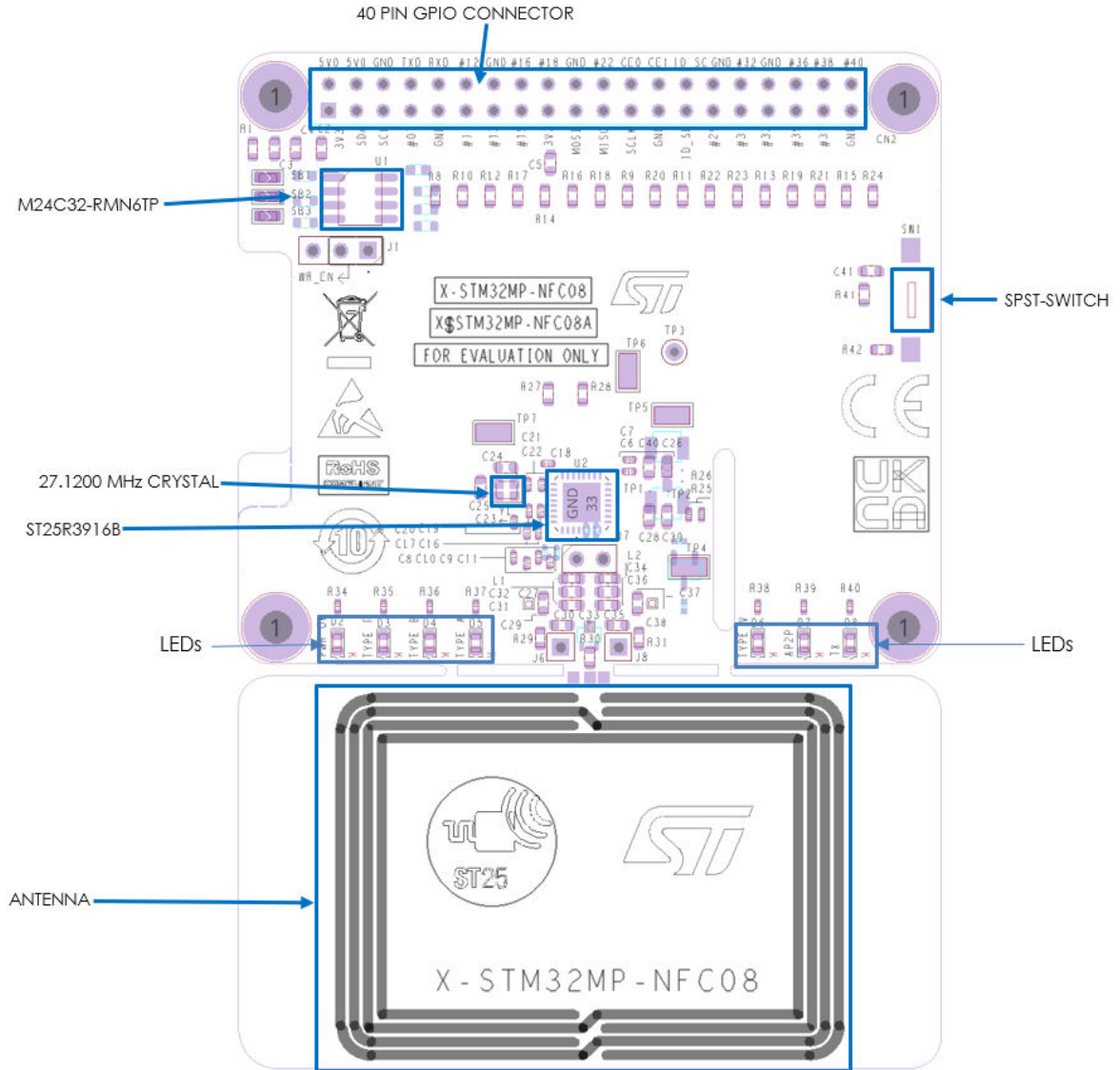
- ST25R3916B NFC card reader IC
- 47 x 34 mm, four turn, 13.56 MHz inductive antenna etched on PCB and associated tuning circuit
- 6 general purpose LEDs and 1 Key for user interface
- EEPROM for automatic GPIO setup and driver setup
- Compatible with STM32MP157F-DK2, STM32MP135F-DK & Raspberry Pi's GPIO connector

Figure 2. Block diagram



The board includes M24C32-RMN6TP, ST25R3916B, LEDs, and switch:

Figure 3. X-STM32MP-NFC08 component placement details



M24C32-RMN6TP: The M24C32 is a 32-Kbit I2C-compatible EEPROM (electrically erasable programmable memory) organized as 4 K × 8 bits. The M24C32-W can operate with a supply voltage from 2.5 to 5.5 V. The M24C32-R can operate with a supply voltage from 1.8 to 5.5 V, over an ambient temperature range of -40 to +85 °C.

Table 1. EEPROM details

Features	Description
Order code	M24C32-RMN6TP
Package	SO-8
Operating voltage	1.8 to 5.5 V

ST25R3916B: The ST25R3916B is a high-performance NFC universal device supporting NFC initiator, NFC target, NFC reader and NFC card emulation modes when applicable.

The **ST25R3916B** device includes an advanced analog front-end (AFE) and a highly integrated data framing system for ISO 18092 passive and active initiator, ISO 18092 passive and active target, NFC-A/B (ISO 14443A/B) reader including higher bit rates, NFC-F (FeliCa™) reader, NFC-V (ISO 15693) reader up to 53 kbps, and NFC-A / NFC-F card emulation.

The **ST25R3916B** is designed to operate from a wide power supply range (2.6 to 5.5 V from -40 °C to +105 °C, 2.4 to 5.5 V from -20 °C to +105 °C), and a wide peripheral IO voltage range (from 1.65 to 5.5 V).

Table 2. ST25R3916B details

Features	Description
Order code	ST25R3916B-AQWT
Package	32-VFQFPN
Operating voltage	2.4 to 5.5 V

LEDs and switch: LEDs are used as an output to detect the presence of various tags. A push button switch is also present for the user interface.

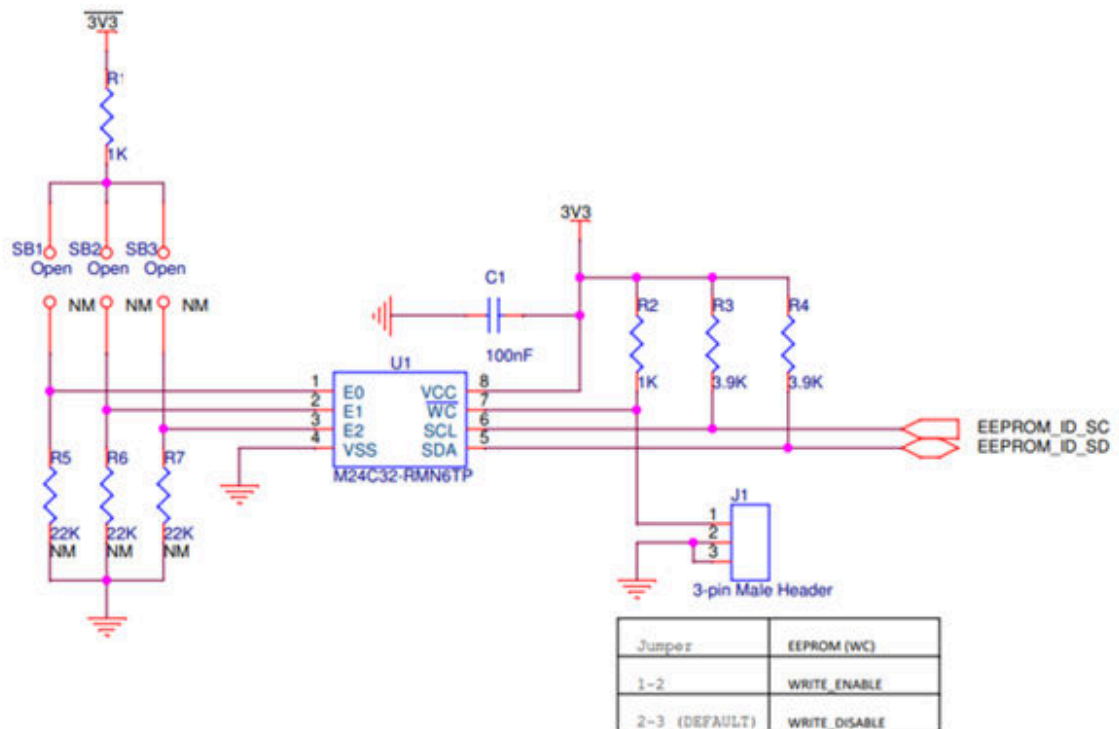
2.1 EEPROM (M24C32-RMN6TP)

The EEPROM communicates with the main board through I2C signals. The jumper J1 enables the write mode.

Table 3. Read and write operation

Jumper	EEPROM
1-2	WRITE_ENABLE
2-3 (default)	WRITE_DISABLE

Figure 4. EEPROM section



2.2 GPIO connector

The on-board devices are controlled through the main board using various peripheral pins available on the GPIO connector. The series resistors are used to isolate the pins of the GPIO connector.

Figure 5. GPIO connector section

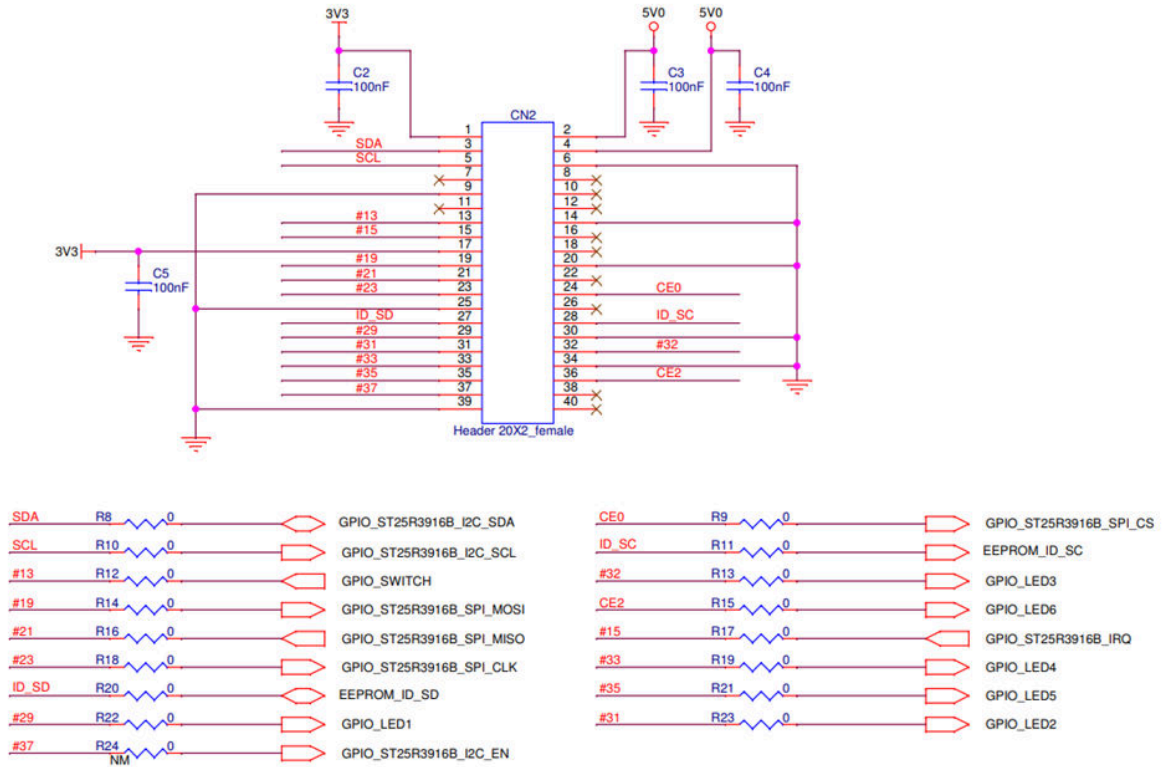


Table 4. GPIO connector pin configuration

Pin no	Name	STM32MP157F-DK2	Pin no	Name	ST32MP157F-DK2
1	3V3		2	5V0	
3	GPIO_ST25R3916 B_I2C_SDA	PA12 / I2C5_SDA	4	5V0	
5	GPIO_ST25R3916 B_I2C_SCL	PA11 / I2C5_SCL	6	GND	
7	#7	PA8 / MCO1	8	#8	PB10 / USART3_TX
9	GND	GND	10	#10	PB12 / USART3_RX
11	#11	PG8 / USART3_RTS	12	#12	PI5 / SAI2_SCKA
13	GPIO_SWITCH	PD7 / SDMMC3_D3	14	GND	
15	GPIO_ST25R3916 B_IRQ	PG15 / SDMMC3_CK	16	#16	PF1 / SDMMC3_CMD
17	3V3		18	#18	PF0 / SDMMC3_D0
19	GPIO_ST25R3916 B_SPI_MOSI	PF9 / SPI5_MOSI	20	GND	
21	GPIO_ST25R3916 B_SPI_MISO	PF8 / SPI5_MISO	22	#22	PF4 / SDMMC3_D1
23	GPIO_ST25R3916 B_SPIB_CLK	PF7 / SPI5_SCK	24	GPIO_ST25R3916 B_SPI_CS	PF6 / SPI5_NSS
25	GND		26	#26	PF3 / GPIO7
27	EEPROM_ID_SD	PF15/I2C1_SDA	28	EEPROM_ID_SC	PD12 / I2C1_SCL
29	GPIO_LED1	PG2 / MCO2	30	GND	
31	GPIO_LED2	PH11 / TIM5_CH2	32	GPIO_LED3	PD13 / TIM4_CH2
33	GPIO_LED4	PC7/TIM3_CH2	34	GND	
35	GPIO_LED5	PI7 / SAI2_FSA	36	GPIO_LED6	PB13 / USART3_CTS
37	#37	PF5 / SDMMC3_D2	38	#38	PI6 / SAI2_SDA
39	GND		40	#40	PF11 / SAI2_SDB

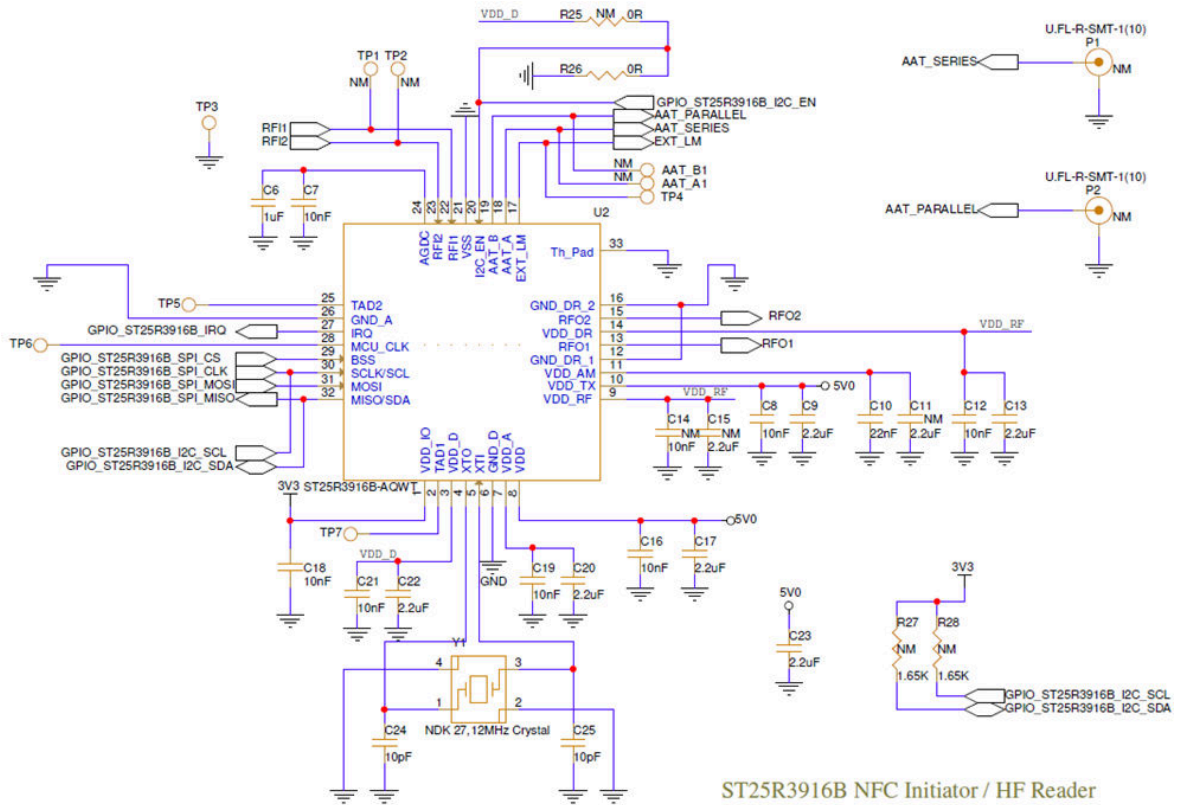
2.3 NFC card reader IC (ST25R3916B)

The **ST25R3916B** is a high-performance NFC universal device supporting: NFC initiator, NFC target, NFC reader, and NFC card emulation modes.

The **ST25R3916B** is designed to operate from a wide power supply range (2.6 to 5.5 V from -40 °C to +105 °C, 2.4 to 5.5 V from -20 °C to +105 °C), and a wide peripheral IO voltage range (from 1.65 to 5.5 V).

RF parameters are: RF power 1.6 W, operating band 13.56 MHz, channel spacing N/A.

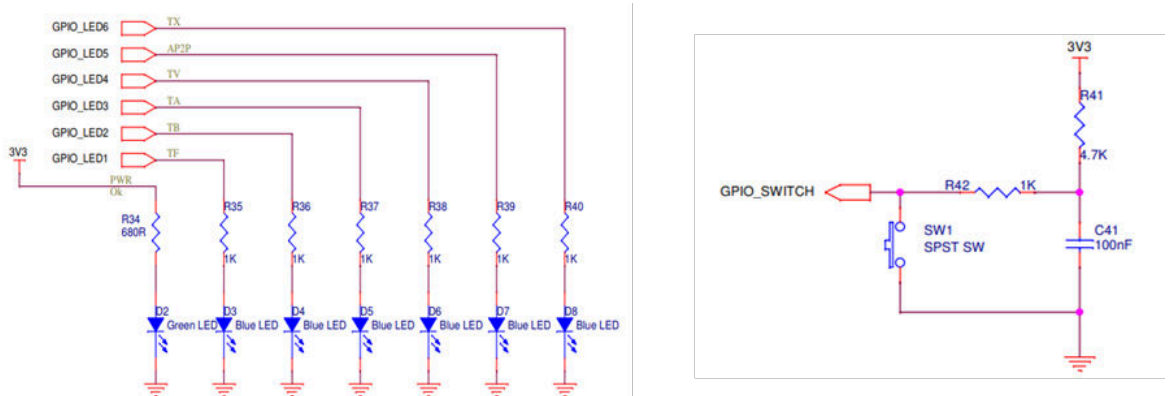
Figure 6. ST25R3916B circuit



2.4 LEDs and switches

LEDs are used as an output to detect several types of tags. The push button switch is used to take input from the user.

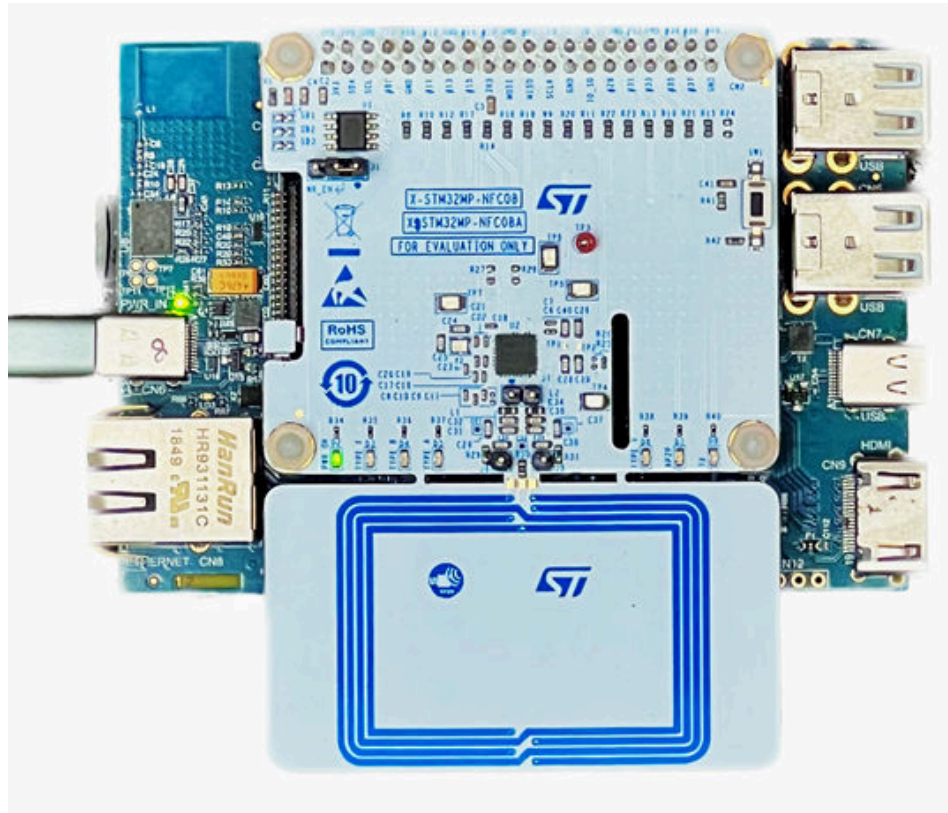
Figure 7. LEDs and switch circuit



3 Getting started with the X-STM32MP-NFC08 expansion board

The X-STM32MP-NFC08 is an expansion board to be used with the STM32MP Discovery kit. As an example, the operation of the X-STM32MP-NFC08 connected to the STM32MP157F-DK2 discovery kit is described.

Figure 8. X-STM32MP-NFC08 connected on STM32MP157F-DK2



3.1 System setup requirements

Ensure that you have the following hardware and software available for programming and evaluation:

Hardware requirements: Below equipment is required to run the tests:

- X-STM32MP-NFC08 expansion board
- STM32MP157F-DK2 discovery kit
- Laptop/Desktop (with Windows 10 or above)
- USB Type-A to Type-micro-B USB cable (for connection as virtual serial device if required)
- USB PD compliant 5 V 3 A power supply with USB Type-C® to Type-C cable

3.2 Safety precautions and protective equipment

Ensure that the DC supply used is compliant with the safety standards required in the region of operation.

3.3 Setting up the board

Perform the following steps to set up the board:

- Check that the jumper on the J1 connector is connected. This jumper enables the write operation for EEPROM
- Connect the [X-STM32MP-NFC08](#) to the [STM32MP157F-DK2](#) 40 pin GPIO connector
- Ensure that pin 1 of the [X-STM32MP-NFC08](#) board matches with pin 1 of the [STM32MP157F-DK2](#) board. Pin 1 can be identified as a rectangular footprint pad on both boards

Note: Boards can be damaged if not connected properly

Note: LED D7 (A P2P) on the [X-STM32MP-NFC08](#) board is shared with audio codec on the [STM32MP157F-DK2](#) boards. To use this LED below solder bridge modifications are required on the [STM32MP157F-DK2](#) board:

Close solder bridge: SB16

Open solder bridge: SB01

Note: Some of the audio functionality of the [STM32MP157F-DK2](#) board may get affected after this modification. If you do not intend to do any modification on the [STM32MP157F-DK2](#) board the NFC LEDs must be disabled in software, please refer to the [X-LINUX-NFC1](#) documentation for more details.

- Power the [STM32MP157F-DK2](#) using the USB Type-C® cable
- Flash the OpenSTLinux Starter package image to a SD card and insert in the [STM32MP157F-DK2](#) board
- [X-STM32MP-NFC08](#) board is ready for use
- Refer to the [X-LINUX-NFC1](#) expansion software package to set up the software for the board

4 Schematic diagrams

Figure 9. X-STM32MP-NFC08 circuit schematics (1 of 6)

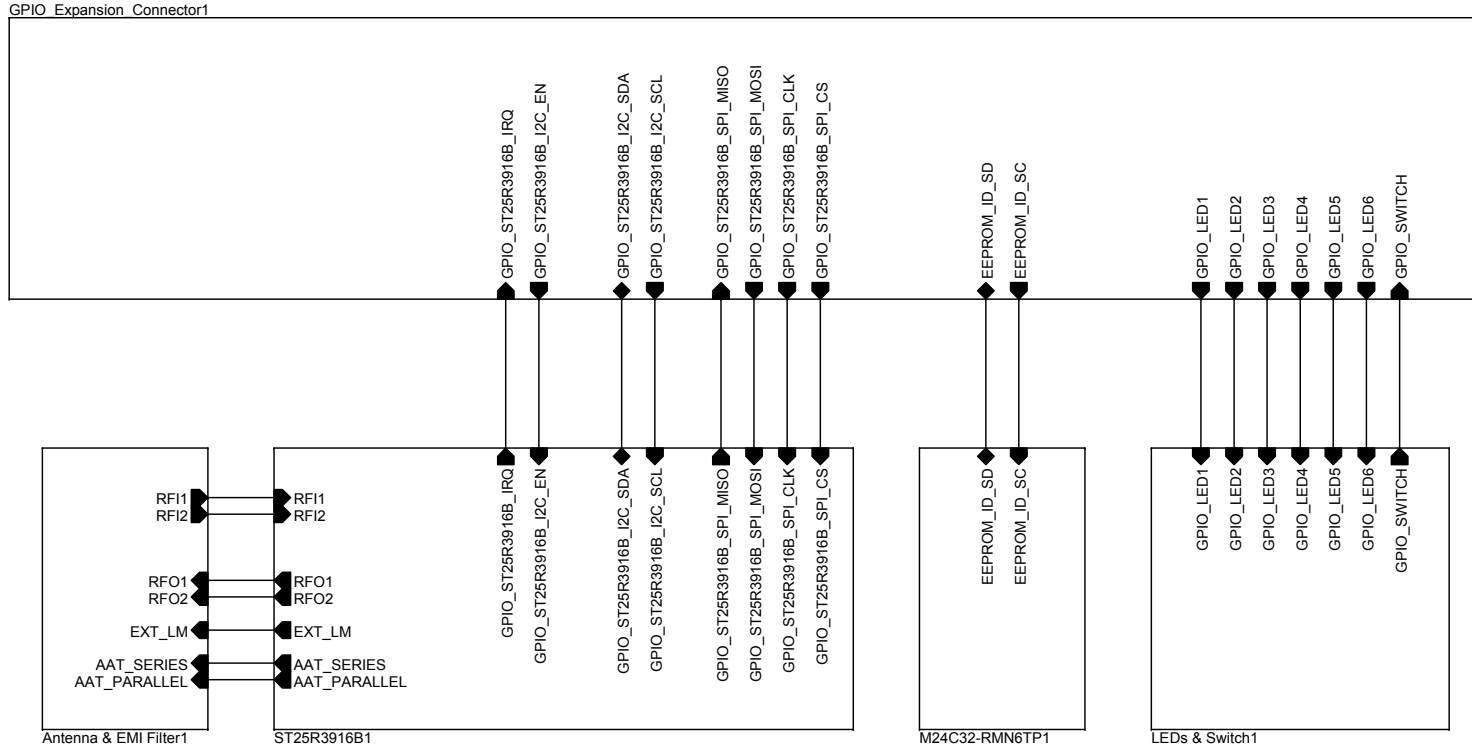


Figure 10. X-STM32MP-NFC08 circuit schematics (2 of 6)

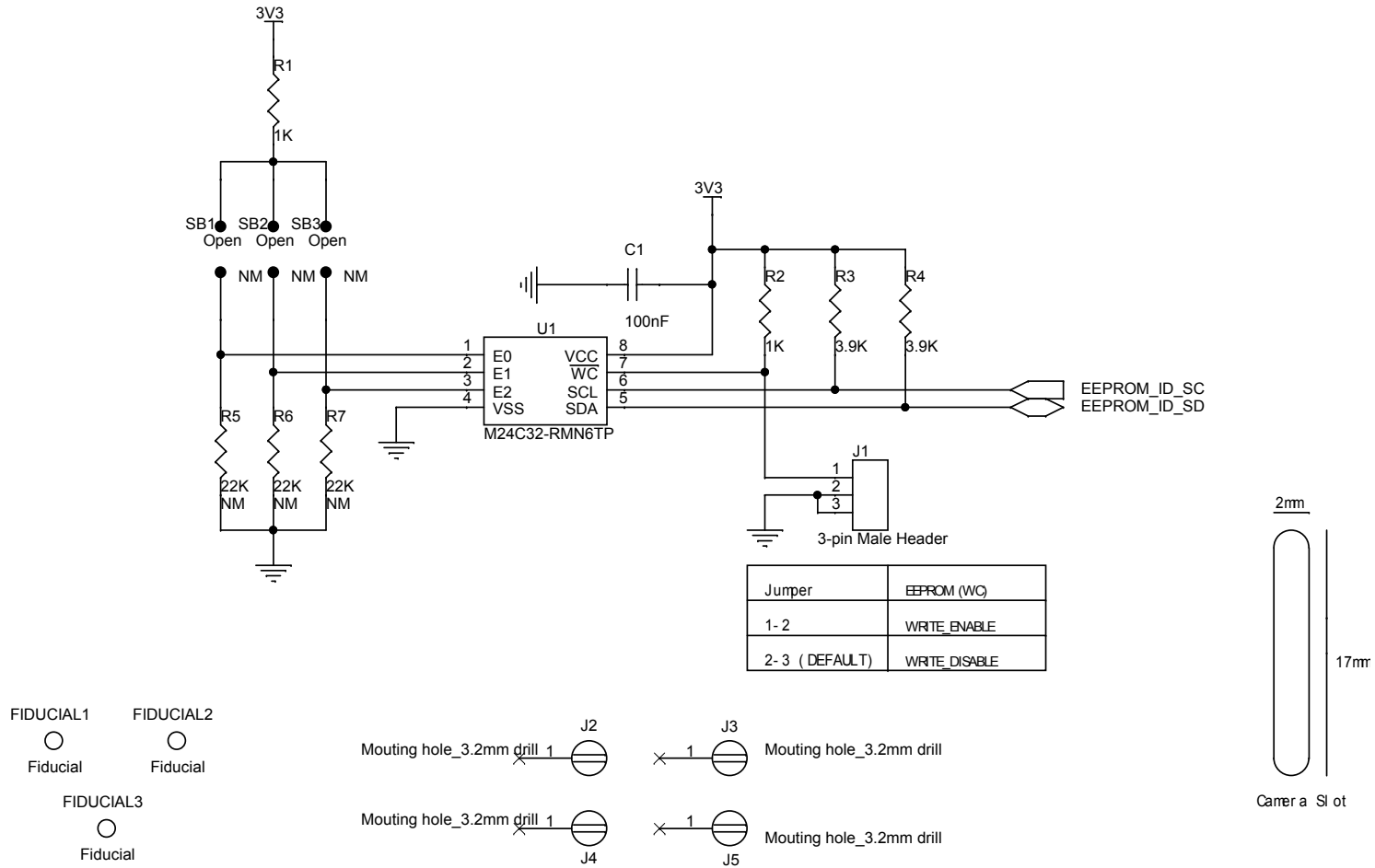


Figure 11. X-STM32MP-NFC08 circuit schematics (3 of 6)

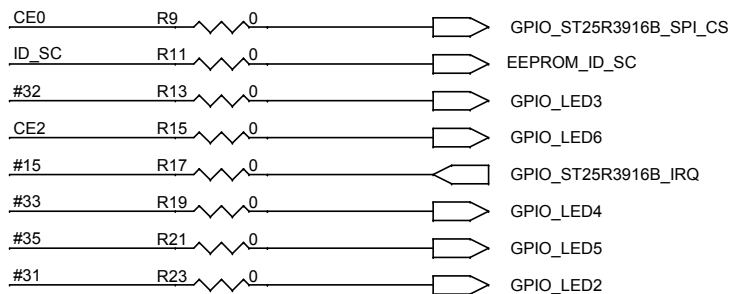
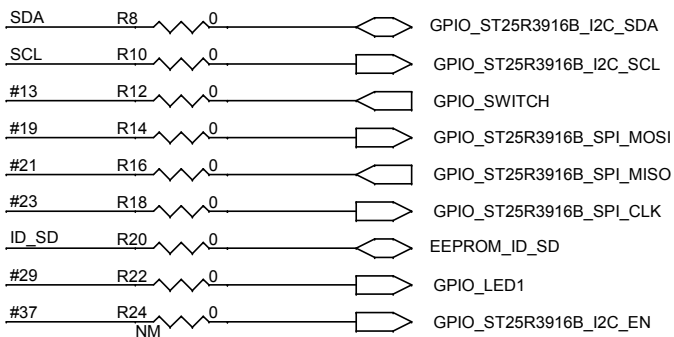
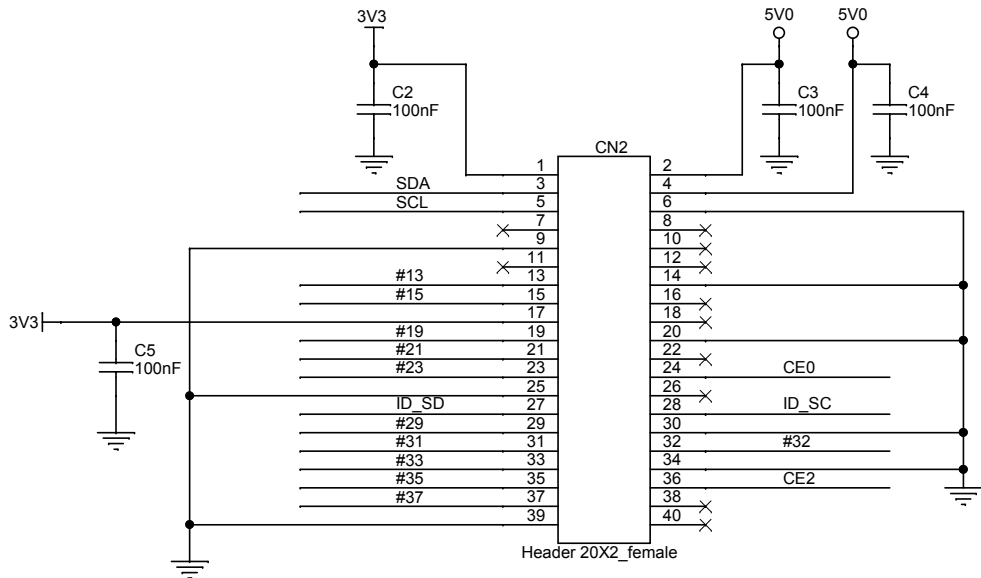


Figure 12. X-STM32MP-NFC08 circuit schematics (4 of 6)

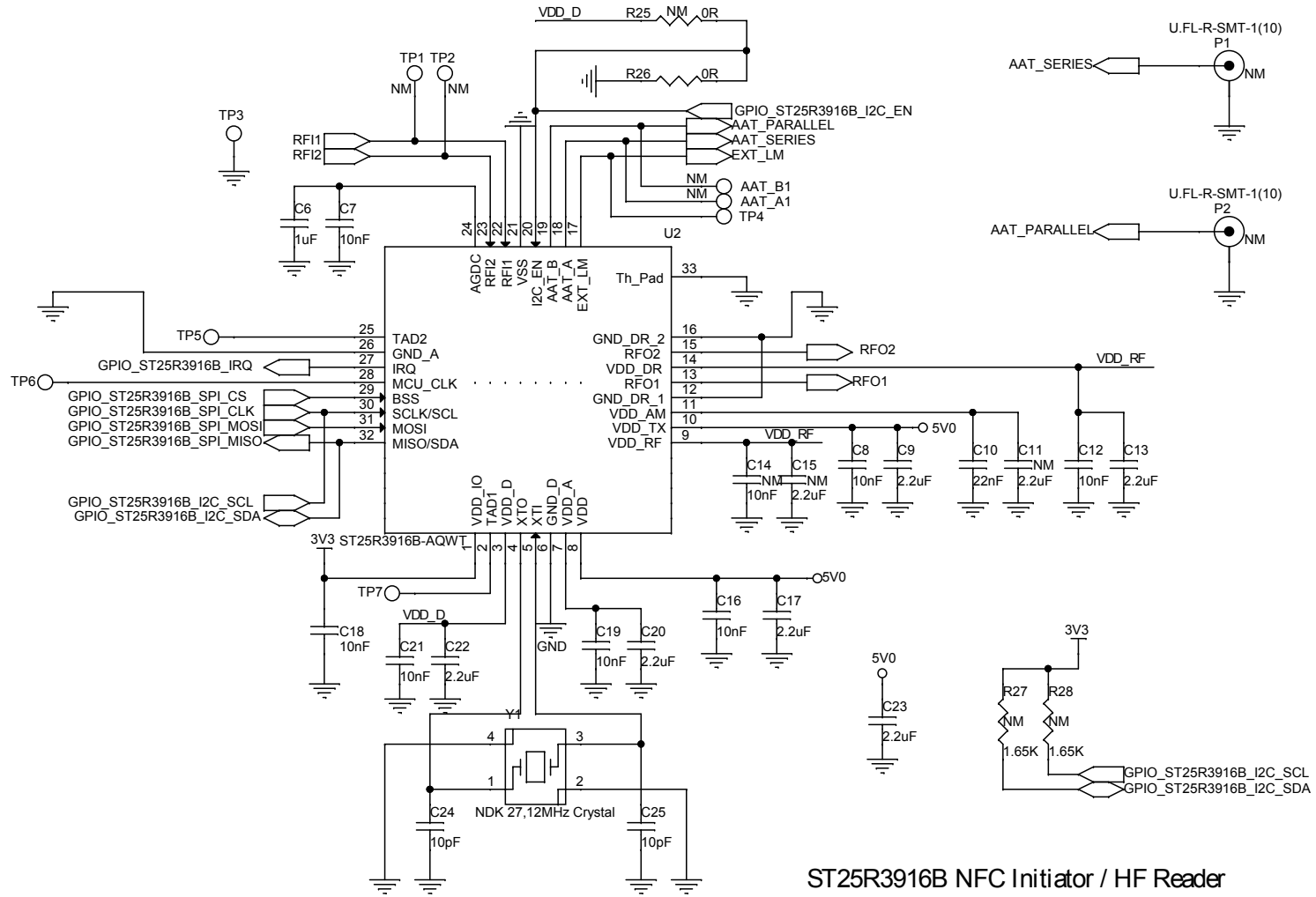
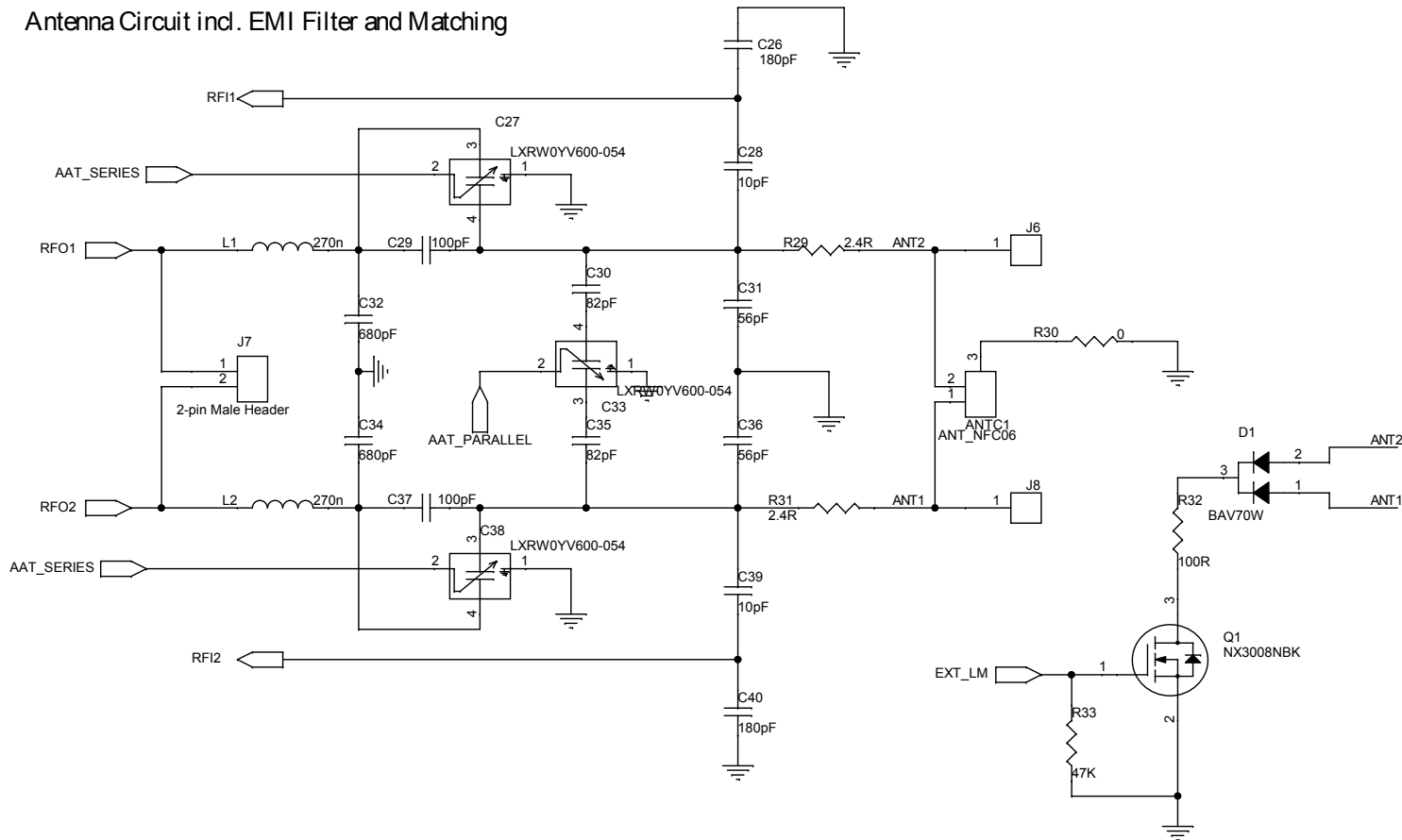
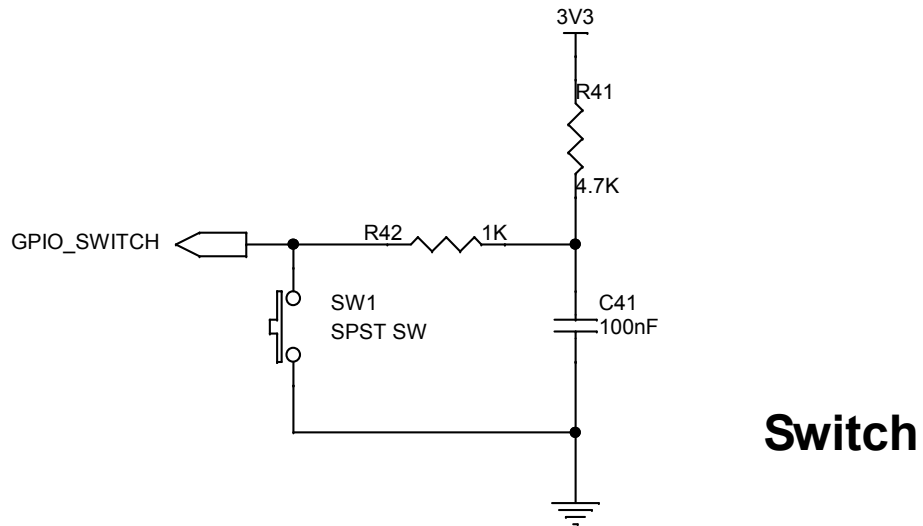
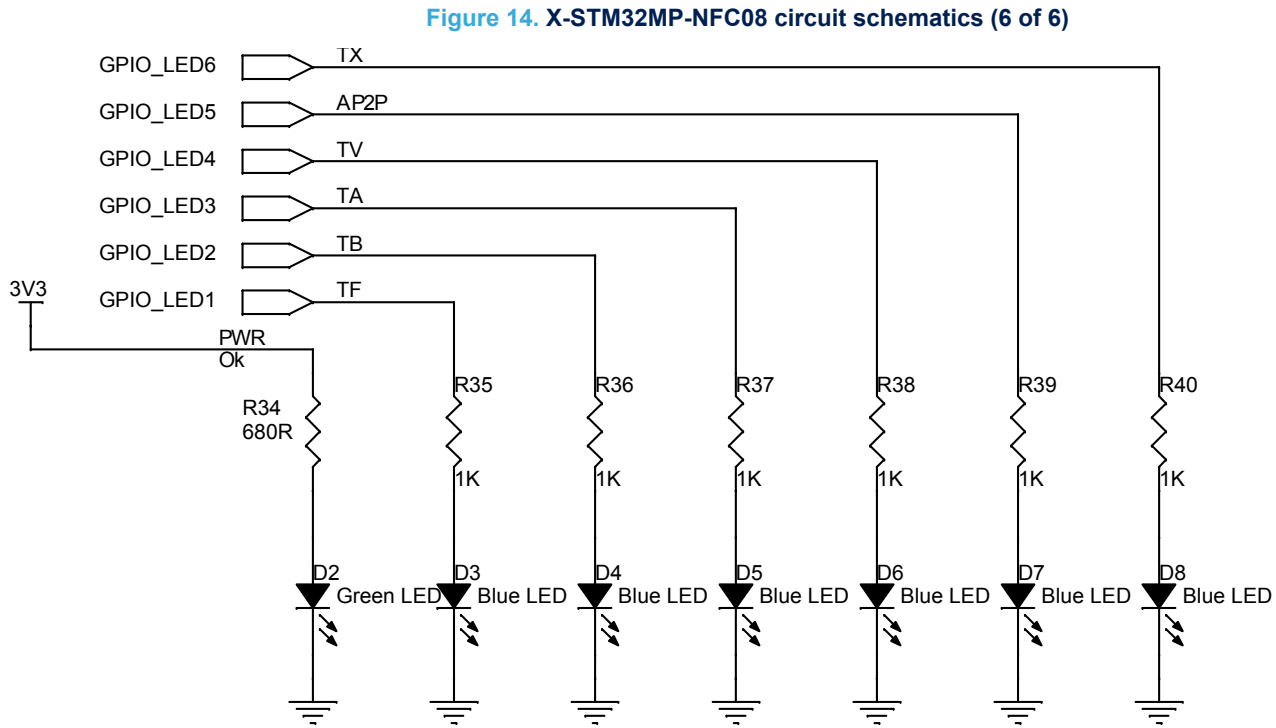


Figure 13. X-STM32MP-NFC08 circuit schematics (5 of 6)

Antenna Circuit incl. EMI Filter and Matching





5 Bill of materials

Table 5. X-STM32MP-NFC08 bill of materials

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
1	4	AAT_A1 AAT_B1 TP1 TP2	TEST POINT, PCB Pads	PCB Pads (not mounted)	PCB Pads	PCB Pads
2	1	ANTC1	ANT_NFC06, PCB Pads	PCB Pads (not mounted)	PCB Pads	PCB Pads
3	6	C1 C2 C3 C4 C5 C41	100nF, 0603 (1608 Metric), 16V, +/-10%	CAP CER 0.1UF 16V X7R 0603	KEMET	C0603C104K4RACTU
4	1	C6	1uF 0402, (1005 Metric),16V, +/-10%	CAPACITOR CERAMIC SMD 0402	Murata Electronics	GRM155R61C105KA12D
5	7	C7 C8 C12 C16 C18 C19 C21	10nF, 0402 (1005 Metric), 25V, +/-10%	CAPACITOR CERAMIC SMD 0402	KYOCERA AVX	04023C103KAT2A
6	6	C9 C13 C17 C20 C22 C23	2.2uF, 0402 (1005 Metric), 6.3V, +/-20%	CAPACITOR CERAMIC SMD 0402	Murata Electronics	GRM155R60J225ME15D
7	1	C10	22nF, 0402 (1005 Metric), 16V, +/-10%	CAPACITOR CERAMIC SMD 0402	KYOCERA AVX	0402YC223KAT2A
8	2	C11 C15	2.2uF, 0402 (1005 Metric), 6.3V, +/-20%	CAPACITOR CERAMIC SMD 0402 (not mounted)	Murata Electronics	GRM155R60J225ME15D
9	1	C14	10nF, 0402 (1005 Metric), 25V, +/-10%	CAPACITOR CERAMIC SMD 0402 (not mounted)	KYOCERA AVX	04023C103KAT2A
10	4	C24 C25 C28 C39	10pF, 0603 (1608 Metric), 50V, +/-1%	CAPACITOR CERAMIC SMD 0603	MULTICOMP	MC0603N100F500CT
11	2	C26 C40	180pF, 0603 (1608 Metric), 50V, +/-2%	CAPACITOR CERAMIC SMD 0603	MURATA	GRM1885C1H181GA01D
12	3	C27 C33 C38	LXRW0YV600-0 54, 0.024" L x 0.024" W (0.60mm x 0.60mm), 50 V	CAP TRIMMER 30-60PF 50V SMD	Murata Electronics	LXRW0YV600-054
13	2	C29 C37	100pF, 0603 (1608 Metric), 50V, +/-1%	CAPACITOR CERAMIC SMD 0603	MURATA	GRM1885C1H101FA01D
14	2	C30 C35	82pF, 0603 (1608 Metric), 50V, +/-1%	CAPACITOR CERAMIC SMD 0603	MURATA	GRM1885C1H820FA01D
15	2	C31 C36	56pF, 0603 (1608 Metric), 50V, +/-1%	CAPACITOR CERAMIC SMD 0603	MURATA	GRM1885C1H560FA01D
16	2	C32 C34	680pF, 0603 (1608 Metric), 50V, +/-2%	CAPACITOR CERAMIC SMD 0603	MURATA	GRM1885C1H681GA01D

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
17	1	CN2	Header 20X2_female Header 20X2_female_2. 54mm pitch	Double Row_Vertical_.100" _Extended Tail Connector	Samtec	SSQ-120-03-T-D
18	1	D1	BAV70W, SC-70, SOT-323, 1.25V @ 150mA, 150mA (DC)	Diode Array 1 Pair Common Cathode Standard 75 V 150mA Surface Mount	Infineon Technologies	BAV70W
19	1	D2	Green LED, 0603 (1608 Metric), 20mA	LED Green CLEAR 0603 SMD	Lite-On Inc.	LTST-C190KGKT
20	6	D3 D4 D5 D6 D7 D8	Blue LED, 0603 (1608 Metric), 20mA	LED Blue CLEAR 0603 SMD	Lite-On Inc.	LTST-C190TBKT
22	1	J1	3-pin Male Header_2.54mm pitch	CONN HEADER .100 STR 3POS	Samtec Inc.	TSW-103-07-F-S
24	2	J6 J8	con1-strip-male, 1-pin Male Header	CONN HEADER .100 STR 1POS	Molex	0022284010
25	1	J7	2-pin Male Header, pin Male Header_2.54mm pitch	Connector Header Through Hole 2 position 0.100" (2.54mm)	Molex	0022284020
26	2	L1 L2	270n, 0603 (16085 Metric)	FIXED IND 270NH 550MA 286MOHM SM	TDK Corporation	MLJ1608WR27JT000
27	2	P1 P2	U.FL-R- SMT-1(10), U.FL-R-SMT-1	CONN U.FL RCPT STR 50 OHM SMD (not mounted)	Hirose Electric Co Ltd	U.FL-R-SMT-1(10)
28	1	Q1	NX3008NBK, TO-236AB, SOT-23-3, 350mW (Ta)	MOSFET N-CH 30V 400mA SOT23	Nexperia	NX3008NBK,215
29	3	R1 R2 R42	1K, 0603 (1608 Metric), 0.1W, 1/10W, +/-1%	RES SMD 1K OHM 1% 1/10W 0603	Vishay Dale	CRCW06031K00FKEA
30	2	R3 R4	3.9K, 0603 (1608 Metric), 0.1W, 1/10W, +/-1%	RES SMD 3.9K OHM 1% 1/10W 0603	Yageo	RT0603FRE073K9L
31	3	R5 R6 R7	22K, 0603 (1608 Metric), 0.1W, 1/10W, +/-5%	RES SMD 22K OHM 5% 1/10W 0603 (not mounted)	Vishay Dale	CRCW060322K0JNEA
32	16	R8 R9 R10 R11 R12 R13 R14 R15 R16 R17 R18 R19 R20 R21 R22 R23	0603 (1608 Metric), 0.1W, 1/10W, +/-1%	RES SMD 0 OHM JUMPER 1/10W 0603	TE Connectivity Passive Product	CRG0603ZR
33	1	R24	0603 (1608 Metric), 0.1W, 1/10W, +/-1%	RES SMD 0 OHM JUMPER 1/10W 0603 (not mounted)	TE Connectivity Passive Product	CRG0603ZR

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
34	1	R25	0R, 0402 (1005 Metric), 0.063W, 1/16W, +/-1%	CHIP RESISTOR SMD 1% 1/16W 0402 (not mounted)	MULTICOMP	MC00625W040210R
35	1	R26	0R, 0402 (1005 Metric), 0.063W, 1/16W, +/-1%	CHIP RESISTOR SMD 1% 1/16W 0402	MULTICOMP	MC00625W040210R
36	2	R27 R28	1.65K, 0603 (1608 Metric), 0.1W, 1/10W, +/-1%	RES SMD 1.65K OHM 1% 1/10W 0603 (not mounted)	YAGEO	RT0603FRE071K65L
37	2	R29 R31	2.4R, 0603 (1608 Metric), 0.333W, 1/3W, +/-1%	CHIP RESISTOR SMD 1% 1/3W 0603	KOA	SG73P1JT2D2R40F
38	1	R30	0603 (1608 Metric), 0.1W, 1/10W, +/-1%	RES SMD 0 OHM JUMPER 1/10W 0603	TE Connectivity Passive Product	CRG0603ZR
39	1	R32	100R, 0402 (1005 Metric), 0.01W, 1/16W, +/-1%	CHIP RESISTOR SMD 1% 1/16W 0402	VISHAY	CRCW0402100RFKED
40	1	R33	47K, 0402 (1005 Metric), 0.063W, 1/16W, +/-1%	CHIP RESISTOR SMD 1% 1/16W 0402	VISHAY	CRCW040247K0FKTD
41	1	R34	680R, 0402 (1005 Metric), 0.063W, 1/16W, +/-5%	CHIP RESISTOR SMD 5% 1/16W 0402	Yageo	RC0402JR-07680RL
42	6	R35 R36 R37 R38 R39 R40	1K, 0402 (1005 Metric), 0.1W, 1/10W, +/-5%	CHIP RESISTOR SMD 5% 1/10W 0402	Panasonic	ERJ2GEJ102X
43	1	R41	4.7K, 0603 (1608 Metric), 0.1W, 1/10W, +/-1%	RES SMD 4.7K OHM 1% 1/10W 0603	Yageo	RC0603FR-074K7P
44	3	SB1 SB2 SB3	Open, 0603	RES 0 OHM JUMPER 1/10W 0603 (not mounted)	Rohm Semiconductor	SFR03EZPJ000
45	1	SW1	SPST SW, 6.00mm x 3.50mm	SWITCH TACTILE SPST-NO 0.05A 24V	TE Connectivity ALCOSWITCH Switches	1437566-3
46	1	TP3	TP, 0.100" Dia x 0.180" L (2.54mm x 4.57mm)	TEST POINT PC MINI .040"D RED	Keystone Electronics	5000
47	4	TP4 TP5 TP6 TP7	TEST POINT, 0.128" L x 0.065" W (3.25mm x 1.65mm)	PC TEST POINT NATURAL	Harwin Inc.	S1751-46R
48	1	U1	M24C32-RMN6TP, 8-SOIC (0.154", 3.90mm Width)	32 Kbit serial I2C bus EEPROM	ST	M24C32-RMN6TP

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
49	1	U2	ST25R3916B-AQWT, VFQFPN32	IC RFID NFC/HF READER	ST	ST25R3916B-AQWT
50	1	Y1	NDK 27,12MHz Crystal, 4-SMD, No Lead, 2x1.6 mm	CRYSTAL 27.1200MHZ 10PF SMD	NDK America, Inc.	NX2016SA-27.12MHZ-EXS00A-CS01188
Misc						
1	4	Nut	PLASTIC HEXAGON NUT M3	M3x0.5 Hex Nut 0.217" (5.50mm) Nylon	Würth Elektronik	709940300
2	4	Spacer	MALE FEMALE THREADED STANDOFF, M	Hex Standoff Threaded M3x0.5 Nylon 0.472" (12.00mm) Natural	Essentra	36M30MF012

6 Board versions

Table 6. X-STM32MP-NFC08 versions

Finished good	Schematic diagrams	Bill of materials
X\$STM32MP-NFC08A ⁽¹⁾	X\$STM32MP-NFC08A schematic diagrams	X\$STM32MP-NFC08A bill of materials

1. This code identifies the X-STM32MP-NFC08 evaluation board first version.

7 Regulatory information

Formal Product Notice Required by FCC:

For evaluation only; not FCC approved for resale

FCC NOTICE - This kit is designed to allow:

(1) Product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and (2) Software developers to write software applications for use with the end product.

This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter 3.1.2.

Formal Product Notice Required by Industry Canada

For evaluation purposes only. This kit generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to Industry Canada (IC) rules.

À des fins d'évaluation uniquement. Ce kit génère, utilise et peut émettre de l'énergie radiofréquence et n'a pas été testé pour sa conformité aux limites des appareils informatiques conformément aux règles d'Industrie Canada (IC).

Notice for the European Union

The kit X-STM32MP-NFC08 is in conformity with the essential requirements of the Directive 2014/53/EU (RED) and of the Directive 2015/863/EU (RoHS). Applied harmonized standards are listed in the EU Declaration of Conformity.

Notice for United Kingdom

The kit X-STM32MP-NFC08 is in compliance with the UK Radio Equipment Regulations 2017 (UK SI 2017 No. 1206 and amendments) and with the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012 (UK SI 2012 No. 3032 and amendments). Applied standards are listed in the UK Declaration of Conformity.

Revision history

Table 7. Document revision history

Date	Revision	Changes
23-Nov-2023	1	Initial release.

Contents

1	Safety and compliance information	2
2	Overview	3
2.1	EEPROM (M24C32-RMN6TP)	5
2.2	GPIO connector	6
2.3	NFC card reader IC (ST25R3916B)	7
2.4	LEDs and switches	8
3	Getting started with the X-STM32MP-NFC08 expansion board	9
3.1	System setup requirements	9
3.2	Safety precautions and protective equipment	9
3.3	Setting up the board	10
4	Schematic diagrams	11
5	Bill of materials	17
6	Board versions	21
7	Regulatory information	22
	Revision history	23
	List of tables	25
	List of figures	26

List of tables

Table 1.	EEPROM details	4
Table 2.	ST25R3916B details	5
Table 3.	Read and write operation	5
Table 4.	GPIO connector pin configuration.	7
Table 5.	X-STM32MP-NFC08 bill of materials	17
Table 6.	X-STM32MP-NFC08 versions	21
Table 7.	Document revision history	23

List of figures

Figure 1.	X-STM32MP-NFC08 evaluation board	1
Figure 2.	Block diagram	3
Figure 3.	X-STM32MP-NFC08 component placement details	4
Figure 4.	EEPROM section	5
Figure 5.	GPIO connector section	6
Figure 6.	ST25R3916B circuit	8
Figure 7.	LEDs and switch circuit	8
Figure 8.	X-STM32MP-NFC08 connected on STM32MP157F-DK2	9
Figure 9.	X-STM32MP-NFC08 circuit schematics (1 of 6)	11
Figure 10.	X-STM32MP-NFC08 circuit schematics (2 of 6)	12
Figure 11.	X-STM32MP-NFC08 circuit schematics (3 of 6)	13
Figure 12.	X-STM32MP-NFC08 circuit schematics (4 of 6)	14
Figure 13.	X-STM32MP-NFC08 circuit schematics (5 of 6)	15
Figure 14.	X-STM32MP-NFC08 circuit schematics (6 of 6)	16

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