

Getting started with the X-NUCLEO-NFC04A1 NFC/RFID tag IC expansion board based on ST25DV04K for STM32 Nucleo

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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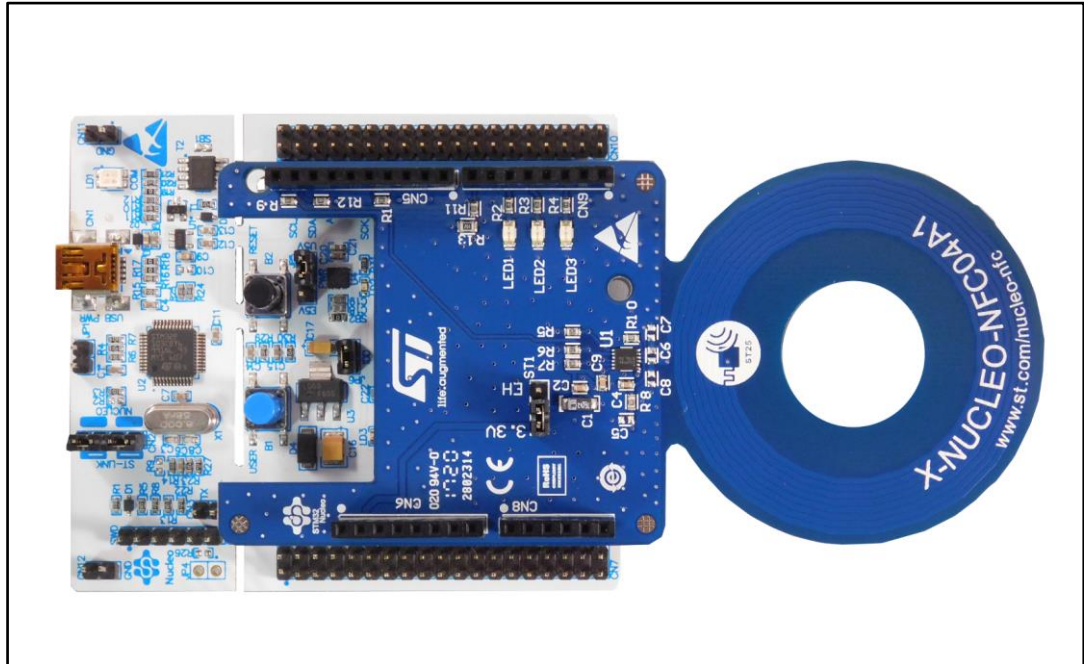
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1 Getting started

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.

^a See [Section 2.1.1: "Power supply option"](#) for further details

- 2 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"](#).
- 3 Power the STM32 Nucleo board using the Mini-B USB cable.
- 4 Program the firmware in the STM32 Nucleo board using the provided firmware example.
- 5 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 V_{out} 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^a (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^b.

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

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.

Signal	Connector	Pin number	STM32 Nucleo board (MCU port)	X-NUCLEO-NFC04A1 expansion board
A1	Analog	2	PA1	-
A2		3	PA4	-
A3		4	PB0	-
A4		5	PC1/PB9 ⁽¹⁾	-
A5		6	PC0/PB8 ⁽¹⁾	-

Notes:

⁽¹⁾ Acting on the STM32 Nucleo board solder bridge.

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

Signal	Connector	Pin number	STM32 Nucleo board (MCU port)	X-NUCLEO-NFC04A1 expansion board
D15	CN5 Digital	10	PB8	ST25DV_SCL
D14		9	PB9	ST25DV_SDA
AREF		8	-	-
GND		7	-	GND
D13		6	PA5	-
D12		5	PA6	ST25DV_GPO
D11		4	PA7	-
D10		3	PB6	-
D9		2	PC7	-
D8		1	PA9	-
D7	CN9 Digital	8	PA8	ST25DV_LPD
D6		7	PB10	-
D5		6	PB4	MCU_LED1
D4		5	PB5	MCU_LED2
D3		4	PB3	-
D2		3	PA10	MCU_LED3
D1		2	PA2	-
D0		1	PA3	-

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_LPD 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)^a.

^a 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

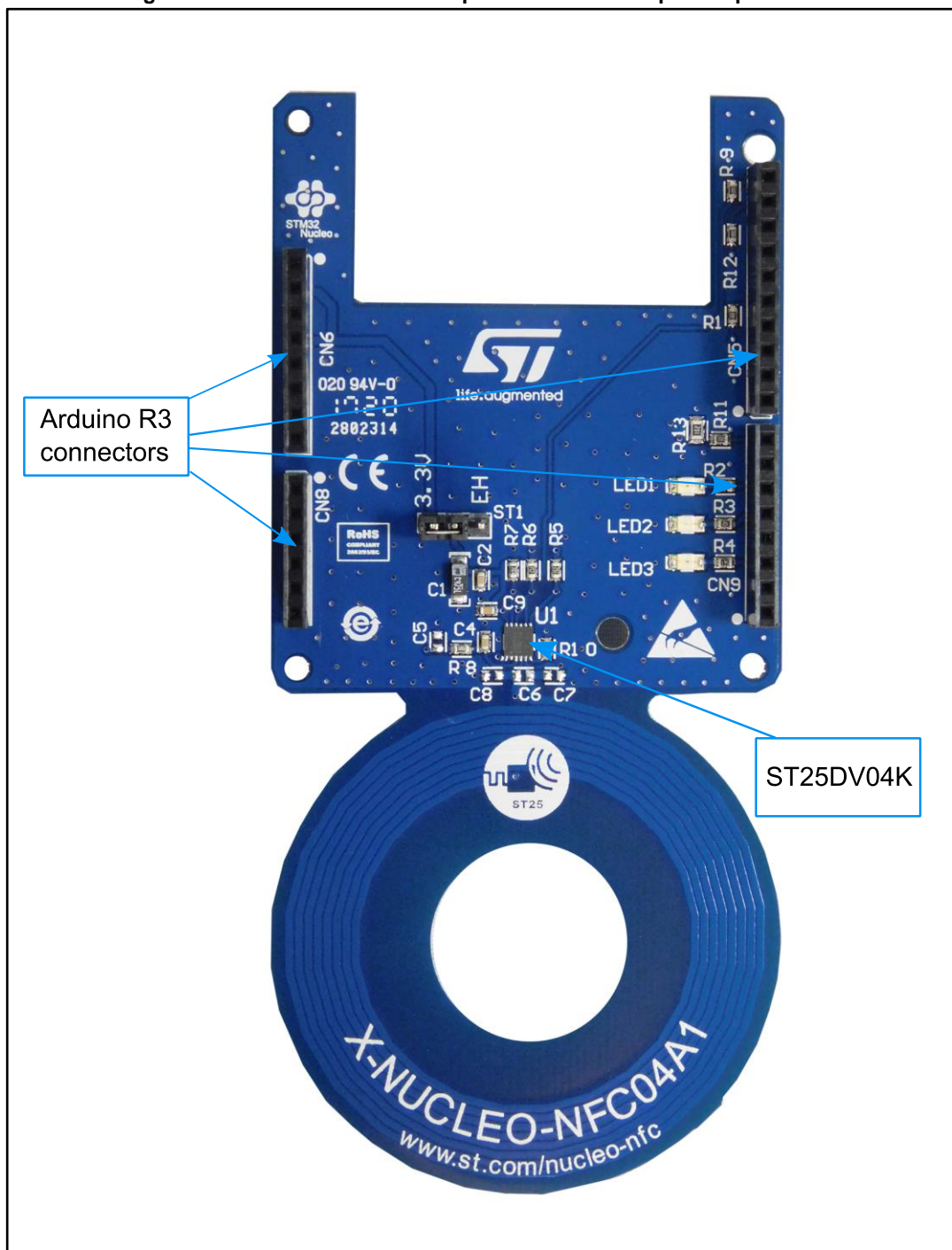


Figure 4: X-NUCLEO-NFC04A1 block diagram

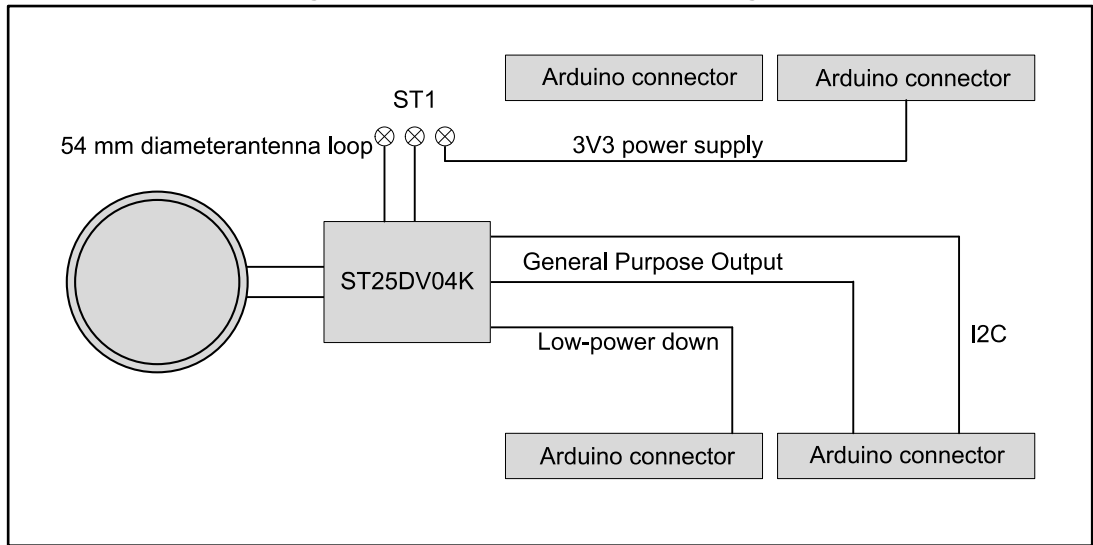


Figure 5: X-NUCLEO-NFC04A1 LED and power supply schematic diagram

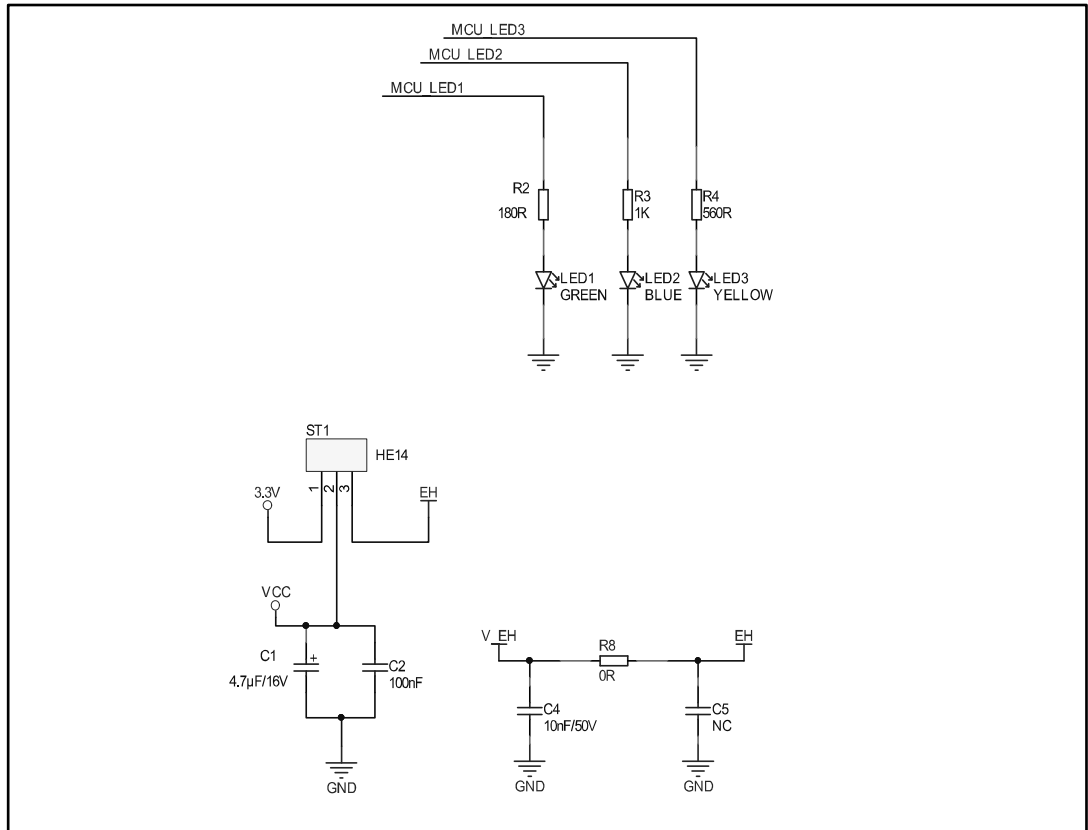


Figure 6: STM32 Nucleo Arduino connectors

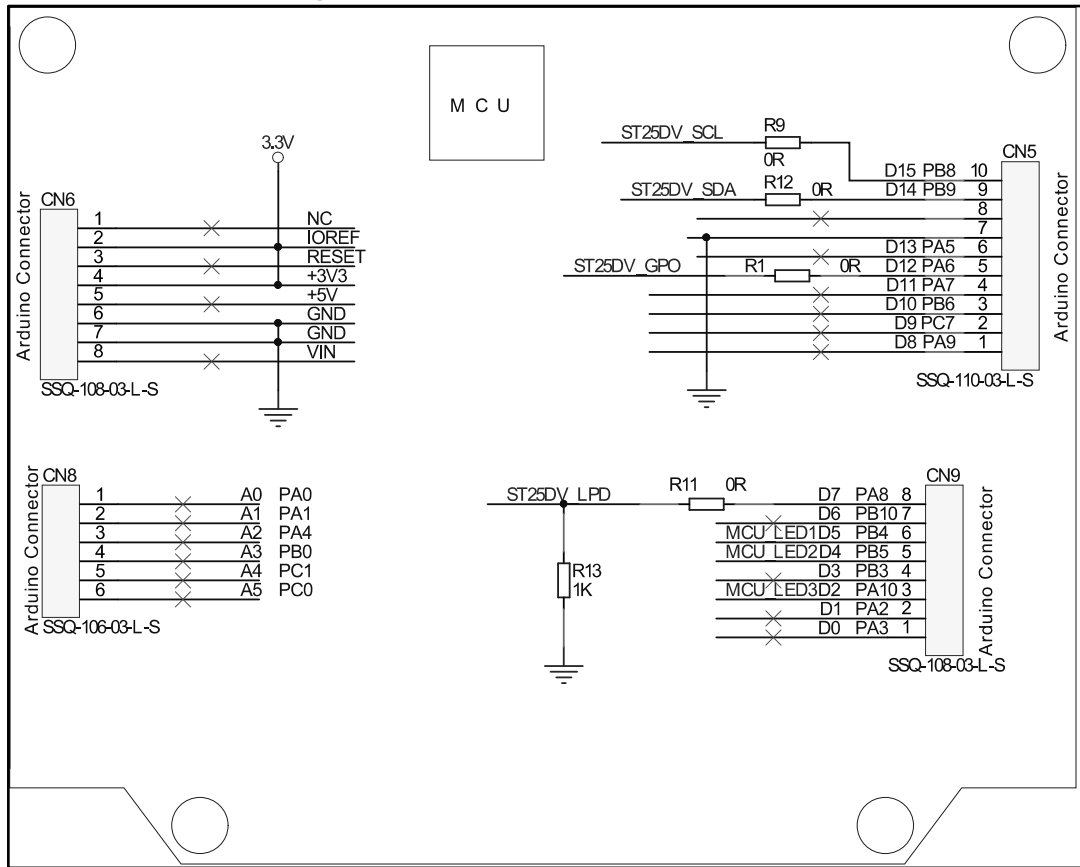
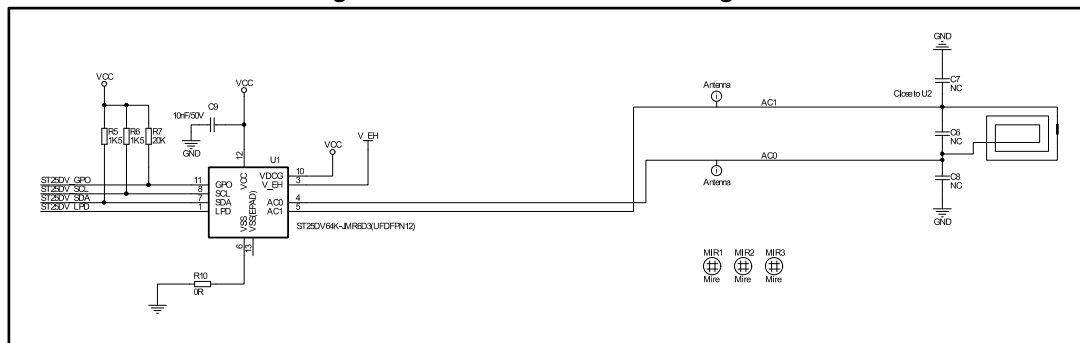


Figure 7: ST25DV04K schematic diagram



4 Bill of materials

Table 3: X-NUCLEO-NFC04A1 bill of materials

Item	Q. ty	Ref.	Part / Value	Description	Manufacturer	Order code
1	1	C1	4.7 μ F, 16 V \pm 10%, SMD_293D-A_REFLOW	Capacitor		
2	1	C2	100 nF, 16 V, X7R, \pm 5%, SMD_C_0603_REFLOW	Ceramic capacitor		
3	2	C4, C9	10 nF, 50 V NPO \pm 5% SMD_C_0603_REFLOW	Ceramic capacitor		
4	4	C5, C6, C7, C8	10 nF, 50 V NPO \pm 5%, SMD_C_0603_REFLOW_ NC	Ceramic capacitor (not mounted)		
5	1	CN5	HDR1X10	Extra-long 10 pin female-male strip	SAMTEC	SSQ-110-03-L-S
6	2	CN6, CN9	HDR1X8	Extra-long 8 pin female-male strip	SAMTEC	SSQ-108-03-L-S
7	1	CN8	HDR1X6	Extra-long 6 pin female-male strip	SAMTEC	SSQ-106-03-L-S
8	1	LED 1	LED-1206	Green LED	DIALIGHT	5988270107F
9	1	LED 2	LED-1206	Blue LED	DIALIGHT	5988291107F
10	1	LED 3	LED-1206	Yellow LED	DIALIGHT	5988240107F
11	6	R1, R8, R9, R10, R11, R12	0 Ohm SMD_R_0603_REFLOW	Resistors		
12	1	R2	180 SMD_R_0603_REFLOW	Resistor		
13	1	R3	1 kohm, \pm 5%, 1/16 W, SMD_R_0603_REFLOW	Resistor		
14	1	R4	560, \pm 5%, 1/16 W, SMD_R_0603_REFLOW	Resistor		
15	1	R7	20 kohm, \pm 5%, 1/16 W, SMD_R_0603_REFLOW	Resistor		
16	2	R5, R6	1K5, \pm 5%, 1/16 W, SMD_R_0603_REFLOW	Resistor		
17	1	R13	1 kohm, \pm 5%, 1/10 W, SMD_R_0805_REFLOW	Resistor		
18	1	ST1	CONN_3PTS_P2.54	CON_3PTS_P2.54	FCI	77311-401-03LF

Bill of materials**UM2235**

Item	Q. ty	Ref.	Part / Value	Description	Manufacturer	Order code
19	1	U1	STM ST25DV DFN12 PACKAGE	ST25DV04	ST	ST25DV04K-JFR6D3
20	1	J1	2.54	Jumper	WURTH ELEKTRONIK	60900213421

5 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

Date	Version	Changes
16-Jun-2017	1	Initial release.

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