

## Getting started with the X-NUCLEO-EEPRMA2 standard I<sup>2</sup>C and SPI EEPROM memory expansion board based on M24xx and M95xx series for STM32 Nucleo

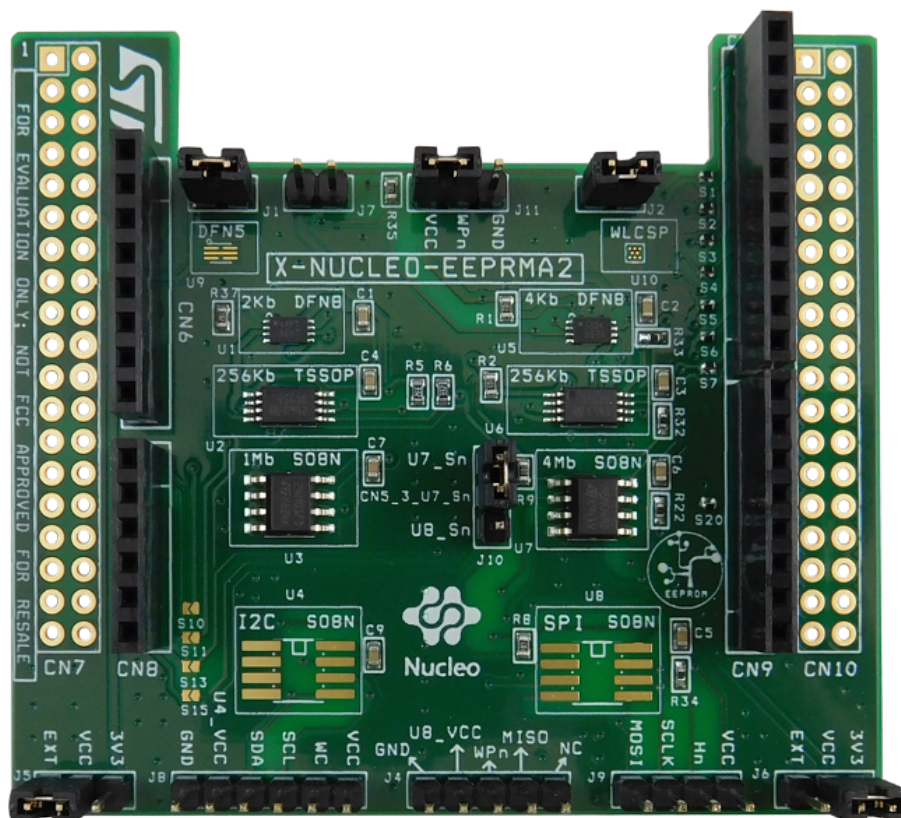
### Introduction

The X-NUCLEO-EEPRMA2 expansion board is designed for M24xx series I<sup>2</sup>C and M95xx series SPI EEPROM for data reading and writing.

The expansion board acts as an external storage device that can be used to store data such as manufacturing traceability, calibration, user settings, error flags, data logs and monitoring data to make applications more flexible and accurate.

The X-NUCLEO-EEPRMA2 expansion board is compatible with the Arduino UNO R3 connector pin assignment and can be easily plugged to any STM32 Nucleo development board. You can mount the ST morpho connectors if required.

Figure 1. X-NUCLEO-EEPRMA2 expansion board



## 1 Acronyms and abbreviations

Table 1. List of acronyms

Acronym	Description
EEPROM	Electrically erasable programmable read only memory
MHz	Mega Hertz
MCU	Microcontroller unit
SPI	Serial peripheral interface
I2C	Inter-integrated circuit

## 2 Getting started

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### 2.1 Overview

The [X-NUCLEO-EEPRMA2](#) main features are:

- Up to 1-Mbit serial I<sup>2</sup>C bus embedded EEPROM
- Up to 4-Mbit SPI bus embedded EEPROM
- Easy portability across different MCU families
- Equipped with Arduino™ UNO R3 connector
- Compatible with [STM32 Nucleo](#) boards
- Free comprehensive development firmware library and sample implementation available when the [X-NUCLEO-EEPRMA2](#) expansion board is plugged on top of a [NUCLEO-F401RE](#) or [NUCLEO-L053R8](#) development board
- Developer can choose and solder an EEPROM to be tested using the evaluation software provided

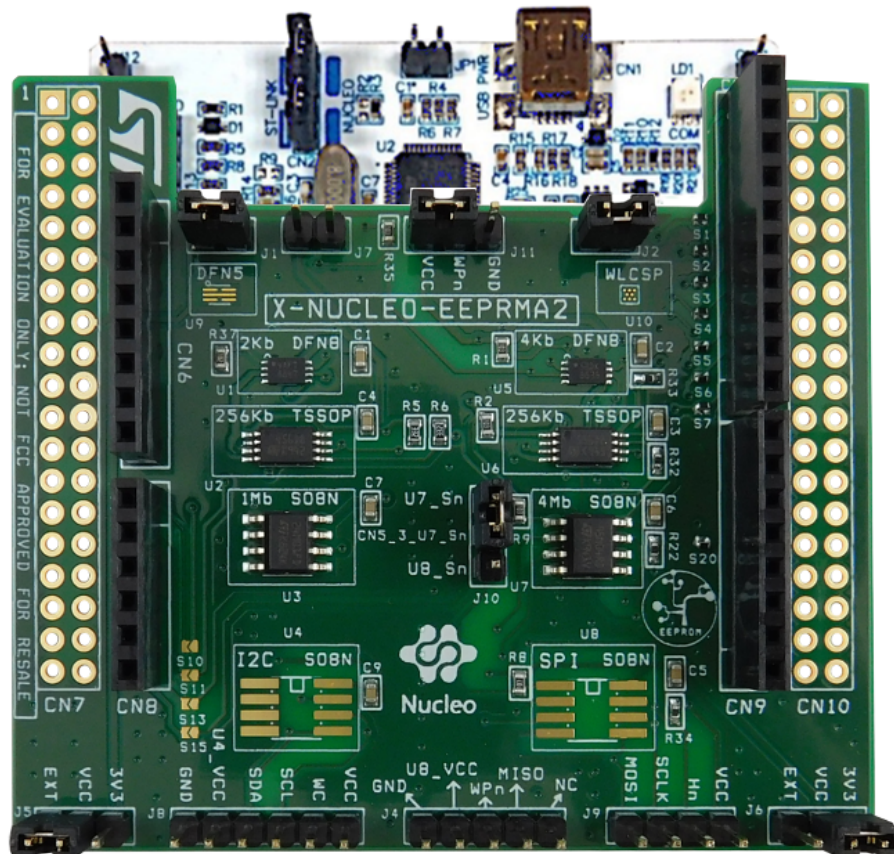
### 2.2 Typical applications

The [X-NUCLEO-EEPRMA2](#) expansion board acts as an external storage device that can be used for storing data such as manufacturing traceability, calibration data, user setting, error flags, data log and monitoring data to make applications more flexible and accurate.

## 2.3 Hardware requirements

To use [STM32 Nucleo](#) development boards with the [X-NUCLEO-EEPROMA2](#) expansion board, connect the boards as shown below.

**Figure 2.** X-NUCLEO-EEPROMA2 expansion board connected to an STM32 Nucleo development board



The EEPROM communicates with the [STM32 Nucleo](#) development board host microcontroller through the SPI or I<sup>2</sup>C signals available on the Arduino UNO R3 connector.

The [X-NUCLEO-EEPROMA2](#) has been designed to allow using any STM32 Nucleo board, although complete testing has been performed using the [NUCLEO-F401RE](#) and [NUCLEO-L053R8](#) boards.

## 2.4 System requirements

To use the [STM32 Nucleo](#) development boards with the [X-NUCLEO-EEPROMA2](#) expansion board you need:

- a Windows PC/laptop (Windows 7 or above) to install the firmware package ([X-CUBE-EEPROMA1](#))
- a type A to Mini-B USB cable to connect the [STM32 Nucleo](#) board to the PC
- an STM32 Nucleo development board ([NUCLEO-F401RE](#) or [NUCLEO-L053R8](#))
- an [X-NUCLEO-EEPROMA2](#) expansion board

## 2.5 Board setup

- Step 1.** Check the jumper on J1 and J2 connectors are connected. These jumpers provide the required voltage to the devices.
- Step 2.** Ensure jumper on J11 is put between VCC and WPn.
- Step 3.** Ensure jumper on J10 is put between U7\_Sn and CN5\_3\_U7\_Sn.

- Step 4.** Connect the [X-NUCLEO-EEPRMA2](#) to the [STM32 Nucleo](#) board as shown in [Figure 2](#).
- Step 5.** Power the [STM32 Nucleo](#) development board using the Mini-B USB cable.
- Step 6.** Program the firmware in the development board.
- Step 7.** Reset the MCU board using the reset button on the [STM32 Nucleo](#) development board. The evaluation kit is ready-to-use.

## 3 Hardware description and configuration

### 3.1 Interconnection details

The X-NUCLEO-EEPRMA2 expansion board and the NUCLEO-L053R8 or NUCLEO-F401RE board connection details are listed below.

**Table 2. X-NUCLEO-EEPRMA2 and NUCLEO-L053R8 connection details (left connector)**

Signal name													
NC	IOREF	RESET	3V3	5V	GND	GND	VIN	A0	A1	A2	A3	A4	A5
Connector name													
CN6 Power							CN8 Analog						
Pin number													
1	2	3	4	5	6	7	8	1	2	3	4	5	6
NUCLEO-L053R8 MCU port													
		NRST						PA0	PA1	PA4	PB0	PC1/PB9	PC0/PB8
NUCLEO-L053R8 MCU signals													
	3.3 V REF	RESET	3.3 V input/output	5 V output	GND	GND	POWER INPUT	ADC_IN0	ADC_IN1	ADC_IN4	ADC_IN8	ADC_IN11(PC1) or I2C1_SDA(PB9)	ADC_IN10(PC0) or I2C1_SCL(PB8)
X-NUCLEO-EEPRMA2 expansion board signals													
NC			3V3		GND	GND		M95_WPn	M24_VCC		M95_Hn		U8_Sn

**Table 3. X-NUCLEO-EEPRMA2 and NUCLEO-L053R8 connection details (right connector)**

Signal name																	
D15	D14	AREF	GND	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
Connector name																	
CN5 Digital										CN9 Digital							
Pin number																	
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
NUCLEO-L053R8 MCU signals																	
I2C_SCL	I2C_SDA	AVDD	GND	SPI1_SCK	SPI1_MISO	TIM12_CH2 SPI1_MOSI	SPI1_CS	TIM12_CH2			TIM2_CH3	TIM12_CH1		TIM2_CH2		USART2_TX	USART2_RX
X-NUCLEO-EEPRMA2 shield signals																	
M24_I2C_SCL	M24_I2C_SDA		GND	M95_SCLK	M95_MISO	M95_MOSI	CN5_3_U7_Sn	U6_Sn							U5_Sn		

**Table 4. X-NUCLEO-EEPRMA2 and NUCLEO-F401RE connection details (left connector)**

Signal name													
NC	IOREF	RESET	3V3	5V	GND	GND	VIN	A0	A1	A2	A3	A4	A5
Connector name													
CN6 Power							CN8 Analog						
Pin number													
1	2	3	4	5	6	7	8	1	2	3	4	5	6
NUCLEO-F401RE MCU port													
		NRST						PA0	PA1	PA4	PB0	PC1	PC0
NUCLEO-F401RE MCU signals													
	3.3 V REF	RESET	3.3 V input/output	5 V output	GND	GND	POWER INPUT	ADC1_0	ADC1_1	ADC1_4	ADC1_8	ADC1_11(PC1) or I2C1_SDA(PB9)	ADC1_10(PC0) or I2C1_SCL(PB8)
X-NUCLEO-EEPRMA2 expansion board signals													
NC			3V3		GND	GND		M95_WPn	M24_VCC		M95_Hn		U8_Sn

**Table 5. X-NUCLEO-EEPRMA2 and NUCLEO-F401RE connection details (right connector)**

Signal name																	
D15	D14	AREF	GND	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
Connector name																	
CN5 Digital										CN9 Digital							
Pin number																	
10	9	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1
NUCLEO-F401RE MCU port																	
PB8	PB9			PA5	PA6	PA7	PB6	PC7	PA9	PA8	PB10	PB4	PB5	PB3	PA10	PA2	PA3
NUCLEO-F401RE MCU signals																	
I2C1_SCL	I2C1_SDA	AVDD	GND	SPI1_SCK	SPI1_MISO	TIM1_CH1N SPI1_MOSI	TIM4_CH4 SPI1_CS	TIM3_CH2			TIM2_CH3	TIM3_CH1		TIM2_CH2		USART2_TX	USART2_RX
X-NUCLEO-EEPRMA2 shield signals																	
M24_I2C_SCL	M24_I2C_SDA		GND	M95_SCLK	M95_MISO	M95_MOSI	CN5_3_U7_Sn	U6_Sn							U5_Sn		

### 3.2 Current measurement

J1 can be used to monitor the I<sup>2</sup>C device power consumption, whereas J2 can be used to monitor the SPI device power consumption. Connect an ammeter probe between the connector pin 1 and pin 2 for measurements.



### 3.3 X-NUCLEO-EEPROM2 component placement details

Figure 3. X-NUCLEO-EEPROM2 component placement details

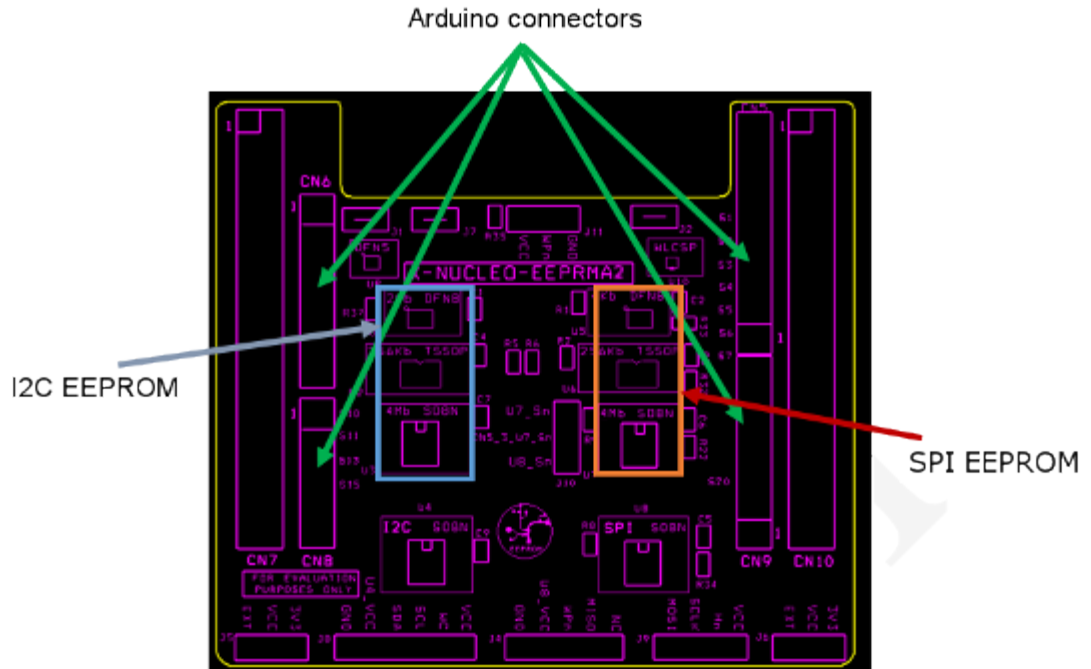


Figure 4. X-NUCLEO-EEPROM2 top view layout

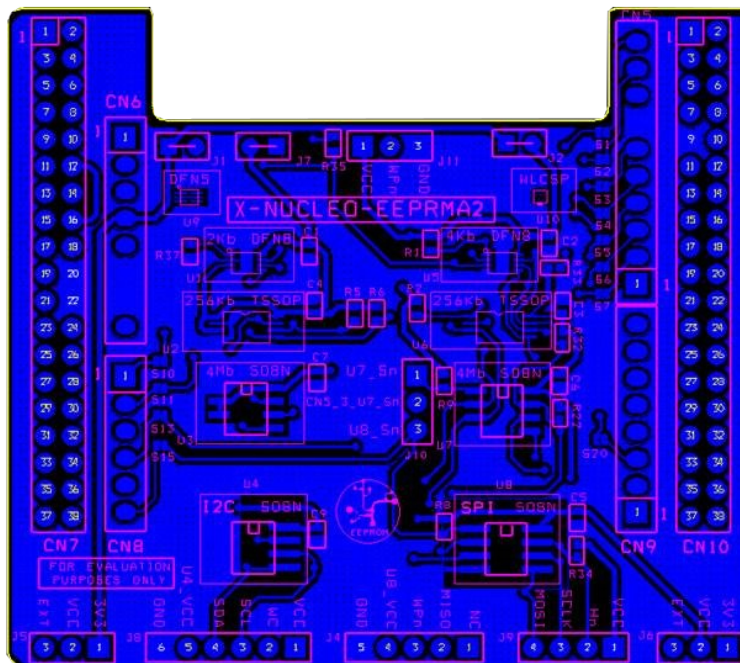
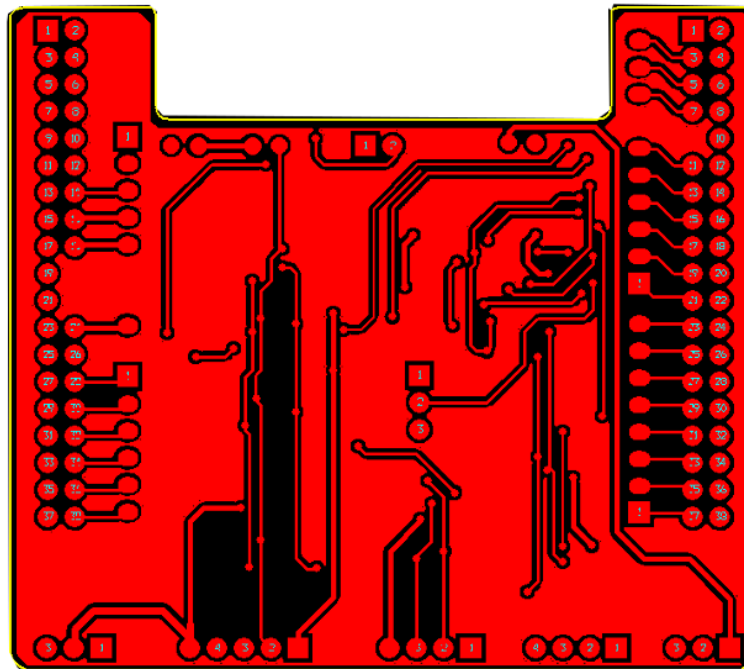


Figure 5. X-NUCLEO-EEPRMA2 bottom view layout



## 4 Component description

### 4.1 M24XX

Table 6. M24C02 details

Feature	Description
Sales type	M24C02-FMC6TG
Package	UFDFPN8
Single supply voltage	1.7 to 5.5 V (full temperature range) and 1.6 to 1.7 V (limited temperature range)

Table 7. M24256 details

Feature	Description
Sales type	M24256-DFDW6TP
Package	TSSOP8
Single supply voltage and high speed	1 MHz clock from 1.7 to 5.5 V

Table 8. M24M01 details

Feature	Description
Sales type	M24M01-DFMN6TP
Package	SO8
Single supply voltage and high speed	1 MHz clock from 1.7 to 5.5 V

### 4.2 M95XX

Table 9. M95040 details

Feature	Description
Sales type	M95040-RMC6TG
Package	UFDFPN8
Single supply voltage	1.7 to 5.5 V

Table 10. M95256 details

Feature	Description
Sales type	M95256-DFDW6TP
Package	TSSOP8
Single supply voltage	1.7 to 5.5 V

Table 11. M95M04 details

Feature	Description
Sales type	M95M04-DRMN6TP
Package	SO8
Single supply voltage	1.8 to 5.5 V

## 5 External EEPROMs

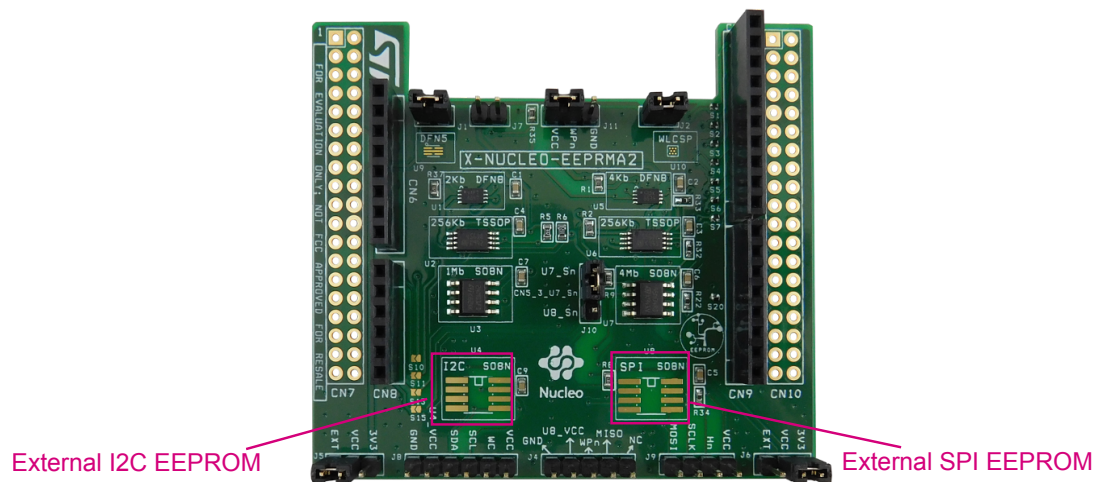
You can easily solder a specific EEPROM density I<sup>2</sup>C or SPI to be used with the [X-NUCLEO-EEPROMA2](#) expansion board. The software can handle any density between 2 Kbit and 4 Mbits.

To use the external EEPROM, you have to apply some changes to the firmware and the hardware, as described below.

- Step 1.** Uncomment the macro M24XX (to use the I<sup>2</sup>C EEPROM) or M95XX (to use the SPI EEPROM) in the "eeprom\_expansion.h" file
- Step 2.** Comment the macro I<sup>2</sup>C (to use the external I<sup>2</sup>C EEPROM) or the macro SPI (to use the external SPI EEPROM).
- Step 3.** Open J5 and J6 3V3 and VCC pins and short the EXT and VCC pins

*Note:* External VCC can be used to power EEPROM with a different VCC for specific evaluations.

**Figure 6.** I<sup>2</sup>C and SPI EEPROM soldered on the X-NUCLEO-EEPROMA2 expansion board



## 6 Bill of materials

**Table 12. X-NUCLEO-EEPRMA2 bill of materials**

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
1	1	U1	2 KBIT 400 KHZ UFDFPN8	2-Kbit serial I <sup>2</sup> C bus EEPROM	ST	M24C02-FMC6TG
2	1	U2	256 KBIT 1 MHZ TSSOP8	256-Kbit serial I <sup>2</sup> C bus EEPROM	ST	M24256-DFDW6TP
3	1	U3	1 MBIT 1 MHZ SO8	1-Mbit serial I <sup>2</sup> C bus EEPROM	ST	M24M01-DFMN6TP
4	1	U5	4 KBIT 5 MHZ UFDFPN8	4-Kbit SPI bus EEPROM with high- speed clock	ST	M95040-RMC6TG
5	1	U6	256 KBIT 20 MHZ TSSOP8	256-Kbit serial SPI bus EEPROM with high speed clock	ST	M95256-DFDW6TP
6	1	U7	4 MBIT 10 MHZ SO8	4-Mbit serial SPI bus EEPROM	ST	M95M04-DRMN6TP
7	2	U4, U8	SO8	Not mounted	Any	
8	1	U9	UFDFPN5	Not mounted	Any	
9	1	U10	WLCSP	Not mounted	Any	
8	1	CN5	10 pin female-male strip, 2.54 mm pitch	Header	Samtec	ESQ-110-24-T-S
9	2	CN6, CN9	8 pin female-male strip, 2.54 mm pitch	Header	Samtec	ESQ-108-24-T-S
10	2	CN7, CN10	19x2 through hole, 2.54 mm pitch	Header	Samtec	ESQ-119-24-T-S
11	1	CN8	6 pin female-male strip, 2.54 mm pitch	Header	Samtec	ESQ-108-24-T-S
12	8	C1, C2, C3, C4, C5, C6, C7, C9	100 nF 25 V ±10% X7R SMD0603	Ceramic capacitor	Murata	GRM188R71E104KA01D
13	2	J1, J2	2 pin male strip	Jumpers	Any	
14	1	J4	5 pin male strip	Jumpers	Any	
15	4	J5, J6, J10, J11	3 pin male strip	Jumpers	Any	
16	1	J7	open - 2 pin male strip	Jumpers	Any	
17	1	J9	4 pin male strip	Jumpers	Any	
18	1	J8	6 pin male strip	Jumpers	Any	
19	5	R1, R2, R8, R9, R35	10 K ±5% 1/10 W SMD0603	Resistors	Panasonic	ERJ-3GEYJ103V
20	2	R5, R6	3.3 K ±5% 1/10 W SMD0603	Resistors	Yageo	RC0603JR-073K3L
21	1	R37	1 kohm ±5% 1/10 W SMD0603	Resistors	Panasonic	ERJ-3GEYJ102V

Item	Q.ty	Ref.	Part / Value	Description	Manufacturer	Order code
22	4	R22, R32, R33, R34	10 K $\pm$ 5% 1/10 W SMD0402	Resistors	Panasonic	ERJ-2GEJ103X
23	8	S1, S2, S3, S4, S5, S6, S7, S20	CLOSE	Solder bridge	Any	
24	2	S11, S15	OPEN	Solder bridge	Any	
25	2	S10, S13	OPEN	Solder bridge	Any	

# 7 Schematic diagrams

Figure 7. X-NUCLEO-EEPRMA2 circuit schematic (1 of 4)

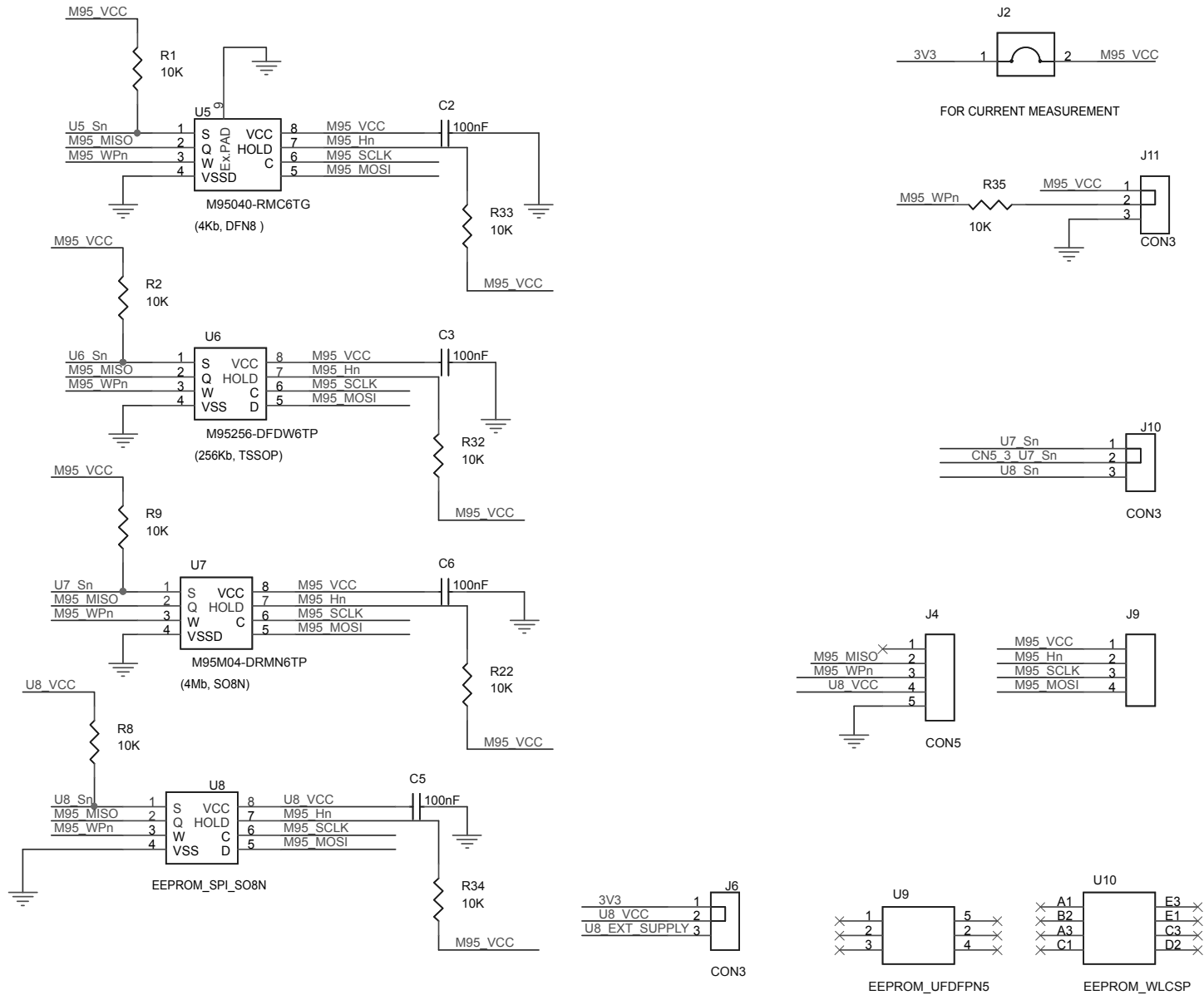




Figure 8. X-NUCLEO-EEPRMA2 circuit schematic (2 of 4)

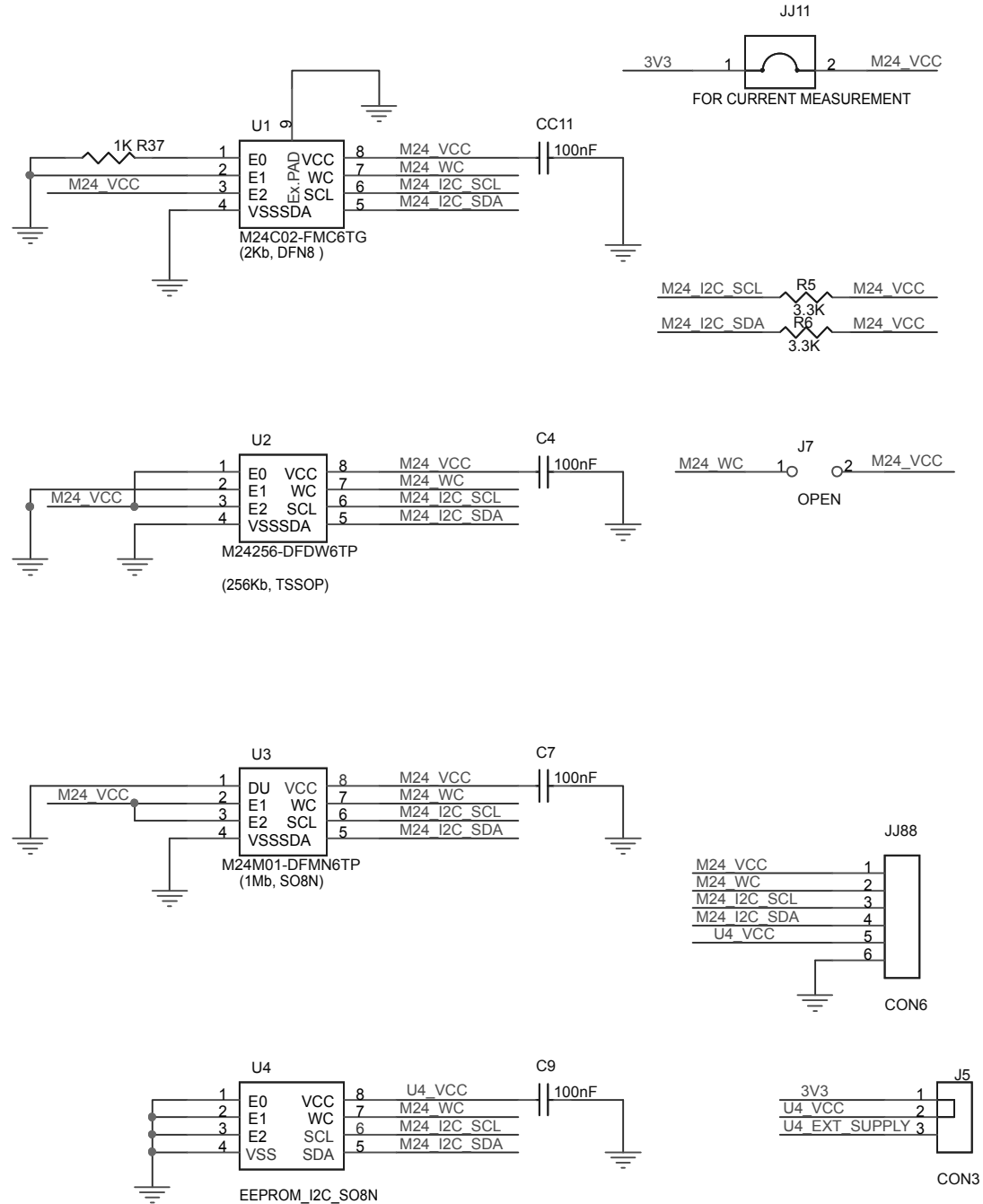


Figure 9. X-NUCLEO-EEPRMA2 circuit schematic (3 of 4)

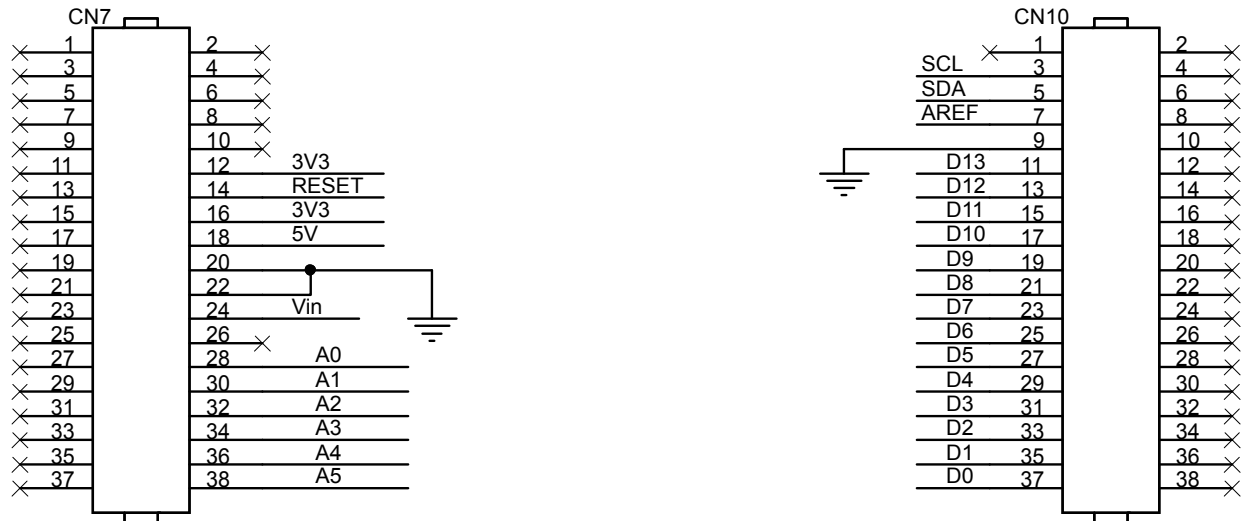
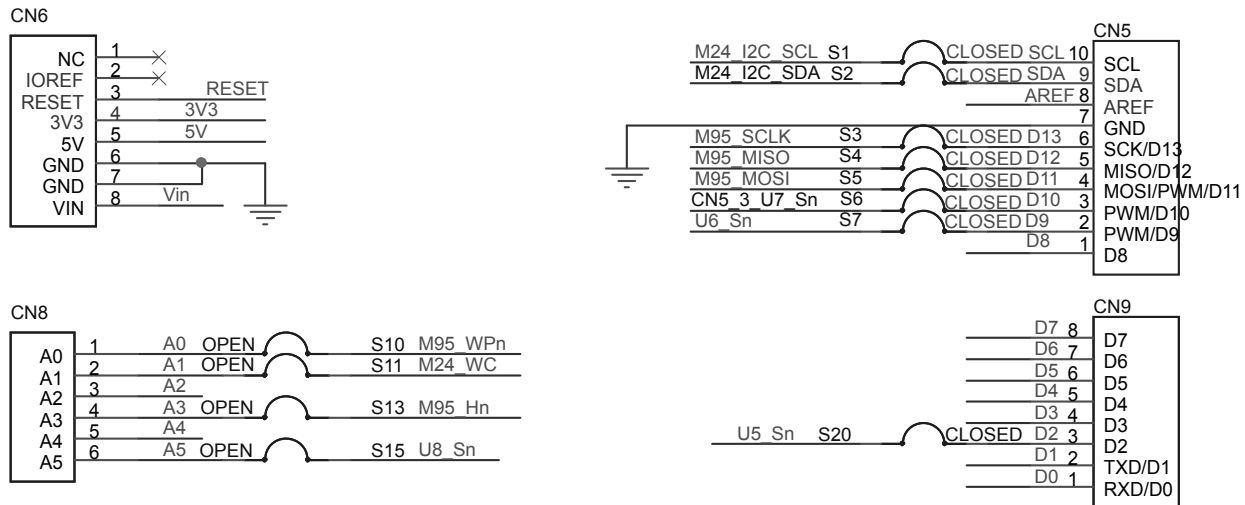


Figure 10. X-NUCLEO-EEPRMA2 circuit schematic (4 of 4)



## Revision history

**Table 13. Document revision history**

Date	Revision	Changes
03-Dec-2019	1	Initial release.
27-Feb-2020	2	Updated Figure 1. X-NUCLEO-EEPRMA2 expansion board and Figure 2. X-NUCLEO-EEPRMA2 expansion board connected to an STM32 Nucleo development board.
28-Aug-2020	3	Updated <a href="#">Section 2.1 Overview</a> .

## Contents

<b>1</b>	<b>Acronyms and abbreviations</b>	<b>2</b>
<b>2</b>	<b>Getting started</b>	<b>3</b>
2.1	Overview	3
2.2	Typical applications	3
2.3	Hardware requirements	4
2.4	System requirements	4
2.5	Board setup	4
<b>3</b>	<b>Hardware description and configuration</b>	<b>6</b>
3.1	Interconnection details	6
3.2	Current measurement	8
3.3	X-NUCLEO-EEPRMA2 component placement details	9
<b>4</b>	<b>Component description</b>	<b>11</b>
4.1	M24XX	11
4.2	M95XX	11
<b>5</b>	<b>External EEPROMs</b>	<b>13</b>
<b>6</b>	<b>Bill of materials</b>	<b>14</b>
<b>7</b>	<b>Schematic diagrams</b>	<b>16</b>
	<b>Revision history</b>	<b>19</b>

## List of tables

<b>Table 1.</b>	List of acronyms . . . . .	2
<b>Table 2.</b>	X-NUCLEO-EEPRMA2 and NUCLEO-L053R8 connection details (left connector) . . . . .	6
<b>Table 3.</b>	X-NUCLEO-EEPRMA2 and NUCLEO-L053R8 connection details (right connector) . . . . .	7
<b>Table 4.</b>	X-NUCLEO-EEPRMA2 and NUCLEO-F401RE connection details (left connector) . . . . .	7
<b>Table 5.</b>	X-NUCLEO-EEPRMA2 and NUCLEO-F401RE connection details (right connector) . . . . .	8
<b>Table 6.</b>	M24C02 details . . . . .	11
<b>Table 7.</b>	M24256 details . . . . .	11
<b>Table 8.</b>	M24M01 details . . . . .	11
<b>Table 9.</b>	M95040 details . . . . .	11
<b>Table 10.</b>	M95256 details . . . . .	11
<b>Table 11.</b>	M95M04 details . . . . .	12
<b>Table 12.</b>	X-NUCLEO-EEPRMA2 bill of materials . . . . .	14
<b>Table 13.</b>	Document revision history . . . . .	19

## List of figures

<b>Figure 1.</b>	X-NUCLEO-EEPRMA2 expansion board . . . . .	1
<b>Figure 2.</b>	X-NUCLEO-EEPRMA2 expansion board connected to an STM32 Nucleo development board . . . . .	4
<b>Figure 3.</b>	X-NUCLEO-EEPRMA2 component placement details . . . . .	9
<b>Figure 4.</b>	X-NUCLEO-EEPRMA2 top view layout . . . . .	9
<b>Figure 5.</b>	X-NUCLEO-EEPRMA2 bottom view layout. . . . .	10
<b>Figure 6.</b>	I2C and SPI EEPROM soldered on the X-NUCLEO-EEPRMA2 expansion board . . . . .	13
<b>Figure 7.</b>	X-NUCLEO-EEPRMA2 circuit schematic (1 of 4). . . . .	16
<b>Figure 8.</b>	X-NUCLEO-EEPRMA2 circuit schematic (2 of 4). . . . .	17
<b>Figure 9.</b>	X-NUCLEO-EEPRMA2 circuit schematic (3 of 4). . . . .	18
<b>Figure 10.</b>	X-NUCLEO-EEPRMA2 circuit schematic (4 of 4). . . . .	18

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