UM2358
User manual

Getting started with ST25R3916-DISCO

Introduction

ST25R3916-DISCO is a ready-to-use development kit to evaluate the features and functionality in reader/writer, peer-to-peer and card emulation modes of the high-performance NFC universal device ST25R3916 for contactless applications.

The kit is composed of two boards:

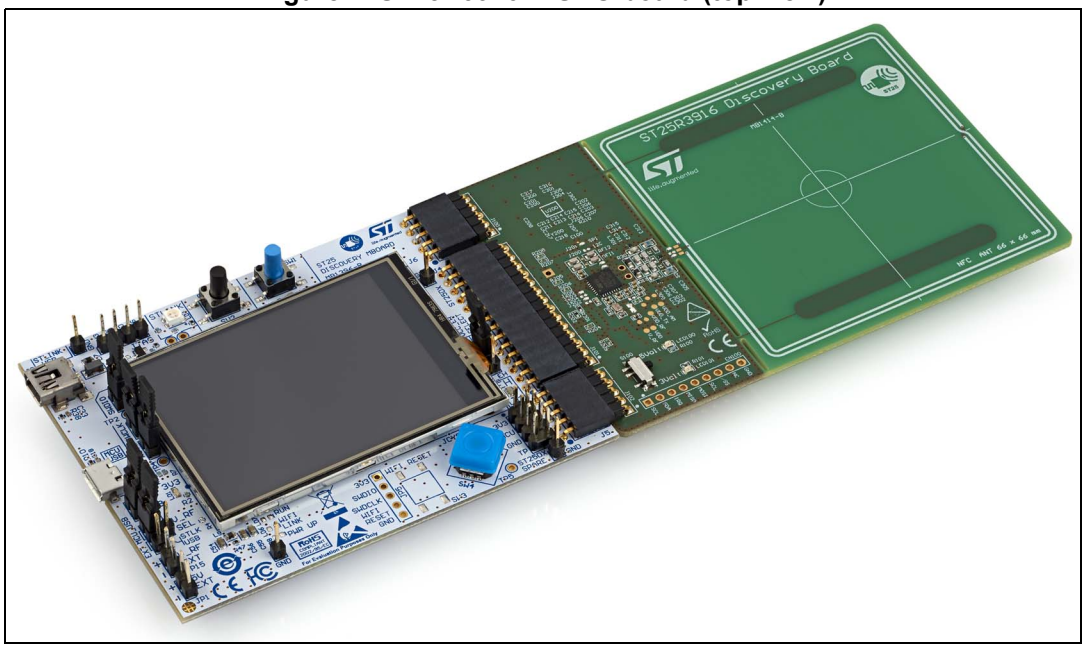
- MB1396 (ST25_Discovery_Mboard): a microprocessor motherboard, which includes a complement of hardware and software tools enabling the use the full STM32 Nucleo ecosystem. The board is powered through USB connectors.
- MB1414 (ST25R3916_Discovery_DB): a daughter board, which embeds the ST25R3916 device and an antenna etched on the PCB with its tuning circuit.

The communication link between the two boards is the SPI bus and the processor card provides the power. Specific data lines complete the pin connector assignment shared between cards.

A variety of demonstrations can be performed with this kit, which allows the users to develop and test their applications.

The MB1396 and the MB1414 boards schematics, BOM, Gerber files, drivers and firmware are available on the STMicroelectronics website *www.st.com*.

Figure 1. ST25R3916-DISCO board (top view)



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1 Features

- ISO 18092 (NFCIP-1) active and passive initiator and target modes
- NFC Forum NFC-A, NFC-B, NFC-F and NFC-V reader
- ISO 14443A, ISO 14443B and ISO15693 reader
- FeliCa™ reader
- Support of all five NFC Forum Tag types in reader mode
- NFC Forum Type 3 tag (NFC-F) host card emulation
- NFC Forum Type 4A tag (NFC-A) host card emulation
- Stream modes to implement other standard and custom protocols
- Integrated capacitive sensing system for low power detection of tag presence
- Integrated inductive sensing system for low power detection of tag presence using phase or amplitude measurement
- High output power
- User selectable and automatic gain control
- Serial peripheral interface (SPI) up to 10 Mb/s
- I2C with up to 400 kbit/s in Fast-mode, 1 Mb/s in Fast-mode Plus
- Automatic antenna tuning (AAT) via variable capacitor

2 Description

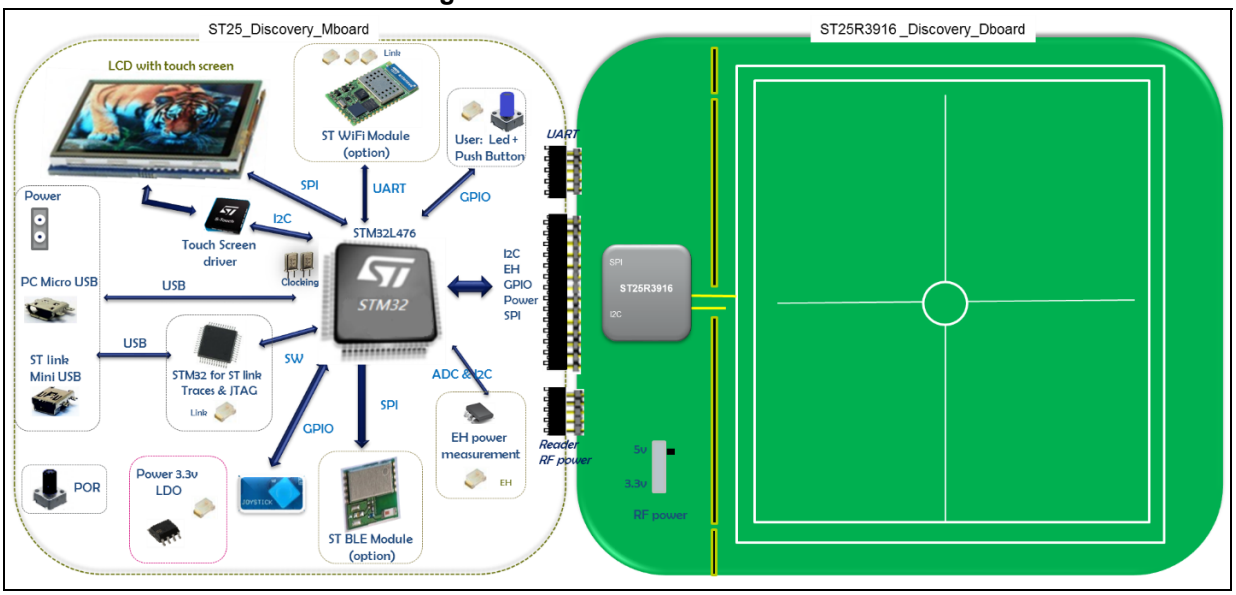
The ST25R3916-DISCO kit allows the user to evaluate the features and capabilities of the ST25R devices, a series of high performance HF readers.

The kit comes with application notes, software applications, drivers, BOM (bill of materials), board schematics, Gerber files and firmware schematics. All these documents can be downloaded from *www.st.com*, they help the user to reduce the design efforts.

The kit is composed of two boards:

1. The MB1396 (ST25_Discovery_Mboard) is a microprocessor motherboard embedding a 32-bit microcontroller of the STM32L476 line, based on Arm®(a) Cortex®-M4 high-performance CPU with FPU.
   The MB1396 is powered through the USB bus. It includes:
   - an ST-LINK in-circuit debugger and programmer for STM32 microcontrollers
   - a 2.4” TFT LCD with touch screen capability
   - LEDs
   - push buttons (reset and user)
   - a mini USB debug connector
   - a user-dedicated micro USB connector.
   - features for ST NFC TAG
2. The MB1414 (ST25R3916_Discovery_DB) daughter board, which embeds the ST25R3916, an antenna etched on the PCB and its tuning circuit. A switch allows the user to select 3.3 V or 5 V RF powering.

Figure 2. Hardware connections



a. Arm is a registered trademark of Arm Limited (or its subsidiaries) in the US and/or elsewhere.

3 Quick start

3.1 Getting started in standalone mode

The motherboard and the daughter board must be connected together.

The jumper configuration when the kit is delivered is the default one.

The ST25R3916-DISCO kit is powered (like a PC) by the micro USB bus via a cable connected to the power source.

The unit must be supplied by a safety extra low voltage (SELV) limited power source through the USB port, the source must not exceed 60 V_{DC} / 8A / 100VA

When powered up, the microcontroller starts the firmware, which is already downloaded in the Flash memory.

This makes it possible to demonstrate the different capabilities of the ST25R3916.

- Reader and writer
- Card emulation
- Peer to peer
- Automatic antenna tuning
- USB mode (see *Section 3.2*)

There is no need for modifications or configurations to run the demonstration. Refer to the firmware's user manual available on STMicroelectronics website to get more details.

3.2 Getting started with USB mode

Connect the discovery kit to a PC using a micro USB cable. The USB port of the PC must be capable of delivering at least 250 mA at 5 Volt.

To control the board, download the software from the dedicated page on *www.st.com* and install it. Further information on how to operate the software and the GUI that can be used to control the control the board can be found in UM2511 "ST25R3916-DISCO kit user manual", available on *www.st.com*.

3.3 System requirements

- Micro USB cable
- USB port, capable of delivering at least 250 mA at 5 V (1.25 W)
- Unit must be supplied by a safety extra low voltage (SELV) limited power source through the USB port
- For embedded ST link and STM32 Nucleo ecosystem development usage a mini USB cable is required

4 MB1396 hardware

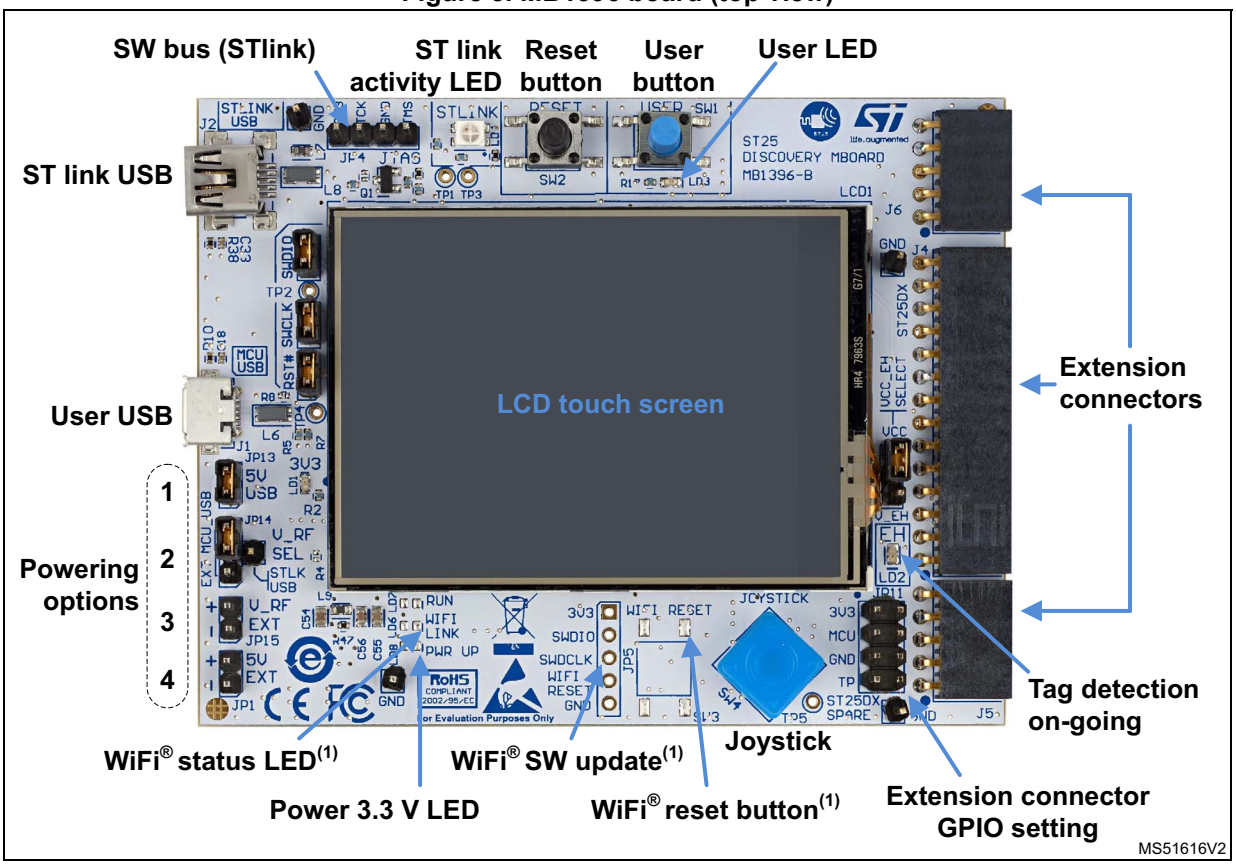
The PCB (printed circuit board) of the motherboard is usually connected via USB to the PC. The embedded firmware controls the STM32 MCU that operates the ST25R3916 via the extension connectors.

Both boards are powered by the 5 V supply of the USB bus. An LDO converts this voltage down to 3.3 V to supply the microcontroller and the ST25R3916. The extension board is provided with both 3.3 and 5 V supplies, it is possible to select one of them.

A green LED close to the motherboard micro USB plug indicates when the board is powered.

4.1 MB1396 board layout

Figure 3. MB1396 board (top view)



1. Available only on demonstration edition.

Figure 4. MB1396 board (bottom view)

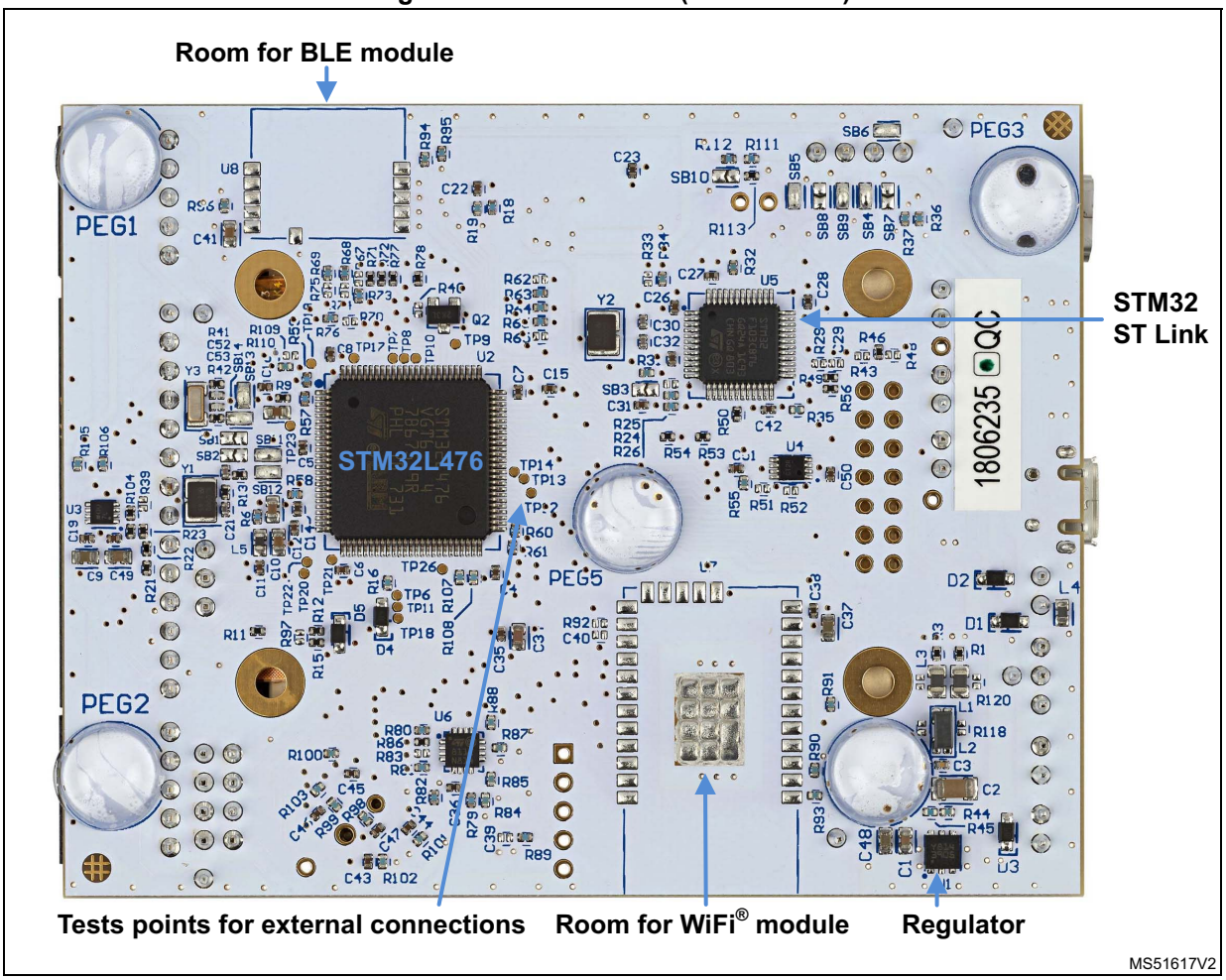


Table 1. Powering options

Reference	Connector	Position	Description
1	JP13	Closed 1-2	Card powered by USB
2	JP14	Closed 2-3	Card powered by micro USB
3	JP15	Open	ST25R3916 board powering, special feature
4	JP16	Open	Card powered by an external source

4.2 MB1396 jumper default configuration

This section details the MB1396 jumpers default configuration (recommended setting), set at kit delivery. With these parameters the USB micro connector provides the kit powering.

Figure 5. MB1396 default configuration

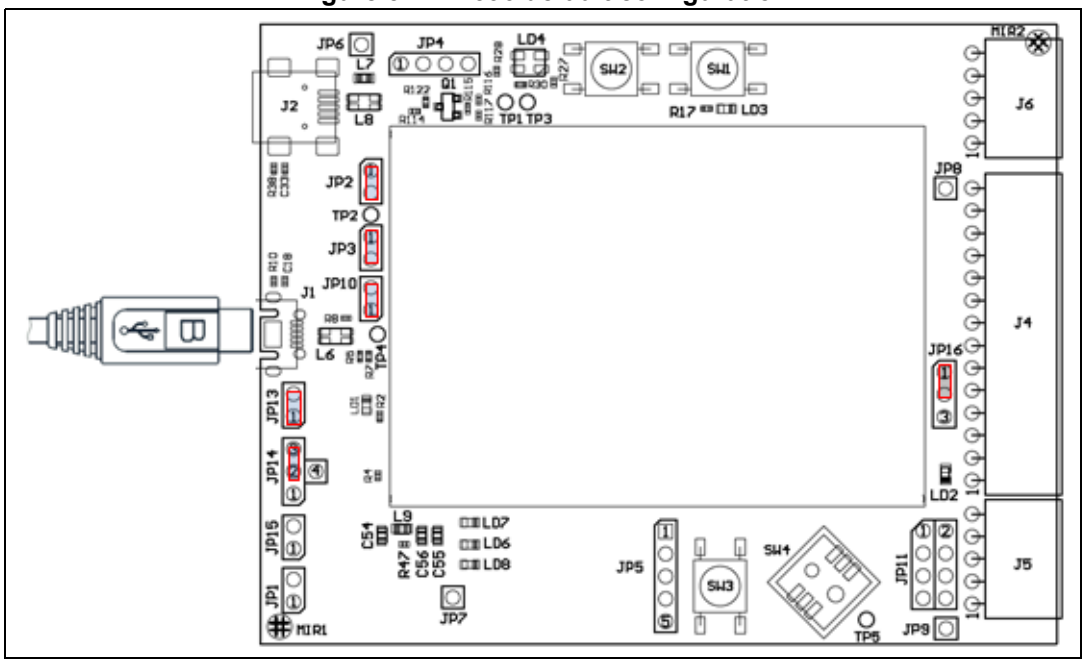


Table 2. Jumpers configuration

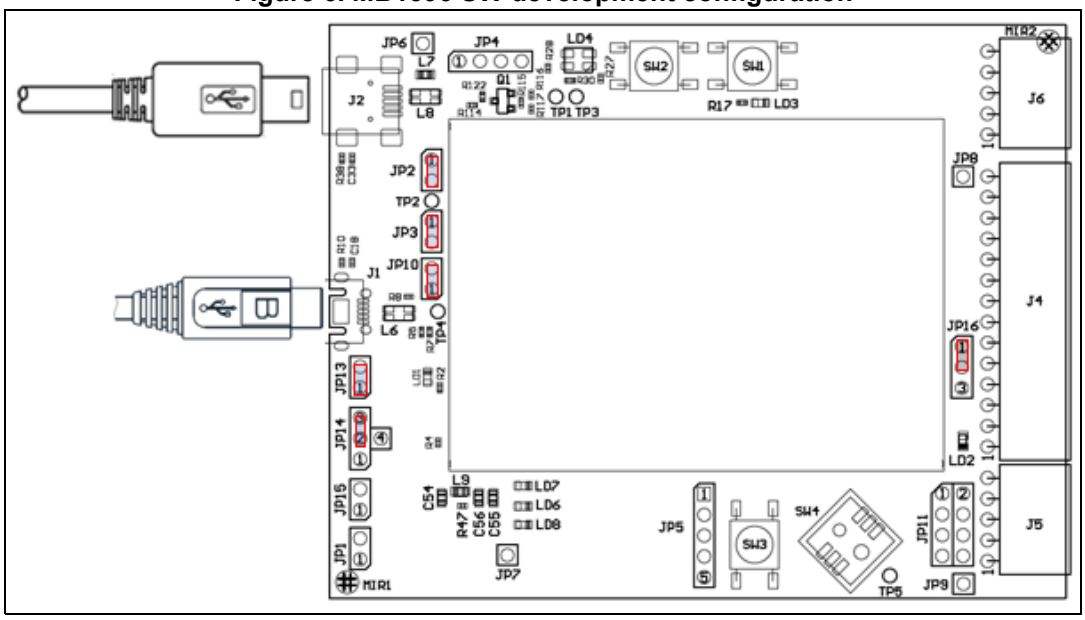
Connector	Position	Description
JP2	Closed 1-2	ST link UART debug features
JP3		
JP10		
JP13		Card powered by USB
JP14	Closed 2-3	Card Powered by micro USB
JP16	Closed 1-2	Board powering special feature

4.3 MB1396 software development configuration

This section describes the MB1396 software development configuration and the USB connection when the embedded ST link is used.

The J1 USB micro connector provides the ST23R3916 powering, the J2 USB mini provides the link for the data exchange between the board and the computer.

Figure 6. MB1396 SW development configuration



5 MB1414 hardware

5.1 ST25R3916

The ST25R3916 is directly connected to the filtered 5 V USB supply. There are additional supply filtering components placed close to the NFC/HF reader IC.

During layout all decoupling capacitors have been placed as close as possible to the ST25R3916 chip.

To demonstrate the capacitive wake-up feature, two capacitive sensing electrodes are placed on the PCB.

For SPI cross-connecting another reader PCB, serial resistors can be removed and CN100 used.

By default, the SPI is the firmware and hardware access bus. The I2C bus can be used instead by changing J200, J201, J202, J203, J204 and J205.

J206 makes it possible to bypass the internal V_{DD_RF} / V_{DD_AM} regulators when an output current higher than 350 mA needs to be supported.

5.2 Antenna and matching network components

This board contains the matching network and the automatic antenna tuning capacitors based on varicap.

5.3 Board layout

Figure 7. MB1414 board (top view)

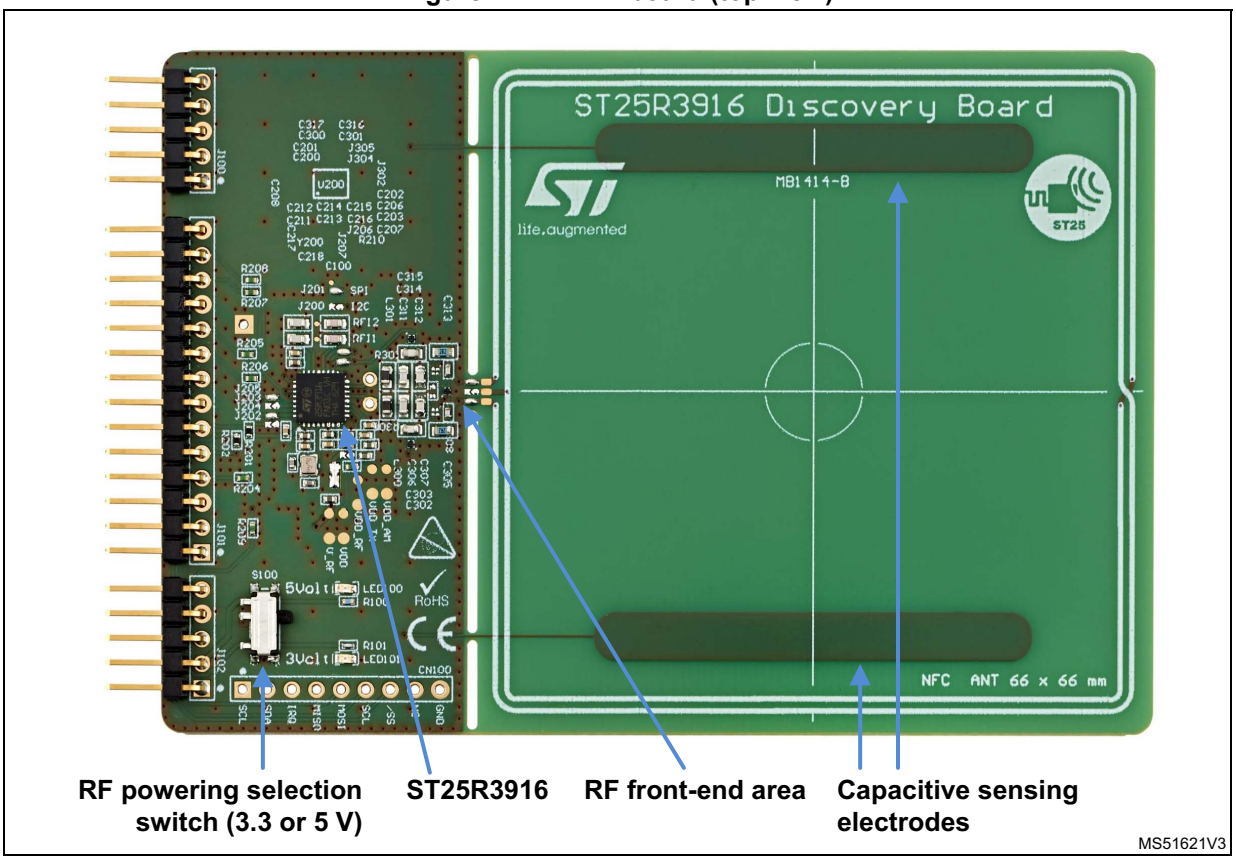
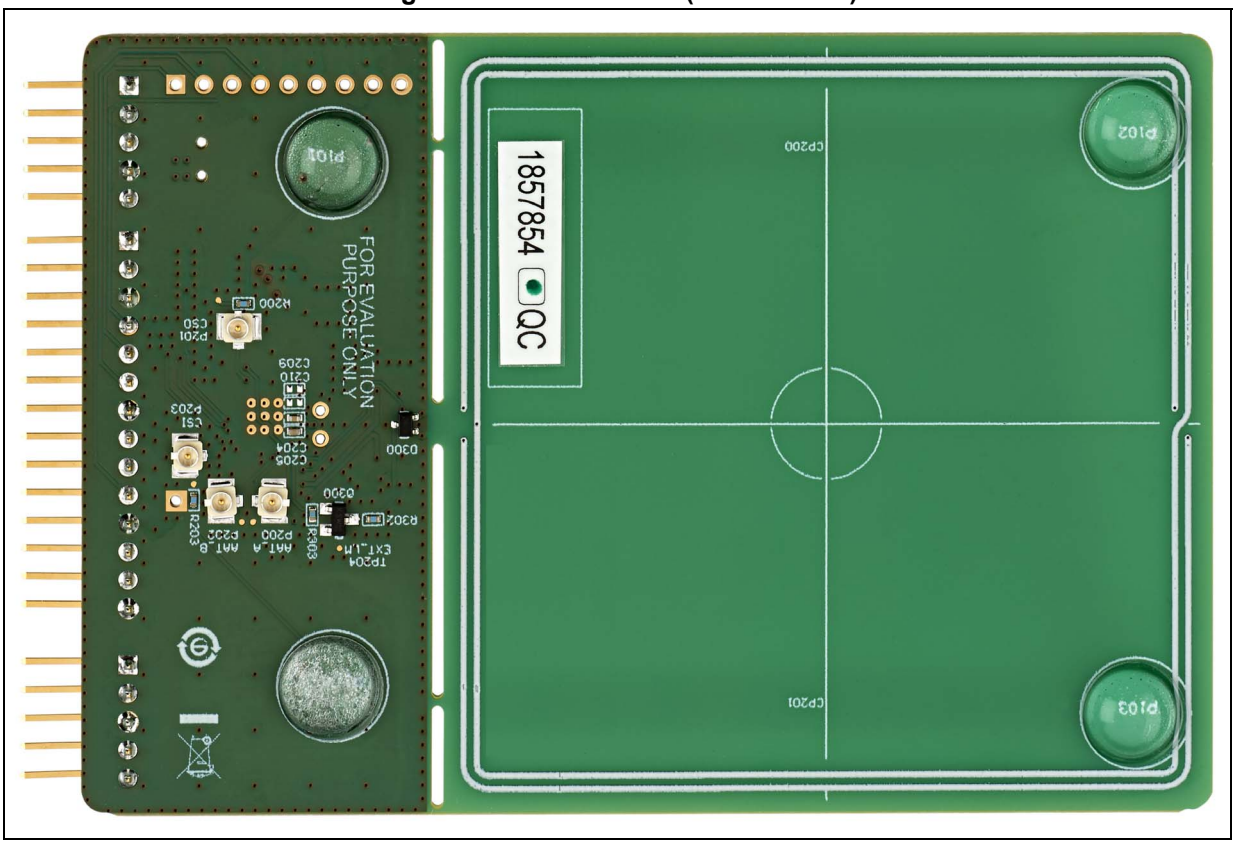


Figure 8. MB1414 board (bottom view)



6 Schematics

This section contains the schematics for the two boards:

- those for the MB1396 MCU motherboard (figures *9* to *18*) include the microcontroller needed to operate the NFC reader IC
- the MB1414 ST25R3916 daughter board (figures *19* to *21*) is connected to the ST25_Discovery_Mboard motherboard.

Figure 9. MB1396 - Overview

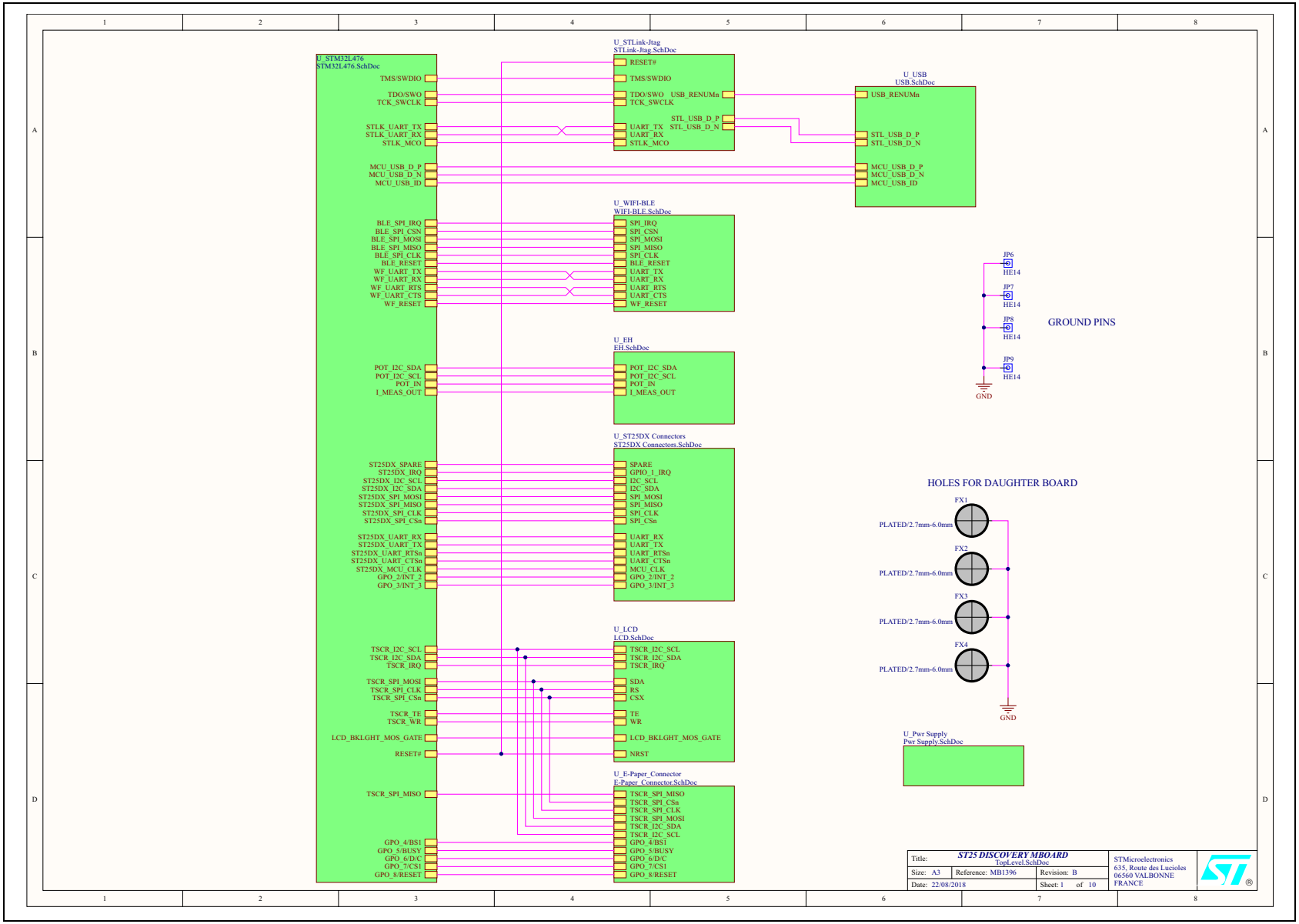


Figure 10. MB1396 - Power

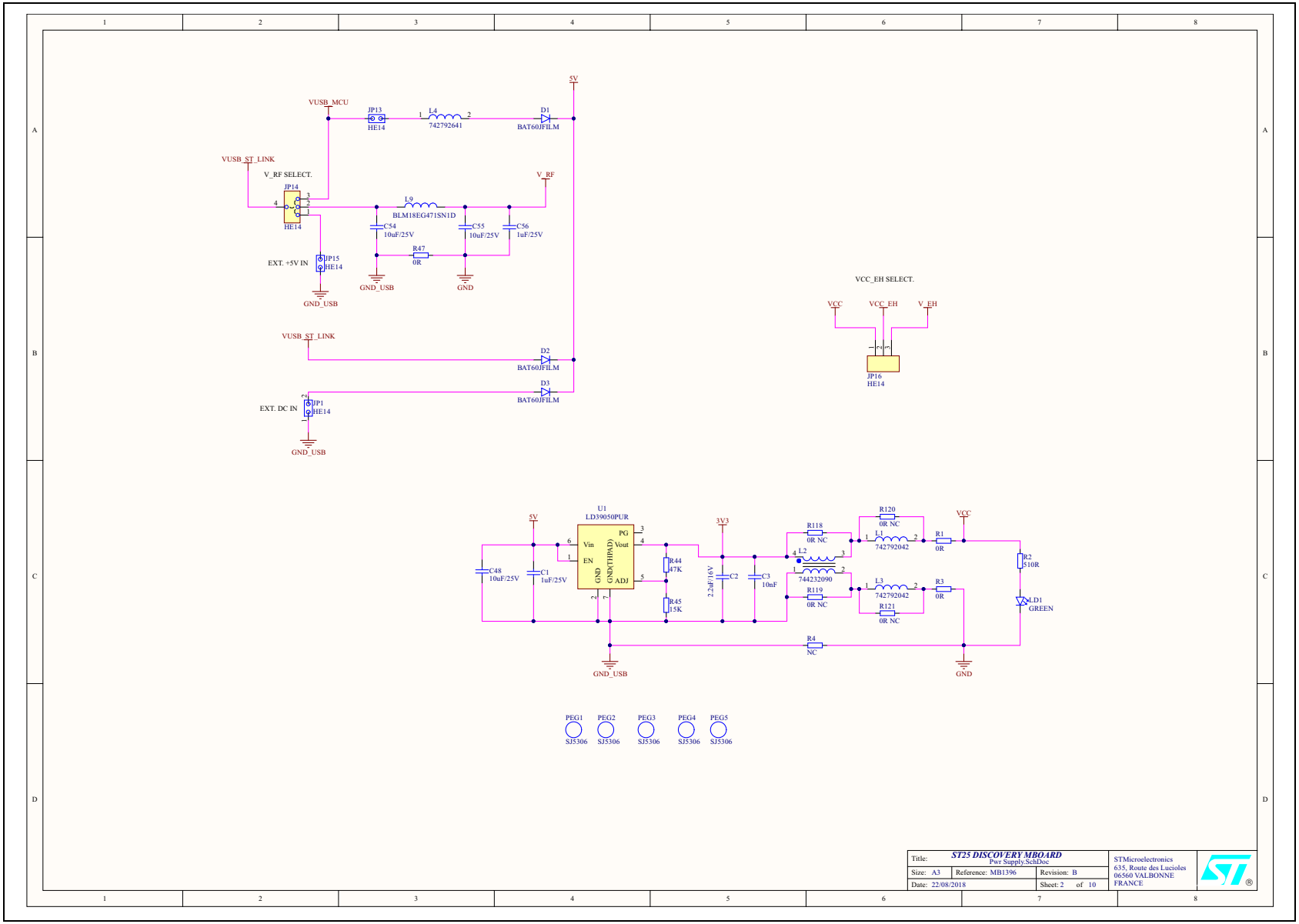
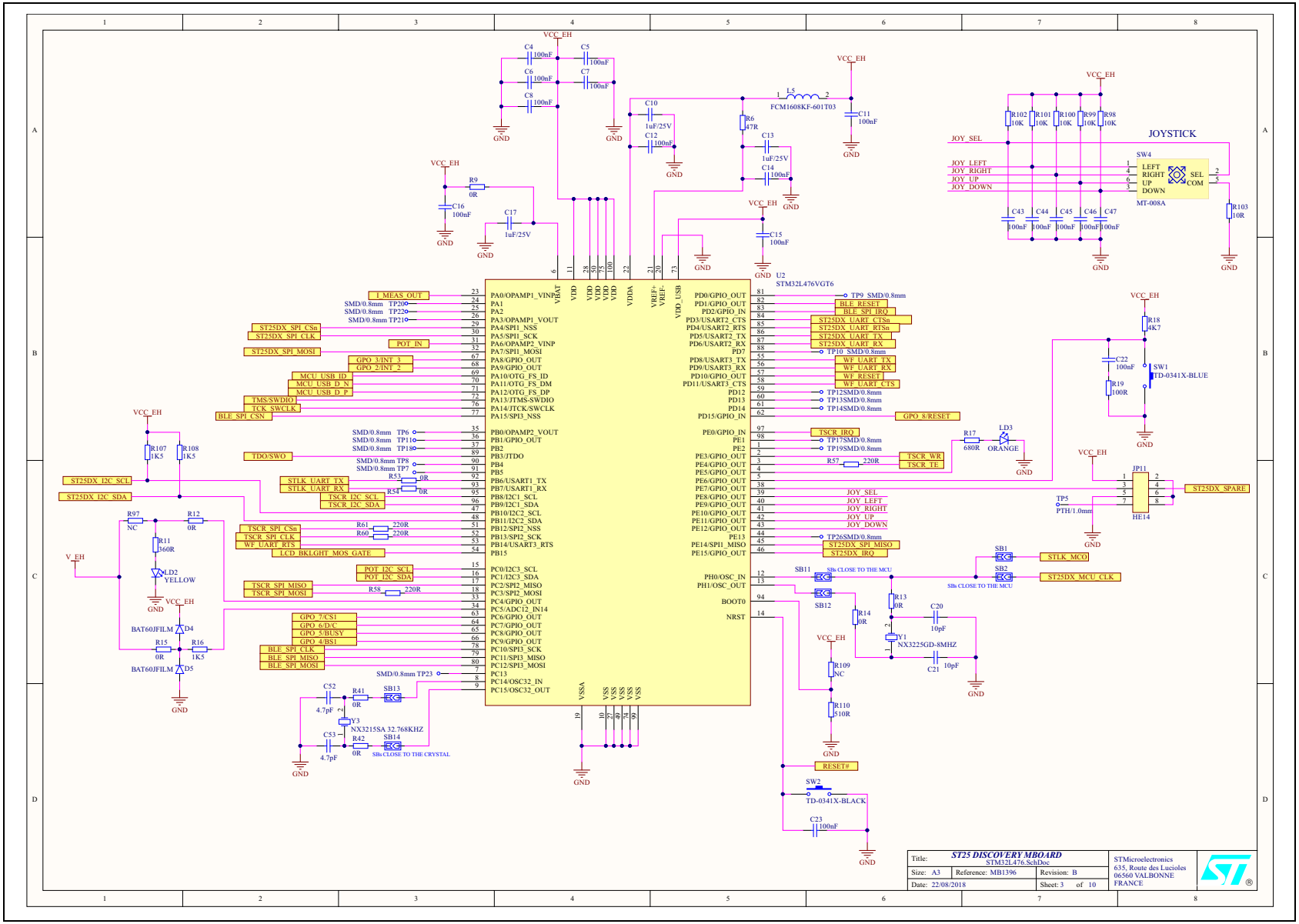


Figure 11. MB1396 - MCU



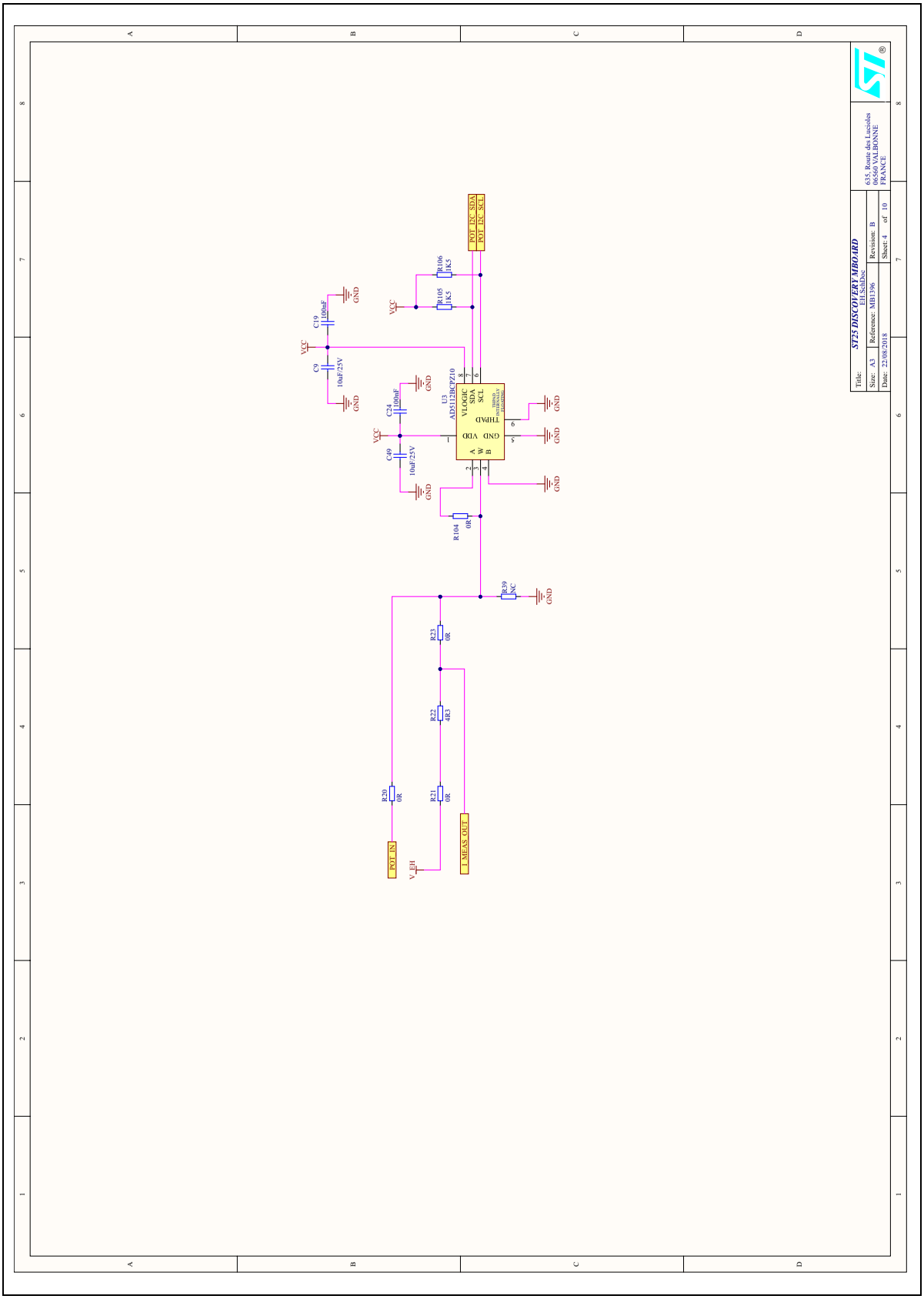


Figure 12. MB1396 - Energy harvesting measurement

Figure 13. MB1396 - ST Link - JTAG

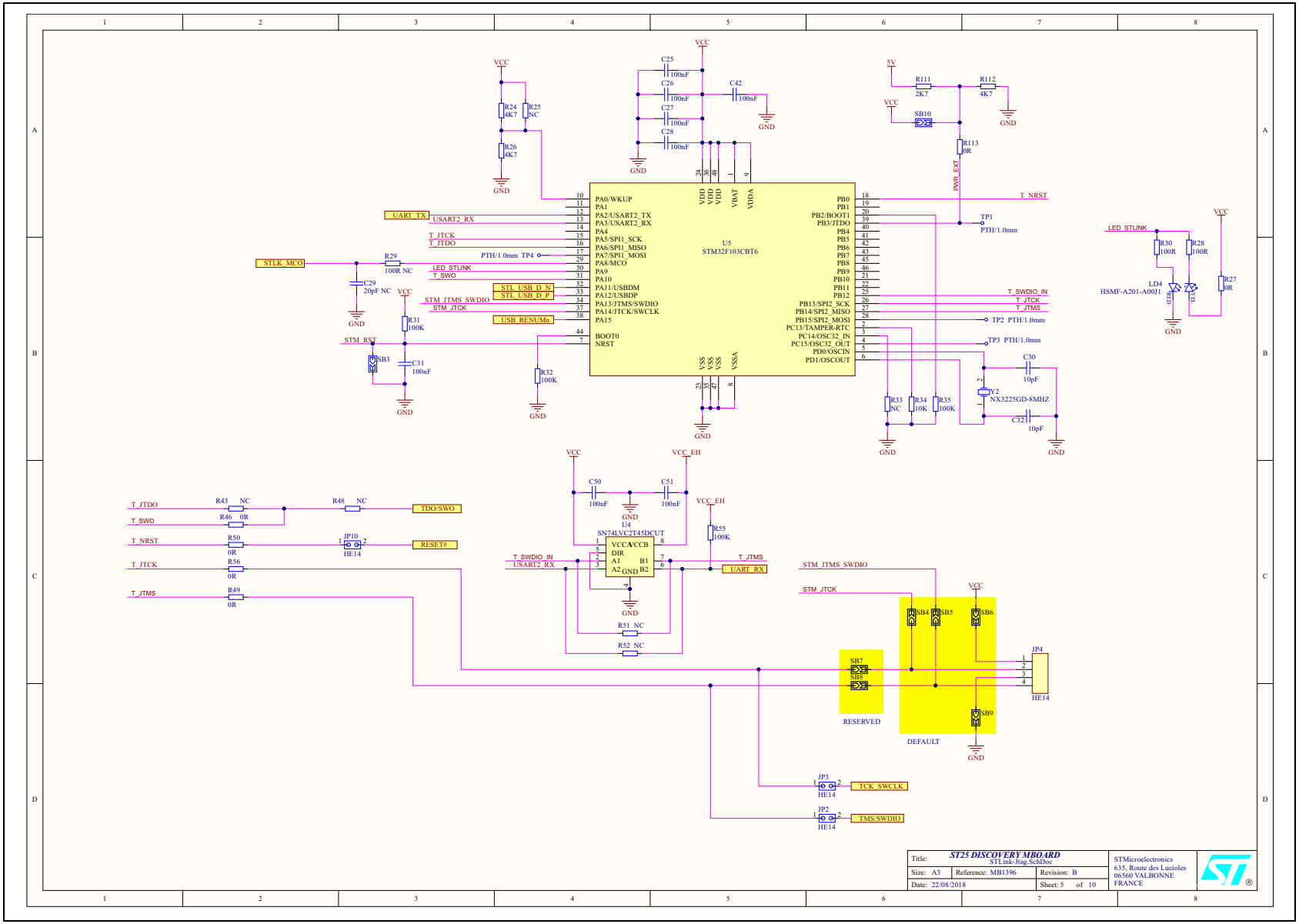


Figure 14. MB1396 - LCD

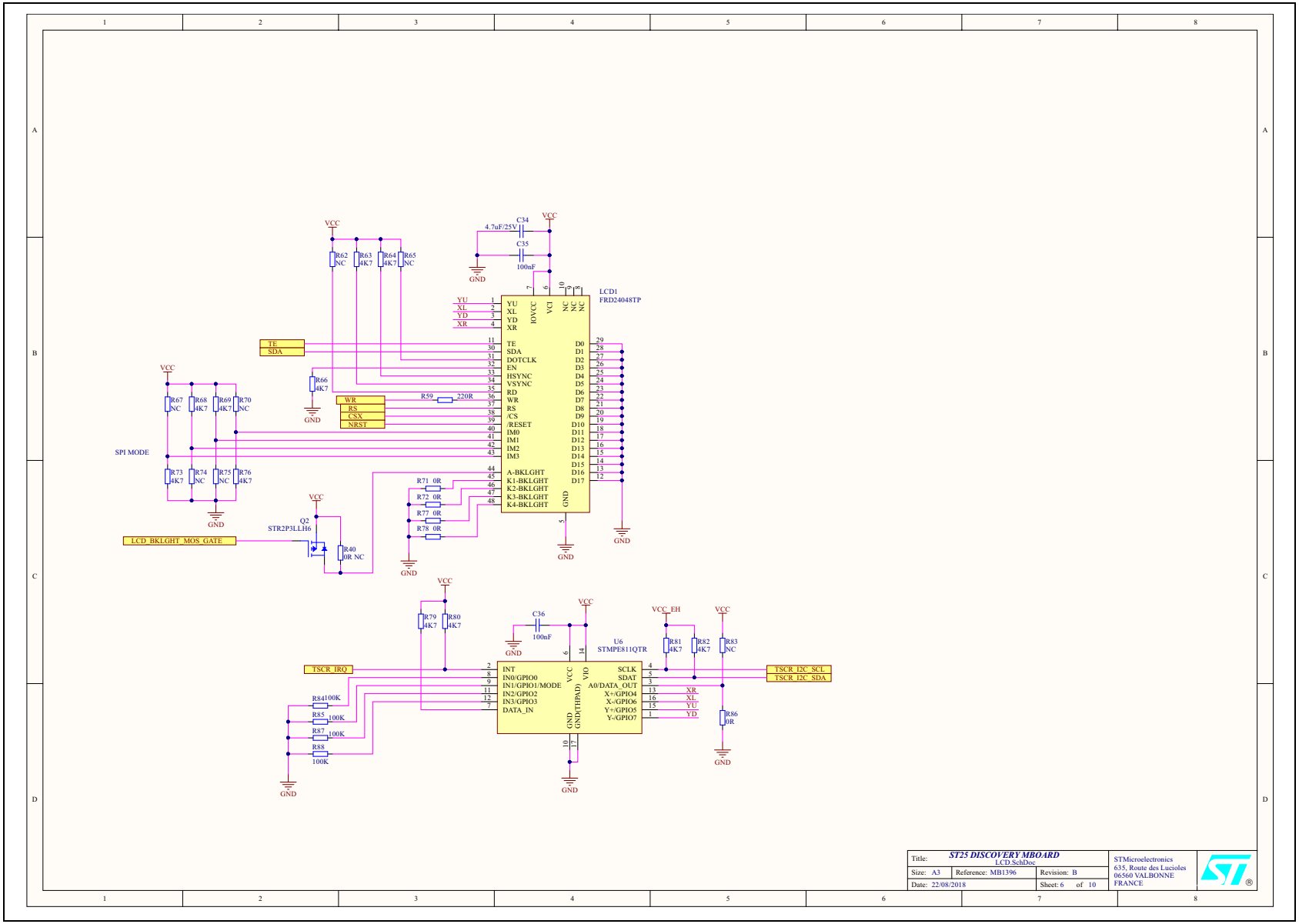


Figure 15. MB1396 - BLE and WiFi® modules

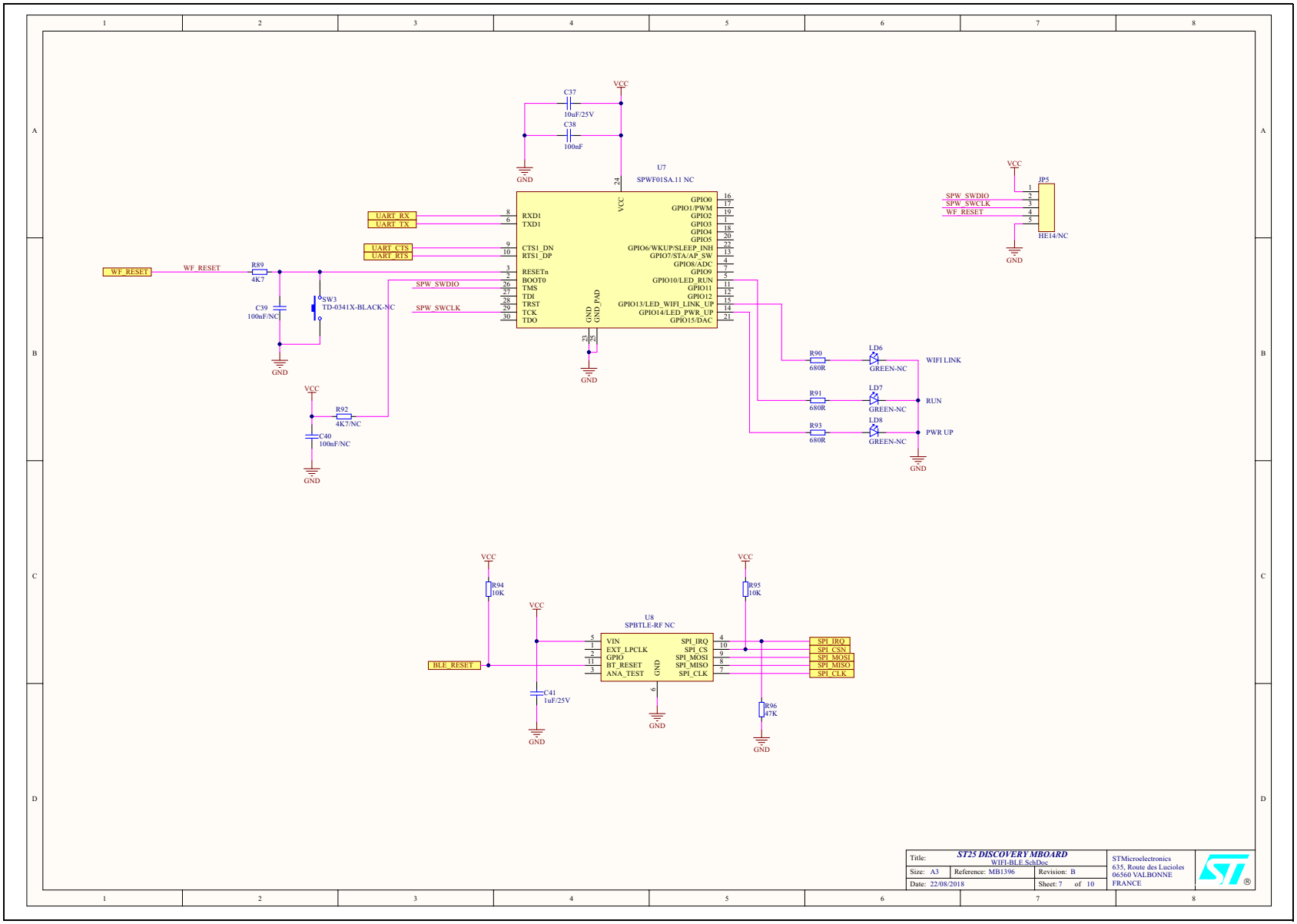


Figure 16. MB1396 - Connectors

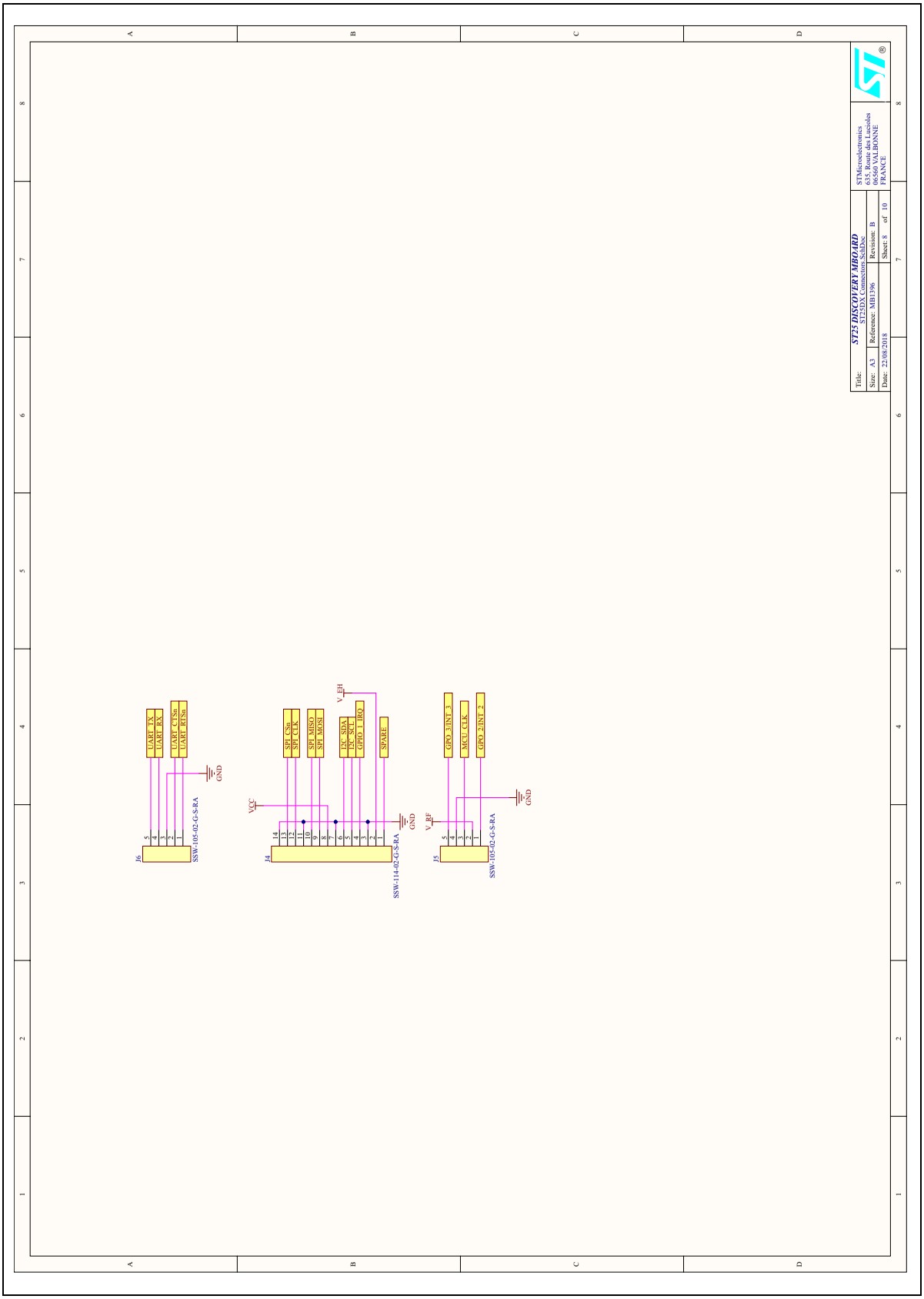
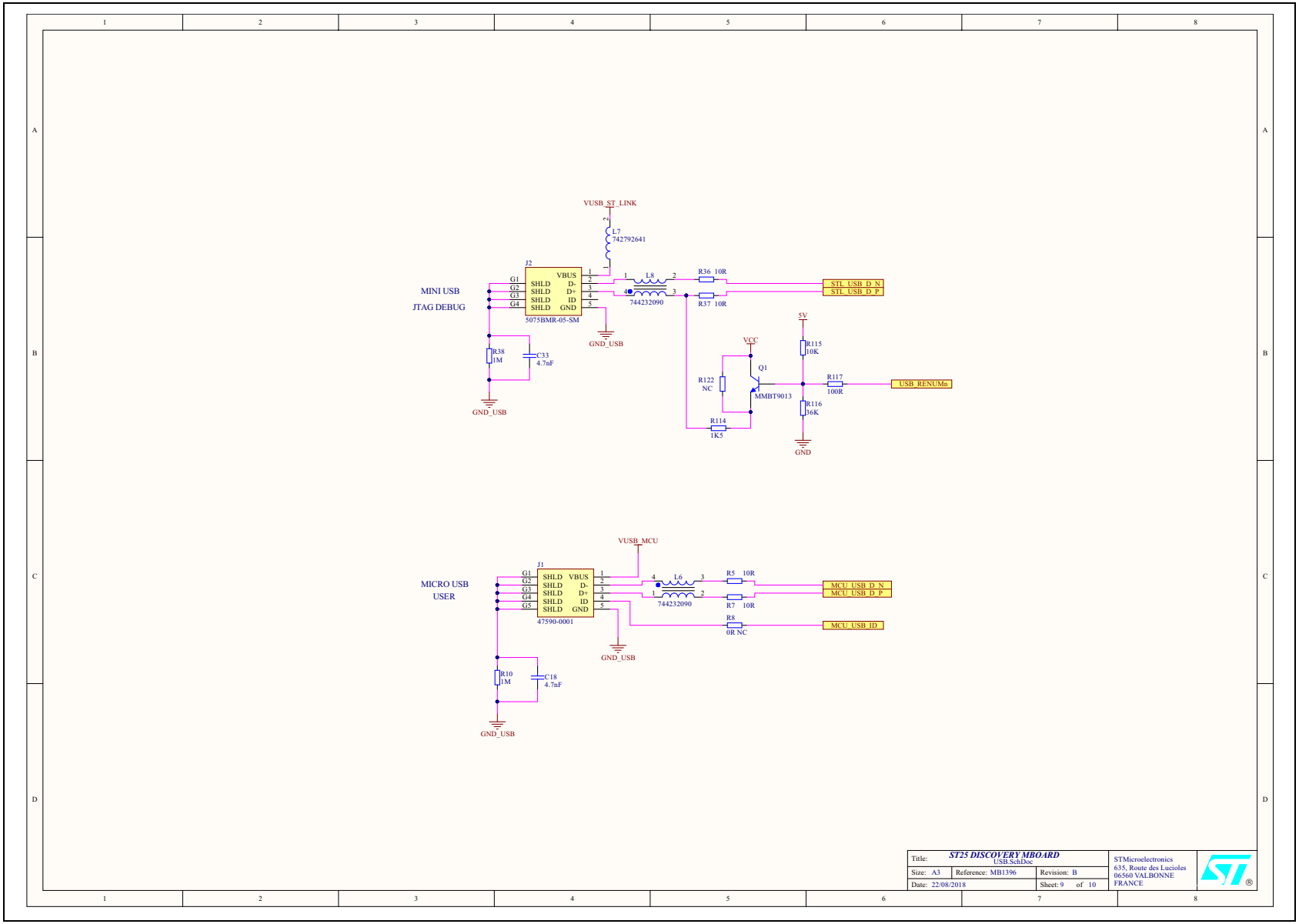


Figure 17. MB1396 - USB



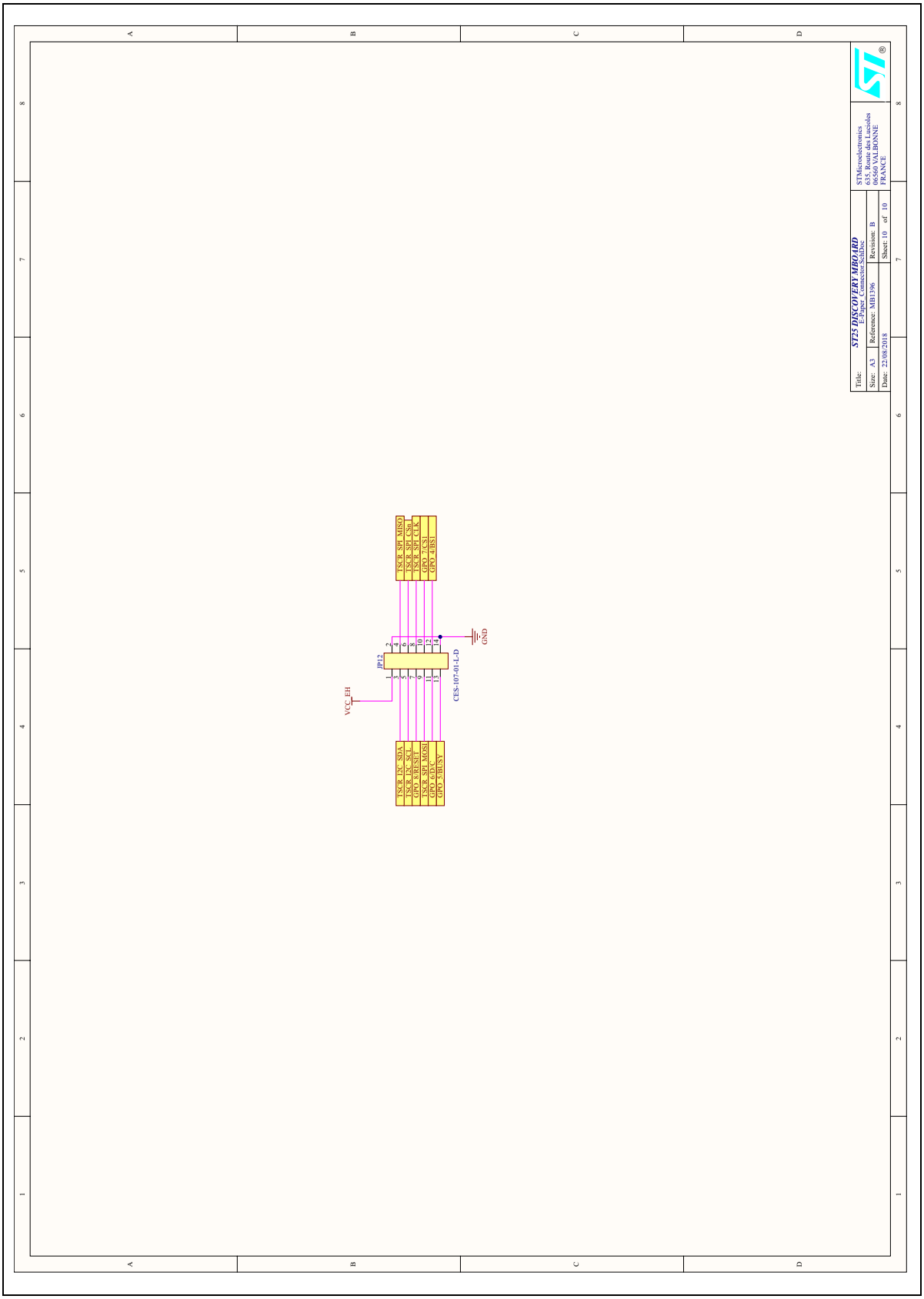


Figure 18. MB1396 - Epaper connector

Figure 19. MB1414 - Connectors

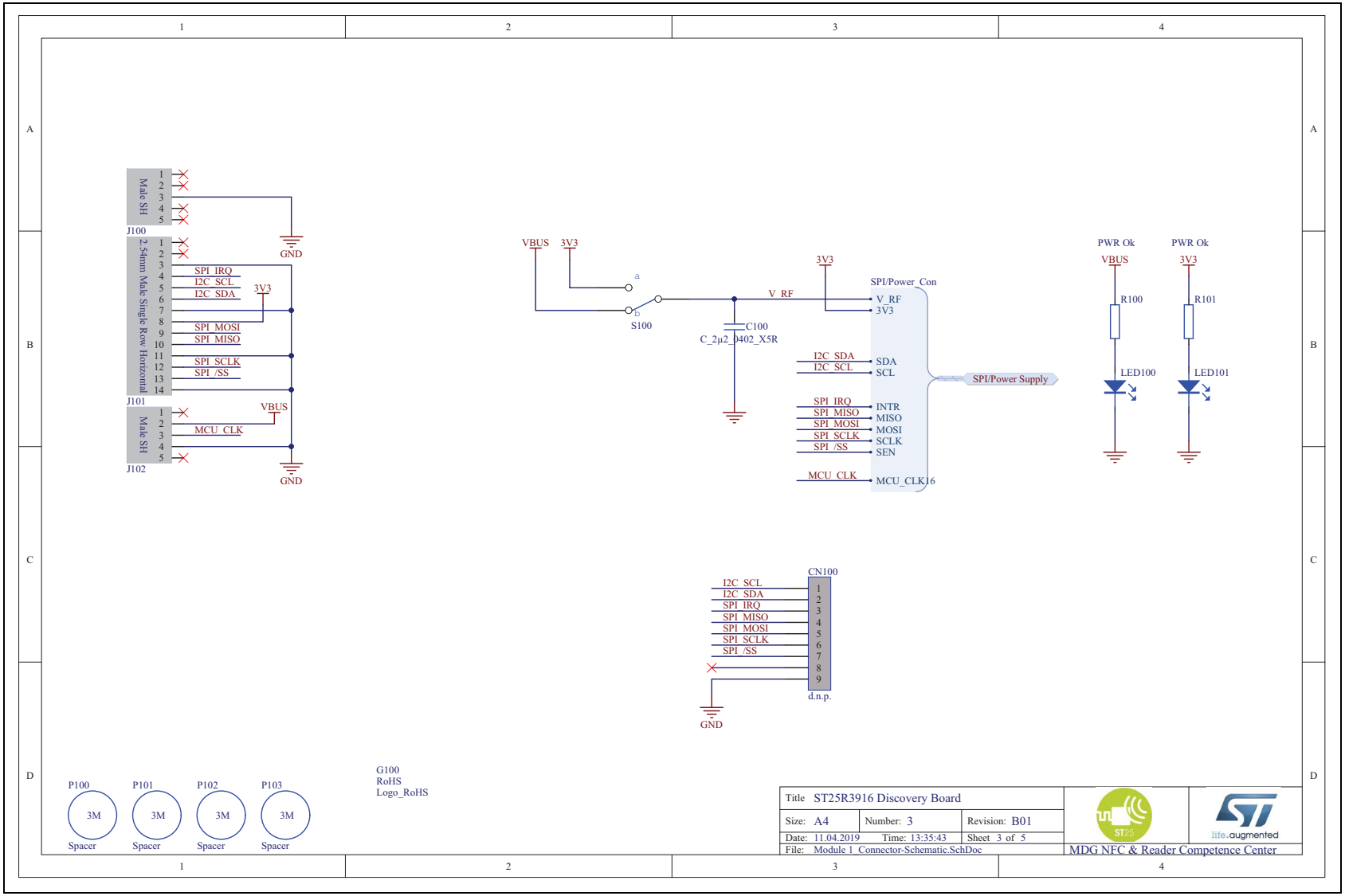


Figure 20. MB1414 - ST25R3916

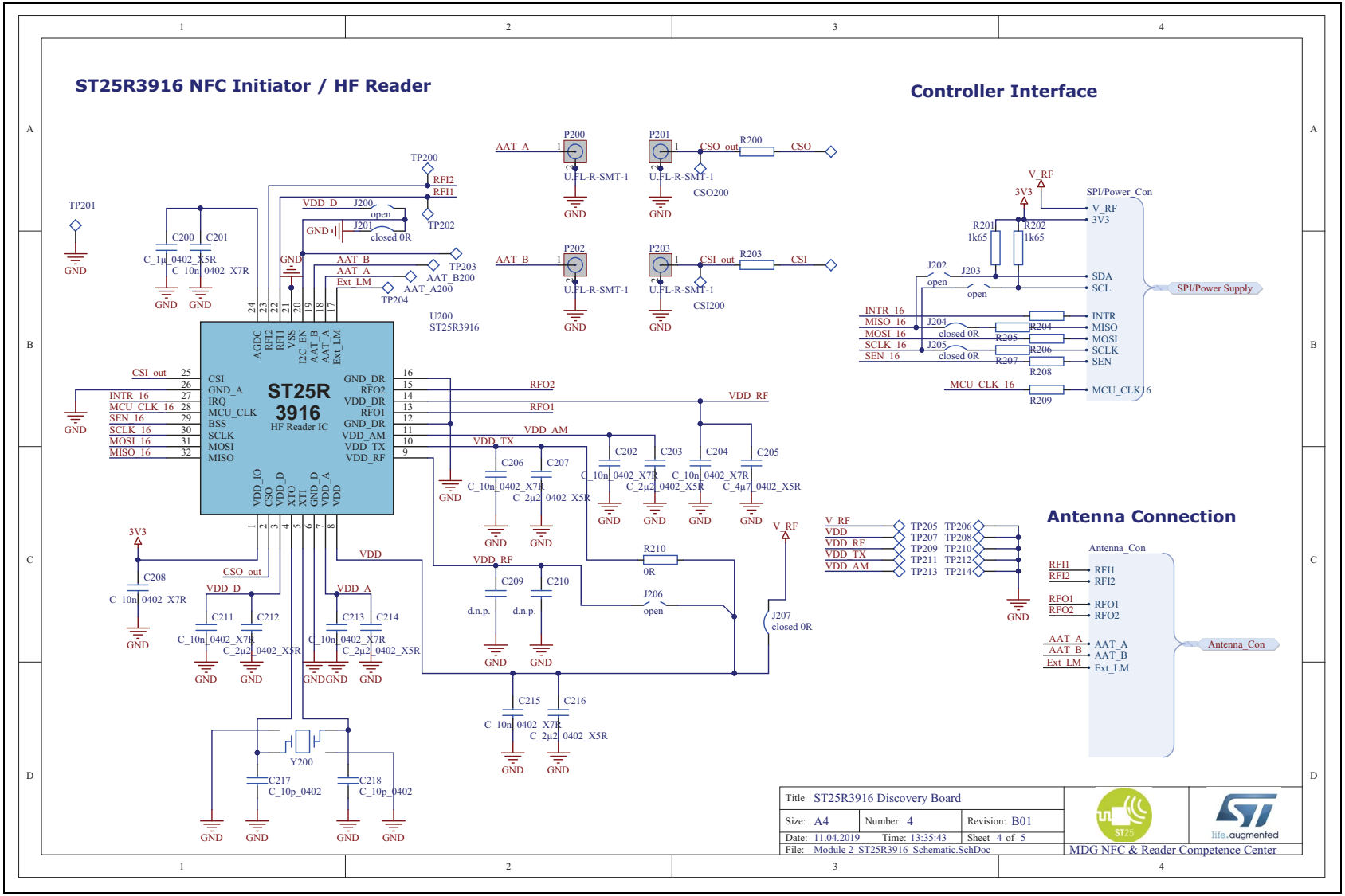
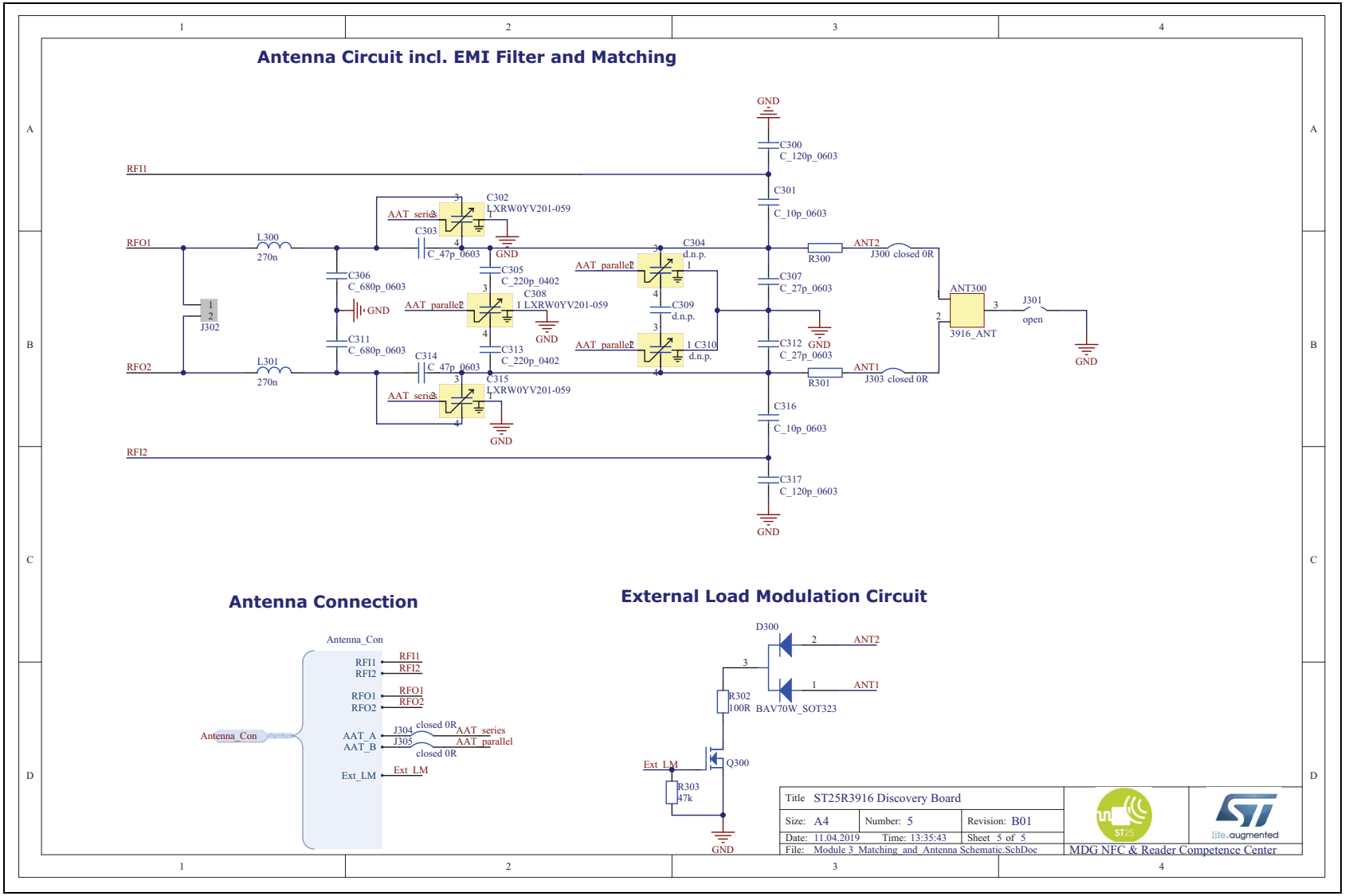


Figure 21. MB1414 - Antenna and external load



7 Federal Communications Commission (FCC) and Industry Canada (IC) compliance statements

7.1 FCC Compliance Statement

7.1.1 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.

7.1.2 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.

7.1.3 FCC ID

FCC ID: YCPR3916DB1

7.2 Formal notices required by the Industry Canada (“IC”)

7.2.1 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.

7.2.2 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.

7.2.3 IC ID

IC ID: 8976A-R3916DB1

8 Revision history

Table 3. Document revision history

Date	Revision	Changes
07-Dec-2018	1	Initial release.
14-May-2019	2	Changed document classification, from ST restricted to public. Updated *Figure 1: ST25R3916-DISCO board (top view)*, *Figure 7: MB1414 board (top view)*, *Figure 8: MB1414 board (bottom view)*, *Figure 19: MB1414 - Connectors*, *Figure 20: MB1414 - ST25R3916* and *Figure 21: MB1414 - Antenna and external load*.
19-Nov-2019	3	Updated *Section 7.2.3: IC ID*.
02-Dec-2019	4	Updated *Section 7.2.3: IC ID*. Updated *Figure 8: MB1414 board (bottom view)*.

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