

## Getting started with the STEVAL-ASTRA1B multiconnectivity asset tracking reference design based on STM32WB5MMG and STM32WL55JC

### Introduction

The ASTRA platform ([STEVAL-ASTRA1B](#)) is a development kit and reference design that simplifies prototyping, testing and evaluating advanced asset tracking applications such as livestock monitoring, fleet management, and logistics.

The kit consists of four boards (not available for separate sale): STEVAL-ASTRA1 (main board), STEVAL-ASTRA1SB (system on board), STEVAL-ASTRA1BC (expansion board) and STEVAL-ASTRA1NA (flexible NFC antenna).

It comes with comprehensive software, firmware libraries, tools, battery, and plastic case. Thanks to its modular and optimized design, it simplifies the development of tracking and monitoring innovative solutions.

The [STEVAL-ASTRA1B](#) is built around the [STM32WB5MMG](#) module and the [STM32WL55JC](#) SoC for short and long range connectivity (BLE, LoRa, and 2.4 GHz and sub 1-GHz proprietary protocols). [ST25DV64K](#) for NFC connectivity is also available. The on-board [STSAFE-A110](#) enhances security features.

The kit embeds a complete set of environmental and motion sensors ([LIS2DTW12](#), [LSM6DSO32X](#), [HTS221](#), [STTS22H](#), [LPS22HH](#)). Moreover, the [Teseo-LIV3F](#) GNSS module provides outdoor positioning.

The power management, built around [ST1PS02](#) and [STBC03](#), is optimized for long battery life.

**Figure 1. STEVAL-ASTRA1B development kit**



# 1 Getting started

## 1.1 Precautions for use

**Danger:** Charge the [STEVAL-ASTRA1B](#) with a DC 5 V–500 mA USB charger at an ambient temperature between 5°C to 35°C. Do not use a USB charger without short-circuit protection to prevent fire hazard.

Use the [STEVAL-ASTRA1B](#) at the recommended working temperature range and store it according to the permitted storage conditions (see [Table 1](#)). Never expose the kit to excessive heat such as direct sunlight, fire, or heating equipment.

Use only the battery provided with the kit, the replacement of the battery with an incorrect type might invalidate the safeguards.

LiPo batteries can be damaged and even explode if they are short-circuited or overcharged or improperly used (mechanical crushes, hot oven, or battery cutting).

**Table 1. Precautions for use**

| Parameter             | Range           |
|-----------------------|-----------------|
| Operating temperature | 10°C to 35°C    |
| Charging temperature  | 10°C to 35°C    |
| Humidity              | From 50% to 80% |
| Operating altitude    | Up to 2000 m    |

## 1.2 Features

- Ultra-low-power and multiconnectivity asset tracking platform
- Two wireless SoCs:
  - [STM32WB5MMG](#) 2.4 GHz wireless dual core SoC module as main application processor, which supports Bluetooth® Low Energy 5.0
  - [STM32WL55JC](#) sub 1-GHz wireless dual core SoC, which supports multimodulation (LoRa and GFSK)
- [ST25DV64K](#) for NFC connectivity
- [Teseo-LIV3F](#) GNSS module with simultaneous multiconstellation
- Environmental and motion sensors: [STTS22H](#), [LPS22HH](#), [HTS221](#), [LIS2DTW12](#), and [LSM6DSO32X](#)
- [STSAFE-A110](#) secure element
- Battery-operated solution with smart power management architecture ([ST1PS02](#), [STBC03](#), and [TCPP01-M12](#))
- [FP-ATR-ASTRA1](#) [STM32Cube](#) function pack
- End-to-end proof of concept ecosystem mobile app and cloud dashboard:
  - [DSH-ASSETTRACKING](#) web cloud dashboard
  - [STAssetTracking](#) mobile app available on Google Play and App store
- 480 mAh LiPo battery
- Plastic case
- SMA antenna
- NFC antenna
- Operating conditions: +5 to 35°C

## 1.3 RF specifications

- RF output power:
  - Bluetooth® Low Energy: +6 dBm
  - LoRaWAN: +14 dBm (limited by the firmware)

- Operating band:
  - Bluetooth® Low Energy frequency range: 2400 MHz to 2480 MHz
  - LoRaWAN: 863 MHz to 870 MHz
  - GNSS (receiver): 1559 MHz to 1610 MHz
  - NFC: 13.56 MHz

## 1.4 Kit components

The **STEVAL-ASTRA1B** is a development kit consists of three boards and a flexible NFC antenna (none of them available for separate sale):

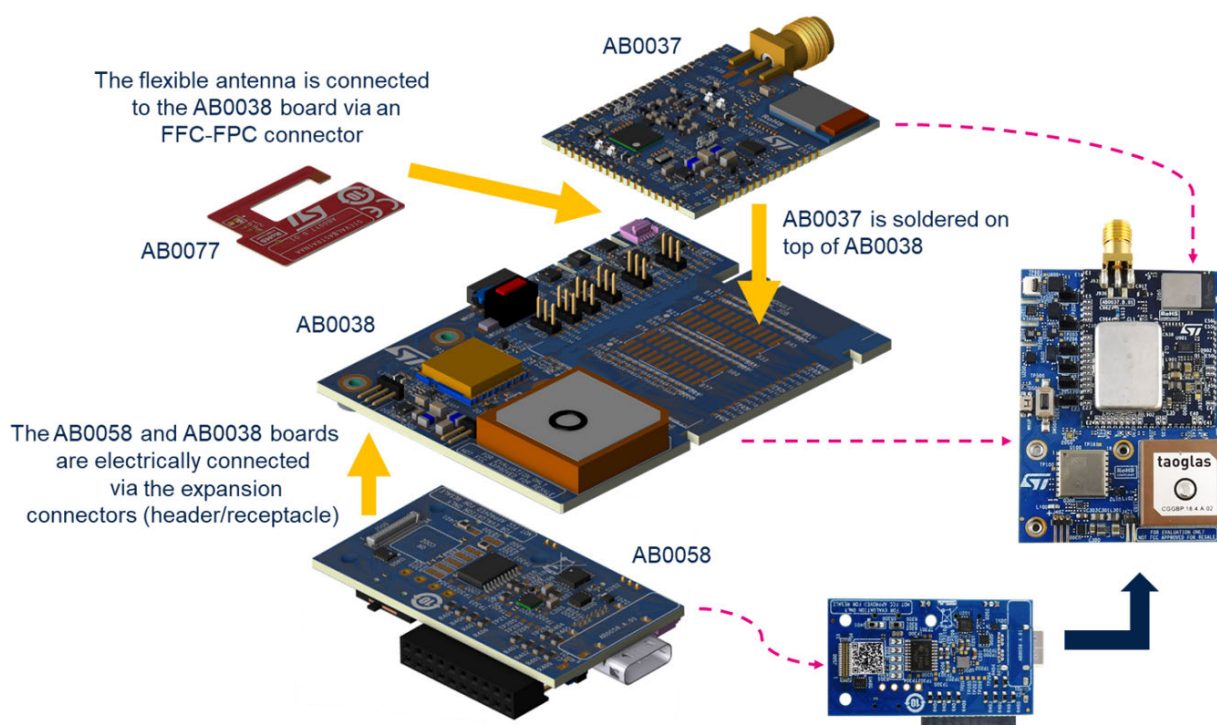
- the STEVAL-ASTRA1SB system on board (with STEVAL\$ASTRA1SBA finished good and AB0037 code printed on the PCB);
- the STEVAL-ASTRA1 main board (with STEVAL\$ASTRA1A finished good and AB0038 code printed on the PCB);
- the STEVAL-ASTRA1BC expansion board (with STEVAL\$ASTRA1BCA finished good and AB0058 code printed on the PCB);
- the STEVAL-ASTRA1NA flexible NFC antenna (with STEVAL\$ASTRA1NAA finished good and AB0077 code printed on the PCB).

Moreover, the kit includes, only for evaluation purposes, a plastic case to host the boards and the LiPo battery included.

The figure below shows how the boards are mechanically connected to each other:

- the STEVAL-ASTRA1SB system on board is soldered on top of the main board;
- the STEVAL-ASTRA1BC expansion board is connected to the main board through the 34-pin expansion connector;
- the STEVAL-ASTRA1NA flexible NFC antenna is connected to the main board via an FPC connector.

**Figure 2. STEVAL-ASTRA1B components and assembly**

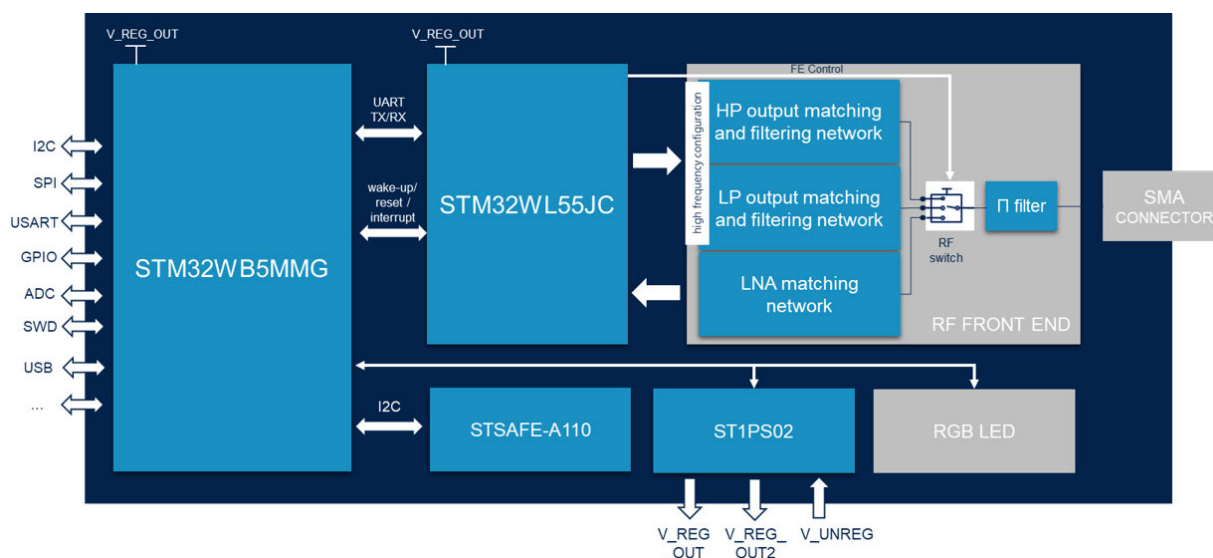


## 1.4.1 STEVAL-ASTRA1SB system on board

### 1.4.1.1 Architecture and pinout

The system on board hosts long and short-range connectivity as well as security functionalities. Moreover, it embeds part of the power management circuitry.

**Figure 3. Block diagram of the STEVAL-ASTRA1SB system on board**



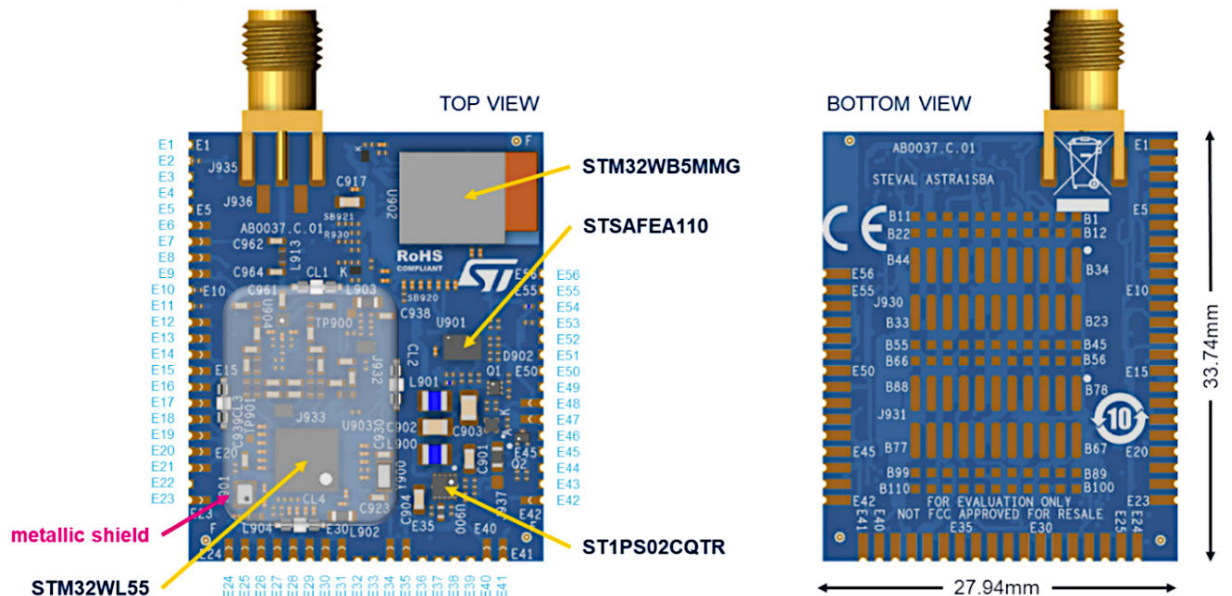
This board main components are:

- The **STM32WB5MMG** (AB0037.U902) ultra-low-power, small-form factor, certified 2.4 GHz wireless module. It integrates the high performance **STM32WB** dual core Arm® Cortex® M4/M0+, crystals, and the chip antenna together with the matching network. The module implements a Bluetooth Low Energy stack, but it can also support Zigbee, Open Thread and other 2.4 GHz proprietary protocols. As an application processor, it exposes its main peripherals for application purposes and also acts as AT master towards the **STM32WL55JC**.
- The **STM32WL55JC** (AB0037.U903) long-range wireless and ultra-low-power system-on-chip. It is a dual core Arm® Cortex®-M4/M0+ that supports sub 1-GHz multimodulation, such as LoRa, GFSK, and others. By default, the **STM32WL55JC** plays the role of network processor running the LoRaWAN modem AT slave firmware. It is connected to the **STM32WB5MMG** through the LPUART interface together with wake-up, reset, and interrupt signals. The **STM32WL55JC** drives the sub-GHz RF front end, acting on high power, low power, and LNA networks. In this **STEVAL-ASTRA1B** version, the RF front end is tuned at high frequency bands (868/915/920 MHz). Low frequencies bands can be achieved with a BOM change of the **STM32WL55JC** RF network. By default, the sub-GHz antenna is connected to a SMA connector (AB0037.J935) but you can optionally solder a micro-FL connector (AB0037.J936).
- The **STSAFE-A110** (AB0037.U901) secure element hooked to the **STM32WB5MMG** for authentication and secure data management services. It consists of a full turnkey solution for IoT, with a secure operating system, running on the latest generation of secure microcontrollers.
- The **ST1PS02CQTR** (AB0037.U900) nano-quiescent synchronous step-down converter. It manages power and can provide up to 400 mA regulated output current. You can select the output voltage via firmware (see [Section 1.4.1.2](#) ).

The figure below shows the main component placement on the system on board.

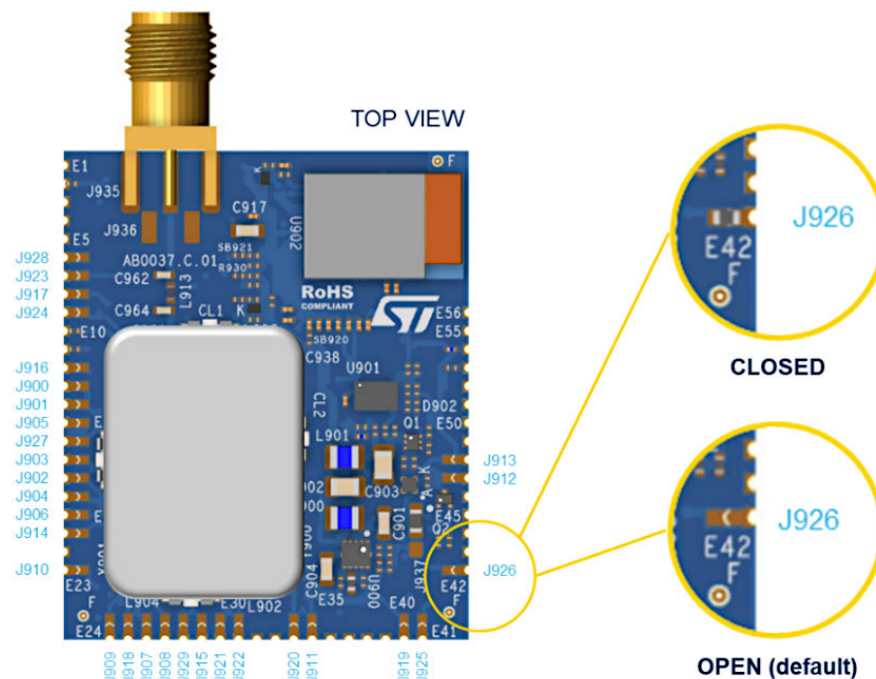
The PCB size is about 34 mm x 28 mm. It consists of six layers optimized for RF performance. The edge and the bottom side of the PCB include several pads. The main peripherals and functionalities are exposed on the 56 edge pins and completed by the 110 pins on the bottom side.

Figure 4. System on board - main component placement and pinout



The flexible architecture allows moving some functionalities from the [STM32WB5MMG](#) to the [STM32WL55JC](#) microcontroller. You can reach this goal by acting on the 30 solder jumpers (AB0037.J900 to AB0037.J929), which are placed on the top side of the system on board, close to the edge of the PCB. You can use a 0 ohm (0402 package) resistor or a tiny solder drop to close the jumpers, thus creating a shortcut between the selected [STM32WB5MMG](#) and [STM32WL55JC](#) pins.

Figure 5. Solder jumpers for remapping



**Table 2. System on board - edge pinout**

| Pin | Function      |
|-----|---------------|
| E1  | GND           |
| E2  | WL_RESET      |
| E3  | WL_PA14 SWCLK |
| E4  | WL_PA13 SWDIO |
| E5  | WL_VDD        |
| E6  | WB_PE0        |
| E7  | WB_PD9        |
| E8  | WB_PC7        |
| E9  | WB_PD11       |
| E10 | WB_PA3        |
| E11 | WB_PA2        |
| E12 | WB_PC5        |
| E13 | WB_PA0        |
| E14 | WB_PA1        |
| E15 | WB_PA15       |
| E16 | WB_PD15       |
| E17 | WB_PA5        |
| E18 | WB_PA4        |
| E19 | WB_PA6        |
| E20 | WB_PB5        |
| E21 | WB_PC1        |
| E22 | V_REG_EN      |
| E23 | WB_PB9        |
| E24 | WB_PB8        |
| E25 | WB_PC11       |
| E26 | WB_PB6        |
| E27 | WB_PB7        |
| E28 | WB_PE3        |
| E29 | WB_PC4        |
| E30 | WB_PD4        |
| E31 | WB_PD5        |
| E32 | WB_PA7        |
| E33 | WB_PD7        |
| E34 | WB_PD3        |
| E35 | WB_PB10       |
| E36 | GND           |
| E37 | WB_VDD_USB    |
| E38 | WB_PA12       |
| E39 | WB_PA11       |
| E40 | WB_PC13       |

| Pin | Function           |
|-----|--------------------|
| E41 | WB_PD12            |
| E42 | WB_PD14            |
| E43 | WL_PA10            |
| E44 | WL_PA9             |
| E45 | WL_PB14            |
| E46 | WL_PB13            |
| E47 | WB_PB11 STSAFE_SDA |
| E48 | WB_PC0 STSAFE_SCL  |
| E49 | WB_VDD             |
| E50 | WB_PA13 SWDIO      |
| E51 | WB_PA14 SWCLK      |
| E52 | WB_RESET           |
| E53 | V_REG_2            |
| E54 | V_REG              |
| E55 | V_UNREG            |
| E56 | GND                |

The bottom side of the system on board embeds 110 pins. Some of them form two extended debug connector footprints. Each footprint is connected to a microcontroller (see [Figure 6](#)).

The supported connectors are: SAMTEC FTSH-107-01-F-DV-K-P-TR ([STLINK-V3MINI](#) receptacle) and SAMTEC FTSH-111-01-L-DV-K-P-TR (neither of this connector is included in the kit). The remaining 62 pins support minor features of the two microcontrollers.

**Table 3. System on board - bottom pinout (from B1 to B68)**

| Pin | Function          |
|-----|-------------------|
| B1  | WB_PD0            |
| B2  | WB_PD2            |
| B3  | WB_PD8            |
| B4  | WB_PH0            |
| B5  | WB_PD10           |
| B6  | WB_PB1            |
| B7  | WB_PH1            |
| B8  | WB_PD13           |
| B9  | WB_PC12           |
| B10 | WB_PE1 POWER GOOD |
| B11 | WB_PB15           |
| B12 | WL_PA3            |
| B13 | WL_PA2            |
| B14 | WL_PA1            |
| B15 | WL_PB2            |
| B16 | WL_PA11           |
| B17 | WB_PD1            |

| Pin | Function      |
|-----|---------------|
| B18 | WB_PB0        |
| B19 | WB_PC6        |
| B20 | WB_PA8        |
| B21 | WL_PA15       |
| B22 | WL_PA12       |
| B23 | WB_PB12       |
| B24 | WB_PD6        |
| B25 | Not connected |
| B26 | WB_PA13 SWDIO |
| B27 | WB_PA14 SWCLK |
| B28 | WB_PB3        |
| B29 | WB_PA15       |
| B30 | WB_RESET      |
| B31 | WB_PA9        |
| B32 | WB_PB4        |
| B33 | WB_PB2        |
| B34 | WB_PB13       |
| B35 | WB_PE2        |
| B36 | Not connected |
| B37 | WB_VDD        |
| B38 | WB_GND        |
| B39 | WB_GND        |
| B40 | WB_PA14       |
| B41 | WB_GND        |
| B42 | WB_PA10       |
| B43 | WB_PB3        |
| B44 | WB_PC3        |
| B45 | Not connected |
| B46 | Not connected |
| B47 | Not connected |
| B48 | WB_PB14       |
| B49 | WL_PC1        |
| B50 | WL_PC6        |
| B51 | WL_PC0        |
| B52 | WL_PB10       |
| B53 | WL_PA7        |
| B54 | WL_PA6        |
| B55 | WL_PA4        |
| B56 | Not connected |
| B57 | Not connected |
| B58 | Not connected |

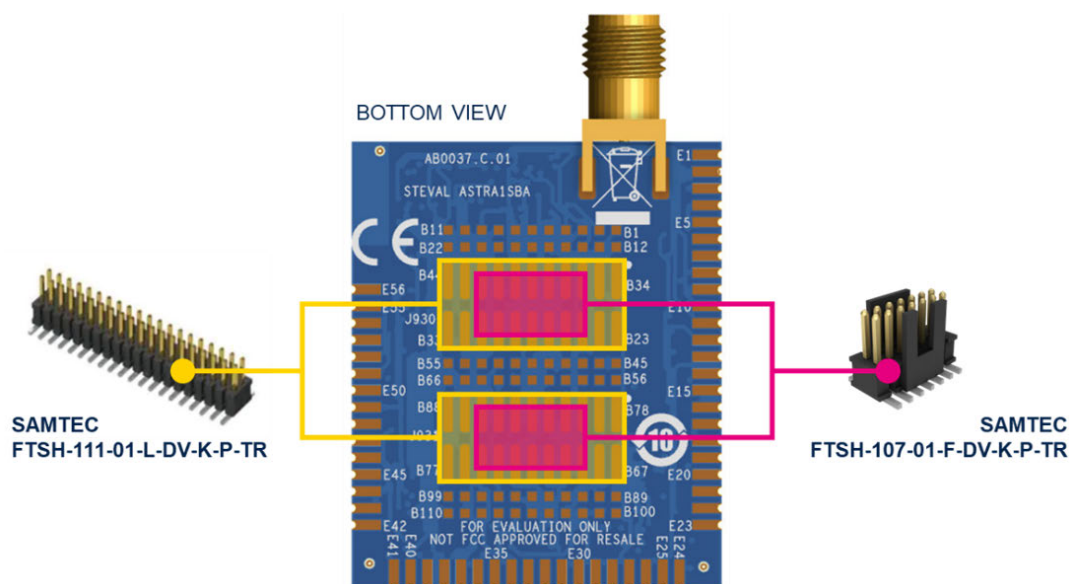
| Pin | Function      |
|-----|---------------|
| B59 | Not connected |
| B60 | WL_PC3        |
| B61 | WL_PC4        |
| B62 | WL_PC5        |
| B63 | WL_PB11       |
| B64 | WL_PA5        |
| B65 | WL_PB0        |
| B66 | WB_PC2        |
| B67 | WL_PA9        |
| B68 | WL_PA10       |

**Table 4. System on board - bottom pinout (from B69 to B110)**

| Pin | Function      |
|-----|---------------|
| B69 | Not connected |
| B70 | WL_PA13 SWDIO |
| B71 | WL_PA14 SWCLK |
| B72 | WL_PB3        |
| B73 | WL_PA15       |
| B74 | WL_RESET      |
| B75 | WL_PB6        |
| B76 | WL_PB4        |
| B77 | WL_PB5        |
| B78 | WL_PA8        |
| B79 | WL_PC2        |
| B80 | Not connected |
| B81 | WL_VDD        |
| B82 | WL_GND        |
| B83 | WL_GND        |
| B84 | WL_PA14       |
| B85 | WL_GND        |
| B86 | WL_PB7        |
| B87 | WL_PB3        |
| B88 | WL_PB4        |
| B89 | Not connected |
| B90 | Not connected |
| B91 | Not connected |
| B92 | Not connected |
| B93 | Not connected |
| B94 | WL_PB15       |
| B95 | WL_VDD        |
| B96 | WL_PH3        |

| Pin  | Function       |
|------|----------------|
| B97  | WB_GND         |
| B98  | WB_VDD         |
| B99  | WB_PD13 D0_1_2 |
| B100 | WB_PE4         |
| B101 | WL_PA0         |
| B102 | WL_PB1         |
| B103 | WL_PB4         |
| B104 | WL_PB9         |
| B105 | WL_PB8         |
| B106 | WL_PC13        |
| B107 | WL_PB12        |
| B108 | WB_VDD         |
| B109 | WB_PH3         |
| B110 | WL_GND         |

**Figure 6. Extended debug footprints and supported connectors**



#### 1.4.1.2

#### Power management

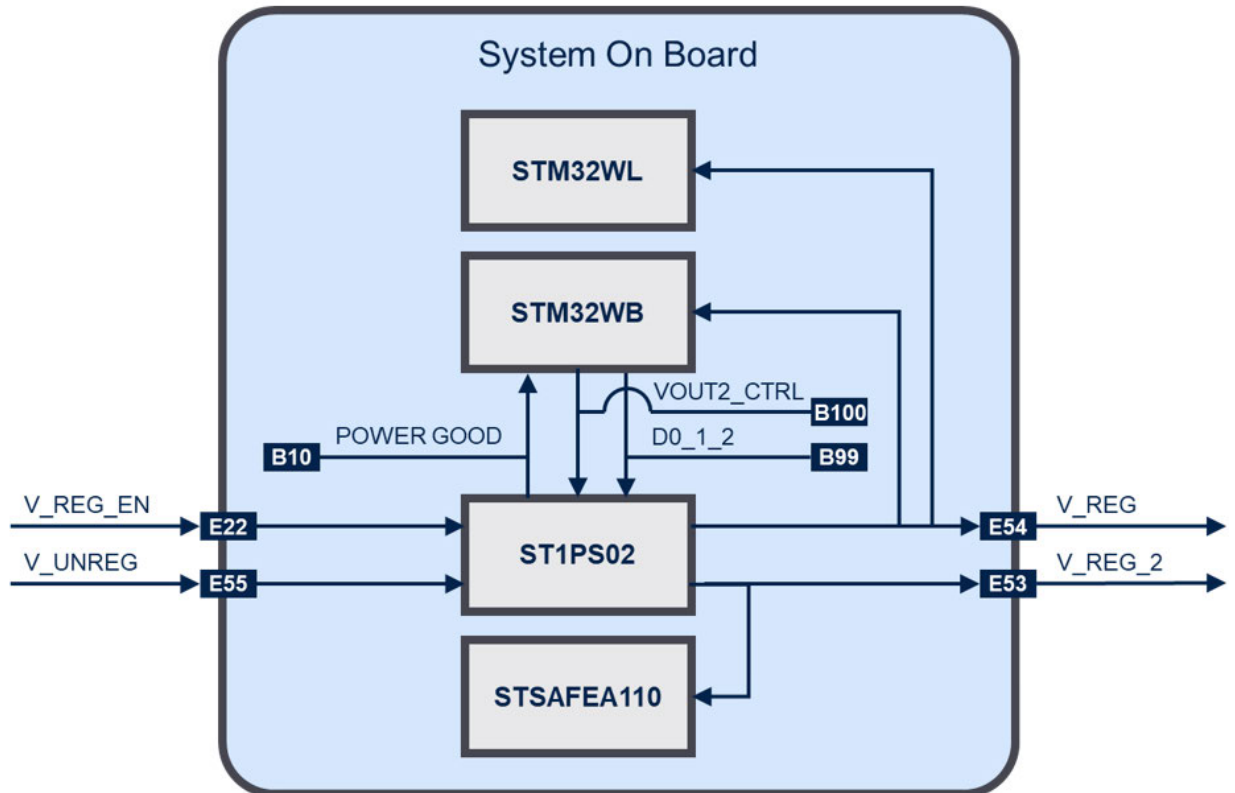
The **ST1PS02CQTR** step-down converter on the system on board is part of the power management circuit. It generates the power domains (V\_REG and V\_REG\_1) that translate the input voltage (V\_UNREG). The V\_REG\_EN signals, which come from the power switch on the main board, enable the step-down converter.

At startup the output voltages (V\_REG and V\_REG\_1) are set at 2.5 V. By acting on the D0\_1\_2 signal, it is possible to switch to 3.3 V. POWER GOOD reports when the output voltage target is reached.

The **STM32WB5MMG** microcontroller activates the second energy domain (V\_REG\_2) acting on the VOUT2\_CTRL signal.

The following figure shows the power management block diagram of the system on board. It also shows the edge and bottom pins that allow accessing the signals.

Figure 7. System on board - power management block diagram



#### 1.4.1.3 RGB LED

The RGB (red, green, and blue) LED (AB0037.D902) signals the application status. The colors and their flashing frequency are strictly linked to the loaded application firmware (refer to the firmware user manual for further details).

#### 1.4.2 STEVAL-ASTRA1 main board

The system on board is soldered on top of the STEVAL-ASTRA1 main board. It embeds:

- the environmental and motion sensors;
- the user and the power-on button (which also acts as a second user button);
- the GNSS, the GNSS RF front end, and the patch antenna;
- the dynamic NFC memory;
- part of the power management circuitry and the battery connector;
- the debug interface of the microcontrollers selectable through switches;
- the additional secure element (not mounted, hooked to [STM32WL55JC](#) for LoRa provisioning)

The additional RGB LEDs are intended for future applications but not mounted in this version of the kit.

Figure 8. Main board block diagram

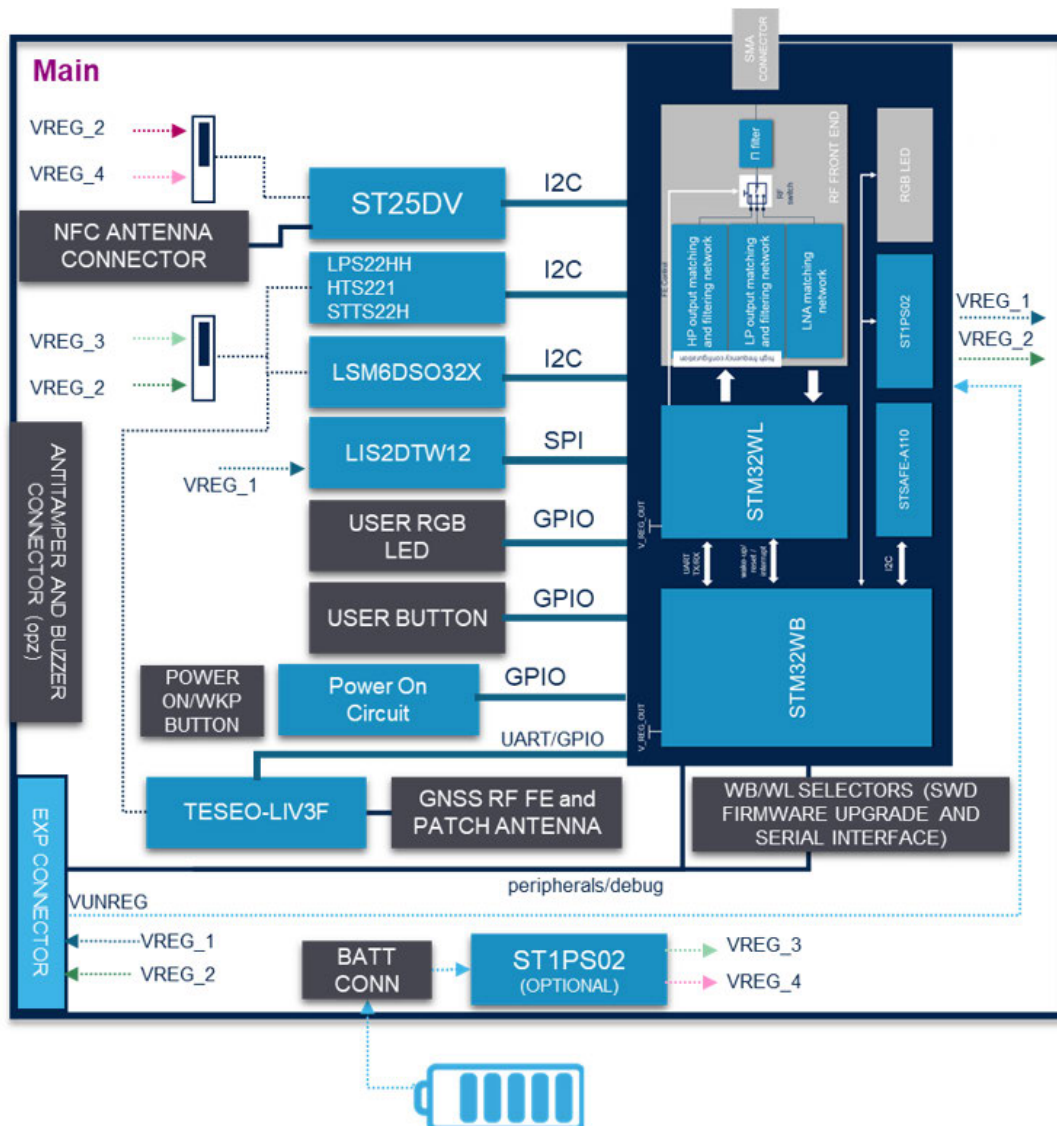
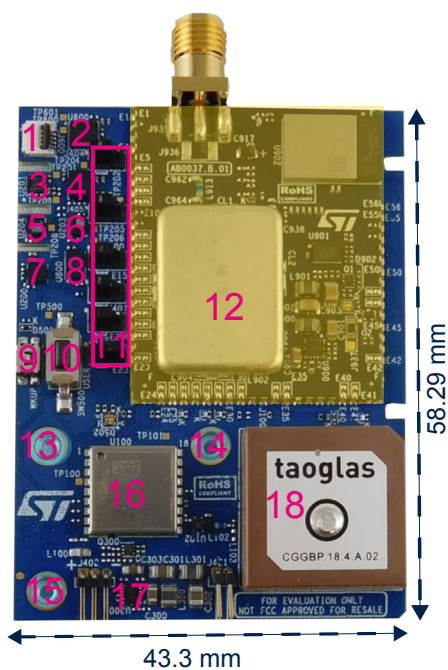


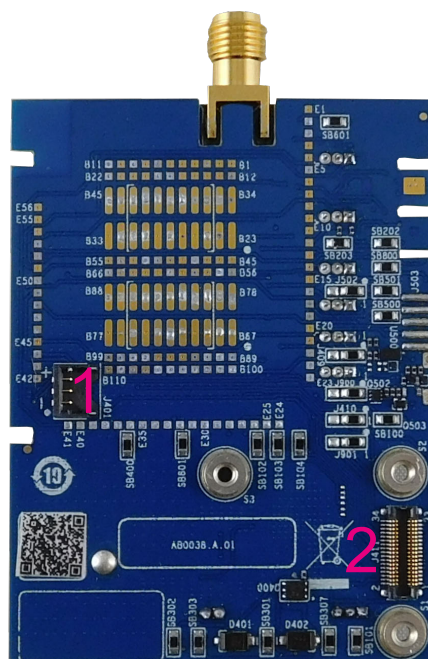
Figure 9. Main board component placement (top view)

1. NFC antenna connector
2. ST25DV64K
3. STTS22H
4. LSM6DSO32X
5. HTS221
6. LPS22HH
7. LIS2DTW12
8. STSAFE-A110
9. Power on/wake-up button
10. User button
11. Jumpers to program pin configuration (for STM32WB5MMG or STM32WL55JC)
12. System on board
13. Screw hole for board-to-board strengthening
14. Screw hole for board-to-board strengthening
15. Screw hole for board-to-board strengthening
16. Teseo-LIV3F
17. ST1PS02CQ
18. GNSS antenna



**Figure 10. Main board component placement (bottom view)**

1. Battery connector
2. 34-pin connector (socket)



#### 1.4.2.1

## Sensors

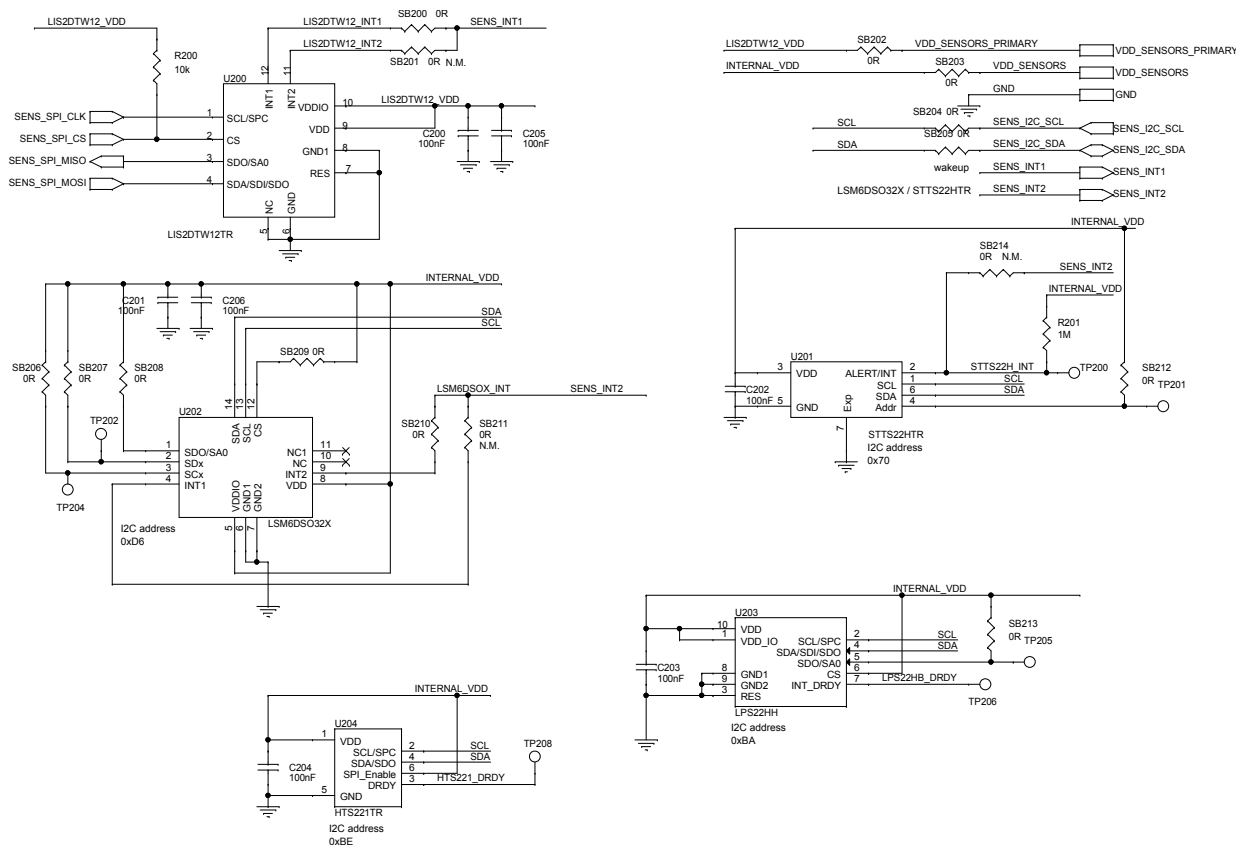
The STEVAL-ASTRA1 main board includes the following environmental and motion sensors:

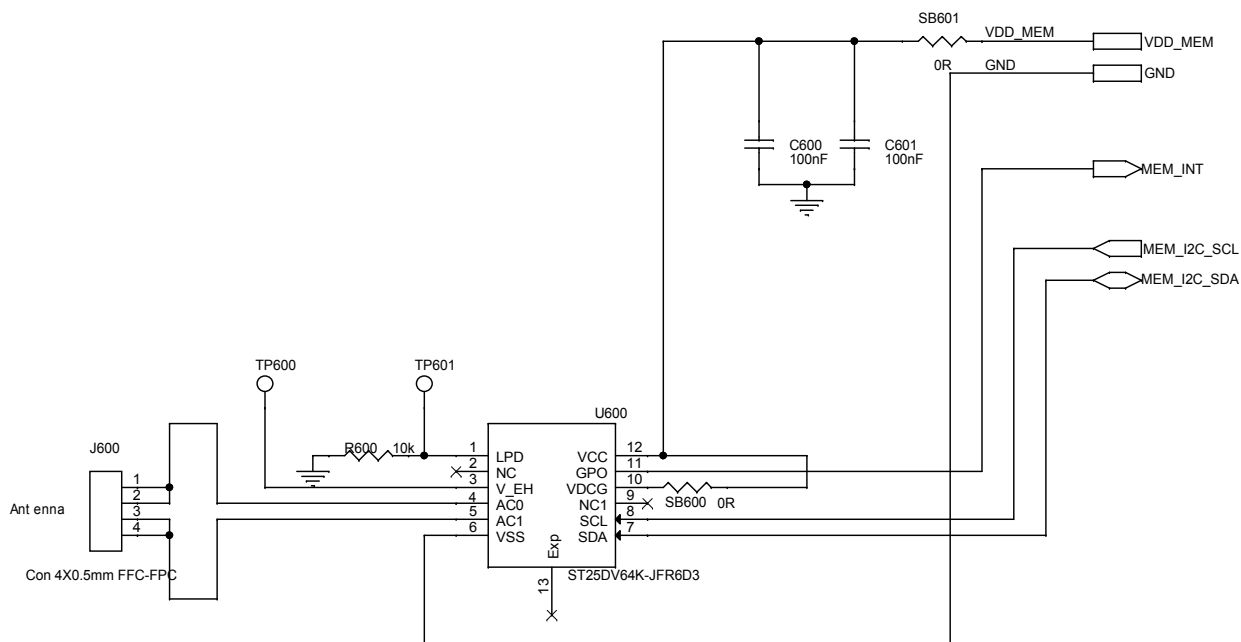
- **STTS22H** (AB0038.U201) ultra-low-power, high accuracy, digital temperature sensor. Thanks to its factory calibration, the **STTS22H** offers high-end accuracy performance over the entire operating temperature range, without requiring any further calibration at the application level. The operating temperature goes from -40°C to +125°C with a  $\pm 0.5^\circ\text{C}$  (-10°C to +60°C) accuracy. The sensor operating mode is user-configurable and allows selecting between different output data rates (ODR) down to 1 Hz or the one-shot mode for battery saving.
- **LPS22HH** (AB0038.U203) ultra-compact piezoresistive absolute pressure sensor, which functions as a digital output barometer. The device embeds a sensing element and an IC interface, which communicates from the sensing element to the application. The operating pressure range goes from 260 to 1260 hPa. The absolute accuracy is 0.5hPa (-20°C to +80°C). Operating temperature range goes from -40°C +85°C, providing a temperature absolute accuracy  $\pm 1.5^\circ\text{C}$  (0 to 80°C).
- **HTS221** (AB0038.U204) combines a relative humidity and a temperature sensor in an ultra-small package. It includes a sensing element and a mixed signal ASIC to provide the measurement information through digital serial interfaces. The humidity range goes from 0% to 100% and the humidity accuracy is  $\pm 3.5\%$  rH (+20% to +80% rH). The temperature range goes from -40°C to +125°C and the temperature accuracy is  $\pm 0.5^\circ\text{C}$  (+15°C to +40°C).
- **LIS2DTW12** (AB0038.U200) ultra-low power, 3-axis accelerometer, enhanced with embedded digital functions (such as free fall, 6D/4D orientation, wake up/inactivity, tap, and double tap). The **LIS2DTW12** has user-selectable full scales of  $\pm 2\text{g}/\pm 4\text{g}/\pm 8\text{g}/\pm 16\text{g}$ . It can measure accelerations with output data rates (ODR) from 1.6 Hz to 1600 Hz. The embedded self-test capability allows the user to check whether the sensor is correctly working in the application. It is guaranteed to operate over an extended temperature range from -40°C to +85°C.
- **LSM6DSO32X** (AB0038.U202) system-in-package that features a 3-axis digital accelerometer at 32 g and a 3-axis digital gyroscope. It boosts power performance at 0.55 mA in high-performance mode and enables always-on low-power features for an optimal motion experience in wearable, hard-fall detection, navigation, and asset tracking applications. The **LSM6DSO32X** embeds a dedicated Machine Learning Core (MLC) processing and a finite state machine (FSM) that provides system flexibility. It allows moving some algorithms to the MEMS sensor with the advantage of a consistent reduction in power consumption. The **LSM6DSO32X** has a full-scale acceleration range of  $\pm 4/\pm 8/\pm 16/\pm 32$  g and an angular rate range of  $\pm 125/\pm 250/\pm 500/\pm 1000/\pm 2000$  dps. The operating temperature range goes from -40°C +85°C.

The environmental sensors and the **LSM6DSO32X** motion sensor share the I<sup>2</sup>C bus, while the **LIS2DTW12** communicates over the SPI bus. Different buses together with the power management architecture allow using environmental sensors and **LSM6DSO32X** sensor on demand. Thus, you can implement different options to reduce power consumption when some sensors are not used.

The **LIS2DTW12** belongs to the same power domain of the microcontrollers. Thus, it is always powered. In low-power mode, the interrupt signal (SENS\_INT1), generated by the activity/inactivity function, can be used to wake up the microcontroller.

**Figure 11. STEVAL-ASTRA1B sensor schematic diagram**



**Figure 12. STEVAL-ASTRA1 NFC tag schematic diagram**


### 1.4.2.3

#### GNSS

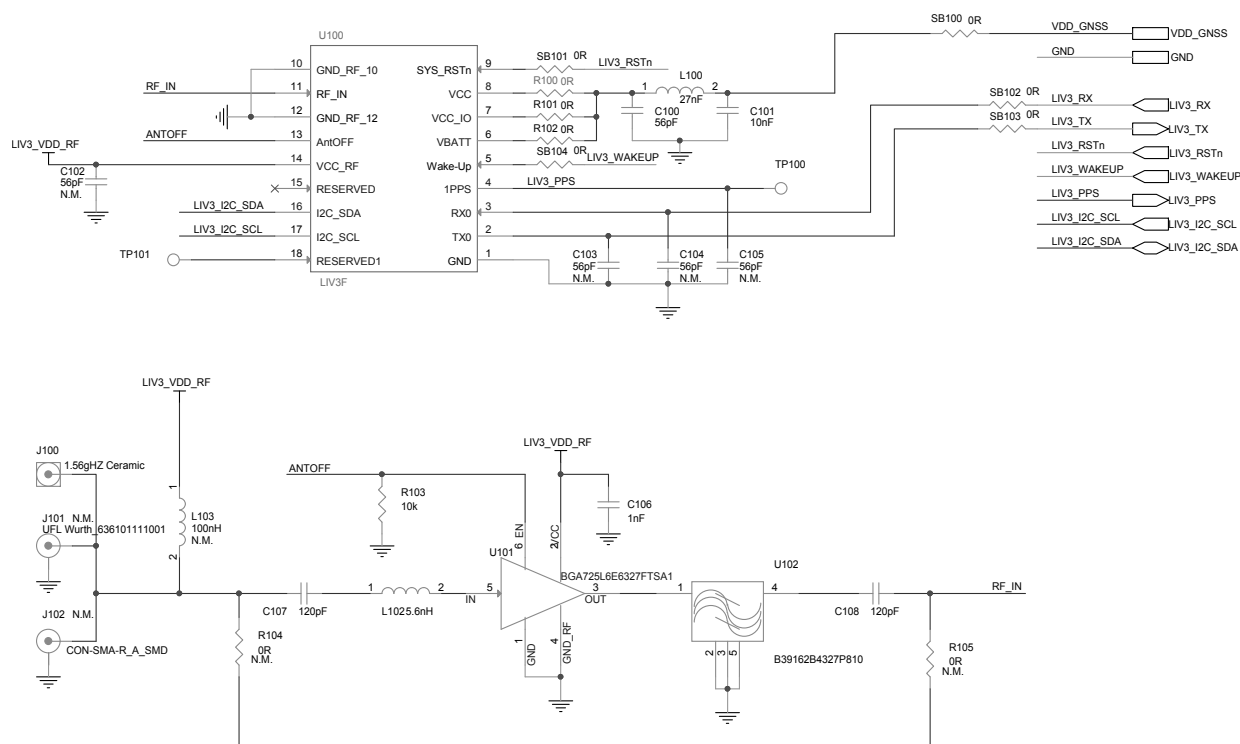
The **Teseo-LIV3F** (AB0038.U100) is a precision GNSS receiver in a tiny module with TCXO and RTC crystal. It embeds the Teseo III single-die standalone positioning receiver IC, which simultaneously works on multiple constellations (GPS/Galileo/Glonass/BeiDou/QZSS).

Thanks to the embedded 16 Mbit flash memory, the **Teseo-LIV3F** features data logging, seven-day autonomous assisted GNSS, firmware reconfigurability, and firmware upgrades.

**Teseo-LIV3F** also provides the autonomous assisted GNSS to predict satellite data on the basis of a prior observation of the satellite.

The temperature operating range goes from -40°C to 85°C.

The **Teseo-LIV3F** drives the RF front end, which ends with the patch antenna (AB0038.J100). Optionally, you can remove and replace the patch antenna with a microFL (AB0038.J101) or a SMA (AB0038.J102) connector.

**Figure 13. STEVAL-ASTRA1 GNSS schematic diagram**


The device and the microcontroller communicate via the UART bus. You can optionally route them to the I<sup>2</sup>C bus. Moreover, some GPIOs (LIV3\_PPS, LIV3\_RSTn, and LIV3\_WAKEUP) complete the connections between the device and the microcontroller.

The *Teseo-LIV3F* is supplied by the V\_REG1\_MAIN domain. Optionally, you can supply it through V\_REG2 generated by the system on board (see [Section 1.4.2.10](#) for further details).

#### 1.4.2.4

#### Debug and programming interface switch

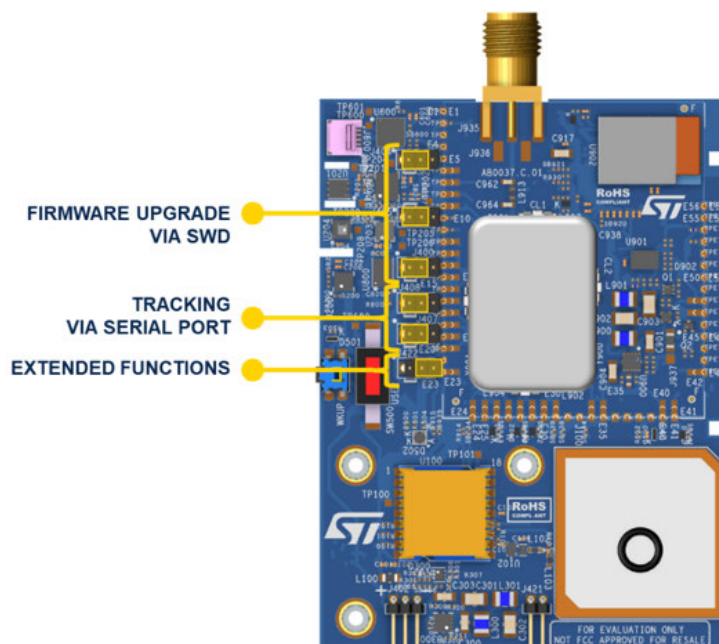
The *STEVAL-ASTRA1B* is compatible with the *STLINK-V3MINI* debugging and programming probe for STM32 microcontrollers.

It supports the SWD protocol to communicate with any STM32 microcontroller. It also provides a virtual COM port interface, which allows the host PC to communicate with the target microcontroller through UART.

The *STEVAL-ASTRA1B* embeds two microcontrollers: the *STM32WB5MMG*, which is the application processor, and the *STM32WL55JC*, which plays the role of network processor, acting as modem AT slave.

By default, application firmware changes are applied to *STM32WB5MMG* but if necessary the *STM32WL55JC* firmware can be updated as well.

On the top side of the main board, the three-pin jumper selectors are organized in three groups, according to their function: firmware upgrade/debugging, tracking, and extended functions.

**Figure 14. STEVAL-ASTRA1 three-pin jumper selectors (default configuration)**

**Table 5. Configuration map of the three-pin jumper selectors**

| Jumper | Group            | Configuration                                                                        | Description                                                                                                                                   |
|--------|------------------|--------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| J400   | Firmware upgrade |  | SWDIO net is connected to the <a href="#">STM32WB5MMG</a> microcontroller as a jumper is connected between pins 1 and 2 (default setting).    |
|        |                  |  | SWDIO net is connected to the <a href="#">STM32WL55JC</a> microcontroller as a jumper is connected between pins 2 and 3.                      |
| J404   | Firmware upgrade |  | SWCLK net is connected to the <a href="#">STM32WB5MMG</a> microcontroller as a jumper is connected between pins 1 and 2 (default setting).    |
|        |                  |  | SWCLK net is connected to the <a href="#">STM32WL55JC</a> microcontroller as a jumper is connected between pins 2 and 3.                      |
| J405   | Firmware upgrade |  | RESET net is connected to the <a href="#">STM32WB5MMG</a> microcontroller as a jumper is connected between pins 1 and 2 (default setting).    |
|        |                  |  | RESET net is connected to the <a href="#">STM32WL55JC</a> microcontroller as a jumper is connected between pins 2 and 3.                      |
| J407   | Tracking         |  | USART_TX net is connected to the <a href="#">STM32WB5MMG</a> microcontroller as a jumper is connected between pins 1 and 2 (default setting). |

| Jumper | Group              | Configuration                                                                      | Description                                                                                                                                     |
|--------|--------------------|------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| J407   | Tracking           |  | USART_TX net is connected to the <a href="#">STM32WL55JC</a> microcontroller as a jumper is connected between pins 2 and 3.                     |
| J408   | Tracking           |  | USART_RX net is connected to the <a href="#">STM32WB5MMG</a> microcontroller as a jumper is connected between pins 1 and 2 (default setting).   |
|        |                    |  | USART_RX net is connected to the <a href="#">STM32WL55JC</a> microcontroller as a jumper is connected between pins 2 and 3.                     |
| J422   | Extended functions |  | RESET net coming from the expansion board is connected to WB_PD7 as a jumper is connected between pins 1 and 2.                                 |
|        | Extended functions |  | RESET net coming from the expansion board is connected to the microcontrollers as a jumper is connected between pins 1 and 2 (default setting). |

The configuration of each jumper must be consistent with the one of the groups it belongs to. For example, if you change one of the jumpers belonging to a group, you have to move the other jumpers that belong to the same group accordingly.

**Warning:** Leave the jumpers in their default position unless it is specifically requested in the official documentation.

**Figure 15.** STEVAL-ASTRA1 jumper configuration to program STM32WB5MMG

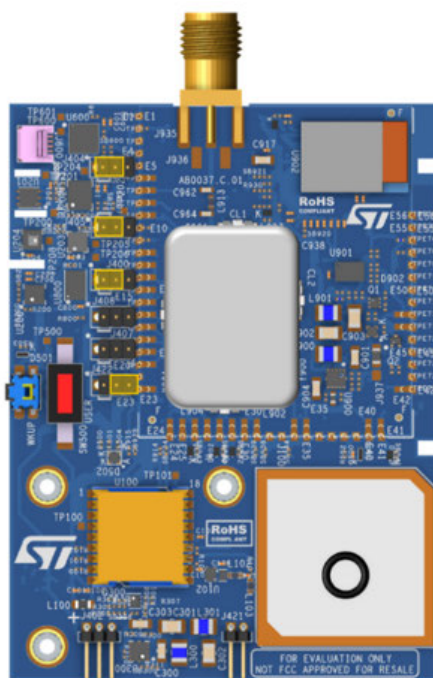
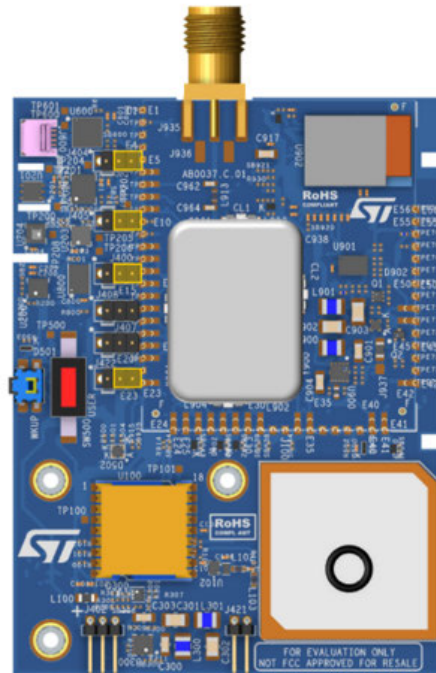


Figure 16. STEVAL-ASTRA1 jumper configuration to program STM32WL55JC



J422 controls the routing of the reset signal. In the default configuration (Figure 14), the reset signal that comes from the expansion board is used to reset the two microcontrollers, according to the position of the J405 selector.

#### 1.4.2.5 RGB LED (optional)

The STEVAL-ASTRA1 main board also embeds an RGB (red, green, and blue) LED (AB0038.D502), which is an additional LED to the one embedded in the system on board. The STM32WB5MMG GPIOs manage both LEDs. However, the main board LED is deactivated as a solder jumper (AB0038.J502) is not assembled.

#### 1.4.2.6 Push buttons, antitampering, and buzzer

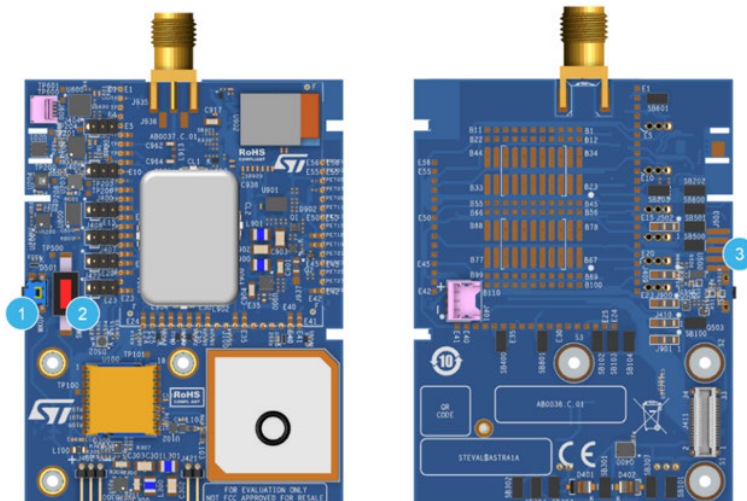
The STEVAL-ASTRA1 main board embeds two push buttons:

1. the power/wake-up button (AB0038.SW501) on the edge, with a dual role: it acts on the application power circuit and sends an interrupt signal (BTN2) to the GPIO PC11 of the STM32WB5MMG microcontroller. Moreover, it contributes to the generation of the STM32WB5MMG wake-up signal (WAKEUP) as described in Section 1.4.2.7 ;
2. the user button (AB0038.SW500) connected to the GPIO PC13 of the STM32WB5MMG microcontroller that manages the BTN1 signal.

The J503 connector (not mounted) allows using the BTN1 signal as antitampering when it is connected to a normally closed (NC) external switch. Moreover, it allows connecting a buzzer driven through a PWM signal (BUZZER) generated by the STM32WB5MMG PA1 GPIO. You can use this PA1 for debugging purposes.

**Figure 17. Push buttons, antitampering, and buzzer**

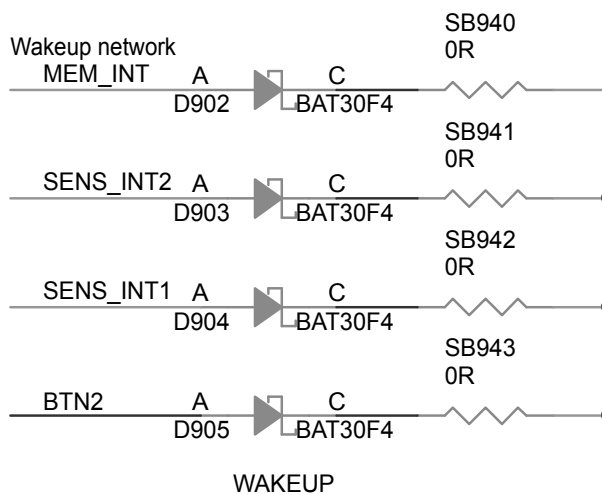
1. Power/wake-up button
2. User button
3. J503 connector


**Table 6. J503 connector pinout (not mounted)**

| Pin | Description |
|-----|-------------|
| 1   | VDD_HMI     |
| 2   | BTN1        |
| 3   | GND         |
| 4   | GND         |
| 5   | BUZZER      |

#### 1.4.2.7 Awakening signal

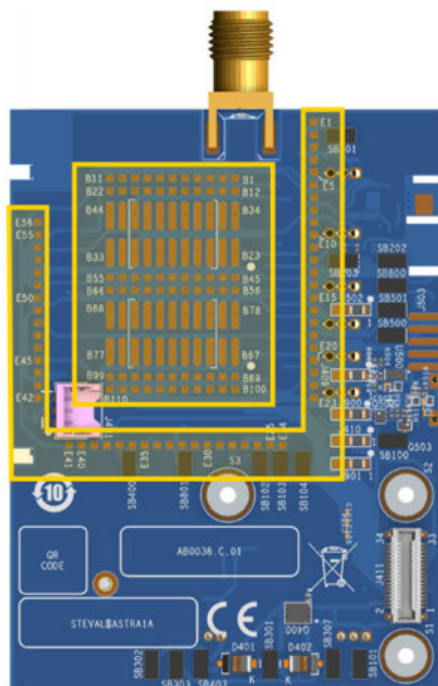
The wake-up network consists of the SENS\_INT1 and SENS\_INT2 interrupt signals generated by the sensors, the MEM\_INT signal, and the BTN2 signal. This network allows the microcontroller to receive an awakening signal generated by, at least, one of them.

**Figure 18. STEVAL-ASTRA1 wake-up network**


#### 1.4.2.8 *Pads on the bottom side*

Despite the fact that the system on-board is welded on top of the main board, the system on board pinout is accessible via the main board bottom pads. They faithfully remap the pinout described in [Section 1.4.1.1](#) (to [Table 2](#), [Table 3](#), and [Table 4](#) for pinout details).

**Figure 19. Bottom pads**



#### 1.4.2.9 *Expansion connector*

The expansion connector (AB0038.J411, Panasonic AXF5G3412) is on the bottom side. It plays multiple roles. By default, it is used to connect the expansion board. You can also use it to plug further expansion boards such as:

- other sensors or connectivity boards;
- OLED/e-ink display;
- SD card;
- Datalogger;
- energy harvesting systems.

Moreover, you can use it to connect flat cables in order to drive remote sensors or devices.

The pinout of this connector is designed for the application needs, but also for future developments.

**Figure 20. 34-pin connector pinout**

|                             |    |  |  |    |                           |
|-----------------------------|----|--|--|----|---------------------------|
| VBAT_NTC                    | 34 |  |  | 33 | GND                       |
| VBAT                        | 32 |  |  | 31 | VCONN                     |
| SPIx_MISOs <sup>(1)</sup>   | 30 |  |  | 29 | VREG2 <sup>(2)</sup>      |
| GPIO4 / SAI1_MCLK_A         | 28 |  |  | 27 | I2Cz_SCL <sup>(1)</sup>   |
| GPIO3/ SAI1_SD_A            | 26 |  |  | 25 | SPIx_SCK <sup>(1)</sup>   |
| GPIO2 / SAI1_FS             | 24 |  |  | 23 | SPIx_MISOp <sup>(1)</sup> |
| GPIO1 / SAI1_SCK_A          | 22 |  |  | 21 | SPIx_MOSIp <sup>(1)</sup> |
| USB_DM                      | 20 |  |  | 19 | SPIx_NSS <sup>(1)</sup>   |
| Reserved 2 <sup>(4)</sup>   | 18 |  |  | 17 | Reserved 1 <sup>(3)</sup> |
| PWM <sup>(1)</sup>          | 16 |  |  | 15 | USB_DP                    |
| ADC <sup>(1)</sup>          | 14 |  |  | 13 | UARTy_RTS <sup>(1)</sup>  |
| RESET <sup>(1)</sup>        | 12 |  |  | 11 | UARTy_RX <sup>(1)</sup>   |
| INT/I2Cz_SMB <sup>(1)</sup> | 10 |  |  | 9  | UARTy_TX <sup>(1)</sup>   |
| I2Cz_SDA <sup>(1)</sup>     | 8  |  |  | 7  | UARTy_CTS <sup>(1)</sup>  |
| VREG1 <sup>(2)</sup>        | 6  |  |  | 5  | SPIx_MOSIs                |
| VCONN                       | 4  |  |  | 3  | VBAT                      |
| GND                         | 2  |  |  | 1  | GND                       |

Note:

- <sup>(1)</sup> It can be used as GPIO.
- <sup>(2)</sup> These pins can be connected. They can be the VDD\_MCU or other regulated voltages.
- <sup>(3)</sup> It can be used for STMOD+ mux driving or SWCLK signal.
- <sup>(4)</sup> It can be used for STMOD+ mux driving or SWDIO signal

On the main board, if the battery does not need the VBAT\_NTC signal, it can be configured as GND by acting on the AB0038.J410 solder bridge.

#### 1.4.2.10 Power management and voltage monitoring

The main board includes some parts of the power management circuit, such as the battery voltage (VBAT) and the VCONN, which comes from the expansion connector and is generated through the USB port.

The battery voltage can be supplied through:

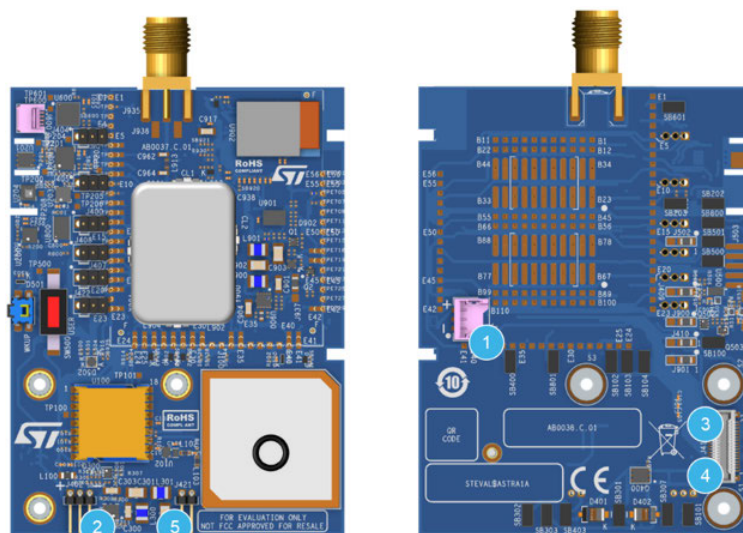
1. the battery connector (AB0038.J401), which is the default choice;
2. the strip line connectors (AB0038.J402);
3. the expansion connector (AB0038.J411) pins (3, 32, and 34) and the GNDs.

The VCONN voltage can be supplied by using:

- the expansion connector (AB0038.J411) pins (4 and 31) and the GNDs;
- the strip line (AB0038.J421) if the solder bridge (AB0038.J411) is closed.

**Figure 21. Supply inputs**

1. Battery connector
2. Strip line connectors
3. Expansion connector (pins 3, 32, and 34)
4. Expansion connector (pins 4 and 31)
5. Strip line



These two supplies generate the V\_UNREG voltage through a selection circuit, which gives priority to the V\_CONN. When both two power sources are present, the V\_CONN generates the V\_UNREG voltage.

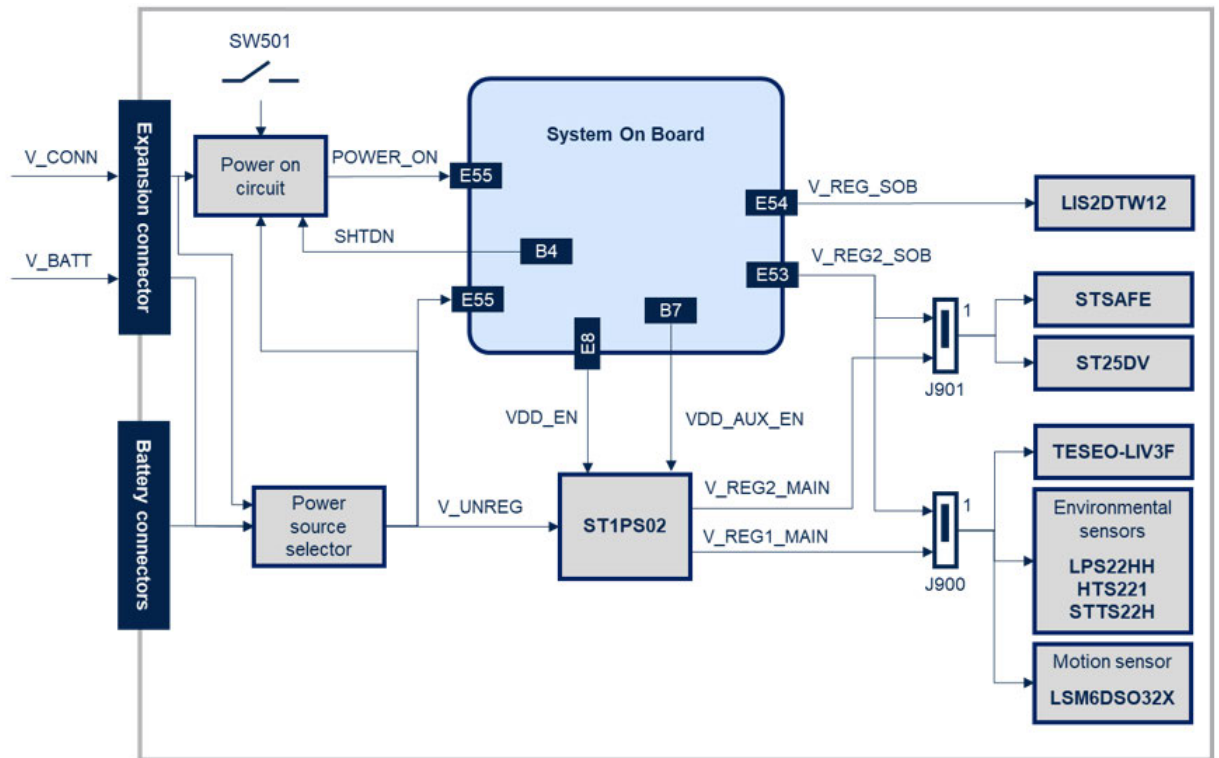
The V\_UNREG voltage is the starting point for the generation of all the other supply voltages. It is the input of the **ST1PS02CQTR** step-down converters embedded in the system on board (as described in [Section 1.4.1.2](#)) and in the main board.

The two step-down converters require a switch-on signal. The one (POWER\_ON) that refers to the **ST1PS02CQTR** on the system on board is generated by a power-on circuit built around the device (AB0038.U500) and triggered by the power/wake-up button (AB0038.SW501). Moreover, the power-on circuit is automatically triggered when the VCONN voltage is present. Therefore, if the **STEVAL-ASTRA1B** is supplied by the battery, you have to push the AB0038.SW501 button to power the circuit. Otherwise, if the USB cable is plugged, it also triggers the circuit power-on.

The **ST1PS02CQTR** device on the main board generates two further supply lines (VDD1 (V\_REG1\_MAIN) and VDD2 (V\_REG2\_MAIN)) by translating the V\_UNREG input voltage. It is enabled through the VDD\_EN signal that comes from the system on board. Moreover, the VDD\_AUX\_EN signal (also coming from the system on board) enables the auxiliary power domain (VDD2).

By default, the VDD1 supply voltage is used for sensors and GNSS purposes, whereas the VDD2 is used to supply the NFC memory and the optional secure element. However, the solder jumpers (J900 and J901) allow supplying the subblocks connected to VDD1 and VDD2 by using the V\_REG\_2 voltage generated by the system on board.

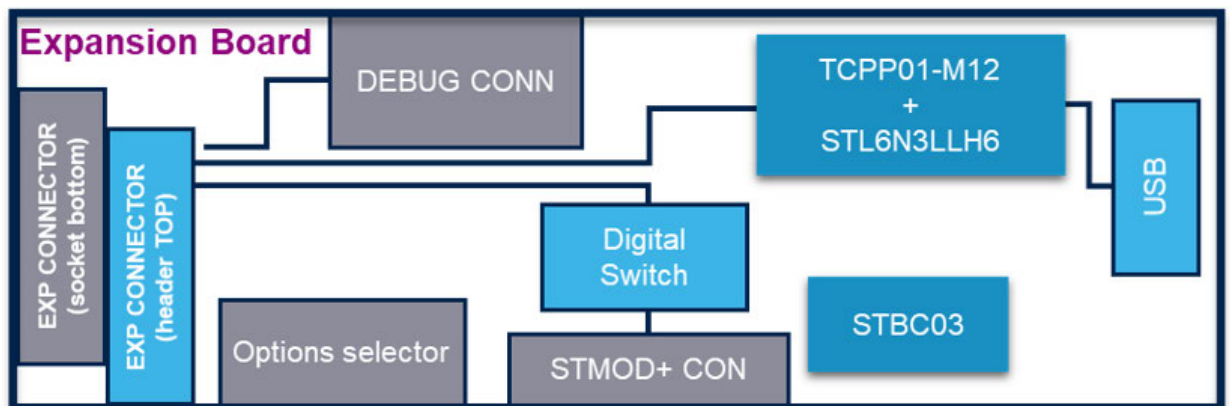
Finally, the main board allows monitoring V\_CONN and V\_BAT voltages. To avoid battery consumption when the system is off, the measurement of the battery voltage is subject to a pass transistor switch driven by the VBAT\_MEAS\_EN signal.

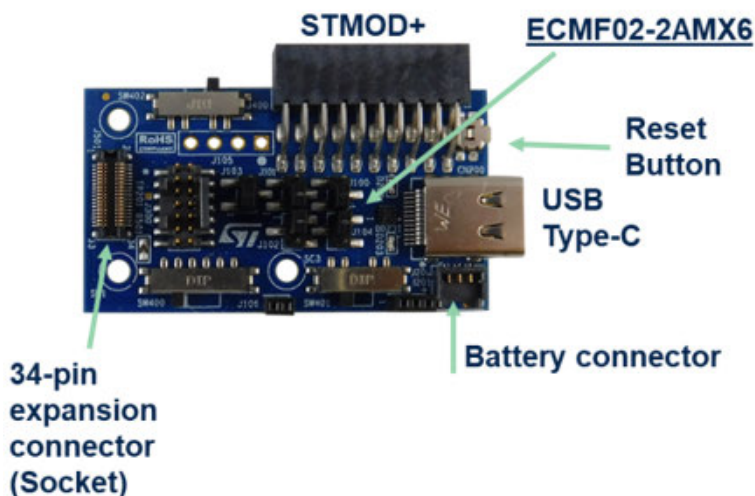
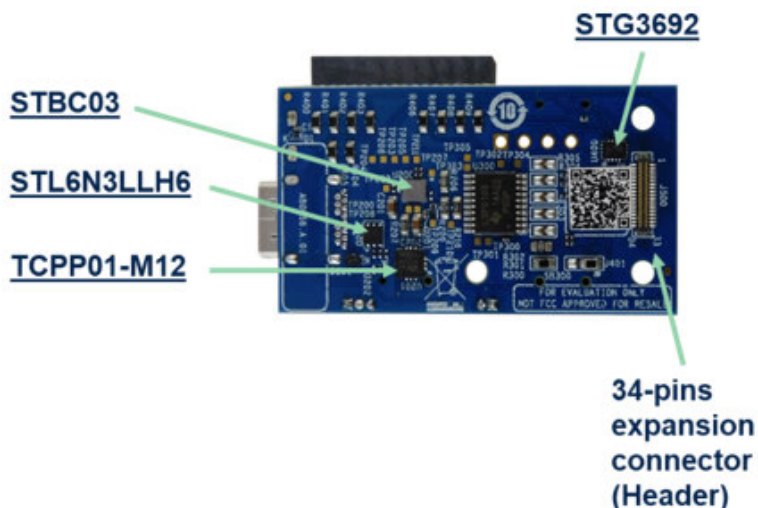
**Figure 22. Power management block scheme**


### 1.4.3 STEVAL-ASTRA1BC expansion board

The main components of the STEVAL-ASTRA1BC expansion board are:

- a USB Type-C receptacle equipped with protections and load switch;
- a battery connector and a battery charging circuit based on **STBC03**;
- a connector for **STLINK-V3MINI** for **STM32WB5MMG** and **STM32WL55JC** programming and debugging;
- two 34-pin expansion connectors;
- an STMOD+ connector;
- selector switches.

**Figure 23. Expansion board block diagram**


**Figure 24. Expansion board top view**

**Figure 25. Expansion board bottom view**


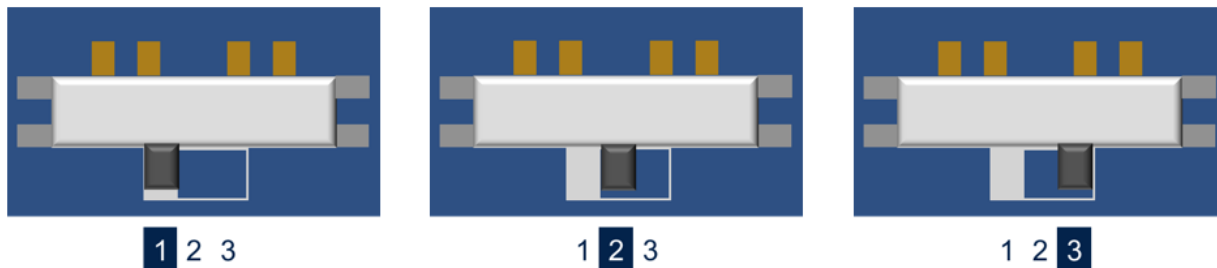
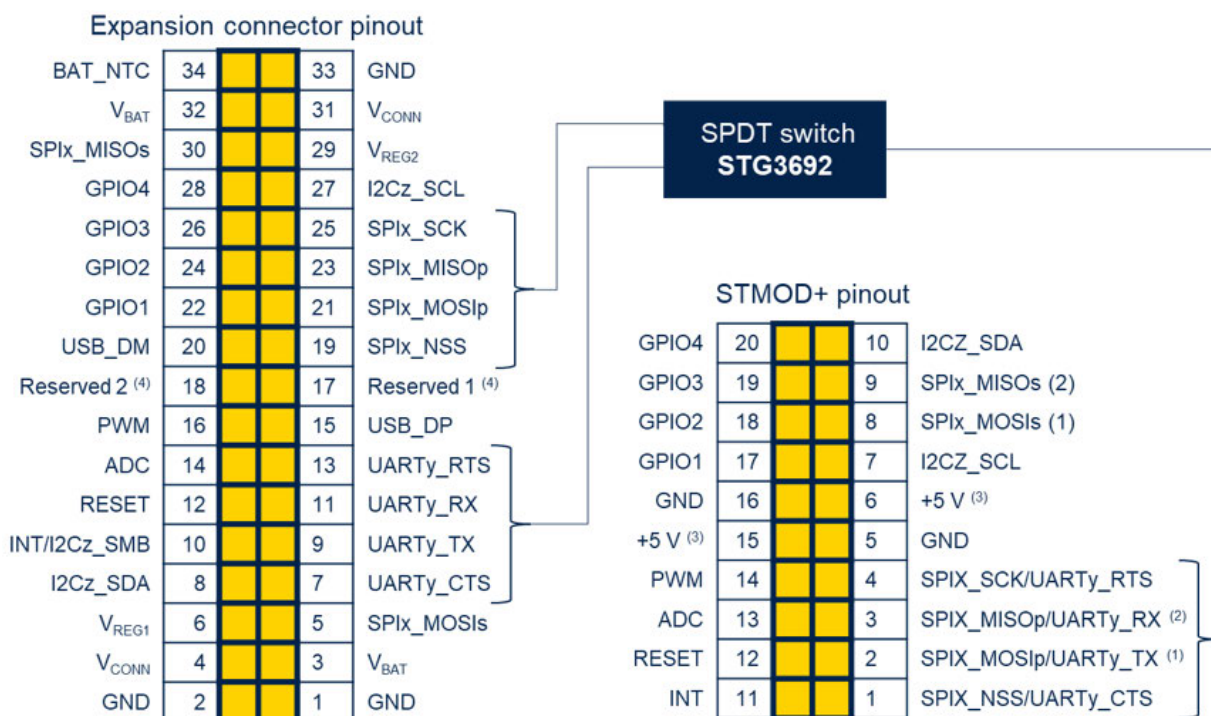
#### 1.4.3.1 34-pin expansion connector

The main board and the expansion board are electrically connected through the 34-pin expansion connectors (header/receptacle). The expansion board can act as an adapter between the 34-pin connector and the STMOD+ connector.

To achieve this purpose, we use a four-channel digital switch ([STG3692](#)). Two selection inputs control the switches: 1-2\_SEL and 3-4\_SEL. Acting on the mechanical selectors (AB0058.SW401 and AB0058.SW402), each selection input can be held to low or high signal. Moreover, it can be controlled through the reserved pins of the 34-pin expansion connector.

**Table 7. Selector logic levels**

| Position | Selection signal    |
|----------|---------------------|
| 1        | High level          |
| 2        | Firmware controlled |
| 3        | Low level           |

**Figure 26. Three-state selector positions**

**Figure 27. Expansion connector versus STMOD+ adapter**


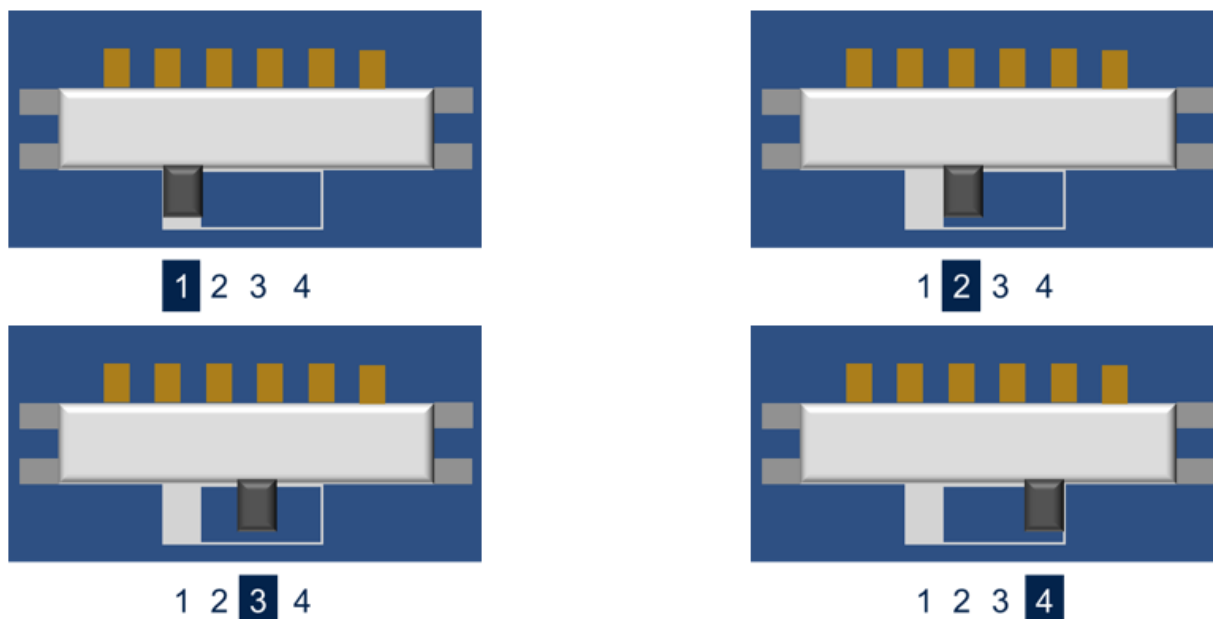
Note:

- (1) Pins 2 and 8 are the same SPIx\_MOSI signals, but they must come from two different I/O.
- (2) Pins 3 and 9 are the same SPIx\_MISO signals, but they must come from two different I/Os.
- (3) These pins are connected to VCONN by default, but optionally can be connected to VREG1, VREG2 or VBATT.
- (4) These pins can be used to drive the SPDT switch.

The STMOD+ connector provides +5 V to be applied to pins 6 and 15. This specification is met when the VCONN voltage is routed to these pins. However, the AB0058.SW400 selector allows addressing different voltages towards these pins as per the table below.

**Table 8. STMOD+ supply voltage selections**

| Position | Supply voltage |
|----------|----------------|
| 1        | VREG1          |
| 2        | VREG2          |
| 3        | VBAT           |
| 4        | VCONN          |

**Figure 28. Four-state selector positions**


#### 1.4.3.2

##### **STDC14 connector for *STLINK-V3MINI***

The STDC14 (AB0058.J300) allows the connection to an STM32 target through the SWD protocol. Moreover, it provides two UART signals for the virtual COM port.

**Table 9. STDC14 connector pinout**

| STDC14 pin number | Pin description     |
|-------------------|---------------------|
| 1                 | Reserved            |
| 2                 | Reserved            |
| 3                 | T_VCC               |
| 4                 | T_SWDIO             |
| 5                 | Insertion detection |
| 6                 | T_SWCLK             |
| 7                 | GND                 |
| 8                 | N.C.                |
| 9                 | N.C.                |
| 10                | N.C.                |
| 11                | GND                 |
| 12                | T_NRST              |
| 13                | T_VCP_RX            |
| 14                | T_VCP_TX            |

As the *STLINK-V3MINI* works from 3 V to 3.6 V, a level shifter (AB0058.U300) is applied between the programmer and the microcontrollers. It allows programming and debugging the two microcontrollers even if their supply voltage is less than 3 V.

#### 1.4.3.3

##### **Three-pin jumpers**

Some functions of the expansion connector are shared among the STMOD+ and the STDC14 connectors.

The configuration of each jumper must be consistent with that of the group it belongs to. For example, if one of the jumpers of the group is changed, the other jumpers that belong to the same group have to be moved accordingly.

For the default jumper configuration, see [Figure 26](#).

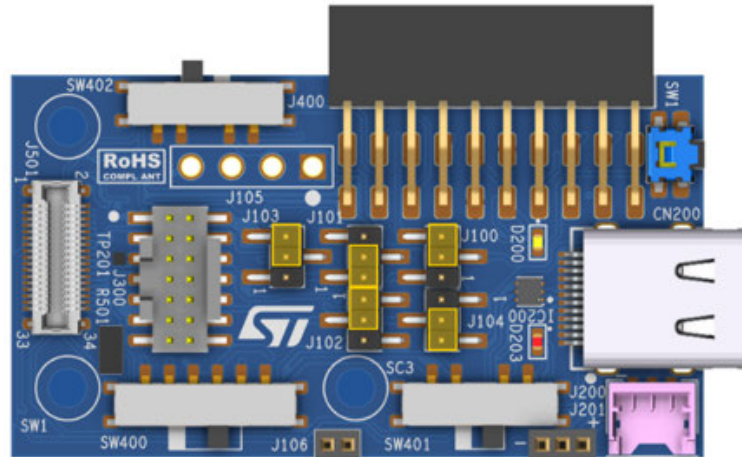
**Table 10. Configuration map of the three-pin jumper selectors**

| Jumper | Group                           | Configuration                                                                       | Description                                                                                                                         |
|--------|---------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| J100   | ST-LINK firmware upgrade/STMOD+ |    | RESET_SIGNAL net is connected to the STLINK_RESET as a jumper is connected between pins 1 and 2 (default setting).                  |
|        |                                 |    | RESET_SIGNAL net is connected to the STMOD_RESET as a jumper is connected between pins 2 and 3.                                     |
| J101   | ST-LINK firmware upgrade/STMOD+ |    | Expansion connector RESERVED1 net is connected to the STLINK_SWCLK as a jumper is connected between pins 1 and 2 (default setting). |
|        |                                 |    | Expansion connector RESERVED1 net is connected to the STMOD_SEL1 as a jumper is connected between pins 2 and 3.                     |
| J102   | ST-LINK firmware upgrade/STMOD+ |    | Expansion connector RESERVED2 net is connected to the STLINK_SWDIO as a jumper is connected between pins 1 and 2 (default setting). |
|        |                                 |  | Expansion connector RESERVED2 net is connected to the STMOD_SEL2 as a jumper is connected between pins 2 and 3.                     |
| J103   | ST-LINK tracking/STMOD+         |  | UARTy_RX net is connected to the STLINK_VCP_RX as a jumper is connected between pins 1 and 2 (default setting).                     |
|        |                                 |  | UARTy_RX net is connected to the STMOD_UART_RX as a jumper is connected between pins 2 and 3.                                       |
| J104   | ST-LINK tracking/STMOD+         |  | UARTy_TX net is connected to the STLINK_VCP_TX as a jumper is connected between pins 1 and 2 (default setting).                     |
|        |                                 |  | UARTy_TX net is connected to the STMOD_UART_TX as a jumper is connected between pins 2 and 3.                                       |

#### 1.4.3.4 Reset switch

The STEVAL-ASTRA1BC embeds a reset switch (AB0058.SW1) to reset the two microcontrollers. For this purpose, place the J100 three-pin jumper of the expansion board in configuration 1-2 and the J422 three-pin jumper of the main board in configuration 3-4. By acting on the J405 three-pin jumper, you can drive the signal coming from the switch to the [STM32WB5MMG](#) or to the [STM32WL55JC](#) microcontroller.

Figure 29. STEVAL-ASTRA1BC default jumper configuration



#### 1.4.3.5 Power management

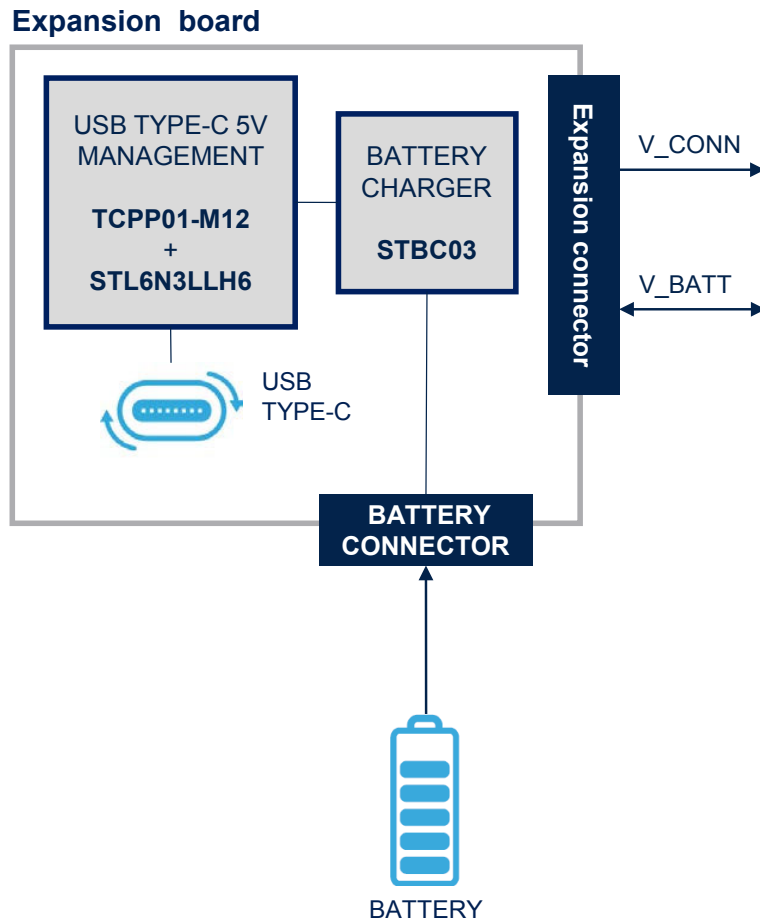
The STEVAL-ASTRA1BC expansion board embeds the last section of the power management circuit. The available power sources are the VBAT battery voltage and the VCONN (which is generated by the USB Type-C™ port).

The battery voltage can be supplied in three ways:

1. via the battery connector (AB0058.J200);
2. via the strip line connector (AB0058.J201);
3. via the expansion connector (AB0038.J411) (pins 3, 32, and 34) and the GNDs.

The VCONN voltage can be supplied via the USB Type-C™ connector.

**Figure 30. Expansion board - power management block scheme**



## 1.5 Product marking

Some kits feature a specific STM32 device version, which allows the operation of any bundled commercial stack/library available. This STM32 device shows a "U" marking option at the end of the standard part number and is not available for sales.

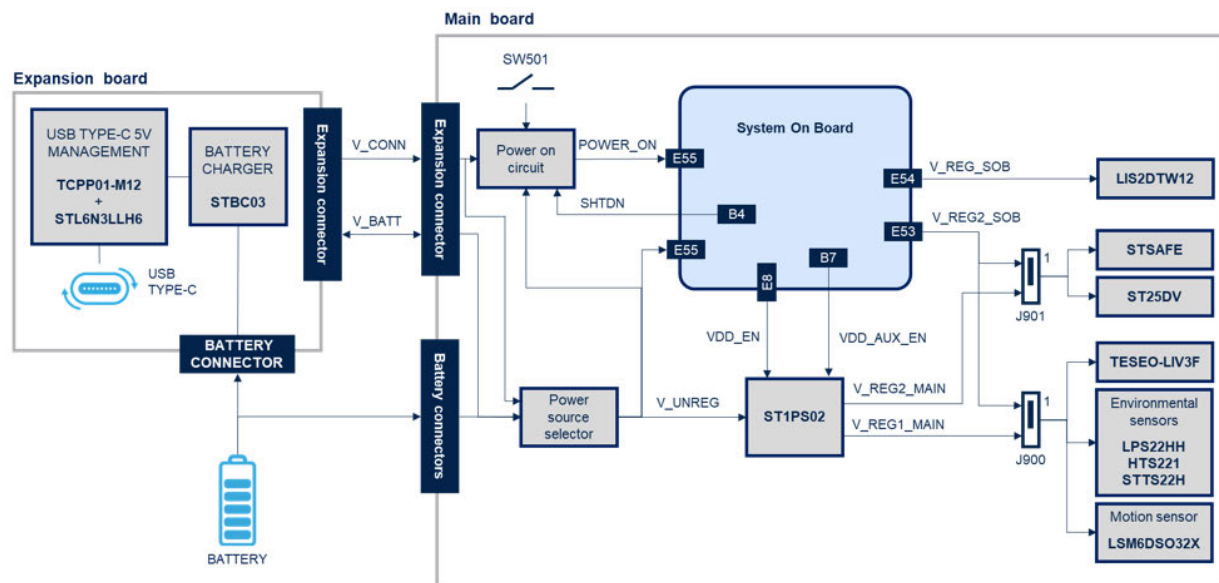
In order to use the same commercial stack in his/her application, a developer may need to purchase a part number specific to this stack/library. The price of those part numbers includes the stack/library royalties.

## 1.6 Power management overall circuit

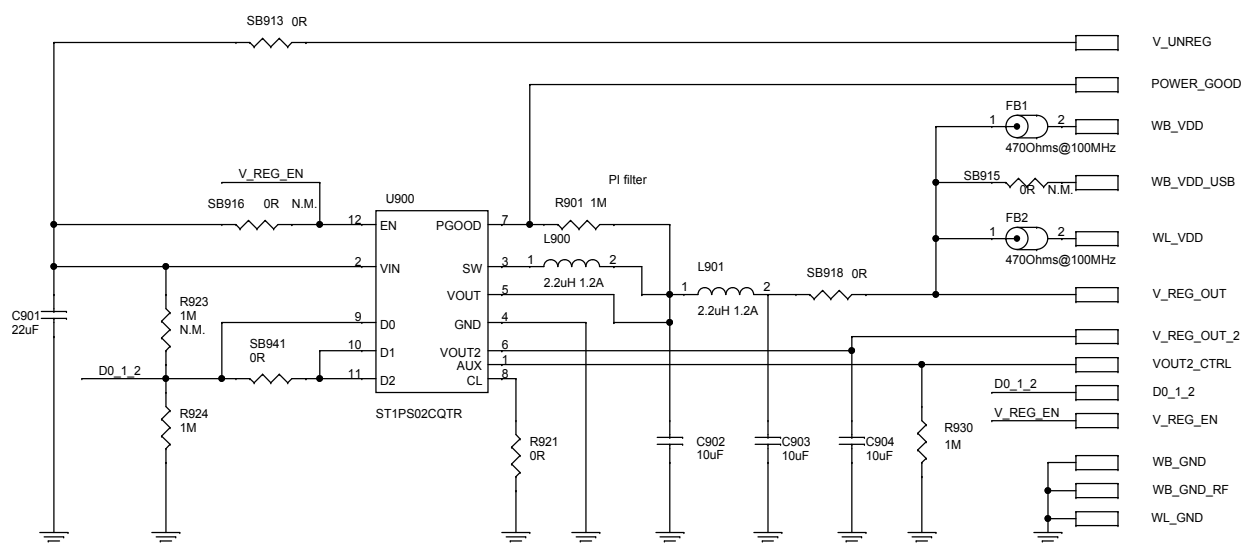
The power management is designed for modularity, flexibility, and power consumption optimization. The power management circuit is made of components that are embedded in the three boards.

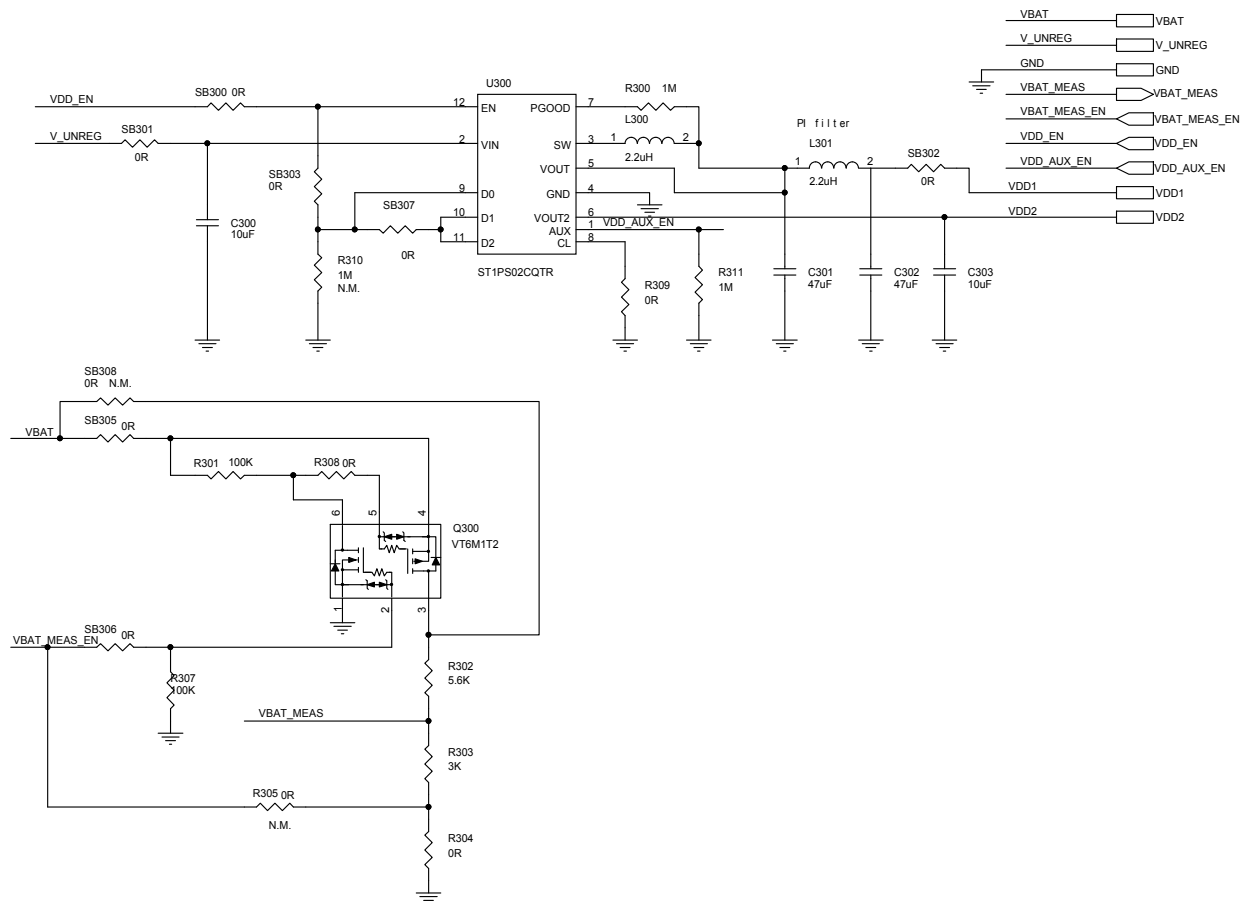
The picture below shows the whole circuit.

**Figure 31. STEVAL-ASTRA1B - power management block scheme**



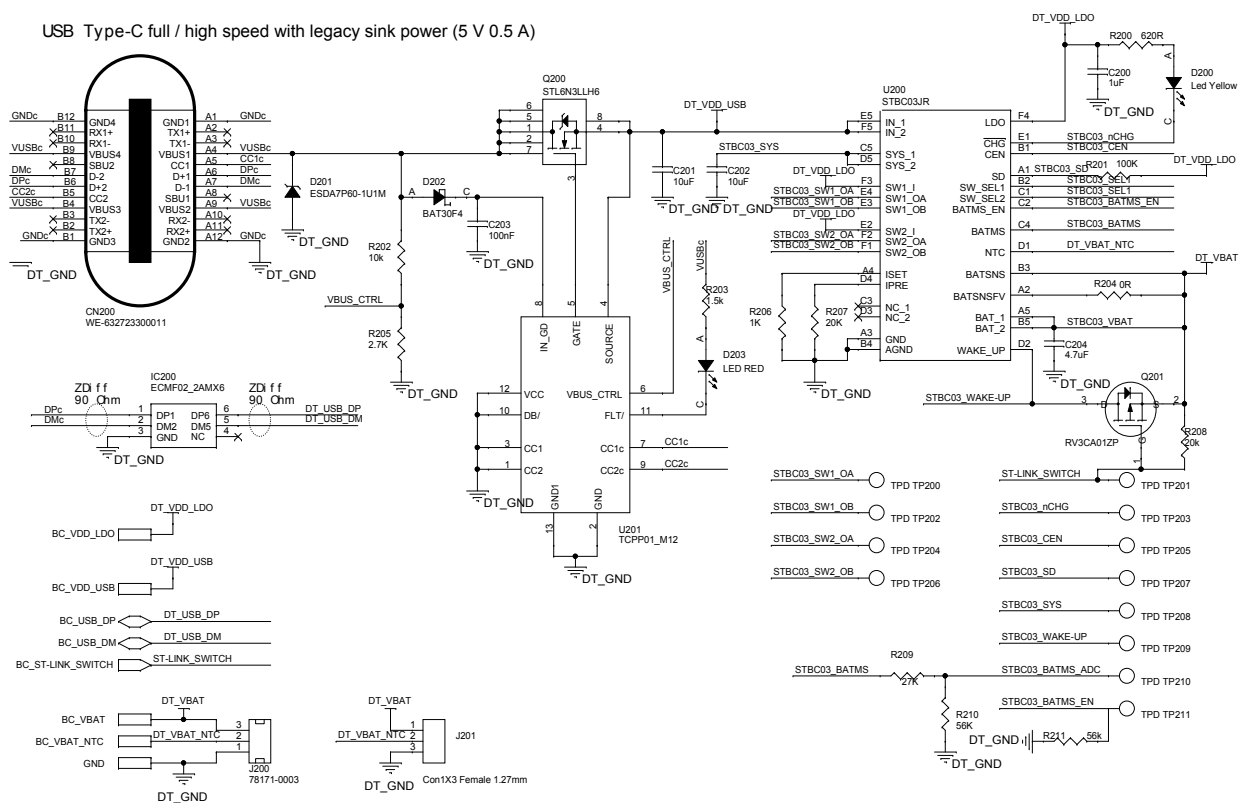
**Figure 32. System on board - power management schematic**



**Figure 33. Main board - power management schematic**


**Figure 34. Expansion board - power management schematic**

USB Type-C full / high speed with legacy sink power (5 V 0.5 A)



## 2 How to use the STEVAL-ASTRA1B

### 2.1 How to assemble the kit

You can use the STEVAL-ASTRA1B with or without expansion board. The first case allows using the battery charger, the debug/programming interface, and the STMOD+ connection.

The battery can be rechargeable or not. In the first case, it can be connected to the main board or to the expansion board. In the second case, it can be connected to the main board without the expansion board.

**Warning:** Pay attention to the sharp pins.

Figure 35. STEVAL-ASTRA1B configuration with primary battery

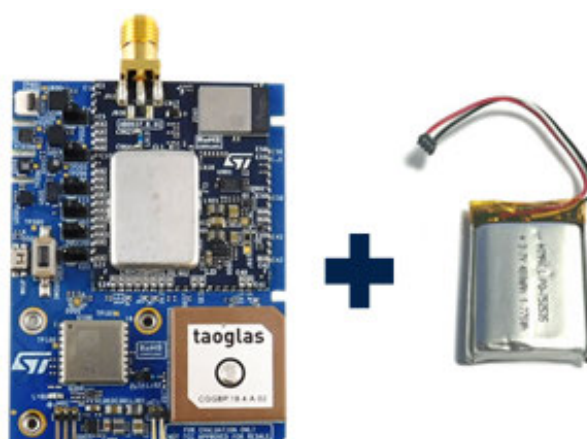
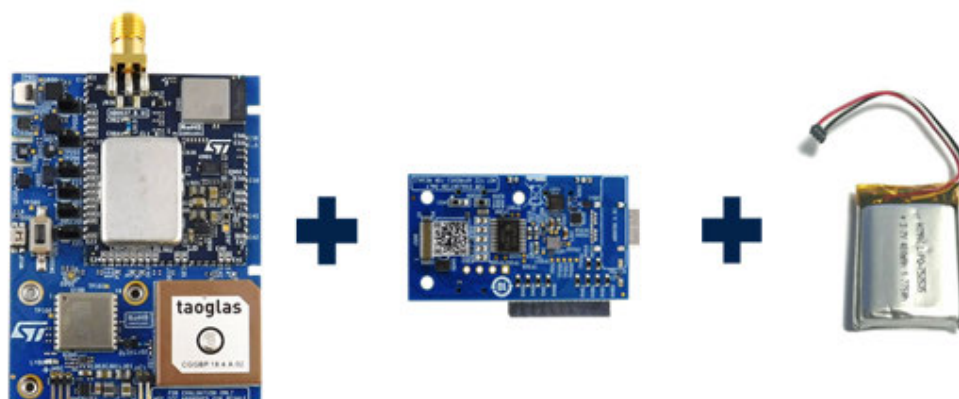


Figure 36. STEVAL-ASTRA1B configuration with rechargeable battery

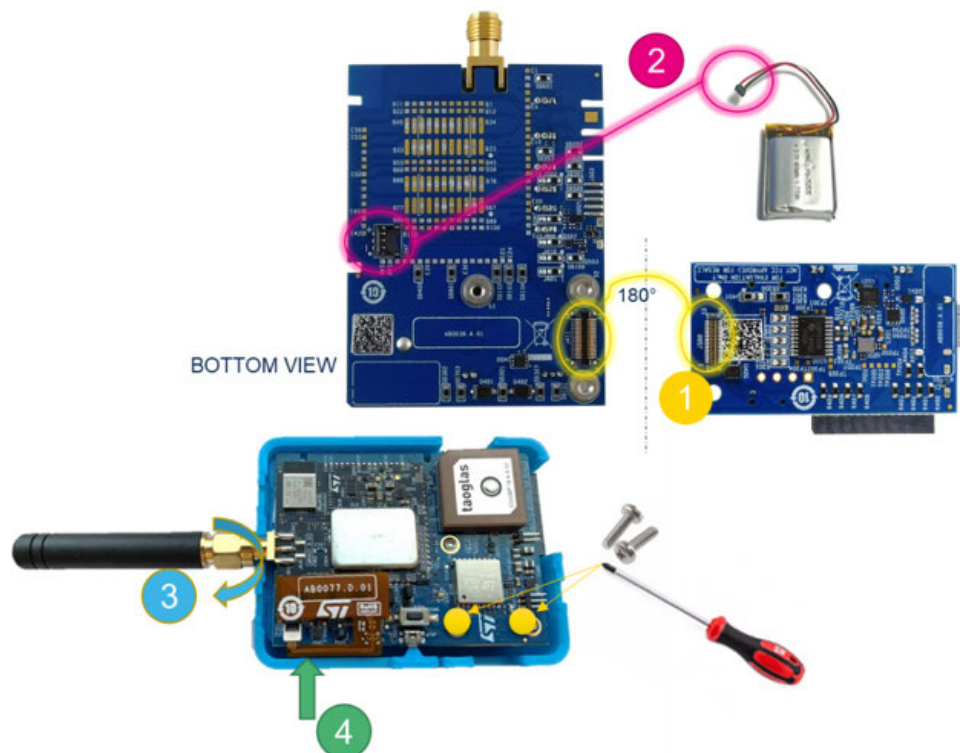


If the STEVAL-ASTRA1B kit is not assembled, follow the steps below to assemble it.

- Step 1.** Connect the expansion board to the main board bottom side and tighten the screws.
- Step 2.** Plug the battery.
- Step 3.** The antenna is already stuck to the SMA connector to prevent attaching any other antenna.

**Step 4.** Insert the NFC antenna.

**Figure 37. STEVAL-ASTRA1B kit assembly**



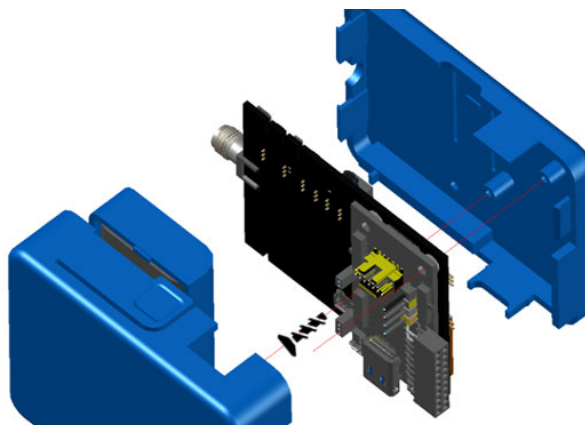
**Step 5.** Tighten the two screws next to the expansion connector.

The STEVAL-ASTRA1B comes with a plastic case to be used only for demo purposes.

**Important:** Do not use the plastic case in real use-cases.  
Do not apply mechanical stress.

**Step 6.** To fix the STEVAL-ASTRA1B to the top of the plastic case, use the long screw.

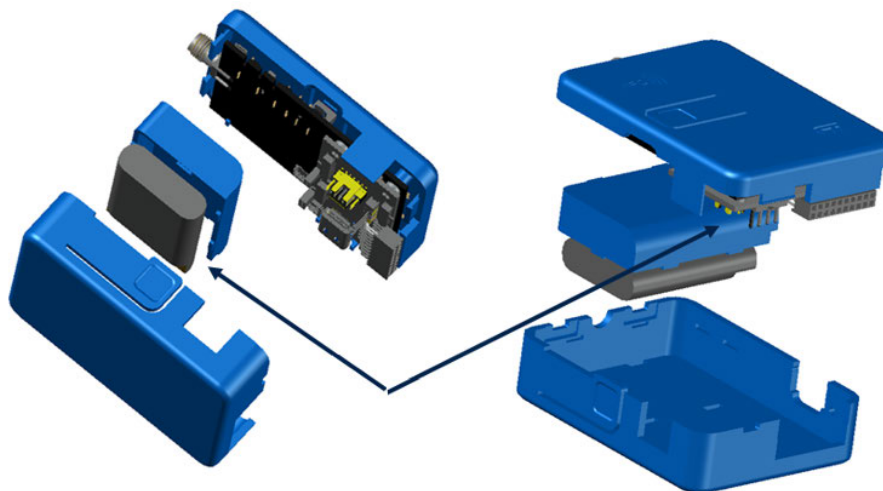
**Figure 38. Plastic case assembly (1 of 2)**



**Step 7.** Insert the battery in the bottom part of the case and apply its cover.

**Step 8.** After battery connection, plug the top and the bottom part of the case.

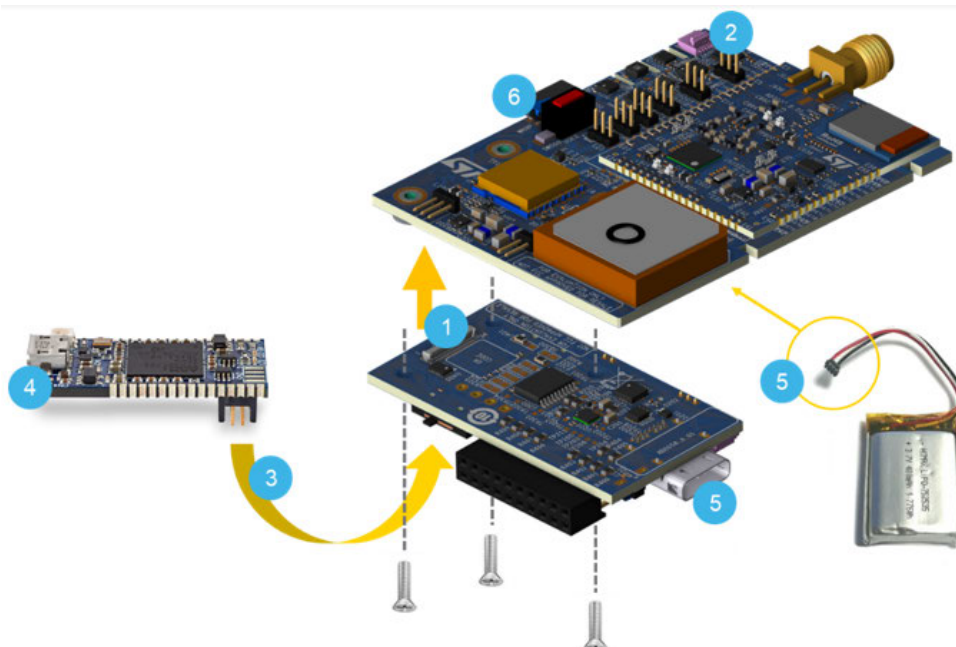
**Figure 39. Plastic case assembly (2 of 2)**



## 2.2 How to program the kit

There are multiple ways of accessing the programming pins of the microcontrollers. As described in [Section 1.4.1.1](#) and in [Section 1.4.2.8](#), some pins placed at the bottom side of the main board allow a direct access. However, the simplest method is based on the use of an **STLINK-V3MINI**, which is a standalone debugging and programming mini probe for STM32 microcontrollers. The figure below shows the complete setup.

**Figure 40. Setup for firmware upgrade**



- Step 1.** Connect the expansion board to the bottom side of the main board and tighten the screws.
- Step 2.** Check the jumper configuration.
- Step 3.** Connect the **STLINK-V3MINI** to the expansion connector through the STDC14 flat cable.

- Step 4.** Supply the programmer via a USB Type-A to Micro-B cable between the [STLINK-V3MINI](#) and the PC and check that the PWR LED is green and the COM LED is red.
- Step 5.** Connect a charged battery to the main board or use a USB Type-C™ cable connected to the expansion board to supply the boards.
- Step 6.** If you use a battery, push the power button to power the system.
- Step 7.** Check the three-pin jumper selection according to the microcontroller to be programmed, as described in [Section 1.4.2.4](#).
- Step 8.** Open the development toolchain or [STM32CubeProgrammer](#) to start programming.

## 2.3

### How to power on the kit and run the asset tracking application

- Step 1.** Push the power button to power on the system (see [Figure 41, 5](#)).
- Step 2.** If you need to recharge the battery, plug a USB cable to the connector (see [Figure 41, 6](#)).

**Figure 41. STEVAL-ASTRA1B power on**



The user RGB LED becomes:

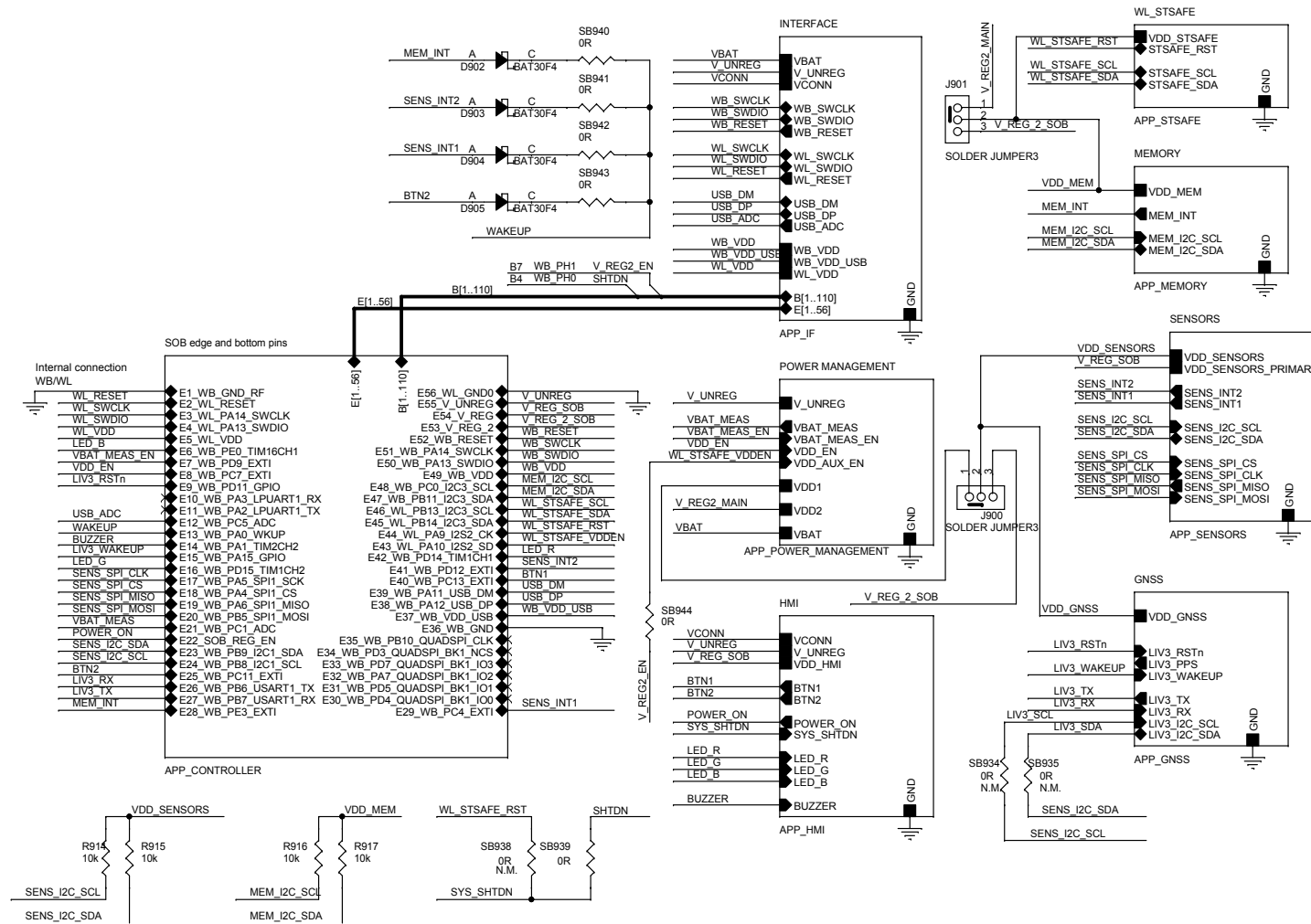
- blue if the configuration is ongoing;
- red if send is ongoing;
- green:
  - with slow blinking if the BLE is not connected;
  - with fast blinking if the BLE is connected;
- yellow if the BLE is connected and sending.

By default, the [STEVAL-ASTRA1B](#) runs the [FP-ATR-ASTRA1](#) firmware package, which implements a full asset tracking application and allows managing all the hardware platform peripherals (refer to the related user manual for further details).

The [STEVAL-ASTRA1B](#) can interact with:

- [STAssetTracking](#) app;
- [STBLESensor](#) app;
- [DSH-ASSETTRACKING](#) dashboard.

Figure 42. Main board (STEVAL-ASTRA1) circuit schematic (1 of 9)



**Figure 43. Main board (STEVAL-ASTRA1) circuit schematic (2 of 9)**

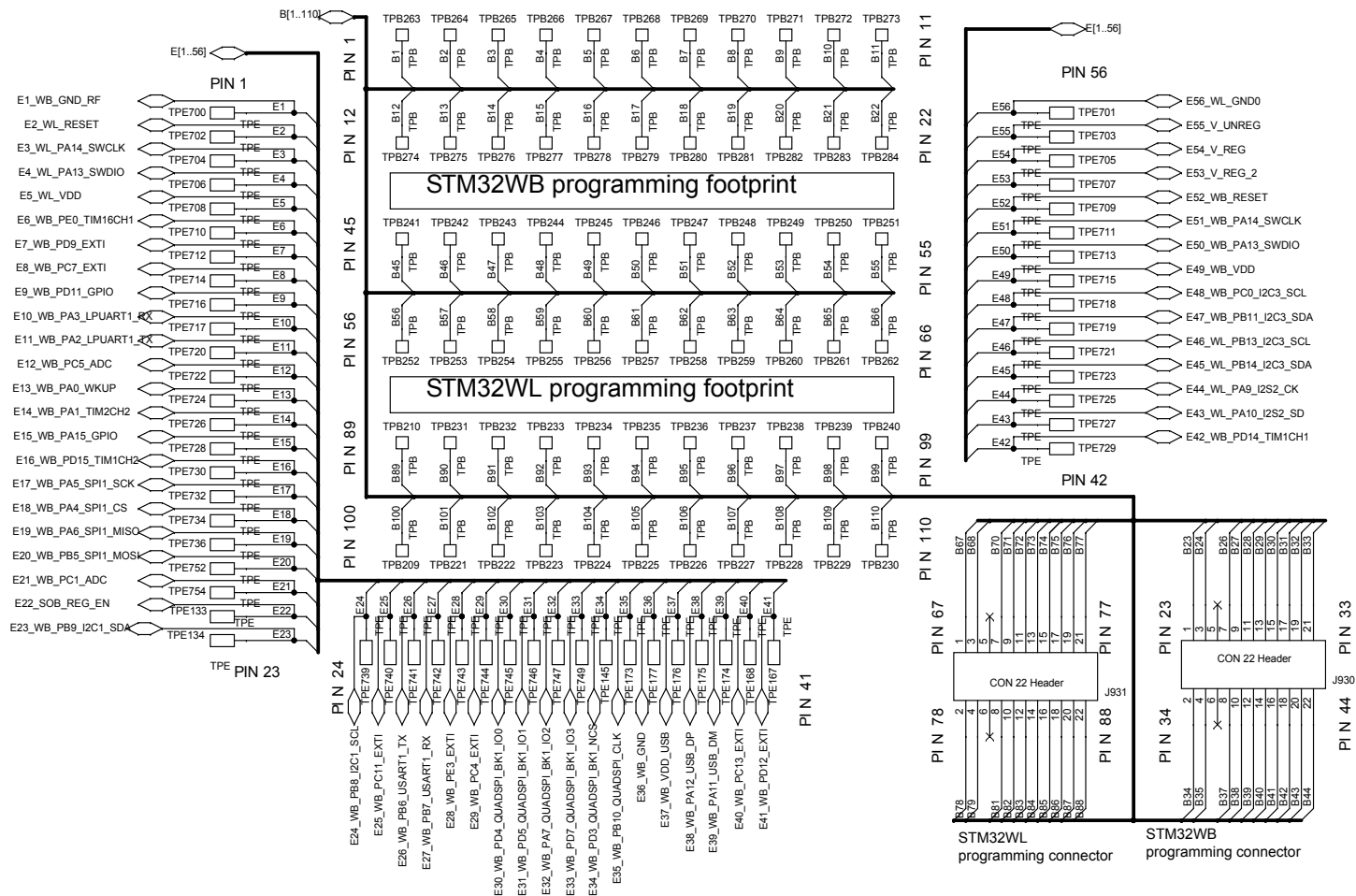


Figure 44. Main board (STEVAL-ASTRA1) circuit schematic (3 of 9)

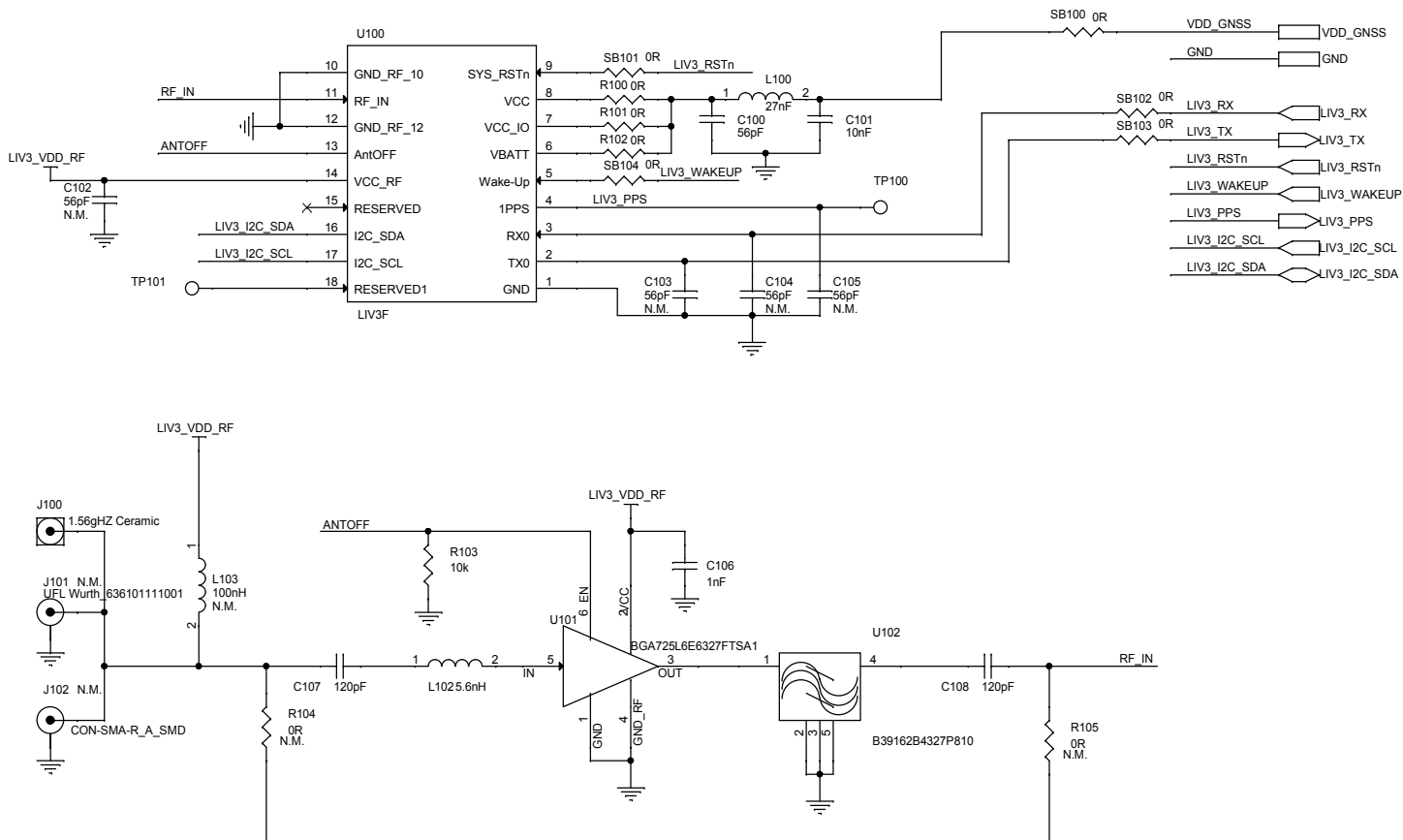


Figure 45. Main board (STEVAL-ASTRA1) circuit schematic (4 of 9)

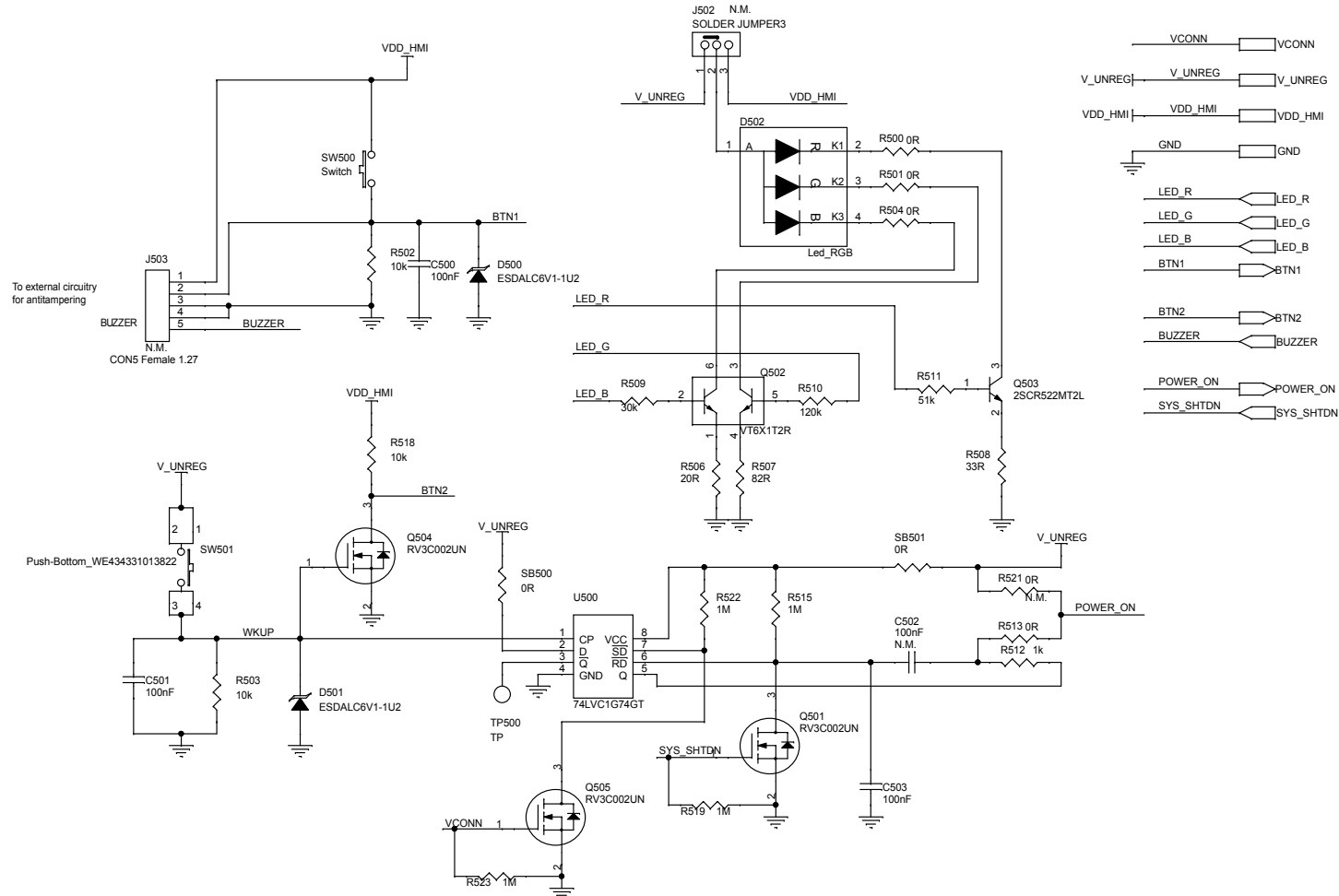


Figure 46. Main board (STEVAL-ASTRA1) circuit schematic (5 of 9)

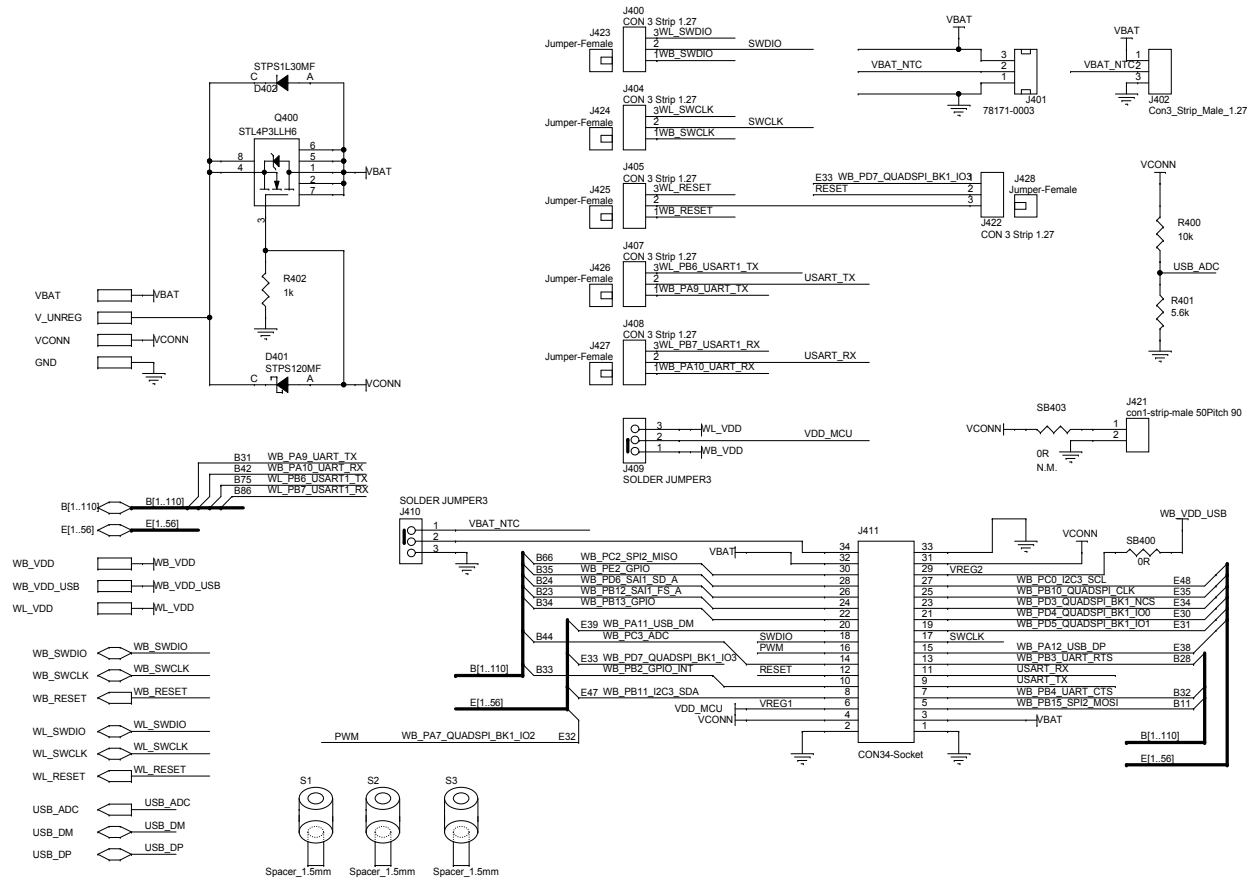
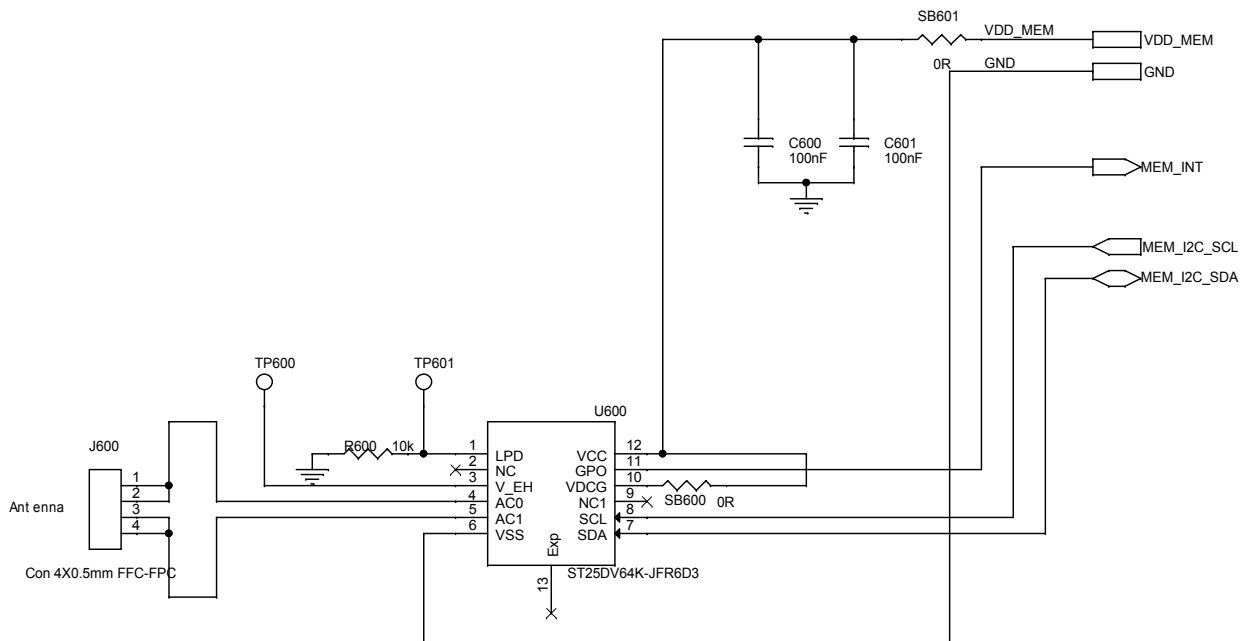
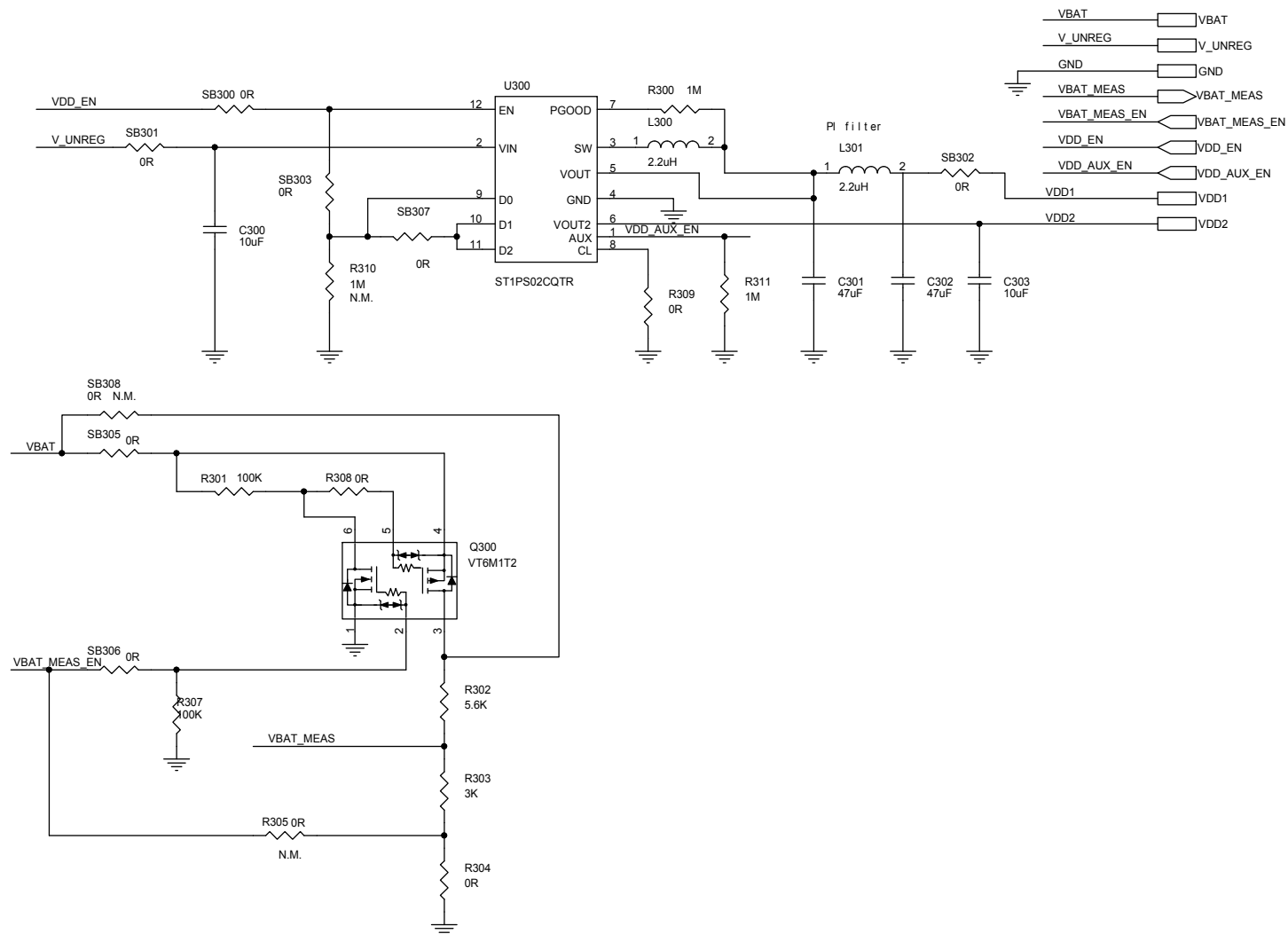


Figure 47. Main board (STEVAL-ASTRA1) circuit schematic (6 of 9)



**Figure 48. Main board (STEVAL-ASTRA1) circuit schematic (7 of 9)**



**Figure 49. Main board (STEVAL-ASTRA1) circuit schematic (8 of 9)**

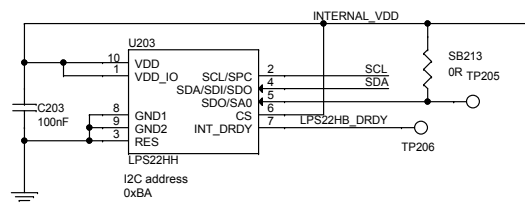
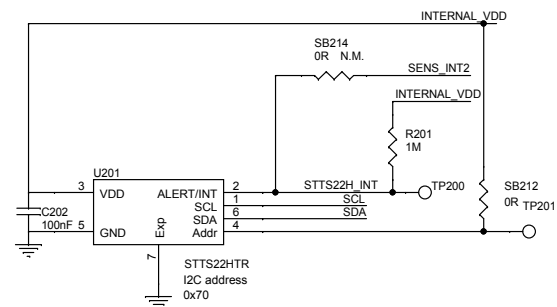
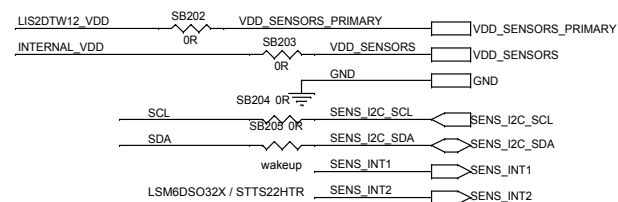
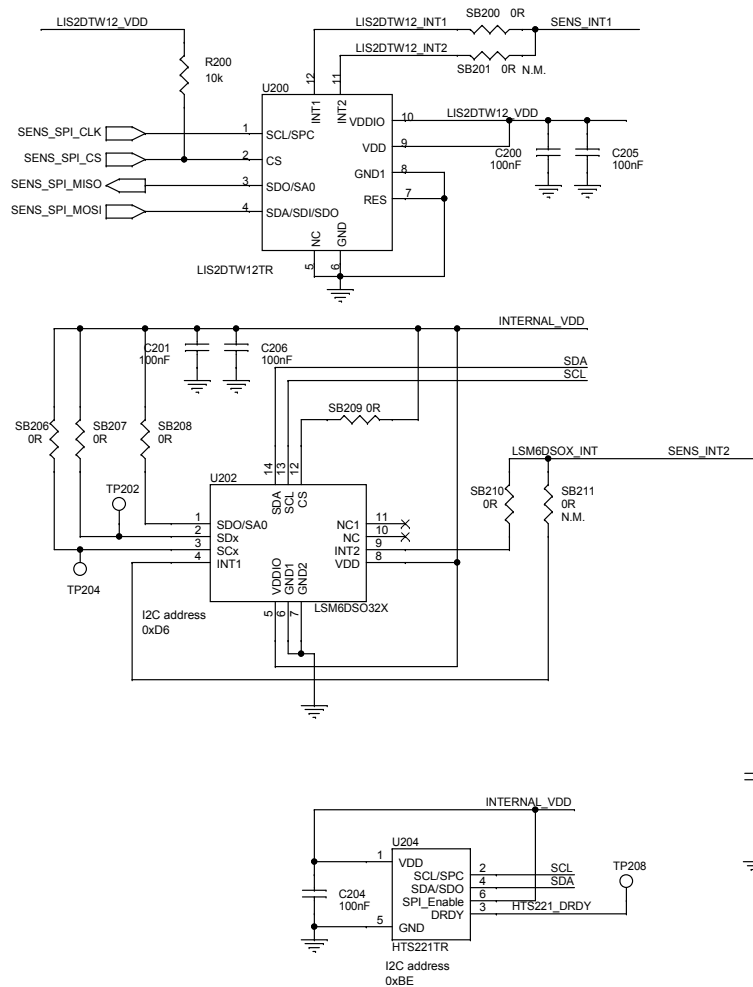


Figure 50. Main board (STEVAL-ASTRA1) circuit schematic (9 of 9)

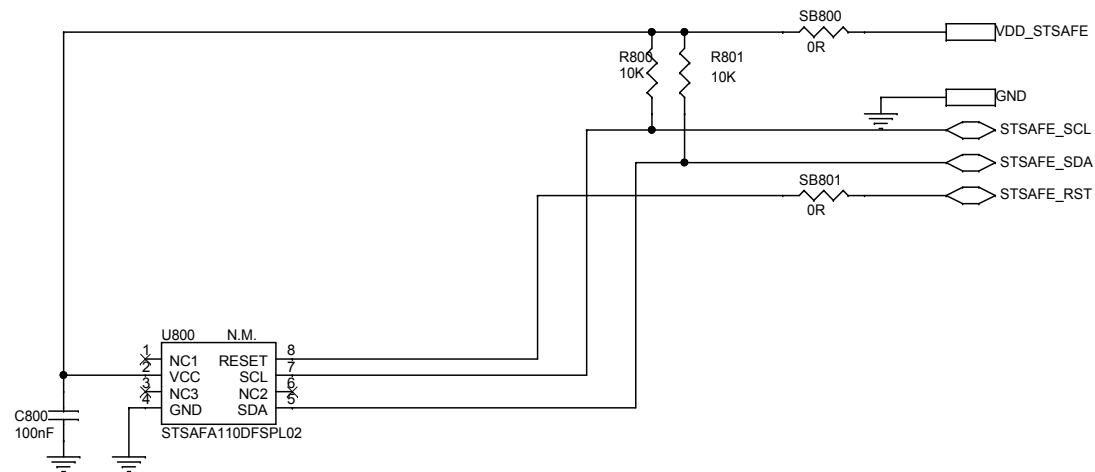
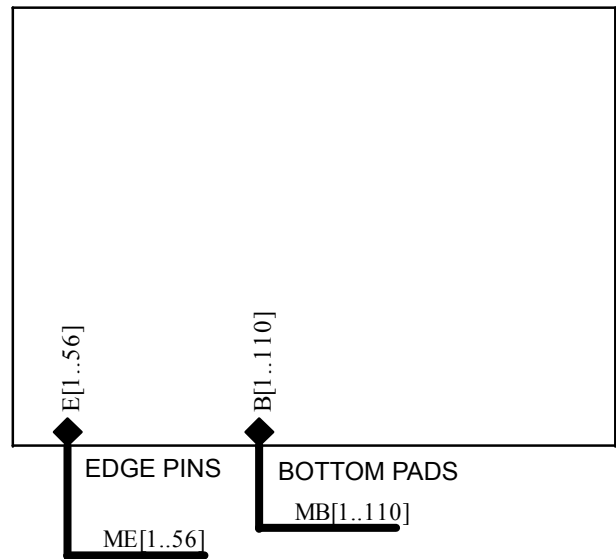


Figure 51. System on board (STEVAL-ASTRA1SB) circuit schematic (1 of 10)



**Figure 52. System on board (STEVAL-ASTRA1SB) circuit schematic (2 of 10)**

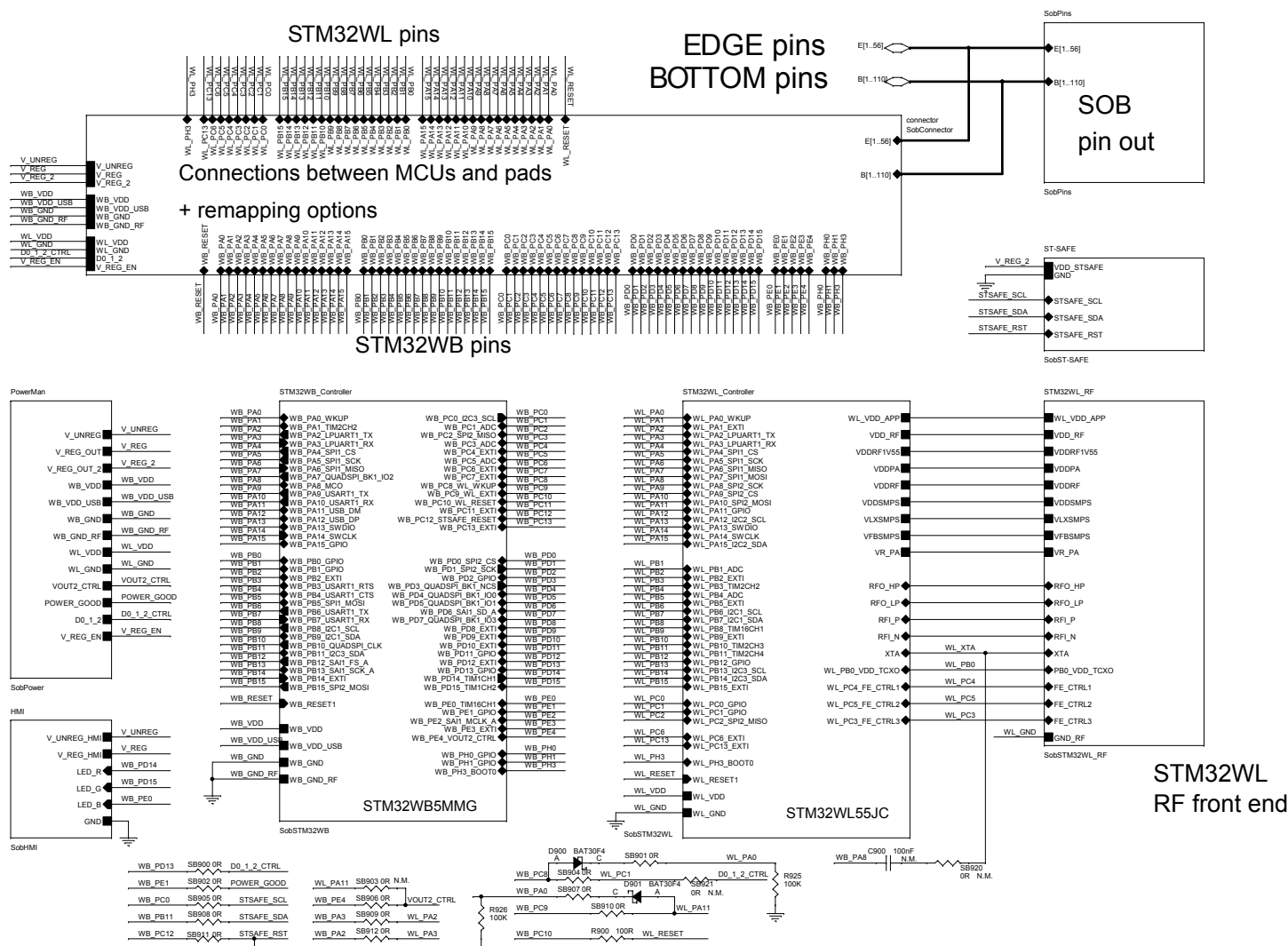
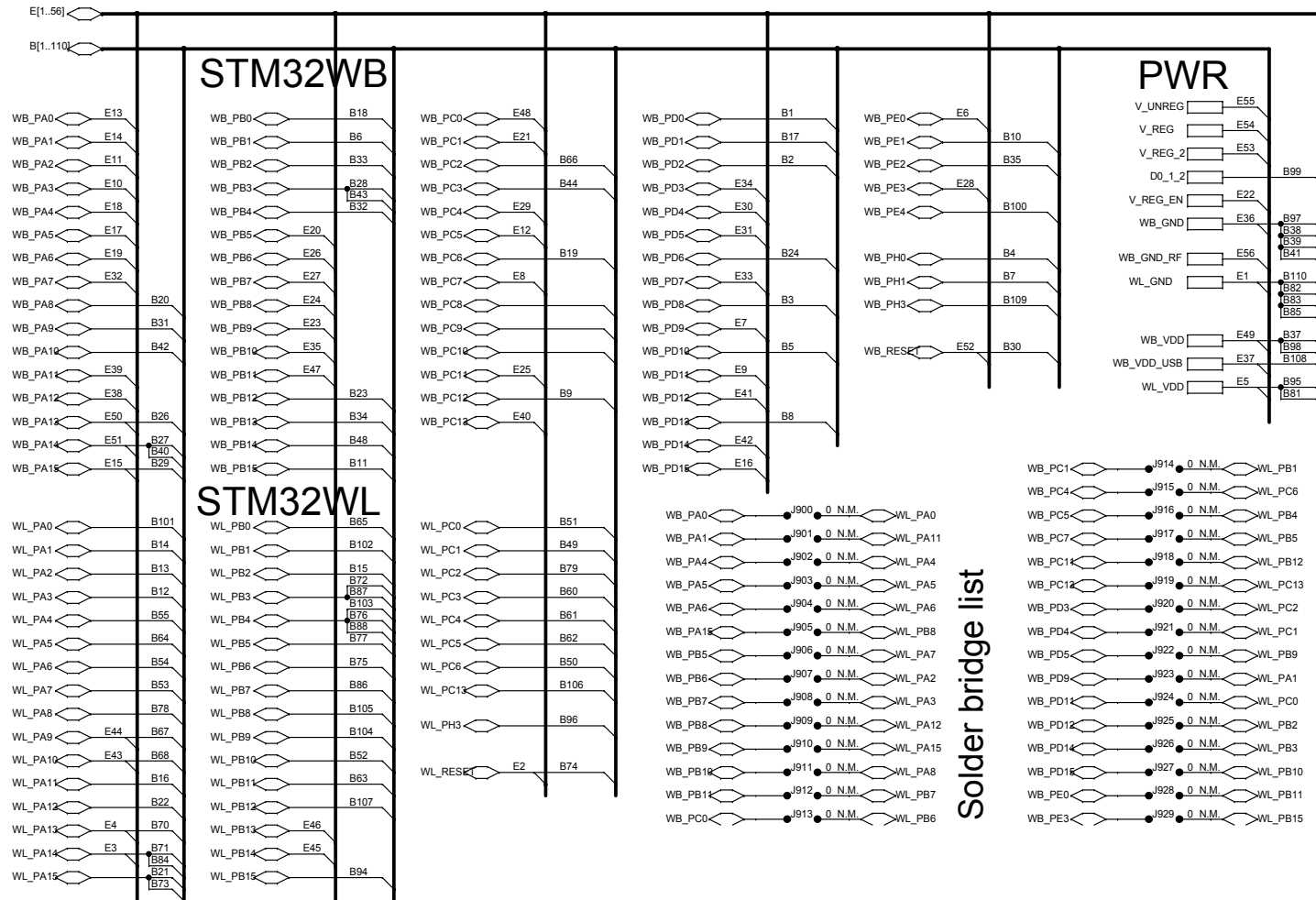


Figure 53. System on board (STEVAL-ASTRA1SB) circuit schematic (3 of 10)

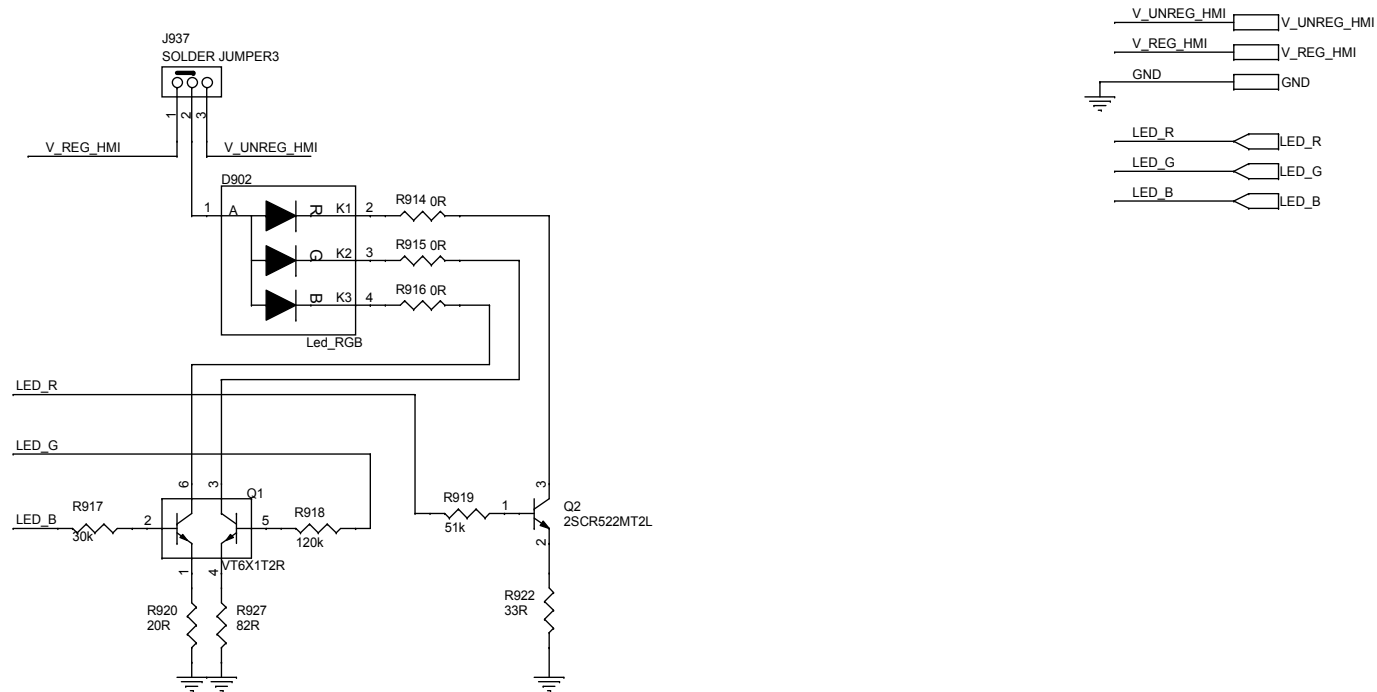


## UM2966

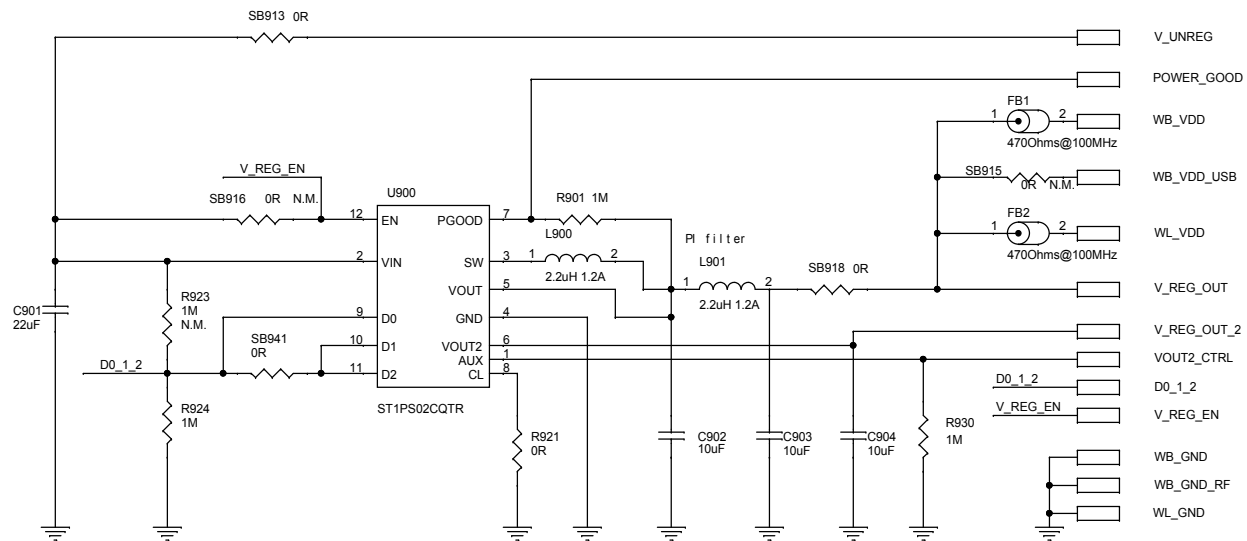
### Schematic diagrams



**Figure 55. System on board (STEVAL-ASTRA1SB) circuit schematic (5 of 10)**



**Figure 56. System on board (STEVAL-ASTRA1SB) circuit schematic (6 of 10)**



[illegible]

Figure 58. System on board (STEVAL-ASTRA1SB) circuit schematic (8 of 10)

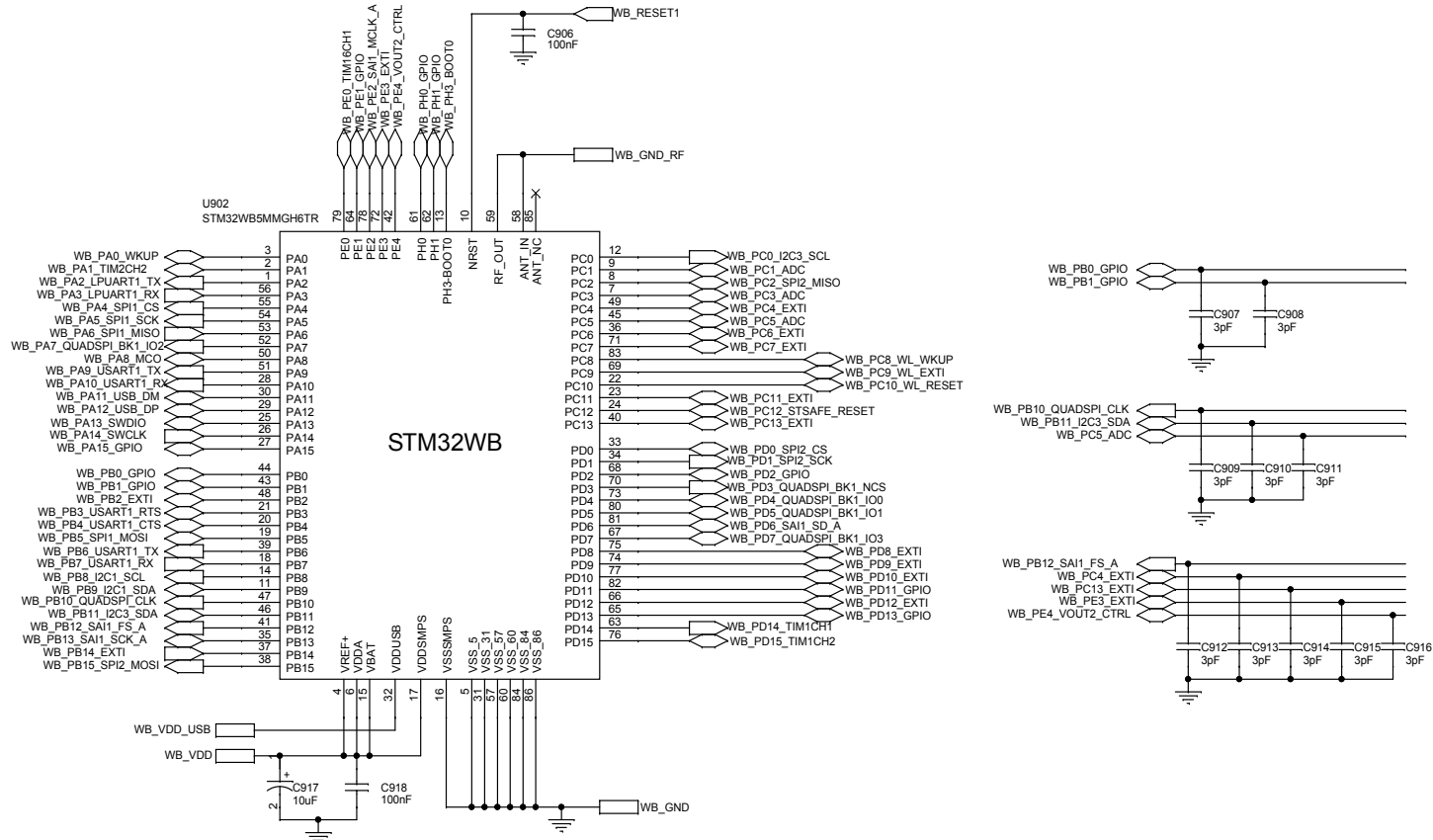
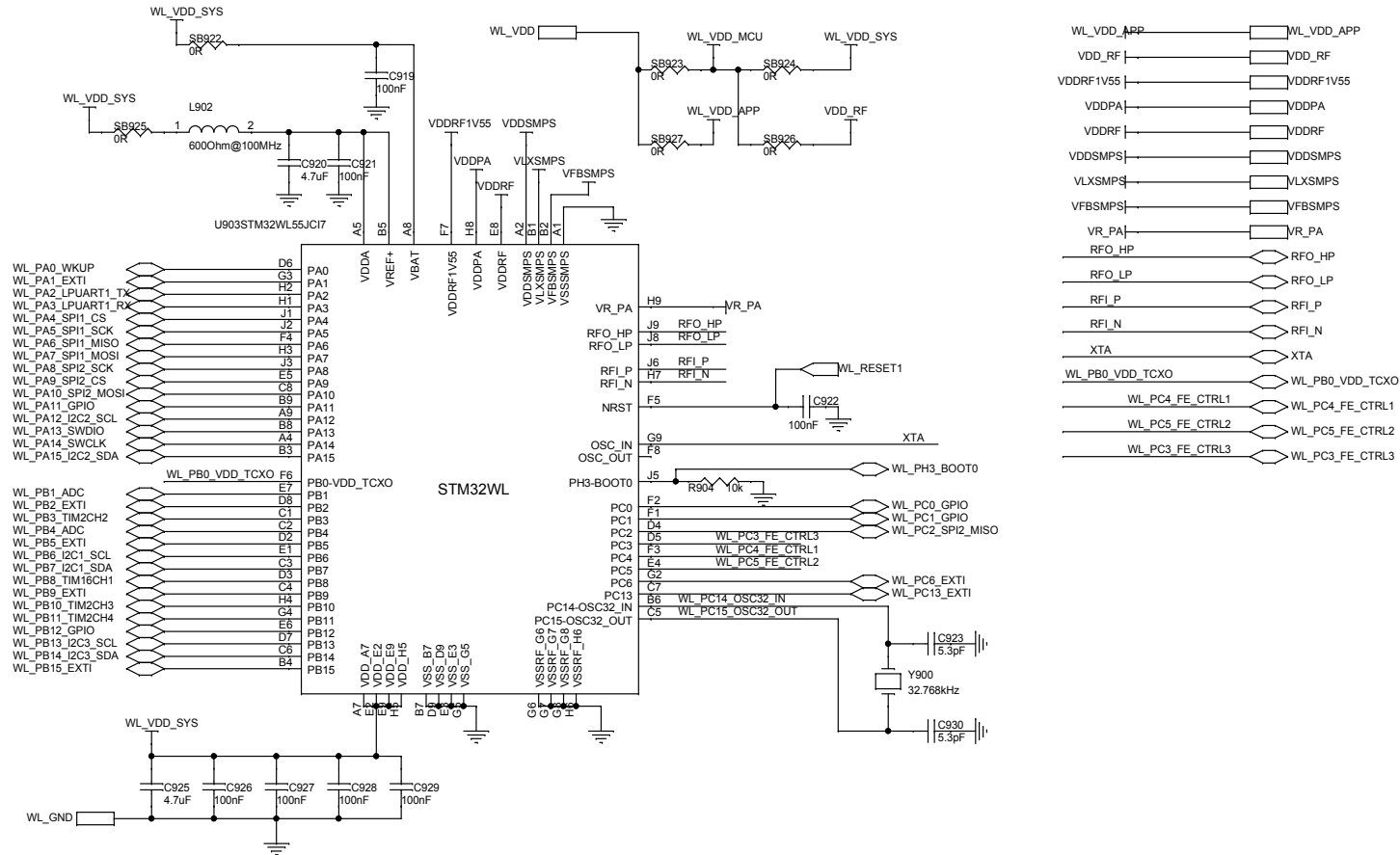


Figure 59. System on board (STEVAL-ASTRA1SB) circuit schematic (9 of 10)



**Figure 60. System on board (STEVAL-ASTRA1SB) circuit schematic (10 of 10)**

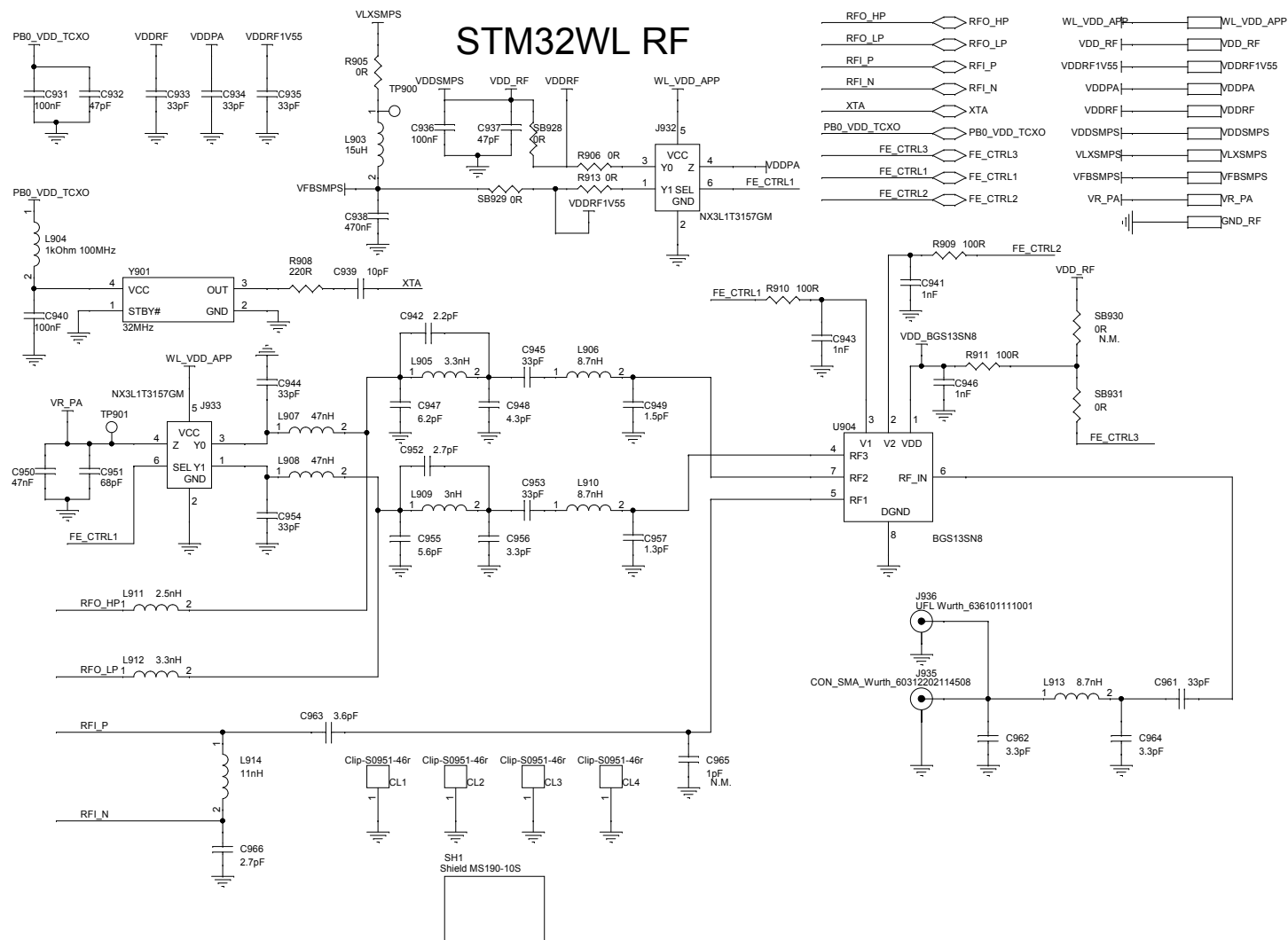
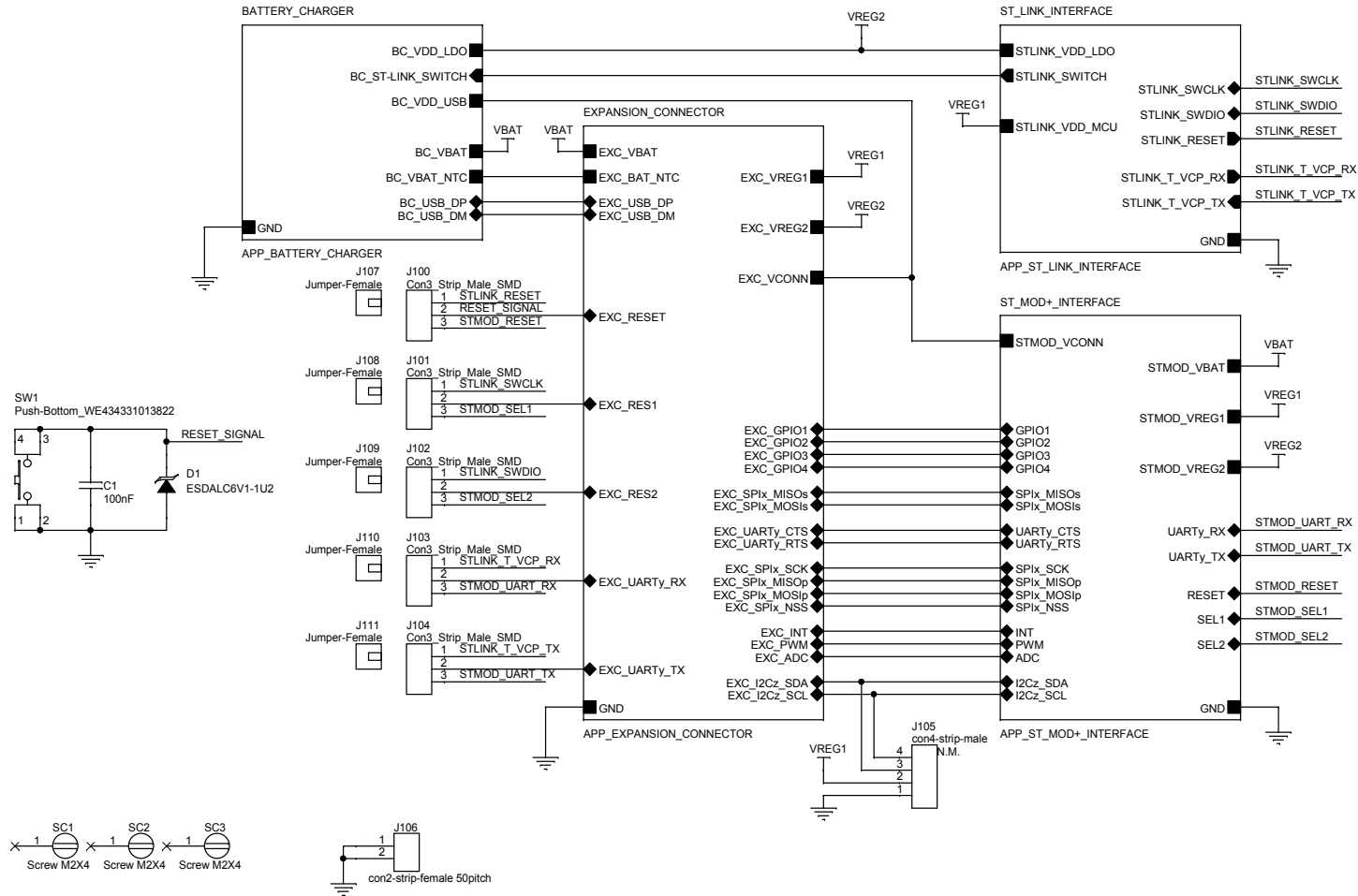
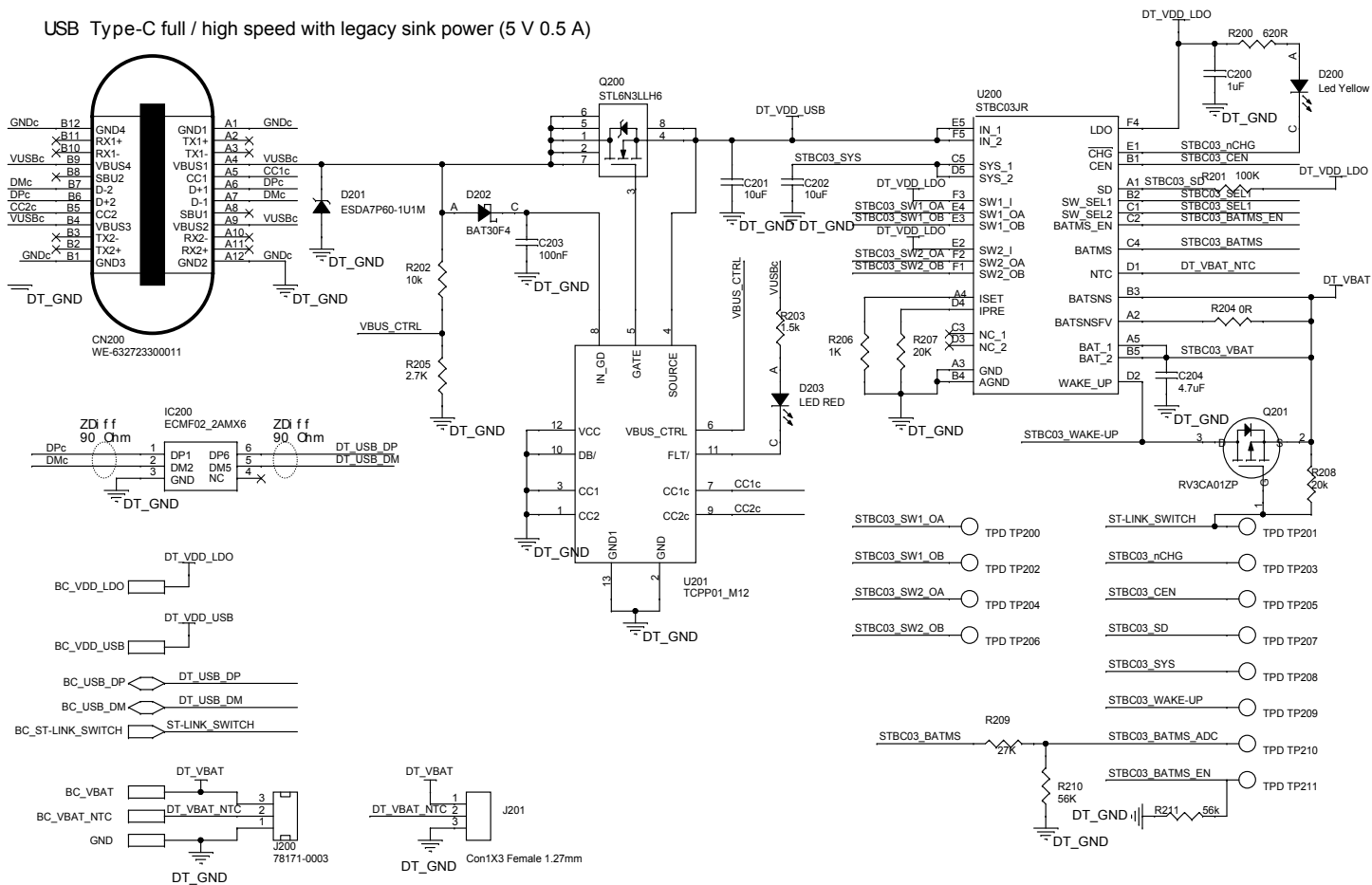


Figure 61. Expansion board (STEVAL-ASTRA1BC) circuit schematic (1 of 5)



**Figure 62. Expansion board (STEVAL-ASTRA1BC) circuit schematic (2 of 5)**

USB Type-C full / high speed with legacy sink power (5 V 0.5 A)



**Figure 63. Expansion board (STEVAL-ASTRA1BC) circuit schematic (3 of 5)**

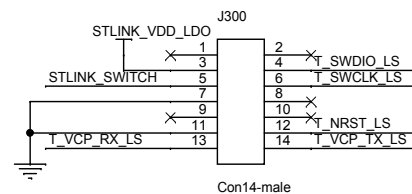
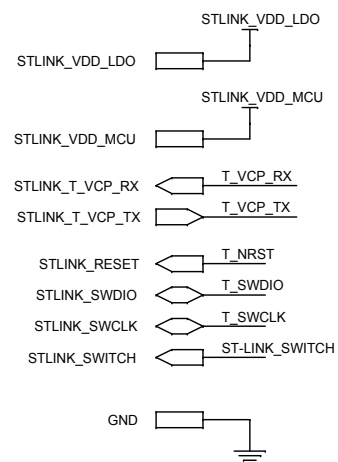
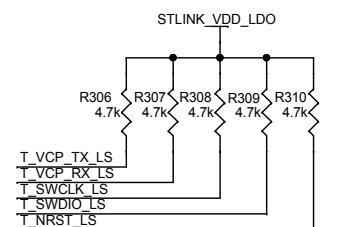
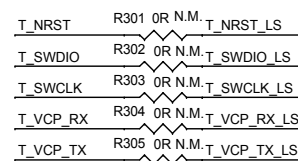
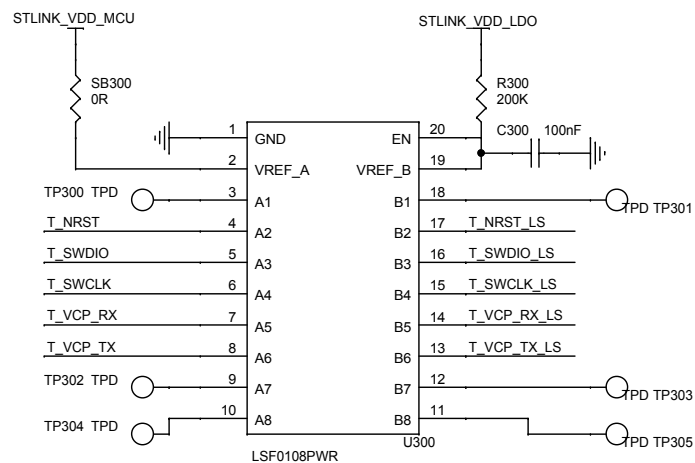


Figure 64. Expansion board (STEVAL-ASTRA1BC) circuit schematic (4 of 5)

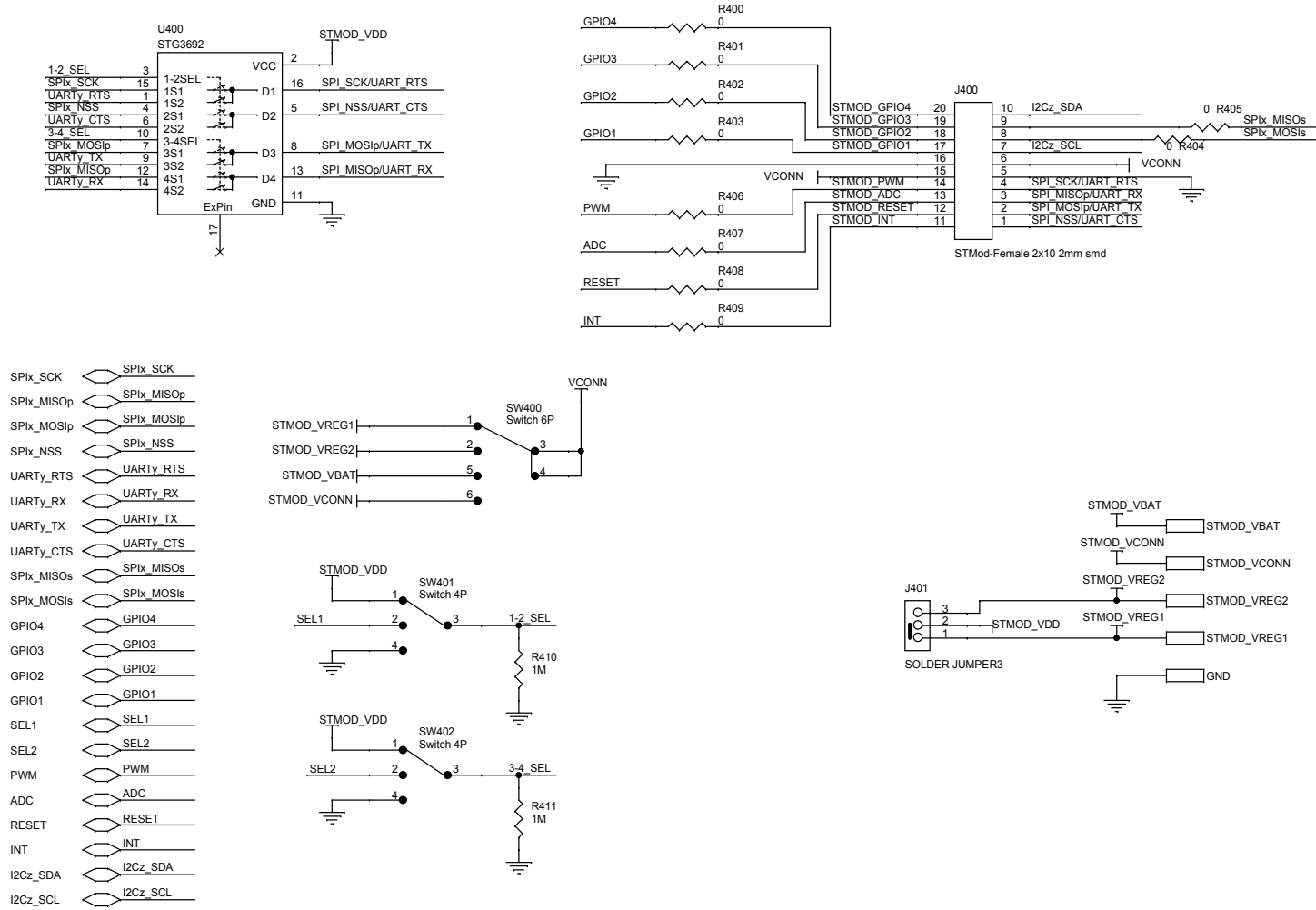
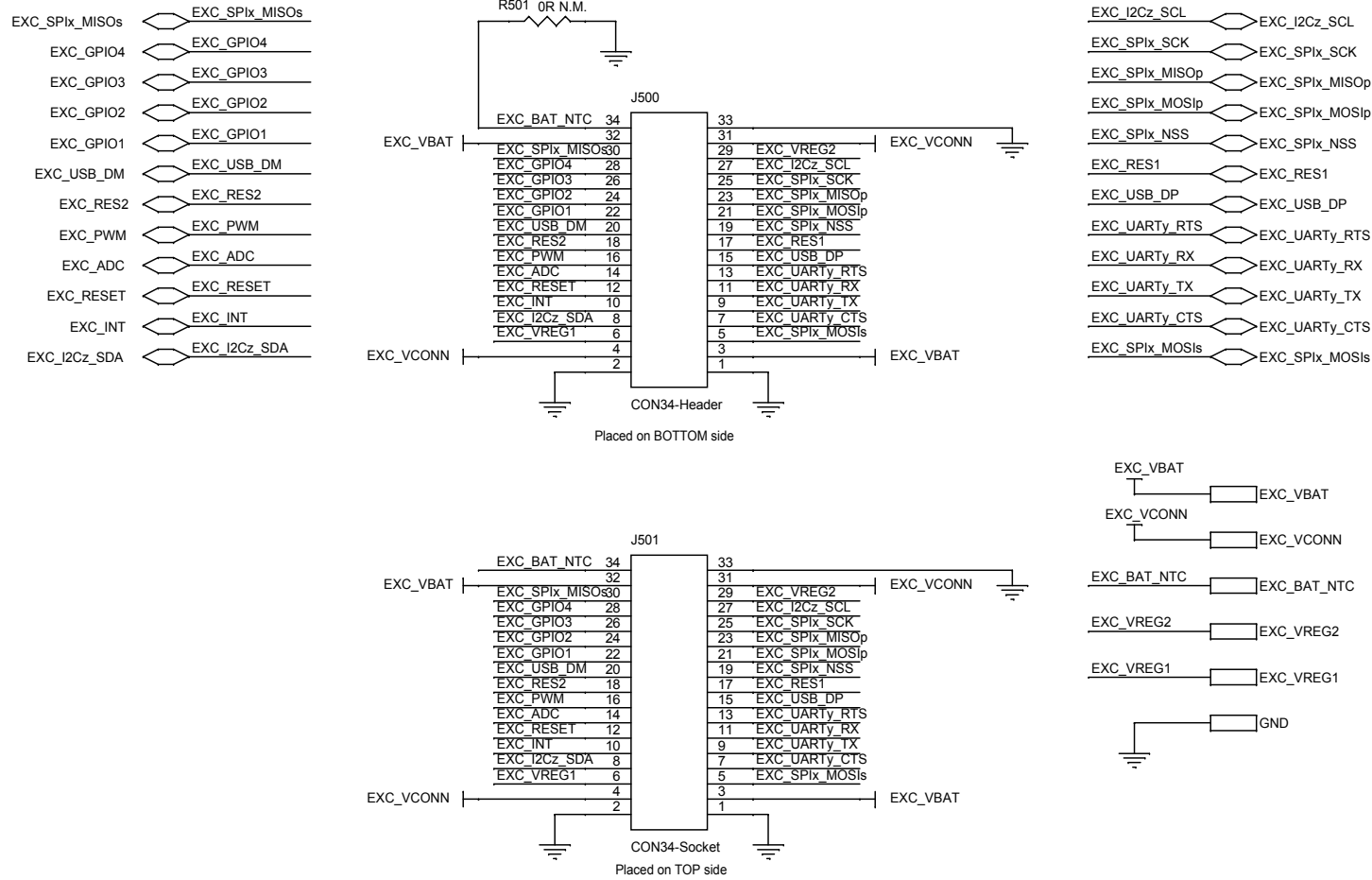
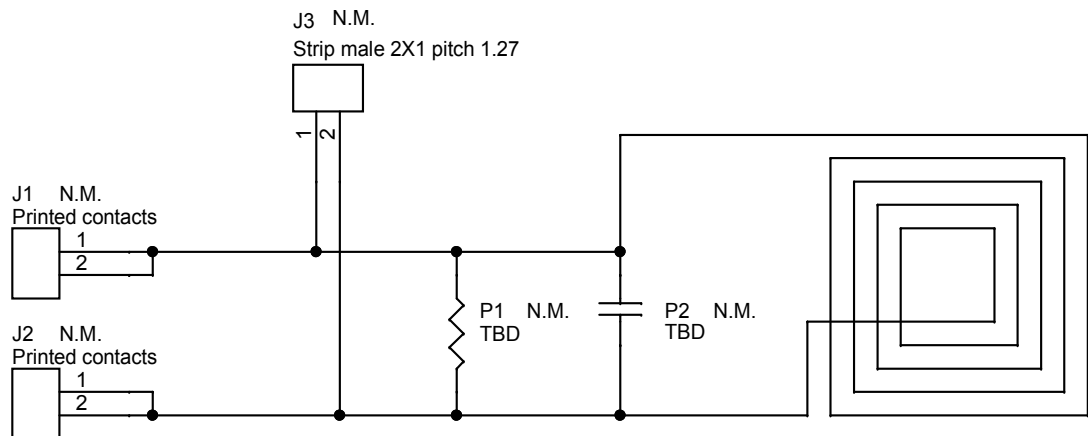


Figure 65. Expansion board (STEVAL-ASTRA1BC) circuit schematic (5 of 5)



**Figure 66. Flexible NFC antenna (STEVAL-ASTRA1NA) circuit schematic**



## 4 Bill of materials

**Table 11. STEVAL-ASTRA1B bill of materials**

| Item | Q.ty | Ref.                      | Part/value                  | Description                           | Manufacturer     | Order code                      |
|------|------|---------------------------|-----------------------------|---------------------------------------|------------------|---------------------------------|
| 1    | 1    | Table 12. STEVAL-ASTRA1   | -                           | Main board                            | ST               | Not available for separate sale |
| 2    | 1    | Table 13. STEVAL-ASTRA1SB | -                           | System on board                       | ST               | Not available for separate sale |
| 3    | 1    | Table 14. STEVAL-ASTRA1BC | -                           | Expansion board                       | ST               | Not available for separate sale |
| 4    | 1    | Table 15. STEVAL-ASTRA1NA | -                           | Flexible antenna                      | ST               | Not available for separate sale |
| 5    | 1    | Plastic case              | -                           | Plastic case                          | -                | -                               |
| 6    | 1    | Antenna                   | -                           | SMA antenna                           | LPRS             | ANT-SS900                       |
| 7    | 1    | Battery                   | 3.7 V, 480 mAh              | LiPo battery                          | Himax            | LIPO-752535                     |
| 8    | 2    | Screws                    | M2 stainless steel, 4 mm    | Conical head metric screws            | RS PRO           | 914-1462                        |
| 9    | 1    | Screw                     | M2 stainless steel, 8 mm    | Conical head metric screw             | RS PRO           | 914-1475                        |
| 10   | 1    | Cable tie mount           | Black, ABS, 4.2 mm x 4.2 mm | 4-way adhesive backed cable tie mount | Panduit          | ABM2S-A-C0                      |
| 11   | 1    | Cable tie                 | Nylon, 200 mm x 4.7 mm      | Releasable nylon cable tie            | Hellermann Tyton | 115-40200 REZ200-PA66-BK        |

**Table 12. STEVAL-ASTRA1 bill of materials**

| Item | Q.ty | Ref.                                                             | Part/value                                         | Description                      | Manufacturer       | Order code          |
|------|------|------------------------------------------------------------------|----------------------------------------------------|----------------------------------|--------------------|---------------------|
| 1    | 1    | C100                                                             | 56 pF SMD 0201 50 V $\pm 5\%$ COG                  | Ceramic capacitor                | Murata Electronics | GRM0335C1H560JA01D  |
| 2    | 1    | C101                                                             | 10 nF SMD 0201 10 V $\pm 10\%$ X7R                 | Ceramic capacitor                | Murata Electronics | GRM033R71A103KA01J  |
| 3    | 4    | C102 C103 C104 C105                                              | 56 pF 0201 50 V $\pm 5\%$ COG                      | Ceramic capacitors (not mounted) | Murata Electronics | GRM0335C1H560JA01D  |
| 4    | 1    | C106                                                             | 1 nF SMD 0201 50 V $\pm 10\%$ X7R                  | Ceramic capacitor                | Murata Electronics | GRM033R71H102KA12J  |
| 5    | 2    | C107 C108                                                        | 120 pF SMD 0201 50 V $\pm 5\%$                     | Ceramic capacitors               | Murata Electronics | GRM0335C1H121JA01D  |
| 6    | 13   | C200 C201 C202 C203 C204 C205 C206 C500 C501 C503 C600 C601 C800 | 100 nF SMD 0201 10 V 20% X5R                       | Ceramic capacitors               | Murata Electronics | GRM033R61A104ME15D  |
| 7    | 2    | C300 C303                                                        | 10 $\mu$ F 0603 (1608 Metric) 6.3 V $\pm 20\%$ X5R | Ceramic capacitors               | TDK Corporation    | C1608X5R0J106M080AB |

| Item | Q.ty | Ref.                        | Part/value                                                                            | Description                                                              | Manufacturer                 | Order code                    |
|------|------|-----------------------------|---------------------------------------------------------------------------------------|--------------------------------------------------------------------------|------------------------------|-------------------------------|
| 8    | 2    | C301 C302                   | 47 $\mu$ F SMD<br>0805 (2012<br>Metric) 6.3 V<br>$\pm$ 20%X5R                         | Ceramic<br>capacitors                                                    | Yageo                        | CC0805MKX5R5BB476             |
| 9    | 1    | C502                        | 100 nF SMD<br>0201 10 V 20%<br>X5R                                                    | Ceramic<br>capacitor (not<br>mounted)                                    | Murata<br>Electronics        | GRM033R61A104ME15D            |
| 10   | 1    | D401                        | STPS120MF<br>DO-222AA 490<br>mV at 1 A<br>STmiteFLAT                                  | 20 V, 1 A<br>STmiteFLAT<br>power Schottky<br>rectifier                   | ST                           | <a href="#">STPS120MF</a>     |
| 11   | 1    | D402                        | STPS1L30MF<br>DO-222AA 390<br>mV at 1 A<br>STmiteFLAT                                 | 30 V, 1 A<br>STmiteFLAT<br>low drop power<br>Schottky<br>rectifier       | ST                           | <a href="#">STPS1L30MF</a>    |
| 12   | 2    | D500 D501                   | ESDALC6V1-1<br>U2 0201 (0603<br>Metric)                                               | Single-line low<br>capacitance<br>Transil for ESD<br>protection          | ST                           | <a href="#">ESDALC6V1-1U2</a> |
| 13   | 1    | D502                        | Led_RGB 0404<br>(1010 Metric) 5<br>mA red, 5 mA<br>green, 5 mA<br>blue WL-SFCC<br>SMT | Full-color chip<br>LED                                                   | Würth<br>Elektronik          | 150044M155260                 |
| 14   | 4    | D902 D903 D904<br>D905      | BAT30F4 0201<br>(0603 Metric)<br>300 mA                                               | 30 V, 300 mA<br>CSP general<br>purpose small<br>signal Schottky<br>diode | ST                           | <a href="#">BAT30F4</a>       |
| 15   | 1    | J100                        | 1.56/1.575 GHz<br>ceramic                                                             | RF antenna                                                               | Taoglas Limited              | CGGBP.18.4.A.02               |
| 16   | 1    | J101                        | UFL<br>Würth_6361011<br>11001 U.FL-R-<br>SMT-1                                        | WR-<br>UMRF_PCB<br>RECEPTACLE<br>_SMT_3 PAD<br>(not mounted)             | Würth<br>Elektronik          | 636101111001                  |
| 17   | 1    | J102                        | CON-SMA-<br>R_A_SMD                                                                   | CONN SMA<br>REC R/A T&R<br>(not mounted)                                 | Linx<br>Technologies<br>Inc. | CONSMA002-SMD-G-T             |
| 18   | 5    | J400 J404 J405<br>J407 J408 | CON 3 Strip<br>1.27 mm<br>vertical                                                    | Connector<br>headers                                                     | Harwin Inc.                  | M50-3530342                   |
| 19   | 1    | J401                        | 78171-0003                                                                            | Headers and<br>wire housings                                             | Molex                        | 78171-0003                    |
| 20   | 1    | J402                        | Con3_Strip_Ma<br>le_1.27 mm 3<br>positions                                            | Connector<br>header                                                      | Harwin Inc.                  | M50-3930342                   |
| 21   | 2    | J409 J410                   | 0 R 0603 1/10<br>W $\pm$ 1% SMD                                                       | Resistors                                                                | Vishay                       | CRCW06030000Z0EB              |
| 22   | 1    | J411                        | CON34-Socket<br>34 positions                                                          | Connector<br>socket                                                      | Panasonic<br>Electric Works  | AXF5G3412A                    |
| 23   | 1    | J421                        | con1-strip-male<br>50 Pitch 90<br>1.27 mm 2<br>positions                              | Connector<br>header                                                      | Harwin Inc.                  | M50-3930242                   |

| Item | Q.ty | Ref.                             | Part/value                                                           | Description                                                                                             | Manufacturer                      | Order code              |
|------|------|----------------------------------|----------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|-----------------------------------|-------------------------|
| 24   | 1    | J422                             | CON 3 Strip<br>1.27 mm 3<br>positions                                | Connector<br>header                                                                                     | Harwin Inc.                       | M50-3530342             |
| 25   | 6    | J423 J424 J425<br>J426 J427 J428 | Jumper-Female<br>1.27 mm                                             | Jumpers                                                                                                 | Sullins<br>Connector<br>Solutions | NPB02SVAN-RC            |
| 26   | 1    | J502                             | SOLDER<br>JUMPER3<br>0603 (3 pin<br>drop) 1/10 W<br>±1%              | Tin drop jumper<br>(not mounted)                                                                        | Yageo                             | RC0603JR-070RL          |
| 27   | 1    | J503                             | CON5 Female<br>1.27 mm                                               | Headers and<br>wire housings<br>(not mounted)                                                           | Preci-dip                         | 851-87-005-40-252101    |
| 28   | 1    | J600                             | Con 4 X 0.5<br>mm FFC-FPC 4<br>positions                             | Connector                                                                                               | Molex                             | 5034800400              |
| 29   | 2    | J900 J901                        | 0 R 0603 1/10<br>W ±1%                                               | Resistor                                                                                                | Vishay                            | CRCW06030000Z0EB        |
| 30   | 2    | J930 J931                        | CON 22<br>Header 22<br>positions 1.27<br>mm SMD                      | Connector<br>headers (not<br>mounted)                                                                   | Samtec Inc.                       | FTSH-111-01-L-DV-K-P-TR |
| 31   | 1    | L100                             | 27 nF 0603<br>(16085 Metric)<br>300 mA ±5%                           | Inductor                                                                                                | Würth<br>Elektronik               | 7447860127              |
| 32   | 1    | L102                             | 5.6 nH 0402<br>(1005 Metric)<br>1.77 A ±3%<br>SMD                    | Inductor                                                                                                | Murata<br>Electronics             | LQW15AN5N6G80D          |
| 33   | 1    | L103                             | 100 nH 0402<br>(1005 Metric)<br>200 mA ±5%<br>SMD                    | Inductor (not<br>mounted)                                                                               | Murata<br>Electronics             | LQG15HNR10J02D          |
| 34   | 2    | L300 L301                        | 2.2 µH 0806<br>(2016 Metric)<br>±20%                                 | Fixed inductors                                                                                         | Würth<br>Elektronik               | 74479776222             |
| 35   | 1    | Q300                             | VT6M1T2 6-<br>SMD, flat leads<br>120 mW 20 V<br>0.1 A N/P-CH<br>VMT6 | MOSFET                                                                                                  | Rohm<br>Semiconductor             | VT6M1T2CR               |
| 36   | 1    | Q400                             | STL4P3LLH6<br>PowerFLAT<br>2x2                                       | P-channel 30 V,<br>0.048 ohm typ.,<br>4 A STripFET<br>H6 Power<br>MOSFET in<br>PowerFLAT<br>2x2 package | ST                                | STL4P3LLH6              |
| 37   | 3    | Q501 Q504 Q505                   | RV3C002UN 3-<br>XFDFN 100<br>mW (Ta) 20 V<br>150 MA SM<br>SIG VML    | NCH MOSFET                                                                                              | Rohm<br>Semiconductor             | RV3C002UNT2CL           |
| 38   | 1    | Q502                             | VT6X1T2R<br>VMT-6 BJT TR<br>NPNX2 20V<br>VCEO                        | Bipolar<br>transistor                                                                                   | Rohm<br>Semiconductor             | VT6X1T2R                |

| Item | Q.ty | Ref.                                                                                                                                                                                                             | Part/value                                              | Description                | Manufacturer             | Order code       |
|------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|----------------------------|--------------------------|------------------|
| 39   | 1    | Q503                                                                                                                                                                                                             | 2SCR522MT2L<br>SOT-723 150<br>mW NPN 20 V<br>0.2 A VMT3 | Transistor                 | Rohm<br>Semiconductor    | 2SCR522MT2L      |
| 40   | 30   | R100 R101 R102<br>R304 R308 R309<br>R500 R501 R504<br>R513 SB200<br>SB204 SB205<br>SB206 SB207<br>SB208 SB209<br>SB210 SB212<br>SB213 SB300<br>SB305 SB306<br>SB600 SB939<br>SB940 SB941<br>SB942 SB943<br>SB944 | 0 R 0201 1/20<br>W $\pm 1\%$ SMD                        | Resistors                  | Stackpole<br>Electronics | RMCF0201ZT0R00   |
| 41   | 13   | R103 R200 R400<br>R502 R503 R518<br>R600 R800 R801<br>R914 R915 R916<br>R917                                                                                                                                     | 10k 0201 1/20<br>W $\pm 1\%$                            | Resistors                  | Yageo                    | RC0201FR-0710KL  |
| 42   | 11   | R104 R105 R305<br>R521 SB201<br>SB211 SB214<br>SB308 SB934<br>SB935 SB938                                                                                                                                        | 0R 0201 1/20<br>W $\pm 1\%$                             | Resistors (not<br>mounted) | Stackpole<br>Electronics | RMCF0201ZT0R00   |
| 43   | 7    | R201 R300 R311<br>R515 R519 R522<br>R523                                                                                                                                                                         | 1M 0201 1/20<br>W $\pm 1\%$                             | Resistors                  | Yageo                    | RC0201FR-071ML   |
| 44   | 2    | R301 R307                                                                                                                                                                                                        | 100 K 0201<br>1/20 W $\pm 1\%$                          | Resistors                  | Yageo                    | RC0201FR-07100KL |
| 45   | 1    | R302                                                                                                                                                                                                             | 5.6 K 0201 1/20<br>W $\pm 1\%$                          | Resistor                   | Panasonic<br>Electronics | ERJ-1GNF5601C    |
| 46   | 1    | R303                                                                                                                                                                                                             | 3 K 0201 1/20<br>W $\pm 1\%$                            | Resistor                   | Panasonic<br>Electronics | ERJ-1GEF3001C    |
| 47   | 1    | R310                                                                                                                                                                                                             | 1 M 0201 1/20<br>W $\pm 1\%$                            | Resistor (not<br>mounted)  | Yageo                    | RC0201FR-071ML   |
| 48   | 1    | R401                                                                                                                                                                                                             | 5.6 K 0201 1/20<br>W $\pm 1\%$                          | Resistor                   | Panasonic<br>Electronics | ERJ-1GNF5601C    |
| 49   | 2    | R402 R512                                                                                                                                                                                                        | 1 k 0201 1/20<br>W $\pm 1\%$                            | Resistors                  | Panasonic<br>Electronic  | ERJ-1GEF1001C    |
| 50   | 1    | R506                                                                                                                                                                                                             | 20 R 0201 1/20<br>W $\pm 5\%$                           | Resistor                   | Panasonic<br>Electronic  | ERJ-1GNJ200C     |
| 51   | 1    | R507                                                                                                                                                                                                             | 82 R 0201 1/20<br>W $\pm 5\%$                           | Resistor                   | Panasonic<br>Electronic  | ERJ-1GNJ820C     |
| 52   | 1    | R508                                                                                                                                                                                                             | 33 R 0201 1/20<br>W 1%                                  | Resistor                   | Panasonic<br>Electronics | ERJ-1GNJ330C     |
| 53   | 1    | R509                                                                                                                                                                                                             | 30 k 0201<br>1/20W $\pm 1\%$                            | Resistor                   | Yageo                    | RC0201FR-0730KL  |
| 54   | 1    | R510                                                                                                                                                                                                             | 120 k 0201<br>1/20 W $\pm 1\%$                          | Resistor                   | Panasonic<br>Electronic  | ERJ-1GNF1203C    |
| 55   | 1    | R511                                                                                                                                                                                                             | 51 k 0201 1/20<br>W $\pm 1\%$                           | Resistor                   | Panasonic<br>Electronic  | ERJ-1GEF5102C    |
| 56   | 3    | S1 S2 S3                                                                                                                                                                                                         | Spacer_1.5 mm                                           | RND standoff               | Würth<br>Elektronik      | 9774015243R      |

| Item | Q.ty | Ref.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Part/value                                                                       | Description             | Manufacturer        | Order code     |
|------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|-------------------------|---------------------|----------------|
| 57   | 9    | SB100 SB101<br>SB102 SB103<br>SB104 SB301<br>SB302 SB303<br>SB307                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0 R 0603 1/10<br>W $\pm 1\%$                                                     | Jumpers                 | Yageo               | RC0603JR-070RL |
| 58   | 2    | SB202 SB203                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0 R 0603 1/10<br>W $\pm 1\%$                                                     | Jumpers                 | Yageo               | RC0603JR-070RL |
| 59   | 1    | SB400                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0 R 0603 1/10<br>W $\pm 1\%$                                                     | Jumper                  | Yageo               | RC0603JR-070RL |
| 60   | 1    | SB403                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0 R 0603 1/10<br>W $\pm 1\%$                                                     | Jumper (not<br>mounted) | Yageo               | RC0603JR-070RL |
| 61   | 4    | SB500 SB501<br>SB800 SB801                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 0 R 0603 1/10<br>W $\pm 1\%$                                                     | Jumper                  | Yageo               | RC0603JR-070RL |
| 62   | 1    | SB601                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 0 R 0603 1/10<br>W $\pm 1\%$                                                     | Jumper                  | Yageo               | RC0603JR-070RL |
| 63   | 1    | SW500                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Switch                                                                           | Switch                  | TE Connectivity     | -              |
| 64   | 1    | SW501                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Push-<br>Bottom_WE434<br>331013822<br>3.50mm x<br>2.90mm SPST-<br>NO 0.05 A 12 V | Tactile switch          | Würth<br>Elektronik | 434331013822   |
| 65   | 12   | TP100 TP101<br>TP200 TP201<br>TP202 TP204<br>TP205 TP206<br>TP208 TP500<br>TP600 TP601                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | TP                                                                               | Test points             | Any                 | Any            |
| 66   | 66   | TPB209 TPB210<br>TPB221 TPB222<br>TPB223 TPB224<br>TPB225 TPB226<br>TPB227 TPB228<br>TPB229 TPB230<br>TPB231 TPB232<br>TPB233 TPB234<br>TPB235 TPB236<br>TPB237 TPB238<br>TPB239 TPB240<br>TPB241 TPB242<br>TPB243 TPB244<br>TPB245 TPB246<br>TPB247 TPB248<br>TPB249 TPB250<br>TPB251 TPB252<br>TPB253 TPB254<br>TPB255 TPB256<br>TPB257 TPB258<br>TPB259 TPB260<br>TPB261 TPB262<br>TPB263 TPB264<br>TPB265 TPB266<br>TPB267 TPB268<br>TPB269 TPB270<br>TPB271 TPB272<br>TPB273 TPB274<br>TPB275 TPB276<br>TPB277 TPB278<br>TPB279 TPB280<br>TPB281 TPB282<br>TPB283 TPB284 | TPB                                                                              | Not mounted             | -                   | -              |

| Item | Q.ty | Ref.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Part/value                                                     | Description                                                                                               | Manufacturer                                                  | Order code                   |
|------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|------------------------------|
| 67   | 56   | TPE133 TPE134<br>TPE145 TPE167<br>TPE168 TPE173<br>TPE174 TPE175<br>TPE176 TPE177<br>TPE700 TPE701<br>TPE702 TPE703<br>TPE704 TPE705<br>TPE706 TPE707<br>TPE708 TPE709<br>TPE710 TPE711<br>TPE712 TPE713<br>TPE714 TPE715<br>TPE716 TPE717<br>TPE718 TPE719<br>TPE720 TPE721<br>TPE722 TPE723<br>TPE724 TPE725<br>TPE726 TPE727<br>TPE728 TPE729<br>TPE730 TPE732<br>TPE734 TPE736<br>TPE739 TPE740<br>TPE741 TPE742<br>TPE743 TPE744<br>TPE745 TPE746<br>TPE747 TPE749<br>TPE752 TPE754 | TPE                                                            | Not mounted                                                                                               | -                                                             | -                            |
| 68   | 1    | U100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Teseo-LIV3F<br>9.7X10.1mm                                      | Tiny GNSS<br>module                                                                                       | ST                                                            | <a href="#">Teseo-LIV3F</a>  |
| 69   | 1    | U101                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | BGA725L6E63<br>27FTSA1 6-<br>XDFN<br>1.55-1.615<br>GHZ TSLP6-2 | IC AMP GPS                                                                                                | Infineon<br>Technologies                                      | BGA725L6E6327FTSA1           |
| 70   | 1    | U102                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | B39162B4327P<br>810 5-SMD, No<br>Lead                          | Filter                                                                                                    | Qualcomm<br>(RF360 - A<br>Qualcomm &<br>TDK Joint<br>Venture) | B39162B4327P810              |
| 71   | 1    | U200                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | LIS2DTW12TR<br>LGA2X2X0.7<br>12 leads                          | MEMS digital<br>output dual<br>motion and<br>temperature<br>sensor                                        | ST                                                            | <a href="#">LIS2DTW12TR</a>  |
| 72   | 1    | U201                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | STTS22HTR<br>UDFN 2X2X.55<br>6L PITCH 0.65                     | Low-voltage,<br>ultra-low-power,<br>0.5°C accuracy<br>I <sup>2</sup> C/SMBus 3.0<br>temperature<br>sensor | ST                                                            | <a href="#">STTS22HTR</a>    |
| 73   | 1    | U202                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | LSM6DSO32X<br>VFLGA2.5X3X.<br>86 14L P.5<br>L.475X.25          | iNEMO inertial<br>module:<br>always-on 3D<br>accelerometer<br>and 3D<br>gyroscope                         | ST                                                            | <a href="#">LSM6DSO32XTR</a> |

| Item | Q.ty | Ref. | Part/value                                                                                | Description                                                                                                     | Manufacturer      | Order code       |
|------|------|------|-------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-------------------|------------------|
| 74   | 1    | U203 | LPS22HH<br>HLGA 2X2X.8<br>10L<br>EXP.SILIC.91S<br>Q                                       | High-performance MEMS nano pressure sensor: 260-1260 hPa absolute digital output barometer                      | ST                | LPS22HHTR        |
| 75   | 1    | U204 | HTS221TR<br>HLGA-6L<br>2X2X0.9                                                            | Capacitive digital sensor for relative humidity and temperature                                                 | ST                | HTS221TR         |
| 76   | 1    | U300 | ST1PS02CQT<br>R MLPQ/QFN<br>1.7x2.0x0.55<br>12L P0.4                                      | 400 mA nano-quiescent synchronous step-down converter with digital voltage selection, power good and AUX switch | ST                | ST1PS02CQTR      |
| 77   | 1    | U500 | 74LVC1G74GT<br>8-XFDFN                                                                    | IC FF D-TYPE SNGL 1BIT 8XSON                                                                                    | Nexperia USA Inc. | 74LVC1G74GT,115  |
| 78   | 1    | U600 | ST25DV64K-<br>JFR6D3<br>UFDFPN 12L<br>3X3X0.55 Pitch<br>0.50                              | Dynamic NFC/RFID tag IC with 64-Kbit EEPROM and fast transfer mode capability                                   | ST                | ST25DV64K-JFR6D3 |
| 79   | 1    | U800 | STSAFA110DF<br>SPL02<br>UFDFPN 8<br>2x3x0.6                                               | Authentication, state-of-the-art security for peripherals and IoT devices (not mounted)                         | ST                | STSAFA110DFSPL02 |
| 80   | 1    | -    | FR4-IT180A-4<br>layers<br>58.29x43.3x1.3<br>8mm, laser drill<br>between layers<br>1 and 2 | PCB                                                                                                             | -                 | -                |

**Table 13. STEVAL-ASTRA1SB bill of materials**

| Item | Q.ty | Ref.      | Part/value                                          | Description                     | Manufacturer              | Order code         |
|------|------|-----------|-----------------------------------------------------|---------------------------------|---------------------------|--------------------|
| 1    | 1    | C900      | 100 nF 0201 10 V<br>±20%X5RSMD                      | Ceramic capacitor (not mounted) | Murata Electronics        | GRM033R61A104ME15D |
| 2    | 1    | C901      | 22 µF 0603<br>(1608 Metric)<br>16 V ±20%<br>X5R SMD | Ceramic capacitor               | Samsung Electro-Mechanics | CL10A226MO7JZNC    |
| 3    | 2    | C902 C903 | 10 µF 0805<br>(2012 Metric)<br>16 V ±10%<br>X5R     | Ceramic capacitors              | Murata                    | GRM21BR61C106KE15L |

| Item | Q.ty | Ref.                                                                         | Part/value                                                      | Description         | Manufacturer       | Order code          |
|------|------|------------------------------------------------------------------------------|-----------------------------------------------------------------|---------------------|--------------------|---------------------|
| 4    | 1    | C904                                                                         | 10 $\mu$ F 0603<br>(1608 Metric)<br>6.3 V $\pm$ 20%             | Ceramic capacitor   | TDK Corporation    | C1608X5R0J106M080AB |
| 5    | 13   | C905 C906 C918<br>C919 C921 C922<br>C926 C927 C928<br>C929 C931 C936<br>C940 | 100 nF 0201 10<br>V $\pm$ 20%                                   | Ceramic capacitors  | Murata Electronics | GRM033R61A104ME15D  |
| 6    | 10   | C907 C908 C909<br>C910 C911 C912<br>C913 C914 C915<br>C916                   | 3 pF 0201 25 V<br>$\pm$ 10%<br>COGSMD                           | Ceramic capacitors  | Murata Electronics | GRM0335C1E3R0CA01D  |
| 7    | 1    | C917                                                                         | 10 $\mu$ F 0603<br>(1608 Metric)<br>10 V $\pm$ 20%<br>solid SMD | Tantalum capacitors | Vishay             | TR8M106M0102T2000   |
| 8    | 2    | C920 C925                                                                    | 4.7 $\mu$ F 0201 6.3<br>V $\pm$ 20%<br>X5RSMD                   | Ceramic capacitors  | Murata Electronics | GRM035R60J475ME15D  |
| 9    | 2    | C923 C930                                                                    | 5.3 pF 0402<br>(1005 Metric)<br>50 V 0.1 pF<br>COG SMD          | Ceramic capacitors  | Murata Electronics | GCQ1555C1H5R3BB01D  |
| 10   | 1    | C932                                                                         | 47 pF 0201 25<br>V $\pm$ 5% COG<br>SMD                          | Ceramic capacitor   | Murata Electronics | GRM0335C1E470JA01J  |
| 11   | 3    | C933 C934 C935                                                               | 33 pF 0201 50<br>V $\pm$ 5%<br>COGSMD                           | Ceramic capacitors  | Murata Electronics | GRM0335C1H330JA01D  |
| 12   | 1    | C937                                                                         | 47 pF 0201 25<br>V $\pm$ 5%<br>SMDX5R                           | Ceramic capacitor   | Murata Electronics | GRM0335C1E470JA01J  |
| 13   | 1    | C938                                                                         | 470 nF 0402<br>(1005 Metric)<br>10 V $\pm$ 10%<br>X5R           | Ceramic capacitor   | Yageo              | CC0402KRX5R6BB474   |
| 14   | 1    | C939                                                                         | 10 pF 0402<br>(1005 Metric)<br>50 V $\pm$ 5% COG                | Ceramic capacitor   | Kemet              | C0402C100J5GACTU    |
| 15   | 3    | C941 C943 C946                                                               | 1 nF 0201 50 V<br>$\pm$ 10% X7RSMD                              | Ceramic capacitors  | Murata Electronics | GRM033R71H102KA12D  |
| 16   | 1    | C942                                                                         | 2.2 pF 0402<br>(1005 Metric)<br>50 V 0.05 pF                    | Ceramic capacitor   | Murata Electronics | GJM1555C1H2R2WB01D  |
| 17   | 1    | C949                                                                         | 1.5 pF 0402<br>(1005 Metric)<br>50 V 0.05 pF<br>COG             | Ceramic capacitor   | Murata Electronics | GJM1555C1H1R5WB01D  |
| 18   | 5    | C944 C945 C953<br>C954 C961                                                  | 33 pF 0402<br>(1005 Metric)<br>50 V $\pm$ 1% COG                | Ceramic capacitors  | Murata Electronics | GJM1555C1H330FB01D  |
| 19   | 1    | C947                                                                         | 6.2 pF 0402<br>(1005 Metric)<br>50 V 0.05 pF<br>COG             | Ceramic capacitor   | Murata Electronics | GJM1555C1H6R2WB01D  |

| Item | Q.ty | Ref.                                                                                                                                                                             | Part/value                                                                            | Description                                                              | Manufacturer          | Order code              |
|------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|--------------------------------------------------------------------------|-----------------------|-------------------------|
| 20   | 1    | C948                                                                                                                                                                             | 4.3 pF 0402<br>(1005 Metric)<br>50 V 0.05 pF<br>COG                                   | Ceramic<br>capacitor                                                     | Murata<br>Electronics | GJM1555C1H4R3WB01D      |
| 21   | 1    | C950                                                                                                                                                                             | 47 nF 0201 16<br>V ±10% X5R                                                           | Ceramic<br>capacitor                                                     | Murata<br>Electronics | GRM033R61C473KE84D      |
| 22   | 1    | C951                                                                                                                                                                             | 68 pF 0201 50<br>V ±5% COG<br>SMD                                                     | Ceramic<br>capacitor                                                     | Murata<br>Electronics | GRM0335C1H680JA01D      |
| 23   | 2    | C952 C966                                                                                                                                                                        | 2.7 pF 0402<br>(1005 Metric)<br>50 V ±0.1 pF<br>COG                                   | Ceramic<br>capacitors                                                    | Yageo                 | CC0402BRNPO9BN2R7       |
| 24   | 1    | C955                                                                                                                                                                             | 5.6 pF 0402<br>(1005 Metric)<br>50 V ±0.25 pF<br>COG                                  | Ceramic<br>capacitor                                                     | Murata<br>Electronics | GRM1555C1H5R6BA01D      |
| 25   | 3    | C956 C962 C964                                                                                                                                                                   | 3.3 pF 0402<br>(1005 Metric)<br>50 V ±0.05 pF<br>COG                                  | Ceramic<br>capacitors                                                    | Murata<br>Electronics | GJM1555C1H3R3WB01D      |
| 26   | 1    | C957                                                                                                                                                                             | 1.3 pF 0402<br>(1005 Metric)<br>50 V ±0.05 pF<br>COG                                  | Ceramic<br>capacitor                                                     | Murata<br>Electronics | GJM1555C1H1R3WB01D      |
| 27   | 1    | C963                                                                                                                                                                             | 3.6 pF 0402<br>(1005 Metric)<br>50 V ±0.05 pF<br>COG                                  | Ceramic<br>capacitor                                                     | Murata<br>Electronics | GJM1555C1H3R6WB01D      |
| 28   | 1    | C965                                                                                                                                                                             | 1 pF 0402<br>(1005 Metric)<br>50V ±0.1 pF<br>COG                                      | Ceramic<br>capacitor (not<br>mounted)                                    | AVX<br>Corporation    | 04025A1R0BAT2A          |
| 29   | 4    | CL1 CL2 CL3 CL4                                                                                                                                                                  | Clip-0951-46R<br>SMD                                                                  | RFI shield clip<br>compact tins                                          | Harwin Inc.           | S0951-46R               |
| 30   | 2    | D900 D901                                                                                                                                                                        | BAT30F4 0201<br>(0603 Metric)<br>300 mA<br>ST0201                                     | 30 V, 300 mA<br>CSP general<br>purpose small<br>signal Schottky<br>diode | ST                    | <a href="#">BAT30F4</a> |
| 31   | 1    | D902                                                                                                                                                                             | Led_RGB 0404<br>(1010 Metric) 5<br>mA red, 5 mA<br>green, 5 mA<br>blue WL-SFCC<br>SMT | Full-color chip<br>LED                                                   | Würth<br>Elektronik   | 150044M155260           |
| 32   | 30   | J900 J901 J902<br>J903 J904 J905<br>J906 J907 J908<br>J909 J910 J911<br>J912 J913 J914<br>J915 J916 J917<br>J918 J919 J920<br>J921 J922 J923<br>J924 J925 J926<br>J927 J928 J929 | 0 0402                                                                                | Tin drop<br>jumpers (not<br>mounted)                                     | -                     | -                       |
| 33   | 2    | J930 J931                                                                                                                                                                        | CON 22<br>positions 1.27<br>MMSMD                                                     | Connector<br>headers (not<br>mounted)                                    | Samtec Inc.           | FTSH-111-01-L-DV-K-P-TR |

| Item | Q.ty | Ref.                   | Part/value                                                 | Description                                                  | Manufacturer            | Order code         |
|------|------|------------------------|------------------------------------------------------------|--------------------------------------------------------------|-------------------------|--------------------|
| 34   | 2    | J932 J933              | NX3L1T3157G<br>M 6-XFDN                                    | IC SWITCH<br>SPDT 6XSON                                      | NXP USA Inc.            | NX3L1T3157GM,132   |
| 35   | 1    | J935                   | CON_SMA_Wu<br>rth_603122021<br>14508                       | SMA PCB end<br>launch jack                                   | Würth<br>Elektronik     | 60312202114508     |
| 36   | 1    | J936                   | UFL<br>Würth_6361011<br>11001 U.FL-R-<br>SMT-1             | WR-<br>UMRF_PCB<br>RECEPTACLE<br>_SMT_3 PAD<br>(not mounted) | Würth<br>Elektronik     | 636101111001       |
| 37   | 1    | J937                   | 0 R 0603 1/10<br>W ±1%                                     | Resistor                                                     | Vishay                  | CRCW06030000Z0EB   |
| 38   | 1    | L900                   | 2.2 µH 1.2 A<br>0806 (2016<br>Metric) ±20%                 | Fixed inductor                                               | Würth<br>Elektronik     | 74479776222        |
| 39   | 1    | L901                   | 2.2 µH 1.2A<br>0806 (2016<br>Metric) ±20%                  | Fixed inductor                                               | Würth<br>Elektronik     | 74479776222        |
| 40   | 1    | L902                   | 600 ohm at 100<br>MHz 0603<br>(16085 Metric)<br>300 mA SMD | Inductor                                                     | Chilisin<br>Electronics | BBBK00160808601Y00 |
| 41   | 1    | L903                   | 15 µH 0603<br>(16085 Metric)<br>250 mA SMD                 | Inductor                                                     | TDK<br>Corporation      | MLZ1608N150LT000   |
| 42   | 1    | L904                   | 1 kohm 100<br>MHz 0402<br>(1005 Metric)<br>250 mA SMD      | Inductor                                                     | Murata<br>Electronics   | BLM15HG102SN1D     |
| 43   | 2    | L905 L912              | 3.3 nH 0402<br>(1005 Metric) 2<br>A ±0.1 nH SMD            | Inductors                                                    | Murata<br>Electronics   | LQW15AN3N3B80D     |
| 44   | 2    | L907 L908              | 47 nH 0402<br>(1005 Metric)<br>210 mA SMD                  | Inductors                                                    | Murata<br>Electronics   | LQW15AN47NJ00D     |
| 45   | 1    | L909                   | 3 nH 0402<br>(1005 Metric)<br>1.35 A SMD                   | Inductor                                                     | Murata<br>Electronics   | LQW15AN3N0C80D     |
| 46   | 3    | L906 L910 L913         | 8.7 nH 0402<br>(1005 Metric)<br>1.42 A ±2%                 | Inductors                                                    | Murata<br>Electronics   | LQW15AN8N7G80D     |
| 47   | 1    | L911                   | 2.5 nH 0402<br>(1005 Metric) 1<br>A SMD                    | Inductor                                                     | Murata<br>Electronics   | LQW15AN2N5B80D     |
| 48   | 1    | L914                   | 11 nH 0402<br>(1005 Metric)<br>500 mA SMD                  | Inductor                                                     | Murata<br>Electronics   | LQW15AN11NG00D     |
| 49   | 1    | Q1                     | VT6X1T2R<br>VMT-6                                          | Bipolar<br>Transistors -<br>BJT TR NPNX2<br>20V VCEO         | Rohm<br>Semiconductor   | VT6X1T2R           |
| 50   | 1    | Q2                     | 2SCR522MT2L<br>SOT-723 150<br>mW 20 V 0.2 A<br>VMT3        | NPN transistor                                               | Rohm<br>Semiconductor   | 2SCR522MT2L        |
| 51   | 4    | R900 R909 R910<br>R911 | 100 R 0201<br>1/20 W ±1%                                   | Resistors                                                    | Panasonic               | ERJ1GNF1000C       |

| Item | Q.ty | Ref.                                                                                                                                                                                                                          | Part/value                             | Description              | Manufacturer          | Order code       |
|------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|--------------------------|-----------------------|------------------|
| 52   | 3    | R901 R924 R930                                                                                                                                                                                                                | 1 M 0201 1/20 W $\pm 1\%$              | Resistors                | Yageo                 | RC0201FR-071ML   |
| 53   | 3    | R902 R903 R904                                                                                                                                                                                                                | 10 k 0201 1/20 W $\pm 1\%$             | Resistors                | VISHAY                | CRCW020110K0FKED |
| 54   | 31   | R905 R906 R913<br>R914 R915 R916<br>SB900 SB901<br>SB902 SB904<br>SB905 SB906<br>SB907 SB908<br>SB909 SB910<br>SB911 SB912<br>SB913 SB918<br>SB922 SB923<br>SB924 SB925<br>SB926 SB927<br>SB928 SB929<br>SB931 SB940<br>SB941 | 0 R 0201 1/20 W $\pm 1\%$              | Resistors                | Stackpole Electronics | RMCF0201ZT0R00   |
| 55   | 1    | R908                                                                                                                                                                                                                          | 220 R 0201 1/20 W $\pm 1\%$            | Resistor                 | Yageo                 | RC0201FR-07220RL |
| 56   | 1    | R917                                                                                                                                                                                                                          | 30 k 0201 1/20 W $\pm 1\%$             | Resistor                 | Yageo                 | RC0201FR-0730KL  |
| 57   | 1    | R918                                                                                                                                                                                                                          | 120 k 0201 1/20 W $\pm 1\%$            | Resistor                 | Panasonic Electronic  | ERJ-1GNF1203C    |
| 58   | 1    | R919                                                                                                                                                                                                                          | 51 k 0201 1/20 W $\pm 1\%$             | Resistor                 | MULTICOMP             | ERJ-MCRE000181   |
| 59   | 1    | R920                                                                                                                                                                                                                          | 20 R 0201 1/20 W $\pm 1\%$             | Resistor                 | Panasonic Electronic  | ERJ-1GNJ200C     |
| 60   | 1    | R921                                                                                                                                                                                                                          | 0 R 0402 (1005 Metric) 1/16 W $1\pm\%$ | Chip resistor            | Yageo                 | RC0402JR-070RL   |
| 61   | 1    | R922                                                                                                                                                                                                                          | 33 R 0201 1/20 W $\pm 1\%$             | Resistor                 | Panasonic Electronics | ERJ-1GNJ330C     |
| 62   | 2    | R925 R926                                                                                                                                                                                                                     | 100 k 0201 1/20 W $\pm 1\%$            | RES SMD 1% 1/20W 0201    | Multicomp             | MCRE000188       |
| 63   | 1    | R923                                                                                                                                                                                                                          | 1 M 0201 1/20 W $\pm 1\%$              | Resistor (not mounted)   | Yageo                 | RC0201FR-071ML   |
| 64   | 1    | R927                                                                                                                                                                                                                          | 82 R 0201 1/20 W $\pm 5\%$             | Resistor                 | Panasonic Electronics | ERJ-1GNJ820C     |
| 65   | 7    | SB903 SB915<br>SB916 SB920<br>SB921 SB930<br>SB932                                                                                                                                                                            | 0 R 0201 1/20 W $\pm 1\%$              | Resistor (not mounted)   | Stackpole Electronics | RMCF0201ZT0R00   |
| 66   | 1    | SH1                                                                                                                                                                                                                           | Shield MS190-10S 19 X 13.9 X 2MM       | EMI/RF shield            | Masach Tech Ltd.      | MS190-10S        |
| 67   | 1    | TP900                                                                                                                                                                                                                         | TP                                     | Test point (not mounted) | -                     | -                |
| 68   | 1    | TP901                                                                                                                                                                                                                         | TP                                     | Test point (not mounted) | -                     | -                |

| Item | Q.ty | Ref.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Part/value                                 | Description               | Manufacturer       | Order code     |
|------|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|---------------------------|--------------------|----------------|
| 69   | 66   | TPB900 TPB901<br>TPB902 TPB903<br>TPB904 TPB905<br>TPB906 TPB907<br>TPB908 TPB909<br>TPB910 TPB911<br>TPB912 TPB913<br>TPB914 TPB915<br>TPB916 TPB917<br>TPB918 TPB919<br>TPB920 TPB921<br>TPB922 TPB923<br>TPB924 TPB925<br>TPB926 TPB927<br>TPB928 TPB929<br>TPB930 TPB931<br>TPB932 TPB933<br>TPB934 TPB935<br>TPB936 TPB937<br>TPB938 TPB939<br>TPB940 TPB941<br>TPB942 TPB943<br>TPB944 TPB945<br>TPB946 TPB947<br>TPB948 TPB949<br>TPB950 TPB951<br>TPB952 TPB953<br>TPB954 TPB955<br>TPB956 TPB957<br>TPB958 TPB959<br>TPB960 TPB961<br>TPB962 TPB963<br>TPB964 TPB965 | TPB                                        | Test points (not mounted) | -                  | -              |
| 70   | 56   | TPE130 TPE131<br>TPE132 TPE133<br>TPE134 TPE148<br>TPE149 TPE150<br>TPE151 TPE152<br>TPE900 TPE901<br>TPE902 TPE903<br>TPE904 TPE905<br>TPE906 TPE907<br>TPE908 TPE909<br>TPE910 TPE911<br>TPE912 TPE913<br>TPE914 TPE915<br>TPE916 TPE917<br>TPE918 TPE919<br>TPE920 TPE921<br>TPE922 TPE923<br>TPE924 TPE925<br>TPE926 TPE927<br>TPE928 TPE930<br>TPE932 TPE934<br>TPE936 TPE943<br>TPE944 TPE945<br>TPE946 TPE947<br>TPE948 TPE949<br>TPE950 TPE951<br>TPE952 TPE953<br>TPE954 TPE955                                                                                      | TPE                                        | Test points (not mounted) | -                  | -              |
| 71   | 2    | FB1 FB2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 470 ohms at 100 MHz 0201 (0603 Metric) 1LN | Ferrite beads             | Murata Electronics | BLM03BD471SN1D |

| Item | Q.ty | Ref. | Part/value                                 | Description                                                                                                                                                                     | Manufacturer          | Order code                        |
|------|------|------|--------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-----------------------------------|
| 72   | 1    | U900 | ST1PS02CQTR MLPQ/QFN 1.7x2.0x0.55 12L P0.4 | 400 mA nano-quiescent synchronous step-down converter with digital voltage selection, Power Good and AUX switch                                                                 | ST                    | ST1PS02CQTR                       |
| 73   | 1    | U901 | STSAFA110DFSPL02 UFDFPN 8 2x3x0.6          | Authentication, state-of-the-art security for peripherals and IoT devices                                                                                                       | ST                    | STSAFA110DFSPL02                  |
| 74   | 1    | U902 | STM32WB5MMGH6TR SIP LGA 86 7.3x11 mm       | Ultra-low-power module dual core Arm® Cortex®-M4 MCU 64 MHz, Arm® Cortex®-M0+ 32MHz with 1 Mbyte of Flash memory, Bluetooth LE 5.2, 802.15.4, Zigbee, Thread, USB, LCD, AES-256 | ST                    | STM32WB5MMGH6TR                   |
| 75   | 1    | U903 | STM32WL55JC I7 UFBGA 73 5x5x0.6 P 0.5 mm   | Dual-core Arm® Cortex®-M4/M0+ at 48 MHz with 256 Kbytes of Flash memory, 64 Kbytes of SRAM, LoRa, (G)FSK, (G)MSK, BPSK modulations, AES 256-bit, multiprotocol system-on-chip   | ST                    | STM32WL55JCI7                     |
| 76   | 1    | U904 | BGS13SN8 8-XFQFN SP3T TSNP8-1              | IC RF switch                                                                                                                                                                    | Infineon Technologies | BGS13SN8E6327XTSA1                |
| 77   | 1    | Y900 | 32.768 kHz 2-SMD, no lead                  | Crystal                                                                                                                                                                         | NDK America, Inc.     | NX2012SA-32.768KHZ-EXS00A-MU00527 |
| 78   | 1    | Y901 | 32 MHz 4-SMD, no lead                      | XTAL OSC VCTCXO 32.0000 MHZ SMD                                                                                                                                                 | NDK America, Inc.     | NT2016SA-32M-END4263A             |
| 79   | 1    | -    | PCB-IT180 FR4-IT180, 6 LAYER-38x28x 1.1 mm | PCB with vias blind/microvias                                                                                                                                                   | -                     | -                                 |

**Table 14. STEVAL-ASTRA1BC bill of materials**

| Item | Q.ty | Ref.                     | Part/value                                         | Description                                                                | Manufacturer                | Order code                    |
|------|------|--------------------------|----------------------------------------------------|----------------------------------------------------------------------------|-----------------------------|-------------------------------|
| 1    | 3    | C1 C203 C300             | 100 nF 0201 10 V $\pm 20\%$ X5R SMD                | Ceramic capacitors                                                         | Murata Electronics          | GRM033R61A104ME15D            |
| 2    | 1    | C200                     | 1 $\mu$ F 0201 6.3 V $\pm 20\%$ X5R SMD            | Ceramic capacitor                                                          | Murata Electronics          | GRM033R60J105MEA2D            |
| 3    | 2    | C201 C202                | 10 $\mu$ F 0603 (1608 Metric) 6.3 V $\pm 20\%$ X5R | Ceramic capacitors                                                         | TDK Corporation             | C1608X5R0J106M080AB           |
| 4    | 1    | C204                     | 4.7 $\mu$ F 0201 6.3 V $\pm 20\%$ X5R              | Ceramic capacitor                                                          | Murata Electronics          | GRM035R60J475ME15D            |
| 5    | 1    | CN200                    | WE-632723300 011 THT/SM                            | USB 3.1 Type-C receptacle                                                  | Würth Elektronik            | 632723300011                  |
| 6    | 1    | D1                       | ESDALC6V1 DFN2 0201 (0603 Metric)                  | Single-line low capacitance Transil for ESD protection                     | ST                          | <a href="#">ESDALC6V1-1U2</a> |
| 7    | 1    | D200                     | Led Yellow 0402 (1005 Metric) **                   | DIODE LED SMD 0402 Yellow                                                  | Würth Elektronik            | 150040YS73240                 |
| 8    | 1    | D201                     | ESDA7P60 QFN-2L                                    | High-power transient voltage suppressor                                    | ST                          | <a href="#">ESDA7P60-1U1M</a> |
| 9    | 1    | D202                     | BAT30F4 (0603 Metric) 300 mA ST0201                | 30 V, 300 mA CSP general purpose small signal Schottky diode               | ST                          | <a href="#">BAT30F4</a>       |
| 10   | 1    | D203                     | LED RED 0402 (1005 Metric) 20 mA                   | Red LED                                                                    | Würth Elektronik            | 150040RS73240                 |
| 11   | 1    | IC200                    | ECMF02_2AM X6 QFN-6L 200 mA                        | Common-mode filter and ESD protection for USB 2.0 and MIPI/MDDI interfaces | ST                          | <a href="#">ECMF02-2AMX6</a>  |
| 12   | 5    | J100 J101 J102 J103 J104 | Con3_Strip_Male_SMD SMD 3POS 1.27 mm               | Connector headers                                                          | Sullins Connector Solutions | GRPB031VWTC-RC                |
| 13   | 1    | J105                     | con4-strip-male                                    | Connector header (not mounted)                                             | Würth Elektronik            | 61300411121                   |
| 14   | 1    | J106                     | con2-strip-female 50 pitch                         | Connector receptacle                                                       | Harwin Inc.                 | M50-3030242                   |
| 15   | 5    | J107 J108 J109 J110 J111 | Jumper-Female 1.27 mm                              | Jumpers                                                                    | Sullins Connector Solutions | NPB02SVAN-RC                  |
| 16   | 1    | J200                     | 78171-0003                                         | Headers and wire housing                                                   | Molex                       | 78171-0003                    |
| 17   | 1    | J201                     | Con1X3 Female 1.27 mm                              | Connector receptacle                                                       | Harwin Inc.                 | M50-3030342                   |

| Item | Q.ty | Ref. | Part/value                                                   | Description                                                                                               | Manufacturer                 | Order code                 |
|------|------|------|--------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|------------------------------|----------------------------|
| 18   | 1    | J300 | Con14-male<br>1.27 mm                                        | Connector<br>header                                                                                       | Samtec Inc.                  | FTSH-107-01-F-DV-K-P-TR    |
| 19   | 1    | J400 | STMod-Female<br>2x10 2mm<br>SMD                              | Connector<br>receptacle                                                                                   | Harwin Inc.                  | M22-6551042R               |
| 20   | 1    | J401 | 0 ohm $\pm 1\%$<br>0603 (3pin<br>drop) 0.1 W,<br>1/10 W SMD  | Chip resistor                                                                                             | Vishay                       | CRCW06030000Z0EB           |
| 21   | 1    | J500 | CON34-Header                                                 | Connector<br>header                                                                                       | Panasonic<br>Electric Works  | AXF6G3412A                 |
| 22   | 1    | J501 | CON34-Socket                                                 | Connector<br>socket                                                                                       | Panasonic<br>Electric Works  | AXF5G3412A                 |
| 23   | 1    | Q200 | STL6N3LLH6<br>PowerFLAT<br>2x2                               | N-channel 30 V,<br>0.021 ohm typ.,<br>6 A STripFET<br>H6 power<br>MOSFET in a<br>PowerFLAT<br>2x2 package | ST                           | <a href="#">STL6N3LLH6</a> |
| 24   | 1    | Q201 | RV3CA01ZPT2<br>CL 3-XFDFN<br>100 mW (Ta)                     | P-channel<br>MOSFET                                                                                       | Rohm<br>Semiconductor        | RV3CA01ZPT2CL              |
| 25   | 1    | R200 | 620 R 0201<br>1/20 W $\pm 1\%$<br>SMD                        | Resistor                                                                                                  | Panasonic<br>Electronics     | ERJ-1GNF6200C              |
| 26   | 1    | R201 | 100 K 0201<br>1/20 W $\pm 1\%$                               | Resistor                                                                                                  | MULTICOMP                    | MCRE000188                 |
| 27   | 1    | R202 | 10 k 0201 1/20<br>W $\pm 1\%$                                | Resistor                                                                                                  | VISHAY                       | CRCW020110K0FKED           |
| 28   | 1    | R203 | 1.5 k 0201 1/20<br>W $\pm 1\%$                               | Resistor                                                                                                  | MULTICOMP                    | MCRE000144                 |
| 29   | 1    | R204 | 0 R 0201 1/20<br>W                                           | Resistor                                                                                                  | Stackpole<br>Electronics Inc | RMCF0201ZT0R00             |
| 30   | 1    | R205 | 2.7 K 0201 1/20<br>W $\pm 5\%$                               | Resistor                                                                                                  | Panasonic<br>Electronics     | ERJ-1GNJ272C               |
| 31   | 1    | R206 | 1 K 0603 (1608<br>Metric) 0.1 W,<br>1/10 W $\pm 1\%$         | Resistor                                                                                                  | Yageo                        | RC0603FR-071KL             |
| 32   | 1    | R207 | 20 K 0603<br>(1608 Metric)<br>0.1 W, 1/10 W<br>$\pm 1\%$ SMD | Chip resistor                                                                                             | Panasonic<br>Electronic      | ERA-3AEB203V               |
| 33   | 1    | R208 | 20 k 0201 1/20<br>W $\pm 1\%$                                | Resistor                                                                                                  | Yageo                        | RC0201FR-0720KL            |
| 34   | 1    | R209 | 27 K 0603<br>(1608 Metric)<br>0.1 W, 1/10 W<br>$\pm 1\%$     | Chip resistor                                                                                             | YAGEO                        | RC0603FR-0727KL            |
| 35   | 1    | R210 | 56 K 0603<br>(1608 Metric)<br>0.1 W, 1/10 W<br>$\pm 1\%$ SMD | Chip resistor                                                                                             | Vishay Dale                  | CRCW060356K0FKTA           |
| 36   | 1    | R211 | 56 k 0201 1/20<br>W $\pm 1\%$                                | Resistor                                                                                                  | Panasonic<br>Electronics     | ERJ-1GNF5602C              |

| Item | Q.ty | Ref.                                                                                                                                | Part/value                                                                       | Description                                                       | Manufacturer         | Order code                 |
|------|------|-------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|-------------------------------------------------------------------|----------------------|----------------------------|
| 37   | 1    | R300                                                                                                                                | 200 k 0603<br>1/10 W $\pm 1\%$<br>SMD                                            | Resistor                                                          | Vishay               | CRCW0603200KFKEA           |
| 38   | 6    | R301 R302 R303<br>R304 R305 R501                                                                                                    | 0 R 0603 1/10<br>W $\pm 1\%$                                                     | Resistors (not<br>mounted)                                        | Yageo                | RC0603JR-070RL             |
| 39   | 5    | R306 R307 R308<br>R309 R310                                                                                                         | 4.7 k 0201 1/20<br>W $\pm 1\%$ SMD                                               | Resistors                                                         | Vishay               | CRCW02014K70FNED           |
| 40   | 10   | R400 R401 R402<br>R403 R404 R405<br>R406 R407 R408<br>R409                                                                          | 0 0603 (1608<br>Metric) 0.1 W,<br>1/10 W<br>$\pm 1\%$ SMD                        | Chip resistors                                                    | Vishay               | CRCW06030000Z0EB           |
| 41   | 2    | R410 R411                                                                                                                           | 1 M 0201 1/20<br>W $\pm 1\%$                                                     | Resistors                                                         | Yageo                | RC0201FR-071ML             |
| 42   | 1    | SB300                                                                                                                               | 0 R 0603 1/10<br>W $\pm 1\%$                                                     | Jumper                                                            | Vishay               | CRCW06030000Z0EB           |
| 43   | 3    | SC1 SC2 SC3                                                                                                                         | Screw M2X4                                                                       | Screws                                                            | RS                   | 914-1462                   |
| 44   | 1    | SW1                                                                                                                                 | Push-<br>Bottom_WE434<br>331013822<br>3.50mm x<br>2.90mm SPST-<br>NO 0.05 A 12 V | Tactile switch                                                    | Würth<br>Elektronik  | 434331013822               |
| 45   | 1    | SW400                                                                                                                               | Switch 6P - 25<br>mA 1P4T (1.4<br>mm height)                                     | Slide switch                                                      | Diptronics           | MSS14-V-T/R                |
| 46   | 2    | SW401 SW402                                                                                                                         | Switch 4P<br>1P3T (1.4 mm<br>height)                                             | Slide switches                                                    | Mountain<br>Switch   | 103-5041-EV                |
| 47   | 18   | TP200 TP201<br>TP202 TP203<br>TP204 TP205<br>TP206 TP207<br>TP208 TP209<br>TP210 TP211<br>TP300 TP301<br>TP302 TP303<br>TP304 TP305 | TPD                                                                              | Test points                                                       | Any                  | Any                        |
| 48   | 1    | U200                                                                                                                                | STBC03JR<br>chip scale<br>package 0.4<br>mm pitch                                | Li-Ion linear<br>battery charger<br>with LDO and<br>load switches | ST                   | <a href="#">STBC03JR</a>   |
| 49   | 1    | U201                                                                                                                                | TCP01-M12<br>QFN-12L                                                             | Overvoltage<br>protection for<br>USB Type-C or<br>Power Delivery  | ST                   | <a href="#">TCP01-M12</a>  |
| 50   | 1    | U300                                                                                                                                | LSF0108PWR<br>20-TSSOP<br>(0.173",<br>4.40mm Width)                              | IC TRNSLTR<br>BIDIRECTION<br>AL 20TSSOP                           | Texas<br>Instruments | LSF0108PWR                 |
| 51   | 1    | U400                                                                                                                                | STG3692<br>VFQFPN 16<br>2.6x1.8x0.5                                              | Low voltage<br>high bandwidth<br>quad SPDT                        | ST                   | <a href="#">STG3692QTR</a> |
| 52   | 1    | PCB                                                                                                                                 | FR4-<br>IT180A-4Layer<br>43.3x23.84x1.3<br>8 mm                                  | PCB                                                               | -                    | -                          |

**Table 15. STEVAL-ASTRA1NA bill of materials**

| Item | Q.ty | Ref.        | Part/value                | Description                      | Manufacturer | Order code |
|------|------|-------------|---------------------------|----------------------------------|--------------|------------|
| 1    | 2    | J1, J2 N.M. | Printed contacts          | Printed contacts (not mounted)   | -            | -          |
| 2    | 1    | J3 N.M.     | Strip male 2X1 pitch 1.27 | Jumper (not mounted)             | -            | -          |
| 3    | 2    | P1, P2 N.M. | -                         | Passive components (not mounted) | -            | -          |

## 5 Kit versions

**Table 16. STEVAL-ASTRA1B kit versions**

| Finished good                   | Schematic diagrams                  | Bill of materials                  |
|---------------------------------|-------------------------------------|------------------------------------|
| STEVAL\$ASTRA1BA <sup>(1)</sup> | STEVAL\$ASTRA1BA schematic diagrams | STEVAL\$ASTRA1BA bill of materials |

1. This code identifies the STEVAL-ASTRA1B evaluation kit first version. The kit consist of the STEVAL-ASTRA1 main board, whose version is identified by the code STEVAL\$ASTRA1A, the STEVAL-ASTRA1SB system on board, whose version is identified by the code STEVAL\$ASTRA1SBA, the STEVAL-ASTRA1BC expansion board, whose version is identified by the code STEVAL\$ASTRA1BCA and the STEVAL-ASTRA1NA flexible NFC antenna, whose version is identified by the code STEVAL\$ASTRA1NAA.

## 6 Regulatory compliance information

### Formal Notice Required by the U.S. Federal Communications Commission

#### 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.

The evaluation kit has been designed to comply with part 15 of the FCC Technical 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.

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.

Standards applied: FCC CFR 47 Part 15 Subpart B (test method applied: ANSI C63.4 v2014), FCC 47 CFR Part 15 Subpart C, §15.209 (test method applied: ANSI C63.10 v2013).

### Formal Product Notice Required by Industry Canada Innovation, Science and Economic Development

#### Canada compliance:

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).

This device has been tested with Innovation, Science and Economic Development RSS standards. 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.

Standard applied: ICES-003 Issue 7 (2020), Class B. Test method applied: ANSI C63.4 (2014).

Cet appareil a été testé pour les normes RSS d'Innovation, Science et Développement économique. L'utilisation est soumise aux deux conditions suivantes: (1) cet appareil ne doit pas causer d'interférences nuisibles, et (2) cet appareil doit accepter de recevoir tous les types d'interférence, y comprises les interférences susceptibles d'entraîner un fonctionnement indésirable.

Norme appliquée: NMB-003, 7e édition (2020), Classe B. Méthode d'essai appliquée: ANSI C63.4 (2014).

### Formal product notice required by EU

The kit STEVAL-ASTRA1B is in conformity with the essential requirements of the Directive 2014/53/EU (RED) and of the Directive 2015/863/EU (RoHS). Harmonized standards applied are listed in the EU Declaration of Conformity.

According to Commission Decision 2000/299/EC, the device falls under the scope of Class I, Subclass 22 "Wideband Data Transmission Systems" and Subclass 07 "Receive-only radio equipment". The device also falls under the scope of Class II, as the LoRaWAN interface, in the band used (863-870 MHz) has limitations and restrictions on use as referenced by the "ERC Recommendation 70-03", in Annex 1, point h1.2: power/magnetic field 25 mW e.r.p. -4.5 dBm/100kHz, spectrum access and mitigation requirements  $\leq 0.1\%$  duty cycle, modulation/maximum occupied bandwidth not specified.

|                                                                                   |    |    |    |  |  |  |  |
|-----------------------------------------------------------------------------------|----|----|----|--|--|--|--|
|  | BG | GR | SE |  |  |  |  |
|                                                                                   |    |    |    |  |  |  |  |
|                                                                                   |    |    |    |  |  |  |  |
|                                                                                   |    |    |    |  |  |  |  |
|                                                                                   |    |    |    |  |  |  |  |

Bulgaria: LoRaWAN band is not implemented

Greece: LoRaWAN band has limited implementation

Sweden: LoRaWAN band has limited implementation

## Revision history

**Table 17. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                          |
|-------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 17-Feb-2022 | 1        | Initial release.                                                                                                                                                                                                                 |
| 11-Mar-2022 | 2        | Added Section 1.3 RF specifications and Section 1.5 Product marking.<br>Updated Section 2.1 How to assemble the kit, Section 3 Schematic diagrams, Section 4 Bill of materials, and Section 6 Regulatory compliance information. |
| 23-Mar-2022 | 3        | Updated <a href="#">Section 6</a> <a href="#">Regulatory compliance information</a> .                                                                                                                                            |

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