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.

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-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 wireless dual core SoC module as main application processor, which supports Bluetooth® Low Energy 5.0 and 2.4 GHz protocols
  - STM32WL55JC wireless dual core SoC, which supports LoRaWAN and sub-GHz protocols
- 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-ASSETRACKING 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):

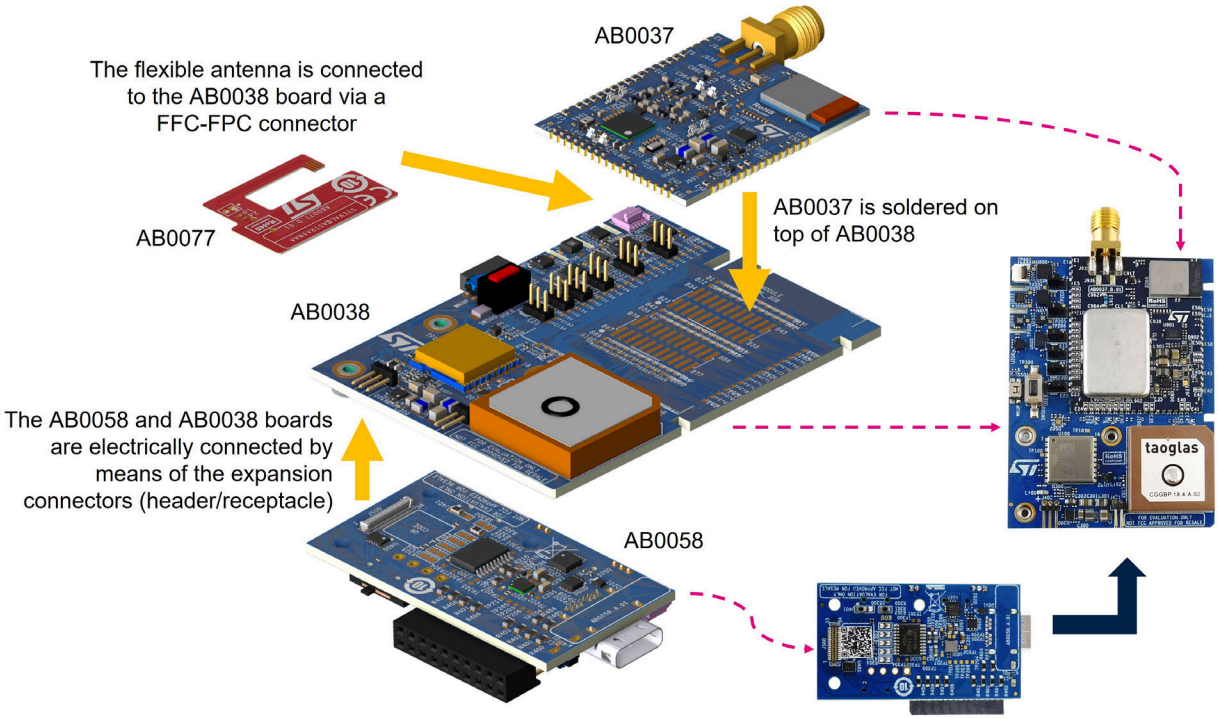
- the STEVAL-ASTRA1SB system on board (with STEVAL$ASTRA1SBA finished good and AB0037 code printed on the PCB);
- the STEVAL-ASTRA1 main board (with STEVAL$ASTRA1A finished good and AB0038 code printed on the PCB);
- the STEVAL-ASTRA1BC expansion board (with STEVAL$ASTRA1BCA finished good and AB0058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

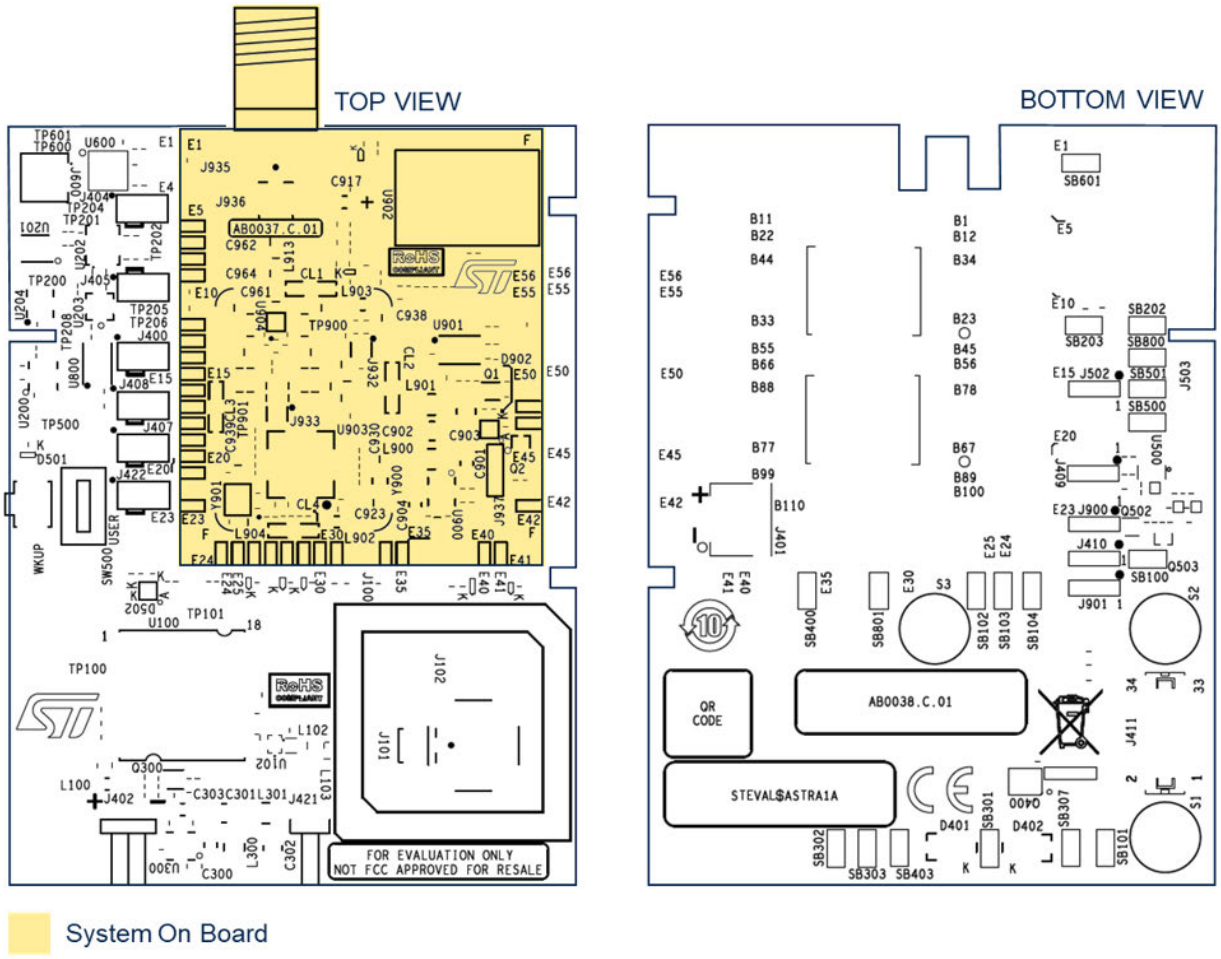
Figure 2. STEVAL-ASTRA1B components and assembly



1.5 Component placement

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). The figure below shows the component placement on the STEVAL-ASTRA1B kit.

Figure 3. **STEVAL-ASTRA1B component placement**

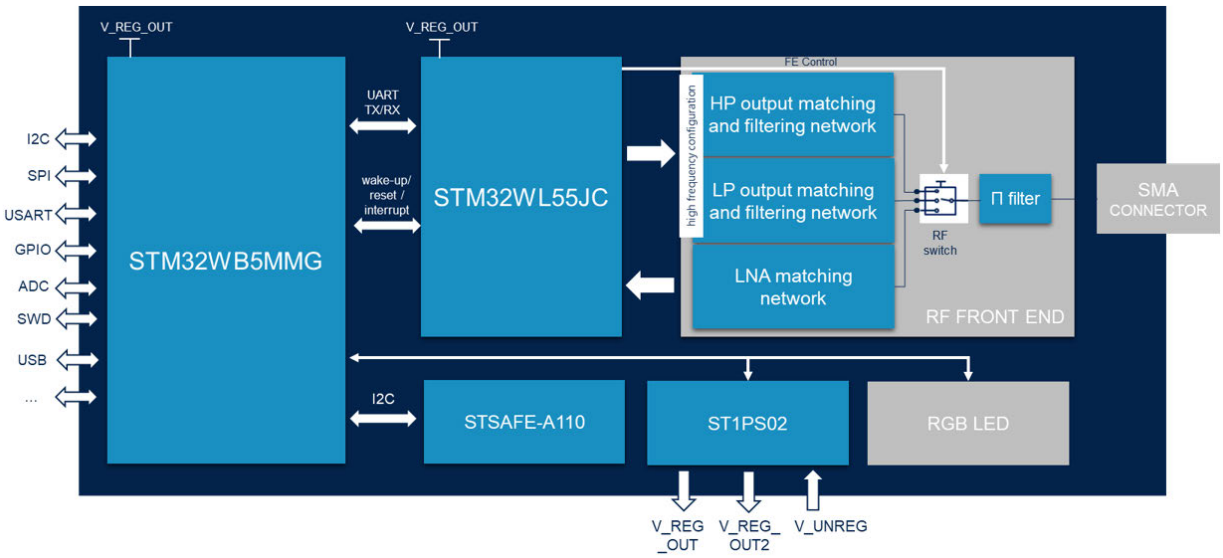


1.5.1 STEVAL-ASTRA1SB system on board

1.5.1.1 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 4. **Block diagram of the STEVAL-ASTRA1SB system on board**



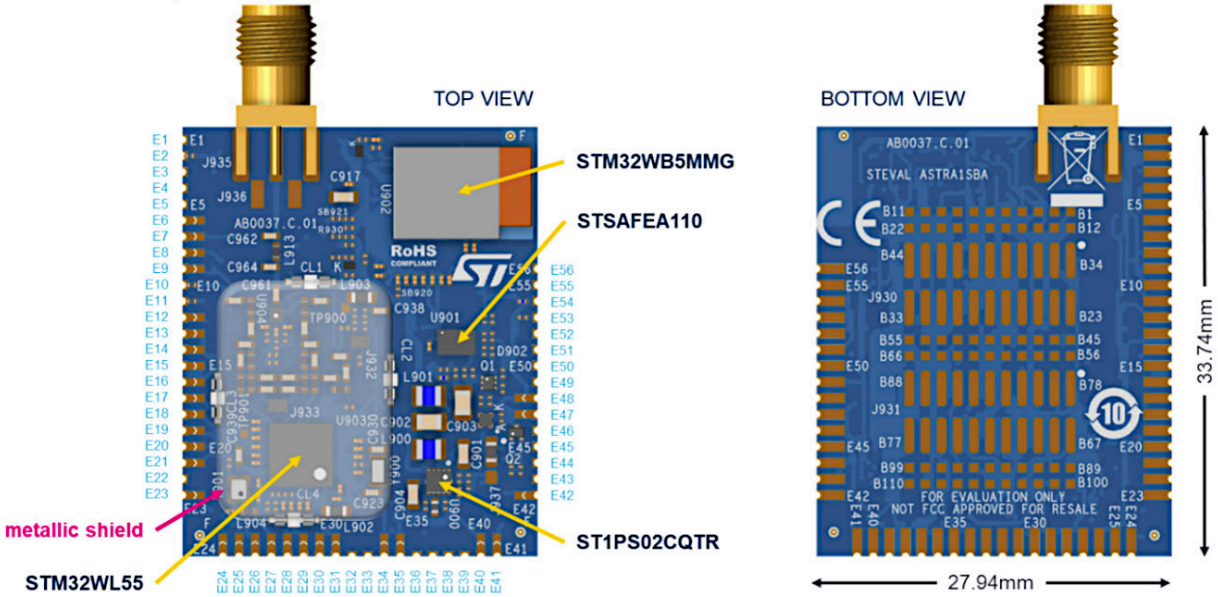
This board main components are:

- 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-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 1.5.1.2).

Figure 5 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 5. 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 6. Solder jumper example remapping

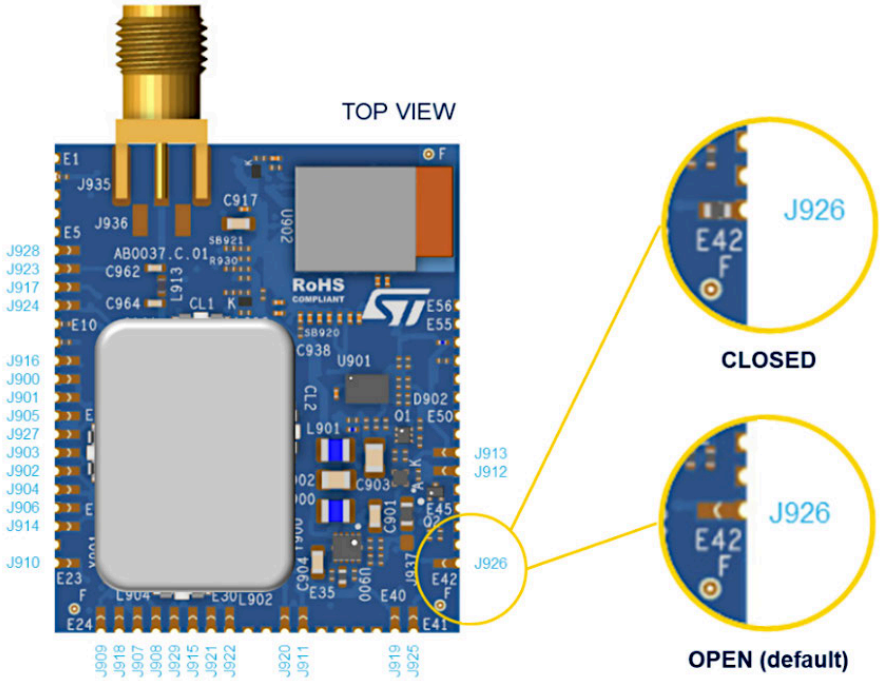


Table 2. **System on board - edge pinout**

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 7).

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

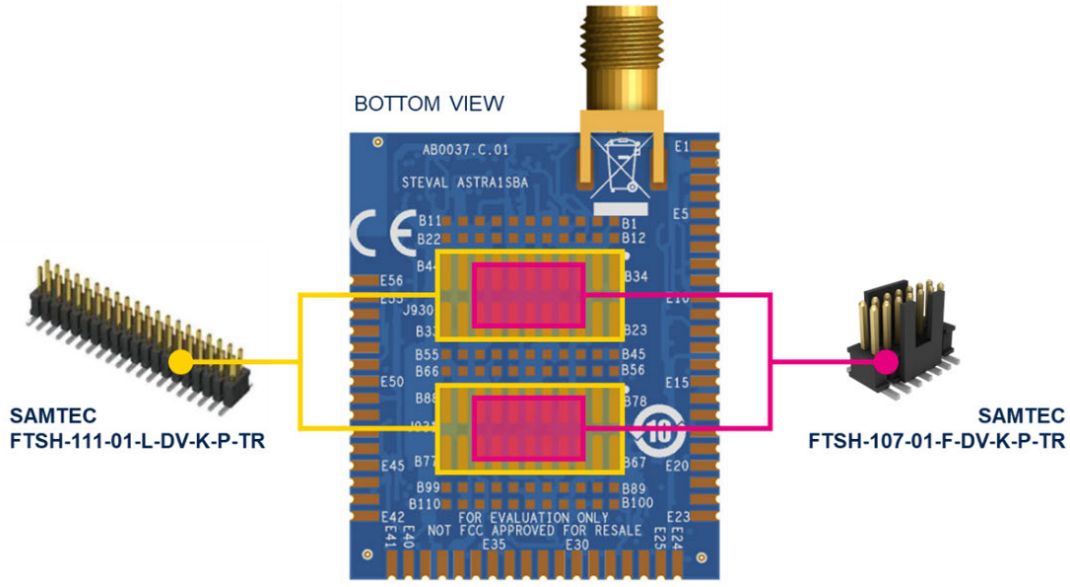
Pin	Function
B1	WB_PD0
B2	WB_PD2
B3	WB_PD8
B4	WB_PH0
B5	WB_PD10
B6	WB_PB1
B7	WB_PH1
B8	WB_PD13
B9	WB_PC12
B10	WB_PE1 POWER GOOD
B11	WB_PB15
B12	WL_PA3
B13	WL_PA2
B14	WL_PA1
B15	WL_PB2
B16	WL_PA11
B17	WB_PD1

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
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
B97	WB_GND
B98	WB_VDD
B99	WB_PD13 D0_1_2

Pin	Function
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 7. Extended debug footprints and supported connectors



1.5.1.2 *Power management*

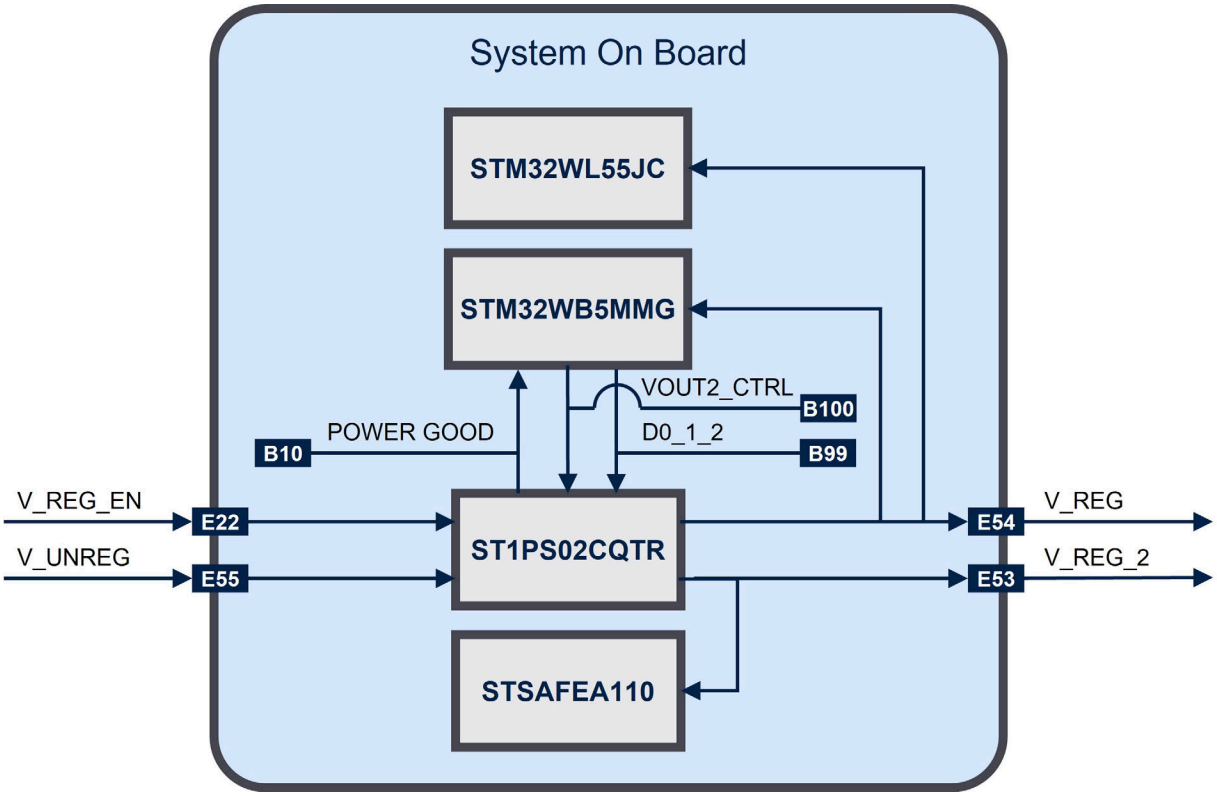
The ST1PS02CQTR step-down converter on the system on board is part of the power management circuit. It generates the power domains (V_REG and V_REG_2) that translate the input voltage (V_UNREG). The V_REG_EN signal, which comes from the power switch on the main board, enables the step-down converter and generates the V_REG energy domain.

The STM32WB5MMG microcontroller can activate the second energy domain (V_REG_2) acting on the VOUT2_CTRL signal.

At startup the output voltages (V_REG and V_REG_2) 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 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 8. **System on board - power management block diagram**



1.5.1.3 *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).

The FP-ATR-ASTRA1 assigns the following meaning to the RGB LED:

- blue, if the configuration is ongoing
- red, if the sending is ongoing
- green:
  - with slow blinking, if the Bluetooth® Low Energy is not connected
  - with fast blinking, if the Bluetooth® Low Energy is connected
  - yellow, if the Bluetooth® Low Energy is connected and sending

1.5.2 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 jumpers.

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

Figure 9. **Main board block diagram**

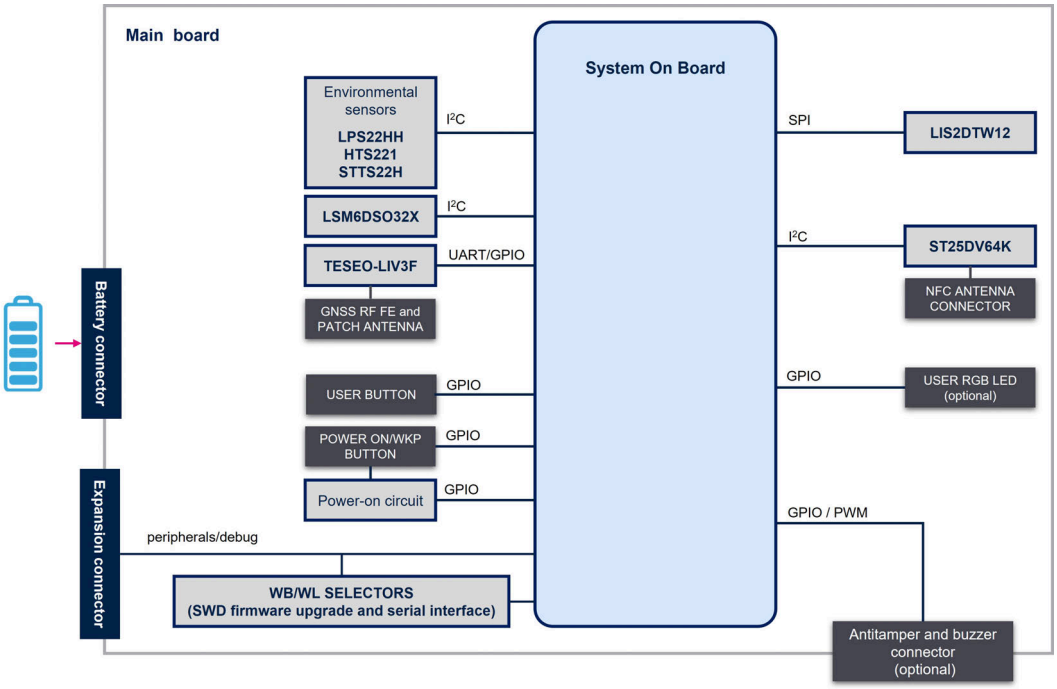


Figure 10. Main board component placement (top view)

1. LSM6DSO32X
2. LPS22HH
3. STTS22H
4. HTS221
5. LIS2DTW12
6. Power on/wake-up button
7. User button
8. Screw hole for board-to-board strengthening
9. ST1PS02CQTR
10. GNSS antenna
11. Teseo-LIV3F
12. System on board
13. Jumpers to select the microcontroller to program (STM32WB5MMG or STM32WL55JC)
14. ST25DV64K
15. NFC connector

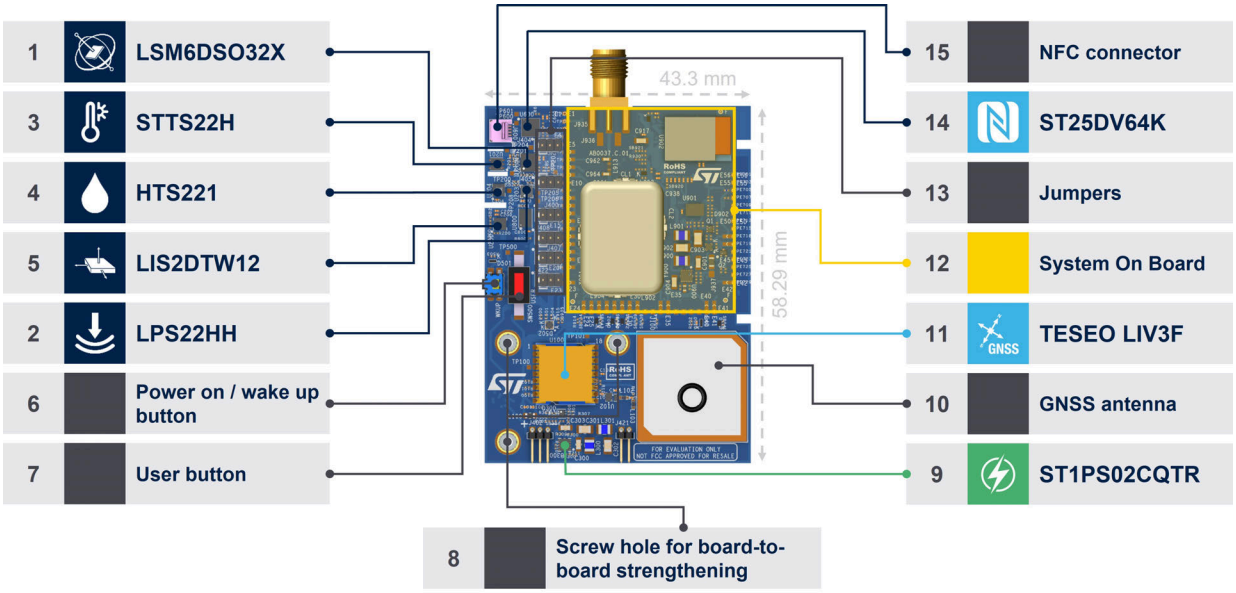
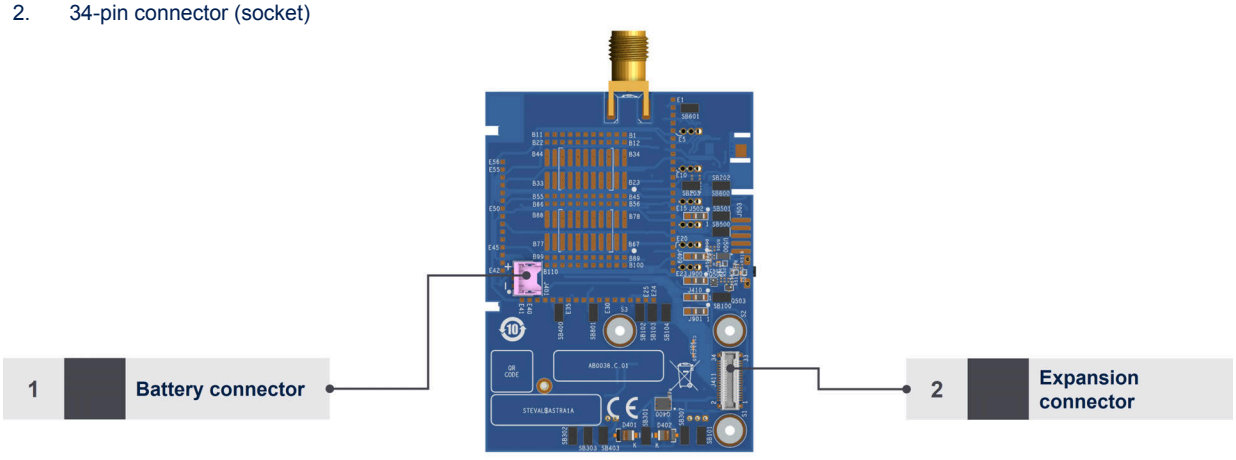


Figure 11. Main board component placement (bottom view)

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



1.5.2.1 *Sensors*

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

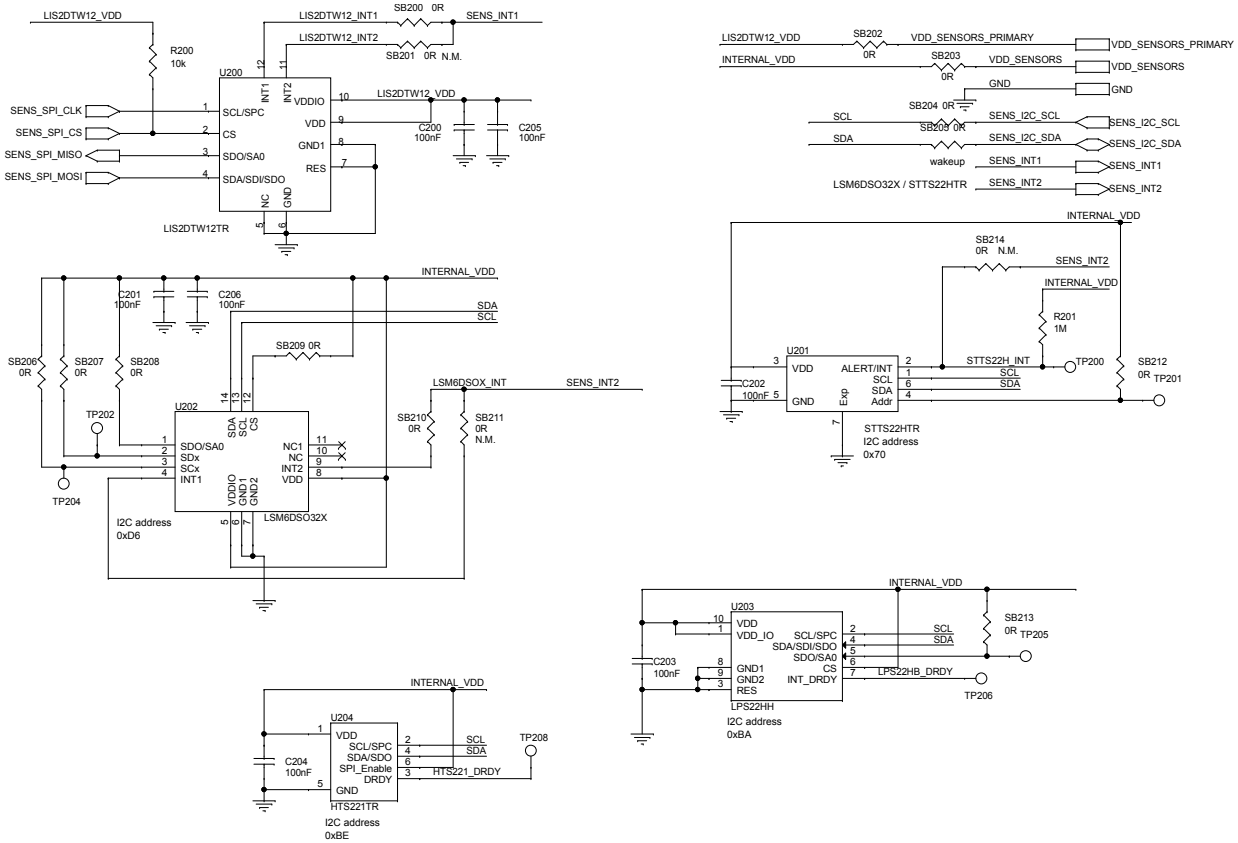
- STTS22H (AB0038.U201) ultra-low-power, high accuracy, digital temperature sensor. Thanks to its factory calibration, the STTS22H offers high-end accuracy performance over the entire operating temperature range, without requiring any further calibration at the application level. The operating temperature goes from -40°C to +125°C with a ±0.5°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 hPa 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 ±1.5°C (0°C 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 ± 3.5% rH (+20% to +80% rH). The temperature range goes from -40°C to +125°C and the temperature accuracy is ± 0.5°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 ±2g/±4g/±8g/±16g. 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 ±4/±8/±16/±32 g and an angular rate range of ±125/±250/±500/±1000/±2000 dps. The operating temperature range goes from -40°C +85°C.

The environmental sensors and the LSM6DSO32X motion sensor share the I²C 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.

Other sensors belongs to the V_REG1_MAIN domain. Optionally, you can supply them through V_REG2_SOB generated by the system on board.

Figure 12. **STEVAL-ASTRA1B sensor schematic diagram**



1.5.2.2 *NFC*

The ST25DV64K (AB0038.U600) is an NFC RFID tag equipped with 64 Kbit of electrically erasable programmable memory (EEPROM). It offers two communication interfaces: an I²C serial link and an RF link.

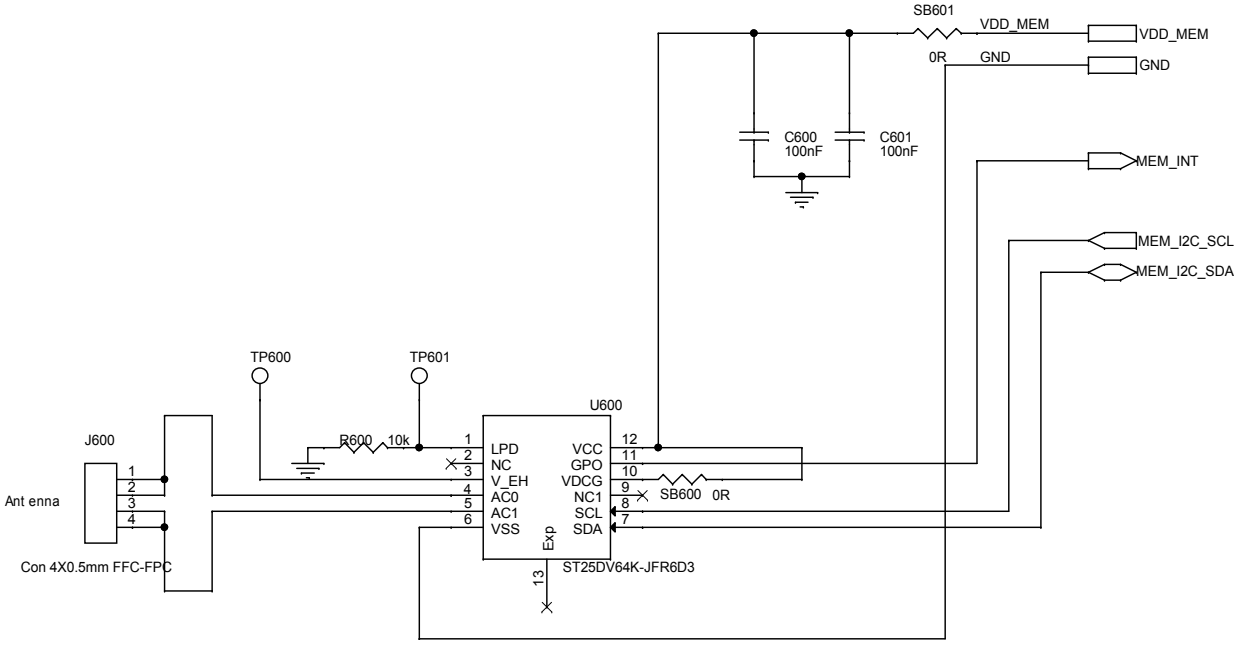
The first one can be operated from a DC power supply, whereas the second one is activated when the ST25DV64K acts as a contactless memory powered by the received carrier electromagnetic wave.

In I²C mode, the ST25DV64K user memory contains up to 512 bytes, 2048 bytes and 8192 bytes, which could be split into four flexible and protectable areas. In RF mode, following ISO/IEC 15693 or NFC forum type 5 recommendations, the ST25DV64K user memory contains up to 2048 blocks of 4 bytes, which could be split into four flexible areas.

The ST25DV64K GPO pin (MEM_INT) provides data about incoming events, like RF field detection, RF activity in progress, or mailbox message availability.

The ST25DV64K belongs to the V_REG2_SOB domain. Optionally, you can supply it through V_REG2_MAIN.

Figure 13. **STEVAL-ASTRA1 NFC tag schematic diagram**



1.5.2.3 *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).

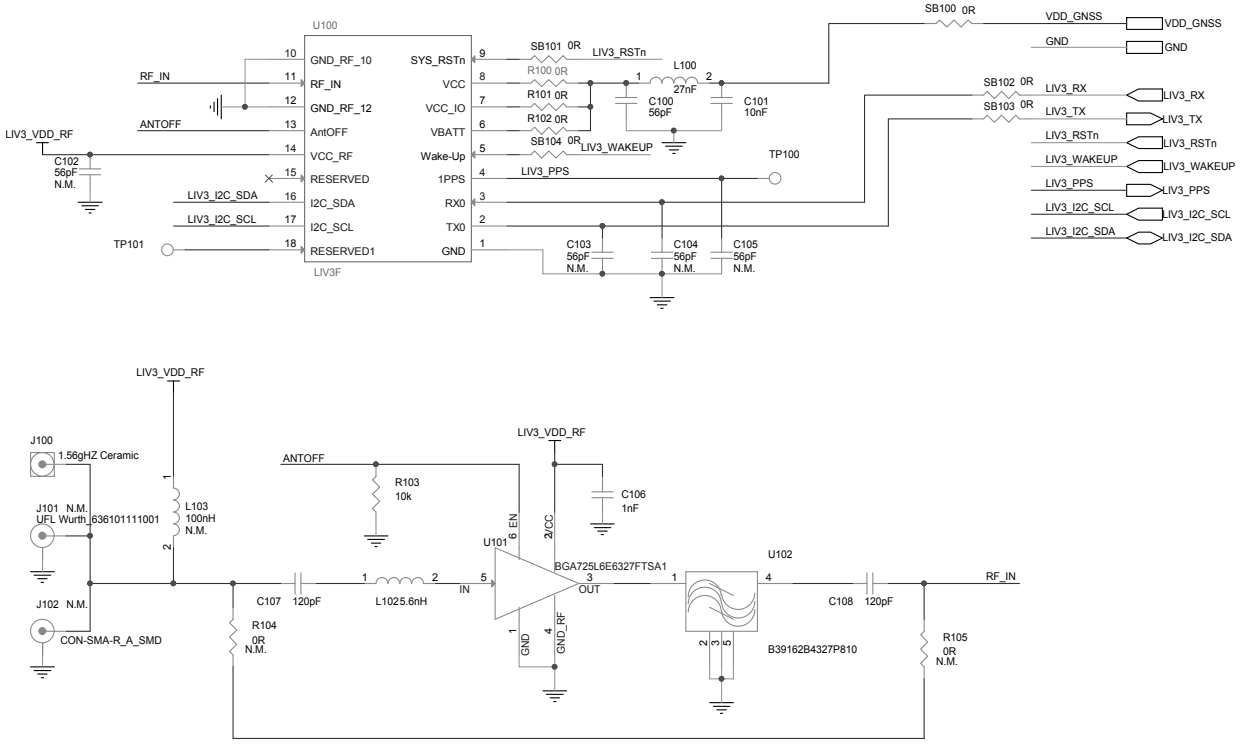
Thanks to the embedded 16 Mbit flash memory, the Teseo-LIV3F features data logging, seven-day autonomous assisted GNSS, firmware reconfigurability, and firmware upgrades.

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 14. STEVAL-ASTRA1 GNSS schematic diagram



The device and the microcontroller communicate via the UART bus. You can optionally route them to the I²C 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_SOB generated by the system on board (see Section 1.5.2.10 for further details).

1.5.2.4 *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 15. **STEVAL-ASTRA1 three-pin jumper selectors (default configuration)**

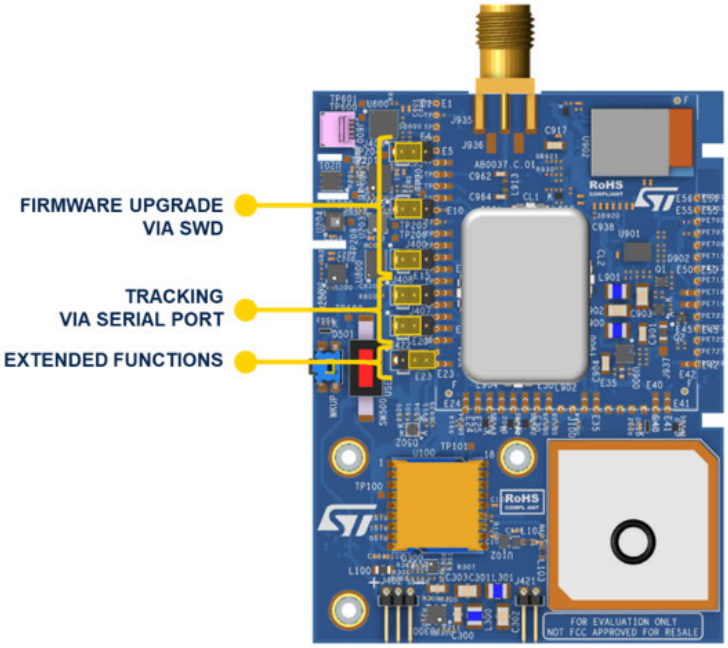


Table 4. **Configuration map of the three-pin jumper selectors**

Jumper	Group	Configuration	Description
J400	Firmware upgrade		SWDIO net is connected to the STM32WB5MMG microcontroller as a jumper is connected between pins 1 and 2 (default setting).
			SWDIO net is connected to the STM32WL55JC microcontroller as a jumper is connected between pins 2 and 3.
J404	Firmware upgrade		SWCLK net is connected to the STM32WB5MMG microcontroller as a jumper is connected between pins 1 and 2 (default setting).
			SWCLK net is connected to the STM32WL55JC microcontroller as a jumper is connected between pins 2 and 3.
J405	Firmware upgrade		RESET net is connected to the STM32WB5MMG microcontroller as a jumper is connected between pins 1 and 2 (default setting).
			RESET net is connected to the STM32WL55JC microcontroller as a jumper is connected between pins 2 and 3.
J407	Tracking		USART_TX net is connected to the STM32WB5MMG 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 STM32WL55JC microcontroller as a jumper is connected between pins 2 and 3.
J408	Tracking		USART_RX net is connected to the STM32WB5MMG microcontroller as a jumper is connected between pins 1 and 2 (default setting).
			USART_RX net is connected to the STM32WL55JC 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 16. STEVAL-ASTRA1 jumper configuration to program STM32WB5MMG

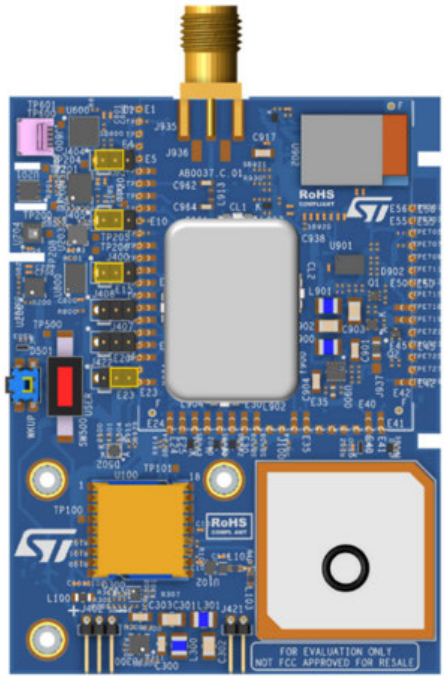
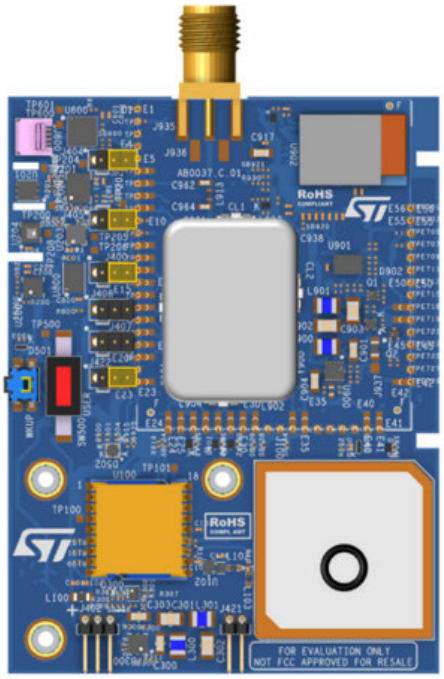


Figure 17. **STEVAL-ASTRA1 jumper configuration to program STM32WL55JC**



J422 controls the routing of the reset signal. In the default configuration (Figure 15), the reset signal that comes from the expansion board is used to reset the two microcontrollers, according to the position of the J405 selector.

1.5.2.5 *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.

1.5.2.6 *Push buttons, antitampering, and buzzer*

The STEVAL-ASTRA1 main board embeds two push buttons. Hardware circuits connected to them and the application firmware allow them to play different roles.

The power-on/side button (AB0038.SW501) on the board edge acts on the power-on circuit, enabling the voltage regulator in the system on board. When the application is already powered, it generates a state change in the BTN2 line, which is connected to the GPIO PC11 of the STM32WB5MMG microcontroller. Moreover, it contributes to the STM32WB5MMG wake-up signal (WAKEUP) generation as described in Section 1.5.2.7 Awakening signal.

The user button (AB0038.SW500) generates a change in the state of the BTN1 line connected to the GPIO PC13 of the STM32WB5MMG microcontroller.

The FP-ATR-ASTRA1 application firmware augments the two buttons behavior by detecting how long each button is pressed. Therefore, each button can support a short and a long press functionality. The table below shows the default actions. Refer to UM3019 for further details.

Table 5. **Short and long button press events managed by FP-ATR-ASTRA1**

Button	Short press	Long press
Side button (AB0038.SW501)	Changes the low-power status to run (or vice versa)	System reboot
User button (AB0038.SW500)	Triggers asynchronous LoRa end data	System shutdown

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 18. **Push buttons, antitampering, and buzzer**

1. Power side button
2. Frontal user button
3. J503 connector

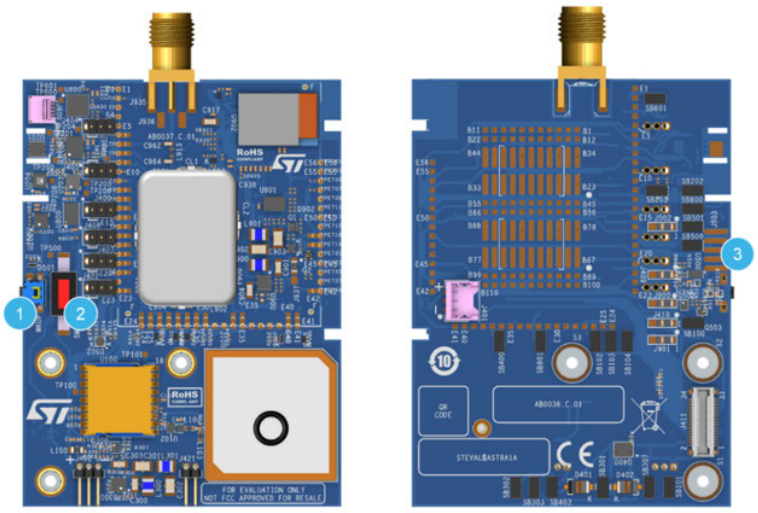


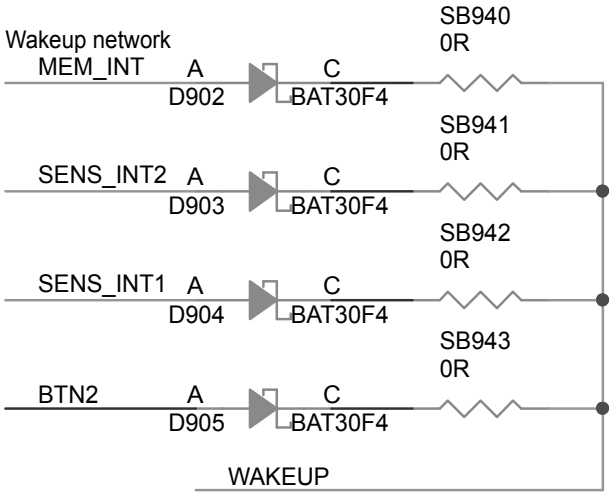
Table 6. **J503 connector pinout (not mounted)**

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

1.5.2.7 *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.

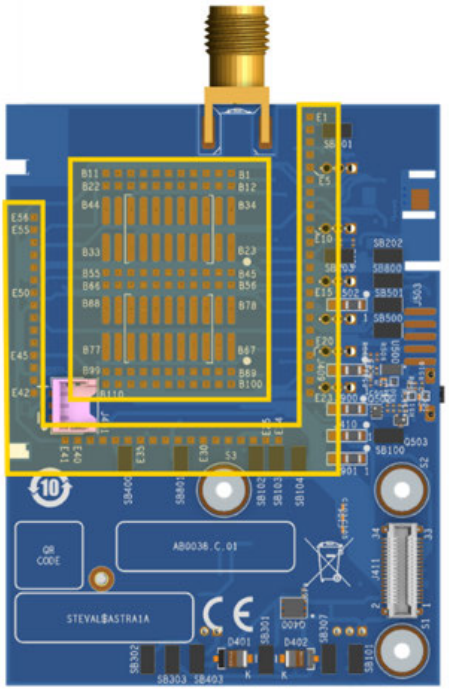
Figure 19. **STEVAL-ASTRA1 wake-up network**



1.5.2.8 *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 1.5.1.1 (to Table 2, Table 3, and Section 1.5.1.1 for pinout details).

Figure 20. Bottom pads



1.5.2.9 *Expansion connector*

The expansion connector (AB0038.J411, Panasonic AXF5G3412) is on the bottom side. It plays multiple roles.

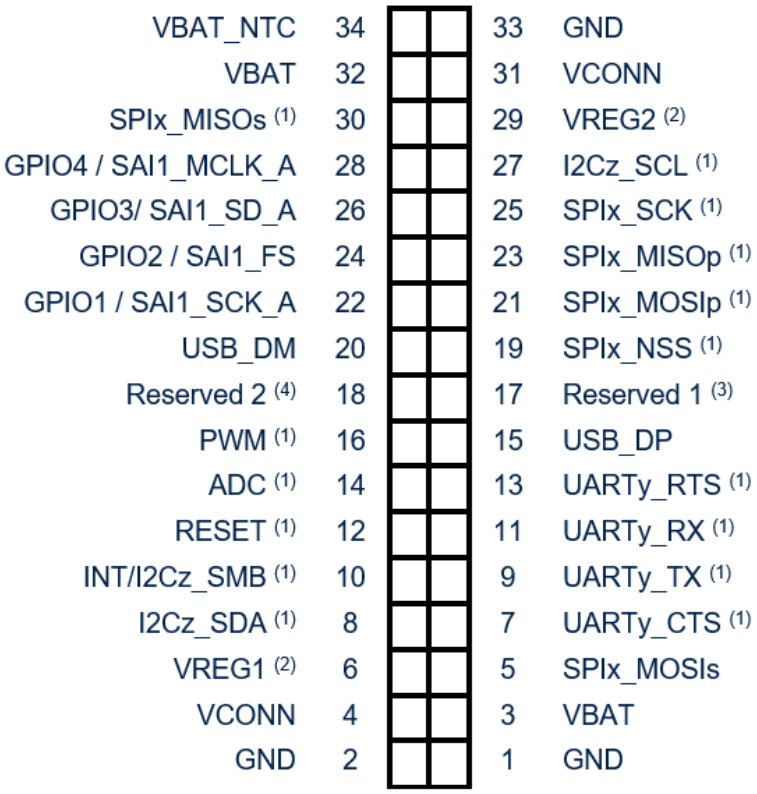
By default, it is used to connect the expansion board. You can also use it to plug further expansion boards such as:

- 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 21. **34-pin connector pinout**



Note:

- *(1) It can be used as GPIO.*
- *(2) These pins can be connected. They can be the VDD_MCU or other regulated voltages.*
- *(3) It can be used for STMOD+ mux driving or SWCLK signal.*
- *(4) 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.

1.5.2.10 *Power management and voltage monitoring*

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

The battery voltage can be supplied through:

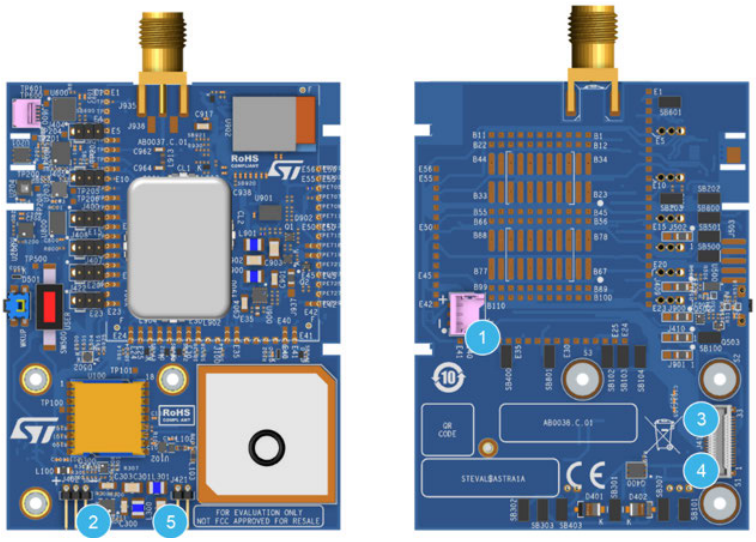
1. the battery connector (AB0038.J401), which is the default choice;
2. the strip line connectors (AB0038.J402);
3. the expansion connector (AB0038.J411) pins (3, 32, and 34) and the GNDs.

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 22. Supply inputs

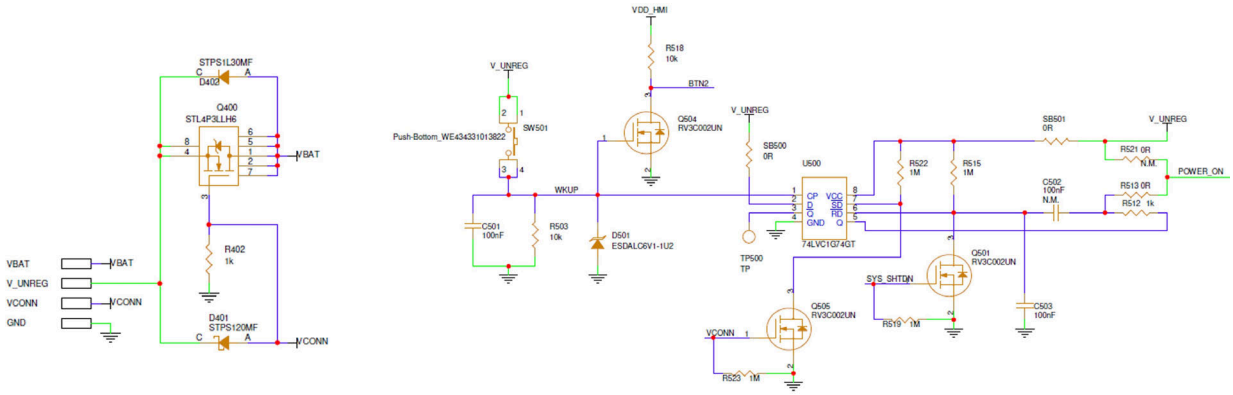
1. Battery connector
2. Strip line connectors
3. Expansion connector (pins 3, 32, and 34)
4. Expansion connector (pins 4 and 31)
5. Strip line



These two supplies generate the V_UNREG voltage through a selection circuit, which gives priority to the V_CONN.

The selection circuit consists of the following components: AB0038.D401, AB0038.D402, AB0038.Q400, and AB0038.R401.

Figure 23. Power management scheme



When both two power sources are present, the V_CONN generates the V_UNREG voltage.

The V_ UNREG voltage is the point of origin of the other energy domains. It is the input of the ST1PS02CQTR step-down converters embedded in the system on board (as described in Section 1.5.1.2) and in the main board.

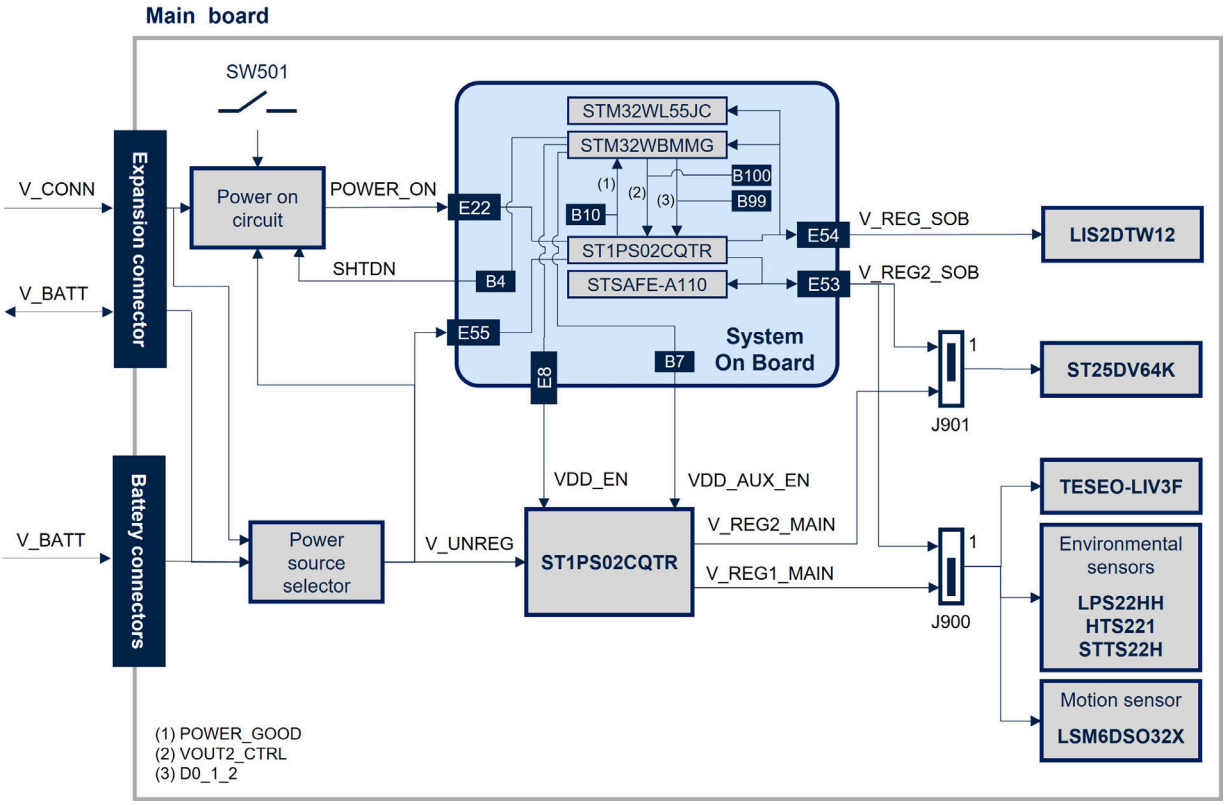
The two step-down converters require a switch-on signal. The one (POWER_ON) that refers to the ST1PS02CQTR on the system on board is generated by a power-on circuit built around the device (AB0038.U500) and triggered by the power/wake-up button (AB0038.SW501). Moreover, the power-on circuit is automatically triggered when the V_CONN 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 (V_REG2_MAIN).

By default, the V_REG1_MAIN supply voltage is used for sensors and GNSS purposes, whereas the V_REG2_MAIN 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 V_REG1_MAIN and V_REG2_MAIN by using the V_REG2_SOB 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 24. Power management block scheme



1.5.3 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;
- low voltage, high bandwidth quad SPDT (STG3692).

Figure 25. **Expansion board block diagram**

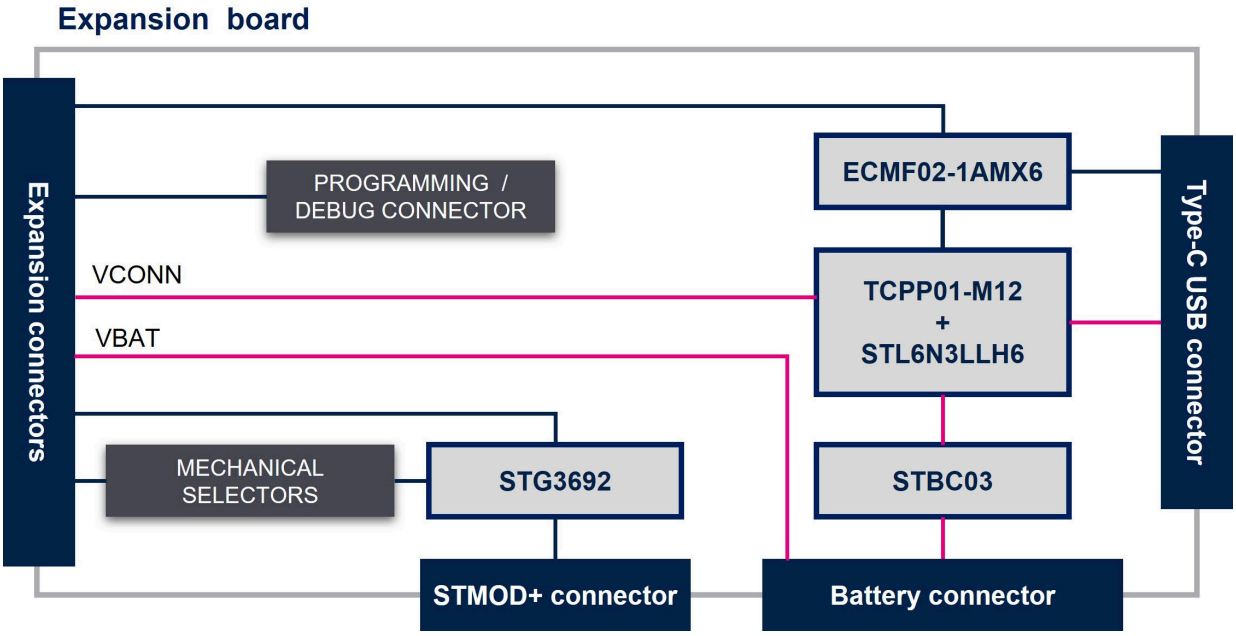
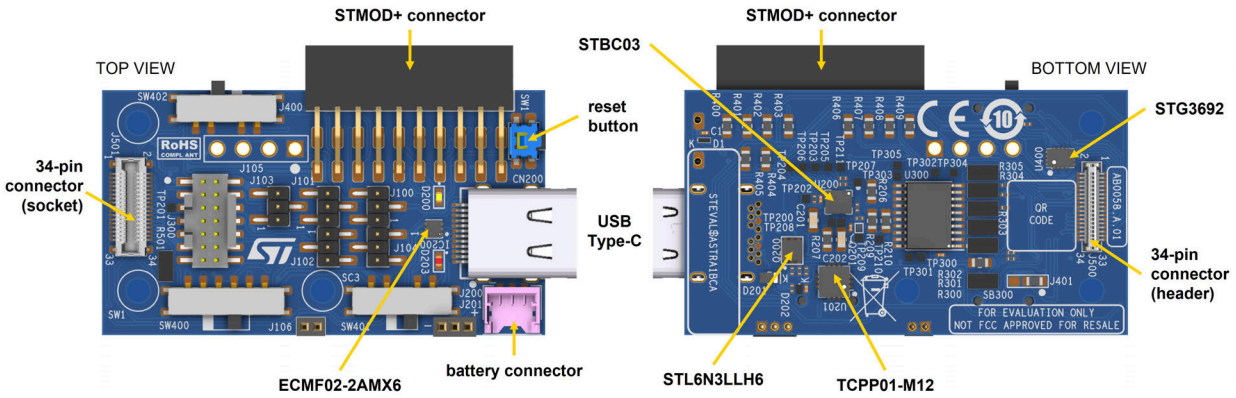


Figure 26. **Expansion board (top and bottom views)**



1.5.3.1 *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 27. **Three-state selector positions**

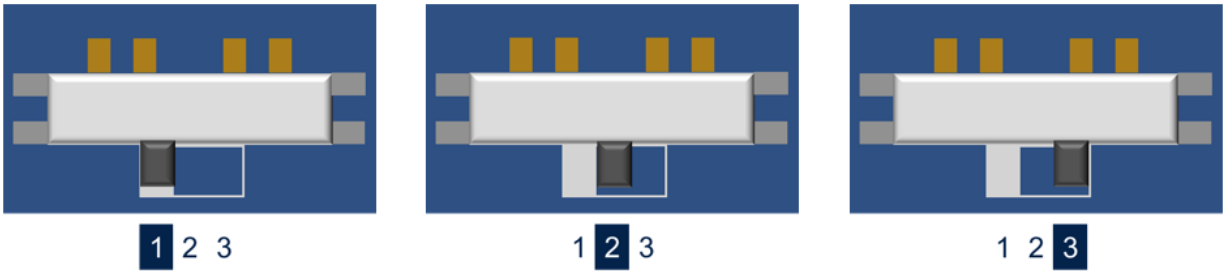
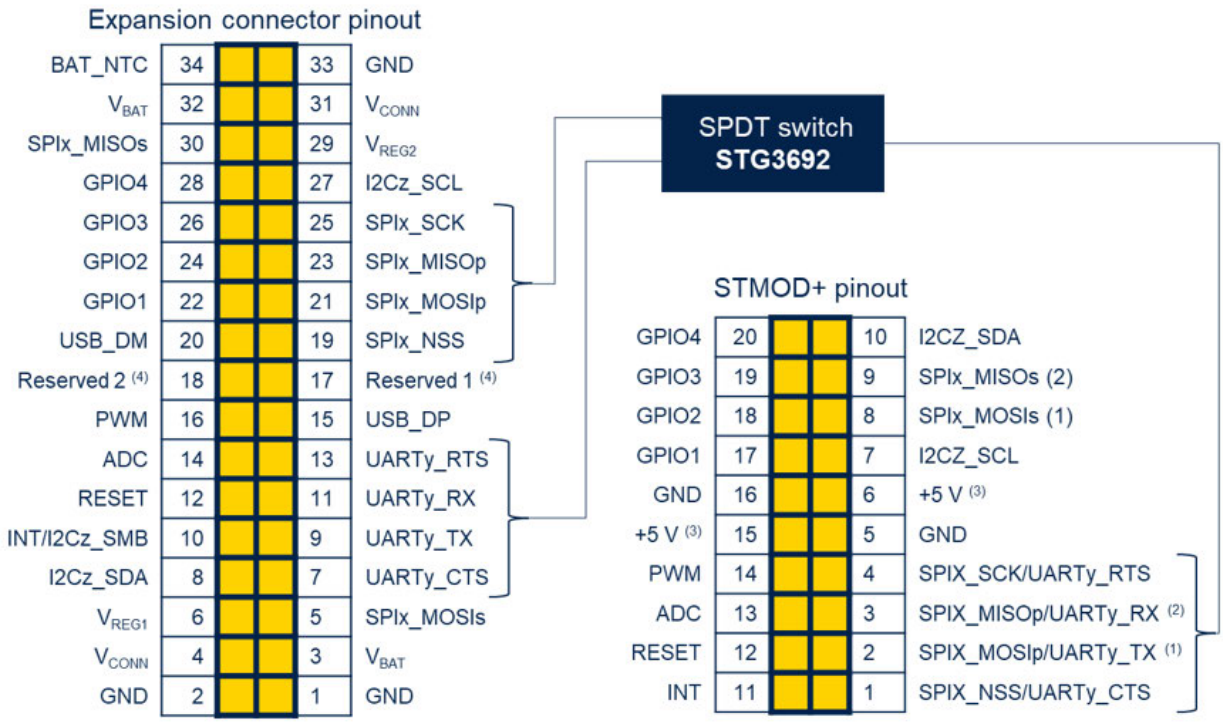


Figure 28. **Expansion connector versus STMOD+ adapter**



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.

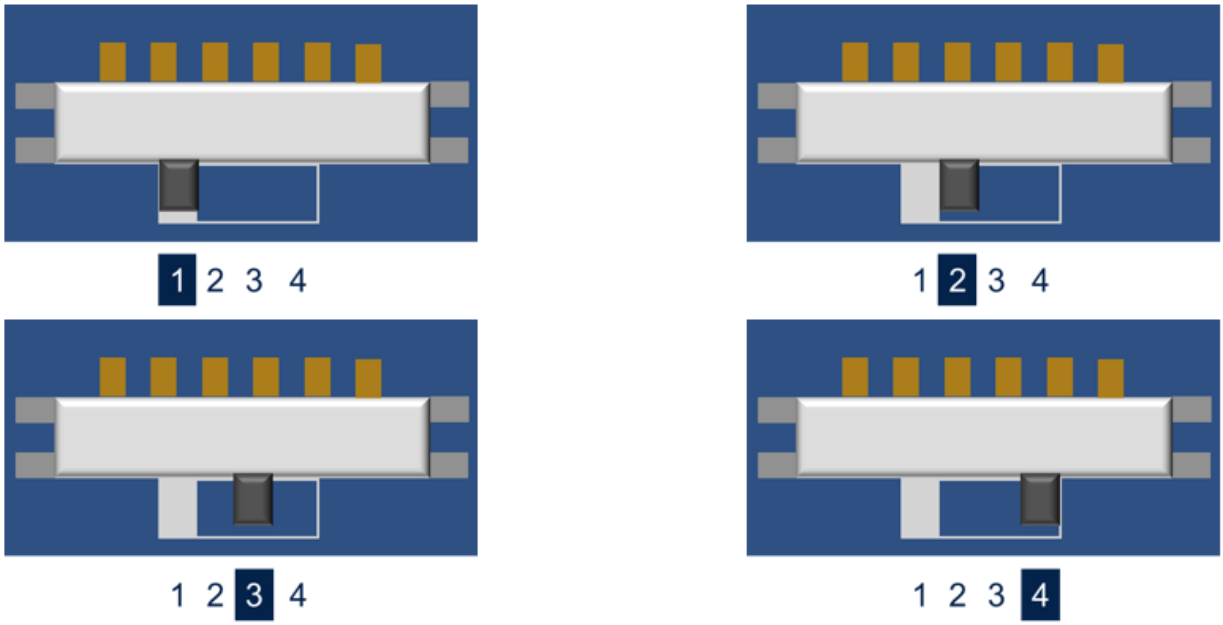
(4) These pins can be used to drive the SPDT switch.

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 29. **Four-state selector positions**



1.5.3.2 *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.

1.5.3.3 *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 27.

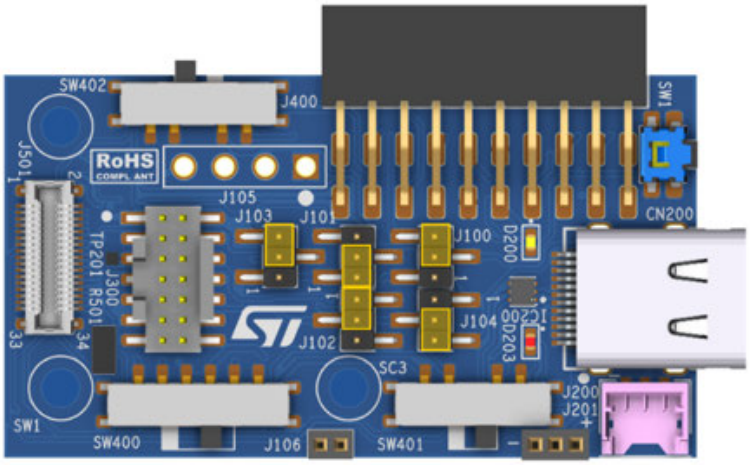
Table 10. Configuration map of the three-pin jumper selectors

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.

1.5.3.4 *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 30. **STEVAL-ASTRA1BC default jumper configuration**



1.5.3.5 *Power management*

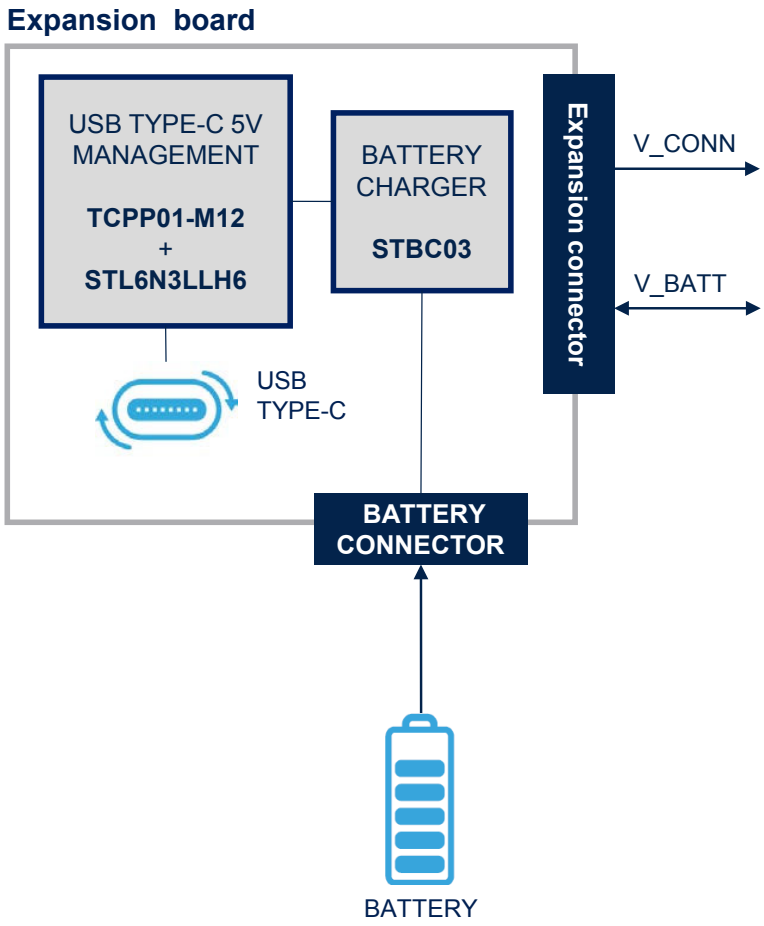
The STEVAL-ASTRA1BC expansion board embeds the last section of the power management circuit. The available power sources are the VBAT battery voltage and the VCONN (which is generated by the USB Type-C™ port).

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 31. **Expansion board - power management block scheme**



1.6 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.

1.7 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 32. **STEVAL-ASTRA1B - power management block scheme**

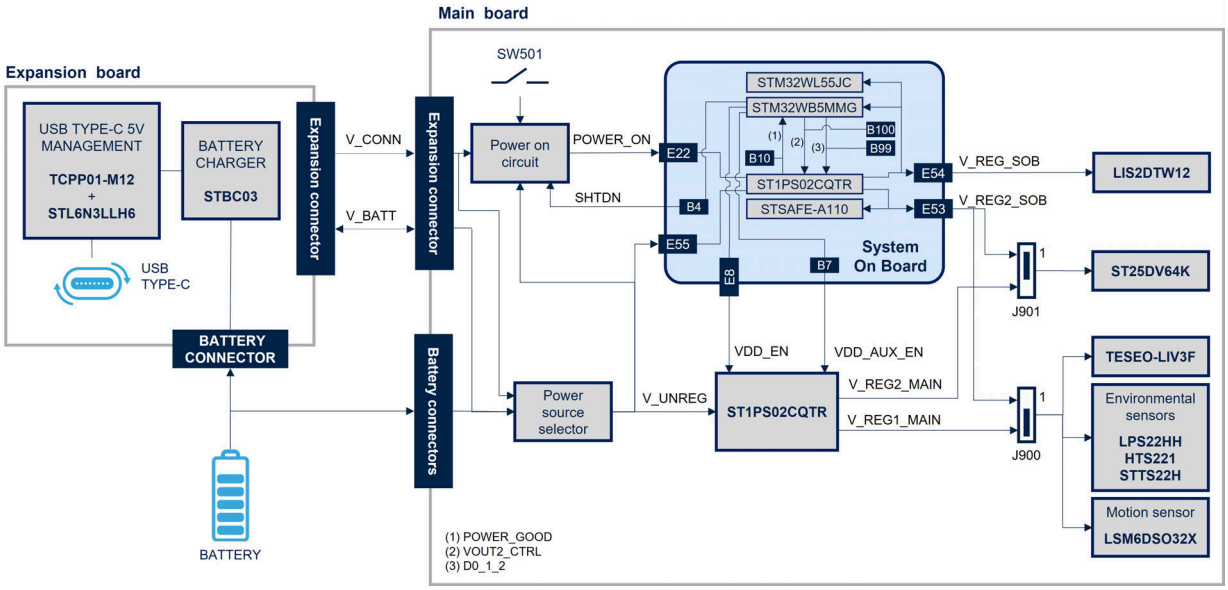


Figure 33. **System on board - power management schematic**

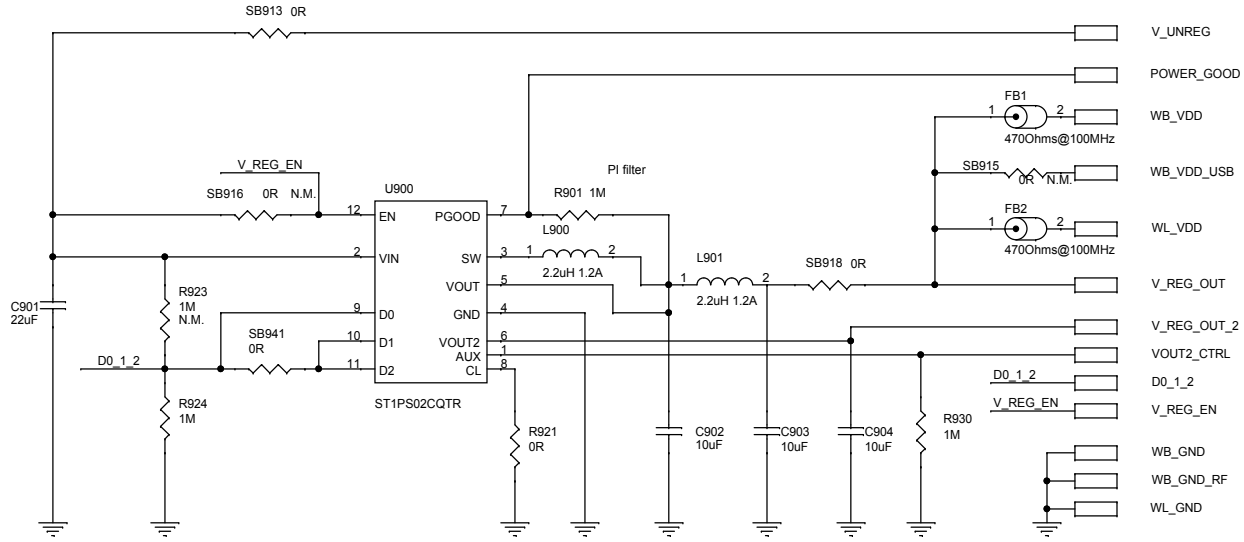


Figure 34. **Main board - power management schematic**

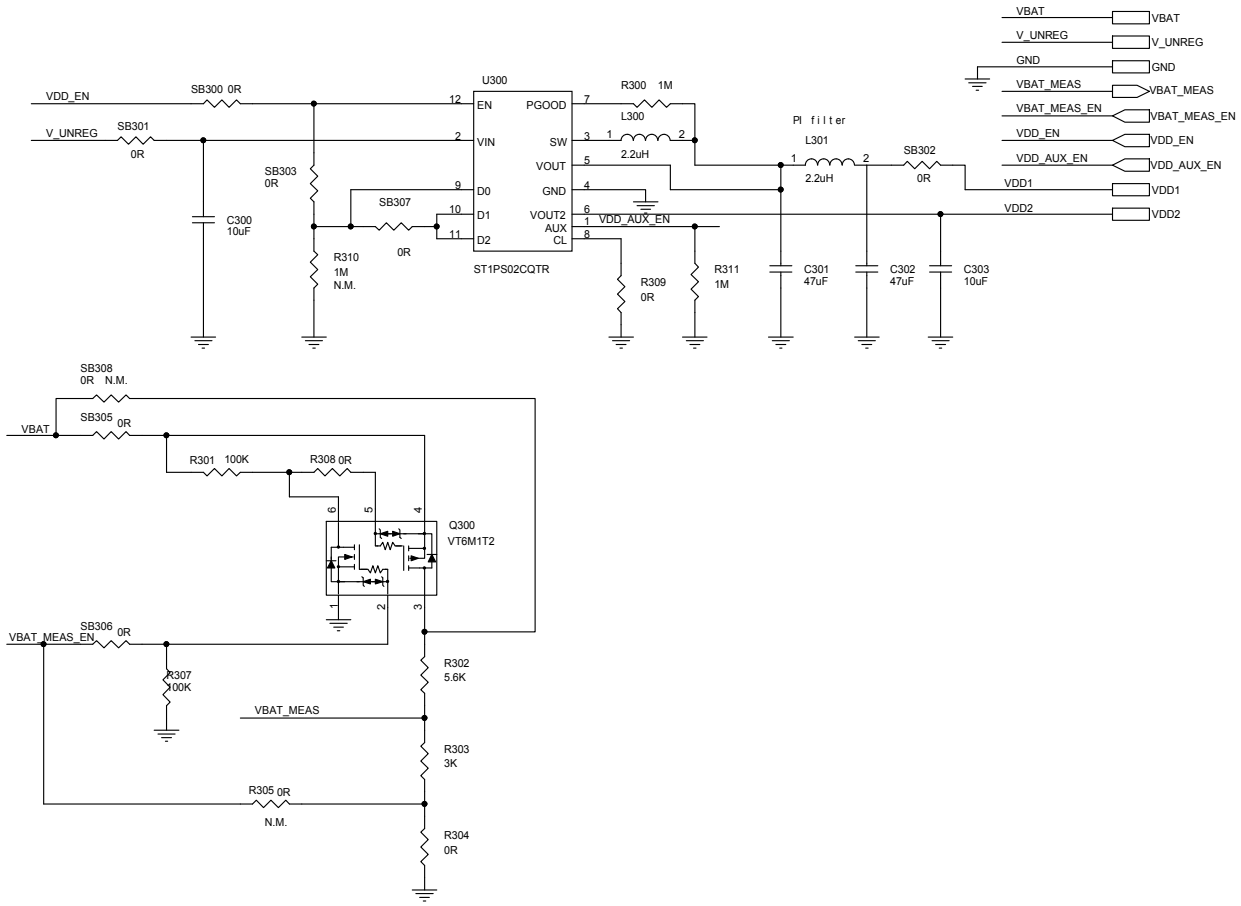
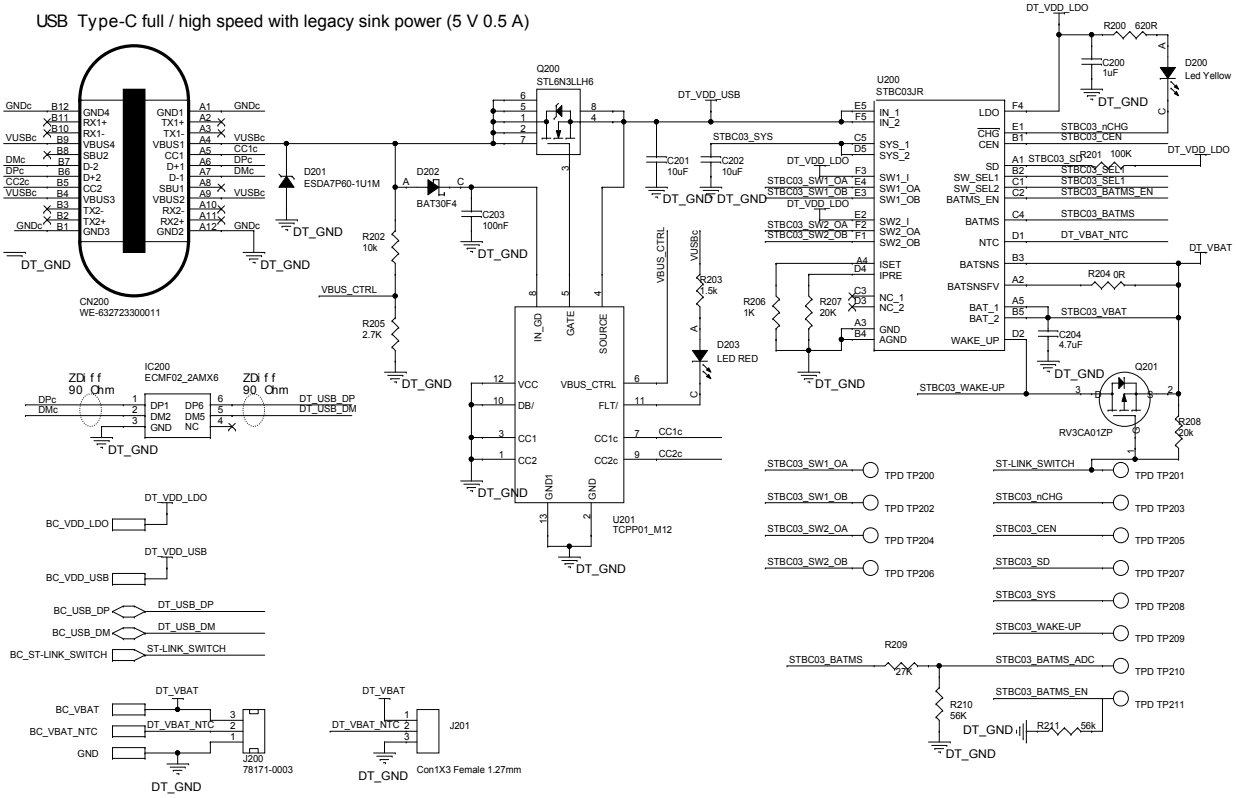


Figure 35. Expansion board - power management schematic



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 36. STEVAL-ASTRA1B configuration with primary battery

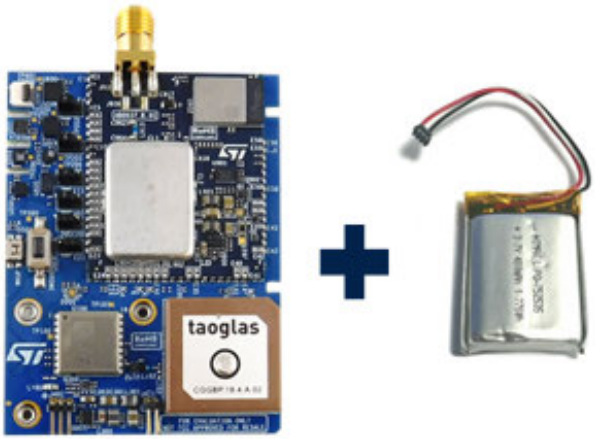
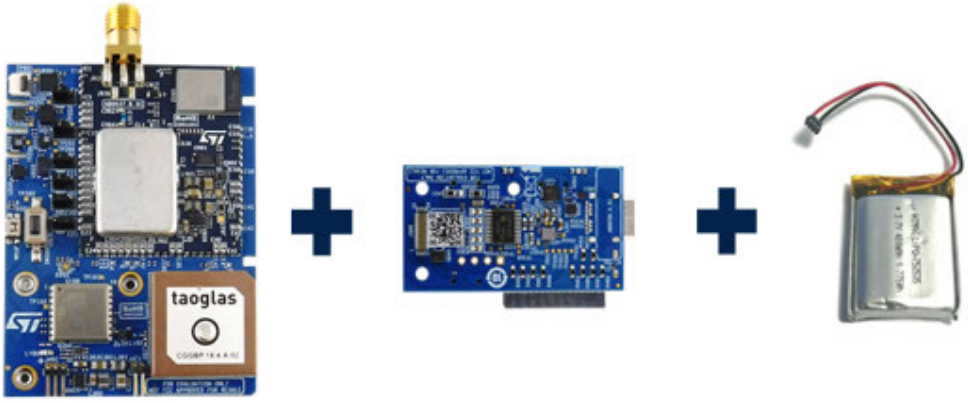


Figure 37. STEVAL-ASTRA1B configuration with rechargeable battery



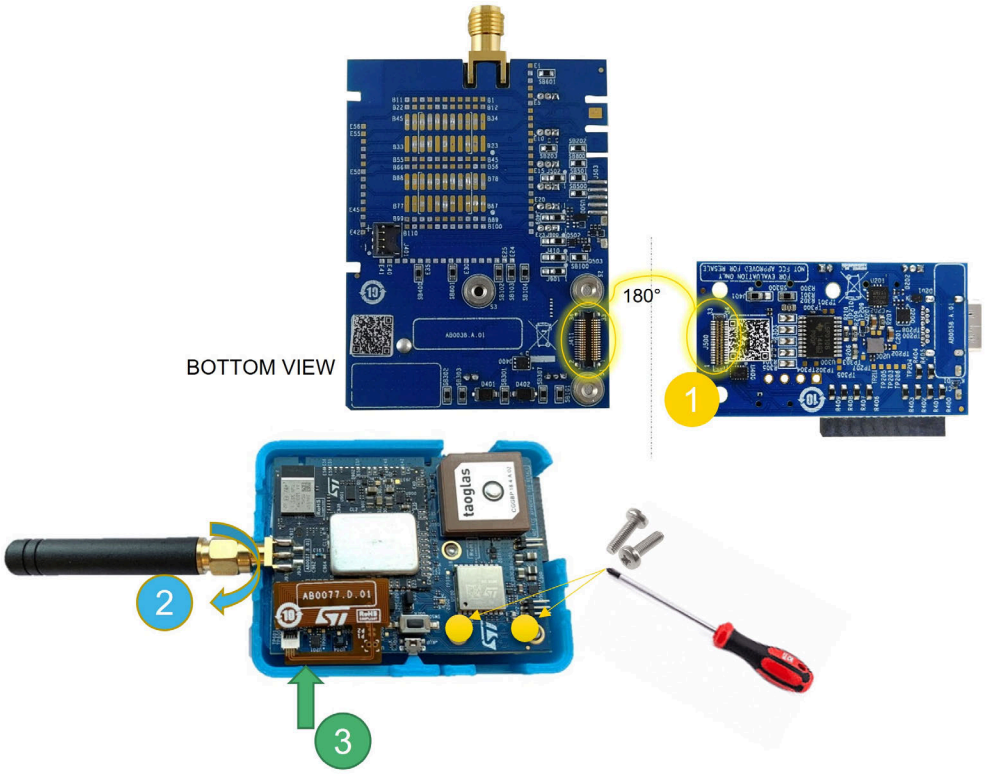
If the STEVAL-ASTRA1B kit is not assembled, follow the steps below to assemble it.

Step 1. Connect the expansion board to the main board bottom side and tighten the screws.

Step 2. The antenna is already stuck to the SMA connector to prevent attaching any other antenna.

Step 3. Insert the NFC antenna.

Figure 38. STEVAL-ASTRA1B kit assembly

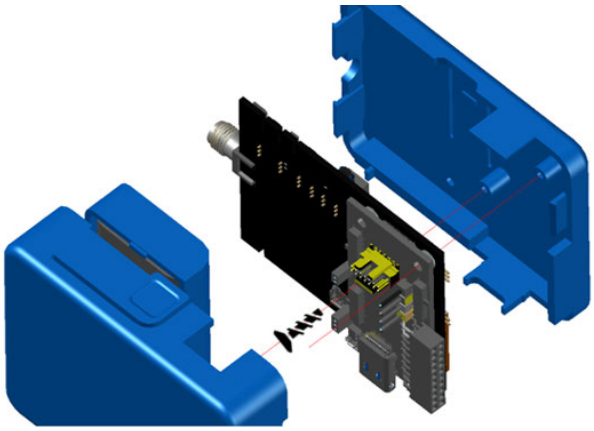


Step 4. Tighten the two screws next to the expansion connector.
The STEVAL-ASTRA1B comes with a plastic case to be used only for demo purposes.

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

Step 5. To fix the STEVAL-ASTRA1B to the top of the plastic case, use the long central screw.

Figure 39. Plastic case assembly (1 of 2)

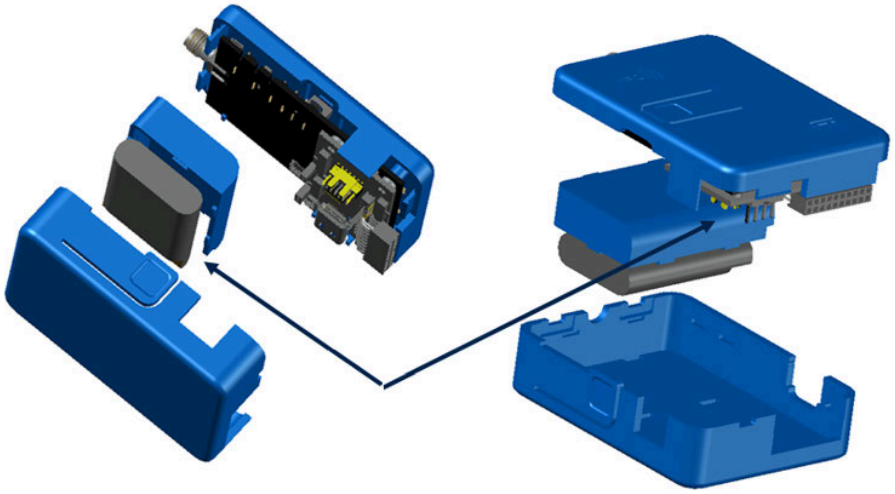


Step 6. Apply the cover to the battery and fix it to the bottom part of the plastic case.

Step 7. Plug the battery.

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

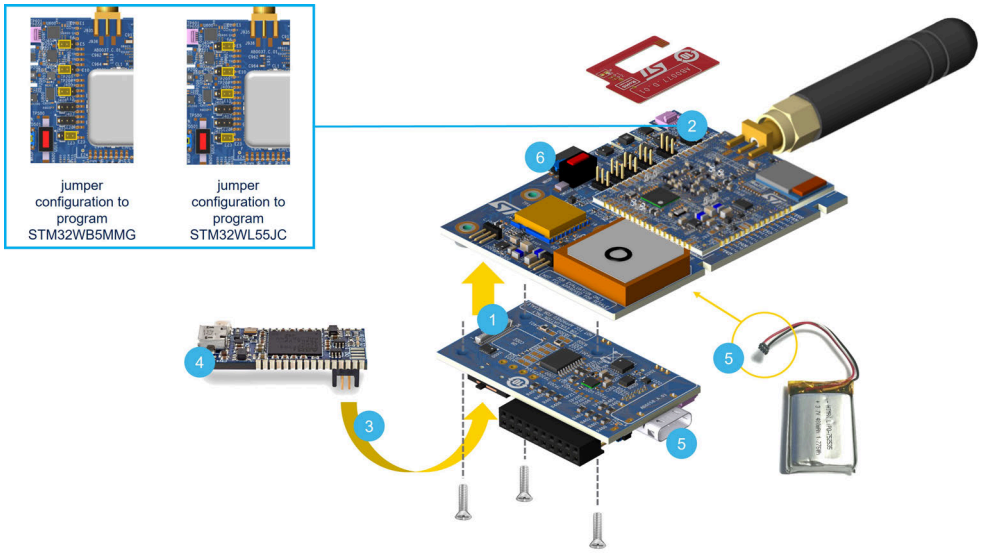
Figure 40. Plastic case assembly (2 of 2)



2.2 How to program the kit

There are multiple ways of accessing the programming pins of the microcontrollers. As described in Section 1.5.1.1 and in Section 1.5.2.8 , 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 41. 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 three-pin jumper selection according to the microcontroller to be programmed, as shown in the picture.

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 1.5.2.4 .

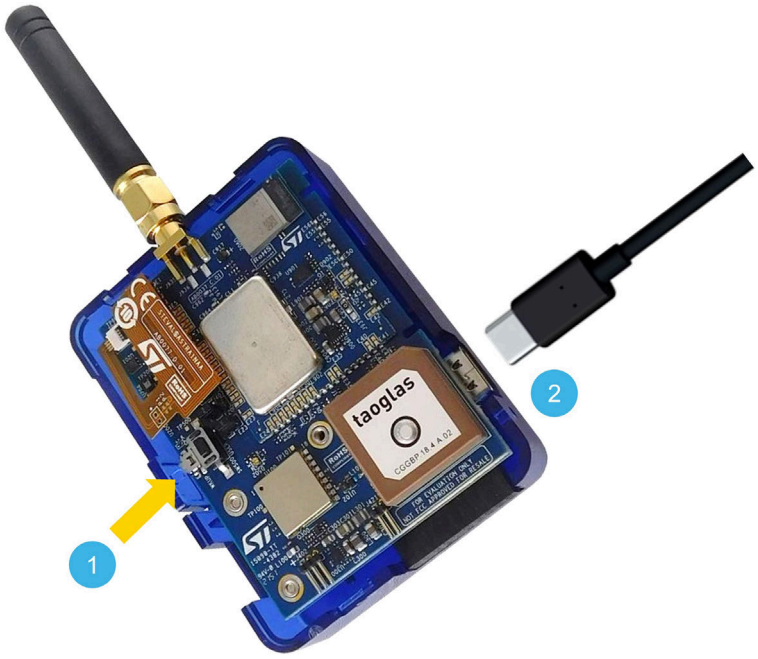
Step 8. Open the development toolchain or STM32CubeProgrammer to start programming.

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 42, 1).

Step 2. If you need to recharge the battery, plug a USB cable to the connector (see Figure 42, 2).

Figure 42. STEVAL-ASTRA1B power on



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 FP-ATR-ASTRA1 firmware package manages the RGB LED as follows:

- 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.

The STEVAL-ASTRA1B can interact with:

- STAssetTracking app;
- STBLESensor app;
- DSH-ASSETRACKING dashboard.

3 Schematic diagrams

Figure 43. Main board (STEVAL-ASTRA1) circuit schematic (1 of 9)

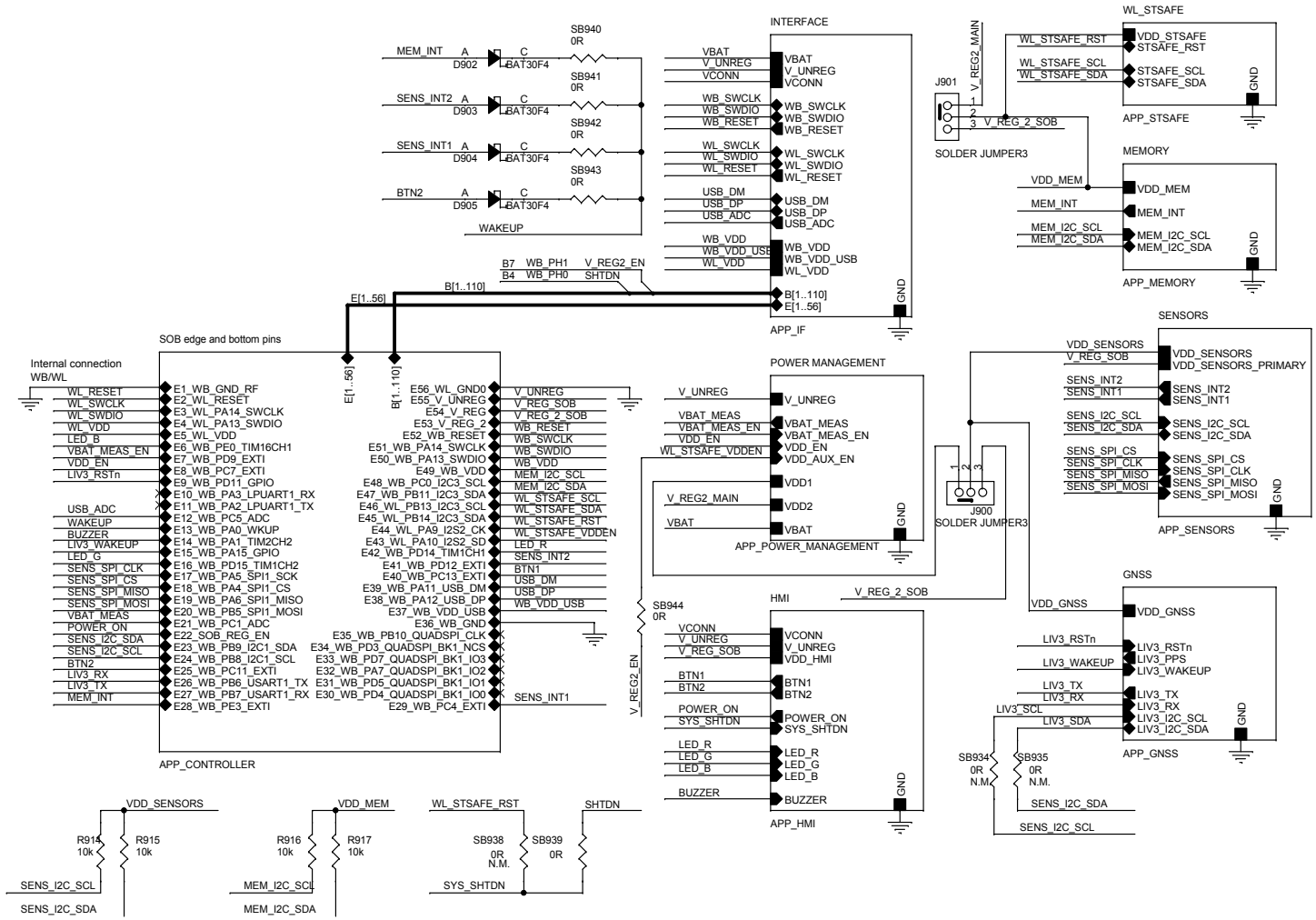


Figure 44. Main board (STEVAL-ASTRA1) circuit schematic (2 of 9)

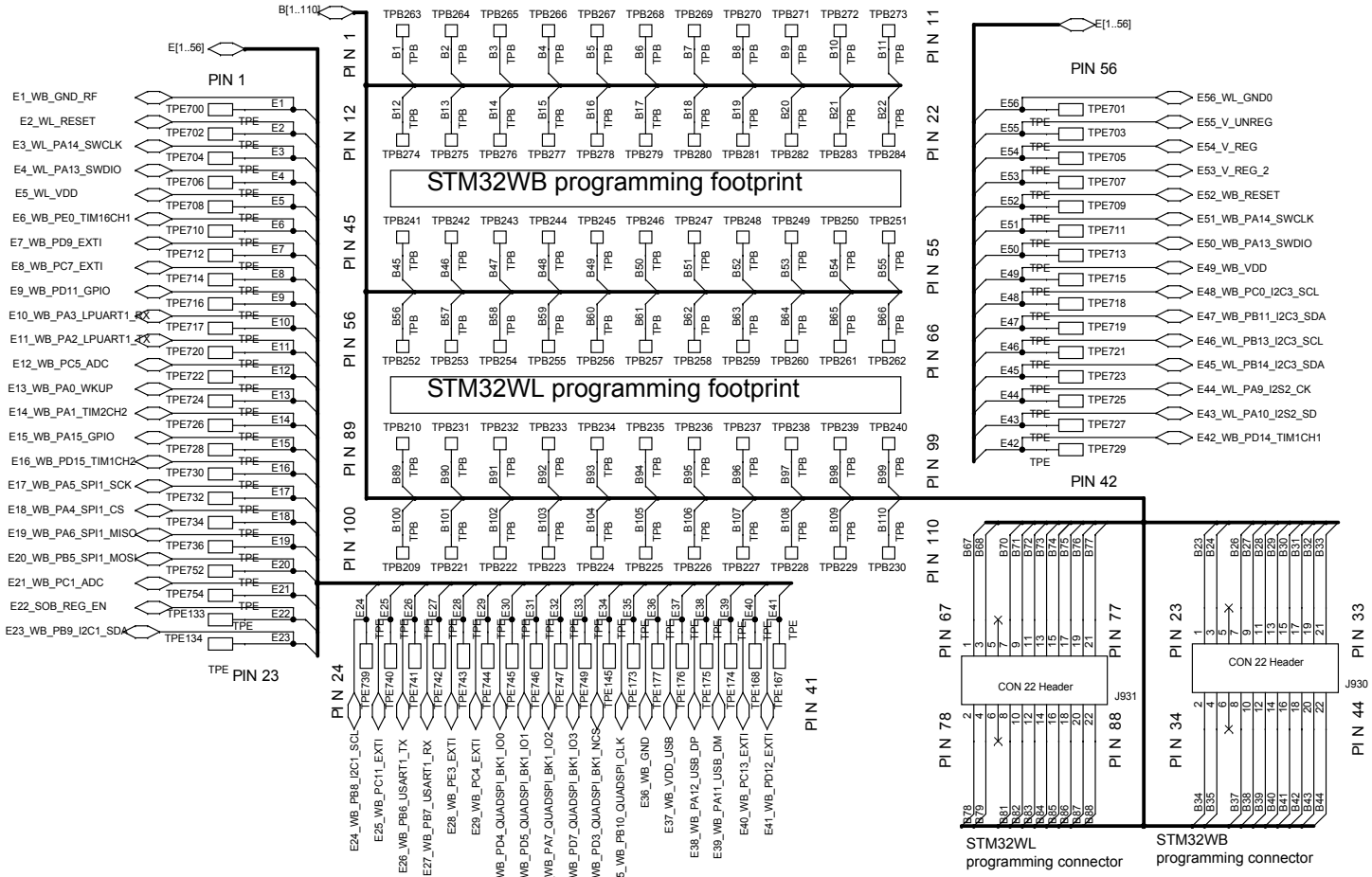


Figure 45. Main board (STEVAL-ASTRA1) circuit schematic (3 of 9)

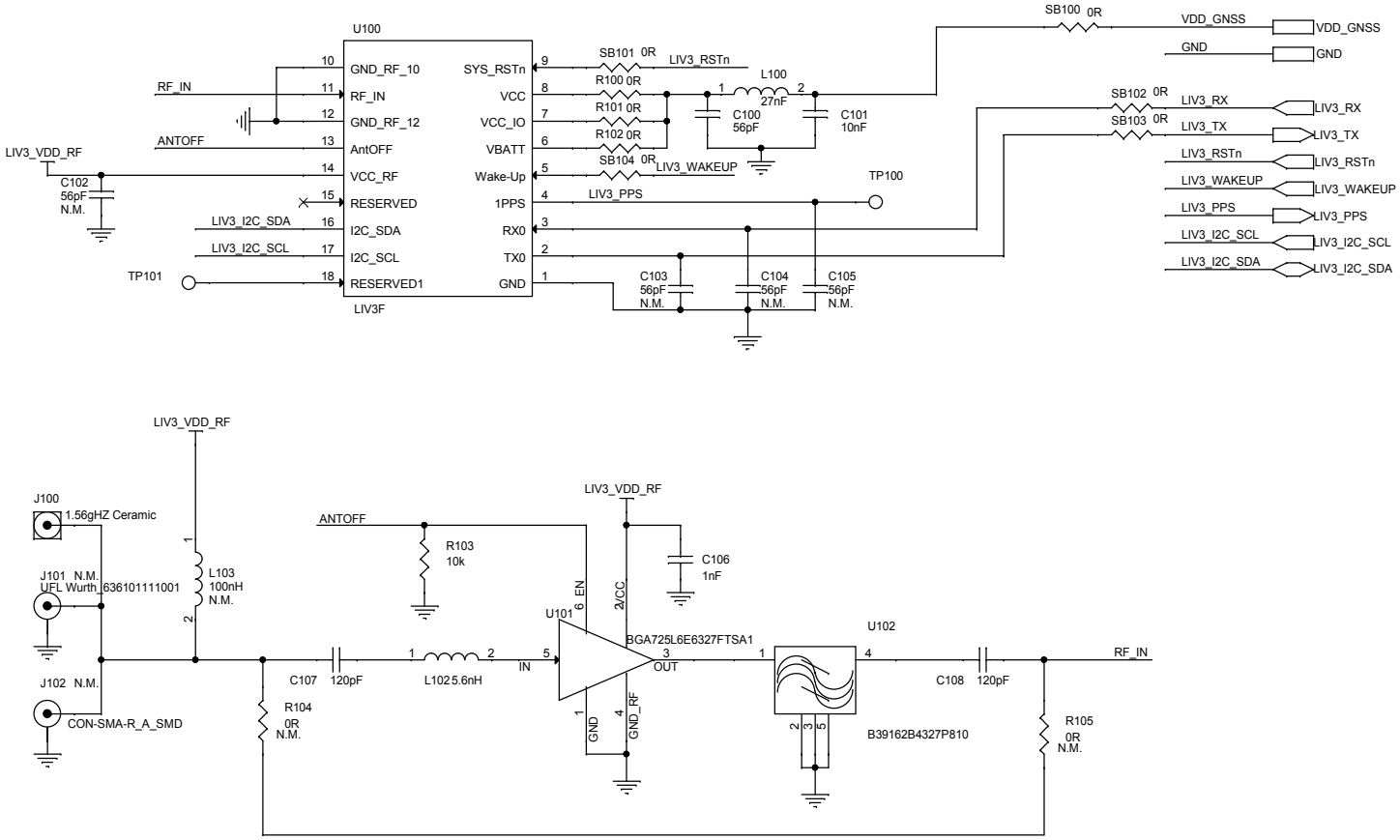


Figure 46. Main board (STEVAL-ASTRA1) circuit schematic (4 of 9)

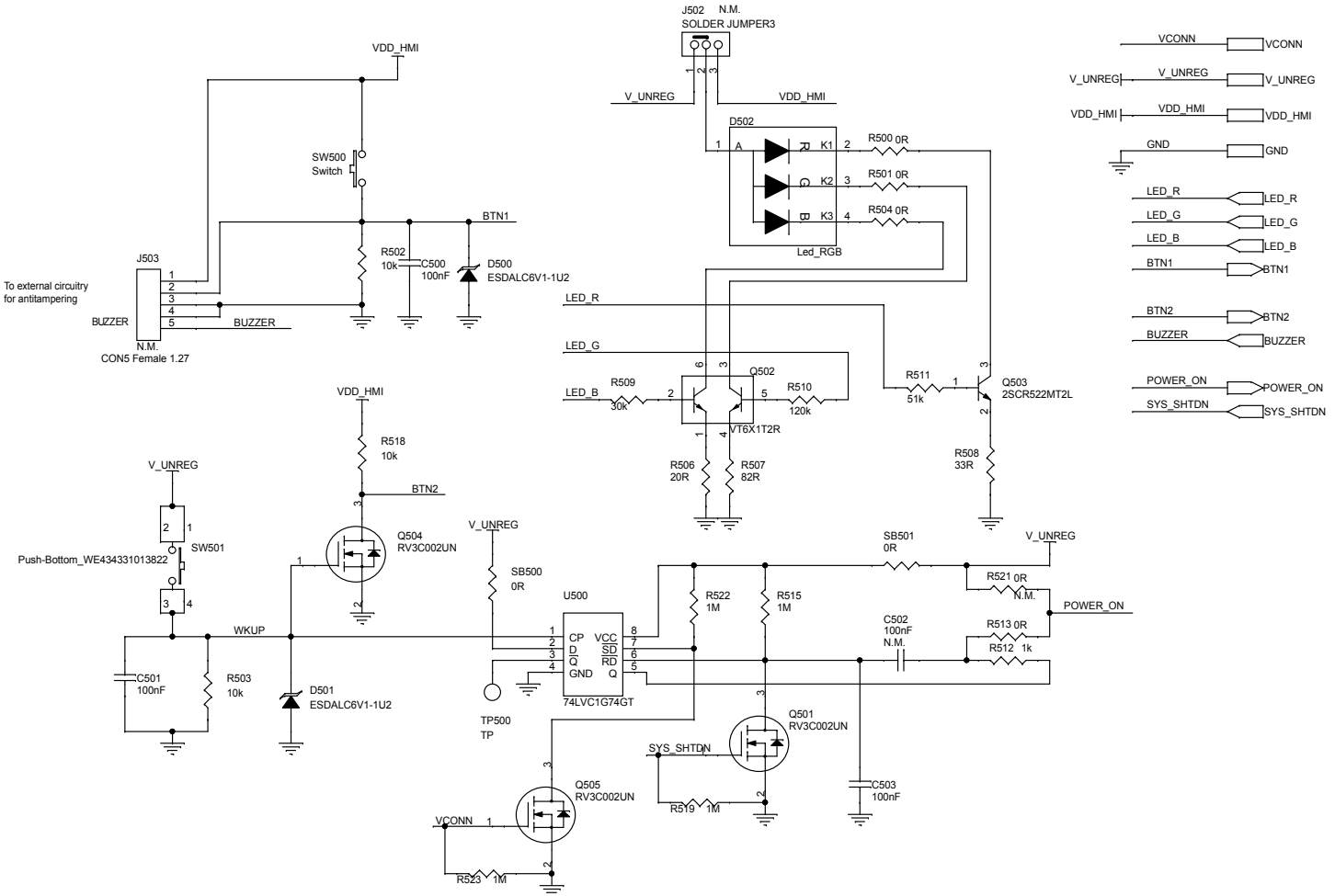


Figure 47. Main board (STEVAL-ASTRA1) circuit schematic (5 of 9)

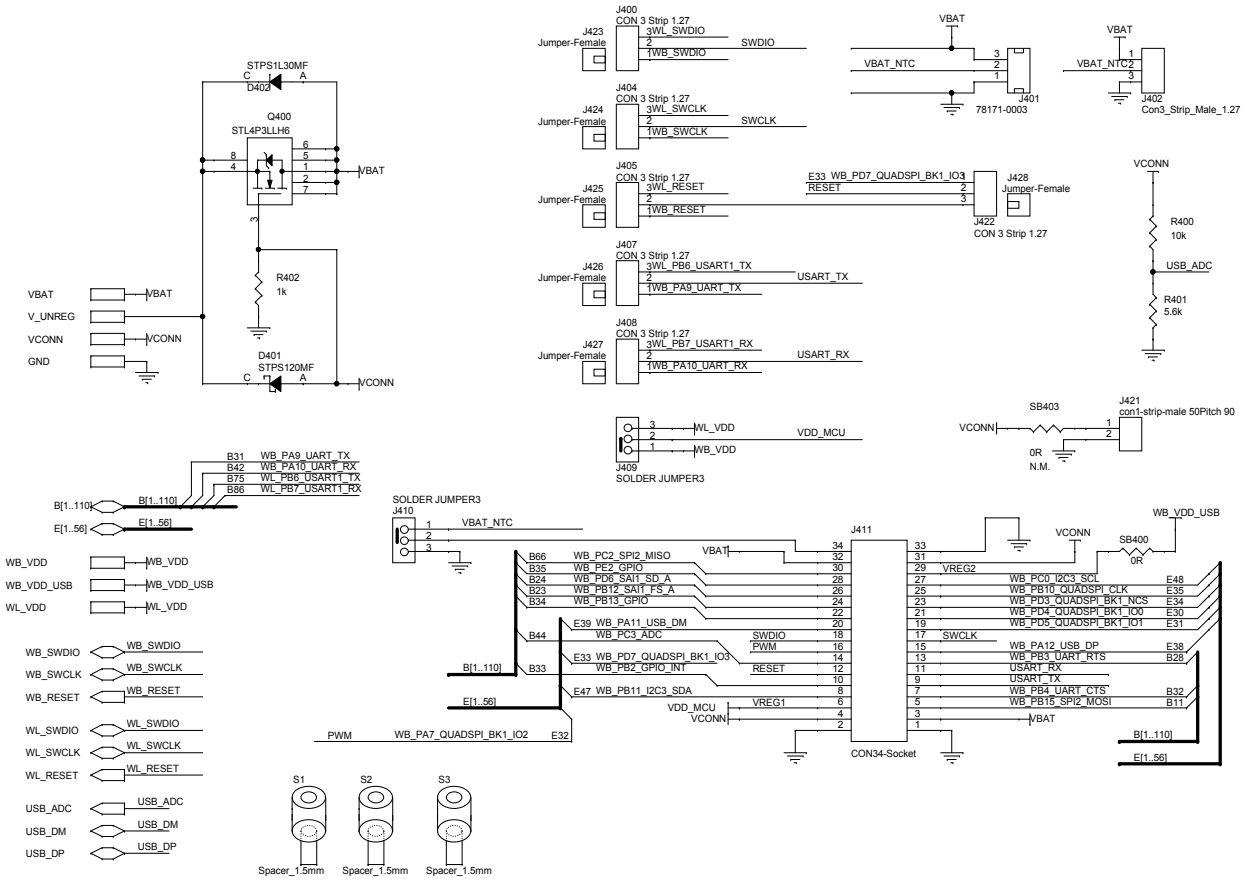


Figure 48. Main board (STEVAL-ASTRA1) circuit schematic (6 of 9)

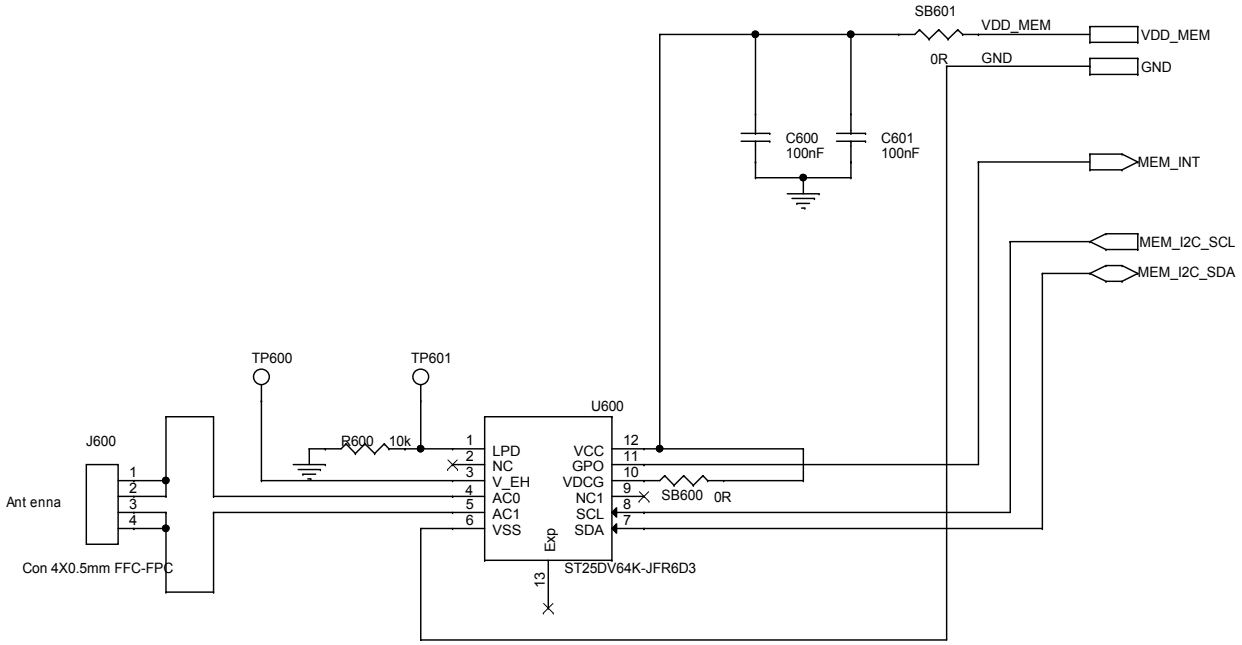


Figure 49. Main board (STEVAL-ASTRA1) circuit schematic (7 of 9)

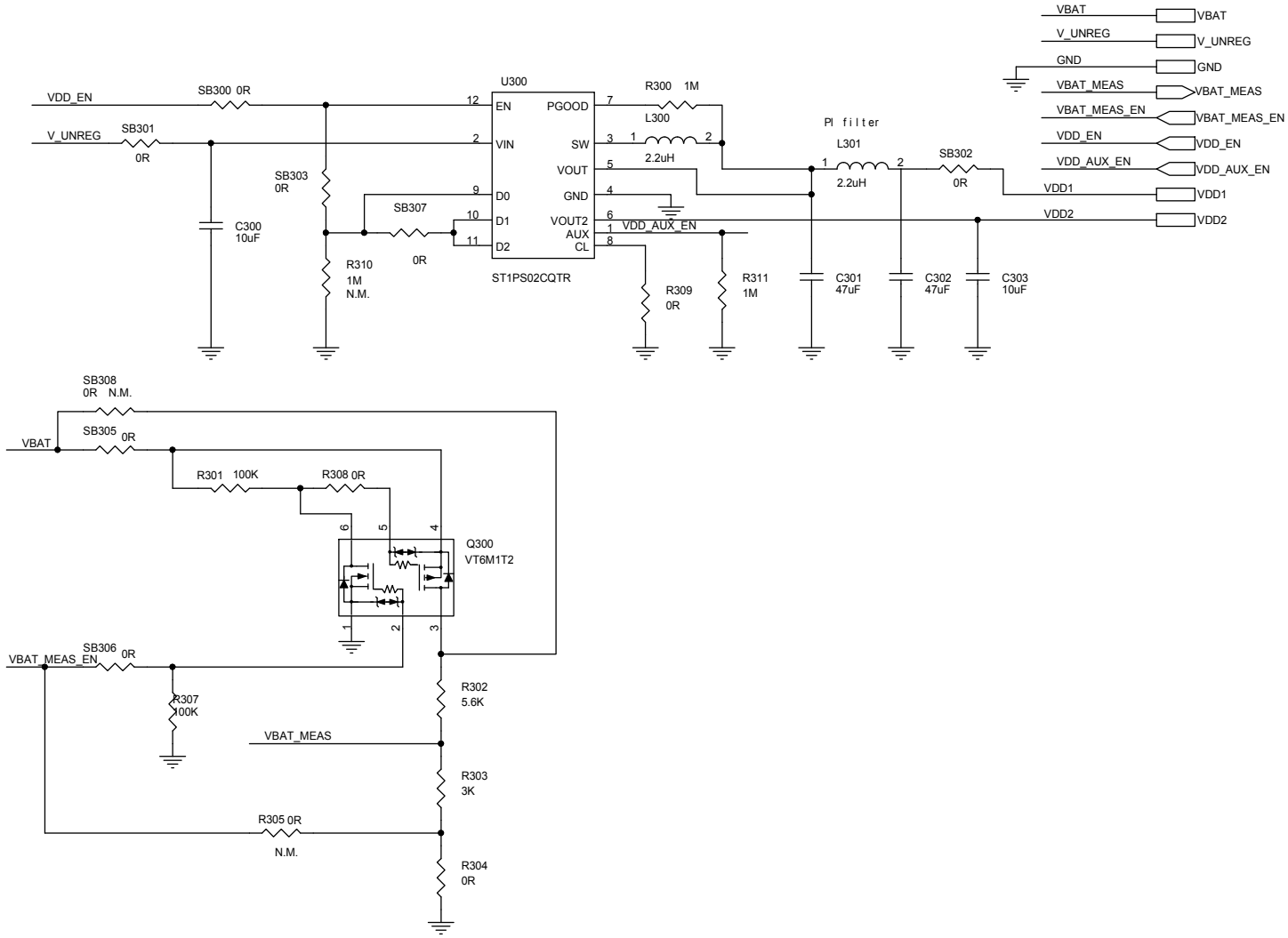


Figure 50. Main board (STEVAL-ASTRA1) circuit schematic (8 of 9)

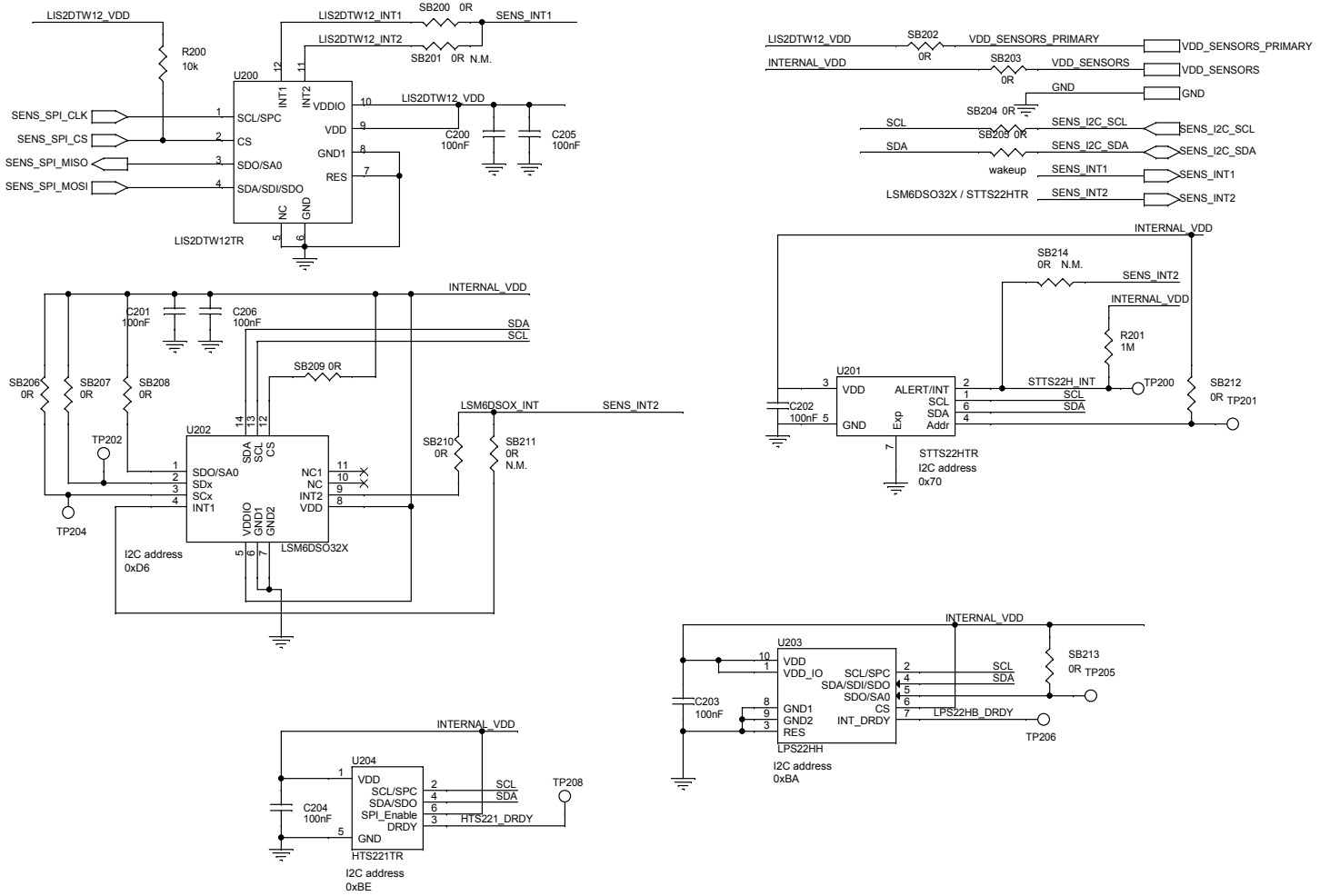


Figure 51. **Main board (STEVAL-ASTRA1) circuit schematic (9 of 9)**

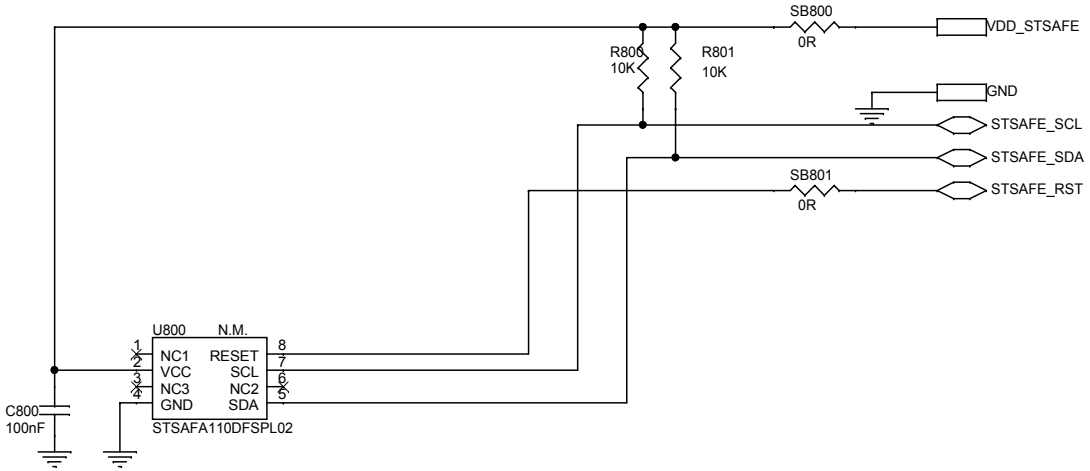


Figure 52. **System on board (STEVAL-ASTRA1SB) circuit schematic (1 of 10)**

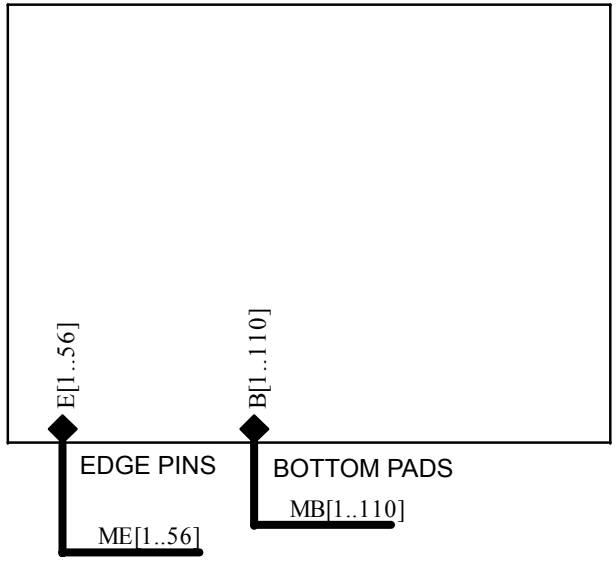


Figure 53. System on board (STEVAL-ASTRA1SB) circuit schematic (2 of 10)

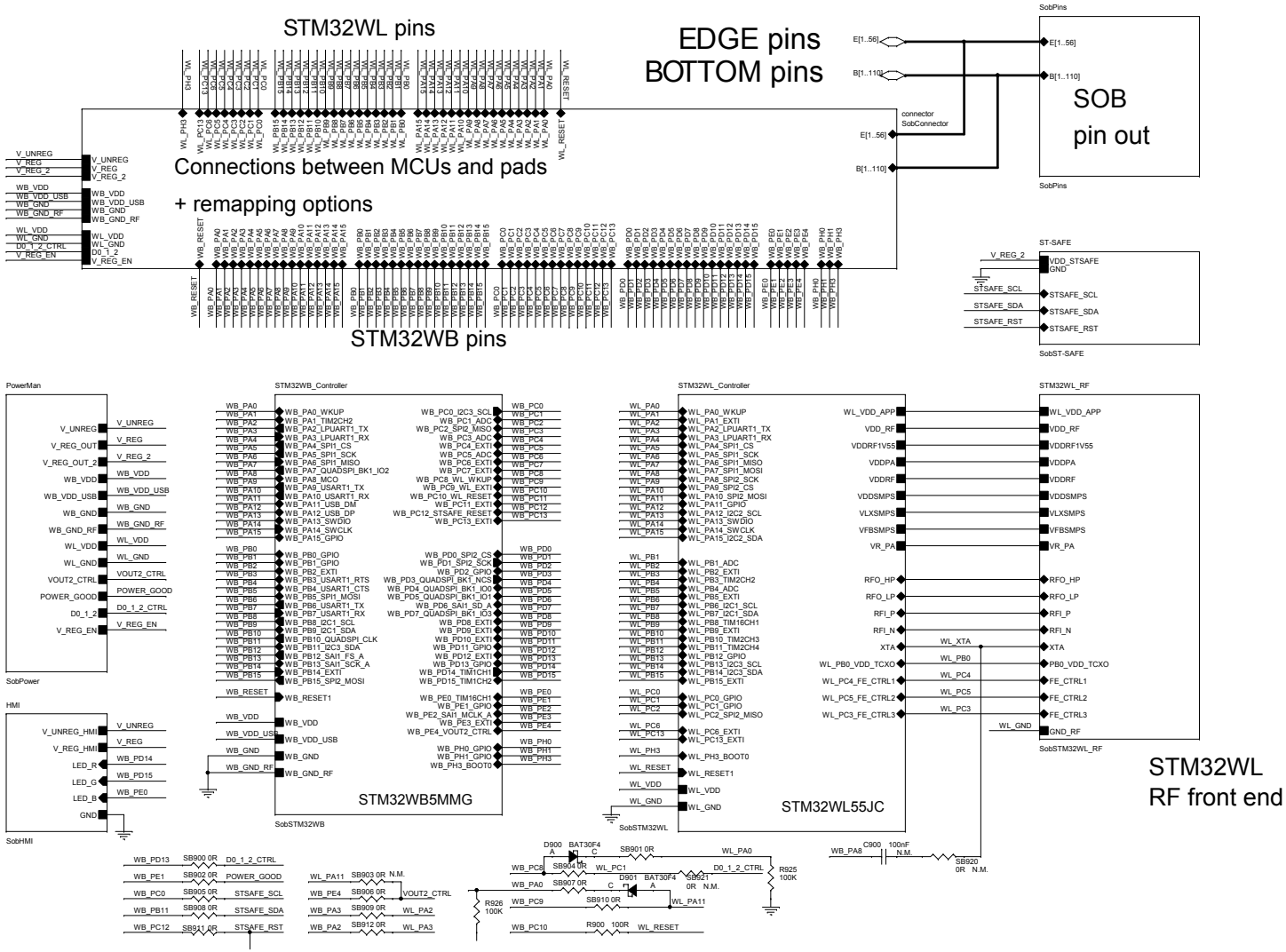


Figure 54. **System on board (STEVAL-ASTRA1SB) circuit schematic (3 of 10)**

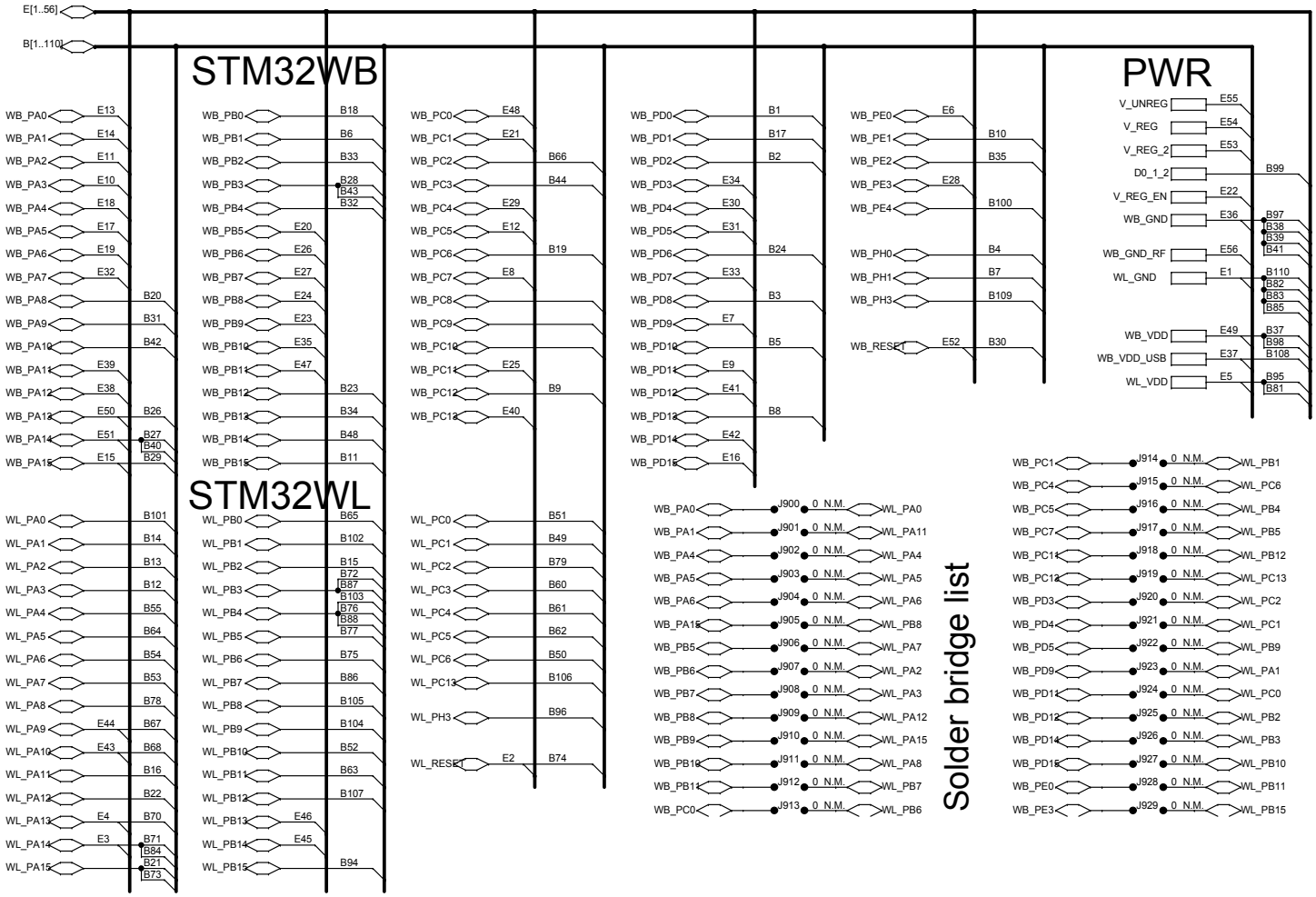


Figure 55. System on board (STEVAL-ASTRA1SB) circuit schematic (4 of 10)

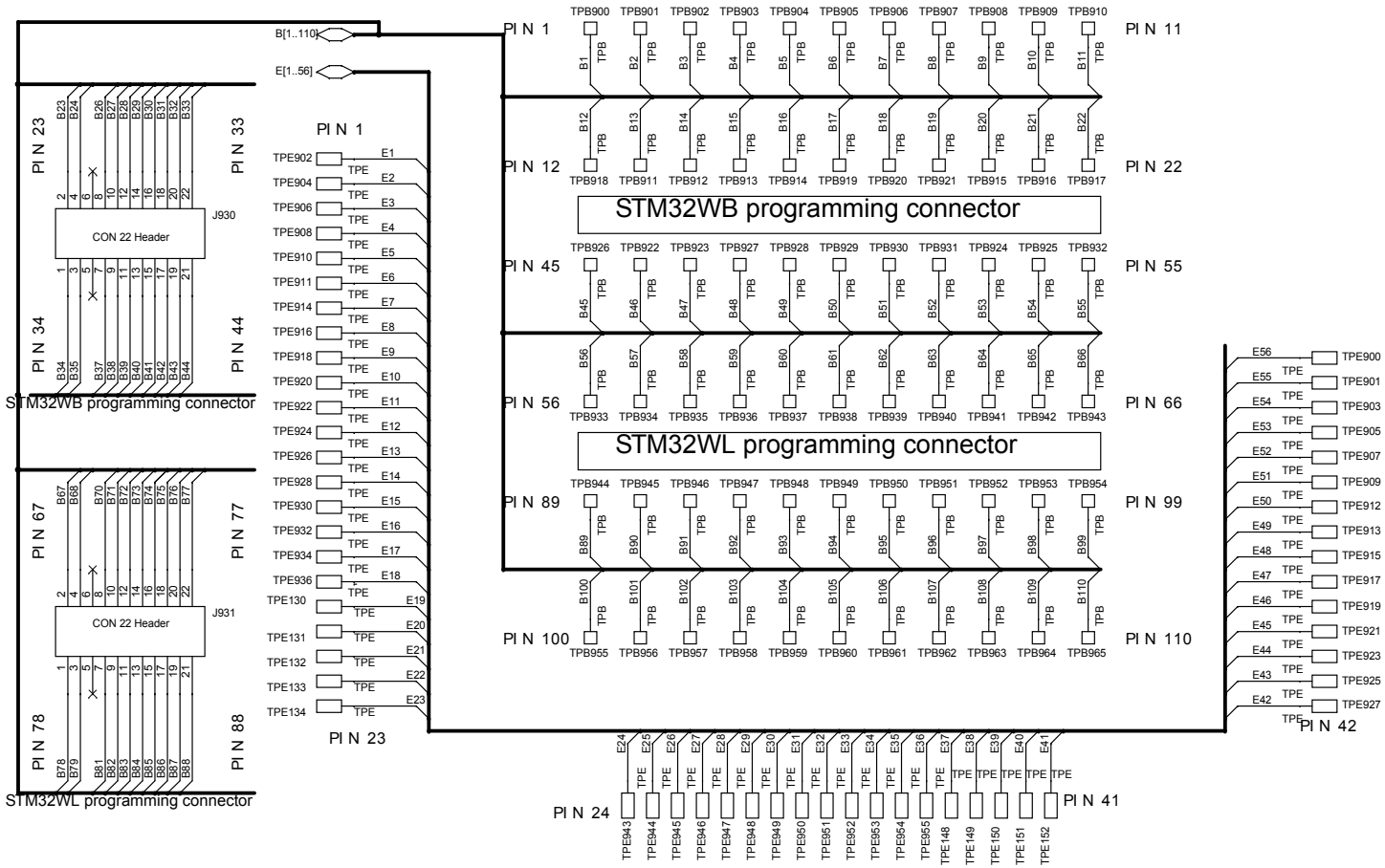


Figure 56. **System on board (STEVAL-ASTRA1SB) circuit schematic (5 of 10)**

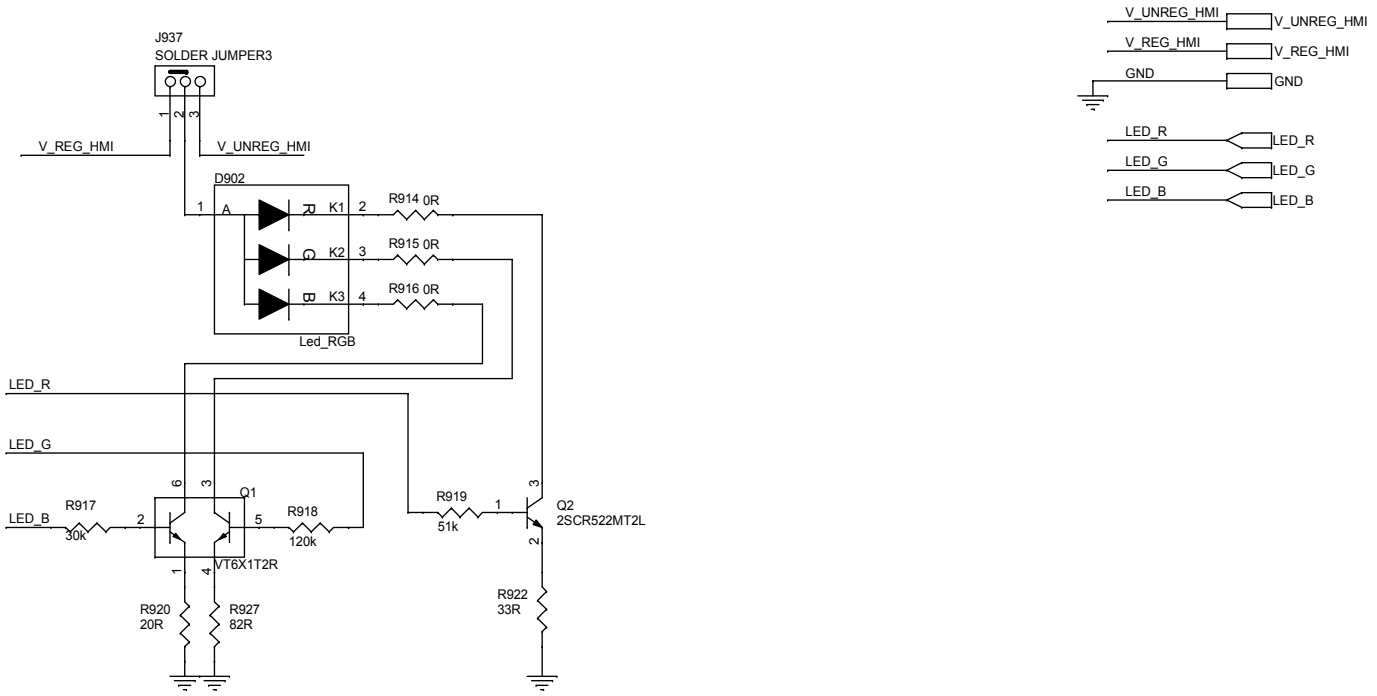


Figure 57. **System on board (STEVAL-ASTRA1SB) circuit schematic (6 of 10)**

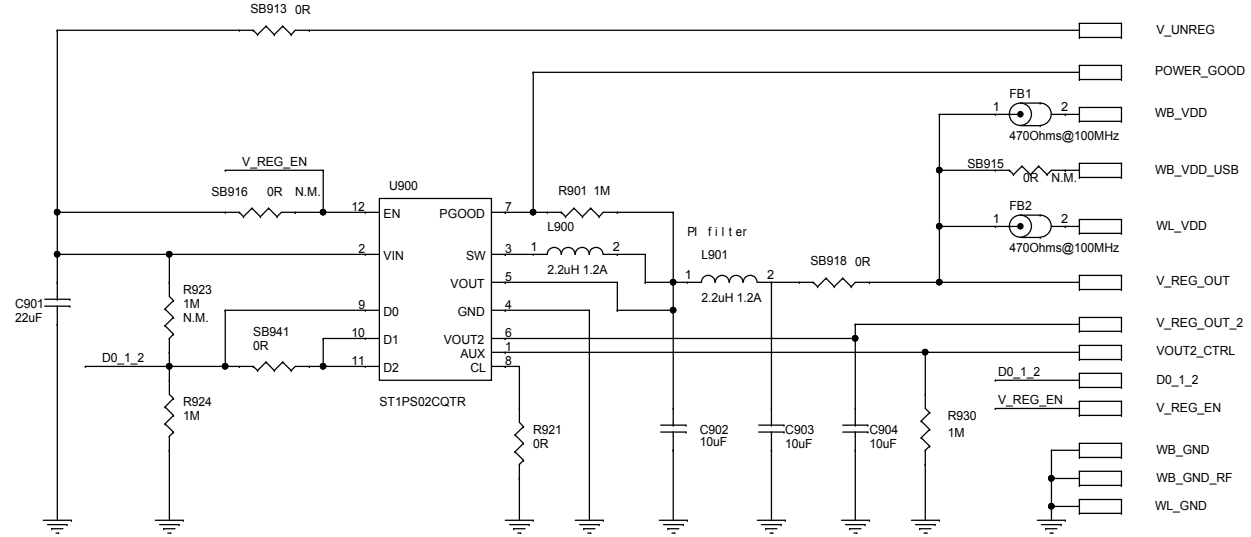


Figure 58. **System on board (STEVAL-ASTRA1SB) circuit schematic (7 of 10)**

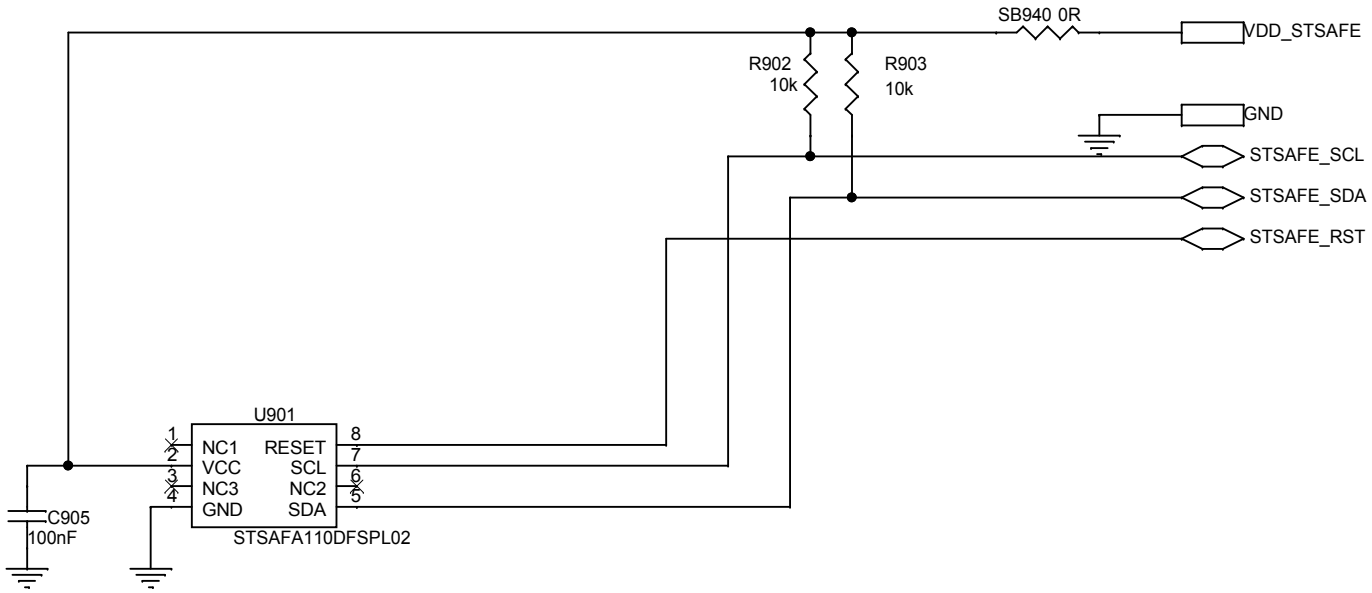


Figure 59. System on board (STEVAL-ASTRA1SB) circuit schematic (8 of 10)

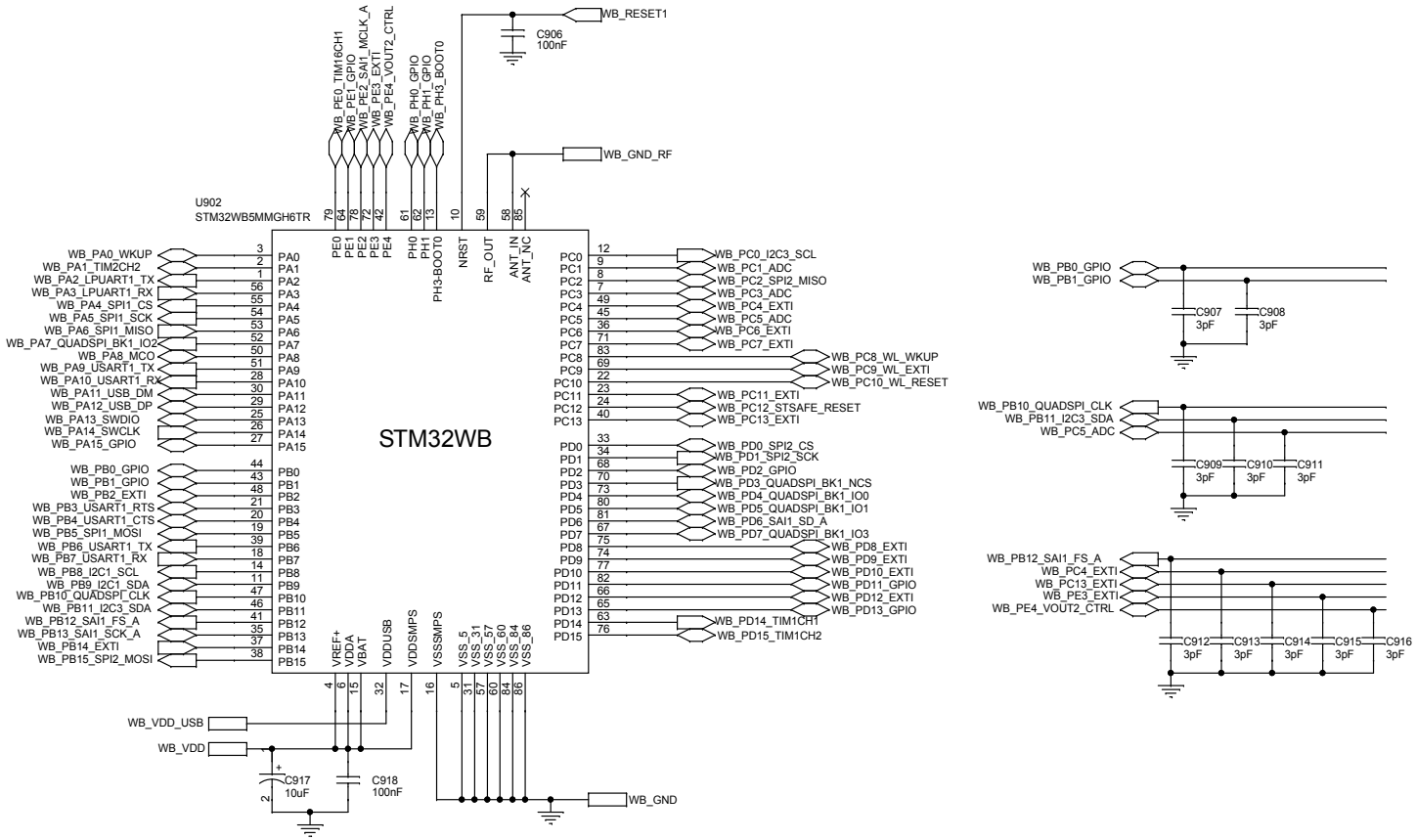


Figure 60. System on board (STEVAL-ASTRA1SB) circuit schematic (9 of 10)

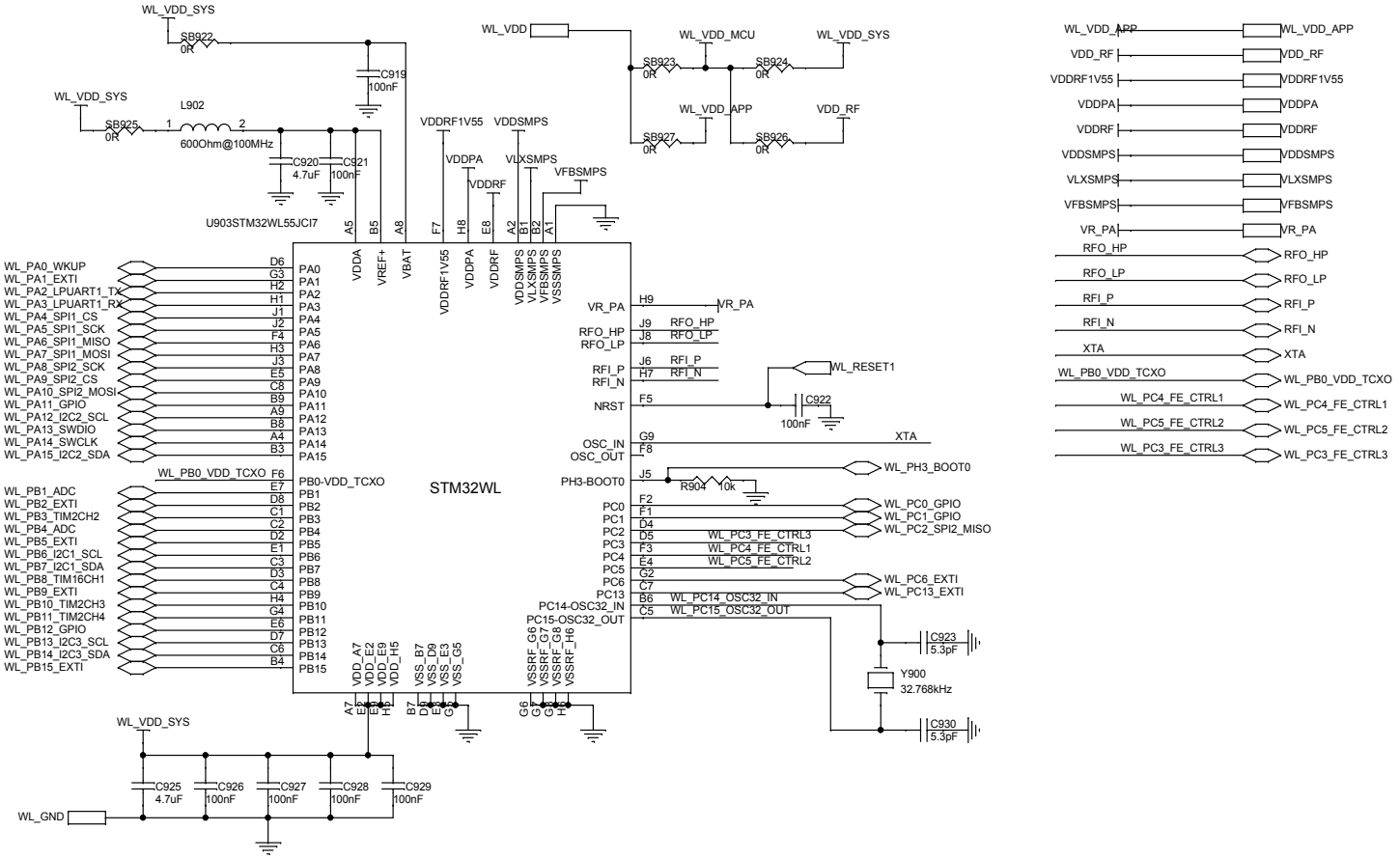


Figure 61. System on board (STEVAL-ASTRA1SB) circuit schematic (10 of 10)

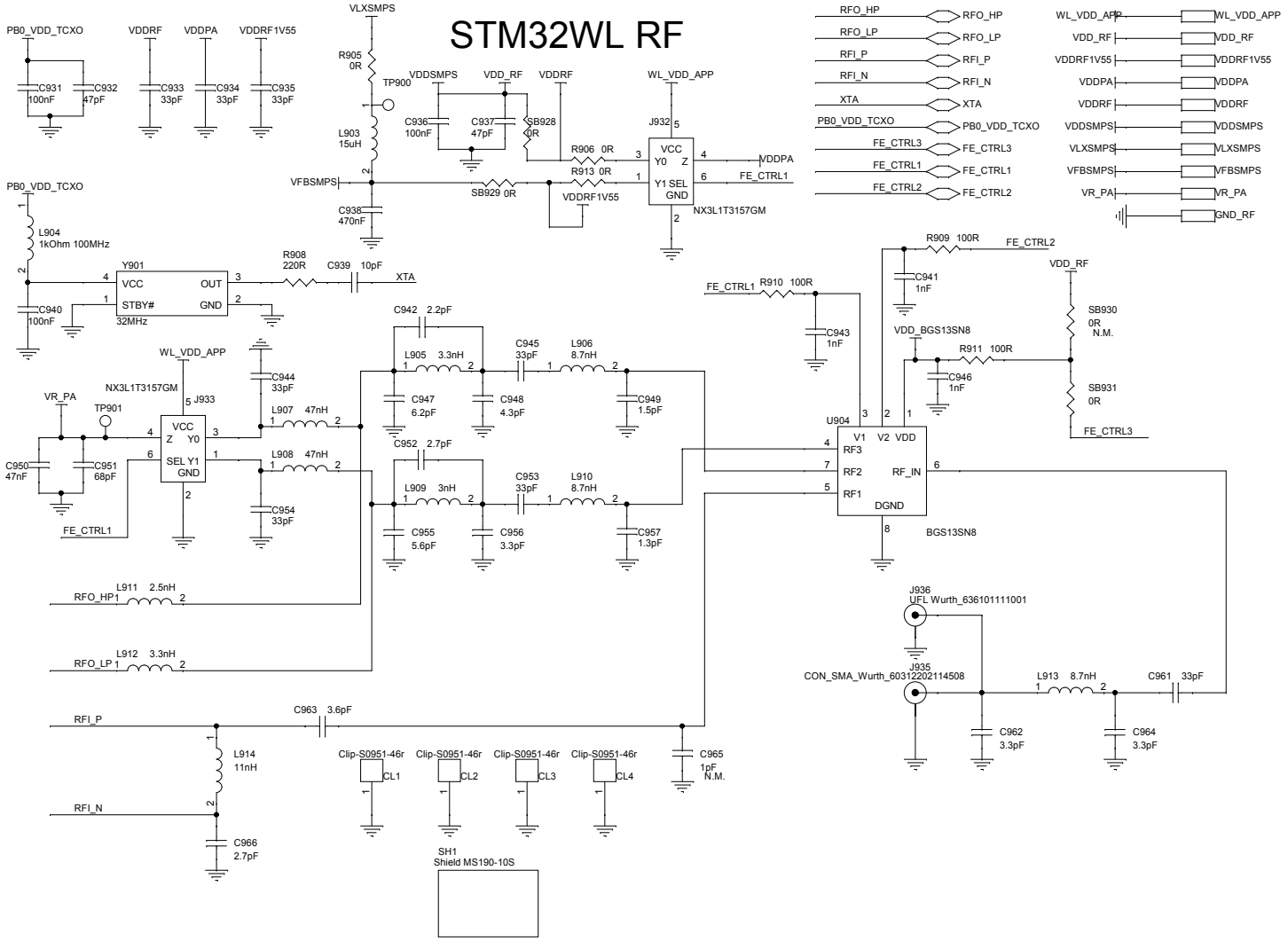


Figure 62. Expansion board (STEVAL-ASTRA1BC) circuit schematic (1 of 5)

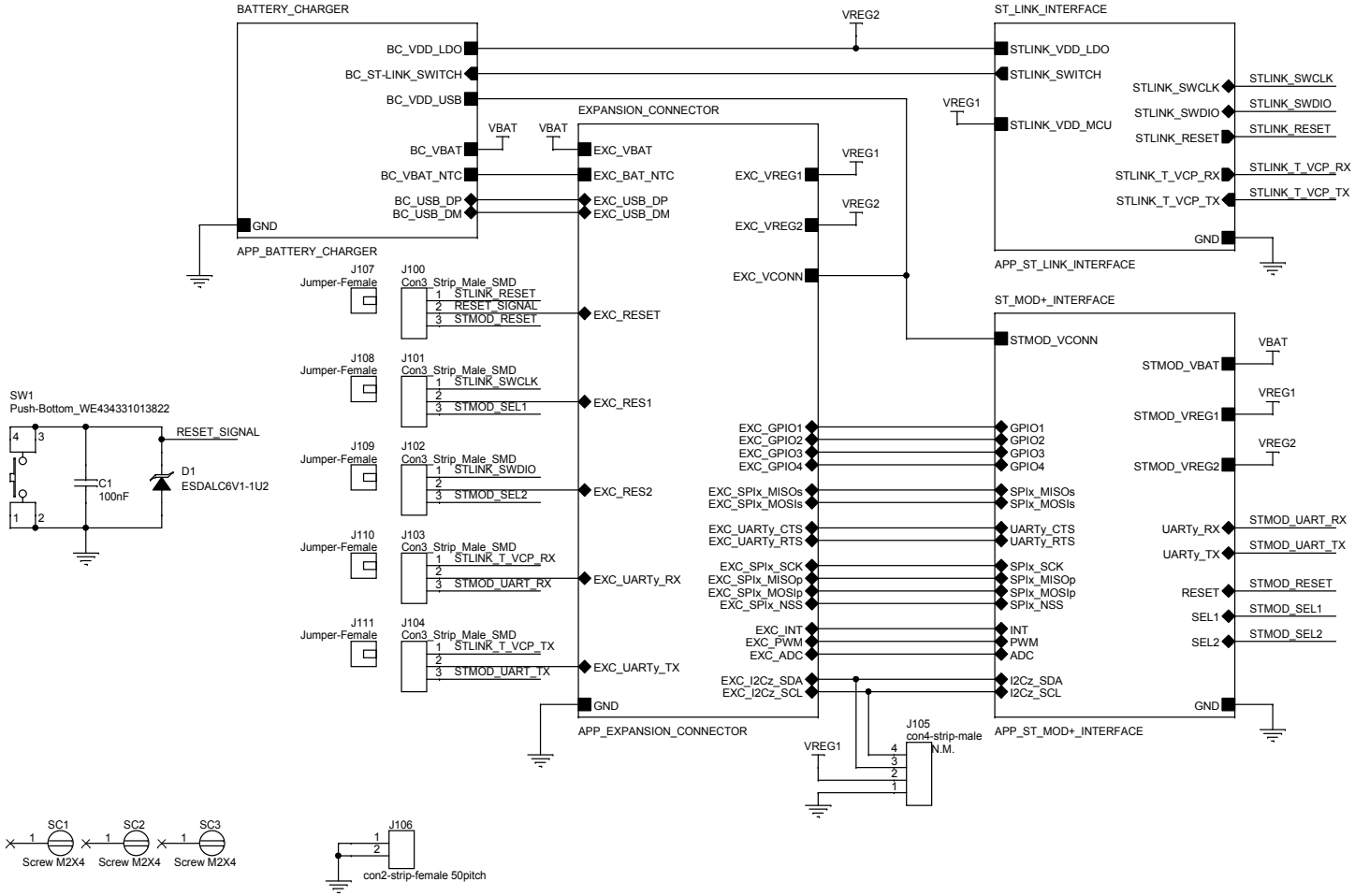


Figure 63. Expansion board (STEVAL-ASTRA1BC) circuit schematic (2 of 5)

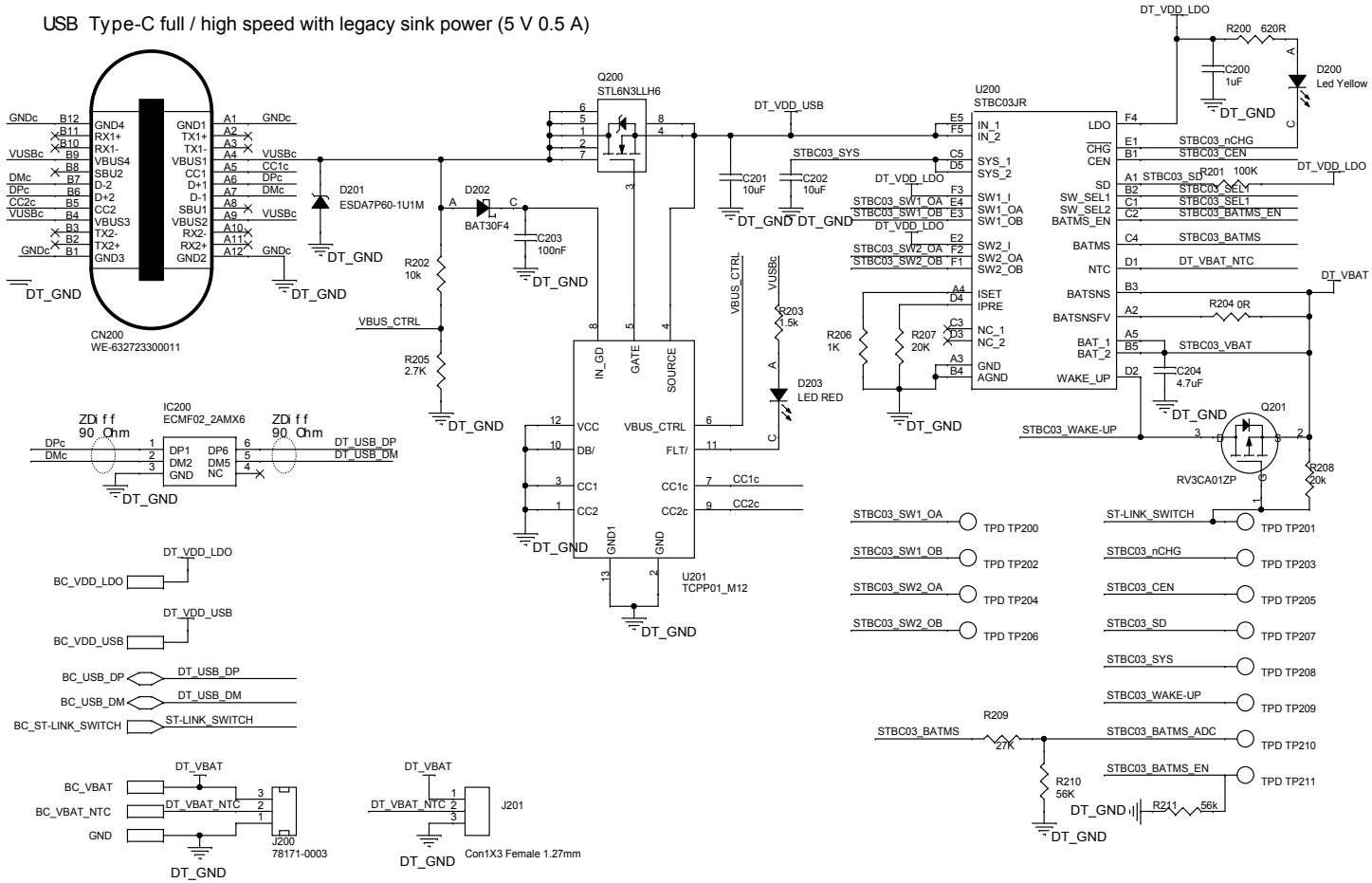


Figure 64. Expansion board (STEVAL-ASTRA1BC) circuit schematic (3 of 5)

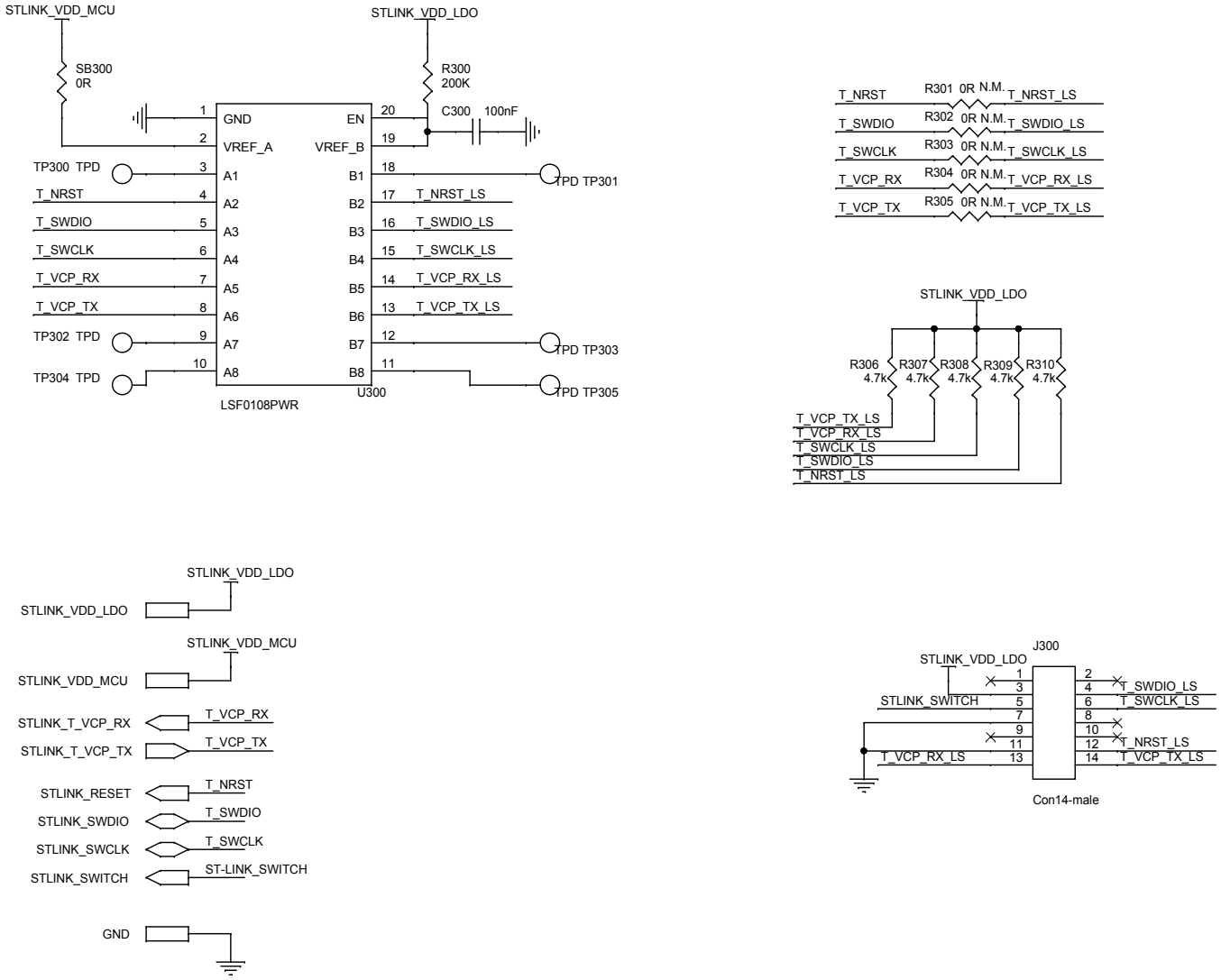


Figure 65. Expansion board (STEVAL-ASTRA1BC) circuit schematic (4 of 5)

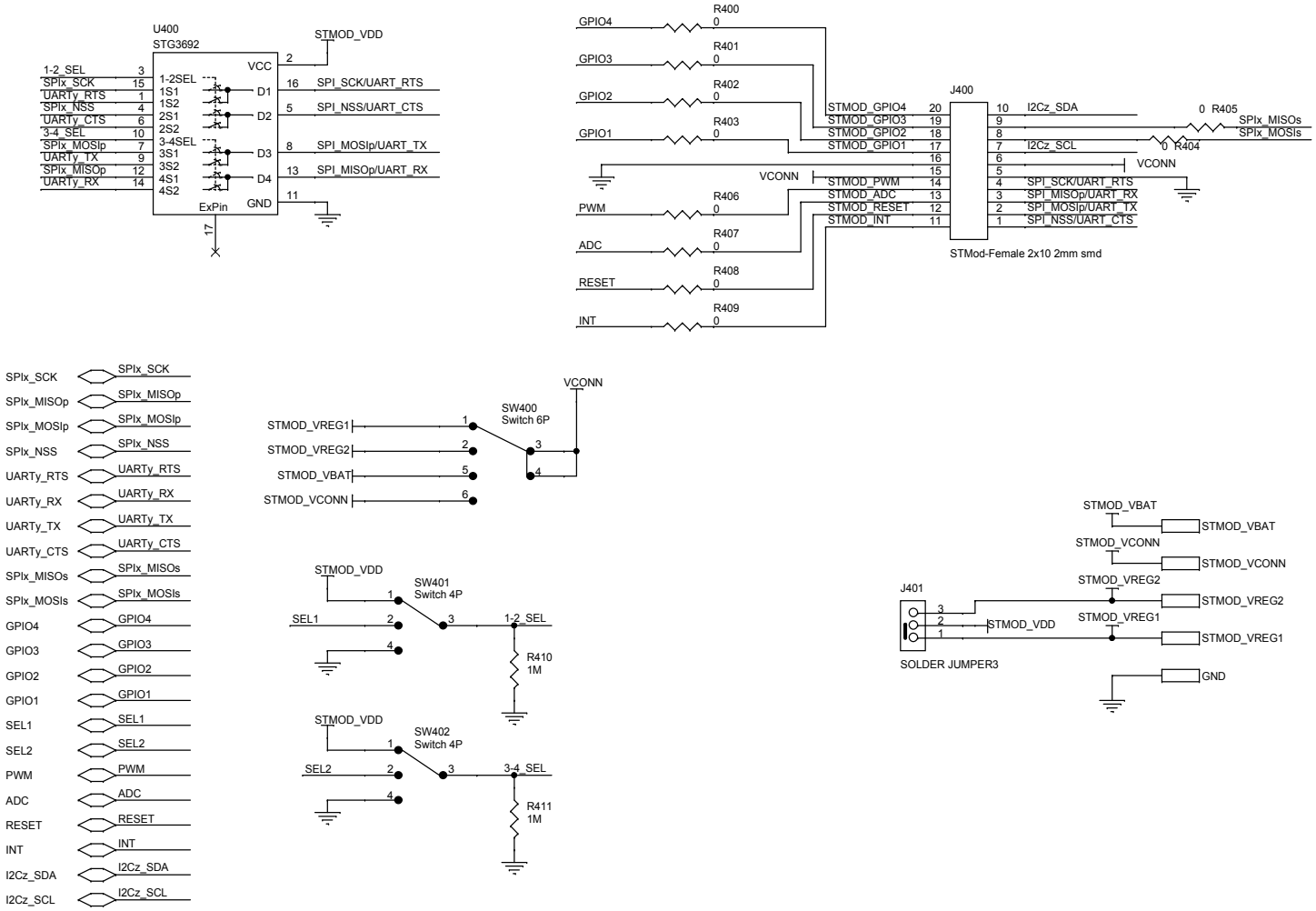


Figure 66. Expansion board (STEVAL-ASTRA1BC) circuit schematic (5 of 5)

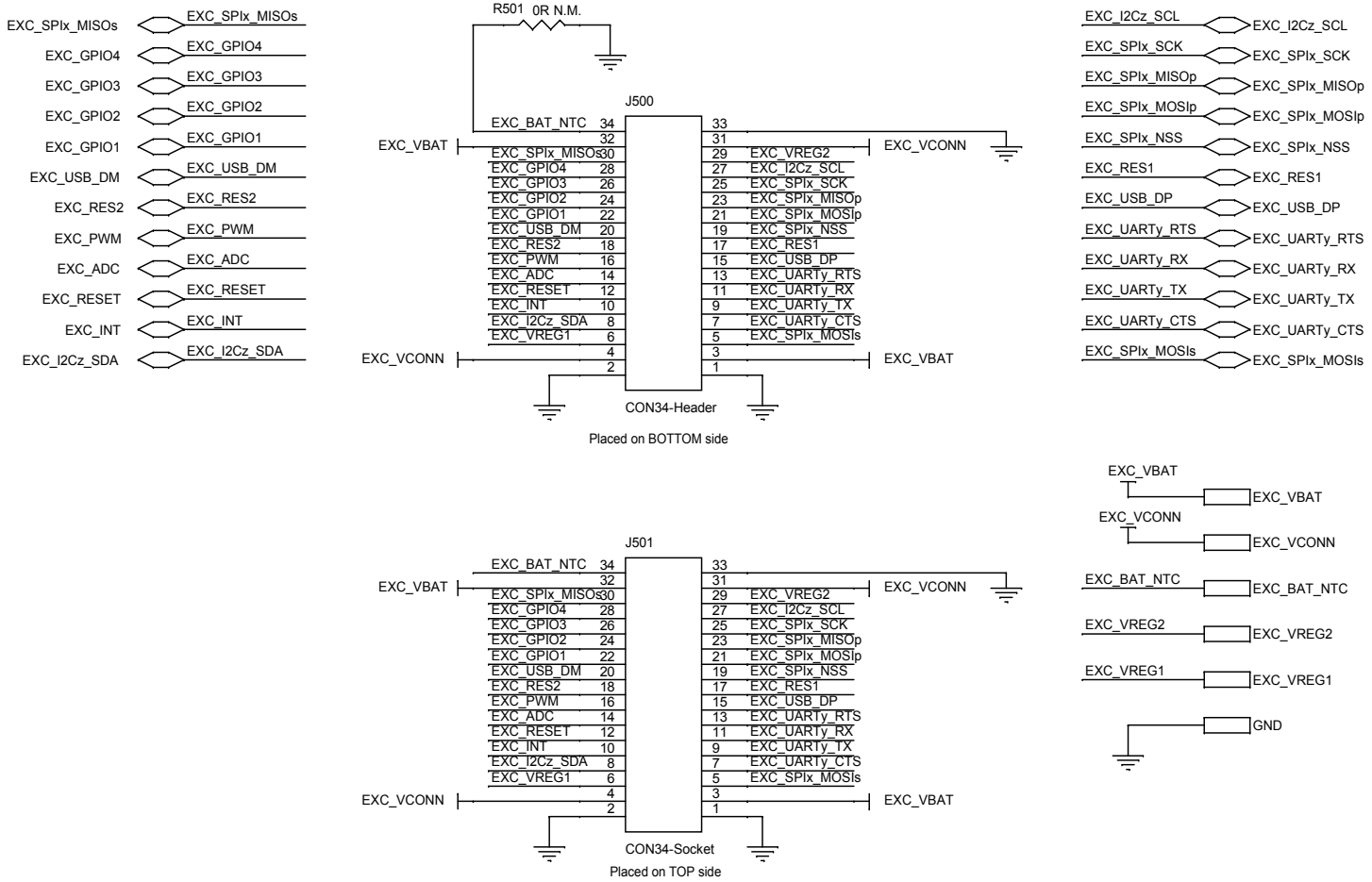
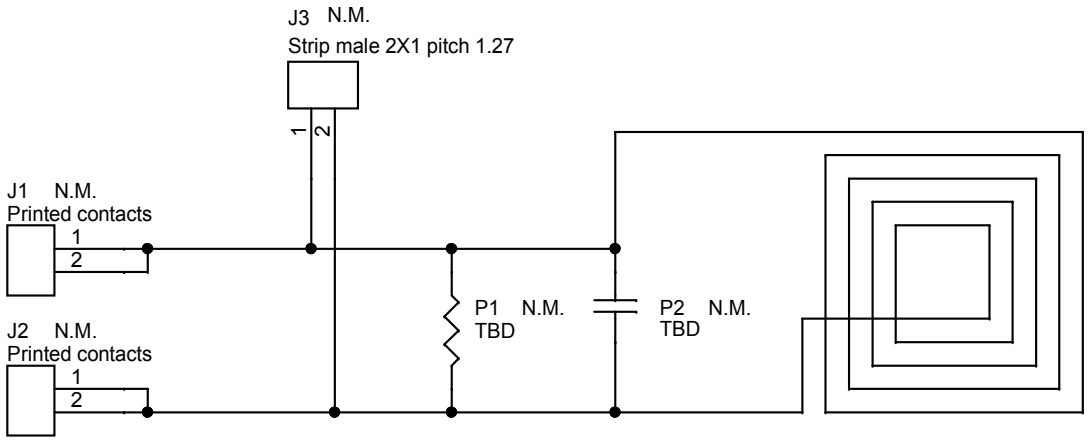


Figure 67. **Flexible NFC antenna (STEVAL-ASTRA1NA) circuit schematic**



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 ±5% COG	Ceramic capacitor	Murata Electronics	GRM0335C1H560JA01D
2	1	C101	10 nF SMD 0201 10 V ±10% X7R	Ceramic capacitor	Murata Electronics	GRM033R71A103KA01J
3	4	C102 C103 C104 C105	56 pF 0201 50 V ±5% COG	Ceramic capacitors (not mounted)	Murata Electronics	GRM0335C1H560JA01D
4	1	C106	1 nF SMD 0201 50 V ±10% X7R	Ceramic capacitor	Murata Electronics	GRM033R71H102KA12J
5	2	C107 C108	120 pF SMD 0201 50 V ±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 µF 0603 (1608 Metric) 6.3 V ±20% X5R	Ceramic capacitors	TDK Corporation	C1608X5R0J106M080AB

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
8	2	C301 C302	47 µF SMD 0805 (2012 Metric) 6.3 V ±20%X5R	Ceramic capacitors	Yageo	CC0805MKX5R5BB476
9	1	C502	100 nF SMD 0201 10 V 20% X5R	Ceramic capacitor (not mounted)	Murata Electronics	GRM033R61A104ME15D
10	1	D401	STPS120MF DO-222AA 490 mV at 1 A STmiteFLAT	20 V, 1 A STmiteFLAT power Schottky rectifier	ST	STPS120MF
11	1	D402	STPS1L30MF DO-222AA 390 mV at 1 A STmiteFLAT	30 V, 1 A STmiteFLAT low drop power Schottky rectifier	ST	STPS1L30MF
12	2	D500 D501	ESDALC6V1-1U2 0201 (0603 Metric)	Single-line low capacitance Transil for ESD protection	ST	ESDALC6V1-1U2
13	1	D502	Led_RGB 0404 (1010 Metric) 5 mA red, 5 mA green, 5 mA blue WL-SFCC SMT	Full-color chip LED	Würth Elektronik	150044M155260
14	4	D902 D903 D904 D905	BAT30F4 0201 (0603 Metric) 300 mA	30 V, 300 mA CSP general purpose small signal Schottky diode	ST	BAT30F4
15	1	J100	1.56/1.575 GHz ceramic	RF antenna	Taoglas Limited	CGGBP.18.4.A.02
16	1	J101	UFL Wurth_636101111001 U.FL-R-SMT-1	WR-UMRF_PCB RECEPTACLE _SMT_3 PAD (not mounted)	Würth Elektronik	636101111001
17	1	J102	CON-SMA-R_A_SMD	CONN SMA REC R/A T&R (not mounted)	Linx Technologies Inc.	CONSMA002-SMD-G-T
18	5	J400 J404 J405 J407 J408	CON 3 Strip 1.27 mm vertical	Connector headers	Harwin Inc.	M50-3530342
19	1	J401	78171-0003	Headers and wire housings	Molex	78171-0003
20	1	J402	Con3_Strip_Male_1.27 mm 3 positions	Connector header	Harwin Inc.	M50-3930342
21	2	J409 J410	0 R 0603 1/10 W ±1% SMD	Resistors	Vishay	CRCW06030000Z0EB
22	1	J411	CON34-Socket 34 positions	Connector socket	Panasonic Electric Works	AXF5G3412A
23	1	J421	con1-strip-male 50 Pitch 90 1.27 mm 2 positions	Connector header	Harwin Inc.	M50-3930242

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

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

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

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
67	56	TPE133 TPE134 TPE145 TPE167 TPE168 TPE173 TPE174 TPE175 TPE176 TPE177 TPE700 TPE701 TPE702 TPE703 TPE704 TPE705 TPE706 TPE707 TPE708 TPE709 TPE710 TPE711 TPE712 TPE713 TPE714 TPE715 TPE716 TPE717 TPE718 TPE719 TPE720 TPE721 TPE722 TPE723 TPE724 TPE725 TPE726 TPE727 TPE728 TPE729 TPE730 TPE732 TPE734 TPE736 TPE739 TPE740 TPE741 TPE742 TPE743 TPE744 TPE745 TPE746 TPE747 TPE749 TPE752 TPE754	TPE	Not mounted	-	-
68	1	U100	Teseo-LIV3F 9.7X10.1mm	Tiny GNSS module	ST	Teseo-LIV3F
69	1	U101	BGA725L6E6327FTSA1 6-XFDFN 1.55-1.615 GHZ TSLP6-2	IC AMP GPS	Infineon Technologies	BGA725L6E6327FTSA1
70	1	U102	B39162B4327P810 5-SMD, No Lead	Filter	Qualcomm (RF360 - A Qualcomm & TDK Joint Venture)	B39162B4327P810
71	1	U200	LIS2DTW12TR LGA2X2X0.7 12 leads	MEMS digital output dual motion and temperature sensor	ST	LIS2DTW12TR
72	1	U201	STTS22HTR UDFN 2X2X.55 6L PITCH 0.65	Low-voltage, ultra-low-power, 0.5°C accuracy I²C/SMBus 3.0 temperature sensor	ST	STTS22HTR
73	1	U202	LSM6DSO32X VFLGA2.5X3X.86 14L P.5 L.475X.25	iNEMO inertial module: always-on 3D accelerometer and 3D gyroscope	ST	LSM6DSO32XTR

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
74	1	U203	LPS22HH HLGA 2X2X.8 10L EXP.SILIC.91S Q	High-performance MEMS nano pressure sensor: 260-1260 hPa absolute digital output barometer	ST	LPS22HHTR
75	1	U204	HTS221TR HLGA-6L 2X2X0.9	Capacitive digital sensor for relative humidity and temperature	ST	HTS221TR
76	1	U300	ST1PS02CQT R 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
77	1	U500	74LVC1G74GT 8-XFDFN	IC FF D-TYPE SNGL 1BIT 8XSON	Nexperia USA Inc.	74LVC1G74GT,115
78	1	U600	ST25DV64K-JFR6D3 UFDFPN 12L 3X3X0.55 Pitch 0.50	Dynamic NFC/RFID tag IC with 64-Kbit EEPROM and fast transfer mode capability	ST	ST25DV64K-JFR6D3
79	1	U800	STSAFA110DF SPL02 UFDFPN 8 2x3x0.6	Authentication, state-of-the-art security for peripherals and IoT devices (not mounted)	ST	STSAFA110DFSPL02
80	1	-	FR4-IT180A-4 layers 58.29x43.3x1.38mm, laser drill between layers 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 ±20%X5RSMD	Ceramic capacitor (not mounted)	Murata Electronics	GRM033R61A104ME15D
2	1	C901	22 µF 0603 (1608 Metric) 16 V ±20% X5R SMD	Ceramic capacitor	Samsung Electro-Mechanics	CL10A226MO7JZNC
3	2	C902 C903	10 µF 0805 (2012 Metric) 16 V ±10% X5R	Ceramic capacitors	Murata	GRM21BR61C106KE15L

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

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
20	1	C948	4.3 pF 0402 (1005 Metric) 50 V 0.05 pF COG	Ceramic capacitor	Murata Electronics	GJM1555C1H4R3WB01D
21	1	C950	47 nF 0201 16 V ±10% X5R	Ceramic capacitor	Murata Electronics	GRM033R61C473KE84D
22	1	C951	68 pF 0201 50 V ±5% COG SMD	Ceramic capacitor	Murata Electronics	GRM0335C1H680JA01D
23	2	C952 C966	2.7 pF 0402 (1005 Metric) 50 V ±0.1 pF COG	Ceramic capacitors	Yageo	CC0402BRNPO9BN2R7
24	1	C955	5.6 pF 0402 (1005 Metric) 50 V ±0.25 pF COG	Ceramic capacitor	Murata Electronics	GRM1555C1H5R6BA01D
25	3	C956 C962 C964	3.3 pF 0402 (1005 Metric) 50 V ±0.05 pF COG	Ceramic capacitors	Murata Electronics	GJM1555C1H3R3WB01D
26	1	C957	1.3 pF 0402 (1005 Metric) 50 V ±0.05 pF COG	Ceramic capacitor	Murata Electronics	GJM1555C1H1R3WB01D
27	1	C963	3.6 pF 0402 (1005 Metric) 50 V ±0.05 pF COG	Ceramic capacitor	Murata Electronics	GJM1555C1H3R6WB01D
28	1	C965	1 pF 0402 (1005 Metric) 50V ±0.1 pF COG	Ceramic capacitor (not mounted)	AVX Corporation	04025A1R0BAT2A
29	4	CL1 CL2 CL3 CL4	Clip-0951-46R SMD	RFI shield clip compact tins	Harwin Inc.	S0951-46R
30	2	D900 D901	BAT30F4 0201 (0603 Metric) 300 mA ST0201	30 V, 300 mA CSP general purpose small signal Schottky diode	ST	BAT30F4
31	1	D902	Led_RGB 0404 (1010 Metric) 5 mA red, 5 mA green, 5 mA blue WL-SFCC SMT	Full-color chip LED	Würth Elektronik	150044M155260
32	30	J900 J901 J902 J903 J904 J905 J906 J907 J908 J909 J910 J911 J912 J913 J914 J915 J916 J917 J918 J919 J920 J921 J922 J923 J924 J925 J926 J927 J928 J929	0 0402	Tin drop jumpers (not mounted)	-	-
33	2	J930 J931	CON 22 positions 1.27 MMSMD	Connector headers (not 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	NX3L1T3157GM 6-XFDFN	IC SWITCH SPDT 6XSON	NXP USA Inc.	NX3L1T3157GM,132
35	1	J935	CON_SMA_Wurth_60312202114508	SMA PCB end launch jack	Würth Elektronik	60312202114508
36	1	J936	UFL Wurth_636101111001 U.FL-R-SMT-1	WR-UMRF_PCB RECEPTACLE_SMT_3 PAD (not mounted)	Würth Elektronik	636101111001
37	1	J937	0 R 0603 1/10 W ±1%	Resistor	Vishay	CRCW06030000Z0EB
38	1	L900	2.2 µH 1.2 A 0806 (2016 Metric) ±20%	Fixed inductor	Würth Elektronik	74479776222
39	1	L901	2.2 µH 1.2A 0806 (2016 Metric) ±20%	Fixed inductor	Würth Elektronik	74479776222
40	1	L902	600 ohm at 100 MHz 0603 (16085 Metric) 300 mA SMD	Inductor	Chilisin Electronics	BBBK00160808601Y00
41	1	L903	15 µH 0603 (16085 Metric) 250 mA SMD	Inductor	TDK Corporation	MLZ1608N150LT000
42	1	L904	1 kohm 100 MHz 0402 (1005 Metric) 250 mA SMD	Inductor	Murata Electronics	BLM15HG102SN1D
43	2	L905 L912	3.3 nH 0402 (1005 Metric) 2 A ±0.1 nH SMD	Inductors	Murata Electronics	LQW15AN3N3B80D
44	2	L907 L908	47 nH 0402 (1005 Metric) 210 mA SMD	Inductors	Murata Electronics	LQW15AN47NJ00D
45	1	L909	3 nH 0402 (1005 Metric) 1.35 A SMD	Inductor	Murata Electronics	LQW15AN3N0C80D
46	3	L906 L910 L913	8.7 nH 0402 (1005 Metric) 1.42 A ±2%	Inductors	Murata Electronics	LQW15AN8N7G80D
47	1	L911	2.5 nH 0402 (1005 Metric) 1 A SMD	Inductor	Murata Electronics	LQW15AN2N5B80D
48	1	L914	11 nH 0402 (1005 Metric) 500 mA SMD	Inductor	Murata Electronics	LQW15AN11NG00D
49	1	Q1	VT6X1T2R VMT-6	Bipolar Transistors - BJT TR NPNX2 20V VCEO	Rohm Semiconductor	VT6X1T2R
50	1	Q2	2SCR522MT2L SOT-723 150 mW 20 V 0.2 A VMT3	NPN transistor	Rohm Semiconductor	2SCR522MT2L
51	4	R900 R909 R910 R911	100 R 0201 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 ±1%	Resistors	Yageo	RC0201FR-071ML
53	3	R902 R903 R904	10 k 0201 1/20 W ±1%	Resistors	VISHAY	CRCW020110K0FKED
54	31	R905 R906 R913 R914 R915 R916 SB900 SB901 SB902 SB904 SB905 SB906 SB907 SB908 SB909 SB910 SB911 SB912 SB913 SB918 SB922 SB923 SB924 SB925 SB926 SB927 SB928 SB929 SB931 SB940 SB941	0 R 0201 1/20 W ±1%	Resistors	Stackpole Electronics	RMCF0201ZT0R00
55	1	R908	220 R 0201 1/20 W ±1%	Resistor	Yageo	RC0201FR-07220RL
56	1	R917	30 k 0201 1/20 W ±1%	Resistor	Yageo	RC0201FR-0730KL
57	1	R918	120 k 0201 1/20 W ±1%	Resistor	Panasonic Electronic	ERJ-1GNF1203C
58	1	R919	51 k 0201 1/20 W ±1%	Resistor	MULTICOMP	ERJ-MCRE000181
59	1	R920	20 R 0201 1/20 W ±1%	Resistor	Panasonic Electronic	ERJ-1GNJ200C
60	1	R921	0 R 0402 (1005 Metric) 1/16 W 1±%	Chip resistor	Yageo	RC0402JR-070RL
61	1	R922	33 R 0201 1/20 W ±1%	Resistor	Panasonic Electronics	ERJ-1GNJ330C
62	2	R925 R926	100 k 0201 1/20 W ±1%	RES SMD 1% 1/20W 0201	Multicomp	MCRE000188
63	1	R923	1 M 0201 1/20 W ±1%	Resistor (not mounted)	Yageo	RC0201FR-071ML
64	1	R927	82 R 0201 1/20 W ±5%	Resistor	Panasonic Electronics	ERJ-1GNJ820C
65	7	SB903 SB915 SB916 SB920 SB921 SB930 SB932	0 R 0201 1/20 W ±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 TPB902 TPB903 TPB904 TPB905 TPB906 TPB907 TPB908 TPB909 TPB910 TPB911 TPB912 TPB913 TPB914 TPB915 TPB916 TPB917 TPB918 TPB919 TPB920 TPB921 TPB922 TPB923 TPB924 TPB925 TPB926 TPB927 TPB928 TPB929 TPB930 TPB931 TPB932 TPB933 TPB934 TPB935 TPB936 TPB937 TPB938 TPB939 TPB940 TPB941 TPB942 TPB943 TPB944 TPB945 TPB946 TPB947 TPB948 TPB949 TPB950 TPB951 TPB952 TPB953 TPB954 TPB955 TPB956 TPB957 TPB958 TPB959 TPB960 TPB961 TPB962 TPB963 TPB964 TPB965	TPB	Test points (not mounted)	-	-
70	56	TPE130 TPE131 TPE132 TPE133 TPE134 TPE148 TPE149 TPE150 TPE151 TPE152 TPE900 TPE901 TPE902 TPE903 TPE904 TPE905 TPE906 TPE907 TPE908 TPE909 TPE910 TPE911 TPE912 TPE913 TPE914 TPE915 TPE916 TPE917 TPE918 TPE919 TPE920 TPE921 TPE922 TPE923 TPE924 TPE925 TPE926 TPE927 TPE928 TPE930 TPE932 TPE934 TPE936 TPE943 TPE944 TPE945 TPE946 TPE947 TPE948 TPE949 TPE950 TPE951 TPE952 TPE953 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	STM32WL55JCI7 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 ±20% X5R SMD	Ceramic capacitors	Murata Electronics	GRM033R61A104ME15D
2	1	C200	1 µF 0201 6.3 V ±20% X5R SMD	Ceramic capacitor	Murata Electronics	GRM033R60J105MEA2D
3	2	C201 C202	10 µF 0603 (1608 Metric) 6.3 V ±20% X5R	Ceramic capacitors	TDK Corporation	C1608X5R0J106M080AB
4	1	C204	4.7 µF 0201 6.3 V ±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	ESDALC6V1-1U2
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	ESDA7P60-1U1M
9	1	D202	BAT30F4 (0603 Metric) 300 mA ST0201	30 V, 300 mA CSP general purpose small signal Schottky diode	ST	BAT30F4
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	ECMF02-2AMX6
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 1.27 mm	Connector header	Samtec Inc.	FTSH-107-01-F-DV-K-P-TR
19	1	J400	STMod-Female 2x10 2mm SMD	Connector receptacle	Harwin Inc.	M22-6551042R
20	1	J401	0 ohm ±1% 0603 (3pin drop) 0.1 W, 1/10 W SMD	Chip resistor	Vishay	CRCW06030000Z0EB
21	1	J500	CON34-Header	Connector header	Panasonic Electric Works	AXF6G3412A
22	1	J501	CON34-Socket	Connector socket	Panasonic Electric Works	AXF5G3412A
23	1	Q200	STL6N3LLH6 PowerFLAT 2x2	N-channel 30 V, 0.021 ohm typ., 6 A STripFET H6 power MOSFET in a PowerFLAT 2x2 package	ST	STL6N3LLH6
24	1	Q201	RV3CA01ZPT2CL 3-XFDFN 100 mW (Ta)	P-channel MOSFET	Rohm Semiconductor	RV3CA01ZPT2CL
25	1	R200	620 R 0201 1/20 W ±1% SMD	Resistor	Panasonic Electronics	ERJ-1GNF6200C
26	1	R201	100 K 0201 1/20 W ±1%	Resistor	MULTICOMP	MCRE000188
27	1	R202	10 k 0201 1/20 W ±1%	Resistor	VISHAY	CRCW020110K0FKED
28	1	R203	1.5 k 0201 1/20 W ±1%	Resistor	MULTICOMP	MCRE000144
29	1	R204	0 R 0201 1/20 W	Resistor	Stackpole Electronics Inc	RMCF0201ZT0R00
30	1	R205	2.7 K 0201 1/20 W ±5%	Resistor	Panasonic Electronics	ERJ-1GNJ272C
31	1	R206	1 K 0603 (1608 Metric) 0.1 W, 1/10 W ±1%	Resistor	Yageo	RC0603FR-071KL
32	1	R207	20 K 0603 (1608 Metric) 0.1 W, 1/10 W ±1%SMD	Chip resistor	Panasonic Electronic	ERA-3AEB203V
33	1	R208	20 k 0201 1/20 W ±1%	Resistor	Yageo	RC0201FR-0720KL
34	1	R209	27 K 0603 (1608 Metric) 0.1 W, 1/10 W ±1%	Chip resistor	YAGEO	RC0603FR-0727KL
35	1	R210	56 K 0603 (1608 Metric) 0.1 W, 1/10 W ±1% SMD	Chip resistor	Vishay Dale	CRCW060356K0FKTA
36	1	R211	56 k 0201 1/20 W ±1%	Resistor	Panasonic Electronics	ERJ-1GNF5602C

Item	Q.ty	Ref.	Part/value	Description	Manufacturer	Order code
37	1	R300	200 k 0603 1/10 W ±1% SMD	Resistor	Vishay	CRCW0603200KFKEA
38	6	R301 R302 R303 R304 R305 R501	0 R 0603 1/10 W ±1%	Resistors (not mounted)	Yageo	RC0603JR-070RL
39	5	R306 R307 R308 R309 R310	4.7 k 0201 1/20 W ±1% SMD	Resistors	Vishay	CRCW02014K70FNED
40	10	R400 R401 R402 R403 R404 R405 R406 R407 R408 R409	0 0603 (1608 Metric) 0.1 W, 1/10 W ±1%SMD	Chip resistors	Vishay	CRCW06030000Z0EB
41	2	R410 R411	1 M 0201 1/20 W ±1%	Resistors	Yageo	RC0201FR-071ML
42	1	SB300	0 R 0603 1/10 W ±1%	Jumper	Vishay	CRCW06030000Z0EB
43	3	SC1 SC2 SC3	Screw M2X4	Screws	RS	914-1462
44	1	SW1	Push-Bottom_WE434331013822 3.50mm x 2.90mm SPST-NO 0.05 A 12 V	Tactile switch	Würth Elektronik	434331013822
45	1	SW400	Switch 6P - 25 mA 1P4T (1.4 mm height)	Slide switch	Diptronics	MSS14-V-T/R
46	2	SW401 SW402	Switch 4P 1P3T (1.4 mm height)	Slide switches	Mountain Switch	103-5041-EV
47	18	TP200 TP201 TP202 TP203 TP204 TP205 TP206 TP207 TP208 TP209 TP210 TP211 TP300 TP301 TP302 TP303 TP304 TP305	TPD	Test points	Any	Any
48	1	U200	STBC03JR chip scale package 0.4 mm pitch	Li-Ion linear battery charger with LDO and load switches	ST	STBC03JR
49	1	U201	TCPP01-M12 QFN-12L	Overvoltage protection for USB Type-C or Power Delivery	ST	TCPP01-M12
50	1	U300	LSF0108PWR 20-TSSOP (0.173", 4.40mm Width)	IC TRNSLTR BIDIRECTIONAL 20TSSOP	Texas Instruments	LSF0108PWR
51	1	U400	STG3692 VFQFPN 16 2.6x1.8x0.5	Low voltage high bandwidth quad SPDT	ST	STG3692QTR
52	1	PCB	FR4-IT180A-4Layer 43.3x23.84x1.38 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$ASTRA1BA (1)	STEVAL$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 ≤ 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. 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 Section 6 Regulatory compliance information.
16-Sep-2022	4	Updated introduction, Section 1.2 Features, Section 1.4 Kit components, Section 1.5.1.1 Architecture and pinout, Section 1.5.1.2 Power management, Section 1.5.1.3 RGB LED, Section 1.5.2 STEVAL-ASTRA1 main board, Section 1.5.2.1 Sensors, Section 1.5.2.2 NFC, Section 1.5.2.3 GNSS, Section 1.5.2.6 Push buttons, antitampering, and buzzer, Section 1.5.2.10 Power management and voltage monitoring, Section 1.5.3 STEVAL-ASTRA1BC expansion board, Section 1.7 Power management overall circuit, Section 2.1 How to assemble the kit, Section 2.2 How to program the kit, and Section 2.3 How to power on the kit and run the asset tracking application. Added Section 1.5 Component placement.

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